


# BATTERY ENERGY STORAGE SYSTEMS (BESS)

Electrical products guide for BESS

A man with a beard and short dark hair, wearing a light green sweater, is looking intently at a complex electrical circuit board. The board is filled with various components, including resistors, capacitors, and integrated circuits, all interconnected with a dense network of white traces. The background is softly blurred, showing a window and some indoor plants.

# LET'S CREATE THE ELECTRICAL CONNECTIONS THAT COUNT.

TE Connectivity (NYSE: TE L) designs and manufactures products at the heart of electronic connections for the world's leading industries, including automotive, energy and industrial, broadband communications, consumer devices, healthcare, and aerospace and defense. TE's long-standing commitment to innovation and engineering excellence helps its customers solve the needs for more energy efficiency, always-on communications, and ever-increasing productivity. With nearly 90,000 employees in over 50 countries, TE Connectivity (TE) makes connections the world relies on to work efficiently every day.

**To connect with the company, visit [te.com](https://www.te.com).**

# TE PROVIDES INDUSTRY-LEADING ELECTRICAL CONNECTION SOLUTIONS.

More Than 60 Years of Experience in the Energy Industry

TE helps you improve power allocation flexibility in various phases of the energy landscape, from power generation to power transmission and consumption.

## SOLUTIONS FOR ON-GRID APPLICATIONS

### POWER GENERATION VIA CLEAN ENERGY



#### Wind Power

- Power conversion system (PCS)
- Battery system

#### Solar Power

- PCS
- Battery system
- Solar inverter



#### AC-coupled systems

- Solar inverter
- Battery system
- PCS

#### DC-coupled systems

- Solar inverter
- Battery system

### POWER TRANSMISSION



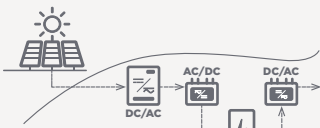
#### Substation BESS

- PCS
- Battery system

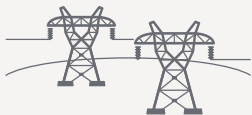
#### POWER GENERATION



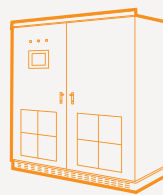
#### BESS - AC-COUPLED SYSTEMS



#### POWER TRANSMISSION



#### BESS STATION > 1MW RETROFITTING

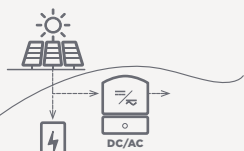


- A** [CENTRAL SOLAR INVERTER](#)
- B** [STRING SOLAR INVERTER](#)
- C** [POWER CONVERSION SYSTEM](#)
- D** [BATTERY SYSTEM](#)

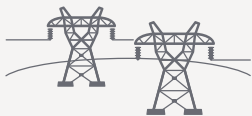
#### POWER GENERATION



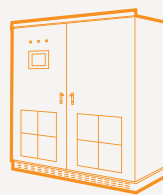
#### BESS DC-COUPLED SYSTEMS



#### POWER TRANSMISSION



#### BESS STATION > 1MW LATEST INSTALLATIONS



- A** [CENTRAL SOLAR INVERTER](#)
- B** [STRING SOLAR INVERTER](#)
- C** [BATTERY SYSTEM](#)

