



CONSTANT CURRENT GLO-DISCHARGE POWER SUPPLY MODEL CL-2A

2850 Seventh Street, Berkeley, California 94710 • Telephone: 415-841-5720, TWX: 910-366-7366

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AIRCO Temescal 2850 Seventh Street, Berkeley, California 94710. Telephone 415-841-5720, TWX 910-366-7386

A DIVISION OF AIRCO, INC.

SALES & SERVICE OFFICES

United States:

California, Berkeley 94710
2850 Seventh Street
Telephone: 415-841-5720
TWX: 910-366-7366

California, Mountain View 94043
1901 Old Middlefield Way
Telephone: 415-965-0400

California, South Pasadena 91030
1510 Oxley St., Suite A
Telephone: 213-682-2121

Illinois, Hillside 60162
High Point Plaza
4415 W. Harrison St., Suite 240C
Telephone: 312-449-3200
312-449-3201

Massachusetts, Needham 02192
33 Marsh Road
Telephone: 617-449-4080

Michigan, Oxford 48051
Automotive Coatings
P.O. Box 428
Telephone: 313-628-9731

New Jersey, New Providence 07974
Mountain Ave., Murray Hill
Telephone: 201-464-2400, X248
Night: 201-665-1242
TWX: 710-984-5450

New York, Tarrytown 10591
17-19 North Broadway
Telephone: 914-631-8205

Clearwater, Florida 33515
Building I, Suite 224B
2189 Cleveland St.
Telephone: 813-441-9476

Europe:

Netherlands, Rotterdam-Airport
Datema-House
Vliegvelddweg 30
Telephone: (010) 375266
(010) 375412
TWX: 844-26528

England, Hants
1 Lawnswood Close
Cowplain nr. Portsmouth
Telephone: Waterlooville 4214

France, Versailles 78000
16 Rue du Champ la Garde
Telephone: 1-9524823
Telex 91715 (HUCPROM)

Italy, Milano 20122
G. Gambetti
Via Lamarmora 33
Telephone: 54.66.982/54.66.986

West Germany
Goldaeckerstrasse 1
7321 Echterdingen
Telephone: 0711-791228
Telex: 7255804 (BAUC)

Japan:

Hakuto Company, Ltd.
Foreign Division
P.O. Box 25
Tokyo Central, Japan
Telephone: 03-502-2211
TWX: 781-22912
781-26280

Hakuto Company, Ltd.
San Sei Building
1-13-18 Esaka-cho
Suita-shi, Osaka, Japan
Telephone: 06-385-8621

Australia & New Zealand:

Austral Engineering Supplies Pty. Ltd.
Mary Street
Ermington, N.S.W. 2115
Australia
Telephone: 85-0211
TWX: 790-20179

W A R N I N G

THIS EQUIPMENT CONTAINS POTENTIALS EXCEEDING 5000 VOLTS. ALL POSSIBLE SAFETY PRECAUTIONS MUST BE TAKEN WHILE INSTALLING, OPERATING, AND MAINTAINING THIS EQUIPMENT.

BEFORE PROCEEDING WITH THE OPERATION OF THIS EQUIPMENT, READ CAREFULLY THE INSTRUCTIONS SET FORTH IN THIS MANUAL.

CAREFUL ADHERENCE TO THE INSTRUCTIONS
IN THIS MANUAL MAY SAVE A LIFE

W A R N I N G

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SECTION 1

SPECIFICATIONS

The Airco Temescal Model CL-2A Power Supply is a 2 KVA constant-current glo-discharge power supply. The output current is adjustable from 0 to 400 Ma by either the front panel control or an external 0-10V dc signal. Output voltage capability is 5 KV volts at rated current (400 Ma), rising to approximately 7 KV volts at low currents. Polarity of output may be internally selected to be dc negative, dc positive, or ac; the meters indicate correctly regardless of the output polarity.

1.1 INPUT POWER REQUIREMENTS

208 or 240V ac, single-phase, 50/60 Hz, three-wire, capable of 30 amps.

NOTE: Voltage taps on transformers T1 and T2 primaries are accessible inside unit. See 3.2.1.

