# EMP-2848M Series Hardware Manual

English Ver. 1.0.0, AUG. 2022



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**CONTACT US**

If you have any questions, please feel free to contact us via email at:

**service@icpdas.com, service.icpdas@gmail.com**



**SUPPORT**

EMP-2848M

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# 1. Introduction

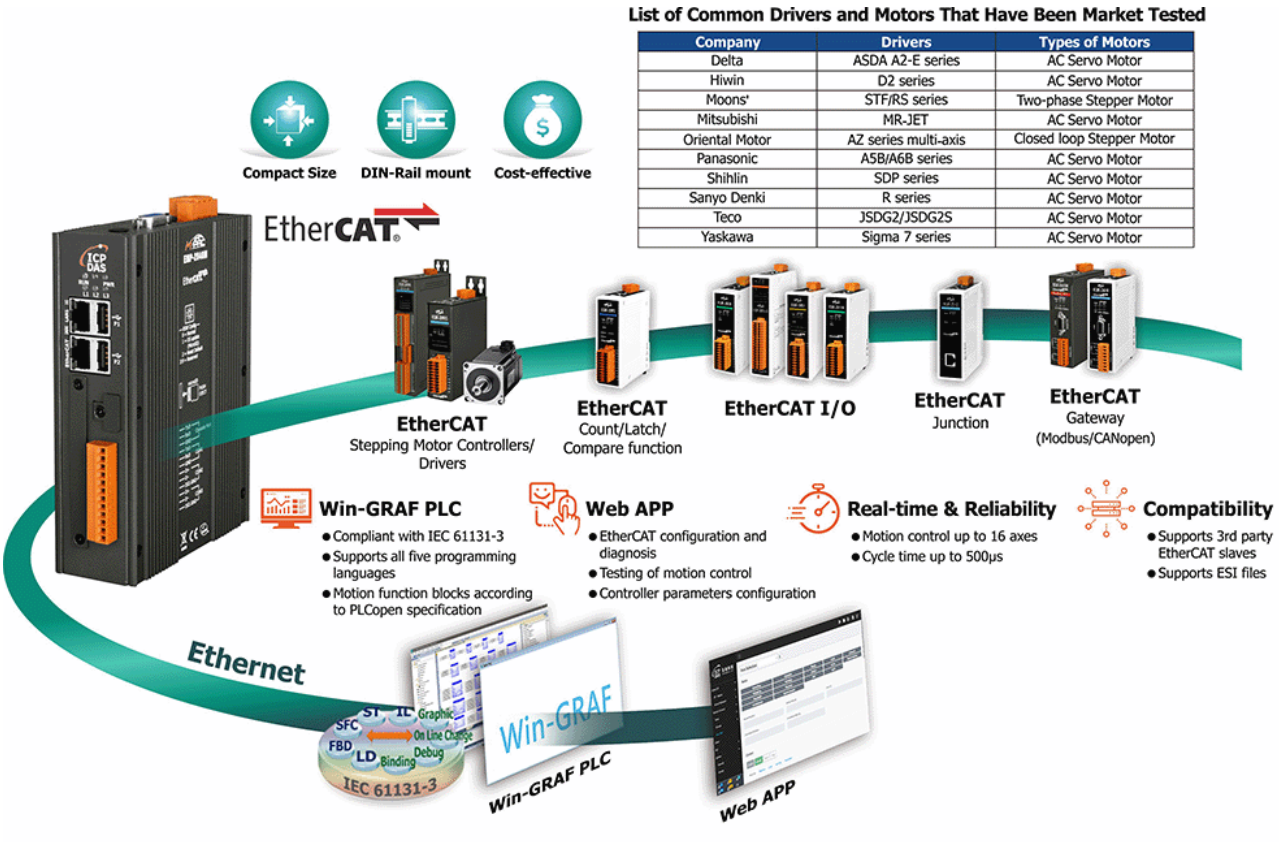
The EMP-2848M series is a SoftPLC based EtherCAT master with an integrated multi-axis motion control kernel. The programmable automation controller combines compact size, economy, flexibility, and excellent performance and is the ideal partner for small and medium-sized motion control applications where cost and space-constrains is an deciding factor.

The high-performance quad-core Cortex-A53 processor together with the Real-Time Linux (RT-Preempt) operating system and built in SoftPLC ensure fast, deterministic and real-time behavior in the motion control applications. The integrated, configurable high-speed EtherCAT master can be connected to any standard, 3rd party EtherCAT slave, such as I/Os, servo motor, stepper motor, encoder, etc.. The EtherCAT master can synchronously update up to 128 slaves including 16 servo/stepper drives within a cycle time of 500 microseconds.

