TECHNICAL MANUAL

UNIVERSAL BOP GPIB
VISA INSTRUMENT DRIVER

KEPCO INC.
An ISO 9001 Company.

MODEL

UNIVERSAL BOP GPIB
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)

Data subject to change without notice.

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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

UNIVERSAL BOP GPIB VISA INSTRUMENT DRIVER

The VISA instrument driver supplied with BOP Series Power Supplies 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). Included in the driver are:

- source code (C) for all VISA functions (kp_BOP.c)
- a complete programming reference manual (kp_BOP.pdf)
- a sample application of the VISA functions (written in C) which can be used to program one or more BOP power supplies using a virtual front panel observed on a computer monitor (bit.4886.exe).

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. DEMONSTRATION PROGRAM USING THE VISA DRIVER

The demonstration program is intended to illustrate the use of the VISA functions included with the BOP power supply. The demonstration program is installed under Windows by running SETUP.EXE. The program can be used to program and view the virtual front panels of up to 10 BOP Power Supplies. After the program is installed, double click on BOP.exe to run the program.

1. Unzip the files and doubleclick on setup.exe to install the driver. The bit_mdac folder will be added to the Start - Programs folder. Doubleclick bit_mdac.exe to run the program, and refer to the visamdac.pdf in the bit_mdac folder for details about using the soft front panel.
2. Install the VISA driver per the text file included with the driver. At the Start-up screen (Figure 1) set the correct GPIB Address and click **CONNECT**. When the Power Supply Type window shows BIT 4886, click **Continue**.

FIGURE 1. GPIB VISA DRIVER START-UP

Once you are connected to the VISA interface, the virtual front panel appears (see Main Panel, Figure 2).

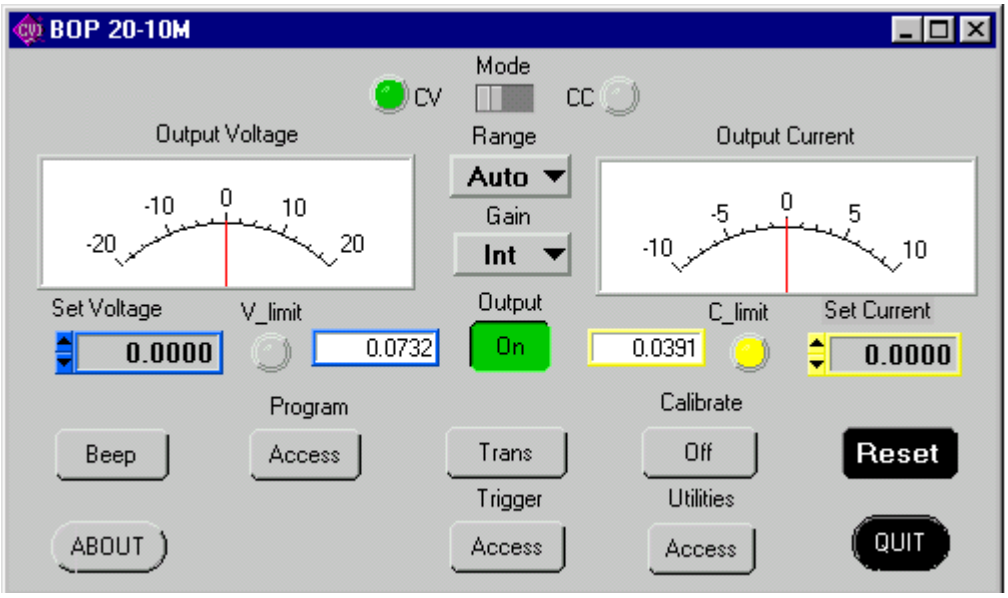


FIGURE 2. MAIN PANEL

1.1 MAIN PANEL BUTTONS

The main panel shows all power supply parameters simultaneously, 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 title bar at the top of the window (not shown) indicates the BOP model connected to the GPIB interface.

NOTE: Some buttons may disabled for special BOP models or those using special BIT cards (special models include a 5-digit suffix).

The **Mode** button changes 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 Display windows at the center provides a more precise digital readout of actual output voltage and current.

