



INSTRUCTION

UPS Module User manual

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Contact us

Shenzhen iManifold Robot Technology Ltd.

Address: 410, Building B, Phase II, Huafeng International Robot Industrial Park,
Bao'an District, Shenzhen

iManifold Technology (Jiangyin) Ltd.

Address : Room 102, Building 60, Tianan Digital City, No. 55 Changshan Avenue,
Jiangyin City, Wuxi City, Jiangsu Province

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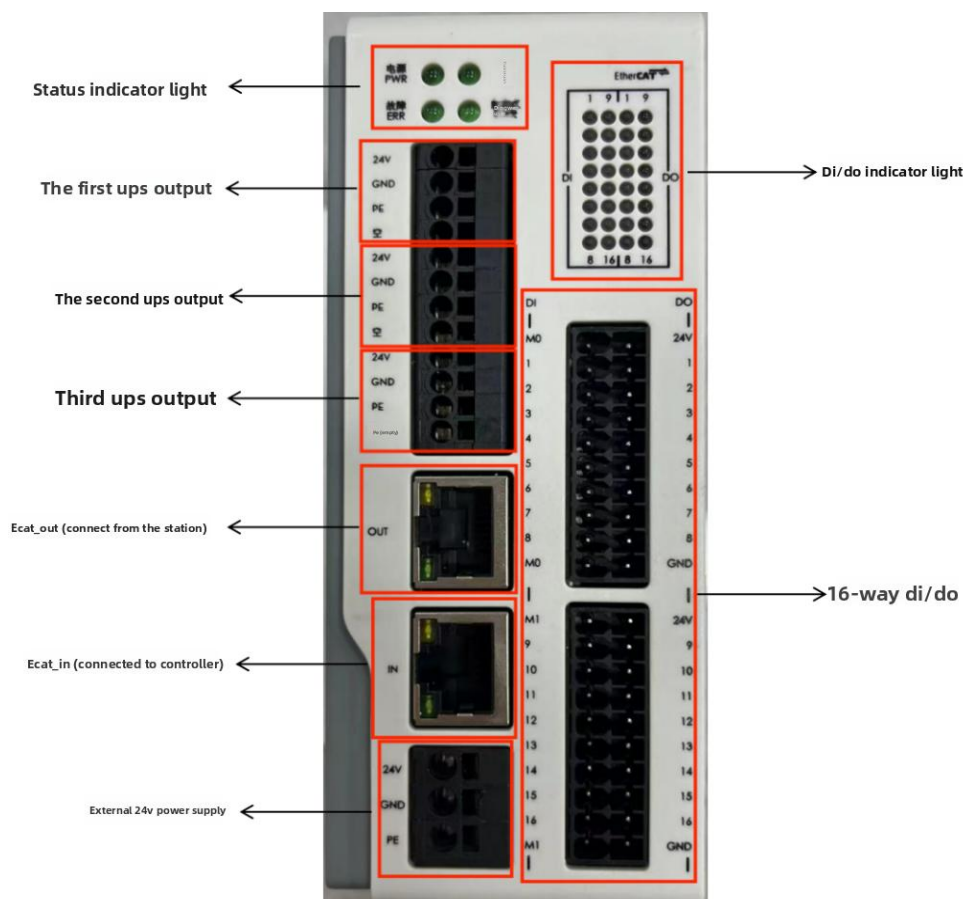
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1 UPS power outage recovery module description

1.1 UPS module interface introduction

The module is shown in the figure:



Interface	Specifications
Digital input	16 inputs
Digital output	16 NPN outputs
UPS output	3-channels 24V output
Communication interface	EtherCAT IN/ EtherCAT OUT
Status indicator	UPS module indicator light
External 24V power supply	External input 24V power supply

1.2 UPS module status indicator light description

1.2.1 Status indicator PWR

The Status indicator remains constantly on after the PWR is powered on, indicating that the power supply status is normal. This status indicator is controlled by the hardware system of the controller and is not subject to upper level program operations.

