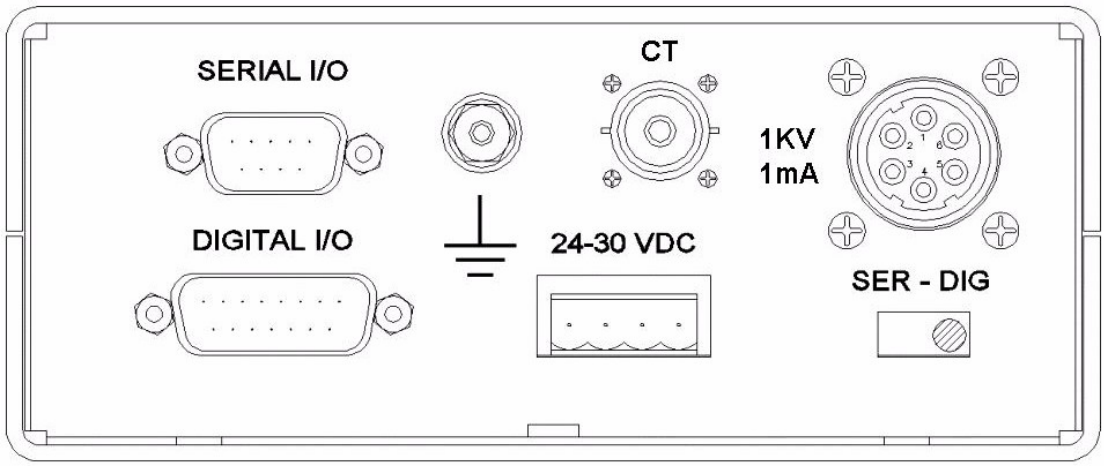
EPS300

Electrostatic Chuck Power Supply (Model G21301-10)

Users Manual



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11930 44th St. North, Suite B • Clearwater, FL 33762 • (727) 572-4100

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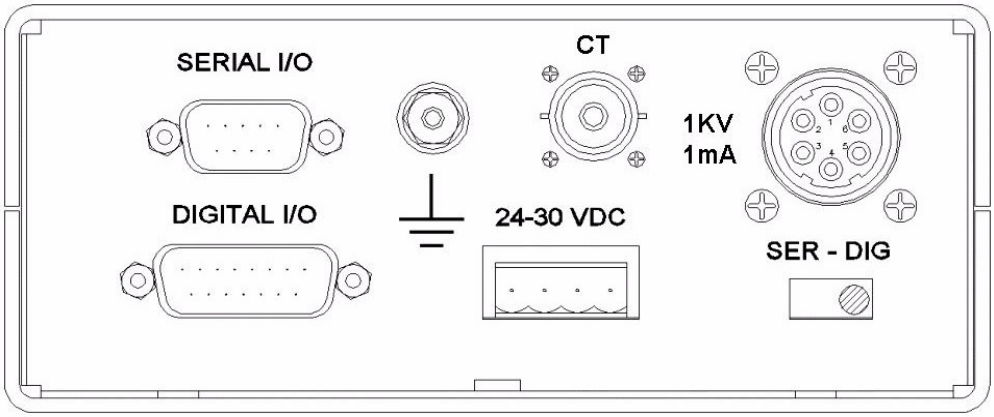


1. INTRODUCTION

1.1. Introduction. The Gripping Power, Inc. EPS300 high voltage power supply is designed to drive electrostatic chucks gripping semiconductor wafers, under various process conditions, with years of reliable performance. The EPS300 combines the process proven technology of the EPS100 and the software flexibility of the EPS200 into a compact, cost-effective instrument. The small size of the EPS300 allows the direct integration of the unit into a process tool, minimizing the hazards associated with lengthy high-voltage cables.

1.2. Features. The EPS300 is microprocessor based and is fully programmable. Two remote operating modes (serial and digital) are provided. An isolated, bipolar output voltage of up to ±1.0kV DC (model G21301-10) can be produced with the unit. The high voltage output is continuously variable, with output voltage regulation and user defined current limiting (up to 1mA of output current). LED indicators provide unit status information.

1.3. Remote Operation. Serial RS-232 and digital remote control modes are provided. All electrical interfaces are isolated from the high-voltage output and are DC ground referenced or optically isolated. The high-voltage can be turned on and off via a single digital bit input or via an RS-232 command. Optically isolated digital input and output signals are provided to minimize interface issues when replacing other ESC power supplies and mechanical clamp mechanisms.

1.4. Programmability. The EPS300 can store up to ten user-defined programs that control the clamping and declamping operation. Each program can be up to 32 steps long. The unit may be directed to execute any one of the ten stored programs, giving the user maximum flexibility in both the setup phase, when testing clamp reliability, and in production operation for a variety of processes. The EPS300 programs are stored in nonvolatile RAM and can be uploaded to a host computer.

The EPS300 programming command set includes over 50 instructions, providing the user optimum flexibility for developing sophisticated clamping algorithms for multiple process conditions. The command set of the EPS300 is a based upon the Gripping Power, Inc. popular EPS200 electrostatic chuck power supply command set. Existing user-programs developed for the EPS200 can be uploaded to and executed on the EPS300.

2. INSTALLATION

2.1. Installation. The compact size of the EPS300 allows it to be directly integrated into OEM process equipment. The unit should be mounted as close to the load as possible, in any orientation, using four #10-32 screws. Refer to Appendix C for mounting dimensions.

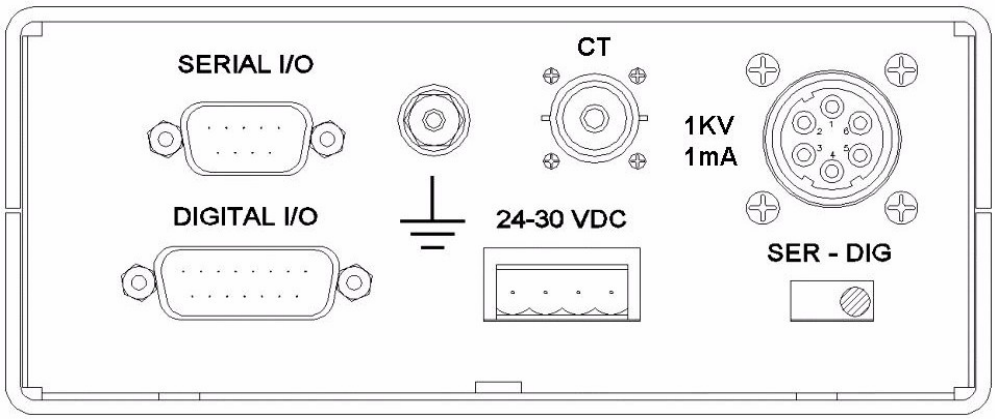


Figure 2.1 - EPS300 Front Panel

2.2. DC Power Requirements. DC power is supplied to the unit via a four-pin, in-line, 5.08 mm connector, located on the front panel. Refer to Appendix D for more information.

2.3. Digital Remote Interface. The analog and digital interface is a 15-pin, D-style subminiature male connector, located on the front panel. The remote 'HV ON', voltage and current monitor outputs, and external safety interlock are contained in this connector. The connector definition is shown in Appendix E.

Setting the recessed toggle switch located on the front panel to the 'DIG' position enters the digital remote operating mode. In this mode, the 'execute program command' is given via the 15-pin remote control connector. Refer to sections 4 and 5 for more information.

Upon activation of the digital 'HV ON' signal, while in digital remote mode, the EPS300 will execute the user-defined program P0. When the unit is returned the serial mode, P0 will be the selected program until it is changed via an RS-232 command.

In digital mode, all serial commands except 'AB', 'OF', 'RS' and 'RP' will be ignored

2.4. Serial Interface. The RS-232 serial interface is a 9-pin, D-subminiature female connector, located on the front panel. The unit is configured as DCE without modem control lines, i.e. CTS, RTS or DTR.

The serial data format is 19,200 baud, eight data bits, one stop bit with no parity. When uploading ASCII text programming files, use a 100 millisecond line-to-line delay. Refer to Appendix F for more information on the serial interface.

Setting the recessed toggle switch located on the front panel to the 'SER' position enters the serial remote operating mode. In this mode, the 'HV ON' command (ON) and/or the execute program (XP) command is given via the command protocol as described in sections 4 and 5.