The **Range** button opens a dropdown box; to change the operating range: either High, Low or Auto range must be selected.

The **Output** button applies the programmed settings to the output terminals (ON) or keeps the output voltage and current at zero (OFF).

The **Gain** button (available only with BOP's of 1000W and above or MDAC BIT card) opens a dropdown box which allows the selection of the reference voltage: INT for Internal or EXT1 or EXT2 for one of two external analog reference voltages used to calibrate the gain.

Indicators on either side of the digital display window, **V limit** and **C limit**, light (yellow) if the programmed voltage or current limit is exceeded and light (red) if a protection error is detected

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.

The **BEEP** button causes the power supply to beep.

The **ABOUT** button displays the model, serial number and firmware version number.

Running or generating a program (pattern) is accomplished by clicking the **Program** button on the Main Panel (see PAR. 2.1 for details).

The **Trans** button (not available with BIT 4882 card) generates a transient pulse with the amplitude and duration specified by the user in the Transient Pulse window (see Figure 3). The output level of the transient will either be V or A, depending on which mode is active. After the transient pulse is generated, the output will return to the programmed values in effect before the transient was generated.

FIGURE 3. TRANSIENT PULSE WINDOW

The **Trigger** button opens the Trigger window (Figure 4) which allows 99 different trigger voltage and current values, as well as mode to be stored and recalled. The STORE button stores the Trigger Mode, Trigger Voltage and Trigger Current values at the selected Memory location (1-99). The Recall button displays the Trigger Mode, Trigger Voltage and Trigger Current values stored in the selected Memory location. Clicking the Trigger button (or double-clicking RECALL) within the Trigger window causes the power supply output to be programmed to the settings stored in the selected Memory location. .

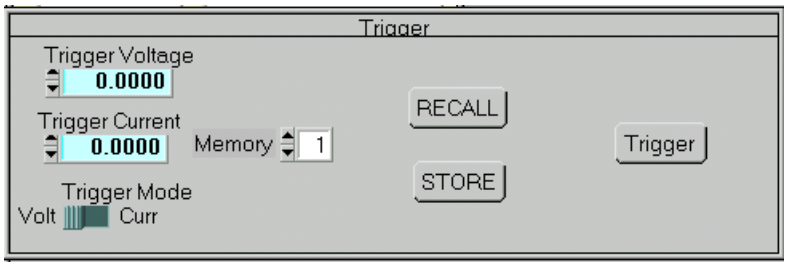


FIGURE 4. TRIGGER WINDOW

The **Calibrate** button opens the Calibration Window (Figure 5), and is used to recalibrate the unit (see Section 3 of the Operator's Manual or Section 4 of the Service Manual).

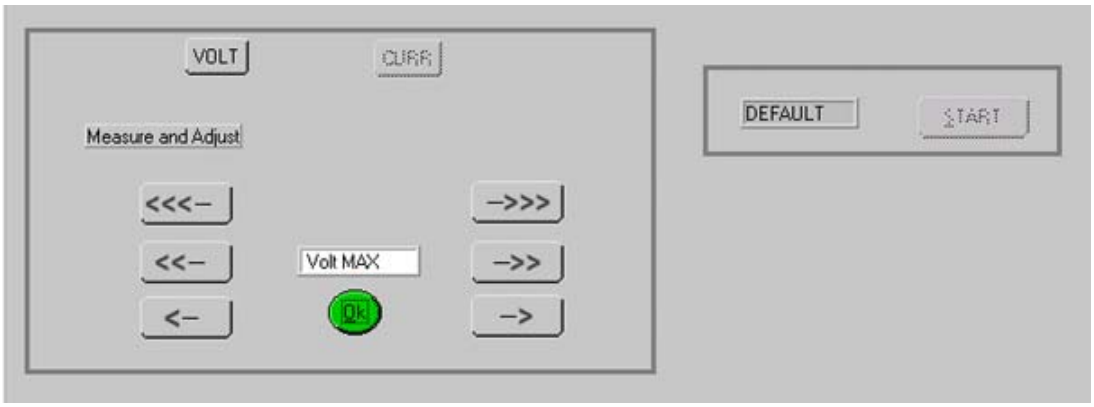


FIGURE 5. CALIBRATION WINDOW

The **Utilities** button opens the Utilities window (Figure 6). The Calibration Data **Dump** button allows calibration data in hex format to be sent to the host computer via the GPIB. If the correct password is entered, the Calibration Data **Restore** button allows the unit to accept previously dumped calibration data and replace the Factory, Working, or Prior calibration.

