

# HVAC

## - Heating, Ventilation, and Air Conditioning

*The OEM and Installers Guide to Low Voltage  
Electrical Control Components  
for HVAC Systems*





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## About c3controls

Since 1976 c3controls ([c3controls.com](http://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 lifetime 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 HVAC Terms

## Air Handling Unit (AHU):

A central unit that conditions the outside air by cleaning, heating or cooling, and then distributing the air within a building.

## Branch Circuit Protection:

The primary method of circuit protection in a control panel provided by UL 489 miniature circuit breakers. UL 489 MCBs protect downstream systems in feeder, branch and control circuits and can be used in both UL 489 and UL 1077 applications.

## Chiller:

A machine that removes heat from a liquid coolant via vapor-compression or absorption refrigeration.

## Combination Motor Starter:

An electrical device that integrates the protective functions into a single unit to provide reliable motor control, motor overload protection, motor disconnecting means, motor branch circuit, short circuit, and ground fault protection.

## Disconnect Switch:

A switch used to ensure that an electrical circuit is completely de-energized for service or maintenance.

## Full Load Amperes (FLA):

Represents the amount of current a motor is designed to draw from the electrical system at the rated horsepower. This can be found on the motor nameplate as Amps or FLA.

## Heat Pump:

A machine that pumps heat both outside and inside providing a combined heating and cooling system within a building.

## Horsepower (HP):

A unit of measurement of power, or the rate at which work is done, usually in reference to the output of engines or motors.

## Manual Motor Starter:

An electrical device that is non-automatic to control the electrical power for starting, stopping, reversing and/or protecting a motor.

## National Electric Code (NEC):

The National Electrical Code, or National Fire Protection Association (NFPA 70), is the adoptable standard in the United States for safe electrical design, installation, and inspection of electrical wiring and equipment to protect people and property from electrical hazards.

## NEMA Type 1:

Enclosures intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment. Often located where unusual service conditions do not exist.

## NEMA Type 3R:

Enclosures intended for outdoor use primarily to provide a degree of protection against rain, sleet and ice. Note: NFPA 70 (National Electric Code) defines new Type 3RX as providing the same degree of protection as Type 3R, with the addition of protection against corrosive agents.

## NEMA Type 4:

Enclosures intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose directed water, undamaged by the formation of ice on the enclosure.

## Non-Combination Motor Starter:

An electrical device that integrates the circuit breaker and overload relay functions to provide reliable motor controller, motor overload protection, and motor disconnecting means.

## Single-Phase System:

A single-phase electric power is the distribution of alternating current electric power using a system in which all the voltages of the supply vary in unison. Single-phase distribution is used when loads are mostly lighting and heating, with few large electric motors.

## Supplementary Circuit Protection:

A form of circuit protection used when branch circuit protection is already provided or not required. UL 1077 supplementary protectors support individual devices and can only be used in UL 1077 applications.

## Three-Phase System:

Three-phase electric power is a common type of alternating current used in electricity generation, transmission, and distribution. It is a type of polyphase system employing three wires and is the most common method used by electrical grids worldwide to transfer power.

## UL508 / UL508A:

UL508 is the standard for industrial control equipment. UL508A is the standard for industrial control panels.

## Ventilation System:

Ventilation is the process of exchanging or replacing air in any space to provide high indoor air quality.

# Overcoming HVAC Challenges

For over 45 years, c3controls has been a leading manufacturer of quality electrical controls for HVAC. We strictly control the manufacturing of our products to provide high quality controls that you can install and forget about for years to come. Our experience serving HVAC has provided us a deep understanding of industry challenges and how to solve them. The post-pandemic HVAC industry we see today presents a variety of hurdles such as:

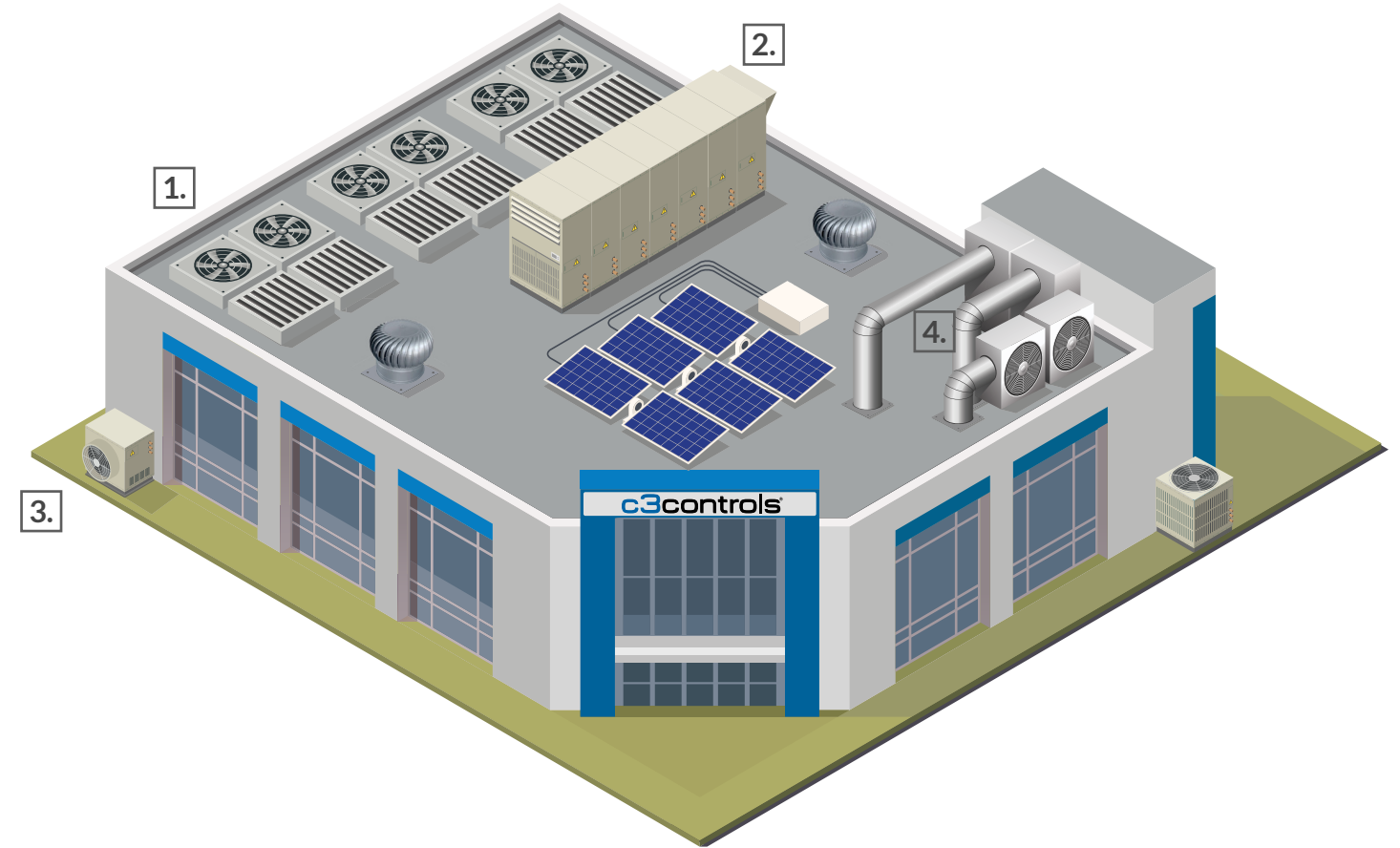
- **Supply chain issues** that bring long lead times for critical system components.
- **Workforce shortages** that limit the availability of qualified workers needed for installation.
- **New standards for indoor air quality** (from the US EPA Clean Air Challenge) that require upgrades to air handling systems.
- **Compliance with laws and regulations** (OSHA, EPA, federal, state and local agencies) that add complexity to HVAC applications.
- **Requirements for funding programs** (through the American Rescue Plan and Bipartisan Infrastructure Law) that dictate ability to make repairs and upgrades.

With these great challenges come great opportunities for the industry and your business. With the right parts, people and processes, your HVAC application can stand out from the rest.

c3controls can help you succeed. We manufacture our products globally and do not source any major products from China. This allows us to operate more efficiently and respond to market conditions quicker. That means faster delivery for your industrial control product needs.

If you are having a difficult time finding qualified electricians and engineers, c3controls operates a UL508A panel shop in Beaver, PA to supplement your inhouse manufacturing for custom or specialty control panels.

With over fifteen million available product configurations, and our own panel shop, c3controls has the resources you need to meet the changing requirements of federal, state and local agencies while capitalizing on your HVAC business opportunities!



