

OPERATOR MANUAL

ATE-DMG SERIES

POWER SUPPLY

KEPCO INC.
An ISO 9001 Company.

MODELS		CE
ATE 6-100DMG, ATE 15-50DMG, ATE 25-40DMG, ATE 36-30DMG, ATE 55-20DMG, ATE 75-15DMG, ATE 100-10DMG, ATE 150-7DMG		
<small>ORDER NO.</small>	<small>REV. NO.</small>	

IMPORTANT NOTES:

- 1) This manual is valid for the following Model and associated serial numbers:

MODEL	SERIAL NO.	REV. NO.
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- 2) A Change Page may be included at the end of the manual. All applicable changes and revision number changes are documented with reference to the equipment serial numbers. Before using this Instruction Manual, check your equipment serial number to identify your model. If in doubt, contact your nearest Kepco Representative, or the Kepco Documentation Office in New York, (718) 461-7000, requesting the correct revision for your particular model and serial number.
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Declaration of Conformity

Application of Council directives: 2006/95/EC (LVD)
2004/108/EC (EMC)

Standard to which Conformity is declared:

IEC61010-1, 3rd Edition	Safety requirements for electrical equipment for measurement, control, and laboratory use (designed to meet)
EN55011 (Class A, conducted and radiated) (radiated is designed to meet)	Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, scientific and radio frequency equipment.
EN61000-4-11, EN61000-4-4 Level 3, EN61000-4-2 Level 4, EN61000-4-5 Level 4. Designed to meet: IEC61000-3-3, IEC61000-4-3, IEC61000-4-6, IEC61000-4-8.	Voltage Dips, Fast Transient EFT, ESD Level 4, Surge Immunity Criteria B, Flicker (designed to meet), Radiated Immunity (designed to meet), Conducted Immunity, Magnetic Field Immunity (designed to meet)

Manufacturer's Name:	KEPCO, INC.
Manufacturer's Address:	131-38 SANFORD AVENUE FLUSHING NY 11355 USA

Importer's Name:	REPRESENTATIVE COPY
Importer's Address:	
Type of Equipment	

Model Series	ATE 50W, 100W, (¼ Rack), 250W (½ Rack), 500W (¾ Rack), 1000W (Full Rack), all models, all options
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Model No.:

Year of Manufacture:

I, the undersigned, declare that the product specified above, when used in conjunction with the conditions of conformance set forth in the product instruction manual, complies with the requirements of the Low Voltage Directive 2006/95/EC, which forms the basis for application of the CE Mark to this product.

Place: Kepco, Inc.
131-38 Sanford Ave.
Flushing NY 11355
USA

Date:	<u>Mark Kupferberg</u> (Full Name) <u>Executive Vice President</u> (position)
-------	--

Conditions of Conformance

When this product is used in applications governed by the requirements of the EEC, the following restrictions and conditions apply:

1. For European applications, requiring compliance to the Low Voltage Directive, 73/23/EEC, this power supply is considered a component product, designed for "built in" applications. Because it is incomplete in construction, the end product enclosure must provide for compliance to any remaining electrical safety requirements and act as a fire enclosure. (EN61010-1:2001, Cl. 6, Cl. 7, Cl.8, and Cl. 9)
2. This power supply is designed for stationary installation, with mains power applied via a detachable power supply cord or via direct wiring to the source power terminal block.
3. This power supply is considered a Class 1 (earthed) product. It is intended for use as part of equipment meant for test, measurement and laboratory use, and is designed to operate from single phase, three wire power systems. This equipment must be installed within a suitably wired equipment rack, utilizing a three wire (grounded) mains connection. See wiring section of this manual for complete electrical wiring instructions. (EN61010-1:2001, Cl.6.10.1)
4. This power supply has secondary output circuits that are considered hazardous, and which exceed 240 VA at a potential of 2V or more.
5. The output wiring terminals of this power supply has not been evaluated for field wiring and, therefore, must be properly configured by the end product manufacturer prior to use.
6. This power supply employs a supplementary circuit protector in the form of a circuit breaker mounted on the front panel. This circuit breaker protects the power supply itself from damage in the event of a fault condition. For complete circuit protection of the end product, as well as the building wiring, it is required that a primary circuit protection device be fitted to the branch circuit wiring. (EN61010-1:2001, Cl. 9.5)
7. Hazardous voltages are present within this power supply during normal operation. All operator adjustments to the product are made via externally accessible switches, controls and signal lines as specified within the product operating instructions. There are no user or operator serviceable parts within the product enclosure. Refer all servicing to qualified and trained Kepco service technicians.

SAFETY INSTRUCTIONS

1. Installation, Operation and Service Precautions

This product is designed for use in accordance with EN 61010-1 and UL 3101 for Installation Category 2, Pollution Degree 2. Hazardous voltages are present within this product during normal operation. The product should never be operated with the cover removed unless equivalent protection of the operator from accidental contact with hazardous internal voltages is provided:



There are no operator serviceable parts or adjustments within the product enclosure. Refer all servicing to trained service technician.



Source power must be removed from the product prior to performing any servicing.



This product is factory-wired for the nominal a-c mains voltage indicated on the rating nameplate located adjacent to the source power connection on the product's rear panel. To reconfigure the product input for other nominal mains voltages as listed herein, the product must be modified by a trained service technician.

2. Grounding

This product is a Class 1 device which utilizes protective earthing to ensure operator safety.



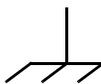
The PROTECTIVE EARTHING CONDUCTOR TERMINAL must be properly connected prior to application of source power to the product (see instructions on installation herein) in order to ensure safety from electric shock.



PROTECTIVE EARTHING CONDUCTOR TERMINAL - This symbol indicates the point on the product to which the protective earthing conductor must be attached.



EARTH (GROUND) TERMINAL - This symbol is used to indicate a point which is connected to the PROTECTIVE EARTHING TERMINAL. The component installer/ assembler must ensure that this point is connected to the PROTECTIVE EARTHING TERMINAL.



CHASSIS TERMINAL - This symbol indicates frame (chassis) connection, which is supplied as a point of convenience for performance purposes (see instructions on grounding herein). This is not to be confused with the protective earthing point, and may not be used in place of it.

3. Electric Shock Hazards

This product outputs hazardous voltage and energy levels as a function of normal operation. Operators must be trained in its use and exercise caution as well as common sense during use to prevent accidental shock.



This symbol appears adjacent to any external terminals at which hazardous voltage levels as high as 500V d-c may exist in the course of normal or single fault conditions.



This symbol appears adjacent to any external terminals at which hazardous voltage levels in excess of 500V d-c may exist in the course of normal or single fault conditions.

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FIGURE 1-1. ATE-DMG SERIES PROGRAMMABLE POWER SUPPLY

SECTION 1- INTRODUCTION

1.1 SCOPE OF MANUAL

This manual contains instructions for the installation, operation and maintenance of the ATE-DMG series of voltage and current stabilized d-c power supplies, manufactured by Kepco, Inc., Flushing, New York, U.S.A.

1.2 GENERAL DESCRIPTION

The Kepco ATE-DMG with programmable overvoltage protector is a precision stabilized power supply which can deliver either stabilized output voltage or current. The prevailing operating mode is indicated by LED mode indicators on the front panel. Operating mode crossover is automatic and may be monitored remotely by commands provided via the GPIB port. A digital front panel display shows the output voltage and output current. This power supply has a linear and fully dissipative NPN pass transistor section driven by high-gain, integrated circuit amplifiers. The output of the power supply is fully programmable via either the GPIB port or the front panel keypad or from an external analog reference when enabled from the front panel menu. Terminals are also provided for remote error sensing, as well as for the connection of the output capacitor directly at the load.

The ATE-DMG power supply features user-selectable "slow" or "fast" operating modes. Slow mode operation is recommended for applications demanding a constant voltage source. Fast mode operation is best if the output voltage must change rapidly, either in response to an external programming signal or, if the ATE-DMG is used as a current stabilizer.

The ATE-DMG power supply is delivered for "slow mode" operation. See Section 2, par. 2.7 for converting the ATE-DMG power supply to "fast mode" operation.

A continuously adjustable overvoltage protection circuit is a built-in feature. The trigger point of the overvoltage protector may be set (or checked) under actual operating conditions by the front panel accessible setup controls (refer to Section 2 of this manual).

Power transistors and drivers on all ATE-DMG designs are mounted onto highly efficient, patented heat sink assemblies which are cooled by low-noise fans. The ATE-DMG main chassis assemblies, as well as the wraparound covers, are constructed from cold-rolled steel. The front panels are made from aluminum (refer to the "Mechanical Outline Drawing," Figure 1-2).

1.3 SPECIFICATIONS

Table 1-1 lists the output parameters applicable to individual models. Table 1-2 lists general specifications applicable to all full-rack models except where otherwise noted. Table 1-3 lists dynamic specifications and Table 1-5 lists static specifications. Mechanical specifications are presented in the mechanical outline drawing, Figure 1-2.

1.4 LOCAL CONTROL

Front panel keypad entries are utilized for setting and adjusting output voltage and current under local control. The keypad's keys are organized to either directly execute commands, or to introduce a program that can either be run once or cycled. Calibration of the unit is facilitated by a password -protected, menu-driven procedure from the front panel.

1.5 REMOTE CONTROL

The ATE-DMG Power Supply can be remotely controlled directly via the IEEE 488.2 (GPIB) bus using SCPI commands. All features available in local mode can also be accessed remotely. In addition, output voltage and current can also be controlled by external analog reference voltages (see PAR. 3.5).

TABLE 1-1. ATE-DMG D-C OUTPUT RATINGS AND OUTPUT IMPEDANCE

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE VOLTAGE MODE			OUTPUT IMPEDANCE CURRENT MODE		
	VOLTS	AMPS	SERIES R	SERIES L ⁽¹⁾		SHUNTR ⁽²⁾	SHUNT C ⁽³⁾	
				SLOW	FAST		SLOW	FAST
SIZE "E" FULL-RACK (1000 Watt)								
ATE 6-100DMG	0-6	0-100	1.2μΩ	0.5μH	5μH	12kΩ	22000μF	15μF
ATE 15-50DMG	0-15	0-50	6μΩ	0.5μH	5μH	30kΩ	12000μF	6μF
ATE 25-40DMG	0-25	0-40	12.5μΩ	1μH	10μH	50kΩ	11000μF	4μF
ATE 36-30DMG	0-36	0-30	24μΩ	1μH	10μH	72kΩ	9500μF	3μF
ATE 55-20DMG	0-55	0-20	55μΩ	2μH	20μH	110kΩ	5200μF	2.25μF
ATE 75-15DMG	0-75	0-15	0.1mΩ	2μH	20μH	150kΩ	3400μF	1.5μF
ATE 100-10DMG	0-100	0-10	0.2mΩ	4μH	40μH	200kΩ	1200μF	0.75μF
ATE 150-7DMG	0-150	0-7	0.42mΩ	4μH	40μH	300kΩ	1050μF	0.3μF
⁽¹⁾ For determining dynamic impedance in voltage mode. ⁽²⁾ Based on 0.5mA load effect in FAST mode. ⁽³⁾ For determining dynamic impedance in current mode.								

TABLE 1-2. ATE-DMG SERIES SPECIFICATIONS

SPECIFICATION	RATING/DESCRIPTION	CONDITION
INPUT CHARACTERISTICS		
A-C Voltage	nominal: 104, 115, 208, 230Va-c	User selectable, See PAR. 2.3
	Tolerance: ± 8.7%	
Frequency	nominal: 50, 60 Hz	
	Tolerance: ± 3Hz	
Current	20A a-c maximum	Max load, 125V a-c
OUTPUT CHARACTERISTICS		
d-c Output	Series Pass Transistor	
Type of Stabilizer	Automatic crossover	Voltage/Current
Voltage	0 to 100% of rating	
Current	0 to +55°C	Usable range limited to approximately 1% to 100%.
	+55 to +65°C	
Static Specifications		See Table 1-5
Dynamic Specifications		See Table 1-3
Error sense	0.5V per load wire (0.25V for 6V model)	Voltage allowance
Isolation Voltage	500V d-c or peak	Between each output terminal and chassis ground
Leakage current Output to Ground	5 microamperes max.	rms at 115V a-c
	50 microamperes max.	p-p at 115V a-c
Software Overvoltage Protection (OVP)	See Table 1-4 and PAR. 3.4.3.	Digital setting, local or remote. Action: crowbar the output.

TABLE 1-2. ATE-DMG SERIES SPECIFICATIONS (Continued)

SPECIFICATION		RATING/DESCRIPTION	CONDITION
OUTPUT CHARACTERISTICS (CONTINUED)			
Hardware Overvoltage Protection (OVP)	Type	Crowbar	
	Control range	1.6% or 3V (whichever is greater) to 110% E_o max.	Local (manual)
	Trigger time: normal	50 microseconds	Slow mode
	Trigger time: delayed	500 microseconds	Fast mode
	Threshold:	Minimum 0.5 volts, or 2% E_o max. whichever is greater.	
Temperature Coefficient:	0.02%max of E_o max per °C.		
Software Overcurrent Protection (OCP)		See Table 1-4 and PAR. 3.4.3.	Digital setting, local or remote. Action: crowbar the output.
CONTROL			
Voltage	Local	Digital with 12 bits resolution	Front panel keypad (24 keys)
	Remote	Digital with 12 bits resolution	Using GPIB (SCPI commands)
Current	Local	Digital with 12 bits resolution	Digital: using front panel (24) keypad
	Remote	Digital with 12 bits resolution	Using GPIB (SCPI commands)
Programming accuracy	Voltage	<0.025% E_o max.	<0.03% E_o max. for 6V, 15V, 100V and 150V models.
	Current	<0.25% I_o max.	<0.03% I_o max. for 6V and 15V models.
Readback/Display accuracy	Voltage	<0.05% E_o max	
	Current	<0.25% I_o max	<0.275% I_o max. for 6V and 15V models.
GENERAL (ENVIRONMENTAL) CHARACTERISTICS			
Operating Temperature		0 to +50°C	Derate output power 10% at temperatures above +55°C.
Storage Temperature		-20 to 70°C	
Humidity		0 to 95% RH	Non condensing, operating & storage
Shock		20g, 11msec ±50% half sine	Non operating, 3-axes, 3 shocks each axis
Vibration		5-10Hz 10mm, double amplitude	Non operating, 3-axes, 1 hour each axis
Cooling		Forced air	High efficiency, single bearing fans, permanently lubricated with special low-noise non-metallic blades. Exhaust to rear.
PHYSICAL CHARACTERISTICS			
Weight		96 lbs. 43.6Kg)	Packed for Shipment
Dimensions	inches	6-31/32 x 19 x 20-1/64	See Figure 1-2
	mm	177 x 482.6 x 506.8	
a-c source connections		Terminal block	
d-c output connections	Rear panel	Binding post	$I_o < 3.0A$
	Rear panel	compression studs	$I_o \geq 3.0A$
User port		50-terminal connector	
Indicators		Three LED's	Voltage/Current/OVP
Remote control programming		One standard GPIB connector	Rear, SCPI & IEEE 488.2 Commands
Digital display front panel		Voltage, current, mode, status, menu, program, etc.	2 x 16 character alphanumeric LCD with LED backlight
Mounting (in Std. 19 in, racks)		Mounting ears supplied	
Finish: Fed. Std. 595		Dark and light gray, Color 26440	

TABLE 1-3. ATE DYNAMIC SPECIFICATIONS, RESISTIVE LOAD

OUTPUT VOLTAGE RATING	PROGRAMMING BANDWIDTH (FAST MODE) (KHz)		PROGRAMMING TIME CONSTANT (FAST MODE) (μsec)	
	Typical	minimum	Typical	maximum
6V	23.0	16.0	7.0	10.0
15V	20.0	10.6	8.0	15.0
25V	11.5	8.0	14.0	10.0
36V	8.0	6.4	20.0	20.0
55V	4.8	4.0	33.0	25.0
75V	4.3	3.5	37.0	40.0
100V	2.7	2.5	60.0	45.0
150V	1.8	1.7	88.0	95.0
325V	1.5	0.937	110.0	170.0

NOTES:

1. **VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT IN FAST MODE:** The time required for the stabilized output voltage to recover to within 0.1% (10mV for ATE 75-15DMG) of the output voltage setting, for a 10 to 100% step in rated load current is typically less than 50μsec., 100μsec. maximum.
2. **CURRENT RECOVERY FOR STEP-LOAD VOLTAGE IN SLOW MODE:** The stabilized output current recovers from a step in load (compliance) voltage with an exponential response, the time constant of which is determined by the load resistance and the tabulated output capacitance (See Table 1-1).
3. **PROGRAMMING SPEED:** The speed with which the power supply output responds to external programming signals is determined by:
 - a) The PROGRAMMING TIME CONSTANT (τ), given in the "slow" mode by either the load resistance (R_L) and the value of the output capacitor (C_O , see Table 1-1): $\tau = R_L C_O$, or by the FEEDBACK TIME CONSTANT, given by the product of the feedback capacitor and the feedback resistor: $\tau = R_f C_f$, whichever is greater. In the "fast" mode, the PROGRAMMING TIME CONSTANT and bandwidth (-3dB) for the Voltage Control Channel is shown above.

For the Current Control Channel, the PROGRAMMING TIME CONSTANT in Fast Mode is 25μsec. typical, 50μsec. maximum. (80μsec. for the ATE 325-0.8M).
 - b) The MAXIMUM RATE OF CHANGE that the power supply output can respond to in Slow Mode is given by the setting of the power supply's current control setting (ILIM), divided by the ATE output capacitor (C_O see Table 1-1):

$$\text{MAXIMUM RATE OF CHANGE} = I_{LIM}/C_O.$$

TABLE 1-4. OVERVOLTAGE/OVERCURRENT SETTINGS

MODEL NUMBER	MAXIMUM OVERVOLTAGE SETTING	MAXIMUM OVERCURRENT SETTING	MODEL NUMBER	MAXIMUM OVERVOLTAGE SETTING	MAXIMUM OVERCURRENT SETTING
ATE 6-100DMG	6.5V	110A	ATE 55-20DMG	60V	22A
ATE 15-50DMG	16.5V	55A	ATE 75-15DMG	82V	16A
ATE 25-40DMG	27V	44A	ATE 100-10DMG	110V	11A
ATE 36-30DMG	39V	33A	ATE 150-7DMG	165V	7.7A

TABLE 1-5. ATE STATIC SPECIFICATIONS

INFLUENCE QUANTITY	OUTPUT EFFECTS VOLTAGE MODE		OUTPUT EFFECTS CURRENT MODE		OFFSETS ⁽⁴⁾		
	TYPICAL	MAXIMUM	TYPICAL	MAXIMUM	ΔE_{IO}	ΔI_{IO}	
SOURCE VOLTAGE (min. - max.)	<0.0005% E_O max.	<0.001% E_O max.	<0.002% I_O max.	<0.005% I_O max.	<1 μ V	<1nV	
LOAD (no load - full load):	<0.001% E_O max.	<0.002% E_O max.	<0.5 mA ⁽¹⁾	<1 mA ⁽¹⁾	-	-	
TIME (8 hour drift)	<0.005% E_O max.	<0.01% E_O max.	<0.01% I_O max.	<0.02% I_O max.	<20 μ V	<1nV	
Temperature per °C	<0.005% E_O max.	<0.01% E_O max.	<0.01% I_O max.	<0.02% I_O max.	<20 μ V	<2nV	
Ripple and noise ⁽²⁾⁽⁵⁾ (Slow mode)	rms:	<0.1mV	<0.3mV	<0.01% I_O max.	<0.03% I_O max.	-	-
	p-p: ⁽³⁾	<1mV	<3mV	<0.1% I_O max.	<0.3% I_O max.	-	-
Ripple and noise ⁽²⁾⁽⁵⁾ (Fast mode)	rms:	<1mV	<3mV ⁽⁴⁾	<0.01% I_O max.	<0.03% I_O max.	-	-
	p-p: ⁽³⁾	<10mV	<30mV ⁽⁴⁾	<0.1% I_O max.	<0.3% I_O max.	-	-

- (1) For $I_O > 50A$, load effect = 2mA typ., 5mA max in slow mode. The output capacitor adds 0 - 6 mA to current mode load effect.
 (2) One terminal grounded so that common mode current does not flow through load or current sense resistor.
 (3) Bandwidth: 20Hz - 10 MHz.
 (4) Preamp offsets are given for the calculation of the output effects of preamplifiers (A, B) if either of these amplifiers is used for operational programming. In this case, the value of the external feedback and input resistors, the amplifier offsets and the reference voltage variations are combined in the "Error Equation," which represents the "worst case" output effects for the application at hand:

$$\Delta E_{O(\text{preamp})} = \Delta E_{\text{ref}}(R_f/R_i) + \Delta E_{iO}(1 + R_f/R_i) + \Delta E_{iO}R_f$$

where: $\Delta E_{O(\text{preamp})}$ = Total Preamp Output Voltage change
 ΔE_{ref} = Change in the Voltage Reference
 ΔE_{iO} = Change in Offset Voltage
 ΔI_{iO} = Change in Offset Current
 R_f = External Feedback Resistor
 R_i = External Input Resistor

NOTE 1: Variations in the value of the feedback and input resistors are considered secondary effects in the error equation.

NOTE 2: In the voltage mode of operation, the calculated preamp output effect $\Delta E_{O(\text{preamp})}$, must be multiplied by the (fixed) gain of the ATE voltage channel to find out the total effect on the output voltage of the ATE power supply. The (fixed) gain of the ATE voltage channel is given by $GAIN = E_{O \text{ max}}/10$, where $E_{O \text{ max}}$ is the maximum rated output voltage of each ATE model. In the current mode of operation, the effect of the preamplifier offsets on the total output current may be expressed as a percentage of $I_{O \text{ max}}$, by the equation:

$$\Delta I_{O(\%)} = \frac{\Delta E_{O(\text{preamp})}}{1 \text{ Volt}} \times 100\%$$

- (5) For high voltage ATE 325-0.8M the maximum output ripple and noise is 10mV rms and 50 mV p-p.

1.6 FEATURES

1.6.1 OVERVOLTAGE/OVERCURRENT PROTECTION

Overvoltages and Overcurrent protection values can be individually programmed via the front panel keypad or remotely via the IEEE 488.2 (GPIB) using SCPI commands (refer to PARs. 3.4.9 and 3.7). When overvoltage or overcurrent is detected, the power supply is programmed to 0 volts with a small current and the power supply responds as if an *RST command was received over the GPIB bus. See Table 1-4 for maximum programmable settings.

1.6.1.1 PROGRAMMABLE OVERVOLTAGE/OVERCURRENT DELAY

Changing the output settings may cause large output transients (common with reactive loads) that can trip the overvoltage/overcurrent protection. The ATE-DMG can be programmed to delay sensing of overvoltage/overcurrent protection when output settings are changed to avoid inadvertent tripping. After the delay, the programmed overcurrent/overvoltage setting is effective. Protection can be delayed up to approximately 8 seconds after the output settings are changed. Refer to PAR. 3.4.10.

1.6.1.2 CROWBAR CIRCUIT

An overvoltage crowbar circuit protects the load from momentary or long term overvoltages. The crowbar conducts across the power supply output and the AC POWER SWITCH/CIRCUIT BREAKER is tripped if such overvoltage occurs. The setting of the front panel LEVEL control determines the threshold between the operating voltage of the power supply and the level at which the crowbar circuit will be activated. The crowbar level is set from the front panel (refer to PAR. 3.3). This feature is used as a hardware backup protection in case of overvoltage.

1.6.2 NON-VOLATILE STORAGE OF PROGRAMMED SEQUENCES OR ACTIVE SETTINGS

The ATE-DMG Power Supply contains 40 memory locations that can be used either to preprogram a sequence of output values or to store the active settings. For programming sequences each memory location accommodates six parameters: output voltage, output current, Overvoltage, Overcurrent, Time (how long the parameters are in effect) and the next address in the sequence. Values are stored in the non-volatile memory, and are retained when the unit is turned off. Refer to PAR. 3.4.12.

The same 40 memory locations are also available to save the active programmed settings (V SET, I SET, OV SET and OC SET). The saved setting can be recalled by specifying the memory location.

1.6.3 USER-DEFINED VOLTAGE/CURRENT LIMITS

The ATE-DMG output can be programmed not to exceed user-defined values. For example, the ATE 25-40DMG, which has a maximum capacity of 25V, 40A, can be limited to 5.5V, 20A for working with circuitry that might be damaged by higher levels. Once the limits are set, the power supply becomes, in effect a 5.5V, 20A supply and values exceeding the limit values will not be accepted. Refer to PAR. 3.4.11.

1.7 EQUIPMENT SUPPLIED

The unit is shipped with a standard Power Cord, 115 VAC (USA, terminated with NEMA 5-20P plug).

1.8 ACCESSORIES

Accessories for the ATE-DMG Power Supply are listed in Table 1-6.

TABLE 1-6. ACCESSORIES

ITEM	FUNCTION	PART NUMBER
IEEE 488 Cable, (1 meter long)	Connects ATE-DMG power supply to GPIB bus	118-0916
IEEE 488 Cable, (2 meter long)	Connects ATE-DMG power supply to GPIB bus	118-0917
IEEE 488 Cable, (4 meter long)	Connects ATE-DMG power supply to GPIB bus	118-0918
Ribbon Cable	Used for connections to Remote Analog Programming connector A11J5 (see PAR. 3.5)	142-0246 (AMP 746285-1)
Housing for discrete wires	Used for connections to Remote Analog Programming connector A11J5 (see PAR. 3.5)	(Molex 22-55-2101) or (Digikey WM2522-ND)
Pins	Used for connections to Remote Analog Programming connector A11J5 (see PAR. 3.5)	(Molex 0016020083) or (Digikey WM9139CT-ND)

1.9 SAFETY

There are no operator serviceable parts inside the case. Service must be referred to authorized personnel. Using the power supply in a manner not specified by Kepco, Inc. may impair the protection provided by the power supply. Observe all safety precautions noted throughout this manual. Table 1-7 lists symbols used on the power supply or in this manual where applicable.

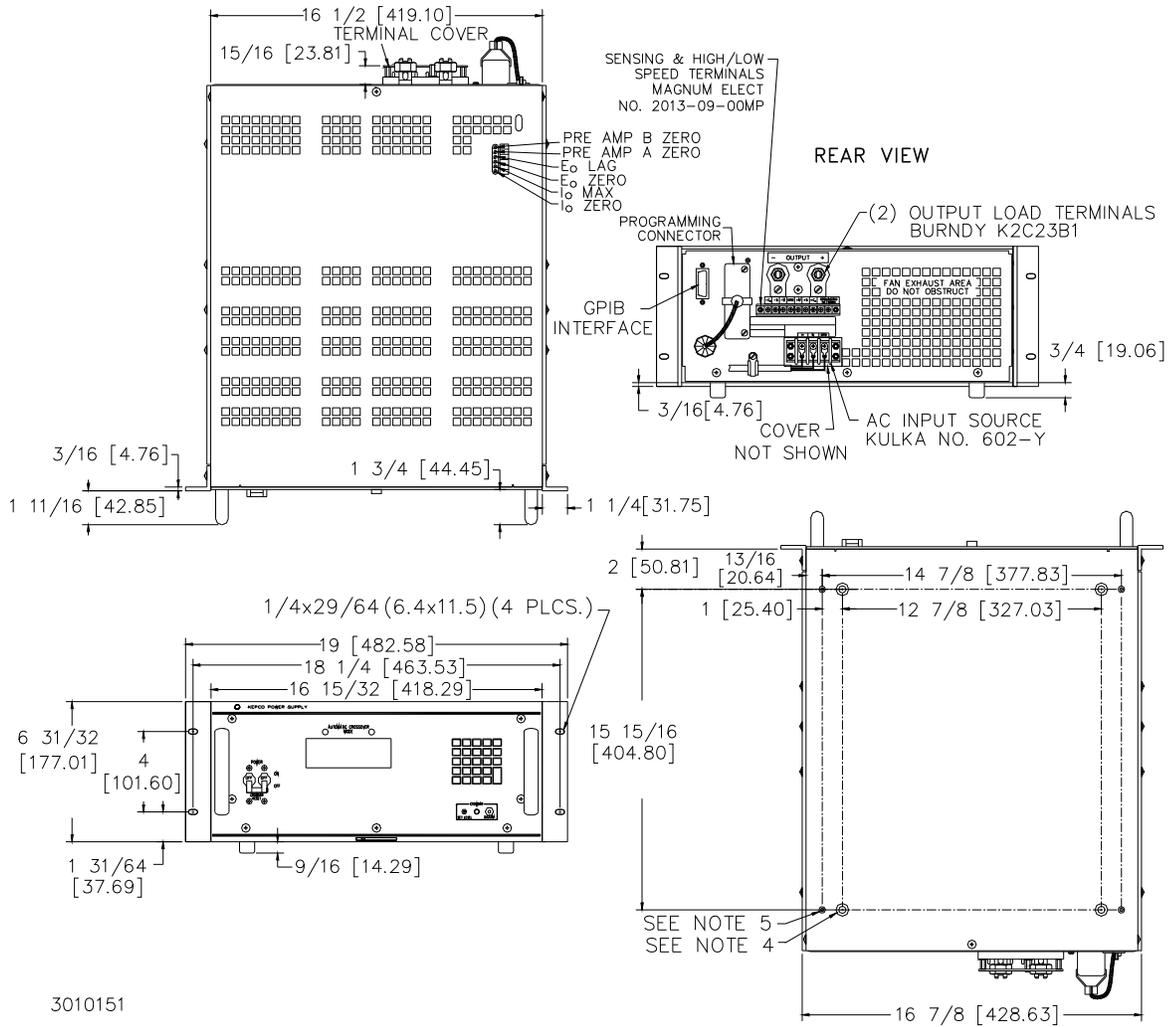
TABLE 1-7. SAFETY SYMBOLS

SYMBOL	MEANING
	CAUTION: RISK OF ELECTRIC SHOCK.
	CAUTION: REFER TO REFERENCED PROCEDURE.
WARNING	INDICATES THE POSSIBILITY OF BODILY INJURY OR DEATH.
CAUTION	INDICATES THE POSSIBILITY OF EQUIPMENT DAMAGE.