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

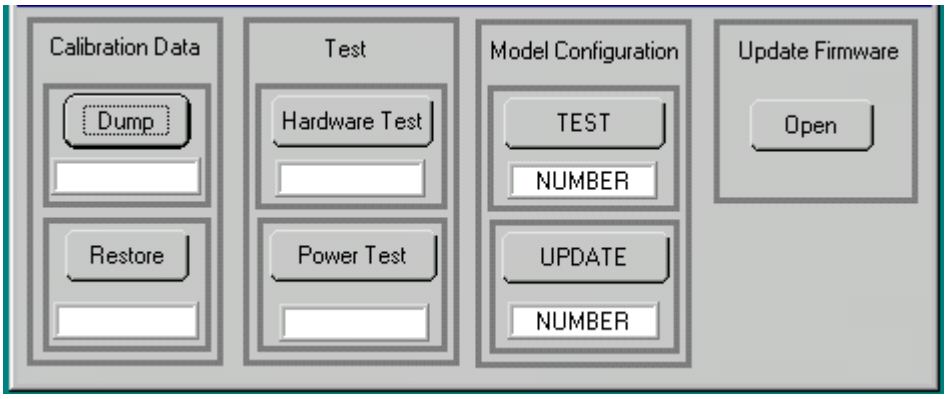


FIGURE 6. UTILITIES WINDOW

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

Model Configuration. Special models of BOP power supplies and BIT interface cards are identified by a 5-digit suffix. A text file supplied with the driver, optionxxxxx.txt (where xxxxx = the 5-digit suffix) identifies how the special unit has been configured using the control commands described in the Theory of Operation section of the applicable technical manual. When the 5-digit number is entered in the Model Configuration TEST **NUMBER** window, and the **TEST** button is pressed, the optionxxxxx.txt file is scanned and the configuration is verified, resulting in either PASSED or TEST FAILS displayed in the TEST **NUMBER** window. **NOTE:** The TEST button must also be used to reconfigure special shutdown requirements each time the VISA application is started.

Entering the 5-digit suffix in the Model Configuration UPDATE **TEST** window and clicking the UPDATE button, restores the factory set special options using the optionxxxxx.txt file. When directed by factory support, this feature can be used to change the configuration of the unit to accommodate customer requests or firmware upgrades.

The **Update Firmware Open** button opens the Update Firmware window (Figure 7) which allows the unit's firmware to be updated with updated information supplied by Kepco.

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

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

1.2 PROGRAM FUNCTIION DETAILS

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.

