THE ADVANCED ENERGY® MDX MAGNETRON DRIVE

User Manual

ADVANCED ENERGY INDUSTRIES, INC

1600 Prospect Parkway
Fort Collins, Colorado 80525
(303) 221-4670
Telex #45-0938

PN: 5700130-A

THE ADVANCED ENERGY® MDX MAGNETRON DRIVE

User Manual

PN: 5700130-A

To ensure years of dependable service, Advanced Energy® products are thoroughly tested and designed to be among the most reliable and highest quality systems available worldwide. All parts and labor carry our standard 1-year warranty.

For **Customer Service**, call:

AE, Colorado office	(303) 221-0108 (24-hour line) ***Fax:*** (303) 221-5583
AE, California office	(408) 263-8784 (8 a.m. to 5 p.m. Pacific Standard Time — California only) ***Fax:*** (408) 263-8992
AE, Japanese office	81 (03) 3222-1311 ***Fax:*** 81 (03) 3222-1315
AE, German office	49 (0711) 777-87-18 ***Fax:*** 49 (0711) 777-87-00
all others	contact your local service center—see the list on the next page

In the interest of providing even better equipment, Advanced Energy Industries, Inc., reserves the right to make product changes without notification or obligation.

For more information, write Advanced Energy Industries, Inc., 1600 Prospect Parkway, Fort Collins, CO 80525.

AE Service Centers

Company Name	Phone/Fax Numbers
Vacutec AB Sweden	46 (0) 40-437270 ***Fax:*** 46 (0) 40-435538
Gambetti Kenologia snc Italy	39 (02) 9055660 ***Fax:*** 39 (02) 9052778
Segen Technologies, Ltd. Israel	972 (03) 9363106 ***Fax:*** 972 (03) 9362030
Zeus Co., Ltd. Korea	82 (02) 577-3181 ***Fax:*** 82 (02) 576-3199
Schmidt Scientific Taiwan	886 (02) 5013468 ***Fax:*** 886 (02) 25029692

Returning Units for Repair

Before returning any product for repair and/or adjustment, call AE Customer Service and discuss the problem with them. Be prepared to give them the serial number of the unit and the reason for the proposed return. This consultation call will allow Customer Service to determine if the unit must actually be returned for the problem to be corrected. Such technical consultation is always available at no charge.

If you return a unit without first getting authorization from Customer Service, and that unit is found to be functional, you will have to pay a retest and calibration fee, and all shipping charges.

Upgrading Units

AE will upgrade older units for a fee (a percentage of the current list price, based on the age of the unit. Such an upgraded unit will carry a 6-month warranty (which will be added to any time remaining on the original warranty).

DESIGNED FOR MAGNETRONS

The new MDX series of Magnetron Drives are designed for hard use in a vacuum environment. Advanced circuit and semiconductor technology makes these amazing units over **90% smaller and lighter than comparable equipment.**

Performance is also remarkably improved through high frequency switching techniques that reduce output energy storage. This decreases splatter and enables faster response to stablize magnetron loads.

FULL POWER

Because full rated power is delivered anywhere within a tap range, you are not limited to delivering the power supply rating at only one rarely-attainable value of voltage and current.

The new MDX Magnetron Drives come equipped with standard features like a power regulator, interlock string, remote interface, full digital meters and a target kilowatt hour integrator.

The drive is fully protected from arcs and open/short circuits. Arc-Out™, a recent Advanced Energy Industries, Inc. development, senses an abnormal load and quenches the arc before damage occurs.

SELF-DIAGNOSTICS

The internal microprocessor continuously checks for proper circuit operation while supervising all internal functions. In addition, a non-volatile memory retains the most recent power supply settings and conditions, target life data, running time of the drive and a summary of all documentation levels for the product during manufacture and test.

FULL I/O

All displayed signals are available continuously at the rear user port. In addition:

* Analog control of ramp and output
* Logic or contact control of ON/OFF
* Fully buffered and ground referenced 0-5 volt analog signals for voltage, current, power and target life
* Logic outputs for interlock, output plasma, arc, target life and setpoint status information

SERVICEABILITY — MODULAR

Advanced Energy Industries, Inc. standard modules are used throughout the MDX, enabling replacements to be made in minutes without special tools, soldering or adjustments.

CONFIDENCE

The MDX family is designed to be among the most reliable and quality-oriented systems available. All parts and labor carry our standard one year warranty, and for a small premium we will extend the warranty to a full five years.

TABLE OF CONTENTS

***** WARNING *****

SAFE OPERATING PROCEDURE AND PROPER USE OF THE EQUIPMENT ARE THE RESPONSIBILITY OF THE USER OF THIS SYSTEM.

Advanced Energy Industries, Inc. provides information on its products and associated hazards, but it assumes no responsibility for the after sale operation and safety practices.

ALL PERSONNEL WHO WORK WITH OR ARE EXPOSED TO THIS EQUIPMENT MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS AND/OR FATAL BODILY INJURY. DO NOT BE CARELESS AROUND THIS EQUIPMENT.

1.0 SAFETY

The high voltage nature of the output of these power supplies dictates the use of caution when near the output power connection.

Precautions:

1) Make certain the the chassis is properly grounded - **THE GROUND CONNECTION PROVIDED SHOULD NOT BE DEFEATED!**

2) The output connector is normally grounded. **VOLTAGE LEVELS AT THE CONNECTOR MAY BE MORE THAN 1000 VOLTS DURING OPERATION.**

3) **THE PROTECTIVE COVERS SHOULD NOT BE REMOVED DURING OPERATION.**

2.0 GENERAL DESCRIPTION

The MDX series of Magnetron Drives is designed as power sources for DC magnetron applications.

The unit will reliabily deliver full power to a magnetron cathode from 500 to 1000V with 3 tap changes.

This power is controlled within any of three regulation modes; power, current or voltage. The control can be made from the front panel, a user port or an RS-232ASCII coded port.

Full instrumentation is included as a programmable ramp, a full interlock string, a target life accumulator and a front panel setpoint lock. A non-volatile memory stores all setpoints and the operating history of the unit.

A high frequency conversion technique coupled with a proprietary ARC-OUT^{TM} circuit enables extremely low stored energy, reducing energy discharged into an arc by several orders of magnitude. This greatly decreases splatter and thermal shock on sensitive targets.

2.1 SPECIFICATIONS

INPUT VOLTAGE: 180v -240VAC, 50/60Hz three phase with neutral (See Wiring Diagram, Figure 1).