The integrated web server assists the user in configuring and diagnosing the EtherCAT networks, and testing of motion control functions. Win-GRAF workbench is a programming software that ICPDAS developed according to the international standard IEC 61131 and aimed at achieving compatibility and reusability.

**List of Common Drivers and Motors That Have Been Market Tested**

| Company | Drivers | Types of Motors |
|---|---|---|
| Delta | ASDA A2-E series | AC Servo Motor |
| Hiwin | D2 series | AC Servo Motor |
| Moons' | STF/RS series | Two-phase Stepper Motor |
| Mitsubishi | MR-JET | AC Servo Motor |
| Oriental Motor | AZ series multi-axis | Closed loop Stepper Motor |
| Panasonic | A5B/A6B series | AC Servo Motor |
| Shihlin | SDP series | AC Servo Motor |
| Sanyo Denki | R series | AC Servo Motor |
| Teco | JSDG2/JSDG2S | AC Servo Motor |
| Yaskawa | Sigma 7 series | AC Servo Motor |




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# 1.1. Specification

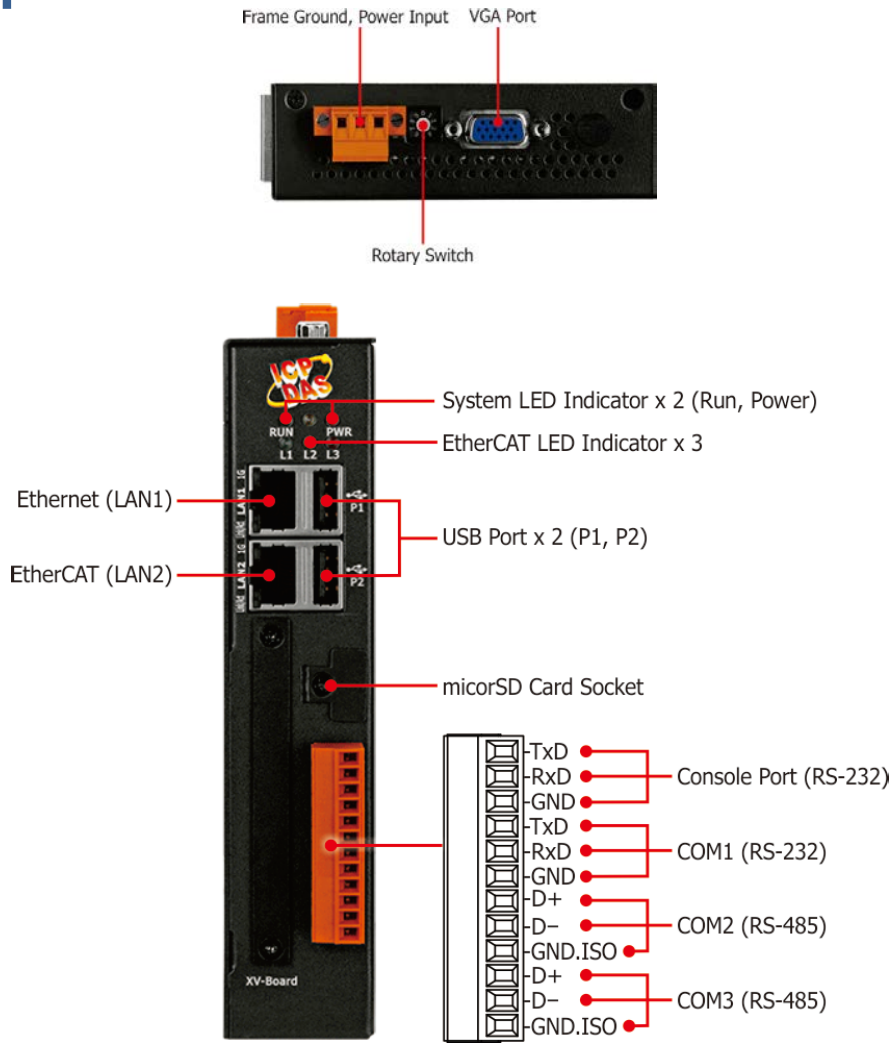
| Model | EMP-2848M |
|---|---|
| **Software** | |
| OS | Real-Time Linux (RT-Preempt, Kernel 4.14.98) |
| Programming languages per IEC 61131-3 | Instruction List (IL) |
| | Ladder Diagram (LD) |
| | Function Block Diagram (FBD) |
| | Structured Text (ST) |
| | Sequential Function Chart (SFC) |
| Development Software | Win-GRAF |
| Protocols | Modbus TCP, Master/Slave<br>Modbus RTU/ASCII, Master/Slave |
| | EtherCAT |
| Motion Control | PLCopen Function Blocks |
| Main Unit | |
| CPU | Cortex-A53, Quad-core, 1.6GHz |
| SDRAM | LPDDR4 - 1GB |
| Storage | eMMC Flash – 8GB<br>MicroSD slot |
| LED Indicators | 1 x Run, 1 x Power, 3 x EtherCAT Runtime |
| **Communication Ports** | |
| Ethernet | 1 x RJ-45, 10/100/1000 Base-TX |
| EtherCAT | 1 x RJ-45 |
| USB | 2 x USB 2.0 |
| Console | RS-232 (RxD, TxD, GND); Non-isolated |
| COM1 | RS-232 (RxD, TxD, GND); Non-isolated |
| COM2 | RS-485 (Data+, Data-); 2500 VDC isolated |
| COM3 | RS-485 (Data+, Data-); 2500 VDC isolated |
| **EtherCAT** | |
| Cycle Time | 500μs (min.) |
| Number of Slaves | 128 |
| Number of Axes | 16 |
| Power | |
| Input Range | +12 ~ 48 VDC |
| Consumption | 7.2 W (0.3 A @ 24 VDC) |
| **Mechanical** | |
| Casing | Metal |
| Dimensions (W x L x H) | 42 mm x 164 mm x 129mm |
| Installation | DIN-Rail Mounting |
| **Environmental** | |
| Operating Temperature | -25 ~ +75 ℃ |
| Storage Temperature | -40 ~ +80 ℃ |
| Ambient Relative Humidity | 10 ~ 90% RH (non-condensing) |