1.2.2 Status indicator RUN

The status indicator light RUN remains constantly off after power on. When the control cabinet is powered off, the driver program will control the status indicator light to switch to a lit state. After holding for 14 seconds, it will turn off to indicate that the power-off holding function is completed.

1.2.3 Status indicator ERR

The status indicator light ERR is a reserved indicator light and currently serves as a fully charged indicator light.

1.2.4 Status indicator USER

The status indicator light ERR is a reserved indicator light and currently serves as a fully charged indicator light.

1.3 Communication Interface description

ECAT_IN	Need to be connected to the controller
ECAT_OUT	Need to connect to the next slave station

Precautions for communication interface:

The communication between the UPS module and the master station must continue after the external 24V power supply is disconnected. The UPS must be connected to the first slave station after the master station, so that the normal communication between the master station and the UPS power module will not be affected after the external power supply is disconnected.

1.4 UPS output characteristic

The first version of the UPS module has a total of 3 UPS outputs, all of which have the same function. If there is only one controller, one UPS output can be used directly.

24V	24V UPS output, connected to equipment 24V power supply. After the external power supply is cut off, the power supply will continue for about 14 seconds before cutting off
GND	Connect the device to GND
PE	Connect equipment PE

24V Power supply instructions:

- (1) When the external input power fails, the UPS continues to maintain

power supply for about 14 seconds, after which the UPS module output power is disconnected and the controller is powered off.。

(2) When the external input power is disconnected, if the external input power is reconnected within 14 seconds, the UPS module will still disconnect the output power of the module after 14 seconds, and the controller will be powered off; Then delay for about 4 seconds, output the external power again, and power on the controller again.

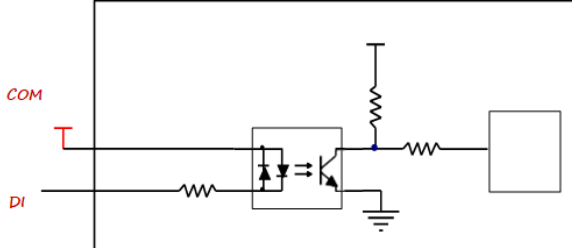
(3) When the external input power is cut off, regardless of how many times the external power is repeatedly turned on and off, as long as the external input power is still in the on state before 14 seconds, the logic is the same as 2.

(4) The external input power supply of the UPS module is disconnected immediately after the first connection, and the UPS function is invalid, and the system cannot be powered on.

1.5 Input/output characteristics

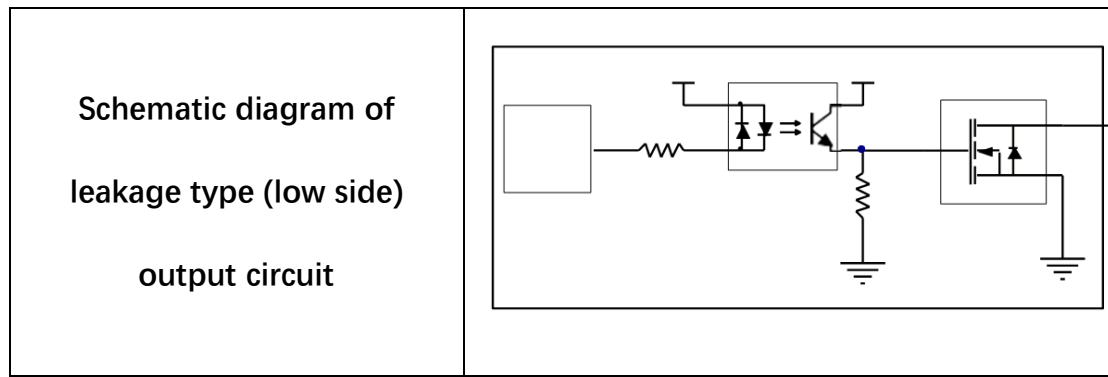
1.5.1 Digital input characteristics

I/O terminal block	Removable terminal block
Number of input channels	16
Pilot lamp	Group green LED indicator light
Input Type	Support PNP/NPN bidirectional input: optional (COM terminal connected to 24V or

