AERO QUALITY SALES

SUPERSEDER II

NICKEL-CADMIUM BATTERY CHARGER/ANALYZER

Technical Manual

Rev 0 - 3 September 1985

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Superseder II
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INTRODUCTION

The Superseder II Battery Charger/Analyzer is basically a programmable constant current source for charging and a constant current sink for discharge, using SCR's with phase chopping for the charge and a transistor linear load for discharge.

The duration of the charge and discharge cycles are automatically controlled by presettable digital timers, programmable in hours or minutes (or seconds in the test clock mode).

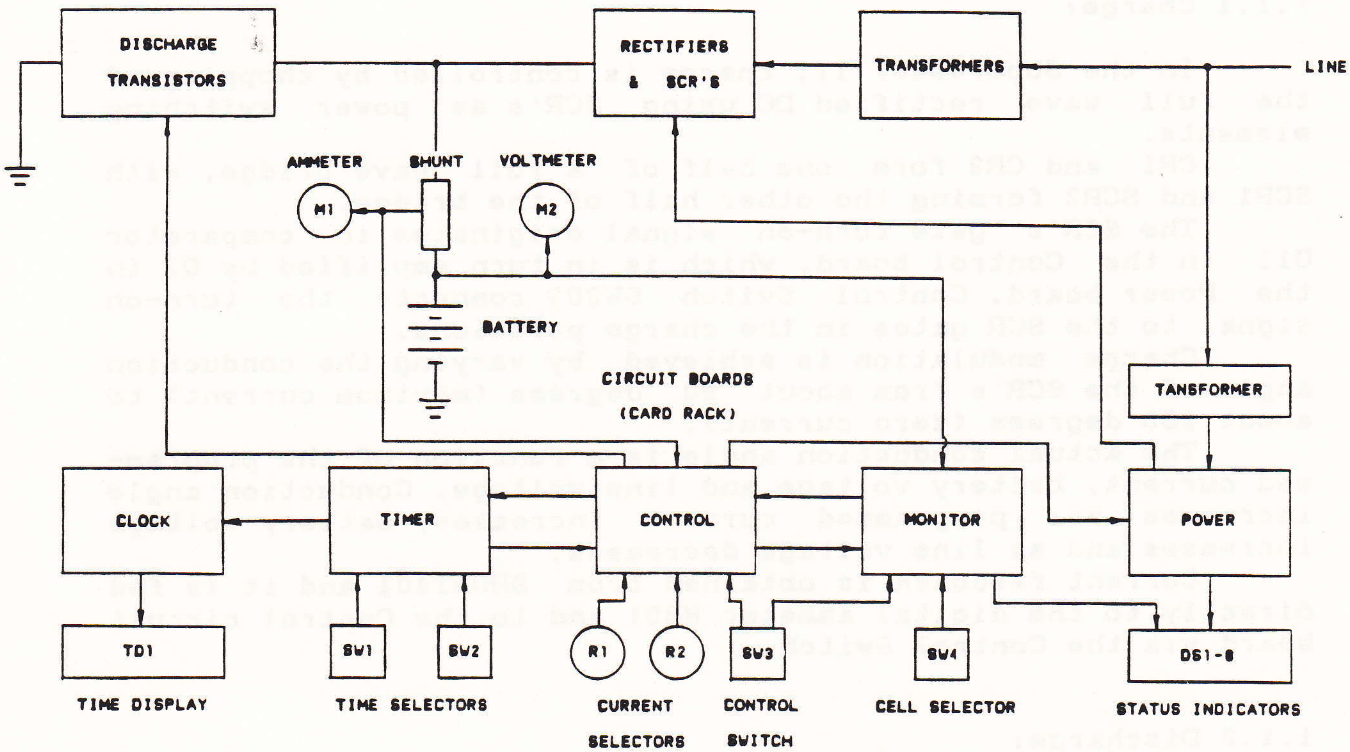
The charge and discharge cycles are also terminated automatically as a function of the battery voltage. A cell selector programs the discharge cut-off voltage at the equivalent of 1.00 Volt/Cell and an overvoltage charge cut-off at the equivalent of 1.70 Volts/cell.

A monitor circuit verifies proper operation and shuts off the instrument if an abnormal condition is detected. Conditions being monitored include current tracking (actual vs programmed) battery overtemperature (through an external plate), reverse polarity, open circuit and discharge load bank overheating.

A control switch selects the operating mode, while a series of indicator lights show the operating status.

Two digital panel meters are used to indicate current flow and battery voltage. The voltmeter can also be selected to measure external voltages.

FIG 1 - BLOCK DIAGRAM



SEC 1 - CIRCUIT DESCRIPTION AND THEORY OF OPERATION

1.1 THEORY OF OPERATION, POWER CIRCUITS

(Refer to the Power Circuit Schematic)

1.1.1 Charge:

In the Superseder II, charge is controlled by chopping of the full wave rectified DC using SCR's as power switching elements.

CR1 and CR2 form one half of a full wave bridge, with SCR1 and SCR2 forming the other half of the bridge.

The SCR's gate turn-on signal originates in comparator U11 in the Control board, which is in turn amplified by Q3 in the Power board. Control Switch SW203 connects the turn-on signal to the SCR gates in the charge positions.

Charge modulation is achieved by varying the conduction angle of the SCR's from about 90 degrees (maximum current) to about 180 degrees (zero current).

The actual conduction angle is a function of the programmed current, battery voltage and line voltage. Conduction angle increases as: programmed current increases, battery voltage increases and as line voltage decreases.

Current feedback is obtained from SHUNT401 and it is fed directly to the digital ammeter M201 and to the Control circuit board via the Control Switch.

1.1.2 Discharge:

A bank of 24 power transistors forms an electronic load that enables the Superseder II to discharge the battery under test at a constant rate.

Power transistors Q3 to ~~Q4~~ Q24 provide a path to ground where the discharge current is controlled by the signal originating in amplifier U9 in the Control board, and subsequently amplified by control transistors Q1 and Q2.

Discharge modulation is achieved by varying the amplitude of the signal applied to the base of Q1 which in turn varies the conduction of Q2 which ultimately varies the conduction of the rest of the transistor bank.

Control switch SW203 connects the drive signal from the Control board to the gate of Q1 in the discharge positions.

Current feedback is obtained from SHUNT401 and it is applied to the digital ammeter M201 and to the Control circuit board (same as for charge but with the polarity of the shunt signal reversed to the Control board).

1.2 THEORY OF OPERATION, CONTROL CIRCUITS:

(Refer to the circuit board, and other circuit schematics)

1.2.1 CONTROL CIRCUIT BOARD.

The Control Circuit Board houses the principal analog and digital circuits to control the current and the operating mode of the Superseder.

a) Analog section:

Amplifier U10 amplifies (x100) the signal from the shunt, yielding an output of -100mV/A (ie: 10A = -1.000 Volts). The Control Switch reverses the polarity of the input when switching from charge (positive input) to discharge (negative input), to maintain the same output polarity.

Capacitors C17 and C19 integrate the short pulses generated during the charge operation producing a smoothed DC output.

Trimpot R37 is used to adjust for an output of 0.000V, with zero current flow (reset state).

Amplifier U8 buffers the programmed current input signal and applies its output to integrator U9 via R24, where it is summed via R36, with the output of amplifier U10.

