DC Metering Setup Guide for PM335/EM235 PRO using UHACS

BG0678 REV.A1

Every effort has been made to ensure that the material herein is complete and accurate. However, the manufacturer is not responsible for any mistakes in printing or faulty instructions contained in this book. Notification of any errors or misprints will be received with appreciation. For further information regarding a particular installation, operation or maintenance of equipment, contact the manufacturer or your local representative or distributor.

REVISION HISTORY

A1	May 2025	Initial Release

LIMITED WARRANTY

The manufacturer offers the customer functional warranty for 36 months from the date of production. This warranty is on a return to factory basis.

The manufacturer does not accept liability for any damage caused by instrument malfunction. The manufacturer accepts no responsibility for the suitability of the instrument to the application for which it was purchased.

Failure to install, set up or operate the instrument according to the instructions herein will void the warranty.

Only a duly authorized representative of the manufacturer may open your instrument. The unit should only be opened in a fully anti-static environment. Failure to do so may damage the electronic components and will void the warranty.

The greatest care has been taken to manufacture and calibrate your instrument. However, these instructions do not cover all possible contingencies that may arise during installation, operation or maintenance, and all details and variations of this equipment are not covered by these instructions.

For additional information regarding installation, operation or maintenance of this instrument, contact the manufacturer or your local representative or distributor.

For more details concerning technical assistance & support visit manufacturer's web site:

www.satec-global.com

May 2025

WARNING

Read the instructions in this manual before performing installation and take note of the following precautions:

➲ Ensure that all incoming DC power and other power sources are turned OFF before performing any work on the instrument. Protect the measurement positive and negative DC Inputs voltage with 2A external overcurrent protection device and the power supply source inputs with 5A external overcurrent protection device, located close to the equipment.

➲ EM235 / PM335 PRO are intended for measurements performed in building and industrial installations, relating to measurement category III (UL61010-1 3rd ed.), pollution degree 2.

➲ The secondary of an external current transformer must never be allowed to be open circuit when the primary is energized. An open circuit can cause high voltages, possibly resulting in equipment damage, fire and even serious or fatal injury. Ensure that the current transformer wiring is secured using an external strain relief to reduce mechanical strain on the screw terminals, if necessary. Use the Listed Energy-Monitoring Current Transformers.

➲ Always open or disconnect circuit from power-distribution system (or service) of building before installing or servicing current transformers.

➲ Secure current transformer and route conductors so that they do not directly contact live terminals or bus.

➲ Ensure that all incoming DC power and other power sources are turned OFF before performing any work on the instrument. Failure to do so may result in serious or even fatal injury and/or equipment damage.

➲ Before connecting the instrument to the power source, check the labels at the front of the instrument to ensure that your instrument is equipped with the appropriate rating input voltages and currents.

➲ Under no circumstances should the instrument be connected to a power source if it is damaged.

➲ Any use or operations not specified by this manual may cause a protection impairment to the device.

➲ To prevent potential fire or shock hazard, do not expose the instrument to rain or moisture.

➲ Only qualified personnel familiar with the instrument and its associated electrical equipment must perform setup procedures.

➲ Do not open the instrument under any circumstances when it is connected to a power source.

➲ Do not use the instrument for primary protection functions where failure of the device can cause fire, injury or death. The instrument can only be used for secondary protection if needed.

➲ This equipment does not require cleaning for proper operation.

➲ **Don´t connect any part of the solution (Meter, VRM, Power Supply, Sensors) to GND.**

➲ This equipment is not intended to be directly connected to medium and high voltage powerlines, only using Listed Energy-Monitoring Current & Voltage Transformers, certified for this purpose.

Read this manual thoroughly before connecting the device to the current carrying circuits. During operation of the device, hazardous voltages are present on input terminals. Failure to observe precautions can result in serious or even fatal injury or damage to equipment.

Table of Contents

Chapter 1 General

This document instructs the user on installation, wiring, and configuring the EM235/PM335 PRO multi-meter for DC application in conjunction with UHACS (Ultra High Accuracy Current Sensors). This guide does not substitute the full user manual or the detailed safety instructions. To download the manual and other related material, please visit our website: www.satec-global.com

Refer to the EM235/PM335 PRO Installation & Operation Manual for additional information concerning communications, operation, configuring the communications parameters, and communications connections in your device.

This addendum is an essential part of the following documents:

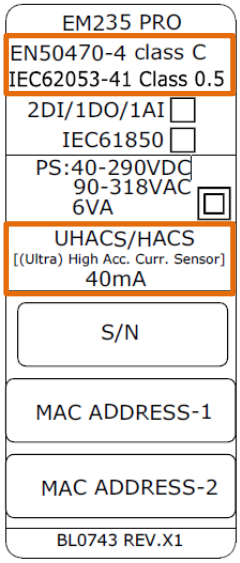
art of the following documents:

- EM235/PM335PRO Advanced Power meter Installation and Operation Manual devices.

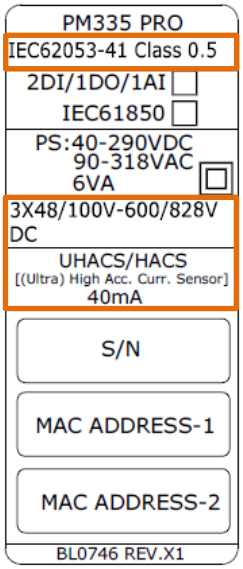
1.1 Labelling

Specification change:

- PM335 PRO UHACS / HACS.
- EM235 PRO UHACS / HACS.



EM235 PRO UHACS / HACS



PM335 PRO UHACS / HACS

Chapter 2 Metering Devices EM235 / PM335 PRO-Electrical Installation

2.1 Preliminary Notes

1. The PM335 PRO is mounted on metallic panel which is part of the switchgear, or as EM235 on DIN rail inside the switchgear, the switchgear metal plate must be connected to earth (ground) for safety purposes.
2. All incoming power sources must be turned OFF before performing any work on the instrument. Failure to do so may result in serious or even fatal injury and/or equipment damage.
3. Before connecting the instrument to the power source, check the labels at the front of the instrument to ensure that your instrument is equipped with the appropriate rating input voltages and currents.
4. **Don´t connect the PM335 or EM235 PRO to GND.**
5. Under no circumstances should the instrument be connected to a power source if it is damaged.
6. To prevent potential fire or shock hazard, do not expose the instrument to rain or moisture.
7. While wiring the UHACS the secondary output must never be allowed to be open circuit when the primary is energized. An open circuit can cause high voltages, possibly resulting in equipment damage, fire and even serious or fatal injury. Ensure that the UHACS wiring is secured using an external strain relief to reduce mechanical strain on the screw terminals, if necessary.
8. Only qualified personnel familiar with the instrument and its associated electrical equipment must perform setup procedures.
9. It is required to use a 2A LV Circuit Breaker / fuses before connecting to mains (voltage inputs).
10. There shall be reliable segregation or separation by barriers between the following different circuits:
    - **Class 1:** field and factory installed wiring (such as CT output leads, voltage measurement leads, mains input power), terminals, and uninsulated live parts.
    - **Class 2 and Class 3:** field installed and factory wiring, terminals, and uninsulated live parts.

2.2 Connecting the Wires

All conductors must be stranded copper. All conductors and insulation systems and crimped devices must be appropriate for the application.