# TE PROVIDES INDUSTRY-LEADING ELECTRICAL CONNECTION SOLUTIONS.

## SOLUTIONS FOR OFF-GRID APPLICATIONS

### POWER CONSUMPTION



**Factory/Commercial BESS**

- PCS
- Battery system



**Residential BESS**

- Solar inverter
- Battery system

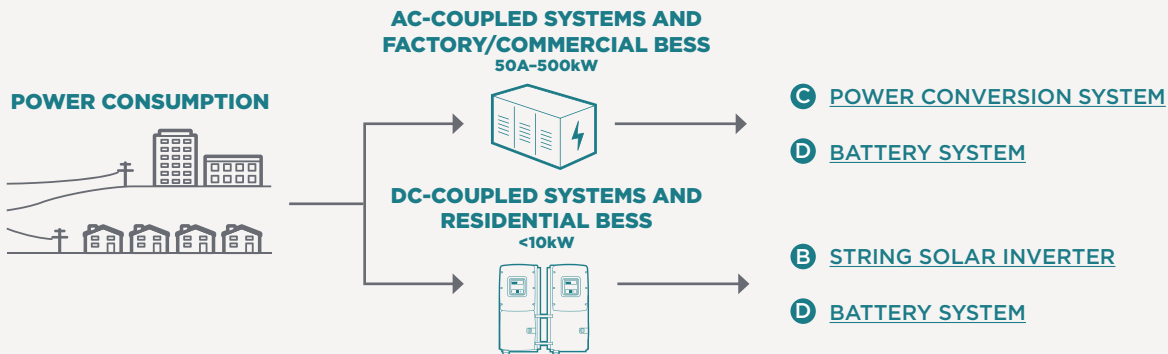


**AC-coupled systems**

- PCS
- Battery system

**DC-coupled systems**

- Solar inverter
- Battery system



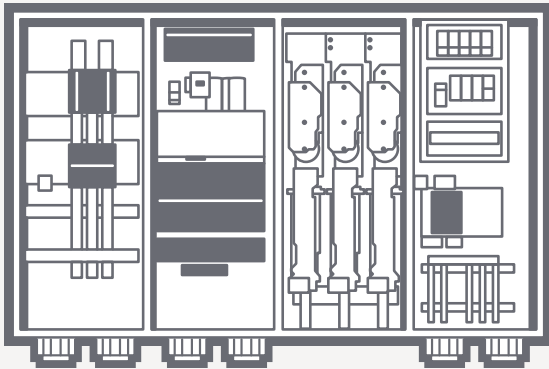
## TECHNOLOGY NEEDS AND TE ELECTRICAL SOLUTIONS

WHAT YOU NEED	WHY YOU NEED IT	HOW TE CAN HELP
<b>Increased Battery Cell Capacity</b>	Increasing battery cell capacity helps you to improve power density and reduce the overall size of battery racks.	Large-capacity battery cells require greater battery consistency, a more precise battery management system (BMS) for thermal management. TE offers highly reliable terminals blocks and connections in small sizes.
<b>Increased BESS Station Voltage</b>	BESS stations are increasingly using 1500 VDC instead of 1000 V to improve power density and system efficiency and reduce installation costs.	The need to upgrade intelligent high voltage (IHV) to 1500V/400A to meet system voltage requirements means the BMS for battery racks must also resist 1500 V. TE DBL power distribution blocks offers ratings of up to 1500 VDC (IEC) and 1000 VDC (UL).
<b>Shorter Design Cycle</b>	Specification configurations in key subsystems are constantly upgrading. For example, a BMS can vary significantly from company to company and require short design cycles (<1.5 years).	TE's new product cadence is designed to keep up with customers' design cycles and product roadmaps. The TE team closely communicates with customers to understand your technology trends and help you prepare for next-generation products.

