

# AVHzY CT-3 USB Multimeter

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## Meter UI Manual

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### V1.00.00

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Welcome to use my product [AVHzY CT-3 USB Multimeter] , this manual will introduce to you usages and tips of the Meter UI of the product. Please read the manual carefully and save it for future look-up.

#### 0.0 Warning

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- 1 After fast-charge trigger, do not plug in any device which cannot cope with the triggered high voltage into any port.
- 2 While the meter monitoring Voltage & Current between one input port and one output port, do not plug-in the third device into other ports.
- 3 After using PD trigger or listener feature, please turn off the switch on the bottom-right side of the meter.
- 4 The author is not responsible for any faulty operation.

#### 0.1 Version & Update

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Due to the complexity of the features, both the firmware and the hardware can vary frequently, this manual might not be applicable for the latest firmware/hardware release.

#### 0.2 Revision History

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Nothing so far.

#### 0.3 Structure

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#### 0.4 Current Direction

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The meter can detect *bi-directional* current between USB-A male and female ports.

The meter can detect *bi-directional* current between USB-C input and USB-C output ports.

The meter can detect *bi-directional* current between USB-C input port and USB-A female port.

But the meter cannot detect the current between USB-C output port and USB-A female port.

#### 0.5 General Operation Logic

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In all the menus, a click on the middle key is considered as confirm, a double-click on the middle key is considered as exit, left/right click is considered as selection or adjustment. This will not be repeated in the rest of the manual.

# 1.0 Home

*Home* is divided into 5 different pages, click the middle key to switch among them, their contents are described as following:

## 1.0.1

1st Page:



On the left side, from top to bottom are: current voltage, current, accumulated energy of the current accumulation group, accumulated capacity of the current accumulation group, accumulated time of the current accumulation group.

On the right side, from top to bottom are: board temperature, accumulation group number, equivalent resistance of the load.

On the bottom-right side, 3 icons from top to bottom represent: connection status of the PC port, connection status of modules, execution status of the lua script.

## 1.0.2

2nd Page:



On the left side, from top to bottom, in big font are: D+ voltage, D- voltage, bus voltage, bus current, bus power. On the top-right side: Fast-charge protocols which are possibly running at the present.

Due to the self power-consumption and a little bit of resistance from the measurement point to the input/output ports, there is a difference in voltage & current between actual input/output ports and the measurement point. The actual voltage, current and power are calculated and displayed in the right-bottom side of the page.

## 1.0.4



4st Page:

This page displays voltage, current, power and temperature in big font.

5st Page:

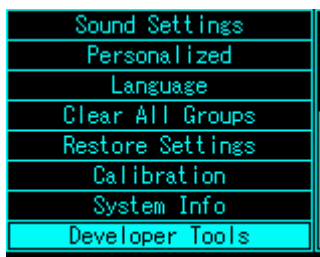
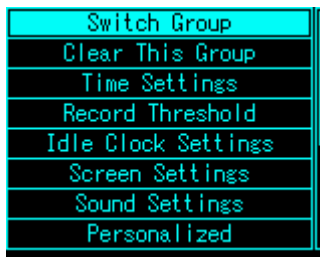
This page makes the meter into low-power mode. The backlight is off and only energy & capacity accumulation work is running, this is designed to improve the accumulation accuracy when no independent power supply is applied, the typical power consumption of the meter is 0.4mA @ 5V in this page.

## 2.0 Menus

Due to the complexity of the features, 4 different menus can be entered on home pages by doing the following:

1. Settings menu, long press the middle key to enter.
2. 'Left-Short' menu, click the left key to enter. It includes fast-charge trigger, protocol enumeration, e-mark cable reading, cable resistance test etc.
3. 'Left-Long' menu, long press the left key to enter. It contains lua scripts, offline data logging, USB storage mounting etc.
4. 'Right-Short' menu, click the right key to enter. It contains features related to extended modules.

## 2.1 Settings Menu



### 2.1.1 Settings Menu>Switch Group

The meter support 5 different accumulation groups, it is useful when you want to test different devices alternatively. You can switch between groups with this option.