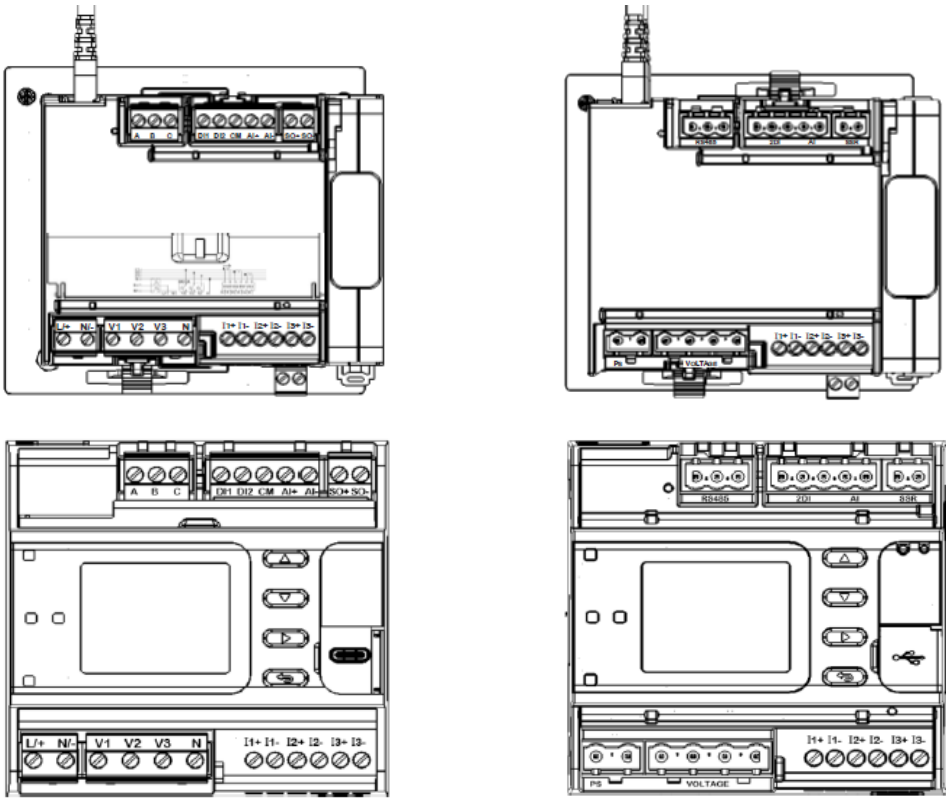
Table below summarizes the different conductor sizes to be used in the EM235/PM335 PRO SERIES external DC connections.

Terminals	Conductor size		Torque [Nm]	Notes
	Minimum AWG (mm²)	Maximum AWG (mm²)		
Power Supply Inputs L/+, N/-	20 (0.5)	10 (<4.5)	0.5-0.7	Use 600V insulated conductors. Required crimped ferrule **(ONLY AC)**: Panduit (22AWG) F75-10-M Panduit (12AWG) F81-10-M
Aux. Power Supply Inputs Sensors L/+ and N/-				
Voltage Inputs V1+, V2+, V3+, Vn-	20 (0.5)	13 (2.5)	0.5-0.6	Use 600V insulated DC conductors.
Current Inputs I1, I2, I3	15 (1.5)	13 (2.5)	0.35-0.4	Use 600V insulated DC Twisted pair shielded conductors.

Minimum temperature rating of the cable to be connected to the field wiring terminals 75°C

2.3 Terminals

All used terminals consist of detachable terminal, except for the current measurement inputs terminals.



EM235/PM335 PRO Terminals View

2.4 Power Source Connection

The equipment installation shall conform to the following instructions:

1. A switch or circuit-breaker shall be included in the building installation;
2. It shall be in close proximity to the equipment and within easy reach of the OPERATOR.
3. It shall be marked as the disconnecting device for the equipment.

Before installing, ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.

The power source can be a dedicated fuse, or a monitored voltage if it is within the instrument power supply range.

2.4.1 To connect an AC power supply:

- Connect the Line wire to terminal L/+.
- Connect the Neutral wire to terminal N/-.

2.4.2 To connect to a DC power supply:

- Connect the positive wire to terminal L/+
- Connect the negative wire to terminal N/-.

Chapter 3 DC Voltage Connection

3.1 Preliminary Notes

The equipment installation shall conform to the following instructions:

1. A switch or circuit-breaker shall be included in the building installation;
2. It shall be in close proximity to the equipment and within easy reach of the OPERATOR.
3. It shall be marked as the disconnecting device for the equipment.

Before installing, ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.

Three different voltage references can be connected to the meter.

Negative pole must be common to all voltage connections.

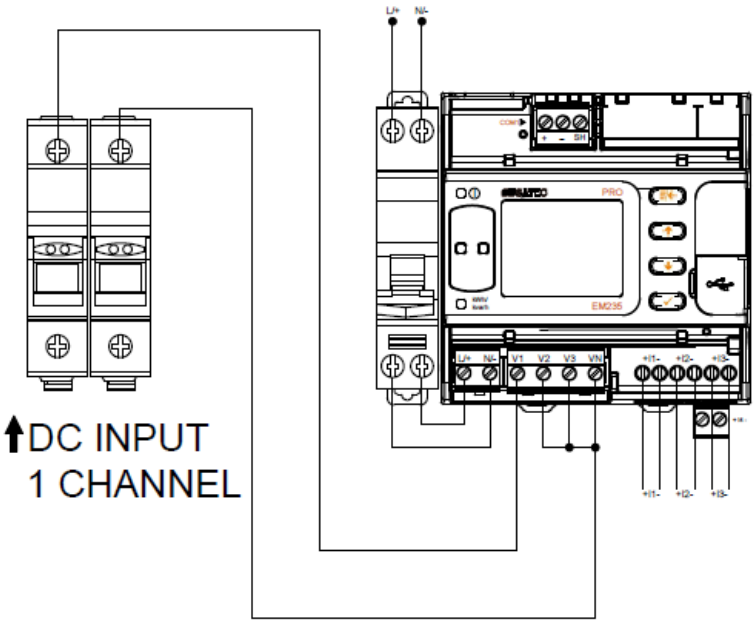
To protect the VDC input, we recommend using specific long 2A PV fuses (10x85mm) with suitable fuse holders rated for the adequate nominal voltage depending on the application (direct connection or above the meter rating) to minimize arcing risk in any maneuver. Recommended to protect Positive and Negative poles.

3.2 Direct Connection

If the connected voltage is less than 800VDC, meter can be connected directly to voltage reference.

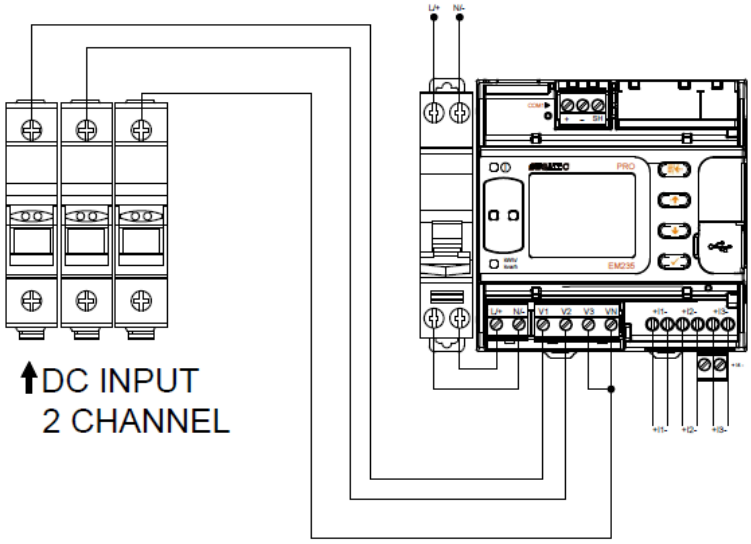
For voltages exceeding 800VDC, the VRM module from SATEC is required, please consult section 3.3 VRM Connection (Above the meter rating) for further information.

3.2.1 1 VDC Input Channel Direct Connection



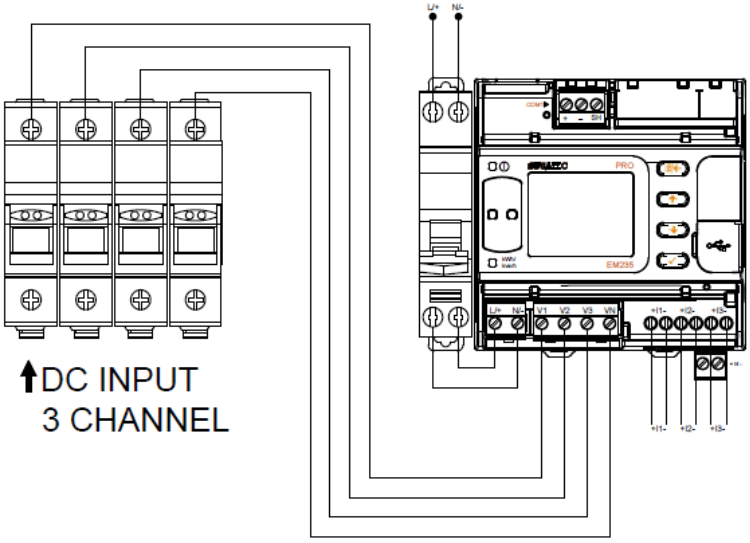
- Connect Input V+ to V1 on the meter.
- Connect Input V- to VN on the meter.
- Bridge V2 and V3 to VN.