	OV) COM terminal 24V: Low level input is valid; COM terminal connected to 0V: High level input is valid;
Input voltage	9V~24V DC
Maximum continuous voltage	30V
Surge	35V DC, 500ms
Rating	24V DC
Turn-on voltage	9V~24V
Turn-off voltage	0V~5V
On current	$\geq 4.2\text{mA}$ (9V) Typical values 6.9mA (24V)
Turn-off current	$\leq 1.2\text{mA}$ (5V)
Optical isolation	3750VAC, 1 minute
Input schematic	

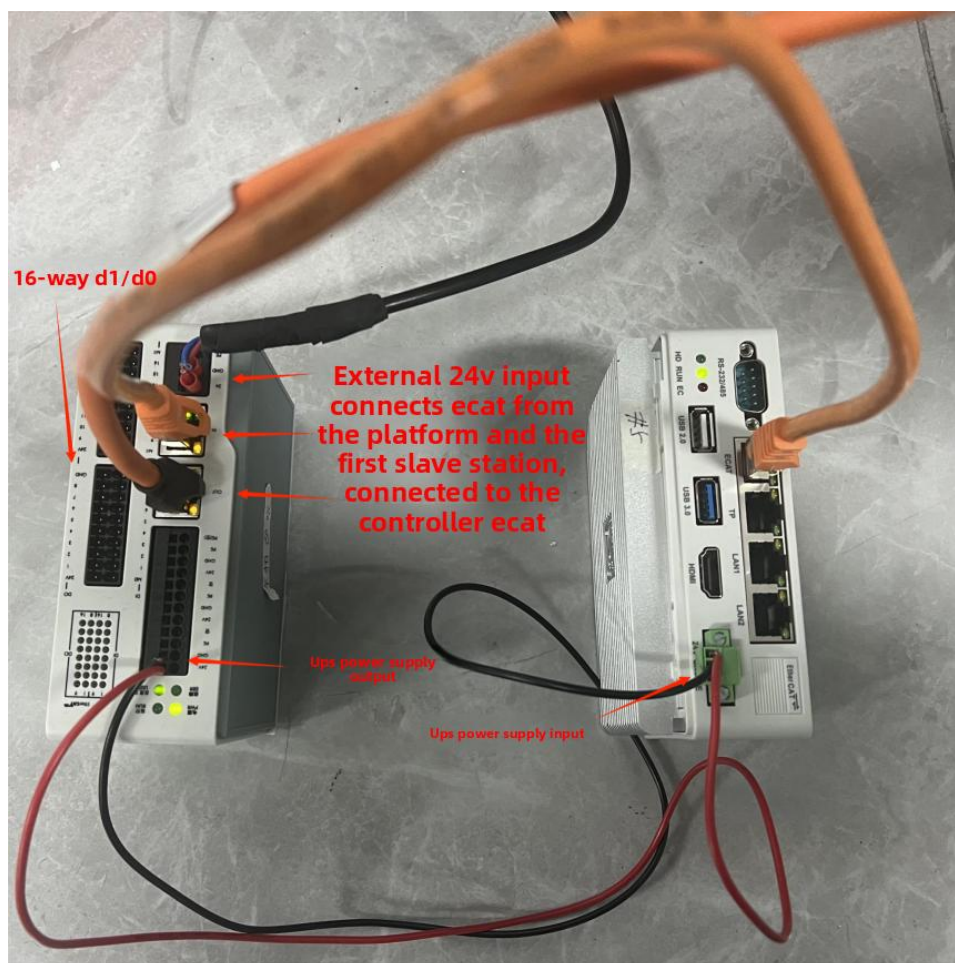
1.5.2 Digital Output Characteristics

I/O terminal block	Removable terminal block
Number of input channels	Low level effective output 16 transistor outputs (NPN)
Pilot lamp	Group green LED indicator light
Output type	DTD: Solid state MOSFET (drain type output, low level output effective 2)
Load voltage	Transistor output: dependent on external power supply 24V ($\pm$ 20%) DC
Output current	Transistor output: 0.5A (maximum current per channel)
Connected impedance (contact impedance)	Transistor output: 0.05 Ω (maximum per channel)
Leakage current	2.0 μ A (maximum per channel)
Surge current	2A, 100ms, maximum
Output protection	Short circuit protection, over temperature protection, over-current protection, over-voltage protection
Optical isolation	3750V AC, 1 minute



2 UPS module wiring configuration descriptions

When using UPS modules, on the basis of 24V power supply, the communication interface must be connected to at least one UPS output line, and other interfaces should be wired according to actual needs.