### 2.1.2 Settings Menu>Clear This Group

Clear current accumulation group.

### 2.1.3 Settings Menu>Time Settings

The meter contains a RTC clock, this option is used to set the time. The time set by this option is also used for filesystem time stamp and lua scripts.

## 2.1.4 Settings Menu>Record Threshold

This option sets the accumulation threshold of the accumulation groups. When the current is more than this value, accumulation is running, while accumulation is paused when the current is less than this value. The range of this option is 0-200mA, when this value is set to 0, the accumulation always runs no matter how much the current is.

## 2.1.5 Settings Menu>Idle Clock Settings

When no user inputs and no accumulation running for a certain amount of time, the meter enters idle clock mode.

### Enable/Disable Idle Clock

Enable/Disable idle clock mode.

### Idle Time

Specify how much time without operation it takes to enter idle clock mode.

## 2.1.6 Settings Menu>Screen Settings

### Enable/Disable Screen Idle

Enable or disable the screen idle behavior(The screen brightness is reduced).

### Screen Idle Time

Specify how much time it takes to enter low brightness idle mode.

### Brightness Settings

Set the brightness of the screen during normal operation.

### Idle Brightness

Set the brightness when the screen is in low brightness idle mode.

### HomePage Update Rate

Set the update speed of the homepage readings. When the speed is reduced, the accuracy is relatively better, vice versa.

### Use Fahrenheit/Centigrade

Set the unit in temperature display.

### Enable/Disable Equal-Resis

Set if the fourth line of the fourth page of home displays the equivalent resistance.(It is the board temperature by default).

### Display Direction

The meter contains an accelerometer which detects the viewing direction, this feature can be disabled.

### Enable/Disable Auto-Rotation

Enable or disable auto-rotation feature.

### **Default Direction**

This specifies the direction of the display when Auto-Rotation is disabled.

## **2.1.7 Settings Menu>Sound Settings**

The meter contains a buzzer to provide better user experience.

### **Enable/Disable Touch-Tone**

Enable/Disable Touch-Tone.

### **Enable/Disable Hint Sound**

Enable/Disable hint sound.

### **Enable/Disable Warning Sound**

Enable/Disable warning sound.

## **2.1.8 Settings Menu>Personalized**

### **Theme Color**

Set the theme color of meter UI.

## **2.1.9 Settings Menu>Language**

Set the language.

## **2.1.10 Settings Menu>Clear All Groups**

Clear all accumulation groups.

## **2.1.11 Settings Menu>Restore Settings**

Restore settings into default.

## **2.1.12 Settings Menu>Calibration**

Don't enter this option.

## **2.1.13 Settings Menu>System Info**

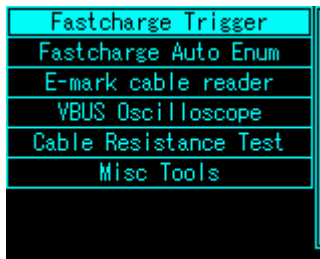
See system information.

## **2.1.14 Settings Menu>Developer Tools**

Don't enter this option.

## **2.2 'Left Short' Menu**

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Left-click on the home page to enter 'Left Short' Menu.

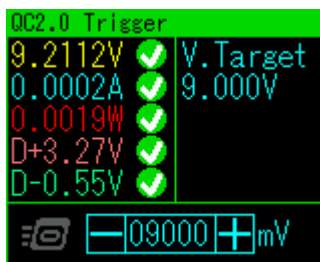
## 2.2.1 Fast-Charge Trigger

The meter supports fast-charge trigger for varies protocols: QC2.0/QC3.0, PD, Huawei FCP/SCP, (Super)VOOC/DASH CV Mode, Samsung AFC.

### Warning

After entering the fast-charge trigger menu, all operations should be considered carefully, in short, do not plug any other device except the charger (unless you know what you are doing). The author is not responsible for any faulty operation.

