TECHNICAL MANUAL

KLP VISA
INSTRUMENT DRIVER

KEPCO INC.
An ISO 9001 Company.

MODEL

KLP VISA
INSTRUMENT DRIVER

ORDER NO.	REV. NO

IMPORTANT NOTES:

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

MODEL	SERIAL NO.	REV. NO.

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.

3) The contents of this manual are protected by copyright. Reproduction of any part can be made only with the specific written permission of Kepco, Inc.

Data subject to change without notice.

P/N 243-1042

KEPCO®
THE POWER SUPPLIER™

KEPCO, INC. ● 131-38 SANFORD AVENUE ● FLUSHING, NY. 11352 U.S.A. ● TEL (718) 461-7000 ● FAX (718) 767-1102
email: hq@kepcopower.com ● World Wide Web: http://www.kepcopower.com

KLP VISA INSTRUMENT DRIVER

The VISA instrument driver supplied for the KLP Power Supply is provided to simplify programming with a VISA compatible GPIB controller. The latest driver can be downloaded from the Kepco website (http://www.kepcopower.com/drivers.htm). The driver includes the source code (C) for all VISA functions (kp_KLP.c).

Since the software drivers supplied by Kepco are VISA compliant, they require the installation of the proper VISA driver from your GPIB card supplier. The Kepco website (http://www.kepcopower.com/drivers.htm) provides links to various vendor sites for these drivers.

1. VISA INSTRUMENT DRIVER FUNCTIONS

Kepco's KLP VISA instrument driver provides programming support for Kepco's KLP Power Supply (VISA I/O). It contains functions for opening, configuring, taking measurements from, testing, calibrating and closing the instrument. To successfully use this module, the instrument must be connected to the GPIB and the GPIB address supplied to the initialize function must match the GPIB address of the instrument.

Table 1 lists the functions that are available.

TABLE 1. KLP VISA DRIVER FUNCTIONS

Purpose	Function Name	Description
INITIALIZE FUNCTION		
Reset	KpKlp_psReset	Resets the instrument to a known state and sends initialization commands to the instrument.
APPLICATION FUNCTIONS — This class of functions contains high-level test and measurement routines. These functions call other instrument driver functions to configure, start, and get readings from the instrument.		
CONFIGURATION FUNCTIONS — This class of functions configures the instrument by setting system configuration parameters.		
Set SRQ Condition	KpKlp_SetSrqCond	Sets SRQ Condition Bit.
Get System Setting	KpKlp_SYST_Set	Gets System Settings
Set Trigger Value	KpKlp_SetTrigValue	Sets the trigger voltage or trigger current level, depending on the switch position.
Get Trigger Value	KpKlp_GetTrigValue	Gets the trigger voltage or the trigger current level, depending on the switch position.
ACTION/STATUS FUNCTIONS — This class of functions executes commands and queries. It also provides functions which allow the user to determine the current status of the instrument.		
Display Status Message	KpKlp_getDisplay	Displays message in Status Display.
Get Digital Pot Setting	KpKlp_CalDigPot	Sends Digital Pot ± values only during calibration.
Initialize Status Registers	KpKlp_InitReg	Clears status Operation and Event registers
Set Max Voltage/Current	KpKlp_SetMaxLimValue	Sets limit to maximum voltage/current.
Get Max Voltage/Current	KpKlp_GetMaxLimValue	Gets maximum voltage/current limit values.
Set/reset Front Panel Lock	KpKlp_SetResetKeyblock	Sets or resets front panel controls lockout.
Front Panel Lock Status	KpKlp_KeybLockStat	Gets status of front panel lockout
Get Questionable Event	KpKlp_StatQues	Tests and returns contents of Questionable Event register.
Wait for Operation to Complete	KpKlp_WaitOPC~	Waits for operation to complete.
Wait for SRQ	KpKlp_WaitSrq	Waits for SRQ
Run/stop LIST program	KpKlp_Prog	Runs or stops LIST program.

