User Manual HVL Series High Voltage DC Electronic Loads







bkprecision.com

Contents

1 1.1 1.2 1.3 1.4 1.5	Compliance Information EMC Safety IEC Measurement Category & Pollution Degree Definitions Product End-of-Life Handling Terms and Symbols	. 6 . 6 . 7
2	Safety Notices	9
3	Introduction	15
3.1	Overview	15
3.2	Features	16
3.3	Package Contents	17
3.4	Dimensions	18
3.5	Clearance Requirement	20
3.6	Front Panel Overview	21
3.7	Rear Panel Overview	22
4	Getting Started	23
4.1	Input Power and Fuse Requirements	23
4.2	Fuse Requirements and Replacements	24
4.3	Input Connection	25
4.3.	1 Current Carrying Capacity	25
4.3.	2 Noise and Impedance Effects	26
4.4	Local/Remote Sense	27
4.5	Preliminary Check	28
5	Front Panel Operation	30
5.1	Keys	30
5.1.	1 Function Keys	30
5.1.	2 Softkeys	30
5.1.3	3 Programmable Keys and ESC	31
5.1.4	4 Numeric Keys	31
5.1.		32
5.1.	6 Navigation Keys and Screenshots	32
6	Operation Modes	33
6.1	Load Modes	34
6.1.	1 CC Mode	35
6.1.	2 CV Mode	36

6.1.3	CR Mode	38
6.1.4	CW Mode	39
6.1.5	Short Mode	40
6.1.6	Ranges	41
6.2	Transient Operation	42
6.2.1	Configure Transient Mode	42
6.2.1.1	Continuous Transient Mode	44
6.2.1.2	2 Pulse Transient Mode	46
6.2.1.3	3 Toggle Transient Mode	48
6.3	List Mode	50
6.3.1	List Setup	51
6.3.2	Edit List	54
6.4	Analog Digital I/O Connector	57
6.4.1	Digital Output Control	60
6.4.2	Analog State	62
6.5	Parallel Mode	64
6.6	Rise/Fall Measurement Settings	68
7 10	nut Configuration	69
	put Configuration	
7.1	Over Protection	70
7.1.1	Overvoltage Protection (OVP)	70
7.1.2	Overcurrent Protection (OCP)	70
7.1.3	Overpower Protection (OPP)	70
7.2	Input Settings	72
7.2.1	Remote Sense	
7.2.2	Timer State and Setting	72
7.2.3	Slew Rise/Slew Fall (A/ms)	
7.2.4	On/Off Delay	
7.2.5	Loop Response and CR Control	74
7.2.6	Oscillation Protection	74
7.2.7	Averaging	75
7.2.8	Soft Start	75
8 D	ata Logger	77
8.1	Configuring the Data Logger	77
	tility Menu	83
9.1	User Settings	84
9.1.1	Key Lock Input	84
9.1.2	Beep Sound	84
9.1.3	Shortcuts	85
9.1.4	Date and Time	85
9.1.5	Screen Intensity	85
9.1.6	Configuring User Settings	86

9.2	Remote Interfaces	87
9.2.1	USB	87
9.2.2	2 LAN	89
9.2.3	3 Configuring LAN Settings	90
9.3	LAN Status	91
9.4	Web Server	92
9.5	GPIB	93
9.6	Test/Admin	94
9.6.1	Self-Test	94
9.6.2	2 Security	95
9.7	Error Log	97
9.7.1	Saving the Error Log	98
9.7.2	2 Clear the Error Log	98
9.8	Help	99
10	Specifications	101
11	Service Information	103
12	LIMITED THREE-YEAR WARRANTY	104

Compliance Information

1.1 EMC

EC Declaration of Conformity - EMC

Compliance was demonstrated to the following specifications listed in the Official Journal of the European Communities: EMC Directive 2014/30/EU.

EN 61000-3-2: 2006 Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)

EN 61000-3-3: 1995+A1: 2001+A2: 2005 Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

EN 61000-4-2 / -3 / -4 / -5 / -6 / -11 Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques:

- Electrostatic discharge immunity test
- Radiated, radio-frequency, electromagnetic field immunity test
- Electrical fast transient/burst immunity test
- Surge immunity test
- Immunity to conducted disturbances, induced by radio-frequency fields
- Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase

EN 61326-1: 2006 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements



1.2 Safety

EC Declaration of Conformity - Low Voltage

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive: 2006/95/EC.

EN61010-1: 2001 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

1.3 IEC Measurement Category & Pollution Degree Definitions

Measurement Category (CAT) - classification of testing and measuring circuits according to the types of mains circuits to which they are intended to be connected.

Measurement Category other than II, III, or IV : circuits that are not directly connected to the mains supply.

Measurement Category II (CAT II) : test and measuring circuits connected directly to utilization points (socket outlets and similar prints) of the low-voltage mains installation.

Measurement Category III (CAT III) : test and measuring circuits connected to the distribution part of a building's low-voltage mains installation.

Measurement Category IV (CAT IV) : test and measuring circuits connected at the source of the building's low-voltage mains installation.

Mains Isolated : is for measurements performed on circuits not directly connected to a mains supply.

Pollution - addition of foreign matter, solid, liquid, or gaseous (ionized gases) that may produce a reduction of dielectric strength or surface resistivity.

Pollution Degree 2 (P2) - only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is expected

1.4 Product End-of-Life Handling

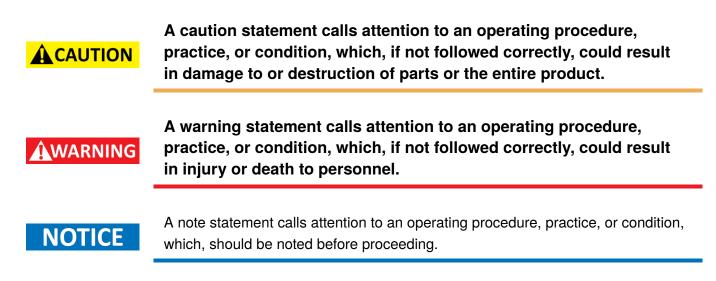
The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product to an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This product is subject to Directive 2012/19/EU of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE), and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal waste. Please utilize your local WEEE collection facilities in the disposition of this product.

1.5 Terms and Symbols

Terms







Symbols



WARNING - HIGH VOLTAGE - possibility of electric shock.



CAUTION – Statements or instructions that must be consulted in order to find out the nature of the potential hazard and any actions which must be taken.



On (Supply). This is the AC mains connect/disconnect switch on the front of the instrument.

 \bigcirc

Off (Supply). This is the AC mains connect/disconnect switch on the front of the instrument.



Alternating current



Chassis (earth ground) symbol

Earth (ground) TERMINAL - Refer to the instructions accompanying this symbol in this manual.

Safety Notices

The following safety precautions apply to both operating and maintenance personnel and must be followed during all phases of operation, service, and repair of this instrument.

Before applying power to this instrument:

- Read and understand the safety and operational information in this manual.
- Apply all the listed safety precautions.
- Verify that the voltage selector at the line power cord input is set to the correct line voltage. Operating the instrument at an incorrect line voltage will void the warranty.
- Make all connections to the instrument before applying power.
- Do not operate the instrument in ways not specified by this manual or by B&K Precision.

Failure to comply with these precautions or with warnings elsewhere in this manual violates the safety standards of design, manufacture, and intended use of the instrument. B&K Precision assumes no liability for a customer's failure to comply with these requirements.

Electrical Power

This instrument is intended to be powered from a CATEGORY II mains power environment. The mains power should be 115 V RMS or 230 V RMS. Use only the power cord supplied with the instrument and ensure it is appropriate for your country of use.

WARNING

Do not use this instrument in an electrical environment with a higher category rating than what is specified in this manual for this instrument.

WARNING

You must ensure that each accessory you use with this instrument has a category rating equal to or higher than the instrument's category rating to maintain the instrument's category rating. Failure to do so will lower the category rating of the measuring system.



Ground the Instrument

WARNING

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical safety ground. This instrument is grounded through the ground conductor of the supplied, threeconductor AC line power cable. The power cable must be plugged into an approved three-conductor electrical outlet. The power jack and mating plug of the power cable meet IEC safety standards.

WARNING

Do not alter or defeat the ground connection. Without the safety ground connection, all accessible conductive parts (including control knobs) may provide an electric shock. Failure to use a properly-grounded approved outlet and the recommended threeconductor AC line power cable may result in injury or death.



Unless otherwise stated, a ground connection on the instrument's front or rear panel is for a reference of potential only and is not to be used as a safety ground. Do not operate in an explosive or flammable atmosphere.

Environmental Conditions

This instrument is intended to be used in an indoor pollution degree 2 environment. The operating temperature range is 0°C to 40°C and 20% to 80% relative humidity, with no condensation allowed.

Measurements made by this instrument may be outside specifications if the instrument is used in nonoffice-type environments. Such environments may include rapid temperature or humidity changes, sunlight, vibration and/or mechanical shocks, acoustic noise, electrical noise, strong electric fields, or strong magnetic fields.

WARNING

Do not operate the instrument in the presence of flammable gases or vapors, fumes, or finely-divided particulates.

The instrument is designed to be used in office-type indoor environments. Do not operate the instrument

- In the presence of noxious, corrosive, or flammable fumes, gases, vapors, chemicals, or finely-divided particulates.
- In relative humidity conditions outside the instrument's specifications.

WARNING

- In environments where there is a danger of any liquid being spilled on the instrument or where any liquid can condense on the instrument.
- In air temperatures exceeding the specified operating temperatures.
- In atmospheric pressures outside the specified altitude limits or where the surrounding gas is not air.
- In environments with restricted cooling air flow, even if the air temperatures are within specifications.
- In direct sunlight.



Do not operate instrument if damaged



If the instrument is damaged, appears to be damaged, or if any liquid, chemical, or other material gets on or inside the instrument, remove the instrument's power cord, remove the instrument from service, label it as not to be operated, and return the instrument to B&K Precision for repair. Notify B&K Precision of the nature of any contamination of the instrument.

WARNING

Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists.

Clean the instrument only as instructed



Do not clean the instrument, its switches, or its terminals with contact cleaners, abrasives, lubricants, solvents, acids/bases, or other such chemicals. Clean the instrument only with a clean dry lint-free cloth or as instructed in this manual. Not for critical applications.



Do not touch live circuits

WARNING

Instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be made by qualified service-trained maintenance personnel who are aware of the hazards involved when the instrument's covers and shields are removed. Under certain conditions, even with the power cord removed, dangerous voltages may exist when the covers are removed.

To avoid injuries, always disconnect the power cord from the instrument, disconnect all other connections (for example, test leads, computer interface cables, etc.), discharge all circuits, and verify there are no hazardous voltages present on any conductors by measurements with a properly-operating voltagesensing device before touching any internal parts. Verify the voltage-sensing device is working properly before and after making the measurements by testing with known-operating voltage sources and test for both DC and AC voltages.

Do not attempt any service or adjustment unless another person capable of rendering first aid and resuscitation is present.

General Safety

WARNING

Do not insert any object into an instrument's ventilation openings or other openings.

WARNING

This instrument is not authorized for use in contact with the human body or for use as a component in a life-support device or system.



Servicing

WARNING

Do not substitute parts that are not approved by B&K Precision or modify this instrument. Return the instrument to B&K Precision for service and repair to ensure that safety and performance features are maintained.



Fuse replacement must be done by qualified service-trained maintenance personnel who are aware of the instrument's fuse requirements and safe replacement procedures. Disconnect the instrument from the power line before replacing fuses. Replace fuses only with new fuses of the fuse types, voltage ratings, and current ratings specified in this manual or on the back of the instrument. Failure to do so may damage the instrument, lead to a safety hazard, or cause a fire. Failure to use the specified fuses will void the warranty.

For continued safe use of the instrument

- Do not place heavy objects on the instrument.
- Do not obstruct cooling air flow to the instrument.
- Do not place a hot soldering iron on the instrument.
- Do not pull the instrument with the power cord, connected probe, or connected test lead.
- Do not move the instrument when a probe is connected to a circuit being tested.

Introduction

3.1 Overview

The HVL Series DC Electronic Loads are versatile instruments used for static and dynamic testing of DC power supplies, batteries, DC-to-DC converters, and battery chargers. Other applications include fuel-cell and photovoltaic cell test.

The DC load can be used in one of the following operation modes: constant voltage (CV), constant current (CC), constant resistance (CR), or constant power (CW). A wide range of dynamic loading applications can be simulated through user-programmable slew rates, load levels, duration, and conducting voltage. The DC load can be remotely programmed via the USB, GPIB, LAN, or RS-232 serial interface. Versatile triggering options allow the dynamic load behavior to be synchronized with other events.

A battery test mode is provided that will measure the ampere-hour (Ah) characteristic of a battery. Shorts can be simulated by either the front panel or custom programming. The DC source or other components can be protected from excessive voltage, current, or power, which will cause the DC load to shut down if excessive levels or reverse polarity are detected.

Model	Max. Input	Max. Input	Max. Input Power
HVL600150	600 V	150 A	3000 W
HVL600300	600 V	300 A	6000 W
HVL80075	800 V	75 A	3000 W
HVL800150	800 V	150 A	6000 W
HVL100025	1000 V	25 A	3000 W
HVL100050	1000 V	50 A	6000 W

Table 3.1HVL Series Models



3.2 Features

- Highest power density of 1.2 kW per 1U rack space
- Input voltage up to 1 kV
- Current range 25 A 300 A
- CC/CV/CR/CP operating modes
- 0.05% CC mode readback accuracy
- Master/Slave parallel operation
- Transient mode up to 10 kHz
- Programmable slew rate
- OVP/OCP/OPP/OTP/ and reverse current protection

3.3 Package Contents

Please inspect the instrument mechanically and electrically upon receiving it. Unpack all items from the shipping carton, and check for any obvious signs of physical damage that may have occurred during transportation. Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment. Every electronic load is shipped with the following contents:

- 1 x HVL DC Electronic Load
- 1 x AC Power Cord
- 1 x Certificate of Calibration



Verify that all items above are included in the shipping container. If anything is missing, please contact B&K Precision.



3.4 Dimensions

The HVL Series dimensions are approximately.