WARNINGS

1. Remove a-c power from the ATE-DMG before making any connections.
2. Wires and/or cables, connected from the ATE-DMG terminals to external components or programming devices must be properly insulated and securely terminated on both sides to make accidental touch impossible.
3. The ATE-DMG chassis and cover must be safety-grounded to a reliable a-c source ground. A safety-ground may be established by using the power cord supplied with a grounded a-c power outlet or, if the latter is not available, by means of a separate wire, from the provided GROUND terminal (at the rear barrier strip) to a reliable a-c source ground point.



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FIGURE 1-2. MECHANICAL OUTLINE DRAWING (SHEET 1 OF 2)

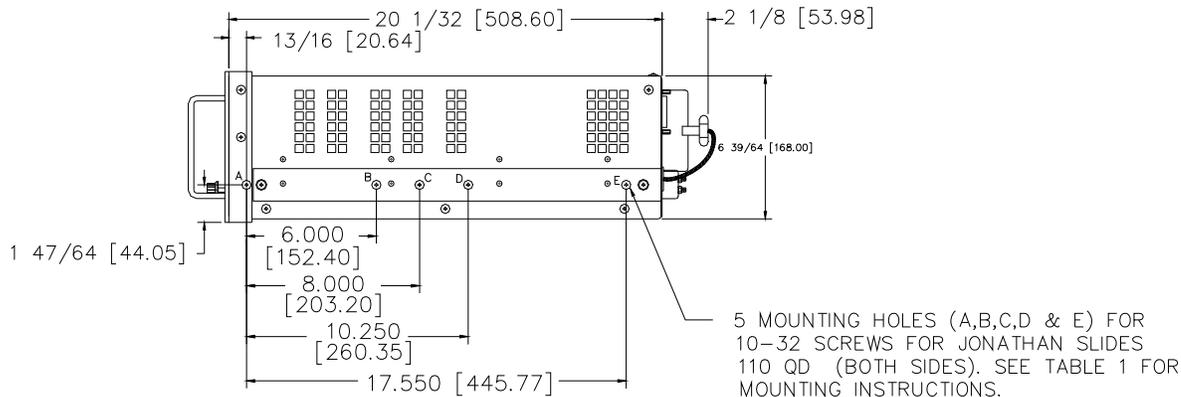


TABLE #1

MOUNTING TABLE					
SLIDE TYPE	USE MOUNTING HOLES				
	A	B	C	D	E
110 QD-20-2	○	○	NOT USED	○	⊗
110 QD-22-2	○	NOT USED	○	NOT USED	⊗
110 QD-24-2	○	NOT USED	○	NOT USED	⊗

⊗ "E" HOLE (0.199 DIA.) HAS TO BE ADDED TO SLIDES

NOTES:

- MATERIAL: A) CHASSIS & BACK PLATE: #14 GA. C.R.S.
B) FRONT PANEL: 1/8 THICK ALUMINUM.
C) COVER: #16 GA. C.R.S.
- FINISH: A) CHASSIS: CADMIUM PLATE WITH CHROMATE WASH.
B) FRONT PANEL: LIGHT GRAY PER FEDERAL STD. 595, COLOR #26440.
C) COVER: CHARCOAL GRAY VINIL TEXTURE.
- FIXED ANGLE BRACKETS AND CHASSIS SIDE SUPPORT BARS (BOTH SIDES) USED FOR RACK OR CABINET INSTALLATION CAN BE REMOVED FOR BENCH OPERATION.
- RACK OR CABINET MOUNTING: REMOVE (4) METAL FEET.
- (4) PLASTIC MOUNTING INSERTS FOR 1/4-20 THREAD CUTTING SCREWS, 5/8 LONG (WITH 1/8 THICK MOUNTING PLATE).
- IF INSTALLATION WITHOUT SLIDES IS DESIRED, THE UNIT MUST BE SUPPORTED BY A RIGID PLATFORM OR BY FIXED BRACKET MOUNTED ON THE RACK.
- DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS.
- TOLERANCES: A. BETWEEN MOUNTING HOLES: $\pm 1/64$ (0.4)
B. ALL OTHER DIMENSIONS $\pm 1/32$ (0.8), EXCEPT AS NOTED.

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FIGURE 1-2. MECHANICAL OUTLINE DRAWING (SHEET 2 OF 2)

SECTION 2 - INSTALLATION

2.1 UNPACKING AND INSPECTION

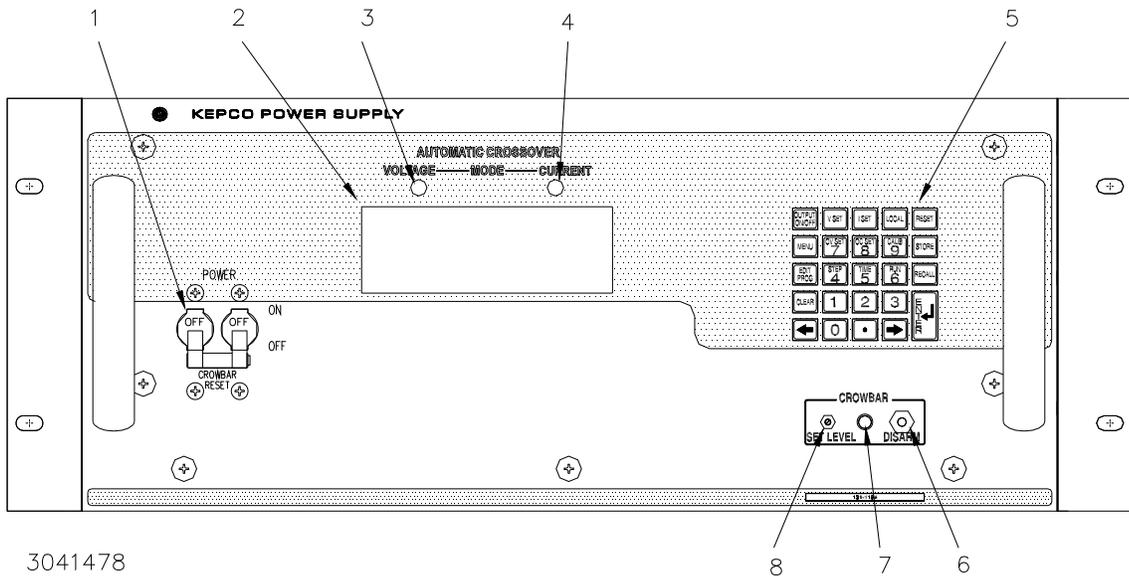
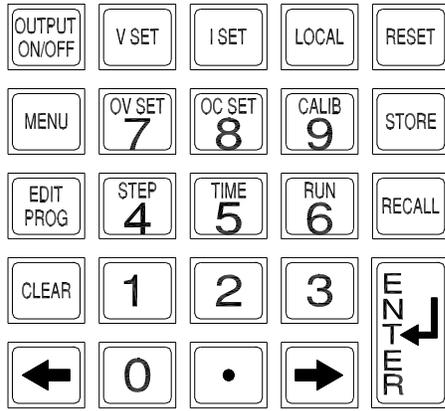
This instrument has been thoroughly inspected and tested prior to packing and is ready for operation. After carefully unpacking, inspect for shipping damage before attempting to operate. Perform the preliminary operational check as outlined in PAR. 2.5 below. If any indication of damage is found, file an immediate claim with the responsible transport service.

2.2 TERMINATIONS AND CONTROLS

- a) Front Panel: Refer to Table 2-1 and Figure 2-1.
- b) Rear panel: Refer to Table 2-4 and Figure 2-2.
- c) Internal Controls: See Table 2-3 and Figure 2-3.

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS AND TERMINATIONS

FIGURE 2-1 INDEX NO.	CONTROL OR TERMINATION	FUNCTION
1	A-C Power switch/circuit breaker	Serves as a-c power switch and turns a-c power off upon overload or over-voltage (hardware induced).
2	Liquid Crystal Display (LCD)	2 x 16 character display with LED backlight. Shows voltage, current mode, settings, menu, program, etc. See PAR. 3.4.1.3 for details,.
3	"V" Mode indicator	Energizes in Voltage Mode.
4	"I" Mode Indicator	Energizes in Current Mode.
5	Keypad	Used to for digital control of all local functions. See PAR. 3.4.1.4 for details.
6	DISARM pushbutton	Push to set Crowbar trigger level
7	CROWBAR indicator	Lights when crowbar is triggered "ON."
8	LEVEL control	Adjusts trigger level of crowbar circuit.



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FIGURE 2-1. ATE-DMG FULL RACK SERIES FRONT PANEL

TABLE 2-2. REAR PANEL TERMINATIONS

FIGURE 2-2 INDEX NO.	TERMINATION	FUNCTION
1	GPIB (IEEE 488) Interface connector	Allows digital control of power supply and provides digital indication of status and power supply output. See Table 2-4 for input/output pin assignments.
2	Interconnection Assembly	Used to gain access to internal circuitry for fast mode conversion, troubleshooting, and parallel/serial connections. Can also be used with PC-12 connector (wired) for troubleshooting.
3	Rear Panel Barrier Strip	Nine terminals provided: 1, 7: Co (-) and Co (+) used to connect external output capacitor. 2, 6: S (-) and S (+) used to connect external sensing leads. 3, 5: M (-) and (+) used for output monitor connections. 4: Ground 8, 9: Used to connect or disconnect internal grounding network (see PAR. 2.6.1.2)
4	Output terminals	Used to connect load
5	Source power terminal block	Used to connect source power; accepts 3-wire a-c input cord (supplied).

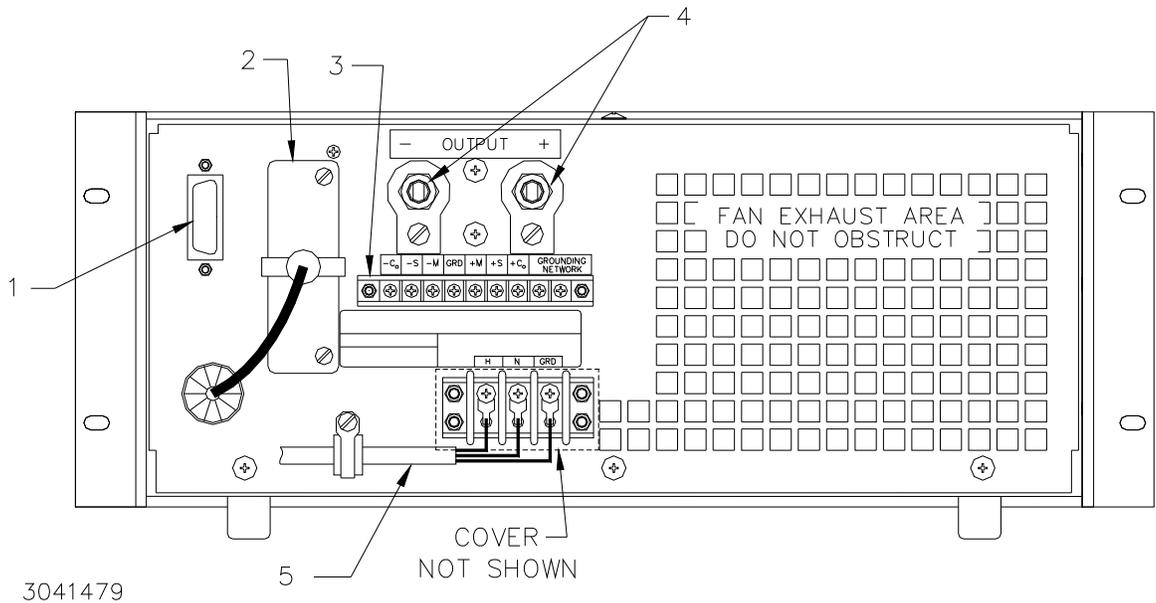


FIGURE 2-2. ATE-DMG FULL RACK SERIES REAR PANEL

TABLE 2-3. INTERNAL CONTROLS AND THEIR FUNCTIONS

REFERENCE DESIGNATION	CONTROL	PURPOSE
CAUTION: Adjustment of any internal control will affect digital control of the output voltage and invalidate factory calibration (refer Calibration, Section 4).		
R18	I _o MAX	Maximum Output Current
R27	E _o LAG	Voltage Channel Stability Control
R30	E _o ZERO	Voltage Channel Zero Control
R35	I _o ZERO	Current Channel Zero Control
R68	PREAMP CURRENT ZERO	Offset Zero Control for CURRENT PREAMP
R67	PREAMP VOLTAGE ZERO	Offset Zero Control for VOLTAGE PREAMP

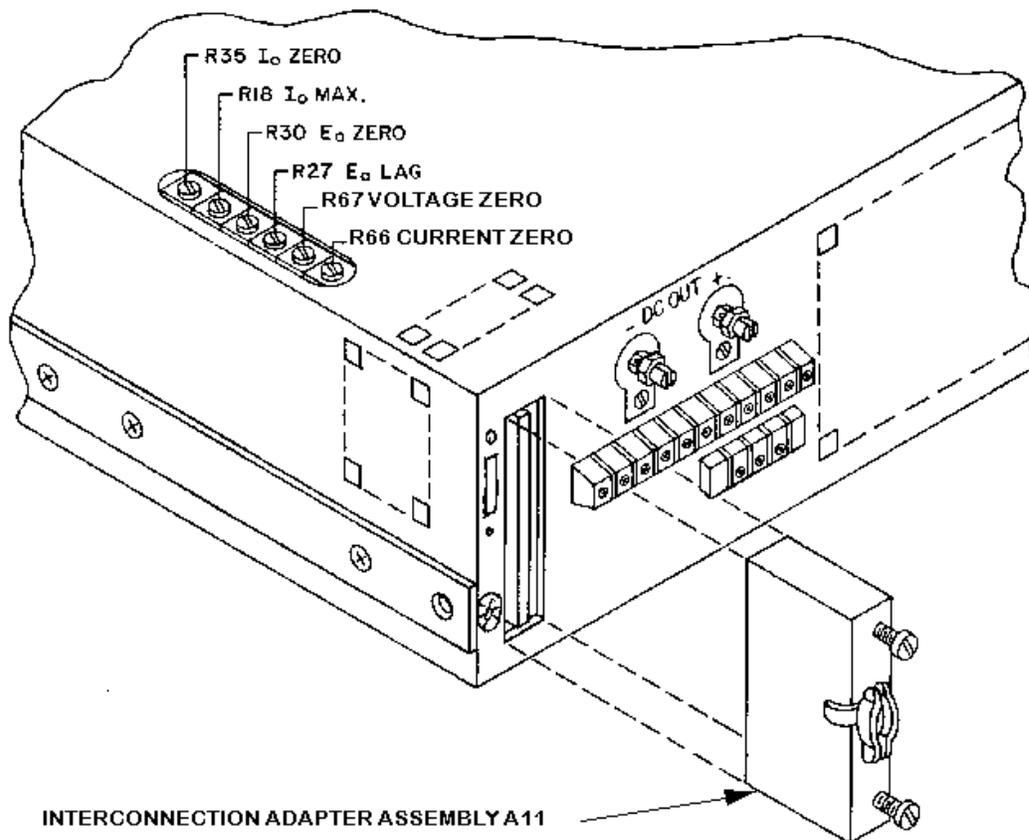


FIGURE 2-3. LOCATION OF INTERNAL CONTROLS

TABLE 2-4. INPUT/OUTPUT PIN ASSIGNMENTS FOR REMOTE CONTROL

CONNECTOR	PIN	SIGNAL NAME	FUNCTION
IEEE 488 PORT	1	DI01	I/O Line
	2	DI02	I/O Line
	3	DI03	I/O Line
	4	DI04	I/O Line
	5	EOI	End or Identify
	6	DAV	Data Valid
	7	NRFD	Not Ready for Data
	8	NDAC	Not Data Accepted
	9	IFC	Interface Clear
	10	SRQ	Service Request
	11	ATN	Attention
	12	SHIELD	Shield
	13	DI05	I/O Line
	14	DI06	I/O Line
	15	DI07	I/O Line
	16	DI08	I/O Line
	17	REN	Remote Enable
	18	GND	Ground (signal common)
	19	GND	Ground (signal common)
	20	GND	Ground (signal common)
	21	GND	Ground (signal common)
	22	GND	Ground (signal common)
	23	GND	Ground (signal common)
	24	LOGIC GND	Logic Ground

2.3 SOURCE POWER REQUIREMENTS

This power supply is normally configured for operation on a single phase, nominal 115V a-c line. For conversion to other a-c source voltages, refer to Figure 2-4. Select your nominal source voltage and change the links on the barrier strip of T201 according to the table provided in Figure 2-4. The circuit breaker (CB101) remains equally effective at all input voltages.

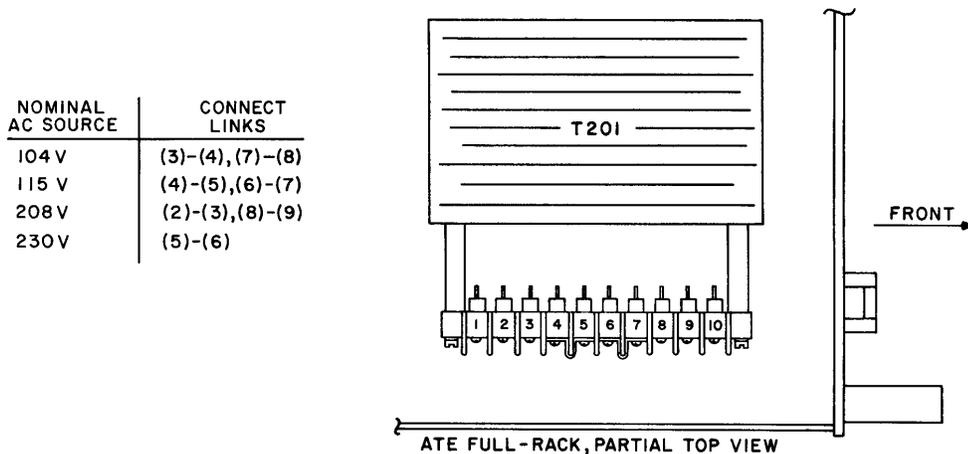


FIGURE 2-4. A-C INPUT SOURCE VOLTAGE SELECTION, ATE-DMG FULL RACK SERIES

2.4 COOLING

The power transistors and rectifiers in the ATE power supplies are maintained within their operating temperature range by means of special heat sink assemblies, cooled by internal fans. SIDE AND REAR PANEL OPENINGS AND THE TOP OF THE CASE MUST BE KEPT CLEAR FROM OBSTRUCTIONS TO INSURE PROPER AIR CIRCULATION. Periodic cleaning of the interior of the power supply is recommended. If the power supply is rack mounted, or installed into confined spaces, care must be taken that the ambient temperature (the temperature immediately surrounding the power supply) does not rise above the limit specified (refer to Table 1-2).

2.5 PRELIMINARY OPERATIONAL CHECK

A simple operational check after unpacking and before equipment installation is advisable to ascertain whether the power supply has suffered damage resulting from shipping.

Refer to Figures 2-1 and 2-2 for location of operating controls and electrical connections. Tables 2-1 and 3-1 explain the functions of operating controls/indicators and keypad keys, respectively.

1. With POWER switch set to off position, connect the power supply to source power.
2. With no load connected, set POWER switch to the ON position. Each time the unit is turned on an internal self-test is performed. If the test is successful the indications of step 3 are visible.
3. The alphanumeric display (LCD) indicates the model and GPIB address. After approximately 2 seconds, the display changes to: the power on default values: Local mode, Constant Voltage (CV) mode, 0.000V, 0.000A, output disabled, command entry status (see Figure 2-5). Overcurrent and Overvoltage protection are set to the maximum values (see Table 1-4), but are not displayed.



NOTE:  indicates blinking colon (:), Command Entry status
 indicates blinking equal sign (=), Data Entry status

FIGURE 2-5. LCD POWER ON DEFAULTS

NOTE: Six keys with dual functions are labeled with both a command and a number. The command label is referred to when the unit is in  command entry status; the number is referred to when the unit is in  data entry status.

4. Press OUTPUT ON/OFF key to enable the output.
5. Connect a digital voltmeter (DVM) to the (+) and (-) terminals at the rear panel and verify DVM reads 0V.
6. Press VSET key. Verify bottom line of LCD reads Vset  nn (where nn = voltage setting).

7. Use number keys to enter rated maximum voltage (e.g. for ATE 25-40DMG, 25V is the rated maximum voltage) and press ENTER. Output voltage will be displayed at bottom left of LCD.
8. Use → and ← keys as necessary to adjust output precisely to rated maximum voltage. Verify DVM voltage reading agrees with displayed voltage on LCD within 0.01% of rated maximum (see associated instruction manual). If the LCD reads VsetMAX= (value), you are entering a value higher than the maximum voltage setting; see PAR. 3.4.11.

2.6 INSTALLATION (Refer to Figure 1-2.)

The Power Supply is intended to be rack-mounted; the (4) bottom feet must be removed.

For all installations into confined spaces, care must be taken that the temperature immediately surrounding the unit does not exceed the maximum specified ambient temperature (see Table 1-2).

2.6.1 GROUNDING

2.6.1.1 A-C (SAFETY) GROUND

The power supply is equipped with a 3-wire safety line cord and polarized plug. The third (green) wire in the line cord is connected to the chassis and the case of the unit. If a 2-terminal receptacle in combination with an adapter is used, it is imperative that the chassis of the power supply be returned to a-c ground with a separate lead. A grounding terminal is provided (at the rear barrier strip) for this purpose.

2.6.1.2 ISOLATION FROM GROUND.

The d-c output is isolated from the a-c source and from any direct connection to chassis or ground. The maximum output voltage that can be supported between either output terminals and chassis ground is 500V (d-c or peak). Either side of the output may be grounded.

A resistor/capacitor network is connected from the negative monitor terminal to the metal chassis of the power supply. If this internal network is *not* desired, the connection to the chassis can be opened by removing the link (8)-(9) on TB201 (see Figure 2-2).

2.7 FAST MODE CONVERSION OF THE ATE POWER SUPPLY

Power supplies designed to operate in a voltage, as well as in a current stabilizing mode, often represent a compromise between the conflicting requirements of a good voltage and a good current source. A good voltage source must have low output impedance, good output voltage stability and good dynamic stability in the presence of loads with capacitive and/or inductive content. It achieves these design goals by relying to a great extent upon a large output capacitor having a very low terminal impedance, large energy storing ability and great resistance to rapid voltage changes.

Unfortunately, the requirements for a good current source are quite opposite to that of the voltage source described above. A current source should have *high* output impedance and its terminal voltage must be able to assume rapidly any value as may be needed to keep the output current at the predetermined level, while the load is changing.

To satisfy these conflicting requirements, the ATE power supply was designed for quick manual change-over from the "slow" mode to the "fast" mode of operation. In the "slow" mode, the ATE power supply approaches an ideal voltage source. Heavy output and feedback capacitors pro-

vide for low output noise, excellent voltage stability and good transient response. In the “fast” mode, the output and main feedback capacitors are completely removed, thereby providing the characteristics of a wide-band amplifier, ideal for applications requiring a current stabilizer or for high speed voltage or current programming.

2.7.1 PRECAUTIONS.

The output capacitor, and to a lesser extent, the feedback capacitor of a power supply, control the programming speed and the current mode recovery time. The removal of these capacitors in the fast mode results in greatly improved power supply performance in these areas. The power supply's dynamic stability, however, is reduced, making the output sensitive to the load phase angle. For this reason, the load presented to the power supply in the fast mode must not contain excessive capacitance (limit: 1000pF). Also, with the output and main feedback capacitors removed, there will be an increase in output noise, mainly high frequency noise and pickup, so that external shielding of programming leads and good grounding practices assume added importance in the fast mode of operation.

2.7.2 LAG NETWORK ADJUSTMENT

The ATE power supply operating in the “fast” mode, is dynamically stabilized by means of an internal lag network (E_O LAG, R27, see Figure 2-3 for location). This control should be adjusted, for each application, by monitoring the load with an oscilloscope and turning the LAG control for best output response and maximum dynamic stability under all operating conditions.

2.7.3 CROWBAR OPERATION, FAST MODE

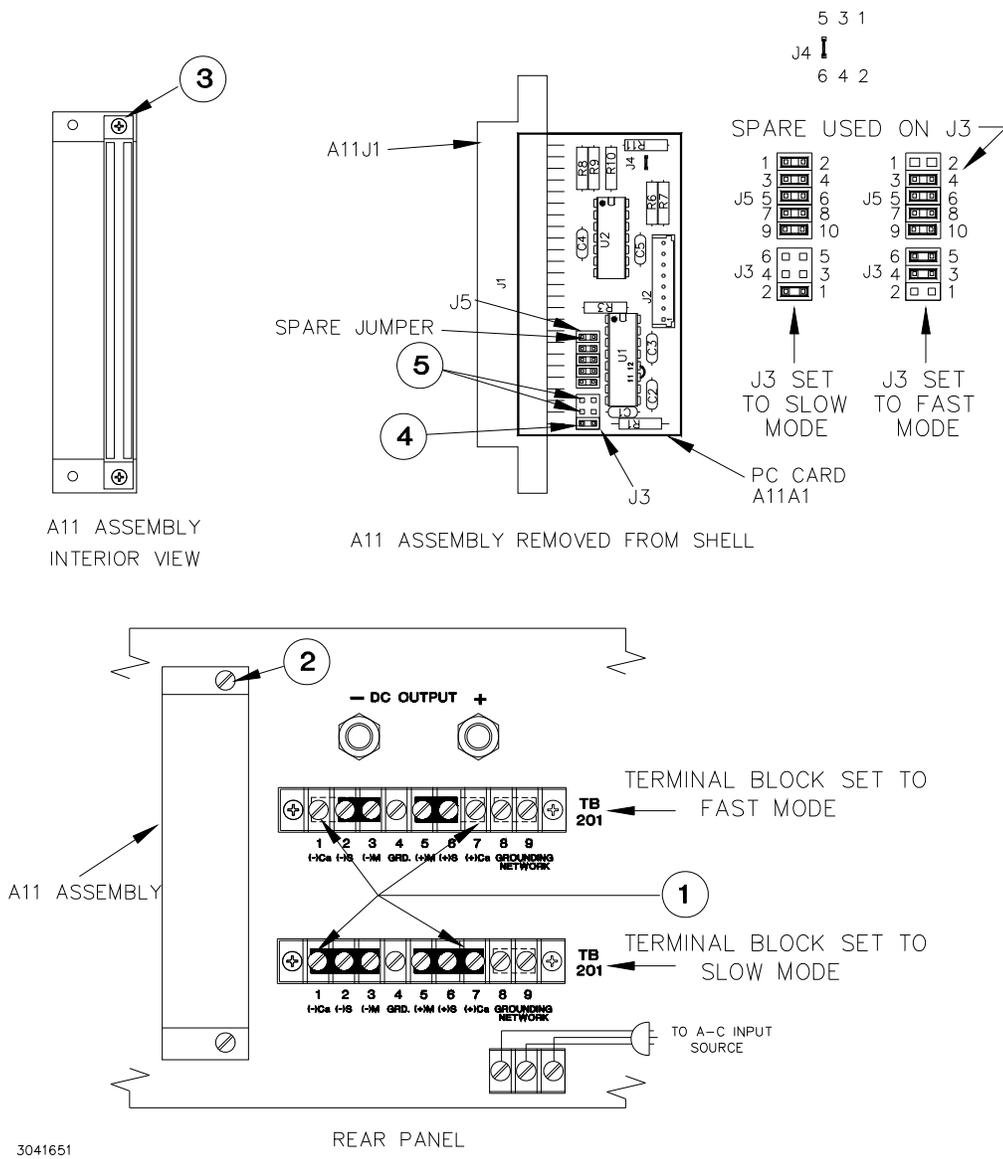
The crowbar circuit in the ATE power supply is not completely removed in the “fast” operating mode, but continues to offer protection against d-c voltage surges which may harm the load.