TABLE 1. KLP VISA DRIVER FUNCTIONS (CONTINUED)

Purpose	Function Name	Description
LIST Program Run Status	KpKlp_Prog_Stat	Status of LIST program (running or stopped)
Relay Mode	KpKlp_GetRelayMode	Gets operating mode of instrument relay. 0 = Factory, 1 = Manual, 2 = List Program
Relay Status	KpKlp_GetRelayStatus	Gets on/off status of instrument relay.
Set Relay Status	KpKlp_SetRelayStatus	Sets relay on (energized) or off (de-energized) if Relay Mode is set to Manual (1).
Set Value	KpKlp_SetValue	Sets the output voltage, the output current of the power supply, depending on the slide selection position. The values are checked against the maximum acceptable values for the corresponding power supply.
Get Value	KpKlp_GetValue	Gets the output voltage, the output current of the power supply depending on slide selection position.
Trigger	KpKlp_Trig	Triggers the instrument once. The output will go to the trigger voltage and current values.
Measure Current and Voltage Output Values	KpKlp_MeasVoltCurr	Measures the values of output (voltage and current).
Get Source Mode	KpKlp_GetSourceMode	Gets the operating mode of the power supply.
Output On/Off	KpKlp_OutputOnOff	Sets the output on or off.
Get Output Status	KpKlp_getOutputState	Returns the output status (on or off).
UTILITY FUNCTIONS — This class of functions provides lower level functions to communicate with the instrument and to change instrument parameters.		
Revision Query	KpKlp_RevisionQuery	Returns the revision numbers of the instrument driver and instrument firmware version from the *idn? query. This instrument driver's Revision Number is "Rev 1.0, 9/99, CVI 5.1" and the KLP firmware version is Firmware Version "1.0". This data is necessary when requesting technical support.
Model Query	KpKlp_ModelQuery	Return the model number of the KLP power supply.
Serial Number Query	KpKlp_SerialnQuery	Returns the serial number of the KLP power supply. The serial number is extracted from the answer to the *idn? query.
Query SCPI Version	KpKlp_GetScpiVersion	Returns the power supply answer to the Query SCPI Version command. Checks the Standard Commands for Programmable Instruments (SCPI) language version.
Self-Test	KpKlp_selfTest	Runs the instrument's self test routine and returns the test result(s).
Error-Query	KpKlp_errorQuery	Reads an error code from the instrument's error queue.
Error Message	KpKlp_errorMessage	Takes the Status Code returned by the instrument driver functions, interprets it and returns it as a user readable string.
Calibration Status On/Off	KpKlp_CalStatus	Used to enter or exit the calibration state. To enter the calibration state a 4-character numeric password is required. When the instrument is shipped from the factory the calibration password is as defined in Table 2. The password protects the instrument against unauthorized calibrations.
Calibration Mode	KpKlp_CalMode	Allows the user to select the calibration mode (either voltage, current or external analog calibration) and also allows selection of 0 (min), full scale (max), or external readback calibration.
Calibration Zero	KpKlp_CalZero	Used to zero the output of the power supply before switching from voltage calibration to current calibration (to allow a calibration resistor to be connected between the power supply output terminals.
Calibration Save	KpKlp_CalSave	Stores the calibration results in the nonvolatile calibration memory of the instrument as well as the date included with the Save command.

TABLE 1. KLP VISA DRIVER FUNCTIONS (CONTINUED)

Purpose	Function Name	Description
Security Code	KpKlp_CalCode	Allows the user to change the password to prevent accidental or unauthorized calibrations of the instrument. The password is stored in non-volatile memory, and does not change when power has been off or after a reset. To change the password, the instrument must already be in calibration status, ensuring that the user knows the current password. If the password is lost, call the factory for support.
Close	KpKlp_close	This function takes the instrument off-line.
Calibration Dump	KpKlp_CalDump	Instrument sends calibration data in Intel Hex format.
Calibration Restore	KpKlp_CalRestore	instrument receives calibration data in Intel hex format and replaces the Working Calibration.

TABLE 2. FACTORY DEFAULT CALIBRATION PASSWORDS

MODEL	PASSWORD	MODEL	PASSWORD
KLP 8-150	8150	KLP 75-33-1200	7533
KLP 15-150-1200	1515	KLP 150-16-1200	1516
KLP 25-80-1200	2580	KLP 300-4-1200	3008
KLP 36-48-1200	3680	KLP 600-2	6002

2. DEMONSTRATION PROGRAM USING THE VISA DRIVER

The demonstration program is intended to illustrate the use of the VISA functions included with the KLP power supply. The demonstration program is installed under Windows by running SETUP.EXE. The program as written presents a virtual front panel for control of a single KLP power supply

The following paragraphs describe the windows and the associated controls and indicators provided with the demonstration program. For additional details regarding operation of the KLP, refer to the operating instructions for local and remote mode found in the KLP Operator's Manual .

2.1 GPIB SETUP

After the program is installed, double click on KLPCTRL.exe to run the program.When the GPIB Setup window opens, enter the GPIB address of the KLP power supply to connect to the VISA interface. If the power supply type is correct, the Continue button will open the Main Panel (Figure 2).