1.2 OUTPUT POWER SPECIFICATIONS

- A. Adjustable current-regulated, 0-400 Ma, at output voltage to at least 5000 volts.
- B. Polarity selectable as dc- or dc+ with respect to ground and ac.

1.3 METERING

- A. Current, 0-500 Ma, and voltage 0-5000 volts.
- B. Meters read correctly regardless of output polarity selected.

1.4 REMOTE SIGNAL CAPABILITY

- A. External interlocks for the vacuum system may be

connected between pins A and B of J1 or B and D if remote high voltage control is required.

- B. Contact closure between pins A and B are necessary for local high voltage operation.
- C. Contact closure between pins B and D provides remote high voltage control through the interlock string.
- D. 120V ac appears between pins B and C of J1 when power supply is ready to supply high voltage.
- E. A contact closure appears between terminals E and F to indicate presence to high voltage output.
- F. 0 to +10 volts from pin G to pin I (ground) remotely controls the high voltage current output from 0 to 400 Ma. Input impedance is greater than 1K ohm.
- G. 0 to +10 volts (10K ohm output impedance) appears from terminal H to pin I (ground) to indicate 0-5000 volts at output for automatic pressure control.

DESCRIPTION OF CONTROLS AND INDICATORS

Descriptions of all controls and indicators are given in the following paragraphs.

2.1 FRONT PANEL

All controls and indicators required for routine operation of the CL-2A are located on the front panel.

- CB1 MAIN POWER CIRCUIT BREAKER - This 2-pole circuit breaker applies utility power to the entire power supply. If the input current exceeds 30 amps, the circuit breaker trips. The circuit breaker must then be reset by moving the handle from the extreme OFF position to the ON position before power will be reapplied.
- PB1 HIGH VOLTAGE OFF Pushbutton Switch (PB1) - When the interlock chain (if any is installed by the customer) is complete, 120V ac power from T1 is applied to this indicator through the associated normally closed switch. The 120V ac power is also applied, through the switch, to the normally open HIGH VOLTAGE ON switch (PB2). Thus, if power is applied to the HIGH VOLTAGE ON switch, it is removed by pressing (and thus opening) the HIGH VOLTAGE OFF switch.
- PB2 HIGH VOLTAGE ON - Pressing (and thus closing) this normally open switch applies 120V ac to contactor MC1, which then closes and applies utility power to the high voltage transformer T2 and its associated SCR control elements.
- R3 CURRENT ADJUST CONTROL - Turning this knob in a clockwise direction increases the output current up to the maximum rated output of 400 Ma.
- ME2 VOLTAGE METER - This 5000-volt full-scale deflection, 1 Ma MVMT, meter indicates the output voltage of the supply.
- ME1 CURRENT METER - This 500 Ma full-scale deflection, 1 Ma MVMT, meter indicates the output current of the supply.

L1 POWER ON Light - This indicator light will illuminate when ac power is applied to the supply as admitted through CB1 and F1.

2.2 REAR PANEL

S2 REMOTE/LOCAL Switch - This switch, when in the REMOTE position, allows the output current of the supply to be adjusted from 0 to 400 Ma by an external 0 to +10V signal.

J1 CONTROL CONNECTOR - This 14-pin MS connector (MS-3102-20-27S) provides access to the supply for all interlock and control signal connections.

B1 COOLING FAN - The supply is provided with a grilled fan to maintain a nominal uniform temperature.

F1 FUSE - This 1/2A fuse protects the 120V control circuits.

CABLE CLAMPS - Cable clamps and binding posts are provided to accommodate power, high voltage and ground cables.

SECTION 3

FUNCTIONAL ANALYSIS

The Model CL-2A Power Supply has been designed to provide maximum flexibility of application. The controls and inputs allow for remotely turning on and off the high voltage output, for remotely controlling the output current and for interlocking the high voltage with the vacuum system.

3.1 INPUT POWER CIRCUITS

3.1.1 Preparation For Power Application. T1 (the control power transformer) and T2 (the high voltage transformer) have two primary taps. One is for operation at 208 volts; the other for 220/240-volt operation. One primary lead of each transformer must be connected to the tap matching the utility power to be used. The other primary lead, which is connected to the "common" terminal, should not be disturbed. Access to the primary terminals of T1 and T2 is obtained by removing the top cover of the CL-2A.