NOTE: For fast mode operation into a load interrupted by contactors or relays (“Arcing Load”), a small, high-frequency-type capacitor may be required across the contacts of the interrupting device, or the power supply output terminals, or directly across the load terminals. A ceramic disc capacitor (0.01 μ .F) has been found to be adequate to prevent spurious triggering of the overvoltage circuit

2.7.4 MANUAL CHANGE-OVER, SLOW/FAST MODE

The ATE power supply is normally delivered for operation in the “slow” mode. By changing jumper connections at the rear of the power supply, the user can convert from the “slow” mode to the “fast” mode or vice versa. The following steps are illustrated in Figure 2-6.

1. Remove Links (1)-(2) and (6)-(7) on TB201. This removes the output capacitor (C_O).
2. At the rear panel, loosen two screws and disconnect interconnection adapter A11.
3. Gain access to A11 jumpers by removing two screws securing connector A11J1 to the shell.
4. Remove jumper on adapter assembly A11 between J3 pins 1 and 2;
5. Install jumpers between J3 pins 3 and 4 and between J3 pins 5 and 6. NOTE: Spare jumpers located on J5
6. Reassemble PC card to A11 and reconnect A11 at rear panel.



NOTE: NUMBERS IN CIRCLES REFER TO STEPS OF PAR. 2.7.4.

FIGURE 2-6. REQUIRED STEPS FOR ATE "FAST MODE" CONVERSION

2.8 OPERATING CONFIGURATION

The operating configuration can be determined by pressing **MENU** on the front panel keypad six times (with the unit in \square command entry status). The LCD top line reads **ATE-VVAA** (VV is Vmax, AA is Imax, e.g., for the ATE 100-10DMG, top line reads 10010). The LCD bottom line displays a 6-digit number (factory calibration date) followed by a 3-digit number, followed by the firmware version number.

SECTION 3 - OPERATION

3.1 GENERAL

Interconnections between an a-c power source and a stabilized power supply, and between the power supply and its load are as critical as the interface between other types of electronic equipment. If optimum performance is expected, certain rules for the interconnection of source, power supply and load must be observed by the user. These rules are described in detail in the following paragraphs.

3.1.1 SAFETY GROUNDING

National and international safety rules dictate the grounding of the metal cover and case of any instrument connected to the a-c power source.



WARNING

KEEP INSTRUMENT GROUNDED WHILE IT IS CONNECTED TO THE A-C POWER SOURCE.

Kepeco power supplies with a flexible a-c power cord are equipped with a 3-prong safety plug, which must be connected to a *grounded* a-c power outlet.

3.1.2 D-C (OUTPUT) GROUNDING

Connections between the power supply and the load (load and sensing connections), as well as connections to the power supply amplifiers (programming connections) may, despite all precautions such as shielding, twisting of wire-pairs, etc., "pickup" radiated noise of a wide frequency spectrum. To minimize these undesired effects, one side of the power supply output/load circuit should be grounded.

Successful d-c grounding depends on careful analysis of the individual situation and only general guide lines can be provided here. One of the major points, however, is to avoid GROUND LOOPS. Ground loops are created when two (or more) points are grounded along the output circuit. Due to the wire impedance between the separated grounded points, a noise voltage is developed which subsequently is superimposed on the load. The only way to avoid ground loops is to investigate the output circuit (including the connected load) carefully by means of an ohmmeter for any resistance to ground. A single d-c ground point can be selected only if the output circuit is completely isolated. A single point is selected along the power supply output/load circuit and this point is returned to ground with a single wire. The exact location of this "best" d-c ground-point is entirely dependent on the application at hand. For single, isolated loads, the d-c ground-point may be located directly at one of the output terminals of the power supply which may be connected to ground. If error sensing is employed, d-c ground can be established at the remote load. In case of an internally grounded load, the d-c ground is automatically established directly at the load.

ATE Power Supplies have **one** side of the output returned to the case over a resistor/capacitor combination (refer to Section 2, PAR. 2.6.1). In those cases, therefore, where the **load** is internally grounded, or where the signal ground must be established elsewhere, the resistor/capacitor combination must be removed from the power supply case in order to avoid ground loop problems. If there is a choice in selecting either the positive or the negative output of the power supply for the d-c ground point, both sides should be tried, and preference given to the ground point producing the least noise. Output ripple specifications (as measured at the output) are,

however, equally valid for either output side grounded. Care should be taken in measuring the ripple and noise at the power supply output or at the load, Measuring devices which are a-c line operated often introduce ripple and noise into the circuit.

In the case where the load must be kept completely off ground (d-c isolated) or it must be operated above ground potential, grounding can be accomplished by means of a suitable capacitor connected from either side of the power supply output to the signal ground. The size of the capacitor should be carefully selected. A value between 0.1 and 1 microfarad has been found to be successful in many cases.

3.1.3 POWER SUPPLY/LOAD INTERFACE

The general function of a voltage or current stabilized power supply is to deliver the rated output quantities to the connected load. The load may have any conceivable characteristic: It may be fixed or variable; it may have predominantly resistive, capacitive, or inductive parameters; it may be located very close to the power supply or it may be a considerable distance away. The power supply designer cannot anticipate every conceivable application, location or nature of the load. The product must be designed for the widest possible application range and performance specifications at the output terminals of the power supply. The aim of the following paragraphs is to aid the user in the final use of the product: The interface of the power supply and the load.

The perfect interface between a power source and its load would mean that the specified performance at the output terminals would be transferred without impairment to any load, regardless of its characteristics, distance from the power supply or environment. To approach this ideal, the power supply must satisfy certain requirements, interconnecting rules must be closely followed and Ohm's Law, as well as basic a-c theory must be considered in selecting the interface wiring.

3.1.3.1 LOAD WIRE SELECTION

The stabilized d-c power supply is definitely not an ideal voltage or current source with zero output impedance (VOLTAGE MODE) or infinite output impedance (CURRENT MODE) at all frequencies: All *voltage* sources have some amount of impedance which *increases* with frequency and all *current* sources have an output impedance which *decreases* with frequency (refer to Figure 3-1).

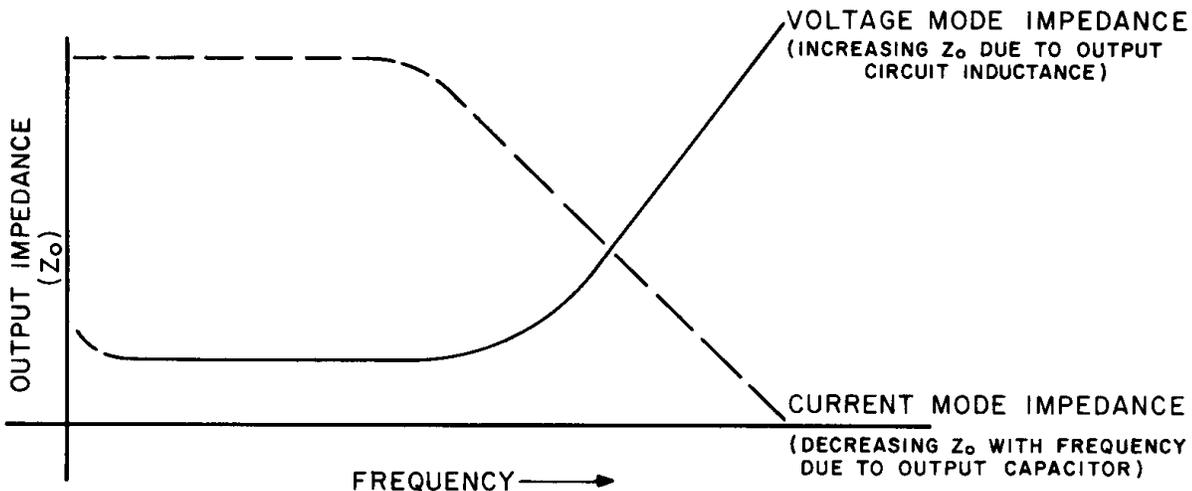


FIGURE 3-1. TYPICAL OUTPUT IMPEDANCE VS. FREQUENCY PLOT FOR STABILIZED D-C SOURCES

NOTE: Load connections for application requiring solely stabilized output current are not as critical as those requiring stabilized output voltage:

- a. D-C wire drops do not influence the current stabilizing action, but must be subtracted from the available compliance voltage.
- b. Wire inductance is “swamped-out” by the action of the output capacity. Emphasis in the following paragraphs is therefore placed on the power supply as a *voltage source*, rather than a current source.

A more realistic model for a voltage stabilized power supply must, for example, include a series resistance, representing the small d-c and low frequency source impedance, in series with an inductance, representing the source impedance at higher frequencies. Load wire selection should therefore proceed with those facts in mind. The load wire size should not only be selected for minimum voltage drop (Error Sensing, as discussed below, will take care of that), but also the series inductance of the load wire must be kept as small as possible compared to the source inductance of the power supply (Error Sensing *cannot* compensate for this). These dynamic considerations are especially important if:

1. The load is constantly changing in value.
2. The load is switched “on” and “off.”
3. The output of the power supply is step programmed.
4. The load has a primarily reactive characteristic.
5. All other cases where the dynamic output response of the power supply is considered important.

3.2 LOAD CONNECTION

3.2.1 GENERAL

Kepeco has provided a group of terminals on the programming connector PC-12 and on the barrier strip (TB210) at the rear of the power supply, which permit maximum flexibility in power supply/load interface techniques. Although all applications tend to exhibit their own problems, the basic interconnections described may be used as a general guide in the interconnection between power supply and load.

The Kepeco power supply is shipped from the factory with several jumper links (see Figure 3-2, connected to the barrier strip (TB201)). These links may be removed and replaced at will, depending on the method of connecting the load. Positioned as shown in Figure 3-2, the links are connected for local error sensing. *Links on the barrier strip must be tightened.* LOOSE LINKS AT THE BARRIER STRIP WILL CAUSE MALFUNCTION OF THE POWER SUPPLY.

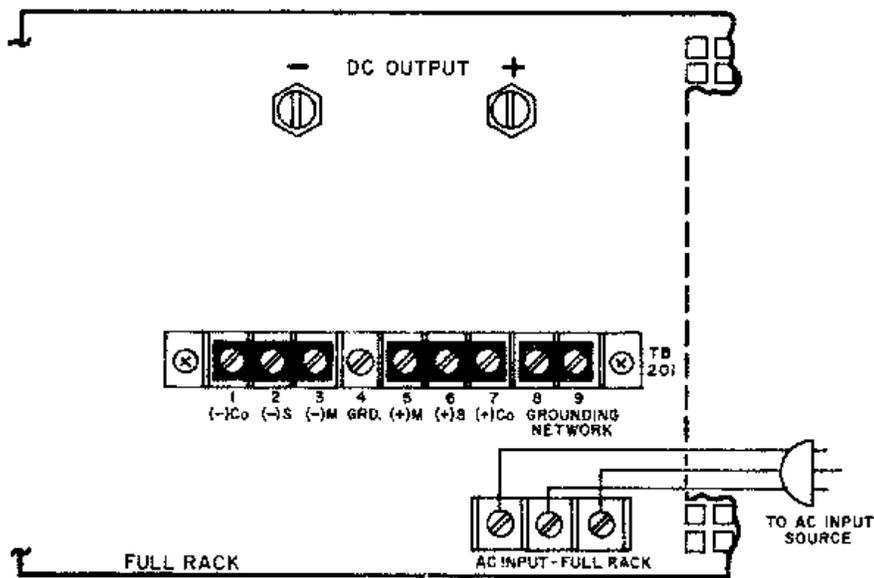


FIGURE 3-2. STANDARD JUMPER LINK CONNECTIONS FOR LOCAL (FRONT PANEL) CONTROL OF OUTPUT VOLTAGE, OUTPUT CURRENT AND VP CROWBAR LEVEL (SLOW MODE)

Note: Connection diagrams in Section 3 are applicable for full-rack ATE power supplies. These diagrams represent partial views of the ATE rear panel. The AC source input, interconnection adapter assembly A11 and the GPIB connector are deleted to simplify the presentation.

3.2.2 LOAD CONNECTION, METHOD I (LOCAL ERROR SENSING) (SEE FIGURE 3-3.)

The most basic power supply interconnection, to primarily resistive, relatively constant loads, located close to the power supply, or for loads requiring stabilized current exclusively, consists of a 2-wire connection from the rear output terminals. Load wire is selected as described previously (refer to PAR. 3.1.3.1). The load leads should be tightly twisted to reduce "pick-up" from stray magnetic fields. After the grounding rules have been applied (refer to PAR's. 3.1.1 to 3.1.2), the power supply can be connected to the a-c source and operation may commence.

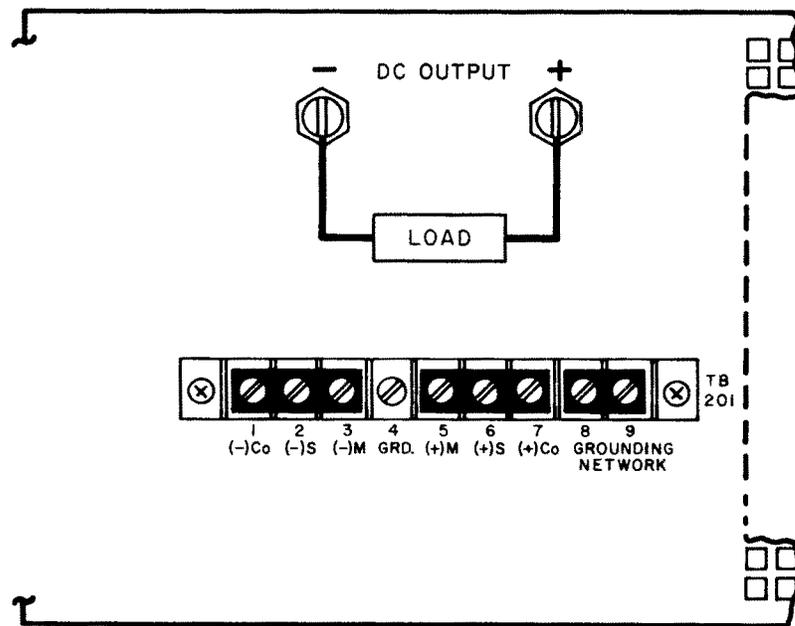


FIGURE 3-3. LOAD CONNECTION METHOD I, LOCAL ERROR SENSING

3.2.3 LOAD CONNECTION, METHOD II (REMOTE ERROR SENSING)

To avoid excessive output effects at remote loads, error sensing must be used. A twisted, shielded pair of wire from the sensing terminals directly to the load will compensate for load wire voltage drops up to 0.5 volt per wire (refer to Figure 3-4). Observe polarities: The *negative sensing wire* must go to the *negative load wire*, and the *positive sensing wire* goes to the *positive load wire*.

NOTE: For long wire runs, twisting each sensing wire with its associated load wire may give improved results in some cases.

ATTENTION

When using remote error sensing with large capacitive loads and long load and sensing wires, low frequency oscillations may be observed at the load. To eliminate the problem the FEEDBACK CAPACITOR should be disconnected from the (-) OUTPUT SENSING terminal and reconnected to the (-) OUTPUT MONITOR terminal. Remove jumper (1)-(2) on the REAR PROGRAMMING CONNECTOR. Connect a short wire from pin 2 to the REAR BARRIER-STRIP (TR201-3).

This method of load interconnection is suitable for loads which do not require rapid changes in voltage or current, or for programming with gradually changing waveforms (sine wave, triangular wave shapes, etc.). See PAR. 3.2.4 for load connections suitable for rapid (step) changes in the load or in programming.

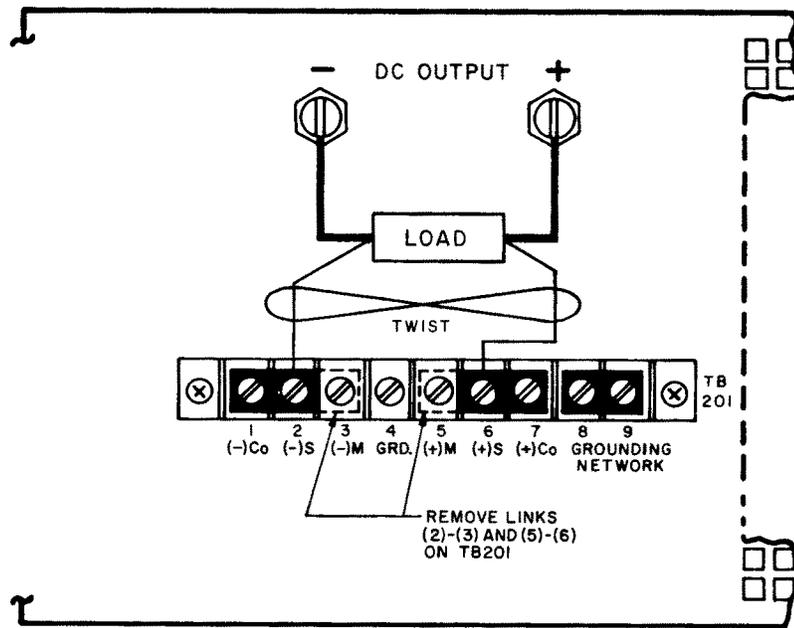


FIGURE 3-4. LOAD CONNECTION, METHOD II USING REMOTE ERROR SENSING.

3.2.4 LOAD CONNECTION, METHOD III

This method is suitable if step changes in the load are expected if, for example, the load is rapidly changing in value and maximum dynamic performance is expected directly at the load terminals. In these cases, the output capacitor is disconnected at the power supply and brought with a heavy, twisted-wire pair directly to the remote load (refer to Figure 3-5).

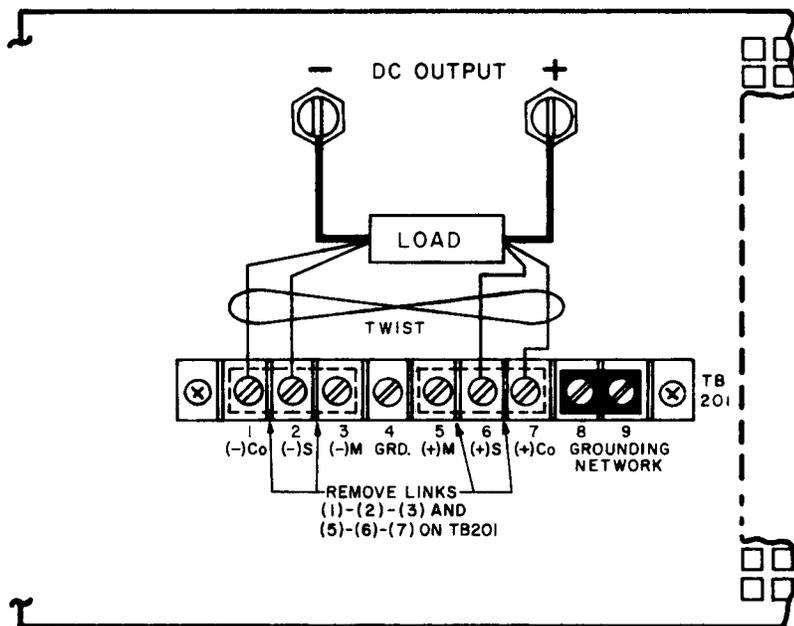


FIGURE 3-5. LOAD CONNECTION, METHOD III

3.3 OVERVOLTAGE CROWBAR, SETUP AND CHECK

The overvoltage crowbar circuit protects the load from momentary or long-term overvoltages. The crowbar SCR conducts across the power supply output, and the A-C POWER SWITCH/CIRCUIT BREAKER is tripped if such overvoltages occur. The setting of the front panel LEVEL control determines the “threshold” between the actual operating voltage of the power supply and the level at which the crowbar circuit will be activated. The LEVEL control can be set from 3 volts to 110% of the rated output voltage. The LEVEL control may be adjusted very close to the operating voltage (minimum threshold = 2% of rated output voltage or 0.5 volt, whichever is greater). The operation of the crowbar circuit can be checked *without* actually triggering the crowbar. All operating controls are accessible at the front panel (refer to Section 2, Figure 2-1).

3.3.1 SETUP AND CHECK PROCEDURE

1. Without connecting the load to the power supply turn Crowbar LEVEL control *fully clockwise*.
2. Turn A-C POWER SWITCH/CIRCUIT BREAKER on. Press VSET key, then use the keypad to enter the desired value *at which the crowbar must trigger* (NOT to the actual operating voltage), then press ENTER.
3. Depress the DISABLE button (and keep it depressed) while turning the LEVEL control *counterclockwise*, until the crowbar INDICATOR energizes (simulated crowbar action).
4. With the DISABLE button still depressed, press VSET key, then use the keypad to enter *the actual operating voltage* and press ENTER key. Release the DISABLE button.

NOTE: This last adjustment established the “threshold” i.e., the difference voltage between the output voltage and the voltage at which the power supply will “crowbar.” For minimum “false triggering” use the largest threshold your load can tolerate.

5. To check the adjusted crowbar trigger level, depress DISARM push button. Press VSET key, then use the keypad to enter the voltage trip point, minus 1%, then press ENTER.
6. Depress the → key and note the voltage at which the crowbar INDICATOR lamp energizes. Correct LEVEL adjustment as described above if necessary. Use VSET to reduce power supply output voltage to its operating value.

NOTE:1 Readjustment of the LEVEL control may be required after load and power supply have reached thermal equilibrium.

NOTE:2)If an *exact* crowbar point at a *remote load* must be established, *remote error sensing*, as described in PAR. 3.2.3 must be used.

3.4 LOCAL MODE OPERATION (KEYPAD OPERATION)

The following paragraphs explaining local mode operation include a description of the interaction between the LCD and the front panel keypad (see PAR. 3.6 for remote mode programming). Each key of the front panel is described, with a reference to a paragraph detailing the use of that key. Local operation of the ATE-DMG Power Supply is accomplished via the 24 key keypad on the front panel. All indications are provided by the 2-line LCD.

3.4.1 FRONT PANEL KEYPAD AND LCD (SEE FIGURE 2-1)

The front panel keypad is comprised of 24 key, 13 dedicated to command functions, 5 dedicated to data functions, and 6 keys that have both command and data functions. When the power supply is in command entry status the command functions are effective; when the power supply is in data entry status the data functions are effective.

3.4.1.1 COMMAND ENTRY STATUS

Indicated by blinking colon (:) on bottom line of LCD; the power supply is waiting for a command to be entered; data will not be accepted (accompanied by brief audible buzz). The LCD indicates the actual voltage and current at the output terminals. When the output is disabled (LCD bottom line reads Output OFF), the power supply is in Command entry status even though the blinking colon is not visible.

NOTE: The blinking colon is indicated by ☺ in this manual.

3.4.1.2 DATA ENTRY STATUS

Indicated by blinking equal sign (=) on bottom line of LCD; the power supply is waiting for data to be entered. A command will not be accepted (accompanied by brief audible buzz). Enter new value (the ← key erases data entered). Press ENTER to accept new setting, or CLEAR to exit without changing setting.

NOTE: The blinking equal sign is indicated by ☹ in this manual.

3.4.1.3 DISPLAY (LCD)

The LCD is a 2-line display with a capacity of 16 characters per line. The information is generally arranged as follows (information that does not follow this format is self-explanatory).

- Top left: Loc/Rem Remote/Local Status
- Top right CV/CC Constant voltage mode/constant current mode
- Bottom left:
 In command entry n.nnnV Output voltage
 In data entry: (parameter) e.g. OVset if OV SET key was pressed.
- Bottom middle: ☺ Command entry status
 ☹ Data entry status
- Bottom right:
 In command entry n.nnnA Output current
 In data entry: n.nnn Present value of parameter, replaced by data entered

3.4.1.4 KEYPAD FUNCTIONS

Keypad functions are listed in Table 3-1. Six keys have dual functions, depending on whether the power supply is in command entry status (waiting for a command to be entered), or data entry status (waiting for a number to be entered). Command entry status is indicated by a blinking colon ☺ and data entry status is indicated by a blinking equal sign ☹.

NOTE: Keys with dual functions are labeled with both a command and a number. The command label is referred to when the unit is in  command entry status; the number is referred to when the unit is in  data entry status.

