MAR 12 1968

Errata for **MND-3607-80**

TECHNICAL MANUAL

OPERATION
AND
FIELD MAINTENANCE

SNAP 19
RADIOISOTOPE POWER SUPPLY

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INTRODUCTION

This manual provides operating and maintenance instructions on the SNAP 19 radioisotope power supply for the Nimbus B spacecraft.

Procedures are given in step-by-step form. These steps, particularly in checkout procedures, must be performed in the sequence given. Maintenance instructions are, in general, limited to isolating troubles to a major unit and replacement of that unit. Defective units are to be returned to the manufacturer for repair.

The manual is divided into six sections and one appendix.

The general content of the manual is as follows:

Section I - general description of the complete system and more detailed descriptions (to the level necessary to support operation and maintenance instructions) of major components.

Section II - descriptive information on fueled generator shipping and handling equipment, and specific procedures to be used in shipping and handling.

Section III - information (similar to Section II) on electrically heated generators

Section IV - system assembly and installation procedures

Section V - checkout procedures

Section VI - troubleshooting and maintenance information

Appendix A - sample data sheets for checkout procedures

The following documents are referenced in this manual and must be available to the using activity:

MIL-P-116E Methods of Preservation (used in preparing equipment for shipment)

MND-3607-83 System Telemetry Calibration Data Book for SNAP 19/B. Martin Marietta Corporation. (Used during equipment checkout.)

MND-3607-186 Subsystems Calibration Data Book for SNAP 19/B. Martin Marietta Corporation. (Used during equipment checkout.)

Change 1
15 January 1968

452B1900110 Martin Marietta drawing, Loading, Transporting, and Unloading SNAP 19 RTG's and Associated Ground Equipment.

All persons concerned with the operation and maintenance of the SNAP 19 radioisotope power supply must become thoroughly familiar with the content of this manual.

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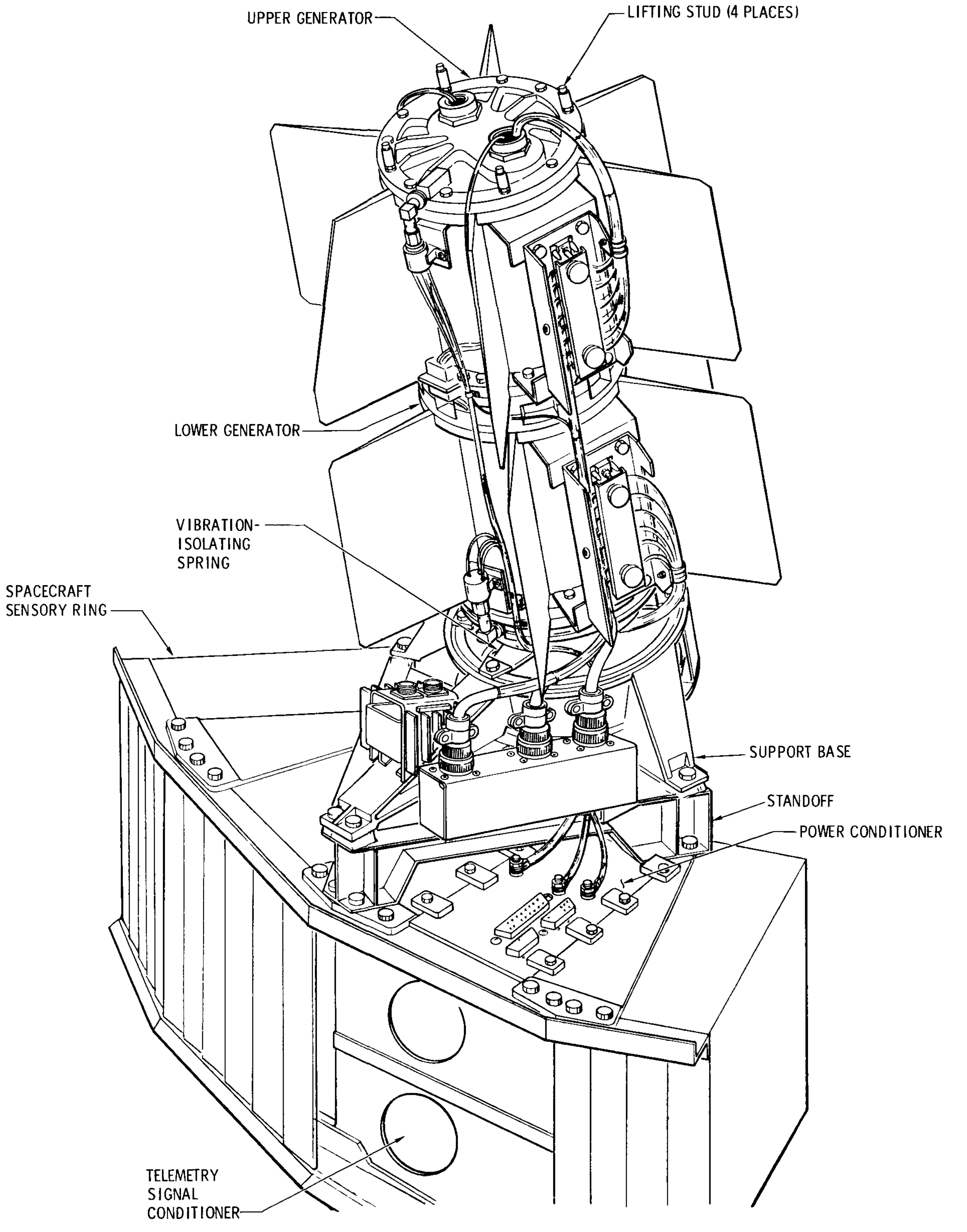

Figure 1-2. SNAP 19 Arrangement

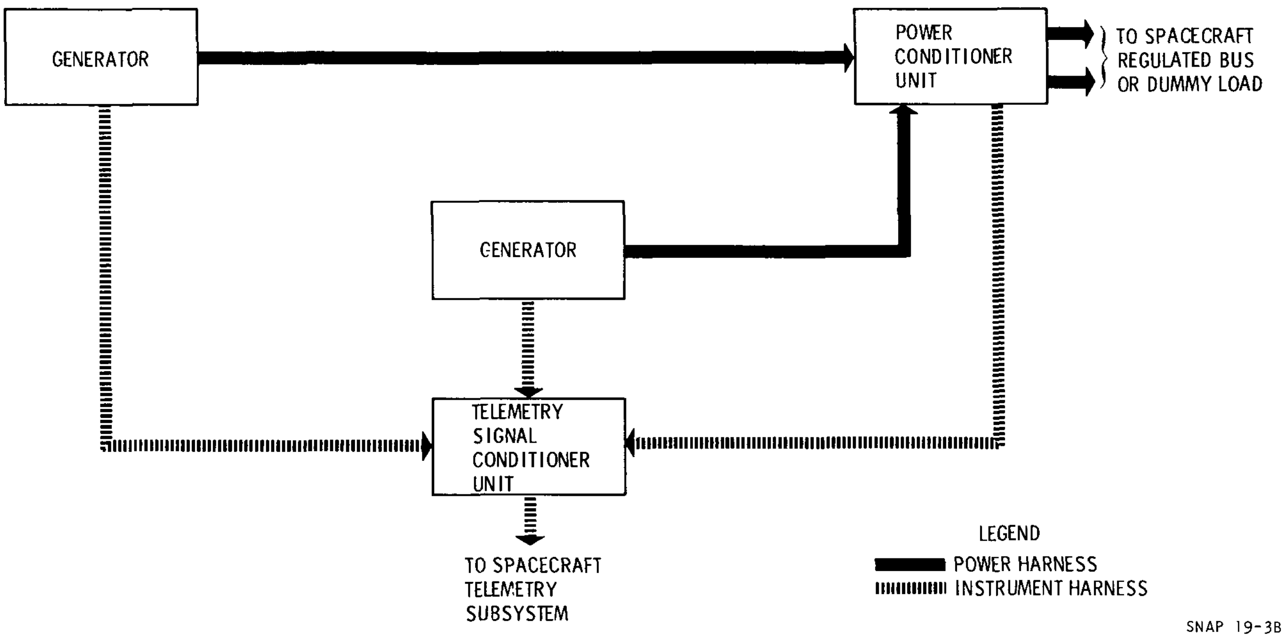

Figure 1-3. SNAP 19 Block Diagram

1-17. Sensors in the generator supply to the telemetry signal conditioner measurement signals of internal and external temperatures, internal pressure, and internal voltage.

1-18. The generators are finished with a special emissive coating. To protect this coating, handling of the generators should be avoided. If handling is necessary, clean white gloves should be used. These should also be used when working close to the generators so as to protect against inadvertent touching of the radiating surfaces.

1-19. Generator Support Structure

1-20. The support structure (figure 1-4) consists of a support base and a standoff. The standoff is a triangular structural adapter that attaches the generator subsystem to the spacecraft sensory ring. Bolted to the top of the standoff is the support base, to which a spoked, vibration-isolating spring assembly is bolted.

1-21. The lower generator is attached to the support base by a piston. A bracket containing two electrical receptacles is clamped to the front of the support base. One of the receptacles is used to connect the generator subsystem to a dummy load, and the other is used to place the generators on short circuit. The bracket (with receptacles) is removed before flight.

1-22. There are three electrical connectors on the standoff through which passes all wiring between the generators and the spacecraft sensory ring. This wiring includes generator power leads, and leads to the telemetry signal conditioner.

1-23. POWER CONDITIONER

1-24. The power conditioner (figure 1-5) consists of two separate 30-watt, high efficiency, low input voltage converters housed within one package. The converters change the DC output voltage from the two radioisotope thermoelectric generators to that required by the spacecraft bus. The output is then applied through a series relay contact to either the spacecraft power bus or an external dummy load. The relays, in series with the converter outputs, are capable of placing either or both converters on or off the spacecraft bus and are controlled by ground commands through the spacecraft.

1-25. The power conditioner is housed in a standard 4/0 Nimbus B module. (See figure 1-5.) The 6-inch by 6 1/2-inch by 7-inch, 13-pound module has eight slotted mounting lugs. All connections to the module are made on one of its sides and at one corner of the same side is a painted dot that indicates the outboard edge of the module.

1-26. The connections on the module and their purposes are as follows:

a. GEN NO. 1 + - power input from generator No. 1

b. GEN NO. 2 + - power input from generator No. 2

c. COM NEG - common connection for both generators

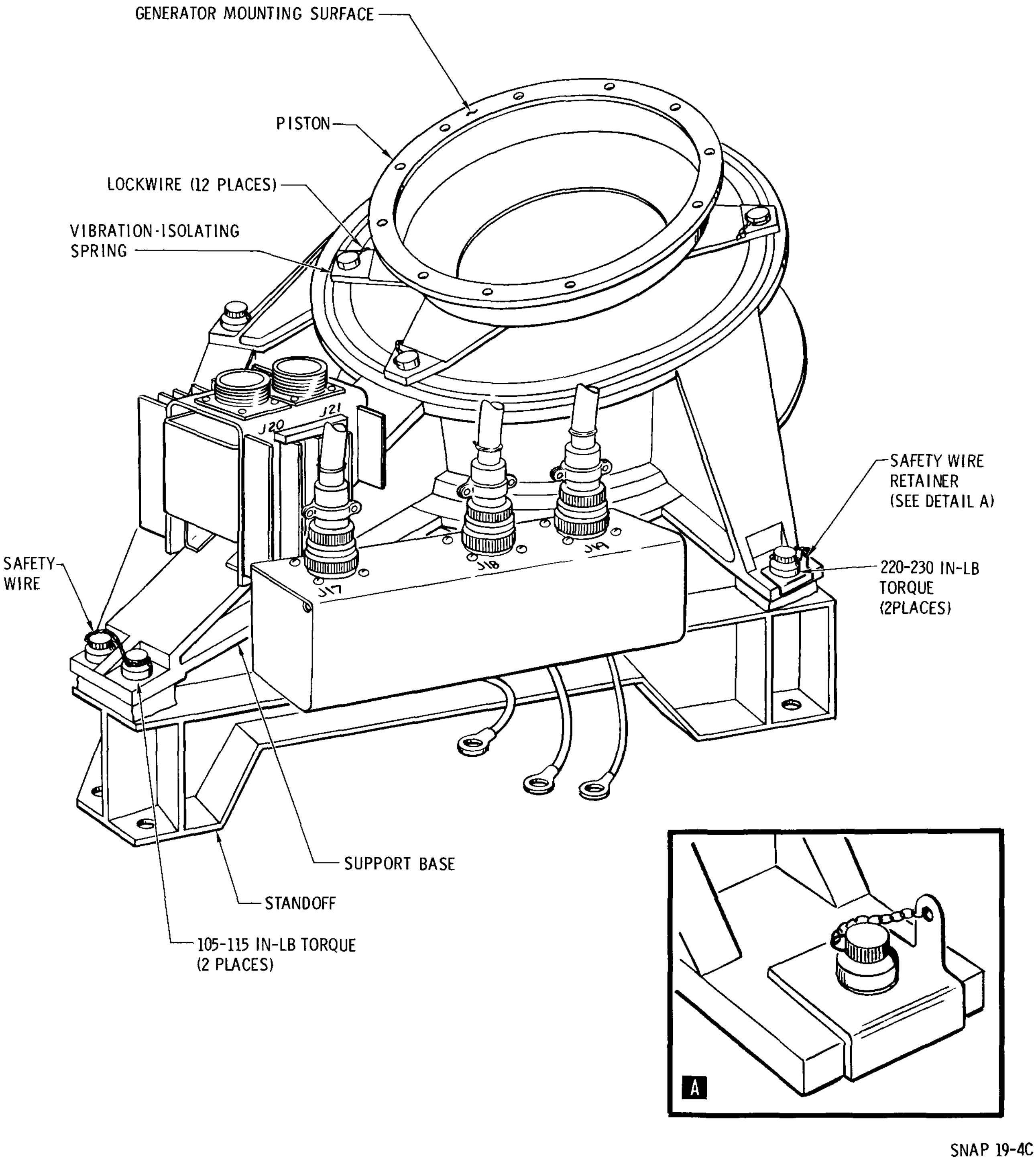

Figure 1-4. Generator Subsystem Support Structure

b. S14 and R3. These controls are used only during calibration of the temperature measurement circuits. They are ineffective unless S16 or S17 is ON. When S16 or S17 is ON, R3 provides smooth adjustment of the simulation resistance for that circuit. The S14 switch extends the resistance range of R3 by adding resistance in series with R3 when S14 is in positions 2 and 3. When S14 is OFF, R3 is open circuited. When S14 is in position 1, zero resistance is added to R3.

c. S16 and S17. These switches must be OFF during functional tests. One is set to ON only during calibration of a temperature measurement circuit. When S16 or S17 is ON, S14 and R3 (b, above) are inserted into the simulation circuit controlled by that switch. Simulation circuits controlled by the switches are:

S16 ---------- Power conditioner temperature No. 1

S17 ---------- Power conditioner temperature No. 2

1-57. Testing of Conditioning Circuits for Power Conditioner Bus Status

1-58. The TELEMETRY TEST PANEL simulates power conditioner outputs that indicate the on-bus/off-bus status of the two converters. The TSCU-processed resultants are measured at the MONITOR PANEL.

1-59. Switches S18 and S19 are the front panel controls for this function. Switch S18 simulates the converter No. 2 status input, and S19 simulates converter No. 1 status input. When either switch is ON, a short is placed across the corresponding TSCU input, simulating the on-bus condition. When the switches are OFF, the TSCU inputs are open circuited, simulating the off-bus condition.

1-60. Testing of Fin Root Temperature Measurement Conditioning Circuits

1-61. The TELEMETRY TEST PANEL simulates the resistance of six thermistors in the generator subsystem and applies these resistive inputs to the TSCU. Conditioned voltage output signals from the TSCU are sent to the MONITOR PANEL for measurement and comparison with calibrated levels. Test panel controls used for this function are lined up above FIN ROOT TEST CKT on the front panel. Their functions are:

a. S20. Provides three discrete resistance inputs to each of the six TSCU conditioning circuits. When S20 is OFF, the inputs are open circuited. As S20 is rotated clockwise to each successive position, the input resistances vary in steps until position 3 is reached. (Positions 4 and 5 are spares.) Note that proper resistances for functional tests are obtained only if switches S23 through S28 are OFF (c, below).

b. S21 and R2. These controls are used only during calibration of the temperature measurement circuits. They are ineffective unless one of switches S23 through S28 is ON. When one of these switches is ON, R2 provides smooth adjustment of the simulation resistance for that circuit. The S21 switch extends the range of R2 by adding resistance in series with R2 when S21 is in positions 2 and 3. When S21 is OFF, R2 is open circuited. When S21 is in position 1, zero resistance is added to R2.

c. S23 through S28. These switches must be OFF during functional tests. They are set to ON only during calibration of the temperature measurement circuits. When one of these switches is ON, S21 and R2 (b, above) are inserted into the simulation circuit controlled by that switch. Simulation circuits controlled by the switches are:

S23 ------ Generator No. 1 fin root T6

S24 ------ Generator No. 1 fin root T7

S25 ------ Generator No. 2 fin root T8

S26 ------ Generator No. 2 fin root T6

S27 ------ Generator No. 2 fin root T7

S28 ------ Generator No. 1 fin root T8

1-62. Testing of Hot Junction Temperature Measurement Conditioning Circuits

1-63. The TELEMETRY TEST PANEL simulates the resistance of six resistance temperature devices (RTD) in the generator subsystem and applies these resistive inputs to the TSCU. Conditioned voltage output signals from the TSCU are sent to the MONITOR PANEL for measurement and comparison with calibrated levels. Test panel controls used for this function are lined up above JUNCTION TEST CKT on the front panel. Their functions are:

a. S30. Provides four discrete resistance inputs to each of the six TSCU conditioning circuits. When S30 is OFF, the inputs are open circuited. As S30 is rotated clockwise to each successive position, the resistances vary in steps until position 4 is reached. (Position 5 is a spare.) Proper resistances for functional tests are obtained only if switches S33 through S38 are OFF (c, below).

b. R1. This control is used only during calibration of the temperature measurement circuits. It is ineffective unless one of switches S33 through S38 is ON. When one of these switches is ON, R1 provides smooth adjustment of the simulation resistance for that circuit.

c. S33 through S38. These switches must be OFF during functional tests. They are set to ON only during calibration of the temperature measurement circuits. When one of these switches is ON, R1 is inserted into the simulation circuit controlled by that switch. Simulation circuits controlled by the switches are:

1-90. HEATER POWER SUPPLY CONTROL PANEL

1-91. The HEATER POWER SUPPLY CONTROL PANEL (A7, figure 1-6) controls the output of two regulated power supplies (A8 and A9, figure 1-6) which provide power to electrically heated thermoelectric generators. Each power supply furnishes heating power to one generator. The HEATER POWER SUPPLY CONTROL PANEL also provides for monitoring of generator temperatures and includes an alarm which is actuated if the temperature of either generator exceeds 975 ± 25°F. An alarm condition produces automatic cutback of heater power to the generator.

1-92. Application of Power to Generators

1-93. Front panel controls and indicators used for this function are:

a. POWER-RELAY DRIVER switch. When set to ON, this switch supplies operating power for control relays in the power supply control panel. The power supplies can be turned on only when this switch is ON.

b. POWER-HEATER NO. 1 and POWER-HEATER NO. 2 switches. When set to OFF, these switches remove power from the heaters. When set to ON, they apply power to the heaters if the following controls are set as indicated:

Circuit breakers (both power supply panels) -------------	ON
POWER-RELAY DRIVER switch -----------------------	ON
VOLTAGE RANGE switches -----------------------	20-30
HEATER NO. 1 and NO. 2 switches (on rear panel) ----	75

c. POWER-HEATER NO. 1 and POWER-HEATER NO. 2 lamps. When lighted, these lamps indicate that heater power is ON.

d. VOLTAGE RANGE switches. Power supply output voltages are adjusted to the ranges indicated on the front panel by rotating these switches. Note that these controls must be set to 20-30 to permit turning on the power supplies. After power is turned on, these switches are slowly rotated clockwise until the desired power input is obtained as indicated on the meter above each switch.

e. FINE ADJ. controls. These controls provide for fine adjustment of the output voltages over the ranges to which the VOLTAGE RANGE switches are set, thereby adjusting power inputs to the heaters.

f. POWER INPUT-HEATER NO. 1 and POWER INPUT-HEATER NO. 2 meters. These meters provide a qualitative indication of power input to each generator heater.

g. HTR POWER NO. 1 and NO. 2 switches. These switches and the four jacks directly above each switch provide for connection of an external laboratory-type wattmeter for accurately measuring power input to the generator heaters. With switches NO. 1 and NO. 2 set to INT., the internal POWER INPUT-

HEATER NO. 1 and POWER INPUT-HEATER NO. 2 meters monitor the input power to the heaters. Setting either switch to EXT. disconnects the corresponding internal meter and activates the four jacks directly above that switch as connecting points for an external wattmeter. The current terminals of the external wattmeter connect between the two CURRENT jacks (red is +, black is -) and the voltage terminals connect between the two VOLTAGE jacks (red is +, black is -).

h. HEATER NO. 1 and NO. 2 switches. These switches are on the rear panel of the HEATER POWER SUPPLY CONTROL PANEL chassis. They limit heater power to the maximum voltage indicated by their settings. Note that they must be set to 75 to permit turning power on to the heaters. They are then advanced as required for correct heater power. For safety to equipment, the setting of each should at all times agree with the upper value of the corresponding VOLTAGE RANGE control.

1-94. Temperature Monitor and Alarm

1-95. Generator hot junction temperatures are sensed by a thermocouple in each thermoelectric generator. The thermocouple outputs are applied to the temperature monitoring and alarm system in the HEATER POWER SUPPLY CONTROL PANEL. If either of the two generator temperatures exceeds 975 ± 25°F, the red lens of one of the ALARM pushbuttons lights, depending on which generator is overheated, to indicate the alarm condition and a buzzer sounds. To acknowledge the alarm condition, the lighted ALARM button is pressed. This turns off the red light, lights the yellow light of the same button, and turns off the buzzer. When the temperature drops below the set point, the yellow light goes off and heater power is applied at the level determined by the VOLTAGE RANGE setting. Note that the red light will not turn off and power input to the heater cannot be increased beyond the reduced level until the acknowledge pushbutton has been pressed and the temperature has dropped below the set point level.

1-96. At any time during operation, either generator temperature can be observed on the TEMPERATURE meter by setting the TEMPERATURE MON switch to either RTG 1 or RTG 2.

1-97. REGULATED POWER SUPPLY, LA80-05B-2201

1-98. Two LA80-05B-2201 power supplies (A8 and A9, figure 1-6) are included in the test console. Each supply furnishes power to one electrically heated thermoelectric generator.

1-99. These power supplies are controlled at the HEATER POWER SUPPLY CONTROL (A7, figure 1-6). The POWER ON indicator on each power supply is lighted when that power supply is energized.

1-100. In the event of thermal overload of either supply, the THERMAL OVERLOAD indicator lamp is energized and the supply itself is de-energized. After the trouble has been corrected, the thermal overload device is reset by pressing the THERMAL OVERLOAD RESET button on the back of the power supply.

1-101. For detailed information on the power supplies, refer to the Lambda Electronics Corp. instruction manual which accompanies each test console.

SECTION II

SHIPPING AND HANDLING FUELED GENERATOR SUBSYSTEMS

2-1. ICC SHIPPING REQUIREMENTS FOR FUELED GENERATOR SUBSYSTEMS

2-2. The shipment of radioactive materials is controlled by the Bureau of Explosives. The Bureau requires that a permit be obtained for the shipping container, and that the terms of the permit be met. Most of these terms are met by the design and construction of the SNAP 19 generator subsystem shipping container, which has been approved by the Bureau of Explosives. However, the shipper must insure compliance with ICC regulations, paragraph 73.393 through 73.396, pertaining to shipment of radioactive materials. The shipper must also notify the Bureau of Explosives of impending shipment, furnishing the following data:

a. Permit number (Permit No. 2258 has been assigned to the SNAP 19 generator subsystem shipping container.)

b. Point of origin and destination

c. Date of shipment

d. Type of transporting vehicle

e. The quantity of radioactive material in terms of curies, and principal types of radiation.

2-3. AEC LICENSING AND SHIPPING REQUIREMENTS FOR FUELED GENERATOR SUBSYSTEMS

2-4. Special Nuclear Material License No. 849 was issued by the AEC to authorize possession of the fuel, and assembly and performance testing of SNAP 19 systems.

2-5. Unless placed in proximity to other special nuclear material, the SNAP 19 fuel presents no possibility of a nuclear incident. However, because of the possibility of proximity to other special nuclear material during transportation by commercial means, AEC approval of the shipping mode and procedures is required prior to shipment. Transportation by a van, carrying no other cargo, is recommended. Use of this transport method is conducive to obtaining AEC approval readily.

2-6. SAFETY PRECAUTIONS AND LIMITATIONS FOR FUELED GENERATOR SUBSYSTEMS

2-7. The fueled generator subsystem must remain in the closed shipping container at all times except for removals or partial exposure of the subsystem required by procedures in this manual. For long-term storage, the shipping container (with subsystem installed) must be kept in a biologically shielded area. The shielding must be equivalent to that afforded by 4 inches of concrete. Since the generator is classified, this area must also meet security requirements.

2-8. Levels for maximum permissible exposure of personnel to radiation have been set by government agencies. For each quarter of a year, a maximum whole body dose equivalent to 1 1/4 rem or a dose to the hands and forearms equivalent to 18 3/4 rem is permissible.

2-9. Accumulation of the dose depends upon the length of time exposed and the distance from the source. Total dose rates (neutron plus gamma) have been measured above and to the side of SNAP 19 subsystem S/N 4. This subsystem contained (at the time of measurement) fuel capsules No. 300 and No. 307. Based on the measured dose rates, the times to receive a quarterly dose at specific points around the subsystem are as follows:

a. To the side of the subsystem:

	Time to receive quarterly dose (in hours)	
Distance (in inches)	Whole body	Hands
0 (at fin tip)	-	26
6	3.4	51
24	14.0	208

b. Above subsystem:

Distance above top	Time to receive quarterly dose (in hours)	
surface (in inches)	Whole body	Hands
6	3.8	57
24	25.0	375

2-10. With the generator subsystem in the shipping container, the dose rate at 5.0 inches from the container surface is 15 mrem/hr, and at 20.0 inches from the container surface (at the approximate mid-point of container height) the rate is 6.6 mrem/hr. These rates are low enough to permit personnel to work around the container continuously for 40 hours per week.

2-11. The area surrounding the generator subsystem shipping container (and the subsystem) must be monitored continuously for radiation when personnel are working. It is suggested that monitoring equipment of the following types be employed:

a. Fast-slow neutron counter (such as BF-3, range 0 to 500,000 events per minute) or a spherical neutron dosimeter employing an Li_6I crystal (europium activated) and associated simulation indicator with a range of 0 to 3,000 mrem/hr.

b. Ionization chamber type instrument with a minimum range of 0 to 5 R/hr.

2-12. GENERATOR SUBSYSTEM SHIPPING CONTAINER DESCRIPTION

2-13. The cylindrical generator subsystem shipping container consists of a storage plate assembly, a shield assembly, and a top shield assembly. (See figure 2-1.) The entire container assembly is approximately 40 inches in diameter by approximately 60 inches high, and weighs 1,800 pounds.

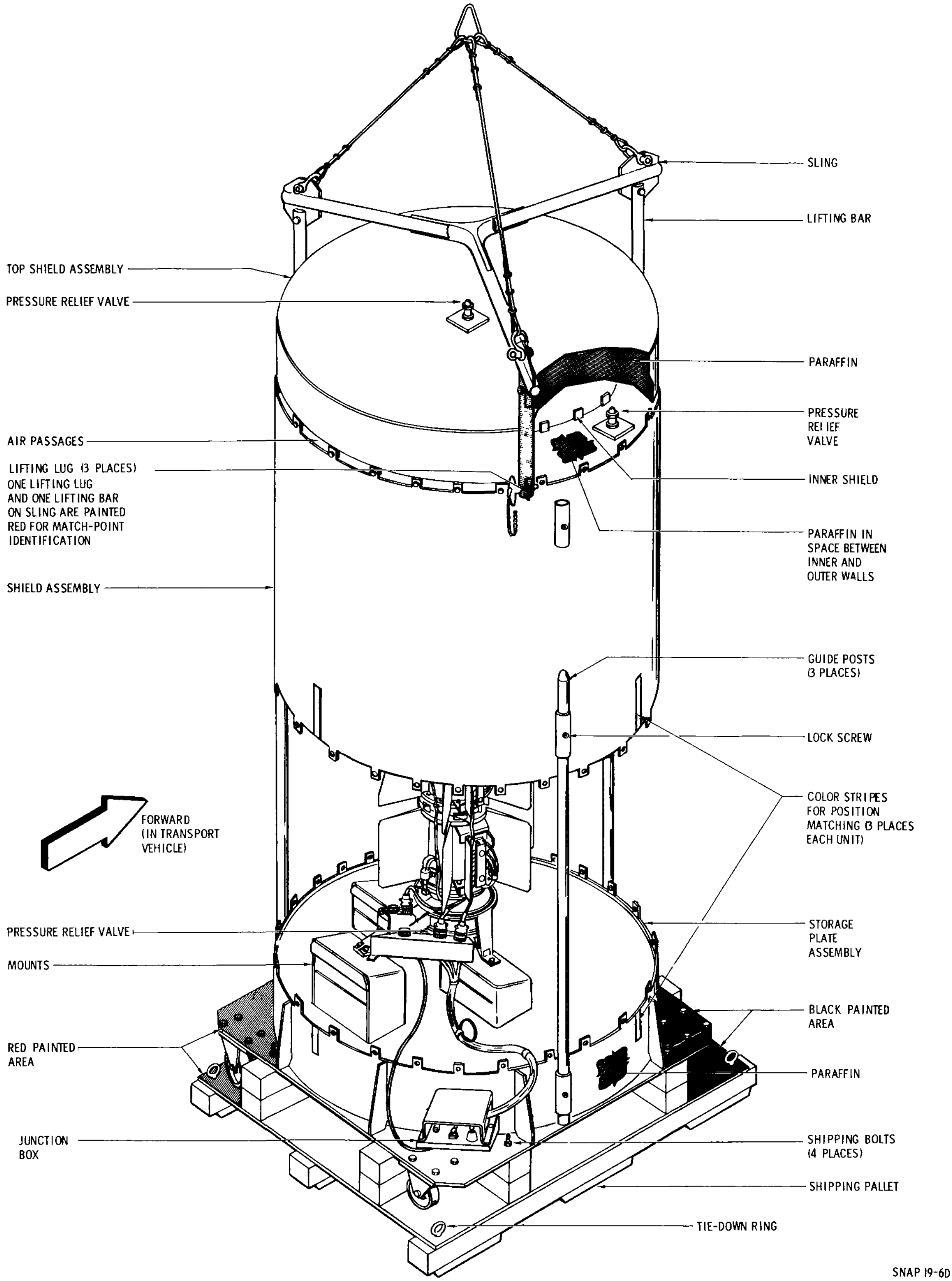

Figure 2-1. Installation of Generator Subsystem in Shipping Container

2-14. The storage plate assembly is the base of the container and is mounted on heavy-duty industrial casters. Two of the casters swivel and are equipped with brakes; two are stationary and have no brakes. Essentially, the assembly is a 9 1/2-inch high ring, closed by top and bottom covers. The internal space thus formed is filled with paraffin for shielding. The upper edge of the ring, above the level of the top cover, is crenelated to permit passage of air when the ring is mated with the shield assembly. On the top of the top cover, at the center, is a check valve that relieves pressure that may build up in the paraffin space. Also on the top cover of the storage plate are mounting pads to which the generator subsystem support base (with generators on it) is attached.

2-15. Deleted.

2-16. One corner of the storage plate assembly is painted black, and one corner is painted red. These corners are to be placed over like-painted corners of the pallet on which the container is shipped. An arrow on a corner of the storage plate assembly and a placard (FORWARD) indicate the side to be forward during transit. Red, yellow, and blue stripes on the assembly are for position-matching with similar stripes on the shield assembly.

2-17. On the storage plate assembly is also mounted the receptacle-half of three connectors, with harnesses running out to a junction box on the side of the storage plate assembly. Three feet of power lead cable (part of the harness) is installed on the container, with the ends terminating at three standoffs. All of the standard generator telemetry leads from the receptacle halves terminate in a 37-pin connector in the junction box, and part of the harness connects to a 9-pin connector in the junction box. This connector is used to monitor the fin root temperature of each generator, There is also a harness from the support structure to a 9-pin connector in the junction box. This connector is used to monitor the hot junction temperature of each generator. The connectors and terminals in the junction box permit monitoring of all the generator operating characteristics normally monitored during flight.

2-18. The shield assembly is a double-walled structure with the annular space between the walls filled with paraffin. The top and bottom edges are crenelated to match the storage plate assembly and the top shield assembly. The openings thus formed must not be obstructed. Three lugs spaced around the top of the shield assembly are for handling sling attachment. A check valve on the upper closure plate in the annular space relieves pressure that may build up in the paraffin area. After the generator subsystem is fixed to the storage plate assembly, the shield assembly is placed around the subsystem and secured to the plate assembly. While it is being lowered, the shield assembly is prevented from striking the generators by three guide posts. Each guide post is secured to the outer surface of the storage plate assembly and engages short tubes on the outer surface of the shield assembly, thus providing alignment of the two assemblies and clearance for the generators.

2-19. The top shield assembly is the closure for the shipping container. Construction is similar to the storage plate assembly, employing a ring with top and bottom covers and paraffin in the space between the covers. The relief valve is in the center of the assembly, on the top surface.

2-20. The generator subsystem handling adapter is used for placing the generator subsystem in the container. The generator shipping container sling is used for handling the shield assembly, the shield assembly with the top shield attached, the complete shipping container, and the complete shipping container with the generator subsystem installed. (See figure 2-1.)

CAUTION

Do not attempt to place an electrically heated subsystem in a fueled subsystem shipping container. Damage to the subsystem may result.

2-21. For shipment, the container is placed on a shipping pallet. This pallet prevents movement of the container and can be handled by fork lift transporter. The pallet is constructed so that the fork lift can be employed only at the forward and after ends. When loading for shipment, the fork lift must enter the end of the pallet opposite the FORWARD placard on the shipping container.

NOTE

The shipping container provides adequate protection for fueled generator subsystems. No special preservation procedures are required, and crates, tarpaulins or other covers that affect airflow through the container must not be used. The associated power conditioner and telemetry signal conditioner units also do not require special preservation procedures, but should be packaged in accordance with MIL-P-116E, Method III.

2-22. MOBILE CARRIAGE DESCRIPTION

2-23. The mobile carriage is used for transporting electrically heated and fueled generator subsystems between working areas, and for storage of electrically heated subsystems.

CAUTION

Fueled subsystems may not be stored on the carriage.

To prevent thermal cycling of electrically heated subsystems, the carriage is equipped with a heater power supply and heater controls to maintain heater power during transportation.

2-24. The mobile carriage consists of a base on swivelling rubber-tired casters, a screen assembly, a subsystem support base and a heater power control assembly. (See figure 2-2.) Two of the casters are equipped with wheel brakes and with locks that prevent swivelling, and two have swivel locks only. A handle at each end of the carriage is for manual positioning; the carriage sling is attached to the handles when hoisting is necessary.

2-25. Holes in the vertical corner members of the carriage permit lowering subsystem support base to the bottom of the carriage. This feature is used only with fueled subsystems, and the heater power control must be removed to permit use in this manner.

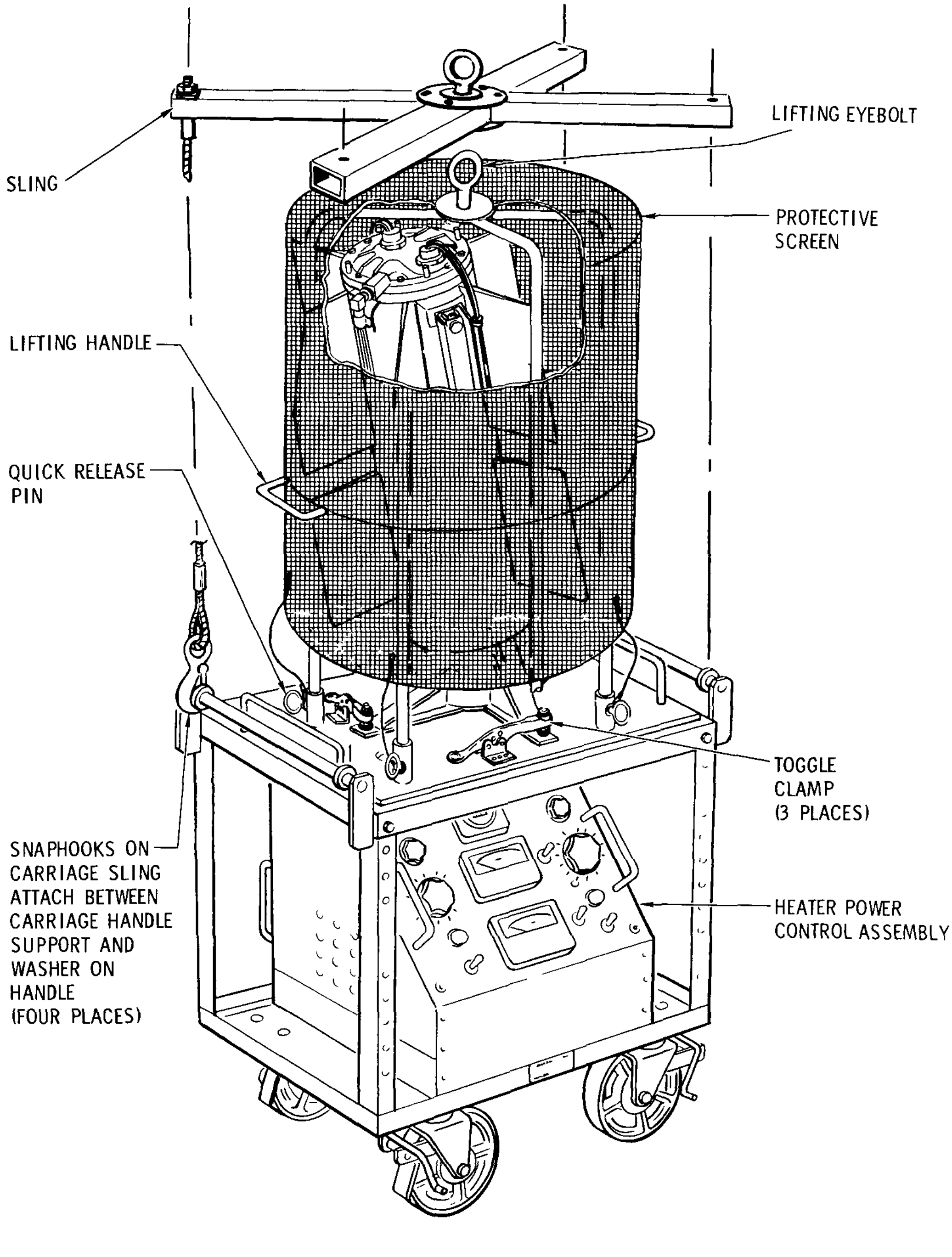

Figure 2-2. Mobile Carriage Arrangement

2-26. A screen is attached to the support base by four quick-release pins. The screen protects the operator from burns and the generator subsystem from damage. There is a handle at each side of the screen for manual removal and an eyebolt at the top for removal by overhead crane.

CAUTION

Use the eyebolt only to lift the screen; damage may result if an attempt is made to lift the entire carriage in this manner.

2-27. The carriage support base contains pins that engage the mounting holes in the generator subsystem support base. Toggle clamps on the carriage secure the subsystem after it is placed over the pins.

NOTE

Refer to paragraphs 2-44 and 3-9 for procedures for installation of generator subsystems on the carriage.

2-28. The heater power control assembly provides 1140 watts of heater power for at least 1/2 hour; the maximum duration of output at this level is approximately 1 hour. The assembly contains controls and instruments for setting the power, monitoring power and temperature, and recording time in use. The time totalizer operates during battery discharge and is used as an aid in determining the state of battery charge. The batteries are rechargeable and should be brought up to full charge after each use of the unit.

2-29. The heater power control assembly contains an alarm buzzer and indicator for each generator to warn of a hot junction temperature in excess of $975 \pm 25°F$. A buzzer sounds upon over-temperature in either generator, and the red ALARM indicator associated with that generator lights. Heater power is automatically reduced to a lower level when an over-temperature condition occurs. The buzzer will sound until the alarm indication is acknowledged by pressing the lighted ALARM switch-indicator.

NOTE

For shipment of the carriage, package in accordance with MIL-P-116E, Method III.

2-30. CHARGER DESCRIPTION

The charger for the cells in the mobile carriage power supply operates on 105- to 120-volt, single-phase, 60-CPS AC. The charger consists of a lower and an upper panel assembly. The lower panel assembly contains the power supply and the variable transformer. The upper panel contains the charging circuit, controls, and indicators.

Refer to the manufacturer's literature furnished with the unit for a detailed description, and to paragraph 6-25 for instructions on use with the mobile carriage power supply.

NOTE

For shipment of the charger, package in accordance with MIL-P-116E, Method III

2-31. PORTABLE MONITOR DESCRIPTION

2-32. The portable monitor is used to check generator subsystem temperatures and pressure. The monitor can be powered by either an external 115-volt, 60 cycle source or by its internal batteries. The AC-OFF-DC switch selects the source. External power is connected to receptacle J4 on the front of the unit.

2-33. External power should be used whenever feasible in order to conserve the internal battery supply. The portable monitor will operate approximately 240 hours on its battery supply.

2-34. The functions monitored by the unit are:

a. Hot junction temperatures (six RTD's and four thermocouples).

b. Pressure measurements (two).

c. Fin root temperatures (eight).

2-35. Cable interconnections and functions measured are:

a. 452B1800031-139 P1 to J1 on portable monitor package; P13 to J13 on generator subsystem. Functions measured are generator pressure, hot junction temperature (RTD) and fin root temperature (six).

b. 452B1800031-149 P2 to J2 on portable monitor package; P14 to J14 on generator subsystem. Functions measured are generator fin root temperature (two).

c. 452B1800031-159 P3 to J3 on portable monitor package; P12 to J12 on generator subsystem. Functions measured are hot junction temperature (T/C).

d. 452B1800031-169 P4 to J4 on portable monitor package; other end to 115-volt, 60-cycle source.

2-36. There is an 800° F check position on the hot junction temperature selector switch and a 300° F check position on the fin root and pressure selector. When the selectors are in these check positions, meters should read 800 ± 10° and 300 ± 5°, respectively, to show that the portable monitor is operating properly. If either or both of the check temperatures are out of tolerance, adjust the unit in accordance with paragraph 6-26. For detailed operating procedures, refer to Martin Marietta drawing 452B1900110, Loading, Transporting, and Unloading SNAP 19 RTG's and Associated Ground Equipment.

NOTE

When J3 on the portable monitor is open circuited, the hot junction temperature selector switch should be placed in 800° F check position to prevent the meter from exceeding full scale. The meter will not be damaged by infrequent and short duration readings above full scale.

NOTE

For shipment, the portable monitor should be packaged in accordance with MIL-P-116E, Method III.

2-37. PREPARATION OF FUELED GENERATOR SUBSYSTEMS FOR SHIPMENT

2-38. SHIPPING CONTAINER

a. Insure that shield assembly and top shield assembly are assembled and conveniently placed in shipping preparation area.

NOTE

It is recommended that the shield assembly and top shield assembly always be maintained as a unit; that is, never disassembled.

b. Place storage plate assembly under hoist rail; then, lock storage plate casters to prevent movement.

c. Deleted.

d. Deleted.

e. Loosen locking screws in guide post on shield assembly; then remove posts from assembly.

f. Position posts in short tubes on outside of storage plate assembly and tighten locking screws in tubes to secure guide posts.

2-39. GENERATOR SUBSYSTEM

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Position generator subsystem under hoist rail.

WARNING

Exterior surfaces of the generator subsystem may be at 300° F. Precautions, such as use of asbestos gloves, must be taken for personnel protection.

b. Deleted.

c. Insure that generator output plug P1 is connected to SHORT receptacle J21 on dummy load box on generator support base.

2-40. INSTALLATION OF FUELED GENERATOR SUBSYSTEM IN SHIPPING CONTAINER

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Remove T-pins from adapters in handling adapter assembly plate.

b. Position adapter assembly over nut adapters on top of generator subsystem. (See figure 2-3.)

WARNING

The temperature of generator subsystem exterior surfaces may be 300° F. Precautions, such as the use of asbestos gloves, must be taken for personnel protection.

CAUTION

Handle the adapter assembly carefully to prevent the T-pins or any part of the assembly from striking the generator subsystem. Damage to the emissive coating, wiring or other parts may result from striking.

c. Align holes in adapters with holes in nut adapters on generator subsystem; then install T-pins.

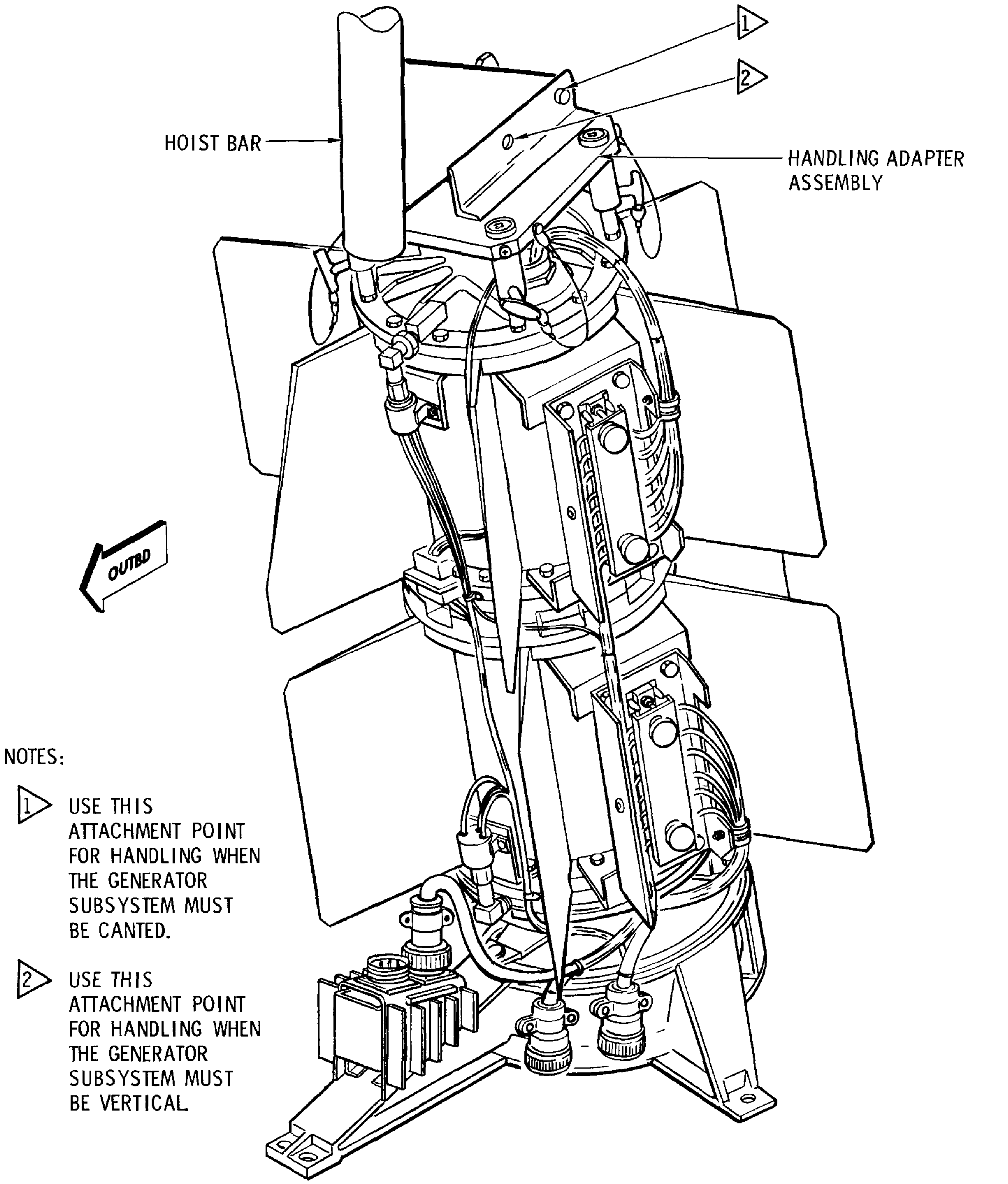

Figure 2-3. System Handling Adapter Installation

d. Position end of offset hoist bar containing small diameter hole between hoisting angles on handling adapter assembly; then insert pin in hole marked GEN AXIS VERTICAL to attach bar to assembly. (See figure 2-3.)

e. Attach hoist hook to free end of hoist bar.

f. Carefully take up slack in hoist; then hoist generator subsystem a few inches.

f.1 Remove support structure standoff and place in separate shipping container.

f.2 Hoist generator subsystem and position it over storage plate assembly.

g. Position generator subsystem so that long leg of support base is over mount nearest outside of storage plate assembly.

h. Carefully lower generator subsystem onto storage plate assembly mounts.

CAUTION

Do not detach the hoist; if unsupported, the generator subsystem may slide off the mounts.

i. When support base contacts mounts on storage plate assembly, install (finger-tight) all bolts through support base and storage plate assembly mount.

j. Detach hoist from handling adapter assembly.

k. Tighten bolts in support base until bolt heads are in firm contact with base.

l. Remove T-pins from adapters; then, lift handling adapter assembly from generator subsystem.

CAUTION

Handle the adapter assembly carefully to prevent striking the generator subsystem.

m. Stow T-pins in holes in handling adapter assembly.

CAUTION

In the following step, leave the generator output plug P1 connected to the SHORT receptacle J21 on the dummy load box.

n. Mate shipping container electrical connector halves with two connector halves on generator subsystem support base. (Connector halves are marked with matching J and P numbers, and are keyed to prevent incorrect connection.)

o. Attach generator subsystem shipping container sling to hoist hook

p. Position sling over shield (red lifting bar on sling and red lug on shield assembly aligned); then, lower sling so that lifting bars (figure 2-1) are adjacent to lifting lugs on shield assembly.

q. Attach lifting bars to lifting lugs on container (use T-pins attached to shield assembly).

r. Carefully take up slack in sling; then, hoist shield assembly.

s. Position shield assembly over generator subsystem with red, yellow, and blue stripes on shield assembly positioned over like-colored stripes on storage plate assembly.

t. Carefully lower shield assembly so that guide posts enter tubes on side of shield assembly.

u. Continue to lower shield assembly until bolt holes at lower edge align with those in storage plate assembly.

v. Install attaching parts.

w. Place shipping pallet under hoist rail.

x. Carefully take up slack in sling; then hoist shipping container.

y. Position shipping container over pallet so that corners of storage plate assembly and pallet are color-matched.

z. Lower shipping container onto pallet, guiding container so that tiedown studs on pallet engage holes in storage plate assembly.

aa. Remove sling.

ab. Install nuts on tiedown studs and tighten to 300 to 330 inch-pounds torque.

ac. Position forks of fork-life transporter under pallet, at end opposite FORWARD placard on storage plate assembly; then move shipping container to van.

ad. Secure pallet in van.

2-41. IN-TRANSIT PROCEDURES

2-41A. For in-transit procedures, refer to Martin Marietta drawing 452B1900110, Loading, Transporting, and Unloading SNAP 19 RTG's and Associated Ground Equipment.

2-42. REMOVAL OF FUELED GENERATOR SUBSYSTEM FROM SHIPPING CONTAINER

2-43. The generator subsystem must not be removed from the shipping container until all is in readiness for mounting on the spacecraft sensory ring or on the mobile carriage assembly. All testing and monitoring must be done with the subsystem in the container.

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Position generator subsystem support structure standoff on spacecraft sensory ring.

b. Install attaching parts and tighten to 50 to 70 inch-pounds torque.

c. Position shipping container under a hoist rail.

d. Remove bolts attaching shield assembly to storage plate assembly.

e. Attach generator subsystem shipping container sling to hoist hook.

f. Position sling over shield assembly (red lifting bar on sling and red lifting lug aligned); then, lower sling so that lifting bars are adjacent to lifting lugs on shield assembly. (See figure 2-1.)

g. Attach lifting bars to lifting lugs on container.

h. Insure that guide posts are engaged in tubes on side of storage plate assembly and lower tubes on side of shield assembly.

CAUTION

Locking screws in the tubes on the storage plate must be tight, and those in the lower tubes on the shield assembly must be loose.

i. Carefully take up slack in sling; then, hoist shield assembly clear of generator subsystem.

WARNING

The temperature of the generator subsystem exterior surfaces may be at 300° F. Precautions, such as use of asbestos gloves, must be taken for personnel protection.

j. Position shield assembly in location clear of work area around the generator subsystem.

CAUTION

Wood blocks (2 x 4) should be placed (4-inch dimension parallel to the floor) between tabs on the shield assembly so that the weight of the assembly is borne by the assembly cylinder rather than the tabs.

k. Attach handling adapter assembly to generator subsystem. (Refer to steps a through c, paragraph 2-40.)

l. Position end of offset hoist bar containing small diameter hole between hoisting angles on handling adapter assembly; then insert pin in GEN AXIS CANTED hole to attach bar to assembly. (See figure 2-3.)

m. Attach hoist hook to free end of hoist bar.

n. Take up slack in hoist, but do not impose any strain.

o. Remove parts attaching generator subsystem to storage plate assembly.

p. Slowly hoist generator subsystem clear of storage plate assembly and install on spacecraft sensory ring (paragraph 4-1) or on mobile carriage (paragraph 2-44).

CAUTION

As the subsystem is hoisted, it will move from the vertical to the canted position. Hoist carefully to prevent damage during the position change.

2-44. INSTALLATION OF FUELED GENERATOR SUBSYSTEM ON MOBILE CARRIAGE

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Set brakes and lock casters on carriage.

b. Remove parts that attach heater power control assembly to carriage; then, remove heater power control assembly.

c. Remove quick-release pins that secure screen to carriage; then, remove screen.

d. Remove positioning bolts at each corner of carriage support base.

e. Position support base at convenient working height; then, install positioning bolts.

f. Remove generator subsystem from shipping container. (Refer to paragraph 2-43, steps a through p.)

g. Position generator subsystem over carriage and lower onto pins in carriage support base.

h. Operate toggle clamps to secure subsystem to carriage.

i. Detach hoist from hoist bar.

j. Detach hoist bar from handling adapter assembly.

k. Remove T-pins that attach handling adapter assembly to adapters on generator subsystem; then remove handling adapter assembly.

l. Position screen over generator subsystem and insert quick-release pins.

SECTION III

SHIPPING AND HANDLING ELECTRICALLY HEATED GENERATOR SUBSYSTEMS

3-1. SHIPPING CONTAINER DESCRIPTION

3-2. The shipping container for the electrically heated generator subsystems is a rectangular wooden box approximately 33 inches square by 4 feet high. Attached to the bottom of the container are heavy wooden skids that permit handling by forklift transporter. Four shock mounts inside the container, on the bottom, support a steel plate on which the generator is mounted.

CAUTION

Do not attempt to place an electrically heated subsystem in a fueled subsystem shipping container. Damage to the subsystem may result.

3-3. PREPARATION OF ELECTRICALLY HEATED GENERATOR SUBSYSTEMS FOR SHIPMENT

a. Remove support structure standoff and ship (with attaching parts) in separate shipping container. Package in accordance with MIL-P-116E, Method III.

b. Position a styrofoam pad on support base, place electrical connectors on pad, and secure with lockwire.

c. Insure that generator output plug P1 is connected to SHORT receptacle J21 on dummy load box.

3-4. INSTALLATION OF ELECTRICALLY HEATED GENERATOR SUBSYSTEMS IN SHIPPING CONTAINER

3-5. Since the generator subsystem is shipped cold (that is, at room temperature), it may be handled without using the handling adapter assembly. The subsystem should be handled by the support base legs. The steps in the following instructions include instructions for preservation of the generator subsystem.

CAUTION

The cold subsystem must not be exposed to humidity exceeding 50% at 75° F.

NOTE

If the associated power conditioner and telemetry signal conditioner are also to be shipped, no special preservation procedures are required. However, the units should be packaged in accordance with MIL-P-116E, Method III.

a. Remove cover and sides from shipping container.

b. Position gaskets and protective bag (in which subsystem was received) over mounts in shipping container.

c. Lift subsystem (two men required) and position it on bag over mounts in shipping container.

d. Install attaching parts to secure subsystem to mounts. Insure that gaskets are properly positioned; then tighten bolts in long leg of support base to 75 to 85 inch-pounds torque, and those in remaining legs to 190 to 200 inch-pounds torque.

e. Position bag around generator subsystem and heat-seal opening.

f. Connect vacuum pump to bag and evacuate bag.

g. Seal off bag and remove pump.

h. Connect a source of argon to the bag and purge for 5 minutes.

i. Seal off bag to retain argon atmosphere.

j. Attach sides of container to base (with wood screws); then fasten sides to each other at each corner.

CAUTION

Do not allow the container parts to strike the protective bag around the generator subsystem.

k. Place cover on container and install attaching screws.

l. Use forklift transporter to move container into van.

3-6. IN-TRANSIT PROCEDURES

3-7. There are no special in-transit procedures. No monitoring is required because the generators are usually shipped cold.

3-8. REMOVAL OF ELECTRICALLY HEATED GENERATOR SUBSYSTEMS FROM SHIPPING CONTAINER

a. Remove cover and sides from shipping container.

CAUTION

Do not allow the container parts to strike the bag containing the generator subsystem.

b. Open the protective bag around the subsystem.

NOTE

Use care in opening the bag; it can be reused for subsequent re-shipment.

CAUTION

The cold subsystem must not be exposed to humidity exceeding 50% at 75° F.

o. On HEATER POWER SUPPLY CONTROL PANEL, set HEATER NO. 1 VOLTAGE RANGE switch to 20-30 and FINE ADJ control fully counterclockwise.

p. On HEATER POWER SUPPLY CONTROL PANEL, verify that MAX POWER INPUT-HEATER NO. 1 switch on rear panel is set to 75.

q. On heater power control assembly, verify that wattmeter indicates 570 $\pm$ 10 watts.

r. On heater power control assembly, set meter switches (two places) to HEATER NO. 2. Connect P3 of cable assembly 452B1800031-119 to J2 of heater power control assembly.

CAUTION

Steps s through u should be accomplished within 45 seconds. (Refer to paragraph 5-8.) If requirements of step u cannot be achieved, perform steps v and w, reconnect P77 to GSTC on POWER SUPPLY RACK, and proceed to paragraph 3-12, step c.

s. On HEATER POWER SUPPLY CONTROL PANEL, set POWER-HEATER NO. 2 switch to OFF.

t. Disconnect P78 of cable assembly 452B1710001-59C from J16 on generator and immediately connect P4 of cable assembly 452B1800031-119 to J16 on generator.

u. On heater power control assembly, set HEATER NO. 2 POWER switch to ON. Immediately adjust HEATER NO. 2 COARSE ADJUST and FINE ADJUST controls for an indication of 570 $\pm$ 5 watts.

v. On HEATER POWER SUPPLY CONTROL PANEL, set HEATER NO. 2 VOLTAGE RANGE switch to 20-30 and FINE ADJ control fully counterclockwise.

w. On HEATER POWER SUPPLY CONTROL PANEL, verify that MAX POWER INPUT-HEATER NO. 2 switch on rear panel is set to 75.

x. Insure that RESET TIME TOTALIZER is operating.

CAUTION

Do not disturb the setting of the RESET TIME TOTALIZER. (Refer to paragraph 2-28.) It has been set as part of charging procedure (paragraph 6-25.)

y. Position screen over generator subsystem and insert quick-release pins.

z. On heater power control assembly, monitor HEATER NO. 1 and HEATER NO. 2 temperature. (Refer to paragraph 2-29.)

aa. On heater power control assembly, continue to monitor and maintain HEATER NO. 1 and HEATER NO. 2 for 570 $\pm$ 10 watts.

3-10. OVER-TEMPERATURE PROCEDURE

a. Press lighted ALARM-RESET pushbutton to turn off buzzer. (Amber indicator will light.)

b. Monitor temperature indicator.

c. Insure that input power to overheated generator has been decreased.

d. Readjust power for unaffected generator to 570 $\pm$ 5 watts input.

NOTE

When the temperature drops below the alarm condition (975 $\pm$ 25° F), heater power is automatically restored to approximately 570 watts.

e. After input power is restored on both generators, continue to monitor and maintain HEATER NO. 1 and HEATER NO. 2 for 570 $\pm$ 10 watts.

3-11. REMOVAL OF ELECTRICALLY HEATED GENERATOR SUBSYSTEM FROM MOBILE CARRIAGE

3-12. The following steps are applicable when transportation is completed or when it is desired to switch the generator heater input power control back to the GSTC or power supply rack.

CAUTION

Perform steps a and b within 45 seconds. (Refer to paragraph 5-8.)

a. Disconnect P2 of cable assembly 452B1800031-109 from J15 on generator and immediately connect P76 of cable assembly 452B1710001-49C to J15.

SECTION V

CHECKOUT PROCEDURES

5-1. GENERAL

5-2. The checkout process consists basically of initial preparations such as ground support test console (GSTC) control settings and interconnections of equipment, application of power to equipment under test, a monitoring period until thermal stability is achieved, the systematic taking and recording of measurements, and comparison of measurements against criteria for normal operation. Step-by-step procedures for these actions are given in the paragraphs that follow. Sample data sheets for each checkout procedure are shown in Appendix A. These sheets facilitate recording of data and show computations to be made where applicable. Their use is important. A record of operating time is required for all units of the thermoelectric power supply systems. Operating time entries must be made accurately on the data sheets.

5-3. To avoid wear on the connector pins of units to be tested, short adapter cables are connected to the plugs and jacks on the units. These adapter cables must be left connected to the units until the units are installed in the spacecraft. During all testing of the units, test cables must be connected to the adapter cables rather than to the units themselves.

5-4. SYSTEM CHECKOUT

5-5. CAUTIONS AND WARNINGS

5-6. Keep Proper Load on Thermoelectric Generators

5-7. During checkout procedures, this caution applies to fueled generators and to electrically heated generators when power is applied to the heaters. Never open the output circuit of either generator for longer than 30 seconds. To do so will cause excessive temperature rise in the generator. Excessive load variations cause thermal disturbances which are detrimental to the generators. The generator temperatures must not be allowed to change at a rate exceeding 50° F per 15 minutes. The ground support test console (GSTC) constitutes a satisfactory load when operated in accordance with procedures herein. When off test for short periods, the dummy load accompanying the generator subsystem is satisfactory. When a fueled generator is to be off test for over 3 hours or when the generator is unattended (an electrically heated generator in hot condition must never be left unattended), the generator output plug P1 must be connected to the SHORT receptacle J21.

5-8. During launch operations, or in other situations where the ground support test console or other external load is not available, the generator output may be switched from short to load, load to short, or open circuited provided the switching is done in open air with the fins uninsulated and the initial fin root temperature is less than 265° F. Although this sequencing is permissible, the number of such operations and the length of time that the generators are open circuited must be held to a minimum.

5-9. Maintain Proper Power to Electrically Heated Generators

5-10. Thermal disturbances are detrimental to the generators. The generators must be brought up to operating temperature slowly, while monitoring the generator temperatures, so that the rate of temperature change does not exceed 50° F per 15 minutes, and this rate of change must not be exceeded thereafter. Once the generator is brought up to operating temperature, every effort must be made to maintain that temperature. Thermal cycling is detrimental to the generators. If the system must be cooled, reduce input power to the heaters slowly and monitor temperatures constantly to avoid exceeding a change rate of 50° F per 15 minutes. The acceptable rate for heating up or cooling down the generator is 25 watts per 15 minutes.

5-11. Keep Radiation Shield in Place During Checkout

5-12. With fueled generators, testing and monitoring must be done with the radiation shield in place for safety of personnel. Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

5-13. Avoid Contact With Hot Generators

5-14. The external surfaces of hot generators may reach a temperature of 370° F. Use care to avoid burns. (The surfaces reach 370° F in simulated orbital conditions, 270° F in ambient air, and 295° F in the generator subsystem shipping container.)

CAUTION

Airflow around the generators must not be obstructed. Fin root temperatures exceeding the maximum allowable (385° F) may result.

5-15. PREPARATION FOR CHECKOUT OF FUELED SYSTEMS

5-16. To prepare for checkout of a fueled system:

a. Set GSTC controls in accordance with table 5-1.

b. Insure that generator output plug P1 is connected to SHORT receptacle J21. (If generator subsystem is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.)

c. Interconnect system units and GSTC as shown on figure 5-1.

Unit	Panel	Control	Initial Setting
Power supply rack (cont)	HEATER POWER SUPPLY CONTROL PANEL (cont)	MAX POWER INPUT* (2 places)	75
	REGULATED POWER SUPPLIES LA80-05B-2201	Circuit breaker	ON (Up)
		Vernier*	0
PORTABLE MONITOR PACKAGE		HOT JUNCT TEMP	800° F CHECK
		HOT JUNCT TEMP T/C	0
		FIN ROOT AND PRESSURE	300° F CHECK
		AC-DC switch	OFF

*These controls are on rear panel.

Table 5-1. Initial Ground Support Equipment Settings (Sheet 5 of 5)

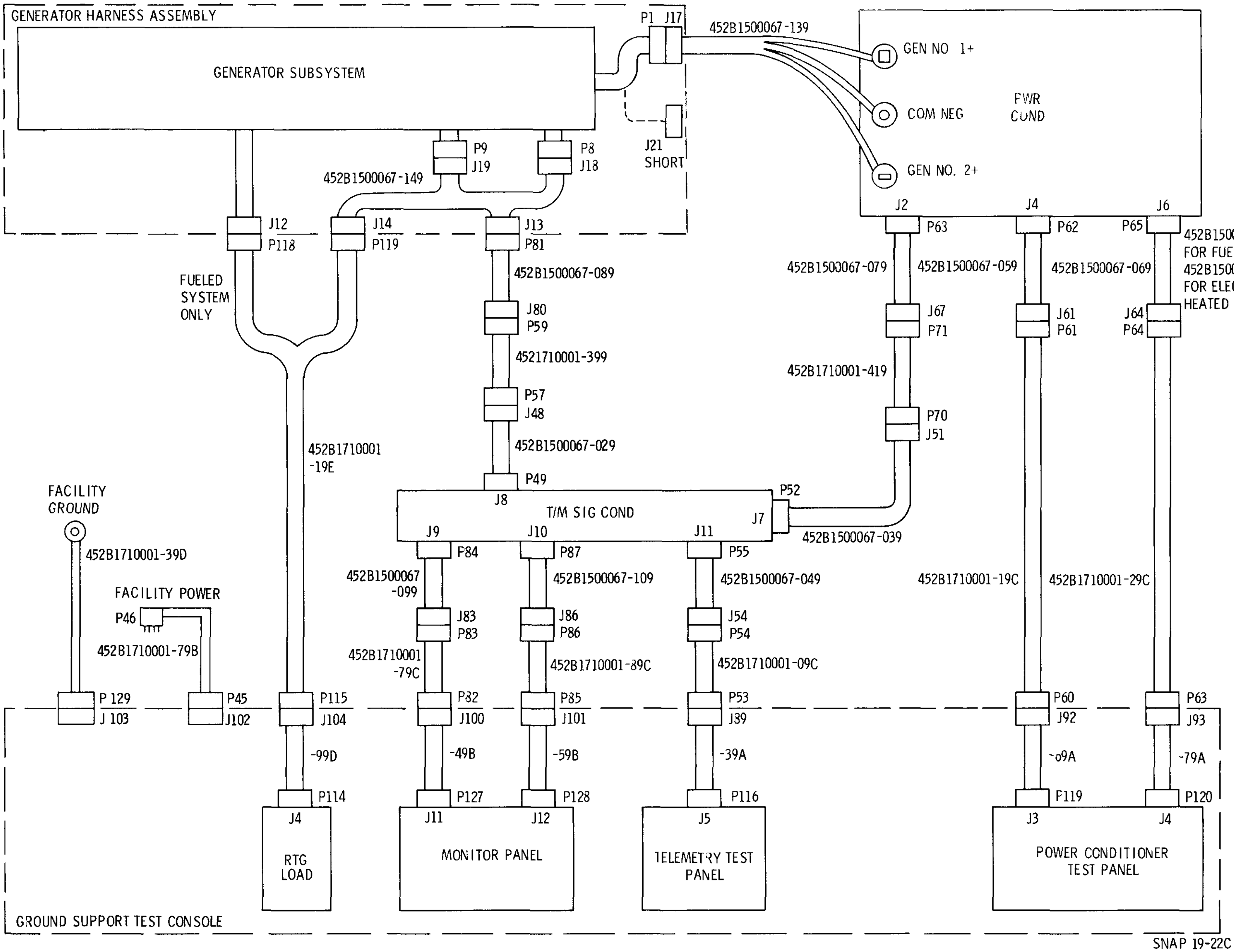

Figure 5-1. Ground Support Test Console-to-System Interconnecting Diagram

j. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS.

k. On POWER CONDITIONER TEST PANEL, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

l. Set INPUT SCANNER to channel 27 and verify DIGITAL VOLTMETER indication of 0 ± 0.100 volt.

m. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 EXT LOAD switch to 20Ω.

n. Set INPUT SCANNER to channel 28 and verify DIGITAL VOLTMETER indication of 0 ± 0.100 volt.

o. On POWER CONDITIONER TEST PANEL, set CONV NO. 2 EXT LOAD switch to 20Ω.

p. Set INPUT SCANNER to monitor channels 03 and 04 and verify that DIGITAL VOLTMETER indicates less than 0.300 volt.

q. Set INPUT SCANNER to scan and print out channels 43 through 46. Record data on data sheet (figure A-1, Appendix A) as Start Time measurement.

r. Record system operation start time on data sheet. (See figure A-2, Appendix A.)

CAUTION

If limits in steps s or u are exceeded, immediately reconnect P1 to J21.

s. Remove generator output plug P1 from SHORT receptacle J21 and connect P1 to J17. (If generator subsystem is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.) The P1 connection change must be accomplished in less than 30 seconds. (Refer to paragraph 5-5.) Immediately monitor channels 01 through 04, verifying that DIGITAL VOLTMETER indication is less than 0.500 volt.

t. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 AND CONV NO. 2 switches to ON BUS.

u. Set INPUT SCANNER to monitor channels 01 through 04 and verify that DIGITAL VOLTMETER indication is less than 0.750 volt.

v. Allow 5 minutes before proceeding.

w. Set INPUT SCANNER to scan and print out channels 43 through 46. Repeat this scan every 5 minutes through performance of step ab. Record data and time on data sheet (figure A-1, Appendix A). Verify that temperature of each generator does not increase at a rate exceeding 50° F per 15 minutes.

x. On POWER CONDITIONER TEST PANEL, slowly rotate POWER CONDITIONER LOAD control clockwise at a rate that causes channel 37 voltage to increase 4.5 ± 0.5 volts per 5 minutes, until a measurement of -19.5 ± 0.5 volts is observed on channels 37 and 38. During this process, frequently check channel 38 to insure that this measurement also changes at a rate not exceeding 5.0 volts per 5 minutes. When clockwise extreme of POWER CONDITIONER LOAD control is reached (5Ω), rapidly rotate control completely counterclockwise to 0Ω and immediately set 0Ω-5Ω PWR COND LOAD switch to 5Ω. Continue raising voltage at specified rate by rotating POWER CONDITIONER LOAD control clockwise.

CAUTION

Do not allow channel 37 or 38 measurement increase rate to exceed 5.0 volts per 5 minutes.

y. Allow 5 minutes before proceeding.

z. On POWER CONDITIONER TEST PANEL, set PWR COND switch to ON BUS.

aa. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.50 ±0.05 volts is obtained on channels 37 and 38.

ab. Readjust VOLTAGE control as required to maintain -24.50 ± 0.10 volts on channels 37 and 38. When voltages of channels 37 and 38 remain within tolerance for a period of 15 minutes without readjustment of VOLTAGE control, proceed to next step.

ac. Set INPUT SCANNER to scan and print out channels 43 through 46. Record data and time on data sheet (figure A-1, Appendix A).

ad. Repeat step ac every 15 minutes for 3 hours.

CAUTION

The hot junction temperature rate of increase must not exceed 50° F per 15 minutes. (Refer to paragraph 5-5.)

e. On power supply rack, set circuit breaker to on (up) position and verify that indicator beside breaker is lighted.

f. On HEATER POWER SUPPLY CONTROL panel, set POWER-RELAY DRIVER switch to ON. Insure that both VOLTAGE RANGE selectors are set to 20-30, that both FINE ADJ controls are completely counterclockwise, and that HEATER NO. 1 and NO. 2 switches (on rear panel) are set to 75. Set POWER HEATER NO. 1 and POWER HEATER NO. 2 switches to ON and verify that POWER ON indicators on POWER SUPPLY (two) are lighted (red).

g. Connect a 1-kw, DC, ± 0.5% wattmeter to four jacks lined up directly above HTR POWER NO. 1 switch on HEATER POWER SUPPLY CONTROL PANEL. Current terminals of wattmeter connect between the two CURRENT jacks (red is + and black is -), and voltage terminals connect between the two VOLTAGE jacks (red is + and black is -).

NOTE

Use short, heavy (approximately 12 guage) wire for current leads.

h. Repeat step g for four jacks lined up directly above HTR POWER NO. 2 switch.

i. Set HTR POWER NO. 1 switch to EXT. and verify slight power deflection on wattmeter, indicating that wattmeter is properly connected.

j. Set HTR POWER NO. 2 switch to EXT and verify slight power deflection on wattmeter, indicating that wattmeter is properly connected.

k. Wait 30 minutes before proceeding.

NOTE

In the following step, as the power input to the generators is increased, monitor hot junction temperature above 400°F to insure that it does not increase at a rate exceeding 50° F per 15 minutes. The temperature of each generator is monitored by setting the TEMPERATURE MON switch on the HEATER POWER SUPPLY CONTROL PANEL to RTG NO. 1 or RTG NO. 2 and observing the TEMPERATURE meter.

l. At 15-minute intervals, increase power input to each heater by 25 watts until a power input of 570 ± 3 watts to each heater is reached. Power input is increased by adjusting appropriate FINE ADJ and VOLTAGE RANGE controls while observing wattmeter. Since HEATER NO. 1 and NO. 2 switches (on back of HEATER POWER SUPPLY CONTROL panel) act as limits on voltage available from VOLTAGE RANGE and FINE ADJ controls, the appropriate HEATER SWITCH must be advanced a step whenever setting of corresponding VOLTAGE RANGE control provides insufficient power. Make this advance one step at a time, so that each HEATER switch setting always agrees with the upper value of its VOLTAGE RANGE control setting. Record time, wattage settings, and generator temperature on data sheet (figure A-7, Appendix A).

CAUTION

If the temperature increases by 50° F or more during any 15-minute period between step increases of input power, allow an additional 15 minutes before increasing the input power to the next step. Do not increase power to either heater by more than 25 watts per 15 minutes.

CAUTION

If wattmeters are to be removed, set HTR POWER switches to INT before disconnecting wattmeters. Do not disconnect wattmeters with HTR POWER switches set to EXT.

m. Allow 90 minutes for stabilization. Continue to monitor and maintain input power at 570 ± 3 watts on each generator throughout the remainder of this procedure.

n. Insure that hot junction temperature on each generator does not exceed 800°F.

NOTE

The temperature monitor circuit is set to give alarm at 975°F. (Refer to paragraph 1-95.)

5-20. Checkout Preparation Procedure

a. Insure that generators are heated and stabilized at 570 ± 3 watts. (Refer to paragraph 5-19 for procedures to achieve heatup and stability.)

NOTE

The following steps are applicable to both GSTC and power supply rack use as power source for generator heaters.

m. On DIGITAL VOLTMETER, set selector switch to ON.

n. Set data acquisition system to measure channel 00.

NOTE

To set the data acquisition system for single-channel measurements required at several points in this procedure, refer to paragraph 1-117.

o. On BUS POWER CONTROL panel, set VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 $\pm$ 0.2 volts; then set MODE switch to PC//TM.

p. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS.

q. On POWER CONDITIONER TEST PANEL, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

r. Set INPUT SCANNER to channel 27 and verify a DIGITAL VOLTMETER indication of 0 $\pm$ 0.100 volt.

s. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 EXT LOAD switch to 20Ω.

t. Set INPUT SCANNER to channel 28 and verify a DIGITAL VOLTMETER indication of 0 $\pm$ 0.100 volt.

u. On POWER CONDITIONER TEST PANEL, set CONV NO. 2 EXT LOAD switch to 20Ω.

v. Set INPUT SCANNER to monitor channels 03 and 04, and verify that DIGITAL VOLTMETER indicates less than 0.300 volt.

w. On POWER SUPPLY CONTROL PANEL, note temperature of hot junction on each generator and record on data sheet (figure A-1, Appendix A) as start time measurement.

NOTE

The temperature of each generator is monitored by setting the TEMPERATURE MON switch to RTG NO. 1 or RTG NO. 2 and observing the indication on the TEMPERATURE meter.

x. Record system operation start time on data sheet (figure A-2, Appendix A).

CAUTION

If the limits in steps y or aa are exceeded, immediately reconnect P1 to J21.

y. Remove generator output plug P1 from SHORT receptacle J21 and connect P1 to J17. This operation must be completed in less than 30 seconds. (Refer to paragraph 5-5.) Immediately monitor channels 01 through 04 and verify that DIGITAL VOLTMETER indication is less than 0.500 volt.

z. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 and CONV NO. 2 switches to ON BUS.

aa. Set INPUT SCANNER to monitor channels 01 through 04 and verify that DIGITAL VOLTMETER indication is less than 0.750 volt.

ab. Wait 5 minutes before proceeding.

NOTE

Monitor hot junction temperature on each generator every 5 minutes through step ag and record temperature and time on data sheet (figure A-1, Appendix A).

CAUTION

Insure that the temperature of each generator does not increase at a rate exceeding 50° F per 15 minutes.

ac. On POWER CONDITIONER TEST PANEL, slowly rotate POWER CONDITIONER LOAD control clockwise at a rate that causes channel 37 voltage to increase 4.5 ± 0.5 volts per 5 minutes, until a measurement of -19.5 ± 0.5 volts is observed on channels 37 and 38. During this process, frequently check channel 38 to insure that this measurement also changes at a rate not exceeding 5.0 volts per 5 minutes. When clockwise extreme of POWER CONDITIONER LOAD control is reached (5Ω), rapidly rotate control completely counterclockwise to 0Ω, and immediately set 0Ω-5Ω PWR COND LOAD switch to 5Ω. Continue raising voltage at specified rate by rotating POWER CONDITIONER LOAD control clockwise.

CAUTION

Do not allow channel 37 or 38 measurement to increase at a rate exceeding 5 volts per 5 minutes.

ad. Allow 5 minutes before proceeding.

ae. On POWER CONDITIONER TEST PANEL, set PWR COND switch to ON BUS.

af. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.50 ± 0.10 volts are obtained on channels 37 and 38.

ag. Readjust VOLTAGE control as required to maintain -24.50 ± 0.10 volts on channels 37 and 38. When both channel 37 and 38 remain within tolerance for a period of 15 minutes without readjustment of VOLTAGE control, proceed to next step.

ah. Using TEMPERATURE MON switch for selection, monitor TEMPERATURE meter for hot junction temperature of each generator. Record temperature and time on data sheet (figure A-1, Appendix A).

ai. Repeat step ah every 15 minutes for 90 minutes.

CAUTION

The hot junction temperature must not increase at a rate exceeding 50° F per 15 minutes. (Refer to paragraph 5-5.)

aj. Proceed with steps in paragraph 5-21.

5-21. SYSTEM CHECKOUT PROCEDURE

a. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. From printed data, record required measurements on data sheet (figure A-2, Appendix A). Mark data tape FULL LOAD ON BUS and save for reference.

b. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to OFF BUS, and press CONV NO. 1 COMMAND pushbutton.

c. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. Record required measurements on data sheet (figure A-2, Appendix A). Mark data tape CONV NO. 1 OFF BUS and save for reference.

d. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

e. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. Record required measurements on data sheet (figure A-2, Appendix A). Mark data tape FULL LOAD OFF BUS and save for reference.

f. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS and press CONV NO. 1 COMMAND pushbutton.

g. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. Record required measurements on data sheet (figure A-2, Appendix A). Mark data tape CONV NO. 2 OFF BUS and save for reference.

h. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

i. Set INPUT SCANNER to channel 37.

j. Connect cable assembly 452B1710001-49E between oscilloscope vertical plug-in 1752A and MONITOR PANEL jack BE; then turn on oscilloscope and allow it to warm up for 5 minutes.

k. On BUS POWER CONTROL panel, set MODE switch to UNREG.

l. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -24.5 ± 0.05 volts. (Refer to paragraph 1-70a and 1-70b.)

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m. Set oscilloscope to measure peak-to-peak ripple voltage. Record measurement on data sheet (figure A-3, Appendix A) under RIPPLE TEST.

n. Disconnect oscilloscope.

o. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -19.5 ±0.5 volts. (Refer to paragraph 1-70a and 1-70b.)

p. On BUS POWER CONTROL panel, set MODE switch to PC/ /TM.

q. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.5 ± 0.10 volts are obtained on channels 37 and 38.

r. After all testing is completed, complete all calculations indicated on data sheet (figure A-3, Appendix A); then, proceed with shutdown procedure (paragraph 5-22).

5-22. COOLDOWN TO SHORT CIRCUIT (FUELED OR ELECTRICALLY HEATED SYSTEM)

5-23. When checkout of a fueled or electrically heated system is completed, the generators must be placed in the shorted condition as follows:

CAUTION

If the system is electrically heated, maintain input power on each generator at 570 ± 3 watts throughout this procedure.

a. On POWER CONDITIONER TEST PANEL, set PWR COND switch to OFF BUS.

b. Wait 5 minutes before proceeding.

c. On POWER CONDITIONER TEST PANEL, slowly rotate POWER CONDITIONER LOAD control counterclockwise at a rate that causes channel 37 voltage to decrease 4.5 ± 0.5 volts per 5 minutes. During this process, frequently check channel 38 to insure that this measurement also changes at a rate not exceeding 5 volts per 5 minutes. When counterclockwise extreme of POWER CONDITIONER LOAD control is reached (0Ω), rapidly rotate control completely clockwise to 5Ω, and immediately set 0Ω-5Ω PWR COND LOAD switch to 0Ω. Continue lowering voltage at specified rate until POWER CONDITIONER LOAD control is completely counterclockwise at 0Ω. Verify that PWR COND LOAD switches (three) are set to 0Ω.

CAUTION

Do not reduce channel 37 or 38 voltages at a rate exceeding 5.0 volts per 5 minutes.

d. Wait 5 minutes before proceeding.

e. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 and CONV NO. 2 switches to OFF BUS.

f. Wait 5 minutes before proceeding.

g. Remove generator output plug P1 from J17 and connect P1 to SHORT receptacle J21. This operation must be accomplished in less than 30 seconds. (If generator subsystem is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.

h. Set INPUT SCANNER to monitor channels 03 and 04, and verify that DIGITAL VOLTMETER indicates less than 0.300 volt.

i. Record system operation stop time on data sheet (figure A-2, Appendix A).

j. On BUS POWER CONTROL panel, set VOLTAGE control fully counterclockwise and set MODE switch to OFF.

k. On DIGITAL VOLTMETER, set selector switch to STD BY.

l. On POWER CONDITIONER TEST PANEL, set controls in accordance with table 5-1.

m. Remove patchcords from MONITOR PANEL.

NOTE

Step n applies only to fueled generators and electrically heated generators being supplied heater power by the power supply rack.

n. Set POWER switch on AC RECEPTACLE PANEL to down position.

o. For electrically heated systems, continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator (with heater power supplied by either the GSTC or the power supply rack).

p. Without disturbing cable assemblies shown in figure 5-2, remove cables connecting system to GSTC.

5-24. GENERATOR SUBSYSTEM CHECKOUT

5-25. CAUTIONS AND WARNINGS

5-26. Keep Proper Load on Thermoelectric Generators

5-27. This caution applies to fueled generators and to electrically heated generators when power is applied to the heaters. Never open the output circuit of either generator for longer than 30 seconds. To do so will cause excessive temperature rise in the generator. Excessive load variations cause thermal disturbances which are detrimental to the generators. The generator temperatures must not be allowed to change at a rate exceeding 50° F per 15 minutes. The ground support test console (GSTC) constitutes a satisfactory load when operated in accordance with procedures herein. When off test for short periods, the dummy load accompanying the generator subsystem is satisfactory. When a fueled generator is to be off test for over 3 hours or when the generator is unattended (an electrically heated generator in hot condition must never be unattended) the generator output plug P1 must be connected to the SHORT receptacle, J21. However, during launch operations, or in other situations where the ground support test console or other external load is not available, the generator output may be switched from short to load, load to short, or open circuited provided the switching is done in open air with the fins uninsulated and the initial fin root temperature is less than 265° F. Although this sequencing is permissible, the number of such operations and the length of time that the generators are open circuited must be held to a minimum.

5-28. Maintain Proper Power to Electrically Heated Generators

5-29. Thermal disturbances are detrimental to the generators. The generators must be brought up to operating temperature slowly, while monitoring the generator temperatures, so that the rate of temperature change does not exceed 50°F per 15 minutes, and this rate of change must not be exceeded thereafter. Once the generator is brought up to operating temperature, every effort must be made to maintain that temperature. Thermal cycling is detrimental to the generators. If the system must be cooled, reduce input power to the heaters slowly and monitor temperatures constantly to avoid exceeding a change rate of 50°F per 15 minutes. Never remove heater power from a hot generator for longer than 45 seconds. The acceptable rate for heating up or cooling down the generators is 25 watts per 15 minutes.

5-30. Keep Radiation Shield in Place During Checkout

5-31. With fueled generators, testing and monitoring must be done with the radiation shield in place for safety of personnel. Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6).

5-32. Avoid Contact With Hot Generators

5-33. The external surfaces of hot generators may reach a temperature of 380°F. Use care to avoid burns. (Simulated orbital conditions result in 380° F temperature; exposed in atmosphere the temperature is 260° F and in the shipping container the temperature is 300° F.)

CAUTION

Airflow around the generators must not be obstructed. Fin root temperatures exceeding the maximum allowable (385° F) may result.

5-34. FUELED GENERATOR CHECKOUT WITH OUTPUT SHORT CIRCUITED

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Set GSTC controls in accordance with table 5-1.

c. Insure that generator output plug P1 is connected to SHORT receptacle, J21. If generator is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.)

d. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

e. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

f. Interconnect generator subsystem and GSTC as shown on figure 5-3.

g. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify the following:

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
00	AA	RTG 1 output volts (direct reading)
01	AC	RTG 2 output volts (direct reading)
02	AB	RTG 1 output current (20a-100 mv shunt)
03	AD	RTG 2 output current (20a-100 mv shunt)
04	AJ	RTG 1 hot jct temp T2 (T/M)
05	AK	RTG 1 hot jct temp T3 (T/M)
06	AL	RTG 1 hot jct temp T5 (T/M)
07	AS	RTG 2 hot jct temp T2 (T/M)
08	AT	RTG 2 hot jct temp T3 (T/M)
09	AU	RTG 2 hot jct temp T5 (T/M)
10	AG	RTG 1 fin root temp T6 (T/M)
11	AH	RTG 1 fin root temp T7 (T/M)
12	AI	RTG 1 fin root temp T8 (T/M)
13	AP	RTG 2 fin root temp T6 (T/M)
14	AQ	RTG 2 fin root temp T7 (T/M)
15	AR	RTG 2 fin root temp T8 (T/M)
16	AE	RTG 1 output volts (T/M)
17	AN	RTG 2 output volts (T/M)
18	AF	RTG 1 pressure (T/M)
19	AO	RTG 2 pressure (T/M)
20	AV	RTG 1 pressure excitation
21	AW	RTG 2 pressure excitation
22	FW	RTG 1 fin root temp T13
23	FX	RTG 2 fin root temp T13

Table 5-3. Monitor Panel Interconnections for Generator Checkout (Sheet 1 of 2)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
24*	FS	RTG 1 hot jct temp T9
25*	FT	RTG 1 hot jct temp T10
26*	FU	RTG 2 hot jct temp T9
27*	FV	RTG 2 hot jct temp T10

*Fueled system only.

Table 5-3. Monitor Panel Interconnections for Generator Checkout (Sheet 2 of 2)

n. Set INPUT SCANNER to monitor channels 24 and 26 and verify that DIGITAL VOLTMETER indication increases at a rate not exceeding 0.230 volt per 5 minutes. Continue to monitor this rate for 25 minutes before proceeding to next step. Every 5 minutes through step t, record DIGITAL VOLTMETER indications and time on data sheet (figure A-4, Appendix A).

o. Set INPUT SCANNER to monitor channel 00.

p. On RTG LOAD panel, slowly rotate RTG NO. 1 control counterclockwise until DIGITAL VOLTMETER indication increases by +0.400 ± 0.100 volt.

q. Set INPUT SCANNER to monitor channel 01

r. On RTG LOAD panel, slowly rotate RTG NO. 2 control counterclockwise until DIGITAL VOLTMETER indication increases by +0.400 ± 0.100 volt.

s. At 5-minute intervals, repeat steps o through r until channels 00 and 01 measurements are +2.6 ± 0.02 volts.

CAUTION

Do not allow channel 00 and 01 measurements to increase at a rate exceeding 0.5 volt per 5 minutes.

t. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at +2.6 ± 0.02 volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at +2.6 ± 0.02 volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

u. Set INPUT SCANNER to channels 24 and 26 and record indications and time on data sheet (figure A-4, Appendix A).

v. Repeat step u every 15 minutes for 2 hours.

NOTE

The hot junction temperature rate of increase should not exceed 50°F per 15 minutes. (Refer to paragraph 5-25.)

w. Set data acquisition system to scan and print out channels 00 through 27.

x. Record data on data sheet (figure A-5, Appendix A) under LOAD measurement. Using appropriate curves in MND-3607-186, convert data to required measurements. Verify that measurements comply with limits on data sheet.

5-35. FUELED GENERATOR CHECKOUT WITH OUTPUT AT NOMINAL LOAD

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Set GSTC controls in accordance with table 5-1.

c. Insure that generator output plug P1 is connected to LOAD receptacle J20. (If generator is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.)

d. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls fully clockwise to MAX.

e. Interconnect generator subsystem and GSTC as shown on figure 5-3.

f. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

g. On AC RECEPTACLE PANEL, set POWER switch to on (up) position and verify that:

1. Both lamps on DIGITAL CLOCK are lighted (green)

2. Both faces of DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display is lighted

4. INPUT SCANNER display is lighted

5. POWER ON indicator on DATA PRINTER is lighted (red)

6. RECORD ON indicator on DATA PRINTER is lighted (white)

7. Indicator on power supply (three) lighted (red)

8. POWER switch-indicator on RECORDER OFF. (If switch-indicator is lighted, press indicator.)

9. Rack exhaust fans (four) are operating

h. Wait 10 minutes for warm-up before proceeding.

i. On DIGITAL VOLTMETER, set selector switch to ON.

j. Set INPUT SCANNER to monitor channels 24 and 26 and record DIGITAL VOLTMETER indications on data sheet (figure A-4, Appendix A) as START time measurements. Monitor and record these indications and time on data sheet every 15 minutes for duration of this checkout.

k. Record generator operation start time on data sheet (figure A-5, Appendix A).

CAUTION

Steps l through n must be accomplished as rapidly as possible.

l. Remove generator output plug P1 from LOAD receptacle of J20 and connect P1 to J17. (Refer to paragraph 2-42 if generator is in shipping container.) This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.)

CAUTION

If voltage settings required in step m or n cannot be achieved, immediately reconnect P1 to J20. Steps l through n must be accomplished as rapidly as possible.

m. Set INPUT SCANNER to monitor channel 00 and adjust RTG NO. 1 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of $+2.6 \pm 0.02$ volts.

n. Set INPUT SCANNER to monitor channel 01 and adjust RTG NO. 2 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of $+2.6 \pm 0.02$ volts.

o. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at $+2.6 \pm 0.02$ volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at $+2.6 \pm 0.02$ volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

p. Continue complying with the requirements of step j for 60 additional minutes.

NOTE

The hot junction temperature rate of increase should not exceed 50°F per 15 minutes. (Refer to paragraph 5-27.)

q. Set data acquisition system to scan and print out channels 00 through 27.

r. Record data on data sheet (figure A-5, Appendix A) under LOAD measurement using appropriate curves in MND-3607-186, convert data to required measurements. Verify that measurements comply with limits on data sheet.

5-36. ELECTRICALLY HEATED GENERATOR CHECKOUT WITH OUTPUT SHORT CIRCUITED

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Insure that generators are heated and stabilized at 570 $\pm$ 3 watts. (Refer to paragraph 5-19 for procedures to achieve heatup and stability.)

c. Continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator throughout this checkout.

d. Insure that generator output plug P1 is connected to SHORT receptacle J21.

NOTE

Steps e through k are applicable only when heater input power is supplied to the generator subsystem by the power supply rack. If the GSTC is supplying power, omit steps e through k and proceed to step l.

e. Set GSTC controls in accordance with table 5-1.

f. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

g. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

h Without disturbing cable assemblies already connected (as shown in figure 5-2), interconnect generator and GSTC as shown on figure 5-3.

i. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify the following:

1. Both lamps on DIGITAL CLOCK lighted (green)

2. Both faces of DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display lighted

4. INPUT SCANNER display lighted

5. POWER ON indicator on DATA PRINTER lighted (red)

6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (3 places) lighted (red)

8. POWER switch-indicator on RECORDER OFF. (If switch-indicator is lighted, press indicator.)

9. Rack exhaust fans (four) operating.

j. When buzzer sounds, press RTG NO. 1 and RTG NO. 2 ALARM switch-indicators on RTG LOAD panel.

k. Wait 10 minutes for warm-up before proceeding

NOTE

Steps l through p are applicable only when the GSTC is furnishing heater power to the generators. Proceed to step r, omitting steps l through p, if power is supplied by the power supply rack.

l. On VARIABLE POWER CONTROL panel, verify that MODE 1 and MODE 2 switches are set to OFF.

m. On BUS POWER CONTROL panel, verify that MODE switch is set to OFF.

n. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

o. Connect patchcords between jacks on MONITOR PANEL as indicated table 5-3.

p. Without disturbing cable assemblies already connected (as shown in figure 5-2), interconnect generator subsystem and GSTC as shown in figure 5-3.

q. When RTG 1 ALARM indicator (on RTG LOAD panel) lights (red) press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red) press RTG 2 ALARM switch indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators light amber.

NOTE

Steps r and up are applicable to use of both the GSTC and the power supply rack.

r. On DIGITAL VOLTMETER, set selector switch to ON.

s. Set data acquisition system to scan and print out channels 04 through 23. Record data on data sheet (figure A-5, Appendix A) under SHORT measurement. Using appropriate curves in MND-3607-186, convert data to required measurements and verify that measurements comply with limits on data sheets.

t. On POWER SUPPLY CONTROL PANEL, note temperature of hot junction on each generator and record on data sheet (figure A-4, Appendix A) as start time measurement.

NOTE

The temperature of each generator is monitored by setting the TEMPERATURE MON switch to RTG NO. 1 or RTG NO. 2 and observing the indication on the TEMPERATURE meter.

u. Record generator operation start time on data sheet (figure A-5, Appendix A).

CAUTION

If limits in steps v and w are exceeded, immediately reconnect P1 to J21.

v. Remove generator output plug P1 from SHORT receptacle J21 and connect P1 to J17. This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.) Immediately monitor channels 00 and 01 and verify that DIGITAL VOLTMETER indication is less than +2.0 volts.

w. Monitor hot junction temperatures of each generator on TEMPERATURE meter, (on POWER SUPPLY CONTROL panel) every 5 minutes. Verify that temperature rate of increase does not exceed 17°F per

5 minutes. Continue to monitor this rate for 25 minutes before proceeding to next step. Every 5 minutes record readings and time through step ac on data sheet (figure A-4, Appendix A).

x. Set INPUT SCANNER to monitor channel 00.

y. On RTG LOAD panel, slowly rotate RTG NO. 1 control counterclockwise until DIGITAL VOLTMETER indication increases by +0.400 $\pm$0.100 volt.

z. Set INPUT SCANNER to monitor channel 01.

aa. On RTG LOAD panel, slowly rotate RTG NO. 2 control counterclockwise until DIGITAL VOLTMETER indication increases by +0.400 $\pm$ 0.100 volt.

ab. At 5-minute-intervals, repeat steps x through aa until channel 00 and 01 measurements are +2.6 $\pm$0.02 volts.

CAUTION

Do not allow channel 00 or 01 measurement to increase at a rate exceeding 0.5 volt per 5 minutes.

ac. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at +2.6 $\pm$ 0.02 volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at +2.6 $\pm$ 0.02 volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

ad. Record hot junction temperature on each generator and time on data sheet (figure A-4, Appendix A). Temperature may be read on TEMPERATURE meter on POWER SUPPLY CONTROL PANEL, using TEMPERATURE MON switch for selection.

ae. Repeat step ad every 15 minutes for 2 hours.

NOTE

The hot junction temperature rate of increase must not exceed 50°F per 15 minutes. (Refer to paragraph 5-27.)

af. Set data acquisition system to scan and print out channels 00 through 23.

ag. Record data on data sheet (figure A-5, Appendix A) under LOAD measurement. Using appropriate curves in MND-3607-186, convert data to required measurements and verify that measurements comply with limits on data sheet.

5-37. ELECTRICALLY HEATED GENERATOR CHECKOUT WITH OUTPUT AT NOMINAL LOAD

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator throughout this checkout.

c. Insure that generator output plug P1 is connected to LOAD receptacle J20.

NOTE

Steps d through j are applicable only when heater input power is supplied to the generator subsystem by the power supply rack. If the GSTC is supplying power, omit steps d through j and proceed to step k.

d. Set GSTC controls in accordance with table 5-1.

e. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

f. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

g. Interconnect generator subsystem, GSTC, and facility as shown on figure 5-3.

h. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify the following:

1. Both lamps on DIGITAL CLOCK lighted (green)
2. Both faces of DIGITAL CLOCK lighted (white)
3. DIGITAL VOLTMETER display lighted
4. INPUT SCANNER display lighted
5. POWER ON indicator on DATA PRINTER lighted (red)
6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (three) lighted (red)

8. POWER switch-indicator on RECORDER OFF (If switch-indicator is lighted, press indicator)

9. Rack exhaust fans (four) operating.

i. When RTG 1 ALARM indicator lights (red) press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red) press RTG 2 ALARM switch-indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators are lighted amber.

j. Wait 10 minutes for warm-up before proceeding.

NOTE

Steps k through p are applicable only when the GSTC is supplying heater power to the generators. Proceed to step q, omitting steps k through p, if power is supplied by the power supply rack.

k. On VARIABLE POWER CONTROL panel, insure that MODE 1 and MODE 2 switches are set to OFF.

l. On BUS POWER CONTROL panel, insure that MODE switch is set to OFF.

m. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

n. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

o. Interconnect generator subsystem and GSTC as shown in figure 5-3.

p. When RTG 1 ALARM indicator lights, (red) press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red) press RTG 2 ALARM switch-indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators are lighted (amber).

