

***Enersine* ESD34 400 V**
Active Harmonic Filter User's Manual

No. 192321852030004



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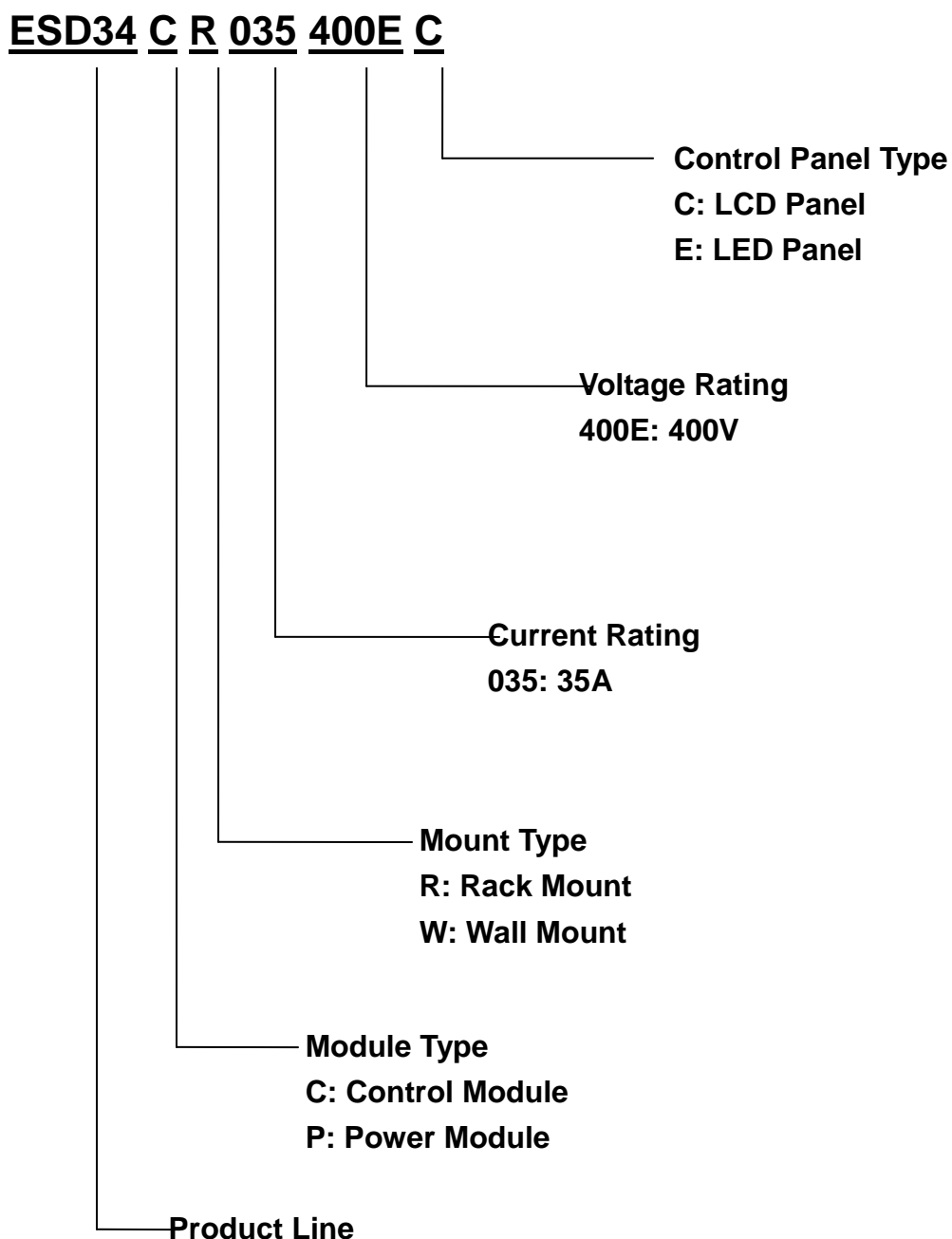
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Model Number Description

This manual describes the following equipment:



Preface

The purpose of this manual is to introduce the operating principles of the **Enersine ESD34** Active Harmonic Filter and to provide instructions for its safe operation. The manual also provides troubleshooting assistance should an abnormal message or behavior occur.

Should an abnormal message not covered in this manual appear, please contact your local authorized service agent for troubleshooting and repair.

All of the installation, operation, and maintenance of this device must be performed by authorized and qualified technicians who are familiar with this manual.

Safety Instructions

While the **Enersine ESD34** Active Harmonic Filter is undergoing installation, operation, maintenance, or calibration, you are reminded of the following safety instructions:

- (1) The **Enersine ESD34** is connected to hazardous high voltage. Death can result if the device is not installed properly.
- (2) The installation, calibration, and maintenance of the **Enersine ESD34** must be done by qualified technicians according to local and international installation standards.
- (3) A proper grounding of the **Enersine ESD34** must be double verified before the filter is powered on. Improper grounding can cause the device to work abnormally and also presents a potential electric shock hazard.
- (4) Before any maintenance work is performed make sure that the power switch is off for at least three minutes to allow the internal capacitors to totally discharge.
- (5) When routine maintenance is performed be sure to avoid potential electric shock hazards from the interior of the filter or energy storage components such as capacitors. Also, we recommend that you wear safety glasses.
- (6) Improper installation of the filter could increase harmonic currents and voltages, which can damage power systems or the load connected.
- (7) Improper operation can damage the internal components of the filter.
- (8) Improper procedure in breaking the circuit can damage the filter or introduce safety hazards.

The operation and maintenance of the filter must be performed by qualified technicians who are familiar with this user's manual.

When replacing any components be sure to proceed as indicated in this manual to avoid safety hazards.

1. About the **Enersine ESD34**

1-1. Functional Features

The **Enersine ESD34** is a solid-state power converter which offers the following features under normal conditions:

- Eliminates harmonic currents generated by non-linear loads.
- Compensates reactive power for lagging or leading loads.
- Acts as a virtual damping resistor to prevent harmonic resonance.

The **Enersine ESD34** is a harmonic current generator that creates opposite, phase-shifted harmonic currents of the same amplitude.

The benefits of the improved harmonic currents are:

- (1) No risk of harmonic resonance
- (2) Reduced voltage waveform distortion
- (3) Reduced voltage drops on transformers and cables
- (4) Reduced overheating of transformers and cables
- (5) Improved power factor

The **Enersine ESD34** is not recommended for use with loads that have a high current rise rate. Such a load, for example that of a rectifier with an extra-low inductance rating employing phase control, may cause the **Enersine ESD34** to shut down. If the **Enersine ESD34** is applied to such a load, we recommend installing a 3-5% reactor at the input side of the load to reduce the rise rate of the load input current.

In certain applications where there are devices having similar characteristics, such as a load which generates high-frequency current, power factor correction capacitors, certain types of passive harmonic filters, etc., those devices may also affect the normal operation of the **Enersine ESD34** or cause it to shut down.

1-2. Major Components

The **Enersine ESD34** employs a modular design. It is composed of one Control Module and several Power Modules.

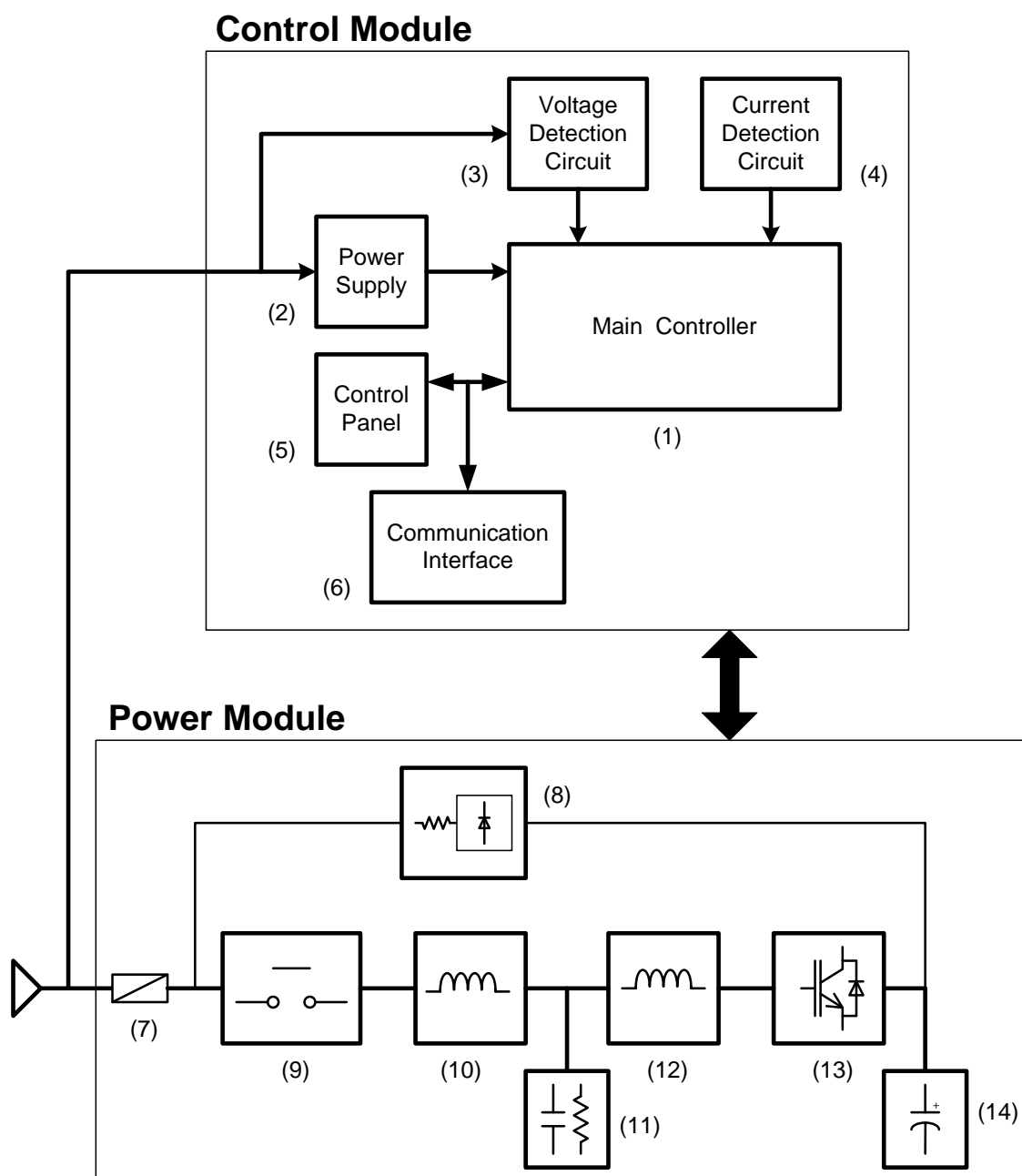


Figure 1-1 Enersine ESD34 Major Components Block Diagram

The Control Module is composed of these parts:

(1) Main Controller

The control core of the **Enersine**. Controls the Power Module.

(2) Power Supply

Provides DC power for the Control Module.

(3) Voltage Detection Circuit

Provides a three-phase AC mains voltage signal for the Main Controller.

(4) Current Detection Circuit

Provides the source- or load-side current signal used by the Main Controller to calculate harmonic and reactive current.

(5) Control Panel

Used to operate the **Enersine** and display the status of operations.

(6) Communication Interface

Provides several communication interfaces.

Each Power Module is composed of these parts:

(7) Main Fuse

Prevents damage from over-current conditions.

(8) Soft-start Module

The major function of this module is to pre-charge the DC Capacitor Module to prevent inrush current during **Enersine** start-up. When the voltage of the DC Capacitor Module reaches a certain level, the **Enersine** can be started up and can begin compensating the harmonic currents.

Major components are:

- a. Current-limit resistor
- b. Rectifier

(9) Electromagnetic Contactor Module

The Electromagnetic Contactor Module is a switch that links the IGBT power converter and the power system. When the **Enersine** is off, the contactor is open to segregate the IGBT power converter from the power system. When the **Enersine** is on, the contactor is closed to link the power converter and the power system.

(10) Link Inductor Module

The link inductor is a power transmission interface between the IGBT power converter and the power system.

(11) Ripple Current Filter Module

The ripple current filter is a shunt-connected passive filter. Its major function is to absorb high-frequency ripple currents from the IGBT power converter.

Major components are:

- a. Parallel/series link resonance filter
- b. Over-current protection fuse

(12) High Frequency Inductor

The major function of the high frequency inductor is to filter high-frequency ripple currents from the IGBT power converter.

(13) IGBT Power Converter Module

The major function of the IGBT Power Converter Module is to convert the energy provided by the power system to harmonic and reactive power compensated current, then feed back to the power system to reduce harmonic currents and improve the power factor.

Major components are:

- a. IGBT Bridge
- b. Driver Circuit
- c. Snubbers

(14) DC Capacitor Module

The DC Capacitor Module is composed of a number of similarly rated DC capacitors connected in parallel and in series. The DC Capacitor Module stores the energy needed to maintain a constant DC voltage, which is controlled by the IGBT power converter.

1-3. System Structure Diagram

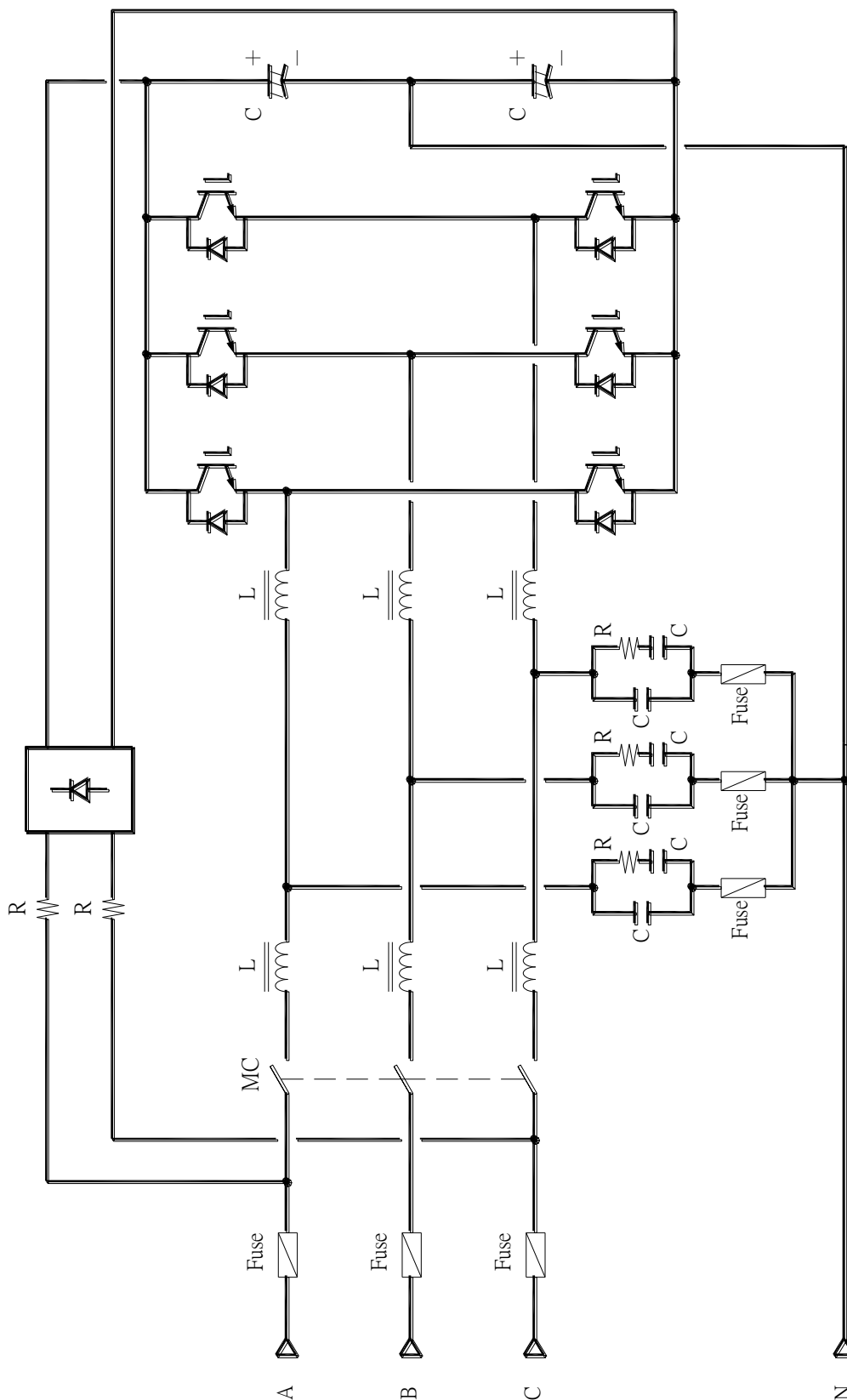


Figure 1-2 Enersine ESD34 400 V Power Module System Structure Diagram

1-4. General Characteristics and Specifications

1-4-1. General Characteristics

Storage Temperature	-20℃ ~ 70℃
Operating Temperature	0℃ ~ 40℃
Relative Humidity	< 95%
Operating Altitude	< 1,000 m
Reference Harmonic Standard	EN 61000-3-4 , IEEE 519-1992
Reference Design Standard	EN60146
Safety Standard	EN50178

1-4-2. Power Module Specification

Input Voltage	400 V +15%, -20%
Phase/Wires	3 phase 4 wires/3wires
Frequency	50/60 Hz ±3 Hz
Maximum Compensation Current/Phase	35 Arms
De-rating Compensation Current/Phase ¹	30 Arms
Maximum Compensation Current of Neutral Line	105 Arms
Inrush Current	Less than rated current
Current Limitation	Yes, at full correction
Maximum Heat Loss	650 watts
Color	RAL9011 (PANTONE Process Black C)
Protection Index	IP20
Dimensions (WxDxH)	440 × 710 × 131 mm
Weight	31 kg

¹When two or more Power Modules work together in a power scalable configuration the power modules will downgrade automatically from 35 A to 30 A. That means 60/90/120 A when 2/3/4 400 V power modules are connected in parallel.

1-4-3. Control Module Specification

Input Voltage	400 V +15%, -20%
Phase/Wires	3 phase 4 wires/3wires
Frequency	50/60 Hz \pm 3 Hz (Auto Sensing)
Compensated Harmonic Orders	From 2 nd to 51 st order Up to 12 orders active simultaneously (2 nd ~31 st) Higher-Order Compensation (32 nd -51 st) Disable/Enable operation
Power Factor Correction	Compensates both lagging and leading reactive power. Power factor can be configured from 0.7 lagging to 0.7 leading.
CT Ratio	Can be set. Primary Current: 100-10,000 A Secondary Current: 1 A (standard)/5 A (optional)
CT Location	Source Side: Closed Loop Control Load Side: Open Loop Control
Response Time	< 20 ms
Number of controllable Power Modules	Up to 4 Power Modules
Parallel	Up to 8 Control Modules
Maximum Heat Loss	50 watts
Color	RAL9011 (PANTONE Process Black C)
Protection Index	IP20
Dimensions (WxDxH)	440 \times 710 \times 86 mm
Weight	14 kg

1-4-4. Control Panel Specification

LED Control Panel	<p>a. 4 status LED indicators: POWER ON, FILTERING, FULL CORRECTING, and ERROR</p> <p>b. ON/OFF and RESET keys</p> <p>c. 4 status LED indicators for Power Modules</p> <p>d. 8 alarm LED indicators for Error Messages</p>
LCD Control and Display Panel (optional)	<p>a. 4 status LED indicators: POWER ON, FILTERING, FULL CORRECTING, and ERROR</p> <p>b. ON/OFF and RESET keys</p> <p>c. 4 directional scrolling keys/Enter key/Escape key</p> <p>d. LCD Display Panel offers the following functions:</p> <ul style="list-style-type: none"> ● Meter: parameter, waveform, and spectrum ● Event log: Up to 300 records (FIFO) ● Configuration: Compensation Setting, Compensation Logic Control, and System Setting. ● Multi-language setting: up to 10 different languages

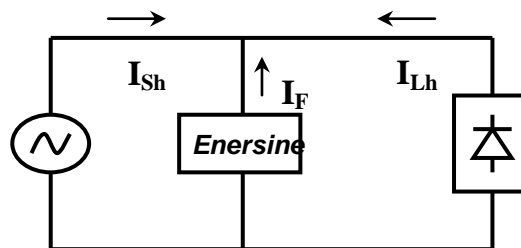
1-4-5. Communication Interface Specification

Dry Contacts (standard configuration)	<p>a. 5 Output Dry Contacts</p> <p>b. 1 Input Dry Contact</p> <p>c. 1 EPO</p>
Communication Interface	<p>Standard : RS-232/USB</p> <p>Optional: RS-485/RS-422</p> <p>Ethernet card</p>
Configuration	Configurable by using our computer service software—Enersine ESD34 Expert Service Program—via USB or RS-232 link, or by using the LCD control panel.
Monitoring Software (optional)	<i>ESD-Link34</i>
Communication Protocol	J-Bus/MOD Bus Protocol

1-5. Compensation Ability

As long as the **Enersine** is powered on and running it provides harmonic current compensation and power factor correction. Therefore the current on the source side is less than that on the load side. In addition, the improvement of the voltage waveform distortion and the voltage regulation may increase harmonic currents on the load side. Therefore, any compensation capability analysis must be done when the **Enersine** is running.

$$\text{Harmonic Attenuation Ratio (HAR)} = \frac{\text{Harmonic Current on Load side (I}_{Lh})}{\text{Harmonic Current on Source side (I}_{Sh})}$$



The harmonic current on the load side is measured when the **Enersine** is running.

1-6. Capacity Selection

The **Enersine** compensates harmonic currents comprehensively, which requires neither measuring the impedance of the power system nor analyzing the load's harmonic spectrum or its individual amplitude. To select the appropriate model, measure the estimated load harmonic current amplitude to be compensated, and then select the **Enersine** model which has an output compensated current rating at least 1.25 times that. For example, if the load harmonic current is 40 A choose the 60 A **Enersine**.

Even if the selected filter offers insufficient compensated harmonic current, the **Enersine** will not be at risk of overloading. It has current-limiting capability up to its full rated compensating capability. Therefore it will not shut down or malfunction as most passive filters do. Simply add Power Modules or a Control Module in parallel to increase its compensating capacity.

Table 1-1 Enersine ESD34 400 V Capacity Selection

Voltage Rating	Current Capacity	Control Module + Power Module
400 V	35 A	ESD34-CR035-400E-C/E + ESD34-PR035-400E x 1
		ESD34-CW035-400E-C/E + ESD34-PW035-400E x 1
	60 A	ESD34-CR035-400E-C/E + ESD34-PR035-400E x 2
		ESD34-CW035-400E-C/E + ESD34-PW035-400E x 2
	90 A	ESD34-CR035-400E-C/E + ESD34-PR035-400E x 3
		ESD34-CW035-400E-C/E + ESD34-PW035-400E x 3
	120 A	ESD34-CR035-400E-C/E + ESD34-PR035-400E x 4
		ESD34-CW035-400E-C/E + ESD34-PW035-400E x 4

2. Control and Power Modules

The **Enersine ESD34** is composed of one Control Module plus several Power Modules. The maximum output current of the **Enersine ESD34** depends on the number of Power Modules.

2-1. Control Module

The Control Module is the control center of the **Enersine**. It analyzes the load current by DSP, then sends control signals to the Power Modules to make them compensate the harmonic and reactive current as required by the load.

The control panel of the Control Module can be either an LED control panel or an LCD control panel. The Control Module with communication capability has communication slots that you can use to add communication capability to the unit. The **Enersine** comes in two mounting styles: Rack Mount and Wall Mount. The control panel, communication slots, and wiring positions for the two styles are different as illustrated in Figures 2-1 and 2-2.

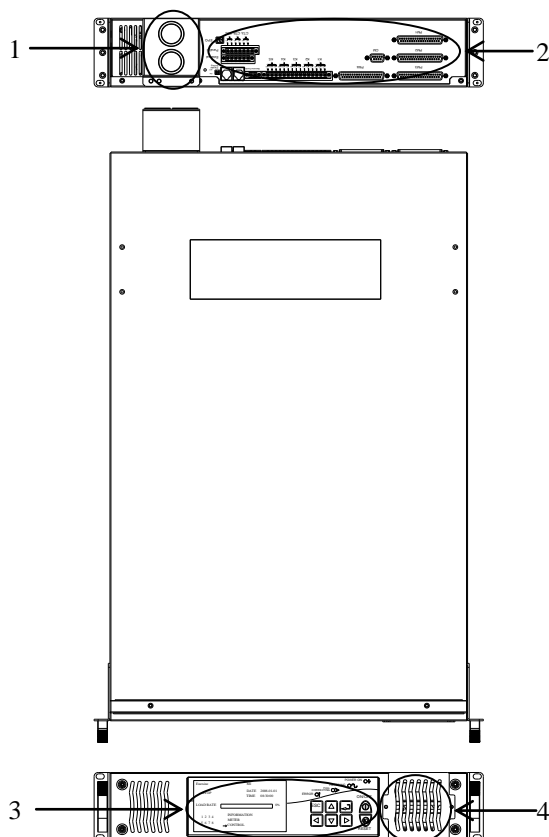


Figure 2-1 Control Module external interfaces, Rack Mount

1. Power Source Terminal Block
2. Control Signal Connectors

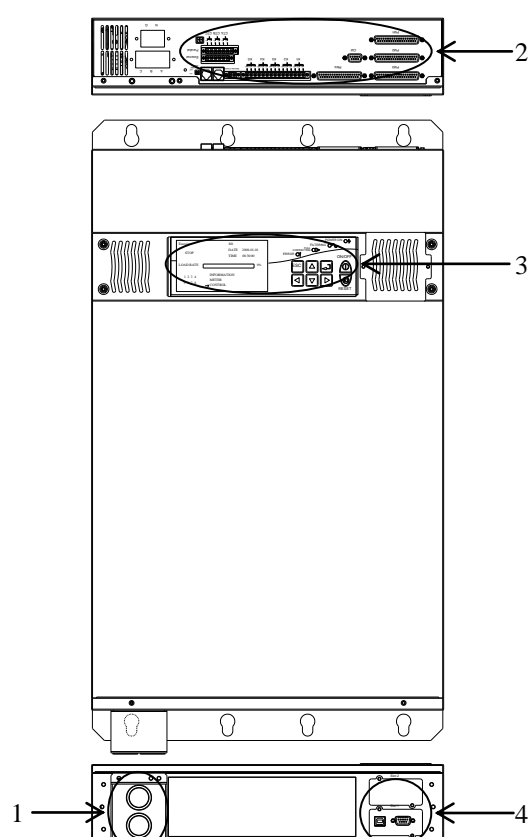


Figure 2-2 Control Module external interfaces, Wall Mount

3. Control Panel
4. Communication Slots

2-1-1. Power Source Terminal Block

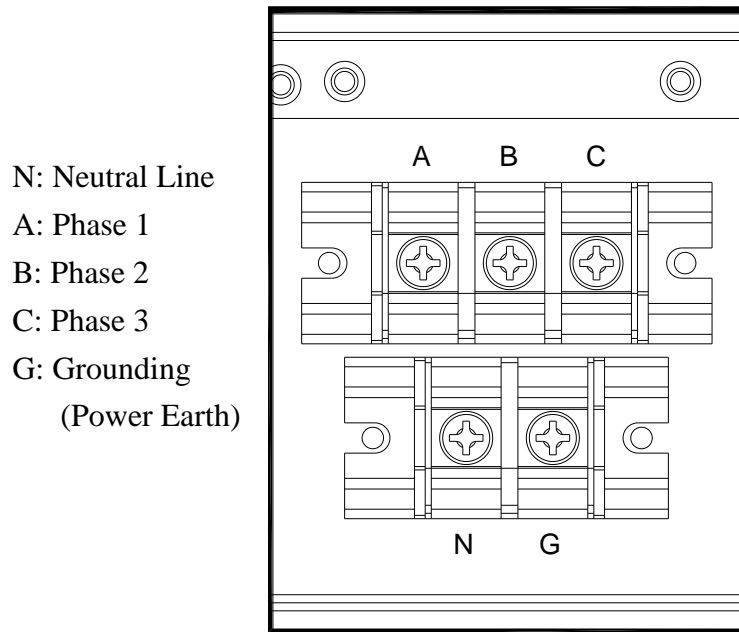


Figure 2-3 Power Source Terminal Block of the Control Module

2-1-2. Control Signal Connectors

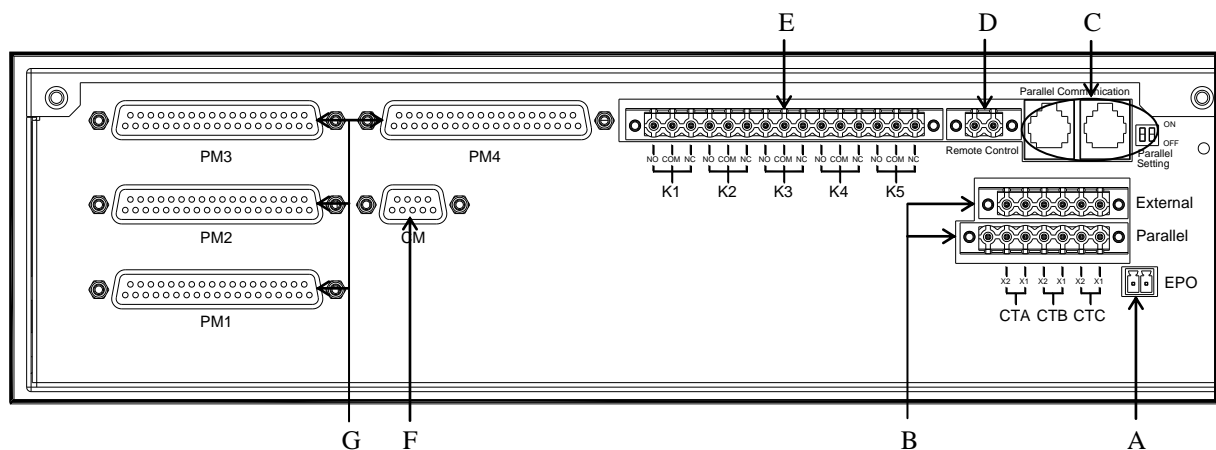


Figure 2-4 Control Signal Connectors

- | | |
|---------------------------------|--------------------------------------|
| A. Emergency Power Off (EPO) | E. Output Dry Contacts |
| B. CT Connectors | F. Control Signal Cable 1 Connector |
| C. Parallel Communication Ports | G. Control Signal Cable 2 Connectors |
| D. Input Dry Contact | |

A. Emergency Power Off (EPO)

The **Enersine** comes with an EPO switch, which allows you to turn off the filter in an emergency. If the LED/LCD control panel is out of order you can still shut down the filter using the EPO switch. Shorting Pin 1 and Pin 2 of the switch turns off the filter immediately.