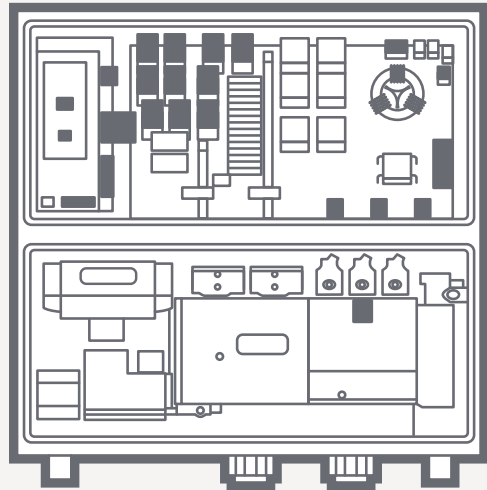


# SUBSYSTEMS IN BESS

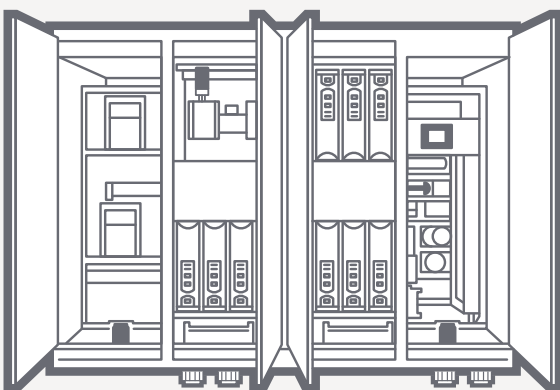
**CENTRAL SOLAR INVERTER**



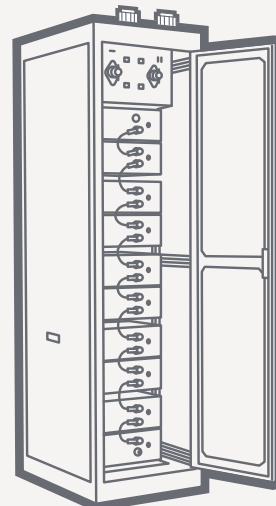
**STRING SOLAR INVERTER**



**POWER CONVERSION SYSTEM  
(PCS)**



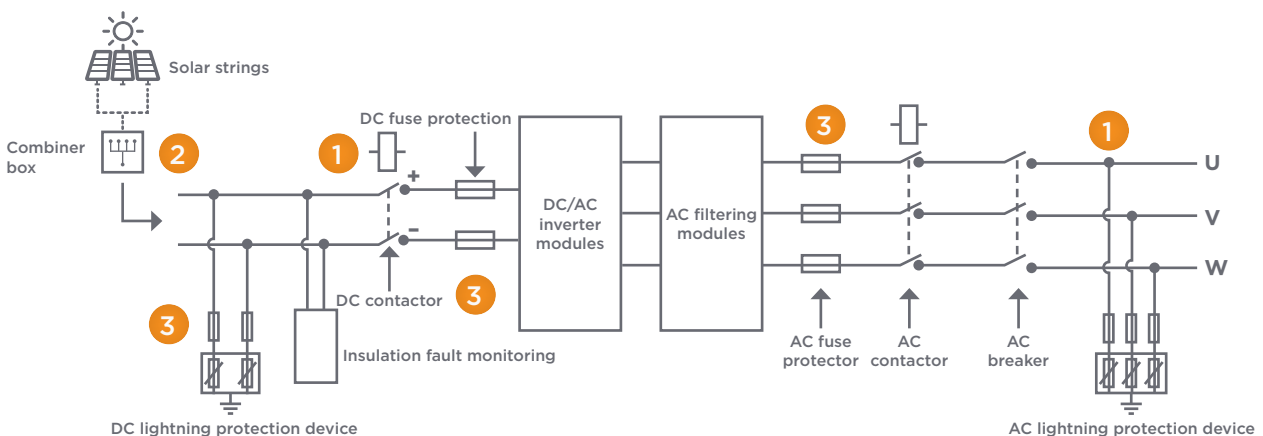
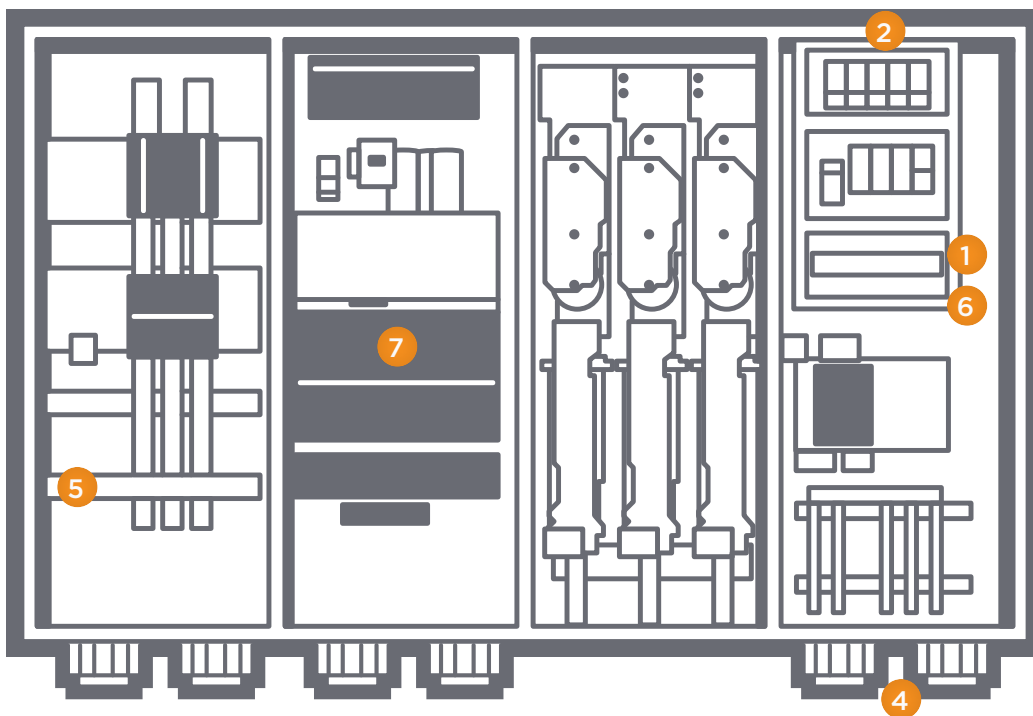
**BATTERY SYSTEM**