2.1 Module interface

Name	Instruction
24V	Connect to 24V power supply
GND	Connect to power supply 0V
PE	Ground wire

ECAT_IN	To connect to the ECAT network port of the controller, it is necessary to be the first station (network cable) of the slave station
ECAT_OUT	Connect ECAT from one station to the next, and if it is the last station, no wiring (network cable) is required

2.2 UPS power output

Name	Instruction
24V	Connect the device power supply to 24V
GND	Connect the device power supply to 0V
PE	Grounding wire for equipment

2.3 DI (Digital Input)

Name	Instruction
DI(1-8)	COM (M0) terminal connected to 24V: Low level input is valid; COM (M0) terminal connected to 0V: High level input is valid;
DI (9-16)	COM (M1) terminal 24V: Low level input is valid; COM (M1) terminal connected to 0V: High level input

	is valid;
M0	COM end, supports PNP/NPN bidirectional input
M1	COM end, supports PNP/NPN bidirectional input

2.4 DO (Digital Output)

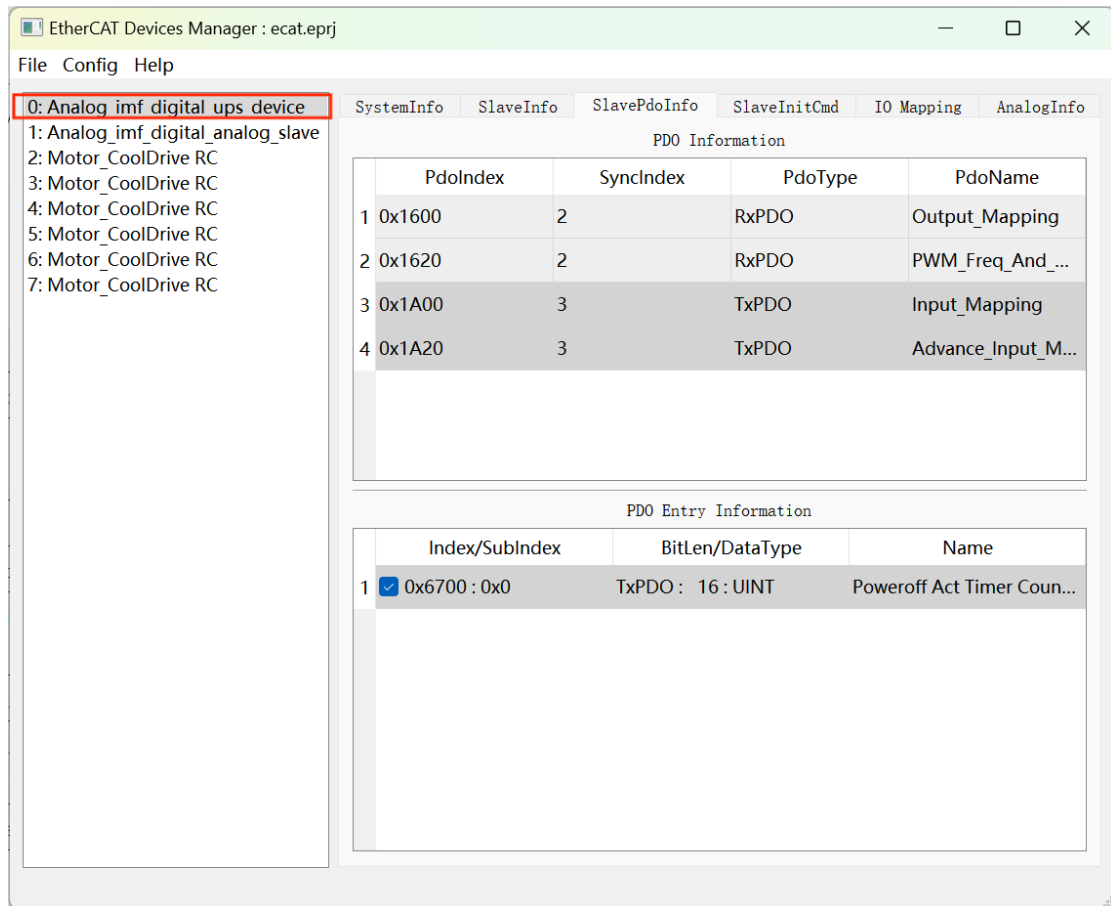
An external 24V power supply is required for output

