ELTEK
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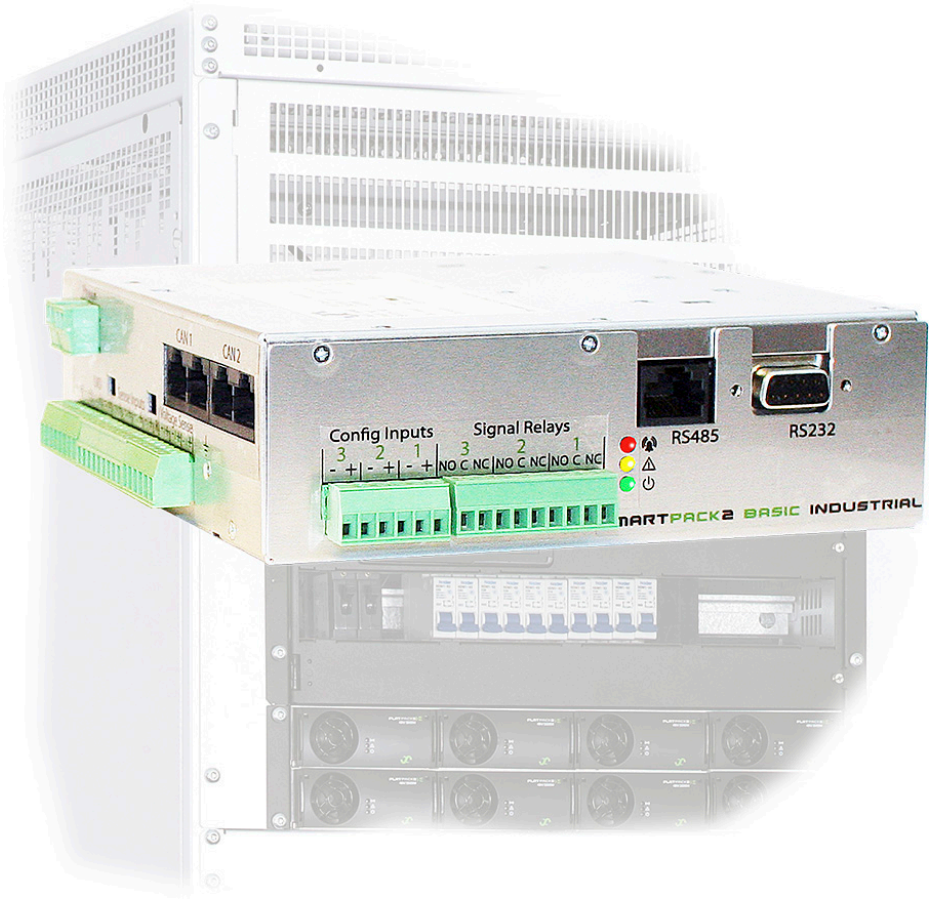
User's Guide

Smartpack2 Basic Industrial



Monitoring and Control Unit

Flatpack2 Power Supply Systems

350025.013

356800.183, 3v7

SAFETY and ENVIRONMENTAL PRECAUTIONS

The **product warranty** becomes invalid if the following safety precautions are not followed during handling, installation, commissioning and general use/operation of *Eltek* power supply systems.

General Precautions


Device Hazard

G1 **CAUTION:** Even though the product incorporates protection circuitry and other safeguards, it can be **damaged, perform poorly or have a reduced lifetime** if it is exposed to **incorrect treatment** during transport, installation or service. Always handle the equipment using proper lifting techniques, do not roll, climb or drill hole in the cabinets or enclosures.


Electric Shock

G2 **WARNING: Opening the equipment may cause personal injury — even if the mains AC supply is disconnected. Hazardous voltages may be present inside, as large capacitors may still be charged.**

Environmental Precautions


Ventilated Hot Surface

E1 **CAUTION:** To avoid damage the equipment, **keep objects clear of system ventilation inlets, outlets and system fans**, if any, ensuring the **airflow** through the units is **not obstructed**, and that the fans rotate freely. Use caution with power modules, as they can reach **extreme temperatures** under load and normal operation.


Current Surge Protection

E2 **WARNING: The installer/user is responsible for ensuring that the power system is not damaged by current surges, over-voltages, etc. caused by external transients, lightning, electrostatic discharge, etc. To avoid damage and obtain the expected system reliability, it is mandatory to always install SPDs in Eltek's power supply systems. Follow the instructions given in "Requirements for Surge Protection", doc. 2024623.**


Humidity & Dust Protection

E3 **WARNING: The electronics in the power supply system are designed for indoor, clean environment. When installed in outdoor enclosures — using heat sinks or closed loop heat management systems — it is important to maintain the equipment closed and tight during operation, to avoid external air entering the enclosure. Also, when using open loop heat management systems, it is important to replace the filters on a regular basis. Indoor installations in dusty or humid areas require appropriate air filtering of the room, or filtering of the air entering the power system. Follow the instructions given in "Generic Guidelines Environmental Protection.", doc. 2038879**

Precautions during Installation


Qualified Personnel

I1 **CAUTION: Read the user documentation carefully** before installing and using the equipment, as installation and operation is to be performed as described in it. Always tighten screws and bolts with the **torque values recommended by the supplier** of the terminals, breakers, etc. Also, refer to **Eltek's Typical Torque Recommendations** in the documentation. For safety reasons, the **commissioning and configuration of the equipment is only to be performed** by *Eltek*'s personnel or by authorized and qualified persons.


EMC, NEC/CEC Regard

I2 **CAUTION:** This product is tested and verified according to international safety, environmental and EMC standards. Any **non-*Eltek* equipment** installed into this product after delivery might influence the performance and **could infringe the original approvals**. The **installer is responsible** for ensuring that the environmental properties of this product/ system do not deteriorate during installation, and that it is performed in accordance with applying regulations.

Installations in USA and Canada must comply with NEC/CEC requirements.


Device Hazard

I3 **CAUTION:** Before you start the electrical installation, you must **always disconnect** all external supply circuit breakers, as well as internal battery and load fuses/ breakers, if any.


Electric Shock

I4 **WARNING: For safety reasons (high leakage current / high touch current) you must always connect the AC earth wire (PE) to the terminals, before you connect the AC input cable(s).**

The batteries, if any, represent a major energy hazard. To avoid short-circuit of battery poles, you must always remove metallic objects — uninsulated tools, rings, watches, etc. — from the vicinity of the batteries.


Electric Shock

I5 **WARNING: 60V power systems, and higher voltage systems, are only to be installed in Restricted Access Locations (RAL). Access must be limited by use of tool, i.e. lock and key.**

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QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001
Certificate No.
4072-2007-AQ-NOR-NA

ENVIRONMENTAL SYSTEM CERTIFICATION
DNV·GL
ISO 14001
Certificate No.
11276-2007-AE-NOR-NA

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1. Introduction

The *Smartpack2 Basic Industrial* controllers are reliable, versatile and cost-effective modules used as slave controllers in *Smartpack2*-based power systems for industrial and telecom applications.

About this Guide

This booklet describes the building blocks, external connections and technical specifications for the *Smartpack2 Basic Industrial* controller.

Read also the **generic and site specific documentation** for your power system.

For detailed functionality description, browse and search through the *Functionality Description* topic in *PowerSuite Online Help* or *CWUI Online Help*. Notice that you must **log in to access Online Help** (contact your Eltek representative). The user guide for the *Smartpack2 Master* controller (Doc 350020.013) might also be helpful.

Short about Industrial Power Systems

Many industrial loads are very sensitive to voltage dips and other disturbances originating from the grid. Industrial power systems solve, among other things, specific power quality problems in industrial applications. Read also *"3. Typical Industrial Applications" on page 22*.

What are Industrial Applications

The term "industrial applications" in this guide refers to power supply systems used in the business of manufacturing products, power generation and transportation, such as: process industry, power generation & distribution, rail and marine & offshore.

Industrial power systems may employ AC-DC rectifiers, DC-DC converters, DC/AC inverters, etc. with system voltages 24V, 48V, 60V, 110V, 125V and 220V. Also, the systems typically implement 2-pole floating DC output (not earthed or floating earth).

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System Diagram ~ Industrial FP2 System with SP2BI

The generic *Smartpack2* (SP2) distributed control system — used in *Flatpack2* PS systems for industrial applications — monitors and controls the whole system, and consists of the *Smartpack2 Master* (SP2M) controller and the *Smartpack2 Basic Industrial* controller (SP2BI).

The *Smartpack2 Master* controller serves as the local user interface between you and the system. The *Smartpack2 Basic Industrial* controller monitors and controls the power system's internal wiring and supplies both CAN bus systems with power. It also provides the system with input monitoring and output controlling signals. The system may also be configured via the controller's web-based user interface (CWUI) on a standard web browser and via the *PowerSuite* PC application.

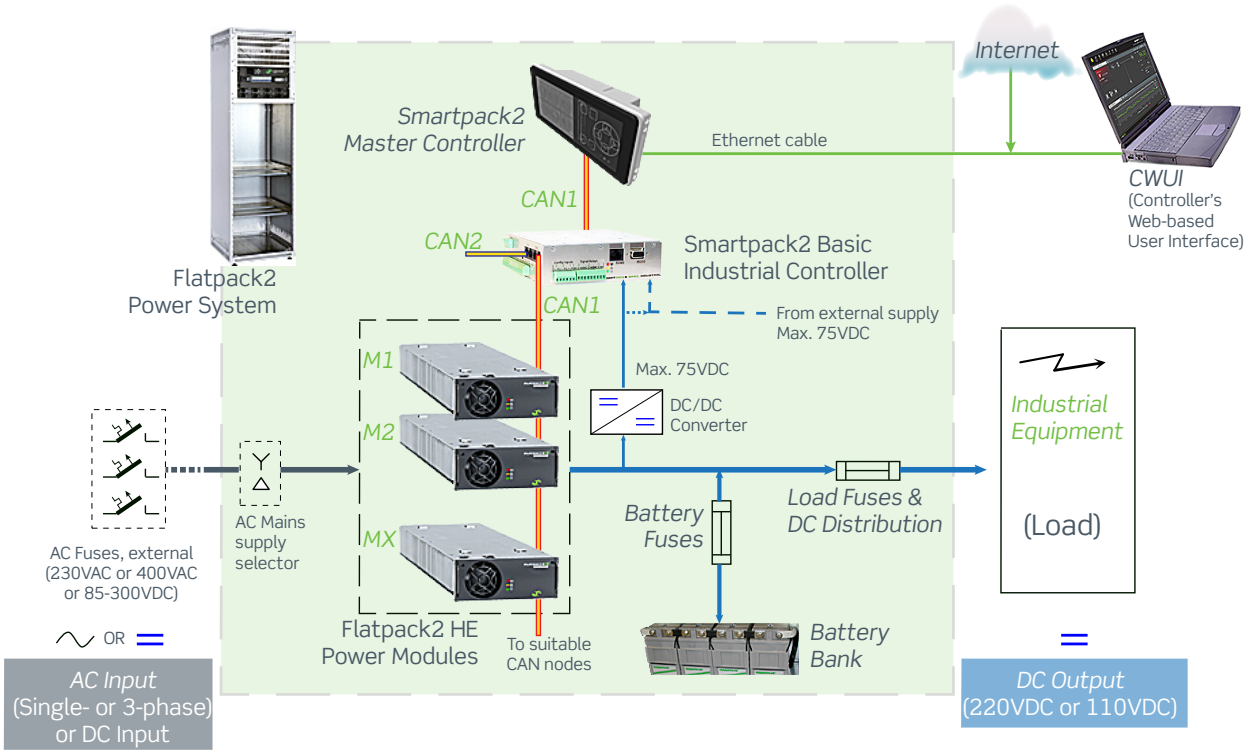

Figure 1. Example of a typical Flatpack2 DC power supply system for 220 or 110VDC industrial equipment. The system is fed from an external AC mains supply or DC supply, and consists of rectifiers in power shelves, master and industrial basic controllers and 2-pole DC distribution unit. Battery banks are typically also a part of the system

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2. The Smartpack2 Basic Industrial Controller

The *Smartpack2 Basic Industrial* controllers are reliable and versatile modules used as **slave controllers** in the distributed control system of *Smartpack2*-based power applications. They can also operate in **stand-alone mode**, maintaining the system in normal operation, thus providing redundancy and improving system reliability.