3.2.2 2 VDC Input Channel Direct Connection



- Connect Input V1+ to V1 on the meter.
- Connect Input V2+ to V2 on the meter.
- Connect Input V- to VN on the meter.
- Bridge V3 to VN.

3.2.3 3 VDC Input Channel Direct Connection



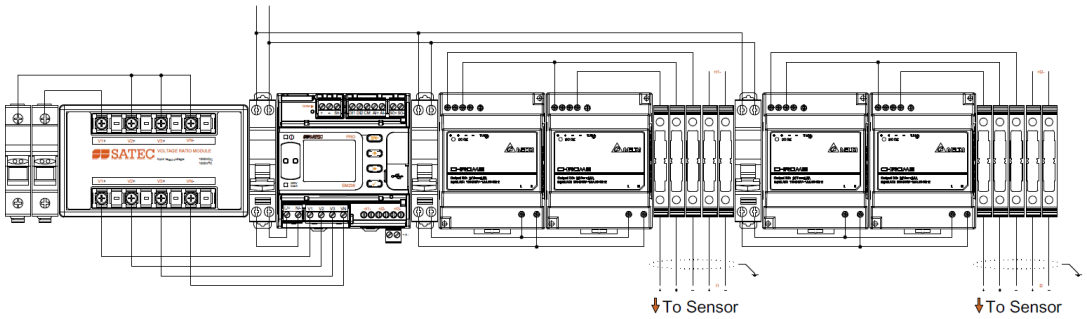
- Connect Input V1+ to V1 on the meter.
- Connect Input V2+ to V2 on the meter.
- Connect Input V3+ to V3 on the meter.
- Connect Input V- to VN on the meter.

3.3 VRM Connection (Above the Meter Rating)

Voltage connections for PRO series meters in DC applications where more than 800VDC is required must be used, ensuring that the nominal voltage per phase (+ / -) does not exceed 1.500VDC).

It is recommended to connect VRM module and the meter using cables that have minimum 600V insulation (CATIII). Recommended distance between VRM and metering deice should be less than 2 meters (cable length).

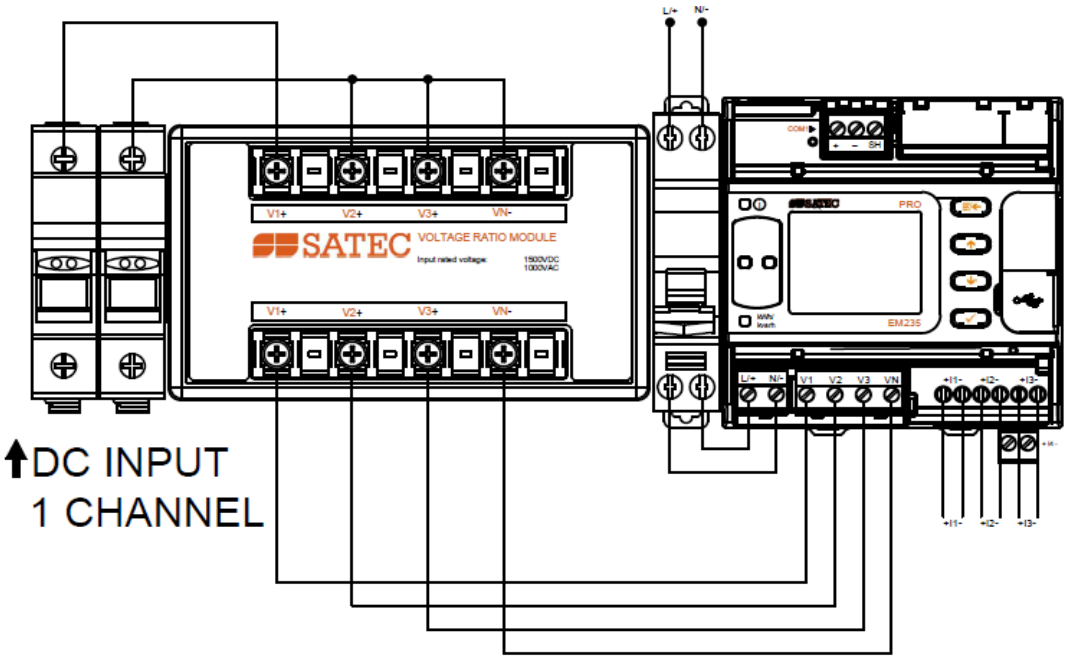
Please note that although the OLD VRM module versions are marked with "Input" and "Output," these terminals are bi-directional and can be exchanged without any issues.



Example: of 1VDC and 2 DC currents with +/- 24DVC power supply connection scheme

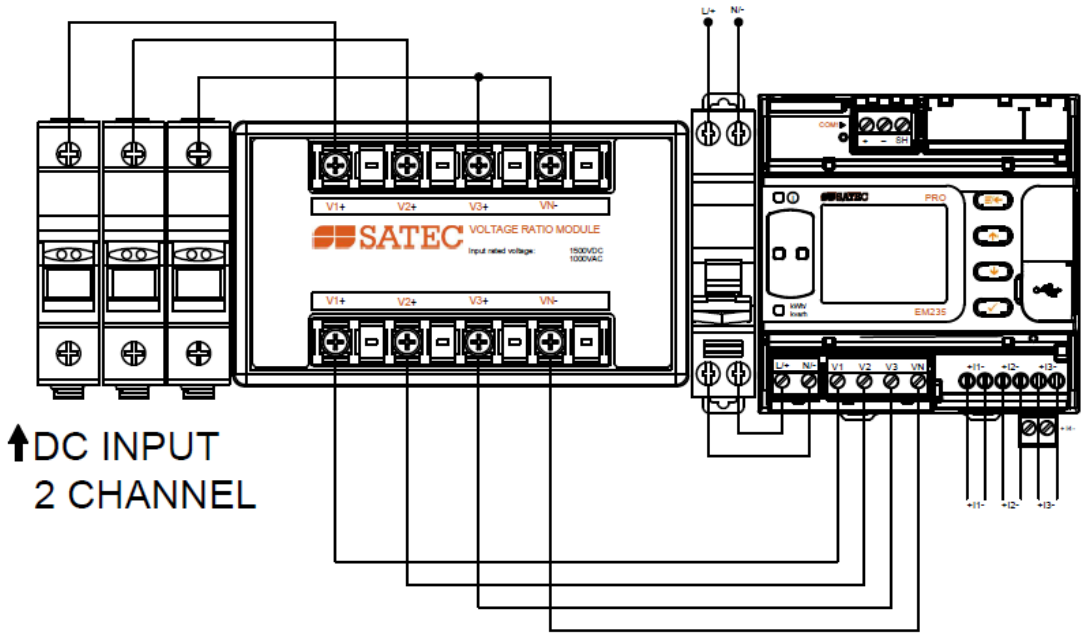
In case of doubt, please contact your local dealer for any required support.

