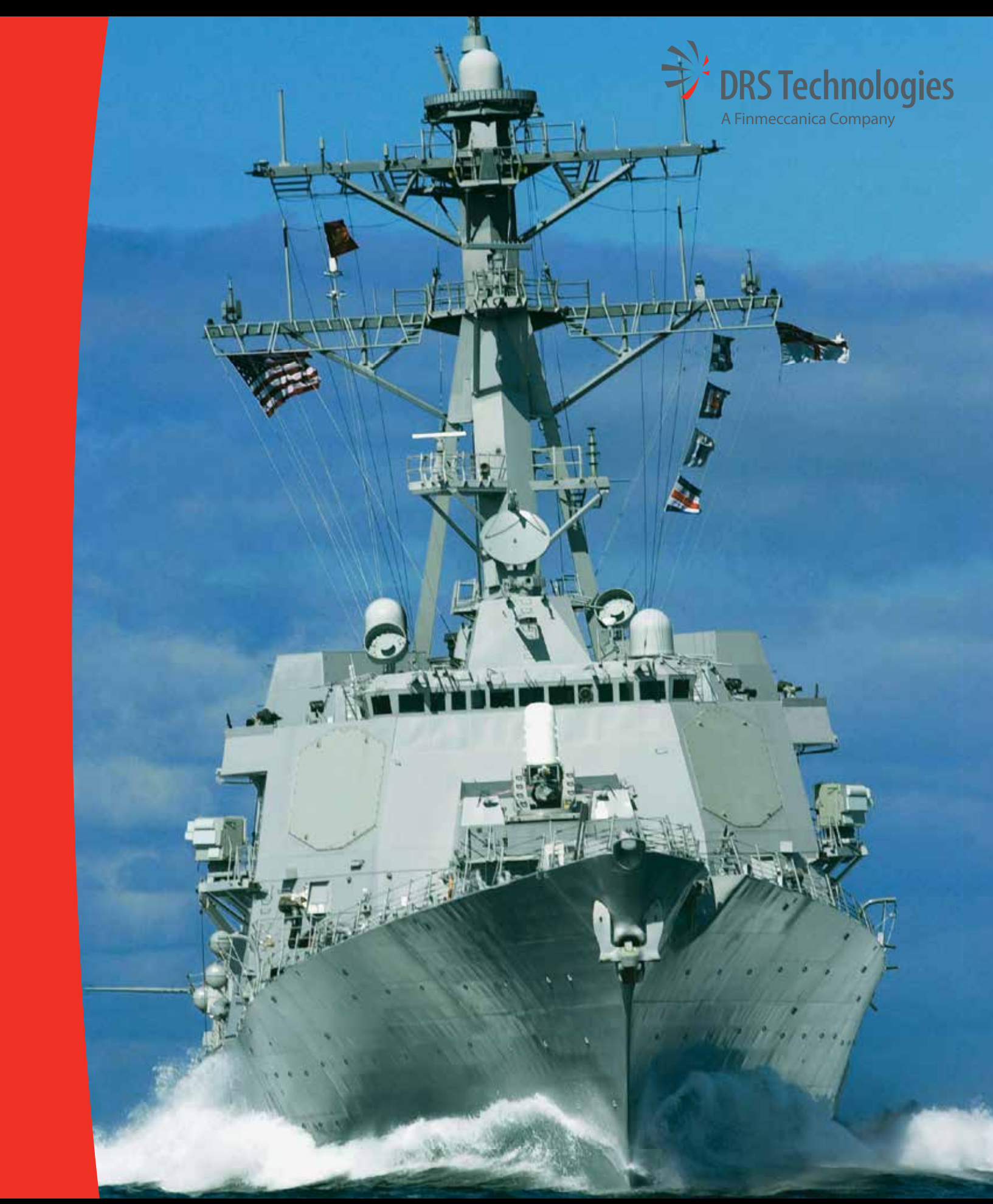

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Some images herein are U.S. Navy Photos. No endorsement expressed or implied.

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Thank you for choosing DRS to meet your system needs. DRS' offerings are vast and range from core hardware and software products to complete system integration and installation services. This Integrated Marine Systems catalog provides an overview of readily available products and services, among them: Propulsion System Integration, Power Distribution, Power Conversion, Heating Ventilation Air Conditioning and Refrigeration, Machinery Plant Controls, Power Conditioning, Electric Motors and Turbo Machinery.

The offerings in this catalog touch on DRS' product and design capabilities. Our full service approach includes a team of product and system experts who are skilled at guiding you through the process of defining, designing and meeting your component or system needs.

This catalog combines the former Ship Systems catalog of DRS Power & Control Technologies with the products and capabilities of DRS Marlo Coil, DRS Pivotal Power and DRS Power Technology. In addition to expanding the offerings found in this catalog, you will find full color photos of our products, and site specific contact information to connect you directly with the product specialist.

For those familiar with the former Ship Controls Systems Catalog you will find the Motor Controllers & Accessories section to be largely reflective of that catalog, with part numbering and page designs that reflect the history of product presentation for ease of use.

DRS is ready to serve with a long history of successfully fielded product and a talented and creative design team.

*Contact information by product area is found to the right on this page. To inquire further or place an order, simply contact the facility by phone or via email. To expedite response to your request please provide us with the following upon inquiry:*

- *Your name*
- *Your contact telephone number and email address*
- *The name of your organization*
- *The country in which your organization resides*
- *The product description and, if applicable, the catalog page number upon which it appears*

*A product specialist will contact you directly within 24 hours of your receipt of your inquiry.*

**NEW PRODUCTS**
**DRS Power & Control Technologies, Inc.**
4265 N. 30th Street, Milwaukee, WI 53216
**Phone:** 414.875.2900 **Fax:** 414.875.4319
**Email:** IMS-BD@drs.com

**MOTOR CONTROL AND OPERATOR INTERFACE SPECIFICATION AND DOCUMENTS**
**DRS Power & Control Technologies, Inc.**
4265 N. 30th Street, Milwaukee, WI 53216
**Phone:** 800.552.2829 **Fax:** 414.875.4764
**Email:** IMS-BD@drs.com

**MOTOR CONTROL AND OPERATOR INTERFACE**
**DRS Power & Control Technologies, Inc.**
4265 N. 30th Street, Milwaukee, WI 53216
**Phone:** 800.552.2829 **Fax:** 414.875.4764
**Email:** IMS-BD@drs.com

**POWER SOLUTIONS**
**DRS Pivotal Power, Inc.**
150 Bluewater Rd., Bedford, NS B4B 1G9
**Phone:** 902.835.7268 **Fax:** 902.835.6026
**Email:** info@pivotalpower.com

**HEATING, VENTILATING, AIR CONDITIONING & REFRIGERATION**
**DRS Marlo Coil**
6060 Highway PP, High Ridge, MO 63049-0171
**Phone:** 636.677.6600 **Fax:** 636.677.1203
**Email:** marlo.navysales@drs.com

**PERMANENT MAGNET MOTORS TURBO MACHINERY**
**DRS Power Technology, Inc.**
166 Boulder Drive, Suite 201E, Fitchburg, MA 01420
**Phone:** 978.353.5500 **Fax:** 978.353.5107
**Email:** powertechnology.info@drs.com

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# Integrated Marine Systems

## Propulsion Systems Integration and Power Distribution

DRS has extensive marine systems experience showcasing capabilities developed through a century of proudly serving the U.S. Navy and our international allies. Whether it's design and/or selection of a single component or full integration of every aspect of a marine propulsion system, our Integrated Marine Systems (IMS) team is focused on developing and deploying the most advanced power generation, conversion, distribution, and propulsion control technology in the world.

Our product is designed and manufactured to meet stringent standards for reliability, durability and maintainability. Among the standards used are: Military Specifications (MIL-SPEC), American Bureau of Shipping (ABS), Institute of Electrical and Electronics, Engineers (IEEE) standards, ISO Certified - 9001 and 14001.

As customer-centric partners DRS listens and delivers solutions through all product offerings. Our commitment to execution excellence, technology innovation and broadly diversified vendor partnerships ensures deployment of superior marine systems, transforming the naval and marine forces of today into highly equipped and versatile war fighters of tomorrow.

Our IMS product and services portfolio is broad and adaptable including:

### Propulsion System Integration

DRS' comprehensive approach to propulsion system integration encompasses design, assembly, test, installation and support. Leveraging our significant experience in component design and system deployment, our products and systems can be found on a variety of ship classes ranging in complexity from nuclear submarines to surface combatant support ships.

### Power Distribution

DRS provides equipment and systems across the full spectrum of shipboard power distribution need including medium and low voltage switchboards and load centers, hardened circuit breakers, and integrated power management systems.

Our new Integrated Fight-Through Power (IFTP) system is a redundant power conversion-based zonal power system designed to support requirements for growing power efficiency demands on future navy ships.

### Machinery Plant Control and Monitoring Systems

Our innovative solutions for naval machinery control, automation and networking include ruggedized COTS technology qualified for shock, vibration, acoustic and EMI requirements. Existing, fielded, and fully qualified DRS products include:

- Server/Network Cabinets
- Logic Processors
- Data Acquisition Units
- Displays/Workstations

**Open Architecture Software: *OpenSea™***

Developed by DRS for naval and marine applications, OpenSea™ provides the ultimate in open architecture, platform-independent distributed control system (DCS) software. Simple, flexible integration enables improved logistical support, enhanced crew training and reduced manning. Redundant communication assures complete communication among all major systems.

**DESIGN | ANALYZE | SELECT | PACKAGE**

## Motor Controls and Drives

Proudly fielded on every U.S. Naval combatant since WWII, DRS motor control products are proven performers in harsh marine environments. Our rugged variable speed drives (VSDs) can be found wherever variable speed/ frequency is a key operating parameter. We provide a wide range of reliable motor control and drive offerings to our customers by leveraging our strong engineering capabilities, full understanding of applicable MIL-SPECs and experience gained from a history of successful products.

## Propulsion and Power Generation

Power-dense DRS Permanent Magnet (PM) machines offer innovative solutions for direct drive ship propulsion, hybrid electric drive and power generation for auxiliary systems.

Our unique set of core competencies enables us to develop a wide range of PM machines in radial and axial-field topologies that meet tough standards for military and commercial applications.

PM motors and generators have significant advantages in size, weight and power over conventional motors. They are ideal for dimension and/or weight constrained applications where significant torque, high efficiency and precise control across load and speed variations are essential.

## Rotating Machinery Packaging

As a full-service equipment packager we have designed and/ or assembled aero-derivative gas turbine packages using each major engine manufacturers' products. These units are in service in naval and ground power applications around the world. Whether build-to-print production or more extensive systems packaging is required DRS is ready to meet the needs of any machinery packaging project.

## Shipboard Power Conversion and Conditioning

DRS power conversion and conditioning systems meet stringent specifications and have been proven to perform in harsh marine environments that can include extreme temperatures, humidity and high shock and vibration. Our products include variable frequency converters; DC rectifiers for helicopter starting; portable multiple-battery chargers and reliable uninterruptible power supply (UPS) systems for powering critical command, control, communication and navigation equipment on-board naval and marine ships.

## Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R)

Shipboard environments require proper control over a wide range of temperatures to support sailors, systems, ships stores and fire suppression. DRS has extensive experience designing and manufacturing rugged HVAC/R equipment specifically for ship applications. Our Naval products are designed to U.S. military specifications and our commercial marine products are designed to U.S. Coast Guard and American Bureau of Shipping regulations. We offer HVAC equipment in many standard sizes and configurations as well as program specific designs for unique applications.

## Integrated Logistical Support (ILS)

DRS' dedication to ILS requirements assures reliability, availability, maintainability and testability across all product lines, including military, commercial, consumer and industrial customers. Our capabilities enable us to provide life-cycle support for DRS manufactured equipment and to tailor specific ILS elements to meet unique requirements. DRS staff is experienced and can provide high-quality solutions to meet all logistics requirements.

## Life Cycle Support

DRS provides unequalled technical and post-delivery support. Our world-wide network of DRS professionals enable us to have qualified personnel on-location, to any location worldwide within 36 hours.

We stand ready to meet your system, component or service needs. Contact us at drs.com for more information.

DRS Technologies
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# NEW PRODUCTS

DRS drives success through innovation and excellence, with a century of tradition and performance providing power and control onboard every Navy combatant since World War II.

At the heart of DRS success is our evolutionary design process, utilizing, integrating and improving the very best innovations across product lines and through successive iterations.

Our products and services are found in fully integrated marine systems, ship propulsion and power generation, power distribution conversion and conditioning, as well as motor controls and drives, auxiliary motors and generators and shipboard HVAC.

For our customers, our depth of experience and breadth of knowledge means battle-hardened dependability of parts, components and systems that meet all applicable specifications and our own stringent quality requirements.

DRS Technologies
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# MIL-SPEC Process Controllers (MSPC)

DRS is the leader in providing MIL-SPEC solutions for the demanding maritime market. The latest technology is used in our innovative designs. The self contained Process Controller integrates military off the shelf equipment with a MIL-SPEC motor controller to provide a small, lightweight, and cost effective solution. Utilized on the latest U.S. Navy ships for pump controls, the MIL-SPEC qualified Process Controller is designed to withstand rugged maritime conditions for the life of the ship.

Whether for new shipbuilding or modernization programs MSPC is ideal for integrated control, condition based maintenance, power monitoring, and interfacing with ship network communications.

Controls and indicators are functionally grouped on the controller to optimize the human interface, visibility, and ease of use.

From power distribution and electrical control products to ship control automation, DRS offers advanced product development, world-class manufacturing and global engineering services and support. That is why our products are found on all U. S. Navy ships since WWII.

## Highlights

- Distributed system architecture control
- Efficient and robust operation
- Autonomous control
- Expandable analog and discrete I/O
- Expandable LED display
- Analog readout displays
- System diagnostics
- Remote PROFIBUS communication
- Navy electronic motor operator
    - Custom thermal overload trip curves
    - Full load current sensing from 0.5 to 150 Amps
    - Voltage sensing from 50 to 550 Volts

## Military Specifications

MIL-STD-461
MIL-S-901, Grade A
MIL-STD-167-1, 4-50 Hz

## Monitors

- Current
- Voltage
- Line frequency
- Apparent power
- Real power
- Reactive power
- Power factor
- Percent FLA
- Percent nominal RMS voltage
- Elapsed run time
- Start count
- Run time since start

## Protective Feature

(Can be set as a trip or alarm)

- Under current
- Over current
- Motor JAM trip level
- Current imbalance
- Under voltage
- Over voltage
- Voltage imbalance
- Single phasing current trip level
- Single phasing voltage trip level

# Navy Electronic Motor Operator (NEMO)

***NEMO is a product enhancement of our existing N2000 and N2001 products.***


DRS's Navy Electronic Motor Operator answers the call for modern ship specifications requiring small, simplistic, cost effective and flexible control and communications. Utilized on the latest U.S. Navy ships for motor control, HVAC control, and ABT control, the MIL-SPEC qualified Navy Electronic Motor Operator is designed to withstand rugged maritime conditions for the life of the ship.

The DRS-PCT Navy Electronic Motor Operator (NEMO) is comprised of an Electronic Control Module, an Overload Application Module, and a solid state Switch module. NEMO integrates control, motor protection, power monitoring, network communications and local network I/O into a single unit in accordance with MIL-DTL-2212. NEMO supplies 24VDC for safe operator control. Configurable discrete inputs and outputs are provided to satisfy most control applications. An LED display provides operating status, diagnostic and fault information. Two sets of parameters allow one module to protect fast and slow speed windings of a motor or to energize/de-energize two separate loads. All interfaces to the main power are galvanically isolated to ensure integrity of the main bus. The network connection design is modular and adaptable to meet current and future Navy machinery control network protocols.

## Features

- Configurable control via mini USB port
- Adapatble network communication
- Local CAN network for I/O expansion
- Four character LED display for status
- Field upgradeable firmware
- Operator safe 24VDC I/O
- 5 inputs for control/monitor
- 4 outputs for control/timing/alarm
- MTBF – 188,000 Hrs at 40° C
- Pluggable control terminals
- Stud terminals for main power
- Galvanic isolation to power lines
- Dual parameter sets for fast and slow motor winding protection

## Specifications

MIL-DTL-2212, including

- MIL-STD-461, Surface / Submarine
- MIL-S-901, Grade A
- MIL-STD-167-1, 33 Hz
- MIL-STD-1399, Section 300A

## Environmental Performance

| | |
|---|---|
| Operating temperature | -20 to 65° C |
| Operating humidity | 95% Non-condensing |
| Storage temperature | -40 to 85° C |

## Functional Ratings

(Ratings are nominal unless stated)

## Power Characteristics

| | |
|---|---|
| Supply voltage | 440 VAC |
| Optional | 115 VAC |
| Supply frequency | 60 Hz |
| Supply isolation (1 minute) | 2500 VAC |
| Current sensing | 0.5 to 30 Arms |
| Optional | 1.2 to 150 Arms |

## Control Characteristics

| | |
|---|---|
| I/O power supply voltage | 24 VDC |
| I/O power supply capacity | 20 W |
| Input on state voltage | 17 to 36 VDC |
| Input on state burden | 17 mADC |
| Input isolation to chassis | 500 VDC |
| Output voltage | 36 VDC maximum |
| Output load current | 100 mA maximum |
| Output leakage current | 0.1 mA |
| Voltage drop | 0.15 VDC Max |
| Output isolation to chassis | 500 VDC |

## Physical Characteristics

| | |
|---|---|
| Four corner mounting holes | 0.3 inch (0.8 cm) thick base |
| Weight | 7.7 lbs. (3498 g) |

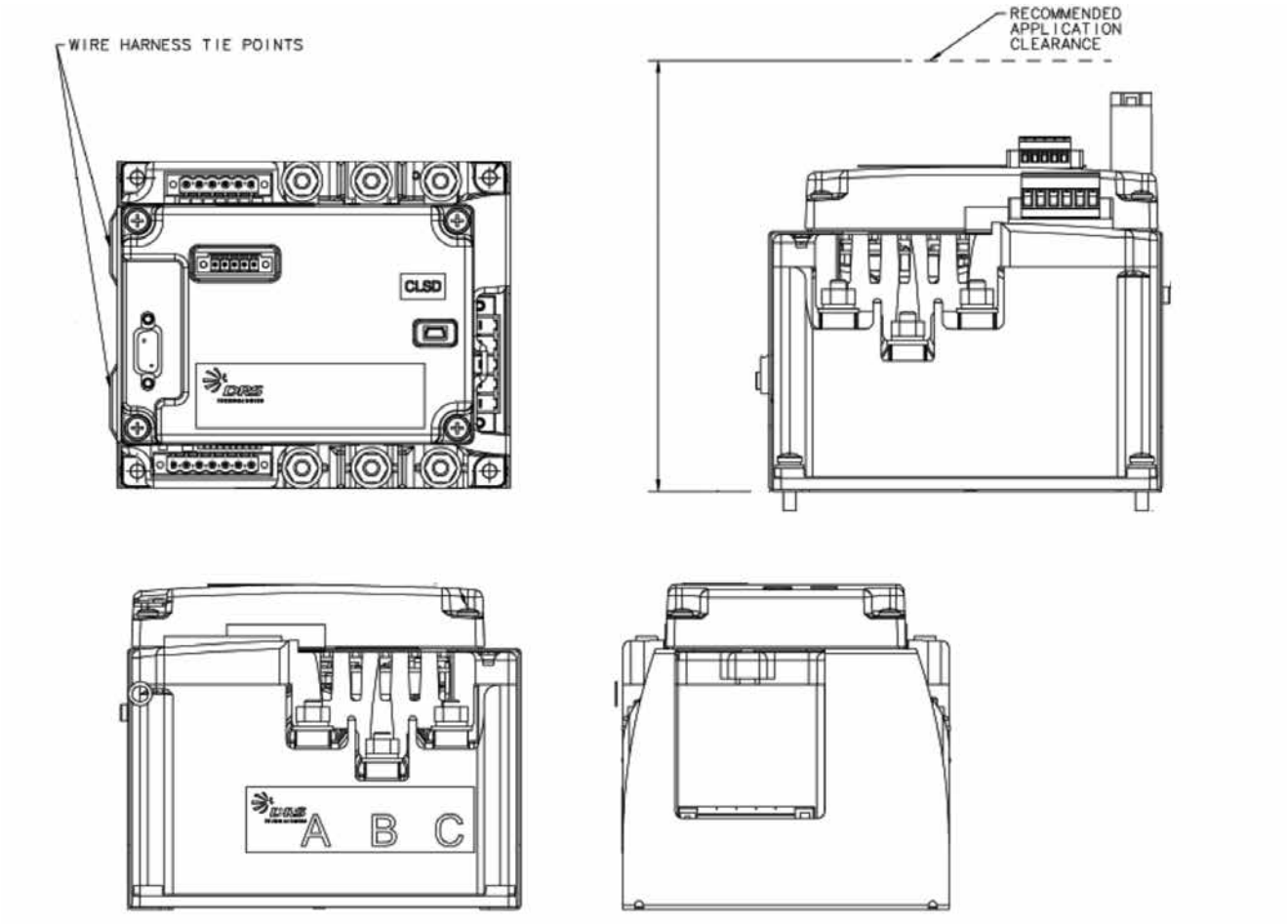
## Related Documentation

| | |
|---|---|
| NEMO operation manual | MC-007067/01 |
| NEMO engineering configuration tool manual | MC-002410/23 |
| Switch module application manual | MC-007055 |

# Navy Electronic Motor Operator (NEMO)

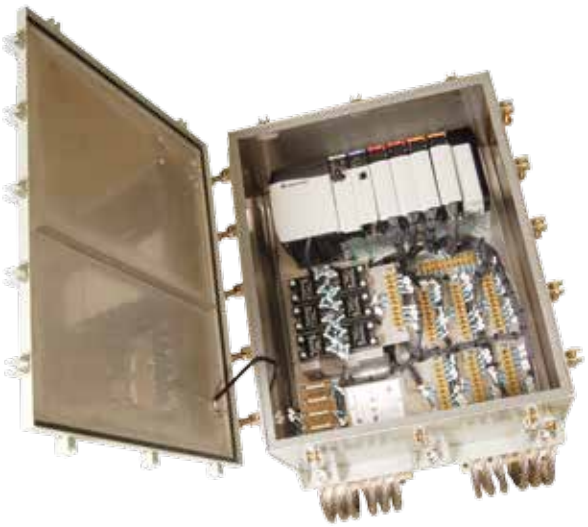
## Navy Electronic Motor Operator Models

| Application | Current | Sensing | Control Voltage | Assembly |
|---|---|---|---|---|
| Overload | 0.5-30 | Internal | 440 | MC-009557-01 |
| | | External | 440 | MC-009557-07 |
| | | | 115 | MC-009557-05 |
| | 1.2-150 | Internal | 440 | MC-009557-04 |
| | | External | 440 | MC-009557-08 |
| | | | 115 | MC-009557-06 |
| HVAC control | 0.5-30 | Internal | 440 | MC-009557-02 |
| HVAC monitoring | | | | MC-009557-03 |
| Bus transfer switch | 0.5-30 | External | 115 | MC-009557-09 |
| Automatic bus transfer | | | | MC-009557-10 |



# Type ENG-DAU-1
# Data Acquisition Unit

## Engineered Systems
## Small Remote Terminal Unit – Single Chassis



## When ordering specify

- Power requirements
- I/O type
- Fieldbus type
- Network and fieldbus media type
- Redundancy requirements
- Ethernet requirements
- Number and type of analog I/O
- Number and type of digital I/O
- Number and type of specialty I/O
- Number and type of communication I/O
- Visual display/Human Machine Interface requirements
- Required environmental qualifications
- Required IMO certifications

## General

A small, application flexible, MIL-SPEC grade I/O enclosure for engineered naval and marine machinery control applications. Supports both Rockwell Automation and Siemens Hardware.

## Specifications

| Parameter | Description |
|---|---|
| Enclosure Dimensions | Enclosure: H 22.82" x W 17.5" X D 10.6" |
| | Mountings: H 28.39" x W 20.0" X D 15.94" |
| | Door Open: H 28.39" x W 21.7" X D 32.42" |
| Enclosure Weight | Unpopulated |
| | Populated |
| Enclosure Type | Drip-proof type |
| Power Supply | 120V/220V AC |
| | 24V DC |

| Parameter | Description | |
|---|---|---|
| Max # of I/O Cards Capacity | (2) x 10 Slot Chassis | |
| Type and Capacity I/O | Typical I/O Is a combo of those below: | |
| | Max Discrete AC Input – 192 | |
| | Max Discrete AC Output – 96 | |
| | Max Discrete DC Input – 192 | |
| | Max Discrete DC Output – 192 | |
| | Max Analog Input – 48 | |
| | Max RTD/Thermo Input - 36 | |
| | Max Analog Output - 48 | |
| Vendor I/O Supported | Rockwell Automation | 1756 |
| | | 1756 XT |
| | | 1794 |
| | | 1794 XT |
| | | 1734 |
| | Siemens | S7-300 |
| | | ET200M |
| Field Bus | Rockwell Automation: | ControlNet |
| | | DeviceNet |
| | | Ethernet/IP |
| | | ProfiBus |
| | | Modbus |
| | | Modbus/TCP |
| | Siemens | Profibus |
| | | CanBus |
| | | ProfiNet |
| | | Modbus |
| | | Modbus/TCP |
| | Redundancy | Optional |
| | Media | Optional |
| Ethernet | Protocols | TCP/IP, UDP |
| | # of Ports | Optional |
| | Redundancy | Optional |
| | Media | Optional |
| MIL-SPEC | *MIL-STD 901D | |
| | *MIL-STD 167-1 | |
| | *MIL-STD 461 | |
| | *MIL-STD 1399 | |
| | *MIL-STD 810 | |
| Temperature | 0-60°C Operating | |
| | -20-70°C Operating with Extreme Temperature I/O Modules | |
| Humidity | 5-95% Noncondensing | |

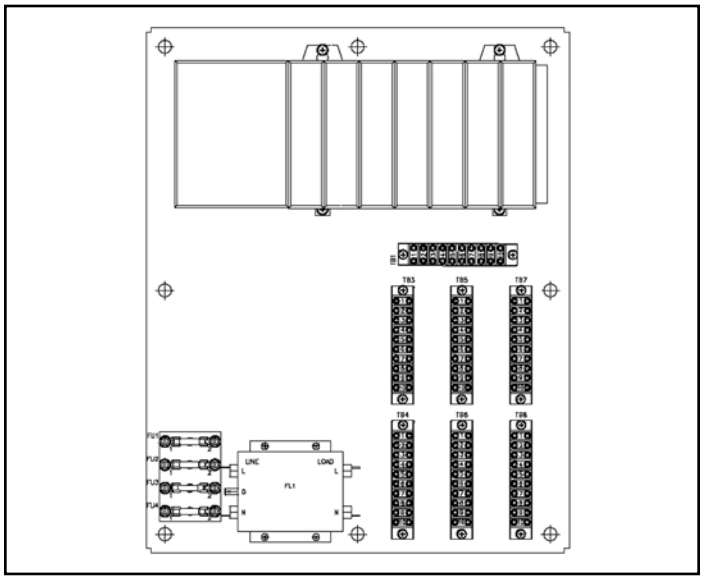
* Designed to specifications

# Type ENG-DAU-1
# Data Acquisition Unit

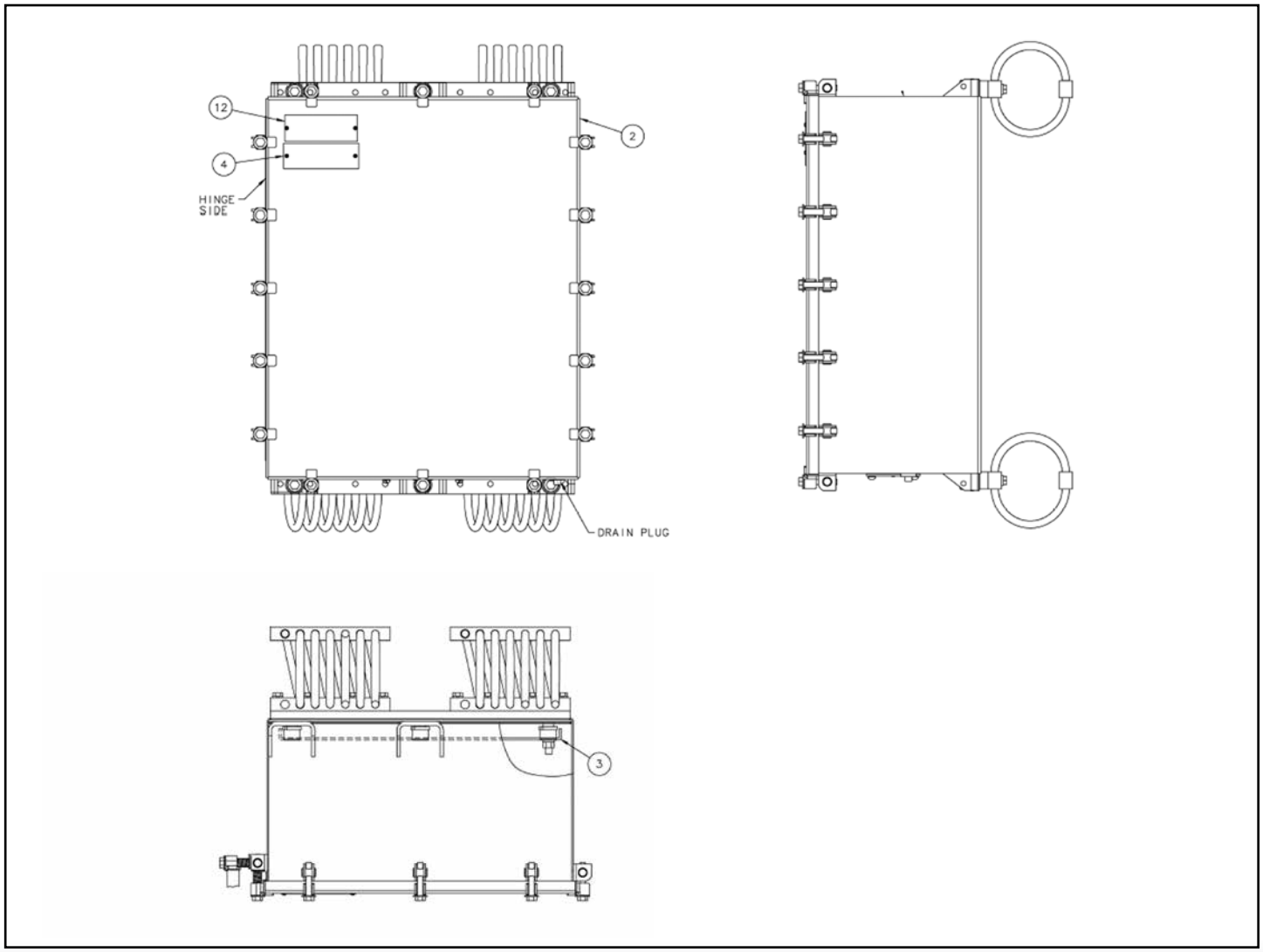
## Features

- Power supply
- Optional processor
- Fieldbus communications
- (1) I/O chassis
- Industry standard I/O modules
- Internal terminal blocks for field wiring
- External power connection with fusing and filtering
- Optional signal conditioning
- Optional local ethernet switch with downlink and local ports
- Optional field bus and ethernet redundancy
- Optional fiber optic field bus
- Optional in chassis industrial PC
- Optional panel mounted LCD display
- Optional OpenSea™ control software

**Typical Writing Diagram**



**Dimensional Diagram**



# Type ENG-DAU-2
# Data Acquisition Unit

## Engineered Systems
## Large Remote Terminal Unit – Three Chassis

## When ordering specify

- Power requirements
- I/O Type
- Field bus type
- Media
- Redundancy requirements
- Ethernet requirements
- Number and type of analog I/O
- Number and type of digital I/O
- Number and type of specialty I/O
- Number and type of communication I/O
- Required environmental qualifications
- Required IMO certifications

## General

A large, application flexible, MIL-SPEC grade I/O enclosure for engineered naval and marine machinery control applications. Supports both Rockwell Automation and Siemens Hardware.

## Specifications

| Parameter | Description |
|---|---|
| Enclosure Dimensions | Enclosure: H 48.0" x W 27.0" X D 12.24" |
| | Mountings: H 48.0 x W 27.0" x D 17.99 |
| | Door Open: H 48.0" x W 53.0" X D 17.99" |
| Enclosure Weight | Unpopulated |
| | Populated |
| Enclosure Type | Drip-proof type |
| Power Supply | 120V/220V AC |
| | 24V DC |

| Parameter | Description | |
|---|---|---|
| Max # of I/O Cards Capacity | (3) x 10 Slot Chassis | |
| Type and Capacity I/O | Typical I/O Is a combo of those below: | |
| | Max Discrete AC Input – 864 | |
| | Max Discrete AC Output – 432 | |
| | Max Discrete DC Input – 864 | |
| | Max Discrete DC Output – 864 | |
| | Max Analog Input – 432 | |
| | Max RTD/Thermo Input - 162 | |
| | Max Analog Output - 216 | |
| Vendor I/O Supported | Rockwell Automation | 1756 |
| | | 1756 XT |
| | | 1794 |
| | | 1794 XT |
| | | 1734 |
| | Siemens | S7-300 |
| | | ET200M |
| Field Bus | Rockwell Automation: | ControlNet |
| | | DeviceNet |
| | | Ethernet/IP |
| | | ProfiBus |
| | | Modbus |
| | | Modbus/TCP |
| | Siemens | Profibus |
| | | CanBus |
| | | ProfiNet |
| | | Modbus |
| | | Modbus/TCP |
| | Redundancy | Optional |
| | Media | Optional |
| Ethernet | Protocols | TCP/IP, UDP |
| | # of Ports | Optional |
| | Redundancy | Optional |
| | Media | Optional |
| MIL-SPEC | *MIL-STD 901D | |
| | *MIL-STD 167-1 | |
| | *MIL-STD 461 | |
| | *MIL-STD 1399 | |
| | *MIL-STD 810 | |
| Temperature | 0-60°C Operating | |
| | -20-70°C Operating with Extreme Temperature I/O Modules | |
| Humidity | 5-95% Noncondensing | |

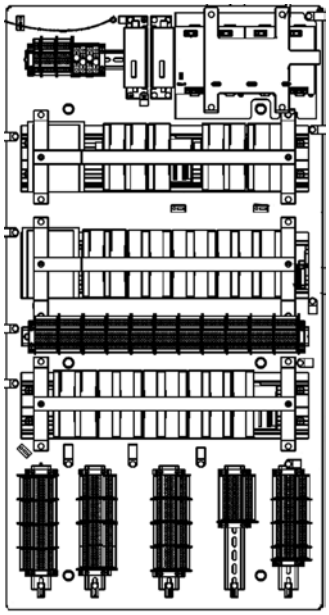
* Designed to specifications

# Type ENG-DAU-2
# Data Acquisition Unit

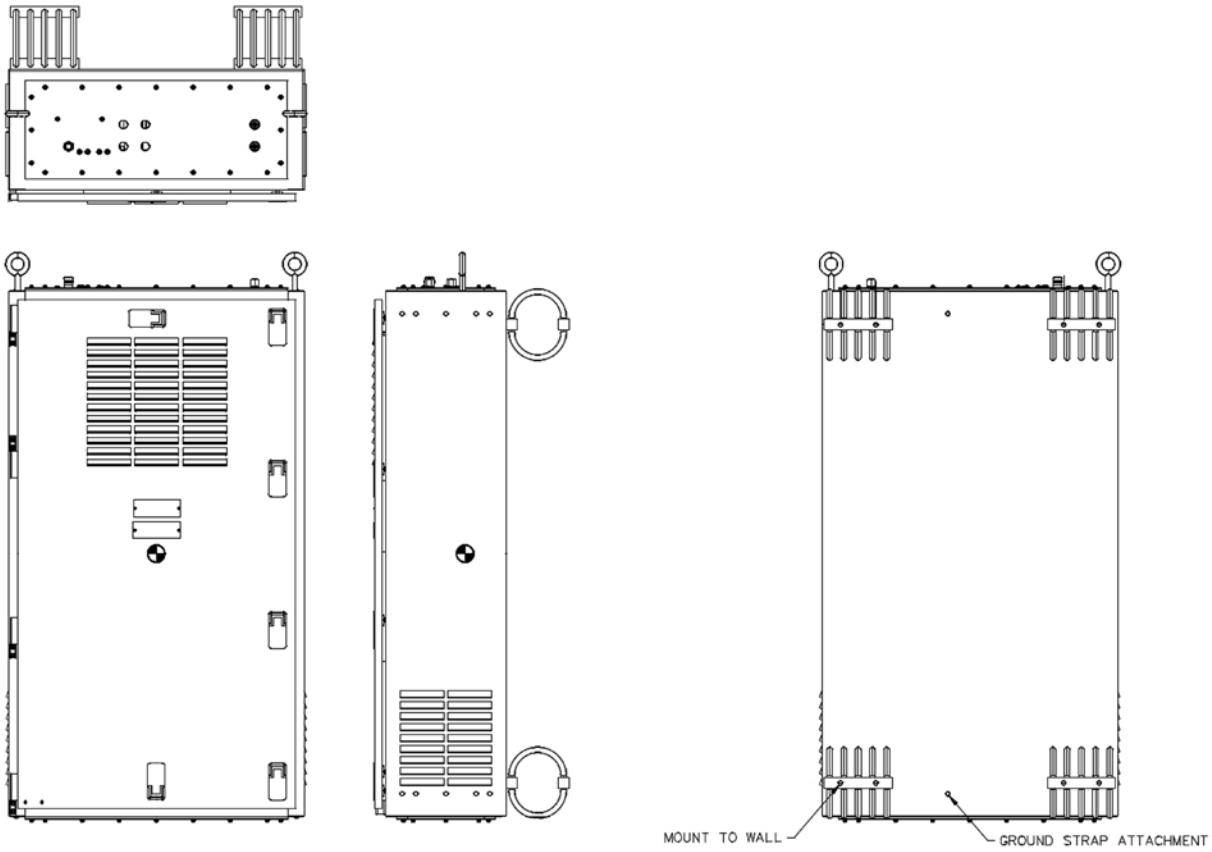
## Features

- Power supply
- Optional processor
- Fieldbus communications
- (3) I/O chassis's
- Industry standard I/O modules
- Internal terminal blocks for field wiring
- External power connection with fusing and filtering
- Optional signal conditioning
- Optional local ethernet switch with downlink and local ports
- Optional field bus and ethernet redundancy
- Optional fiber optic field bus
- Optional in chassis industrial PC
- Optional panel mounted LCD display
- Optional OpenSea™ control software

**Typical Writing Diagram**



**Dimensional Diagram**



# DRS 15kV VCB
# Vacuum Circuit Breaker (VCB)

The DRS 15kV VCB is a 1600 A medium voltage Vacuum Circuit Breaker (VCB). This circuit breaker is based on a COTS breaker that is militarized by DRS providing a small, lightweight, and cost effective solution. Utilized on the latest U.S. Navy ships for power distribution, the military hardened VCB is designed to withstand rugged maritime conditions for the life of the ship.

This is the Navy's first and only Vacuum Interrupter-Based Circuit Breaker qualified for military use. The Vacuum Interrupter design significantly reduces breaker size and weight as arc chutes are not needed. Maintenance is reduced since no contact adjustments are required, only a periodic check of the integral wear indicator is needed. The VCB is drawout (removable) for ease of inspection and replacement.

From power distribution and electrical control products to ship control automation, DRS offers advanced product development, world-class manufacturing and global engineering services and support. That is why our products are found on all U. S. Navy ships since WWII.

## Highlights

- Maintenance free vacuum interrupter
- Trip free operation
- Interlocks for proper and safe operation
- Built-in contact erosion indicator
- Operations counter
- Mechanical position indicator
- Closing springs charged indicator
- Mechanical and electric close capability
- Mechanical and electric open capability

## Military Specifications

MIL-S-901, Grade A
MIL-STD-167-1, 4-21 Hz
MIL-STD-461
MIL-STD-1399-300A

## Physical Characteristics

Circuit breaker:

| | |
|---|---|
| Width | 27.6 inches (70.1 cm) |
| Height | 32.2 inches (81.8 cm) |
| Depth | 25.1 inches (63.8 cm) |
| Weight | 430 lbs. (195.0 kg) |

## Environmental Performance

| | |
|---|---|
| Operating temperature | -30 to +65° C |
| Operating humidity | 95% Non-condensing |

## Functional Ratings

(Ratings are nominal unless stated)

Power characteristics

| | |
|---|---|
| Max. continuous current | 1600A |
| Max. voltage and frequency | 15,000VAC, 60Hz |
| Max. short circuit interrupting current | 40,000A symmetrical |
| Short circuit duration | 3 seconds |
| Max. short circuit making current | 103,000A peak |
| Max. trip time | 3 cycles |
| Max. close time | 5 cycles |
| Mechanical endurance | 10,000 cycles |
| Number of poles | 3 |

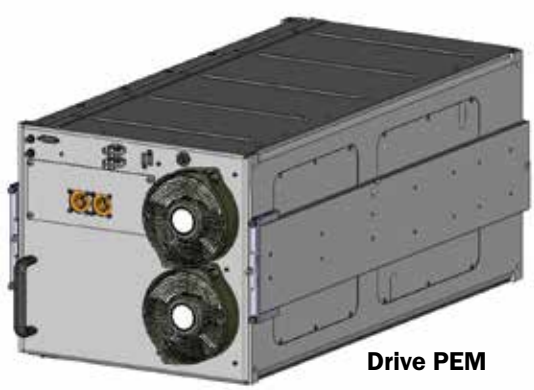
Voltage characteristics

| | |
|---|---|
| Dielectric withstand | 36,000 V for 1 second |
| Basic Impulse Level (BIL) | 95,000V |
| Corona extinction voltage level | 17,500V |

Attachments

| | |
|---|---|
| Electrical closing device | Standard |
| Shunt trip device | Standard |
| Charging motor protection | Standard |
| Grounding contacts | Standard |
| Auxiliary switches – quantity | 15 |
| Auxiliary switches – ratings | 120VAC, 15A / 125VDC, 10A |
| Secondary disconnect pins | 50 |

# DRS LV - PEMS
# Low Voltage Power Electronic Modules



Drive PEM

Power Converter PEM

The DRS LV - PEMS is a complete series of Low Voltage Power Electronic Modules. This next generation of power conversion equipment is based on DRS' experience in 3 level power converters for Drive, DC/AC Inverter and DC/DC converter applications. This next generation of PEMS offers a significant increase in power density and decrease in cost over the previous generation.

Potential applications include VFD's, soft starters, frequency converters, point of use power conversion (AC/DC, DC/AC, DC/DC, AC/AC), propulsion drives or power conversion based power systems.

From power distribution and electrical control products to ship control automation, DRS offers advanced product development, world-class manufacturing and global engineering services and support.

## Highlights

- High efficiency
- Fault tolerance
- Excellent power quality
- High power density
- Modular (drawer mounted)
- Scalable systems (multiple units in parallel)
- Liquid cooled
- 4th generation IGBT's
- Low voltage distortion for direct connect drive applications
- Communication interfaces include fiber optic, ethernet, and CAN
- All applications are capable of bidirectional power flow

## Military Specifications

MIL-S-901, Grade A (mitigated enclosure)
MIL-STD-167-1
MIL-STD-461
MIL-STD-1399

## Physical Characteristics

Drive only:

| | |
|---|---|
| Width | 16.5 inches (70.1 cm) |
| Height | 14.6 inches (81.8 cm) |
| Depth | 32 inches (63.8 cm) |
| Weight | 300 lbs. (195.0 kg) |

Power converter (with output filtering):

| | |
|---|---|
| Width | 16.5 inches (70.1 cm) |
| Height | 29.6 inches (81.8 cm) |
| Depth | 32 inches (63.8 cm) |
| Weight | 800 lbs. (195.0 kg) |

## Environmental Performance

| | |
|---|---|
| Operating air temperature | -40 to +70° C |
| Operating humidity | 95% non-condensing |
| Operating water temperature | 1 to +43° C |

## Functional Ratings

(Ratings are nominal unless stated)
Power characteristics

| | |
|---|---|
| Max. continuous current | 750A/phase (drive), 600A/phase (inverter), 900A (converter) |
| Max. output voltage and frequency | 690 VAC 60hz (400hz option), 1200VDC |
| Number of output poles | 4 (drive), 3 (inverter), 2 (converter) |

Voltage characteristics

| | |
|---|---|
| dielectric withstand | 5,000 VDC for 60 second |

# ACB-2020
# Low Voltage Air Circuit Breaker

Navy Type ACB-2020 is an 800-2000A low voltage Air Circuit Breaker utilizing the latest technology electronic trip unit. This circuit breaker is based on a COTS breaker that is militarized by DRS providing a small, lightweight, and cost effective solution. Utilized on the latest U.S. Navy ships for power distribution, the MIL-SPEC qualified air circuit breaker is designed to withstand rugged maritime conditions for the life of the ship.

Whether for new shipbuilding or modernization programs DRS's ACB-2020 is ideal for integrated control, condition based maintenance, power monitoring, and interfacing with ship network communications. The built-in electronic trip unit can be remotely accessed for diagnostics, breaker status, ampere, voltage and power monitoring.

Controls and indicators are functionally grouped on the breaker faceplate to optimize the human interface, visibility, and ease of use. For maximum safety, a modern, through-the-door design permits access to the breaker levering system, trip unit, controls and indicators with the door closed.

## Highlights

- Electronic trip unit with long, short, and instantaneous trip curve settings
- 24 character LED display for status
- System diagnostics:
  - Cause of trip
  - Trip log
  - Waveform capture
  - Breaker health monitor
  - Remote signal contacts
  - Programmable contacts
  - Electronic operations counter

## Military Specifications

MIL-C-17587
MIL-S-901, Grade A
MIL-STD-167-1, 4-50 Hz

## Physical Characteristics

Circuit breaker:

| | |
|---|---|
| Width | 16.5 inches (41.9 cm) |
| Height | 18.2 inches (46.2 cm) |
| Depth | 16.8 inches (42.7 cm) |
| Weight | 200 lbs. (90.7 kg) |

Cassette:

| | |
|---|---|
| Width | 18.3 inches (46.5 cm) |
| Height | 20.8 inches (52.8 cm) |
| Depth | 17.7 inches (45.0 cm) |
| Weight | 120 lbs. (54.4 kg) |

## Environmental Performance

| | |
|---|---|
| Operating temperature | -20 to +70° C |
| Operating humidity | 95% non-condensing |

## Functional Ratings

(Ratings are nominal unless stated)

Power characteristics

| | |
|---|---|
| Max. continuous current | 2000A |
| Max. voltage and frequency | 500VAC, 60Hz |
| Max. interrupting rating | 85,000 A symmetrical |
| Rated short time current | 85,000A |
| Rated short time current duration | 0.5 Sec |
| Number of poles | 3 |

Attachments

| | |
|---|---|
| Electrical closing mechanism | Standard |
| Shunt trip device | Standard |
| Remote close function | Optional |
| Vertical bus stab adapters | Optional |
| Auxiliary switches – quantity | 8 |
| Auxiliary switches – ratings | 120VAC, 15A / 480VAC, 5A |
| Mechanical lockout device | Standard |
| Mechanical position indicator | Standard |
| Secondary disconnect | 8 @ 15A and 4 @ 10A |
| Cell switch | 120VAC, 15A |

Protective features

(Can be set as a trip or alarm)

- Time over current
- Ground fault
- Over voltage
- Over frequency
- Reverse power
- Zonal interlocking
- Under voltage
- Under frequency
- Voltage unbalance
- Phase rotation

# DRS-4040
# Low Voltage Air Circuit Breaker

The DRS-4040 is a 2400-4000A low voltage Air Circuit Breaker utilizing the latest technology electronic trip unit. This circuit breaker is based on a COTS breaker that is militarized by DRS providing a small, lightweight, and cost effective solution. Utilized on the latest U.S. Navy ships for power distribution, the military hardened air circuit breaker is designed to withstand rugged maritime conditions for the life of the ship.

Whether for new shipbuilding or modernization programs the DRS-4040 is ideal for integrated control, condition based maintenance, power monitoring, and interfacing with ship network communications. The built-in electronic trip unit can be remotely accessed for diagnostics, breaker status, ampere, voltage and power monitoring.

Controls and indicators are functionally grouped on the breaker faceplate to optimize the human interface, visibility, and ease of use. For maximum safety, a modern, through-the-door design permits access to the breaker levering system, trip unit, controls and indicators with the door closed.

