DPAC-S FIELD TROUBLESHOOTING GUIDE

April 3, 1980
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GENERAL DESCRIPTION

The DPAC-S is an SCR or thyristor Power Controller utilizing the zero crossover firing method. The single phase DPAC-S (DPAC-1S) uses only one set of back-to-back SCR'S. The three phase DPAC-S (DPAC-3S) utilizes the master slave technique for three phase power control. It incorporates two sets of back-to-back SCR'S to control the power in a three phase delta or ungrounded Y-Load, L1 to T1 is the master or controlled section on a single phase, L2 to T2 is a direct connection and has no control and L3 to T3 is the slave section on a three phase DPAC-S.

Troubleshooting the DPAC-S in the Field should be limited to checkout of fuses, SCR’S or monor calibration.

INDICATIONS OF A MALFUNCTION

A malfunction is present if:
1. The output is full on and not controllable.
2. No output is obtained under any input condition.
3. Output is not appropriately proportional to the command signal.
4. Output is erratic or inconsistent.
5. The output is unbalanced on a three phase unit. This is usually due to the wrong phase rotation on L1, L2, and L3 connections. Correct by reversing any two leads at the L terminals.
6. The output proportions on and off but has no control by the command signal or room thermostat.

TEST EQUIPMENT

1. VOM (Volt ohm milliammeter)
2. Clamp-on ammeter
3. Half wave detector (can be easily made, see Figure 5).

SYSTEM TROUBLESHOOTING

NOTE: Use extreme caution when power is on, the internal heat sinks, fuses and power terminals are electrically NOT!

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>PROBABLE CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Output</td>
<td>No power input</td>
<td>Check for proper voltages on L1 to L2, L2 to L3, and L1 to L3.</td>
</tr>
<tr>
<td>No Output</td>
<td>Blown Fuse</td>
<td>Check Fuses</td>
</tr>
<tr>
<td>No Output</td>
<td>Blown Foil Fuse</td>
<td>See-Bench Troubleshooting</td>
</tr>
<tr>
<td>No Output</td>
<td>Improper Command Signal</td>
<td>Check command signal for proper control input.</td>
</tr>
</tbody>
</table>
(System Troubleshooting Cont'd)

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>PROBABLE CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Output</td>
<td>Open Load Contactor</td>
<td>Check Load Contactor</td>
</tr>
<tr>
<td>No Output</td>
<td>Open Heaters</td>
<td>Check Heaters</td>
</tr>
<tr>
<td>No Output</td>
<td>Defective Part on PC Board</td>
<td>See Bench Troubleshooting Section.</td>
</tr>
<tr>
<td>Partial Output or Partial Heat</td>
<td>Improper or Low Command Signal.</td>
<td>Check for Proper or Full Command Signal from Temperature Controller or Room Thermostat.</td>
</tr>
<tr>
<td>Partial Output or Partial Heat</td>
<td>Phase Sequence Reversal on DPAC-3S Only</td>
<td>Check all Outputs for Proper Balance, if not; Reverse any two Input Leads.</td>
</tr>
<tr>
<td>Partial Output or Partial Heat</td>
<td>Half Wave Operation</td>
<td>Check Output with Half Wave Detector, if Half Waving is Observed, refer to the Bench Troubleshooting Section.</td>
</tr>
<tr>
<td>Uncontrolled full Output</td>
<td>Shorted SCR</td>
<td>See Next Major Heading.</td>
</tr>
</tbody>
</table>

CHECKING SCR'S

Note: Power OFF ONLY!

Testing SCR'S
A shorted SCR will give full uncontrollable line voltage at the T terminals. Turn off Main power and remove L wires and T wires. With the unit disconnected, measure the resistance between terminals L1 and T1 on the DPAC-1S, and also L3 and T3 on the DPAC-3S.

