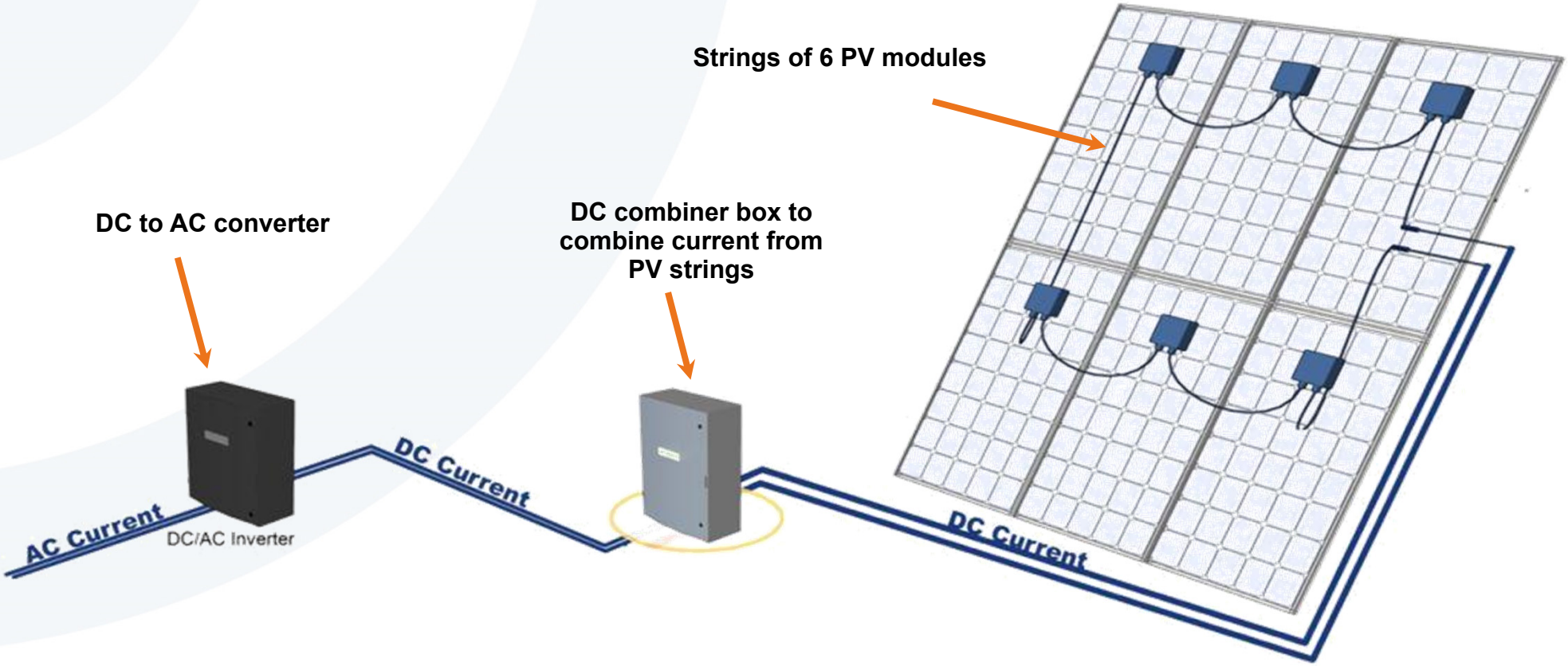
MERSEN Safety Solution for PV Installation

HelioProtection® Program

What is a PV Installation ?



