

Energy Storage

The OEM and Installers Guide to Control Components for Energy Storage Systems



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About c3controls

Since 1976 c3controls (c3controls.com) has provided OEMs and electrical equipment builders a comprehensive portfolio of industrial control products that meet the most demanding applications. By maintaining strict control over the development and manufacturing of all products, c3 can provide customers extraordinary value through unmatched quality, competitive pricing, same-day shipping and a 36-month product warranty. This vertically integrated approach coupled with a direct sales model brings c3 closer to the end-user, fostering a degree of innovation that leads the industry.



Glossary of Terms

- Batteries:**
An ESS technology. Electro-chemical processes convert chemical energy back into electricity when needed. Common types include flow, lead-acid, and lithium-ion batteries.

Capacity:
The maximum amount of energy that an ESS can store. Typically measured in kilowatt-hours (kWh) or megawatt-hours (MWh).

Charge:
The first step in energy storage. Energy is supplied and kept in a storage system for future use.

Community, Commercial, and Industrial (CCI) Storage:
Mid-size energy storage systems deployed at commercial businesses and industrial facilities to help optimize energy usage.

Discharge:
After an ESS is charged and optimized, the final step is to discharge, or convert energy back into electrical energy and release it when needed.

Energy Storage System (ESS):
Technology that captures and stores energy for later use to help balance supply and demand. Common types include battery, thermal, mechanical, hydrogen, and pumped hydro energy storage systems.

Grid Modernization:
The process of upgrading the electrical grid to incorporate advanced technologies (such as energy storage) in order to improve reliability, efficiency, and flexibility.

Grid-Scale Storage:
Large-scale, typically utility applications, that store and manage significant amounts of energy to support the electrical grid.

Hydrogen:
An ESS technology. Excess electricity is converted into hydrogen via electrolysis and stored until it is re-electrified.

Mechanical:
An ESS technology. Force is applied to harness kinetic or potential energy and store it for future use. Common types include flywheels and compressed air.

Microgrid:
A localized energy system that uses integrated distributed energy resources, such as renewables and storage, to act as a small-scale grid. Microgrids can operate both connected to the main electrical grid and in isolation.
- Optimization:**
After an ESS is charged, optimization is the process of maximizing efficiency and effectiveness using various software algorithms.

Power Conversion:
Vital for transferring energy between a storage system and the electrical grid, this is the process of converting energy from one form to another. An inverter is a common power conversion technology.

Pumped Hydropower:
An ESS technology. Excess electricity is used to pump water from a lower to an upper reservoir. When energy is needed, water is released back to the lower reservoir, passing through turbines to generate electricity.

Residential Storage:
Small-scale energy storage installed in the home. Typically these systems use batteries to store excess electricity generated from solar panels.

Standalone Microgrid:
An energy system that is not connected to the electrical grid but can store and release energy as needed. A standalone system often relies on a combination of renewable energy sources (solar, wind) and energy storage.

Switchgear:
Electrical equipment that can be used in an ESS to control, protect, and/or isolate electricity and electrical equipment.

Thermal:
An ESS technology. Heat or cold is captured and stored in a medium (such as molten salts, water, or fluids) to create energy on demand.

Transformer:
A device that transfers electrical energy between different voltage levels and ensures efficient and safe energy transfer between an ESS and the electrical grid.

-ESS – Powering the Future

Energy in its original form cannot be stored on any scale. An Energy Storage System (ESS) is necessary to capture and convert electricity into another form so that it can be stored for future use. Stored energy helps stabilize energy resources by balancing supply and demand, providing benefits including, but not limited to the following:

- **Reliability:** An ESS provides backup power during disruptions.
- **Economics:** An ESS saves low-cost energy to use when rates are higher.
- **Sustainability:** An ESS can integrate renewable energy sources.