Model	Dimensions (W x H x D)	Weight
HVL 3 kW 3U	478.0 mm x 152.8 mm x 665.0 mm	48.5 lbs (22 kg)
HVL 6 kW 5U	478.0 mm x 241.8 mm x 615.0 mm	73.8 lbs (33.5 kg)

Table 3.2 Dimensions and Weight

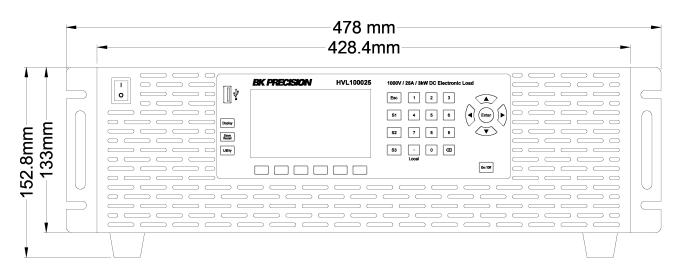


Figure 3.1 Front View HVL 3 kW 3U

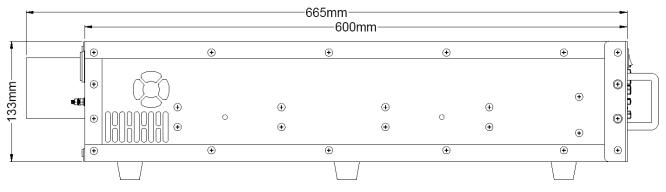
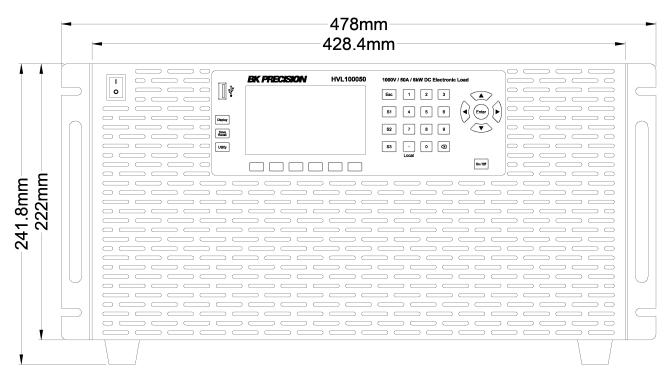


Figure 3.2 Side View HVL 3 kW 3U





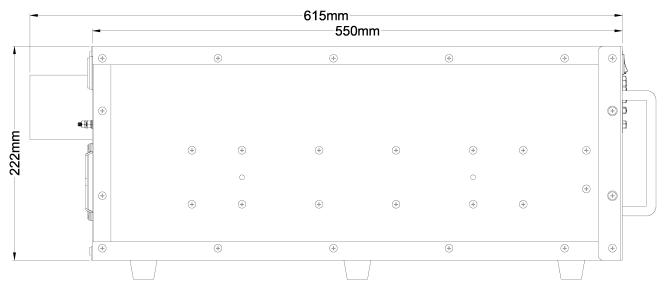


Figure 3.4 Side View HVL 6 kW 5U

3.5 Clearance Requirement

The electronic load draws power from the DUT, generating heat equivalent to the power consumed. Hence, it's crucial to provide sufficient clearance for the electronic load. The HVL series is an air-cooled electronic load with front intake and rear exhaust. During installation, caution must be exercised to ensure that the hot air expelled at the rear does not circulate back to the front intake. Failure to prevent this could lead to over temperature protection (OTP) issues, causing the electronic load to cease operation. Refer to figure 3.5 for the specified clearance requirements for the electronic load.

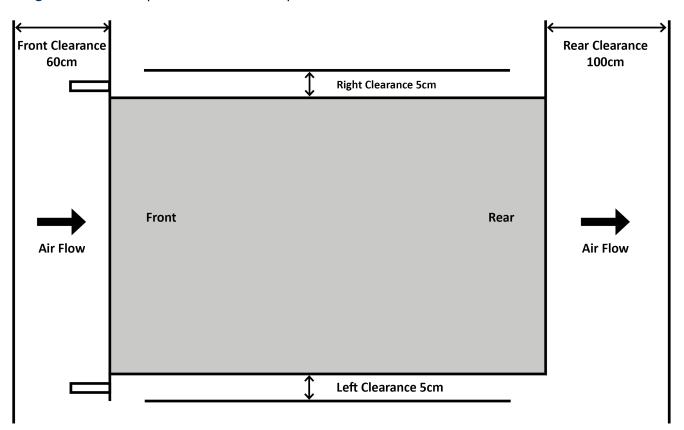
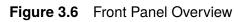


Figure 3.5 Clearance Requirement

3.6 Front Panel Overview

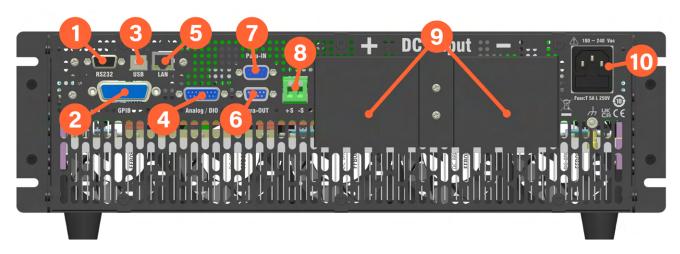


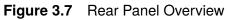
Item	Name	Description
1	Power Button	Toggles the instrument ON or OFF.
2	USB Host Port	USB port used to connect a flash drive.
3	Function Keys	See section 5.1.1 for details.
4	Softkeys	Used to invoke any functions displayed above them.
5	Programmable Keys	See section 5.1.3 for details.
6	Numeric Keypad	Used to enter precise values.
7	Navigation Keys	Used to navigate menus or configure parameters.
8	Input Power Button	Toggles the input ON or OFF

Table 3.3Front Panel Overview

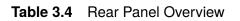


3.7 Rear Panel Overview





Item	Name	Description
1	RS232	Connect a RS232 cable to remotely control the unit.
2	GPIB	Connect a GPIB cable to remotely control the unit.
3	USB interface	Connect a USB type B to type A to remotely control the unit.
4	Analog/DIO	Hardware connection external analog control.
5	LAN interface	Connect a Cat 5/6 Ethernet straight-through patch cable to remotely control the unit.
6	Para-OUT	DB9 connector which provides the synchronization signal for parallel operations.
7	Para-IN	DB9 connector input for the synchronization signal used in parallel operations
8	Sense	Remote Sense terminals
9	Input	Input protection cover.
10	AC power input & fuse box	Houses the fuse as well as the AC input.



Getting Started

Before connecting and powering up the instrument, please review the instructions in this chapter.

4.1 Input Power and Fuse Requirements

The supply has a universal AC input that accepts line voltage input within:

	3 kW 3U Models	6 kW 5U Models		
AC Line Input	100 - 240 Va	ac, 50/60 Hz		
AC Line Phase	Single	Phase		
Maximum Rated Input Power	250 VA	400 VA		

Before connecting to an AC outlet or external power source, be sure that the power switch is in the OFF position and verify that the AC power cord, including the extension line, is compatible with the rated voltage/current and that there is sufficient circuit capacity for the dc load. Once verified, connect the cable firmly.



The included AC power cord is safety certified for this instrument operating in rated range. To change a cable or add an extension cable, be sure that it can meet the required power ratings for this instrument. Any misuse with wrong or unsafe cables will void the warranty.



The power cord provides a chassis ground through a third conductor. Verify that your power outlet is of the three-conductor type with the correct pin connected to earth ground.

AC POWER CORD SPECIFICATION

Wire Size: 16AWG Conductor Type: SJT Rating: 105°C Length: <3m



4.2 Fuse Requirements and Replacements

An AC input fuse is necessary when powering the instrument. All models in the HVL series require a Time delay low breaking capacity 5A/250V (**T 5A L 250V**).

WARNING

For safety, no power should be applied to the instrument while changing line voltage operation. Disconnect all cables connected to the instrument before proceeding.

- 1. Locate the fuse box next to the AC input connector in the rear panel. (See figure 3.7)
- 2. Insert a small flathead screwdriver into the fuse box slit to pull and slide out the fuse box.
- 3. Check and replace fuse if necessary. (See figure 4.1)

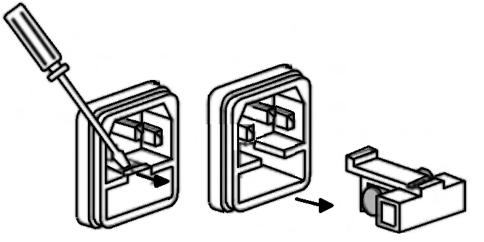


Figure 4.1 Fuse Removal



Any disassembling of the case or changing the fuse not performed by an authorized service technician will void the warranty of the instrument.



Hazardous voltages may exist at the outputs and the load connections when using a power supply with a rated output greater than 60 V. To protect personnel against accidental contact with hazardous voltages, ensure that the load and its connections have no accessible live parts. Ensure that the load wiring insulation rating is greater than to the maximum output voltage of the power supply.

4.3 Input Connection

The electronic load input terminals use M10 screws and nuts or M6 screws threads to connect to the input source. It is recommended to use the proper wire and lug for the load wiring. The following factors are needed to take into consideration:

- Insulation rating of the wire
- Current carrying capacity of the wire
- Noise and impedance effects of the load lines
- Maximum load wiring length for remote sense operation

4.3.1 Current Carrying Capacity

As a minimum, load wiring must have a current capacity greater than the output current rating of the power source. This ensures that the wiring will not be damaged even if the load is shorted.

Table 4.3.1 shows the maximum current rating, based on 450 A/cm², for various gauges of wire rate for 105°C operations. Operating at the maximum current rating results in an approximately 30°C temperature rise for a wire operating in free air.

When load wiring must operate in areas with elevated ambient temperatures or bundled with other wiring, use larger gauges or wiring rated for higher temperature.

Wire Size AWG	2/0	1/0	1	2	4	6	8	10	12	14
Max. Current(A)	303	247	192	155	97	61	36	21	16	10

 Table 4.1
 Current Carrying Capacity



Hazardous voltages may exist at the input terminals with a power source output greater than 40V. To protect personnel against accidental contact with hazardous voltages, ensure that the power source and its connections have no accessible live parts. Ensure that the load wiring insulation rating is greater than to the maximum output voltage of the power source. And, use the input protection cover.

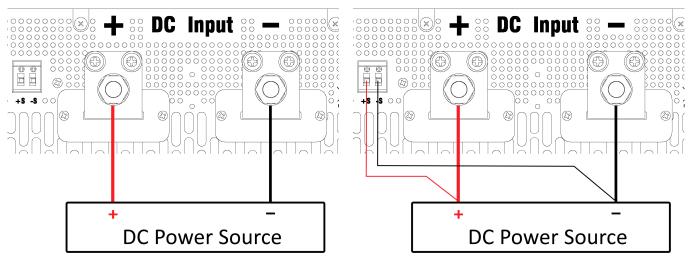
4.3.2 Noise and Impedance Effects

To minimize noise pickup or radiation interference, use a shielded pair wiring or the shortest possible length for load wires. Connect the shield to the chassis via a rear panel mounting screw.

If shielding is impossible or impractical, simply twisting the wires together will offer some noise immunity. When using local sense connections, the user must use the largest practical wire size to minimize the effects of load line impedance on the regulation of the load.

4.4 Local/Remote Sense

The electronic load is capable of sensing voltage locally or remotely. If the load wiring is relatively short and the load regulation is not critical, local sense configuration is good enough. On the other hand, if the load wiring is relatively long, configuring to remote sense will compensate for the voltage drop of the long load leads. Below are figures for local and remote sense configurations.



Local Remote Sense

Remote Sense

Figure 4.2 Local/Remote Sense

To configure the local or remote sense:

- Step 1. Press the Utility softkey to view the utility menu.
- Step 2. Press the Input Config softkey.
- Step 3. Press the Input Settings softkey.
- Step 4. Press the Remote Sense softkey to toggle the remote sense state.



To prevent oscillation or noise interference, it is recommended to twist the remote sense + and – leads.

4.5 Preliminary Check

Complete the following steps to verify the load is ready for use.

Verify AC Input Voltage

Verify and check to make sure proper AC voltages are available to power the instrument. The AC voltage range must meet the acceptable specification as explained in section "2.1 Input Power and Fuse Requirements".

Connect Power & Self-Test

NOTICE

Connect AC power cord to the AC receptacle in the rear panel and press the power button. It will run through a self-test procedure initially before booting to the main screen.

After Power on, during the self-test, the following should be displayed:

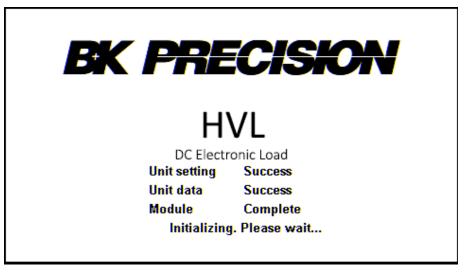


Figure 4.3 Initializing

After the system scan is complete the LCD will display as shown in Figure 4.4

The initial power on state is based on the settings set on Power-ON

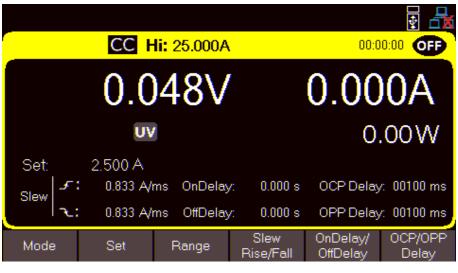


Figure 4.4 Home Display



The HVL series is fully operable upon switching the power ON. However, to reach the specified equipment accuracy, please allow the electronic load to warm up for at least 15 minutes.

Front Panel Operation

At power-on, the load will automatically enter the front-panel operation mode and the instrument can be controlled via the front panel keys and knob.

5.1 Keys

5.1.1 Function Keys

There are three function keys:



When navigating any menu the **Display** key will return to the main display.



Opens up a menu giving access to various save and load options, regardless of the current display of the screen.



Opens the main menu bar. Pressing **Utility** will navigate to the main menu bar if any menu bar is already open.

5.1.2 Softkeys

The unit has six soft keys, which are located beneath the screen. Each key selects the corresponding function. Functions will vary depending on the current menu or display.



Figure 5.1 Soft Keys

5.1.3 Programmable Keys and ESC

The instrument provides three programmable keys. These keys are specialized buttons that can be assigned to perform specific functions or trigger predefined actions. The programmable keys are labeled **S1**, **S2**, and **S3**.