1

PV module electrical
- ***Voc = 40 Vdc***
- ***Isc = 9 A***

2

PV modules put in series to build strings:
- ***Vtotal = 1000 Vdc***
- ***Isc = 9A***

3

PV strings combined to increase current:
- ***Vtotal = 1000 Vdc***
- ***Itotal = up to several 100A***

Mersen PV safety system solution

Smart PV switch

Product features:

- **Safety:** DC shut-down for fire-fighters emergency or maintenance team intervention
- **Flexible solution:** can be used as an add-on when PV module junction box exists or embedded in PV modules
- **Monitoring:** performance measurement, default detection and localization at PV module level
- **Theft detection**

PV DC Safety in German VDE-AR-E2100-712

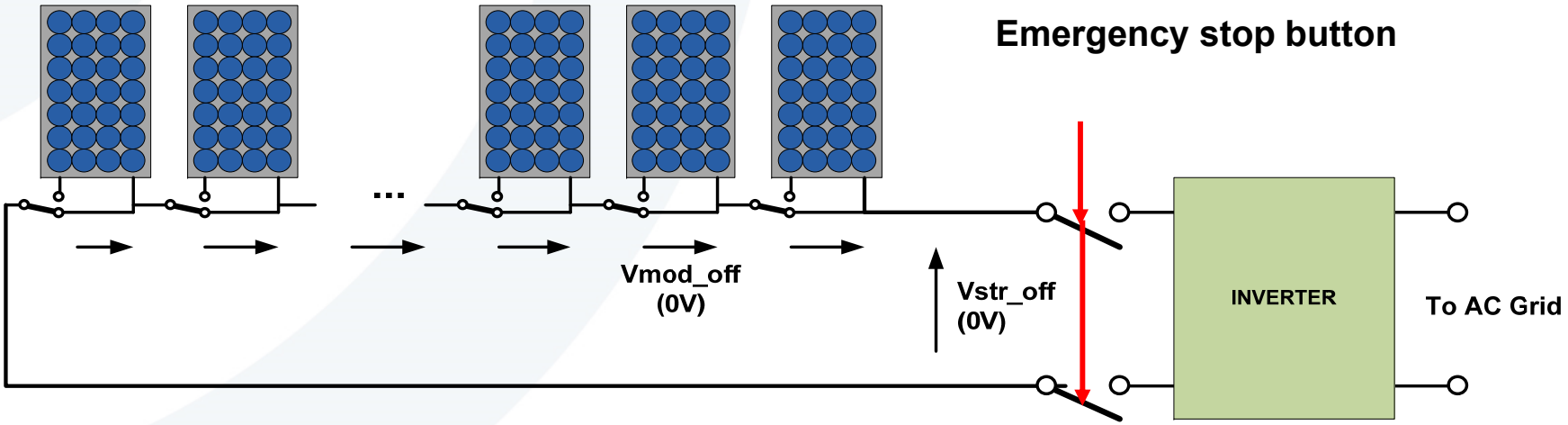
Measures for the DC range of a PV installation for the maintenance of safety in the case of fire fighting or technical assistance.

- **Protection measures against fire can be of 2 kinds**
  - Fire-proof construction (for cables, modules …)
  - Technical measure: Safety system
- **PV Energy source has to be disconnected**
- **Disconnection can be done either by AC disconnection or remote DC disconnection**
  - Any DC voltage < 120V or total current < 12mA
- **Safety system must be fail safe**
- **Blocking diodes are required to avoid reverse current**
- **Short circuit of a string is not allowed**
- **Switch-off for the module voltage must be done**
  - Directly at the module
  - At the output of the junction box
  - Or an external box connected to the module

Emergency shut-down in French UTE C15712-1

- Every energy source has to be disconnected
- Disconnection has to be done through a remote control DC switch (pulse emission or lack of control voltage)
- PV energy source has to be shut-down as close as possible from the PV modules
  - all controls of the safety shut-off have to be grouped together
  - emergency shut-off at PV module level can be done through electronic shut-off in addition to electromechanical disconnect at string level
  - visualization of installation switch-off has to be done through voltage measurements (< 60V) and shut-off of an emergency light
- Control of shutdown function has to be failsafe

Principle of Mersen PV safety system:

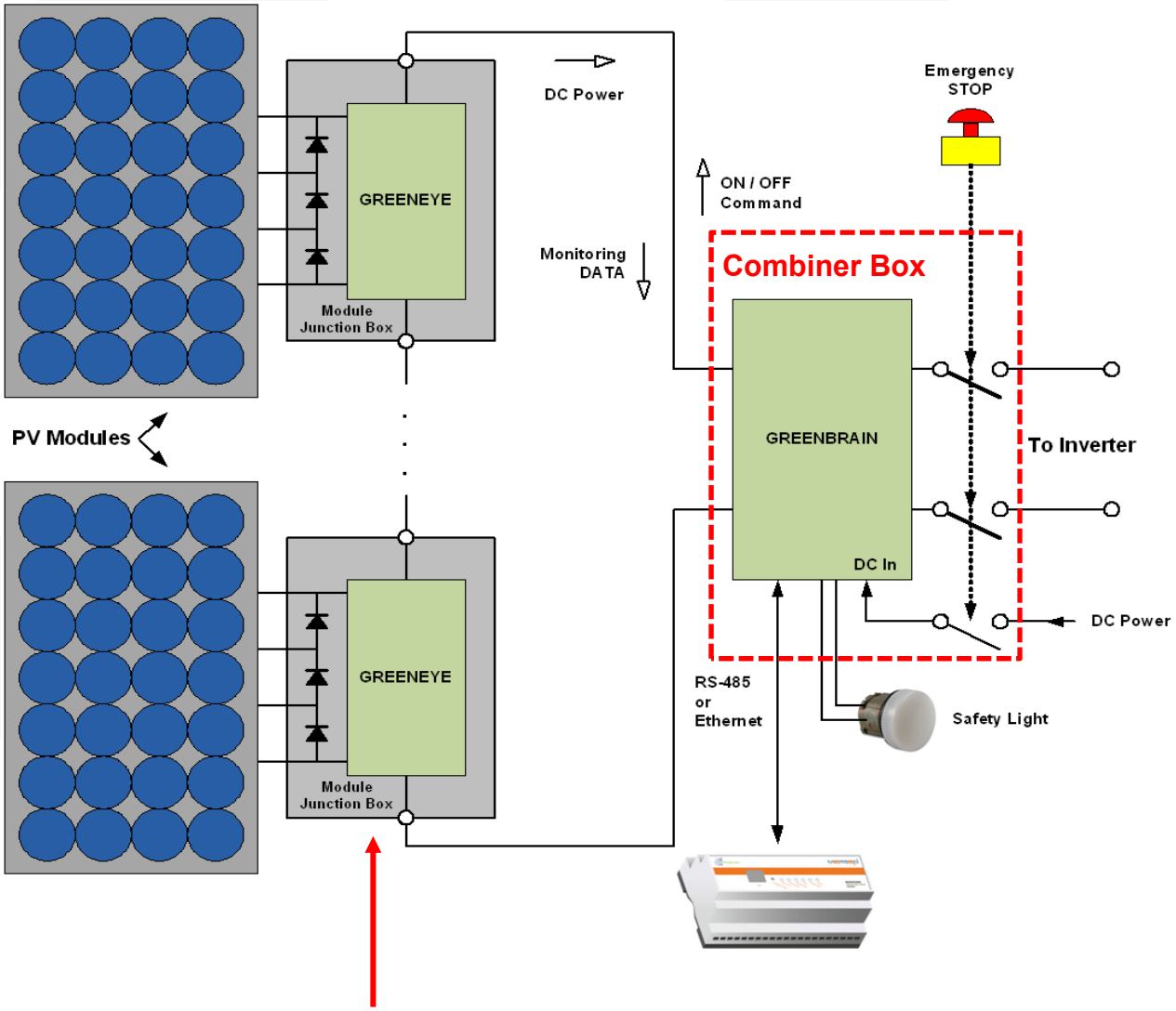


A safe dual level emergency shutdown:

- PV strings are disconnected from the inverter by remote controlled electromechanical DC switch

- Each PV module is disabled and disconnected from the string by electronic module
- Mersen is targeting **SIL2** IEC 61508 safety standard compliance
  → alone on the market with such safety robustness