2.5. High Voltage Connections. The power supply high voltage output is via a six-pin, high-voltage connector located on the front panel of the unit. An additional MHV (high voltage BNC) style connector is included to allow a remote biasing of the high voltage output.

WARNING: High-voltages are produced by the EPS300. Installation and operation of the unit should be performed only by qualified and authorized personnel.

2.6. Safety ground. A safety ground connection is provided via a #6-32 stud. A connection should be made from this terminal to the load ground point (chamber, frame, etc.) or other suitable safety ground point. The high-voltage output is fully floating from ground and is bipolar. High voltage current does not flow in the ground return conductor except when the remote CT bias option (MHV connector) has an applied voltage.

For those units equipped with the 'center-tap monitor' option, the measured center-tap voltage value is the voltage measured from the center tap pin and the chassis (case) ground. Refer to the 'MC' command and Section 6.2 and 6.3 for additional information.

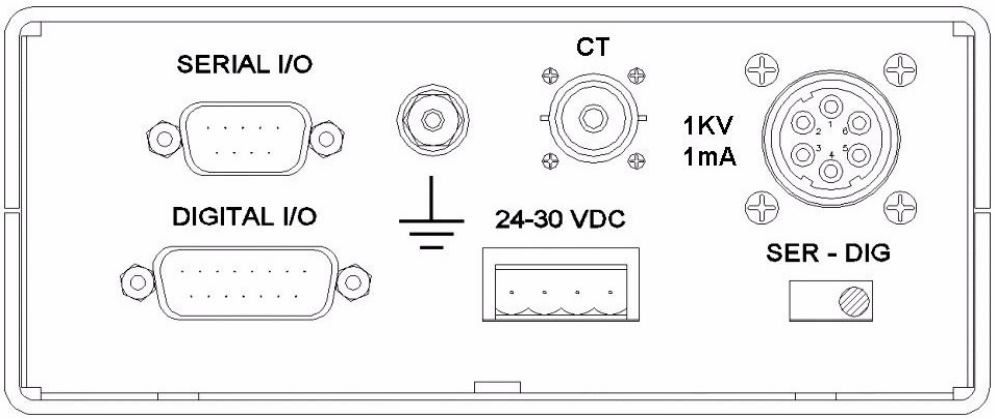


Figure 2.2 - EPS300 Front Panel

2.7. Load Connections. For proper operation and continued reliability, the high voltage outputs of the EPS300 must be electrically isolated from extremely high DC bias voltages, induced RF voltages, or other sources of potential damage.

It is recommended that only accessories manufactured, or specifically authorized, by Gripping Power, Inc. should be used with the EPS300 when developing an electrostatic chuck application for plasma processes. Gripping Power, Inc. can provide interconnect cables, RF decoupling traps and other accessories to meet any specific need.

A typical electrostatic chuck system for a high-energy semiconductor plasma process is shown below. Each of the components is required for protection of the EPS300 power supply, and for proper clamping and release operation. Semiconductor process applications vary. Please consult the Gripping Power, Inc. engineering staff for additional assistance.

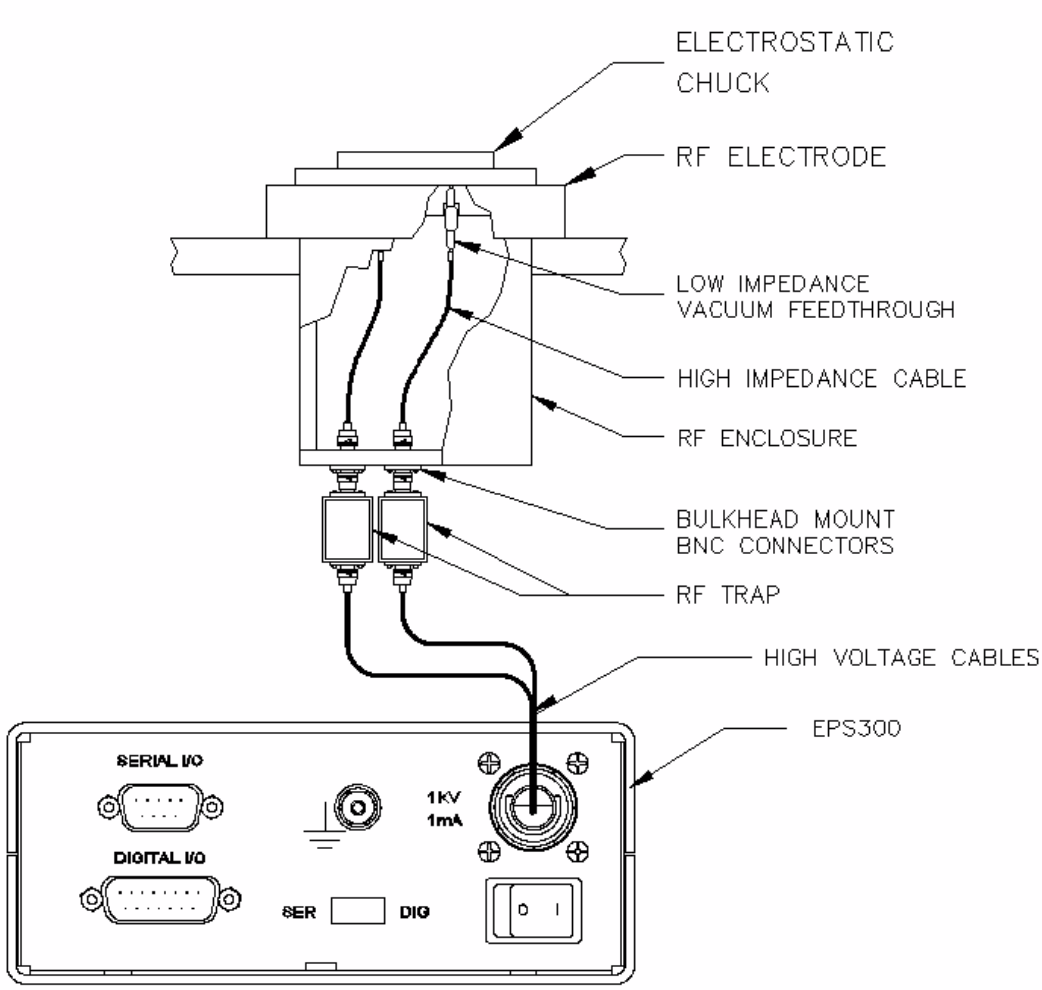


Figure 2.3 – EPS300 Typical Installation

3. OPERATION

3.1. Operation. The EPS300 is specifically designed to operate electrostatic chucks and contains many features not normally associated with a standard high voltage power supply.

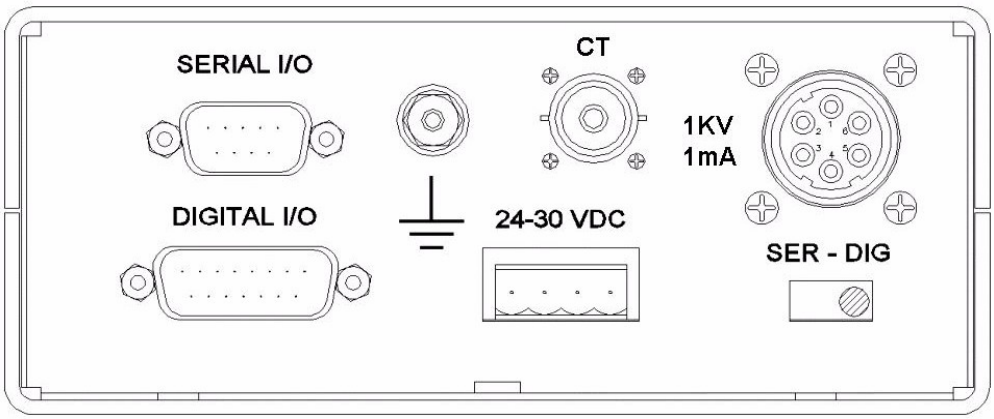


Figure 3.1 - EPS300 Front Panel

3.2. The Front Panel. The EPS300 front panel contains the high-voltage output, the remote control and the serial interface connectors, and access to the mode select switch.

3.3. The Status Panel. LED indicators are located on the top panel of the unit. They indicate the current general condition of the EPS300.