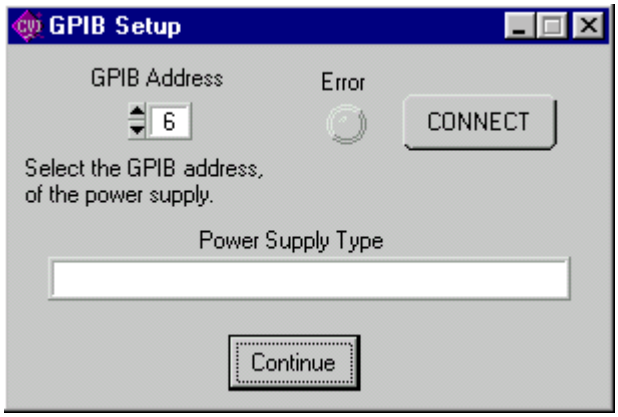


FIGURE 1. GPIB SETUP WINDOW

. Once you are connected, you will see the Main Panel (Figure 2).

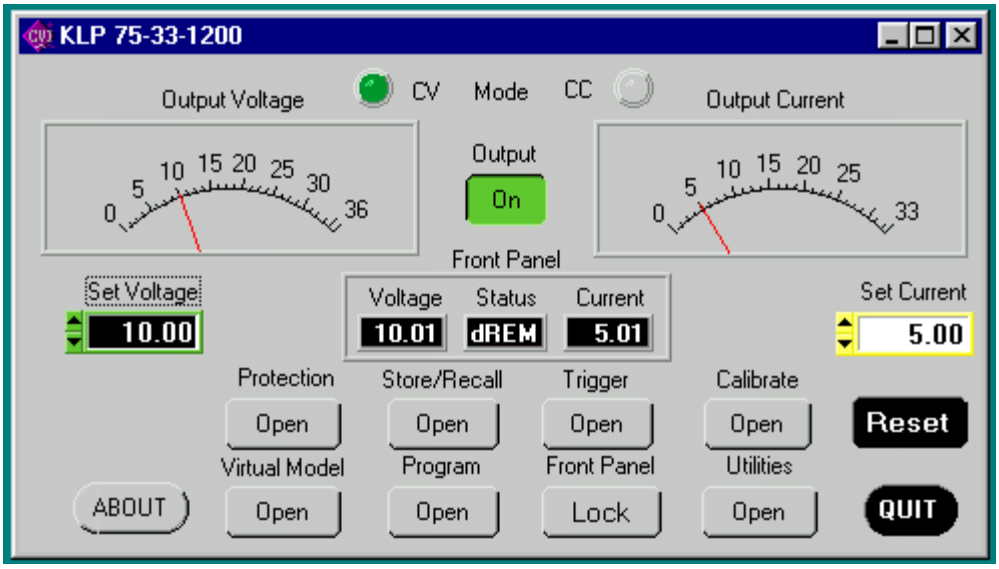


FIGURE 2. MAIN PANEL WINDOW

2.2 MAIN PANEL

The main panel window allows access to all power supply parameters without having to execute local controls and read the corresponding display. The main panel is a real-time display of output values and programmed parameters. All functions are available from the main panel.

The operating mode (CV or CC) Mode indicators light to indicate whether the power supply is operating in either CV (constant voltage) or CC (constant current) mode.

The analog meters read actual output voltage and current; Two windows beneath the meters are provided to enter voltage and current setpoints. The **Front Panel box** shows a precise digital readout of the voltage and current displayed on the analog meters (this is identical to the readouts on the KLP front panel DC VOLTS and DC AMPERES displays) as well as showing messages appearing on the front panel Status Display.

2.2.1 The **Output** button applies the programmed settings to the output terminals when set to ON or keeps the output voltage at zero and current at minimum when set to OFF.

2.2.2 **Set Voltage** and **Set Current** windows are used to program the output voltage and current for the unit; settings can be changed either by clicking on the arrows to the left of the display window, or by using the mouse to highlight the setting, then typing in the new value.

2.2.3 The **Protection** button opens the Protection Window (Figure 3) which allows changing of the overvoltage and overcurrent settings.