NOTE

Steps q and up are applicable to use of both the GSTC and the power supply rack.

q. On DIGITAL VOLTMETER, set selector switch to ON.

r. On POWER SUPPLY CONTROL PANEL, note temperature of hot junction on each generator on the TEMPERATURE meter. The temperature of each generator is monitored by setting the TEMPERATURE MON switch to RTG NO. 1 or RTG NO. 2. Record on data sheet (figure A-4, Appendix A) as start time measurement. Monitor and record the readings and time on data sheet every 15 minutes for duration of this test.

s. Record generator operation start time on data sheet (figure A-5, Appendix A)

CAUTION

Steps t through v must be accomplished as rapidly as possible.

t. Remove generator output plug P1 from LOAD receptacle J20 and connect P1 to J17. This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.)

CAUTION

If voltage settings required in step u or v cannot be achieved, immediately reconnect P1 to J20.

u. Set INPUT SCANNER to channel 00 and adjust RTG NO. 1 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of +2.6 ± 0.02 volts.

v. Set INPUT SCANNER to channel 01 and adjust RTG NO. 2 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of +2.6 ± 0.02 volts.

w. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at +2.6 ± 0.02 volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at +2.6 ± 0.02 volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

x. Continue complying with the requirements of step r for 60 additional minutes.

NOTE

The hot junction temperature rate of increase should not exceed 50°F per 15 minutes. (Refer to paragraph 5-27.)

y. Set data acquisition system to scan and print out channels 00 through 23.

a. Insure that generator subsystem has been cooled down to short-circuit condition. (Refer to paragraph 5-39.)

b. Insure that two 1-KW, DC ± 0.5% wattmeters are connected to four jacks lined up directly above HTR POWER NO. 1 and HTR POWER NO. 2 switches on HEATER POWER SUPPLY CONTROL PANEL. Voltage terminals of wattmeter connect between the two VOLTAGE jacks (red is + and black is -), and current terminals connect between two CURRENT jacks (red is + and black is -).

NOTE

Use short, heavy (approximately 12 gauge) wire for current leads.

c. Insure that HTR POWER NO. 1 switch is set to EXT.

d. Decrease power input to heater No. 1 by 25 watts while observing wattmeter. Power input is decreased by adjusting the appropriate FINE ADJ and VOLTAGE RANGE controls.

e. Insure that HTR POWER NO. 2 switch is set to EXT

f. Decrease power input to heater No. 2 by 25 watts.

g. As power input to generators is decreased, monitor hot junction temperatures above 400°F to insure that temperature does not decrease at a rate exceeding 50° F per 15-minute period. Record time wattage settings, and generator temperatures on data sheet (figure A-7, Appendix A).

NOTE

The temperature of each generator may be monitored by setting the TEMPERATURE MON switch on the HEATER POWER SUPPLY CONTROL PANEL to RTG NO. 1 or RTG NO. 2 and observing the TEMPERATURE meter.

h. At 15-minute intervals, repeat steps d, f, and g until voth VOLTAGE RANGE controls are set to 20-30 and both FINE ADJ controls are completely counterclockwise. Then, 15 minutes later, set POWER-HEATER NO. 1 and POWER-HEATER NO. 2 switches to OFF. Set HEATER NO. 1 and NO. 2 switches (on rear of panel) to 75. Set POWER RELAY-DRIVER switch to OFF.

CAUTION

If the temperature decreases by 50°F or more during any 15-minute period between step decreases of input power, allow an additional 15 minutes before decreasing the input power to the next step. Do not decrease power to either heater by more than 25 watts per 15-minute period.

CAUTION

If wattmeters are to be removed, set HTR POWER switches to INT before disconnecting wattmeters. Do not disconnect wattmeters with HTR POWER switches set to EXT.

i. If GSTC is being used, set POWER switch on AC RECEPTACLE PANEL to off (down) position.

j. If power supply rack is being used, set circuit breaker to down position.

k. Disconnect interconnecting cables. (Refer to figure 5-2.)

5-46. POWER CONDITIONER CHECKOUT PROCEDURE

a. Set ground support test console (GSTC) controls in accordance with table 5-1.

b. Connect cables between GSTC, power conditioner unit, and facility as shown on figure 5-4.

NOTE

Do not connect terminal lugs of cables 452B1710001-99C and -09D to power conditioner at this time. Instead, short the four heavy lugs (one coded with a square, one with a rectangle, and two with circles) to one another by using a 1/4-inch bolt, washers, and nut to fasten the lugs firmly together. Leave the four smaller lugs unattached.

c. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-4.

p. On POWER CONDITIONER TEST PANEL, set CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT switches to OFF.

q. Remove shorting bolt from lugs on ends of cables 452B1710001-99C and -09D, and connect all lugs on these cables to power conditioner as shown on figure 5-4. Tighten power conditioner terminal nuts to 25 to 28 inch-pounds of torque.

r. Set data acquisition system to measure channel 25.

s. On BUS POWER CONTROL panel, set VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.01 volts.

t. On BUS POWER CONTROL panel, set MODE switch to PC POWER.

u. On POWER CONDITIONER TEST PANEL, with FUNCTION switch set to OFF BUS, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

v. Set data acquisition system to measure channel 02. Verify a DIGITAL VOLTMETER indication of 120 ± 6K ohms.

w. Set data acquisition system to measure channel 03. Verify a DIGITAL VOLTMETER indication of 120 ± 6K ohms.

x. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS, and press CONV NO. 1 COMMAND pushbutton.

y. Set data acquisition system to measure channel 02. Verify a DIGITAL VOLTMETER indication between 0 and 4 ohms.

z. Set data acquisition system to measure channel 03. Verify a DIGITAL VOLTMETER indication of 120 ± 6K ohms.

aa. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

ab. Measure channels 02 and 03. Verify a DIGITAL VOLTMETER indication between 0 and 4 ohms.

ac. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD 0Ω - 5Ω switch to 5Ω and set POWER CONDITIONER LOAD control to approximately 4 ohms (4/5 rotation toward the 5Ω clockwise extreme). (This provides a total load resistance of approximately 9 ohms.)

ad. On POWER CONDITIONER TEST PANEL, set CONV NO. 1, CONV NO. 2, and PWR COND switches to ON BUS.

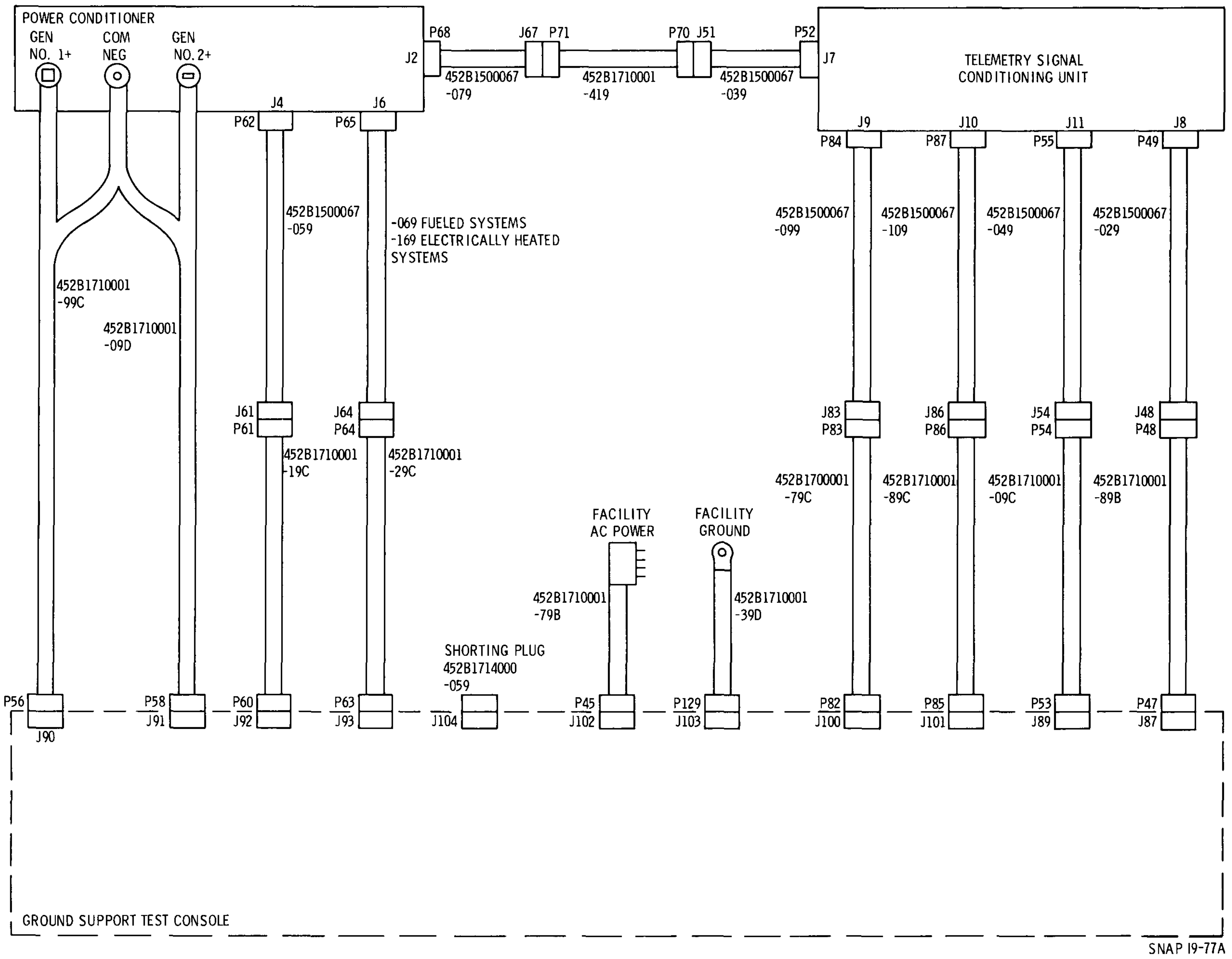


Figure 5-6. Interconnection for System Checkout with Generator Simulation

r. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -24.5 ± 0.05 volts. (Refer to paragraphs 1-70a and 1-70b.)

s. Set oscilloscope to measure peak-to-peak ripple voltage. Record measurement on Data Sheet (figure A-10, Appendix A) under RIPPLE TEST.

t. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -19.5 ±0.5 volts. (Refer to paragraphs 1-70a and 1-70b.)

u. Disconnect oscilloscope. On BUS POWER CONTROL panel, set MODE switch to PC/ /TM.

v. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.50 ±0.10 volts is obtained on channels 08 and 10.

w. From data tapes, record required data and complete all calculations indicated on data sheet (figure A-9, Appendix A). Verify data compliance with limits on data sheet.

NOTE

Observe that on data tape marked TSCU INPUTS are recorded the simulated inputs to the TSCU. On the data tape marked full load test ON BUS channels 28 through 43 are the corresponding TSCU outputs. Table 5-6 defines the signals that correspond to each channel. Using the appropriate input versus output curves supplied in MND-3607-186 and the values recorded on the above mentioned data tapes, compare the values on the data tapes versus the calibrated value on the appropriate curve. Channels 28 through 33 should be compared to be within limits -0 to + 0.3 volts. Channels 34 through 43 should be compared to be within the limits of ±0.15 volts. Enter findings on data sheet (figure A-10, Appendix A) under TSCU CHECKOUT.

5-67. GENERATOR SIMULATION SYSTEM CHECKOUT TEST COMPLETION

a. On DIGITAL VOLTMETER, set selector switch to STD BY.

b. On VARIABLE POWER CONTROL panel, set VOLTAGE 1 and VOLTAGE 2 controls fully counterclockwise. Set MODE 1 and MODE 2 switches to OFF.

c. On BUS POWER CONTROL, set VOLTAGE control fully counterclockwise and set MODE switch to OFF.

d. Set all switches on the TELEMETRY TEST PANEL to OFF.

e. On AC RECEPTACLE PANEL, set POWER switch to down position.

f. Set all GSTC controls on POWER CONDITIONER TEST PANEL to initial settings per table 5-1.

g. Disconnect all cable assemblies between GSTC, PCU, TSCU, and facility.

h. Disconnect all patchcords from MONITOR PANEL.

SECTION VI

MAINTENANCE

6-1. MAINTENANCE OF THERMOELECTRIC POWER SUPPLY SYSTEM

6-2. CAUTIONS AND WARNINGS

6-3. Keep Proper Load on Thermoelectric Generators

6-4. During checkout procedures, this caution applies to fueled generators and to electrically heated generators when power is applied to the heaters. Never open the output circuit of either generator for longer than 30 seconds. To do so will cause excessive temperature rise in the generator. Excessive load variations cause thermal disturbances which are detrimental to the generators. The generator temperatures must not be allowed to change at a rate exceeding 50° F per 15 minutes. The ground support test console (GSTC) constitutes a satisfactory load when operated in accordance with procedures herein. When off test for short periods, the dummy load accompanying the generator subsystem is satisfactory. During off-test periods exceeding 3 hours, or when the generator is unattended, the generator output plug must be connected to the short receptacle J21. During launch operations, or in other situations where the ground support test console or other external load is not available, the generator output may be switched from short to load, load to short, or open circuited provided the switching is done in open air with the fins uninsulated and the initial fin root temperature is less than 265° F. Although this sequencing is permissible, the number of such operations and the length of time that the generators are open circuited must be held to a minimum.

6-5. Maintain Proper Power to Electrically Heated Generators

6-6. Thermal disturbances are detrimental to the generators. The generators must be brought up to operating temperature slowly, while monitoring the generator temperatures, so that the rate of temperature change does not exceed 50° F per 15 minutes, and this rate of change must not be exceeded thereafter. Once the generator is brought up to operating temperature, every effort must be made to maintain that temperature. Thermal cycling is detrimental to the generators. If the system must be cooled, reduce input power to the heaters slowly and monitor temperatures constantly to avoid exceeding a change rate of 50° F per 15 minutes. Never remove heater power from a hot generator for longer than 45 seconds. The acceptable rate for heating up or cooling down the generator is 25 watts per 15 minutes.

6-7. Keep Radiation Shield in Place Whenever Possible

6-8. With fueled generators, testing and monitoring must be done with the radiation shield in place for safety of personnel. Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

6-9. Avoid Contact With Hot Generators

6-10. The external surfaces of hot generators may reach a temperature of 370° F. Use care to avoid burns. (The surfaces reach 370° F in simulated orbital conditions, 270° F in ambient air, and 295° F in the generator subsystem shipping container.)

CAUTION

Airflow around the generators must not be obstructed. Fin root temperatures exceeding the maximum allowable (385° F) may result.

6-11. TROUBLESHOOTING AND REPAIR

6-12. If a power supply system does not meet the performance requirements specified under paragraph 5-7, System Checkout Procedures, analyze the data obtained during system checkout to determine which of the subsystems is most likely to be malfunctioning, and perform a subsystem checkout of that unit. If necessary, check out all subsystems independently to isolate the defective unit.

6-13. All units of the power supply system are classed as non-reparable in the field. Do not attempt to repair a defective subsystem. Instead, contact the Martin Marietta Corporation, Baltimore, Maryland, regarding disposition of the unit.

6-14. MAINTENANCE OF GROUND SUPPORT TEST CONSOLE

6-15. EQUIPMENT CALIBRATION

6-16. Calibration is recommended at the intervals listed for each of the following ground support test console (GSTC) panels:

	Interval (Months)
a. TELEMETRY TEST PANEL	12
b. POWER CONDITIONER TEST PANEL	12
c. RTG LOAD	6
d. UNIVERSAL EPUT AND TIMER, MODEL 7350A	6
e. OSCILLOSCOPE, MODEL 175A	6
f. HEATER POWER SUPPLY CONTROL PANEL	6
g. POWER SUPPLY (2), CCI 94N4-1	6
h. DIGITAL VOLTMETER, SERIES 5000	3
i. INPUT CONVERTER, SERIES 1100	6
j. INPUT SCANNER, MODEL 262S701	12
k. DATA PRINTER, MODEL 155	12
l. POWER SUPPLY (3), MODEL ECR 36-30	6
m. RECORDING SYSTEM, MARK 200	6

6-17. Calibration of the TELEMETRY TEST PANEL consists of checking the shunts (R91 and R92) and verifying they are within manufacturer's specified accuracy (R91- ± 0.1%; R92- ± 0.5%).

6-18. Calibration of the POWER CONDITIONER TEST PANEL consists of checking the R14 and R15 shunts for an accuracy of ± 0.5%, checking the R16, R17, R27, and R28 shunts for an accuracy of ± 0.1%, and checking and adjusting, if necessary, two relay driver circuit boards. These circuit boards, 452B1711220-009, are connected to jacks J11 and J12 along the side of the power conditioner test panel chassis. To adjust the circuit boards (both are adjusted in the same manner):

a. Obtain a power supply capable of being adjusted to 24.5 volts DC and an oscilloscope with external triggering capability.

b. Remove circuit boards from jacks J11 and J12.

c. Connect high side of oscilloscope vertical input to pin A of circuit board plug, and connect ground side of oscilloscope input to pin B. Connect a 1-K ohm, 1-watt resistor between pins A and B.

d. Connect external trigger input of oscilloscope to pin A.

e. Connect a momentary-action, normally closed switch between pins C and D.

f. Connect positive side of power supply to pin C and negative side to pin S, and adjust to 24.5 volts DC.

g. Set oscilloscope to observe a +20 ± 1.0-volt pulse of approximately 50 milliseconds duration.

h. Actuate momentary switch and measure pulse width.

i. No adjustment is required if pulse width is 50 ± 5 ms. If width is out of tolerance, adjust potentiometer R6 on the circuit board for pulse width of 50 ± 5 ms.

6-19. Calibration of the RTG LOAD panel consists of checking the R3 and R4 shunts for accuracy of ± 0.5% and of checking and adjusting, if necessary, TCT1, TCT2, TCA1 and TCA2 thermocouple transmitter units as follows:

a. Set range of Acromag, Inc. part No. 314-AX and 314-AT to 4 VDC ± 0.02% output with 400°F input and 20 VDC ± 0.02% output with 1200°F input.

b. Verify that units are linear within 1% at the following points:

Input (°F)	Output (VDC)
600	8 ± 0.2
800	12 ± 0.2
1000	16 ± 0.2

c. Set alarm to trigger at 975°F (-0 +25°F), with dropout set for 975°F (+0 -25°F). (Refer to calibration instructions supplied with transmitters by Acromag, Inc.)

6-20. Calibration of the HEATER POWER SUPPLY CONTROL PANEL consists of checking the two wattmeters and temperature meter (the temperature meter is a 20 VDC full scale, 1% voltmeter) and of checking and adjusting, if necessary, the TCA1 and TCA2 thermocouple transmitter alarm units as follows:

a. Set range of Acromag, Inc. part No. 314-AT to 400 to 1200°F.

b. Verify that units are linear within 1%, full scale, at 600°F, 800°F, and 1000°F.

c. Set alarm to trigger at 975°F (-0 +25°F) with dropout set for 975°F (+0 -25°F). (Refer to calibration instructions supplied with transmitters by Acromag, Inc.)

6-21. Calibration procedures for other units listed under paragraph 6-16 are given in the manufacturers' literature. The following precautions must be observed:

a. The digital voltmeter must be calibrated with filter assembly 452B1713002 connected, using cable assembly 452B1710001-89D.

b. Power supplies A15, A16 and A21, figure 1-6, must be calibrated with terminals 3 and 4 of TB1 jumpered. This jumper must be removed prior to reinstalling the power supplies in the GSTC.

c. Power supplies A8 and A9, figure 1-6, must be calibrated with terminals 8 and 9 of TB2 jumpered. This jumper must be removed prior to reinstalling the power supplies in the GSTC or the power supply rack.

d. Recording system ink supply valves must be turned off when the system is not in use.

6-22. TROUBLESHOOTING AND REPAIR

6-23. Troubleshooting and repair information for the commercial equipment panels of the GSTC is given in the manufacturers' literature furnished with the equipment.

6-24. Functional and schematic diagrams are shown in figures 6-1 through 6-51. These diagrams and the functional descriptions under paragraph 1-35 provide sufficient data for a skilled electronics technician to isolate any trouble that may occur. Conventional electronics servicing techniques are applicable to all GSTC equipment.

6-25. MOBILE CARRIAGE HEATER POWER CONTROL ASSEMBLY BATTERY CHARGING PROCEDURE

a. Set heater power control assembly and battery charger controls in accordance with table 5-1.

b. Connect P5 of cable assembly 452B1800031-129 to J3 of heater power control assembly. Connect the red and black plugs to the battery charger DC OUTPUT 0 TO 5 AMPS red and black jacks, respectively.

c. On battery charger, set POWER switch to ON.

d. Verify that CHARGING CURRENT ON lamp is lighted (white).

e. On battery charger, press CALIBRATE switch and adjust bottom screw on VOLTAGE CUT-OFF METER for CAL position.

f. Insure that CELL SELECTOR on battery charger is set to 20.

g. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to BANK 1.

h. Adjust CURRENT CONTROL on battery charger to obtain a 2-ampere indication on ammeter.

i. Maintain 2-ampere indication until CHARGING CURRENT OFF lamp lights amber.

j. On battery charger, press RESET switch for 5 seconds. If CHARGING CURRENT OFF lamp goes off, repeat step i, and then press RESET switch again. When CHARGING CURRENT OFF lamp remains lighted after pressing RESET switch, proceed to step k.

k. Set battery charger POWER switch to OFF.

l. Set battery charger CURRENT CONTROL fully counterclockwise.

m. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to BANK 2.

n. Repeat steps c through f and h through l.

o. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to BANK 3.

p. Repeat steps c through e.

q. On battery charger, set CELL SELECTOR to 21.

r. Repeat steps h through l.

s. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to OFF.

t. Set battery charger CELL SELECTOR to 20.

u. On heater power control assembly, set RESET TIME TOTALIZER to 00000.

v. Disconnect cable assembly 452B1800031-129.

6-26. PORTABLE MONITOR CALIBRATION

NOTE

Calibration at 6-month intervals is recommended.

a. Connect a voltmeter across battery voltage test jacks on panel of portable monitor. If voltage is less than 11.25 VDC, replace batteries.

NOTE

Steps b through f are for DC adjustment.

b. Set AC-OFF-DC switch to DC.

c. Set HOT JUNCT TEMP switch to 800° F CHECK.

d. Adjust R11 (under front panel) for 800° F indication on meter.

e. Set FIN ROOT AND PRESSURE switch to 300° F CHECK.

f. Adjust R4 (under front panel) for 300° F indication on meter.

NOTE

Steps g through i are for AC adjustment.

g. Connect J4 to AC power source. (Refer to paragraph 2-35.)

h. Set AC-OFF-DC switch to AC.

i. Set HOT JUNCT TEMP switch to 800° F CHECK.

i.1 Set power supply output adjustment screw (under front panel) for 800° F indication on HOT JUNCT TEMP meter.

j. Calibrate HOT JUNCT TEMP meter over entire range for 1% full scale accuracy.

k. Calibrate FIN ROOT AND PRESSURE meter over entire range for 1% full scale accuracy.

l. Check pyrometer over entire range for 1% full scale accuracy employing 10.8-ohm cable resistance.

Table 6-2. Voltage Measurement Circuit Calibration Procedures (Sheet 2 of 2)

Step (See figure A-9, Appendix A, data sheets 85-1-1 through 85-1-6)	RTG 1 output	RTG 2 output	PC 1 input	PC 2 input	PC 1 output	PC 2 output
g. On TELEMETRY TEST PANEL, adjust R5 control for required input value (for all circuits)	X	X	X	X	X	X
h. Set INPUT SCANNER to channel -	03	05	07	09	11	13
i. Record DIGITAL VOLTMETER indication under output voltage RUN 1 on data sheet -	85-1-1	85-1-2	85-1-3	85-1-4	85-1-5*	85-1-6*
j. Perform steps e through i for all input values listed on data sheet.						
k. On VARIABLE POWER CONTROL panel, rotate VOLTAGE 2 control fully counter clockwise (for all circuits)	X	X	X	X	X	X
l. On VARIABLE POWER CONTROL panel, set MODE 2 switch to OFF (for all circuits)	X	X	X	X	X	X
m. On TELEMETRY TEST PANEL, set to OFF switches -	S1 through S7	S1 through S7	S1 through S7	S1 through S7	S1 through S7 and S29	S1 through S7 and S29
n. On TELEMETRY TEST PANEL, rotate R5 fully counter clockwise (for all circuits)	X	X	X	X	X	X

*Record on data sheet as a negative value.

Table 6-3. Current Measurement Circuit Calibration Procedures

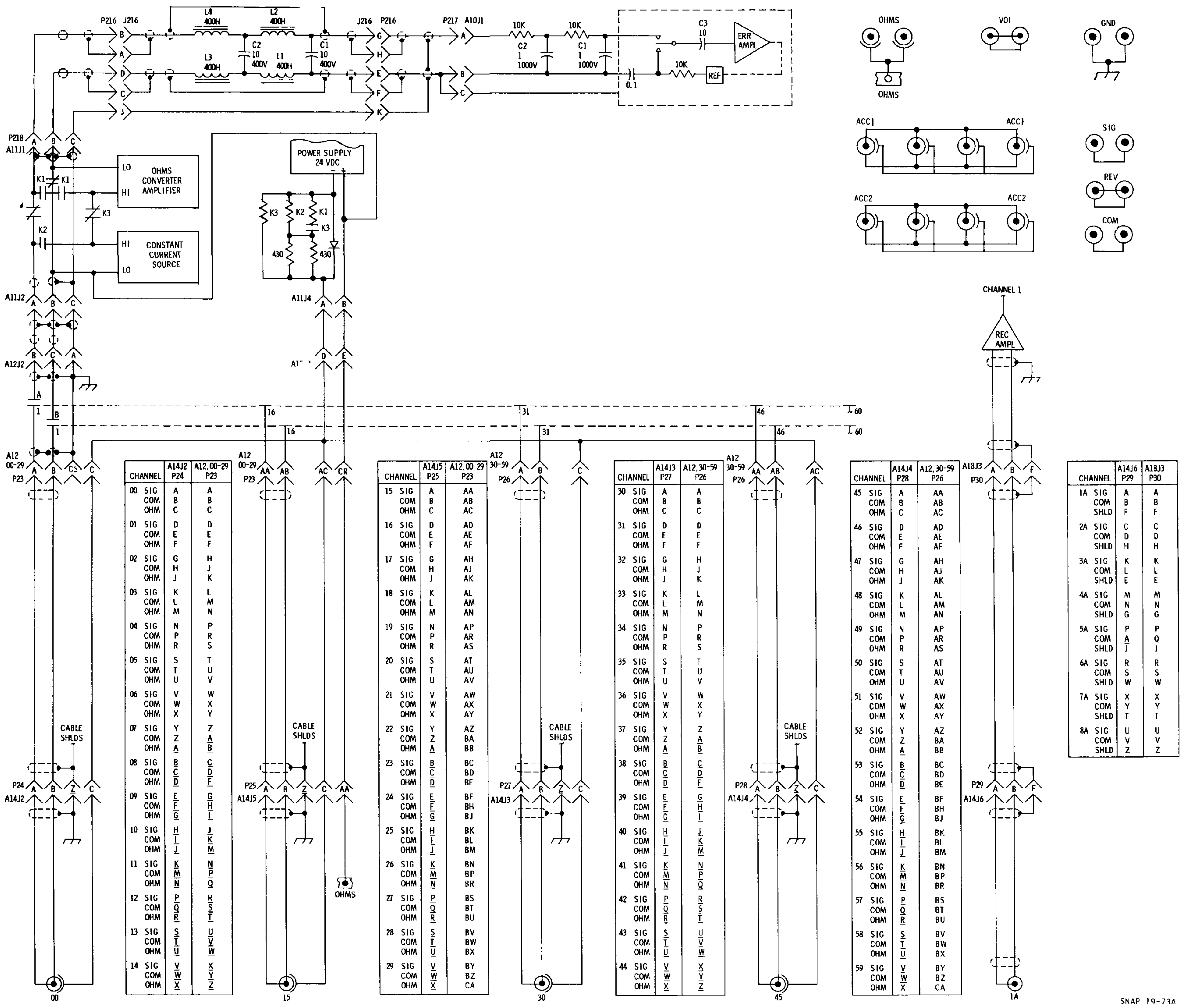
Step (See figure A-9, Appendix A, data sheets 85-2-1 through 85-2-4)	PC 1 input	PC 2 input	PC1 output	PC 2 output
a. On VARIABLE POWER CONTROL panel, set to TM TRANSDUCTOR the -	MODE 1 switch	MODE 1 switch	MODE 2 switch	MODE 2 switch
b. Set INPUT SCANNER to channel -	14	14	17	17
c. On VARIABLE POWER CONTROL panel, adjust to required input value the -	VOLTAGE 1 control	VOLTAGE 1 control	VOLTAGE 2 control	VOLTAGE 2 control
d. Set INPUT SCANNER to channel -	15	16	18	19
e. Record DIGITAL VOLTMETER indication under output voltage RUN 1 on data sheet	85-2-1	85-2-2	85-2-3	85-2-4
f. Perform steps b through e for all input values listed on data sheet.				
g. On VARIABLE POWER CONTROL rotate VOLTAGE control (1 or 2, as indicated at right) fully counter-clockwise, and set MODE switch (1 or 2, as indicated at right) to OFF.	VOLTAGE 1 MODE 1	VOLTAGE 1 MODE 1	VOLTAGE 2 MODE 2	VOLTAGE 2 MODE 2

Table 6-4. RTG Pressure Measurement Circuit Calibration Procedures

Step (See figure A-9, Appendix A, data sheets 85-3-1 and 85-3-2	RTG 1 Pressure Measurement	RTG 2 Pressure Measurement
a. On TELEMETRY TEST PANEL, set to ON the -	S10 switch	S11 switch
b. Set INPUT SCANNER to channel -	20	22
c. On TELEMETRY TEST PANEL set to OFF the -	S9 switch	S32 switch
d. On TELEMETRY TEST PANEL, adjust R4 for required input value (for each circuit)	X	X
e. Set INPUT SCANNER to channel	21	23
f. On TELEMETRY TEST PANEL, set to ON the -	S9 switch	S32 switch
g. Record DIGITAL VOLTMETER indication under output voltage RUN 1 on data sheet	85-3-1	85-3-2
h. Perform steps b through g for all input values listed on data sheet		
i. On TELEMETRY TEST PANEL, set to OFF the -	S9 and S10 switches	S11 and S32 switches
j. On TELEMETRY TEST PANEL, rotate R1 fully counterclockwise (for all circuits)	X	X

Table 6-5. PC 1 and PC 2 Temperature Measurement Circuit Calibration Procedures

Step (See figure A-9, Appendix A, data sheets 85-4-1 and 85-4-2)	PC 1 Temperature	PC 2 Temperature
a. On TELEMETRY TEST PANEL, set to ON the -	S16 switch	S17 switch
b. Set INPUT SCANNER to channel -	24	26
c. On TELEMETRY TEST PANEL, set S15 switch to OFF	X	X
d. On TELEMETRY TEST PANEL, set S14 switch to obtain data sheet value -	X	X
NOTE Values are obtained by the following switch settings. 2.5K to 15K — S14 to 1 25K to 40K — S14 to 2 62K to 80K — S14 to 3		
e. On TELEMETRY TEST PANEL, adjust R3 for required input value -	X	X
f. Set INPUT SCANNER to channel -	25	27
g. On TELEMETRY TEST PANEL, set S15 switch to -	ON	ON
h. Record DIGITAL VOLTMETER indication under RUN 1 on data sheet -	85-4-1	85-4-2
i. Perform steps b through g for all values listed on data sheet -	X	X
j. On TELEMETRY TEST PANEL, set to OFF the -	S14 through S16 switches	S14, S15, and S17 switches
k. On TELEMETRY TEST PANEL, rotate R3 fully counterclockwise -	X	X



CHANNEL		A14J2 P24	A12, 00-29 P23
00	SIG	A	A
	COM	B	B
	OHM	C	C
01	SIG	D	D
	COM	E	E
	OHM	F	F
02	SIG	G	H
	COM	H	J
	OHM	J	K
03	SIG	K	L
	COM	L	M
	OHM	M	N
04	SIG	N	P
	COM	P	R
	OHM	R	S
05	SIG	S	T
	COM	T	U
	OHM	U	V
06	SIG	V	W
	COM	W	X
	OHM	X	Y
07	SIG	Y	Z
	COM	Z	$\underline{A}$
	OHM	$\underline{A}$	$\underline{B}$
08	SIG	$\underline{B}$	$\underline{C}$
	COM	$\underline{C}$	$\underline{D}$
	OHM	$\underline{D}$	$\underline{F}$
09	SIG	$\underline{E}$	$\underline{G}$
	COM	$\underline{F}$	$\underline{H}$
	OHM	$\underline{G}$	$\underline{I}$
10	SIG	$\underline{H}$	$\underline{J}$
	COM	$\underline{I}$	$\underline{K}$
	OHM	$\underline{J}$	$\underline{M}$
11	SIG	$\underline{K}$	$\underline{N}$
	COM	$\underline{M}$	$\underline{P}$
	OHM	$\underline{N}$	$\underline{Q}$
12	SIG	$\underline{P}$	$\underline{R}$
	COM	$\underline{Q}$	$\underline{S}$
	OHM	$\underline{R}$	$\underline{T}$
13	SIG	$\underline{S}$	$\underline{U}$
	COM	$\underline{T}$	$\underline{V}$
	OHM	$\underline{U}$	$\underline{W}$
14	SIG	$\underline{V}$	$\underline{X}$
	COM	$\underline{W}$	$\underline{Y}$
	OHM	$\underline{X}$	$\underline{Z}$

CHANNEL		A14J5 P25	A12, 00-29 P23
15	SIG	A	AA
	COM	B	AB
	OHM	C	AC
16	SIG	D	AD
	COM	E	AE
	OHM	F	AF
17	SIG	G	AH
	COM	H	AJ
	OHM	J	AK
18	SIG	K	AL
	COM	L	AM
	OHM	M	AN
19	SIG	N	AP
	COM	P	AR
	OHM	R	AS
20	SIG	S	AT
	COM	T	AU
	OHM	U	AV
21	SIG	V	AW
	COM	W	AX
	OHM	X	AY
22	SIG	Y	AZ
	COM	Z	BA
	OHM	$\underline{A}$	BB
23	SIG	$\underline{B}$	BC
	COM	$\underline{C}$	BD
	OHM	$\underline{D}$	BE
24	SIG	$\underline{E}$	BF
	COM	$\underline{F}$	BH
	OHM	$\underline{G}$	BJ
25	SIG	$\underline{H}$	BK
	COM	$\underline{I}$	BL
	OHM	$\underline{J}$	BM
26	SIG	$\underline{K}$	BN
	COM	$\underline{M}$	BP
	OHM	$\underline{N}$	BR
27	SIG	$\underline{P}$	BS
	COM	$\underline{Q}$	BT
	OHM	$\underline{R}$	BU
28	SIG	$\underline{S}$	BV
	COM	$\underline{T}$	BW
	OHM	$\underline{U}$	BX
29	SIG	$\underline{V}$	BY
	COM	$\underline{W}$	BZ
	OHM	$\underline{X}$	CA

CHANNEL		A14J3 P27	A12, 30-59 P26
30	SIG	A	A
	COM	B	B
	OHM	C	C
31	SIG	D	D
	COM	E	E
	OHM	F	F
32	SIG	G	H
	COM	H	J
	OHM	J	K
33	SIG	K	L
	COM	L	M
	OHM	M	N
34	SIG	N	P
	COM	P	R
	OHM	R	S
35	SIG	S	T
	COM	T	U
	OHM	U	V
36	SIG	V	W
	COM	W	X
	OHM	X	Y
37	SIG	Y	Z
	COM	Z	$\underline{A}$
	OHM	$\underline{A}$	$\underline{B}$
38	SIG	$\underline{B}$	$\underline{C}$
	COM	$\underline{C}$	$\underline{D}$
	OHM	$\underline{D}$	$\underline{F}$
39	SIG	$\underline{E}$	$\underline{G}$
	COM	$\underline{F}$	$\underline{H}$
	OHM	$\underline{G}$	$\underline{I}$
40	SIG	$\underline{H}$	$\underline{J}$
	COM	$\underline{I}$	$\underline{K}$
	OHM	$\underline{J}$	$\underline{M}$
41	SIG	$\underline{K}$	$\underline{N}$
	COM	$\underline{M}$	$\underline{P}$
	OHM	$\underline{N}$	$\underline{Q}$
42	SIG	$\underline{P}$	$\underline{R}$
	COM	$\underline{Q}$	$\underline{S}$
	OHM	$\underline{R}$	$\underline{T}$
43	SIG	$\underline{S}$	$\underline{U}$
	COM	$\underline{T}$	$\underline{V}$
	OHM	$\underline{U}$	$\underline{W}$
44	SIG	$\underline{V}$	$\underline{X}$
	COM	$\underline{W}$	$\underline{Y}$
	OHM	$\underline{X}$	$\underline{Z}$

CHANNEL		A14J4 P28	A12, 30-59 P26
45	SIG	A	AA
	COM	B	AB
	OHM	C	AC
46	SIG	D	AD
	COM	E	AE
	OHM	F	AF
47	SIG	G	AH
	COM	H	AJ
	OHM	J	AK
48	SIG	K	AL
	COM	L	AM
	OHM	M	AN
49	SIG	N	AP
	COM	P	AR
	OHM	R	AS
50	SIG	S	AT
	COM	T	AU
	OHM	U	AV
51	SIG	V	AW
	COM	W	AX
	OHM	X	AY
52	SIG	Y	AZ
	COM	Z	BA
	OHM	$\underline{A}$	BB
53	SIG	$\underline{B}$	BC
	COM	$\underline{C}$	BD
	OHM	$\underline{D}$	BE
54	SIG	$\underline{E}$	BF
	COM	$\underline{F}$	BH
	OHM	$\underline{G}$	BJ
55	SIG	$\underline{H}$	BK
	COM	$\underline{I}$	BL
	OHM	$\underline{J}$	BM
56	SIG	$\underline{K}$	BN
	COM	$\underline{M}$	BP
	OHM	$\underline{N}$	BR
57	SIG	$\underline{P}$	BS
	COM	$\underline{Q}$	BT
	OHM	$\underline{R}$	BU
58	SIG	$\underline{S}$	BV
	COM	$\underline{T}$	BW
	OHM	$\underline{U}$	BX
59	SIG	$\underline{V}$	BY
	COM	$\underline{W}$	BZ
	OHM	$\underline{X}$	CA

CHANNEL		A14J6 P29	A18J3 P30
1A	SIG	A	A
	COM	B	B
	SHLD	F	F
2A	SIG	C	C
	COM	D	D
	SHLD	H	H
3A	SIG	K	K
	COM	L	L
	SHLD	E	E
4A	SIG	M	M
	COM	N	N
	SHLD	G	G
5A	SIG	P	P
	COM	$\underline{A}$	Q
	SHLD	J	J
6A	SIG	R	R
	COM	S	S
	SHLD	W	W
7A	SIG	X	X
	COM	Y	Y
	SHLD	T	T
8A	SIG	U	U
	COM	V	V
	SHLD	Z	Z

Figure 6-1. Ground Support Test Console Subsystem--Monitor Circuits

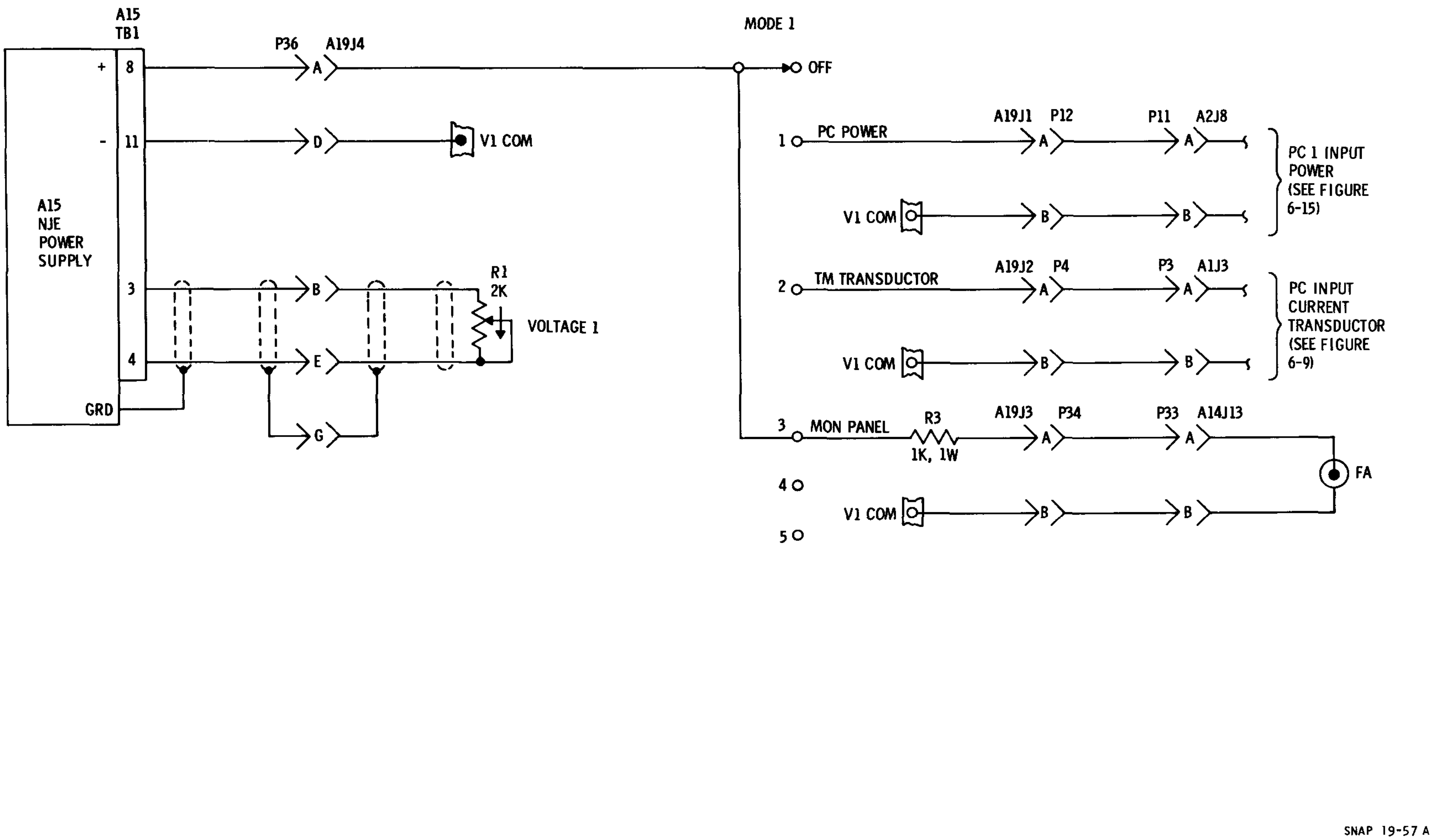


Figure 6-2. Ground Support Test Console Subsystem--Variable I Power Circuit

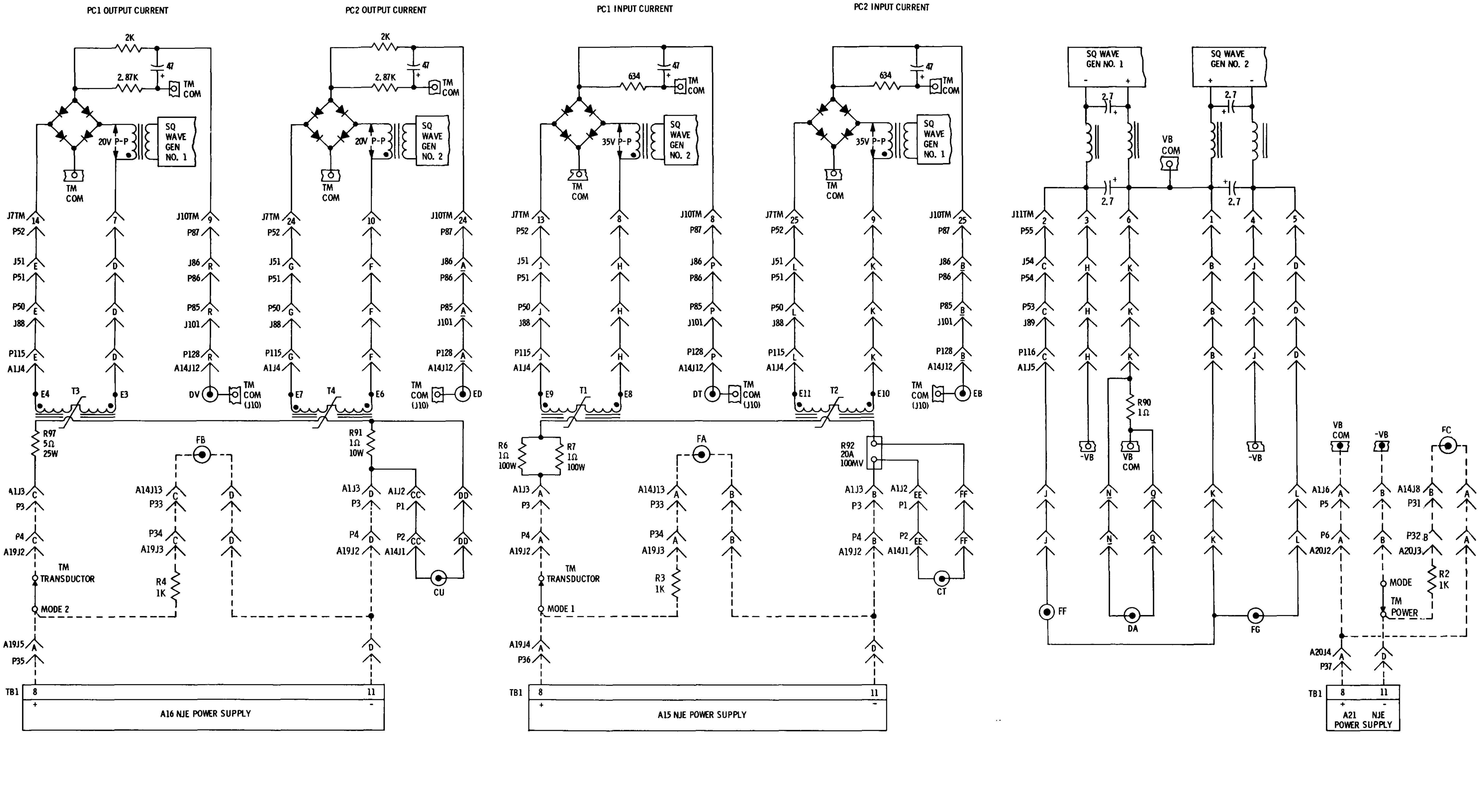


Figure 6-9. Telemetry Signal Conditioner Unit Subsystem--Power Conditioner Unit Current Circuit and Telemetry Signal Conditioner Unit Input Circuit

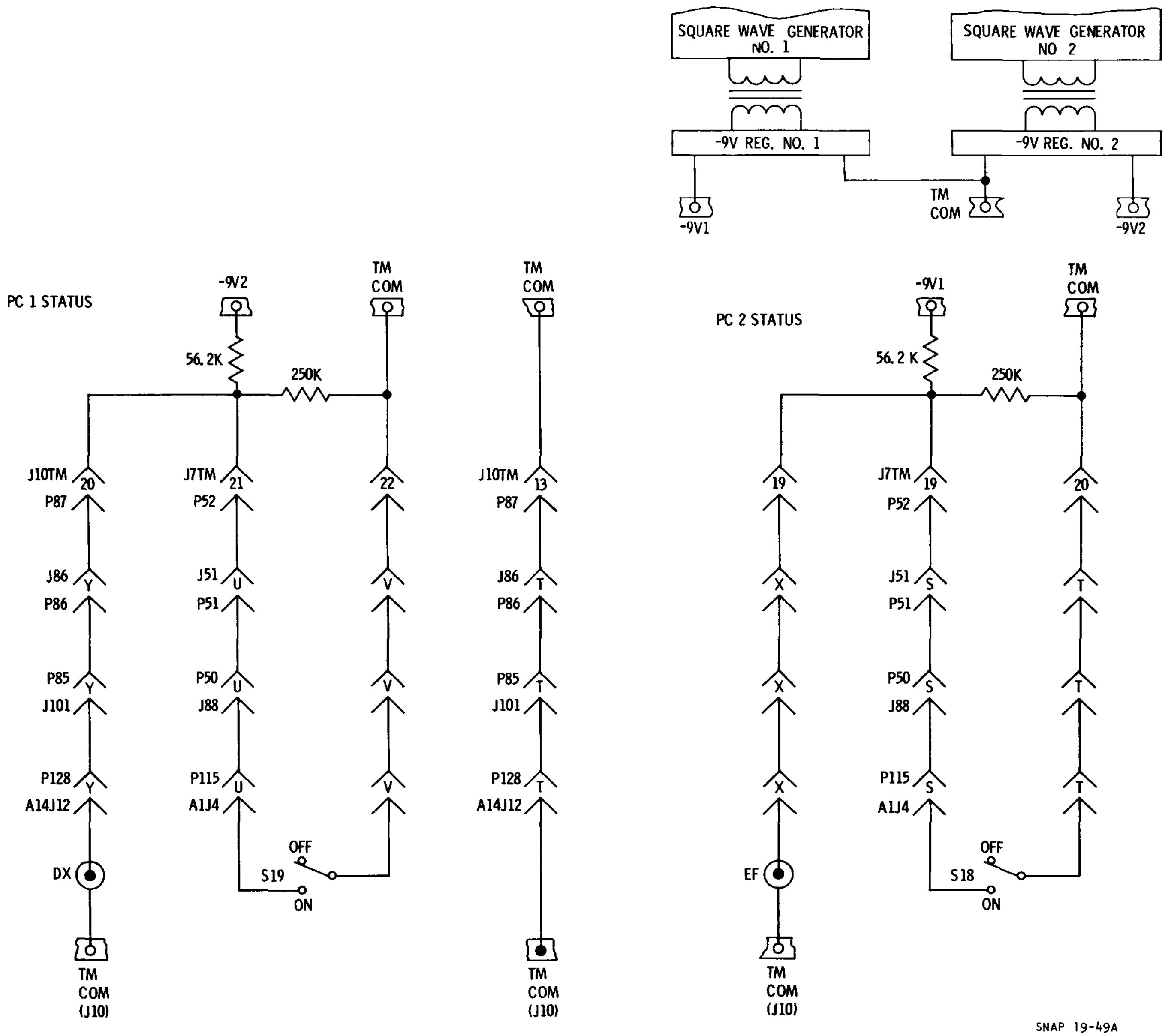


Figure 6-10. Telemetry Signal Conditioner Unit Subsystem--Power Conditioner Unit On/Off Bus Status Circuit

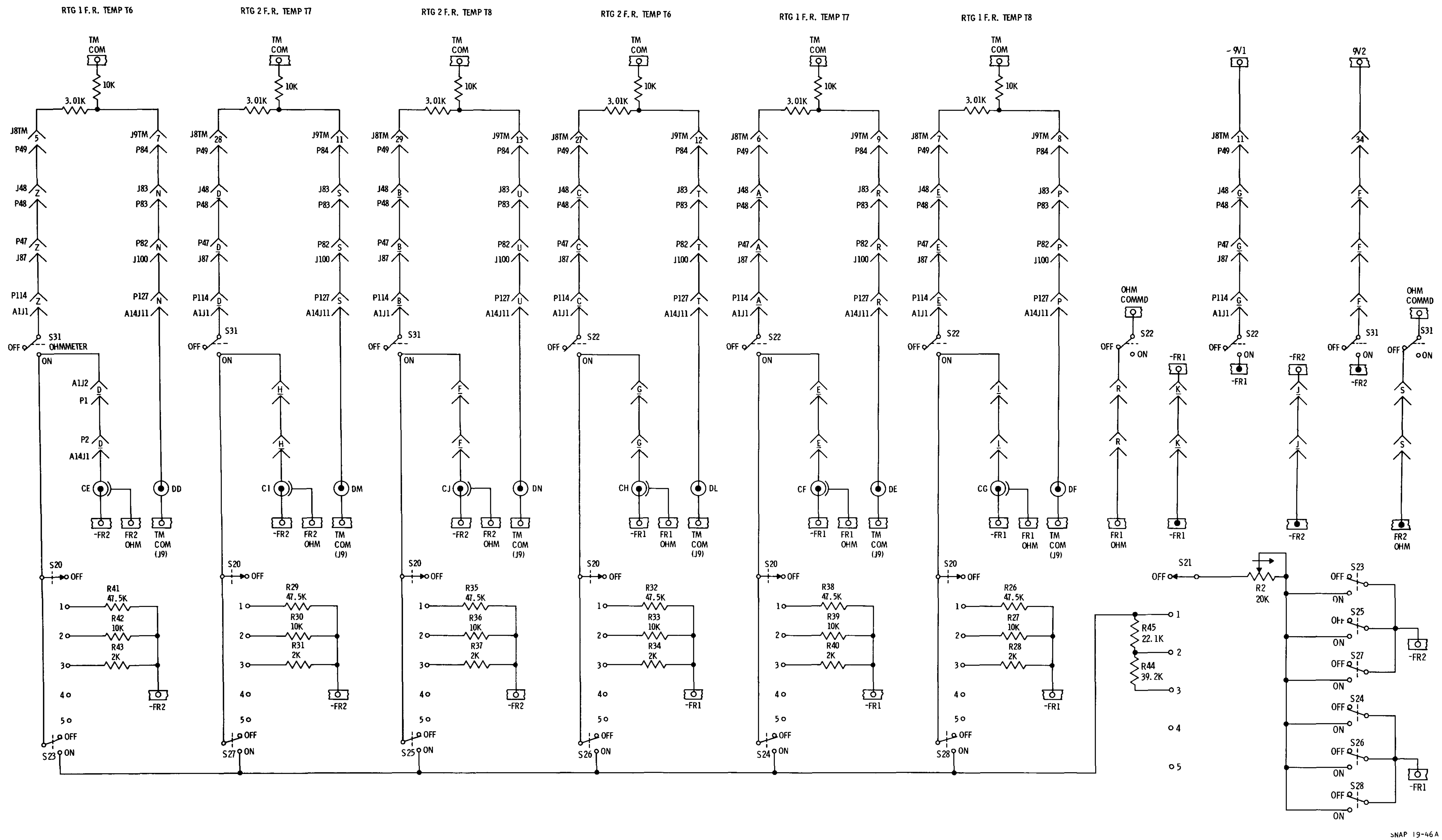


Figure 6-11. Telemetry Signal Conditioner Unit Subsystem--Generator Fin Root Temperature Circuit

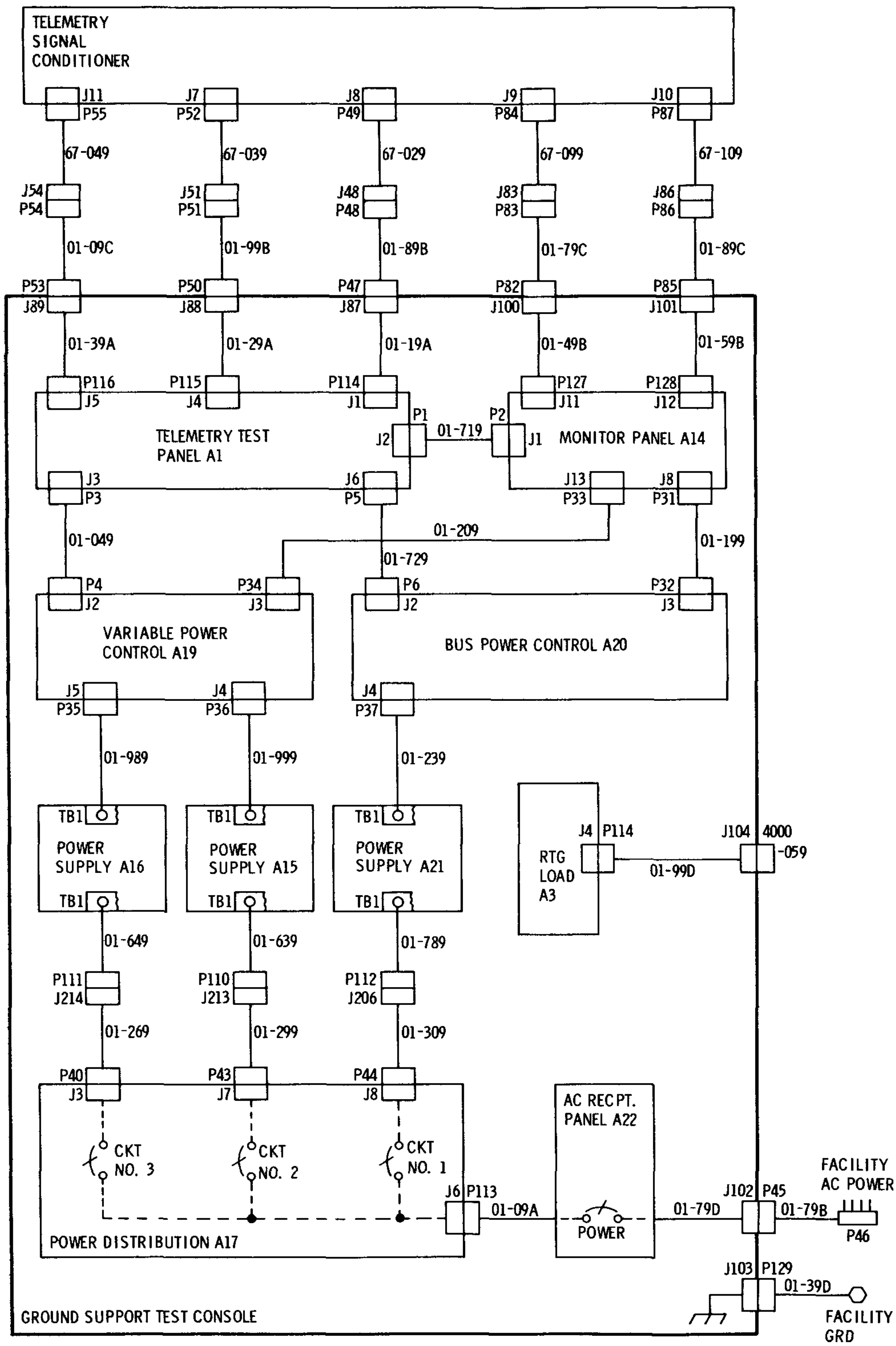


Figure 6-12. Telemetry Signal Conditioner Unit Subsystem--Interconnecting Cabling

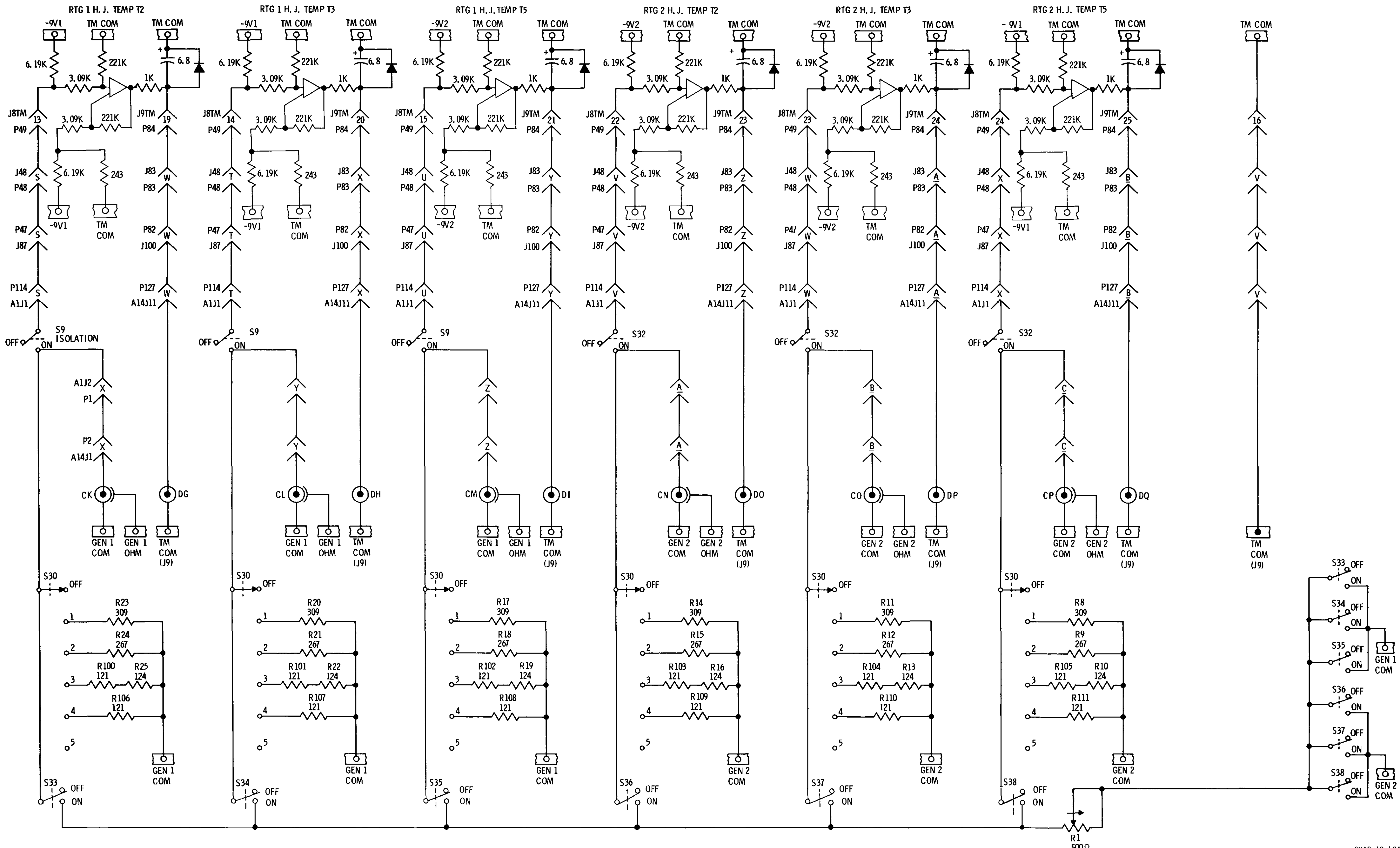


Figure 6-13. Telemetry Signal Conditioning Unit Subsystem--Generator Hot Junction Temperature Circuit

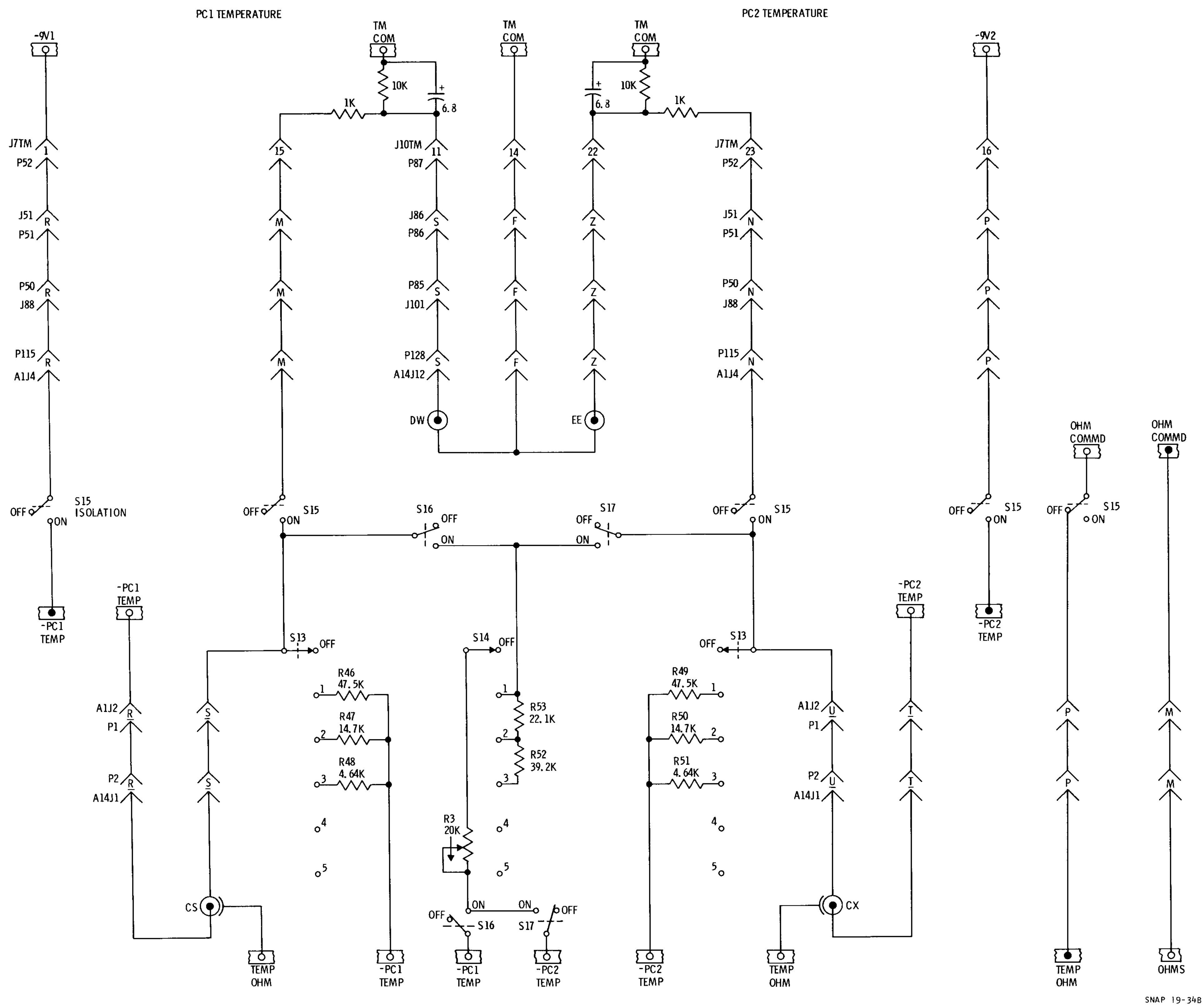


Figure 6-14. Telemetry Signal Conditioner Unit Subsystem--Power Conditioner Unit Temperature Circuit

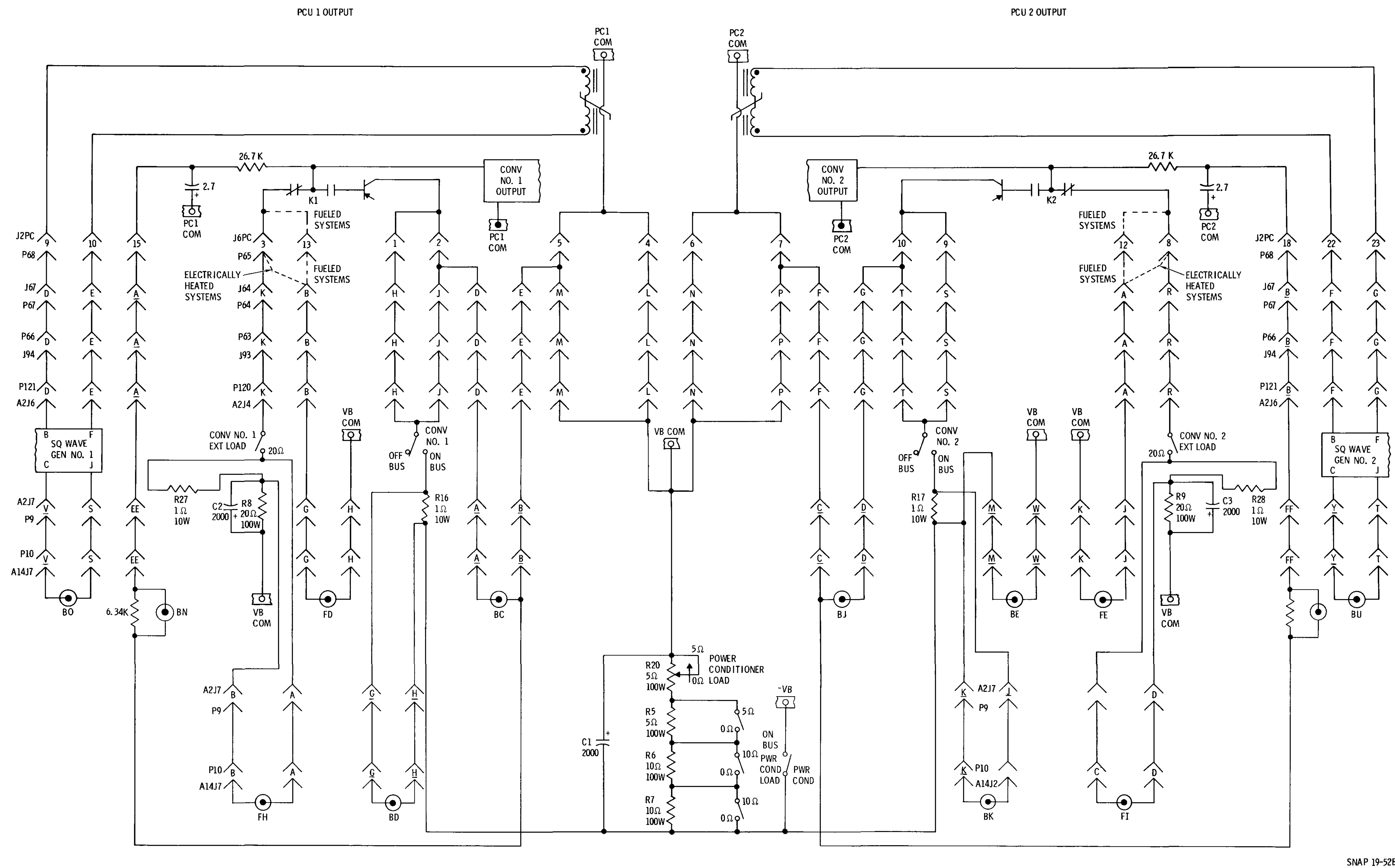


Figure 6-17. Power Conditioner Unit Subsystem--Power Conditioner Unit Output Circuit

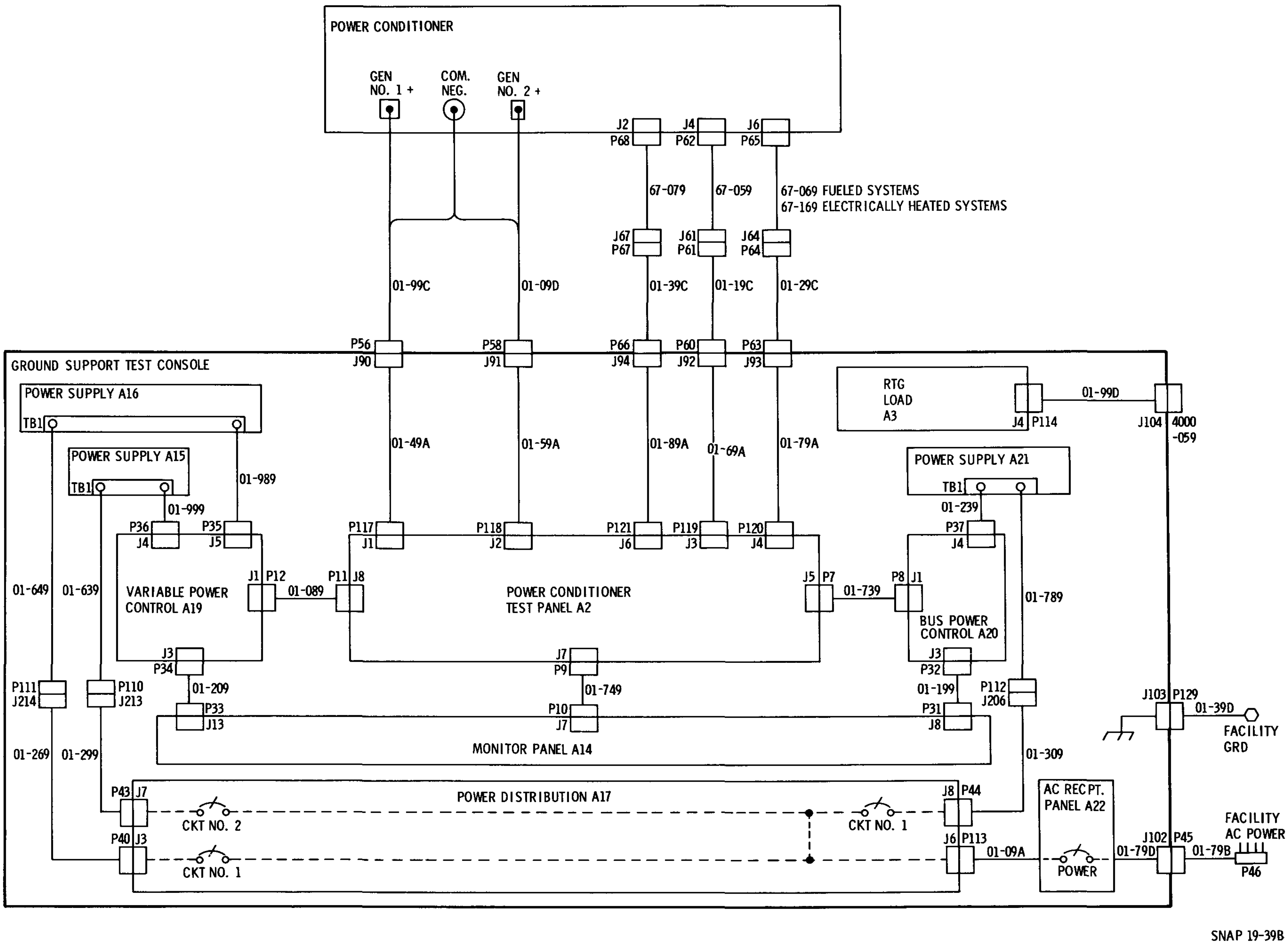


Figure 6-18. Power Conditioner Unit Subsystem--Interconnecting Cabling

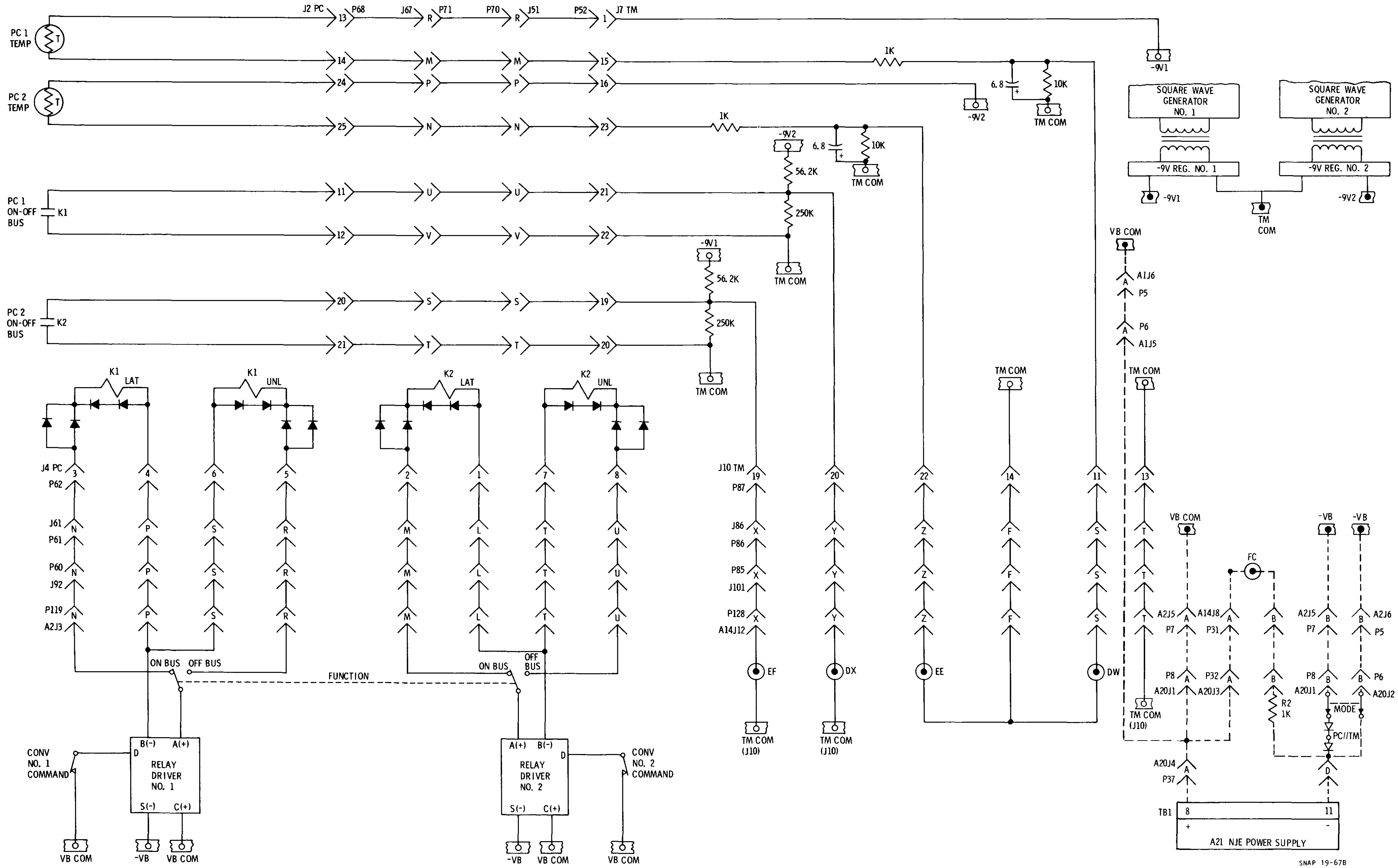


Figure 6-21. Generator (Simulated) Power Supply System--Power Conditioner Unit Status Circuit

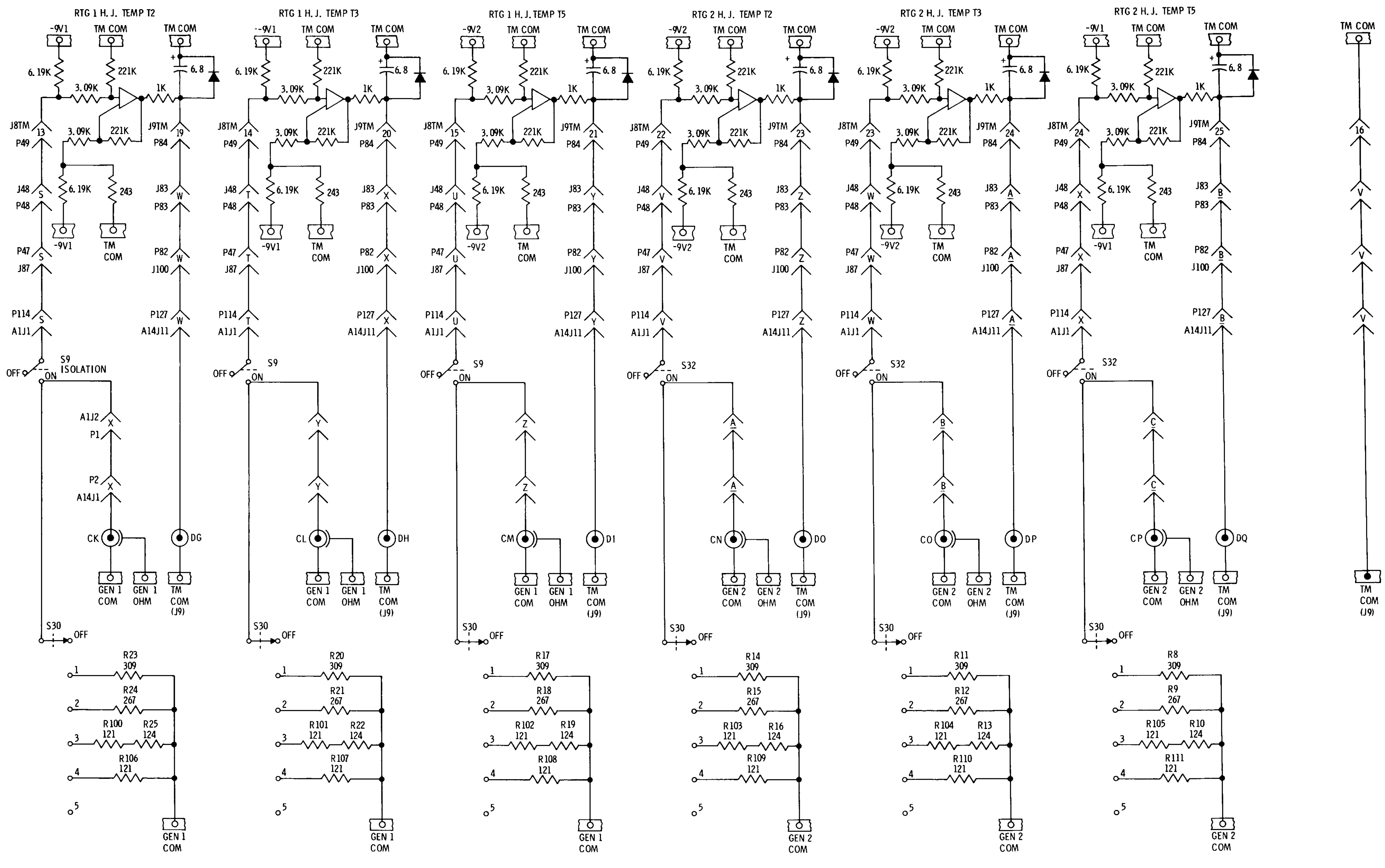


Figure 6-22. Generator (Simulated) Power Supply System--Generator (Simulated) Hot Junction Temperature Circuit

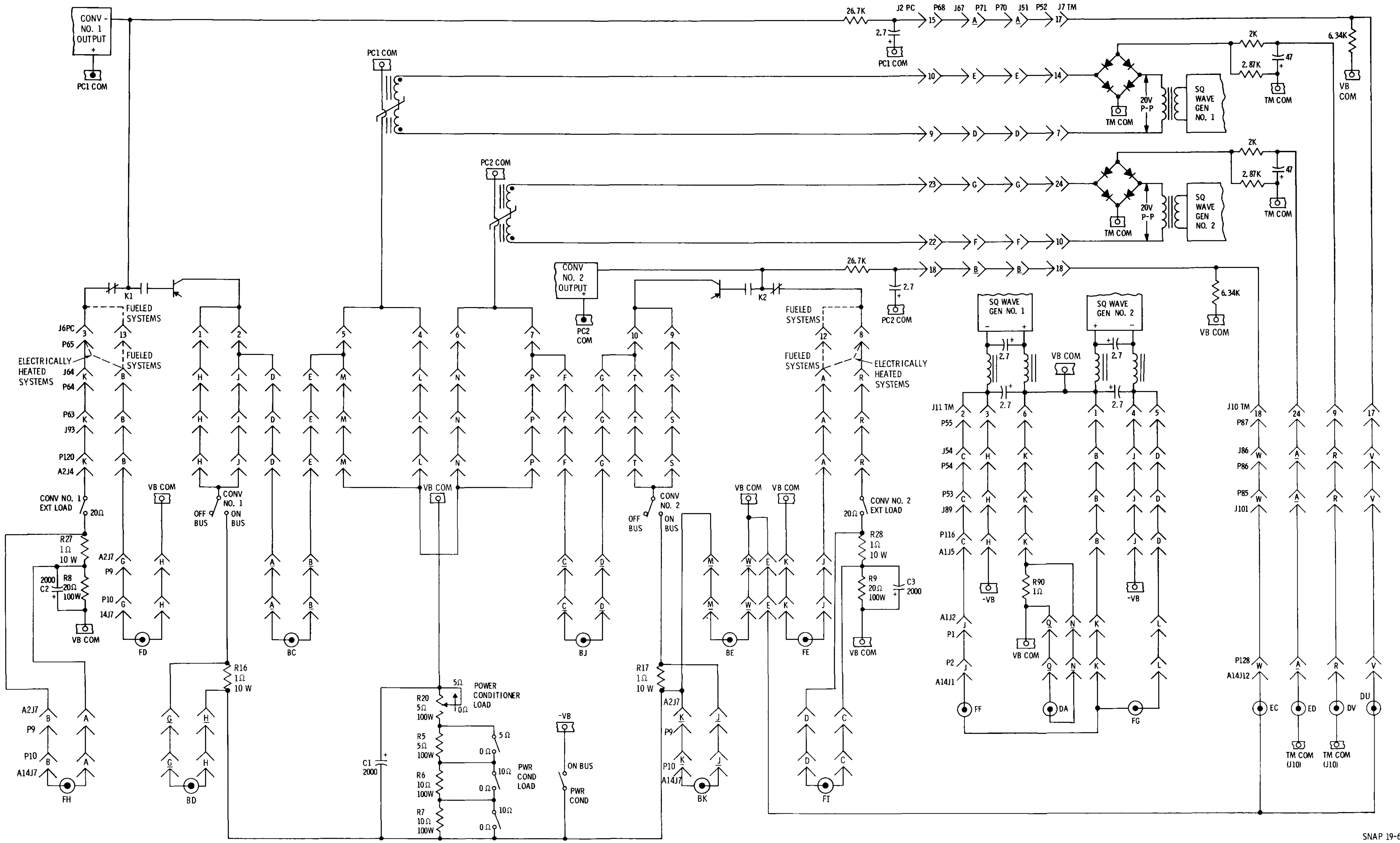


Figure 6-25. Generator (Simulated) Power Supply System--Power Conditioner Unit Output, Telemetry Signal Conditioner Unit Input

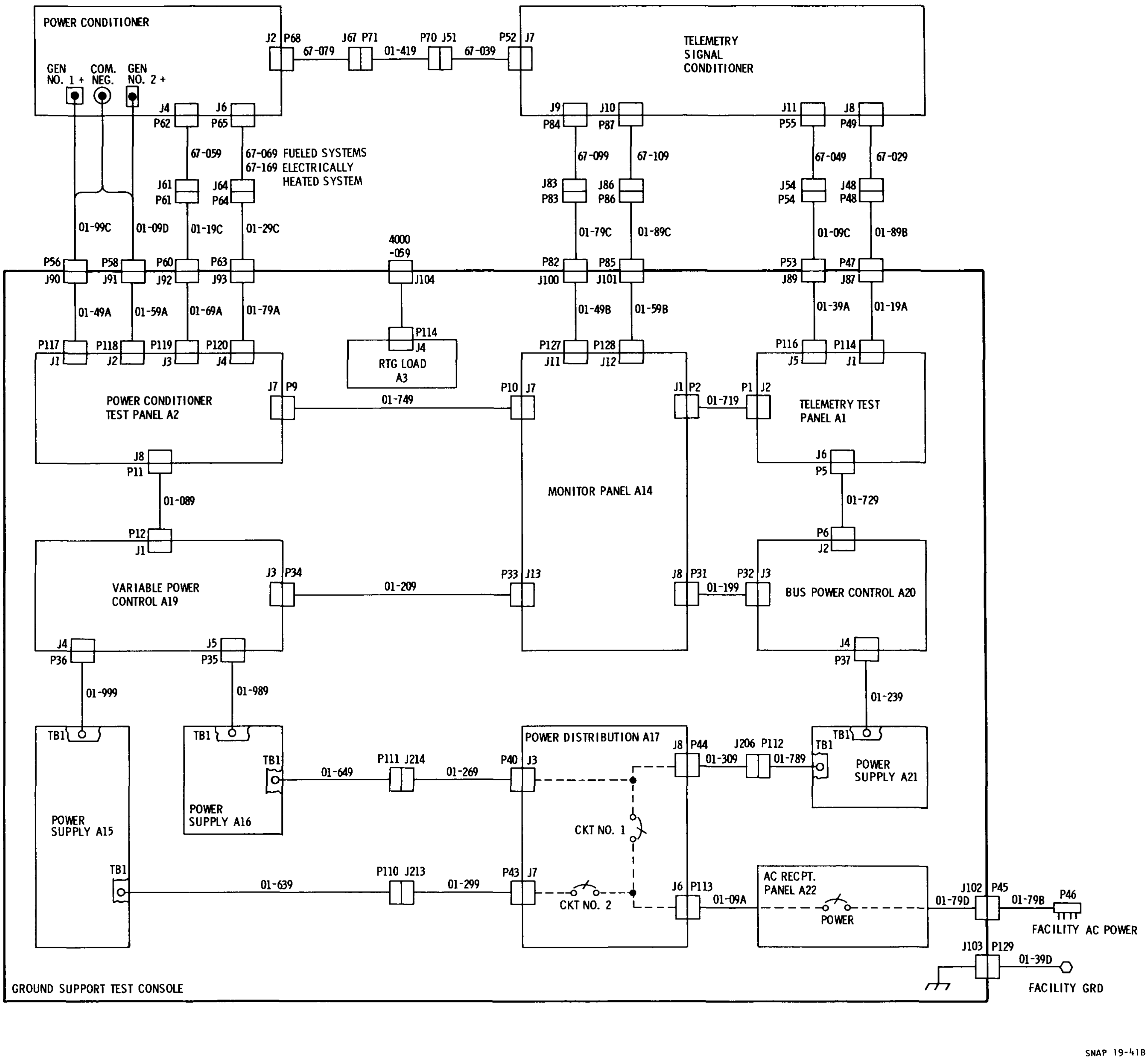


Figure 6-26. Generator (Simulated) Power Supply System Interconnecting Cabling

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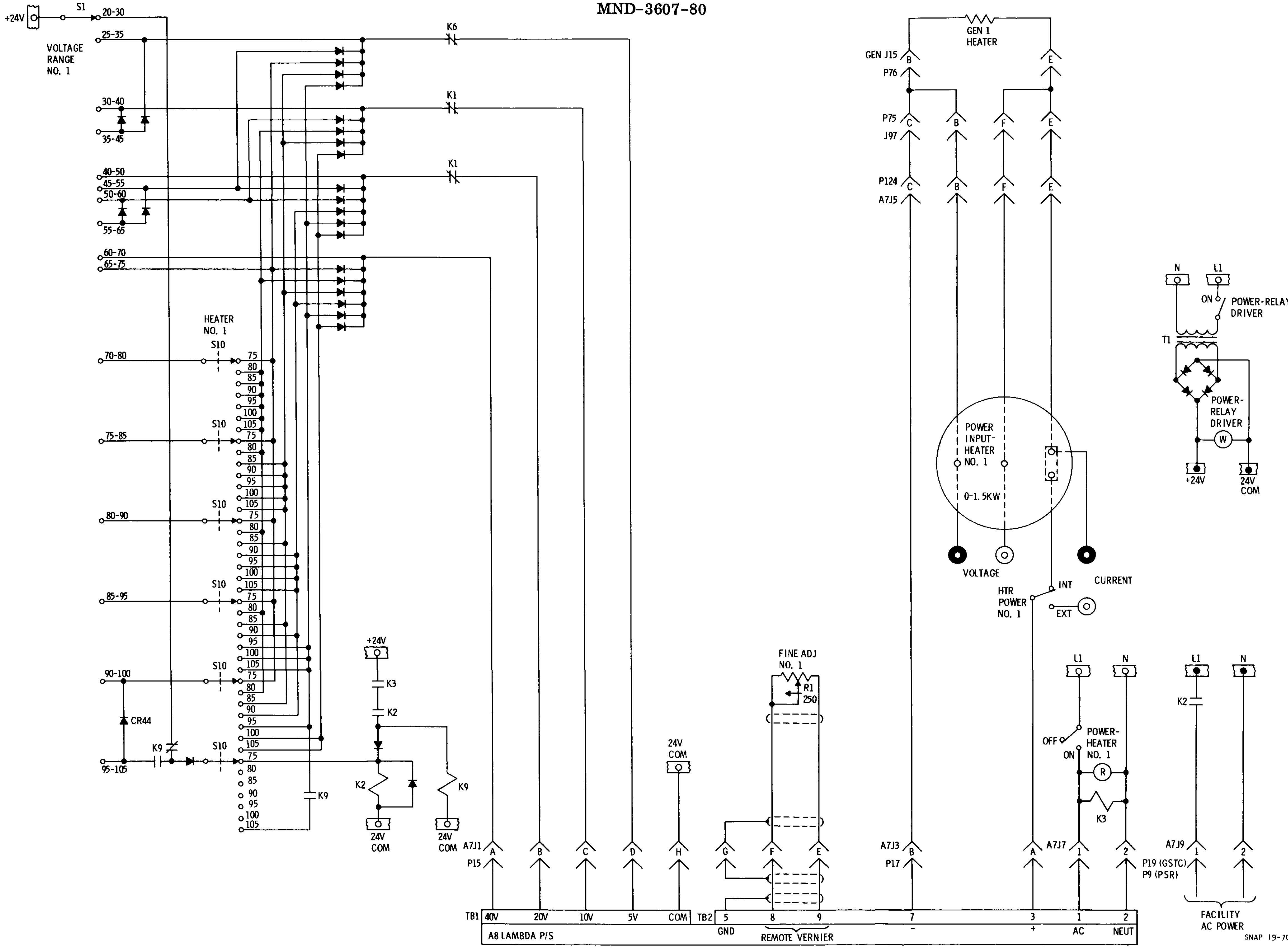

Figure 6-31. Generator Electrical Heater 1 Voltage Control Circuit

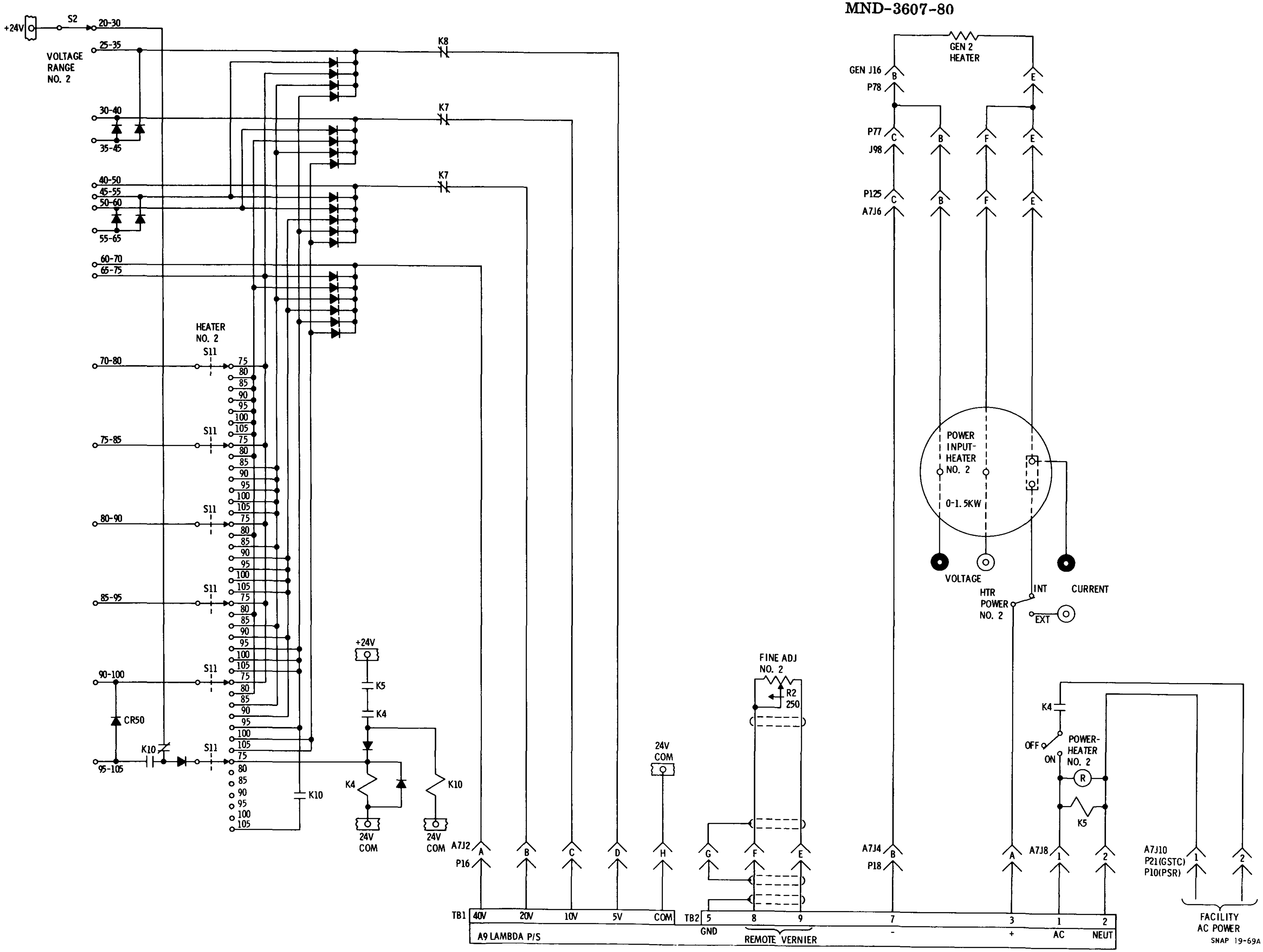

Figure 6-32. Generator Electrical Heater 2 Voltage Control Circuit

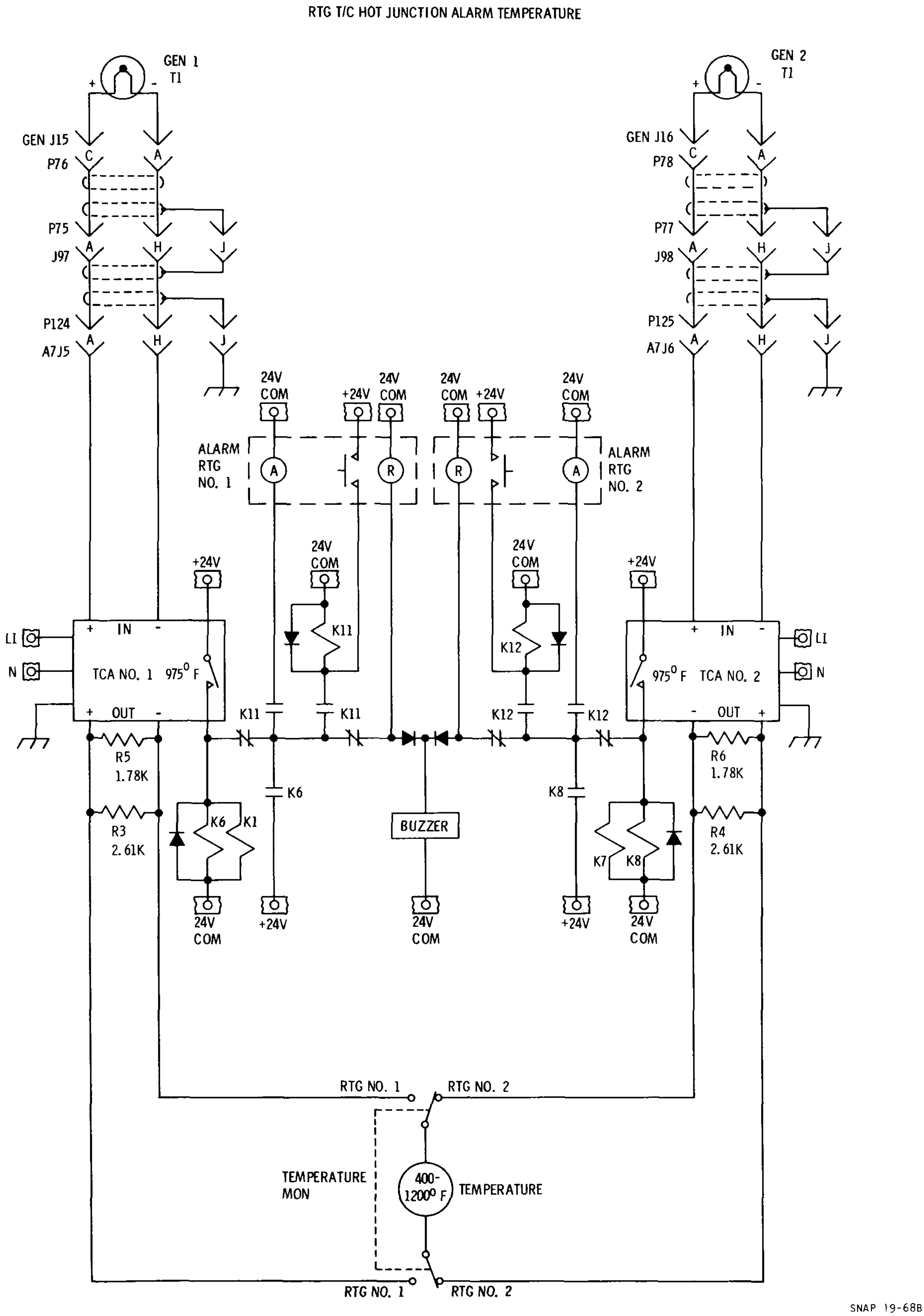

Figure 6-33. Generator Electrical Heater Temperature Alarm Circuit

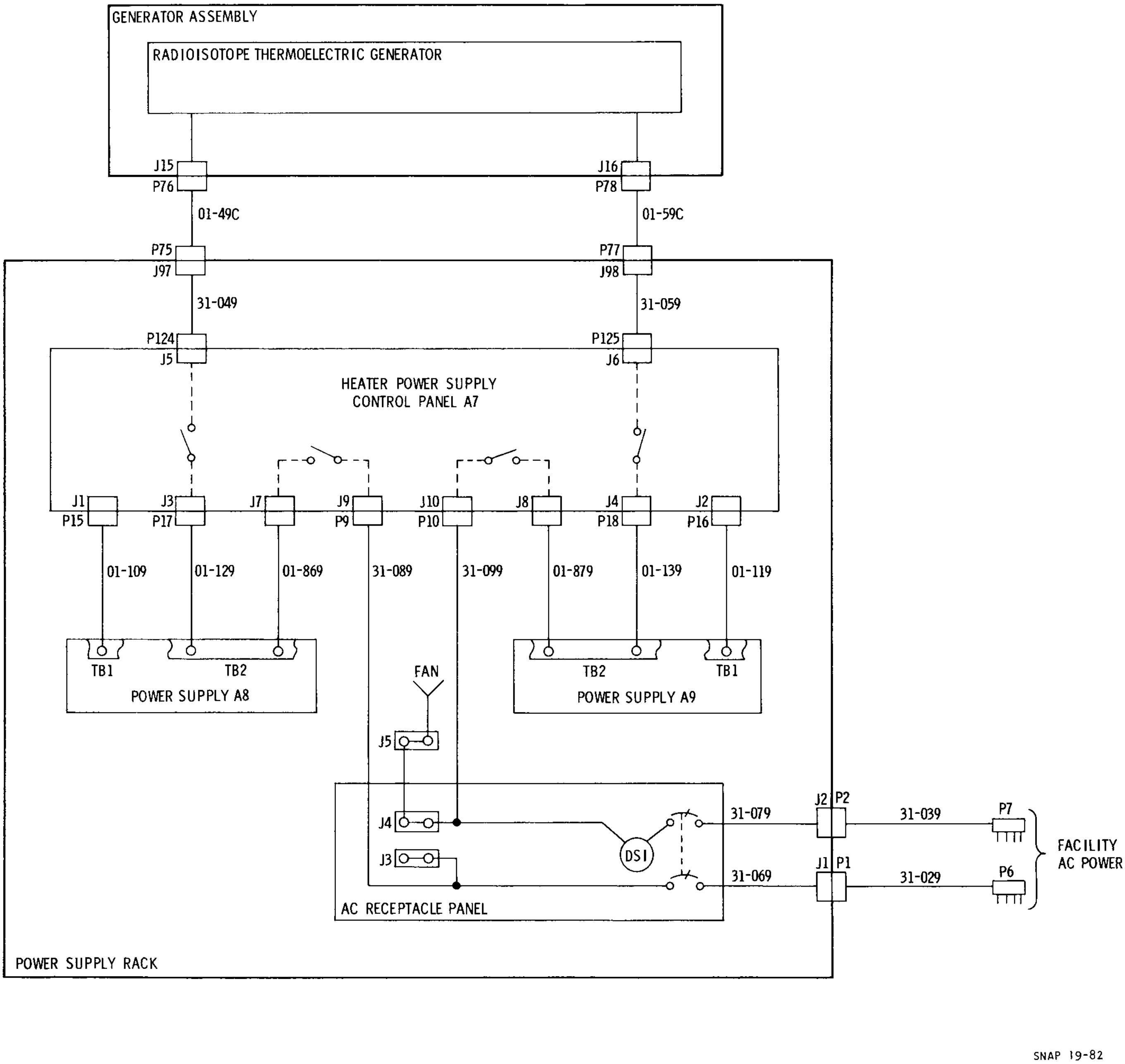

Figure 6-34. Generator Electrical Heater Interconnecting Cabling (Power Supply Rack)

