OPERATING MANUAL

FOR A

DµP(R) SERIES W/MICROSTAR PULSE POWER SUPPLY

TWO YEAR NEW PRODUCT WARRANTY

DYNATRONIX, INC., hereby warrants to the purchaser that all new products sold are guaranteed against defects in materials or manufacture for **two years** after shipment. DYNATRONIX, INC., expressly reserves the right to offer an extended warranty at its sole discretion. Such express warranty shall not be deemed effective unless expressly authorized by DYNATRONIX, INC., personnel. DYNATRONIX, INC., at its sole discretion, will repair or replace any defective products that are returned in accordance within the time period proscribed by this warranty. All products for repair or examination must be returned to DYNATRONIX, INC., prepaid. The defective product, as repaired or replaced, requires the issuance of a Return Material Authorization Number ("RMA") from DYNATRONIX, INC., personnel prior to acceptance for repair or replacement by DYNATRONIX, INC. An RMA will be issued upon determination by DYNATRONIX, INC., personnel that the defective product requires factory repair. The customer assumes all shipment expenses of the returned product to and from DYNATRONIX, INC., within the warranty period.

DYNATRONIX, INC.'s liability, under this warranty, shall in any event not exceed the original purchase price of the product. To make a claim under this warranty, it is the responsibility of the purchaser to immediately contact DYNATRONIX, INC., and provide proof of the product's model, part number, input and output voltage and serial number. DYNATRONIX, Inc., will then determine whether the product remains under warranty.

This warranty **DOES NOT COVER** failures caused by any of the following:

1. Misuse, negligence or accident;
2. Alterations made by individuals or parties not directly employed by DYNATRONIX, INC.

This warranty **DOES NOT EXTEND** to commercial sub-assemblies that are guaranteed by a manufacturer's warranty.

This warranty becomes effective upon the date the product is shipped. In the event that a product no longer covered by the NEW PRODUCT WARRANTY is sent for repair, the provisions of the REPAIR WARRANTY as detailed below govern.

DYNATRONIX, INC., EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, ALL EXPRESS WARRANTIES, THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND THE IMPLIED WARRANTY OF MERCHANTABILITY. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

REPAIR WARRANTY

DYNATRONIX, INC., hereby warrants to the purchaser that products previously purchased as new from DYNATRONIX, INC., and returned to DYNATRONIX, INC., for repair or replacement be hereby governed by the provisions of the REPAIR WARRANTY. DYNATRONIX, INC., expressly reserves the right to extend the REPAIR WARRANTY to products not purchased from DYNATRONIX, INC., at its sole discretion. The REPAIR WARRANTY shall exclude all products not purchased from DYNATRONIX, INC., unless expressly authorized by DYNATRONIX, INC., personnel.

DYNATRONIX, INC., guarantees that all repairs be free from defects for ninety (90) days after return shipment to purchaser. Product failures not related to repairs done by DYNATRONIX, INC., shall not be covered by the REPAIR WARRANTY. DYNATRONIX, INC., further warrants that repair investigations that fail to identify product defects shall be guaranteed for a ninety (90) day period after return shipment to customer. In the event that the product fails within the stated ninety (90) day period after the inspection, DYNATRONIX, INC., agrees to assume the in-out freight costs for subsequent returns of the product, experiencing the complained of problem, for an additional ninety (90) day period.

Effective Date: January 1, 2006

TABLE OF CONTENTS

MODEL NUMBER: _____

PART NUMBER: _____

SERIAL NUMBER: _____

INPUT POWER REQUIREMENTS

VOLTS_____ AMPS_____

Hz_____ PHASE_____

MANUFACTURER CONTACT INFORMATION:	
USA SALES	
Corporate Headquarters Dynatronix Inc. 462 Griffin Blvd. Amery, WI 54001 USA 715-268-8118 715-268-8183 sales@dynatronix.com www.dynatronix.com	 phone fax e-mail internet
South Central Region Office Mark Thede 1524 E. Ironwood Dr. Chandler AZ 85225 480-629-4056 480-695-4344 mthede@dynatronix.com	 phone fax e-mail
Eastern Region Office Christopher C. Smith 45 Eagle Harbor Trail Palm Coast, FL 32164 386-437-6294 928-752-2976 csmith@dynatronix.com	 phone fax e-mail
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USA SERVICE	
Customer Support Dynatronix, Inc. 462 Griffin Blvd. Amery, WI 54001 USA 715-268-8118 phone 715-268-8183 fax techsupport@dynatronix.com e-mail www.dynatronix.com internet Self Service Portal - Knowledge Base	
Western Regional Service Center Livermore CA 94551 925-245-1008 phone wroservicecenter@dynatronix.com e-mail	
EUROPE SERVICE	
Fast Technologies Ltd Joe Gallagher Unit 3 Phase II Robinson Park Pennyburn Industrial Estate Londonderry, N. Ireland, UK BT48 OLU +44 (0)28 7136 4106 phone +44 (0)28 7136 4107 fax joe@fasttechnologies.co.uk e-mail www.fasttechnologies.co.uk internet	
Logitex Instruments GmbH Jens-Gunther Jensen Am Pfanderling 72 D-85778 Haimhausen, Germany +49 (0)8133 9332 - 34 phone +49 (0)8133 9332 - 39 fax jens-gunther.jensen@logitex.de e-mail www.logitex-instruments.com internet	

SECTION 2

SAFETY PRECAUTIONS

Before proceeding any further through this manual, this section should be read thoroughly to protect yourself and your equipment.

C A U T I O N

TO REDUCE THE RISK OF ELECTRIC SHOCK. UNIT MUST BE CONNECTED TO EARTH GROUND.
REMOVE POWER BEFORE OPENING PANELS.

1. To properly operate this power supply, only electric cords with a 3-prong grounded system are to be used.

2. The electric cord providing power to the machine should be plugged in only to a grounded outlet that complies with U.L. and/or OSHA safety requirements, or local regulations.

3. If necessary to work inside the cabinet, remember to remove AC power before opening any panels. Not doing so may endanger yourself and your equipment. The means of disconnecting the power supply is either the removal of the detachable power supply cord from the power inlet or power receptacle or both. If the power cord is direct connected to the AC source as well as the power supply, turn off the local safety or power panel branch breaker which provides AC to the power supply. Follow your lock out / tag out procedures to ensure that power is not unexpectedly applied while servicing.

4. This unit contains no user serviceable parts. All repairs or modifications to this unit must be done at the Dynatronix factory, or at an authorized Dynatronix Service Center, or by a qualified service technician. See the Table of Contents section for a list of authorized service centers in the USA and Europe.

5. If necessary to work inside of cabinet with power on DO NOT wear metal objects on hands or wrists because of the various DC and AC voltages present.

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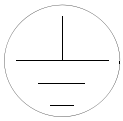
6. This symbol indicates a protective earth connection.



7. This symbol means to consult the product manual for additional information.

8. This label indicates where high AC or DC voltages are located inside of the unit. Be aware of these locations if power is needed for any work being done inside of unit. Not doing so may endanger yourself and your equipment.

9. This label indicates where components or surfaces are operating at temperatures which might cause injury either directly (burn) or indirectly (involuntarily moving body into another danger). This label is used most often on the output transistor heatsinks.

10. If this power supply weighs more than 40lb / 18kg (see Section 4 - Specifications), it must be lifted by two persons.

11. Use of this product for purposes other than those specified in this manual is not recommended. Use for other purposes may give unexpected results or cause damage to the power supply and/or the system it is being used in.

SECTION 3

FUNCTIONAL DESCRIPTION
Pulse or Pulse Reversing Power Supply with MicroStar Interface

The Dynatronix PULSE SERIES (DP/DuP / DPR/DuPR / DPD/DuPD) with MicroStar interface are peak voltage or current regulating, pulse (DP) pulse reversing (DPR) and dual level (DPD) power supplies designed for the electroplating industry.

The DP/DPR/DPD front panel control consists of the MicroStar interface. The MicroStar interface features large, easy-to-read digital displays for both amps and volts as well as a third digital display and a soft-touch keypad for setting additional features.

Operation with the MicroStar is quick. With a press of a button, the operator sets desired output levels and pulse timing parameters for the rectifier. Additional first time parameters can be entered using the soft-touch keypad with the digital display guiding the operator through the setup of ampere time cycles, real time cycles, regulation mode, and auxiliary timer settings. Once these settings are entered, the data is saved in the onboard memory of the rectifier. Simply pressing the "Operate" button activates the plating cycle using the parameters retained in the memory. With the ability to save and recall up to 10 different process settings, the MicroStar Interface makes it easy to plate a variety of parts.

Some standard features of the DP/DPR/DPD Series include an ampere-time totalizer; a voltage/current limit indicator; built-in calibration, fault detection circuitry, real time control and ampere-time control with local alarm; Optional features include: auxiliary timers; output ramp up; recipe control with up to 8 steps plus looping ability; analog interface control (for PLC control); timer/controller relay contacts; and remote front panel capabilities. As with all the MicroStar interface controls upgrading from the standard capabilities to: “Ramp Timer”, Relay control, Recipe control or Analog control can easily be added in the field or during the initial assembly at the factory.

The MicroStar controller is Flash memory based that will allow upgrading firmware in the field using a computer with a serial port.

The DP/DPR/DPD Series is available in both bench top and rack mount configurations with models ranging from 10 to 400 peak amps at 20 volts or 40 volts. Several options are available for AC input power.

The DuP/DuPR/DuPD Series is available in bench top configuration with models ranging from 0.1 to 6 peak amps at 10 volts. Several options are available for AC input power.

SECTION 4 - PRODUCT SPECIFICATIONS

4.1 INPUT POWER	**DµP/DµPR** - 10 volt series Standard: 110-120 Vac Single Phase 50-60hz w/single fuse and one spare Optional 220-240 Vac Single Phase 50-60hz w/single fuse and one spare Optional 220-240 Vac Single Phase 50-60hz w/dual fuses Dual fusing would be required for units shipped to Europe.
4.2 INPUT PROTECTION	***MAIN:*** On/Off switch with a fuse inside power module. See below for fuse ratings. Located on back panel. (The fuse is inside the small drawer that slides out underneath power cord connection. Use a small screwdriver to remove. Note: The arrow underneath the drawer should align with the arrow of the input power configuration. For example if the unit is wired for a 110/120V input the 110/120V arrow on the drawer will need to be aligned with the arrow underneath the drawer.)

MODEL	CURRENT RATING 115 / 230	INPUT PROTECTION
DµP(R)10-.1-.3	1.0 / 0.50	1.25A / 1A fuse
DµP(R)10-.5-1.5	1.0 / 0.50	1.25A / 1A fuse
DµP(R)10-1-3	1.0 / 0.50	1.25A / 1A fuse
DµP(R)10-3-6	1.0 / 0.50	1.25A / 1A fuse

4.3 CONTROLS	Standard: Power supply is controlled and monitored through the front panel MicroStar keypad.

4.4 PULSE TIMING GENERATOR

The MicroStar controller has four microprocessor controlled outputs that can generate either unipolar or bipolar (periodic reverse) waveforms. The DµP series utilizes unipolar waveforms while the DµPR series utilizes bipolar (periodic reverse) waveforms.

The available configurations are as follows:

DµP SERIES:

4 Digit On/Off Timing Resolution:
00.10mS-99.99mS Range (.01mS Resolution)
000.1mS-999.9mS Range (.1mS Resolution)
0.001Sec-9.999Sec Range (.001S Resolution)
00.01Sec-99.99Sec Range (.01S Resolution)

DµPR SERIES:

4 Digit Fwd/Rev Timing Resolution:
00.10mS-99.99mS Range (.01mS Resolution)
000.1mS-999.9mS Range (.1mS Resolution)
0.001Sec-9.999Sec Range (.001S Resolution)
00.01Sec-99.99Sec Range (.01S Resolution)

4 Digit On/Off Timing Resolution:
00.10mS-99.99mS Range (.01mS Resolution)
000.1mS-999.9mS Range (.1mS Resolution)
0.001Sec-9.999Sec Range (.001S Resolution)
00.01Sec-99.99Sec Range (.01S Resolution)

NOTE: Values greater than 100mS in the On or Fwd/Rev Time will limit the output to the average rating of the supply.

4.5 OUTPUT RATING

MODEL	OUTPUT RATING
DµP(R)10-.1-.3	0-10V, 0.1A avg, 0.3A peak
DµP(R)10-.5-1.5	0-10V, 0.5A avg, 1.5A peak
DµP(R)10-1-3	0-10V, 1A avg, 3A peak
DµP(R)10-3-6	0-10V, 3A avg, 6A peak

SECTION 4 - PRODUCT SPECIFICATIONS	
4.6 PULSED OUTPUT WAVESHAPE	**DμP SERIES** Waveshape: Uni-polar square wave Rise and Fall Time: 20usec maximum into a non-inductive load resistor (resistor rated for maximum voltage and peak current) connected to the power supply output by 10 feet of cable comprised of 1 pair of the appropriate #AWG twisted wire (See Section 5, Table 5-7). Rise and fall times measured between 10% and 90 % of pulse amplitude.
	DμPR SERIES Waveshape: Bi-polar square wave Rise and Fall Time: 20usec maximum into a non-inductive load resistor(resistor rated for maximum voltage and peak current) connected to the power supply output by 10 feet of cable comprised of 1 pair of the appropriate #AWG twisted wire (See Section 5, Table 5-8). Rise and fall times measured between 10% and 90 % of pulse amplitude.
4.6.1 Overshoot (current mode)	**DμP/DμPR SERIES OVERSHOOT** (current mode): With the same test conditions as 4.6, overshoot of the output current, when in current regulation mode, shall be less than the greater of: 10% of the peak output current setting or 1% of the peak output current rating of the channel.
4.7 OUTPUT PROTECTION	Software: The internal controller will not accept commands that will exceed the output rating of the power supply.
4.8 LOAD REGULATION	+/-1% of setting or +/-0.1% of peak rating whichever is greater.
4.9 LINE REGULATION	+/-1% of setting or +/-0.1% of peak rating whichever is greater.

SECTION 4 - PRODUCT SPECIFICATIONS		
4.10 TEMPERATURE STABILITY	+/- 0.2% of peak rating after 15 minutes warmup.	
4.11 OUTPUT RESOLUTION	<u>3 or 4 Digit Output Control:</u> Peak Current Regulated. See resolutions below.	
	MODEL	**OUTPUT RESOLUTION**
	DµP(R)10-.1-.3	10.0V / 300.0mA
	DµP(R)10-.5-1.5	10.0V / 1.500A
	DµP(R)10-1-3	10.0V / 3.000A
	DµP(R)10-3-6	10.0V / 6.00A
4.12 METER RESOLUTION	Meter displays average reading.	
	MODEL	**METER RESOLUTION**
	DµP(R)10-.1-.3	10.0V / 100.0mA
	DµP(R)10-.5-1.5	10.0V / 0.500A
	DµP(R)10-1-3	10.0V / 1.000A
	DµP(R)10-3-6	10.0V / 3.00A
4.13 ENVIRONMENTAL CONDITIONS	INDOOR USE ONLY Operating temperature: 0 - 40C Storage temperature: -20 - 85C	
4.14 COOLING	Natural convection cooling.	
4.15 ENCLOSURE	White powder painted aluminum chassis and cover.	

SECTION 4 - PRODUCT SPECIFICATIONS		
4.16 SIZE	**MODEL**	**CABINET SIZE**
	DµP(R)10-.1-.3	12"W x 5.85"H x 13.5"D 305mm x 149mm x 343mm
	DµP(R)10-.5-1.5	12"W x 5.85"H x 13.5"D 305mm x 149mm x 343mm
	DµP(R)10-1-3	12"W x 5.85"H x 13.5"D 305mm x 149mm x 343mm
	DµP(R)10-3-6	12"W x 5.85"H x 13.5"D 305mm x 149mm x 343mm
4.17 WEIGHT	**MODEL**	**APPROXIMATE WEIGHT**
	DµP(R)10-.1-.3	15 lbs / 7 kg
	DµP(R)10-.5-1.5	15 lbs / 7 kg
	DµP(R)10-1-3	15 lbs / 7 kg
	DµP(R)10-3-6	15 lbs / 7 kg

SECTION 5
INSTALLATION INSTRUCTIONS
DµP/DµPR W/MICROSTAR SERIES

LOCATION

Locate the Power Supply as close as possible to the plating bath to minimize inductive effects and plater cable (IR) heating.

Power supply must be installed such that the circuit breaker(on/off) switch is easily accessible.

The DµP(R) W/MicroStar series are designed to located on a shelf or desktop.

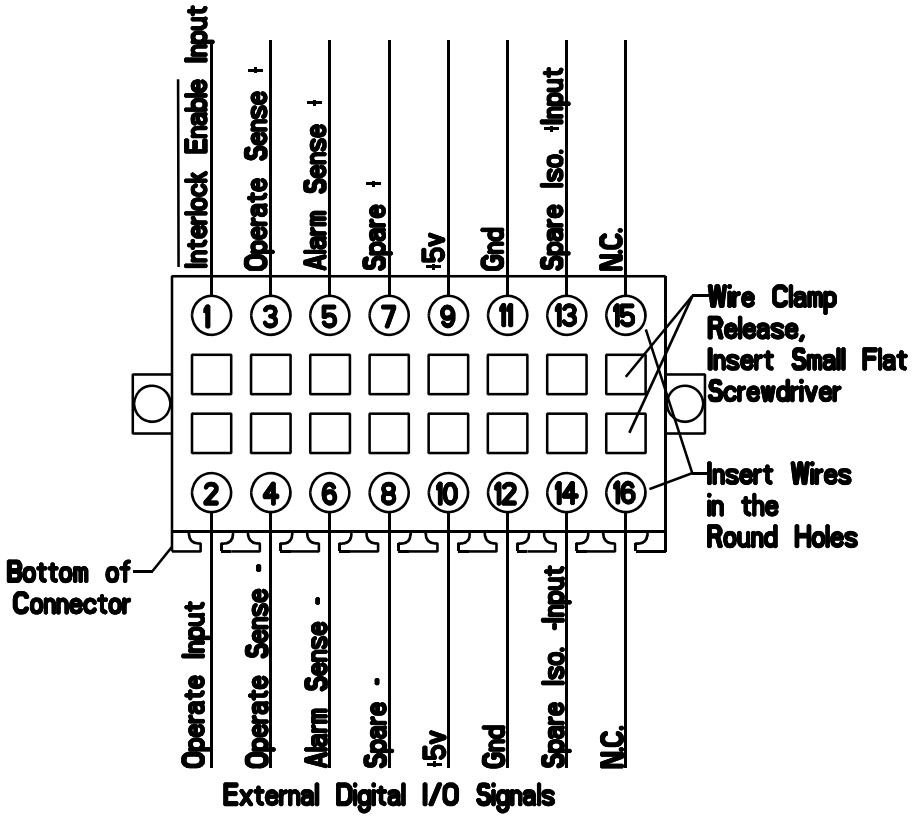
CONNECTIONS

5.1 A.C. Connections

Connect the power cord to a source of power as specified in Section 4.1 - INPUT POWER REQUIREMENTS. This equipment requires **grounding** in accordance with local regulations.

5.2 External Digital I/O Connections

The **External Digital I/O Connector** is a 16-pin block which mates to the corresponding 16-pin jack located at the rear of the supply (See Fig. 5-8). This connector is used for external digital connections such as Interlock enable & operate input as well as alarm and operate sense.