**1. Chiller:**  
*A machine that removes heat from a liquid coolant via vapor-compression or absorption refrigeration.*

**2. Air Handling Unit (AHU):**  
*A central unit that conditions the outside air by cleaning, heating or cooling, and then distributing the air within a building.*

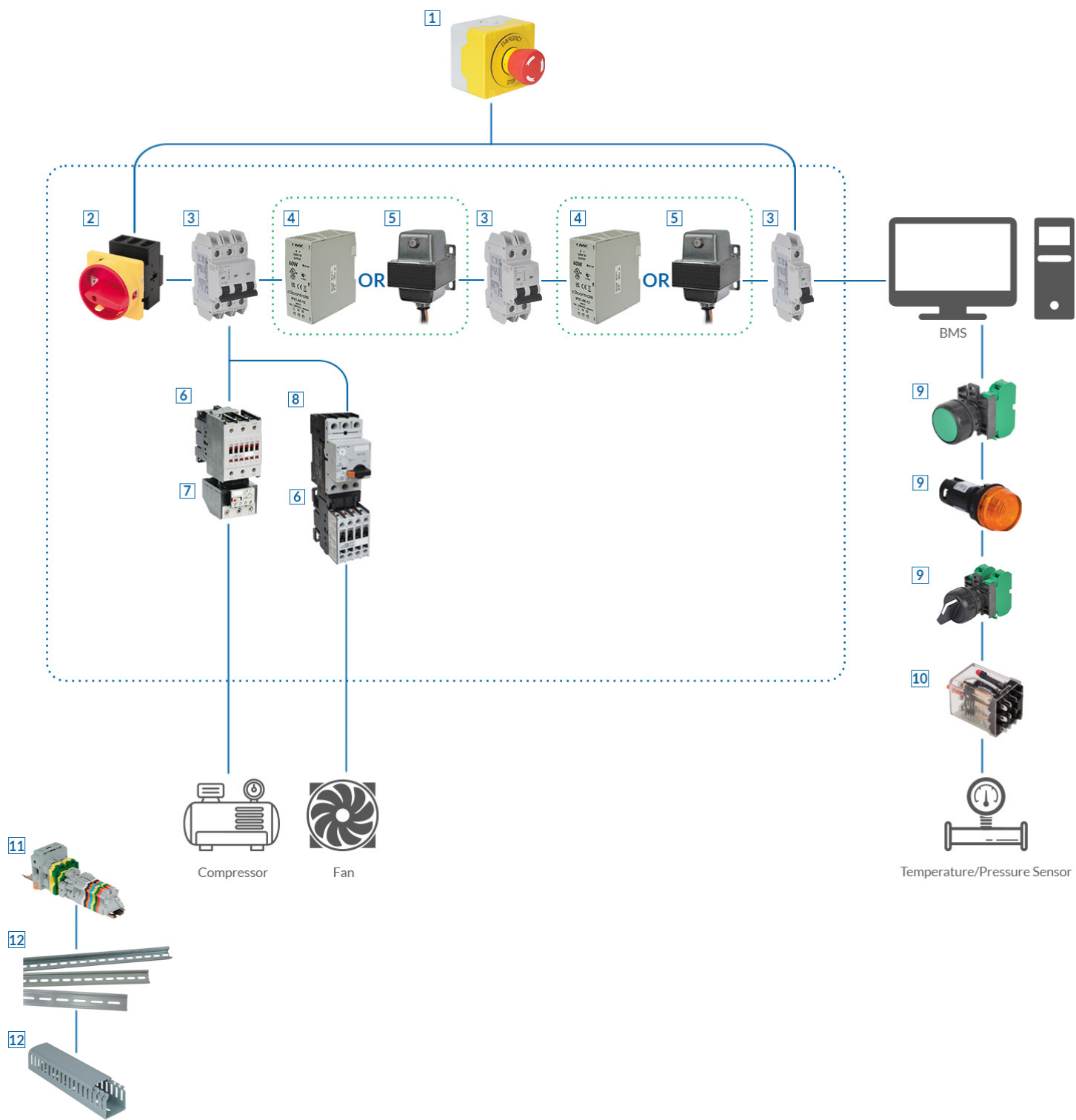
**3. Heat Pump:**  
*A machine that pumps heat both outside and inside providing a combined heating and cooling system within a building.*

**4. Ventilation System:**  
*Ventilation is the process of exchanging or replacing air in any space to provide high indoor air quality.*



# HVAC Application Example and Control Components

c3controls has component and finished solutions for all your air handling, chiller, heat pump, and ventilation systems.



For illustration purposes only. Other c3controls solutions may be applicable depending on your application design requirements.