3.3.1 1 VDC Input Channel with VRM



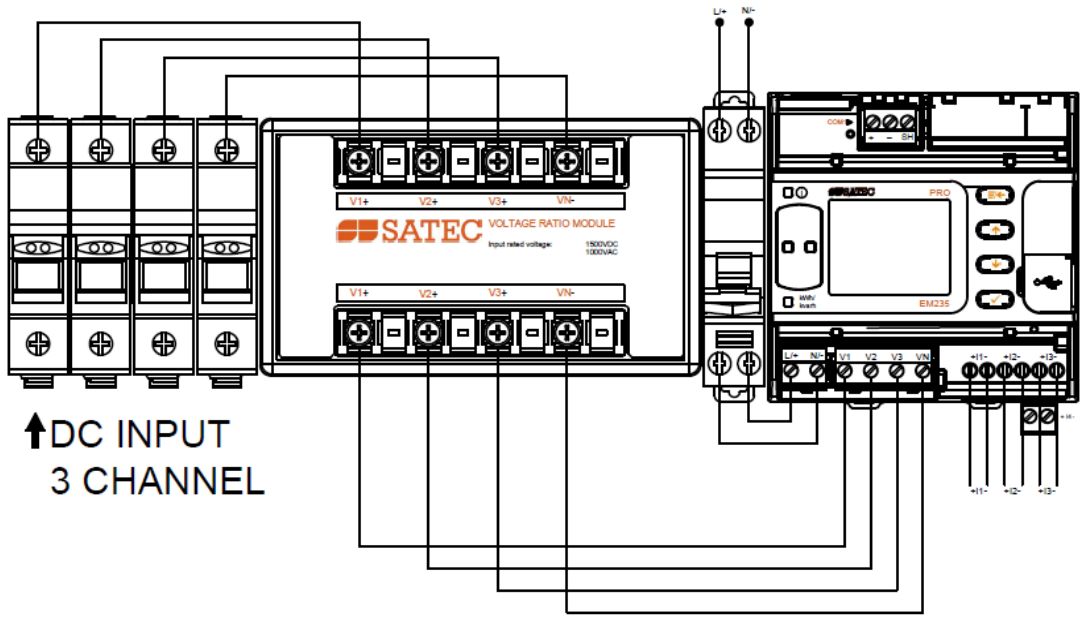
- Connect Input V1+ to CH1 (V1) on the VRM. Connect V1 VRM to V1 on the meter.
- Connect Input Vn- to CHn (VN) on the VRM. Connect Vn VRM to Vn on the meter.
- Bridge Input V2+ and Input V3+ to CHn (VN) on VRM.
- Connect V2 VRM to V2 on the meter and V3 VRM to V3 on the meter.

3.3.2 2 VDC Input Channel with VRM



- Connect Input V1+ to CH1 (V1) on the VRM. Connect V1 VRM to V1 on the meter.
- Connect Input V2+ to CH2 (V2) on the VRM. Connect V2 VRM to V2 on the meter.
- Connect Input Vn- to CHn (VN) on the VRM. Connect Vn VRM to Vn on the meter.
- Bridge Input V3+ to CHn (VN) on VRM. Connect V3 VRM to V3 on the meter.

3.3.3 3 VDC Input channel with VRM



- Connect Input V1+ to CH1 (V1) on the VRM. Connect V1 VRM to V1 on the meter.
- Connect Input V2+ to CH2 (V2) on the VRM. Connect V2 VRM to V2 on the meter.
- Connect Input V3+ to CH3 (V3) on the VRM. Connect V3 VRM to V3 on the meter.
- Connect Input Vn- to CHn (VN) on the VRM. Connect Vn VRM to Vn on the meter.

Chapter 4 UHACS – Ultra High Accuracy Current Sensor Connection

4.1 Preliminary Notes

The equipment installation shall conform to the following instructions:

1. A switch or circuit-breaker shall be included in the building installation;
2. It shall be in close proximity to the equipment and within easy reach of the OPERATOR.
3. It shall be marked as the disconnecting device for the equipment.
4. Don´t connect the UHACS nor the power supply to GND.
5. While wiring the UHACS the secondary output must never be allowed to be open circuit when the primary is energized. An open circuit can cause high voltages, possibly resulting in equipment damage, fire and even serious or fatal injury. Ensure that the UHACS wiring is secured using an external strain relief to reduce mechanical strain on the screw terminals, if necessary.
6. Ensure that shorting bars are present at the meter current terminals to allow safe disconnection.

Before installing, ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.

This section covers wiring and connection schemes for the following UHACS sensors: FCS-300, FCS-600, FCS-1000 and FCS-2500-13. Later will be also adding FCS-30 and FCS-100.

The meter supports up to three independent current channels. The fourth channel is reserved for future applications. All sensors connected to the meter must be of the same type (i.e., same primary current rating).

UHACS sensors are active sensors that need a Power Supply to work.

The UHACS sensor range spans from 30A DC to 2500A DC, all operating on the same principles and having same internal design, differing only in shape / size and weight.

FCS-300, FCS-600, FCS-1000 use the same type of Power Supply so the connection schematics is exactly the same and 300A and 600A will be covered in the same section.

FCS-1000 requires the same voltage but higher power supply, however the connector is different from 300A and 600A. FCS-1000 sensor uses the same as connector FCS-2500-13.

4.2 Power Supply-Requirements

As stated previously UHACS sensors are active sensors that need a Power Supply to work. A suitable power supply for this application should meet the following requirements:

a) Class II Power Supply (Double or reinforced insulation barrier between Input and Output).

WARNING: Class II and Class 2 is not the same.

b) Each UHACS sensor requires its own power supply.

c) Output (voltage and power) depends on the UHACS model (Please refer to the datasheet of the UHACS that will be used).

d) When choosing a power supply please take into account derating parameters such as height (sea level), humidity, temperature, etc.

4.2.1 Tested Power Supplies

The following power supplies have been tested with each type of sensors:

- TRACO TMP 15215C (± 15VDC / 15W) for FCS-300, FCS-600
- TRACO TMP 30215C (± 15VDC / 30W) for FCS-1000
- MeanWell HDR 30-24 (2 PS connected in parallel) for FCS-2500-13 to provide ± 24VDC (please see wiring diagrams in Item 2.4.2)

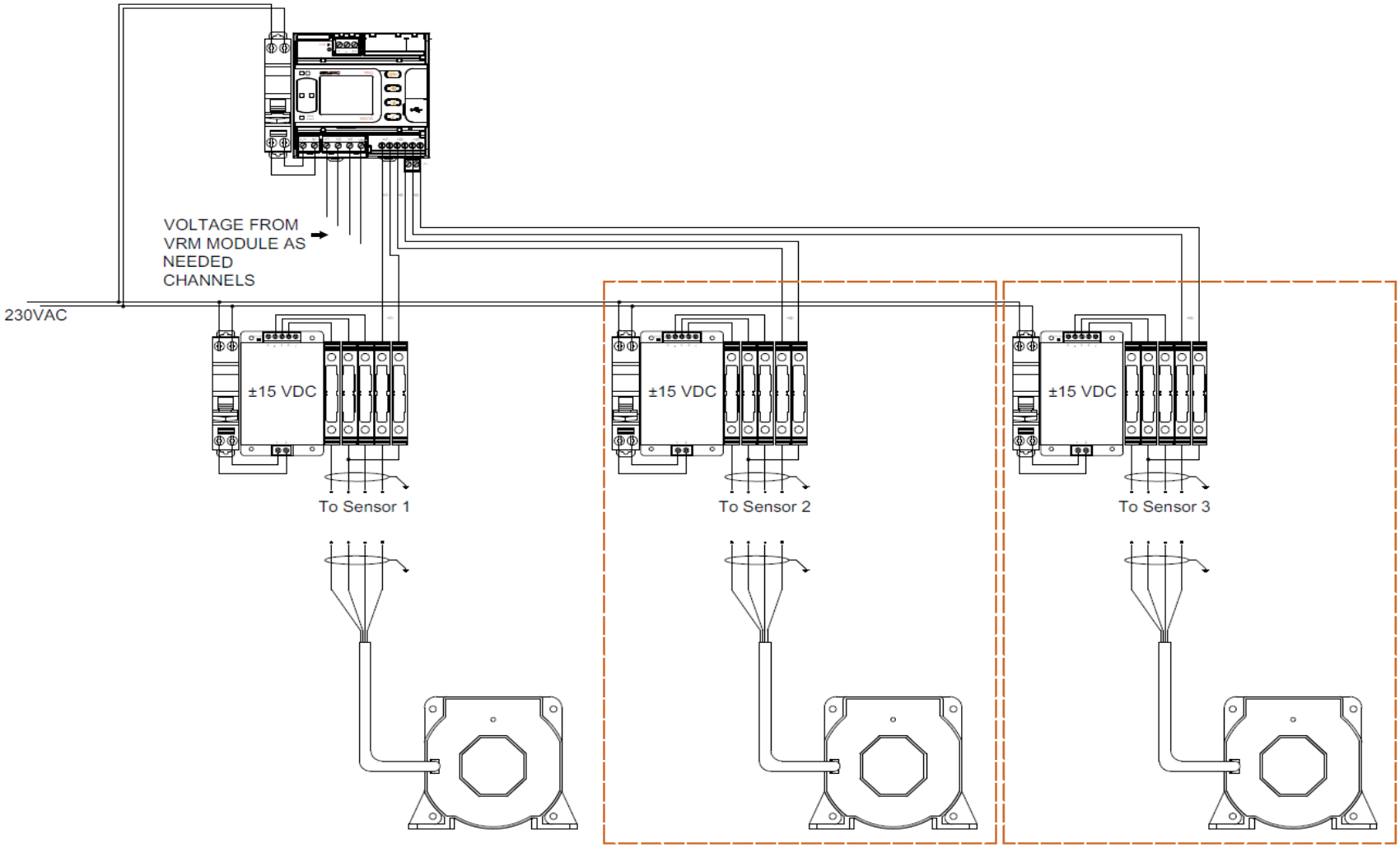
Incorrect sensor connection or an unsuitable Power Supply may result in sensor failure.