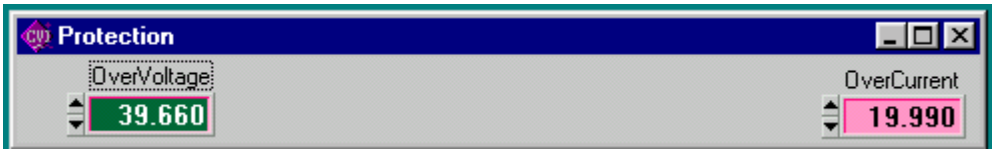


FIGURE 3. PROTECTION WINDOW

2.2.4 The **Store/Recall** button displays the Store/Recall window which can be used to store or recall up to 40 different power supply settings. After selecting a location, the Store button saves the following power supply settings. Voltage Setpoint, Current Setpoint, Relay status, and Output On/Off status. Whenever the same location is selected, the Recall button restores the saved settings.

FIGURE 4. STORE/RECALL WINDOW

2.2.5 The **Trigger** button opens the Trigger window (Figure 5) which allows setting of trigger voltage and current values. Clicking the Trigger button within the Trigger window causes the power supply output to be programmed to the settings stored in the Trigger Voltage and Trigger Current displays. .

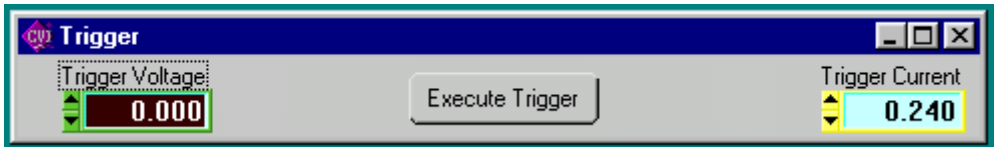


FIGURE 5. TRIGGER WINDOW

2.2.6 The **Calibrate** button opens the Calibration Window (Figure 6), and is used to recalibrate the unit (see Section 4 of the KLP Technical Manual).

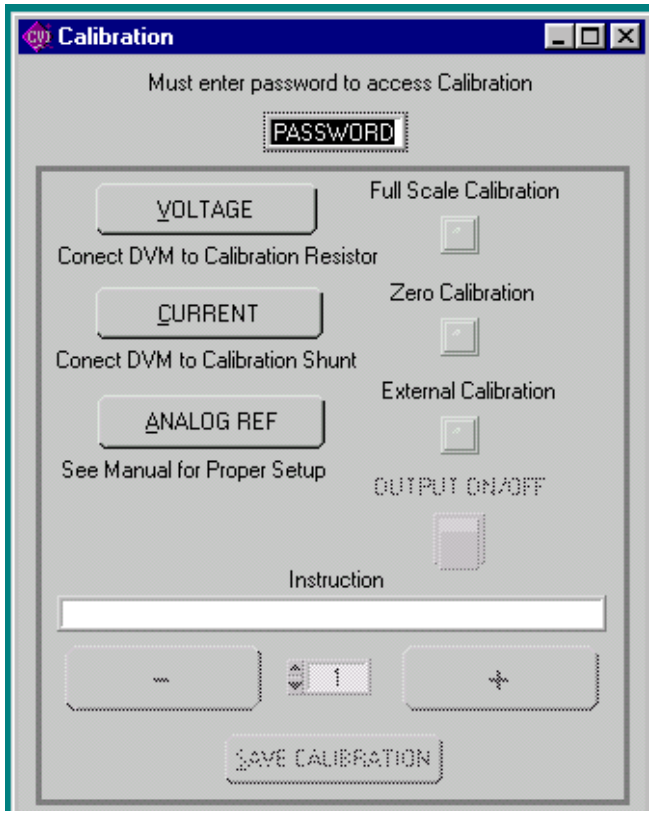


FIGURE 6. CALIBRATION WINDOW

2.2.7 The **ABOUT** button displays the model, serial number, firmware version number and driver version number. Click OK to close the window

2.2.8 The **Virtual Model** button opens the Virtual Model window (Figure 7). The Password must be entered, then the voltage and current limits for a virtual model can be set.

FIGURE 7. VIRTUAL MODEL WINDOW

2.2.9 Running or generating a program (pattern) is accomplished by clicking the **Program** button on the Main Panel, opening the Program Lists window (Figure 8). Programs can either be defined point-by-point using the **Pattern Generator Open** button, or by using the **Pattern Import File Select** button to import a file containing the program parameters. Once the program is started, actual values of output current and voltage are displayed. If you exit the program while the power supply is still on, the programmed settings in effect at that time are maintained after exiting the program. Errors are discussed in PAR. 2.2.14.

2.2.9.1 The **Pattern Generator Open** button opens the Pattern Generation Window (Figure 10); the **Pattern Execution Open** button opens the Pattern Execution window (Figure 11).