The programmed current input signal originates in Potentiometer R201 for Main current and Potentiometer R202 for Topping/Discharge current. The Potentiometers are 5 turn devices with a dial range from 000 to 500, with a voltage range of 0.000 to 5.000 volts, corresponding to 00.0 to 50.0 Amps.

The outputs of U10 and U8 are also fed to the Monitor board where they are compared for actual to programmed current tracking.

The sum of the ouputs of U8 and U10 generates the error signal, which is the difference between the programmed and the actual value of the current. The Integrator amplifies and filters the error signal and applies it to Comparator U11.

The output of the integrator is about +0.55V at reset and about -1.5V at medium currents.

Trimpot R28 is used to calibrate the low end (1Amp) of the current range.

Comparator U11 receives a ramp (synchronized with the line via signal TDL and Q1), extending from nearly 0 volts to a peak of about 3 volts, which is compared with the output of Integrator U9. The result is a square wave that goes low (turning the SCR's on) when the positive ramp signal crosses the negative integrator signal, and remains low until the ramp resets (at the line zero crossing).

The conduction angle then, increases or decreases as a function of the error signal, to maintain the programmed charge rate. In the discharge mode the ouput of Integrator U9 is applied to the discharge bank of transistors via R30. In this case, the output signal goes more negative to increase the conduction (and thus the current) of the transistors.

Amplifier U8 receives its input through Analog Gates U7A, U7B and U7D, which determine the source of the programmed current value. U7D switches the MAIN current, as programmed by potentiometer R201, U7A switches the TOPPING/DISCHARGE current, as programmed by potentiometer R202 and U7B switches a small negative voltage (-50mV) during reset to force the Integrator to go positive.

R46 and C25 form a simple integrator to provide a slow rise (soft start) of the current, from zero to the programed value in a matter of 3 to 5 seconds.

R47 and CR4 rapidly discharge C25, when the charge or discharge are interrupted by the pressing of the RESET button, to insure a soft start.

Voltage regulator U12 is used to generate a precision +10.000 volts reference for the Control and Monitor circuit boards.

b) Digital section:

The digital circuitry of the Control board together with the Control Switch and the Timer board, estabish and control the operating modes of the Superseder.

The Main and Topping/Discharge modes are controlled through the flip-flop formed by gates U3C and U3B. Their outputs, through gates U6A and U6B and inverters U5B and U5A enable analog gate U7D for Main current or U7A for Topping/Discharge current. Gate U3A enables analog gate U7B and disables (through inverter U5C) gates U6A and U6B in the Reset state.

The outputs of inverters U5B and U5A are also applied to amplifers in the Power board to turn on the Main and Topping or Discharge indicators in the Control Panel.

The mode flip-flop is started in the Main position (by the Reset switch), or it may be started in the Topping/Discharge position if the signal TIE is low (having selected the Single Rate or Discharge mode).

If started in the Main position (having selected the Two Rate mode), the flip-flop will change state when the Timer board generates the TIC signal, which ocurs when the elapsed time equals the time programmed for Main charge.

The flip-flop formed by gates U2A and U2B is used to terminate the operation of the Superseder, from signals originating in the Timer or Monitor circuit boards.

The flip-flop is started in its off position in the Reset state, and it is set to the Cycle End position by either TTC, the signal from the Timer that is generated at the end of the programmed time, or by Cycle End at the Monitor board generated when the battery being discharged reaches 1.00V/cell.

The output of the flip-flop (EAL) is applied to the Power circuit board to turn on the beeper and the flashing green light that indicates the completion of a cycle.

Operation of the Superseder is halted by the Hold signal, generated by the Monitor circuit board (when it detects a fault condition) or by the Power Fail Comparator, that switches when the power sigal 12V"A" falls below 85% of its normal value, as referenced by zener diode ZR1 which is fed by the battery backed 12V"B" supply. Note: 12V"B" supplies all the digital circuits except the clock LED readout.

If halted by the Power Fail Detector, the Superseder will resume operation upon normal return of the power (provided that the control switch has not been disturbed).

1.2.2 TIMER CIRCUIT BOARD.

The Timer Circuit Board consists of the Time Counters and Comparator circuits required to program the elapsed operating times of the Superseder.

Counter U1 receives the timing signal TDL (line frequency, zero crossing, 120 pps for 60Hz and 100 pps for 50 Hz), from the Power board, which divides it down to 2Hz. The jumper at E1-E2-E3 serves to program division by 5 or 6 for operation at 50Hz or 60Hz respectively. An additional output of 60 pps is also generated (pin 3).

Flip-flop U2 divides the 2Hz signal down to 1Hz (1pps) while counter U5 divides by 60 to generate a 1ppm signal.

Counters U6, U3A and U3B divide by 60, 10 and 10 respectively to achieve a final output of HH:MM or MM:SS depending on the setting of switch SW1.

In the Normal position of SW1 the Timer functions as HH:MM (the display at the Clock board advances at the rate of one count per minute). In the Fast position, the Timer funtions as MM:SS (the display at the Clock board advances at the rate of one count per second).

In the Test position, the Clock is advanced at the rate of 60 counts per second.

The Reset signal originates at the Control board. It is low during timer operation (power failure shutdown condition included), and it is high when the unit is in the reset state.

The HLD (hold) signal is generated by the Control board. It is low during normal operation and goes high during a power failure, when a malfunction is detected or at the end of a cycle.

Note: HLD stops the Timer (and Clock) but does not alter the display. Reset returns all counters to zero.

Comparator U8 receives input from the Main Time selector switch (T1) and compares it to the output of counter U3A (hours or minutes). Comparators U7 and U4 receive inputs from the Total Time selector switch (T2) and compare it to the outputs of Counters U3A and U3B (hours and tens of hours, or minutes and tens of minutes).

Outputs TIC and TTC (positive pulses of .5 sec duration), are sent to the Control board to signal that Main and Total elapsed times equal the programmed values.

Diodes CR2, CR3, CR4 and CR5 and transistor Q1 form a gate to generate a TTC signal when the elapsed time equals 60 (hours or minutes). Total Time switch settings greater than 60 are not recognized by the circuit and will produce inconsistent elapsed times.

1.2.3 CLOCK CIRCUIT BOARD.

The Clock/Display Circuit Board consists of the Time Counter and LED readouts to display the elapsed time.

Counters U5 and U2 divide the Clock signal (1ppm, 1pps or 60pps) by 60 and 100 respectively, to achieve a display format of HH:MM or MM:SS in accordance to the clock speed setting at the Timer board.

Decoder-drivers U1, U3, U4 and U6 interprete the BCD encoded signal from the counters and convert them into outputs for the 7 segment LED readouts.

The output section of the decoder-drivers is powered from 12V"A", while the rest of the circuits are powered by 12V"B". In the event of a power failure (while the unit is running), the 12V"A" will drop out, thus turning the LED readouts off, but 12"B" (which is battery backed-up), will maintain the counter positions until power is restored.

The Reset signal originates at the Control board. It is low during clock operation (including during a power failure shutdown condition), and it is high when the unit is in reset.

Transistor Q1 drives the colon LED's at the rate of one flash per second, using the 1pps signal from the Timer board as input.