CAUTION

ENSURE THAT ALL INPUT POWER IS DISABLED BEFORE REMOVING THIS COVER.

3.1.2 Initial Power Application.

- A. Front panel circuit breaker CB1 applies source power to the power supply. When this switch is closed, ac power is immediately applied to the normally open contacts MC1-1 and MC1-2 of contactor MC1 and the primary of T1 through F1.
- B. 120V ac power, from the secondary of T1, is applied to the fan (B1), to the Silicontrol (A1), to the reference power supply (on A2), and to pins B and C of the control connector (J1).

3.1.2 (cont.)

- C. Any desired external interlocks are to be connected between pins 1 and 2 of J1. These interlocks must provide a contact closure when the interlock is in an operable condition. If more than one interlock is desired, the interlocks should be connected in series, so that all interlocked conditions must be safe before the power supply can be operated.
- D. When all interlocks (in C above) are in an operable condition, the ac power is connected to the HIGH VOLTAGE OFF switch/indicator (PB1) via J1 pins 1 and 2. This power is connected to the normally open contact of the HIGH VOLTAGE ON switch (PB2) through the normally closed contact of the HIGH VOLTAGE OFF switch (PB1). The HIGH VOLTAGE OFF indicator lights, finding a ground path through the coil of MC1.
- E. Pressing the HIGH VOLTAGE ON switch applies power to the coil of MC1. When MC1 is energized, normally open contact MC1-3 closes, providing a seal circuit around the HIGH VOLTAGE ON switch, causing MC1 to remain energized and the HIGH VOLTAGE ON indicator to light. The HIGH VOLTAGE OFF indicator is extinguished when MC1 energizes.
- F. For remote high voltage control, the interlocks are connected between J1 pins B and D, and must include a contact which is closed during the desired high voltage operating time. No connection is made to J1 pin A. Closure of all contacts in this chain results in the lighting of the HIGH VOLTAGE ON indicator, energizing MC1 and providing high voltage at the output. Opening of any contact in this chain extinguishes the HIGH VOLTAGE ON indicator and removes the high voltage output. In this mode, the HIGH VOLTAGE OFF indicator does not light, and both the HIGH VOLTAGE ON and the HIGH VOLTAGE OFF push-buttons are ineffective.
- G. Contacts MC1-1 and MC1-2 when closed (see E or F above) supply source power to the SCR's and the high voltage transformer T2. Contact MC1-4, connected between J1 pins E and F provide a contact closure indicating the presence of high voltage output.

3.2 HIGH VOLTAGE CIRCUIT

The high voltage network consists of high voltage transformer T2, spike suppressor (CR5), high voltage rectifiers CR6-9, output mode jumpers (E1 and E2) and the current sensing resistors (R10 and R11). By means of the mode selecting jumper (E1 and E2 on A2) the polarity of the high voltage output lead may be selected to be dc-, dc+ or ac. The low side of the supply is grounded through the current sense resistors R10 and R11, which provide the current feedback signal to the control network. The high voltage meter (ME2) operates from a bleeder connected directly to the output terminal. This bleeder feeds a full wave rectifier whose output is connected to the meter movement. Output current is sensed across the feedback circuit and fed to the current meter (ME1). ME1 is calibrated with R2 on A2. (See Section 5 for procedure.)

3.3 CURRENT CONTROL CIRCUIT

The control network consists of two SCR's (SCR1 and SCR2), the Silicontrol (A1), which controls them, a zener regulated reference power supply, and the current feedback network.

3.3.1 SCR1 and SCR2. The SCR's act as switches in that when triggered by the Silicontrol they will conduct as long as the current flows through them in the forward direction. When this current flow ceases, the SCR's immediately revert to the blocking state (no current can flow). Since the SCR's are fed by ac power, and the Silicontrol triggers each SCR alternately, once each cycle, each SCR can conduct for at most one-half cycle each time it is triggered.

3.3.2 Silicontrol (A1). The Silicontrol is the primary control element of the CL-2A. It compares the reference signal (0-10V dc from R3 or remote control) with the current feedback signal from R10 and R11. Thus, the Silicontrol and the SCR's regulate the high voltage current output by regulating the primary voltage of T2. The difference between these two signals causes a proportional signal to control the SCR's until reference and feedback current are equal.