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# 2.Hardware Information

## 2.1. Appearance



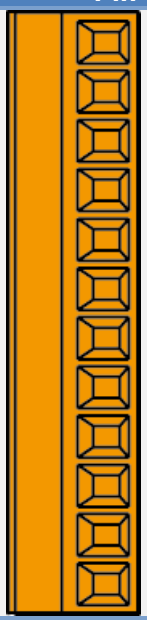
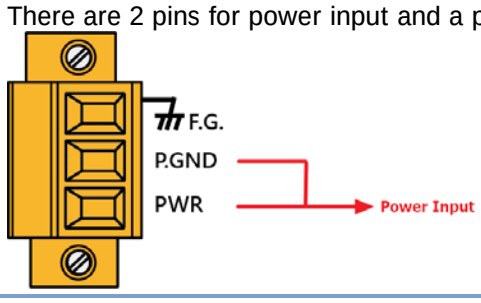

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<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>LED Indicator</td><td>The details are shownas below.
<table>
<tr><th>LED Indicator</th><th>Color</th><th>Meaning</th></tr>
<tr><td>RUN</td><td>Green</td><td>OS is running</td></tr>
<tr><td>PWR</td><td>Red</td><td>Power is on</td></tr>
<tr><td>L1</td><td>Green</td><td>
<table>
<tr><th colspan="2">EtherCAT Runtime Running</th></tr>
<tr><td>State</td><td>Meaning</td></tr>
<tr><td>ON</td><td>Operation task is running</td></tr>
<tr><td>OFF</td><td>Runtime is stopped</td></tr>
<tr><td>Blinking</td><td>Operation task is stopped</td></tr>
</table>
</td></tr>
<tr><td>L2</td><td>Orange</td><td>
<table>
<tr><th colspan="2">Motion Control Error Status</th></tr>
<tr><td>State</td><td>Meaning</td></tr>
<tr><td>ON</td><td>An error occurred</td></tr>
<tr><td>OFF</td><td>No error occurred</td></tr>
</table>
</td></tr>
<tr><td>L3</td><td>Red</td><td>
<table>
<tr><th colspan="2">EtherCAT Runtime Error Status</th></tr>
<tr><td>State</td><td>Meaning</td></tr>
<tr><td>ON</td><td>An error occurred</td></tr>
<tr><td>OFF</td><td>No error occurred</td></tr>
</table>
</td></tr>
</table>
</td></tr>
<tr><td>Ethernet (LAN1)</td><td>The details are shownas below.
<table>
<tr><th>LED Indicator</th><th>State (Color)</th><th>Meaning</th></tr>
<tr><td rowspan="2">1G</td><td>ON (Orange)</td><td>Network Speed: 1 G</td></tr>
<tr><td>OFF</td><td>Network Speed: 10/100 M</td></tr>
<tr><td rowspan="3">Link/Act</td><td>ON (Green)</td><td>The Link is active</td></tr>
<tr><td>OFF</td><td>The Link is inactive</td></tr>
<tr><td>Blinking(Green)</td><td>Network activity</td></tr>
</table>
</td></tr>
<tr><td>EtherCAT</td><td>The EtherCAT master output port is used to manage the network, monitor the status of the slaves and exchange I/O data with slaves.<br>Do not use a standard Ethernet switch for wiring between master and slave.<br>For daisy chaining and branch connection, please use EtherCAT Junction module.</td></tr>
<tr><td>USB</td><td>Two USB 2.0 port that allows support for the USB devices such as mouse, keyboard or an external USB hard drive.</td></tr>
<tr><td>MicroSD slot</td><td>Supports up to 32 GB</td></tr>
</table>