External Digital Connections
Figure 5-2

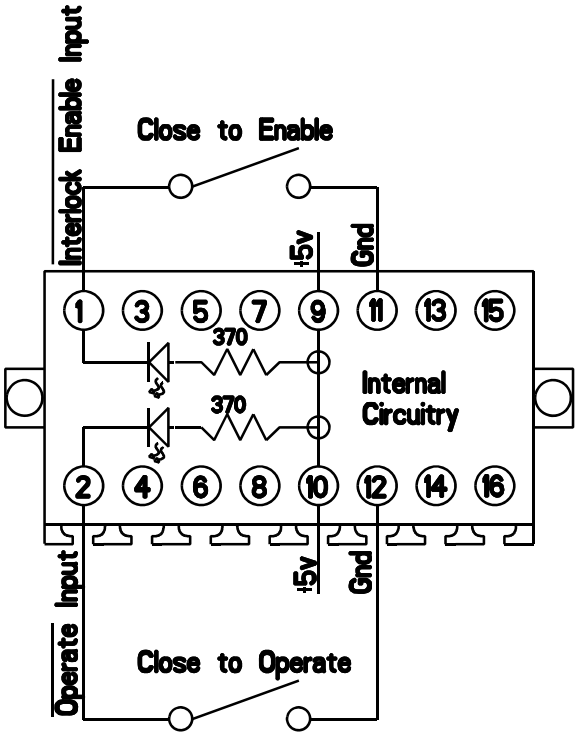
Digital Inputs

The two standard digital inputs are the **Interlock Enable** and the **Operate input**.

The Interlock Enable (Pin 1) when tied to Gnd (Pin 11) allows for proper operation of the supply. When this connection is open supply operation is disabled. If the supply is operating when this input is opened the unit will go into standby and a message will be displayed.

The Operate input (Pin 2) when tied to Gnd (Pin 12) allows the output of the supply to be remotely enabled (Remote Operate/Standby).

When either of these digital inputs are closed, the current flowing thru the corresponding circuit will be approximately 10mA.



Typical Digital Input Connections

External Digital Inputs
Figure 5-2a

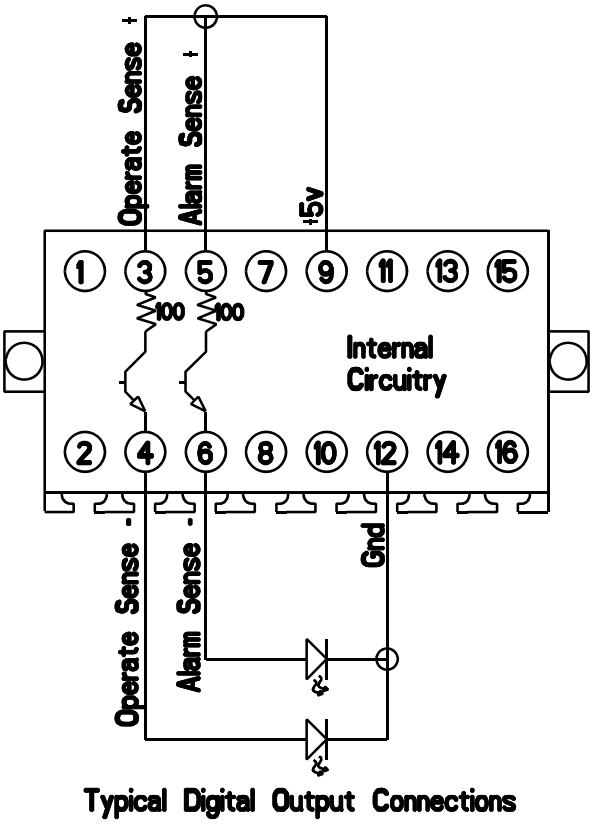
Digital Outputs

The two standard digital outputs are the **Operate Sense** and the **Alarm Sense**.

The Operate Sense (Pins 3 & 4) when configured as shown below, can be used to sense whether the unit is in the Operate or Standby condition. The Operate condition will cause current flow thru the circuit and the external optocoupler shown will be in the “on” state.

The Alarm Sense (Pins 5 & 6) when configured as shown below, can be used to sense if an alarm condition has occurred. An alarm condition will cause current to flow thru the circuit and the external optocoupler shown will be in the “on” state.

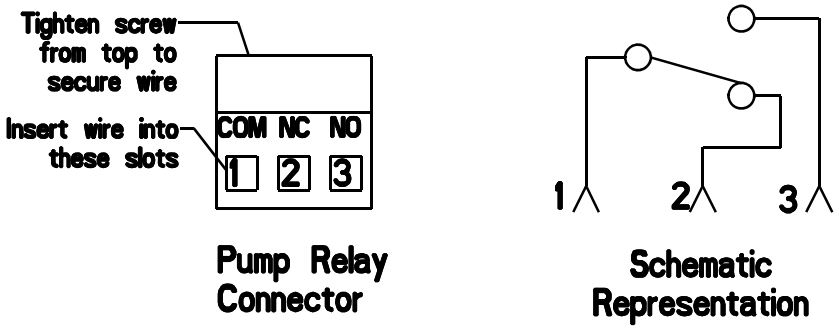
The maximum current flow thru either of the digital outputs is 10mA.



External Digital Outputs
Figure 5-2b

5.3 Pump Control (Isolated Relay Contacts) Connections

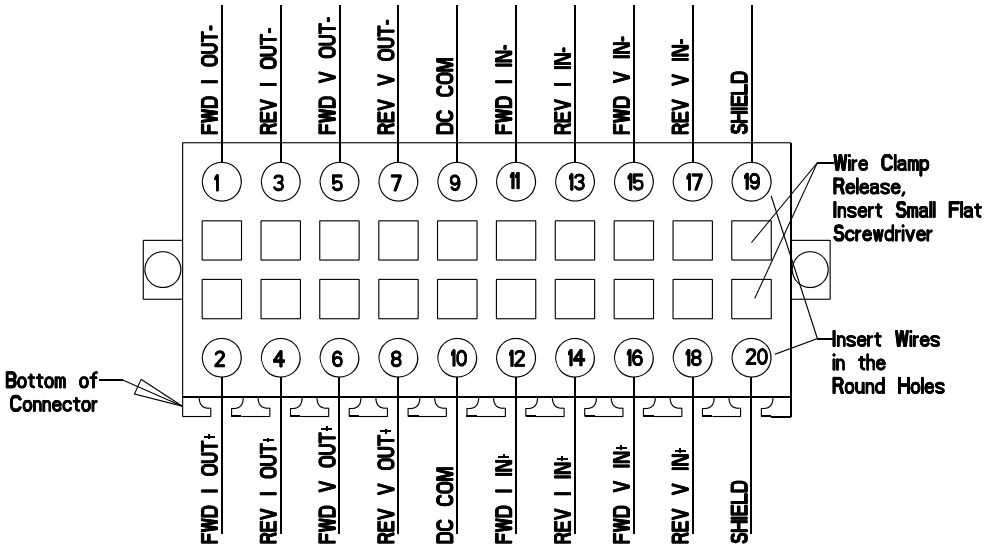
The **Pump Control Connector** is a 3-pin block which mates to the corresponding jack at the rear of the supply (See Fig. 5-8). This connector is used for controlling an external device. Contacts 1 and 2 are normally closed. When the condition is positive, contacts 1 and 3 close. The rating of these contacts are 12 amps @ 125V AC/DC, the connector accepts 24 to 12 gauge wire.



Pump Control Connector
Figure 5-3

5.4 Optional Analog Control Connections

The **Analog Control Connector** is a 20-pin block which mates to the corresponding 20-pin jack at the rear of the unit (See Fig. 5-8). This connector is used for external analog control of the supply.



Analog Control Connector
Figure 5-4

NOTE: The DC COM (Pins 10 & 9) is used to connect the power supplies DC COM to the controllers DC COM. The SHIELD (Pins 19 & 20) for the readbacks (Fwd I out, Rev I out, Fwd V out, and Rev V out) should be attached at this connector and cut off at the controller. The shield for the controls (Fwd I in, Rev I in, Fwd V in, and Rev V in) should be grounded at the controller and cut-off at this connector.

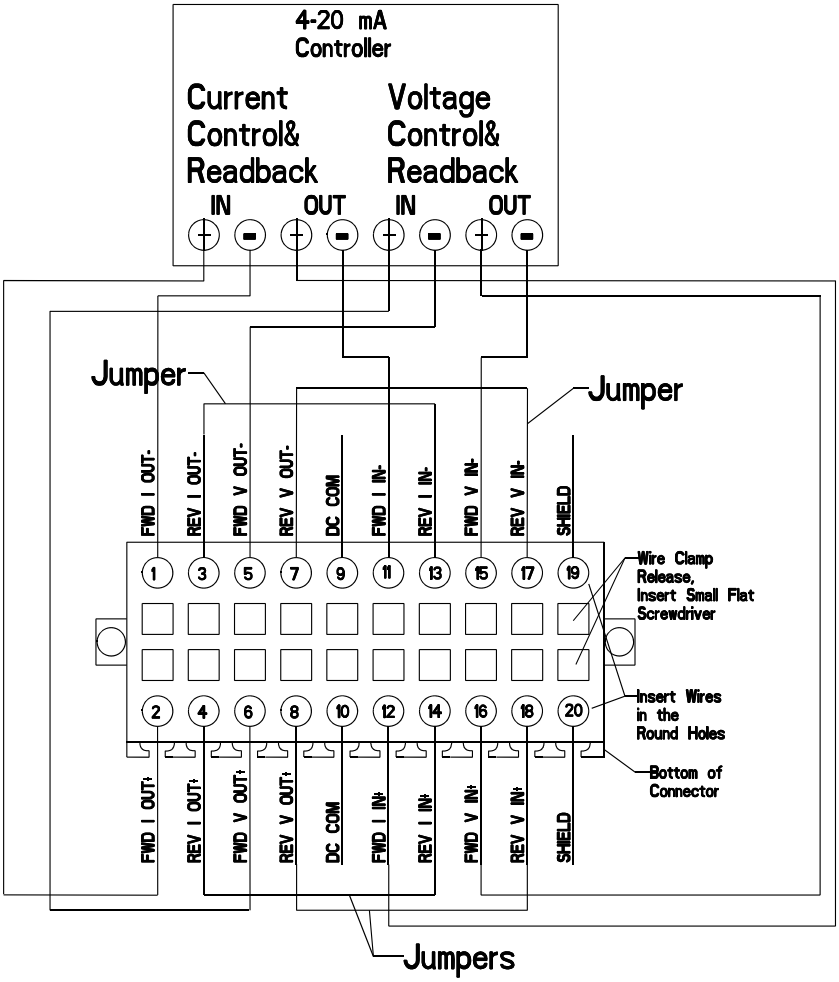


Figure 5-4a
DµP SERIES with 4-20mA ANALOG INTERFACE CONNECTIONS

For the DµP Series, peak current and voltage output can be controlled and average current and voltage can be monitored. The wiring used to connect to each input/output should be twisted shielded pairs. (Pins 1&2, 5&6, 11&12, 15&16 should be twisted shielded pairs) See Table 5-1 & 5-2 for 4-20mA operation. **For proper operation the following four jumpers must be added: Pins 3 to 13, 7 to 17, 4 to 14 and 8 to 18.**

TABLE 5-1: 4-20mA CONTROL/READBACK (DµP SERIES IN PULSE MODE)				
	4-20mA Current Readback Pin 1(Fwd I Out -) Pin 2(Fwd I Out+)	4-20mA Voltage Readback Pin 5(Fwd V Out -) Pin 6(Fwd V Out+)	4-20mA Current Control Pin 11(Fwd I IN -) Pin 12(Fwd I IN+)	4-20mA Voltage Control Pin 15(Fwd V IN -) Pin 16(Fwd V IN+)
DµP10-.1-.3	0-.1A Average	0-10V Average	0-.3A Peak	0-10V Peak
DµP10-.5-1.5	0-.5A Average	0-10V Average	0-1.5A Peak	0-10V Peak
DµP10-1-3	0-1A Average	0-10V Average	0-3A Peak	0-10V Peak
DµP10-3-6	0-3A Average	0-10V Average	0-6A Peak	0-10V Peak

TABLE 5-2: 4-20mA CURRENT CONTROL (DµP SERIES IN DC MODE)	
	Current Control Pin 11(Fwd I IN -) Pin 12(Fwd I IN+)
DµP10-.1-.3	4-9.33mA = 0-.1A Peak/Average
DµP10-.5-1.5	4-9.33mA = 0-.5A Peak/Average
DµP10-1-3	4-9.33mA = 0-1A Peak/Average
DµP10-3-6	4-12mA = 0-3A Peak/Average

Note 1: The power supply controller will automatically limit the current if these control levels are exceeded.

Note2: In DC MODE Current Readback, Voltage Readback and Voltage Control are the same as in PULSE MODE.

DµPR SERIES with 4-20mA ANALOG INTERFACE CONNECTIONS

For the DµPR Series, peak forward current, forward voltage, peak reverse current and reverse voltage levels can be controlled and average forward current, forward voltage, average reverse current and reverse voltage can be monitored. (Pins 1&2, 3&4, 5&6, 7&8, 11&12, 13&14, 15&16, 17&18 should be twisted shielded pairs) See Table 5-3 thru 5-6 for 4-20mA operation. **Note: In this mode all inputs (Pins 11&12, 13&14, 15&16, 17&18) <u>must</u> to be connected to a 4-20mA controller in order for the inputs to work correctly.**

DµPR SERIES with 4-20mA ANALOG INTERFACE CONNECTIONS with FORWARD CONTROL & MONITOR <u>ONLY</u>

For the DµPR Series, using the forward control and readback only, the peak forward current and voltage output can be controlled and forward average current and voltage can be monitored. The wiring used to connect to each input/output should be twisted shielded pairs. (Pins 1&2, 5&6, 11&12, 15&16 should be twisted shielded pairs) See Table 5-3 & 5-4 for 4-20mA operation in this mode. **For proper operation in this mode the following four jumpers must be added: Pins 3 to 13, 7 to 17, 4 to 14 and 8 to 18.**

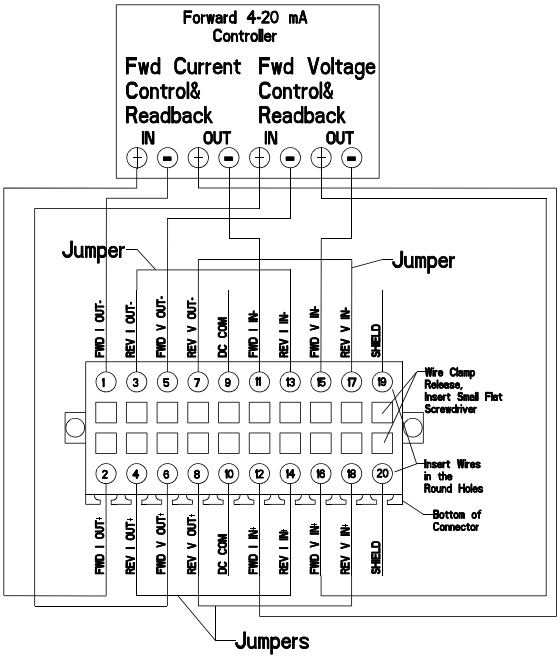


Figure 5-4b
DµPR SERIES with 4-20mA ANALOG INTERFACE CONNECTIONS
(Using Forward Only)

DµPR SERIES with 4-20mA ANALOG INTERFACE CONNECTIONS with REVERSE CONTROL & MONITOR <u>ONLY</u>

For the DµPR Series, using the reverse control and readback only, the peak reverse current and voltage output can be controlled and reverse average current and voltage can be monitored. The wiring used to connect to each input/output should be twisted shielded pairs. (Pins 3&4, 7&8, 13&14, 17&18 should be twisted shielded pairs) See Table 5-5 & 5-6 for 4-20mA operation in this mode. **For proper operation the following four jumpers must be added: Pins 1 to 11, 5 to 15, 2 to 12 and 6 to 16.**

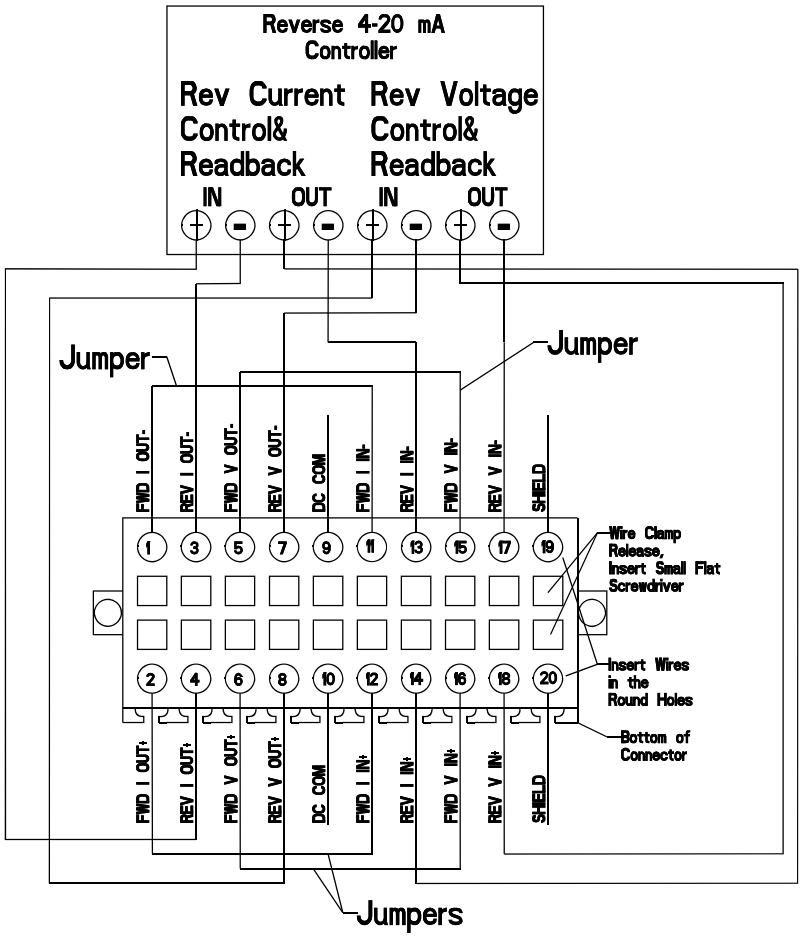


Figure 5-4c
DµPR SERIES with 4-20mA ANALOG INTERFACE CONNECTIONS
(Using Reverse Only)

TABLE 5-3: 4-20mA CONTROL/READBACK (DµPR SERIES IN FORWARD PULSE MODE)				
	4-20mA Current Readback Pin 1(Fwd I Out -) Pin 2(Fwd I Out+)	4-20mA Voltage Readback Pin 5(Fwd V Out -) Pin 6(Fwd V Out+)	4-20mA Current Control Pin 11(Fwd I IN -) Pin 12(Fwd I IN+)	4-20mA Voltage Control Pin 15(Fwd V IN -) Pin 16(Fwd V IN+)
DµPR10-.1-.3	0-.1A Average	0-10V Average	0-.3A Peak	0-10V Peak
DµPR10-.5-1.5	0-.5A Average	0-10V Average	0-1.5A Peak	0-10V Peak
DµPR10-1-3	0-1A Average	0-10V Average	0-3A Peak	0-10V Peak
DµPR10-3-6	0-3A Average	0-10V Average	0-6A Peak	0-10V Peak

TABLE 5-4: 4-20mA CURRENT CONTROL (DµPR SERIES IN FORWARD DC MODE)	
	Current Control Pin 11(Fwd I IN -) Pin 12(Fwd I IN+)
DµPR10-.1-.3	4-9.33mA = 0-.1A Peak/Average
DµPR10-.5-1.5	4-9.33mA = 0-.5A Peak/Average
DµPR10-1-3	4-9.33mA = 0-1A Peak/Average
DµPR10-3-6	4-12mA = 0-3A Peak/Average

Note 1: The power supply controller will automatically limit the current if these control levels are exceeded.

Note2: In DC MODE Current Readback, Voltage Readback and Voltage Control are the same as in PULSE MODE.