# CENTRAL SOLAR INVERTER

Central solar inverters are used to convert DC power from solar panels into AC power so it can be used by homes or businesses or connected to the grid. These inverters are typically floor- or ground-mounted, as opposed to string inverters that are installed on a wall or other structure. As inverters get bigger, manufacturers are looking for new innovations — cutting costs, creating smart grid features, standardizing monitoring and control interfaces — to maximize efficiencies and improve reliability. Central solar inverters are often associated with combiner boxes that group the output from individual solar strings, facilitating the convergence of DC outputs into a singular circuit that will be connected to inverter input.

TE supports next-generation inverters and combiner boxes with high-quality, reliable components that help save space without sacrificing power, including power and control connections (terminal blocks, crimp terminals), protections (modular fuse holders), identification and labeling, wire and cable management solutions.



Configuration of 500 kW Central Solar Inverter

- |  |                                |                                      |
|--|--------------------------------|--------------------------------------|
| <b>1</b> ENTRELEC Terminal blocks      | <b>4</b> Cable glands          | <b>7</b> Identification and Labeling |
| <b>2</b> DBL Power distribution blocks | <b>5</b> Wiring duct           |                                      |
| <b>3</b> Modular fuse holders          | <b>6</b> Terminals and splices |                                      |

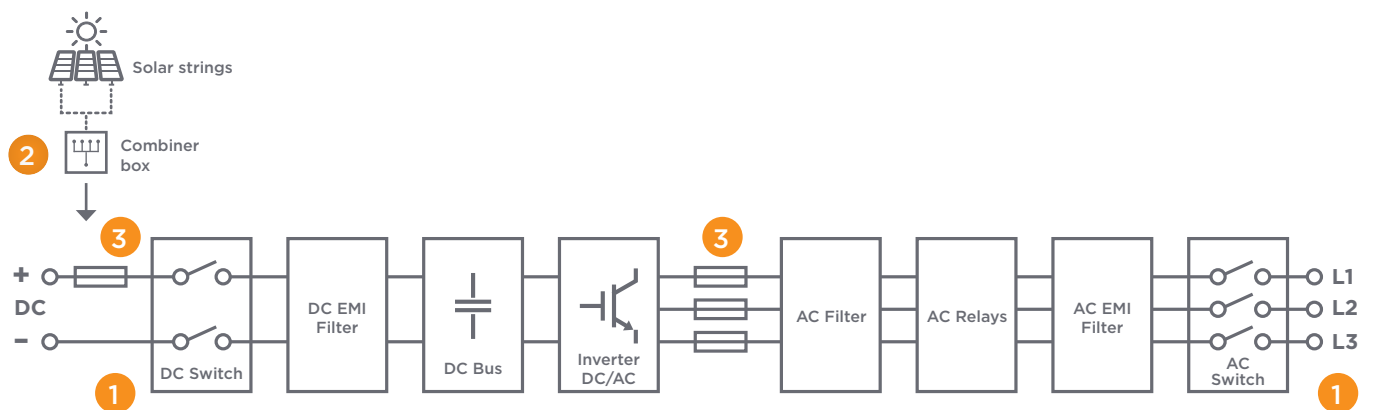
# STRING SOLAR INVERTERS

String solar inverters are an essential part of solar panel systems because they aggregate the power output of solar panels into “strings”. These strings are connected to a single inverter where electricity is converted from DC to AC so it can be used in homes or businesses or connected to the grid.

String inverters are continually evolving — newer systems have advanced features that are compatible with smart grids. In addition, sensors and monitoring tools are being used to enhance string inverters into energy management centers. TE supports the string solar inverter market with highly dependable yet compact and powerful products such as power and control connections (terminal blocks, crimp terminals), protections (modular fuse holders), identification and labeling, wire and cable management solutions.