## Highlights

- Electronic trip unit with long, short, and instantaneous trip curve settings
- 24 character LED display for status
- System diagnostics:
  - Cause of trip
  - Trip log
  - Waveform capture
  - Breaker health monitor
  - Remote signal contacts
  - Programmable contacts
  - Electronic operations counter
- Remote communications (Modbus, Profibus, Incom, PowerNet, TripLink)
- Metering: Amps, Volts, Hz, kW, kVA, kVAr, THD, IHD, Power Factor, Crest Factor
- Pad-lockable levering device shutter
- Optional remote close module
- Optional remote communications module

## Military Specifications

Designed to MIL-C-17587
MIL-S-901, Grade A

## Physical Characteristics

Circuit breaker:

| | |
|---|---|
| Width | 35.3 inches (89.7 cm) |
| Height | 18.2 inches (46.2 cm) |
| Depth | 16.8 inches (42.7 cm) |
| Weight | 365 lbs. (165.6 kg) |

Cassette:

| | |
|---|---|
| Width | 37.0 inches (94.0 cm) |
| Height | 20.8 inches (52.8 cm) |
| Depth | 17.7 inches (45.0 cm) |
| Weight | 120 lbs. (54.4 kg) |

## Environmental Performance

| | |
|---|---|
| Operating temperature | -20 to +70° C |
| Operating humidity | 95% non-condensing |

## Functional Ratings

(Ratings are nominal unless stated)

Power characteristics

| | |
|---|---|
| Max. continuous current | 4000A |
| Max. voltage and frequency | 500VAC, 60Hz |
| Max. interrupting rating | 85,000 A symmetrical |
| Rated short time current | 85,000A |
| Rated short time current duration | 0.5 Sec |
| Number of poles | 6 |

Attachments

| | |
|---|---|
| Electrical closing mechanism | Standard |
| Shunt trip device | Standard |
| Remote close function | Optional |
| Vertical bus stab adapters | Optional |
| Auxiliary switches – quantity | 8 |
| Auxiliary switches – ratings | 120VAC, 15A / 480VAC, 5A |
| Mechanical lockout device | Standard |
| Mechanical position indicator | Standard |
| Secondary disconnect | 8 @ 15A and 4 @ 10A |
| Cell switch | 120VAC, 15A |

Protective Features

(Can be set as a trip or alarm)

- Time over current
- Ground fault
- Over voltage
- Over frequency
- Reverse power
- Zonal interlocking
- Under voltage
- Under frequency
- Voltage unbalance
- Phase rotation

# Variable Speed/Frequency Drives

DRS is a leader in providing Variable Frequency Drives to military or marine grade specifications. Our rugged Variable Speed Drives can be found wherever speed/frequency is a key operating parameter. We provide a wide range of drive offerings to our customers by leveraging our strong engineering capabilities, full understanding of applicable MIL-SPEC's or Commercial requirements gained from a history of successfully deployed products.

From power distribution and electrical control products to ship control automation, DRS offers advanced product development, world-class manufacturing and global engineering services and support. That is why our products are found on all U. S. Navy ships since WWII.

## 15HP Variable Frequency Drive (VFD)

The 15HP VFD utilizes a Commercial-Off-The-Shelf (COTS) solution that provides low cost, induction motor control. This 15HP drive takes advantage of DRS designed filter components to meet strict EMI requirements for conducted and radiated emissions. Using a unique COTS drive allows for future and back-fit applications where the existing motor is not inverter grade. This VFD is best suited for pump and fan applications where variable speed control and high efficiency power electronics can save energy. Network capabilities allow flexibility of control from automated systems to local manual user control.

### Highlights

- Variable speed control of induction motors
- 440VAC, 3 phase input
- 460VAC, 3 phase output
- Motor protection
- Meets:
  - MIL-STD-461
  - MIL-STD-1399, 300
  - MIL-STD-901
  - MIL-STD-167
- 15HP @ 50°C
- Bulkhead mount design
- Ethernet and profibus network capability
- Digital and analog I/O for local and remote user stations
- Fan cooled
- Drip proof

## 250HP Variable Frequency Drive

The 250HP VFD utilizes a Commercial-Off-The-Shelf (COTS) solution that provides low cost, induction motor control. This 250HP drive takes advantage of DRS designed filter components to meet strict EMI requirements for conducted and radiated emissions. Using a unique COTS drive allows for future and back-fit applications where the existing motor is not inverter grade. This VFD is best suited for pump and fan applications where variable speed control and high efficiency power electronics can save energy. Network capabilities allow flexibility of control from automated systems to local manual user control.

### Highlights

- Variable speed control of induction motors
- 650VDC input
- 460VAC, 3 phase output
- Motor protection
- Meets:
  - MIL-STD-461
  - MIL-STD-1399, 300
  - MIL-STD-901
  - MIL-STD-167
- 250HP @ 50°C
- Floor & bulkhead mount design
- Ethernet and profibus network capability
- Digital and analog I/O for local and remote user stations
- Fan cooled
- Drip proof

## High Frequency Drive

The High Frequency Drive (HFD) utilizes DRS drive technology. The HFD utilizes an active, power factor corrected front end combined with a buck topology that yields the ability to control standard 460VAC motors as well as lower voltage machines. A high switching frequency reduces the size of filter components creating a highly power dense package. Plug-in option cards provide options for resolver, hall-effect or encoder position feedback as well as network cards and I/O expansion. The HFD is capable of driving induction and brushless DC (BLDC) permanent magnet motors increasing its capability for applications such as pumps, blowers, valve actuators and chillers.

### Highlights

- Variable frequency control of induction and brushless DC (BLDC) permanent magnet motors
- 440VAC, 3 phase input
- 110VAC – 460VAC, 3 phase output
- Embedded web server for drive configuration and monitoring / diagnostics
- Motor protection
- Meets:
  - MIL-STD-461
  - MIL-STD-1399, 300
  - MIL-STD-901
  - MIL-STD-167
- 20HP @ 50°C, fan cooled
- 5HP @ 50°C, convection cooled
- Bulkhead, hard-mount design
- Networks: Ethernet, Profibus, CAN/DeviceNet, USB
- Digital and analog I/O for local and remote user stations
- Splash proof

## Steering Gear Actuation System (SGAS)

The Steering Gear Actuation System (SGAS) drive has been designed using innovative power electronics and packaging techniques. Three drive sections along with an integral dynamic braking section are provided in the cabinet along with redundant control and monitoring of drive, motor and cabinet status and faults. The drive has been designed to control permanent magnet AC motors and has provision to accept resolver feedback but could be modified to interface with induction machines. It is well suited to provide high performance in position, velocity or torque control types of applications.

### Highlights

- Control of three (3) individual PM AC motors
- 650 VDC input
- Maximum of 460 VAC, 3 phase variable voltage / frequency output
- 3 drive sections @ 50ºC
- Integral dynamic brake for regenerative applications
- Redundant drive control and system monitoring
- Chilled water cooled with condensation management system
- Rugged compact design
- Cabinet IP54 rated
- Redundant ethernet connectivity
- Meets:
  - MIL-STD-461
  - MIL-STD-1399, 300
  - MIL-STD-901
  - MIL-STD-167

These are just some examples of our drive offerings. To discuss your particular drive applications please contact our factory directly.

# Low Voltage Switchgear

DRS is a leader in providing Low Voltage Switchboards and load centers to military or marine grade specifications. Utilized on the latest U.S. Navy ships for power distribution, the military hardened switchgear is designed to withstand rugged maritime conditions for the life of the ship.

DRS has supplied switchgear with an unprecedented level of automation for ship applications. This includes generator controls, synchronization, load shedding, and protective features. The switchgear can also provide custom HMI screens for power monitoring, control, diagnostics, condition based maintenance, and interfacing with ship network communications.

From power distribution and electrical control products to ship control automation, DRS offers advanced product development, world-class manufacturing and global engineering services and support. That is why our products are found on all U. S. Navy ships since WWII.

## Highlights

- Drip proof or spray tight enclosures
- Wide range of standard distribution units
- AC or DC switchgear
- Arc fault detection
- Optional insulated bus bars
- Remote monitoring and control to SCADA
- Modbus/Profibus communications

## Military Specifications

ABS NVR
MIL-S-901, Grade A
MIL-STD-167-1
MIL-STD-461
MIL-STD-1399 Section 300

## Commercial Marine Specifications

ABS SVR
IEEE 45

## Integrated Generator Controls

- Start and automatically parallel generators to the bus
- Automatically parallel to and from shore power
- Automatically recover from a dark ship condition
- Automatically start or stop generators based on load demands via the power management system
- Automatically perform load sharing among generators (KW and VAR) in a split or monolithic bus
- Provide digital under voltage and over current protection
- Two stage load shed capability

# Medium Voltage Switchgear

DRS is a leader in providing Medium Voltage Switchgear to military requirements. DRS can provide switchgear up to 15kV, in a compact and rugged enclosure that is a 40% reduction in volume over typical commercial switchgear. Utilized on the latest U.S. Navy ships for power distribution, the military hardened switchgear is designed to withstand rugged maritime conditions for the life of the ship.

The switchboards provide custom HMI screens for power monitoring, control, diagnostics, condition based maintenance, and interfacing with ship network communications. Built-in safety features are provided to keep the operator out of harms way while operating the circuit breakers.

## Highlights

- Metal clad construction for operator safety
- Meets 95kV BIL rating
- Two-high breaker arrangement is standard
- Vacuum circuit breakers provide low maintenance, long life
- Fluidized bed epoxy coated bus bar
- Silicone (non-PVC) insulating boots
- Remote communications (Modbus, Profibus)
- HMI for metering, control, and diagnostics
- Circuit breaker condition-based monitoring

## Military Specifications

MIL-S-901, Grade A
MIL-STD-167-1
MIL-STD-461
MIL-STD-1399 Section 300

## Protective Relaying Features

(Can be set as a trip or alarm)

- Current differential
- Time over current
- Zonal interlocking
- Ground fault
- Under voltage
- Over voltage
- Under frequency
- Over frequency
- Voltage unbalance
- Reverse power
- Phase rotation
- Loss of field
- Negative phase sequence
- Volts per Hertz

## Supplemental Devices

- Compact foldable lifting cart
- Manual ground and test device
- VCB electrical test box

# MOTOR CONTROL & OPERATOR INTERFACE SPECIFICATION AND DOCUMENTS

## Our customer's mantra is our mantra - Pride, Purpose, Performance.

*Pride* - DRS has a rich history of providing robust equipment to the U.S. Navy and its international allies. In recent history, DRS has become the largest Hull, Mechanical, and Electrical provider for the CVN 78 Class Aircraft Carrier, the DDG 1000 Destroyer, and the Lockheed Martin Freedom Class of Littoral Combat Ships.

*Purpose* - DRS' heritage of products reaches back to 1904, when it delivered its first motor controller products. This heritage continues today into the U.S. Navy's new platforms including key positions on the DDG 51 restart efforts (motor controllers, hybrid-electric drives, next generation power distribution and conversion programs) support of the Ohio Submarine Replacement Program, the Lockheed Martin Littoral Combat Ship, and the LHA 7 Amphibious Assault Ship design.

*Performance* - DRS has demonstrated that it has the design capabilities and bench depth to meet the demanding needs of today's Navy. DRS' extensive field service support and shipyard interaction has provided a unique perspective on product design. Our newest motor controller designs include a next generation overload and a revolutionary lightweight enclosure. The designers of this enclosure dismissed conventional thought on motor controller design while incorporating customer needs for installation. The results are an astonishing new cabinet with open corners and an integral back panel that significantly reduces in house production costs and shipyard/shipboard installation time and materials.

Pride, Purpose, Performance at DRS we live it everyday.

## Controlling Standards/Specifications

MIL-DTL-2212 is the controlling specification for motor control equipment used on Naval vessels. It invokes 24 other Military Specifications and Standards. Some of these are:

| | |
|---|---|
| MIL-E-917 | Electric Power Equipment, Basic Requirements |
| MIL-S-901 | Shock Tests, High Impact; Shipboard Machinery, Equipment and Systems, Requirements for |
| MIL-STD-167-1 | Mechanical Vibrations of Shipboard Equipment (I – Environmental and II – Internally Excited) |
| DOD-STD-1399 | Interface Standard for Shipboard Systems Section 300– Electric Power, Alternating Current |

## Protective Enclosures

The controlling specifications for Navy motor control equipment require dripproof enclosures as a general minimum. Other types of enclosures may be required depending on the application. These include splashproof, submersible and explosion proof.

The Navy definitions of these enclosure types are shown below.

### Dripproof

An enclosure constructed so that enclosed equipment operates satisfactorily in the presences of falling drops of liquid or solid particles. This protection must be provided for up to 45° of inclination from the vertical.

### Explosion Proof

Enclosed equipment operates safely in the presence of any concentration of a specified gas or vapor. The enclosure must be constructed to withstand the explosion of the gas or vapor within it and show no distortion or significant damage as a result. It shall contain the explosion and other sparks and flashes so that the gas or vapor surrounding the enclosure is not ignited. Class I, Group D, MIL-E-2036.

### Splashproof

An enclosure constructed so that equipment within it operates satisfactorily in the presence of a coarse spray of liquid or solid particles. The spray is to be directed at all exposed surfaces and the surface to which the controller is mounted. The test duration is five minutes at a water flow rate of 15 gallons per minute.

### Submersible

An enclosure constructed so that equipment within operates satisfactorily when submerged in water up to a specified depth. Water leakage is not permitted. The most common test is 15 feet for 24 hours.

### Watertight

An enclosure constructed to prevent entry of water from a solid stream striking it on any surface and at any angle. The test required a solid stream of water from a one inch nozzle, sprayed from a 10 foot distance, with a flow rate of 65 gallons per minute. The test duration is 60 minutes. An alternative test method is submersion in water so the enclosure is covered, the test duration is five minutes. Entry of water during the test shall be cause for rejection.

The Navy definition of dripproof and splashproof permit the entry of some liquid or solid particulate into the enclosure cavity. The entering contaminant, however, may not affect the operation of the equipment within the enclosure.

A comparison of similar Navy and NEMA enclosure grades follows:

| Navy Classification | NEMA Type | Navy Requirement | NEMA Requirement |
|---|---|---|---|
| Dripproof | 12 | Protection to 45 ° inclination | No inclination requirement |
| Watertight | 4 | 60 minute hose test at 65 gallons per minute | 5 minute hose test at 65 gallons per minute |
| Submersible | 6 | Minimum -15 ft of submersion for 24 hours | 6 ft of submersion for 30 minutes |

Corrosion protection is an obvious necessity for motor control equipment in a seagoing environment. DRS-PCT provides corrosion protection for its Navy motor control equipment through the use of corrosion-resistant materials and high quality finishes. All enclosures are designed and tested to pass a standard 200 hour salt spray test.

## Features

DRS AC controllers, components and pilot devices are designed and built to meet the requirements of MIL-DTL-2212.

Additional features include:

- **Temperature Rating** – 50°C as required by MIL-DTL-2212.
- **Compensation** – Overload relays are insensitive to variations in Ambient temperature.
- **Diagram** – Heat resistant, durable copy of controller diagram is attached to inside of controller.
- **Voltage** – 440V and 115V; other voltages available upon request.
- **High Shock** – MIL-S-901, Grade A, Class 1, Type A requirements.
- **Vibration** – MIL-STD-167-1 to 33 Hz as standard
- **Operational** – Equipment will operate at inclinations up to 45° from the normal mounting orientation.

## Documentation and Other Information

Equipment documentation is an important consideration for motor control equipment to be used at sea. DRS-PCT provides extensive documentation configured to support the end-user.

For example, standard plans provide the physical and electrical information necessary to install and maintain a controller. Certification Data Sheets provide important reference information for identifying the application, manufacturer, applicable drawing numbers, and quantities involved. Tech manuals support repair and maintenance activities by providing disassembly and adjustment information, repair parts data and electrical diagrams useful for troubleshooting.

The documentation that is available from DRS-PCT to support its Navy Motor control equipment is described in the following sections:



## Testing

The prices for motor controllers and accessories include the standard inspections and routine tests required by MIL-DTL-2212. They do not include First Article Testing or factory provided installation supervision.

AC Controllers, components and pilot devices are designed and built to meet the requirements of MIL-DTL-2212. IAW with MIL-DTL-2212 a representative sample of controllers, components and pilot devices are periodically subjected to Conformance Testing. The tested and related types of controller, component and pilot devices are placed on QPL-2212 for general use in Naval applications.

DC Controllers and components were last qualified to meet the QPL requirements of MIL-C-2212F. Representative samples of these devices are subjected to periodic non-witnessed Conformance Testing IAW MIL-C-2212F which precludes inclusion on the current QPL-2212 listing.

DRS-PCT does not imply a full suite of QPL testing is completed for every variation of controller, component and pilot device manufactured. If additional individual qualification testing is required, DRS-PCT will provide a separate quote for those specifically requested tests. If qualification testing is required, DRS-PCT must be notified prior to the placement of a Purchase Order.

In addition, pricing for any special inspections, or installation support can be provided upon request.

## Drawings

Drawings and certification data are normally provided for approval purposes or when required by a purchase specification.

The information included in these documents follow.

### Standard Plan

The Standard Navy Plan provided for DRS-PCT Navy motor control equipment conforms to the requirements of MIL-DTL-2212. Included are the following (minimum):

1. Manufacturer's name and Cat. I.D. of apparatus.
2. Applicable specifications.
3. Weight of controller.
4. Outline drawing and dimensions of enclosure, location of mounting holes, center of gravity.
5. Description of operation, adjustments.
6. List of repair parts.
7. Connection and schematic diagrams.
8. List of material, overload heater table.
9. Descriptive data of controller, i.e. enclosure, rating, operation, type, etc.
10. Descriptive and electrical design data of coils, resistors, transformers, etc.
11. Approval status.

### Certification Data (CD Sheets)

Certification Data Sheets provided conform to the requirements of DOD-STD-100C. The standard form is an 8-1/2" x 11". Information provided is as follows:

1. Navy Contract No. of Shipbuilder's Order No.
2. Manufacturer's Number
3. Subcontractor's Order Number
4. Applications:
   a. Auxiliary
   b. No. of controls per vessel
   c. Motor hp rating
   d. Full load amps.
   e. Volts
   f. Heater Coil Cat. No.
5. Number of controllers involved
6. Number of controllers per vessel
7. Number of sets of repair parts per vessel contract
8. Number of vessels involved
9. Vessel of hull numbers
10. Drawing numbers of associated equipment

### Copies of Standard Plans and CD Sheets

The plan price includes one full size reproducible (vellum) plus additional paper copies when ordered with the control. Other requirements are priced by request and in accordance with the following table.

| |
|---|
| Paper, Vellum or Electronic Reproduction of controller and accessory plans, ordered separately. |
| Paper or Electronic Reproductions of Certification Data (CD) sheets. |
| Reduced size copies of standard plans –<br>First 50 or fewer copies.<br>Each additional 50 copies. |
| 35 mm Aperture cards, in accordance with MIL-M-9868/1. |

# Packaging

### Packaging and packing of Controllers and Components

A. Commercial (Level C).....No Charge
B. Military – Per any military standard of specification or "Packaging Requirement Code"
   1. Enclosed controllers and accessories: 5% or minimum of $188. Per order
   2. Open controllers, components or accessories: 12% or minimum of $188. per order

### Packaging and Packing of Repair Parts

A. Commercial (bulk) – Package marking only – No Preservation..... No Charge
B. Military – Per any military standard or specification or "Packaging Requirement Code" ..... 12% Minimum $188. per order

### Bar Code Marking

$295 per order plus $20 per item and each additional destination.
FCA Destination ..... 12%

# Provisioning Technical Documentation

Provisioning Technical Documentation (PTDs) can recommend on-board and stock repair part levels. These recommendations are normally made on NAVSHIPS forms 4786 and 4786A in accordance with MIL-P-15137. Alternatively, Short Form Provisioning data (SFPPL) can be provided on NAVSEA forms 4423/3 and 4423/3A in accordance with MIL-STD-1552 and MIL STD 1561.

**Price:** Forms 4786 & 4786A – included if requested at time of order, if not $250 fee will apply.
Forms 4432/3 & 4423/3A - $550.

### Repair Parts

Repair Parts are normally an optional and unpriced item on an initial contract or order. When such an option is exercised, the required parts are added to the contract or order based on the Government's selection of items and quantities from the standard Provisioning Technical Documentation (PTD) forms. Consult the factory for current pricing.

### Non-magnetic Construction

Special situations require the use of motor control equipment that presents a low "magnetic profile." One example is a mine sweeper. Reducing the magnetic profile requires the use of non-ferrous (i.e. non-magnetic) materials where feasible. Additional steps may be necessary to counteract the impact of ferrous materials and magnetic structures that cannot be eliminated.

Navy qualified non-magnetic control will be provided when required. Contact the factory for price information.

# Quality Assurance

The DRS-PCT Milwaukee facility is ISO 9000 certified and quality programs exceed the requirements of MIL-I-45208A - "Inspection System Requirements". DRS-PCT motor controllers, components, and accessories are designed and manufactured in conformance with MIL-C-2212 and MIL-DTL-2212 and applicable subtier Military Specifications, as indicated in this catalog. Most DRS-PCT products are listed on the Qualified products list (QPL) of the specification indicated in this catalog.

The Quality Assurance documentation normally provided includes Government Source Inspections, Certificate of Compliance, Certificate of Identicality, and a copy of the final test report. Applicable pricing can be provided upon request.

### Quiet Control (MIL-STD-740)

MIL-STD-740 defines acceptable levels for airborne and structure borne noise when "Quiet" operation is required. Airborne noise is undesired sound carried through the air. Structure borne noise is an undesired vibration carried through a solid medium such as the ship's hull.

Navy motor control equipment and components can be provided to meet the requirements of MIL-STD-740B. Special manufacturing methods, parts selection and verification test are necessary to guarantee compliance. Prices for quiet components, controls and noise testing are gladly provided upon request.

# Technical Manuals

Standard Tech Manual Inserts conforming to MIL-DTL-2212 will be supplied when ordered. These provide ample information for the installation, maintenance and repair of our Navy qualified motor control equipment. Included are the following:

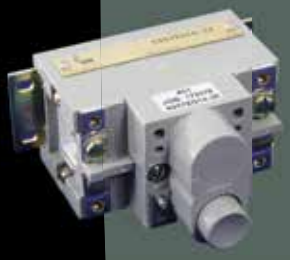
1. Title Page
2. Table of Contents
3. Copies of applicable CD Sheets
4. Reduced size copies of applicable Navy Plans
5. Applicable component Technical Publications

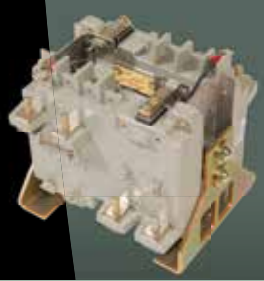
Preliminary copies will be supplied for approval. The final copies will consist of black and white reproducibles.

| Standard Tech Manual Inserts | Price |
|---|---|
| First 5 copies or part thereof when ordered with control | No Charge |
| Each additional 50 copies | Provided by request |

Complete Tech Manuals conforming to MIL-M-15071 or similar specifications can be provided if required. Please contact the factory.

# MOTOR CONTROL AND OPERATOR INTERFACE





## Exceptional engineering, proven solutions

DRS marries exceptional engineering capability with a long history of successfully fielded products to deliver proven solutions. Our motor controllers, variable frequency drives, electronic motor operators, starters and UPS units are the natural choice for critical applications specified for the U.S. Navy and other Maritime applications. MIL-STD Naval specifications are only the start. DRS products are battle-tested and hardened, having proven themselves time and again, providing continuous, flawless operations in the harshest environments.

DRS commands a 60-year service record other providers can only envy: building and supporting motor controllers, starters and accessory products since World War II.

DRS products are also ever evolving as our company looks to future Navy needs, with innovative products including our Navy Electronic Motor Operators (NEMO).

DRS delivers. As we develop innovations and improvements, we incorporate the very best ideas across product lines and through successive product iterations.

DRS Technologies
A Finmeccanica Company

# Type 6922
# AC/DC Manual Across-the-Line Starter

*Starter in watertight enclosure*

## When ordering specify

Catalog number
- Horsepower
- Voltage
- Full load motor current
- Type of motor with which starter is to be used
- Application

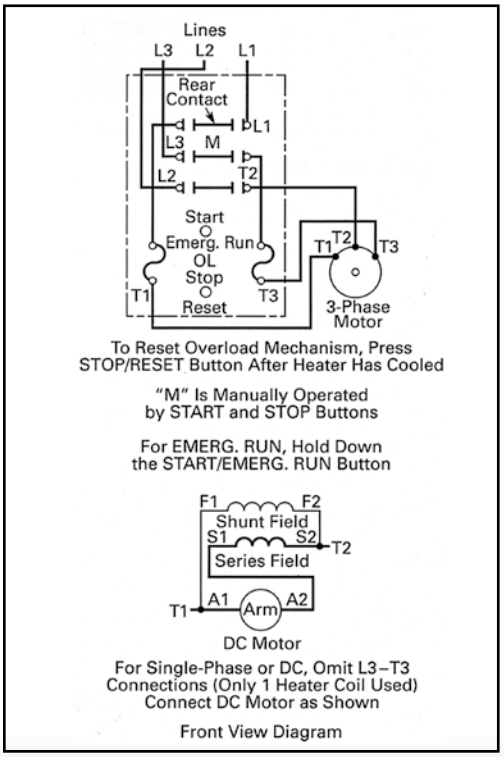
## Specifications

- MIL-SPEC.....MIL-DTL-2212
- Enclosure .....Dripproof or watertight
- Operation .....Manual
- Type .....Across-the-line
- Function .....Motor starting
- Duty .....Continuous
- Protection.....Low voltage release effect -
  Overload protection - thermal type relay
  Compensation - Change in rating does not exceed 5% for each 10°C change in ambient between 20°C and 70°C
  Adjustability - Adjustable from 90 to 110% of relay rating
  Type of reset - Hand from STOP button
- Performance ..... Manual
- Ambient temp ..... 50°C
- Insulation ..... Class B
- Emergency Run..... By holding START button depressed

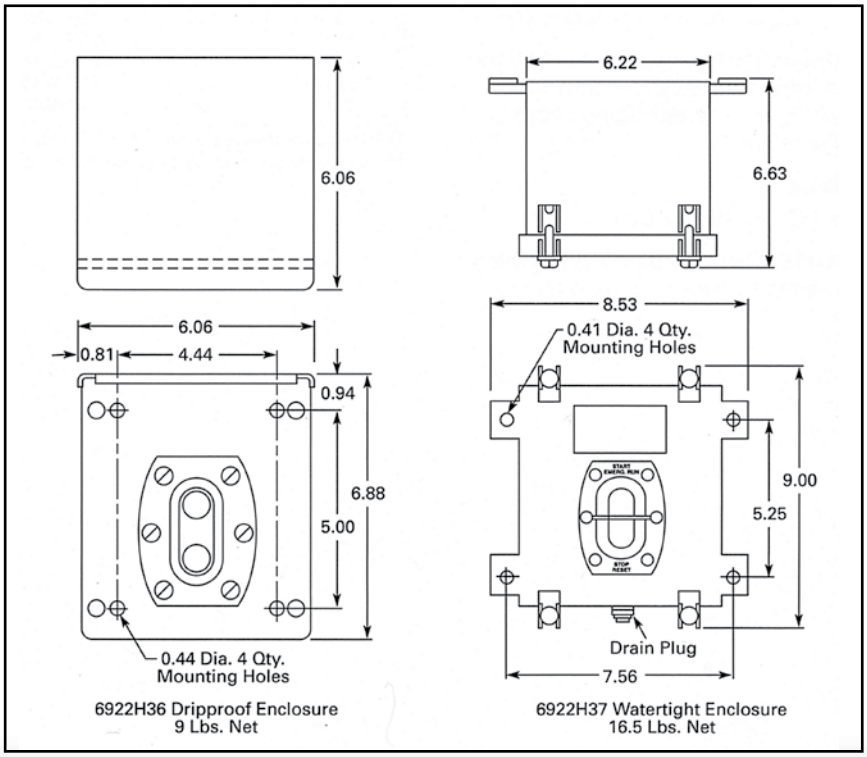
| Max. hp | Starter | | | |
|---|---|---|---|---|
| 440V 3-Phase | Dripproof | | Watertight | |
| | Cat. No. | Lbs. Net | Cat. No. | Lbs. Net |
| 7 1/2 | 6922H36B | 9.5 | 6922H37D | 16.5 |

**Starter price does not include heater coils.** Select Heater Coils from table on following page.

### Typical Wiring Diagram




### Approximate Dimensions in Inches and Shipping Weights



# AC Manual Across-the-Line Starter Overload Heater Coil Selection

## General

The 9104 Heater Coils listed at right are for use on Type 6922 Manual Starters.

## Heater Selection

Select Heater Coils based on motor nameplate full load current.

Heater coils are rated to protect 40°C motors. Open and dripproof motors have a **service factor of 1.15** where the motor and the controller are at the same Ambient temperature.

For other conditions:

A. For 50°C, 55°C, 75°C rise motors and **enclosed motors having a service factor of 1.0, select a heater coil two sizes smaller.**
B. Ambient temperature of controller lower than the motor by 26°C, use one size smaller heater coil.
C. Ambient temperature of controller higher than the motor by 26°C, use on size larger coil.

Ultimate tripping current of heater is approximately 1.20 times the minimum current rating listed in the tables.

**NOTE:** There are some coils which require minimum order quantity.

| Motor Amperes ❶ | | Catalog Number | Motor Amperes ❶ | | Catalog Number |
|---|---|---|---|---|---|
| Min. | Max. | | Min. | Max. | |
| 0.320 | 0.343 | **9104H3812** | 3.01 | 3.23 | **9104H3771** |
| 0.344 | 0.370 | **9104H3813** | 3.24 | 3.55 | **9104H3772** |
| 0.371 | 0.397 | **9104H3814** | 3.56 | 3.83 | **9104H3773** |
| 0.398 | 0.424 | **9104H3815** | 3.84 | 4.16 | **9104H3774** |
| 0.425 | 0.461 | **9104H3816** | 4.17 | 4.50 | **9104H3775** |
| 0.462 | 0.500 | **9104H3817** | 4.51 | 4.94 | **9104H3776** |
| 0.501 | 0.540 | **9104H3818** | 4.95 | 5.29 | **9104H3777** |
| 0.541 | 0.583 | **9104H3819** | 5.30 | 5.79 | **9104H3778** |
| 0.584 | 0.629 | **9104H3820** | 5.80 | 6.25 | **9104H3779** |
| 0.630 | 0.671 | **9104H3821** | 6.26 | 6.79 | **9104H3780** |
| 0.672 | 0.730 | **9104H3822** | 6.80 | 7.29 | **9104H3781** |
| 0.731 | 0.789 | **9104H3823** | 7.30 | 7.99 | **9104H3782** |
| 0.790 | 0.859 | **9104H3754** | 8.00 | 8.74 | **9104H3783** |
| 0.860 | 0.917 | **9104H3755** | 8.75 | 9.59 | **9104H3784** |
| 0.918 | 1.00 | **9104H3756** | 9.60 | 10.4 | **9104H3785** |
| 1.01 | 1.07 | **9104H3757** | 10.5 | 11.3 | **9104H3786** |
| 1.08 | 1.15 | **9104H3758** | 11.4 | 12.2 | **9104H3787** |
| 1.16 | 1.26 | **9104H3759** | 12.3 | 13.2 | **9104H3788** |
| 1.27 | 1.35 | **9104H3760** | 13.3 | 14.3 | **9104H3789** |
| 1.36 | 1.46 | **9104H3761** | 14.4 | 15.3 | **9104H3790** |
| 1.47 | 1.57 | **9104H3762** | 15.4 | 16.3 | **9104H3791** ❷ |
| 1.58 | 1.68 | **9104H3763** | 16.4 | 17.9 | **9104H3792** ❷ |
| 1.69 | 1.82 | **9104H3764** | 18.0 | 19.2 | **9104H3793** ❷ |
| 1.83 | 1.96 | **9104H3765** | 19.3 | 20.7 | **9104H3794** ❷ |
| 1.97 | 2.16 | **9104H3766** | 20.8 | 22.1 | **9104H3795** ❷ |
| 2.17 | 2.31 | **9104H3767** | 22.2 | 24.0 | **9104H3796** ❷ |
| 2.32 | 2.53 | **9104H3768** | 24.1 | 26.3 | **9104H3797** ❷ |
| 2.54 | 2.74 | **9104H3769** | 26.4 | 28.8 | **9104H3798** ❷ |
| 2.75 | 3.00 | **9104H3770** | | | |

❶ Based on starter in a maximum 50°C ambient.
❷ These coils are quantity sensitive and have minimum order size of five (5) pieces.

# Type 6956
# AC Magnetic Contactors - Enclosed

*Contactor Only – No Overload Relay*

*6956ED*

## When ordering specify

- Type number
- Ampere rating
- Voltage
- Frequency
- Type of enclosure
- LVR or LVP (type of pilot device)
- Application
- Type and number of interlocks required

## Specifications

- MIL-SPEC . . . . . MIL-DTL-2212
- Enclosure . . . . . Dripproof type
- Poles . . . . . Three poles
- Operation . . . . . Magnetic
- Duty . . . . . Continuous
- Protection . . . . . Low voltage release or low voltage protection (depending upon type of master)
- Performance . . . . Non-automatic or automatic (depending on type of master)
- Ambient temp. . . . 50°C .
- Insulation. . . . . Class B, except coils, Class A

### AC Magnetic Contactors

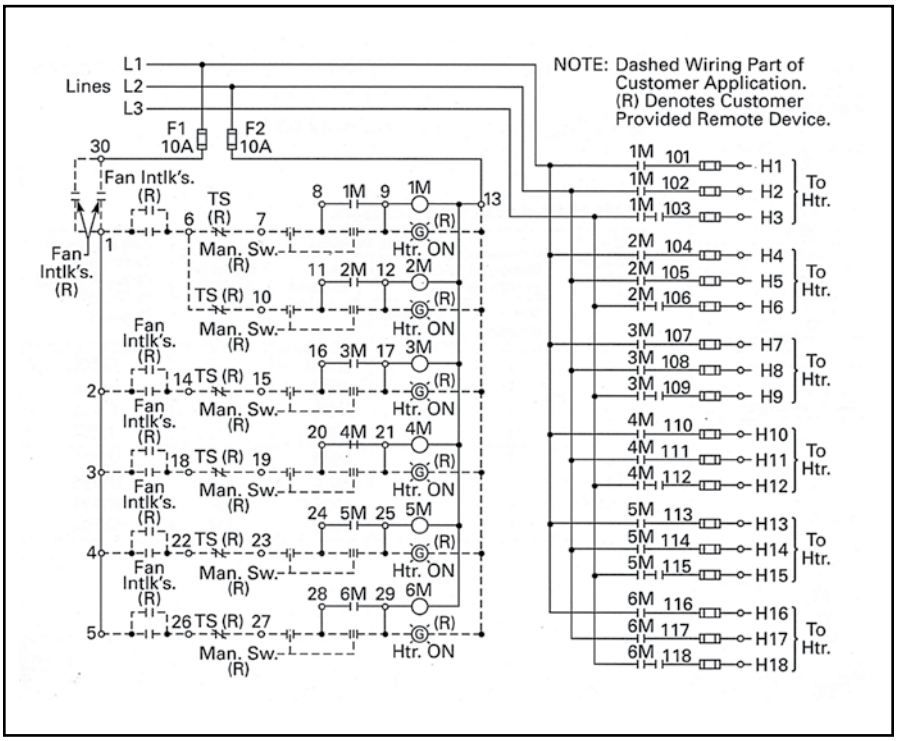
For open panels or watertight enclosures, refer to factory

| Size | Max. Amps Enclosed |
|---|---|
| 0 | 18 |
| 1 | 27 |
| 2 | 45 |
| 3 | 90 |
| 4 | 135 |
| 5 | 270 |
| 5 SP | 420 |

### Heater Loads (kW)

| Size | 110V | 440V | |
|---|---|---|---|
| | | Single-Phase | Three-Phase |
| 0 | 1.9 | 7.9 | 13 |
| 1 | 2.9 | 11 | 20 |
| 2 | 4.9 | 19 | 34 |
| 3 | 9.9 | 39 | 68 |
| 4 | 14.8 | 58 | 100 |
| 5 | 29.7 | 118 | 205 |
| 5 SP | 46.2 | 184 | 320 |

### Sample Wiring Diagram




### Approximate❶ Dimensions and Weights

| Size | Dimension in Inches | | | Wt. Lbs. |
|---|---|---|---|---|
| | Wide A | Wide B | Wide C | |
| 0/1 | 8.25 | 11.25 | 6.50 | 18 |
| 2 | 9.38 | 13.13 | 7.88 | 25 |
| 3 | 11.38 | 15.75 | 8.75 | 36 |
| 4 | 11.38 | 15.75 | 8.75 | 37 |
| 5 | 18.13 | 23.13 | 11.50 | 100 |

❶ Design variables will affect size and/or weight.

# AC Magnetic Starters
# General Data

*6962ED*

## When ordering specify

- Catalog or type number
- Specifications applying
- Voltage
- Horsepower rating
- Frequency
- Type of enclosure
- Full load motor current
- Local or remote master switch
- Scheme of operation (LVP or LVR)
- Non-automatic or automatic
- Application
- Type of motor with which starter will be used
- Any special contract requirements involving operation, construction, plans, packing, etc.

### Maximum Horsepower Ratings – 60 Hertz

| Navy Starter Size | Maximum Horsepower | |
|---|---|---|
| | 115V, 1-Phase | 440V, 3-Phase |
| **Types 6962 and 6963 Single Speed Across-the-Line** | | |
| 0 | – | 5 |
| 1 | 2 | 10 |
| 2 | 3 | 25 |
| 3 | 7-1/2 | 50 |
| 4 | – | 100 |
| 5 | – | 200 |
| 5SP | – | 375 |
| 6 | – | 400 |

**Types 6967 and 6968 Two Speed Across-the-Line**

| | 440V, 3-Phase | |
|---|---|---|
| | Constant or Variable Torque | Constant Horsepower |
| 1 | 10 | 7-1/2 |
| 2 | 25 | 20 |
| 3 | 50 | 40 |
| 4 | 100 | 75 |

**Type 6966 Reduced Voltage Autotransformer**

| | 110V | 440V |
|---|---|---|
| 2 | 7-1/2 | 25 |
| 3 | 15 | 50 |
| 4 | 25 | 100 |
| 5 | 50 | 200 |
| 5 SP | – | 375 |
| 6 | – | 400 |

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Dripproof, watertight (other types available, contact factory)
- Operation ..... Magnetic
- Type ..... Electromagnetic
- Function
  - Type 6962 ..... Motor starting
  - Type 6963 ..... Motor starting and reversing
  - Type 6966 ..... Reduced voltage motor starting
  - Type 6967 ..... Motor starting and speed selection
  - Type 6968 ..... Motor starting, reversing and speed selection
  - Type 6969 ..... Special
- Duty ..... Continuous
- Protection ..... Low voltage protection and low voltage release types
- Overload
  - Protection ..... Eutectic thermal type relay (N750) **See Page 53**
  - Compensation ..... Less than 3% change for each 10° variation in ambient between 20° and 70°C
  - Adjustability ..... -10%, +10% of heater rating
  - Reset ..... Hand (local) or electrical (remote)
- Performance ..... Non-automatic or automatic (depending on type of master switch used)
- Ambient temp ..... 50°C
- Insulation ..... Class B, except contactor coils, Class A
- Emergency Run Optional, by separate emergency RUN button
- Rating ..... AC only 60 Hz

### Table of Contactor Type Numbers

| Navy Starter Size | Main Contactor | | | | Type number of Control Relay (When Furnished for Special Purposes) |
|---|---|---|---|---|---|
| | Number of Contactors per Starter | | Type number of Contactor | Enclosed Ampere Rating | |
| | Non-reversing | Reversing | | | |
| 0 | 1 | – | **N1291** | 18 | **N1154** |
| 1 | 1 | 2 | **N850** | 27 | **N1154** |
| 2 | 1 | 2 | **N894** | 45 | **N1154** |
| 3 | 1 | 2 | **N846** | 90 | **N1154** |
| 4 | 1 | 2 | **N862** | 135 | **N1154** |
| 5 | 1 | 2 | **N878** | 270 | **N1154** |
| 5 SP | 1 | 2 | **N1178** | 420 | **N1154** |
| 6 | 1 | 2 | **N630** | 540 | **N1154** |

# Type 6962H Non-Reversing
# Standard (Non-engineered) AC Motor Starters

*Across-the-Line, Single Speed*

## When ordering specify

- Catalog number
- Horsepower rating
- Full load motor current

## Specifications

- MIL-SPEC. . . . . MIL-DTL-2212
- Enclosure . . . . . .Dripproof with wraparound cover
- Voltage. . . . . 440V AC, 60 Hz, 3-phase only
- Operation. . . . . .Magnetic

### Remote Control – With Provision for Remote START/STOP Pushbutton (LVP) or ON/OFF Selector Switch (LVR)

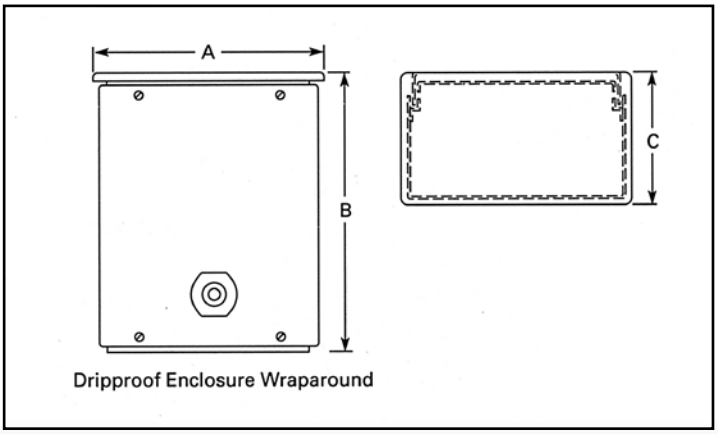
| Size | Remote START/STOP Pushbutton (LVP) | | | Remote ON/OFF Selector Switch (LVR) | | | Dim. Table Reference |
|---|---|---|---|---|---|---|---|
| | Catalog number | | | Catalog number | | | |
| | Without Additional Features | With Provisions for | | Without Additional Features | With Provisions for | | |
| | | Remote Protective Device | Remote Emergency Run | | Remote Protective Device | Remote Emergency Run | |
| **Without Indicating Light (1 Pilot Circuit Fuse)** | | | | | | | |
| 1 | **6962H154A2** | **6962H154A6** | **6962H154A3** | **6962H154A4** | – | **6962H154A5** | B |
| 2 | **6962H161A2** | **6962H161A4** | **6962H161A3** | **6962H161A7** | – | **6962H161A8** | E |
| 3 | **6962H170A2** | **6962H170A4** | **6962H170A3** | **6962H171A2** | – | **6962H171A3** | G |
| 4 | **6962H178A2** | **6962H178A4** | **6962H178A3** | **6962H179A2** | – | **6962H179A3** | H |
| **With Provision for Indicating Light (3 Pilot Circuit Fuses)** | | | | | | | |
| 1 | **6962H155A2** | – | **6962H155A3** | **6962H155A4** | – | **6962H155A5** | B |
| 2 | **6962H163A2** | – | **6962H163A3** | **6962H163A4** | – | **6962H163A5** | E |
| 3 | **6962H172A2** | – | **6962H172A3** | **6962H173A2** | – | **6962H173A3** | G |
| 4 | **6962H180A2** | – | **6962H180A3** | **6962H181A2** | – | **6962H181A3** | H |

### Local Control – With START/STOP Pushbutton (LVP) or ON/OFF Selector Switch (LVR) – 440A – 60 Hz

| Size | START/STOP Pushbutton in Cover (LVP) | | | | | | | | ON/OFF Selector Switch in Cover (LVR) with Local Emergency Run | | START/STOP Pushbutton and MAN/AUTO Selector Switch in Cover (LVP) with Provisions for Remote 2-Wire Automatic Device | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Without Additional Features | | With Local Emergency Run | | With Provisions for | | | | | | | |
| | | | | | Remote Pushbuttons (1 Pilot Fuse) | | Remote Safety Switch (1 Pilot Fuse) | | | | | |
| | Catalog number | Dim. Ref. | Catalog number | Dim. Ref. | Catalog number | Dim. Ref. | Catalog number | Dim. Ref. | Catalog number | Dim. Ref. | Catalog number | Dim. Ref. |
| **Without Indicating Light** | | | | | | | | | | | | |
| 1 | **6962H156A2** | A | **6962H157A2** | A | **6962H159A2** | B | **6962H159A3** | B | **6962H158A2** | B | **6962H160A2** | C |
| 2 | **6962H165A2** | D | **6962H166A2** | D | **6962H168A2** | E | **6962H168A3** | E | **6962H167A2** | E | **6962H169A2** | J |
| 3 | **6962H174A2** | F | **6962H175A2** | F | **6962H177A2** | G | **6962H177A3** | G | **6962H176A2** | G | **–** | – |
| 4 | **6962H182A2** | H | **6962H183A2** | H | **6962H185A2** | H | **6962H185A3** | H | **6962H184A2** | H | **–** | – |

Prices of starters do not include overload heater coils. Two required per controller. Heater Coil Selection, **Page 60.**

### Approximate Dimensions and Weights



Dripproof Enclosure Wraparound

| Reference Letter | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | Wide A | High B | Deep C | |
| A | 8.38 | 11.30 | 6.68 | 20 |
| B | 8.24 | 15.56 | 6.68 | 25 |
| C | 11.74 | 15.30 | 6.44 | 35 |
| D | 9.38 | 12.80 | 8.06 | 30 |
| E | 9.38 | 17.30 | 8.06 | 35 |
| F | 11.38 | 15.30 | 8.94 | 40 |
| G | 11.38 | 19.80 | 8.94 | 45 |
| H | 11.38 | 19.80 | 8.94 | 47 |
| J | 13.74 | 16.80 | 8.06 | 40 |

# Type 6967H Non-Reversing Standard (Non-engineered) AC Motor Starters

## When ordering specify

- Catalog number
- Horsepower rating
- Full load motor current

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Dripproof with wraparound cover
- Voltage..... 440V AC, 60 Hz, 3-phase only
- Operation ..... Magnetic. Two speed, Two-Winding LVP

### Local Control — FAST/SLOW/STOP

| Size | Maximum Horsepower | Catalog number | | |
|---|---|---|---|---|
| | | | With Provisions for | |
| | | Local FAST/SLOW/STOP Only | Remote FAST/SLOW/STOP | Remote FAST/SLOW/STOP and MOTOR RUN Lights ❶ and Remote EM-START/EM-STOP |
| 1<br>2 | 10<br>25 | **6967H21A2**<br>**6967H28A2** | –<br>**6967H26A2** | –<br>**6967H27A2** |

### Remote Control Only

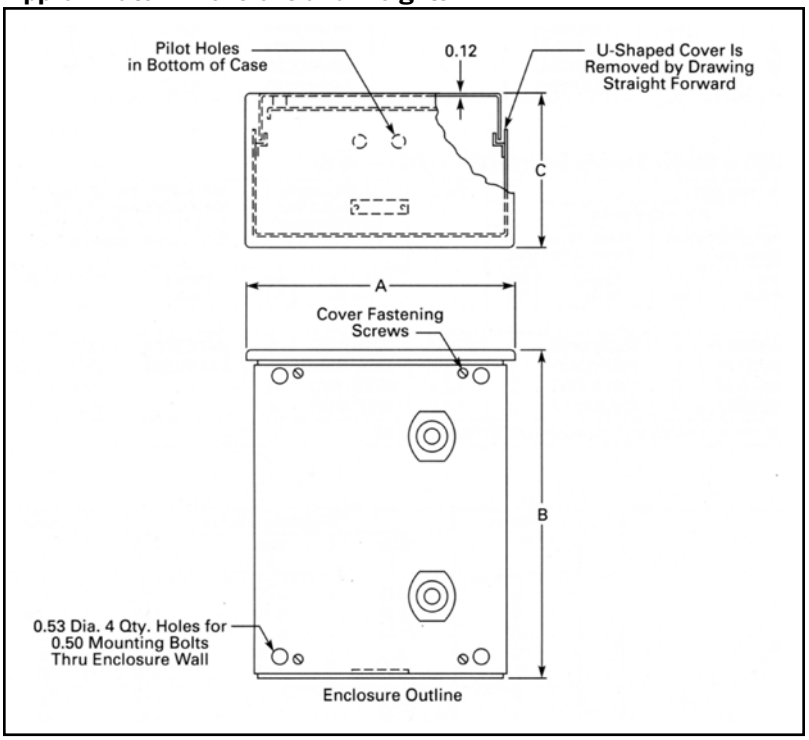
| Size | Maximum Horsepower | Catalog number | |
|---|---|---|---|
| | | With Provisions for | |
| | | Remote FAST/SLOW/STOP | Remote FAST/SLOW/STOP and MOTOR RUN Lights ❶ and Remote EM-START/EM-STOP |
| 1<br>2 | 10<br>25 | **6967H21A2**<br>**6967H28A2** | –<br>**6967H29A2** |

**Prices of Starters do not include overload heater coils.** Four required per controller. Heater Coil Selection, **Page 60.**

❶ Motor run light for each speed.

| Size | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | Wide A | High B | Deep C | |
| 1<br>2 | 11.8<br>13.8 | 15.3<br>16.8 | 6.5<br>8.1 | 32<br>47 |

### Approximate Dimensions and Weights



# Type 6962 Non-Reversing and Type 6963 Reversing Engineered AC Magnetic Starters

*Across-the-Line, Single Speed*

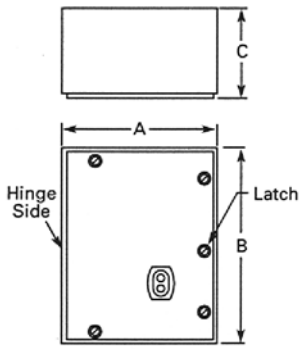
## When ordering specify

- Base type number. Example 6962-3
- Voltage and frequency
- Type of enclosure
- Full load motor current
- Low voltage protection or low voltage release
- Features required
- Desired circuit operation
- Description of application
- Any special instructions

## Specifications

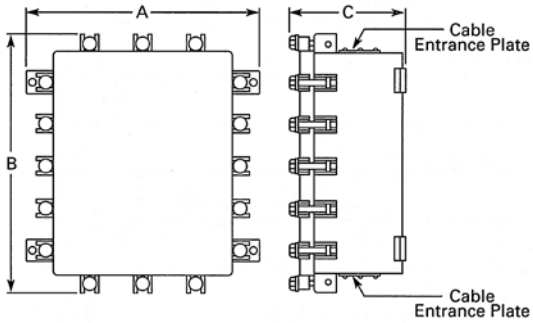
- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Dripproof or watertight
- Operation ..... Magnetic
- Rating ..... 440V AC, 60 Hz, 3-Phase
  other voltages available

### Approximate Dimensions and Shipping Weights - Dripproof




| Controller Size | Dripproof Enclosure ❶ | | | |
|---|---|---|---|---|
| | Dimensions in Inches | | | Shipping Weight Lbs. |
| | Wide A | High B | Deep C | |
| **Type 6962 Non-reversing** | | | | |
| 0 | 12.0 | 18.0 | 9.5 | 35 |
| 1 | 12.0 | 18.0 | 9.5 | 35 |
| 2 | 12.0 | 18.0 | 9.5 | 35 |
| 3 | 12.0 | 18.0 | 9.5 | 45 |
| 4 | 14.0 | 18.0 | 9.5 | 51 |
| 5 | 22.13 | 28.13 | 11.5 | 120 |
| 5 SP | 22.13 | 28.13 | 11.5 | 120 |
| 6 | 35.5 | 60.0 | 24.0 | 790 |
| **Type 6963 Reversing** | | | | |
| 1 | 12.0 | 18.0 | 9.5 | 35 |
| 2 | 14.0 | 20.0 | 9.5 | 47 |
| 3 | Contact Factory | | | |
| 4 | | | | |

### Approximate Dimensions and Shipping Weights - Watertight




| Controller Size | Watertight Enclosure ❶ | | | |
|---|---|---|---|---|
| | Dimensions in Inches | | | Shipping Weight Lbs. |
| | Wide A | High B | Deep C | |
| **Type 6962 Non-reversing** | | | | |
| 0 | 9.5 | 19.0 | 7 | 34 |
| 1 | 9.5 | 19.0 | 7 | 35 |
| 2 | 13.5 | 19.0 | 9 | 52 |
| 3 | Contact Factory | | | |
| 4 | | | | |
| 5 | | | | |
| 5 SP | | | | |
| 6 | | | | |
| **Type 6963 Reversing** | | | | |
| 1 | 13.28 | 21.13 | 9 | 50 |
| 2 | 15.38 | 21.13 | 9 | 60 |
| 3 | Contact Factory | | | |
| 4 | | | | |

❶ Dimensions and weights shown are for the base controller only. The addition of optional features will affect the size and weight.