The versatile *Smartpack2 Basic Industrial* controllers can be used in typical industrial and telecom power supply applications, with system voltage ranging from **12VDC to 430VDC**, and using **negative-, positive- and floating DC distribution** units. Read also section *"3. Typical Industrial Applications" on page 22*.

They are developed for monitoring and controlling the power system's internal functionality, and provide two isolated distributed power sources for CAN nodes connected to **two separated CAN bus systems with floating voltage references**. While the two CAN bus systems are used for internal system communication, the SP2BI controllers may also communicate with external systems via **isolated RS232** (COM1) and **RS485** (COM2) serial ports.

For increased reliability, the controllers may be **fed from two external supplies**, as the two internal switch mode power supplies feed one CAN interface each, and both feed the controller's measuring circuitry. The controller's core functionality and one CAN interface will still function normally, even after the loss of one of the external power inputs.

The *Smartpack2 Basic Industrial* controllers implement — among many other features — isolated and floating measuring circuitry with **selectable measuring reference point**, with voltage sense inputs ranging from **0 to 430VDC**.

The **3 configurable multipurpose inputs** operate in the range of max. – 10 to +10VDC, and are intended for **great accurate measurements**, e.g. for temperature sensing using an external temperature NTC probe. Also, these inputs are suitable for monitoring other sensors (of pressure, humidity, etc.) that output 4mA to 20mA. An external 470 ohms resistor is then to be connected to the input's terminals on the controller, in parallel with the sensor's cables.

Key Features

A wide range of features are implemented in the *Smartpack2 Basic Industrial* controllers:

- 3 LED lamps for local visual alarming (Major, Minor, Power ON)
- 2 separated CAN bus systems with distributed power for connected CAN nodes
- 2 serial communication ports, RS232C and RS485, for external equipment
- 5 sense inputs for internal monitoring: 3 voltage sense inputs and 2 current sense inputs
- 2 configurable inputs for load and battery fuse monitoring
- 1 internal isolation sense input for Earth fault detection

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- ◊ 3 configurable multipurpose inputs (temperature, digital inputs or analog signals)
- ◊ 3 LVD control outputs, configurable for latching and non-latching contactors
- ◊ 3 user programmable NC-C-NO relay outputs for remote control
- ◊ Up to 10 *Smartpack2 Basic Industrial* controllers may be connected each CAN bus
- ◊ CAN bus addressing via DIP switches
- ◊ Compatible with telecom and industrial system voltages up to 430VDC
- ◊ Suitable for power systems with negative-, positive- and floating DC distribution
- ◊ Controller's electronics implemented in 7 different isolated sections
- ◊ Configuration via the master controller's front keys and via the controller's web-based user interface (CWUI) on a standard web browser and via the *PowerSuite* PC application
- ◊ Firmware upgrade via the CAN bus (refer to *page 21*)

Read also section *"Technical Specifications" on page 20*, for more details.

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Block Diagram

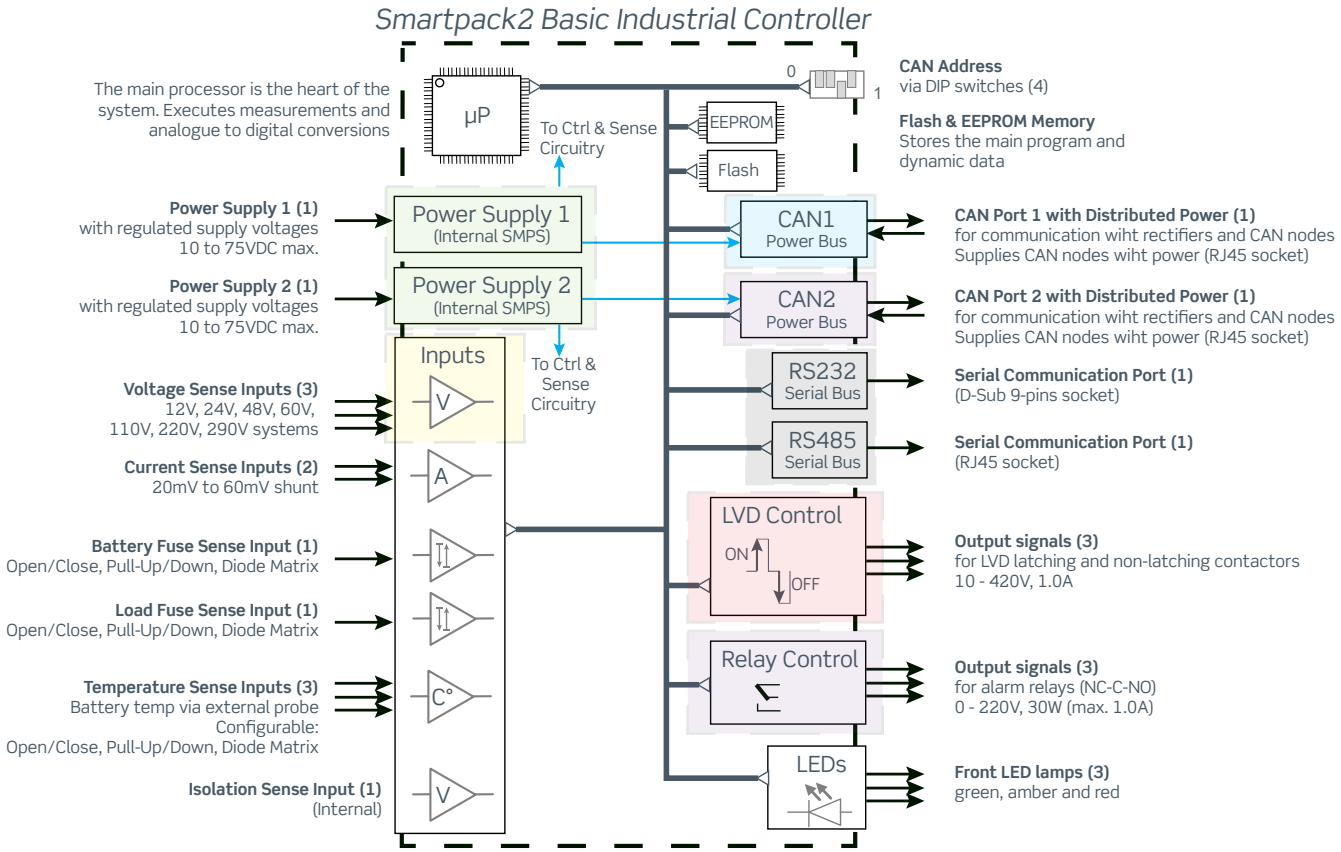

Figure 2. Block diagram for the Smartpack2 Basic Industrial controller, indicating the 7 different isolated sections

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Location of Components

Terminal Blocks, Ports and LEDs

For a complete list of signals, pin-out, etc., refer to section *"Connection Drawing" on page 16*.

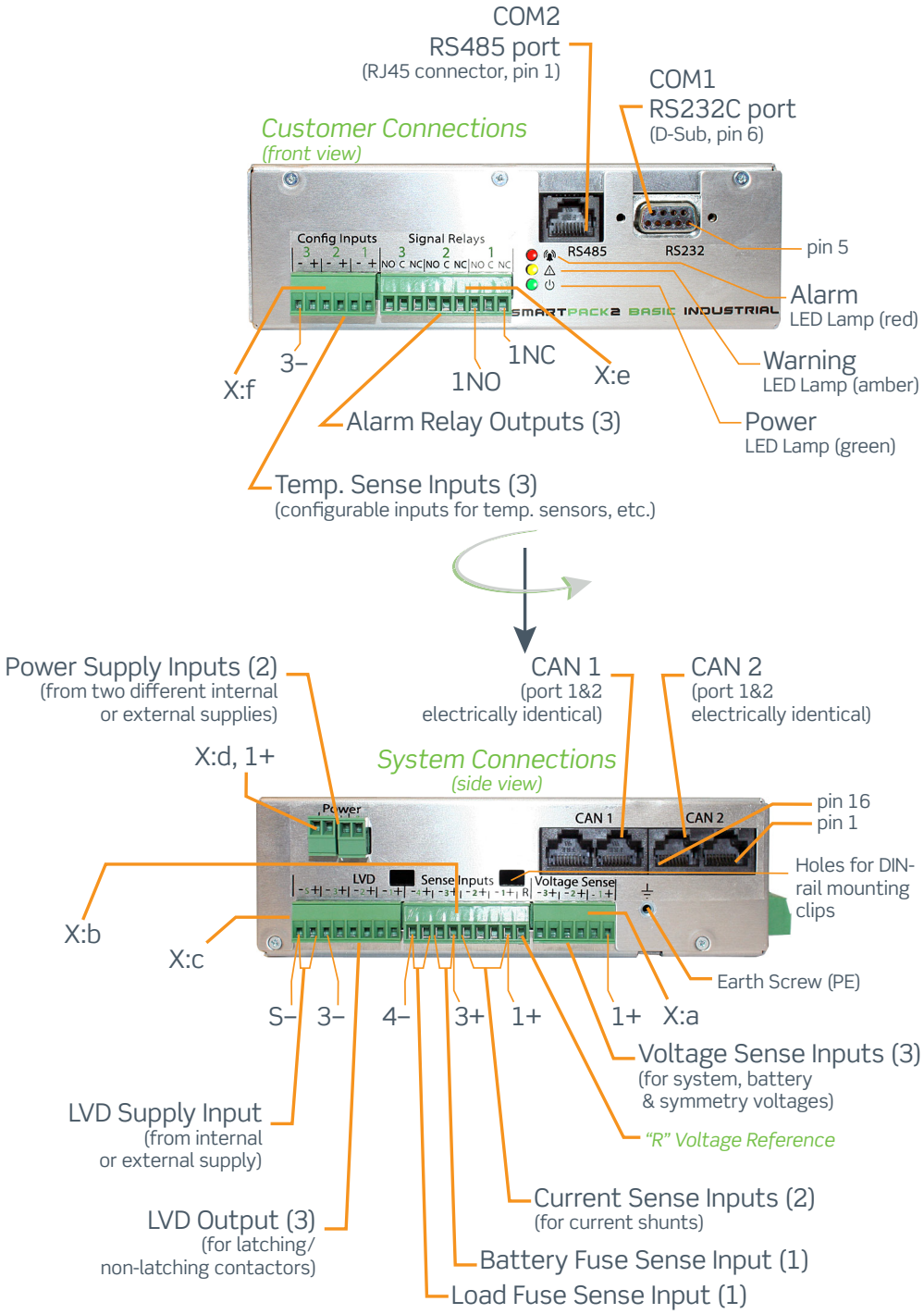

Figure 3. Location of pluggable terminal blocks, CAN ports, RS232C, RS485 serial ports and LED indicators in the Smartpack2 Basic Industrial controller. (The pluggable terminals may be black or green)

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CAN1 port 1 and 2 and CAN2 port 1 and 2 are electrically identical, and are used to enable connection of the CAN bus incoming and outgoing cables, or the RJ45 CAN bus termination plug.

To increase reliability, the **two power supply inputs** can be connected to two different power sources. When only one power source is used, the power input terminals must be connected together or paralleled (+ & + and — & —).

Voltage Reference, "R" Terminal

To obtain accurate voltage measurements, the "R" terminal (Voltage Reference) must be connected to the system's positive- or negative bus-bar, where the system's current shunts or monitored fuses are installed. When no current shunts are used and no fuses are monitored, the "R" terminal is to be connected to either the system's positive- or negative bus-bar.

For interpreting the LED lamps indications, refer to *Table 1 on page 11*.