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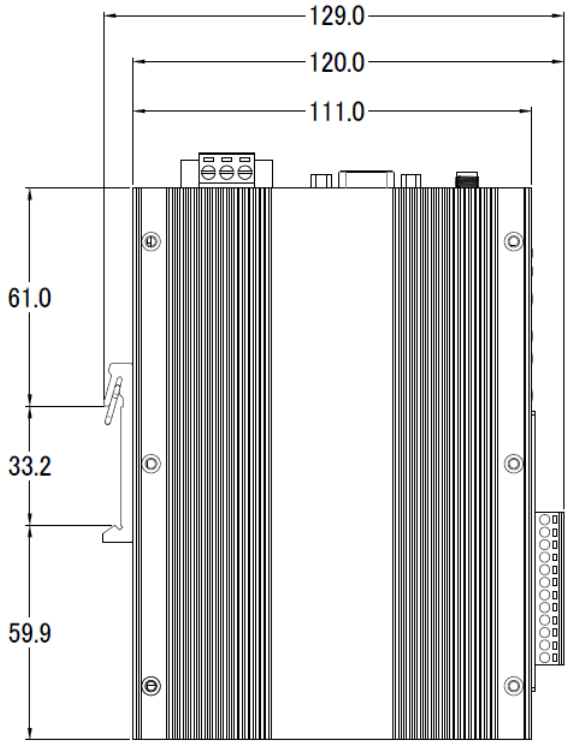

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<table>
<tr><td>Pin Assignment</td><td>
<table>
<tr><th colspan="2">Pin</th><th>Signal</th><th>Description</th></tr>
<tr><td rowspan="12"></td><td>1</td><td>TxD</td><td rowspan="3">Console Port (RS-232)</td></tr>
<tr><td>2</td><td>RxD</td></tr>
<tr><td>3</td><td>GND</td></tr>
<tr><td>4</td><td>TxD</td><td rowspan="3">COM1 (RS-232)</td></tr>
<tr><td>5</td><td>RxD</td></tr>
<tr><td>6</td><td>GND</td></tr>
<tr><td>7</td><td>TxD</td><td rowspan="3">COM2 (RS-485)</td></tr>
<tr><td>8</td><td>RxD</td></tr>
<tr><td>9</td><td>GND</td></tr>
<tr><td>10</td><td>TxD</td><td rowspan="3">COM3 (RS-485)</td></tr>
<tr><td>11</td><td>RxD</td></tr>
<tr><td>12</td><td>GND</td></tr>
</table>
</td></tr>
<tr><td>VGA</td><td>Maximum resolution 1920x1080</td></tr>
<tr><td>Rotary Switch</td><td>Rotary Switch is an operating mode selector switch which provides seven functions related to the selection of the operating mode.</td></tr>
<tr><td>Power Input and Frame Ground</td><td>There are 2 pins for power input and a pin for frame ground as follows:<br>
</td></tr>
</table>

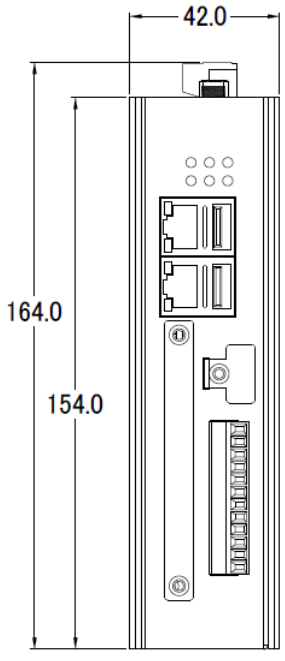
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## 2.2. Dimensions (Units: mm)