- 1 ENTRELEC Terminal blocks
- 2 DBL Power distribution blocks
- 3 Modular fuse holders
- 4 Cable glands
- 5 Wiring duct
- 6 Terminals and splices
- 7 Identification and Labeling

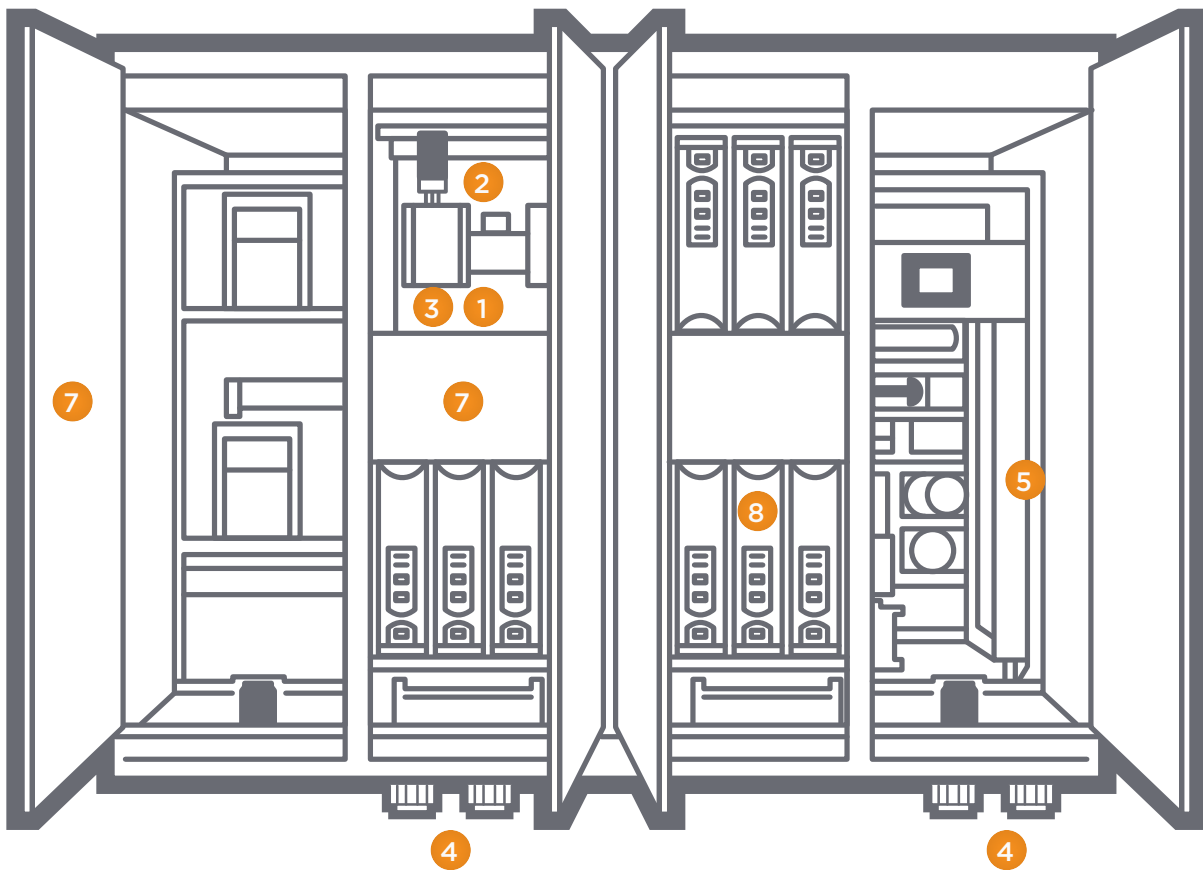


Configuration of 125 kW String Solar Inverter

# POWER CONVERSION SYSTEM (PCS)

A PCS is the critical device that allows a battery system to convert DC stored energy into AC transmissible energy. The PCS also controls the charging and discharging process of the battery and allows for the large-scale utilization of renewable energy sources, energy storage, and microgrids.

TE supports the PCS industry with industry-leading connectivity solutions, power and control connections (terminal blocks, crimp terminals), identification and labeling, wire and cable management solutions.