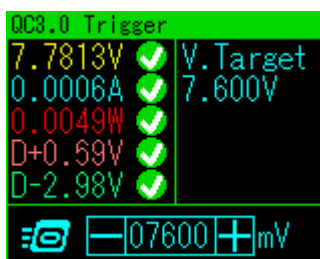
### QC2.0



In QC2.0 mode, the user adjust the voltage being triggered by scrolling the key to left or right. On the left side, current meter readings are displayed to check if a trigger is successful.

Double-click the middle key to go back to home-page, the triggered voltage maintains.

### QC3.0



In QC3.0 mode, the user adjust the voltage being triggered by scrolling the key to left or right (200mV per step as the protocol defined.).

Double-click the middle key to go back to home-page, the triggered voltage maintains.

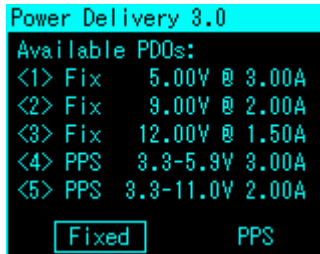
### Power Delivery 2.0/3.0

The meter supports requesting specified voltage from a charger running PD protocol. The internal PD transceiver is separated to the outside with a switch, which can be found on the right-bottom side of the meter.

To allow PD transceiver communicate with the charger, turn the switch on the right-bottom side of the meter into "ON" position. After using this feature, you should turn it back into "OFF" position.

Connect the meter and the charger with a Type-C to Type-C cable, if nothing goes wrong, the meter should start up. Enter fast-charge trigger menu, select "Power Delivery", the meter might reset, after that, the meter reports the voltage & current that the charger supports.

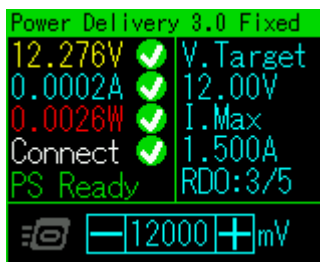
You can also press and hold the middle button while start-up to enter PD trigger mode, it's a shortcut for batch tests.



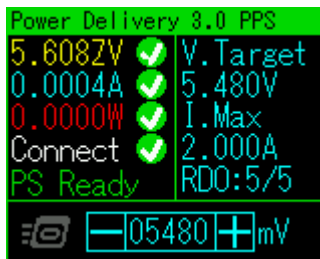
A charger's report is shown above.

This charger is PD3.0 and PPS capable. It has 3 fixed PDOs and 2 PPS PDOs. Scroll to select the type of PDO you want to trigger(fixed or PPS).

Note that not every PD charger supports PPS, it's highly possible that you will have only one choice "Fixed" here.



In fixed mode, the user adjust the voltage being triggered by scrolling the key to left or right.



In PPS mode, the user adjust the voltage being triggered by scrolling the key to left or right (Each step is 20mV defined by protocol).

Double-click the middle key to go back to home-page, the triggered voltage maintains.

## Huawei FCP

The same as QC2.0 mode except the protocol is different.

## Samsung AFC

The same as QC2.0 mode except the protocol is different.

## Huawei SCP

The same as QC3.0 mode except the protocol is different.

## Huawei SSCP

The same as QC3.0 mode except the protocol is different.

## VOOC/DASH/WARP CV

The same as QC3.0 mode except the protocol is different.

## Super VOOC

Notice that **Super VOOC need a load more than 500mA to be triggered properly, and Super VOOC has only one step of voltage which is 10.5V.**

### 2.2.1 Fast-Charge Release

After triggering any fast-charge protocol, if you want to discard the voltage triggered, enter 'Left Short' menu again and select fast-charge release.

### 2.2.2 Fast-Charge Auto Enum

```
Fastcharge Auto Enum
Apple          Samsung-5V-2A
QC3.0         DCP-1.5A
QC2.0-3V-12V-20V
Samsung-AFC-9V-12V
Huawei-FCP-9V-12V
Huawei-SCP-3.3V-5.5V
Huawei-SSCP-3.3V-12.0V
VOOC/DASH/WARP
SuperVOOC-10V Done.
```

In "Fast-Charge Auto Enum" mode, the meter tries to trigger fast-charge protocols one by one, and list them on the screen, if one protocol is supported, it is displayed green, otherwise it is displayed gray.