	MDX 5K	MDX 10K	MDX 15K	MDX 20K	MDX 25K	MDX 30K		OUTPUT VOLTAGE
Input Current @ Full Power @208 Input Voltage	17A	34A	51A	68A	85A	102A		
Output Power	0-5KW	0-10KW	0-15KW	0-20KW	0-25KW	0-30KW		
							Tap#	
Output Current	0-10A	0-20A	0-30A	0-40A	0-50A	0-60A	1	
	0-8.0A	0-16A	0-24A	0-32A	0-40A	0-48A	2	
	0-6.25A	0-12.5A	0-18.75A	0-25A	0-31.25A	0-37.5A	3	0-1000
Output Ripple	5% RMS	2% RMS	2% RMS	2% RMS	2% RMS	2% RMS		1500V
Output Ripple Freq.	50Khz	100Khz	100Khz	100Khz	100Khz	100Khz		
# Units per System	1	1	2	2	3	3		
LOW Z								
Output Current	12.5A	25.0A	37.5A	50.0A	62.5A	75.0A	1	0-500V
	10.0A	20.A	30.0A	40.0A	50.0A	60.0A	2	0-640V
	7.75A	15.5A	23.25A	31.0A	38.75A	46.50A	3	0.800V
Cooling - 0-45° ambient. Six (6) inches of clearance to rear of unit required.								1500V Open Circuit
Humidity - 0-92% noncondensing.								

3.0 DETAILED DESCRIPTION

3.1 Unpacking

DO NOT APPLY POWER TO THE UNIT BEFORE FOLLOWING THIS PROCEDURE:

Unpack and inspect your power supply carefully. Check for obvious physical damage.

Remove the top cover(6 phillips screws). Inspect the plexiglass shield for signs of physical damage and if none is observed, proceed to the connection section.

3.2 Power Connections

The standard power is 208V, 30, 50/60Hz with either a connected Y or auxiliary 110V. See Figure 1. Three-phase rotation is important.

WARNING

MAKE CERTAIN USER MAIN CIRCUIT BREAKER IS OFF DURING HOOK UP.

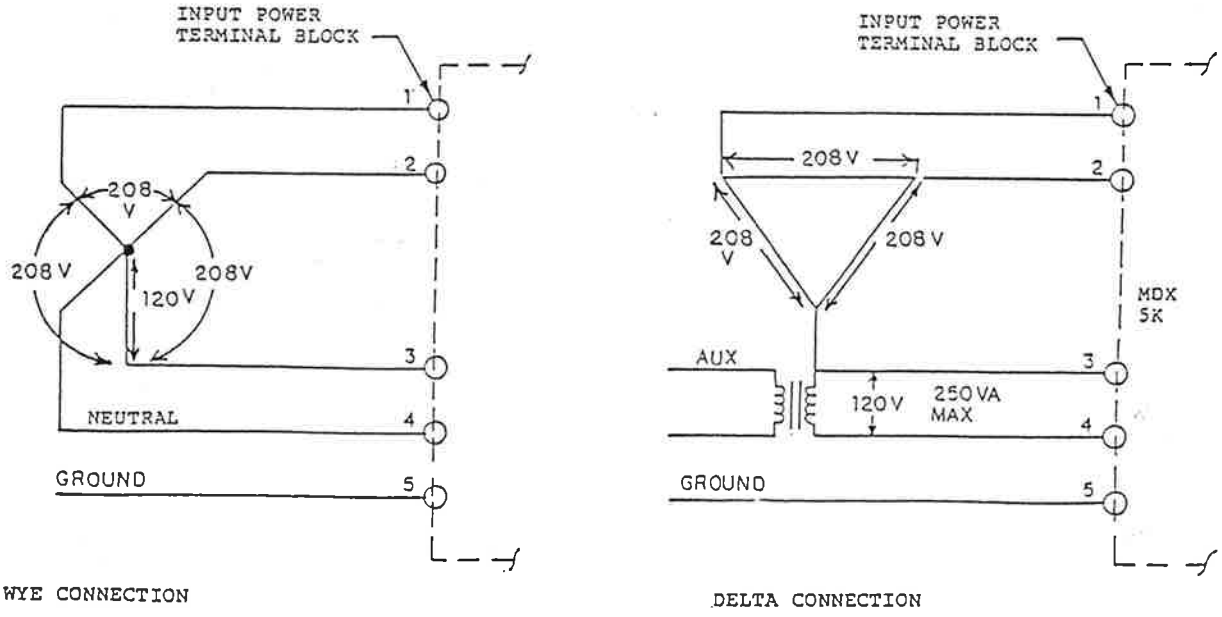


Figure 1. Three-Phase Wiring Diagram

3.3 INTERFACE, USER CONNECTOR

Pin No.	Name	Description	Ref. Section No.
1	------	-----	-----
2	D.OUTPUT	Digital indication representing output present	3.3.1
3	D.SETPOINT	Digital indication representing output at setpoint	3.3.2
4	TARGET Ø	Target select bit Ø	3.3.3
5	I.REG	Remote current regulation select	3.3.4
6	P.REG	Remote power regulation select	3.3.4
7	D.XON	Remote system on command	3.3.5
8	-----	-----	-----
9	A.OUTCOM	Indicator common	3.3.6
1Ø	A.INCOM	External program common	3.3.7
11	D.XAUX	User auxiliary interlock	3.3.8
12	D.XVAC	User vacuum interlock	3.3.8
13	D.XWATER	User water interlock	3.3.8
14	D.XOFF	Remote system off command	3.3.9
15	D.RESTORE	External emergency stop restore	3.3.1Ø
16	-----	-----	-----
17	-----	-----	-----
18	-----	-----	-----
19	INTLKCOM	Interlock common	3.3.11

Notes

1. Connector is a subminiature "D"-type (37 pins)
2. With pins 5 and 6 both LOW - direct regulation is provided
3. With pins 5 and 6 both HIGH - voltage regulation is provided

3.3 INTERFACE, USER CONNECTOR (continued)

Pin No.	Name	Description	Ref. Section No.
20	-----	-----	-----
21	D.ARC	Digital indication representing arc condition exists (active low)	3.3.13
22	D.EOTL	Digital indication representing end of target life (active low)	3.3.14
23	A.VOUT	Analog signal representing output voltage	3.3.12
24	A.POUT	Analog signal representing output power	3.3.15
25	A.IOUT	Analog signal representing output current	3.3.16
26	A.XRAMP	Remote system ramp adjust	3.3.17
27	A.XLEVEL	Remote system level adjust	3.3.18
28	A.RAMPOUT	Analog signal representing ramp time remaining	3.3.19
29	-----	-----	-----
30	A.KWOUT	Target life remaining	3.3.20
31	A.LEVELOUT	Analog signal representing program level	3.3.21
32	A.XREF	External reference voltage (5.0V)	3.3.22
33	-----	-----	-----
34	TARGET2	Target select bit 2	3.3.3
35	TARGET1	Target select bit 1	3.3.3
36	D.INCOM	Digital input common	3.3.23
37	-----	-----	-----

3.3.1 D.OUTPUT

D.OUTPUT (user Pin 2) is an output signal that duplicates the OUTPUT light on the front panel. The OUTPUT light on the front panel will illuminate when the OUTPUT is enabled. D.OUTPUT is a driver that goes low when the OUTPUT is enabled. D.OUTPUT will sink up to 75mA. D.OUTPUT should be referenced to OUTCOM.