# Type 6967 Non-Reversing and Type 6968 Reversing Engineered AC Magnetic Starters

*Two Speed, Across-the-Line*

## When ordering specify

- Type number
- Applicable specifications
- Two-winding or single-winding reconnected
- Horsepower rating at high and low speeds
- Full load motor current at high and low speeds
- Voltage and frequency
- Low voltage release or low voltage protection
- Non-automatic or automatic
- Local or remote master
- Type of enclosure
- Application

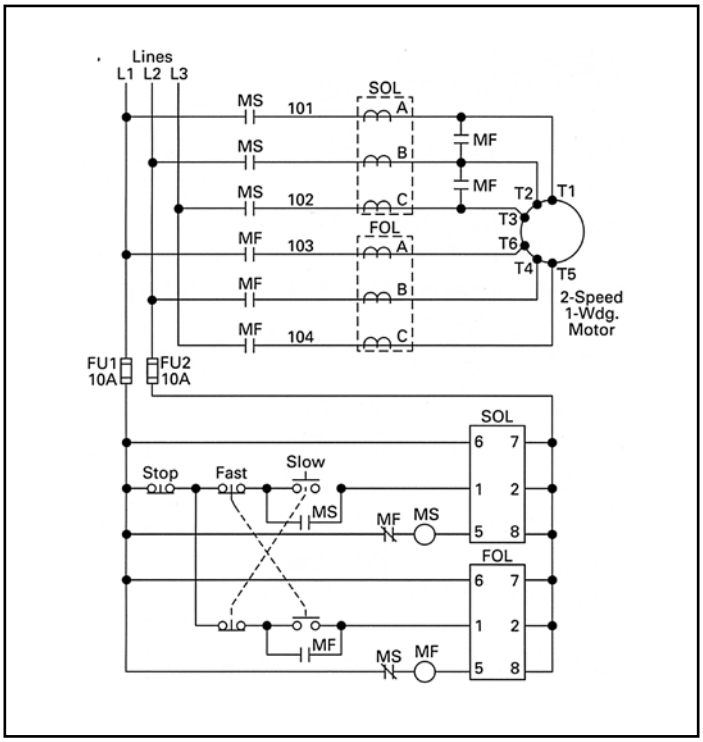
## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Dripproof or watertight
- Operation ..... Magnetic
- Rating ..... 440V AC, 60 Hz, 3-Phase
  other voltages available

### Maximum Horsepower Ratings

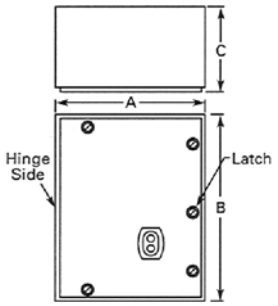
| Size | Maximum Horsepower 3-Phase, 60 Hz | |
|---|---|---|
| | Constant or Variable Torque | Constant Horsepower |
| | 440V | 440V |
| 1 | 10 | 7-1/2 |
| 2 | 25 | 20 |
| 3 | 50 | 40 |
| 4 | 100 | 75 |

### Diagram




### Approximate Dimensions and Weights –

Watertight enclosure dimensions on application. Design variables prevent accurate dimensions.




| Size | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | Wide A | High B | Deep C | |
| **Non-reversing - Dripproof** | | | | |
| 1 | 14.13 | 18.13 | 9.38 | 45 |
| 2 | 14.13 | 20.13 | 9.38 | 55 |
| 3 | 16.13 | 22.13 | 9.38 | 73 |
| 4 | 16.13 | 22.13 | 9.38 | 85 |
| **Reversing - Dripproof** | | | | |
| 1 | 16.13 | 20.13 | 9.38 | 60 |
| 2 | 16.13 | 24.13 | 9.38 | 79 |
| 3 | 22.13 | 28.13 | 9.38 | 132 |
| 4 | 22.13 | 32.13 | 9.38 | 141 |

# Type 6966
# Engineered AC Magnetic Starters

*Autotransformer, Reduced Voltage Type*

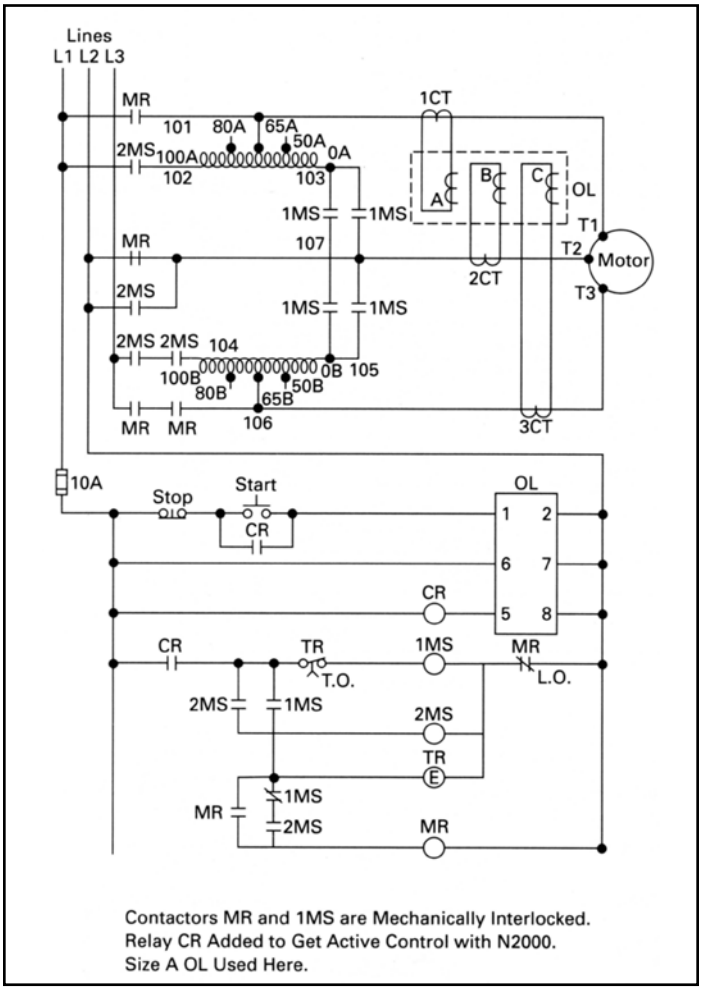
## When ordering specify

- Type number
- Application specifications
- Horsepower
- Voltage and frequency
- Full load motor current
- Type of enclosure
- Local or remote control
- Low voltage protection or low voltage release
- Non-automatic or automatic
- Application

## Specifications

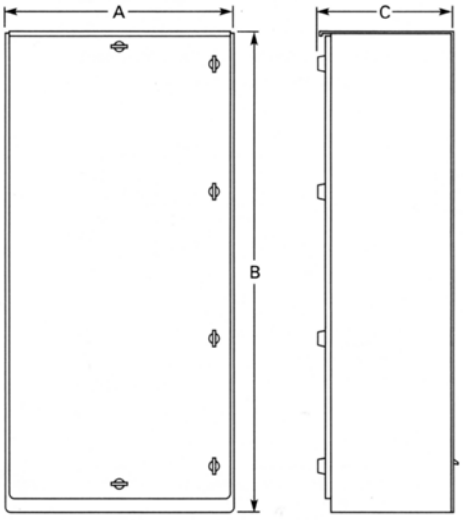
- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Dripproof
- Operation ..... Magnetic
- Rating ..... 440V AC, 60 Hz, 3-Phase
  Other voltages available

### Typical Wiring Diagram




Contactors MR and 1MS are Mechanically Interlocked.
Relay CR Added to Get Active Control with N2000.
Size A OL Used Here.

### Approximate Dimensions in Inches and Weights – Type 6966-1❶




Size 4, 5 and 6 Deck Mounted
(Bottom Open for Cable Entry)

| Size | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | Wide A | High B | Deep C | |
| **Dripproof Enclosure** | | | | |
| 1 | 20 | 42 | 14 | 190 |
| 2 | 20 | 42 | 14 | 200 |
| 3 | 20 | 42 | 14 | 300 |
| 4 | 26 | 60 | 24 | 700 |
| 5 | 32.50 | 84 | 28.25 | 1275 |
| 6 | 34.25 | 90 | 30.25 | 1700 |

❶ Design variables prevent accurate dimensions.

# Type 6999
# Engineered AC Magnetic Starters and Controls

*Other Configurations*

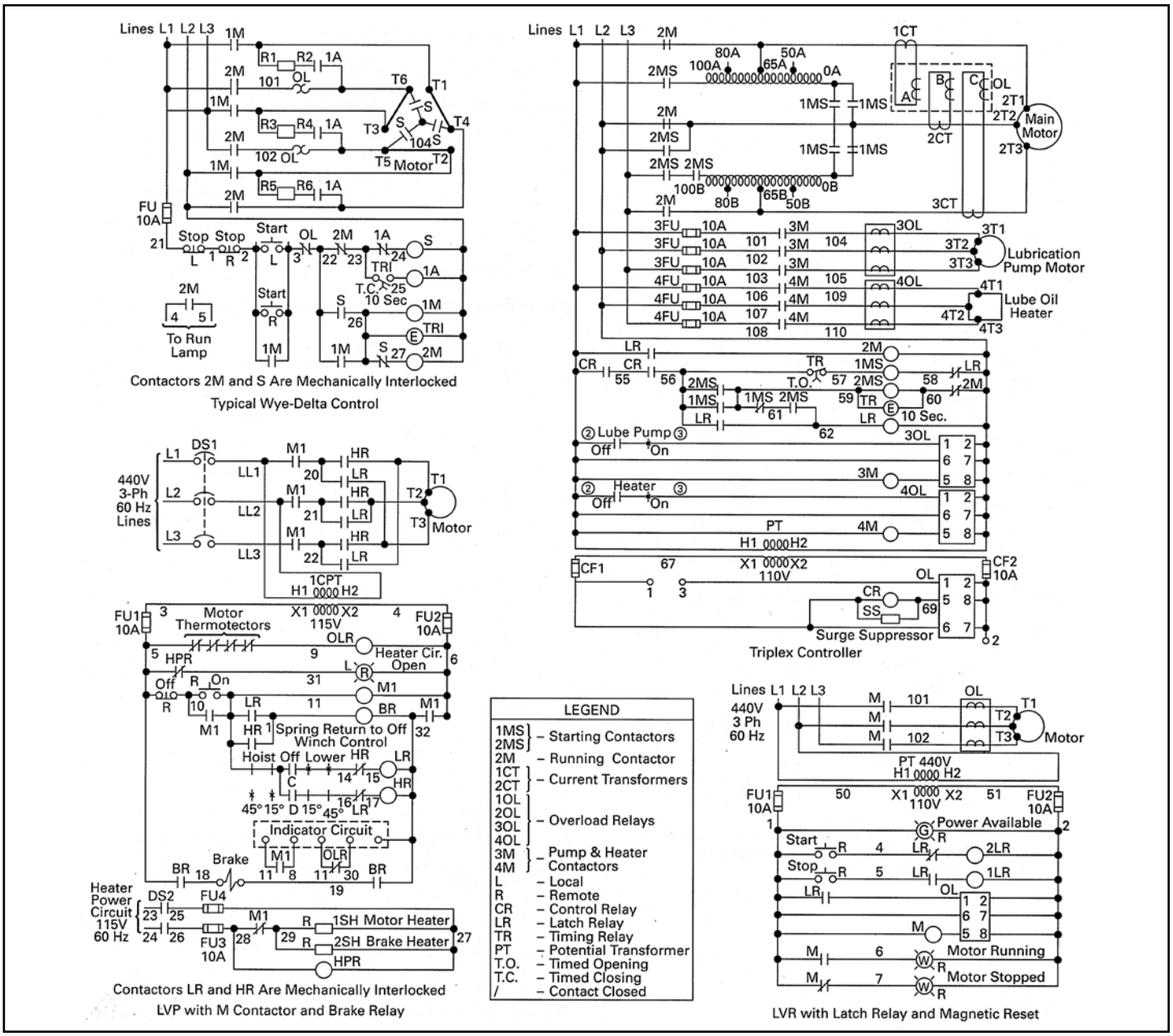
## When ordering specify

- Application specifications
- Function description
- Circuit configuration
- Horsepower rating
- Full load amperes
- Voltage and frequency
- Operation – LVP or LVR
- Local or remote master
- Enclosure type
- Application description

## Possible Configurations

- Reversing autotransformer
- Wye-Delta reduced voltage
- Part-winding
- Wound rotor
- Special control needs

### Example Diagrams



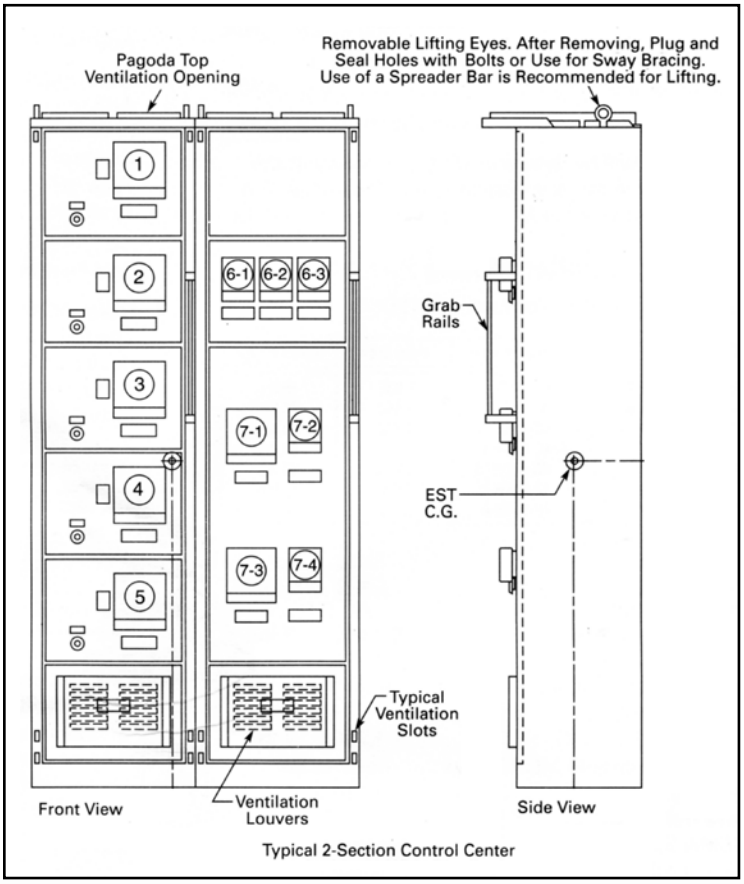
# Type 6976
# Navy Underdeck Control Centers

## When ordering specify

- Type number
- Applicable specifications
- Control center layout and individual cell application
- Type number of individuals cells - specify voltage, frequency, horsepower and full load motor current for each cell.

## Specifications

- MIL-SPEC ..... MIL-C-23742
- Enclosure — Splash proof (meets "Water Spray Protected" requirement)
- Operation ..... Magnetic
- Function — Motor starting, speed selection and power distribution. Variable voltage control.
- Duty ..... Continuous
- Protection ..... Low voltage release or low voltage protection Overload protection - thermal type, adjustable overload relay
- Performance ..... Non-automatic or automatic
- Ambient temp. ..... 50°C
- Insulation — Class B - except magnet coils which have Class A insulation
- Emergency Run..... Included
- Ratings ..... 440V, 3-Phase, 60 Hz



Typical 2-Section Control Center

## Type 6962

### Across-the-Line – 20 Inch Wide

| Size | Maximum Horsepower | Circuit Breaker Ampere Rating | Space |
|---|---|---|---|
| 0 | 5 | 100 | 1-13 Inch |
| 1 | 10 | 100 | 1-13 Inch |
| 2 | 25 | 100 | 1-13 Inch |
| 3 | 50 | 100 | 1-13 Inch |
| 4 | 75 | 100 | 1-13 Inch |

## Type 6967

### 2 Speed – 20 Inch Wide

| Size | Maximum Horsepower | Circuit Breaker Ampere Rating | Space |
|---|---|---|---|
| 1 | 10 | 100 | 1-26 Inch |
| 2 | 25 | 100 | 1-26 Inch |

## Circuit Breaker Distribution Section

### 22-1/4 Inch Wide

| Circuit Breaker Type | Space |
|---|---|
| 1 to 4 AQB-A-101 | 1-13 Inch |
| 1 to 2 AQB-LF-250 | 1-13 Inch |

## Variable Voltage Static Control

### 20 Inch Wide

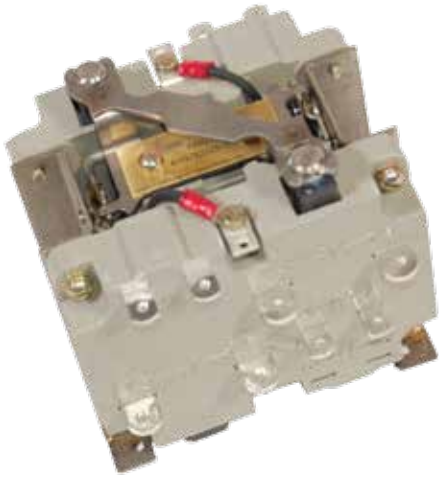
| Horsepower Rating | Speed Range | Space |
|---|---|---|
| 10-20 | 3:1 | 1-13 Inch |
| 50 | 5:1 | 1-13 Inch |

### Optional Features Available

- Pushbuttons, selector switches and indicating lights.
- Control relays and timers.
- Space only for future or special control.

# Type 6957
# AC Navy Contactors

*N850-N851 – Size 1 and N1291 – Size 0*



*6957ED25-1C*

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Operation ..... Magnetic
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B, except coils, Class A

## Electrical Data (Enclosed)

| | N850 | N851 | N1291 |
|---|---|---|---|
| Number of Poles | 4 | 5 | 3 |
| Ampere Rating – Enclosed | 27 | 27/13.5 | 18 |
| Horsepower Rating – 440V, 3-Phase, 60 Hz | 10 | 10 | 5 |
| Maximum Break – Amperes at 484V, 40% PF | 162 | 162 | 108 |
| No. of Interlocks – Hi-Shock NO | 2 | 2 | 1 |
| NC | 2 | 1 | - |

### Interlock Contact

| | Amperes | | |
|---|---|---|---|
| | Make | Break | Continuous |
| 440V AC | 6 | 1 | 15 |
| 110V AC | 15 | 1 | 15 |

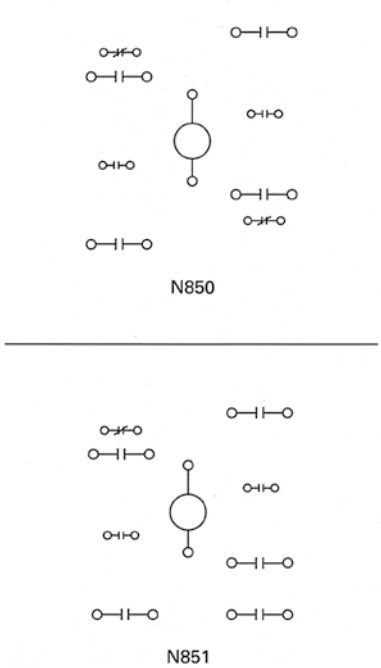
### Coil Data – 60 Hertz (All Devices)

| | | 440V | 110V |
|---|---|---|---|
| Inrush | Amperes | 0.46 | 1.84 |
| | Watts | 170 | 170 |
| | VA | 200 | 200 |
| Sealed | Amperes | 0.04 | 0.16 |
| | Watts | 5.4 | 5.4 |
| | VA | 17.8 | 17.8 |

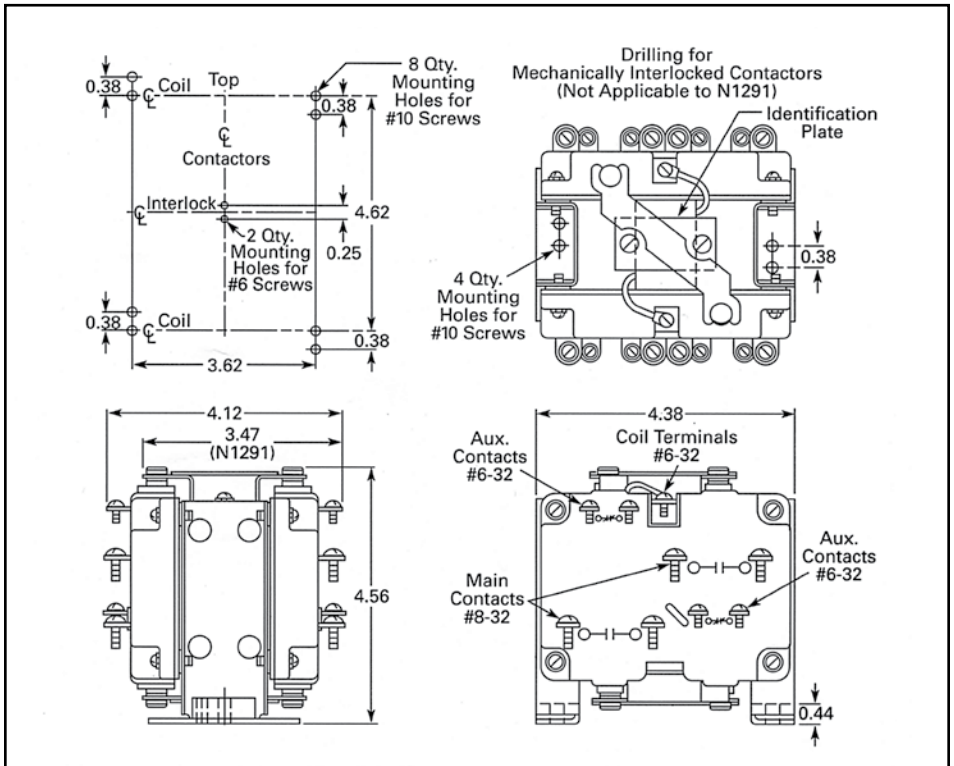
### Contactor Weight

| | N850 | N851 | N1291 |
|---|---|---|---|
| Pounds | 3.1 | 3.1 | 3.0 |

### Diagram Symbols

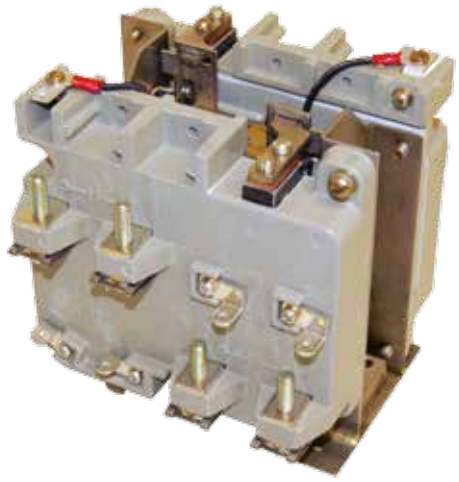



### Approximate Dimensions in Inches



# Type 6957
# AC Navy Contactors

*N894-N895 – Size 2*



*6957ED29-2A*

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Operation ..... Magnetic
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B, except coils, Class A

## Electrical Data (Enclosed)

| | N894 | N895 |
|---|---|---|
| Number of Poles | 4 | 5 |
| Ampere Rating – Enclosed | 45 | 45/22.5 |
| Horsepower Rating – 440V, 3-Phase, 60 Hz | 25 | 25 |
| Maximum Break – Amperes at 484V, 40% PF | 270 | 270 |
| No. of Interlocks – Hi-Shock NO | 2 | 1 |
| NC | 2 | 2 |

### Interlock Contact

| | Amperes | | |
|---|---|---|---|
| | Make | Break | Continuous |
| 440V AC | 6 | 1 | 15 |
| 110V AC | 15 | 1 | 15 |

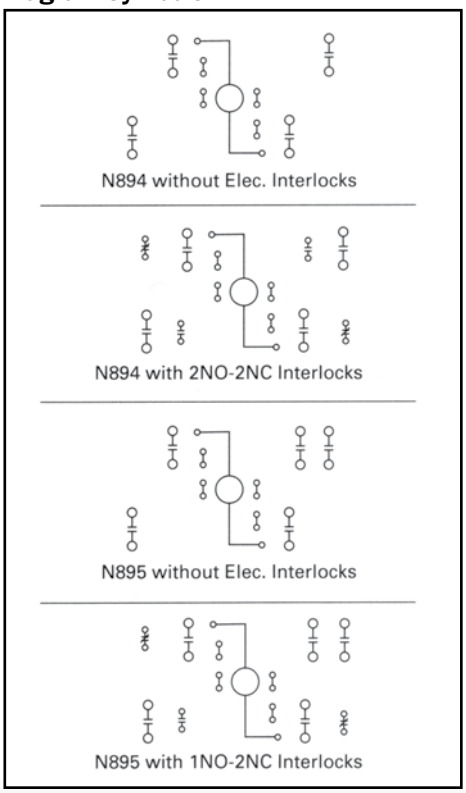
### Coil Data – 60 Hertz (All Devices)

| | | 440V | 110V |
|---|---|---|---|
| Inrush | Amperes | 0.56 | 2.24 |
| | Watts | 220 | 220 |
| | VA | 245 | 245 |
| Sealed | Amperes | 0.03 | 0.12 |
| | Watts | 5.6 | 5.6 |
| | VA | 13.1 | 13.1 |

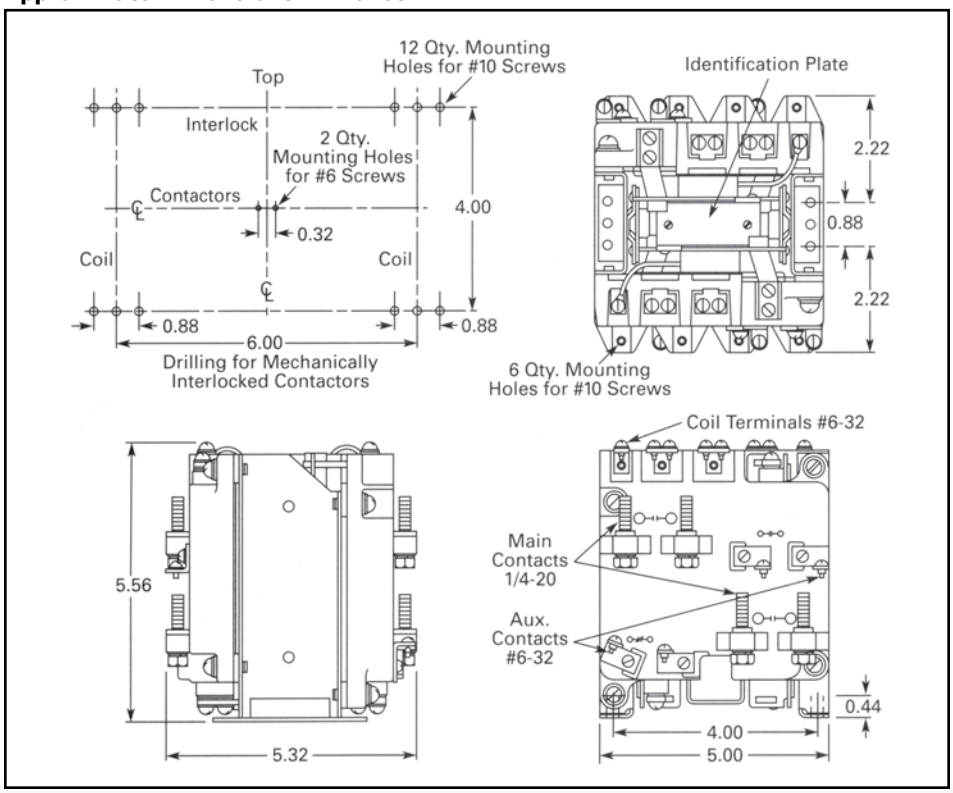
### Contactor Weight

| | N894 | N895 |
|---|---|---|
| Pounds | 5.25 | 5.40 |

### Diagram Symbols

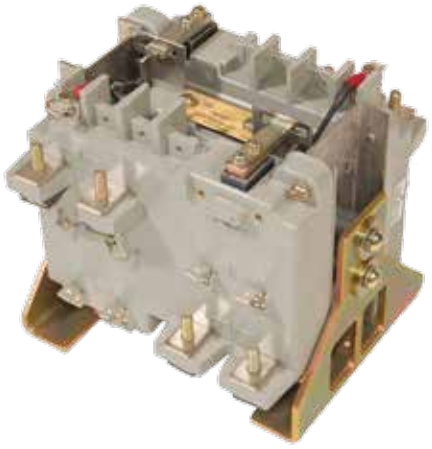



### Approximate Dimensions in Inches



# Type 6957
# AC Navy Contactors

*N846/N847 – Size 3*



*6957ED31-2C*

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Operation ..... Magnetic
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B, except coils, Class A

## Electrical Data (Enclosed)

| | N846 | N847 |
|---|---|---|
| Number of Poles | 4 | 5 |
| Ampere Rating – Enclosed | 90 | 90/45 |
| Horsepower Rating – 440V, 3-Phase, 60 Hz | 50 | 50 |
| Maximum Break – Amperes at 484V, 40% PF | 540 | 540 |
| No. of Interlocks – Hi-Shock NO | 4 | 3 |
| NC | 4 | 3 |

### Interlock Contact

| | Amperes | | |
|---|---|---|---|
| | Make | Break | Continuous |
| 440V AC | 6 | 1 | 15 |
| 110V AC | 15 | 1 | 15 |

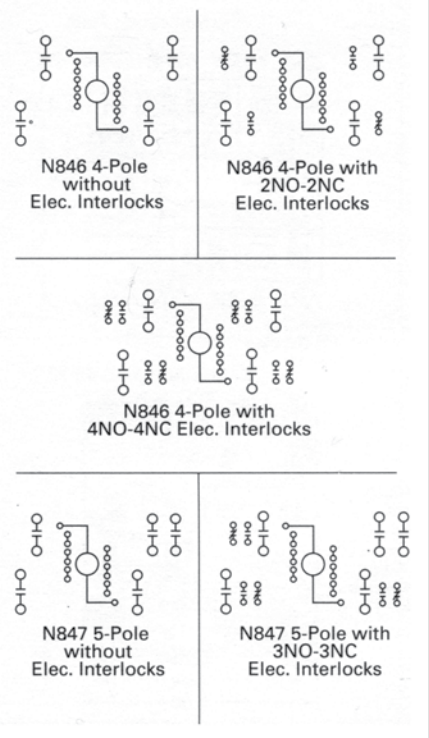
### Coil Data – 60 Hertz (All Devices)

| | | 440V | 110V |
|---|---|---|---|
| Inrush | Amperes | 1.3 | 5.20 |
| | Watts | 309 | 309 |
| | VA | 570 | 570 |
| Sealed | Amperes | 0.044 | 0.18 |
| | Watts | 8.8 | 8.8 |
| | VA | 19.5 | 19.5 |

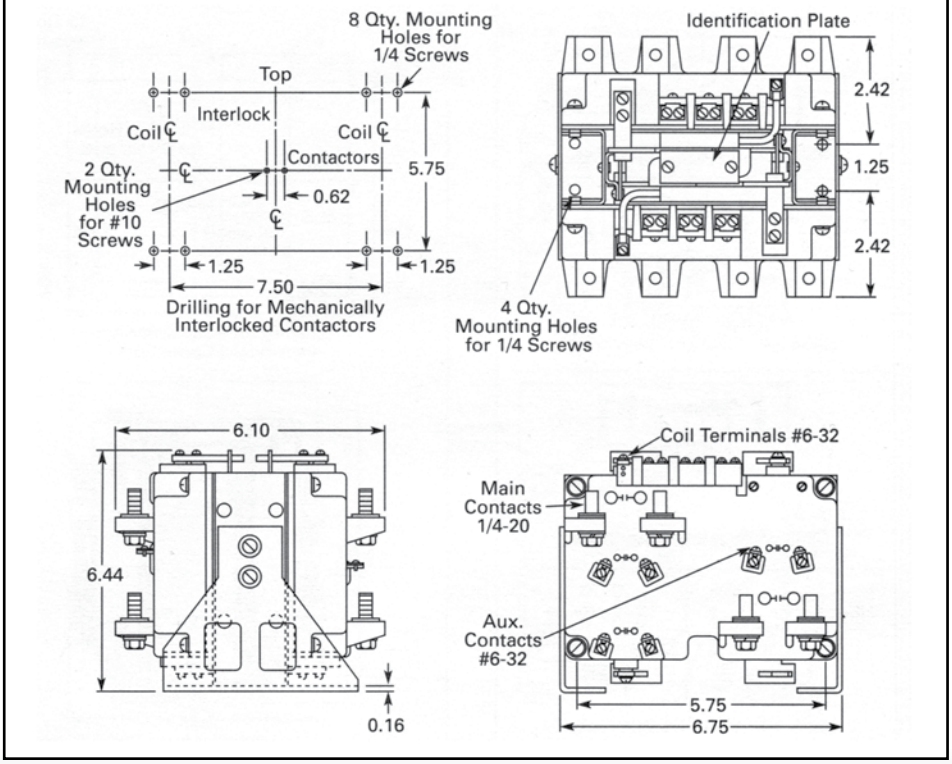
### Contactor Weight

| | N846 | N847 |
|---|---|---|
| Pounds | 9.6 | 10.0 |

### Diagram Symbols




### Approximate Dimensions in Inches



# Type 6957
# AC Navy Contactors

*N862/N863 – Size 4*

*6957ED33-2CA*

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Operation ..... Magnetic
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B, except coils, Class A

## Electrical Data (Enclosed)

| | N862 | N863 |
|---|---|---|
| Number of Poles | 4 | 5 |
| Ampere Rating – Enclosed | 135 | 135/67.5 |
| Horsepower Rating – 440V, 3-Phase, 60 Hz | 100 | 100 |
| Maximum Break – Amperes at 484V, 40% PF | 810 | 810 |
| No. of Interlocks – Hi-Shock NO | 4 | 3 |
| NC | 4 | 3 |

### Interlock Contact

| | Amperes | | |
|---|---|---|---|
| | Make | Break | Continuous |
| 440V AC | 6 | 1 | 15 |
| 110V AC | 15 | 1 | 15 |

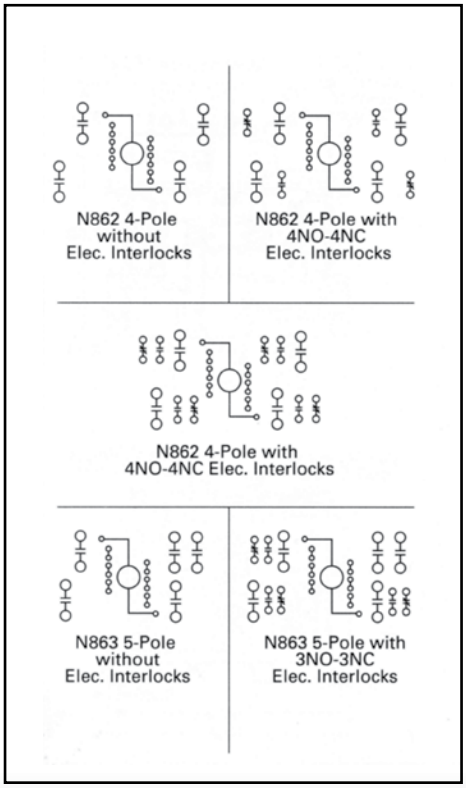
### Coil Data – 60 Hertz (All Devices)

| | | 440V | 110V |
|---|---|---|---|
| Inrush | Amperes | 1.3 | 5.20 |
| | Watts | 309 | 309 |
| | VA | 570 | 570 |
| Sealed | Amperes | 0.044 | 0.18 |
| | Watts | 8.8 | 8.8 |
| | VA | 19.5 | 19.5 |

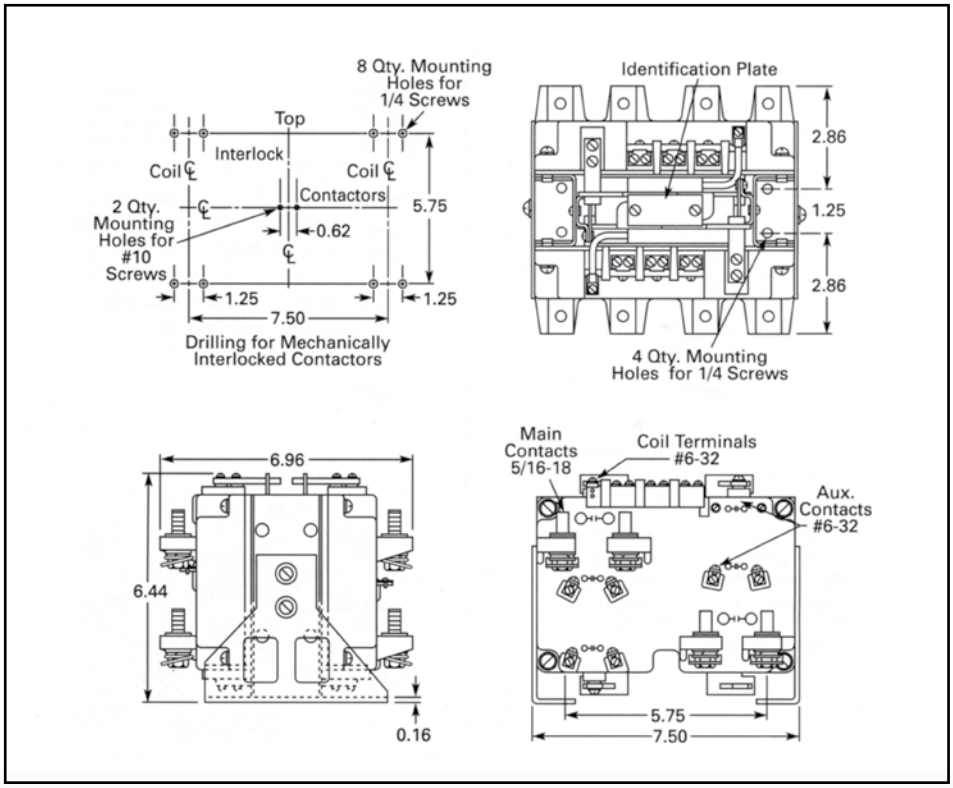
### Contactor Weight

| | N862 | N863 |
|---|---|---|
| Pounds | 12.5 | 12.9 |

### Diagram Symbols




### Approximate Dimensions in Inches



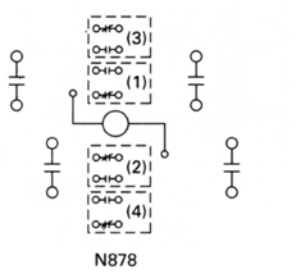
# Type 6957
# AC Navy Contactors

*N878-Size 5 and N1178-Size 5 SP*

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Operation ..... Magnetic
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B, except coils, Class A

### Diagram Symbols




N878

| Interlocks | Use Position |
|---|---|
| 1NO-2NC | 1 |
| 2N0-2NC | 1 and 2 |
| 4NO-4NC | 1-2-3 amd 4 |
| 2NO-1NC-1NC LO | 1 and 2 (LO) |
| 1NO-1NC LO | 1 (LO) |

LO - Late Opening

## Electrical Data (Enclosed)

| | N878 | N1178 |
|---|---|---|
| Number of Poles | 4 | 3 |
| Ampere Rating – Enclosed | 270 | 420 |
| Horsepower Rating – 440V, 3-Phase, 60 Hz | 200 | 375 |
| Maximum Break – Amperes at 484V, 40% PF | 1620 | 2520 |
| No. of Interlocks – HI-Shock NO | 1, 2, 4 | 1, 2, 4 |
| NC | 1, 2, 4 | 1, 2, 4 |

### Interlock Contact

| | Amperes | | |
|---|---|---|---|
| | Make | Break | Continuous |
| 440V AC | 6 | 1 | 15 |
| 110V AC | 15 | 1 | 15 |

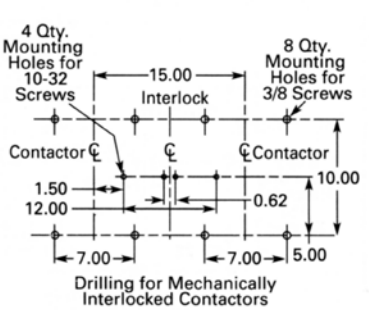
### Coil Data – 60 Hertz (All Devices)

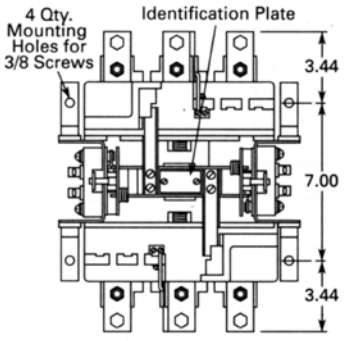
| | | 440V | 110V |
|---|---|---|---|
| Inrush | Amperes | 4.1 | 16.4 |
| | Watts | 210 | 210 |
| | VA | 1750 | 1750 |
| Sealed | Amperes | 0.2 | 0.8 |
| | Watts | 36 | 36 |
| | VA | 88 | 88 |

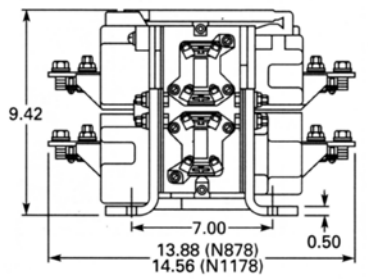
### Contactor Weight

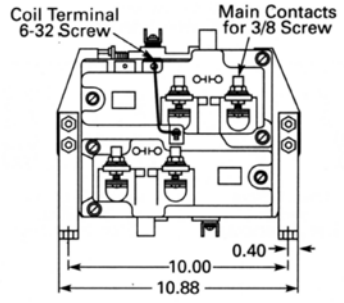
| | N878 | N1178 |
|---|---|---|
| Pounds | 40 | 41 |

### Approximate Dimensions in Inches



# Type 6957
# AC Magnetic Contactors

## AC Magnetic Contactors

| Size | Device Number | Main Contacts | | Auxiliary Contacts | Standard | "Quiet" ❷ |
|---|---|---|---|---|---|---|
| | | Rating (Amperes) | Numbers | | Catalog number ❶ | Catalog number ❶ |
| 0 | N1291 | 18 | 3NO | 1NO | **6957ED58-1_** | **6957ED58-1_Q** |
| 1 | N850 | 27 | 4NO<br>3NO | 2NO-2NC<br>2NO-1NC | **6957ED25-1_**<br>**6957ED25-4_** | **6957ED25-1_Q**<br>**6957ED25-4_Q** |
| | N851 | 27 | 5NO ❸ | 2NO-1NC | **6957ED26-4_** | **6957ED26-4_Q** |
| 2 | N894 | 45 | 4NO<br>4NO<br>3NO | -<br>2NO-2NC<br>2NO-2NC | **6957ED29-1_**<br>**6957ED29-2_**<br>**6958ED29-4_** | **6957ED29-1_Q**<br>**6957ED29-2_Q**<br>**6958ED29-4_Q** |
| | N895 | 45 | 5NO ❸<br>5NO ❸ | -<br>1NO-2NC | **6957ED30-1_**<br>**6957ED30-2_** | **6957ED30-1_Q**<br>**6957ED30-2_Q** |
| 3 ❺ | N846 | 90 | 4NO<br>4NO<br>4NO<br>3NO<br>3NO | -<br>2NO-2NC<br>4NO-4NC<br>2NO-1NC<br>3NO-3NC | **6957ED31-1_**<br>**6957ED31-2_**<br>**6957ED31-3_**<br>**6957ED31-7_**<br>**6957ED31-8_** | **6957ED31-1_Q**<br>**6957ED31-2_Q**<br>**6957ED31-3_Q**<br>**6957ED31-7_Q**<br>**6957ED31-8_Q** |
| | N847 | 90 | 5NO ❸<br>5NO ❸ | -<br>3NO-3NC | **6957ED32-1_**<br>**6957ED32-2_** | **6957ED32-1_Q**<br>**6957ED32-2_Q** |
| 4 ❺ | N862 | 135 | 4NO<br>4NO<br>4NO<br>3NO<br>3NO | -<br>2NO-2NC<br>4NO-4NC<br>2NO-1NC<br>3NO-3NC | **6957ED33-1_**<br>**6957ED33-2_**<br>**6957ED33-3_**<br>**6957ED33-7_**<br>**6957ED33-8_** | **6957ED33-1_Q**<br>**6957ED33-2_Q**<br>**6957ED33-3_Q**<br>**6957ED33-7_Q**<br>**6957ED33-8_Q** |
| | N863 | 135 | 5NO ❸<br>5NO ❸ | -<br>3NO-3NC | **6957ED34-1_**<br>**6957ED34-2_** | **6957ED34-1_Q**<br>**6957ED34-2_Q** |
| 5 ❺ | N878 | 270 | 4NO<br>4NO<br>4NO | 1NO-1NC<br>2NO-2NC<br>4NO-4NC | **6957ED39-1_**<br>**6957ED39-2_**<br>**6957ED39-3_** | **6957ED39-1_Q**<br>**6957ED39-2_Q**<br>**6957ED39-3_Q** |
| 5 SP ❺ | N1178 | 420 | 3NO<br>3NO<br>3NO | 1NO-1NC<br>2NO-2NC<br>4NO-4NC | **6957ED53-1_**<br>**6957ED53-2_**<br>**6957ED53-3_** | **6957ED53-1_Q**<br>**6957ED53-2_Q**<br>**6957ED53-3_Q** |
| 6 | N630 | 540 | 3NO | 1NO | **6957ED6-__** ❹ | - |

### Magnetic Coil Suffix

Contact factory for other volts and hertz

| Coil Voltage (60Hz) | Suffix Letter | |
|---|---|---|
| | Size 0 and 1 thru 5 SP | Size 6 Only |
| 440 | A | C |
| 220 | B | B |
| 110 | C | A |

### High Temperature (65ºC Ambient) and Very Quiet (MIL-STD-740-2) Magnetic Contactors

The high temperature, very quiet magnetic contactor (HTVQ) is qualified to operate in a 65°C Ambient temperature and meets the noise limits of MIL-STD-740-2.

### Replacement Type 6957 AC Magnetic Contactors

| Size | Device Number | Catalog number ❻ |
|---|---|---|
| Relay | N841 | **6957ED24** |
| 1 | N892 | **6957ED27** |
| 1 | N893 | **6957ED28** |
| Timer | N867 | **6957ED35** |

❶Add or insert Magnet Coil Suffix letter from table at left. Examples: 6957ED58-1A. 6957ED58-1AQ.
❷"Quiet" devices are qualified to MIL-STD-740B.
❸One pole has half rating.
❹Contactor factory mounted to a plywood panel. Latching relay not included.
❺No-NC auxiliary contacts in the same cavity (adjacent to each other) must be wired with the same voltage and polarity.
❻These are replacement devices only. Obtain complete Part Number from existing controller bill of material.

# Type 6957
# AC Magnetic Pneumatic Timing Relay – N907

## When ordering specify
- Catalog number

## General
The relay must be adjusted to provide timing in the range of 0.05 seconds to three minutes.

Minimum time between successive operations – 0.2 seconds – Specification – DTL-2212-H.

## AC Pneumatic Timing Relay

| Type | Contacts | | Catalog No. ❶ | Suffix Letter | |
|---|---|---|---|---|---|
| | Main | Timing | | 440V 60Hz | 110V 60Hz |
| Timer (ON Delay) | 1NO-1NC | Timed | **6957ED41-1** | A | B |
| | 1NO-1NC<br>1NO-1NC | Timed Inst. | **6957ED41-3**<br>**6957ED41-3** | A<br>A | B<br>B |
| | 1NO-1NC<br>2NO-2NC | Timed Inst. | **6957ED41-5**<br>**6957ED41-5** | A<br>A | B<br>B |
| Timer (OFF Delay) | 1NO-1NC | Timed | **6957ED41-2** | A | B |
| | 1NO-1NC<br>1NO-1NC | Timed Inst. | **6957ED41-4**<br>**6957ED41-4** | A<br>A | B<br>B |
| | 1NO-1NC<br>2NO-2NC | Timed Inst. | **6957ED41-6**<br>**6957ED41-6** | A<br>A | B<br>B |

❶ Complete Catalog number consists of the Basic Number, plus the Suffix Letter. Example: 6957ED41-1A.