Always refer to the power supply manufacturer's datasheet for guidance. If further assistance is required, please contact your local dealer.

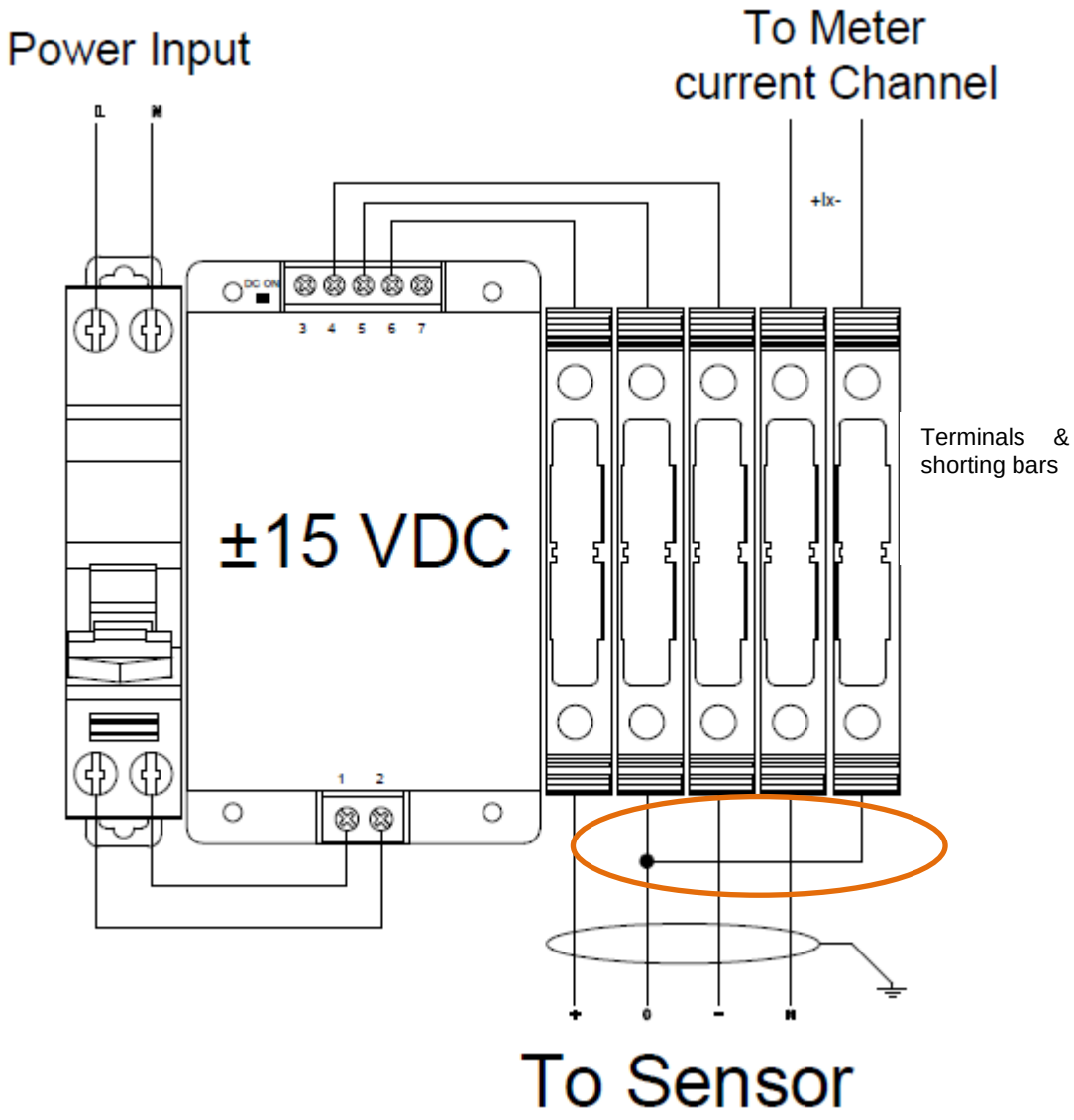
4.3 UHACS - Ultra High Accuracy Current Sensor Connection

For sensor connections, refer to the following diagrams. If fewer than three channels are needed, ignore the sensors and other elements inside the red boxes.

4.3.1 UHACS FCS-300, FCS-600 Sensor Wiring



4.3.2 UHACS FCS-300, FCS-600 Sensor Wiring (DETAIL)



Ensure that shorting bars are present at the meter current terminals to allow safe disconnection.

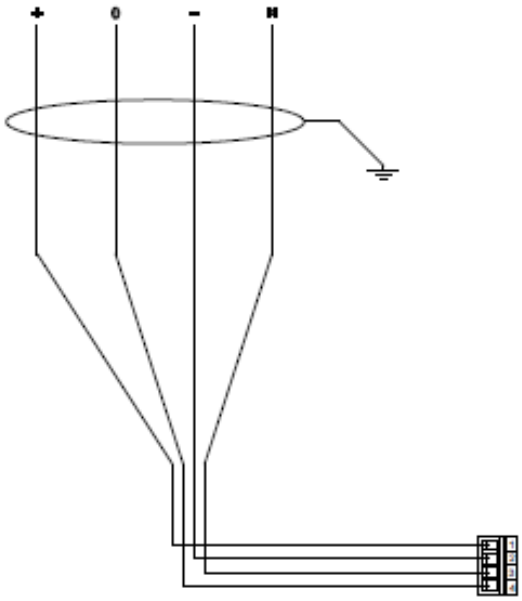
Use only the recommended power supplies and adhere to the manufacturer's specifications.

SPECIAL ATTENTION:

Bridge the negative current channel of the meter to the 0V from Power Supply.

4.3.3 UHACS FCS-300, FCS-600 Sensor Connectors (DETAIL)

PINS	NOTE	
1	+	Power Supply
2	-	Power Supply
3	M	Meter Positive Current Input
4	0V	Power Supply
		Meter Negative Current Input



Ensure proper polarity to prevent damage.

Twisted pairs shielded cable is recommended.