3.3.1. Power LED. The 'POWER' LED is lit when DC power is applied to the unit.

3.3.2. Interlock LED. If DC power is applied and the safety interlock circuit is closed, the green 'INTERLOCK' LED will light. If the external safety interlock circuit opens, the interlock LED is extinguished, the high voltage turned off, and the current program aborted. The unit will remain in this state until the external safety interlock is closed.

3.3.3. HV On LED. The yellow 'HV ON' LED is lit whenever the high voltage is enabled and is on, regardless of the high voltage setpoint.

3.3.4. Data LED. The green 'DATA' LED is lit whenever serial data is being received at the RS-232 communications port.

3.3.5. Fault LED. In the event of an overload, or other system fault, the red 'FAULT' LED is lighted. Refer to Section 7 for more information on troubleshooting.

3.3.6. Sense LED. In those units equipped with the substrate detector option, the green 'SENSE' LED lights whenever the substrate signal is at the established level and the substrate detector is enabled. Refer to Section 6.1 for more information.

3.4. Setting the Operating Mode. The EPS300 has two operating modes - digital and serial. The operating mode is selected by setting the recessed toggle switch located behind the front panel to the corresponding position.

3.5. Digital Remote Mode. Setting the switch to the 'DIG' position enters the digital remote operating mode. In this mode, the execute program command is given via the 15-pin remote control connector. Refer to Appendix E for more information on the digital interface.

When the digital 'HV ON' signal is activated, the unit executes program zero (P0). This will be the selected program when the unit is returned to serial mode.

The execution of a program may change the output voltage from the stored value. To retain the previously stored high voltage setting (as set by the SV command), the selected program should not contain 'SV' commands, which will change the stored output voltage setpoint. To change the output voltage without altering the stored setpoint value, use the 'SO' command.

3.6. Serial Remote Mode. Setting the switch to the 'SER' position enters the serial remote operating mode. In this mode, the program commands are received via the 9-pin RS-232 serial port connector. The host computer must be capable of supporting a DTE RS-232 device and have the proper software installed to communicate with the EPS300 via the serial port. Refer to Appendix F for interface specifications.

A versatile command protocol has been developed for the EPS300 to make it a flexible production or development instrument for most electrostatic chuck applications. Refer to sections 4 and 5 for additional information on the EPS300 command set and program development. There are two immediate command formats used with the EPS300.

Immediate mode command only format:

```
> a [sp] cc [cr]
```

Immediate mode command with parameters format:

```
> a [sp] cc [sp] dddd [cr]
```

All messages sent to the EPS300 must start with an ASCII '>' (hex 3E) or the message will be ignored. The one-byte code [a] is the unique address of the target unit. The EPS300 currently does not support unit addressing and this value should be an ASCII '0' (hex 1E) in all cases.

ASCII space characters [sp] (hex 32) act as delimiters and must be inserted as shown between fields. No space is permitted after the attention character and the address field. The following field [cc] is the command field, which contains a two-byte ASCII character from the EPS300 instruction set.

The data field [dddd], if required, contains the data that the command requires. For example, if the desired target voltage is 850 volts, for example, ' 850' should be in the data field.

```
> 0 [sp] SV [sp] 850 [cr]
```

After the complete message has been sent, a carriage return [cr] (hex 0D) must be sent to unit to indicate the end of the message. If the command does not pass syntax and validity checks, the command and data are ignored and the following (NAK) is returned to the host:

```
> 0 [sp] ? [cr]
```

Except where indicated, the EPS300 buffers the incoming data, tests for a valid command, and executes the command or stores the data. The acknowledge message will be returned to the host only after the command has been processed.

The EPS300 will not respond to additional polls until the previous command has been processed and acknowledged, which can be up to 250mS or longer, in some cases.

The host system must wait until the current command has been acknowledged before issuing additional commands or requests to the EPS300.

3.7. Serial Command Lockout. If the EPS300 is running a program (refer to section 5 for programming information), the unit will only respond to a subset of commands, which provide limited control and status information only.

AB	Abort the current program
ID	Identify
MA	Measure the substrate detector analog value (if equipped)
MB	Measure and return data in burst mode
MC	Measure the center-tap voltage
MI	Measure output current at terminals
MV	Measure output voltage at terminals
OF	High voltage off
R1	Read timer 1
R2	Read timer 2
R3	Read timer 3
RC	Return compliance value
RE	Resume
RI	Return overcurrent trip point
RM	Report maximum voltage
RP	Return program number/step/run-stop
RR	Return the ramp rate
RS	Return hardware status
RV	Return the high voltage setpoint
??	HELP command

Table 3.1 - Valid Serial Commands When a Program is Executing

This feature prevents the unit from acting on commands that are improper for, or conflict with, an executing program. Refer to the section for each command for additional information.

4. PROGRAM AND CONTROL COMMANDS

4.1. Introduction. The command set of the EPS300 has been designed to provide the user with outstanding process flexibility. In addition to basic on (ON) and off (OF) commands, there are a wide range of reporting, configuration, and control commands. All EPS300 commands, except 'SO', 'WF', 'WR' and 'WT' can be used in immediate mode, as shown in the examples. Refer to section 5 for additional information on program specific commands.

Unless otherwise indicated, EPS300 commands do not require parameters. When entering numeric parameters, leading zeros, or fixed length fielding is not required. Current and voltage units are reported in volts (V) and microamps (uA), respectively.

4.2. High voltage control commands. The following commands control, and adjust parameters related to, the high voltage output.

4.2.1. (CF) Set high voltage compliance off. If the user expects the load to change significantly, such as during thermal stabilization, the EPS300 can be set to ignore high voltage compliance faults completely by sending a CF command.

```
Send:     >0 CF [cr]
Receive:  >0 CF [cr]
```

4.2.2. (CN) Set high voltage compliance on. Once the load had stabilized and voltage regulation errors become significant to the user, the CN command can be used to turn the voltage compliance error detection on. Voltage compliance deviations outside the compliance widow will produce an overload fault.

```
Send:     >0 CN [cr]
Receive:  >0 CN [cr]
```

4.2.3. (OF) High voltage output off. If an OF command is received, when a program is not executing, the high voltage output is immediately turned off.

```
Send:     >0 OF [cr]
Receive:  >0 OF [cr]
```

If a program is running, and a WF instruction is active, the high voltage output will be turned off and the program will continue normal execution. Refer to section 5 for additional information regarding the WF command.

4.2.4. (ON) High voltage output on. If the ON command is received and a program is not executing, the high voltage output is immediately turned on.

```
Send:     >0 ON [cr]
Receive:  >0 ON [cr]
```

The high voltage output will remain on until another command is received by the EPS300 that can override the high voltage on condition, such as the off (OF) or abort (AB) command. If a program is running, the ON command will be ignored.

4.2.5. (PP) Set polarity positive. The PP command causes the output voltage polarity to be set to positive. If the high voltage is on and at a negative polarity, the output will be set to a positive polarity. If the high voltage is not on, the set polarity command will take effect with the next ON command. The value (magnitude) of the setpoint voltage is not affected.

```
Send:     >0 PP [cr]
Receive:  >0 PP [cr]
```

4.2.6. (PN) Set polarity negative. The PN command causes the output voltage polarity to be set to negative. If the high voltage is on and at the positive polarity, the output will be set to a negative polarity. If the high voltage is not on, the set polarity command will take effect with the next ON command. The value (magnitude) of the setpoint voltage is not affected.

```
Send:     >0 PN [cr]
Receive:  >0 PN [cr]
```

The NP command can also be used to invoke a negative polarity. Both commands work identically. This command provides backward compatibility for older EPS300s.

```
Send:     >0 NP [cr]
Receive:  >0 NP [cr]
```

4.2.7. (SB) Set output back to default value. During program execution, the 'SA' and 'SO' commands can temporarily change the high voltage output setpoint from the stored value. The high voltage setpoint can be reset back to the stored setpoint by executing the SB command. The high voltage setpoint will then equal the value set by the most recent SV command. Any execution of a SV command will update the high voltage setpoint.

```
Send:     >0 SB [cr]
Receive:  >0 SB [cr]
```

4.2.8. (SC) Set high voltage compliance window. If the high voltage is on, the unit will attempt to adjust the output voltage to compensate for varying load conditions. An overload fault results if compliance is required ('CN' command) and the high voltage output deviates from the setpoint by more than the compliance window.

```
Send:     >0 SC 10 [cr]
Receive:  >0 SC 10 [cr]
```

The compliance window can be up to 99 VDC. Valid parameters are 0 up to 99.