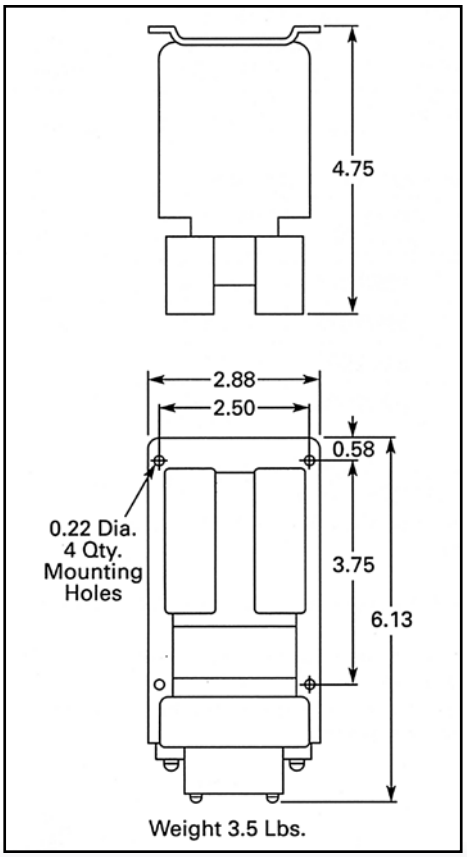
This timing relay can be supplied for either On Delay or OFF Delay timing, but is not convertible from one to the other.

**NOTE:** Solenoid plunger may move during shock and cause contacts to operate. An energized timing relay may even recycle.

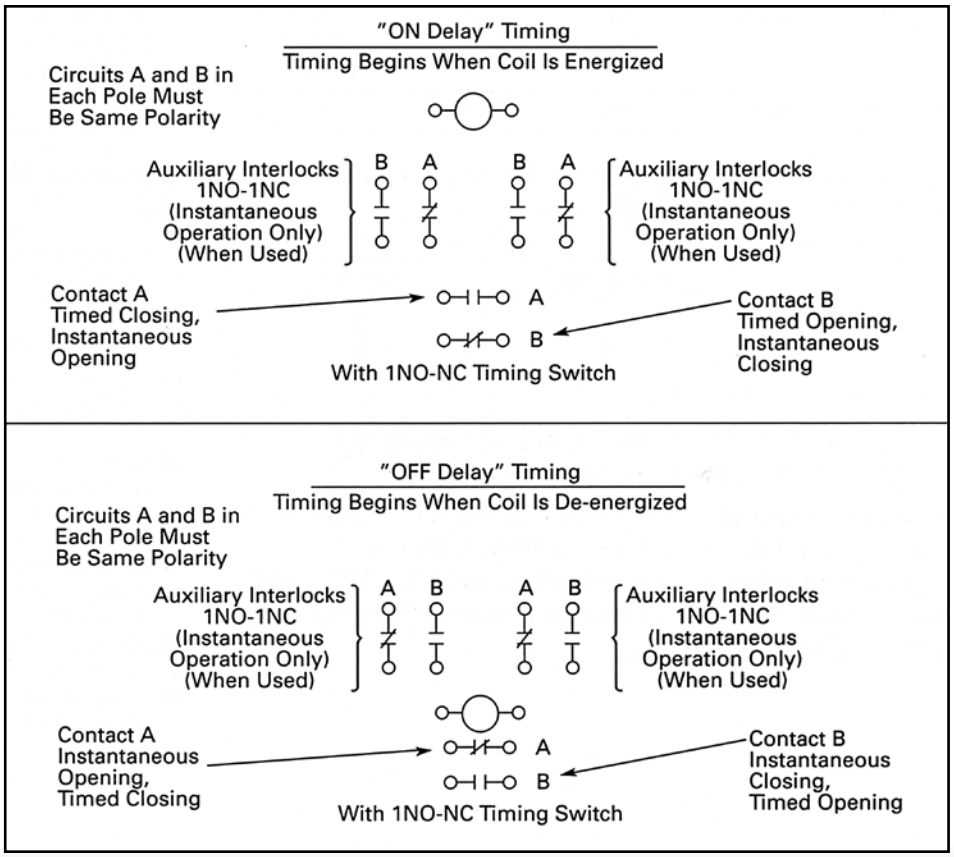
## Ampere Rating – AC Pilot Duty

| | AC Volts | |
|---|---|---|
| | 440 | 110 |
| Continuous | 15 | 15 |
| Maximum Interrupting | 6 | 15 |
| Maximum Inrush | 10 | 40 |

### Approximate Dimensions in Inches




### Connection Diagrams



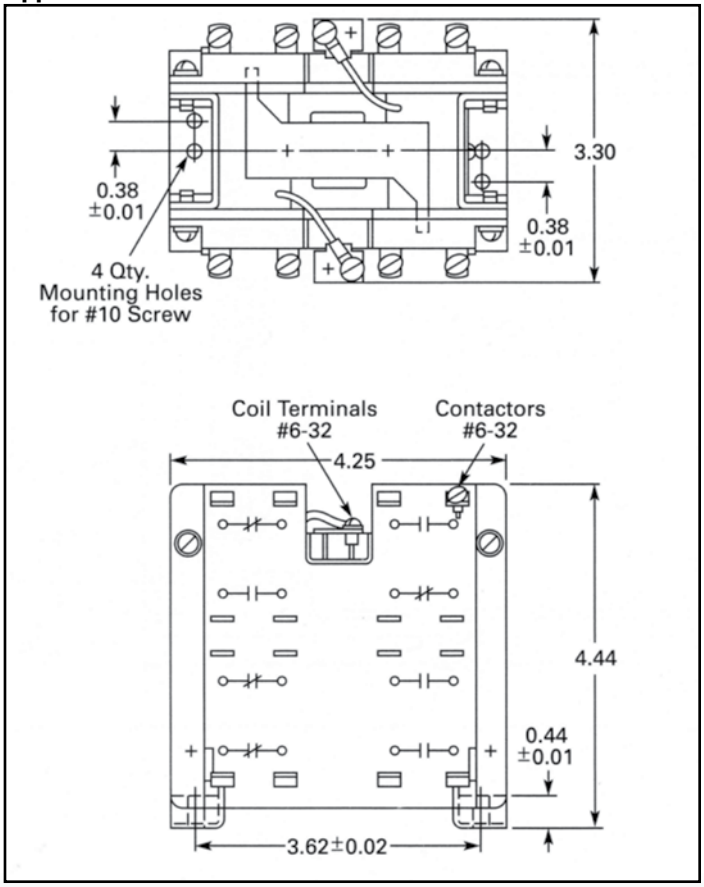
# Type 6957
# AC Multi-Pole General Purpose Relay – N1154

*6957ED59-10C*
*8-Pole*

## When ordering specify
- Catalog number

## Features
- Replaceable contacts fully rated to 440V.
- Easy installation and wiring.
- Repair part commonality with widely used Size 1 N850 device.
- Low Noise (Quiet) version available.

### Approximate Dimensions in Inches




## Specifications
- MIL-SPEC . . . . . .MIL-DTL-2212
- Number of poles . . . . . .8 maximum

### Interlock Contact

| | Amperes | | |
|---|---|---|---|
| | Make | Break | Continuous |
| 440V AC | 6 | 1 | 15 |
| 110V AC | 15 | 1 | 15 |

- Contact bounce .... 4 milliseconds – Equivalent to Class II shockproofness as defined in MIL-R-19523A
- Contact weight..... 2.4 Pounds

### Coil Data – 60 Hertz (All Devices)

| | | 440V | 110V |
|---|---|---|---|
| Inrush | Amperes<br>Watts<br>VA | 0.46<br>170<br>200 | 1.84<br>170<br>200 |
| Sealed | Amperes<br>Watts<br>VA | 0.04<br>5.4<br>17.8 | 0.16<br>5.4<br>17.8 |

### Coil Data – 60 Hertz (All Devices)

| Catalog number ❶ ❷ | Poles | |
|---|---|---|
| | NO | NC |
| **6957ED59-1** | 4 | 0 |
| **6957ED59-2** | 3 | 1 |
| **6957ED59-3** | 2 | 2 |
| **6957ED59-4** | 1 | 3 |
| **6957ED59-5** | 0 | 4 |
| **6957ED59-6** | 8 | 0 |
| **6957ED59-7** | 7 | 1 |
| **6957ED59-8** | 6 | 2 |
| **6957ED59-9** | 5 | 3 |
| **6957ED59-10** | 4 | 4 |
| **6957ED59-11** | 3 | 5 |
| **6957ED59-12** | 2 | 6 |
| **6957ED59-13** | 1 | 7 |
| **6957ED59-14** | 0 | 8 |

❶ Add Magnet coil Suffix to Part Number for appropriate coil voltage. Example: 6957ED59-2A for 440V AC coil.
❷ Add "Q" suffix to part number for "Quiet" version. Example: 6957ED59-2AQ. Quiet devices meet MIL-STD-740B.

| Suffix | Coil Voltage |
|---|---|
| **A** | 440V |
| **B** | 220V |
| **C** | 110V |

# Type 6957ED104
# Navy Electronic Overload Relay – N2000

*A more capable and upgraded product is the NEMO found on page 10.*

*N2000*

## General

The N2000 Overload Relay is a solid-state overload relay designed to protect a motor against excessive heavy loads.

The N2000 is available in five current ranges:

- Size A..... (0.25 to 18A)
- Size B ..... (9 to 32A)
- Size C..... (16 to 72A)
- Size D ..... (31 to 135A)
- Size E..... (135A and above – requires external CTs)

## Features

- Motor trip current selected by program function (no heater coils required)
- Separate trip curves available for standard, high efficiency and high inertia motors
- Phase-loss protection
- Phase-unbalance protection
- JAM protection
- Auto-rest
- Undercurrent trip
- Emergency run

## Programmability

The N2000 can be programmed with the Hand Held Programmer shown on page 52.

**Catalog number Format — N2000 Overload Relay**

**6957ED104 – A 1 A T N**

**Overload Ampere Rating**
**A** – 19 Amperes
**B** – 32 Amperes
**C** – 72 Amperes
**D** – 135 Amperes
**E** – 19 Amperes❶

**Control Voltage**
**1** – 110 Volts AC
**2** – 440 Volts AC

**Operation**
**A** – 1 Button (RESET/EMER. RUN)
**B** – 1 Button (STOP/RESET)
**C** – 2 Button (STOP – RESET/EMER. RUN)
**D** – 2 Button (START – RESET/EMER. RUN)
**E** – 2 Button (START – STOP/RESET)

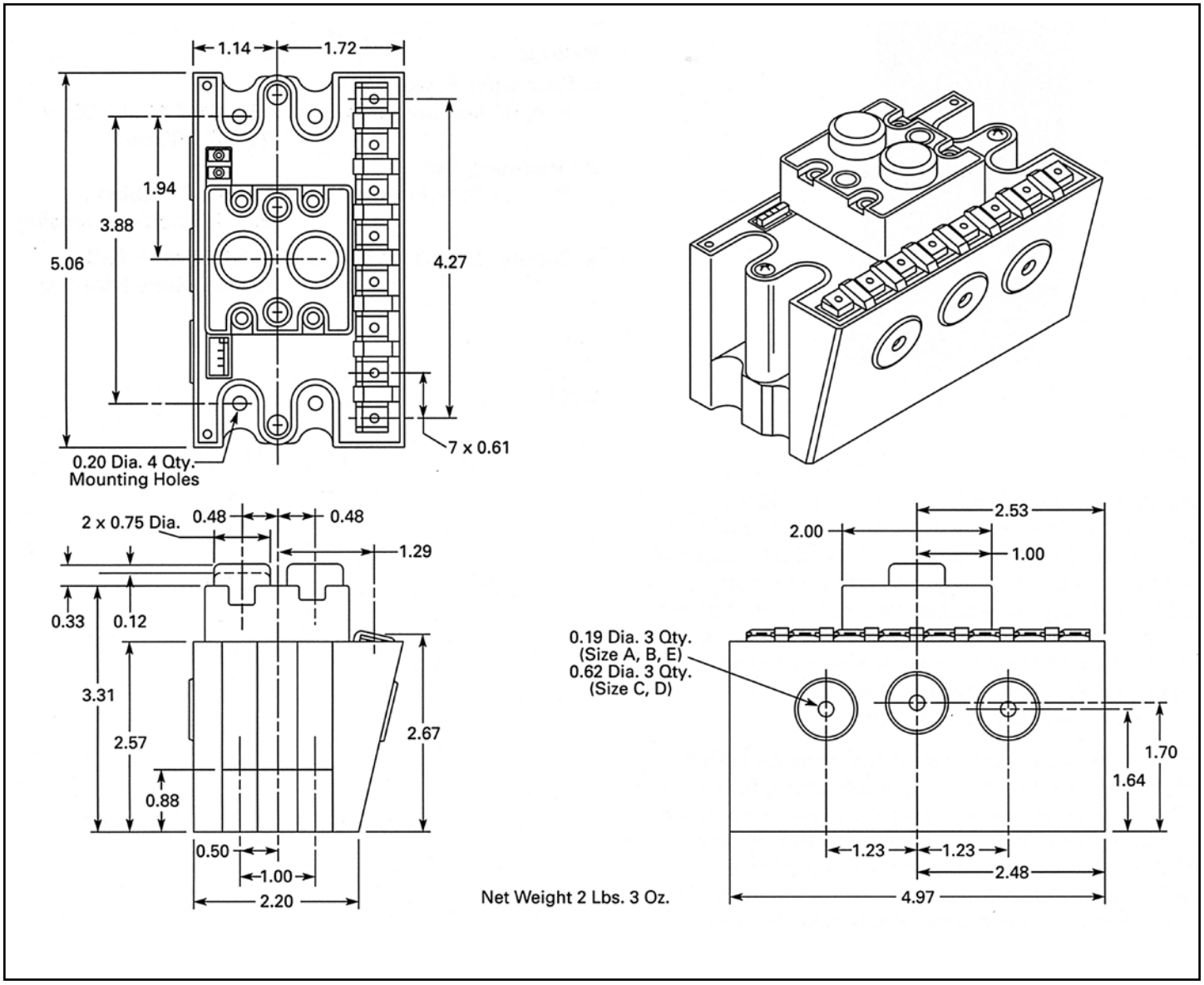
**Control Terminals**
**T** – Top (Standard)
**B** – Bottom

**N** – Non-reversing
**R** – Reversing

❶ Used with external 500:5 current transformers for Size 5 and 5S applications. NOTE: This Size E device will not drive a Size 5 or 5S coil at 110 volts. Use only with 440 volt contactor coils.

# Type 6957ED104
# Navy Electronic Overload Relay – N2000

**Approximate Dimensions in Inches**



# Type 6991ED27
# Navy Communication Module – N2001

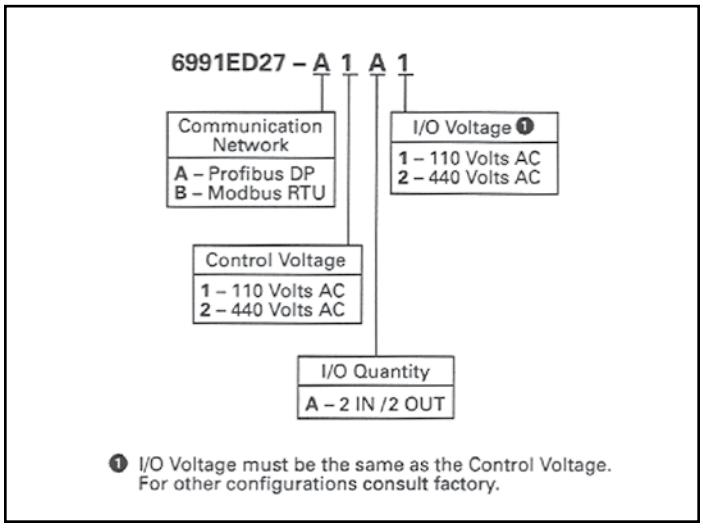
*A more capable and upgraded product is the NEMO found on page 10.*

*N2001*

## General

The N2001 Navy Communication Module (NCM) connects the N2000 Navy Electronic Overload Relay (NEOLR) to a Profibus or Modbus-RTU communication network. The NCM is designed to mount under the NEOLR on a controller panel. A receptacle on the top of the NCM connects directly into a plug on the bottom of the NEOLR. The NCM and NEOLR provide users with the ability to control and monitor the controller operation. The NCM also includes independent discrete inputs and outputs that can be monitored and controlled over the network.)

**Catalog number Format — N2001 Communication Module**




## Specifications MIL-DTL-2212H

### Ratings

- **Environmental**
  - Enclosure ..... General
  - Operating temp ..... -40°C to +50°C
  - Storage temp ..... -40°C to +80°C
  - Humidity ..... 95% non-condensing

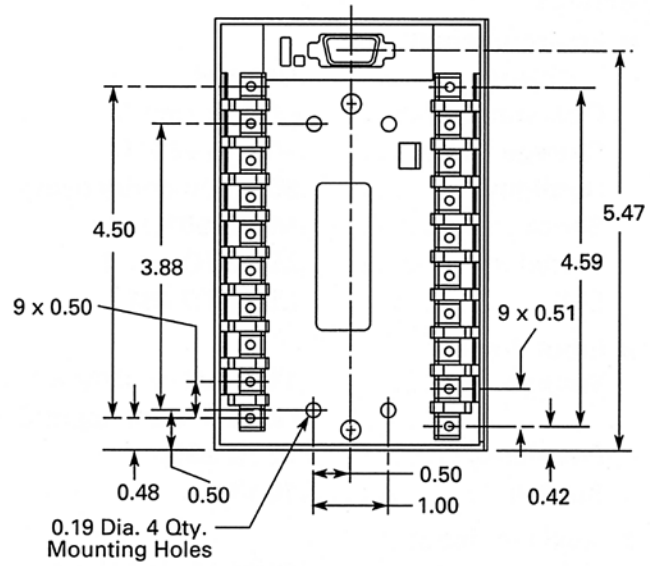
- **Input Power**
  - Voltage ..... 115V AC or 440V AC, +10% -20% (model dependent)
  - Frequency ..... 60 Hz ±3%
  - Burden ..... 10 VA

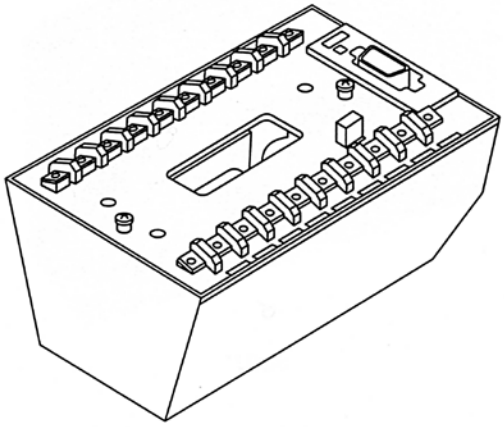
- **Auxiliary Input**
  - Voltage ..... 115V AC or 440V AC, +10% -20% (model dependent)
  - Frequency ..... 60 Hz ±3%
  - Burden ..... 2.7 mA @115V AC, 5 mA @ 440V AC
  - Turn ON delay ..... 32 milliseconds
  - Turn OFF delay ..... 32 milliseconds
  - Turn ON level ..... 92V AC minimum for 115V AC 352V AC minimum for 440V AC
  - Turn OFF level ..... 12V AC maximum for 115V AC 44V AC maximum for 440V AC
  - Withstand voltage ..... 1880V AC for 1 minute

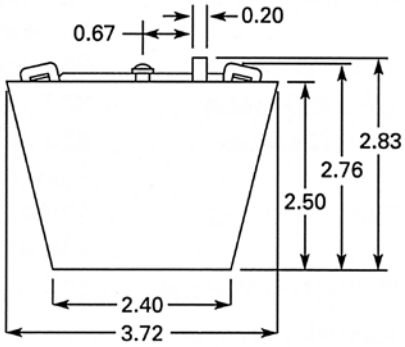
- **Auxiliary Output**
  Output circuit has two triacs in series.
  - Voltage ..... 115V AC or 440V AC, +10% -20% (model dependent)
  - Frequency ..... 60 Hz ±3%
  - Continuous rating ..... 200 mA
  - Holding current ..... 20 mA minimum
  - OFF leakage current ..... 5 mA maximum
  - Inrush ratin ..... 14A for 100 ms
  - Turn ON delay ..... 32 milliseconds
  - Turn OFF delay ..... 32 milliseconds
  - Withstand voltage ..... 1880V AC for 1 minute

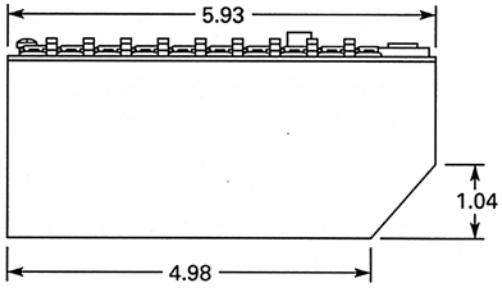
# Type 6991ED27
# Navy Communication Module

**Approximate Dimensions in Inches and Weight**






Net Weight 2 Lbs. 14 oz.

# Type N2000HHP
# N2000 Hand Held Programmer

***A more capable and upgraded product is the NEMO found on page 10. The NEMO does not require a special external programming device.***

*N2000HHP*

## General

The N2000 Hand Held Programmer (N2000HHP) is designed to facilitate the setup of any of the various styles of the N2000 Overload Relay. The N2000 Overload Relay family contains many programmable motor protection and control features. The N2000HHP is able to access and modify all of the programmable features of the N2000 Overload Relay. These features may be accessed directly via the function select keys, or indirectly by means of stored setups.

The N2000HHP supports multiple customer definable setups. In addition to the direct programming functions, the N2000HHP also supports diagnostic and monitoring functions such as start/stop and current display. The N2000HHP is designed to provide enough voltage to the N2000 Overload Relay to power its logic circuits, and to allow programming even when the N2000 Overload Relay is not energized.

## Specifications

### Ratings

- Recharger power supply requirements..... 110/220V AC, 50/60 Hz 9V DC, 300 mA
- Operating and storage temperature..... 0-50°C ambient, 90% RH non-condensing
- Battery requirements ..... 4 AA 60 mAH NiCd rechargeable batteries

# Type 6957
# AC Navy Overload Relay – N750

*6957ED14-3A*

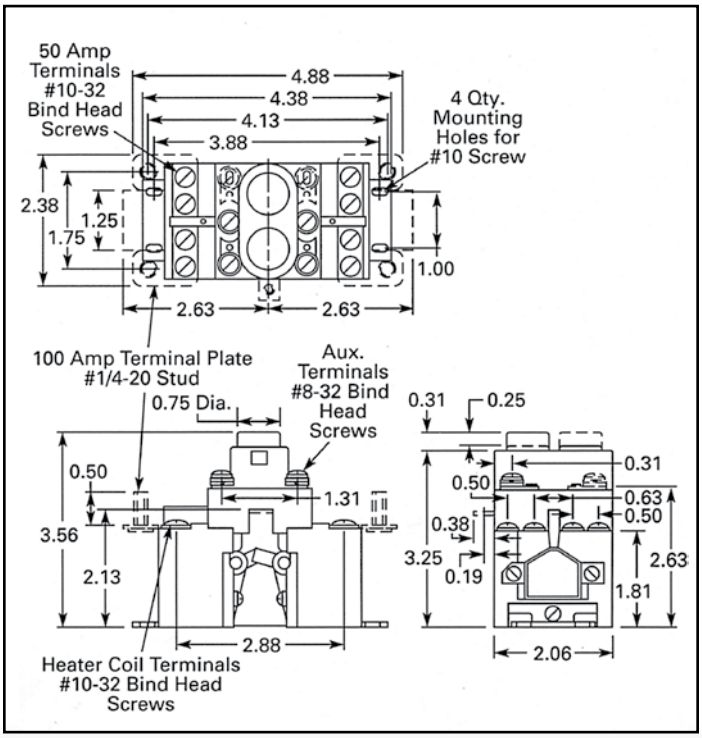
## When ordering specify

- Catalog number

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Compensation ..... Insensitive to variations in temperature – Less than 3% change in trip current for each 10°C change in ambient
- Trip Mechanism ..... Eutectic alloy
- Number of Heaters ..... 2 (phase)
- Motor Current Range .. 0.5 to 126 Amps ❷
- Relay Weigh ..... 1.0 Pounds ❸

### Approximate Dimensions in Inches




## Overload Relays

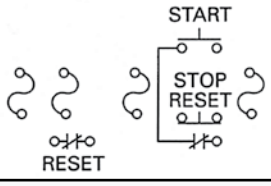
| Number of Buttons | Terminal Rating Amperes | Markings | Catalog Number |
|---|---|---|---|
| **Standard Devices** | | | |
| 1 | 50<br>100 | RESET | **6957ED14-1A**<br>**6957ED14-6A** |
| | 50<br>100 | RESET ❹ | **6957ED14-26A**<br>**6957ED14-36A** |
| | 50<br>100 | RESET ❸ | **6957ED14-24A**<br>**6957ED14-25A** |
| | 50<br>100 | STOP – RESET | **6957ED14-27A**<br>**6957ED14-34A** |
| 2 | 50<br>100 | START – STOP/RESET | **6957ED14-2A**<br>**6957ED14-7A** |
| | 50<br>100 | EM. RUN – STOP/RESET | **6957ED14-4A**<br>**6957ED14-9A** |
| | 50<br>100 | START – RESET | **6957ED14-5A**<br>**6957ED14-10A** |
| 3 | 50<br>100 | EM RUN – START – STOP/RESET | **6957ED14-3A**<br>**6957ED14-8A** |
| **With Remote (Solenoid) Reset ❶** | | | |
| 1 | 50<br>100 | RESET | **6957ED14-11_**<br>**6957ED14-16_** |
| | 50<br>100 | RESET ❸ | **6957ED14-15_**<br>**6957ED14-20_** |
| | 50<br>100 | RESET ❹ | **6957ED14-38_**<br>**6957ED14-37_** |
| 2 | 50 | START – STOP/RESET | **6957ED14-12** |
| | 50<br>100 | EM RUN – STOP/RESET | **6957ED14-14_**<br>**6957ED14-19_** |
| | 100 | START – RESET | **6957ED14-17_** |
| 3 | 50<br>100 | EM RUN – START – STOP/RESET | **6957ED14-13_**<br>**6957ED14-18_** |
| For Heater Coil selection, see Page 60. | | | |

❶ Add Suffix Letter for solenoid coil voltage.
Example: 6957ED14-19F. Contact factory for information.
❷ For current limiting reactors or current transformers, contact the factory.
❸ Device supplied with extra terminals.
❹ Device has a Form C contact alarm circuit. Consult factory for application.

### Replacement Operator Boots

| Number of Buttons | Boot Part Number |
|---|---|
| 1 | **32-17** |
| 2 | **32-251** |
| 3 | **32-20** |

### Diagram Symbols

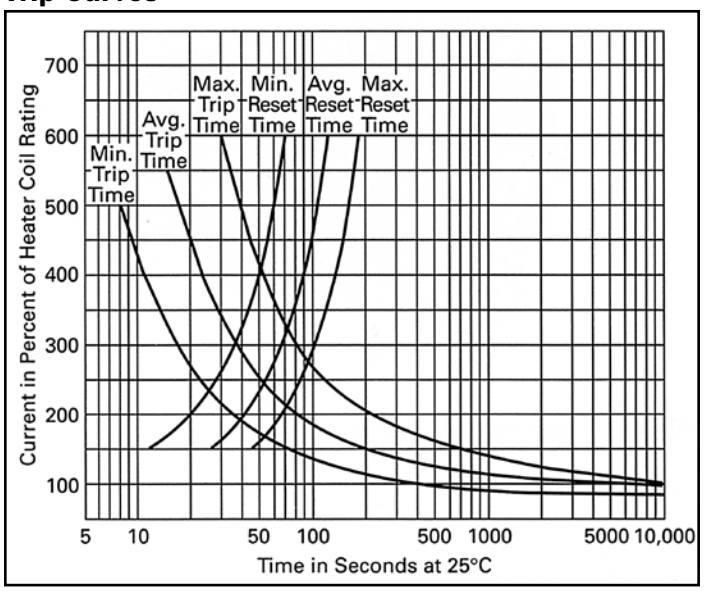


# Type 6957
# AC Navy Overload Relay – N750

## Trip Adjustability

The relay may be adjusted to trip at a value between 90 and 110 percent of the rated coil current. Loosening the binding screws that hold the relay heater coil and moving the heater coil out away from the relay will increase the value of current required to trip the relay. Moving the heater coil assembly in will decrease the value of current required to trip the relay. Serrations on the terminal plates and on the underside of the slotted brackets of the heater coil assembly securely lock the heater coil in position when the binding head screws are tightened.

## Trip Curves



# Type 9104
# AC Heater Coils

*Overload Heater Coils for N750*

*Heater Coil*

## General

The 9104 Heater Coils listed at right are for use on the following AC magnetic Starters with the N750 Overload Relay:

6262 ..... 6963
6966 ..... 6967
6968 ..... 6999

## Heater Selection

Select the Heater based on motor nameplate full load current.

Heater Coils are rated to protect 40°C motors, and open and dripproof motors having a **service factor of 1.15** where the motor and the controller are at the same Ambient temperature.

For other conditions:

A. For 50°C, 55°C, 75°C rise motors and **enclosed motors having a service factor of 1.0,** select a heater coil two sizes smaller.
B. Ambient temperature of controller lower than motor by 26°C, use one size smaller heater coil.
C. Ambient temperature of controller higher than motor by 26°C, use one size larger heater coil.

Ultimate tripping current of heater is approximately 1.20 times the minimum current listed in the tables.

## For Size 1-4 Controller

| Motor Amperes ❶ | | Catalog Number ❷ | Motor Amperes ❶ | | Catalog Number ❷ | Motor Amperes ❶ | | Catalog Number ❷ |
|---|---|---|---|---|---|---|---|---|
| Min. | Max. | | Min. | Max. | | Min. | Max. | |
| 0.5 | 0.53 | **H3815** | 3.53 | 3.79 | **H3934** | 22.5 | 24.1 | **H3958** |
| 0.54 | 0.57 | **H3816** | 3.8 | 4.06 | **H3935** | 24.2 | 26.1 | **H3959** |
| 0.59 | 0.63 | **H3817** | 4.07 | 4.36 | **H3936** | 26.2 | 28.4 | **H3960** |
| 0.66 | 0.69 | **H3818** | 4.37 | 4.74 | **H3937** | 28.5 | 30.7 | **H3961** |
| 0.7 | 0.74 | **H3819** | 4.75 | 5.14 | **H3938** | 30.8 | 33.1 | **H3962** |
| 0.817 | 0.866 | **H3915** | 5.15 | 5.56 | **H3939** | 33.2 | 35.9 | **H3963** |
| 0.867 | 0.941 | **H3916** | 5.57 | 6.04 | **H3940** | 36 | 38.7 | **H3964** |
| 0.942 | 1.01 | **H3917** | 6.05 | 6.51 | **H3941** | 38.8 | 42.2 | **H3965** |
| 1.02 | 1.1 | **H3918** | 6.52 | 6.99 | **H3942** | 42.3 | 45.8 | **H3966** |
| 1.11 | 1.17 | **H3919** | 7 | 7.55 | **H3943** | 45.9 | 49.2 | **H3967** |
| 1.18 | 1.28 | **H3920** | 7.56 | 8.15 | **H3944** | 49.3 | 53 | **H3968** |
| 1.29 | 1.39 | **H3921** | 8.16 | 8.74 | **H3945** | 53.1 | 57.6 | **H3969** |
| 1.4 | 1.51 | **H3922** | 8.75 | 9.57 | **H3946** | 57.7 | 61.8 | **H3970** |
| 1.52 | 1.6 | **H3923** | 9.58 | 10.2 | **H3947** | 61.9 | 67.3 | **H3971** |
| 1.61 | 1.75 | **H3924** | 10.3 | 11.2 | **H3948** | 67.4 | 724 | **H3972** |
| 1.76 | 1.88 | **H3925** | 11.3 | 12.1 | **H3949** | 72.5 | 78.7 | **H3973** |
| 1.89 | 2.05 | **H3926** | 12.2 | 13 | **H3950** | 78.8 | 84.9 | **H3974** |
| 2.06 | 2.21 | **H3927** | 13.1 | 14 | **H3951** | 85 | 91.6 | **H4078** |
| 2.22 | 2.38 | **H3928** | 14.1 | 15.1 | **H3952** | 91.7 | 99.9 | **H4079** |
| 2.39 | 2.59 | **H3929** | 15.2 | 16.3 | **H3953** | 100 | 107 | **H4080** |
| 2.6 | 2.77 | **H3930** | 16.4 | 17.8 | **H3954** | 108 | 116 | **H4081** |
| 2.78 | 2.96 | **H3931** | 17.9 | 19.2 | **H3955** | 117 | 126 | **H4082** |
| 2.97 | 3.24 | **H3932** | 19.3 | 20.8 | **H3956** | | | |
| 3.25 | 3.52 | **H3933** | 20.9 | 224 | **H3957** | | | |

## For Controller with Current Transformers

| Size 3 and 4 For use with 30.9:1 Transformer | | | Sizes 5 and 5 SP For Use With 62:1 Transformer | | | Size 6 For use with 120:1 Transformer | | |
|---|---|---|---|---|---|---|---|---|
| Motor Amperes ❶ | | Catalog Number ❷ | Motor Amperes ❶ | | Catalog Number ❷ | Motor Amperes ❶ | | Catalog Number ❶ |
| Min. | Max. | | Min. | Max. | | Min. | Max. | |
| 53.2 | 57.1 | **H3925** | 84.3 | 91.5 | **H3922** | 227 | 246 | **H3926** |
| 57.2 | 62.1 | **H3926** | 91.6 | 97.4 | **H3923** | 247 | 265 | **H3927** |
| 62.2 | 66.9 | **H3927** | 97.5 | 105 | **H3924** | 266 | 285 | **H3928** |
| 67 | 72.2 | **H3928** | 106 | 113 | **H3925** | 286 | 311 | **H3929** |
| 72.3 | 78.4 | **H3929** | 114 | 123 | **H3926** | 312 | 332 | **H3930** |
| 78.5 | 83.1 | **H3930** | 124 | 135 | **H3927** | 333 | 355 | **H3931** |
| 83.2 | 89.1 | **H3931** | 136 | 145 | **H3928** | 356 | 389 | **H3932** |
| 89.2 | 97.4 | **H3932** | 146 | 156 | **H3929** | 390 | 422 | **H3933** |
| 97.5 | 105 | **H3933** | 157 | 167 | **H3930** | 423 | 455 | **H3934** |
| 106 | 113 | **H3934** | 168 | 177 | **H3931** | 456 | 487 | **H3935** |
| 114 | 121 | **H3935** | 178 | 193 | **H3932** | 488 | 523 | **H3936** |
| 122 | 130 | **H3936** | 194 | 203 | **H3933** | 524 | 569 | **H3937** |
| 131 | 141 | **H3937** | 204 | 223 | **H3934** | | | |
| 142 | 153 | **H3938** | 224 | 240 | **H3935** | | | |
| | | | 241 | 257 | **H3936** | | | |
| | | | 258 | 279 | **H3937** | | | |
| | | | 280 | 303 | **H3938** | | | |
| | | | 304 | 328 | **H3939** | | | |
| | | | 329 | 362 | **H3940** | | | |
| | | | 363 | 390 | **H3941** | | | |
| | | | 391 | 419 | **H3942** | | | |
| | | | 420 | 453 | **H3943** | | | |

❶ Based on relay inside a controller and all in a 50°C ambient.
❶ Catalog number must have a 9104 prefix to be complete. Example: 9104H3945. Each catalog Number above covers one heater coil only. Two are required for a three-phase application.

# Type 6957
# Reactor Coils for AC Navy Overload Relay – N750

## General

The N750 overload relay with parallel reactor is intended to provide a slower time response to motor inrush currents than the standard N750 overload. This is done to eliminate nuisance overload tripping during long duration motor acceleration currents as required by a particular mechanical system.

The underlying principle states that as a reactor becomes saturated, its inductive impedance becomes very small in comparison to the heater coil impedance and consequently the reactor will handle the largest part of the inrush current, avoiding premature tripping. As the inrush current subsides to normal full load and the reactor comes out of saturation, the reactor impedance increases to become very large in comparison to the heater coil impedance. The heater coil then carries most of the full load current and standard overload protection is then provided. Each specific heater coil has its own matching reactor that will provide the time delay required.

- Contact factory for application guidance.
- When reactors are used, two are required for each N750 overload relay.

## Heater and Reactor Coils

| Motor Amperes | | Heater Coil Number | Reactor Coil Number |
|---|---|---|---|
| Min. | Max. | | |
| 0.817 | 0.866 | **9104H3915** | **9-1584-1** |
| 0.867 | 0.941 | **9104H3916** | **9-1584-2** |
| 0.942 | 1.01 | **9104H3917** | **9-1584-3** |
| 1.02 | 1.1 | **9104H3918** | **9-1584-4** |
| 1.11 | 1.17 | **9104H3919** | **9-1584-4** |
| 1.18 | 1.28 | **9104H3920** | **9-1584-4** |
| 1.29 | 1.39 | **9104H3921** | **9-1584-5** |
| 1.4 | 1.51 | **9104H3922** | **9-1584-5** |
| 1.52 | 1.6 | **9104H3923** | **9-1584-6** |
| 1.61 | 1.75 | **9104H3924** | **9-1584-7** |
| 1.76 | 1.88 | **9104H3925** | **9-1584-8** |
| 1.89 | 2.05 | **9104H3926** | **9-1584-9** |
| 2.06 | 2.21 | **9104H3927** | **9-1584-9** |
| 2.22 | 2.38 | **9104H3928** | **9-1584-10** |
| 2.39 | 2.59 | **9104H3929** | **9-1584-10** |
| 2.6 | 2.77 | **9104H3930** | **9-1584-11** |
| 2.78 | 2.96 | **9104H3931** | **9-1584-12** |
| 2.97 | 3.24 | **9104H3932** | **9-1584-12** |
| 3.25 | 3.52 | **9104H3933** | **9-1584-13** |
| 3.53 | 3.79 | **9104H3934** | **9-1584-14** |
| 3.8 | 4.06 | **9104H3935** | **9-1584-14** |

| Motor Amperes | | Heater Coil Number | Reactor Coil Number |
|---|---|---|---|
| Min. | Max. | | |
| 4.07 | 4.36 | **9104H3936** | **9-1584-14** |
| 4.37 | 4.74 | **9104H3937** | **9-1584-15** |
| 4.75 | 5.14 | **9104H3938** | **9-1584-15** |
| 5.15 | 5.56 | **9104H3939** | **9-1584-16** |
| 5.57 | 6.04 | **9104H3940** | **9-1584-17** |
| 6.05 | 6.51 | **9104H3941** | **9-1584-17** |
| 6.52 | 6.99 | **9104H3942** | **9-1584-17** |
| 7 | 7.55 | **9104H3943** | **9-1584-18** |
| 7.56 | 8.15 | **9104H3944** | **9-1584-19** |
| 8.16 | 8.74 | **9104H3945** | **9-1584-19** |
| 8.75 | 9.57 | **9104H3946** | **9-1584-20** |
| 9.58 | 10.2 | **9104H3947** | **9-1584-21** |
| 10.3 | 11.2 | **9104H3948** | **9-1584-21** |
| 11.3 | 12.1 | **9104H3949** | **9-1584-22** |
| 12.2 | 13 | **9104H3950** | **9-1584-22** |
| 13.1 | 14 | **9104H3951** | **9-1584-23** |
| 14.1 | 15.1 | **9104H3952** | **9-1584-23** |
| 15.2 | 16.3 | **9104H3953** | **9-1584-23** |
| 16.4 | 17.8 | **9104H3954** | **9-1584-24** |
| 17.9 | 19.2 | **9104H3955** | **9-1584-24** |
| 19.3 | 20.8 | **9104H3956** | **9-1584-24** |

# Type 6956
# Size “0” Reverser Assembly

## When ordering specify
- Catalog number

## General
The Size “0” Reverser Assembly is a special purpose control panel consisting of two N1310 contactors, which are electrically and mechanically interlocked. The assembly is completely qualified to MIL-DTL-2212 and is ideally suited for reversing applications that have severe space limitations.

| Size | Catalog number | Suffix Letter | | |
|---|---|---|---|---|
| | | 440V | 220V | 110V |
| 0 | **6956ED464-1** | A | B | C |

## Electrical Data (Enclosed)

| | N1310 |
|---|---|
| Number of Poles<br>Ampere Rating – Enclosed<br>Horsepower Rating – 440V, 3-Phase, 60 Hz | 3<br>18<br>5 |
| Maximum Break – Amperes at 484V, 40% PF<br>No. of Interlocks – Hi Shock NO<br>NC ❶ | 108<br>1<br>1 |

### Interlock Contact

| | Amperes | | |
|---|---|---|---|
| | Make | Break | Continuous |
| 440V AC | 6 | 1 | 15 |
| 110V AC | 15 | 1 | 15 |

### Coil Data – 60 Hertz (All Devices)

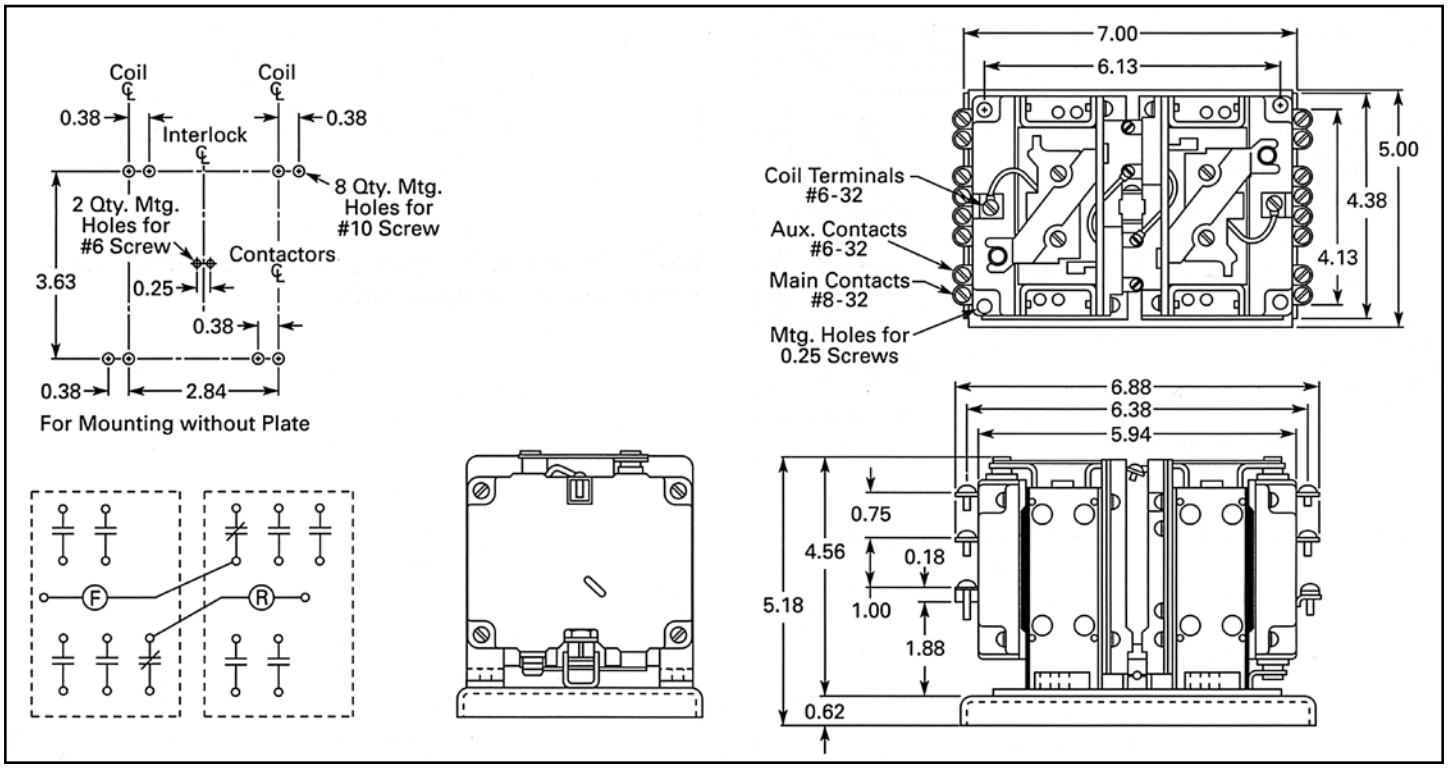
| | | 440V | 110V |
|---|---|---|---|
| Inrush | Amperes<br>Watts<br>VA | 0.46<br>170<br>200 | 1.84<br>170<br>200 |
| Sealed | Amperes<br>Watts<br>VA | 0.04<br>5.4<br>17.8 | 0.16<br>5.4<br>17.8 |

❶ This NC contact is factory wired for electrical interlocking. It cannot be used in other circuits.

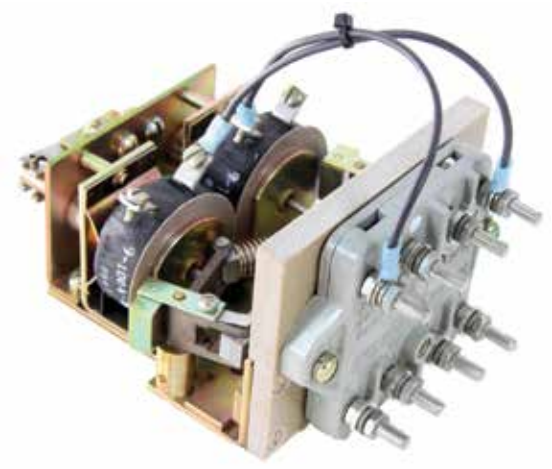
## Reverser Weight

| | N1310 |
|---|---|
| Pounds | 7 |

### Approximate Dimensions in Inches



# Type 6957
# AC Magnetic Latch Relay – N639



*6957ED12-5B*

## General

The contact setting on this relay is retained or latched with a two-position toggle mechanism. No permanent latching magnets are used.

The set of contacts marked “A” are designed for control of the coil circuits and is not adaptable for other circuits. The set of contacts marked “B” are available for control of external circuits.

The coils are energized momentarily to position the switch and are de-energized by the opening of the corresponding “A” contacts on the switch.

