



AS56UPS001 user manual

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1. Introduction

This chapter provides necessary information of the product such as the features and manuals before actual use.




1.1 Related Manuals

The manuals related to the product are listed below, please read them as necessary along with this document before actual use.

| Name | Purpose | Contents | How to get |
|-----------------|--|--|------------------------------|
| User manual | Must read when operating the product. | Describes the hardware features and settings | Download from ASTOR website. |
| SDK user manual | Must read when developing the IO functions | Describes the API functions and useage | Download from ASTOR website. |

1.2 Safety Information

This document provides safety information using the following symbols to prevent accidents resulting in injury or death and the destruction of equipment and resources. Understand the meanings of these symbols to operate the equipment safely.

| Symbol | Description |
|---|---|
|  | WARNING WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
|  | DANGER DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. |
|  | NOTE NOTE provide the reader with additional information or refer to detailed sources of information. |

1.3 Terminology

- DC_IN : the DC power input of the UPS.
- DC_OUT: the DC power output of the UPS.
- SOC: Status Of Charging.
- PMS: Power Management System.
- UPS: Uninterruptible Power Supply.
- AS56UPS001: the name of the UPS box.
- DC_OK: the status of the main supply input.
- Bat.Start: Battery Start, digital input to be used to force the DC output.
- Bat.Mode: Battery Mode, digital output to indicates supercapacitor supply.
- Bat.Ready: Battery Ready, digital output to indicates that the supercapacitor is charged successfully.
- Dev.Psts: Device Power Status, digital output to indicates the power status of the load device.
- SW: Remote switch on/off output.
- SVout: Signal Voltage output, is used to provide DC24V for the IO.
- SGnd: Signal Ground, is used to provide GND for the IO.

1.4 Product Description

AS56UPS001 is a standalone UPS module that can protect your PC in case of power outage, the module is composed of four supercapacitors and intelligent power management system, can offer supply power to the back-end system reliably and manage the boot and shutdown automatically by the serial port or IO signals connected to prevent the data loss during the power outage, meanwhile, the module provide properties to be configurable, thanks to the supercapacitors, It can operate in harsh environment from -20 to 65°C and have extremely high durability lasting over 10 years.

- DC12V/24V voltage input
 - Configurable backup mode and power output
- Safe, efficient and environmentally friendly
 - Up to 10 years service life with high conversion efficiency, environmentally friendly, safe and long backup time characteristics.
- Real Time monitoring
 - The equipment or computer can be monitored in real time by RS232 or USB device, configurable power management strategy, as well as remote switcher by DIO setting
- Wide operating temperature
 - Industrial grade components to make sure operating under -20 to 60 degrees Celsius

Target to be easily test the UPS box, we provide the tool to test its functionality. A brief description on the usage will be introduced in this document.

Meanwhile, the UPS module also supports the Modbus RTU protocol which will be very convenient for the users to develop their own UPS manager application or to do the integration into their own application. The protocol and Modbus registers will be introduced in this document.

2. About Product

This chapter describes product component and their functions, pin assignment of each connector in detail.

2.1 AS56UPS001

The AS56UPS001 is an energy storage power device. The input voltage is DC12V \pm 5% or DC24V \pm 5%, and the output voltage is DC12V or DC24V. Please remind that the device may be damaged if the power supply does not meet its specifications.

2.1.1 Features

- Industrial supercapacitor energy storage devices and intelligent power management system;
- Real-time monitoring of DC_IN status;
- Multiple I/O interfaces;
- Power input protection of overvoltage and polarity inverse;
- Output short circuit and overcurrent protection;
- Modbus RTU communication protocol;

2.1.2 Specifications

| Parameter Type | | AS56UPS001 |
|-----------------------|--------------------------|---|
| DC_IN | Voltage | DC12V / DC24V |
| | Current | 12A |
| | Protection | Overvoltage and power anti-reverse connection protection, EFT \pm 1500V, electrical surge DC2000V |
| DC_OUT | Voltage | 12V / 24V |
| | Current | 9A |
| | Protection | Overcurrent |
| Electrical parameters | Power In Idle | 3W |
| | Maximum Power | 60W/12V, 120W/24V |
| | Maximum charging current | 3A |
| Supercapacitor | Capacitance | 1080 Ws |
| | Active life | The charge and discharge times are up to 500,000 |
| IO | IO voltage | DC24V |
| | Isolation mode | Optocoupler |
| | Isolation voltage | 3.75kV |
| Signal type | Power | DI/DO dc-dc isolated power VCC, DC24V, 40mA. |
| | DC OK | Relay Normal Open output |
| | Bat.Mode | NPN output |
| | Bat.Ready | NPN output |
| | SW | NPN output |
| | Remote | NPN input |
| | Bat.Start | NPN input |
| | Dev.Psts | NPN input |
| Data interface | Interface | DB9 |
| | Mode | RS232 / RS485 |
| | Protocol | Modbus RTU |

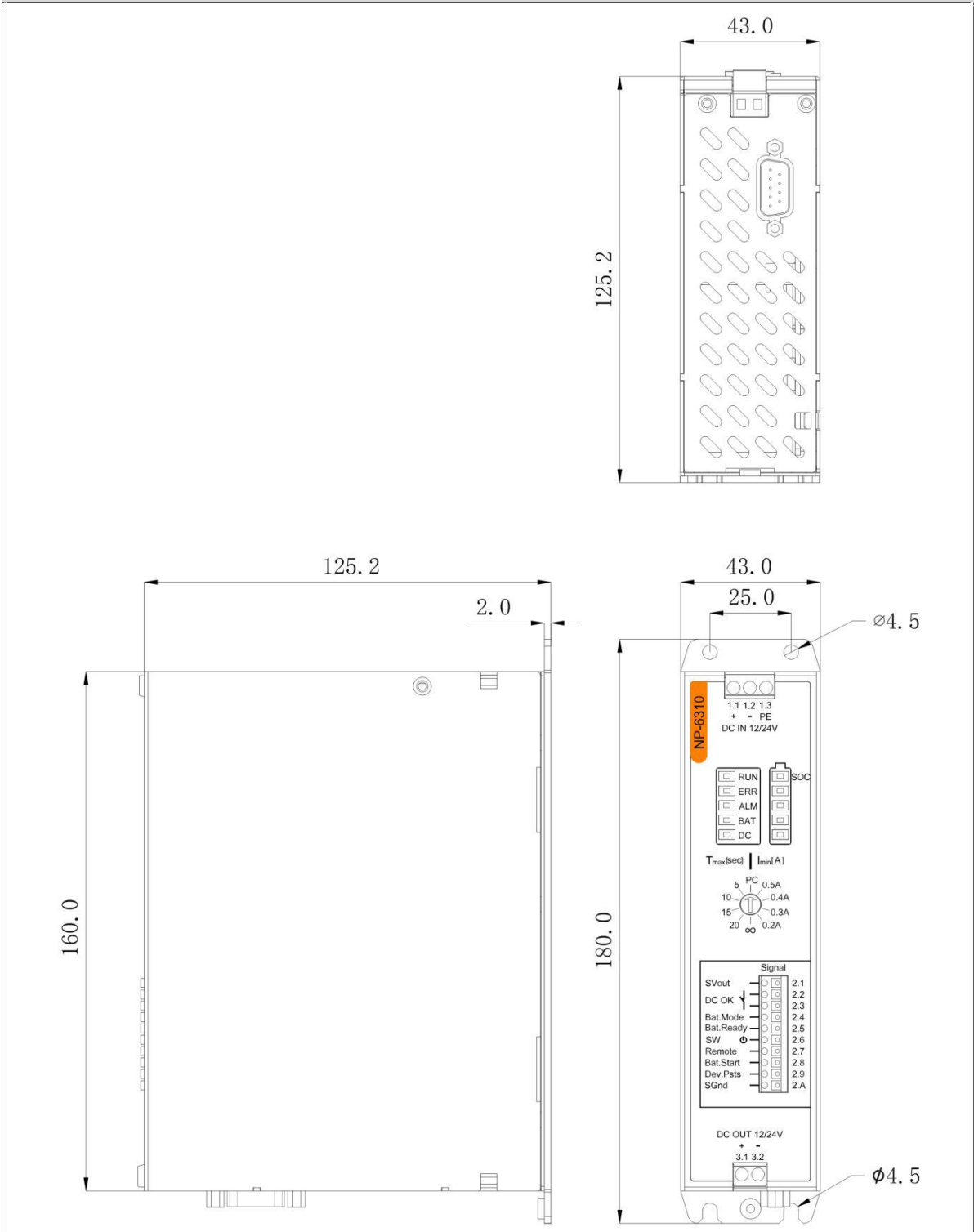
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| | | |
|--------------------------|----------------------|---|
| | Parameters | Can be set via register 40003, default baud rate 115200bps,8-bit data bit,1-bit stop bit, no parity |
| | Modbus slave address | The address can be set via register 40004, default is 1 |
| Environmental parameters | Working temperature | -20°C ~ 60°C |
| | Storage temperature | -40°C ~ 80°C |
| | Operating humidity | 5~95% |
| Mounting | Mode | Wall-Mounted or Din-Rail |
| | Dimensions | 180.0(mm) × 43.0(mm) × 125.2(mm) |
| | Weight | 850(g) |