3.3.3 Reference Power Supply. This zener regulated power supply takes 120V ac from transformer T1 and provides a regulated dc voltage used as a reference by the Silicontrol. The CURRENT ADJUST potentiometer (R3) provides the Silicontrol with a greater or lesser amount

3.3.3 (cont.)

of this voltage in proportion to its adjustment. In remote control, this reference voltage is supplied from an external source. The Silicontrol reference signal should be 0 - +10 dc (to ground) from either the internal or remote source.

3.3.4 Current Feedback Network. This network takes the signal developed across the current sensing resistors (R10 and R11) and adjusts its polarity, through S1, to be suitable for the Silicontrol. Also included in this network is a meter (ME2) which indicates the current output of the supply. The position of S1 must correspond to the position of the output mode selecting links.

SECTION 4

OPERATING PROCEDURE

4.1 PREPARATION

Ensure that the following items are correct before any application of power to the CL-2A is made.

CAUTION

ENSURE THAT ALL INPUT POWER IS DISABLED BEFORE REMOVING TOP COVER TO CHANGE T1 AND T2 CONNECTIONS.

4.1.1 Input Power. Ensure that the utility power supplied to the CL-2A meets the specifications of 1.1 and that T1 and T2 are connected according to Section 3.1.1.

4.1.2 Output Connection. Ensure that the high voltage output cable is firmly locked into its compression feedthrough, that the shield is properly connected to the ground stud, and that the output ends of the cable and shield are properly connected to the tank high voltage feedthrough and ground stud. Also, ensure that both HIGH VOLTAGE OUTPUT links are set to the desired output polarity and agree with the position of S1. (Ref 4.1.5)

4.1.3 Interlocks. Ensure that any interlocks connected between J1 pins A and B are in an operable configuration. If remote HV start is to be used, the interlocks are connected between pins B and D and must also include a contact which closes only during the desired period of operation of the power supply. No connection is made to pin A of J1 for remote operation.

4.1.4 REMOTE/LOCAL Current Control (S2). If the front panel CURRENT ADJUST control is to be used, ensure that the REMOTE/LOCAL switch is in the LOCAL position. If remote current adjust is to be used, ensure that this switch is in the REMOTE position, and in addition, that a suitable input signal is provided at pin G of J1 according to Section 1.4F.

4.1.5 Output Polarity Switch (S1). This switch, located on P.C. board A2, must be set to match the output polarity as selected by the HIGH VOLTAGE OUTPUT jumpers, E1 and E2, also on A2. (Ref 4.1.2)

4.2 OPERATION

After the specifications of Section 4.1 have been checked and found to be satisfactory, the supply may be operated as follows.

4.2.1 Manual Operation.

- A. Set the front panel CURRENT ADJUST control fully counterclockwise.
- B. Turn on the front panel main switch CB1. The HIGH VOLTAGE OFF indicator and POWER ON light (L1) should immediately light.
- C. Press and release the HIGH VOLTAGE ON switch. It should immediately light, extinguishing the HIGH VOLTAGE OFF indicator.
- D. Rotate the CURRENT ADJUST knob clockwise until the desired current is obtained (Note: The vacuum in the tank must be in the proper glo-discharge range, or no current can be obtained), as indicated on the CURRENT meter.
- E. When the glo-discharge cleaning operation is complete, pressing and releasing the HIGH VOLTAGE OFF switch turns off the high voltage, causing the associated HIGH VOLTAGE OFF indicator to light, and extinguishes the HIGH VOLTAGE ON indicator.

4.2.2 Automatic Operation.

- A. Turn on the front panel main switch CB1. POWER ON indicator (L1) will light.
- B. When the system, of which the CL-2A is part, supplies a contact closure between terminals B and D of J1 the HIGH VOLTAGE ON indicator will light and the output

current will rise to whatever value has been selected by the front panel CURRENT ADJUST control (LOCAL mode) or the remote input signal (REMOTE mode) at pin 6. (Ref 3.3.3)

- C. When the system removes contact closure between pins 8 and 9 of J1, the high voltage output will be turned off and the HIGH VOLTAGE ON indicator will be extinguished.