Name	Instruction
DO(1-8)	Low level effective output NPN
DO(9-16)	Low level effective output NPN
24V	24V Power +24V
GND	24VPower 0V

2.5 ECAT configuration

Configure the XML file according to the location of the UPS slave station (with the UPS module as the first slave station), using the Smart Manifold Configuration Tool as an example: select the UPS XML file as the first slave station, followed by the IO module slave station and drive configuration files.

The XML file of UPS will automatically configure the required parameters, just add it as the first slave station.



3 Scope of power outage restoration effectiveness

This chapter elaborates on the scope of system power recovery from the following four dimensions.

Attention: Do not interrupt the power outage process as it may result in a failed save. Power outage will only restore the executed program recorded last time. Continuous power outage means that there was no program running last time and it will be restored to an empty program.

3.1 System Status

Attention: The power-off recovery function will only restore some system states after clicking run, provided that the interface status is restored. Switching between teaching/playback during the recovery process does not affect the recovery results, but after switching modes, you need to select the last row to continue executing the recovery program.

System status	Notes
Project name/Program name	Restore the current program interface after restarting
Stop line	Line number for resuming operation after restart
Current coordinate system	Coordinate system that resumes operation after restart
Subroutine	Can be restored within the subroutine

Cycle Mode	Circular mode for resuming operation after restart
Current line	After switching modes, you need to select the last row. The current row cannot be restored
Teaching speed	Unrecoverable, restore default speed after restart
External axle options	Unrecoverable, restore default robot options after restart

3.2 Execution status

Execution status	Notes
Playback speed	Click again to run automatic recovery
IO trigger status	Click again to run automatic recovery
Analog quantity AO	Click again to run automatic recovery
Remote IO	After restarting, the program will execute normally, and the number of appointments will still be retained
Communication status	Unrecoverable
Backend tasks	Normal recovery based on backend task startup mode

3.3 Command recovery

3.3.1 Motion Instructions

Attention: Motion supports the recovery of motion commands.

Cannot support restoring Movj transition segment, Movl transition segment, Movc transition segment, Movs motion command, Movp motion command, and cannot be restored when the robot leaves the current motion trajectory.

Motion command	Notes
Movj motion command	Click again to run automatic recovery
Movl motion command	Click again to run automatic recovery
Movc motion command	Click again to run automatic recovery
BL transition section	When the robot is in the transition phase, it cannot be restored and will run directly to the next point
Movs motion command	Unrecoverable
Movp motion command	Unrecoverable

MovExt motion command	Click again to run automatic recovery
Moveuntil conditional interrupt instruction	Click again to run automatic recovery
Movincp motion command	Click again to run automatic recovery

3.3.2 Non motion commands

Non motion commands can resume normal operation.

3.4 Technique recovery

The UPS module will record process operation related information, and specific recovery information can be found in the process manual

4 Advanced operation of UPS module

Modify the automatic shutdown waiting time: The default automatic shutdown waiting time of the system is 5000, which means that after the UPS external power is disconnected for 5 seconds, the operating system automatically shuts down (the first 5 seconds are used for data backup of the robot system). The total effective time of the UPS power is 14 seconds, and about 9 seconds are reserved for the operating system to shut down the power.

Users can set the automatic shutdown function by configuring the `/home/imf/sys/imf_sys_ups_poweroff_delay_time_ms` configuration file.



