

Energy Storage Test With PLI Series

An implemented test function enables discharging energy storages such as accumulators, batteries, ultracaps etc. in an easy way and supplying determined values like charge and energy.

Caution when handling energy storage devices!



At improper handling irreversible damages up to fire outbreaks can happen to the unit under test. Read the operation and test conditions of your UUT carefully, also the user manual of the electronic load and the connection notes at the end of this document. Do not leave your energy storage unattended while a test is running!



The Discharge function *Discharge* is selected in the FUNCTION menu.

FUNCTION MENU

- ☐ Constant
- ☐ List
- ☒ Discharge
- ☐ MPPT

OFF OK Esc

In the DISCHARGE menu you decide whether data are logged to a USB mass storage device and in which operation mode the discharge will proceed.

DISCHARGE

Logging: Enter
Abort discharging: Abort

Remember function initialization!

Initialize function: Init.
Press OK to use function

OFF OK Esc

USB DATA LOGGING

State: Device attached

Logging in progress

Enable data logging

Stop logging now:	Stop
Sample rate in s:	0.5
Follow-up time in s:	10

OFF OK Esc

In the USB DATA LOGGING menu the data logging is activated or deactivated. Activation is only possible when an USB MSD is attached. After activation the sample rate can be set to 0.5 ... 10 s and the follow-up time (duration after test has stopped) up to 999 s. Confirm with OK to get back to the DISCHARGE menu.



DISCHARGE

Logging: Enter
Abort discharging: Abort

Remember function initialization!

Initialize function: Init.
Press OK to use function

OFF OK Esc

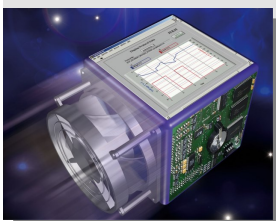
Then go to the initialize function by the *Init.* button to choose the operating mode and the setting value for the discharge.

DISCHARGE MODE

- ☒ Current 40.000 A
- ☐ Power 520.00 W
- ☐ Resistance 5.7813 R

OFF OK Esc

In the DISCHARGE MODE menu you select the operating mode current, power or resistance and the corresponding setting value for discharge. Confirming by OK, you get to the next menu. The setting value may be varied



The Stop Conditions for Finishing the Discharge

After choosing the operating mode and the corresponding setting value you automatically are guided to the DISC. STOP COND. menu. Here you activate and define the stop conditions for the discharge.

You must activate at least one stop condition, otherwise you won't get to the next menu but will go back to the DISCHARGE MODE menu.

Any number of stop conditions may be activated. The first one detected will stop the discharge.



If possible, you shall always activate a second stop condition to protect the UUT.

Example: You discharge a 10000 mAh accumulator down to a minimum voltage X as stop condition. You expect a discharge time of about 30000 s. Additionally set a time stop condition which is a little more than these 30000 s. Furthermore you could activate and set the charge stop condition to the value defined by the specified UUT's capacity.

DISC. STOP COND.

Charge (Q) >	10.000 Ah
Energy (E) >	0.0000 Ws
Time (t) >	30000 s
Current (I) <	0.0000 A
Voltage (V) <	7.500 V

OFF OK Esc

Charge (Q) > 0.0000 Ah
Energy (E) > 0.0000 Ws

Charge and energy are checked for overrun. That means discharging is stopped if the cumulated charge or, respectively, the energy is equal or higher than the corresponding stop condition value. The charge condition is well suitable as safety condition (when testing accumulators or batteries; we recommend to set the charge condition to the value of the UUT's capacity).

Time (t) > 300 s

The time is checked for overrun. That means discharging is stopped if the elapsed time is equal or higher than the corresponding stop condition value. The time is reset when the input is switched on and therefore when the discharging is started.

Voltage (V) < 0.0000 V

The voltage is checked for underrun. That means discharging is stopped if the measured voltage is equal or lower than the corresponding stop condition value.

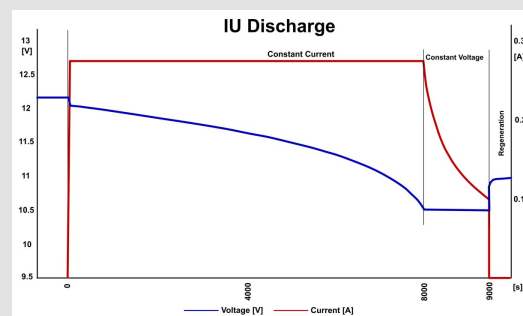
Current (I) < 0.0000 A

IUa Discharge, CCCV/CPCV/CRCV Discharge

A special discharge mode is to discharge the UUT via an IUa characteristic where it is first loaded in constant-current mode and discharged down to a certain voltage. When this minimum voltage is reached the electronic load implicitly changes to constant-voltage mode and keeps the voltage constant until the measured current is equal or lower than the current stop condition. Only then the load input is switched off and the test is finished.

This works in principle also with constant-power or constant-resistance mode.

Note that the voltage limit at which the electronic load changes to constant-voltage mode is represented by the Voltage Protection (see below).



PROTECTION [3]

Current prot.: 40.00 A

Voltage prot.: 0.500 V

Volt. prot. mode:

Regulation (CC-CV)

Switching

OFF OK Esc

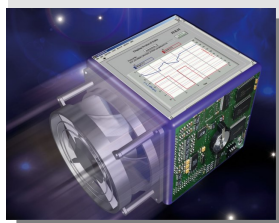
The PROTECTION menu is the last stage in configuring the discharge function. It is one of the most important things helping to protect the UUT.

Current prot.: The maximum allowable current is set here. The default value is the maximum possible current of the electronic load. Match this value to the maximum tolerable current of your UUT to prevent damage caused by over-current, especially in power and resistance operating modes. When discharging in current mode the current protection value shall be a little higher than the discharge current.