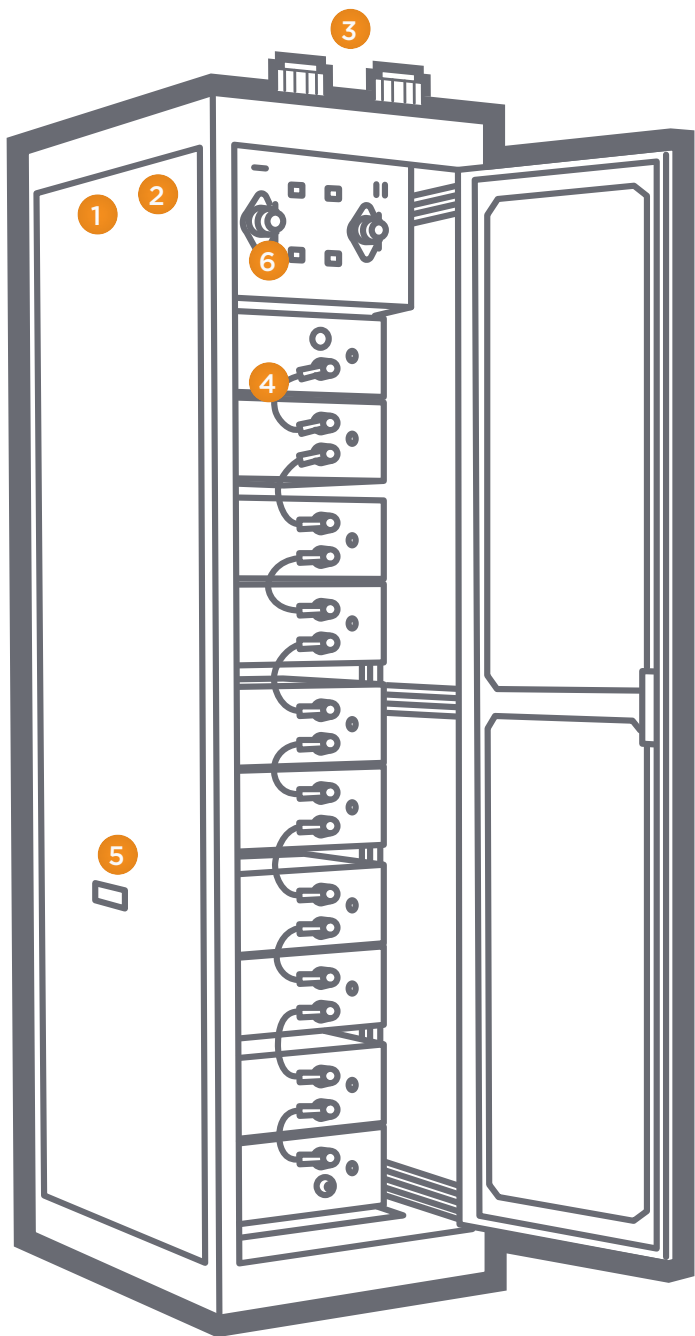
- 1 ENTRELEC Terminal blocks
- 2 DBL Power distribution blocks
- 3 Modular fuse holders
- 4 Cable glands
- 5 Wiring duct
- 6 Terminals and Splices
- 7 Identification and Labeling
- 8 Compact power blocks



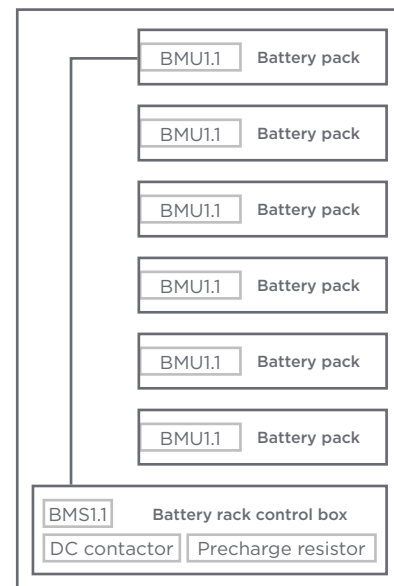
# BATTERY SYSTEMS

A battery system is a complete energy storage system that plays a key role in renewable energy success by helping to balance renewable energy supplies with electricity demands. As batteries are asked to do more – complete a higher number of duty cycles, last longer, and hold more power – manufacturers are working with new thermal management technologies.

TE supports next-generation battery systems with a broad portfolio of more reliable, compact, safer components, including switches, connectors, DC contactors, off-board power resistors, power and control connections (terminal blocks, crimp terminals), identification and labeling, cable glands, and EMI filters.