4.2.9. (SH) Shunt HV output. The SH command will cause the power supply to shunt the output terminals through an internal resistor network.

```
Send:    >0 SH [cr]
Receive: >0 SH [cr]
```

This command can be used to assist in the removal of residual charges on the chuck after processing. The output remains shunted until a 'HV ON' request is made.

4.2.10. (SI) Set overcurrent trip point. The SI command sets the value of the overcurrent trip point used in all operating modes. Valid parameters are 0 to 1000 (units are uA).

```
Send:    >0 SI 500 [cr]
Receive: >0 SI 500 [cr]
```

The EPS300 will turn off the high voltage output when the overcurrent trip point is reached. When this occurs, the 'FAULT' indicator is lit and the unit will indicate an overcurrent error in the status word. The alarm condition can be cleared by any RS-232 status poll.

4.2.11. (SR) Set ramp rate. The SR command sets the rate at which the high voltage ramps to the target set point. This command can be used to control the rise-time or the fall-time rate of the high voltage output, for those applications requiring such control. Valid parameters range are 0 and 2 to 1000 (units in Volts/Sec).

```
Send:    >0 SR 100 [cr]
Receive: >0 SR 100 [cr]
```

Upon power-up, the EPS300 normally defaults to the maximum ramp-rate possible, as determined by factory settings. This setting results in an output ramp-rate (both rising and falling) of approximately 1000V/100mS.

Once a user-defined ramp-rate is set, the EPS300 continues to use the user ramp-rate setting value for all output setpoint changes. The EPS300 can be returned to the default (factory high-speed) ramp rate setting by resetting the unit (via a power recycle) or by sending the SR command with a value of '0'.

```
Send:    >0 SR 0 [cr]
Receive: >0 SR 0 [cr]
```

This will reset the EPS300 output ramp rate to approximately 1000V/100mS.

4.2.12. (SV) Set high voltage setpoint. The SV command sets the magnitude of the default high voltage output used whenever the 'ON' command is issued, either directly or within a program, in serial or digital remote mode. Valid parameters range from 0 to 1000 (units in Volts).

```
Send:    >0 SV 900 [cr]
Receive: >0 SV 900 [cr]
```

4.2.13. (TP) Toggle polarity. The TP command causes the polarity of the high voltage output to reverse.

```
Send:    >0 TP [cr]
Receive: >0 TP [cr]
```

If the high voltage is on, the output polarity will be reversed. If the high voltage is not on, the output polarity will reverse with the next 'ON' command. The value of the setpoint voltage does not change. This command may take up to 1.2 seconds to process when the high voltage is on.

Reversing the chuck voltage polarity is typically performed to remove stored charges from the chuck surface prior to, or after, clamping substrates.

4.3. Status information commands. The following commands provide status information about the unit, operating parameters or program condition.

4.3.1. (ID) Return software version. The ID command returns the firmware number and version installed in the EPS300.

```
Send:     >0 ID [cr]
Receive:  >0 EPS300 13218 4.4 [cr]
```

4.3.2. (MA) Measure analog setpoint voltage. The MA command returns the measured and scaled magnitude of the remote analog setpoint voltage. The returned value has a range of 0 to 1000 (units in Volts). This is the value that will be used when an SA command is invoked.

```
Send:     >0 MA [cr]
Receive:  >0 1000 [cr]
```

4.3.3. (MB) Measure values in burst mode. The MB command returns the measured value of the EPS300 output voltage and output current simultaneously.

```
Send:     >0 MB [cr]
Receive:  >0 950V 35I [cr]
```

If the unit is equipped with a substrate detector, the substrate detector value (offset and scaled) is also included in the reply message. Refer to Section 6.1 for more information.

```
Send:     >0 MB [cr]
Receive:  >0 950V 35I 18192D [cr]
```

4.3.4. (MI) Measure current at terminals. The MI command returns the measured value of the EPS300 output current. The value is expressed in microamps. The polarity indicator character, (+) or (-), will indicate the current relative to the E1 (+) output pin.

```
Send:     >0 MI [cr]
Receive:  >0 -250 [cr]
```

4.3.5. (MV) Measure volts at terminals. The MV command returns the measured value of the voltage at the EPS300 output terminals. The value is expressed in volts. The polarity indicator character, (+) or (-), will indicate the E1 pin relative to the E2 pin.

```
Send:     >0 MV [cr]
Receive:  >0 +750 [cr]
```

4.3.6. (RC) Return compliance value. The RC command returns the value of the voltage compliance window, in Volts, as set by the SC command.

```
Send:     >0 MV [cr]
Receive:  >0 10 [cr]
```

4.3.7. (RI) Return overcurrent trip point. The RI command returns the setting of the overcurrent trip value, as set by the SI command. Units are in microamps (uA).

```
Send:     >0 RI [cr]
Receive:  >0 500 [cr]
```

4.3.8. (RM) Report maximum voltage. The RM command returns the maximum, full-scale, high-voltage output limit of the EPS300 (units are in Volts).

```
Send:     >0 RM [cr]
Receive:  >0 1000 [cr]
```

All G21301-10 units have a maximum full scale range of 0 to 1000 VDC.

4.3.9. (RP) Return program status. The RP command returns the number of the active selected program, the program step number that is currently executing (if any), and the activity of the program ('R' for running, 'S' for stopped).

```
Send:     >0 RP [cr]
Receive:  >0 P0 01 S [cr]
```

In the above example, the selected program (P0) is program zero, the current step (01) is step one and the program is stopped (S).

4.3.10. (RR) Return ramp rate. The RR command returns the value of the currently active user ramp rate, previously set by an SR command.

```
Send:     >0 RR [cr]
Receive:  >0 250 [cr]
```

Valid parameters range are 0 and 2 to 1000 (units in Volts/Sec).

Upon power-up, the EPS300 normally defaults to the maximum ramp-rate possible, as determined by factory settings. This setting results in an output ramp-rate (both rising and falling) of approximately 1000V/100mS.

Once a user-defined ramp-rate is set, the EPS300 continues to use the user ramp-rate setting value for all output setpoint changes, for both increases and decreases in output voltage. The EPS300 can be returned to the default (factory high-speed) ramp rate setting by resetting the unit (via a power recycle) or by sending the SR command with a value of '0'.

4.3.11. (RS) Return Status. The RS command will return a four byte ASCII hexadecimal value that can be decoded to determine the status of the unit.

```
Send:     >0 RS [cr]
Receive:  >0 dddd [cr]
```

The 'dddd' is an ASCII hexadecimal value. Each bit represents an operating mode or condition of the unit.

D15	Wafer detector is on (set by DN or hardware)
D14	Wafer detector digital value (set by DN, DH and DL)
D13	0
D12	HV output failure
D11	Hardware interlock(s) OK
D10	Voltage compliance mode is active/inactive
D9	Overcurrent or overload fault
D8	Voltage compliance fault
D7	EPS mode bit (see table 4.2)
D6	EPS mode bit (see table 4.2)
D5	1
D4	HV is on
D3	Output polarity (set is negative)
D2	Program stop/run
D1	Auxiliary output bit 2 is on (cleared and set by CX/SX commands)
D0	Auxiliary output bit 1 is on (cleared and set by CX/SX commands)

Table 4.1 - 16 bit Status Data Bit Description

The EPS300 operating mode can be determined by decoding bit 7 of the status message.

D7	D6	
0	0	RS-232 interface
0	1	Digital remote interface

Table 4.2 - EPS300 Mode Bits in the Status Value

The program run/stop bit (D2) will be set when a program is running (or in a "WF" hold) and the bit will be cleared when a program is aborted or has completed.

The polarity bit (D3) is cleared when the power supply output is in a positive polarity mode (pin E1 is greater than pin E2) and the bit will be set when the power supply output is in a negative polarity mode, whether high voltage is actually present or not. The polarity bit is static until a PP, PN (NP) or TP command is received.

The remaining bits are set when the indicated conditions are active and reset when they are inactive.

4.3.12. (RV) Return voltage setpoint. The RV commands returns the current value of the stored high voltage setpoint used in all of the operating modes. This value is set by the SV command.

```
Send:    >0 RV [cr]
Receive: >0 900 [cr]
```

4.4. Digital output control. The EPS300 provides the user with two digital output bits on the 15 pin D-subminiature connector. The auxiliary output bits are user defined control bits for external devices. Both bits are cleared after power-up or system reset.