## When ordering specify

• Catalog number

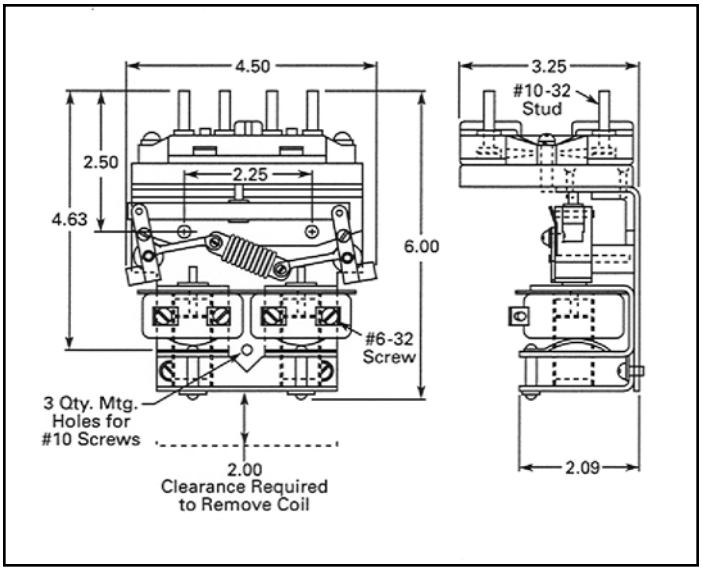
| Type | Contacts | Catalog number ❶ | Suffix Letter | |
|---|---|---|---|---|
| | | | 440V 60 Hz | 110V 60 Hz |
| Latch | 1NO-1NC | **6957ED12-5** | B | C |

❶ Complete Catalog number consists of the Basic Number, plus the suffix.
Example: 6957ED12-5B.
Weight: 2 Lbs.
QPL Test reference: NY 4456-A-39A

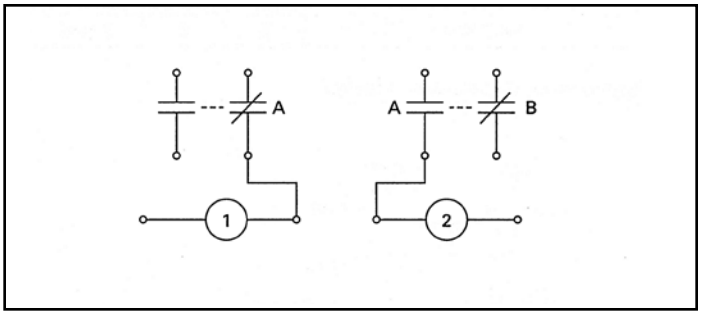
### Ampere Rating AC Pilot Duty

| | AC Volts | |
|---|---|---|
| | 440V 60 Hz | 110V 60 Hz |
| Continuous | 15 | 15 |
| Maximum Interrupting | 6 | 15 |
| Maximum Inrush | 10 | 40 |

### Approximate Dimensions in Inches




### Typical Wiring Diagram




**NOTE:** In each A-B contact pair, the contacts must be wired with the same polarity.

# Type 6922
# DC Manual Across-the-Line Starter

*Starter in watertight enclosure*

## When ordering specify

- Catalog number
- Horsepower
- Voltage
- Full load motor current
- Motor inrush current
- Type of motor with which starter is to be used
- Application

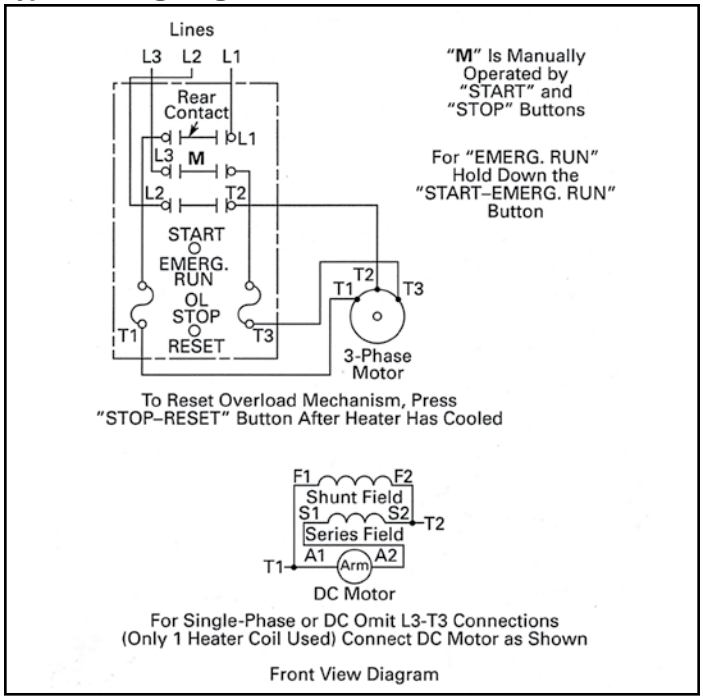
## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Dripproof or watertight
- Operation ..... Manual
- Type ..... Across-the-line
- Function ..... Motor starting
- Duty ..... Continuous
- Protection ..... Low voltage release effect
- Overload protection Thermal type relay
- Compensation ..... Change in rating does not exceed 5% for each 10°C change in ambient between 20°C and 70°C
- Adjustability ..... Adjustable from 90 to 110% of relay rating
- Type of reset..... Hand from STOP button
- Performance ..... Manual
- Ambient temp ..... 50°C
- Insulation ..... Class B
- Emergency Run..... By holding START button depressed

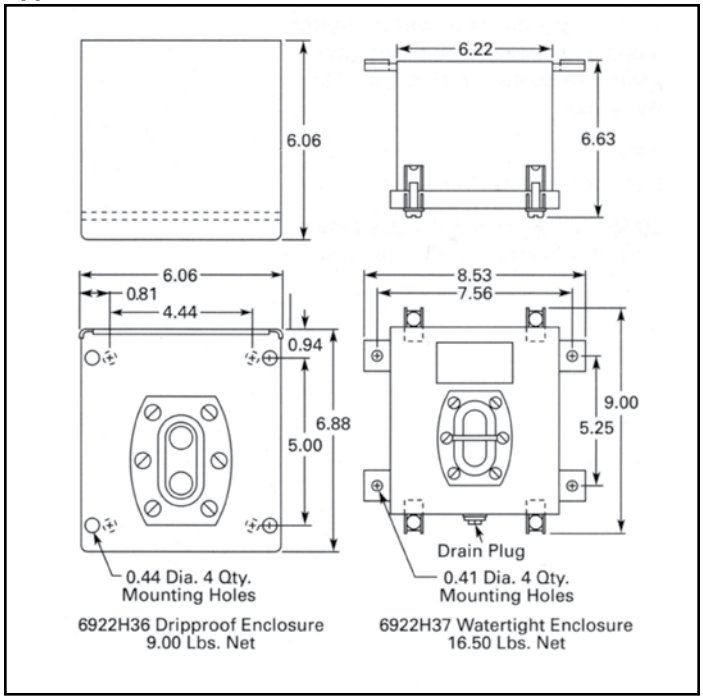
| Max. hp | Starter | | | |
|---|---|---|---|---|
| 115V or 230V DC | Dripproof | | Watertight | |
| | Cat. No. | Lbs. Net | Cat. No. | Lbs. Net |
| ½ | **6922H36B** | 9.5 | **6922H37D** | 16.5 |

Select heaters from table on Page 60.

### Typical Wiring Diagram




### Approximate Dimensions in Inches



# DC Manual Across-the-Line Starter Overload Heater Coil Selection

## General

The 9104 Heater Coils listed at right are for use on Type 6922 Manual Starters.

## Heater Selection

Select Heater Coils based on motor nameplate full load current.

Heater coils are rated to protect 40°C motors. Open and dripproof motors have a **service factor of 1.15** where the motor and the controller are at the same Ambient temperature.

For other conditions:

A. For 50°C, 55°C, 75°C rise motors and **enclosed motors having a service factor of 1.0, select a heater coil two sizes smaller.**

B. Ambient temperature of controller lower than the motor by 26°C, use one size smaller heater coil.

C. Ambient temperature of controller higher than the motor by 26°C, use on size larger coil.

Ultimate tripping current of heater is approximately 1.20 times the minimum current rating listed in the tables.

**NOTE:** There are some coils that require minimum order quantity.

| Motor Amperes ❶ | | Catalog number | Motor Amperes ❶ | | Catalog number |
|---|---|---|---|---|---|
| Min. | Max. | | Min. | Max | |
| 0.32 | 0.343 | **9104H3812** | 3.01 | 3.23 | **9104H3771** |
| 0.344 | 0.37 | **9104H3813** | 3.24 | 3.55 | **9104H3772** |
| 0.371 | 0.397 | **9104H3814** | 3.56 | 3.83 | **9104H3773** |
| 0.398 | 0.424 | **9104H3815** | 3.84 | 4.16 | **9104H3774** |
| 0.425 | 0.461 | **9104H3816** | 4.17 | 4.5 | **9104H3775** |
| 0.462 | 0.5 | **9104H3817** | 4.51 | 4.94 | **9104H3776** |
| 0.501 | 0.54 | **9104H3818** | 4.95 | 5.29 | **9104H3777** |
| 0.541 | 0.583 | **9104H3819** | 5.3 | 5.79 | **9104H3778** |
| 0.584 | 0.629 | **9104H3820** | 5.8 | 6.25 | **9104H3779** |
| 0.63 | 0.671 | **9104H3821** | 6.26 | 6.79 | **9104H3780** |
| 0.672 | 0.73 | **9104H3822** | 6.8 | 7.29 | **9104H3781** |
| 0.731 | 0.789 | **9104H3823** | 7.3 | 7.99 | **9104H3782** |
| 0.79 | 0.859 | **9104H3754** | 8 | 8.74 | **9104H3783** |
| 0.86 | 0.917 | **9104H3755** | 8.75 | 9.59 | **9104H3784** |
| 0.918 | 1 | **9104H3756** | 9.6 | 10.4 | **9104H3785** |
| 1.01 | 1.07 | **9104H3757** | 10.5 | 11.3 | **9104H3786** |
| 1.08 | 1.15 | **9104H3758** | 11.4 | 12.2 | **9104H3787** |
| 1.16 | 1.26 | **9104H3759** | 12.3 | 13.2 | **9104H3788** |
| 1.27 | 1.35 | **9104H3760** | 13.3 | 14.3 | **9104H3789** |
| 1.36 | 1.46 | **9104H3761** | 14.4 | 15.3 | **9104H3790** |
| 1.47 | 1.57 | **9104H3762** | 15.4 | 16.3 | **9104H3791** ❷ |
| 1.58 | 1.68 | **9104H3763** | 16.4 | 17.9 | **9104H3792** ❷ |
| 1.69 | 1.82 | **9104H3764** | 18 | 19.2 | **9104H3793** ❷ |
| 1.83 | 1.96 | **9104H3765** | 19.3 | 20.7 | **9104H3794** ❷ |
| 1.97 | 2.16 | **9104H3766** | 20.8 | 22.1 | **9104H3795** ❷ |
| 2.17 | 2.31 | **9104H3767** | 22.2 | 24 | **9104H3796** ❷ |
| 2.32 | 2.53 | **9104H3768** | 24.1 | 26.3 | **9104H3797** ❷ |
| 2.54 | 2.74 | **9104H3769** | 26.4 | 28.8 | **9104H3798** ❷ |
| 2.75 | 3 | **9104H3770** | | | |

❶ Based on starter in a maximum 50°C ambient.
❷ These coils are quantity sensitive and have minimum order size of five (5) pieces.

# Type 6942
# Engineered DC Magnetic Control

## When ordering specify

- Type number
- Specifications applying
- Voltage
- Horsepower rating
- Full load motor current
- Local or remote master switch
- Scheme of operation (LVP or LVR)
- Semi-automatic or automatic operation
- For adjustable speed motor - speed range by field control, shunt field resistance, field current at weakened field speed, and horsepower rating at full speed
- Application - nature of load, Example: fan, MG set
- Any special contract requirements involving operation, construction, plans, packing, etc.
- Shockproofness

## Specifications

- MIL-SPEC ..... MIL-C-2212
- Enclosure ..... Dripproof; for watertight enclosed controllers, contact factory
- Operation ..... Magnetic
- Type ..... Sizes 1 to 7 – Resistor
- Function -
- Non-reversing type.... Motor starting; motor starting and speed regulation by field control
- Reversing type ..... Refer to factory
- Duty ..... Continuous
- Protection..... Low voltage protection and low voltage release types
- Shockproofness..... Timer is mechanically shockproof only.
- Overload Protection.. Thermal or magnetic (based on application)
- Performance ..... Non-automatic or automatic (depending upon type of master switch used)

Standard controller design will permit accelerating timer and contactors to recycle under shock. To eliminate recycling (if system prohibits this), additional components and circuitry will be required. Refer to factory for pricing with complete details.

- Ambient temp ..... 50°C
- Insulation ..... Class B, except for contactor coils Class A

| Size | Maximum Horsepower 230V | Number of Accelerators | Dimension References ❶ |
|---|---|---|---|
| 1 | 5 | 1 | A |
| 2 | 10 | 1 | B |
| 3 | 25 | 2 | C |
| 4 | 40 | 2 | D |
| 5 | 75 | 2 | E |
| 6 | 150 | 3 | F |

### Approximate Dimensions in Inches and Weights

| Dimension Reference Letter ❷ | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | Wide | High | Deep | |
| A | 16 | 22 | 10 | 80 |
| B | 18 | 24 | 10 | 100 |
| C | 18 | 26 | 12 | 125 |
| D | 24 | 32 | 13 | 200 |
| E | 34 | 50 | 17 | 500 |
| F | Contact Factory | | | |

❶ See Approximate Dimensions and Weights table.
❷ From Specifications table above.

# Type 6942
# Engineered DC Magnetic Control

**Adding Features / Modifying / Sample Circuit Diagrams**

## Optional Features

| 1. Relays – | Added Weight |
|---|---|
| Field failure | 8 lbs. |
| Series (for current limit acceleration) (N175) | 8 lbs. |
| Control (N617) | 7 lbs. |
| Timer, N907 – DC (for timed acceleration) | 4 lbs. |
| Accelerator, size 2 | 7 lbs. |
| Accelerator, size 4 | 8 lbs. |
| Overload Relay, N709 (Magnetic) | |
| Overload Relay, N750 (up to 126 Amperes)❶ | 4 lbs.<br>1 lb. |

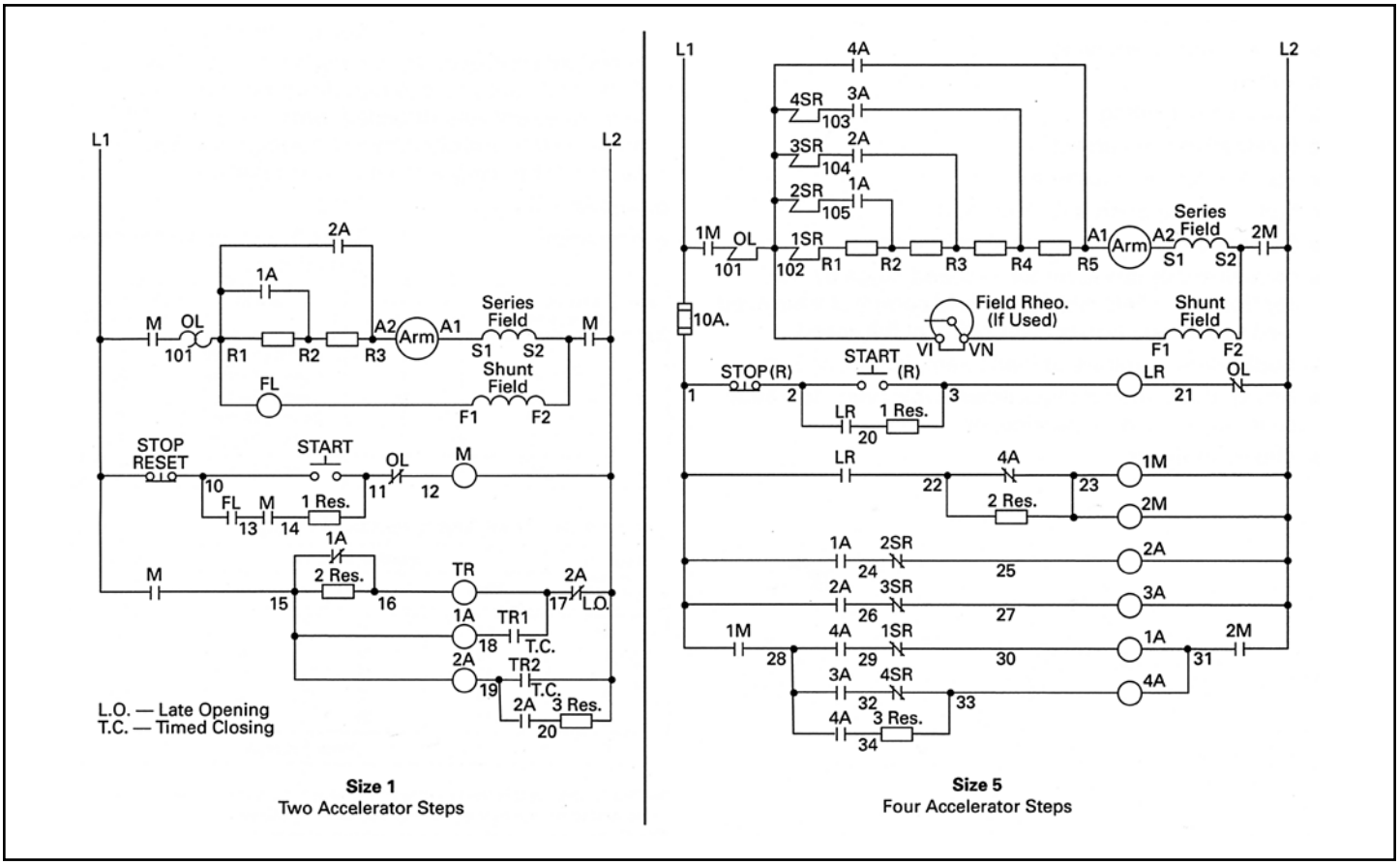
| 2. Pilot Devices – | Added Weight |
|---|---|
| Momentary Pushbutton | 5 oz. |
| Indicator Light (includes resistors) | 24 oz. |
| Selector Switch | 8 oz. |
| Rotary Switches – 4 finger | 12 oz. |
| 7 finger | 24 oz. |

**3. Other Additions –**

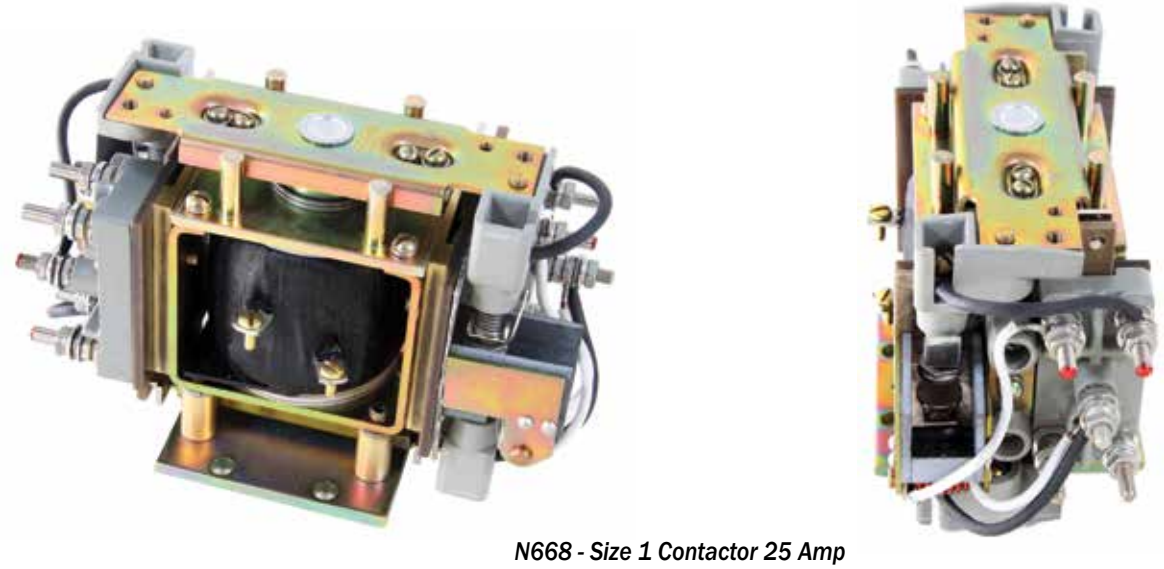
| | |
|---|---|
| Additional Control Circuit Fuse | 8 oz. |
| Wired Interlock | 8 oz. |
| Anti-Condensate Heaters | |
| Size 1, 2 | – |
| Size 3, 4 | – |
| Size 5 | – |
| Size 6 | – |

❶ The N750 Overload Relay requires one Heater Coil for DC operation. Use the Controller, Size 1-4, table on Page 60 for Heater Coil selection.

**Sample Circuit Diagrams**



# Type 6938
# DC Magnetic Contactors and Relays



*N668 - Size 1 Contactor 25 Amp*

## When ordering specify❶

- Base catalog number
- Application
- Contact amperes
- Blow-out coil amperes❷
- Coil voltage
- Auxiliary contact needs
- Thickness of mounting panel, if appropriate❸

- Example: 6938ED20, 75 Amp contacts,
  75 Amp blow-out coil,
  230V DC operating coil,
  1NO-1NC auxiliary contact,
  0.75 inch thick mounting panel.

❶ Refer to selection table on **Page 64**.
❷ A blow-out coil is required to minimize arcing on DC power contactors. To work properly, they must be sized correctly.
❸ Melamine mounted contactors are shipped mounted to a plywood base of the stated thickness. This configures the parts in a correct relationship and provides mounting hardware of the proper length for your application.

## Specifications

- MIL-SPEC ..... MIL-C-2212
- Operation ..... Magnetic
- Ambient temp ..... 50°C
- Insulation ..... Class B, except coils, Class A
- Mounting ..... Designed and shipped for mounting to a melamine panel if appropriate. Standard thickness is 0.63 inch, other thicknesses are available. Some devices can mount directly to a steel panel. **See Page 64**, Dimension Reference Table.

# Type 6938
# DC Magnetic Contactors and Relays

### Contactors - Include Blow-Out Coils

| Size | Device Number | Main Contacts | | Available ❶ Aux. Contacts | Available Coil Voltage (DC) | Base Catalog❷❸ Number | Dim. Ref. |
|---|---|---|---|---|---|---|---|
| | | Rating | Poles | | | | |
| 1 | N668 | 25A | 2NO | 1NO-1NC | 115, 230, 250 | **6938ED18** | A |
| 2 | N669 | 50A | 2NO | 2NO-2NC | 115, 230, 250 | **6938ED19** | B |
| 3 | N700 | 100A | 2NO | 2NO-2NC | 115, 230, 250 | **6938ED20** | C |
| 4 | N701 | 150A | 2NO | 2NO-2NC | 115, 230, 250 | **6938ED21** | D |
| 5 | N542 ❹ | 300A | 1NO | 1NO-1NC | 115, 230, 250 | **6938ED7** | E |
| 6 | N545 ❹ | 600A | 1NO | 2NO-1NC | 115, 230, 250 | **6938ED8** | F |
| - | N546 ❹ | 1200A | 1NO | 1NO | 115, 230 | **6938ED9** | G |

### Contactors - No Blow-Out Coils

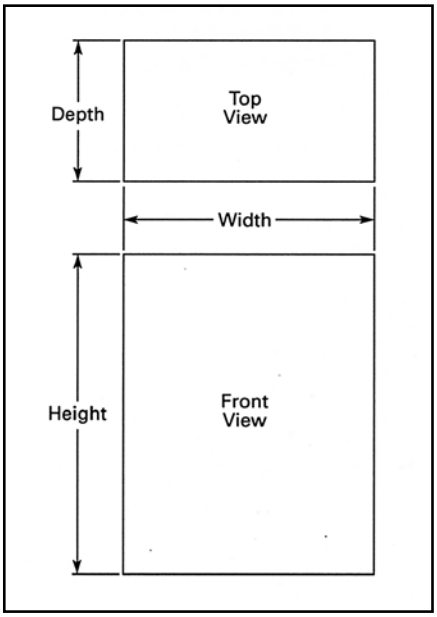
| Size | Device Number | Main Contacts | | Available ❶ Aux. Contacts | Available Coil Voltage (DC) | Base Catalog❷❸ Number | Dim. Ref. |
|---|---|---|---|---|---|---|---|
| | | Rating | Poles | | | | |
| 2 | N912 | 50A | 1NO | 1NO-1NC | 115, 230, 250 | **6938ED38** | H |
| 4 | N913 | 150A | 1NO | 1NO-1NC | 115, 230, 250 | **6938ED39** | J |

### Relays - No Blow-Out Coils

| Type | Device Number | Description | Contacts | Available Coil Voltages (DC) | Base Catalog❷❸ Number | Dim. Ref. |
|---|---|---|---|---|---|---|
| Control | N617 | Control Circuit | 4NO-4NC | 115, 230, 250 | **6938ED16** | K |
| Timer | N867 | Duplex Timer | 2NO-2NC | 115, 230, 250 | **6938ED37** | L |
| Timer | N907 | ON/OFF Delay | 1NO-1NC | 115, 230, 250 | **6938ED46** | M |
| Overload | N709 | Magnetic Operation | 1NC | 115, 230, 250 | **6938ED22** ❺ | N |
| Series | N175 | Current Sensitive | 1NC | Not Applicable | **6938ED3** | P |
| Latch ❹ | N621 | Special Purpose | 2NO-2NC | 115, 230, 250 | **6938ED17** | R |

❶ Some devices offer various auxiliary contact configurations. Data shown is maximum available.
❷ **Catalog numbers shown are not complete.** A suffix is required to identify coil voltage, auxiliary contact configuration and panel thickness. Contact factory for assistance.
❸ The Catalog number do not include economizing resistors. Contact factory for assistance.
❹ For two-pole (main contact) applications, use of N621 is required. Contact factory for assistance.
❺ Need motor full load rating.

### Approximate Dimensions in Inches




### Dimension Reference Table

| Ref. | Panel Space (Inches | | | Weight Lbs. | Mount to Steel Panel |
|---|---|---|---|---|---|
| | Footprint | | Depth Required | | |
| | Width | Height | | | |
| A | 4.5 | 6.5 | 4.5 | 5 | Yes |
| B | 5.5 | 6 | 6 | 10 | Yes |
| C | 7 | 8 | 6.5 | 16 | Yes |
| D | 8 | 8.5 | 7.5 | 25 | No |
| E | 7.5 | 14 | 8.5 | 28 | No |
| F | 8 | 23 | 8.5 | 42 | No |
| G | 10.5 | 12.5 | 14.5 | 137 | No |
| H | 7.5 | 11 | 5.5 | 7 | Yes |
| J | 4.5 | 12.5 | 8 | 8 | Yes |
| K | 4 | 6.5 | 6 | 7 | No |
| L | 4.5 | 7.5 | 5.5 | 8 | Yes |
| M | 4 | 6.5 | 5 | 4 | Yes |
| N | 4.5 | 9.5 | 5.5 | 4 | No |
| P | 3.8 | 4.5 | 5 | 2 | Yes |
| R | 3.8 | 6.5 | 5.8 | 7 | No |

# Type 6901
# Standard Dripproof Enclosures

*Wraparound*

*Hinged*

## General

Enclosures listed below are supplied with all panel and enclosure mounting holes pre-drilled. Other sizes and classes (e.g. Watertight, Non-magnetic, Spraytight) are available. Contact the factory for price and availability.

## Specifications

MIL-SPEC.....MIL-DTL-2212, MIL-E-2036
Class .....Dripproof
Venting.....None

## When ordering specify

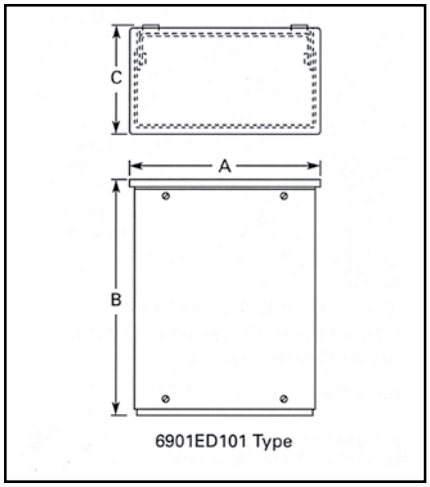
- Catalog number

### Type 6901 Dripproof Enclosures

| Enclosure Dimensions in Inches | | | | | | Interior Panel Dimensions in Inches | | | | | | Weight Lbs. | Catalog number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wide A | High B | Deep C | Mounting ❶ | | | Width | Height | Panel Mounting | | | Door to Panel | | |
| | | | D | E | Holes | | | Width | Height | Holes | | | |
| **Wraparound Cover Style ❷** | | | | | | | | | | | | | |
| 8.24 | 11.3 | 6.68 | 4.75 | 9.38 | 4 | 6.5 | 8 | 4.75 | 6 | 4 | 5.24 | 17 | **6901ED101-1A** |
| 8.24 | 15.56 | 6.68 | 4.75 | 13.62 | 4 | 6.5 | 12.25 | 4.75 | 10.25 | 6 | 5.24 | 21 | **6901ED101-2A** |
| 9.38 | 17.3 | 8.06 | 6 | 14.5 | 4 | 7.75 | 13 | 6 | 11 | 6 | 6.63 | 26 | **6901ED101-3A** |
| 11.38 | 19.8 | 8.94 | 8 | 17 | 4 | 9.75 | 15.25 | 8 | 13 | 6 | 7.45 | 35 | **6901ED101-4A** |
| 13.74 | 16.8 | 8.06 | 10.24 | 14.88 | 4 | 12 | 13.5 | 10.25 | 11.75 | 6 | 6.63 | 36 | **6901ED101-5A** |
| **Hinged Door with Diamond Latch Style** | | | | | | | | | | | | | |
| 12.12 | 18.12 | 9.76 | 8.5 | 16 | 4 | 10 | 14.5 | 8.5 | 13 | 4 | 8.12 | 33 | **6901ED102-1A** |
| 14.12 | 18.12 | 9.76 | 10.5 | 16 | 4 | 12 | 14.5 | 10.5 | 13 | 4 | 8.12 | 36 | **6901ED102-2A** |
| 14.12 | 20.12 | 9.76 | 10.5 | 18 | 4 | 12 | 16.5 | 10.5 | 15 | 6 | 8.12 | 40 | **6901ED102-3A** |
| 16.12 | 20.12 | 9.76 | 12.5 | 18 | 4 | 14 | 16.5 | 12.5 | 15 | 6 | 8.12 | 43 | **6901ED102-4A** |
| 16.12 | 22.12 | 9.76 | 12.5 | 20 | 4 | 14 | 18.5 | 12.5 | 17 | 6 | 8.12 | 47 | **6901ED102-5A** |
| 16.12 | 24.12 | 9.76 | 12.5 | 22 | 4 | 14 | 20.5 | 12.5 | 19 | 6 | 8.12 | 50 | **6901ED102-6A** |
| 18.12 | 26.12 | 9.76 | 14.5 | 24 | 6 | 16 | 22.5 | 14.5 | 21 | 9 | 8.12 | 64 | **6901ED102-7A** |
| 22.12 | 28.12 | 9.76 | 18.5 | 26 | 6 | 20 | 24.5 | 18.5 | 23 | 9 | 8.12 | 78 | **6901ED102-5A** |

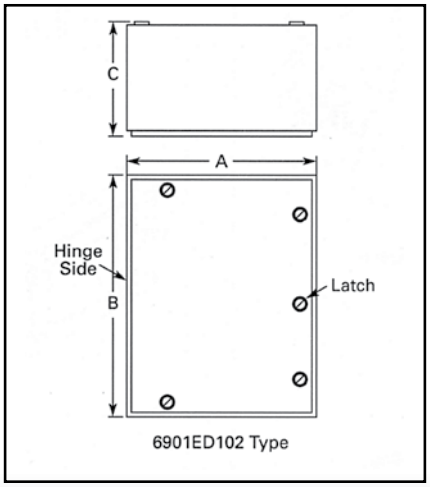
❶ Enclosures are designed for 0.50" diameter mounting bolts.
❷ Wraparound style enclosures are not suitable for cover mounted control elements.

### Wraparound Cover Style



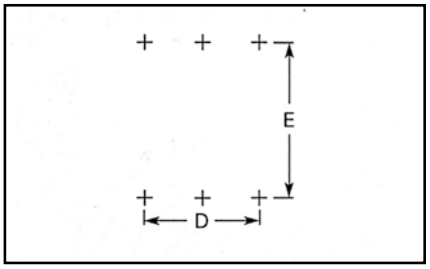

6901ED101 Type

### Hinged Door Style




6901ED102 Type

### Enclosure Mounting Reference



# Type 6981ED165 and 6981ED166
# Separate Flush Mounting Pushbuttons and Indicating Lights


## When ordering specify

**Units by catalog number** - Examples table at right
- Catalog number and complete description

**Unlisted Units** – See **Page 67**

## General

Each single element unit consists of either a contact block or an indicating light element, brackets for behind the panel mounting, and the gasket and mounting plate for the front of the panel. On the indicating light, a lens is sandwiched between the gasket and the mounting plate. Mounting hardware is supplied for panel thicknesses as shown in sketches below.

Indicating light elements are of the double lamp type. AC indicating lights have self-contained 440/1.8-1.8V or 117/1.8-1.8V transformers. Indicating light current draw is 1.6 mA @ 440V and 6.4 mA @110V. DC indicating lights require a separate series resistor for each bulb at any supply voltage above 24 volts. Resistors are not included in the price.

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B
- Enclosure ..... Open type for watertight mounting (3 ft. head – 5 min.)

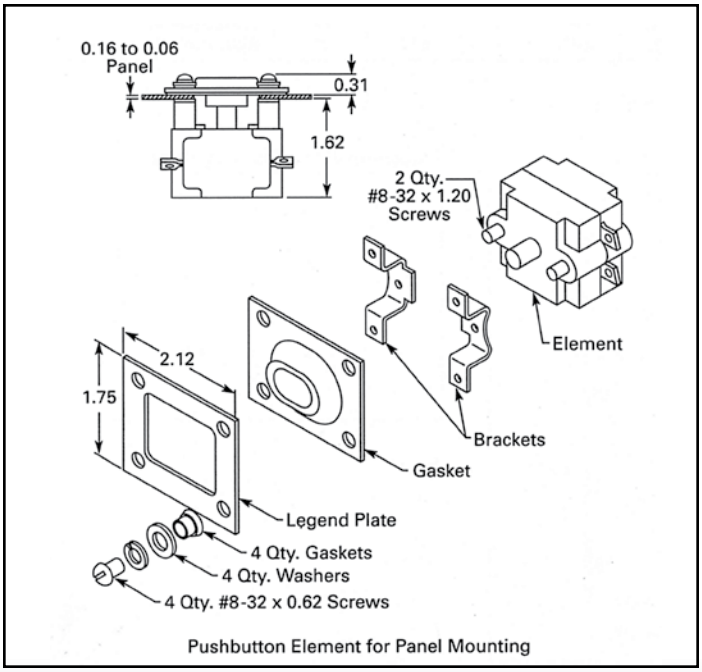
**Rating (Pushbutton)**

| Inductive Rating | AC 60 Hertz | | | DC | | |
|---|---|---|---|---|---|---|
| | 100V | 220V | 440V | 115V | 230V | 355V |
| Make | 60 | 50 | 50 | 2 | 0.75 | 0.5 |
| Break | 6 | 5 | 5 | 2 | 0.75 | 0.5 |

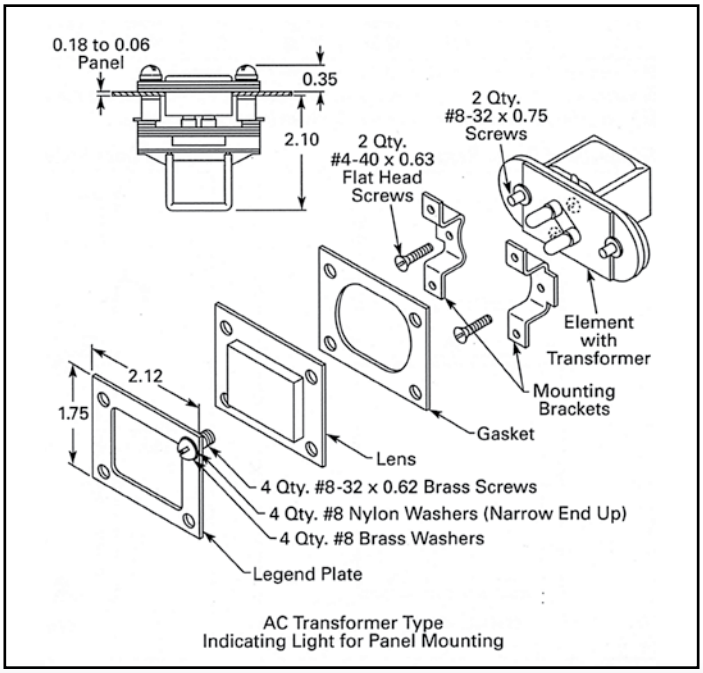
**Examples of Common Catalog numbers**
To Order by Description See **Page 67**

| Element Identification Code ❶ | Marking ❷ | Catalog number |
|---|---|---|
| **Pushbuttons** | | |
| C | FAST | **6981ED165-1** |
| C | SLOW | **6981ED165-2** |
| A | L.P. BYPASS | **6981ED165-3** |
| C | FORWARD | **6981ED165-4** |
| C | REVERSE | **6981ED165-5** |
| C | START | **6981ED165-6** |
| C | STOP | **6981ED165-7** |
| **Indicating Lights** | | |
| B1 | MOTOR RUNNING | **6981ED166-1** |
| A2 | MOTOR RUNNING | **6981ED166-2** |
| C5 | POWER ON | **6981ED166-3** |

❶ For description of Element Identification Code, see Page 67.
❷ Pushbutton legend stamped on legend plate. Indicating light legend engraved on lens.



Pushbutton Element for Panel Mounting



AC Transformer Type
Indicating Light for Panel Mounting

# Type 6981ED165 and 6981ED166
# Separate Flush Mounting Pushbuttons and Indicating Lights

## When ordering specify

**Order by complete description** –

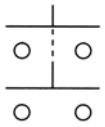
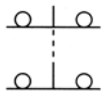
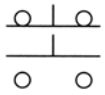
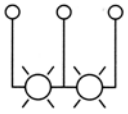
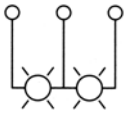
- Basic catalog number
- Element Identification Code
- Required Legend

**Example**:
6981ED166- with element B5, marked POWER AVAILABLE

## Legend Data

- Pushbutton legend may consist of one or two lines, each with a maximum of eight characters.
- Light legend may consist of one, two or three lines, each with a maximum of eight characters.
- Use of the letter "I" in a line will permit one additional character.

**Information Table for Ordering by Description**

| Basic Catalog number | Element Identification Code | | Circuit Symbol | Description | Weight – Oz. |
|---|---|---|---|---|---|
| **6981ED165-** | A | |  | Pushbutton – 2NO Contacts | 5 |
| **6981ED165-** | B | |  | Pushbutton – 2NC Contacts | 5 |
| **6981ED165-** | C | |  | Pushbutton – 1NO-1NC Contacts | 5 |
| | **Lens Color** | | | | |
| **6981ED166-** | Red | **A1** |  | Indicating Light – 115V 60Hz ❷ | 7 |
| **6981ED166-** | Green | **A2** | | | |
| **6981ED166-** | Amber | **A3** | | | |
| **6981ED166-** | Blue | **A4** | | | |
| **6981ED166-** | White | **A5** | | | |
| **6981ED166-** | Red | **B1** |  | Indicating Light – 440V 60Hz ❷ | 7 |
| **6981ED166-** | Green | **B2** | | | |
| **6981ED166-** | Amber | **B3** | | | |
| **6981ED166-** | Blue | **B4** | | | |
| **6981ED166-** | White | **B5** | | | |
| **6981ED166-** | Red | **C1** |  | Indicating Light – 24V DC ❶❸ | 4 |
| **6981ED166-** | Green | **C2** | | | |
| **6981ED166-** | Amber | **C3** | | | |
| **6981ED166-** | Blue | **C4** | | | |
| **6981ED166-** | White | **C5** | | | |
| **6981ED166-** | Red | **D1** |  | Indicating Light – 10V DC ❹ | 4 |
| **6981ED166-** | Green | **D2** | | | |
| **6981ED166-** | Amber | **D3** | | | |
| **6981ED166-** | Blue | **D4** | | | |
| **6981ED166-** | White | **D5** | | | |

❶ These are Resistor Type indicating lights. Each lamp requires the following series resistance depending on the voltage used. Resistors must be separately mounted and are not included.

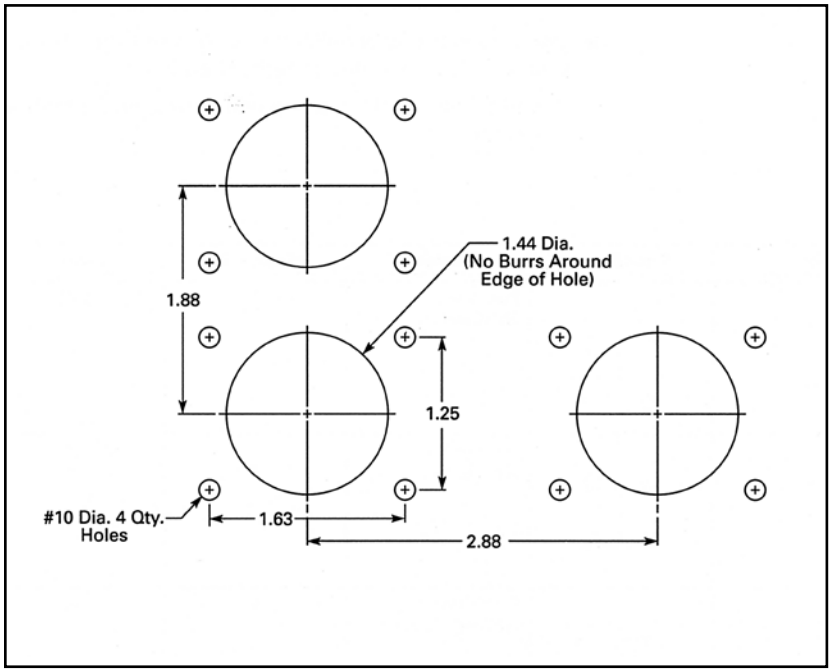
| | |
|---|---|
| 24V DC – None | 120V DC – 2800 Ohms, 5 Watts |
| 48V DC – 710 Ohms, 2 Watts | 240V DC – 6300 Ohms, 10 Watts |
| Resistor not included in above price. | 250V DC – 8000 Ohms, 10 Watts (Nominal submarine voltage 180-355V range) |

❷ Lamp type: No. 1769, T1-3/4 Midget Screw Base.
❸ Lamp type: No. 335, T1-3/4 Midget Screw Base.
❹ Lamp type: No. 373, T1-3/4 Midget Screw Base.

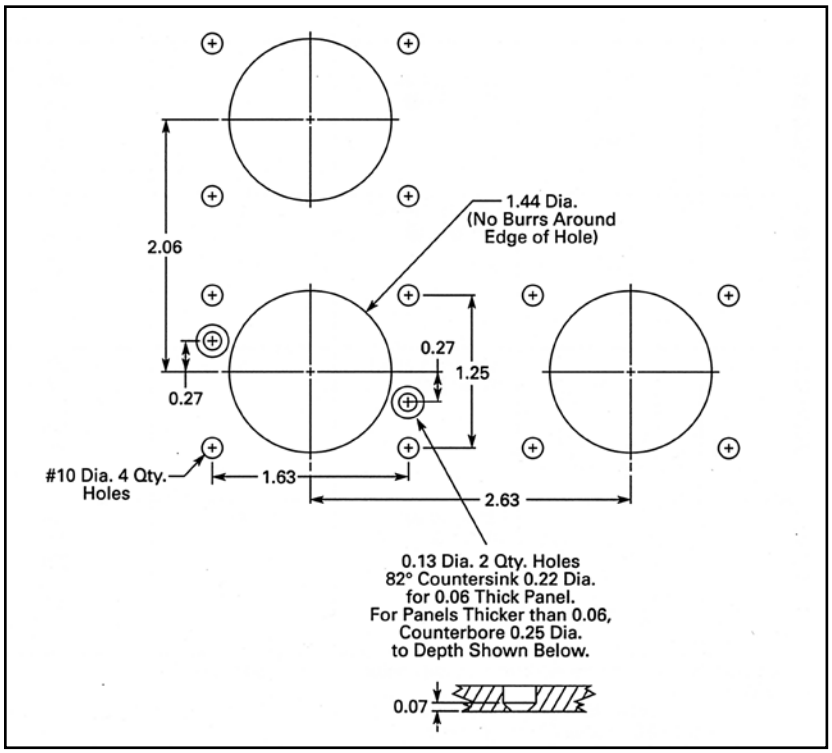
# Type 6981ED165 and 6981ED166
# Separate Flush Mounting Pushbuttons and Indicating Lights

## Drilling and Spacing Dimensions (in Inches)

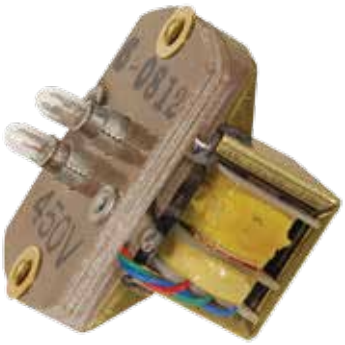
### Flush Mounting Pushbutton




### Flush Mounting Indicating Light - Front View of Door



# Replacement Indicating Light Transformers




## General

When installed in the flush mounted configuration or in a remote control station enclosure, the transformers meet the shock, vibration and temperature requirements of MIL-DTL-2212.

Lamps are included with the transformer.

| Description | Catalog number |
|---|---|
| 115V AC to 2V AC Type B-41A | **42-1091** |
| 440V AC to 2V AC Type B-41B | **42-1091-2** |
| Replacement Lamp, Midget Screw Base #1769 2.5V | **28-651** |

## Specifications

Manufactured to BUSHIPS DWG 9000 S6202 F 73919.

# Type 6981ED200
# Separate Flush Mounting Selector Switches


## When ordering specify

**Units by Catalog number** - Examples table at right

- Catalog Number

**Unlisted Units** – Order by complete description, including:

- Type number – 6981ED200
- Element Identification Code – Consists for a number from Table 1 on this page and a letter from Table 2 on **Page 71**. Example: **1A**
- Legend required
  Example: 6981ED200 switch with element 5P, marked MAN-OFF-AUTO ❷

## General

Selector switches for watertight mounting are available in two- or three-position configurations, self-centering or non self-centering.

Self-centering two-position switches may be spring return from either side to center. Three-position self-centering switches may be spring return fro m either or both sides to center.

The basic selector switch element has a maximum of 8 stationary contacts/terminals, 4 in each of two planes. Movable contacts consist of shaft mounted segments, available in several shapes to provide various circuit combinations for each of the two planes. Segments in the front and rear plane can be electrically connected by use of a jumper through the shaft assembly.

Segments can be assembled to the shaft in any of four positions at 90° displacement. Further variation is available though 45° displacement of the shaft when the starwheel is assembled to the shaft.

## Ordering Instructions for Unlisted Units

Order switch by Type Number and Element Identification from Table 1 on this page and Table 2 on **Page 71**. Select basic operating characteristics from Table 1, and circuit from Table 2. Specify legend.

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Open, for watertight mounting
- Duty ..... Continuous
- Operation ..... Manual
- Ambient temp ..... 50°C
- Insulation ..... Class B

**Rating**

| Operation | Inductive Load (Amperes) | | | | | |
|---|---|---|---|---|---|---|
| | AC 60 Hz | | | DC | | |
| | 115V | 220V | 440V | 115V | 230V | 355V |
| Make | 30 | 15 | 7.5 | 1.1 | 0.55 | 0.4 |
| Break | 3 | 1.5 | .75 | 1.1 | 0.55 | 0.4 |
| Carry | 10 | 10 | 10 | 10 | 10 | 10 |

**Examples of Some Common Catalog numbers and Their Descriptions**

| Element Identification Code | Marking | Catalog number |
|---|---|---|
| 1C | (Blank) | **6981ED200-1** |
| 1B | ON/OFF | **6981ED200-2** |
| 1C | MAN/AUTO | **6981ED200-3** |
| 1C | OPEN/CLOSE | **6981ED200-10** |
| 5P | HAND/OFF/AUTO | **6981ED200-11** |
| 1C | ON/OFF | **6981ED200-15** |
| 6E | STOP/START | **6981ED200-54** |
| 7A | HAND/OFF/AUTO | **6981ED200-63** |
| 8E | STOP/RUN/START | **6981ED200-92** |

**Table 1 –**
Selector Switch Configurations

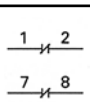
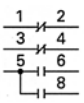
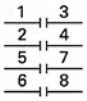
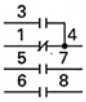
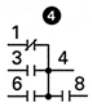
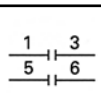
| Partial Element ❶ Identification Code ❷ | Basic Configuration | |
|---|---|---|
| | No. of Positions | Operation |
| 1 | 2 | Maintained Contact, Center and CW |
| 2 | 2 | Maintained Contact, Center and CCW |
| 3 | 2 | Spring Return from CW to Center |
| 4 | 2 | Spring Return from CCW to Center |
| 5 | 3 | Maintained Contact |
| 6 | 3 | Spring Return from CW & CCW to Center |
| 7 | 3 | Spring Return from CCW to Center |
| 8 | 3 | Spring Return from CW to Center |

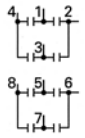
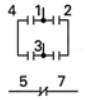
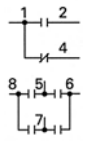
❶ Element Identification consists of this number plus letter from Table 2 on **Page 71**.

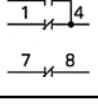
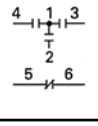
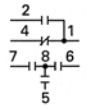
❷ **Do not use Element Identification Code as Suffix to Catalog Number.**

# Type 6981ED200
# Separate Flush Mounting Selector Switches

**Table 2 – Selector Switch Circuits**

| Partial Element I.D. Code ❶ | Circuit Connections | | | | |
|---|---|---|---|---|---|
| | Contact | Position | | | Schematic Symbol ❷ |
| | | CCW | C | CW | |
| A | 1-4 | X | | |  |
| | 1-2 | | | X | |
| | 7-6 | X | | | |
| | 7-8 | | | X | |
| B | 1-2 | | X | |  |
| | 7-8 | | X | | |
| C | 1-2 | | X | |  |
| | 3-4 | | X | | |
| | 5-6 | | | X | |
| | 5-8 | X | | | |
| D | 1-3 | | | X |  |
| | 2-4 | X | | | |
| | 5-7 | | | X | |
| | 6-8 | X | | | |
| E | 1-4 | | X | X |  |
| | 3-4 | X | | | |
| | 5-7 | X | | | |
| | 6-8 | | | X | |
| F | 2-4-5-8 | | | X |  |
| | 5-6-8 | | X | | |
| G | 1-4 | | X | |  |
| | 1-4-6-8 | | | X | |
| | 3-4 | X | | | |
| H | 1-2-4 | X | | |  |
| | 1-2-3 | | | X | |
| J | 1-3 | X | | |  |
| | 5-6 | X | | X | |

| Partial Element I.D. Code ❶ | Circuit Connections | | | | |
|---|---|---|---|---|---|
| | Contact | Position | | | Schematic Symbol ❷ |
| | | CCW | C | CW | |
| K | 1-3-4 | X | | |  |
| | 3-4-6-8 | | | X | |
| L | 1-2-5-6 | X | | |  |
| | 2-3 | | | X | |
| | 6-7 | | | X | |
| M | 1-2 | | | X |  |
| | 3-4 | | | X | |
| | 5-6 | | | X | |
| | 7-8 | | | X | |
| | 1-4 | X | | | |
| | 2-3 | X | | | |
| | 5-8 | X | | | |
| | 6-7 | X | | | |
| N | 1-2 | | | X |  |
| | 3-4 | | | X | |
| | 5-7 | | X | | |
| | 1-4 | X | | | |
| | 2-3 | X | | | |
| P | 1-2 | X | | |  |
| | 2-3 | | | X | |
| Q | 1-2 | | | X |  |
| | 1-4 | X | X | | |
| | 7-8 | | X | | |
| R | 1-2 | | | X |  |
| | 1-4 | X | X | | |
| | 5-6 | | | X | |
| | 7-8 | | | X | |
| | 5-8 | X | | | |
| | 6-7 | X | | | |

| Partial Element I.D. Code ❶ | Circuit Connections | | | | |
|---|---|---|---|---|---|
| | Contact | Position | | | Schematic Symbol ❷ |
| | | CCW | C | CW | |
| S | 1-4 | | X | X |  |
| | 3-4 | X | | | |
| | 7-8 | | X | | |
| T | 1-2-4 | X | | |  |
| | 1-2-3 | | | X | |
| | 5-6 | | X | | |
| U | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 5-6 | X | | | |
| | 6-7 | | X | X | |
| W | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 6-7 | X | X | | |
| | 7-8 | | | X | |
| X | 1-2 | X | | |  |
| | 2-3 | | X | X | |
| | 5-8 | | X | X | |
| | 7-8 | X | | | |
| Y | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 5-7 | X | | | |
| | 6-8 | | | X | |
| Z | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 5-6-8 | | | X | |
| | 5-7-8 | X | | | |

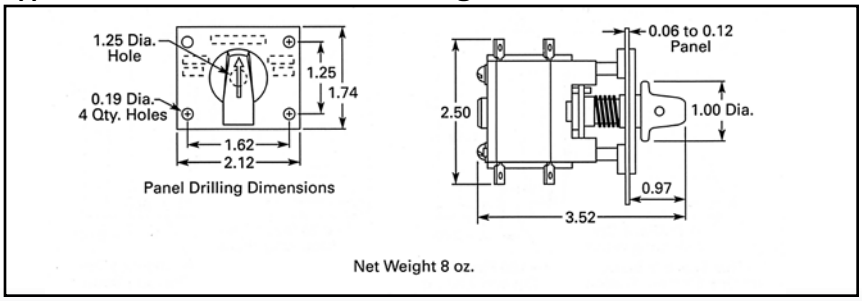
❶ Element Identification Code consists of number from Table 1 on **Page 70** plus letter from this Table. Example: 1A.