These keys provide users with the flexibility to personalize their experience by assigning frequently used commands. The Default values for each key are as follow:

- S1 : Transient Trigger Settings Menu
- S2 : List Setup Menu
- S3 : Help Menu

For more information on how to program each programmable key refer to **section 9.1**.

The **ESC** key is located on the same column as the programmable keys. Pressing the **ESC** will exit the currently selected parameter or menu. If a parameter is chosen the configuration of the parameters will be exited without saving any values that may have been adjusted after entering the parameter configuration.

When viewing a menu pressing the **ESC** key will return the user to the previous menu.

5.1.4 Numeric Keys

The numeric keys allow for the configuration of the currently selected parameter. Using the numeric keys provides a fast and precise input.

Pressing the Enter key will assign the selected value to the desired parameter.

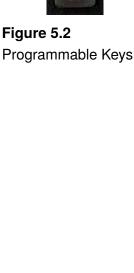




Figure 5.3 Numeric Keys



5.1.5 Input Control

The **ON** button toggles the input On/Off. When input is enabled, the ON button will turn green and the load will commence the loading function.



5.1.6 Navigation Keys and Screenshots

The navigation keys are a set of keys used to navigate through parameters in menus or increase/decrease the value of the selected parameter.

The **Enter** key is included in the navigation keys and is used to select parameters or confirm input values of the selected parameter.

Screenshots can be saved to an external USB device. To take a screenshot insert a U disk into the USB interface located in the front panel, then press and hold the **Enter** + **Save**/ **Recall** keys for 3 seconds.



Figure 5.5 Navigation Keys

A saved indicator will appear in the left top portion of the display. (Figure 5.6)

Screen	shot	t saved succ		🛃 🛃			
		CC H	<mark>li:</mark> 25.000A		00:0		
		0.0	48V	,	0.00	0A	
		UV	l.		0.00W		
Set:	5	2.500 A	ms OnDelay	/: 0.000 s	OCP Delay	/: 00100 ms	
Slew	æ.	0.833 A/	-		-	/: 00100 ms	
Mode		Set	Range	Slew Rise/Fall	OnDelay/ OffDelay	OCP/OPP Delay	

Figure 5.6 Screenshot Indicator

Operation Modes

The HVL series offers the following modes.

6.1 Load Modes	34
6.1.1 CC Mode	35
6.1.2 CV Mode	36
6.1.3 CR Mode	38
6.1.4 CW Mode	39
6.1.5 Short Mode	40
6.1.6 Ranges	41
6.2 Transient Operation	42
6.2.1 Configure Transient Mode	42
6.2.1.1 Continuous Transient Mode	44
6.2.1.2 Pulse Transient Mode	46
6.2.1.3 Toggle Transient Mode	48
6.3 List Mode	50
6.3.1 List Setup	51
6.3.2 Edit List	54
6.4 Analog Digital I/O Connector	57
6.4.1 Digital Output Control	60
6.4.2 Analog State	62
6.5 Parallel Mode	64
6.6 Rise/Fall Measurement Settings	68



6.1 Load Modes

The electronic load provides five static load modes. They are constant current (CC) mode, constant voltage (CV) mode, constant resistance (CR) mode, constant power (CP) mode and short mode.

To view the **Modes** menu return to the home page by pressing the **Display function key**, then press the F1.



Figure 6.1 Static Modes

When programmed to a mode, the electronic load remains in that mode until another mode is selected.

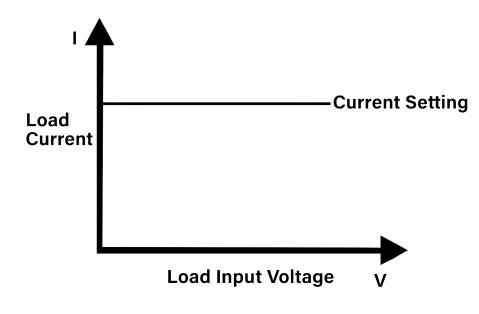


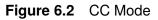
If the selected mode is in operation, the input must first be disabled in order to change to any other **Static** mode.



6.1.1 CC Mode

In constant current mode, the load will sink a current in accordance with the programmed value regardless of the input voltage.





To select CC mode return to the home page by pressing the **Display function key**, then press the **F1 softkey** to enter the **Mode Menu**. In the **Mode Menu** press the **F1 softkey** to select CC.

Configure CC Parameters

There are several parameters that must be setup in CC mode. These parameters are accessible once CC is selected. Use the softkey to select the available parameters, then use either the **numeric keypad** or the **navigation keys** to configure the parameter.

Set

Sets the current value the load will sink.

Slew Rise/Fall A/ms

Sets the rise and fall slew rate of the load, which determines the rate at which the input current increases and decreases to a new programmed value.



6.1.2 CV Mode

In constant voltage mode the load will sink enough current to control the DUT voltage to the programmed value. The load acts as a shunt voltage regulator when operating in CV mode.

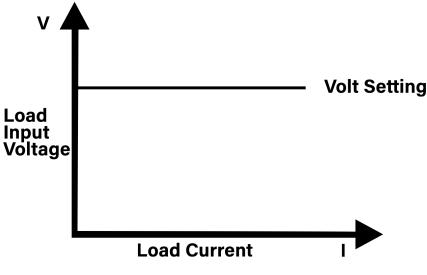


Figure 6.3 CV Mode

To select CV mode return to the home page by pressing the **Display function key**, then press the **F1 softkey** to enter the **Mode Menu**. In the **Mode Menu** press the **F2 softkey** to select CV.

Configure CV Parameters

There are several parameters that must be setup in CV mode. These parameters are accessible once CV is selected. Use the softkey to select the available parameters, then use either the **numeric keypad** or the **navigation keys** to configure the parameter.

Set

Sets the voltage value the load will maintain.

Slew Rise/Fall A/ms

Sets the rise slew rate of the load, which determines the rate at which the input voltage increases to a new programmed value.

Oscillation in CV Mode

In CV mode, the system's response speed correlates directly with three factors:

- 1. Equivalent output capacitance of the Device Under Test (DUT): A higher output capacitance results in slower voltage climb/fall speed.
- 2. Load's current sink capacity: Greater capacity leads to faster voltage drop.
- 3. DUT's current output capacity: Higher output capacity leads to faster voltage climb.

The potential combinations of output capacitance and output current in the DUT are practically infinite. Hence, the HVL series incorporates various loop response settings to ensure compatibility across a broad spectrum of power supplies. These settings adapt the loop response speed to the varying output capacitance values of the DUT.

In contrast to CC mode, a slower response speed doesn't necessarily diminish the likelihood of oscillation. If the power's output capacitance is extensive and the CV loop control lacks sufficient compensation, the power supply might oscillate between CC and CV modes, manifesting a gradual oscillation pattern.

The factory default setting, carefully crafted to suit most scenarios, strikes a balance between speed and caution, avoiding extremes of either excessive sluggishness or undue haste. High-Voltage Limiting is employed to maximize the "Normal" operational range within the CV loop control.

If a user encounters the aforementioned slow oscillation, switching the speed setting to "Fast" is recommended. For other abnormalities or higher frequency oscillations, adjusting the speed setting to "Low" is advised. In applications where a DC electronic load is essential for testing power supplies, a response speed capable of accommodating load transients without undue delay is essential. However, in CV mode, a universal loop response speed applicable to all DUTs or power supplies does not exist.

As a result, users must acknowledge the potential for oscillations when utilizing a load. High-power oscillations, reaching several kilowatts, pose a substantial risk, potentially causing damage to both the load and the DUT, emphasizing the importance of precautionary measures. In such cases, the HVL Series integrates an Oscillation Protection feature, offering post-oscillation adjustments to align with the user's requirements.



6.1.3 CR Mode

In constant resistance mode the load will sink a current linearly proportional to the voltage in accordance with the programmed resistance value.

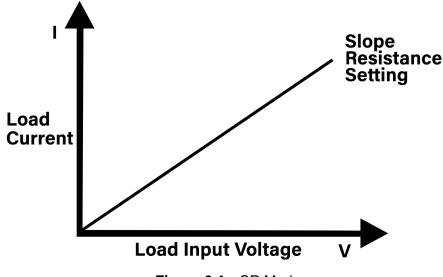


Figure 6.4 CR Mode

To select CR mode return to the home page by pressing the **Display function key**, then press the **F1 softkey** to enter the **Mode Menu**. In the **Mode Menu** press the **F3 softkey** to select CR.

Configure CR Parameters

There are several parameters that must be setup in CR mode. These parameters are accessible once CR is selected. Use the softkey to select the available parameters, then use either the **numeric keypad** or the **navigation keys** to configure the parameter.

Set

Sets the resistance value the load will maintain.

Slew Rise/Fall A/ms

Sets the rise slew rate of the load, which determines the rate at which the input current increases/decreases due to a new programmed resistance.

Free-Run/Fine-Tune

The FREE-RUN setting will set the user desired CR value once and will not change during the operation.

The FINE-TUNE setting will set the user desired CR value and continuously adjust the internal DAC from the feedback of the voltage and current to maintain more accurate CR value. For more information on how to configure this parameters please refer to **section 7.2**.



6.1.4 CW Mode

In constant power mode the load will maintain the input power at the specified programmed power level.

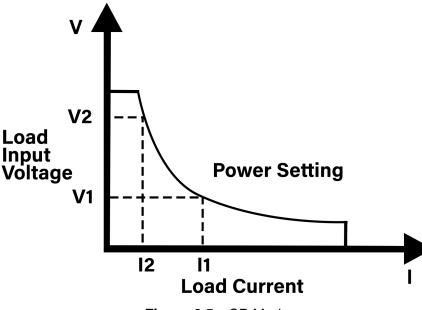


Figure 6.5 CP Mode

To select CP mode return to the home page by pressing the **Display function key**, then press the **F1 softkey** to enter the **Mode Menu**. In the **Mode Menu** press the **F4 softkey** to select CP.

Configure CW Parameters

There are several parameters that must be setup in CW mode. These parameters are accessible once CW is selected. Use the softkey to select the available parameters, then use either the **numeric keypad** or the **navigation keys** to configure the parameter.

Set

Sets the wattage value the load will maintain.

Slew Rise/Fall A/ms

Sets the rise slew rate of the load, which determines the rate at which the input current increases/decreases due to a new programmed wattage.

6.1.5 Short Mode

The HVL Series can simulate a short-circuit at the input. This allows for a short-circuit load test up to the maximum current range of the load.

					¥ 🖧
	CC Hi: 25.000A			00:0	0:00 OFF
0.048V		1	0.00	0A	
	U	/		0	W00.
Set:	2.500 A				Short
Slew	0.833 A/	ms OnDelay	/. 0.000 s	OCP Delay	/: 00100 ms
ا ت	0.833 A/	ms OffDelay	/: 0.000 s	OPP Delay	/: 00100 ms
Mode	Set	Range	Slew Rise/Fall	OnDelay/ OffDelay	OCP/OPP Delay

Figure 6.6 Short Mode

To select **Short** mode return to the home page by pressing the **Display function key**, then press the **F1 softkey** to enter the **Mode Menu**. In the **Mode Menu** press the **F5 softkey** to select Short.



The load will still report the previously selected mode. In **Figure 6.6** we can see the instrument is still displaying CC but the **Short** indicator is now present below the wattage read back.

NOTICE

The input on/off and the input protection functions take precedence over an input short.



6.1.6 Ranges

The HVL series provides three range settings; High, Low, and Custom. **Low Range** is 1/10 of the full scale, while **High Range** is full scale. **Custom (Set Range)** allows the user manually configure any range equal to or less than full scale. These ranges are all applicable to all **Static Modes**; CC, CV, CR, CW.

The range can be configured by pressing the **F3 softkey** while in the home page of the selected mode.

The selected range will be displayed in the Input Status Bar.

NOTICE

If a custom range was set, the Input Status Bar will display Lo or Hi depending on where the value falls on the full scale.

6.2 Transient Operation

Transient operation enables the module to periodically switch between two load levels. This function allows for dynamic characteristics of power supplies or other DC sources. Transient operation is available in CC, CR, CV and CP modes.

Transient testing can be used to check the stability of the source voltage. Transient functions have two current levels denoted as Level-A and Level-B, which must be in the same range. You can set the frequency as well as the duty cycle, which will affect the timing and width of each level. The slew rate determines the rate at which the level changes.

6.2.1 Configure Transient Mode

There are five 4 transient testing modes: Continuous, Toggle, Pulse, List, and Trigger. To set the transient mode follow the steps below:

Step 1. Press Utility > Input/Seq. Mode > Transient Mode to enter the Transient Trigger Settings menu.

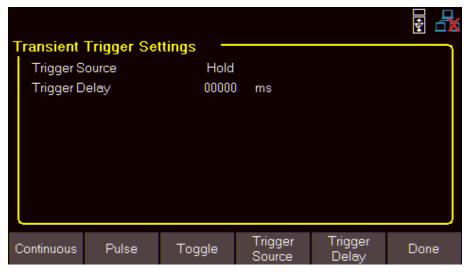


Figure 6.7 Transient Trigger Settings Menu

- Press the **F4 softkey** to configure the **Trigger Source**. Three trigger sources are available **Hold, Bus, External**
 - **Hold**: The trigger source is the press of the trigger key, either assigned to a programmable key or appears as a softkey when the trigger function becomes available (see **Figure 6.8**).
 - Bus: The trigger source is sent remotely using the SCPI command *TRG.
 - External: External triggering is offer through the Analog Digital I/O Connector. An external TTL compatible signal is used to trigger the next level of the transient mode.



0.047V 0	0.000A
UV	0.00W
A Level: 2.500 A A B Level: 5.000 A	
Stop A/B Trigger Transient Level	Done

Figure 6.8Hold Trigger Available

- Step 2. Press the F5 softkey to configure the Trigger Delay function.
 - Sets the delay time between the trigger being sent and the triggering function occurring.

NOTICE The trigger parameters do I

The trigger parameters do not apply to continuous transient mode.

- Step 3. Press the corresponding softkey to select the desired Transient mode; Continuous(F1 Softkey), Pulse(F2 Softkey), Toggle(F3 Softkey)
- **Step 4.** Configure the parameters needed for each transient mode. (refer to the subsection of the corresponding mode.)