Each digital output can be configured to sink or source current. Refer to Appendix E for additional information on the digital output bits.

4.4.1. (CX) Clear auxiliary output bit. The CX command sets the selected auxiliary output bit off (clears). Select the desired bit [n] with a '1' or a '2'.

```
Send:     >0 CX n [cr]
Receive:  >0 CX n [cr]
```

4.4.2. (SX) Set auxiliary output bit. The SX command sets the selected auxiliary output bit on (sets). Select the desired bit [n] with a '1' or a '2'.

```
Send:     >0 SX n [cr]
Receive:  >0 SX n [cr]
```

4.5. T1, T2 and T3 timer commands. The timer commands allow the user to reset, load, start, wait for, and display the timer data. The EPS300 has three process timers.

Timer 1 (T1) is a user programmable timer that can be used as a general-purpose countdown timer. When used with the ST, RT and WT commands, it may be used to control the progress through a program.. The resolution of T1 is one second. It has a maximum time period of 59 minutes and 59 seconds.

The Timer 2 (T2) count-up timer tracks the period the high voltage has been on since Timer 2 was last cleared. The C2 command can be used to clear Timer 2, however, there is no corresponding set timer or start timer command for Timer 2. Timer 2 can be used as a chuck or chamber preventative maintenance timer. The resolution of T2 is one second. It has a maximum time period of 59,999 hours, 59 minutes and 59 seconds.

Timer 3 (T3) is the OEM 'HV ON' timer. This timer cannot be reset by the user and is used by the manufacturer for MTBF information. The resolution of T3 is one minute. It is a count-up timer and it has a maximum time period of 59,999 hours and 59 minutes.

4.5.1. (C1) Clear timer 1. The C1 command resets Timer 1, the general-purpose timer, to 00:00 and stops it.

```
Send:     >0 C1 [cr]
Receive:  >0 C1 [cr]
```

4.5.2. (C2) Clear timer 2. This command resets Timer 2, the high voltage on timer, to 00:00. If Timer 2 is reset with the high voltage in the on state, the timer will reset and continue timing until the high voltage is turned off.

```
Send:     >0 C2 [cr]
Receive:  >0 C2 [cr]
```

4.5.3. (R1) Read timer 1. The R1 command returns the time remaining on Timer 1.

```
Send:     >0 R1 [cr]
Receive:  >0 12m 34s [cr]
```

4.5.4. (R2) Read timer 2. The R2 command returns the time that the high voltage has been on since the last reset of Timer 2. This time can be used as a chuck or chamber preventative maintenance indicator.

```
Send:     >0 R2 [cr]
Receive:  >0 5h 49m 24s [cr]
```

4.5.5. (R3) Read timer 3. The R3 command returns the contents of the OEM cumulative high voltage on period timer. The user cannot reset this timer.

```
Send:     >0 R3 [cr]
Receive:  >0 345h 23m [cr]
```

4.5.6. (RT) Reload and start timer 1. The RT command reloads Timer 1 with the last value specified by an 'ST' command and restarts the timer.

```
Send:     >0 RT [cr]
Receive:  >0 RT [cr]
```

4.5.7. (ST) Set timer 1. The ST command loads a user defined countdown time value into Timer 1 and starts the timer.

```
Send:     >0 ST mmss [cr]
Receive:  >0 ST mmss [cr]
```

The minutes and seconds entry may be entered as seconds only (up to 99 seconds). Leading zeros in this case are ignored.

```
Send:     >0 ST 1 [cr]
Receive:  >0 ST 1 [cr]
```

Time periods as short as one-second can be generated.

5. PROGRAMMING

5.1. Introduction. One of the unique features of the EPS300 is its ability to allow the user to develop complex clamping algorithms using a proprietary command language. The unit can store up to ten programs that control the clamping and declamping operation. Each program can be up to 32 steps long. The unit may be directed to execute any one of the ten stored programs giving the user the optimum flexibility for developing sophisticated clamping algorithms for multiple process conditions. All ten of the EPS300 programs are stored in nonvolatile RAM

Each of the ten programs can be uploaded to a host computer for archiving or modification, and then downloaded to the same or another EPS300. This feature allows the user to maintain process parameter continuity, with a minimum of downtime, in the event an EPS300 unit must be replaced.

5.2. Entering program commands. User programs may be up to 32 steps long. Each program instruction is entered similar to the immediate mode commands, with the exception that a line number is included with the instruction. The instructions are stored and executed in sequence, based upon the instruction line number. There are two program instruction formats used with the EPS300.

Program instruction only format:

```
> a [sp] nn [sp] cc [cr]
```

Program instruction with parameters format:

```
> a [sp] nn [sp] cc [sp] dddd [cr]
```

All program instructions sent to the EPS300 must start with an ASCII '>' (hex 3E) or the command will be ignored.

The following one byte code [a] is the unique address of the target unit. The EPS300 currently only supports address zero (hex 1E).

ASCII space characters [sp] (hex 32) act as delimiters and must be inserted as shown between fields. No space is permitted between the attention character and the address.

The following field [nn] is the instruction step (line) number, which can range from 1 to 32. Instruction lines can be entered in any order. Instructions are stored and listed in order, sorted by step number. Steps (lines) may be skipped. Empty program locations are treated as “no operation” and are skipped.

The next field [cc] is the instruction field, which contains a two-byte ASCII mnemonic from the instruction set. The program instruction can be any instruction that is valid within a program.

The data field [dddd], if it is used, contains the command data. For example, if the desired target voltage is 850 volts, then an ASCII '850' should be in the data field. Leading zeros are ignored.

After the complete message has been sent, a carriage return (hex 0D) must be sent to the unit to indicate the end of the message. If the last byte after the command message is not a carriage

return, or if the command does not pass syntax checks, the command will be ignored and a '?' character will be returned. Multiple program instructions per line number are not allowed.

Some EPS300 instructions cannot be used within programs. The following instructions are not valid within programs.

ID	Identify
MA	Measure analog setpoint
MB	Measure both V and I
MC	Measure center-tap voltage
MI	Measure current at terminals
MV	Measure volts at terminals
R1	Read timer 1
R2	Read timer 2
R3	Read timer 3
RA	Return substrate detector analog value
RC	Return compliance value
RI	Return overcurrent trip point
RM	Report maximum voltage
RP	Return program number/step/run-stop
RS	Return hardware status
RV	Return voltage setpoint

Table 5.1 - Instructions that are Invalid Within a Program

Refer to Section 4 for additional information on EPS300 instruction set.

5.3. Program control commands. The following commands give the user the ability to execute, abort, list and clear programs. These commands cannot be used within a program. Once the EPS300 has begun program execution, all program control commands except 'AB' will be ignored.

5.3.1. (AB) Abort the current program. The AB command stops the operation of the current program, turns off the high voltage, resets the digital outputs, returns to program step 01 and if possible, returns to the ready state.

```
Send:     >0 AB [cr]
Receive:  >0 AB [cr]
```

5.3.2. (CA) Clears all programs. The CA command clears all ten of the EPS300 stored programs. The user is prompted for a Y(es) or N(o) validation response to confirm that erasure of all of the stored programs is desired.

```
Send:     >0 CA [cr]
Receive:  Preparing to clear ALL programs. [cr]
          Are you sure (Y-N)? [cr]
```

5.3.3. (CP) Clear current program. The CP command erases all steps of the current program. Be cautious using this command. No validation prompt is provided. Only the currently selected program is erased.

```
Send:     >0 CP [cr]
Receive:  >0 CP [cr]
```

5.3.4. (LP) List current program. The LP command sends a listing of the currently selected program to the serial port. The output format includes line numbers so that it may be uploaded into another EPS300 with minimal editing. A simple program is shown for example.

```
Send:     >0 LP [cr]
Receive:  P0 [cr]
          01 SV 850 [cr]
          02 ON [cr]
          03 WF [cr]
```

5.3.5. (Pn) Select program. The EPS300 supports up to ten user defined programs, stored as P0 through P9. To select a program, enter the desired program number immediately after the select program mnemonic. All program locations are identical in function.

```
Send:     >0 P3 [cr]
Receive:  >0 P3 [cr]
```

In the G21302-10 model of EPS300 units, the digital remote mode 'HV ON' runs program P0.