3.3.2 D.SETPOINT

D.SETPOINT (user pin 3) is an output signal that duplicates the SETPOINT light indication on the front panel. The SETPOINT light on the front panel will illuminate when the output has reached final setpoint. D.SETPOINT is a drive driver that goes low when the output setpoint has been reached. D.SETPOINT will sink up to 75mA. D.SETPOINT should be referenced to OUTCOM.

3.3.3 TARGET 0,1,2

The TARGET commands (user pins 4, 35, 34) are digital input signals. These signals allow the user to designate any one of 8 targets. With this information, the MDX CPU can keep track of the KWH usage for all 8 targets.

TRUTH TABLE

(2,1,0)	Front Panel
H H H	0
H H L	1
L H H	2
H L L	3
L H H	4
L H L	5
L L H	6
L L L	7

Notes:

1. An open input defaults high (+15V)
2. A shorted input defaults low (0 $\pm$ 0.5V)
3. Target 0 is User Pin 4
   Target 1 is User Pin 35
   Target 2 is User Pin 34
   INCOM is User Pin 36

3.3.4 I.REG, P. REG

I.REG (user pin 5) and P.REG (user pin 6) are digital input signals used to set the control of the power supply when the supply is in the REMOTE LEVEL mode.

I.REG	P.REG	MODE
1	1	Voltage
0	1	Current
1	0	Power

An open input defaults high (+15V). A low input is 0 $\pm$ .5V.

3.3.5 D.XON

D.XON command (user pin 7) allows remote turn-on of the magnetron drive. To use this command, the REMOTE ON must be selected on the front panel. This transfers the OUTPUT ON command to D.XON. A momentary contact closure of D.XON to D.INCOM pin 36 will cause the magnetron drive to turn on if D.XOFF is connected through a contact closure to D.INCOM. See Figure 2.

3.3.6 A.OUTCOM

Ground return (user pin 9) used as a reference for MDX drives that parallel front panel status indicators. A dedicated ground that returns to the internal system ground, then chassis ground, and finally to safety ground.

3.3.7 A.INCOM

All analog input control connections are referred to A.INCOM, a dedicated ground (user pin 10) that returns to the internal system ground, then chassis ground, and finally to safety ground.

3.3.8 D.XAUX, D.XVAC, D.XWATER

These allow the user (user pins 11, 12 and 13) to gain access to the interlock string. With the string not satisfied, the main contactor will not close, or if the contactor is closed, breaking the string will cause the main contactor to open. After activation, the appropriate interlock status indicator will flash and the alarm will sound. To silence the alarm, press OUTPUT OFF or momentarily close D.XOFF to INTLKCOM. Connect the appropriate interlock through a closed switch to INTLKCOM to indicate a good interlock. To turn on the magnetron drive again, the failed interlock must be corrected and OUTPUT OFF pressed or D.XOFF momentarily closed to INTLKCOM. After this, D.XON or OUTPUT ON will turn on the magnetron drive. See Figure 8.

3.3.9 D.XOFF

The D.XOFF (user pin 14) command duplicates the OUTPUT OFF of the front panel. This function overrides all other commands and forces the magnetron drive to turn off, opens the main contactor, resets interlocks and silences all alarms except END and TARGET LIFE.

3.3.10 D.RESTORE

The D.RESTORE command (user pin 15) is used to acknowledge that EMERGENCY STOP has been activated. See Figures 4 and 5. A momentary closure of D.RESTORE to INTLKCOM will restore EMERGENCY STOP if EMERGENCY STOP has been pulled out. A solid closure as in Figure 4 will cause EMERGENCY STOP to restore itself when pulled out. This restore action will cause EMERGENCY OFF to stop blinking on the displays. To turn on the Magnetron Drive, press OUTPUT OFF or connect D.XOFF to INTLKCOM. After this, D.XON or OUTPUT ON will turn on the magnetron drive.

3.3.11 INTLKCOM

All interlock connections are referred to INTLKCOM (user pin 19), a dedicated ground that returns to the internal system ground, the chassis ground, and finally to safety ground.

3.3.12 **A.VOUT**

The A.VOUT connection (user pin 23) provides a fully buffered 0 to 5 volt output signal representing output voltage. 5V equals 1000VDC. See Figure 6. A.VOUT is referenced to A.OUTCOM. Source impedance is 100 ohms. When the open circuit output voltage equals 1700VDC, A.VOUT equals 8VDC.

3.3.13 **D.ARC**

D.ARC (user pin 21) is an output signal that will go low whenever an arc is detected at the supply output and will stay low until the arc is cleared. D.ARC is a driver that will sink up to 75mA. D.ARC should be referenced to OUTCOM.

3.3.14 **D.EOTL**

D.EOTL (user pin 22) is an output signal that duplicates the TARGET LIFE on the front panel. When the target life counter reaches zero this line will go low. D.EOTL will sink up to 75mA. D.EOTL should be referenced to OUTCOM.

3.3.15 **A.POUT**

The A.POUT connection (user pin 24) provides a fully buffered 0 to 5 volt output signal representing output power. 5V equals 5K watts for an MDX 5K and 10K watts for an MDX 10K. See Figure 6. A.POUT is referenced to A.OUTCOM. Source impedance is 100 ohms.

3.3.16 **A.IOUT**

The A.IOUT connection (user pin 25) provides a fully buffered 0 to 5 volt output signal representing output current. 5V equals 10A for an MDX 5K and 20A for an MDX 10K. See Figure 6. A.IOUT is referenced to A.OUTCOM. Source impedance is 100 ohms.

3.3.17 **A.XRAMP**

The A.XRAMP connection (user pin 26) allows the user to program ramp time from an external source. See Figure 7. The signal should be a 0 to 5V signal with 5V being max ramp time (99.0 min). To enable this function, REMOTE LEVEL must be selected. Reference A.XLEVEL to A.INCOM.

3.3.18 **A.XLEVEL**

The A.XLEVEL connection (user pin 27) allows the user to program output level from an external source. See Figure 7. The signal should be a 0 to 5V signal with 5V giving max level. (10A, 1000V, 5KW for an MDX 5K and 20A, 1000V, 10KW for an MDX 10K). To enable this function, REMOTE LEVEL must be selected. Reference A.XLEVEL to A.INCOM.