LED Indicator	Illumination Status	Description
Power	OFF ON green Flashing green	The controller is OFF, has NO supply ON or Supply healthy Distributed Power Fault
Warning	OFF ON amber Flashing amber	No Warning Warning (Minor alarm, non-critical alarm) Communications Fault
Alarm	OFF ON red Flashing red	No Alarm Alarm (Major Alarm, critical alarm) SW Fault or Boot Loader Mode

Table 1. Description of the SP2BI controller's LED illumination status

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Jumpers and DIP Switches

On the controller's bottom you find the Isolation Sense jumper and four DIP switches. While the RS485 EOL resistor jumper is located on the controller's top.

RS485 End-of-Line Resistor Jumper

When the RS485 EOL resistor jumper (JP300), on the controller's top, is inserted, the RS485 serial line is automatically terminated with a 150Ω end-of-line resistor at the controller's side.

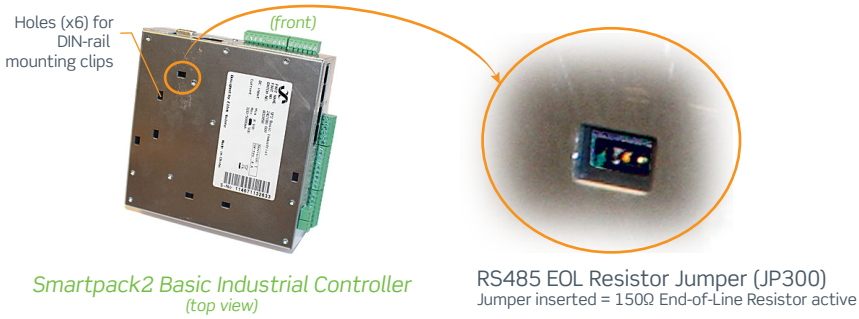

Figure 4. Location of the RS485 EOL resistor jumper in the SP2BI controller

DIP switches

The **four DIP switches,** see *Figure 5 on page 12,* are used for configuring the controller's unique CAN bus ID number, refer to section *"CAN Bus Addressing" on page 18*.

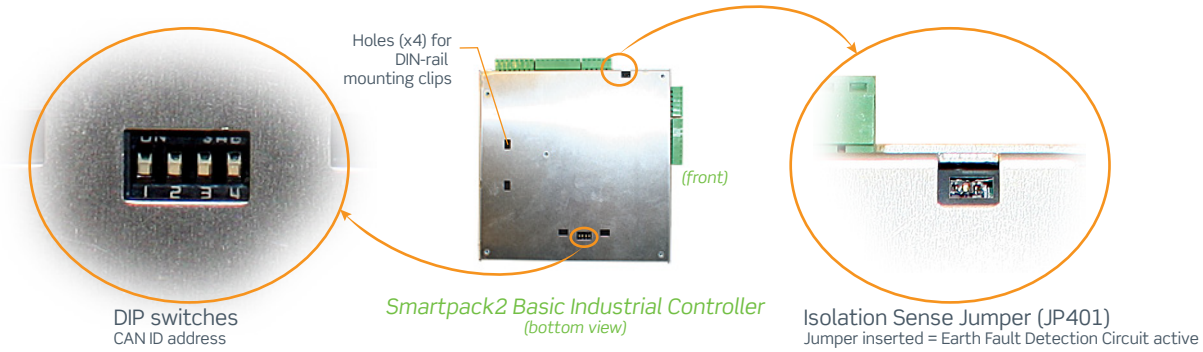

Figure 5. Location of DIP switches, and Isolation jumper in the SP2BI controller

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"Earth Fault" Isolation Jumper

The Isolation Sense jumper (JP401), see *Figure 5 on page 12*, can be used to "connect" or **isolate the internal Earth Fault Detection measuring circuitry**.

Inserting the jumper makes the internal circuitry active. Removing the jumper (e.g. with needle-nose pliers) isolates or disconnects the circuitry from the ground (read topic *Earth Fault Detection* in Online Help), which is required e.g. during isolation tests at the factory or in Telecom systems with grounded DC output or when using external earth fault detection equipment.

Earth Fault Isolation Relay

Smartpack2 Basic Industrial controllers, v1.1 or higher — Read "A" in *"Endnotes" on page 35* — are shipped from factory with the Isolation Sense jumper (JP401) removed, as they incorporate an **internal relay that automatically implements the jumper's function**, when you enable and configure the Earth Fault Alarm Monitor to be able to generate earth fault alarms.

By default the Earth Fault Alarm Monitor is disabled and the internal Earth Fault Detection measuring circuitry is isolated. When you enable the Earth Fault Alarm Monitor, the internal relay automatically "connects" the measuring circuitry.

When the internal Earth Fault Detection measuring circuitry is active, you can **enable and configure the Earth Fault Alarm Monitor** to monitor the circuitry and be able to generate earth fault alarms. You can do this e.g. using PowerSuite (read topic *Control Unit Earth Fault tab* in Online Help) or the master controller's keypad or via its web-based user interface (CWUI).

Earth Fault Detection Circuitry

This circuitry can raise an earth fault alarm when the impedance *ground-to-positive supply conductor* is not the same as the impedance *ground-to-negative supply conductor* (asymmetric fault), and this impedance is lower than the configured trigger level or R-limit. This situation will occur when there is current leakage from the supply conductor (from + or – or both) to ground.

The circuitry is not accurate enough to measure the exact ground-to-supply conductor impedance, because the power system may contain many parameters that will affect the accuracy, e.g. the system's output voltage, installed current shunts, etc.

For more detailed description of this circuitry and its calibration, read topics *Earth Fault Detection* and *Calibration - Earth Fault Detection* in Online Help.

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Installation of the SP2BI Controller

The *Smartpack2 Basic Industrial* controller is **usually factory installed** in *Flatpack2* PS systems that are pre-engineered with this controller.

The controller's metal enclosure can be mounted anywhere in the system cabinet or subassembly, snapping the two DIN rail clips directly on a suitable internal DIN rail.

You can snap the controller on the DIN rail with different orientations, depending on which holes on the metal enclosure you use to fasten the DIN rail clips, see *Figure 6 on page 14* and *Figure 7* and *Figure 8 on page 15*.

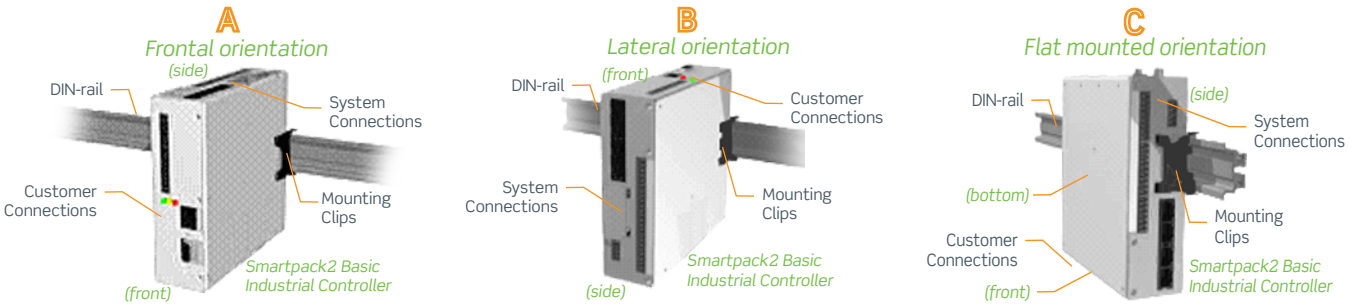

Figure 6. Smartpack2 Basic Industrial controller's mounting orientation

Frontal orientation (A) provides easy front access to the customer connection terminals, good visibility of the LED lamps and top access for the system connection terminals.

Lateral orientation (B) offers easy access to the system connection terminals and top access to the customer connection terminals.

Flat-mounted orientation (C) is suitable when there is little space in front of the DIN rail.

The controller can also be fixed on any place inside the system, using screws and special mounting clips.

The length of the controller's connection cables must be adapted to the actual mounting location. Refer to section *"Connection Drawing" on page 16*.

If you need to replace the *Smartpack2 Basic Industrial* controller with a new one, always follow the precautions relevant for installation, commissioning and general handling of the *Smartpack* and *Smartpack2*-based power systems.

Qualified Personnel

CAUTION: For safety reasons, the **commissioning and configuration of the equipment is only to be performed** by *Eltek*'s personnel or by authorized and qualified persons; otherwise the warranty may be invalidated.

Please, **read the user documentation carefully** before installing and using the equipment, as installation and operation is to be performed as described in it.

You need standard installation tools and equipment used by an authorized electrician. NOTE: All tools must be insulated.

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Fastening the Controller to the DIN Rail

Before fastening the controller inside the power cabinet or subassembly, configure its CAN ID address — refer to section *"CAN Bus Addressing" on page 18* — and switch OFF the power system.

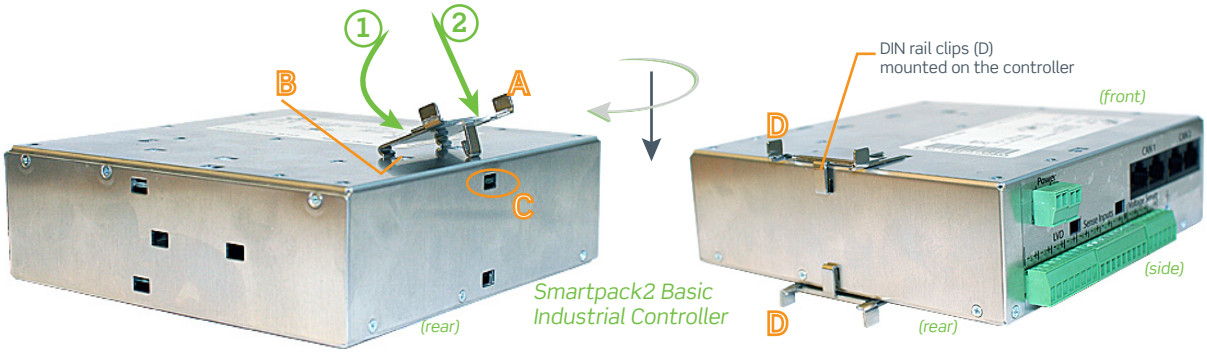


Figure 7. Mounting DIN rail clips on the Smartpack2 Basic Industrial controller

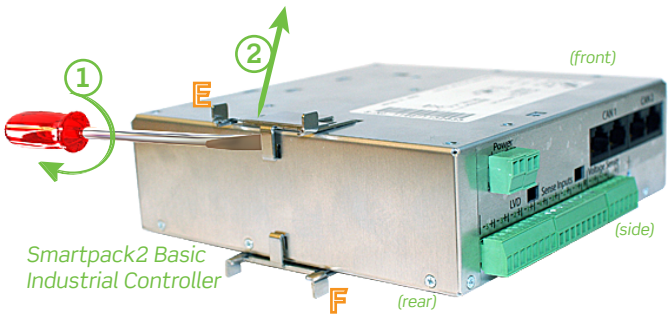
To fasten the *Smartpack2 Basic Industrial* controller to a DIN rail inside the power cabinet or subassembly, use the two dedicated DIN rail clips.

Carry out the following, see *Figure 7 on page 15*:

Power is OFF!

1. Hook DIN rail clip (A) in the controller's suitable holes (B)
2. Press the clip's front (A) down until it snaps in hole (C)

Repeat steps 1 and 2 to mount the second DIN rail clip, as shown (D)(D), and finally snap the controller's clips fast into a suitable location on the DIN rail.



To remove the DIN rail clips from the controller — to change its mounting orientation, or for other reasons — carry out the following, see *Figure 8 on page 15*

Figure 8. Dismounting DIN rail clips on the Smartpack2 Basic Industrial controller

1. Press a flat screwdriver between the clip's single hook and the controller, and then turn the screwdriver to disengage the clip's hook from the controller
2. Lift the clip (E) to unhook it completely from the controller

Repeat steps 1 and 2 to remove the second DIN rail clip (F).