Left Side View



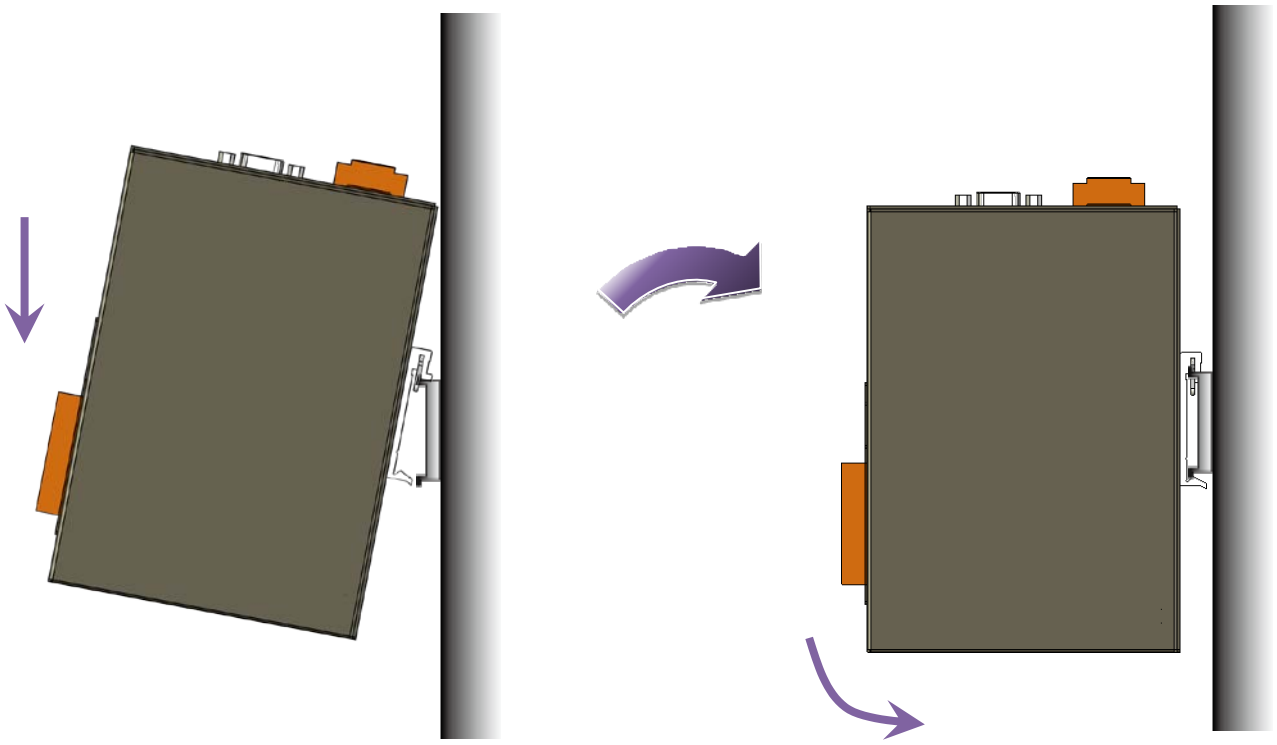

Front View

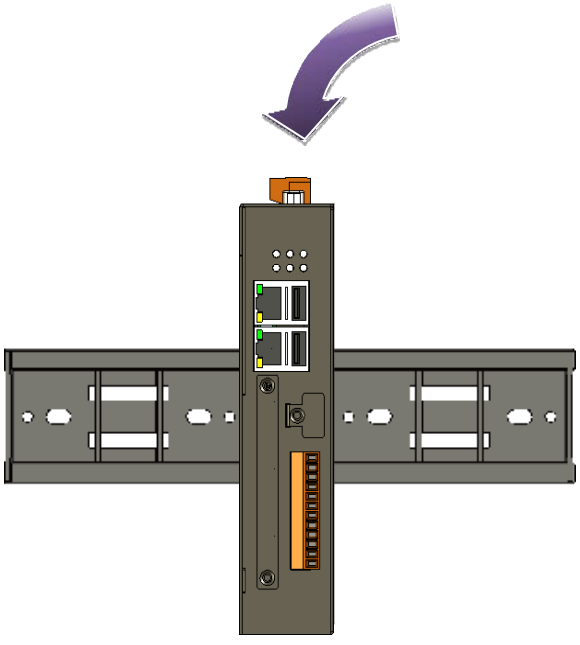
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# 3. Mounting the Hardware

The hardware has simple rail clips for mounting reliably on a standard 44 mm DIN rail.





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# 4.System Restore and Reset Default

This chapter describes how to use Rotary Switch to restore the system and reset the default.

| | Rotary Switch | Mode |
|---|---|---|
|  | 0 | Normal mode |
| | 1 | Restore system using SD card |
| | 2 | Reset default |
| | 3 | Delete configuration file |

## 4.1. Restore System Using microSD (Rotary Switch: 1)

[Restore the image to the microSD card]

1. Download the latest version of the SD card system restore image from Download Center. https://www.icpdas.com/tw/download/index.php?model=EMP-2848M
2. The file emp-2848m-system-restore-sd-xxxx-xx-xx.zip contains the emp-2848m-system-restore-sd-xxxx-xx-xx.img image file.
3. Prepare a microSD card with at least 4GB of space. Use HDDRawCopy or Win32DiskImager tool to restore the image file to the SD card.