TABLE 5-5: 4-20mA CONTROL/READBACK (DµPR SERIES IN REVERSE PULSE MODE)				
	4-20mA Current Readback Pin 3(Rev I Out -) Pin 4(Rev I Out+)	4-20mA Voltage Readback Pin 7(Rev V Out -) Pin 8(Rev V Out+)	4-20mA Current Control Pin 13(Rev I IN -) Pin 14(Rev I IN+)	4-20mA Voltage Control Pin 17(Rev V IN -) Pin 18(Rev V IN+)
DµPR10-.1-.3	0-.1A Average	0-10V Average	0-.3A Peak	0-10V Peak
DµPR10-.5-1.5	0-.5A Average	0-10V Average	0-1.5A Peak	0-10V Peak
DµPR10-1-3	0-1A Average	0-10V Average	0-3A Peak	0-10V Peak
DµPR10-3-6	0-3A Average	0-10V Average	0-6A Peak	0-10V Peak

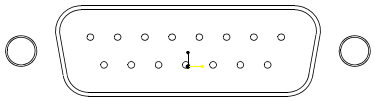
TABLE 5-6: 4-20mA CURRENT CONTROL (DPR SERIES IN REVERSE DC MODE)	
	Current Control Pin 13(Rev I IN -) Pin 14(Rev I IN+)
DμPR10-.1-.3	4-9.33mA = 0-.1A Peak/Average
DμPR10-.5-1.5	4-9.33mA = 0-.5A Peak/Average
DμPR10-1-3	4-9.33mA = 0-1A Peak/Average
DμPR10-3-6	4-12mA = 0-3A Peak/Average

Note 1: The power supply controller will automatically limit the current if these control levels are exceeded.

Note2: In DC MODE Current Readback, Voltage Readback and Voltage Control are the same as in PULSE MODE.

5.5 Optional Master/Slave Timing Connection

The Master/Slave Timing Connector is a 15-pin D-Type male connector which when used in conjunction with another power supply equipped with the Master/Slave Timing Option allows the user to synchronize the output pulse timing of the two supplies. A standard master/slave cable with pin per pin 15-pin D-Type female connectors on each end is supplied to connect the two power supplies together.



Master/Slave DB-15-M Connector
Figure 5-5

5.6 Service Port Connection

The service port connection is an RS-232 protocol (115200 baud, no parity, 8 data bits, 1 stop bit, XON/XOFF flow control) that is used mainly for downloading updated software. A “strait through” DB9F to DB9M serial cable is required. To connect to a personal computer that has a 25-pin DB25M RS232 COM Port connector, a special 25-pin to 9-pin adapter or adapter cable must be used.

Pin 2	**Tx(term)**
Pin 3	**Rx(term)**
Pin 5	**Gnd**

SERVICE PORT DB-9 PINOUT (ref. to power supply)
TABLE 5-7

5.7 **Power Supply/Bath Connections**

There are two critical parameters to be considered when connecting a pulse power supply to the plating bath. The first, which applies to all rectifiers, D.C. as well as pulse, is IR loss in the cable. The wire should be sized such that the voltage drop from rectifier to bath does not exceed 10% of the peak voltage.

Example: Power Supply 20 volts peak @ 100 amps peak
Distance (Rectifier to bath) 50 feet

20 volts x 10% = 2 volts
2 volts ÷ 100 amps = .02 ohms total
.02 ohms ÷ 100 feet (50 feet X 2) = .0002 ohms/ft.

The wire tables show #2 stranded copper to have .000165 ohm/ft. resistance and, therefore, would be the correct choice.

The second parameter to be considered is relevant only to pulse power supplies. This is the inductance of the cable connecting the power supply to the bath. Inductance opposes the immediate flow of current to the bath so that as ON time begins there will be no corresponding immediate flow of current. This causes the pulse to be distorted which in turn causes the actual current to be incorrect. Monitoring the voltage and current waveforms will clearly show this problem.

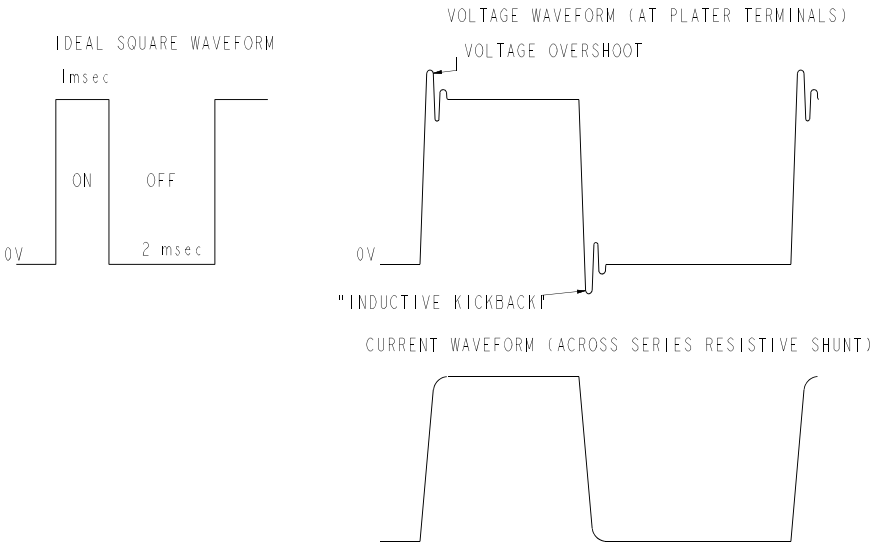


FIGURE 5-6: PULSE WAVEFORMS

The overshoot as ON time begins occurs because the inductance prevents immediate current flow and the regulator, not sensing any current flow, continues to apply more and more voltage attempting to force current flow. The result is that part of the current pulse is missing and, therefore, the actual current will not be as calculated. In peak regulated pulse power supplies, this problem shows itself as a discrepancy between the peak output setting and the actual meter display (average current) which will be lower than calculated (Amps peak X duty cycle = Amps average).

The inductive kickback shown at the end of ON time is caused by the collapse of the inductive field around the connecting cable. Although this has less effect on the current waveform than the overshoot, it can be more catastrophic to the power supply. If this negative voltage spike becomes large enough, it will damage the power supply's output transistors.

The amplitude of the overshoot and inductive kickback is dependent on the inductance of the cable and the rise and fall time of the pulse. The greater the cable inductance, the greater the amplitude and the faster the rise and fall time, the greater the amplitude.

It should be clear now that, with pulse rectifiers, the inductance of the rectifier-to-bath connection must be held to a minimum. As inductance is proportional to length, keeping the connection from the power supply to the bath as short as possible will help. Beyond that, Dynatronix recommends several methods of accomplishing this depending on the maximum current and distance involved.

	Type	**Maximum Peak Current**
1.	Twisted pair	30 amps peak
2.	Multiple twisted pair	400 amps peak
3.	Laminated bus bars	1,000 amps peak

The following table indicates the method and the size of conductor to be used based on the peak current and the distance from rectifier to bath:

AMPS PEAK	FEET									
	10	20	30	40	50	60	70	80	90	100
<10	22	22	20	18	18	16	16	16	14	14
10	18	16	14	12	12	12	10	10	10	10
30	12	12	10	2 x 10	2 x 10	3 x 10	3 x 10	3 x 10	4 x 10	4 x 10
100	10	3 x 10	4 x 10	5 x 10	7 x 10	8 x 10	9 x 10	10 x 10	12 x 10	13 x 10
200	3 x 10	5 x 10	8 x 10	10 x 10	13 x 10	15 x 10	18 x 10	20 x 10	23 x 10	25 x 10
400	5 x 10	10 x 10	15 x 10	20 x 10	25 x 10	30 x 10	35 x 10	40 x 10	45 x 10	50 x 10
750	1/8 x 2	1/8 x 2	1/8 x 2	1/8 x 3	1/8 x 3	1/4 x 3	1/4 x 3	1/4 x 3	1/4 x 3	1/4 x 3
1000	1/4 x 3	1/4 x 3	1/4 x 3	1/4 x 3	1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3
1500	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3	2-1/4 x 3
4000	3-1/4 x 4	3-1/4 x 4	3-1/4 x 4	3-1/4 x 4	3-1/4 x 4	3-1/4 x 4	3-1/4 x 4	3-1/4 x 4	4-1/4 x 4	4-1/4 x 4

LEGEND: 18 - SINGLE PAIR OF TWISTED 18 AWG WIRE
2 x 10 - TWO PAIR OF TWISTED 10 AWG WIRE
1/8 x 3 - BUS BAR 1/8" x 3"
2-1/4 x 3 - 2 EACH 1/4" x 3" BUS BARS PARALLELED

Selection Table
Pulse Power Supply/Bath Connections
Table 5-8

5.8 Ventilation/Cooling Requirements

See section 4 for ventilation and cooling requirements for unit

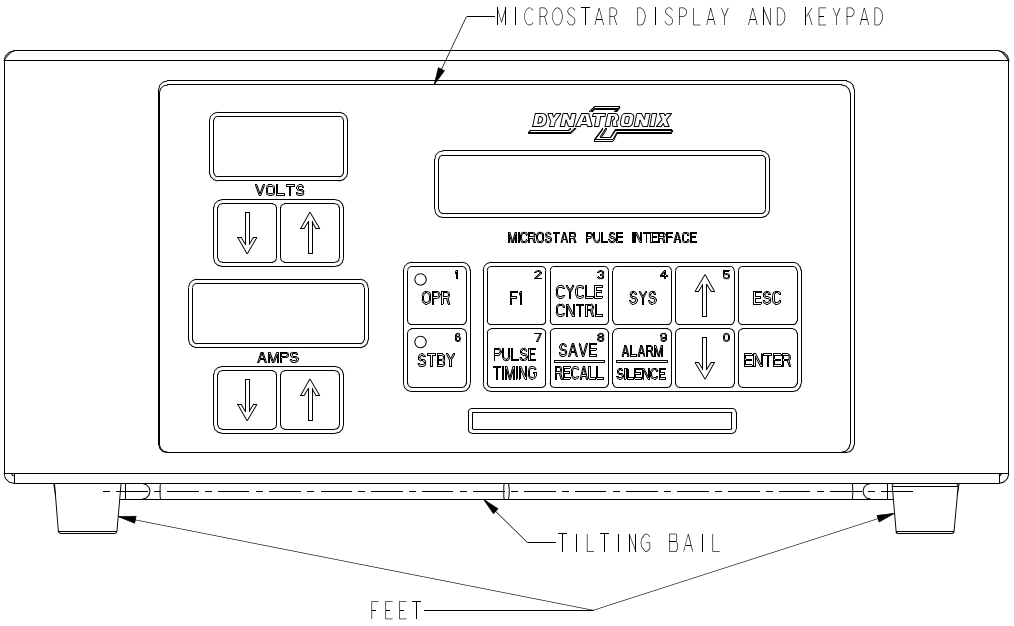
5.9 Options

Please check Section 9 - Optional Controls for connection information regarding any option/s which a power supply may have.

5.10 **Front Panel**

The front panel accommodates the MicroStar keypad and display. Underneath the unit there is a tilting bail to raise the front of unit for easier viewing of the display, if desired.

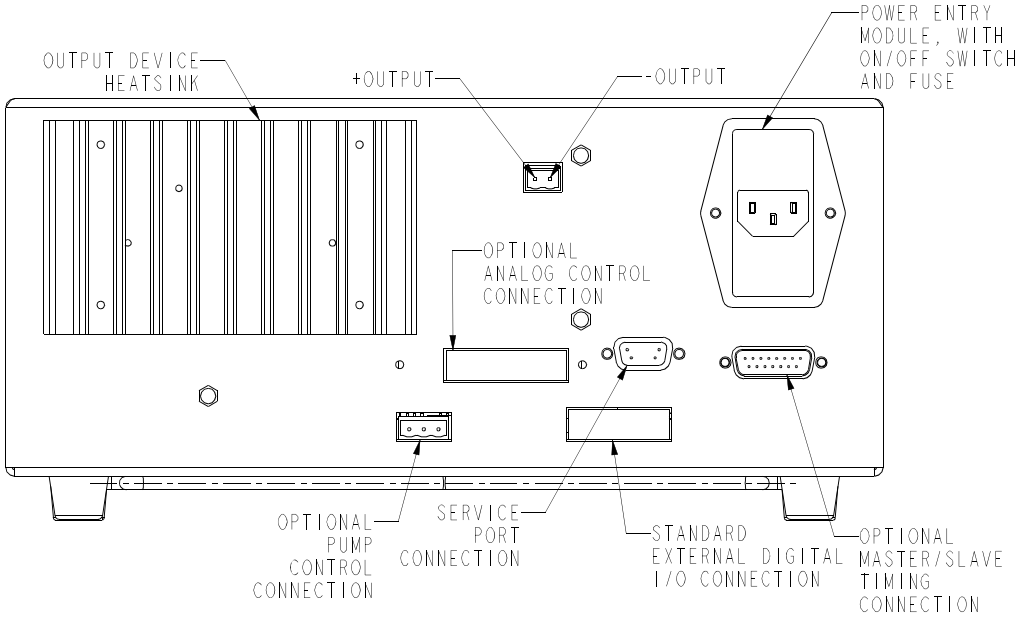
FIGURE 5-7: FRONT PANEL WITH MICROSTAR



5.11 INPUT/OUTPUT (REAR) PANEL

This panel provides access to all outside connections to the power supply. It has the on/off switch located on the top of the power entry module. There is a 1 Amp fuse inside the power module for input line protection. The fuse is located in the drawer that is under the input power cord. `See Figure 5-8 below. Certain features depicted may or may not be present on your supply. Detailed connection information is found in Section 6 - Installation.

FIGURE 5-8: REAR PANEL



SECTION 6

OPERATING INSTRUCTIONS
For MicroStar Pulse Series Units with Mach2 Controller

6.0 Overview

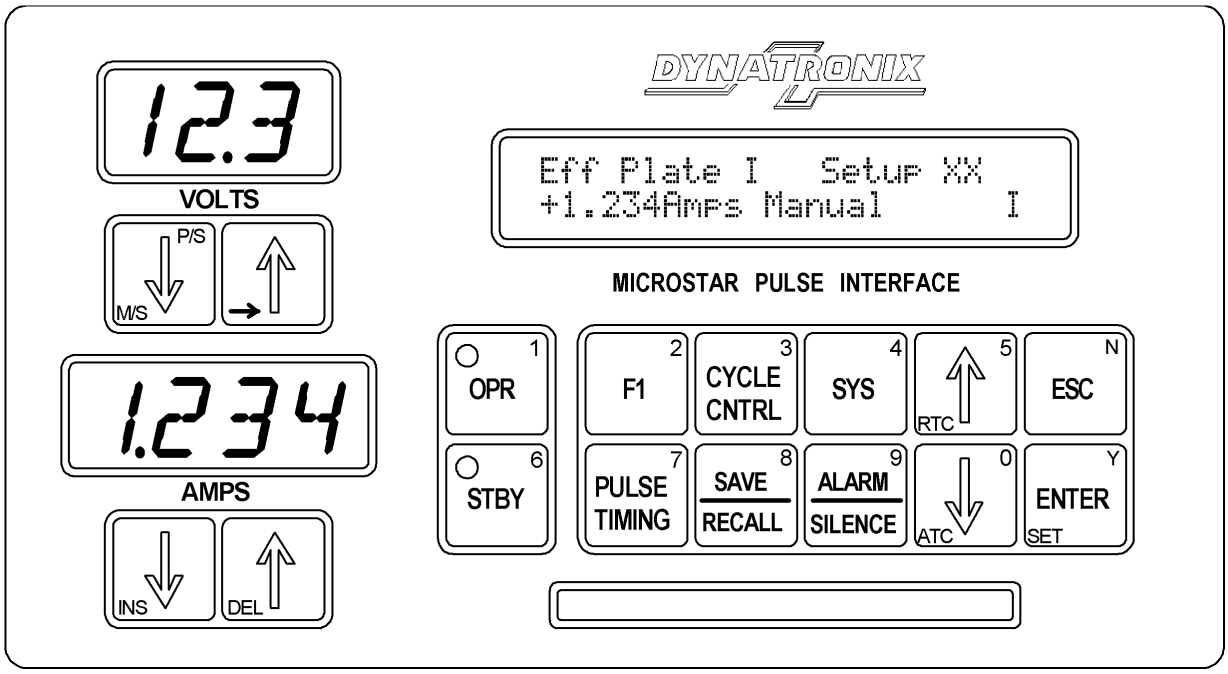


Figure 6-1: MicroStar Control Panel

The MicroStar control panel is a user friendly power supply interface. It has many features that allow for complex plating processes but is also easy to set up for basic plating cycles.

The MicroStar controller is menu driven. When a menu key is pressed a list of options is displayed on the screen, two at a time. The ARROW KEYS are used to cycle through the menu and the ENTER key is used to select menu items. The ESC key will lead back to the Main Screen.

Some of the features are PASSWORD protected. The default password is 0000. The password is entered using the keys with numbers on them.

A summary of the different control panel features and their operation and use follows.

Read through Section 6.1, Controls, below to get familiar with the User Interface. Section 6.4, Getting Started, can be used for an overview of using the unit.

The operation of the more advance functions are described in Section 6.2, Programming.

Optional features that can be added to the unit are described in Section 6.3, Options. Use Appendix A to view a complete flow chart of the screens and menus available.

6.1 Controls

Display:
The Display shows settings, status and menus. Figure 6-2 below shows the Main screen of the display. This is the default screen and shows how the power supply is set up to run a job. Each area of the display has different information about the settings as shown below.

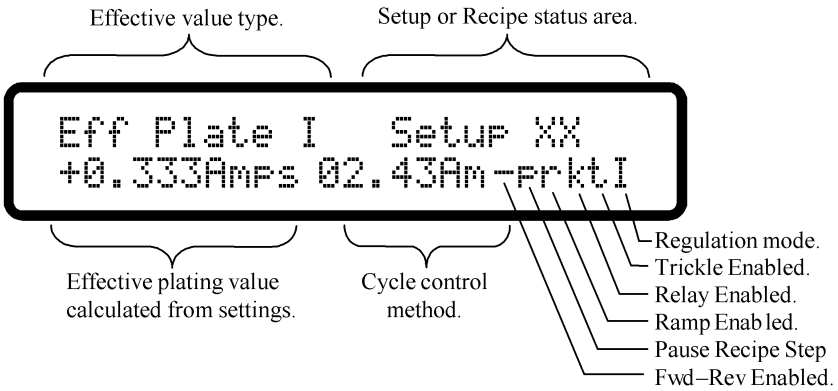


Figure 6-2: MicroStar Main Screen

There are up to 3 screens that display general status and settings. They are cycled through by using the ENTER key. The Main screen is the first, the Forward screen is the second and, optionally, the Reverse screen is the third. The user must select the Forward or Reverse screens in order to set the voltage and current levels for forward or reverse respectively.

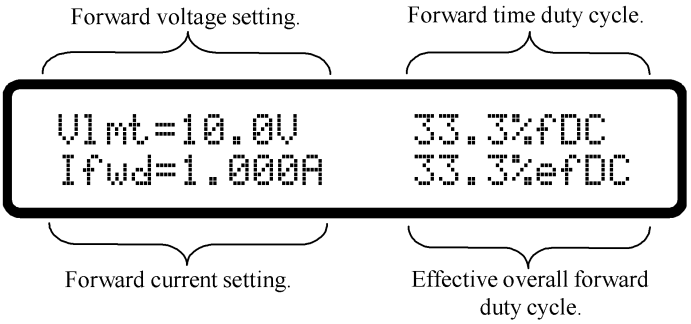


Figure 6-3: Forward Settings Screen

Figure 6-3 shows the settings for the forward voltage and current. The voltage and current settings are peak levels (On Time level). Depending on the regulation mode that is selected, one of the settings may show a limit value (i.e. Ilim= for voltage regulation mode). This setting is the one that is not being regulated but will not allow the output to go beyond that level. Also shown on this screen are the duty cycles of the pulsing settings. The fDC is the duty cycle of the settings during the forward time of the waveform. The efDC is the duty cycle of the forward time relative to the overall waveform including any reverse time. If there are no reverse settings then the two duty cycle values will be the same.