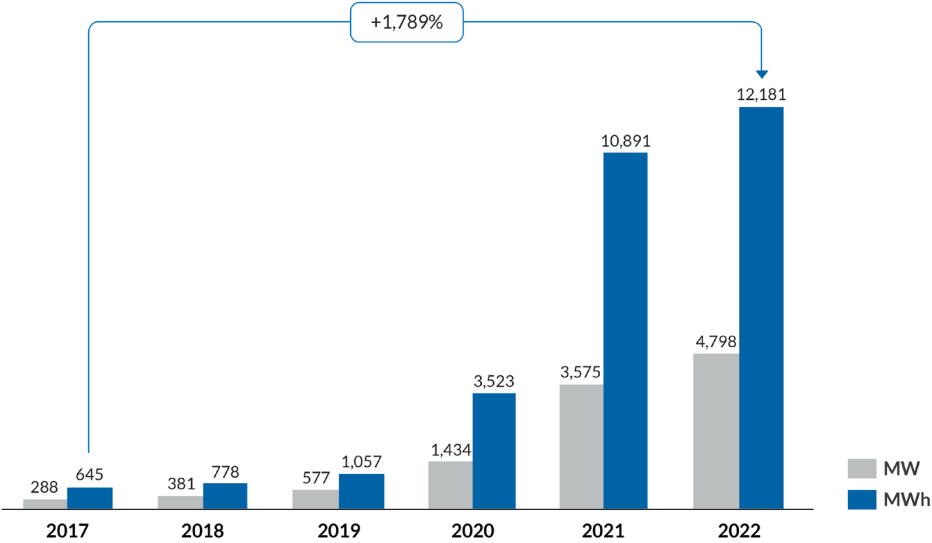
These benefits are not going unnoticed as there has been a 1,789% increase in en-ergy storage deployments over the last 5 years. The record years are projected to continue as the nation may add as much as 75 GW (75,000 MW) of energy storage by 2027 to meet all-time high demand across all market segments — grid-scale, residen-tial, and commercial & industrial (C&I).

There are billions of dollars in ESS invest-ments with billions more to come. This will drive the market forward and common energy storage technologies (batteries, thermal, mechanical, hydrogen, pumped hydropower) will continue to advance. However, challenges remain. Supply chain volatility, product costs, and uncertainty in a fast-moving environment will make maxi-mizing potential difficult.

c3controls can help. With more than 50 years of experience manufacturing electrical controls, we provide the reliable control products that are essential to energy storage systems. Our vertically integrated approach allows us to operate efficiently, respond quickly to changing market conditions, and provide the quality products you need with fast delivery. Whether supporting grid-scale, residential, or commercial and industrial applications, c3controls is equipped to help meet the demands of a rapidly evolving energy storage market.

With over seventeen million product configurations from c3controls and custom UL 508A-certified panel solutions from Covenant Panelworks (CPW), you have a trusted source for complete electrical control solutions. Contact us today and discover how our expertise can help you improve the reliability, efficiency, and performance of your energy storage applications.

U.S. ENERGY DEPLOYMENTS ACROSS ALL MARKET SEGMENTS, 2017-2022



-Energy Storage Isometrics

Here's an example of a grid-scale energy storage system:

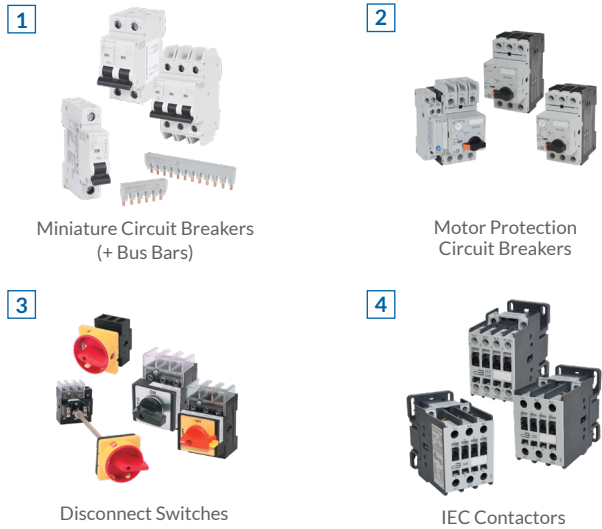


Energy Storage Products

c3controls can support all key function areas in your energy storage system:

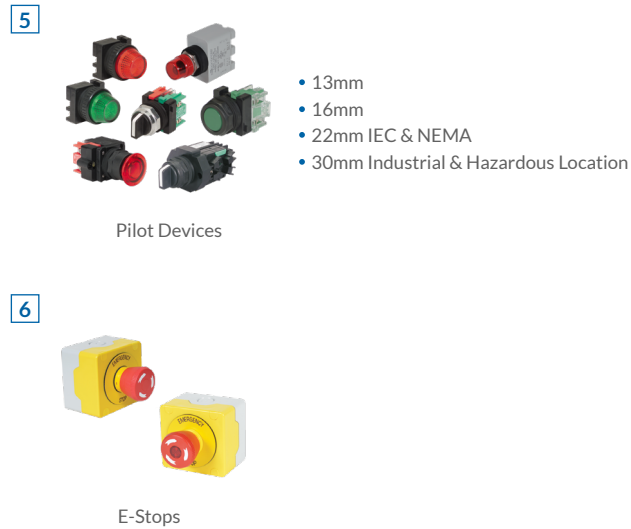
Power & Actuation

Disconnect, control, and/or protect a circuit from a ground fault, short-circuit, or overload current.