[Automatic system restore process]

1. Insert the microSD card into the microSD slot and connect the keyboard and monitor to the USB and VGA ports, turn the Rotary Switch to 1, then turn on the power.
2. Wait for the following message to appear on the screen, please enter y to start the automatic system restore process. This message will stay for 5 seconds waiting for user input, if the user does not enter y, you can use the manual system restore process to restore.

```
Welcome To ICPDAS System Restore
Do you want to continue? [y/n]
```

3. When the restore is successful, one long beeps from buzzer and "system restore successful" will be displayed, press any key to end. If the restore fails, three short beeps from buzzer and "xxx restore failed" will be displayed.

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```
mkfs.fat 4.1 (2017-01-24)
22.1MiB 0:00:01 [19.9MiB/s] [================================>] 100%
Image restore successful
22.1MiB 0:00:01 [20.3MiB/s] [================================>] 100%
Image_rt restore successful
37.9KiB 0:00:00 [11.5MiB/s] [================================>] 100%
fsl-imx8mm-iwg34m.dtb restore successful
umount: /dev/mmcblk0p2: not mounted.
mke2fs 1.45.5 (07-Jan-2020)
/dev/mmcblk0p2 contains a ext4 file system
        last mounted on /mnt on Wed Feb 16 11:30:32 2022
Discarding device blocks: done
Creating filesystem with 1755600 4k blocks and 438912 inodes
Filesystem UUID: 1b788641-5160-47fb-89c6-0ad62d6b63dd
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632

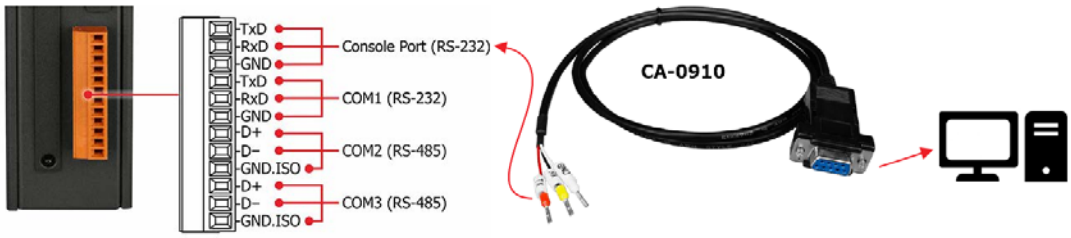
Allocating group tables: done
Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

 447MiB 0:00:50 [8.85MiB/s] [================================>] 100%
rootfs restore successful
system restore successful
```

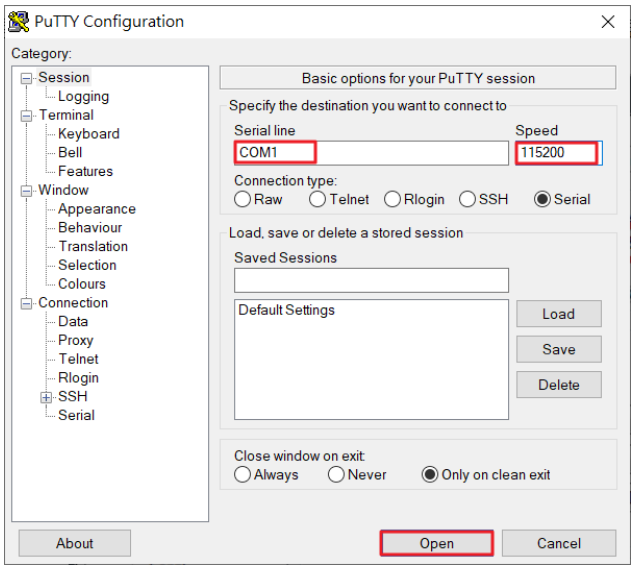
4. Finally, turn the Rotary Switch to 0 normal mode and reapply power.

[Manual system restore process]

1. If the user does not want to connect to the keyboard and monitor, the Console Port can be used for manual system restore.
2. Connect the CA-0910 female connector to the PC and the other side to the Console Port on the hardware pin.




3. Insert the microSD card into the microSD slot and turn the Rotary Switch to 1, then turn on the power.
4. Use an SSH/Telnet software, e.g. PuTTY, to connect to UA via the Serial connection. Input your Serial line (default: COM1) and Speed (115200 for UA). And then click “Open” button.




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5. After the login message, enter the default username (root) and password (icpdas).

```
         Starting Update UTMP about System Runlevel Changes...
[  OK  ] Finished Update UTMP about System Runlevel Changes.

Ubuntu 20.04.1 LTS icpdas.lp2841 ttymxc3

icpdas login:
```

6. Enter "cd recovery" to change the directory.

```
root@icpdas:~# cd recovery
root@icpdas:~/recovery#
```

7. Enter "./sys_recovery.sh" to run the system restore program, wait for the following message to appear, please enter ”y” to start the system restore process.