1.2.4 MONITOR CIRCUIT BOARD.

The Monitor Circuit Board consists of various comparator circuits that detect certain abnormalities in the operation of the Superseder.

a) Battery voltage section.

Amplifier U11 generates an output which is -.1 x battery voltage (Note: The Superseder II electronics floats on the battery voltage). Input divider R68 and R65 attenuate the battery voltage while R39 calibrates the attenuation.

Amplifier U12 buffers the cell selector and sums its output (positive) with the output of U11 (negative) through R64 and R40 respectively. Comparator U17 switches positive when the battery voltage is less than the input from the cell selector, and it switches low when the battery voltage exceedes the input from cell selector. R38 calibrates the switching point (during charge).

The cell selector is excited with 10V during charge, generating a signal of .1V/cell, but the summing ratio of R64, R38 and R40 establish a switching point equivalent to 1.70V/-cell for overvoltage cut-off.

In the discharge positions, the cell selector excitation is dropped to 5.88V to yield an equivalent of 1.00V/cell for discharge cut-off.

The output switching of Comparator U17 results in Cycle End (discharge) or Overvoltage Malfunction (charge), depending on the state of the Discharge Enable signal (present at pin 8/J and originating in the Control Switch).

If Discharge Enable is high (discharge), gate U7A will be enabled (and gate U7B disabled), and a high to low transition at U17 will generate a high output at gate U7C which will signal the Control board to terminate the cycle. If Full Discharge is selected (grounding of pin C), U7A is disabled, thus eliminating cycle ending due to battery voltage.

If Discharge Enable is low (charge), gate U7B will be enabled (and gate U7A disabled), and a low to high transition at U17 will generate a low output at gate U7B signaling an overvoltage malfunction condition.

Transistor Q3 and diodes CR9 and CR10 momentarily disable gates U7A and U7B at power-on to eliminate false outputs. The base of Q3 is controlled by a power-on reset network formed by CR6, CR7, R41, R42 and C3. The voltage at C3, starting from zero at power-off, will remain low for several seconds thus holding all circuits at reset.

The output of amplifier U11 is also applied to various comparators that monitor battery voltage.

Comparator U10D is an absolute overvoltage detector, which will yield a low output if the battery voltage exceeds 85V. Its output is OR'ed with the output of gate U7B to generate a voltage malfunction indication.

Comparator U15 is set to yield a low ouput for reverse polarity battery voltages greater than .35V.

Comparator U10C is set to yield a high output at battery voltages greater than 36V. Its output is AND'ed with the output of comparator U10A, which is set to yield a high output for battery currents greater than 20A. The outputs of both comparators will then rise only for battery voltages greater than 36V and currents greater than 20A.

The comparators establish one of the inputs of gate U1C. The other input is Discharge Enable. If both inputs are high, the low output of gate U1C through transistor Q2 will generate a current fault condition in the discharge mode. The low output is also applied, through diode CR11, to the output of Discharge selector potentiometer R202, thus limiting the discharge current to 20A, to protect the discharge transistors from excessive power dissipation.

Comparator U10B is set to yield a high output at battery voltages less than 2V. Gate U1B will receive this signal and also Discharge Enable, to disable under-current monitoring during dicharge at battery voltages under 2V.

A low output at gate U1B is applied to gate U1D, used as an inverter, which turns transistor Q1 on, ultimately disabling comparator U8.

b) Current monitoring section.

Comparators U8 and U9 form a window comparator where the outputs are OR'ed and will go low, signaling a current fault if the charge (or discharge) current differs from the programmed current by more than one amp (over or under).

Resistors R27 and R26 sum the Programmed Current (positive value) and Actual Current (negative value) signals from the Control board. The difference signal forms one input of the comparators. The other input is a resistive divider generating +.05V and -.05V, for the undercurrent and overcurrent comparators respectively.

If the current difference exceedes one amp (over or under) then the summed signal difference will exceed 50mV (negative or positive), thus triggering the comparators.

c) Heatsink overheat monitoring section.

Comparators U13 and U14 are set to sense an overheating of the discharge heat sinks and to signal an Overheat Malfunction condition by generating a low output.

The signal input for each of the comparators is generated by a resistive divider formed by a precision resistor (R44 and R47) connected to +10V and a precision (30K at 25 deg C) thermistor connected to ground. The reference input is a divider, formed by R45 and R48, set to produce +1.45V. If the surface temperature at either heatsink reaches 90 deg C, then the input signal will equal the refence, thus generating a low output at the comparators.

d) Battery overtemp monitoring section.

Comparators U3 (4 sections) and U6 (4 sections) monitor the signal originating in the Temp-plate. The outputs of U3 will go low if the surface temperature of the Temp-plate exceedes 45 deg C, signaling a Battery Overtemp malfunction. The outputs of U6 will go low if any of the Temp-plate thermistors, or its connections (cable disconnected) are open, signaling an abnormality by turning on the red Overtemp light through transistor Q5.

The signal input for each of the comparators is generated by a resistive divider formed by a precision resistor connected to +10V (R18, R19, R20 and R21), and a precision thermistor (30K at 25 deg C) connected to ground.

The reference input for the U3 comparators is a divider formed by R14 and R16, set to generate 6.29V for the sensing of an overheated battery. The reference input for the U6 comparators is a divider formed by R17 and R15, set to generate 9.1V for the sensing of open circuited inputs (open circuit = 10.00V).

e) Output signaling section.

The signals from the various monitoring circuits are applied to the flip-flop, formed by gates U2A and U2B, and to the four section latch U5.

The flip-flop sets with any of the faults and generates a low output, through driver U4B and test/run switch SW1, to signal a Fault to the Power board (alarm) and to signal Hold to the Control board, through diode CR2.

The flip-flop is reset by the Reset button in the Control switch, through CR7 and R41, and by the loss of 12V"A", as a result of a power failure.

Note: any fault signals present while the unit is in the reset state will signal via the alarm, even though the flip-flop will not latch and the indicators will not light up, except for the Reverse Polarity fault, that will drive the indicator directly and the multiple latch and Hold, through diodes CR3, CR4 and CR5.

Capacitor C3 holds initially the reset input low (as it charges through R41 and R42) to reject false fault conditions that may be generated while the power and control circuits stabilize at power-on.

All signals from the fault monitoring comparators are also integrated by RC circuits, to filter any false (brief), fault condition that may occur during power turn-on, start-up or a power line transient. Transistor Q4 is used specifically to hold off any possible response to a current fault during the start-up process. The signal for Q4 is derived from the emitter of Q3 which is in turn driven by the Reset RC network of R41, R42 and C3, with an effective time delay of several seconds.

The stages of the multiple latch are set by the correspon-ding inputs derived from the comparators. The outputs are con-nected to lamp drivers that turn on the front panel fault indi-cators. A 1Hz strobe signal received from the Power board is used to turn on and off the ouputs of the multiple latch, to pulsate (blink) the fault indicators.

1.2.5 POWER CIRCUIT BOARD.

The Power Circuit Board provides various regulated volt-ages needed throughout the control circuits of the Superseder.

Bridge rectifier CR2, resistors R9 and R10 and capacitor C3 and C5 form a basic positive and negative raw dc supply of about 20 to 25V.