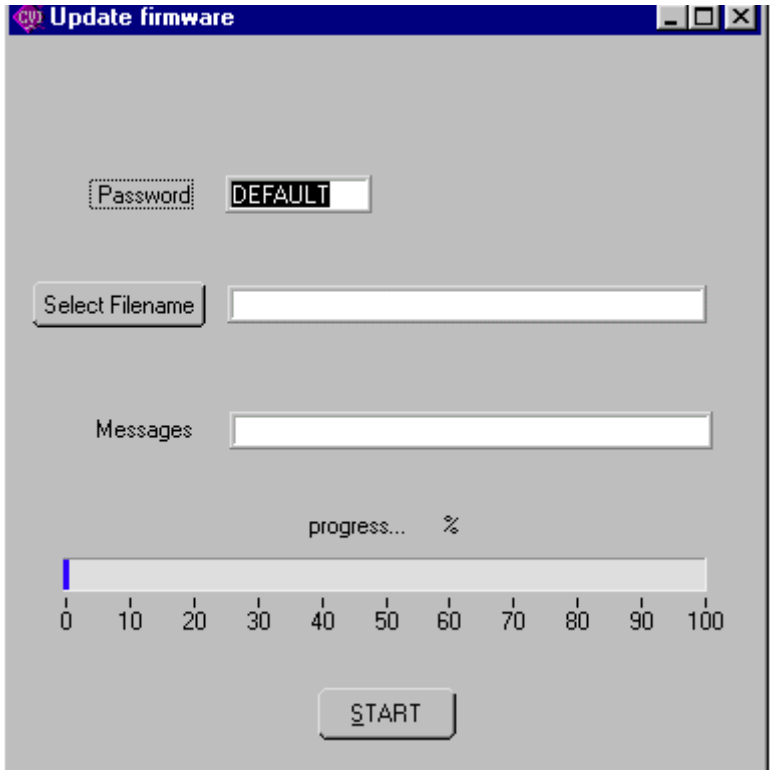


FIGURE 7. UPDATE FIRMWARE WINDOW

1.2.1 PATTERN GENERATION BASICS

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

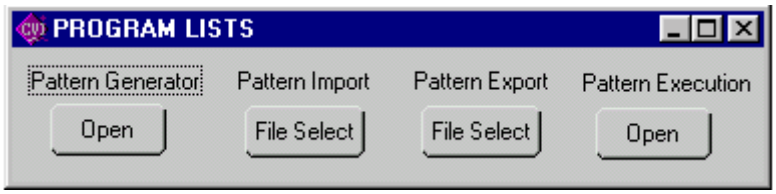


FIGURE 8. PROGRAM LISTS WINDOW

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:

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 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 addi-