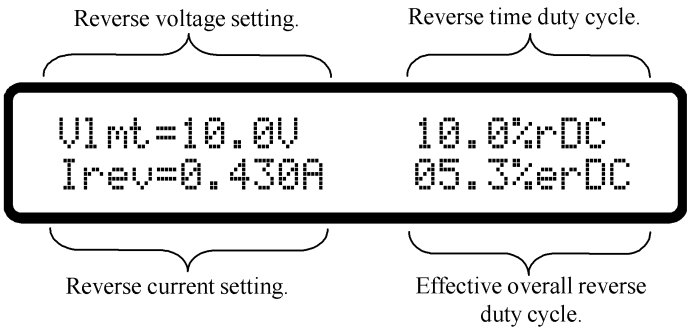


Figure 6-4: Reverse Settings Screen

Figure 6-4 shows the optional reverse voltage and current settings. It will only be displayed if the Reverse Option is installed in the power supply. The duty cycle information is similar to the forward screen but for the reverse settings.

Dual Level Control (DPD & DuPD systems Only)

The Dual Level control system uses the Forward settings and Reverse settings as two different levels rather than having the reversing capability. When running Dual Level, note that the reverse current level (2nd fwd level) is not used for ATC cycle control. The reverse current is still accumulated in the main totalizers however and can be accessed using the CYCLE CNTRL key.

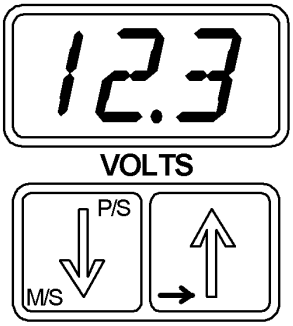


Figure 6-5: Volts Controls

VOLTS Meter:
Displays average output voltage when the unit is operating. The Volt Meter has an auto-range feature and will change between 9.99 and 10.0 volt resolutions when at 10 volts. When the display is at the Main screen the Effective Average Voltage is displayed on the meter. When at the Forward Screen the Average Forward Voltage is displayed. Optionally when at the Reverse Screen the Average Reverse Voltage is displayed.

VOLTS Arrow Keys:
Adjusts voltage output levels. These keys are active when Forward or Reverse settings are showing on the display (use the ENTER key to access them). The voltage level setting can be adjusted when the unit is in standby or while operating.

In the optional Recipe mode, the Volts Up (Right Arrow) key is used to cycle through the recipe steps shown on the main screen. Each time the Volts Up key is pressed the next Recipe step will be loaded. The recipe step can then be edited.

Also for the optional Recipe mode, the Volts Down (P/S) key is used to set a step to pause when its cycle time is done. See the Programming section for more information.

Figure 6-6: Amps Controls

AMPS Meter:
Displays the Average output current when the unit is operating. When the display is at the Main screen the Effective Average Current is displayed. When at the Forward Screen the Average Forward Current is displayed. Optionally when at the Reverse Screen the Average Reverse Current is displayed. Note that when the reading is reverse current (negative) the last digit will alternate between the digit value and the - (minus) sign.

AMPS Arrow Keys:
Adjusts voltage output levels. These keys are active when Forward or Reverse settings are showing on the display (use the ENTER key to access them). The current level setting can be adjusted when the unit is in standby or while operating.

In the optional Recipe Edit mode the Amps Down key will Insert a step at the current cursor location. The Amps Up key will Delete the step at the current cursor location.

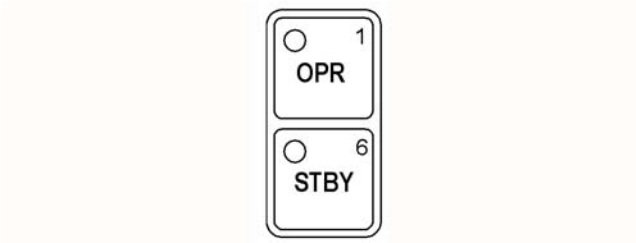


Figure 6-7: Operate and Standby Controls

OPR - Operate Key:
Enables the output and starts a timer-based cycle if one is enabled. This key is disabled if the Analog Remote Control Option is enabled.

The light on the key comes on when the unit is operating.

The light will flash when the unit is in the optional Trickle Mode.

STBY - Standby Key:
Disables the output and allows an operating ATC or RTC cycle to be interrupted. An interrupted cycle can be restarted by pressing OPR or cancled by pressing STBY.

The light on the key is on when the unit is in standby and the output is off.

The light will flash when the unit is in Pause mode.

Menus

Menus are used to select various settings and functions. The screen displays 2 menu items at a time. The menu item on the first line with the small < pointer at the end of the line is the active menu item as shown in the screen shot of the SYS menu below.

```
1>Status and Misc. Sets◀
2>Set Regulation Mode
```

Pressing the blue DOWN Arrow key will go down through the menu list (brings the larger numbers up to the first row). Pressing the blue UP Arrow key will go up through the menu list (smaller numbers to the first row). To select a given menu item use the blue UP and DOWN arrow keys to get the item on the first line and then press the ENTER key.

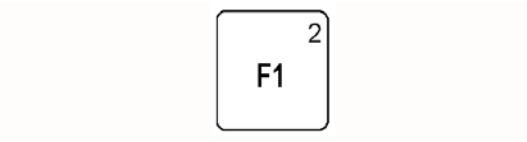


Figure 6-8: Function 1 Key

F1 - Function 1 Key:
Used to access some of the factory installed MicroStar Options as described below.

`1>Ramp Time - Option`
Allows setting a ramp-up time so the current or voltage will ramp up at the start of a cycle. A zero setting disables the ramp. The ramp will start at the Ramp Offset value and ramp up to the current or voltage setting over the Ramp Time and then hold that setting until the cycle is done. The ramp will control current in the current and crossover regulation modes and voltage in the voltage regulation mode.

`2>Ramp Offset - Option`
Sets an offset value in % of setting and is the starting level for the ramp.

`3>Trickle Level - Option`
Used to set a low current level for Trickle mode. When the unit is powered up the output is off. To start Trickle mode press the OPR key. The OPR light will flash while the unit is in the trickle mode indicating that the output is active. A cycle can now be started from the trickle mode by pressing the OPR key again. When a cycle ends, by pressing STBY when a Manual cycle is running or automatically when an ATC or RTC cycle is finished, the unit will set the output current to the trickle level. It will then read the voltage at the output and switch the unit to crossover regulation mode and set the voltage setting to the same value as the reading. The trickle mode will remain on until the OPR key is pressed to start another cycle or the STBY key is pressed to shut off the output completely. Use the ESC key at the end of an ATC or RTC cycle to clear the flashing display. Settings cannot be adjusted when the Trickle mode is active.

`4>Trickle Enable - Option`
This item is used to enable and disable the Trickle mode. Press ENTER to turn the trickle mode on and off. Press ESC once to get back to the F1 menu and again to get to the main screen.

Figure 6-9: Cycle Control Key

CYCLE CNTRL - Cycle Control Key:
Accesses the Cycle Control settings.

`1>Real Time Cycle (RTC)`
This allows setting the duration of a Real Time Cycle. Real Time Cycles have a duration in hours, minutes or seconds. The resolution of the duration is set in the SYS, `4>Set Resolutions`, `2>Set Real Time Resol.` menu item. An RTC will run for the preset time and then turn off automatically.

`2>Amp Time Cycle (ATC) - Option`
This allows setting the duration of a Amp Time Cycle. Real Time Cycles have a duration in Amp-Hours or Amp-Minutes. The resolution of the duration is set in the SYS, `4>Set Resolutions`, `3>Set Amp Time Resol.` An ATC will run for the preset amp-time and then turn off automatically.

`3>Recipe Cycle - Option`
Recipe Cycle is used to set up a recipe that runs multiple setups in succession. See the Programming section below for more detailed information on recipes.

`4>Recipe Looping - Option`
Recipe Cycle is used to set up a recipe where steps can loop back to previous steps a preset number of times. See the Programming section below for more detailed information on recipes.

`5>Manual Cycle`
The Manual Cycle item is used to cancel an RTC, ATC or the recipe mode. The active recipe step will become the active setup when the recipe mode is canceled but the cycle time will change to manual. The recipe mode can also be canceled by recalling a setup. An ATC or RTC cycle can be canceled by setting the value to zero.

`6>Relay Trip Point - Option`
This is used to set the time between relay turn on points. After a cycle is started, the relay will turn on after the set amount of amp-time has been accumulated. The relay amp-time counter will be cleared and start accumulating amp-time again immediately. The relay will stay on for the duration set in menu item 7 below and then the relay will turn off. This will repeat for the duration of the cycle. Be sure to enter an amp-time setting that will run longer than the Relay On Time setting.

`7>Relay On Time - Option`
This is the duration that the relay will stay on after the Relay Trip Point amp-time, set in item 6 above, has been accumulated.

8>View the main Totalizer

Allows the operator to view the main Totalizer. It will display the forward totalizer for a system that does not have reverse and both forward and reverse totalizers for systems that have reverse. This totalizer can be cleared using menu item 9 below.

9>Clear the main Totalizer

This menu item will clear the main totalizer. The correct password is required to clear the totalizer.

10>Subtract Reverse Amp Time for ATC

This item is used to set the mode that an Amp Time Cycle counter uses to accumulate amp-time. When Subtract Reveres Amp Time is Disabled the duration of an ATC is determined by the forward amp-time only. When it is Enabled the amp-time accumulated for an ATC is the forward amp-time minus the reverse amp-time.

Figure 6-10: System Key

SYS - System Key:
Used to access System status and settings.

`1>Status and Misc Settings`
This item is use to check various unit values and change unit settings including:

`1>Show Firmware Version` - in the controller board (not the terminal).

`2>Show Installed Options` - that are in the unit. See Section 6.3 Options.

`3>Show System Timers` - shows the overall times for the unit which include the duration the unit has been powered On, the duration the unit has been in Operate and the overall amp-time, in Amp-Hours, the unit has delivered including both forward and reverse amp-time.

`4>Ext Opr Input Options` - allows setting up how a remote operate switch will control the unit. NOTE that these settings are Unit based, not Step based so they will be active during a complete recipe.

`1>OPR w/Ext Inpt Closed` - this is the default mode. The unit will operate when the switch is closed and go to standby or pause when the switch is opened. Uses an on/off switch.

`2>Set Opr/Stby 1 Push` - this mode allows the cycle to be started with 1 push of a momentary switch. When the cycle is done pressing the switch again will stop the flashing display, turn off the alarm if enabled and start a new cycle.

`3>Set Opr/Stby 2 Push` - this mode will start a cycle with the first push of a momentary switch. When the cycle is finished pressing the switch will only stop the flashing display and turn off any alarm. Pressing the switch a second time will start a new cycle.

`5>Relay Control Options` - control what turns the relay on and off. NOTE that these settings are Unit based, not Step based so they will be active during a complete recipe.

`1>ATC Controlled` - the relay is controlled by Amp-Time accumulation using the settings in the CYCLE CNTRL menu.

`2>On During Operate` - the relay is on when the unit is operating. The relay will turn off when a cycle is paused and back on when restarted. The relay is off when the Trickle Mode is active.

`3>On During Alarm` - the relay turns on whenever an alarm sounds. Could be used for an external End Of Cycle indication using the EOC alarm.

6>Edit Protect is, Off - this setting will not allow any Setups or Recipes to be edited when it is turned on. Setups or Recipes can only be recalled from memory when edit protection is on. To change the edit protection state press the ENTER key with this item showing on the top line. Enter the password to change the state.

2>Regulation Modes

Used to set the type of output regulation.

1>Current Reg - regulates current to the user set limit and allows the voltage to go the power supply's rated voltage.

2>Crossover Reg - regulates both current and voltage so they do not go beyond the user set limits.

3>Voltage Reg - regulates voltage to the user set limit and allows the current to vary up to the power supply's current rating, peak or average depending on settings.

3>Current and Voltage Tolerances

Sets the Tolerance limit for the output current and voltage to stay within. A setting of zero disables the tolerance checking. The setting is a percentage of the current or voltage setting. When in Operate, if the output goes out of tolerance the meter for that given signal will flash. If the alarm is enabled for a current or voltage error the alarm will also sound. If the alarm is sounding, pressing the ALARM key will show which signal was out of tolerance.

4>Resolution of Settings and Totalizer

The Resolution menu item is used to set the resolutions of the various parameters in the system. Resolution can be set for:

1>Set Totalizer Resol. - sets the main totalizer resolution.

2>Set Real Time Resol. - set the resolution of real time cycles.

3>Set Amp Time Resol. - set the resolution of amp time cycles

4>Set Fwd/Rev Resolution - sets the forward and reverse (if reverse is installed) timing resolution.

5>Set On/Off Resolution - sets the on time and off time pulsing resolution (if the unit has pulsing capability).

6>Set Ramp Time Resol. - sets the resolution of the ramp time

5>Calibration

This menu item is used to calibrate the output and meters. Refer the Calibration section of this manual for more information.

6>Password setup - Option

Set Password allows the operator to set a password other than the default password of 0000. The current password is required in order to set a new password. Use the number keys to enter the old and new passwords.

7>Control Sources - Option

Used to select Panel control mode or Analog control mode if the optional Analog Interface is installed.

Figure 6-11: Pulse Timing Key

PULSE TIMING - Pulse Timing Key:
Accesses the settings to control the pulsing and reversing of the output waveform.

```
1>Forward Pulse On Time
2>Forward Off Time between pulses
3>Forward Time Duration - Option
4>Reverse Time Duration - Option
5>Reverse Pulse On Time - Option
6>Reverse Off Time between pulses - Option
```

DC Timing (DC, DCR, CRS & CRSR systems Only)
DC units do not use the Pulse Timing key (**F2 key**) unless they has a reversing option. DC units with the reversing capability only use the Forward Time Duration and Reverse Time Duration menu items.

Dual Level Timing (DPD & DuPD systems Only)
The Dual Level control system uses the Forward and Reverse timing settings to control the timing of the two different levels rather than having the reversing capability.

When setting timing values the following rules apply.

- When running single direction, forward only or reverse only, <u>the On and Off times rule</u> the wave shape. The Direction time can be any non-zero value. For example, if the Forward Direction time is 1ms and the Forward On and Off times are 10ms then the waveform period would be 20ms for a frequency of 50Hz and a duty cycle of 50%.

- To run DC the Direction time and On time can be any value and the Off time must be zero. For single direction DC on a Pulse Reverse unit or DC unit with reverse, the opposite Direction time must be zero.

- When running optional pulse reversing <u>the Direction times rule</u>. The On and Off times work within the given Direction time. For example, if the timing was set the same as in 1 above in both forward and reverse then the output would be on for 1ms forward and 1ms reverse for a waveform period of 2ms, a frequency of 500Hz and a duty cycle of 50% fwd/rev. Another example would be Fon=2ms,

Foff=2ms, Fwd=6ms, Rev=4ms, Ron=1ms and Roff=1ms. This would yield a waveform with 2 pulses of 2ms each in the forward direction for a 66.7%fDC ((2+2) / 6) and 40%efDC ((2+2) / (6+4)), and 2 pulses of 1ms each in the reverse direction for a 50%rDC ((1+1) / 4) and 20%erDC ((1+1) / (6+4)).

See Section 7, Pulse Math, for more information about the calculations involved in pulse plating.

Figure 6-12: Save / Recall Key

SAVE / RECALL - Save and Recall Key:
Used to Save, Recall and Delete settings as Setups and optionally Recipes.

```
1>Save Setup
2>Recall Setup
3>Delete Setup
4>Save Recipe - Option
5>Recall Recipe - Option
6>Delete Recipe - Option
```

See the Programming section below for more information on saving and recalling.

Figure 6-13: Alarm / Silence Key

ALARM / SILENCE - Alarm Key:
Used to enable and disable Alarms and to Silence alarms that are sounding. Press ENTER to enable or disable an alarm and ESC to exit the menu. If an alarm is sounding and this key is pressed the Display will show what type of alarm caused the problem and silence the alarm (if the alarm condition persists the alarm will sound again when the key is released, press STBY and determine the cause of the alarm).

```
1>End Of Cycle Alarm
```

The alarm will sound at the end of an ATC or RTC cycle when this alarm is enabled. The alarm output will also go active when the alarm is sounding.

```
2>Current Tolerance Error Alarm
```

When this alarm is enabled the alarm will sound when the current at the output is outside the tolerance setting. Note that a tolerance setting of 0 disables tolerance checking.

```
3>Voltage Tolerance Error Alarm
```

When this alarm is enabled the alarm will sound when the voltage at the output is outside the tolerance setting. Note that a tolerance setting of 0 disables tolerance checking.

```
4>Relay Output On Alarm
```

Enabling this alarm will cause the alarm to sound while the Relay Output is on.

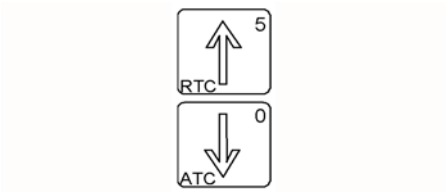


Figure 6-14: Arrow Keys

Arrow Keys:
Used to adjust settings and to scroll through the menu options.

The Up Arrow key can also be used to quick-set a Real Time cycle when the unit is in Manual cycle mode.

Optionally, the Up Arrow key will show the Recipe Looping status during operate. The Looping values count down from the loop count setting to 1.

Optionally, the Down Arrow key can be used to quick-set an Amp Time cycle when the unit is in the Manual cycle mode.

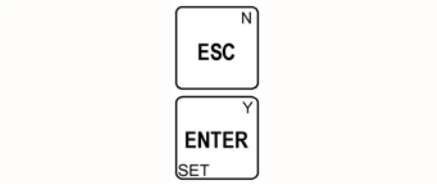


Figure 6-15: Escape and Enter Keys

ESC - Escape Key:
Takes the Display back to the Main screen. When in menus, pressing ESC will go back to the previous menu. Also gets out of settings that are being adjusted. NOTE: Settings will not be changed back to previous values if they have been adjusted. The ESC key is also used for a NO response to action confirmation questions.

In the optional Recipe Edit mode the ESC key is used to go to the start of the recipe. If pressed again when at the start of the recipe the ESC key will take the unit out of the Recipe Edit mode. When in the Loop Edit mode the ESC key will go back to step 1 settings if at a different step or exit the Loop setting mode if at step 1.

ENTER - Enter Key:
Used to cycle through the Main screen and the Forward settings screen and optional Reverse settings screen. Also used to accept values that have been adjusted. The ENTER key is also used as a YES response to action confirmation questions.

In the optional Recipe Edit mode the ENTER key is used to cycle through the recipe steps. In the Loop mode the ENTER key switches between the 2 loop settings.

Figure 6-16: Number Keys

Number Keys:
Used to enter Passwords, Setup Numbers and Recipe Steps and Numbers.

6.2 Programming

Setups

Setups are used to save a set of settings for recall when needed. A Setup can save settings for a Manual cycle, a RTC cycle or an ATC cycle. All the settings that control the power supply for any given cycle are saved to non-volatile memory. The Setups that are saved can be recalled when needed for a particular job. They can also be used as steps in the Recipe option.

The status of the setup is shown in the upper right corner of the main screen as in Figure 6-17: Main Screen with Setup. If the setup status shows Setup XX*, the XX means that the setup has not been saved to permanent memory yet. The * means that the setup has changed since the last save or operate and needs to be saved.

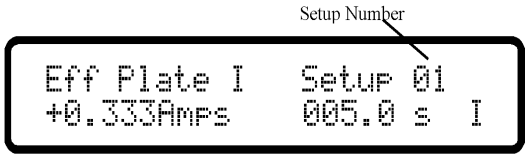
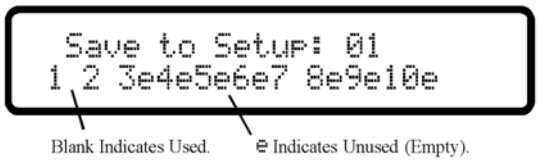


Figure 6-17: Main Screen with Setup

Saving Setups

To create a Setup, change all the settings to the desired values. Then press the SAVE / RECALL key. Select 1>Save Setup from the menu. The following screen will appear:

After a short time the second line of the screen will change showing the Setups that are used and unused as shown on the following screen.