Voltage regulators U4 and U3 regulate this input voltage and produce +- 15V respectively. Capacitors C7 and C6 filter the output and diodes CR9, CR13, CR14 and CR8 protect the regulators in case of input shorts or output connection to power rails of opposite polarity.

Diodes CR1 and CR4 produce a full wave unfiltered DC signal (about 16V avg) used as a source for the timing pulse TDL, the 12V regulator, to trickle charge an external 7.2V nickel-cadmium battery, and to supply the SCR trigger ampli-fier.

The timing signal TDL is a positive pulse of 1-2ms pro-duced by the turn off of transistor Q2 at the zero crossing of the rectified full wave.

The rectified full wave is passed through diode CR3 and resistor R11 and filtered by capacitor C4 to produce about 20V as input for U5, the 12V regulator. Capacitor C10 filters the output while diodes CR10 and CR12 protect the regulator against input shorts or output connection to opposite polarity power rails.

Diodes CR5 and CR6 sum and isolate the output from the battery with the output of the 12V regulator to generate the 12V"B" power rail. In case of a power (line) failure the 12V"B" output will drop from 11.4V as supplied by the regulator, to about 7.8V as supplied by the battery, to maintain the timing and control circuits.

Diode CR11 isolates and outputs 12V"A" (non battery backed), to supply 11.4V to the displays in the Clock board and the Power fail comparator in the Control board.

Transistor Q3 receives via resistor R15 the trigger input signal, a low pulse originating in the Control board, and amplifies it into a positive pulse applied to the SCR gates through resistor R16.

Power drivers U1E and U1C receive the MAIN and TOPPING/ DISCHARGE status signals from the Control board and output the corresponding drive signals to the MAIN indicator directly and to the TOPPING or DISCHARGE indicators through the Control switch.

Oscillator U2 generates a 1Hz square wave which is applied to the cycle end alarm and indicator circuit and to the Monitor board to produce beeping of the alarm and flashing of the indicators.

Transistor Q1 receives via CR17 the EAL (cycle end) signal generated at the Control board and amplifies it to drive the input of power driver U1B.

When EAL is present, as a high signal, the base of Q1 will be pulled high by resistor R19, thus driving the emitter output high, but the square wave output of oscillator U2, through diode CR19, will produce a corresponding square wave at the emiter output of Q1 and at the output of U1B, thus beeping the alarm (through diode CR15) and flashing the Cycle end/Reset indicator (through CR20).

If the Fault input is pulled low (normally high) by the Monitor board, the beeper is turned on continuously through diode CR16, and the base of Q1 is pulled low, through diode CR18, thus turning off the cycle end indicator circuit.

1.2.6 CONTROL SWITCH.

The Control Switch provides all signals and switching pertinent to the specific operating modes of the Superseder.

RESET: low signal applied to the Control and Monitor boards, to stop and reset the operation of the instrument.

TIE: high signal to the Control board to enable the two rate mode.

SCR GATES: connects SCR gates to the output of the driver transistor in the Power board in the two charge positions. They are otherwise grounded to common.

DISCHARGE ENABLE: high signal applied to the Monitor board in the discharge positions.

FULL DISCHARGE: low signal applied to the Monitor board to enable full discharge.

RESET INDICATOR: turns on (grounds) the Reset indicator in the Reset position.

BATTERY: disconnects the back-up battery in the Reset position

TOPPING/DISCHARGE INDICATOR: routes the indicator driver signal (low) from the Power board to either the Topping or Discharge indicators.

DISCHARGE TRANSISTOR: connects the base of control transistor #1 to the drive ouput in the Control board. Otherwise it is shorted to its emitter.

CELL SELECTOR: drops the excitation to the cell selector to switch from 1.7V/cell in charge to 1.0V/cell in discharge.

SHUNT AMPLIFIER: reverses the polarity of the shunt signals going to the amplifier in the Control board when changing from charge to discharge.

ADJUSTMENTS: the Control Switch circuit board also houses the adjustments for the current selector potentiometers and the Cell selector (see section on Calibration).

1.2.7 DPM CIRCUIT.

The DPM circuit provides all signal routing and attenuation for the operation of the Digital Ammeter and the Digital Voltmeter.

a) AMMETER: the digital ammeter is a 3-1/2 digit DPM with a full scale of 199.9 mVDC. It is connected directly to a shunt with an output of 1mv/A, thus reading directly in Amperes (199.9A).

b) VOLTMETER: the digital voltmeter is a 3-1/2 digit DPM with a full scale of 1.999 VDC. It is connected to the battery under test or to the external jacks via the DPM selector switch. The switch selects also the 1M/110K voltage divider for a full scale of 19.99 V or switches an additional attenuator (2K/10K) for a full scale of 199.9 V.

SEC 2 - VERIFICATION OF PERFORMANCE

The Superseder II has been designed, manufactured and tested to give thousands of hours of trouble free operation, but if you find that your unit is not performing properly (or as expected), please refer first to the operating instructions for re-assurance that proper procedures are being followed.

If it is determined then, that your Superseder II is malfunctioning, please refer to the verification of performance, calibration and troubleshooting sections which will show you how to use the various built-in test features to determine or approximate the nature of the problem.

NOTE: In the following tests make no connection to a battery unless specifically indicated. Always start from reset and always reset at the conclusion of a test.
Refer to the troubleshooting section in case any deviations are observed.

2.1.1 VISUAL VERIFICATION.

Turn power on. Reset/cycle end (green) light must be on and the digital panel meters and elapsed time display must read zero (colon must be off).

2.1.2 TIMER VERIFICATION.

Set main and topping charge current selectors to zero.
Set both time selectors to zero. Set the switch in the timer board to the test (center) position.
NOTE: current and voltage readings must remain at zero during the following tests.

Start the unit by depressing the two rate charge selector. Unit will go immediately into cycle end. Reset.

Set the total time to 01 and start. Unit will start in main charge and immediately transfer to topping, going into cycle end after one second. Reset.
Set the main time to 1, total time to 02 and start.
Unit will start in the main mode, transfer to topping after one second and go into cycle end after two seconds. Reset.

Repeat the above tests, each time advancing the main and total time selectors as follows: 2/04, 4/08, 8/09, 9/10, 9/20, 9/40 and 9/60.

2.1.3 BATTERY OVERTEMP CUT-OFF.

Set current selectors to zero.

Set the timer speed switch in the normal (right) position.

Set time selectors to 1/01 and cell selector to 20.

Connect the battery cable to the unit but make no battery or temp-plate connections. The red overtemp light will be on.

Connect one 16.5 K-OHM (1%) resistor between pins D and B and one each 50 K-OHM (1%) resistors between pins D and C, D and E, and D and H. The red light will turn off and an audible alarm will be heard.

Start in either of the charge modes. Unit will start and immediately go into overtemp fault (red light flashing and alarm on). Reset.

Repeat the previous test by rotating the 16.5 K-OHM resistor in all four positions.

Repeat the first test using four 18 K-OHM (1%) resistors. Unit must not show overtemp fault.

2.1.4 VOLTAGE FAULT TEST.

Remove battery cable.

Set current selectors (both) to 010. Set time selectors to 1/01. Set cell selector to 20.

Start in either of the charge modes. Unit will start and the output voltage will slowly rise. Unit will stop, indicating a voltage fault. Reset.

