RoMan Manufacturing, Inc.

TESTING THREE PHASE DC POWER SUPPLIES
FOR TRANSFORMER OR DIODE FAILURE
Revision 1: December 10, 1998

A. Prerequisites

1. Only personnel familiar with electrical power systems, transformers and rectifiers will be allowed to service and test DC power supplies.

2. Only personnel familiar with safety and lock out procedures of electrical power systems will be allowed to perform the service and test on DC power supplies.

3. The power system supplying the power supply has been checked for proper line voltage and frequency.

4. The welding control has been checked for proper functioning.

5. Make sure the secondary circuit of the welder is open with out a part clamped in the tooling or by electrodes.

6. Any load testing of the power supply must be done with proper water cooling.

7. The procedure applies to power supplies equipped with hockey puck diodes such as R2060 or R2121 diode assemblies. These diode assemblies fail in shorted condition. For power supplies equipped with SKWD 7000 diodes the procedure applies if the diode fails in the shorted condition. There is however a remote possibility that a diode fails in open conditions.

8. This procedure cannot cover all possible symptoms or reasons for failure thus requiring an analytical approach to determine the problem.

B. Testing the DC Power Supply

1. Figure 1 (page 6) shows a DC Power Supply with a shorted diode in one leg of the rectifier.

2. Figure 2 (page 6) shows a DC Power Supply with a primary to secondary or primary to case fault in the transformer (Primary DELTA connected).

3. Figure 3 (page 7) shows a DC Power Supply with a primary to secondary or primary to case fault in the transformer (Primary WYE connected).

4. Figure 4 (page 7) shows a DC Power Supply with a turn to turn short in the primary or secondary winding of the rectifier transformer.

Note: Figures 1 through 4 are generic diagrams to show the location of the faults discussed in this procedure.

5. Set the DC Power Supply on the lowest voltage tap. Set the control on the lowest heat setting possible and a weld time not exceeding 3 cycles. Initiate the welder with the welding circuit open and without a part in the welder see (A.5). The primary current read out of the control should indicate a negligible current since it only measures the excitation current of the transformers. Repeat this test by gradually increasing to full heat setting. The primary current readout should continue to be negligible through full heat setting (99%). Terminate the test if the current exceeds 10 to 30 amperes depending on the size of the power supply. Excessive current indicates a failed power supply.

6. If the power supply fails the test described in B.5 the following reasons are the probable cause:

    a. A shorted diode or diodes (Figure 1)

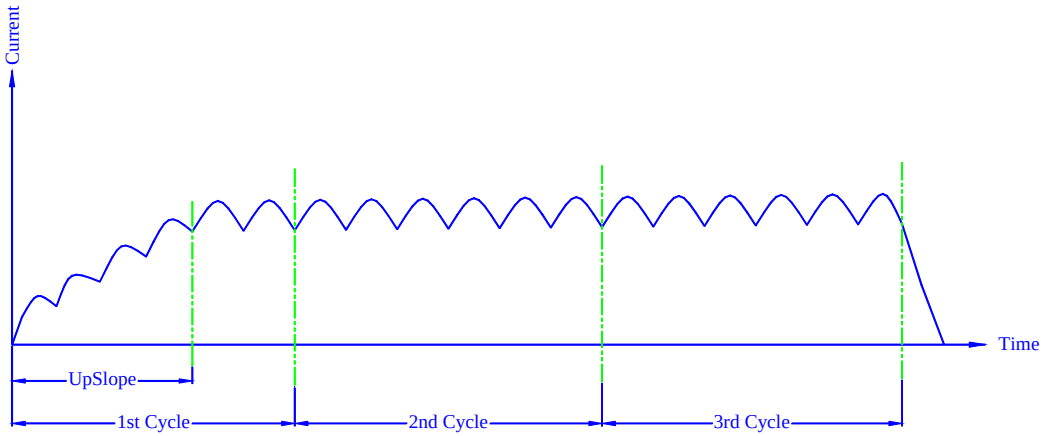
    b. A short in the rectifier/bus system

    c. A transformer fault in form of a primary to secondary or primary to case short (figure 2 & 3). This assumes a properly grounded machine including the secondary circuit, a grounded power system and a WYE connected primary (figure 3). Note: In a DELTA connected primary and the SCR contactors installed in the DELTA, one side of the primary windings is always connected to the line. Thus a short circuit exists without the control being initiated leading to tripping of the over current protection (figure 2).

    d. A transformer fault in the form of a turn to turn short in the primary or secondary winding of the rectifier transformer (figure 4).