```
root@icpdas:~/recovery# ./sys_recovery.sh
Welcom To ICPDAS System Restore
Do you want to continue? [y/n]
```

8. When the restore is successful, one long beeps from buzzer and "system restore successful" will be displayed, press any key to end. If the restore fails, three short beeps from buzzer and "xxx restore failed" will be displayed.

```
mkfs.fat 4.1 (2017-01-24)
22.1MiB 0:00:01 [19.9MiB/s] [================================>] 100%
Image restore successful
22.1MiB 0:00:01 [20.3MiB/s] [================================>] 100%
Image_rt restore successful
37.9KiB 0:00:00 [11.5MiB/s] [================================>] 100%
fsl-imx8mm-iwg34m.dtb restore successful
umount: /dev/mmcblk0p2: not mounted.
mke2fs 1.45.5 (07-Jan-2020)
/dev/mmcblk0p2 contains a ext4 file system
        last mounted on /mnt on Wed Feb 16 11:30:32 2022
Discarding device blocks: done
Creating filesystem with 1755600 4k blocks and 438912 inodes
Filesystem UUID: 1b788641-5160-47fb-89c6-0ad62d6b63dd
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632

Allocating group tables: done
Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

 447MiB 0:00:50 [8.85MiB/s] [================================>] 100%
rootfs restore successful
system restore successful
```

9. Finally, turn the Rotary Switch to 0 normal mode and reapply power.

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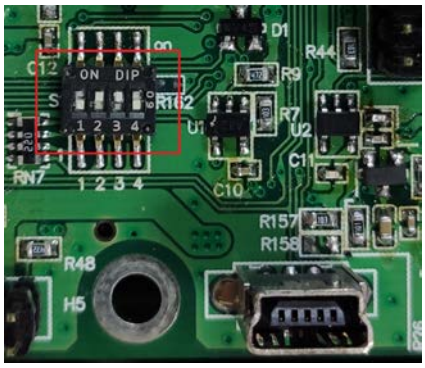
## 4.2. Restore System Using UUU Tool

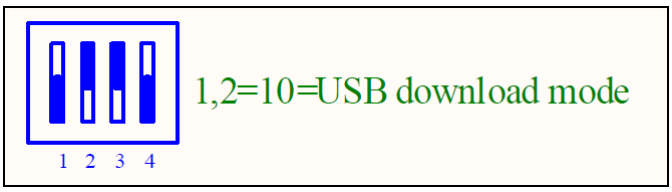
If you cannot restore the system from the SD card, you can use this method to restore the system.

1. Download the latest version of UUU system restore file from Download Center (emp-2848m-system-restore-uuu-xxxx-xx-xx.zip).
   https://www.icpdas.com/tw/download/index.php?model=EMP-2848M
2. prepare a Mini USB cable.

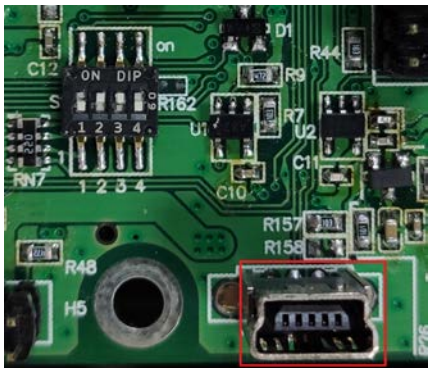


3. Disassemble the hardware case and adjust the SW1 dip switch to USB download mode, as shown below.



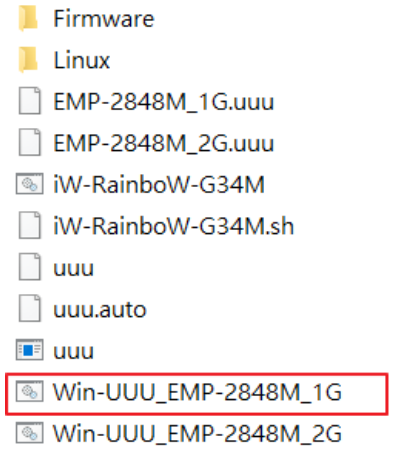