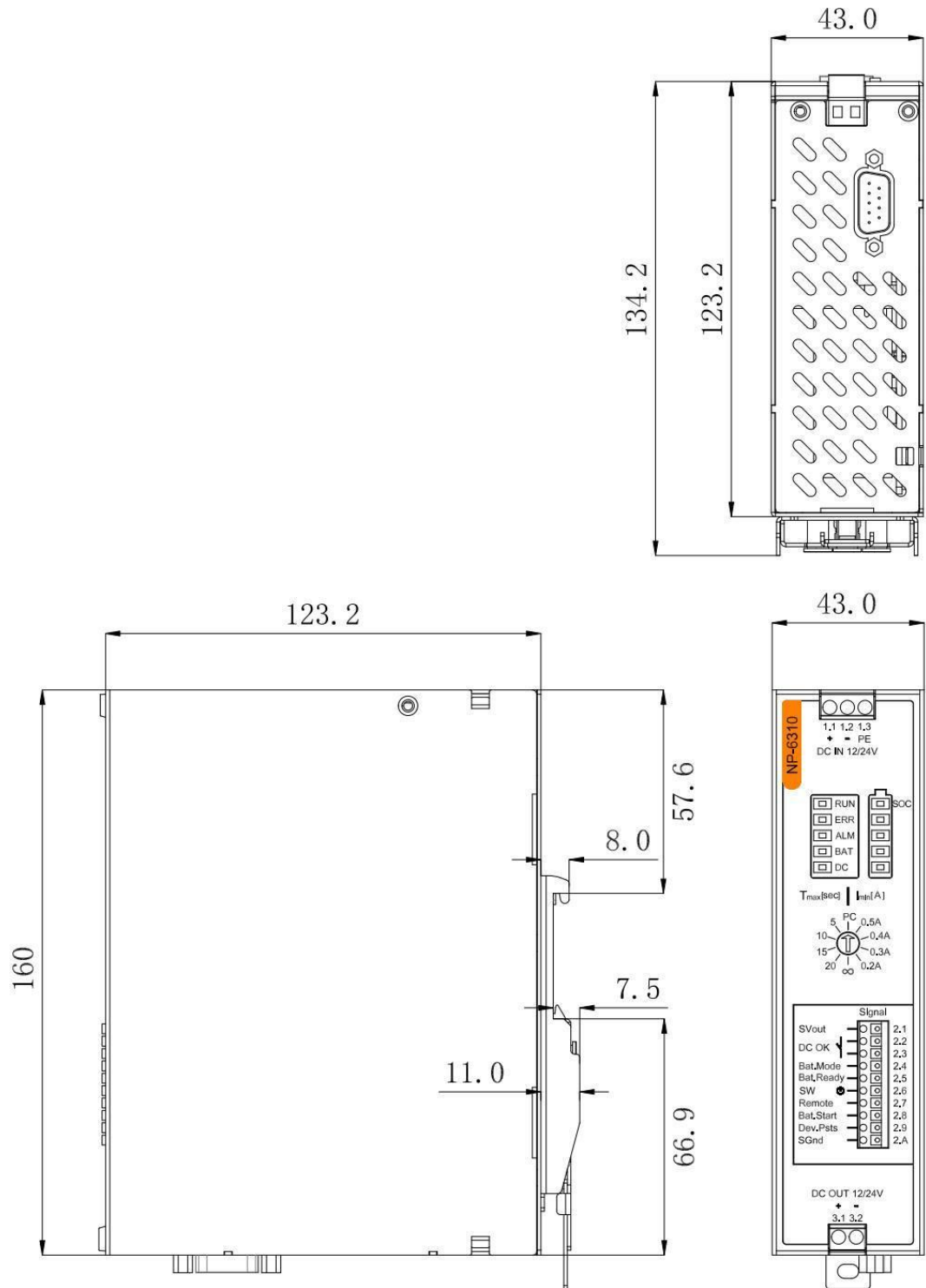
2.1.3 Dimension

Unit: mm

2.1.3.1 Wall-mounted

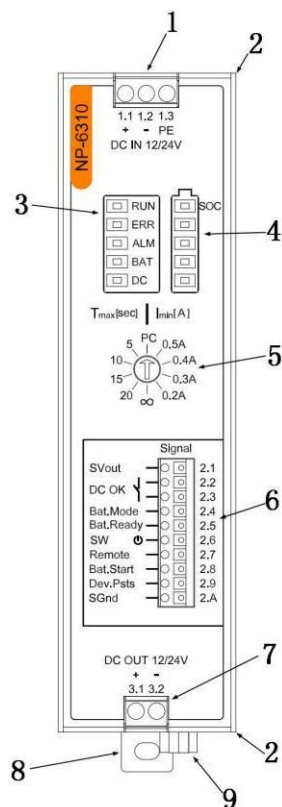


2.1.3.2 Din-Rail



2.1.4 Device interfaces

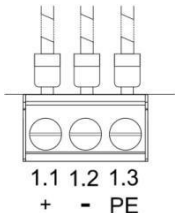
The DC input and output terminal blocks on the front of the UPS feature screw connection technology. The signal level wiring is connected via tool-free Push-in connection technology. The UPS also provides leds showing the working status and battery charging status.



| No. | Description | Remarks |
|-----|-------------------------------|---------|
| 1 | DC_IN terminal | |
| 3 | Working status leds | |
| 4 | Status leds of the Charging | |
| 5 | Working mode rotary switch | |
| 6 | Signal terminal | |
| 7 | DC_OUT terminal | |
| 9 | Serial communication terminal | |

2.1.4.1 DC input terminal blocks

The UPS is primarily supplied by a current-limiting source with a 24VDC or 12VDC voltage. The UPS is connected on the primary side via the DC IN connection terminal blocks.

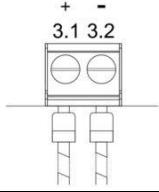
| Port pin | Marking | Description | Example |
|----------|---------|---------------------|---|
| 1.1 | + | VCC |  |
| 1.2 | - | GND | |
| 1.3 | PE | Protecting Earthing | |



- UPS only supports DC12V ± 5% or DC24V ± 5% power supply. Using power supply that does not meet the specifications will cause equipment damage.
- To dimension the power supply correctly, you must first determine the total current consumption of the system being supplied. The total current consumption is made up of the maximum load current and the maximum battery charging current.
- When there are requirements for anti EMC, it is necessary to ensure good grounding, and install a filter before the power input.

2.1.4.2 DC output terminal blocks

The UPS provides two pins of the screw terminal to be used to connect the load device. The output voltage of the DC output is the same as the DC input. In the event of a malfunction of the upstream power supply, the load is supplied with the energy stored in the supercapacitor.

| Port pin | Marking | Description | Example |
|----------|---------|-------------|---|
| 3.1 | + | DC_OUT VCC |  |
| 3.2 | - | DC_OUT GND | |

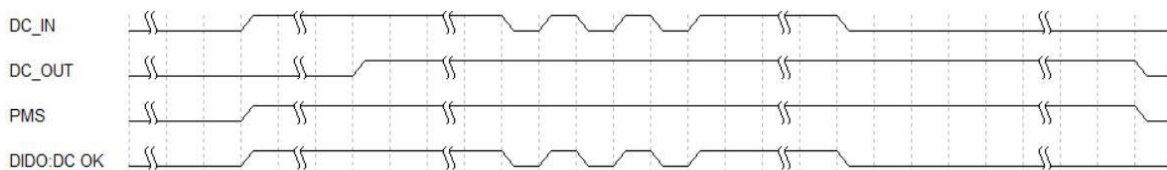
2.1.4.3 Signal terminal blocks

The connection terminal block signals are divided into the following signals for controlling and signaling the operating states of the UPS.

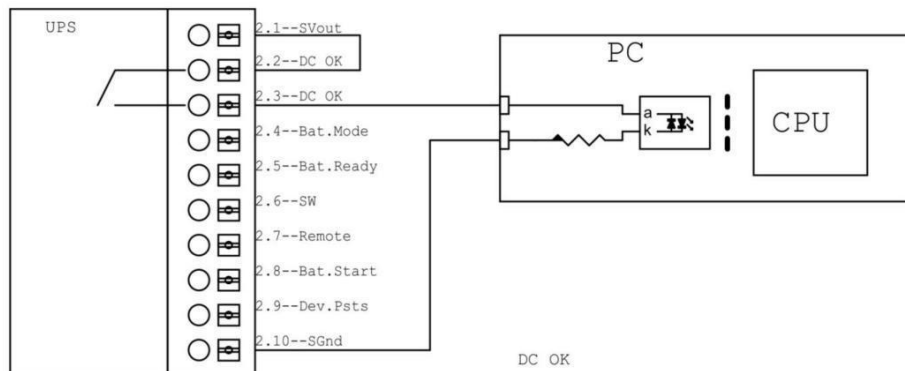
| Marking | | Description |
|----------|-----------|---|
| Port pin | Function | |
| 2.1 | SVout | Continuous +24 V signal voltage, e. g. to supply the floating switch contact. The signal voltage is available during mains and battery-powered operation. DC24V, I _{max} : 40mA. |
| 2.2-2.3 | DC OK | Relay normally open output, is is close when DC_IN is connected, otherwise is open. |
| 2.4 | Bat.Mode | NPN output, on when the supercapacitor is supplied, otherwise is off. |
| 2.5 | Bat.Ready | NPN output, on when the supercapacitor is charged full, else is off. |
| 2.6 | SW | NPN output, in the discharge state, when the power level is lower than the power off threshold, it will be switched on once. The turn-on hold time value is set in the 40013 register. |
| 2.7 | Remote | NPN input, When DC_IN is disconnected, and remote signal is valid, DC_OUT stops output immediately. |
| 2.8 | Bat.Start | NPN input, force the supercapacitor supply output when the DC IN is disconnected. |
| 2.9 | Dev.Psts | NPN input, indicates the power on status of the load. |
| 2.A | SGnd | The signal ground SGnd , which is the reference potential for the signal voltage 24V DC. SGnd is also the reference potential for signal outputs and signal inputs. |

■ DC_OK

The DC_OK signal is the output of the normally open relay. When the DC_IN input is valid, its state is Close, and when DC_IN is disconnected, its state is Open. The reference timing diagram is shown as below. In the figure, the high level state means the DC OK contact is closed with signal output, while the low level state means the DC OK contact is open with no signal output.



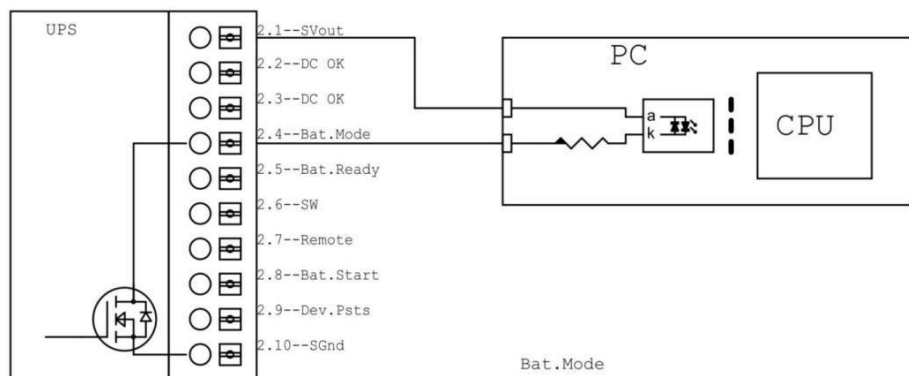
The equivalent circuit is as follows:



■ Bat.Mode

The Bat.Mode signal indicates whether internal supercapacitor power is used. It is an NPN output signal. When Supercapacitor power is used, the Bat.Mode signal is connected to SGnd.

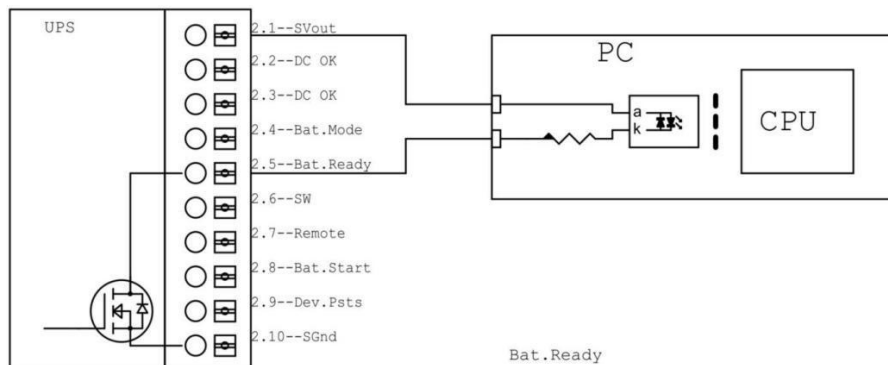
The equivalent circuit is as follows:



■ Bat.Ready

The Bat.Ready signal is an NPN output signal. When the supercapacitor is fully charged, the Bat.Ready signal is output and connected with SGnd.

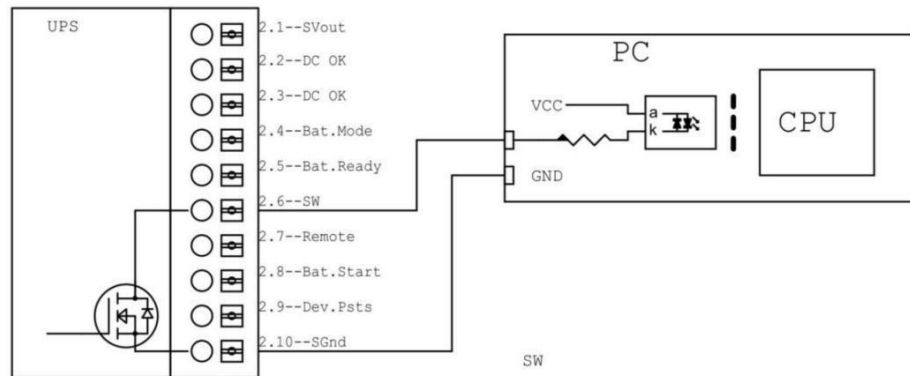
The equivalent circuit is as follows:



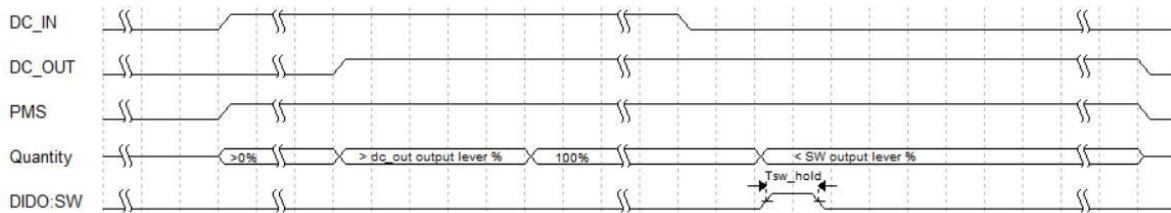
■ SW

When the powered device has a remote switch interface, the SW signal is used to connect to the remote switch interface of the powered device to simulate the function of pressing power button. This signal is an NPN output signal. When there is a SW signal output, it is connected to SGnd, otherwise it is in the opened state.