- 1 ENTRELEC Terminal blocks
- 2 Compact power blocks
- 3 Cable glands
- 4 Terminals and Splices
- 5 Identification and Labeling



*Configuration of Battery Rack in Commercial/Factory BESS*

## ENTRELEC TERMINAL BLOCKS

## DBL POWER DISTRIBUTION TERMINAL BLOCKS

## COMPACT POWER BLOCKS



The ENTRELEC terminal blocks offer one of the largest DIN rail terminal block offerings in the market with many technologies found in over 8000 products and solutions.

They allow efficient signal connection, distribution and devices protection into BESS sub systems such as PCS, central and solar inverters, battery systems.

### BENEFITS:

- Connection and mounting ergonomics thanks to the noteworthy SNK range available in PI-Spring (Push-In and Spring), screw clamp and pluggable technologies
- Common accessories to the three technologies
- Qualified for worldwide applications and harsh environments.

### TE featured products:

#### SNK Series:

- Screw-clamp terminal blocks
- PI-Spring terminal blocks
- Pluggable terminal blocks

Our compact and modular power distribution blocks distribute or group single phase or three phase electrical circuits from a single input source to several devices in the branch circuit. Power distribution blocks are easier to install, helps save space, and supports increased productivity as well as flexibility of use into BESS systems.

### BENEFITS:

- Three configurations in one product: single pole and multipole splitter, grouping up to 12 solar strings
- 1500 VDC voltage rating adapted to most recent solar and BESS inverters requirements
- Connect round or flat conductors and take up only 50% of the space compared to copper bars
- Reduce assembly time by up to 80% since no additional fastening or isolating components are needed.

### TE featured products:

#### DBL power distribution blocks

The compact power blocks allow the connection of power cables at input or output of BESS sub-systems control panels such as PCS, central and solar inverters. They combine high performance ratings (up to 300 mm<sup>2</sup>, 520 A) in a compact and light format.

### BENEFITS:

- From 50 mm<sup>2</sup> to 300 mm<sup>2</sup> (10 AWG to 600 Kcmil UL), 150 A to 520 A (120 A to 420 A UL)
- Modularity, 2 connection versions for power connection and 4 connections versions for power distribution purposes
- Economical solution for power connections
- Compatible with aluminum and copper wire
- Two mounting option, panel and DIN rail mounting.

### TE featured products:

#### Compact power blocks

## MODULAR FUSE HOLDERS

## CABLE GLANDS

## WIRING DUCT



The modular fuse terminal blocks are designed to provide for fine protection of electrical devices in DC and AC single phase and three phase networks. DC versions rated up to 1500 VDC are used to protect solar strings inputs of combiner box or DC inputs of central inverters or PCS.

AC versions protect 3 phase outputs of inverters or PCS.

### BENEFITS:

- Compatible with wide range of global and regional, application regulations
- Compact design
- Complete portfolio of fuse function with new fuse size: 10 x 38, 10 x 85 mm and CC
- To protect DC side of inverter up to 1500 VDC.

**TE featured products:**  
**Modular Fuse holders**

Our cable glands are engineered to provide excellent strain relief for cables and high ingress protection against dirt, dust, water, and other liquids for electrical enclosures of BESS installation that are often located outside and in harsh environments.

### BENEFITS:

- High ingress protection up to IP69
- 3 material choices: polyamide, brass, and stainless
- 3 thread types: metric, PG, and NPT
- Vast range of accessories, including washers, locknuts and various plugs to provide drainage, ventilation, or sealing.

**TE featured products:**  
**Cable Glands**

The WD wiring duct range includes popular profile widths such as 24 mm, 40 mm, 60 mm, 80 mm, 100 mm and 120 mm.

The high-quality PVC and Halogen free material supports the use in many applications such as standard industrial applications with PVC range to the most demanding applications such as railway, high buildings, marine and public buildings with the low smoke and Halogen Free range. The specific design offers many solutions to enhance and simplify the wiring.

### BENEFITS:

- Save time while breaking off ribs virtually without using any tools
- Additional hole on the side, allow the use of cable ties to group your cables in an efficient manner
- Quickly mount wire retainers on the bottom rail of the duct without screw and slide them along the rail
- Wiring duct covers hold securely even in a vertical position and under vibration.

**TE featured products:**  
**Wiring duct**

## WIRE IDENTIFICATION

## EQUIPMENT AND PANEL IDENTIFICATION

## TERMINAL BLOCKS IDENTIFICATION



The printable heat shrink tube supports durable marking in harsh environments. They are available in ladder or continuous format and resist to abrasion, solvent, high temperature. They suite well BESS applications like inverters, PCS, Battery systems.