### 2.2.3 E-mark Cable Reader

This dumps the data of the E-mark chip (if present) inside C-C cable.

Power the meter with USB-A port or PC port (More recommended to power with PC port), **switch the PD communication switch on the right-bottom side of the meter into "ON" position.** Enter this mode, and plug-in the cable being tested (The other side of the cable should be leave float).

```
E-mark cable reader
Present Attached CC: CC1
ID Header VDO: 0x18002e99
Cert Stat VDO: 0x00001514
Product VDO: 0x00000000
Cable VDO: 0x00084040
Vconn. Pin Current: 4.8mA
Passive Hynetek
Double-End HW: 0H FW: 0H
20V@5A USB2.0 ~2m
```

The top of the screen shows the CC pin which is in communication with the cable, followed by the raw data received from the cable.

Below the raw data is the analysis of the cable, providing information like cable type, brand, HW/FW version etc.

The data is refreshed every 1 second, hot-plug is supported.

Double-click the middle key to exit the mode, and remember to switch the PD communication switch back into "OFF" position.

### 2.2.4 VBUS Oscilloscope



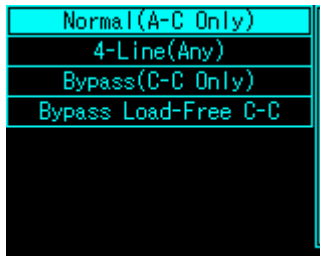
The meter contains an ADC and related circuit to display the AC coupled voltage on VBUS.

The maximum sample rate is 3.2Msps, with bandwidth 1.6MHZ, it's applicable for viewing ripple of most chargers, but the ripple of some power-banks might not be shown properly as they usually comes with a higher frequency.

Read the ripple frequency on the top-right side, Vpp on the bottom-right side.

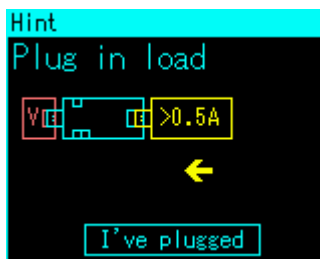
Scroll the key to left & right to adjust the sample frequency, click the middle key to pause or continue.

## 2.2.5 Cable Resistance Test

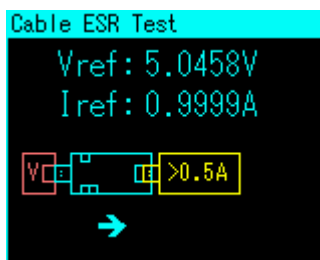


### 2.2.5.1 Cable Resistance Test > Normal (A-C Only)

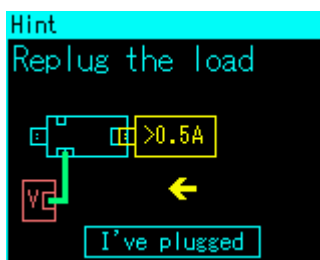
*Normal* mode calculates the cable resistance by comparing the voltage drop with and without the cable on the same load current.



The first step is: Plug in a power source to the USB-A male port, and plug-in a **constant-current** load to the USB-A female port, click the middle key to confirm.

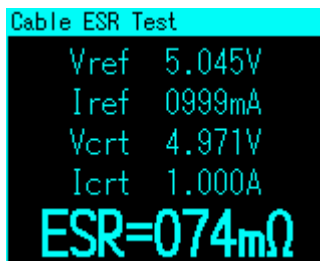


Then unplug the meter from the power source.



Reconnect the meter to the power source with **the A-C cable being tested**.

And plug-in the same load as before, click the middle key to confirm.



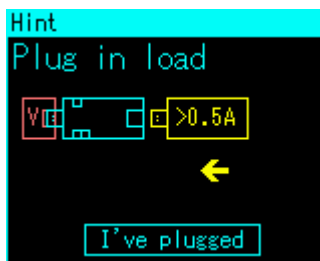
Then you should be able to read out the resistance.