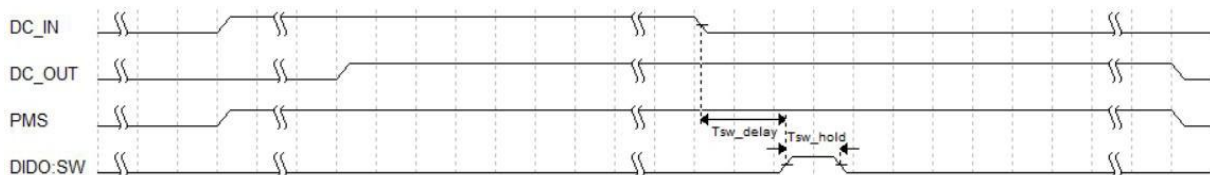
The equivalent circuit is as follows:



When the AS56UPS001 works in the load current monitoring mode, if the load current is lower than the set threshold (set by the rotary switch), the SW will output a pulse signal, whose pulse width time_h can be set by Modbus register 40013.



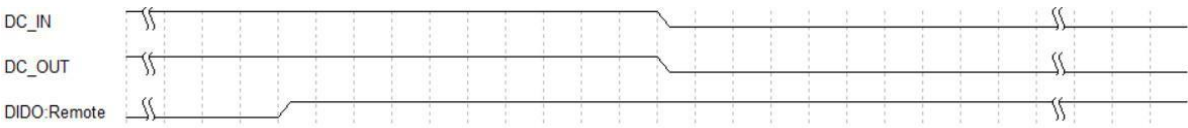
When the AS56UPS001 works in the mode of time limited mode, if the DC_IN power off, start the timeout timer (timing time time_d can be set through the rotary switch), if the timer times out, SW will output a pulse signal, the pulse width time_h can be set through the Modbus register 40013.



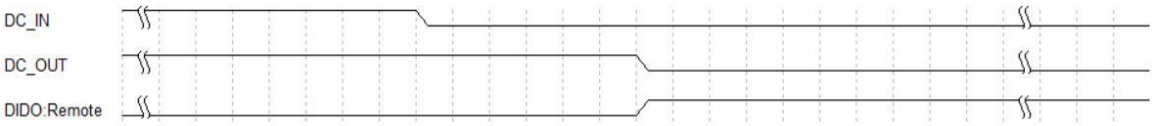
■ Remote

The Remote signal is an NPN input circuit used to control the UPS from stopping power output. When the Remote signal is valid and the DC_IN is disconnected, the DC_OUT of the AS56UPS001 UPS stops output immediately.

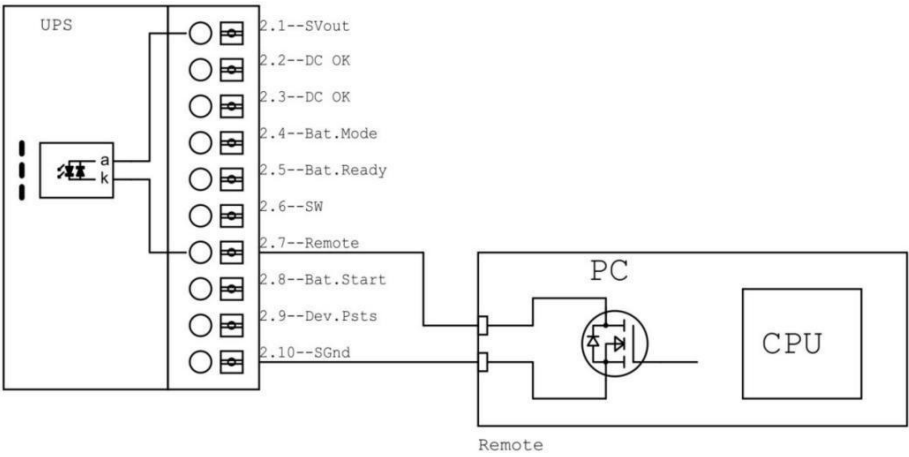
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If the AS56UPS001 UPS is in discharge state, the DC_OUT stops output immediately when the Remote signal is effective.

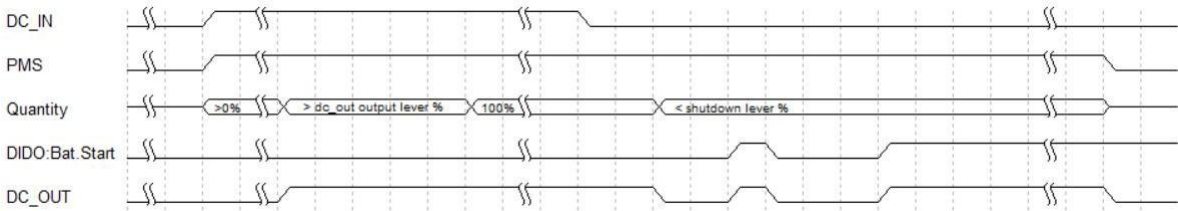


The equivalent circuit is as follows:

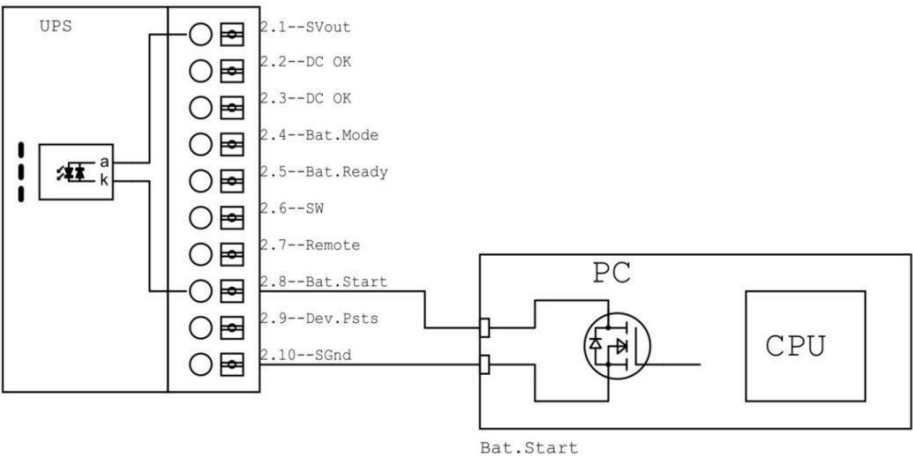


■ Bat.Start

The Bat.Start signal is used to force the internal supercapacitor to power output. When DC_IN is disconnected, if Bat.Start is valid, the internal supercapacitor DC_OUT output is used.

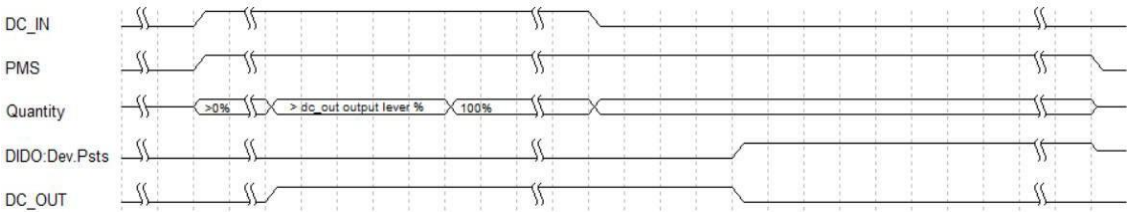


This signal is the NPN input circuit, the input signal internal common anodic processing, The equivalent circuit is as follows:

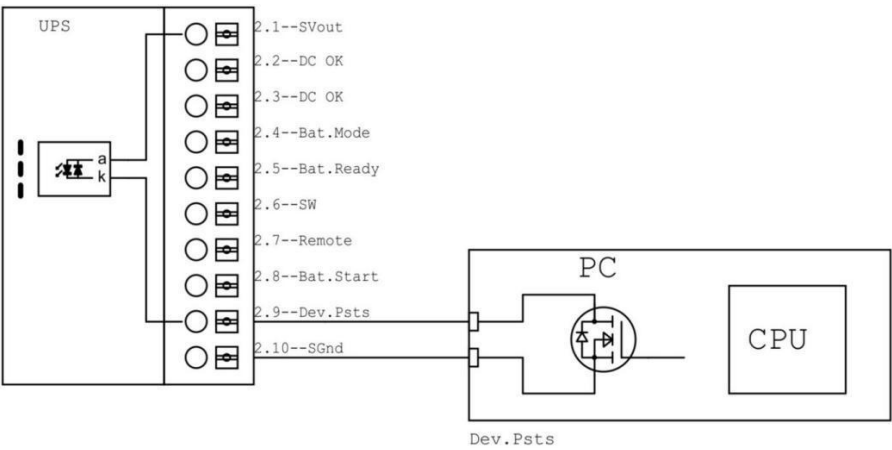


■ Dev.Psts

The Dev.Psts signal is used to receive the power status signal of the load device so that the UPS can determine whether the current powered device is shut down and stop power output. The polarity of its change can be set through the Modbus register 40008.

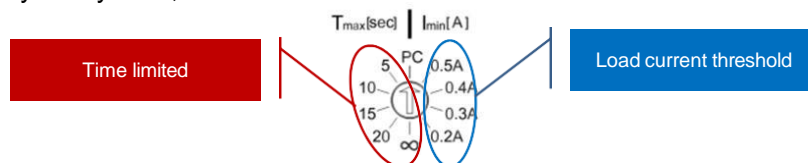


This signal is the NPN input circuit, the input signal internal common anodic processing, The equivalent circuit is as follows:



2.1.4.4 Rotary selector switch

The UPS can also be used without serial communication, the behavior can be set via the 10-stage rotary selector switch T_{max} [Sec.] or I_{min} [mA] on the front of the UPS device. Depending on the application in your system, select between time-limited or load current threshold operation.