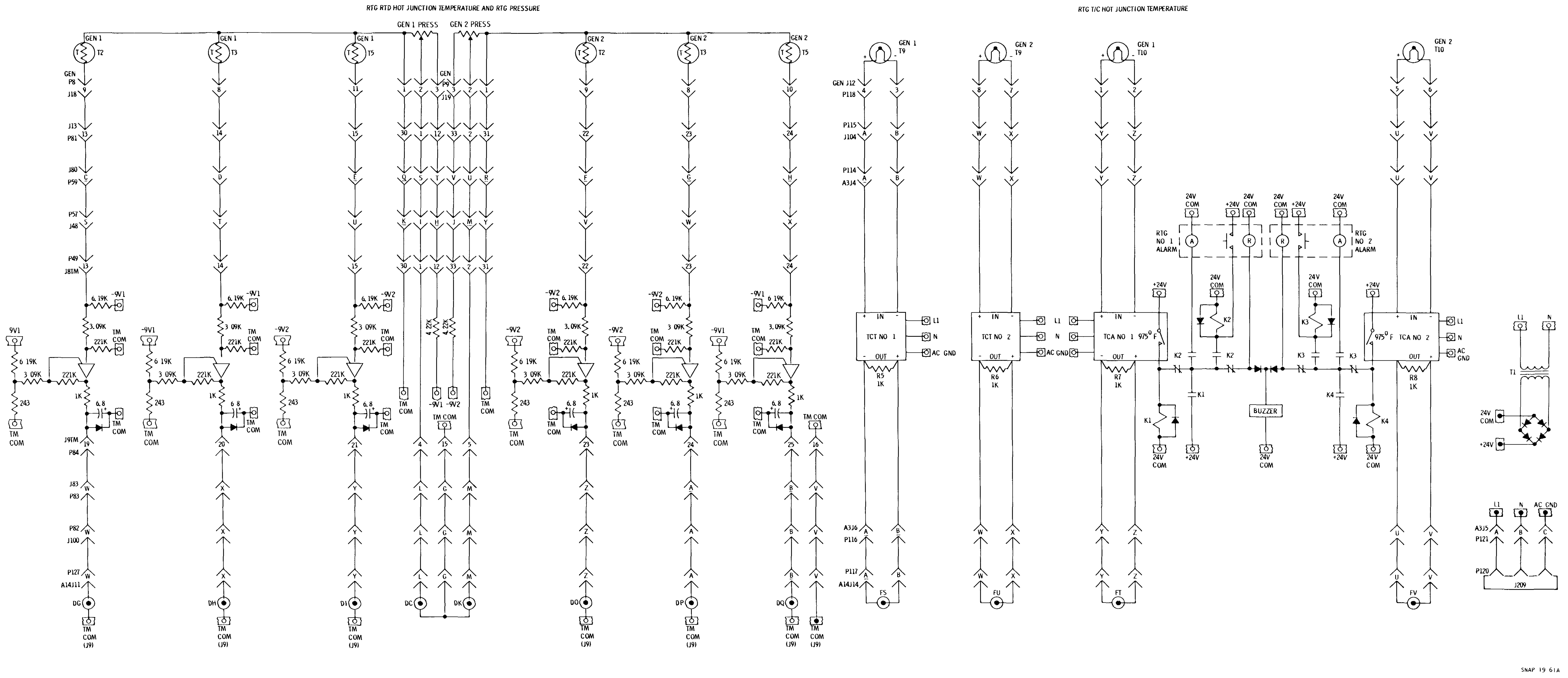

Figure 6-37. Generator Power Supply System--Generator Hot Junction Temperature and Pressure Circuit (Fueled System Only)

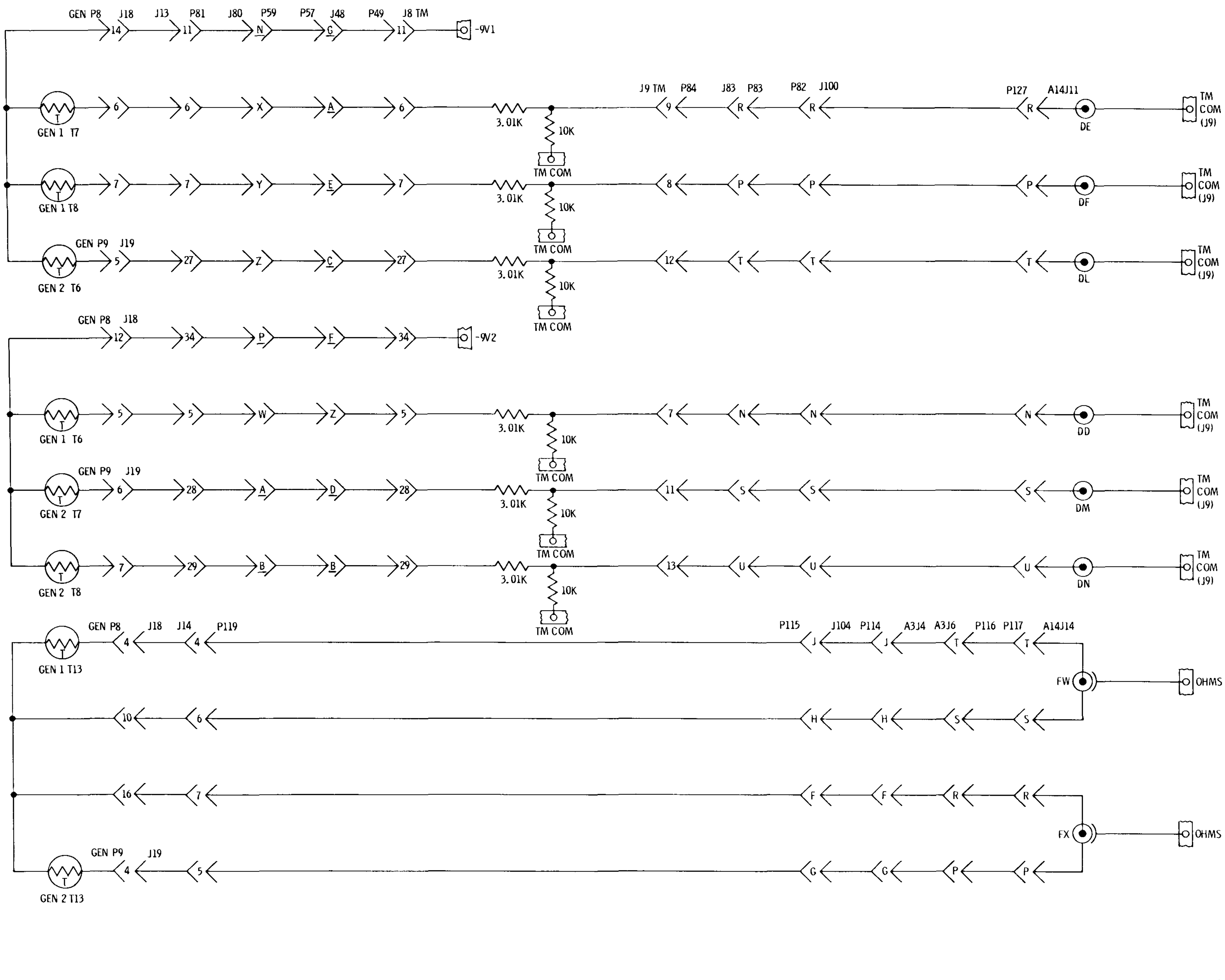

Figure 6-38. Generator Power Supply System--Generator Fin Root Temperature Circuit

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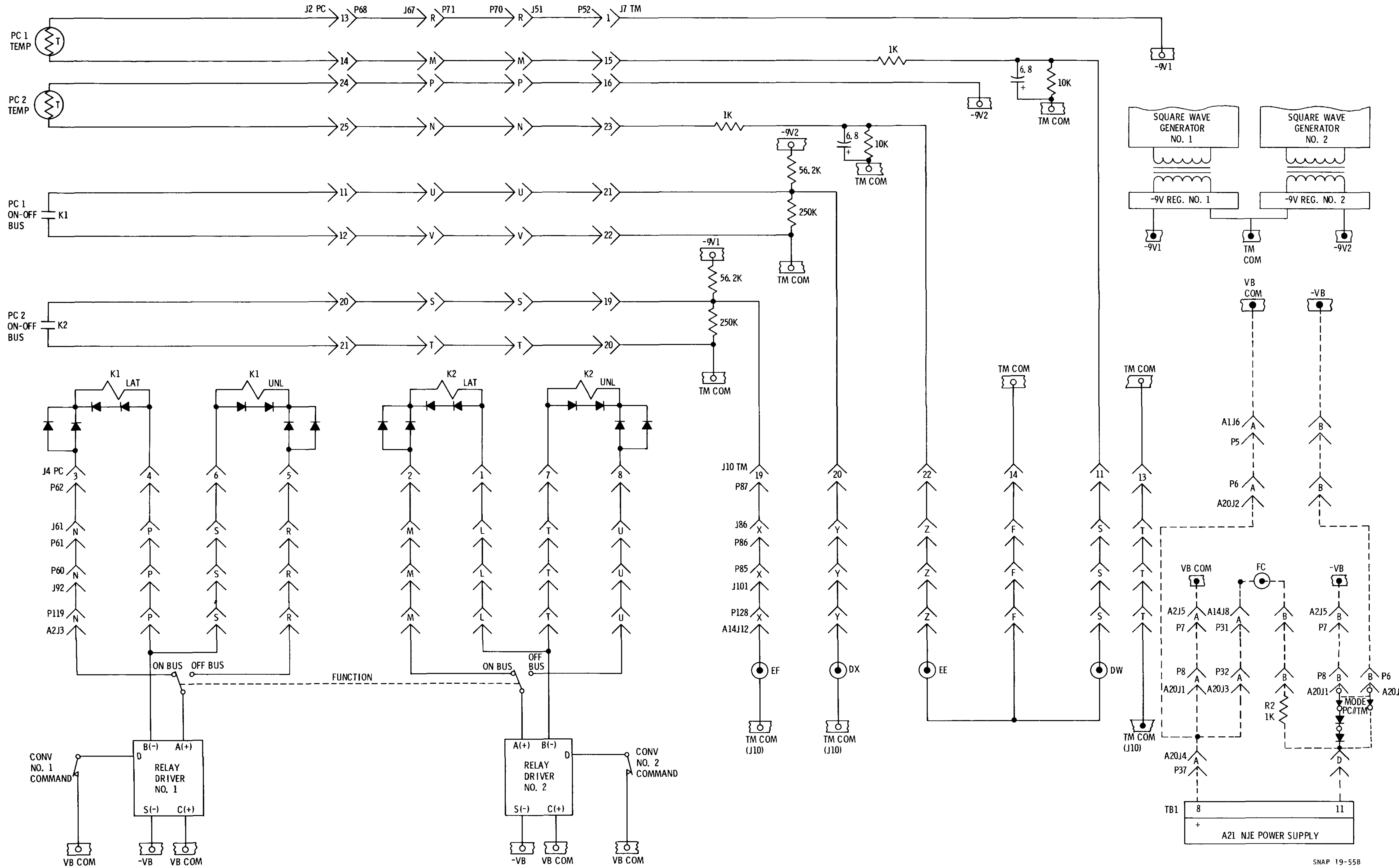


Figure 6-39. Generator Power Supply System--Power Conditioner Unit Status Circuit

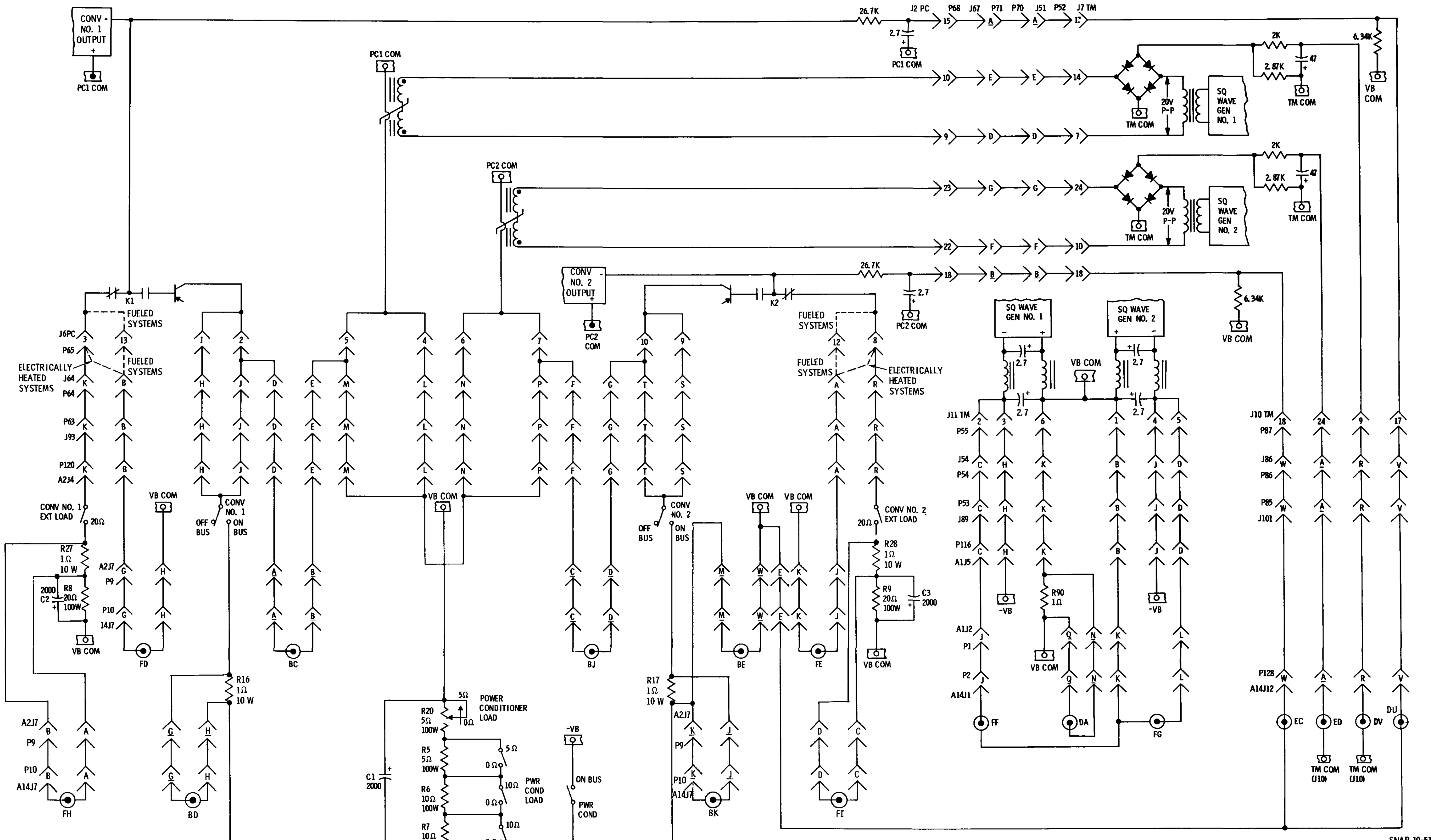


Figure 6-40. Generator Power Supply System--Power Conditioner Unit Output, Telemetry Signal Conditioner Unit Input Circuits

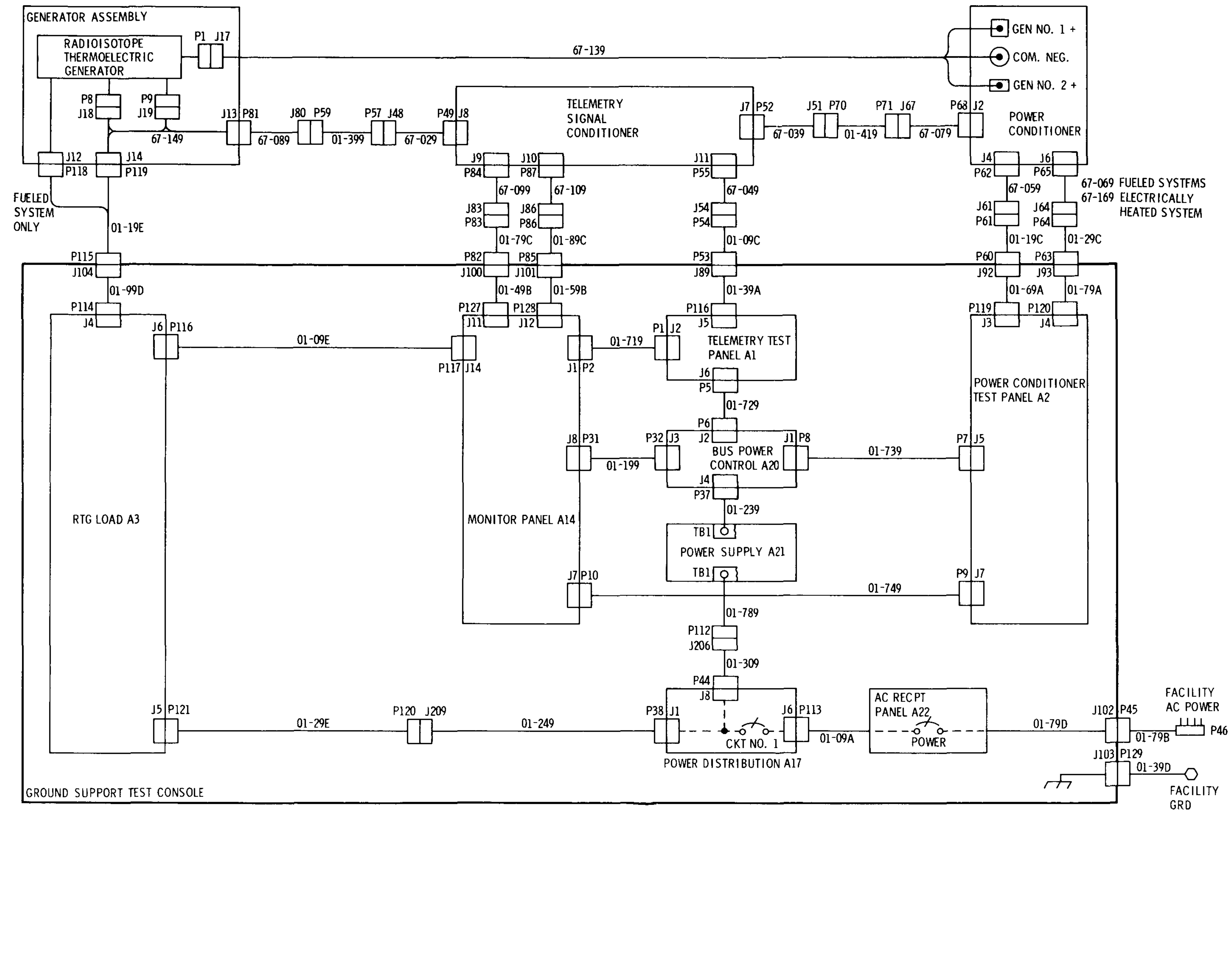


Figure 6-41. Generator Power Supply System--Interconnecting Cabling

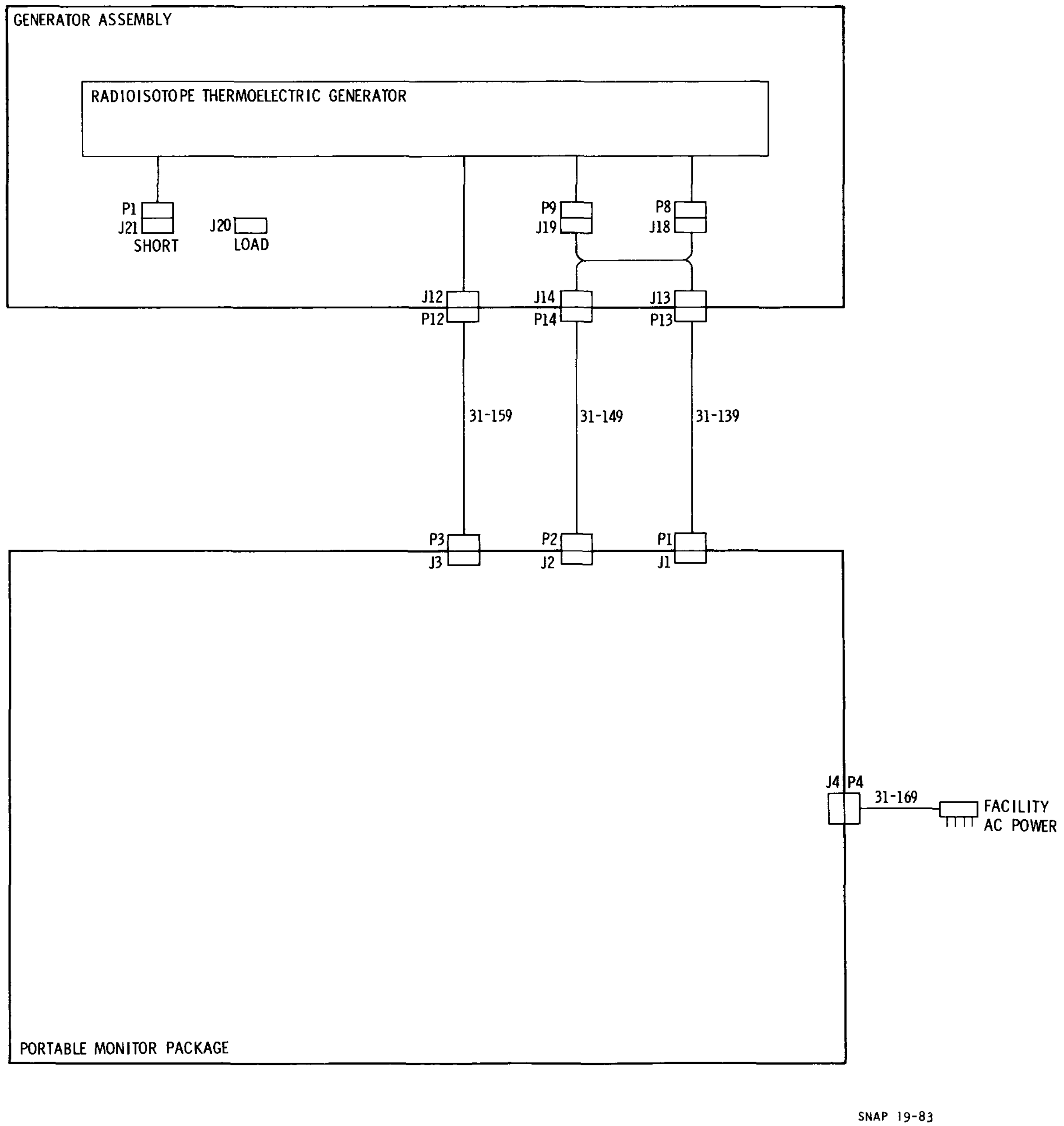


Figure 6-42. Portable Monitor Package--Interconnecting Cabling

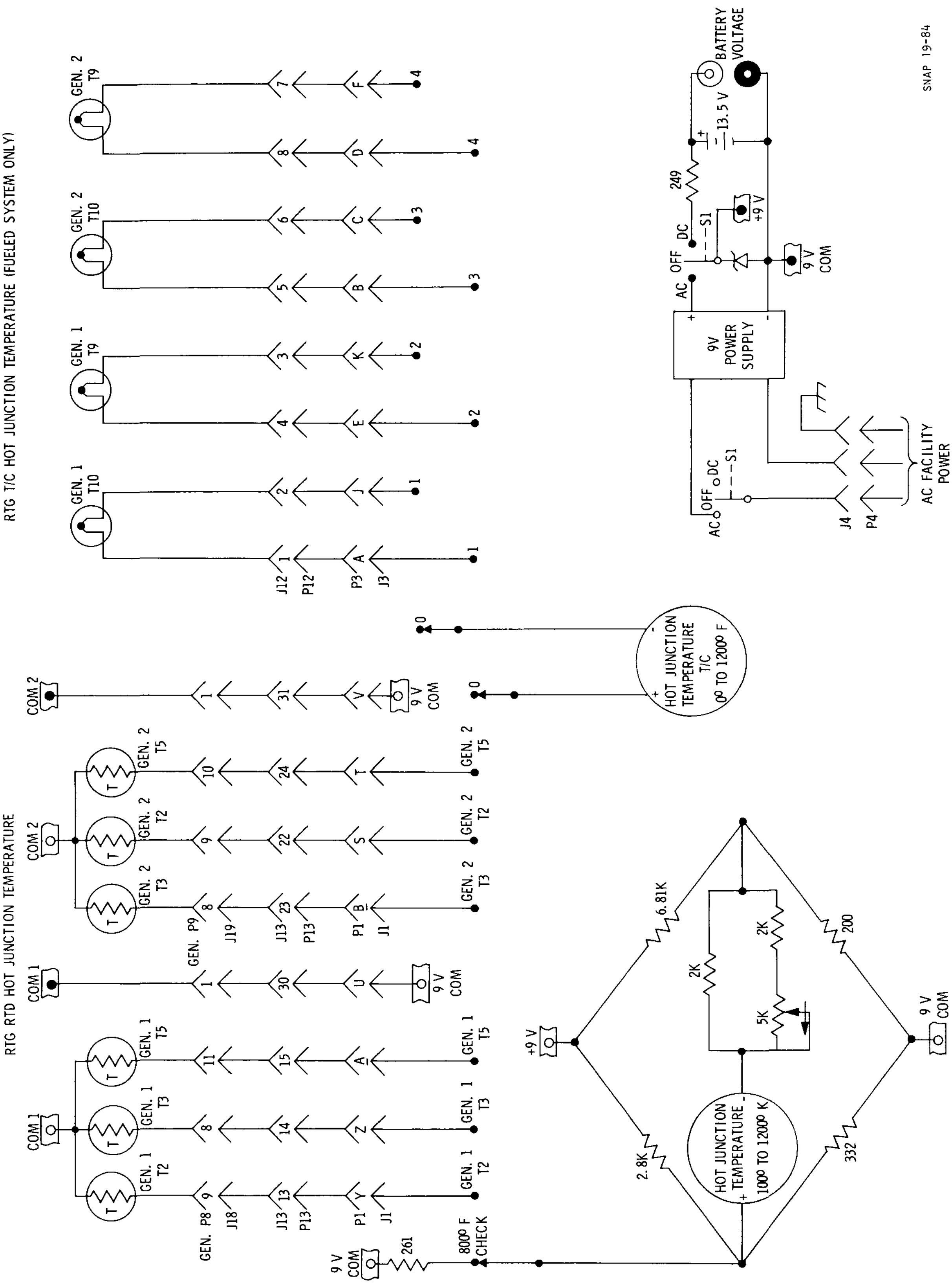


Figure 6-43. Portable Monitor Package--Generator Hot Junction Temperature Circuit

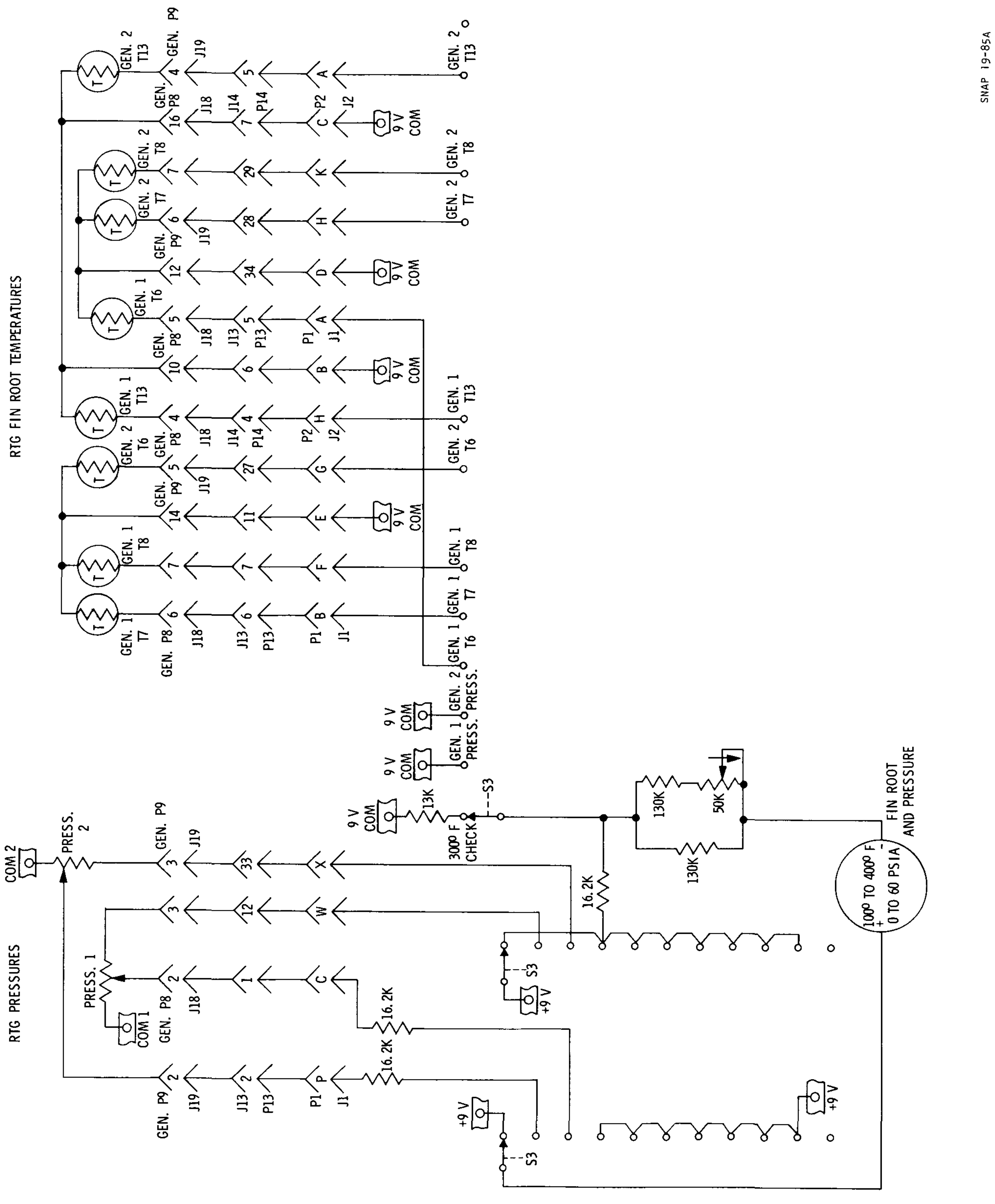


Figure 6-44. Portable Monitor Package--Generator Fin Root Temperature and Pressure Circuit

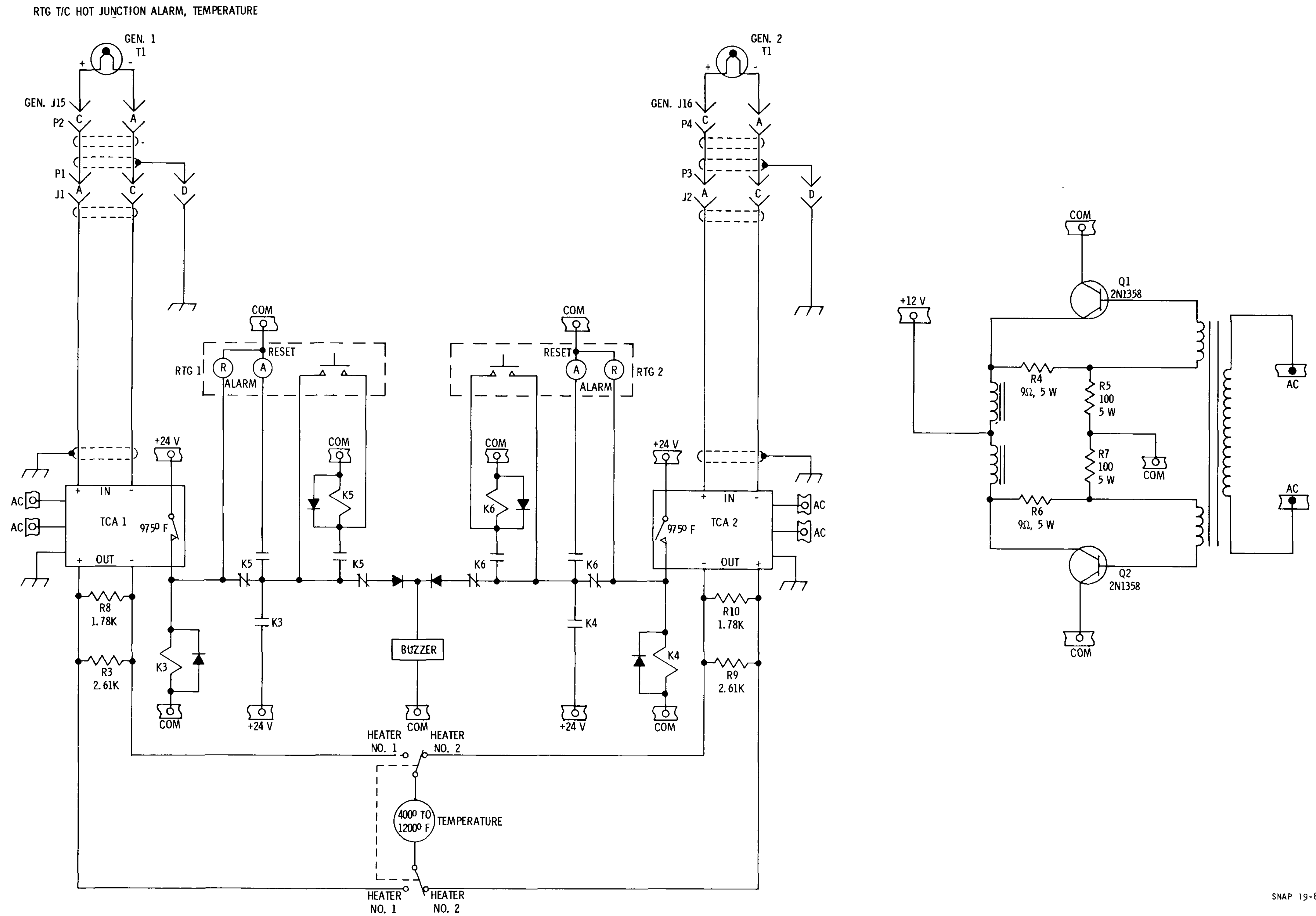


Figure 6-47. Heater Power Control Assembly--Temperature Alarm Circuits

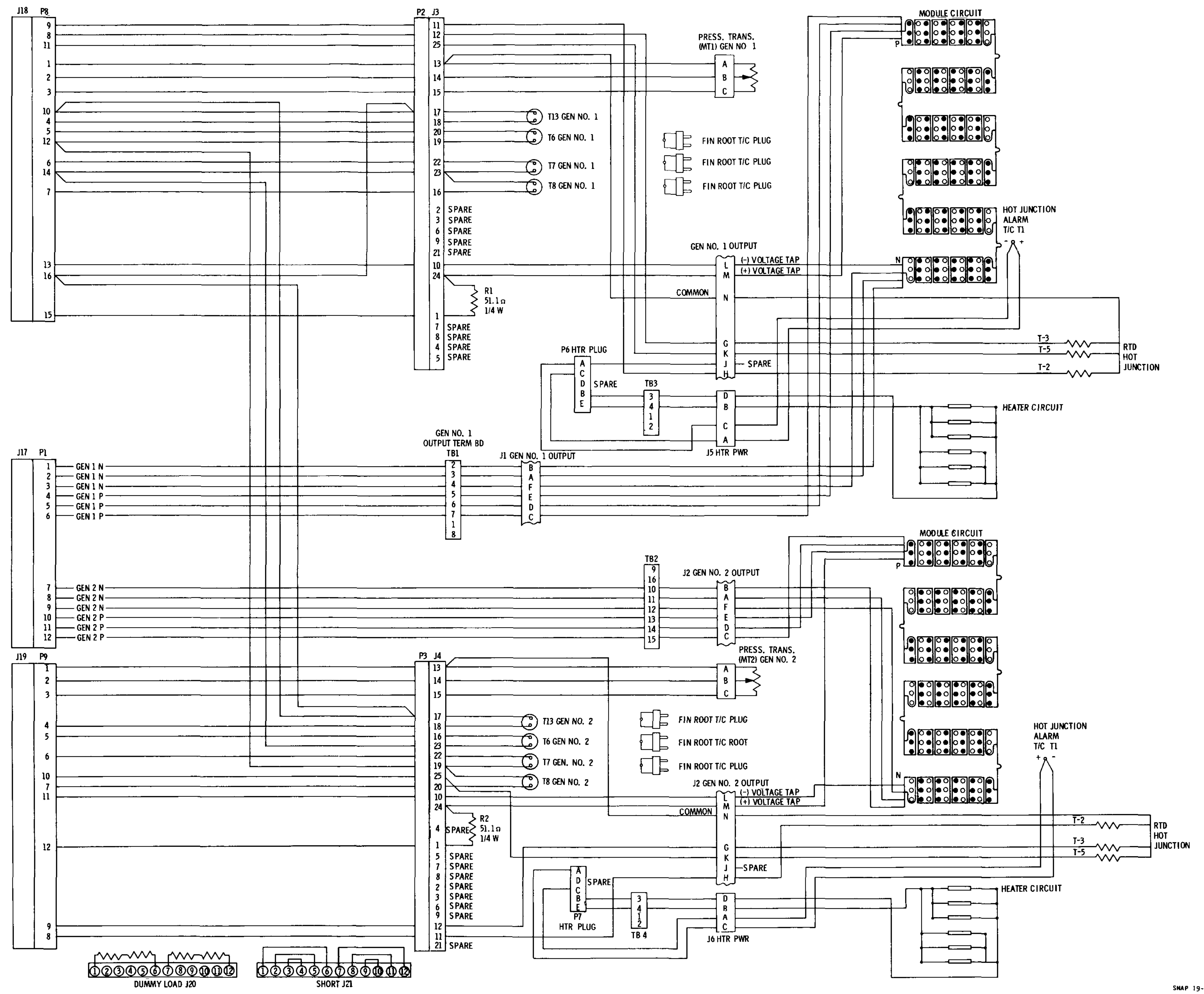
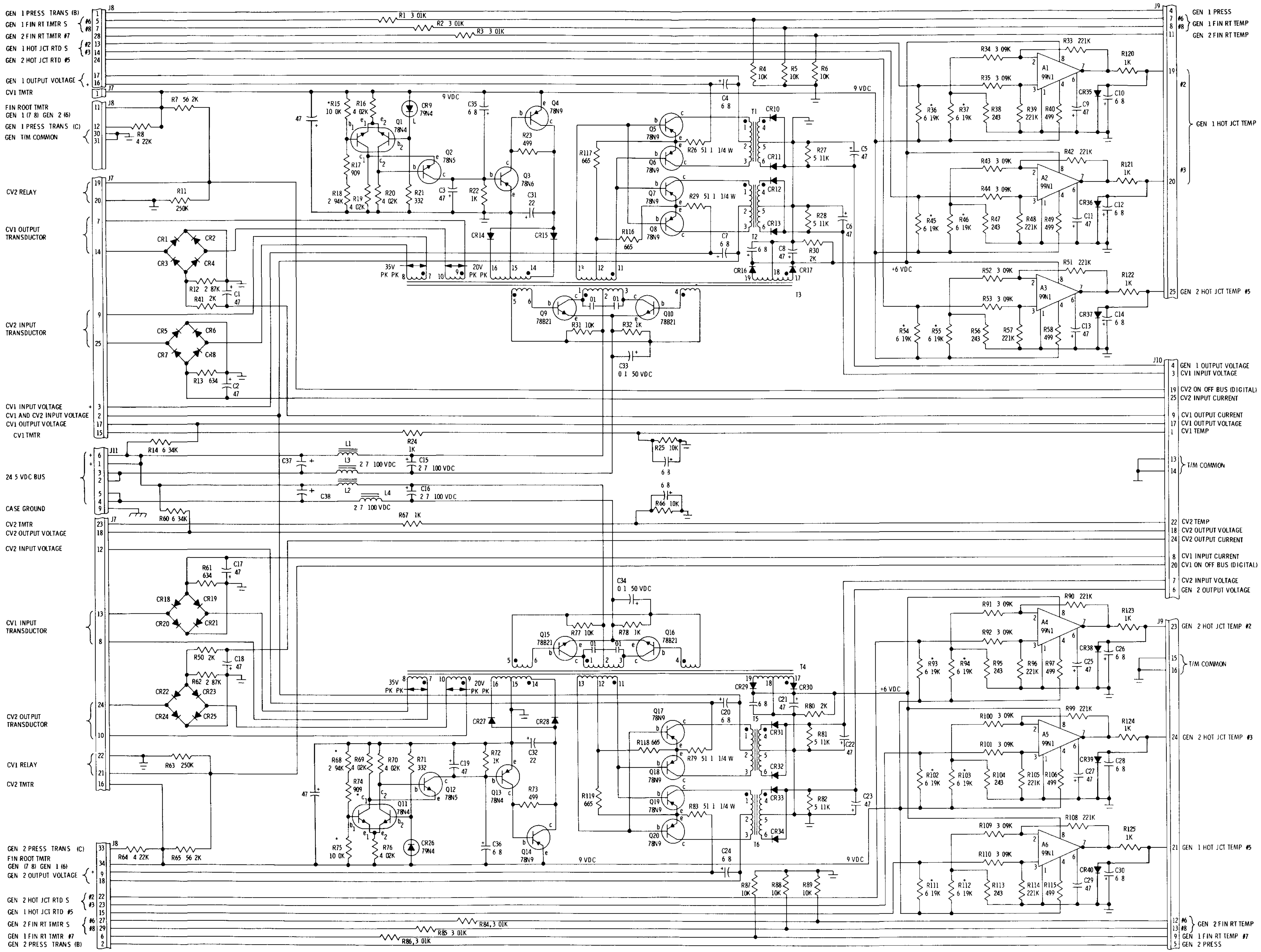


Figure 6-48. Electrically Heated Generator Schematic



NOTES

1 ALL RESISTOR VALUES IN OHMS
ALL RESISTORS ARE 1/8 WATT EXCEPT WHERE NOTED
ALL CAPACITOR VALUES IN MICRO FARAD
ALL CAPACITORS ARE 35 VDC EXCEPT AS NOTED

2 ALL DIODES ARE TYPE 79N1 EXCEPT AS NOTED

3 DESIGNATIONS

LAST DIODE	CR40
LAST RESISTOR	R125
LAST CAPACITOR	C38
LAST TRANSFORMER	J6
LAST TRANSISTOR	Q20
LAST AMPLIFIER	A6
LAST FILTER INDUCTOR	L4

4 ⊥ DENOTES INTERNAL COMMON

5 ABBREVIATIONS

JCT	JUNCTION
GEN	GENERATOR
PRESS	PRESSURE
TRANS	TRANSDUCER
TEMP	TEMPERATURE
T/M	TELEMETERING
CV	CONVERTER
RT	ROOT
TMTR	THERMISTOR
RTD	RESISTIVE TEMPERATURE DETECTOR

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Figure 6-51. Telemetry Signal Conditioner Unit Schematic

SNAP 19/NIMBUS B
SYSTEM CHECKOUT DATA SHEET A
TEMPERATURE MONITORING AND STABILITY CRITERIA

DATE:________________________ GEN. SER. NO. __________________________

TEST ENGR:__________________ PWR. COND. SER. NO. ____________________

QUALITY WITNESS:___________ T/M SIG. COND. SER. NO. ________________

	Fueled System								Electrical System Temperature	
	Chan. 43		Chan. 44		Chan. 45		Chan. 46			
Time	Data	Temp.	Data	Temp.	Data	Temp.	Data	Temp.	RTG 1	RTG 2
Start										

NOTE: 1. Conversion formula for fueled subsystem temperature voltage measurement:

Temp. (° F) + 50 x (voltage reading) + 200

2. Allowable temperature excursion per 15 min. = 50° F.

Figure A-1. Sample of System Checkout Data Sheet A

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SNAP 19/NIMBUS B
GENERATOR CHECKOUT DATA SHEET A
TEMPERATURE MONITORING AND STABILITY CRITERIA

DATE:____________ GENER. SUBSYS. SER. NO.:____________

TEST ENGR.:____________

QUALITY WITNESS:____________

	Fueled Systems Chan. 24		Fueled Systems Chan. 26		Electrical System Temperature	
Time	Data	Temp.	Data	Temp.	RTG 1	RTG 2

NOTE: 1. Conversion formula for fueled subsystem temperature volt meas.:
Temp. (°F) = 50 x (volt reading) + 200

2. Allowable temperature deviation between any two successive time periods are as follows:
for 5 min. periods - 17°F
for 15 min. periods - 50°F

Figure A-4. Sample of Generator Checkout Data Sheet A

SNAP 19/NIMBUS B

GENERATOR SUBSYSTEM CHECKOUT DATA SHEET B

DATE:____________________ Generator Subsystem Serial No. ______________

Generator Operating Time: TEST ENGR:____________________

START_______ STOP_________ QUALITY WITNESS:________________

Channel	Signal	Conversion Formula	Short Measurement	Converted Measurement	Typical Measurement	Load Measurement	Converted Measurement	Typical Measurement
00	RTG 1 output volts	V = V x 1				V	V	+2.6 ± 0.10V
01	RTG 2 output volts					V	V	
02	RTG 1 output current	A = V x 200				V	A	Acceptance 9.6 amps minimum 1 yr storage 8.7 amps minimum 2 yr storage 8.5 amps minimum
03	RTG 2 output current					V	A	
04	RTG 1 hot jct temp T2 (T/M)	Refer to MND-3607 -186	______Ω	________°F	Each channel: Air: 710 ± 65° F Shipping Container: 745 ± 65° F Max deviation between channels = 60°F Note: Fueled include channels 24 - 27	Ω	°F	Each channel: Air: 790 ± 65° F Shipping Container: 835 ± 65° F Max deviation between channels = 60°F Note: Fueled - include channels 24 - 27
05	RTG 1 hot jct temp T3 (T/M)		______Ω	________°F		Ω	°F	
06	RTG 1 hot jct temp T5 (T/M)		______Ω	________°F		Ω	°F	
07	RTG 2 hot jct temp T2 (T/M)		______Ω	________°F		Ω	°F	
08	RTG 2 hot jct temp T3 (T/M)		______Ω	________°F		Ω	°F	
09	RTG 2 hot jct temp T5 (T/M)		______Ω	________°F		Ω	°F	
10	RTG 1 fin root temp T6 (T/M)		________ KΩ	________°F	Each channel: Air: 235 ± 20° F Shipping Container: 260 ± 20° F Max deviation between channels = 20° F Note: Include channels 22, 23	KΩ	°F	Each channel: Air: 235 ± 20° F Shipping Container: 260 ± 20° F Max deviation between channels = 20°F Note: Include channels 22, 23
11	RTG 1 fin root temp T7 (T/M)		________ KΩ	________°F		KΩ	°F	
12	RTG 1 fin root temp T8 (T/M)		________ KΩ	________°F		KΩ	°F	
13	RTG 2 fin root temp T6 (T/M)		________ KΩ	________°F		KΩ	°F	
14	RTG 2 fin root temp T7 (T/M)		________ KΩ	________°F		KΩ	°F	
15	RTG 2 fin root temp T8 (T/M)		________ KΩ	________°F		KΩ	°F	
16	RTG 1 output volts (T/M)	V = V x 1.231	________ V	________ V	+0.15 ± 0.15V	V	V	+2.7 ± 0.10V
17	RTG 2 output volts (T/M)		________ V	________ V		V	V	

Figure A-5. Sample of Generator Checkout Data Sheet B (Sheet 1 of 2)

SNAP 19/NIMBUS B

SYSTEM CHECKOUT DATA SHEET

DATE: ______________________ **Serial Numbers**

TEST ENGR: ______________________ Generator Subsystem ______________________

QUALITY WITNESS: ______________________ Power Conditioner ______________________

T/M Signal Conditioner ______________________

Time	Heater No. 1 Power	Temp RTG 1	Heater No. 2 Power	Temp RTG 2

NOTES:
1. Allowable wattage excursion per 15 min = 25 watts
2. Allowable temperature excursion per 15 min = 50° F

Figure A-7. Sample of Generator Heatup and Cooldown Data Sheet

SNAP 19/NIMBUS B

TELEMETRY SIGNAL CONDITIONER UNIT CHECKOUT
DATA SHEET

TSCU OPERATING TIME:

START____________ DATE:__________________________

STOP ____________ TEST ENGR:______________________

TSCU Serial No. _______ QUALITY WITNESS:__________________

Voltage Measurement Circuits:
All within ± 0.15 VDC? _________________
Out-of-tolerance channels____

Current Measurement Circuits
All within ± 0.15 VDC?__________________
Out-of-tolerance channels____

Pressure and Temperature Measurement Circuits
A. Switches at 1:
All within tolerance? _______________
Out-of-tolerance channels _____________________________________

B. Switches at 2:
All within tolerance? _______________
Out-of-tolerance channels _____________________________________

C. Switches at 3:
All within tolerance? _______________
Out-of-tolerance channels _____________________________________

D. Switches at 4:
All inputs within 121 ± 2 Ω ? __________
All outputs within ± 0.15 volts of each other ________
All outputs between 0 and +0.9 VDC _______________
Out of tolerance channels ______________________________________

Digital Measurement Circuits
A. With switches OFF:
All outputs -7.300 ± 0.05V?__________
Out-of-tolerance channels _____________________________________

B. With switches ON:
All outputs 0.0 ± 0.100V? ___________
Out-of-tolerance channels _____________________________________

Power Input Test
Voltage input -24.46 to -24.50? __________
Current input -0.080 or less? __________

Figure A-8. Sample of Telemetry Signal Conditioner Unit Checkout Data Sheet

ALPHABETICAL INDEX

*Asterisk denotes illustrations, other listings are paragraphs

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Q

R

S

S (Cont'd)

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MASTER

TECHNICAL MANUAL

OPERATION
AND
FIELD MAINTENANCE

SNAP 19
RADIOISOTOPE POWER SUPPLY

19 cup.

C-33

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MASTER

TECHNICAL MANUAL

OPERATION
AND
FIELD MAINTENANCE

SNAP 19
RADIOISOTOPE POWER SUPPLY

MARTIN MARIETTA CORPORATION
NUCLEAR DIVISION

USAEC AT(30-1)-3607

31 OCTOBER 1967

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INTRODUCTION

This manual provides operating and maintenance instructions on the SNAP 19 radioisotope power supply for the Nimbus B spacecraft.

Procedures are given in step-by-step form. These steps, particularly in checkout procedures, must be performed in the sequence given. Maintenance instructions are, in general, limited to isolating troubles to a major unit and replacement of that unit. Defective units are to be returned to the manufacturer for repair.

The manual is divided into six sections and one appendix.

The general content of the manual is as follows:

Section I	-	general description of the complete system and more detailed descriptions (to the level necessary to support operation and maintenance instructions) of major components.
Section II	-	descriptive information on fueled generator shipping and handling equipment, and specific procedures to be used in shipping and handling.
Section III	-	information (similar to Section II) on electrically heated generators
Section IV	-	system assembly and installation procedures
Section V	-	checkout procedures
Section VI	-	troubleshooting and maintenance information
Appendix A	-	sample data sheets for checkout procedures

The following publications are referenced in this manual and must be available to the using activity:

MIL-P-116E	Methods of Preservation (used in preparing equipment for shipment)
MND-3607-83	System Telemetry Calibration Data Book for SNAP 19/B. Martin Marietta Corporation. (Used during equipment checkout.)
MND-3607-186	Subsystems Calibration Data Book for SNAP 19/B. Martin Marietta Corporation. (Used during equipment checkout.)

All persons concerned with the operation and maintenance of the SNAP 19 radioisotope power supply must become thoroughly familiar with the content of this manual.

JAN 11 1968

The attached sheets describe changes that will be made to the SNAP 19 technical manual, MND-3607-80, dated 31 October 1967. Field copies of the existing manual should be annotated from these sheets. Formal changed pages will be issued at such time in the future as data on pending additional changes are available.

14 December 1967

Page No.	Change
1-8	Change illustration callouts: From: 75-85 IN-LBS TORQUE — To: 105-115 IN-LBS TORQUE From: 190-200 IN-LBS TORQUE — To: 220-230 IN-LBS TORQUE
1-18	Change margin information in upper left corner: From: Paragraphs 1-52 to 1-63 — To: Paragraphs 1-61 to 1-63
1-23	Change margin information in upper right corner: From: Paragraphs 1-91 to 1-93 — To: Paragraphs 1-90 to 1-93
2-5	Between paragraphs 2-20 and 2-21, add the following: CAUTION Do not attempt to place an electrically heated subsystem in a fueled subsystem shipping container. Damage to the subsystem may result.
2-7	Change last sentence of paragraph 2-28 to: The batteries are rechargeable and should be brought up to full charge after each use of the unit.
2-12	Change step k to: k. Tighten bolts in support base until bolt heads are in firm contact with base.
2-14	Change margin information in upper left corner: From: Section I — To: Section II
2-15	In last line of step 1, paragraph 2-43, change: From: GEN AXIS VERTICAL — To: GEN AXIS CANTED

Change step p to begin:

Slowly hoist generator subsystem---

After step p, add:

CAUTION

As the subsystem is hoisted, it will move from the vertical to the canted position. Hoist carefully to prevent damage during the position change.

3-1 In paragraph 3-3, preceding step a, add:

CAUTION

Do not attempt to place an electrically heated subsystem in a fueled subsystem shipping container. Damage to the subsystem may result.

5-2 In paragraph 5-10, penultimate line, change first word:

From	To
seconds	minutes

5-18 In paragraph 5-19, step 1, change penultimate sentence to:

Make this advance one step at a time, so that each HEATER switch setting always agrees with the upper value of its VOLTAGE RANGE control setting.

5-25 In paragraph 5-21, reverse order of steps o and p; i.e., redesignate step o as step p, and step p as step o.

5-45 In step g, last line, change:

From	To
(figure A-10,	(figure A-7,

5-69 In paragraph 5-63, first line, last word, change:

From	To
simulator	simulated

5-79	In paragraph 5-66, reverse order of steps t and u; i.e., redesignate step t as step u, and step u as step t. Change last sentence of step t (formerly step u) to: (Refer to paragraphs 1-70a and 1-70b.) After step v, add a new step, w. Move all text from step i (and the NOTE) in paragraph 5-67 (on page 5-80) to this new step w. Change the reference in the step from "(figure A-9,--"to "(figure A-10,--".
5-80	Delete all material on this page. (Text is moved to paragraph 5-66 step w by change immediately above.)
6-16	Move the VOLTAGE 1, MODE 1 and VOLTAGE 2, MODE 2 entries in last four columns (approximately opposite step f) down to place them opposite step g.
6-17	In the last two columns, move the X's opposite step i down to a position opposite step j, and move the switch entries (S9 and S10, S11 and S32) opposite step h down to a position opposite step i.
6-18	In the first line of the NOTE in the first column, change:

From	To
Values as	Values are

The permissible rate of hot junction temperature change has been increased from 35°F per 15 minutes to 50°F per 15 minutes. Points in the manual at which this change must be made are:

Page	Paragraph	Location
5-1	5-7	7th line
5-2	5-10	4th and 8th lines
5-14	5-16	Step w, 4th line
		Step ad, 2d line of CAUTION
5-17	5-19	Step k, 5th line of NOTE
5-18	5-19	Step l, 1st line of CAUTION
5-22	5-20	Step ab, last line of CAUTION
5-23	5-20	Step ai, 2d line of CAUTION
5-27	5-27	6th line
	5-29	4th and 9th lines
5-33	5-34	Step V, 2d line of NOTE
5-35	5-35	Step p, 2d line of NOTE
5-39	5-36	Step ae, 2d line of NOTE
5-42	5-37	Step X, 2d line of NOTE

5-45	5-45	Step g, 3d line
5-46	5-45	Step h, 1st line of NOTE
6-1	6-4	7th line
	6-6	4th and 8th lines

The temperature changes must also be made in the following illustrations:

Page	Figure No.	Location
A-2	A-1	In NOTE 2
A-9	A-4	In NOTE 2
A-17	A-7	In NOTE 2

Corresponding changes for periods less than 15 minutes must be made at the following points in the manual:

Page 5-38, paragraph 5-36, step w, last line--change "12°F" to "17°F"

Page A-9, figure A-4, NOTE 2--change "12°F" to "17°F"

SECTION I

DESCRIPTION

1-1. SYSTEM DESCRIPTION

1-2. The SNAP 19 power supply is a radioisotope thermoelectric generator system mounted on the Nimbus B spacecraft to augment the spacecraft solar array and batteries. (See figure 1-1.)

1-3. The power supply (figure 1-2) consists of a generator subsystem, a power conditioner unit, and a telemetry signal conditioner unit.

1-4. The generator subsystem is mounted on the top of the spacecraft sensory ring, and the power conditioner and telemetry signal conditioner are in bay 18 of the ring.

1-5. Voltage produced by the generator subsystem is furnished to the power conditioner, where the voltage is wave-shaped, transformed to higher voltage, rectified, and filtered. (During ground operations, the generator output can be switched from the power conditioner to dummy loads.) The power conditioner supplies approximately 44 watts of power at -24.5 volts to the spacecraft regulated bus. The telemetry signal conditioner measures generator and power conditioner performance through connections to sensors in those units. The sensor signals are conditioned and furnished to the analog-to-digital converter of the spacecraft telemetry subsystems. The telemetry signal conditioner also provides digital signals on conditioner status.

1-6. The two generators in the generator subsystem are electrically in parallel, but each of the generators is in series with one of the DC-to-DC converters in the power conditioner. (See figure 1-3.)

1-7. Ground support equipment for the SNAP 19 includes:

a. Ground support test console (GSTC)

b. Generator subsystem shipping container

c. Generator subsystem handling adapter

d. Generator subsystem offset hoist bar

e. Shipping container handling sling

f. Shipping container pallet

g. Mobile carriage (including heater power control assembly and battery charger)

h. Portable monitor package

i. Power supply rack

j. Mobile carriage sling

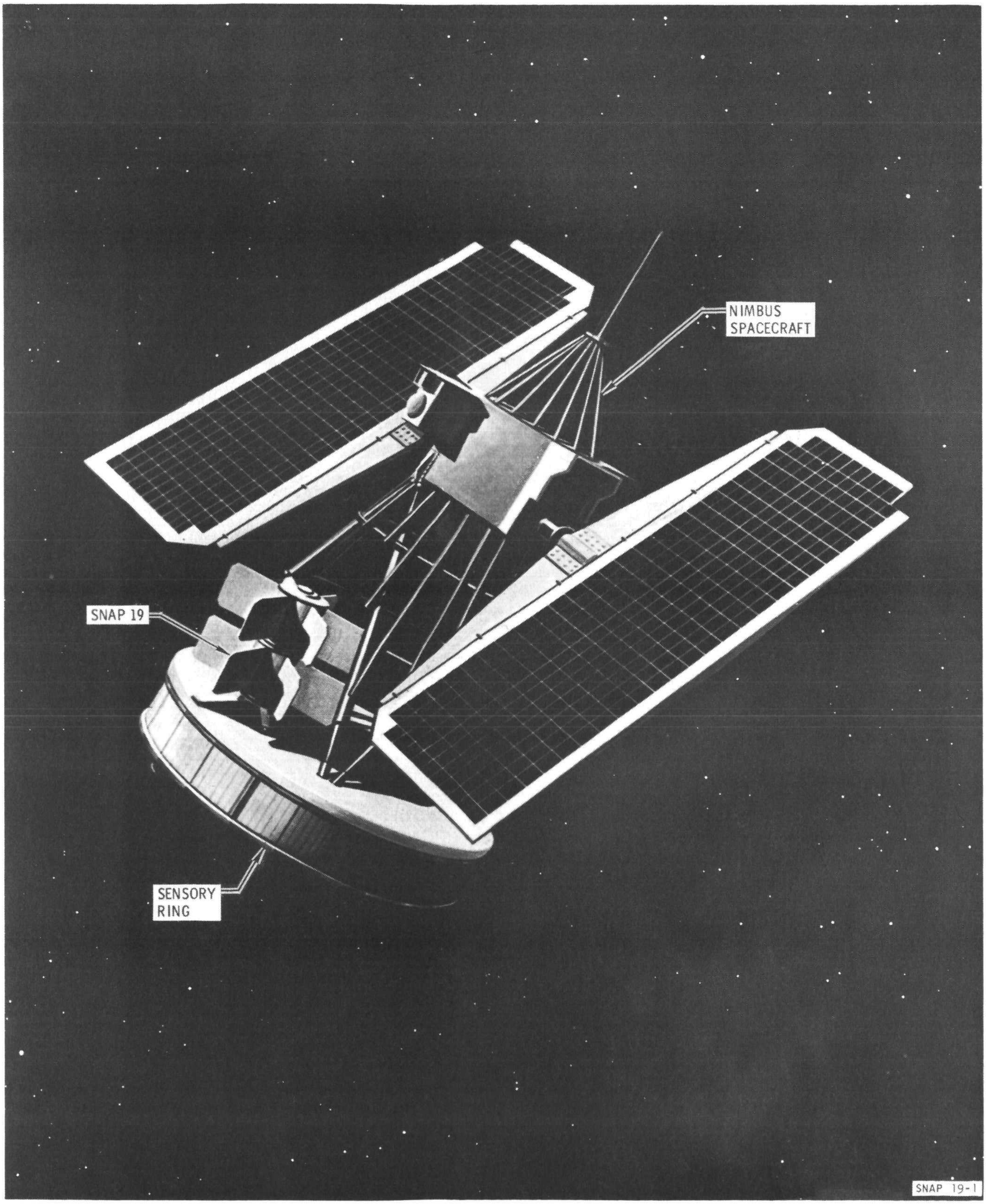


Figure 1-1. Nimbus B--SNAP 19 Arrangement

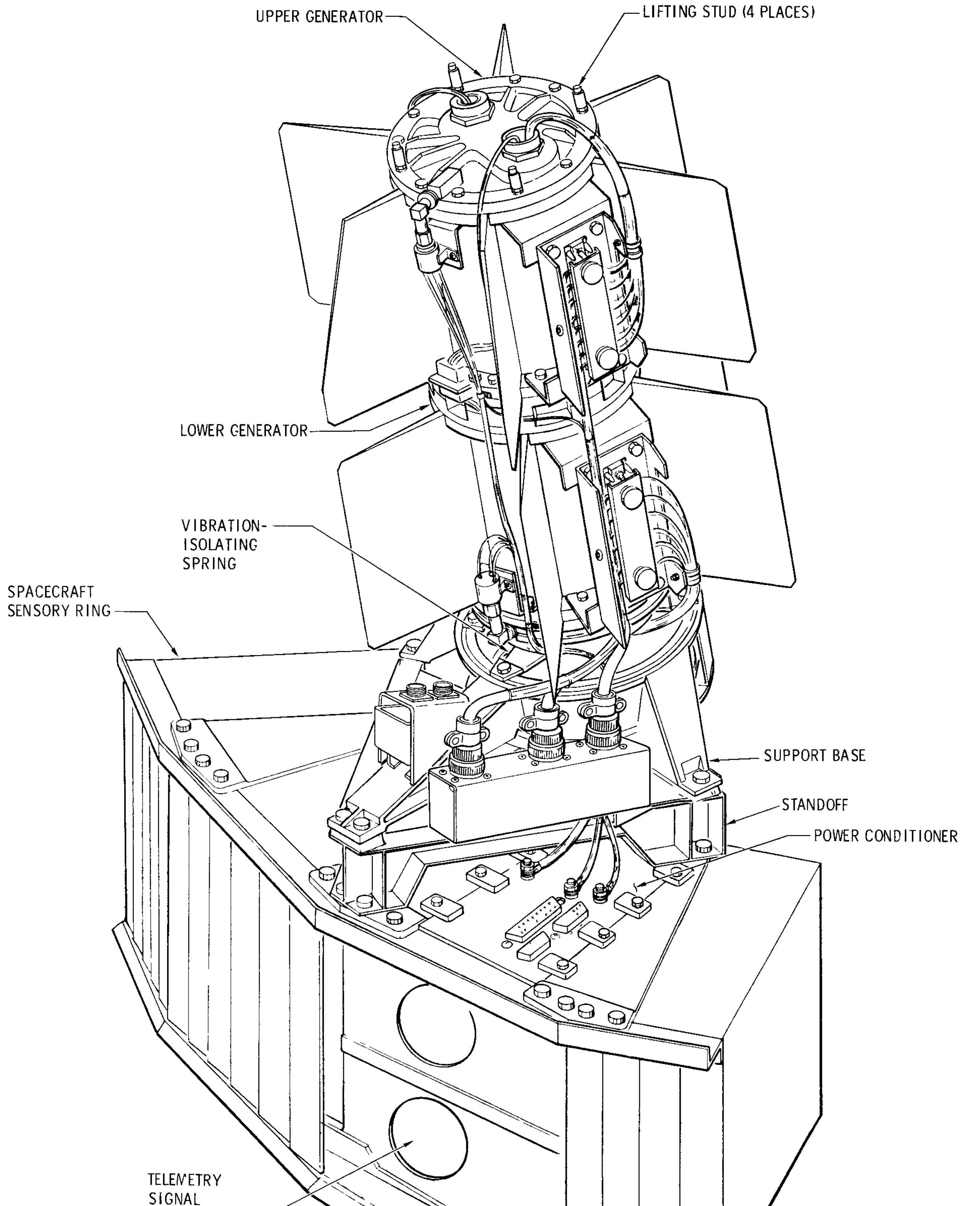


Figure 1-2. SNAP 19 Arrangement

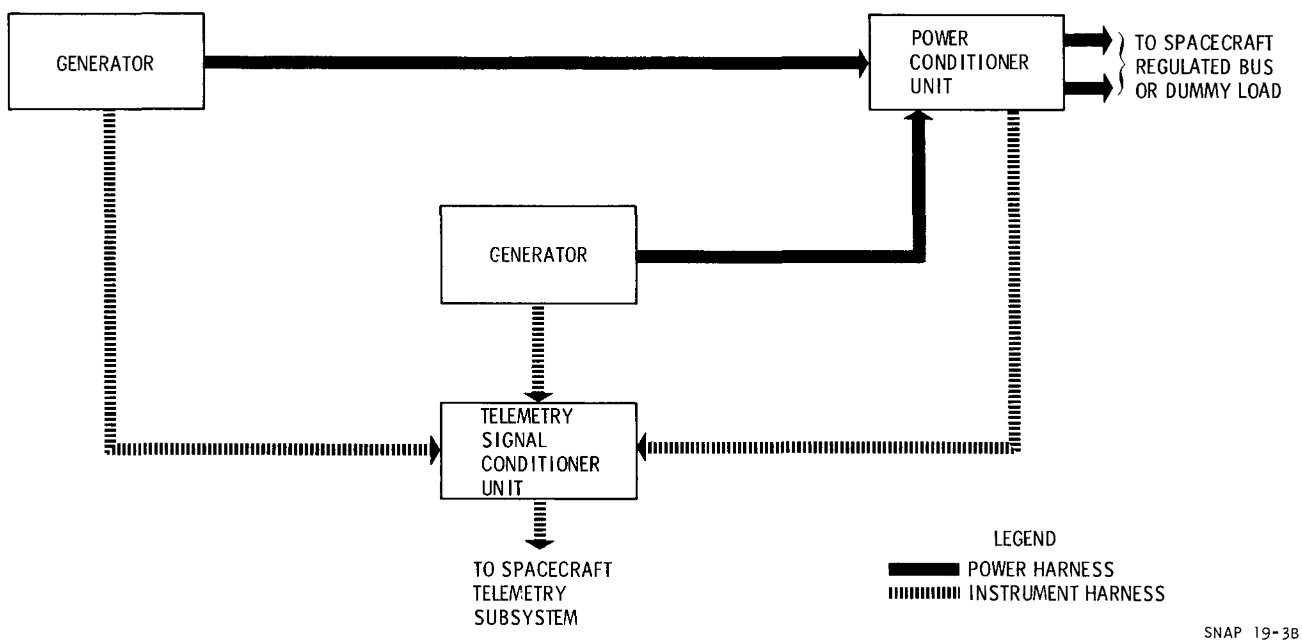


Figure 1-3. SNAP 19 Block Diagram

1-8 Supplied with the system are electrically heated generator subsystems to be used for spacecraft compatibility tests. These generator subsystems are dimensionally the same as the radioisotope-fueled units and have the same power output characteristics. The major differences are the use of an electrical resistance heater block as a heat source instead of the radioisotope, and additional electrical connectors on the subsystem base for application of heater power. Power for the heaters is supplied by the ground support test console or the power supply rack. Once these generators are heated, the temperature should be maintained at a constant level because temperature-cycling is detrimental to the generators. When the generators are cold, the environment humidity must not exceed 50% at a temperature of 75° F. There are no special environment conditions for heated generators, but water droplets must not be allowed to contact the surfaces.

1-9 Refer to table 1-1 for a listing of major power supply and ground support equipment part numbers.

1-10. MAJOR COMPONENTS OF POWER SUPPLY

1-11. GENERATOR SUBSYSTEM

1-12. The generator subsystem consists principally of two radioisotope-fueled thermoelectric generators and a support structure. (See figure 1-2.) The two generators are mounted in tandem, one above the other (back-to-back) at an angle (approximately 16° from the vertical). The support structure attaches the generators to the spacecraft sensory ring.

1-13. Radioisotope Thermoelectric Generators

1-14. In radioisotope thermoelectric generators, heat is generated by isotope decay. Part of the heat produced is converted into electricity by an energy conversion device, and the remainder is dissipated to the environment. There are no moving parts in the SNAP 19 radioisotope thermoelectric generators.

1-15. The SNAP 19 generators are fueled with plutonium 238 and employ lead-telluride thermoelectric couples for energy conversion. Each of the electrically paralleled generators produces approximately 30 watts at beginnning of life.

1-16. Each generator (figure 1-2) with terminal connections weighs less than 35 pounds and is housed in a right circular cylinder, 6-1/2 inches in diameter by 10-3/4 inches high. The thermal radiation surface is increased by six fins. Configuration of the fins on the upper generator differs slightly from those on the lower generator to provide clearance for the spacecraft shroud. The average orbital radiator temperature is 337° F at the base of the fins.

CAUTION

Airflow around the generators must not be obstructed. Fin root temperature exceeding the maximum allowable (385° F) may result.

Component	Basic Part Number
Generator subsystem	452B1000002
Power conditioner unit [(1)]	452B1500035
Telemetry signal conditioner unit [(2)]	452B1500054
Ground support test console [(3)]	452B1710000
Generator subsystem shipping container	452B1800006
Generator subsystem handling adapter	452B1800024
Generator subsystem offset hoist bar	452B1800022
Generator subsystem shipping container handling sling	452B1800023
Mobile carriage	452B1800018
Portable monitoring package	452B1800025
Power supply rack	452B1800030
Mobile carriage sling	452B1800043
Charger	Yardney VC 24-10

[(1)] Short forms of nomenclature used in text are power conditioner and PCU.

[(2)] Short forms of nomenclature used in text are telemetry signal conditioner and TSCU.

[(3)] Short form of nomenclature used in text is GSTC.

Table 1-1. Component Part Numbers

1-17. Sensors in the generator supply to the telemetry signal conditioner measurement signals of internal and external temperatures, internal pressure, and internal voltage.

1-18. The generators are finished with a special emissive coating. To protect this coating, handling of the generators should be avoided. If handling is necessary, clean white gloves should be used. These should also be used when working close to the generators so as to protect against inadvertent touching of the radiating surfaces.

1-19. Generator Support Structure

1-20. The support structure (figure 1-4) consists of a support base and a standoff. The standoff is a triangular structural adapter that attaches the generator subsystem to the spacecraft sensory ring. Bolted to the top of the standoff is the support base, to which a spoked, vibration-isolating spring assembly is bolted.

1-21. The lower generator is attached to the support base by a piston. A bracket containing two electrical receptacles is clamped to the front of the support base. One of the receptacles is used to connect the generator subsystem to a dummy load, and the other is used to place the generators on short circuit. The bracket (with receptacles) is removed before flight.

1-22. There are three electrical connectors on the standoff through which passes all wiring between the generators and the spacecraft sensory ring. This wiring includes generator power leads, and leads to the telemetry signal conditioner.

1-23. POWER CONDITIONER

1-24. The power conditioner (figure 1-5) consists of two separate 30-watt, high efficiency, low input voltage converters housed within one package. The converters change the DC output voltage from the two radioisotope thermoelectric generators to that required by the spacecraft bus. The output is then applied through a series relay contact to either the spacecraft power bus or an external dummy load. The relays, in series with the converter outputs, are capable of placing either or both converters on or off the spacecraft bus and are controlled by ground commands through the spacecraft.

1-25. The power conditioner is housed in a standard 4/0 Nimbus B module. (See figure 1-5.) The 6-inch by 6 1/2-inch by 7-inch, 13-pound module has eight slotted mounting lugs. All connections to the module are made on one of its sides and at one corner of the same side is a painted dot that indicates the outboard edge of the module.

1-26. The connections on the module and their purposes are as follows:

a. GEN NO. 1 + - power input from generator No. 1

b. GEN NO. 2 + - power input from generator No. 2

c. COM NEG - common connection for both generators

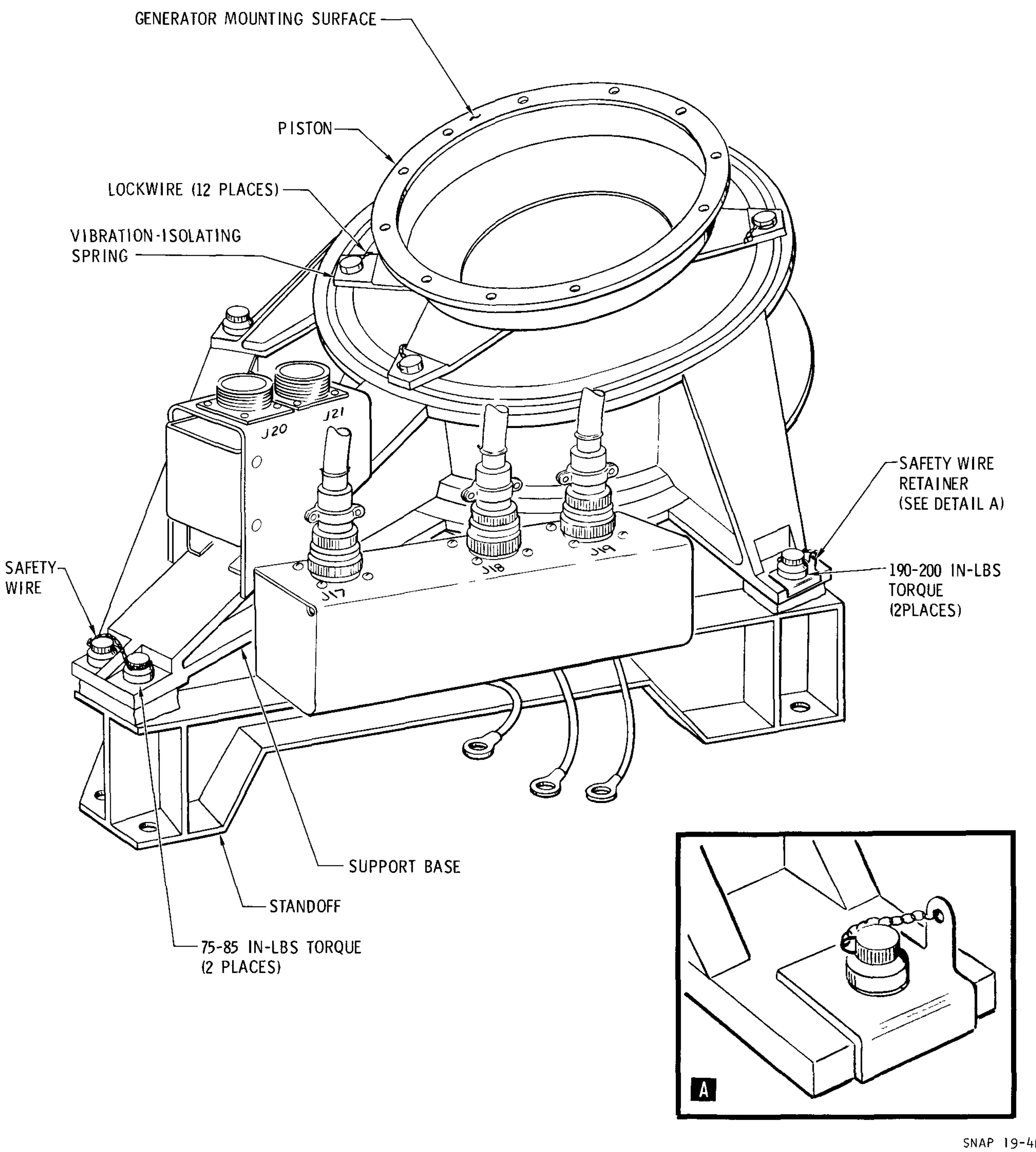


Figure 1-4. Generator Suosystem Support Structure

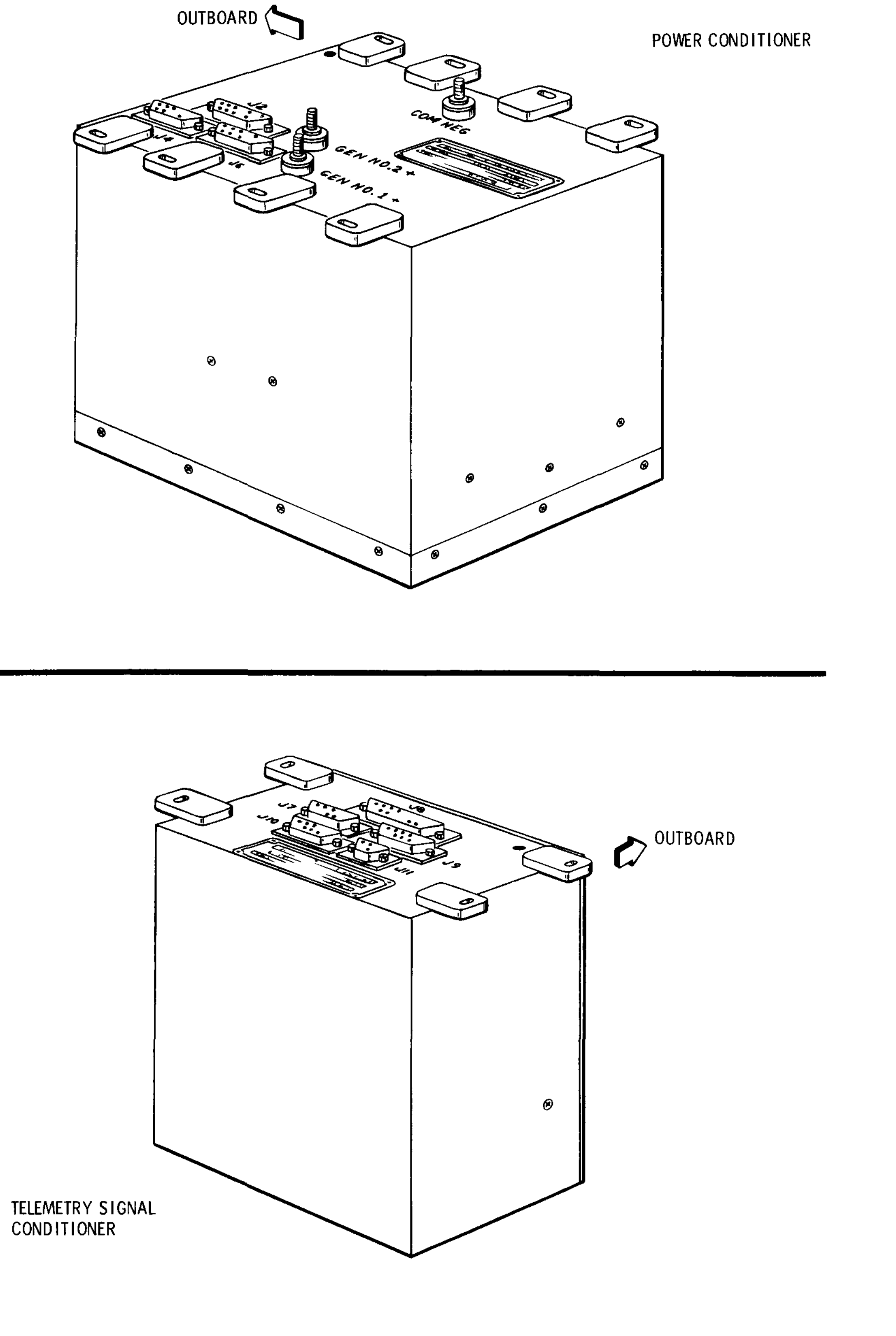


Figure 1-5. Power Conditioner and Telemetry Signal Conditioner Arrangement

d. Jack J2 - power conditioner telemetry measurements to the telemetry signal conditioner

e. Jack J4 - command signals to the relays that control application of converted generator power to the spacecraft bus

f. Jack J6 - power conditioner outputs to the spacecraft bus or dummy load

1-27. The power conditioner contains sensors that monitor the following:

a. The input voltage and current to both converters.

b. The output voltage and current from both converters.

c. The temperature of the transistor mounting bracket for both converters.

d. The position of the series output relay for both converters.

The output telemetry signals from the monitored points are sent to the telemetry signal conditioner for additional processing before going to the spacecraft telemetry system.

1-28. A protective circuit in the DC-to-DC converters insures that the radioisotope thermoelectric generator will not undergo an open circuit condition.

The protective circuit detects the converter open circuit condition and automatically places a simulated short circuit on the generator output. When the converter load returns, the protective circuit becomes inoperative and normal system operation is restored. An open circuit condition is one in which the load resistance is large enough to cause a converter output voltage exceeding 30 volts DC.

NOTE

For shipment, the power conditioner should be packaged in accordance with MIL-P-116E, Method III

1-29. TELEMETRY SIGNAL CONDITIONER

1-30. The telemetry signal conditioner (figure 1-5) receives 26 analog and two digital signals from sensors in the generators and power conditioner, conditions the analog signals to a range of 0 to -6.4 volts, and then supplies the 26 analog signals to the spacecraft analog-to-digital converter. The telemetry signal conditioner also furnishes two digital signals that indicate the status of the power conditioner output.

1-31. The telemetry signal conditioner is housed in a standard 0/2 Nimbus B module. (See figure 1-5.) The 4-inch by 6 1/2-inch by 6 1/2-inch, 3 1/2-pound module has four slotted mounting lugs. All connections to the module are made on one of its sides, and at one corner of this same side is a painted dot that indicates the outboard edge of the module. Power (less than two watts) for the telemetry signal conditioner is furnished by the -24.5 spacecraft bus.

1-32. The connections on the module and their purposes are:

a. Jack J7 - power conditioner parameter measurement inputs to the telemetry signal conditioner

b. Jack J8 - generator subsystem parameter measurement inputs to the telemetry signal conditioner

c. Jack J9 - conditioned parameter measurement signals to the spacecraft analog-to-digital converter

d. Jack J10 - conditioned parameter measurement signals to the spacecraft analog-to-digital converter

e. Jack J11 - power input from spacecraft -24.5 VDC bus

1-33. Analog signals processed by the telemetry signal conditioner are:

a. Three hot junction temperatures in each generator

b. Three fin root temperatures for each generator

c. Output voltage of each generator

d. Input voltage to each power conditioner converter

e. Output voltage of each power conditioner converter

f. Input current to each power conditioner converter

g. Output current of each power conditioner converter

h. Temperature of each power conditioner converter

i. Internal pressure of each generator

1-34. The digital inputs to the telemetry signal conditioner indicate status of the power conditioner (either of the converters on or off the spacecraft bus). The signals for an ON-ONE condition are -5 to -10 VDC, and those for an OFF-ZERO condition are 0 to -1 VDC.

NOTE

For shipment, the unit should be packaged in accordance with MIL-P-116E, Method III.

1-35. GROUND SUPPORT TEST CONSOLE

1-36. The ground support test console (figure 1-6) contains all equipment necessary for complete functional testing of the SNAP 19 system. In addition to the overall system test capability, the console provides for the following:

a. Testing of radioisotope or electrically-heated thermoelectric generator subsystem

b. Testing of power conditioner

c. Testing of telemetry signal conditioner unit

d. Calibration of the telemetry signal conditioner unit

e. Testing of the system with the generators simulated

1-37. Consisting of four racks of equipment integrated to form a single unit, the console is mounted on casters for limited mobility. It is designed for indoor use in a protected area such as a launch complex assembly building or an industrial environment.

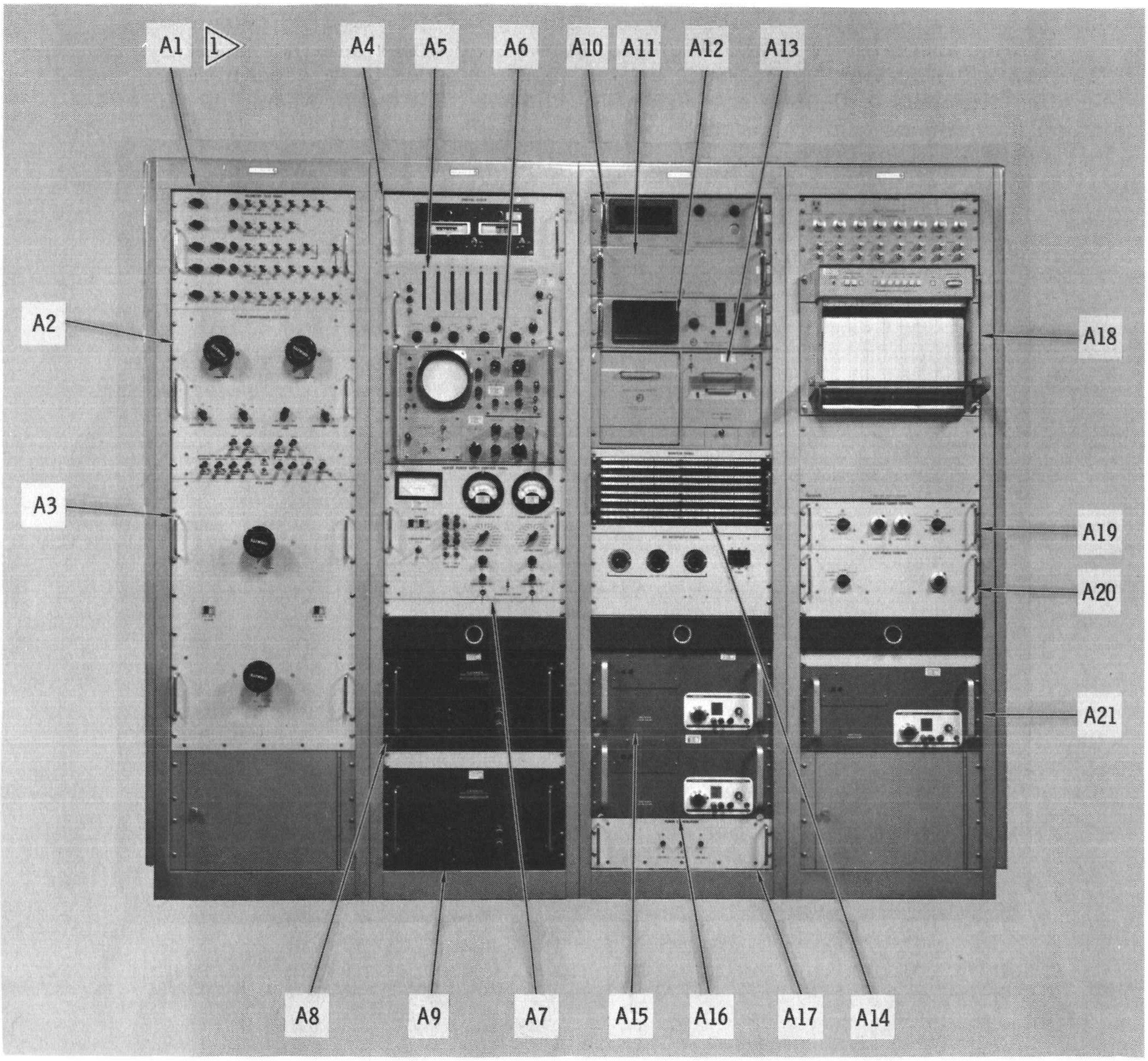
1-38. Accessories furnished with the console include 75 patchcords (45 patchcords 24 inches long and 30 patchcords 12 inches long), two 40-foot cables for connection to an electrically heated generator subsystem, a set of 25-foot cables for connections to a power supply system or subsystem under test, and all cables necessary to interconnect subsystems under test. An oscilloscope camera is supplied to enable permanent recording of oscilloscope indications. There are two storage spaces in the console, one at the bottom of each of the outside equipment racks. Cables are also provided for interconnection of the oscilloscope and Eput to the MONITOR PANEL. There are two vertical input amplifier plug-ins supplied for the oscilloscope. One is a high gain unit with a differential input (model 1752A) and the other is a dual trace unit (model 1755A).

1-39. For power input to the console, a source of 120/208-VAC, 3-phase (4 wire), 60-CPS power rated at 12.5 KVA is required.

1-40. Each panel of the console is described individually in the paragraphs that follow.

NOTE

For shipment, the console should be packaged in accordance with MIL-P-116E, Method III. The chassis and panels are not removed for shipment.



NOTE

1 NUMBERS ARE DESIGNATORS USED FOR IDENTIFICATION IN TEXT.

SNAP 19-11B

Figure 1-6. Ground Support Test Console Arrangement

1-41. TELEMETRY TEST PANEL

1-42. The TELEMETRY TEST PANEL (A-1, figure 1-6) provides for complete testing and calibration of a telemetry signal conditioner unit independently of the rest of the system. In general, the test panel provides these capabilities by simulating all inputs to the telemetry signal conditioner unit and providing measurements of these inputs to the MONITOR PANEL for comparison with the telemetry signal conditioner unit (TSCU) outputs.

1-43. Since the TSCU applies a voltage to all simulated resistive signals, this voltage must be removed in order to measure the resistance directly. The voltage is removed by ISOLATION switches S9, S15, S22, S31, and S32 on the TELEMETRY TEST PANEL. In performing TSCU calibration and functional tests, the simulated sensor resistance is compared with the corresponding TSCU response. Therefore, when the resistive input to the TSCU is measured, the isolation switch must be at OFF, and when the TSCU response to a resistive input is measured the switch must be at ON. The isolation switch designations and the simulated signals they control are as follows:

S9 ---- RTG 1 hot junction T2, T3, T5 and RTG 1 pressure

S15 --- PC 1 and PC 2 temperature

S22 --- RTG 2 fin root T6, RTG 1 fin root T7, and RTG 1 fin root T8

S31 --- RTG 1 fin root T6, RTG 2 fin root T7, and RTG 2 fin root T8

S32 --- RTG 2 hot junction T2, T3, T5, and RTG 2 pressure

1-44. Specific functions of the test panel and descriptions of controls associated with each function are given below.

1-45. Testing of Voltage Measurement Conditioning Circuits

1-46. This function is accomplished by applying simulated voltage measurement signals to the telemetry signal conditioner unit and to the monitor panel. The conditioned outputs of the telemetry signal conditioner unit (TSCU) are compared against the known inputs to determine the TSCU accuracy. The VARIABLE POWER CONTROL panel (A19 on figure 1-6) is the voltage source for this function, and is appropriately set up when the MODE 2 control is set to TM VOLT. Telemetry test panel controls applicable to this function are arranged in a line above VOLTAGE MEASUREMENT TEST CKT on the front panel. Their functions are:

a. S1. This control provides four discrete voltages to each of the six voltage measurement inputs (generator No. 1 output, generator No. 2 output, power conditioner input No. 1, power conditioner input No. 2, power conditioner output No. 1, and power conditioner output No. 2). When S1 is OFF, all TSCU inputs are open circuited. The highest voltage step is applied when S1 is in position 1. As the control is set to each succeeding clockwise position, the voltage applied to all TSCU inputs decreases in steps (step 5 is a spare position). The voltages provided in this manner are evenly distributed within the desired range for each TSCU input circuit. Note that proper voltages for functional tests will be obtained only if switches S2 through S7 are OFF. (Refer to c., below).

b. R5. This control is used only during calibration of the TSCU voltage measurement circuits. Depending on the circuit to be calibrated, the appropriate switches (c, below) are set to ON. The R5 control is then used, with S1, to provide the required voltage setting for the simulated voltage.

c. S2 through S7. These switches must be OFF during all functional tests. They are set to ON only during calibration of the TSCU voltage measurement circuits. Simulated voltages controlled by the switches are:

S2, S5 ------- Generator No. 1 output voltage

S3, S4 ------- Generator No. 2 output voltage

S3, S4 ------- Power conditioner input No. 2 voltage

S2, S5 ------- Power conditioner input No. 1 voltage

S6 ------- Power conditioner output No. 1 voltage

S7 ------- Power conditioner output No. 2 voltage

1-47. Testing of Current Measurement Conditioning Circuits

1-48. This function is associated with the VARIABLE POWER CONTROL panel (A19, figure 1-6). With the power control panel MODE 1 and MODE 2 selectors set to TM TRANSDUCTOR, two power sources are connected to the TELEMETRY TEST PANEL for use in simulating outputs from the current-measuring transductors in the power conditioner. These simulated outputs are sent to the TSCU, conditioned by the TSCU, and sent to the MONITOR PANEL for comparison with measurements of current actually flowing in the simulation circuit.

1-49. No TELEMETRY TEST PANEL controls apply to this function. Currents through the simulation circuit are controlled by the VOLTAGE 1 and VOLTAGE 2 controls on the VARIABLE POWER CONTROL panel.

1-50. Measurement of Input Power for Telemetry Signal Conditioner Unit

1-51. The BUS POWER CONTROL panel (A20, figure 1-6) supplies telemetry signal conditioner unit (TSCU) operating power when the MODE control on the power control panel is set to TM POWER or PC//TM. This voltage is applied through the TELEMETRY TEST PANEL to the TSCU under test. A measurement of TSCU operating power is obtained by measuring voltage drop across a 1-ohm resistor in series with the line to the TSCU. This measurement is sent to the MONITOR PANEL where the TSCU input voltage is monitored. These values are used for computation of the TSCU input power.

1-52. In making this measurement, the TSCU operating voltage is adjusted by the VOLTAGE control on the BUS POWER CONTROL panel.