6.2.1.1	Continuous Transient Mode	44
6.2.1.2	Pulse Transient Mode	46
6.2.1.3	Toggle Transient Mode	48

6.2.1.1 Continuous Transient Mode

Generates a respective pulse stream that toggles between two load levels. Upon receiving a trigger, and the load will continuously switch between the A/B levels preset.

Transient loads are usually used to test the power supply's performance under continuous changing load conditions. **Figure 6.9** shows an example waveform of continuous transient operation mode.

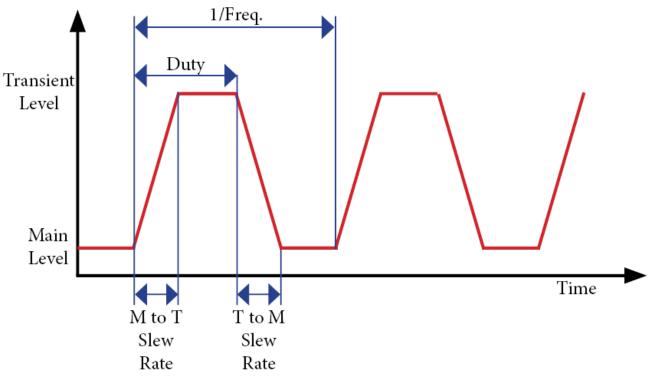


Figure 6.9 Continuous Transient Mode



Continuous CC Hi: 25.000A	L.	00:00	
0.047V	,	0.00	0A
UV		0.	00W
A Duty Duty 50 %			500 A 000 A
Start Freq Duty Transient Period Cycle	A/B Level		Done

Figure 6.10 Continuous Transient Mode Menu

To start the Continuous Transient Function press the F1 Softkey.



Pressing the **Start Transient** softkey will not enable the load input. The input must be enabled manually.

Freq/Period

The period value represents the time it takes for a periodic waveform to complete one full cycle or repetition. The period is set in seconds and is inversely proportional to the frequency of the waveform.

A shorter period indicates a higher frequency and faster repetition of the waveform, while a longer period signifies a lower frequency and slower repetition.

Duty Cycle

Duty cycle value refers to the ratio of time that a periodic waveform spends in the "on" state compared to the total period of the waveform. It describes the proportion or percentage of time that a signal or pulse is active or high during each cycle.

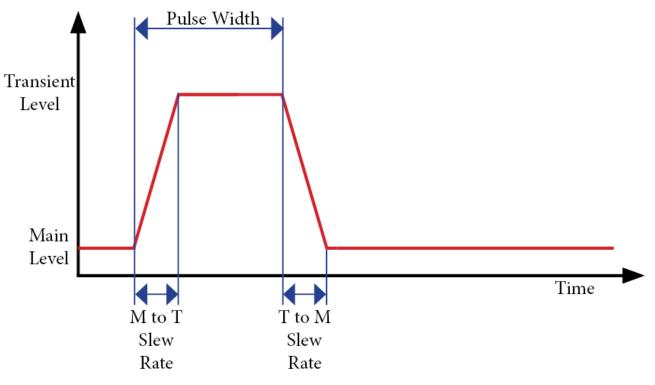
The duty cycle is expressed as a percentage where a duty cycle of 50% means the signal is active for half of the period, and a duty cycle of 100% indicates that the signal remains active for the entire period. Conversely, a duty cycle of 0% means the signal is always inactive. The duty cycle can only be set between 01% and 99%.

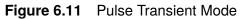
A/B Level

The A/B Level refers to the two values the transient function will transition between. The values units will vary depending on the selected **Load Mode**.

6.2.1.2 Pulse Transient Mode

In pulse transient operation, the electronic load generates a pulse with user-defined amplitude and width when a trigger signal is received.







Pulse CC Hi: 25.000A	00:00:00 OFF
0.048V	0.000A
UV	0.00W
B A A Width: 500.000 ms A Level: 2.500 A B Level: 5.000 A	
Start Pulse A/B Transient Width Level	Done

Figure 6.12 Pulse Transient Mode Menu

To start the Pulse Transient Function press the F1 Softkey.



Pressing the **Start Transient** softkey will not enable the load input. The input must be enabled manually.

Pulse Width

The pulse width value refers to the duration or length of time that a pulse remains on the specified level. Pulse width is measured is specified in ms.

A shorter pulse width corresponds to a narrower active portion of the waveform, resulting in a higher frequency and faster switching. Conversely, a longer pulse width indicates a wider active portion, resulting in a lower frequency and slower switching. By adjusting the pulse width, the duty cycle can precisely be manipulate to achieve the behavior and functionality of a transient system.

A/B Level

The A/B Level refers to the two values the transient function will transition between. The values units will vary depending on the selected **Load Mode**.

6.2.1.3 Toggle Transient Mode

In toggle transient operation the electronic load will switch between the main level and the transient level when a trigger signal is received.

The load will remain at the transient level until another trigger is received, at which time the load will switch back from the transient level to the main level.

Both of these switches in level occur in accordance with the user specified slew rate. **Figure 6.13** shows the current waveform in toggle transient operation.

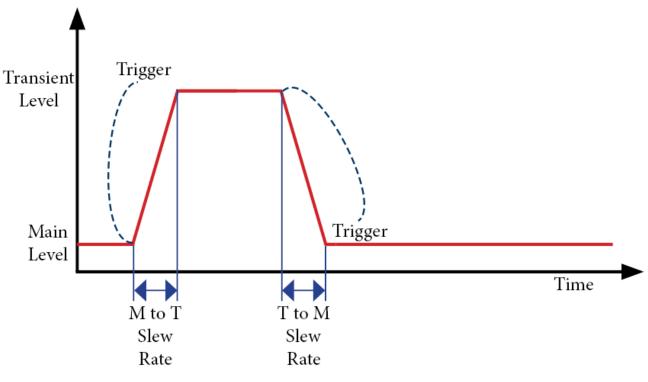


Figure 6.13 Toggle Transient Mode



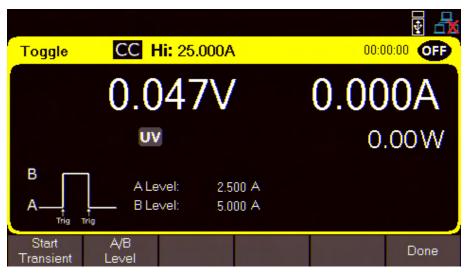


Figure 6.14 Toggle Transient Mode Menu

To start the Toggle Transient Function press the F1 Softkey.



Pressing the **Start Transient** softkey will not enable the load input. The input must be enabled manually.

A/B Level

The A/B Level refers to the two values the transient function will transition between. The values units will vary depending on the selected **Load Mode**.



6.3 List Mode

List mode allows users to generate complex sequences of input changes with rapid, precise timing, which may be synchronized with internal or external signals.

The HVL series is capable of storing up to 10 programmable lists in the internal memory. Each list can have up to 100 configurable steps.

If all ten list numbers are taken, a list can also be saved to a USB drive. Lists can be loaded from a USB drive, allowing for a larger collection of programmed lists.

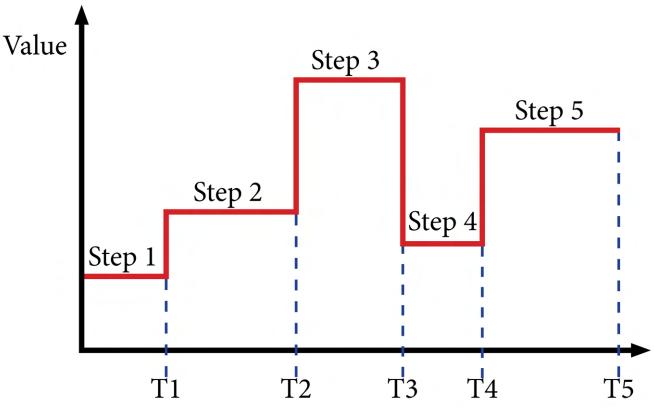


Figure 6.15 List Programmed Steps

6.3.1 List Setup

List mode consist of two portions List Setup and List Configuration.

To setup up list mode follow the steps below:

Step 1. Press Utility > Input/Seq. Mode > List Setup > List Setup to enter the List Setup menu.

.ist Setup				¥ 🖧
List State	Off			
List Number	01			
Pace	Dwell			
Trigger Source	Manual			
Trigger Delay	00000			
After List	DC			
				J
List State List Number	Pace	Trigger Source	> NextPg.	Done

Figure 6.16 List Setup Menu Page 1

Step 2. Press the F1 softkey to toggle the List State ON/OFF.



List State must be enabled in order to be able to execute the sequence from the home page. When enabled the function of the F1 softkey in the home page will change to List Start as shown in figure 6.17

	CC F	<mark>li:</mark> 25.000A	L Contraction	00:0	
	0.0	47V	f	0.00	0A
	UV			0.	.00W
Set: : Slew	2.500 A 0.417 A/i 0.417 A/i	-		-	x: 00100 ms x: 00100 ms
List Start	Set	Range	Slew Rise/Fall	OnDelay/ OffDelay	OCP/OPP Delay

Figure 6.17 List Start

Step 3. Press the F2 softkey to set the List Number of the list to be executed or configured.

- The numeric keypad or the up and down navigation keys can be used to set the value.
- Step 4. Press the F3 softkey toggle the Pace between Dwell and Trigger.
 - a. **Dwell**: The next step outputs once the dwell time elapsed
 - b. Trigger: After the dwell time elapsed, wait for a trigger before outputting the next step.
- Step 5. Press the F4 softkey open the Trigger Source submenu.
 - a. **Manual**: Select to use a manual trigger. The **Trigger** softkey will be available once **List State** is on and exit out of the menu to the main display. Press it to manually trigger the list program. If the step dwell time has not elapsed, then **Trigger** will not have a white background. When dwell time elapses, **Trigger** background color will turn white to indicate the trigger is ready.

_					🛃 🗗
	CC F	<mark>li:</mark> 25.000A		00:0	0:00 OFF
	0.0)48V		0.00	0A
	UV	1		0	.00W
Set:	2.500 A				
Slew S	0.417 A/	ms OnDelay	r. 0.000 s	OCP Delay	/: 00100 ms
ا ت	0.417 A/	ms OffDelay	r 0.000 s	OPP Delay	/: 00100 ms
List Abort	Trigger	Set Range	Slew Rise/Fall	OnDelay/ OffDelay	OCP/OPP Delay

Figure 6.18 Waiting for Trigger

- b. **Digital IO**: Select to use the digital I/O pins to receive a trigger. To assign trigger input function to a pin see **section 6.4.1**.
- c. **Remote**: Select to receive a trigger from the remote interface.



Step 6. Press the F5 softkey to view Page 2 of the List Setup menu.

- Figure 6.19 List Setup Menu Page 2
- Step 7. Press the F2 softkey to set a Trigger Delay.
 - a. Intentionally introduces a delay between the initiation of the trigger and the start of the following step.
- Step 8. Press the F3 softkey to toggle After List between DC and Last.
 - a. **DC**: Returns to the last DC output voltage and current setting prior to enabling list mode.
 - b. Last: Retains the last step voltage and current setting after the list program ends.



If the list is aborted, the output will return to the last set value before the list began, even if After List is set to Last.

6.3.2 Edit List

To edit a list follow the steps below:

Step 1. Press Utility > Input/Seq. Mode > List Setup > Edit List to enter the Edit List menu.

List Nui	mber Ma	ode CC	Ne	xt	Rep	eat
Step	(I/V/P/	R)-Set		BOST	EOST	Dwell
1	2.000				\sim	3.0
Load/Sav List	ve List Number	Mode	١	Next	Next Pg	Done

Figure 6.20 Edit List Menu Page 1

- Step 2. Press the F2 softkey to set the List Number of the list to be configured.
 - The numeric keypad or the up and down navigation keys can be used to set the value.
- Step 3. Press the F3 softkey to set the operation Mode for the selected list.
- Step 4. Press the F4 softkey to set the Next list program to run once the current list elapse.
 - a. To make a list run continuously and indefinitely, set **Next** to the same number as **List Number**.
 - b. To run different list sequences continuously, set **Next** to each other.

Example

Set **Next** on List 1 to 2. Set **Next** on List 2 to 1.

List Nu	mber Mo	ode CC	Ne:	xt	Rep	eat
Step	(IN/P/	R)-Set		BOST	EOST	Dwell
1	2.000				- X -	3.0
<pre> Prev. P</pre>	g Repeat	Steps				Done

Step 5. Press the F5 softkey to view Page 2 of the Edit List menu.

Figure 6.21 Edit List Menu Page 2

- Step 6. Press the F2 softkey to set the Repeat count. The repeat count determines how many times the list will be executed before elapsing or moving on to the selected Next list.
- Step 7. Press the F3 softkey to enter the Step menu.

List Nur	mber Mo	ode CC	Next —	Rep	eat
Step	(I/V/P/	R)-Set	BOST	EOST	Dwell
1	2.0	00		X	3.0
2	2.0	100		X	3.0
3	2.0	00		X	3.0
Add Step	Delete Step	Clear All			Done

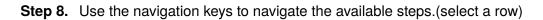
• In the Step menu the steps and its parameters can be configured.

Figure 6.22 Edit List Step

- Add Step: Adds a step to the list. The step added will be a duplication of the step selected before pressing Add Step. To select a step to duplicate, use the navigation keys to navigate the available steps. If the list is new, only one default step will be available. Pressing Add Step will duplicate the default step.
- **Delete Step**: Deletes the selected step.



• Clear All: Clears all current steps.



Step Parameters	Description
(I/V/W/R)- Set	Set the level value for the selected mode.
BOST	Press the Enter button to enable/disable a trigger-out signal at the beginning of the step (BOST).
EOST	Press the Enter button to enable/disable a trigger-out signal at the end of the step (EOST).
Dwell	Sets the dwell time of the selected step.

Table 6.1Step Parameters

6.4 Analog Digital I/O Connector

The analog digital input/output port provides a hardware connection for input voltage and current monitoring, external analog control, external trigger, digital output, fault output, remote on/off input and a relay connection.