❷ Numbers adjacent to circuit diagrams represent terminals.

❸ X = Contact closed, all circuits shown with switch in center position.

❹ Element with internal jumper between front and rear elements.

**Approximate Dimensions in Inches and Weights**



# Type 6981
# Watertight Remote Control Stations

*Using Pushbuttons, Indicating Lights and Selector Switches*


## When ordering specify

- Catalog number (if known)
- Number of elements
- Element identification code
- Type of each element
- Enclosure
- For indicating light elements, color of lens
- Legend required for each element
- Voltage
- Application

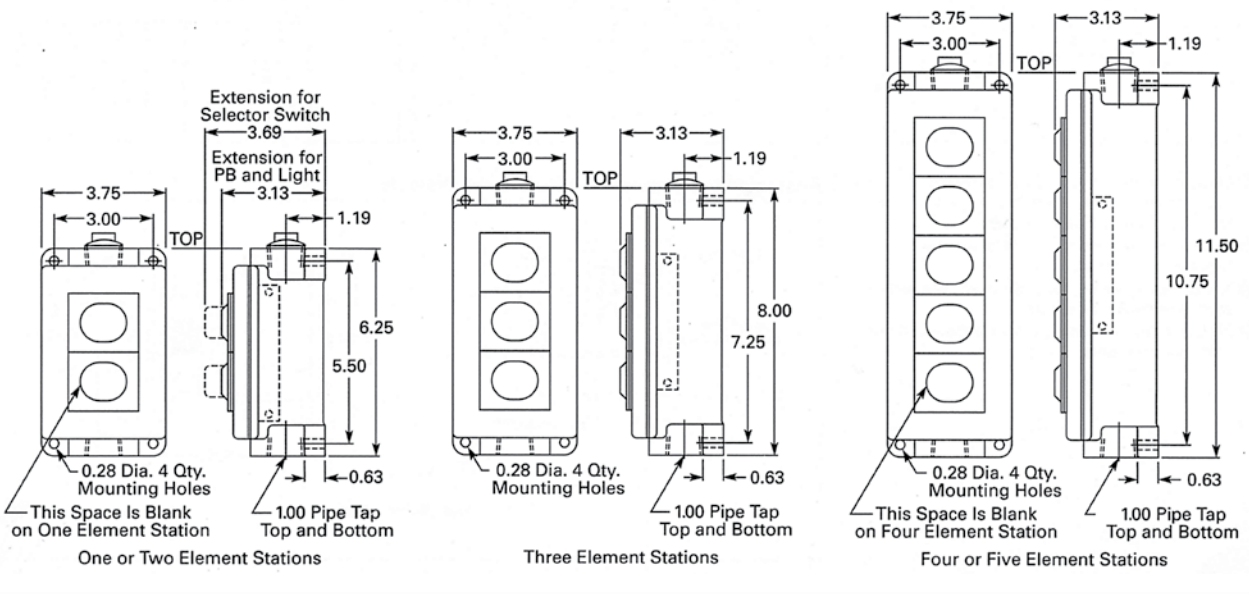
## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Watertight – below
  Explosion-proof – **Page 77**
  Cast brass – **Page 79**
- Operation ..... Manual
- Ambient temp ..... 50°C
- Insulation ..... Class B
- Rating ..... Pilot circuits only

| Type of Element | Continous Capacity Amps. | Inductive ratings | | | | |
|---|---|---|---|---|---|---|
| | | AC (60 Hz) | | | DC | |
| | | Volts | Amps Make | Amps Break | Volts | Amps Break |
| Heavy-Duty Pushbutton | 10<br>10<br>10 | 440<br>220<br>110 | 50<br>50<br>60 | 5 ❶<br>5<br>6 | 250 ❶<br>230<br>115 | 0.5<br>0.75<br>2.0 |
| Selector Switch | 10<br>10<br>10 | 440<br>220<br>110 | 7.5<br>15<br>30 | 0.75<br>1.5<br>3.0 | 250 ❶<br>230<br>115 | 0.4<br>0.55<br>1.1 |

❶ Nominal submarine voltage (355 volts maximum).

**Approximate Dimensions in Inches, Watertight**



# Type 6981
# Watertight Remote Control Stations

## When ordering specify

- Enclosure Catalog number
- Element Identification Code(s) – For Selector Switch Elements on **Pages 74** and **75**, Element Identification Code consists of a number from Table 1 and a letter from Table 2. Example: **1A**
- Location of Elements
- Legend required for each Element

## General

Whenever possible, select a typical pushbutton or indicating light station from the tables on Page 76. For example, Catalog number 6981ED172-1 covers a two element station with two Type "C" pushbuttons marked START and STOP respectively.

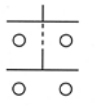
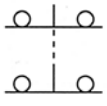
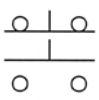
If required station cannot be found in the Typical listings, then select a station from this and the following pages.

Selector switch elements are listed on the following pages.

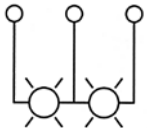
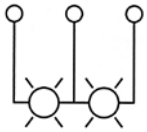
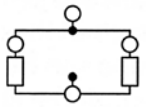
**Basic Element Selection Table (Surface Mounting, WT)**

| Number of Units | Incomplete Catalog number | Weight |
|---|---|---|
| 1 | **6981ED171** | 2 lbs., 3 oz. |
| 2 | **6981ED172** | 2 lbs., 2 oz. |
| 3 | **6981ED173** | 2 lbs., 6 oz. |
| 4 | **6981ED174** | 3 lbs., 5 oz. |
| 5 | **6981ED175** | 3 lbs., 4 oz. |

**Pushbutton Elements**

| Element Identification Code | Circuit Symbol | Description | Weight |
|---|---|---|---|
| A |  | Pushbutton 2NO Contacts | 4 oz. |
| B |  | Pushbutton 2NC Contacts | 4 oz. |
| C |  | Pushbutton 1NO-1NC Contacts | 4 oz. |

**Indicating Light Elements**

| Element Identification Code | Circuit Symbol | Description | Weight |
|---|---|---|---|
| D1 – Red<br>D2 – Green<br>D3 – Amber<br>D4 – Blue<br>D5 – White |  | Indicating Light – 115V 60Hz ❶ | 6 oz. |
| E1 – Red<br>E2 – Green<br>E3 – Amber<br>E4 – Blue<br>E5 – White |  | Indicating Light – 440V 60Hz ❶ | 6 oz. |
| F1 – Red<br>F2 – Green<br>F3 – Amber<br>F4 – Blue<br>F5 – White |  | Indicating Light – 24V DC ❷❸ | 3 oz. |
| G1 – Red<br>G2 – Green<br>G3 – Amber<br>G4 – Blue<br>G5 – White |  | Indicating Light – 10V DC ❹ | 3 oz. |
| H1 – Red<br>H2 – Green<br>H3 – Amber<br>H4 – Blue<br>H5 – White |  | Indicating Light – 48V DC ❸ | 3 oz. |

❶ Lamp Type: No. 1769, T1-3/4 Midget Screw Base.

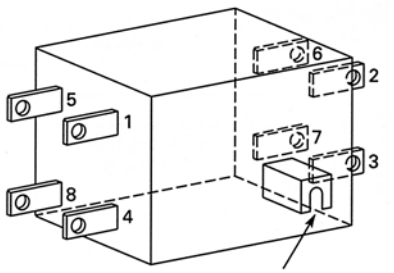
❷ These are resistor type indicating lights. Each lamp requires the following series resistance, depending on the voltage used. Resistors must be separately mounted and are not included.

| Voltage | Resistance |
|---|---|
| 24V DC | None |
| 120V DC | 2800 ohms – 5 watts |
| 240V DC | 6300 ohms – 10 watts |
| 250V DC | 8000 ohms – 10 watts (Nominal submarine voltage, 180-355V range) |

❸ Lamp Type: No. 335, T1-3/4 Midget Screw Base.

❹ Complete assembly including resistors. Lamp Type: No. 373, T1-3/4 Midget Screw Base.

# Type 6981
# Watertight Remote Control Stations




***Basic Element Showing Orientation of Terminals***

## Selector Switch Elements

Selector switches are available in two- or three-position configurations, self-centering or non self-centering.

Self-centering two-position switches may be spring return from either side of center. Three-position self-centering switches may be spring return form either or both sides of center.

The basic selector switch element has a maximum of eight stationary contact/terminals, four in each of two planes. Moveable contacts consist of shaft mounted segments, available in several shapes to provide various circuit combinations for each of the two planes. Segments in the front and rear plane can be electrically connected by use of a jumper through the shaft assembly.

Segments can be assembled to the shaft in any one of four positions at 90° displacement. Further variation is available through 45° displacement of the shaft when the starwheel is assembled to the shaft.

The circuits shown in Table 2, on **Page 75**, are intended for use with either the two- or three-position selector switch. A portion of the contacts, or circuit, as shown may not be used with a particular basic configuration.

Circuits shown are designed to accommodate the majority of standard control requirements. Other combinations are available and can be set up as required.

**Table 1 – Selector Switch Configurations**

| Partial Element Identification Code ❶ | Basic Configuration | | Weight |
|---|---|---|---|
| | No. of Positions | Operation | |
| 1 | 2 | Maintained Contact, Center and CW | 8 oz. |
| 2 | 2 | Maintained Contact, Center and CCW | 8 oz. |
| 3 | 2 | Spring Return fro CW to Center | 8 oz. |
| 4 | 2 | Spring Return form CCW to Center | 8 oz. |
| 5 | 3 | Maintained Contact | 8 oz. |
| 6 | 3 | Spring Return from CW & CCW to Center | 8 oz. |
| 7 | 3 | Spring Return from CCW to Center | 8 oz. |
| 8 | 3 | Spring Return from CW to Center | 8 oz. |

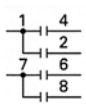
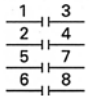
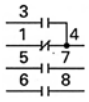
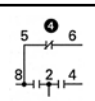
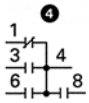
❶ Element identification consists of this number plus letter from Table 2 on **Page 75**.

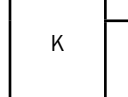
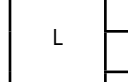
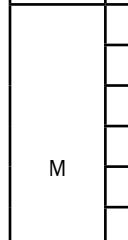
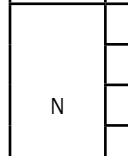
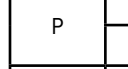
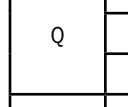
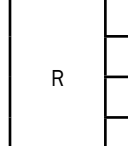
**Table 2 is shown on following page.**

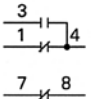
# Type 6981
# Watertight Remote Control Stations

## Selector Switch Elements (Continued)

**Table 2 – Selector Switch Circuits**

| Partial Element I.D. Code ❶ | Circuit Connections | | | | |
|---|---|---|---|---|---|
| | Contact | Position | | | Schematic Symbol ❷ |
| | | CCW | C | CW | |
| A | 1-4 | X | | |  |
| | 1-2 | | | X | |
| | 7-6 | X | | | |
| | 7-8 | | | X | |
| B | 1-2 | | X | |  |
| | 7-8 | | X | | |
| C | 1-2 | | X | |  |
| | 3-4 | | X | | |
| | 5-6 | | | X | |
| | 5-8 | X | | | |
| D | 1-3 | | | X |  |
| | 2-4 | X | | | |
| | 5-7 | | | X | |
| | 6-8 | X | | | |
| E | 1-4 | | X | X |  |
| | 3-4 | X | | | |
| | 5-7 | X | | | |
| | 6-8 | | | X | |
| F | 2-4-5-8 | | | X |  |
| | 5-6-8 | | X | | |
| G | 1-4 | | X | |  |
| | 1-4-6-8 | | | X | |
| | 3-4 | X | | | |
| H | 1-2-4 | X | | |  |
| | 1-2-3 | | | X | |
| J | 1-3 | X | | |  |
| | 5-6 | X | | X | |

| Partial Element I.D. Code ❶ | Circuit Connections | | | | |
|---|---|---|---|---|---|
| | Contact | Position | | | Schematic Symbol ❷ |
| | | CCW | C | CW | |
| K | 1-3-4 | X | | |  |
| | 3-4-6-8 | | | X | |
| L | 1-2-5-6 | X | | |  |
| | 2-3 | | | X | |
| | 6-7 | | | X | |
| M | 1-2 | | | X |  |
| | 3-4 | | | X | |
| | 5-6 | | | X | |
| | 7-8 | | | X | |
| | 1-4 | X | | | |
| | 2-3 | X | | | |
| | 5-8 | X | | | |
| | 6-7 | X | | | |
| N | 1-2 | | | X |  |
| | 3-4 | | | X | |
| | 5-7 | | X | | |
| | 1-4 | X | | | |
| | 2-3 | X | | | |
| P | 1-2 | X | | |  |
| | 2-3 | | | X | |
| Q | 1-2 | | | X |  |
| | 1-4 | X | X | | |
| | 7-8 | | X | | |
| R | 1-2 | | | X |  |
| | 1-4 | X | X | | |
| | 5-6 | | | X | |
| | 7-8 | | | X | |
| | 5-8 | X | | | |
| | 6-7 | X | | | |

| Partial Element I.D. Code ❶ | Circuit Connections | | | | |
|---|---|---|---|---|---|
| | Contact | Position | | | Schematic Symbol ❷ |
| | | CCW | C | CW | |
| S | 1-4 | | X | X |  |
| | 3-4 | X | | | |
| | 7-8 | | X | | |
| T | 1-2-4 | X | | |  |
| | 1-2-3 | | | X | |
| | 5-6 | | X | | |
| U | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 5-6 | X | | | |
| | 6-7 | | X | X | |
| W | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 6-7 | X | X | | |
| | 7-8 | | | X | |
| X | 1-2 | X | | |  |
| | 2-3 | | X | X | |
| | 5-8 | | X | X | |
| | 7-8 | X | | | |
| Y | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 5-7 | X | | | |
| | 6-8 | | | X | |
| Z | 1-4 | X | X | |  |
| | 1-2 | | | X | |
| | 5-6-8 | | | X | |
| | 5-7-8 | X | | | |

❶ Element Identification Code consists of number from Table 1 on **Page 74** plus letter from this Table. Example: 1A.

❷ Numbers adjacent to circuit diagrams represent terminals.

❸ X = Contact closed, all circuits shown with switch in center position.

❹ Element with internal jumper between front and rear elements.

**Optional Features for Watertight Remote Control Stations –**

- Hinged Protective Covers
- Warning Plate
- Special Message Plate
- Special Ink Color on Legend Plate
- Special Character Size on Legend Plate
- Blank Station
- Space Heater (not available in a 5 element station)
- Non-magnetic Configuration
- Red Legend Plate
- Dim Out Unit on Indicator Light

# Type 6981
# Watertight Remote Control Stations

### Examples of Some Common Catalog numbers and Their Descriptions

| Element Identification Code and Marking ❶ | | | | | Catalog number | Weight Lbs.-Oz. |
|---|---|---|---|---|---|---|
| Position 1 (Top) | Position 2 | Position 3 | Position 4 | Position 5 | | |
| **One Element Stations** | | | | | | |
| C - STOP | - | - | - | - | **6981ED171-1** | 2-7 |
| C - START | - | - | - | - | **6981ED171-2** | 2-7 |
| C - EM. RUN | - | - | - | - | **6981ED171-3** | 2-7 |
| C - EM. STOP | - | - | - | - | **6981ED171-4** | 2-7 |
| E4 - CLOSED | - | - | - | - | **6981ED171-8** | 2-9 |
| **Two Element Stations** | | | | | | |
| C - START | C - STOP | - | - | - | **6981ED172-1** | 2-10 |
| C - OPEN | C - CLOSE | - | - | - | **6981ED172-2** | 2-10 |
| C - HOIST | C - LOWER | - | - | - | **6981ED172-3** | 2-10 |
| C - EM. START | C - EM. STOP | - | - | - | **6981ED172-4** | 2-10 |
| E2 - FAST | E2 - SLOW | - | - | - | **6981ED172-5** | 2-14 |
| E3 - OPEN | E4 - CLOSED | - | - | - | **6981ED172-6** | 2-14 |
| E5 - POWER ON | A - START | - | - | - | **6981ED172-7** | 2-12 |
| E5 - FAST | E5 - SLOW | - | - | - | **6981ED172-14** | 2-14 |
| A - START | C - STOP | - | - | - | **6981ED172-20** | 2-10 |
| **Three Element Stations** | | | | | | |
| C - FORWARD | C - REVERSE | C - STOP | - | - | **6981ED173-1** | 3-0 |
| C - FAST | C - SLOW | C - STOP | - | - | **6981ED173-2** | 3-0 |
| C - HOIST | C - LOWER | C - STOP | - | - | **6981ED173-3** | 3-0 |
| D2 - MOTOR RUN | C - START | C - STOP | - | - | **6981ED173-4** | 3-2 |
| E2 - MOTOR RUN | C - START | C - STOP | - | - | **6981ED173-19** | 3-2 |
| C - EM. RUN | C - START | C - STOP | - | - | **6981ED173-6** | 3-0 |
| E5 - ON | C - ON | C - OFF | - | - | **6981ED173-9** | 3-2 |
| C - UP | C - DOWN | C - JOG | - | - | **6981ED173-11** | 3-0 |
| C - TEST | C - START | C - STOP | - | - | **6981ED173-14** | 3-0 |
| **Four Element Stations** | | | | | | |
| C - E.M RUN | C - FORWARD | C - REVERSE | C - STOP | - | **6981ED174-1** | 4-5 |
| E2 - MOTOR RUN | C - EM. RUN | C - START | C - STOP | - | **6981ED174-2** | 4-7 |
| E3 - OPEN | E4 - CLOSED | C - OPEN | C - CLOSE | - | **6981ED174-3** | 4-9 |
| E5 - POWER ON | E2 - HEATER ON | C - START | C - STOP | - | **6981ED174-4** | 4-9 |
| C - HOIST | C - LOWER | C - FORWARD | C - REVERSE | - | **6981ED174-9** | 4-5 |
| **Five Element Stations** | | | | | | |
| E2 - FAST | E2 - SLOW | C - FAST | C - SLOW | C - STOP | **6981ED175-1** | 4-12 |
| E3 - OPEN | E4 - CLOSED | C - OPEN | C - CLOSE | C - STOP | **6981ED175-2** | 4-12 |

❶ For description of Element Identification codes, see table below.

### Element Symbol Identification

| Pushbuttons | Indicating Lights ❷ | Indicating Lights Lens Color |
|---|---|---|
| A - 2ND Contact Pushbutton | D - 110V, 60 Hz Indicating Light | (Suffix Number to Base Light) |
| B - 2NC Contact Pushbutton | E - 440V, 60 Hz Indicating Light | 1 - Red Lens |
| C - 1 NO-I NC Contact Pushbutton | F - 24V DC Indicating Light | 2 - Green Lens |
| | G - 10V DC Indicating Light | 3 - Amber Lens |
| | H - 48V DC Indicating Light | 4 - Blue Lens |
| | | 5 - White Lens |

❷ Requires Suffix Number to designate lens color. Example: D1-110V, 60 Hz indicating light with red lens.

# Type 6981
# Explosion-Proof Remote Control Stations

**When ordering specify**

- Complete description of Explosion-Proof Station from table following. Listed prices include required elements.
- Element Identification Code for each element required. Select from the tables on **Pages 73** thru **75**. For Selector Switch elements on **Page 74**, the Element Identification Code consists of a number from Table 1 on **Page 74** and a letter from Table 2 on **Page 75**. Example: 1A.
- Location of Elements.
- Legend required for each Element.

## General

Select pushbutton, indicating light or selector switch station from table following. The prices as listed cover the complete stations including the required elements. Pushbutton and selector switch elements may be intermixed within a single, two or three-element enclosure. **Indicating lights may not be combined with other type elements.** Consult the factory for indicating light elements.

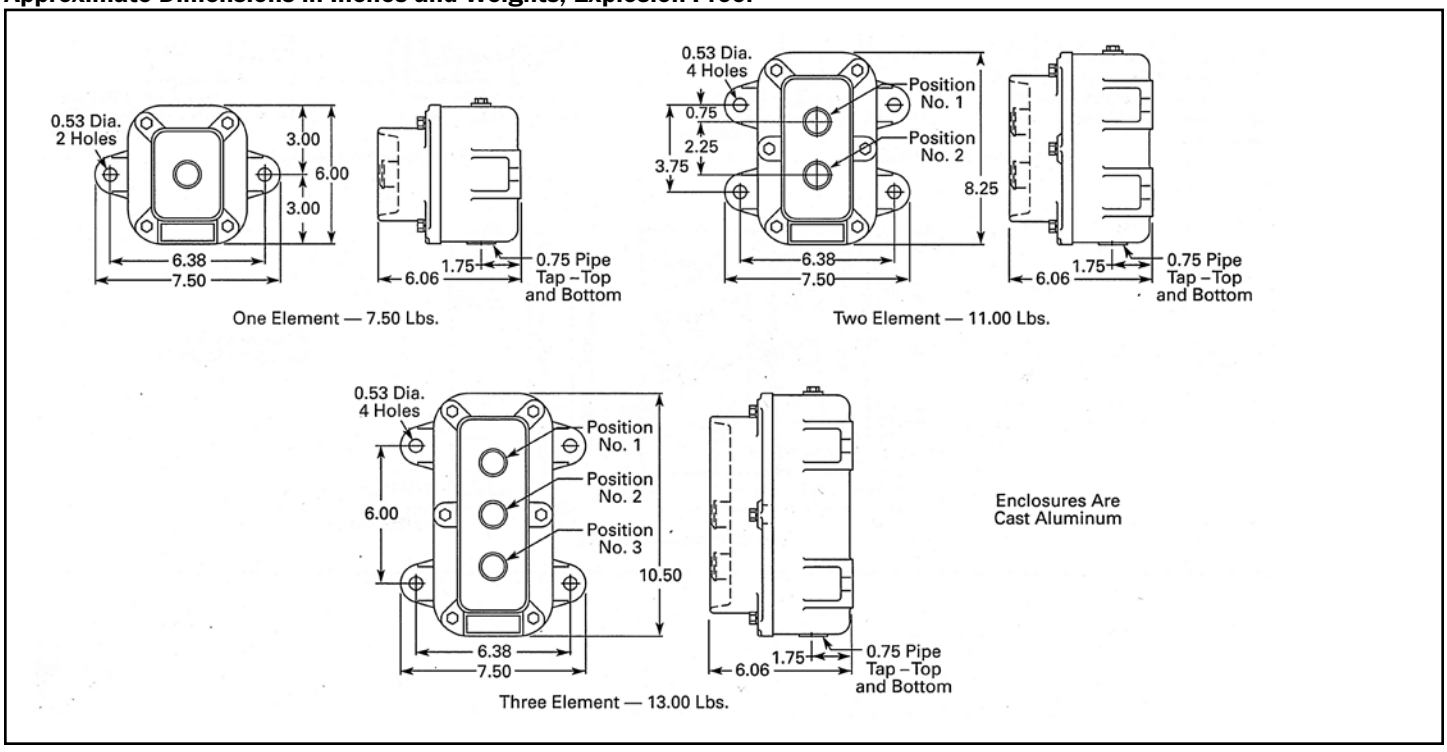
**Explosion-Proof Stations - NEMA 7 ❶**

| Number of Elements | Pushbutton. Selector Switch and/or Indicating Light Elements ❷ |
|---|---|
| 1 | Pushbutton, Selector Switch Indicating Light, AC or DC |
| 2 | 2 - Pushbuttons |
| 3 | 3 - Pushbuttons |

❶ Class 1, Group D, unless specifically defined otherwise.
❷ Contact factory for other options

**Order by complete description with Element Identification from Pages 73 thru 75, plus required legend(s).**

**Approximate Dimensions in Inches and Weights, Explosion-Proof**



# Type 6981
# Explosion-Proof Remote Control Stations

## When ordering specify

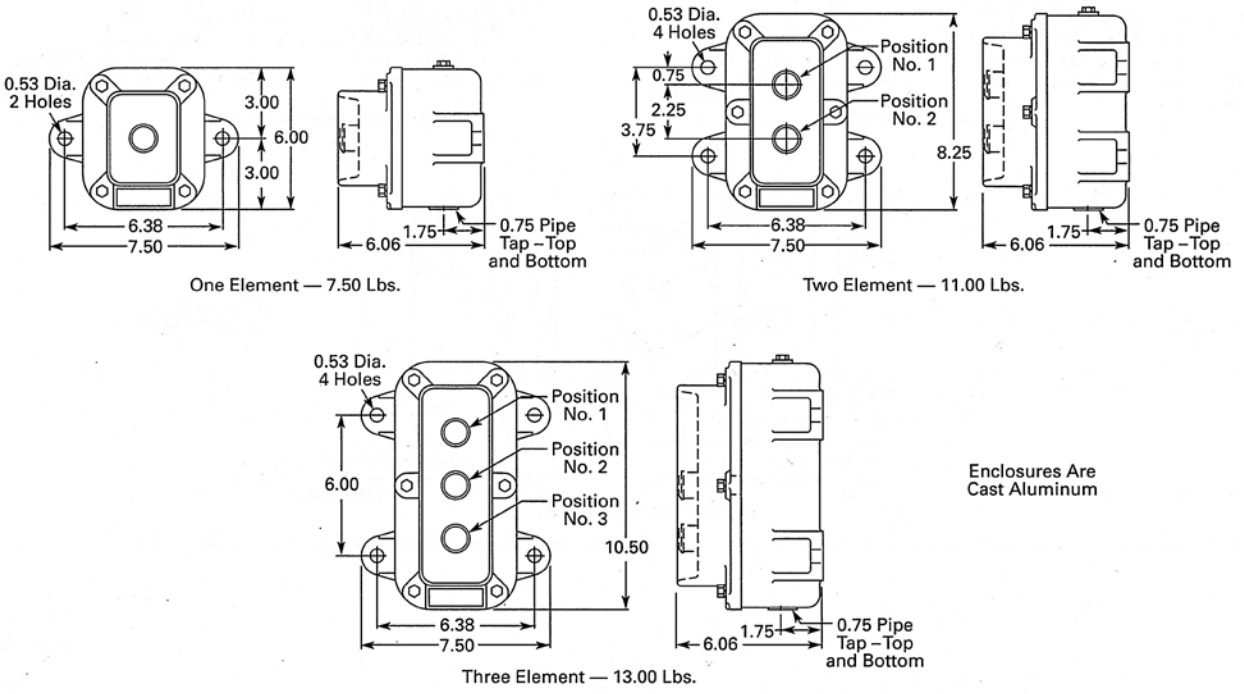
• Complete Catalog number

### Examples of Some Common Catalog numbers and Their Descriptions

| Element Identification Code and Marking ❶ | | | Catalog number |
|---|---|---|---|
| Position 1 (Top) | Position 2 | Position 3 | |
| **One Element Station** | | | |
| C – STOP | - | - | **6981ED202-1** |
| C – START | - | - | **6981ED202-2** |
| C – EMERG. RUN | - | - | **6981ED202-3** |
| 5A – MAN/OFF/AUTO | - | - | **6981ED202-6** |
| 1P – ON/OFF | - | - | **6981ED202-8** |
| **Two Element Station** | | | |
| C – START | C – STOP | - | **6981ED203-1** |
| C – OPER. | C – CLOSE | - | **6981ED203-2** |
| C – HOIST | C – LOWER | - | **6981ED203-3** |
| A – START | B – STOP | - | **6981ED203-24** |
| A – OPER. | A – CLOSE | - | **6981ED203-25** |
| C – UP | C – DOWN | - | **6981ED203-36** |
| **Three Element Station** | | | |
| C – FORWARD | C – REVERSE | C – STOP | **6981ED204-1** |
| C – FAST | C – SLOW | C – STOP | **6981ED204-2** |
| C – HOIST | C – LOWER | C – STOP | **6981ED204-3** |
| A – UP | B – DOWN | B – STOP | **6981ED204-23** |

❶ For description of Element Identification codes, see table on **Page 76.**

### Approximate Dimensions in Inches and Weights, Explosion-Proof



# Type 6981
# Cast Brass Watertight Remote Control Stations

## When ordering specify

- One, Two, or Three Element Station
- Element Identification Code for each element required. Select from the tables on **Pages 73** thru **75**. For Selector Switch elements on **Page 74**, the Element Identification Code consists of a number from Table 1 on **Page 74** and a letter from Table 2 on **Page 75**. Example: 1A.
- Location of Elements.
- Legend required for each Element.

| Number of Elements | Incomplete Catalog number ❶ |
|---|---|
| 1 | **6981ED241** |
| 2 | **6981ED242** |
| 3 | **6981ED243** |

❶ Enclosure size the same for all three stations.

## Specifications

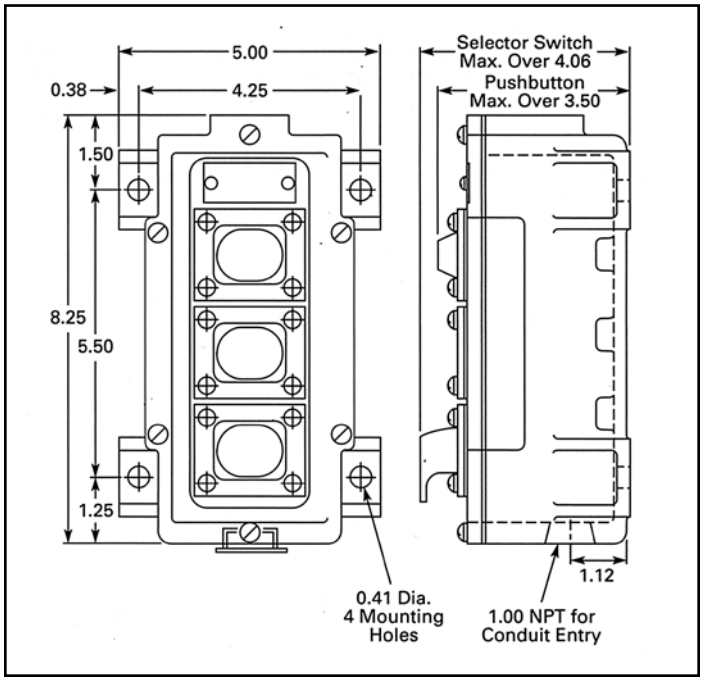
- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Cast Brass, Watertight
- Operation ..... Manual
- Ambient temp ..... 50°C
- Insulation ..... Class B

**Ratings**

| Type of Element | Continuous Capacity Amps | Inductive Rating | | | | |
|---|---|---|---|---|---|---|
| | | AC (60 Hz) | | | DC | |
| | | Volts | Amperes | | Volts | Amperes |
| | | | Make | Break | | Break |
| **Two Element Station** | | | | | | |
| Heavy Duty Pushbutton | 10 | 440 | 50 | 5 | 250❸ | 0.5 |
| | 10 | 220 | 50 | 5 | 230 | 0.75 |
| | 10 | 110 | 60 | 6 | 115 | 2 |
| Selector Switch | 10 | 440 | 7.5 | 0.75 | 250❸ | 0.4 |
| | 10 | 220 | 15 | 1.5 | 230 | 0.55 |
| | 10 | 110 | 30 | 3 | 115 | 1.1 |

❸ Nominal submarine voltage (355V maximum).

**Approximate Dimensions in Inches, Cast Brass**



# Type 6981
# Typical Cast Brass Watertight Remote Control Stations

## When ordering specify

- Catalog number

### Examples of Some Common Catalog numbers and Their Descriptions

| Element Identification Code and Marking ❶ | | | Catalog number |
|---|---|---|---|
| Position 1 (Top) | Position 2 | Position 3 | |
| **One Element Station** | | | |
| A – START | - | - | **6981ED241-1** |
| C – EMERG RUN | - | - | **6981ED241-2** |
| A – ON | - | - | **6981ED241-3** |
| **Two Element Station** | | | |
| C – OPEN | C – CLOSE | - | **6981ED242-3** |
| A – START | A – STOP | - | **6981ED242-4** |
| A – ON | A – OFF | - | **6981ED242-6** |
| A – HOIST | A – LOWER | - | **6981ED242-7** |
| **Three Element Station** | | | |
| C – START | C – STOP | C – EMERG RUN | **6981ED243-1** |
| A – START | B – STOP | A – EMERG RUN | **6981ED243-4** |
| D3 – POWER ON | C – START | C – STOP | **6981ED243-5** |
| E2 – MOTOR RUNNING | 8E – START/STOP | C – EMERG RUN | **6981ED243-6** |

❶ For Description of Element Identification Codes, see table below.

### Element Symbol Identification

| Pushbuttons | Indicating Lights ❷ | Indicating Lights Lens Color |
|---|---|---|
| A - 2ND Contact Pushbutton | D - 110V, 60 Hz Indicating Light | (Suffix Number to Base Light) |
| B - 2NC Contact Pushbutton | E - 440V, 60 Hz Indicating Light | 1 - Red Lens |
| C - 1 NO-I NC Contact Pushbutton | F - 24V DC Indicating Light | 2 - Green Lens |
| | G - 10V DC Indicating Light | 3 - Amber Lens |
| | H - 48V DC Indicating Light | 4 - Blue Lens |
| | | 5 - White Lens |

❷ Requires Suffix Number to designate lens color. Example: D1-110V, 60 Hz indicating light with red lens.

# Type 6981
# "Emergency Stop" Pushbutton Stations


## Specifications

- MIL-SPEC ..... MIL-DTL-2212
- Enclosure ..... Watertight or Explosion-Proof
- Duty ..... Continuous
- Operation ..... Manual
- Ambient temp ..... 50°C
- Insulation ..... Class B

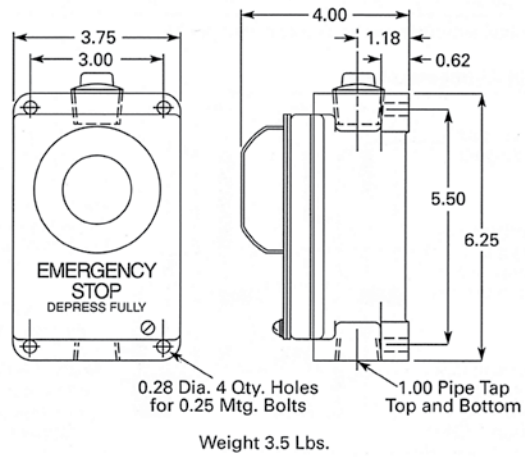
### Ratings

| Inductive Rating | Maximum Amperes | | | | | |
|---|---|---|---|---|---|---|
| | AC 60 Hz | | | DC | | |
| | 110V | 220V | 440V | 115V | 230V | 355V |
| Make | 60 | 50 | 50 | 2 | 0.75 | 0.5 |
| Break | 6 | 5 | 5 | 2 | 0.75 | 0.5 |

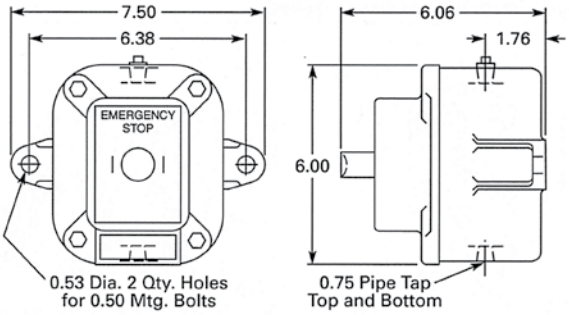
## When ordering specify

- Complete catalog number

### Approximate Dimensions in Inches and Weight - Watertight




### Approximate Dimensions in Inches and Weight - Explosion-Proof




| Catalog number | Pushbutton Contacts |
|---|---|
| **Watertight Enclosure** | |
| **6981ED236-1** | 2NO |
| **6981ED236-2** | 2NC |
| **6981ED236-3** | 1NO-1NC |
| **6981ED236-4NM ❶** | 2NO |
| **6981ED236-5NM ❶** | 2NC |
| **6981ED236-6NM ❶** | 1NO-1NC |

❶ Non-magnetic construction.

| Catalog number | Pushbutton Contacts |
|---|---|
| **Explosion-Proof Enclosure ❷** | |
| **6981ED239-1** | 2NO |
| **6981ED239-2** | 2NC |
| **6981ED239-3** | 1NO-1NC |

❷ Class 1, Group D, unless specifically defined otherwise.

# Type 6982-T5
# Flush Mounting Drum Type Transfer or Selector Switch

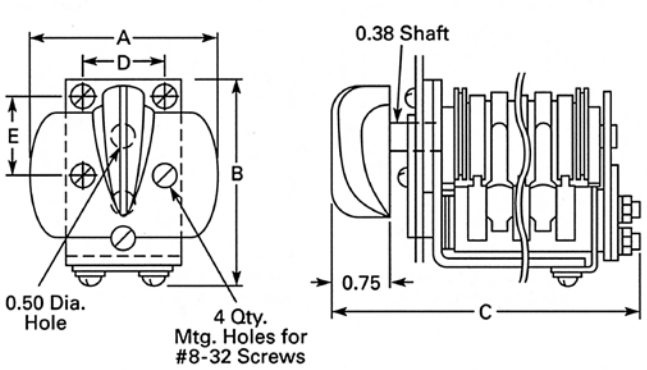
## When ordering specify

- Type number – 6982-T5
- Voltage, AC or DC
- Number of fingers and circuit arrangements
- Number of positions
- Self-centering or no-self-centering
- Legend required
- Application

### Prices

| Description | Type of Enclosure |
|---|---|
| **4 Finger (Max.) – Flush Mounting** | |
| 2-, 3-, 4- or 5-Position | Open |
| **7 Finger (Max.) – Flush Mounting** | |
| 2-, 3-, 4- or 5-Position | Open |

### Approximate Dimensions in Inches




### Open Type

| Type | Dimensions in Inches | | | | | Weight Lbs. |
|---|---|---|---|---|---|---|
| | Wide | High | Deep | Mounting | | |
| | A | B | C | D | E | |
| 4 Finger | 2.5 | 2.875 | 5.19 | 1.06 | 1.06 | 0.75 |
| 7 Finger | 2.5 | 2.875 | 6.875 | 1.06 | 1.06 | 1.5 |

## Specifications

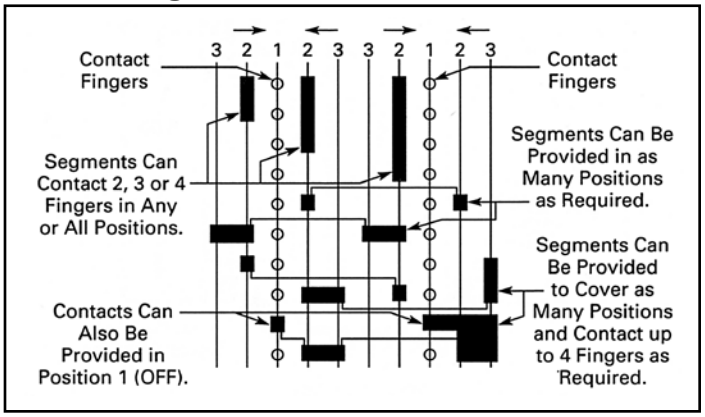
- MIL-SPEC.....MIL-DTL-2212
- Enclosure .....Open types for watertight mounting
- Operation .....Manual, self-centering and non-self-centering types
- Type .....6982-T5 – 2-, 3-, 4- or 5- position, including OFF position
- Function .....Pilot circuit transfer or selector switch
- Duty .....Continuous
- Ambient temp .....50°C
- Insulation .....Class B

### Ratings – Pilot Circuits Only

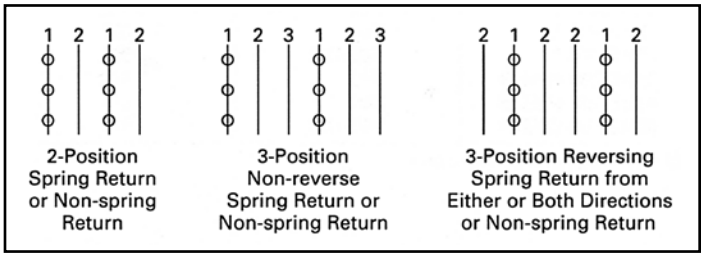
| Inductive Rating | Maximum Amperes | | | | | |
|---|---|---|---|---|---|---|
| | AC 60 Hz | | | DC | | |
| | 110V | 220V | 440V | 115V | 230V | 250V❶ |
| Make | 40 | 25 | 12 | 2 | 2 | 2 |
| Break | 4 | 2 | 1 | 1.5 | 0.75 | 0.2 |
| Carry (cont.) | 15 | 15 | 15 | 15 | 15 | 15 |

❶ Nominal submarine voltage (355V maximum)

### Contact Arrangement ❷ ❸




❷ A 10 Finger long device is shown to display capability. The maximum length available in a flush mount is 7 Fingers.
❸ Diagram for 5-position reversing selector switch showing typical contact segment combinations which are available.




**4 Fingers Long** – Total 8 fingers (maximum). Can be supplied 2-, 3-, 4- or 5-position. Spring return can be supplied but unit is limited to 3 Fingers maximum length.

**7 Fingers Long** – Total 14 fingers (maximum). Can be supplied 2-, 3-, 4- or 5-position. Spring return can be supplied but unit is limited of 6 Fingers maximum length.

# Type 6982-T5
# Drum Type Transfer or Selector Switch

## When ordering specify

- Type number – 6982-T5
- Voltage, AC or DC
- Number of fingers and circuit arrangements
- Number of positions
- Self-centering or non-self-centering
- Type of enclosure
- Application and legends required
- Type of handle (counterbalanced lever, round knob or teardrop knob)
- Bulkhead or surface mounting

## Specifications

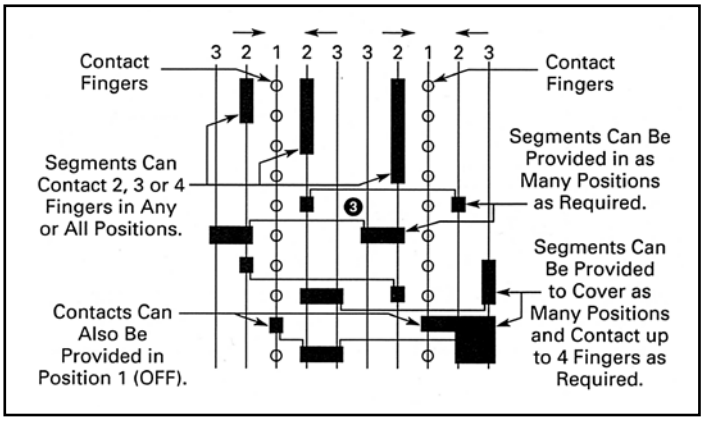
- MIL-SPEC.....MIL-DTL-2212
- Enclosure .....Watertight or dripproof
- Operation .....Manual, self-centering and non-self-centering types
- Type .....6982-T5 – 2-, 3-, 4- or 5-position, including OFF position
- Function .....Pilot circuit transfer or selector switch
- Duty .....Continuous
- Ambient temp .....50°C
- Insulation .....Class B

### Ratings – Pilot Circuits Only

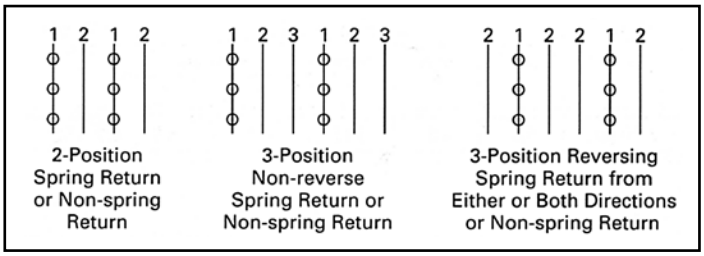
| Inductive Rating | Maximum Amperes | | | | |
|---|---|---|---|---|---|
| | AC 60 Hz | | DC | | |
| | 110V | 440V | 115V | 230V | 250V❶ |
| Make | 40 | 12 | 2 | 2 | 2 |
| Break | 4 | 1 | 1.5 | 0.75 | 0.2 |
| Carry (cont.) | 15 | 15 | 15 | 15 | 15 |

❶ Nominal submarine voltage (355V maximum)

### Contact Arrangement ❷




❷ Diagram for 5-position reversing selector switch showing typical contact segment combinations which are available.




**7 Fingers Long** – Total 14 fingers (maximum). Can be supplied 2-, 3-, 4- or 5-position. Spring return can be supplied but unit is limited to 6 Fingers maximum length.

**10 Fingers Long** – Total 20 fingers (maximum). Can be supplied 2-, 3-, 4- or 5-position. Spring return can be supplied but unit is limited to 9 Fingers maximum length.