If the resistance is less than 5 ohms, at least one (1) SCR is shorted. A "0" ohm reading will be obtained between L2 and T2. This is normal. Typically, only one (1) SCR will be defective. Since the two (2) SCR'S in each line are connected inverse parrel, one of the SCR'S must be isolated to determine which one is defective. Unplug the gate lead from one of the SCR'S and disconnect the cathode lead from that same SCR. A resistance of greater than 10K ohms between cathode and anode on the disconnected SCR is normal. If the resistance is less than 5 ohms it is defective.

INSTALLING SCR'S

The installation of a new SCR must be done very carefully and must be torqued accurately. The quarter inch SCR'S used in the DPAC-5 series should be torqued between 25 and 30 inch pounds. Not enough torque results in excessive heat build up and too much torque results in a cracked junction inside the SCR.

If an inch pound torque wrench is available the SCR itself can be replaced by removing the wires, removing the old SCR, putting a thin coating of DOW DC4 thermal joint compound or Wakefield thermal joint compound on the base of the SCR, (do not put any on the threads), torque the new SCR between 25 and 30 inch pounds, and reconnect the wires.
CALIBRATION

Calibration is only necessary after changing or replacing a range card or one of the IC's (integrated circuits).

1. Calibration of non-thermistor range cards.
   a. Apply power, adjust input signal for zero power point i.e., zero volts, 4 mills, etc.
   b. Adjust bias potentiometer R20 until DPAC is just full off (not cycling at all).
   c. Slowly increase input command signal until DPAC is just full on. Input signal should be within 2% of the full on input signal.
   d. Turn input command signal down to 50% of input. DPAC should be now cycling on and off approximately 50% on and 50% off.

2. Calibration of thermistor range cards.
   a. Use a decade resistance box connected across the inputs to simulate the thermistor room thermostat.
   b. Set it for the mid-point i.e. 1700 ohms for a 1.7K thermistor or 2200 ohms for a 2.2K thermistor.
   c. Set the bias potentiometer R20 in its mid position.
   d. Apply power and adjust R27 on the range card for approximately 50% on and 50% off. This is an approximate setting and may require quite a bit of adjustment since it is a 22 turn potentiometer.
   e. Slowly increase the resistance of the decade box until the DPAC is just full on. Note the Reading.
   f. Slowly decrease the resistance of the decade box until the DPAC is just full off. Note the Reading.
   g. Re-adjust the normal bias potentiometer R20 slightly and re-check to see that the full off point and full on point are equally centered either side of the 1700 ohm or 2200 ohm 50% power points.
   h. Disconnect the input signal. The fail safe detector should completely shut the DPAC down, allowing no power output. (This only works with the thermistor input).

REPLACEMENT PARTS

1. BOARD ASSEMBLIES
   Master PC BOARD ASSEMBLY (Less power transformer)...08-5050
   Slave PC BOARD ASSEMBLY (Less R24).................08-5051
   Range Card
     0-5VDC or Slide Wire.....08-5052
     0-16VDC..................08-5053
     3-10VDC..................08-5054
     5-7VDC..................08-5055
     5-10VDC..................08-5056
     6-9VDC..................08-5057
     Not Assigned..............08-5058
     0-5MA into 1K ohms........08-5059
     1-5 MA into 1K ohms........08-5060
     2-12MA into 1K ohms........08-5061
     4-20MA into 270 ohms........08-5062
     4-20MA into 500 ohms........08-5063
     1.7K Thermistor...........08-5064
     2.2K Thermistor...........08-5065
(Replacement Parts Cont’d)

2. TRANSFORMERS
   Power Transformer  120V  16-0149
   Power Transformer  208/240V  16-0150
   Power Transformer  277V  16-0151
   Power Transformer  480V  16-0152
   Pulse Transformer  ALL  16-0147
   Slave Transformer  3 Phase  16-0148

3. SCR’S
   
<table>
<thead>
<tr>
<th>Voltage</th>
<th>10A-20A</th>
<th>30A</th>
<th>50A</th>
</tr>
</thead>
<tbody>
<tr>
<td>120V</td>
<td>18-5070</td>
<td>18-5112</td>
<td>18-5062</td>
</tr>
<tr>
<td>208/240V</td>
<td>18-5072</td>
<td>18-5056</td>
<td>18-5066</td>
</tr>
<tr>
<td>277/480V</td>
<td>18-5074</td>
<td>18-5058</td>
<td>18-5076</td>
</tr>
</tbody>
</table>