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Connection Drawing

Use this drawing as a connection reference for all cabling. You find the exact location of connection terminals, plugs, DIP switches, jumpers, etc. by referring to section *"Location of Components" on page 10*. Notice that **power input 1 & 2** are to be paralleled, when only one supply is used.

The LVD control outputs may be configured for both latching and non-latching contactors using the controller's web-based user interface (CWUI) on a standard web browser or via the *PowerSuite* PC application.

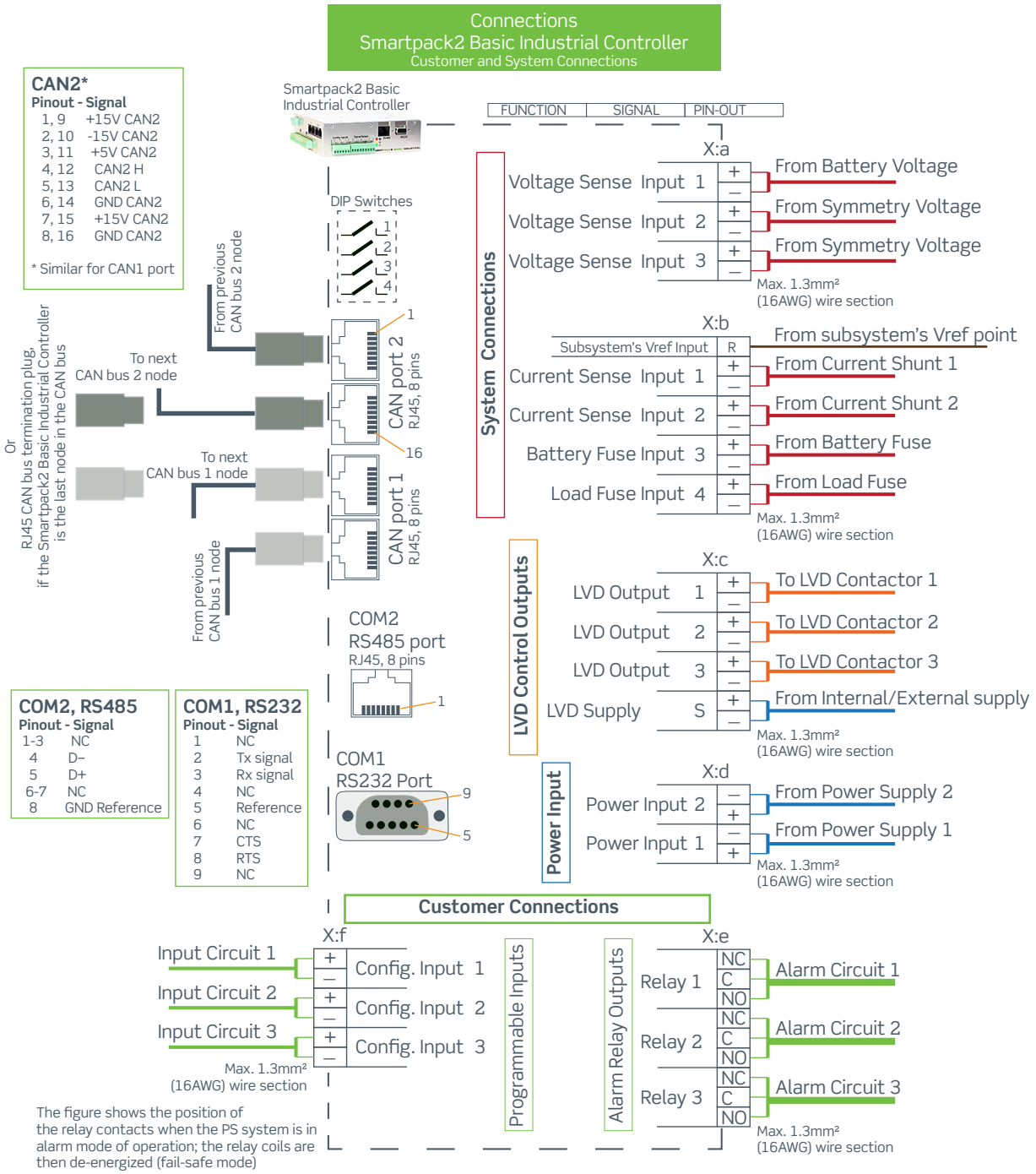

Figure 9. Connection Drawing for Smartpack2 Basic Industrial controller. Torque recommendation for terminal connections: 0.4 Nm (±10%)

Read also section *"Technical Specifications" on page 20*.

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CAN Bus Termination

To ensure a correct bus communication and avoid data reflection, you must always **terminate the CAN bus with two 120 Ω resistors**, one at each end of the line (60 Ω bus impedance).

Eltek's power systems are shipped from factory with the CAN buses already terminated with 120 Ω resistors. The **CAN bus termination** is implemented with a special RJ45 plug with built-in 120 Ω end-of-line resistor.

When **connecting more CAN nodes to the bus**, you have to remove the CAN bus termination plug from one of the CAN bus ends, and plug it in one of the CAN ports on the last connected CAN node.

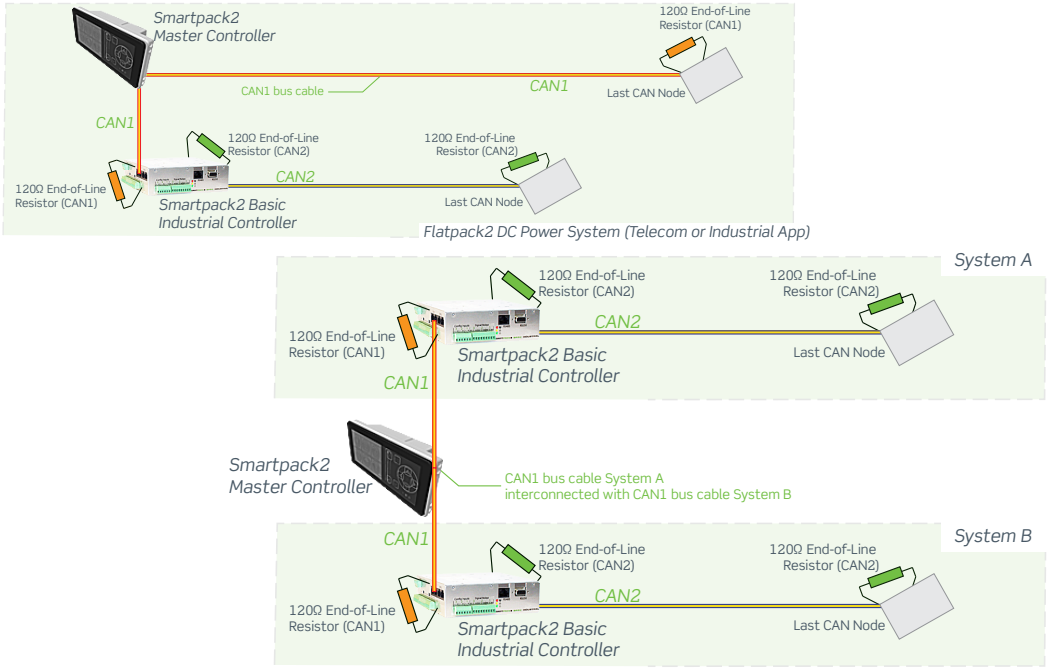

Figure 10. Examples of CAN bus termination in a power system with 2 CAN busses (above) and in System A and System B power systems

Smartpack2-based DC power systems implemented with the *Smartpack2 Basic Industrial* controller have more than one CAN bus, as this **industrial controller has two separated buses: CAN1 and CAN2**.

All the CAN buses in the system are to be terminated with two 120 Ω resistors.

Usually, control units and power modules with standard functionality are connected to CAN1 bus. They are connected to CAN2 bus when special functionality is required, such as Grouping, etc. Read about CAN1-or-CAN2 on *page 32.* Refer also to section *"3. Typical Industrial Applications" on page 22*.

CAN Bus Cabling

In addition to the two dedicated wires for communication, the CAN bus multi-wire cable must integrate wires for the CAN power supply and other signals. In standard industrial environments, the CAN bus can use standard cabling without shielding or twisted pair wiring. If very low interference (EMI) is required, a CAT-5 twisted-pair cable is recommended.

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Configuration

By the default, *Smartpack2*-based power systems are shipped from factory with one or several *Smartpack2* Basic controllers or *Smartpack2 Basic Industrial* controllers correctly installed and configured inside the power system.

CAN Bus Addressing

The power system's master controller dynamically software-assigns ID numbers to rectifiers. The master controller registers the rectifiers' ID numbers — or CAN bus address (01, 02...) — together with their Serial Numbers (**software assignment**).

Other control units make use of DIP switches for configuring their unique CAN bus ID number (**hardware assignment**).

The *Smartpack2 Basic Industrial* controller's ID numbers (1, 2...10) are assigned by DIP switches on the controller's bottom, refer to section *"Jumpers and DIP Switches" on page 12*.

A maximum of 10 *Smartpack2 Basic Industrial* controllers may be connected to the CAN bus.

*Smartpack2 Basic Industrial Controller***	ID #	DIP Switch Position 1	2	3	4
1st Controller	1	OFF	OFF	OFF	OFF
2nd Controller	2	**ON**	OFF	OFF	OFF
3rd Controller	3	OFF	**ON**	OFF	OFF
4th Controller	4	**ON**	**ON**	OFF	OFF
5th Controller	5	OFF	OFF	**ON**	OFF
6th Controller	6	**ON**	OFF	**ON**	OFF
7th Controller	7	OFF	**ON**	**ON**	OFF
8th Controller	8	**ON**	**ON**	**ON**	OFF
9th Controller	9	OFF	OFF	OFF	**ON**
10th Controller	10	**ON**	OFF	OFF	**ON**

** The DIP switch positions above applies to all controllers, except for *Smartpack2 Master* and Compack controllers, which have unchangeable ID# 11 and 1 respectively

Note:
The Controller's ID # corresponds to the DIP switch's binary value plus 1

Smartpack2 Basic Industrial
DIP switch configuration
ID <1>
(All Switches OFF)

Table 2. Smartpack2 Basic Industrial controller's DIP switch addressing

About Power System Configuration

The *Eltek* power supply system's functionality represents a vast **set of functions, characteristics or capabilities** implemented in the hardware and software of the controllers, control units and nodes connected to the system's CAN bus.

You can use following types of **user interfaces** to access the functions and parameters:

- The master **controllers' front panel display and keypad**
  using software menus and submenu options
- A **standard web browser**
  to access the CWUI firmware (Controller Web-based User Interface), a platform-independent user interface built-in the controllers
- The **PowerSuite program**
  A PC application run on computers using MS Windows operating systems

Logical Groups or Menu Options

All the mentioned functions, characteristics and parameters are **fully configurable**, and are presented in the controller's display (**Main Menu Options**) in following *task-oriented logical groups*:

1. System Status
2. System Configuration
3. Alarm Configuration
4. Commands
5. Logs and Reports
6. Statistics
7. Commissioning
8. Up/Download

Main Menu Options (Level 1)

Selecting a Main Menu option, will display **submenus** ("Sys. Status", "Sys. Config", etc.) with the functions, characteristics and parameters organized in following *system-oriented logical groups*:

- Power System
  - Mains
  - Generator
  - Rectifiers
  - Solar
  - DCDC
  - Rectiverters
  - Invertifier
  - Inverter
- Load
- Battery
- Inputs
- Outputs
- Control System
- OutDoor

WARNING!
To avoid false alarms and system malfunction, do not enable nor configure alarm monitors for hardware (Solar, Rectiverters, etc.) that is not installed in the power system.

For detailed functionality description, browse and search through the many topics of the Functionality Description of *Online Help*

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Technical Specifications

The technical specifications for the *Smartpack2 Basic Industrial* controller described in this section may have being updated or improved.

Refer to *Eltek*'s data sheet about this controller, which you can download from the *Eltek* web site, to read the controller's latest and freshest technical specifications.