2.1.5 REVERSE POLARITY TEST.

Connect the battery cable, with the single cell adaptor, to one cell with the polarity reversed. Unit will immediately show a fault through the alarm and the voltage fault light.

2.1.6 OVERVOLTAGE CUT-OFF.

Set current selectors to zero and time selectors to 1/01.

Set cell selector to 20.

Connect the battery cable to an adjustable voltage source (low current power supply), set to approximately 30 VOLTS and start the unit in either charge mode.

Slowly increase the voltage. Unit will stop and indicate a voltage fault at 34V +- .5V. Reset.

2.1.7 DISCHARGE VOLTAGE CUT-OFF.

Set current selectors to zero and time selectors to 1/01. Set cell selector to 20.
Connect the battery cable to a voltage source (low current power supply), set to approximately 24V and start the unit in the auto discharge mode (blue).
Slowly decrease the voltage. Unit will go into cycle end at 20V +- .3V. Reset.

2.1.8 FULL DISCHARGE.

Set current selectors to zero. Set time selectors to 1/01. Set cell selector to 20.
Start the unit in the full discharge mode (red). Unit will run. Increase the discharge current selector to any value above 1 AMP (010). Unit will continue to run.
Switch to auto discharge. Unit will go to cycle end.
Reset.

2.1.9 CURRENT TRACKING.

Connect cable to battery. Set time selectors to 1/01 and cell selector consistent with the battery.
Set the main charge current selector to 25 AMPS (250) and the topping charge to 1 AMP (010).
Start the unit in the two rate mode. Current will rise to 25.0A +- .35A.
Switch to the single rate mode. Current will drop to 1.0A +- .2A. Reset.
Repeat this test for other high and low settings.
Repeat also for the discharge mode.
NOTE: In discharge, the readings may be lower by .1A to .2A.

2.1.10 CURRENT FAULT TEST.

Connect cable to battery. Set time selectors to 1/01 and cell selector consistent with battery.
Set the main charge current to zero and the topping current selector to 2A (020).
Start the unit in the topping mode (yellow button).
Adjust the low current calibrate trimpot in the Control board until the current approaches 3A. Slowly increase it until a current fault is achieved. It will occur at 3A +-.2A
Reset and return the trimpot (down 5-10 turns) to about its original setting before the next test.
Start the unit in the topping mode. Adjust the low current calib-ate trimpot until it approaches 1A. Slowly decrease the current until a current fault is obtained. It will occur at 1A +- .2A.
Reset and return the low current calibrate to its proper calibration.

SEC 3 - CALIBRATION

NOTE: The Superseder II must be verified/calibrated at least once every 12 months, or earlier if deviation from performance is observed.

Perform adjustments only when changing parts and components that require recalibration or when the procedure for verification of performance indicates that the unit is essentially functioning but it is out of adjustment.

3.1 DIGITAL PANEL METERS.

CAUTION! 115VAC is present on the DPM circuit board.
Digital panel meters are adjusted by means of a multiturn trimming potentiometer (trimpot) located in the right hand corner of the meter, which is exposed by the removal of the front bezel/red filter window.

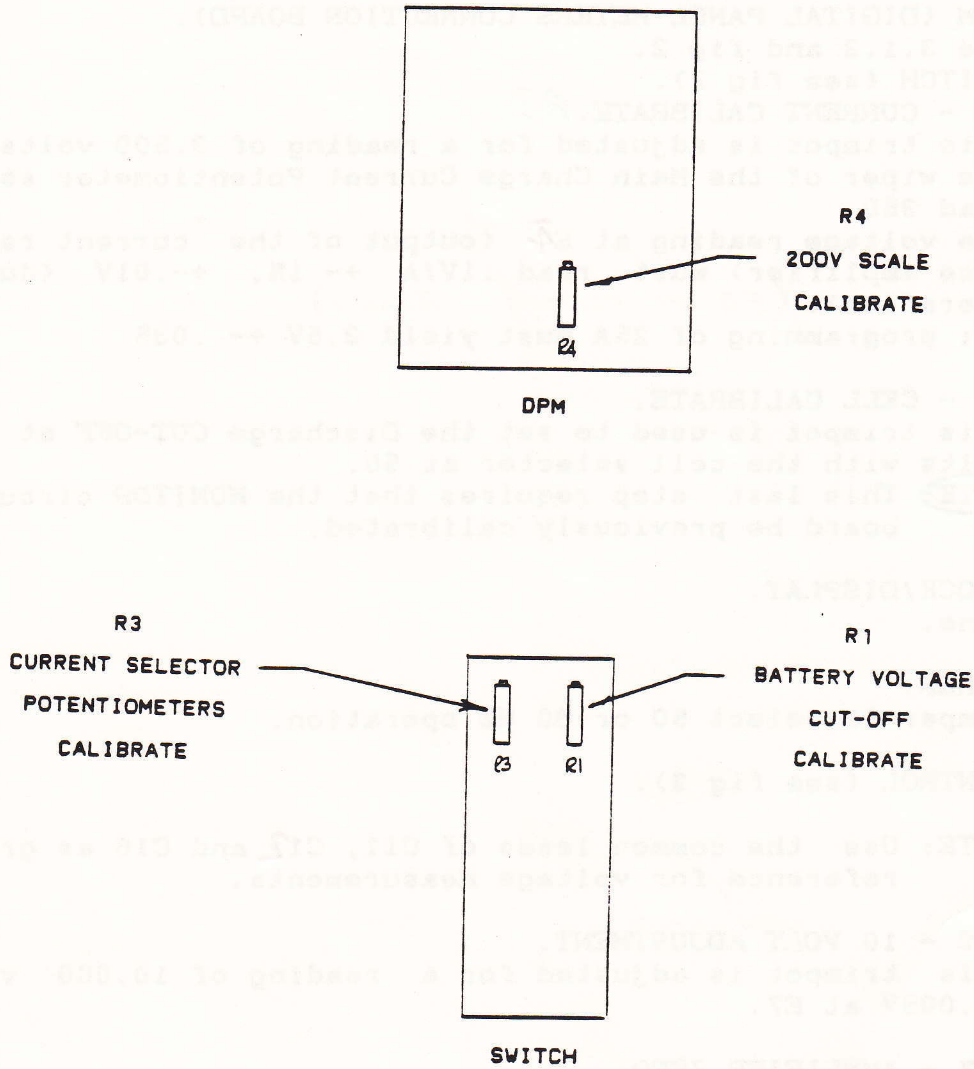
3.1.1 "CURRENT" METER.

This meter has a full scale of 199.9 millivolts to read a 50 AMP shunt with an output of one millivolt per AMP.
Verify and calibrate using a low voltage source of 50 to 100 millivolts (battery or power supply and suitable attenuator) or, by measuring the voltage at the shunt with a digital voltmeter in the .2A (200mA) scale.
Also, check against an external ammeter having an accuracy of .25% or better.

3.1.2 "VOLTAGE" METER.

This meter has a full scale of 1.999 volts, but an attenuator on the DPM board converts it to a full scale of 19.99 or 199.9 volts, as selected by the DPM selector switch.
Calibrate (meter trimpot) using a voltage source between 10 and 20 volts in the "EXTERNAL 20V" position.
Calibration of the 200V scale is acomplished by adjusting the trimpot located on the DPM circuit board. Calibrate by using a source between 50 and 100V with the DPM Selector in the "EXTERNAL 200V" position.