4. HEAT SINK ASSEMBLIES
   (Including SCR)

<table>
<thead>
<tr>
<th>Voltage</th>
<th>10A-20A</th>
<th>30A</th>
<th>50A</th>
</tr>
</thead>
<tbody>
<tr>
<td>120V</td>
<td>08-5080</td>
<td>08-5083</td>
<td>08-5086</td>
</tr>
<tr>
<td>208/240V</td>
<td>08-5081</td>
<td>08-5084</td>
<td>08-5087</td>
</tr>
<tr>
<td>277/480V</td>
<td>08-5082</td>
<td>08-5085</td>
<td>08-5088</td>
</tr>
</tbody>
</table>

5. FUSES
   (All Voltages)

<table>
<thead>
<tr>
<th>Amps</th>
<th>Gould/Shawmut/P.N.</th>
<th>Loyola/P.N.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>A70P10-4</td>
<td>17-0100</td>
</tr>
<tr>
<td>20</td>
<td>A70P20-4</td>
<td>17-0050</td>
</tr>
<tr>
<td>30</td>
<td>A70P30-4</td>
<td>17-0111</td>
</tr>
<tr>
<td>50</td>
<td>A60X50-4</td>
<td>17-0051</td>
</tr>
</tbody>
</table>

HALF WAVE DETECTOR

T \[\rightarrow \]

R1 \[\rightarrow \]

D1 \[\rightarrow \] D2

L1//L2 \[\rightarrow \]

R1 1K ohm 10w Resistor
D1-D2 500MA 400v
Silicone Diode
L1-L2 7.5w 120v
Nite Light Bulb

Connect "T" leads to output terminals of DPAC. On 3 phase units each phase must be checked.

If both lights light equally, both SCR’S are firing normally.

If only one light is lit, only one SCR is operating.
LEGEND (Refer to Schematic 01-0520)

- Scope or Volt Meter Common
- Scope Probe or Volt Meter Positive.

1. B+ 30VDC + 20% Can be measured with V.O.M.
2. Reg. B+ 6.2 VDC + 10% Can be measured with V.O.M.
3. Timing Output
   (Linerized)
   Timing Period
   _4v
   _2v
   Scope Measurement Only
4. Trigger Point
   Timing Period
   _3.3
   _2.3 Scope Only
5. Bias Setting
   0-6 VDC Depending on Position of R20
6. Gating Output
   6v Load On
   Scope Only
   0v Load Off
    on time
    off time
    total timing
    period
7. Input Signal
  Varies Depending on Input Signal and Range Card Used.
   Can be measured with V.O.M.
8. Zero Crossover Sync
   6 VDC
   Scope only
   -0.5 VDC
   16.66ms
   (one cycle)
   20 ms
   50 Hz

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9. (I.) Gating (Output Only)

10. Time Base Generator

11. Time Base Switch Output
12. Phase Shift

Single phase
(without C 5)

Three phase
(with C 5)

0.6ms delay

2ms delay

Dual Trace
Scope

12.1 A Trace
12.2 B Trace

9. Time Reference for Firing Signal

Single Phase
(without C 5)

Three Phase
(with C 5)

.3ms delay

1.4ms delay
DUMMY LOAD

Three Phase

240v
All bulbs 150w  240v

480v

NOTE: On 10 or 20 Amp DPAC'S bypass fuses while testing on lamp loads.

DUMMY LOAD

Single Phase
T1

L1

T2

1. For 120v use 150w 120v Bulb
2. For 208/240v use 150w 240v Bulb
3. For 277/480v use 2 ea 150w 240v Bulb.

NOTE: On 10 or 20 Amp DPAC'S bypass fuses while testing on lamp loads.