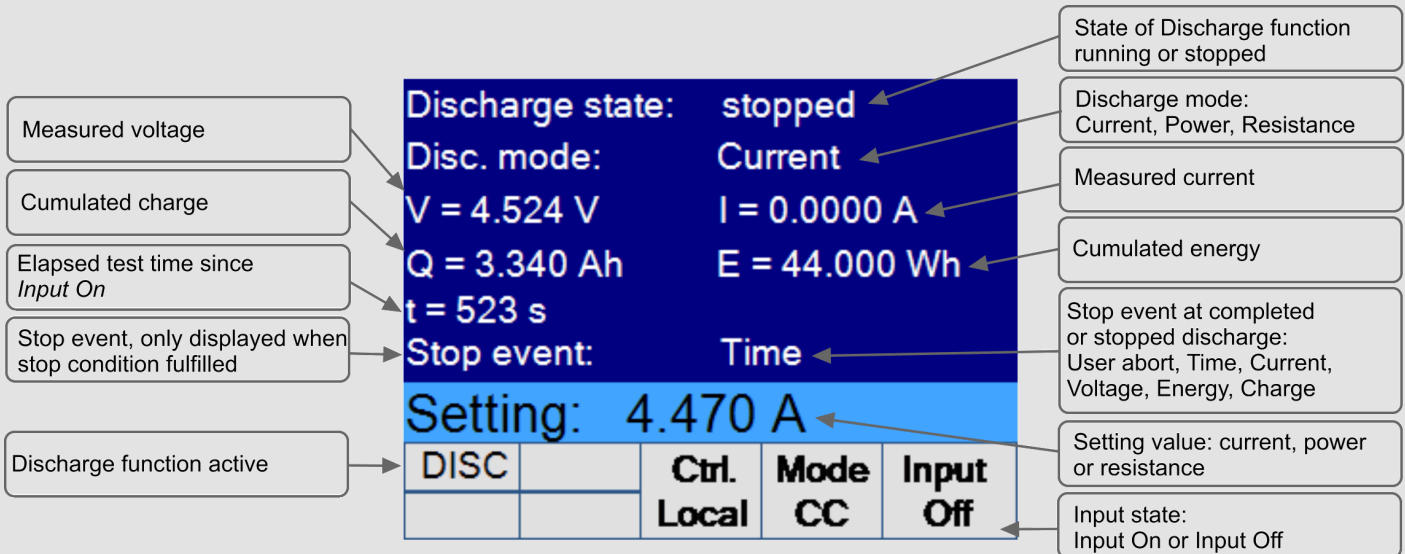
Voltage prot.: The minimum allowable voltage to draw current from the UUT is set here. This voltage is controlled by the electronic load's hardware. As default, 0.5 V are set.



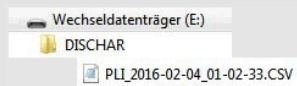
When the Current (I) < stop condition is not activated, due to safety reasons you shall set the voltage value so that the UUT won't be deeply discharged or even destroyed. In contrast, when the Current (I) < stop condition is activated the Voltage prot. value is the setting value for transitioning from the discharging operation mode to constant-voltage regulation with current reduction.



Main Menu While Discharging



The Log File



;Data log start: 2016-02-04 01:02:33		
;Rel. time in s	Voltage in V	Current in A
0	12.038941	0
1	10.978352	7.99712
2	10.960367	7.997163
3	10.938271	7.997205
4	10.922342	7.997205
5	10.904871	7.997163
6	10.884831	7.997163
7	10.86813	7.997163
8	10.847833	7.997205
9	10.836528	7.997205
10	10.816489	7.997205
11	11.87939	0
12	11.895577	0
13	11.906368	0
14	11.909964	0
15	11.909964	0
;Data log end: 2016-02-04 01:02:48		
;Stop condition: Time	Charge: 0.02199 Ah	Energy: 0.24014 Wh

The Data Logging function generates a folder named DISCHAR on the USB MSD. Each test generates a file in this folder. The file name is composed of the Electronic Load's date and time at start of test:

Example: PLI_2016-02-04-01-02-33.CSV

The test was started on Feb 04, 2016 at 1:02.33.

The csv file can be opened with a spreadsheet program such as MS Excel. It contains the following information:

Row 1: Date, time at test start

Row 2: Measured values with units

From row 3: Elapsed time, voltage, current

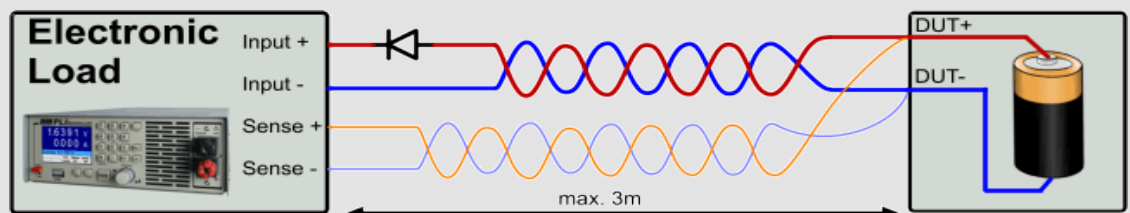
Penultimate row: Date, time at test end

Last row: Stop condition, cumulated charge and energy

Important Connection Hints



You must take particular caution when connecting an energy storage device to an electronic load! PLI series loads are protected against reverse polarity up to its nominal current. This is realized by a reverse diode. That means connecting an energy storage device in reverse polarity is similar to a short-circuit. Therefore we recommend to connect an external diode or a fuse into the load circuit as shown:



H&H does not guarantee the correct function of the suggested applications.

H&H does not overtake the costs for damages which can be caused by using this application note.