Enter the desired setup number using the number keys. Press the ENTER key to save the setup. If there is already a setup saved at that location the unit will ask for confirmation as to whether or not the setup should be overwritten. Pressing ENTER again will save the setup and overwrite the old one. Pressing ESC will not save the setup and return to the SAVE / RECALL menu where the setup can be saved to a different location.

Recalling Setups

To recall a setup, press the SAVE / RECALL key. Select 2>Recall Setup from the menu. Enter the desired setup number using the number keys. Press ENTER to recall the setup. A confirmation screen will appear asking whether or not the currently active settings should be overwritten by this setup being recalled.

Deleting Setups

To delete a setup, press the SAVE / RECALL key. Select 3>Delete Setup from the menu. Enter the desired setup number using the number keys. Press ENTER to delete the setup. A confirmation screen will appear asking whether or not the selected setup should be deleted.

Recipes

Recipes are an optional feature that allow setups to be linked together to perform more complex plating cycles. A recipe has up to 8 steps that can be loaded with setups. The steps can be any setup that has been saved. The setups can be in any order and any setup can be repeated any number of times in the recipe up to the maximum number of steps allowed in the recipe.

Recipes use the setups in memory. This means that if a setup is part of a recipe and that setup is changed and saved, the function of the recipe will also change.

NOTE: Care must be taken to prevent undesired changes to recipes when editing and saving setups.

Editing Recipes

There are several steps in creating a working recipe. A basic recipe with the desired number of steps with setup numbers entered must be created. The setups in a recipe can be created and saved before or after a recipe is created. If the setups were not edited and saved before creating the recipe, then they will need to be edited and saved before the recipe can be run.

To create a recipe, select CYCLE CNTRL, 3>Setup Recipe Cycle menu item. A screen will appear with a blank recipe ready for editing as shown below. The S1 at the top left of the display stands for Step1 of the recipe. The flashing cursor below the S1 is waiting for the entry of a setup number. Enter the desired setup numbers for the recipe using the Number Keys. The step numbers will automatically increment as setup numbers are entered.

```
S1    Enter Recipe Steps
 _    Using Number Keys
```

There are a number of keys used to edit and modify a recipe when in the Recipe Edit mode. These are listed below.

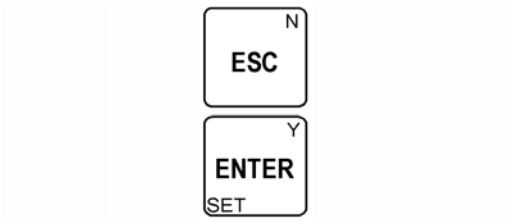


Figure 6-18: Escape and Enter Keys

ESC - Escape Key:

In the Recipe Edit mode the ESC key is used to go to the start of the recipe. If pressed again when at the start of the recipe the ESC key will take the unit out of the Recipe Edit mode and into Recipe Run mode (unless no setups were entered).

A recipe can be cleared out (no steps) by pressing the ESC key for about 1 second. This can be used to start a new recipe.

ENTER - Enter Key:

In the Recipe Edit mode the ENTER key is used to cycle through the recipe steps.

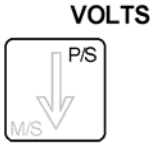


Figure 6-19: Pause Recipe Step Key

P/S - Pause Recipe Step Key (VOLTS Down Key)

In the Recipe Edit mode the P/S key is used to change the pause state of the recipe step that the flashing cursor is under. Pressing the P/S key will change the step from S to P and back again, i.e. S2 to P2 to S2.

Use the ENTER key to position the cursor under the step to be paused. Press the P/S key to change the pause state of that step.

When the step shows a P, the step will run and then pause the recipe when the step's cycle is done. This can be used when a part has to be moved or rotated during a recipe.

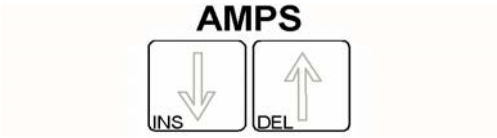


Figure 6-20: Insert and Delete Keys

INS and DEL - Insert and Delete keys (AMPS Arrow Keys):
In the Recipe Edit mode the INS key will Insert a step at the current cursor location. The DEL key will Delete the step at the current cursor location.

When finished entering steps press the ESC key once to get to the start of the recipe and again to exit the Recipe Edit mode. Press ESC to get back to the Main screen if it is not shown. The Main screen will now show the recipe status in the upper right corner as shown in Figure 6-20: Main Screen with Recipe. This is the Recipe Run mode where the recipe can be run or the setups in the recipe edited.

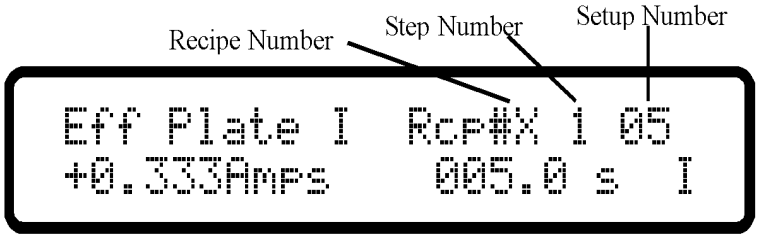


Figure 6-21: Main Screen with Recipe

When the screen shows Rcp#X, the X means that the recipe does not have a number yet because it has not been saved. If the recipe status shows Rcp#X*, the * means that the recipe has changed but is not saved. Also a * behind the Setup number means the active step's setup has changed and is not saved. A recipe cannot be run if a setup is unsaved.

The setups within the recipe can be edited when in the Recipe Run mode if desired. Use the RIGHT ARROW key, as shown in Figure 6-21: Right Arrow Key, to cycle through the steps. If a step has changed the unit will not allow the next step to be displayed unless the current setup is saved or the edits canceled. A confirmation screen will appear showing that the setup has changed and asking if it should be saved. Pressing ENTER will save the setup changes and then display the next step. Pressing ESC will display the next step and the previous step's setup changes will be lost.

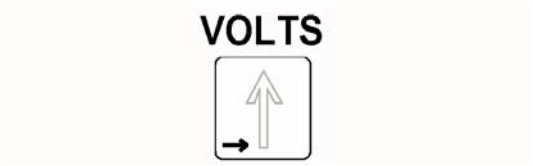


Figure 6-22: Right Arrow Key

ARROW RIGHT key (VOLTS UP Key):
When in the Recipe Run mode (Rcp# is shown on the main screen) the Volts Up arrow key is used to cycle through the recipe steps shown on the main screen. Each time the Volts Up key is pressed the next Recipe step will be loaded. The recipe step can then be edited.

Saving, Recalling and Deleting Recipes
Recipes are Saved, Recalled and Deleted just like the Setups description above.

> **NOTE: A recipe that has not been saved can be run. However, if the power supply is turned off or power is lost any changes to the active recipe step will be lost (the saved setups will not be lost). Be sure to save the recipe steps promptly.**

Running a Recipe
If a Rcp# is showing on the display then the unit is in the Recipe Run mode. To run the recipe, press the OPR key. The unit will check the setups in the recipe to see if they are valid before operating. If one or more are not valid, a screen will appear to allow the first invalid setup to be saved. If the setups are valid the unit will load the first step's setup and run it. When that setup is finished the next step's setup will load and run. This will continue until all steps have been run and the unit goes to standby and flashes the end of cycle display message.

> **NOTE: All setups within a recipe must have either Real Time or Amp Time cycle control. If a setup in a recipe has Manual cylce control the recipe will run any preceding RTC or ATC steps and then run the Manual step forever until the STBY key is pressed. Any steps beyond the Manual one will not run.**

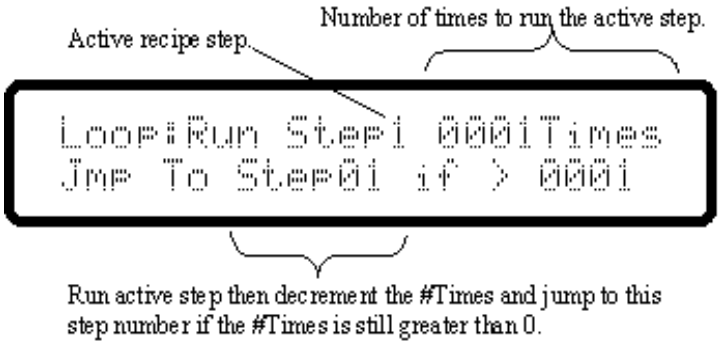
Canceling Recipe Run Mode
The Recipe Run mode can be canceled by selecting CYCLE CNTRL, 5>Setup Manual Cycle menu item. It can also be canceled by recalling a setup.

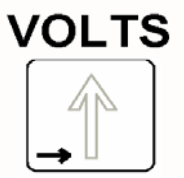
Looping Recipe Steps

The Looping function allows a step or series of steps to be repeated a preset number of times. Looping only works with the Recipe option. The loops can be nested up to 8 levels (one loop for each of the 8 available recipe steps). Up to 8 steps can be repeated in any given loop (only the 8th step can repeat all 8 steps). Each loop can run up to 9999 times.

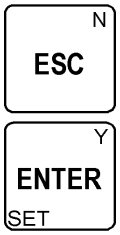
Editing Loops

Loop Edit mode is entered by selecting the 4>Setup Recipe Looping menu item in the CYCLE CNTRL menu. A recipe needs to be active for this function to work. The editing screen looks like the one shown below.



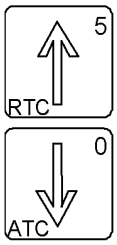


Use the RIGHT ARROW (VOLTS Up) key to cycle through the steps in the recipe so that Number Of Times and Jump To Step for each step can be set.



Use the ENTER key to switch between the 'Number Of Times' to repeat this step and the 'Jump To Step Number' selections.

Use the ESC key to return to the first step. If at the first step then pressing the ESC key will take the unit out of Loop Edit mode. Holding down the ESC key for about 1 second when in the Loop Edit mode will clear the looping values to the defaults.



To enter the **Number Of Times** use the UP and DOWN arrow keys. Press the ENTER key if the cursor is not blinking next to the Number Of Times. The minimum number of times is 1, which runs the active step only once and continues with the following step. Setting this value to 2 will run this step and then decrement the Number Of Times to 1 and then go to the Jump To Step and run that step and any step between that step and this active step. It will then run this step again and decrement the Number Of Times to 0 and go on to the following step. Any number up to 9999 can be entered.
To enter the **Jump To Step Number** use the NUMBER keys. Press the ENTER key if the cursor is not blinking next to the Jump To Step number. Press the number key corresponding to the step number in the recipe that the recipe should jump to after this step is complete. Only numbers 1 to 8 can be entered. The editor will not allow entry of a number larger than the current active step number (can only jump to previous steps). Holding down the ESC key for about 1 second when in the Loop Edit mode will clear the looping values to the defaults (Number Of Times = 1 and Jump To Step = 1, for no looping). These values are also cleared when a new recipe is started or a recipe is cleared.

6.3 Options

The MicroStar has many optional features that allow a customer to purchase only the features that are needed for the processes being run. The Options installed in a power supply can be viewed using the SYS, 1>Status and Misc. Sets, 2>Show Installed Options menu item. A list of options installed will be shown on the Display. If there are more than 5 options installed, pressing the ENTER key will show more options.

```
 Options Installed
RTC ATC RLY SUP  MORE..
```

Figure 6-23: Options List Screen

The following is a list of the Option abbreviations and a description of the option.

RTC - Real Time Control:
This Standard feature allows the duration of a cycle to be controlled automatically by "Real-Time" (same as clock time; hours, minutes or seconds). This feature can be accessed through the CYCLE CONTROL key or quickly through the blue ARROW UP key.

ATC - Ampere Time Control:
This allows the duration of a cycle to be controlled automatically by Amp-Time (amps times time, 5Amps * 5Minutes = 25AmpMinutes). This feature can be accessed through the CYCLE CONTROL key or quickly through the blue ARROW DOWN key.

RMP - Ramp Function:
This allows the start of a cycle to ramp up the current or voltage setting over a period of time starting at a user settable starting offset level. This feature can be accessed via the F1 key.

RLY - Relay Output Control:
This feature controls a relay that can control a pump to add chemicals to a bath or circulate the plating solution. The pump can come on after a user set amount of Amp-Time and remain on for a user set amount of Real-Time. This feature can be accessed through the CYCLE CONTROL key.

SUP - Setups Feature:
This Standard feature allows saving of setups to non-volatile memory for future recall. This feature can be accessed through the SAVE / RECALL key.

REV - Reverse Package:
This optional package allows the power supply to reverse the output current for Periodic Pulse Reverse Plating. Setting the Reverse pulsing parameters via the PULSE TIMING key enables this feature.

ANL - Analog Control:
This option allows the power supply current and voltage levels to be controlled by analog input levels. The pulsing parameters must be preset using the control panel for this feature to work properly. This feature is enabled via the SYS key, 7>Set Control Source menu item.

LFP - Low Frequency Pulse:
This setting is for CRS style power supplies with low frequency pulsing capability. Power supplies with this capability have certain limits on pulsing. They can run DC or pulse with a minimum on-time of 4ms and off-time of 1ms. With these limits the highest frequency pulsing that can be output is 200Hz with an 80% duty cycle.

DCO - DC Output:
This setting is for power supplies that only work in the DC mode.

MSV - Master Slave:
This option allows a unit set as a Master to control the timing and operation of a unit set as a Slave. The Master can control up to 9 Slave units. The control panel on the Master is used to make settings on the Slave units. All units use the timing set in the Master.

RCP - Recipe Control:
This optional feature allows the power supply to control complex multi-step plating processes. Recipes work by linking multiple Setups together and running them in sequence. Looping is used to repeat 1 or more steps in a recipe for a preset number of times. This feature is accessed through the CYCLE CONROL key for editing a recipe and the SAVE / RECALL key to allow recipes to be saved, recalled and deleted.

TKL - Trickle Mode:
This optional feature allows the power supply to output a low level current at the end of a cycle. When enabled, the Trickle function sets the output level to the trickle setting, checks the voltage level at the output and then changes the reg mode to crossover and sets the voltage setting to the voltage level. This allows a part to be extracted from the bath with a voltage controlled limit on the current so the part does not burn. The trickle function works when the operator presses the STBY key if the unit is in MANUAL mode or when the unit goes to Standby at the end of an ATC or RTC cycle.

6.4 Getting Started

Basic Operation of the unit is described below. Go through the tests in the order shown for the settings to work properly. For DP and DuP units follow the DP flow. For DPR and DuPR units follow the DPR flow. For DC follow the DC flow in section 6.4.1.

6.4.1. DC output test.

6.4.1.1. Connect a load to the output of the power supply that can handle the supply's ratings.

6.4.1.2. Turn on the unit using the breaker switch on the front panel.

6.4.1.3. The unit is supplied with all settings defaulted and set to zero so timings and output levels must be entered. For DC units, go to 6.4.1.11.

6.4.1.4. Press the PULSE TIMING key.

6.4.1.5. Select 1>Set Forward On Time using the blue UP and DOWN arrow keys and press ENTER.

6.4.1.6. Use the blue UP and DOWN arrow keys to set a non-zero time, say 1.00ms and press ENTER.

6.4.1.7. For DP units, go to 6.4.1.10.

6.4.1.8. For DPR units select 3>Set Forward Duration using the blue arrow keys and then press the ENTER key.

6.4.1.9. Use the blue UP and DOWN arrow keys to set a non-zero time, say 2.00ms and press ENTER.

6.4.1.10. Press ESC and the Main screen will show.

6.4.1.11. Press the ENTER key once and the Forward Settings screen will appear. Notice that the forward duty cycle is 100% due to the pulsing settings entered and not setting a forward off time and no reverse settings (if the unit has reverse).

6.4.1.12. Press the green AMPS UP arrow key to set a low test current level of say 10% of rating (the default regulation mode is current).

6.4.1.13. Press the ENTER key to accept the current setting.

6.4.1.15. The unit is now ready to run a DC output at the current setting shown on the display.

6.4.1.16. Press the OPR key to turn on the unit's output.

6.4.1.17. The meters should show an output current and voltage depending upon the load being used.

6.4.1.18. Press the STBY key to turn the output off. For DC units, continue with 6.4.4.

6.4.2. Pulsing output test.

6.4.2.1. Press the PULSE TIMING key.

6.4.2.2. Select 2>Set Forward Off Time using the blue UP and DOWN arrow keys and press ENTER.

6.4.2.3. Use the blue UP and DOWN arrow keys to set a non-zero time, say 1.00ms.

6.4.2.4. Press ENTER and then ESC and the Main screen will show.

6.4.2.5. Press the ENTER key once and the Forward Settings screen will appear. Notice that the forward duty cycle is now 50% due to the pulsing settings entered.

6.4.2.6. Press ESC to get to the main screen. Notice that the Effective Plate Current is 50% of the current setting entered above for the DC settings.

6.4.2.7. Press the OPR key to turn on the unit's output.

6.4.2.8. The meters should show an output current and voltage depending upon the load being used and about half the value that showed when running the DC settings above.

6.4.2.9. Press the STBY key to turn the output off.

6.4.3. Pulse Reverse output test (Pulse Reverse units only).

6.4.3.1. Press the PULSE TIMING key.

6.4.3.2. Select 4>Set Reverse Duration using the blue UP and DOWN arrow keys and press ENTER.

6.4.3.3. Use the blue UP and DOWN arrow keys to set a non-zero time, say 2.00ms, and press ENTER.

6.4.3.4. Select 5>Set Rev On Time using the blue UP and DOWN arrow keys and press ENTER.

6.4.3.5. Use the blue UP and DOWN arrow keys to set a non-zero time, say 1.00ms, and press ENTER.

6.4.3.6. Select 6>Set Rev Off Time using the blue UP and DOWN arrow keys and press ENTER.

6.4.3.7. Use the blue UP and DOWN arrow keys to set a non-zero time, say 1.00ms, and press ENTER.

6.4.3.8. Press ENTER and then ESC and the Main screen will show.

6.4.3.9. Press the ENTER key once and the Forward Settings screen will appear. Notice that the forward duty cycle is now 50% and the effective forward duty cycle is 25% due to the pulsing settings entered.

6.4.3.10. Press the ENTER key once and the Reverse Settings screen will appear. Notice that the reverse duty cycles are the same as the forward duty because the settings are the same.

6.4.311. Press the green AMPS UP arrow key to set the reverse current to the same value as the forward current set above.

6.4.3.12. Press the ENTER key to accept the current setting.

6.4.3.13. Press ESC to get to the main screen. Notice that the Effective Plate Current is 0 (zero). This is due to the reverse settings being the same as the forward settings resulting in no effective plating current.

6.4.3.14. Press the ENTER key once to get to the Forward Settings screen.

6.4.3.15. Press the green AMPS UP arrow key to set the forward current to a value twice as large as entered before, say 20% of unit rating.

6.4.3.16. Press the ENTER key to accept the current setting.

6.4.3.17. Now the Effective Plate Current should be 12.5% of the forward current setting if all the values were entered as described.

6.4.3.18. Press the OPR key to turn on the unit's output.

6.4.3.19. The meters should show an output current and voltage depending upon the load being used and about one quarter the value that showed when running the DC settings above.

6.4.3.20. The meters show the Effective values when the Main screen is showing. Press the ENTER key once to display the Forward screen. Now the meters will show the Average Forward output values only. Press the ENTER key one more time to display the Reverse screen. The meters now show the Average Reverse output values. Press the ENTER key once and you will be back to the Effective values. Notice that the Effective values equal the Average Forward minus the Average Reveres values.

6.4.3.21. Press the STBY key to turn the output off.

6.4.4. Real Time Controlled (RTC) cycle setup.

6.4.4.1. Press the blue UP arrow key to quickly set an RTC cycle. (Timed cycles can also be set up using the CYCLE CNTRL key.)