TABLE 3-1. KEY FUNCTIONS

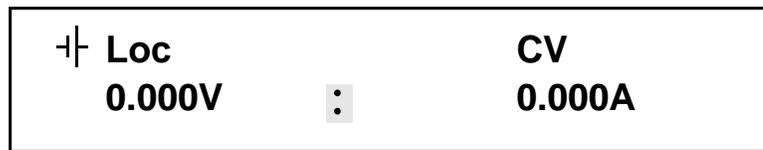
KEY	POWER SUPPLY STATUS ACTIVE	DESCRIPTION	REFERENCE PARAGRAPH
OUTPUT ON/OFF	Command Entry	If bottom line of LCD reads Output OFF, press to enable the output. If output is on (voltage and current measurements displayed on bottom line of LCD), press to disable the output.	3.4.6
V SET	Command Entry	Press to set output voltage. After V SET is pressed, previous setting is displayed. Data entry required to enter new value of output voltage; press ENTER to accept displayed value.	3.4.8
I SET	Command Entry	Press to set output current. After I SET is pressed, previous setting is displayed. Data entry required to enter new value of output current; press ENTER to accept displayed value.	3.4.8
LOCAL	Command Entry	If the power supply is in remote mode, keypad is disabled except for LOCAL key. Press to enable keypad. If LCD reads KEYPAD LOCKED, The LOCAL key is disabled and can only be unlocked by remote operation.	3.4.3
RESET	Command Entry	Press to restore the power on default values: CV mode, output voltage = 0, output current = minimum (1-2% of I_{Omax}), output enabled, overvoltage and overcurrent values per associated instruction manual. Also resets overvoltage or overcurrent condition.	3.4.7
MENU	Command Entry	Press to enter Menu commands: press repeatedly to scroll through Menu functions: (1) set LCD contrast, (2) GPIB address, (3) DCL Control, (4) Speaker on/off, (5) Calibration password, (6) previous calibration values, (7) factory calibration values, (8) view firmware serial number, (9) set maximum voltage, (10) set maximum current, (11) protection delay. Press ENTER or RESET to exit Menu.	(1) 3.4.4, (2) 3.6.3, (3) 3.6.2, (4) 3.4.5, (5) 3.4.16, (6) 3.4.16, (7) 3.4.16 (8) 2.8, (9, 10) 3.4.11 (11) 3.4.10,
OV SET 7	Command Entry	Press to set overvoltage protection value. Data entry required to enter the overvoltage protection value; press ENTER to accept displayed value.	3.4.9
	Data Entry	Press to enter number 7.	3.4.1.2
OC SET 8	Command Entry	Press to set overcurrent protection value. Data entry required to enter new overcurrent protection value; press ENTER to accept displayed value.	3.4.9
	Data Entry	Press to enter number 8.	3.4.1.2
CALIB 9	Command Entry	Press to enter Calibration status. Requires password entry; instructions appear on LCD.	Section 4
	Data Entry	Press to enter number 9.	3.4.1.2
STORE	Command Entry	Press to store present values of output voltage and current and overvoltage and overcurrent protection. Data entry required to select memory location where values are to be stored	3.4.12
EDIT PROG	Command Entry	Press to select the starting memory location to be edited. Then use  or  to view or modify the parameters of a specific memory location or to create a new program.	
STEP 4	Command Entry	Press to select starting address of program to be executed one step at a time.	3.4.15.3
	Data Entry	Press to enter number 4.	3.4.1.2

TABLE 3-1. KEY FUNCTIONS (CONTINUED)

KEY	POWER SUPPLY STATUS ACTIVE	DESCRIPTION	REFERENCE PARAGRAPH
TIME 5	Command Entry	Press to edit time value for specific memory location. Select memory location (data entry), then enter time value, 0.01 to 2.5 seconds (data entry).	
	Data Entry	Press to enter number 5.	3.4.1.2
RUN 6	Command Entry	Press to run a program. Requires data entry to select starting location. Press ENTER to accept displayed value.	3.4.15.2
	Data Entry	Press to enter number 6.	3.4.1.2
RECALL	Command Entry	Press to recall previously stored values of output voltage and current, and overvoltage and overcurrent protection. Data entry required to select memory location containing values to be recalled; press ENTER to accept displayed value.	3.4.13
CLEAR	Data Entry	Press to exit Data Entry status; any numbers entered are lost. Restores Command Entry status	3.4.8
1	Data Entry	Press to enter number 1.	3.4.1.2
2	Data Entry	Press to enter number 2.	3.4.1.2
3	Data Entry	Press to enter number 3.	3.4.1.2
ENTER	Data Entry	Press to accept data entered and return to Command Entry status.	3.4.8
←	Command Entry	<ul style="list-style-type: none"> — In CV (constant voltage), press to decrease output voltage by increment equal to voltage resolution ($\leq 0.025\%$ of E_{Omax}). — In CC (constant current), press to decrease output current by increment equal to current resolution ($\leq 0.025\%$ of I_{Omax}). — In EDIT PROG status, changes the parameter displayed on LCD for a specific memory location and decrements memory location displayed on LCD. 	3.4.8,
	Data Entry	Erases number to left, or decreases value shown (e.g. Display Contrast setting).	3.4.8
0	Data Entry	Press to enter number 0.	3.4.1.2
(.)	Data Entry	Press to enter decimal point	3.4.1.2
→	Command Entry	<ul style="list-style-type: none"> — In CV (constant voltage), press to increase output voltage by increment equal to voltage resolution ($\leq 0.025\%$ of E_{Omax}). — In CC (constant current), press to increase output current by increment equal to current resolution ($\leq 0.025\%$ of I_{Omax}). — In EDIT PROG status, changes the parameter displayed on LCD for a specific memory location and increments memory location displayed on LCD 	3.4.8,
	Data Entry	Not used.	—

3.4.2 TURNING THE POWER SUPPLY ON

Pressing the upper half (|) of the POWER switch turns the power supply on; pressing the lower half of the switch (O) shuts the power supply off. When the power supply is turned on, the LCD first shows the power supply type, e.g., Kepeco **ATE25-40 GPIB addr. = nn**, where nn is the GPIB address (factory default GPIB address = 6). The LCD then shows the power on defaults (see Figure 3-6). The defaults are: output enabled, voltage mode, output voltage set to zero, output current set to a minimum value (1-2% of I_{Omax}). Power on defaults also include setting maximum values for overcurrent and overvoltage protection indicated in Table 1-4.



NOTE:  indicates blinking colon (:), Command Entry status
 indicates blinking equal sign (=), Data Entry status

FIGURE 3-6. LCD POWER ON DEFAULTS

3.4.3 SETTING LOCAL MODE

When the power supply is turned on, it is automatically set to Local mode. If remote commands are accepted over the GPIB bus, the power supply will automatically go into Remote mode (**Rem** at the upper left of the LCD). Pressing the **LOCAL** key will restore Local mode. When in Remote mode, all keys except **LOCAL** are disabled.

The ATE-DMG incorporates a “keypad lockout” command which allows the **LOCAL** key to be disabled during remote operation, preventing inadvertent setting of the power supply to Local mode. If the keypad is locked, it must be unlocked either by a remote command (see Appendix B, PAR. B.87), or cycling the power supply off then on.

3.4.4 ADJUSTING LCD CONTRAST

With the power supply in command entry status , press **MENU** key. Press **→** or **←** key to increase or decrease contrast for optimum viewing. The contrast can also be set directly by entering a number from **1** to **9**. Press **ENTER** or **CLEAR** to exit menu.

3.4.5 ENABLING/DISABLING AUDIBLE BEEPS

With the power supply in command entry status , press **MENU** key three times. The top line indicates if the speaker is on or off (the factory default setting is speaker on). Enter **1** to enable the speaker, or **0** to disable the speaker. Press **ENTER** or **CLEAR** to exit menu.

3.4.6 ENABLING/DISABLING DC OUTPUT POWER

When the power supply is turned on, the output is automatically enabled, and the bottom line of the LCD gives voltage and current measurements at the output. To disable the output, press the red **OUTPUT ON/OFF** key; the lower line of the LCD reads: **Output OFF**. When the output is disabled, voltage and current are programmed to zero; the power supply remains in Command Entry status. Pressing the **OUTPUT ON/OFF** key again enables the output: the previously programmed values of voltage and current are restored and the LCD displays the mode (CV or CC) and actual values of output voltage and current.

3.4.7 RESET

RESET overrides all other local commands to reset the power supply to the power on defaults: output enabled, voltage mode, output voltage set to zero, output current set to a minimum value (1-2% of I_O max), overcurrent and overvoltage protection set to the maximum values per Table 1-4. The power supply remains in command entry status.

3.4.8 SETTING OUTPUT VOLTAGE OR CURRENT

V SET and **I SET** set output voltage and current limit, respectively, when the unit is in constant voltage (CV) mode and set voltage limit and output current, respectively, when the unit is in constant current (CC) mode. The mode (CV or CC) is determined by the load together with the programmed settings. As long as the voltage across the load produces a current that is less than or equal to the **I SET** value, the unit operates in CV mode (voltage programmed to **V SET** value, current limited by **I SET** value). If the load changes to the point that current through the load reaches the **I SET** value, the unit automatically enters CC mode (current programmed to **I SET** value, voltage limited by **V SET** value).

With the power supply in command entry status ⏏ , press **V SET** (voltage) or **I SET** (current) key to put the power supply in data entry status ⏏ . The lower right side of the LCD shows the programmed setting in effect when the key is pressed. Press **ENTER** or **CLEAR** to exit without changing setting. Enter new value (the ⬅ key erases data just entered) and press **ENTER** to accept new setting or **CLEAR** to exit without changing setting.

With the power supply in command entry status ⏏ , an alternative is to use ➡ (increase) or ⬅ key (decrease) to change the output by the minimum increment ($\leq 0.025\%$ of E_{Omax} for voltage, $\leq 0.025\%$ of I_{Omax} for current). In CC mode, these keys control output current; in CV mode they control output voltage. The ➡ key has no effect after the maximum (or programmed limit) has been reached. The ⬅ key has no effect when the value is 0.

If the value entered exceeds the maximum setting, the LCD bottom line flashes **VsetMAX=nn V** or **IsetMAX=n.n A** where n.n is the maximum setting (see PAR.3.4.11). The unit returns to ⏏ waiting for a value that does not exceed the maximum.

3.4.9 SETTING OVERVOLTAGE OR OVERCURRENT PROTECTION

With the power supply in command entry status ⏏ , press **OV SET** (overvoltage) or **OC SET** (overcurrent) to put the power supply in data entry status ⏏ . The lower right side of the LCD shows the programmed setting in effect when the key is pressed. Press **ENTER** or **CLEAR** to exit without changing setting. Enter new value and press **ENTER** to accept new setting (the ⬅ key erases data just entered), or **CLEAR** to exit without changing setting. To recover from overvoltage or overcurrent condition, press **RESET**; this restores the power on defaults (see PAR. 3.4.7).

Table 1-4 lists the maximum settings for overvoltage and overcurrent protection. Overvoltage and overcurrent settings are recommended to be left set to the factory default values or should be at least 1% higher than the expected output voltage or output current.

An additional 5% in overvoltage and overcurrent protection above the digitally controlled setting is provided to allow the user when using external references to utilize the headroom of the basic ATE power supply. The ATE power supply can provide at least 1% additional voltage or current as long as the total unit power is not exceeded. Total power varies from 600 watts to 1080 watts depending on model. (total power = nominal voltage * nominal current)

3.4.10 CHANGING PROTECTION DELAY

The overvoltage and overcurrent protection normally trips immediately upon detection of an overvoltage/overcurrent condition. However, changing output settings (particularly with reactive loads) large transients can cause inadvertent tripping of the protection. For this reason, tripping of the overvoltage/overcurrent protection can be delayed approximately 8 seconds after the output is changed.

With the power supply in command entry status ⏏ , press **MENU** key eleven times. LCD reads **Prot. Delay Count** = **nn** where nn is the active setting. A count of 0 means no delay, a count of 255 (highest value) means approximately 8 seconds delay (a count of 30 provides a delay of 1 second).

3.4.11 CHANGING MAXIMUM VOLTAGE OR CURRENT VALUE

The maximum values of voltage and current are determined by the model, e.g., 25V and 40A for the ATE 25-40DMG. These values can be lowered by the user, e.g., to prevent inadvertent damage to a specific circuit under test. Changing the maximum values of the ATE 25-40DMG to 10V and 1A, effectively makes the unit a 10V 1A power supply.

With the power supply in command entry status ⏏ , press **MENU** key nine (voltage) or ten (current) times. The LCD reads **New MAXIMUM Vset (or Iset)** = **nn** where nn is the maximum value setting to be changed. Press **ENTER** or **CLEAR** to exit menu without changing setting. Press number keys to enter new value and press **ENTER**. Press **ENTER** again to exit the menu and return to command status ⏏ .

If a value is entered that is higher than the rated maximum for the power supply, the bottom line of the LCD flashes **Vset or Iset MAX = nn** where nn is the rated maximum of the power supply. The unit remains in data entry status ⏏ waiting for a value equal to or less than the rated maximum. Press **CLEAR** to exit without changing the value.

Once the maximum value has been changed, if a value higher than the new maximum is attempted to be programmed, the LCD flashes **Vset (or Iset) MAX = nn** where nn is the programmed maximum.

NOTES: 1. If the programmed output value is higher than the new maximum value established with the **MENU** key, the output will be limited to the new maximum value.

2. The front panel CURRENT control provides secondary limiting. To disable limiting from the CURRENT control, rotate fully counterclockwise.

3.4.12 STORING POWER SUPPLY OUTPUT SETTINGS

The programmed settings of voltage, current, overvoltage protection and overcurrent protection can be stored in one of the 40 memory locations available for local programming (see PAR. 3.4.15).

With the power supply in command entry status ⏏ , press **STORE** key. The LCD reads **STORE mem** = **nn** where nn is the memory location where the settings are to be stored. Press **ENTER** or **CLEAR** to exit without changing setting. Enter memory location (from 1 to 40) and press **ENTER**. The programmed voltage, current, overvoltage protection and overcurrent protection settings in effect when **ENTER** is pressed are stored in the selected memory location. To recall stored settings, see PAR. 3.4.13

3.4.13 RECALLING STORED OUTPUT SETTINGS

With the power supply in command entry status ⏏ , press **RECALL**. The LCD reads **RECALL mem** = **nn** where nn is the memory location holding the settings to be retrieved. Press **ENTER** or **CLEAR** to exit without changing setting. Enter memory location (from 1 to 40) and press **ENTER**. The stored settings for voltage, current, overvoltage protection and overcurrent protection replace the current values, and the unit returns to ⏏ command entry status.

3.4.14 ENABLING REMOTE ANALOG CONTROL

The power supply may be controlled by external analog voltages (see PAR. 3.5), but the feature must be enabled first.

CAUTION: Hazardous voltage may be present at the output if this feature is enabled with the output on. An OUTPUT OFF to ON transition must occur before the external references can take control.

With the power supply in command entry status ⏏ , ensure the output is **OFF** (see PAR. 3.4.6) and press **MENU** key until LCD reads **Extern. Ref On** or **Extern. Ref Off** ⏏ and the bottom line reads **0=Off, 1=On**. Enter 1 (enable) or 0 (disable), then press **ENTER** to enable or disable the feature. Press the red **OUTPUT ON/OFF** key to enable the output; the external references are now in control of the output. Refer to PAR. 3.5 for using this feature.

3.4.15 LOCAL MODE PROGRAMMING OF THE POWER SUPPLY.

Local mode programming offers the user 40 memory locations that can be used to program the power supply. Each location defines values for output voltage, output current, overcurrent protection, overvoltage protection, time duration (between 0.1 and 2.5 seconds) for the programmed settings, and the address of the next memory location in the program.

NOTE: When programming sequential voltage levels, it is important to set the Overvoltage to accommodate the highest voltage of the sequence. Otherwise, when going from higher to lower voltage levels, the overvoltage protection will trip and shut down the unit.

3.4.15.1 CREATING OR MODIFYING A PROGRAM (PROGRAM EDIT MODE)

Creating a program and modifying an existing program are identical except that a program modification requires only selected parameters to be changed rather than all new parameter values. With the power supply in command entry status ⏏ , press **EDIT PROG** key. The top line indicates the **STARTaddr.** ⏏ **nn**, where nn is one of 40 memory location. To select a different address, enter new value and press **ENTER**.

The top line of the LCD indicates the active memory location, e.g. **ViewVAL Mem <n>** where n is the memory location previously chosen. The bottom line of the LCD indicates the parameter on the left (**Iset**, **Vset**, **OVset**, **OCset**, **TIMEval**, **NEXT STEP**), the parameter's value on the right, and data entry status ⏏ in the middle. To modify time values see PAR.3.4.15.1.1.

Press **ENTER** to accept displayed value, or enter new value and press **ENTER** to accept new setting (the LCD displays the next parameter). Press **CLEAR** to exit Program Edit mode without changing value. Use ➡ or ⬅ key to scroll forward (or backward) to view next (or previous) parameter or memory location. For a program to run once, then stop, see PAR. 3.4.15.6; to cycle a program continuously, see 3.4.15.4. After all program values have been set, press **CLEAR** or **ENTER** to exit Program Edit mode. Setting up a program can be made easier by copying the Memory Location Worksheet (Table 3-3) and filling in the values before programming the power supply.

3.4.15.1.1 MODIFYING PROGRAMMED TIME INTERVAL

The **TIME** key offers a quick and easy way to change the time for any memory location. With the power supply in command entry status ⏏ , press **TIME** key. The LCD displays **TIMEval** ⏏ **nn** where nn is the time value set for the selected location. Press **ENTER** to accept displayed value, or enter new value (between 0.01 and 300 seconds) and press **ENTER** to accept new

value or press **CLEAR** to exit without changing value. The unit returns to command entry status ⏏ . Refer to PAR. 3.4.15.1.2 if accuracy of time values is important.

3.4.15.1.2 TIME INTERVAL ACCURACY

The accuracy of the time interval is $\pm 2.5\%$. For setting time intervals from 0.01 to 2.50 seconds, the unit will accept times that are accurate to 0.01 second. (e.g., 2.49 seconds). For setting time intervals between 2.50 seconds and 50 seconds the second decimal place is ignored, providing accuracy to 0.1 second (e.g., entering 2.79 is accepted as 2.7). When the time interval is greater than 50 seconds, the decimal is ignored and the time increment is in full seconds.

3.4.15.1.3 DISPLAY PROGRAM OPTION

When running a program, if the Display Program option is on, the LCD will display the mode (**Loc/Rem RunPg CV/CC**) and active voltage and current values (programmed). If the Display Program option is turned off, the LCD displays the message ****PROGRAM RUNNING****. Since the accuracy of the time intervals is affected by whether this option is on or off, it is recommended that this option be turned off when accurate time intervals are important; otherwise this option should be turned on.

With the power supply in command entry status ⏏ , press **MENU** key 11 times. The LCD top line reads **DispPrg** ⏏ **ON** or **OFF**. Choosing **ON** displays the programmed values, choosing **OFF** displays the ****PROGRAM RUNNING**** message. Press **ENTER** or **CLEAR** to exit without changing setting. Enter **0** (**OFF**) or **1** (**ON**) and press **ENTER** or **CLEAR** to menu.

3.4.15.2 RUNNING A PROGRAM

With the power supply in command entry status ⏏ , press **RUN** key. The LCD bottom line indicates the start address of the program. Press **ENTER** key to run the program starting with that address. To change the starting address, enter new value and press **ENTER** to run the program. Press **CLEAR** to exit without running the program.

3.4.15.3 STEPPING THROUGH A PROGRAM

The STEP function is useful for examining a program that has just been created or edited before running in real-time. With the power supply in command entry status ⏏ , press **STEP** key. The LCD bottom line indicates the start address of the program; press **ENTER** to begin stepping at that address. To change the starting address, enter new value and press **ENTER** to begin stepping at the new address, press **CLEAR** to exit without stepping through the program.

The LCD top line shows **LOC** to indicate local mode, **aa→bb** where **aa** is the memory location just executed, **bb** is the NEXT STEP location, and shows **CV** (constant voltage) or **CC** (constant current) to indicate the actual operating mode. The LCD bottom line shows the output voltage and current measurements for the location just executed, and ⏏ indicates command status. Press **STEP** to execute location **bb**. The LCD will again display the location just executed, voltage and current measurements, and the NEXT STEP location. Continue to press **STEP** to execute the program one step at a time, or press **CLEAR** to exit Step function.

3.4.15.4 CYCLING A PROGRAM

To cycle a program, modify the program (see PAR.) and go to the last memory location to be executed and set the NEXT STEP address to the Starting address, causing the program to loop and repeat indefinitely. For example, if the last location is 14, and the starting location is 05, press **EDIT PROG**, enter **14**, then press **ENTER**. Press ➔ until LCD reads **ViewVAL Mem14**

NEXT STEP = Enter **5** and press **ENTER**. When the program runs, it will start at location 05, continue to 14, then loop back to the location 05, and repeat indefinitely.

TABLE 3-2. MEMORY LOCATION WORKSHEET

MEMORY LOCATION	I SET (Current) (A)	V SET (Voltage) (V)	OCset (Overcurrent Protection) (A)	OV set (Overvoltage Protection) (V)	TIMEval (0. to 300 Sec) (Sec)	NEXT STEP (Next location to execute)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						

3.4.15.5 RUNNING A PROGRAM ONCE

To set up a program to stop after running once, modify the program (see PAR.) and go to the last memory location to be executed and set the NEXT STEP address to 0. For example, with the power supply in command entry status ⏏ , press **EDIT PROG**. Enter the last memory location you want executed (e.g. 14), then press **ENTER**. Press ➔ key until LCD reads **ViewVAL Mem14 NEXT STEP** ⏏ . Enter 0 and press **ENTER**. The program will now stop after memory location 14 is executed. When the program stops, the power supply will continue to provide the output specified by the last location (in the above example, location 14).

3.4.15.6 STOPPING A PROGRAM

To set up a program to stop after running once, set the NEXT STEP address of the last memory location to be executed to 0. For example, with the power supply in command entry status ⏏ , press **EDIT PROG**. Enter the last memory location you want executed (e.g. 14), then press **ENTER**. Press ➔ key until LCD reads **ViewVAL Mem14 NEXT STEP** ⏏ . Enter 0 and press **ENTER**. The program will now stop after memory location 14 is executed.

3.4.15.7 STOPPING A RUNNING PROGRAM

There are three ways to stop a program that is running:

- Press CLEAR key: the program immediately stops at the step (location) that was being executed when the key was pressed. The power supply output remains at the values specified by that step.
- Press RESET key: The program stops and power on defaults are restored (see PAR. 3.4.7).
- Press OUTPUT ON/OFF key: the output is disabled (programmed to zero) and the program immediately stops at the step (location) that was being executed when the key was pressed. Pressing the OUTPUT ON/OFF key again restores the output to the values specified by the step in effect when the program was stopped.

3.4.15.8 SAMPLE PROGRAM

Table 3-3 shows a sample program designed to cycle continuously; if the NEXT STEP value for location 3 is set to 00, the program will run once and stop.

TABLE 3-3. SAMPLE PROGRAM (MODEL ATE 25-40DMG)

MEMORY LOCATION	I SET (Current) (A)	V SET (Voltage) (V)	OCset (Overcurrent Protection) (A)	OV set (Overvoltage Protection) (V)	TIMEval (0. to 2.5) (Sec)	NEXT STEP (Next location to execute)
1	2.1	4.3	11	11	1.5	02
2	1.2	5.0	1.3	5.2	1.8	03
3	4.5	6.2	4.8	6.4	1.0	01

3.4.16 CALIBRATION

Refer to associated Service Manual for calibration of specific ATE-DMG models.

3.5 ANALOG REMOTE PROGRAMMING

The ATE-DMG has the capability to control the output using external d-c analog reference voltages. Analog references for both voltage and current are required to produce an output. Two uncommitted amplifiers (preamps "A" and "B") included in the unit can be used for signal conditioning. Each preamp has an inverting input (-), non-inverting input (+), and output, and a zero adjustment, the preamps are accessible via A11J5 pins as shown in Figures 2-3 and 3-7 and listed in Table 3-4. To gain access to A11J5, loosen two screws at the rear panel and disconnect interconnection adapter A11, then remove two screws securing connector A11J1 to the shell.

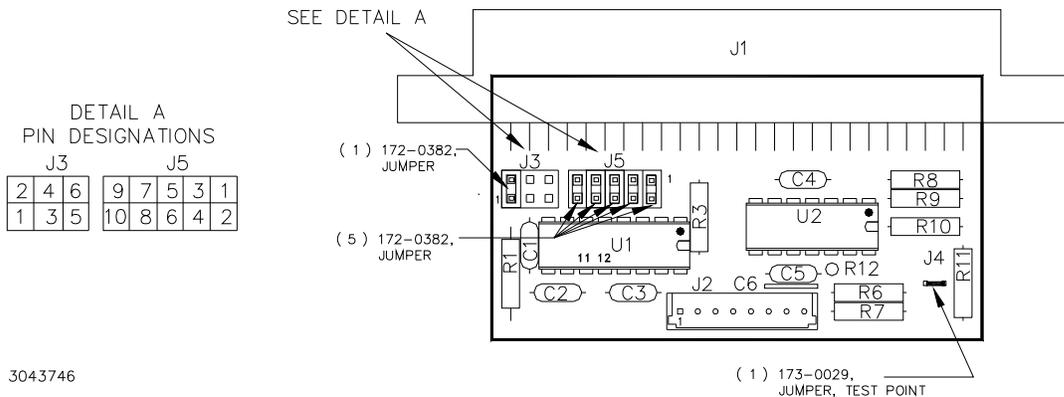


FIGURE 3-7. A11 ASSEMBLY CONNECTOR AND PIN LOCATIONS

TABLE 3-4. CONNECTOR A11J5 PIN FUNCTIONS

PIN	FUNCTION	PIN	FUNCTION
1	VEXT	6	GND
2	CEXT	7	PREAMP "B" IN (+)
3	PREAMP "A" OUT	8	GND
4	PREAMP "A" IN (-)	9	PREAMP "B" IN (-)
5	PREAMP "A" IN (+)	10	PREAMP "B" OUT

(For further details about Preamp "A" and "B" go to www.kepcopower.com/support and download the Operator manual for ATE 1/4 Rack, 1/2 Rack 3/4 Rack or Full Rack, and refer to PAR's 3-37 through 3-84.)

Connections to A11J5 can be made via discrete wires, a flat ribbon cable not exceeding 1 foot in length or by discrete wires terminated into crimp style pins inserted into a 5x2 housing (not supplied). Recommended parts (ribbon cable, housing for discrete wires and pins) are listed as accessories in Table 1-6).

NOTE: When making connections to A11J5, move unused jumper to a single pin of connector J3 (DO NOT SHORT J3 PINS).

1. Connect a 0 to 10V voltage reference to A11J5 pin 1 (pin 6 common); 0V programs the output voltage to zero, 10V programs output voltage to full scale.
2. Connect a 0 to 1V current reference to A11J5 pin 2 (pin 8 common), 0V programs the output current to zero, 1V programs output current to full scale.
3. Enable the external reference feature from either the front panel (PAR. 3.4.14) or using GPIB commands (see PAR. B.12).

To access the external reference feature from the front panel, with the power supply in command entry status, press MENU key until the top line of the display reads Extern. Ref On or Extern. Ref Off. and the bottom line reads 0=Off, 1=On. Enter 1 to enable or 0 to disable and press ENTER to enable or disable the feature.

3.6 DIGITAL REMOTE MODE PROGRAMMING

ATE-DMG Power Supplies may be programmed over a control bus using SCPI (Standard Commands for Programmable Instruments). SCPI provides a common language conforming to IEEE 488.2 for instruments used in an automatic test system. The control bus used must be the IEEE 488 standard communication bus (General Purpose Interface Bus, GPIB). Refer to Table 2-4 for input/output signal allocations.) Most power supply functions available from the keypad can be programmed via remote commands, in addition to some that are not available from the keypad (e.g. triggering, and local lockout).

This section includes a discussion of GPIB bus protocols (PAR. 3.6.1), instructions for changing the GPIB address (PAR. 3.6.3), followed by a detailed explanation of SCPI programming (PAR. 3.7)

3.6.1 IEEE 488 (GPIB) BUS PROTOCOL

Table 3-5 defines the interface capabilities of the ATE-DMG power supply (Talker/Listener) relative to the IEEE 488 (GPIB) bus (reference document *ANSI/IEEE Std 488: IEEE Standard Digital Interface for Programmable Instrumentation*) communicating with a Host Computer—Controller (Talker/Listener). Tables 3-6 and 3-7 define the messages sent to the ATE-DMG, or received by the ATE-DMG, via the IEEE 488 bus in IEEE 488 command mode when ATN is asserted and IEEE 488 data mode, respectively. These messages are enabled during the “handshake” cycle, with the ATE-DMG power supply operating as either a Talker or a Listener.

TABLE 3-5. IEEE 488 (GPIB) BUS INTERFACE FUNCTIONS

FUNCTION	SUBSET SYMBOL	COMMENTS
Source Handshake	SH1	Complete Capability (Interface can receive multiline messages)
Acceptor Handshake	AH1	Complete Capability (Interface can receive multiline messages)
Talker	T6	Basic talker, serial poll, unaddress if MLA (My Listen Address) (one-byte address)
Listener	L4	Basic listener, unaddress if MTA (My Talk Address) (one-byte address).
Service Request	SR1	Complete Capability. The interface sets the SRQ line true if there is an enabled service request condition.
Remote/Local	RL1	Complete capability. Interface selects either local or remote information. In local mode the ATE-DMG executes front panel commands, but can be set to remote mode via IEEE 488 bus. When in Remote mode all front panel keys are disabled except LOCAL. LOCAL key can be disabled using keypad lockout command (see Appendix B, PAR. B.87) so that only the controller or a power on condition can restore Local mode.
Parallel Poll	PP0	No Capability
Device Clear	DC1	Complete Capability. ATE-DMG accepts DCL (Device Clear) and SDC (Selected Device Clear).
Device Trigger	DT1	Respond to *TRG and <GET> trigger functions.
Controller	C0	No Capability

TABLE 3-6. IEEE 488 (GPIB) BUS COMMAND MODE MESSAGES

MNEMONIC	MESSAGE DESCRIPTION	COMMENTS
DCL	Device Clear	Received
GET	Group Execute Trigger	Received
GTL	Go To Local	Received
IFC	Interface Clear	Received
LLO	Local Lockout	Received
MLA	My Listen Address	Received
MTA	My Talk Address	Received
OTA	Other Talk Address	Received (Not Used)
RFD	Ready for Data	Received or Sent
SDC	Selected Device Clear	Received
SPD	Serial Poll Disable	Received
SPE	Serial Poll Enable	Received
SRQ	Service Request	Sent
UNL	Unlisten	Received
UNT	Untalk	Received

TABLE 3-7. IEEE 488 (GPIB) BUS DATA MODE MESSAGES

MNEMONIC	MESSAGE DESCRIPTION	COMMENTS
DAB	Data Byte	Received or Sent
END	End	Received or Sent
EOS	End of String	Received or Sent
RQS	Request Service	Sent
STB	Status Byte	Sent

3.6.2 DCL CONTROL

The device clear (DCL) and selected device clear can be set to operate in two modes. In the “output = 0V” mode, when the device clear is received, the output of the power supply is set to zero volts. In the “output unchanged” mode sending DCL or selected DCL has no effect on output voltage and current as required by IEEE specification 488.2. The factory default value is “output unchanged” mode. NOTE: When set to “output = 0V” mode, the power supply will power up with OUTPUT set to OFF.