1		<b>22mm IEC E-Stops</b>	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
2		<b>UL 508 Disconnect Switches</b>	Door mount, panel-base mount, and panel mount with integral operator	Certified for use in Manual Motor Controller applications suitable as Motor Disconnects	16 to 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
3		<b>Miniature Circuit Breakers</b>	UL 489 & UL 1077	1, 2 and 3 Pole combinations	10kA SCCR @ 480Y/277VAC	Current ratings up to 63 Amps	B, C and D curve ratings
4		<b>Industrial Power Supplies</b>	Output power range from 60W to 480W	Adjustable output voltage from 100 to 116%	DC OK Relay Contacts on 240W to 480W power supplies	Delivers power with up to 93% efficiency	Ultra-compact design to save valuable panel space
5		<b>Control Circuit Transformers</b>	Ratings from 20 to 300VA	Operating voltages from 120V to 480V on primary side, and 24V on secondary side	Overcurrent protection options; either inherent or non-inherent, or manual resettable circuit breaker	Integrated grounding system and space-saving footprint	Versatile for Class 2, Class 3, and general-purpose applications
6		<b>IEC Contactors</b>	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 75HP @ 400V (55kW @ 400V)
7		<b>Bimetallic Overload Relays</b>	Current Adjustment Range of 0.28 to 112 Amps	FLC ratio of 1:1.5	100kA SCCR @ 480V and 600V with Class J fuses	Trip Class 10	Single phase sensitivity
8		<b>Motor Protection Circuit Breakers</b>	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
9		<b>Pilot Devices</b>	Modular range of 30mm, 22mm, 16mm, and 13mm	Type 1, 2, 3, 3R, 4/4X, 12, and 13	Non-Illuminated, Illuminated & Keyed Operators in both maintained & momentary operations	Color-coded snap-on contact blocks with angled captive screws and pressure plates	Full voltage, multi-voltage, resistor, & dual input light units in a wide range of voltages up to 600VAC/VDC
10		<b>General Purpose Relays</b>	Square base, flange mounted, and miniature	SPDT, DPDT, 3PDT, 4PDT with a current rating of 5A to 25A	24-240VAC and 12-110VDC	Optional indicating light and/or mechanical actuator	Relays available in convenient multi-packs
11		<b>IEC Terminal Blocks</b>	Screw Clamp, Spring Clamp, and Miniature	5mm to 25mm widths	25 to 230 Amps	Feed Through, Ground, Multi-Conductor, Double & Triple Level, Fuse Holder, Power Distribution, and more	DIN Rail mounting; snap-on, snap-off assembly
12		<b>Wire Duct &amp; DIN Rail</b>	Wire Duct: 13 dimensions from 25mm wide up to 80mm, and up to 2m in length	Wire Duct: Narrow and Wide Slot	DIN Rail: 35mm rails in steel and aluminum	DIN Rail: 1m (3.28ft) or 2m (6.56ft) lengths	DIN Rail: Standard package quantities or pallet options available

# Power Supply Solutions

## series EPS Enclosed Power Supplies

Specially designed for use in BAS (building automation systems) Variable Air Volume (VAV) applications.

c3controls' Enclosed Power Supplies deliver reliable 24VAC power with on/off control, power indication and equipment overcurrent protection.

- The transformer steps down the input voltage to 24VAC at the output
- Optional voltage separation compartments and convenient receptacle outlets
- Durable, Type 1 metallic enclosure



## series IPS Industrial Power Supplies

Regulated power for industrial & commercial loads and residential applications.



Ranging from 60W to 480W, c3controls' Series IPS power supplies deliver, with up to 93% efficiency, the best in its class.

- Adjustable output voltage from 100 to 116%
- 240W to 480W come with DC OK Relay Contacts to provide status signals
- LED indication displays availability of DC power output

For more information on our Power Supply Solutions or to download technical specifications, CAD drawings and product certifications visit [www.c3controls.com/industrial-power](http://www.c3controls.com/industrial-power).

# Motor Starter Solutions

## series ECP 300 Enclosed UL508A Combination Motor Starters

HVAC Panel Solutions

Specially designed for air handling applications, our Enclosed UL508A Combination Motor Starters provide motor disconnect, short-circuit, and ground fault protection, motor control, and motor overload protection.