- Current threshold mode is used by the UPS to determine whether the load device is normally shut down.
- Time limited mode is used to set the UPS duration after DC_IN is disconnected. If the time exceeds this value, DC_OUT output is stopped.
- PC mode is used to set the customized logic by changing the registers value.

| Type | Marking | Description |
|-------------------|---------|--|
| Customize | PC | User-defined control mode. The UPS control logic is defined by setting the control mode, shutdown logic, shutdown threshold, SW pulse width and other information in the according Modbus registers. |
| Current threshold | 0.5A | When the DC_IN is disconnected, the Supercapacitors power is lower than the preset shutdown power threshold (95% by default, which can be modified through the register 40015), and the UPS outputs the SW signal. When the load current is less than or equal to 0.5A, the UPS shuts down and stop the DC_OUT output. |
| | 0.4A | When the DC_IN is disconnected, the Supercapacitors power is lower than the preset shutdown power threshold (95% by default, which can be modified through the register 40015), and the UPS outputs the SW signal. When the load current is less than or equal to 0.4A, the UPS shuts down and stop the DC_OUT output. |
| | 0.3A | When the DC_IN is disconnected, the Supercapacitors power is lower than the preset shutdown power threshold (95% by default, which can be modified through the register 40015), and the UPS outputs the SW signal. When the load current is less than or equal to 0.3A, the UPS shuts down and stop the DC_OUT output. |
| | 0.2A | When the DC_IN is disconnected, the Supercapacitors power is lower than the preset shutdown power threshold (95% by default, which can be modified through the register 40015), and the UPS outputs the SW signal. When the load current is less than or equal to 0.2A, the UPS shuts down the DC_OUT output. |
| Time limited | 5 | After the DC_IN disconnection time reaches the set value 5S, SW signal will be output, and then DC_OUT output will be delayed to close (the default delay is 5S, which can be modified by register 40006). |
| | 10 | After the DC_IN disconnection time reaches the set value 10S, SW signal will be output, and then DC_OUT output will be delayed to close (the default delay is 10S, which can be modified by register 40006). |
| | 15 | After the DC_IN disconnection time reaches the set value 15S, SW signal will be output, and then DC_OUT output will be delayed to close (the default delay is 15S, which can be modified by register 40006). |
| | 20 | After the DC_IN disconnection time reaches the set value 20S, SW signal will be output, and then DC_OUT output will be delayed to close (the default delay is 20S, which can be modified by register 40006). |
| | ∞ | When the DC_IN is disconnected, stop the power output until the supercapacitor power is exhausted. |

During the shutdown phase of load equipment, when the DC_IN power supply is energized again, different policies can be set via the modbus register 40014:

| 40014 register | Policy |
|----------------|--|
| 0(default) | After the shutdown stage of the load device is complete, DC_OUT stops the power output, and then delays the power output again by 5 seconds. |
| 1 | Indicates that the policy has no operation. During the load shutdown process, DC_IN restores power supply and DC_OUT maintains output state. |

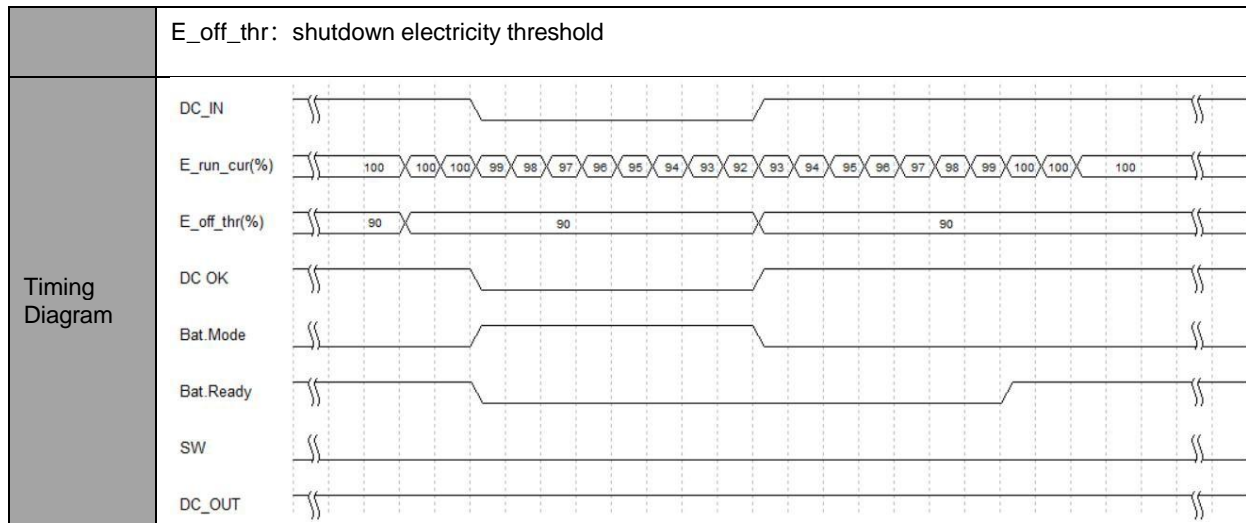
■ Current threshold is enabled

Case 1: After the DC_IN is powered off, the power supply is not restored before the device is shut down

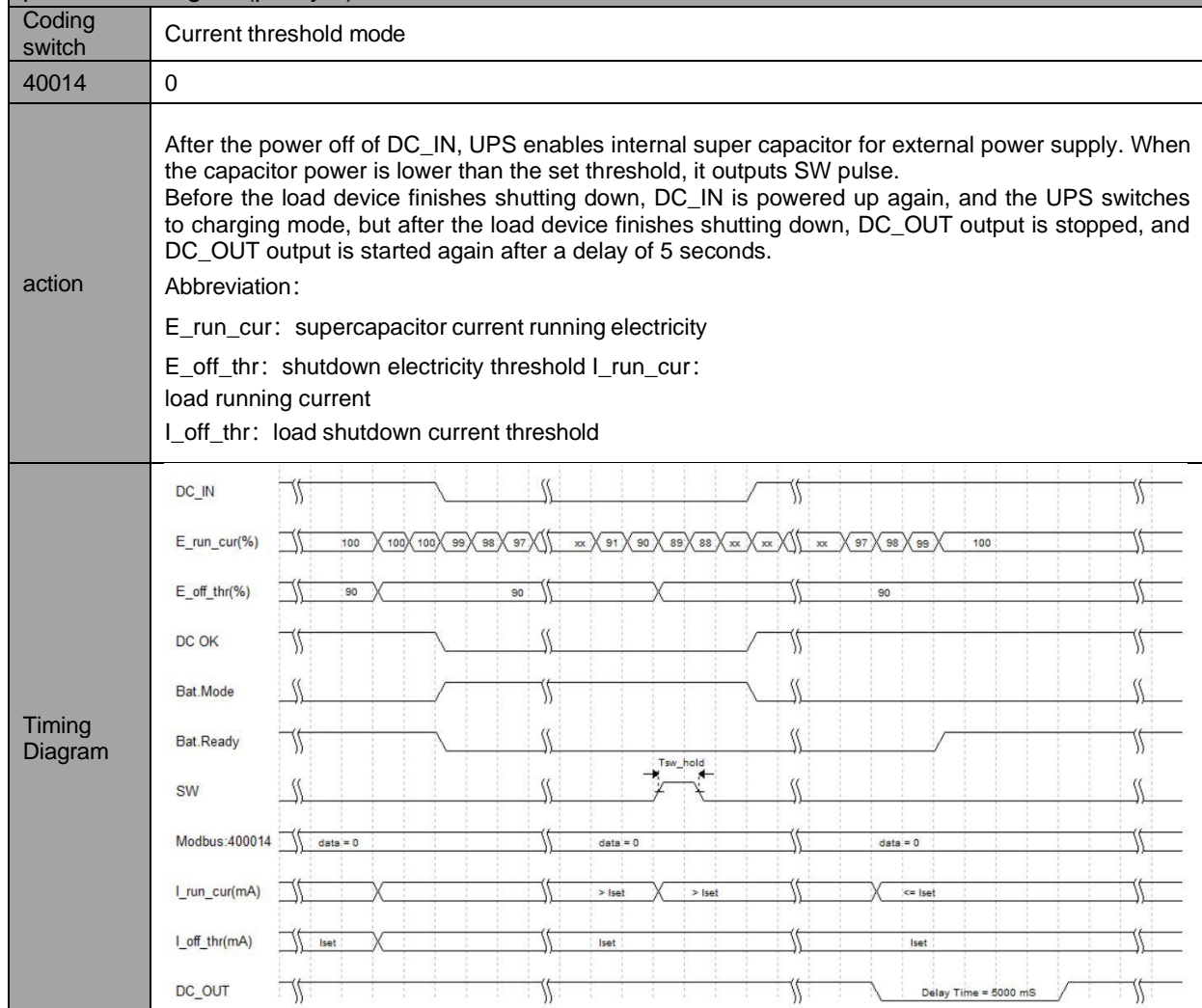
| Coding switch | Current threshold mode |
|----------------|--|
| action | <p>After the power off of DC_IN, UPS starts internal super capacitor for external power supply. When the supercapacitor current electricity is lower than the shutdown electricity threshold set in register 40010, the SW pulse signal is output. When the load running current is detected to be lower than the minimum load shutdown current threshold set in the coding switch, the DC_OUT power supply output is stopped.</p> <p>Abbreviation:</p> <p>E_run_cur: supercapacitor current running electricity</p> <p>E_off_thr: shutdown electricity threshold</p> <p>I_run_cur: load running current</p> <p>I_off_thr: load shutdown current threshold</p> |
| Timing Diagram | |

Case 2: After the DC_IN powered off, power on again before the remaining supercapacitor capacity exceeds the threshold

| Coding switch | Current threshold mode |
|---------------|--|
| action | <p>After DC_IN is powered off, UPS enables internal super capacitor to supply external power, and DC_IN recovers power supply before capacitor power is lower than shutdown threshold, UPS switches to supercapacitor charging mode, and keeps DC_OUT power supply, SW signal has no action.</p> <p>Abbreviation:</p> <p>E_run_cur: supercapacitor current running electricity</p> |



Case 3 : After the DC_IN powered off, during the load device shutdown phase, the DC IN is powered on again (policy 0).



| | |
|---|---|
| Case 4: After the DC_IN powered off, during the load device shutdown phase, the DC IN is powered on again (policy 1). | |
| Coding switch | Current threshold mode |
| 40014 | 1 |
| action | <p>After the power off of DC_IN, UPS enables internal super capacitor for external power supply. When the capacitor power is lower than the set threshold, it outputs SW pulse.</p> <p>Before the load device finishes shutting down, DC_IN is powered up again, and the UPS switches to charging mode, DC_OUT output is maintained after the load device completes the shutdown.</p> <p>Abbreviation:</p> <p>E_run_cur: supercapacitor current running electricity</p> <p>E_off_thr: shutdown electricity threshold I_run_cur: load running current</p> <p>I_off_thr: load shutdown current threshold</p> |
| Timing Diagram | <p>The timing diagram illustrates the sequence of events during the load device shutdown phase. The signals shown are:</p> <ul style="list-style-type: none"> DC_IN: Shows a transition from high to low, followed by a return to high. E_run_cur(%): Shows a sequence of values: 100, 100, 100, 99, 98, 97, then a series of 'xx' values (91, 90, 89, 88, xx, xx), then 97, 98, 99, and finally 100. E_off_thr(%): Shows a threshold value of 90. DC OK: Shows a transition from high to low, followed by a return to high. Bat.Mode: Shows a transition from low to high. Bat.Ready: Shows a transition from low to high. SW: Shows a pulse labeled 'Tsw_hold'. Modbus.400014: Shows a sequence of 'data = 1' values. I_run_cur(mA): Shows a sequence of values: 'set', '> Iset', '> Iset', and '<= Iset'. I_off_thr(mA): Shows a sequence of values: 'Iset', 'Iset', and 'Iset'. DC_OUT: Shows a transition from high to low, followed by a return to high. |

- Time limited is enabled

In time limited control mode, the total shutdown time is:

$$T = t_{\text{sw delay}} + t_{\text{sw hold}} + t_{\text{off}}$$

- T is the total shutdown time, that is, the time from DC_IN power down to DC_OUT stopping output, t_{sw_delay} is the time set by coding switch or register, t_{sw_hold} is the SW signal output holding time, t_{off} is the time from DC_IN power down to start output SW signal.
- t_{sw_delay} , when adjusted by the coding switch, the t_{sw_delay} value corresponds to the value indicated by the coding switch; When the PC mode is set to time control mode, the default is 5000mS, which can be modified by modbus 40006 register.
- t_{sw_hold} , default is 500mS and can be changed via Modbus register 40013.
- t_{off} , default is 5000mS and can be changed via Modbus register 40011.