1-53. Testing of Generator Pressure Measurement Conditioning Circuits

1-54. The TELEMETRY TEST PANEL simulates the resistance of two generator pressure transducers and applies these inputs to the TSCU. Conditioned voltage output signals from the TSCU are sent to the MONITOR PANEL for measurement and comparison with calibrated levels. Test panel controls applicable to this function are lined up above GENERATOR PRESSURE TEST CKT on the front panel. Their functions are:

a. S8. Provides three discrete inputs to each of the two TSCU conditioning circuits. When S8 is OFF, the inputs are open circuited. As the control is rotated clockwise to each successive position, both of the input resistances increase in steps until position 3 is reached. (Positions 4 and 5 are spares.) Note that proper resistances for functional tests are obtained only if switches S10 and S11 are OFF.

b. R4. This control is used only during calibration of the pressure measurement circuits. It is ineffective unless S10 or S11 is set to ON. When R4 is switched into the circuit by setting S10 or S11 to ON, R4 becomes a smooth adjustment of the simulation resistance in the circuit controlled by that switch. (Refer to c., below).

c. S10 and S11. These switches must be OFF during functional tests. One is set to ON during calibration of a pressure measurement circuit. When either switch is ON, R4 is inserted into the circuit controlled by that switch, providing smooth adjustment of the simulation resistance in that circuit. Simulation resistances controlled by the switches are:

S10 ---------- Generator No. 1 pressure

S11 ---------- Generator No. 2 pressure

1-55. Testing of Power Conditioner Temperature Measurement Conditioning Circuits

1-56. The TELEMETRY TEST PANEL simulates the resistances of two thermistors in the power conditioner and applies these resistive inputs to the TSCU. Conditioned voltage output signals from the TSCU are sent to the MONITOR PANEL for measurement and comparison with calibrated levels. Test panel controls used for this function are lined up above POWER CONDITIONER TEMPERATURE TEST CKT on the front panel. Their functions are:

a. S13. Provides three discrete resistance inputs to each of the two TSCU conditioning circuits. When S13 is OFF, the inputs are open circuited. As S13 is rotated clockwise to each successive position, the input resistances vary in steps until position 3 is reached. (Positions 4 and 5 are spares.) Note that proper resistances for functional tests are obtained only if switches S16 and S17 are OFF (c, below).

b. S14 and R3. These controls are used only during calibration of the temperature measurement circuits. They are ineffective unless S16 or S17 is ON. When S16 or S17 is ON, R3 provides smooth adjustment of the simulation resistance for that circuit. The S14 switch extends the resistance range of R3 by adding resistance in series with R3 when S14 is in positions 2 and 3. When S14 is OFF, R3 is open circuited. When S14 is in position 1, zero resistance is added to R3.

c. S16 and S17. These switches must be OFF during functional tests. One is set to ON only during calibration of a temperature measurement circuit. When S16 or S17 is ON, S14 and R3 (b, above) are inserted into the simulation circuit controlled by that switch. Simulation circuits controlled by the switches are:

S16 ---------- Power conditioner temperature No. 1

S17 ---------- Power conditioner temperature No. 2

1.57. <u>Testing of Conditioning Circuits for Power Conditioner Bus Status</u>

1-58. The TELEMETRY TEST PANEL simulates power conditioner outputs that indicate the on-bus/off-bus status of the two converters. The TSCU-processed resultants are measured at the MONITOR PANEL.

1-59. Switches S18 and S19 are the front panel controls for this function. Switch S18 simulates the converter No. 2 status input, and S19 simulates converter No. 1 status input. When either switch is ON, a short is placed across the corresponding TSCU input, simulating the on-bus condition. When the switches are OFF, the TSCU inputs are open circuited, simulating the off-bus condition.

1-60. <u>Testing of Fin Root Temperature Measurement Conditioning Circuits</u>

1-61. The TELEMETRY TEST PANEL simulates the resistance of six thermistors in the generator subsystem and applies these resistive inputs to the TSCU. Conditioned voltage output signals from the TSCU are sent to the MONITOR PANEL for measurement and comparison with calibrated levels. Test panel controls used for this function are lined up above FIN ROOT TEST CKT on the front panel. Their functions are:

a. S20. Provides three discrete resistance inputs to each of the six TSCU conditioning circuits. When S20 is OFF, the inputs are open circuited. As S20 is rotated clockwise to each successive position, the input resistances vary in steps until position 3 is reached. (Positions 4 and 5 are spares.) Note that proper resistances for functional tests are obtained only if switches S23 through S28 are OFF (c, below).

b. S21 and R2. These controls are used only during calibration of the temperature measurement circuits. They are ineffective unless one of switches S23 through S28 is ON. When one of these switches is ON, R2 provides smooth adjustment of the simulation resistance for that circuit. The S21 switch extends the range of R2 by adding resistance in series with R2 when S21 is in positions 2 and 3. When S21 is OFF, R2 is open circuited. When S21 is in position 1, zero resistance is added to R2.

c. S23 through S28. These switches must be OFF during functional tests. They are set to ON only during calibration of the temperature measurement circuits. When one of these switches is ON, S21 and R2 (b, above) are inserted into the simulation circuit controlled by that switch. Simulation circuits controlled by the switches are:

S23 ------ Generator No. 1 fin root T6

S24 ------ Generator No. 1 fin root T7

S25 ------ Generator No. 2 fin root T8

S26 ------ Generator No. 2 fin root T6

S27 ------ Generator No. 2 fin root T7

S28 ------ Generator No. 1 fin root T8

1-62. <u>Testing of Hot Junction Temperature Measurement Conditioning Circuits</u>

1-63. The TELEMETRY TEST PANEL simulates the resistance of six resistance temperature devices (RTD) in the generator subsystem and applies these resistive inputs to the TSCU. Conditioned voltage output signals from the TSCU are sent to the MONITOR PANEL for measurement and comparison with calibrated levels. Test panel controls used for this function are lined up above JUNCTION TEST CKT on the front panel. Their functions are:

a. S30. Provides four discrete resistance inputs to each of the six TSCU conditioning circuits. When S30 is OFF, the inputs are open circuited. As S30 is rotated clockwise to each successive position, the resistances vary in steps until position 4 is reached. (Position 5 is a spare.) Proper resistances for functional tests are obtained only if switches S33 through S38 are OFF (c, below).

b. R1. This control is used only during calibration of the temperature measurement circuits. It is ineffective unless one of switches S33 through S38 is ON. When one of these switches is ON, R1 provides smooth adjustment of the simulation resistance for that circuit.

c. S33 through S38. These switches must be OFF during functional tests. They are set to ON only during calibration of the temperature measurement circuits. When one of these switches is ON, R1 is inserted into the simulation circuit controlled by that switch. Simulation circuits controlled by the switches are:

S33 ------ Generator No. 1 hot junction T2

S34 ------ Generator No. 1 hot junction T3

S35 ------ Generator No. 1 hot junction T5

S36 ------ Generator No. 2 hot junction T2

S37 ------ Generator No. 2 hot junction T3

S38 ------ Generator No. 2 hot junction T5

1-64. POWER CONDITIONER TEST PANEL

1-65. The POWER CONDITIONER TEST PANEL (A2, figure 1-6) provides for complete testing of a power conditioner unit, either independently of the rest of the system or as part of a complete system. In general, the test panel provides these capabilities by simulating all inputs to the power conditioner, providing measurements of these inputs to the MONITOR PANEL, simulating loads for the power conditioner outputs, and providing measurements of the outputs to the MONITOR PANEL.

1-66. Specific functions of the test panel and descriptions of controls associated with each function are given below.

1-67. Simulation of Power Input to Power Conditioner

1-68. This function is associated with the VARIABLE POWER CONTROL panel (A19, figure 1-6). With the power control panel MODE 1 and MODE 2 selectors set to PC POWER, two power sources are connected to the POWER CONDITIONER TEST PANEL for use in simulating the two generator outputs. The panel adds simulated source resistance and control to each power source and applies the resultants to the power conditioner under test. Controls used for this function are:

a. Rs CONVERTER NO. 1 and Rs CONVERTER NO. 2. These controls determine the source resistances of the simulated generator outputs. The source resistances decrease as the controls are rotated clockwise.

b. CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT. When these controls are at ON, simulated generator outputs are applied to the power conditioner under test. At OFF, the simulated generator outputs are not applied.

c. POWER CONDITIONER INPUT SHORTING. This switch must be in OPEN position for all procedures covered by this manual. (The SHORT position places a direct short across each of the power conditioner input circuits.)

1-69. Simulation of Power Conditioner Loads

1-70. The normal power conditioner load is either the regulated spacecraft bus or the off-bus external load. Both of these loads are simulated by the POWER CONDITIONER TEST PANEL. The off-bus load is simulated by two 20-ohm resistors, one for each converter output. Each load resistor is in parallel with a

2,000-mfd capacitor. The regulated spacecraft bus is simulated by adjustable load resistances (in parallel with a 2,000-mfd capacitor) and an external regulated power supply. Power to simulate the regulated spacecraft bus is obtained from the BUS POWER CONTROL panel when the MODE control on the power control panel is set to PC POWER or PC//TM. Controls provided for load simulation are:

a. POWER CONDITIONER LOAD. This control provides for precise adjustment of the power conditioner load resistance. It is a variable resistor with a range of zero to 5 ohms. Load resistance increases with clockwise rotation. This variable resistance is in series with three fixed-load resistors which are controlled by the PWR. COND. LOAD switches (b, below). With the proper combination ot switch positions and variable resistor setting, the total load resistance is adjustable to any value between zero and 30 ohms.

b. PWR. COND. LOAD switches. These three switches provide for insertion of load resistance (in 5-ohm increments) in series with the variable load resistor. (Refer to a, above). With all switches set to 0Ω, the variable load resistor comprises the total load resistance. Five ohms are added in series by setting the 5Ω switch to the 5Ω position. The 10Ω switches each add 10 ohms in series when set to the 10Ω position. Thus the total load resistance is adjustable to any value between zero and 30 ohms with the proper combination of switch and variable resistor settings.

c. PWR. COND. (ON BUS/OFF BUS) switch. This switch controls application of the simulated spacecraft bus voltage (from the BUS POWER CONTROL panel) across the power conditioner load resistance. When the switch is at OFF BUS, only the load resistance is available to the power conditioner output. At ON BUS, the simulated spacecraft bus voltage is applied across the load resistance.

d. CONV. NO. 1 and CONV. NO. 2 (ON BUS/OFF BUS) switches. These switches control the output of the two converters in the power conditioner. In the OFF BUS positions, the outputs are open circuited. In the ON BUS positions, the outputs are connected to the simulated spacecraft bus.

e. CONV. NO. 1 EXT. LOAD and CONV. NO. 2 EXT. LOAD switches. With these switches at 20Ω, the 20-ohm off-bus load resistors are available to the external load outputs from the power conditioner. With the switches at OPEN, the external load outputs are open circuited.

1-71. Testing of Output Control Relays

1-72. The output of each converter in the power conditioner is controlled by a relay which reacts to externally generated commands from the spacecraft. These relays are checked for proper operation by the POWER CONDITIONER TEST PANEL. Controls used for this function, grouped under CONV. ON-OFF BUS COMMAND, function as follows:

a. CONV. NO. 1 COMMAND and CONV. NO. 2 COMMAND. These controls are momentary-contact pushbuttons. When either is pressed, a simulated command from the spacecraft is generated and applied to the corresponding converter relay in the power conditioner. The position of the FUNCTION switch (b, below) determines whether the generated signal is applied as an on-bus command or an off-bus command. The signal may also be used to start an interval counter for measurement of the relay actuation interval (c, below).

b. FUNCTION. When this switch is at ON-BUS, command signals generated as in a, above, are applied to the on-bus relay coil, placing the converter output on the bus. At OFF BUS, command signals are sent to the off-bus relay coil, removing the converter output from the bus and applying it to the external load.

c. CONV. NO. 1 STATUS and CONV. NO. 2 STATUS. When these switches are at JACK PANEL, the status contacts of each converter relay are connected to jacks on the MONITOR PANEL for measurement of the relay contact status. When these switches are at INTERVAL MEAS., the status contacts on the relays are connected into a circuit in a manner that they may be used to stop an interval counter being used to measure relay actuation interval.

d. INTERVAL MEAS. With this switch at CONV. NO. 1, the start and stop signals sent to the interval counter for relay actuation interval measurements apply to the relay in converter No. 1. With the switch at CONV. NO. 2, the start and stop signals relate to the relay in converter No. 2.

1-73. Testing of Telemetry Signals from Power Conditioner

1.74. Signals from the input and output transductors in the power conditioner (representing input and output current of each converter) are processed by the POWER CONDITIONER TEST PANEL and sent to the MONITOR PANEL for comparison with actual levels as measured in the test panel. In this respect, the POWER CONDITIONER TEST PANEL simulates the telemetry signal conditioner unit. Other measurement signals from the power conditioner that are sent to the MONITOR PANEL for observation include input and output voltages as sensed in the power conditioner and resistance outputs of two thermistors which sense transitor mounting bracket temperatures for both converters.

1.75. There are no front panel controls applicable to the telemetry signal monitoring function of the POWER CONDITIONER TEST PANEL.

1-76. RTG LOAD PANEL

1-77. The RTG LOAD panel (A3, figure 1-6) contains two 1-kilowatt, 2-ohm rheostats and two overtemperature alarm indicators. Each of the 2-ohm rheostats is a variable load for one radioisotope thermoelectric generator (RTG) under test. Two 25-foot cables, one for each generator, are supplied to connect the generators to the panel.

1-78. Measurement signals supplied by the RTG LOAD panel include the output voltage and current of each RTG. (The output currents are expressed in millivolt form, 0-100 mv representing 0-20A.) These outputs are available to the data acquisition system through the MONITOR PANEL.

1-79. Load controls on the RTG LOAD panel consist of two knobs, RTG NO. 1 and RTG NO. 2. Each knob controls one of the load rheostats. The MIN position (counterclockwise) of the knobs corresponds to minimum load.

1-80. The RTG NO. 1 ALARM and RTG NO. 2 ALARM illuminated pushbuttons are overtemperature alarm indicators for fueled generators. If either generator hot junction temperature exceeds 975 ± 25°F, the red lens of RTG NO. 1 ALARM or RTG NO. 2 ALARM (according to which generator is hot) lights and a buzzer sounds. The alarm condition may be acknowledged by pressing the lighted pushbutton. This turns off the buzzer and red lens and lights the yellow lens. The yellow indication will remain until the overtemperature condition is corrected.

1-81. DIGITAL CLOCK

1-82. A 24-hour clock (A4, figure 1-6) is provided for convenience in determining stabilization time and unit operating time for the power supply system or subsystem under test. The clock provides a digital indication of hours, minutes, and seconds.

1-83. The clock is started or stopped when desired by operating the CLOCK SWITCH on the front panel.

1-84. UNIVERSAL EPUT AND TIMER, MODEL 7350A

1-85. The UNIVERSAL EPUT AND TIMER (A5, figure 1-6) is used to measure operating time interval of the on bus/off bus relays in a power conditioner under test. For this function, the instrument is used in the TIM (time-interval-meter) mode, with the A input jack on the front panel connected to the STOP jack (BG) on the MONITOR PANEL and the B input jack connected to the START jack (BF) on the MONITOR PANEL.

1-86. For detailed information on the UNIVERSAL EPUT AND TIMER, refer to the Beckman/Berkeley instruction manual which accompanies each test console.

1-87. OSCILLOSCOPE, MODEL 175A

1-88. The OSCILLOSCOPE (A6, figure 1-6) is used during power conditioner tests for measurement of output ripple voltages. Connections between the oscilloscope and the measurement point are made by connecting a cable from the vertical input jack on the front panel directly to jack BE on the MONITOR PANEL. For detailed information on the instrument, refer to the Hewlett-Packard operating and service manual which accompanies each test console.

1-89. An oscilloscope camera, Model 196B, is supplied as an accessory to the oscilloscope. It provides for permanent recording of the oscilloscope trace. For detailed information, refer to the Hewlett-Packard manual which accompanies each test console.

1-90. HEATER POWER SUPPLY CONTROL PANEL

1-91. The HEATER POWER SUPPLY CONTROL PANEL (A7, figure 1-6) controls the output of two regulated power supplies (A8 and A9, figure 1-6) which provide power to electrically heated thermoelectric generators. Each power supply furnishes heating power to one generator. The HEATER POWER SUPPLY CONTROL PANEL also provides for monitoring of generator temperatures and includes an alarm which is actuated if the temperature of either generator exceeds 975 ± 25°F. An alarm condition produces automatic cutback of heater power to the generator.

1-92. Application of Power to Generators

1-93. Front panel controls and indicators used for this function are:

a. POWER-RELAY DRIVER switch. When set to ON, this switch supplies operating power for control relays in the power supply control panel. The power supplies can be turned on only when this switch is ON.

b. POWER-HEATER NO. 1 and POWER-HEATER NO. 2 switches. When set to OFF, these switches remove power from the heaters. When set to ON, they apply power to the heaters if the following controls are set as indicated:

Circuit breakers (both power supply panels)	ON
POWER-RELAY DRIVER switch	ON
VOLTAGE RANGE switches	20-30
HEATER NO. 1 and NO. 2 switches (on rear panel)	75

c. POWER-HEATER NO. 1 and POWER-HEATER NO. 2 lamps. When lighted, these lamps indicate that heater power is ON.

d. VOLTAGE RANGE switches. Power supply output voltages are adjusted to the ranges indicated on the front panel by rotating these switches. Note that these controls must be set to 20-30 to permit turning on the power supplies. After power is turned on, these switches are slowly rotated clockwise until the desired power input is obtained as indicated on the meter above each switch.

e. FINE ADJ. controls. These controls provide for fine adjustment of the output voltages over the ranges to which the VOLTAGE RANGE switches are set, thereby adjusting power inputs to the heaters.

f. POWER INPUT-HEATER NO. 1 and POWER INPUT-HEATER NO. 2 meters. These meters provide a qualitative indication of power input to each generator heater.

g. HTR POWER NO. 1 and NO. 2 switches. These switches and the four jacks directly above each switch provide for connection of an external laboratory-type wattmeter for accurately measuring power input to the generator heaters. With switches NO. 1 and NO. 2 set to INT., the internal POWER INPUT-

HEATER NO. 1 and POWER INPUT-HEATER NO. 2 meters monitor the input power to the heaters. Setting either switch to EXT. disconnects the corresponding internal meter and activates the four jacks directly above that switch as connecting points for an external wattmeter. The current terminals of the external wattmeter connect between the two CURRENT jacks (red is +, black is -) and the voltage terminals connect between the two VOLTAGE jacks (red is +, black is -).

h. HEATER NO. 1 and NO. 2 switches. These switches are on the rear panel of the HEATER POWER SUPPLY CONTROL PANEL chassis. They limit heater power to the maximum voltage indicated by their settings. Note that they must be set to 75 to permit turning power on to the heaters. They are then advanced as required for correct heater power. For safety to equipment, the setting of each should at all times agree with the upper value of the corresponding VOLTAGE RANGE control.

1-94. Temperature Monitor and Alarm

1-95. Generator hot junction temperatures are sensed by a thermocouple in each thermoelectric generator. The thermocouple outputs are applied to the temperature monitoring and alarm system in the HEATER POWER SUPPLY CONTROL PANEL. If either of the two generator temperatures exceeds 975 ± 25°F, the red lens of one of the ALARM pushbuttons lights, depending on which generator is overheated, to indicate the alarm condition and a buzzer sounds. To acknowledge the alarm condition, the lighted ALARM button is pressed. This turns off the red light, lights the yellow light of the same button, and turns off the buzzer. When the temperature drops below the set point, the yellow light goes off and heater power is applied at the level determined by the VOLTAGE RANGE setting. Note that the red light will not turn off and power input to the heater cannot be increased beyond the reduced level until the acknowledge pushbutton has been pressed and the temperature has dropped below the set point level.

1-96. At any time during operation, either generator temperature can be observed on the TEMPERATURE meter by setting the TEMPERATURE MON switch to either RTG 1 or RTG 2.

1-97. REGULATED POWER SUPPLY, LA80-05B-2201

1-98. Two LA80-05B-2201 power supplies (A8 and A9, figure 1-6) are included in the test console. Each supply furnishes power to one electrically heated thermoelectric generator.

1-99. These power supplies are controlled at the HEATER POWER SUPPLY CONTROL (A7, figure 1-6). The POWER ON indicator on each power supply is lighted when that power supply is energized.

1-100. In the event of thermal overload of either supply, the THERMAL OVERLOAD indicator lamp is energized and the supply itself is de-energized. After the trouble has been corrected, the thermal overload device is reset by pressing the THERMAL OVERLOAD RESET button on the back of the power supply.

1-101. For detailed information on the power supplies, refer to the Lambda Electronics Corp. instruction manual which accompanies each test console.

1-102. DIGITAL DATA ACQUISITION SYSTEM

1-103. The digital data acquisition system sequentially scans up to 60 inputs (volts and ohms intermixed) and prints out each measurement on paper tape. In contrast, the system can be used in a manual mode to display a single measurement on a digital voltmeter. Its primary purpose in the ground support test console is to facilitate logging of the many measurements required during system and subsystem testing. The system measures DC voltages from 0 to ± 200 volts and resistances from 0 to 999.9 K ohms.

1-104. Each of the 60 input channels to the system is terminated at a jack on the MONITOR PANEL (00 through 59). The signals that require measurement are also terminated at jacks on the MONITOR PANEL (AA through FX). Signals that are to be measured for any particular test are connected to input channels of the system by patchcords. The input jacks accept a three-wire signal (i.e., signal high, signal low, and ohm command). The signal jacks to be measured provide either a two-wire or three-wire signal. For voltage measurements, the signal jack provides a two-wire signal (signal high and signal low). For resistance measurements, the signal jack provides a three-wire signal (signal high, signal low, and ohm command). Thus, the system scans and prints out both resistive and voltage measurements.

1-105. The system consists of four panels on the test console. These panels are described in paragraphs 1-106 through 1-114 below. Operation as a system is described in paragraphs 1-115 through 1-118, below.

1-106. Input Scanner, Model 262S701

1-107. The INPUT SCANNER panel (A12, figure 1-6) sequentially scans the selected inputs and provides the input to the converter. Operation as part of the data acquisition system is described in paragraphs 1-115 through 1-118, below. For detailed information, refer to the Non-Linear Systems, Inc. instruction manual furnished with each test console.

1-108. Input Converter, Series 1100

1-109. The INPUT CONVERTER panel (A11, figure 1-6) receives the output of the INPUT SCANNER as either a resistive or voltage measurement. The voltage measurement signal is routed directly to the DIGITAL VOLTMETER. For resistive measurements, the converter interrupts the signal input from the DIGITAL VOLTMETER and applies the signal to a bridge type measurement circuit which, in turn, develops a corresponding voltage and transmits it to the DIGITAL VOLTMETER.

1-110. DIGITAL VOLTMETER, Series 5000

1-111. The DIGITAL VOLTMETER panel (A10, figure 1-6) displays in digital form the value of voltage or resistance under measurement. Operation as part of the data acquisition system is described in paragraphs 1-115 through 1-118, below. For detailed information on the unit, refer to the Non-Linear Systems, Inc. instruction manual furnished with each test console. (The DIGITAL VOLTMETER is designated model 5010.)

1-112. The accuracy of the DIGITAL VOLTMETER is affected by the setting of the SENSITIVITY control as follows:

SENSITIVITY Control Setting	Accuracy
LO	± 0.01% of indication + (± 10 LSD*)
1	± 0.08% of indication + (± 8 LSD)
2	± 0.04% of indication + (± 4 LSD)
3	± 0.02% of indication ± (± 2 LSD)
HI	± 0.01% of indication + (± 1 LSD)

1-113. DATA PRINTER, Model 155

1-114. The DATA PRINTER (A13, figure 1-6) prints out on paper tape the channel number, unit of measurement, and four-digit numerical value for each measurement, when desired. The printout format is shown in figure 1-7. Operation of the printer as part of the data acquisition system is described in paragraphs 1-115 through 1-118 below. For detailed information, refer to the Non-Linear Systems, Inc. instruction manual furnished with each test console.

1-115. Operating Procedure for Multi-Channel Scanning and Printout

1-116. To use the data acquisition system in the multi-channel scanning and printout mode:

a. Set digital voltmeter selector switch to STD BY.

b. Set printer POWER ON switch to ON.

c. Set scanner selector switch to ONE CYCLE.

d. Using patchcords furnished with console, connect data acquisition inputs (jacks 00 through 59 on monitor panel) to measurement points specified in checkout procedure (or as determined from table 1-2). Do not leave gaps between input channel numbers that are to be scanned as one operation; otherwise the scanner will stop at the open channel(s).

e. Set scanner RESET selector drums to indicate lowest input channel number to be scanned. (00 is lowest possible channel number, but if channels 20 through 40, for example, are to be scanned set RESET drums to 20.)

*LSD = least significant digit

Printout Examples	Interpretations
0 0 - V 5 4 2 3 .3	Chan. 00 -5.423 Volts
1 2 + V 2 4 5 0 .2	Chan. 12 +24.50 Volts
2 3 KΩ 3 5 0 2 .3	Chan. 23 3.502 KΩ

Move decimal point this many places to the left.

Digital instrument reading

Unit of measurement

Channel number

Figure 1-7. Measurement Printout Format

Panel Marking	Measurement	Expressed In---	Source
AA	RTG 1 output volts	Volts	RTG 1 (through RTG LOAD panel)
AB	RTG 1 output current	Volts	RTG LOAD panel (20a-100 mw shunt)
AC	RTG 2 output volts	Volts	RTG 2 (through RTG LOAD panel)
AD	RTG 2 output current	Volts	RTG LOAD panel (20a-100 mw shunt)
AE	RTG 1 output volts (T/M)	Volts	RTG 1
AF	RTG 1 pressure (T/M)	Ohms	RTG 1
AG	RTG 1 fin root temp. T6 (T/M)	Ohms	RTG 1
AH	RTG 1 fin root temp. T7 (T/M)	Ohms	RTG 1
AI	RTG 1 fin root temp. T8 (T/M)	Ohms	RTG 1
AJ	RTG 1 hot jct. temp. T2 (T/M)	Ohms	RTG 1
AK	RTG 1 hot jct. temp. T3 (T/M)	Ohms	RTG 1
AL	RTG 1 hot jct. temp. T5 (T/M)	Ohms	RTG 1
AM	Spare		
AN	RTG 2 output volts (T/M)	Volts	RTG 2
AO	RTG 2 pressure (T/M)	Ohms	RTG 2
AP	RTG 2 fin root temp. T6 (T/M)	Ohms	RTG 2
AQ	RTG 2 fin root temp. T7 (T/M)	Ohms	RTG 2
AR	RTG 2 fin root temp. T8 (T/M)	Ohms	RTG 2
AS	RTG 2 hot jct. temp. T2 (T/M)	Ohms	RTG 2
AT	RTG 2 hot jct. temp. T3 (T/M)	Ohms	RTG 2
AU	RTG 2 hot jct. temp. T5 (T/M)	Ohms	RTG 2
AV	RTG 1 pressure excitation	Ohms	RTG 1

Table 1-2. Monitor Panel Jack Directory (Sheet 1 of 6)

Panel Marking	Measurement	Expressed In---	Source
AW	RTG 2 pressure excitation	Ohms	RTG 2
AX	Spare		
BA	PC 1 input volts	Volts	PC (through PC test panel)
BB	PC 1 input current	Volts	PC test panel (20a-100 mv shunt)
BC	PC 1 output volts	Volts	PC (through PC test panel)
BD	PC 1 output current	Volts	PC test panel (1-ohm shunt)
BE	PC output load volts	Volts	PC test panel
BF	Interval start	Volts	PC test panel
BG	Interval stop	Volts	PC test panel
BH	PC 2 input volts	Volts	PC (through PC test panel)
BI	PC 2 input current	Volts	PC test panel (20a-100 mv shunt)
BJ	PC 2 output volts	Volts	PC (through PC test panel)
BK	PC 2 output current	Volts	PC test panel (1-ohm shunt)
BL	PC 1 input volts (T/M)	Volts	PC (through PC test panel)
BM	PC 1 input current (T/M)	Volts	PC (through PC test panel)
BN	PC 1 output volts (T/M)	Volts	PC (through PC test panel)
BO	PC 1 output current (T/M)	Volts	PC (through PC test panel)
BP	PC 1 temp. (T/M)	Ohms	PC (through PC test panel)
BQ	PC 1 status (T/M)	Ohms	PC (through PC test panel)
BR	PC 2 input volts (T/M)	Volts	PC (through PC test panel)
BS	PC 2 input current (T/M)	Volts	PC (through PC test panel)
BT	PC 2 output volts (T/M)	Volts	PC (through PC test panel)

Table 1-2. Monitor Panel Jack Directory (Sheet 2 of 6)

Panel Marking	Measurement	Expressed In---	Source
BU	PC 2 output current (T/M)	Volts	PC (through PC test panel)
BV	PC 2 temp. (T/M)	Ohms	PC (through PC test panel)
BW	PC status (T/M)	Ohms	PC (through PC test panel)
BX	Spare	--	
CA	RTG 1 output volts (sim.)	Volts	T/M test panel
CB	RTG 2 output volts (sim.)	Volts	T/M test panel
CC	RTG 1 pressure (sim.)	Ohms	T/M test panel
CD	RTG 2 pressure (sim.)	Ohms	T/M test panel
CE	RTG 1 fin root temp. T6 (sim.)	Ohms	T/M test panel
CF	RTG 1 fin root temp. T7 (sim.)	Ohms	T/M test panel
CG	RTG 1 fin root temp. T8 (sim.)	Ohms	T/M test panel
CH	RTG 2 fin root temp. T6 (sim.)	Ohms	T/M test panel
CI	RTG 2 fin root temp. T7 (sim.)	Ohms	T/M test panel
CJ	RTG 2 fin root temp. T8 (sim.)	Ohms	T/M test panel
CK	RTG 1 hot jct. temp. T2 (sim.)	Ohms	T/M test panel
CL	RTG 1 hot jct. temp. T3 (sim.)	Ohms	T/M test panel
CM	RTG 1 hot jct. temp. T5 (sim.)	Ohms	T/M test panel
CN	RTG 2 hot jct. temp. T2 (sim.)	Ohms	T/M test panel
CO	RTG 2 hot jct. temp. T3 (sim.)	Ohms	T/M test panel
CP	RTG 2 hot jct. temp. T5 (sim.)	Ohms	T/M test panel
CQ	PC 1 input volts (sim.)	Volts	T/M test panel
CR	PC 1 output volts (sim.)	Volts	T/M test panel
CS	PC 1 temp. (sim.)	Ohms	T/M test panel

Table 1-2. Monitor Panel Jack Directory (Sheet 3 of 6)

Panel Marking	Measurement	Expressed In---	Source
CT	PC 1 and 2 input current (sim.)	Volts	T/M test panel (20a-100 mv shunt)
CU	PC 1 and 2 output current (sim.)	Volts	T/M test panel (1 ohm shunt)
CV	PC 2 input volts (sim.)	Volts	T/M test panel
CW	PC 2 output volts (sim.)	Volts	T/M test panel
CX	PC 2 temp. (sim.)	Ohms	T/M test panel
DA	TSCU input current	Volts	T/M test panel(1-ohm shunt)
DB	RTG 1 output volts	Volts	TSCU
DC	RTG 1 pressure	Volts	TSCU
DD	RTG 1 fin root temp. T6	Volts	TSCU
DE	RTG 1 fin root temp. T7	Volts	TSCU
DF	RTG 1 fin root temp. T8	Volts	TSCU
DG	RTG 1 hot jct. temp. T2	Volts	TSCU
DH	RTG 1 hot jct. temp. T3	Volts	TSCU
DI	RTG 1 hot jct. temp. T5	Volts	TSCU
DJ	RTG 2 output volts	Volts	TSCU
DK	RTG 2 pressure	Volts	TSCU
DL	RTG 2 fin root temp. T6	Volts	TSCU
DM	RTG 2 fin root temp. T7	Volts	TSCU
DN	RTG 2 fin root temp. T8	Volts	TSCU
DO	RTG 2 hot jct. temp T2	Volts	TSCU
DP	RTG 2 hot jct. temp. T3	Volts	TSCU
DQ	RTG 2 hot jct. temp. T5	Volts	TSCU
DR	Spare		
DS	PC 1 input volts	Volts	TSCU

Table 1-2. Monitor Panel Jack Directory (Sheet 4 of 6)

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Panel Marking	Measurement	Expressed In---	Source
DT	PC 1 input current	Volts	TSCU
DU	PC 1 output volts	Volts	TSCU
DV	PC 1 output current	Volts	TSCU
DW	PC 1 temp.	Volts	TSCU
DX	PC 1 on-off bus	Volts	TSCU
EA	PC 2 input volts	Volts	TSCU
EB	PC 2 input current	Volts	TSCU
EC	PC 2 output volts	Volts	TSCU
ED	PC 2 output current	Volts	TSCU
EE	PC 2 temp.	Volts	TSCU
EF	PC 2 on-off bus	Volts	TSCU
EG through EX	Spares		
FA	Variable power supply volts (No. 1)	Volts	Variable power control
FB	Variable power supply volts (No. 2)	Volts	Variable power control
FC	Bus power supply volts	Volts	Bus power control
FD	PC 1 EXT. load volts	Volts	PC (through PC test panel)
FE	PC 2 EXT. load volts	Volts	PC (through PC test panel)
FF	TSCU input volts (1)	Volts	TSCU (through T/M test panel)
FG	TSCU input volts (2)	Volts	TSCU (through T/M test panel)
FH	PC 1 ext. load current	Volts	PC test panel (1-ohm shunt)
FI	PC 2 ext. load current	Volts	PC test panel (1-ohm shunt)
FJ through FR	Spares		

Table 1-2. Monitor Panel Jack Directory (Sheet 5 of 6)

Panel Marking	Measurement	Expressed In---	Source
FS	RTG 1 hot jct. temp. T9	Volts	RTG 1 (through RTG LOAD panel)
FT	RTG 1 hot jct. temp. T10	Volts	RTG 1 (through RTG LOAD panel)
FU	RTG 2 hot jct. temp. T9	Volts	RTG 2 (through RTG LOAD panel)
FV	RTG 2 hot jct. temp. T10	Volts	RTG 2 (through RTG LOAD panel)
FW	RTG 1 fin root temp. T13	Ohms	RTG 1 (through RTG LOAD panel)
FX	RTG 2 fin root temp. T13	Ohms	RTG 2 (through RTG LOAD panel)
1A through 8A	Inputs to eight-channel strip recorder		
00 through 59	Inputs to data acquisition scanner (Panel markings designate channel numbers.)		
ACC 1) ACC 1)	Auxiliary patch No. 1		
SIG	Signal hi only patch		
VOL	Voltage only patch		
REV	Voltage only, polarity reversal patch		
OHMS	Auxiliary ohms command		
GND	Signal lo to ground		
COM	Signal lo only patch		
ACC 2) ACC 2)	Auxiliary patch No. 2		

Table 1-2. Monitor Panel Jack Directory (Sheet 6 of 6)

NOTE

Input channels can be scanned in blocks if desired; for example, channels 00 through 12 are one operation, and 15 through 18 are another operation. For each operation, set the RESET drums to lowest channel number to be scanned during that operation.

f. Set scanner STOP selector drums to indicate highest input channel number to be scanned during this operation.

g. Press scanner RESET pushbutton. This sets scanner to channel indicated on RESET selector drums.

h. Set digital voltmeter SENSITIVITY completely clockwise to HI. (Refer to paragraph 1-112.)

i. Set digital voltmeter selector switch to CONT. PRINT.

j. Set printer RECORD ON switch to ON.

k. Press scanner START pushbutton. This starts scan-measure-print cycle. The system will sequentially print out measurements beginning with RESET channel number and ending at STOP channel number.

NOTE

If printouts stop because the DIGITAL VOLTMETER display is unstable, slowly rotate digital voltmeter SENSITIVITY control toward LO until printout occurs; then return the SENSITIVITY control to the original setting.

1-117. Operating Procedure for Single-Channel Measurements

1-118. To use the data acqusition system in the single channel mode, with or without printout of measurement:

a. Set digital voltmeter selector switch to ON.

b. If printout is desired, set printer POWER ON and RECORD ON switches to ON.

c. Set scanner selector switch to ONE CYCLE.

d. Set scanner RESET selector drums to desired channel number.

e. Press scanner RESET pushbutton.

f. Adjust digital voltmeter SENSITIVITY to furthest clockwise setting that provides stable indication on digital voltmeter.

g. If printout is desired, rotate digital voltmeter function switch momentarily to MANUAL PRINT, then back to ON.

h. To proceed to any other input channel, set scanner RESET drums to desired channel number and press RESET pushbutton.

1-119. MONITOR PANEL

1-120. The MONITOR PANEL (A-14, figure 1-6) contains 384 jacks arranged in eight rows, 48 jacks to a row, and it is used to connect the indicating and recording instruments to measurement points by means of patchcords. All measurement points in the various test panels and the system or subsystem under test are terminated at specific jacks on the MONITOR PANEL. Two adjacent jacks are provided for each measurement point to permit use of two indicating instruments simultaneously if desired. Each of the eight input channels to the chart recorder is terminated at one jack on the monitor panel, and each of the 60 input channels to the data acquisition scanner is terminated at one jack. Using patchcords of the appropriate length, the instruments are connected to the measurement points as specified under Section V, Checkout Procedures.

1-121. To connect the UNIVERSAL EPUT AND TIMER and the OSCILLOSCOPE to desired measurement points, connect appropriate cables directly between the front panels of the instruments and the measurement jacks.

1-122. All jack designations as marked on the front panel and the measurement or indicating instrument available at each jack are given in table 1-2. As indicated in the table, all measurements are in terms of either ohms or volts. When an input channel of the data acquisition system is patched to an ohms measurement jack, the digital readout and printout for that channel is in terms of ohms; the readout and printout for each channel that is patched to a volts measurement jack is in terms of volts. The switching function (volts/ohms) is accomplished automatically.

1-123. AC RECEPTACLE PANEL

1-124. The AC RECEPTACLE PANEL contains the main POWER on-off switch for the ground support test console. The on position for this switch is up; the off position is down. Note that this POWER switch is effective only when the CKT NO. 1, CKT NO. 2, and CKT NO. 3 controls on the POWER DISTRIBUTION panel are pushed in to the on position. Three 120-VAC receptacles, for use with auxiliary equipment, are also provided on this panel.

1-125. POWER SUPPLY, CR-36-30

1-126. Three CR-36-30 power supplies (A-15, A-16, and A-21, figure 1-6) are included in the test console. Each of these units supplies regulated voltage, manually adjustable from 2.5 to 36 volts DC, at 0 to 30 amperes.

1-127. The outputs of these power supplies are controlled at two separate panels in the test console. The BUS POWER CONTROL panel (A20, figure 1-6) controls the output voltage and distribution of the A21 unit, and the VARIABLE POWER CONTROL panel (A19, figure 1-6) controls the output voltages and distribution of the A15 and A16 units. (Refer to paragraphs 1-135 and 1-139 for information on the output voltage functions.)

1-128. With the outputs controlled from other panels, operation of the power supply front panel controls is not normally desired. However, the controls on each of the three power supplies must be set as follows for normal operation:

a. OUTPUT ADJUST - zero (extreme counterclockwise position)

b. CURRENT CONTROL - maximum (extreme clockwise position)

c. AC switch - ON

1-129. For detailed information on the power supplies, refer to the NJE Corporation instruction manual which accompanies each test console.

1-130. POWER DISTRIBUTION PANEL

1-131. In the POWER DISTRIBUTION panel (A-17, figure 1-6), the power input line to the test console branches out to three 120-VAC, 60-CPS, single-phase circuits which supply power to the various panels of the console. Each circuit is protected and controlled by a 35-ampere circuit breaker on the front panel. The circuit breakers are set to ON by pushing them in or set to OFF by pulling them out. All power is removed from the console when the CKT NO. 1, CKT NO. 2 and CKT. NO. 3 controls are pulled out to OFF position.

1-132. RECORDING SYSTEM, MARK 200, MODEL 2222-1707-141

1-133. The recording system (A-18, figure 1-6) consists basically of an eight-channel chart recorder with associated pre-amplifier, drive amplifier, and system power panels. The system provides the capability of simultaneously recording up to eight signal voltages consisting of inputs to and/or outputs from the unit(s) under test. Each of the eight input channels to the recording system is terminated at a jack on the MONITOR PANEL (jacks 1A through 8A). These jacks are connected to the desired measurement points by means of patchcords supplied with the console.

1-134. For detailed information on the recording system, refer to the Brush Instruments Division operating manual supplied with each test console.

NOTE

The RECORDER channel inputs (jacks 1A through 8A) must never be connected when a DIGITAL VOLTMETER indication is desired and the recorder is turned off. The input impedance of the RECORDER, when it is off, is very low and will affect the indication of the DIGITAL VOLTMETER.

1-135. VARIABLE POWER CONTROL PANEL

1-136. The VARIABLE POWER CONTROL panel (A19, figure 1-6) controls the output of two CR-36-30 power supplies (A15 and A16, figure 1-6). The MODE 1 and VOLTAGE 1 controls on the front of the control panel are associated with the A15 power supply, and the MODE 2 and VOLTAGE 2 controls are associated with the A16 supply.

1-137. Adjustment of the output voltages from the power supplies is accomplished by rotating the VOLTAGE 1 and VOLTAGE 2 controls. Voltage increases with clockwise rotation.

1-138. Distribution of the power supply outputs is determined by the settings of the MODE 1 and MODE 2 controls. The MODE control settings and corresponding power distribution are as follows:

a. OFF. No load on power supply. Voltage measurement is available on the MONITOR PANEL, jacks FA and FB.

b. PC POWER. Output is applied to the input circuits of the power conditioner unit under test (through the POWER CONDITIONER TEST PANEL). Each power supply in this mode thus simulates the output of one radioisotope thermoelectric generator.

c. TM TRANSDUCTOR. Output is applied to transductors in the TELEMETRY TEST PANEL, providing transductor outputs to the telemetry signal conditioning unit under test. MODE 1 supplies current to the input-simulating transductors, and MODE 2 supplies current to the output-simulating transductors.

d. TM VOLT (MODE 2 only). Output is applied to the TELEMETRY TEST PANEL as a voltage source for simulation of voltage measurement signals to the telemetry signal conditioner unit under test.

NOTE

Output is applied to the MONITOR PANEL for level measurement in all positions of the MODE switch.

1-139. BUS POWER CONTROL PANEL

1-140. The BUS POWER CONTROL panel (A20, figure 1-6) controls the output of POWER SUPPLY CR-36-30 (A21, figure 1-6). The power supply output voltage is manually adjusted to the desired level by rotating the VOLTAGE control on the power control panel. Voltage increases as the knob is rotated clockwise. Distribution of the power supply output is determined by the setting of the MODE control on the power control panel.

1-141. The MODE control settings and corresponding power distribution are as follows:

a. OFF. No load on power supply. Voltage measurement is available on the MONITOR PANEL, jack FC.

b. PC POWER. Output voltage is applied to the POWER CONDITIONER TEST PANEL to simulate the spacecraft bus (-24.5 VDC).

NOTE

Output voltage is applied to the MONITOR PANEL for level measurement in all positions of the MODE switch.

c. TM POWER. Output voltage is applied to the telemetry signal conditioner unit under test (through the TELEMETRY TEST PANEL), thus simulating the -24.5 VDC spacecraft bus.

d. PC//TM. Output voltage is applied as in both b and c, above.

1-142. POWER SUPPLY RACK

1-143. The power supply rack provides a convenient method of supplying power to the electrically heated generator subsystems and may be used instead of the ground support test console. To use the rack, the power supplies and the heater power supply control panel must be removed from the ground support test console and installed in the rack.

1-144. The caster-mounted rack contains a circuit breaker, a power light, two AC receptacles, a mechanical clock, a fan, and internal cabling.

1-145. External cabling connections are as follows:

a. Plug P1 of cable 452B1800031-029 connects to jack J1 of the rack; plug P6 connects to 60-CPS single phase power.

b. Plug P2 of cable 452B1800031-039 connects to jack J2 of the rack; plug P7 connects to 60-CPS single phase power.

c. Plug P75 of cable 452B1710001-49C connects to jack J97 of the rack; plug P76 connects to the generator No. 1 heater (J15).

d. Plug P77 of cable 452B1710001-59C connects to J98 of the rack; plug P78 connects to the generator No. 2 heater (J16).

1-146. With the ground support test console units installed in the rack and the cable connections made, operation is the same as for the console.

NOTE

For shipment of the rack, the power supplies must be removed. The rack should be packaged in accordance with MIL-P-116E, Method III.

SECTION II

SHIPPING AND HANDLING FUELED GENERATOR SUBSYSTEMS

2-1. ICC SHIPPING REQUIREMENTS FOR FUELED GENERATOR SUBSYSTEMS

2-2. The shipment of radioactive materials is controlled by the Bureau of Explosives. The Bureau requires that a permit be obtained for the shipping container, and that the terms of the permit be met. Most of these terms are met by the design and construction of the SNAP 19 generator subsystem shipping container, which has been approved by the Bureau of Explosives. However, the shipper must insure compliance with ICC regulations, paragraph 73.393 through 73.396, pertaining to shipment of radioactive materials. The shipper must also notify the Bureau of Explosives of impending shipment, furnishing the following data:

a. Permit number (Permit No. 2258 has been assigned to the SNAP 19 generator subsystem shipping container.)

b. Point of origin and destination

c. Date of shipment

d. Type of transporting vehicle

e. The quantity of radioactive material in terms of curies, and principal types of radiation.

2-3. AEC LICENSING AND SHIPPING REQUIREMENTS FOR FUELED GENERATOR SUBSYSTEMS

2-4. Special Nuclear Material License No. 845 was issued by the AEC to authorize possession of the fuel, and assembly and performance testing of SNAP 19 systems.

2-5. Unless placed in proximity to other special nuclear material, the SNAP 19 fuel presents no possibility of a nuclear incident. However, because of the possibility of proximity to other special nuclear material during transportation by commercial means, AEC approval of the shipping mode and procedures is required prior to shipment. Transportation by a van, carrying no other cargo, is recommended. Use of this transport method is conducive to obtaining AEC approval readily.

2-6. SAFETY PRECAUTIONS AND LIMITATIONS FOR FUELED GENERATOR SUBSYSTEMS

2-7. The fueled generator subsystem must remain in the closed shipping container at all times except for removals or partial exposure of the subsystem required by procedures in this manual. For long-term storage, the shipping container (with subsystem installed) must be kept in a biologically shielded area. The shielding must be equivalent to that afforded by 4 inches of concrete. Since the generator is classified, this area must also meet security requirements.

2-8. Levels for maximum permissible exposure of personnel to radiation have been set by government agencies. For each quarter of a year, a maximum whole body dose equivalent to 1 1/4 rem or a dose to the hands and forearms equivalent to 18 3/4 rem is permissible.

2-9. Accumulation of the dose depends upon the length of time exposed and the distance from the source. Total dose rates (neutron plus gamma) have been measured above and to the side of SNAP 19 subsystem S/N 4. This subsystem contained (at the time of measurement) fuel capsules No. 300 and No. 307. Based on the measured dose rates, the times to receive a quarterly dose at specific points around the subsystem are as follows:

a. To the side of the subsystem:

Distance (in inches)	Time to receive quarterly dose (in hours) Whole body	Hands
0 (at fin tip)	-	26
6	3.4	51
24	14.0	208

b. Above subsystem:

Distance above top surface (in inches)	Time to receive quarterly dose (in hours) Whole body	Hands
6	3.8	57
24	25.0	375

2-10. With the generator subsystem in the shipping container, the dose rate at 5.0 inches from the container surface is 15 mrem/hr, and at 1 meter from the center of the generators the rate is 6.6 mrem/hr. These rates are low enough to permit personnel to work around the container continuously for 40 hours per week.

2-11. The area surrounding the generator subsystem shipping container (and the subsystem) must be monitored continuously for radiation when personnel are working. It is suggested that monitoring equipment of the following types be employed:

a. Fast-slow neutron counter (such as BF-3, range 0 to 500,000 events per minute) or a spherical neutron dosimeter employing an Li_6I crystal (europium activated) and associated simulation indicator with a range of 0 to 3,000 mrem/hr.

b. Ionization chamber type instrument with a minimum range of 0 to 5 R/hr.

2-12. <u>GENERATOR SUBSYSTEM SHIPPING CONTAINER DESCRIPTION</u>

2-13. The cylindrical generator subsystem shipping container consists of a storage plate assembly, a shield assembly, and a top shield assembly. (See figure 2-1.) The entire container assembly is approximately 40 inches in diameter by approximately 60 inches high, and weighs 1,800 pounds.

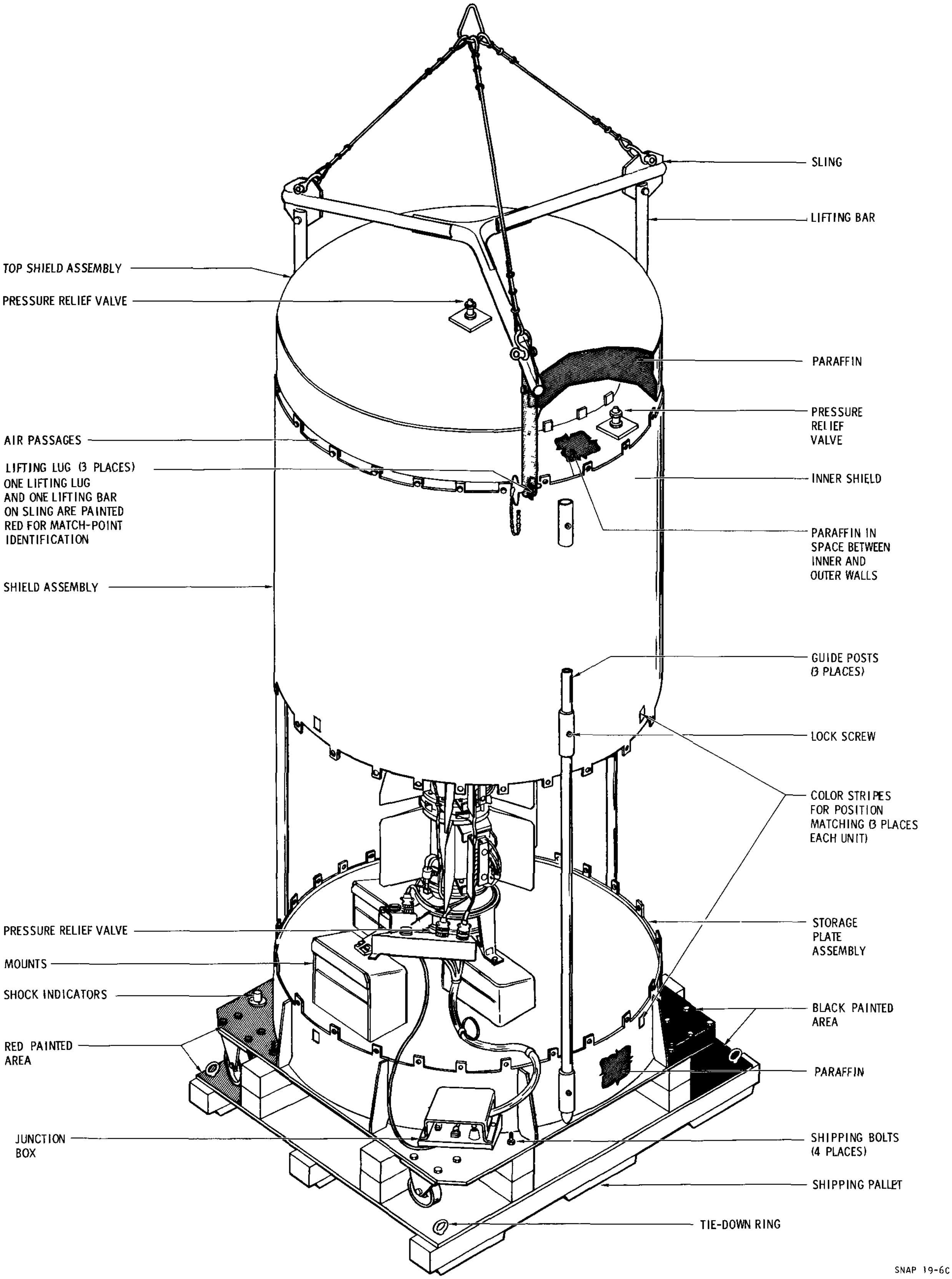


Figure 2-1. Installation of Generator Subsystem in Shipping Container

2-14. The storage plate assembly is the base of the container and is mounted on heavy-duty industrial casters. Two of the casters swivel and are equipped with brakes; two are stationary and have no brakes. Essentially, the assembly is a 9 1/2-inch high ring, closed by top and bottom covers. The internal space thus formed is filled with paraffin for shielding. The upper edge of the ring, above the level of the top cover, is crenelated to permit passage of air when the ring is mated with the shield assembly. On the top of the top cover, at the center, is a check valve that relieves pressure that may build up in the paraffin space. Also on the top cover of the storage plate are mounting pads to which the generator subsystem support base (with generators on it) is attached.

2-15. There are two shock indicators at each of two corners of the storage plate. These indicators give a "yes" or "no" answer to whether or not shock levels of 5g vertically, 5g fore-and-aft, 10g vertically, and 10g fore-and-aft have been exceeded. The indicators consist of a small ball held in a seat by a magnet. When the set-point shock level is exceeded, the ball disappears. The unit is indefinitely resettable and reusable.

2-16. One corner of the storage plate assembly is painted black, and one corner is painted red. These corners are to be placed over like-painted corners of the pallet on which the container is shipped. An arrow on a corner of the storage plate assembly indicates the side to be forward during transit. Red, yellow, and blue stripes on the assembly are for position-matching with similar stripes on the shield assembly.

2-17. On the storage plate assembly is also mounted the receptacle-half of three connectors, with harnesses running out to a junction box on the side of the storage plate assembly. Three feet of power lead cable (part of the harness) is installed on the container, with the ends terminating at three standoffs. All of the standard generator telemetry leads from the receptacle halves terminate in a 37-pin connector in the junction box, and part of the harness connects to a 9-pin connector in the junction box. This connector is used to monitor the fin root temperature of each generator. There is also a harness from the support structure to a 9-pin connector in the junction box. This connector is used to monitor the hot junction temperature of each generator. The connectors and terminals in the junction box permit monitoring of all the generator operating characteristics normally monitored during flight.

2-18. The shield assembly is a double-walled structure with the annular space between the walls filled with paraffin. The top and bottom edges are crenelated to match the storage plate assembly and the top shield assembly. The openings thus formed must not be obstructed. Three lugs spaced around the top of the shield assembly are for handling sling attachment. A check valve on the upper closure plate in the annular space relieves pressure that may build up in the paraffin area. After the generator subsystem is fixed to the storage plate assembly, the shield assembly is placed around the subsystem and secured to the plate assembly. While it is being lowered, the shield assembly is prevented from striking the generators by three guide posts. Each guide post is secured to the outer surface of the storage plate assembly and engages short tubes on the outer surface of the shield assembly, thus providing alignment of the two assemblies and clearance for the generators.

2-19. The top shield assembly is the closure for the shipping container. Construction is similar to the storage plate assembly, employing a ring with top and bottom covers and paraffin in the space between the covers. The relief valve is in the center of the assembly, on the top surface.

2-20. The generator subsystem handling adapter is used for placing the generator subsystem in the container. The generator shipping container sling is used for handling the shield assembly, the shield assembly with the top shield attached, the complete shipping container, and the complete shipping container with the generator subsystem installed. (See figure 2-1.)

2-21. For shipment, the container is placed on a shipping pallet. This pallet prevents movement of the container and can be handled by fork lift transporter. The pallet is constructed so that the fork lift can be employed only at one end, thus assuring that orientation will be correct when the pallet and container are placed in the van.

NOTE

The shipping container provides adequate protection for fueled generator subsystems. No special preservation procedures are required, and crates, tarpaulins or other covers that affect airflow through the container must not be used. The associated power conditioner and telemetry signal conditioner units also do not require special preservation procedures, but should be packaged in accordance with MIL-P-116E, Method III.

2-22. MOBILE CARRIAGE DESCRIPTION

2-23. The mobile carriage is used for transporting electrically heated and fueled generator subsystems between working areas, and for storage of electrically heated subsystems.

CAUTION

Fueled subsystems may not be stored on the carriage.

To prevent thermal cycling of electrically heated subsystems, the carriage is equipped with a heater power supply and heater controls to maintain heater power during transportation.

2-24. The mobile carriage consists of a base on swivelling rubber-tired casters, a screen assembly, a subsystem support base and a heater power control assembly. (See figure 2-2.) Two of the casters are equipped with wheel brakes and with locks that prevent swivelling, and two have swivel locks only. A handle at each end of the carriage is for manual positioning; the carriage sling is attached to the handles when hoisting is necessary.

2-25. Holes in the vertical corner members of the carriage permit lowering subsystem support base to the bottom of the carriage. This feature is used only with fueled subsystems, and the heater power control must be removed to permit use in this manner.

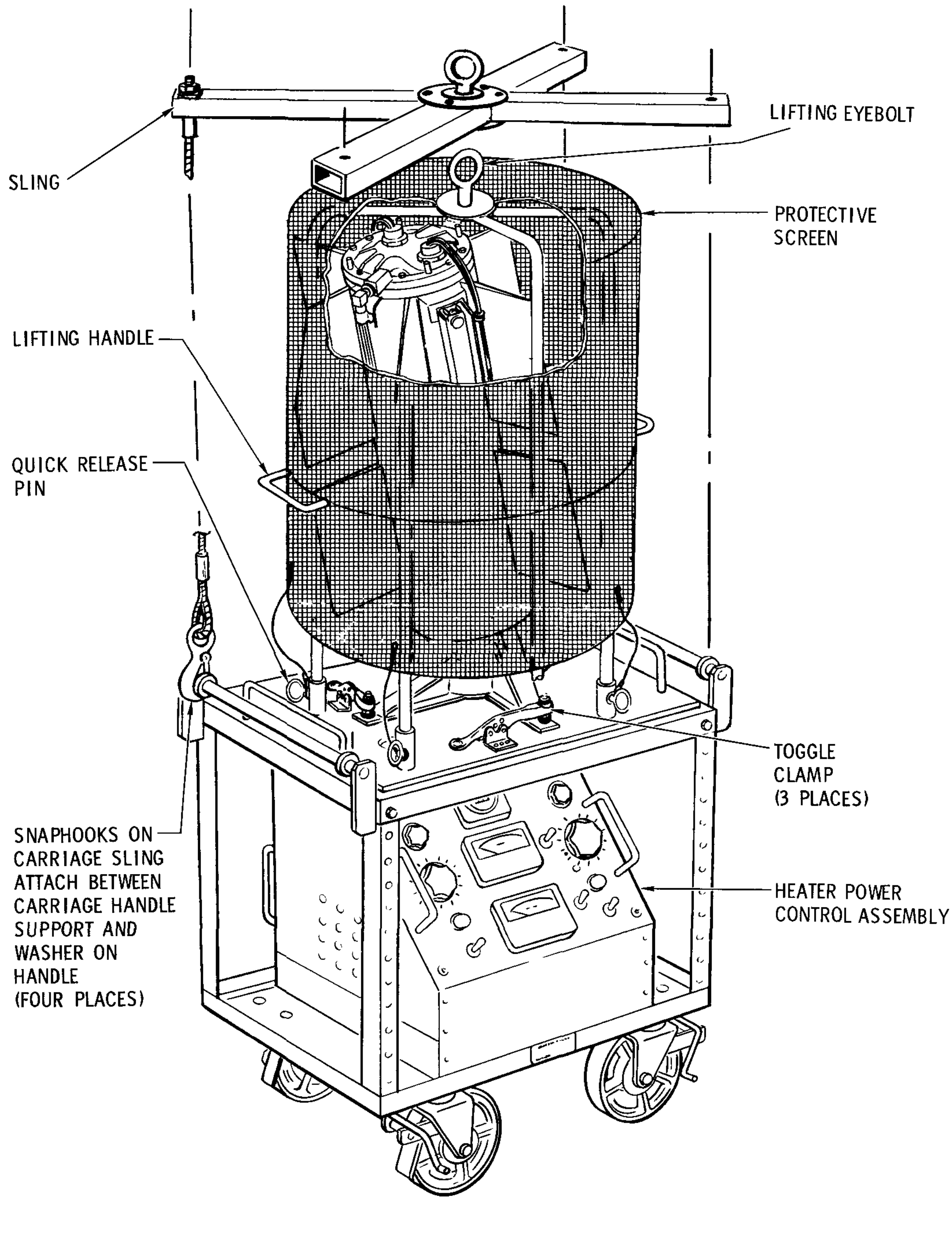


Figure 2-2. Mobile Carriage Arrangement

2-26. A screen is attached to the support base by four quick-release pins. The screen protects the operator from burns and the generator subsystem from damage. There is a handle at each side of the screen for manual removal and an eyebolt at the top for removal by overhead crane.

CAUTION

Use the eyebolt only to lift the screen; damage may result if an attempt is made to lift the entire carriage in this manner.

2-27. The carriage support base contains pins that engage the mounting holes in the generator subsystem support base. Toggle clamps on the carriage secure the subsystem after it is placed over the pins.

NOTE

Refer to paragraphs 2-44 and 3-9 for procedures for installation of generator subsystems on the carriage.

2-28. The heater power control assembly provides 1140 watts of heater power for at least 1/2 hour; the maximum duration of output at this level is approximately 1 hour. The assembly contains controls and instruments for setting the power, monitoring power and temperature, and recording time in use. The time totalizer operates during battery discharge and is used as an aid in determining the state of battery charge. The batteries are rechargeable.

2-29. The heater power control assembly contains an alarm buzzer and indicator for each generator to warn of a hot junction temperature in excess of 975 ± 25°F. A buzzer sounds upon over-temperature in either generator, and the red ALARM indicator associated with that generator lights. Heater power is automatically reduced to a lower level when an over-temperature condition occurs. The buzzer will sound until the alarm indication is acknowledged by pressing the lighted ALARM switch-indicator.

NOTE

For shipment of the carriage, package in accordance with MIL-P-116E, Method III.

2-30. <u>CHARGER DESCRIPTION</u>

The charger for the cells in the mobile carriage power supply operates on 105- to 120-volt, single-phase, 60-CPS AC. The charger consists of a lower and an upper panel assembly. The lower panel assembly contains the power supply and the variable transformer. The upper panel contains the charging circuit, controls, and indicators.

Refer to the manufacturer's literature furnished with the unit for a detailed description, and to paragraph 6-25 for instructions on use with the mobile carriage power supply.

NOTE

For shipment of the charger, package in accordance with MIL-P-116E, Method III

2-31. PORTABLE MONITOR DESCRIPTION

2-32. The portable monitor is used to check generator subsystem temperatures and pressure. The monitor can be powered by either an external 115-volt, 60 cycle source or by its internal batteries. The AC-OFF-DC switch selects the source. External power is connected to receptacle J4 on the front of the unit.

2-33. External power should be used whenever feasible in order to conserve the internal battery supply. The portable monitor will operate approximately 240 hours on its battery supply.

2-34. The functions monitored by the unit are:

a. Hot junction temperatures (six RTD's and four thermocouples).

b. Pressure measurements (two).

c. Fin root temperatures (eight).

2-35. Cable interconnections and functions measured are:

a. 452B1800031-139 P1 to J1 on portable monitor package, P13 to J13 on generator subsystem. Functions measured are generator pressure, hot junction temperature (RTD) and fin root temperature (six).

b. 452B1800031-149 P2 to J2 on portable monitor package; P14 to J14 on generator subsystem. Functions measured are generator fin root temperature (two).

c. 452B1800031-159 P3 to J3 on portable monitor package; P12 to J12 on generator subsystem. Functions measured are hot junction temperature (T/C).

d. 452B1800031-169 P4 to J4 on portable monitor package; other end to 115-volt, 60-cycle source.

2-36. There is an 800° F check position on the hot junction temperature selector switch and a 300° F check position on the fin root and pressure selector. When the selectors are in these check positions, meters should read 800 ± 10° and 300 ± 5°, respectively, to show that the portable monitor is operating properly. If either or both of the check temperatures are out of tolerance, adjust the unit in accordance with paragraph 6-26.

NOTE

When J3 on the portable monitor is open circuited, the hot junction temperature selector switch should be placed in 800° F check position to prevent the meter from exceeding full scale. The meter will not be damaged by infrequent and short duration readings above full scale.

NOTE

For shipment, the portable monitor should be packaged in accordance with MIL-P-116E, Method III.

2-37. PREPARATION OF FUELED GENERATOR SUBSYSTEMS FOR SHIPMENT

2-38. SHIPPING CONTAINER

a. Insure that shield assembly and top shield assembly are assembled and conveniently placed in shipping preparation area.

NOTE

It is recommended that the shield assembly and top shield assembly always be maintained as a unit; that is, never disassembled.

b. Place shipping pallet under hoist rail.

c. Place storage plate assembly on pallet with corners of storage plate assembly and pallet color-matched; then lock casters to prevent movement. (See figure 2-1.)

d. Tighten nuts on tiedown studs to 300 to 330 inch-pounds torque.

e. Loosen locking screws in guide post on shield assembly; then remove posts from assembly.

f. Position posts in short tubes on outside of storage plate assembly and tighten locking screws in tubes to secure guide posts.

2-39. GENERATOR SUBSYSTEM

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Position generator subsystem under hoist rail.

WARNING

Exterior surfaces of the generator subsystem may be at 300° F. Precautions, such as use of asbestos gloves, must be taken for personnel protection.

b. Remove support structure standoff and place in separate shipping container.

c. Insure that generator output plug P1 is connected to SHORT receptacle J21 on dummy load box on generator support base.

2-40. INSTALLATION OF FUELED GENERATOR SUBSYSTEM IN SHIPPING CONTAINER

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Remove T-pins from adapters in handling adapter assembly plate.

b. Position adapter assembly over nut adapters on top of generator subsystem. (See figure 2-3.)

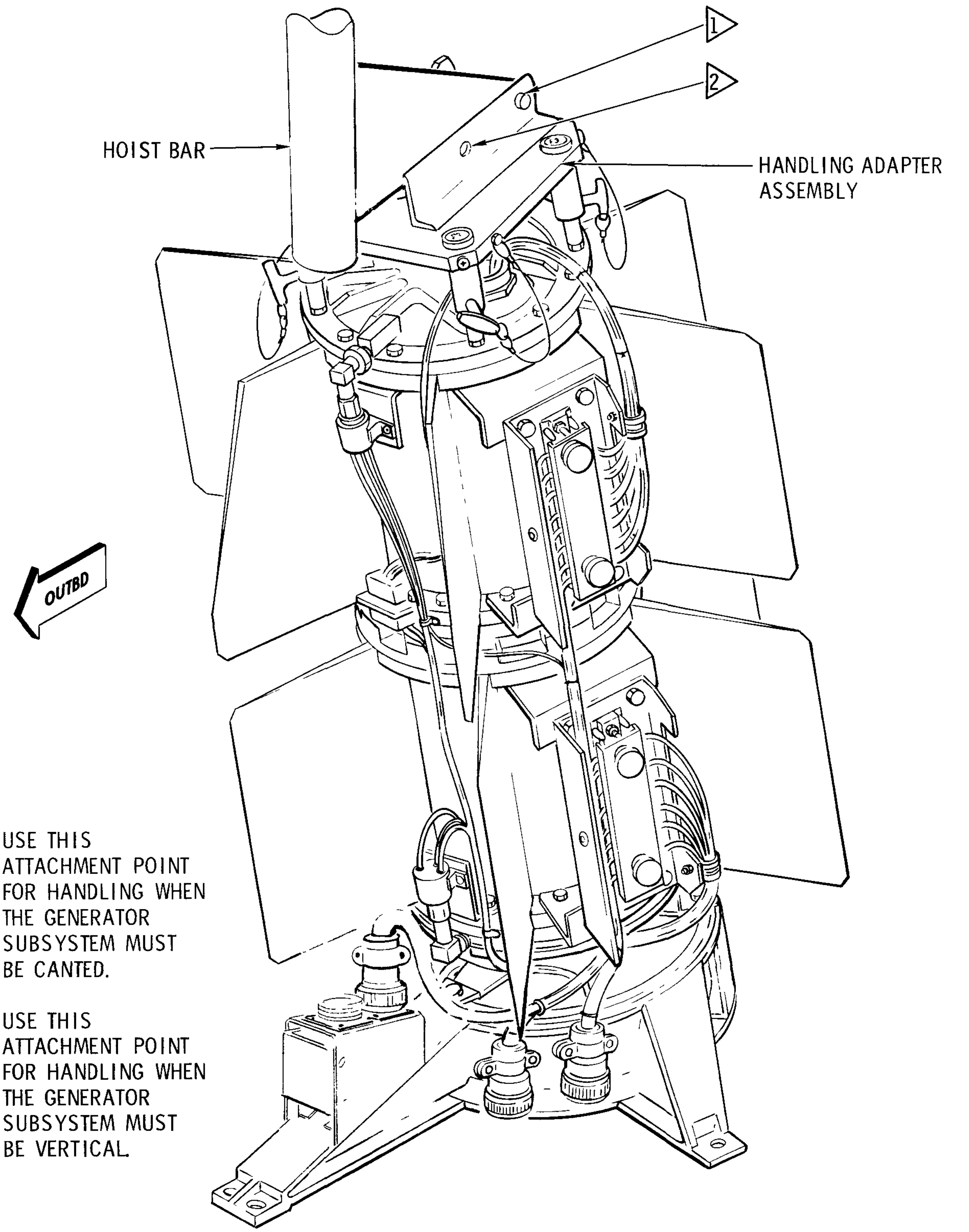
WARNING

The temperature of generator subsystem exterior surfaces may be 300° F. Precautions, such as the use of asbestos gloves, must be taken for personnel protection.

CAUTION

Handle the adapter assembly carefully to prevent the T-pins or any part of the assembly from striking the generator subsystem. Damage to the emissive coating, wiring or other parts may result from striking.

c. Align holes in adapters with holes in nut adapters on generator subsystem; then install T-pins.



NOTES:

1. USE THIS ATTACHMENT POINT FOR HANDLING WHEN THE GENERATOR SUBSYSTEM MUST BE CANTED.

2. USE THIS ATTACHMENT POINT FOR HANDLING WHEN THE GENERATOR SUBSYSTEM MUST BE VERTICAL.

Figure 2-3. System Handling Adapter Installation

d. Position end of offset hoist bar containing small diameter hole between hoisting angles on handling adapter assembly; then insert pin in hole marked GEN AXIS VERTICAL to attach bar to assembly. (See figure 2-3.)

e. Attach hoist hook to free end of hoist bar.

f. Carefully take up slack in hoist; then hoist generator subsystem and position it over storage plate assembly.

g. Position generator subsystem so that long leg of support base is over mount nearest outside of storage plate assembly.

h. Carefully lower generator subsystem onto storage plate assembly mounts.

CAUTION

Do not detach the hoist; if unsupported, the generator subsystem may slide off the mounts.

i. When support base contacts mounts on storage plate assembly, install (finger-tight) all bolts through support base and storage plate assembly mount.

j. Detach hoist from handling adapter assembly.

k. Tighten bolts in support base to 60 to 80 inch-pounds torque.

l. Remove T-pins from adapters; then, lift handling adapter assembly from generator subsystem.

CAUTION

Handle the adapter assembly carefully to prevent striking the generator subsystem.

m. Stow T-pins in holes in handling adapter assembly.

CAUTION

In the following step, leave the generator output plug P1 connected to the SHORT receptacle J21 on the dummy load box.

n. Mate shipping container electrical connector halves with two connector halves on generator subsystem support base. (Connector halves are marked with matching J and P numbers, and are keyed to prevent incorrect connection.)

o. Attach generator subsystem shipping container sling to hoist hook

p. Position sling over shield (red lifting bar on sling and red lug on shield assembly aligned); then, lower sling so that lifting bars (figure 2-1) are adjacent to lifting lugs on shield assembly.

q. Attach lifting bars to lifting lugs on container (use T-pins attached to shield assembly).

r. Carefully take up slack in sling; then, hoist shield assembly.

s. Position shield assembly over generator subsystem with red, yellow, and blue stripes on shield assembly positioned over like-colored stripes on storage plate assembly.

t. Carefully lower shield assembly so that guide posts enter tubes on side of shield assembly.

u. Continue to lower shield assembly until bolt holes at lower edge align with those in storage plate assembly.

v. Install attaching parts.

w. Remove sling.

x. Insure that ball is visible in shock indicators.

y. Using fork-lift transporter, move assembly to van.

z. Orient in van as indicated on shipping container.

aa. Secure pallet in van.

2-41. IN-TRANSIT PROCEDURES

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Monitor shock indicators before and after shipment, and immediately after any unusual incident (road shock, violent vehicle maneuvers).

b. At 4-hour $\pm$ 1-hour intervals, observe and log generator subsystem fin root and hot junction temperatures.

2-42. REMOVAL OF FUELED GENERATOR SUBSYSTEM FROM SHIPPING CONTAINER

2-43. The generator subsystem must not be removed from the shipping container until all is in readiness for mounting on the spacecraft sensory ring or on the mobile carriage assembly. All testing and monitoring must be done with the subsystem in the container.

WARNING

> Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Position generator subsystem support structure standoff on spacecraft sensory ring.

b. Install attaching parts and tighten to 50 to 70 inch-pounds torque.

c. Position shipping container under a hoist rail.

d. Remove bolts attaching shield assembly to storage plate assembly.

e. Attach generator subsystem shipping container sling to hoist hook.

f. Position sling over shield assembly (red lifting bar on sling and red lifting lug aligned); then, lower sling so that lifting bars are adjacent to lifting lugs on shield assembly. (See figure 2-1.)

g. Attach lifting bars to lifting lugs on container.

h. Insure that guide posts are engaged in tubes on side of storage plate assembly and lower tubes on side of shield assembly.

CAUTION

> Locking screws in the tubes on the storage plate must be tight, and those in the lower tubes on the shield assembly must be loose.

i. Carefully take up slack in sling; then, hoist shield assembly clear of generator subsystem.

WARNING

> The temperature of the generator subsystem exterior surfaces may be at 300° F. Precautions, such as use of asbestos gloves, must be taken for personnel protection.

j. Position shield assembly in location clear of work area around the generator subsystem.

CAUTION

Wood blocks (2 x 4) should be placed (4-inch dimension parallel to the floor) between tabs on the shield assembly so that the weight of the assembly is borne by the assembly cylinder rather than the tabs.

k. Attach handling adapter assembly to generator subsystem. (Refer to steps a through c, paragraph 2-40.)

l. Position end of offset hoist bar containing small diameter hole between hoisting angles on handling adapter assembly; then insert pin in GEN AXIS VERTICAL hole to attach bar to assembly. (See figure 2-3.)

m. Attach hoist hook to free end of hoist bar.

n. Take up slack in hoist, but do not impose any strain.

o. Remove parts attaching generator subsystem to storage plate assembly.

p. Hoist generator subsystem clear of storage plate assembly and install on spacecraft sensory ring (paragraph 4-1) or on mobile carriage (paragraph 2-44).

2-44. INSTALLATION OF FUELED GENERATOR SUBSYSTEM ON MOBILE CARRIAGE

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Set brakes and lock casters on carriage.

b. Remove parts that attach heater power control assembly to carriage; then, remove heater power control assembly.

c. Remove quick-release pins that secure screen to carriage; then, remove screen.

d. Remove positioning bolts at each corner of carriage support base.

e. Position support base at convenient working height; then, install positioning bolts.

f. Remove generator subsystem from shipping container. (Refer to paragraph 2-43, steps a through p.)

g. Position generator subsystem over carriage and lower onto pins in carriage support base.

h Operate toggle clamps to secure subsystem to carriage.

i. Detach hoist from hoist bar.

j. Detach hoist bar from handling adapter assembly.

k. Remove T-pins that attach handling adapter assembly to adapters on generator subsystem; then remove handling adapter assembly.

l. Position screen over generator subsystem and insert quick-release pins.

SECTION III

SHIPPING AND HANDLING ELECTRICALLY HEATED GENERATOR SUBSYSTEMS

3-1. SHIPPING CONTAINER DESCRIPTION

3-2. The shipping container for the electrically heated generator subsystems is a rectangular wooden box approximately 33 inches square by 4 feet high. Attached to the bottom of the container are heavy wooden skids that permit handling by forklift transporter. Four shock mounts inside the container, on the bottom, support a steel plate on which the generator is mounted.

3-3. PREPARATION OF ELECTRICALLY HEATED GENERATOR SUBSYSTEMS FOR SHIPMENT

a. Remove support structure standoff and ship (with attaching parts) in separate shipping container. Package in accordance with MIL-P-116E, Method III.

b. Position a styrofoam pad on support base, place electrical connectors on pad, and secure with lockwire.

c. Insure that generator output plug P1 is connected to SHORT receptacle J21 on dummy load box.

3-4. INSTALLATION OF ELECTRICALLY HEATED GENERATOR SUBSYSTEMS IN SHIPPING CONTAINER

3-5. Since the generator subsystem is shipped cold (that is, at room temperature), it may be handled without using the handling adapter assembly. The subsystem should be handled by the support base legs. The steps in the following instructions include instructions for preservation of the generator subsystem.

CAUTION

The cold subsystem must not be exposed to humidity exceeding 50% at 75° F.

NOTE

If the associated power conditioner and telemetry signal conditioner are also to be shipped, no special preservation procedures are required. However, the units should be packaged in accordance with MIL-P-116E, Method III.

a. Remove cover and sides from shipping container.

b. Position gaskets and protective bag (in which subsystem was received) over mounts in shipping container.

c. Lift subsystem (two men required) and position it on bag over mounts in shipping container.

d. Install attaching parts to secure subsystem to mounts. Insure that gaskets are properly positioned; then tighten bolts in long leg of support base to 75 to 85 inch-pounds torque, and those in remaining legs to 190 to 200 inch-pounds torque.

e. Position bag around generator subsystem and heat-seal opening.

f. Connect vacuum pump to bag and evacuate bag.

g. Seal off bag and remove pump.

h. Connect a source of argon to the bag and purge for 5 minutes.

i. Seal off bag to retain argon atmosphere.

j. Attach sides of container to base (with wood screws); then fasten sides to each other at each corner.

CAUTION

Do not allow the container parts to strike the protective bag around the generator subsystem.

k. Place cover on container and install attaching screws.

l. Use forklift transporter to move container into van.

3-6. IN-TRANSIT PROCEDURES

3-7. There are no special in-transit procedures. No monitoring is required because the generators are usually shipped cold.

3-8. REMOVAL OF ELECTRICALLY HEATED GENERATOR SUBSYSTEMS FROM SHIPPING CONTAINER

a. Remove cover and sides from shipping container.

CAUTION

Do not allow the container parts to strike the bag containing the generator subsystem.

b. Open the protective bag around the subsystem.

NOTE

Use care in opening the bag; it can be reused for subsequent re-shipment.

CAUTION

The cold subsystem must not be exposed to humidity exceeding 50% at 75° F.

c. Position standoff securely on bench or other work surface.

d. Remove attaching parts securing generator subsystem to container base.

e. Remove generator subsystem from base and place on standoff.

NOTE

Because the generators are not hot, use of the handling adapter assembly is not required. Two men are required for handling.

f. Install and lockwire bolts in standoff as shown in figure 1-4.

g. Remove protective bag and gaskets from shipping container and store bag and gaskets for future use.

h. Reassemble shipping container and place in storage area.

i. Insure that generator output plug P1 is connected to SHORT receptacle J21 on dummy load box.

NOTE

The generator subsystem may now be connected to the ground support test console for heat-up and tests.

CAUTION

Once the generator subsystem is heated, maintain it at a constant temperature. Temperature cycling may damage the unit.

3-9. INSTALLATION OF ELECTRICALLY HEATED GENERATOR SUBSYSTEM ON MOBILE CARRIAGE

a. Set brakes and lock casters on carriage.

b. Remove quick-release pins that secure screen to carriage; then, remove screen.

c. Insure that heater power control assembly is installed on carriage.

CAUTION

If generators are hot, maintain connection to power source until the last possible moment, and connect as quickly as possible to the carriage power source. The generator heaters must not be without power longer than absolutely necessary.

d. Attach generator subsystem handling adapter to subsystem and crane. (Refer to steps k through n, paragraph 2-43.)

e. Hoist generator subsystem, position it over carriage, and lower onto pins on carriage support base.

f. Operate toggle clamps to secure subsystem to carriage.

g. Remove handling adapter assembly. (Refer to paragraph 2-44, steps i through k.)

h. Insure that generators are heated and stabilized at 570 $\pm$ 3 watts. (Refer to paragraph 5-19 for procedures to achieve heatup and stability.)

i. Insure that heater power control assembly controls are in accordance with table 5-1.

j. On heater power control assembly, verify RESET TIME TOTALIZER indication allows completion of the transportation time anticipated.

k. On heater power control assembly, set meter switches (two places) to HEATER NO. 1; then connect P1 of cable assembly 452B1800031-109 to J1 of heater power control assembly.

CAUTION

Steps l through n, below, should be accomplished within 45 seconds. (Refer to paragraph 5-8.)

l. On heater power supply control panel, set POWER-HEATER NO. 1 switch to OFF.

m. Disconnect P76 of cable assembly 452B1710001-49C from J15 on generator and immediately connect P2 of cable assembly 452B1800031-109 to J15 on generator.

CAUTION

If requirements of step n cannot be achieved, perform steps o and p, reconnect P76 to J15 on generator and proceed to paragraph 3-11.

n. On heater power control assembly, set HEATER NO. 1 power switch to ON. Immediately adjust HEATER NO. 1 COARSE ADJUST and FINE ADJUST controls for an indication of 570 $\pm$ 5 watts.

o. On HEATER POWER SUPPLY CONTROL PANEL, set HEATER NO. 1 VOLTAGE RANGE switch to 20-30 and FINE ADJ control fully counterclockwise.

p. On HEATER POWER SUPPLY CONTROL PANEL, verify that MAX POWER INPUT-HEATER NO. 1 switch on rear panel is set to 75.

q. On heater power control assembly, verify that wattmeter indicates 570 $\pm$ 10 watts.

r. On heater power control assembly, set meter switches (two places) to HEATER NO. 2. Connect P3 of cable assembly 452B1800031-119 to J2 of heater power control assembly.

CAUTION

Steps s through u should be accomplished within 45 seconds. (Refer to paragraph 5-8.) If requirements of step u cannot be achieved, perform steps v and w, reconnect P77 to GSTC on POWER SUPPLY RACK, and proceed to paragraph 3-12, step c.

s. On HEATER POWER SUPPLY CONTROL PANEL, set POWER-HEATER NO. 2 switch to OFF.

t. Disconnect P78 of cable assembly 452B1710001-59C from J16 on generator and immediately connect P4 of cable assembly 452B1800031-119 to J16 on generator.

u. On heater power control assembly, set HEATER NO. 2 POWER switch to ON. Immediately adjust HEATER NO. 2 COARSE ADJUST and FINE ADJUST controls for an indication of 570 $\pm$ 5 watts.

v. On HEATER POWER SUPPLY CONTROL PANEL, set HEATER NO. 1 VOLTAGE RANGE switch to 20-30 and FINE ADJ control fully counterclockwise.

w. On HEATER POWER SUPPLY CONTROL PANEL, verify that MAX POWER INPUT-HEATER NO. 2 switch on rear panel is set to 75.

x. Insure that RESET TIME TOTALIZER is operating.

CAUTION

Do not disturb the setting of the RESET TIME TOTALIZER. (Refer to paragraph 2-28.) It has been set as part of charging procedure (paragraph 6-25.)

y. Position screen over generator subsystem and insert quick-release pins.

z. On heater power control assembly, monitor HEATER NO. 1 and HEATER NO. 2 temperature. (Refer to paragraph 2-29.)

aa. On heater power control assembly, continue to monitor and maintain HEATER NO. 1 and HEATER NO. 2 for 570 ± 10 watts.

3-10. OVER-TEMPERATURE PROCEDURE

a. Press lighted ALARM-RESET pushbutton to turn off buzzer. (Amber indicator will light.)

b. Monitor temperature indicator.

c. Insure that input power to overheated generator has been decreased.

d. Readjust power for unaffected generator to 570 ± 5 watts input.

NOTE

When the temperature drops below the alarm condition (975 ± 25° F), heater power is automatically restored to approximately 570 watts.

e. After input power is restored on both generators, continue to monitor and maintain HEATER NO. 1 and HEATER NO. 2 for 570 ± 10 watts.

3-11. REMOVAL OF ELECTRICALLY HEATED GENERATOR SUBSYSTEM FROM MOBILE CARRIAGE

3-12. The following steps are applicable when transportation is completed or when it is desired to switch the generator heater input power control back to the GSTC or power supply rack.

CAUTION

Perform steps a and b within 45 seconds. (Refer to paragraph 5-8.)

a. Disconnect P2 of cable assembly 452B1800031-109 from J15 on generator and immediately connect P76 of cable assembly 452B1710001-49C to J15.

b. On HEATER POWER SUPPLY CONTROL PANEL, set POWER-HEATER NO. 1 switch to ON. Immediately adjust HEATER NO. 1 VOLTAGE RANGE switch and FINE ADJ control for wattmeter indication of 570 ± 3 watts.

CAUTION

Perform steps c and d within 45 seconds. (Refer to paragraph 5-8.)

c. Disconnect P4 of cable assembly 452B1800031-119 from J16 on generator. Immediately connect P78 of cable assembly 452B1710001-59C to generator J16.

d. On HEATER POWER SUPPLY CONTROL PANEL, set POWER-HEATER NO. 2 switch to ON. Immediately adjust HEATER NO. 2 VOLTAGE RANGE switch and FINE ADJ control for wattmeter indication of 570 ± 3 watts.

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SECTION IV

ASSEMBLY AND INSTALLATION PROCEDURES

4-1. GENERATOR SUBSYSTEM-TO-SPACECRAFT ASSEMBLY

WARNING

Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

a. Insure that generator subsystem support structure standoff is installed on spacecraft sensory ring (steps a and b, paragraph 2-43), power conditioner is installed and connected (paragraph 4-2), and telemetry signal conditioner unit is installed and connected (paragraph 4-3).

NOTE

In following step, use GEN AXIS CANTED hole in hoist bar.

b. Attach generator subsystem handling adapter to subsystem and to hoist. (Refer to paragraph 2-43, steps k through n.)

c. Position generator subsystem over standoff so that attaching points will mate.

WARNING

The temperature of the exterior surfaces of the generator subsystem may be at 300° F. Precautions, such as use of asbestos gloves, must be taken for personnel protection.

d. Carefully lower generator into position and install attaching parts. (See figure 1-4.)

e. Tighten bolts in outboard mount to 105 to 115 inch-pounds torque, and those in inboard mounts to 220 to 230 inch-pounds torque. (See figure 1-2.)

f. Install lockwire in bolts. (See figure 1-4.)

g. Mate generator connections (P8 to J18, P9 to J19).

NOTE

Plug P1 will be removed from J21 and connected to J17 at the time point designated in the launch procedures.

h. Remove handling adapter assembly. (Refer to paragraph 2-44, steps i through k.)

CAUTION

At the time-point designated in launch procedures, remove all items (brackets, connectors, and wiring) that are painted red.

NOTE

If, for any reason, the fueled generator subsystem must be removed from the spacecraft, it must be returned to the SNAP 19 test area and connected to the ground support test console. Instrument indications must be recorded at least once each week.

4-2. POWER CONDITIONER INSTALLATION

a. Position power conditioner on top side of bay 18 of spacecraft sensory ring with power conditioner reference locating mark (dot) on outboard side of spacecraft.

b. Coat power conditioner outboard surface and surface under screw lugs with a silicon grease-silver powder mixture to improve thermal radiation through shutter system and thermal conduction to structure.

c. After power conditioner has been positioned, set module clamps with sufficient torque to present a 144-pound load at contact area.

d. Install power conditioner attaching screws and tighten to 18 to 20 inch-pound torque.

NOTE

See figure 4-1 when making the following connections.

e. Connect power conditioner output power cable P4R06 (W6) to power conditioner connector J6 by securing attaching screws on connector socket. Tighten attaching screws to 4 inch-pounds torque.

f. Connect power conditioner command signals cable P4R04 (W4) to power conditioner connector J4 by securing attaching screws on connector socket. Tighten attaching screws to 4 inch-pounds torque.

g. Connect telemetry signal conditioner cable P4R02 (W5) to power conditioner connector J2 by securing attaching screws on connector socket. Tighten attaching screws to 4 inch-pounds torque.

NOTE

Steps h through j, below, connect the radioisotope thermoelectric generator output power cable to the power conditioner terminal lugs.

h. Connect generator No. 1 and generator No. 2 output common connectors to power conditioner COM NEG terminal lug.

NOTE

The generator cable common connectors have a round, keyed hole which mates with the round, slotted power conditioner terminal lug.

i. Attach connector to terminal lug with parts supplied with power conditioner unit.

j. Tighten fastening nut to 25 to 28 inch-pounds torque.

k. Connect generator No. 1 positive output connector to power conditioner GEN NO. 1+ terminal lug.

NOTE

The generator No. 1 positive cable connector has a square hole which mates with the square slotted power conditioner terminal lug.

l. Attach connector to terminal lug with parts supplied with power conditioner unit.

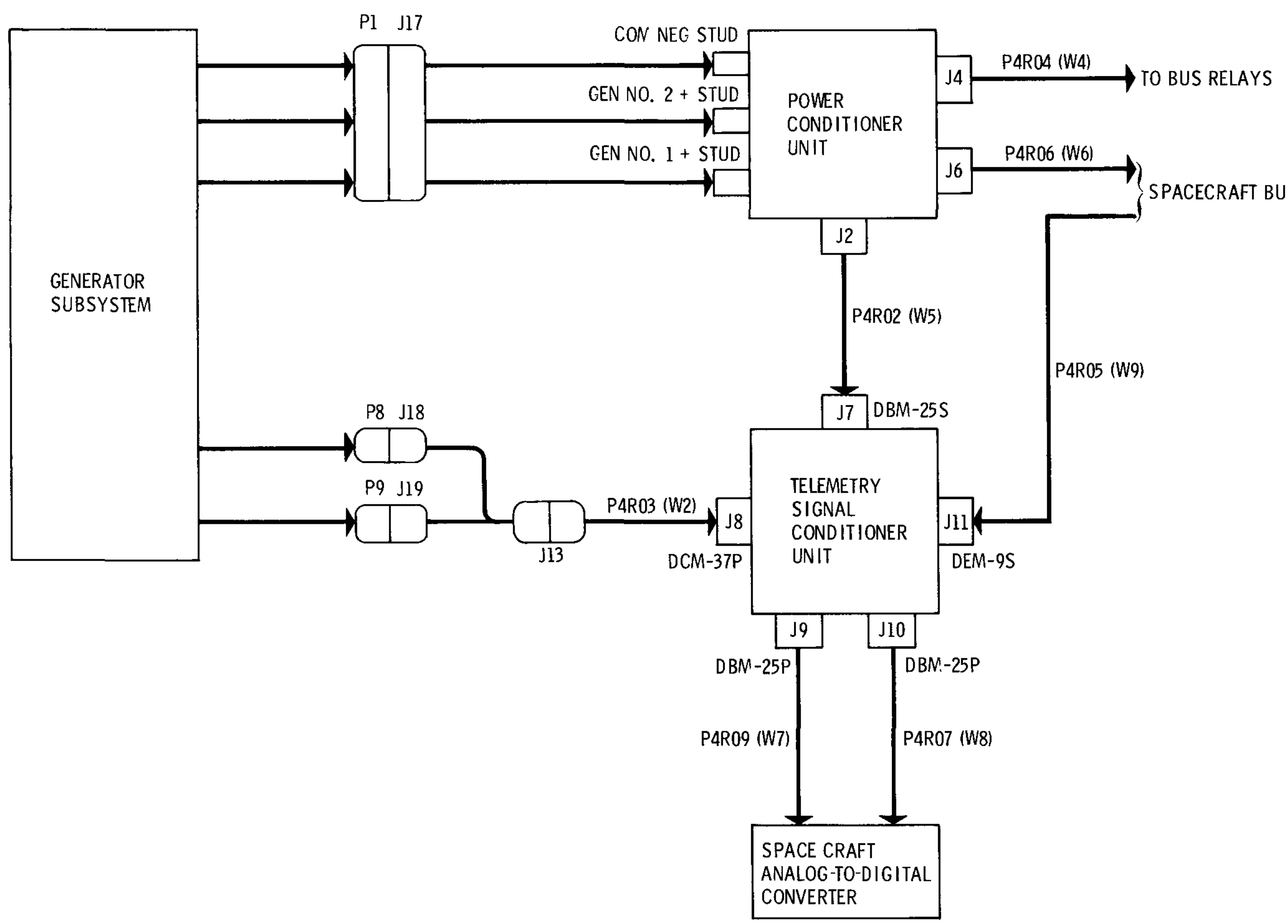

Figure 4-1. System Interconnecting Diagram

m. Tighten fastening nut to 25 to 28 inch-pounds torque.

n. Connect generator No. 2 positive output connector to power conditioner GEN NO. 2+ terminal lug.

NOTE

The generator No. 2 positive cable connector has a rectangular hole which mates with the rectangular power conditioner terminal lug.

o. Attach connector to terminal lug with parts supplied with power conditioner. Tighten fastening nut to 25 to 28 inch-pounds torque.

4-3. TELEMETRY SIGNAL CONDITIONER INSTALLATION

a. Position telemetry signal conditioner on bottom side of bay 18 of spacecraft sensory ring, with conditioner reference mark (dot) on outboard side of spacecraft.

b. Coat conditioner outboard surface and surfaces under screw lugs with a silicon grease-silver powder mixture to improve thermal conduction to structure.

c. After module has been positioned, set module clamps with sufficient torque to present a 144-pound load at contact area.

d. Install attaching screws and tighten to 18 to 20 inch-pounds torque.

NOTE

See figure 4-1 when making the following connections.

e. Connect power conditioner telemetry signal cable P4R01 (W5) to telemetry signal conditioner connector J4R01 (J7) by securing connector socket DBM-25S to connector plug DBM-25P with attaching screws. Tighten attaching screws to 4 inch-pounds torque.

f. Connect generator telemetry signal cable P4R03 (W2) to telemetry signal conditioner connector J4R03 (J8) by securing connector plug DCM-37P to connector socket DCM-37S with attaching screws. Tighten attaching screws to 4 inch-pounds torque. Verify that other end of cable is connected to J13 on generator.

g. Connect spacecraft analog-to-digital telemetry signal cable P4R09 (W7) to telemetry signal conditioner connector J4R09 (J9) by securing connector socket DBM-25S to connector plug DBM-25P with attaching screws. Tighten attaching screws to 4 inch-pounds torque.

h. Connect spacecraft analog-to-digital telemetry signal cable P4R07 (W8) to TSCU connector J4R07 (J10) by securing connector socket DBM-25S to connector plug DBM-25P with attaching screws. Tighten attaching screws to 4 inch-pounds torque.

i. Connect generator telemetry power cable P4R05 (W9) to TSCU connector J4R05 (J11) by securing connector plug DEM-9P to connector socket DEM-9S with attaching screws. Tighten attaching screws to 4 inch-pounds torque.

SECTION V

CHECKOUT PROCEDURES

5-1. GENERAL

5-2. The checkout process consists basically of initial preparations such as ground support test console (GSTC) control settings and interconnections of equipment, application of power to equipment under test, a monitoring period until thermal stability is achieved, the systematic taking and recording of measurements, and comparison of measurements against criteria for normal operation. Step-by-step procedures for these actions are given in the paragraphs that follow. Sample data sheets for each checkout procedure are shown in Appendix A. These sheets facilitate recording of data and show computations to be made where applicable. Their use is important. A record of operating time is required for all units of the thermoelectric power supply systems. Operating time entries must be made accurately on the data sheets.

5-3. To avoid wear on the connector pins of units to be tested, short adapter cables are connected to the plugs and jacks on the units. These adapter cables must be left connected to the units until the units are installed in the spacecraft. During all testing of the units, test cables must be connected to the adapter cables rather than to the units themselves.

5-4. SYSTEM CHECKOUT

5-5. CAUTIONS AND WARNINGS

5-6. Keep Proper Load on Thermoelectric Generators

5-7. During checkout procedures, this caution applies to fueled generators and to electrically heated generators when power is applied to the heaters. Never open the output circuit of either generator for longer than 30 seconds. To do so will cause excessive temperature rise in the generator. Excessive load variations cause thermal disturbances which are detrimental to the generators. The generator temperatures must not be allowed to change at a rate exceeding 35° F per 15 minutes. The ground support test console (GSTC) constitutes a satisfactory load when operated in accordance with procedures herein. When off test for short periods, the dummy load accompanying the generator subsystem is satisfactory. When a fueled generator is to be off test for over 3 hours or when the generator is unattended (an electrically heated generator in hot condition must never be left unattended), the generator output plug P1 must be connected to the SHORT receptacle J21.

5-8. During launch operations, or in other situations where the ground support test console or other external load is not available, the generator output may be switched from short to load, load to short, or open circuited provided the switching is done in open air with the fins uninsulated and the initial fin root temperature is less than 265° F. Although this sequencing is permissible, the number of such operations and the length of time that the generators are open circuited must be held to a minimum.

5-9. Maintain Proper Power to Electrically Heated Generators

5-10. Thermal disturbances are detrimental to the generators. The generators must be brought up to operating temperature slowly, while monitoring the generator temperatures, so that the rate of temperature change does not exceed 35° F per 15 minutes, and this rate of change must not be exceeded thereafter. Once the generator is brought up to operating temperature, every effort must be made to maintain that temperature. Thermal cycling is detrimental to the generators. If the system must be cooled, reduce input power to the heaters slowly and monitor temperatures constantly to avoid exceeding a change rate of 35° F per 15 seconds. The acceptable rate for heating up or cooling down the generator is 25 watts per 15 minutes.

5-11. Keep Radiation Shield in Place During Checkout

5-12. With fueled generators, testing and monitoring must be done with the radiation shield in place for safety of personnel. Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

5-13. Avoid Contact With Hot Generators

5-14. The external surfaces of hot generators may reach a temperature of 370° F. Use care to avoid burns. (The surfaces reach 370° F in simulated orbital conditions, 270° F in ambient air, and 295° F in the generator subsystem shipping container.)

CAUTION

Airflow around the generators must not be obstructed. Fin root temperatures exceeding the maximum allowable (385° F) may result.

5-15. PREPARATION FOR CHECKOUT OF FUELED SYSTEMS

5-16. To prepare for checkout of a fueled system:

a. Set GSTC controls in accordance with table 5-1.

b. Insure that generator output plug P1 is connected to SHORT receptacle J21. (If generator subsystem is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.

c. Interconnect system units and GSTC as shown on figure 5-1.

Unit	Panel	Control	Initial Setting
GSTC	TELEMETRY TEST PANEL	Switches S1 through S38	OFF
		Controls R1 through R5	Counterclockwise
	POWER CONDITIONER TEST PANEL	Rs CONVERTER NO. 1	Counter-clockwise
		Rs CONVERTER NO. 2	Counter-clockwise
		CONVERTER NO. 1 INPUT	OFF
		POWER CONDITIONER INPUT SHORTING	OPEN
		POWER CONDITIONER LOAD	0Ω
		CONVERTER NO. 2 INPUT	OFF
		CONV NO. 1	OFF BUS
		CONV NO. 1 EXT LOAD	OPEN
		CONV NO. 2 EXT LOAD	OPEN
		CONV NO. 2	OFF BUS
		CONV NO. 1 STATUS	JACK PANEL
		CONV NO. 2 STATUS	JACK PANEL
		INTERVAL MEAS	CONV NO. 2
		FUNCTION	OFF BUS
		PWR COND LOAD 0Ω-10Ω	0

Table 5-1. Initial Ground Support Equipment Control Settings (Sheet 1 of 5)

Unit	Panel	Control	Initial Setting
GSTC (cont)	POWER CONDITIONER TEST PANEL (cont)	PWR COND LOAD 0Ω-10Ω	0
		PWR COND LOAD 0Ω-5Ω	0
		PWR COND	OFF BUS
	RTG LOAD PANEL	RTG NO. 1	MIN
		RTG NO. 2	MIN
	DIGITAL CLOCK	LIGHT SWITCH	ON
		CLOCK SWITCH	ON
	UNIVERSAL EPUT & TIMER	POWER	Off (down)
	OSCILLOSCOPE	POWER	Off (down)
	HEATER POWER SUPPLY CONTROL PANEL	VOLTAGE RANGE (2 places)	20-30
		HTR POWER (2 places)	INT.
		FINE ADJ (2 places)	Counter-clockwise
		POWER-HEATER NO. 1	OFF
		POWER-RELAY DRIVER	OFF
		POWER-HEATER NO. 2	OFF
		MAX POWER INPUT* (2 places)	75
	REGULATED POWER SUPPLIES LA80-05B-2201 (2 places)	Circuit breaker	ON (Up)
		Vernier*	0

*These controls are on rear panel.