- Enclosure constructions in Polycarbonate or Carbon Steel
- Each pre-wired assembly includes a: Series 330 MPCB, Series 300 contactor, UL 489 circuit breaker, a variety of 22mm IEC pilot devices, and external operating handle
- 50kA SCCR @ 480V in high fault applications
- Overload relay can be set to the exact FLA of the motor



For more information on Enclosed UL508A Combination Motor Starters or to download technical specifications, CAD drawings and product certifications visit [www.c3controls.com/ECP-300](http://www.c3controls.com/ECP-300).

## series EVP VFD Bypass Panel

Designed to maintain motor operation during maintenance and VFD failures.

COMING SOON



c3controls' Series EVP VFD Bypass Panels are compatible for use with most VFD series applicable in the HVAC industry from multiple manufacturers.

- Can be installed as either a temporary replacement to a VFD or as a system backup
- Each enclosed assembly includes a fused disconnect switch, contactors, control transformer, a variety of 22mm IEC pilot devices, and power and control terminal blocks
- Optimized width to save wall space



# Product Portfolio

Our 15 million+ product configurations deliver durability and reliability—even in the most punishing environments—meeting and exceeding global standards for quality and safety.

 <p><b>DISCONNECT SWITCHES</b></p>	 <p><b>ENCLOSED DISCONNECT SWITCHES</b></p>	 <p><b>MINIATURE CIRCUIT BREAKERS</b></p>	 <p><b>CONTACTORS &amp; CONTROL RELAYS</b></p>
 <p><b>OVERLOAD RELAYS</b></p>	 <p><b>DIRECT-ON-LINE STARTERS</b> CONTACTOR + OVERLOAD RELAY</p>	 <p><b>ENCLOSED DIRECT-ON-LINE STARTERS</b> CONTACTOR + OVERLOAD RELAY</p>	 <p><b>MOTOR PROTECTION CIRCUIT BREAKERS</b></p>
 <p><b>ENCLOSED MOTOR PROTECTION CIRCUIT BREAKERS</b></p>	 <p><b>DIRECT-ON-LINE STARTERS</b> MOTOR PROTECTION CIRCUIT BREAKER + CONTACTOR</p>	 <p><b>ENCLOSED DIRECT-ON-LINE STARTERS</b> MOTOR PROTECTION CIRCUIT BREAKER + CONTACTOR</p>	 <p><b>30MM INDUSTRIAL PILOT DEVICES</b></p>
 <p><b>30MM PILOT DEVICES FOR HAZARDOUS LOCATION</b></p>	 <p><b>22MM IEC PILOT DEVICES</b></p>	 <p><b>WORLD TOWER LIGHTS</b></p>	 <p><b>CAM SWITCHES</b></p>
 <p><b>22MM NEMA PILOT DEVICES</b></p>	 <p><b>16MM PILOT LIGHTS</b></p>	 <p><b>13MM PILOT LIGHTS</b></p>	 <p><b>CONTROL STATION ENCLOSURES</b></p>
 <p><b>ENCLOSED UL508A COMBINATION MOTOR STARTERS</b></p>	 <p><b>ENCLOSED POWER SUPPLIES</b></p>	 <p><b>INDUSTRIAL POWER SUPPLIES</b></p>	 <p><b>TERMINAL BLOCKS</b></p>
 <p><b>TERMINAL BLOCK RELAYS</b></p>	 <p><b>ELECTRONIC TIMING RELAYS</b></p>	 <p><b>GENERAL PURPOSE RELAYS</b></p>	 <p><b>WIRING DUCT</b></p>

# Why choose c3controls



## Integrated Manufacturing

Vertical integration is the cornerstone of c3controls as it places innovation, development, design, manufacturing, testing, and shipping all within our control. With Everything Under Control, we can ensure the highest quality and customer satisfaction.

## Innovation

Product innovation is in our DNA. We approach our products as solutions. Unlike our competition, our business model allows us to provide customers with premium controls without the premium price.



## Same-Day Shipping

Reduce inventory. Improve cash-flow. Save money. Our customers enjoy peace of mind knowing they'll get what they need, when they need it. Our promise, guaranteed!



## Limited Lifetime Warranty

With total control over engineering and manufacturing, we are able to guarantee the highest quality products on the market—products free of defects in material, workmanship, and design.



## Advantage Pricing

Total control means lower overhead and direct sales. For our customers, this translates to savings of up to 40+% on c3controls premium products.



## Customer First

Commitment to the success of our customers is a core value and the driving force behind all we do. We promise concierge style service that makes doing business easy, personalized, and responsive.



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**c3controls**<sup>®</sup>  
*Everything under control.*