### 2.2.5.2 Cable Resistance Test>4-Line(Any)

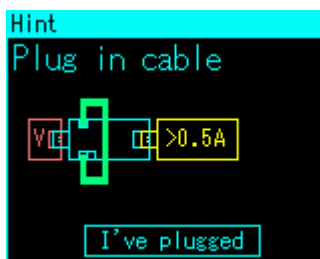
The meter provides the software implementation of this method only, for detailed information, contact your accessory provider.

### 2.2.5.3 Cable Resistance Test>Bypass(C-C Only)

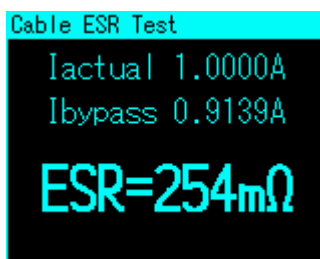
This method is capable of calculating the resistance of the positive bus wire inside the C-C cable, and therefore estimate the full cable resistance. Usually, the positive and the negative wire inside the cable share the same diameter and material, so the result is usually reliable.



The first step is: Plug in a power source to the USB-A male port, and plug-in a **constant-current** load to the USB-A female port, click the middle key to confirm.



Then you plug-in your C-C cable being tested to both Type-C ports of the meter, click the middle key to confirm.



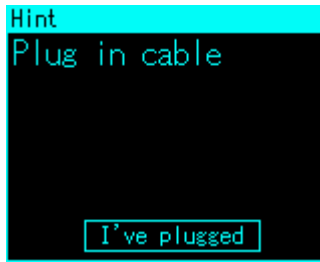
Then you should be able to read out the resistance.

You can replace the being tested cable more than once to do a batch test.

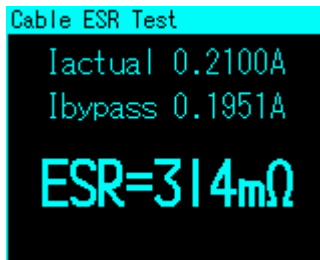
### 2.2.5.4 Cable Resistance Test>Bypass Load-Free C-C

This shares the same principle as 2.25.3, the difference is, the meter utilizes its internal small resistor load to replace the external load to provide more convenience.

You should connect a 5V power source to the USB-A male port of the meter, enter this method:



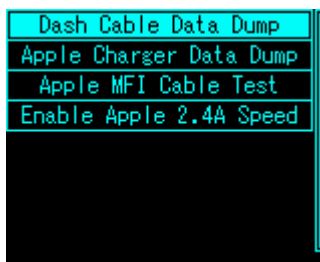
Then you plug-in your C-C cable being tested to both Type-C ports of the meter, click the middle key to confirm.



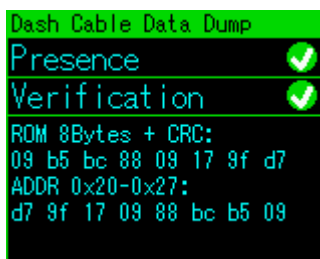
Then you should be able to read out the resistance.

You can replace the being tested cable more than once to do a batch test.

## 2.2.6 Misc Tools



### 2.2.6.1 Dash Cable Data Dump



This is able to check the validity of a DASH/VOOC/WARP cable.

Power up the meter with PC port.

Plug in **USB-A connector** of the DASH/VOOC/WARP cable into the **USB-A female port** of the meter.

The program reads out the content inside the cable.

It refreshes automatically, you can exit by double-clicking the middle key.

### 2.2.6.2 Apple Charger Data Dump

This is able to dump information saved inside an apple PD charger.

Connect the charger and the meter with a C-C cable (You also need to turn on the PD communication switch).

Select this option, wait a few seconds, the meter should show the data of the charger:

```
Apple Charger Data Dump
SN:          nil
ID:          0x1656
HW_Ver:      1.0
FW_Ver:      01070034
MFR:         Apple, Inc
Wattage:     60
Name: 85W USB-C Power Adapter
```

### 2.2.6.3 Apple MFI Cable Test

```
Apple MFI Cable Test
Test started...
5V @ 394uA OK...
Requesting QC3.0...
7.08V @ 129uA

Result:Passed
```

Connect the meter to a **QC3.0 supported** charger, and connect the MFI cable to the output port of the meter, the other side of the MFI cable should be left float.