Human Machine Interface

Actuated by a person to direct the operation of another device and/or indicate the status of an operating system.



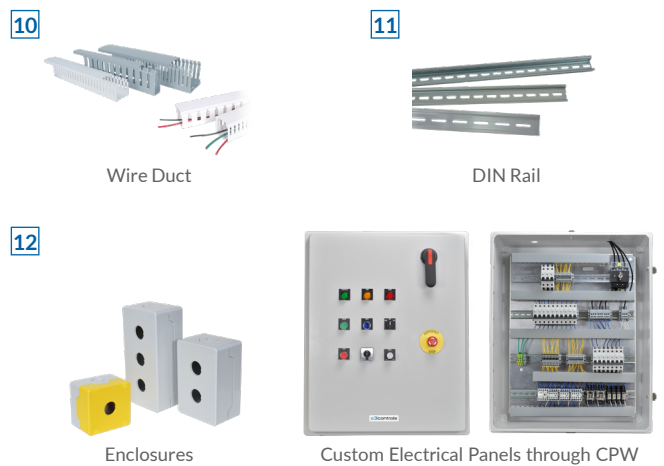
Control Logic

Devices that control other products in a control circuit in a logical sequence or based on a defined period of time.



Panel Solutions

Support and protect electrical components that control and monitor a number of mechanical processes.

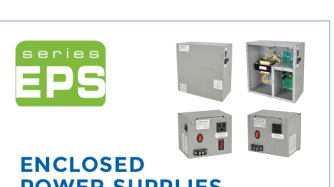
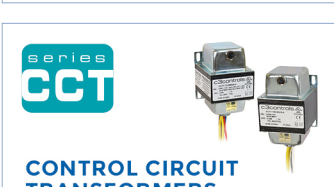
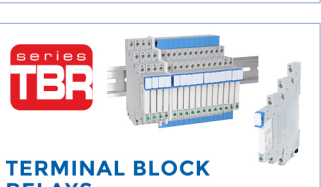


1		Miniature Circuit Breakers	UL 489 & UL 1077 in 1, 2 and 3 pole combinations	Rated 60VDC single pole and 125VDC two pole (wired in series)	10kA SCCR @ 480Y/277VAC	Current ratings up to 63 Amps (non-derated)	B, C and D curve ratings
2		Motor Protection Circuit Breakers	Multi-Function: Manual Motor Controller, Motor Disconnect, Group Motor Installations	50kA SCCR @ 480V	Self-protected Type E up to 50kA @ 460V	FLC up to 32 Amps	Trip Class 10 Thermal and Magnetic Elements
3		UL 508 Disconnect Switches	Door mount, panel-base mount, and panel mount with integral operator	Certified for use in Manual Motor Controller applications suitable as Motor Disconnects	16 - 125 Amps in 3-, 4-, and 5-pole configurations	Motor loads up to 40HP @ 480V (55kW @ 400V)	Operating handles rated for Type 1, 2, 3, 3R, 4/4X, 12, 13, IP55, and IP65
4		IEC Contactors	9 to 105 Amps	100kA SCCR @ 480V and 600V with Class J fuses	AC and DC - electronic coil control on DC devices	Integral auxiliary	Up to 75 HP @ 400V (55kW @ 400V)
5		Pilot Devices	Modular range of 30mm, 22mm, 16mm, and 13mm	Type 1, 2, 3, 3R, 4/4X, 12, and 13	Non-Illuminated, Illuminated and Keyed Operators in both maintained and momentary operations	Color-coded, snap-on contact blocks with angled captive screws and pressure plates	Full voltage, multi-voltage, resistor, and dual input light units in a wide range of voltages up to 600VAC/VDC
6		22mm IEC E-Stops	Non-Illuminated and Illuminated versions	UL Listed Polycarbonate enclosure rated for Type 1, 2, 3, 3R, 4/4X, 12, 13, and IP66	Meets EN418 Safety of Machinery global compliance standards	Operating temperatures from -40 to +55° C (-40 to + 131° F)	UV and corrosion resistant
7		General Purpose Relays	Square base, flange mounted and miniature	Only 14mm wide	Transparent housing	Pole combinations available in SPDT, DPDT, 3PDT and 4PDT	Carrying current rating 5A-25A
8		High Density Terminal Blocks	4, 6, and 12 point in a single molded housing. 6-point shorting block available.	Rated for 600V, 30A continuous service	Replacement for GE CR151 and EB27B06S terminal blocks	Integrated 35mm DIN rail snap and panel mounting construction	Captive screws with spring-return open terminals
9		IEC Terminal Blocks	Screw Clamp, Spring Clamp, and Miniature	5mm - 25mm widths	25 - 230 Amps	Feed Through, Ground, Multi-Conductor, Double & Triple Level, Fuse Holder, Power Distribution, and more	DIN Rail mounting; snap-on, snap-off assembly
10		Wire / Cable Duct	13 Selectable dimensions from 25mm wide up to 80mm, and up to 2m in length	Narrow and Wide Slot	Rigid “U” shaped duct with non-slip-cover in gray or white	Optional adhesive backing	
11		DIN Rail	35mm rails in steel and aluminum	1m (3.28ft) or 2m (6.56ft) lengths	Each simply fasten by screws to the mounting surface	Standard package quantities, or pallet options available	
12		Enclosures	Polyester, Polycarbonate and Die Cast Aluminum constructions	Accommodates 22mm and 30mm pilot devices, and disconnect switches	Options up to four holes, or unpunched	A variety of seals to keep dust and moisture out of the enclosures	UL Listed and CSA certified