Specifications	*Smartpack2* Basic Industrial controller
Input Voltage	10 - 75 VDC, Shutdown: < 10 VDC, 2 separated power inputs
Storage Temperature Operating Temperature	-40 to +85˚C (-40 to 185˚F) -20 to +70˚C (-4 to 158˚F)
Current Consumption	Max 1.6A
Electric Isolation	7 different isolated sections
Customer Connections • Configurable Inputs • Relay Outputs • Serial Communication	 3x, "digital", temperature / voltage /current measurements. - NO/NC, Pull Up/Dn, Diode Matrix: -10V→+10V (2mV full range) - Current measurements: 4-20mA (ext. sense resistor 100-500Ω) - Temperature measurements: NTC probe 3x, NO-C-NO, 0-220V, 30W (max. 1A), configurable RS232C port and RS485 port
System Connections • Voltage Sense Inputs • Current Sense Inputs • Battery Fuse Sense Inputs • Load Fuse Sense Inputs • LVD Contactor Outputs • CAN interface • Earth Fault Detection	 3x, Max. 420VDC, Symmetry& battery monitoring 2x, for 20mV to 60mV current shunts 1x, NO/NC, Pull Up/Dn, Diode Matrix: -10V→+10V (2mV full range) 1x, NO/NC, Pull Up/Dn, Diode Matrix: -10V→+10V (2mV full range) 3x, 10-420V, 1A, Configurable as latching or non-latching LVD Supply input: 10-420V, 1A 2 x, CAN bus systems (separated and isolated) 1x, internal Isolation input
Power System compatibility	Industrial & Telecom, Positive, negative and floating DC distributions
Frontal indicators	3x, LED lamps (green, amber, red)
Max number of controller nodes	10 on a single CAN-bus, in addition to *Smartpack2 Master* controller
Controller configuration	Front keys in the *Smartpack2 Master* controller, via CWUI in an standard web browser (Controller's Web-based User Interface) and via *PowerSuite* application
Firmware upgrade	Via the CAN bus, using SD card in the *Smartpack2 Master* controller or from PC
Dimensions (WxHxD)	146.0 x 146.0 x 45.6 mm (5.7 x 5.7 x 1.8")

Specifications are subject to change without notice

242100.???.DS3– vX

Applicable	Standards
Electrical safety	IEC 60950-1 UL 60950-1
EMC	IEC 61000-6-1 IEC 61000-6-2 IEC 61000-6-3 /A1 IEC 61000-6-4 IEC 61000-6-5 FCC Part 15B Subpart 109
Environment	ETSI EN 300 019-2-1 V2.1.2 ETSI EN 300 019-1-3 v2.3.2 2002/95/EC (RoHS) & 2002/96/EC (WEEE)
Marine	DNV – 05 – D202

Part No.:	Description
242100.601	*Smartpack2 Basic Industrial Controller*
242100.501	*Smartpack2* Basic Controller (Telecom)
242100.500	*Smartpack2 Master* Controller
242100.502	I/O Monitor2 CAN node (type 2 G2)

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Firmware Upgrade Controller

Upgrade of the *Smartpack2 Basic Industrial* controller's firmware is performed via the power system's CAN bus, while the system is live. Upgrading the firmware does not delete or change any of the configuration and calibration values stored in the *Smartpack2 Basic Industrial* controller.

You can upgrade the *Smartpack2 Basic Industrial* controller's firmware using one of the following two methods. Refer to *Figure 11 on page 21*.

A. **From the Smartpack2 Master controller's SD Card**
— Insert in the SP2M controller an SD card containing the Smartpack2 Basic Industrial controller's firmware source file <SP2BASIN.S19>.
— Use then the front keys to download the firmware.

Refer to the master controller's guide (350020.013) or to Online Help, in topics *Up/Download options* and *Firmware Upgrade - Smartpack2 Controllers*

Notice: The files stored in the SD Card must have specific file names.
For example, if your firmware source file name is "*Smartpack2*_Basic_Industrial_405007.???_V1.1.mhx", rename it to "SP2BASIN.S19" before copying it to the SD Card.

B. **From a Personal Computer**
— Connect a PC — via an USB-to-CAN Converter (art. 208565) and *Eltek's* circuit board (art. 240241) — to one of the power system's CAN1 bus ends, and move the end-of-line resistor to one of the converter's CAN ports.
— Run then the FWLoader program on the PC to download the firmware <*.S19> to the Smartpack2 Basic Industrial controller .

You find a detailed description by reading the FWLoader Help file or the topic *Firmware Upgrade from a Computer* in Online Help.

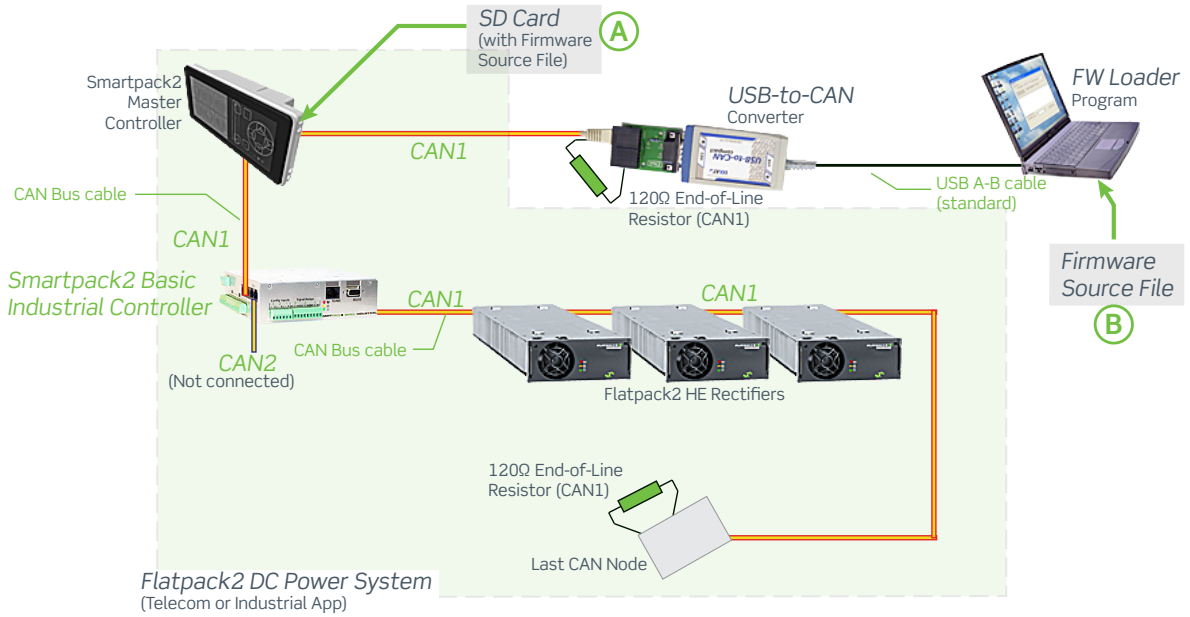

Figure 11. Example of Smartpack2 Basic Industrial controller's firmware upgrade via SD card (A) or via PC (B). Read about CAN1-or-CAN2 on page 32

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3. Typical Industrial Applications

The *Smartpack2 Basic Industrial* controllers are reliable and versatile modules used as **secondary controllers** or **bay controllers** in the distributed control system of *Smartpack2*-based power applications.

These flexible controllers are developed to meet industrial requirements within the same power supply system, such as:

- ◊ Power system with one or with **different DC output voltages** (App. 1 & 2)
- ◊ Systems with **High DC output voltage** (App. 3)
- ◊ One **large, expandable system**, with 960 rectifiers maximum (App. 4)
- ◊ Individual **voltage control** of two systems, **A+B Systems** (App. 5)

Usually, control units and power modules with standard functionality are connected to CAN1 bus. They are connected to CAN2 bus when special functionality is required, such as Grouping, etc. Read about CAN1-or-CAN2 on *page 32*.

For a complete list of signals, pin-out, etc., refer to section *"Connection Drawing" on page 16*.

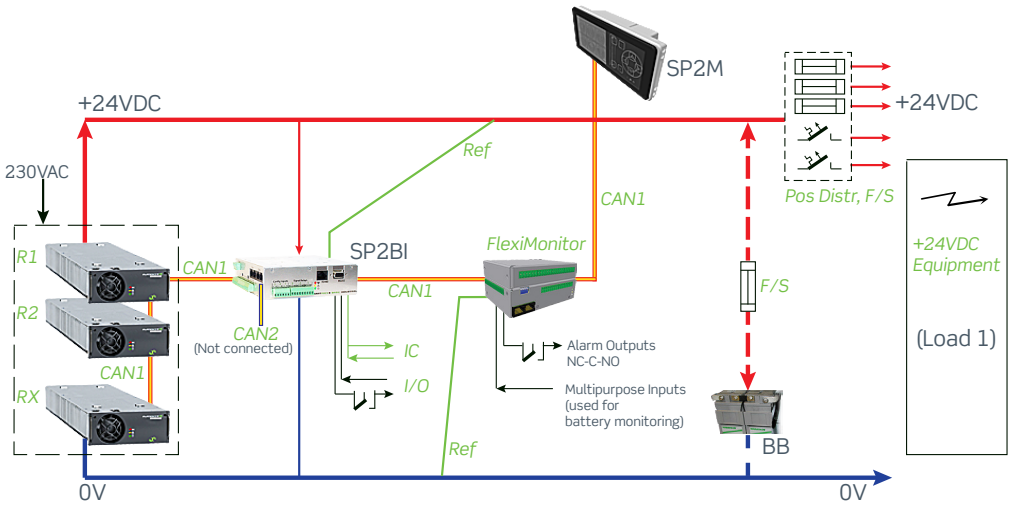
Generic System

App 1: Telecom System, +24V or -48V

Application 1 is an example of a generic telecom +24VDC power system implemented with a *Smartpack2 Basic Industrial* controller as secondary controller.

All parameters are collected in one *Smartpack2 Master* controller (SP2M).

The industrial controller's measuring reference ("R" or Ref) is to be connected to the pole where the current shunts are connected.



SP2BI = Smartpack2 Basic Industrial Controller
SP2M = Smartpack2 Master Controller
I/O-M = I/O Monitor CAN node
L-M = Load Monitor CAN node
B-M = Battery Monitor CAN node
BB = Battery Bank
RX = Flatpack2 power module or rectifier

CAN1 = CAN bus 1 from the SP2BI controller
CAN2 = CAN bus 2 from the SP2BI controller
Ref = SP2BI controller's and FlexiMonitor's measuring references, "R" terminal
F/S = Fuses, MCBs, current shunts, etc.
Pos Distr, F/S = Positive DC Distribution with fuses, MCBs, current shunts, etc.
Neg Distr, F/S = Negative DC Distribution with fuses, MCBs, current shunts, etc.
I/O = Input and Output signals for customer connections
IC = Internal system I/O Connections

Figure 12. Application 1, +24V system. Read about CAN1-or-CAN2 on *page 32*

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Similarly, a generic telecom -48V power system with negative DC distribution could be implemented with the *Smartpack2 Basic Industrial* controller.