To change the DCL mode the unit must be in command entry mode **⏏**, then depress the **MENU** key three times. The top line of the display will show the current setting: either **DCL OUTP = 0V** or **DCL = OUTP UNCHNG**. Depress 1 for “output unchanged” mode where the output is unaffected by DCL; depress 0 for “output = 0V” mode where DCL sets the output to 0 volts.

3.6.3 CHANGING THE GPIB ADDRESS

When the power supply is in local mode, command entry status **⏏**, press **MENU** key twice. The top line of the LCD indicates the current GPIB address. Enter new value and press **ENTER** to accept new setting, or **CLEAR** to exit without changing setting.

3.6.4 ENABLING REMOTE ANALOG CONTROL

Before using the remote analog control feature (see PAR. 3.5_ which allows an external reference to control output voltage and current, the feature must first be enabled, either from the front panel (see PAR. 3.4.14) or by using the following commands and queries via the remote interface: **DIAG:EXT** (see PAR. B.12), **DIAG:EXT?** (see PAR. B.13), **CURR:MODE** (see PAR. B.54), **CURR:MODE?** (see PAR. B.55), **VOLT:MODE** (See PAR. B.68) and **VOLT:MODE?** (See PAR. B.69).

3.6.5 PROGRAMMING TECHNIQUES TO OPTIMIZE PERFORMANCE

Kepeco's auto-crossover digital supplies can operate in either voltage mode with current limit, or current mode with voltage limit. The operating mode is determined by the voltage and current commands received, as well as the load. Each time voltage and current commands are received, the unit must evaluate the commands and the load conditions to determine the proper operating mode. Reducing the number of times this evaluation must be made is desirable because Kepeco's digital auto-crossover supplies employ two separate feedback loops. Each time there is a potential mode change, there is always an uncontrolled period of a few milliseconds while the two feedback loops compete for control of the output. By changing only the active parameter (e.g., voltage for voltage mode), there is no doubt as to what the operating

mode will be, so the unit is never uncontrolled, response is quick and no transients are possible. Recommended programming techniques are:

1. Minimize programmed mode (voltage or current) changes. Unless absolutely required by the test parameters, allow the power supply to automatically switch modes as determined by the load. This will improve response time and reduce undesirable transients. For those power supplies that employ relays (Kepeco's MBT with "R" option, MAT and MST) this will also increase the life of the relay.
2. Once the mode (voltage or current) is programmed, program the active parameter to zero and the complementary limit parameter to the maximum anticipated for application. Then program only the active parameter. The active parameter is the parameter that controls the output, e.g., voltage controls the output in voltage mode.
3. Never program both the active and complementary limit parameter to zero. This can result in long response times. Set the active parameter to zero and the complementary limit parameter to a minimum, e.g., 10% of maximum, to ensure that the active mode is defined.

3.7 SCPI PROGRAMMING

SCPI (Standard Commands for Programmable Instruments) is a programming language conforming to the protocols and standards established by IEEE 488.2 (reference document *ANSI/IEEE Std 488.2, IEEE Standard Codes, Formats, Protocols, and Common Commands*). SCPI commands are sent to the ATE-DMG Power Supply as ASCII output strings within the selected programming language (PASCAL, BASIC, etc.) in accordance with the manufacturer's requirements for the particular GPIB controller card used.

Different programming languages (e.g., BASIC, C, PASCAL, etc.) have different ways of representing data that is to be put on the IEEE 488 bus. It is up to the programmer to determine how to output the character sequence required for the programming language used. Address information (GPIB address) must be included before the command sequence. (See PAR.3.6.3 to establish the ATE-DMG Power Supply GPIB address.)

3.7.1 SCPI MESSAGES

There are two kinds of SCPI messages: program messages from controller to power supply, and response messages from the power supply to the controller. Program messages consist of one or more properly formatted commands/queries and instruct the power supply to perform an action; the controller may send a program message at any time. Response messages consist of formatted data; the data can contain information regarding operating parameters, power supply state, status, or error conditions.

3.7.2 COMMON COMMANDS/QUERIES

Common commands and queries are defined by the IEEE 488.2 standard to perform overall power supply functions (such as identification, status, or synchronization) unrelated to specific power supply operation (such as setting voltage/current). Common commands and queries are preceded by an asterisk (*) and are defined and explained in Appendix A (see Table 4-4). Refer also to syntax considerations (PARs 3.4.3 through 3.4.6).

3.7.3 SCPI SUBSYSTEM COMMAND/QUERY STRUCTURE

Subsystem commands/queries are related to specific power supply functions (such as setting output voltage, current limit, etc.) Figure 3-8 is a tree diagram illustrating the structure of SCPI

subsystem commands used in the ATE-DMG Power Supply with the “root” at the left side, and specific commands forming the branches. The following paragraphs introduce the subsystems; subsystem commands are defined and explained in Appendix B.

3.7.3.1 ABORT SUBSYSTEM

This subsystem allows pending trigger levels to be cancelled.

3.7.3.2 DIAG SUBSYSTEM

This subsystem is used to enable/disable external analog control of the output.

3.7.3.3 DISPLAY SUBSYSTEM

This subsystem controls the second line of the LCD. The first line will always display the LOCal or REMote operation status and the constant Voltage (CV) or constant Current functioning mode (CC).

3.7.3.4 INITIATE SUBSYSTEM

This subsystem enables the trigger system. When a trigger is enabled, the triggering action will occur upon receipt of a GPIB <GET>, *TRG or TRIGger command. If a trigger circuit is not enabled, all trigger commands are ignored.

3.7.3.5 LIST SUBSYSTEM

The LIST subsystem is represented by the 40 memory locations (groups of settings) which are stored in the nonvolatile memory. Each setting contains values for: Current, Voltage, Overcurrent, Overvoltage, Next memory location, and Time. The range for the first four values is the maximum available range for the specific power supply. The Next memory location is the address of the next group of settings and is between 1 and 40. A value of 0 means end of chain. The Time setting is between 0.01 and 300 seconds. In order to access one of the 40 memory locations an index value must be provided. The 40 memory locations can be very useful in remote mode using the *RCL command (see Appendix A, PAR. A.10.)

3.7.3.6 MEASURE SUBSYSTEM

This query subsystem returns the voltage and current measured at the power supply's output terminals.

3.7.3.7 OUTPUT SUBSYSTEM

This subsystem controls the power supply's voltage and current outputs

3.7.3.8 PROTECTION SUBSYSTEM

This subsystem allows overvoltage/overcurrent protection tripping to be delayed to prevent brief transients (caused by application of power to a reactive load) from tripping overvoltage/overcurrent protection.

3.7.3.9 STATUS SUBSYSTEM

This subsystem programs the power supply status register. The power supply has two groups of status registers: Operation and Questionable. Each group consists of three registers: Condition, Enable, and Event.

3.7.3.10 TRIGGER SUBSYSTEM

This subsystem controls the remote triggering of the power supply.

3.7.3.11 [SOURCE:]VOLTAGE AND [SOURCE:]CURRENT SUBSYSTEMS

These subsystems program the output voltage and current of the power supply.

3.7.3.12 CALIBRATE SUBSYSTEM

The ATE-DMG series of power supplies support software-assisted calibration. A full calibration consist of a voltage calibration and a current calibration. Both voltage and current calibrations consist of a zero and a full scale calibration. There are two ways to perform the calibration: locally using the front panel keys, or remotely sending commands through the GPIB bus. These two ways cannot be combined.

In order to enter the calibration mode the correct calibration access code (password) must be entered. If the password has been forgotten call the factory and a secret password (which has been assigned to your power supply) will be provided. During the calibration, new calibration data is computed which is than stored in the non volatile memory.

The following equipment is required for calibration: Digital Voltmeter (DVM) with 6 digits Dc accuracy. Shunt 0.01 to 0.1 Ohm, 0.04%, minimum 100A, power > 100W (200W recommended).

Because the voltage measured will be used as reference for calibration, the DVM itself must be calibrated accurately. During voltage calibration, the voltage, overvoltage and voltage readback are calibrated and during current calibration the current, overcurrent and current readback are calibrated. The normal procedure is to calibrate voltage first and then current. However, you do not have to do a complete calibration each time. If required, you may calibrate only the voltage or the current and then proceed to saving the calibration results. For voltage calibration all loads must be disconnected and the sense terminals connected to the corresponding output terminals. The digital voltmeter will be connected to the output of the power supply. For current calibration after disconnecting all loads an appropriate shunt resistor will be connected across output terminals and the digital voltmeter will be connected across the sense terminals of the shunt resistor.

3.7.4 PROGRAM MESSAGE STRUCTURE

SCPI program messages (commands from controller to power supply) consist of one or more *message units* ending in a *message terminator* (required by Kepco power modules). The message terminator is not part of the syntax; it is defined by the way your programming language indicates the end of a line ("newline" character). The message unit is a keyword consisting of a single command or query word followed by a message terminator (e.g., CURR?<newline> or TRIG<end-of-line>). The message unit may include a data parameter after the keyword separated by a space; the parameter is usually numeric (e.g., CURR 5<newline>), but may also be a string (e.g., OUTP ON<newline>). Figure 3-9 illustrates the message structure, showing how message units are combined. The following subparagraphs explain each component of the message structure.

NOTE: An alternative to using the message structure for multiple messages defined in the following paragraphs is to send each command as a separate line. In this case each command must use the full syntax shown in Appendix B.

ROOT : (colon)

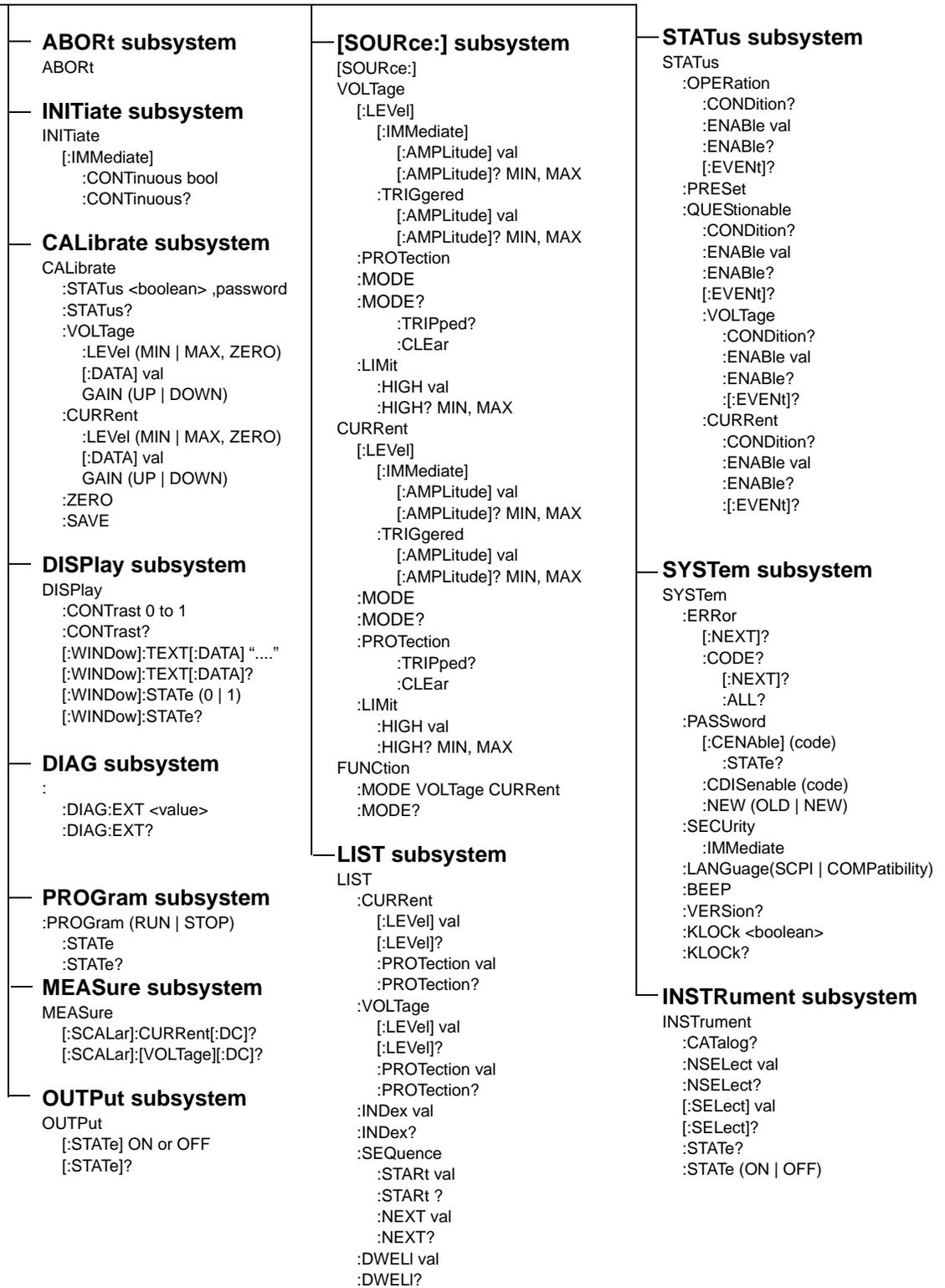


FIGURE 3-8. TREE DIAGRAM OF SCPI COMMANDS USED WITH ATE-DMG POWER SUPPLY

3.7.4.1 KEYWORD

Keywords are instructions recognized by a decoder within the ATE-DMG, referred to as a “parser.” Each keyword describes a command function; all keywords used by the ATE-DMG are listed in Figure 3-8.

Each keyword has a long form and a short form. For the long form the word is spelled out completely (e.g. STATUS, OUTPUT, VOLTAGE, and TRIGGER are long form keywords). For the short form only the first three or four letters of the long form are used (e.g., STAT, VOLT, OUTP, and TRIG). The rules governing short form keywords are presented in Table 3-8.

TABLE 3-8. RULES GOVERNING SHORTFORM KEYWORDS

IF NUMBER OF LETTERS IN LONGFORM KEYWORD IS:	AND FOURTH LETTER IS A VOWEL?	THEN SHORT FORM CONSISTS OF:	EXAMPLES
4 OR FEWER	(DOES NOT MATTER)	ALL LONG FORM LETTERS	MODE
5 OR MORE	NO	THE FIRST FOUR LONG FORM LETTERS	MEASure, OUTPut, EVEnt
	YES	THE FIRST THREE LONG FORM LETTERS	LEVel, IMMEDIATE, ERRor

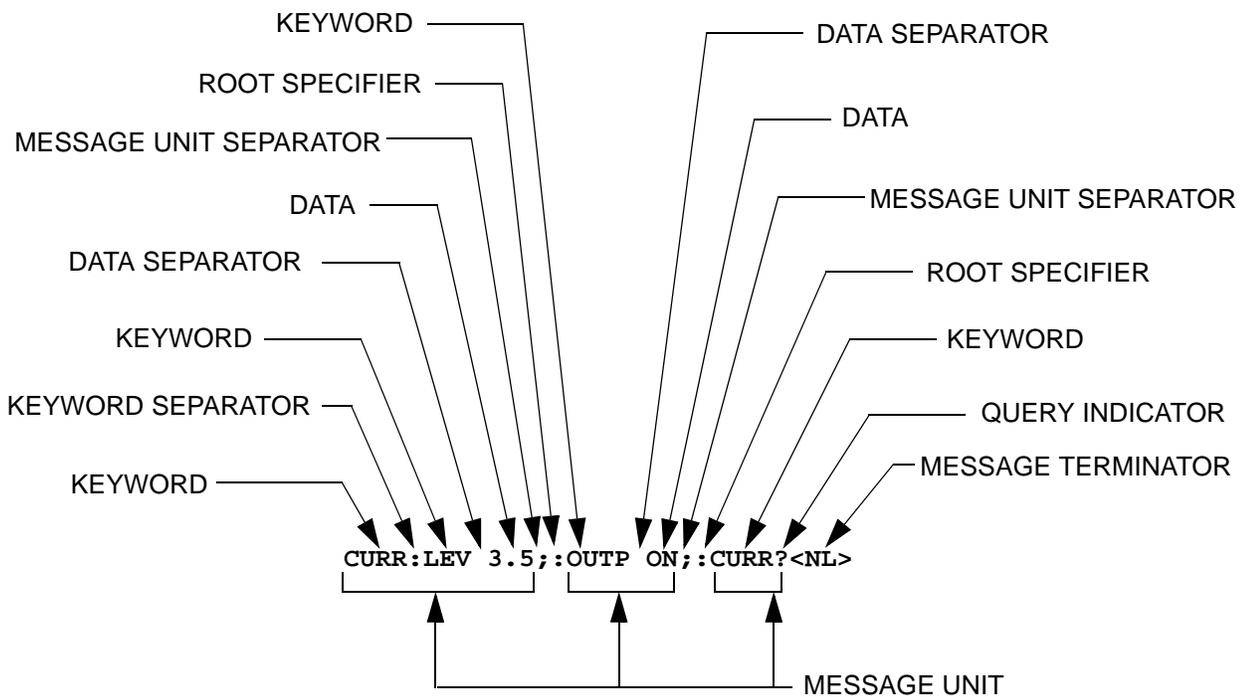


FIGURE 3-9. MESSAGE STRUCTURE

You must use the rules above when using keywords. Using an arbitrary short form such as ENABL for ENAB (ENABLE) or IMME for IMM (IMMEDIATE) will result in an error. Regardless of which form chosen, you must include all the letters required by that form.

To identify the short form and long form in this manual, keywords are written in upper case letters to represent the short form, followed by lower case letters indicating the long form (e.g., IMMEDIATE, EVENT, and OUTPUT). The parser, however, is not sensitive to case (e.g., outp, OutP, OUTPUT, ouTPut, or OUTp are all valid).

3.7.4.2 KEYWORD SEPARATOR

If a command has two or more keywords, adjacent keywords must be separated by a colon (:) which acts as the keyword separator (e.g., CURR:LEV:TRIG). The colon can also act as a root specifier (PAR. 3.7.4.7).

3.7.4.3 QUERY INDICATOR

The question mark (?) following a keyword is a query indicator. This changes the command into a query. If there is more than one keyword in the command, the query indicator follows the last keyword. (e.g., VOLT? and MEAS:CURR?).

3.7.4.4 DATA

Some commands require data to accompany the keyword either in the form of a numeric value or character string. Data always follows the last keyword of a command or query (e.g., VOLT:LEV:TRIG 14 or SOUR:VOLT? MAX

3.7.4.5 DATA SEPARATOR

Data must be separated from the last keyword by a space (e.g., VOLT:LEV:TRIG 14 or SOUR:VOLT? MAX

3.7.4.6 MESSAGE UNIT SEPARATOR

When two or more message units are combined in a program message, they must be separated by a semicolon (;) (e.g., VOLT 15;MEAS:VOLT? and CURR 12; CURR:TRIG 12.5).

3.7.4.7 ROOT SPECIFIER

The root specifier is a colon (:) that precedes the first keyword of a program message. This places the parser at the root (top left, Figure 3-8) of the command tree. Note the difference between using the colon as a keyword separator and a root specifier in the following examples:

VOLT:LEV:IMM 16 Both colons are keyword separators.

:CURR:LEV:IMM 4 The first colon is the root specifier, the other two are keyword separators.

VOLT:LEV 6;:CURR:LEV 15 The second colon is the root specifier, the first and third are keyword separators

:INIT ON;:TRIG;:MEAS:CURR?:VOLT? The first three colons are root specifiers.

3.7.4.8 MESSAGE TERMINATOR

The message terminator defines the end of a message. One message terminator is permitted:

- new line (<NL>), ASCII 10 (decimal) or 0A (hex)

NOTE: Kepco power supplies *require* a message terminator at the end of each program message. The examples shown in this manual assume a message terminator will be added at the end of each message. Where a message terminator is shown it is represented as <NL> regardless of the actual terminator character.

3.7.5 UNDERSTANDING THE COMMAND STRUCTURE

Understanding the command structure requires an understanding of the subsystem command tree illustrated in Figure 3-8. The “root” is located at the top left corner of the diagram. The parser goes to the root if:

- a message terminator is recognized by the parser
- a root specifier is recognized by the parser

Optional keywords are enclosed in brackets [] for identification; optional keywords can be omitted and the power supply will respond as if they were included in the message. The root level keyword [SOURce] is an optional keyword. Starting at the root, there are various branches or paths corresponding to the subsystems. The root keywords for the ATE-DMG Power Supply are :ABORt, :CALibrate, :DISPlay, :INITiate, :LIST, :MEASure, :OUTPut, [:SOURce], :STATus, :SYSTem and :TRIGger. Because the [SOURce] keyword is optional, the parser moves the path to the next level, so that VOLTage, CURRent, and FUNCtion commands are at the root level.

Each time the parser encounters a keyword separator, the parser moves to the next indented level of the tree diagram. As an example, the STATus branch is a root level branch that has three sub-branches: OPERation, PRESet, and QUEStionable. The following illustrates how SCPI code is interpreted by the parser:

STAT:PRES<NL>

The parser returns to the root due to the message terminator.

STAT:OPER?;PRES<NL>

The parser moves one level in from STAT. The next command is expected at the level defined by the colon in front of OPER?. Thus you can combine the following message units STAT:OPER? and STAT:PRES;

STAT:OPER:COND?;ENAB 16<NL>

After the OPER:COND? message unit, the parser moves in one level from OPER, allowing the abbreviated notation for STAT:OPER:ENAB.

3.7.6 PROGRAM MESSAGE SYNTAX SUMMARY

- Common commands begin with an asterisk (*).
- Queries end with a question mark (?).
- Program messages consist of a root keyword and, in some cases, one or more message units separated by a colon (:) followed by a message terminator. Several message units of a program message may be separated by a semicolon (;) without repeating the root keyword.
- If a program message has more than one message unit, then a colon (:) must precede the next keyword in order to set the parser back to the root (otherwise the next keyword will be taken as a subunit of the previous message unit).

e.g., the command `meas:volt?;curr?` will read output voltage and output current since both `volt?` and `curr?` are interpreted as subunits of the `meas` command.

- Several commands may be sent as one message; a line feed terminates the message. Commands sent together are separated by a semicolon (;). The first command in a message starts at the root, therefore a colon (:) at the beginning is not mandatory.

e.g., the command `meas:volt?;:curr?` will read output voltage and programmed current since the colon preceding `curr?` indicates that `curr?` is not part of the `meas` command and starts at the root.

- UPPER case letters in mnemonics are mandatory (short form). Lower case letters may either be omitted, or must be specified completely (long form)
e.g., **INST** (long form) has the same effect as **INST** (short form).
- Commands/queries may be given in upper/lower case (long form)
e.g., **SoURCe** is allowed.
- Text shown between brackets [] is optional.
e.g., **:[SOUR]VOLT:[LEV] TRIG** has the same effect as **:VOLT TRIG**

3.7.7 SCPI PROGRAM EXAMPLES

Refer to Appendix B, Figures B-1 through B-8 for examples illustrating the use of SCPI commands.

Figure 3-10 is an example of a program using SCPI commands to program the ATE-DMG Power Supply. The program illustrated is for a configuration using an IBM PC or compatible with a National Instruments GPIB interface card. (It will be necessary to consult the manufacturer's data to achieve comparable functions with an interface card from a different manufacturer.) This program sets output voltage (Voltage mode) or voltage limit (Current mode) to 5V, and current limit (Voltage mode) or output current (Current mode) to 1A, then reads the measured (actual) voltage and current, then prints the measurements.

```

/*****
/*      Sample Program For KEPCO power supply, using National Instruments      */
/*      GPIB interface card and IBM PC or compatible computer                  */
/*****

#include <stdio.h>
#include "decl.h"

char rd_str[80];           // Input buffer
char dat_str[80];        // Output buffer
int  bd,adr;

main() {
    adr = ibfind("DEV6");           // Open DEV6 (defined by IBCONF)
    bd = ibfind ("GPIB0");         // Open GPIB card
    ibsic (bd);                    // Send Interface Clear
    ibsre(bd,1);                  // Set remote line true

    strcpy(dat_str,"VOLT 5;CURR 1"); // Define a set command
    strcat(dat_str,"\r\n");         // Append delimiter
    ibwrt(adr,dat_str,strlen(dat_str)); // Send string to power supply

    strcpy(dat_str,"MEAS:VOLT?;CURR?"); // Define a measure command
    strcat(dat_str,"\r\n");         // Append delimiter
    ibwrt(adr,dat_str,strlen(dat_str)); // Send string to power supply

    strset(rd_str,'\0');           // Clear input buffer
    ibrd(adr,rd_str,64);           // Read result of measure
    printf("received : %s\n",rd_str); // Print voltage and current
}

```

FIGURE 3-10. TYPICAL EXAMPLE OF ATE-DMG POWER SUPPLY PROGRAM USING SCPI COMMANDS

APPENDIX A - IEEE 488.2 COMMAND/QUERY DEFINITIONS

A.1 INTRODUCTION

This appendix defines the IEEE 488.2 commands and queries used with the ATE Power Supply. These commands and queries are preceded by an asterisk (*) and are defined and explained in Figures A-1 through A-14, arranged in alphabetical order. Table A-1 provides a quick reference of all IEEE 488.2 commands and queries supported in the ATE Power Supply.

TABLE A-1. IEEE 488.2 COMMAND/QUERY INDEX

COMMAND	PAR.	COMMAND	PAR.
*CLS	A.2	*RST	A.11
*ESE, ?	A.3, A.4	*SAV	A.12
*ESR?	A.5	*SRE, ?	A.13, A.14
*IDN?	A.6	*STB?	A.15
*OPC, ?	A.7, A.8	*TRG	A.16
*OPT	A.9	*TST?	A.17
*RCL	A.10		

A.2 *CLS — CLEAR STATUS COMMAND

***CLS**

Syntax: *CLS

Description: **Clears status data.** Clears the error queue of the instrument. It also clears the following registers without affecting the corresponding Enable Registers: Standard Event Status Register (ESR), Operation Status Event Register, Questionable Status Event Register, and Status Byte Register (STB). Related commands: *OPC *OPC?. (See example, Figure A-1.)

A.3 *ESE — STANDARD EVENT STATUS ENABLE COMMAND

***ESE**

Syntax: *ESE <integer> where <integer> = positive whole number: 0 to 255 per Table A-2.
Default Value: 0

Description: **This command programs the standard Event Status Enable register bits.** The contents function as a mask to determine which events of the Event Status Register (ESR) are allowed to set the ESB (Event Summary Bit) of the Status Byte Register. Enables the Standard events to be summarized in the Status Byte register (1 = set = enable function, 0 = reset = disable function). All of the enabled events of the standard Event Status Enable register are logically ORed to cause ESB (bit 5) of the Status Byte Register to be set (1 = set = enable, 0 = reset = disable). (See example, Figure A-1.)

TABLE A-2. STANDARD EVENT STATUS ENABLE REGISTER AND STANDARD EVENT STATUS REGISTER BITS

CONDITION	PON	NU	CME	EXE	DDE	QUE	NU	OPC
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1

PON Power On
 NU (Not Used)
 CME Command Error
 EXE Execution Error
 DDE Device Dependent Error
 QUE Query Error
 OPC Operation Complete

A.4 *ESE? — STANDARD EVENT STATUS ENABLE QUERY *ESE?

Syntax: *ESE? Return value: Integer> value per Table A-2.

Description: **Returns the mask stored in the Standard Event Status Enable Register.** Contents of Standard Event Status Enable register (*ESE) determine which bits of Standard Event Status register (*ESR) are enabled, allowing them to be summarized in the Status Byte register (*STB). All of the enabled events of the Standard Event Status Enable Register are logically ORed to cause ESB (bit 5) of the Status Byte Register to be set (1 = set = enable function, 0 = reset = disable function). (See example, Figure A-1.)