    Proceed to section C and D for rectifier bus, diode and transformer testing.

7. If the power supply passes the test in B.5 a load test should be performed to support the results of test B.5. Repeat the first test setting of B.5 (lowest tap, lowest heat setting, 3 cycles weld time) with a coupon firmly clamped in the tooling or by electrodes. Connect the probe of a memory scope across the coupon and initiate the welder. The scope should show a rectified waveform with six pulses per cycle of weldtime. The pulses should be even in size, shape and spacing. If a continuous DC component exists the current will show an upslope during the first few half cycles. A scope isolator might be required to obtain representative waveforms.



8. If the power supply passes the test in B.7 it is in operational condition.

9. If the power supply passes the test in B.5 but fails the test in B.7 proceed as follows. Verify first the prerequisites A.3 and A.4 and then the tests in B.5 before committing the power supply to removal from the welder for service. Proceed to Section C and D for rectifier/bus, diode and transformer testing.

C. Rectifier Bus and Diode Testing

1. The large number of parallel diodes mounted in heatsinks with water cross over connections makes checking for a shorted diode difficult. It is necessary to remove the rectifier output and collection bus system so that each rectifier leg can be tested separately.
   EXCEPTION:
   On smaller three phase DC power supplies, the diodes of the two rectifier legs of one phase, may be mounted to the same + DC bus. In this case follow the same procedure as outlined below, however the testing is done per phase rather than per rectifier leg.

2. Use a multi-meter in “diode check” position or a continuity tester with a 6 volt DC power source between the AC bus and the + DC bus to check the conduction in the “forward” and blocking in the “reverse” direction of the diodes in each rectifier leg. A shorted diode in a rectifier leg will show conduction in the forward and reverse direction. Since there are multiple diodes in parallel in one rectifier leg it is necessary to remove and check each diode assembly in the rectifier leg to find the faulty diode(s). The diodes are forward voltage drop matched in each rectifier leg. The replacement diode(s) must have the same forward voltage drop as the ones remaining in the leg. If this cannot be accomplished a new matched set of diodes must be installed. After changing the diodes the rectifier leg should be checked for proper function.
   If a short in a rectifier leg persists after all diodes have been checked, the short is most likely in the rectifier bus system. A short between the AC bus and

+ DC bus within the rectifier bus system acts like a shorted diode (see Section C.2). A short between the – DC bus and AC bus within the rectifier bus system acts like a shorted secondary turn (see Section D). A short between – DC bus and + DC bus within the rectifier bus system can be tested using an Ohm meter or continuity tester. For this purpose all diodes in the rectifier leg must be removed.

Disassemble and inspect the bus bars for shorts, which will be evident by burned spots on bus bars and insulation.

3. After each rectifier leg has been tested and found operational but before reinstalling the rectifier collection and output bus system, the transformers should be checked.

D. Transformer Testing

1. The insulation resistance between primary and secondary as well as primary to case must be tested. For this test a 500 or 1000 volt DC insulation tester should be used. Disconnect the power supply from the weld control. Remove WYE connection in WYE operated power supplies (figure 3 or 4). In DELTA operated power supplies the primaries should be separate after disconnecting the power supply from the weld control (figure 2). Any component such as primary terminal boards, switches etc. become part of the insulation test unless they are disconnected from the transformer.
   CAUTION. If a rectifier is mounted to the secondary output pads, the "center tap and both AC pads" must be connected together with a wire (#14 AWG Cu. Minimum) to assure that the test voltage cannot be accidentally applied to the diodes.
   A minimum insulation resistance of 10,000,000 Ohms should be measured between primary and secondary as well as primary to case at an ambient temperature not exceeding 30°C. If the insulation resistance is less the integrity of the insulation is questionable which might require repair of the transformer. After the tests, make sure the wire connecting the "center tap and both AC pads" is removed.