The pinout of the **Analog Digital I/O Connector** can be seen in **figure 6.23**. For more details on the function of each pin refer to **tables 6.2** and **6.3**

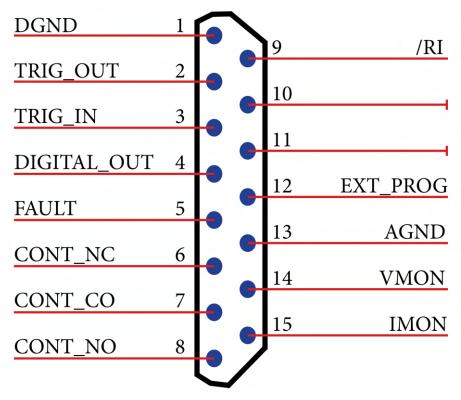


Figure 6.23 Analog Digital Input/Output



1DGNDDigital ground - Provides the common or reference digital signals such as TRIG_OUT, TRIG_IN, PORT RI.2TRIG_OUTExternal trigger signal output - A TTL compatible activated when the trigger signals from the trigger signals activated. The trigger source set can EXTERNAL, H triggering.3TRIG_INExternal trigger signal input - A TTL compatible n triggered signal that is used to trigger the event in tr To enable this external TRIG_IN, the trigger source external.4DIGITAL_OUTDigital port output - A TTL compatible output port ops or by remote SCPI command.5FAULTFalse signal out - A TTL compatible signal will be high) if alarm, hardware fail or internal fault is trigger	COUT, FAULT and signal that is cource setting is HOLD or BUS legative edge ransient operation.
2 TRIG_OUT activated when the trigger signals from the trigger signals from the trigger signals from the trigger signal input - A TTL compatible n triggering. 3 TRIG_IN External trigger signal input - A TTL compatible n triggered signal that is used to trigger the event in trigger source external. 4 DIGITAL_OUT Digital port output - A TTL compatible output port ops or by remote SCPI command. 5 FAULT False signal out - A TTL compatible signal will be	HOLD or BUS HOLD or BUS House edge ransient operation.
3 TRIG_IN triggered signal that is used to trigger the event in tr To enable this external TRIG_IN, the trigger source external. 4 DIGITAL_OUT Digital port output - A TTL compatible output port ops or by remote SCPI command. 5 FAULT False signal out - A TTL compatible signal will be	ransient operation.
DIGITAL_OUT ops or by remote SCPI command. False signal out - A TTL compatible signal will be	
5 FAULI	t active by front panel
6 CONT_NO C	rm panel. When
7 CONT_CO Contact relay common - Provides the common or connection for relay contacts of CONT_NO and CO	
8 CONT_NC When fault condition occurs, the CONT_NC and CO (disconnected).	ternal alarm panel.



Pin	Signal Name	Description
9	RI	Remote inhibit signal input - A TTL compatible negative activated input signal is used as an emergency switch to disable the electronic load input. RI can be connected to an external switch reference to DGND. If the switch is closed, the RI is activated and the input will turn off.
10	NC	No connection
11	NC	No connection
12	EXT_PROG	Ext analog programming signal input - This is an external analog input from 0V to 10V that represents zero to full scale of the range of programming level.
13	AGND	Analog ground - the common or reference connection for analog signals such as EXT_PROG, VMON and IMON.
14	VMON	Input voltage monitoring signal - Outputs a zero to 10V signal that is linearly proportional to the input voltage from zero to full scale of high range.
15	IMON	Input current monitoring signal - Outputs a 0 to 10V signal that is linearly proportional to the input current from zero to full scale of high range.

Table 6.3 Analog Digital IO Connector 2/2

Dry Contact Relay

The internal dry contact relay serves as a valuable mechanism for safely interlocking the electronic load with an external disconnection device, such as a contactor. This is particularly important when testing the electronic load with an unprotected power source like a battery. It is highly advisable to install a DC contactor in conjunction with the electronic load and battery in series. In the event of a fault or alarm condition, the dry contact relay can be utilized to turn off and disconnect the DC contactor, preventing potential hazards like large currents and fire.

It is strongly recommended to install a DC contactor in series with the electronic load and battery. In case of any fault or alarm condition, the dry contact relay can be served to turn off and disconnect the DC contactor to prevent a large current which may cause fire hazard.

6.4.1 Digital Output Control

A TTL compatible DIGITAL_OUT digital output pin can be configured by the user or by the input state of the electronic load. This pin is located at the pin 4 of the Analog DIO connector.

To configure the **Digital Output**:

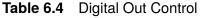
Step 1. Press Utility button > Utility softkey > I/O Config > Digital I/O to enter the Digital I/O menu.

C	Digital I/O			<u>ه</u> ک
	Digital Output Control Digital Output Delay Remote Inhibit	Force High 000 Disable		
[Digital Out Digital Out Control Delay	Remote Inhibit		Done
			Disting 1/0	

Figure 6.24 Digital I/O

- Step 2. Press the F1 softkey to expand the Digital Out Control settings.
 - **Table 6.4** shows the available controls.

Control Setting	Description
FORCE LOW	DIGITAL_OUT is permanently low.
FORCE HIGH	DIGITAL_OUT is permanently high.
LOW @ ON	DIGITAL_OUT is low when input is on.
HIGH @ ON	DIGITAL_OUT is high when input is on.



Step 3. Press the F2 softkey and use the numeric keypad to configure the Digital Out Delay.



Step 4. Press the F3 softkey to expand the Remote Inhibit settings.

• Table 6.5 shows the available controls.

Remote Setting	Description
DISABLE	The remote inhibit is disabled
LIVE	The RI input acts as an input on/off control signal. If the RI is low or short from DGND, the input turns off. If the RI is high or open from DGND, the input turns on.
LATCH	The RI input acts as a negative triggered signal. The input turns off when RI goes from high to low. The user will have to turn on the input by either front panel operation or SCPI remote command.

 Table 6.5
 Remote Inhibit



6.4.2 Analog State

To enable Analog State press Utility > Input/Seq. Mode > Analog Control > Analog State.

The analog 0 to 10 volts external programming signal is equivalent of zero to full scale of the high or low range in CC, CV, CP or CP modes. **Table 6.6** shows an example of external programming signal level vs. main value of a HVL100050. For a setup example refer to **figure 6.26**

/	Analog Co	ontrol Setti	ngs ——		a
	Analog S	tate D)isable		
	Analog State				Done

Figure 6.25 Analog Control Settings

EXT_PROG Voltage	Mode-Range	Full Scale Value	Main Value
0 V	ССН	50 A	0 A
5 V	ССН	50 A	25 A
10 V	ССН	50 A	50 A
0 V	CCL	5 A	0 A
5 V	CCL	5 A	2.5 A
10 V	CCL	5 A	5 A
5 V	СѴН	1000 V	500 V
5 V	CVL	100 V	50 V

Table 6.6External Control for HVL100050

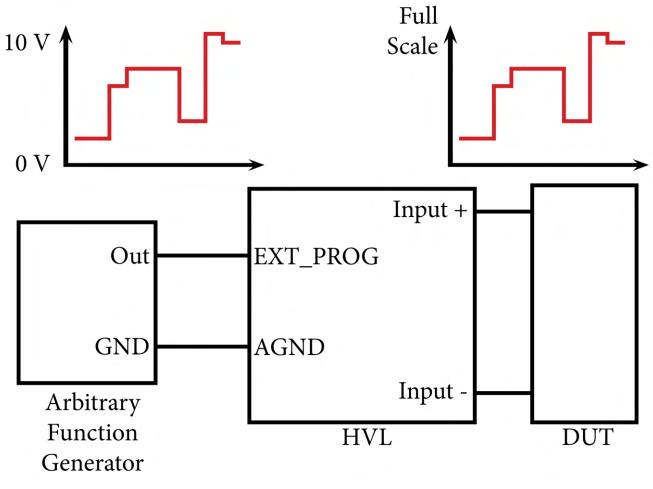


Figure 6.26 External Control Setup

6.5 Parallel Mode

For the applications that require a large electronic load, the HVL series is capable of being connected in parallel with up to 10 units of the same voltage rating model. The electronic load can be set to master or slave unit in the parallel operation.

For one group of parallel operated electronic loads, set only one unit as the master unit and rest of the units as the slave unit. To connect multiple electronic loads in this operation, use the standard DB9 male to female cable and connect from Para-OUT connector of the master unit to Para-IN connector of the slave unit.

If multiple slave units are desired, use more DB9 male to female cables to cascade the Para-OUT connector of the slave unit to the Para-IN connector of the next slave unit. **Figure 6.32** shows the back panel connection in parallel operation.

To setup the master/slave configurations:

Step 1. Press Utility > Input/Config> List Setup > Parallel Settings to enter the Parallel Settings menu.



Figure 6.27 Parallel Settings

Step 2. Press the F2 softkey to set the instrument's Master/Slave state.

• Use the Up/Down navigation keys to toggle between the available modes. (off, Master, Slave1....,Slave10)

		¥ 🛃					¥ 🛃
Parallel Settings	Master		Parallel S Parallel		Slave	1	
Parallel Mode Number of slaves: 0			Not conr	lected to master			
Set Master/	Scan	Done	Off	Set Master/	Scan		Done
Slave Slave	Master	Done	01	Slave		ave	Dolle

Figure 6.28 Master/Slave

- Step 3. Press the F3 softkey to Scan for a master or slave units.
 - The instrument will indicated it is scanning as shown in figure 6.29.

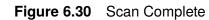
Parallel S	ettings —			¥ 🛃
Parallel N		Maste	er	
Scanning	.			
	Set Master/			
Off	Slave	Scan		Done

Figure 6.29 Scanning



- Once the scan is complete the master will display the number of slaves that were found.
- If a master was found the slaves will display it is connected to the master.

						.
Parallel Settings	Master		Parallel Setting Parallel Mode	s Slave1		
Number of slaves: 1			Connected to ma	aster.		
Parallel Mode Number of slaves: 1						
						J
Off Set Master/ Slave	Scan	Done		faster/ ave	Done	
Mast	er Number of Sla	aves		Slave Conne	cted	

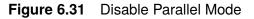


- Step 4. Pressing the F1 softkey will turn parallel mode Off.
 - The instrument will first notify the user the mode is being disabled.
 - Once disabled the "Success" message will be displayed

					¥ 🛃						¥ 🛃
arallel Se	ettings ——					Parallel S	ettings —				
Parallel N	/lode	Off				Parallel	Mode	Off			
Setting to	off					Success					
Off	Set Master/ Slave	Scan			Done	Off	Set Master/ Slave	Scan			Done
			Off Set Master/ Scan	Off Set Master/ Scen	Off Set Master/ Scen	arallel Settings Parallel Mode Off Setting to off Off Set Master/ Scen Done	arallel Settings Parallel S Parallel Mode Off Setting to off Success Off Set Master/ Scen Done	arallel Settings Parallel Settings Parallel Mode Off Setting to off Parallel Mode Off Success.	arallel Settings Parallel Settings Parallel Mode Off Setting to off Parallel Mode Off Set Master/ Set Master/ Scen	arallel Settings Parallel Mode Off Setting to off Off Success.	arallel Settings Parallel Mode Off Setting to off Off Success.

Disabling Parallel Settings

Parallel Settings OFF





During parallel operation, set the desired value in CC, CV, CP or CR mode of the master unit, the slave units will share the proportional current with the master unit.



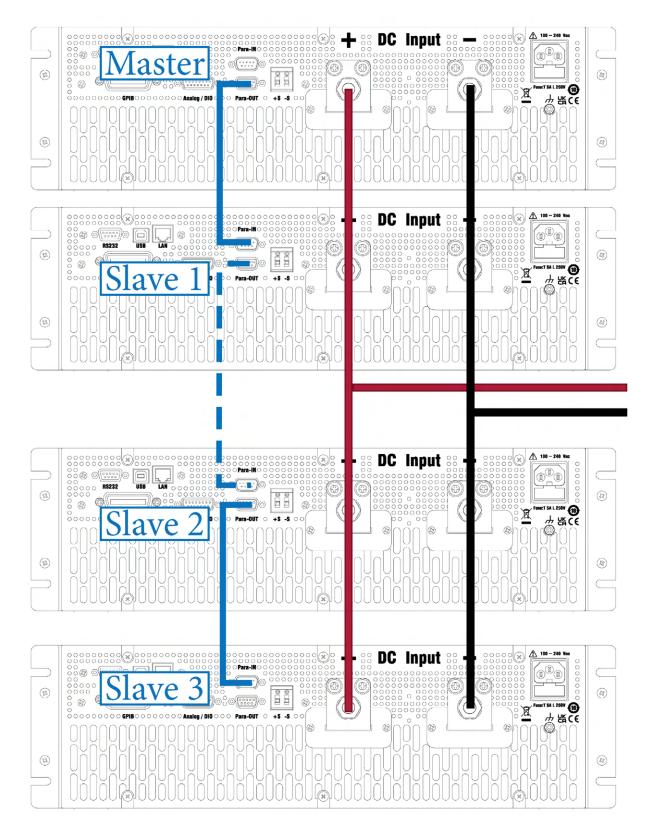


Figure 6.32 Parallel Operation Diagram

Done

6.6 Rise/Fall Measurement Settings

The rise and fall measurement function measures and analyzes the response time and characteristics of the load when subjected to changes in voltage or current levels. This function allows users to evaluate the load's performance in terms of how quickly and smoothly it can transition between different input levels.

To configure the Rise/Fall Measurement settings:

Measure

State

Measure State	Disable	
Voltage 1	1.000 V	
Voltage 2	2.000 V	

Step 1. Press Utility > Input/Seq. Mode to enter the Rise/Fall Measurement Settings menu.

Figure 6.33 Rise/Fall Measurement Settings

Voltage2

Step 2. Press the softkey corresponding to the desired parameter.

Voltage1

- Step 3. Use the numeric keypad to enter desired voltage levels.
 - For the **State** parameter, pressing the softkey will toggle the state between **Enable** and **Disable**.

Input Configuration

The Input Configuration settings of a DC load refer to the various parameters and options that can be adjusted to control the behavior and characteristics of the load. These settings enable users to tailor the load's performance to suit specific testing or operational requirements.

7.1	Over Protection	70
7.1.1	Overvoltage Protection (OVP)	70
7.1.2	Overcurrent Protection (OCP)	70
7.1.3	Overpower Protection (OPP)	70
7.2	Input Settings	72
7.2.1	Remote Sense	72
7.2.2	Timer State and Setting	72
7.2.3	Slew Rise/Slew Fall (A/ms)	73
7.2.4	On/Off Delay	73
7.2.5	Loop Response and CR Control	74
7.2.6	Oscillation Protection	74
7.2.7	Averaging	75
7.2.8	Soft Start	75

7.1 Over Protection

The over protection settings are configurable parameters and safeguards designed to prevent damage to the load itself or the connected power source in the event of excessive voltage, current, or power levels. These settings play a critical role in ensuring the safe and reliable operation of the load and the equipment under test.