A.5 *ESR? — EVENT STATUS REGISTER QUERY *ESR?

Syntax: *ESR?
Return value: <integer> (Value = contents of Event Status register as defined in Table A-2.)

Description: **Causes the power supply to return the contents of the Standard Event Status register. After it has been read, the register is cleared.** The Standard Event Status register bit configuration is defined in Table A-2 (1 = set, 0 = reset). The error bits listed in Table A-2 are also related to error codes produced during parsing of messages and to errors in the power supply. (See example, Figure A-1.)

A.6 *IDN? — IDENTIFICATION QUERY *IDN?

Syntax: *IDN?
Return value: Character string

Description: **Identifies the instrument.** This query requests identification. The power supply returns a string which contains the manufacturer name, the model, the serial number and the firmware level. The character string contains the following fields: <Manufacturer>, <Model>, <Serial Number>, <Firmware revision> where: <Manufacturer> = KEPCO, <Model> = ATE-VV-AA (V V is Vmax, AA is Imax, e.g. 100-10 or 6-100), <Serial Number> = MM,DD,YY-SSS (MM - month, DD - day, YY - year, SSS - serial number in that day) <Firmware revision>=n.m (n.m revision, e.g, 1.0) (See example, Figure A-1.)

A.7 *OPC — OPERATION COMPLETE COMMAND *OPC

Syntax: *OPC

Description: **Causes power supply to set status bit 0 (Operation Complete) when pending operations are complete** This command sets Standard Event Status Register bit 0 (see Table A-2) to “1” when all previous commands have been executed and changes in output level have been completed. This command does not prevent processing of subsequent commands, but bit 0 will not be set until all pending operations are completed. (1 = set = enable function, 0 = reset = disable function). (See example, Figure A-1.) As an example, the controller sends command(s), then sends *OPC. If controller then sends *ESR?, the power supply responds with either a “0” (if the power supply is busy executing the programmed commands), or a “1” (if the previously programmed commands are complete). (See example, Figure A-1.)

A.8 *OPC? — OPERATION COMPLETE QUERY *OPC?

Syntax: *OPC?
Return value: <1> (ASCII) placed in output queue when power supply has completed operation.

Description: **Indicates when pending operations have been completed.** When all pending operations are complete (all previous commands have been executed and changes in output level have been completed) a “1” is placed in the Output Queue. Subsequent commands are inhibited until the pending operations are completed. *OPC? is intended to be used at the end of a command line so that the application program can monitor the bus for data until it receives the “1” from the power supply Output Queue. (See example, Figure A-1.)

A.9 *OPT? — OPTIONS QUERY

***OPT?**

Syntax: *OPT?
Returns string determined by power supply model.

Description: **Causes the power supply to return an ASCII string which defines the functionality of the power supply.** The functionality is defined as follows:

STRING DATA	MEANING
CAL	Support for CALibrate command is present.
RL3	Hardware switch controlling remote/local is functional. Unit can be used to take measurements in local mode, but all other functions require the unit to be in remote mode (REN must be asserted).
MEM	Indicates the number of memory steps supported.
DSM	Indicates the number of characters supported for user messages on LCD.
LST	Indicates LIST command is equivalent to *SAV.

A.10 *RCL — RECALL COMMAND

***RCL**

Syntax: *RCL <integer> (1 to 40)

Description: **Restores power supply to previously defined levels of output voltage, output current, overvoltage protection, and overcurrent protection.** This command selects one of the 40 power supply memory locations, each of which stores values for output current, output voltage, overvoltage protection, and overcurrent protection. The following parameters are affected by *RCL: CURR[:LEV][:IMM] VOLT[:LEV][:IMM] CURR:PROT[:LEV] VOLT:PROT[:LEV]. The recall function also sets the unit to operating parameters to SCPI compatible mode, or device clear operation and output on or off. If the recall value was not initialized by the *SAV command, but from an edit save or front panel save, the output condition will remain unchanged along with the language preferences. (See example, Figure A-1.)

A.11 *RST — RESET COMMAND

***RST**

Syntax: *RST

Description: **Resets power supply to the power on default state.** The power supply is programmed to the power on values of the following parameters: CURR[:LEV][:IMM] = 0, VOLT[:LEV][:IMM] = 0, CURR:PROT[:LEV] = max overcurrent value (see Table 1-2), VOLT:PROT[:LEV] = (maximum overvoltage value (see Table 1-2), OUTP[:STAT] = OFF. If the power supply is in either an overvoltage or overcurrent state, this condition is reset by *RST. (See example, Figure A-1.)

A.12 *SAV — SAVE COMMAND

***SAV**

Syntax: *SAV <integer> (1 to 40)

Description: **Saves the present state of output voltage, output current, overvoltage and overcurrent to the specified memory location.** This command stores the present state of the power supply to one of 40 memory locations. The following parameters are stored by *SAV: CURR[:LEV][:IMM], VOLT[:LEV][:IMM], CURR:PROT[:LEV], and VOLT:PROT[:LEV]. The *SAV command also saves the language status and output on/off state. The stored values can be restored by the *RCL command. (See example, Figure A-1.)

*CLS	Power supply clears status data.
*ESE 60	Power supply enables bits 5, 4, 3 and 2, allowing command error, execution error, device dependent error and query error to set the Event Status Summary bit when an STB command is executed.
*ESE?	Returns 60, (value of the mask) verifying that bits 5, 4, 3 and 2 are enabled.
*ES	Unknown command will set command error (Bit 5).
*ESR?	Returns 32 (bit 5 set), indicating Command Error has occurred since the last time the register was read.
*IDN?	Power supply returns: KEPCO,ATE-100-10, 082495-001, 1.0.
*OPC	Allows status bit 0 to be set when pending operations complete
VOLT 21;CURR 3	Sets output voltage to 21V, output current to 3A
*SAV33	The present state of the power supply is stored in memory location 33.
*ESR?	Returns 129 (128 + 1, power on, bit 7 = 1, operation complete, bit 1 = 1)
*ESR?	Returns 0 (event status register cleared by prior *ESR?)
VOLT 15;CURR 5;*OPC?	Sets output voltage to 15V, output current to 5A, puts "1" on output bus when command operations are complete.
*RCL33	Values in memory location 33 recalled (21V, 3A).
*RST	Power supply reset to power on default state.
*SRE 40	When ESB or QUES bits are set (Table A-3), the Request for Service bit will be set.
*SRE?	Returns the value of the mask (40).
*STB?	For example, the Power supply responds with 96 (64 + 32) if MSS and the Event Status Byte (Table A-3) summary bit have been set. The power supply returns 00 if no bits have been set.
VOLT 25	Power supply voltage commanded to 25V.
VOLT:TRIG 12	Programs power supply voltage to 12V when *TRG received.
INIT	Trigger event is initialized.
*TRG	Power supply reverts to commanded output voltage of 12V.
*TST?	Power supply executes self test and responds with 0 if test completed successfully, with 1 if test failed.

FIGURE A-1. GPIB COMMANDS

A.13 *SRE — SERVICE REQUEST ENABLE COMMAND

***SRE**

Syntax: *SRE<integer> where <integer> = value from 0 - 255 per Table A-3, except bit 6 cannot be programmed.

Description: **Sets the condition of the Service Request Enable register.** The Service Request Enable register determines which events of the Status Byte Register are summed into the MSS (Master Status Summary) and RQS (Request for Service) bits. RQS is the service request bit that is cleared by a serial poll, while MSS is not cleared when read. A "1" (1 = set = enable, 0 = reset = disable) in any Service Request Enable register bit position enables the corresponding Status Byte bit to set the RQS and MSS bits. All the enabled Service Request Enable register bits then are logically ORed to cause Bit 6 of the Status Byte Register (MSS/RQS) to be set. Related Commands: *SRE?, *STB?. (See example, Figure A-1.)

TABLE A-3. SERVICE REQUEST ENABLE AND STATUS BYTE REGISTER BITS

CONDITION	OPER	MSS RQS	ESB	MAV	QUES	ERR QUE	NU	NU
BIT	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1

OPER Operation Status Summary
MSS Master Status Summary
RQS Request for Service
ESB Event Status Byte summary
MAV Message available
QUES QUEStionable Status Summary
ERR QUE 1 or more errors occurred (see
PAR. B.84)
NU (Not Used)

A.14 *SRE? — SERVICE REQUEST ENABLE QUERY

***SRE?**

Syntax: *SRE? Response: <integer> = value from 0 - 255 per Table A-3.

Description: **Reads the Service Enable Register.** Used to determine which events of the Status Byte Register are programmed to cause the power supply to generate a service request (1 = set = function enabled, 0 = reset = function disabled). Related Commands: *SRE, *STB? (See example, Figure A-1.)

A.15 *STB? — STATUS BYTE REGISTER QUERY

***STB?**

Syntax: *STB? Response: <integer> value from 0 to 255 per Table A-3.

Description: **Reads Status Byte Register without clearing it.** This Query reads the Status Byte Register (bit 6 = MSS) without clearing it (1 = set = function enabled, 0 = reset = function disabled). The register is cleared only when subsequent action clears all set bits. MSS is set when the power supply has one ore more reasons for requesting service. (A serial poll also reads the Status Byte Register, except that bit 6 = RQS, not MSS; and RQS will be reset.) Related Commands: *SRE, *SRE?. (See example, Figure A-1.)

A.16 *TRG — TRIGGER COMMAND

***TRG**

Syntax: *TRG

Description: **Triggers the power supply to be commanded to preprogrammed values of output current and voltage.** When the trigger is armed (checked by examining WTG bit in Status Operational Condition register) *TRG generates a trigger signal. The trigger will change the output of the power supply to the output voltage and current levels specified by VOLT:TRIG and CURR:TRIG commands and clear the WTG bit in the Status Operation Condition register. If INIT:CONT has been issued, the trigger subsystem is immediately rearmed for subsequent triggers, and the WTG bit is again set to 1. *TRG or GET are both addressed commands (only devices selected as listeners will execute the command). Related Commands: ABOR, INIT, TRIG, CURR:TRIG, VOLT:TRIG. (See example, Figure A-1.)

A.17 *TST? — SELF TEST QUERY

***TST?**

Syntax: *TST? Returned value: 0 or 1 (0 = pass test, 1 = fail test)

Description: **Power Supply test.** This query causes the power supply to do a self test and provide the controller with pass/fail results. A cyclic redundancy check (CRC) is performed on non-volatile RAM. A "1" is returned if there is an error.

APPENDIX B - SCPI COMMAND/QUERY DEFINITIONS

B.1 INTRODUCTION This appendix defines the SCPI subsystem commands and queries used with the ATE Power Supply. Subsystem commands are defined in PAR. B.2 through B.96, arranged in groups as they appear in the tree diagram, Figure 3-7. Table B-1 provides a quick reference of all SCPI subsystem commands and queries used in the Interface Card.

TABLE B-1. SCPI SUBSYSTEM COMMAND/QUERY INDEX

COMMAND	PAR.	COMMAND	PAR.
ABORT	B.2	READ:VOLT?	B.49
CAL:VOLT:GAIN	B.3	[SOUR:]CURR[:LEV][:IMM][:AMP], ?	B.50, B.51
CAL:CURR[:DATA]	B.4	[SOUR:]CURR:LIM:HIGH, ?	B.52, B.53
CAL:PASS, ?	B.5	[SOUR:]CURR:PROT[:LEV], ?	B.56, B.57
CAL:CURR:GAIN	B.6	[SOUR:]CURR:PROT:CLE	B.58
CAL:STAT, ?	B.7, B.8	[SOUR:]CURR:PROT:TRIP	B.59
CAL:VOLT:LEV	B.9	[SOUR:]CURR[:LEV]:TRIG[:AMP], ?	B.60, B.61
CAL:VOLT[:DATA]	B.10	[SOUR:]VOLT[:LEV][:IMM][:AMP], ?	B.62, B.63
CAL:ZERO	B.11	[SOUR:]VOLT[:LEV]:TRIG[:AMP]?	B.64, B.65
DIAG:EXT, ?	B.12, B.13	[SOUR:]VOLT:LIM:HIGH, ?	B.66, B.67
DISP:CONT, ?	B.14, B.15	[SOUR:]VOLT:PROT:LEV, ?	B.70, B.71
DISP:MODE, ?	B.16, B.17	[SOUR:]VOLT:PROT:CLE	B.72
DISP:TEXT, ?	B.18, B.19	[SOUR:]VOLT:PROT:TRIP?	B.73
INIT[:IMM]	B.20	[SOUR:]FUNC:MODE?	B.74
INIT:CONT, ?	B.21, B.22	STAT:OPER:COND?	B.75
INST:STAT	B.23	STAT:OPER:ENAB, ?	B.76, B.77
[SOUR:]LIST:CURR, ?	B.24, B.25	STAT:OPER[:EVENT]?	B.78
[SOUR:]LIST:CURR:PROT, ?	B.26, B.27	STAT:PRES	B.79
[SOUR:]LIST:DWELL, ?	B.28, B.29	STAT:QUES[:EVENT]?	B.80
[SOUR:]LIST:IND, ?	B.30, B.31	STAT:QUES:COND?	B.81
[SOUR:]LIST:SEQ:NEXT, ?	B.32, B.33	STAT:QUES:ENAB, ?	B.82, B.83
[SOUR:]LIST:SEQ:START, ?	B.34, B.35	SYST:ERR?	B.84
[SOUR:]LIST:VOLT, ?	B.36, B.37	SYST:ERR:CODE?	B.85, B.86
[SOUR:]LIST:VOLT:PROT, ?	B.38, B.39	SYST:KLOCK, ?	B.87, B.88
MEAS:CURR?	B.40	SYST:LANG, ?	B.89, B.90
MEAS:VOLT?	B.41	SYST:PASS CEN, DIS	B.91, B.92
OUTP[:STAT], ?	B.42, B.43	SYST:PASS:STAT	B.93
OUTP:PROT:DEL, ?	B.44, B.45	SYST:SEC	B.94
PROG:STAT, ?	B.46, B.47	SYST:SET	B.95
READ:CURR?	B.48	SYST:VERS?	B.96

B.2 ABORt COMMAND

ABOR

Syntax: Short Form: ABOR Long Form: ABORt

Description: **Cancels previously stored trigger levels, resets WTG.** The ABORt command cancels any pending trigger levels previously stored by the CURR:TRIG or VOLT:TRIG commands. The pending level is set equal to the corresponding immediate value. ABORt also resets the WTG (Wait TriGger) bit in the Operation Condition status register. If INIT:CONT ON has been programmed, the trigger system re-arms itself immediately after ABORt, thereby setting WTG. WTG is bit 5 in the STATUS OPERATION CONDITION register. The ABORt is executed each time power is turned on. Related Commands: INIT, *RST, *TRG. (See example, Figure B-1.)

NOTE: Power supply assumed to be operating in constant voltage mode.

OUTP ON	Output enabled.
OUTP?	Power supply returns "1" (output enabled).
VOLT 21; CURR 1.5	Power supply output programmed to go to 21V, current limit 1.5A
INIT:CONT ON	Continuous triggers enabled.
INIT:CONT?	Power supply returns "1."
VOLT:TRIG 15;CURR:TRIG 3	Power supply output programmed to return to 15V, current limit 3A upon receipt of trigger.
*TRG	Power supply output returns to 15V,current limit 3A.
VOLT 21; CURR 5E-2	Power supply output programmed to go to 21V, current limit 0.05A
MEAS:VOLT?	If actual value of output voltage is 20.9V, power supply returns 2.09E+1.
MEAS:CURR?	If actual value of output current is 0.0483A, power supply returns 4.83E-2.
FUNC:MODE?	Returns VOLT if power supply operating in constant voltage mode, CURR for constant current mode.
CURR:TRIG?	Returns 3 (current value established by CURR:TRIG.
VOLT:TRIG?	Returns 15 (voltage value established by VOLT:TRIG.
ABOR	Pending trigger levels changed to 21V, 0.05A (immediate values)
VOLT 17; CURR 2	Power supply output programmed to go to 17V, 2A.
*TRG	Power supply output returns to 21V, current limit 0.05A.
INIT:CONT 0	Triggers disabled.
INIT:CONT?	Power supply returns "0."
OUTP OFF	Output disabled.
OUTP?	Returns 0 (output disabled).
MEAS:VOLT?	Returns 0. (measured output voltage).
VOLT?	Returns 17.(programmed output voltage)/
CURR?	Returns 1.5 (programmed current)
CURR? MAX	Returns 10 (assuming maximum allowable current for power supply being addressed is 10A, i.e. ATE 100-10DMG).
CURR? MIN	Returns 0 (minimum allowable current).
CURR:PROT 2.6	Current protection set to 2.6A.
CURR?	Returns 1.5, indicating programmed current value = 1.5A.
CURR:PROT?	Returns 2.6 , indicating programmed overcurrent protection current value = 2.6A.
CURR:PROT? MAX	For ATE 100-10DMG, returns 11A (see Table 1-2).
SYST:VERS?	Returns 2003.0.

FIGURE B-1. PROGRAMMING THE OUTPUT

B.3 CALibrate:CURRent:LEVel COMMAND

CAL:CURR:LEV

Syntax: Short Form: CAL:CURR:LEV {MIN | MAX} Long Form: CALibrate:CURRent:LEVel {MIN | MAX}

Description: **Selects Current calibration, only effective with power supply in Calibrate status.**
CAL:CURR:LEV MIN selects Current Zero Calibration. CAL:CURR:LEV MAX selects Current Full Scale Calibration. Normally Current Zero is done first, then Current Full Scale Calibration. Related Commands: CAL:STAT, CAL:PASS, CAL:VOLT, CAL:CURR, CAL:ZERO, CAL:SAVE. (See example, Figure B-2.)

B.4 CALibrate:CURRent[:DATA] COMMAND

CAL:CURR

Syntax: Short Form: CAL:CURR[:DATA] {0 | 1 | 2 | 3} Long Form: CALibrate:CURRent[:DATA] {0 | 1 | 2 | 3}

Description: **Increases or decreases output current during calibration only.** CAL:CURR[:DATA] 0 decreases output current by small increment. CAL:CURR[:DATA] 1 increases output current by small increment. CAL:CURR[:DATA] 2 decreases output current by large increment. CAL:CURR[:DATA] 3 increases output current by large increment. This command is used during current calibration to adjust the output current for current zero calibration as well as full scale current calibration. Output current is monitored on a calibrated digital multimeter (reading voltage at the sense terminals of the shunt resistor) and increased or decreased as required using this command. This command is only effective if Calibration status and either Current Zero or Current Full Scale calibration are active. This command is equivalent to the on the front panel left and right arrow keys for fine adjustment and the 1 and 3 keys for coarse adjustment. Related Commands: CAL:STAT, CAL:PASS, CAL:VOLT, CAL:CURR, CAL:ZERO, CAL:SAVE. (See example, Figure B-2.)

SYST:PASS:CEN:1234	Sets Password Enable state.
CAL:STAT ON	Power supply enters Calibrate status.
CAL:STAT?	Returns 00 indicating power supply in Calibrate status.
CAL:VOLT:LEV MIN	Voltage Zero Calibration selected.
CAL:VOLT 1	Output voltage increased
CAL:VOLT:LEV MAX	Voltage Full Scale Calibration selected, voltage zero values stored in volatile memory
CAL:VOLT 0	Output voltage decreased.
CAL:ZERO	Output voltage and current set to zero. Voltage maximum and values established; analog to digital conversion values read calculations performed. Voltage and current output set to zero.
---	* User connects shunt and connects DVM to it.
CAL:CURR:LEV MIN	Current Zero Calibration selected.
CAL:CURR 1	Output current increased
CAL:CURR:LEV MAX	Current Full Scale Calibration selected, current zero values stored in volatile memory
CAL:CURR 0	Output current decreased.
CAL:SAVE	Calibration values saved. current maximum values calculated based on power supply settings an measurements. The non-volatile current calibration constants are moved to area of non-volatile memory reserved for previous calibration data. New volatile constants are stored in memory.
CAL:STAT 0	Power supply exits Calibrate mode.
CAL:STAT?	Returns 0 indicating power supply not in Calibrate status

FIGURE B-2. USING CALIBRATION COMMANDS AND QUERIES

B.5 CALibrate:PASSword COMMAND

CAL:PASS

Syntax: Short Form: CAL:PASS new_password (new_password is 4 digits)
Long Form: CALibrate:PASSword new_password (new_password is 4 digits)

Description: **Changes the password used to put the power supply in Calibrate status.** To execute this command, the power supply must be in Calibrate status (see CAL:STAT).
password = 4 digits, required to enter Calibrate status. Related Commands: CAL:PASS, CAL:VOLT, CAL:CURR, CAL:ZERO, CAL:SAVE. (See example, Figure B-2.)

B.6 CALibrate:SAVE COMMAND

CAL:SAVE

Syntax: Short Form: CAL:SAVE Long Form: CALibrate:SAVE

Description: **Saves computed calibration values in non-volatile memory.** The Analog to Digital (A/D) converter is read to establish the final values of the calibration state. For example, if VOLT:MAX was the last calibration state, the voltage A/D converter is read and the volts per step multiplier is calculated. The voltage per step for the voltage Digital to Analog (D/A) converter is also calculated and the non-volatile memory is updated from the volatile calibration constants. Previous values are not lost, and can be restored using Local mode (see Service Manual applicable to specific model). This command should be the last command before exiting Calibrate status. CAL:STAT, CAL:PASS, CAL:VOLT, CAL:CURR, CAL:ZERO, CAL:SAVE. (See example, Figure B-2.)

B.7 CALibrate:STATus COMMAND

CAL:STAT

Syntax: Short Form: CAL:STAT <boolean>[,password]
Long Form: CALibrate:STATus <boolean>[,password]
where boolean = 0 or OFF, 1 or ON, password = 4 digits, required if <boolean = 1 or ON>

Description: **Sets the power supply to Calibrate status.** <boolean> 1 or ON causes power supply to enter Calibrate status. <boolean> 0 or OFF causes power supply to exit Calibrate status. Upon entering Calibrate status the current calibration constants are stored in the volatile memory. If the state is 0, the non-volatile calibration constants are supplied to the ASC working calibration.
password = 4 digits, required to enter Calibrate status. If the wrong password is entered, error message -224 is posted to the queue. Related Commands: CAL:PASS, CAL:VOLT, CAL:CURR, CAL:ZERO, CAL:SAVE. (See example, Figure B-2.)

B.8 CALibrate:STATus? QUERY

CAL:STAT?

Syntax: Short Form: CAL:STAT? Long Form: CALibrate:STATus?
Return Value: <boolean> (boolean = 0 or OFF, 1 or ON)

Description: **Identifies whether the power supply is in Calibrate status.** 1 indicates power supply is in Calibrate status. 0 indicates power supply is not in Calibrate status. (See example, Figure B-2.)

B.9 CALibrate:VOLTage:LEVel COMMAND

CAL:VOLT:LEV

Syntax: Short Form: CAL:VOLT:LEV {MIN | MAX} Long Form: CALibrate:VOLTage:LEVel {MIN | MAX}

Description: **Selects Voltage calibration, only effective with power supply in Calibrate status.**
CAL:VOLT:LEV MIN selects Voltage Zero Calibration. CAL:VOLT:LEV MAX selects Voltage Full Scale Calibration. Normally Voltage Zero is done first, then Voltage Full Scale Calibration. CAL:VOLT:MAX causes the maximum value to be read and saved in the working calibration table at the end of the calibration sequence. The power supply then raises the output level to maximum and waits for CAL:VOLT[:DATA] commands. Related Commands: CAL:STAT, CAL:PASS, CAL:VOLT, CAL:CURR, CAL:ZERO, CAL:SAVE. (See example, Figure B-2.)

B.10 CALibrate:VOLTage[:DATA] COMMAND

CAL:VOLT

Syntax: Short Form: CAL:VOLT[:DATA] {0 | 1 | 2 | 3} Long Form: CALibrate:VOLTage[:DATA] {0 | 1 | 2 | 3}

Description: **Increases or decreases output voltage during calibration only.**

CAL:VOLT[:DATA] 0 decreases output voltage by small increment. CAL:VOLT[:DATA] 1 increases output voltage by small increment. CAL:VOLT[:DATA] 2 decreases output voltage by large increment. CAL:VOLT[:DATA] 3 increases output voltage by large increment. This command is used during voltage calibration to adjust the output voltage for voltage zero calibration as well as full scale voltage calibration. Output voltage is monitored on a calibrated digital multimeter and increased or decreased as required using this command. This command is only effective if Calibration status and either Voltage Zero or Voltage Full Scale calibration are active. This command is equivalent to the front panel left and right arrow keys for fine adjustment and the 1 and 3 keys for coarse adjustment. Related Commands: CAL:STAT, CAL:PASS, CAL:VOLT, CAL:CURR, CAL:ZERO, CAL:SAVE. (See example, Figure B-2.)

B.11 CALibrate:ZERO COMMAND

CAL:ZERO

Syntax: Short Form: CAL:ZERO Long Form: CALibrate:ZERO

Description: Sets output to zero while calibration equipment connections are changed. This command is used when changing from Voltage to Current calibration or vice-versa. CAL:ZERO sets output voltage and current to zero. The user then connects or disconnects the shunt resistor or the digital voltmeter from the output terminals of the power supply as required for the subsequent Voltage or Current calibration. The next command should select the new parameter to be calibrated. Related Commands: CAL:STAT, CAL:VOLT, CAL:CURR, CAL:SAVE. (See example, Figure B-2.)

B.12 DIAG:EXT COMMAND

DIAG:EXT

Syntax: Short Form: DIAG:EXT <value>
Long Form: DIAG:EXT <value>
where <value> xx_{HEX}

Description: **DIAG:EXT 01 initializes external analog control and 03 sets VOLT:MODE and CURR:MODE to EXTERNAL DIAG:EXT 00 turns off the external analog control feature).** Setting is stored in NVRAM and retained upon subsequent power up.

B.13 DIAG:EXT? QUERY

DIAG:EXT?

Syntax: Short Form: DIAG:EXT?
Long Form: DIAG:EXT]?
Return Value: 00_{HEX}, 01_{HEX} or 03_{HEX}

Description: **Returns 00 when external analog control feature is disabled. Returns 01 when external analog control feature is enabled. Returns 03 when external analog control feature is enabled upon power up.**

B.14 DISPlay:CONTRast COMMAND

DISP:CONT

Syntax: Short Form: DISP:CONT <num_value> (0 to 1)
Long Form: DISPlay:CONTRast <num_value> (0.0 to 1.0)

Description: **Sets the contrast of the front panel LCD.** The contrast value from (0.1 to 0.9) is stored in the non-volatile memory and is retained when the power supply is turned off. A contrast value of 0 is best when looking up at the display, 1 is best when looking down at the display. Values in between provide adjustment for optimum viewing. Setting the values to 0.1 or 0.9 are not reported back and are rounded to 0 or 1 respectively. Related Commands: DISP:CONT?. (See example, Figure B-3.)

DISP:CONT 0.9	Sets LCD contrast value to 0.9.
DISP:CONT?	Returns 0.9.
DISP:MODE NORM	Changes LCD to Normal metering mode.
DISP:MODE?	Returns NORMAL.
DISP:MODE TEXT	Changes LCD to Text mode.
DISP:TEXT "***ATE IS IN USE"	Second line of display reads **ATE IS IN USE.
DISP:MODE?	Returns "TEXT"
DISP:TEXT?	Returns "***ATE IS IN USE"

FIGURE B-3. USING DISPLAY COMMANDS

B.15 DISPlay:CONTRast? QUERY

DISP:CONT?

Syntax: Short Form: DISP:CONT? Long Form: DISPlay:CONTRast?
Return Value: Numerical value from 0 to 1 indicating contrast setting.

Description: **Identifies LCD contrast setting.** Returns 0 if LCD is at minimum setting, 1 if at maximum setting, and returns values between 0.2 through 0.8 for other contrast settings. Related Commands: DISP:CONT. (See example, Figure B-3.)