Table 5-1. Initial Ground Support Equipment Control Settings (Sheet 2 of 5)

Unit	Panel	Control	Initial Setting
GSTC (cont)	DIGITAL VOLTMETER	Selector switch	STD BY
		SENSITIVITY	HI
	INPUT SCANNER	Selector switch	ONE CYCLE
	DATA PRINTER	POWER ON	On (Up)
		RECORD ON	On (Up)
	AC RECEPTACLE PANEL	POWER	OFF (down)
	POWER SUPPLY CR-36-30 (3 places)	Toggle switch	On (Up)
		OUTPUT ADJUST	Counterclock-wise
		CURRENT CONTROL	Max.
	POWER DISTRIBUTION	CKT NO. 1	On (in)
		CKT NO. 2	On (in)
		CKT NO. 3	On (in)
	VARIABLE POWER CONTROL	MODE 1	OFF
		MODE 2	OFF
		VOLTAGE 1	Counter-clockwise
		VOLTAGE 2	Counter-clockwise
	BUS POWER CONTROL	MODE	OFF
		VOLTAGE	Counter-clockwise
	RECORDER	Chart Speed	Stop (in)

Table 5-1. Initial Ground Support Equipment Settings (Sheet 3 of 5)

Unit	Panel	Control	Initial Setting
GSTC (cont)	RECORDER (cont)	Chart speed	X.01 (in)
		Control mode	Local
		Sensitivity (8 places)	OFF
		Sensitivity (X1-X100) Switches (8 places)	X100
		Sensitivity X1	Clockwise
YARDNEY SILVER CEL CHARGER (VC-24-10)		CELL SELECTOR	20
		AMPERES	0-10
		VOLTAGE CUT-OFF METER (red pointer)	Red marker
		CURRENT CONTROL	Counter-clockwise
		POWER switch	OFF
HEATER POWER CONTROL ASSEMBLY		FINE ADJUST (2 places)	Counter-clockwise
		COARSE ADJUST (2 places)	1
		POWER switch (2 places)	OFF
Power supply rack	HEATER POWER SUPPLY CONTROL PANEL	VOLTAGE RANGE (2 places)	20-30
		HTR POWER (2 places)	INT
		FINE ADJ (2 places)	Counter-clockwise
		POWER-HEATER NO. 1	OFF
		POWER-RELAY DRIVER	OFF
		POWER-HEATER NO. 2	OFF

Table 5-1. Initial Ground Support Equipment Settings (Sheet 4 of 5)

Unit	Panel	Control	Initial Setting
Power supply rack (cont)	HEATER POWER SUPPLY CONTROL PANEL (cont)	MAX POWER INPUT* (2 places)	75
	REGULATED POWER SUPPLIES LA80-05B-2201	Circuit breaker	ON (Up)
		Vernier*	0
PORTABLE MONITOR PACKAGE		HOT JUNCT TEMP	800° F CHECK
		HOT JUNCT TEMP T/C	0
		FIN ROOT AND PRESSURE	300° F CHECK
		AC-DC switch	OFF

*These controls are on rear panel.

Table 5-1. Initial Ground Support Equipment Settings (Sheet 5 of 5)

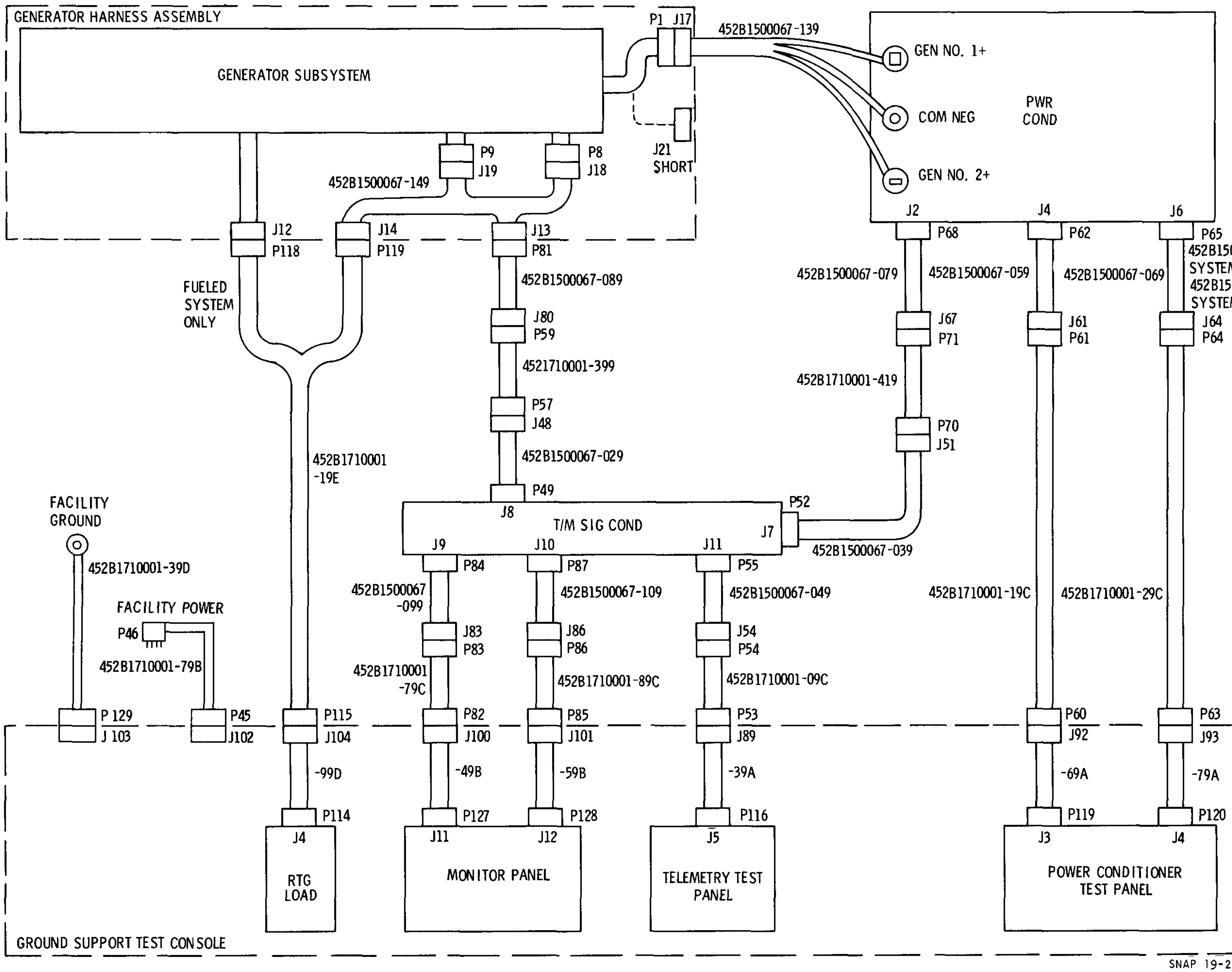

Figure 5-1. Ground Support Test Console-to-System Interconnecting Diagram

d. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-2.

e. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify the following:

1. Both DIGITAL CLOCK lamps lighted (green)
2. Both faces of DIGITAL CLOCK lighted (white)
3. DIGITAL VOLTMETER display lighted
4. INPUT SCANNER display lighted
5. POWER ON indicator on DATA PRINTER lighted (red)
6. RECORD ON indicator on DATA PRINTER lighted (white)
7. Indicator on power supply (three) lighted (red)
8. Power switch indicator on RECORDER off. (If lighted, press power switch indicator.)
9. Rack exhaust fans (four) operating

NOTE

Allow 10 minutes for warm-up before proceeding.

f. Set data acquisition system for single channel measurement of channel 00.

NOTE

To set data acquisition system for single channel measurements required at several points in this procedure, refer to paragraph 1-117.

g. On DIGITAL VOLTMETER, set selector switch to ON.

h. On BUS POWER CONTROL panel, set VOLTAGE control for digital voltmeter indication of -24.50 ± 0.02 volt.

i. On BUS POWER CONTROL panel, set MODE switch to PC//TM.

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
00	FC	Bus power supply volts (direct reading)
01	DS	PC 1 input volts
02	EA	PC 2 input volts
03	DB	RTG 1 output volts
04	DJ	RTG 2 output volts
05	DG	RTG 1 hot junction temperature T2
06	DH	RTG 1 hot junction temperature T3
07	DI	RTG 1 hot junction temperature T5
08	DO	RTG 2 hot junction temperature T2
09	DP	RTG 2 hot junction temperature T3
10	DQ	RTG 2 hot junction temperature T5
11	DD	RTG 1 fin root temperature T6
12	DE	RTG 1 fin root temperature T7
13	DF	RTG 1 fin root temperature T8
14	DL	RTG 2 fin root temperature T6
15	DM	RTG 2 fin root temperature T7
16	DN	RTG 2 fin root temperature T8
17	DC	RTG 1 pressure
18	DK	RTG 2 pressure
19	DT	PC 1 input current
20	EB	PC 2 input current
21	DU	PC 1 output volts

Table 5-2. Monitor Panel Interconnections for System Checkout (Sheet 1 of 3)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
22	EC	PC 2 output volts
23	DV	PC 1 output current
24	ED	PC 2 output current
25	DW	PC 1 temperature
26	EE	PC 2 temperature
27	DX	PC 1 on-off bus status
28	EF	PC 2 on-off bus status
29	FD	PC 1 external load volts (direct reading)
30	FE	PC 2 external load volts (direct reading)
31	FH	PC 1 external load current (1-ohm shunt)
32	FI	PC 2 external load current (1-ohm shunt)
33	FW	RTG 1 fin root temperature T13
34	FX	RTG 2 fin root temperature T13
35	BD	PC 1 output current (1-ohm shunt)
36	BK	PC 2 output current (1-ohm shunt)
37	BC	PC 1 output volts (direct reading)
38	BJ	PC 2 output volts (direct reading)
39	BE	PC output load volts (direct reading)
40	DA	TSCU input current (1-ohm shunt)
41	FF	TSCU input volts (1) (direct reading)
42	FG	TSCU input volts (2) (direct reading)

Table 5-2. Monitor Panel Interconnections for System Checkout (Sheet 2 of 3)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
*43	FS	RTG 1 hot junction temperature T9
*44	FT	RTG 1 hot junction temperature T10
*45	FU	RTG 2 hot junction temperature T9
*46	FV	RTG 2 hot junction temperature T10

*Fueled system only.

Table 5-2. Monitor Panel Interconnections for System Checkout (Sheet 3 of 3)

j. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS.

k. On POWER CONDITIONER TEST PANEL, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

l. Set INPUT SCANNER to channel 27 and verify DIGITAL VOLTMETER indication of 0 $\pm$ 0.100 volt.

m. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 EXT LOAD switch to 20Ω.

n. Set INPUT SCANNER to channel 28 and verify DIGITAL VOLTMETER indication of 0 $\pm$ 0.100 volt.

o. On POWER CONDITIONER TEST PANEL, set CONV NO. 2 EXT LOAD switch to 20Ω.

p. Set INPUT SCANNER to monitor channels 03 and 04 and verify that DIGITAL VOLTMETER indicates less than 0.300 volt.

q. Set INPUT SCANNER to scan and print out channels 43 through 46. Record data on data sheet (figure A-1, Appendix A) as Start Time measurement.

r. Record system operation start time on data sheet. (See figure A-2, Appendix A.)

CAUTION

If limits in steps s or u are exceeded, immediately reconnect P1 to J21.

s. Remove generator output plug P1 from SHORT receptacle J21 and connect P1 to J17. (If generator subsystem is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.) The P1 connection change must be accomplished in less than 30 seconds. (Refer to paragraph 5-5.) Immediately monitor channels 01 through 04, verifying that DIGITAL VOLTMETER indication is less than 0.500 volt.

t. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 AND CONV NO. 2 switches to ON BUS.

u. Set INPUT SCANNER to monitor channels 01 through 04 and verify that DIGITAL VOLTMETER indication is less than 0.750 volt.

v. Allow 5 minutes before proceeding.

w. Set INPUT SCANNER to scan and print out channels 43 through 46. Repeat this scan every 5 minutes through performance of step ab. Record data and time on data sheet (figure A-1, Appendix A). Verify that temperature of each generator does not increase at a rate exceeding 35°F per 15 minutes.

x. On POWER CONDITIONER TEST PANEL, slowly rotate POWER CONDITIONER LOAD control clockwise at a rate that causes channel 37 voltage to increase 4.5 $\pm$ 0.5 volts per 5 minutes, until a measurement of -19.5 $\pm$ 0.5 volts is observed on channels 37 and 38. During this process, frequently check channel 38 to insure that this measurement also changes at a rate not exceeding 5.0 volts per 5 minutes. When clockwise extreme of POWER CONDITIONER LOAD control is reached (5Ω), rapidly rotate control completely counterclockwise to 0Ω and immediately set 0Ω-5Ω PWR COND LOAD switch to 5Ω. Continue raising voltage at specified rate by rotating POWER CONDITIONER LOAD control clockwise.

CAUTION

Do not allow channel 37 or 38 measurement increase rate to exceed 5.0 volts per 5 minutes.

y. Allow 5 minutes before proceeding.

z. On POWER CONDITIONER TEST PANEL, set PWR COND switch to ON BUS.

aa. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.50 $\pm$0.05 volts is obtained on channels 37 and 38.

ab. Readjust VOLTAGE control as required to maintain -24.50 $\pm$ 0.10 volts on channels 37 and 38. When voltages of channels 37 and 38 remain within tolerance for a period of 15 minutes without readjustment of VOLTAGE control, proceed to next step.

ac. Set INPUT SCANNER to scan and print out channels 43 through 46. Record data and time on data sheet (figure A-1, Appendix A).

ad. Repeat step ac every 15 minutes for 3 hours.

CAUTION

The hot junction temperature rate of increase must not exceed 35°F per 15 minutes. (Refer to paragraph 5-5.)

ae. Proceed with steps in paragraph 5-21.

5-17. PREPARATION FOR CHECKOUT OF ELECTRICALLY HEATED SYSTEMS

5-18. Heat-up of Electrically Heated Systems

5-19. The checkout procedure requires that the generator be in the heated and stabilized condition. If the generators are cold, use the following steps to achieve heatup:

a. Insure that generator output plug P1 is connected to SHORT receptacle J21.

b. Set ground support test console (and power supply rack, if it is being used) controls in accordance with table 5-1.

c. Interconnect generator subsystem and ground support test console (and power supply rack, if used) as shown in figure 5-2.

NOTE

If power supply rack is used, proceed to step e, omitting step d.

d. On AC RECEPTACLE panel, set POWER switch to on (up) position; then verify the following:

1. Both lamps on DIGITAL CLOCK lighted (green)

2. Both faces of DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display lighted

4. INPUT SCANNER display lighted

5. POWER ON indicator on DATA PRINTER lighted (red)

6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (three) lighted (red)

8. Power switch-indicator on RECORDER off. (If switch-indicator is lighted, press indicator.)

9. Rack exhaust fans (four) operating.

NOTE

Allow 10-minute warm-up period before proceeding to step f.

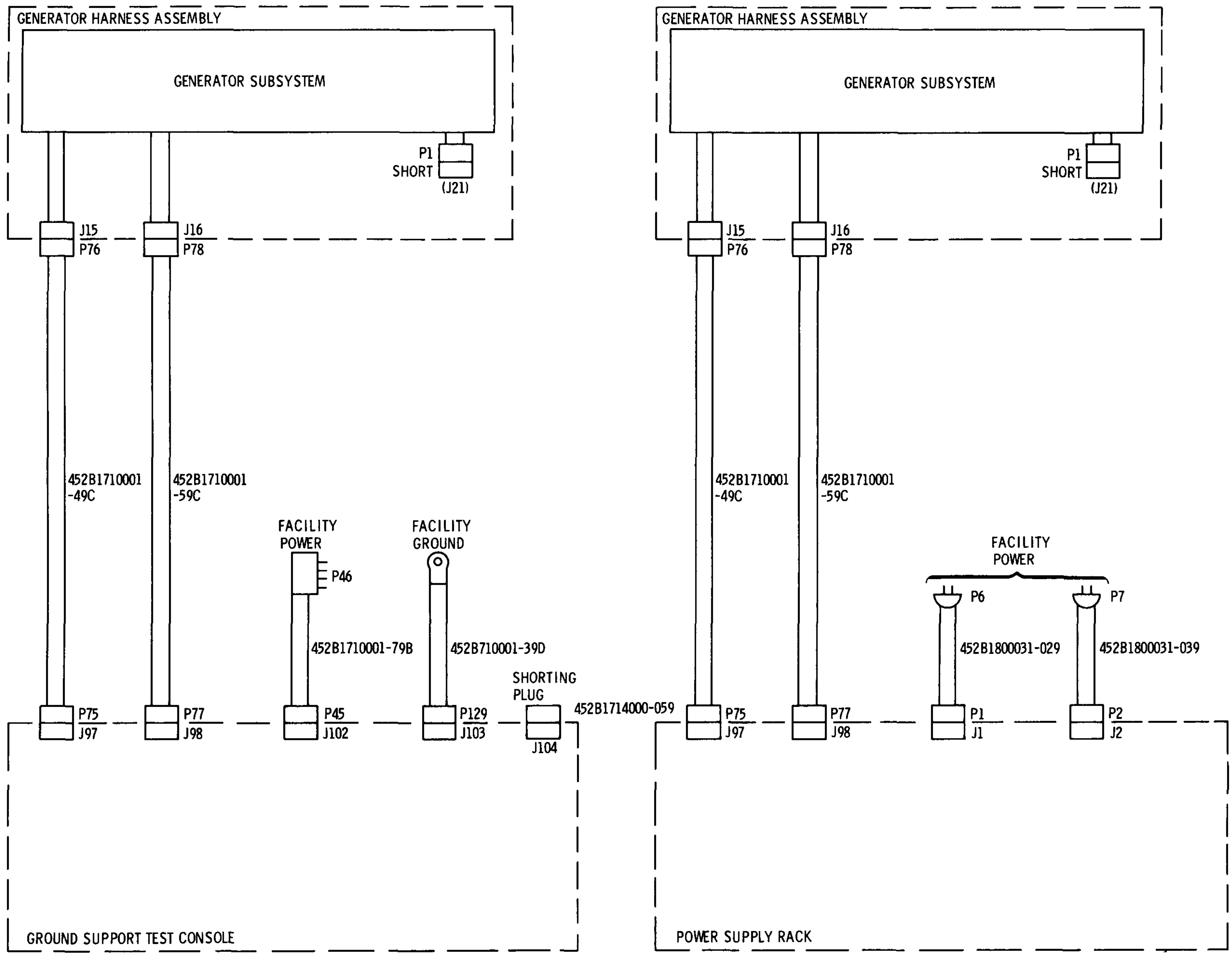

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Figure 5-2. Interconnections for Heater Power Input to Electrically Heated Generator Subsystem

e. On power supply rack, set circuit breaker to on (up) position and verify that indicator beside breaker is lighted.

f. On HEATER POWER SUPPLY CONTROL panel, set POWER-RELAY DRIVER switch to ON. Insure that both VOLTAGE RANGE selectors are set to 20-30, that both FINE ADJ controls are completely counterclockwise, and that HEATER NO. 1 and NO. 2 switches (on rear panel) are set to 75. Set POWER HEATER NO. 1 and POWER HEATER NO. 2 switches to ON and verify that POWER ON indicators on POWER SUPPLY (two) are lighted (red).

g. Connect a 1-kw, DC, $\pm$ 0.5% wattmeter to four jacks lined up directly above HTR POWER NO. 1 switch on HEATER POWER SUPPLY CONTROL PANEL. Current terminals of wattmeter connect between the two CURRENT jacks (red is + and black is -), and voltage terminals connect between the two VOLTAGE jacks (red is + and black is -).

NOTE

Use short, heavy (approximately 12 guage) wire for current leads.

h. Repeat step g for four jacks lined up directly above HTR POWER NO. 2 switch.

i. Set HTR POWER NO. 1 switch to EXT. and verify slight power deflection on wattmeter, indicating that wattmeter is properly connected.

j. Set HTR POWER NO. 2 switch to EXT and verify slight power deflection on wattmeter, indicating that wattmeter is properly connected.

k. Wait 30 minutes before proceeding.

NOTE

In the following step, as the power input to the generators is increased, monitor hot junction temperature above 400°F to insure that it does not increase at a rate exceeding 35°F per 15 minutes. The temperature of each generator is monitored by setting the TEMPERATURE MON switch on the HEATER POWER SUPPLY CONTROL PANEL to RTG NO. 1 or RTG NO. 2 and observing the TEMPERATURE meter.

l. At 15-minute intervals, increase power input to each heater by 25 watts until a power input of 570 $\pm$ 3 watts to each heater is reached. Power input is increased by adjusting appropriate FINE ADJ and VOLTAGE RANGE controls while observing wattmeter. Since HEATER NO. 1 and NO. 2 switches (on back of HEATER POWER SUPPLY CONTROL panel) act as limits on voltage available from VOLTAGE RANGE and FINE ADJ controls, the appropriate HEATER SWITCH must be advanced a step whenever setting of corresponding VOLTAGE RANGE control provides insufficient power. Make this advance one step at a time, so that each HEATER switch setting. Record time, wattage settings, and generator temperature on data sheet (figure A-7, Appendix A).

CAUTION

If the temperature increases by 35°F or more during any 15-minute period between step increases of input power, allow an additional 15 minutes before increasing the input power to the next step. Do not increase power to either heater by more than 25 watts per 15 minutes.

CAUTION

If wattmeters are to be removed, set HTR POWER switches to INT before disconnecting wattmeters. Do not disconnect wattmeters with HTR POWER switches set to EXT.

m. Allow 90 minutes for stabilization. Continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator throughout the remainder of this procedure.

n. Insure that hot junction temperature on each generator does not exceed 800°F.

NOTE

The temperature monitor circuit is set to give alarm at 975°F. (Refer to paragraph 1-95.)

5-20. Checkout Preparation Procedure

a. Insure that generators are heated and stabilized at 570 $\pm$ 3 watts. (Refer to paragraph 5-19 for procedures to achieve heatup and stability.)

NOTE

Monitor and maintain heater input power at 570 $\pm$ 3 watts on each generator throughout this procedure.

b. Insure that generator output plug P1 is connected to SHORT receptacle J21.

NOTE

If generator heater input power is being supplied by the ground support test console (GSTC) proceed to step i, omitting steps c through h. If power is being supplied by the power supply rack, proceed to step c.

c. Set GSTC controls in accordance with table 5-1.

d. Connect patch cords between jacks on MONITOR PANEL as indicated in table 5-2.

e. Without disturbing cable assemblies already connected (as shown in figure 5-2), interconnect system as shown in figure 5-1.

CAUTION

Do not interrupt power being supplied to the generator heaters.

f. On AC RECEPTACLE PANEL, set POWER switch to on (up) position, then verify the following:

1. Both lamps on DIGITAL CLOCK lighted (green)
2. Both faces of the DIGITAL CLOCK lighted (white)
3. DIGITAL VOLTMETER display lighted
4. INPUT SCANNER display lighted
5. POWER ON indicator on DATA PRINTER lighted (red)
6. RECORD ON indicator on DATA PRINTER lighted (white)
7. Indicator on power supply (three) lighted (red)

8. Power switch-indicator on RECORDER off. (If switch-indicator is lighted, press indicator.)

9. Rack exhaust fans (four) operating

g. When RTG 1 ALARM indicator (on RTG LOAD panel) lights (red), press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red), press RTG 2 ALARM switch-indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators light amber.

h. Allow 10 minutes for warm-up before proceeding.

NOTE

Omit steps i through l, and proceed to step m. Steps i through l are employed only when the power supply rack is furnishing heater power.

i. Insure that controls on the following chassis only are set in accordance with table 5-1:

1. VARIABLE POWER CONTROL

2. BUS POWER CONTROL

3. Power supplies (three)

4. POWER CONDITIONER TEST PANEL

CAUTION

Do not interrupt power being supplied to the generator heaters.

j. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

k. Without disturbing cable assemblies already connected (as shown in figure 5-2), interconnect system as shown in figure 5-1.

l. When RTG 1 ALARM indicator (on RTG LOAD panel) lights (red), press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red), press RTG 2 ALARM switch-indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators light amber.

NOTE

The following steps are applicable to both GSTC and power supply rack use as power source for generator heaters.

m. On DIGITAL VOLTMETER, set selector switch to ON.

n. Set data acquisition system to measure channel 00.

NOTE

To set the data acquisition system for single-channel measurements required at several points in this procedure, refer to paragraph 1-117.

o. On BUS POWER CONTROL panel, set VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.2 volts; then set MODE switch to PC//TM.

p. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS.

q. On POWER CONDITIONER TEST PANEL, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

r. Set INPUT SCANNER to channel 27 and verify a DIGITAL VOLTMETER indication of 0 ± 0.100 volt.

s. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 EXT LOAD switch to 20Ω.

t. Set INPUT SCANNER to channel 28 and verify a DIGITAL VOLTMETER indication of 0 ± 0.100 volt.

u. On POWER CONDITIONER TEST PANEL, set CONV NO. 2 EXT LOAD switch to 20Ω.

v. Set INPUT SCANNER to monitor channels 03 and 04, and verify that DIGITAL VOLTMETER indicates less than 0.300 volt.

w. On POWER SUPPLY CONTROL PANEL, note temperature of hot junction on each generator and record on data sheet (figure A-1, Appendix A) as start time measurement.

NOTE

The temperature of each generator is monitored by setting the TEMPERATURE MON switch to RTG NO. 1 or RTG NO. 2 and observing the indication on the TEMPERATURE meter.

x. Record system operation start time on data sheet (figure A-2, Appendix A).

CAUTION

If the limits in steps y or aa are exceeded, immediately reconnect P1 to J21.

y. Remove generator output plug P1 from SHORT receptacle J21 and connect P1 to J17. This operation must be completed in less than 30 seconds. (Refer to paragraph 5-5.) Immediately monitor channels 01 through 04 and verify that DIGITAL VOLTMETER indication is less than 0.500 volt.

z. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 and CONV NO. 2 switches to ON BUS.

aa. Set INPUT SCANNER to monitor channels 01 through 04 and verify that DIGITAL VOLTMETER indication is less than 0.750 volt.

ab. Wait 5 minutes before proceeding.

NOTE

Monitor hot junction temperature on each generator every 5 minutes through step ag and record temperature and time on data sheet (figure A-1, Appendix A).

CAUTION

Insure that the temperature of each generator does not increase at a rate exceeding 35°F per 15 minutes.

ac. On POWER CONDITIONER TEST PANEL, slowly rotate POWER CONDITIONER LOAD control clockwise at a rate that causes channel 37 voltage to increase 4.5 ± 0.5 volts per 5 minutes, until a measurement of -19.5 ± 0.5 volts is observed on channels 37 and 38. During this process, frequently check channel 38 to insure that this measurement also changes at a rate not exceeding 5.0 volts per 5 minutes. When clockwise extreme of POWER CONDITIONER LOAD control is reached (5Ω), rapidly rotate control completely counterclockwise to 0Ω, and immediately set 0Ω-5Ω PWR COND LOAD switch to 5Ω. Continue raising voltage at specified rate by rotating POWER CONDITIONER LOAD control clockwise.

CAUTION

Do not allow channel 37 or 38 measurement to increase at a rate exceeding 5 volts per 5 minutes.

ad. Allow 5 minutes before proceeding.

ae. On POWER CONDITIONER TEST PANEL, set PWR COND switch to ON BUS.

af. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.50 ± 0.10 volts are obtained on channels 37 and 38.

ag. Readjust VOLTAGE control as required to maintain -24.50 ± 0.10 volts on channels 37 and 38. When both channel 37 and 38 remain within tolerance for a period of 15 minutes without readjustment of VOLTAGE control, proceed to next step.

ah. Using TEMPERATURE MON switch for selection, monitor TEMPERATURE meter for hot junction temperature of each generator. Record temperature and time on data sheet (figure A-1, Appendix A).

ai. Repeat step ah every 15 minutes for 90 minutes.

CAUTION

The hot junction temperature must not increase at a rate exceeding 35°F per 15 minutes. (Refer to paragraph 5-5.)

aj. Proceed with steps in paragraph 5-21.

5-21. SYSTEM CHECKOUT PROCEDURE

a. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. From printed data, record required measurements on data sheet (figure A-2, Appendix A). Mark data tape FULL LOAD ON BUS and save for reference.

b. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to OFF BUS, and press CONV NO. 1 COMMAND pushbutton.

c. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. Record required measurements on data sheet (figure A-2, Appendix A). Mark data tape CONV NO. 1 OFF BUS and save for reference.

d. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

e. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. Record required measurements on data sheet (figure A-2, Appendix A). Mark data tape FULL LOAD OFF BUS and save for reference.

f. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS and press CONV NO. 1 COMMAND pushbutton.

g. Set data acquisition system to scan and print out measurements of channels 01 through 46 for fueled systems or channels 01 through 42 for electrically heated systems. Record required measurements on data sheet (figure A-2, Appendix A). Mark data tape CONV NO. 2 OFF BUS and save for reference.

h. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

i. Set INPUT SCANNER to channel 37.

j. Connect cable assembly 452B1710001-49E between oscilloscope vertical plug-in 1752A and MONITOR PANEL jack BE; then turn on oscilloscope and allow it to warm up for 5 minutes.

k. On BUS POWER CONTROL panel, set MODE switch to UNREG.

l. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -24.5 ± 0.05 volts. (Refer to paragraph 1-70a and 1-70b.)

m. Set oscilloscope to measure peak-to-peak ripple voltage. Record measurement on data sheet (figure A-3, Appendix A) under RIPPLE TEST.

n. Disconnect oscilloscope.

o. On BUS POWER CONTROL panel, set MODE switch to PC/ /TM.

p. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -19.5 $\pm$ 0.5 volts. (Refer to paragraph 1-70a and 1-70b.)

q. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.5 $\pm$ 0.10 volts are obtained on channels 37 and 38.

r. After all testing is completed, complete all calculations indicated on data sheet (figure A-3, Appendix A); then, proceed with shutdown procedure (paragraph 5-22).

5-22. COOLDOWN TO SHORT CIRCUIT (FUELED OR ELECTRICALLY HEATED SYSTEM)

5-23. When checkout of a fueled or electrically heated system is completed, the generators must be placed in the shorted condition as follows:

CAUTION

If the system is electrically heated, maintain input power on each generator at 570 $\pm$ 3 watts throughout this procedure.

a. On POWER CONDITIONER TEST PANEL, set PWR COND switch to OFF BUS.

b. Wait 5 minutes before proceeding.

c. On POWER CONDITIONER TEST PANEL, slowly rotate POWER CONDITIONER LOAD control counterclockwise at a rate that causes channel 37 voltage to decrease 4.5 $\pm$ 0.5 volts per 5 minutes. During this process, frequently check channel 38 to insure that this measurement also changes at a rate not exceeding 5 volts per 5 minutes. When counterclockwise extreme of POWER CONDITIONER LOAD control is reached (0Ω), rapidly rotate control completely clockwise to 5Ω, and immediately set 0Ω-5Ω PWR COND LOAD switch to 0Ω. Continue lowering voltage at specified rate until POWER CONDITIONER LOAD control is completely counterclockwise at 0Ω. Verify that PWR COND LOAD switches (three) are set to 0Ω.

CAUTION

Do not reduce channel 37 or 38 voltages at a rate exceeding 5.0 volts per 5 minutes.

d. Wait 5 minutes before proceeding.

e. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 and CONV NO. 2 switches to OFF BUS.

f. Wait 5 minutes before proceeding.

g. Remove generator output plug P1 from J17 and connect P1 to SHORT receptacle J21. This operation must be accomplished in less than 30 seconds. (If generator subsystem is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.

h. Set INPUT SCANNER to monitor channels 03 and 04, and verify that DIGITAL VOLTMETER indicates less than 0.300 volt.

i. Record system operation stop time on data sheet (figure A-2, Appendix A).

j. On BUS POWER CONTROL panel, set VOLTAGE control fully counterclockwise and set MODE switch to OFF.

k. On DIGITAL VOLTMETER, set selector switch to STD BY.

l. On POWER CONDITIONER TEST PANEL, set controls in accordance with table 5-1.

m. Remove patchcords from MONITOR PANEL.

NOTE

Step n applies only to fueled generators and electrically heated generators being supplied heater power by the power supply rack.

n. Set POWER switch on AC RECEPTACLE PANEL to down position.

o. For electrically heated systems, continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator (with heater power supplied by either the GSTC or the power supply rack).

p. Without disturbing cable assemblies shown in figure 5-2, remove cables connecting system to GSTC.

5-24. GENERATOR SUBSYSTEM CHECKOUT

5-25. CAUTIONS AND WARNINGS

5-26. Keep Proper Load on Thermoelectric Generators

5-27. This caution applies to fueled generators and to electrically heated generators when power is applied to the heaters. Never open the output circuit of either generator for longer than 30 seconds. To do so will cause excessive temperature rise in the generator. Excessive load variations cause thermal disturbances which are detrimental to the generators. The generator temperatures must not be allowed to change at a rate exceeding 35°F per 15 minutes. The ground support test console (GSTC) constitutes a satisfactory load when operated in accordance with procedures herein. When off test for short periods, the dummy load accompanying the generator subsystem is satisfactory. When a fueled generator is to be off test for over 3 hours or when the generator is unattended (an electrically heated generator in hot condition must never be unattended) the generator output plug P1 must be connected to the SHORT receptacle, J21. However, during launch operations, or in other situations where the ground support test console or other external load is not available, the generator output may be switched from short to load, load to short, or open circuited provided the switching is done in open air with the fins uninsulated and the initial fin root temperature is less than 265° F. Although this sequencing is permissible, the number of such operations and the length of time that the generators are open circuited must be held to a minimum.

5-28. Maintain Proper Power to Electrically Heated Generators

5-29. Thermal disturbances are detrimental to the generators. The generators must be brought up to operating temperature slowly, while monitoring the generator temperatures, so that the rate of temperature change does not exceed 35°F per 15 minutes, and this rate of change must not be exceeded thereafter. Once the generator is brought up to operating temperature, every effort must be made to maintain that temperature. Thermal cycling is detrimental to the generators. If the system must be cooled, reduce input power to the heaters slowly and monitor temperatures constantly to avoid exceeding a change rate of 35°F per 15 minutes. Never remove heater power from a hot generator for longer than 45 seconds. The acceptable rate for heating up or cooling down the generators is 25 watts per 15 minutes.

5-30. Keep Radiation Shield in Place During Checkout

5-31. With fueled generators, testing and monitoring must be done with the radiation shield in place for safety of personnel. Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6).

5-32. Avoid Contact With Hot Generators

5-33. The external surfaces of hot generators may reach a temperature of 380°F. Use care to avoid burns. (Simulated orbital conditions result in 380° F temperature; exposed in atmosphere the temperature is 260° F and in the shipping container the temperature is 300° F.)

CAUTION

Airflow around the generators must not be obstructed. Fin root temperatures exceeding the maximum allowable (385° F) may result.

5-34. FUELED GENERATOR CHECKOUT WITH OUTPUT SHORT CIRCUITED

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Set GSTC controls in accordance with table 5-1.

c. Insure that generator output plug P1 is connected to SHORT receptacle, J21. If generator is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.)

d. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

e. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

f. Interconnect generator subsystem and GSTC as shown on figure 5-3.

g. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify the following:

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
00	AA	RTG 1 output volts (direct reading)
01	AC	RTG 2 output volts (direct reading)
02	AB	RTG 1 output current (20a-100 mv shunt)
03	AD	RTG 2 output current (20a-100 mv shunt)
04	AJ	RTG 1 hot jct temp T2 (T/M)
05	AK	RTG 1 hot jct temp T3 (T/M)
06	AL	RTG 1 hot jct temp T5 (T/M)
07	AS	RTG 2 hot jct temp T2 (T/M)
08	AT	RTG 2 hot jct temp T3 (T/M)
09	AU	RTG 2 hot temp T5 (T/M)
10	AG	RTG 1 fin root temp T6 (T/M)
11	AH	RTG 1 fin root temp T7 (T/M)
12	AI	RTG 1 fin root temp T8 (T/M)
13	AP	RTG 2 fin root temp T6 (T/M)
14	AQ	RTG 2 fin root temp T7 (T/M)
15	AR	RTG 2 fin root temp T8 (T/M)
16	AE	RTG 1 output volts (T/M)
17	AN	RTG 2 output volts (T/M)
18	AF	RTG 1 pressure (T/M)
19	AO	RTG 2 pressure (T/M)
20	AV	RTG 1 pressure excitation
21	AW	RTG 2 pressure excitation
22	FW	RTG 1 fin root temp T13
23	FX	RTG 2 fin root temp T13

Table 5-3. Monitor Panel Interconnections for Generator Checkout (Sheet 1 of 2)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
24*	FS	RTG 1 hot jct temp T9
25*	FT	RTG 1 hot jct temp T10
26*	FU	RTG 2 hot jct temp T9
27*	FV	RTG 2 hot jct temp T10

*Fueled system only.

Table 5-3. Monitor Panel Interconnections for Generator Checkout (Sheet 2 of 2)

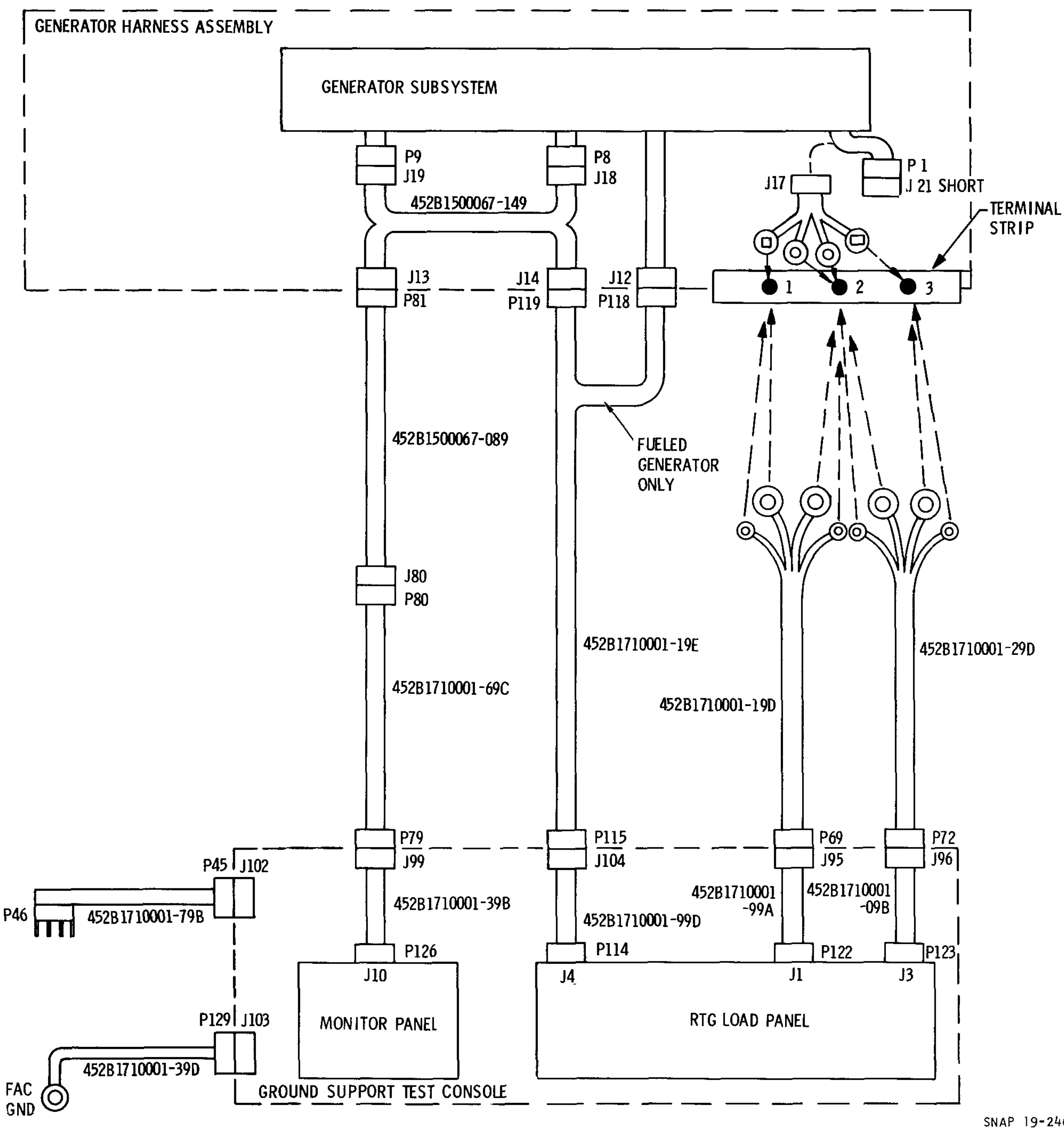


Figure 5-3. Interconnection for Generator Checkout

1. Both lamps on DIGITAL CLOCK lighted (green)

2. Both faces of DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display lighted

4. INPUT SCANNER display lighted

5. POWER ON indicator on DATA PRINTER lighted (red)

6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (three) lighted (red)

8. POWER switch-indicator on RECORDER OFF. (If switch-indicator is lighted, press indicator.)

9. Rack exhaust fans (four) operating.

h. Wait 10 minutes for warm-up before proceeding.

i. On DIGITAL VOLTMETER, set selector switch to ON.

j. Set data acquisition system to scan and print out channels 04 through 27. Record data on data sheet under SHORT measurement (figure A-5, Appendix A). Using appropriate curves in MND-3607-186, convert data to required measurements. Verify that measurements comply with limits on data sheet.

k. Record data taken in step j for channels 24 and 26 on data sheet (figure A-4, Appendix A) as start time measurements.

l. Record generator operation start time on data (figure A-5, Appendix A).

CAUTION

If voltage limits in steps m and n are exceeded, immediately reconnect P1 to J21.

m. Remove generator output plug P1 from SHORT receptacle J21, and connect P1 to J17. (Refer to paragraph 2-42 if generator is in shipping container.) This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.) Immediately monitor channels 00 and 01 and verify DIGITAL VOLTMETER indication is less than +2.0 volts.

n. Set INPUT SCANNER to monitor channels 24 and 26 and verify that DIGITAL VOLTMETER indication increases at a rate not exceeding 0.230 volt per 5 minutes. Continue to monitor this rate for 25 minutes before proceeding to next step. Every 5 minutes through step t, record DIGITAL VOLTMETER indications and time on data sheet (figure A-4, Appendix A).

o. Set INPUT SCANNER to monitor channel 00.

p. On RTG LOAD panel, slowly rotate RTG NO. 1 control counterclockwise until DIGITAL VOLTMETER indication increases by $+0.400 \pm 0.100$ volt.

q. Set INPUT SCANNER to monitor channel 01

r. On RTG LOAD panel, slowly rotate RTG NO. 2 control counterclockwise until DIGITAL VOLTMETER indication increases by $+0.400 \pm 0.100$ volt.

s. At 5-minute intervals, repeat steps o through r until channels 00 and 01 measurements are $+2.6 \pm 0.02$ volts.

CAUTION

Do not allow channel 00 and 01 measurements to increase at a rate exceeding 0.5 volt per 5 minutes.

t. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at $+2.6 \pm 0.02$ volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at $+2.6 \pm 0.02$ volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

u. Set INPUT SCANNER to channels 24 and 26 and record indications and time on data sheet (figure A-4, Appendix A).

v. Repeat step u every 15 minutes for 2 hours.

NOTE

The hot junction temperature rate of increase should not exceed 35°F per 15 minutes. (Refer to paragraph 5-25.)

w. Set data acquisition system to scan and print out channels 00 through 27.

x. Record data on data sheet (figure A-5, Appendix A) under LOAD measurement. Using appropriate curves in MND-3607-186, convert data to required measurements. Verify that measurements comply with limits on data sheet.

5-35. FUELED GENERATOR CHECKOUT WITH OUTPUT AT NOMINAL LOAD

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Set GSTC controls in accordance with table 5-1.

c. Insure that generator output plug P1 is connected to LOAD receptacle J20. (If generator is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.)

d. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls fully clockwise to MAX.

e. Interconnect generator subsystem and GSTC as shown on figure 5-3.

f. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

g. On AC RECEPTACLE PANEL, set POWER switch to on (up) position and verify that:

1. Both lamps on DIGITAL CLOCK are lighted (green)

2. Both faces of DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display is lighted

4. INPUT SCANNER display is lighted

5. POWER ON indicator on DATA PRINTER is lighted (red)

6. RECORD ON indicator on DATA PRINTER is lighted (white)

7. Indicator on power supply (three) lighted (red)

8. POWER switch-indicator on RECORDER OFF. (If switch-indicator is lighted, press indicator.)

9. Rack exhaust fans (four) are operating

h. Wait 10 minutes for warm-up before proceeding

i. On DIGITAL VOLTMETER, set selector switch to ON.

j. Set INPUT SCANNER to monitor channels 24 and 26 and record DIGITAL VOLTMETER indications on data sheet (figure A-4, Appendix A) as START time measurements. Monitor and record these indications and time on data sheet every 15 minutes for duration of this checkout.

k. Record generator operation start time on data sheet (figure A-5, Appendix A).

CAUTION

Steps l through n must be accomplished as rapidly as possible.

l. Remove generator output plug P1 from LOAD receptacle of J20 and connect P1 to J17. (Refer to paragraph 2-42 if generator is in shipping container.) This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.)

CAUTION

If voltage settings required in step m or n cannot be achieved, immediately reconnect P1 to J20. Steps l through n must be accomplished as rapidly as possible.

m. Set INPUT SCANNER to monitor channel 00 and adjust RTG NO. 1 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of +2.6 ± 0.02 volts.

n. Set INPUT SCANNER to monitor channel 01 and adjust RTG NO. 2 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of +2.6 ± 0.02 volts.

o. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at +2.6 ± 0.02 volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at +2.6 ± 0.02 volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

p. Continue complying with the requirements of step j for 60 additional minutes.

NOTE

The hot junction temperature rate of increase should not exceed 35°F per 15 minutes. (Refer to paragraph 5-27.)

q. Set data acquisition system to scan and print out channels 00 through 27.

r. Record data on data sheet (figure A-5, Appendix A) under LOAD measurement using appropriate curves in MND-3607-186, convert data to required measurements. Verify that measurements comply with limits on data sheet.

5-36. ELECTRICALLY HEATED GENERATOR CHECKOUT WITH OUTPUT SHORT CIRCUITED

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Insure that generators are heated and stabilized at 570 $\pm$ 3 watts. (Refer to paragraph 5-19 for procedures to achieve heatup and stability.)

c. Continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator throughout this checkout.

d. Insure that generator output plug P1 is connected to SHORT receptacle J21.

NOTE

Steps e through k are applicable only when heater input power is supplied to the generator subsystem by the power supply rack. If the GSTC is supplying power, omit steps e through k and proceed to step l.

e. Set GSTC controls in accordance with table 5-1.

f. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

g. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

h Without disturbing cable assemblies already connected (as shown in figure 5-2), interconnect generator and GSTC as shown on figure 5-3.

i. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify the following:

1. Both lamps on DIGITAL CLOCK lighted (green)

2. Both faces of DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display lighted

4. INPUT SCANNER display lighted

5. POWER ON indicator on DATA PRINTER lighted (red)

6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (3 places) lighted (red)

8. POWER switch-indicator on RECORDER OFF. (If switch-indicator is lighted, press indicator.)

9. Rack exhaust fans (four) operating.

j. When buzzer sounds, press RTG NO. 1 and RTG NO. 2 ALARM switch-indicators on RTG LOAD panel.

k. Wait 10 minutes for warm-up before proceeding

NOTE

Steps l through p are applicable only when the GSTC is furnishing heater power to the generators. Proceed to step r, omitting steps l through p, if power is supplied by the power supply rack.

l. On VARIABLE POWER CONTROL panel, verify that MODE 1 and MODE 2 switches are set to OFF.

m. On BUS POWER CONTROL panel, verify that MODE switch is set to OFF.

n. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

o. Connect patchcords between jacks on MONITOR PANEL as indicated table 5-3.

p. Without disturbing cable assemblies already connected (as shown in figure 5-2), interconnect generator subsystem and GSTC as shown in figure 5-3.

q. When RTG 1 ALARM indicator (on RTG LOAD panel) lights (red) press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red) press RTG 2 ALARM switch indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators light amber.

NOTE

Steps r and up are applicable to use of both the GSTC and the power supply rack.

r. On DIGITAL VOLTMETER, set selector switch to ON.

s. Set data acquisition system to scan and print out channels 04 through 23. Record data on data sheet (figure A-5, Appendix A) under SHORT measurement. Using appropriate curves in MND-3607-186, convert data to required measurements and verify that measurements comply with limits on data sheets.

t. On POWER SUPPLY CONTROL PANEL, note temperature of hot junction on each generator and record on data sheet (figure A-4, Appendix A) as start time measurement.

NOTE

The temperature of each generator is monitored by setting the TEMPERATURE MON switch to RTG NO. 1 or RTG NO. 2 and observing the indication on the TEMPERATURE meter.

u. Record generator operation start time on data sheet (figure A-5, Appendix A).

CAUTION

If limits in steps v and w are exceeded, immediately reconnect P1 to J21.

v. Remove generator output plug P1 from SHORT receptacle J21 and connect P1 to J17. This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.) Immediately monitor channels 00 and 01 and verify that DIGITAL VOLTMETER indication is less than +2.0 volts.

w. Monitor hot junction temperatures of each generator on TEMPERATURE meter, (on POWER SUPPLY CONTROL panel) every 5 minutes. Verify that temperature rate of increase does not exceed 12°F per

5 minutes. Continue to monitor this rate for 25 minutes before proceeding to next step. Every 5 minutes record readings and time through step ac on data sheet (figure A-4, Appendix A).

x. Set INPUT SCANNER to monitor channel 00.

y. On RTG LOAD panel, slowly rotate RTG NO. 1 control counterclockwise until DIGITAL VOLTMETER indication increases by +0.400 ±0.100 volt.

z. Set INPUT SCANNER to monitor channel 01.

aa. On RTG LOAD panel, slowly rotate RTG NO. 2 control counterclockwise until DIGITAL VOLTMETER indication increases by +0.400 ± 0.100 volt.

ab. At 5-minute-intervals, repeat steps x through aa until channel 00 and 01 measurements are +2.6 ±0.02 volts.

CAUTION

Do not allow channel 00 or 01 measurement to increase at a rate exceeding 0.5 volt per 5 minutes.

ac. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at +2.6 ± 0.02 volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at +2.6 ± 0.02 volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

ad. Record hot junction temperature on each generator and time on data sheet (figure A-4, Appendix A). Temperature may be read on TEMPERATURE meter on POWER SUPPLY CONTROL PANEL, using TEMPERATURE MON switch for selection.

ae. Repeat step ad every 15 minutes for 2 hours.

NOTE

The hot junction temperature rate of increase must not exceed 35°F per 15 minutes. (Refer to paragraph 5-27.)

af. Set data acquisition system to scan and print out channels 00 through 23.

ag. Record data on data sheet (figure A-5, Appendix A) under LOAD measurement. Using appropriate curves in MND-3607-186, convert data to required measurements and verify that measurements comply with limits on data sheet.

5-37. ELECTRICALLY HEATED GENERATOR CHECKOUT WITH OUTPUT AT NOMINAL LOAD

a. Disconnect cables if portable monitor package and generator subsystem are interconnected. (Refer to paragraph 2-31.)

b. Continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator throughout this checkout.

c. Insure that generator output plug P1 is connected to LOAD receptacle J20.

NOTE

Steps d through j are applicable only when heater input power is supplied to the generator subsystem by the power supply rack. If the GSTC is supplying power, omit steps d through j and proceed to step k.

d. Set GSTC controls in accordance with table 5-1.

e. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

f. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

g. Interconnect generator subsystem, GSTC, and facility as shown on figure 5-3.

h. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify the following:

1. Both lamps on DIGITAL CLOCK lighted (green)
2. Both faces of DIGITAL CLOCK lighted (white)
3. DIGITAL VOLTMETER display lighted
4. INPUT SCANNER display lighted
5. POWER ON indicator on DATA PRINTER lighted (red)
6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (three) lighted (red)

8. POWER switch-indicator on RECORDER OFF (If switch-indicator is lighted, press indicator)

9. Rack exhaust fans (four) operating.

i. When RTG 1 ALARM indicator lights (red) press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red) press RTG 2 ALARM switch-indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators are lighted amber.

j. Wait 10 minutes for warm-up before proceeding.

NOTE

Steps k through p are applicable only when the GSTC is supplying heater power to the generators. Proceed to step q, omitting steps k through p, if power is supplied by the power supply rack.

k. On VARIABLE POWER CONTROL panel, insure that MODE 1 and MODE 2 switches are set to OFF.

l. On BUS POWER CONTROL panel, insure that MODE switch is set to OFF.

m. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls completely clockwise to MAX.

n. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-3.

o. Interconnect generator subsystem and GSTC as shown in figure 5-3.

p. When RTG 1 ALARM indicator lights, (red) press RTG 1 ALARM switch-indicator; when RTG 2 ALARM indicator lights (red) press RTG 2 ALARM switch-indicator. Verify that buzzer stops sounding and RTG 1 and RTG 2 ALARM indicators are lighted (amber).

NOTE

Steps q and up are applicable to use of both the GSTC and the power supply rack.

q. On DIGITAL VOLTMETER, set selector switch to ON.

r. On POWER SUPPLY CONTROL PANEL, note temperature of hot junction on each generator on the TEMPERATURE meter. The temperature of each generator is monitored by setting the TEMPERATURE MON switch to RTG NO. 1 or RTG NO. 2. Record on data sheet (figure A-4, Appendix A) as start time measurement. Monitor and record the readings and time on data sheet every 15 minutes for duration of this test.

s. Record generator operation start time on data sheet (figure A-5, Appendix A)

CAUTION

Steps t through v must be accomplished as rapidly as possible.

t. Remove generator output plug P1 from LOAD receptacle J20 and connect P1 to J17. This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.)

CAUTION

If voltage settings required in step u or v cannot be achieved, immediately reconnect P1 to J20.

u. Set INPUT SCANNER to channel 00 and adjust RTG NO. 1 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of +2.6 $\pm$ 0.02 volts.

v. Set INPUT SCANNER to channel 01 and adjust RTG NO. 2 control on RTG LOAD panel for a DIGITAL VOLTMETER indication of +2.6 $\pm$ 0.02 volts.

w. On RTG LOAD panel, readjust RTG NO. 1 control as required to maintain channel 00 voltage at +2.6 $\pm$ 0.02 volts and readjust RTG NO. 2 control as required to maintain channel 01 voltage at +2.6 $\pm$ 0.02 volts. When voltages remain within tolerance for 15 minutes without readjustment of RTG NO. 1 or RTG NO. 2 controls, proceed to next step.

x. Continue complying with the requirements of step r for 60 additional minutes.

NOTE

The hot junction temperature rate of increase should not exceed 35°F per 15 minutes. (Refer to paragraph 5-27.)

y. Set data acquisition system to scan and print out channels 00 through 23.

z. Record data on data sheet (figure A-5, Appendix A) under LOAD measurement. Using appropriate curves in MND 3607-186, convert data to required measurements and verify measurements comply with limits on data sheet.

5-38. POST-OPERATION PROCEDURES

5-39. Cooldown to Short Circuit (Fueled or Electrically Heated Subsystem)

5-40. When testing of a fueled generator subsystem is completed, the generators must be placed in the shorted condition and disconnected from the GSTC as follows:

a. On RTG LOAD panel, set RTG NO. 1 control fully clockwise.

b. On RTG LOAD panel, set RTG NO. 2 control fully clockwise.

c. With INPUT SCANNER set to channels 00 and 01, verify DIGITAL VOLTMETER indicates less than +2.0 volts.

d. Wait 15 minutes before proceeding.

e. Remove generator output plug P1 from J17 and connect P1 to SHORT receptacle J21. (If generator is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.) This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.) Immediately verify DIGITAL VOLTMETER indication of less than +0.3 volts with the INPUT SCANNER set to channels 16 and 17.

f. Record generator operation stop time on data sheet (figure A-5, Appendix A).

g. On RTG LOAD panel, set RTG NO. 1 and RTG NO. 2 controls fully counterclockwise to MIN.

h. On DIGITAL VOLTMETER, set selector switch to STD BY.

i. Remove patchcords from MONITOR PANEL.

j. Remove cable assemblies connecting generator and GSTC, as shown on figure 5-3.

NOTE

Step k applies only to fueled generators and electrically heated generators being supplied heater power by the power supply rack.

k. Set POWER switch on AC RECEPTACLE PANEL to down position.

l. For electrically heated systems, continue to monitor and maintain input power at 570 $\pm$ 3 watts on each generator (with power supplied by either the GSTC or the power supply rack).

5-41. Generators on Standby at Nominal Voltage (Fueled or Electrically Heated Subsystem)

5-42. Electrically heated generators must not be cycled (heated and cooled) more frequently than absolutely necessary. It is best to keep the generators hot if practicable between periods of test. This practice also reduces the time required to achieve thermal stability prior to test.

CAUTION

Electrically heated generators in hot condition must be attended at all times to insure that heater power and generator loads are not interrupted.

5-43. The generators may be disconnected from an external load (that is, the GSTC) and placed on standby or dummy load. If required, proceed as follows:

a. With INPUT SCANNER set to channel 00, verify DIGITAL VOLTMETER indication of +2.6 $\pm$ 0.05 volts. Readjust RTG NO. 1 control on RTG LOAD panel if required.

b. With INPUT SCANNER set to channel 01, verify DIGITAL VOLTMETER indication of +2.6 $\pm$ 0.05 volts. Readjust RTG NO. 2 control on RTG LOAD panel if required.

c. Remove generator output plug P1 from J17 and connect P1 to LOAD receptacle J20. (If generator is in shipping container, refer to paragraph 2-42 for instructions on raising shield assembly for access to receptacle.) This operation should be accomplished in less than 30 seconds. (Refer to paragraph 5-27.)

d. With INPUT SCANNER set to monitor channels 16 and 17, verify a DIGITAL VOLTMETER indication of less than + 3.0 volts. If indication of either channel 16 or 17 is greater than +3.0 volts, disconnect P1 from LOAD receptacle J20, and connect P1 to SHORT receptacle J21.

5-44. Shutdown to Cold Condition

5-45. When it is necessary to completely shut down an electrically heated generator subsystem, proceed as follows:

a. Insure that generator subsystem has been cooled down to short-circuit condition. (Refer to paragraph 5-39.)

b. Insure that two 1-KW, DC $\pm$ 0.5% wattmeters are connected to four jacks lined up directly above HTR POWER NO. 1 and HTR POWER NO. 2 switches on HEATER POWER SUPPLY CONTROL PANEL. Voltage terminals of wattmeter connect between the two VOLTAGE jacks (red is + and black is -), and current terminals connect between two CURRENT jacks (red is + and black is -).

NOTE

Use short, heavy (approximately 12 gauge) wire for current leads.

c. Insure that HTR POWER NO. 1 switch is set to EXT.

d. Decrease power input to heater No. 1 by 25 watts while observing wattmeter. Power input is decreased by adjusting the appropriate FINE ADJ and VOLTAGE RANGE controls.

e. Insure that HTR POWER NO. 2 switch is set to EXT

f. Decrease power input to heater No. 2 by 25 watts.

g. As power input to generators is decreased, monitor hot junction temperatures above 400°F to insure that temperature does not decrease at a rate exceeding 35° F per 15-minute period. Record time wattage settings, and generator temperatures on data sheet (figure A-10, Appendix A).

NOTE

The temperature of each generator may be monitored by setting the TEMPERATURE MON switch on the HEATER POWER SUPPLY CONTROL PANEL to RTG NO. 1 or RTG NO. 2 and observing the TEMPERATURE meter.

h. At 15-minute intervals, repeat steps d, f, and g until voth VOLTAGE RANGE controls are set to 20-30 and both FINE ADJ controls are completely counterclockwise. Then, 15 minutes later, set POWER-HEATER NO. 1 and POWER-HEATER NO. 2 switches to OFF. Set HEATER NO. 1 and NO. 2 switches (on rear of panel) to 75. Set POWER RELAY-DRIVER switch to OFF.

CAUTION

If the temperature decreases by 35°F or more during any 15-minute period between step decreases of input power, allow an additional 15 minutes before decreasing the input power to the next step. Do not decrease power to either heater by more than 25 watts per 15-minute period.

CAUTION

If wattmeters are to be removed, set HTR POWER switches to INT before disconnecting wattmeters. Do not disconnect wattmeters with HTR POWER switches set to EXT.

i. If GSTC is being used, set POWER switch on AC RECEPTACLE PANEL to off (down) position.

j. If power supply rack is being used, set circuit breaker to down position.

k. Disconnect interconnecting cables. (Refer to figure 5-2.)

5-46. POWER CONDITIONER CHECKOUT PROCEDURE

a. Set ground support test console (GSTC) controls in accordance with table 5-1.

b. Connect cables between GSTC, power conditioner unit, and facility as shown on figure 5-4.

NOTE

Do not connect terminal lugs of cables 452B1710001-99C and -09D to power conditioner at this time. Instead, short the four heavy lugs (one coded with a square, one with a rectangle, and two with circles) to one another by using a 1/4-inch bolt, washers, and nut to fasten the lugs firmly together. Leave the four smaller lugs unattached.

c. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-4.

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
00	BP	PC 1 temp (T/M)
01	BV	PC 2 temp (T/M)
02	BQ	PC 1 status (T/M)
03	BW	PC 2 status (T/M)
04	BB	PC 1 input current (20a-100 mv shunt)
05	BI	PC 2 input current (20a-100 mv shunt)
06	BA	PC 1 input volts (direct reading)
07	BH	PC 2 input volts (direct reading)
08	BD	PC 1 output current (one ohm shunt)
09	BK	PC 2 output current (one ohm shunt)
10	BC	PC 1 output volts (direct reading)
11	BJ	PC 2 output volts (direct reading)
12	BN	PC 1 output volts (T/M)
13	BT	PC 2 output volts (T/M)
14	BO	PC 1 output current (T/M)
15	BU	PC 2 output current (T/M)
16	BL	PC 1 input volts (T/M)
17	BR	PC 2 input volts (T/M)
18	BM	PC 1 input current (T/M)
19	BS	PC 2 input current (T/M)
20	BE	PC output load volts
21	FD	PC 1 external load volts
22	FE	PC 2 external load volts
23	FH	PC 1 external load current (1-ohm shunt)

Table 5-4. Monitor Panel Interconnections for Power Conditioner Checkout (Sheet 1 of 2)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
24	FI	PC 2 external load current (1-ohm shunt)
25	FC	Bus power supply volts
26	FA	Variable power supply volts (No. 1)
27	FB	Variable power supply volts (No. 2)

Tabel 5-4. Monitor Panel Interconnections for Power Conditioner Checkout (Sheet 2 of 2)

CAUTION

Connect each patchcord first to the desired scanner jack (00 through 59) and then to the signal jack. This sequence avoids the possibility of shorting across a voltage measurement jack.

d. On AC RECEPTACLE PANEL, set POWER switch to on (up) position; then verify that:

1. Both lamps on DIGITAL CLOCK lighted (green).

2. Both faces of DIGITAL CLOCK lighted (white).

3. DIGITAL VOLTMETER display lighted.

4. INPUT SCANNER display lighted.

5. POWER ON indicator on DATA PRINTER lighted (red).

6. RECORD ON indicator on DATA PRINTER lighted (white).

7. Indicator on power supply (three) lighted (red).

8. Power switch-indicator on RECORDER off. (If switch indicator is lighted press power switch-indicator.)

9. Exhaust fans (four) are operating.

NOTE

Allow 10 minutes for warm-up before proceeding.

e. Set selector switch on DIGITAL VOLTMETER to ON.

f. Set data acquisition system for single channel measurement of channel 26.

NOTE

For the single-channel settings of data acquisition system required at several points in this procedure, refer to paragraph 1-117.

g. On VARIABLE POWER CONTROL panel, set VOLTAGE 1 control for digital voltmeter indication as follows:

Serial Number of Power Conditioner	Voltage Indication
004	+ 5.000 V $\pm$ 0.005 V
007	+ 5.200 V $\pm$ 0.005 V
008	+ 5.200 V $\pm$ 0.005 V

h. Set data acquisition system to measure channel 27.

i. On VARIABLE POWER CONTROL panel, set VOLTAGE 2 control for same DIGITAL VOLTMETER indication as in step g.

j. On VARIABLE POWER CONTROL panel, set MODE 1 and MODE 2 switches to PC POWER.

k. Set data acquisition system to measure channel 04.

l. On POWER CONDITIONER TEST PANEL, set CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT switches to ON.

m. On POWER CONDITIONER TEST PANEL, set Rs CONVERTER NO. 1 control for DIGITAL VOLTMETER indication as follows:

Serial Number of Power Conditioner	Voltage Indication	Equivalent Current (Amperes)
004	+ .1200 $\pm$ .0050	24.0 $\pm$ 1.000
007	+ .1156 $\pm$ .0050	23.12 $\pm$ 1.000
008	+ .1156 $\pm$ .0050	23.12 $\pm$ 1.000

NOTE

Leave Rs CONVERTER NO. 1 control at this setting until power conditioner checkout is completed.

n. Set data acquisition system to measure channel 05.

o. On POWER CONDITIONER TEST PANEL, set Rs CONVERTER NO. 2 control for same DIGITAL VOLTMETER indication as in step m, and leave control at this setting during subsequent steps.

p. On POWER CONDITIONER TEST PANEL, set CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT switches to OFF.

q. Remove shorting bolt from lugs on ends of cables 452B1710001-99C and -09D, and connect all lugs on these cables to power conditioner as shown on figure 5-4. Tighten power conditioner terminal nuts to 25 to 28 inch-pounds of torque.

r. Set data acquisition system to measure channel 25.

s. On BUS POWER CONTROL panel, set VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.01 volts.

t. On BUS POWER CONTROL panel, set MODE switch to PC POWER.

u. On POWER CONDITIONER TEST PANEL, with FUNCTION switch set to OFF BUS, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

v. Set data acquisition system to measure channel 02. Verify a DIGITAL VOLTMETER indication of 120 ± 6K ohms.

w. Set data acquisition system to measure channel 03. Verify a DIGITAL VOLTMETER indication of 120 ± 6K ohms.

x. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS, and press CONV NO. 1 COMMAND pushbutton.

y. Set data acquisition system to measure channel 02. Verify a DIGITAL VOLTMETER indication between 0 and 4 ohms.

z. Set data acquisition system to measure channel 03. Verify a DIGITAL VOLTMETER indication of 120 ± 6K ohms.

aa. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

ab. Measure channels 02 and 03. Verify a DIGITAL VOLTMETER indication between 0 and 4 ohms.

ac. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD 0Ω - 5Ω switch to 5Ω and set POWER CONDITIONER LOAD control to approximately 4 ohms (4/5 rotation toward the 5Ω clockwise extreme). (This provides a total load resistance of approximately 9 ohms.)

ad. On POWER CONDITIONER TEST PANEL, set CONV NO. 1, CONV NO. 2, and PWR COND switches to ON BUS.

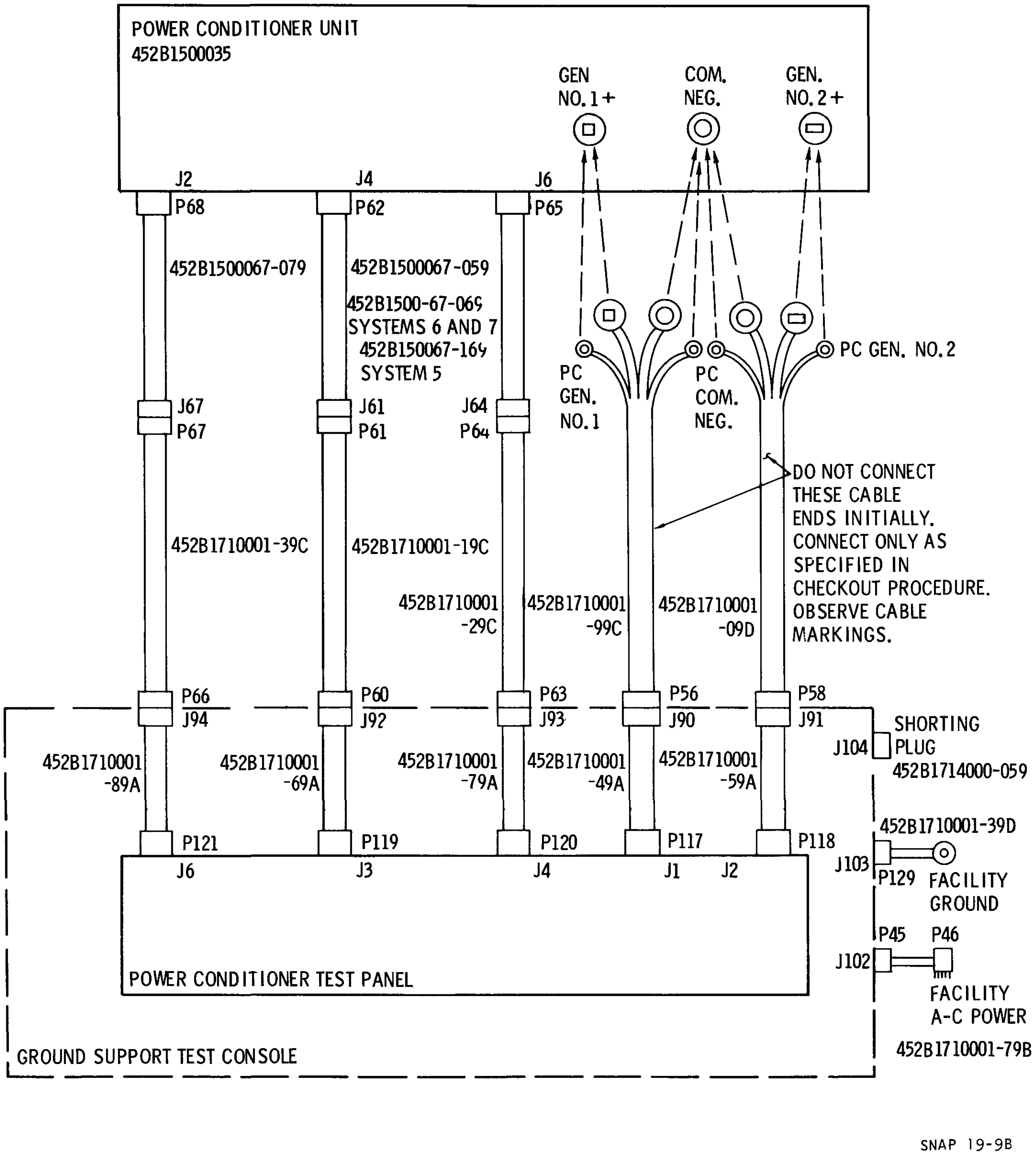


Figure 5-4. Interconnection for Power Conditioner Checkout

ae. On POWER CONDITIONER TEST PANEL, set CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT switches to ON.

NOTE

This step applies power to the power conditioner. Record the time on data sheet (figure A-6, Appendix A) as the start of unit operating time.

af. On BUS POWER CONTROL panel, set VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.05 volts on channels 10 and 11.

ag. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 EXT LOAD and CONV NO. 2 EXT LOAD switches to 20Ω.

ah. At 5-minute intervals, print out channels 00 and 01 until thermal stability is achieved, maintaining channels 10 and 11 at -24.50 ± 0.05 volts. (Channels 10 and 11 may be varied by adjusting the VOLTAGE control on the VARIABLE POWER CONTROL panel.)

NOTE

Thermal stability is achieved when the DIGITAL VOLTMETER indication varies less than 200 ohms per 5-minute period.

ai. After thermal stability is reached, set data acquisition system to scan and print out channels 00 through 20 measurements. (Refer to paragraph 1-115.) Mark data tape FULL LOAD TEST ON BUS VOLTAGE, and save for reference.

aj. On POWER CONDITIONER TEST PANEL, with FUNCTION switch set to OFF BUS, press CONV NO. 1 COMMAND pushbutton.

ak. Perform step ah at 5-minute intervals, maintaining channel 11 at -24.50 ± 0.01 volts, until thermal stability is achieved.

al. After thermal stability is reached, set data acquisition system to scan and print out channels 00 through 24. Mark data tape CONV NO. 1 OFF BUS, and save for reference.

am. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

an. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS and press CONV NO. 1 COMMAND pushbutton.

ao. Perform step ah at 5-minute intervals, maintaining channel 10 at -24.50 ± 0.01 volts, until thermal stability is achieved.

ap. After thermal stability is reached, set data acquisition system to scan and print out channels 00 through 24. Mark data tape CONV NO. 2 OFF BUS, and save for reference.

aq. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to OFF BUS and press CONV NO. 1 COMMAND pushbutton.

ar. At 5-minute intervals, print out channels 00 and 01 until thermal stability is achieved. Thermal stability is achieved when the DIGITAL VOLTMETER indication varies less than 200 ohms per 5-minute period.

as. After thermal stability is reached, set data acquisition system to scan and print out channels 00 through 24. Mark data tape FULL LOAD TEST OFF BUS VOLTAGE, and save for reference.

at. On POWER CONDITIONER TEST PANEL, with FUNCTION switch set to ON BUS, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

au. Set data acquisition system to measure channel 10, and set VOLTAGE control on BUS POWER CONTROL panel for DIGITAL VOLTMETER -25.0 ± 0.01 volts.

av. Perform step ah at 5-minute intervals, maintaining channel 10 measurement at -25.0 ± 0.01 volts, until thermal stability is achieved.

aw. After thermal stability is reached, set data acquisition system to scan and print out channels 00 through 20 measurements. Mark data tape FULL LOAD TEST WITH HIGH BUS VOLTAGE NO. 1, and save for reference.

ax. Set data acquisition system to measure channel 11, and set VOLTAGE control on BUS POWER CONTROL panel for DIGITAL VOLTMETER indication of -25.0 ± 0.01 volts.

ay. Perform step ah at 5-minute intervals, maintaining channel 11 measurement at -25.0 ± 0.01 volts, until thermal stability is reached.

az. Set data acquisition system to scan and print out channels 00 through 20 measurements. Mark data tape FULL LOAD TEST WITH HIGH BUS VOLTAGE NO. 2, save for reference.

ba. Set data acquisition system to channel 10, and set VOLTAGE control on BUS POWER CONTROL panel for indication of -24.0 ± 0.01 volts.

bb. Perform step ah at 5-minute intervals, maintaining channel 10 measurement at -24.00 ± 0.01 volts, until thermal stability is reached.

bc. Set data acquisition system to scan and print out channels 00 through 20 measurements. Mark data tape FULL LOAD TEST WITH LOW BUS VOLTAGE NO. 1, and save for reference.

bd. Set data acquisition system to channel 11, and set VOLTAGE control on BUS POWER CONTROL panel for -24.0 ± 0.01 volts.

be. Perform step ah at 5-minute intervals, maintaining channel 11 at -24.0 ± 0.01 volts, until thermal stability is reached.

bf. Set data acquisition system to scan and print out channels 00 through 20 measurements. Mark data tape FULL LOAD TEST WITH LOW BUS VOLTAGE NO. 2, and save for reference.

bg. On POWER CONDITIONER TEST PANEL, set PWR COND switch to OFF BUS.

bh. Set data acquisition system to monitor channels 10 and 11, and adjust POWER CONDITIONER LOAD control and PWR COND LOAD switches for indication of -24.50 ± 0.10 volts. (Refer to paragraph 1-70 a and b.)

bi. Connect cable 452B1710001-49E between oscilloscope vertical plug-in (1752A) and MONITOR PANEL jack BE.

bj. Set POWER switch on oscilloscope to up position, set oscilloscope to measure peak-to-peak ripple voltage, and record measurement on data sheet (figure A-6, Appendix A) under Ripple Test.

bk. Disconnect oscilloscope and set oscilloscope POWER switch to down position.

bl. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 and CONV NO. 2 switches to OFF BUS.

bm. At 5-minute intervals, print out DIGITAL VOLTMETER indication on channels 00 and 01 until thermal stability is reached.

NOTE

Thermal stability is achieved when the DIGITAL VOLTMETER indication varies less than 200 ohms per 5-minute period.

bn. Set data acquisition system to scan and print out channels 00 through 20 measurements. Mark data tape OPEN CIRCUIT POWER DISSIPATION TEST, and save for reference.

bo. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 and CONV NO. 2 switches to ON BUS, set three PWR COND LOAD switches of 0Ω, and set POWER CONDITIONER LOAD control completely counterclockwise to 0.

bp. Perform step bm at 5-minute intervals until thermal stability is reached.

bq. Set data acquisition system to scan and print out channels 00 through 20. Mark data tape SHORT CIRCUIT POWER DISSIPATION TEST, and save for reference.

br. On DIGITAL VOLTMETER, set selector switch to STD BY.

bs. On VARIABLE POWER CONTROL panel, set VOLTAGE 1 and VOLTAGE 2 controls completely counterclockwise. Set MODE 1 and MODE 2 switches to OFF.

NOTE

This step removes power from the POWER CONDITIONER. Record the time on data sheet (figure A-6, Appendix A) as the stop of unit operating time.

bt. On BUS POWER CONTROL, set VOLTAGE control completely counterclockwise, and set MODE switch to OFF.

bu. On AC RECEPTACLE PANEL, set POWER switch to down position.

bv. Return all GSTC POWER CONDITIONER TEST PANEL controls to initial settings per table 5-1.

bw. Disconnect all cables between GSTC and power conditioner unit, and between GSTC and facility.

bx. Disconnect all patchcords from MONITOR PANEL jacks.

by. From printouts, record required data and complete all calculations indicated on data sheet (figure A-6, Appendix A).

5-47. TELEMETRY SIGNAL CONDITIONER UNIT CHECKOUT PROCEDURE

5-48. PREPARATION FOR CHECKOUT

5-49. To prepare for checkout of a telemetry signal conditioner unit (TSCU):

a. Set ground support test console (GSTC) controls in accordance with table 5-1.

b. Connect cables between GSTC, TSCU and facility as shown on figure 5-5.

c. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-5.

d. On AC RECEPTACLE PANEL, set POWER switch to up position; then verify that:

1. Both lamps on DIGITAL CLOCK lighted (green)

2. Both faces on DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display lighted

4. INPUT SCANNER display lighted

5. POWER ON indicator on DATA PRINTER lighted (red)

6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (three) lighted (red)

8. Power switch indicator on RECORDER off. (If switch-indicator is lighted, press power switch-indicator.)

9. Exhaust fans (four) operating.

e. On DIGITAL VOLTMETER, set selector switch to ON.

f. Set data acquisition system for single channel measurement of channel 00.

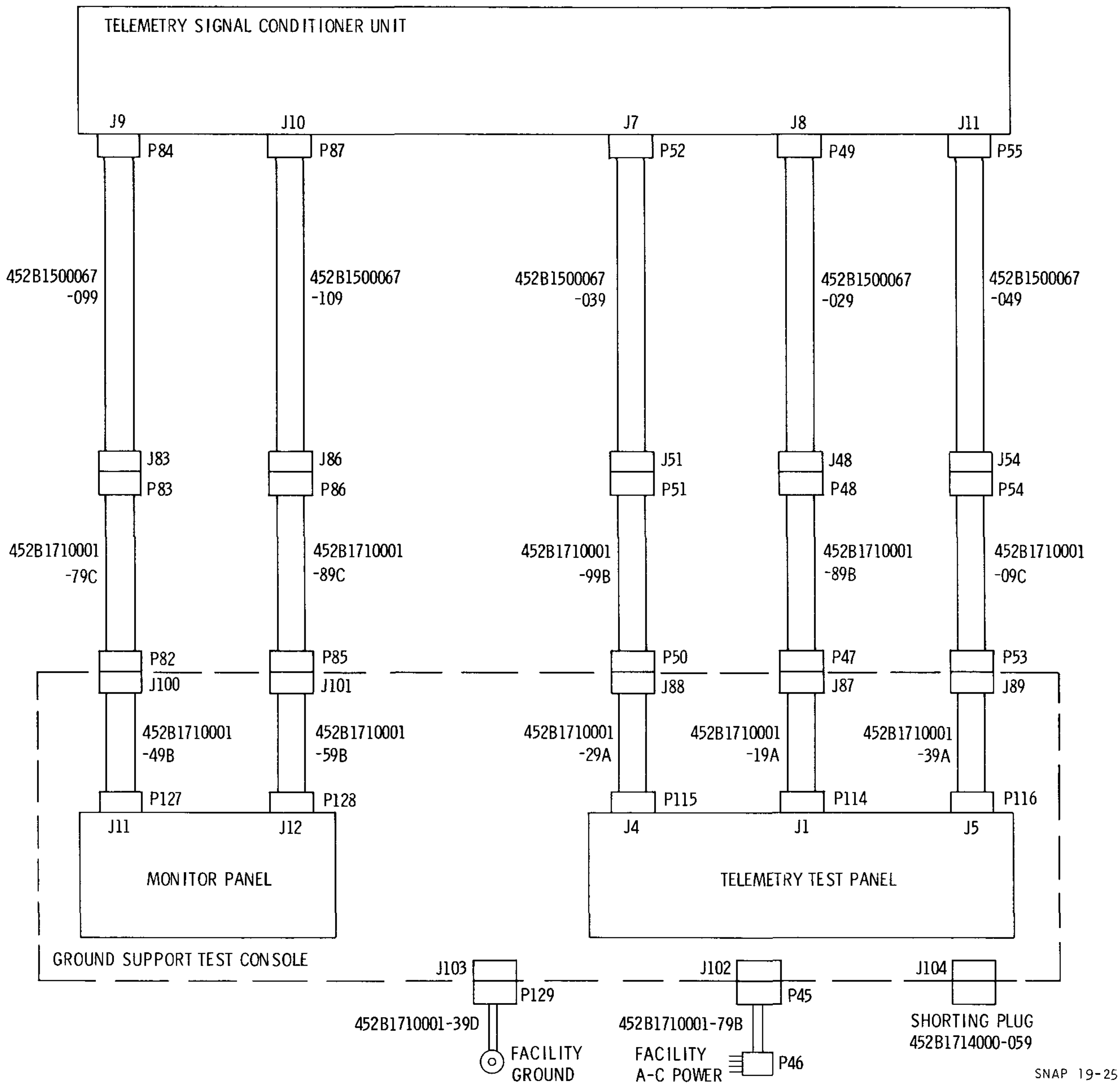


Figure 5-5. Interconnection for Telemetry Signal Conditioner Unit Checkout

Connect Scanner Input Jack No.	To Jack No.	(Measurement)
00	FC	Bus power supply volts
01	FB	Variable power supply volts (No. 2)
02	CA	RTG 1 output volts (sim.)
03	DB	RTG 1 output volts
04	CB	RTG 2 output volts (sim.)
05	DJ	RTG 2 output volts
06	CQ	PC 1 input volts (sim.)
07	DS	PC 1 input volts
08	CV	PC 2 input volts (sim.)
09	EA	PC 2 input volts
10	CR	PC 1 output volts (sim.)
11	DU	PC 1 output volts
12	CW	PC 2 output volts (sim.)
13	EC	PC 2 output volts
14	CT	PC 1 and PC 2 input current (sim.) (20a-100 mv shunt)
15	DT	PC 1 input current
16	EB	PC 2 input current
17	CU	PC 1 and PC 2 output current (sim.) (1-ohm shunt)
18	DV	PC 1 output current
19	ED	PC 2 output current
20	CK	RTG 1 hot jct temp T2 (sim.)
21	CL	RTG 1 hot jct temp T3 (sim.)
22	CM	RTG 1 hot jct temp T5 (sim.)
23	CN	RTG 2 hot jct temp T2 (sim.)

Table 5-5. Monitor Panel Interconnections for Telemetry Signal Conditioner Unit Checkout (Sheet 1 of 3)

Connect Scanner Input Jack No.	To Jack No.	(Measurement)
24	CO	RTG 2 hot jct temp T3 (sim.)
25	CP	RTG 2 hot jct temp T5 (sim.)
26	CE	RTG 1 fin root temp T6 (sim.)
27	CF	RTG 1 fin root temp T7 (sim.)
28	CG	RTG 1 fin root temp T8 (sim.)
29	CH	RTG 2 fin root temp T6 (sim.)
30	CI	RTG 2 fin root temp T7 (sim.)
31	CJ	RTG 2 fin root temp T8 (sim.)
32	CS	PC 1 temp (sim.)
33	CX	PC 2 temp (sim.)
34	CC	RTG 1 pressure (sim.)
35	CD	RTG 2 pressure (sim.)
36	DG	RTG 1 hot jct temp T2
37	DH	RTG 1 hot jct temp T3
38	DI	RTG 1 hot jct temp T5
39	DO	RTG 2 hot jct temp T2
40	DP	RTG 2 hot jct temp T3
41	DQ	RTG 2 hot jct temp T5
42	DD	RTG 1 fin root temp T6
43	DE	RTG 1 fin root temp T7
44	DF	RTG 1 fin root temp T8
45	DL	RTG 2 fin root temp T6
46	DM	RTG 2 fin root temp T7
47	DN	RTG 2 fin root temp 78

Table 5-5. Monitor Panel Interconnections for Telemetry Signal Conditioner Unit Checkout (Sheet 2 of 3)

Connect Scanner Input Jack No.	To Jack No.	Measurement
48	DW	PC 1 temp
49	EE	PC 2 temp
50	DC	RTG 1 pressure
51	DK	RTG 2 pressure
52	DX	PC 1 on-off bus
53	EF	PC 2 on-off bus
54	DA	TSCU input current (1-ohm shunt)
55	FF	TSCU input volts No. 1
56	FG	TSCU input volts No. 2

Table 5-5. Monitor Panel Interconnections for Telemetry Signal Conditioner Unit Checkout (Sheet 3 of 3)

NOTE

To set data acquisition system for single-channel measurements required at several points in this procedure, refer to paragraph 1-117.

g. On BUS POWER CONTROL panel, adjust VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.10 volts; then set MODE switch to TM POWER.

NOTE

Step g applies operating power to the TSCU. Record operation start time on data sheet (figure A-8, Appendix A).

h. Allow 15-minute warm-up period.

i. On BUS POWER CONTROL, adjust VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.05 volts.

j. Proceed with steps in paragraph 5-50.

5-50. CHECKOUT OF VOLTAGE MEASUREMENT CIRCUITS

5-51. After paragraph 5-49 (preparation for checkout) steps have been accomplished, check out voltage measurement circuits as follows:

a. Set data acquisition system to measure channel 01.

NOTE

To set data acquisition system for single-channel measurements required in this procedure, refer to paragraph 1-117.

b. On VARIABLE POWER CONTROL panel, set MODE 2 switch to TM VOLT; then adjust VOLTAGE 2 control for +33.0 volts.

c. On TELEMETRY TEST PANEL, set S1 switch to 1 and S29 switch to ON.

d. Set data acquisition system to scan and print out channels 02 through 09.

NOTE

To set data acquisition system for multi-channel scanning and printout required at several points in this procedure, refer to paragraph 1-115.

e. On TELEMETRY TEST PANEL, set S1 switch to 2, and repeat step d.

f. Set S1 switch to 3, and repeat step d.

g. Set S1 switch to 4, and repeat step d.

h. On TELEMETRY TEST PANEL, set S1 switch to 1.

i. Set data acquisition system to scan and print out channels 10 through 13.

j. On TELEMETRY TEST PANEL, set S1 switch to 2 and repeat step i.

k. Set S1 switch to 3 and repeat step i.

l. Set S1 switch to 4 and repeat step i.

m. Identify the printout tape by marking it VOLTAGE MEASUREMENT CIRCUITS. The tape becomes part of the checkout record.

n. Observe that the even-numbered channels on the tape are simulated inputs to the TSCU, and the odd-numbered channels are the resulting TSCU outputs. Tabel 5-5 defines the signals which correspond to each channel. Each channel has been measured four times (each time with a different input), providing four check points for each channel. Using the appropriate input versus output curves in MND-3607-186, determine whether or not the outputs measured for each channel are within ±0.15 VDC of the calibrated values. Enter the findings on data sheet (figure A-8, Appendix A).

o. On VARIABLE POWER CONTROL panel, set VOLTAGE 2 control completely counterclockwise; then set MODE 2 to OFF.

p. On TELEMETRY TEST PANEL, set S1 and S29 switches to OFF.

q. Proceed with steps under paragraph 5-52.

5-52. CHECKOUT OF CURRENT MEASUREMENT CIRCUITS

5-53. To check out the TSCU current measurement circuits:

a. Set data acquisition system to monitor channel 14.

NOTE

To set data acquisition system for single-channel measurements required in this procedure, refer to paragraph 1-117.

b. On VARIABLE POWER CONTROL panel, insure that VOLTAGE 1 and VOLTAGE 2 controls are set completely counterclockwise; then set MODE 1 control to TM TRANSDUCTOR, and rotate VOLTAGE 1 control slowly clockwise until digital voltmeter indicates +.0250 ± .0002 volts.

c. Set data acquisition system to monitor channel 17.

d. On VARIABLE POWER CONTROL panel, set MODE 2 control to TM TRANSDUCTOR, and rotate VOLTAGE 2 control slowly clockwise until voltmeter indicates +.5000 ± .0010 volt.

e. Allow 5-minute warm-up period; then repeat steps a through d.

f. Set data acquisition system to scan and print out channels 14 through 19.

g. Set data acquisition system to monitor channel 14.

h. On VARIABLE POWER CONTROL panel, rotate VOLTAGE 1 control slowly clockwise until voltmeter indicates + .0600 ± .0002 volt.

i. Set data acquisition system to monitor channel 17.

j. On VARIABLE POWER CONTROL panel, rotate VOLTAGE 2 control slowly clockwise until voltmeter indicates + 1.250 ± .0010 volt.

k. Allow 5-minute warm-up; then repeat steps g through j.

l. Set data acquisition system to scan and print out channels 14 through 19.

m. Repeat steps g through l, except that VOLTAGE 1 control must be set for + .1000 ± .0002 volt indication on channel 14 and VOLTAGE 2 control must be set for + 2.000 ± .0010 volts indication on channel 17.

n. Identify the printout tape by marking it CURRENT MEASUREMENT CIRCUITS. The tape becomes part of the checkout record.

o. Channel 14 voltages represent actual current through transductors which simulate the power conditioner (PC) input circuits. Convert all three printouts of channel 14 to amperes, using the following formula: amperes = volts x 200. Mark amperes on printout tape.

p. Channel 17 voltages represent actual current through power conditioner output-simulating transductors. Convert all (three) channel 17 printouts to amperes, using the following formula: amperes = volts x 1. Mark amperes on printout tape.

q. Channels 15, 16, 18 and 19 are the TSCU outputs resulting from the channels 14 and 17 inputs. Each channel has been measured at three different levels. Using the appropriate input versus output curves in MND-3607-186, determine whether or not the three outputs measured for each channel are within $\pm$ 0.15 VDC of the calibrated values. Enter the findings on data sheet (figure A-8, Appendix A).

r. On VARIABLE POWER CONTROL panel, set VOLTAGE 1 and VOLTAGE 2 controls completely counterclockwise. Then set MODE 1 and MODE 2 controls to OFF.

s. Proceed with steps under paragraph 5-54.

5-54. CHECKOUT OF PRESSURE AND TEMPERATURE MEASUREMENT CIRCUITS

5-55. To checkout the TSCU pressure and temperature measurement circuits:

a. On TELEMETRY TEST PANEL, set S8, S13, S20, and S30 switches to 1.

b. Set data acquisition system to scan and print out channels 20 through 35.

NOTE

To set data acquisition system for multi-channel scanning and printout required in this procedure, refer to paragraph 1-115.

c. On TELEMETRY TEST PANEL, set S31 OHMETER, S9 ISOLATION, S15 ISOLATION, S22 ISOLATION, and S32 ISOLATION switches to ON.

d. Set data acquisition system to scan and print out channels 36 through 51.

e. On TELEMETRY TEST PANEL, set S9, S15, S22, S31 and S32 switches to OFF.

f. Identify the printout tape by marking it PRESSURE AND TEMPERATURE MEASUREMENT CIRCUITS - SWITCHES AT 1. The tape becomes part of the checkout record.

g. Repeat steps a through e except that S8, S13, S20 and S30 switches must be set to 2 rather than 1.

h. Identify the printout tape by marking it PRESSURE AND TEMPERATURE MEASUREMENT CIRCUITS - SWITCHES AT 2. The tape is part of the checkout record.

i. Repeat steps a through e except that S8, S13, S20 and S30 switches must be set to 3 rather than 1.

j. Identify the printout tape by marking it PRESSURE AND TEMPERATURE MEASUREMENT CIRCUITS - SWITCHES AT 3. The tape is part of the checkout record.

k. On TELEMETRY TEST PANEL, set S30 switch to 4 and S8, S13, and S20 switches to OFF.

l. Set data acquisition system to scan and print out channels 20 through 25.

m. On TELEMETRY TEST PANEL, set S9 and S32 to ON.

n. Set data acquisition system to scan and print out channels 36 through 41.

o. Identify the printout tape by marking it PRESSURE AND TEMPERATURE MEASUREMENT CIRCUITS - SWITCH AT 4. The tape is part of the checkout record. Enter finds on data sheet (figure A-8, Appendix A).

p. On TELEMETRY TEST PANEL, set S9, S30 and S32 switches to OFF.

NOTE

Channels 20 through 35 printouts are simulation resistances applied to the TSCU input circuits. Channels 36 through 51 printouts are the TSCU output voltages resulting from the simulated inputs. Table 5-5 identifies these signals. Output curves are supplied in MND-3607-186.

q. Using the appropriate input versus output curves in MND-3607-186, determine what the calibrated value of the TSCU output voltage should be for the measured simulated input (channels 20 through 35). For tape printouts marked PRESSURE AND TEMPERATURE - SWITCHES AT 1,--SWITCHES AT 2, and--SWITCHES AT 3, verify the output printouts (channels 36 through 51) are as follows:

Input channels	Output channels	Output Printout; Maximum Variance from Calibrated Value
20 through 25	36 through 41	-0 to +0.3 VDC
26 through 31	42 through 47	±0.15 VDC
32 and 33	48 and 49	±0.15 VDC
34 and 35	50 and 51	±0.15 VDC

r. Enter findings from step q on data sheet (figure A-8, Appendix A).

s. Proceed with steps under paragraph 5-56.

5-56. CHECKOUT OF DIGITAL MEASUREMENT CIRCUITS

5-57. To checkout the digital measurement circuits:

a. Insure that all TELEMETRY TEST PANEL switches are set to OFF.

b. Set data acquisition system to scan and print out channels 52 and 53.

NOTE

To set data acquisition system for multi-channel scanning and printout required in this procedure, refer to paragraph 1-115.

c. Mark printout tape DIGITAL MEASUREMENT CIRCUITS -SWITCHES OFF. The tape is part of the checkout record. Observe whether or not all printouts are -7.300 ± 0.05 volts, and record findings on data sheet (figure A-8, Appendix A).

d. On TELEMETRY TEST PANEL, set S18 and S19 to ON.

e. Set data acquisition system to scan and print out channels 52 and 53.

f. Mark printout tape DIGITAL MEASUREMENT CIRCUITS - SWITCHES ON. Observe whether or not all printouts are 0.0 ± .1000 volt, and record findings on data sheet (figure A-8, Appendix A).

g. On TELEMETRY TEST PANEL set S18 and S19 switches to OFF.

h. Proceed with steps under paragraph 5-58.

5-58. POWER INPUT TEST

5-59. To check power input to the TSCU:

a. Set input scanner to channel 00.

b. On BUS POWER CONTROL panel, adjust VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.01 volts.

c. On TELEMETRY TEST PANEL, set S9, S15 through S19, S22 through S28, and S31 through S38 switches to ON.

d. On TELEMETRY TEST PANEL, set S14 and S21 switches to 1.

e. Set data acquisition system to scan and print out channels 54 through 56.

NOTE

To set data acquisition system for multi-channel scanning and printout required in this procedure, refer to paragraph 1-125.

f. Mark printout tape POWER INPUT TEST. Verify that channels 55 and 56 (voltage input channels to TSCU) indicate between -24.35 and -24.50 volts and are within 0.1 volt of each other. (Voltage indication of channel 54 is input current to TSCU in amperes.) Verify that channel 54 indication is less than -0.0800 amperes. Record findings on data sheet (figure A-8, Appendix A).

g. Set all switches on TELEMETRY TEST PANEL to OFF.

5-60. SHUTDOWN PROCEDURE

5-61. After all TSCU testing has been completed:

a. On BUS POWER CONTROL panel, set VOLTAGE control completely counterclockwise, and set MODE switch to OFF.

NOTE

This step removes operating power from the TSCU. Record operation stop time on data sheet (figure A-8, Appendix A).

b. On DIGITAL VOLTMETER, set selector switch to STD BY.

c. On AC RECEPTACLE PANEL, set POWER switch to off (down) position.

d. Disconnect interconnecting cables, and remove patchcords from MONITOR PANEL.

NOTE

The input versus output curves required to evaluate the data taken during the TSCU checkout procedure are in MND-3607-186.

5-62. SYSTEM CHECKOUT PROCEDURE WITH GENERATOR SIMULATION

5-63. The objectives of the SNAP 19 system test with generator simulator are to provide a means of checking out the PCU and TSCU when the RTG subsystem is not available and to allow for trouble shooting the system without resorting to the long procedure required when the RTG subsystem is used.

5-64. PREPARATION FOR GENERATOR SIMULATION SYSTEM CHECKOUT

a. Set ground support test console (GSTC) controls in accordance with table 5-1.

b. Connect cables between facility, GSTC, PCU, and TSCU as shown on figure 5-6.

NOTE

Do not connect terminal lugs of cables 452B1710001-99C and -09D to power conditioner at this time. Instead, short the four heavy lugs (one coded with a square, one with a rectangle, and two with circles) to one another by using a 1/4-inch bolt, washers, and nut to fasten the lugs firmly together. Leave four smaller lugs unattached.

c. Connect patchcords between jacks on the MONITOR PANEL as indicated below.