6.4.4.2. Use the blue arrow keys to adjust the time to 5 seconds.

6.4.4.3. Press the ENTER key to accept the time.

6.4.4.4. The main screen will show a 005.0s real time cycle period.

6.4.4.5. Press the OPR key to run this 5 second cycle.

6.4.4.6. At the end the unit will automatically turn off it's output and go to standby. Press the STBY key to clear the flashing display.

6.4.5. Amp Time Controlled (ATC) cycle setup (if this option is installed).

6.4.5.1. Now press the blue DOWN arrow key until the RTC setting is 0.

6.4.5.2. Press the ENTER key and the main screen will show that the RTC control is canceled and back to Manual control.

6.4.5.3. Press the blue DOWN arrow key again and the display will go to the quick ATC cycle setting screen.

6.4.5.4. Press the UP arrow key and set a small amp time value, say 0.100 Am (Amp Minute).

6.4.5.5. Press the ENTER key to accept this setting.

6.4.5.6. The main screen will show a 0.100Am amp time cycle period.

6.4.5.7. Press the OPR key to run this .100 Am cycle.

6.4.5.8. At the end the unit will automatically turn off it's output and go to standby. Press the STBY key to clear the flashing cycle done display.

6.4.6. Using Setups.

6.4.6.1. Press the SAVE/RECALL key.

6.4.6.2. Select 1>Save Setup using the ENTER key.

6.4.6.3. The bottom line of the screen will show numbers 1 to 10 with either an 'e' or a space behind them. The 'e' shows that the location is empty while a space shows that the location has something saved in it.

6.4.6.4. Enter a setup number, using the number keys, to set the location where the current settings will be saved to, say 2 (the F1 key).

6.4.6.5. Press the ENTER key and the setup will be saved.

6.4.6.6. Press ENTER again to get back to the SAVE/RECALL menu

6.4.6.7. Press ESC to get back to the main screen. You will notice that the Setup number has changed from XX to 02.

6.4.6.8. Press the blue DOWN arrow key to set the ATC to 0 and press ENTER to get Manual mode. You will notice that a * is next to the Setup 02 showing that the setup has changed.

6.4.6.9. Press the SAVE/RECALL key.

6.4.6.10. Select 1>Save Setup using the ENTER key.

6.4.6.11. Enter a setup number to set the location the current settings will be saved to, say 3.

6.4.6.12. Press the ENTER key and the setup will be saved.

6.4.6.13. Press ENTER again to get back to the SAVE/RECALL menu

6.4.6.14. Select 2>Recall Setup.

6.4.6.15. Press the 2 key and press ENTER.

6.4.6.16. The screen will show a message asking if you wish to load this setup. Press ENTER to load it and ESC, ESC to get back to the main screen.

6.4.6.17. The main screen shows that the ATC cycle setup has been recalled.

6.4.6.18. Repeat the recall for setup 3 and the Manual cycle setup will be recalled.

6.4.6.19. To delete a setup, select 3>Delete Setup from the SAVE/RECALL menu and enter number 2 and press ENTER.

6.4.6.20. The screen will show a message asking for confirmation to delete the setup. Press the ENTER key and the setup will be deleted. Press ESC to get back to the SAVE/RECALL menu.

6.4.6.21. Try recalling setup #2 and a message will be displayed saying it was deleted.

6.4.7. Setup System Settings

This section describes setting up the system for the process being run.

6.4.7.1. **Set the desired resolutions.**

6.4.7.1.1. Resolutions control the range and precision that a given timer or totalizer can span. For example the ATC timer has 4 digits of resolution but the user can select from 8 ranges in Amp-Minutes and Amp-Hours.

6.4.7.1.2. Press the SYS button and select the 4>Set Resolutions menu item.

6.4.7.1.3. The following resolution items can be set.

6.4.7.1.3.1. Totalizer is the main user totalizer that can be reset when desired.

6.4.7.1.3.2. Real Time timer (RTC) controls the duration of a timed cycle in real time (clock time).

6.4.7.1.3.3. Amp Time timer (ATC) controls the duration of a timed cycle in amp time (amps x clock time).

6.4.7.1.3.4. Forward and Reverse Direction times controls the duration of a given direction when pulse reversing.

6.4.7.1.3.5. On and Off Pulse times controls the duration of pulses and off time between pulse.

6.4.7.1.3.6. Ramp time in seconds or minutes.

6.4.7.1.4. Use the blue UP and DOWN arrow keys and the ENTER key to select the desired item and the desired resolutions for each item.

6.4.7.1.5. When done use the ESC key to get back to the main screen.

6.4.7.2. **Set the Regulation Mode.**

6.4.7.2.1. Press the SYS button and select the 2>Set Regulation Mode menu item.

6.4.7.2.2. Select one of the following regulation modes using the blue UP and DOWN arrow keys and the ENTER key.

6.4.7.2.2.1. Current Reg - regulates current to the user set limit and allows the voltage to go the power supplies rated voltage.

6.4.7.2.2.2. Crossover Reg - regulates both current and voltage so they do not go beyond the user set limits.

6.4.7.2.2.3. Voltage Reg - regulates voltage to the user set limit and allows the current to vary up to the power supplies current rating, peak or average depending on settings.

6.4.8. Messages

The following are messages that may be displayed and their meaning.

6.4.8.1. **Msg01 I Limit: >100ms**

This message is displayed when the pulse On Time is greater than 100ms or DC and the current setting is greater than the unit's average current rating. Either the pulse duration must be decreased or the current setting reduced to the average rating or below.

6.4.8.2. **Msg02 I Limit: Sum > Ave**

This message means that the average forward or reverse current when running single direction or the sum of the average forward and reverse current when running pulse reverse is greater than the unit's average current rating. The sum of the current in both directions cannot be greater than the average current rating of the unit. Reduce the current levels or reduce the duty cycles to keep this message from showing.

6.4.8.3. **Msg03 I Limit: V Reg Duty**

This message shows that the peak current is being automatically reduced because the duty cycle set in voltage regulation mode could cause the output to go beyond the unit's ratings. The current is reduced proportionally to the duty cycle until the average current rating is reached. This is an information only message because the current reduction process is automatic in voltage regulation mode.

6.4.8.4. **Pulsing Params Not Valid, Please Recheck Them**

This message is displayed when the waveform timing settings are not valid for pulsing. This would be displayed if all pulse settings, the ON time or the DIR time (for a PR unit) are set to 0.

6.4.8.5. If messages like Msg01 and Msg02 are being displayed the best thing to do is to reduce the current settings to a value below the average current rating of the unit. Then adjust the pulsing values to the desired settings. Then readjust the current to the desired level. If the message is displayed when adjusting the current back up, then the desired current cannot be obtained with the pulsing parameters that are set. One or the other will have to change.

SECTION 7

PULSE MATHEMATICS
HOW TO DETERMINE DUTY CYCLE, AVERAGE CURRENT, PEAK CURRENT, AVERAGE VOLTAGE, PEAK VOLTAGE, AND PLATING CYCLE PRESET

7.0 OVERVIEW - D.C. vs. PULSE

Platers are accustomed to calculating plating time (ampere-time) using D.C. amperage which, for practical purposes, is a steady, unchanging current. See Figure 7-1a. When a pulse power supply is used, the current is no longer steady and unchanging. It now is ON for some time and OFF for some time. This is depicted in Figure 7-1b.

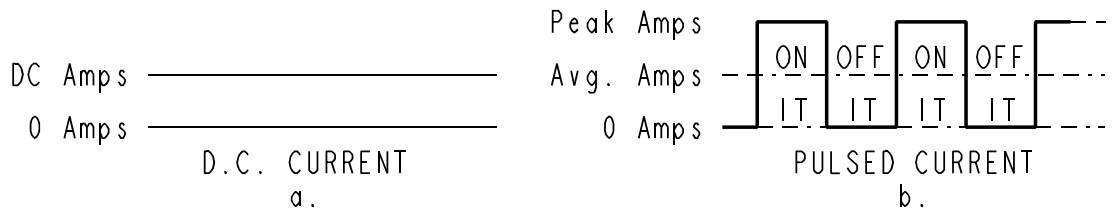


Figure 7-1

This ON and OFF current introduces the parameter DUTY CYCLE into the calculations. This is the ratio that the power supply is ON in relation to the total ON and OFF (cycle) time.

As shown in Figure 7-1, the level of current during the ON time of the Pulsed Current is twice the amplitude of the D.C. Current. However, the current is only there half of the time since both the ON and OFF time are 1 Time unit long. Therefore, twice the amplitude times half of the time will equal one (1/2 x 2 = 1) or if the upper half of the pulse ON Time in Figure 7-1b were placed in the lower half of the OFF time the energy in the output would equal one times the D.C. level shown in Figure 7-1a.

The amplitude of the pulse (ON time) is called PEAK current. The level of energy which is equal to the D.C. level when time (or DUTY CYCLE) is considered is called AVERAGE current.

The relationship of these 3 parameters is:

$$Average\_current = Peak\_current \times Duty\_cycle$$

All pulse plating calculations are performed, basically, to obtain the D.C. equivalent (AVERAGE) current to allow the plater to control the plating thickness. Pulse mathematics are straight-forward when calculating unipolar (single direction ON and OFF) parameters. Unipolar may be either cathodic or anodic. As the pulse waveform becomes more complicated, so do the calculations. This will be apparent when PERIODIC REVERSE is introduced. Also remember that the same relationship (Avg. = Pk. x Duty Cycle) given above for current is true when calculating voltage.

7.1 DUTY CYCLE

As previously stated, DUTY CYCLE is the ratio of the ON time to the total ON and OFF period (cycle) time. Referring to Figure 7-2, the total ON and OFF period time is 10 milliseconds (mS). The ON time is 1 mS. and the OFF time is 9 mS. This is a 10% DUTY CYCLE because the ON time is 1/10 of the period (ON + OFF).

$$DUTY\_CYCLE = \frac{ON\_Time}{ON\_Time + OFF\_TIME}$$

$$DC\,\% = \frac{1\,mS}{1\,mS + 9\,mS} \times 100 = \frac{1\,mS}{10\,mS} \times 100 = .1 \times 100 = 10\%$$

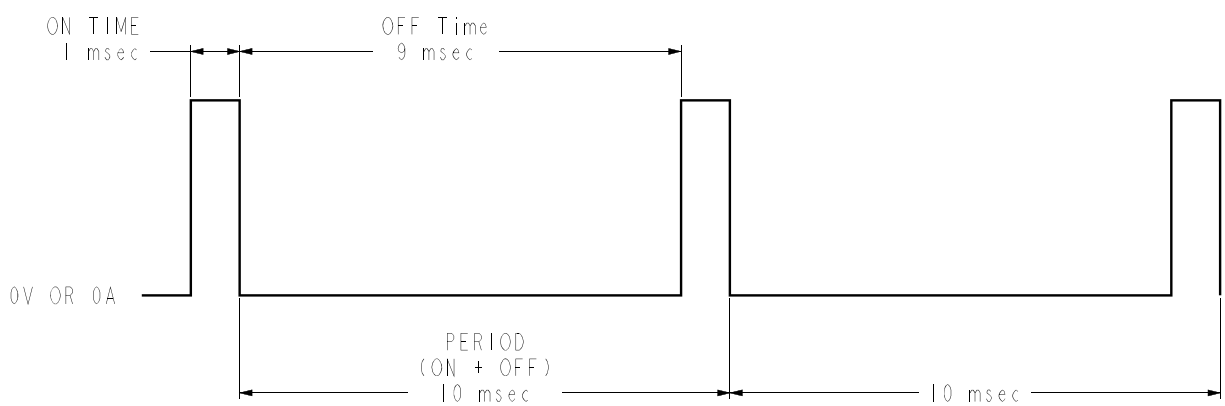


Figure 7-2

If the ON time increases and the OFF time decreases by the same amount, the ON + OFF period time would remain the same while the DUTY CYCLE would increase. For example, if the ON time was 2 mS and the OFF time 8 mS the ON + OFF period would be the same, 10 mS, but the DUTY CYCLE would become 20%.

The fact that the PERIOD does not change means that the FREQUENCY of the pulsed waveform is not changing either since:

$$Frequency = \frac{1}{Period}$$

Therefore, DUTY CYCLE can be changed while maintaining a certain FREQUENCY by changing ON and OFF time equal but opposite amounts.

Conversely, FREQUENCY can be changed while DUTY CYCLE remains unchanged by changing both ON and OFF times proportionate amounts in the same direction. For example, if, in the previous example where ON time was increased to 2 mS, the OFF time was increased two-fold also instead of decreased by 1 mS, the DUTY CYCLE would be:

$$DC = \frac{2\ mS}{2\ mS + 18\ mS} \times 100 = \frac{2\ mS}{20\ mS} \times 100 = .1 \times 100 = 10\%$$

The FREQUENCY, however, would be:

$$Freq. = \frac{1}{2\ mS + 18\ mS} = \frac{1}{20\ mS} = 50\ Hz$$

Whereas, in the first example, it was:

$$Freq. = \frac{1}{1\ mS + 9\ mS} = \frac{1}{10\ mS} = 100\ Hz$$

7.2 PEAK REGULATION

Typically, Dynatronix power supplies are PEAK regulated whether they are constant current or constant voltage. This means that the operator control sets the PEAK current or voltage and the power supply holds that peak value constant despite any change in load resistance or DUTY CYCLE.

Of course, a change in DUTY CYCLE, with the PEAK being held constant will change the AVERAGE output in accordance with:

$$Average = Peak \times Duty\_cycle$$

When The operator selects

to regulate the average current, the power supply maintains that AVERAGE value despite any change in load resistance or DUTY CYCLE. For this reason the PEAK must be calculated rather than the AVERAGE. It is as follows:

$$Peak = \frac{Average}{Duty\_cycle}$$

It is important with this type of regulation that the operator be cognizant that a change in DUTY CYCLE will change the PEAK amplitude with <u>no</u> apparent change in the output as displayed on the front-panel meters. This is because the meters are displaying AVERAGE which is the parameter being held constant. This is also true for the readback via analog programmable control.

7.3 AVERAGE

All Dynatronix Power Supplies, whether manual, programmable or both, measure, display and/or report output in AVERAGE. This is appropriate as AVERAGE is the equivalent of D.C. with which the majority of plating personnel is familiar. AVERAGE, which is the product of PEAK and DUTY CYCLE, is, therefore, used in calculating current density and AMPERE-TIME among other things.

7.4 AMPERE-TIME

AMPERE-TIME is used to control plating thickness and is calculated as follows:

$$Ampere \bullet Time = Average\_current \times Time$$

If an Ampere-Time
Controller is being used to determine the plating cycle (thickness), the AMPERE-TIME is set directly into the PRESET. The ATC then monitors the output current over a period of time, calculates the AMPERE-TIME and stops the plating when the PRESET amount is reached.

If a Real-Time Timer is used instead, it is PRESET to the TIME which the power supply must run at a given AVERAGE current to reach the correct AMPERE-TIME. The TIME is calculated as follows:

$$Time(To\_be\_Preset) = \frac{Required\_Ampere \bullet Time}{Average\_Current}$$

7.5 PERIODIC REVERSE

Periodic Reversing or Bipolar Power Supplies have the capability of changing the direction or polarization of the output. Output in the same direction as a unipolar unit is called FORWARD. This is when the (+) terminal (anode) is positive with respect to the (-) terminal (cathode). Output in the opposite direction as a unipolar unit is called REVERSE. This is when the (+) terminal (anode) is <u>negative</u> with respect to the (-) terminal (cathode).

DUTY CYCLE (PR)

Calculating the DUTY CYCLE for P/R is essentially the same as for unipolar - the ratio of the ON time to the total PERIOD or cycle.
As seen in Figure 7-2, the PERIOD is the total ON + OFF time or the PERIOD of time from a beginning point of the waveform to the point where the waveform begins to repeat. This is one cycle or PERIOD.
With PERIODIC REVERSE, there are 3 possible PERIODS:

1) **Forward ON + OFF**
2) **Reverse ON + OFF**
3) **FORWARD + REVERSE**

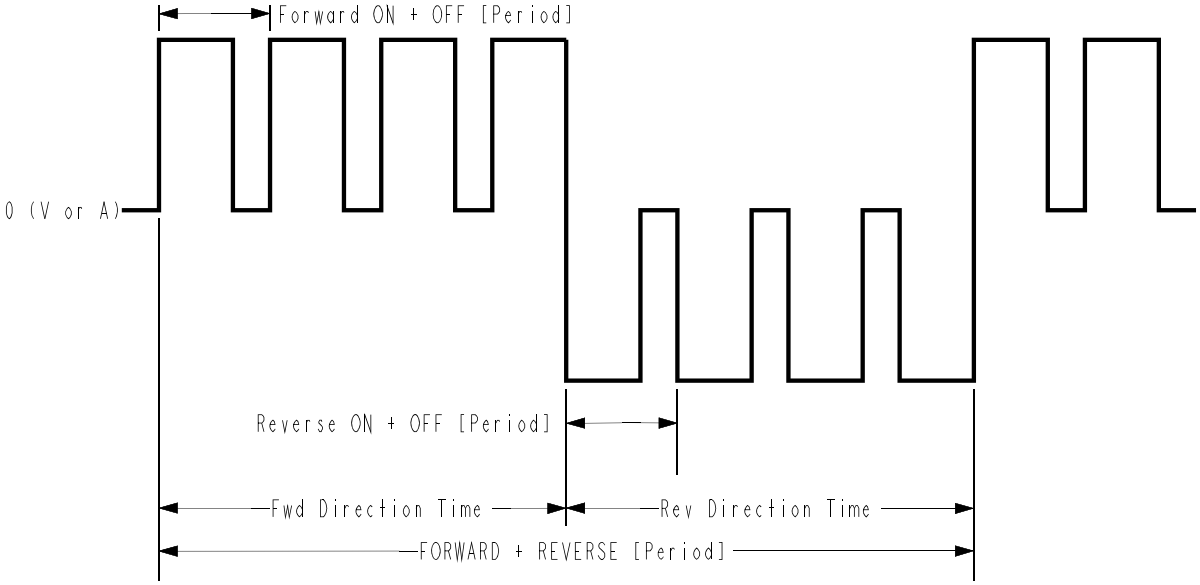


Figure 7-4
THREE POSSIBLE PERIODS OF A P/R WAVEFORM

Figure 7-4 points out these different PERIODS using a P/R waveform with pulsing in both directions.
The difference in calculating DUTY CYCLE of unipolar and bipolar waveforms is that with unipolar it is only necessary to deal with one PERIOD - the ON + OFF. Only one ON time and one PERIOD (ON + OFF) is used. Whereas, with bipolar, several ON + OFF PERIODS, as well as the FWD + REV PERIOD must be used to determine DUTY CYCLE. P/R DUTY CYCLE is sometimes referred to as the EFFECTIVE DUTY CYCLE and is calculated as follows:

$$EDC(this\_dir.) = \frac{Total\_On\_Time(this\_dir.)}{Time(this\_dir.) + Time(opposite\_dir.)}$$

The two most important things to remember are that any time in the opposite direction is the same as OFF time to the direction being calculated and that <u>all</u>. of.the ON time must be considered for the direction being calculated not just the ON time of one ON + OFF period.
The difficult part of the calculation is the TOTAL ON TIME, especially if there are not an even number of ON + OFF cycles in the direction being calculated.

To determine the TOTAL ON TIME, the number of ON + OFF cycles must be extracted. This is accomplished by dividing the time for the direction being calculated by the ON + OFF period for that direction. Take the integer (whole number) from this calculation and multiply it by the ON time set for the direction being calculated. Note this value as it is to be used later. Next any fractional value remaining from the number of ON + OFF cycles calculation is multiplied times the ON + OFF period time. If the set ON time is larger than this value, add this value to the noted value above this is the TOTAL ON TIME (This Direction). If the value is larger than the set ON time, add the set ON time to the previously noted value and this is the TOTAL ON TIME (This Direction).

Once the TOTAL ON TIME is known, simply divide it by the sum of the TIME (This Direction) + TIME (Opposite Direction), which is the FWD + REV PERIOD, to obtain the EFFECTIVE DUTY CYCLE (This Direction). Multiply by 100 to put into a percentage. As with unipolar, once the EFFECTIVE DUTY CYCLE is determined, it is multiplied by the PEAK current set for this direction to obtain the AVERAGE current. The next step would be to calculate AMPERE-TIME PRESET to ultimately determine the plating thickness.