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Case 5: After the DC_IN powered off, the power supply is not restored before the device is shut down

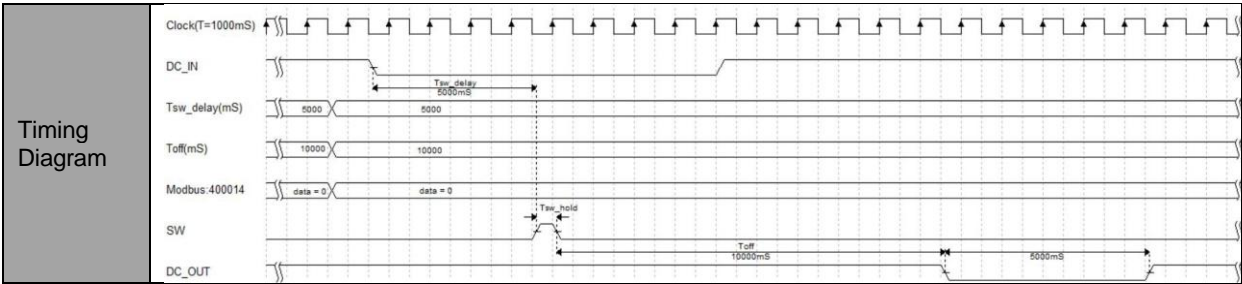
| | |
|----------------|--|
| Coding switch | Time limited mode |
| action | After the power off of DC_IN, the UPS will start the supercapacitor to supply external power. When the power supply time exceeds the set time, the SW pulse signal will be output, and the DC_OUT power supply will be stopped after a period of time. |
| Timing Diagram | <p>The timing diagram illustrates the sequence of events for Case 5. It includes a clock signal with a period of 1000ms. The DC_IN signal transitions from high to low. Following this, a delay of 5000ms (Tsw_delay) occurs before the SW signal transitions from low to high. After the SW pulse, a delay of 10000ms (Toff) occurs before the DC_OUT signal transitions from high to low. The Modbus:400014 signal is shown as data = 0 throughout the sequence.</p> |

Case 6 : After the power off of DC_IN, the UPS starts the supercapacitor to supply external power, and the power supply time does not exceed the set time

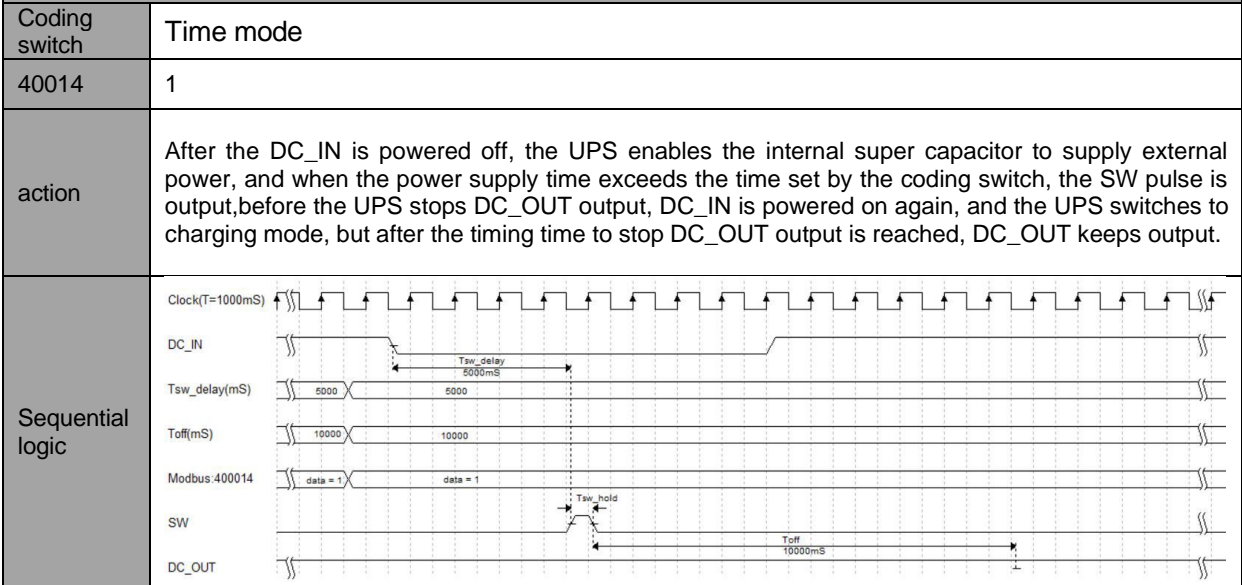
| | |
|----------------|--|
| Coding switch | Time limited mode |
| action | After the power off of DC_IN, the UPS starts the supercapacitor to supply external power, and the power supply time does not exceed the set time, SW signal does not act, DC_OUT will supply power continuously. |
| Timing Diagram | <p>The timing diagram illustrates the sequence of events for Case 6. It includes a clock signal with a period of 1000ms. The DC_IN signal transitions from high to low. Following this, a delay of 5000ms (Tsw_delay) occurs before the SW signal transitions from low to high. After the SW pulse, a delay of 10000ms (Toff) occurs before the DC_OUT signal transitions from high to low. The Modbus:400014 signal is shown as data = 0 throughout the sequence.</p> |

Case 7 : After the DC_IN powered off, during the load device shutdown phase, the DC IN is powered on again (policy 0).

| | |
|---------------|--|
| Coding switch | Time mode |
| 40014 | 0 |
| action | After the DC_IN is powered off, the UPS enables the internal super capacitor to supply external power, and when the power supply time exceeds the time set by the coding switch, the SW pulse is output, before the UPS stops DC_OUT output, DC_IN is powered on again, and the UPS switches to charging mode, but after the timing time for stopping DC_OUT output is reached, the port output 5S outputs DC_OUT again. |



Contextual8: After the DC_IN powered off, during the load device shutdown phase, the DC IN is powered on again (policy 1).

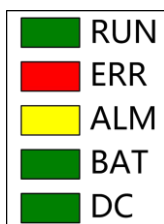


When the coding switch points to the PC file, the user can customize the supercapacitor life or turn off the device to detect the minimum current through Modbus registers 40005, 40006, 40007.

| coding switch | Mode | 40005 | 40006 | 40007 | Function |
|---------------|-------------------|-------|-----------------|----------------------|--|
| PC | Time limited | 1 | t_{sw_delay} | invalid | The same effect as the time mode of the coding switch |
| | Current threshold | 2 | Invalid | $I_{min_threshold}$ | The same effect as the current mode of the coding switch |

2.1.4.5 UPS working status LED

The front panel of AS56UPS001 provides five working status leds, which respectively represent the status of RUN, ERR, ALM, BAT and DC.



| LED | Color | Status | Function |
|-----|--------|----------|--|
| RUN | Green | ON | PMS is normal operation condition |
| | | Flashing | PMS is abnormal operation condition or loading operation parameter after reset |
| | | OFF | UPS Power OFF |
| ERR | Red | ON | Initialization failed |
| | | Flashing | PMS Error |
| | | OFF | UPS normaloperation or UPS power off status |
| ALM | Yellow | ON | DC_IN Corresponding DC OK(2.2-2.3) signal ON |
| | | OFF | DC_IN the normal power supply or UPS shutdown state, the corresponding DC OK (2.2-2.3) OFF |
| BAT | Green | ON | When the super capacitor discharges, the corresponding Bat.mode (2.4) is ON |
| | | OFF | When the super capacitor is not discharged or the UPS is off, the corresponding Bat. Mode (2.4) is off |
| DC | Green | ON | DC_IN case of normal power supply |
| | | OFF | DC_IN case of abnormal power supply or UPS shutdown |

■ RUN

The RUN led is used to indicate the operation status of AS56UPS001. When the UPS is working normally, it will be on normally, and it will be off or flashing when it is not working normally. The reference timing diagram is shown below. The high-level status in the timing diagram represents that the LED is on, and the low-level status represents that the LED is off.

■ ERR

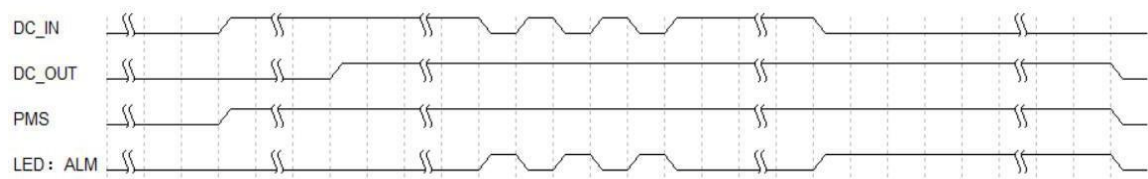
When AS56UPS001 works normally, the ERR indicator is off. If there is a fault, the ERR indicator will flash.

| Error | Error ID | ERR LED flashing timing |
|-----------------------------------|----------|-------------------------|
| Null | 0 | |
| Initialization failed | 1 | |
| PMS failed | 2 | |
| Capacitor lose | 3 | |
| DC_IN overvoltage or undervoltage | 4 | |
| DC_OUT overcurrent | 5 | |

■ ALM

ALM led represents the state of DC IN, when the UPS DC power supply input is disconnected, this light is always on, and when the power supply is normal, this light is off. The reference timing diagram is shown below. In the timing diagram, the high level status

represents that the LED is on, and the low level status represents that the LED is off.



■ BAT

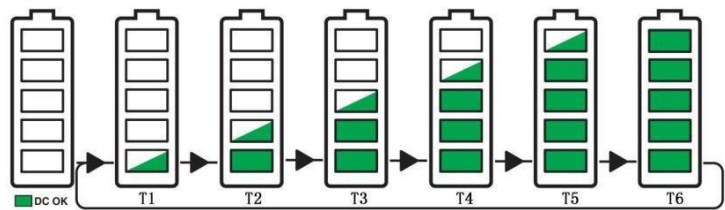
BAT led indicates whether the UPS uses supercapacitor powered output. It is on when using supercapacitor powered output and off when using DC powered output.

■ DC

The DC led indicates whether the UPS uses DC power supply output. It is on when DC power supply output is used and off when supercapacitor power supply output is used.

2.1.4.6 UPS charging status LED

The front panel SOC area is the charging status LEDs. When the UPS is working, the leds displays according to the corresponding level; When the UPS is turned off, all the leds are off; When the power is turned on but the power management system fails, the leds will flash. The state of leds during charging is shown in the figure below, T1 to T6 indicates the charging process. The discharge sequence is reverse. The discharge state is from T6 to T1. (The green box indicates that the current led is always on, and the green white box indicates that the current led is flashing)



When the capacitance power level reaches a certain level, the led is always on. When it is about to reach a certain level, the led flashes at 1Hz frequency. For example, when the capacitance power level is 50%, 20% and 40% of the state led are constant on, while 60% of the led are flashing, 80% and 100% of the led are off, and the discharge state is the same.

| Level | LED | Status | Level | LED | Status | Level | LED | Status |
|---------------|------|----------|----------------|------|----------|---------------|------|----------|
| T1 1%~20% | SOC5 | OFF | T2 21%~40% | SOC5 | OFF | T3 41%~60% | SOC5 | OFF |
| | SOC4 | OFF | | SOC4 | OFF | | SOC4 | OFF |
| | SOC3 | OFF | | SOC3 | OFF | | SOC3 | Flashing |
| | SOC2 | OFF | | SOC2 | Flashing | | SOC2 | ON |
| | SOC1 | Flashing | | SOC1 | ON | | SOC1 | ON |
| T4 61%~80% | SOC5 | OFF | T5 81%~100% | SOC5 | Flashing | T6 = 100% | SOC5 | ON |
| | SOC4 | Flashing | | SOC4 | ON | | SOC4 | ON |
| | SOC3 | ON | | SOC3 | ON | | SOC3 | ON |
| | SOC2 | ON | | SOC2 | ON | | SOC2 | ON |
| | SOC1 | ON | | SOC1 | ON | | SOC1 | ON |

2.1.5 Communicating function

2.1.5.1 serial communication

Load device can use RS232 or RS485 interface, using the standard Modbus RTU protocol to communicate with AS56UPS001, and can do data saving, system shutdown and other operations when DC input status is changed.