tional 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(cr,lf)
1.0123E+02,3.600E+02,1.0E-02(cr,lf)
(eof)
```

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

1.2.2 PATTERN GENERATION WINDOW

The Pattern Generation window (Figure 10) allows a user-specified program of up to 250 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 power supply and the load conditions.

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

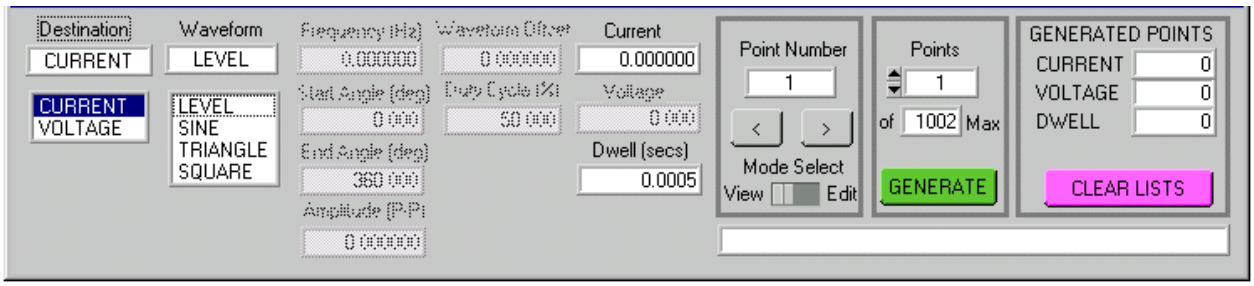


FIGURE 10. PATTERN GENERATION WINDOW

There are two choices for **DESTINATION**: CURRENT or VOLTAGE. This determines what type of waveform to generate. 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. 1.2.3 for details).

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

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.

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

1.2.3 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.

Selection of LEVEL means that all four parameters, CURRENT, VOLTAGE and DWELL must be entered for each point. CURRENT and VOLTAGE must be within the operating range of the Model settings in effect, 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.

The SINE, TRIANGLE and SQUARE waveform types are defined by the following parameters:

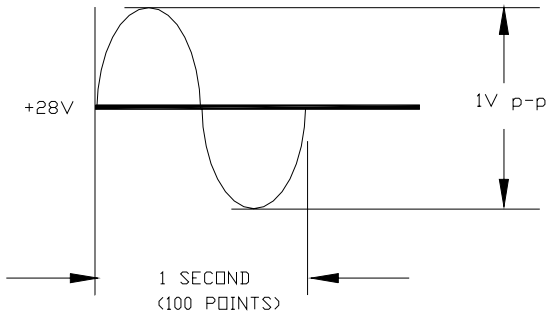
- Frequency (Hz) - Determines the dwell time of the waveform segment by 1/F (Hz) = Time (sec).
- Start Angle (deg) - Integer from 0 to 360 - The starting point for the waveform segment (e.g., to start a sine wave at max positive excursion, the start angle = 90, to start at max negative excursion, start 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.

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 500 points will be close to a true triangle wave, while one produced using 5 points will resemble stair-steps.

1.2.4 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, and a total duration of 1 second, enter the parameters listed in Table 1.

TABLE 1. 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	(blank)	
Points	100	

1.2.5 PATTERN GENERATION, EXAMPLE 2

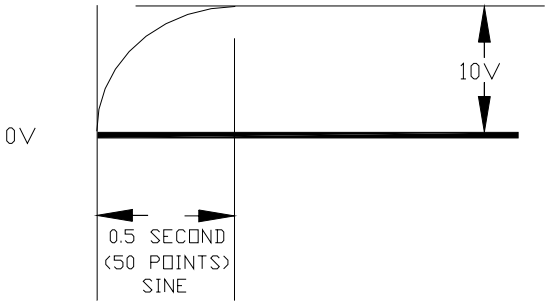
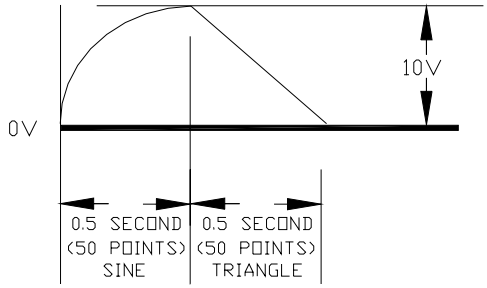
To generate a 100 point voltage complex waveform comprised of 1/4 cycle sine wave and 1/4 cycle triangle wave with an amplitude of 10 volt peak to peak riding on 0 volt level, and a total duration of 1 second, enter the parameters listed in Table 2.

By using combinations of the four basic waveform types, complex waveforms can be generated, and repeated using the Pattern Execution window (see PAR. 1.2.6) to provide great flexibility in determining the output.

1.2.6 PATTERN EXECUTION

The Pattern Execution window (Figure 11) allows the program established by the pattern generation window 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.

TABLE 2. 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	(blank)	
	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	(blank)	
	Points	50	

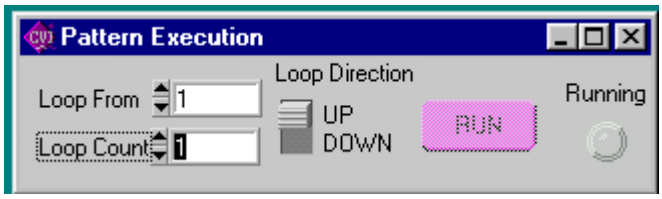


FIGURE 11. PATTERN EXECUTION WINDOW

2. PROGRAMMER REFERENCE

2.1 VISA INSTRUMENT DRIVER FUNCTIONS

Kepco's BOP VISA instrument driver provides programming support for Kepco's BOP Power Supply (VISA I/O). It contains functions for opening, configuring, taking measurements from, test, calibration 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 3 lists the functions that are available.

TABLE 3. BOP VISA DRIVER FUNCTIONS

Purpose	Function Name	Description
INITIALIZE FUNCTION		
Initialize	KpBop_init	Initializes the instrument and sets it to a default configuration.
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.		
Set and Measure	KpBop_ApplicSetMeas	Used to either set and read back, or just read back the output voltage, current and operating mode of the power supply
CONFIGURATION FUNCTIONS — This class of functions configures the instrument by setting system configuration parameters.		
Get Current Range Status	Kpbop_getCurrRange	Unit can operate in either auto, high or low range. The function will return 0 for auto, 1 for high range and 4 for low range
Set Current Range	Kpbop_setCurrRange	Sets the current operating range (auto, high or low)
Get Voltage Range Status	Kpbop_getVoltRange	Unit can operate in either auto, high or low range. The function will return 0 for auto, 1 for high range and 4 for low range
Set Voltage Range	Kpbop_setVoltRange	Sets the voltage operating range (auto, high or low)