DEAD TIME is a factory determined settling time between direction changes in Dynatronix pulse reversing power supplies. Figure 7-5 shows Dead Time. Dead Time is actually a time between direction changes where the output is 0 Amps. Dead Time is repeatable, and is almost always of extremely short duration. Due to these factors, it can be, and is, generally disregarded in duty cycle calculations.

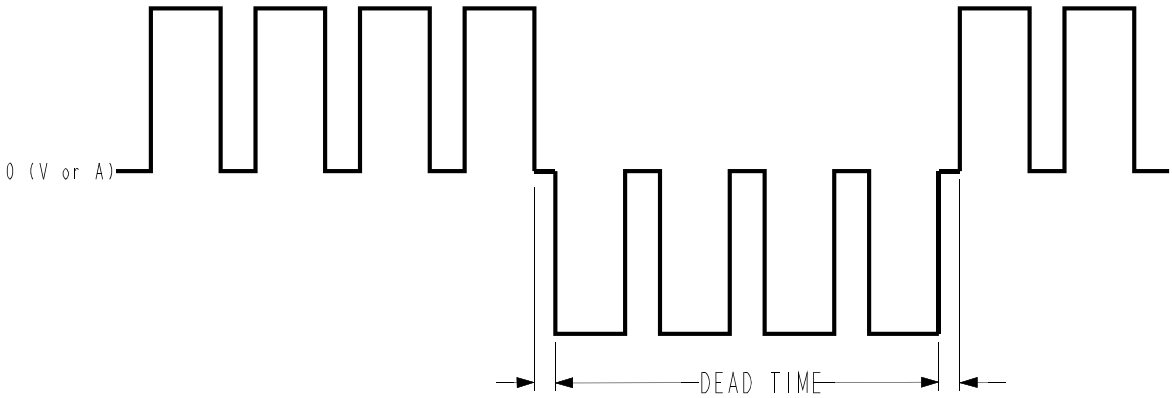


Figure 7-5
Dead Time

PERIODIC REVERSE AMPERE-TIME PRESET

AMPERE-TIME PRESET with a unipolar power supply is simply setting the desired AMPERE-TIME required into an ATC or dividing it by the calculated AVERAGE current to determine the TIME to be set into a Real-Time Timer.
However, in order to obtain the desired plating thickness when using P/R, the REVERSE AMPERE-TIME must be factored in because any time spent in REV subtracts from the progress made during FWD due to the fact that REV actually etches material away.

To calculate the EFFECTIVE PLATING CURRENT, the REV AVERAGE CURRENT is subtracted from the FWD AVERAGE CURRENT. One more parameter that may be considered is the REV DEPLATING (etching) to PLATING RATIO of the bath being used. Certain baths may deplate (etch) slower (or faster) than they plate and would thus affect the AMPERE-TIME PRESET required for the desired plating thickness. The calculation for EFFECTIVE PLATING CURRENT is:

$$Effective\_Plating\_current = Forward\_Average\_Current - (Reverse\_Average\_Currrent. \times Rev\_Dpltg\_to\_Pltg\_Ratio)$$

NOTE: If AMPERE-TIME is recorded for chemical additions, some chemicals may be depleted in REV. as well as FWD. in which case the FWD. AVERAGE CURRENT and REV. AVERAGE CURRENT should be added rather than subtracted.

Having calculated the EFFECTIVE PLATING CURRENT, the actual plating time required can be determined by dividing the AMPERE-TIME required for the desired thickness by the EFFECTIVE PLATING CURRENT:

$$Time = \frac{Required\_Ampere \bullet Time}{Effective\_Plating\_Current}$$

If a Real-Time Timer is being used to control the plating cycle, this TIME would be entered into its PRESET. If an AMPERE-TIME CONTROLLER is controlling the plating cycle an additional calculation is required. The ATC is normally accumulating only the FWD. AMPERE-TIME which, as shown above, would be a higher rate than the EFFECTIVE PLATING RATE. A larger number would, therefore, have to be entered into the PRESET so that the actual plating cycle would equal the TIME based on the EFFECTIVE AVERAGE CURRENT previously calculated. The PERIODIC REVERSE AMPERE-TIME PRESET is determined as follows:

$$ATC\_Preset = Forward\_Average\_current \times \frac{Required\_Ampere \bullet Time}{Effective\_Plating\_Current}$$

SECTION 8
CALIBRATION

8.0 Overview

The MicroStar Pulse interface utilizes digital trimming techniques rather than discrete trim pots. Calibrating these units is accomplished by adjusting trim settings for each calibration parameter through the MicroStar Pulse interface.

There are up to 32 calibration parameters for a MicroStar Pulse unit with analog control. Only the output settings need to be manually calibrated through the interface. The input readings are calibrated automatically reducing the calibration time by about half. Table 8-1 shows the number of calibration values for various units. The calibration values are written into non-volatile memory where they are retained permanently.

Unit Features	# of Manual Calibration Values	# of Automatic Calibration Values	Total
Fwd only or DC	4	4	8
Fwd + Rev	8	8	16
Fwd + Analog	8	8	16
Fwd + Rev + Analog	16	16	32

Table 8-1: Calibration Values by Unit Feature

Calibration accuracy is still measured by certified test equipment connected externally, but the supply enclosure does not have to be entered. Calibration equipment required are a meter, a current shunt and a load as described below.

8.1 Equipment

Meter(s)

One or two calibrated Digital Volt Meters (DVMs) of at least 4.5 digit resolution and .01% overall accuracy. Using 2 meters is faster when switching from current to voltage calibration but is not necessary.

Current Shunt

A certified shunt with a temperature coefficient of no more than 5 ppm should be used. It is recommended that a 100 mV shunt which is rated at an even power of ten (1A, 10A, etc.) be used. This will require less conversion of the meter reading, requiring only decimal point placement. The rating of the shunt should be at least 1.25 times greater than the average current rating of the power supply. Certified shunts are available from most shunt manufacturers including:

EMPRO MANUFACTURING COMPANY INC.
P.O.BOX 26060
INDIANAPOLIS, IN. 46226
PHONE: (317) 823-4478
Part Number - MLA-1-100 for a 100mV/1Amp Shunt

Loads

The load should be a resistor of approximately twice the required wattage to prevent injury to personnel or equipment and to prevent significant temperature drift. When calibrating the current settings, a value should be chosen which allows approximately 50% of the voltage at the rated current of the power supply.

When calibrating the voltage settings, the value should allow for 50% of the current at the rated voltage of the power supply. An adjustable carbon pile load works well.

EXAMPLE: Power supply rating is 12-100-400 or 12 Volts at 100 Amps average and 400 Amps peak current. Use the average current value when calculating the required load for calibration.

CURRENT CALIBRATION: The voltage developed across load should be approximately 6 volts at 100 amps average current.

To determine the resistor value use Ohms law:

$$\frac{6volts}{100amps} = 0.06ohms$$

To determine the wattage use:

$$6 \text{ volts x } 100 \text{ amps} = 600 \text{ watts}$$

To calibrate the current settings it will be necessary to connect a load resistor with a value of .06 ohms and 1200 watts.

VOLTAGE CALIBRATION: The current developed across load should be 50 amps at 12 volts.

To determine the resistor value use Ohms law:

$$\frac{12volts}{50amps} = 0.24ohms$$

To determine the wattage use:

$$12 \text{ volts x } 50 \text{ amps} = 600 \text{ watts}$$

To calibrate the voltage settings it will be necessary to connect a load resistor with a value of .24 ohms and 1200 watts.

8.2 Output Calibration

Setup

1. Connect the calibration load , shunt and meters to the output of the power supply as shown in Figure 8-1.
2. With the unit in STANDBY press the SYS key.
3. Use the ARROW keys to scroll to 5)Calibrate Sets/Reads \ and press ENTER.
4. Enter 4 digit password.
5. Use the ARROW keys to select the parameter being calibrated.

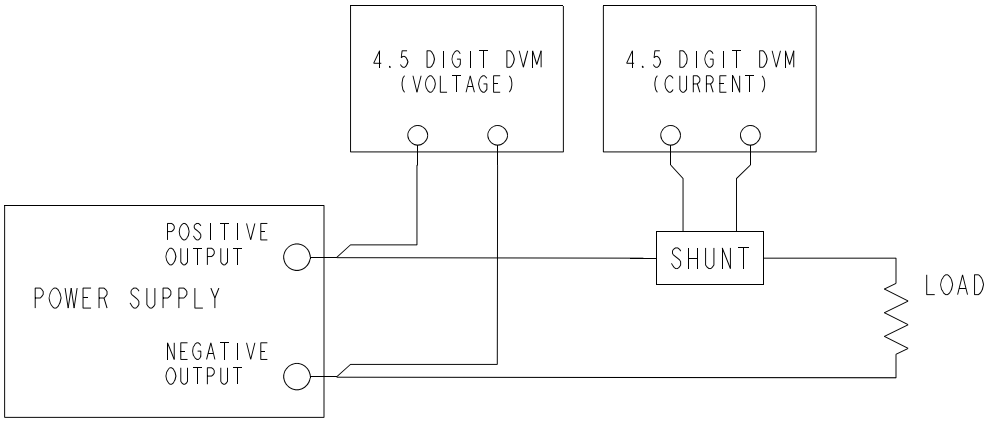


Figure 8-1: Output Calibration Connections

Current Output Cal - Forward

1. Connect the appropriate load for current calibration as determined in section 8.1.
2. Use the ARROW keys to select `1)Cal Hi Fwd I Out R0 \` and press ENTER.
3. Use the ARROW keys to adjust the calibration value until the output current on the meter connected to the shunt reads the proper value for 100% of the average current rating of the supply. (Example: For a DP(R)20-30-100 using a 100A/100mV shunt, 100% of the average current rating of the supply will be 30mV).
4. When the meter reading is correct press the ENTER key.

> NOTE: The READING calibration value is taken when the ENTER key is pressed. Allow at least **1 second** after the calibration value is adjusted before pressing the enter key to allow the output and readback to stabilize.

5. Use the ARROW keys to select `2)Cal Lo Fwd I Out R0 \` and press ENTER.
6. Use the ARROW keys to adjust the calibration value until the output current on the meter connected to the shunt reads the proper value for 10% of the average current rating of the supply. (Example: For a DP(R)20-30-100 using a 100A/100mV shunt, 10% of the average current rating of the supply will be 3mV).
7. When the meter reading is correct press the ENTER key.

> NOTE: Adjusting the calibration value UP will bring the output current UP and vice versa.

8. Repeat steps 2 through 7 as necessary to recheck the calibration.

Current Output Cal - Reverse (Option)

If the Reverse Option is installed, the Reverse Current Output is calibrated in the same way as Forward by using the ARROW keys to select

`3)Cal Hi Rev I Out R0 \` and
`4)Cal Lo Rev I Out R0 \` menu items

Voltage Output Cal - Forward

1. Connect the appropriate load for voltage calibration as determined in section 8.1.
2. Use the ARROW keys to select `5)Cal Hi Fwd V Out \` and press ENTER.
3. Use the ARROW keys to adjust the calibration value until the output voltage on the meter connected across the power supply outputs reads the proper value for 100% of the voltage rating of the supply.
4. When the meter reading is correct press the ENTER key.

> NOTE: The READING calibration value is taken when the ENTER key is pressed. Allow at least 1 second after the calibration value is adjusted before pressing the enter key to allow the output and readback to stabilize.

5. Use the ARROW keys to select `6)Cal Lo Fwd V Out \` and press ENTER.
6. Use the ARROW keys to adjust the calibration value until the output voltage on the meter connected across the power supply outputs reads the proper value for 10% of the voltage rating of the supply.
7. When the meter reading is correct press the ENTER key.

> NOTE: Adjusting the calibration value UP will bring the output current UP and vice versa.

8. Repeat steps 2 through 7 as necessary to recheck the calibration.

Voltage Output Cal - Reverse (Option)

If the Reverse Option is installed, the Reverse Voltage Output is calibrated in the same way as Forward by using the ARROW keys to select

`7) Cal Hi Rev V Out \` and

`8) Cal Lo Rev V Out \` menu items.

8.3 Analog Calibration (Option)

If the optional Analog Control interface is installed in the power supply, follow this procedure to calibrate it.

Setup - 4-20mA, 0-5v or 0-10v Interface

1. Connect the calibrator (Ronan model x86 or equiv.) to the Analog Control connector of the power supply as shown below. The calibrator should be set to a range that will maximize resolution for a 20ma signal (5v for 0-5v or 10v for 0-10v).
2. Install two jumpers as shown below. One jumper from 3 to13 and one from 4 to 14.
3. With the unit in STANDBY press the SYS key.
4. Use the ARROW keys to scroll to `5)Calibrate Sets/Reads \` and press ENTER.
5. Enter 4 digit password.
6. Use the ARROW keys to select the parameter being calibrated.

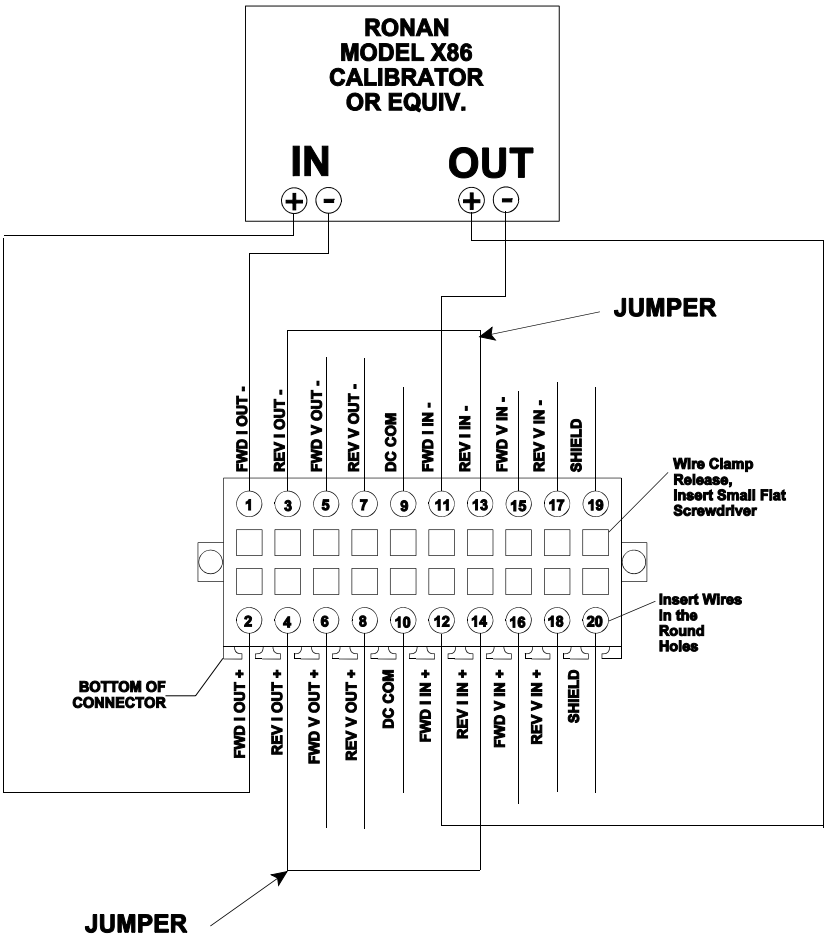


Figure 8-2: Analog Calibration Connections
Forward Current channel

Analog Channel Cal

1. Set the **calibrator output** to 20mA. (5v for 0-5v or 10v for 0-10v).
2. Use the ARROW keys to select 13)Cal Hi Anl Fwd I Out\ and press ENTER.
3. Use the ARROW keys to adjust the calibration value until the **calibrator input** reads the proper value for 100% analog control signal 20mA for 4-20mA interface (5v for 0-5v or 10v for 0-10v).
4. When the **calibrator input** reading is correct press the ENTER key.

> NOTE: The Analog Input calibration value is taken when the ENTER key is pressed. Allow at least **3 seconds** after the calibration value is adjusted before pressing the enter key to allow the output and readback to stabilize.

5. Set the **calibrator output** to 5.6mA for 4-20mA (0.5v for 0-5v or 1v for 0-10v).
6. Use the ARROW keys to select 14)Cal Lo Anl Fwd I Out\ and press ENTER.
7. Use the ARROW keys to adjust the calibration value until the **calibrator input** reads the proper value for 10% analog control signal 5.6mA for 4-20mA interface (0.5v for 0-5v or 1v for 0-10v).
8. When the **calibrator input** reading is correct press the ENTER key.

> NOTE: Adjusting the calibration value UP will bring the output current UP and vice versa.

9. Repeat steps 1 through 8 as necessary to recheck the calibration.
10. Repeat steps 1 through 9 for the remaining Analog Control channels. Switch the meter connections to the next set of + and - terminals (i.e. from 1 and 2 to 3 and 4 respectively, and from 11 and 12 to 13 and 14 respectively) that the supply uses for analog control. Also, switch the jumpers (See Fig. 8-2a thru 8-2d). If the Reverse Option is not installed, skip the reverse terminals and menu items.