### BENEFITS:

- Self-extinguishing printable heat shrink tube available in a range of sizes and colors
- Ladder or continuous tubing
- Large operating temperature range
- Available in supplied diameter from 2.4 mm to 38.1 mm
- High product and print resistance to industrial fluids and chemicals.

#### TE featured products:

[Printable heat shrink tube](#)

Our printable labels solutions support equipment and panel identification. High temperature PCB labels helps allow' direct wave and Ir reflow PCB applications.

Temper evident labels are designed for serial number, calibration or rating plate information labels that requires protection against removal.

### BENEFITS:

- Polyester labels for industrial surfaces and used to display product information or as rating plate
- Hash environment labels and wire markers for durable marking
- Panel labels resist exposure to industrial fluids, solvents and abrasion from frequent handling
- High temperature labels suitable for direct wave (bottom side) and Ir reflow (top side) PCB applications. Designed to resist fluxes, cleaning solvents and molten solder
- Printable metalized polyester (MP) or polyethylene (TN) labels with strong acrylic adhesive are designed for serial number, calibration or rating plate information labels that requires protection against removal.

#### TE featured products:

[Labels](#)

Our large portfolio of terminal block markers and labels helps ease the identification of circuits in the control panel. They are delivered pre-printed or blank for custom marking. Clip-on markers or adhesive strips available. New SNK / SNA identification strips are supplied blank, ready for custom identification printing.

### BENEFITS:

- SNK series terminal blocks support the use of adhesive strip markers
- Rigid blank markers allow high marking durability and quality when used with our thermal transfer printing systems
- Pre-printed markers is a cost effective solution for standard identification needs. The offering is declined in more than 1500 different versions with vertical or horizontal marking, letters, numbers, series etc.
- Rigid markers are delivered in cards and strips for a quick and easier mounting on the blocks.

#### TE featured products:

[Terminal block markers](#)

[Terminal block marker strips](#)

## TERMINALS AND SPLICES

### PIDG NYLON TERMINALS



PIDG terminals and splices are designed to offer high and uniform reliability in the one of the most difficult circuit environments. They consist of a nylon or PVC insulated copper body, plus a copper sleeve that crimps to the wire insulation for added support. This advanced premium design is vibration resistant and allows the wire to bend in any direction without damaging the wire insulation or conductor.

#### BENEFITS:

- From 0.12 mm<sup>2</sup> to 6 mm<sup>2</sup> - 26 AWG to 10 AWG
- Color coded insulation
- Ring tongue, spades, wire pins, splices, disconnect
- High mechanical resistance: Wire can be bent into basically any direction reducing the connection fail risks
- High resistance to harsh environment and vibrations. Insulation repels hydrocarbons (greases, oils, etc.) and has high dielectric strength
- Serrations in the crimp barrel provide reliable contact and tensile strength after crimping.

#### TE featured products:

**PIDG terminals**

## TERMINALS AND SPLICES

### PLASTIGRIP VINYL TERMINALS



PLASTI-GRIP terminals are pre-insulated terminals and splices specifically designed to answer the need for inexpensive insulated electrical terminations. They consist of a high conductivity copper body and color coded PVC insulation that can be used in almost all commercial applications. The wire and terminal barrel provide a connection of high conductivity, tensile strength, and high resistance to corrosion.

#### BENEFITS:

- From 0.12 mm<sup>2</sup> to 76 mm<sup>2</sup> - 26 AWG to 2/0 AWG
- PVC insulation provides good dielectric strength and supports the wire insulation so that no bare wire is exposed
- Funneled wire entry on terminal prevents turned back wire strands and permits rapid wire insertion during high speed production
- Serrations in the crimp barrel provide reliable contact and tensile strength after crimping.

#### TE featured products:

**PLASTI-GRIP terminals**

## MARKETING

### SPOTLIGHT



**“TE is a key supplier of electrical components for BESS market. Our broad portfolio of connections and wire management solutions and power distribution solutions helps in designing more compact and more efficient BESS systems.”**

— **Abhijeet Paranjape**,  
Global product manager  
TE Connectivity

## Connect With Us

We make it easy to connect with our experts and are ready to provide all the support you need. Visit [te.com/support](https://te.com/support) to chat with a Product Information Specialist.

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### te.com

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05-24

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