Enter this option, wait a few seconds for the result.

Also notice the validity of this method is no longer proved.

### 2.2.6.4 Apple 2.4A

This will apply recognition voltage on D+ & D- lines to make the apple device convinced that it's connected to an apple charger, therefore increase the charging speed.

## 2.3 'Left Long' Menu

Long-press the left key to enter "Left Long" menu.

```
Lua Script Execute
Offline Record
Mount USB Mass Storage
Format Internal Storage
```

### 2.3.1 Lua Script Execute/Stop

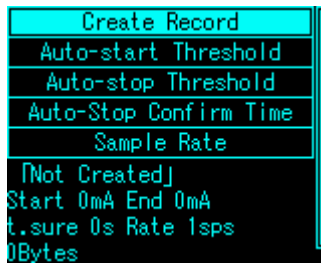
Select a script from internal storage 0:/lua/user to run.

For details of lua scripts, please visit: TODO TODO

### 2.3.2 Offline Record

The meter is able to log voltage & current into the internal storage, after data logging, you can open them in PC software.

The offline record files are saved in 0:/record/



### 2.3.2.1 Create/Stop Record

Create or stop the record manually.

### 2.3.2.2 Auto-start Threshold

Specify the start threshold current after record created, if 0mA is given, the record will start immediately after creating.

### 2.3.2.3 Auto-stop Threshold

Specify the stop threshold current under which the record will be stopped. If 0mA is given, the record will never stop automatically.

### 2.3.2.4 Auto-stop Confirm Time

Specify the time for the auto-stop condition to be triggered. If the device consumes less than the auto-stop threshold for this amount of time, auto-stop will be triggered.

### 2.3.2.5 Sample Rate

Set the sample rate of the offline record. Higher sample rates record more details, also consume more space.

This can be set in the range of 1-100sps.

## 2.3.3 Mount/Umount USB Mass Storage

This mount/umount the internal storage to the PC as a mass storage device.



The user can access internal storage, read offline record, copy in lua scripts, copy in firmware package to upgrade etc.

## 2.3.4 Format Internal Storage

Format the internal storage.

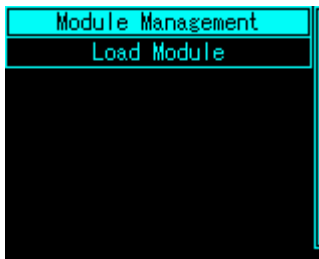
## 2.4 "Right Click" Menu

Right click on the home page to enter "Right Click" menu.

The user utilize and manage the modules in this menu.

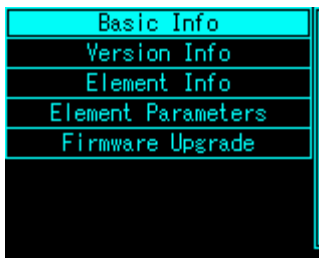
So far, there's only one module "SM-LD-01" is available.

For more information about modules, please visit: TODO TODO



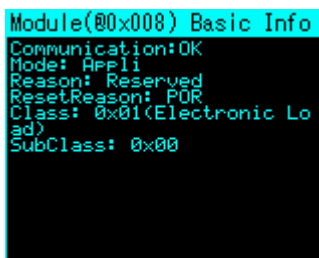
## 2.4.1 Module Management

Select target module:



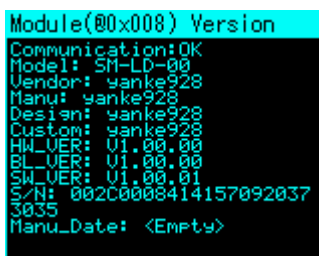
### 2.4.1.1 Basic Info

Show basic information of the module.



### 2.4.1.2 Version Info

Show version information of the module.