In order to protect both the load and the connected devices, the HVL series is equipped with various over protection settings, which include:

7.1.1 Overvoltage Protection (OVP)

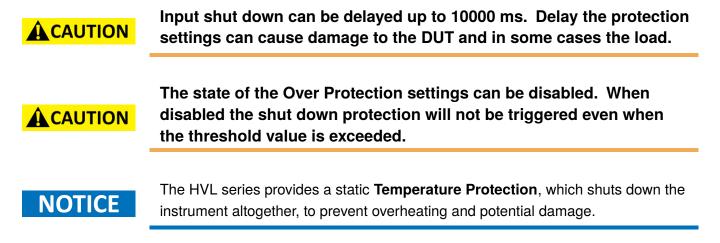
This setting establishes a maximum voltage threshold beyond which the load automatically shuts down to prevent excessive voltage from reaching the load. OVP safeguards against voltage spikes or regulator failures that could otherwise damage the load or connected equipment.

7.1.2 Overcurrent Protection (OCP)

OCP limits the maximum current that can flow through the load. When the current exceeds the set threshold, the load shuts down to prevent damage to the load or the power source. OCP is crucial for preventing excessive current that could lead to overheating, component failure, or unsafe conditions.

7.1.3 Overpower Protection (OPP)

OPP limits the power dissipation within the load. By defining a maximum power threshold, the load can react to situations where the power exceeds the allowed limit, ensuring the load and the connected devices operate within safe operating conditions.



To configure the protection settings:

Step 1. Press Utility > Input/Config > Protection Settings to enter the Over Protection Settings menu.

C	over Prote	ection Set	tings ——			e 1
	OVP Stat	e l	Enable			
	OVP Limi	t(V) 10	050.000			
	OVP Delay(ms)		00100			
	OCP State		Enable			
	OCP Limit(A)		27.500			
	OCP Delay(ms)		00100			
	OPP State		Enable			
	OPP Delay(ms)		00100			
	OVP State	0VP Limit	OVP Delay	OCP State	> Next Pg.	Done

Figure 7.1 Over Protection Settings Menu

- Step 2. Press the **softkey** corresponding to the desired parameter.
- **Step 3.** Use the numeric keypad to enter desired threshold.
 - For State parameters, pressing the softkey will toggle the state between Enable and Disable.

7.2 Input Settings

The input settings of a DC load encompass the adjustable parameters that determine how the load's input interacts. These settings allow users to customize and control the behavior of the input, facilitating precise testing.

The HVL series is equipped with the following input settings:

7.2.1 Remote Sense

Remote sense enables accurate voltage regulation at the load's terminals, compensating for voltage drops along the connecting cables. It allows the load to sense and regulate the voltage directly at the (DUT), providing more precise and reliable measurements.

The remote sense function is particularly valuable when testing sensitive or high-precision devices that require accurate voltage regulation.

The remote sense function involves the use of additional sense wires that are connected to the load and attached near the terminals of the DUT. These sense wires monitor the voltage directly at the DUT, compensating for any voltage drop that may occur across the connecting cables due to their resistance.

By comparing the sensed voltage at the DUT terminals with the desired voltage set by the load, the remote sense function allows the load to adjust its output voltage accordingly, compensating for voltage loss up to 1 V, and ensuring that the DUT receives the desired voltage level. This feature becomes particularly crucial when the DUT is located far away from the load or when using long and resistive cables that can introduce significant voltage drops.

7.2.2 Timer State and Setting

The timer setting allows users to define a specific duration or time limit for the load operation. This feature enables automated control over the load's on/off cycles, providing convenient timing capabilities for testing and operational purposes.

With the timer setting, users can specify the duration of the load operation in terms of hours, minutes, and seconds. Once the set time limit is reached, the load can automatically turn off, completing the desired testing cycle. This feature is particularly useful when conducting endurance tests, evaluating battery life, or performing time-based evaluations.

7.2.3 Slew Rise/Slew Fall (A/ms)

The slew rate determines the rate at which the load can change its output voltage or current levels. These parameters control the load's ability to mimic rapid changes in the power source and simulate dynamic load conditions accurately.

The slew rate is expressed in A/ms), indicating the rate of change over time. A higher slew rate value means that the load can respond more rapidly to input signal changes.

By configuring the slew rate parameters, users can accurately replicate scenarios where the load experiences sudden changes in voltage or current, such as voltage spikes or transients. This is particularly important when testing the performance of power supplies, batteries, or electronic components that need to withstand or respond to fast load variations.

FAST and Normal Loop Response	CC Low Range (A/ms)	CC High Range (A/ms)	CV Low Range (V/ms)	CV High Range (V/ms)	CW Low Range (A/ms)	CW High Range (A/ms)	CR Low Range (V/ms)	CR High Range (A/ms)
HVL600150	0.05-3000	0.05-3000	0.2-1200	0.2-1200	0.05-300	0.05-300	1000	0.05-300
HVL600300	0.1-6000	0.1-6000	0.2-1200	0.2-1200	0.1-600	0.1-600	1000	0.1-600
HVL80075	0.025-1500	0.025-1500	0.267-1600	0.267-1600	0.025-150	0.025-150	1000	0.025-150
HVL800150	0.05-3000	0.05-3000	0.267-1600	0.267-1600	0.05-300	0.05-300	1000	0.05-300
HVL100025	0.008~500	0.008~500	0.333-2000	0.333-2000	0.008-50	0.008-50	1000	0.008-50
HVL100050	0.017-1000	0.017-1000	0.333-2000	0.333-2000	0.017-100	0.017-100	1000	0.017-100

7.2.4 On/Off Delay

The On/Off Delay parameters determines the time delay between the activation/deactivation command and the actual start/end of load operation. These parameters allow users to introduce a controlled delay before the load begins applying its simulated load characteristics to the power source being tested.

By configuring the On/Off Delay parameters, users can introduce a time delay to simulate real-world scenarios where devices may take some time to stabilize or reach their operating state. This delay can be used to account for warm-up periods, initialization processes, or other time-dependent factors that affect the load's behavior.

7.2.5 Loop Response and CR Control

The Loop Response setting determines how quickly the load can respond to changes in the input conditions, such as voltage or current. It characterizes the load's dynamic behavior and its ability to track rapid variations in the power source.

By adjusting the Loop Response setting, users can control the load's ability to follow changes in the input signal. A fast loop response setting enables the load to respond quickly to sudden variations in voltage or current, simulating dynamic load conditions accurately. This is particularly important when evaluating the performance of power supplies under transient load scenarios or testing the stability and response time of control systems.

Conversely, a slower loop response setting may be preferred in certain applications where a slower load response is desired, such as testing the behavior of power sources in steady-state or low-dynamic conditions.

The Loop Response setting is expressed in four speeds: Fast, Normal, Slow, and Slowest, Where Fast loop response offers the best tracking capabilities.

The CR Control setting determines the tracking method for loop control. It is expressed as either Fine-Tune or Free-Run, where Fine-Tune sets a constant CR value for the duration of the operation, and Free-Run continuously adjust the internal DAC from feedback of the measured V and I. Free-Run allows for more accurate CR values.

7.2.6 Oscillation Protection

The loop response setting has a direct effect on the slew rate between load changes, therefore it is important to select the setting that best fits the application. Ideally, the FAST speed setting will provide the fastest transition between load changes, however oscillations may occur. These oscillations are usually caused by parasitic inductance in the wires connected between the load and the DUT. In general, the longer the wires, the higher the parasitic inductance. This in turn causes oscillation to the load, which is reflected when the load input becomes unstable or unregulated. On the contrary, when the SLOW or SLOWEST speed setting is selected, long wires will less likely cause any load oscillation. However, the slew rate will also be slower between load transitions. Therefore, it is recommended to set Loop Response to NORMAL speed, and only adjust based on the requirements of the application

7.2.7 Averaging

The averaging parameters determines how the load calculates and presents averaged measurements of voltage, current, or power. This parameter allow users to smooth out fluctuations and obtain more stable and representative readings during testing and evaluation processes.

By configuring the averaging parameters, users can set the sample count used to calculate the average values.

The averaging parameters help mitigate the effects of transient variations or noise in the measured signals. By averaging the values over a specific sample size, the load provides a more stable and representative measurement, reducing the impact of short-term fluctuations and providing a clearer picture of the overall performance of the power source.

Users can adjust the averaging parameters to strike a balance between responsiveness and stability. A smaller sample size offer more real-time measurements but may be susceptible to noise and rapid variations, while a larger sample size provide smoother and more stable measurements at the cost of reduced responsiveness to immediate changes.

7.2.8 Soft Start

The Soft Start function ramps up the load's output voltage or current when it is initially turned on. This function is designed to prevent sudden voltage or current surges that could potentially damage the load or the device under test (DUT), ensuring a controlled and safe startup process.

When the Soft Start function is activated, the load initially operates at a lower input voltage or current level, gradually increasing it over a specific time period. This gradual increase helps prevent sudden voltage or current spikes that could stress or damage the DUT, particularly when dealing with sensitive or fragile devices.

The Soft Start function is particularly useful in situations where the load is connected to power sources or DUTs that are susceptible to voltage or current transients during startup. By gradually ramping up the input parameters, it provides a controlled and safe transition, reducing the risk of damage and ensuring the integrity of the testing process.

To configure the input settings:

Step 1.	Press Utility >	Input/Confia > Ir	nput Settinas	to enter the In	put Settings menu.

				¥ 🛃
nput Settings —				
Remote Sense	Disable			
Timer State	Disable			
Timer Setting	99 : 59 : 59			
Slew Rise(A/ms)	0.833	Slew Fall(Ay	/ms)	0.833
On Delay (sec)	0.000	Off Delay (sec)		0.000
CR Control	Fine-Tune	Soft Start		On
Loop Response	Normal			
Averaging	8			
Remote Time Sense State		Slew Rate	> NextPa.	Done

Figure 7.2 Input Settings Menu

- Step 2. Press the softkey corresponding to the desired parameter.
- Step 3. Use the numeric keypad to enter desired threshold.
 - For State parameters, pressing the softkey will toggle the state between Enable and Disable.

Data Logger

The data logging function allows the load to record and store various measurements and parameters during testing or operation to and external flash drive. This function enables users to capture and analyze data over time, facilitating detailed analysis, troubleshooting, and performance evaluation of the power source being tested.

With the data logging function, users can specify the parameters to be logged, such as voltage, current, or power. The load continuously monitors and records these parameters at regular intervals up to 200ms, creating a comprehensive data log of the load's behavior and the performance of the power source.

The logged data can be is saved to a .csv file which can then be exported and analyzed using external software tools.

8.1 Configuring the Data Logger 77

8.1 Configuring the Data Logger

To configure and enable the data logger follow the instructions below:

Step 1. Press Utility button > Data Log to enter the Data Logger Settings menu.

						¥ 🗄
I	Data Logg	jer Settings	s ———			
	Sampling	g Interval(Sec)	0.2			
	File Path		Usbdrive	e:/		
	Timestan	np Filename	Enable			
	Log Data		All			
	Status Co	de	Enable			
	Trigger S	lource	Manual			
	Max. Rec	ording Time		n l		
	2 00 ~ 200	day 4 hour 3	9 min	J		J
	Datalog Start/Stop	Sampling Interval	File Path	T.Stamp Filename	> NextPg.	Done

Figure 8.1 Data Logger Settings Menu 1/2

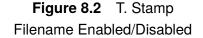
Step 2. Press the F2 softkey to set the Sampling Interval.

• Use the numeric keypad to enter the sampling interval (200 ms to 300 s).

Step 3. Press the F3 softkey to set the File Path where the file will be stored.

- Use the navigation keys to navigate to the directory where the file will be saved.
- Once in the desired directory press the **F1 softkey** to confirm the file path.
- Step 4. Press the F4 softkey to toggle the T. Stamp Filename.
 - When enabled the time and date will be appended to the file name.
 - Figure 8.2 shows both file names with T.Stamp Filename enabled and disabled.

* HVL6003006K_log.csv * HVL6003006K_log_20230803100354.csv



Step 5. Press the F5 softkey to view the remaining data logger parameters.

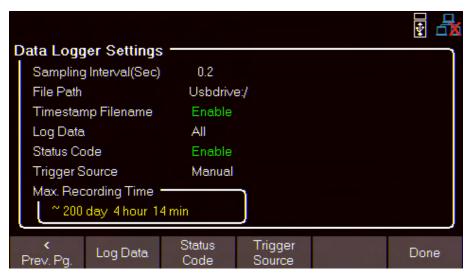


Figure 8.3 Data Logger Settings Menu 2/2

Step 6. Press the F2 softkey to view the available Log Data.

- The logger can be configured to log all parameters, only voltage, or only current.
- Figure 8.4 demonstrates an example where Log Data is set to All.

HVL6003006K 00000000 Dat	talog	
Sample interval: 0.2		
Log data:All		
Date: 2023-06-29 23:07:39		
00:00:00.00	<u> </u>	0 0x0000 0x0000
00:00:00.20	0	0 0x0000 0x0000
00:00:00.40	0	0 0x0000 0x0000
00:00:00.60	0	0 0x0000 0x0000
00:00:00.80	0	0 0x0000 0x0000
00:00:01.00	0	0 0x0000 0x0000
00:00:01.20	0	0 0x0000 0x0000
00:00:01.40	0	0 0x0000 0x0000
00:00:01.60	0	0 0x0000 0x0000
	Status Coo	de 1 Status Code

Figure 8.4 Data Log set to All

The data is recorded in the following order:								
Elapsed Time	Voltage	Current	Status Code					

Table 8.1Data Order

NOTI<u>CE</u>

Data Order will vary depending on the set Log Data.

- Step 7. Press the F3 softkey to toggle the Status Code recording state.
 - Enabled Status Code will record all codes reported.



The **Status Code** column contains two separate codes as shown **figure 8.4**. The status code is shown in 2 byte hexadecimal and is determined by the bit state of the registers shown in **tables 8.2** and **8.3**.



Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
LV	OSC	PS	UVP	OVP	UNR	RI		RSF	RCP	OTP		OPP	OTS	OCP	OTW

Table 8.2 Status Code 1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
FLT	INT								PAE	PAD	WTG	ACL	INF	OPL	ACF



• For example, if the code 0x2800 0x0000 is logged we can determine that PS (**Bit13**) and OVP (**Bit11**) are triggered.



Examining each nibble individually facilitates reading the status code. See **table 8.4** for a short description of each bit



Bit	[nc=2]Stat	[nc=2]Status Code 2		
0	OTW	Over temperature warning	ACF	Internal communication failure
1	OCP	Over current protection	OPL	Over power lock/clamping
2	OTS	Over temperature on power stage	INF	MOSFET failure
3	OPP	Over power protection	ACL	AC lost or internal power supply fail
4	[nc=2] — WTG		Wait for trigger	
5	OTP	Over temperature protection	PAD	Parallel disabled
6	RCP	Reverse current protection	PAE	Parallel error
7	RSF	Remote sense fault		
8		-	_	
9	RI	Remote inhibit	[nc=2] —	
10	UNR	Unregulated on power stage	[nc=2] —	
11	OVP	Over voltage protection	[nc=2] —	
12	UVP	Under voltage protection	[nc=2] —	
13	PS Protect of system shutdown		[nc=2] —	
14	OSC	Oscillation	INT	RESERVE: interlock event
15	LV	Low voltage	FLT	General Fault

Table 8.4 Status Description

Step 8. Press the F4 softkey to view the available Trigger Sources.

- Datalog can be triggered in three ways: Manual, Digital IO, and Remote.
 - **Manual**: Select to use manual trigger. The trigger softkey will be available as Datalog Start/Stop.
 - **Digital IO**: Select to use the digital I/O pins to receive a trigger.
 - **Remote**: Select to receive a trigger from a remote interface.

For Digital IO and Remote the first trigger will turn Data log on. A second trigger



will begin data recording. will be displayed on the top right when data is being logged.

Step 9. Press the F1 softkey to return to the Data Logger Settings Menu page 1/2.

Step 10. Press the F1 softkey to initiate Datalog.



will be displayed on the top right when data logger is on but not recording. The command INIT:IMM:DLOG will turn on data logger. For **Digital IO** press **Datalog Start/Stop** to turn data logger on.



will be displayed on the top right when data logger is recording. The command TRIG:DLOG:IMM will begin the recording. For **Digital IO** an input high signal to the set pin will turn data logger on.



If **Trigger Source** is set to manual pressing **Datalog Start/Stop** will start/stop recording without a second signal.

Utility Menu

The Utility Menu consist of the following submenus:

9.1	User Settings	84
9.1.1	Key Lock Input	84
9.1.2	Beep Sound	84
9.1.3	Shortcuts	85
9.1.4	Date and Time	85
9.1.5	Screen Intensity	85
9.1.6	Configuring User Settings	86
9.2	Remote Interfaces	87
9.2.1	USB	87
9.2.2	LAN	89
9.2.3	Configuring LAN Settings	90
9.3	LAN Status	91
9.4	Web Server	92
9.5	GPIB	93
9.6	Test/Admin	94
9.6.1	Self-Test	94
9.6.2	Security	95
9.7	Error Log	97
9.7.1	Saving the Error Log	98
9.7.2	Clear the Error Log	98
9.8	Help	99

9.1 User Settings

The user settings encompass the adjustable parameters that determine how the user interacts with the load. These settings allow user to customize and control the behavior of the front panel, Display, shortcut keys, etc.

The HVL series is equipped with the following user settings:

9.1.1 Key Lock Input

The Key Lock Input function ensures the security and integrity of load settings and parameters. With this function enabled, the DC load's front panel controls are locked, preventing accidental or unauthorized changes to critical load configurations.

This feature is particularly useful in situations where precise load settings are crucial for accurate testing or when maintaining consistent load conditions is essential.

To make adjustments or modifications to the load settings, the user must first unlock the Key Lock Input by following the sequence; press Utility button> Utility softkey> User Settings > toggle Key Lock Input off.

9.1.2 Beep Sound

The beep sound setting controls the audible feedback generated by the load during certain operations or events. By enabling or disabling the beep sound, users can customize their experience and adjust the load's audio notifications to align with their preferences and working environment.

When the beep sound setting is activated, the DC load emits audible signals to indicate various events, such as over protection settings being triggered or error conditions being reported. These beeps serve as a helpful auditory feedback mechanism, providing users with real-time information about the load's status or changes in its operation.

9.1.3 Shortcuts

The Programmable Keys are customizable keys found on the front panel. These keys provide a flexible and personalized way to streamline workflows, enhance productivity, and improve user experience.

The HVL series provides 3 programmable keys; **S1**, **S2**, and **S3**. Each of these keys can be programmed to function as shortcuts to the following menus:

- Over Protection
- UV Inhibit
- OSC Protection
- Input Settings
- Parallel Settings
- List Setup
- Transient Mode
- LAN Status
- Error Log
- Help

9.1.4 Date and Time

The date and time settings options configure the date and time parameters on the device. These settings enable users to synchronize the current date and time information. This ensures that the load's internal clock is aligned with the correct time reference, providing accurate timestamps for data logging or error logging.

9.1.5 Screen Intensity

The screen intensity setting allows users to adjust the brightness or intensity of the screen's backlight. By modifying this setting, users can customize the visual experience to match their preferences and optimize visibility in different lighting conditions.

The screen's intensity is represented on a scale from 1 to 10. With 10 being the brightest option and 1 the dimmest.

Increasing the intensity enhances visibility in well-lit environments, making content on the screen more distinct and easier to read. On the other hand, reducing the intensity lowers the brightness, which can be helpful in low-light situations or when working in darkened environments to prevent eye strain or discomfort.



9.1.6 Configuring User Settings

To configure the user settings:

Step 1. Press the Utility button> Utility softkey> User Settings to enter the User Settings menu.

					¥ 🗗
Ļ	Jser Settings				
	Key Lock Input	On			
	Beep Sound	On			
	S1 Shortcut	Transie	nt Mode		
	S2 Shortcut	List Set	up		
	S3 Shortcut	Help			
	Date(YY/MM/DD)	23 /	06 / 15		
	Time(HH:MM:SS)	11 :	33 : 58		
	Screen Intensity	10			
	Key Lock Beep Input Sound	S1 Shortcut	S2 Shortcut	> Next Pg.	Done

Figure 9.1 User Settings Menu

- **Step 2.** Press the **softkey** corresponding to the desired parameter. Use the numeric keypad to enter the appropriate value
 - For State parameters, pressing the softkey will toggle the state between Enable and Disable.

9.2 Remote Interfaces

The remote interface function enables remote control and communication between the load and external devices or systems. This feature allows users to operate and monitor the DC load from a distance, providing convenience, flexibility, and enhanced integration in various applications.

Through the remote interface function, users can establish a connection between the load and a controlling device, such as a computer, programmable logic controller (PLC), or other instrumentation systems. This enables remote configuration, control, and data acquisition, eliminating the need for direct physical interaction with the load.

The remote interface function supports various communication protocols, such as USB, Ethernet, and GPIB (General Purpose Interface Bus. This ensures compatibility and interoperability with a wide range of devices and systems, facilitating seamless integration into existing setups.

Once connected, users can remotely adjust load parameters, set test conditions, initiate tests, and monitor data. This allows for remote operation in applications where physical access to the load may be challenging, unsafe, or impractical.

9.2.1 USB

The HVL series supports USBVCP and USBTMC

						¥ 🗄
4	JSB Setti	ngs				
	VISA Res	source string :	USB0::0x3121	::0x8003::100	025007::INSTR	3
	LICOM	-	LICENCO	0		
	USB Mod	ie –	USBVC	P		
	USBVCP	USBTMC				Done

Figure 9.2 USB Settings

The VISA Resource string provides the following information: USB0::<Vendor ID>::<Product ID>::<Serial Number>:INSTR <Vendor ID> = 0x3121 <Product ID> = 0x000b for <Serial Number> = XXXXXXXXX

USBTMC

The USBTMC (USB Test and Measurement Class) interface is a standardized protocol used for communication and control between test and measurement instruments and computers via USB (Universal Serial Bus) connections. It provides a reliable and efficient means of transferring data and commands between the computer and the instrument, enabling seamless integration and control of various measurement devices.

The USBTMC interface allows test and measurement instruments, to be recognized and configured as USB devices by the computer. This enables easy plug-and-play functionality and compatibility across different platforms, as the USBTMC protocol is supported by most operating systems.

To access the USBTMC from a PC, the NI-VISA driver has to be installed. It can be found on the National Instruments website.

USBVCP

USBVCP (USB Virtual COM Port) is a communication protocol that emulates a traditional serial COM port over a USB (Universal Serial Bus) connection. It enables the establishment of a virtual serial port between a computer and a peripheral device, allowing bidirectional serial communication between the two.

The USBCP interface requires the following port settings:

Port Settings		
Baud rate	9600	
Data bits	8	~
Parity	None	Ŷ
Stop bits	1	Y
Flow control	None	Y

Figure 9.3 USBVCP Port Settings

To access the USB virtual COM from a PC, the USB virtual COM driver has to be installed. It can be found on the web site of B&K Precision.

9.2.2 LAN

The LAN (Local Area Network) interface provides a means for network connectivity and communication between the load and other devices or systems within a local network. This interface allows users to remotely control, monitor, and integrate the DC load into networked environments, providing convenience, flexibility, and enhanced capabilities.

The HVL series is LXI certified. LXI (LAN eXtensions for Instrumentation) LAN certification is a recognized industry standard that ensures compatibility, interoperability, and compliance of instruments and devices with the LXI specification for LAN-based test and measurement systems.

LXI LAN certification guarantees that the certified instrument conforms to the LXI specification, ensuring seamless integration and interoperability with other LXI-compliant devices and software applications. It establishes a common language and protocol VXI-11 for communication and control, enabling users to easily configure, command, and acquire data from multiple instruments within the LXI ecosystem. The following parameters must be configured in order to establish connectivity over the LAN interface.

IP Mode

The IP mode setting allows users to define how devices obtain its IP (Internet Protocol) addresses. In the IP mode setting, users have two main options: Static IP and Dynamic IP.

Static IP: In static IP mode, users manually assign a fixed IP address to each device within the LAN network. This means that the IP address remains constant and does not change unless manually reconfigured. Static IP mode provides stability and predictability as devices always have the same IP address, which can be beneficial for applications that require consistent and controlled network communication.

Dynamic IP (DHCP): In dynamic IP mode, the LAN network utilizes a DHCP (Dynamic Host Configuration Protocol) server to automatically assign IP addresses to devices within the network. Devices request an IP address from the DHCP server, which dynamically assigns an available IP address from a pool. Dynamic IP mode simplifies network administration as IP addresses are managed centrally and can be easily reassigned to devices as needed. It is commonly used in larger networks where frequent addition or removal of devices occurs.

NOTICE

When IP Mode is set to Static IP the rest of the LAN parameters will have to be configured manually.

9.2.3 Configuring LAN Settings

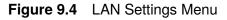
To configure the LAN settings:

Step 1. Press the Utility button> Utility softkey> I/O Config > LAN Settings to enter the LAN Settings menu.

LAN Settings IP Mode Manual IP Address 192.168.0.100 IP Address	
IP Address 192.168.0.100 IP Address	
Subnet Mask 255,255,255.0 Subnet Mask	
Gateway IP 192.168.0.1 Gateway IP	
Primary DNS 192.168.0.1 Primary DNS	
Hostname BK-HVL100025-25007 Hostname BK-HVL100025-25007	
IP IP Subnet Gateway → Done IP Hostname LAN Restore Done Mode Hostname Reset Default	Done

Static IP Mode

Dynamic IP Mode



- Step 2. Press the softkey corresponding to the desired parameter.
- Step 3. Use the numeric keypad to enter the appropriate value.
 - For State parameters, pressing the softkey will toggle the state between Enable and Disable.



LAN Reset sets all LAN settings and webpage passwords to its default values, while **Restore Default** only sets the LAN settings to default but does not affect webpage passwords.

9.3 LAN Status

A LAN Status function is a feature that provides information about the status of a local network. It allows users to monitor the connectivity of the load.

The LAN Status function provides details such as:

- MAC address
- IP Address
- Subnet Mask
- Gateway IP
- Primary DNS
- DNS Hostname
- mDNS Hostname

To view the LAN Status page press the Utility button> Utility softkey> I/O Config > LAN Status.

AN Status	
MAC address	00:17:F8:00:00:00
IP Mode	Manual
IP Address	0.0.0.0
Subnet Mask	0.0.0.0
Gateway IP	0.0.0.0
Primary DNS	0.0.0.0
DNS Hostname	BK-HVL100025-25007
mDNS Hostname	BK-HVL100025-25007.local
	Done

Figure 9.5 LAN Status

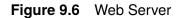
DV DDECIGIONI

9.4 Web Server

The HVL web server enables remote management and configuration of the device's input and LAN settings through a user-friendly web interface. The web server provides secure access to the power supply via any browser, allowing users to configure key parameters such as input operation mode, input limits, and power modes. The interface includes monitoring of input values, status indicators, and controls to configure the input.

Additionally, the web server offers configuration of communication settings such as network (IP address, gateway, and port settings). This setup enhances operational flexibility by allowing remote control and real-time adjustments, making it ideal for environments where physical access to the power supply is limited or cumbersome.

	HVL100	0050 DC Electronic L Serial Number:	oad
Home Lan configuration Configuration Control	Hostname Description IP Mode IP Address Netmask Gateway	255 255 254 0 10 0.1.254 10 0.0.1 2	150





To access the web server the dafault password is "bk".

9.5 GPIB

The GPIB (General Purpose Interface Bus), also known as IEEE 488, is a standard communication interface. It is primarily designed to facilitate communication between various devices.

The GPIB interface provides a common method for connecting multiple devices and allows them to exchange data and commands over a shared bus. It utilizes a parallel bus architecture, consisting of a host controller (such as a computer) and multiple devices connected via a cable.