FIG 2 - DPM AND SWITCH CIRCUIT BOARD ADJUSTMENTS



3.2 CIRCUIT BOARD ADJUSTMENTS AND CALIBRATION.

WARNING! The ground of the electronics circuitry floats on the battery voltage. Make no connections between the electronics ground and the battery or chassis ground.

3.2.1 DPM (DIGITAL PANEL METERS CONNECTION BOARD).

see 3.1.2 and fig 2.

3.2.2 SWITCH (see fig 2).

R4 - CURRENT CALIBRATE.
This trimpot is adjusted for a reading of 3.500 volts at the wiper of the Main Charge Current Potentiometer set to read 350.
The voltage reading at E4 (output of the current reference amplifier) must read .1V/A +- 1%, +-.01V (during operation).
ie: programming of 25A must yield 2.5V +- .035

R2 - CELL CALIBRATE.
This trimpot is used to set the Discharge CUT-OFF at 50.0 volts with the cell selector at 50.
NOTE: This last step requires that the MONITOR circuit board be previously calibrated.

3.2.3 CLOCK/DISPLAY.

None.

3.2.4 TIMER.

Jumper to select 50 or 60 HZ operation.

3.2.5 CONTROL (see fig 3).

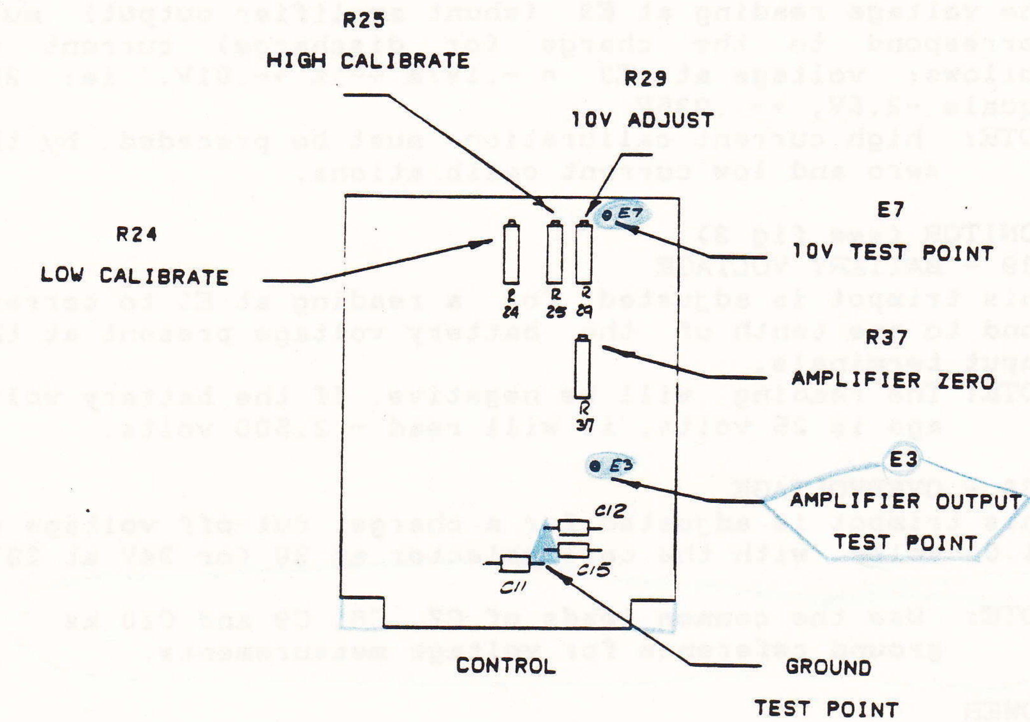
NOTE: Use the common leads of C11, C11 and C16 as ground reference for voltage measurements.

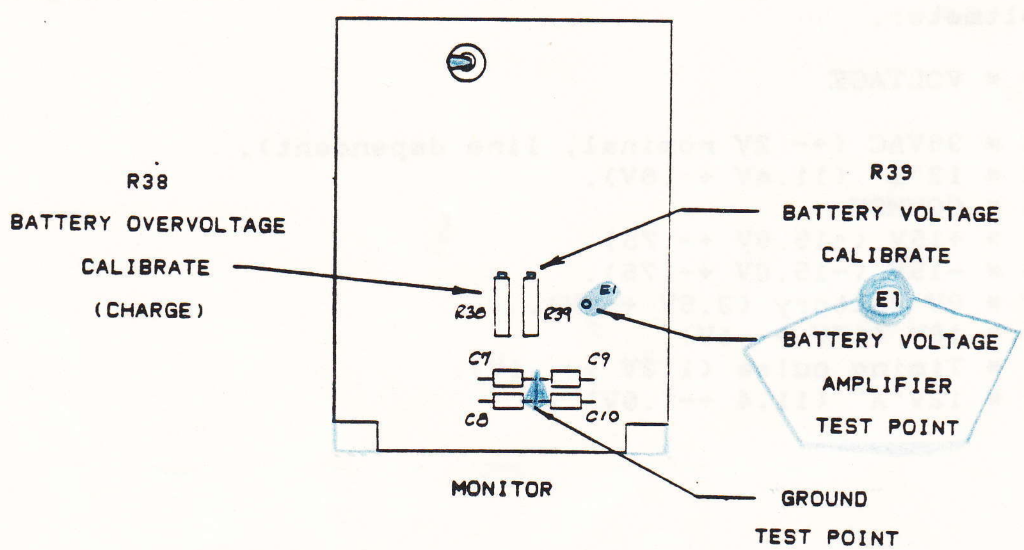
R29 - 10 VOLT ADJUSTMENT.
This trimpot is adjusted for a reading of 10.000 volts +-.005V at E7.

R37 - AMPLIFIER ZERO.
This trimpot is adjusted for a reading of 0.000 volts +-.005V at E3.

R28 - LOW CURRENT CALIBRATE.
This trimpot is adjusted for a reading of 1.0 AMP at the current digital panel meter, with the topping charge current potentiometer set for 1 AMP (010).

FIG 3 - CONTROL AND MONITOR CIRCUIT BOARD ADJUSTMENTS





R25 - HIGH CURRENT CALIBRATE
This trimpot is adjusted for a reading of 35.0 AMPS at the current digital panel meter, with the main current potentiometer set for 35 AMPS (350).
The voltage reading at E3 (shunt amplifier output) must correspond to the charge (or discharge) current as follows: voltage at E3 = -.1V/A +-1% +-.01V. ie: 25A equals -2.5V, +- .035V
NOTE: high current calibration must be preceded by the zero and low current calibrations.

3.2.6 MONITOR (see fig 3).
R39 - BATTERY VOLTAGE
This trimpot is adjusted for a reading at E1 to correspond to one tenth of the battery voltage present at the input terminals.
NOTE: The reading will be negative. If the battery voltage is 25 volts, it will read - 2.500 volts.

R38 - OVERVOLTAGE
This trimpot is adjusted for a charge cut-off voltage of 51.0 volts, with the cell selector at 30 (or 34V at 20).