■ Interface definition

| Type | DB9 pin | Signal | Signal definition diagram |
|-------|---------|--------|---------------------------|
| RS232 | Pin_2 | TXD | |
| | Pin_3 | RXD | |
| | Pin_5 | GND | |
| RS485 | Pin_9 | A | |
| | Pin_4 | B | |

Note: When the AS56UPS001 device is restored to factory Settings, the default communication parameters are baud rate: 115200bps, data bit: 8bit, stop bit: 1bit, parity: none, and device address: 1.

■ Modbus register definition

Function code support : 03(read) / 06(write).

| Address | Function | Function description | R/W | Note | | | |
|---------------------|--------------------------|--------------------------|--------|--|-----------|------------|-------------|
| Parameter of device | | | | | | | |
| 40000 | Device Type | Device Type ID | R | UPS: 0x03 | | | |
| 40001 | Hardware version | Hardware version | R | The version number is in the format 0xABCC, where A stands for major version, B for minor version, and CC for release.For example, 0x1001 means that the current version is V1.0.01 | | | |
| 40002 | Firmware version | Firmware version | R | The version number is in the format 0xABCC, where A stands for major version, B for minor version, and CC for release.For example, 0x1001 means that the current version is V1.0.01 | | | |
| 40003 | Communication parameters | Communication parameters | R/W | Using the 0xPMRB representation, where: P stands for parity, P=1 means no parity, P=2 means odd parity, and P=3 means even parity M stands for communication mode, 0: RTU R stands for reserved value; the default value is 0, which represents 1 stop bit and 8 data bits B stands for Baudrate serial number, see the Settings as follows: | | | |
| | | | | Baudrate | value | | |
| | | | | | no parity | odd parity | even parity |
| | | | | 9600 | 0x1001 | 0x2001 | 0x3001 |
| 19200 | 0x1002 | 0x2002 | 0x3002 | | | | |

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| | | | | | | | | | | | | | | | | | | | | |
|-------------------|--|---|--------|--|-------|--------|--------|--------|-------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|
| | | | | <table><tr><td>38400</td><td>0x1003</td><td>0x2003</td><td>0x3003</td></tr><tr><td>57600</td><td>0x1004</td><td>0x2004</td><td>0x3004</td></tr><tr><td>76800</td><td>0x1005</td><td>0x2005</td><td>0x3005</td></tr><tr><td>115200</td><td>0x1006</td><td>0x2006</td><td>0x3006</td></tr></table> <p>Note: The default value is 0x1006, which means the current baud rate is 115200, 8 data bits, 1 stop bit, and no parity bit</p> | 38400 | 0x1003 | 0x2003 | 0x3003 | 57600 | 0x1004 | 0x2004 | 0x3004 | 76800 | 0x1005 | 0x2005 | 0x3005 | 115200 | 0x1006 | 0x2006 | 0x3006 |
| 38400 | 0x1003 | 0x2003 | 0x3003 | | | | | | | | | | | | | | | | | |
| 57600 | 0x1004 | 0x2004 | 0x3004 | | | | | | | | | | | | | | | | | |
| 76800 | 0x1005 | 0x2005 | 0x3005 | | | | | | | | | | | | | | | | | |
| 115200 | 0x1006 | 0x2006 | 0x3006 | | | | | | | | | | | | | | | | | |
| 40004 | Communication address | Modbus RTU address | R/W | Data range 1-65535, the default value is 1 | | | | | | | | | | | | | | | | |
| Setting parameter | | | | | | | | | | | | | | | | | | | | |
| 40005 | Policy basis for stopping DC OUT output | Policy basis for stopping DC OUT output,this register data is only valid when the rotary switch is in "PC" stage | R/W | 0x00: represents no policy, DC_OUT according to "PC" mode parameter 0x01: Time limited mode, the effect is the same as the rotary switch is in T stage 0x02: Current threshold mode, the effect is the same as the rotary switch in I stage The default value : 0x02 | | | | | | | | | | | | | | | | |
| 40006 | t _{sw_delay} value set in time limited mode | When the register 40005 is set to 0x01, this register represents the corresponding t _{sw_delay} value, similar to the time limited set by the rotary switch. | R/W | Data range 0-65535, Unit: mS The default value : 5000mS | | | | | | | | | | | | | | | | |
| 40007 | Current mode Current threshold | When the register 40005 is set to 0x02,this register represents the threshold current of the load to stop the DC output, similar to the current threshold limited set by the rotary switch. | R/W | Data range 0-65535, Unit: mA The default value : 400mA | | | | | | | | | | | | | | | | |
| 40008 | Dev.Pst(2.9) Signal effective level type | Dev.Pst(2.9) Signal effective level type | R/W | 0: From high level to low level 1: From low level to high level The default value : 0 | | | | | | | | | | | | | | | | |
| 40009 | SW(2.6) controls the policy type | SW(2.6) controls the policy type | R/W | 0: According to the percentage of power left 1: According to the the delay time has been set The default value : 0 | | | | | | | | | | | | | | | | |
| 40010 | SW(2.6) operation residual electricity value | The percent of power left to active the SW output, which is only valid when 40009 is set to 0 | R/W | Data range 0~100%, The default value : 95% | | | | | | | | | | | | | | | | |
| 40011 | t _{off} register value set in time mode | The delay time to active the SW output, which is only valid when 40009 is set to 1 | R/W | Data range 0~65535, Unit: mS The default value : 5000mS | | | | | | | | | | | | | | | | |
| 40012 | SW(2.6) active mode | SW(2.6) Signal effective level type | R/W | 0: floating when inactive, turn low when active; 1: connect to GND when inactive, turn high when active | | | | | | | | | | | | | | | | |
| 40013 | t _{sw_hold} register value | SW(2.6) active duration | R/W | Data range 0~65535, Unit: mS | | | | | | | | | | | | | | | | |

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| | | | | |
|-----------------|------------------------|--|-----|--|
| | | | | The default value : 500mS |
| 40014 | The policy of shutdown | Set the policy when DC is restore during the shutting down | R/W | 0: stop DC out and start DC out after 5s delay; 1: don't care |
| 40015 | Power output threshold | Set the power threshold percent to start DC output during charging | R/W | Data range :0%~100%, The default value : 95% |
| State parameter | | | | |
| 40016 | DC_IN voltage | UPS input voltage value | R | Unit: mV |
| 40017 | DC_IN current | UPS input current value | R | Unit: mA |
| 40018 | DC_OUT voltage | UPS output voltage value | R | Unit: mV |
| 40019 | DC_OUT current | UPS output current value | R | Unit: mA |
| 40020 | Output power | Instantaneous power | R | Unit: mW |
| 40021 | Voltage | Total capacitor voltage | R | Unit: mV |
| 40022 | Voltage | Supercapacitor 1 voltage | R | Unit: mV |
| 40023 | Voltage | Supercapacitor 2 voltage | R | Unit: mV |
| 40024 | Voltage | Supercapacitor 3 voltage | R | Unit: mV |
| 40025 | Voltage | Supercapacitor 4 voltage | R | Unit: mV |
| 40026 | Power percent | The power percent of the supercapacitor | R | Data range: 0%~100% |
| 40027 | Working status | UPS working status | R | 1: UPS charging (mains power supply) 2: UPS discharge |
| 40028 | DC OK signal status | The status of DC_OK output | R | 0: DC OK(2.2/2.3) port has No output 1: DC OK(2.2/2.3) port has output |
| 40029 | Bat.Mode signal | The Bat.Mode signal outputs the signal status | R | 0: Bat.Mode(2.4) port has No output 1: Bat.Mode(2.4) port has output |
| 40030 | Bat.Ready signal | The Bat.Ready signal output state, which represents whether the capacitor is full or not | R | 0: Bat.Ready(2.5) port has No output 1: Bat.Ready(2.5) port has output(fully charged) |
| 40031 | SW signal | SW signal output status | R | 0: SW(2.6) port has No output 1: SW(2.6) port has output,inform load device to shut down |
| 40032 | Remote signal | Remote signal input status | R | 0: Remote(2.7) port has no signal access or the access signal is 0 1: Remote(2.7) port has a valid signal access |
| 40033 | Bat.Start signal | Bat.Start signal input status | R | 0: Bat.Start(2.8) port has no signal access or the access signal is 0 1: Bat.Start(2.8)port has a valid signal access |
| 40034 | Dev.Psts signal | Dev.Psts signal input status | R | 0: Dev.Psts(2.9) port has no signal access or the access signal is 0 1: Dev.Psts(2.9)port has a valid signal access |
| 40035 | Temperature | UPS internal temperature | R | Unit: °C |
| 40036 | ErrorCode | The fault code in case of a system failure | R | |

2.1.5.2 SDK

Since the standard Modbus RTU protocol, users can easily develop their own Modbus RTU communication protocol to communicate with UPS, We also providee dynamic library to the user to develop their own application fastly.

■ Function list

| function name | function description |
|--------------------|---|
| UPS_DeviceOpen | Open the device serial port |
| UPS_DeviceClose | Close the device serial port |
| UPS_ReadRegisters | Reading single or multiple Holding registers in the UPS |
| UPS_WriteRegisters | Writing single or multiple Holding registers in the UPS |

■ Function return value

| value | description | note |
|-------|---------------------------------|------|
| 0 | No error | |
| 1 | Illegal register address | |
| 2 | Illegal argument | |
| 3 | Porting layer error | |
| 4 | Insufficient resources | |
| 5 | I/O error | |
| 6 | Protocol stack in illegal state | |
| 7 | Retry I/O operation | |
| 8 | Timeout error occurred | |
| 10 | Illegal function exception | |
| 11 | Illegal data address | |
| 12 | Illegal data value | |
| 13 | Slave device failure | |
| 14 | Slave acknowledge | |
| 15 | Slave device busy | |
| 16 | Memory parity error | |

■ Function declaration

Data structure

```
typedef struct _COM_InitConfig
{
    unsigned char mode;           /* communication mode, 0: Modbus RTU */
    unsigned char port;           /* serial port number */
    unsigned char slaveAddr;      /* slave address when using modbus rtu protocol */
    unsigned char parity;         /* parity: 0: None, 1: ODD, 2: EVEN */
    unsigned char stopBits;      /* stop bits, default is 1 */
    unsigned char dataLen;        /* data length, default is 8 bits */
    unsigned char fillUp[2];
    unsigned int baudRate;        /* baudrate, maximum is 115200 */
    unsigned int respTimeout;     /* slave response timeout, minimum is 500 ms */
    unsigned int retries;         /* number of retries internal used */
}COM_InitConfig, *PCOM_InitConfig;

typedef struct _UPS_HandleTypeDef
{
    void *Instance;               /* modbus protocol handle */
    COM_InitConfig initConfig;    /* serial init data */
    int status;                   /* status */
}UPS_HandleTypeDef, *PUPS_HandleTypeDef;

typedef struct _UPS_DeviceInformation
{
    unsigned short typeId;        /* device type ID, 3: UPS*/
    unsigned short hardwareVersion; /* hardware version */
    unsigned short firmwareVersion; /* firmware version */
}
```

```
unsigned short driverVersion;      /* driver version */
}UPS_DeviceInformation, *PUPS_DeviceInformation;
```

Function declaration

UPS_DeviceOpen

- ◆ Functional description
Open the serial port and establish communication with the UPS device.
- ◆ Functional
int UPS_DeviceOpen(PUPS_HandleTypeDef pHdl, PUPS_DeviceInformation pInfo)
- ◆ Parameter
 - Input
 - ◆ pHdl: Serial communication handle pointer
 - Output
 - ◆ pInfo : Device information stores data structure pointers
- ◆ Returned value
It returns 0 on success and the corresponding error code for all other errors.
- ◆ Other description
Before the device can be accessed, this function must first be called to open the device communication port.