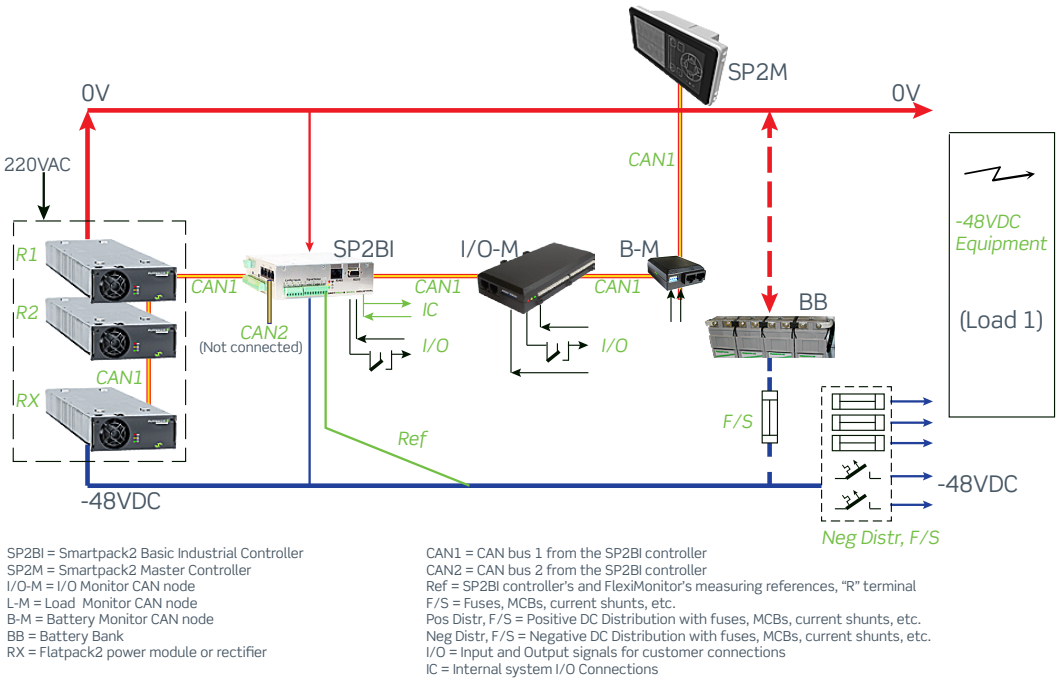
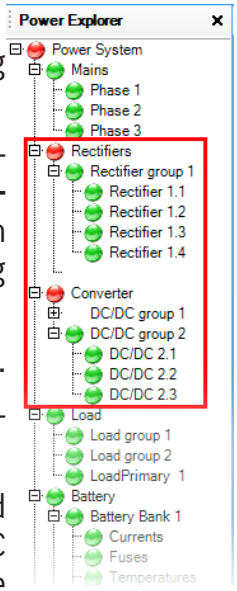


Figure 13. Application 1, -48V system. Read about CAN1-or-CAN2 on *page 32*

Different DC Output Voltages

App 2: Industrial System 220 & 24 & 48VDC



Application 2 is an example of an industrial power system implementing different DC output voltages: 220VDC, 48VDC and 24VDC.

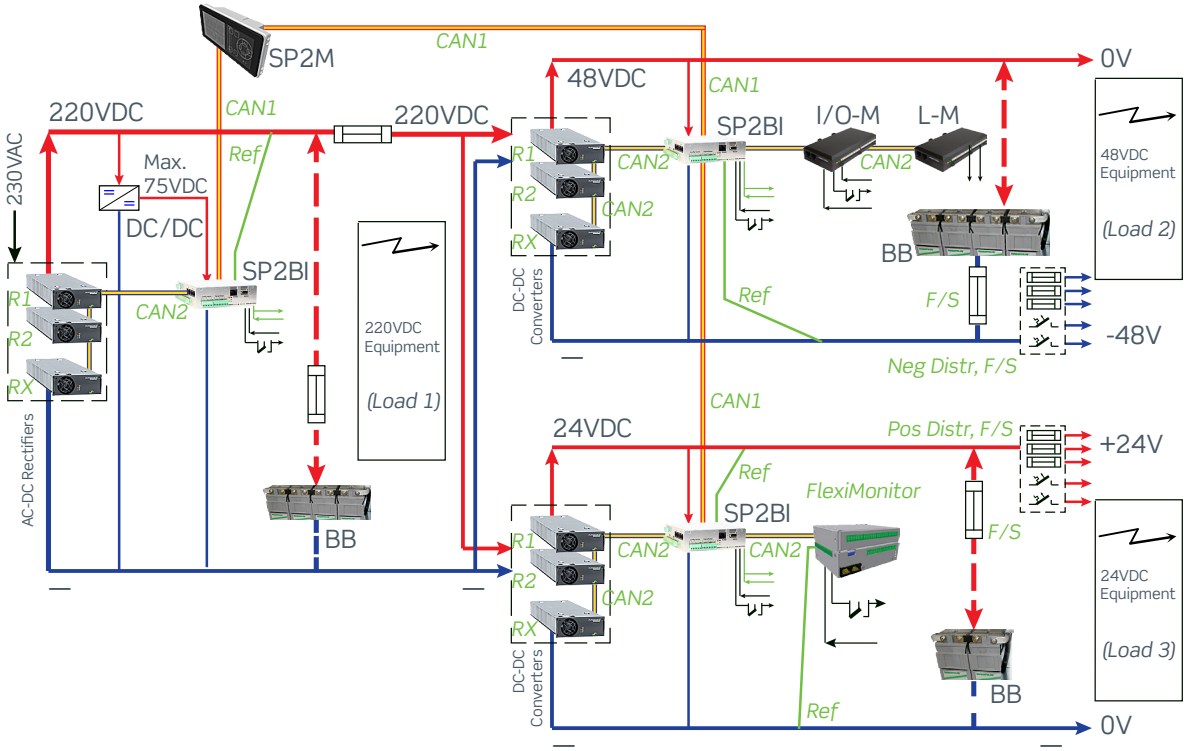
Installing one *Smartpack2 Basic Industrial* controller for each output voltage section (**secondary controllers**) and connecting suitable **power modules on their CAN2 busses**, enables to measure system parameters with different voltage references (e.g. 220VDC, 48VDC and 24VDC) in a floating or earthed system.

All parameters are collected in one *Smartpack2 Master* controller (SP2M).

Each industrial controller's measuring reference ("R" or Ref) is to be connected to the pole where the current shunts are connected.

In the 220VDC section, an external DC-DC converter is to be used to feed the *Smartpack2 Basic Industrial* controller (max. 75VDC). The 220VDC output section (**Rectifier Group 1**) supplies Load 1, and DC-feeds both the 48VDC section (**Converter Group 1**) and the 24VDC section (**Converter Group 2**), which supply Load 2 and 3 respectively.

The groups must be configured as rectifier groups or DC-DC converter groups either via *PowerSuite* or via the controller's web-based user interface (CWUI). Read *"Configuration of Rectifier and DCDC Groups" on page 28*



SP2BI = Smartpack2 Basic Industrial Controller
SP2M = Smartpack2 Master Controller
DC/DC = DC/DC Converter
I/O-M = I/O Monitor CAN node
L-M = Load Monitor CAN node
B-M = Battery Monitor CAN node
BB = Battery Bank
RX = Flatpack2 power module or rectifier

CAN1 = CAN bus 1 from the SP2BI controller
CAN2 = CAN bus 2 from the SP2BI controller
Ref = SP2BI controller's and FlexiMonitor's measuring references, "R" terminal
F/S = Fuses, MCBs, current shunts, etc.
Pos Distr, F/S = Positive DC Distribution with fuses, MCBs, current shunts, etc.
Neg Distr, F/S = Negative DC Distribution with fuses, MCBs, current shunts, etc.
I/O = Input and Output signals for customer connections
IC = Internal system I/O Connections

Figure 14. Application 2. Read about CAN1-or-CAN2 on *page 32*

High DC Output Voltages

App 3: Industrial System 110 or 220VDC

Application 3 is an example of a generic industrial power system for high DC output voltage: 220VDC. An industrial 110VDC or 380VDC power system could also be implemented.

Installing a *Smartpack2 Basic Industrial* controller enables to measure and monitor high DC system voltages up to 430VDC in a floating or earthed system.

All parameters are collected in the *Smartpack2 Master* controller (SP2M).

The controller's measuring reference ("R" or Ref) is to be connected to the pole where the current shunts are connected.

An external DC-DC converter is to be used to feed the *Smartpack2 Basic Industrial* controller (max. 75VDC).

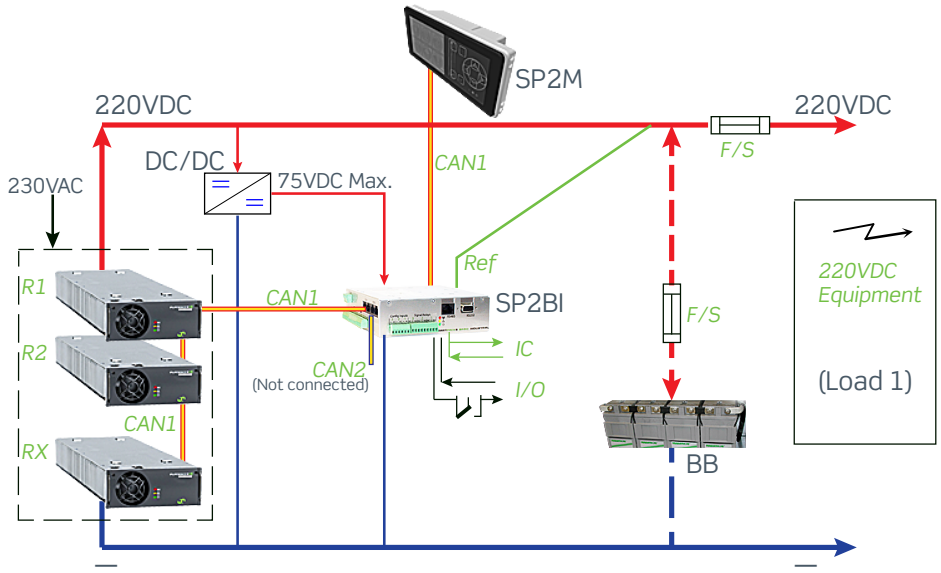
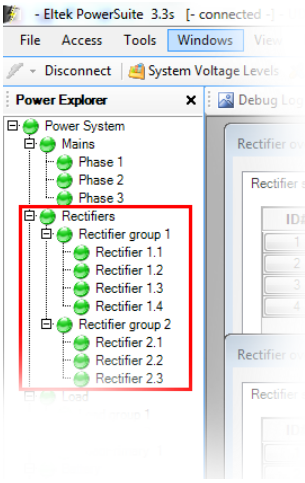


Figure 15. Application 3. Read about CAN1-or-CAN2 on *page 32*

Large, Expandable Power Systems

App 4: Telecom & Industrial System (over 96 Rectifiers)

Application 4 is an example of a large industrial and telecom -48V power system implemented by several subsystems or groups, each in its cabinet or bay, with all their DC outputs paralleled to supply the load and recharge the battery bank.

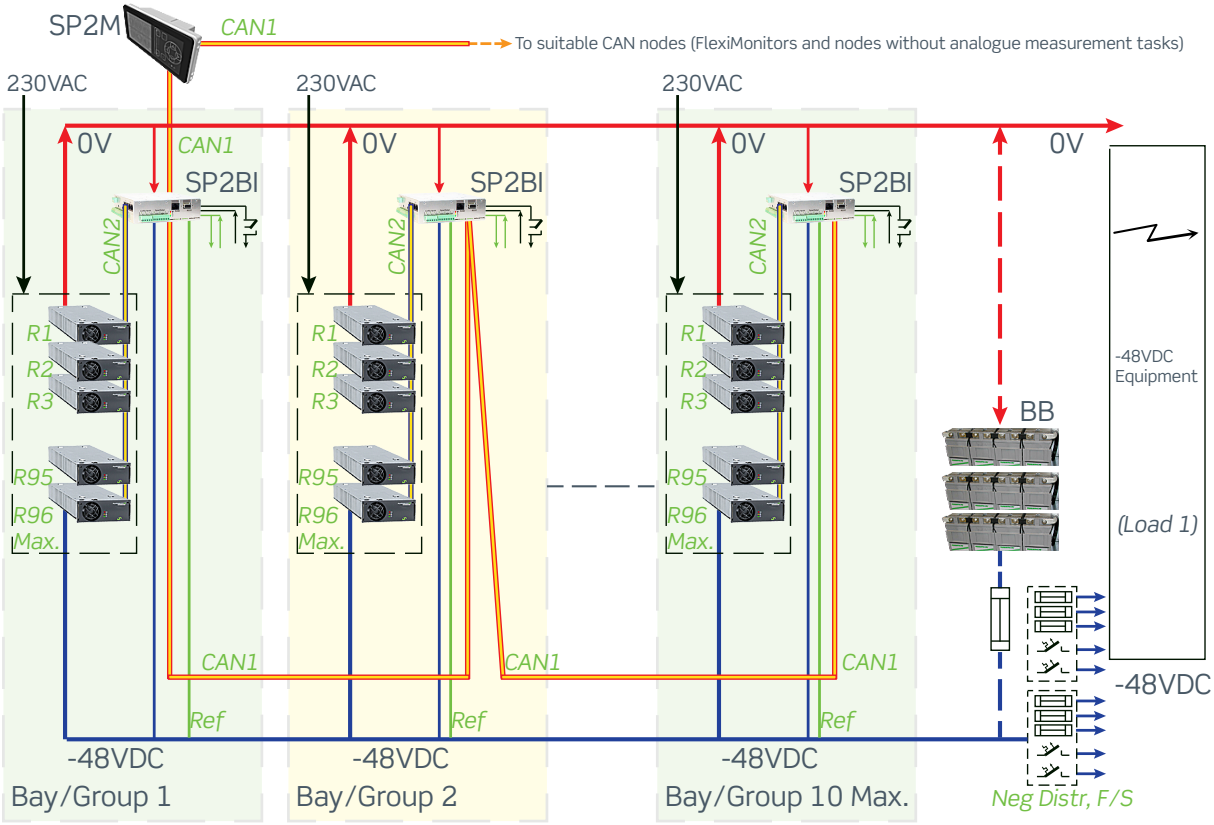


Installing one *Smartpack2 Basic Industrial* controller in each subsystem (**bay controllers**) and connecting suitable **rectifiers on their CAN2 busses**, enables to implement up to 96 rectifiers in each bay or group, and parallel up to 10 subsystems or bays. This large power system with a maximum of 960 rectifiers may then supply a vast load. The system implements current sharing among all the rectifiers, both within a group and within the bays.