5.3.6. (Xn) Execute specified program. The Xn command causes the specified program (n) to begin execution. The return message indicates that the indicated program started execution.

```
Send:     >0 X1 [cr]
Receive:  >0 XP P1 [cr]
```

Allowable values for program numbers are 0 to 9. This command can be used within a program or in immediate mode. This command can be used to create 'chained' programs and endless loops. The abort ('AB') command can be used to exit an endless loop.

5.3.7. (XP) Execute current program. The XP command causes the currently selected program to begin execution. The return message indicates the program number that has started execution.

```
Send:     >0 XP [cr]
Receive:  >0 XP P0 [cr]
```

5.3.8. (??) Help. A brief listing of all available EPS300 commands can be displayed by sending the unit the help listing command.

```
Send:     >0 ?? [cr]
```

5.4. Special program commands. These commands are related to program flow, or have other special functions. These commands can only be used from within a program, unless otherwise noted.

5.4.1. (GO) Go to step. The GO command cause the program to branch to the program step (nn) indicated. Allowable values for program step numbers are 1 to 32. This command can be used within a program or in immediate mode.

Program Instruction Format: `GO nn [cr]`

Immediate mode command format:

```
Send:    >0 GO nn [cr]
Receive: >0 GO nn [cr]
```

Endless loops can be created using this command. The abort ('AB') command can be used in immediate mode to exit a loop.

5.4.2. (RE) Resume. This command causes the program to continue normal execution after encountering a wait for resume ('WR') command. No arguments are required.

```
Send:     >0 RE [cr]
Receive:  >0 RE [cr]
```

This command cannot be used within a program, and so must be sent via RS-232. This command will be acknowledged by the EPS300 even if the unit is set to 'DIG' mode.

5.4.3. (WF) Wait for HV off. This command will cause a program to pause execution and wait for a high voltage off condition or command. If a 'high voltage is off' condition is already present when the WF instruction is encountered, possibly through an improper program sequence, program execution will continue with the next instruction.

Instruction Format: `WF [cr]`

In serial interface mode, once a program has been started by sending an 'XP' command and a 'WF' is encountered, the EPS300 will wait for an 'OF' command before continuing to process the program.

In digital remote mode, once a program has been started by setting the high voltage go on bit (digital interface pin 9 active) and a 'WF' is encountered, the EPS300 will wait for the high voltage go on bit to be cleared (digital interface pin 9 inactive) before proceeding.

5.4.4. (WR) Wait for resume. This command causes the program to pause until a resume ('RE') command is received via the serial interface. No arguments are required.

Instruction Format: `WR [cr]`

This command can be used only within a program. It cannot be used as an immediate (direct) command.

5.4.5. (WT) Wait for timer 1. This command causes program execution to pause until timer one (T1) expires. No arguments are required.

Instruction Format: `WT [cr]`

Before the WT command can be used, the program interpreter must have encountered an 'RT' or 'ST' command. The 'RT' or 'ST' command will load and start the timer. When the program interpreter then encounters the 'WT' command, program execution will stop until the timer one count reaches 00:00.

5.4.6. (SA) Set output to analog setpoint. During program execution, the 'SA' command can be used temporarily change the high voltage output setpoint to a value that is proportional in magnitude to the analog input present on pin 1 of the remote control connector. When an SA command is encountered, the analog setpoint is sampled and the value is scaled and used to establish the magnitude of the high voltage output. Refer to Appendix E for more information.

Instruction Format: `SA [cr]`

The 'SA' command functions like the 'SO' command. The high voltage setpoint can be reset back to the stored setpoint by executing the 'SB' command. The high voltage setpoint will then equal the value set by the most recent 'SV' command. Execution of an 'SV', 'SO', or another 'SA' command will update the high voltage setpoint.

Upon termination of the program, the 'SV' setpoint value is restored as the active high voltage output setpoint level.

5.4.7. (SO) Set high voltage output level. The SO command sets the high voltage output level from within a program without altering the setpoint value stored in memory, previously set by the 'SV' command.

Instruction Format: `SO 850 [cr]`

A valid range for the parameter is 0 to 1000 (units in Volts).

When a program is not running, an 'ON' command will produce an output voltage that corresponds to the most recent SV command setting. The SO command temporarily overrides this value and can be used to develop complex declamping waveforms without affecting the set point for clamping. Upon termination of the program, the SV setpoint becomes the active output setpoint again.

6. OPTIONS

6.1. Substrate/Wafer Detector. The following commands provide control of the substrate/wafer (capacitance) sensor option.

6.1.1. (DF) Turn off the substrate/wafer detector. The DF turns off the substrate/wafer detector. Parameters are not required.

```
Send:       >0 DF [cr]
Receive:    >0 DF [cr]
```

6.1.2. (DG) Set detector gain. The DG command sets the gain the substrate/wafer detector. The offset raw detector value is multiplied by this value. Valid parameters range from 1 to 32.

```
Send:       >0 DG 16 [cr]
Receive:    >0 DG 16 [cr]
```

The magnitude of the wafer detector analog output value (available at pin 6 of the remote control connector) is affected by the setting of this value. Refer to Appendix E for additional information.

6.1.3. (DH) Set detector high threshold. The DH command sets the high threshold value for the substrate/wafer detector. Refer to section 6.1.4 for additional information. Valid parameters range from 0 to 65535.

```
Send:       >0 DH 12000 [cr]
Receive:    >0 DH 12000 [cr]
```

6.1.4. (DL) Set detector low threshold. The DL command sets the low threshold value for the substrate/wafer detector. Refer to section 6.1.4 for additional information. Valid parameters range from 0 to 65535.

```
Send:       >0 DL 8000 [cr]
Receive:    >0 DL 8000 [cr]
```

6.1.5. (DN) Turn on the substrate/wafer detector. The DN command turns on the substrate/wafer detector and sets/clears the detector threshold mode bit. Valid parameters are 1 and 0.

```
Send:       >0 DN 1 [cr]
Receive:    >0 DN 1 [cr]
```

If the substrate/wafer detector threshold mode is set to 0, the low threshold value is active. Then, if the offset and scaled substrate/wafer detector value is below the low threshold, the substrate/wafer detector bit is set, both in the status word ('RS') and the digital output (refer to Appendix E).

If the substrate/wafer detector threshold mode is set to 1, the high threshold value is active. Then, if the offset and scaled substrate/wafer detector value exceeds the high threshold, the substrate/wafer detector bit is set, both in the status word ('RS') and the digital output (refer to Appendix E).

6.1.6. (DZ) Set the substrate/wafer detector zero offset. The DZ command sets the substrate/wafer detector offset (zero) value. Valid parameters range from 0 to 65535.

```
Send:      >0 DL 7950 [cr]
Receive:   >0 DL 7950 [cr]
```

The user specified value is subtracted from the value measured by the substrate/wafer detector. The result of this subtraction affects the value returned by the RA command and the analog output value (measured at the I/O connector).

6.1.7. (RA) Return the substrate/wafer detector analog value. The RA command returns the value measured by the substrate/wafer detector.

```
Send:      >0 RA [cr]
Receive:   >0 10324 [cr]
```

The returned value is computed by subtracting the substrate detector zero value (set by the DZ command) from the raw substrate/wafer detector value and multiplying that value by the gain value (set by the DG command). If the raw substrate/wafer detector value is required, set the DZ value to zero (0) and the DG value to one (1).

6.1.8. (RG) Return the substrate/wafer gain setting. The RG command returns the stored substrate/wafer detector gain setting.

```
Send:      >0 RG [cr]
Receive:   >0 16 [cr]
```

6.1.9. (RH) Return the substrate/wafer high threshold value. The RH command returns the stored substrate/wafer detector high threshold value.

```
Send:      >0 RH [cr]
Receive:   >0 12000 [cr]
```

6.1.10. (RL) Return the substrate/wafer low threshold value. The RL command returns the stored substrate/wafer detector low threshold value.

```
Send:     >0 RL [cr]
Receive:  >0 8000 [cr]
```

6.1.11. (RZ) Return the substrate/wafer zero/offset value. The RZ command returns the stored substrate/wafer detector zero/offset value.

```
Send:     >0 RZ [cr]
Receive:  >0 7950 [cr]
```

6.2. Center-Tap Voltage Monitor. The center-tap voltage monitor returns the value of the measured voltage at the center-tap pin of the high voltage connector, or in EPS300 units equipped with a remote center-tap bias (MHV/BNC) connection, the returned value is the voltage on this connection, relative to the case/safety ground terminal..