Get Minimum or Maximum Value	KpBop_GetMinMaxValue	Gets the minimum or the maximum output voltage, output current of the power supply depending on the min_max switch and slide selection position.
Set Trigger Voltage and Current	KpBop_SetTrig_Volt_Curr	Sets the trigger voltage and trigger current at the same time
Set Trigger Value	KpBop_SetTrigValue	Sets the trigger voltage or trigger current level, depending on the switch position.
Get Trigger Value	KpBop_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.		
Set Voltage and Current	KpBop_Set_Volt_Curr	Sets the output voltage and current at the same time.
Set Value	KpBop_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	KpBop_GetValue	Gets the output voltage, the output current of the power supply depending on slide selection position.
Transient pulse in voltage mode	Kpbop_TransVolt	Sets the power supply to the required value for the indicated time
Transient pulse in current mode	Kpbop_TransCurr	Sets the power supply to the required value for the indicated time
Clear List parameter	Kpbop_ListClr	Clears all the parameters of a list, set direction to UP and SEQ to Default (DSEQ)
Count list parameter	Kpbop_ListCount	Sets the LIST seq to run for COUNT periods

TABLE 3. BOP VISA DRIVER FUNCTIONS (CONTINUED)

Purpose	Function Name	Description
Dwell list parameter	Kpbop_ListDwell	Sets the time a list will run the current step (if entered for only location 0 will apply for all steps)
Executes a list	Kpbop_ListExec	Starts the execution of a list, if all the parameters were correctly set.
Defines list parameters (V or C)	Kpbop_ListData	Calculates the value (V or C, depending on which mode is active) for each of the STEPS of a list, in accordance with the waveform and the max and min values selected
Trigger	KpBop_Trig	Triggers the instrument once. The output will go to the trigger voltage and current values.
Measure Current and Voltage Output Values	Kpbop_MeasVoltCurr	Measures the values of output (voltage and current).
Measure Current and Voltage Output Values	Kpbop_MsVoltCurr	Measures the value of output voltage and then the value of output current.
Measure Output Value	KpBop_MeasValue	Measures the value of output voltage or current depending on the switch position.
Get Source Mode	KpBop_GetSourceMode	Gets the operating mode of the power supply.
Set Gain	Kpbop_SetGain	Select reference voltage INT (internal) , EXT1 or EXT2
Set Source Mode	Kpbop_SetSourceMode	Set power supply mode: voltage or current depending on the switch position.
Output On/Off	KpBop_OutputOnOff	Sets the output on or off.
Get Output Status	KpBop_getOutputState	Returns the output status (on or off).
Abort Measurement	KpBop_abortMeas	Sends the abort command.
Beep	KpBop_beep	The selected BOP power supply will emit a beep.
DATA FUNCTIONS — This class of functions transfers data to or from the instrument.		
Save/Recall Settings	KpBop_SaveRecSet	Saves the current settings to the selected memory location or restores previously stored settings from a memory location. The memory location range is from 1 to 40.
UTILITY FUNCTIONS — This class of functions provides lower level functions to communicate with the instrument and to change instrument parameters.		
Identify Power Supply	KpBop_identify	Returns the full message returned by the power supply to the *IDN? query. This message contains four fields: manufacturer, power supply type, serial number and firmware version.
Revision Query	KpBop_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 BOP firmware version is Firmware Version "1.0". This data is necessary when requesting technical support.
Model Query	KpBop_ModelQuery	Return the model number of the BOP power supply.
Serial Number Query	KpBop_SerialnQuery	Returns the serial number of the BOP power supply. The serial number is extracted from the answer to the *idn? query.
Query SCPI Version	KpBop_GetScpiVersion	Returns the power supply answer to the Query SCPI Version command. Checks the Standard Commands for Programmable Instruments (SCPI) language version.
Write To Instrument	KpBop_writeInstrData	This function writes commands and queries to the instrument to modify parameters and query device settings.