B.16 DISPlay:MODE COMMAND

DISP:MODE

Syntax: Short Form: DISP:MODE NORM or DISP:MODE TEXT
Long Form: DISPlay:MODE NORMAl or DISPlay:MODE TEXT

Description: **Switches the LCD display between Normal and Text mode.** Switches the display between its normal metering mode and a mode in which it displays text sent by the user on the second line. The default status at power up or after *RST is NORMAl. In order to display text on the second line the display mode has to be changed to TEXT. Related Commands: DISP:MODE?, DISP:TEXT, DISP:TEXT?, *RST. (See example, Figure B-3.)

B.17 DISPlay:MODE? QUERY

DISP:MODE?

Syntax: Short Form: DISP:MODE? Long Form: DISPlay:MODE?
Return Value: NORMAL or TEXT.

Description: **Identifies the LCD mode.** Returns NORMAL when the display is in normal mode, TEXT when the display is in text mode. Related Commands: DISP:MODE, DISP:TEXT, *RST. (See example, Figure B-3.)

B.18 DISPlay:TEXT COMMAND

DISP:TEXT

Syntax: Short Form: DISP:TEXT[:DATA] <char_string> Long Form: DISPlay:TEXT [:DATA] <char_string>

Description: **Allows entry of character string to be viewed when LCD display is set to Text mode.** Allows for character strings of maximum 16 characters to be displayed (on the second line of the LCD) when the display mode is TEXT, e.g., DO NOT TOUCH or ATE IS IN USE, etc. The LCD has the following character set: A to Z, 0 to 9 and special characters as < > + - / = : ... If the message exceeds the display capacity only the first 16 characters will be displayed and no error message will be generated. Upon executing *RST, character string set to 16 spaces: " ". Related Commands: DISP:TEXT?, DISP:MODE, DISP:MODE?, *RST. (See example, Figure B-3.)

B.19 DISPlay:TEXT? QUERY

DISP:TEXT?

Syntax: Short Form: DISP:TEXT? Long Form: DISPlay:TEXT]?
Return Value: Character string displayed on second line of LCD display.

Description: **Returns the text displayed on second line of LCD in TEXT mode.** When the display set to TEXT mode, returns the character string entered by DISP:TEXT. If the display set to NORMAL mode, returns information displayed on second line of display. (This can be used to see the monitored values presently being displayed on the second line of the LCD.) Related Commands: DISP:MODE, DISP:TEXT, *RST. (See example, Figure B-3.)

B.20 INITiate[:IMMEDIATE] COMMAND

INIT[:IMM]

Syntax: Short Form: INIT[:IMM] Long Form: INITiate[:IMMEDIATE]

Description: **Enables a single trigger.** If INIT:CONT is OFF, then INIT[:IMM] arms the trigger system for a single trigger. If INIT:CONT is ON, then the trigger system is continuously armed and INIT[:IMM] is redundant. This command enables a single trigger. A GPIB <GET>, *TRG or command completes the sequence. Upon receipt of the <GET> or *TRG command, the power supply will return to the programmed values of voltage and current established by the VOLT:TRIG and CURR:TRIG commands. After a GPIB <GET> or *TRG command has been received, subsequent GPIB <GET>, *TRG commands have no effect unless preceded by INIT or INIT:CONT ON. Related Commands: <GET>, *RST, *TRG. (See example, Figure B-1.)

B.21 INITiate:CONTINUOUS COMMAND

INIT:CONT

Syntax: Short Form: INIT:CONT {ON | OFF} or {1 | 0} (1 = on, 0 = off)
Long Form: INITiate:CONTinuous {ON | OFF} or {1 | 0} (1 = on, 0 = off)

Description: **INIT:CONT ON enables continuous triggers.; INIT:CONT OFF disables continuous triggers.** If INIT:CONT is OFF, then INIT[:IMM] arms the trigger system for a single trigger. If INIT:CONT is ON, then the trigger system is continuously armed and INIT[:IMM] is redundant. Executing *RST command sets INIT:CONT to OFF. (See example, Figure B-1.)

B.22 INITiate:CONTINUOUS QUERY

INIT:CONT?

Syntax: Short Form: INIT:CONT? Long Form: INITiate:CONTinuous?
Return Value: 1 or 0

Description: **Determines whether continuous triggers are enabled or disabled.** Power supply returns value of INIT:CONT flag: "1" = continuous triggers are enabled (INIT:CONT ON); "0" = continuous triggers disabled (INIT:CONT OFF). (See example, Figure B-1.)

B.23 INSTRument:STATe COMMAND

INST:STAT

Syntax: Short Form: INST:STAT <val> Long Form: INSTRument:STATe <val>

Description: Operation is identical to OUTPut:STATe command (PAR. B.42) and is provided for compatibility with other vendors products.

B.24 LIST:CURRent COMMAND

LIST:CURR

Syntax: Short Form: LIST:CURR[:LEV] <exp_value> Long Form: LIST:CURRent[:LEVel] <exp_value>
<exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets the current (Amps) value for the memory location selected by LIST:IND.** If the value is out of the acceptable current range for the power supply model, an error message: -222,"Data out of range" is posted in the output queue. The current value is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:IND. LIST:IND?, LIST:CURR?. (See example, Figure B-4.)

B.25 [SOUR:]LIST:CURRent? QUERY

LIST:CURR?

Syntax: Short Form: LIST:CURR[:LEV]? Long Form: LIST:CURRent[:LEVel]?
Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns current value (Amps) stored in indexed memory location selected by LIST:IND.** Related Commands: LIST:IND. LIST:IND?, LIST:CURR. (See example, Figure B-4.)

B.26 [SOUR:]LIST:CURREnt:PROtect COMMAND

LIST:CURREnt:PROT

Syntax: Short Form: LIST:CURREnt:PROT<num_value> Long Form: LIST:CURREnt:PROtect <num_value>
<num_value> = digits with decimal point and Exponent

Description: **Sets the current protection (Amps) value for the memory location selected by LIST:IND.** If the value is out of the acceptable current range for the power supply model, an error message: -222, "Data out of range" is posted in the output queue. The current value is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:IND. LIST:IND?, LIST:CURREnt:PROT?. (See example, Figure B-4.)

LIST:IND 21	Selects memory location 21.
LIST:IND?	Returns 21.
LIST:CURREnt:PROT 2.35E-1	Sets output current value of memory location 21 to 0.235A.
LIST:CURREnt:PROT?	Returns 2.35E-1.
LIST:CURREnt:PROT 0.67E+1	Sets current protection value of memory location 21 to 6.7A.
LIST:CURREnt:PROT?	Returns 0.67E+1.
LIST:VOLT:PROT 2.77E+1	Sets voltage protection value of memory location 21 to 27.7V.
LIST:VOLT:PROT?	Returns 2.77E+1.
LIST:DWEL 0.6	Sets memory location 21 time value to 0.6 second. During program execution, after parameters specified by memory location 21 have been applied for 0.6 second, power supply will switch to parameters specified by memory location 21 sequence number.
LIST:SEQ:NEXT 39	Sets memory location sequence number to 39. During program execution, when memory location 21 is complete, the next location to be executed will be 39.
LIST:SEQ:NEXT?	Returns 39.
LIST:IND 22	Selects memory location 22.
LIST:IND?	Returns 22.
LIST:VOLT 1.256E+2	Sets output voltage value of memory location 22 to 125.6V.
LIST:VOLT?	Returns 1.256E+2.
LIST:SEQ:STAR 21	Sets memory location 21 as the starting location for executing a program.
LIST:SEQ:STAR?	Returns 21.

FIGURE B-4. USING LIST COMMANDS AND QUERIES

B.27 [SOUR:]LIST:CURREnt:PROtect? QUERY

LIST:CURREnt:PROT?

Syntax: Short Form: LIST:CURREnt[:LEV]? Long Form: LIST:CURREnt[:LEVel]?
Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns current protection value (Amps) stored in indexed memory location selected by LIST:IND.** Related Commands: LIST:IND. LIST:IND?, LIST:CURREnt. (See example, Figure B-4.)

B.28 [SOUR:]LIST:DWELI COMMAND

LIST:DWEL

Syntax: Short Form: LIST:DWEL <value> (0.01 to 300) Long Form: LIST:DWELI <value> (0.01 to 300)

Description: **Determines the execution time duration during a programmed sequence for the memory location selected by LIST:IND.** Sets time value (from 0.01 to 300) in seconds for memory location selected by LIST:IND. A value of 0 means that this memory location will be skipped during the RUN command (LOCAL mode). The time value is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:IND. LIST:IND?, LIST:DWEL?, LIST:SEQ. (See example, Figure B-4.)

B.29 [SOUR:]LIST:DWELI? QUERY**LIST:DWEL?**

Syntax: Short Form: LIST:DWEL? Long Form: LIST:DWELI?
Return Value: <value> (0.01 to 300)

B.30 [SOUR:]LIST:INDEX COMMAND**LIST:IND**

Syntax: Short Form: LIST:IND <int_value> (from 1 to 40) Long Form: LIST:INDEX <int_value> (from 1 to 40)

Description: **Selects one 40 memory locations for viewing or modification of parameter selected by subsequent LIST:CURR, LIST:CURR:PROT, LIST:VOLT, LIST:VOLT:PROT commands or queries.** The index value (the selected memory location) is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:IND?. (See example, Figure B-4.)

B.31 [SOUR:]LIST:INDEX? QUERY**LIST:IND?**

Syntax: Short Form: LIST:IND? Long Form: LIST:INDEX?
Return Value: <int_value> 1 to 40

Description: **Returns index value.** Identifies which one 40 memory locations has been selected for viewing or modification by subsequent LIST:CURR, LIST:CURR:PROT, LIST:VOLT, LIST:VOLT:PROT commands or queries. Related Commands: LIST:IND?. (See example, Figure B-4.)

B.32 [SOUR:]LIST:SEQUENCE:NEXT COMMAND**LIST:SEQ:NEXT**

Syntax: Short Form: LIST:SEQ:NEXT <int_value> (0 to 40)
Long Form: LIST:SEQUENCE:NEXT <int_value> (0 to 40)

Description: **Determines the next memory location to be addressed during a programmed sequence.** Sets sequence number (from 1 to 40) of next memory location to be addressed. Sequence number is set for memory location selected by LIST:IND. Setting sequence number to 0 indicates the end of the program chain, and the programmed sequence will stop. The sequence number is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:IND, LIST:IND?, LIST:SEQ?. (See example, Figure B-4.)

B.33 [SOUR:]LIST:SEQUENCE:NEXT? QUERY**LIST:SEQ:NEXT?**

Syntax: Short Form: LIST:SEQ:NEXT? Long Form: LIST:SEQUENCE:NEXT?
Return Value: <int_value> (0 to 40)

Description: **Returns sequence number stored in memory location selected by LIST:IND.** Related Commands: LIST:IND, LIST:IND?, LIST:SEQ. (See example, Figure B-4.)

B.34 [SOUR:]LIST:SEQUENCE:START COMMAND**LIST:SEQ:STAR**

Syntax: Short Form: LIST:SEQ:STAR <int_value> (1 to 40)
Long Form: LIST:SEQUENCE:START <int_value> (1 to 40)

Description: **Determines the first memory location (start of sequence) to be addressed during a programmed sequence.** Sets memory location (from 1 to 40) of first memory location to be addressed when a program (chain of memory locations) is executed. This is the start address for the STEP and RUN commands (LOCAL mode). The starting sequence number is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:SEQ:STAR?. (See example, Figure B-4.)

B.35 [SOUR:]LIST:SEQUENCE:START? QUERY**LIST:SEQ:STAR?**

Syntax: Short Form: LIST:SEQ:STAR? Long Form: LIST:SEQUENCE:START?
Return Value: <int_value> between 1 and 40

Description: **Identifies the starting address for program execution.** Returns the starting sequence location set by LIST:SEQ:STAR command. Related Commands: LIST:SEQ:STAR. (See example, Figure B-4.)

B.36 [SOUR:]LIST:VOLTage COMMAND

LIST:VOLT

Syntax: Short Form: LIST:VOLT[:LEV] <exp_value> Long Form: LIST:VOLTage[:LEVel] <exp_value>
<exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets the voltage value for the memory location selected by LIST:IND.** If the value is out of the acceptable voltage range for the power supply model, an error message: -222,"Data out of range" is posted in the output queue. The voltage value is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:IND. LIST:IND?, LIST:VOLT? (See example, Figure B-4.)

B.37 [SOUR:]LIST:VOLTage? QUERY

LIST:VOLT?

Syntax: Short Form: LIST:VOLT[:LEV]? Long Form: LIST:VOLTage[:LEVel]?
Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns voltage value stored in indexed memory location selected by LIST:IND.** Related Commands: LIST:IND. LIST:IND?, LIST:VOLT. (See example, Figure B-4.)

B.38 [SOUR:]LIST:VOLTage:PROTect COMMAND

LIST:VOLT:PROT

Syntax: Short Form: LIST:VOLT:PROT<exp_value> Long Form: LIST:VOLTage:PROTect <exp_value>
<exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets the voltage protection value for the indexed memory location selected by LIST:IND.** If the value is out of the acceptable voltage range for the power supply model, an error message: -222,"Data out of range" is posted in the output queue. The voltage value is stored in non-volatile memory and is retained when the power supply is turned off. Related Commands: LIST:IND. LIST:IND?, LIST:VOLT:PROT?. (See example, Figure B-4.)

NOTE: When programming sequential voltage levels, it is important to set the Overvoltage to accommodate the highest voltage of the sequence. Otherwise, when going from higher to lower voltage levels, the overvoltage protection will trip and shut down the unit because the overvoltage setting registers faster than the power supply can attain the lower voltage.

B.39 [SOUR:]LIST:VOLTage:PROTect QUERY

LIST:VOLT:PROT?

Syntax: Short Form: LIST:VOLT[:LEV]? Long Form: LIST:VOLTage[:LEVel]?
Return Value: <num_value> (digits with decimal point and Exponent)

Description: **Returns voltage protection value stored in indexed memory location selected by LIST:IND.** Related Commands: LIST:IND. LIST:IND?, LIST:VOLT. (See example, Figure B-4.)

B.40 MEASure[:SCALar]:CURRent[:DC]? QUERY

MEAS:CURR?

Syntax: Short Form: MEAS[:SCAL]:CURR[:DC]? Long Form: MEASure[:SCALar]:CURRent[:DC]?
Return Value: <num_value> (digits with decimal point and Exponent)

Description: **Measures actual current.** This query returns the actual value of output current (measured at the output terminals) as determined by the programmed value of voltage and current and load conditions. NOTE: The SCPI convention for this command allows the controller to establish the range and accuracy of the measurement if nn,nn is added after the question mark; the power supply accepts this format but sets the command warning bit (13) in the status questionable register and ignores the extra characters. (See example, Figure B-1.)

B.41 MEASure[:VOLTage][:SCALar][:DC]? QUERY

MEAS:VOLT?

Syntax: Short Form: MEAS[:SCAL]:VOLT[:DC]? Long Form: MEASure[:SCALar]:VOLTage[:DC]?

Description: **Measures actual voltage.** This query returns the actual value of output voltage (measured at the output terminals) as determined by the programmed value of voltage and current and load conditions. NOTE: The SCPI convention for this command allows the controller to establish the range and accu-

racy of the measurement if nn,nn is added after the question mark; the power supply accepts this format but sets the command warning bit (13) in the status questionable register and ignores the extra characters. (See example, Figure B-1.)

B.42 OUTPut[:STATe] COMMAND

OUTP

Syntax: Short Form: OUTP[:STAT] <boolean> Long Form: OUTPut[:STATe] <boolean>
<boolean>=(0 or OFF, 1 or ON)

Description: **Enables or disables the power supply output.** Upon power up the output is enabled (OUTP ON). When OUTP OFF is executed, the programmed values of voltage and current are saved, then voltage and current are programmed to 0. When OUTP ON is executed, the power supply output is restored to the previously saved programmed values. The saved values of voltage and current can be viewed by VOLT? and CURR? queries. Related Commands: OUTP?. (See example, Figure B-1.)

B.43 OUTPut[:STATe] QUERY

OUTP?

Syntax: Short Form: OUTP[:STAT]? Long Form: OUTPut[:STATe]?
Return Value: <int_value> (0 or 1)

Description: **Indicates whether power supply output is enabled or disabled.** Returns 0 if output disabled, returns 1 if output enabled. Related Commands: OUTP. (See example, Figure B-1.)

B.44 OUTPut:PROTection:DELAy COMMAND

OUTP:PROT:DEL

Syntax: Short Form: OUTP:PROT:DEL <n.n> Long Form: OUTPut:PROTection:DELAy <n.n>
where n.n = seconds

Description: **Delays tripping of overvoltage/overcurrent protection.** The overvoltage and overcurrent protection can be programmed to trip immediately upon detection of an overvoltage/overcurrent condition, or can be delayed approximately 8 seconds. This delay is set in increments of 0.033 milliseconds. If delay is programmed, overcurrent/overvoltage protection trips only if condition still present at end of delay. A count of 0 means no delay, the maximum delay possible is 8.50 seconds.

B.45 OUTPut:PROTection:DELAy QUERY

OUTP:PROT:DEL?

Syntax: Short Form: OUTP:PROT:DEL? Long Form: OUTPut:PROTection:DELAy?
Return Value: <integer 1 to 8.5>

Description: **Returns value of overvoltage/overcurrent delay.** A count of 0 means no delay, The maximum value is 8.5. The delay constants are set in .033 milliseconds per internal value. Related Commands: OUTP:PROT:DEL. (See example, Figure B-5.)

B.46 PROGram:SElect:STATe COMMAND

PROG:SEL:STAT

Syntax: Short Form: PROG:SEL:STAT {RUN | STOP}
Long Form: PROGram:SElect:STATe {RUN | STOP}

Description: **Starts or stops user programmed sequence.** Program sequence is preprogrammed using LIST commands, starting address is established by LIST:SEQ:STAR. When PROG:SEL:STAT command is executed the keyboard is locked until the program stops running. *RST command aborts a program that is running. Related commands: PROG:SEL:STAT?, LIST:CURR, LIST:CURR:PROT, LIST:VOLT, LIST:VOLT:PROT, LIST:DWEL, LIST:SEQ:NEXT, LIST:SEQ:STAR

B.47 PROGram:SElect:STATe? QUERY

PROG:SEL:STAT?

Syntax: Short Form: PROG:SEL:STAT? Long Form: PROGram:SElect:STATe?
Return value: <boolean> (0 = stopped, 1 = running)

Description: **Indicates status of user programmed sequence.** 1 returned when program is running. 0 returned when program is stopped. Related commands: PROG:STAT

B.48 READ[:SCALar]:CURRent[:DC]? QUERY**READ:CURR?**

Syntax: Short Form: READ[:SCAL]:CURR[:DC]? Long Form: READ[:SCALar]:CURRent[:DC]?
 Return Value: <num_value> (digits with decimal point and Exponent)

Description: **Measures actual current.** Same as MEAS:CURR? (see PAR. B.40)

B.49 READ[:VOLTage][:SCALar][:DC]? QUERY**READ:VOLT?**

Syntax: Short Form: READ[:SCAL]:VOLT[:DC]? Long Form: READ[:SCALar]:VOLTage[:DC]?
 Return Value: <num_value> (digits with decimal point and Exponent)

Description: **Measures actual voltage.** Same as MEAS:VOLT? (see PAR. B.41)

B.50 [SOURce:]CURRent[:LEVel][:IMMEDIATE][:AMPLitude] COMMAND**CURR**

Syntax: Short Form: [SOUR:]CURR[:LEV][:IMM][:AMP] <exp_value>
 Long Form: [SOURce:]CURRent[:LEVel][:IMMEDIATE][:AMPLitude] <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets programmed current level at power supply output.** This command programs output current to a specific value; actual output current will depend on load conditions. If the value exceeds the maximum for the model being programmed, error message -222, "Data out of range" is posted in output queue. If value programmed exceeds the CURR:LIM:HIGH value, a value corresponding to the current limit will be programmed. Related Commands: *RCL, *SAV, CURR:LIM:HIGH. (See example, Figure B-1.)

B.51 [SOURce:]CURRent[:LEVel][:IMMEDIATE][:AMPLitude] QUERY**CURR?**

Syntax: Short Form: [SOUR:]CURR[:LEV][:IMM][:AMP]? MIN, MAX
 Long Form: [SOURce:]CURRent[:LEVel][:IMMEDIATE][:AMPLitude]? MIN, MAX
 Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns either the programmed value, maximum value, or minimum value of current.** The CURR? query returns the programmed value of current. Actual output current will depend on load conditions. The CURR?MAX query returns the maximum current allowed for a particular model. CURR? Returns programmed current value. CURR? MAX returns maximum current allowed for power supply. CURR? MIN returns minimum current allowed for power supply (always 0). Related Commands: CURR. (See example, Figure B-1.)

B.52 [SOURce:]CURRent:LIMit:HIGH Command**CURR:LIM:HIGH**

Syntax: Short Form: [SOUR:]CURR:LIM:HIGH <exp_value>
 Long Form: [SOURce:]CURRent:LIMit:HIGH <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets limit for maximum power supply output current.** If the value is out of the acceptable current range for the power supply model, error message -222, "Data out of range" is posted in the output queue. If the user tries to set an output current value larger than the CURR:LIM:HIGH setting, a value corresponding to the current limit will be programmed and error message -301, "Value bigger than limit" is posted in the output queue. NOTE: If the current limit is changed, any previously established trigger levels higher than the new limit must be reprogrammed to be lower than the new limit; otherwise triggers will cause the output to exceed the new limit. Once the limit is established, the unit will not accept trigger values higher than the programmed limit. Related Commands: CURR. (See example, Figure B-5.)

B.53 [SOURce:]CURRent:LIMit:HIGH? Query**CURR:LIM:HIGH?**

Syntax: Short Form: [SOUR:]CURR:LIM:HIGH? Long Form: [SOURce:]CURRent:LIMit:HIGH?
 Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns value representing current limit set by CURR:LIM:HIGH command.** Related Commands: CURR:LIM:HIGH, CURR. (See example, Figure B-5.)

B.54 [SOURce:]CURRent[:LEVel]MODE COMMAND**CURR:MODE**

Syntax: Short Form: [SOUR:]CURR[:LEV]:MODE {FIX | EXT}
 Long Form: [SOURce:]CURRent[:MODE] {FIXed | EXTernal}

Description: **Establishes whether control of the output current is via keypad or GPIB commands (FIXED) or via external analog 0 to 1V reference (EXTERNAL).** Setting is stored in NVRAM and retained upon subsequent power up.

B.55 [SOURce:]CURRent[:LEVel]MODE? QUERY**CURR:MODE?**

Syntax: Short Form: [SOUR:]CURR[:LEV]:MODE?
 Long Form: [SOURce:]CURRent[:LEVel]MODE?
 Return Value: FIXED or EXTERNAL

Description: **Returns FIXED or EXTERNAL depending on whether current control is from the keypad or GPIB interface (FIXED) or from an external analog reference voltage (EXTERNAL).**

B.56 [SOURce:]CURRent:PROTection[:LEVel] COMMAND**CURR:PROT**

Syntax: Short Form: [SOUR:]CURR:PROT[:LEV] <exp_value>
 Long Form: [SOURce:]CURRent:PROTection[:LEVel] <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets overcurrent protection level for power supply.** If the value is out of the acceptable overcurrent range for the power supply model, error message -222, "Data out of range" is posted in the output queue. If the power supply output exceeds the current protection level programmed, then the power supply output is disabled (programmed to 0) and the OV bit in the Questionable Condition status register is set. An overcurrent condition can be cleared with the CURR:PROT:CLE command. The current protection level can be programmed independently of the output current level. Setting current protection to a value lower than the output current causes the current protection mechanism to trigger after the delay established by OUTP:PROT:DEL command. (See example, Figure B-5.)

NOTES: 1. Power supply assumed to be operating in constant voltage mode.
 2. Examples below are intended only to illustrate command functions. Refer to PAR. 3.6.5 for programming techniques to optimize performance.

VOLT 21; CURR 1.1	Power supply programmed to voltage limit 21V, 1.1A.
CURR?	Returns 1.1.
CURR:LIM:HIGH 3.3	Current limit set to 3.3A.
CURR:LIM:HIGH?	Returns 3.3.
CURR 4.2	Power supply output current programmed to 3.3A.
SYST:ERR?	Error message -301 "Value bigger than limit."
CURR?	Returns 3.3.
OUTP:PROT:DEL 0	Protection will trip immediately upon detection of overvoltage or overcurrent condition.
OUTP:PROT:DEL?	Returns 0.
CURR:PROT:TRIP?	0 indicating overcurrent protection not tripped.
	--- OVERCURRENT CONDITION (1 SECOND) OCCURS.
CURR:PROT:TRIP?	1 indicating overcurrent protection tripped.
CURR:PROT:CLE	Overcurrent condition cleared.
CURR:PROT:TRIP?	0 indicating overcurrent condition not tripped.
CURR?	Returns small value (approx. 1% of full scale current rating).
OUTP:PROT:DEL 7.47	Protection will trip if overvoltage or overcurrent condition still present approx. 0.575 seconds after detection.
OUTP:PROT:DEL?	Returns 7.50.
CURR 2.5	Power supply output current programmed to 2.5A
	--- OVERCURRENT CONDITION (1 SECOND) OCCURS.
(After 10 seconds)	
CURR:PROT:TRIP?	0 indicating overcurrent condition not tripped.
CURR?	Returns 2.5.

FIGURE B-5. PROGRAMMING CURRENT

B.57 [SOURce:]CURRent:PROTection[:LEVel]? QUERY**CURR:PROT?**

Syntax: Short Form: [SOUR:]CURR:PROT[:LEV]? {MIN | MAX}
 Long Form: [SOURce:]CURRent:PROTection[:LEVel]? {MIN | MAX}
 Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns value representing current protection level.** CURR:PROT? returns value set by CURR:PROT. CURR:PROT?MAX returns maximum current protection value (see Table 1-2). This value is determined at the factory and cannot be changed by the user. CURR:PROT?MIN returns the minimum current protection value (always 0). (See example, Figure B-5.)

B.58 [SOURce:]CURRent:PROTection:CLEar COMMAND**CURR:PROT:CLE**

Syntax: Short Form: [SOUR:]CURR:PROT:CLE Long Form: [SOURce:]CURRent:PROTection:CLEar

Description: **Clears overcurrent condition.** Output programmed to 0V; current limit programmed to small value (approximately 1% of full scale current rating). Overcurrent Protection Tripped is reset so that CURR:PROT:TRIP? returns 0. Related Commands: CURR:PROT, CURR:PROT:TRIP? (See example, Figure B-5.)

B.59 [SOURce:]CURRent:PROTection:TRIPped? QUERY**CURR:PROT:TRIP?**

Syntax: Short Form: [SOUR:]CURR:PROT:TRIP? Long Form: [SOURce:]CURRent:PROTection:TRIPped?
 Return Value: 0 or 1.

Description: **Identifies whether overcurrent condition was detected.** 0 if overcurrent protection tripped. 1 if overcurrent protection not tripped. Related Commands: CURR:PROT, CURR:PROT:CLE. (See example, Figure B-5.)

B.60 [SOURce:]CURRent[:LEVel]TRIGgered[:AMPlitude] COMMAND**CURR:TRIG**

Syntax: Short Form: [SOUR:]CURR[:LEV]:TRIG[:AMP] <exp_value>
 Long Form: [SOURce:]CURRent[:LEVel]:TRIGgered[:AMPlitude] <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Programs current value to be transferred to output by *TRG commands.** Actual output current will depend on load conditions. If the value exceeds the maximum for the model being programmed, error message -222, "Data out of range" is posted in output queue. If value exceeds CURR:LIM:HIGH value, a value corresponding to the current limit will be programmed. Related Commands: CURR. (See example, Figure B-1.)

B.61 [SOURce:]CURRent[:LEVel]TRIGgered[:AMPlitude]? QUERY**CURR:TRIG?**

Syntax: Short Form: [SOUR:]CURR[:LEV]:TRIG[:AMP]?
 Long Form: [SOURce:]CURRent[:LEVel]:TRIGgered[:AMPlitude]?
 Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns the current value established by CURR:TRIG command.** (See example, Figure B-1.)