### 2.4.1.3 Element info

List elements inside the module.

```
Module(0x008) Element
Communication:OK
ELoad "ELoad_0"
T.Sensor "TSen_Mosfet"
T.Sensor "TSen_MCU"
V.Sensor "VSen_Fan"
V.Sensor "VSen_VBUS"
V.Sensor "VSen_V3V3"
Buzzer "Buzz_0"
Fan "Fan_0"
```

### 2.4.1.4 Element Parameters

Show parameters of a specified element.

```
ELoad "ELoad_0"
T.Sensor "TSen_Mosfet"
T.Sensor "TSen_MCU"
V.Sensor "VSen_Fan"
V.Sensor "VSen_VBUS"
V.Sensor "VSen_V3V3"
Buzzer "Buzz_0"
Fan "Fan_0"
```

Select an element to view its parameters:

```
Module@008H Element@080H
PATH: UBUS0(+)=>GND(-)
DriverMode: Desc Based
U: 0.50-26.00V
I: 0.05-6.00A
P: 0.00-100.00W
T: 25.1-32.1K
Periph: Ub.Sen Tm.Sen Vf.
Sen Fan Buzz
OB Mode: Wzr teDuty I_Full
=8 9A 0_Full=48000 Int1=i
3H Int2=00H Msk1=19H Msk2
=00H
```

### 2.4.1.5 Firmware Upgrade

You can perform a firmware upgrade to the module.

The upgrade package will be released on website TODO TODO. You should copy the package into the internal storage and perform a module firmware upgrade.

```
Module FW Upgrade
Entering Bootloader...
FW_Ver: V1.00.01
Opening SM-LD-00.bin...
Reading PLGDR...
Sending chunks...
Begin verify...OK
Resetting target...
App running.
FW_Ver now: V1.00.01

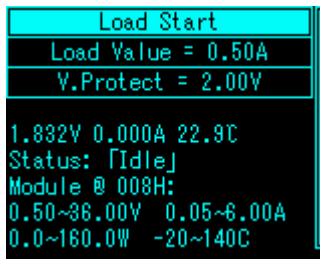
Upgrade Success
```

## 2.4.2 Load Module

The user controls load module in this option.

```
Constant-current Mode
Constant-Power Mode
Ramp-up Mode
Load Controller Info
```

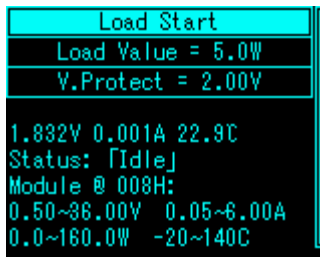
### 2.4.2.1 Constant-current Mode



Set proper load value and protection voltage, then click "Load Start" to enable the load.

Voltage, current, status information etc. is shown at the bottom.

### 2.4.2.2 Constant-power Mode



Set proper load value and protection voltage, then click "Load Start" to enable the load.

Voltage, current, status information etc. is shown at the bottom.

### 2.4.2.3 Ramp-up Mode

Ramp-up mode will increase the current gradually in the specified current range.

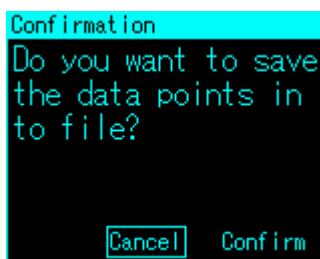
Select Ramp-up mode, set the parameters one by one:

**Start Current** : The current where the ramping begins.

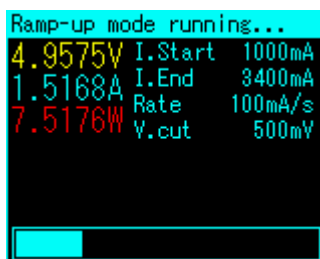
**End Current** : The current where the ramping ends.

**Slope** : The slope of the ramping.

**V.Protect** : Set the voltage below which the test will be stopped event without completion.



After setting the parameters, you can choose whether the voltage & current data will be logged or not.