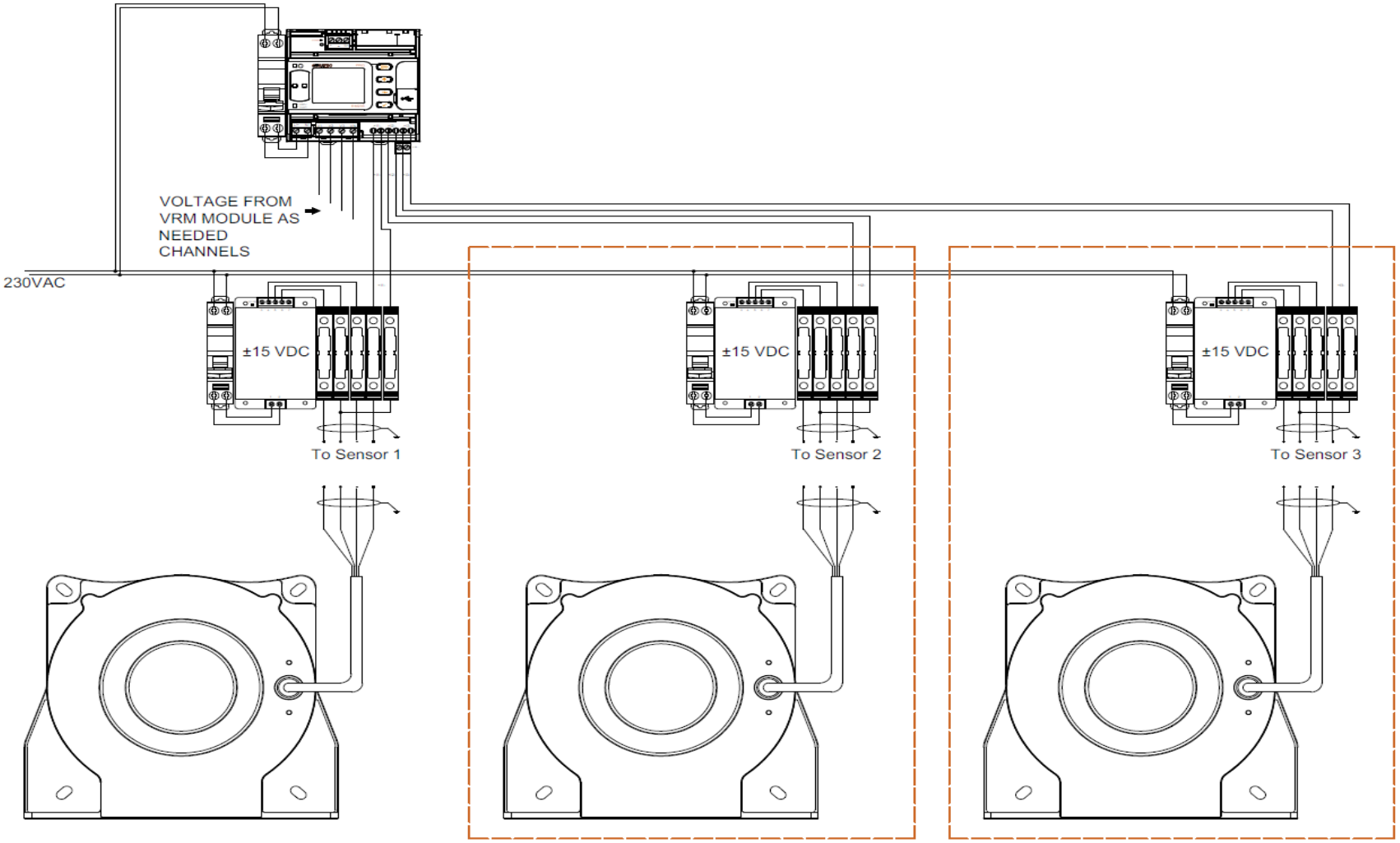
First pair:

- Pins 1 & 2 (Positive and Negative pole from Power supply)

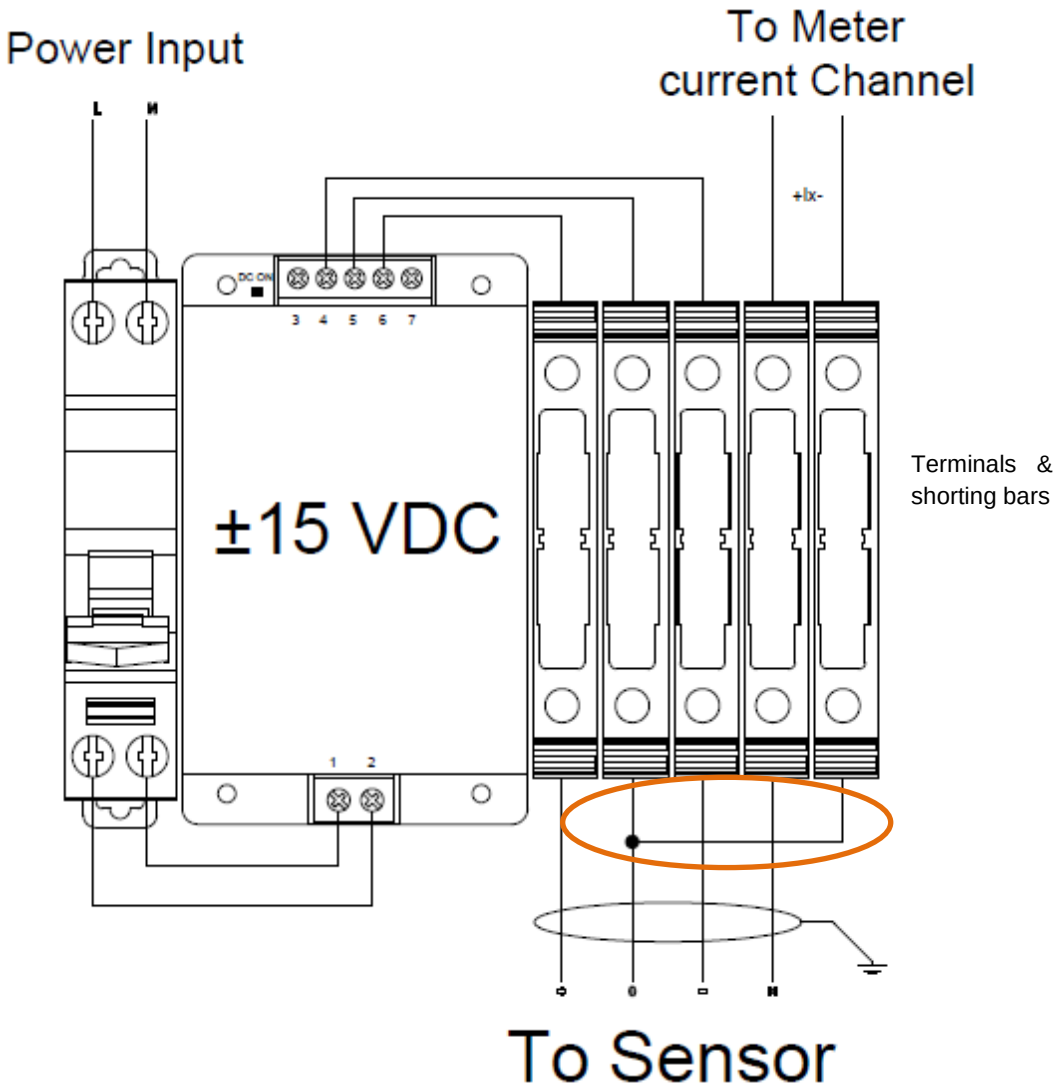
Second Pair:

- Pins 3 & 4 (Zero Power Supply / Negative current Input and M Positive Current Input)

4.3.4 UHACS FCS 1000 Sensor Wiring



4.3.5 UHACS FCS 1000 Sensor Wiring (DETAIL)



Ensure that shorting bars are present at the meter current terminals to allow safe disconnection.

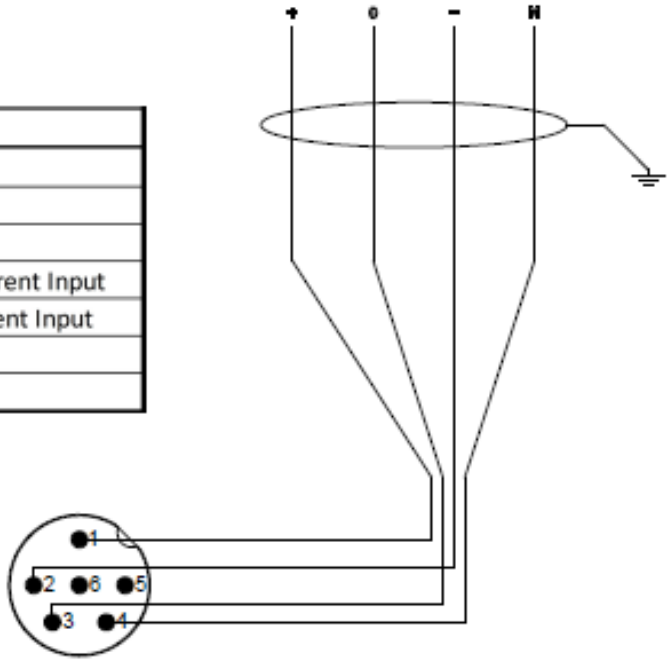
Use only the recommended power supplies and adhere to the manufacturer's specifications.