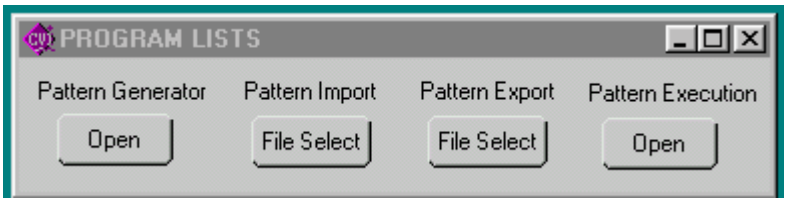


FIGURE 8. PROGRAM LISTS WINDOW

2.2.9.2 Patterns can be imported in comma-delineated text format using the **Pattern Import File Select** button (Figure 8). The format, showing a single data point, is illustrated in Figure 9 and defined as follows:

2.2.9.3 The first line is a header, that defines columns (separated by commas) with a corresponding parameter. The column with a “C” or “c” is defined as Current, “V” or “v” is defined as voltage, “D” or “d” is defined as Dwell Time, and “Y” or “y“ is defined as Relay followed by (CR,LF). The second line defines the first data point, with data separated by commas (in the same order as defined by the header), followed by (CR,LF). Additional data lines define additional data points. The EOF defines the end of the pattern. A pattern produced using the Pattern Generation window (Figure 10) can be saved in this format using the **Pattern Export File Select** button.

```
Current,Voltage,Dwell,Relay(cr,lf)
1.0123E+02,3.600E+02,1.0E-02,0(cr,lf)
(eof)
```

FIGURE 9. FORMAT FOR TYPICAL COMMA-DELINEATED PATTERN GENERATION FILE

2.2.9.4 The Pattern Generation window (Figure 10) allows a user-specified program of up to 100 points to be generated. This method of generating complex patterns, allows rigorous testing of a UUT (Unit Under Test), within the boundaries determined by the virtual model and the load conditions.

2.2.9.5 The **GENERATED POINTS** window shows the number of points currently included in the list for each of the four parameters, CURRENT, VOLTAGE, DWELL and RELAY. The **CLEAR LISTS** button clears all points in the list (individual points can be edited, but not deleted once they have been added).

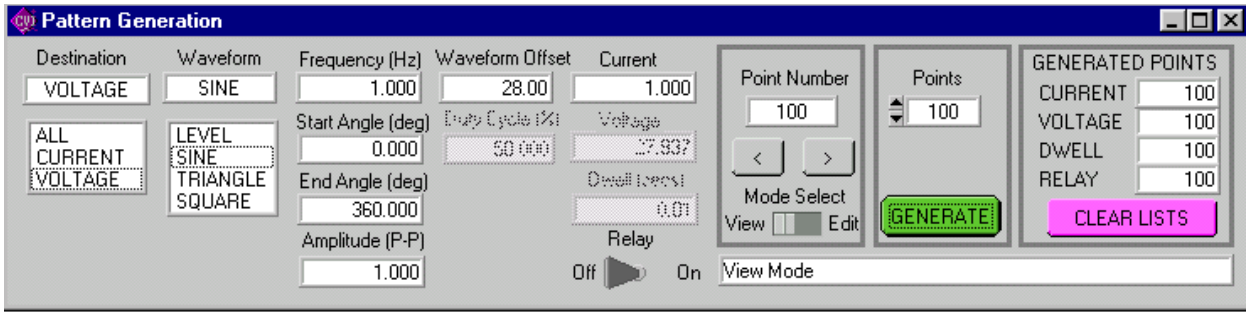


FIGURE 10 PATTERN GENERATION WINDOW

2.2.9.6 There are three choices for **DESTINATION**: ALL, CURRENT or VOLTAGE.

- Destination of **ALL** means that all four parameters, CURRENT, VOLTAGE, DWELL and RELAY must be entered for each point (RELAY is only available if the internal relay has been set to PROGRAM mode). If a Virtual Model has been established, CURRENT and VOLTAGE must be within the operating range of the Virtual Model, otherwise they must be within the rated maximum values of the power supply. DWELL, the amount of time that the programmed parameters will be in effect, can be set to any value from 0.01 to 655.36 seconds. RELAY ON (energized) or OFF (de-energized) controls the Normally Open (I/O Connector, pin 2) and Normally Closed (I/O Connector, pin 10) contacts relative to Relay Common (I/O Connector, pin 4).

- Destination of **CURRENT** or **VOLTAGE** means that a waveform must be selected. The four waveform choices are LEVEL, SINE, TRIANGLE and SQUARE. Waveforms may consist of a single segment, or multiple segments, each defined separately (see PAR. 2.2.9.9 for details).