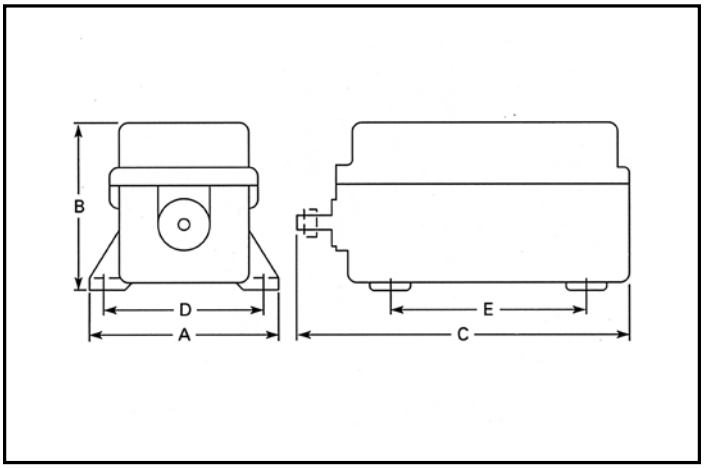
# Type 6982-T5
# Drum Type Transfer or Selector Switch

### Master Transfer Switches – Types T8 and T5

| Type | Description | Type of Enclosure |
|---|---|---|
| **Cam Type Masters ❶** | | |
| 6982T8 | Surface or Pedestal Mounting<br>Two-Speed Reversing | Watertight |
| **Optional Features – Cam Type** | | |
| | ON/OFF or ON/OFF/EMERG. RUN Selector Switch | |
| **Drum Type Pilot Circuit Transfer Switches** | | |
| 6982T5 | 2-, 3-, 4-, or 5-position – 7 fingers maximum | Dripproof |
| 6982T5 | 2-, 3-, 4-, or 5-position – 10 fingers maximum | Dripproof |
| 6982T5 | 2-, 3-, 4-, or 5-position – 7 fingers maximum | Watertight |

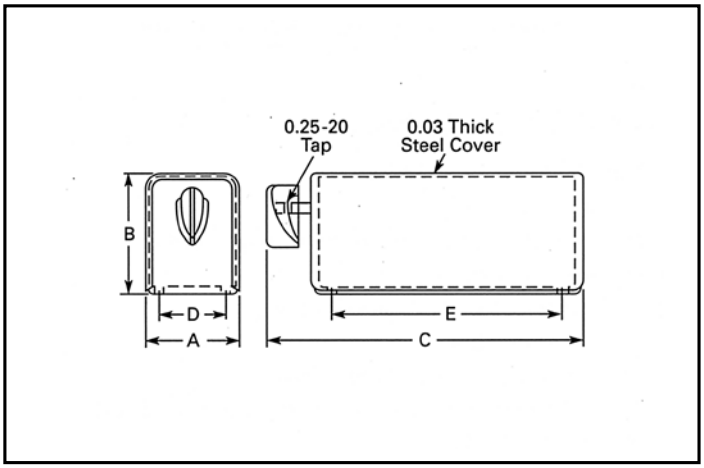
❶ Non-closing on Hi-shock

### Approximate Dimensions in Inches and Weights — Watertight Type T5



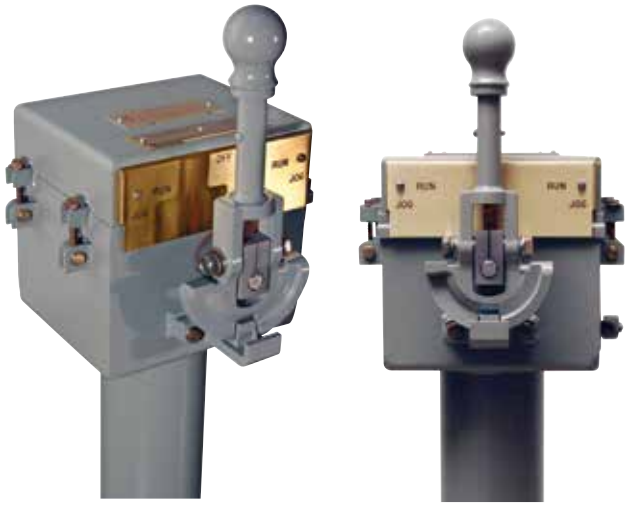

| Type | Dimensions in Inches | | | | | Weight Lbs. |
|---|---|---|---|---|---|---|
| | Wide A | High B | Deep C | Mounting D | Mounting E | |
| 7 Finger | 5 | 4.8 | 9.12 | 4.25 | 5.5 | 17.5 |

### Approximate Dimensions in Inches and Weights — Dripproof Type T5




| Type | Dimensions in Inches | | | | | Weight Lbs. |
|---|---|---|---|---|---|---|
| | Wide A | High B | Deep C | Mounting D | Mounting E | |
| 7 Finger | 2.38 | 3.25 | 8.13 | 1.75 | 5.88 | 1.5 |
| 10 Finger | 2.38 | 3.25 | 9.88 | 1.75 | 7.88 | 2.25 |

# Type 6982-T8
# Cam Type Master Switch



## When ordering specify

- Type number – 6982-T8
- Voltage, AC or DC
- Circuit arrangement
- Self-centering or non-self-centering
- Applications and legends
- Non-plugging or counterbalanced lever

## Specifications

- MIL-SPEC ..... MIL-DTL-2212
  Master switch contacts are non-closing on Class HI-Shock. Contacts may momentarily bounce open on Class HI-Shock.
- Enclosure ..... Watertight
- Operation ..... Manual, self-centering and non-self-centering types
- Location ..... Remote
- Type ..... 2-speed reversing (6 circuits)
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B

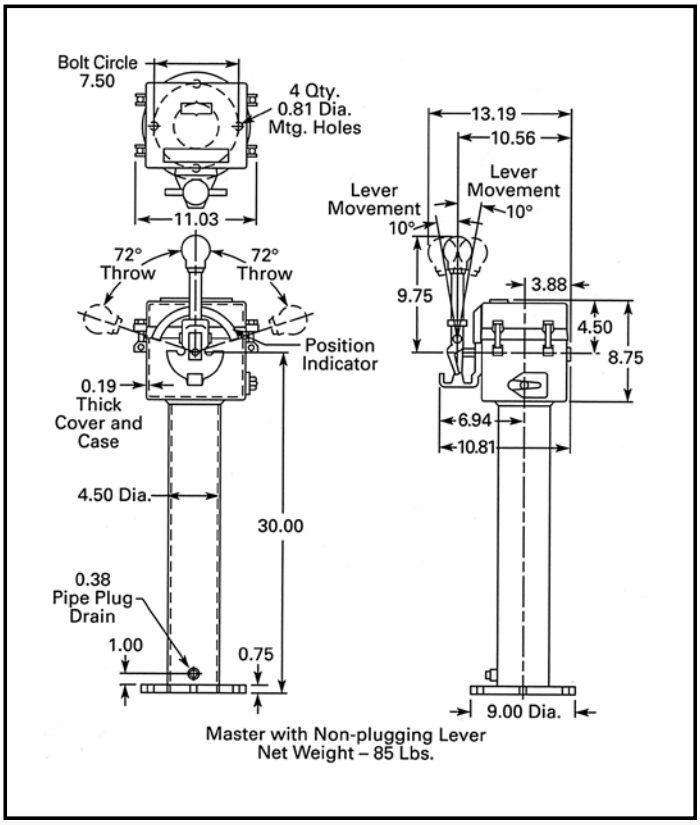
### Ratings – Pilot Circuits Only

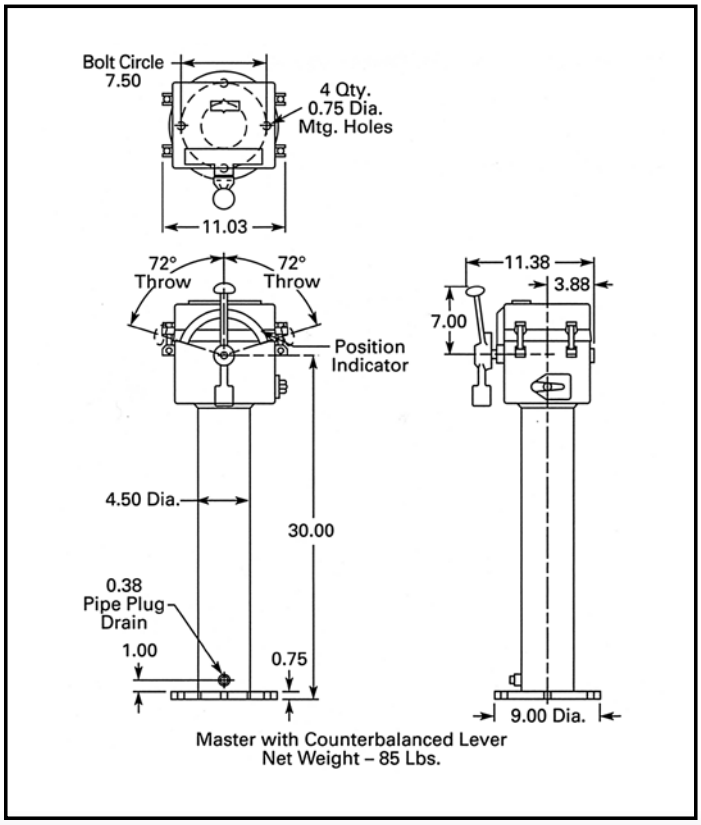
| Inductive Rating | Maximum Amperes | | | |
|---|---|---|---|---|
| | AC 60 Hz | | DC | |
| | 110V | 440V | 115V | 230V |
| Make | 40 | 10 | 3 | 1.5 |
| Break | 10 | 2.5 | 3 | 1.5 |
| Carry (cont.) | 10 | 10 | 10 | 10 |

### When Ordering Renewal Parts –

For a master switch in service, be sure to give nameplate data and description of parts required.

### Approximate Dimensions in Inches and Weights



# Type 6982-T9
# Pedestal Mounted Cam Type Master Switch

## When ordering specify

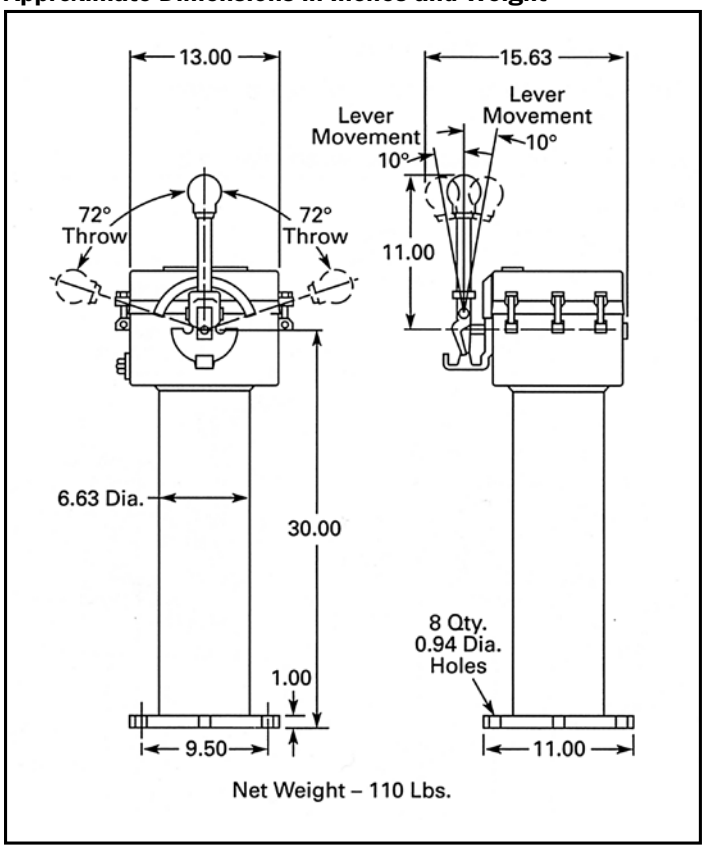
- Type number – 6982-T9
- Voltage, AC or DC
- Circuit Arrangement
- Application and legends
- Non-plugging or counterbalanced lever

**When Ordering Renewal Parts –**
For a master switch in service, be sure to give nameplate data and description of parts required.

## Specifications

- MIL-SPEC .....MIL-DTL-2212
  Master switch contacts are non-closing on Class HI-Shock. Contact may momentarily bounce open on Class HI-Shock.
- Enclosure .....Watertight
- Operation .....Manual, self-centering and non-self-centering types
- Location .....Remote
- Type .....Cam Type – 5 positions each direction
- Duty .....Continuous
- Ambient temp .....50°C

**Approximate Dimensions in Inches and Weight**

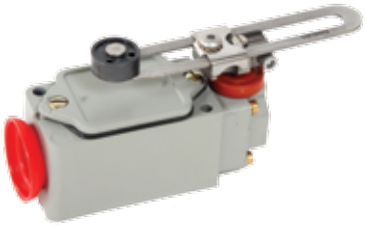



**Ratings – Pilot Circuits Only**

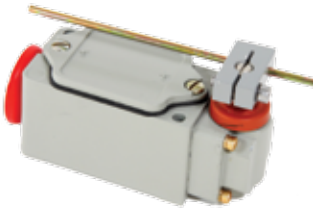
| Inductive Rating | Maximum Amperes | | | |
|---|---|---|---|---|
| | AC 60 Hz | | DC | |
| | 110V | 440V | 115V | 230V |
| Make | 40 | 10 | 3 | 1.5 |
| Break | 10 | 2.5 | 3 | 1.5 |
| Carry (cont.) | 10 | 10 | 10 | 10 |

# Type 6984NL
# Snap Action Limit Switches

*Counterbalanced Roller Lever*



*Adjustable Roller Lever*



*Adjustable Rod Actuator*

*Top Pushbutton Roller*

## Specifications

- MIL-SPEC .....MIL-DTL-2212
- Enclosure .....Watertight, zinc alloy die casting with corrosion resistant finish
- Type .....Snap action precision type, single-pole double-throw (NO-NC), or double-pole single-throw (2NO-2NC)
- Operation .....5 types of operating heads available; in addition to four-position, 90° operating head rotation, all rotary lever type limit switches offer 360° lever adjustability. Spring return to normal.
- Duty .....Continuous
- Ambient temp .....50°C
- Insulation .....Navy molding material, removable as complete unit
- Weight .....1.25 Lbs.

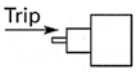
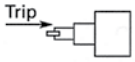
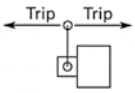
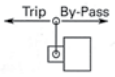
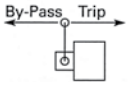
## When ordering specify

- Catalog number
- Voltage
- Type of operating head
- For roller lever, adjustable lever or adjustable rod, specify if bypass is required in either direction of operation.

### Ratings – Pilot Duty AC or DC

| Contacts | Current Amperes | AC | | DC | | |
|---|---|---|---|---|---|---|
| | | 110V | 440V | 115V | 230V | 355V |
| NO-NC | Max. Inrush | 40 | 10 | - | - | - |
| | Max. Continuous | 15 | 6 | 0.5 | 0.2 | 0.1 |
| 2NO or 2NC | Max. Inrush | 17 | 4.5 | - | - | - |
| | Max. Continuous | 3 | 0.75 | 0.1 | 0.05 | - |

### Type NL

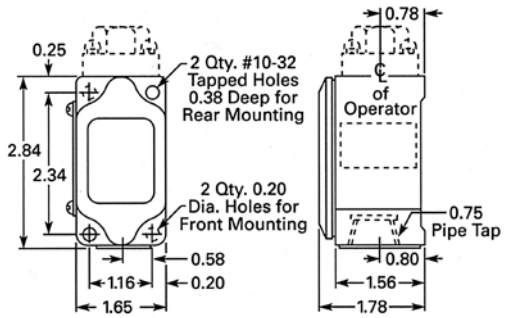
| Description | | 1NO-1NC ❸ | 2NO | 2NC |
|---|---|---|---|---|
| Type of Operator | Function | Cat. No. | Cat. No. | Cat. No. |
| Pushbutton |   | **6984H42A** | **6984H79A** | **6984H80A** |
| Push Roller |   | **6984H43A** | **6984H81A** | **6984H82A** |
| Adjustable Rod Lever |   | **6984H50A** | **6984H95A** | **6984H98A** |
| Adjustable Roller Lever | | **6984H47A** | **6984H89A** | **6984H92A** |
| 1.5" Counterbalance Roller Lever ❷ | | **6984H53A ❶** | **6984H83A** | **6984H86A** |
| Adjustable Rod Lever |   | **6984H51A** | **6984H96A** | **6984H99A** |
| Adjustable Roller Lever | | **6984H48A** | **6984H90A** | **6984H93A** |
| 1.5" Counterbalance Roller Lever ❷ | | **6984H54A ❶** | **6984H84A** | **6984H87A** |
| Adjustable Rod Lever |   | **6984H52A** | **6984H97A** | **6984H100A** |
| Adjustable Roller Lever | | **6984H49A** | **6984H91A** | **6984H94A** |
| 1.5" Counterbalance Roller Lever ❸ | | **6984H55A ❶** | **6984H85A** | **6984H88A** |

❶ These switches are electrically "HI-Shock." All others are mechanical "HI-Shock" only.
❷ Switch with 2.5" counterbalance roller lever is available. Information and price based on application.
❸ Must be same polarity

# Type 6984NL
# Snap Action Limit Switches

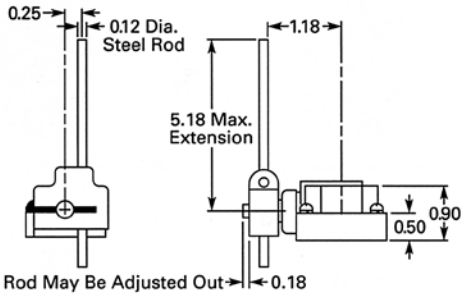
**Approximate Dimensions in Inches and Operating Data**

### Without Operating Head



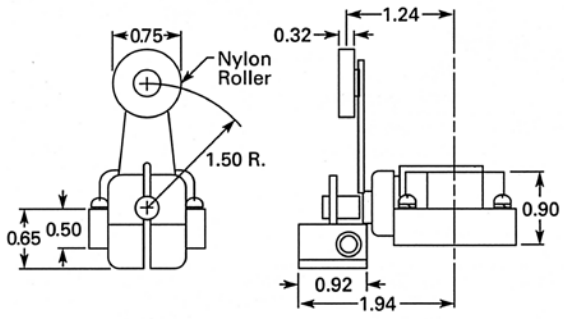

| | |
|---|---|
| Travel to Close Contacts | 10° |
| Pounds Force to Trip @ 1.5" Radius | 2 |
| Total Travel | 50° |
| Travel to Reset from Trip Point | 4° |

### Adjustable Rod Actuator



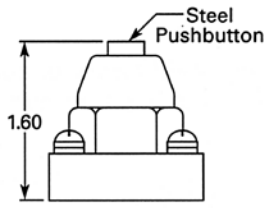

| | |
|---|---|
| Travel to Close Contacts | 10° |
| Pounds Force to Trip @ 1.5" Radius | 2 |
| Total Travel | 50° |
| Travel to Reset from Trip Point | 4° |

### Counterbalanced Roller Lever



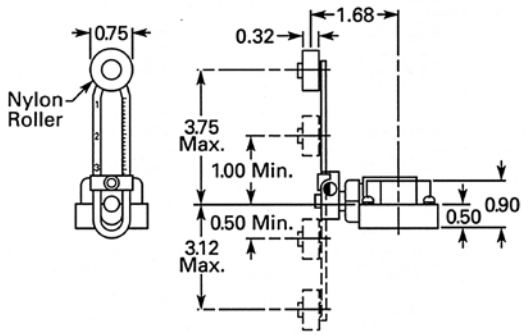

| | |
|---|---|
| Travel to Close Contacts | 10° |
| Pounds Force to Trip @ 1.5" Radius | 2 |
| Total Travel | 50° |
| Travel to Reset from Trip Point | 4° |

### Top Pushbutton



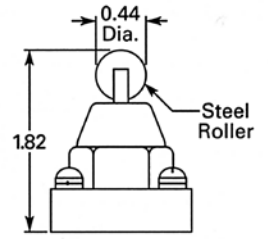

| | |
|---|---|
| Travel to Close Contacts | 0.05" |
| Pounds Force to Trip Contacts | 4.0 |
| Total Travel | 0.28" |
| Travel to Reset | 0.02" |

### Adjustable Roller Lever




| | |
|---|---|
| Travel to Close Contacts | 10° |
| Pounds Force to Trip @ 1.5" Radius | 2 |
| Total Travel | 50° |
| Travel to Reset from Trip Point | 4° |

### Top Push Roller




| | |
|---|---|
| Travel to Close Contacts | 0.04" |
| Pounds Force to Trip Contacts | 4.0 |
| Total Travel | 0.28" |
| Travel to Reset | 0.02" |

# Type 6984NL X–W
# Explosion–Proof❶/Watertight Limit Switches

## Specifications

- MIL-SPEC .....MIL-DTL-2212
- Enclosure .....Watertight (hose test) and explosion-proof ❶. Completely corrosion-proof switch. All metallic external parts are silicon bronze.
- Type .....Snap action precision type: NO-NC, 2NO or 2 NC
- Operation .....Top pushbutton, top push roller and roller lever types available. In addition to four-position, 90° operating head rotation, all rotary lever type limit switches offer 360° lever adjustability. Spring return to normal.
- Duty .....Continuous
- Ambient temp .....50°C

**Ratings – Pilot Duty AC or DC**

| Contacts | Current Amperes | AC | | DC | | |
|---|---|---|---|---|---|---|
| | | 110V | 440V | 115V | 230V | 355V |
| NO-NC | Max. Inrush | 40 | 10 | - | - | - |
| | Max. Continuous | 15 | 6 | 0.5 | 0.2 | 0.1 |
| 2NO or 2NC | Max. Inrush | 17 | 4.5 | - | - | - |
| | Max. Continuous | 3 | 0.75 | 0.1 | 0.05 | - |

## When ordering specify

- Catalog number

**Type NLXW Silicon Bronze Limit Switches**

| Contacts | Rotation | Operator Type ❷ – Catalog number | | | | Weight Lbs. |
|---|---|---|---|---|---|---|
| | | Top Pushbutton | Top Roller | 1.5" Counterbalanced Roller Lever | 2.5" Counterbalanced Roller Lever | |
| NO-NC ❹ | - | **6984ED64-21** | **6984ED64-24** | - | - | 6.25 |
| | CW and CCW | - | - | **6984ED64-27** ❸ | **6984ED64-36** ❸ | |
| | CCW | - | - | **6984ED64-28** ❸ | **6984ED64-40** ❸ | |
| | CW | - | - | **6984ED64-29** ❸ | **6984ED64-41** ❸ | |
| 2NO | - | **6984ED64-22** | **6984ED64-25** | - | - | 6.25 |
| | CW and CCW | - | - | **6984ED64-30** | **6984ED64-37** | |
| | CCW | - | - | **6984ED64-31** | - | |
| | CW | - | - | **6984ED64-32** | - | |
| 2NC | - | **6984ED64-23** | **6984ED64-26** | - | - | 6.25 |
| | CW and CCW | - | - | **6984ED64-33** | **6984ED64-38** | |
| | CCW | - | - | **6984ED64-34** | - | |
| | CW | - | - | **6984ED64-35** | - | |

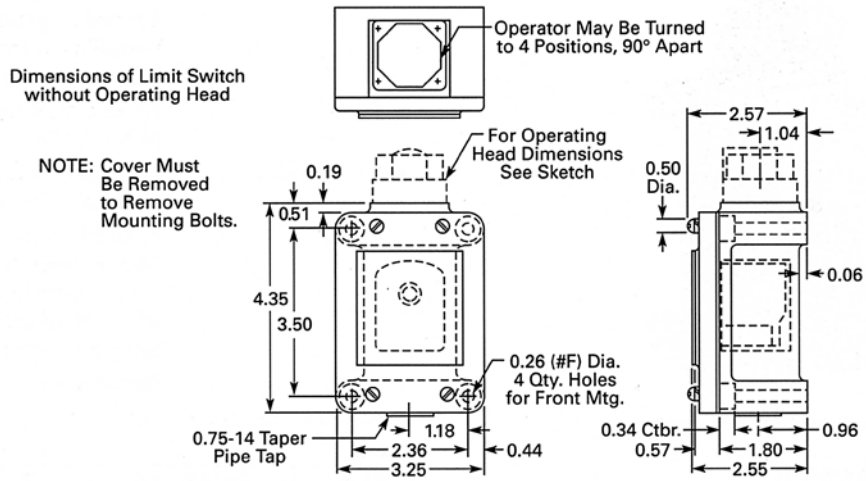
❶ Class I, Group D, unless specifically defined otherwise.
❷ For dimensions and operating characteristics, see dimension drawings on **Page 86**.
❸ Only these switches are electrically and mechanically "HI-Shock." All others are mechanically "HI-Shock" only.
❹ Both contacts must be the same polarity.

# Type 6984NLX-W
# Explosion-Proof[1] / Watertight Limit Switches

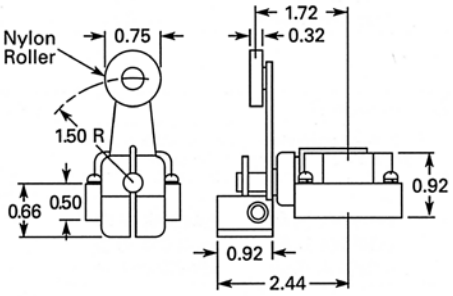
**Silicon Bronze**

## Approximate Dimensions in Inches and Operating Data

### Silicon Bronze Limit Switch without Operating Head

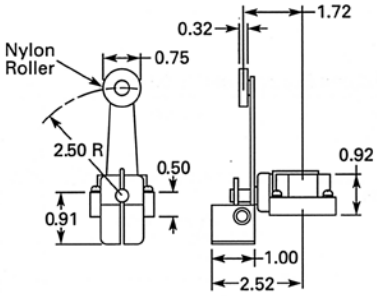



### 1.5" Counterbalanced Roller Lever with Nylon Roller



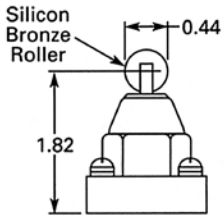

| | |
|---|---|
| Travel to Trip | 10° |
| Pounds Force to Trip @ 1.5" Radius | 2 |
| Total Travel | 50° |
| Travel to Reset | 4° |

### 2.5" Counterbalanced Lever with Nylon Roller



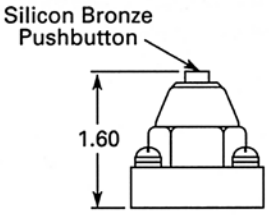

| | |
|---|---|
| Travel to Trip | 10° |
| Pounds Force to Trip @ 2.5" Radius | 1.2 |
| Total Travel | 50° |
| Travel to Reset | 4° |

### Top Push Roller




| | |
|---|---|
| Travel to Close Contacts (maximum) | 0.05" |
| Pounds Force to Trip Contacts | 5.75 |
| Total Travel (minimum) | 0.27" |
| Travel to Reset (maximum) | 0.05" |

### Top Pushbutton




| | |
|---|---|
| Travel to Close Contacts (maximum) | 0.05" |
| Pounds Force to Trip Contacts | 5.75 |
| Total Travel (minimum) | 0.27" |
| Travel to Reset (maximum) | 0.05" |

[1] Class I, Group D, unless Specifically defined otherwise.

**NOTE:** Dimensions are approximate and are not to be used for construction.

# Type 6984-T11 and T12
# Snap Action Limit Switch

*Type T11 – Watertight with 3.5 Inch Lever and Large Nylon Roller*

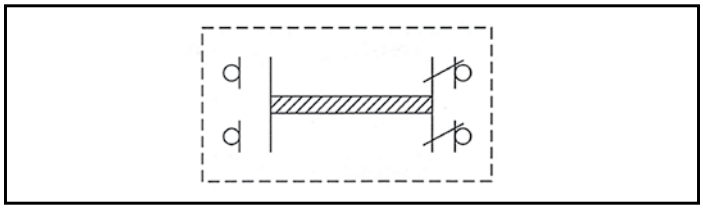
## When ordering specify

- Catalog number
- Voltage
- Type of operating head
- For roller lever type operator, specify if bypass is required in either direction of operation.

## Arrangement of Contacts

### Type T11

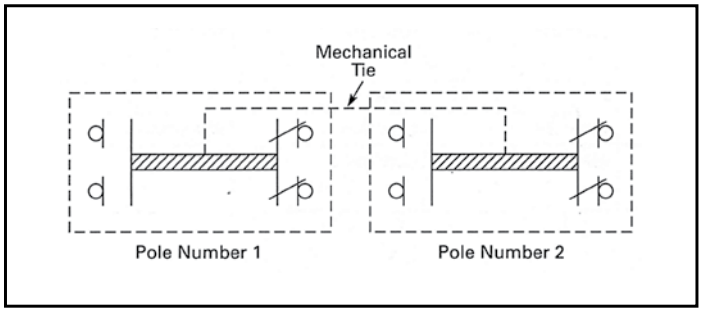
Single-Pole, Double-Throw Switch — Normal Position



Normally open and normally closed contacts should be on the same side of the line.

### Type T12

Double-Pole, Double-Throw Switch — Normal Position




The poles can be used on opposite sides of the line. Normally open and normally closed contacts on each pole must be on the same side of the line.

## Specifications

- MIL-SPEC.....MIL-DTL-2212
- Enclosure .....Watertight or explosion-proof ❶.
- Type .....Snap action limit switch
  C-H Type T11 -
  Single-Pole, Double-Throw
  C-H Type T12 -
  Double-Pole, Double-Throw
- Operation .....Three types of operating head available:
  Roller lever operator
  Push roller operator
  Pushbutton operator
  Spring return to normal position
- Duty .....Continuous
- Ambient temp .....50°C
- Insulation .....Class B

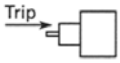
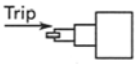
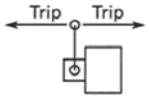
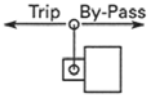
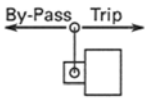
### Ratings – Pilot Circuits Only

| Inductive Rating | Maximum Amperes | | | | | |
|---|---|---|---|---|---|---|
| | AC 60 Hertz | | | DC | | |
| | 110V | 220V | 440V | 115V | 230V | 250V❷ |
| Make | 60 | 30 | 20 | 10 | 10 | 10 |
| Break | 6 | 3 | 1.5 | 2.2 | 1.1 | 0.5 |
| Carry (Cont.) | 10 | 10 | 10 | 10 | 10 | 10 |

❶ Class I, Group D, unless specifically defined otherwise.
❷ Nominal submarine voltage (355V maximum).

# Type 6984-T11 and T12
# Snap Action Limit Switch

**Types T11 and T12 – Watertight or Explosion Proof ❶**

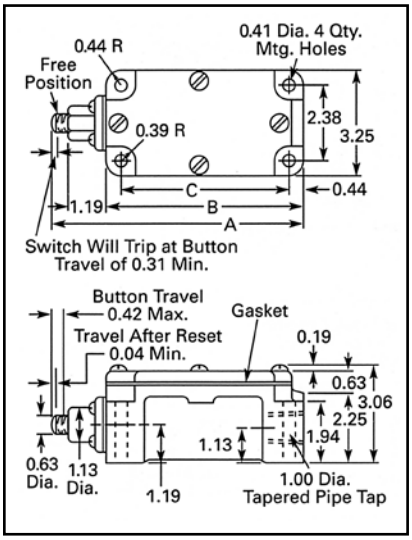
| Description | | Type T11 – 1NO-1NC | | Type T12 – 2NO-2NC | |
|---|---|---|---|---|---|
| Type of Operator | Function | Watertight | Explosion-Proof ❶ | Watertight | Explosion-Proof ❶ |
| | | Catalog number | Catalog number | Catalog number | Catalog number |
| Pushbutton |  | 6984H5C | 6984H21B | 6984ED89-1 | 6984ED86-1 |
| Push Roller |  | 6984H6C | 6984H22B | 6984ED89-2 | 6984ED86-2 |
| 1.19” Long Roller Lever, Steel Roller |  | 6984ED5-2 | 6984ED39-2 | 6984ED92-1 | - |
| 2.5” Long Roller Lever, Steel Roller | | 6984H27A | 6984ED64-36 | 6984ED90-1 | 6984ED87-1 |
| 3.5” Long Roller Lever, Nylon Roller ❷ | | 6984H36A | 6984H33A | 6984ED91-1 | 6984ED88-1 |
| 1.19” Long Roller Lever, Steel Roller |  | 6984ED6-2 | 6984ED39 | 6984ED92-2 | - |
| 2.5” Long Roller Lever, Steel Roller | | 6984H28A | 6984H25A | 6984E90-2 | 6984ED87-3 |
| 3.5” Long Roller Lever, Nylon Roller ❷ | | 6984H37A | 6984H34A | 6984ED91-2 | 6984ED88-2 |
| 1.19” Long Roller Lever, Steel Roller |  | 6984ED7 | - | 6984ED92-3 | - |
| 2.5” Long Roller Lever, Steel Roller | | 6984H29A | 6984H26A | 6984ED90-3 | 6984ED87-4 |
| 3.5” Long Roller Lever, Nylon Roller ❷ | | 6984H38A | 6984H35A | 6984ED91-3 | 6984ED88-3 |

❶ Class I, Group D, unless specifically defined otherwise.
❷ Nylon roller is 1.5” diameter.

# Type 6984-T11 and T12
# Snap Action Limit Switches

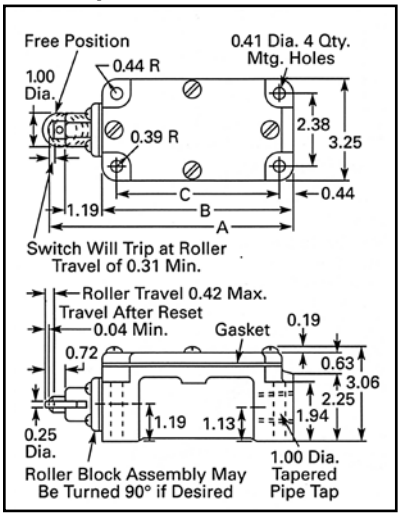
## Approximate Dimensions in Inches and Weights – Watertight Enclosures

### Snap Action Limit Switch with Pushbutton Operator



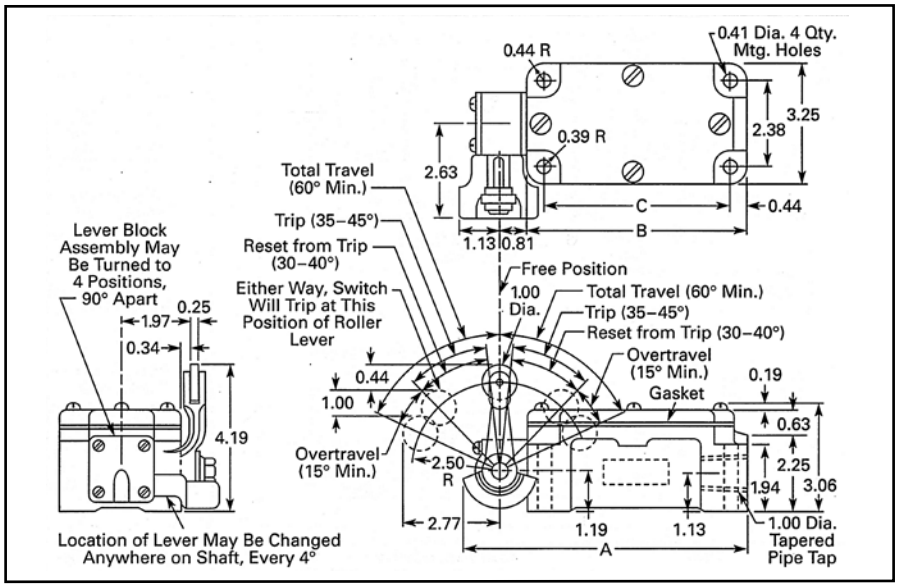

| Type | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | A | B | C | |
| T11-Single-Pole, Double Throw | 7.91 | 6.13 | 5.25 | 4 |
| T12 – Double-Pole, Double Throw | 11.03 | 9.25 | 8.38 | 5 |

### Snap Action Limit Switch with Push Roller Operator



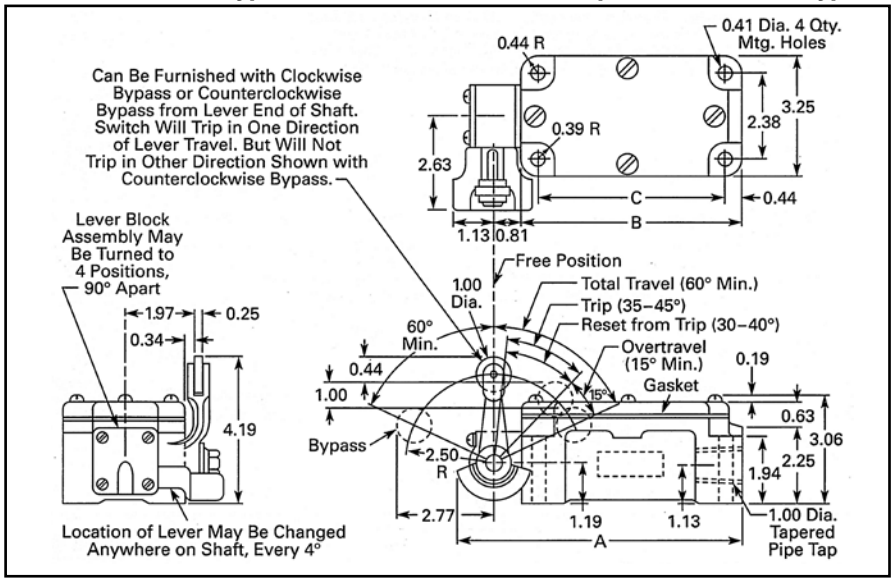

| Type | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | A | B | C | |
| T11-Single-Pole, Double Throw | 8.03 | 6.13 | 5.25 | 4 |
| T12 – Double-Pole, Double Throw | 11.16 | 9.25 | 8.38 | 5 |

### Snap Action Limit Switch with Roller Lever Operator, Clockwise and Counterclockwise Trip




| Type | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | A | B | C | |
| T11-Single-Pole, Double Throw | 8 | 6.13 | 5.25 | 4 |
| T12 – Double-Pole, Double Throw | 11.25 | 9.25 | 8.38 | 5 |

### Snap Action Limit Switch with Roller Lever Operator, Clockwise Trip and Counterclockwise Bypass - or Counterclockwise Trip and CLockwise Bypass



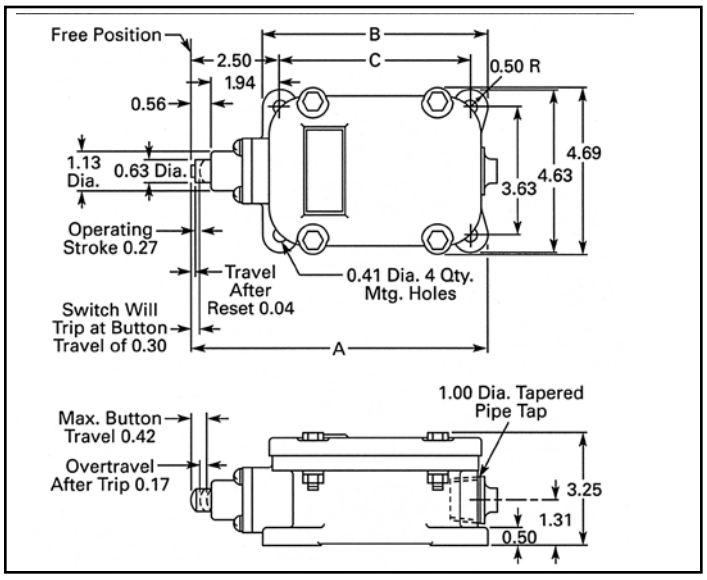

| Type | Dimensions in Inches ❶ | | | Weight Lbs. |
|---|---|---|---|---|
| | A | B | C | |
| T11-Single-Pole, Double Throw | 8.06 | 6.13 | 5.25 | 4 |
| T12 – Double-Pole, Double Throw | 11.19 | 9.25 | 8.38 | 5 |

❶ Nylon Roller is 1.5" diameter.

# Type 6984-T11 and T12
# Snap Action Limit Switch

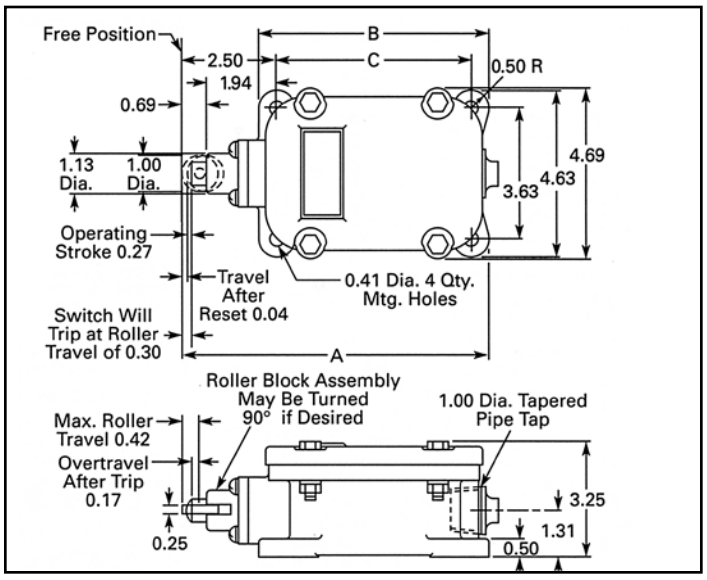
## Approximate Dimensions in Inches and Weights – Explosion-Proof Enclosures ❶ (Cast Brass)

### Snap Action Limit Switch with Pushbutton Operator



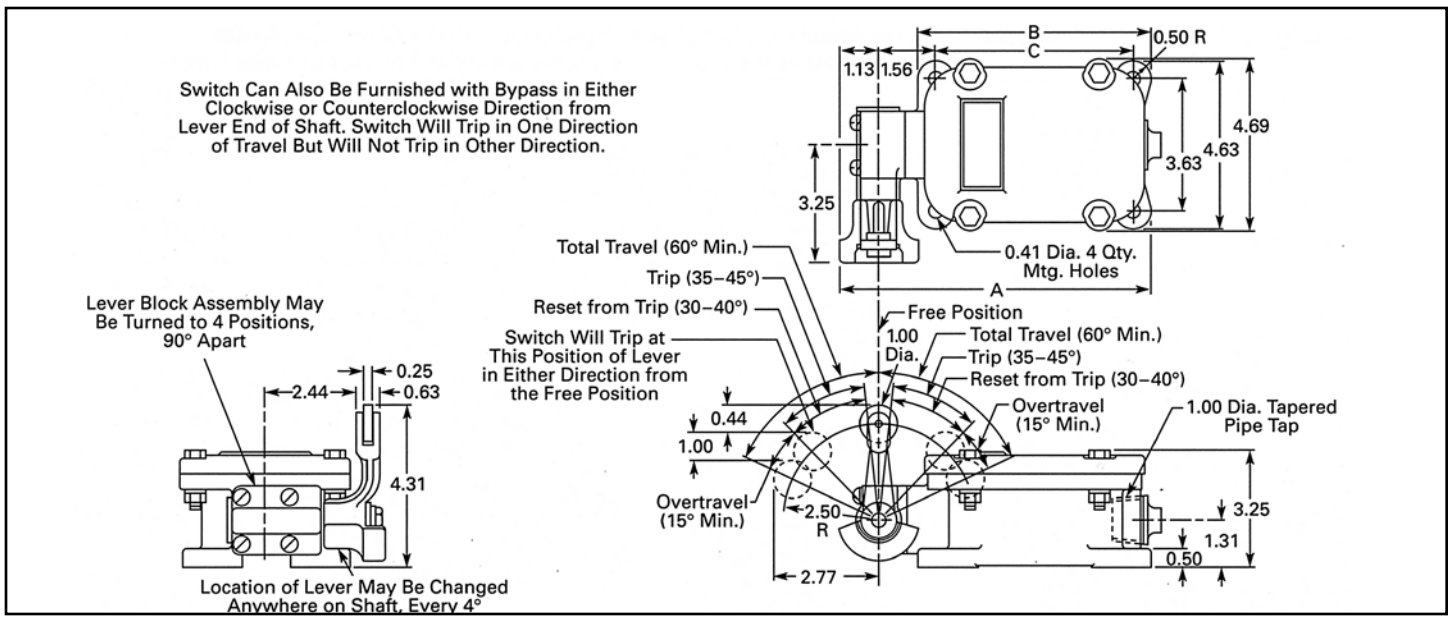

| Type | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | A | B | C | |
| T11-Single-Pole, Double Throw | 8.38 | 6.38 | 5.38 | 14 |
| T12 – Double-Pole, Double Throw | 11.5 | 9.5 | 8.5 | 20 |

### Snap Action Limit Switch with Push Roller Operator




| Type | Dimensions in Inches | | | Weight Lbs. |
|---|---|---|---|---|
| | A | B | C | |
| T11-Single-Pole, Double Throw | 8.5 | 6.38 | 5.38 | 14 |
| T12 – Double-Pole, Double Throw | 11.63 | 9.5 | 8.5 | 20 |

### Snap Action Limit Switch with Roller Lever Operator




| Type | Dimensions in Inches ❷ | | | Weight Lbs. |
|---|---|---|---|---|
| | A | B | C | |
| T11-Single-Pole, Double Throw | 9 | 6.38 | 5.38 | 14 |
| T12 – Double-Pole, Double Throw | 11.69 | 9.5 | 8.5 | 20 |

❶ Class I, Group D, unless specifically defined otherwise.

❷ Nylon roller is 1.5" diameter.

# Type 6984
# Geared Type Limit Switch

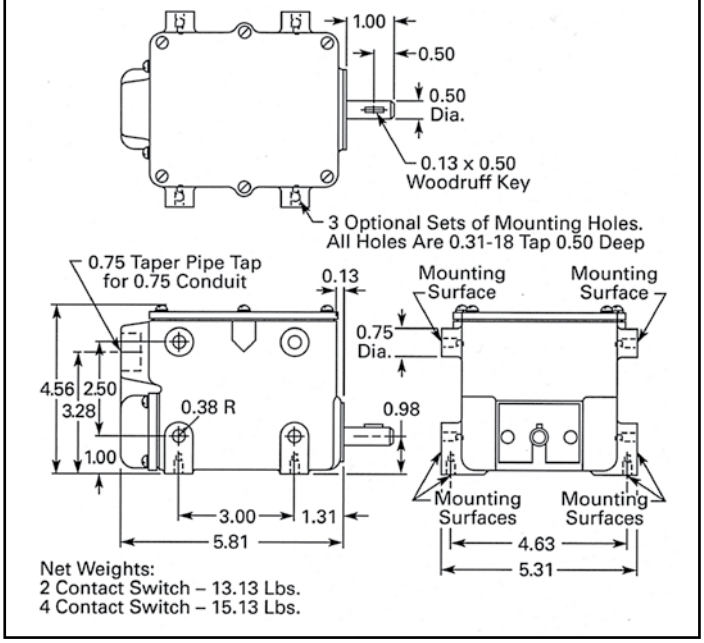
## When ordering specify

- Type number
- Voltage
- 2 contact or 4 contact
- Shaft speed
- Settings

### Geared Limit Switch - Watertight

| Description | Catalog No. |
|---|---|
| Rotating Shaft – 2 Contact (A&B) | **6984H133A-NM** |
| Rotating Shaft – 4 Contact (A-D) | **6984ED84NM** |

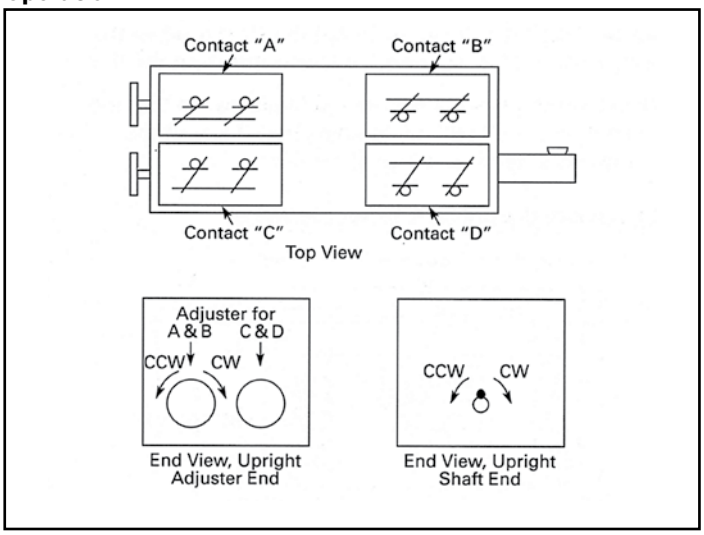
### Approximate Dimensions in Inches and Weights




## Specifications

- MIL-SPEC ..... MIL-DTL-2212
  Contact may open or close momentarily on Class HI-Shock
- Enclosure ..... Watertight – brass case and cover
- Type ..... Geared Type, 2 contact or 4 contact
- Operation ..... Shaft driven, tripping points are adjustable between ½ and 100 turns of operating shaft in increments of 1/20th of a shaft turn. For shaft speeds of 600 rpm (max.), 10 rpm (min.)
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Insulation ..... Class B

### Operation




All contacts are closed between limits, the switch construction is such that contact "A" and "D" are normally open before they are mounted in the switch, and contacts "B" and "C" are normally closed before mounting in switch.

Contacts "A" and "C" are opened by clockwise rotation of the adjuster, and clockwise rotation of the shaft. Contact "A" and "C" are set by driving the machine to its end of travel in the direction that turns the adjuster clockwise, and then opening the contacts with the adjuster.

Contacts "B" and "D" are opened by counterclockwise rotation of the adjuster, and the counterclockwise rotation of the shaft. Contacts "B" and "D" are set by driving the machine to its end of travel in the direction that turns the adjuster counterclockwise, and then opening the contacts with the adjuster.

One turn of the adjuster corresponds to 1-1/3 turns of the main shaft.

# Type 6991
# Overtemperature Monitor

## When ordering specify

- Catalog number of Overtemperature Monitor
- Resistance value of installed thermistors

**Type 6991 Overtemperature Monitor**

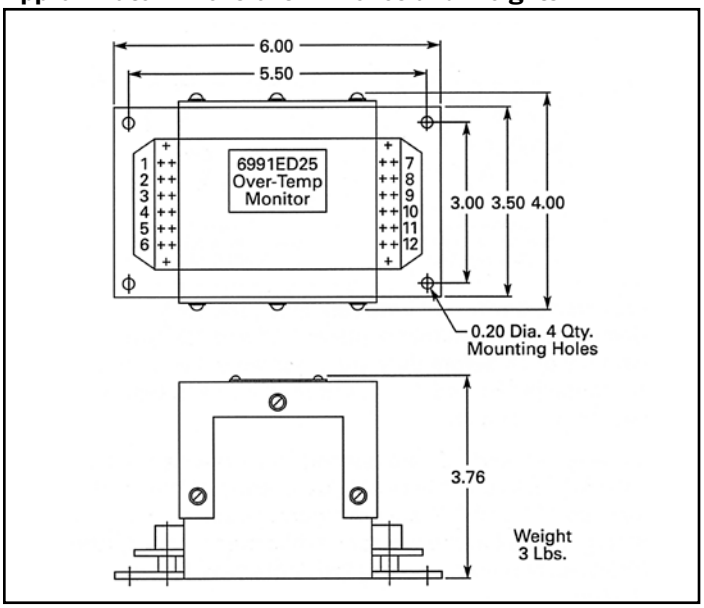
| Description | Catalog No. |
|---|---|
| Overtemperature Monitor | **6991ED25** |

## General

The Overtemperature Monitor measures the individual resistance of up to three thermistors which are attached to or imbedded in the motor windings. When one or more of the thermistors reaches its trip temperature (a resistance of 450 ohms), a control circuit relay (not supplied) is de-energized. The contacts of the control relay (not supplied) are wired in series with the motor starter magnet coil and drop out the starter when the relay opens. This disconnects the motor from the line.

The Overtemperature Monitor is "failsafe" in that the control relay coil will be de-energized if any of the thermistors open circuit or short out.

**Approximate Dimensions in Inches and Weights**




Catalog No. 6991ED25 supersedes and is interchangeable with Overtemperature Monitor Catalog No. 6999ED207C2.