SPECIAL ATTENTION:

Bridge the negative current channel of the meter to the 0V from Power Supply.

4.3.6 UHACS FCS 1000 Sensor Connector (DETAIL)

PINS	NOTE	
1	+	Power Supply
2	-	Power Supply
3	0V	Power Supply
		Meter Negative Current Input
4	M	Meter Positive Current Input
5	N/A	
6	N/A	



Ensure proper polarity to prevent damage.

Twisted pairs shielded cable is recommended.

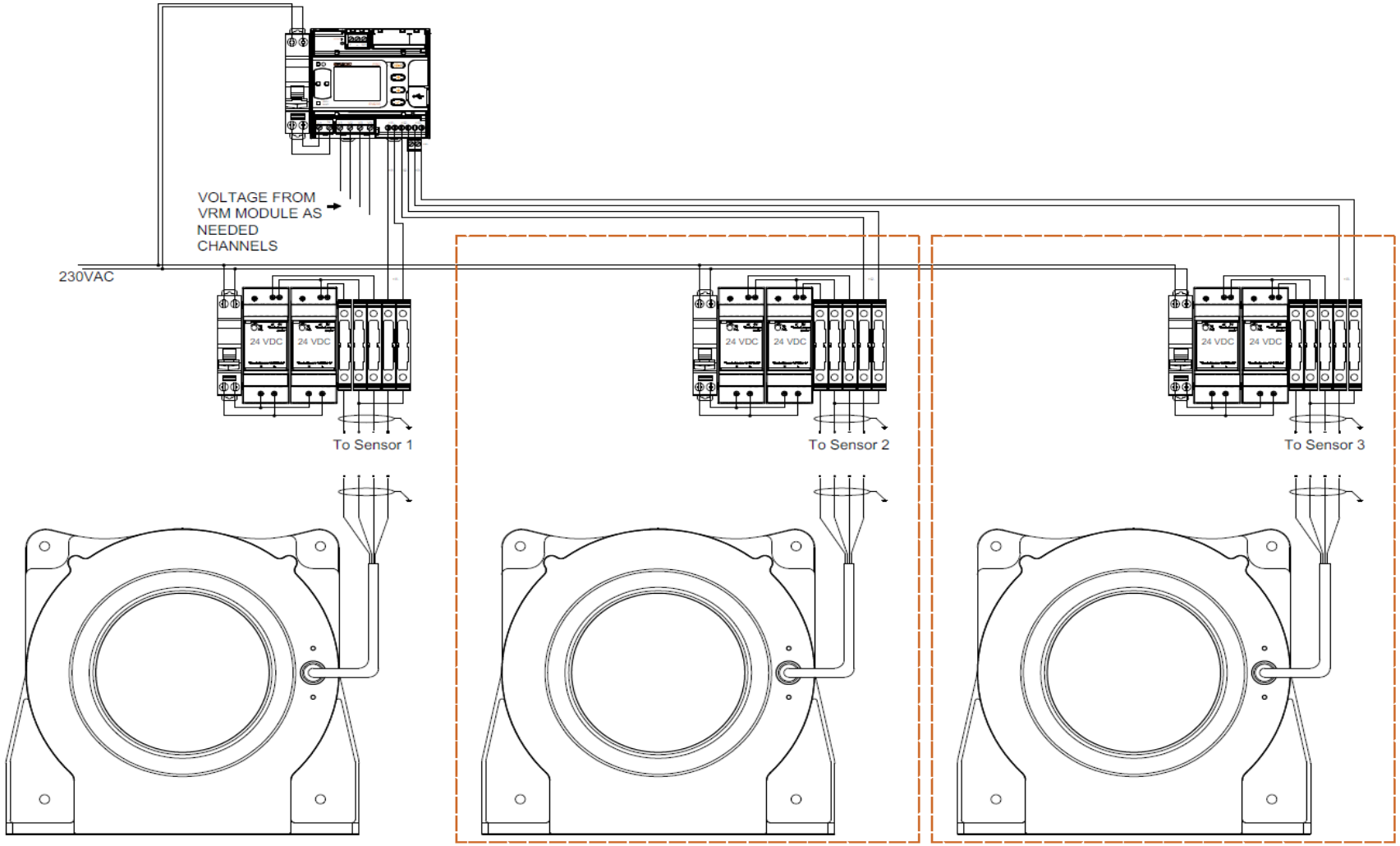
First pair:

- Pins 1 & 2 (Positive and Negative pole from Power supply)

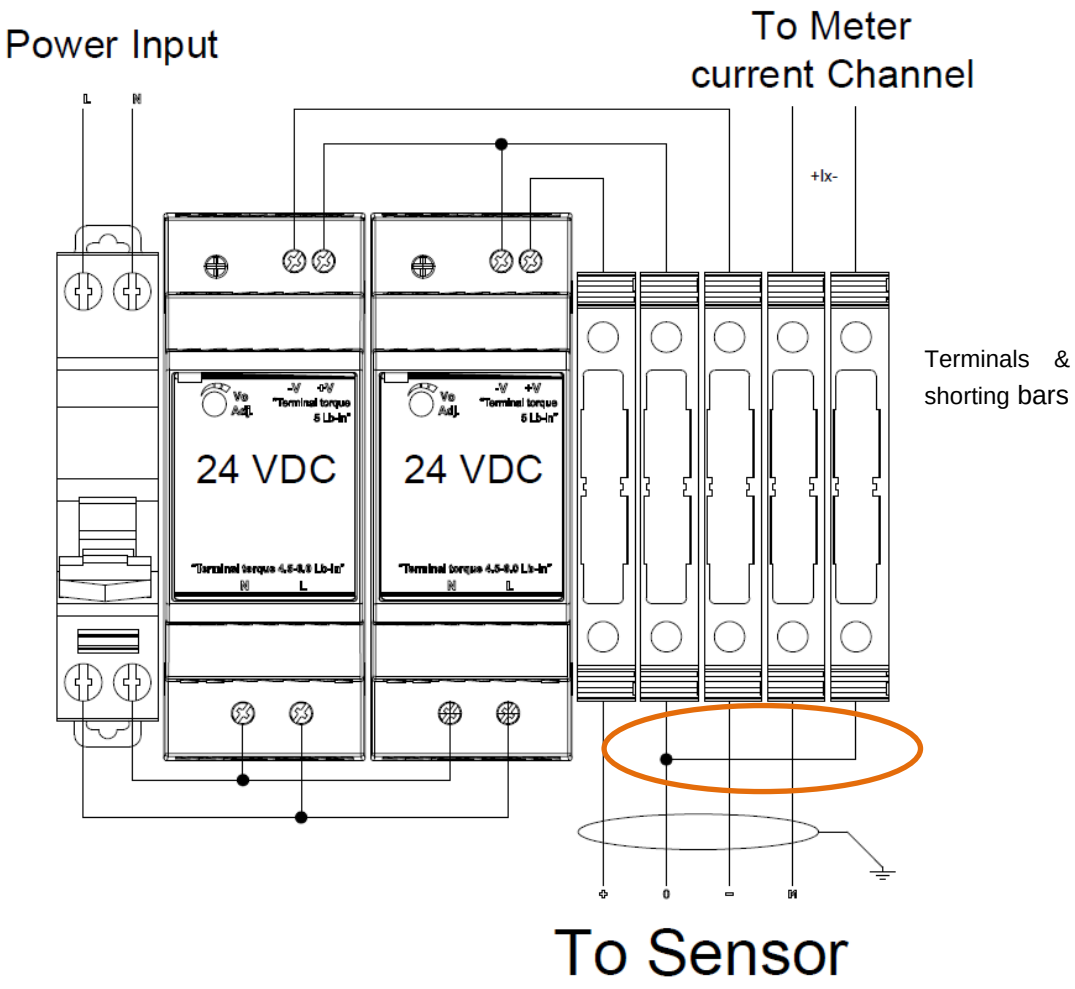
Second Pair:

- Pins 3 & 4 (Zero Power Supply / Negative current Input and M Positive Current Input)

4.3.7 UHACS FCS 2500-13 Sensor Wiring



4.3.8 UHACS FCS 2500-13 Sensor Wiring (DETAIL)



Ensure that shorting bars are present at the meter current terminals to allow safe disconnection.