4. Connect the Mini USB cable to the Mini USB connector (J4) of the module and the other end to the PC.



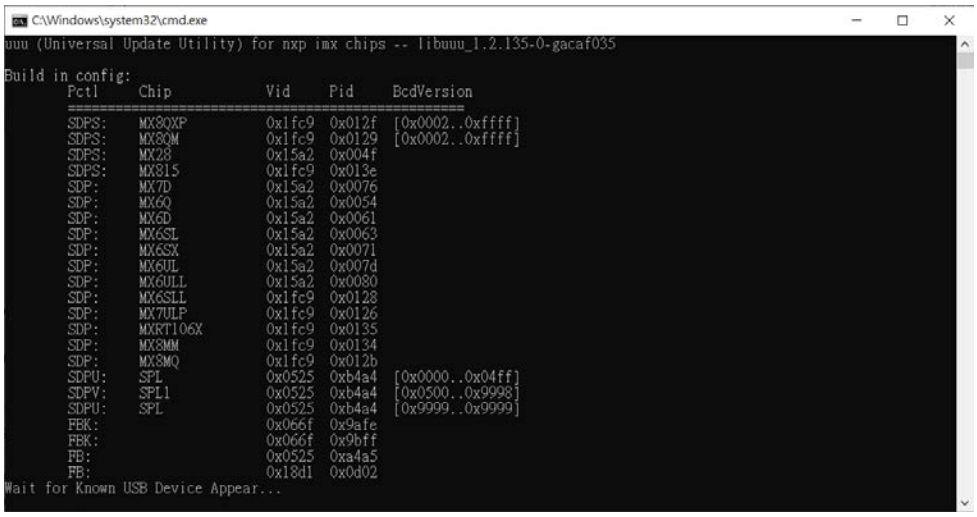

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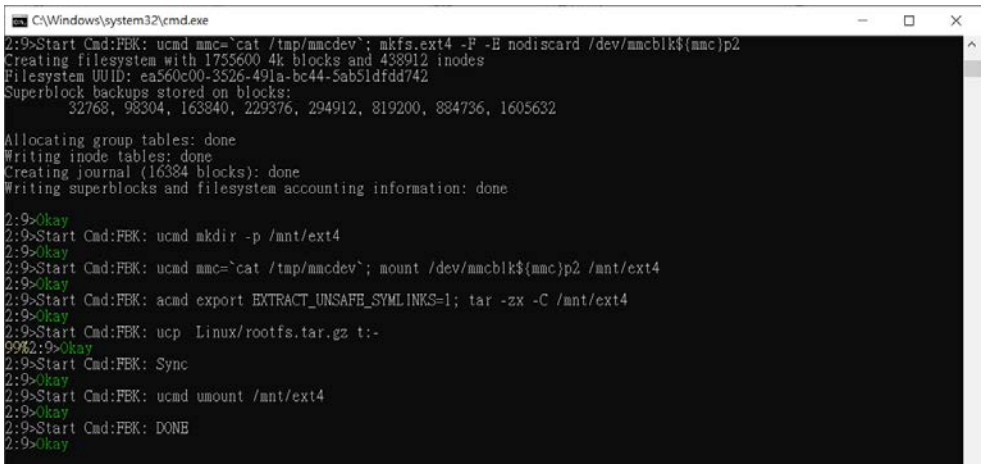
5. Extract emp-2848m-system-restore-uuu-xxxx-xx-xx.zip file, and execute Win-UUU_EMP-2848M_1G.bat.




6. Wait for "Wait for Known USB Device Appear" to appear in the command prompt.



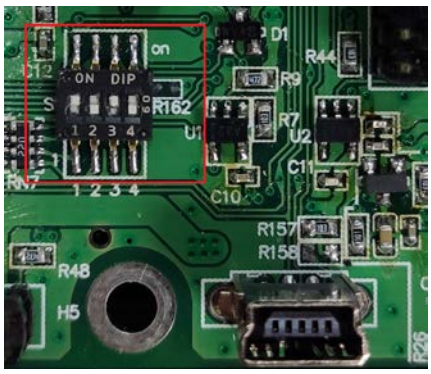

7. Turn on the module power, the system restore process will start, wait for "Start Cmd:FBK Done" to appear and show "Okay", it means the system restore is successful.




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8. As shown in the figure below, adjust the SW1 DIP switch to the internal SPI boot mode and reapply power.







1,2=01=Internal SPI boot mode

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## 4.3. Reset Default (Rotary Switch: 2)

1. Turn the Rotary Switch to 2 and turn on the power. Wait for the buzzer to beep every three seconds to indicate a successful reset of the default value.

| Factory Default Settings | | |
|---|---|---|
| **Network** | IP (LAN1) | 192.168.255.1 |
| | Netmask | 255.255.0.0 |
| | Gateway | 192.168.1.1 |
| **OS Account** | Username | Password |
| | root | icpdas |
| | icpdas | icpdas |
| **Web Account** | Username | Password |
| | admin | admin |

2. Turn the Rotary Switch to 0 normal mode and reapply power.

## 4.4. Delete the Configuration File (Rotary Switch: 3)

1. Turn the Rotary Switch to 3 and turn on the power. Wait for the buzzer to beep every three seconds to indicate successful deletion of the configuration file.

| Configuration file | |
|---|---|
| **EtherCAT** | Delete the default ENI file |
| **Win-GRAF** | Delete the PLC program file |

2. Turn the Rotary Switch to 0 normal mode and reapply power.

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# Revision History

| Revision | Date | Description |
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| 1.0 | 2022/07 | Initial issue |

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