3.3.19 **A.RAMPOUT**

The RAMPOUT connection (user pin 28) provides a fully buffered 0 to 5V output signal representing the amount of ramp time remaining. 5V equals 99 minutes. Reference A.RAMPOUT to A.OUTCOM. Source impedance is 100 ohms.

3.3.20 **A.KWOUT**

The A.KWOUT connection (user pin 30) provides a fully buffered 0 to 5V output signal representing the amount of target kilowatt hours remaining. 5V equals 990.0 hours. References A.KWOUT to A.OUTCOM. Source impedance is 100 ohms.

3.3.21 **A.LEVELOUT**

The A.LEVELOUT connection (user pin 31) provides a fully buffered 0 to 5V output signal representing the presently programmed setpoint of the magnetron drive. 5V equals max setpoint. Reference A.LEVELOUT to A.OUTCOM. Source impedance is 100 ohms.

3.3.22 **A.XREF**

The A.XREF connection (user pin 32) provides the user with an accurate 5V reference (5V $\pm$ 10mV). Reference A.XREF to INCOM. **Note:** Do not load the A.XREF to more than 5mA. Source impedance is 100 ohms.

3.3.23 **D.INCOM**

An additional digital input common (user pin 36) used interchangeably with INTLKCOM (pin 19).

USER PLUG

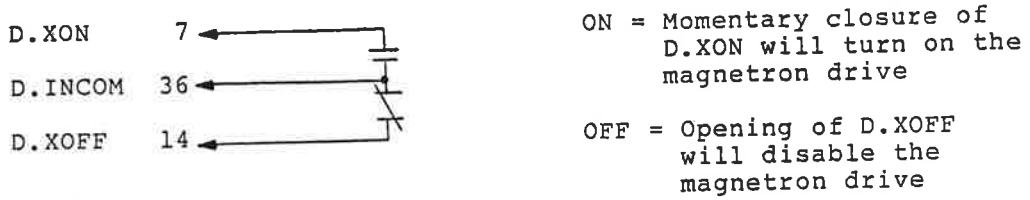


Figure 2. Three-Wire Control Connection

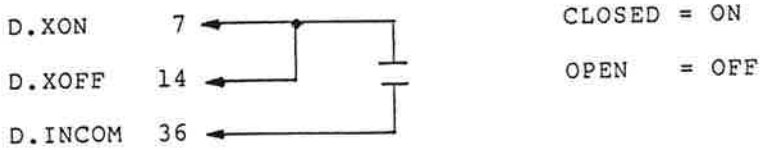


Figure 3. Two-Wire Control Connection

Figure 4. Restore Strapped

Figure 5. Restore Normal

* *

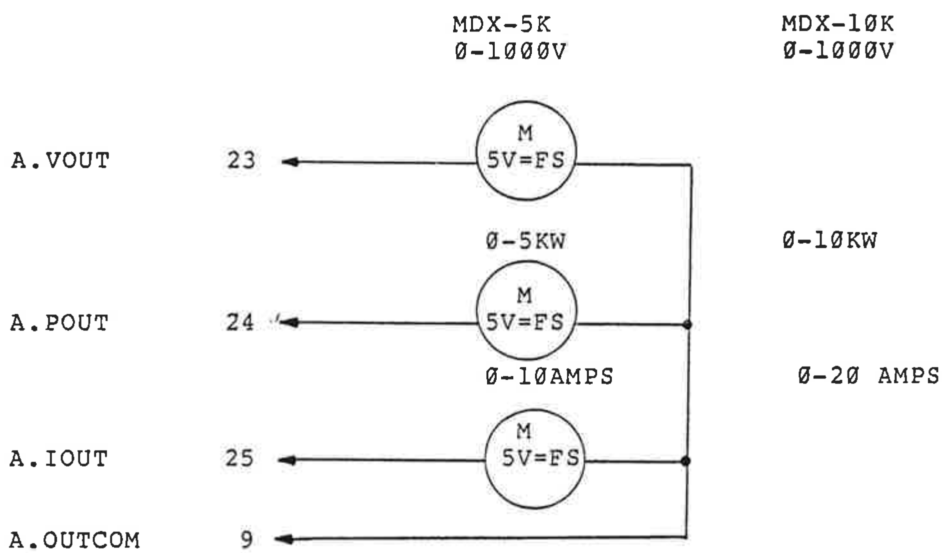


Figure 6. External Metering

* *

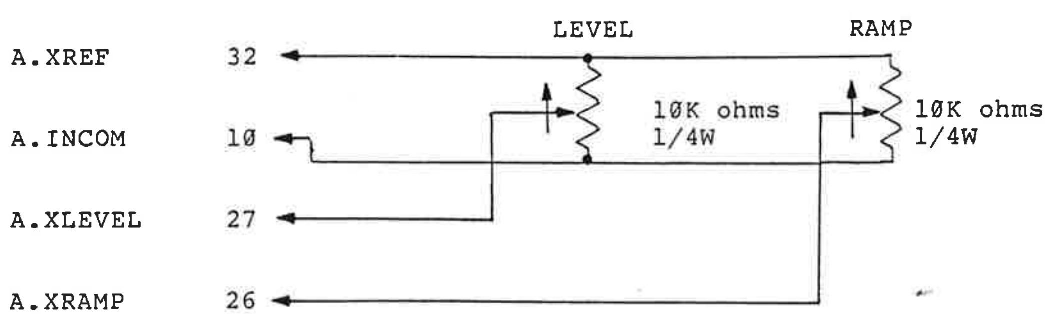


Figure 7. External Programs

* *

* *

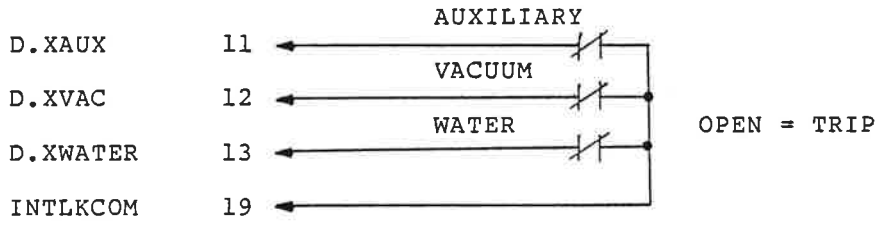


Figure 8. Normal Interlock Connection

* *

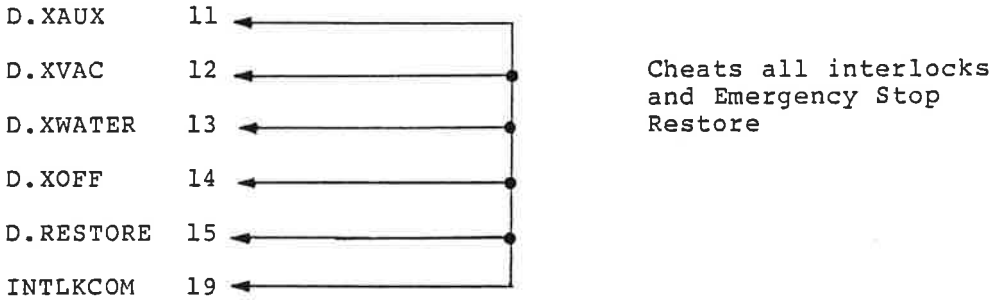


Figure 9. Cheater Plug

* *

3.4 Interface, Front Panel

3.4.1 Emergency Stop

EMERGENCY STOP immediately turns off the magnetron drive independent of any other command. When activated, the displays show E OFF. To clear EMERGENCY STOP, pull EMERGENCY STOP out, then restore EMERGENCY STOP. This is done by connecting D.RESTORE to INTLKCOM (See 3.3.10). Pressing OUTPUT OFF or connecting D.XOFF to INTLKCOM momentarily prepares the magnetron drive for turn-on.

3.4.2 Left Display

The Left Display allows continuous monitoring of output voltage, current, or power. This data is selectable through the LEFT DISPLAY push button. An LED indicates which of the three modes the user has selected. The same display is used by the front panel microprocessor for diagnostic messages.

3.4.3 Left Display (Push Button)

The LEFT DISPLAY push button allows the user to select the desired mode of monitoring the Left Display. Monitor modes are advanced each time the push button is pressed.

3.4.4 Status

3.4.4.1 ARC

The ARC LED flashes when an ARC is sensed or if the ARC-OUT™ circuit is activated.

3.4.4.2 SETPOINT

The SETPOINT LED turns on when the output reaches the preselected setpoint.

3.4.4.3 **RAMP**

The RAMP LED turns on when the output is ramping toward the preselected setpoint. If the pause function is initiated (by pressing LEVEL), the RAMP LED will blink and continue to blink until pause is released or until the final setpoint is reached. Once the final setpoint is reached, the LED will turn off and an audible signal will be heard.