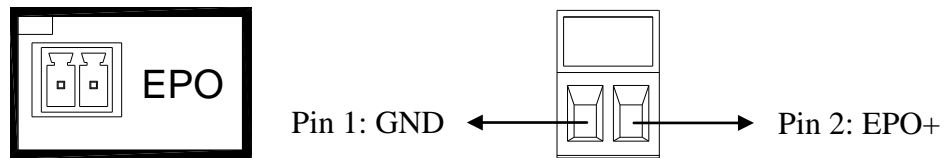


Figure 2-5 EPO Switch

B. CT Connectors

External terminals connect with external CTs, which can be installed on the source or load side.

Parallel terminals connect with parallel CTs, which must be installed at the overall output of all filters when several Control Modules operate in parallel.

You may install these CTs as indicated in Figure 2-6. The wire connections will be explained in detail in Chapter 4.

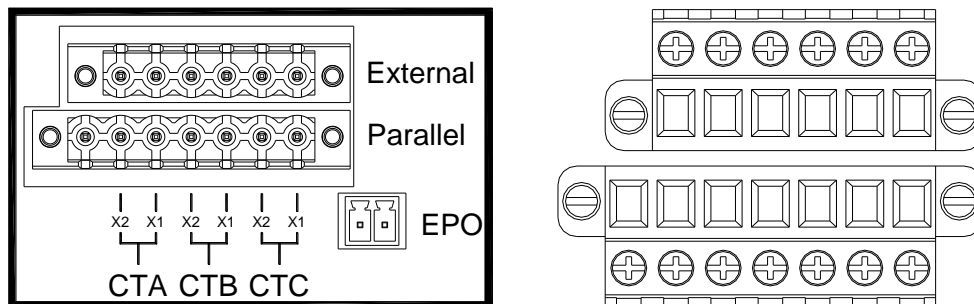


Figure 2-6 CT Connectors

C. Parallel Communication Ports

The Parallel Communication ports are for running multiple Control Modules in parallel. To avoid noise interference, do not intermix these cables with power cables. If intermixing cannot be avoided, align them at 90 degrees or separate them by at least 20 cm as indicated in Figure 2-7.

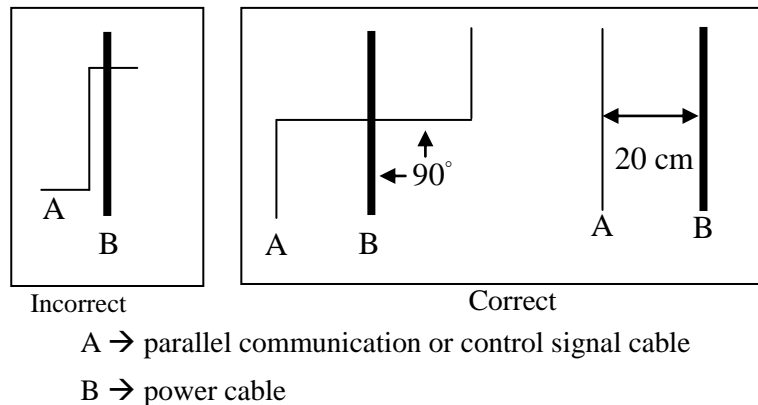


Figure 2-7 Recommended Layout of Parallel Communication Cable

The maximum total length of the parallel communication cables must be less than 20 meters, and they must be connected in a ring topology as shown in Figure 2-8. To ensure good communication quality you must set the switches of the two farthest Control Modules to the “ON” position as shown in Figure 2-8.

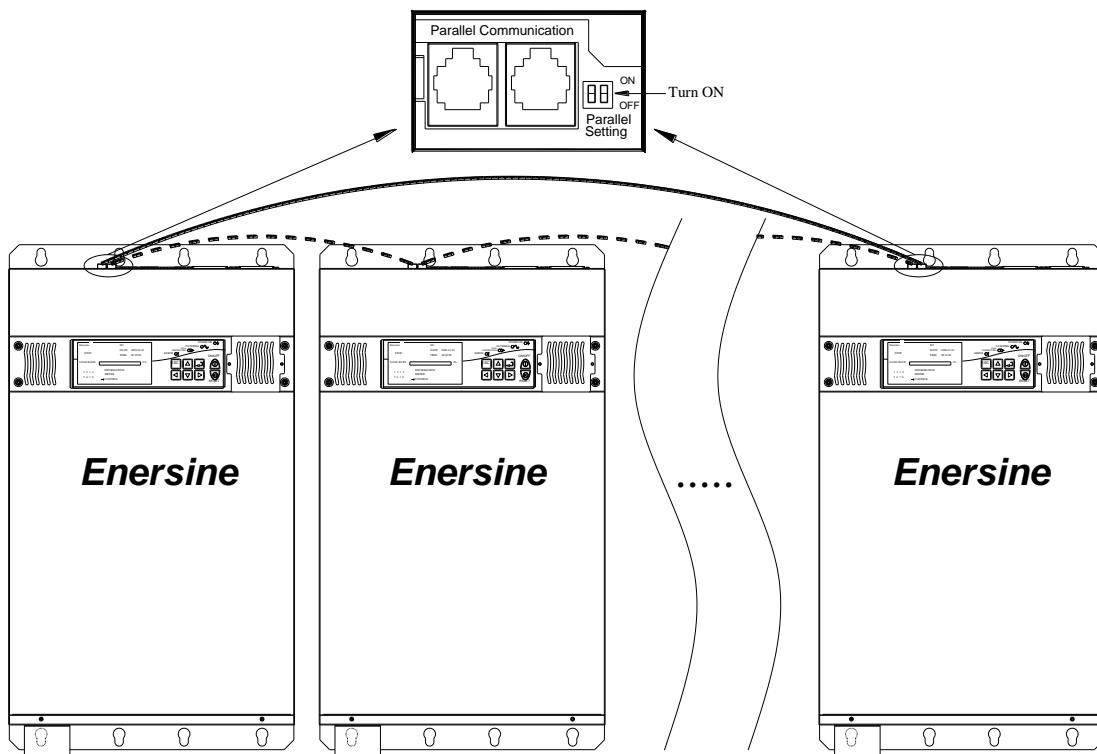
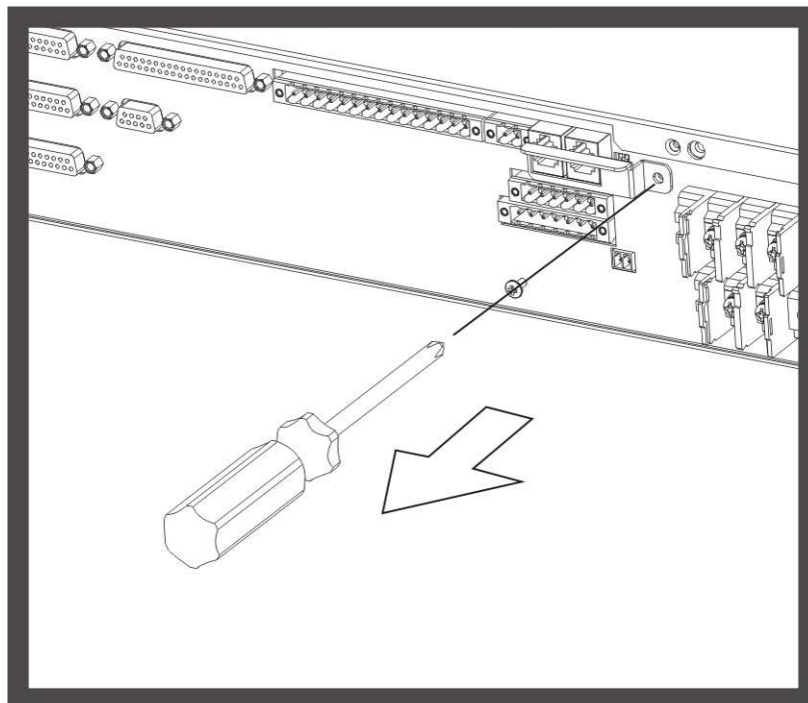


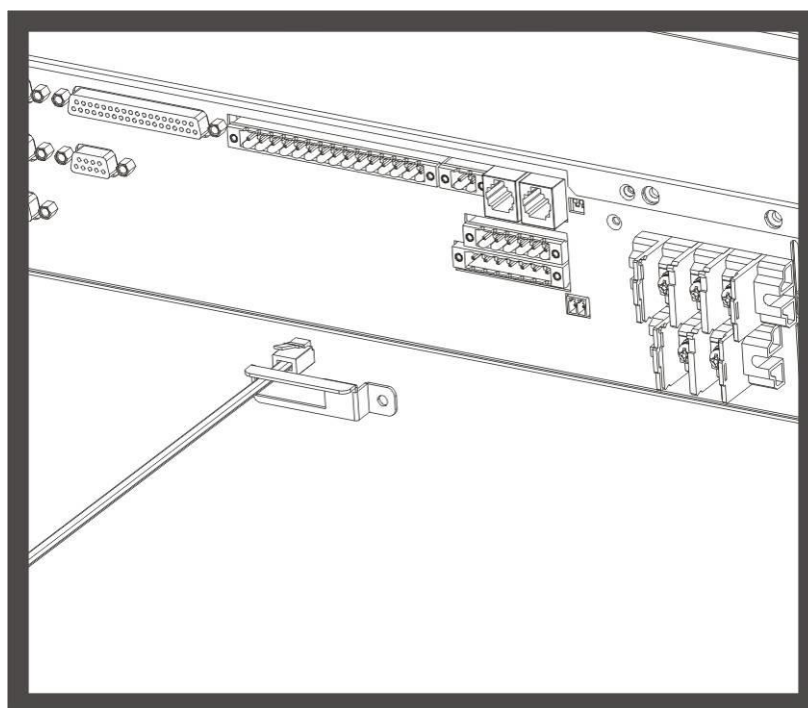
Figure 2-8 Connection for parallel communication cables

Connect the parallel communication cables as shown below.

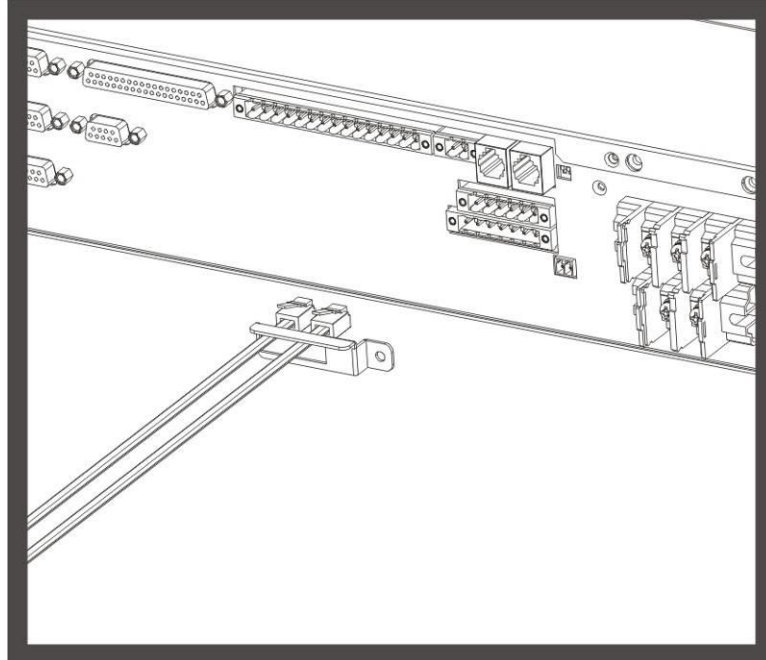
Step 1: Remove the fixed plate of the communication ports.



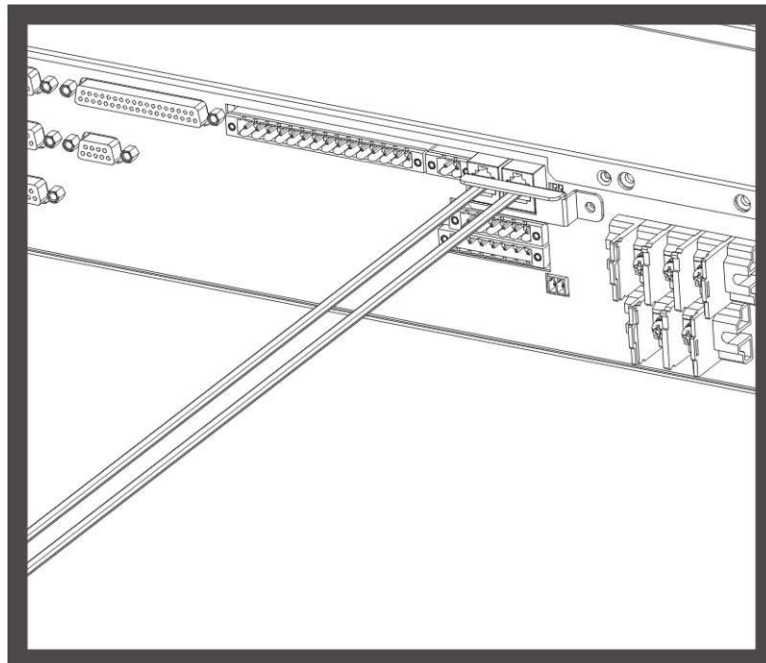
Step 2: Put the first RJ11 communication cable through the fixed plate.



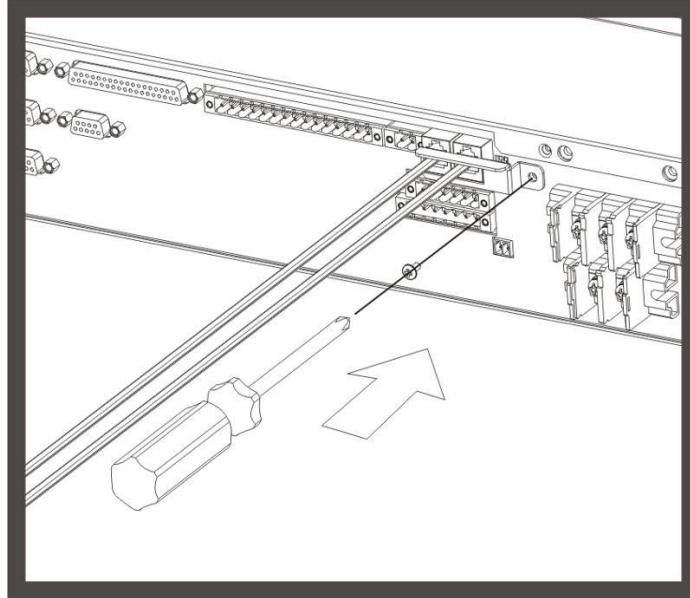
Step 3: Put the second RJ11 cable through the fixed plate.



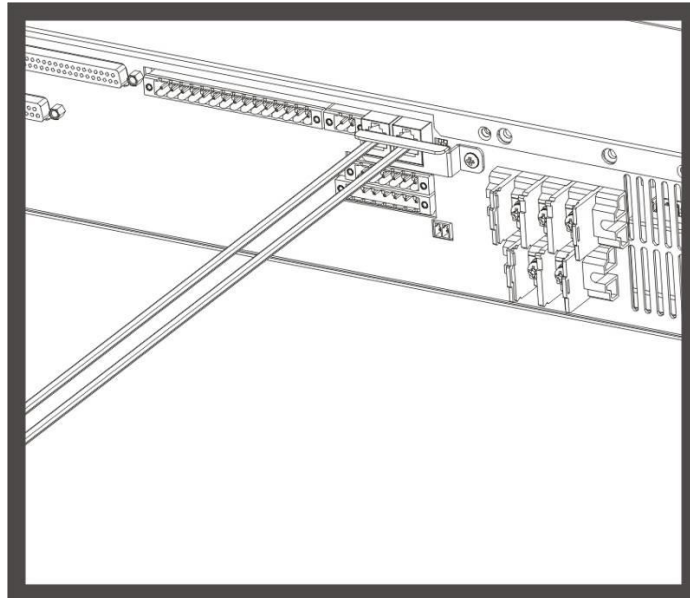
Step 4: Plug the two RJ11 cables into the communication ports.



Step 5: Fasten the fixed plate back onto the rear panel of the Control Module.



Step 6: The communication cables are now installed properly.



Notice: Make sure the filter is turned off when performing the above procedure. After the connections of the RJ11 cables are complete, turn on the power and set the number of parallel Control Modules and the unique “Parallel Number” of each Control Module using either our configuration software or the LCD panel as explained in the *Enersine ESD34 Active Harmonic Filter Service Manual*. In case of wrong settings, the **Enersine** will alarm and can not be started up. Consult your local authorized service agent for help with the parallel settings.

D. Input Dry Contact

The input dry contact is connected to an external switch, which can be used to turn the filter on and off. There are two operation modes that can be selected: Mode 0 and Mode 1. The default mode is Mode 0. You can change to Mode 1 via the monitoring software **ESD-Link34** or consult your local authorized service agent.

Operation Mode 0:

Refer to Figure 2-9 to connect an external tack switch for use in turning the filter on and off. If you press the switch for two seconds the filter will change from on to off and vice versa as indicated in Figure 2-10.

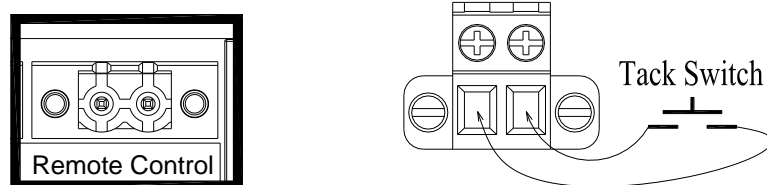


Figure 2-9 Input Dry Contact Connections for Mode 0

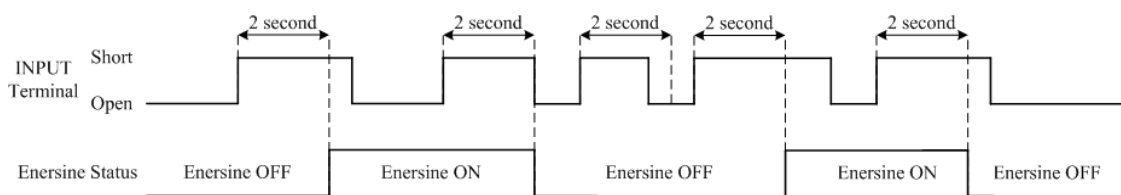


Figure 2-10 Operation in Mode 0

Operation Mode 1:

Refer to Figure 2-11 to connect an external, two-position switch for use in turning the filter on and off. Two seconds after the switch position is changed to either the “on” or “off” position the filter will correspondingly be started up or shut down, as indicated in Figure 2-12.

When in Mode 1 please close the external switch first, and then press the ON/OFF key on the Control Panel to put the filter in standby mode (FILTERING LED blinking). Then you may control the filter from the external switch.

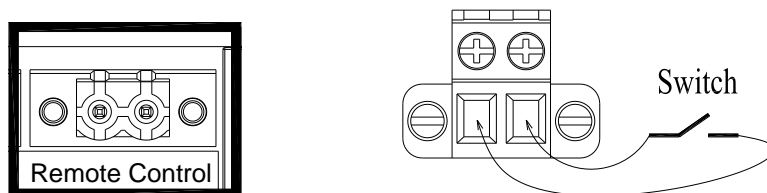


Figure 2-11 Input Dry Contact Connections for Mode 1

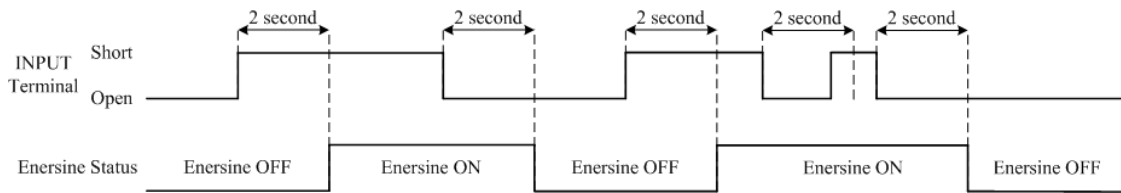


Figure 2-12 Operation in Mode 1

E. Output Dry Contacts

There are five output dry contact connectors for remote monitoring. The pin assignments are as shown in Figure 2-13. These output dry contacts are programmable. The user can change the definition for each contact using the **ESD-Link34** software or by consulting their local authorized service agent. The default definitions of the output dry contacts are shown in Table 2-1.

Electrical specification: 250 VAC/2 A

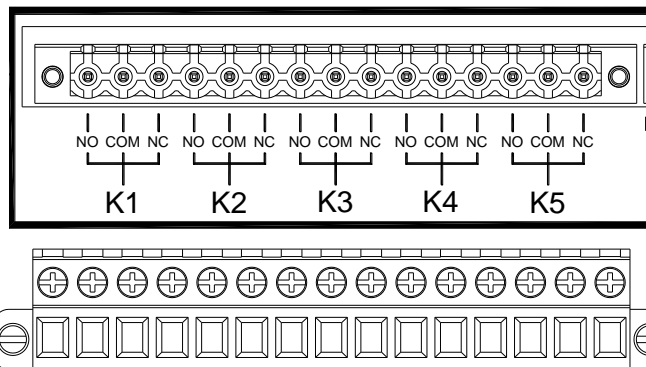


Figure 2-13 Pin Assignments of Output Dry Contacts

Table 2-1 Default Definitions of the Output Dry Contacts

Port	Function	Description
K1	POWER ON	The control logic circuits of the Control Module are energized.
K2	FILTERING	The filter is providing compensating current to the load.
K3	FULL CORRECTING	The capacity of the filter is insufficient for the load. At this time the filter should be in current-limit state and continue to compensate the current up to its rated value.
K4	ERROR	There are some external abnormal conditions or internal breakdown. The filter should stop providing compensating current.
K5	DC Bus Error	The DC bus voltage is abnormal.

F. Control Signal Cable 1 Connector

This port is connected to a Power Module. When more than one Power Module is connected, connect this port to the PM1 port on the Master Power Module.

G. Control Signal Cable 2 Connectors

There are four control signal ports (PM1-PM4), which means you can connect up to four Power Modules. Be sure to connect the Power Modules in sequence from PM1 to PM4. The one connected to PM1 is the Master Power Module, as shown in Figure 2-14.

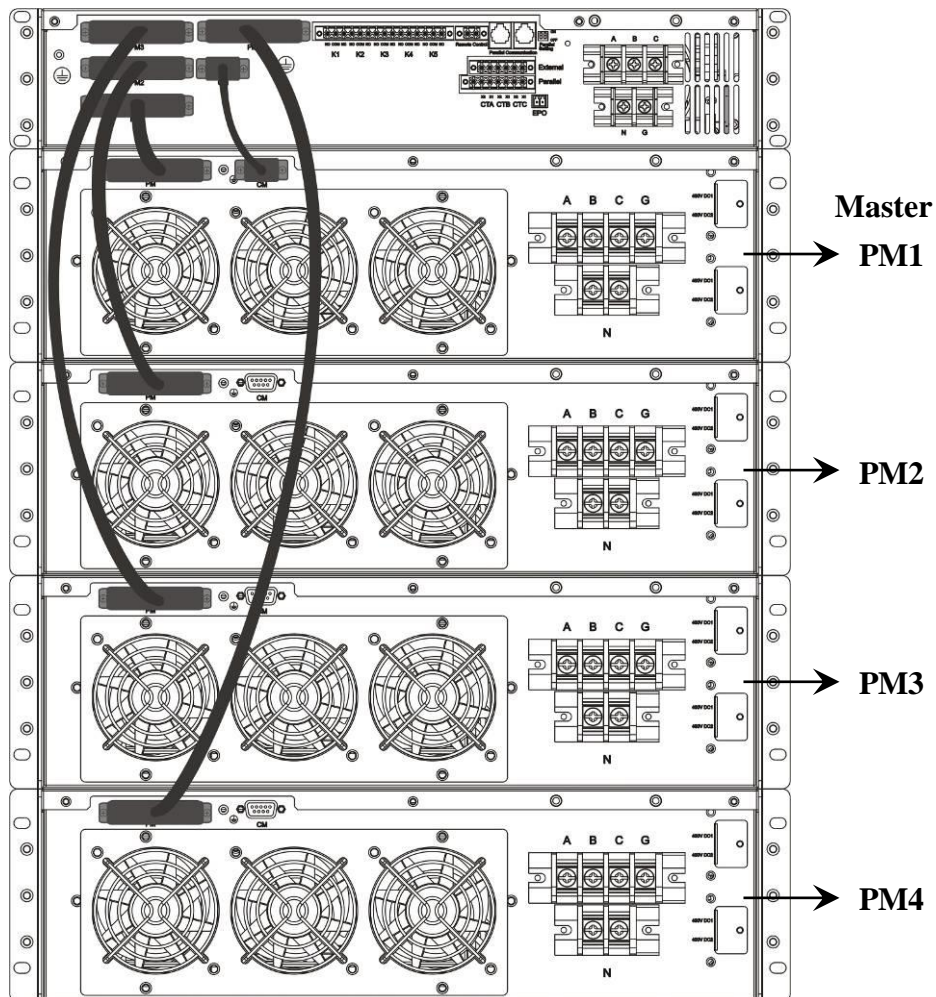


Figure 2-14 Connections for Control Signal Cables

2-1-3. Control Panel

There are two types of control panels available: LED and LCD.

A. LED Control Panel

The LED Control Panel displays the filter status with LED indicators, which may provide the end user sufficient information for control and operation.

It has 4 filter status indicators, 4 Power Module status indicators, 8 Error Message Alarm indicators, and 2 control keys for the following functions:

- To turn the filter on and off
- To silence the alarm and clear the fault status
- To indicate the operation status of the filter
- To indicate the status of the Power Modules
- To display error messages

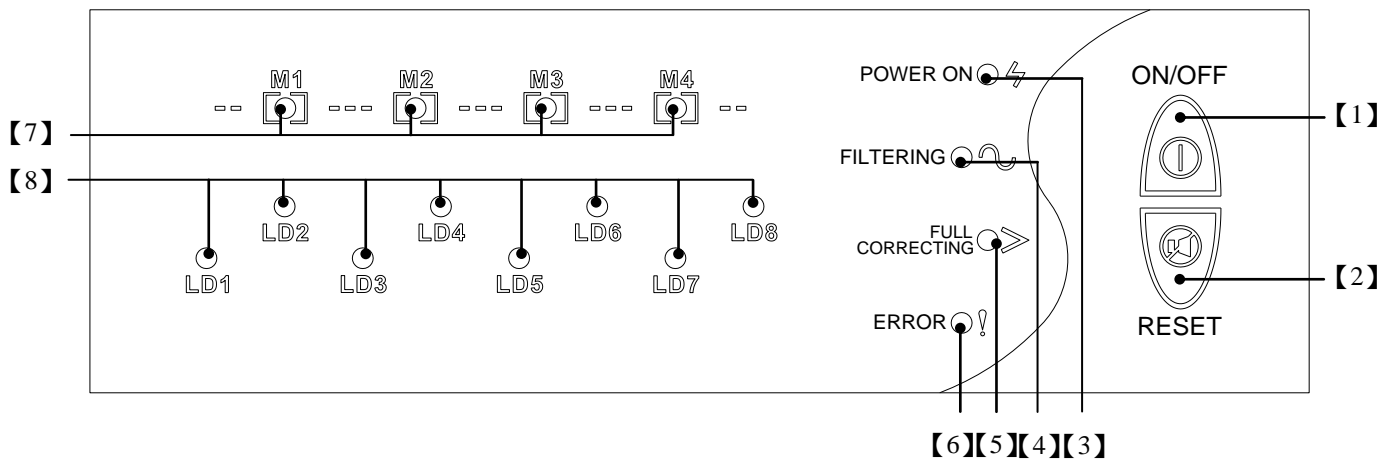


Figure 2-15 LED Control Panel

- | | |
|------------------------|-----------------------------------|
| 1. ON/OFF Key | 5. FULL CORRECTING Indicator |
| 2. RESET Key | 6. ERROR Indicator |
| 3. POWER ON Indicator | 7. Power Module Status Indicators |
| 4. FILTERING Indicator | 8. Error Alarm Indicators |

The LED indicators on the LED Control Panel are described in Table 2-2.

Table 2-2 LED Indicators on the LED Control Panel

Indicator	Color	Description
POWER ON	Red	Indicates that the control logic circuits of the Control Module are energized.
FILTERING	Green	Indicates that the filter is providing compensating current to the load. This indicator light will switch off when the filter is shut down by the user or by system malfunction. If the LED is blinking , it means the filter is in standby mode.
FULL CORRECTING	Yellow	Indicates that the capacity of the filter is insufficient for the load. At this time the filter should be in current-limit state and continue to compensate the current up to its rated value.
ERROR	Red	Indicates that there are some external abnormal conditions or internal abnormal breakdown. The filter should stop providing compensating current.
M1	Green	Indicates that a control signal cable is connected to a Power Module. If the LED is blinking , it means the Power Module is out of order.
M2	Green	
M3	Green	
M4	Green	
LD1	Red	1. The phase rotation or polarity of the External CTs is reversed. 2. The phase rotation or polarity of the Parallel CTs is reversed.
LD2	Red	1. The system voltage is over-voltage, under-voltage, or has high distortion. 2. The system frequency is out of range. 3. The phase rotation of system voltage is not clockwise. 4. The filter may resonate with the load.
LD3	Red	1. The controller is not working properly. 2. The control board EEPROM is not working properly. 3. The control panel EEPROM is not working properly. 4. The power supply of the Control Module is out of service. 5. The CT signal connection inside the Control Module is incorrect. 6. If the LED is blinking , communication between the control panel and the control board is disconnected. 7. If the LED is blinking , parallel communication is not working properly or the parallel communication settings are not correct.
LD4	Red	The DC Bus voltage is abnormal.