All parameters are collected in one *Smartpack2 Master* controller.

Each industrial controller's measuring reference ("R" or Ref) is to be connected to the pole where the current shunts are connected.

The *Flatpack2* rectifiers are **displayed in groups or bays** in the *Smartpack2 Master* controller's display and in the controller's web-based user interface (CWUI) and in the *PowerSuite* PC application.



SP2BI = Smartpack2 Basic Industrial Controller
SP2M = Smartpack2 Master Controller
BB = Battery Bank
RX = Flatpack2 power module or rectifier

CAN1 = CAN bus 1 from the SP2BI controllers
CAN2 = CAN bus 2 from the SP2BI controllers
Ref = SP2BI controller's and FlexiMonitor's measuring references, "R" terminal
Neg Distr, F/S = Negative DC Distribution with fuses, MCBs, current shunts, etc.
CAN nodes with analogue measurement tasks must be connected to CAN2 of the group they measure

Figure 16. Application 4. Read about CAN1-or-CAN2 on *page 32*

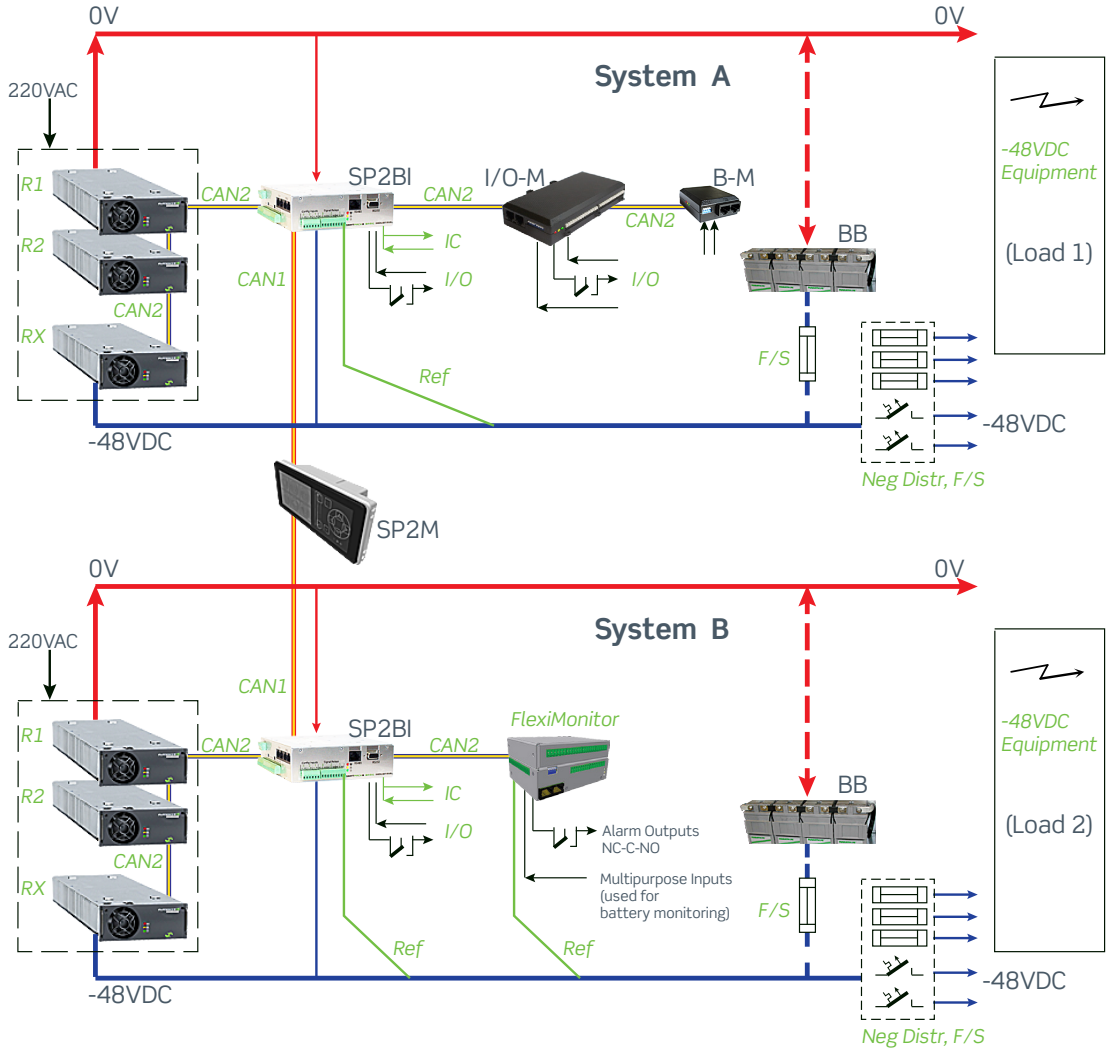
App 5: Telecom & Industrial A+B System

Application 5 is an example of two 48VDC power systems A and B — each with one *Smartpack2 Basic Industrial* controller (**secondary controller**).

All parameters are collected and displayed in one *Smartpack2 Master* controller (SP2M), otherwise the two systems are electrically isolated from each other.

Each *Smartpack2 Basic Industrial* controller uses their local voltage and current measurements to control its rectifiers, which **must be connected to its CAN2 bus**, e.g. for implementation of local current sharing. The rectifiers in system A and B have no common current sharing. Also, each secondary controller has individual voltage control of its battery bank. This individual control must be configured via *PowerSuite* or via the controller's web-based user interface (CWUI). Read *"Configuration of Individual Control in A+B Systems" on page 29*

The controller's measuring reference ("R" or Ref) is to be connected to the pole where the current shunts are connected.



SP2BI = Smartpack2 Basic Industrial Controller
SP2M = Smartpack2 Master Controller
I/O-M = I/O Monitor CAN node
B-M = Battery Monitor CAN node
BB = Battery Bank
RX = Flatpack2 power module or rectifier

CAN1 = CAN bus 1 from the SP2BI controller
CAN2 = CAN bus 2 from the SP2BI controller
Ref = SP2BI controller's and FlexiMonitor's measuring references, "R" terminal
F/S = Fuses, MCBs, current shunts, etc.
Pos Distr, F/S = Positive DC Distribution with fuses, MCBs, current shunts, etc.
Neg Distr, F/S = Negative DC Distribution with fuses, MCBs, current shunts, etc.
I/O = Input and Output signals for customer connections
IC = Internal system I/O Connections

Figure 17. Application 5. Read about CAN1-or-CAN2 on *page 32*

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4. Appendix

Configuration — Systems Globals

Configuration of Rectifier and DCDC Groups

Power systems implemented with several *Smartpack2 Basic Industrial* controllers (secondary controllers) identify the *Flatpack2* power modules **connected on the CAN2 bus** of each secondary controller as **a group**. Notice that grouping of modules is not possible, if they are connected on the CAN1 bus.

The groups must always be configured to be either **Rectifier Groups** or **DCDC Groups**, depending on the modules work as rectifiers or as DC-DC converters. The group configuration is performed via the controller's web-based user interface (CWUI) or via *PowerSuite*.

For example, the figures below show this configuration for the power system shown in *"App 2: Industrial System 220 & 24 & 48VDC" on page 24*, using the CWUI and *PowerSuite* respectively.

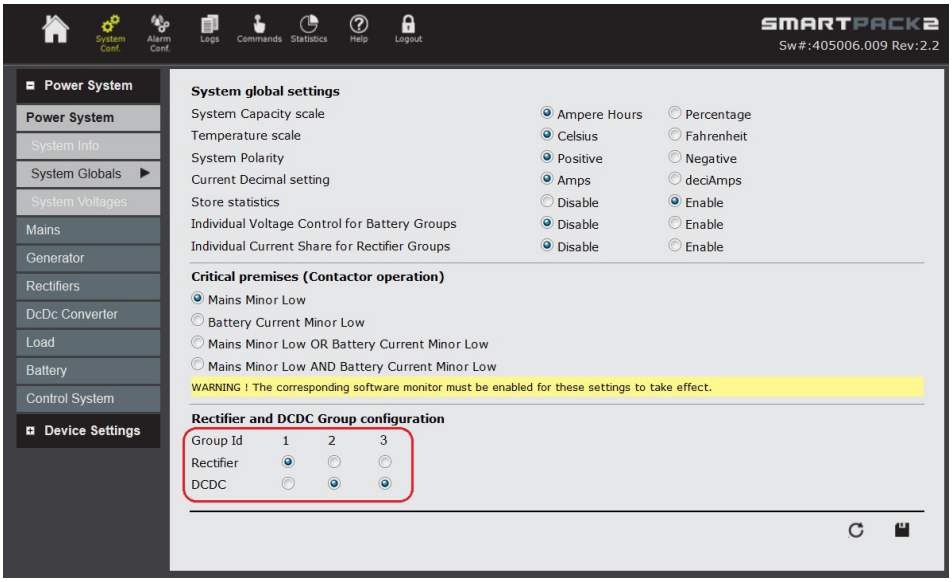

Figure 18. Rectifier and DCDC Group configuration using the CWUI
In **Power System ›› System Globals**, *select appropriate radio buttons*

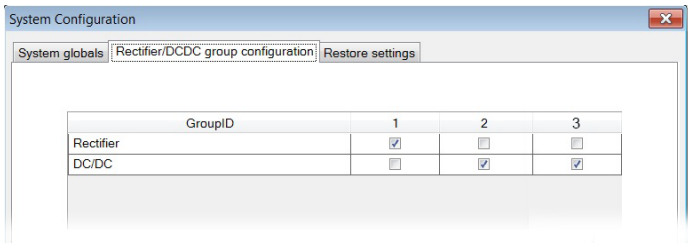

Figure 19. Rectifier and DCDC Group configuration using PowerSuite
On the toolbar, click on **System Configuration** *, then on the "***Rectifier/DCDC Group Configuration***" tab. Check then the appropriate boxes*

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Configuration of Individual Control in A+B Systems

A+B power systems utilize two *Smartpack2 Basic Industrial* controllers (secondary controllers), each having **individual voltage control** on its battery bank and **individual current sharing** on its power modules or rectifiers, which **must be connected to its CAN2 bus**. Notice that grouping of modules is not possible, if they are connected on the CAN1 bus.

The individual control must be configured via the controller's web-based user interface (CWUI) or via *PowerSuite*.