Modify the value and take effect after power failure and restart

Users can obtain the actual automatic shutdown time parameters during driver loading by entering `dmesg | grep -i UPS`, for example: [26.376402] EtherCAT: master UPS power-off delay time is 5000 ms, count is 21973.

```
imf@imanifold:~$ dmesg | grep -i UPS
[ 0.124004] ftrace: allocated 179 pages with 5 groups
[ 26.549038] EtherCAT: master UPS poweroff delay time is 5000 ms, count is 21973.
[ 28.670391] EtherCAT 0-0: Slave[0] is the first UPS power station, master use this station as UPS power.
```

The automatic shutdown time is 5000ms

At the same time, the Ethercat driver cannot be loaded in simulation mode, and the UPS automatic shutdown function cannot be used.

(1) You can use the following command to check the UPS power count

time for debugging: `watch -n 0.1 cat /proc/ec_master_ups_stat`

A value of -1 indicates that the UPS function is not in effect;

A value of 0 indicates that the UPS is working normally and the external power supply has not been disconnected;

Count value 1-65535: The UPS output timer has started, the external power supply has been disconnected, and the system is entering a power-off countdown. When the timer value is 65535, the input power supply of the controller will be powered off (65535 corresponds to a timing time of 14 seconds, and one timer tick value is about 227.5555us, which is $65535 \times 227.5555\text{us} = 14\text{s}$).

```
Every 0.1s: cat /proc/ec_master_ups_stat          imanifold: Tue Apr  9 14:52:10 2024
0
```

The UPS is currently working and the external power supply has not been disconnected

(2) Write the UPS power outage trigger information and system automatic shutdown log to `/home/imf/log/system_update.log` in the following format: `=====> 2024-03-30_17:31:48 UPS power off triggered, system will power off after 9000ms ...=====> 2024-03-30_17:31:57 UPS power off now ...`

```
* system_update.log
541===== 2024-03-30_17:21:25 linux kernel is 6.1.45
542===== 2024-03-30_17:21:25 sys_boot_auto_run end.
543
544=====
545===== 2024-03-30_17:21:25 start imf_modules...
546===== 2024-03-30_17:21:30 start of imf_update_from_usb
547===== 2024-03-30_17:21:40 No system auto update file imf_update_auto_usb.tar.gz on /media/usb/
548===== 2024-03-30_17:21:40 No system autorun file imf_autorun_from_usb.sh on /media/usb/
549===== 2024-03-30_17:21:40 end of imf_update_from_usb
550===== 2024-03-30_17:21:41 imf_robot service stop
551===== 2024-03-30_17:21:41 robot mode [0] change start
552===== 2024-03-30_17:21:41 EtherCAT use Intel igb(i210/i211) MAC [00:23:04:07:01:01]
553===== 2024-03-30_17:21:41 ECAT mac vendor is 0x8086, use intel igb driver
554===== 2024-03-30_17:21:41 imf_robot service stop
555===== 2024-03-30_17:21:42 rmod ethernet igb, e1000e, r8169 ko...
556===== 2024-03-30_17:21:42 insmod ethernet et_igb, e1000e, r8169 ko...
557===== 2024-03-30_17:21:42 EtherCAT use Intel igb(i210/i211) MAC [00:23:04:07:01:01]
558===== 2024-03-30_17:21:45 netplan file generate: /home/imf/etc/01-network-manager-all.yaml, dhcp, 192.168.101.3, 192.168.100.3,
559===== 2024-03-30_17:21:45 execute netplan apply...
560===== 2024-03-30_17:21:46 imf_robot service enabled and start run...
561===== 2024-03-30_17:21:47 robot mode [0] change finish
562===== 2024-03-30_17:21:49 ping 192.168.100.121 success after imf_modules first time
563===== 2024-03-30_17:21:54 end imf_modules
564=====
565===== 2024-03-30_17:31:48 UPS power off triggered, system will power off after 9000ms ...
566===== 2024-03-30_17:31:57 UPS power off now ...
567
```

Display UPS automatic shutdown time and working status information

(3) Please refer to the manual for the user programming interface:

《ImaniFold Motion Controller System Instruction Interface Description. pdf》