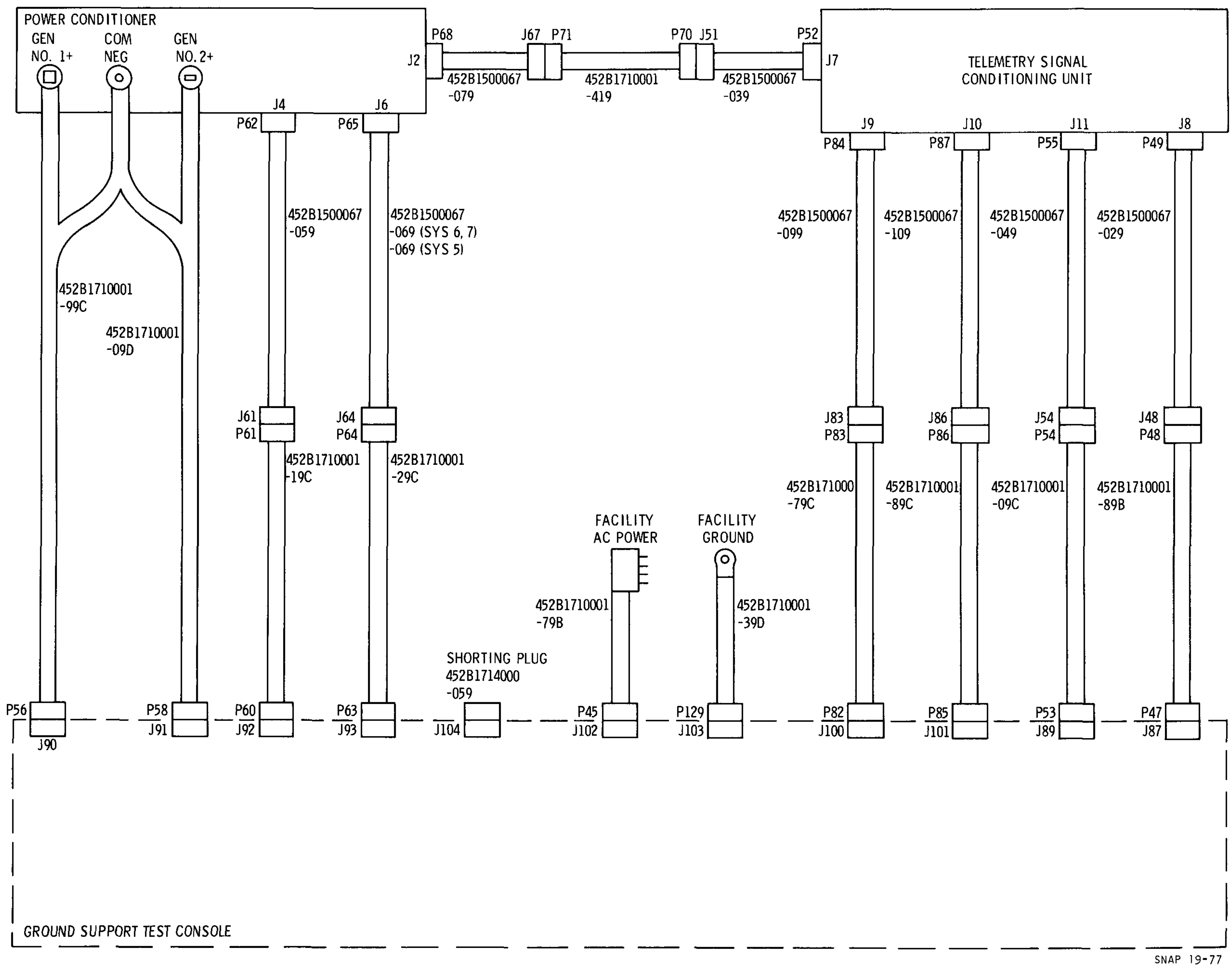


Figure 5-6. Interconnection for System Checkout with Generator Simulation

Connect Jack No.	To Jack No.	Measurement
00	FA	Variable power supply volts No. 1
01	FB	Variable power supply volts No. 2
02	FC	Bus power supply volts

d. On AC RECEPTACLE PANEL, set POWER switch to up position; then verify that:

1. Both lamps on DIGITAL CLOCK are lighted (green)
2. Both faces of DIGITAL CLOCK are lighted (white)
3. DIGITAL VOLTMETER display lighted
4. INPUT SCANNER display lighted
5. POWER ON indicator on DATA PRINTER lighted (red)
6. RECORD ON indicator on DATA PRINTER lighted (white)
7. Indicator on power supply (three) lighted (red)
8. POWER switch-indicator on RECORDER is OFF. (If switch-indicator is lighted, press indicator.
9. Exhaust fans (four) are operating.

e. Allow 10-minute warmup before proceeding.

f. Set selector switch on DIGITAL VOLTMETER to ON.

g. Set INPUT SCANNER to channel 00.

h. On VARIABLE POWER CONTROL panel, adjust VOLTAGE 1 control for a DIGITAL VOLTMETER indication as follows:

Serial Number of Power Conditioner	Voltage Indication
004	+5.000 $\pm$ 0.005 volts
007	+5.200 $\pm$0.005 volts
008	+5.200 $\pm$0.005 volts

i. Set INPUT SCANNER to channel 01.

j. On VARIABLE POWER CONTROL panel, adjust VOLTAGE 2 control for same DIGITAL VOLTMETER indication as in step h.

k. Set INPUT SCANNER to channel 02.

l. On BUS POWER CONTROL panel, adjust VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.01 volts.

m. Remove patchcords from MONITOR PANEL.

n. On TELEMETRY TEST PANEL, set S29 to ON.

o. Connect patchcords between jacks on MONITOR PANEL as indicated in table 5-6.

NOTE

Connect each patchcord first to the desired scanner jack (00 through 59) and then to the signal jack.

p. On VARIABLE POWER CONTROL panel, set MODE 1 and MODE 2 switches to PC POWER.

q. On BUS POWER CONTROL panel, set MODE switch to PC//TM.

r. Set INPUT SCANNER to channel 04.

s. On POWER CONDITIONER TEST PANEL, set CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT switches to ON.

t. On POWER CONDITIONER TEST PANEL, adjust R_S CONVERTER NO. 1 control for a DIGITAL VOLTMETER indication as follows:

Serial Number of Power Conditioner	Voltage Indication (volts)	Equivalent Current (amps)
004	+0.1200 ± 0.0050	24.0 ± 1
007	+0.1156 ± 0.0050	23.12 ± 1
008	+0.1156 ± 0.0050	23.12 ± 1

u. Set INPUT SCANNER to channel 06.

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
00	BA	PC 1 input volts (direct measurement)
01	DS	PC 1 input volts (TM)
02	BH	PC 2 input volts (direct measurement)
03	EA	PC 2 input volts (TM)
04	BB	PC 1 input current (20a -100 mv shunt)
05	DT	PC 1 input current (TM)
06	BI	PC 2 input current (20a -100 mv shunt)
07	EB	PC 2 input current (TM)
08	BC	PC 1 output volts (direct measurement)
09	DU	PC 1 output volts (TM)
10	BJ	PC 2 output volts (direct measurement)
11	EC	PC 2 output volts (TM)
12	BD	PC 1 output current (1Ω shunt)
13	DV	PC 1 output current (TM)
14	BK	PC 2 output current (1Ω shunt)
15	ED	PC 2 output current (TM)
16	DW	PC 1 Temperature (TM)
17	EE	PC 2 Temperature (TM)
18	DX	PC 1 on-off bus status (TM)
19	EF	PC 2 on-off bus status (TM)
20	FD	PC 1 ext load volts (direct reading)
21	FE	PC 2 ext load volts (direct reading)

Table 5-6. Monitor Panel Interconnections for System Checkout with Generator Simulation (Sheet 1 of 3)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
22	FH	PC 1 ext load current (1-ohm shunt)
23	FI	PC 2 ext load current (1-ohm shunt)
24	FF	TSCU input volts No. 1 (direct reading)
25	FG	TSCU input volts No. 2 (direct reading)
26	DA	TSCU input current (1-ohm shunt)
27	BE	PC output load volts (direct measurement)
28	DG	RTG 1 hot junction T2 (TM)
29	DH	RTG 1 hot junction T3 (TM)
30	DI	RTG 1 hot junction T5 (TM)
31	DO	RTG 2 hot junction T2 (TM)
32	DP	RTG 2 hot junction T3 (TM)
33	DQ	RTG 2 hot junction T5 (TM)
34	DD	RTG 1 fin root T6 (TM)
35	DE	RTG 1 fin root T7 (TM)
36	DF	RTG 1 fin root T8 (TM)
37	DL	RTG 2 fin root T6 (TM)
38	DM	RTG 2 fin root T7 (TM)
39	DN	RTG 2 fin root T8 (TM)
40	DC	RTG 1 pressure (TM)
41	DK	RTG 2 pressure (TM)
42	DB	RTG 1 output volts (TM)
43	DJ	RTG 2 output volts (TM)

Table 5-6. Monitor Panel Interconnections for System Checkout with Generator Simulation (Sheet 2 of 3)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
44	CK	RTG 1 hot junction T2 (sim)
45	CL	RTG 1 hot junction T3 (sim)
46	CM	RTG 1 hot junction T5 (sim)
47	CN	RTG 2 hot junction T2 (sim)
48	CO	RTG 2 hot junction T3 (sim)
49	CP	RTG 2 hot junction T5 (sim)
50	CE	RTG 1 fin root T6 (sim)
51	CF	RTG 1 fin root T7 (sim)
52	CG	RTG 1 fin root T8 (sim)
53	CH	RTG 2 fin root T6 (sim)
54	CI	RTG 2 fin root T7 (sim)
55	CJ	RTG 2 fin root T8 (sim)
56	CC	RTG 1 pressure (sim)
57	CD	RTG 2 pressure (sim)
58	CA	RTG 1 output volts (sim)
59	CB	RTG 2 output volts (sim)
CA	FA	--
CB	FB	--

Table 5-6. Monitor Panel Interconnections for System Checkout with Generator Simulation (Sheet 3 of 3)

v. On POWER CONDITIONER TEST PANEL, adjust R_s CONVERTER NO. 2 control for the same DIGITAL VOLTMETER indication as in step t.

w. On POWER CONDITIONER TEST PANEL, set CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT switches to OFF.

x. Remove shorting bolt from lugs on ends of cables 452B1710001-99C and -09D. Connect all lugs on these cables to power conditioner as shown on figure 5-6. Tighten power conditioner terminal nuts to 25 to 28 inch-pounds of torque.

y. On POWER CONDITIONER TEST PANEL, with FUNCTION switch set to OFF BUS, press CONV. NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

5-65. INITIAL SET-UP FOR GENERATOR SIMULATION SYSTEM CHECKOUT

a. Set INPUT SCANNER to channel 18 and verify a DIGITAL VOLTMETER indication between -7.20 and -7.40 volts.

b. Set INPUT SCANNER to channel 19 and verify a DIGITAL VOLTMETER indication between -7.20 and -7.40 volts.

c. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS, and press CONV NO. 1 COMMAND pushbutton.

d. Set INPUT SCANNER to channel 18 and verify a DIGITAL VOLTMETER indication between 0.0 and -0.10 volt.

e. Set INPUT SCANNER to channel 19 and verify a DIGITAL VOLTMETER indication between -7.20 and -7.40 volts.

f. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

g. Set INPUT SCANNER to channel 18 and verify a DIGITAL VOLTMETER indication between 0.0 and -0.10 volt.

h. Set INPUT SCANNER to channel 19 and verify a DIGITAL VOLTMETER indication between 0.0 and -0.10 volt.

i. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD 0Ω - 5Ω switch to 5Ω and set POWER CONDITIONER LOAD control to approximately 4 ohms (4/5 rotation toward the $5\,\Omega$ clockwise extreme).

j. On POWER CONDITIONER TEST PANEL, set CONV NO. 1, CONV NO. 2, and PWR COND switches to ON BUS.

k. On POWER CONDITIONER TEST PANEL, set CONVERTER NO. 1 INPUT and CONVERTER NO. 2 INPUT switches to ON.

l. On POWER CONDITIONER TEST PANEL, set CONV NO. 1 EXT LOAD and CONV NO. 2 EXT LOAD switches to 20Ω.

m. On BUS POWER CONTROL panel, adjust VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.05 volts with INPUT SCANNER set to channels 08 and 10.

n. On TELEMETRY TEST PANEL, set S8, S20, and S30 to 2.

o. At 5-minute intervals, print out channels 16 and 17 until thermal stability is achieved, maintaining channels 08 and 10 at -24.50 ± 0.05 volts. (Channels 08 and 10 may be varied by adjusting the VOLTAGE control on the BUS POWER CONTROL panel.)

NOTE

Thermal stability is achieved when the DIGITAL VOLTMETER indication varies less than 1° F per 5-minute period. (Refer to appropriate curve in MND-3607-186.)

5-66. GENERATOR SIMULATION SYSTEM CHECKOUT

a. Set data acquisition system to scan and print out channels 44 through 59. Mark the data tape TSCU INPUTS and save for reference.

b. On TELEMETRY TEST PANEL, set S9, S22, S31, and S32 to ON.

c. Set data acquisition system to scan and print out channel 00 through 43. Mark the data tape FULL LOAD TEST ON BUS, and save for reference.

d. On POWER CONDITIONER TEST PANEL, with FUNCTION switch set to OFF BUS, press CONV NO. 1 COMMAND pushbutton.

e. Perform step o of paragraph 5-65 at 5-minute intervals, maintaining channel 10 at -24.50 ± 0.01 volts, until thermal stability is achieved.

f. After thermal stability is reached, set data acquisition system to scan and printout channels 00 through 26. Mark the data tape CONV NO. 1 OFF BUS and save for reference.

g. On POWER CONDITIONER TEST PANEL, press CONV NO. 2 COMMAND pushbutton.

h. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to ON BUS and press CONV NO. 1 command pushbutton.

i. Perform step o of paragraph 5-65 at 5-minute intervals, maintaining channel 08 at -24.50 $\pm$ 0.01 volts, until thermal stability is achieved.

j. After thermal stability is reached, set data acquisition system to scan and print out channels 00 through 26. Mark the data tape CONV NO. 2 OFF BUS and save for reference.

k. On POWER CONDITIONER TEST PANEL, set FUNCTION switch to OFF BUS and press CONV NO. 1 COMMAND.

l. At 5-minute intervals, print out channels 16 and 17 until thermal stability is achieved.

NOTE

Thermal stability is achieved when the DIGITAL VOLTMETER indication varies less than 1°F per 5-minute period. (Refer to appropriate curve in MND-3607-186.)

m. After thermal stability is reached, set data acquisition system to scan and print out channels 00 through 26. Mark the data tape full load OFF BUS and save for reference.

n. On POWER CONDITIONER TEST PANEL, with FUNCTION switch set to ON BUS, press CONV NO. 1 COMMAND and CONV NO. 2 COMMAND pushbuttons.

o. Set INPUT SCANNER to channel 08.

p. Connect cable assembly 452B1710001-49E between oscilloscope vertical plug-in, 1752A, and MONITOR PANEL jack, BE; then turn on oscilloscope and allow it to warm up for 5 minutes.

q. On BUS POWER CONTROL panel, set MODE switch to UNREG.

r. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -24.5 $\pm$ 0.05 volts. (Refer to paragraphs 1-70a and 1-70b.)

s. Set oscilloscope to measure peak-to-peak ripple voltage. Record measurement on Data Sheet (figure A-10, Appendix A) under RIPPLE TEST.

t. Disconnect oscilloscope. On BUS POWER CONTROL panel, set MODE switch to PC//TM.

u. On POWER CONDITIONER TEST PANEL, set PWR COND LOAD switches and POWER CONDITIONER LOAD control for a DIGITAL VOLTMETER indication of -19.5 $\pm$ 0.5 volts. (Refer to paragraphs 1-70a and

v. On BUS POWER CONTROL panel, adjust VOLTAGE control until -24.50 $\pm$ 0.10 volts is obtained on channels 08 and 10.

5-67. GENERATOR SIMULATION SYSTEM CHECKOUT TEST COMPLETION

a. On DIGITAL VOLTMETER, set selector switch to STD BY.

b. On VARIABLE POWER CONTROL panel, set VOLTAGE 1 and VOLTAGE 2 controls fully counterclockwise. Set MODE 1 and MODE 2 switches to OFF.

c. On BUS POWER CONTROL, set VOLTAGE control fully counterclockwise and set MODE switch to OFF.

d. Set all switches on the TELEMETRY TEST PANEL to OFF.

e. On AC RECEPTACLE PANEL, set POWER switch to down position.

f. Set all GSTC controls on POWER CONDITIONER TEST PANEL to initial settings per table 5-1.

g. Disconnect all cable assemblies between GSTC, PCU, TSCU, and facility.

h. Disconnect all patchcords from MONITOR PANEL.

i. From data tapes, record required data and complete all calculations indicated on data sheet (figure A-9, Appendix A). Verify data compliance with limits on data sheet.

NOTE

Observe that on data tape marked TSCU INPUTS are recorded the simulated inputs to the TSCU. On the data tape marked full load test ON BUS channels 28 through 43 are the corresponding TSCU outputs. Table 5-6 defines the signals that correspond to each channel. Using the appropriate input versus output curves supplied in MND-3607-186 and the values recorded on the above mentioned data tapes, compare the values on the data tapes versus the calibrated value on the appropriate curve. Channels 28 through 33 should be compared to be within limits -0 to + 0.3 volts. Channels 34 through 43 should be compared to be within the limits of $\pm$ 0.15 volts. Enter findings on data sheet (figure A-10, Appendix A) under TSCU CHECKOUT.

SECTION VI

MAINTENANCE

6-1. MAINTENANCE OF THERMOELECTRIC POWER SUPPLY SYSTEM

6-2. CAUTIONS AND WARNINGS

6-3. Keep Proper Load on Thermoelectric Generators

6-4. During checkout procedures, this caution applies to fueled generators and to electrically heated generators when power is applied to the heaters. Never open the output circuit of either generator for longer than 30 seconds. To do so will cause excessive temperature rise in the generator. Excessive load variations cause thermal disturbances which are detrimental to the generators. The generator temperatures must not be allowed to change at a rate exceeding 35° F per 15 minutes. The ground support test console (GSTC) constitutes a satisfactory load when operated in accordance with procedures herein. When off test for short periods, the dummy load accompanying the generator subsystem is satisfactory. During off-test periods exceeding 3 hours, or when the generator is unattended, the generator output plug must be connected to the short receptacle J21. During launch operations, or in other situations where the ground support test console or other external load is not available, the generator output may be switched from short to load, load to short, or open circuited provided the switching is done in open air with the fins uninsulated and the initial fin root temperature is less than 265° F. Although this sequencing is permissible, the number of such operations and the length of time that the generators are open circuited must be held to a minimum.

6-5. Maintain Proper Power to Electrically Heated Generators

6-6. Thermal disturbances are detrimental to the generators. The generators must be brought up to operating temperature slowly, while monitoring the generator temperatures, so that the rate of temperature change does not exceed 35°F per 15 minutes, and this rate of change must not be exceeded thereafter. Once the generator is brought up to operating temperature, every effort must be made to maintain that temperature. Thermal cycling is detrimental to the generators. If the system must be cooled, reduce input power to the heaters slowly and monitor temperatures constantly to avoid exceeding a change rate of 35°F per 15 minutes. Never remove heater power from a hot generator for longer than 45 seconds. The acceptable rate for heating up or cooling down the generator is 25 watts per 15 minutes.

6-7. Keep Radiation Shield in Place Whenever Possible

6-8. With fueled generators, testing and monitoring must be done with the radiation shield in place for safety of personnel. Insure that exposure of personnel to radiation does not exceed permissible limits. (Refer to paragraph 2-6.)

6-9. Avoid Contact With Hot Generators

6-10. The external surfaces of hot generators may reach a temperature of 370° F. Use care to avoid burns. (The surfaces reach 370° F in simulated orbital conditions, 270° F in ambient air, and 295° F in the generator subsystem shipping container.)

CAUTION

Airflow around the generators must not be obstructed. Fin root temperatures exceeding the maximum allowable (385° F) may result.

6-11. TROUBLESHOOTING AND REPAIR

6-12. If a power supply system does not meet the performance requirements specified under paragraph 5-7, System Checkout Procedures, analyze the data obtained during system checkout to determine which of the subsystems is most likely to be malfunctioning, and perform a subsystem checkout of that unit. If necessary, check out all subsystems independently to isolate the defective unit.

6-13. All units of the power supply system are classed as non-reparable in the field. Do not attempt to repair a defective subsystem. Instead, contact the Martin Marietta Corporation, Baltimore, Maryland, regarding disposition of the unit.

6-14. MAINTENANCE OF GROUND SUPPORT TEST CONSOLE

6-15. EQUIPMENT CALIBRATION

6-16. Calibration is recommended at the intervals listed for each of the following ground support test console (GSTC) panels:

	Interval (Months)
a. TELEMETRY TEST PANEL	12
b. POWER CONDITIONER TEST PANEL	12
c. RTG LOAD	6
d. UNIVERSAL EPUT AND TIMER, MODEL 7350A	6
e. OSCILLOSCOPE, MODEL 175A	6
f. HEATER POWER SUPPLY CONTROL PANEL	6
g. POWER SUPPLY (2), CCI 94N4-1	6
h. DIGITAL VOLTMETER, SERIES 5000	3
i. INPUT CONVERTER, SERIES 1100	6
j. INPUT SCANNER, MODEL 262S701	12
k. DATA PRINTER, MODEL 155	12
l. POWER SUPPLY (3), MODEL ECR 36-30	6
m. RECORDING SYSTEM, MARK 200	6

6-17. Calibration of the TELEMETRY TEST PANEL consists of checking the shunts (R91 and R92) and verifying they are within manufacturer's specified accuracy (R91- ± 0.1%; R92- ± 0.5%).

6-18. Calibration of the POWER CONDITIONER TEST PANEL consists of checking the R14 and R15 shunts for an accuracy of ± 0.5%, checking the R16, R17, R27, and R28 shunts for an accuracy of ± 0.1%, and checking and adjusting, if necessary, two relay driver circuit boards. These circuit boards, 452B1711220-009, are connected to jacks J11 and J12 along the side of the power conditioner test panel chassis. To adjust the circuit boards (both are adjusted in the same manner):

a. Obtain a power supply capable of being adjusted to 24.5 volts DC and an oscilloscope with external triggering capability.

b. Remove circuit boards from jacks J11 and J12.

c. Connect high side of oscilloscope vertical input to pin A of circuit board plug, and connect ground side of oscilloscope input to pin B. Connect a 1-K ohm, 1-watt resistor between pins A and B.

d. Connect external trigger input of oscilloscope to pin A.

e. Connect a momentary-action, normally closed switch between pins C and D.

f. Connect positive side of power supply to pin C and negative side to pin S, and adjust to 24.5 volts DC.

g. Set oscilloscope to observe a +20 ± 1.0-volt pulse of approximately 50 milliseconds duration.

h. Actuate momentary switch and measure pulse width.

i. No adjustment is required if pulse width is 50 ± 5 ms. If width is out of tolerance, adjust potentiometer R6 on the circuit board for pulse width of 50 ± 5 ms.

6-19. Calibration of the RTG LOAD panel consists of checking the R3 and R4 shunts for accuracy of ± 0.5% and of checking and adjusting, if necessary, TCT1, TCT2, TCA1 and TCA2 thermocouple transmitter units as follows:

a. Set range of Acromag, Inc. part No. 314-AX and 314-AT to 4 VDC ± 0.02% output with 400°F input and 20 VDC ± 0.02% output with 1200°F input.

b. Verify that units are linear within 1% at the following points:

Input (°F)	Output (VDC)
600	8 ± 0.2
800	12 ± 0.2
1000	16 ± 0.2

c. Set alarm to trigger at 975°F (-0 +25°F), with dropout set for 975°F (+0 -25°F). (Refer to calibration instructions supplied with transmitters by Acromag, Inc.)

6-20. Calibration of the HEATER POWER SUPPLY CONTROL PANEL consists of checking the two wattmeters and temperature meter (the temperature meter is a 20 VDC full scale, 1% voltmeter) and of checking and adjusting, if necessary, the TCA1 and TCA2 thermocouple transmitter alarm units as follows:

a. Set range of Acromag, Inc. part No. 314-AT to 400 to 1200°F.

b. Verify that units are linear within 1%, full scale, at 600°F, 800°F, and 1000°F.

c. Set alarm to trigger at 975°F (-0 +25°F) with dropout set for 975°F (+0 -25°F). (Refer to calibration instructions supplied with transmitters by Acromag, Inc.)

6-21. Calibration procedures for other units listed under paragraph 6-16 are given in the manufacturers' literature. The following precautions must be observed:

a. The digital voltmeter must be calibrated with filter assembly 452B1713002 connected, using cable assembly 452B170001-89D.

b. Power supplies A15, A16 and A21, figure 1-6, must be calibrated with terminals 3 and 4 of TB1 jumpered. This jumper must be removed prior to reinstalling the power supplies in the GSTC.

c. Power supplies A8 and A9, figure 1-6, must be calibrated with terminals 8 and 9 of TB2 jumpered. This jumper must be removed prior to reinstalling the power supplies in the GSTC or the power supply rack.

d. Recording system ink supply valves must be turned off when the system is not in use.

6-22. TROUBLESHOOTING AND REPAIR

6-23. Troubleshooting and repair information for the commercial equipment panels of the GSTC is given in the manufacturers' literature furnished with the equipment.

6-24. Functional and schematic diagrams are shown in figures 6-1 through 6-51. These diagrams and the functional descriptions under paragraph 1-35 provide sufficient data for a skilled electronics technician to isolate any trouble that may occur. Conventional electronics servicing techniques are applicable to all GSTC equipment.

6-25. <u>MOBILE CARRIAGE HEATER POWER CONTROL ASSEMBLY BATTERY CHARGING PROCEDURE</u>

a. Set heater power control assembly and battery charger controls in accordance with table 5-1.

b. Connect P5 of cable assembly 452B1800031-129 to J3 of heater power control assembly. Connect the red and black plugs to the battery charger DC OUTPUT 0 TO 5 AMPS red and black jacks, respectively.

c. On battery charger, set POWER switch to ON.

d. Verify that CHARGING CURRENT ON lamp is lighted (white).

e. On battery charger, press CALIBRATE switch and adjust bottom screw on VOLTAGE CUT-OFF METER for CAL position.

f. Insure that CELL SELECTOR on battery charger is set to 20.

g. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to BANK 1.

h. Adjust CURRENT CONTROL on battery charger to obtain a 2-ampere indication on ammeter.

i. Maintain 2-ampere indication until CHARGING CURRENT OFF lamp lights amber.

j. On battery charger, press RESET switch for 5 seconds. If CHARGING CURRENT OFF lamp goes off, repeat step i, and then press RESET switch again. When CHARGING CURRENT OFF lamp remains lighted after pressing RESET switch, proceed to step k.

k. Set battery charger POWER switch to OFF.

l. Set battery charger CURRENT CONTROL fully counterclockwise.

m. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to BANK 2.

n. Repeat steps c through f and h through l.

o. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to BANK 3.

p. Repeat steps c through e.

q. On battery charger, set CELL SELECTOR to 21.

r. Repeat steps h through l.

s. On rear panel of heater power control assembly, set BATTERY CHARGING SELECTOR switch to OFF.

t. Set battery charger CELL SELECTOR to 20.

u. On heater power control assembly, set RESET TIME TOTALIZER to 00000.

v. Disconnect cable assembly 452B1800031-129.

6-26. PORTABLE MONITOR CALIBRATION

NOTE

Calibration at 6-month intervals is recommended.

a. Connect a voltmeter across battery voltage test jacks on panel of portable monitor. If voltage is less than 11.25 VDC, replace batteries.

NOTE

Steps b through f are for DC adjustment.

b. Set AC-OFF-DC switch to DC.

c. Set HOT JUNCT TEMP switch to 800° F CHECK.

d. Adjust R11 (under front panel) for 800° F indication on meter.

e. Set FIN ROOT AND PRESSURE switch to 300° F CHECK.

f. Adjust R4 (under front panel) for 300° F indication on meter.

NOTE

Steps g through i are for AC adjustment.

g. Connect J4 to AC power source. (Refer to paragraph 2-35.)

h. Set AC-OFF-DC switch to AC.

i. Verify that HOT JUNCT TEMP meter indicates 800° F.

j. Calibrate HOT JUNCT TEMP meter over entire range for 1% full scale accuracy.

k. Calibrate FIN ROOT AND PRESSURE meter over entire range for 1% full scale accuracy.

l. Check pyrometer over entire range for 1% full scale accuracy employing 10.8-ohm cable resistance.

6-27. TELEMETRY SIGNAL CONDITIONER UNIT CALIBRATION

6-28. The procedures following provide instructions for obtaining data from which calibration curves for each of the telemetry signal conditioner unit (TSCU) circuits can be plotted. Figure A-9, Appendix A contains sample data sheets for recording the data obtained by performance of the procedures. The procedures set the input value (from the data sheets) into the ground support test console and the output indication is then recorded on the data sheet beside the appropriate input value.

6-29. Before any circuit is calibrated, the preparation for calibration (paragraph 6-32) must be performed. Following completion of the preparation, all circuits may be calibrated in the sequence presented in the procedures, or calibration of selected circuits may be performed.

6-30. The calibration procedures are presented in tabular form, with the procedures for several similar circuits contained in a single table. For example, table 6-2 contains instructions for all voltage measurement circuits.

6-31. CALIBRATION FIRST RUN

a. Select appropriate table from list below:

Voltage measurement circuits -	table 6-2
Current measurement circuits -	table 6-3
RTG pressure measurement circuits -	table 6-4
PC temperature measurement circuits -	table 6-5
RTG fin root temperature measurement circuits -	table 6-6
RTG hot junction temperature measurement circuits -	table 6-7

b. Perform calibration preparation procedure (steps a through j, paragraph 6-32).

c. Perform procedures in Step column of selected table, complying with entries in columns headed by name of circuit to be calibrated.

NOTE

Some steps in the tables bear the notation "(for all circuits)", with an X in all circuit columns. This means that the step is identical for all circuits.

d. After run 1 of the calibration is completed, perform the subsequent runs in accordance with paragraph 6-33.

NOTE

The tabulated procedures are specifically for the first calibration run. The subsequent runs are essentially repetitions of the first run.

6-32. PREPARATION FOR TELEMETRY SIGNAL CONDITIONER UNIT CALIBRATION

a. Set ground support test console (GSTC) controls in accordance with table 5-1.

b. Connect cables between facility, GSTC, and telemetry signal conditioner unit (TSCU) as shown on figure 5-5.

c. Connect patchcords between jacks on MONITOR PANEL as indicated in table 6-1.

d. On AC RECEPTACLE PANEL, set at POWER switch to the up position. Verify that:

1. Both lamps on DIGITAL CLOCK lighted (green)

2. Both faces on DIGITAL CLOCK lighted (white)

3. DIGITAL VOLTMETER display lighted

4. INPUT SCANNER display lighted

5. POWER ON indicator on DATA PRINTER lighted (red)

6. RECORD ON indicator on DATA PRINTER lighted (white)

7. Indicator on power supply (three) lighted (red).

8. POWER switch indicator on RECORDER off. (If switch-indicator is lighted, press power switch-indicator.)

9. Rack exhaust fans (four) are operating.

e. On DIGITAL VOLTMETER, set selector switch to ON

f. Set input scanner to channel 00

g. On BUS POWER CONTROL panel, adjust VOLTAGE control DIGITAL VOLTMETER indication for -24.50 ± 0.1 volts.

h. On BUS POWER CONTROL panel, set MODE switch to TM POWER.

i. Allow 15-minute warm up period.

j. On BUS POWER CONTROL panel, adjust VOLTAGE control for DIGITAL VOLTMETER indication of -24.50 ± 0.05 volts.

k. Perform circuit calibration from tables. (Refer to paragraph 6-31, step a.)

6-33. CALIBRATION RE-RUNS

a. On BUS POWER CONTROL panel, set MODE switch to OFF.

b. After 10 minutes, repeat steps f through j of paragraph 6-32 and the steps in the appropriate calibration procedure table.

NOTE

Make required data sheet entries in the RUN 2 column.

c. Repeat steps a and b, above, until a total of five calibration runs has been made.

NOTE

Make required data sheet entries in the RUN 3, RUN 4, and RUN 5 columns in accordance with the run sequence.

d. For each calibration point, compute the average value of the data from the five runs.

e. Enter average in right hand column on data sheet.

NOTE

The average value and the input value provide the data necessary to plot a curve of simulated input parameter ranges as a function of TSCU output voltage.

6-34. SHUTDOWN AFTER CALIBRATION

a. On DIGITAL VOLTMETER, set selector switch to STD BY.

b. On BUS POWER CONTROL panel, rotate VOLTAGE control fully counter clockwise and set MODE switch to OFF.

c. On AC RECEPTACLE PANEL, set POWER switch to down position.

d. Disconnect cables between facility, GSTC, and TSCU.

e. Remove patchcords between jacks on MONITOR PANEL.

6-35. MOBILE CARRIAGE HEATER POWER CONTROL ASSEMBLY CALIBRATION

NOTE

Calibration at 6-month intervals is recommended.

a. Insure that batteries are charged. (Refer to paragraph 6-25.)

b. Calibrate TEMPERATURE meter over entire range for 1% full scale accuracy.

c. Calibrate wattmeter over entire range for 3% full scale accuracy.

NOTE

The following steps calibrate the thermocouple transmitter alarm units.

d. Set range of Acromag, Inc. part No. 314-AT to 400 to 1200° F.

e. Verify that units are linear within 1%, full scale, at 600° F, 800° F, and 1000° F.

f. Set alarm to trigger at 975° F (-0 + 25° F) with dropout set for 975° F (+0 - 25° F). (Refer to calibration instructions supplied with transmitters by Acromag, Inc.)

6-36. BATTERY CHARGER CALIBRATION

6-37. Calibration of the battery charger at 6-month intervals is recommended. Refer to the manufacturer's literature (supplied with the unit) for calibration instructions.

6-38. POWER SUPPLY RACK CHASSIS CALIBRATION

6-39. Calibration of the HEATER POWER SUPPLY CONTROL PANEL and the two power supplies at 6-month intervals is recommended. Refer to the manufacturer's literature (supplied with the units) for general calibration procedures, and to paragraphs 6-20 (control panel) and 6-21c (power supply) for calibration instructions peculiar to units used with the SNAP 19.

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
00	FC	Bus power supply volts
01	FB	Variable power supply volts (No. 2)
02	CA	RTG 1 output volts (sim)
03	DB	RTG 1 output volts
04	CB	RTG 2 output volts (sim)
05	DJ	RTG 2 output volts
06	CQ	PC 1 input volts (sim)
07	DS	PC 1 input volts
08	CV	PC 2 input volts (sim)
09	EA	PC 2 input volts
10	CR	PC 1 output volts (sim)
11	DU	PC 1 output volts
12	CW	PC 2 output volts (sim)
13	EC	PC 2 output volts
14	CT	PC 1 and PC 2 input current (sim)
15	DT	PC 1 input current
16	EB	PC 2 input current
17	CU	PC 1 and PC 2 output current (sim)
18	DV	PC 1 output current
19	ED	PC 2 output current
20	CC	RTG 1 pressure (sim)
21	DC	RTG 1 pressure
22	CD	RTG 2 pressure (sim)
23	DK	RTG 2 pressure

Table 6-1. Monitor Panel Interconnections for TSCU Calibration (Sheet 1 of 3)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
24	CS	PC 1 temperature (sim)
25	DW	PC 1 temperature
26	CX	PC 2 temperature (sim)
27	EE	PC 2 temperature
28	CE	RTG 1 fin root temp T6 (sim)
29	DD	RTG 1 fin root temp T6
30	CF	RTG 1 fin root temp T7 (sim)
31	DE	RTG 1 fin root temp T7
32	CG	RTG 1 fin root temp T8 (sim)
33	DF	RTG 1 fin root temp T8
34	CH	RTG 2 fin root temp T6 (sim)
35	DL	RTG 2 fin root temp T6
36	CI	RTG 2 fin root temp T7 (sim)
37	DM	RTG 2 fin root temp T7
38	CJ	RTG 2 fin root temp T8 (sim)
39	DN	RTG 2 fin root temp T8
40	CK	RTG 1 hot jct temp T2 (sim)
41	DG	RTG 1 hot jct temp T2
42	CL	RTG 1 hot jct temp T3 (sim)
43	DH	RTG 1 hot jct temp T3
44	CM	RTG 1 hot jct temp T5 (sim)
45	DI	RTG 1 hot jct temp T5
46	CN	RTG 2 hot jct temp T2 (sim)

Table 6-1. Monitor Panel Interconnections for TSCU Calibration (Sheet 2 of 3)

Connect Scanner Input Channel Jack No.	To Jack No.	Measurement
47	DO	RTG 2 hot jct temp T2
48	CO	RTG 2 hot jct temp T3 (sim)
49	DP	RTG 2 hot jct temp T3
50	CP	RTG 2 hot jct temp T5 (sim)
51	DQ	RTG 2 hot jct temp T5

Table 6-1. Monitor Panel Interconnections for TSCU Calibration (Sheet 3 of 3)

Table 6-2. Voltage Measurement Circuit Calibration Procedures (Sheet 1 of 2)

Step (See figure A-9, Appendix A, data sheets 85-1-1 through 85-1-6)	RTG 1 output	RTG 2 output	PC 1 input	PC 2 input	PC 1 output	PC 2 output
a. Set INPUT SCANNER to channel 01 (for all circuits)	X	X	X	X	X	X
b. On VARIABLE POWER CONTROL panel set MODE 2 switch to TM VOLT (for all circuits)	X	X	X	X	X	X
c. On VARIABLE POWER CONTROL panel, adjust VOLTAGE 2 control for DIGITAL VOLTMETER indication of +33.00 ± 0.01 volts (for all circuits)	X	X	X	X	X	X
d. Set to ON the TELEMETRY TEST PANEL switches listed at right	S2 through S7	S2 through S7	S2 through S7	S2 through S7	S2 through S7 and S29	S2 through S7 and S29
e. Set INPUT SCANNER to channel	02	04	06	08	10	12
f. Set TELEMETRY TEST PANEL S1 switch to obtain data sheet input value.	X	X	X	X	X	X
NOTE						
Input values are obtained by the following switch settings:						
0.15 volts	S1 to 4	S1 to 4	S1 to 4	S1 to 4	--	--
0.5 and 0.75 volts	S1 to 3	S1 to 3	S1 to 3	S1 to 3	--	--
1.5 and 2.5 volts	S1 to 2	S1 to 2	S1 to 2	S1 to 2	--	--
4.0 and 5.5 volts	S1 to 1	S1 to 1	S1 to 1	S1 to 1	--	--
1.0 and 4.0 volts	--	--	--	--	S1 to 4	S1 to 4
8.0 and 12.0 volts	--	--	--	--	S1 to 3	S1 to 3
16.0 and 20.0 volts	--	--	--	--	S1 to 2	S1 to 2
25.0 and 32.0 volts	--	--	--	--	S1 to 1	S1 to 1

Table 6-2. Voltage Measurement Circuit Calibration Procedures (Sheet 2 of 2)

Step (See figure A-9, Appendix A, data sheets 85-1-1 through 85-1-6)	RTG 1 output	RTG 2 output	PC 1 input	PC 2 input	PC 1 output	PC 2 output
g. On TELEMETRY TEST PANEL, adjust R5 control for required input value (for all circuits)	X	X	X	X	X	X
h. Set INPUT SCANNER to channel -	03	05	07	09	11	13
i. Record DIGITAL VOLTMETER indication under output voltage RUN 1 on data sheet -	85-1-1	85-1-2	85-1-3	85-1-4	85-1-5*	85-1-6*
j. Perform steps e through i for all input values listed on data sheet.						
k. On VARIABLE POWER CONTROL panel, rotate VOLTAGE 2 control fully counter clockwise (for all circuits)	X	X	X	X	X	X
l. On VARIABLE POWER CONTROL panel, set MODE 2 switch to OFF (for all circuits)	X	X	X	X	X	X
m. On TELEMETRY TEST PANEL, set to OFF switches -	S1 through S7	S1 through S7	S1 through S7	S1 through S7	S1 through S7 and S29	S1 through S7 and S29
n. On TELEMETRY TEST PANEL, rotate R5 fully counter clockwise (for all circuits)	X	X	X	X	X	X

*Record on data sheet as a negative value.

Table 6-3. Current Measurement Circuit Calibration Procedures

Step (See figure A-9, Appendix A, data sheets 85-2-1 through 85-2-4)	PC 1 input	PC 2 input	PC1 output	PC 2 output
a. On VARIABLE POWER CONTROL panel, set to TM TRANSDUCTOR the -	MODE 1 switch	MODE 1 switch	MODE 2 switch	MODE 2 switch
b. Set INPUT SCANNER to channel -	14	14	17	17
c. On VARIABLE POWER CONTROL panel, adjust to required input value the -	VOLTAGE 1 control	VOLTAGE 1 control	VOLTAGE 2 control	VOLTAGE 2 control
d. Set INPUT SCANNER to channel -	15	16	18	19
e. Record DIGITAL VOLTMETER indication under output voltage RUN 1 on data sheet	85-2-1	85-2-2	85-2-3	85-2-4
f. Perform steps b through e for all input values listed on data sheet.	VOLTAGE 1 MODE 1	VOLTAGE 1 MODE 1	VOLTAGE 2 MODE 2	VOLTAGE 2 MODE 2
g. On VARIABLE POWER CONTROL rotate VOLTAGE control (1 or 2, as indicated at right) fully counter-clockwise, and set MODE switch (1 or 2, as indicated at right) to OFF.				

Table 6-4. RTG Pressure Measurement Circuit Calibration Procedures

Step (See figure A-9, Appendix A, data sheets 85-3-1 and 85-3-2	RTG 1 Pressure Measurement	RTG 2 Pressure Measurement
a. On TELEMETRY TEST PANEL, set to ON the -	S10 switch	S11 switch
b. Set INPUT SCANNER to channel -	20	22
c. On TELEMETRY TEST PANEL set to OFF the -	S9 switch	S32 switch
d. On TELEMETRY TEST PANEL, adjust R4 for required input value (for each circuit)	X	X
e. Set INPUT SCANNER to channel	21	23
f. On TELEMETRY TEST PANEL, set to ON the -	S9 switch	S32 switch
g. Record DIGITAL VOLTMETER indication under output voltage RUN 1 on data sheet	85-3-1	85-3-2
h. Perform steps b through g for all input values listed on data sheet	S9 and S10 switches	S11 and S32 switches
i. On TELEMETRY TEST PANEL, set to OFF the -	X	X
j. On TELEMETRY TEST PANEL, rotate R1 fully counterclockwise (for all circuits)		

Table 6-5. PC 1 and PC 2 Temperature Measurement Circuit Calibration Procedures

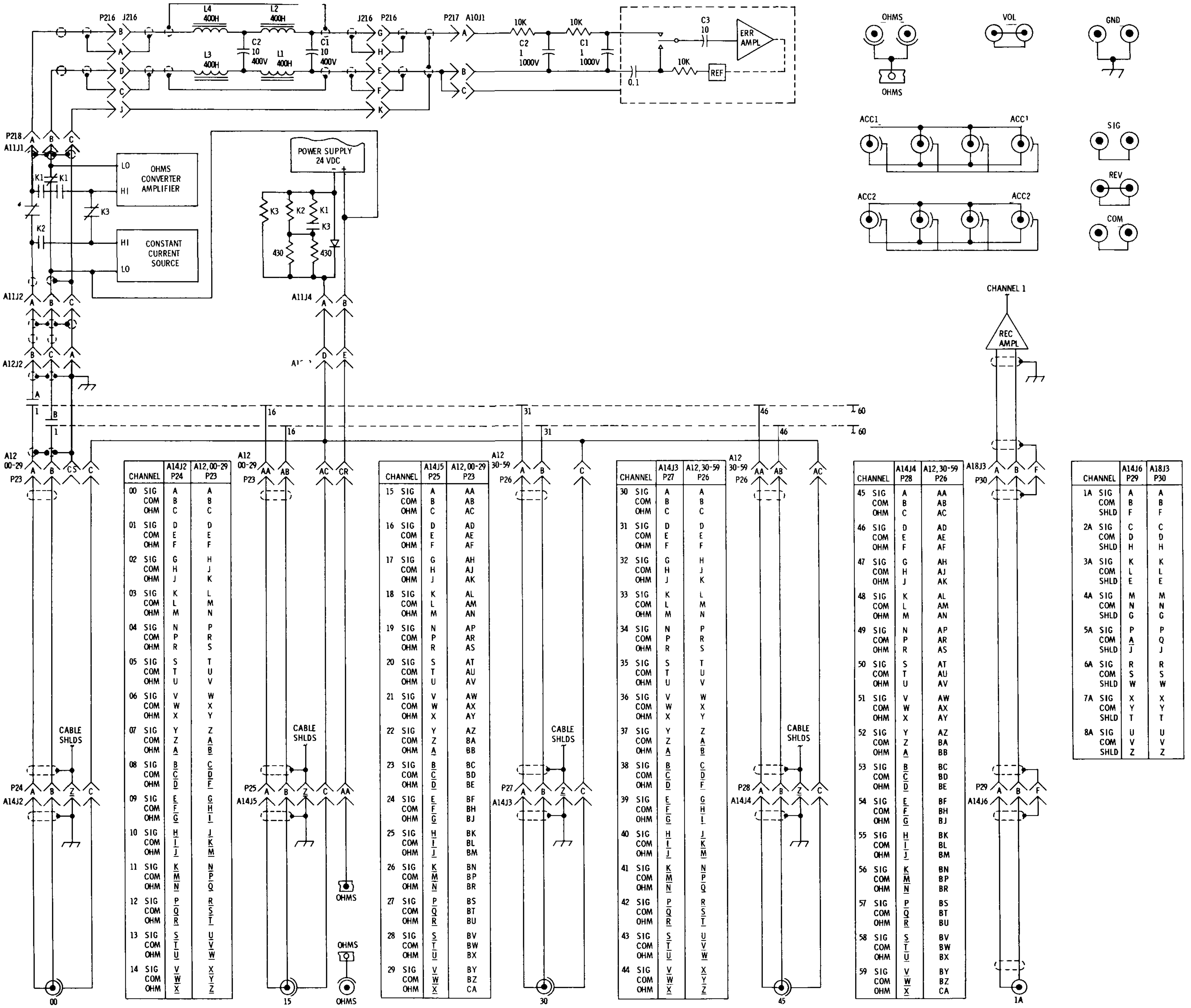
Step (See figure A-9, Appendix A, data sheets 85-4-1 and 85-4-2)	PC 1 Temperature	PC 2 Temperature
a. On TELEMETRY TEST PANEL, set to ON the -	S16 switch	S17 switch
b. Set INPUT SCANNER to channel -	24	26
c. On TELEMETRY TEST PANEL, set S15 switch to OFF	X	X
d. On TELEMETRY TEST PANEL, set S14 switch to obtain data sheet value -	X	X
NOTE Values as obtained by the following switch settings. 2.5K to 15K — S14 to 1 25K to 40K — S14 to 2 62K to 80K — S14 to 3		
e. On TELEMETRY TEST PANEL, adjust R3 for required input value -	X	X
f. Set INPUT SCANNER to channel -	25	27
g. On TELEMETRY TEST PANEL, set S15 switch to -	ON	ON
h. Record DIGITAL VOLTMETER indication under RUN 1 on data sheet -	85-4-1	85-4-2
i. Perform steps b through g for all values listed on data sheet -	X	X
j. On TELEMETRY TEST PANEL, set to OFF the -	S14 through S16 switches	S14, S15, and S17 switches
k. On TELEMETRY TEST PANEL, rotate R3 fully counterclockwise -	X	X

Table 6-6. RTG Fin Root Temperature Measurement Circuit Calibration Procedure

Step (See figure A-9, Appendix A, data sheets 85-5-1 through 85-5-6)	RTG 1 T6	RTG 1 T7	RTG 1 T8	RTG 2 T6	RTG 2 T7	RTG 2 T8
a. On TELEMETRY TEST PANEL, set to ON switch -	S23	S24	S28	S26	S27	S25
b. Set INPUT SCANNER to channel -	28	30	32	34	36	38
c. On TELEMETRY TEST PANEL, set to OFF switch -	S31	S22	S22	S22	S31	S31
d. On TELEMETRY TEST PANEL, set S21 switch to value listed on data sheet -	85-5-1	85-5-2	85-5-3	85-5-4	85-5-5	85-5-6
NOTE Values are obtained by setting switch as follows: 2.5K to 15K — S21 to 1 25K to 40K — S21 to 2 62K to 80K — S21 to 3						
e. On TELEMETRY TEST PANEL, adjust R2 for required input	X	X	X	X	X	X
f. Set INPUT SCANNER to channel -	29	31	33	35	37	39
g. On TELEMETRY TEST PANEL, set to ON switch -	S31	S22	S22	S22	S31	S31
h. Record DIGITAL VOLTMETER indication under RUN 1 of data sheet -	85-5-1	85-5-2	85-5-3	85-5-4	85-5-5	85-5-6
i. Perform steps b through h for all values listed on data sheet.	X	X	X	X	X	X
j. On TELEMETRY TEST PANEL, set to OFF the	S21, S23, and S31 switches	S21, S22, and S24 switches	S21, S22, and S28 switches	S21, S22, and S26 switches	S21, S27, and S31 switches	S21, S25, and S31 switches
k. On TELEMETRY TEST PANEL, rotate R2 fully counterclockwise.	X	X	X	X	X	X

Table 6-7. RTG Hot Junction Temperature Measurement Circuit Calibration Procedures

Step (See figure A-9, Appendix A, data sheets 85-6-1 through 85-6-6)	RTG 1 T2	RTG 1 T3	RTG 1 T5	RTG 2 T2	RTG 2 T3	RTG 2 T5
a. On TELEMETRY TEST PANEL, set to ON the -	S33 switch	S34 switch	S35 switch	S36 switch	S37 switch	S38 switch
b. Set INPUT SCANNER to channel -	40	42	44	46	48	50
c. On TELEMETRY TEST PANEL, set to OFF the -	S9 switch	S9 switch	S9 switch	S32 switch	S32 switch	S32 switch
d. On TELEMETRY TEST PANEL, adjust R1 for the required input value (for all circuits)	X	X	X	X	X	X
e. Set INPUT SCANNER to channel -	41	43	45	47	49	51
f. On TELEMETRY TEST PANEL, set to ON the -	S9 switch	S9 switch	S9 switch	S32 switch	S32 switch	S32 switch
g. Record DIGITAL VOLTMETER indication under output voltage RUN 1 on data sheet	85-6-1	85-6-2	85-6-3	85-6-4	85-6-5	85-6-6
h. Perform steps b through g for all input values listed on data sheet.						
i. On TELEMETRY TEST PANEL, set to OFF the -	S9 and S33 switches	S9 and S34 switches	S9 and S35 switches	S32 and S36 switches	S32 and S37 switches	S32 and S38 switches
j. On TELEMETRY TEST PANEL, rotate R1 fully counterclockwise (for all circuits)	X	X	X	X	X	X



CHANNEL		A14J2 P24	A12, 00-29 P23
00	SIG	A	A
	COM	B	B
	OHM	C	C
01	SIG	D	D
	COM	E	E
	OHM	F	F
02	SIG	G	H
	COM	H	J
	OHM	J	K
03	SIG	K	L
	COM	L	M
	OHM	M	N
04	SIG	N	P
	COM	P	R
	OHM	R	S
05	SIG	S	T
	COM	T	U
	OHM	U	V
06	SIG	V	W
	COM	W	X
	OHM	X	Y
07	SIG	Y	Z
	COM	Z	A
	OHM	A	B
08	SIG	B	C
	COM	C	D
	OHM	D	F
09	SIG	E	G
	COM	F	H
	OHM	G	I
10	SIG	H	J
	COM	I	K
	OHM	J	M
11	SIG	K	N
	COM	M	P
	OHM	N	Q
12	SIG	P	R
	COM	Q	S
	OHM	R	T
13	SIG	S	U
	COM	T	V
	OHM	U	W
14	SIG	V	X
	COM	W	Y
	OHM	X	Z

CHANNEL		A14J5 P25	A12, 00-29 P23
15	SIG	A	AA
	COM	B	AB
	OHM	C	AC
16	SIG	D	AD
	COM	E	AE
	OHM	F	AF
17	SIG	G	AH
	COM	H	AJ
	OHM	J	AK
18	SIG	K	AL
	COM	L	AM
	OHM	M	AN
19	SIG	N	AP
	COM	P	AR
	OHM	R	AS
20	SIG	S	AT
	COM	T	AU
	OHM	U	AV
21	SIG	V	AW
	COM	W	AX
	OHM	X	AY
22	SIG	Y	AZ
	COM	Z	BA
	OHM	A	BB
23	SIG	B	BC
	COM	C	BD
	OHM	D	BE
24	SIG	E	BF
	COM	F	BH
	OHM	G	BJ
25	SIG	H	BK
	COM	I	BL
	OHM	J	BM
26	SIG	K	BN
	COM	M	BP
	OHM	N	BR
27	SIG	P	BS
	COM	Q	BT
	OHM	R	BU
28	SIG	S	BV
	COM	T	BW
	OHM	U	BX
29	SIG	V	BY
	COM	W	BZ
	OHM	X	CA

CHANNEL		A14J3 P27	A12, 30-59 P26
30	SIG	A	A
	COM	B	B
	OHM	C	C
31	SIG	D	D
	COM	E	E
	OHM	F	F
32	SIG	G	H
	COM	H	J
	OHM	J	K
33	SIG	K	L
	COM	L	M
	OHM	M	N
34	SIG	N	P
	COM	P	R
	OHM	R	S
35	SIG	S	T
	COM	T	U
	OHM	U	V
36	SIG	V	W
	COM	W	X
	OHM	X	Y
37	SIG	Y	Z
	COM	Z	A
	OHM	A	B
38	SIG	B	C
	COM	C	D
	OHM	D	F
39	SIG	E	G
	COM	F	H
	OHM	G	I
40	SIG	H	J
	COM	I	K
	OHM	J	M
41	SIG	K	N
	COM	M	P
	OHM	N	Q
42	SIG	P	R
	COM	Q	S
	OHM	R	T
43	SIG	S	U
	COM	T	V
	OHM	U	W
44	SIG	V	X
	COM	W	Y
	OHM	X	Z

CHANNEL		A14J4 P28	A12, 30-59 P26
45	SIG	A	AA
	COM	B	AB
	OHM	C	AC
46	SIG	D	AD
	COM	E	AE
	OHM	F	AF
47	SIG	G	AH
	COM	H	AJ
	OHM	J	AK
48	SIG	K	AL
	COM	L	AM
	OHM	M	AN
49	SIG	N	AP
	COM	P	AR
	OHM	R	AS
50	SIG	S	AT
	COM	T	AU
	OHM	U	AV
51	SIG	V	AW
	COM	W	AX
	OHM	X	AY
52	SIG	Y	AZ
	COM	Z	BA
	OHM	A	BB
53	SIG	B	BC
	COM	C	BD
	OHM	D	BE
54	SIG	E	BF
	COM	F	BH
	OHM	G	BJ
55	SIG	H	BK
	COM	I	BL
	OHM	J	BM
56	SIG	K	BN
	COM	M	BP
	OHM	N	BR
57	SIG	P	BS
	COM	Q	BT
	OHM	R	BU
58	SIG	S	BV
	COM	T	BW
	OHM	U	BX
59	SIG	V	BY
	COM	W	BZ
	OHM	X	CA

CHANNEL		A14J6 P29	A18J3 P30
1A	SIG	A	A
	COM	B	B
	SHLD	F	F
2A	SIG	C	C
	COM	D	D
	SHLD	H	H
3A	SIG	K	K
	COM	L	L
	SHLD	E	E
4A	SIG	M	M
	COM	N	N
	SHLD	G	G
5A	SIG	P	P
	COM	A	Q
	SHLD	J	J
6A	SIG	R	R
	COM	S	S
	SHLD	W	W
7A	SIG	X	X
	COM	Y	Y
	SHLD	T	T
8A	SIG	U	U
	COM	V	V
	SHLD	Z	Z

Figure 6-1. Ground Support Test Console Subsystem--Monitor

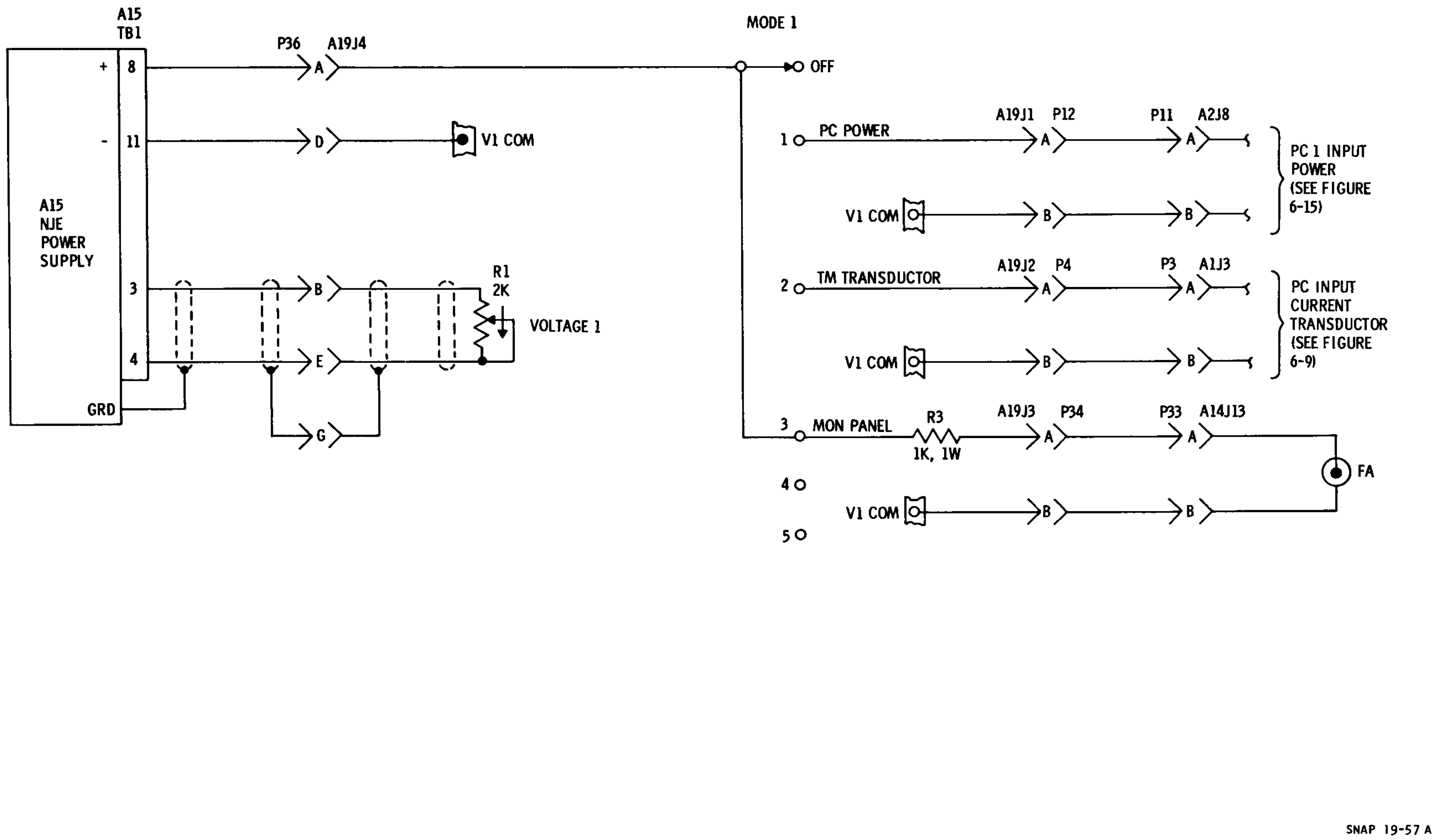


Figure 6-2. Ground Support Test Console Subsystem--Variable I Power Circuit

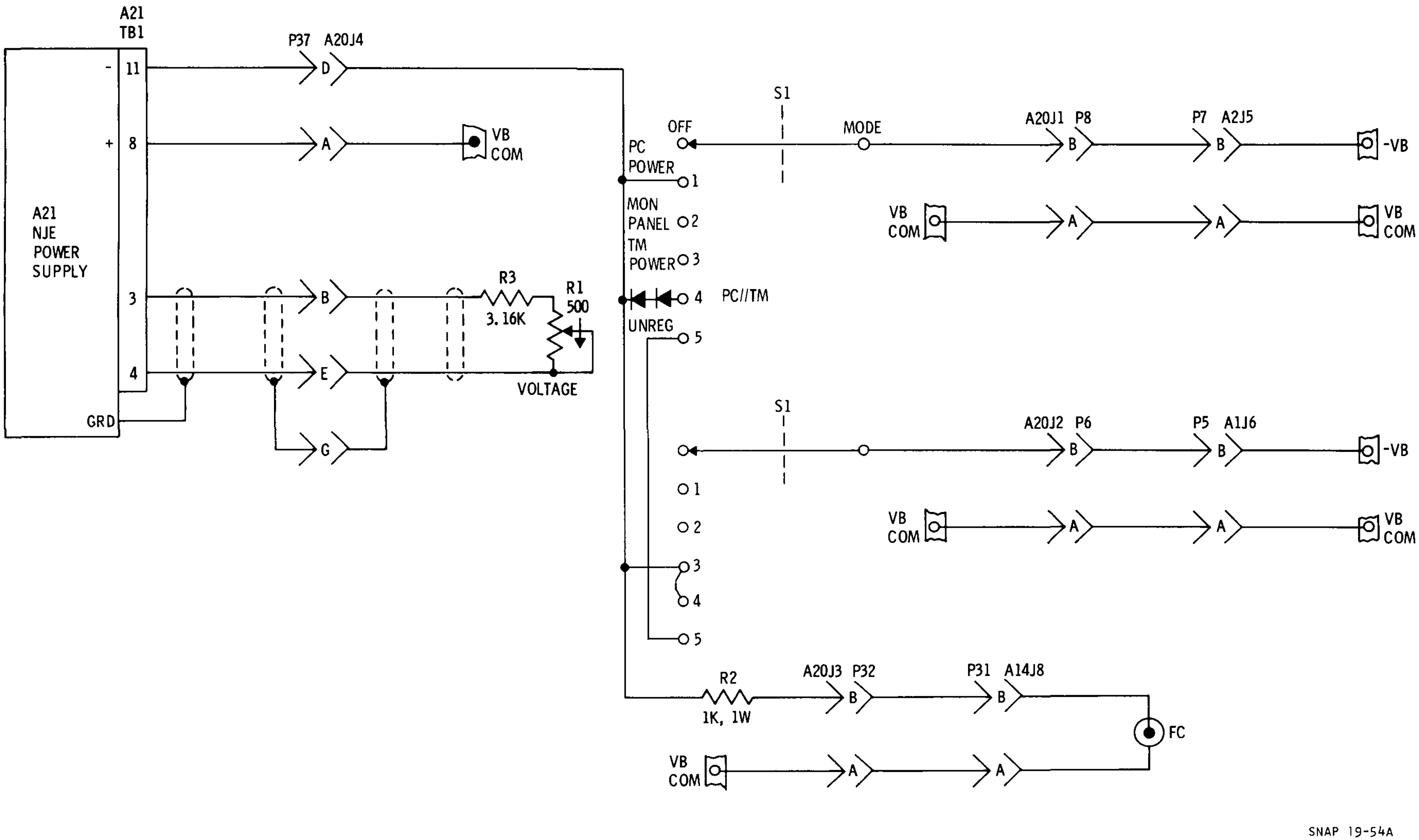


Figure 6-3. Ground Support Test Console Subsystem--Bus Power Circuit

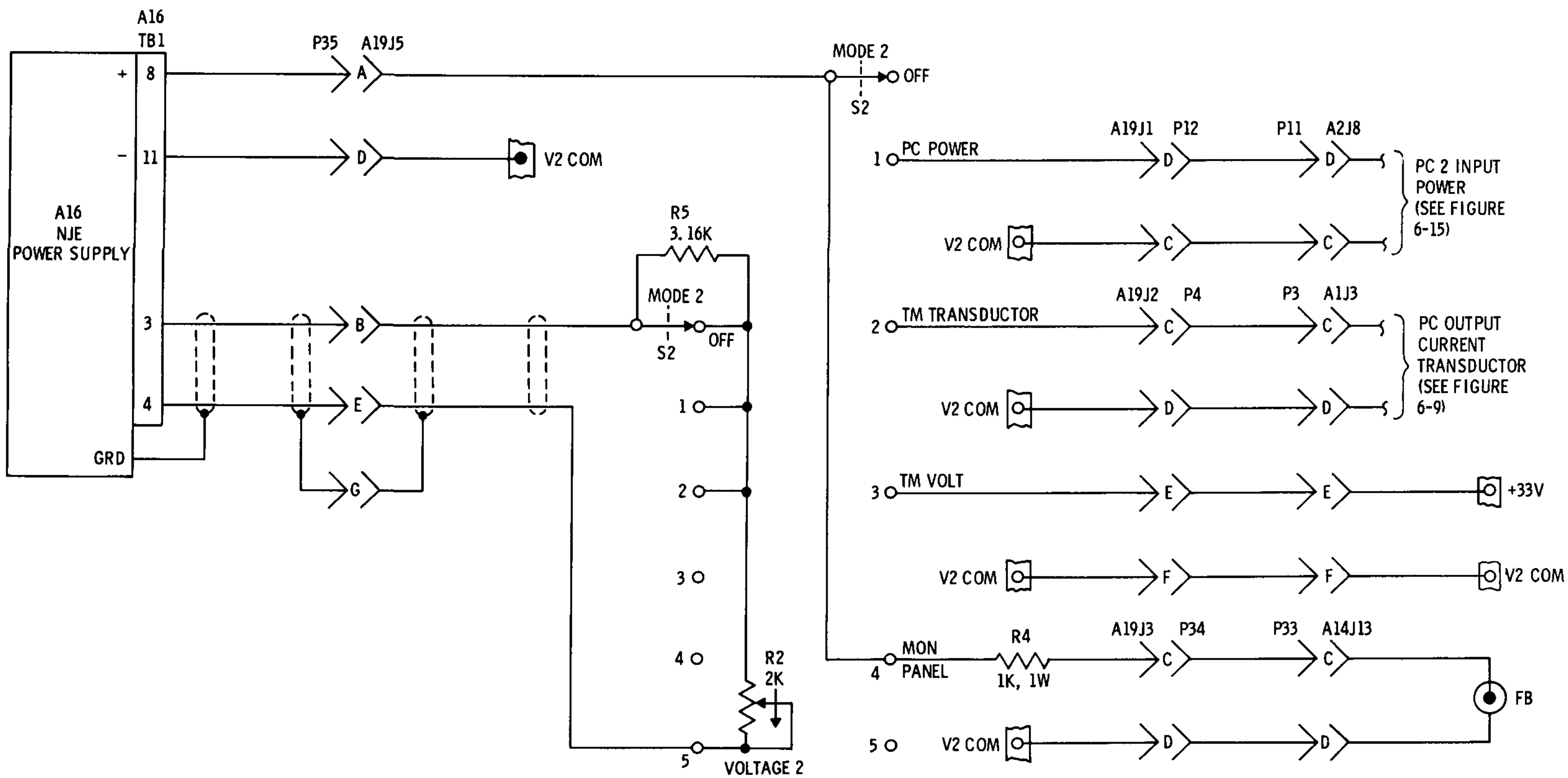


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Figure 6-4. Ground Support Test Console Subsystem--Variable II Power Circuit

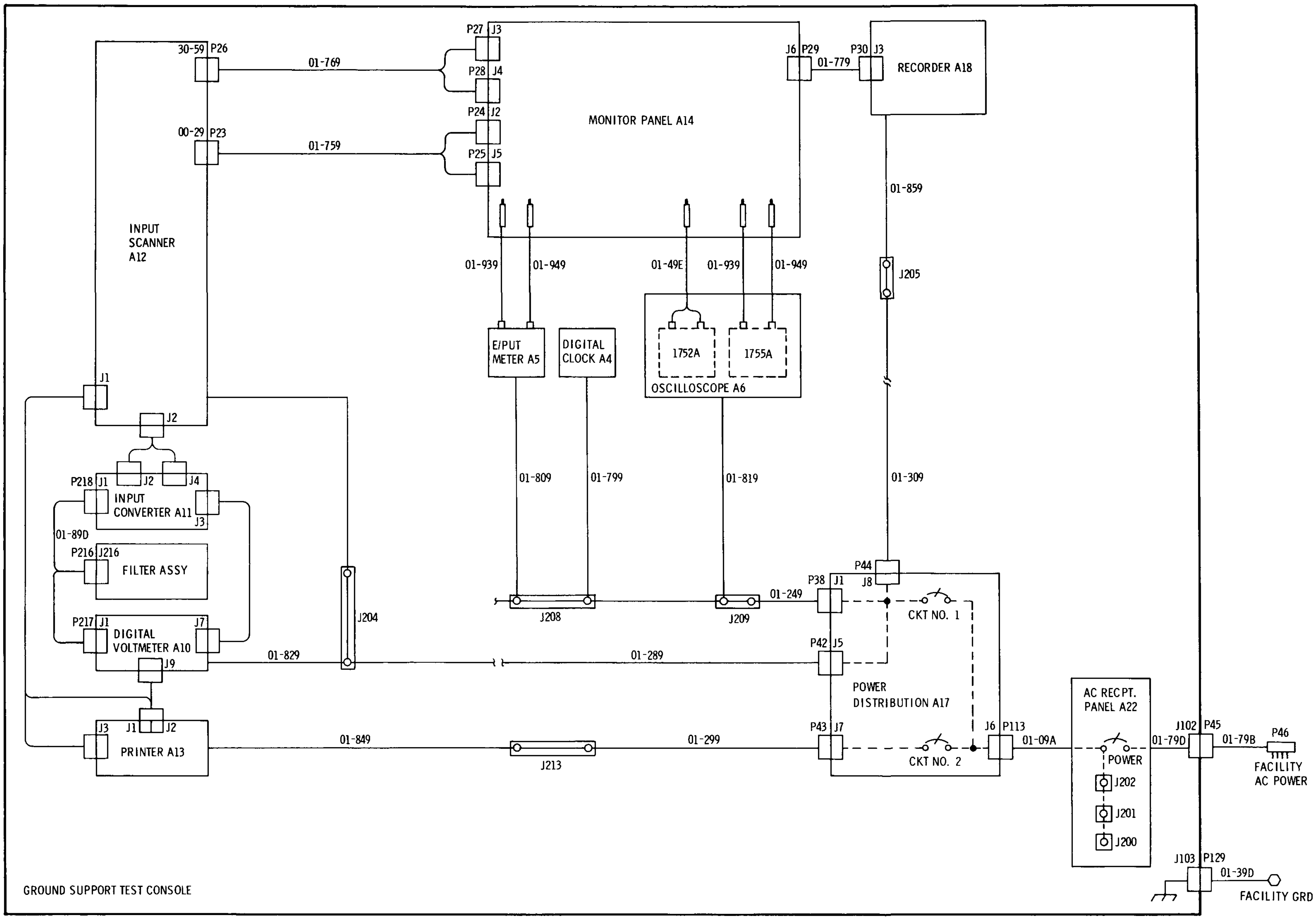

Figure 6-5. Ground Support Test Console Subsystem--Interconnecting Cabling

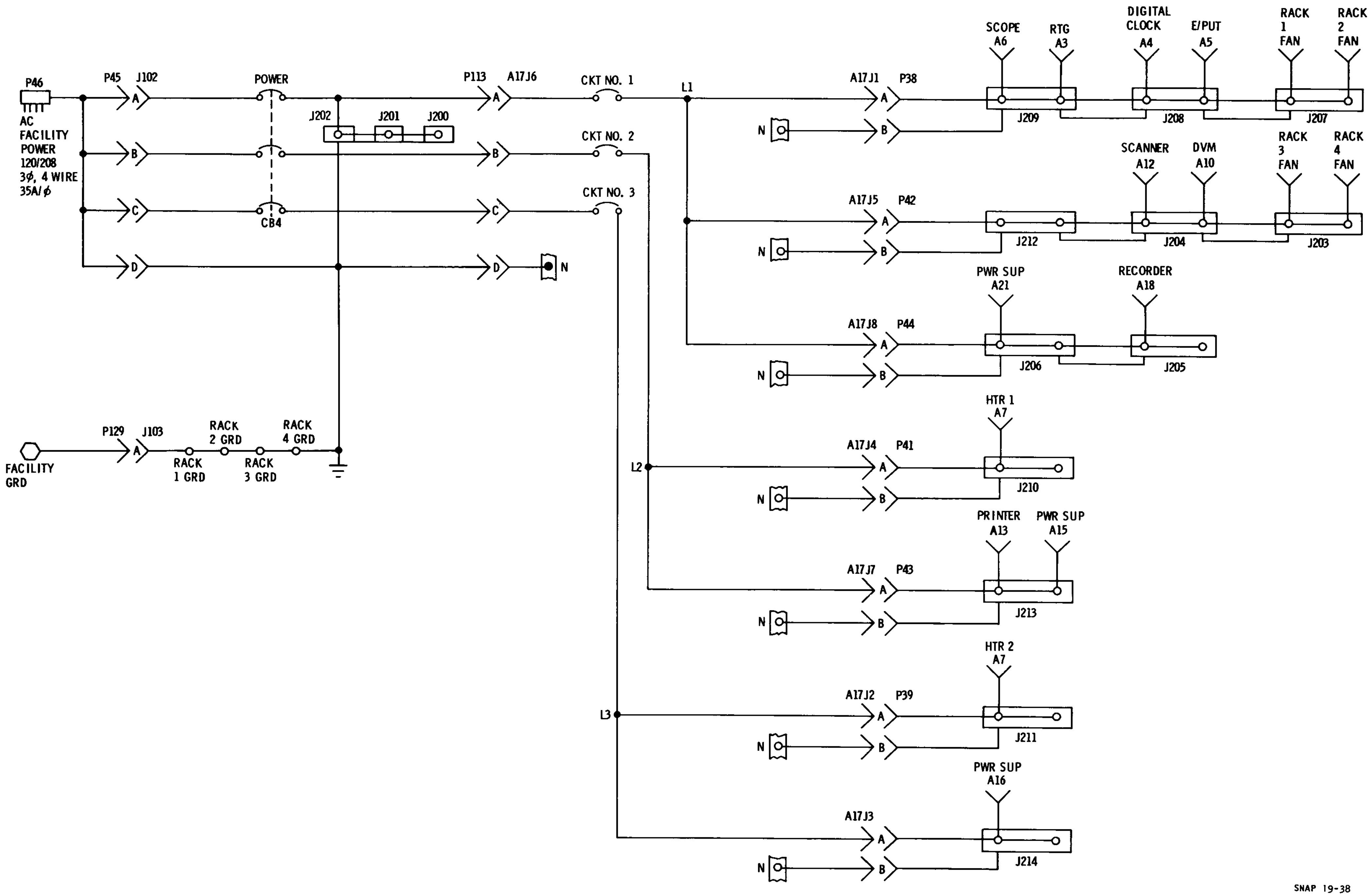

Figure 6-6. Ground Support Test Console Subsystem--AC Power Circuit

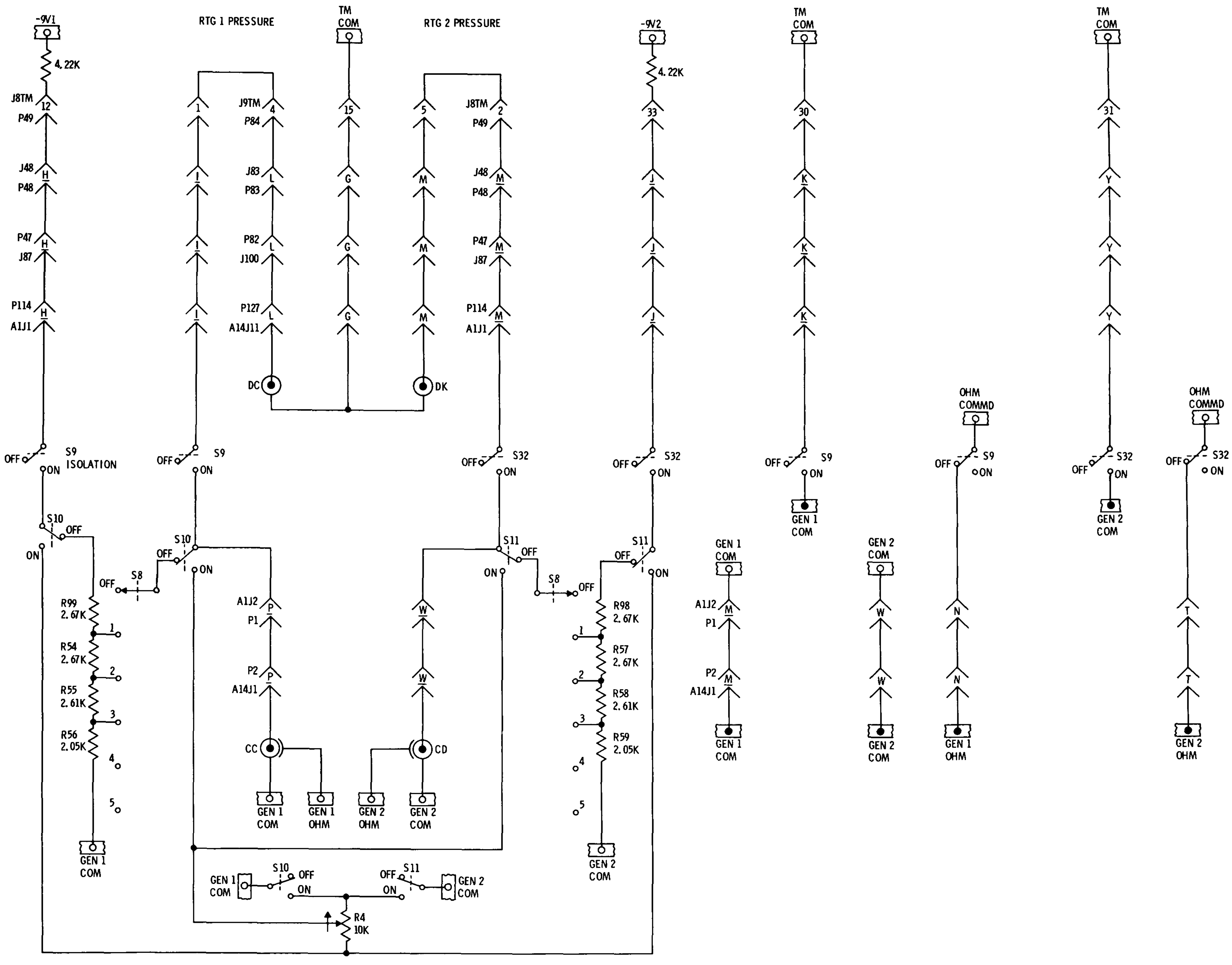

Figure 6-7. Telemetry Signal Conditioner Unit Subsystem--Generator Pressure Circuit

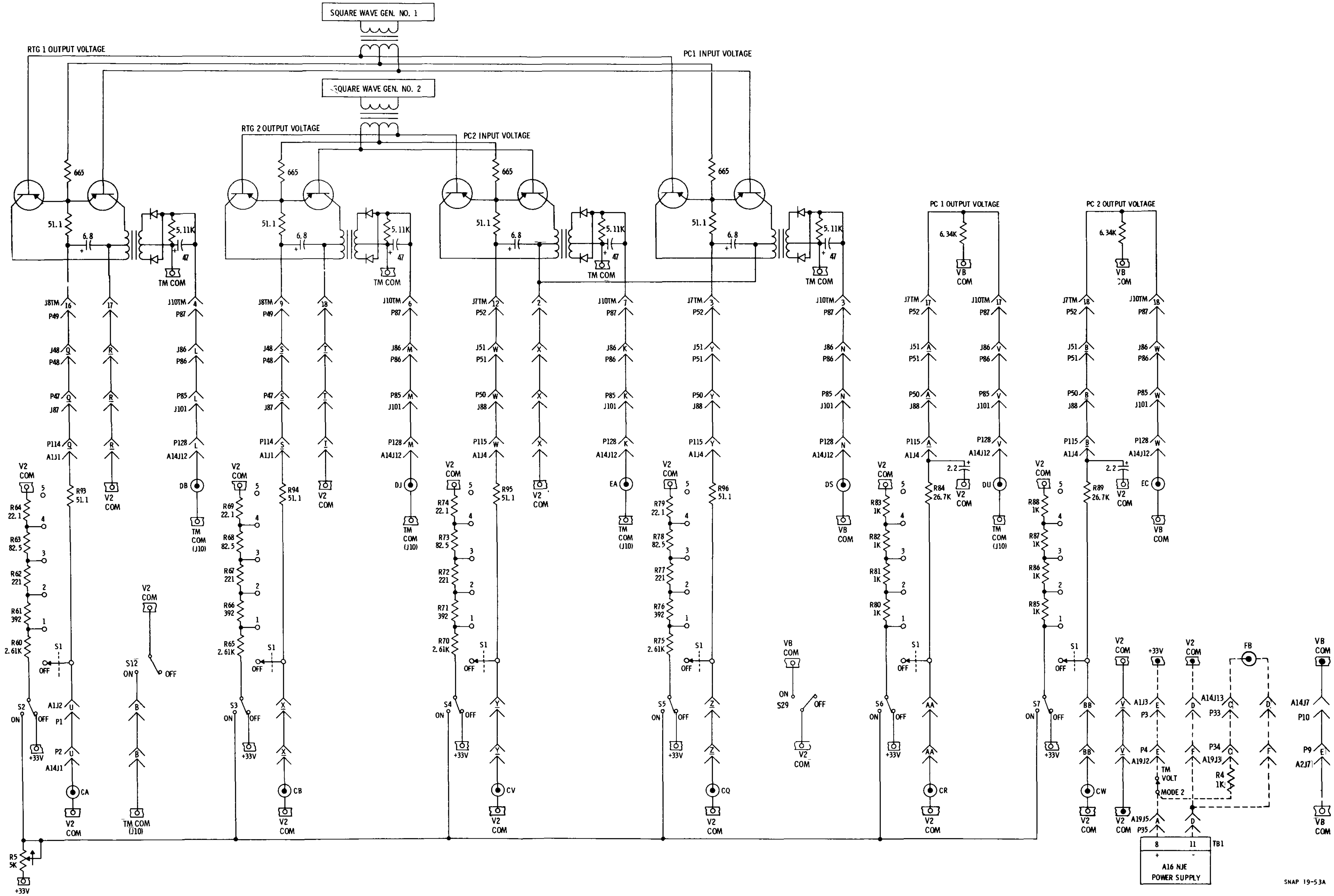

Figure 6-8. Telemetry Signal Conditioner Unit Subsystem--Voltage Circuit

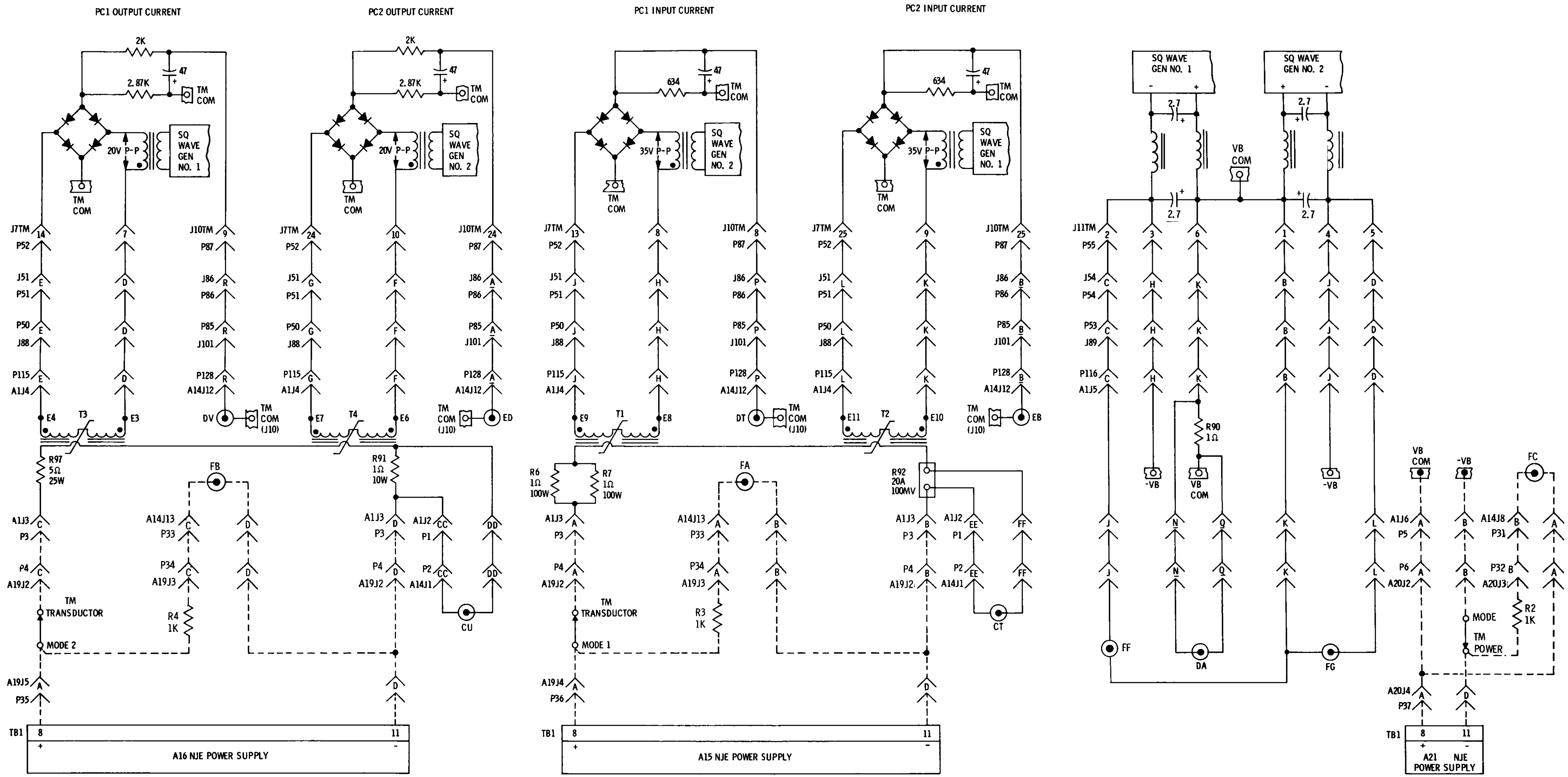

Figure 6-9. Telemetry Signal Conditioner Unit Subsystem--Power Conditioner Unit, Telemetry Signal Conditioner Unit Input Circuit

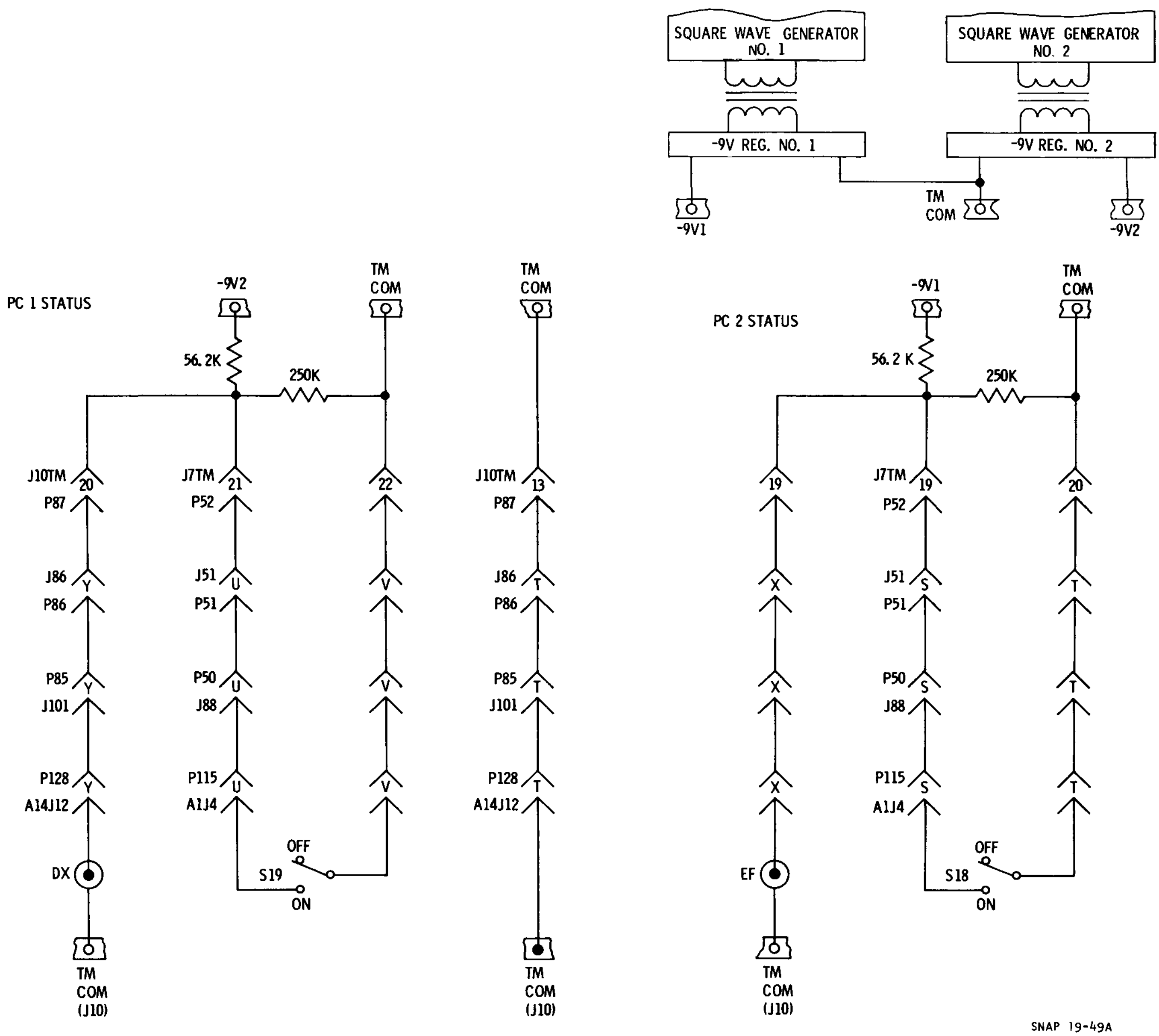

Figure 6-10. Telemetry Signal Conditioner Unit Subsystem--Telemetry Signal Conditioner Unit On/Off Bus Status Circuit

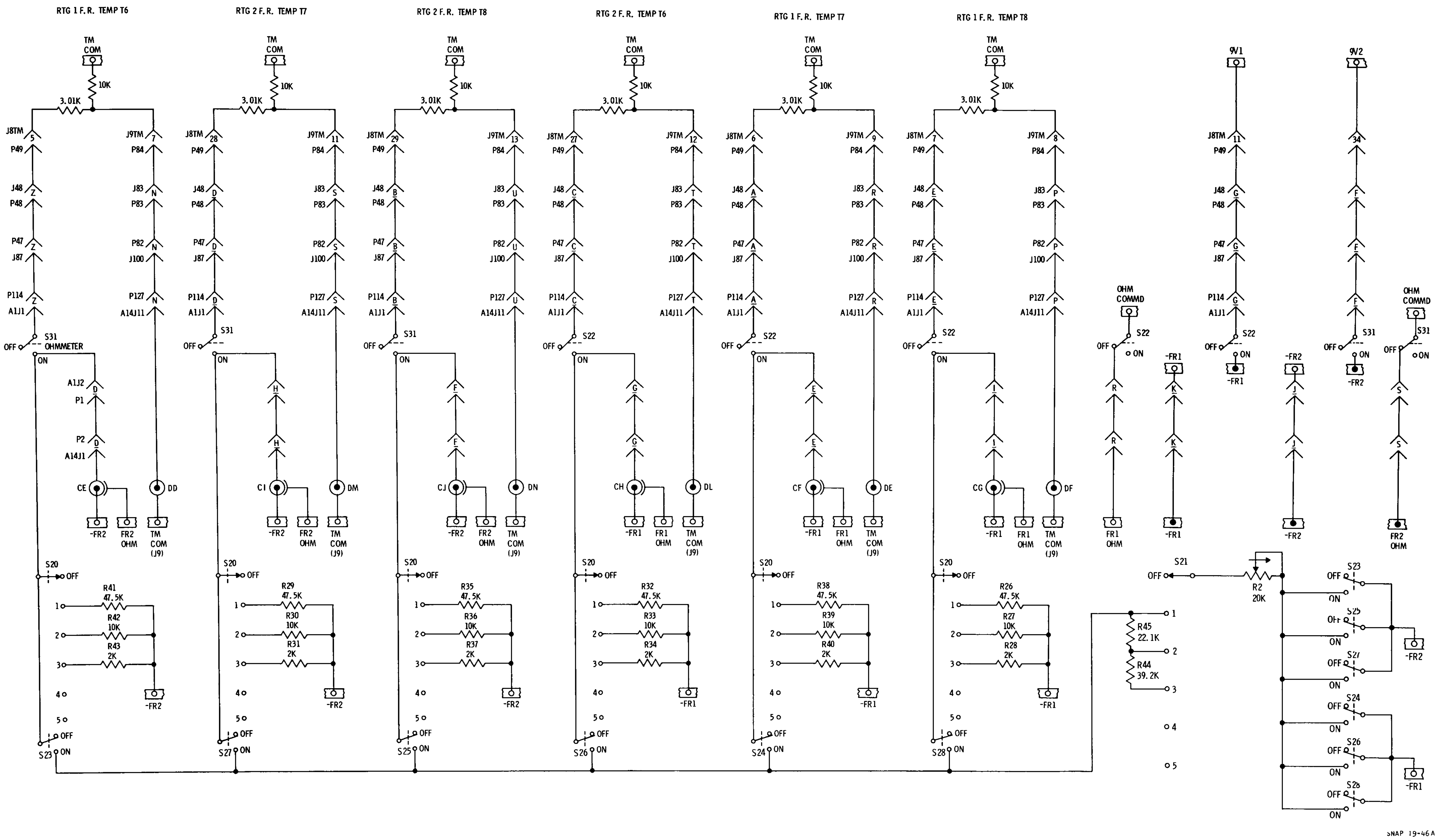

Figure 6-11. Telemetry Signal Conditioner Unit Subsystem--Generator Fin Root Temperature Circuit

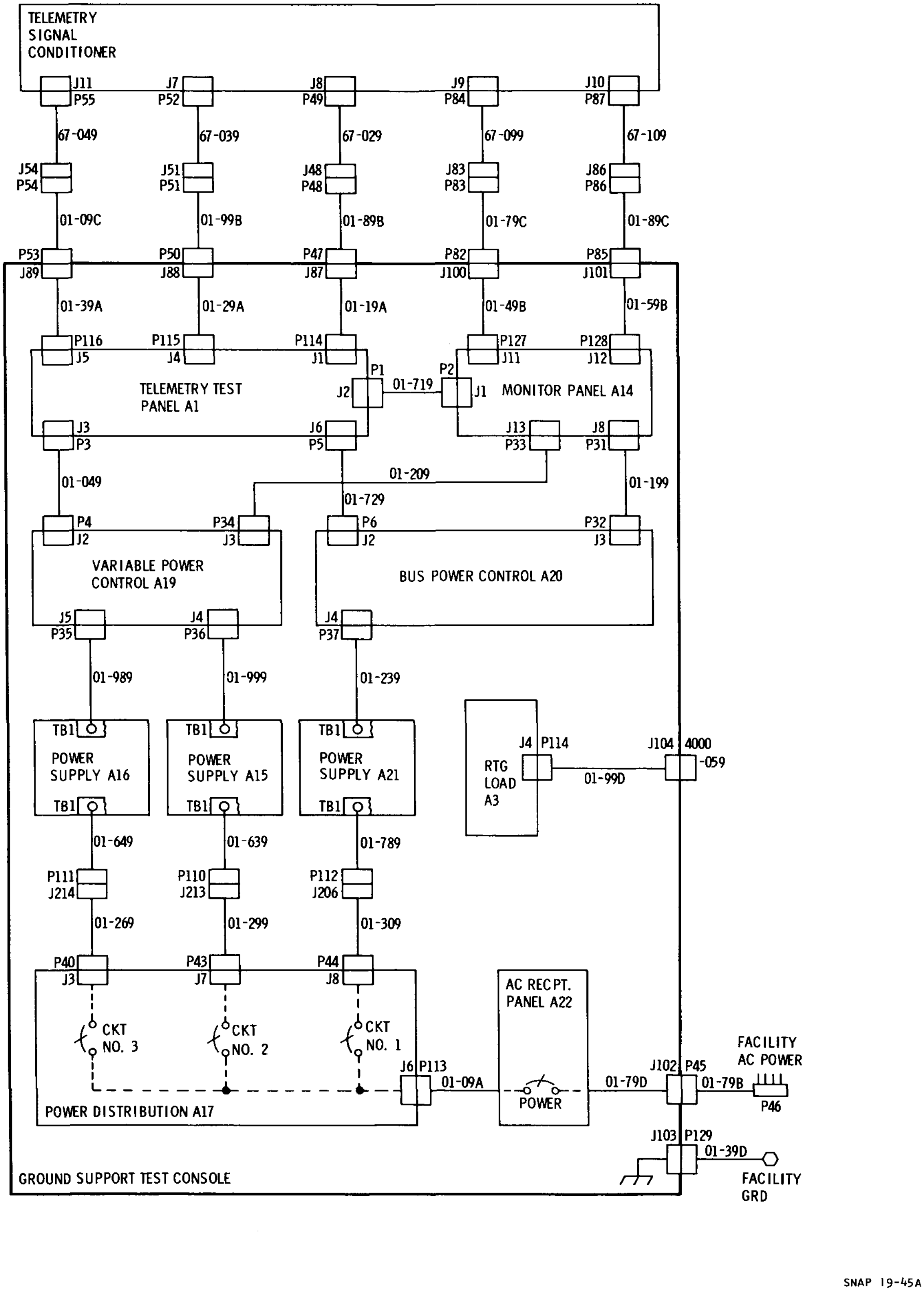

Figure 6-12. Telemetry Signal Conditioner Unit Subsystem--Interconnecting Cabling