3.4.4.4 **Plasma**

The PLASMA LED turns on when a minimum current threshold is being delivered to the plasma.

3.4.4.5 **Output**

The OUTPUT LED turns on when the magnetron drive has been enabled and the main contactor closes.

3.4.4.6 **Target Life**

TARGET LIFE LED flashes when the programmed end of target life is reached. If the unit is turned off and then on, the LED will continue to flash. To stop the flashing, a new target life must be entered or dashes (disable target life) put in for target life. When the LED flashes, an audible signal will be heard. To stop the audible signal, press the TARGET button.

3.4.4.7 **Temp**

Not used.

3.4.4.8 **Water, Vacuum, Aux**

These LEDs are user interlock indicators. Each LED is on when the interlock will cause its LED to blink and will be accompanied by an audible signal. The audible signal can be stopped by pressing OUTPUT OFF. To stop the blinking, the interlock failure must be corrected and OUTPUT OFF pressed. When an interlock fails, the magnetron drive is turned off and cannot be re-started until the interlock LED is on again.

3.4.5 **RIGHT DISPLAY**

The RIGHT DISPLAY allows continuous monitoring of the following parameters in conjunction with the ACTUAL or SETPOINT switches.

3.4.5.1 **KW**

When the KW LED is on, the RIGHT DISPLAY is monitoring either output kilowatts if the ACTUAL push button lED is on or is monitoring the power setpoint if the SETPOINT push button LED is on and the supply is in the POWER REGULATE MODE. Press SETPOINT push button or press LEVEL push button and hold to view the programmed setpoint.

3.4.5.2 **VOLTS**

When the VOLTS LED is on, the RIGHT DISPLAY is monitoring the output voltage if the ACTUAL push button LED is on or the VOLTAGE REGULATION SETPOINT if the SETPOINT push button LED is on and the supply is in the VOLTAGE REGULATE MODE. Press SETPOINT push button or LEVEL push button and hold to view the programmed setpoint.

3.4.5.3 AMPS

When the VOLTS LED push button is on, the RIGHT DISPLAY is monitoring output current if the ACTUAL LED is on or the CURRENT REGULATION setpoint if the SETPOINT push button LED is on and the supply is in the VOLTAGE REGULATE MODE. Press SETPOINT push button or LEVEL push button and hold to view the programmed setpoint.

3.4.5.4 KWH

When the KWH LED is on, the RIGHT DISPLAY is monitoring the remaining TARGET kilowatt hours. Press SETPOINT push button to display the current target counter being used.

3.4.5.5 MINUTES

When the MINUTES and ACTUAL push button LEDS are on, the RIGHT DISPLAY is monitoring remaining ramp time (when ramping) or accumulated time at setpoint after ramping. After the supply has illuminated the SETPOINT LED, the display will accumulate the time at setpoint.

3.4.6 ALARM

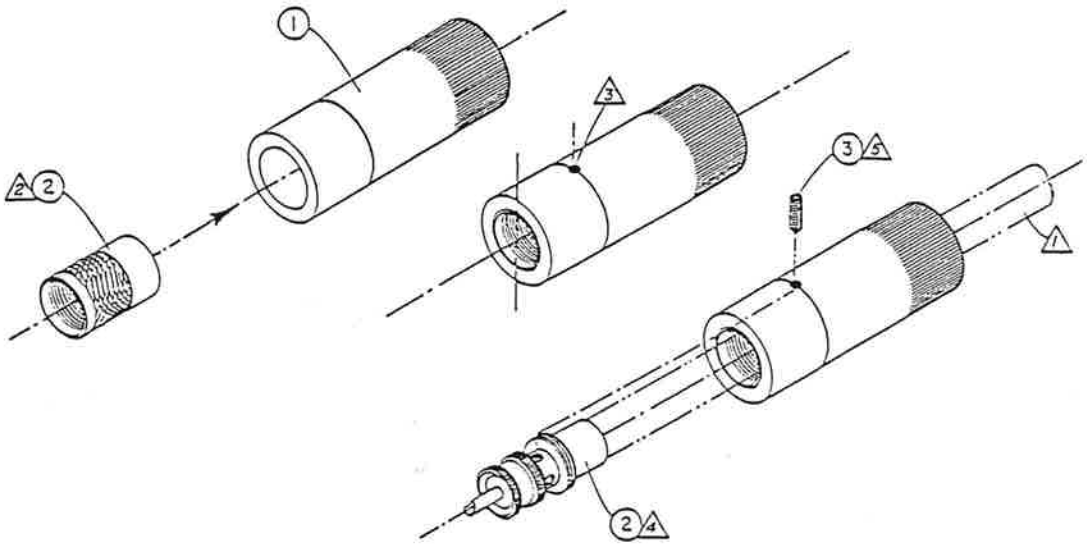
The ALARM emits audible signals to alert the user to a status light flashing, to an error in panel programming or to a diagnostic message being presented on the display.