For illustration purposes only. Other solutions may be applicable depending on your application design requirements.

Product Portfolio

Our 17 million+ product configurations deliver durability and reliability—even in the most punishing environments—meeting and exceeding global standards for quality and safety.

 DISCONNECT SWITCHES NON-FUSED & ENCLOSED	 MINIATURE CIRCUIT BREAKERS	 CONTACTORS & CONTROL RELAYS	 OVERLOAD RELAYS
 DIRECT-ON-LINE STARTERS CONTACTOR + OVERLOAD RELAY	 ENCLOSED DIRECT-ON-LINE STARTERS CONTACTOR + OVERLOAD RELAY	 MOTOR PROTECTION CIRCUIT BREAKERS OPEN & ENCLOSED	 DIRECT-ON-LINE STARTERS MOTOR PROTECTION CIRCUIT BREAKER + CONTACTOR
 ENCLOSED DIRECT-ON-LINE STARTERS MOTOR PROTECTION CIRCUIT BREAKER + CONTACTOR	 30MM PILOT DEVICES FOR INDUSTRIAL & HAZARDOUS LOCATION	 22MM PILOT DEVICES IEC & NEMA	 WORLD TOWER LIGHTS
 CAM SWITCHES	 16MM PILOT LIGHTS	 13MM PILOT LIGHTS	 CONTROL STATION ENCLOSURES
 ENCLOSED UL508A COMBINATION MOTOR STARTERS	 ENCLOSED POWER SUPPLIES	 VFD BYPASS PANELS	 INDUSTRIAL POWER SUPPLIES
 CONTROL CIRCUIT TRANSFORMERS	 CONTROL POWER TRANSFORMERS	 TERMINAL BLOCKS	 TERMINAL BLOCK RELAYS
 ELECTRONIC TIMING RELAYS	 GENERAL PURPOSE RELAYS	 WIRING DUCT	 DIN RAIL

White Papers

Product professionals AND subject experts!
Check out c3controls' extensive library of white papers:



Battery Basics: Energy Storage Systems

Energy storage systems are becoming more popular. Read this battery basics guide to understand the different types of energy storage systems.

[READ WHITEPAPER](#)



Understanding Energy Storage Systems

In this issue, learn how Energy Storage could help the US power grid operate more efficiently, reduce brownouts during peak demand, and allow for more renewable resources to be used, becoming net-zero carbon emissions by 2035.

[READ WHITEPAPER](#)



Energy Storage Industry Outlook

Explore the latest trends and challenges in the energy storage industry with our comprehensive whitepaper. Discover the latest technologies and opportunities in this rapidly growing sector.

[READ WHITEPAPER](#)



The Smart Grid & Grid Modernization

The increasing demand for electric power continues to accelerate. Read our paper for an overview of what is needed to strengthen the Smart Grid and ensure that the future electricity needs for the US are fulfilled.

[READ WHITEPAPER](#)



Solar Energy - New Trends in Technology

It makes perfect sense that we are turning to the Sun to help fulfill our energy needs. We have finally evolved our technology to be able to capture the Sun's energy, store and distribute it. Find out all about that in our latest paper on Solar Energy Trends in Technology.

[READ WHITEPAPER](#)



EV Charging Guide

Charging your electric vehicle is super easy with this complete step-by-step guide that covers all key things related to electric vehicle charging. Learn the basics, including what you should know before you charge and which chargers work with your type of car.

[READ WHITEPAPER](#)

10.



Innovation

Same-Day Shipping

36-Month Warranty

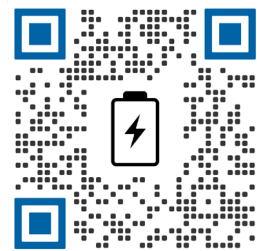
Advantage Pricing

Customer First



1.

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