System partitioning



Individual PV module shutdown and module monitoring

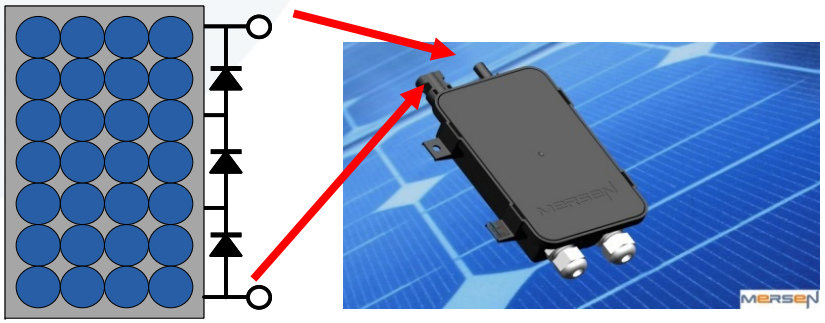
Safety centralized shutdown:

- Remote controlled disconnection of the strings from the PV inverter
- ON/OFF control of PV module electronic switch
- Safety light control

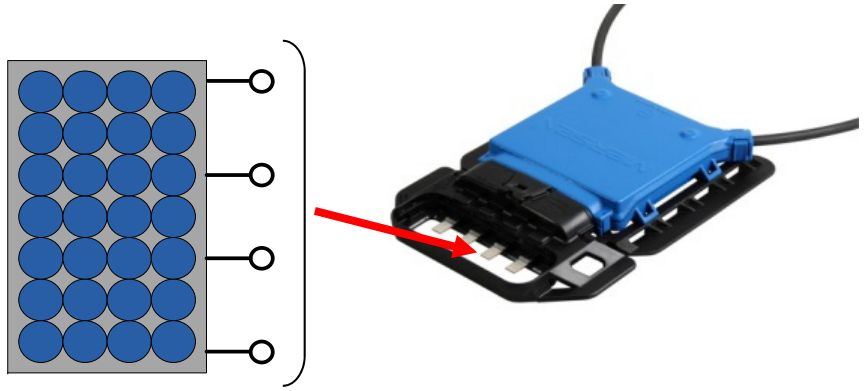
Option:

- Individual PV module and string monitoring

Individual PV module shutdown:



GreenEye add-on module



GreenEye embedded module(Huber+Suhner)