Indicator	Color	Description
LD5	Red	<ol style="list-style-type: none"> 1. A Power Module is overheated. 2. A cooling fan is out of order. 3. The wire of the thermal sensor is disconnected. 4. The Control Module is overheated.
LD6	Red	<ol style="list-style-type: none"> 1. The peak current of the IGBT power converter is too high. 2. Output rms current of the IGBT power converter is too high.
LD7	Red	<ol style="list-style-type: none"> 1. The IGBT or IGBT driver circuit is faulty. 2. The instantaneous current of the IGBT is too high. 3. Too much high frequency ripple current generated from the IGBT power converter.
LD8	Red	<ol style="list-style-type: none"> 1. The electromagnetic contactor is tripped or malfunctioning. 2. The fuse is blown. 3. The input power source of the Power Module is abnormal.

B. LCD Control Panel

The LCD control panel provides information in graphical form.

The LCD control panel has eight control keys, four status indicators, and one LCD display for the following functions:

- To turn the filter on and off.
- To silence the alarm and clear the fault status
- To indicate operation status of the filter
- To display power system settings
- To display the waveforms of voltage and current
- To display the measurement and spectrum of harmonics
- To provide a HID interface

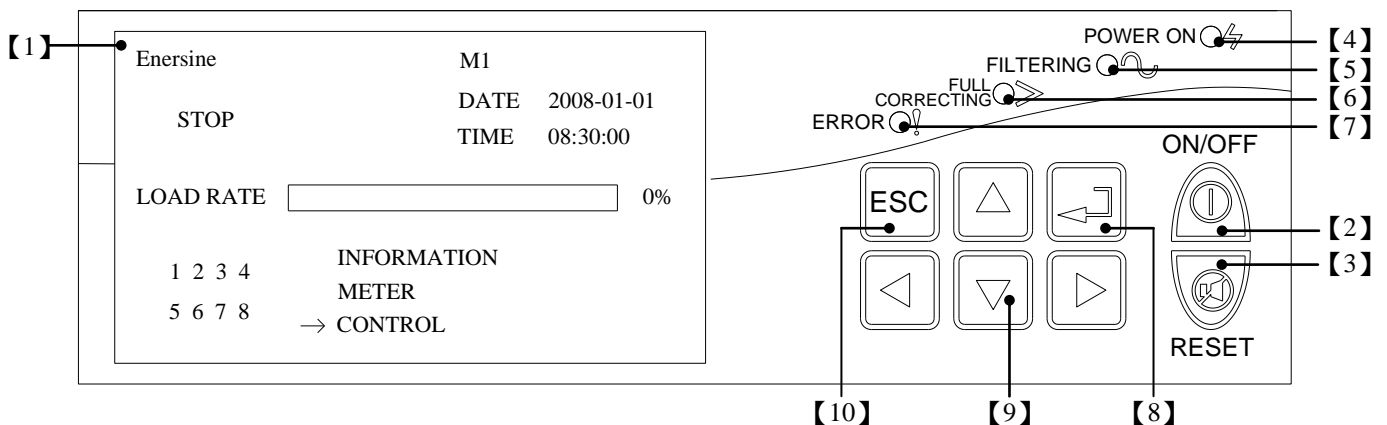


Figure 2-16 LCD Operation Panel

- | | |
|---------------------------|-------------------------------|
| 1. Graphic Display Screen | 6. FULL CORRECTING Indicator |
| 2. ON/OFF Key | 7. ERROR Indicator |
| 3. RESET Key | 8. Confirmation/Enter Key |
| 4. POWER ON Indicator | 9. Directional Scrolling Keys |
| 5. FILTERING Indicator | 10. Escape/Cancel Key |

The four status indicators on the LCD Control Panel provide the same indications as those on the LED Control Panel. Refer to Table 2-2 for details.

2-1-4. Communication Slots

The filter provides both RS-232 and USB interfaces as standard, and RS-485/RS-422 and Ethernet cards are optional. (Refer to Chapter 5 for more detail.) The installation location of those cards is indicated in Figure 2-17.

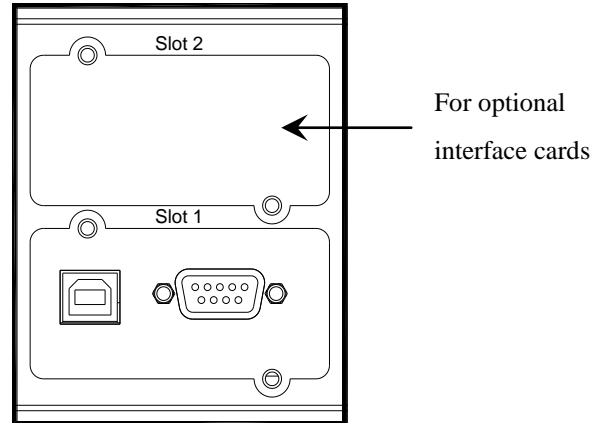


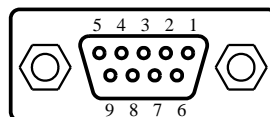
Figure 2-17 Communication Slots

A. RS-232 Communication Port

Communication Interface Configuration:

baud rate	Programmable, 2400-57,600 bps. Default is 57,600 bps.
data length	8 bits
stop bits	1
parity	NO

Pin Assignment:



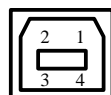
Pin2→RS-232C TX
Pin3→RS-232C RX
Pin5→Ground

B. USB Communication Port

Complies with USB V.1.0, 1.5 Mbps

Complies with USB HID (Human Interface Device) V.1.0

Pin Assignment:



1 → VCC (+5V)
2 → D-
3 → D+
4 → Ground

The filter comes with a configuration tool that runs as a Windows application. It can help you to set the IP addresses, baud rate, and ID of the filter. For more information refer to Chapter 5. Optional monitoring software, **ESD-Link34**, may be purchased from your local authorized service agent.

2-2. Power Module

The Power Module is designed to compensate harmonic currents and reactive power. There are two styles of Power Module: Rack Mount and Wall Mount. The wiring positions for these two styles are different, as shown in Figures 2-18 and 2-19.

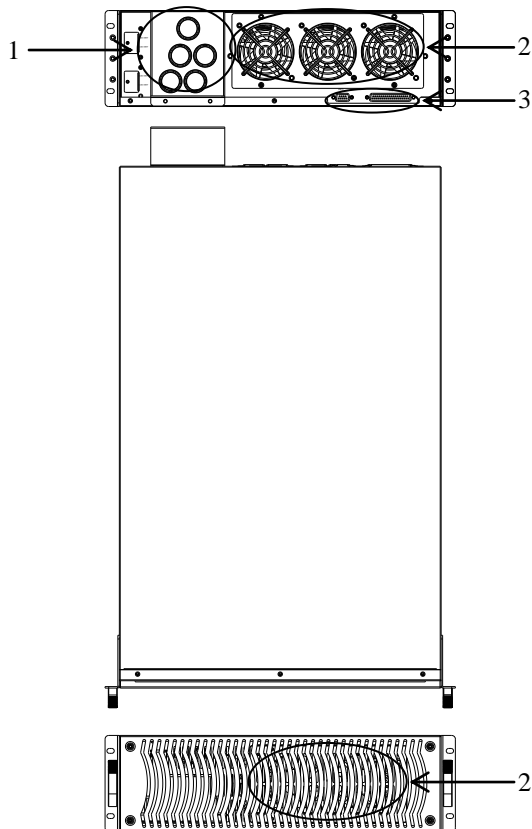


Figure 2-18 Power Module wiring positions, Rack Mount

1. Power Source Terminal Block
2. Cooling Fan and Ventilation Openings

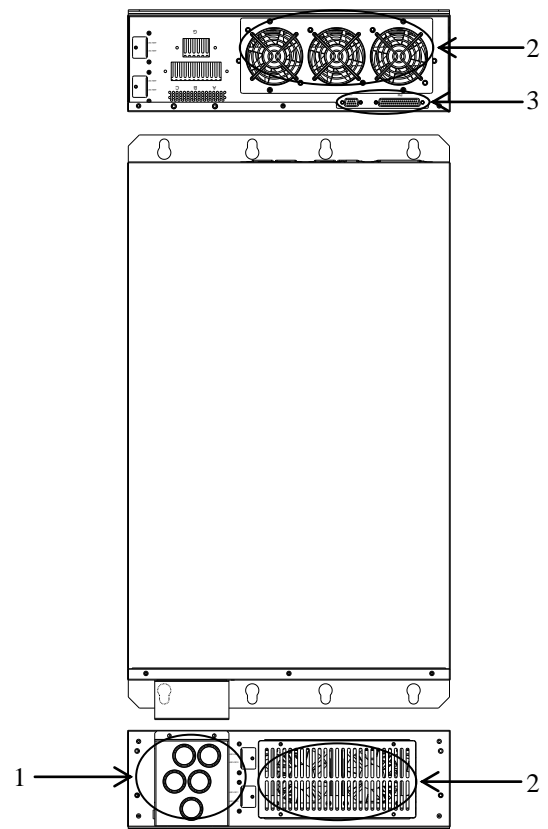


Figure 2-19 Power Module wiring positions, Wall Mount

3. Control Signal Connectors

2-2-1. Power Source Terminal Block

N: Neutral Line
A: Phase 1
B: Phase 2
C: Phase 3
G: Grounding (Power Earth)
DC1 & DC2: DC Bus Terminal

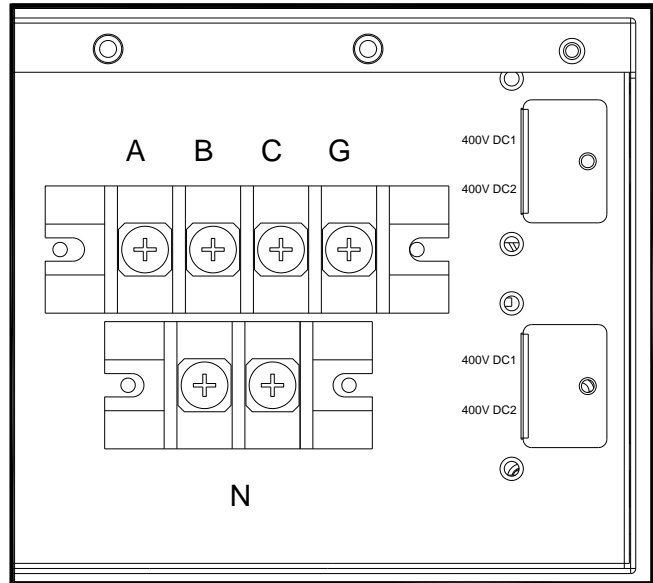
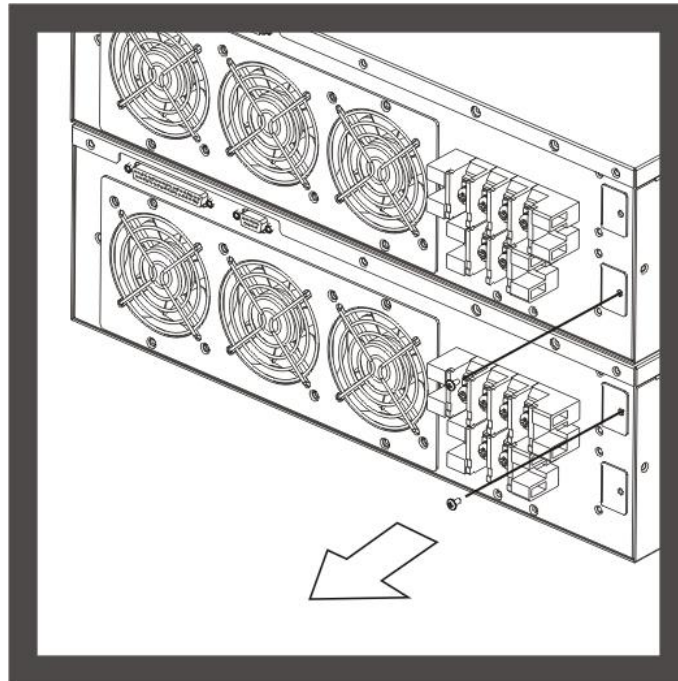


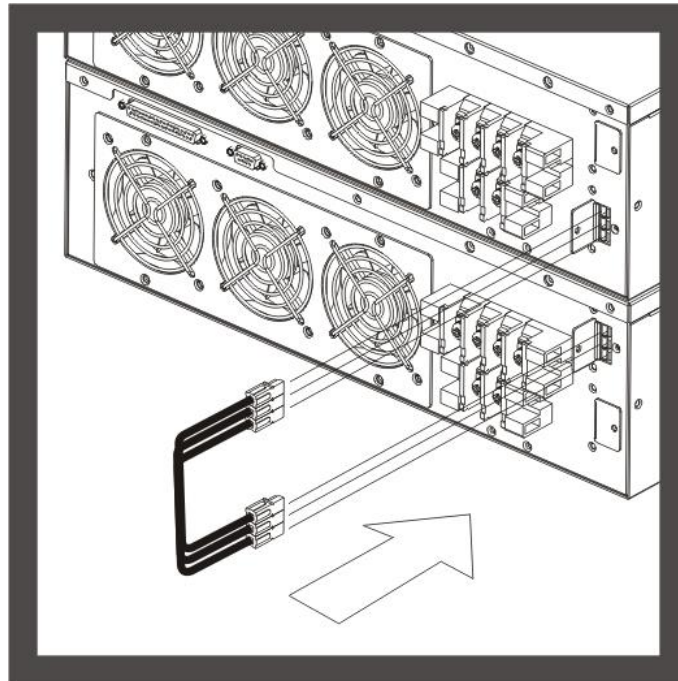
Figure 2-20 Power Source Terminal of the Power Module

When multiple Power Modules are to be connected in a chain, connect DC1 and DC2 of each Power Module in parallel, as follows:

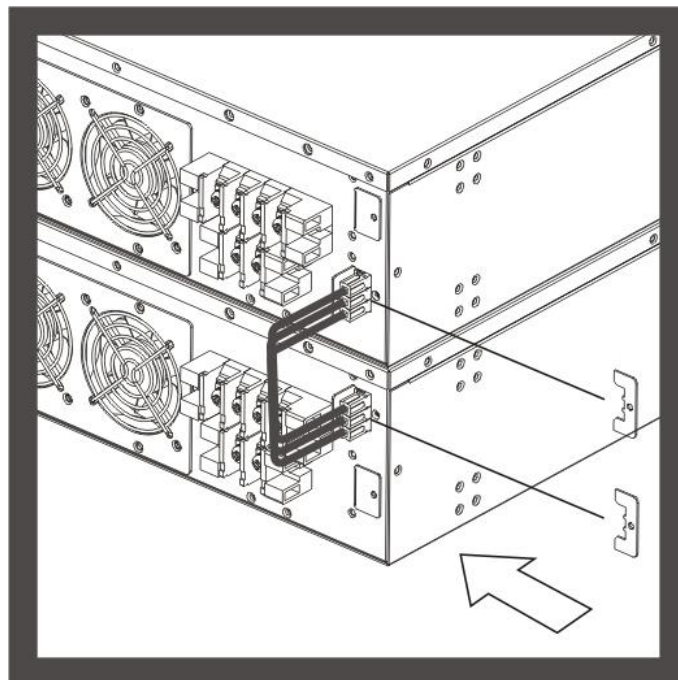
Step 1: Remove the cover of the terminal.



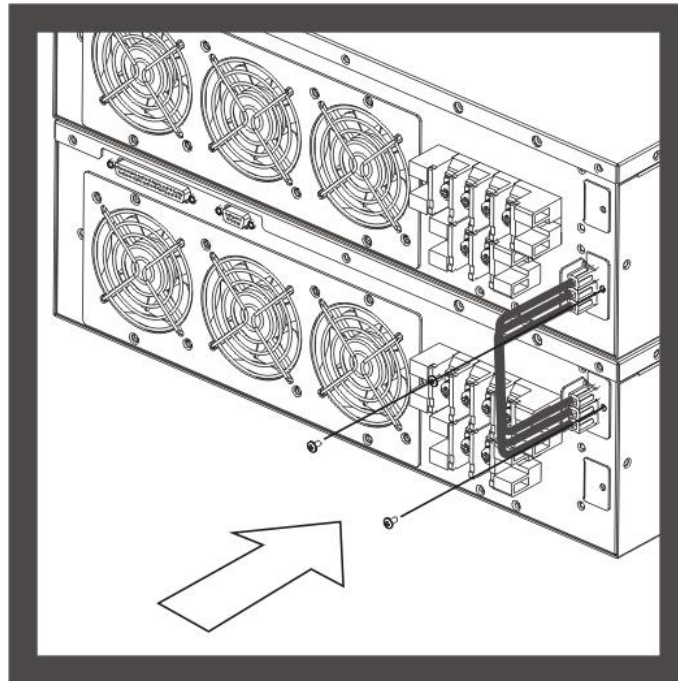
Step 2 : Connect the wires to the terminals as indicated below.



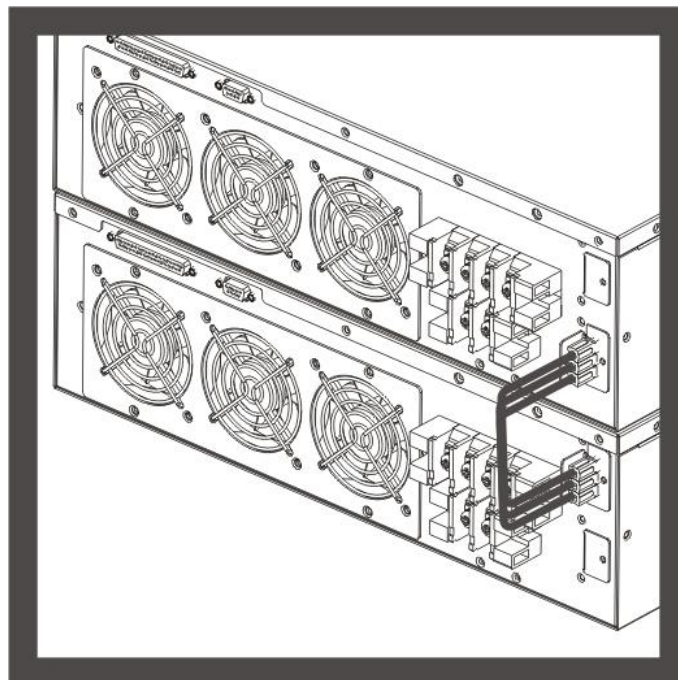
Step 3 : Use the plates as illustrated to fix the wires properly.



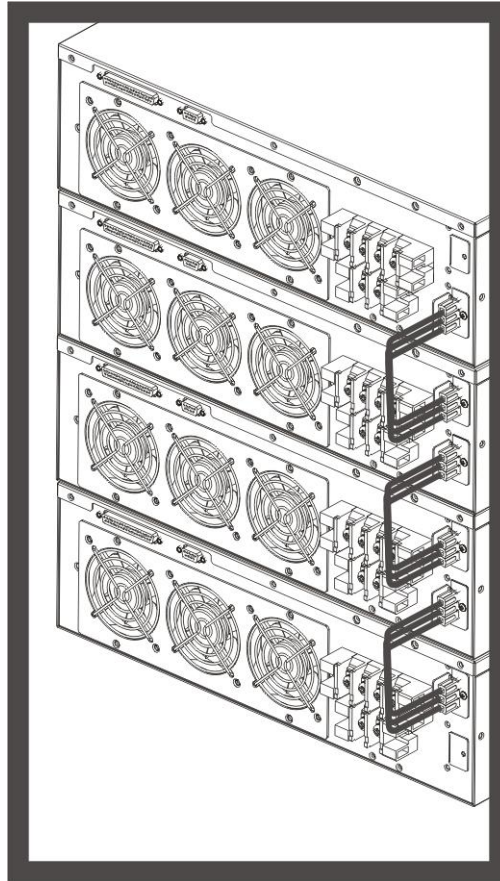
Step 4 : Then fasten the covers with screws.



Step 5: The DC Bus connection for two Power Modules is complete.



Step 6: This shows four Power Modules properly connected.



2-2-2. Cooling Fan and Ventilation Openings

The purpose of the cooling fan and ventilation openings is to expel the heat generated by the Power Module. To prevent the Power Module from overheating make sure there are no obstacles blocking the ventilation openings.

2-2-3. Control Signal Connectors

A Power Module has two control signal connectors: CM and PM, both of which can be connected to the Control Module. The connections are shown in Figure 2-14. Only the Master Power Module connects both the CM and PM connectors with the Control Module. The other Power Modules use only the PM connector.

3. LCD Control Panel

Figure 3-1 is a block diagram of the functions provided by the LCD control panel.

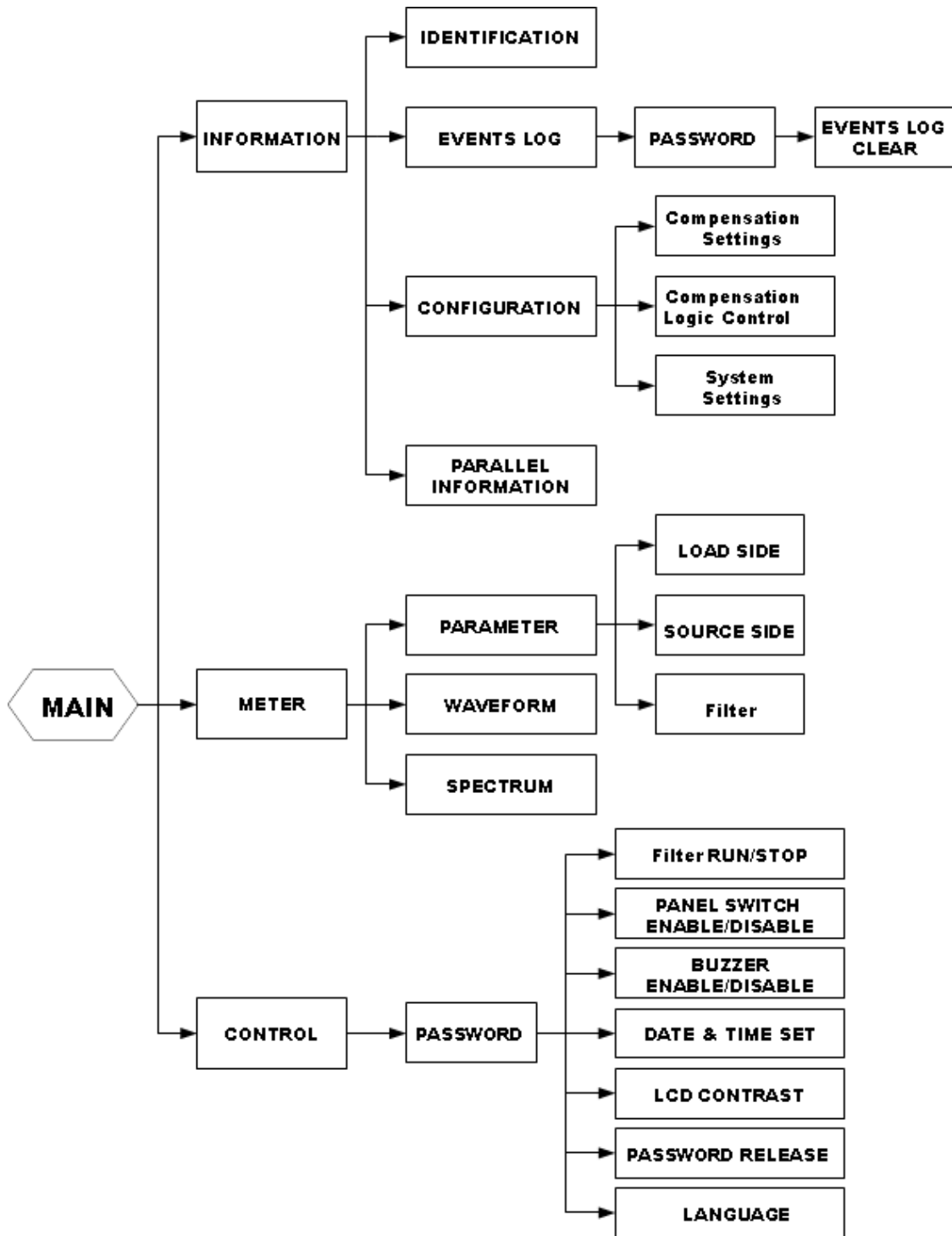
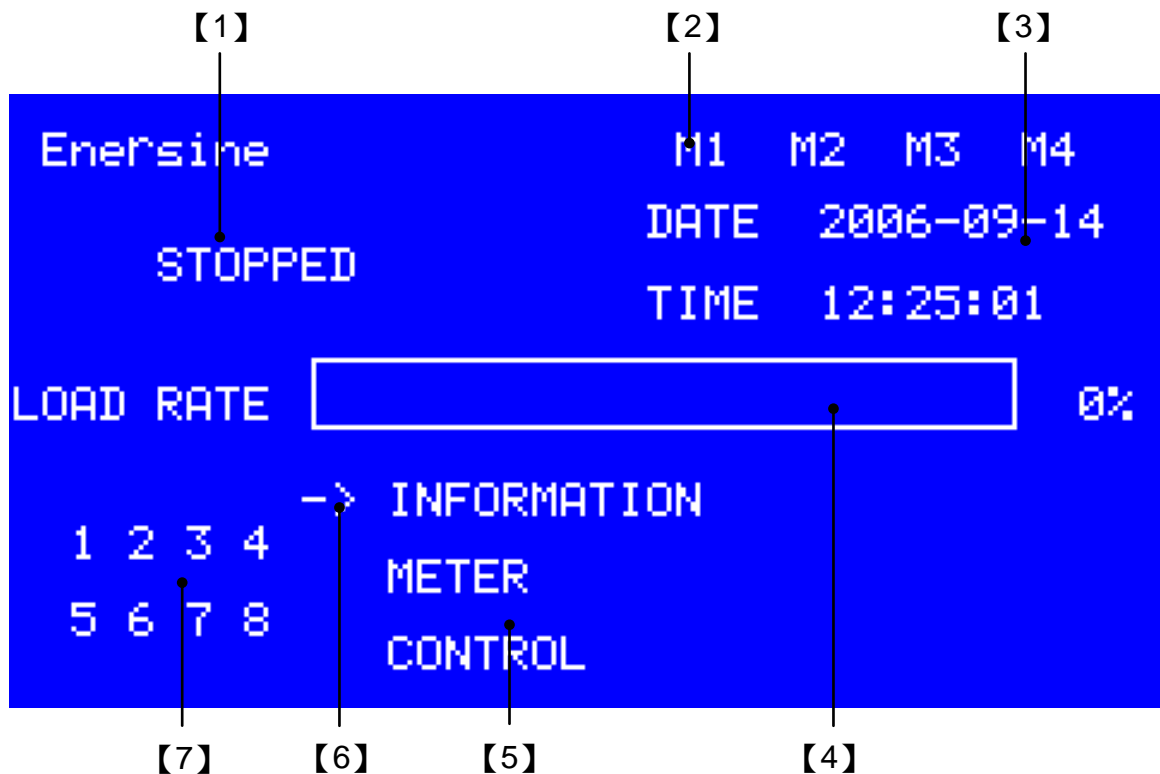


Figure 3-1 LCD Control Panel Functions, Block Diagram




3-1. Main Screen



- 【1】 The operation status of the filter
"RUNNING >>>>"
"STOPPED"
- 【2】 Power Module status
M1/M2/M3/M4 Displayed: Power Module is connected with the Control Module.
M1/M2/M3/M4 Blinking: Power Module is abnormal.
M1/M2/M3/M4 Hidden: Power Module is not connected.
- 【3】 Current date and time
- 【4】 Percentage of compensation capacity being used
- 【5】 Main Menu
- 【6】 Cursor : Use the ▼ ▲ keys to move the cursor.
- 【7】 Control Module Parallel Status
1/2/3/4/5/6/7/8 Displayed: The Control Module has communicated with the displayed Control Module.
1/2/3/4/5/6/7/8 Hidden: The Control Module whose number is hidden is disconnected.