UPS_DeviceClose

- ◆ Functional description
Close the serial port and disconnect the communication between UPS devices.
- ◆ Functional
int UPS_DeviceClose(PUPS_HandleTypeDef pHdl)
- ◆ Parameter
 - Input
 - ◆ pHdl: Serial communication handle pointer
- ◆ Returned value
It returns 0 on success and the corresponding error code for all other errors.
- ◆ Other description
If you do not need to communicate with the device, you need to call this function to close the port and release the resource.

UPS_ReadRegisters

- ◆ Functional description
Read single or multiple Holding registers in the UPS device.
- ◆ Functional
int UPS_ReadRegisters(PUPS_HandleTypeDef pHdl, unsigned short usRegStartAddr, unsigned char ubNRegs, unsigned short aruBufferOut[])
- ◆ Parameter
 - Input
 - ◆ pHdl: Serial communication handle pointer
 - ◆ usRegStartAddr: The start address of the register
 - ◆ ubNRegs: The number of registers
 - Output
 - ◆ aruBufferOut: Save the read register data
- ◆ Returned value
It returns 0 on success and the corresponding error code for all other errors.
- ◆ Other description

UPS_WriteRegisters

- ◆ Functional description
Write single or multiple Holding registers in the UPS device.
- ◆ Functional
int UPS_WriteRegisters(PUPS_HandleTypeDef pHdl, unsigned short usRegStartAddr, unsigned char ubNRegs, const unsigned short aruBufferIn[])
- ◆ Parameter
 - Input
 - ◆ pHdl: Serial communication handle pointer
 - ◆ usRegStartAddr: The start address of the register

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- ◆ ubNRegs: The number of registers
- ◆ arusBufferIn: Register data to be saved
- ◆ Returned value
It returns 0 on success and the corresponding error code for all other errors.
- ◆ Other description

2.1.6 Test Tool

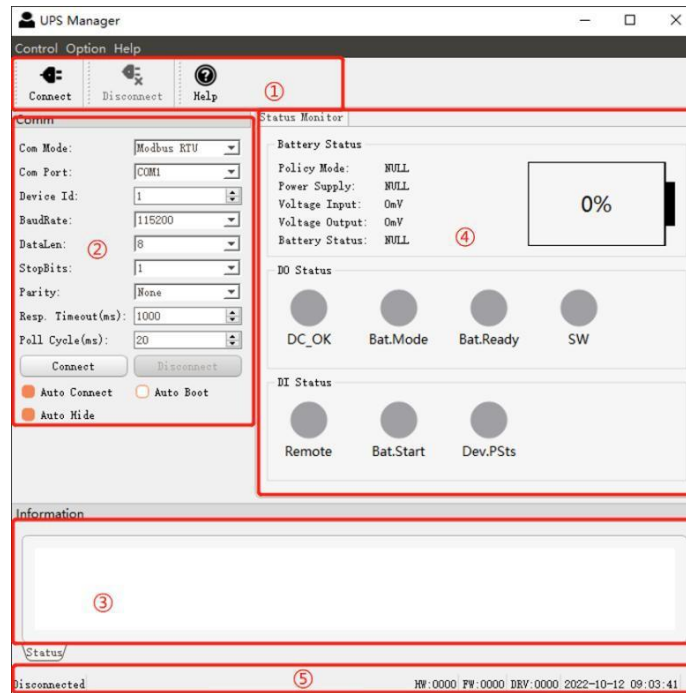
In order to set UPS parameters and test conveniently, We provide graphical test tool “AS56UPS001 utility”.

2.1.6.1 Installation

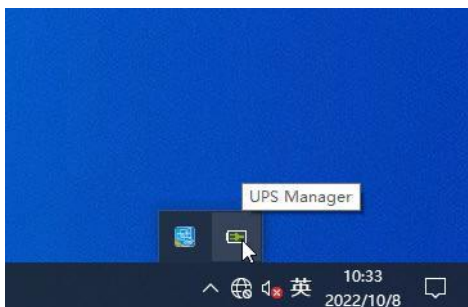
Double-click (Utility_Setup.exe) to install the SDK toolkit. After successful installation, the following directory will appear:

| | | |
|--|--------------|-------------------------------------|
|  Bin | ■ Bin: | Testing tools working folder |
|  Include | ■ Include: | Header file to define the functions |
|  Lib | ■ Lib: | Dynamic library |
|  Manual | ■ Manual: | User manual |
|  Sample | ■ Sample: | Sample projects |
|  vc_redist | ■ vc_redist: | VC++ runtime library |
|  unins000.dat | | |
|  unins000.exe | | |

2.1.6.2 Software Introduction



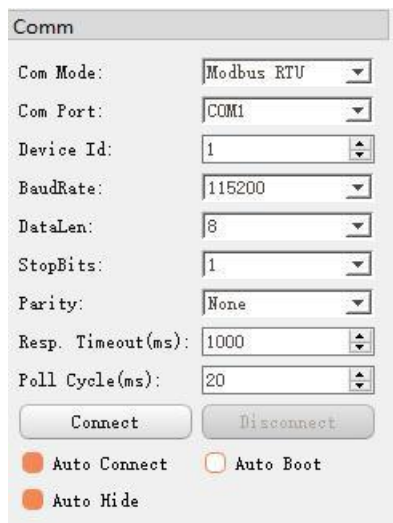
- ① Control area, used to control the connection and disconnection of communication, and the opening and closing of the parameter register interface;
- ② Communication parameter setting area, when Auto Connect is checked, the tool will connect to the device using the setting parameters automatically when the tool is started. When Auto Boot is checked, the tool will be launched automatically when the system is boot. When Auto Hide is checked, the tool will be hidden to the system tray when the tool is launched and connected to the device at the first time.



- ③ Information area, which is used to show the operation information.
- ④ UPS state display area, which can display the DC input power state, voltage, UPS output voltage, super capacitor working state, super capacitor current power, UPS panel DO interface control state, UPS panel DI interface state information;
- ⑤ UPS connection status bar to show the connect status, device hardware version, device firmware version and current date when connecting to the device successfully.

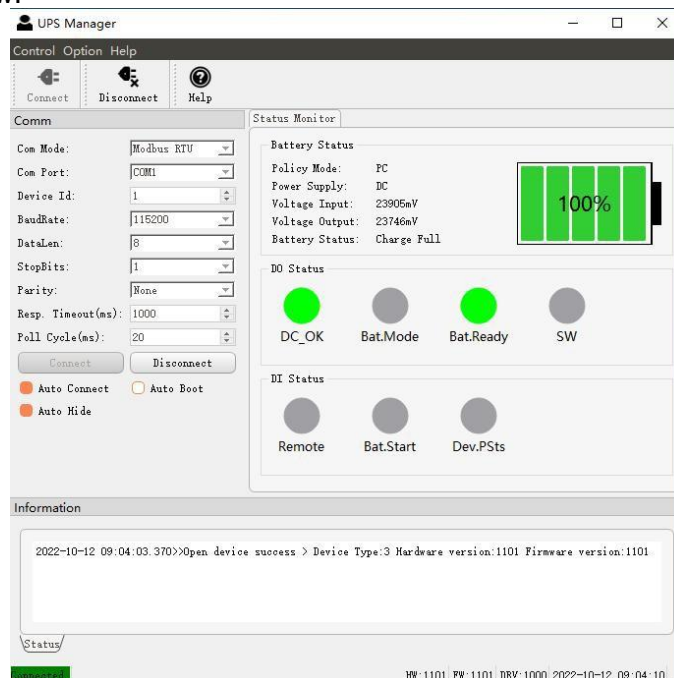
2.1.6.3 How to use

1. Open the tool and set the communication parameters



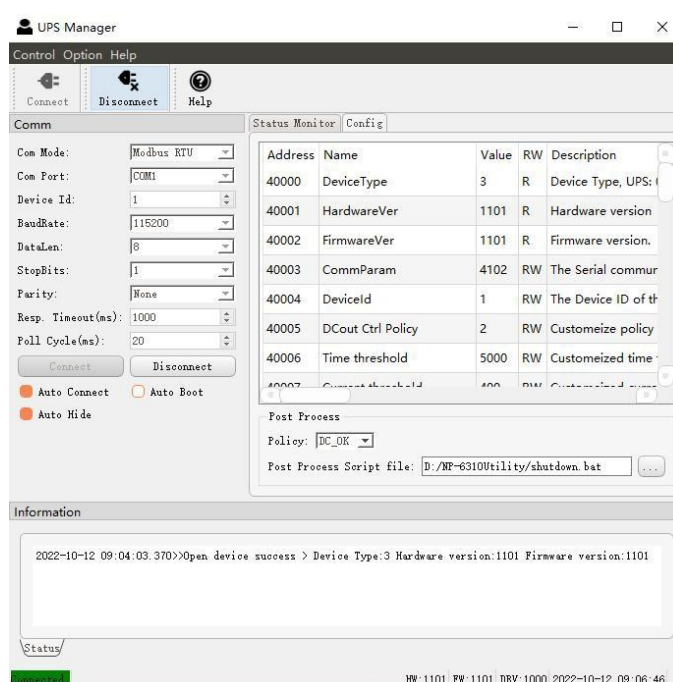
- ComMode: Default Modbus RTU mode
- Com Port: Set serial port number on the PC to connect to the UPS device.
- Device Id: Modbus Slave ID of the UPS device
- BaudRate: Baud rate of serial communication
- DataLen: Serial communication data length
- StopBits: Stop bit for serial communication
- Parity: Parity bit for serial communication
- Resp.Timeout: The timeout for the Modbus Slave device communication response
- Poll Delay: Time between Modbus polls
- Connect: Connect communication with UPS device
- Disconnect: Disconnect communication with UPS device
- Auto Connect: When the setup tool software is started, it will automatically establish communication with UPS according to the set parameters
- Auto Boot: The tool starts automatically on startup
- Auto Hide: After the tool is started, it is automatically hidden into the system tray when communication with the UPS is first established

- Click the Connect button in the communication setting interface or Connect in the toolbar to establish communication with the UPS device. If the communication is successfully established, the hardware version number and firmware version number of the currently connected device will be displayed in the status bar. At the same time, the current power supply status and the electricity status of the supercapacitor will be displayed in the electricity information window.