TABLE 1. ABSOLUTE MAXIMUM OUTPUTS

Power Supply	Voltage Tap (V)	Maximum Current (A)
MDX-5K	600	10
MDX-5K	800	8
MDX-5K	1000	6.25
MDX-10K	600	20
MDX-10K	800	16
MDX-10K	1000	12.5
MDX-20K	600	40
MDX-20K	800	32
MDX-20K	1000	25
MDX-10K LOW Z	500	25
MDX-10K LOW Z	640	20
MDX-10K LOW Z	800	15.5
MDX-20K LOW Z	500	50
MDX-20K LOW Z	640	40
MDX-20K LOW Z	800	31
MDX-5K LOW Z	500	12.5
MDX-5K LOW Z	640	10
MDX-5K LOW Z	800	7.75

NOTES: 1. Low Z software (Rev. 2) will respond with 6,8 or 10 for voltage taps. These correspond to 4, 6 and 8 voltage taps. Run timer not available in Rev. 2 software.

3.5 OUTPUT CONNECTOR



Parts List

Item No.	Part No.	Qty.	Description
③	2451004	1	#4-40 Set Screw
②	3521003	1	Cnctr,Oth,M Amphenol #83-822
①	2205027	1	Output Conn. Sleeve

Notes:

1. Cable to be furnished by customer.
2. Press fit knurled shell of Item No. 2 flush into Item No. 1.
3. Drill and tap for one #4-40 set screw. (thru both parts)
4. Thread inner piece of Item No. 2 into knurled shell of Item No. 2. (install with from surface flush)
5. Install #4-40 set screw, Item No. 3 (set screw must be recessed)
7. Connector - Amphenol 83-822
8. Use RG-8U cable for the output connection. The correct connection has been supplied.
9. The shield will be grounded.

Figure 10. Output Connector Assembly

3.6 TAP SELECTION

The MDX magnetron drive has 3 tap ranges available; 0-600V, 0-800V, 0-1000V. All MDX magnetron drives are shipped with the 0-600V tap selected unless specially requested by the user.

To change the tap, use the following step-by-step procedure:

Make sure the breaker on the back of the MDX is off. Also make sure the power to the MDX (user breaker) is turned off. Both are required for good safety.

Remove the top cover (black) by removing 6 black screws.

Before doing the next step, make sure power has been removed from the MDX for 10 minutes. This will allow all capacitors to discharge.

Remove the safety shield (smoke colored plexiglass) by removing 4 black oval head screws. Under the safety shield is the Logic Tray. The Logic Tray covers most of the top of MDX (about 3/4 of the area exposed) and starts at the right side of the chassis (as you look from the front panel end into the top of the MDX). There are three boards that plug into a fourth board; the Transductor, Logic and Predrive boards plug into the Motherboard. The Motherboard is mounted to the Logic Tray. See Safety Shield.

To remove the Logic Tray, disconnect the front panel cable (ribbon cable) from the Motherboard. Disconnect the USER cable if connected. Disconnect the MF1 and MF2 cables and slide back through hole in Logic Tray. Disconnect HOST cable if connected. Disconnect the output cable if connected.

Now remove the 5 screws (6 screws on the MDX-10K) securing the Logic Tray to the Chassis, one by P2, three at the front panel edge and one on the right side of the Logic Tray across from P2.

The Logic Tray is now ready to be lifted straight up. Be sure to life straight up or the Logic Tray will bind on the 4 guide posts. When the Logic Tray is almost out it will catch on the right side of the chassis. Lift the left side of Logic Tray to clear all 4 guide posts and the Logic Tray will come free. **SET THE TRAY DOWN CAREFULLY OR THE BOTTOM PINS WILL BEND.**

Looking down on the 5K Power Module (or 10K Modules) that are now exposed, there is a jumper bar with a red tab. The jumper bar is about in the middle of the 5K Power Module. The jumper bar has three possible tap positions, they are marked 600V, 825V, and 1000V. Pick the appropriate tap position and move the jumper bar to this position. Make sure all screws are tight before continuing (two on MDX-5K; four on MDX-10K).

Check the bottom of the Logic Tray. There are two groups of 6 pins protruding through the Logic Tray. Make sure they are all straight.

Re-install the Logic Tray using the reverse procedure of Step 3.7.7. Make sure that the Logic Tray slides straight down. Push the rear right corner down securely.

Once the Logic Tray is in position, check between the following pins for 1 ohm + .25 ohm. On MDX 5K, J1-1 and 3, J3-7 and 8, J1-6 and 7. On MDX 10K, also check J2-1 and 3, J4-7 and 8, J2-6 and 7. Pin 1 of each connector is to the rear of the unit. If all readings are not as specified, remove Logic Tray and check for bent pins.

Re-install the 5 screws (6 screws on the MDX-10K) that hold the Logic Tray to the chassis.

Change the microprocessor tap selection by moving the plug on P2 to the appropriate position. THIS TAP SELECTOR MUST MATCH THE ONE ON THE 5K POWER MODULE OR THE MAX LIMITS FOR VOLTAGE AND CURRENT WILL BE WRONG AND THE MDX COULD BE DAMAGED.

Jumper Between Pins	TAP
3 & 4	1000V
2 & 3	825V
1 & 2	600V

Re-install the HOST, USER, front panel and output cables.

Re-install MF1 (red, black and white wires) and MF2 (orange and yellow wires). Do not reverse these connectors.

Re-install safety shield using 4 oval head screws.

Turn on power to MDX. Turn on breaker on the back of MDX magnetron drive. Verify the green Drive LEDs are illuminated (two on MDX-5K; four on MDX-10K). The magnetron drive is now ready to test.

Set REGULATION for POWER; set output level for 0.2KW.

The next step requires the magnetron drive to supply power to a load. Make sure the load will not be damaged by turning on the output.

Turn on the output and monitor the yellow LEDs on the left side of the Predrive (marked DRIVE COMMAND) on an MDX-5K, and on both the left and right sides of the Predrive on an MDX-10K. If one is on brightly, then one or more of the six pins on the bottom of the Logic Tray is bent and will require the Logic Tray be removed (go to Step 3.7.10). If the yellow LEDs are very dimly lit, then the magnetron drive is ready to operate.