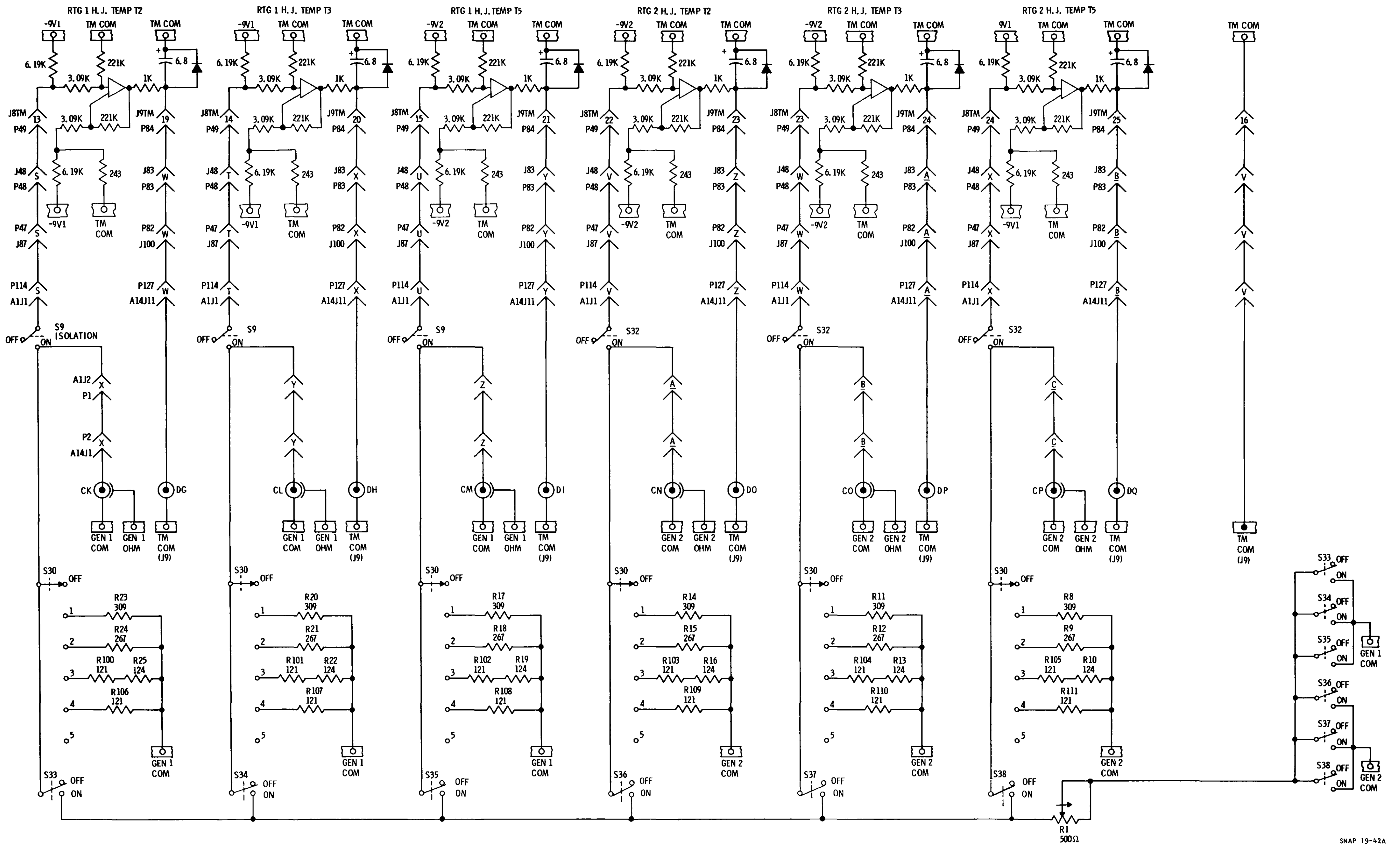

Figure 6-13. Telemetry Signal Conditioning Unit Subsystem--Generator Hot Junction Temperature Circuit

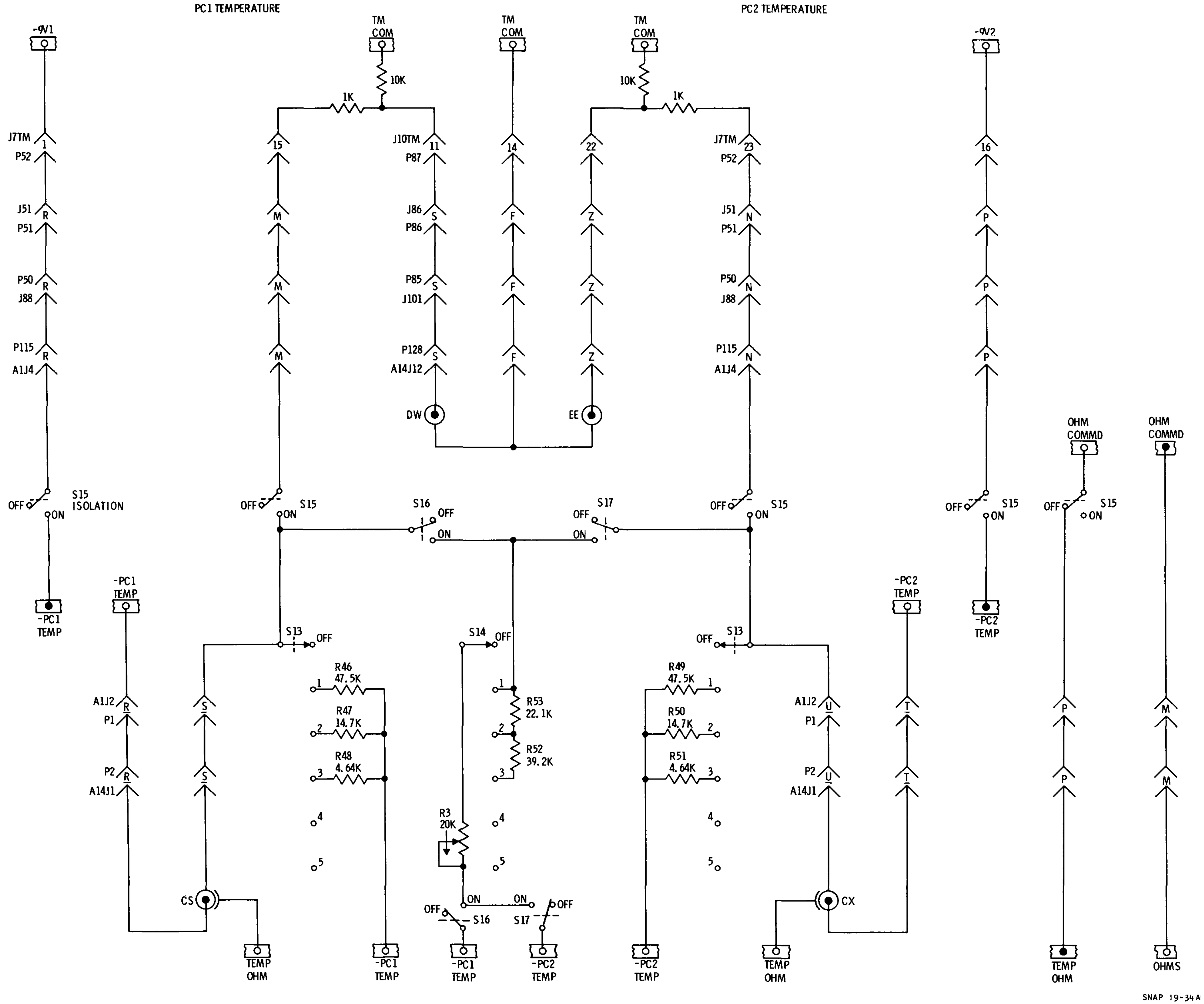

Figure 6-14. Telemetry Signal Conditioner Unit Subsystem--Power Conditioner Unit Temperature Circuit

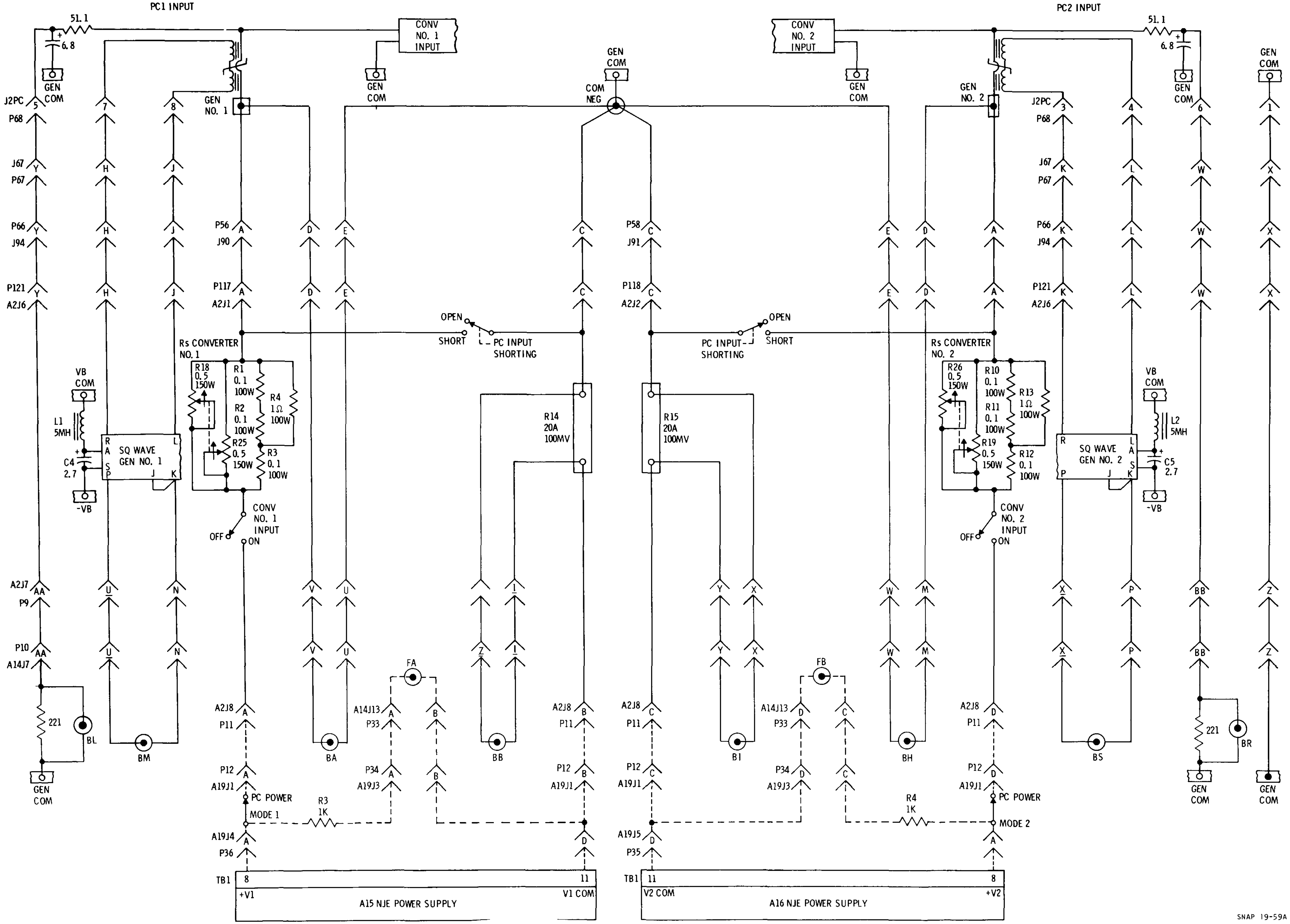

Figure 6-15. Power Conditioner Unit Subsystem--Power Conditioner Unit Input Circuit

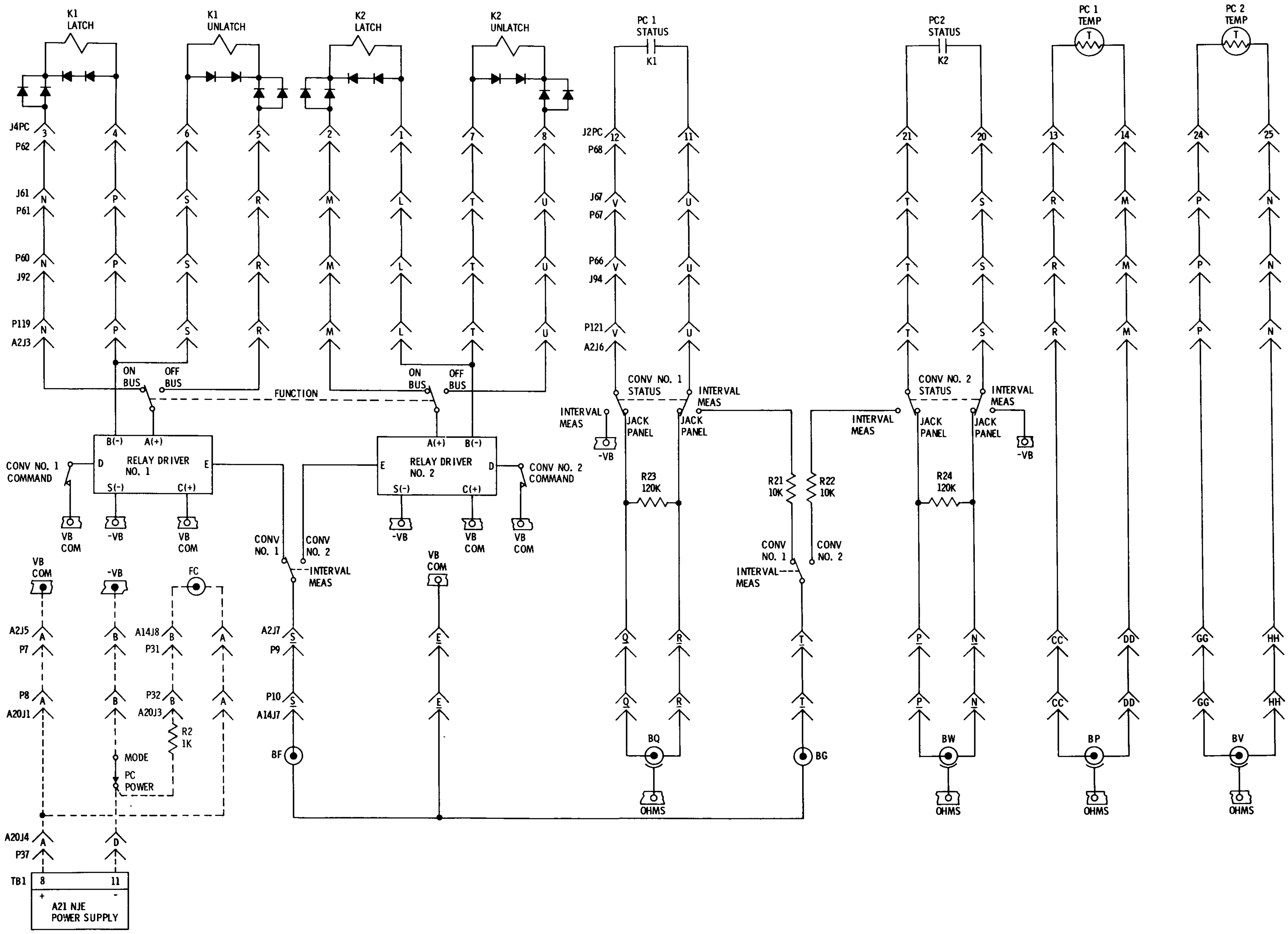

Figure 6-16. Power Conditioner Unit Subsystem--Power Conditioner Unit Status Circuit

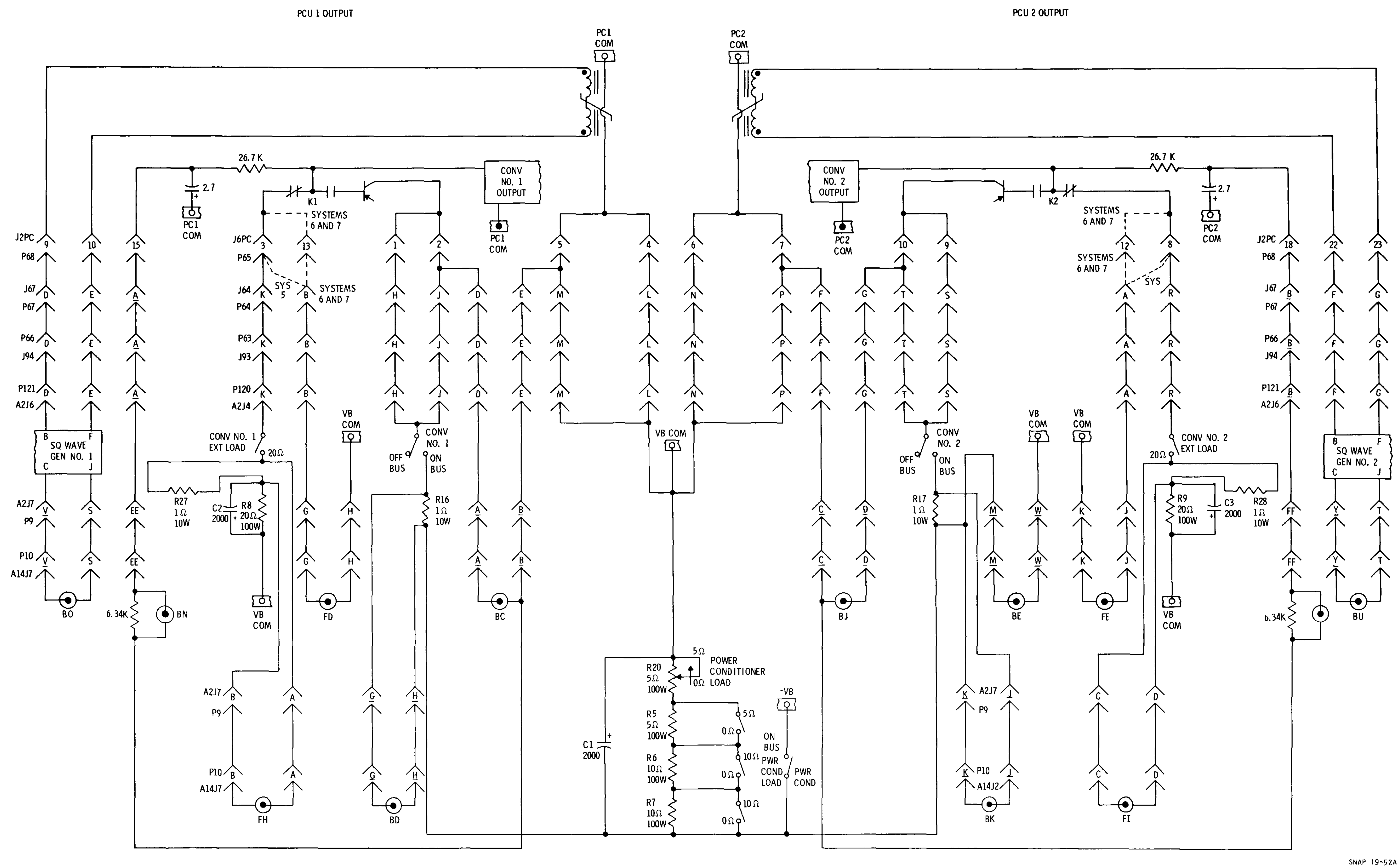

Figure 6-17. Power Conditioner Unit Subsystem--Power Conditioner Unit Output Circuit

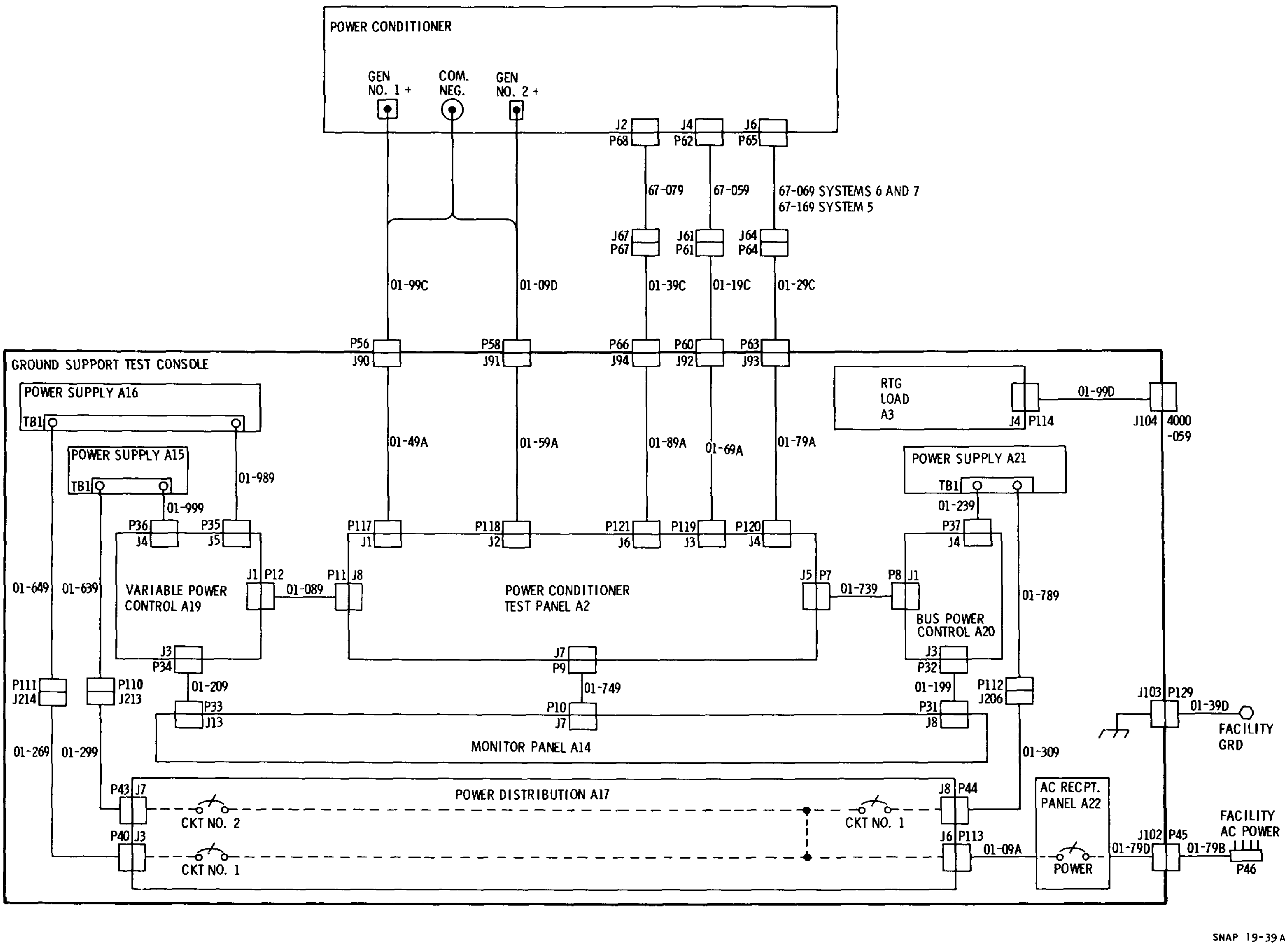

Figure 6-18. Power Conditioner Unit Subsystem--Interconnecting Cabling

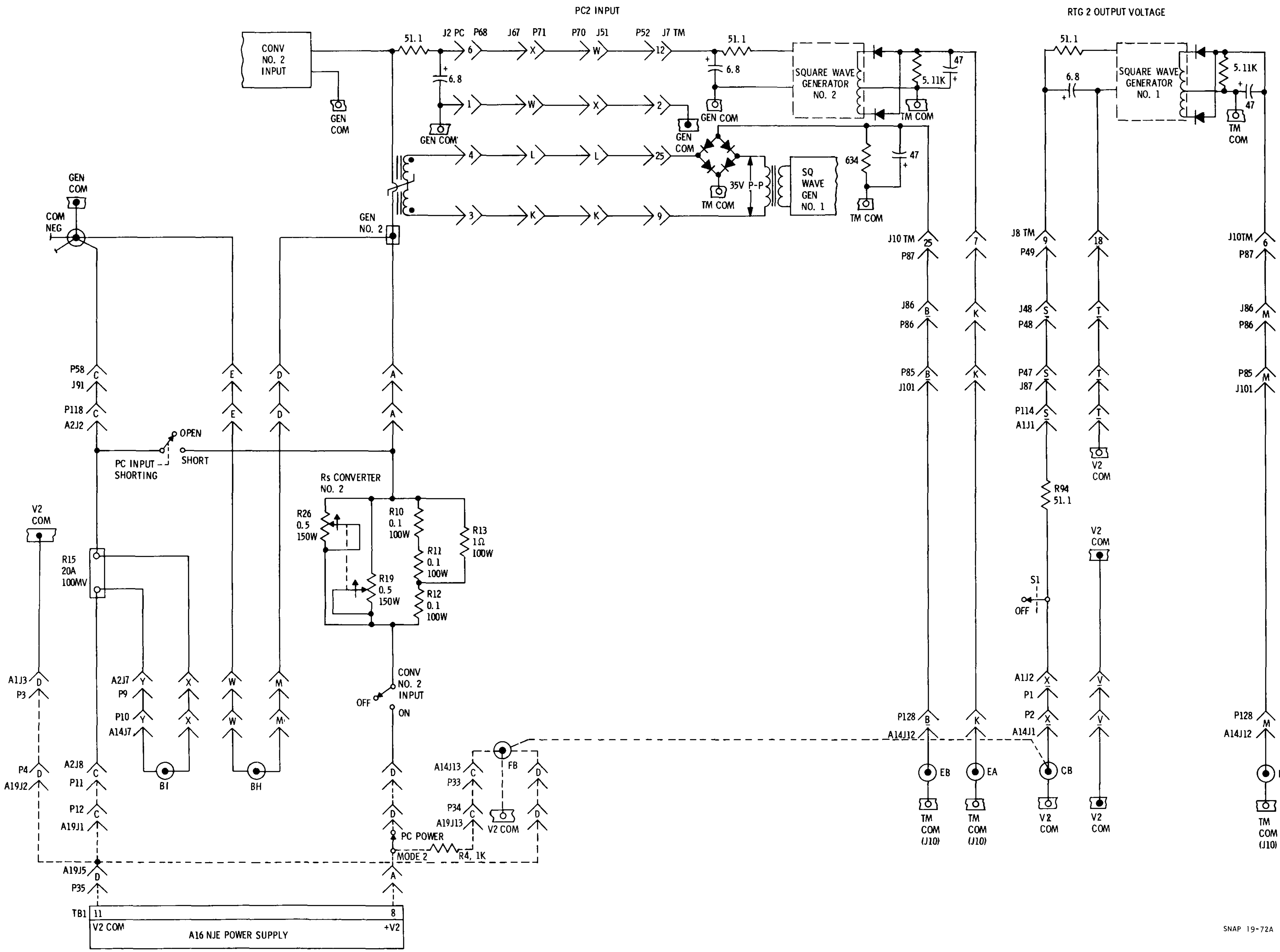

Figure 6-19. Generator (Simulated) Power Supply System--Power Conditioner Unit 2 (Simulated) Input, Generator 2 (Simulated) Output Circuit

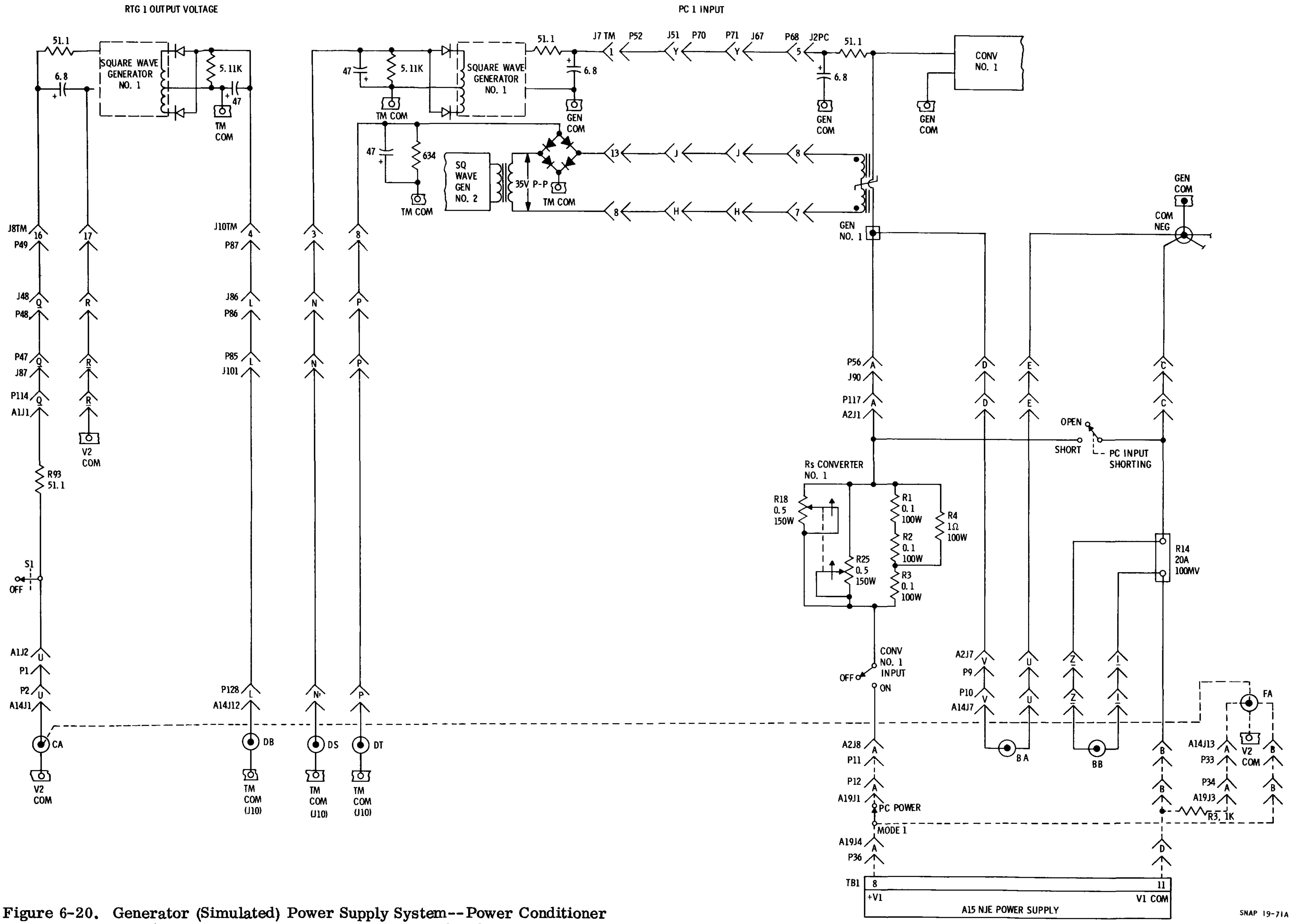

Figure 6-20. Generator (Simulated) Power Supply System--Power Conditioner Unit 1 (Simulated) Input, Generator 1 (Simulated) Output Circuit

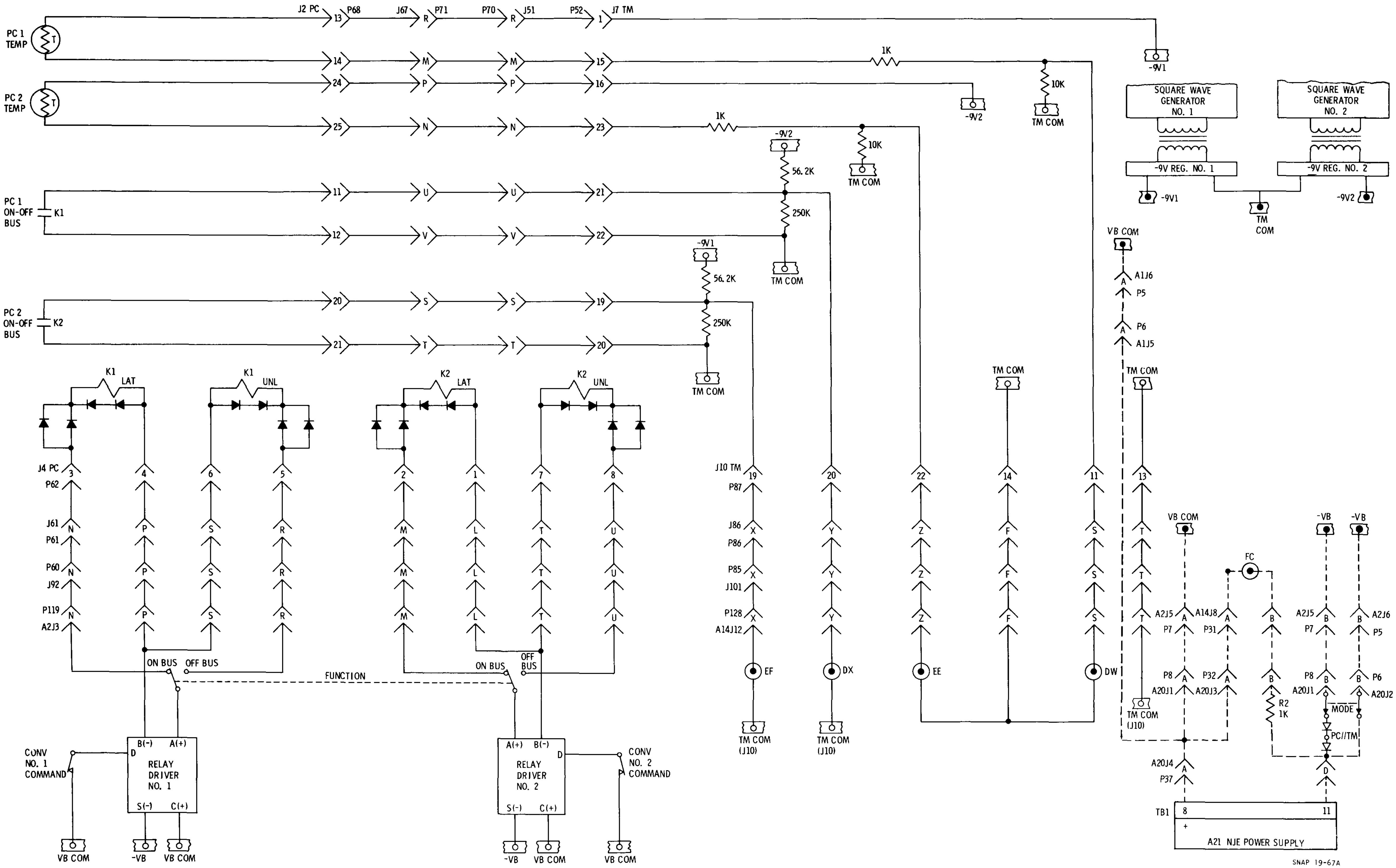

Figure 6-21. Generator (Simulated) Power Supply System--Power Conditioner Unit Status Circuit

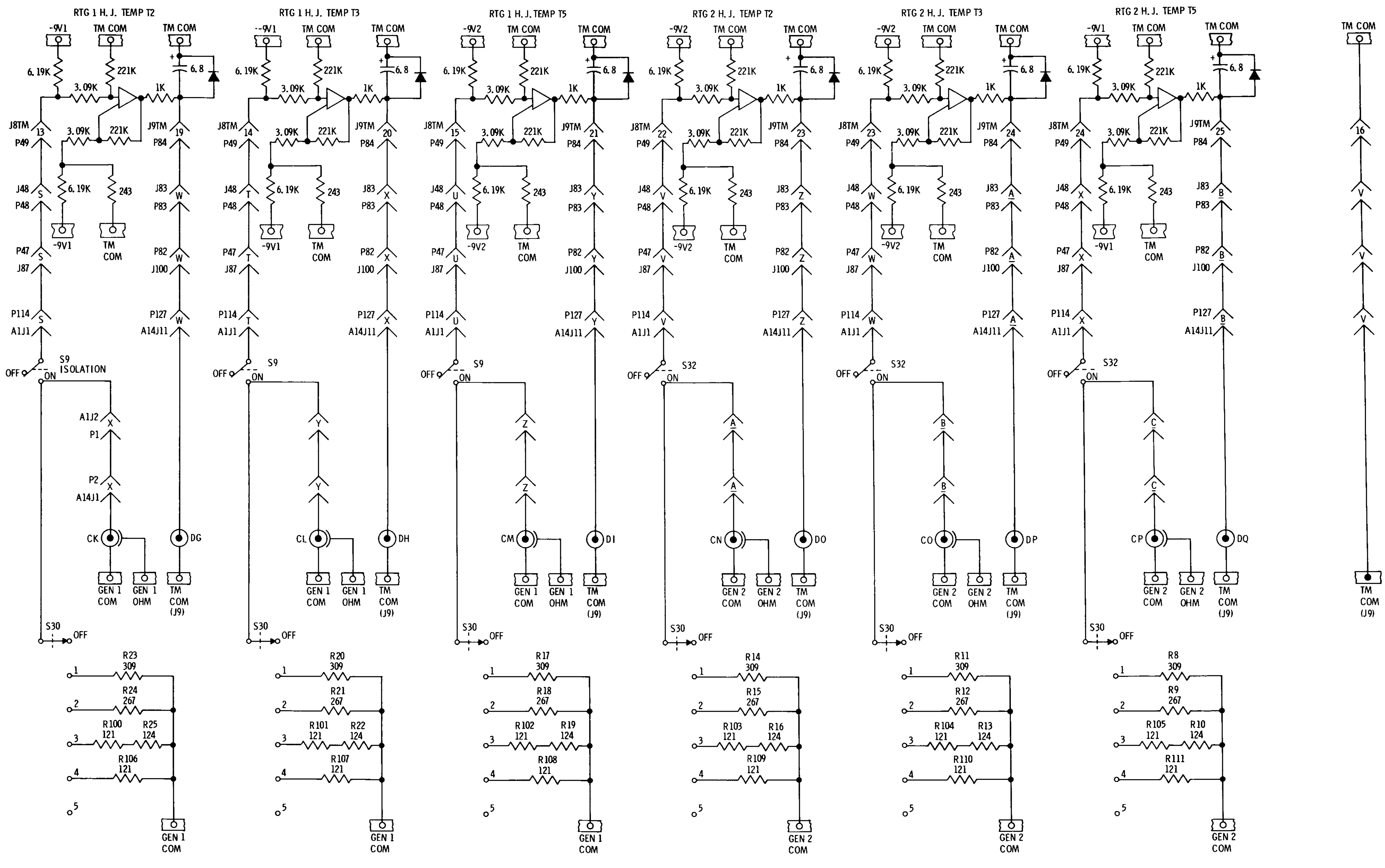

Figure 6-22. Generator (Simulated) Power Supply System--Generator (Simulated) Hot Junction Temperature Circuit

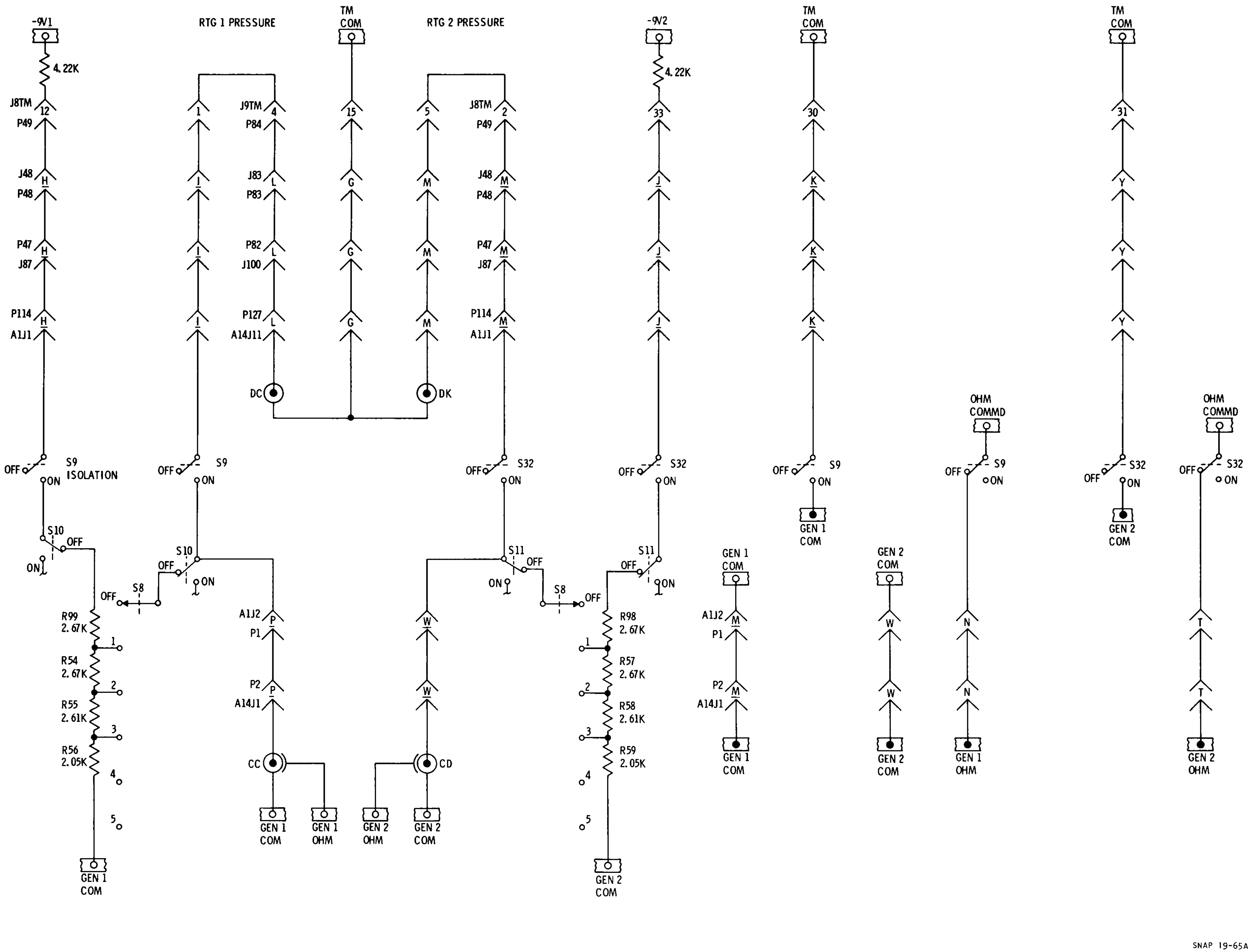

Figure 6-23. Generator (Simulated) Power Supply System--Generator (Simulated) Pressure Circuit

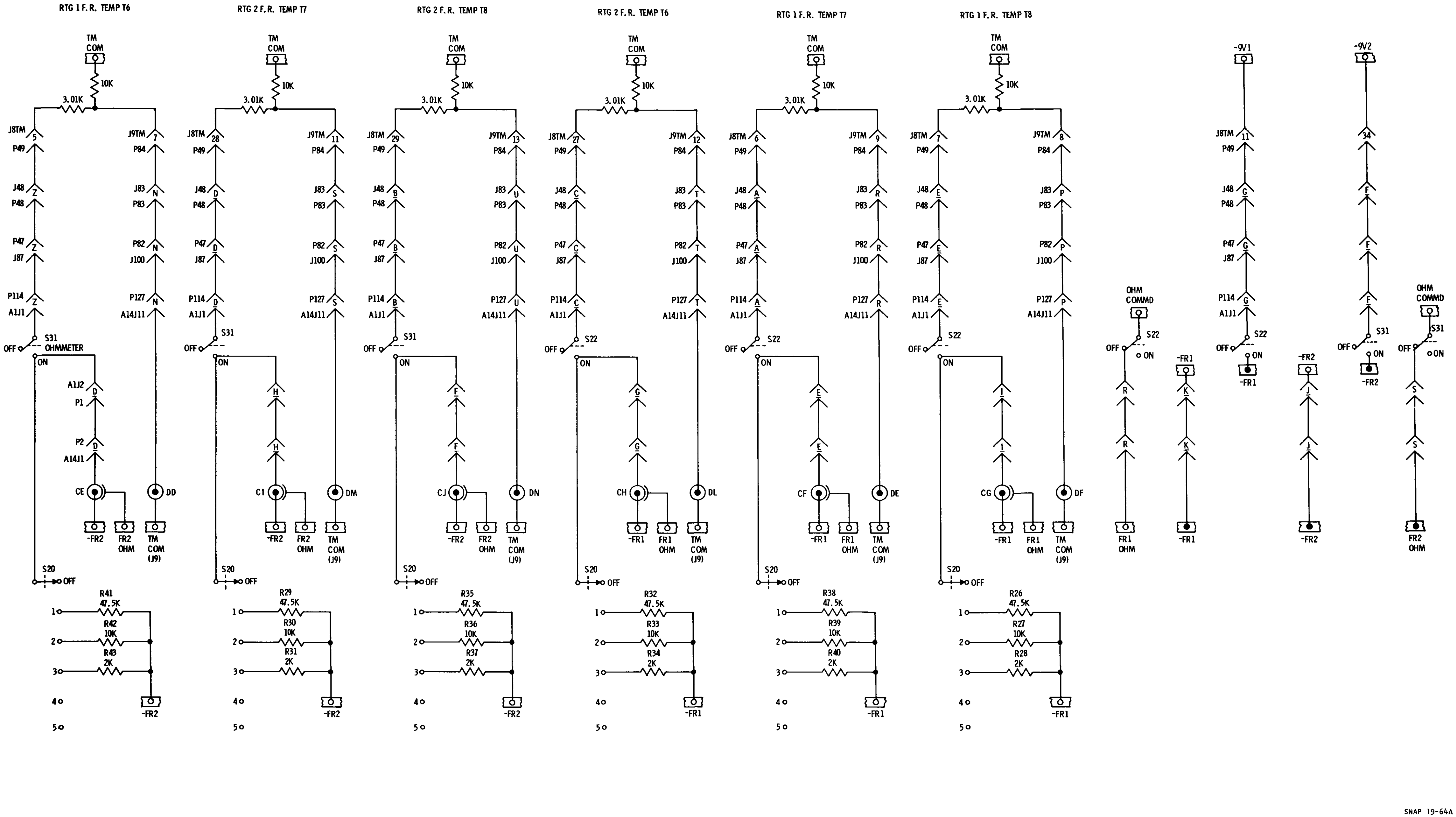

Figure 6-24. Generator (Simulated) Power Supply System--Generator (Simulated) Fin Root Temperature Circuit

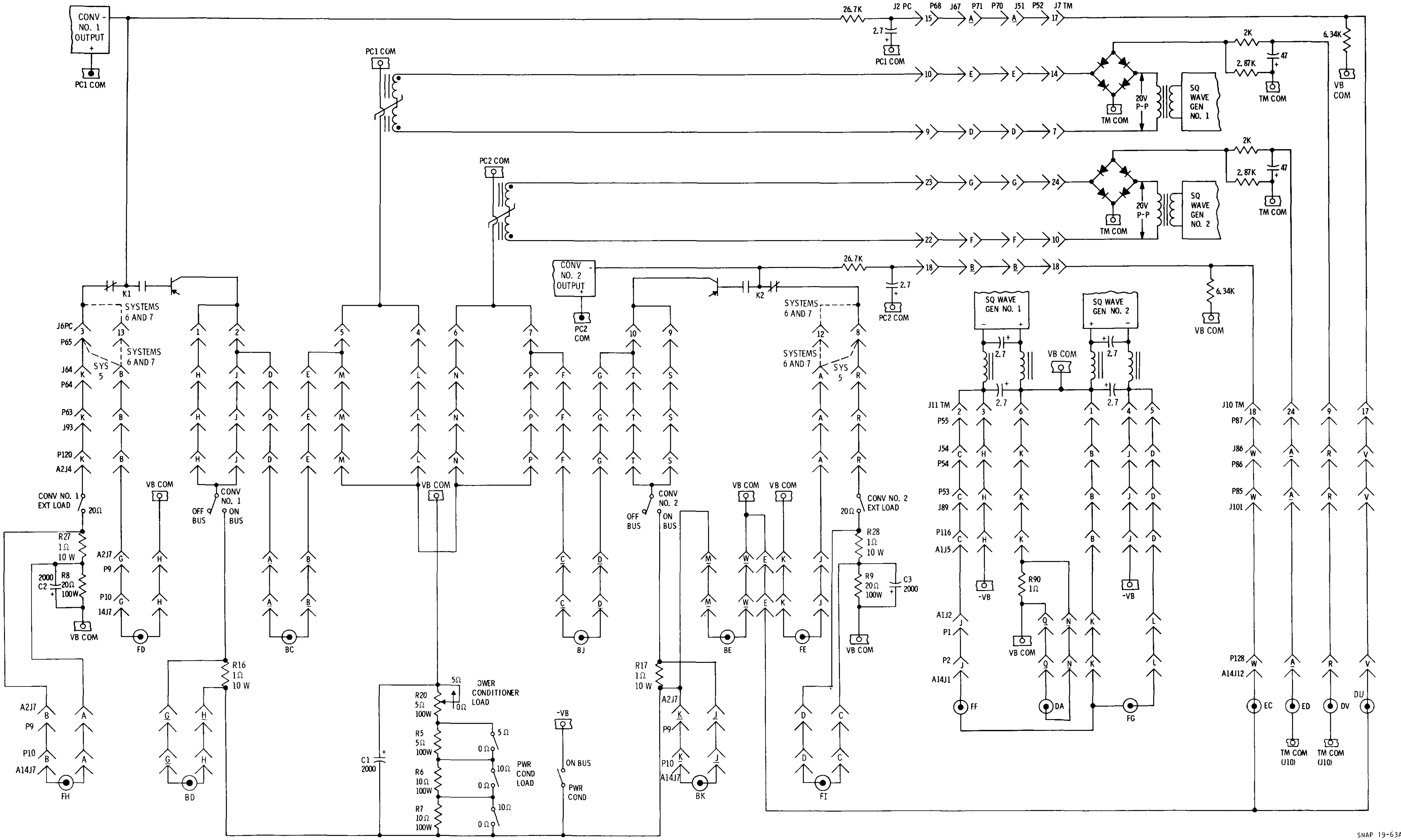

Figure 6-25. Generator (Simulated) Power Supply System--Power Conditioner Unit Output, Telemetry Signal Conditioner Unit Input

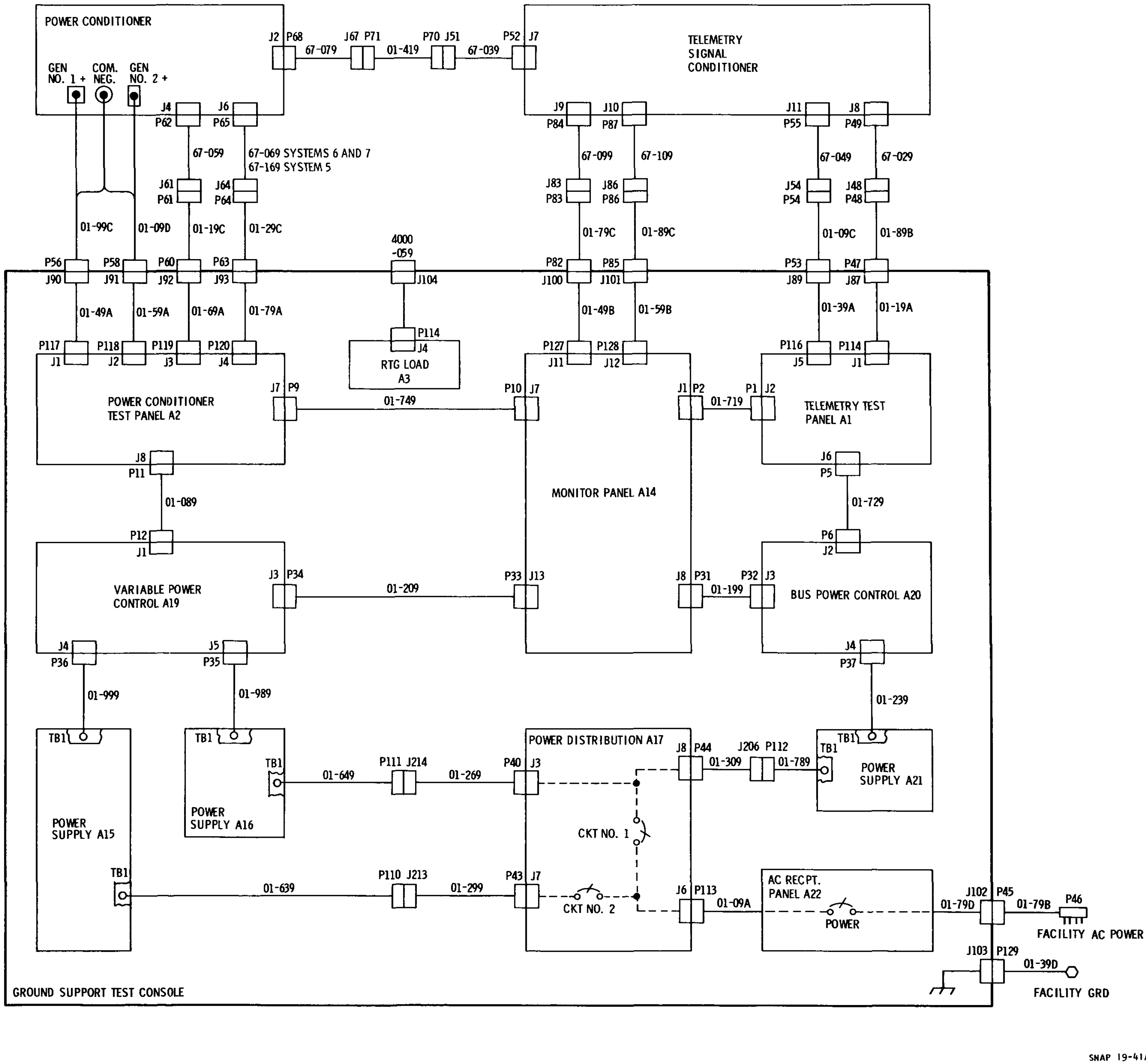

Figure 6-26. Generator (Simulated) Power Supply System Circuit

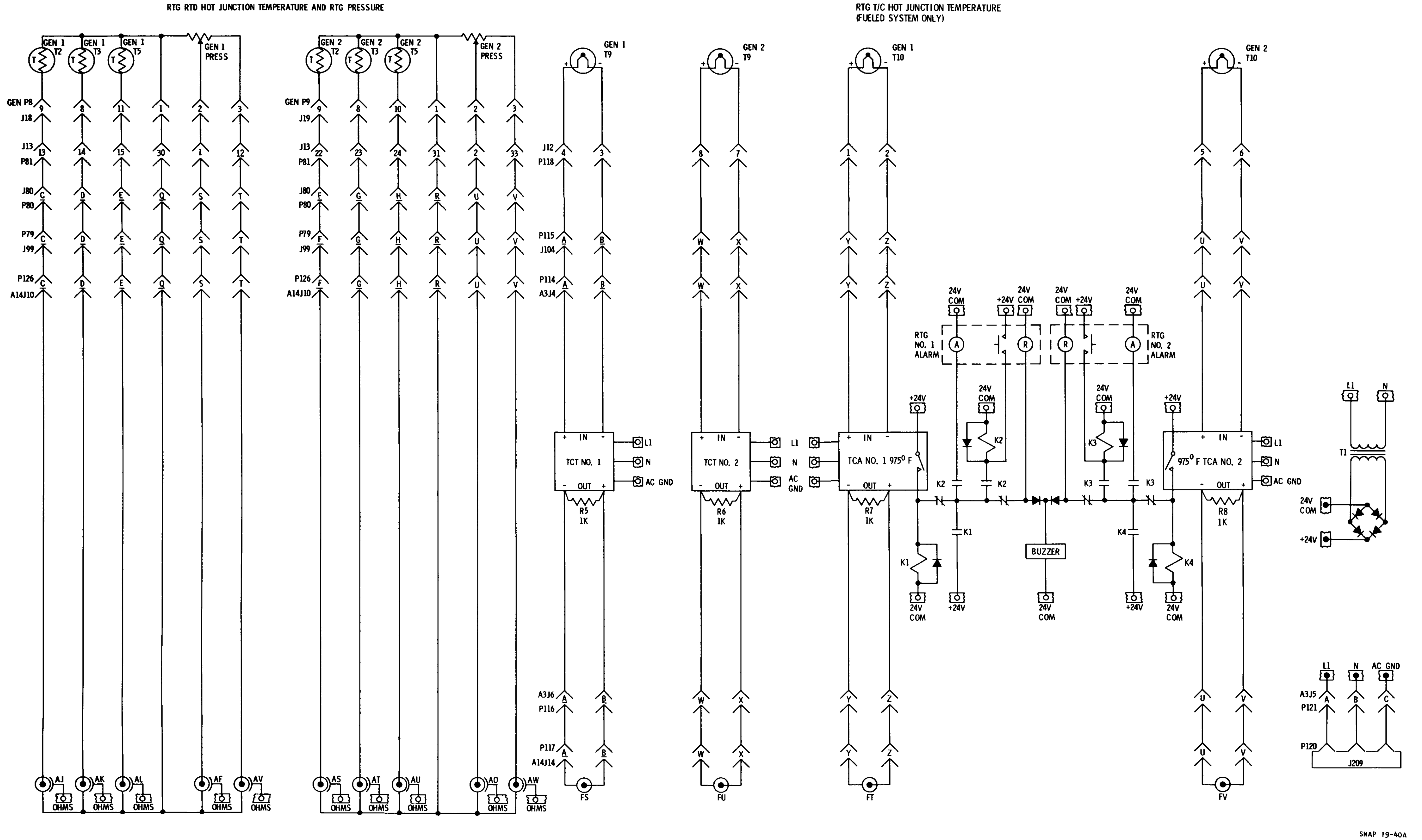

Figure 6-27. Generator Subsystem--Generator Hot Junction Temperature and Pressures Circuit

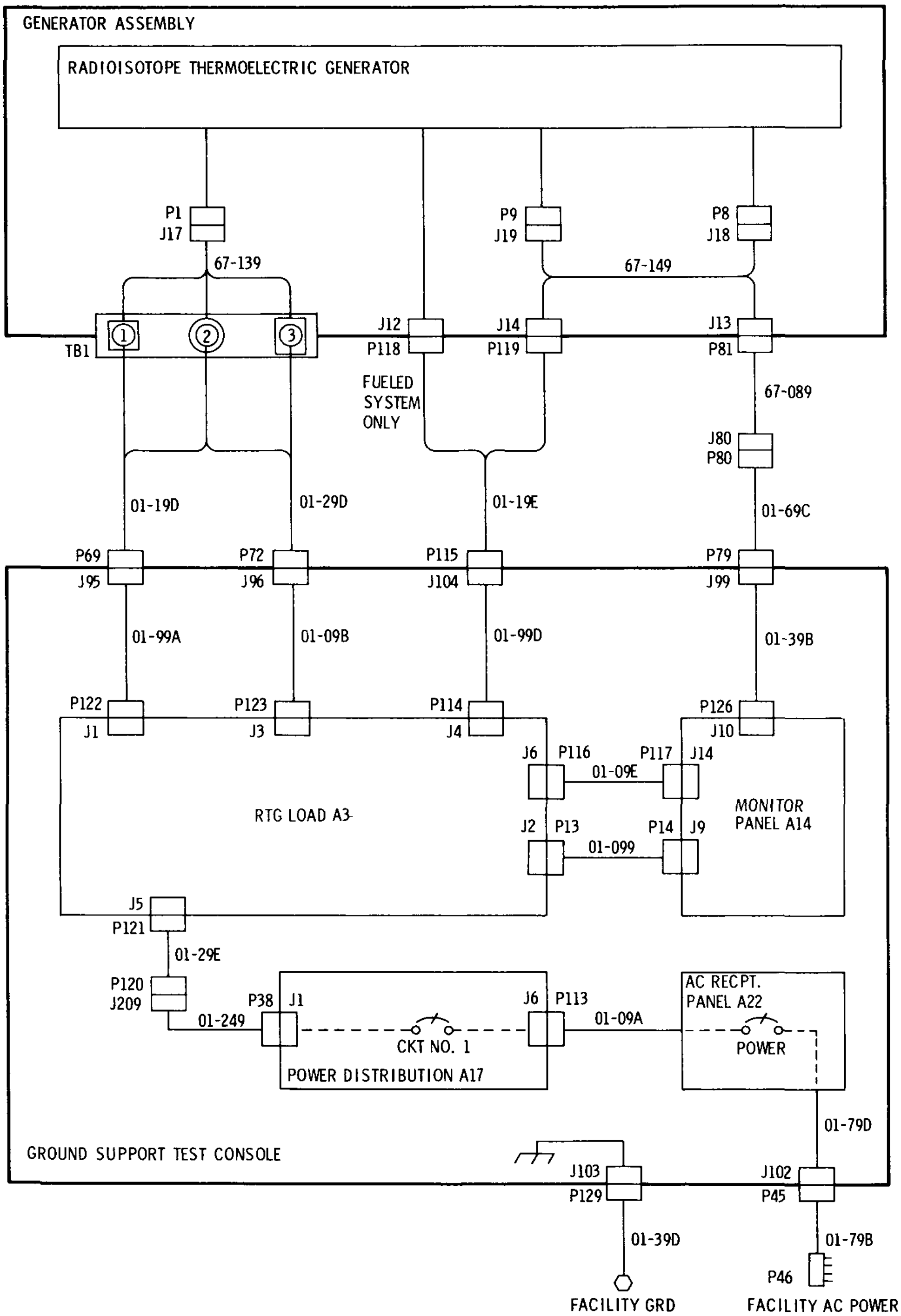

Figure 6-28. Generator Subsystem--Interconnecting Cabling

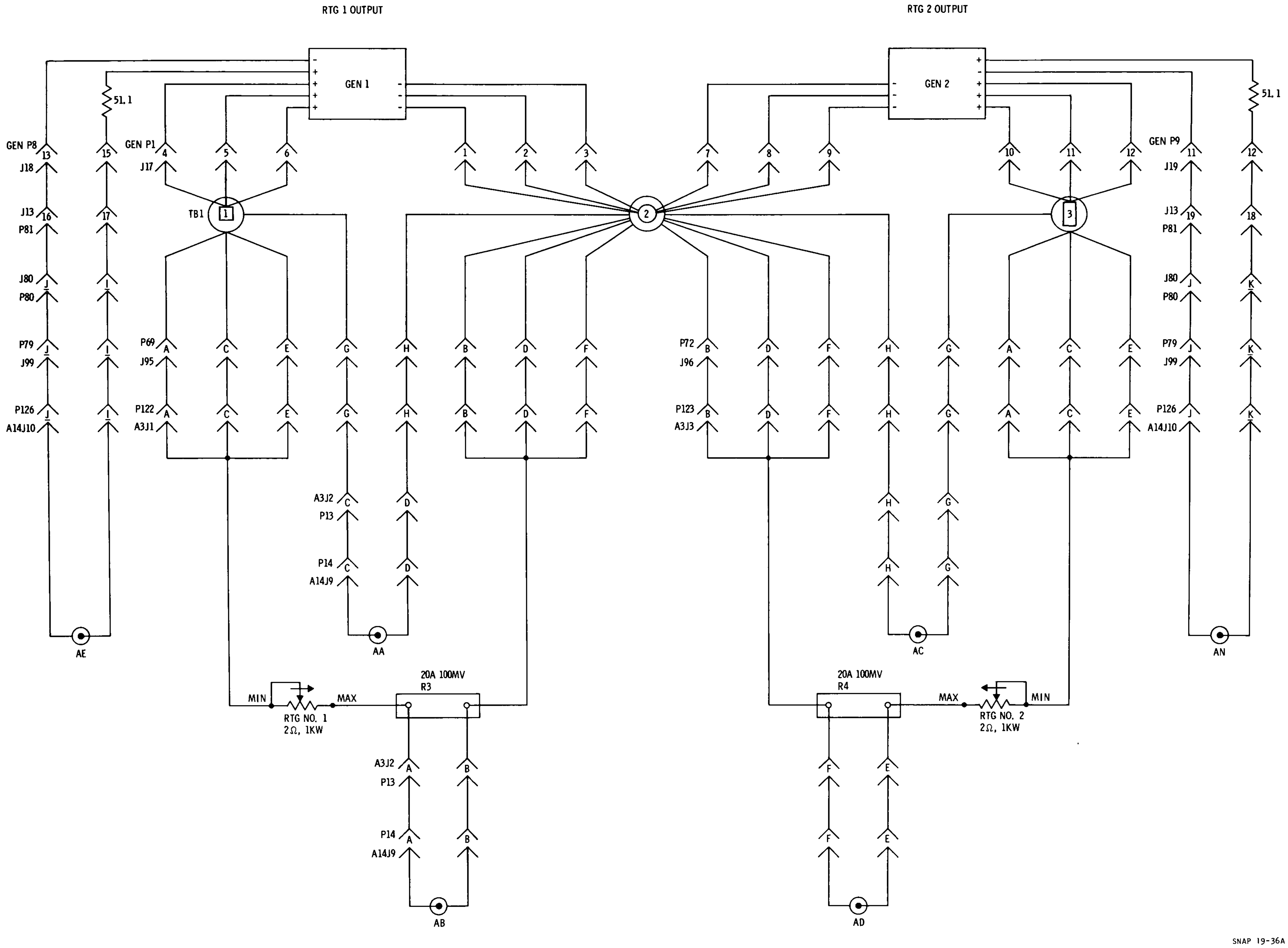

Figure 6-29. Generator Subsystem--Generator Output Circuit

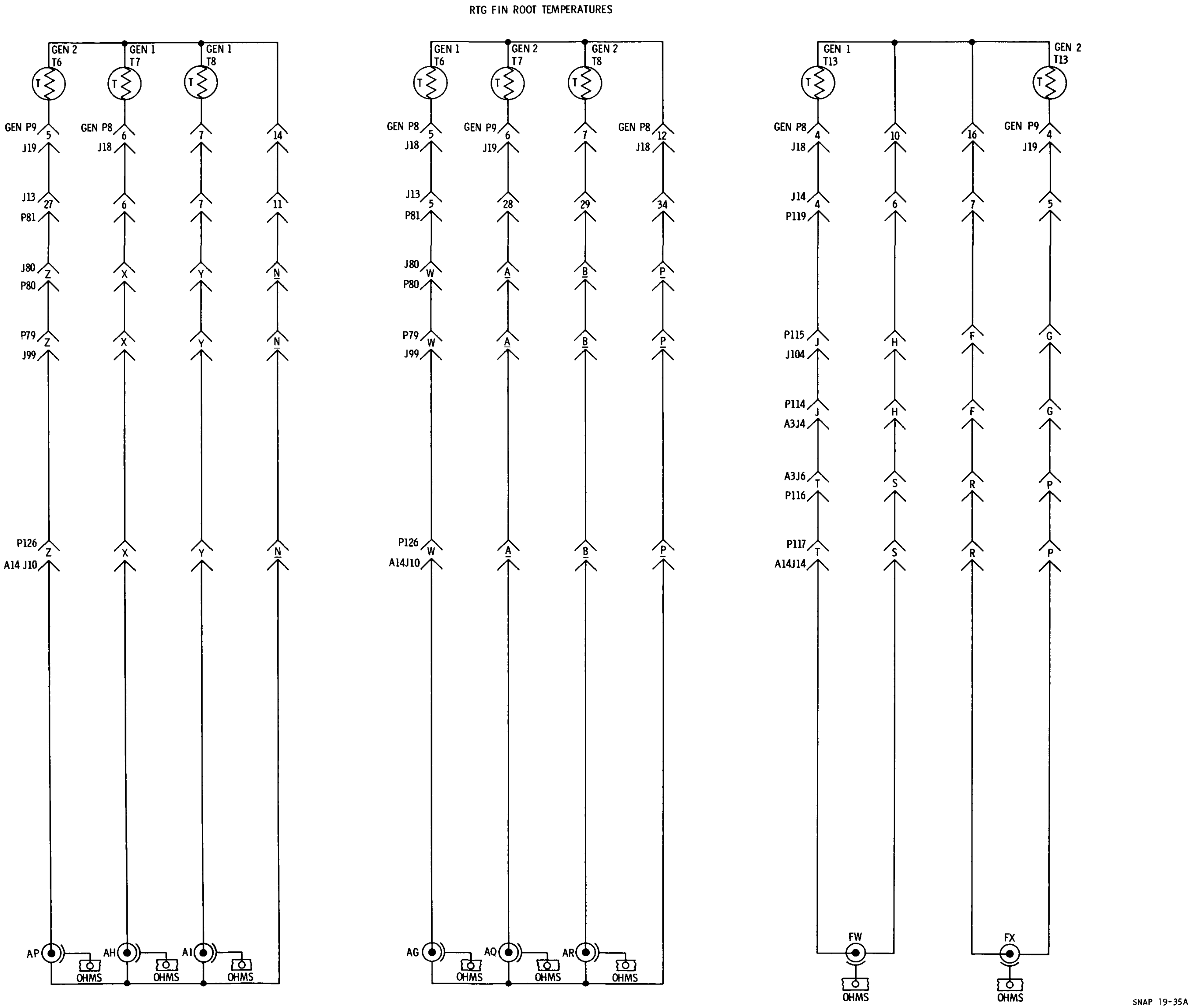

Figure 6-30. Generator Subsystem--Generator Fin Root Temperature Circuit

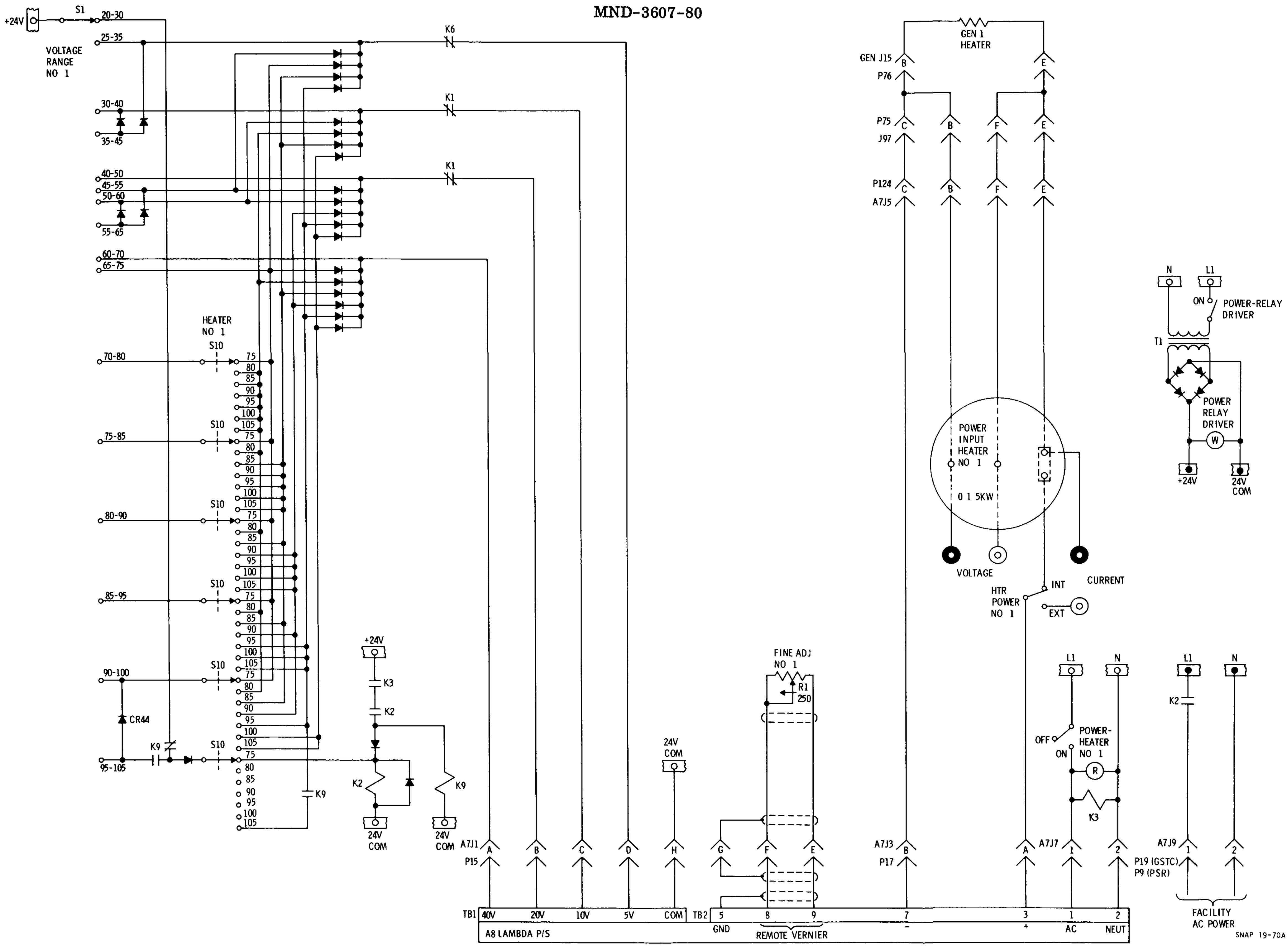

Figure 6-31. Electrically Heated Generator Subsystem--Heater 1 Voltage Control Circuit

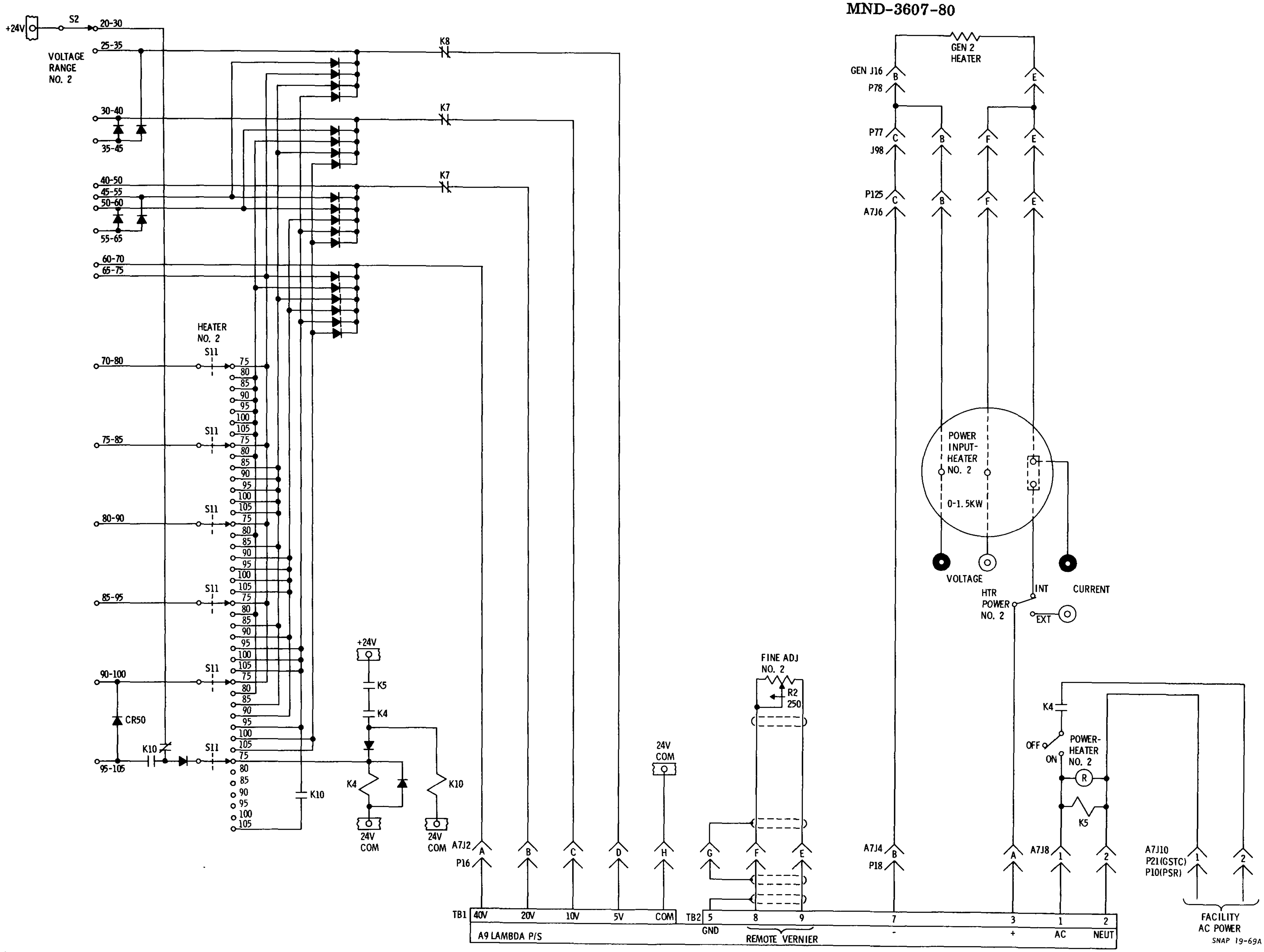

Figure 6-32. Electrically heated Generator Subsystem--Heater 2 Voltage Control Circuit

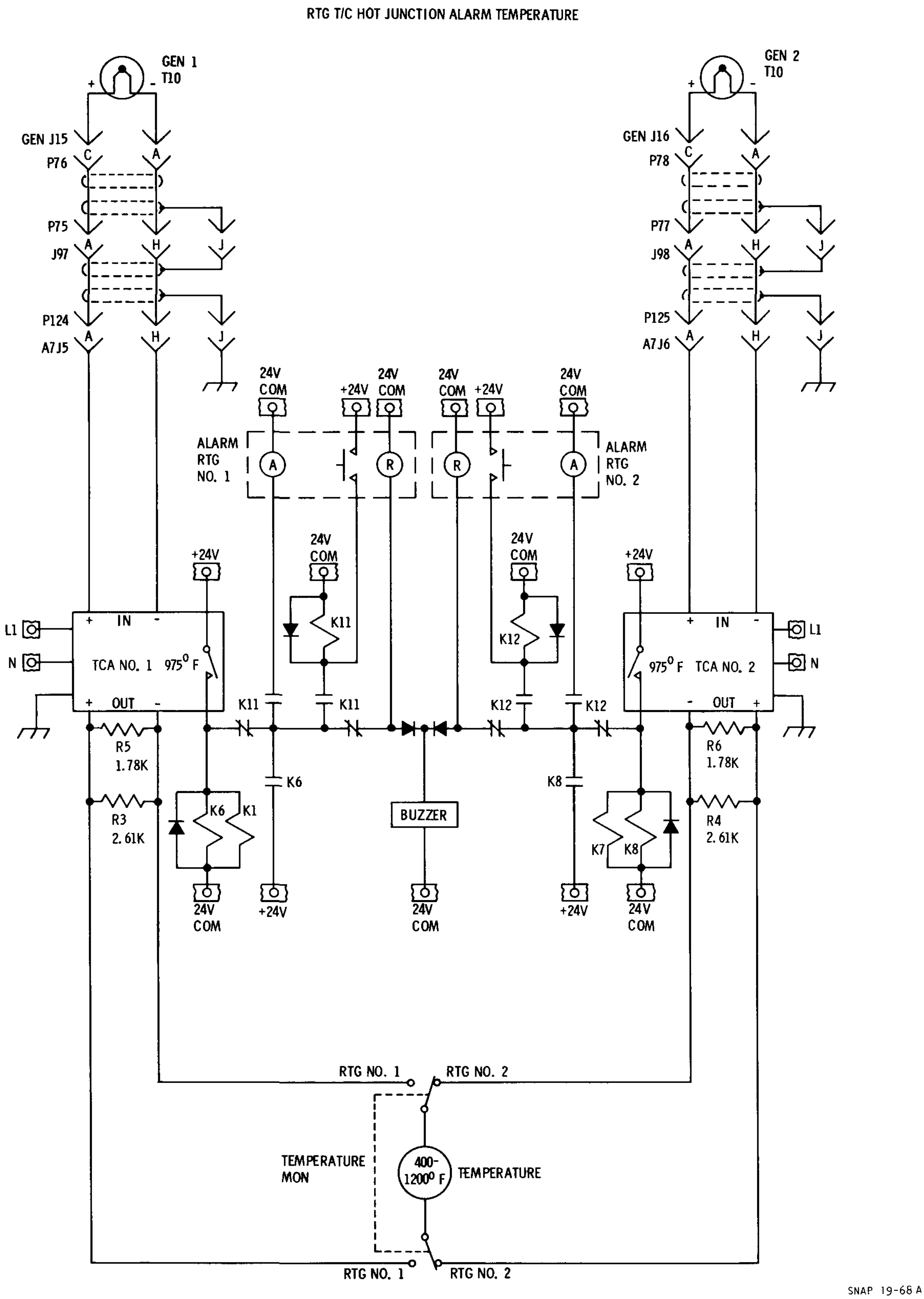

Figure 6-33. Electrically Heated Generator Subsystem--Temperature Alarm Circuit

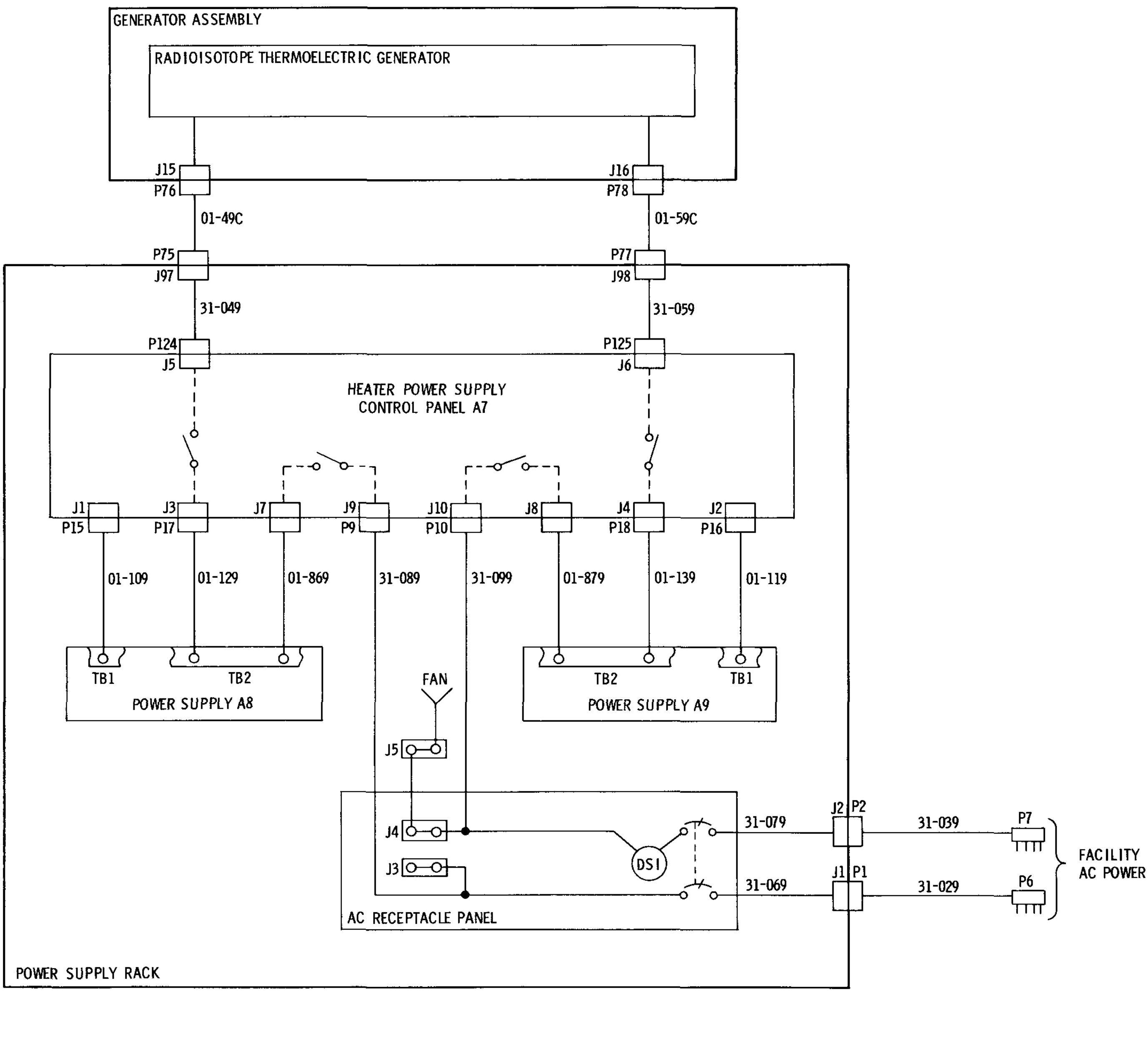

Figure 6-34. Electrically Heated Generator Subsystem--Interconnecting Cabling (Power Supply Rack)

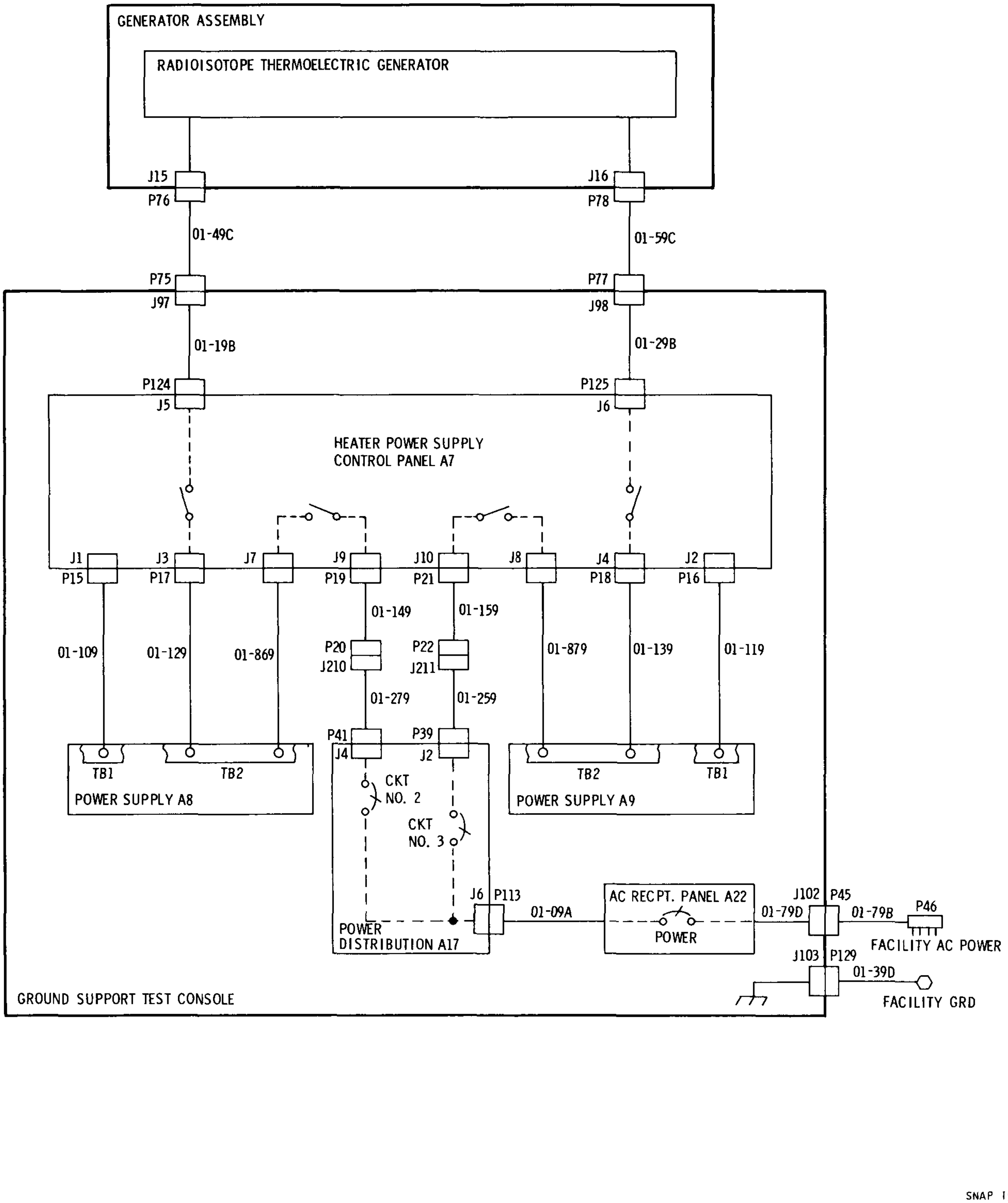

Figure 6-35. Electrically Heated Generator Subsystem--Interconnecting Cabling (Ground Support Test Console)

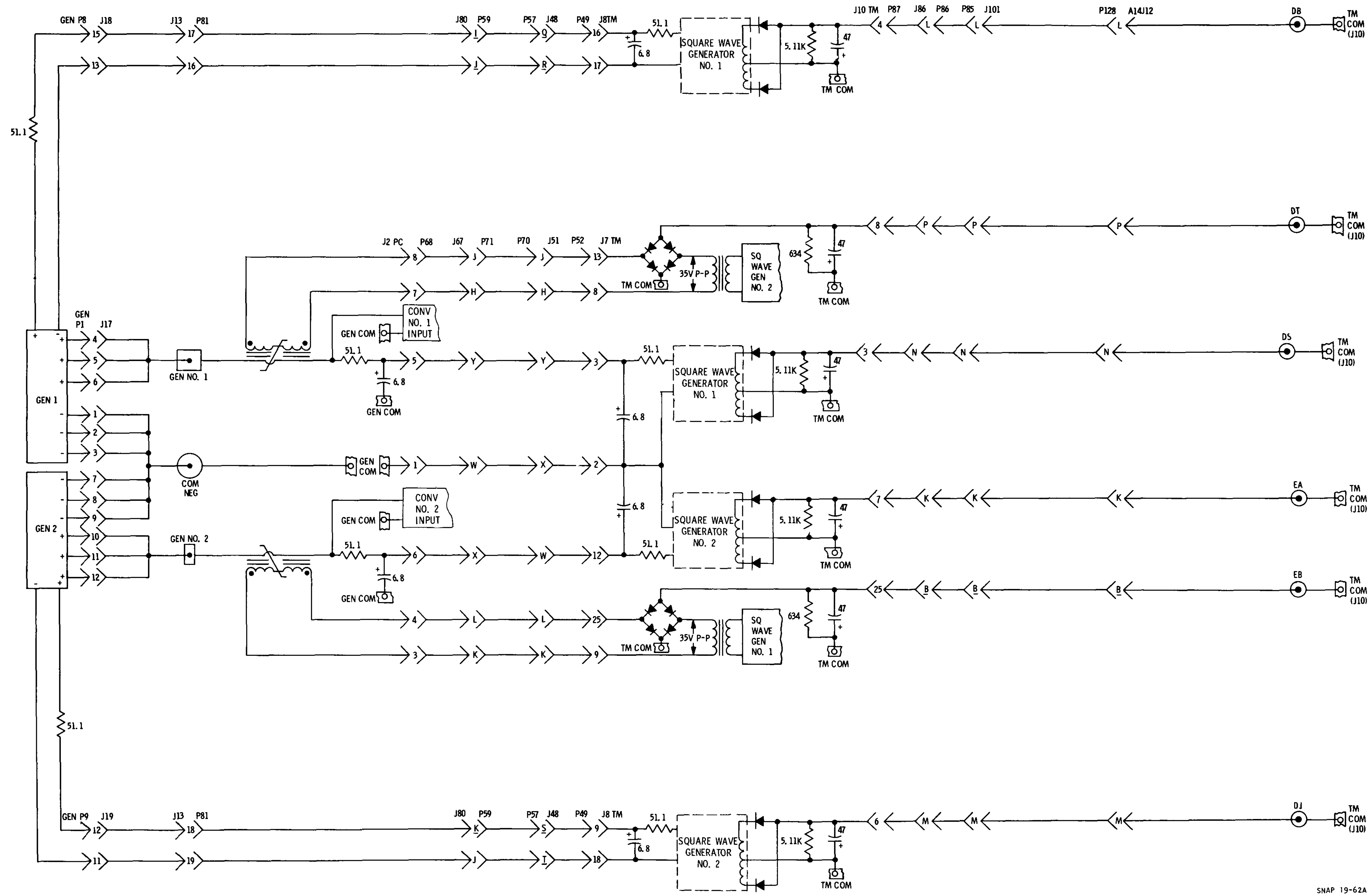

Figure 6-36. Generator Power Supply System--Generator Output, Power Conditioner Unit Input Circuit

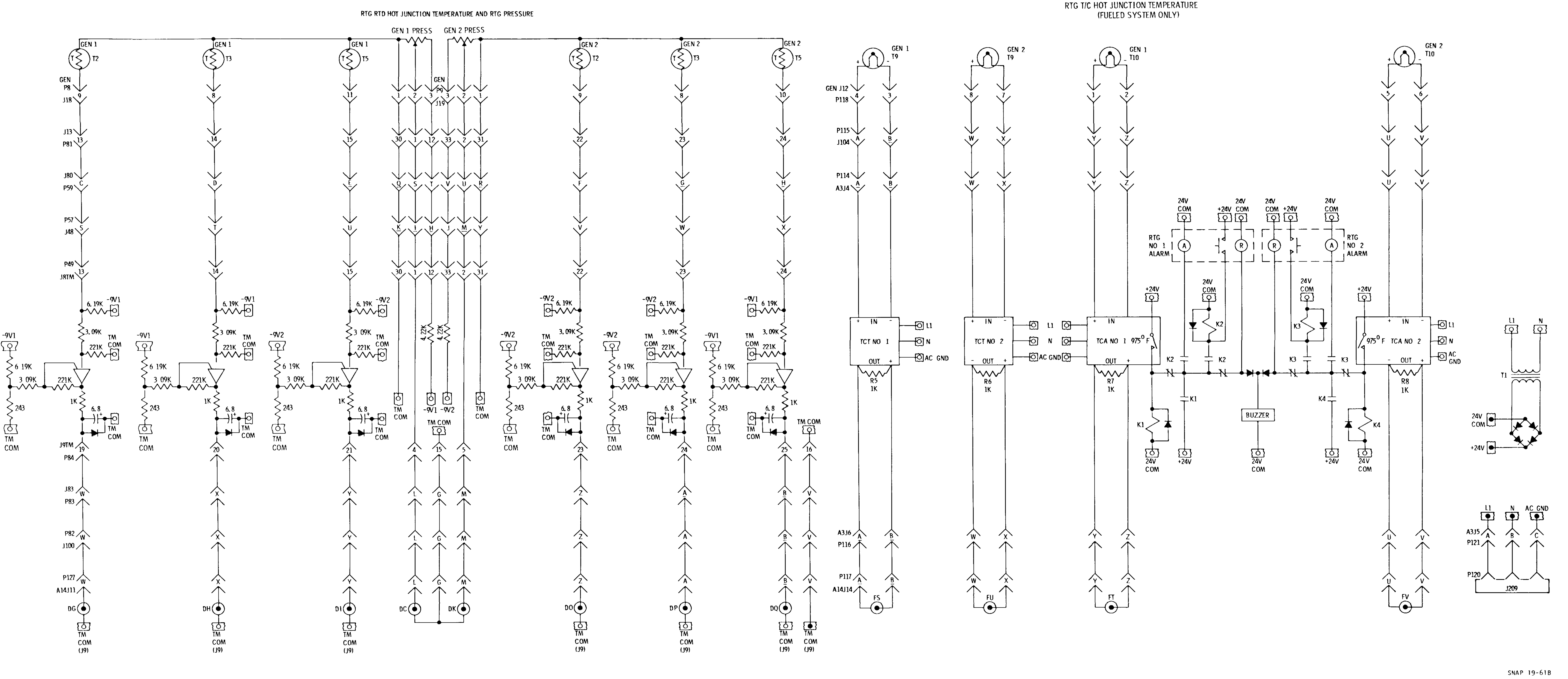

Figure 6-37. Generator Power Supply System--Generator Hot Junction Temperature and Pressure Circuit

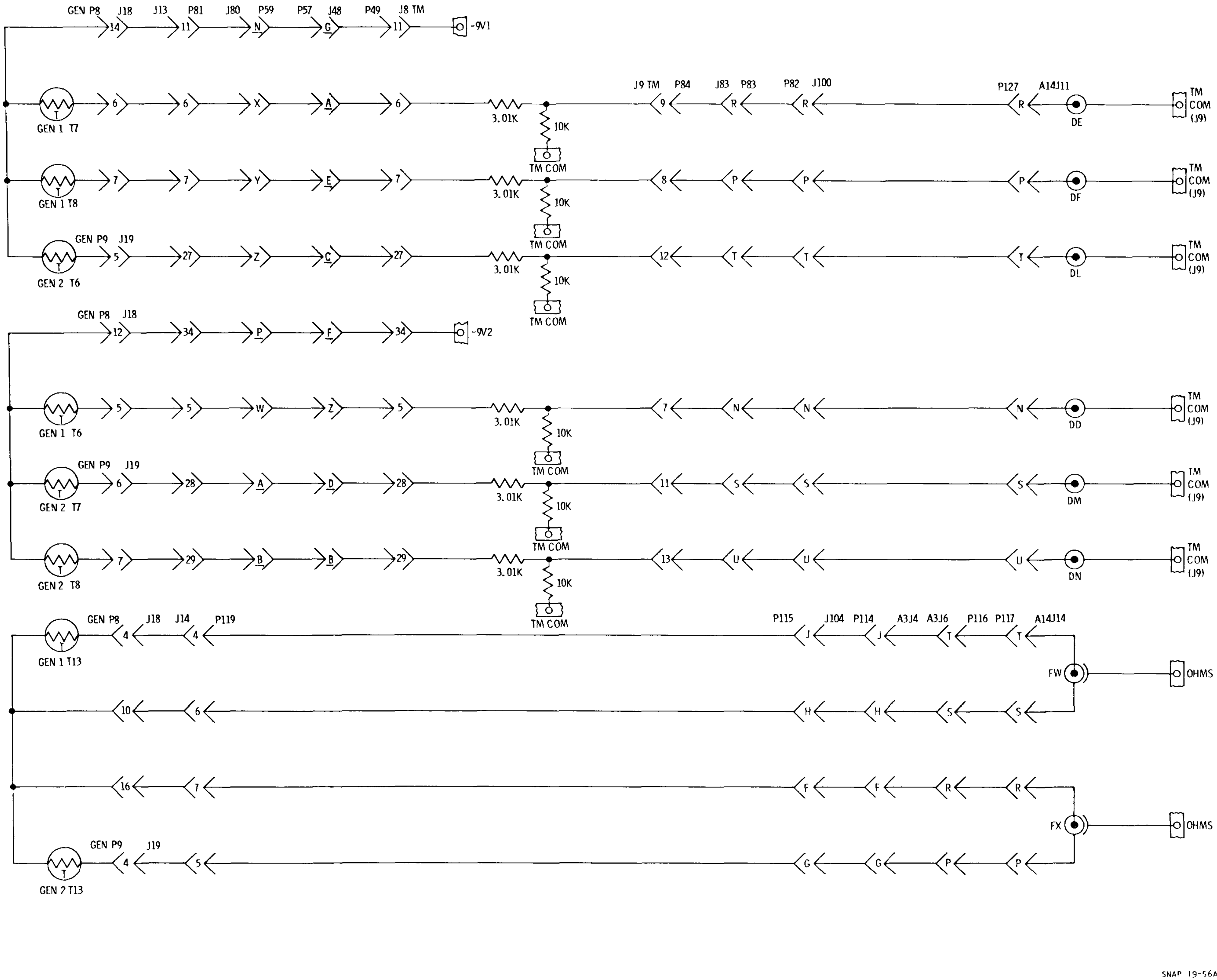

Figure 6-38. Generator Power Supply System--Generator Fin Root Temperature Circuit