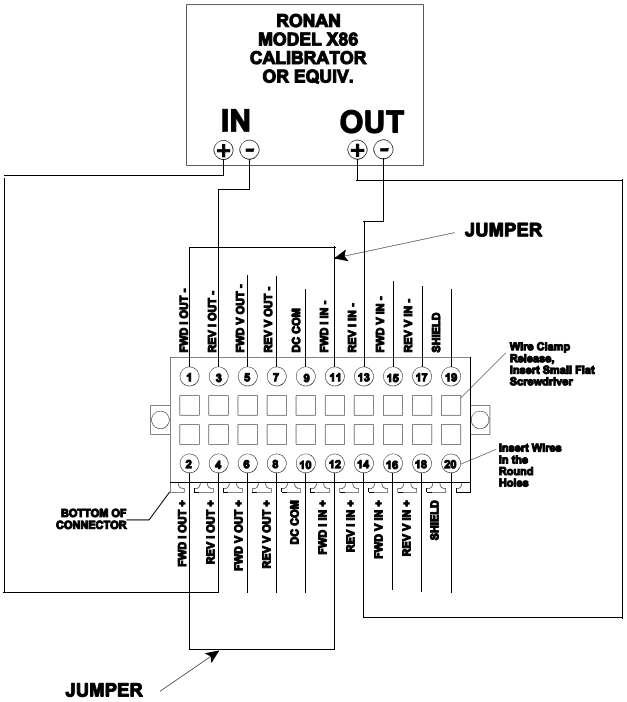


Figure 8-2b: Analog Calibration Connections
Reverse Current Channel

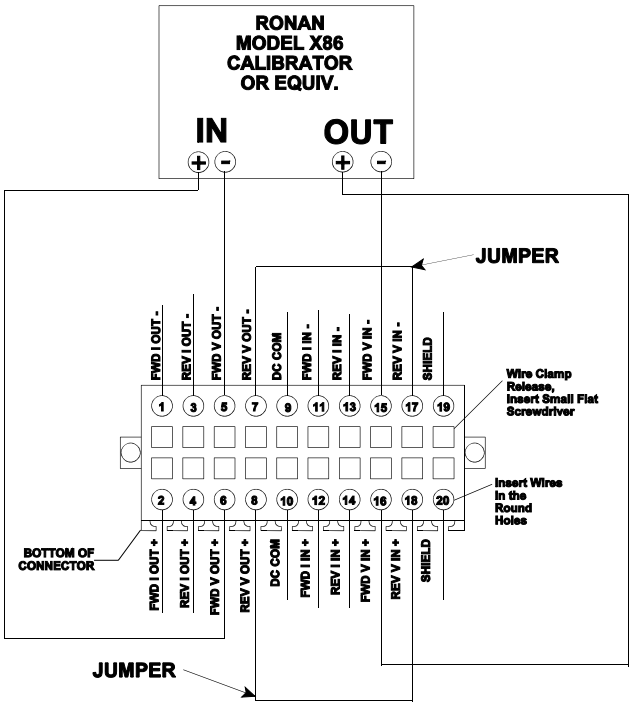


Figure 8-2c: Analog Calibration Connections
Forward Voltage Channel

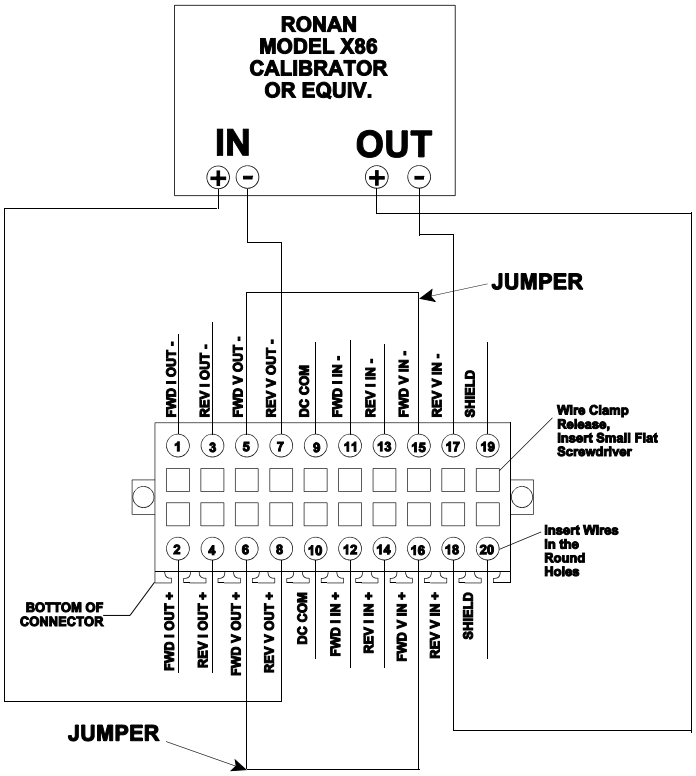


Figure 8-2d: Analog Calibration Connections Reverse Voltage Channel

Section 9
OPTIONAL FEATURES AND CONTROLS

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10.1 **Spare Parts List**

Qty	Description	Dynatronix P/N
1	CCA, Mach-2 Terminal	138-0348-01
1	CCA, Mach-2 Controller	138-0334-xx
1	CCA, Output Driver, with Bridge	138-0385-xx
1	Diode Block, 35Amp, 600V	022-0178-00
1	230Vac Fuse, 1 Amp, 250VAC, slow blow, 1/4x1-1/4	070-0221-00
1	115Vac Fuse, 1.25 Amp, 250VAC,slow blow, 1/4x1-1/4	070-0101-00
Note:	Configuration information must be set into the second item (138-0334-xx) when replacing a malfunctioning board assembly. Consult factory when replacing the second item. The -xx on the part number will change depending on unit size.	

10.2 **Reference Documentation**

Description	Part Number
Schematic, DµP(R)10 Series Overall	131-0711-00
Schematic, Mach-2 Terminal	231-0348-01
Schematic, Mach-2 Controller	231-0334-00
Schematic, Output Driver, with Bridge	231-0385-00
Schematic, Mach-2 Analog Interface	231-0362-00
Manual, DµP(R)10 Series w/MicroStar	198-1300-00

APPENDIX A - MicroStar Pulse Display Flow Diagram

Power On

Micro* DP Trmnl VX.XX.XX Controller Initializing	Terminl Sign-On
Dynatronix Inc. Microstar DP/R Control	Control Sign-On
Eff Plate I Setup XX +0.333Amps 1.234AM-prktI	Main Screen

Main Screen Desciption

	Plate Mode Label, Ave Curr or Volt, Setup or Recipe Control Features
Indicator	Control Feature Descp.
-	Fwd minus Rev ATC control
p	Pause Recipe Step at end
r	Ramp feature enabled
k	Relay feature enabled
t	Trickle feature enabled
I, X, V	Active Regulation mode

NOTE: ESC always takes the display back to the Main screen

↑ Arrows select menu
↓ items or adjust values

Press ENTER to accept a value

At Main Screen

Switching Settings Screens

Main Screen

ENTER

Eff Plate I Setup XX	
+0.333Amps Manual I	

Press ENTER

Forward Settings

Vfwd=XX.XV	33.3%fDC
Ifwd=1.000A	33.3%efDC

Press ENTER

Reverse Settings(optional)

Vrev=XX.XV	33.3%fDC
Irev=0.000A	33.3%efDC

Press ENTER

Main Screen

Eff Plate I	Setup XX
+0.333Amps	Manual I

Regulation mode changed to Cross-over using SYS menu.

To Adjust Peak Current

AMPS ↑ ↓

Eff Plate I	Setup XX
+0.333Amps	Manual X

Press ENTER

Vfwd=20.0V	33.3%fDC
Ifwd=1.000A	33.3%efDC

AMPS ↑

Incr Fwd Current Setting
Current Setting = 1.550A

Press ENTER

Vfwd=20.0V	33.3%fDC
Ifwd=1.550A	33.3%efDC

Press ESC

To Adjust Peak Voltage

VOLTS ↑ ↓

Eff Plate I	Setup XX
+0.516Amps	Manual X

Press ENTER

Forward Settings

Vfwd=20.0V	33.3%fDC
Ifwd=1.550A	33.3%efDC

VOLTS ↓

Value Adjustment Screens

Decr Fwd Voltage Setting
Voltage Setting =07.8V

Press ENTER

Vfwd=07.8V	33.3%fDC
Ifwd=1.550A	33.3%efDC

Press ESC

Same for Reverse but _Press_ ENTER **twice (Reverse is an option).**

Quick Set a Real Time cycle

↑ ↓

Eff Plate I	Setup XX
+0.516Amps	Manual X

↑ to start

Real Time cycle
Preset=000.1 Sec

↑ to ↓ adjust

Real Time cycle
Preset=056.5 s

Press ENTER

Eff Plate I	Setup XX
+0.516Amps	056.5 s X

To Clear a Timer cycle

↑ ↓

Eff Plate I	Setup XX
+0.516Amps	056.5 s X

↓ to start

Real Time cycle
Preset=056.4 s

↓ until zero

Time cycle
Preset=0000 s

Press ENTER

Eff Plate I	Setup XX
+0.516Amps	Manual X

Quick Set an Amp Time cycle

↑ ↓

Eff Plate I	Setup XX
+0.516Amps	Manual X

↓ to start

Amp Time cycle
Preset=0000Am

↑ to ↓ adjust

Amp Time cycle
Preset=0187Am

Press ENTER

Eff Plate I	Setup XX
+0.516Amps	0187Am X

SYS	1>Status and Misc. Sets<	_Press_ ENTER	1>Show Firmware Version	_Press_ ENTER	Version 1.20.00	Press ESC			
			2>Show Installed Options	"	Options Installed RTC ATC RLY SUP More...	_Press_ ENTER	Options Installed REV RCP	Press ESC
			3>Show System Timers	"	Hr Mtr On00037 Opr00021 AHr Meter = 0000159	"		
			4>Ext Opr Input Options	"	1>OPR w/Ext Input Closed	"		
				"	2>Set Opr/Stby 1 Push	"		
				"	3>Set Opr/Stby 2 Push	"		
			5>Relay Control Options	"	1>ATC Controlled	"		
				"	2>On Durning Operate	"		
				"	3>On During Alarm	"		
			6>Edit Protect is, Off	"	6>Edit Protect is, Off Password =	Enter Password	6>Edit Protect is, On	Press ESC
SYS	2>Set Regulation Mode <	_Press_ ENTER	1>Set Current Reg. Mode	_Press_ ENTER	Unit Set To Current Reg Ctol=00% Vtol=00%	Press ESC		
			2>Set Crssovr Reg. Mode	"	Unit Set To Crssovr Reg Ctol=00% Vtol=00%	"		
			3>Set Voltage Reg. Mode	"	Unit Set To Voltage Reg Ctol=00% Vtol=00%	"		
SYS	3>Set Curr & Volt Tol	_Press_ ENTER	1>Set Curr Tol. Window	_Press_ ENTER	Current Tol. % Window Tolerance % =00	↑ to ↓ adjust	NOTE: A setting of Zero disables Tolerance checking.	Press ENTER
			2>Set Volt Tol. Window	"	Voltage Tol. % Window Tolerance % =00	"		"
SYS	4>Set Resolutions	"	1>Set Totalizer Resol.	_Press_ ENTER	1>X.XXX Amin	_Press_ ENTER	X.XXX Amin Resolution Set	Press ESC
					2>XX.XX Amin	"	XX.XX Amin Resolution Set	"
					3>XXX.X Amin	"	XXX.X Amin Resolution Set	"
					4>XXXX Amin	"	XXXX Amin Resolution Set	"
					5>X.XXX Ahrs	"	X.XXX Ahrs Resolution Set	"
					6>XX.XX Ahrs	"	XX.XX Ahrs Resolution Set	"
					7>XXX.X Ahrs	"	XXX.X Ahrs Resolution Set	"
					8>XXXX Ahrs	"	XXXX Ahrs Resolution Set	"

2>Set Real Time Resol.	_Press_ ENTER	1>XXX.X Sec	_Press_ ENTER	XXX.X Sec Resolution Set	Press ESC
		2>XX.XX Min	“	XX.XX Min Resolution Set	“
		3>XXX.X Min	"	XXX.X Min Resolution Set	"
		4>XX.XX Hrs	"	XX.XX Hrs Resolution Set	"
		5>XXX.X Hrs	"	XXX.X Hrs Resolution Set	"
3>Set Amp Time Resol.	_Press_ ENTER	1>X.XXX Amin	_Press_ ENTER	X.XXX Amin Resolution Set	Press ESC
		2>XX.XX Amin	“	XX.XX Amin Resolution Set	“
		3>XXX.X Amin	"	XXX.X Amin Resolution Set	"
		4>XXXX Amin	"	XXXX Amin Resolution Set	"
		5>X.XXX Ahrs	"	X.XXX Ahrs Resolution Set	"
		6>XX.XX Ahrs	"	XX.XX Ahrs n Resolution Set	"
		7>XXX.X Ahrs	"	XXX.X Ahrs Resolution Set	"
		8>XXXX Ahrs	"	XXXX Ahrs Resolution Set	"
4>Set Fwd/Rev Resolution	_Press_ ENTER	1>XX.XX mSec	Press ENTER		
		2>XXX.X mSec	"		
		3>X.XXX Sec	"		
		4>XX.XX Sec	"		
5>Set On/Off Resolution	_Press_ ENTER	1>XX.XX mSec	Press ENTER		
		2>XXX.X mSec	"		
		3>X.XXX Sec	"		
		4>XX.XX Sec	"		
5>Set Ramp Time Resol.	_Press_ ENTER	1>XXXX Sec	Press ENTER		
		2>XXXX Min	"		

SYS	5>Calibrate Sets/Reads	_Press_ ENTER	Password=XXXX	Enter Passwrd			
			1>Cal Hi Fwd I Out R0	_Press_ ENTER	Cal Ave. Fwd Curr Out R0 Arrows to Adjust: 1333	↑ to ↓ adjust	Then ENTER
			2>Cal Lo Fwd I Out R0	"	Cal 10% Fwd Curr Out R0 Arrows to Adjust: 0400	"	Then display goes to Cal menu to allow next Cal
			3>Cal Hi Rev I Out R0	"	Cal Ave. Rev Curr Out R0 Arrows to Adjust: 1333	"	Or Press ESC to Exit
			4>Cal Lo Rev I Out R0	"	Cal 10% Rev Curr Out R0 Arrows to Adjust: 0400	"	Then asks to Save Cal Table? ENTER=Yes ESC=No
			5>Cal Hi Fwd V Out	"	Cal 100% Fwd Volt Output Arrows to Adjust: 4000	"	"
			6>Cal Lo Fwd V Out	"	Cal 100% Fwd Volt Output Arrows to Adjust: 0400	"	"
			7>Cal Hi Rev V Out	"	Cal 100% Rev Volt Output Arrows to Adjust: 4000	"	"
			8>Cal Lo Rev V Out	"	Cal 100% Rev Volt Output Arrows to Adjust: 0400	"	"
	NOTE: Menu items 9 to 12 are only for a Dual Ramge system.		9>Cal Hi Fwd I Out R1	"	Cal Ave. Fwd Curr Out R1 Arrows to Adjust: 4000	"	"
			10>Cal Lo Fwd I Out R1	"	Cal Ave. Fwd Curr Out R1 Arrows to Adjust: 0400	"	"
			11>Cal Hi Rev I Out R1	"	Cal Ave. Rev Curr Out R1 Arrows to Adjust: 4000	"	"
			12>Cal Lo Rev I Out R1	"	Cal Ave. Rev Curr Out R1 Arrows to Adjust: 0400	"	"
	NOTE: Menu items 13 to 20 are only displayed if Analog Option installed.		13>Cal Hi Anl Fwd I Out	"	Cal 100% Anlg Fwd I Out Arrows to Adjust: 4000	"	"
			14>Cal Lo Anl Fwd I Out	"	Cal 10% Anlg Fwd I Out Arrows to Adjust: 0400	"	"
			15>Cal Hi Anl Rev I Out	"	Cal 100% Anlg Rev I Out Arrows to Adjust: 4000	"	"
			16>Cal Lo Anl Rev I Out	"	Cal 10% Anlg Rev I Out Arrows to Adjust: 0400	"	"
			17>Cal Hi Anl Fwd V Out	"	Cal 100% Anlg Fwd V Out Arrows to Adjust: 4000	"	"
			18>Cal Lo Anl Fwd V Out	"	Cal 10% Anlg Fwd V Out Arrows to Adjust: 0400	"	"
			19>Cal Hi Anl Rev V Out	"	Cal 100% Anlg Rev V Out Arrows to Adjust: 4000	"	"
			20>Cal Lo Anl Rev V Out	"	Cal 10% Anlg Rev V Out Arrows to Adjust: 0400	"	"
SYS	6>Set Password	"	Old Password=XXXX	Enter Old Password	Correct Password Entered New Password=XXXX	Enter New Password	Press ENTER
SYS	7>Set Control Source	_Press_ ENTER	1>Set Panel Cntrl Mode	_Press_ ENTER			
	NOTE: Control Source menu only displayed if analog option is enabled		2>Set Analog Cntrl Mode	"			

ALARM SILENCE	1>EOC Alarm Disabled	_Press_ ENTER	1>EOC Alarm Enabled	Press ESC				
ALARM SILENCE	2>Ierr Alarm Enabled	"	2>Ierr Alarm Disabled	"				
ALARM SILENCE	3>Verr Alarm Disabled	"	3>Verr Alarm Enabled	"				
ALARM SILENCE	4>Relay Alarm Disabled	"	4>Relay Alarm Enabled	"				
CYCLE CNTRL	1>Setup Real Time Cycle<	_Press_ ENTER	Real Time Cycle Preset =0000 s	↑ to ↓ adjust		Press ENTER	Press ESC	
CYCLE CNTRL	2>Setup Amp Time Cycle	"	Amp Time Cycle Preset =8.000 Am	"		"	"	
CYCLE CNTRL	3>Setup Recipe Cycle	"	S1 Enter Recipe Steps Using Number Keys	Press Numbers	S1 S2 S3 S4 S5 S6 S7 S8 02 04 05 06 07 03 01		Press ESC ESC	Eff Plate I Rcp#X 1 02 +0.333Amps 005.0 s I
CYCLE CNTRL	4>Setup Manual Cycle	"	Cycle Set To Manual	Press ESC				
CYCLE CNTRL	5>Set Relay Trip Point	"	Set Relay Trip Point Preset =0025Am	Press ENTER				
CYCLE CNTRL	6>Set Relay On Time	"	Set Relay On Time Duration =001.5 m	Press ENTER				
CYCLE CNTRL	7>View Totalizer	"	Fwd Total=2604.685 Amin Rev Total=0000.000 Amin	Press ESC	NOTE: Reverse Totalizer only shown with Reverse Option			
CYCLE CNTRL	8>Clear Totalizer	"	Password =XXXX	Enter Password	Correct Password Entered Totalizer Cleared		Press ESC	
CYCLE CNTRL	9>Subtract Rev AmpTime	"	Forward Minus Reverse is Disabled	Press ENTER	Forward Minus Reverse is Enabled		Press ESC	

SAVE RECALL	1>Save Setup	Press ENTER	Save To Setup: 01 Use Num. Keys [1-9 0=10]	Press ENTER	Overwrite Setup: 01 ? ENTER = Yes ESC = No	AND / OR	Setup Has Been Saved	Press ESC Or ENTER
SAVE RECALL	2>Recall Setup	"	Recall From Setup: 01 Use Num. Keys [1-9 0=10]	"	Overwrite Settings? ENTER = Yes ESC = No	AND / OR	Setup Has Been Recalled	Press ESC Or ENTER
SAVE RECALL	3>Delete Setup	"	Delete Setup: 01 Use Num. Keys [1-9 0=10]	"	Delete Setup: 01 ? ENTER = Yes ESC = No	AND / OR	Setup Has Been Deleted	Press ESC Or ENTER
SAVE RECALL	4>Save Recipe	"	Save To Recipe: 01 Use Num. Keys [1-8]	"	Overwrite Recipe: 01 ? ENTER = Yes ESC = Nov	AND / OR	Recipe Has Been Saved	Press ESC Or ENTER
SAVE RECALL	5>Recall Recipe	"	Recall From Recipe: 01 Use Num. Keys [1-8]	"	Overwrite Settings? ENTER = Yes ESC = No	AND / OR	Recipe Has Been Recalled	Press ESC Or ENTER
SAVE RECALL	6>Delete Recipe	"	Delete Recipe: 01 Use Num. Keys [1-8]	"	Delete Recipe: 01 ? ENTER = Yes ESC = No	AND / OR	Recipe Has Been Deleted	Press ESC Or ENTER

F1	1>Set Ramp Time	"	Ramp Up Duration Time Preset=002.0 Sec	↑ to ↓ adjust	Press ENTER
F1	2>Set Ramp Offset	"	Ramp Up Offset Percent Offset % = 05	"	"
F1	3>Set Trickle Level	"	Trickle Current Level % of Ifwd = XX% X.XXXA	↑ to ↓ adjust	Press ENTER
F1	4>Trickle Mode is Off<	"	4>Trickle Mode is On	Press ESC	4>Trickle Mode is On <

Note: Menu for DPR, DuPR, DPD & DuPD

PULSE TIMING	1>Set Fwd. On Time	_Press_ ENTER	Fon =01.00ms	↑ to ↓ adjust	Press ENTER
PULSE TIMING	2>Set Fwd. Off Time	"	Foff =02.00ms	"	"
PULSE TIMING	3>Set Forward Duration	"	Fwd =05.00ms	"	"
PULSE TIMING	4>Set Reverse Duration	"	Rev = 00.00ms	"	"
PULSE TIMING	5>Set Rev On Time	"	Ron = 00.00ms	"	"
PULSE TIMING	6>Set Rev Off Time	"	Roff = 00.00ms	"	"

Note: Menu for DP, DuP & LFP

PULSE TIMING	1>Set Fwd. On Time	_Press_ ENTER	Fon =01.00ms	↑ to ↓ adjust	Press ENTER
PULSE TIMING	2>Set Fwd. Off Time	"	Foff =02.00ms	"	"

Note: Menu for DCR and CRSR (units have reversing module)

F2	1>Set Forward Duration	"	Fwd =05.00ms	"	"
F2	2>Set Reverse Duration	"	Rev = 00.00ms	"	"

Note: Menu for DC or CRS

F2	Eff Plate I Setup XX Option Not Installed

Revision History				
Rev	Description	ECO	Date	Initials
E	Changed amp rating and fuse rating for CE..	2961	12/14/06	es bh
F	Adding Ext. Opr, Relay Options, Recipe Password & Pause.	2960	12/14/06	PJB