6.2.1. (MC) Measure Center-Tap Voltage. The MC command returns the measured value of the voltage at the EPS300 center-tap terminal relative to the chassis ground post. The value is expressed in volts. The polarity is relative to the ground point.

```
Send:       >0 MC [cr]
Receive:    >0 +750 [cr]
```

6.3. Center-Tap Remote Bias Connection. A BNC/MHV type connector is provided on the front panel to allow the EPS300 high voltage center tap to be biased with an external DC power supply. The externally applied voltage on this pin should not exceed 500 VDC. The current flow in this connection should not exceed 10mA.

7. TROUBLESHOOTING

7.1. Introduction. This section provides the user with information on methods to resolve problems that may be encountered in the event that the EPS300 appears to be operating incorrectly. To assist in determining the fault condition, refer to the LED status display on the top panel.

7.2. Overload Fault. An overload fault can be caused by an overcurrent trip point setting that is too low, an output voltage setpoint that is beyond the capability of the EPS300 for the given load, or an electrical problem with the load.

The output overcurrent limit setpoint can be adjusted with an 'SI' command. Increase the setting, up to 1000 uA, and turn the high voltage back on. If the load current exceeds the over current trip point, the unit will shut off the high voltage output, and/or abort a running program. This allows the user to set a lower limit for the expected load impedance.

If voltage compliance monitoring is activated and voltage compliance cannot be maintained, the unit will produce an overload fault. Correct the problem by turning off voltage compliance monitoring ('CF' command), reset the voltage setpoint to a lower value ('SV' command) or inspect the load for excessive current draw.

If the unit continues to display an overload fault, disconnect the unit from the load and turn on the high voltage. If the high voltage comes on and achieves the desired voltage level, the unit is performing normally. If the 'FAULT' indicator continues to light when isolated from the load, the unit has an internal failure and must be returned to the factory for repair.

7.3. Fault LED. The 'FAULT' LED is on continuously whenever an overload fault occurs. A status poll will clear the 'FAULT' LED. A flashing 'FAULT' LED indicates a hardware failure.

7.4. No Output. If the unit does not produce a high voltage output, verify that it is properly powered and that the LED status display indicates a ready state. If the external safety interlock circuit is open, the 'READY' LED will be extinguished, the high voltage will be off, and the current program will be aborted.

If the unit could not achieve voltage compliance, or an overload condition exists, the red 'FAULT' LED will be lit.

7.5. Component replacement. There are no user serviceable components in any of the EPS series power supplies. In the event of an EPS series power supply failure, the unit must be returned to the factory for repair or replacement.

WARNING: High-voltages are produced by the EPS300. Installation and operation of the unit should be performed only by qualified and authorized personnel.

APPENDIX A - Programming Examples

The following program illustrates the basic electrostatic chuck power supply functions of clamping and declamping. The program will set the high voltage setpoint to 800 VDC, wait for the 'high voltage go off' command and then apply a reverse pulse of 800 VDC for four seconds to discharge the chuck and release the substrate.

```
01 TP         ; toggle the polarity
02 SV 800     ; set the output to 800 VDC
03 ON         ; turn on the high voltage
04 WF         ; wait for the high voltage off command
05 TP         ; hv is off, toggle polarity
06 ON         ; turn on the high voltage
07 ST 4       ; load and start a four second timer
08 WT         ; wait for the timer to expire
09 OF         ; turn off the high voltage
```

This program better illustrates the flexibility of the EPS300. An oscillating voltage can be produced by the EPS300 to discharge the chuck, and more effectively release the substrate. The 'SO' command is used here to avoid changing the 800 volt setpoint value.

```
01 TP         ; toggle polarity
02 SV 800     ; set the output to 800 VDC
03 CX 1       ; clear Aux 1 digital I/O bit
04 SX 2       ; set Aux 2 digital I/O bit
05 ON         ; turn on the high voltage
06 WF         ; wait for the high voltage off command
07 TP         ; toggle polarity
08 ON         ; turn on the high voltage
09 SO 800     ; set output to 800V
10 ST 8       ; start eight second timer
11 WT         ; wait for timer to expire
12 TP         ; toggle polarity
13 ON         ; turn on the high voltage
14 SO 400     ; set output to 400V
15 ST 6       ; start six second timer
16 WT         ; wait for timer to expire
17 TP         ; toggle polarity
18 ON         ; turn on the high voltage
19 SO 200     ; set output to 200V
20 ST 4       ; start four second timer
21 WT         ; wait for timer to expire
22 0F         ; turn high voltage off
23 SX 1       ; set Aux 1 digital I/O bit
24 CX 2       ; clear Aux 2 digital I/O bit
```

These programs are shown for example only. Some electrostatic chuck clamping and/or release algorithms and AC clamping techniques have been patented. Use of patented algorithms and/or techniques may be a violation of federal patent law.

APPENDIX B - Technical Specifications

DC Power Requirements

Input power required:	+24 VDC or ±15 VDC, 15 watts
Input power mating connector:	4 pin, 5.08mm, terminal block plug Phoenix Contact Part No, PX 1757035

Environmental

Storage temperature range:	0°F - 140°F
Operation temperature range:	40°F - 125°F
Humidity:	10 - 85%, non-condensing

Physical

Dimensions (H x W x D):	2.5"H x 6.0"W x 9.9"D
Weight:	3 lb. (1.3 kgs)
Mounting requirement:	Operation is allowed in any orientation Use four #8-32 or #10-32 screws

Output

High voltage output:	Bipolar, 1,000 volts DC, ±1%
High voltage output current limit:	1 mA, ±1%
High voltage output isolation from chassis:	1000 Mohm min.
Output impedance:	100 Kohm
Output connector:	Medical grade, six-pin, twist-lock, 5 kV rated AMP part No. 867535-1
Output connector electrically interlocked:	Yes

CT Bias Input

CT bias input voltage (max):	Bipolar, 500 volts DC
CT bias input current (max):	10 mA

Operating Modes and Interface Options

Operating modes	Two remote modes
Remote control interfaces	Digital, RS-232

Program Specifications

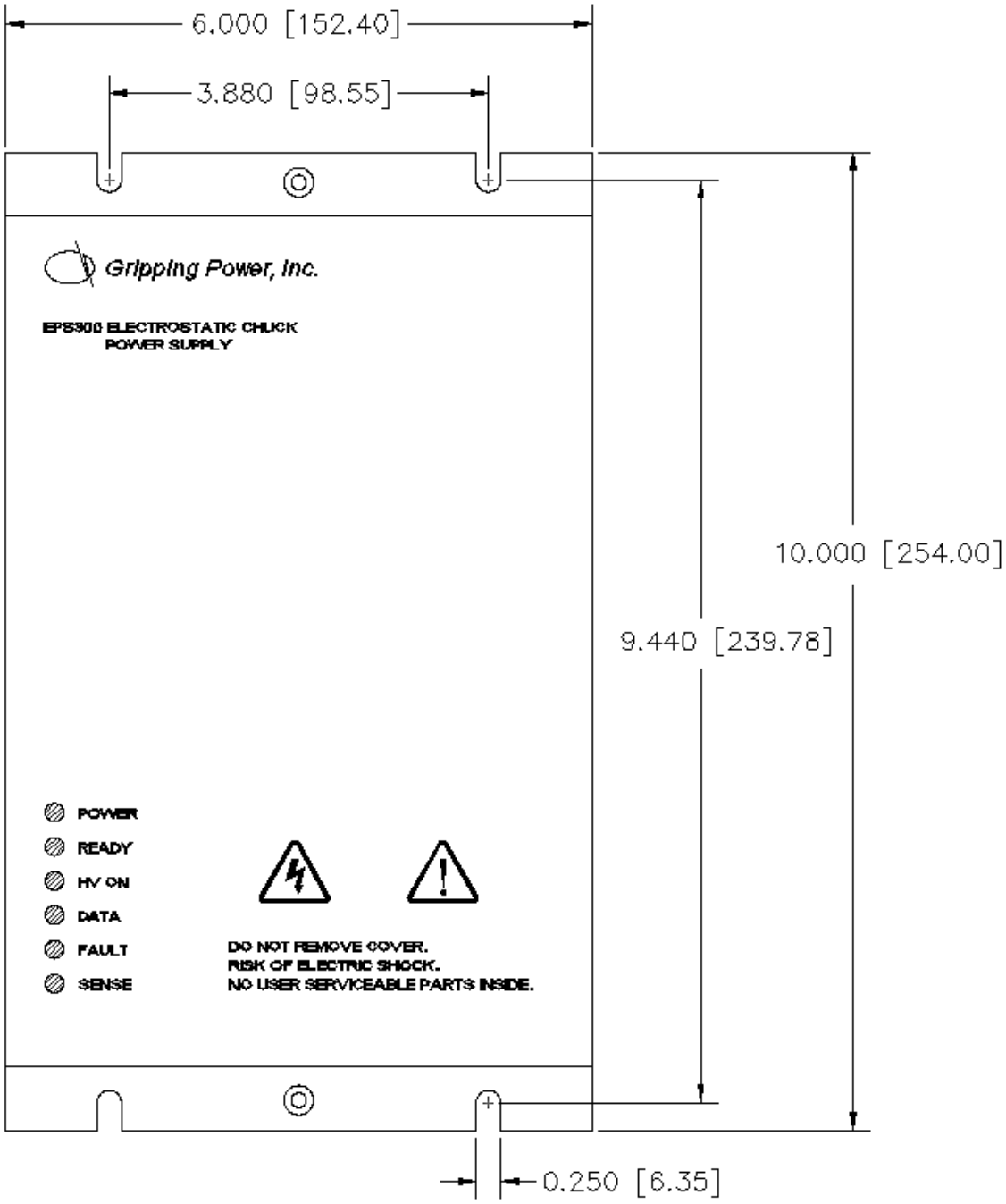
Number of user defined programs	10
Number of steps per program	32