B.62 [SOURce:]VOLTage[:LEVel][:IMMEDIATE][:AMPlitude] COMMAND**VOLT**

Syntax: Short Form: [SOUR:]VOLT[:LEV][:IMM]:AMP <exp_value>
 Long Form: [SOURce:]VOLTage[:LEVel][:IMMEDIATE][:AMPlitude] <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets programmed voltage level at power supply output.** This command programs output voltage to a specific value; actual output voltage will depend on load conditions. If the value exceeds the maximum for the model being programmed, error message -222, "Data out of range" is posted in output queue. If value programmed exceeds the VOLT:LIM:HIGH value, a value corresponding to the voltage limit will be programmed. Related Commands: *RCL, *SAV, VOLT:LIM:HIGH. (See example, Figure B-1.)

B.63 [SOURce:]VOLTage[:LEVel][:IMMEDIATE][:AMPLitude]? QUERY**VOLT?**

Syntax: Short Form: [SOUR:]VOLT[:LEV][:IMM][:AMP]? {MIN | MAX}
 Long Form: [SOURce:]VOLTage[:LEVel][:IMMEDIATE][:AMPLitude]? {MIN | MAX}

Description: **Identifies programmed voltage, maximum allowable voltage, or minimum voltage (always 0).** The VOLT? query returns the programmed value of voltage. Actual output voltage will depend on load conditions. The VOLT?MAX query returns the maximum voltage allowed for a particular model (e.g., 25V for ATE100-10DMD). VOLT?MIN returns minimum voltage allowed for power supply (always 0).
 Related Commands: VOLT. (See example, Figure B-6)

B.64 [SOURce:]VOLTage[:LEVel]TRIGgered[:AMPLitude] COMMAND**VOLT:TRIG**

Syntax: Short Form: [SOUR:]VOLT[:LEV]:TRIG[:AMP] <exp_value>
 Long Form: [SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude] <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Programs voltage value to be transferred to output by *TRG commands.** Actual output voltage will depend on load conditions. If the value exceeds the maximum for the model being programmed, error message -222, "Data out of range" is posted in output queue. If value exceeds VOLT:LIM:HIGH value, a value corresponding to the voltage limit will be programmed. (See example, Figure B-1.)

B.65 [SOURce:]VOLTage[:LEVel]TRIGgered[:AMPLitude]? QUERY**VOLT:TRIG?**

Syntax: Short Form: [SOUR:]VOLT[:LEV]:TRIG[:AMP]?
 Long Form: [SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude]?
 Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns value representing voltage value to be programmed by *TRG command established by VOLT:TRIG command.** (See example, Figure B-1.)

B.66 [SOURce:]VOLTage:LIMit:HIGH COMMAND**VOLT:LIM:HIGH**

Syntax: Short Form: [SOUR:]VOLT:LIM:HIGH <exp_value>
 Long Form: [SOURce:]VOLTage:LIMit:HIGH <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets voltage limit for power supply output.** If the value is out of the acceptable voltage range for the power supply model, error message -222, "Data out of range" is posted in the output queue. If the user tries to set an output voltage level larger than the VOLT:LIM:HIGH setting, a value corresponding to the voltage limit will be programmed and error message -301, "Value bigger than limit" is posted in the output queue. NOTE: If the voltage limit is changed, any previously established trigger levels higher than the new limit must be reprogrammed to be lower than the new limit; otherwise triggers will cause the output to exceed the new limit. Once the limit is established, the unit will not accept trigger values higher than the programmed limit. Related Commands: VOLT. (See example, Figure B-6.)

B.67 [SOURce:]VOLTage:LIMit:HIGH? QUERY**VOLT:LIM:HIGH?**

Syntax: Short Form: [SOUR:]VOLT:LIM:HIGH? Long Form: [SOURce:]VOLTage:LIMit:HIGH?
 Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Returns value representing voltage limit set by VOLT:LIM:HIGH command.** Related Commands: VOLT:LIM:HIGH, VOLT. (See example, Figure B-6.)

B.68 [SOURce:]VOLTage[:LEVel]MODE COMMAND**VOLT:MODE**

Syntax: Short Form: [SOUR:]VOLT[:LEV]:MODE {FIX | EXT}
 Long Form: [SOURce:]VOLTage[:LEVel]:MODE {FIXed | EXTernal}

Description: **Establishes whether control of the output voltage is via keypad or GPIB commands (FIXED) or via external analog 0 to 10V reference (EXTERNAL).** Setting is stored in NVRAM and retained upon subsequent power up.

B.69 [SOURce:]VOLTage[:LEVel]MODE? QUERY

VOLT:MODE?

Syntax: Short Form: [SOUR:]VOLT[:LEV]:MODE?
 Long Form: [SOURce:]VOLTage[:LEVel]MODE?
 Return Value: FIXED or EXTERNAL

Description: Returns **FIXED** or **EXTERNAL** depending on whether voltage control is from the keypad or GPIB interface (FIXED or from an external analog reference voltage (EXTERNAL)).

B.70 [SOURce:]VOLTage:PROTection[:LEVel] COMMAND

VOLT:PROT

Syntax: Short Form: [SOUR:]VOLT:PROT[:LEV] <exp_value>
 Long Form: [SOURce:]VOLTage:PROTection[:LEVel] <exp_value>
 <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Sets overvoltage protection level for power supply.** If the value is out of the acceptable overvoltage range for the power supply model, error message -222, "Data out of range" is posted in the output queue. If the power supply output exceeds the voltage protection level programmed, then the power supply output is disabled (programmed to 0) and the OV bit in the Questionable Condition status register is set. An overvoltage condition can be cleared with the VOLT:PROT:CLE command. The voltage protection level can be programmed independently of the output voltage level. Setting voltage protection to a value lower than the output voltage causes the voltage protection mechanism to trigger immediately. (See example, Figure B-6.)

NOTES: 1. Power supply assumed to be operating in constant voltage mode.
 2. Examples below are intended only to illustrate command functions. Refer to PAR. 3.6.5 for programming techniques to optimize performance.

VOLT 21; CURR 1.1	Power supply programmed to 21V, 1.1A.
VOLT 2.157E1	Power supply programmed to go to 21.57V.
VOLT?	Returns 2.157E1, indicating programmed voltage = 2.157V.
VOLT? MAX	For ATE 100-10DM, returns 100 (100V).
VOLT? MIN	Returns 0 (minimum allowable voltage).
VOLT:PROT 2.365E+1	Voltage protection set to 23.65V.
VOLT?	Returns 21.57, indicating programmed voltage value = 21.57V.
VOLT:PROT?	Returns 2.365+E1, (programmed overvoltage protection = 23.65V
VOLT:PROT? MAX	For ATE 100-10DMG, returns 110.
VOLT:PROT:TRIP?	0 indicating overvoltage protection not tripped.
	--- OVERVOLTAGE CONDITION OCCURS.
VOLT:PROT:TRIP?	1 indicating overvoltage protection tripped.
VOLT:PROT:CLE	Overvoltage condition cleared.
VOLT:PROT:TRIP?	0 indicating overvoltage condition not tripped.
VOLT?	Returns 0, programmed voltage value = 0V.
VOLT 21; CURR 1.1	Power supply programmed to go to 21V, 1.1A.
VOLT?	Returns 21.
VOLT:LIM:HIGH 5	Voltage limit set to 5V.
VOLT:LIM:HIGH?	Returns 5
VOLT 33	Power supply programmed to 5V.
SYST:ERR?	Error message -301 "Value bigger than limit."
VOLT?	Returns 5.

FIGURE B-6. PROGRAMMING VOLTAGE

B.71 [SOURce:]VOLTage:PROTection[:LEVel]? QUERY

VOLT:PROT?

Syntax: Short Form: [SOUR:]VOLT:PROT[:LEV] MIN, MAX
 Long Form: [SOURce:]VOLTage:PROTection[:LEVel] MIN, MAX
 Return Value: <exp_value> = digits with decimal point and Exponent, e.g., 2.71E+1 for 27.1

Description: **Identifies overvoltage protection setting, maximum allowable overvoltage protection, or minimum overvoltage protection.** VOLT:PROT? returns value set by VOLT:PROT. VOLT:PROT? MAX

returns maximum voltage protection value (see Table 1-2); this value is determined at the factory and cannot be changed by the user. VOLT:PROT? MIN returns the minimum voltage protection value (always 0). (See example, Figure B-6.)

B.72 [SOURce:]VOLTage:PROTection:CLEar COMMAND VOLT:PROT:CLE

Syntax: Short Form: [SOUR:]VOLT:PROT:CLE Long Form: [SOURce:]VOLTage:PROTection:CLEar

Description: **Clears overvoltage condition.** Output programmed to 0V; current limit programmed to small value (approximately 1% of full scale current rating). Overvoltage Protection Tripped is reset so that VOLT:PROT:TRIP? returns 0. Related Commands: VOLT:PROT, VOLT:PROT:TRIP?. (See example, Figure B-6.)

B.73 [SOURce:]VOLTage:PROTection:TRIPped? QUERY VOLT:PROT:TRIP?

Syntax: Short Form: [SOUR:]VOLT:PROT:TRIP? Long Form: [SOURce:]VOLTage:PROTection:TRIPped?
Return Value: 0 or 1

Description: **Identifies whether overvoltage condition was detected.** Returns 0 if overvoltage protection tripped; 1 if overvoltage protection not tripped. Related Commands: VOLT:PROT, VOLT:PROT:CLE. (See example, Figure B-6.)

B.74 [SOURce:]FUNCtion:MODE? QUERY FUNC:MODE?

Syntax: Short Form: FUNC:MODE? Long Form: [SOURce:]FUNCtion:MODE?
Return Value: VOLT or CURR

Description: **Identifies the operating mode of the power supply.** VOLT = Constant Voltage mode (CV). CURR = Constant Current mode (CC). (See example, Figure B-1.)

B.75 STATus:OPERation:CONDition QUERY STAT:OPER:COND?

Syntax: Short Form: STAT:OPER:COND? Long Form: STATus:OPERation:CONDition?
Return Value: <int_value> 0 to 1313 (1 + 32 + 256 + 1024).

Description: **Returns the value of the Operation Condition Register (see Table B-2).** The Operation Condition Register contains unlatched real-time information about the operating conditions of the power supply. Bit set to 1 = function enabled (active, true); bit reset to 0 = function disabled (inactive, false). (See example, Figure B-7.)

TABLE B-2. OPERATION CONDITION REGISTER, OPERATION ENABLE REGISTER, AND OPERATION EVENT REGISTER BITS

CONDITION	NU	CC	NU	CV	NU	WTG	NU	CAL
BIT	15-11	10	9	8	7 - 6	5	4 - 1	0
VALUE	32,768 - 2048	1024	512	256	128 - 64	32	16 - 2	1

CAL - INTERFACE COMPUTING NEW CALIBRATION CONSTANTS
 CC - POWER SUPPLY IN CONSTANT CURRENT MODE
 CV - POWER SUPPLY IN CONSTANT VOLTAGE MODE
 NU - NOT USED
 WTG - WAIT FOR TRIGGER (SET BY INIT SUBSYSTEM)

B.76 STATus:OPERation:ENABle COMMAND STAT:OPER:ENAB

Syntax: Short Form: STAT:OPER:ENAB <int_value> 0 to 1313 (1 + 32 + 256 + 1024)
Long Form: STATus:OPERation:ENABle <int_value> 0 to 1313 (1 + 32 + 256 + 1024)

Description: **Sets Operation Enable Register.** The Operation Enable Register is a mask for enabling specific bits in the Operation Event Register which will cause the operation summary bit (bit 7) of the Status Byte register to be set Bit set to 1 = function enabled (active, true); bit reset to 0 = function disabled (inactive, false). The operation summary bit is the logical OR of all the enabled bits in the Operation Event register. (See example, Figure B-7.)

B.77 STATus:OPERation:ENABle? QUERY

STAT:OPER:ENAB?

Syntax: Short Form: STAT:OPER:ENAB? Long Form: STATus:OPERation:ENABle?
Return Value: <int_value> 0 to 1313 (1 + 32 + 256 + 1024).

Description: **Reads Operation Enable Register (see Table B-2).** Returns value of Operation Enable Register bits. Bit set to 1 = function enabled (active, true); bit reset to 0 = function disabled (inactive, false). (See example, Figure B-7.)

B.78 STATus:OPERation[:EVENT] QUERY

STAT:OPER?

Syntax: Short Form: STAT:OPER[:EVEN]? Long Form: STATus:OPERation[:EVENT]?
Return Value: <int_value> 0 to 1313 (1 + 32 + 256 + 1024).

Description: **Indicates changes in conditions monitored by Operational Event Register.** Returns the value of the Operation Event register. The Operation Event register is a read-only register which holds (latches) all events that occur. Reading the Operation Event register clears it. (See example, Figure B-7.)

B.79 STATus:PRESet COMMAND

STAT:PRES

Syntax: Short Form: STAT:PRES Long Form: STATus:PRESet

Description: **Disables reporting of all status events.** This command sets all bits of the Operation Condition (Table B-2) and Questionable Condition Registers to 0, preventing all status events from being reported. (See example, Figure B-7.)

NOTE: The power supply is assumed to be operating in cV (constant voltage) mode.

STAT:OPER:ENAB 1056Mask enabled for CC, WTG and bits.
STAT:OPER:ENAB? Returns 1056 (32 + 1024) (CC, WTG bits set).
STAT:QUES:ENAB 3 Mask enabled for OV and OC bits (1 + 2).
STAT:QUES:ENAB? Returns 3 (1 + 2) indicating OV and OC bits are enabled.
STAT:PRES Operation Condition and Questionable Condition registers are reset.

INIT:CONT ON Continuous triggers enabled.
STAT:OPER:COND? Power supply returns 288 (256 + 32) to indicate that power supply is constant voltage mode and Wait For Trigger is true.
STAT:OPER? Returns 1057, e.g., indicating that since the last reading of the Operation Event Register the power supply has entered Constant Current mode, the Wait Trigger was set.
STAT:OPER? Returns 0 indicating no changes since previous reading of the Operation Event register.
STAT:QUES? Returns 0 (no questionable conditions occurred since previous reading

--- (SHORT OUTPUT) OVERCURRENT CONDITION OCCURS
STAT:QUES? Returns 2 (overcurrent protection tripped since the last STAT:QUES? query).
STAT:QUES:COND? Returns 2, (Power supply still in overcurrent protection state).
STAT:QUES? Returns 0, (Register cleared by previous STAT:QUES?).
STAT:QUES:COND? Returns 2, (Power supply still in overcurrent protection state).
— (REMOVE SHORT FROM OUTPUT)
CURR:PROT:CLE Overcurrent condition cleared.
STAT:QUES:COND? Returns 0, (register cleared by CURR:PROT:CLE).
SYST:ERR? Power supply returns 0, "No error" message.

FIGURE B-7. USING STATUS COMMANDS AND QUERIES

B.80 STATus:QUEStionable[:EVENT]? QUERY

STAT:QUES?

Syntax: Short Form: STAT:QUES[EVEN]? Long Form: STATus:QUEStionable[EVENT]?
Return Value: <int_value> actual register value

Description: **Indicates questionable events that occurred since previous STAT:QUES? query.** Returns the value of the Questionable Event register (see Table B-3). The Questionable Event register is a read-only register which holds (latches) all events. Reading the Questionable Event register clears it. (See example, Figure B-7.)

TABLE B-3. QUESTIONABLE EVENT REGISTER, QUESTIONABLE CONDITION REGISTER AND QUESTIONABLE CONDITION ENABLE REGISTER BITS

CONDITION	NU	OC	OV
BIT	15 - 2	1	0
VALUE	32,768 - 4	2	1

OC - OVERCURRENT PROTECTION TRIPPED
OV - OVERVOLTAGE PROTECTION TRIPPED
NU - NOT USED

B.81 STATus:QUEStionable:CONDition? QUERY

STAT:QUES:COND?

Syntax: Short Form: STAT:QUES:COND? Long Form: STATus:QUEStionable:CONDition?
Return Value: <int_value> actual register value

Description: **Returns the value of the Questionable Condition Register (see Table B-3).** The Questionable Condition Register contains unlatched real-time information about questionable conditions of the power supply. Bit set to 1 = condition (active, true); bit reset to 0 = condition (inactive, false). (See example, Figure B-7.)

B.82 STATus:QUEStionable:ENABle COMMAND

STAT:QUES:ENAB

Syntax: Short Form: STAT:QUES:ENAB <int_value> Long Form: STATus:QUEStionable:ENABle <int_value>

Function: **Programs Questionable Condition Enable Register.**

Description: **Programs Questionable Condition Enable Register (see Table B-3).** The Questionable Condition Enable Register determines which conditions are allowed to set the Questionable Condition Register; it is a mask for enabling specific bits in the Questionable Event register that can cause the questionable summary bit (bit 3) of the Status Byte register to be set. The questionable summary bit is the logical OR of all the enabled bits in the Questionable Event register. Bit set to 1 = function enabled (active, true); bit reset to 0 = function disabled (inactive, false). (See example, Figure B-7.)

B.83 STATus:QUEStionable:ENABle? QUERY

STAT:QUES:ENAB?

Syntax: Short Form: STAT:QUES:ENAB? Long Form: STATus:QUEStionable:ENABle?
Return Value: <int_value> actual register value

Description: **Reads Questionable Condition Enable Register (see Table B-3).** Power supply returns value of Questionable Condition Enable Register, indicating which conditions are being monitored. Bit set to 1 = function enabled (active, true); bit reset to 0 = function disabled (inactive, false). Related Commands: STAT:QUES?. (See example, Figure B-7.)

B.84 SYSTem:ERRor[:NEXT]? QUERY

SYST:ERR?

Syntax: Short Form: SYST:ERR[:NEXT]? Long Form: SYSTem:ERRor[:NEXT]?
Return Value: <int_value,string>

Description: **Posts error messages to the output queue.** Returns the next error number followed by its corresponding error message string from the instrument error queue. The error queue is a FIFO (first in first out) buffer that stores errors as they occur. As it is read, each error is removed from the queue and the next error message is made available. When all errors have been read, the query returns 0, "No error". If more than 15 errors are accumulated, it will overflow. The oldest errors stay in the queue but the most recent errors are discarded. The last error in the queue will be -350, "Too many errors." Error messages are defined in Table B-4.

B.85 SYSTem:ERRor:CODE? QUERY

SYST:ERR:CODE?

Syntax: Short Form: SYST:ERR:CODE?] Long Form: SYSTem:ERRor:CODE?

Description: Returns the three character error code without the ASCII definition string. The error codes are defined in table B-4 (See example, Figure B-1.)

B.86 SYSTem:ERRor:CODE:ALL? QUERY

SYST:ERR:CODE:ALL?

Syntax: Short Form: SYST:ERR:CODE:ALL?] Long Form: SYSTem:ERRor:CODE:ALL?
Return Value:

Description: Returns a comma-separated list of all error codes. A maximum of 15 codes will be returned; if the queue is empty, the power supply returns 0.

B.87 SYSTem:KLOCK COMMAND

SYST:KLOC

Syntax: Short Form: SYST:KLOC <boolean> Long Form: SYSTem:KLOCK <boolean>
<boolean> (0 or OFF, 1 or ON)

Description: **Locks (ON or 1) or unlocks (OFF or 0) the keypad.** With the keypad unlocked the power supply enters Remote mode as soon as a command or query is received. Once in Remote mode (with keypad unlocked) the front panel keys are disabled with the exception of the LOCAL key, which is used to return to Local mode.

After sending a SYST:KLOC ON (keypad lock) command, all front panel keys, including LOCAL, are disabled. The power supply is now in the “local lockout” state. Local lockout can also be entered by sending the GPIB <LLO> code (hex 11) to the power supply. The power supply remains in “local lockout” until a SYST:KLOC OFF command is received. Related Commands: SYST:KLOCK?. (See example, Figure B-8.)

B.88 SYSTem:KLOCK? QUERY

SYST:KLOC?

Syntax: Short Form: SYST:KLOC? Long Form: SYSTem:KLOCK?
Return Value: <int_value> 0 or 1

Description: **Identifies whether keypad is locked or unlocked.** 0 = keypad unlocked, local operation possible by pressing LOCAL key. 1 = keypad locked, LOCAL key disabled, only remote operation possible. Related Commands: SYST:KLOCK. (See example, Figure B-8.)

B.89 SYSTem:LANGuage? QUERY

SYST:LANG?

Syntax: Short Form: SYST:LANG? Long Form: SYSTem:LANGuage?
Return Value: <string> SCPI or COMP

Description: **Identifies whether unit responds to older command formats.** SCPI means the unit will not respond to older formats such as LIST:TIME. COMP means the unit will respond to older formats such as LIST:TIME for compatible operation with software written for ATE power supplies up to Revision 1.

B.90 SYSTem:LANGuage COMMAND

SYST:LANG

Syntax: Short Form: SYST:LANG {COMP | SCPI} Long Form: SYSTem:LANGuage {COMP | SCPI}

Description: **Determines whether unit responds to older command formats.** Sending SYST:LANG COMP causes the unit to respond to older formats such as LIST:TIME for compatible operation with software written for ATE power supplies up to Revision 1. SYST:LANG COMP has been selected at the factory to permit the VISA demonstration program (which uses older command formats) to operate. SYST:LANG SCPI disables responses to older command formats.

TABLE B-4. ERROR MESSAGES

ERROR MESSAGE	ESR ERROR BIT SET (SEE PAR. A.5)	EXPLANATION
0, "No error"	None	No error.
-100, "Command error"	Command Error bit 5	Command and data understood, but more information included which is not recognized.
-102, "Syntax error"	Command Error bit 5	First 4 characters recognized, subsequent characters not recognized.
-103, "Invalid separator"	Command Error bit 5	For example, VOLT.PROT received instead of VOLT:PROT.
-108, "Parameter Not Allowed Error"	Command Error bit 5	Volt12 sequence, channel number is invalid.
-109, "Missing parameter"	Command Error bit 5	For example, VOLT instead of VOLT 21.
-111, "Header separator error"	Command Error bit 5	Missing space between volt and value or ; missing.
-113, "Undefined header"	Command Error bit 5	First 4 characters could not be identified as legal command. For example, command VLT instead of VOLT.
-120, "Numeric data error"	Command Error bit 5	Expected number but other characters were detected.
-121, "Invalid character in number"	Command Error bit 5	Volt 1,500 (comma not allowed).
-123, "Exponent too large"	Command Error bit 5	Exponent E+3 or greater is invalid.
-141, "Invalid character data"	Command Error bit 5	For example OUTP OFD or OUTP STOP instead of OUTP OFF.
-150, "String data error"	Command Error bit 5	Invalid characters were detected in numeric entry. For example E.1 instead of E+1 or 4d3 instead of 4.3.
-203, "Command protected"	Execution error bit 4	Command only valid in password Cenable state.
-221, "Settings conflict"	Execution error bit 4	Invalid password from syst:pass:cen command.
-222, "Data out of range"	Execution error bit 4	Value exceeds power supply rating.
-223, "Data format error"	Execution error bit 4	Multiple decimals in digit, Multiple E, etc.
-224, "Illegal parameter value"	Execution error bit 4	For example, OUTP 2 instead of OUTP 1.
-241, "Hardware missing"	Execution error bit 4	Requesting device 2 status (INST:NSEL 2).
-282, "Illegal program name"	Execution error bit 4	Executing prog:run without LIST:SEQ command.
-301, "Value bigger than limit"	Device Error bit 3	Requesting a time of 301 which is bigger than limit.
-311, "Memory error"	Device Error bit 3	Power-up NV RAM error.
-314, "Save/recall memory error"	Device Error bit 3	Using cell other than 1 - 41 for SAV and RCL.
-341, "Non Volatile Mem. CRC error"	Device Error bit 3	Power supply constants may be corrupted; recalibration may be necessary.
-350, "Queue overflow"	Query Error bit 2	More than 15 errors are in queue.
-410, "Query interrupted"	Query Error bit 2	New command sent before data from previous query read. Previous query data lost.
-430, "Query Deadlocked"	Query Error bit 2	Over 255 characters received in single input string.

B.91 SYSTem:PASSword:CENable COMMAND**SYST:PASS:CEN**

Syntax: Short Form: SYST:PASS:CEN <val> Long Form: SYSTem:PASSword:CENable <val>

Description: Sets the password enable state if the value matches the current password. This command allows other commands such as *SAV 41 to operate.

B.92 SYSTem:PASSword:CDISable COMMAND**SYST:PASS:CDIS**

Syntax: Short Form: SYST:PASS:CDIS <val> Long Form: SYSTem:PASSword:CDISable <val>

Description: Clears the password enable state if the value matches the current password.

B.93 SYSTem:PASSword:STATe? QUERY**SYST:PASS:STAT?**

Syntax: Short Form: SYST:PASS:STAT? Long Form: SYSTem:PASSword:STATe?
Return Value: <int_value> 0 or 1

Description: Returns a 1 if the password state is enabled or a 0 if it is disabled.

B.94 SYSTem:SECurity:IMMEDIATE COMMAND**SYST:SEC:IMM**

Syntax: Short Form: SYST:SEC:IMM Long Form: SYSTem:SECurity:IMMEDIATE

Description: Initializes all NVRAM variable to factory defaults. This includes all memory steps to be set to 0 volts, 1.28% of full scale current, overvoltage and overcurrent to be set to l_{max}+10%, time value to be set to 0, and next step equal to 0.).It also initializes the power -up state to have DC Output Control off (see DCL Control, PAR 3.5.2). The calibration password is reset per Table B-5. Use master password (see below, Table B-6) If password has been lost. Related Commands: SYST:PASS:CEN must be sent prior to this command

TABLE B-5. FACTORY DEFAULT CALIBRATION PASSWORDS

MODEL	PASSWORD
ATE 6-100DMG	6100
ATE 15-50DMG	1550
ATE 25-40DMG	2540
ATE 36-30DMG	3630
ATE 55-20DMG	5520
ATE 75-15DMG	7515
ATE 100-10DMG	1001
ATE 150-7DMG	1507

TABLE B-6. MASTER PASSWORDS

MODEL	PASSWORD	MODEL	PASSWORD	MODEL	PASSWORD
ATE 6-100DMG	..17	ATE 36-30DM	..44	ATE 100-10DMG	..78
ATE 15-50DMG	..26	ATE 55-20DMG	..52	ATE 150-7DMG	..86
ATE 25-40DMG	..35	ATE 75-15DMG	..69		

B.95 SYSTem:SET COMMAND

SYST:SET

Syntax: Short Form: SYST:SET {CM0 | CM1 | DC0 | DC1 | LF0 | LF1 | STR | RLX}
Long Form: SYSTem:SET {CM0 | CM1 | DC0 | DC1 | LF0 | LF1 | STR | RLX}

Description: Sending SYST:SET CM1 sets the unit to operate in compatible mode and have all GPIB functions compatible with software version 1.2 and lower units. Sending SYST:SET CM0 sets the unit to be fully SCPI 1997 compliant.

Sending SYST:SET DC1 causes Device Clear to be identical to *RST command. Sending SYST:SET DC0 causes Device Clear to have no effect on output voltage, output current or output on/off state.

Sending SYST:SET LF1 causes the power supply to respond with line feed if read occurs with output buffer empty. Sending LF0 causes the power **not** to send a line feed if read occurs with output buffer empty (SCPI 1997 compliant).

Sending SYST:SET RLX allows the power supply to accept special debug and troubleshooting commands (for KEPCO use only - e.g., after sending SYST:SET RLX the power supply will respond to the \$vda? command by returning the value of the internal D/A converter for voltage). Sending SYST:SET STR disables the special debug and troubleshooting commands.

Related Commands:

SYST:PASS:CEN - the password must be enabled prior to saving the SYST:SET configuration using the *SAV41 command.

*SAV41 - this command saves the configuration established by SYST:SET and OUTP commands and restores it upon power up.

B.96 SYSTem:VERSion QUERY

SYST:VERS?

Syntax: Short Form: SYST:VERS? Long Form: SYSTem:VERSion?
Return Value: <int_value>.<int_value> (YYYY.V)

Description: **Identifies SCPI Version implemented.** Returns SCPI Version number:
YYYY = year, V = Revision number for specified year. (See example, Figure B-8.)

SYST:VERS?	Returns 2003.0.
SYST:KLOC ON	keypad locked, only remote control possible.
SYST:KLOC?	Returns 1 indicating keypad locked.
SYST:KLOC OFF	keypad unlocked, pressing LOCAL key allows Local mode operation.
SYST:KLOC?	Returns 0 indicating keypad unlocked.

FIGURE B-8. USING SYSTEM COMMANDS AND QUERIES