Turn off the output.

Re-install the top cover.

4.0 OPERATION

4.1 First Time Operation

Check for correct tap selection (600V, 85V, 1000V).

Set key to OFF.

Connect output connector.

Pull ESTOP out.

Turn on breaker at rear of magnetron. Both displays will read OFF and there will be an audible beep.

Turn key to LOCK mode. The displays will read all zeros. There will be an audible beeping and the OUTPUT OFF light will be blinking. By pressing OUTPUT OFF the beeping will stop and the OUTPUT OFF light will be on solid. Other lights that will be on, both DISPLAY ACTUALS, a regulation mode, WATER, VAC, and AUX. The only function switches are ON, OFF, both ACTUALS and SETPOINT.

Turn key to PROGRAM mode. The following lights will be on: OFF, both ACTUAL lights, WATER, VAC, AUX, one regulation mode light, one position in each display. Select a regulation mode (CURRENT, POWER or VOLTAGE) by pressing the appropriate button. The selected regulation light will illuminate.

To set ramp rate, press RAMP (hold) while adjusting MODIFY. Observe Right Display for desired value. Release ramp.

To set output level, press LEVEL (hold) while adjusting MODIFY. Observe Right Display for desired value. Release level.

CAUTION

The next step will cause high voltage to be present at the output connector. Take appropriate steps to prevent electrical shock.

To enable output, press ON. The main contactor will close, the ARC light will momentarily light, the OUTPUT, RAMP, and PLASMA lights will come on.

The output will ramp to selected output level at which time RAMP light will go out and SETPOINT light will come on. Also, an end of ramp alarm will sound.

You may pause in Ramp by pressing LEVEL. The LEVEL and SETPOINT switch lights will blink; also, RAMP INDICATOR will blink.

While in pause, the MODIFY KNOB will allow you to decrease to zero or increase to pre-set Output Level. If you release pause after changing the Modifier, Ramp function will continue from new setpoint.

4.2 Run Timer

This improvement will allow the user to program a specified time that the power supply will run at programmed output and then shut itself off (RUN TIME).

NOTE: The RAMP TIME to programmed output is not included in this RUN TIME.

To view the Run Timer Setpoint: Hold in the RAMP switch and tap the SETPOINT switch. The Right Display will display the programmed Run Timer Setpoint.

To modify the Run Timer Setpoint: Hold in the Ramp switch and tap the SETPOINT switch, then using the MODIFY knob program and desired Run Timer Setpoint.

To disable the RUN TIMER: Hold in the RAMP switch and tap the SETPOINT switch, then turn the MODIFY knob counterclockwise until the Right Display indicates all dashes (----).

5.0 PRINCIPLES OF OPERATION

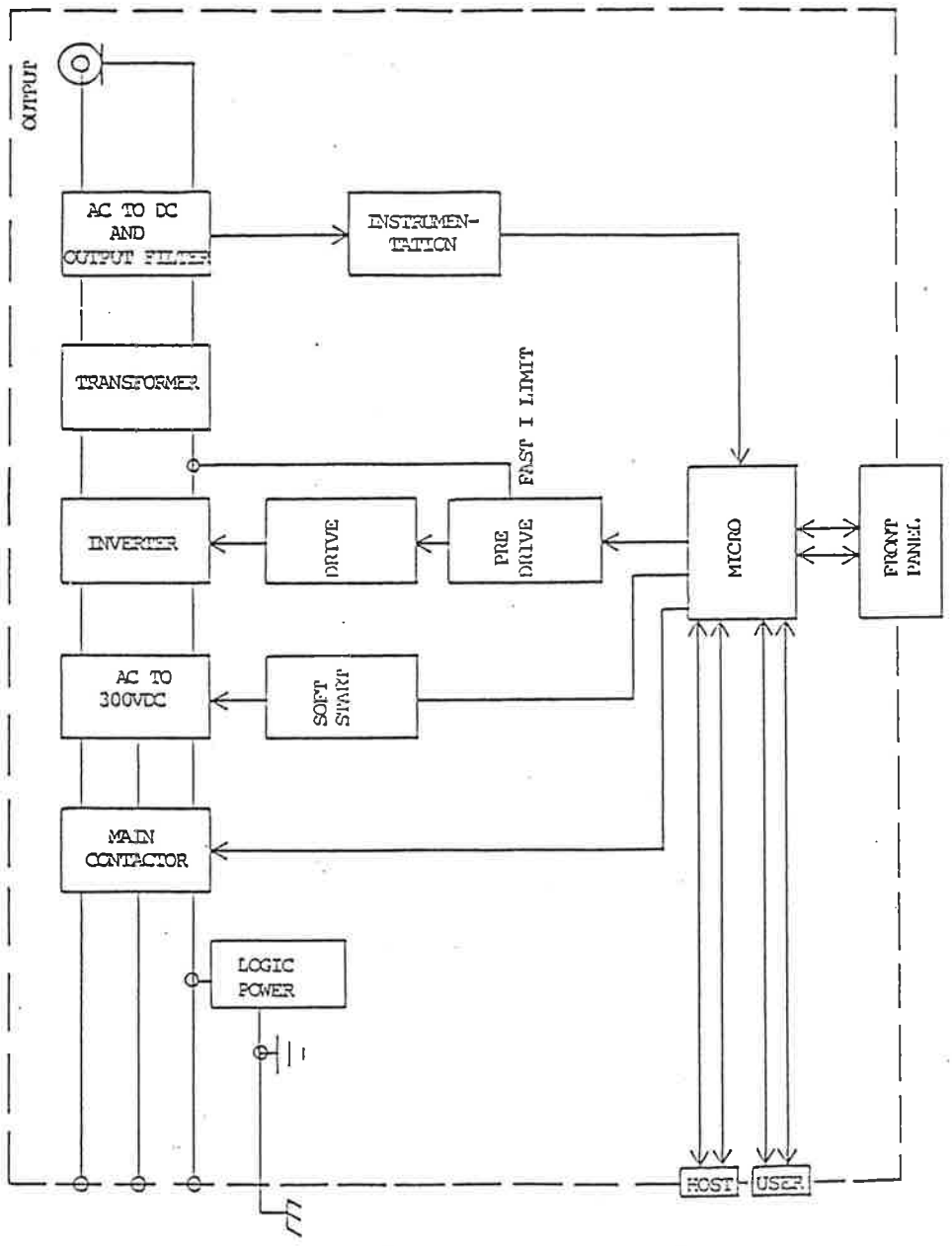


Figure 11. Block Diagram

6.0 TROUBLESHOOTING

6.1 MDX Software - Front Panel Messages

E-01 One or more front panel switches are stuck "ON"

E-02 Internal test (re-initialize system)

E-03 Not assigned

E-04 Not assigned

E-10 RS-232 communication failure between front panel and main frame

E-12 Unit shutdown due to shutdown setpoint

E-13 Soft-start fail in MDX (buss voltage failed to reach soft-start level)

E-14 Buss voltage too high

E-15 Drive 1 failed

E-16 Drive 2 failed

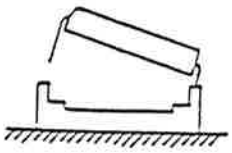
E-17 Buss voltage too low

Errors 02 thru 04 are cleared by running TEST again.