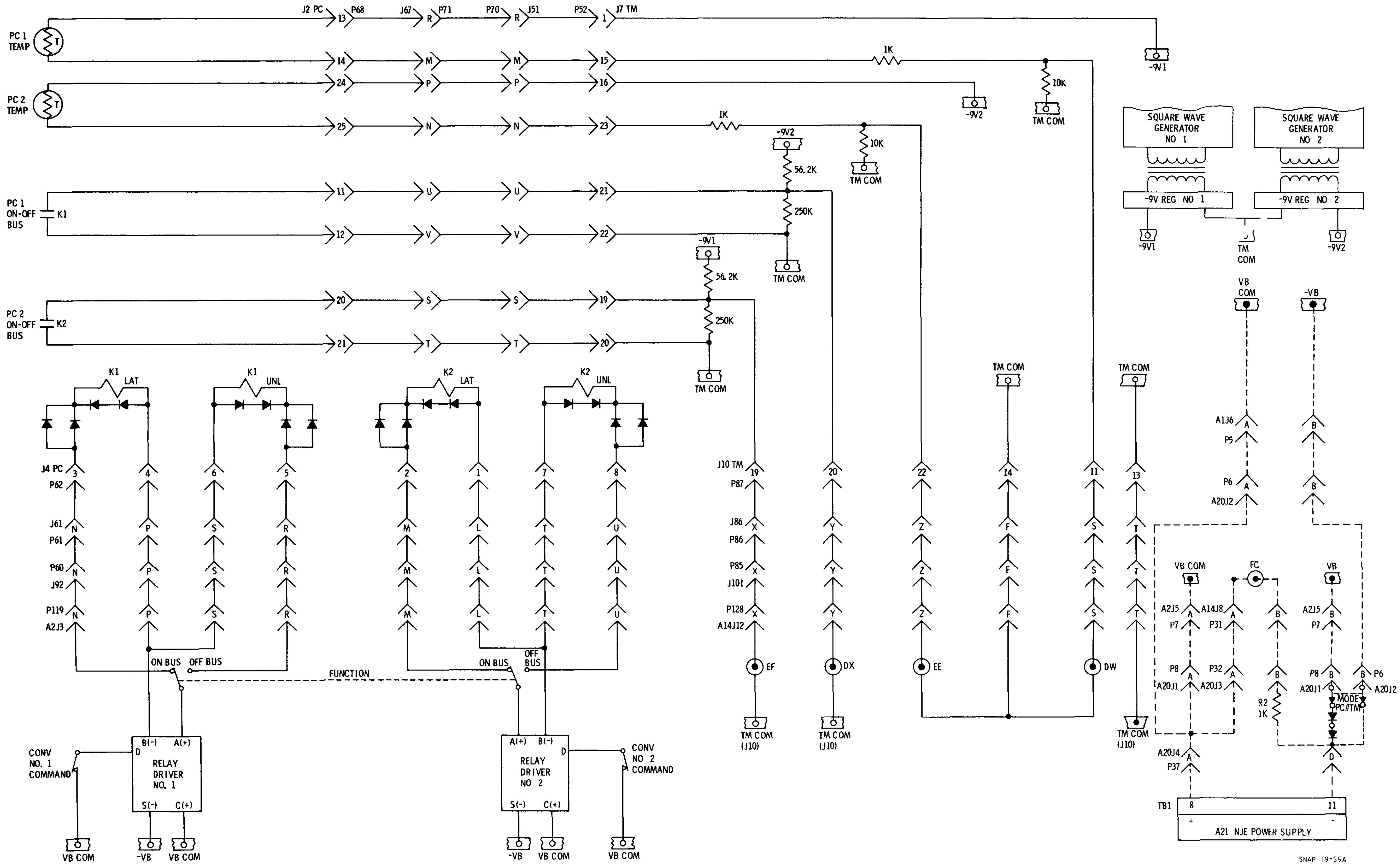

Figure 6-39. Generator Power Supply System--Power Conditioner Unit Status Circuit

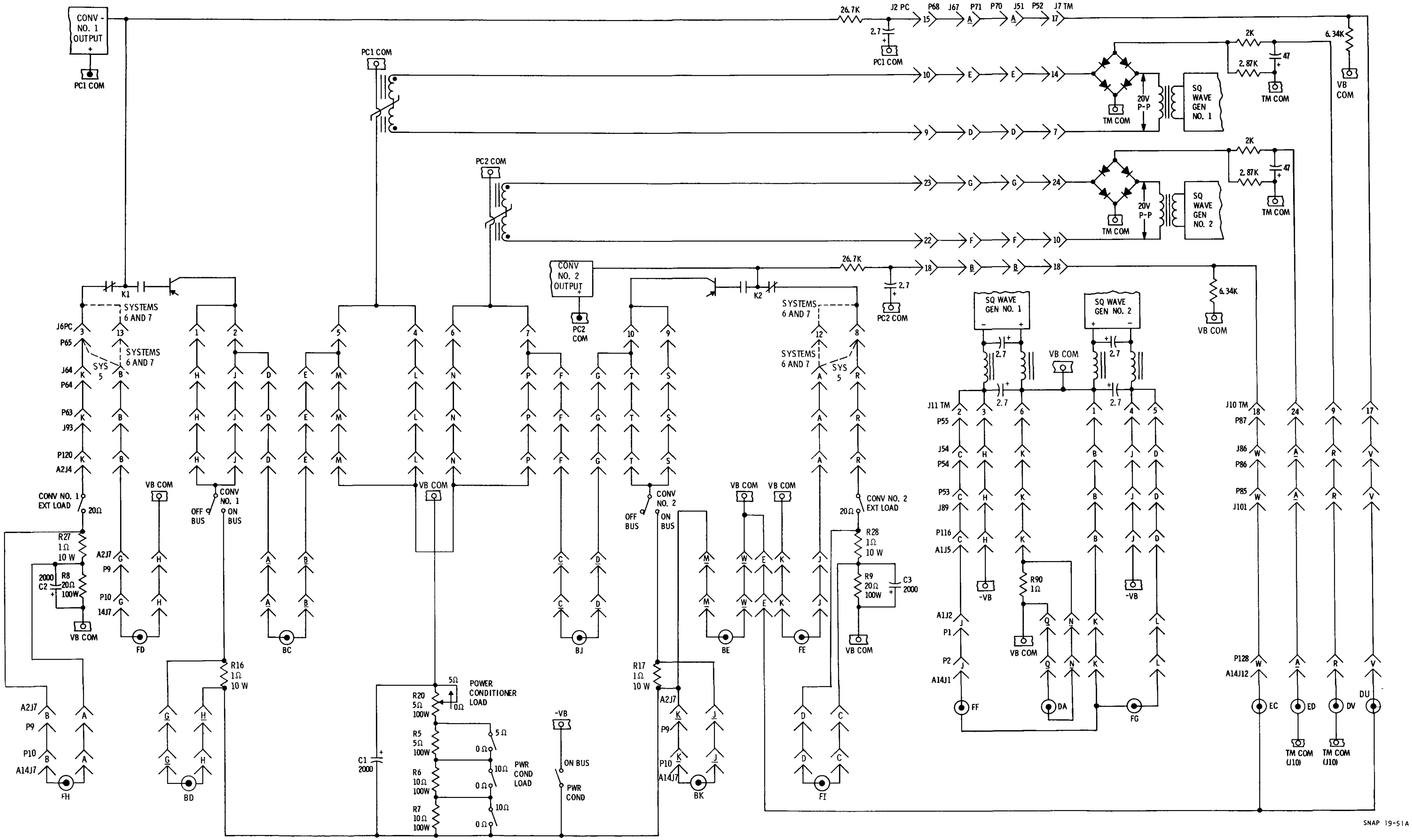

Figure 6-40. Generator Power Supply System--Telemetry Signal Conditioner Unit Output and Input Circuits

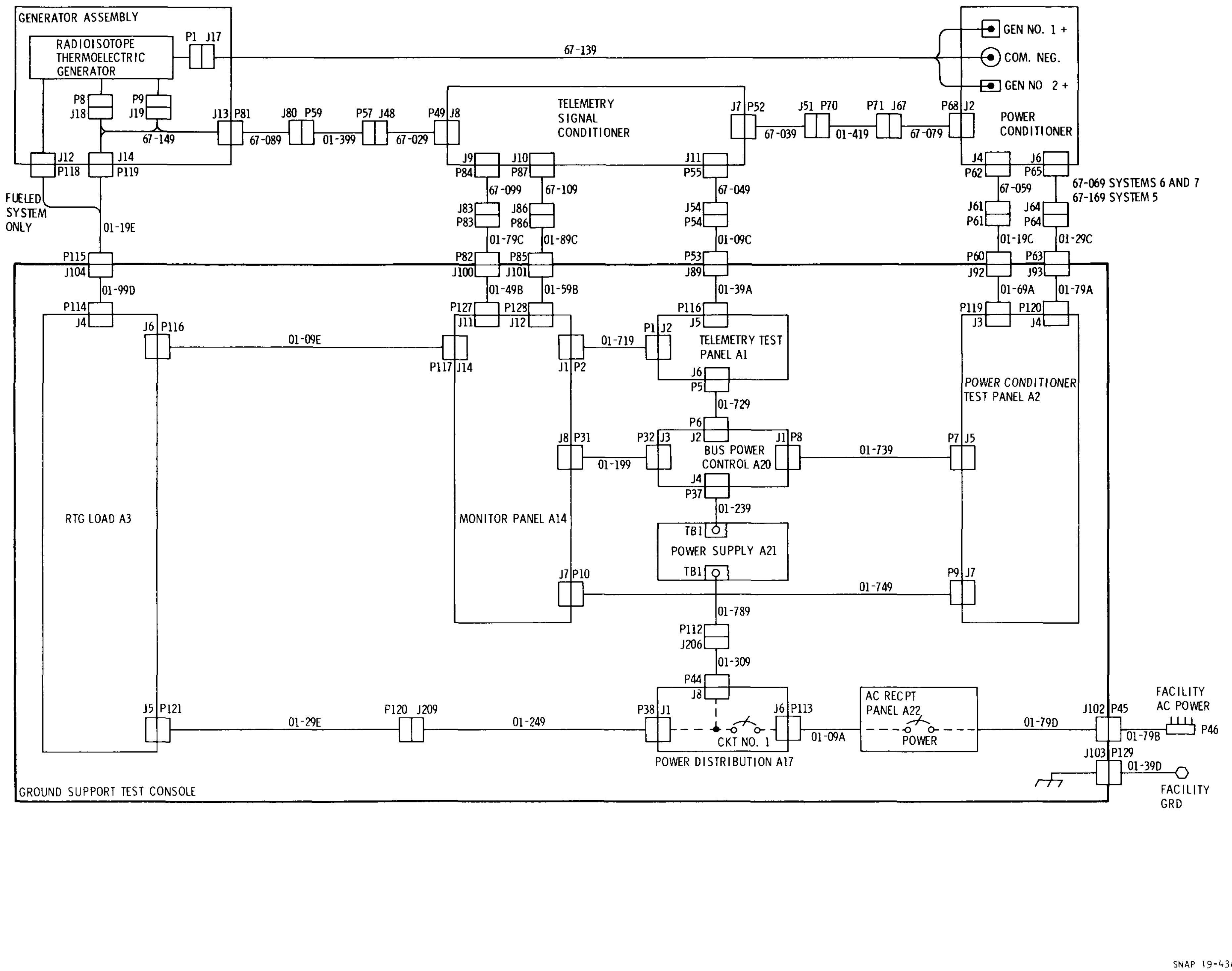

Figure 6-41. Generator Power Supply System--Interconnecting Cabling

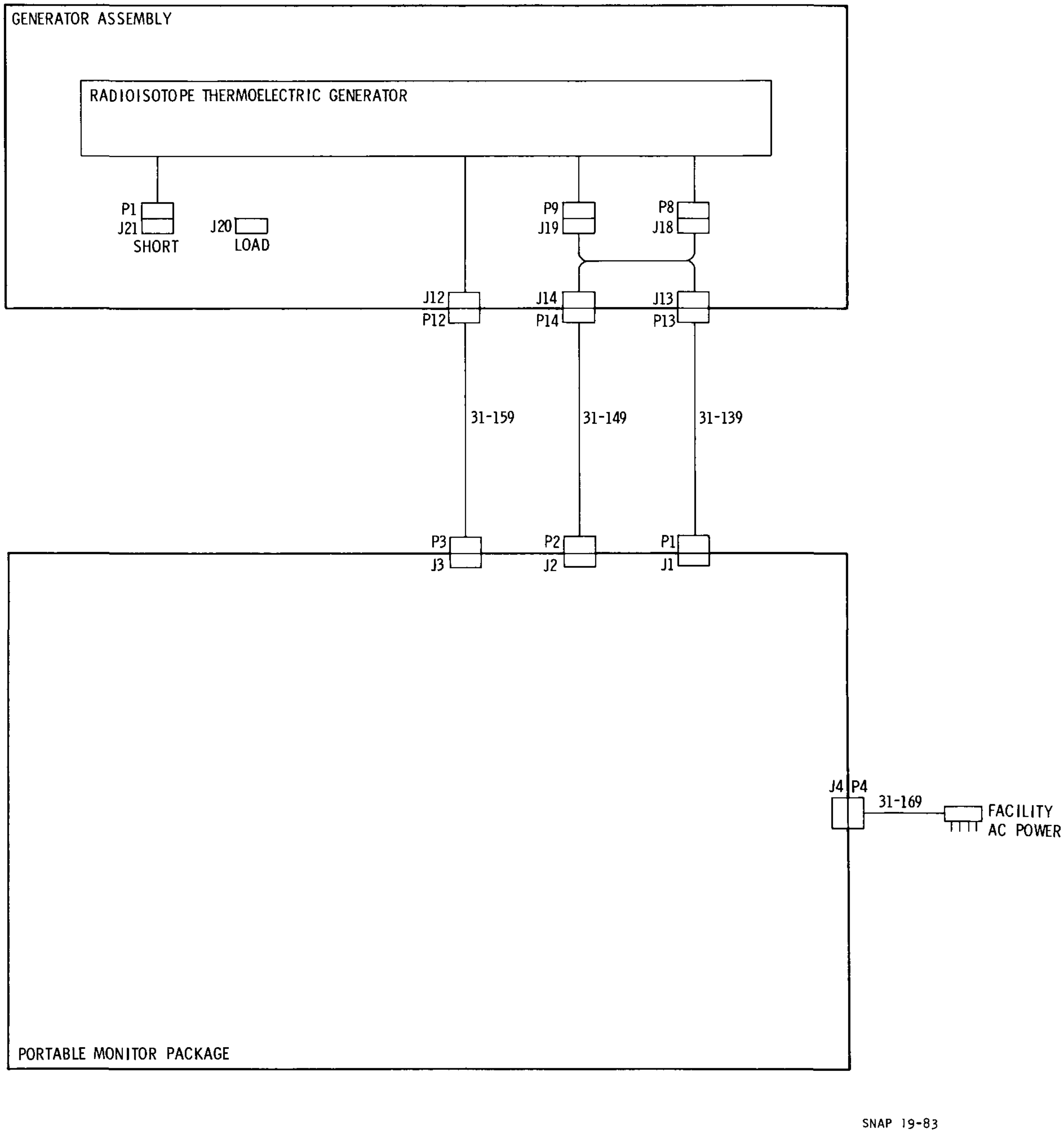

Figure 6-42. Portable Monitor Package--Interconnecting Cabling

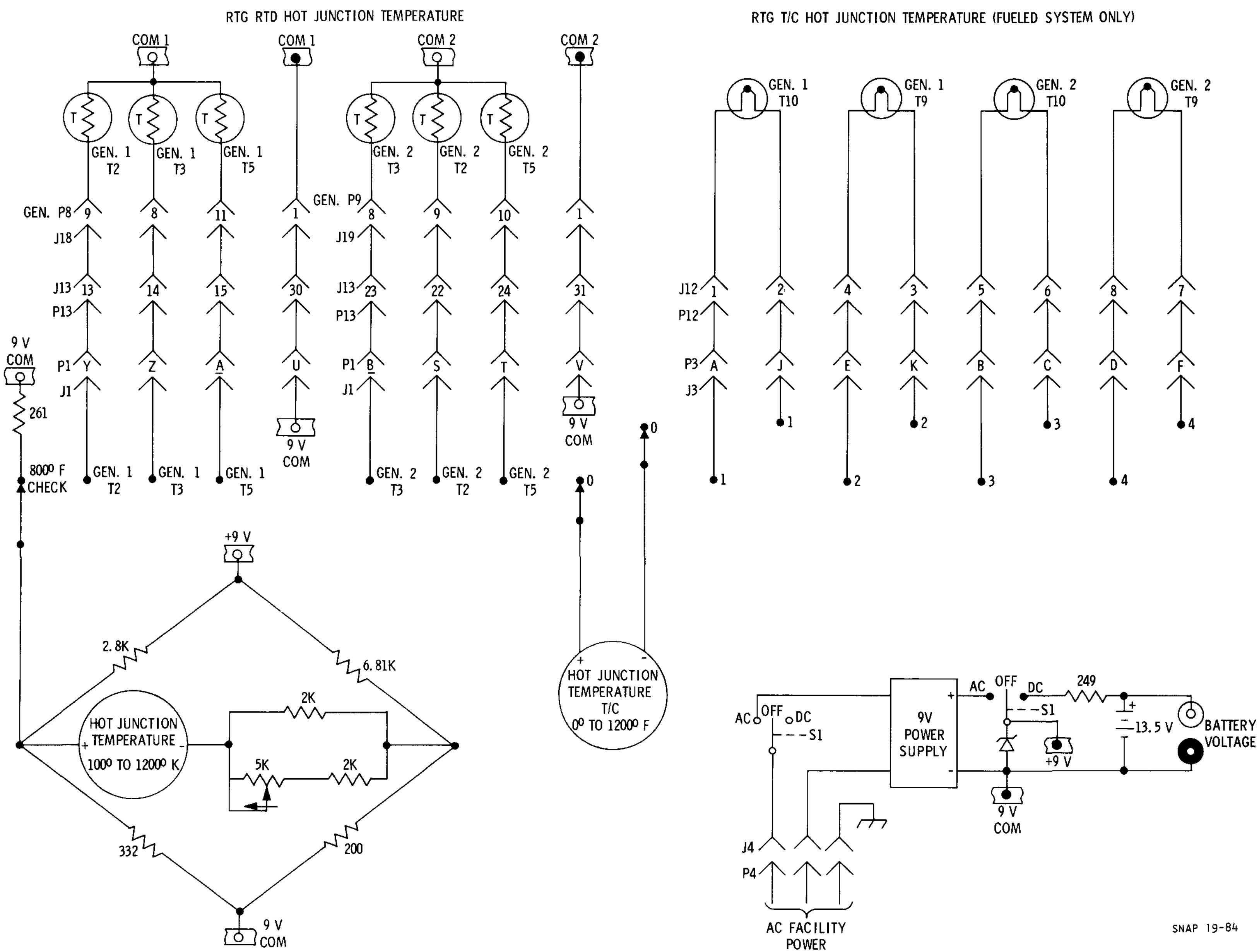

Figure 6-43. Portable Monitor Package--Generator Hot Junction Temperature Circuit

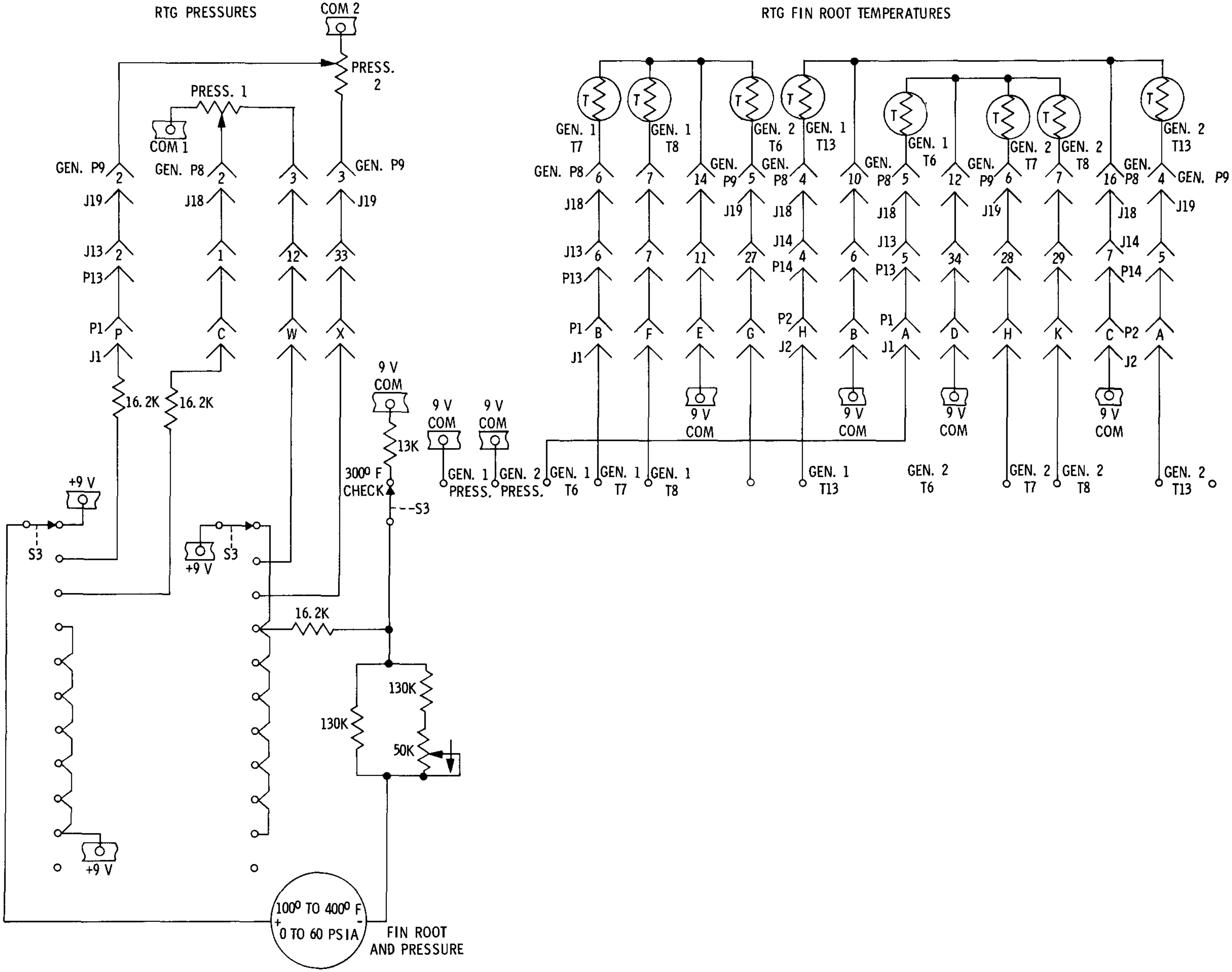

Figure 6-44. Portable Monitor Package--Generator Fin Root Temperature and Pressure Circuit

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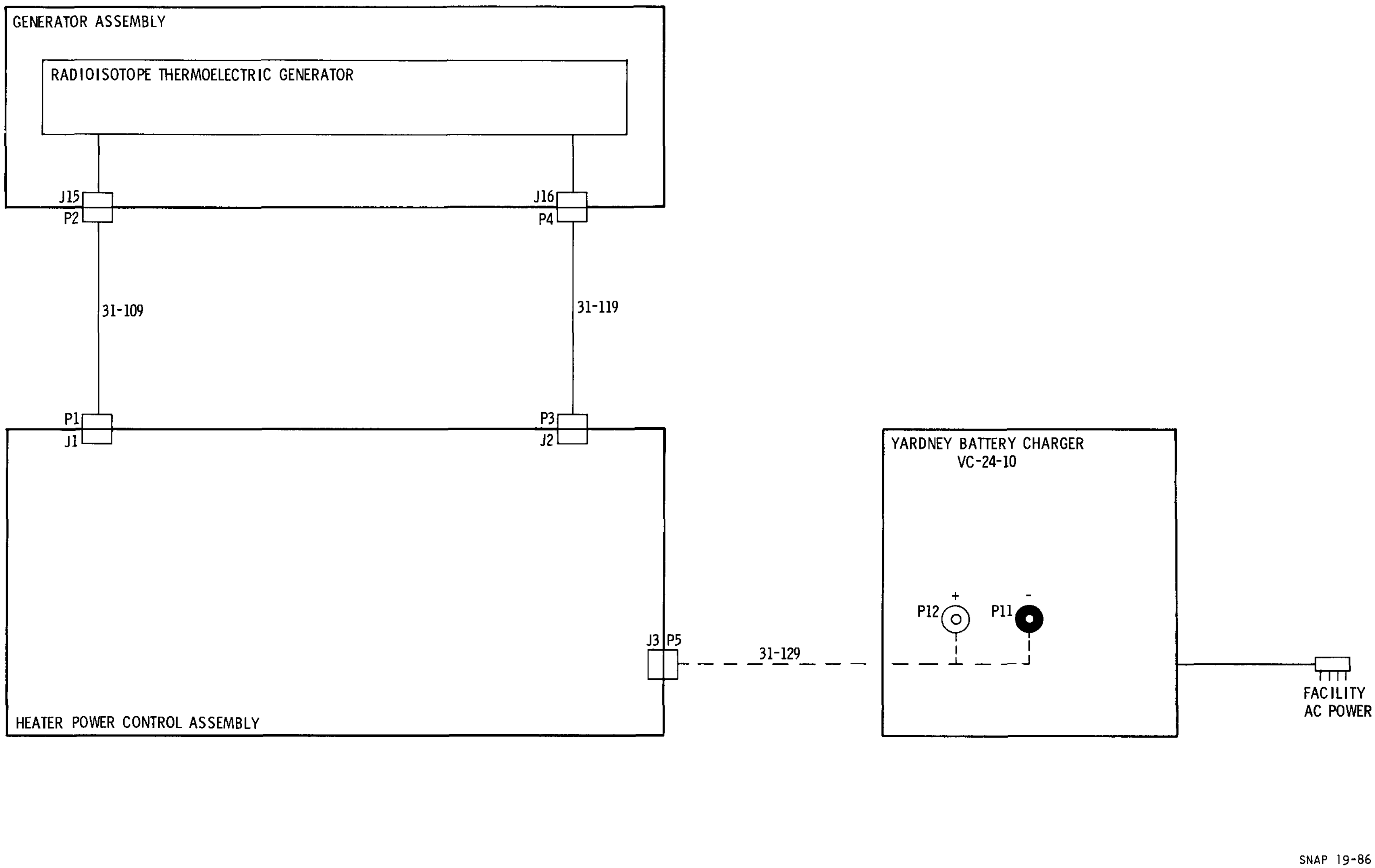


Figure 6-45. Heater Power Control Assembly--Interconnecting Cabling

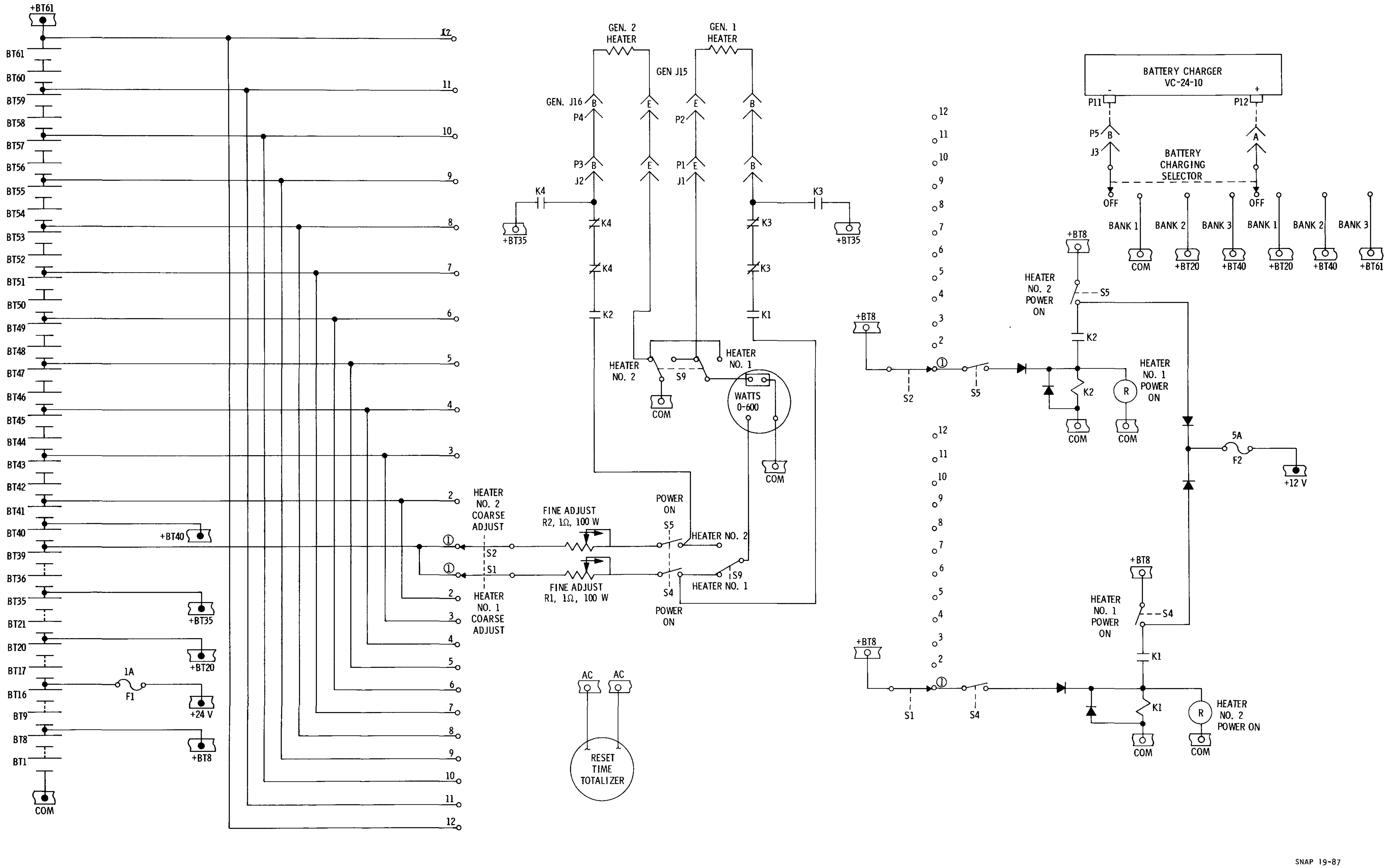


Figure 6-46. Heater Power Control Assembly--Heater Voltage Control Circuit

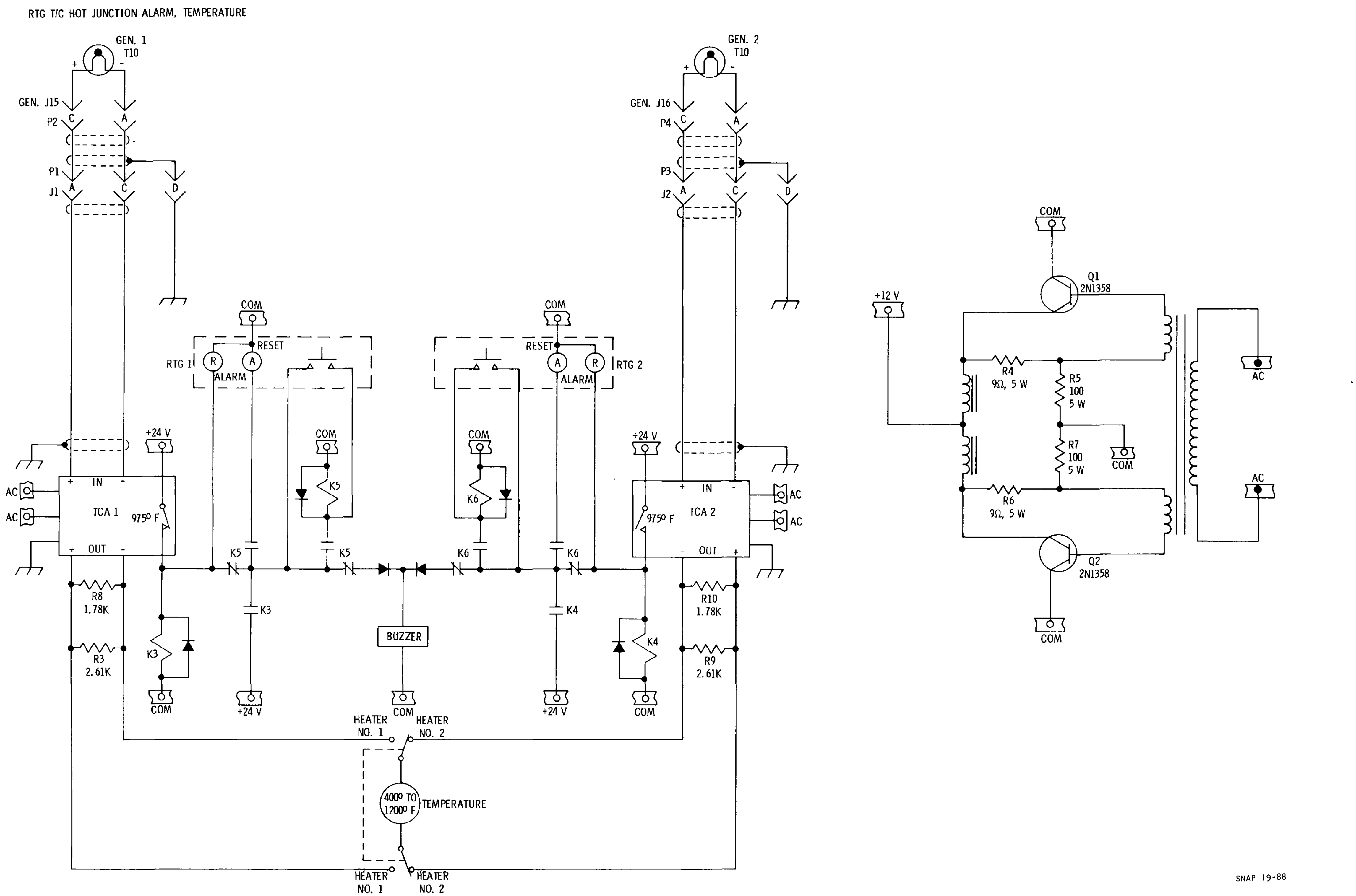


Figure 6-47. Heater Power Control Assembly--Temperature Alarm Circuits

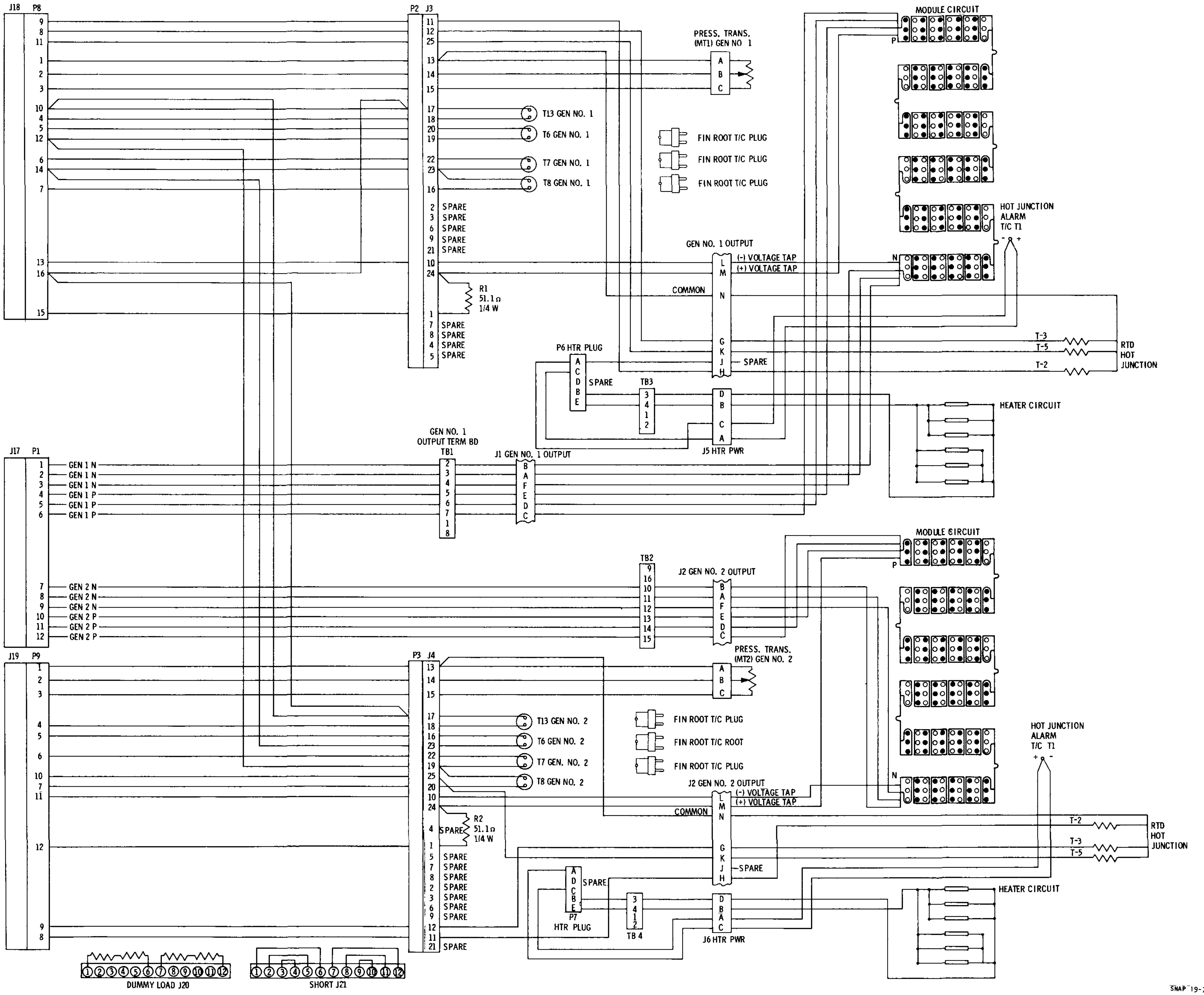


Figure 6-48. Electrically Heated Generator Schematic

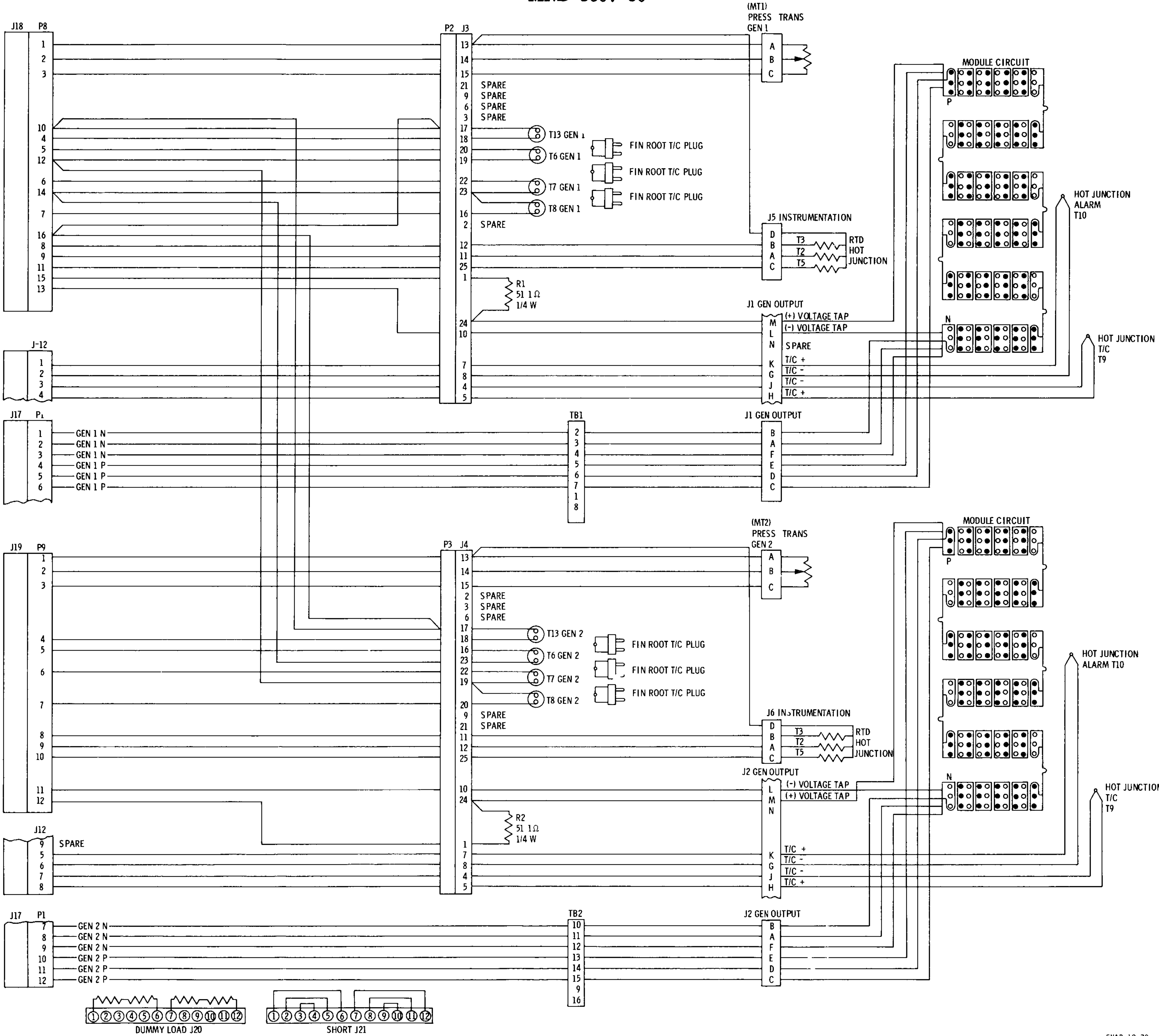


Figure 6-49. Fueled Generator Schematic

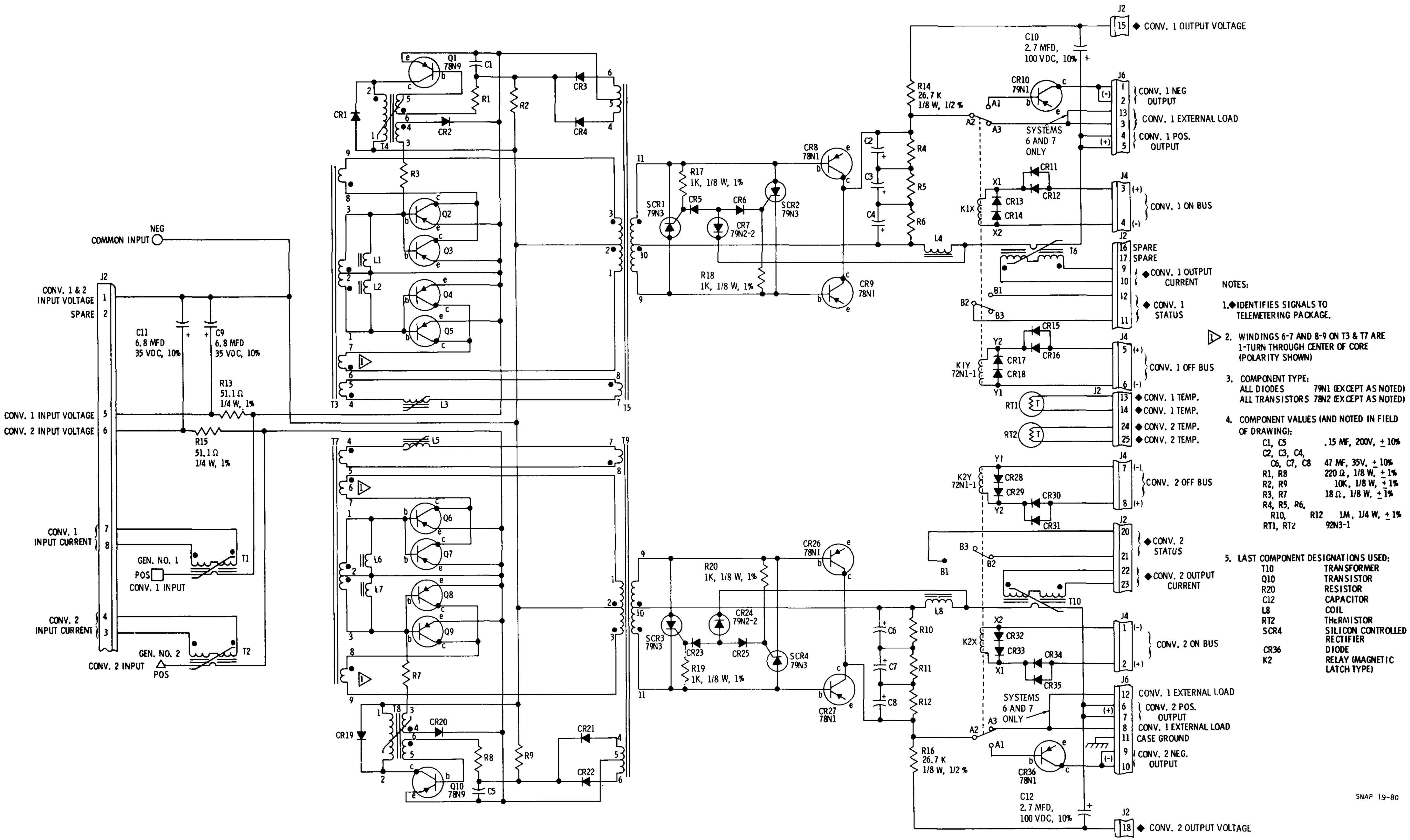
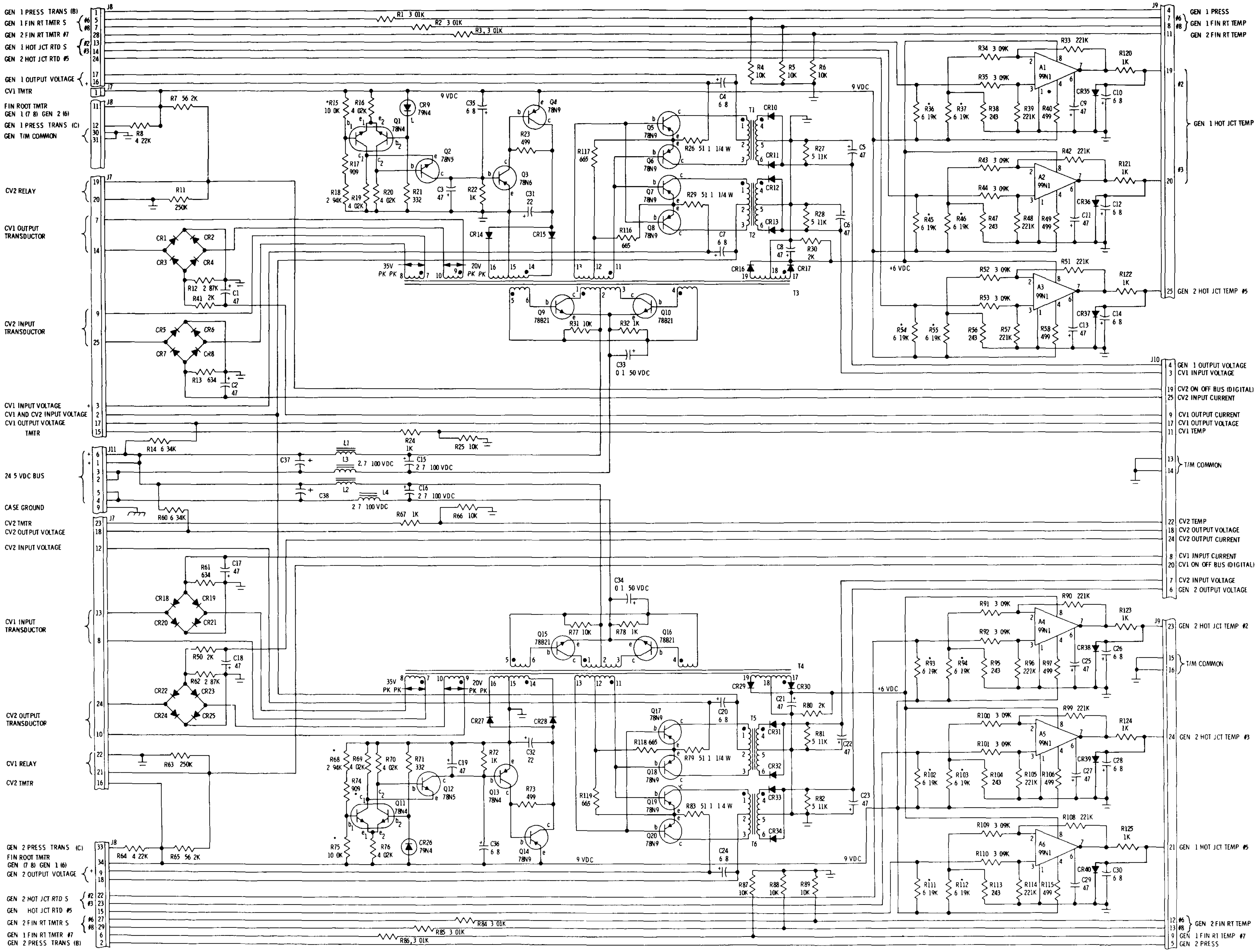


Figure 6-50. Power Conditioner Unit Schematic



NOTES

1 ALL RESISTOR VALUES IN OHMS
ALL RESISTORS ARE 1/8 WATT EXCEPT WHERE NOTED
ALL CAPACITOR VALUES IN MICRO FARAD
ALL CAPACITORS ARE 35 VDC EXCEPT AS NOTED

2 ALL DIODES ARE TYPE 79N1 EXCEPT AS NOTED

3 DESIGNATIONS

LAST DIODE	CR40
LAST RESISTOR	R125
LAST CAPACITOR	C38
LAST TRANSFORMER	J6
LAST TRANSISTOR	Q20
LAST AMPLIFIER	A6
LAST FILTER INDUCTOR	L4

4 ⊥ DENOTES INTERNAL COMMON

5 ABBREVIATIONS

JCT	JUNCTION
GEN	GENERATOR
PRESS	PRESSURE
TRANS	TRANSDUCER
TEMP	TEMPERATURE
T M	TELEMETERING
CV	CONVERTER
RT	ROOT
TMTR	THERMISTOR
RTD	RESISTIVE TEMPERATURE DETECTOR

Figure 6-51. Telemetry Signal Conditioner Unit Schematic

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APPENDIX A

This Appendix consists of samples of data sheets required during the various checkout procedures.

SNAP 19/NIMBUS B
SYSTEM CHECKOUT DATA SHEET A
TEMPERATURE MONITORING AND STABILITY CRITERIA

DATE:_______________________ GEN. SER. NO. _________________________

TEST ENGR:__________________ PWR. COND. SER. NO. ____________________

QUALITY WITNESS:____________ T/M SIG. COND. SER. NO. ________________

	Fueled System								Electrical System	
	Chan. 43		Chan. 44		Chan. 45		Chan. 46		Temperature	
Time	Data	Temp.	Data	Temp.	Data	Temp.	Data	Temp.	RTG 1	RTG 2
Start										

NOTE: 1. Conversion formula for fueled subsystem temperature voltage measurement:

Temp. (° F) + 50 x (voltage reading) + 200

2. Allowable temperature excursion per 15 min. = 35° F.

Figure A-1. Sample of System Checkout Data Sheet A

SNAP 19/NIMBUS B

SYSTEM CHECKOUT DATA SHEET B

SYSTEM OPERATING TIME:

START:__________ STOP:__________

DATE:__________ DATE:__________

TEST ENGINEER:______________

QUALITY WITNESS:______________

SERIAL NUMBERS:

GENERATOR SUBSYSTEM______________

POWER CONDITIONER______________

T/M SIGNAL CONDITIONER______________

Channel	Signal	Conversion Formula	Full Load On Bus		Conv No. 1 Off Bus		Full Load Off Bus		Conv. No. 2 Off Bus	
			Data	Conv	Data	Conv	Data	Conv	Data	Conv
01	PC 1 input volts		____V	____V	____V	____V	____V	____V	____V	____V
02	PC 2 input volts		____V	____V	____V	____V	____V	____V	____V	____V
03	RTG 1 output volts		____V	____V	____V	____V	____V	____V	____V	____V
04	RTG 2 output volts		____V	____V	____V	____V	____V	____V	____V	____V
05	RTG 1 hot jct temp T2	Refer to MND-3607-83	____V	____°F	____V	____°F	____V	____°F	____V	____°F
06	RTG 1 hot jct temp T3		____V	____°F	____V	____°F	____V	____°F	____V	____°F
07	RTG 1 hot jct temp T5		____V	____°F	____V	____°F	____V	____°F	____V	____°F
08	RTG 2 hot jct temp T2		____V	____°F	____V	____°F	____V	____°F	____V	____°F
09	RTG 2 hot jct temp T3		____V	____°F	____V	____°F	____V	____°F	____V	____°F
10	RTG 2 hot jct temp T5		____V	____°F	____V	____°F	____V	____°F	____V	____°F
11	RTG 1 fin root temp T6		____V	____°F	____V	____°F	____V	____°F	____V	____°F
12	RTG 1 fin root temp T7		____V	____°F	____V	____°F	____V	____°F	____V	____°F

Figure A-2. Sample of System Checkout Data Sheet B (Sheet 1 of 3)

Channel	Signal	Conversion Formula	Full Load On Bus		Conv No. 1 Off Bus		Full Load Off Bus		Conv. No. 2 Off Bus	
			Data	Conv	Data	Conv	Data	Conv	Data	Conv
13	RTG 1 fin root temp T8		___V	___°F	___V	___°F	___V	___°F	___V	___°F
14	RTG 2 fin root temp T6		___V	___°F	___V	___°F	___V	___°F	___V	___°F
15	RTG 2 fin root temp T7		___V	___°F	___V	___°F	___V	___°F	___V	___°F
16	RTG 2 fin root temp T8		___V	___°F	___V	___°F	___V	___°F	___V	___°F
17	RTG 1 pressure		___V	___psia	___V	___psia	___V	___psia	___V	___psia
18	RTG 2 pressure		___V	___psia	___V	___psia	___V	___psia	___V	___psia
19	PC 1 input current		___V	___A	___V	___A	___V	___A	___V	___A
20	PC 2 input current	Refer to MND-3607-83	___V	___A	___V	___A	___V	___A	___V	___A
21	PC 1 output volts		___V	___V	___V	___V	___V	___V	___V	___V
22	PC 2 output volts		___V	___V	___V	___V	___V	___V	___V	___V
23	PC 1 output current		___V	___A	___V	___A	___V	___A	___V	___A
24	PC 2 output current		___V	___A	___V	___A	___V	___A	___V	___A
25	PC 1 temperature		___V	___°F	___V	___°F	___V	___°F	___V	___°F
26	PC 2 temperature		___V	___°F	___V	___°F	___V	___°F	___V	___°F
27	PC 1 on-off bus status		___V	___V	___V	___V	___V	___V	___V	___V
28	PC 2 on-off bus status	V = V x 1	___V	___V	___V	___V	___V	___V	___V	___V
29	PC 1 ext load volts		___V	___V	___V	___V	___V	___V	___V	___V
30	PC 2 ext load volts		___V	___V	___V	___V	___V	___V	___V	___V

Figure A-2. Sample of System Checkout Data Sheet B (Sheet 2 of 3)

Channel	Signal	Conversion Formula	Full Load On Bus Data	Full Load On Bus Conv	Conv No. 1 Off Bus Data	Conv No. 1 Off Bus Conv	Full Load Off Bus Data	Full Load Off Bus Conv	Conv No. 2 Off Bus Data	Conv No. 2 Off Bus Conv
31	PC 1 ext load current	A = V x 1	___V	___A	___V	___A	___V	___A	___V	___A
32	PC 2 ext load current		___V	___A	___V	___A	___V	___A	___V	___A
33	RTG 1 fin root temp T13	Refer to MND-3607-186	___KΩ	___°F	___KΩ	___°F	___KΩ	___°F	___KΩ	___°F
34	RTG 2 fin root temp T13		___KΩ	___°F	___KΩ	___°F	___KΩ	___°F	___KΩ	___°F
35	PC 1 output current	A = V x 1	___V	___A	___V	___A	___V	___A	___V	___A
36	PC 2 output current		___V	___A	___V	___A	___V	___A	___V	___A
37	PC 1 output volts	V = V x 1	___V	___V	___V	___V	___V	___V	___V	___V
38	PC 2 output volts		___V	___V	___V	___V	___V	___V	___V	___V
39	PC output load volts		___V	___V	___V	___V	___V	___V	___V	___V
40	TSCU input current	A = V x 1	___V	___A	___V	___A	___V	___A	___V	___A
41	TSCU input volts (1)	V = V x 1	___V	___V	___V	___V	___V	___V	___V	___V
42	TSCU input volts (2)	V = V x 1	___V	___V	___V	___V	___V	___V	___V	___V
43	RTG 1 hot jct temp T9	T(° F) = 50V + 200	___V	___°F	___V	___°F	___V	___°F	___V	___°F
44	RTG 1 hot jct temp T10		___V	___°F	___V	___°F	___V	___°F	___V	___°F
45	RTG 2 hot jct temp T9		___V	___°F	___V	___°F	___V	___°F	___V	___°F
46	RTG 2 hot jct temp T10		___V	___°F	___V	___°F	___V	___°F	___V	___°F

Figure A-2. Sample of System Checkout Data Sheet B (Sheet 3 of 3)

SNAP 19/NIMBUS B

SYSTEM PERFORMANCE DATA SHEET

DATE:____________________

TEST ENGINEER:____________________

QUALITY WITNESS:____________________

SERIAL NUMBERS:

GENERATOR SUBSYSTEM____________________

POWER CONDITIONER____________________

T/M SIGNAL CONDITIONER____________________

Channels	Function	Formulation	Full Load On Bus	Conv No. 1 Off Bus	Conv No. 2 Off Bus	Full Load Off Bus	Typical Measurement
01	PC 1 input volts		V	NA	V	NA	PCU Ser No. / Volts: 004 + 2.50 ± 0.23; 007 + 2.60 ± 0.24; 008 + 2.60 ± 0.24
02	PC 2 input volts		V	V	NA	NA	
03	RTG 1 output volts		V	NA	V	NA	PCU Ser No. / Volts: 004 + 2.60 ± 0.24; 007 + 2.70 ± 0.25; 008 + 2.70 ± 0.25
04	RTG 2 output volts		V	V	NA	NA	
05 thru 10 43 thru 46	Hot jct temp each ch within tolerance ? (yes/no)						Air: 790 ± 70°F Ship. cont: 835 ± 70°F 70° F maximum spread
05 thru 07 43 and 44	RTG 1 hot jct temp maximum deviation		°F	°F	°F	°F	70° F maximum spread
08 thru 10 45 and 46	Hot jct temp max deviation		°F	°F	°F	°F	
11 thru 16, 33, and 34	Fin root temp each ch within tolerance ? (yes/no)						Air: 235 ± 35° F Ship cont: 260 ± 35° F
11 thru 16, 33, and 34	Fin root temp max deviation		°F	°F	°F	°F	50° F maximum spread
17	RTG 1 pressure		psia	psia	psia	psia	Elec: 18 psia minimum*
18	RTG 2 pressure		psia	psia	psia	psia	Fueled: 9 psia minimum*
21, 37	PC 1 output volts	$\% = \frac{ch\ 21 - ch\ 37}{ch\ 37} \times 100$	%	NA	%	NA	5% maximum
22, 38	PC 2 output volts	$\% = \frac{ch\ 22 - ch\ 38}{ch\ 38} \times 100$	%	%	NA	NA	5% maximum
23, 35	PC 1 output current	$\% = \frac{ch\ 23 - ch\ 35}{ch\ 35} \times 100$	%	NA	%	NA	5% maximum
24, 36	PC 2 output current	$\% = \frac{ch\ 24 - ch\ 36}{ch\ 36} \times 100$	%	%	NA	NA	5% maximum
21, 29	PC 1 output volts	$\% = \frac{ch\ 21 - ch\ 29}{ch\ 29} \times 100$	NA	%	NA	%	5% maximum
22, 30	PC 2 output volts	$\% = \frac{ch\ 22 - ch\ 30}{ch\ 30} \times 100$	NA	NA	%	%	5 maximum

*Minimum values at delivery. Pressure decreases as a function of time.

Figure A-3. Sample of System Performance Data Sheet (Sheet 1 of 3)

Channel	Function	Formulation	Full Load On Bus	Conv No. 1 Off Bus	Conv. No. 2 Off Bus	Full Load Off Bus	Typical Measurement
23, 31	PC 1 output current	$\% = \frac{\text{ch } 23 - \text{ch } 31}{\text{ch } 31} \times 100$	NA	%	NA	%	5% maximum
24, 32	PC 2 output current	$\% = \frac{\text{ch } 24 - \text{ch } 32}{\text{ch } 32} \times 100$	NA	NA	%	%	5% maximum
25	PC 1 temperature		°F	°F	°F	°F	85 ± 20°F
26	PC 2 temperature		°F	°F	°F	°F	85 ± 20°F
27	PC 1 on-off bus status		V	NA	V	NA	0 ± 0.10 volts
28	PC 2 on-off bus status		V	V	NA	NA	
27	PC 1 on-off bus status		NA	V	NA	V	-7.3 ± 0.10 volts
28	PC 2 on-off bus status		NA	NA	V	V	
31	PC 1 ext load current		NA	A	NA	A	1.0 ± 0.2 amps
32	PC 2 ext load current		NA	NA	A	A	
35	PC 1 output current		A	NA	A	NA	
36	PC 2 output current		A	A	NA	NA	
31	PC 1 ext load current		A	NA	A	NA	0 ± 0.01 amps
32	PC 2 ext load current		A	A	NA	NA	
35	PC 1 output current		NA	A	NA	A	
36	PC 2 output current		NA	NA	A	A	
37	PC 1 output volts		V	NA	V	NA	-24.5 ± 0.5 volts
38	PC 2 output volts		V	V	NA	NA	
40	TSCU input current		A	A	A	A	0.080 amps maximum
41	TSCU input volts (1)		V	V	V	V	-24.5 ± 0.5 volts
42	TSCU input volts (2)		V	V	V	V	
03, 04, 19, 20	RTG 1 power	Ch 03 volts x ch 19 amps	W	W	W	W	22.0 watts minimum
	RTG 2 power	Ch 04 volts x ch 20 amps	W	W	W	W	
	Subsystem power	RTG 1 power + RTG 2 power	W	W	W	W	46.5 watts minimum

Figure A-3. Sample of System Performance Data Sheet (Sheet 2 of 3)

Channel	Function	Formulation	Full Load On Bus	Conv No. 1 Off Bus	Conv No. 2 Off Bus	Full Load Off Bus	Typical Measurement
35 thru 38	PC 1 power	Ch 37 volts x ch 35 amps	W	NA	W	NA	19.0 watts minimum
	PC 2 power	Ch 38 volts x ch 36 amps	W	W	NA	NA	
	System power	PC 1 power + PC 2 power	W	NA	NA	NA	39.0 watts minimum
39	Ripple test		mv	NA	NA	NA	50 mv p-p maximum
40 thru 42	TSCU input power	Larger value of ch 41 or 42 volts x ch 40 amps	W	W	W	W	2 watts maximum

Figure A-3. Sample of System Performance Data Sheet (Sheet 3 of 3)

MND-3607-80

SNAP 19/NIMBUS B
GENERATOR CHECKOUT DATA SHEET A
TEMPERATURE MONITORING AND STABILITY CRITERIA

DATE:________________________ GENER. SUBSYS. SER. NO.:____________

TEST ENGR.:____________________

QUALITY WITNESS:________________

	Fueled Systems				Electrical System Temperature	
	Chan. 24		Chan. 26			
Time	Data	Temp.	Data	Temp.	RTG 1	RTG 2

NOTE: 1. Conversion formula for fueled subsystem temperature volt meas.:
Temp. (°F) = 50 x (volt reading) + 200

2. Allowable temperature deviation between any two successive time periods are as follows:
for 5 min. periods - 12°F
for 15 min. periods - 35°F

Figure A-4. Sample of Generator Checkout Data Sheet A

SNAP 19/NIMBUS B

GENERATOR SUBSYSTEM CHECKOUT DATA SHEET B

DATE:____________ Generator Subsystem Serial No. ____________

Generator Operating Time: TEST ENGR:____________

START______ STOP______ QUALITY WITNESS:____________

Channel	Signal	Conversion Formula	Short Measurement	Converted Measurement	Typical Measurement	Load Measurement	Converted Measurement	Typical Measurement
00	RTG 1 output volts	V = V x 1				V	V	+2.6 ± 0.10V
01	RTG 2 output volts					V	V	
02	RTG 1 output current	A = V x 200				V	A	Acceptance 9.6 amps minimum 1 yr storage 8.7 amps minimum 2 yr storage 8.5 amps minimum
03	RTG 2 output current					V	A	
04	RTG 1 hot jct temp T2 (T/M)	Refer to MND-3607 -186	____Ω	____°F	Each channel: Air: 710 ± 65° F Shipping Container: 745 ± 65° F Max deviation between channels = 60°F Note: Fueled include channels 24 - 27	Ω	°F	Each channel: Air: 790 ± 65° F Shipping Container: 835 ± 65° F Max deviation between channels = 60°F Note: Fueled - include channels 24 - 27
05	RTG 1 hot jct temp T3 (T/M)		____Ω	____°F		Ω	°F	
06	RTG 1 hot jct temp T5 (T/M)		____Ω	____°F		Ω	°F	
07	RTG 2 hot jct temp T2 (T/M)		____Ω	____°F		Ω	°F	
08	RTG 2 hot jct temp T3 (T/M)		____Ω	____°F		Ω	°F	
09	RTG 2 hot jct temp T5 (T/M)		____Ω	____°F		Ω	°F	
10	RTG 1 fin root temp T6 (T/M)		____KΩ	____°F	Each channel: Air: 235 ± 20° F Shipping Container: 260 ± 20° F Max deviation between channels = 20° F Note: Include channels 22, 23	KΩ	°F	Each channel: Air: 235 ± 20° F Shipping Container: 260 ± 20° F Max deviation between channels = 20°F Note: Include channels 22, 23
11	RTG 1 fin root temp T7 (T/M)		____KΩ	____°F		KΩ	°F	
12	RTG 1 fin root temp T8 (T/M)		____KΩ	____°F		KΩ	°F	
13	RTG 2 fin root temp T6 (T/M)		____KΩ	____°F		KΩ	°F	
14	RTG 2 fin root temp T7 (T/M)		____KΩ	____°F		KΩ	°F	
15	RTG 2 fin root temp T8 (T/M)		____KΩ	____°F		KΩ	°F	
16	RTG 1 output volts (T/M)	V = V x 1.231	____ V	____ V	+0.15 ± 0.15V	V	V	+2.7 ± 0.10V
17	RTG 2 output volts (T/M)		____ V	____ V		V	V	

Figure A-5. Sample of Generator Checkout Data Sheet B (Sheet 1 of 2)

Channel	Signal	Conversion Formula	Short Measurement	Converted Measurement	Typical Measurement	Load Measurement	Converted Measurement	Typical Measurement
18	RTG 1 pressure (T/M)	MND 3607-186 $\frac{\text{Chan 18}}{\text{Chan 20}}$ x 100 =% output	KΩ	psia	Elec 18 psia min* Fueled 9 psia min*	KΩ	psia	Elec 18 psia min* Fueled 9 psia min*
19	RTG 2 pressure (T/M)	MND 3607-186 $\frac{\text{Chan 19}}{\text{Chan 21}}$ x 100 =% output	KΩ	psia		KΩ	psia	
20	RTG 1 pressure excitation	KΩ = KΩ x 1	KΩ	KΩ	10.0 ± 0.5 KΩ	KΩ	KΩ	10.0 ± 0.5 KΩ
21	RTG 2 pressure excitation		KΩ	KΩ		KΩ	KΩ	
22	RTG 1 fin root temp T13	Refer to MND 3607-186	KΩ	°F	Include with channels 10-15	KΩ	°F	Include with channels 10-15
23	RTG 2 fin root temp T13		KΩ	°F		KΩ	°F	
24	RTG 1 hot jct temp T9	T(°F) = 50V + 200	V	°F	Include with channels 04 - 09	V	°F	Include with channels 04 - 09
25	RTG 1 hot jct temp T10		V	°F		V	°F	
26	RTG 2 hot jct temp T9		V	°F		V	°F	
27	RTG 2 hot jct temp T10		V	°F		V	°F	
		RTG 1 power = ch 16 (volts) x ch 02 (amps)					W	Acceptance: 24.5 watts min. 1 yr storage: 23.0 watts min. 2 yr storage: 22.0 watts min.
		RTG 2 power = ch 17 (volts) x ch 03 (amps)					W	
		Subsystem power = RTG 1 power + RTG 2 power					W	Acceptance: 55.0 watts min. 1 yr storage: 47.5 watts min. 2 yr storage: 46.5 watts min.

*Minimum at delivery. Pressure decreases as a function of time.

Figure A-5. Sample of Generator Checkout Data Sheet B (Sheet 2 of 2)

SNAP 19/NIMBUS B POWER CONDITIONER DATA SHEET

DATE__________ POWER CONDITIONER OPERATING TIME START__________ STOP__________

TEST ENGR__________ QUALITY WITNESS__________ POWER CONDITIONER SERIAL NO. ____

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
FULL LOAD TEST ON BUS VOLTAGE					
00	PC 1 temp	______ KΩ	Refer to MND-3607-186	______ °F	85 ± 20°F
01	PC 2 temp	______ KΩ		______ °F	85 ± 20°F
					Ser No. / Volts
06	PC 1 input V.	______ V	V = V x 1	V	004 +2.50 ± 0.10
07	PC 2 input V.	______ V		V	007 +2.60 ± 0.10
16	PC 1 input V. (T/M)	______ V	V = V x 1.231	V	008 +2.60 ± 0.10
17	PC 2 input V. (T/M)	______ V		V	
10	PC 1 output V.	______ V			-24.5 ± 0.10 volts
11	PC 2 output V.	______ V			
12	PC 1 output V (T/M)	______ V	V = V x 5.211	V	-24.8 ± 0.20 volts
13	PC 2 output V (T/M)	______ V		V	
04	PC 1 input current	______ V	A = V x 200	______ A	
05	PC 2 input current	______ V		______ A	Channel 18 within 15% of channel 04 and channel 19 within 15% of channel 05.
18	PC 1 input current (T/M)	______ V	A = 4.1 x V	______ A	
19	PC 2 input current (T/M)	______ V		______ A	

Figure A-6. Sample of Power Conditioner Checkout Data Sheet (Sheet 1 of 5)

POWER CONDITIONER DATA SHEET

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
08	PC 1 output current	______V	$A = V \times 1$	______A	Channel 14 within 15% of channel 08 and channel 15 within 15% of channel 09
09	PC 2 output current	______V		______A	
14	PC 1 output current (T/M)	______V	$A = \frac{V-0.3}{2.7}$	______A	
15	PC 2 output current (T/M)	______V		______A	

$$\text{Efficiency}_{PC\ 1} = \frac{\text{Chan. 10 volts} \times \text{Chan. 08 amps}}{\text{Chan. 06 volts} \times \text{Chan. 04 amps}} \times 100 = \_\_\_\_\_\_\_\_\_\_ \%$$

89% minimum

$$\text{Efficiency}_{PC\ 2} = \frac{\text{Chan. 11 volts} \times \text{Chan. 09 amps}}{\text{Chan. 07 volts} \times \text{Chan. 05 amps}} \times 100 = \_\_\_\_\_\_\_\_\_\_ \%$$

89% minimum

FULL LOAD TEST WITH HIGH BUS VOLTAGE NO. 1

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
00	PC 1 temp	______KΩ	Refer to MND-3607-186	______°F	85 ± 20°F
01	PC 2 temp	______KΩ		______°F	85 ± 20°F
06	PC 1 input volts	______V	$V = V \times 1$	V	
16	PC 1 input volts (T/M)	______V	$V = V \times 1.231$	V	

FULL LOAD TEST WITH HIGH BUS VOLTAGE NO. 2

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
07	PC 2 input volts	______V	$V = V \times 1$	V	
17	PC 2 input volts (T/M)	______V	$V = V \times 1.231$	V	
00	PC 1 temp	______KΩ	Refer to MND-3607-186	______°F	85 ± 20°F
01	PC 2 temp	______KΩ		______°F	85 ± 20°F

Ser No.	Volts
004	+2.50 ± 0.10
007	+2.50 ± 0.10
008	+2.60 ± 0.10

Figure A-6. Sample of Power Conditioner Checkout Data Sheet (Sheet 2 of 5)

POWER CONDITIONER DATA SHEET

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
FULL LOAD TEST WITH LOW BUS VOLTAGE NO. 1					
00	PC 1 temp	________ KΩ	Refer to MND-3607-186	________ °F	85 ± 20°F
01	PC 2 temp	________ KΩ		________ °F	85 ± 20°F
					Ser No. / Volts
06	PC 1 input volts	________ V	V = V x 1	________ V	
16	PC 1 input volts (T/M)	________ V	V = V x 1.231	V	004 / +2.50 ± 0.10
FULL LOAD TEST WITH LOW BUS VOLTAGE NO. 2					007 / +2.60 ± 0.10
07	PC 2 input volts	________ V	V = V x 1	V	008 / +2.60 ± 0.10
17	PC 2 input volts (T/M)	________ V	V = V x 1.231	V	
00	PC 1 temp	________ KΩ	Refer to MND-3607-186	________ °F	85 ± 20°F
01	PC 2 temp	________ KΩ		________ °F	85 ± 20°F
RIPPLE TEST					
	PC output ripple (P-P)	________ V			50 mv maximum
OPEN CIRCUIT POWER DISSIPATION TEST					
00	PC 1 temp	________ KΩ	Refer to MND-3607-186	________ °F	85 ± 20°F
01	PC 2 temp	________ KΩ		________ °F	85 ± 20°F
04	PC 1 input current	________ V	A = V x 200	________ A	
05	PC 2 input current	________ V		________ A	
06	PC 1 input volts	________ V			
07	PC 2 input volts	________ V			

P = (chan. 04 amps x chan. 06 volts) + (chan. 05 amps x chan. 07 volts) = ________ W   14 watts maximum

Figure A-6. Sample of Power Conditioner Checkout Data Sheet (Sheet 3 of 5)

POWER CONDITIONER DATA SHEET

SHORT CIRCUIT POWER DISSIPATION TEST

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
00	PC 1 temp	________ KΩ	Refer to MND-3607-186	________ °F	85 ± 20°F
01	PC 2 temp	________ KΩ		________ °F	85 ± 20°F
04	PC 1 input current	________ V	A = V x 200	________ A	
05	PC 2 input current	________ V		________ A	
06	PC 1 input volts	________ V			
07	PC 2 input volts	________ V			

P = (chan 04 amps x chan 06 volts) + (chan 05 amps x chan 07 volts)
 -(chan 08 amps x chan 10 volts) + (chan 09 amps x chan 11 volts) = ________ W   14 watts maximum

CONV NO. 1 OFF BUS

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
00	PC 1 temp	________ KΩ	Refer to MND-3607-186	________ °F	85 ± 20°F
01	PC 2 temp	________ KΩ		________ °F	85 ± 20°F
08	PC 1 output current	________ V	A = V x 1	________ A	0.0 ± 0.01A
09	PC 2 output current	________ V		________ A	1.0 ± 0.2A
23	PC 1 ext. load current	________ V		________ A	1.0 ± 0.2A
24	PC 2 ext. load current	________ V		________ A	0.0 ± 0.01A
21	PC 1 ext. load volts	________ V			-24.25 ± 0.3V
22	PC 2 ext. load volts	________ V			0.0 ± 0.01V

Figure A-6. Sample of Power Conditioner Checkout Data Sheet (Sheet 4 of 5)

POWER CONDITIONER DATA SHEET

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
CONV. NO. 2 OFF BUS					
00	PC 1 temp	________KΩ	Refer to MND-3607-186	________°F	85 ± 20°F
01	PC 2 temp	________KΩ		________°F	85 ± 20°F
08	PC 1 output current	________V	A = V x 1	________A	1.0 ± 0.2A
09	PC 2 output current	________V		________A	0.0 ± 0.01A
23	PC 1 ext load current	________V		________A	0.0 ± 0.01A
24	PC 2 ext load current	________V		________A	1.0 ± 0.02A
21	PC 1 ext load volts	________V			0.0 ± 0.01V
22	PC 2 ext load volts	________V			-24.25 ± 0.3V
FULL LOAD OFF BUS					
00	PC 1 temp	________KΩ	Refer to MND-3607-186	________°F	85 ± 20°F
01	PC 2 temp	________KΩ		________°F	85 ± 20°F
08	PC 1 output current	________V	A = V x 1	________A	0.0 ± 0.01A
09	PC 2 output current	________V		________A	0.0 ± 0.02A
23	PC 1 ext load current	________V		________A	1.0 ± 0.02A
24	PC 2 ext load current	________V		________A	1.0 ± 0.02A
21	PC 1 ext load volts	________V			-24.25 ± 0.3V
22	PC 2 ext load volts	________V			-24.25 ± 0.3V

Figure A-6. Sample of Power Conditioner Checkout Data Sheet (Sheet 5 of 5)

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SYSTEM CHECKOUT DATA SHEET

DATE: ______________________ Serial Numbers

TEST ENGR: ________________ Generator Subsystem ________________

QUALITY WITNESS: ____________ Power Conditioner ________________

T/M Signal Conditioner ______________

Time	Heater No. 1 Power	Temp RTG 1	Heater No. 2 Power	Temp RTG 2

NOTES: 1. Allowable wattage excursion per 15 min = 25 watts

2. Allowable temperature excursion per 15 min = 35° F

Figure A-7. Sample of Generator Heatup and Cooldown Data Sheet

MND-3607-180

SNAP 19/NIMBUS B

TELEMETRY SIGNAL CONDITIONER UNIT CHECKOUT
DATA SHEET

TSCU OPERATING TIME:

START ______________ DATE: ______________________________

STOP ______________ TEST ENGR: ________________________

TSCU Serial No. ________ QUALITY WITNESS: __________________

Voltage Measurement Circuits:
All within ± 0.15 VDC? ____________________
Out-of-tolerance channels ____

Current Measurement Circuits
All within ± 0.15 VDC? ____________________
Out-of-tolerance channels ____

Pressure and Temperature Measurement Circuits
A. Switches at 1:
All within tolerance? _________________
Out-of-tolerance channels ____

B. Switches at 2:
All within tolerance? _________________
Out-of-tolerance channels ____

C. Switches at 3:
All within tolerance? _________________
Out-of-tolerance channels ____

D. Switches at 4:
All inputs within $121 \pm 2\Omega$? ___________
All outputs within ± 0.15 volts of each other _________
All outputs between 0 and +0.9 VDC ________________
Out of tolerance channels ____

Digital Measurement Circuits
A. With switches OFF:
All outputs -7.300 ± 0.05V? ___________
Out-of-tolerance channels ____

B. With switches ON:
All outputs 0.0 ± 0.100V? ____________
Out-of-tolerance channels ____

Power Input Test
Voltage input -24.46 to -24.50? __________
Current input -0.080 or less? __________

Figure A-8. Sample of Telemetry Signal Conditioner Unit Checkout Data Sheet

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DATA SHEET 85-1-1

RTG 1 OUTPUT VOLTS

TSCU SERIAL No.: __________

DATE: __________ TEST ENGINEER: __________ QUALITY WITNESS: __________

RTG 1 OUTPUT VOLTS (SIM)	RTG 1 OUTPUT VOLTS TSCU OUTPUT VOLTAGE (-VOLTS)					
INPUT (+ VOLTS)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0.15 ± 0.001						
0.50 ± 0.001						
0.75 ± 0.001						
1.50 ± 0.005						
2.50 ± 0.005						
4.00 ± 0.005						
5.50 ± 0.005						

Figure A-9. Sample of Telemetry Signal Conditioner Unit Calibration Data Sheet (Sheet 1 of 26)

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DATA SHEET 85-1-2

RTG 2 OUTPUT VOLTS

TSCU SERIAL NO.: ____________

DATE: ______________ TEST ENGINEER: ______________________ QUALITY WITNESS: ____________

RTG 2 OUTPUT VOLTS (SIM)	RTG 2 OUTPUT VOLTS TSCU OUTPUT VOLTAGE (-VOLTS)					
INPUT (+ VOLTS)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0.15 ± 0.001						
0.50 ± 0.001						
0.75 ± 0.001						
1.50 ± 0.005						
2.50 ± 0.005						
4.00 ± 0.005						
5.50 ± 0.005						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 2 of 26)

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DATA SHEET 85-1-3

PC 1 INPUT VOLTS

TSCU SERIAL NO.__________

DATE:__________ TEST ENGINEER:__________ QUALITY WITNESS:__________

PC 1 INPUT VOLTS (SIM)	PC 1 INPUT VOLTS TSCU OUTPUT VOLTAGE (-VOLTS)					
INPUT (+ VOLTS)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0. 15 ± 0. 001						
0. 50 ± 0. 001						
0. 75 ± 0. 001						
1. 50 ± 0. 005						
2. 50 ± 0. 005						
4. 00 ± 0. 005						
5. 50 ± 0. 005						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 3 of 26)

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DATA SHEET 85-1-4

PC 2 INPUT VOLTS

TSCU SERIAL NO.__________

DATE:__________ TEST ENGINEER:__________ QUALITY WITNESS:__________

PC 2 INPUT VOLTS (SIM) INPUT (+VOLTS)	PC 2 INPUT VOLTS TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0.15 ± 0.001						
0.50 ± 0.001						
0.75 ± 0.001						
1.50 ± 0.005						
2.50 ± 0.005						
4.00 ± 0.005						
5.50 ± 0.005						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 4 of 26)

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DATA SHEET 85-1-5

PC 1 OUTPUT VOLTS

TSCU SERIAL NO.:__________

DATE:______________ TEST ENGINEER:____________________ QUALITY WITNESS:________________

PC 1 OUTPUT VOLTS (SIM) INPUT (-VOLTS)	PC 1 OUTPUT VOLTS TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
1.0 ± 0.005						
4.0 ± 0.005						
8.0 ± 0.005						
12.0 ± 0.02						
16.0 ± 0.02						
20.0 ± 0.05						
25.0 ± 0.05						
32.0 ± 0.05						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 5 of 26)

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DATA SHEET 85-1-6

PC 2 OUTPUT VOLTS

TSCU SERIAL NO.:___________

DATE:_____________ TEST ENGINEER:_________________ QUALITY WITNESS:________________

PC 2 OUTPUT VOLTS (SIM)	PC 2 OUTPUT VOLTS					
	TSCU OUTPUT VOLTAGE (-VOLTS)					
INPUT (- VOLTS)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
1.0 ± 0.005						
4.0 ± 0.005						
8.0 ± 0.005						
12.0 ± 0.02						
16.0 ± 0.02						
20.0 ± 0.05						
25.0 ± 0.05						
32.0 ± 0.05						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 6 of 26)

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DATA SHEET 85-2-1

PC 1 INPUT CURRENT

TSCU SERIAL NO.:____________

DATE:_____________ TEST ENGINEER:____________________ QUALITY WITNESS:_______________

PC 1 INPUT CURRENT (SIM)		PC 1 INPUT CURRENT TSCU OUTPUT VOLTAGE (-VOLTS)					
Input (volts)	Input (amps)	Run 1	Run 2	Run 3	Run 4	Run 5	Avg
0.011 ± 0.0005	2.2						
0.020 ± 0.0005	4.0						
0.030 ± 0.0005	6.0						
0.050 ± 0.0005	10.0						
0.080 ± 0.0005	16.0						
0.100 ± 0.0005	20.0						
0.110 ± 0.0005	22.0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 7 of 26)

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DATA SHEET 85-2-2

PC 2 INPUT CURRENT

TSCU SERIAL NO.:________

DATE:____________ TEST ENGINEER:______________________ QUALITY WITNESS:______________

PC 2 INPUT CURRENT (SIM)		PC 2 INPUT CURRENT TSCU OUTPUT VOLTAGE (-VOLTS)					
INPUT (volts)	INPUT (amps)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0.011 ± 0.0005	2.2						
0.020 ± 0.0005	4.0						
0.030 ± 0.0005	6.0						
0.050 ± 0.0005	10.0						
0.080 ± 0.0005	16.0						
0.100 ± 0.0005	20.0						
0.110 ± 0.0005	22.0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 8 of 26)

SNAP 19/NIMBUS B

DATA SHEET 85-2-3

PC 1 OUTPUT CURRENT

TSCU SERIAL NO.____________

DATE:____________ TEST ENGINEER:____________________ QUALITY WITNESS:______________

PC 1 OUTPUT CURRENT (SIM)		PC 1 OUTPUT CURRENT TSCU OUTPUT VOLTAGE (-VOLTS)					
INPUT (volts)	INPUT (amps)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0.21 ± 0.0005	0.21						
0.40 ± 0.0005	0.40						
0.60 ± 0.0005	0.60						
1.00 ± 0.001	1.00						
1.40 ± 0.001	1.40						
1.60 ± 0.001	1.60						
2.10 ± 0.001	2.10						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 9 of 26)

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DATA SHEET 85-2-4

PC 2 OUTPUT CURRENT

TSCU SERIAL No.:__________

DATE:__________ TEST ENGINEER:______________ QUALITY WITNESS:______________

PC 2 OUTPUT CURRENT (SIM)		PC 2 OUTPUT CURRENT TSCU OUTPUT VOLTAGE (-VOLTS)					
INPUT (volts)	INPUT (amps)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0.21 ± 0.0005	0.21						
0.40 ± 0.0005	0.40						
0.60 ± 0.0005	0.60						
1.00 ± 0.001	1.00						
1.40 ± 0.001	1.40						
1.60 ± 0.001	1.60						
2.10 ± 0.001	2.10						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 10 of 26)

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DATA SHEET 85-3-1

RTG 1 PRESSURE

TSCU SERIAL NO.:______

DATE:__________ TEST ENGINEER:________________ QUALITY WITNESS:________________

RTG 1 PRESSURE (SIM) INPUT (K-OHMS)	RTG 1 PRESSURE TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0 ± 0.005						
2 ± 0.005						
4 ± 0.005						
6 ± 0.005						
8 ± 0.005						
9.5 ± 0.005						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 11 of 26)

SNAP 19/NIMBUS B

DATA SHEET 85-3-2

RTG 2 PRESSURE

TSCU SERIAL NO. __________

DATE: __________ TEST ENGINEER: __________ QUALITY WITNESS: __________

RTG 2 PRESSURE (SIM) INPUT (K-OHMS)	RTG 2 PRESSURE TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
0 ± 0.005						
2 ± 0.005						
4 ± 0.005						
6 ± 0.005						
8 ± 0.005						
9.5 ± 0.005						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 12 of 26)

SNAP 19/NIMBUS B

DATA SHEET 85-4-1

PC 1 TEMPERATURE

TSCU SERIAL NO.____________

DATE:____________ TEST ENGINEER:____________________ QUALITY WITNESS:________________

PC 1 TEMPERATURE (SIM) INPUT (K-OHMS)	PC 1 TEMPERATURE TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2. 5 ± 0. 005						
3. 0 ± 0. 005						
4. 0 ± 0. 005						
6. 0 ± 0. 005						
8. 0 ± 0. 005						
10. 0 ± 0. 02						
15. 0 ± 0. 02						
25. 0 ± 0. 02						
40. 0 ± 0. 02						
62. 0 ± 0. 02						
80. 0 ± 0. 02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 13 of 26)

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DATA SHEET 85-4-2

PC 2 TEMPERATURE

TSCU SERIAL NO.:___________

DATE:______________ TEST ENGINEER:__________________ QUALITY WITNESS:_________________

PC 2 TEMPERATURE (SIM) INPUT (K-OHMS)	PC 2 TEMPERATURE TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2.5 ± 0.005						
3.0 ± 0.005						
4.0 ± 0.005						
6.0 ± 0.005						
8.0 ± 0.005						
10.0 ± 0.02						
15.0 ± 0.02						
25.0 ± 0.02						
40.0 ± 0.02						
62.0 ± 0.02						
80.0 ± 0.02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 14 of 26)

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DATA SHEET 85-5-1

RTG 1 FIN ROOT TEMPERATURE T6 TSCU SERIAL NO.:________

DATE:__________ TEST ENGINEER:____________________ QUALITY WITNESS:______________

RTG 1 F.R. TEMP T6 (SIM) INPUT (K-OHMS)	RTG 1 FIN ROOT TEMPERATURE T6 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2.5 ± 0.005						
3.0 ± 0.005						
4.0 ± 0.005						
6.0 ± 0.005						
8.0 ± 0.005						
10.0 ± 0.02						
15.0 ± 0.02						
25.0 ± 0.02						
40.0 ± 0.02						
62.0 ± 0.02						
80.0 ± 0.02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 15 of 26)

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DATA SHEET 85-5-2

RTG 1 FIN ROOT TEMPERATURE T7 TSCU SERIAL NO.:__________

DATE:__________ TEST ENGINEER:__________________ QUALITY WITNESS:______________

RTG 1 F.R. TEMP T7 (SIM) INPUT (K-OHMS)	RTG 1 FIN ROOT TEMPERATURE T7 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2.5 ± 0.005						
3.0 ± 0.005						
4.0 ± 0.005						
6.0 ± 0.005						
8.0 ± 0.005						
10.0 ± 0.02						
15.0 ± 0.02						
25.0 ± 0.02						
40.0 ± 0.02						
62.0 ± 0.02						
80.0 ± 0.02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 16 of 26)

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DATA SHEET 85-5-3

RTG 1 FIN ROOT TEMPERATURE T8 TSCU SERIAL NO.:________

DATE:____________ TEST ENGINEER:______________________ QUALITY WITNESS:____________

RTG 1 F.R. TEMP T8 (SIM) INPUT (K-OHMS)	RTG 1 FIN ROOT TEMPERATURE T8 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2.5 ± 0.005						
3.0 ± 0.005						
4.0 ± 0.005						
6.0 ± 0.005						
8.0 ± 0.005						
10.0 ± 0.02						
15.0 ± 0.02						
25.0 ± 0.02						
40.0 ± 0.02						
62.0 ± 0.02						
80.0 ± 0.02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 17 of 26)

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DATA SHEET 85-5-4

RTG 2 FIN ROOT TEMPERATURE T6 TSCU SERIAL NO.:___________

DATE:_____________ TEST ENGINEER:____________________ QUALITY WITNESS:_________________

RTG 2 F.R. TEMP T6 (SIM) INPUT (K-OHMS)	RTG 2 FIN ROOT TEMPERATURE T6 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2.5 ± 0.005						
3.0 ± 0.005						
4.0 ± 0.005						
6.0 ± 0.005						
8.0 ± 0.005						
10.0 ± 0.02						
15.0 ± 0.02						
25.0 ± 0.02						
40.0 ± 0.02						
62.0 ± 0.02						
80.0 ± 0.02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 18 of 26)

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DATA SHEET 85-5-5

RTG 2 FIN ROOT TEMPERATURE T7 TSCU SERIAL NO.:__________

DATE:____________ TEST ENGINEER:______________________ QUALITY WITNESS:____________

RTG 2 F.R. TEMP T7 (SIM) INPUT (K-OHMS)	RTG 2 FIN ROOT TEMPERATURE T7 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2.5 ± 0.005						
3.0 ± 0.005						
4.0 ± 0.005						
6.0 ± 0.005						
8.0 ± 0.005						
10.0 ± 0.02						
15.0 ± 0.02						
25.0 ± 0.02						
40.0 ± 0.02						
62.0 ± 0.02						
80.0 ± 0.02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 19 of 26)

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DATA SHEET 85-5-6

RTG 2 FIN ROOT TEMPERATURE T8 TSCU SERIAL NO.:________

DATE:______________ TEST ENGINEER:______________________ QUALITY WITNESS:____________

RTG 2 F.R. TEMP T8 (SIM) INPUT (K-OHMS)	RTG 2 FIN ROOT TEMPERATURE T8 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
2.5 ± 0.005						
3.0 ± 0.005						
4.0 ± 0.005						
6.0 ± 0.005						
8.0 ± 0.005						
10.0 ± 0.02						
15.0 ± 0.02						
25.0 ± 0.02						
40.0 ± 0.02						
62.0 ± 0.02						
80.0 ± 0.02						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 20 of 26)

SNAP 19/NIMBUS B

DATA SHEET 85-6-1

RTG 1 HOT JUNCTION TEMPERATURE T2 TSCU SERIAL NO.:__________

DATE:____________ TEST ENGINEER:_________________________ QUALITY WITNESS:______________

RTG 1 H.J. TEMP T2 (SIM) INPUT (OHMS)	RTG 1 HOT JUNCTION TEMPERATURE T2 TSCU OUTPUT VOLTAGE (-VOLTS) RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
241 ± 0						
243 ± 0						
245 ± 0						
250 ± 0						
265 ± 0						
290 ± 0						
309 ± 0						
314 ± 0						
316 ± 0						
318 ± 0						
320 ± 0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 21 of 26)

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DATA SHEET 85-6-2

RTG 1 HOT JUNCTION TEMPERATURE T3 TSCU SERIAL NO.:________

DATE:____________ TEST ENGINEER:____________________ QUALITY WITNESS:_________________

RTG 1 H.J. TEMP T3 (SIM) INPUT (OHMS)	RTG 1 HOT JUNCTION TEMPERATURE T3 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
241 ± 0						
243 ± 0						
245 ± 0						
250 ± 0						
265 ± 0						
290 ± 0						
309 ± 0						
314 ± 0						
316 ± 0						
318 ± 0						
320 ± 0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 22 of 26)

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DATA SHEET 85-6-3

RTG 1 HOT JUNCTION TEMPERATURE T5 TSCU SERIAL NO.:__________

DATE:__________ TEST ENGINEER:____________________ QUALITY WITNESS:__________

RTG 1 H.J. TEMP T5 (SIM) INPUT (OHMS)	RTG 1 HOT JUNCTION TEMPERATURE T5 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
241 ± 0						
243 ± 0						
245 ± 0						
250 ± 0						
265 ± 0						
290 ± 0						
309 ± 0						
314 ± 0						
316 ± 0						
318 ± 0						
320 ± 0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 23 of 26)

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DATA SHEET 85-6-4

RTG 2 HOT JUNCTION TEMPERATURE T2 TSCU SERIAL NO.:__________

DATE:__________ TEST ENGINEER:__________________ QUALITY WITNESS:______________

RTG 2 H.J. TEMP T2 (SIM) INPUT (OHMS)	RTG 2 HOT JUNCTION TEMPERATURE T2 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
241 ± 0						
243 ± 0						
245 ± 0						
250 ± 0						
265 ± 0						
290 ± 0						
309 ± 0						
314 ± 0						
316 ± 0						
318 ± 0						
320 ± 0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 24 of 26)

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DATA SHEET 85-6-5

RTG 2 HOT JUNCTION TEMPERATURE T3 TSCU SERIAL NO.:__________

DATE:__________ TEST ENGINEER:______________________ QUALITY WITNESS:______________

RTG 2 H.J. TEMP T3 (SIM) INPUT (OHMS)	RTG 2 HOT JUNCTION TEMPERATURE T3 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
241 ± 0						
243 ± 0						
245 ± 0						
250 ± 0						
265 ± 0						
290 ± 0						
309 ± 0						
314 ± 0						
316 ± 0						
318 ± 0						
320 ± 0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 25 of 26)

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DATA SHEET 85-6-6

RTG 2 HOT JUNCTION TEMPERATURE T5 TSCU SERIAL NO.:__________

DATE:__________ TEST ENGINEER:____________________ QUALITY WITNESS:______________

RTG 2 H.J. TEMP T5 (SIM) INPUT (OHMS)	RTG 2 HOT JUNCTION TEMPERATURE T5 TSCU OUTPUT VOLTAGE (-VOLTS)					
	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	AVG
241 ± 0						
243 ± 0						
245 ± 0						
250 ± 0						
265 ± 0						
290 ± 0						
309 ± 0						
314 ± 0						
316 ± 0						
318 ± 0						
320 ± 0						

Figure A-9. Sample of TSCU Calibration Data Sheet (Sheet 26 of 26)

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GENERATOR SIMULATION SYSTEM CHECKOUT DATA SHEET

PC SERIAL NO. ________

DATE ____________ TEST ENGINEER ______________________ QUALITY WITNESS ________________________

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
TSCU Checkout					
	All within tolerance? ____________				
	Out-of-tolerance channels ________				
FULL LOAD TEST ON BUS					
16	PC 1 temp	________ V	MND-3607 -83	________ °F	85 ± 20°F
17	PC 2 temp	________ V		________ °F	
					PCU SER. NO. — VOLTS
00	PC 1 input volts	________ V			004 — +2.5 ± 0.10
					007 — +2.6 ± 0.10
02	PC 2 input volts	________ V			008 — +2.6 ± 0.10
01	PC 1 input volts (T/M)	________ V	MND-3607 -83	________ V	Within 5% of chan 00
03	PC 2 input volts (T/M)	________ V		________ V	Within 5% of chan 02
08	PC 1 output volts	________ V			
10	PC 2 output volts	________ V			-24.5 ± 0.10 volts
09	PC 1 output volts (T/M)	________ V		________ V	Within 5% of (chan 08 + 0.3V)
11	PC 2 output volts (T/M)	________ V		________ V	Within 5% of (chan 10 + 0.3V)

Figure A-10. Sample of Generator Simulation System Checkout Data Sheet (Sheet 1 of 4)

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
04	PC 1 input current	________ V	A = V x 200	________ A	Chan 05 within 5% of chan 04
06	PC 2 input current	________ V		________ A	
05	PC 1 input current (T/M)	________ V	MND-3607-83	________ A	Chan 07 within 5% of chan 06
07	PC 2 input current (T/M)	________ V		________ A	
12	PC 1 output current	________ V	A = V x 1	________ A	Chan 13 within 5% of chan 12
14	PC 2 output current	________ V		________ A	
13	PC 1 output current (T/M)	________ V	MND-3607-83	________ A	Chan 15 within 5% of chan 14
15	PC 2 output current (T/M)	________ V		________ A	

$$\text{Efficiency PC 1} = \frac{\text{Ch. 08 x Ch. 12}}{\text{Ch. 00 x Ch. 04}} \times 100 = \_\_\_\_\_\_\_\_ \%$$

$$\text{Efficiency PC 2} = \frac{\text{Ch. 10 x Ch. 14}}{\text{Ch. 02 x Ch. 06}} \times 100 = \_\_\_\_\_\_\_\_ \%$$

89% minimum

RIPPLE TEST

Signal	Measurement	Typical Measurement
PC output ripple	________ mv	50 mv maximum

Figure A-10. Sample of Generator Simulation System Checkout Data Sheet (Sheet 2 of 4)

Figure A-10. Sample of Generator Simulation System Checkout Data Sheet (Sheet 3 of 4)

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
CONV. NO. 1 OFF BUS					
16	PC 1 temp	______ V	MND-3607 -83	______ °F	85 ± 20°F
17	PC 2 temp	______ V		______ °F	
12	PC 1 output current	______ V	A = V x 1	______ A	0.0 ± 0.01A
14	PC 2 output current	______ V		______ A	1.0 ± 0.2A
22	PC 1 EXT LOAD current	______ V		______ A	1.0 ± 0.2A
23	PC 2 EXT LOAD current	______ V		______ A	0.0 ± 0.01A
20	PC 1 EXT LOAD volts	______ V			-24.25 ± 0.75V
21	PC 2 EXT LOAD volts	______ V			0.0 ± 0.01V
CONV. NO. 2 OFF BUS					
16	PC 1 temp	______ V	MND-3607 -83	______ °F	85 ± 20°F
17	PC 2 temp	______ V		______ °F	
12	PC 1 output current	______ V	A = V x 1	______ A	1.0 ± 0.2A
14	PC 2 output current	______ V		______ A	0.0 ± 0.01A
22	PC 1 EXT LOAD current	______ V		______ A	0.0 ± 0.01A
23	PC 2 EXT LOAD current	______ V		______ A	1.0 ± 0.2A
20	PC 1 EXT LOAD volts	______ V			0.0 ± 0.01V
21	PC 2 EXT LOAD volts	______ V			-24.25 ± 0.75V

Channel	Signal	Measurement	Conversion Formula	Converted Measurement	Typical Measurement
FULL LOAD OFF BUS					
16	PC 1 temp	________ V	MND-3607-83	________ °F	85 ± 20°F
17	PC 2 temp	________ V		________ °F	
12	PC 1 output current	________ V	A = V x 1	________ A	0.0 ± 0.01A
14	PC 2 output current	________ V		________ A	
22	PC 1 EXT LOAD current	________ V		________ A	1.0 ± 0.2A
23	PC 2 EXT LOAD current	________ V		________ A	
20	PC 1 EXT LOAD volts	________ V			-24.25 ± 0.75V
21	PC 2 EXT LOAD volts	________ V			

Figure A-10. Sample of Generator Simulation System Checkout Data Sheet (Sheet 4 of 4)

ALPHABETICAL INDEX

*Asterisk denotes illustrations, other listings are paragraphs

C (Cont'd)

C (Cont'd)

D

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