NOTE: Use the common leads of C7, C8, C9 and C10 as ground reference for voltage measurements.

3.2.7 POWER
There are no adjustments in the Power circuit board, but the following voltages must be measured at the card edge connection fingers (bottom), using a standard digital voltmeter.

PIN #	VOLTAGE
11-13	36VAC (+- 2V nominal, line dependent).
12	12"B" (11.4V +-.6V).
14	COMMON
15	+15V (+15.0V +-.75).
16	-15V (-15.0V +-.75).
17	9V Battery (3.5V +-1V).
18	18V (17V +- 1V).
21	Timing pulse (1.2V +- .1V).
22	12V"A" (11.4 +- .6V).

SEC 4 - TROUBLESHOOTING AND REPAIRS

4.1 TROUBLESHOOTING.

The following are hints and directions to help you locate the most probable causes of deviation of performance as established in the procedures of section 3.

4.1.1 UNIT CHARGES BUT DOES NOT DISCHARGE.
Open discharge current limiter. Signal to base of control transistor #1 interrupted.

4.1.2 UNIT CHARGES PROPERLY ONE BATTERY BUT CANNOT CHARGE TWO BATTERIES AT HIGH RATES.
Low line voltage.

4.1.3 UNIT GOES INTO VOLTAGE FAULT IMMEDIATELY OR SHORTLY AFTER STARTING UP (charge mode).
Open link or one or more cells developing a high voltage. Check that the number of cells selected agrees with the battery.

4.1.4 UNIT DISCHARGES BUT WILL NOT CHARGE.
Defective Power or Control circuit boards. Signal to SCR gates interrupted.

4.1.5 THE UNIT CHARGES LOW CURRENT (BELOW 10 AMPS) PROPERLY BUT HUMS NOTICEABLY AT HIGHER CURRENTS.
One of the SCR's is inoperative. Measure the current at the red output lead of each SCR with a clamp-on ammeter capable of reading pulsating DC, or measure as follows: Disconnect the gate of one of the SCR's (any one), and repeat the test. Having disconnected the gate of the defective device will have no effect. Disconnecting the gate of the good SCR will result in no current flow.

4.1.6 UNIT STARTS IN THE DISCHARGE MODE BUT THERE IS NO CURRENT FLOW. CURRENT FAULT FOLLOWS.
Open discharge current limiter, or faulty connection to the control transistors, or defective control transistors.

4.1.7 UNIT STARTS IN THE DISCHARGE MODE BUT GOES INTO CYCLE END IMMEDIATELY.
Battery not properly connected. Open link. Open cable. Number of cells selected not consistent with the battery.

4.1.8 THE DISCHARGE CURRENT LIMITER OPENS THE MOMENT A BATTERY IS CONNECTED TO THE CHARGER.
Shorted discharge transistors(s).

4.1.9 BURNED RESISTOR(S) IN THE DISCHARGE HEATSINK(S).
Transistor(s) shorted. Often due to wrong discharge fuse.

4.1.10 UNIT WILL NOT CHARGE OR DISCHARGE. NO CURRENT FAULT.
Faulty current selector potentiometer(s). 10V not reaching the Control Switch circuit board. Wiring

interruption between the Control Switch circuit board and the potentiometers. Faulty Control circuit board.

4.1.11 CYCLE END INDICATOR AND TIMER DISPLAY DO NOT TURN ON.
Open fuse to electronics card rack or problems with the Power circuit board or the transformer feeding it.

4.1.12 DIGITAL VOLTMETER REGISTERS A VOLTAGE (36 VOLTS APPROXIMATELY) WITH THE UNIT IN RESET AND NO BATTERY CONNECTED.
One or both SCR'S shorted. Do not connect a battery under this condition!!!
To test, disconnect one of the SCR's, both output lead (red) and the gate lead (blu/gry) and measure accross with an ohmmeter.

4.1.13 CURRENT TRACKING IS OFF BY A SMALL CONSTANT AMOUNT.
Amplifier zero or low current calibrate out of adjustment (CONTROL board).

4.1.14 CURRENT TRACKING IS OFF BY A SMALL AMOUNT WHICH INCREASES AS THE PROGRAMED VALUE IS INCREASED.
High current calibrate out of adjustment (CONTROL board).

4.1.15 THE CLOCK RUNS 20% FASTER (OR SLOWER).
Incorrect line frequency selection on the TIMER circuit board.

4.1.16 THE UNIT STARTS BUT EXHIBITS CURRENT FAULT AFTER SOME TIME (from a few seconds to a few minutes).
a) Current tracking is off, exceeding 1 AMP: Verify Control board calibration. See 3.2.5 and 3.2.2.
b) Current tracking is proper: Verify that the shunt amplifier in the Control board reads properly. See 3.2.5 and 3.2.2.

4.1.17 FAULT LIGHT(S) ON AND NO AUDIBLE ALARM. UNIT RUNS NORMALLY.
a) Switch in the Monitor board is set in the test position.
b) If the switch is in the correct position (run), turn power off and back on to clear the condition and resume operation without resetting.
c) Defective switch.

4.1.18 DIGITAL METERS DO NOT TURN ON.
Open fuse to digital panel meters.

4.2 FINDING A SHORTED DISCHARGE TRANSISTOR.

Since all discharge transistors are wired in parallel, a single shorted transistor will short the entire bank. It is necessary then, to test each transistor individually in order to find the defective one.

The procedure that follows will allow the finding of the shorted transistor without requiring removal and testing of each device individually.

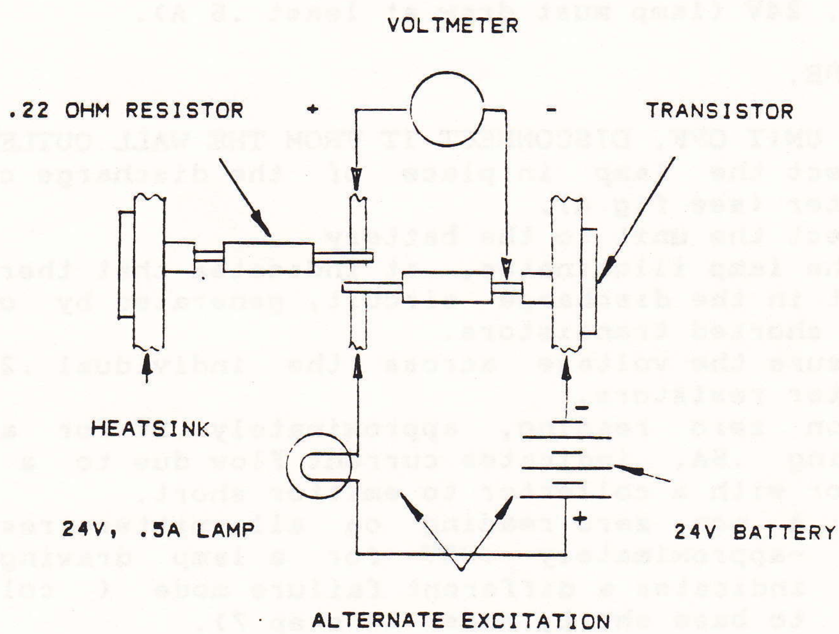
4.2.1 EQUIPMENT REQUIRED. (see fig 4)

1) Voltmeter (digital prefered).
2) Battery, 24V.
3) Lamp, 24V (lamp must draw at least .5 A).