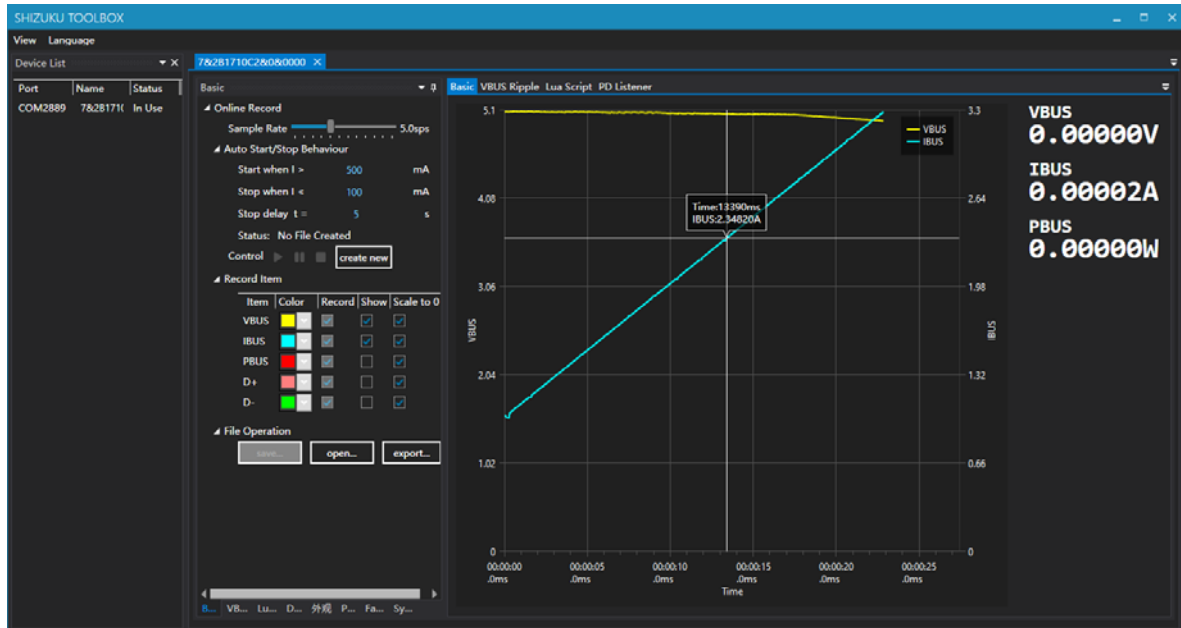
Then it enters running mode.

Wait for the progress to be done.



After completion, the meter gives you a graph of voltage & current during the ramping, double-click the middle key to exit.

If you just want to get a rough look at the voltage & current relation of your charger, you can simply not to log the data into file. If you want to analysis them carefully, you should save the data points into a file (Select "Confirm" in the dialogue before).



Open the ramp-up log file in the PC software to get a further look.

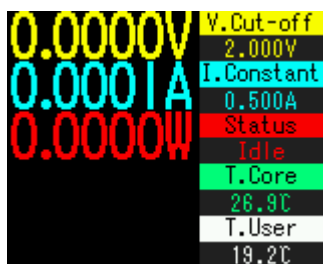
For detailed description of the PC software, please see [PC Software Manual](#).

#### 2.4.2.4 Load Controller Info

View the load controller information, for debug uses.

#### 2.4.2.5 Load extended home page

If any load module is connected, one more page is added to the home page:



Here, most of the values should be familiar.

**T. Core** is the mosfet temperature of the load module.

**T. User** is the reading of the user plugged temperature sensor, it is usually attached to the being tested device. For details of this accessory, please see: TODO TODO.

## 3.0 Misc

### 3.1 About USB3.1

Here USB3.1 refers to USB3.1 Gen1 & Gen2.

The meter **partially** supports USB3.1 super-speed signaling, this is not advertised, **it's not guaranteed to pass all USB3.1 signal normally.**

This is due to extra PCB routing of the meter for USB3.1 signal, the signal is attenuated making poor compatibility. If you want to test USB3.1 devices whatsoever, please follow the tips below to make the setup work as well as possible:

1. When testing USB3.1 devices through USB-A ports, collect a shortest possible cable with good quality.

2. When testing USB3.1 devices through Type-C ports, collect a shortest possible cable with good quality, and replace at least one of the cable with a Type-C male to male plug converter, replace all of the two when necessary.