NOTE: The values chosen for Amplitude and Waveform Offset must be within the limits established by the Protection and Virtual Model windows.

2.2.9.7 With the **MODE SELECT** switch set to VIEW, the parameters for each point can be viewed, but not changed. The values displayed apply to the point indicated in the **Point Number** window. Use the **<** and **>** buttons to navigate through the list or enter a number directly in the **Point Number** window and press ENTER on the computer keyboard to get to a specific point. By changing the **MODE SELECT** switch to **EDIT**, values for existing points can be changed by entering a new value for any of the parameters.

2.2.9.8 As an example, if a five point list was to be entered, where all the values were the same except the voltage, the list could be initially generated by specifying 5 points (which will all be identical), then setting the **MODE SELECT** switch to EDIT and using the **<** and **>** buttons to view and edit the voltage for each point

2.2.9.9 **Complex Pattern Generation.** When the **Destination** is set to CURRENT or VOLTAGE, the pattern generator window (Figure 10) can be used to produce a complex waveform. The complex output is built by adding segments from each of the four basic waveform types: LEVEL, SINE, TRIANGLE or SQUARE. Each time the GENERATE button is clicked, the waveform selected is generated using the number of points specified in the **Points Window**. Setting **Destination** set to CURRENT produces a current waveform; a **Destination** of VOLTAGE produces a voltage waveform.

2.2.9.9.1 The SINE, TRIANGLE and SQUARE waveform types are defined by the following parameters (LEVEL is identical to DESTINATION of ALL, refer to PAR. 2.2.9.6):

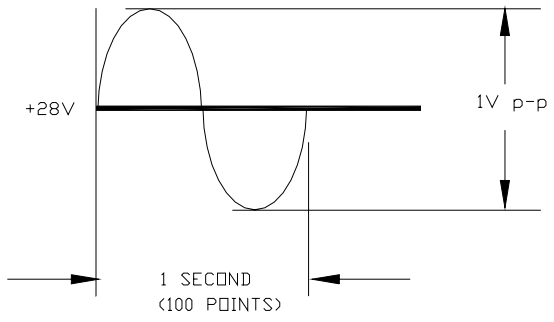
- Frequency (Hz) - Determines the dwell time of the waveform segment by 1/F (Hz) = Time (sec).
- Start Angle (deg) - Integer from 0 to 360 - The starting point for the waveform segment (e.g., to start a sine wave at max positive excursion, the start angle = 90, to start at max negative excursion, start angle = 270).
- End Angle (deg) - Integer from 0 to 360 - The ending point of the waveform segment. E.g., for a negative half cycle of a sine wave, the start angle = 180, end angle = 360.
- Amplitude (p-p) - The peak to peak amplitude of the *complete* waveform segment. E.g., if you want a positive sine wave half cycle (start angle = 0, end angle = 180) from 0 to 15V, the p-p amplitude for that segment must be set to 30V.
- Waveform offset - The d-c level on which the waveform rides. If the negative excursion of the waveform is used, the waveform offset must be sufficient to prevent the output from going below zero, otherwise an error will result when Program RUN is attempted. E.g., if you want a full 15V p-p sine wave cycle (start angle = 0, end angle = 360) from 10 to 25V, the p-p amplitude =15, and the offset must be set to 17.5V (if the offset = 0 an error is produced when Program RUN is attempted because the negative half cycle would require a negative voltage.
- Current (If VOLTAGE destination) or Voltage (if CURRENT destination) - establishes the output current for a voltage waveform, or the output voltage for a current waveform.

2.2.9.9.2 When the segment parameters have been entered, pressing the **GENERATE** button adds the number of points specified in the **Points** window to the list. Note that, particularly in the case of the SINE and TRIANGLE waveforms, the accuracy of the waveshape is affected by the number of points, e.g., a triangle wave produced using 100 points will be close to a true triangle wave, while one produced using 5 points will resemble stair-steps.

2.2.9.9.3 **Pattern Generation, Example 1.** To generate a single cycle of a voltage sine wave comprised of one cycle with an amplitude of 1 volt peak to peak riding on a 28 volt level, a fixed current of 1 amp, with relay off, and a total duration of 1 second, enter the parameters listed in Table 3.