MAINTENANCE AND TROUBLESHOOTING

5.1 PREVENTIVE MAINTENANCE

Preventive maintenance on the power supply requires only that the components be kept clean and free of foreign material. If visual inspection discloses any accumulation of dust, grease or any foreign substance, it should be removed with a residueless solvent and a clean lint-free cloth. Particular attention should be given to all high voltage components and the fan, blades and filter.

5.2 CURRENT METER (M1) ADJUSTMENT

The output current meter is carefully adjusted at the factory and should need recalibration only after circuit component changes. In the event that this adjustment must be made in the field, a ten volt power supply, capable of .6 amps, is the only instrument required. With the ac line cord (W1) disconnected:

- A. Set the MODE SELECT switch (S1 on A2) to the (-) position.
- B. Connect the (+) lead of the ten volt power supply to E2 on A2 and the (-) lead to chassis ground.
- C. Adjust R2, located next to S1 on A2, for a reading of 500 ma on M1.
- D. Remove both power supply leads.

This completes the current meter adjustment and the only calibration possible on the CL-2A.

5.3 OUTPUT POLARITY CHANGES

The CL-2A Power Supply is capable of delivering three modes of output power. The high voltage may be positive with respect to ground, negative with respect to ground or ac. (WARNING: DO NOT FLOAT SUPPLY) The output mode may be changed easily by selecting the desired

5.3 (cont.)

polarity on S1 (located on A2) and reconnecting E1 and E2 (also located on A2) in the following manner.

- A. AC OUTPUT - E1 connects to BP10, E2 connects to BP7.
- B. POSITIVE OUTPUT - E1 connects to BP9, E2 connects to BP6.
- C. NEGATIVE OUTPUT - E1 connects to BP8, E2 connects to BP5.

5.4 INPUT POWER CHANGES

The CL-2A will operate from a line supply of either 208V or 220V, 50/60 Hz. However, if the supply is to be changed from one input voltage to another, the power leads must be changed from one primary tap to the other on T1 and T2. These wires are readily accessible when the top cover is removed from the supply.

5.5 TROUBLESHOOTING

<u>SYMPTOM</u>	<u>POSSIBLE CAUSE</u>
1. Cooling fan, B1, off - no lights on BP1 and BP2 - no meter deflections.	F1 open - CB1 open - line power not connected to TS1.
2. B1 on - no lights - no meter deflection.	J1 pin A and pin B not connected with interlocks or a jumper - HV ON light burned out.
3. HV ON indicator lights and meters deflect only when PB2 is held in.	MC1 defective.
4. Output voltage meter (ME2) reads over 500 ma - Output current meter (ME1) reads 0 - Current control potentiometer ineffective.	No load on power supply - S2 in wrong position - R13, CR19, CR20 defective - A1 defective.

5. ME2 reads 480 ma - ME1 reads 0 volts.

E1 and E2 in wrong place - supply output shorted - inadequate vacuum in chamber - current feedback components R11, R12, CR13, CR21 and CR22, S1 defective - A1 defective.

6. MC1 energized - ME1 and ME2 read 0.

E1 or E2 open - CR5-CR9 or T2 defective - A1 inoperative.