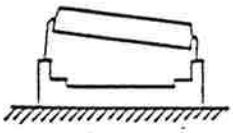
Error 10 will clear itself when communication is restored.

Errors 11 thru 20 are cleared by pushing OFF to restore interlock. If successful, error message will clear.

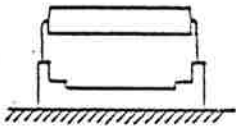
6.2 CHIP INSTALLATION



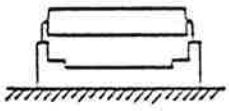
1. Lightly insert pins on one side



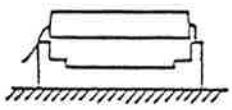
2. Guide pins on other side into position

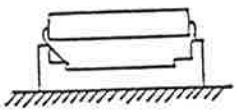


3. Level the chip in the socket



4. Press the chip all the way into the socket





5. Check for bent pins

6.3 Chip Removal

To remove chips from the boards, insert a screwdriver blade under the chips to slowly and evenly pry them out of their sockets as shown in Figure 12. (A) Insert the blade at one end of the IC, (B) pry it out the rest of the way.

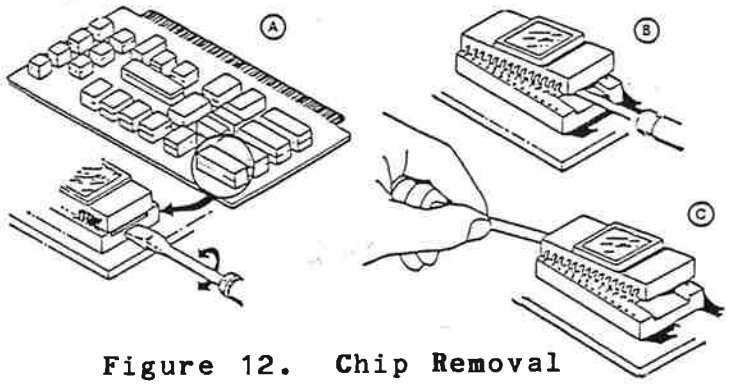


Figure 12. Chip Removal

6.4 Chip Insertion

Read all the following insertion instructions BEFORE attempting to install chips. Be extremely careful when installing chips because damage to any of the legs could make the entire unit nonfunctional.

A suggested method of installing the chips is shown in Figure 13. The first step is to make sure that all the legs on the chip are straight as shown. The chips can be held sideways and the legs can be carefully pushed against a table top to line them up as shown in Figure 13A.

Next, line up and insert one side of the chip into the socket as shown in Figure 13B.

The last step is to slowly line up the second row of legs as shown in Figure 13C and then carefully push them into place. Be sure to look for legs that were bent in or out instead of properly seating in the socket.

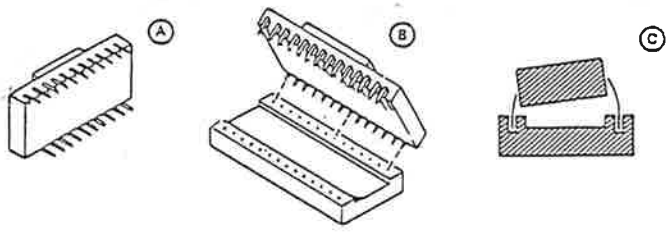


Figure 13. Chip Insertion

Warranty Claims

Advanced Energy® products are warranted to be free from failures due to defects in material and workmanship for 12 months after they are shipped from the factory (please see warranty statement, below, for details).

In order to claim shipping or handling damage, you must inspect the delivered goods and report such damage to AE within 30 days of your receipt of the goods. Please note that failing to report any damage within this period is the same as acknowledging that the goods were received undamaged.

For a warranty claim to be valid, it must:

- be made within the applicable warranty period
- include the product serial number and a full description of the circumstances giving rise to the claim
- have been assigned a return authorization number (see below) by AE Customer Service

All warranty work will be performed at an authorized AE service center (see list of contacts at the front of the manual). You are responsible for obtaining authorization (see details below) to return any defective units, prepaying the freight costs, and ensuring that the units are returned to an authorized AE service center. AE will return the repaired unit (freight prepaid) to you by second-day air shipment (or ground carrier for local returns); repair parts and labor will be provided free of charge. Whoever ships the unit (either you or AE) is responsible for properly packaging and adequately insuring the unit.

Authorized Returns

Before returning any product for repair and/or adjustment, call AE Customer Service and discuss the problem with them. Be prepared to give them the serial number of the unit and the reason for the proposed return. This consultation call will allow Customer Service to determine if the unit must actually be returned for the problem to be corrected. Such technical consultation is always available at no charge.

Units that are returned without authorization from AE Customer Service and that are found to be functional will not be covered under the warranty (see warranty statement, below). That is, you will have to pay a retest and calibration fee, and all shipping charges.

Upgrading Units

AE's products are continually changing as ways to improve them are discovered. AE is happy to upgrade older units so that they reflect recent improvements. The fee for upgrading a unit will be a percentage of the current list price, based on the age of the unit. Such an upgraded unit will carry a 6-month warranty (which will be added to any time remaining on the original warranty). Contact Customer Service for specifics on getting an older unit upgraded to the current revision level.

Warranty

The seller makes no express or implied warranty that the goods are merchantable or fit for any particular purpose except as specifically stated in printed AE specifications. The sole responsibility of the Seller shall be that it will manufacture the goods in accordance with its published specifications and that the goods will be free from defects in material and workmanship. The seller's liability for breach of an expressed warranty shall exist only if the goods are installed, started in operation, and tested in conformity with the seller's published instructions. The seller expressly excludes any warranty whatsoever concerning goods that have been subject to misuse, negligence, or accident, or that have been altered or repaired by anyone other than the seller or the seller's duly authorized agent. This warranty is expressly made in lieu of any and all other warranties, express or implied, unless otherwise agreed to in writing. The warranty period is 12 months after the date the goods are shipped from AE. In all cases, the seller has sole responsibility for determining the cause and nature of the failure, and the seller's determination with regard thereto shall be final.