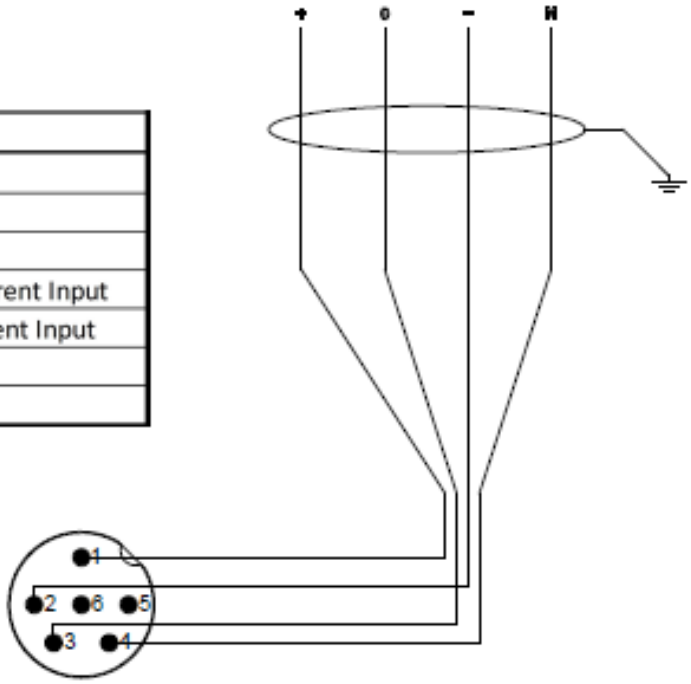
Use only the recommended power supplies and adhere to the manufacturer's specifications.

SPECIAL ATTENTION:

Bridge the negative current channel of the meter to the 0V from Power Supply.

4.3.9 UHACS FCS 2500-13 Sensor Connector (DETAIL)

PINS	NOTE	
1	+	Power Supply
2	-	Power Supply
3	0V	Power Supply
		Meter Negative Current Input
4	M	Meter Positive Current Input
5	N/A	
6	N/A	



Ensure proper polarity to prevent damage.

Twisted pairs shielded cable is recommended.

First pair:

- Pins 1 & 2 (Positive and Negative pole from Power supply)

Second Pair:

- Pins 3 & 4 (Zero Power Supply / Negative current Input and M Positive Current Input)

Chapter 5 UHACS – Operating Status and Troubleshooting

5.1 Operating Status

NORMAL STATUS

After the device is powered on, the green indicator light is on when the device is running normally.

FAULT STATUS

The green light will be off when the transducer is in fault mode.

5.2 Troubleshooting

a) When the green light is OFF:

1. Check power supply MCB.
2. Check power supply Input voltage.
3. Check power supply Output Voltage.
4. Ensure proper polarity to the sensor.
5. Check cable to sensors and connector.

b) When the power supply, cable and connector is normal and green light remains OFF:

1. UHACS is working in non-zero flux mode. At this time, if the primary current is over the specified measurement range, the UHACS will be in overload mode, the secondary and primary currents are not proportional.
2. In overload mode, the output current always remains at the maximum output state, the green light is off.
3. When the input current returns to the specified measurement range, the transducer recover to normal condition, the green light return to be steady on.

c) Green light is ON but the readings are not correct:

1. One of the outputs of the Power supply is not connected or it´s failing (it can be Negative “-” / Common “0” / Positive “+”).

Disconnect the sensors as you find this issue, the internal PCB may have burned out and the sensor will become useless.

Chapter 6 DC Meter Configuration

6.1 Preliminary Notes

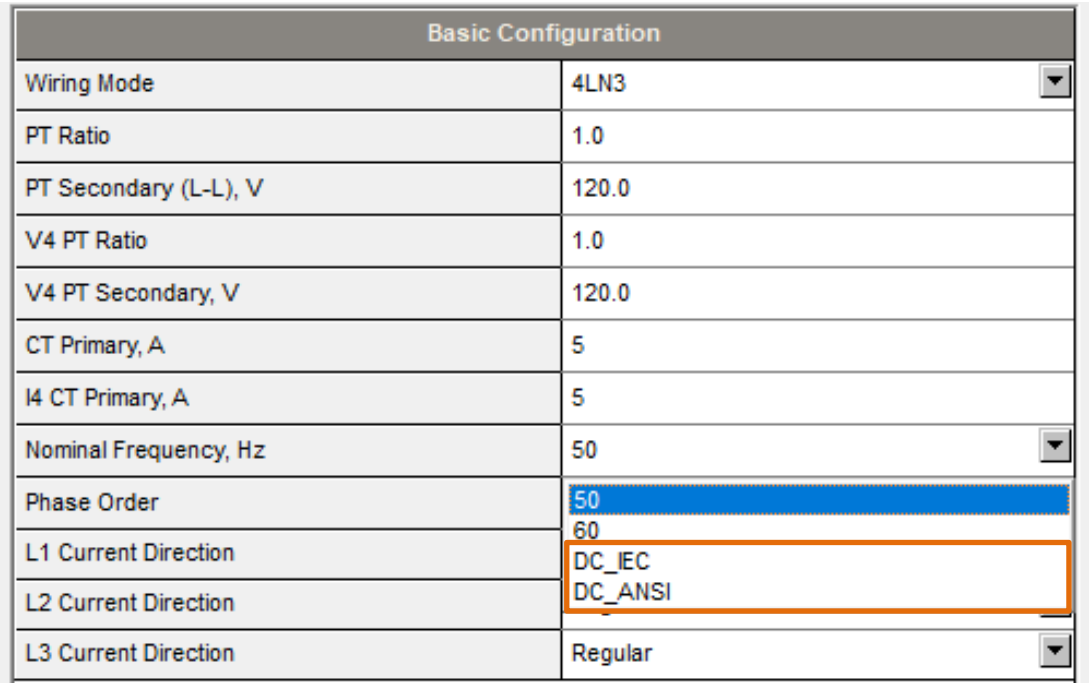
1. The PRO series meters include a feature (exclusive to the HACS version) that allows their use in DC applications.
2. For proper configuration PAS software is required.
3. Only qualified personnel familiar with the instrument and its associated electrical equipment must perform setup procedures.

6.2 Configuration Steps

6.2.1 DC Mode (Frequency)

Navigate to: ***Menu > Meter Setup > General Setup > Basic Setup***

- In the Basic Configuration section, set Nominal Frequency, Hz to DC_IEC or DC_ANSI as required standard.



6.2.2 Power Calculation Mode

Navigate to: ***Menu > Meter Setup > General Setup > Device Options***

- In the Power/Energy Options section, set Power Calculation Mode to Q = f (S, P).

Power/Energy Options	
Power Calculation Mode	Q = f(S,P)
Energy Roll Value	S = f(P,Q) Q = f(S,P)
Energy Decimals	0
Interval Energy, min	15
Tariff Control	Calendar
Number of Tariffs	1
Relay Pulse Rate Decimals	1

6.2.3 Voltage Configuration & Wiring mode

Navigate to: ***Menu > Meter Setup > General Setup > Basic Setup***

- In the Basic Configuration section, specify the PT Ratio:
  - If using the VRM module, set PT Ratio = 3.5.

Basic Configuration	
Wiring Mode	4LN3
PT Ratio	3.5
PT Secondary (L-L), V	120.0

  - If not using the VRM module, leave PT Ratio = 1.

Basic Configuration	
Wiring Mode	4LN3
PT Ratio	1.0
PT Secondary (L-L), V	120.0

- Do not change Wiring Mode setting for DC application, keep default 4LN3.

Basic Configuration	
Wiring Mode	4LN3

6.2.4 Current Configuration

Navigate to: ***Menu > Meter Setup > General Setup > Basic Setup***

- In the Basic Configuration section, set CT Primary, A to half the capacity of the UHACS sensor:

UHACS Sensor	CT Primary Setting
2500A	1250A
1000A	500A
600A	300A
300A	150A
100A	50A
30A	15A