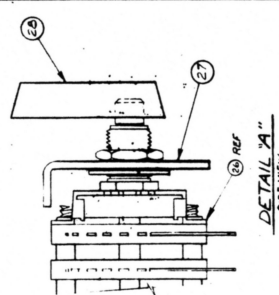
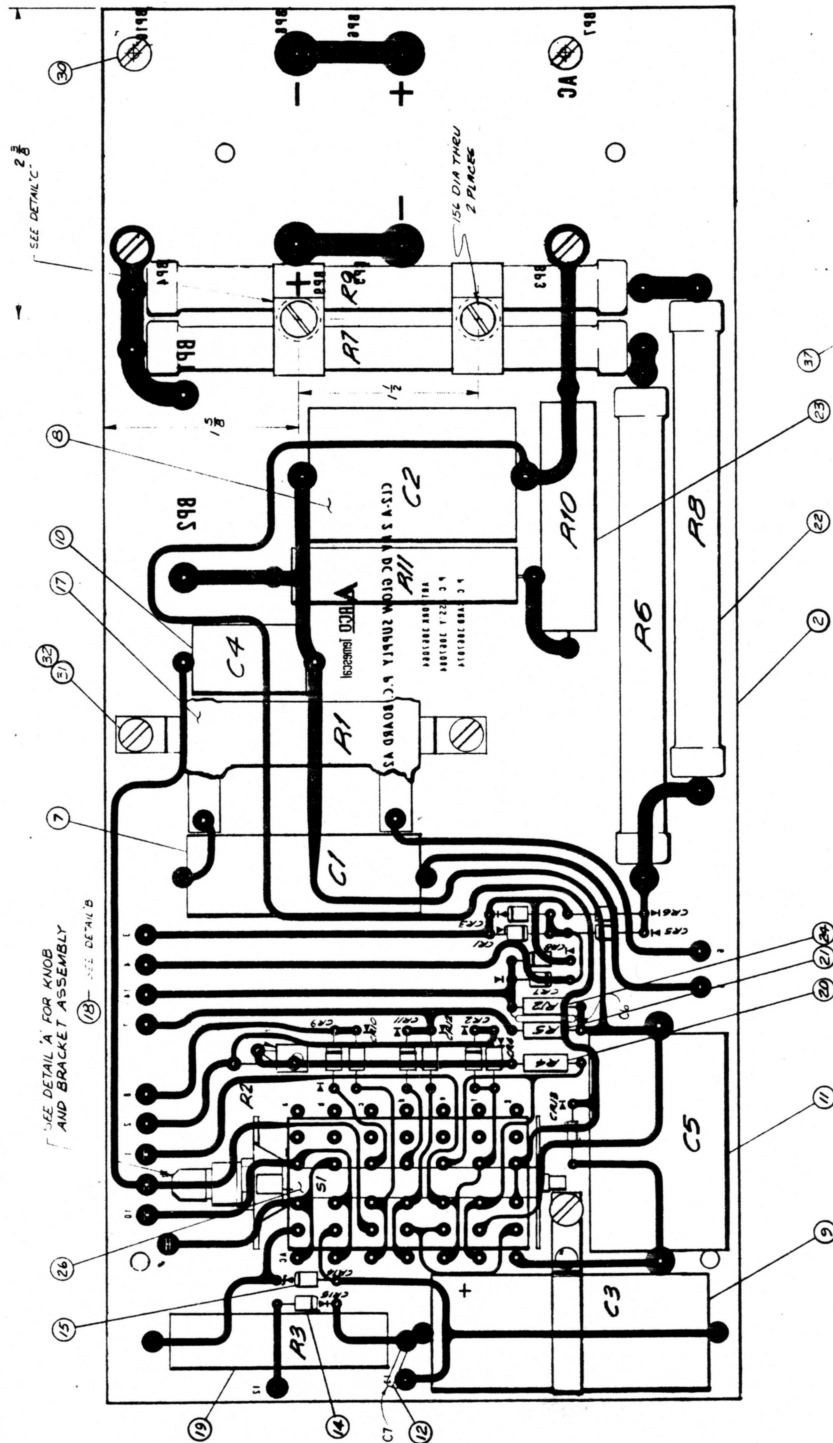
SECTION 6

CL-2A SPARE PARTS LIST

It is recommended that the spare parts listed below be kept on hand to reduce down time of the system in the event that excessive loading or aging causes failure.

<u>Item</u>	<u>Description</u>	<u>Qty.</u>
Fuses	3AG, 1/2A	1 box
* Pushbutton	Molex, N.C. #1175-2, white	1
* Pushbutton	Molex, N.O. #1175-2, red	1
Rectifiers	Motorola #SDA-10176	2
Diodes	Diodes, Inc. #10D8	6
Rectifier	Silicon controlled, Westinghouse #219H	1
Transistor	Sprague 2N2959	1
Zener Diode	1N4740A	1

* When replacing a pushbutton, the original engraved lens can be used again.



ASSEMBLY NOTES

0 PATCH CABLE, MAKE FROM GTO-15 CABLE, AND INSTALL CRIMP CLOSED TERMINAL ON ONE END, AND CRIMP OPEN TERMINAL ON OTHER, AS SHOWN.

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