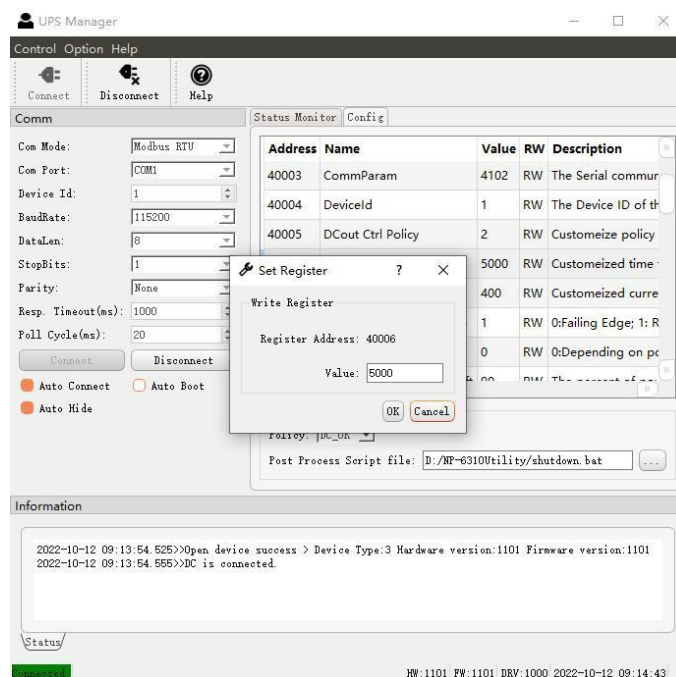
- Policy Mode: Display the coding switch status on the UPS front panel
- Power Supply: Display whether the current DC power supply or UPS discharge
- Voltage Input: Display the voltage value of the current DC IN supply input, Unit: mV

- Voltage Output: Display the voltage value of the current DC OUT supply output, Unit: mV
 - Supercapacitor Status: Display the current UPS charging and discharging status
 - DO Status: Display the output status of the DO on the front panel of the UPS device
 - DI Status: Display the input status of the DI on the front panel of the UPS device
3. When communication is successfully established, the TAB of UPS parameter configuration can be displayed through the menu bar (Option -> Config).
Note: When the (Config) TAB is opened, the (Status Monitor) TAB will stop refreshing

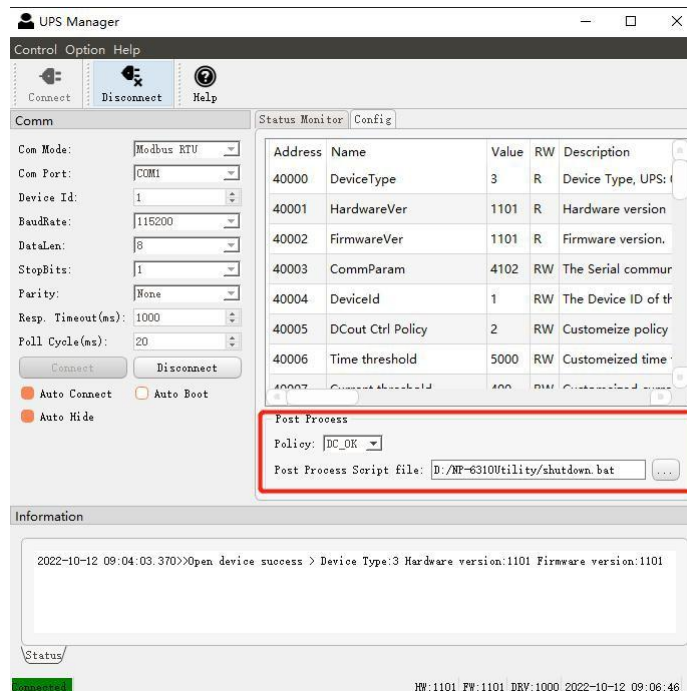


In the Config TAB, the registers of the UPS device with read operation permission can be refreshed in real time, and the parameters with write operation permission can be configured. When double-clicking the parameter with write operation, the parameter setting dialog box will pop up, and the current parameter can be modified and set.

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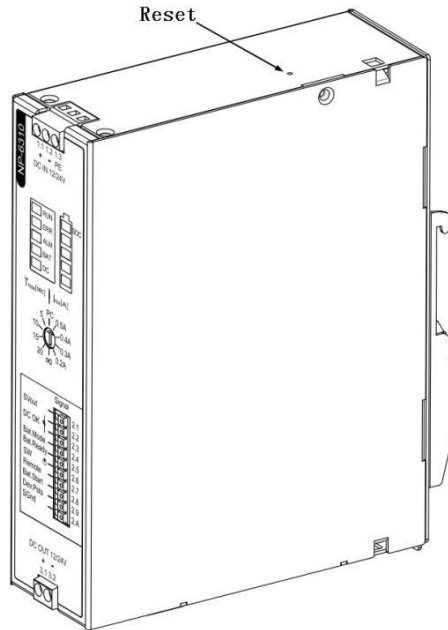
This tool can execute the user-defined batch script file when the DC_OK or SW signal output is monitored in the Status Monitor TAB. The user can define the actions in the batch script file that the PC needs to perform after power failure.



Note that this batch file is executed only when the Status Monitor TAB is selected, and in the Config TAB is only used to configure the parameters of the device. The Config TAB closes automatically when communication is disconnected.

2.1.7 Restore factory setting

If the AS56UPS001 UPS fails to work properly due to parameter setting errors, you can press the reset button for more than 5 seconds until all the status lights are on. At this time, the UPS enters the factory data recovery phase. In the process of factory data recovery, the RUN status light will flicker until the data recovery is completed.

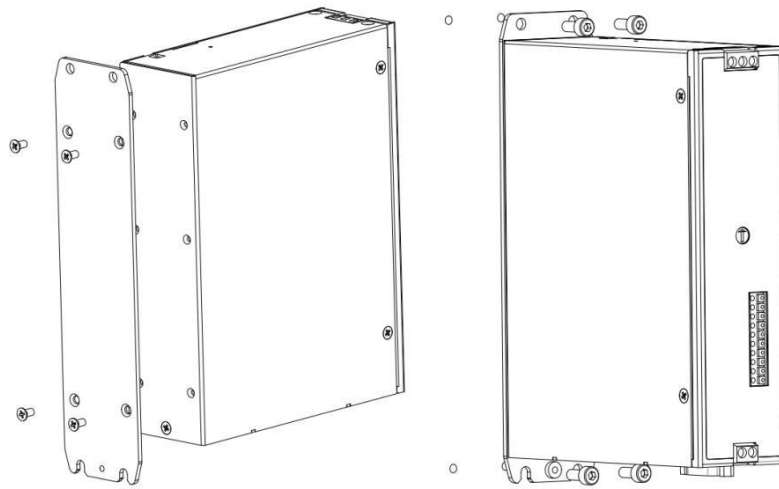


The following table shows the factory default register parameter values:

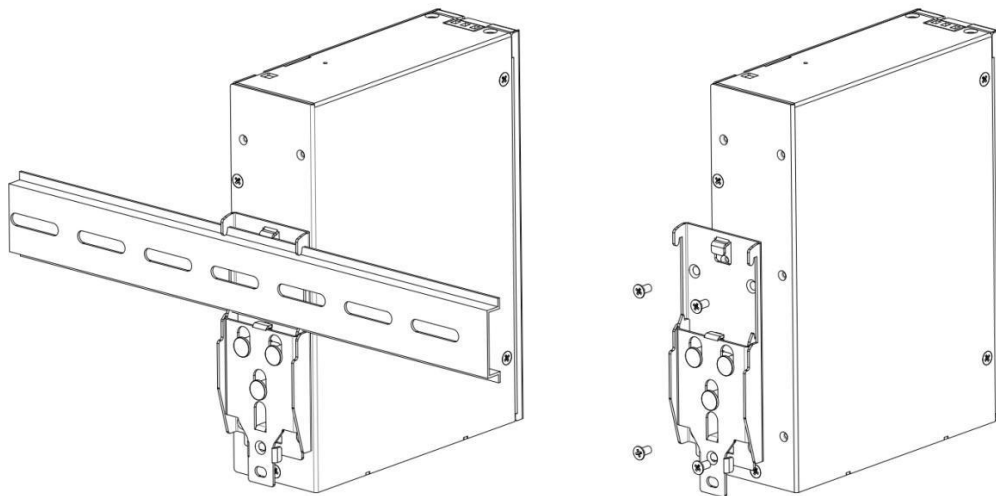
| Address | Default | Description |
|---------|---------|---|
| 40003 | 0x1006 | Modbus communication baud rate: 115200, data bits: 8, stop bits: 1, check mode: no check |
| 40004 | 1 | Modbus communication address: 1 |
| 40005 | 2 | Current control mode |
| 40006 | 5000 | Through the time control mode set by communication, T_{sw_delay} time is 5000mS |
| 40007 | 400 | Current control mode set by communication or coding switch, minimum shutdown current 400mA |
| 40008 | 1 | Dev.Psts effective signal level policy: from high to low state |
| 40009 | 0 | SW control is based on the remaining electricity percentage |
| 40010 | 90 | Current control mode, output SW signal electricity threshold of 90% |
| 40011 | 5000 | Time control mode, t_{off} time 5000mS |
| 40012 | 0 | SW signal output type: OD gate mode |
| 40013 | 500 | The SW signal output hold time t_{sw_hold} hold is 500mS |
| 40014 | 0 | DC_IN recovery policy during UPS shutdown: output DC_OUT again after 5 seconds of complete shutdown |
| 40015 | 95 | DC OUT output electricity threshold of 95% |

3. Mounting/remove

3.1 Wall-Mounted



3.2 DIN-Rail



4. Safety and Maintenance

Please follow the precautions described in this chapter, otherwise may cause device damaged.

4.1 Safety Precautions

Please follow the safety precautions described in this section below.

4.1.1 General Safety Precautions

Please ensure that the following safety precautions are followed:

- Follow electrostatic precautions if you open the device;
- When installing, moving or modifying the device, ensure that the power is switched off and the power cable is disconnected;
- It is forbidden to use more than the specified voltage as this may cause a fire or electric shock;
- Electric shock may occur if the device chassis is opened while the device is running;
- Do not drop or insert any debris into the device vents;
- If large quantities of dust, water or liquid enter the device, disconnect the power supply and contact the supplier;
- The following are prohibited:
 - It is forbidden to drop the device on a hard surface;
 - It is forbidden to knock or apply excessive force to the device;
 - It is forbidden to use the device in places where the rated environment exceeds the standard.

4.1.2 ESD Precautions

Failure to take ESD precautions during device installation may result in damage to the device or injury to the user. Electrostatic discharge (ESD) can cause damage to the components of a device. Dry climates are more prone to ESD. Therefore, the following anti-static precautions need to be strictly followed when opening the equipment:

- Wearing anti-static bracelet;
- Personally well grounded: When handling electronic components, grounded conductive substances should be touched frequently;
- Using anti-static mats: Electronic components should be operated on anti-static mats, which can reduce the possibility of ESD damage.
- Touch only the edges of electronic components: operate by holding the edge of electronic components.

4.1.3 Product Disposal

Disposal of used batteries must be in accordance with local environmental regulations.

- Outside the European Union:

If you want to dispose the used electrical and electronic products outside the European Union, please contact your local authority so as to comply with the correct disposal method.

- Within the European Union:

EU-wide legislation, as implemented in each Member State, requires that waste electrical and electronic products carrying the mark (right) must be disposed of separately from normal household waste. This includes monitors and electrical accessories, such as signal cables or power cords. When you need to dispose of your display products, please follow the guidance of your local authority, or ask the shop where you purchased the product. The mark on electrical and electronic products only applies to the current European Union Member States. Please follow the national guidelines for electrical and electronic product disposal.



4.2 Maintenance and Cleaning Precautions

Please follow the guidelines below when maintaining or cleaning the product.

4.2.1 Maintenance and Cleaning

Prior to cleaning any part or component of the product, please read the details below:
Never spray or squirt liquids directly onto any other components.

- The interior does not require cleaning. Keep fluids away from the interior.
- Be careful not to damage the small, removable components inside.
- Turn off before cleaning.
- Never drop any objects or liquids through the openings.
- Be cautious of any possible allergic reactions to solvents or chemicals used when cleaning.
- Avoid eating, drinking and smoking nearby.
- Fans are regularly cleaned of dust.

4.2.2 Cleaning Tools

Some components may only be cleaned using special tool for the safety. In such case, the product will be explicitly mentioned in the cleaning tips.
Below is a list of items to be used for cleaning.

- **Cloth** – Although paper towels or tissues can be used, a soft, clean piece of cloth is recommended.
 - **Water or rubbing alcohol** – A cloth moistened with water or rubbing alcohol should be used;
 - **Using solvents** – The use of solvents is not recommended as they may damage the plastic parts.
 - **Vacuum cleaner** – Using a vacuum specifically designed for computers is one of the best methods of cleaning. Dust and dirt can restrict the airflow and cause circuitry to corrode.
 - **Cotton swabs** - Cotton swabs moistened with rubbing alcohol or water are excellent tools for wiping hard to reach areas.
 - **Foam swabs** - Whenever possible, it is best to use lint free swabs such as foam swabs for cleaning.
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5. Q&A

This section explains and illustrates common problems that users may encounter when using the product.

5.1 Technical Support and Services

For documentation and related drivers, please visit ASTOR website
<https://www.astor.com.pl/wsparcie/dokumentacja-techniczna.html>.