4.2.2 PROCEDURE.

1) TURN UNIT OFF, DISCONNECT IT FROM THE WALL OUTLET.
2) Connect the lamp in place of the discharge current limiter (see fig 4).
3) Connect the unit to the battery.
4) If the lamp illuminates, it indicates that there is a short in the discharge circuit, generated by one or more shorted transistors.
5) Measure the voltage across the individual .22 OHM emitter resistors.
   A non zero reading, approximately .1V for a lamp drawing .5A, indicates current flow due to a transistor with a collector to emitter short.
   NOTE: A non zero reading on all emitter resistors -approximately .02V for a lamp drawing .5A- indicates a different failure mode (collector to base short; refer to step 7).
6) Remove any shorted transistors and repeat steps 4 and 5 until a no short reading is obtained. Replace defective devices only with types MJ15023, MJ15004, MJ15002 or 2N6031.
7) If all transistors appear to be shorted (ALL emitter resistors reading a voltage), then, one or more have failed with a collector to base short, causing the remainder of the transistors to turn on. It will then be necessary to check each transistor individually.
   This can be greatly facilitated by searching for a zero reading. This will indicate the shorted device.
8) When replacing transistors, add heat sinking compound and make sure that the base and emitter pins engage properly in the socket contacts. Torque the screws properly to insure a good thermal transfer.
   NOTE: If replacing any of the control transistors (Q1 and Q2), note that they are mounted with a mica insulator.

FIG 4 - MEASURING FOR SHORTED TRANSISTORS



SECTION 5 - INSTALLATION

5.1 BENCH SPACE.

The Superseder II system occupies 19" x 17" (48.3 cm x 43.2 cm) of table top space for the charger and 10" x 25" (25 cm X 63.5 cm) for the temp-plate.
Allow also at least 6" (15.2 cm) of separation from the wall and adjacent equipment, in order to maintain proper air flow (VITAL!).

NOTE: Operation in dusty or otherwise "dirty" air environments will severely reduce the cooling capacity of the fans and lead to premature failure.

5.2 LINE VOLTAGE.

Connect the unit to a wall receptacle NEMA 6-30R, 230V (or 208V) with a 30 AMP capacity.

NOTE: Operation of this unit with a "soft" line or with a line voltage 10% above or below the nominal 208/230 VAC will result in erratic operation and may also lead to equipment damage if large voltage surges occur.

5.3 CHANGING LINE VOLTAGE.

The Superseder II is normally wired for 230V operation. The following directions are for changes to 208V or 115V. (Refer to figures 5 and 6)

5.3.1 208VAC operation:

1) Shift left red jumper from position 3 to position 2.
2) Shift white lead (from the breaker) from position 6 to position 5.
3) Shift right red jumper from position 12 to position 11.
4) Shift white lead (from the breaker) from position 15 to position 14.

NOTE: Line current will increase by about 10%.

5.3.2 115VAC operation:

1) Remove red jumpers (2).
2) Instal first black jumper from position 1 to position 4
3) Install first white jumper from position 4 to position 6
4) Install second black jumper from position 10 to position 13.

5) Install second white jumper from position 12 to position 15.
6) Remove the 230V 30A line cord.
7) Install a 115V 20A line cord.

NOTE: Line current will double. Limit charging current to 20A.

FIG 5 - POWER WIRING, 208/230V

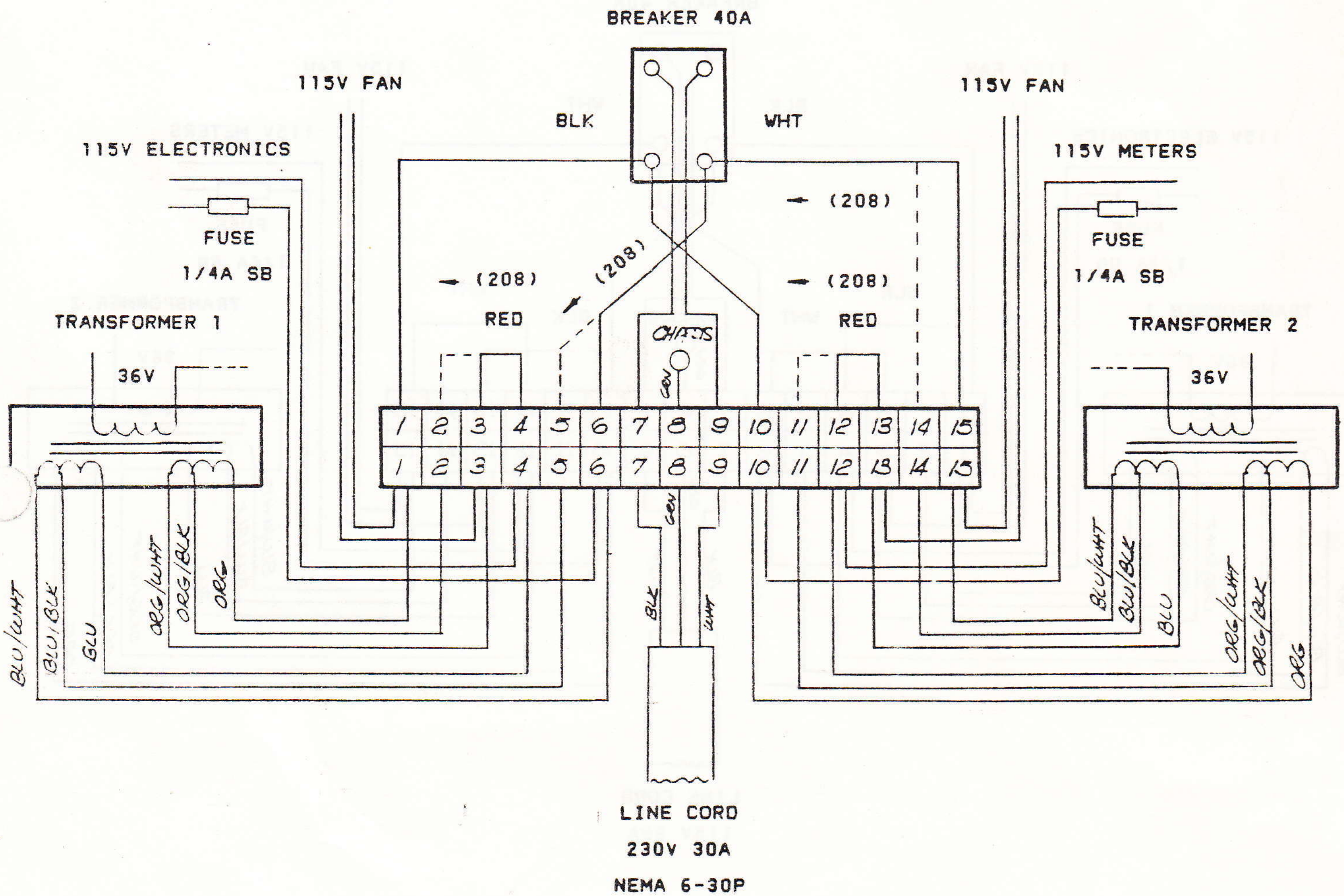


FIG 6 - POWER WIRING, 115V