3-2. INFORMATION

3-2-1. IDENTIFICATION

- 1) In the Main screen move the cursor to **INFORMATION** by using the   keys, and then press  to enter the **INFORMATION** page.

```

Enersine          M1 M2 M3 M4
                  DATE 2006-09-14
                  TIME 12:25:01
LOAD RATE  0%

1 2 3 4  -> INFORMATION
5 6 7 8  METER
          CONTROL
  
```

- 2) Move the cursor by using the   keys to **IDENTIFICATION**, and then press  to enter the **IDENTIFICATION** page.

```

INFORMATION

-> IDENTIFICATION
EVENTS LOG
CONFIGURATION
PARALLEL INFORMATION
  
```

- 3) You will see all factory data set in the filter.

```

IDENTIFICATION (1/2)
Model Number      :ESD34CR035400EC
Serial Number     :TD760030001
Rated Voltage     :400 V
Module Current    : 35 A
Rated Current     :120 A
Phase/Wire        :3 P 4 W
Frequency         :60 Hz
  
```

4) Use the   keys to change pages.

```
IDENTIFICATION (2/2)
CPU1 Controller Ver.      : 1.06
CPU2 Controller Ver.      : 1.10
LCD Panel Program Ver.    : 2.12
ID                          : 1
Number of Parallel Units  : 1
Parallel Number           : 1
```



Model Number:	Model Number of Control Module
Serial Number:	
Rated Voltage:	The voltage rating of this filter
Module Current:	Current rating of each Power Module
Rated Current:	Total current rating of this filter
Phase/Wire:	Power system (3P4W/3P3W) connected to the filter
Frequency:	System frequency (50/60 Hz)
CPU1 Controller Ver.:	main control board CPU1 program version
CPU2 Controller Ver.:	main control board CPU2 program version
LCD Panel Program Ver.:	LCD control panel program version
ID:	Identification number for remote monitoring control
Number of Parallel Units:	The number of Control Modules in parallel
Parallel Number:	The parallel number of this Control Module

3-2-2. EVENTS LOG

- 1) Move the cursor by using the   keys to **EVENTS LOG**, and then press  to enter the **EVENTS LOG** page.

```

INFORMATION
      IDENTIFICATION
->  EVENTS LOG
      CONFIGURATION
      PARALLEL INFORMATION
  
```

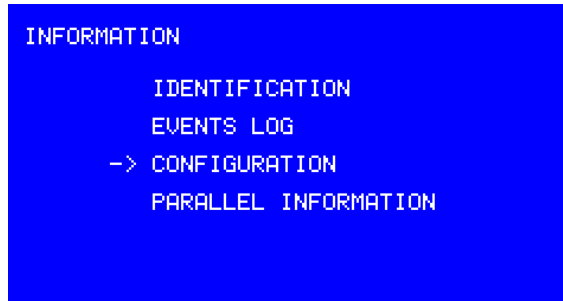
- 2) You will see the latest three events log records. You may browse other records by using the   keys. Each LCD control panel may record a maximum of 300 events log records. Old data is deleted to to make room for new in FIFO (first in, first out) order.

```

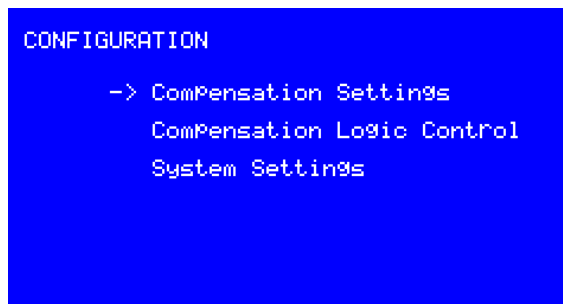
EVENTS LOG
300  2006-01-17 15:21:06  CODE:A03701
      Power Supply Error      YES
299  2006-01-13 15:14:09  CODE:A03501
      Control Board EEPROM Error YES
298  2006-01-11 15:01:02  CODE:A01401
      DC Bus Under Voltage    YES
  
```

3-2-3. CONFIGURATION

- 1) Move the cursor to **CONFIGURATION** by using the   keys, and then press  to enter the **CONFIGURATION** page.



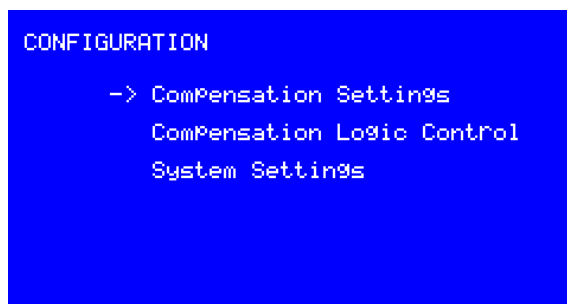
- 2) The **CONFIGURATION** page offers three options.



This information is not configurable. If you need to change any setting you must consult your local authorized service agent.

3-2-3-1. Compensation Settings

- 1) Move the cursor to **Compensation Settings** by using the   keys, and then press  to enter the **Compensation Settings** page.



2) Compensation Settings Details:

Harmonic Compensation	Shows whether Harmonic Compensation is enabled or disabled.
Power Factor Correction	Shows whether Power Factor Correction is enabled or disabled.
Compensation Priority	Shows which setting has priority, Harmonic Compensation or Power Factor Correction.
Reactive Power	Shows whether the reactive power compensation mode is Target DPF or Fixed KVAR when Power Factor Correction is enabled.
Target DPF (cosΦ)	Shows the Target DPF setting.
Fixed KVAR	Shows the Fixed KVAR setting.
Balance Utility	When 3-Phase current of the load is unbalanced and Balance Utility is enabled the filter will compensate the system current to balance.
High-Order Compensation	The filter will compensate from the 31 st to 51 st harmonic orders when this is enabled.
Application Mode	The filter computes several control parameters for different load types to obtain the best performance. 0 For single-phase rectifier 1 For 3P3W, 6-pulse rectifier 2 For 3P3W, 6-pulse and single-phase rectifiers 3 For 3P3W, 6-pulse rectifier with even-order harmonic 4 For single-phase rectifier with even-order harmonic 5, 6 For all load types (default)
Harmonic Selection	Shows information about selected harmonic orders.

Compensation Settings (1/2)	
Harmonic Compensation	ENABLED
Power Factor Correction	ENABLED
Compensation Priority	PFC
Reactive Power	Dynamic
Target DPF (cosΦ)	± 0.95
Balance Utility	DISABLED

Compensation Settings (1/2)	
Harmonic Compensation	ENABLED
Power Factor Correction	ENABLED
Compensation Priority	PFC
Reactive Power	Fixed
Fixed KVAR	± 12.1
Balance Utility	DISABLED

- 3) Scroll to the next page of the **Compensation Settings** by using the  key. You will see **High-Order Compensation**, **Application Mode**, and **Harmonic Selection**.

```

Compensation Settings (2/2)
  High-Order Compensation  DISABLED
  Application Mode         5
-> Harmonic Selection
  
```

- 4) The first page of **Harmonic Selection** shows the status of 2nd-order to 13th-order harmonics. Use the   keys to scroll through the pages.

```

Harmonic Selection (1/3)
Ord. Sel. Act. Red. Ord. Sel. Act. Red.
2nd           100% 3rd  ✓    ✓   100%
4th           100% 5th  ✓    ✓   100%
6th           100% 7th  ✓    ✓   100%
8th           100% 9th  ✓    ✓   100%
10th          100% 11th ✓    ✓   100%
12th          100% 13th ✓    ✓   100%
  
```

Ord.: Harmonic order

Sel.: The selected harmonic order

Act.: The active harmonic order

Red.: The reduction ratio for the specific order

- 5) The second page shows the status of 14th-order to 25th-order harmonics, and the third page shows the status of 26th-order to 31st-order harmonics.




```

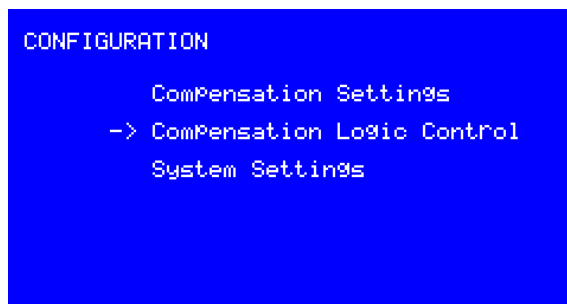
Harmonic Selection (2/3)
Ord. Sel. Act. Red. Ord. Sel. Act. Red.
14th           100% 15th  ✓    ✓   100%
16th           100% 17th  ✓    ✓   100%
18th           100% 19th  ✓    ✓   100%
20th           100% 21st           100%
22th           100% 23th           100%
24th           100% 25th           100%
  
```

```

Harmonic Selection (3/3)
Ord. Sel. Act. Red. Ord. Sel. Act. Red.
26th           100% 27th           100%
28th           100% 29th           100%
30th           100% 31st           100%
  
```

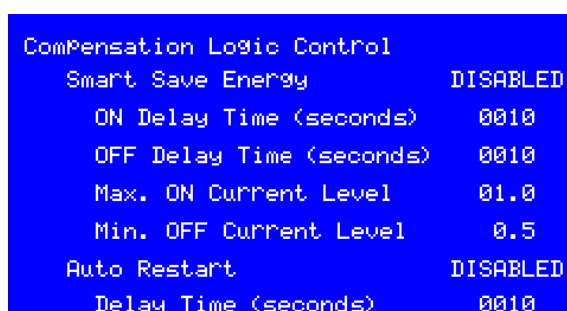
3-2-3-2. Compensation Logic Control

- 1) Move the cursor to **Compensation Logic Control** by using the   keys, and then press  to enter the **Compensation Logic Control** page.



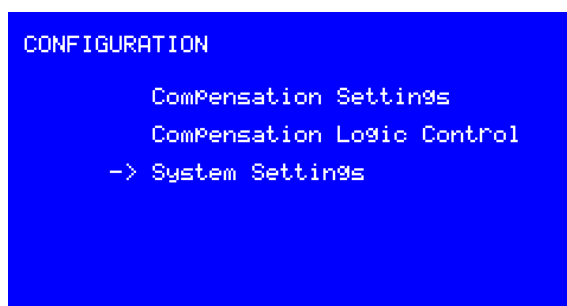
- 2) **Compensation Logic Control** details:

Smart Save Energy	Smart Save Energy	When this function is enabled the filter will start up and shut down automatically according to the load current level. When the load current is less than Min. OFF Current Level for OFF Delay Time the filter will shut down automatically until the load current is greater than Max. ON Current Level for ON Delay Time .
	ON Delay Time	The delay time for automatic start-up
	OFF Delay Time	The delay time for automatic shutdown
	Max. ON Current Level	The current level for automatic start-up
	Min. OFF Current Level	The current level for automatic shutdown
Auto Restart	Auto Restart	When this function is enabled the filter is allowed to automatically restart when some abnormal conditions return to normal. Such abnormal conditions include system voltage abnormal, frequency error, etc.
	Delay Time	The delay time for automatic restart



3-2-3-3. System Settings



- 1) Move the cursor to **System Settings** by using the   keys, and then press  to enter the **System Settings** page.



- 2) **System Settings** details:




Phase/Wire	Select 3P3W or 3P4W according to the power system that the filter is connected to. If the system is 3P3W then the neutral line does not need to be connected.
Number of External CTs	Select 2 or 3 as the number of external CTs that are installed on the Source/Load side. If the system is 3P4W then 3 CTs are needed.
Primary Amperage of CTs	Set the primary current rating of the External CTs.
Secondary Amperage of CTs	Set the secondary current rating of the External CTs. The Control Module can accept 1A and 5A ratings. 1A is standard. If 5A CTs will be used then the optional PCB APKT2 is needed.
CT Position	Select the location where External CTs are installed.
CT Direction Detection	When this function is enabled the filter will diagnose the polarity of External CTs. When the polarity is incorrect the filter will alarm and cannot be started up.
Phase A CT	When the polarity of an External CT is incorrect, reversing the CT's polarity here eliminates the need to reconnect the CT wires.
Phase B CT	
Phase C CT	
Parallel CT Ratio	Available Parallel CT ratios are 500:1, 1000:1, 1500:1, and 2000:1. When Control Modules operate in parallel a Parallel CT Ratio must be chosen.
Primary Voltage Level	The filter allows you to apply different voltage levels from an external transformer installed at the input side of the filter. When an external transformer is used the voltage level should be set to the primary voltage of the transformer.

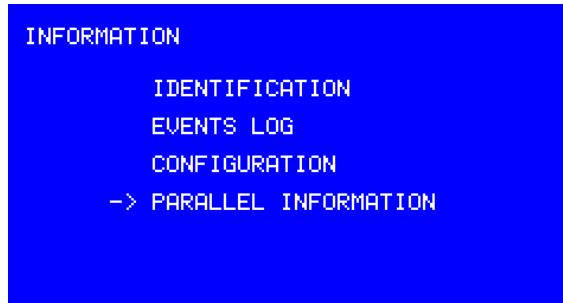
System Settings (1/2)	
Phase/Wire	3P4W
Number of External CTs	3 CTs
Primary AmPerage of CTs	01000
Secondary AmPerage of CTs	1
CT Position	Load

3) Use the   keys to change pages.

System Setting (2/2)	
CT Direction Detection	DISABLED
Phase A CT	Normal
Phase B CT	Normal
Phase C CT	Normal
Parallel CT Ratio	500/1
Primary Voltage Level	0400

3-2-4. PARALLEL INFORMATION

- 1) Move the cursor to **PARALLEL INFORMATION** by using the   keys, and then press  to enter the **PARALLEL INFORMATION** page.



- 2) You will see the following information.

PARALLEL INFORMATION				
Num.	1	2	3	4
State	RUN	STOP	STOP	STOP
Amp.	120	120	60	90
Num.	5	6	7	8
State	STOP	RUN	STOP	STOP
Amp.	90	120	35	60




Num.: The number of the parallel Control Module

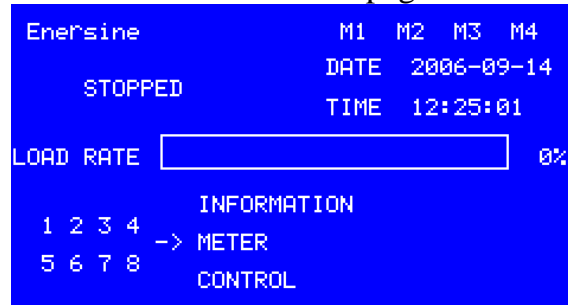
State: The state of the filter




Amp.: The current rating of the filter

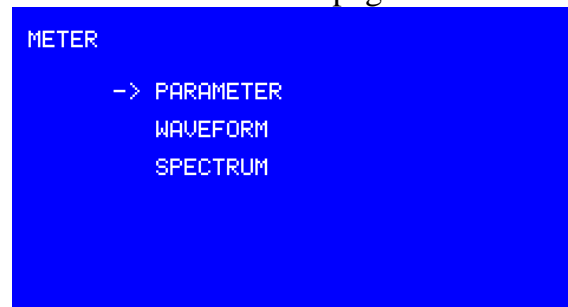
3-3. METER

3-3-1. PARAMETER

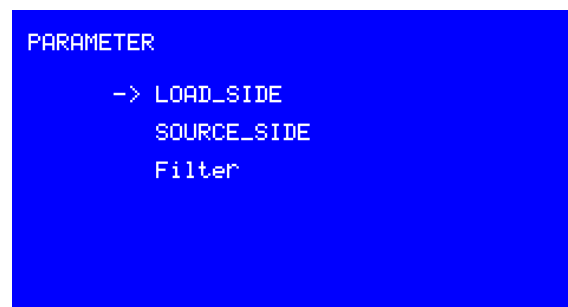
- 1) On the **Main** screen move the cursor to **METER** by using the   keys, and then press  to enter the **METER** page.



- 2) Move the cursor to **PARAMETER** by using the   keys and then press  to enter the **PARAMETER** page.



- 3) The three options below will appear.



- LOAD_SIDE:** Shows the power parameters of the load.
SOURCE_SIDE: Shows the power parameters of the source.
Filter: Shows the power parameters of the filter.

4) **LOAD_SIDE** and **SOURCE_SIDE** show the following parameters.




```
LOAD_SIDE
KVA = 89.3 Freq= 60.1Hz PF = 0.76
Uab = 401 V Ubc = 400 V Uca = 403 V
THDv= 1.3% THDv= 1.6% THDv= 1.8%
Ia = 128 A Ib = 125 A Ic = 128 A
THDi= 82.1% THDi= 84.2% THDi= 81.7%
In = 216 A
```

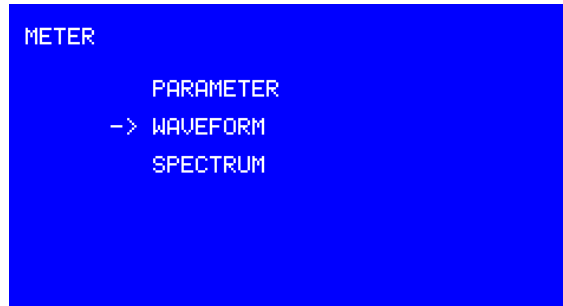
5) The **Filter** page shows the following parameters.





```
Filter
KVA = 53.5 Freq= 60.1Hz
Uab = 401 V Ubc = 400 V Uca = 403 V
THDv= 1.3% THDv= 1.6% THDv= 1.8%
Ia = 102 A Ib = 100 A Ic = 103 A
In = 206 A
```

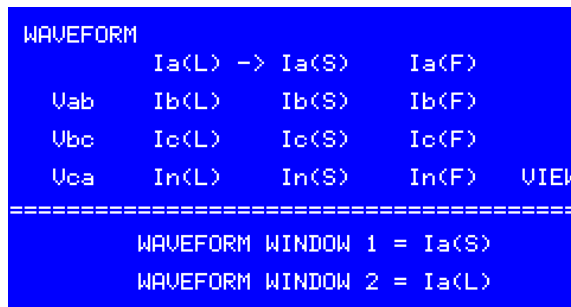
KVA:	Complex power
Freq:	System frequency
PF:	Power Factor
Vab, Vbc, Vca:	Three-phase line-to-line rms voltage
Ia, Ib, Ic:	Three-phase line rms current
In:	Neutral line rms current
THDv:	Total harmonic voltage distortion
THDi:	Total harmonic current distortion

3-3-2. WAVEFORM


- 1) Move the cursor to **WAVEFORM** by using the   keys, and then press  to enter the **WAVEFORM** page.

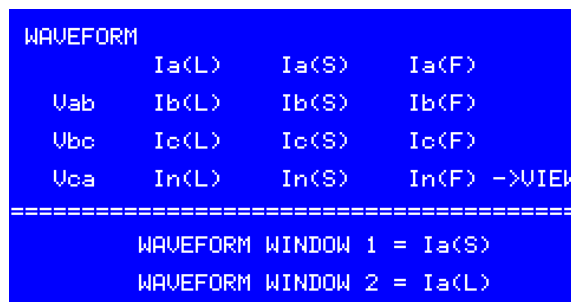




- 2) In the **WAVEFORM** page use the     keys to move the cursor to the parameter for which you wish to view the waveform. You can choose up to two parameters for viewing. The waveforms will be displayed in “**WAVEFORM WINDOW 1**” and “**WAVEFORM WINDOW 2**”.

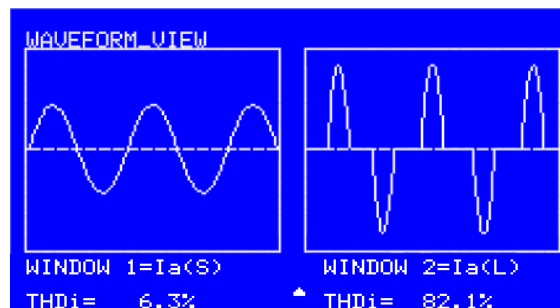
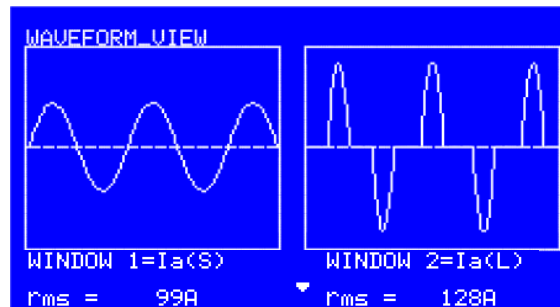


Vab, Vbc, Vca: Three-phase line-to-line voltage
 Ia(L), Ib(L), Ic(L): Three-phase line current of load side
 Ia(S), Ib(S), Ic(S): Three-phase line current of source side
 Ia(F), Ib(F), Ic(F): Three-phase line current of filter side
 In(L): Neutral line current of load side
 In(S): Neutral line current of source side
 In(F): Neutral line current of filter side




- 3) Once you have selected the desired parameter move the cursor to **VIEW**, and then press  .

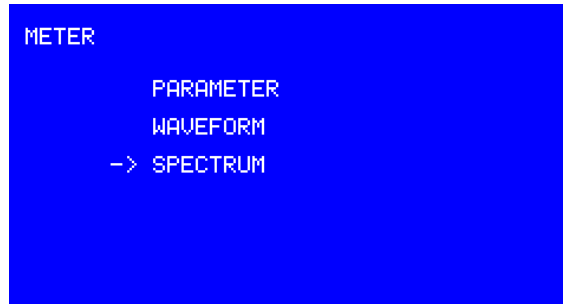







- 4) You will see the two waveforms you selected in one screen simultaneously.
Use the   keys to display rms or THD of the waveforms.

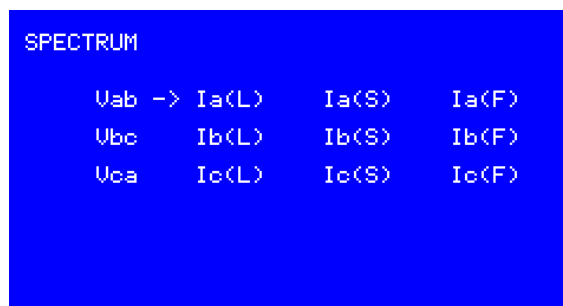


3-3-3. SEPCTRUM





- 1) Move the cursor to **SPECTRUM** by using the   keys, and then press  to enter the **SPECTRUM** page.

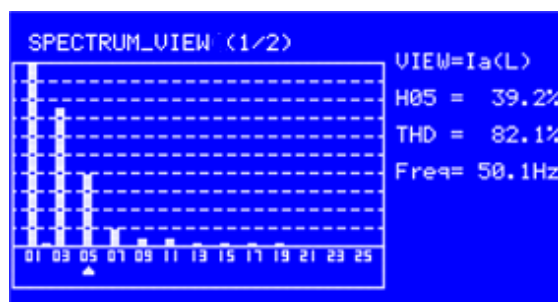


- 2) In the **SPECTRUM** page use the     keys to move the cursor to the parameter for which you wish to view the spectrum, and then press  to view the spectrum.



Vab, Vbc, Vca: Three-phase line-to-line voltage
 Ia(L), Ib(L), Ic(L): Three-phase line current of load side
 Ia(S), Ib(S), Ic(S): Three-phase line current of source side
 Ia(F), Ib(F), Ic(F): Three-phase line current of filter side

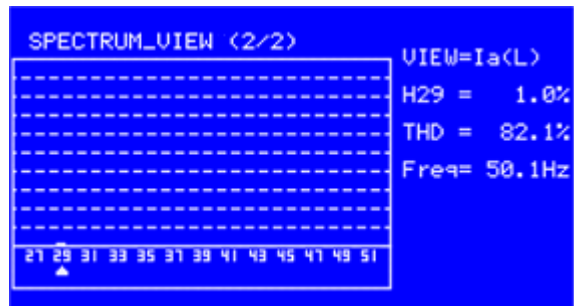
- 3) Page 1 shows the spectrum from the 1st to 26th order. Use the   keys to move the cursor to the harmonic order you wish to view. Use the   keys to change to another page.



Hxx : The harmonic distortion for a specific harmonic order
THD: Total harmonic distortion




Freq : System frequency

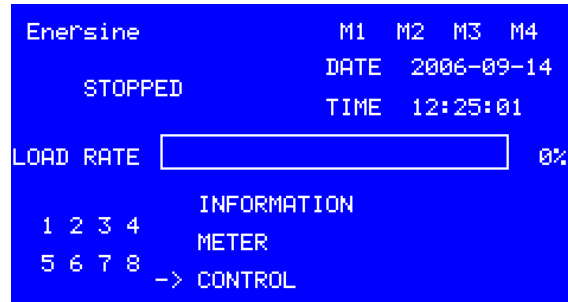
4) Page 2 shows the spectrum from the 27th to 51st order.








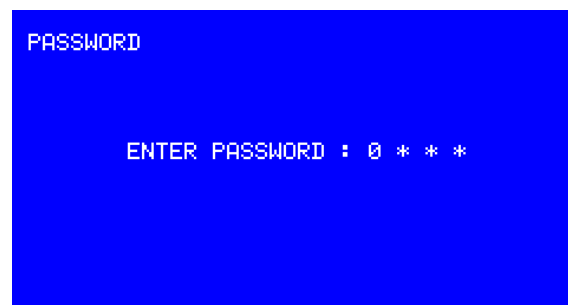
3-4. CONTROL

3-4-1. Getting to the CONTROL Menu

- 1) In the **Main** screen move the cursor to **CONTROL** by using the   keys, and press  to enter the **CONTROL** page.






- 2) The system will ask for the password before displaying the **CONTROL** page. To enter the password use the   keys to select from 0-9 for each digit, and use the   keys to move from the 1st digit to 4th digit. Press  to enter the password. Once the password is confirmed by the system the **CONTROL** page will be displayed. The default password is "0000". The user can change the password. Please refer to section 3-4-7 to change the password.

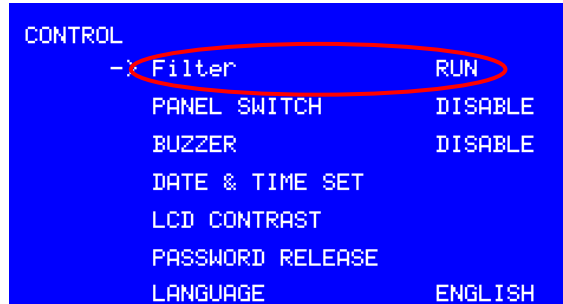


- 3) The **CONTROL** page offers seven functions as shown below:



3-4-2. Filter RUN/STOP





- 1) The **Filter** function provides a command to start up or shut down the filter. Move the cursor to **Filter** by using the   keys, and then press  to send the start-up or shutdown command to the filter.



Filter RUN is the start-up command.

Filter STOP is the shutdown command.





When the filter is filtering, **Filter STOP** is displayed. Otherwise **Filter RUN** is displayed.

- 2) Press  to send a start-up command. A confirmation screen will be displayed as below. Use the   keys to move the cursor to "YES", and then press  to start up the filter.






- 3) When the filter is on, the "**FILTERING**" LED indicator on the control panel will be lit up, and **Filter RUN** will change to **Filter STOP**.

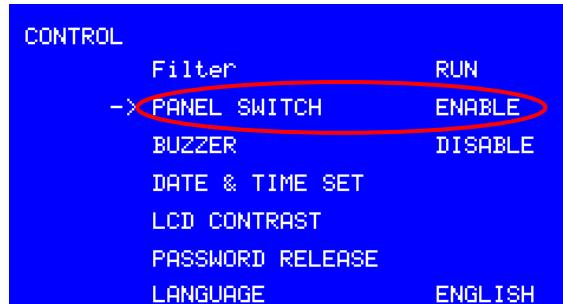
CONTROL		
->	Filter	STOP
	PANEL SWITCH	DISABLE
	BUZZER	DISABLE
	DATE & TIME SET	
	LCD CONTRAST	
	PASSWORD RELEASE	
	LANGUAGE	ENGLISH

- 4) Press  to send a shutdown command. A confirmation screen will be displayed as below. Use the   keys to move the cursor to “YES”, and press  to shut down the filter.



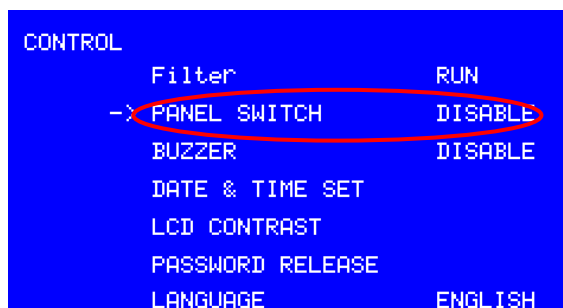
3-4-3. PANEL SWITCH ENABLE/DISABLE

- 1) The **PANEL SWITCH** command enables/disables the ON/OFF keypad on the control panel. Use the   keys to move the cursor to **PANEL SWITCH**, and then press  to enable/disable the ON/OFF keypad.






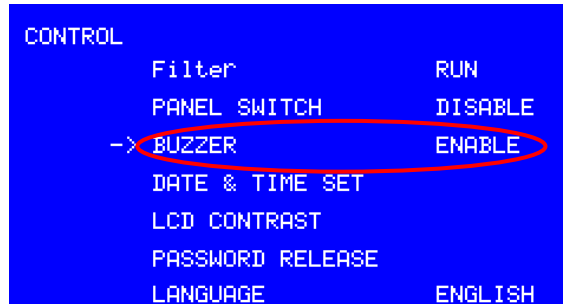
PANEL SWITCH ENABLE is the command to enable the ON/OFF keypad.
PANEL SWITCH DISABLE is the command to disable the ON/OFF keypad.

- 2) When **PANEL SWITCH DISABLE** is displayed, it means the ON/OFF keypad is functional and the user can start up or shut down the filter by using the ON/OFF keypad. On the other hand, when **PANEL SWITCH ENABLE** is displayed, the ON/OFF keypad is nonfunctional.



3-4-4. BUZZER ENABLE/DISABLE

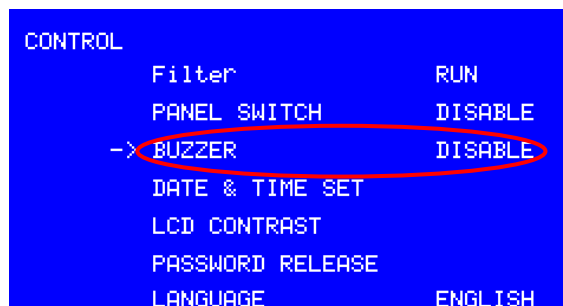
- 1) The **BUZZER** command enables/disables the buzzer. Use the   keys to move the cursor to **BUZZER**, and then press  to enable/disable the buzzer.






BUZZER ENABLE is the command to enable the buzzer.

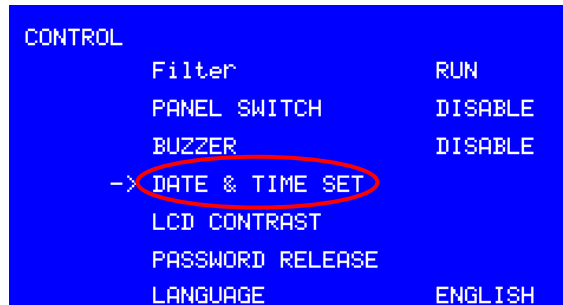
BUZZER DISABLE is the command to disable the buzzer.






- 2) When **BUZZER DISABLE** is displayed, it means the buzzer will sound if an abnormal condition occurs. On the other hand, when **BUZZER ENABLE** is displayed, the buzzer will be silent.

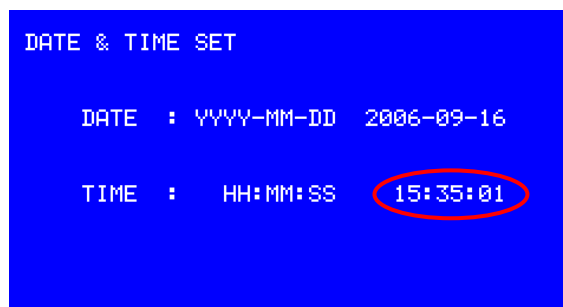


3-4-5. DATE & TIME SET

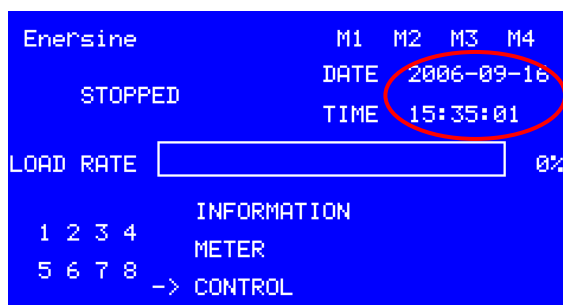
- 1) Use the   keys to move the cursor to **DATE & TIME SET**, and then press  to set the current date and time.