For example, the figures below show this configuration for the power system shown in *"App 5: Telecom & Industrial A+B System" on page 27*, using the CWUI and *PowerSuite* respectively.

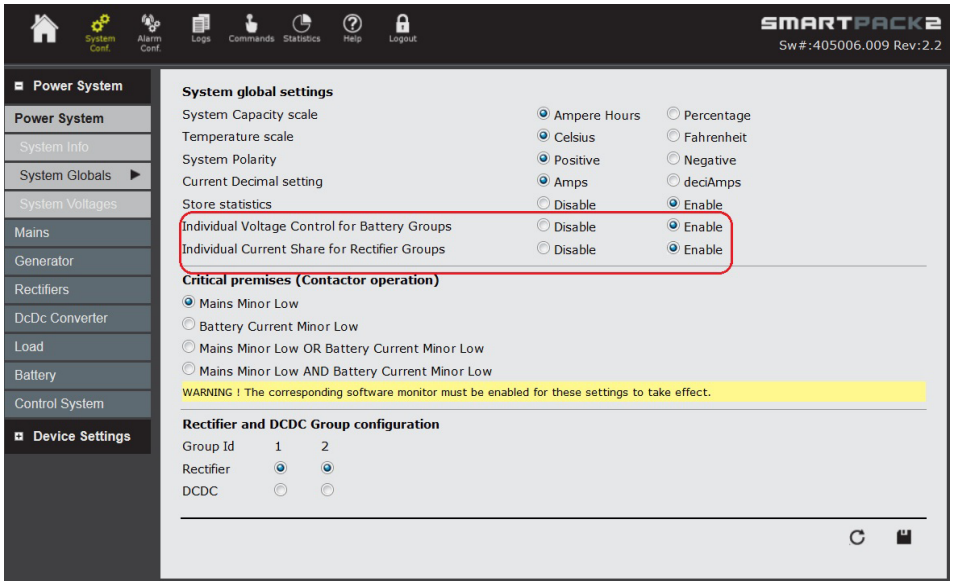

Figure 20. Using the CWUI, In **Power System ›› System Globals**, *enable the radio buttons for* **Individual Voltage Control** *and* **Individual Current Share**

Notice that the two systems' rectifiers are also configured as **Rectifier Group 1** and **Rectifier Group 2**. Read also section in *page 28*.

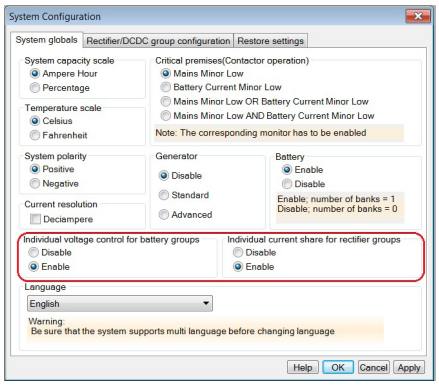

Figure 21. Using PowerSuite, on the toolbar, click on **System Configuration** *, then on the "***System Globals***" tab. Enable the radio buttons for* **Individual Voltage Control** *and* **Individual Current Share**

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Correct Use of CAN1 and CAN2 Busses

The *Smartpack2 Basic Industrial* controller has two CAN busses: CAN1 and CAN2. Other *Eltek* controllers have only one CAN bus.

Rectifiers can work either as conventional AC-DC rectifiers or as DC-DC converters ("DC-DC rectifiers"). *Rectiverters* work as rectifiers and inverters at the same time.

The power system's master controller automatically identify the power modules (rectifiers, converters, etc.), and thus they can be connected to the CAN1 or CAN2 busses in the *Smartpack2 Basic Industrial* controller.

Generic Rules for Using CAN1 and CAN2 Bus in Power Systems

Eltek designs power systems with *Smartpack2 Basic Industrial* controllers following specific generic rules for connecting power modules and control units to the CAN1 and CAN2 busses.

1. **CAN1 bus is the preferable bus**. In general, *Eltek* connects all power modules and control units (controllers and CAN nodes) with **standard functionality** to CAN1 bus. (Grouping NOT required)
   The power modules can be *Rectiverters*, Inverters, *Invertifiers*, Solar Chargers, Wind Chargers, etc.
2. **CAN2 bus must be used when special functionality is required**, such as Grouping, etc.
   Eltek implements power systems with the power modules, the rectifiers or DC-DC converters connected to the CAN2 bus in the following cases:
   A. CAN2 is used to connect the rectifiers in a power system, when the total number of **rectifiers** is **higher than 96**.
      It is implemented by connecting the rectifiers in groups or bays of maximum 96 rectifiers, and paralleling a maximum of 10 groups. All groups have the same output voltage.
      See *"App 4: Telecom & Industrial System (over 96 Rectifiers)" on page 26*
   B. CAN2 is used to connect DC-DC Converters in a power system that requires **different output voltages**.
      It is implemented using one Converter Group for each output voltage.
      See *"App 2: Industrial System 220 & 24 & 48VDC" on page 24*
   C. CAN2 is used to connect the rectifiers in **A+B power systems**, which require individual control of each battery bank, etc.
      It is implemented using one Rectifier Group for the A system and another for the B system.
      See *"App 5: Telecom & Industrial A+B System" on page 27*
      Notice that A+B power systems have a maximum of 2 rectifier groups, and the systems can have different output voltages within the same nominal output voltage, e.g. 48VDC

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NOTICE:
– You could connect power modules — rectifiers, DC-DC Converters, *Rectiverters*, etc. — to the CAN2 bus, even if grouping of modules is not required or necessary. In this case, the controller will identify them as a group.
– Notice that *Rectiverters* connected to CAN2 can only form one group (per 2018-01)

Expanding the Power System with Additional CAN nodes

If you need to expand the power system with several CAN nodes – Battery Monitors, I/O Monitors, Load Monitors, *FlexiMonitors*, etc. – follow the rules below:

3. Connect to **CAN1 bus** the following:
   a. All monitor units or CAN nodes.
   Exception:
   In A+B power systems, you must connect to CAN2 the Battery Monitors and the *FlexiMonitors (*configured as "Battery FlexiMonitor") .
   Read "Notice 4b" below
   See *"App 5: Telecom & Industrial A+B System" on page 27*

4. Connect to **CAN2 bus** the following:
   a. In A+B power systems, Battery Monitors and *FlexiMonitors,* when configured as "Battery FlexiMonitor"
   Read "Notice 4b"

NOTICE 4b:
FlexiMonitors are usually connected to CAN1, but they must be connected to CAN2 when they are used in A+B power systems and they are configured as "Battery FlexiMonitor" (e.g. inputs used for accurate battery symmetry monitoring), otherwise, the results of battery tests may malfunction.
Read about configuring a *FlexiMonitor* as "Battery FlexiMonitor" in Step 1 of the tutorial "*How to Configure FlexiMonitor Inputs & Outputs*", in Online Help.

Considerations for the Measuring Reference of Monitors

- In 48VDC and 60VDC power systems, **Battery Monitors and Load Monitors can measure** battery symmetry voltages and "shunt" currents, if you connect the monitors to the same CAN bus as the power modules. The measuring reference ("GNDcs") and the load and battery shunts are on the minus pole ("-48V" or "-60V").
  See *Figure 13 on page 23*

- In 24VDC power systems, you **must use** *FlexiMonitors* **to measure** battery symmetry voltages and "shunt" currents, regardless of the CAN bus you connect them to.
  In 24VDC systems, you cannot use Battery Monitors and Load Monitors to measure "shunt" currents because the measuring reference ("GNDcs") is connected to the minus pole ("0V"), and the load and battery shunts are on the positive pole ("+24V").
  See *Figure 12 on page 22*

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Voltage Reference in Battery Monitors, Load Monitors, I/O Monitors, etc.

Battery Monitors, Load Monitors, I/O Monitors and AC Mains Monitors perform analogue measurements using the "GNDcs" wire in the **CAN bus cable as measuring reference**.

Internally, in the power shelves, *Eltek* connects the "GNDcs" wire to the power system's minus pole, e.g. to the "-48V" pole in -48V DC systems and to the "0V" pole in +24V DC systems.

Read "*About Negative & Positive DC Distribution Systems*" in Online Help

See an example in *Figure 22 on page 34*

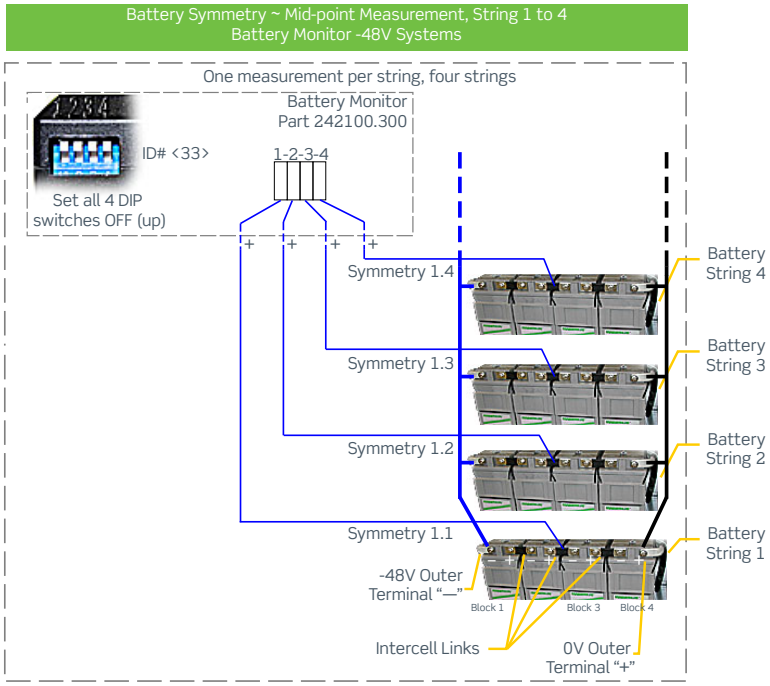

Figure 22. Example of the Battery Monitor using the "- " reference from the CAN bus cable when measuring battery symmetry voltages

Voltage Reference in FlexiMonitors

FlexiMonitors have isolated and floating measuring circuitry with **selectable measuring reference point**. They do not use the measuring reference "GNDcs" from the CAN bus cables

Refer to *"Voltage Reference, "R" Terminal" on page 11*

See an example in *Figure 23 on page 34.*

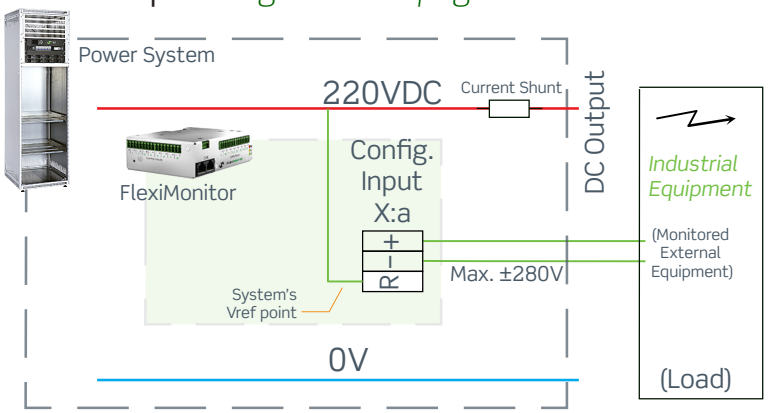

Figure 23. The FlexiMonitor can select which measuring reference point to use by connecting correctly its "Vref" wire

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Endnotes

A. Notice that *Smartpack2 Basic Industrial* controllers with version lower than v1.1 were not implemented with the internal relay for isolation of the "Earth Fault Detection measuring circuitry".
In these controllers, you need to insert the Isolation Sense jumper (JP401) and also enable and configure the Earth Fault alarm monitor, for the power system to display Earth Fault alarms. You can do this e.g. using *PowerSuite* (read topic *Control Unit Earth Fault tab* in Online Help) or the master controller's keypad or via its web-based user interface (CWUI)

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