Key Features

Key features of the GPIB interface include:

- **Data Transfer**: The GPIB supports fast and reliable data transfer between devices. It allows for both uni-directional and bi-directional communication, enabling devices to send and receive data seamlessly.
- **Addressing**: Each device connected to the GPIB bus is assigned a unique address. This addressing scheme ensures that data is sent and received accurately between the intended devices.
- **Command/Control Signals**: The GPIB supports a set of standardized control signals, such as ATN (attention), REN (remote enable), and EOI (end or identify). These signals help coordinate and synchronize the operation of multiple devices on the bus.
- **Daisy-Chaining**: Multiple devices can be daisy-chained together using the GPIB interface, allowing for easy expansion and scalability of the system. This simplifies the setup and management of complex measurement or control systems.

To configure the GPIB Address of the load press the **Utility button> Utility softkey> I/O Config > GPIB** and use the numeric keypad to enter the desired address.

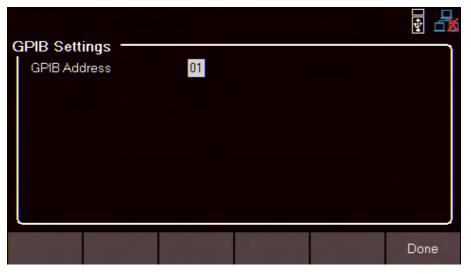


Figure 9.7 GPIB



9.6 Test/Admin

The test and admin menu provides two primary functions: conducting an assessments of the loads state and provide administrative capabilities.

9.6.1 Self-Test

The self-test function performs a diagnostic tests to verify proper functioning. It allows the DC load to check its internal components to provide a pass fail result on the load's state and module.

To perform a self-test press the Utility button> Utility softkey> Test/Admin > Self-Test > Run.

c	Self Test-			
	State Module	Process Checkin		
	Start			Done

Figure 9.8 Self-Test

Once the test is complete, if no issues were reported the instrument will display:



Figure 9.9 Self-Test Complete

9.6.2 Security

The security page of a DC load refers to a dedicated section safeguarding the load's functions and features from unauthorized access. This function/features are safeguarded since miss used of them could lead to impairment of the loads operation.

The security page encompasses the following functions/features:

Calibration

The calibration function allows for the adjustment and verification of the load's measurement accuracy and performance. Calibration ensures that the load provides accurate and reliable measurements of voltage, current, and power.

Firmware Update

The firmware update function allows user to update firmware to enhance or address bugs.

NISPOM

The NISPOM function refers to the instrument function to completely wipe: settings, list memory, help files, and hex files from the instrument.

Restore FAC. CAL.

The "Restore Factory Cal" function allows users to reset the load's calibration settings back to the original factory calibration. It enables users to revert to the load's initial calibration values in cases where calibration adjustments have been made or when there is a need to restore the load's accuracy to its factory specifications.

To access the functions/features located in the security section follow the steps below:

Step 1. Press the Utility button> Utility softkey> Test/Admin > Security.

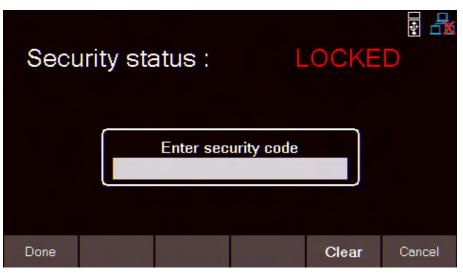


Figure 9.10 Security Status Locked



The **Security Settings** are locked and be accessed by entering the default code **13579**.

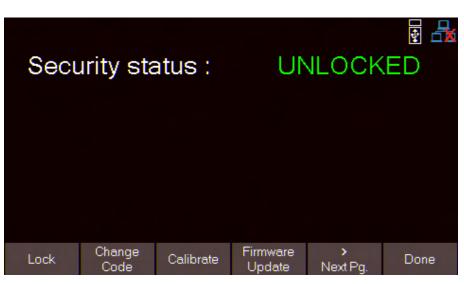


Figure 9.11 Security Status Unlocked



The default password can be change in the Change Code menu. If the set code is forgotten contact B&K Precision customer support.

Step 2. Press the softkey corresponding to the desired parameter.



9.7 Error Log

The error log can store up to 50 previously triggered error codes.

The error log function records up to 50 previously triggered error code caused by faults, or abnormal conditions that occur during the operation of the load. It provides a log or history of these events, allowing users to identify and analyze issues.

Each recorded error is timestamped to indicate when the event occurred. This helps in identifying the sequence of events and analyzing patterns or trends related to specific errors.

Errors are placed in the order that they were encountered. 1 being the most recent. The error log displays up to 50 error codes. After reaching 50 error codes no more codes will be reported in the error log. To continue filing error codes the error log list must be cleared

			•
No.	Time	Error code	
01	2023/06/15 13:41:42	0x000b	
02	2023/06/15 13:41:42	b000x0	
ear All	Save to USB		Done
	USB		Boild

To view the error log press the Utility button > Utility softkey > Error Log .

Figure 9.12 Error Log



 Table 9.1 provides a description of the reported error codes.



Code	Description			
0X01	Over current protection			
0X03	Over power protection			
0X05	Over temperature protection			
0X06	Reverse current protection			
0X07	Remote sense fault			
0X09	Remote inhibit			
0X0b	Over voltage protection			
0X0c	Under voltage protection			
0X0d	Protect of system shutdown			
0X0e	Oscillation			
0X10	Internal communication failure			
0X12	MOSFET failure			
0X14	Wait for trigger			
0X1f	General Fault			

Table 9.1Error Log Status Codes

9.7.1 Saving the Error Log

The error log can be saved into a USB flash drive connected to the USB port on the front panel. To save the error log:

Step 1. Press the Utility button > Utility softkey > Error Log> Save to USB.

Step 2. Use the navigation keys to navigate to the directory where the file will be saved.

Step 3. press the Save softkey.

9.7.2 Clear the Error Log

To clear the error log press the Utility button > Utility softkey > Error Log> Clear All.



9.8 Help

To enter the Help menu:

Press the Utility button > Utility softkey > Help.

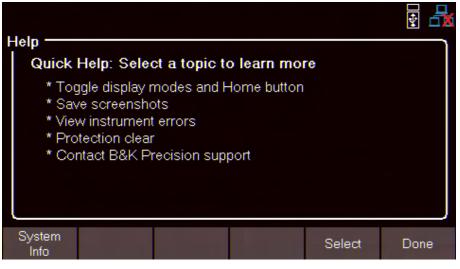


Figure 9.13 Help Menu

Use the navigation keys to select one the help options shown in figure **9.13**. To select the Quick help topic press the **Enter** button or press the **Select** softkey.



System Info

To view the instrument's general information: Press the **Utility button > Utility softkey > Help > System Info**.

System Information -		· · · · · · · · · · · · · · · · · · ·
Model Serial No. Version Date and Time MAC Address IP Address	HVL100025 100025007 0.12, 2.11-2, 1-A1.52 2023/06/15 13:42:48 00:17:F8:00:00:00 0.0.0.0	
		Done

Figure 9.14 System Info

Specifications

Specifications

Note: All specifications apply to the unit after a temperature stabilization time of 30 minutes over an ambient temperature range of 23 °C ± 5 °C.

Model		HVL600150	HVL80075	HVL100025	HVL600300	HVL800150	HVL100050	
Input Ratings								
Input Voltag	ze	0 to 600 V	0 to 800 V	0 to 1000 V	0 to 600 V	0 to 800 V	0 to 1000 V	
Input Curre	nt	0 to 150 A	0 to 75 A	0 to 25 A	0 to 300 A	0 to 150 A	0 to 50 A	
Input Power			3000 W	I		6000 W	1	
Minimum Operating	g Voltage	3.5 V	2.0 V	3.5 V	3.5 V	2.0 V	3.5 V	
CV Mode				1				
	Low	0 to 60 V	0 to 80 V	0 to 100 V	0 to 60 V	0 to 80 V	0 to 100 V	
Range	High	0 to 600 V	0 to 800 V	0 to 1000 V	0 to 600 V	0 to 800 V	0 to 1000 V	
Programming Rea Accuracy	idback /		l	±(0.05% +	0.05% FS) ^(I)	! 		
CC Mode				1		1	1	
Pango	Low	0 to 15 A	0 to 7.5 A	0 to 2.5 A	0 to 30 A	0 to 15 A	0 to 5 A	
Range	High	0 to 150 A	0 to 75 A	0 to 25 A	0 to 300 A	0 to 150 A	0 to 50 A	
Programming Readback / Accuracy		$\pm (0.05\% + 0.05\% \text{ FS})^{(i)}$						
CR Mode				1		1		
Pango	Low	$0.03~\Omega$ to 4 Ω	0.03 Ω to 10.66 Ω	0.2 Ω to 40 Ω	0.015 Ω to 2 Ω	0.015 Ω to 5.33 Ω	0.1 Ω to 20 Ω	
Range	High	4 Ω to 3200 Ω	10.66 Ω to 5000 Ω	40 Ω to 10 k Ω	2 Ω to 1600 Ω	5.33 Ω to 4000 Ω	20 Ω to 5 k Ω	
Programming Accuracy (I > 10% of Range)			1% + 0.1% of full range		1% + 0.1% of Full Range			
CW Mode	1							
Pange	Low		0 to 300 W			0 to 600 W		
Range	High	0 to 3000 W			0 to 6000 W			
Programming Ac	curacy			±(0.2%	+ 1% FS)			
Transient Mode (CC Mode							
TI & T2				100 µs	s to 10 s			
Accuracy				5 µs ± 1	00 ppm			
Slew Rate (2)	Low High	0.05 to 3000 A/ms	0.025 to 1500 A/ms	0.008 to 500 A/ms	0.1 to 6000 A/ms	0.05 to 3000 A/ms	0.017 to 1000 A/m	
External Program	0					·		
VMON Accur	асу	0.1% + 0.1% FS						
IMON Accur	асу			0.1% +	0.1% FS			
Input Impeda	nce	210 kΩ ± 5%						
1 1				-				

(I) Applies when set voltage (CV mode) or set current (CC mode) is greater than 0.2% of full scale.

(2) The slew rate specifications are not warranted, but are descriptions of typical performance. The actual transition time is defined as the time for the input to change from 10% to 90%, or vice versa, of the programmed current values. In case of very large load changes, e.g. from no load to full load, the actual transition time will be larger than the expected time. The load will automatically adjust the slew rate to fit within the range (high or low) that is closest to the programmed value.



Specifications (cont.)

Note: All specifications apply to the unit after a temperature stabilization time of 30 minutes over an ambient temperature range of 23 °C ± 5 °C.

Model	HVL600150	HVL80075	HVL100025	HVL600300	HVL800150	HVL100050	
Programmable Protection							
Voltage (OVP)							
Range	0.394 V to 630 V	0.525 V to 840 V	0.656 V to 1050 V	0.394 V to 630 V	0.525 V to 840 V	0.656 V to 1050 V	
Accuracy	0.2% + 0.788 V	0.2% + 1.05 V	0.2% + 1.313 V	0.2% + 0.788 V	0.2% + 1.05 V	0.2% + 1.313 V	
Current (OCP)					1		
Range	0.098 A to 157.5 A	0.049 A to 78.75 A	0.016 A to 26.25 A	0.197 A to 315 A	0.098 A to 157.5 A	0.033 A to 52.5 A	
Accuracy	0.2% + 0.197 A	0.2% + 0.098 A	0.2% + 0.033 A	0.2% + 0.394 A	0.2% + 0.197 A	0.2% + 0.066 A	
Under Voltage Lockout (UV	L)						
Range	0.45 V to 600 V	0.6 V to 800 V	0.75 V to 1000 V	0.45 V to 600 V	0.6 V to 800 V	0.75 V to 1000 V	
Accuracy	2.5% + 0.75 V	2.5% + 1 V	2.5% + 1.25 V	2.5% + 0.75 V	2.5% + I V	2.5% + 1.25 V	
General							
AC Input			100 VAC to 240 VAC	\pm 10%, 47 to 63 Hz			
Operating Temperature			41 °F to 104 °F	(5 °C to 40 °C)			
Dimensions (H x W x D)	5.24" x 16.8	7" x 26.18" (133 x 428.	4 x 665 mm)	8.74" x 16.8	57" x 24.21" (222 x 428	3.4 x 615 mm)	
Weight		48.5 lbs (22 kg)			73.8 lbs (33.5 kg)		
Warranty		3 Years					
Standard Accessories	Power cord, removable input protection cover, and certificate of calibration						
Regulatory Compliance							
Safety	Low Voltage Direc	Low Voltage Directive (LVD) 2014/35/EU, EN61010-1:2010+A1, cTUVus certification mark ⁽³⁾ fulfills US (UL 61010-1:2012) and Canadian (CAN/CSA-C22.2 NO. 61010-1-12) safety standards					
Electromagnetic Compatibility			EMC Directive 2014/30	D/EU, EN61326-1:2013	3		

(3) Tested and certified by a Nationally Recognized Testing Laboratory (NRTL), accredited by OSHA.

Service Information

Warranty Service: Please go to the support and service section on our website at bkprecision.com to obtain an RMA #. Return the product in the original packaging with proof of purchase to the address below. Clearly state on the RMA the performance problem and return any leads, probes, connectors and accessories that you are using with the device.

Non-Warranty Service: Please go to the support and service section on our website at bkprecision.com to obtain an RMA #. Return the product in the original packaging to the address below. Clearly state on the RMA the performance problem and return any leads, probes, connectors and accessories that you are using with the device. Customers not on an open account must include payment in the form of a money order or credit card. For the most current repair charges please refer to the service and support section on our website.

Return all merchandise to B&K Precision Corp. with prepaid shipping. The flat-rate repair charge for Non-Warranty Service does not include return shipping. Return shipping to locations in North America is included for Warranty Service. For overnight shipments and non-North American shipping fees please contact B&K Precision Corp.

Include with the returned instrument your complete return shipping address, contact name, phone number and description of problem.

B&K Precision Corp. 22820 Savi Ranch Parkway Yorba Linda, CA 92887 **bkprecision.com** 714-921-9095

LIMITED THREE-YEAR WARRANTY

B&K Precision Corp. warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of **13years** from date of purchase.

B&K Precision Corp. will, without charge, repair or replace, at its option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

To help us better serve you, please complete the warranty registration for your new instrument via our website www.bkprecision.com

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. The warranty is void if the serial number is altered, defaced or removed.

B&K Precision Corp. shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitations of incidental or consequential damages. So the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

B&K Precision Corp. 22820 Savi Ranch Parkway Yorba Linda, CA 92887 www.bkprecision.com 714-921-9095

Version: October 10, 2024