Testing Agency Approvals

The EPS300 has been designed to meet SEMI S2 and CE requirements.

APPENDIX C – Mounting Dimensions

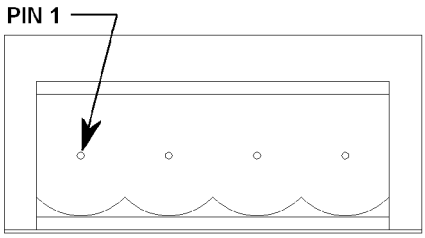
The compact size of the EPS300 allows it to be integrated into OEM process equipment directly below the electrostatic chuck.



The unit can be mounted in any orientation, using four #8-32 or #10-32 screws and should be mounted as close to the electrostatic chuck as possible. Four mounting points are provided on the unit as shown.

APPENDIX D – DC Power Input Specifications

The DC power input is via a female, four-pin, single-row, 5.08mm, connector.



DC Power Connector

The input power mating connector is a 4 pin, 5.08mm, terminal block plug, Phoenix Contact part #PX 1757035. A mating power connector is supplied with each EPS300 unit.

The DC power input is auto-selecting and can connected to either +24 VDC or ±15 VDC.

DC power connections for **+24 VDC** operation:

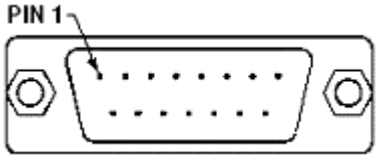
Pin	Description	Signal Type
1	+24 VDC	Power input
2	DC Common	DC common or ground
3	No connection required	
4	Chassis ground	Chassis safety system ground

DC power connections for **±15VDC** operation:

Pin	Description	Signal Type
1	+15 VDC	Power input
2	DC Common	DC common or ground
3	-15 VDC	Power input
4	Chassis ground	Chassis safety system ground

APPENDIX E - Remote Control Interface Specifications

The analog and digital remote control interface connector is a male, 15 pin, D-subminiature style connector, located on the front panel.



Remote Control Connector

Pin	Description	Signal Type
1	High voltage analog setpoint	Input (0-10 VDC)
2	Substrate detector threshold signal	Digital output (dry contact, source or sink)
3	Measured output current	Analog output (±10V = ±1,000V)
4	Digital input source/sink voltage	Input source/sink voltage (+24 or GND)
5	Substrate detector enable	Digital input (opto, source/sink input)
6	Substrate detector analog signal	Analog output (+10V F/S)
7	Aux. digital output 1	Digital output (dry contact, source or sink)
8	Aux. digital output 2	Digital output (dry contact, source or sink)
9	Execute selected program	Digital input (opto, source/sink input)
10	Analog common	Analog signal common
11	Digital output source/sink voltage	Output source/sink voltage (+24 or GND)
12	Measured output current	Analog output (±10V = ±1,000uA)
13	Center tap voltage monitor	Analog output (±10V = ±1,000V)
14	Interlock input	Must be tied to pin 15.
15	Interlock input	Must be tied to pin 14.

The analog voltage and current monitors (pins 3 and 12) are configured for ±10 VDC = ±1,000 VDC and ±10 VDC = ±1,000uA output, respectively.

The ‘center-tap voltage monitor’ (pin 13), if available, is configured for ±10 VDC = ±1,000 VDC. All analog output signals are referenced to pin 10. Pin 10 is tied to chassis ground.

The ‘substrate detector signal’ (pin 6), if available, is configured for 10 VDC full-scale.

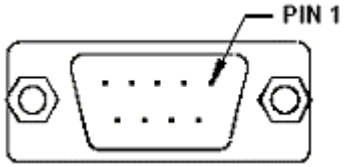
The ‘substrate detector sense’ output (pin 2), if available, and the ‘auxiliary digital outputs’ (pins 7, 8) and will source or sink, depending upon the voltage applied to pin 11.

The ‘high-voltage enable’ signal (pin 9) and the ‘substrate detector enable’ signal (pin 6) are active high or active low, depending upon the voltage applied to pin 4.

For proper operation, the interlock enable pins (pins 14 and 15) must be tied directly together or connected through a remote dry contact relay or switch.

APPENDIX F - Serial Communications Connector Specifications

The serial communications interface connector is a female, 9 pin, D-subminiature style connector, located on the rear panel.



Serial Interface Connector

Pin	Description	Direction
1	No connection	
2	RS-232 Transmit Data	Output
3	RS-232 Receive Data	Input
4	No connection	
5	Signal common	
6	No connection	
7	No connection	
8	No connection	
9	No connection	

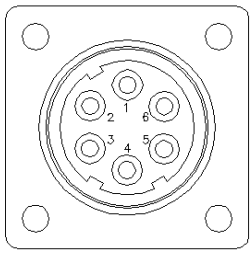
The RS-232 serial communications baud rate is factory set at 19,200 baud, no parity and one stop bit. Modem control lines, such as RTS and CTS, are not provided. Handshaking protocols, such as XON and XOFF, are not supported. The host system must wait for the EPS300 to acknowledge all messages to avoid overflowing the internal serial buffer.

The unit can be optionally factory configured for 9,600 baud RS-232 operation. Contact your EPS300 sales representative for more information.

Connecting DTR, RTS and CTS signals to pins identified as ‘No connection’ will have no effect on the operation of the RS-232 communications with the EPS300.

APPENDIX G - High Voltage Output Connector

The interlocked, six-pin, high-voltage output connector is an AMP No. 867535-1, rated at 5.0 kV. The connector is located on the front panel of the EPS300.



Pin	Description	Direction
1	High voltage output E1	Output (+)
2	No connection	
3	High voltage output E2	Output (-)
4	Chassis GND (safety ground)	
5	Interlock	Input
6	Interlock	Input

The high voltage output is bipolar (±1,000 VDC) and is fully floating from the chassis, ground, analog or digital common.

The interlock pins (5 and 6) must be shunted together via a dry contact relay or switch. The 'INTERLOCK' LED will not illuminate if the interlock is open. The EPS300 will disable the high-voltage output and abort the current program, if running, when the interlock opens.

APPENDIX H - Ordering and Service Information

Before returning materials for evaluation, repair, or replacement, a Returned Materials Authorization (RMA) number must be obtained from Gripping Power, Inc.. Materials returned to Gripping Power without an RMA number will not be processed until an RMA number, or written authorization, has been obtained.

All items returned for repair must be packaged properly prior to shipment or any available warranty may be voided. Returned items that are improperly packaged or damaged in transit will be held until disposition arrangements have been made.

Ship to: **Gripping Power, Inc.**
11930 44th St. North, Suite B
Clearwater, Florida 33762

Tel: (727) 572-4100
FAX: (727) 592-9894

For more information visit *http://www.GrippingPower.com.*