- 2) In the **DATE & TIME SET** page use the   keys to move the cursor to the desired field, and then use the   keys to change to the desired date and time. Press  to save the final setting.






- 3) Now the date and time have been changed.



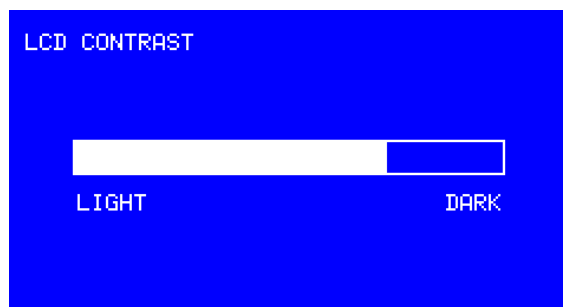
Note: The current date and time will be lost and reset to the initial conditions (2000-00-00 00:00:00) when the filter is disconnected from the power utility for 168 hours (7 days). This change will not affect the stored parameters in the control panel.

3-4-6. LCD CONTRAST




- 1) Use the   keys to move the cursor to **LCD CONTRAST**, and then press  to adjust the contrast of the LCD display.

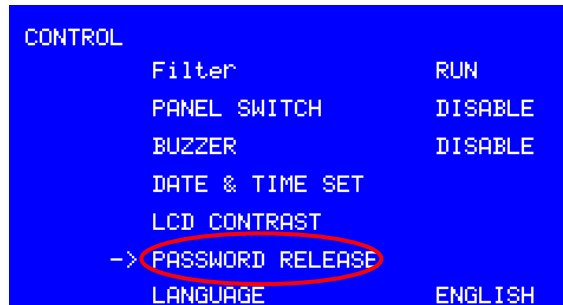







- 2) Use the   keys to adjust the contrast.

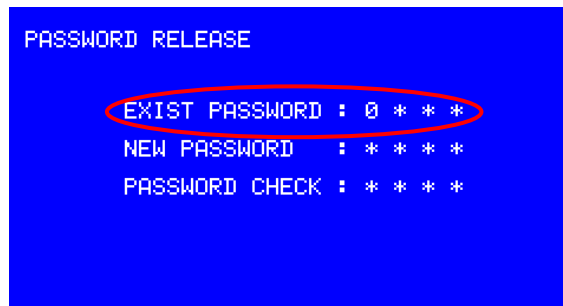



3-4-7. PASSWORD RELEASE

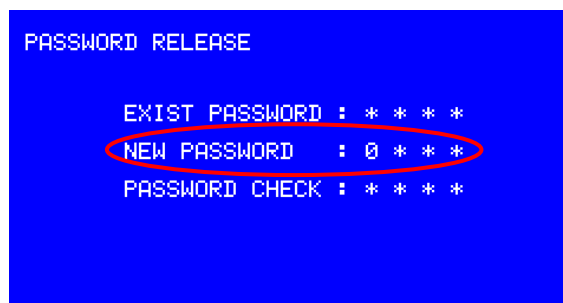
- 1) Use the   keys to move the cursor to **PASSWORD RELEASE**, and then press  to change the password.



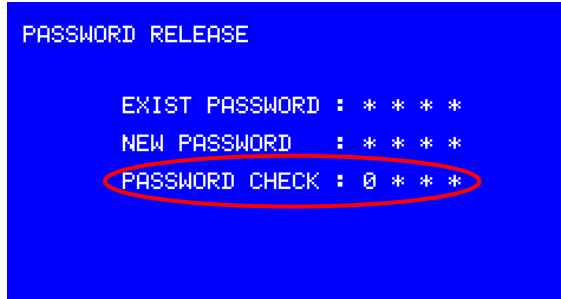
- 2) First enter the existing password. Use the   keys to select from 0-9 for each digit, and the   keys to move from the 1st digit to the 4th digit. Use  to enter the password.



- 3) Second, enter the new password, and then press  .



- 4) Third, enter the new password again, and then press  .

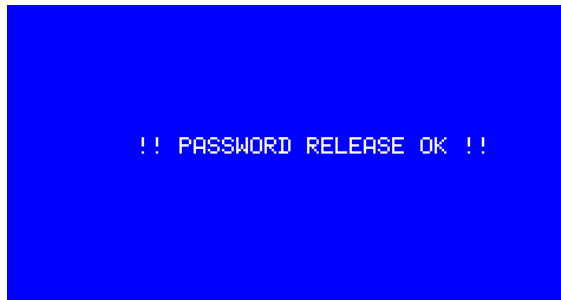


```

PASSWORD RELEASE

EXIST PASSWORD : * * * *
NEW PASSWORD   : * * * *
PASSWORD CHECK : 0 * * *
```

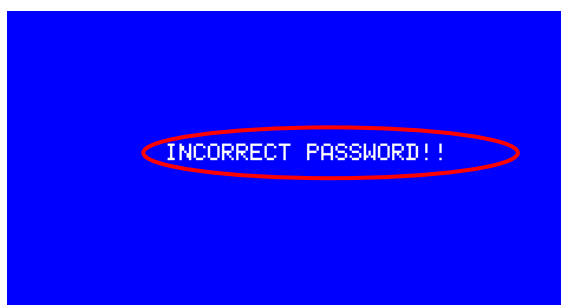
- 5) Now the password has been changed.



```

!! PASSWORD RELEASE OK !!
```




- 6) If the password is incorrect a warning will appear on the screen. Please follow the procedure in this section to change the password again.

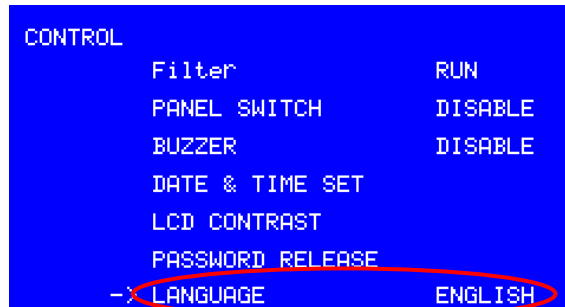


```

INCORRECT PASSWORD!!
```

3-4-8. LANGUAGE

- 1) Use the   keys to move the cursor to **LANGUAGE**, and then press  to change the language that is used by the LCD display.



4. Installation and Wiring

4-1. Installation Environment

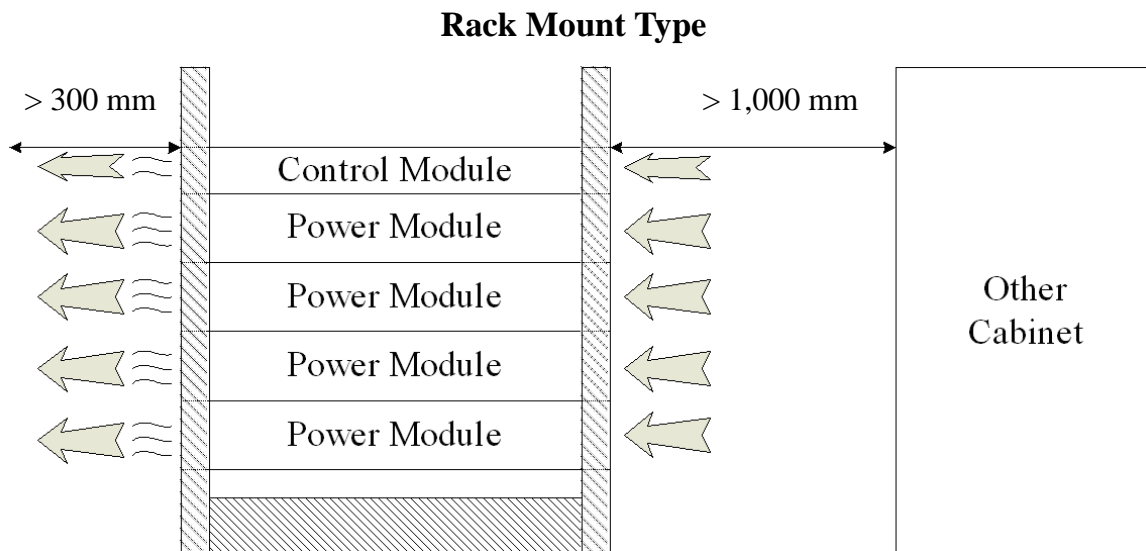
1. Because the **Enersine ESD34** is an electronic control device, its installation environment can affect its operational reliability and lifetime. The filter is equipped with cooling fans to reduce the heat generated during operation. Therefore, do not block the ventilation openings during installation.
2. Do not install the filter in an environment which is overly dusty, hot, humid, corrosive, or vibrating. It is strongly recommended that you install the filter in a clean and dust-free room with controlled temperature at 15-25 °C.

4-2. General Requirement for Ventilation and Maintenance

4-2-1. Rack Mount Type

During installation ensure that the following conditions are met.

3. Keep at least 300 mm of free space around the filter to make sure the air flow around the filter is not blocked, as illustrated below.
4. Make sure that a cooling fan is installed in the top of the rack cabinet to expel the heat generated by the filter itself.
5. Keep at least 1,000 mm of free space in front of the filter for future maintenance purposes.

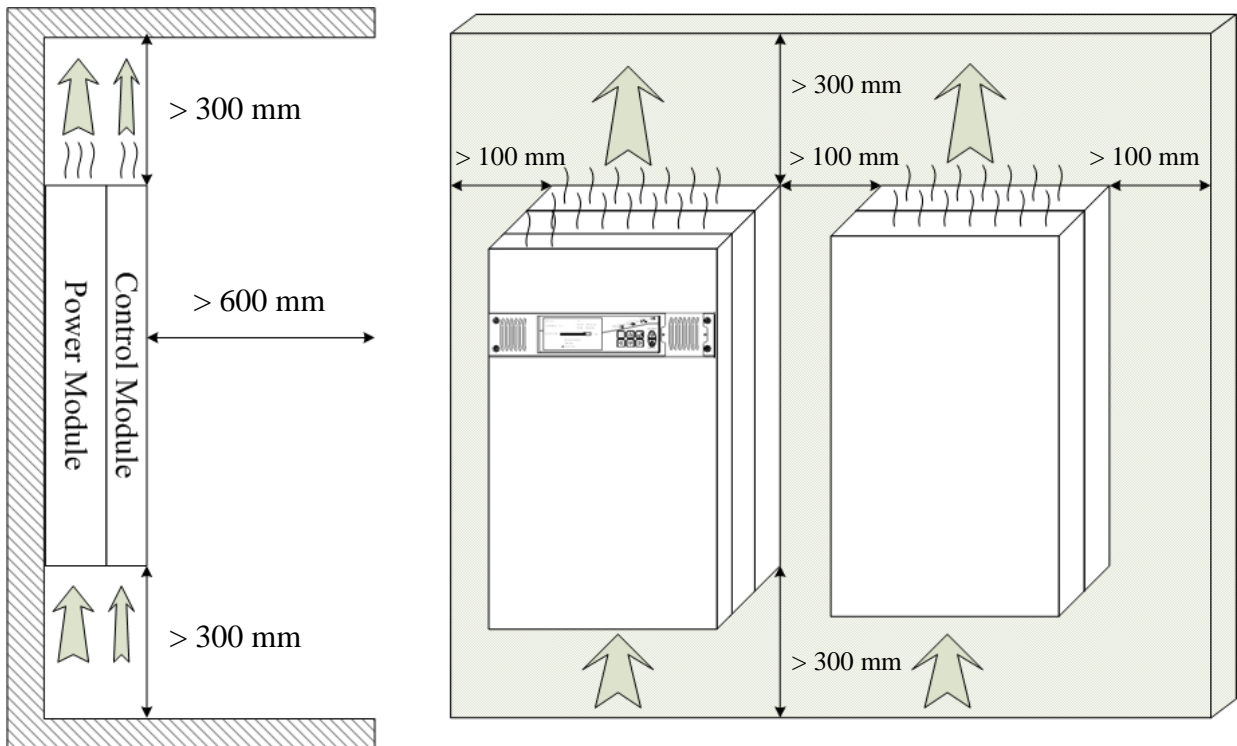


4-2-2. Wall Mount Type

During installation ensure that the following conditions are met.

1. Keep at least 300 mm of air-flow space around both the top and bottom of the filter, and do not block the air flow around the filter.
2. Keep at least 600 mm of free space in front of the filter for future maintenance purposes.
3. The space between two filters must be at least 100 mm.

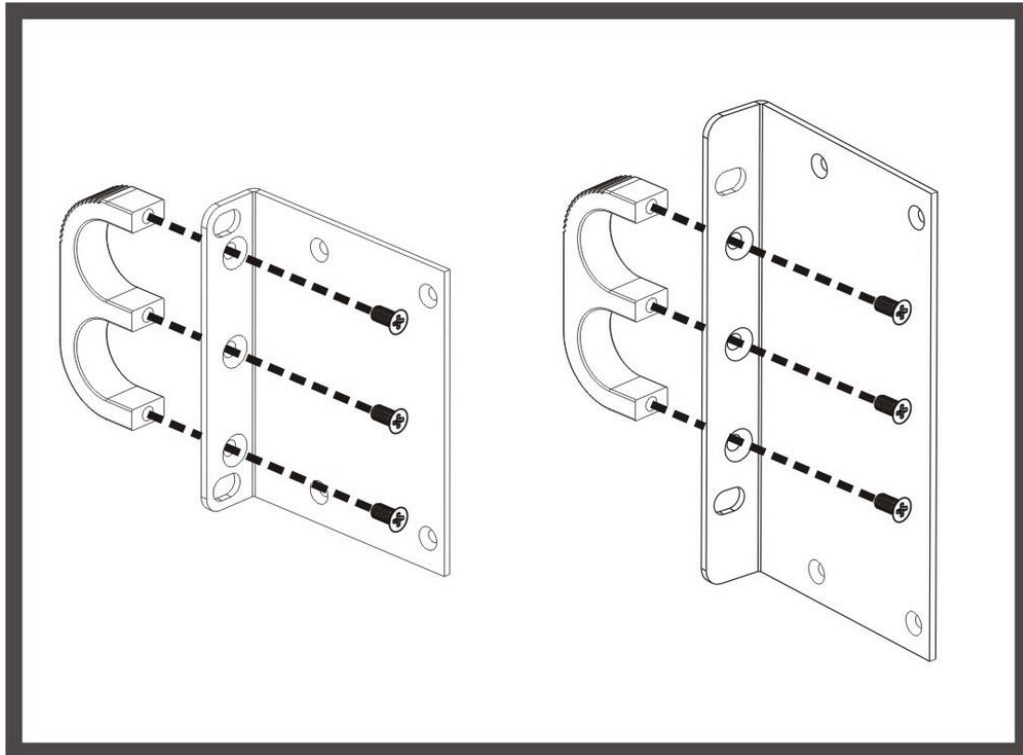
Wall Mount Type



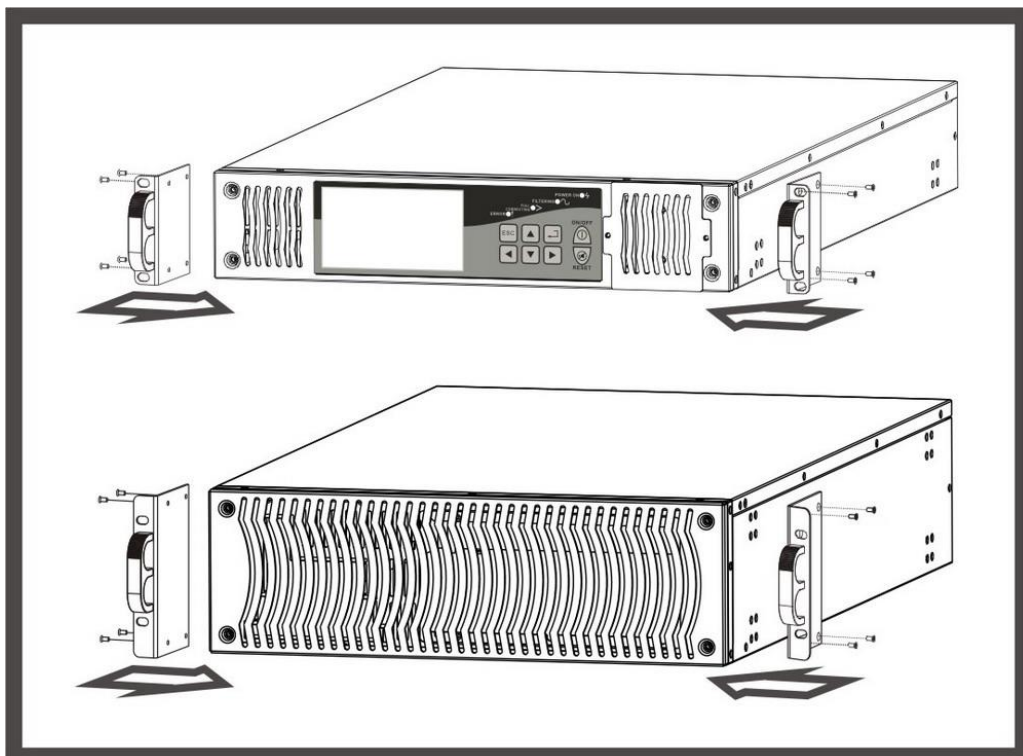
4-3. Installation

4-3-1. Rack Mount Installation

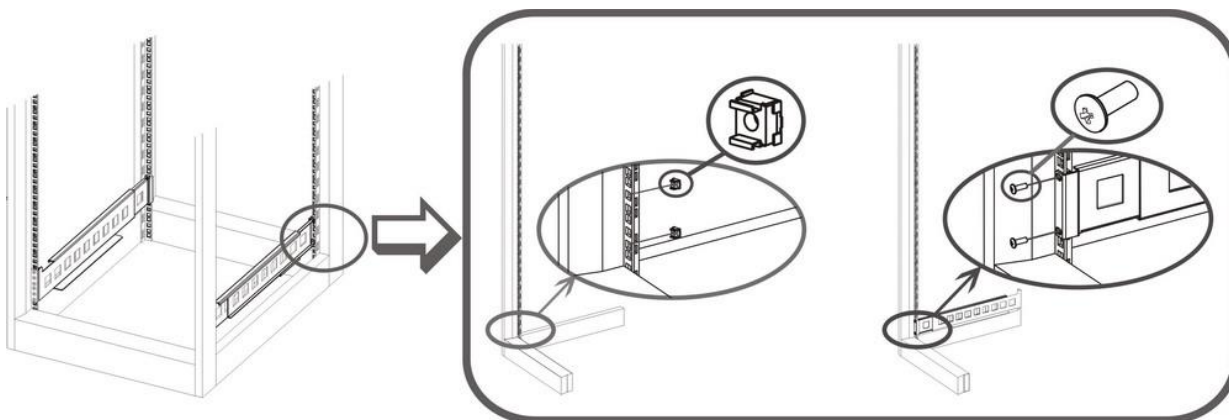
Step 1:



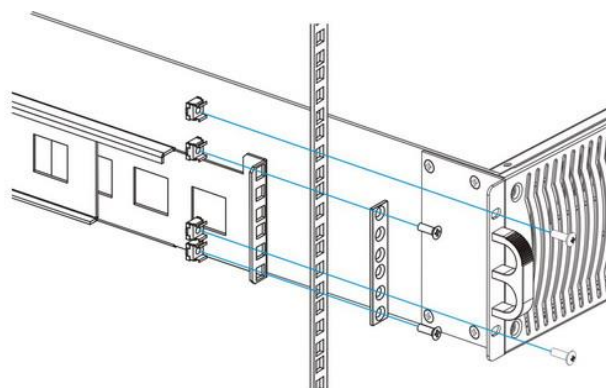
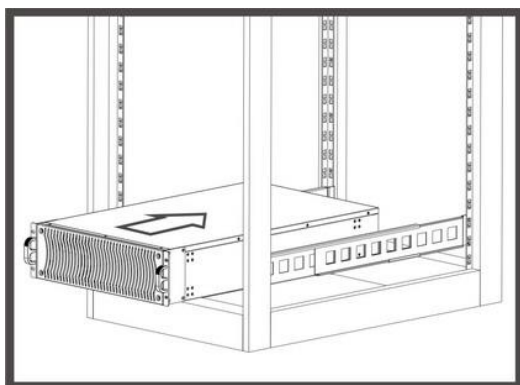
Step 2:



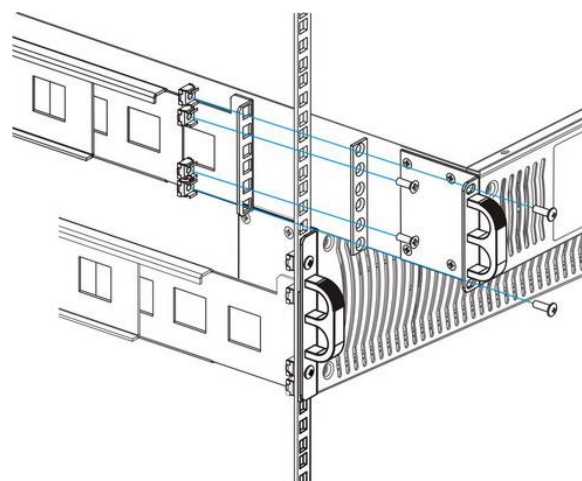
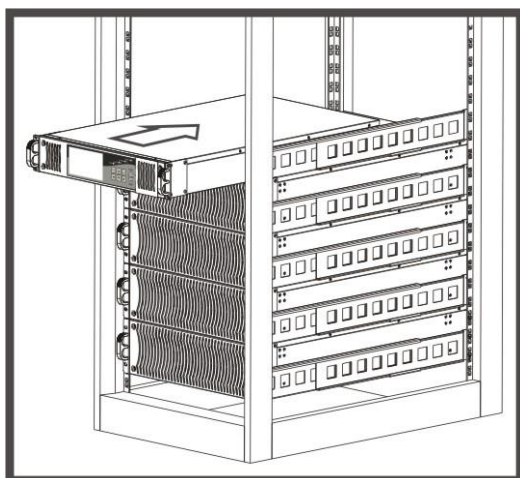
Step 3:



Step 4:



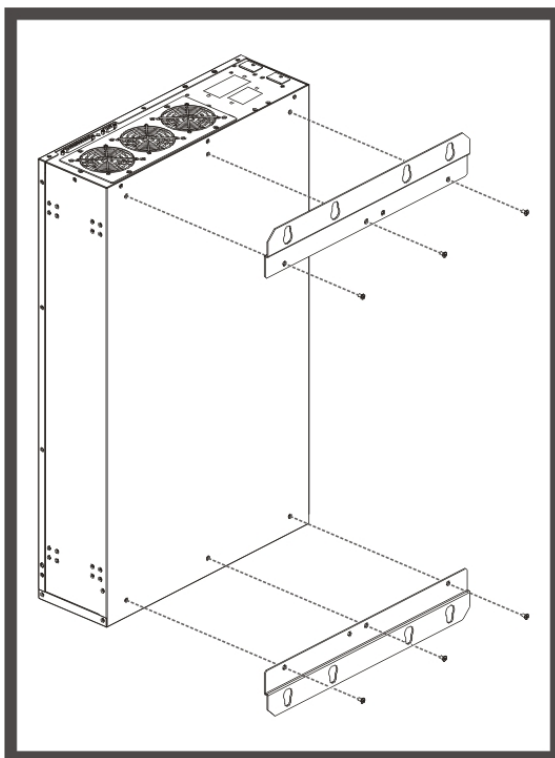
Step 5:



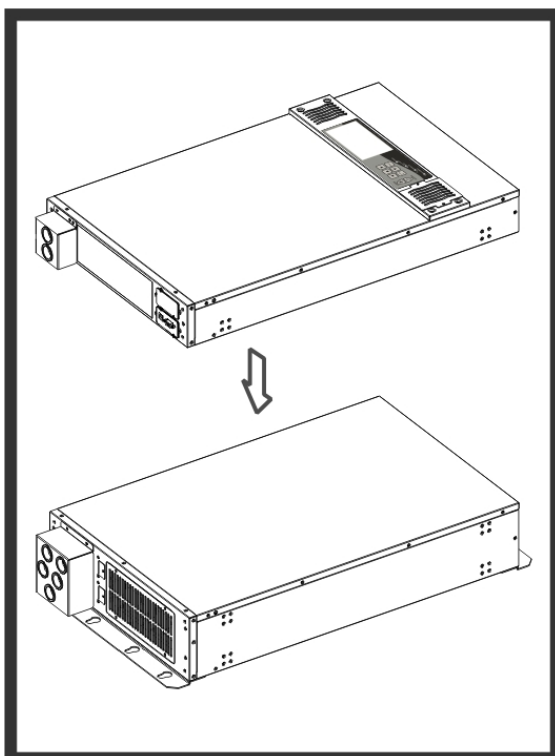
4-3-2. Wall Mount Installation

4-3-2-1. For One Control Module and One Power Module

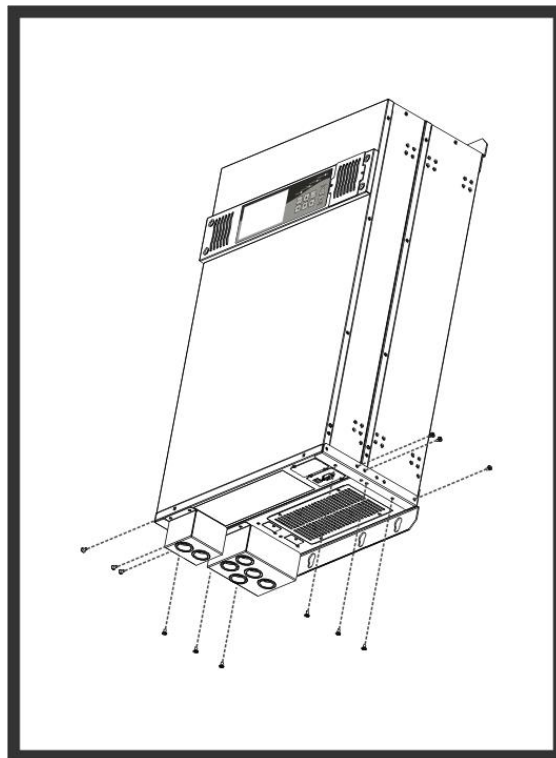
Step 1:



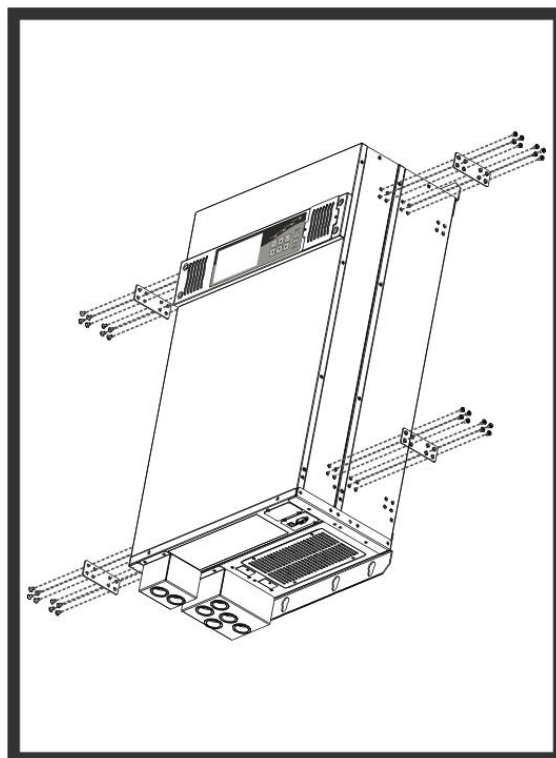
Step 2:



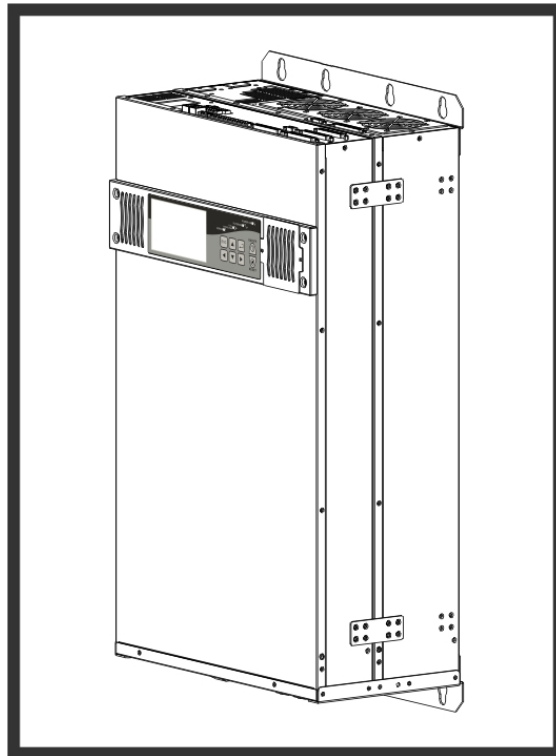
Step 3:



Step 4:

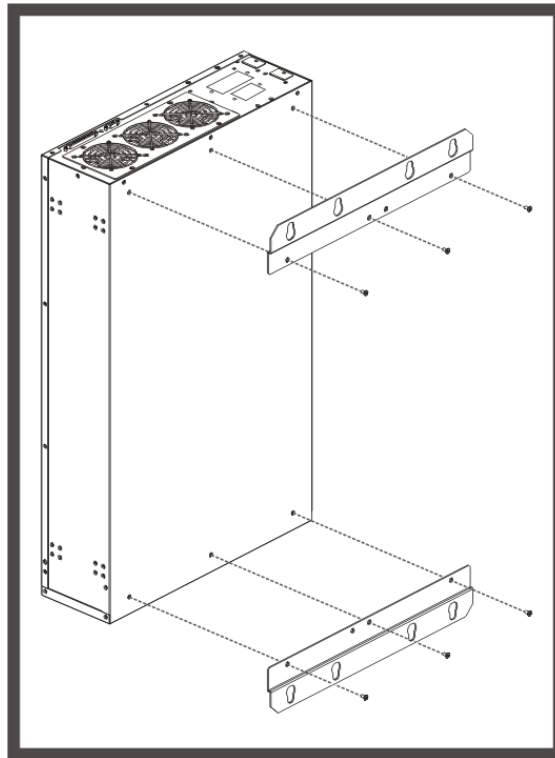


Step 5:

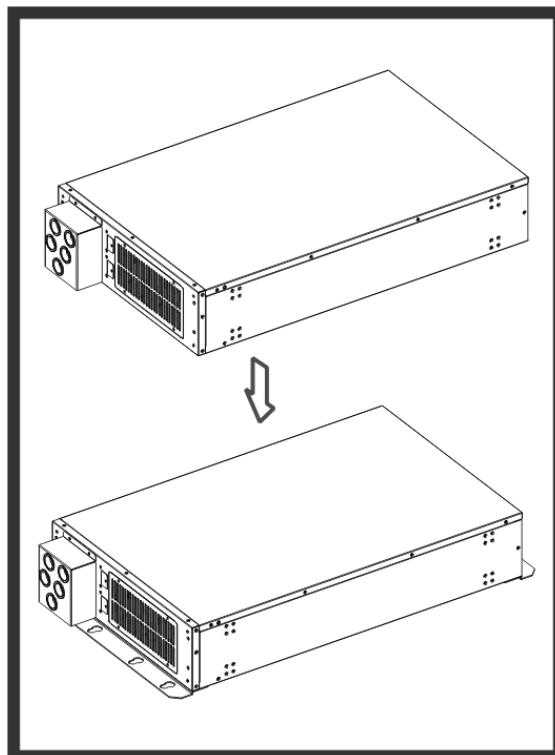


4-3-2-2. For two Power Modules

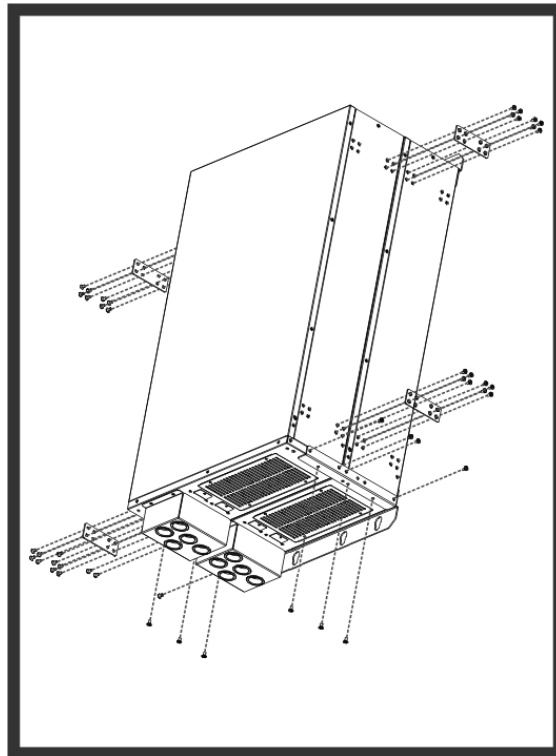
Step 1:



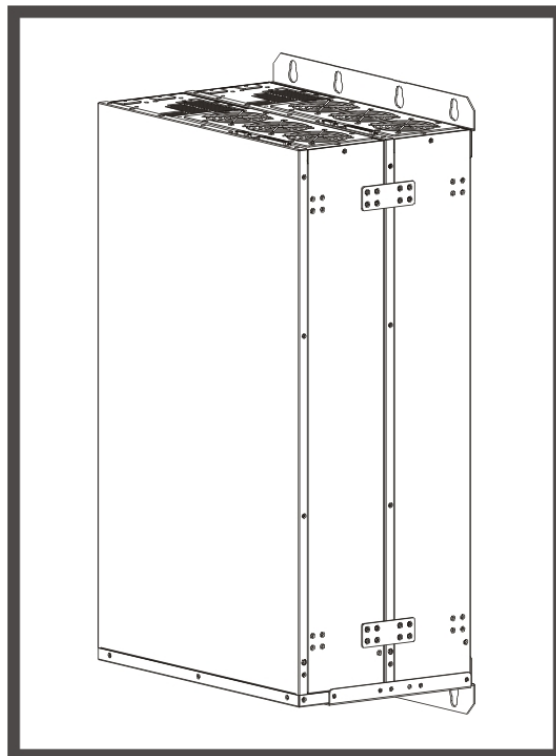
Step 2:



Step 3:



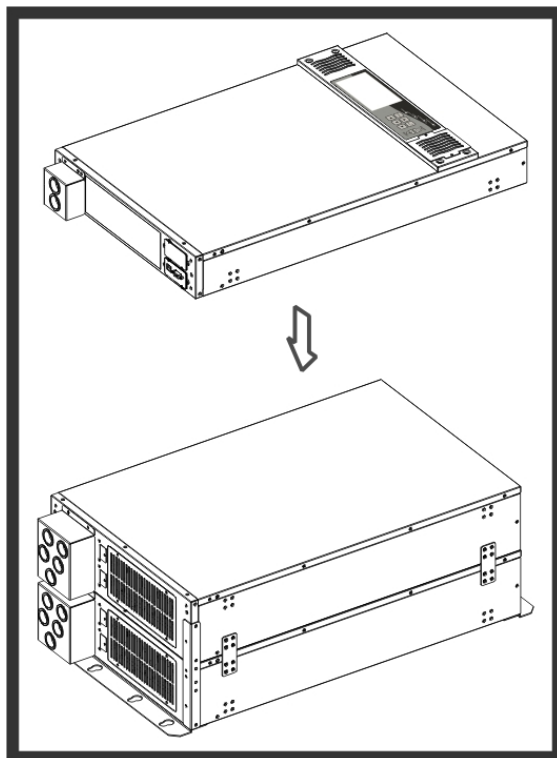
Step 4:



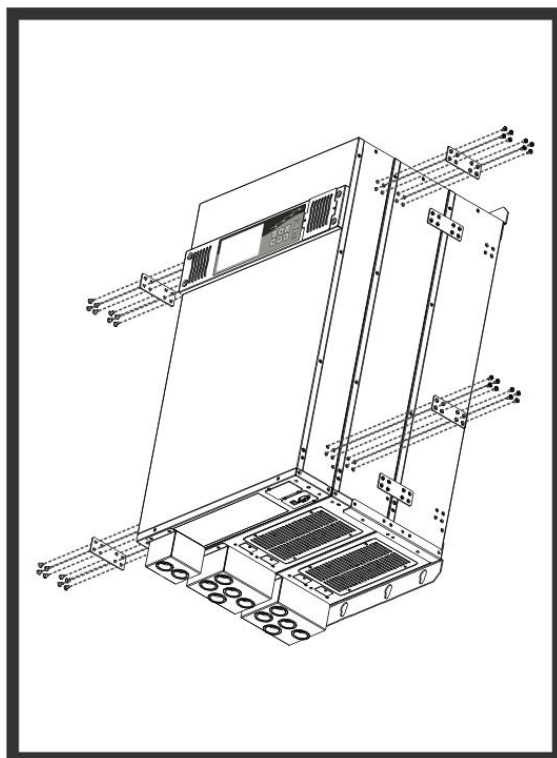
4-3-2-3. For one Control Module and two Power Modules

Steps 1 to 3: same as 4-3-2-2 For two Power Modules

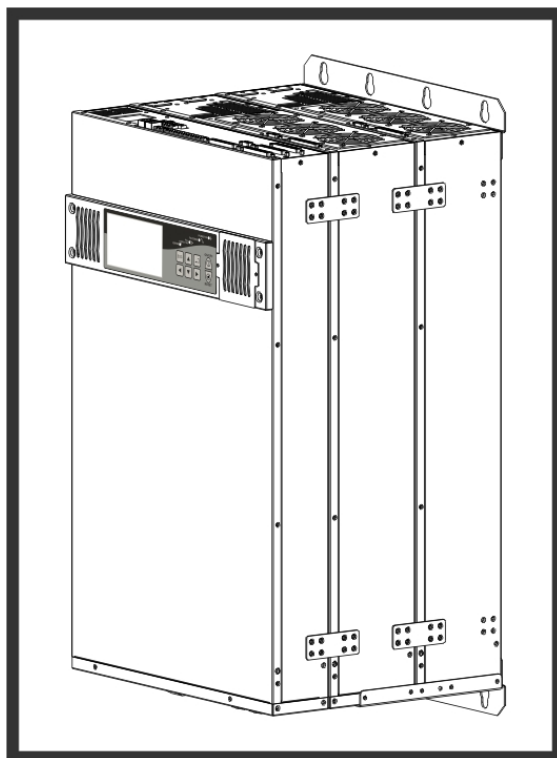
Step 4:



Step 5:



Step 6:



4-4. Wiring and Cables

The **Enersine ESD34** is composed of a Control Module and Power Modules. Wire connections will be introduced and explained below.

4-4-1. Wire connections for the Control Module

Wires for the Control Module:

- (1) 3 power cables
- (2) 1 neutral cable (for 3-phase/4-wire systems only)
- (3) 1 ground cable
- (4) 4-6 external CT wires connect to the External terminal block of the filter.
When N Control Modules operate in parallel, 2N or 3N additional wires are needed to connect between Control Modules.
- (5) 3 (N+1) parallel CT wires connect to the parallel terminal block of the filter.
(for N Control Modules operating in parallel)
- (6) 1 9-pin control signal cable connects to the Master Power Module. This cable comes with the Control Module.
- (7) N+1 RJ11 parallel cables (for N Control Modules operating in parallel)

The **Enersine ESD34** can be used with 3-phase/3-wire or 3-phase/4-wire systems. The external CTs can be installed on the source side or on the load side as indicated in Figures 4-1 to 4-4. When used in a 3-phase/3-wire system, the connections can be made as in Figure 4-1 to 4-4. When used in a 3-phase/4-wire system, external CTs can be connected as in Figure 4-3 and Figure 4-4. For proper cabling position please refer to section 2-1-2 .

We recommend installing the external CTs on the source side, and we recommend using three CTs for the best performance. If the external CTs must be installed on the load side please contact your local authorized service agent.

To avoid the possibility of interference with the CT output signal, do not place power cables and the CT twisted-pair signal cable in the same tray or conduit. If both power and signal cables need to be in the same tray or conduit, ensure that proper partitions are in place to provide isolation between them.

Use appropriately rated power cables and over-current protection devices in conjunction with the **Enersine**, and adhere to local electrical regulations and the technical descriptions provided by original equipment manufacturers. In addition, a

minimum 10% over-sizing of the power cables and over-current protection devices is recommended, due to “skin effect” caused by the compensating harmonics generated by the **Enersine**.

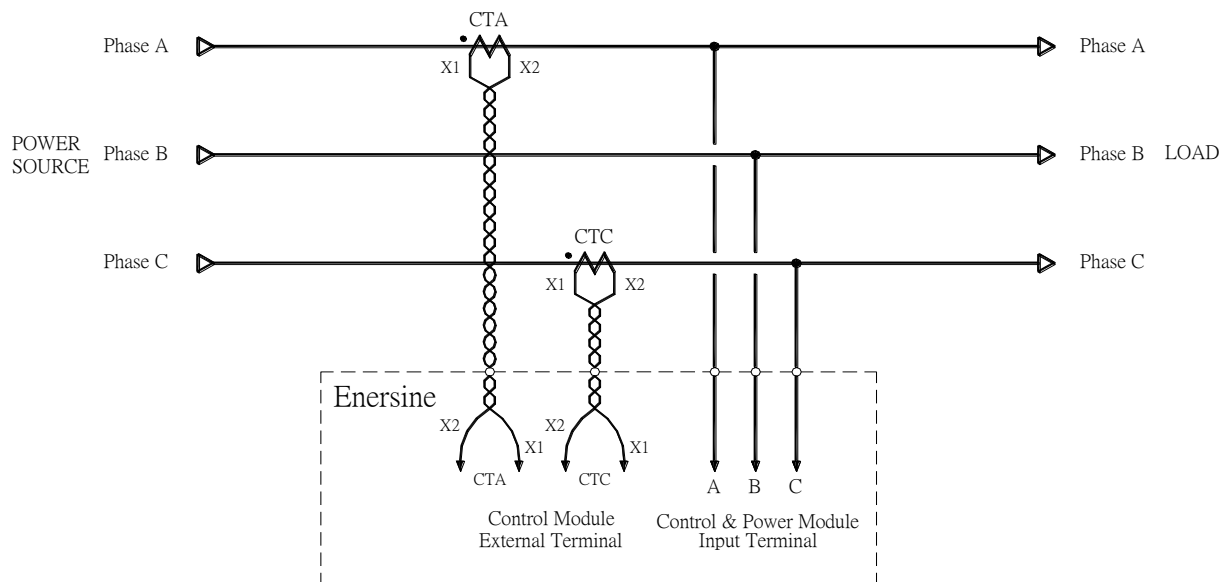


Figure 4-1 Two External CTs Installed at Source Side

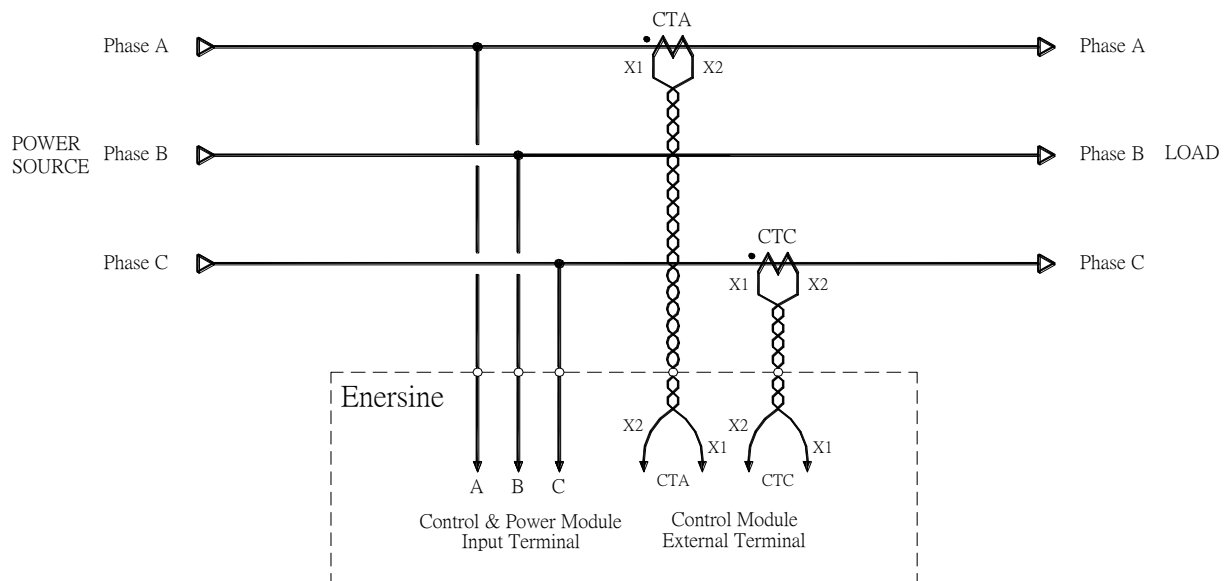


Figure 4-2 Two External CTs Installed at Load Side

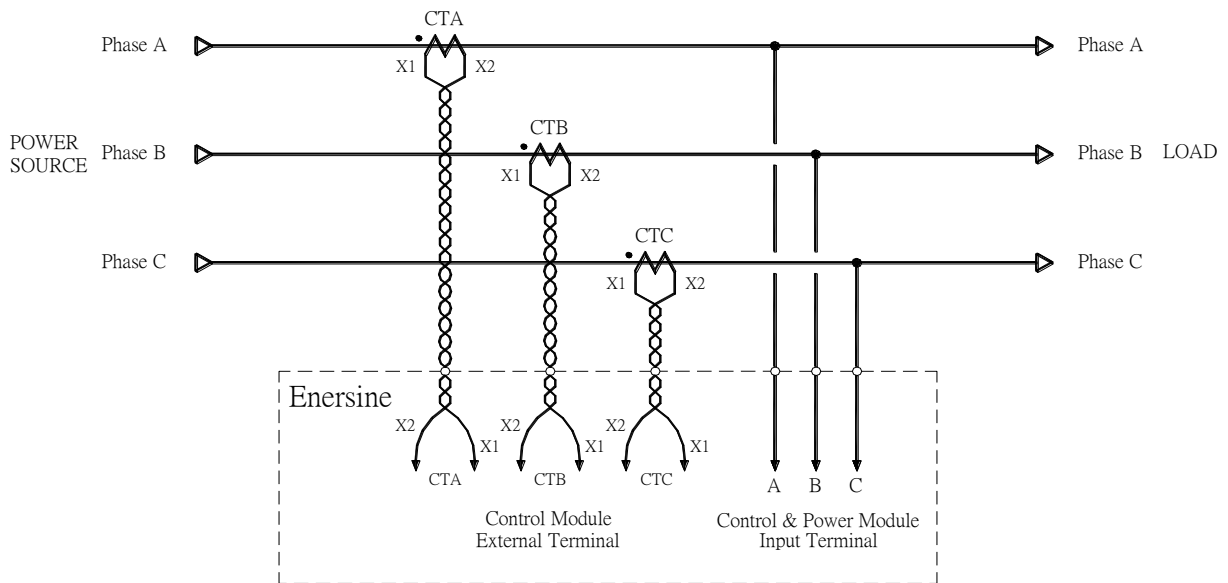


Figure 4-3 Three External CTs Installed at Source Side

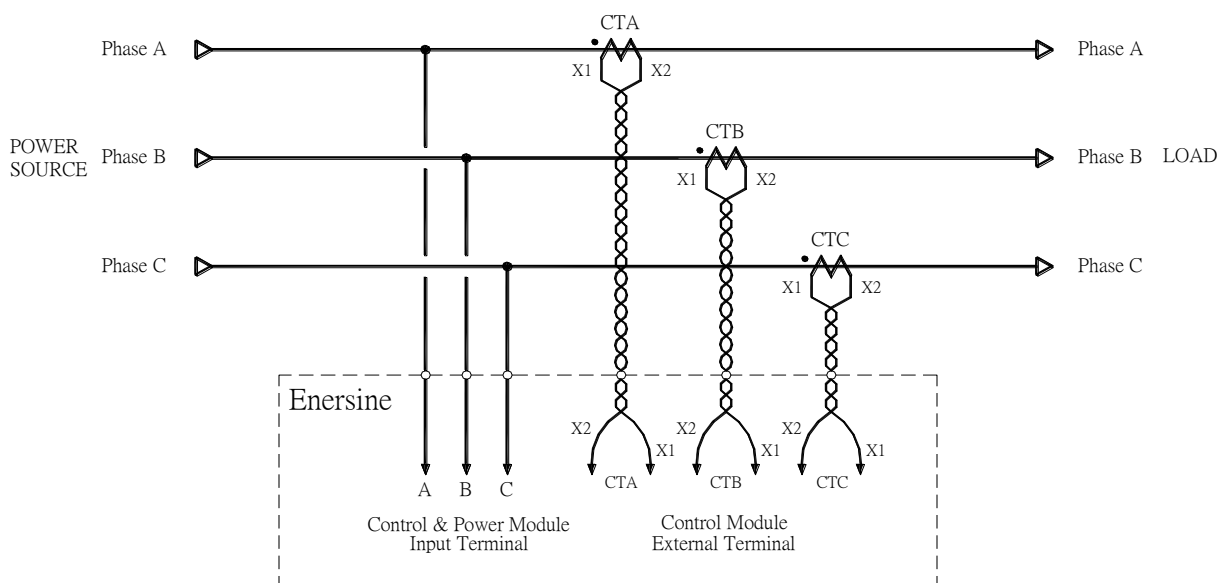


Figure 4-4 Three External CTs Installed at Load Side

When Control Modules are installed in parallel, the RJ11 cables must be connected according to section 2-1-2. In addition, the wiring of the external CTs is different from the standalone unit. Each CT's output signals must be connected to the External terminal block of the Control Modules in series as shown in Figure 4-5.

Three parallel CTs must be installed at the total output of the *Enersine* modules when Control Modules operate in parallel. Refer to Figure 4-6 for parallel CT connections.

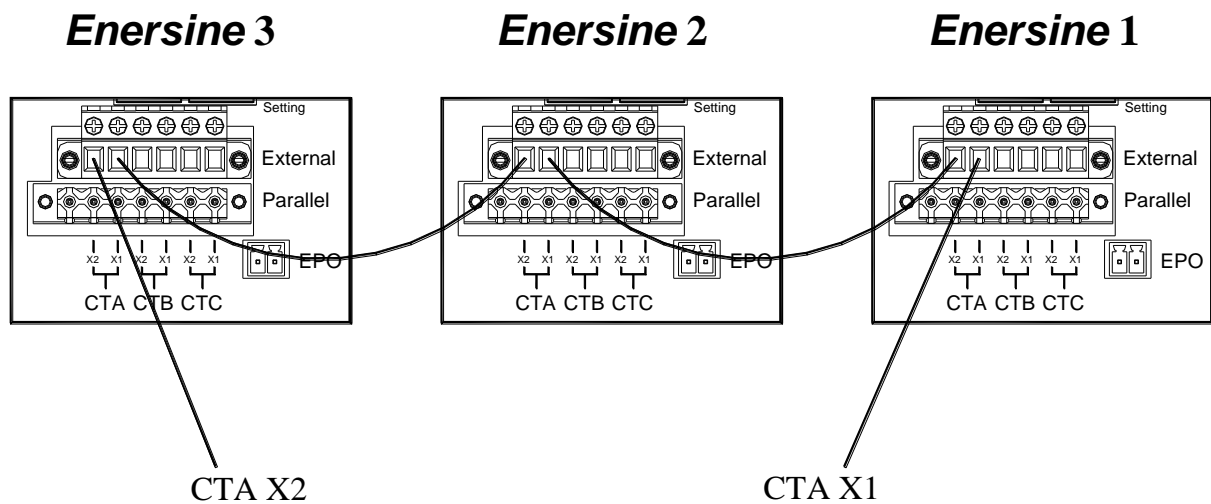
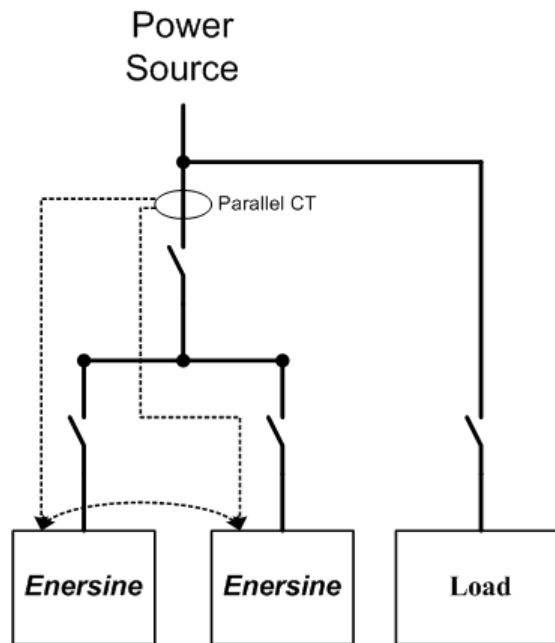
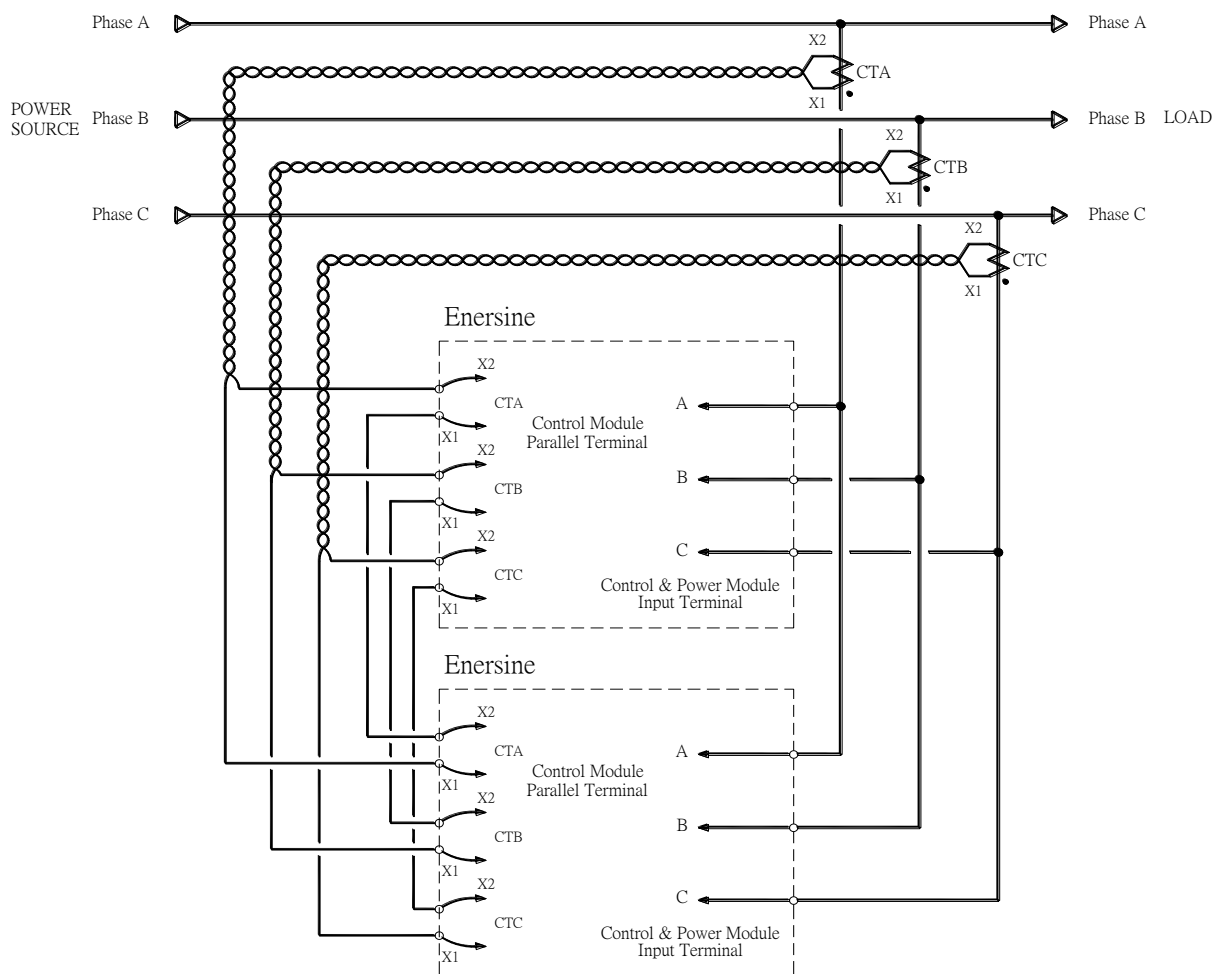


Figure 4-5 The External CT connection for Control Modules operating in parallel



(a)



(b)

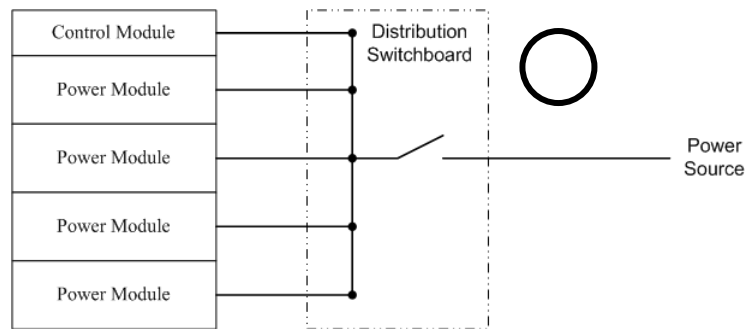
Figure 4-6 Parallel CT installation and connection

4-4-2. Wire connections for Power Modules

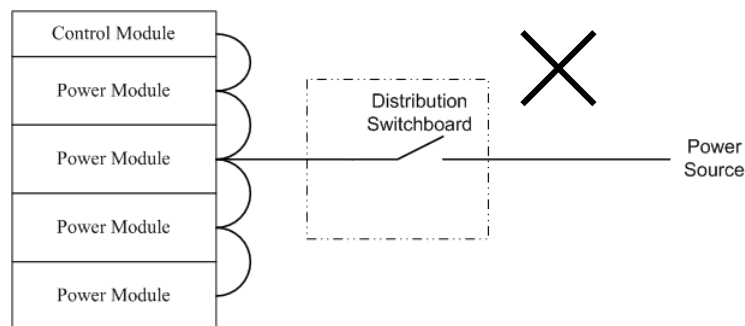
Wires and cables for each Power Module:

- (1) 3 power cables
- (2) 1 neutral cable (for 3-phase/4-wire systems only)
- (3) 1 ground cable
- (4) 1 DC bus cable for connecting to another Power Module. This cable comes with the Power Module.
- (5) 1 37-pin control-signal cable for connecting to the Control Module. This cable comes with the Power Module.

When several Power Modules are connected, the cables (from item 1 to item 3) for each Power Module must be connected to the distribution switch box as show in Figure 4-7(a).



(a) Correct Connection



(b) Incorrect Connection

Figure 4-7 Cable connections for Power Modules

The Control Module can control and monitor up to four Power Modules. When more than one Power Module is connected, in order to make sure that the DC bus voltage of each Power Module is the same, the DC buses of the Power Modules must be connected in parallel. If the DC bus of the Power Modules is not connected properly then it may affect the operation of the Power Modules, or even worse, the Power Modules could be damaged. Regarding the connection of the DC bus, please refer to section 2-2-1.

4-5. Wiring/Cabling Positions and Specifications

The Rack Mount type must be connected from the rear side. The Wall Mount type must be connected from the bottom side.