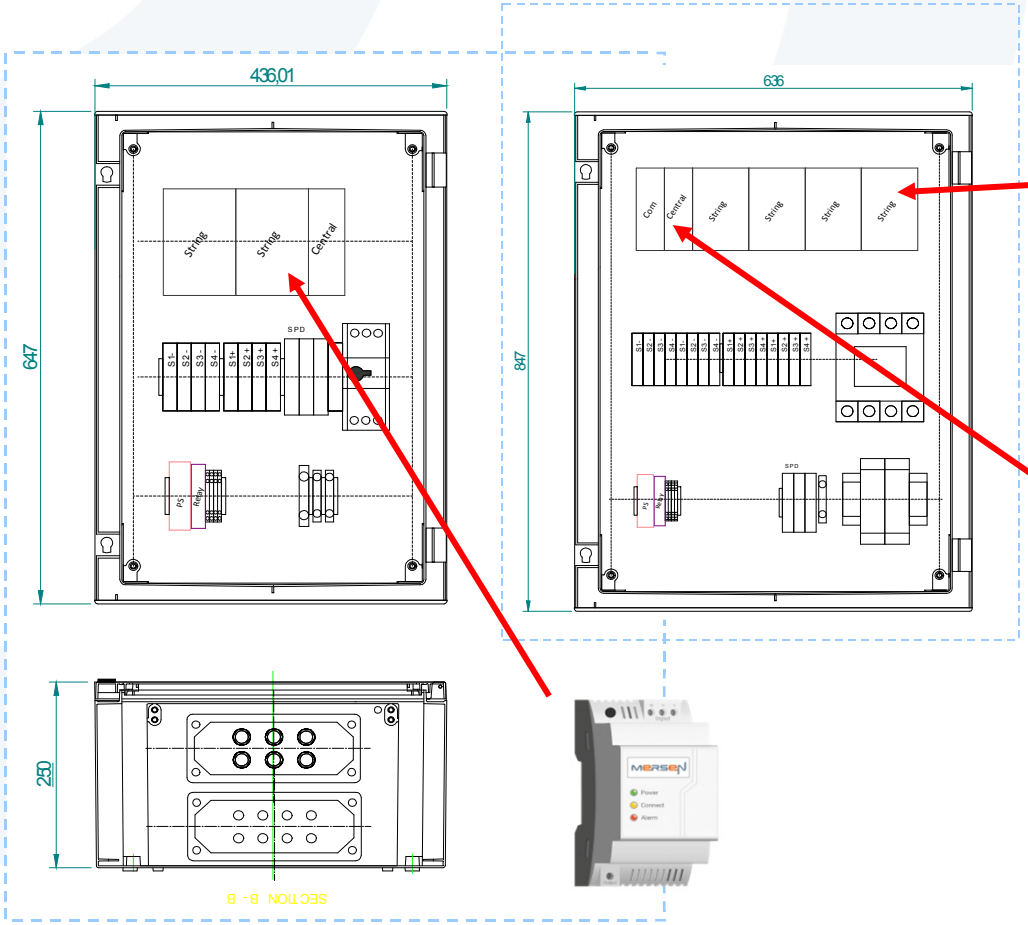
Basic features:

- Electronic shut off and bypass of PV modules
- Safe operating mode (PV modules are OFF by default)
- Control of shut off over DC wires
- Low power consumption from PV modules (#500mW)
- Active bypass diodes
- Automatic shut down in case of over-temperature detection

Optional feature: Monitoring

- Individual measurement of voltage and temperature one time per minute
- Defect localization through individual module address (32bits)
- Robust proprietary Power Line Communication for data scanning (no additional wire)

Modular combiner box control system:



Flexible design of combiner boxes
2 to 8 strings

3 different control modules:

GreenBrain-S: PV string control

- Activation and shut down of GreenEye
- Controls 2 strings of 24 PV modules
- Monitoring of PV modules through power line communication
- DC arc detection (in future release)

GreenBrain-C:

- Control of electromechanical DC switch
- Detection of dangerous string voltage and control of safety light
- Control of multiple combiner boxes through one emergency button

GreenBrain-M (monitoring option)**:**

- Individual PV module monitoring and defect localization
- Dual communication protocol: RS485/Modbus and Ethernet

FEATURES

- Mersen solution allows shut down at PV module level
- The command to switch-off is through a single button and can be operated in full load thanks to an electromechanical DC switch
- The safety position is indicated by a safety light which turns off when all DC voltages are <60V
- The safety solution is failsafe
- Mersen GreenEye modules are available in add-on boxes or PV module junction boxes with H+S
- The control of the switch-on/switch-off is over the DC wire (PLC): no additional wire and no wireless communication
- The basic solution address the safety and is SIL2 compliant
- Mersen solution offers module level monitoring through robust low cost power line communication and individual localization of PV modules
- Monitoring solution is embedding Ethernet and Modbus communication links

BENEFITS

- The solution is fully safe as each PV module is disconnected from the string and bypassed (0 volts & 0 current)
- This is compliant with firefighters request and French & German requirements
- Indication compliant with French & German requirements
- All PV modules are off during installation
- Optimization of the solution to new PV installations or retro-fit of existing installations to include safety
- The control is safe (no wireless) and low cost
- The solution is optimized for safety and is the only SIL2 solution on the market. It is also and much lower cost than DC optimizers and micro-inverters
- Optimized performance monitoring and maintenance for roof top installations
- Allows easy integration of monitoring from residential to large scale installations