2. To test the transformer for a turn to turn short, energize the primary winding of the transformer with a low voltage variable AC power source. (VARIAC, 0 to 120 volt AC rated 10 amperes minimum) slowly increase the primary voltage from zero and monitor the primary current. If the transformer has a turn to turn short, the primary current will rapidly increase as soon as voltage is applied. If the transformer is operational, the primary current will be negligible after the available voltage (ie: 120 volts) is fully applied. The transformer must be repaired if a turn to turn short exists. Note: It is highly unlikely that the secondary of the rectifier develops a turn to turn short. Thus the shorted turn is either in the primary winding or the short is caused by the rectifier bus system.

E. Reassembly

1. After all tests and repairs in section C and D are completed reassemble the output and collection bus system making sure all connections have a good fit up and are tight. Contact surfaces must be cleaned before reassembly.

2. Repeat test D.2 which will verify that there are no shorts in the power supply if the primary current is negligible with full voltage (120 volts) applied.

3. Install the power supply in the welder.

4. Repeat tests B.5 and B.7 after the power supply has been reinstalled. Only after the DC power supply passes tests B.5 and B.7 should it be returned to service.

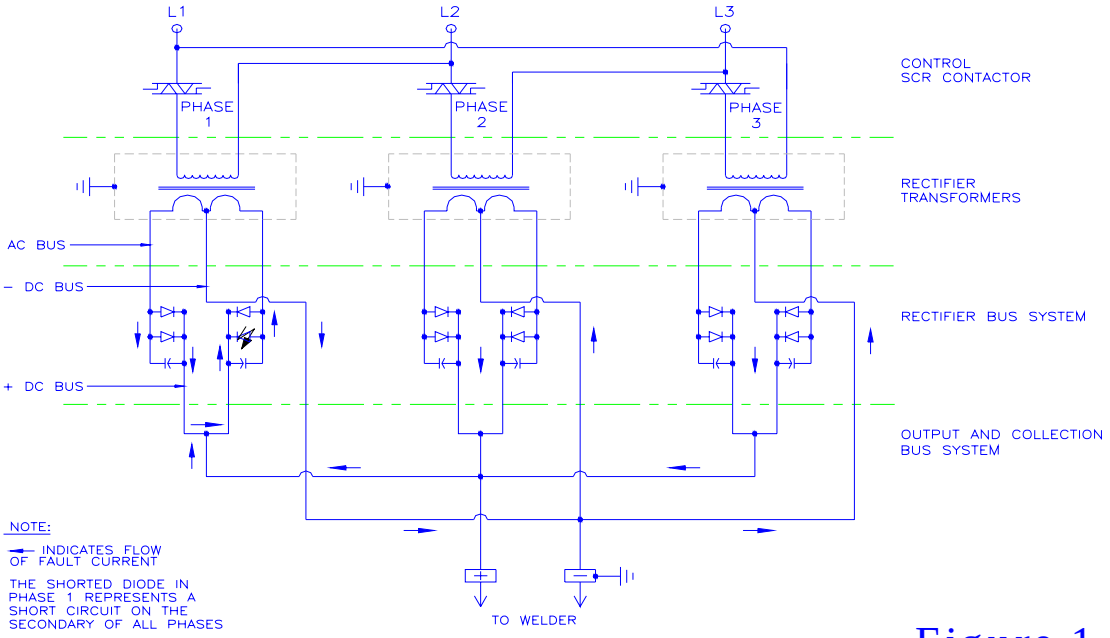


Figure 1

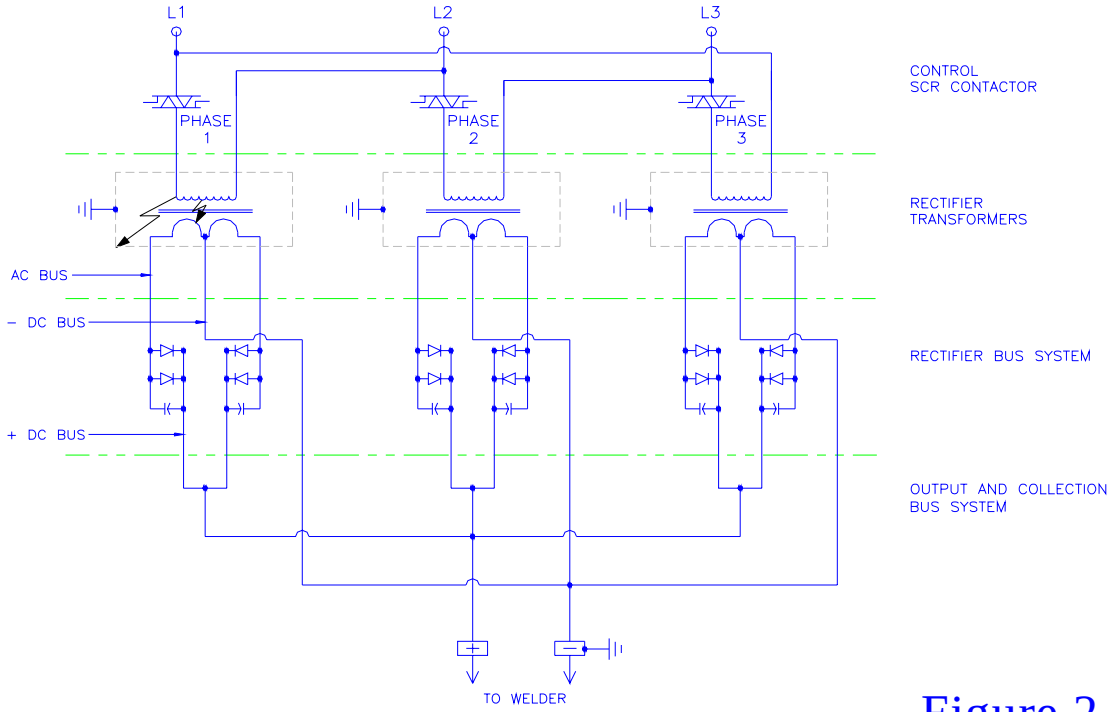


Figure 2

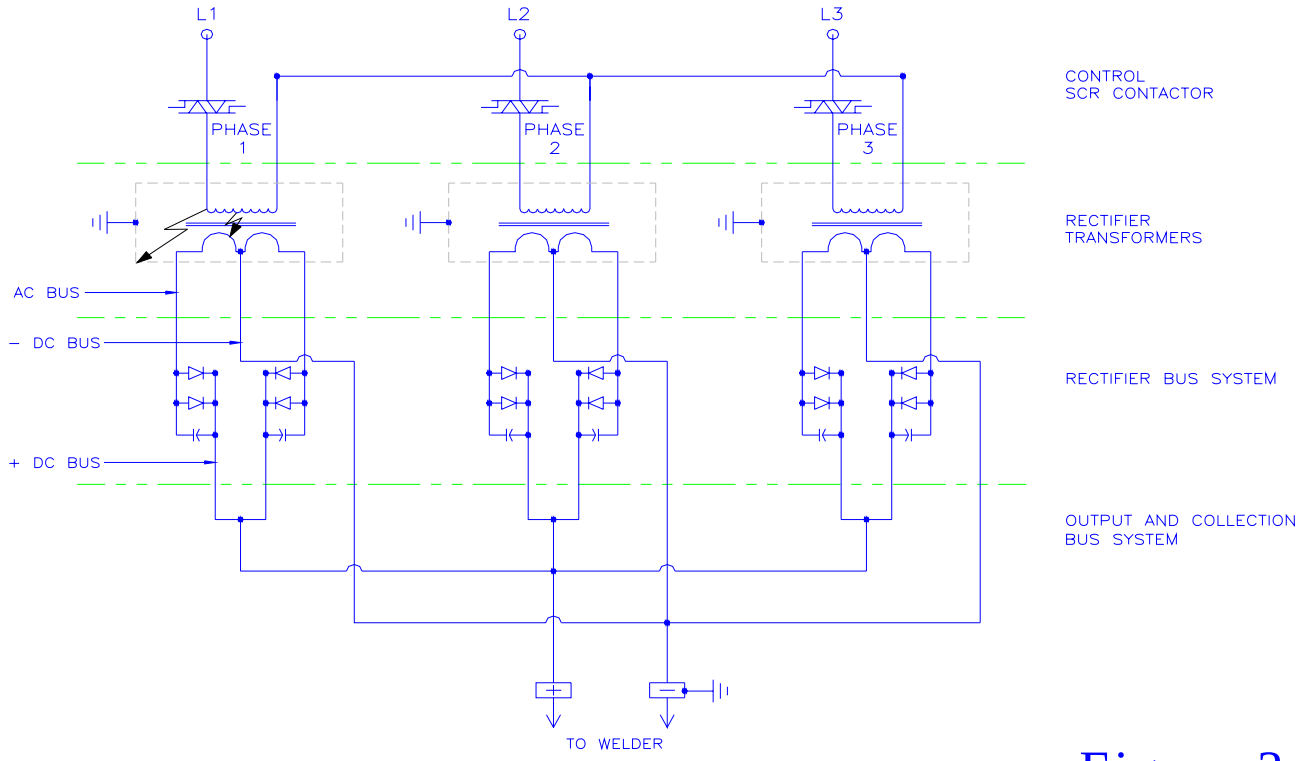


Figure 3

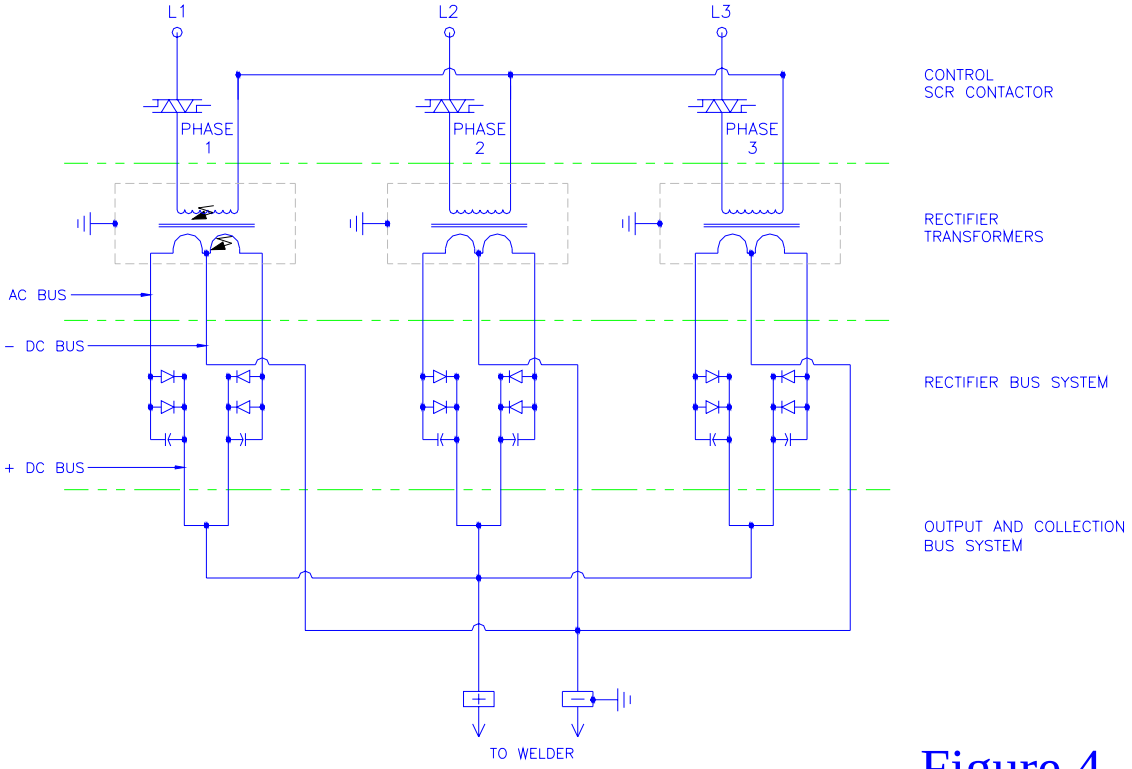


Figure 4