		Recommended Minimum Cable Size	Terminal Block Specification	Recommended Maximum Length
Control Module	Power Cables A, B, C	20 AWG/0.5 mm ²	Fastening with screw, M5	20 m
	Neutral Cable	20 AWG/0.5 mm ²	Fastening with screw, M5	20 m
	CT Signal Wires	20 AWG/0.5 mm ²	Crimping, maximum 4 mm ²	30 m
	Dry Contact Wires	24 AWG/0.2 mm ²	Crimping, maximum 4 mm ²	30 m
	EPO Signal Wire	24 AWG/0.2 mm ²	Crimping, maximum 1.5 mm ²	30 m
Power Module	Power Cables A, B, C	8 AWG/6 mm ²	Fastening with screw, M6	20 m
	Neutral Cable × 2	8 AWG/8.4 mm ²	Fastening with screw, M6	20 m

Wire connections for the Control Module and Power Modules are shown in Figure 4-8 and Figure 4-9.

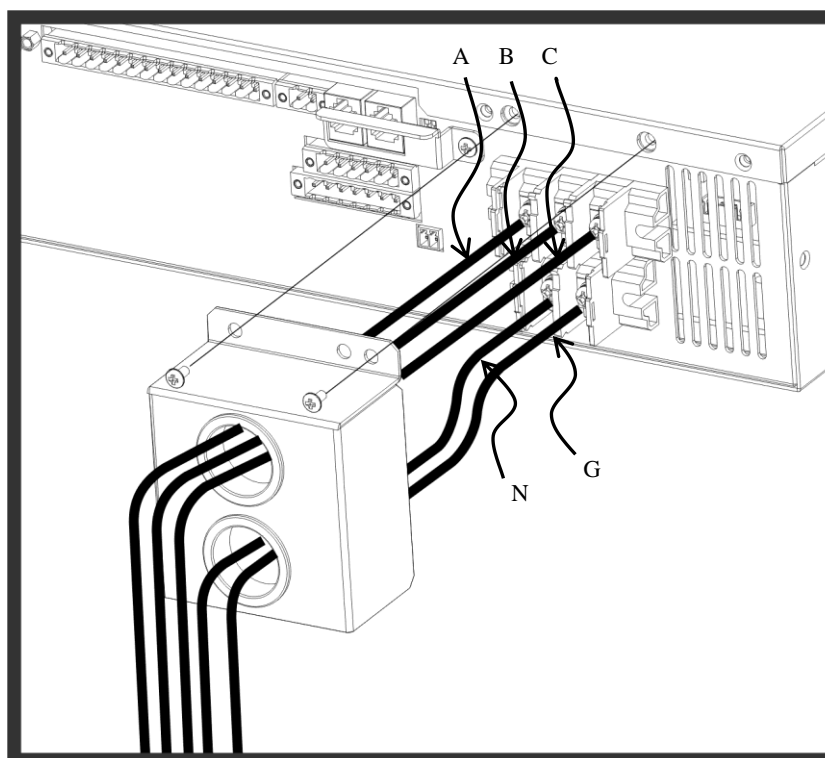


Figure 4-8 Control Module Wire Connections

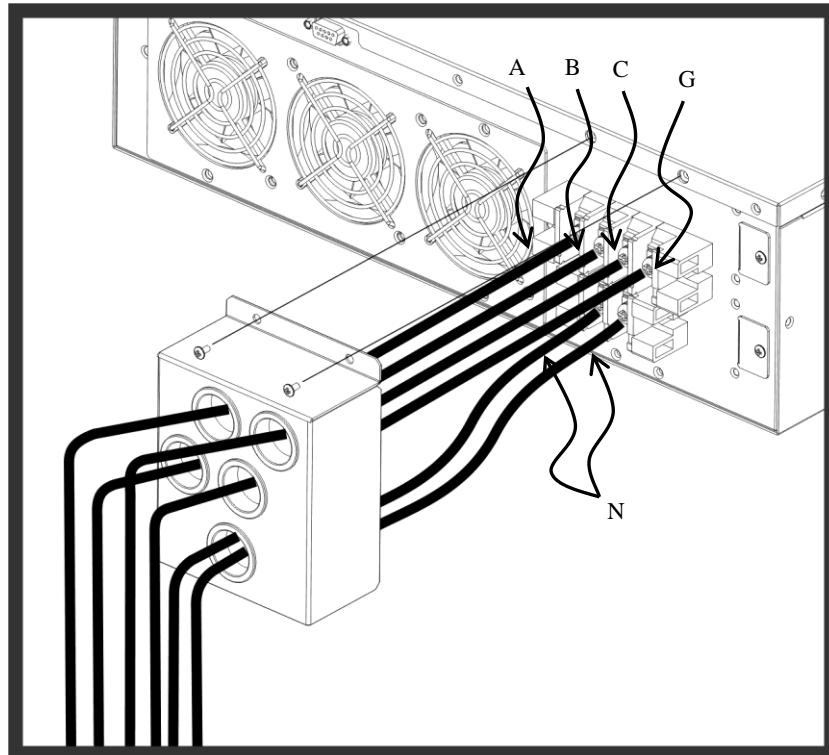


Figure 4-9 Power Module Wire Connections

4-6. External Views and Dimensions

Figures 4-10 to 4-17 show the outer dimensions of both the Rack Mount type and Wall Mount type.

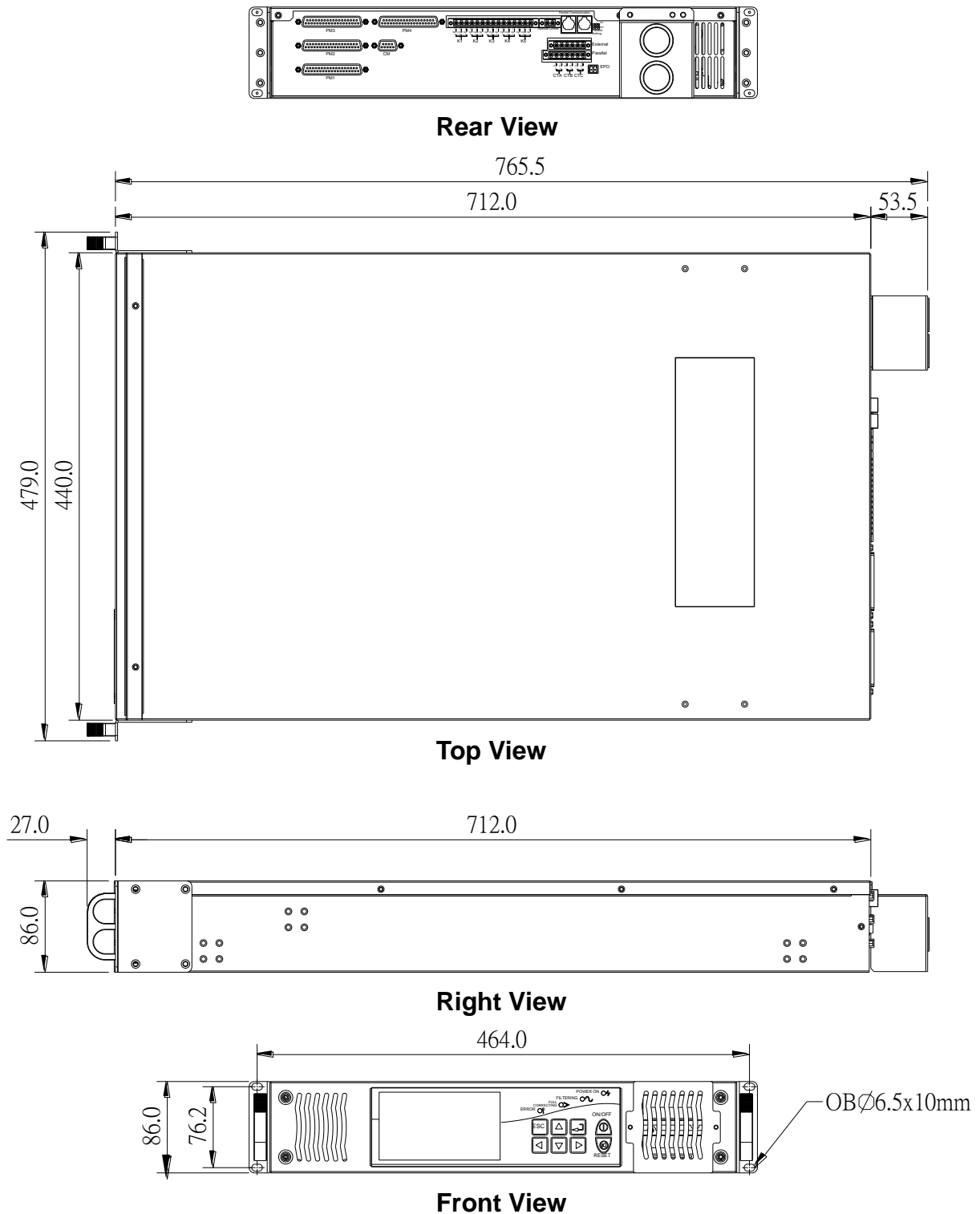


Figure 4-10 Rack Mount LCD Control Module ESD34-CR035-400E-C

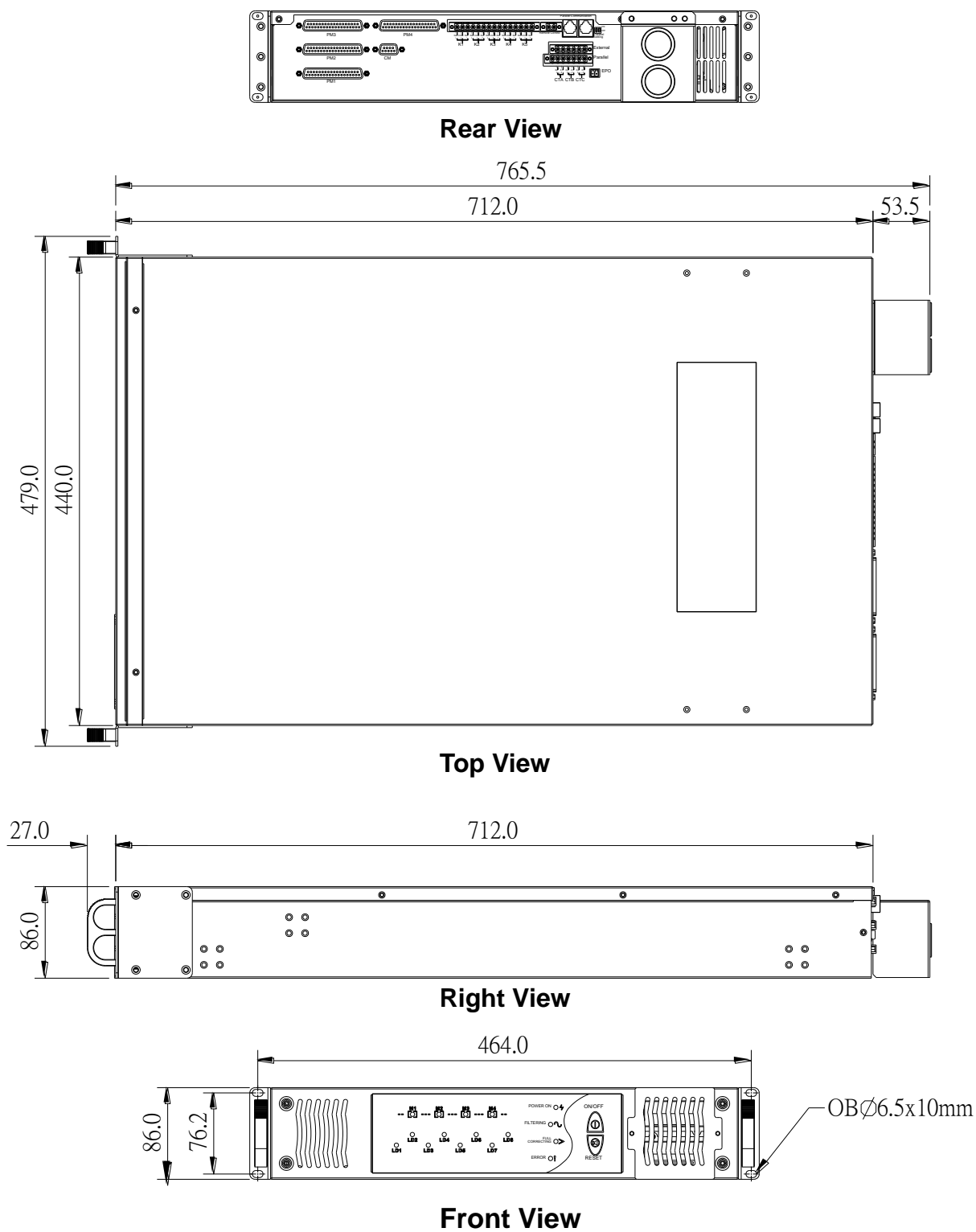
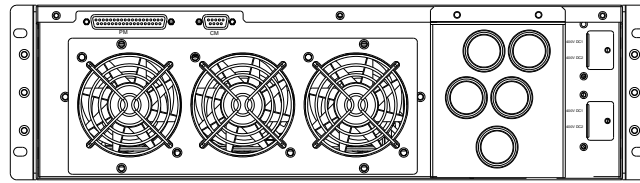
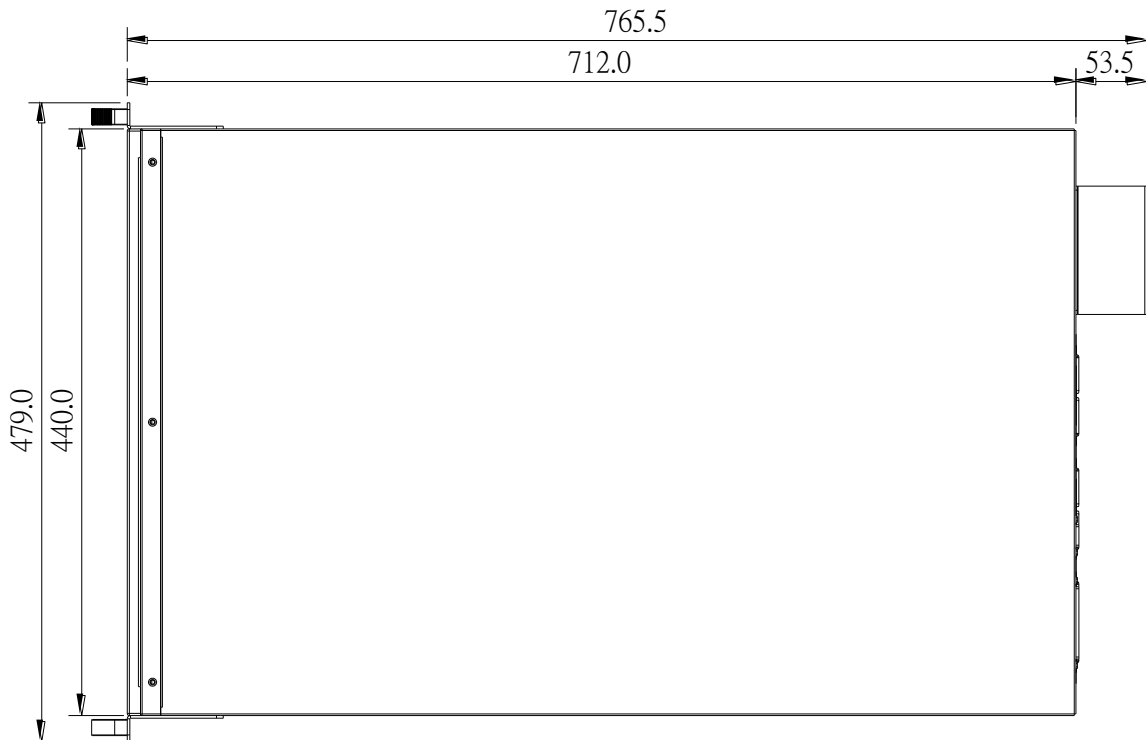


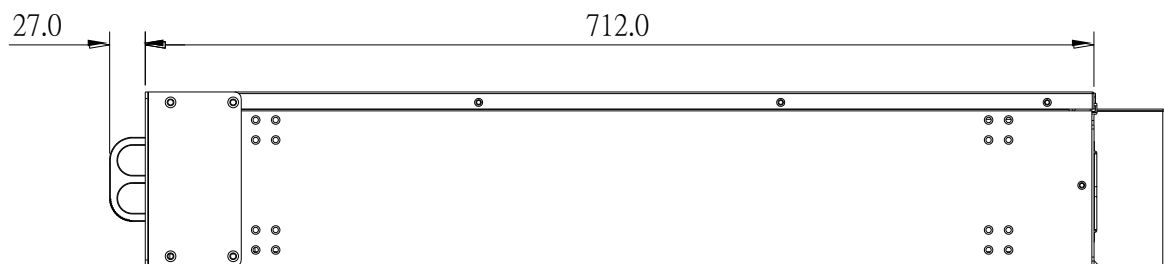
Figure 4-11 Rack Mount LED Control Module ESD34-CR035-400E-C



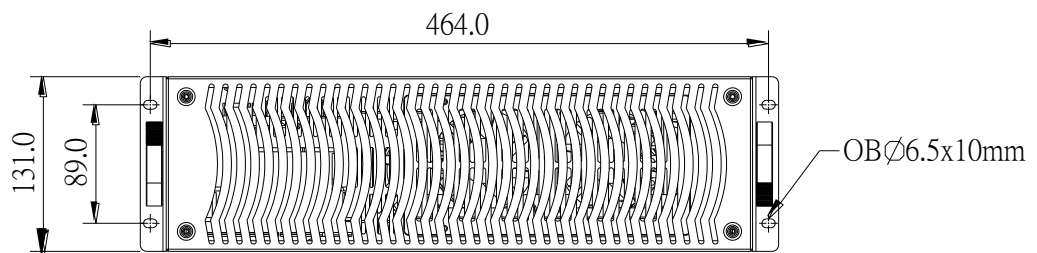
Rear View



Top View



Right View



Front View

Figure 4-12 Rack Mount Power Module ESD34-PR035-400E

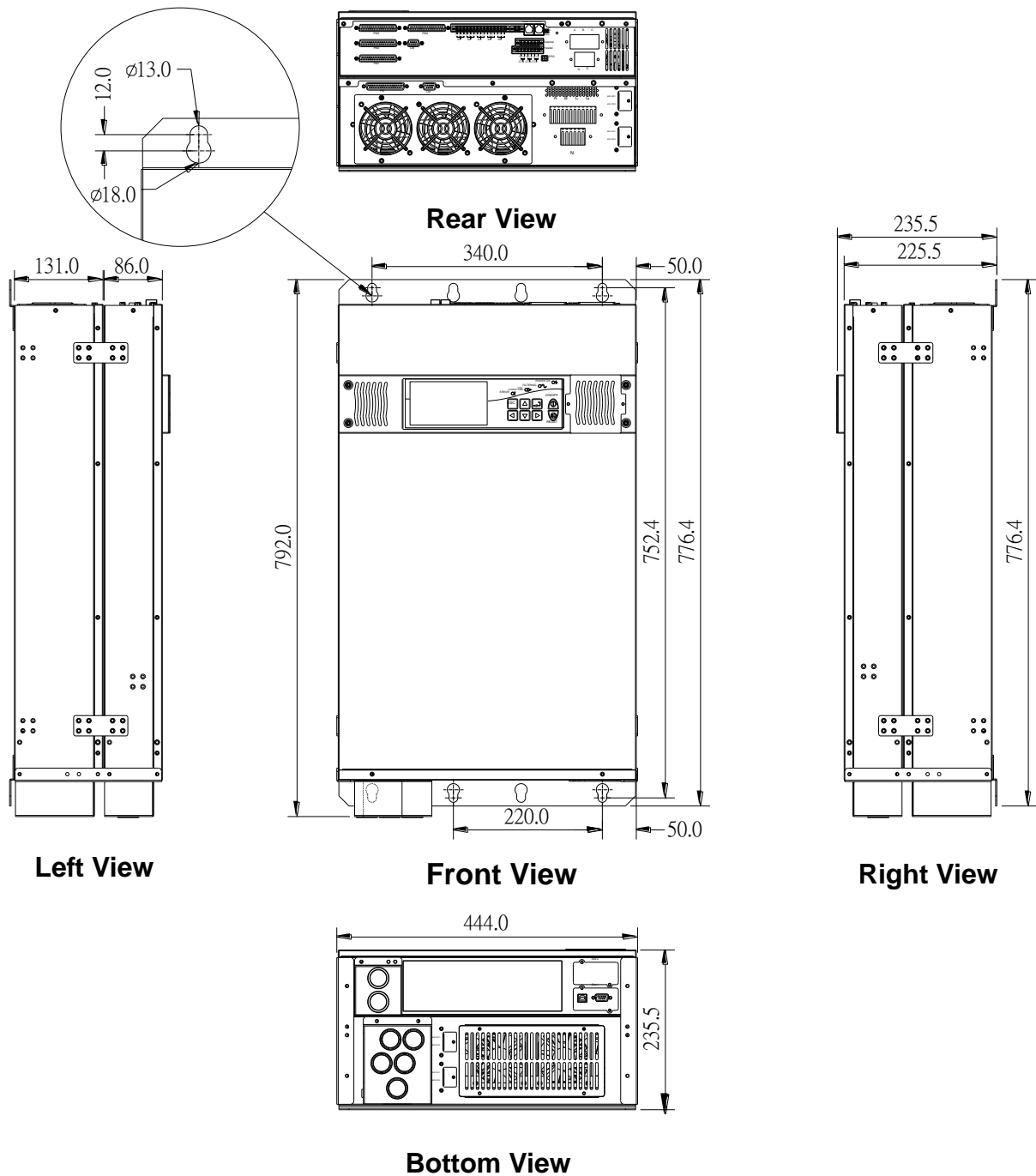


Figure 4-13 Wall Mount LCD Control Module ESD34-CW035-400E-C and Power Module ESD34-PW035-400E

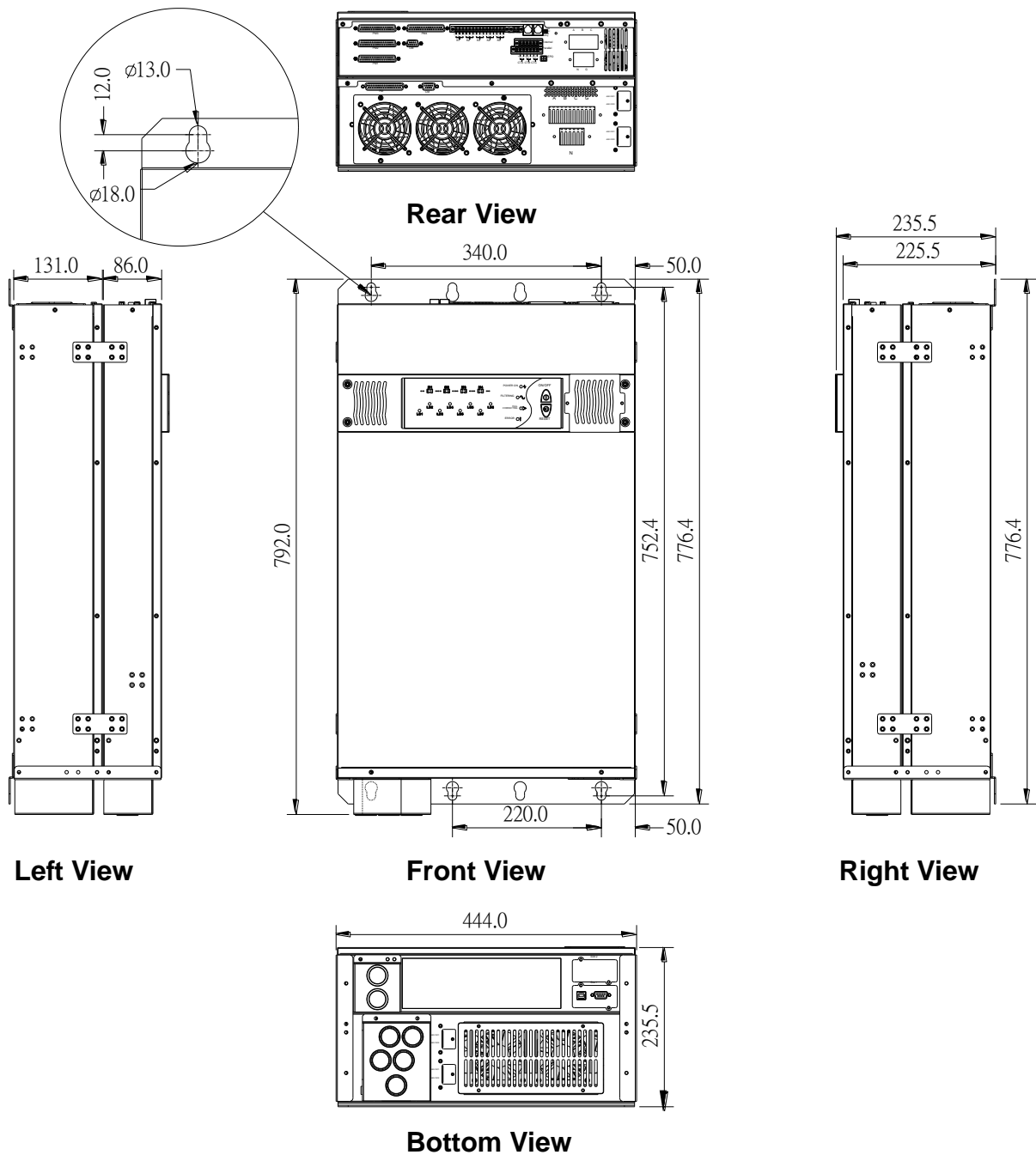


Figure 4-14 Wall Mount LED Control Module ESD34-CW035-400E-E and Power Module ESD34-PW035-400E

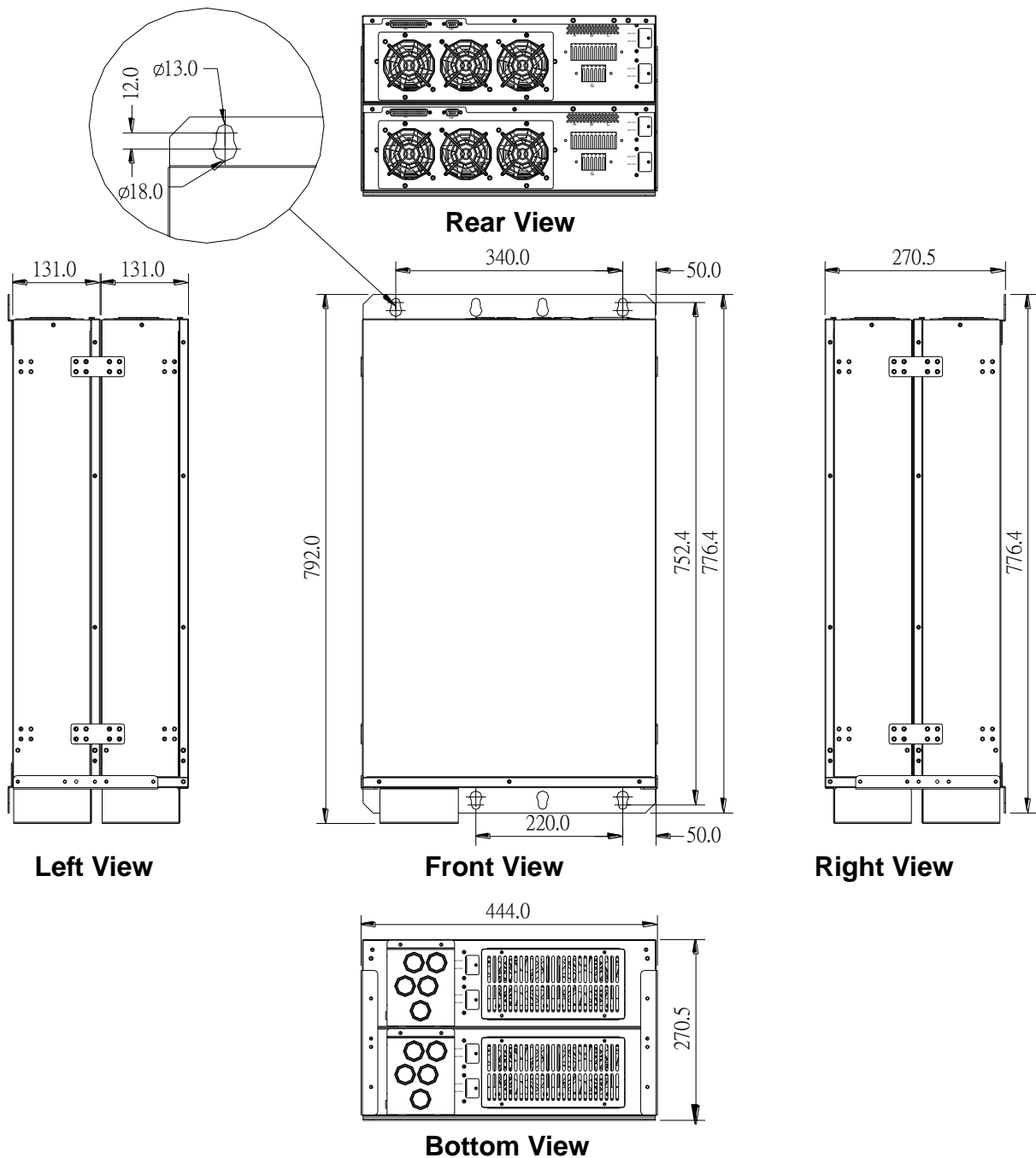


Figure 4-15 Two Wall Mount Power Modules ESD34-PW035-400E

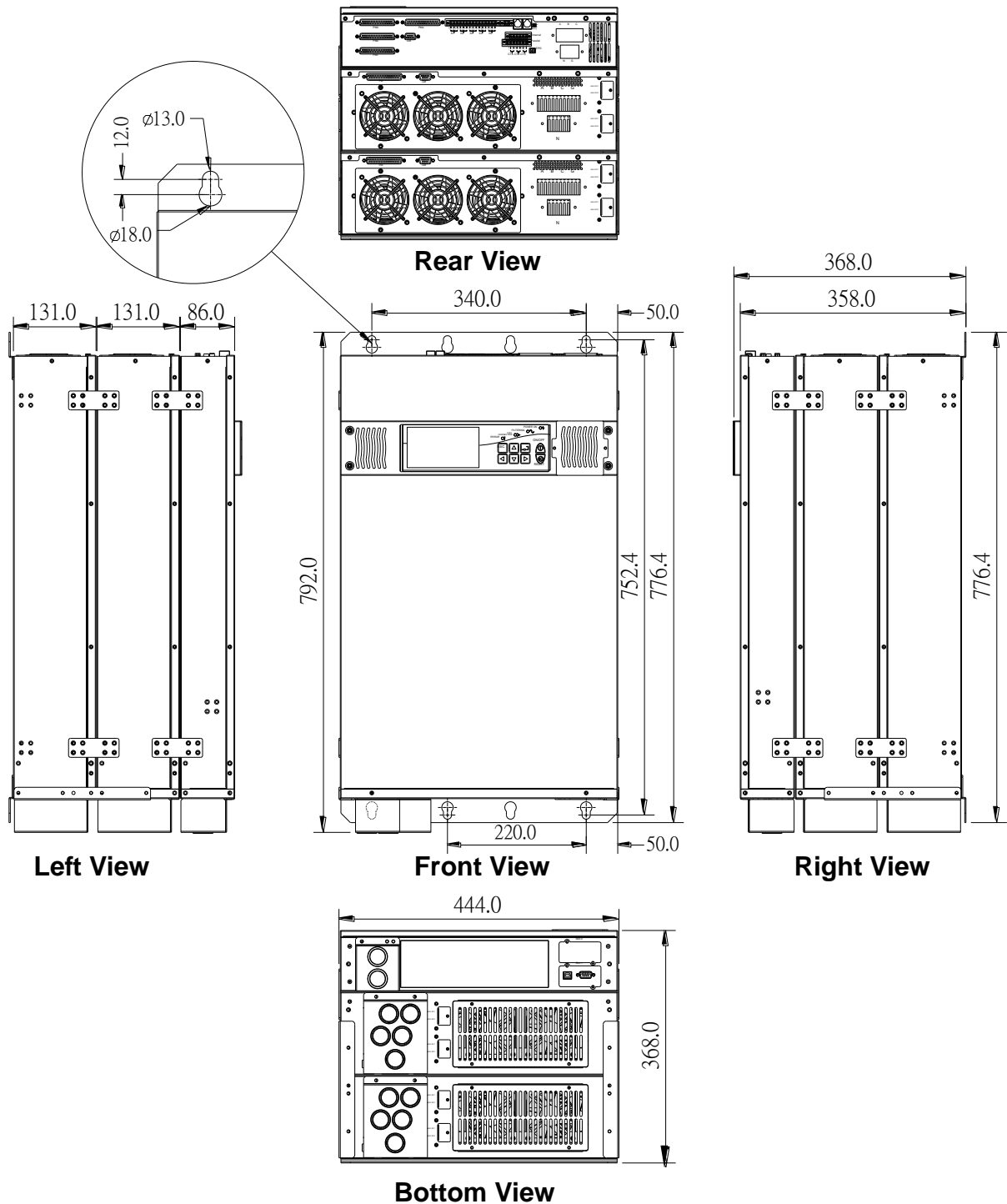


Figure 4-16 Wall Mount LCD Control Module ESD34-CW035-400E-C and Two Power Modules ESD34-PW035-400E