Read Instrument Data	KpBop_readInstrData	This function reads data from the instrument's output buffer and returns it to the specified variable in memory. Because the instrument may return both numeric and text data in response to queries, this function returns the data in string format. NOTE: If valid data is not available at the instrument's output buffer when this function is called, the instrument will hang up and the function will not return until it times out. If the time-out is disabled, this function will hang indefinitely and it may be necessary to reboot the computer to break out.

TABLE 3. BOP VISA DRIVER FUNCTIONS (CONTINUED)

Purpose	Function Name	Description
Reset	KpBop_psReset	Resets the instrument to a known state and sends initialization commands to the instrument.
Self-Test	KpBop_selfTest	Runs the instrument's self test routine and returns the test result(s).
Error-Query	KpBop_errorQuery	Reads an error code from the instrument's error queue.
Error Message	KpBop_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	KpBop_CalStatus	Used to enter or exit the calibration state. To enter the calibration state an 11-character password is required. When the instrument is shipped from the factory the calibration password is "DEFAULT". The password protects the instrument against unauthorized calibrations.
Calibration Mode	KpBop_CalMode	Allows the user to select the calibration mode (either voltage or current calibration) and also allows selection of 0 (min) or full scale (max) calibration.
Calibration Output	KpBop_CalOutput	Allows the user to perform the power supply calibration in both voltage or current mode. By moving the digital to analog converter the number of LSB's specified in the repeat count, the user can approach the 0 or full scale value of the corresponding power supply. This is a fine adjustment for the 0 or full scale value. The user can specify a repeat count between 1 and 9 in order to avoid having to repeat sending the command
Calibration Zero	KpBop_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.
Zero Voltage Calibration	Kpbop_CalVoltZero	Calibrate output zero in Voltage mode.
Zero Current Calibration	Kpbop_CalCurrZero	Calibrate output zero in Current mode.
Volt_low Calibration constants	Kpbop_CalVLSD	Read Calibration constants when unit is in low-volt calibration mode.
Volt Calibration constants	Kpbop_CalVSND	Read Calibration constants when unit is in voltage calibration mode.
Curr_low Calibration constants	Kpbop_CalCLSD	Read Calibration constants when unit is in low-current calibration mode.
Curr_high Calibration constants	Kpbop_CalCSND	Read Calibration constants when unit is in current calibration mode.
Calibration Save	KpBop_CalSave	Stores the calibration results in the nonvolatile calibration memory of the instrument.
Security Code	KpBop_CalCode	Allows the user to change the password to prevent accidental or unauthorized calibrations of the instrument. The password is stored in nonvolatile 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.
Disable Password	Kpbop_PassDis	Allow user to disable the security code.
Dump Calibration	Kpbop_CalDUMP	Save Calibration constants in files.
Restore Calibration	Kpbop_CalRestore	Restore Calibration constants from files.
Close	KpBop_close	This function takes the instrument off-line.

2.2 PROGRAM PRACTICES

In addition to providing prototype functions listed in Table 3, the BOP_MDAC.H file, also provides enumerations for various Kepco-specific variables. The PS_TYPE enumeration defines the various Kepco BOP models supported by the driver and the associated INVALID TYPE. The CAL:MODE and CAL:STATe enumerations provide details for the calibration of various BOP/BIT combinations.

3. EXAMPLES

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

Example 1:

```
#INCLUDE “BOP_MDAC.N”                          /*add definition for driver prototype*/
ViByte ps_type;
ViSession BOP_Session;

Kpbop_init ("GPIB0::6", 1, &ps_type, &BOP_Session);   //init ps
Kpbop_Set_Volt_Curr (BOP_Session, 15, 2);             //voltage and current
Kpbop_OutputOnOff ( BOP_Session, KEPCO_ON);           //output on
```

Example 2:

```
#INCLUDE “BOP_MDAC.N”                          /*add definition for driver prototype*/
ViByte ps_type;
ViSession BOP_Session;

Kpbop_init ("GPIB0::6", 1, &ps_type, &BOP_Session);   //init ps
Kpbop_SetValue (BOP_Session, KEPCO_VOLT, 15);         //voltage
Kpbop_SetValue (BOP_Session, KEPCO_CURRENT, 2);//current
Kpbop_OutputOnOff ( BOP_Session, KEPCO_ON);           //output on
Delay (1);
Kpbop-SetValue BOP_SESSION, KEPCO_VOLT, 25);          //voltage now 25 volts
Delay (1);
Kpbop-SetValue BOP_SESSION, KEPCO_VOLT, 10);          //voltage now 10 volts
```