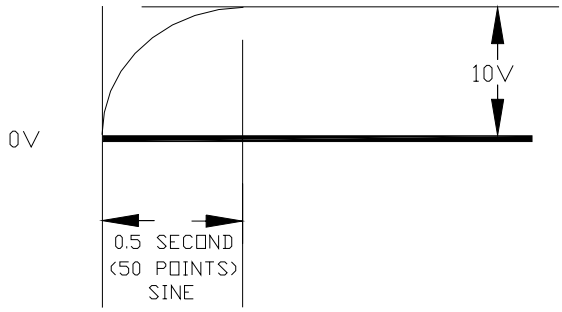
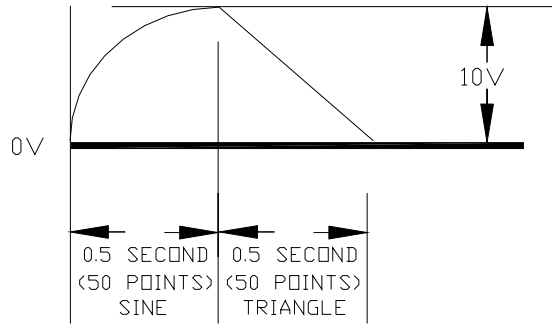
TABLE 3. PATTERN GENERATION, EXAMPLE 1

PARAMETER	ENTER	RESULT
Destination	VOLTAGE	Press GENERATE button after all parameters entered to add 100 points to list which will produce the following output:
Waveform	SINE	
Frequency (Hz)	1.000	
Start Angle	0.000	
End Angle	360.000	
Amplitude (p-p)	1.000	
Waveform Offset	28.000	
Current	1.000	
Relay	OFF	
Points	100	



2.2.9.9.4 **Pattern Generation, Example 2.** To generate a 100 point voltage complex waveform comprised of 1/4 cycle sine wave and 1/4 cycle triangle wave with an amplitude of 10 volt peak to peak riding on 0 volt level, a fixed current of 1 amp, with relay off, and a total duration of 1 second, enter the parameters listed in Table 4.

TABLE 4. PATTERN GENERATION. EXAMPLE 2

STEP	PARAMETER	ENTER	RESULT
1	Destination	VOLTAGE	Press GENERATE button after all parameters entered to add first 50 points to the list:  3042673–2
	Waveform	SINE	
	Frequency (Hz)	2.000	
	Start Angle	0.000	
	End Angle	90.000	
	Amplitude (p-p)	20.000	
	Waveform Offset	0.000	
	Current	1.000	
	Relay	OFF	
	Points	50	
2	Destination	VOLTAGE	Press GENERATE button after all parameters entered to add second 50 points to list which will produce the following output:  3042673–3
	Waveform	TRIANGLE	
	Frequency (Hz)	2.000	
	Start Angle	90.000	
	End Angle	180.000	
	Amplitude (p-p)	20.000	
	Waveform Offset	0.000	
	Current	1.000	
	Relay	OFF	
	Points	50	

2.2.9.9.5 By using combinations of the four basic waveform types, complex waveforms can be generated, and repeated using the Pattern Execution window (see PAR. 2.2.9.10) to provide great flexibility in determining the output.

2.2.9.10 The Pattern Execution window (Figure 11) allows the program established by either the pattern generation window or imported file (see PAR. 2.2.9.2) to be executed. If the **Loop Direction** is set to UP, the **Loop From** window establishes the point in the loop that will start repeating. For example, if the list is 10 points, and **Loop From** is set to 3, the first 2 points would only be executed once, and the points from 3 to 10 would be repeated the number of times specified in the Loop Count Window. If **Loop Count** is set to 0 the program will run continuously until stopped by the user The **RUN** button starts the program. While the program is running the **Running** indicator is on and the **RUN** button changes to a **STOP** button used to halt the program. When the program is halted, the unit reverts to the settings in effect prior to issuing the RUN command. If the **Loop Direction** is set to DOWN, the entire loop will be repeated in the reverse direction (the **Loop From** window is not active). The **Loop count** functions as described above for Loop Direction UP.

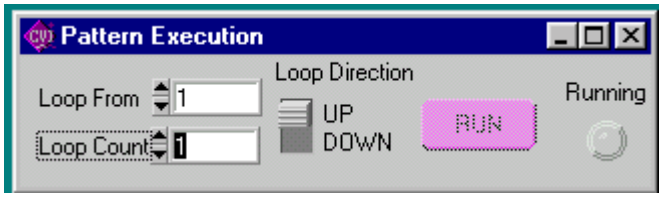


FIGURE 11. PATTERN EXECUTION WINDOW

2.2.10 The **Front Panel** button allows the front panel keyboard to be locked during remote operation.

2.2.11 The **Utilities** button opens the Utilities window (Figure 12).

2.2.11.1 The Calibration Data **Dump** button allows calibration data in hex format to be sent to the host computer via the GPIB.