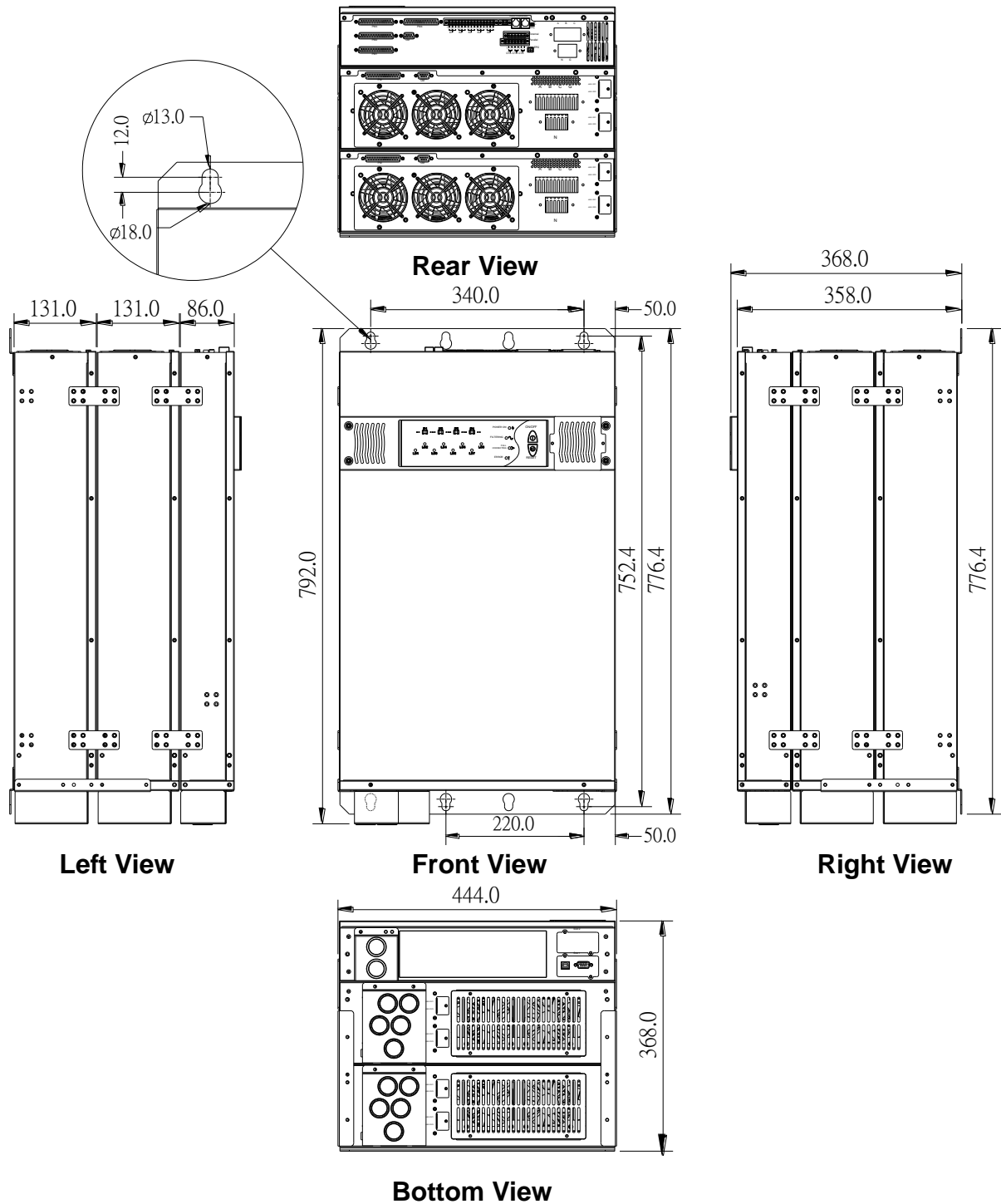


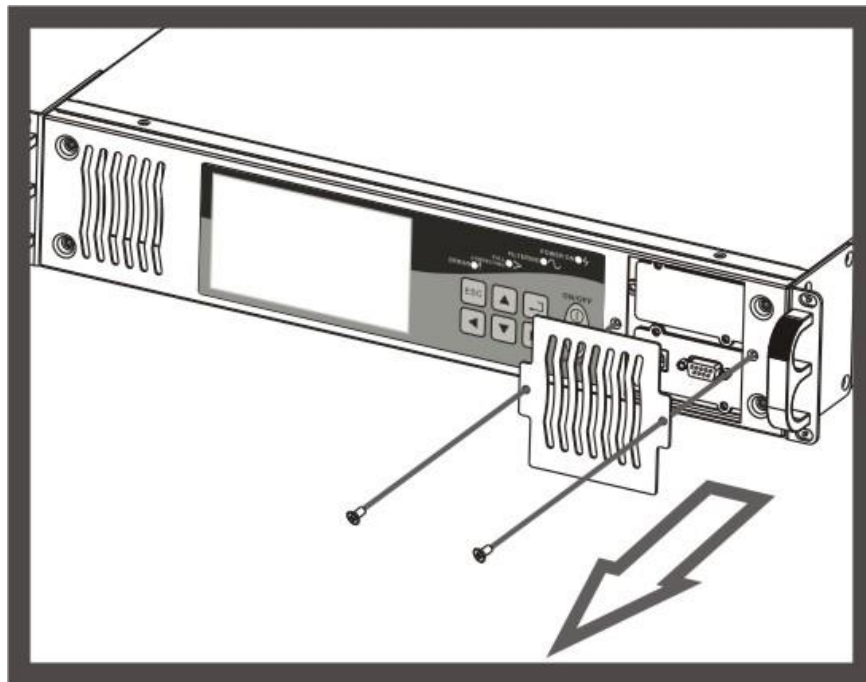
Figure 4-17 Wall Mount LED Control Module ESD34-CW035-400E-E and Two Power Modules ESD34-PW035-400E

5. Optional Communication Card

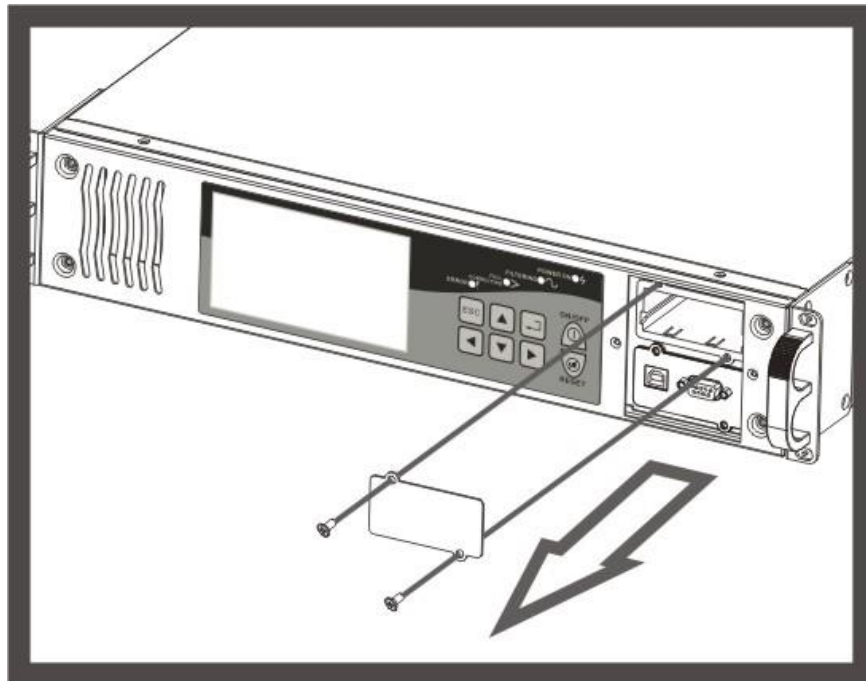
This chapter introduces the function and installation of optional RS-485/RS-422 and Ethernet communication cards.

Install the communication cards as follows.

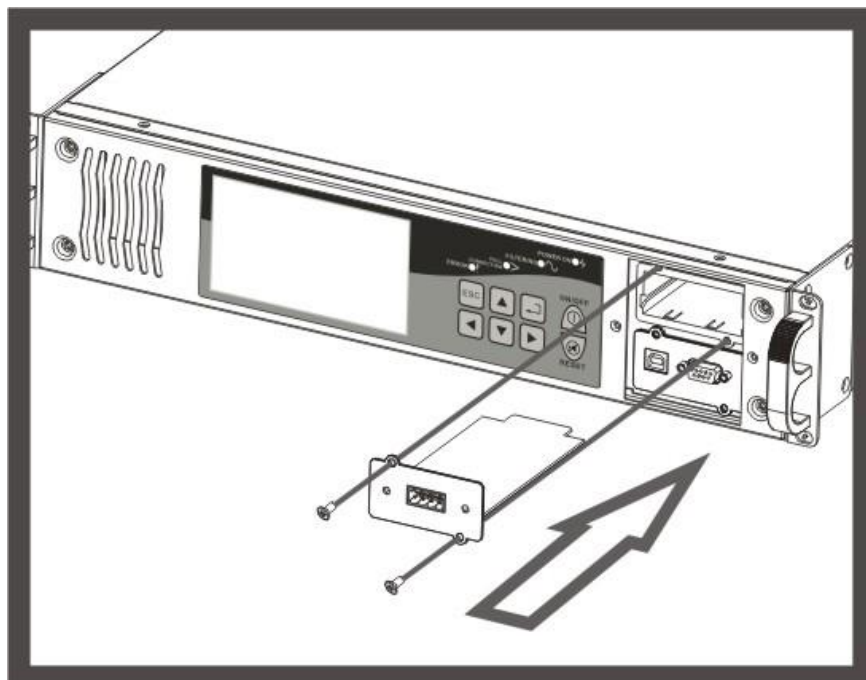
Step 1: Remove the fixed front plate of the Control Module.



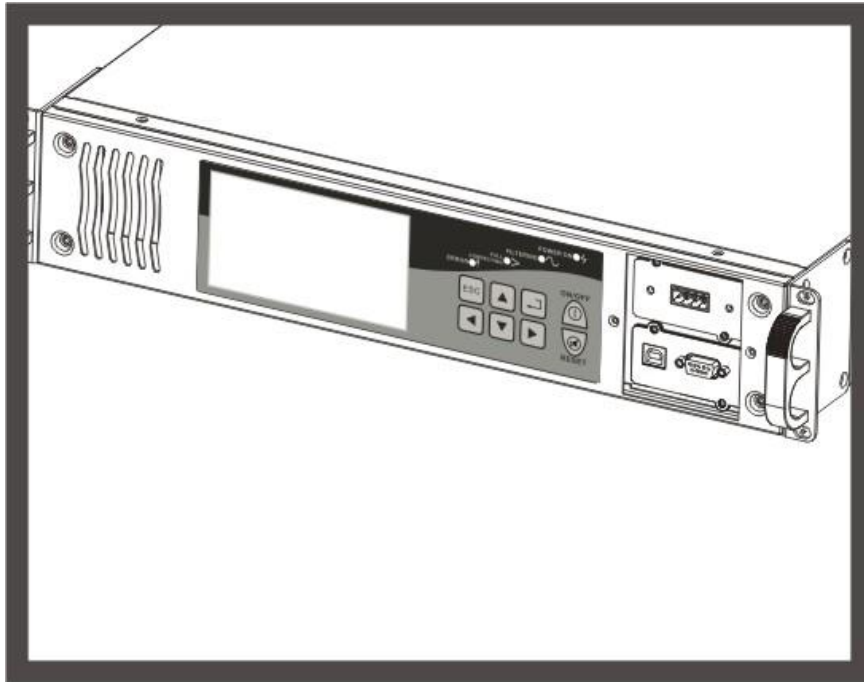
Step 2: Remove the front cover of the communication slot.



Step 3: Fasten the communication card in the slot.



Step 4: The communication card is now installed properly.

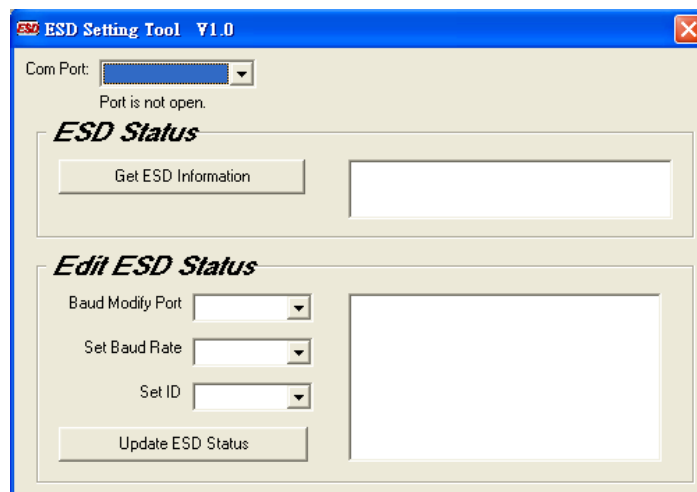


5-1. RS-485/422 Communication Card

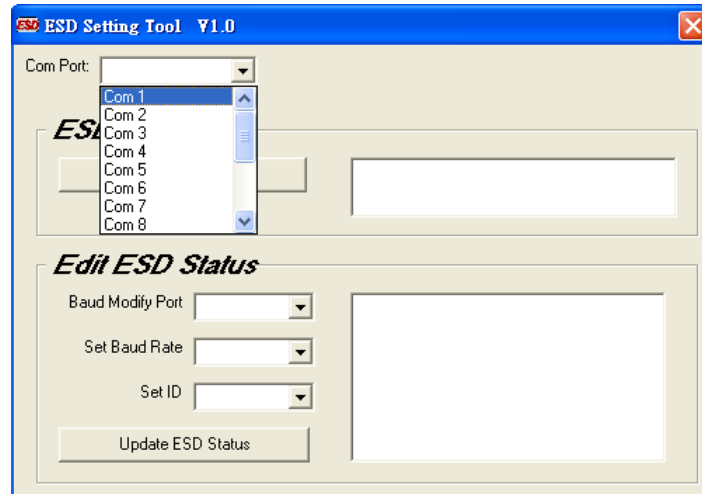


RS-422 and RS-485 communication interfaces cannot be used at the same time. The ID numbers of Control Modules must be different when using RS-485 or RS-422 for communication. Use the **ESD Setting Tool** software to set the ID number as described below.

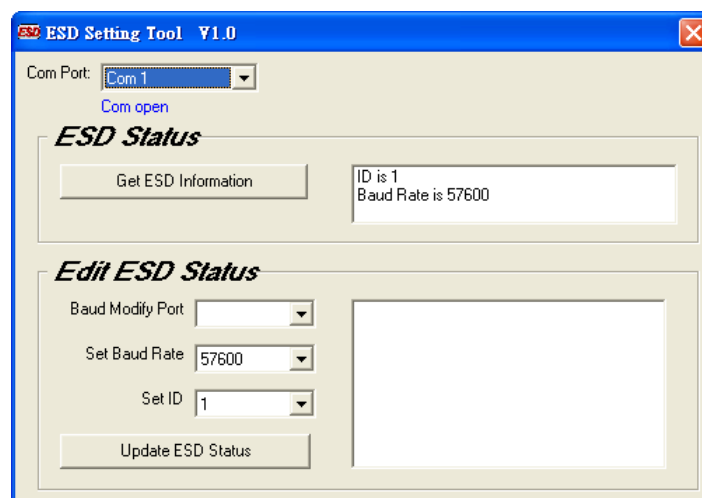
Step 1: Link with the computer through the RS-232 communication port of the Control Module, and then execute the **ESD Setting Tool**.



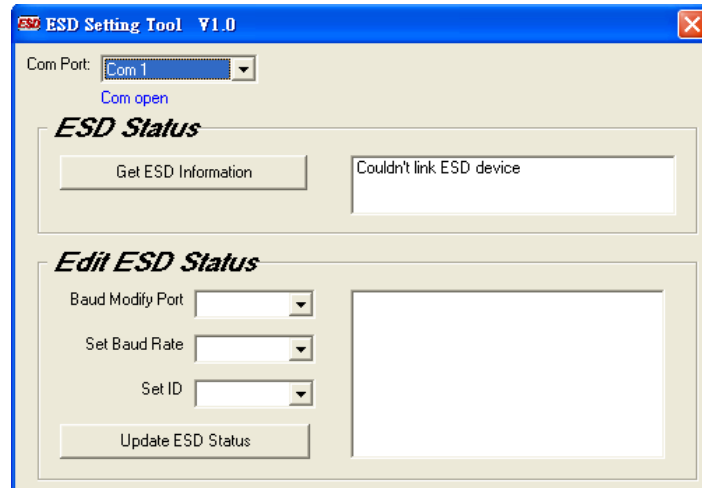
Step 2: Select the communication port of the computer.

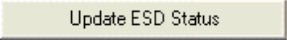


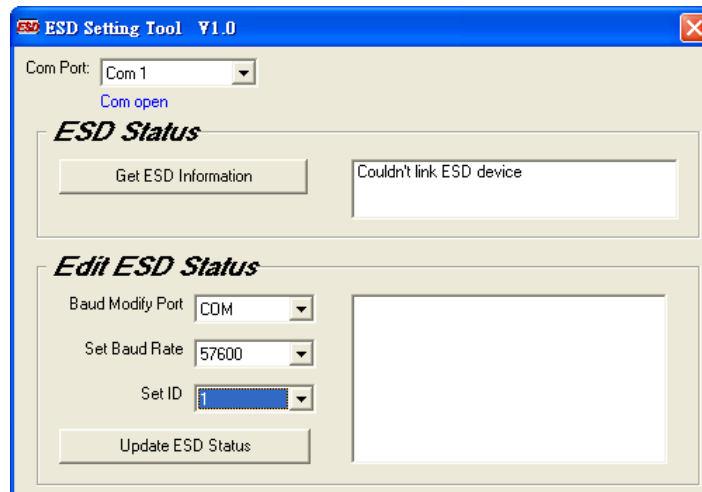
Step 3: After the communication port is set properly the computer can read the ID and baud rate of communication card.

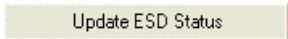


Step 4: If the communication port is set incorrectly or the communication connection between the computer and the Control Module is disconnected the message “Couldn’t link ESD device” will appear.



Step 5: Press  to refresh the screen if the message “Couldn’t link ESD device” still appears after ensuring that the communication port and communication connection are sound.

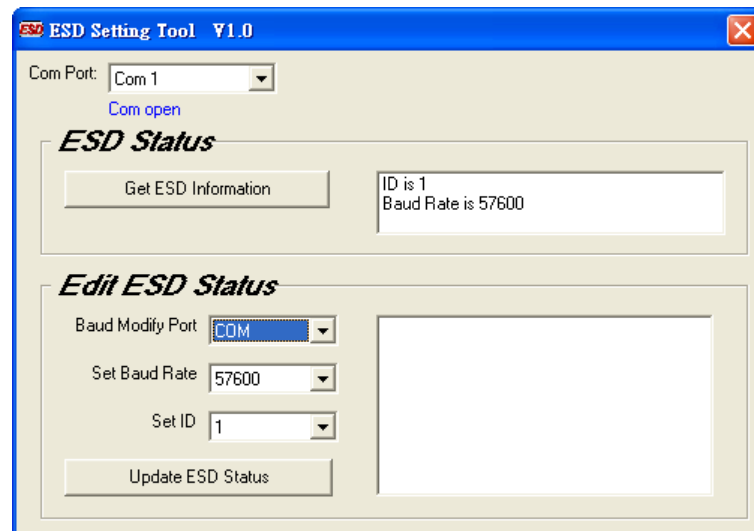


Step 6: The user can change communication card settings when the communication link is okay. Type the new setting and then press  to update the setting.

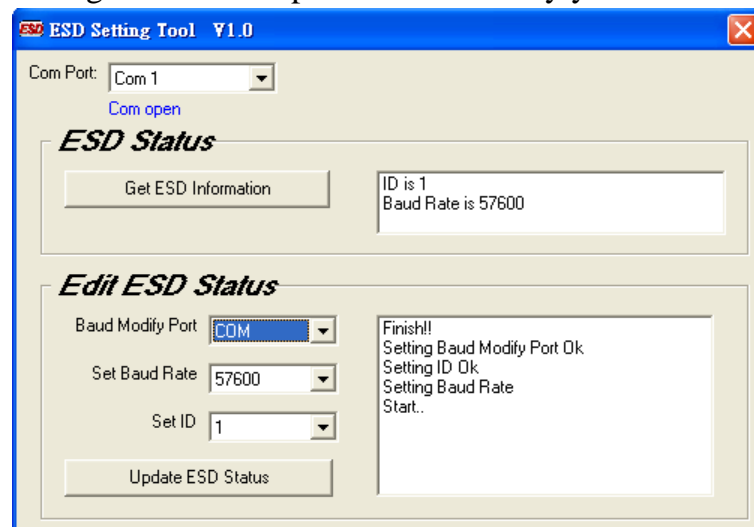
Baud Modify Port: Select which communication interface is allowed to modify the Baud Rate through monitoring software **ESD-Link34**.

Set Baud Rate: Set the baud rate for communication.

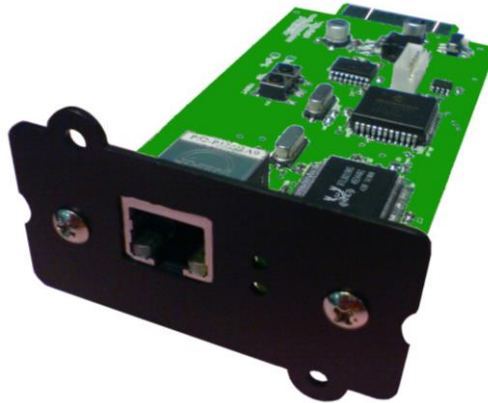
Set ID: The ID number for RS-485/RS-422 communication



Step 7: When the settings have been updated successfully you will see the following.



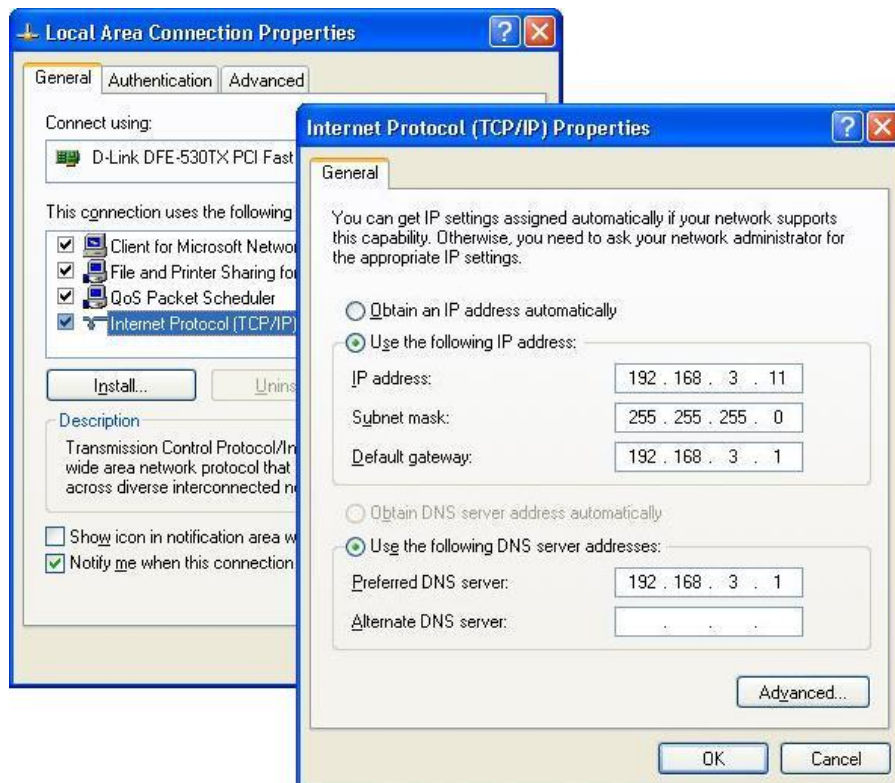
5-2. Ethernet Communication Card



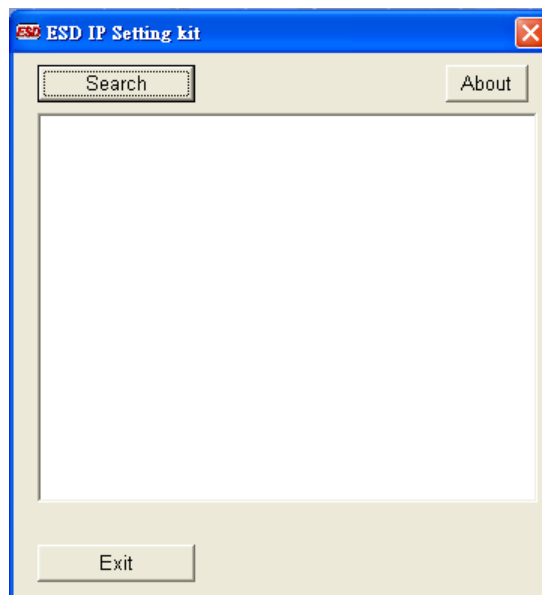
Use the **ESD IP Setting Kit** software to set the IP address and baud rate for your Ethernet communication card as follows.

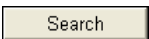
Step 1: Connect the Ethernet card to the computer using the RJ45 cable that comes with the Ethernet card.

Step 2: Use the following IP address settings.



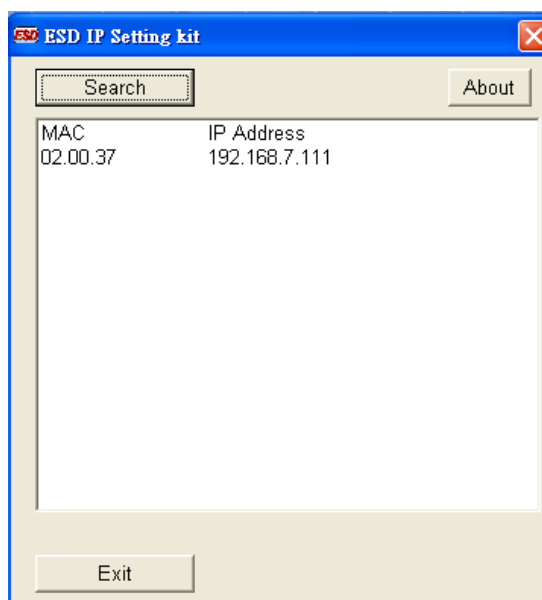
Step 3: Execute the **ESD IP Setting Kit**.



Step 4: Press  to search for the Ethernet card.

MAC: Media Access Control address of the Ethernet card

IP Address: Internet Protocol address of the Ethernet card



Step 5: Click the desired Ethernet card to open the Setting window, and set the IP address and baud rate for this Ethernet card. Press to update the settings.

Note: The Baud Rate setting must be the same as that of the RS-232/USB communication card.