2.2.11.2 If the correct password is entered, the calibration Data **Restore** button allows the unit to accept previously dumped calibration data and replace the Working calibration.

2.2.11.3 The **Hardware Test** button tests the validity of system parameters (e.g., CRC).

2.2.11.4 The **Full Power Test** button performs a full power test by first testing maximum voltage output, then testing minimum voltage output.

2.2.11.5 The Update Firmware **Open** button allows the unit's firmware to be updated with information supplied by Kepco.

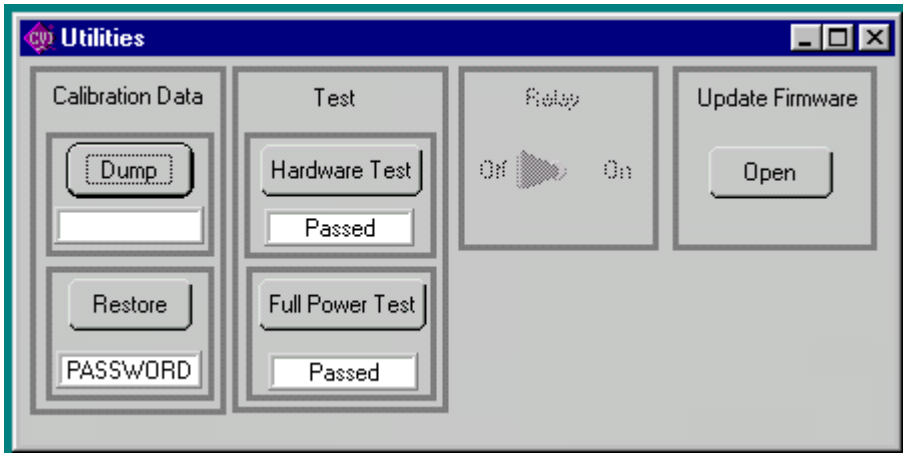


FIGURE 12. UTILITIES WINDOW

2.2.12 The **Reset** button resets the unit to the power up defaults: output voltage set to zero, current set to minimum current, and output off.

2.2.13 The **QUIT** button on the virtual panel (Figure 2) is used to exit the sample VISA application.

2.2.14 Errors will cause the Power Supply Event Window (Figure 13) to open. This allows the user an opportunity to correct the error condition and continue or quit the VISA application.

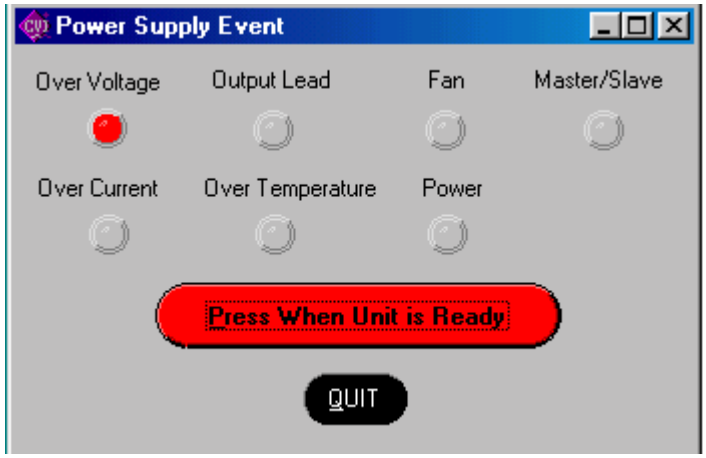


FIGURE 13. POWER SUPPLY EVENT WINDOW

3. PROGRAMMING EXAMPLES.

The following examples show the functions needed to set voltage to 15V, current to 2 amp and output ON.

3.1 EXAMPLE 1:

```
ViByte ps_type;
ViSession KLP_Session;

Kpklp_init ("GPIB0::6", 1, &ps_type, &KLP_Session);     //init ps
Kpklp_Set_Volt_Curr (KLP_Session, 15, 2);               //voltage and current
Kpklp_OutputOnOff ( KLP_Session, 1);                    //output on
```

3.2 EXAMPLE 2:

```
ViByte ps_type;
ViSession KLP_Session;

Kpklp_init ("GPIB0::6", 1, &ps_type, &KLP_Session);     //init ps
Kpklp_SetValue (KLP_Session, 0, 15);                    //voltage
Kpklp_SetValue (KLP_Session, 1, 2);                     //current
Kpklp_OutputOnOff ( KLP_Session, 1);                    //output on
```