## Specifications

- MIL-SPEC ..... MIL-E-917 and MIL-S-901
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Rating ..... 110V AC pilot duty

Three thermistors with the following characteristics are required:

- Type ..... Negative Temperature Coefficient
- Max. resistance ..... 4000 ohms at 20°C
- "Trip" resistance 450 ohms at desired "Trip" temperature

**NEMA Insulation Classes**

| Motor Insulation Class | Trip Temperatures |
|---|---|
| A | 100° C |
| B | 130° C |
| F | 155° C |
| H | 180° C |

# Type 6999
# Overspeed Trip Drive

## When ordering specify

- Catalog number

**Type 6999 Overspeed Trip Device**

| Description | Tachometer Voltage | Catalog number |
|---|---|---|
| Overspeed Trip Device | 0 - 40V<br>0 - 60V | **6999ED203A4**<br>**6999ED203A5** |

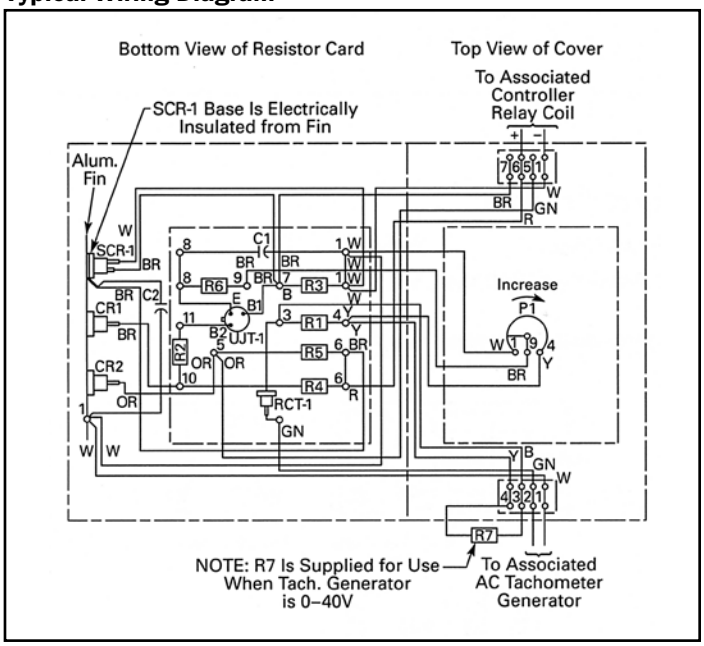
## General

The Overspeed Trip Device is designed to prevent overspeeding on DC driven M-G sets, centrifugal pumps, etc., by measuring tachometer voltage of the driven machine and stopping the motor at a predetermined voltage. Stopping is accomplished by de-energizing the coil of a DC control relay (not included), which then opens the main motor controller contactor.

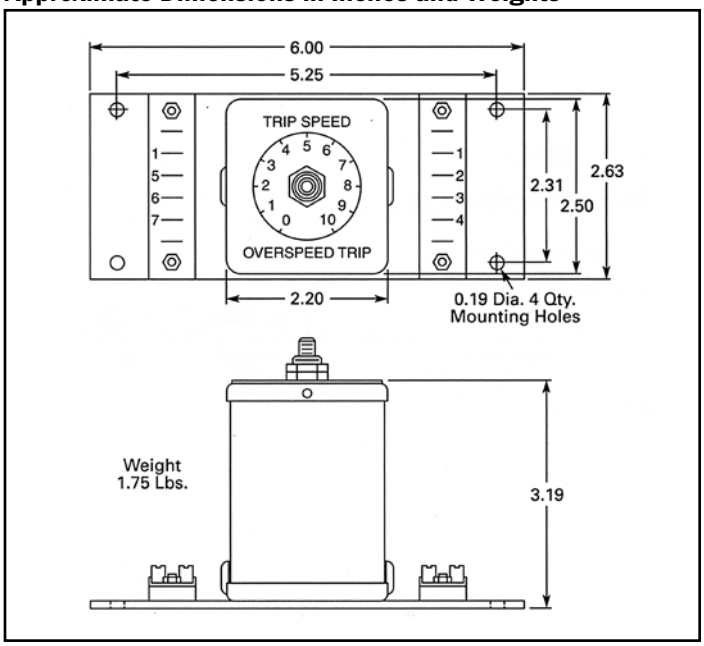
## Specifications

- MIL-SPEC ..... MIL-E-917 and MIL-S-901
- Duty ..... Continuous
- Ambient temp ..... 50°C
- Repair parts ..... Complete unit is supplied
- Ratings ..... Tachometer input 0-40V or 0-60V AC. Maximum voltage on terminals 1 through 6, 100V DC. Maximum application voltage with control relay, 250V DC nominal (180V - 355V submarine)

**Typical Wiring Diagram**




**Approximate Dimensions in Inches and Weights**



# Navy Control Circuit Wiring
# Terminal Boards / Fuse Blocks

## Terminal Boards

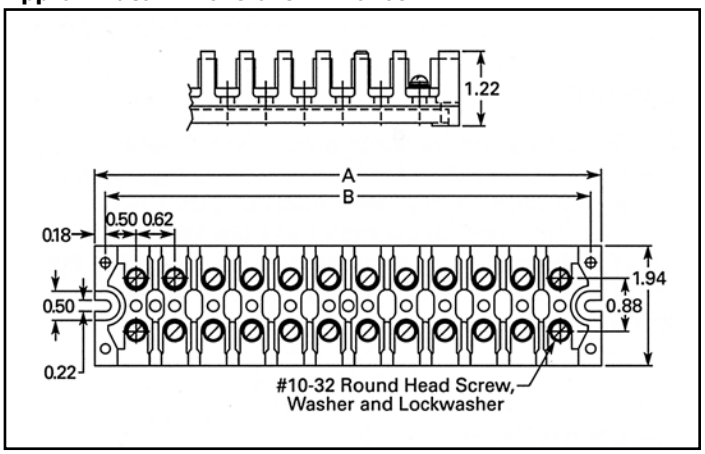
### When ordering specify
- Catalog number

**Terminal Boards**

| Tie Points | Dimensions In Inches | | Part Number |
|---|---|---|---|
| | A | B | |
| 4 | **3.25** | **2.88** | **80-958-4** |
| 8 | **5.75** | **5.38** | **80-958-5** |
| 12 | **8.25** | **7.88** | **80-958-6** |

### Specifications
- MIL-SPEC ..... MIL-DTL-2212
- Ratings ..... 440V AC, 30A continuous

**Approximate Dimensions in Inches**




## Fuse Blocks

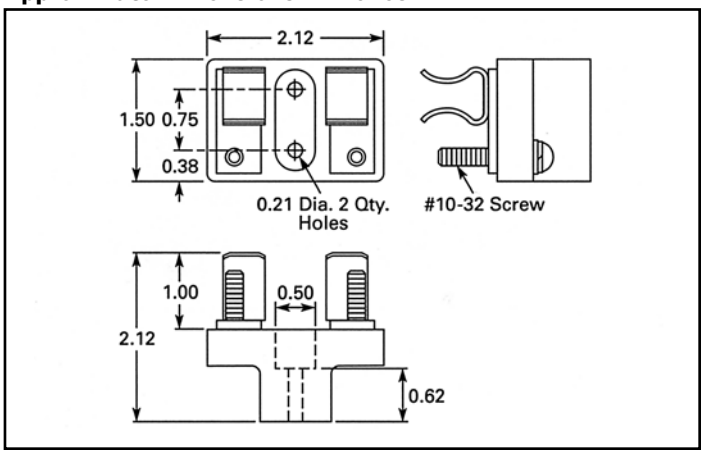
### When ordering specify
- Catalog number

**Terminal Boards**

| Fuse Type | Part Number |
|---|---|
| F60 (MIL-F-15160/60) | **44-1804A** |
| F61 (MIL-F-15160/61) | **44-647-5** |

### Specifications
- MIL-SPEC ..... MIL-DTL-2212
- Maximum Ratings..... 500V AC, 30A continuous

**Approximate Dimensions in Inches**



# Navy Power Terminal Blocks
# 100, 150 and 300 Amperes

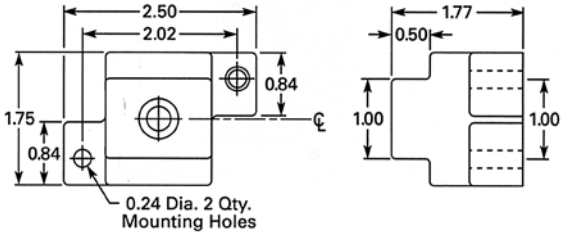
## When ordering specify
- Catalog number

## Specifications
- MIL-SPEC ..... MIL-DTL-2212
- Maximum ratings..... 600V

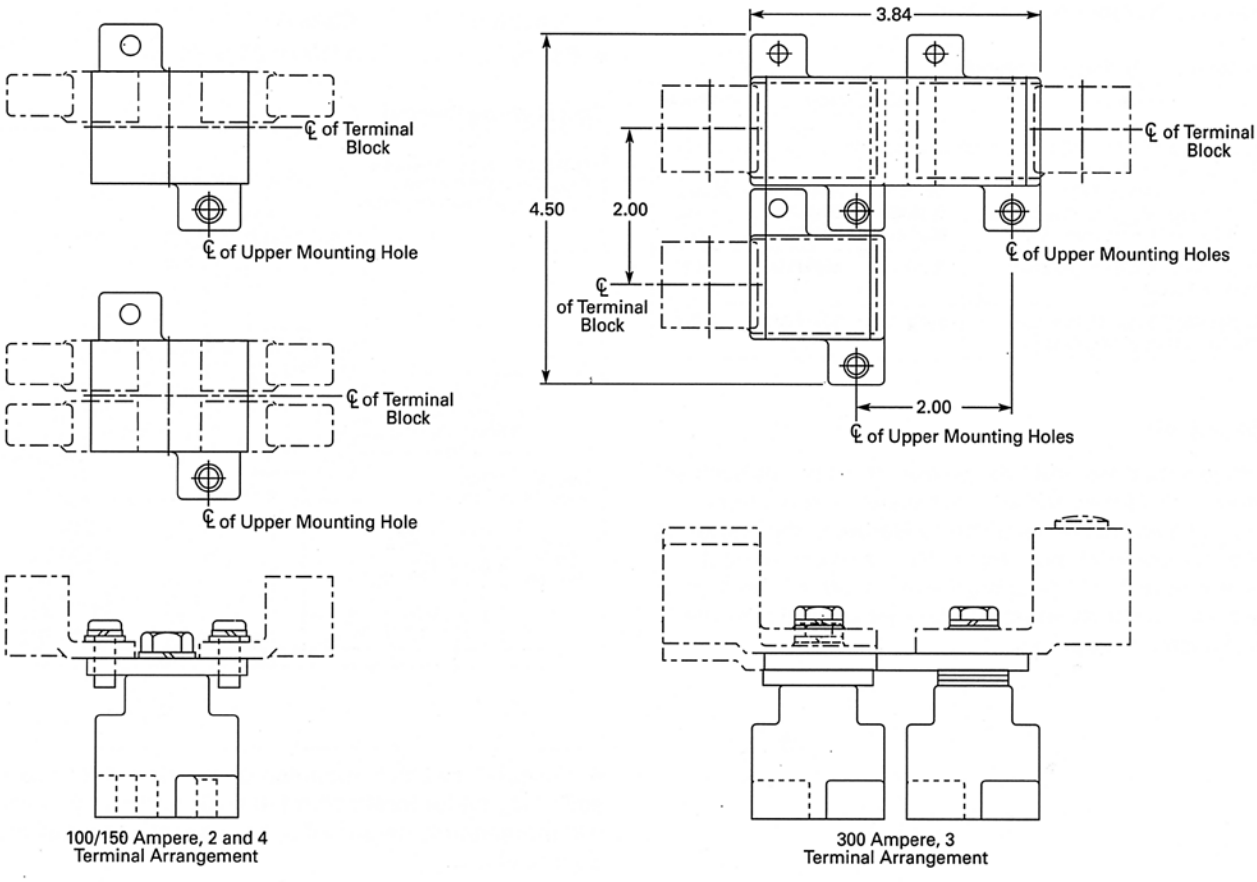
### Power Terminal Blocks

| Ampere Rating | Tie Points | Part Number |
|---|---|---|
| 100 | 2 | **81-7712** |
| 100 | 4 | **81-7712-2** |
| 150 | 2 | **81-7712-5** |
| 150 | 4 | **81-7712-6** |
| 300 | 2 | **81-7712-3** |
| 300 | 3 | **81-7712-4** |

### Basic Block Dimensions in Inches




### Terminal Arrangements, Approximate Dimensions in Inches



# POWER SOLUTIONS

## The Solution Leader - 100W - 200kW

DRS Power Solutions is a proven leader in the design, development and manufacturer of high reliability power generation and power conversion equipment from 100W to 200kW. Our combined capabilities blend the respected abilities of DRS Pivotal Power, DRS Fermont and DRS Universal Power Systems, providing an unmatched customer relationship commitment to fully understanding and providing your power requirements.

With over two decades of customer satisfaction and success, DRS Power Solutions delivers products to Navy operations world-wide, consistently exceeding expectations and bolstering our reputation for high reliability in power conversion equipment including UPS systems, rectifiers, vehicle starters, battery chargers and frequency converters. Units are available with hard mounting for bulkhead or deck, hard-mounted or isolated rack mounting, single- or three-phase ship power input and are all full MIL-SPEC qualified. We also offer affordable COTS systems.

In-house tests include environmental screening, EMI/EMC confidence and vibration.

### Engineered Center of Excellence

DRS Power Solutions has created an “Center of Excellence”, staffed by a dedicated and experienced engineering team for second-to-none capability and a thorough understanding of maritime needs.

DRS Technologies
A Finmeccanica Company

# 0.8 KW DC UPS

*841-01*

## General

DRS Pivotal Power's Uninterruptible Power Supply (UPS) systems are intended for use on board naval combat ships to power critical command, control, communications and navigation equipment.

## Features

- Mean Time Between Failures (MTBF) – 40,000 hours
- Isolation switches for input, output and battery
- SNMP communications and control options
- Draw-out sub-assemblies and printed wiring boards
- Built-In Test (BIT) capability
- On-line maintenance of batteries and battery charger
- 841-01 offers 30 minutes of backup*

  * Battery enclosures are sold separately

| Electrical Characteristics | |
|---|---|
| Input voltage | 440VAC, 3-Phase, 60Hz conforming to Type 1 of MIL-STD-1399, Section 300 A |
| **Output** | |
| Voltage nominal | 28 VDC |
| Voltage regulation | ± 2% |
| Power rating | 800W |
| Overload capacity | 125% for 1 minute |
| Short circuit current | 200% rated load current for 1 second |
| Maximum transient voltage for 50% load step | 10% |
| Maximum transient voltage recovery time for 50% load step | 100 ms |
| Ripple and noise | 200 mV p-p |
| Efficiency at rated load | 80% minimum |
| Remote signal communications | Multiple options available |
| Battery charging time | 6 hours for 40% capacity to 80% capacity |

| Environmental Characteristics | |
|---|---|
| Operating temperature | 0°C to 50°C / 32°F to 122°F |
| Storage temperature | -40°C to +70°C / -40°F to +158°F |
| Electromagnetic compatibility / Electromagnetic interference | MIL-STD-461D, CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, 4-33Hz |
| Shock | MIL-S-901D, Grade A, Class I |
| Airborne noise | MIL-STD-740-1, Class A12 |

| Reliability and Maintainability | |
|---|---|
| Mean time between failures (MTBF) | 40,000 hours |
| Mean time to repair | 20 minutes |
| Maximum time to repair | 45 minutes |

| Physical Characteristics (Please refer to the power unit interface control drawing for detailed dimensions) | | |
|---|---|---|
| Enclosure protection | Drip proof protected as per MIL-STD-108E (45°) | |
| Cooling method | Forced air | |
| **Approximate Dimensions / Mounting** | **Bulkhead** | **Rack** |
| Width (mm / inches) | 513 / 20.5 | 483 / 19.3 |
| Depth (mm / inches) | 231 / 9.1 | 725 / 28.6 |
| Height (mm / inches) | 640 / 25.2 | 222 / 8.9 (5U) |
| Weight (kg / pounds) | 47 / 114 | 47 / 114 |

# 2.4 KW DC UPS

*843-01*

## General

DRS Pivotal Power's Uninterruptible Power Supply (UPS) systems are intended for use on board naval combat ships to power critical command, control, communications and navigation equipment.

## Features

- Mean Time Between Failures (MTBF) – 40,000 hours
- Isolation switches for input, output and battery
- SNMP communications and control options
- Draw-out sub-assemblies and printed wiring boards
- Built-In Test (BIT) capability
- On-line maintenance of batteries and battery charger
- Key system LED status indicators, LCD status display
- 843-01 offers 30 minutes of backup*
  * Battery enclosures are sold separately

| Electrical Characteristics | |
|---|---|
| Input voltage | 440VAC, 3-Phase, 60Hz conforming to Type 1 of MIL-STD-1399, Section 300 A |
| **Output** | |
| Voltage nominal | 28 VDC |
| Voltage regulation | ± 2% |
| Power rating | 2.4 kW |
| Overload capacity | 125% for 1 minute |
| Short circuit current | 200% rated load current for 1 second |
| Maximum transient voltage for 50% load step | 10% |
| Maximum transient voltage recovery time for 50% load step | 100ms |
| Ripple and noise | 200 mV p-p |
| Efficiency at rated load | 80% minimum |
| Remote signal communications | Multiple options available |
| Battery charging time | 6 hours for 40% capacity to 80% capacity |

| Environmental Characteristics | |
|---|---|
| Operating temperature | 0°C to 50°C / 32°F to 122°F |
| Storage temperature | -40°C to +70°C / -40°F to +158°F |
| Electromagnetic compatibility / Electromagnetic interference | MIL-STD-461D, CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, 4-33Hz |
| Shock | MIL-S-901D, Grade A, Class I |
| Airborne noise | MIL-STD-740-1, Class A12 |

| Reliability and Maintainability | |
|---|---|
| Mean time between failures (MTBF) | 40,000 hours |
| Mean time to repair | 20 minutes |
| Maximum time to repair | 45 minutes |

| Physical Characteristics (Please refer to the power unit interface control drawing for detailed dimensions) | | |
|---|---|---|
| Enclosure protection | Drip proof protected as per MIL-STD-108E (45°) | |
| Cooling method | Forced air | |
| **Approximate Dimensions / Mounting** | **Bulkhead** | **Rack** |
| Width (mm / inches) | 513 / 20.5 | 483 / 19.3 |
| Depth (mm / inches) | 260 / 10.2 | 725 / 28.6 |
| Height (mm / inches) | 710 / 28.0 | 262 / 10.3 (6U) |
| Weight (kg / pounds) | 74 / 163 | 74 / 163 |

# 1.0 KW DC Rectifier

*841-01-14*

## General

DRS Pivotal Power's Rectifier systems are intended for use on board naval combat ships to provide regulated power to critical command, control, communications and navigation equipment.

## Features

- Mean Time Between Failures (MTBF) – 40,000 hours
- Isolation switches for input and output
- SNMP communications and control options
- Draw-out sub-assemblies and printed wiring boards
- Built-In Test (BIT) capability
- Available with Manually Adjustable Output Voltage and Line Loss Compensation Option (per MIL-P-15736)
- Also available in 2.4 KW Power Level

| Electrical Characteristics | |
|---|---|
| Input voltage | 440VAC, 3-Phase, 60Hz conforming to Type 1 of MIL-STD-1399, Section 300 A |
| **Output** | |
| Voltage nominal | 28 VDC |
| Voltage regulation | ± 2% |
| Power rating | 800W |
| Overload current, 125% | 44 A, shutdown in 80 sec. |
| Short circuit current | 80 A, shutdown in 2.5 sec. |
| Ripple and noise | 200 mV p-p |
| Efficiency at rated load | 80% minimum |
| Remote signal communications | Multiple options available |

| Environmental Characteristics | |
|---|---|
| Operating temperature | 0°C to 50°C / 32°F to 122°F |
| Storage temperature | -40°C to +70°C / -40°F to +158°F |
| Electromagnetic compatibility / Electromagnetic interference | MIL-STD-461D, CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, 4-33Hz |
| Shock | MIL-S-901D, Grade A, Class I |
| Airborne noise | MIL-STD-740-1, Class A12 |

| Reliability and Maintainability | |
|---|---|
| Mean time between failures (MTBF) | 40,000 hours |
| Mean time to repair | 20 minutes |
| Maximum time to repair | 45 minutes |

| Physical Characteristics (Please refer to the power unit interface control drawing for detailed dimensions) | | |
|---|---|---|
| Enclosure protection | Drip proof protected as per MIL-STD-108E (45°) | |
| Cooling method | Forced air | |
| **Approximate Dimensions / Mounting** | **Bulkhead** | **Rack** |
| Width (mm / inches) | 513 / 20.5 | 483 / 19.3 |
| Depth (mm / inches) | 231 / 9.1 | 725 / 28.6 |
| Height (mm / inches) | 640 / 25.2 | 222 / 8.9 (5U) |
| Weight (kg / pounds) | 47 / 114 | 43 / 95 |

# 2 KVA AC UPS

*832-01A*

## General

DRS Pivotal Power's Uninterruptible Power Supply (UPS) systems are intended for use on board naval combat ships to power critical command, control, communications and navigation equipment.

## Features

- Mean Time Between Failures (MTBF) – 40,000 hours
- Isolation switches for input, output and battery
- SNMP communications and control options
- Draw-out sub-assemblies and printed wiring boards
- Built-In Test (BIT) capability
- On-line maintenance of batteries and battery charger
- Key system LED status indicators, LCD status display
- 832-01A offers 30 Minutes of battery back up
  * Battery enclosures are sold separately

| Electrical Characteristics | |
|---|---|
| Input voltage | 440VAC, 3-Phase, 60Hz conforming to Type 1 of MIL-STD-1399, Section 300 A |
| **Output** | |
| Voltage | 115 VAC |
| Frequency | 60 Hz |
| Number of phases | 1 |
| Voltage regulation | ± 2 % |
| Frequency regulation | ± 0.5 % |
| Power rating | 2 kVA |
| Overload capacity | 125% for 1 minute |
| Short circuit current | 200% rated load current for 1 second |
| Maximum transient voltage for 50% load step | 10% |
| Maximum transient voltage recovery time for 50% load step | 100 ms |
| Linear load | < 3 % |
| Nonlinear load | < 5 % |
| Maximum deviation factor for linear load | 1 % |
| Current crest factor capacity | 2.5 |
| Efficiency at rated load | 80% minimum |
| Remote signal communications | Multiple options available |
| Battery charging time | 6 hours for 40% capacity to 80% capacity |

| Environmental Characteristics | |
|---|---|
| Operating temperature | 0°C to 50°C / 32°F to 122°F |
| Storage temperature | -40°C to +70°C / -40°F to +158°F |
| Electromagnetic compatibility / Electromagnetic interference | MIL-STD-461D, CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, 4-33Hz |
| Shock | MIL-S-901D, Grade A, Class I |
| Airborne noise | MIL-STD-740-1, Class A12 |

| Reliability and Maintainability | |
|---|---|
| Mean time between failures (MTBF) | 40,000 hours |
| Mean time to repair | 20 minutes |
| Maximum time to repair | 45 minutes |

| **Physical Characteristics** (Please refer to the power unit interface control drawing for detailed dimensions) | | |
|---|---|---|
| Enclosure protection | Drip proof protected as per MIL-STD-108E (45°) | |
| Cooling method | Forced air | |
| **Approximate Dimensions / Mounting** | **Bulkhead** | **Rack** |
| Width (mm / inches) | 445 / 17.8 | 483 / 19.3 |
| Depth (mm / inches) | 262 / 10.5 | 725 / 28.6 |
| Height (mm / inches) | 715 / 28.6 | 222 / 8.9 (5U) |
| Weight (kg / pounds) | 81 / 178 | 81 / 178 |

# 3 KVA AC UPS

*833-01A*

## General

DRS Pivotal Power's Uninterruptible Power Supply (UPS) systems are intended for use on board naval combat ships to power critical command, control, communications and navigation equipment.

## Features

- Mean Time Between Failures (MTBF) – 40,000 hours
- Isolation switches for input, output and battery
- SNMP communications and control options
- Draw-out sub-assemblies and printed wiring boards
- Built-In Test (BIT) capability
- On-line maintenance of batteries and battery charger
- Key system LED status indicators, LCD status display
- 833-01 offers 10 or 30 minutes of backup*
  * Battery enclosures are sold separately

| Electrical Characteristics | |
|---|---|
| Input voltage | 440VAC, 3-Phase, 60Hz conforming to Type 1 of MIL-STD-1399, Section 300 A |
| **Output** | |
| Voltage | 115 VAC |
| Frequency | 60 Hz |
| Number of phases | 1 |
| Voltage regulation | ± 2 % |
| Frequency regulation | ± 0.5 % |
| Power rating | 3 kVA |
| Overload capacity | 125% for 1 minute |
| Short circuit current | 200% rated load current for 1 second |
| Maximum transient voltage for 50% load step | 10% |
| Maximum transient voltage recovery time for 50% load step | 100ms |
| Linear load | < 3 % |
| Nonlinear load | < 5 % |
| Maximum deviation factor for linear load | 1% |
| Current crest factor capacity | 2.5 |
| Efficiency at rated load | 80% minimum |
| Remote signal communications | Multiple options available |
| Battery charging time | 6 hours for 40% capacity to 80% capacity |

| Environmental Characteristics | |
|---|---|
| Operating temperature | 0°C to 50°C / 32°F to 122°F |
| Storage temperature | -40°C to +70°C / -40°F to +158°F |
| Electromagnetic compatibility / Electromagnetic interference | MIL-STD-461D, CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, 4-33Hz |
| Shock | MIL-S-901D, Grade A, Class I |
| Airborne noise | MIL-STD-740-1, Class A12 |

| Reliability and Maintainability | |
|---|---|
| Mean time between failures (MTBF) | 40,000 hours |
| Mean time to repair | 20 minutes |
| Maximum time to repair | 45 minutes |

| Physical Characteristics (Please refer to the power unit interface control drawing for detailed dimensions) | | |
|---|---|---|
| Enclosure protection | Drip proof protected as per MIL-STD-108E (45°) | |
| Cooling method | Forced air | |
| **Approximate Dimensions / Mounting** | Bulkhead | Rack |
| Width (mm / inches) | 513 / 20.5 | 483 / 19.3 |
| Depth (mm / inches) | 262 / 10.5 | 715 / 28.6 |
| Height (mm / inches) | 715 / 28.6 | 222 / 8.9 (5U) |
| Weight (kg / pounds) | 81 / 178 | 81 / 178 |

# 6 KVA AC UPS

*836-01A*

## General

DRS Pivotal Power's Uninterruptible Power Supply (UPS) systems are intended for use on board naval combat ships to power critical command, control, communications and navigation equipment.

## Features

- Mean Time Between Failures (MTBF) – 40,000 hours
- Isolation switches for input, output and battery
- SNMP communications and control options
- Draw-out sub-assemblies and printed wiring boards
- Built-In Test (BIT) capability
- On-line maintenance of batteries and battery charger
- Key system LED status indicators, LCD status display
- 836-01 offers 10 or 30 minutes of backup*
  * Battery enclosures are sold separately

| Electrical Characteristics | |
|---|---|
| Input voltage | 440VAC, 3-Phase, 60Hz conforming to Type 1 of MIL-STD-1399, Section 300 A |
| **Output** | |
| Voltage | 115 VAC |
| Frequency | 60 Hz |
| Number of phases | 1 |
| Voltage regulation | ± 2 % |
| Frequency regulation | ± 0.5 % |
| Power rating | 6 kVA |
| Overload capacity | 125% for 1 minute |
| Short circuit current | 200% rated load current for 1 second |
| Maximum transient voltage for 50% load step | 10% |
| Maximum transient voltage recovery time for 50% load step | 100ms |
| Linear load | < 3 % |
| Nonlinear load | < 5 % |
| Maximum deviation factor for linear load | 1 % |
| Current crest factor capacity | 2.5 |
| Efficiency at rated load | 80% minimum |
| Remote signal communications | Multiple options available |
| Battery charging time | 6 hours for 40% capacity to 80% capacity |

| Environmental Characteristics | |
|---|---|
| Operating temperature | 0°C to 50°C / 32°F to 122°F |
| Storage temperature | -40°C to +70°C / -40°F to +158°F |
| Electromagnetic compatibility / Electromagnetic interference | MIL-STD-461D, CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, 4-33Hz |
| Shock | MIL-S-901D, Grade A, Class I |
| Airborne noise | MIL-STD-740-1, Class A12 |

| Reliability and Maintainability | |
|---|---|
| Mean time between failures (MTBF) | 40,000 hours |
| Mean time to repair | 30 minutes |
| Maximum time to repair | 60 minutes |

| Physical Characteristics (Please refer to the power unit interface control drawing for detailed dimensions) | | |
|---|---|---|
| Enclosure protection | Drip proof protected as per MIL-STD-108E (45°) | |
| Cooling method | Forced air | |
| **Approximate Dimensions / Mounting** | Bulkhead | Rack |
| Width (mm / inches) | 513 / 20.5 | 483 / 19.3 |
| Depth (mm / inches) | 400 / 16.0 | 710 / 28.4 |
| Height (mm / inches) | 710 / 28.4 | 355 / 14.2 |
| Weight (kg / pounds) | 151 / 332 | 151 / 332 |

# Helicopter Starter

*137-01B*

## General

DRS Pivotal Power's DC rectifier power supply (RPS) is intended for use on board combat ships. The RPS is capable of providing up to 1000 A short term high starting currents.

## Features

- Mean Time Between Failures (MTBF) – 60,000 hours
- Remote sensing capability
- Programmable battery charging algorithm
- UPS functionality
- Two output channels
- Use of Insulated Gate Bipolar Transistors (IGBT) as power switching devices
- Parallellable, up to three units

| Input Specifications | |
|---|---|
| Voltage | 440 VAC, 3 phase, 3 wire, 60 Hz |
| Current | Nominal 18 A – Maximum 30 A Full Load Output |
| **Output Specifications** | |
| Applicable standards | MIL-P-15736/1D |
| Output voltage | 26 to 32 VDC adjustable<br>Line drop compensated for up to 3.5V cable drop with 1000A output current |
| Voltage regulation | ± 2% |
| Rated output current | 350A |
| Short-term output current | 1000A for 1 sec |
| | 750A for 4 sec |
| | 500A for 15 sec |
| | 350A for 30 sec |
| | (Four consecutive cycles repeatable with 5 minute rest time) |
| Short circuit capacity | 1100A for 2 seconds |
| Ripple and noise | 2Vpp |
| Efficiency at rated load | 80% |
| Parallel operation | Up to 3 units can be paralleled to provide up to 1000A continuous output. |

| Environmental Qualifications | |
|---|---|
| Electromagnetic | 440 VAC, 3 phase, 3 wire, 60 Hz |
| Interference/Electromagnetic Compatibility (EMI/EMC) | MIL-STD-461D Surface Ships CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, 4-33 Hz |
| Noise | MIL-STD-740-1, Class A12, Grade B |
| Shock | MIL-STD-901D, Grade A, Type A, Class I |
| Ambient temperature | 0 to 50 degrees Celsius |
| Relative Humidity | Up to 95% |

| Reliability | |
|---|---|
| Mean time between failures (MTBF) | 40,000 hours |
| Mean time to repair | 20 min |
| Maximum time to repair | 45 min |

| Physical Characteristics | |
|---|---|
| Weight | 290 kg / 638 lbs |
| Width | 565 mm / 22.6 in |
| Depth | 603 mm / 24.1 in |
| Height | 921 mm / 36.8 in |

# DRS Trusted Series

Engineered for worldwide deployment and operation, the TR-IV Series rackmount UPS system stands alone in providing clean, reliable, isolated power to sensitive electronic loads.

For conditioned, true on-line regulated sinewave power and unmatched power protection, specify the 1500/2000 or 3000TR-IVglobal uninterruptible power supply (UPS) from DRS Technologies. Built using DRS' patented Intelligent Voltage Selection™ circuit combined with a matching isolation transformer, the unit configures and conditions a wide range of power inputs, permitting operation from domestic, international, and field generator power sources.

Major components of the system include a battery / maintenance bypass module with removable battery pack and, included with the 3000TR-IV, a separate UPS electronics module. Engineered for worldwide deployment and operation, this rackmount global UPS system stands alone in providing clean, reliable, isolated power to sensitive electronic loads.

Each unit is equipped with a B-Type USB port communications interface for remote monitoring, and an auxiliary outlet to support laser printers. Illuminated color indicators provide a reliable display of both operating and alarm conditions. Front panel touch controls provide alarm silence, manual battery test and standby options.

Rugged construction and advanced design makes this global UPS system ideal for any deployable or fixed site application. A front removable battery pack allows for easy battery replacement and/or an option for reduced transport weight. ADD an optional battery cabinet to provide extended battery backup.

## Features

- Global input power
- True sinewave output
- MIL-STD- 167-1
- Removable battery pack
- Self-contained, ruggedized unit
- Input isolation transformer
- B-Type USB Port Communications Interface

# DRS Trusted Series

| Specifications | 1500TR-IV | 2000TR-IV | 3000TR-IV |
|---|---|---|---|
| **Input Voltage Range** | 92-254 VAC | 92-127VAC, 198-254 VAC | |
| **Input Voltage Rating** | 120 V / 240 V | | 100/120/220/240 VAC |
| **Input Current Rating** | 40 - 70 HZ auto-sensin | | |
| **Input Power Factor** | > 0.95 typical | | |
| **Output Ratings** | | | |
| UPS | 1500 VA/1050W | 2000VA / 1400W | 3000 VA / 2100 W |
| AUX | 1050VA/1050W | 1400VA / 1400W | |
| Combined | 1500VA/1050W | 2000VA / 1400W | |
| **Output Voltage Settings** | 110/115/120/127 VAC; user selectable, max 5% THD; full non-linear load | | |
| **Output Frequency** | 50 / 60 Hz (fixed selectable, or synchronized to input | | |
| **Output Overload** | 200% for 2 seconds; 150% for 50 sec (1, 1.5, 2kW) or 10 sec (3kW) w transfer to bypass | | |
| **Transfer time to Battery** | None | | |
| **Reserve Battery Time** | 7 min at full load | 6 minutes at full load | 5 mins at full load |
| **Recharge Battery Time** | 3 hours to 90% after full load discharge | | |
| **Battery Rating** | 48 VDC | | 72 VDC / 9 Ah |
| **Battery Type** | valve regulated, non-spillable, lead acid | | |
| **Replacement Time** | < 5 min | | |
| **Ambient Temperature** | 0 C to 40 C / 32 F to 104 F operating for alt 0-3000m /0 - 10,000ft above sea level;<br>-15 C to 50 C / 5 F to 122 F non-operating. | | |
| **Relative Humidity** | 0 to 95 % non-condensing | | |
| **Operating Altitude** | full rating up to 3000m /10,000ft when operated within temperature range specified;<br>15,000m / 50,000ft non-operating. | | |
| **Audible Noise** | < 50 dB at 1m / 3.3ft; | | < 63 dB at 1m / 3.3ft |
| **Dimensions (H x W x D)** | | | |
| UPS Module | 13.3cm x 43.2cm x 53.3cm or<br>5.25in x 17in x 21in | 13.3cm x 43.2cm x 61cm<br>5.25in x 17in x 24in | 13.3cm x 43.2cm x 50.8cm<br>5.25in x 17in x 20in |
| Battery Mod | n/a | n/a | 13.3cm x 43.2cm x 50.8cm<br>5.25in x 17in x 20in |
| **Weight (kg / lbs)** | | | |
| Electronics | n/a | n/a | 12.3kg / 28lbs |
| With Battery | 34.9kg / 77lbs | 37kg / 81.5lbs | 45.4kg / 100lbs |
| Battery only | 11.8kg / 26lbs | 11.8kg / 26lbs | 17.7kg / 39lbs |
| **Input Power Cord** | 1.8m / 6ft with 5-15P plug | 1.8m / 6ft with 5-20Pplug | 1.8m / 6ft with L6-30 plug |
| **Output Receptacles** | (4) 5-15R, (1) 5-15R aux | (4) 5-20R, (1) 5-20R aux | (1) L5-30R, (2) 5-15/20R,<br>(2) 5-15R aux |

# Forklift Battery Charger

*225-01*

## General

DRS Pivotal Power's Forklift Battery Charger's high output power quality is achieved using state-of-the-art control algorithms. The monitoring scheme uses microprocessor based digital techniques to monitor various circuits continuously to detect any impeding faults early, initiate a gracious shutdown of the equipment and indicate the fault status on the digital display.

## Features

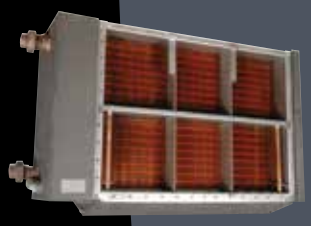
- Mean Time Between Failures (MTBF) – 40,000 hours
- Current limit selector switch.
- Voltage selector switch
- Remote line drop compensation
- Reverse battery protection through fuse of circuit
- Input circuit breaker
- Key system LED status indicators
- LCD status display

| Electrical Characteristics | |
|---|---|
| Input voltage | 440 VAC nominal, 60 Hz, 3 phase conforming to MIL-STD-1399, Section 300, Type I |
| **Output** | |
| Battery voltages | 24, 36 VDC selectable (12,18 cells) |
| Current ranges | 130, 150, 180, 200 A |
| Voltage adjustment range | 2.2 V – 2.5 V per cell through internal potentiometer |
| Temperature compensation of the output voltage | Yes |
| Voltage regulation | ± 0.02 Volts per cell |
| Ripple and noise | 2 % Maximum |
| Efficiency | 80% minimum at rated load |

| Environmental Qualifications | |
|---|---|
| EMC/EMI | MIL-STD-461D CE101, CE102, CS101, CS114, CS116, RE101, RE102, RS101, RS103 |
| Vibration | MIL-STD-167/1, Type I, up to 33 Hz |
| Shock resistance | MIL-S-901D, Class I |
| Airborne noise | MIL-STD-740B, Class B |
| Cooling method | Natural convection |
| Operating temperature | 0°C to +50°C |
| Mean time between failures | 40,000 hours |

| Physical Characteristics (Please refer to the power unit interface control drawing for detailed dimensions) | |
|---|---|
| **Approximate Dimensions** | |
| Width (mm / inches) | 674 / 26.9 |
| Depth (mm / inches) | 520 / 20.8 |
| Height (mm / inches) | 647 / 25.8 |
| Weight ( kgs / pounds) | 250 / 550 |

# HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION



DRS Marlo Coil is the leader in custom engineered heating, ventilating, air conditioning and refrigeration (HVAC&R) and is an NQA certified ISO 9001 Registered Company.

DRS is the U.S. Navy's largest supplier of heating and cooling coils, air handling units, product coolers and refrigeration plants. Our customer base also includes the Military Sealift Command, the U.S. Coast Guard and international governments.

DRS has developed and qualified virtually all U.S. Navy shipboard HVAC&R cooling and heating coils, fan coil units and fan coil assemblies since the 1940s. An unwavering commitment to quality, customer service and product flexibility continues to this day.

In addition to providing high quality custom engineered equipment for Navy and marine applications, DRS also regularly provides custom engineered equipment for pharmaceuticals, clean rooms, hospitals and other applications requiring quality levels higher than commercial grade equipment.

We design our equipment around your project. At DRS, we continue a 7-decade record of providing unparalleled design, test, manufacture and support for military, commercial, industrial and critical process HVAC&R applications.

DRS Technologies
A Finmeccanica Company

# Type S21X-T38X Ventilation Heaters

## General

Navy Ventilation Heaters are duct type steam ventilation heaters for use in heating, ventilating and air conditioning systems aboard ship.

## Specifications

- MIL-SPEC ..... MIL-H-16235
- Qualified products list ..... QPL-16235
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167

## When ordering specify

- Type I standard construction
- Type II 304 stainless steel non-magnetic construction
- Size (21-38)
- Fin spacing (L/M/H)
- Optional welded header box
- Hull number for replacement applications

**Approximate Dimensions in Inches and Weights**

| Model X = L, M or H | Weight (Lbs) L / M / H | CFM @ 600 FPM | Coil Face Size L" x W" | Frame Size L" x W" x D" |
|---|---|---|---|---|
| S21X (L / M / H) | 9/10/10 | 81 | 6 x 3-3/4 | 9 x 6-1/4 x 5 |
| S22X (L / M / H) | 10/10/11 | 122 | 9 x 3-3/4 | 12 x 6-1/4 x 5 |
| S23X (L / M / H) | 12/12/13 | 190 | 14 x 3-3/4 | 17 x 6-1/4 x 5 |
| S24X (L / M / H) | 12/13/14 | 234 | 9 x 6-3/4 | 12 x 9-1/4 x 5 |
| S25X (L / M / H) | 18 / 19 / 21 | 364 | 14 x 6-3/4 | 17 x 9-1/4 x 5 |
| T26X (L / M / H) | 35 / 38 / 40 | 572 | 22 x 7 | 25 x 9-1/4 x 7 |
| T27X (L / M / H) | 42 / 45 / 48 | 848 | 22 x 10 | 23 x 12-1/4 x 7 |
| T28X (L / M / H) | 51 / 55 / 60 | 1,160 | 30 x 10 | 33 x 12-1/4 x 7 |
| T29X (L / M / H) | 59 / 65 / 76 | 1,534 | 30 x 13 | 33 x 15-1/4 x 7 |
| T30X (L / M / H) | 67 / 74 / 83 | 1,910 | 30 x 16 | 33 x 18-1/4 x 7 |
| T31X (L / M / H) | 72 / 79 / 88 | 2,140 | 42 x 13 | 45 x 15-1/4 x 7 |
| T32X (L / M / H) | 76 / 84 / 94 | 2,280 | 30 x 19 | 33 x 21-1/4 x 7 |
| T33X (L / M / H) | 90 / 101 / 114 | 2,940 | 42 x 17-1/2 | 45 x 19-3/4 x 7 |
| T34X (L / M / H) | 104 / 117 / 133 | 3,560 | 56 x 16 | 59 x 18-1/4 x 7 |
| T35X (L / M / H) | 116 / 132 / 153 | 4,240 | 42 x 25 | 45 x 27-1/4 x 7 |
| T36X (L / M / H) | 128 / 147 / 171 | 4,960 | 56 x 22 | 59 x 24-1/4 x 7 |
| T37X (L / M / H) | 153 / 178 / 208 | 6,350 | 42 x 37 | 45 x 39-1/4 x 7 |
| T38X (L / M / H) | 178 / 208 / 245 | 7,750 | 56 x 34 | 59 x 36-1/4 x 7 |

# Type UW51-55
# Unit Coolers

## General

Unit Coolers consist of a vaneaxial fan and motor, a DW type duct cooling coil, with air filtersand directional louvers built as a single unit foroverhead mounting.

## Specifications

- MIL-SPEC ..... MIL-C-2939-E
- Qualified products list ..... QPL-2939
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167

## When ordering specify

- Size (51-55)
- Class
  - UW - Chilled water, gravity
- Composition:
  - M – Magnetic
  - N – Nonmagnetic
- Hand:
  - Left or right hand
  - (Left if not specified)
- Hull number for replacement applications

**Approximate Dimensions in Inches and Weights**

| Model | Flowrate GPM | Capacity BTU/Hr | Frame Size L" x W" x D" | Air Flow CFM | Weight (Lbs) | |
|---|---|---|---|---|---|---|
| | | | | | Dry | Wet |
| **UW51** | 4 | 11,500 | 23 x 12-1/8 x 38-7/8 | 215 | 202 | 207 |
| **UW52** | 7 | 22,200 | 25-1/4 x 14-3/8 x 38-5/8 | 340 | 236 | 239 |
| **UW53** | 10 | 33,500 | 32-1/4 x 14-3/8 x 40-3/8 | 510 | 315 | 326 |
| **UW54** | 15 | 49,300 | 374 x 16-5/8 x 40-7/8 | 750 | 411 | 427 |
| **UW55** | 19 | 62,400 | 43-1/2 x 18-7/8 x 43-7/8 | 1120 | 510 | 534 |

# Type DW51-58
# Cooling Coils (50 Series)

## When ordering specify

- Size (51-58)
- Class
  - Class 1 – Chilled water, DW duct mounted
  - Class 2 – seawater (DWS), duct mounted
- Composition:
  - M – Magnetic
  - N – Nonmagnetic
- Hand:
  - Left or right hand
  - (Left if not specified)
- Hull number for replacement applications

## General

Navy Duct Water Coils (50 Series) use chilled water for the cooling and dehumidification of air. The cooling coils are built as a single unit consisting of supporting framework, cooling element and removable drain pan. Each cooling coil is built ready for installation and connection to the appropriate water supply, return lines and condensate drainage piping.

## Specifications

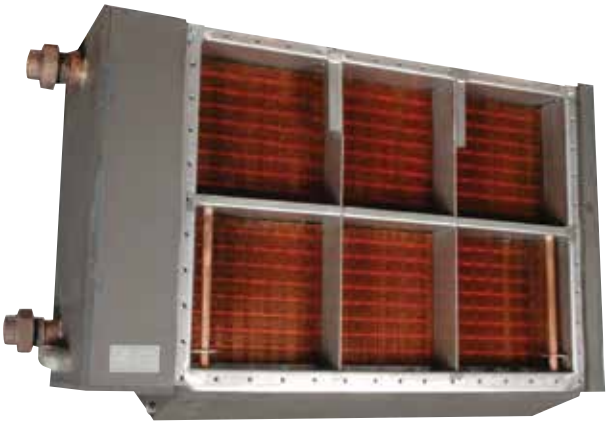
- MIL-SPEC ..... MIL-C-2939-E
- Qualified products list ..... QPL-2939
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167
- Refrigerant ..... R-12

**Approximate Dimensions in Inches and Weights**

| Model DW Series | Weight (Lbs) | | Airflow | | Capacity BTU/Hr ❶ | Coil Face Size | | Outside Dimensions W" x H" x D" |
|---|---|---|---|---|---|---|---|---|
| | Dry | Wet | CFM | Ft/Min | | W" x H" | Ft² | |
| **51** | 152 | 157 | 280 | 491 | 14,000 | 11-3/4 x 7 | 0.57 | 26-1/2 x 12-1/8 x 15 |
| **52** | 176 | 183 | 450 | 500 | 23,000 | 14 x 9-1/4 | 0.90 | 28-3/4 x 14-3/8 x 15 |
| **53** | 225 | 236 | 670 | 496 | 34,000 | 21 x 9-1/4 | 1.35 | 35-3/4 x 14-3/8 x 15 |
| **54** | 301 | 317 | 975 | 488 | 50,000 | 25 x 11-1/2 | 2.00 | 40-1/2 x 16-7/8 x 15 |
| **55** | 390 | 414 | 1500 | 483 | 65,000 | 31-1/2 x 13-3/4 | 3.00 | 47 x 18-7/8 x 15 |
| **56** | 562 | 602 | 2500 | 500 | 121,000 | 39-1/2 x 18-1/4 | 5.00 | 55 x 23-3/8 x 15 |
| **57** | 975 | 1040 | 3750 | 507 | 190,000 | 39-1/2 x 28-7/16 | 7.50 | 56-3/8 x 36-7/8 x 17-5/8 |
| **58** | 1225 | 1310 | 5000 | 500 | 234,000 | 39-1/2 x 37-7/16 | 10.00 | 56-3/8 x 45-7/8 x 17-5/8 |

❶ BTU rating based on the following conditions:
Entering air: 80°F DB, 67F WB
Entering water: 45F
Water flowrate: 3.6 GPM per Ton

# Type DW61-68
# Cooling Coils (60 Series)



## General

Navy Duct Water Coils (60 Series) use chilled water for the cooling and dehumidification of air. The cooling coils are built as a single unit consisting of supporting framework, cooling element and integral drain pan. Each cooling coil is built ready for installation and connection to the appropriate water supply, return lines and condensate drainage piping.

## When ordering specify

- Size (61-68)
- Class 1 – Chilled water, DW duct mounted
- Composition:
  - M – Magnetic
  - N – Nonmagnetic
- Hull number for replacement applications

## Specifications

- MIL-SPEC ..... MIL-C-2939-E
- Qualified products list ..... QPL-2939
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167

**Approximate Dimensions in Inches and Weights**

| Model DW Series | Weight (Lbs) | | Airflow | | Capacity BTU/Hr ❶ | Coil Face Size | | Outside Dimensions W" x H" x D" |
|---|---|---|---|---|---|---|---|---|
| | Dry | Wet | CFM | Ft/Min | | W" x H" | Ft2 | |
| **61** | 106 | 111 | 280 | 491 | 9,020 | 11-3/4 x 7 | 0.57 | 26-5/8 x 12-3/4 x 16-1/4 |
| **62** | 125 | 132 | 450 | 500 | 16,470 | 14 x 9-1/4 | 0.90 | 28-15/16 x 15 x 16-1/4 |
| **63** | 157 | 163 | 670 | 496 | 27,260 | 21 x 9-1/4 | 1.35 | 35-15/16 x 14-3/8 x 16-1/4 |
| **64** | 203 | 218 | 975 | 488 | 39,970 | 25 x 11-1/2 | 2.0 | 40-5/8 x 17-1/4 x 16-1/4 |
| **65** | 278 | 302 | 1500 | 483 | 63,440 | 31-1/2 x 13-3/4 | 3.0 | 47-1/8 x 19-1/2 x 16-1/4 |
| **66** | 416 | 454 | 2500 | 500 | 112,200 | 39-1/2 x 18-1/4 | 5.0 | 55-1/8 x24 x 16-1/4 |
| **67** | 688 | 752 | 3750 | 507 | 183,600 | 39-1/2 x 28-7/16 | 7.5 | 55-7/16 x 34-7/8 x 18-7/8 |
| **68** | 838 | 923 | 5000 | 500 | 240,700 | 39-1/2 x 37-7/16 | 10.0 | 55-7/16 x 43-7/8 x 18-7/8 |

❶ BTU rating based on the following conditions:
Entering air: 80°F DB, 67F WB
Entering water: 45F
Water flowrate: 3.6 GPM per Ton

# Type FCA
# Fan Coil Assemblies

## General

HVAC Fan Coil Assemblies (FCAs) are designed for floor mounting, used in conjunction with a chilled water system, a drainage system, an air distribution system and a power source for air conditioning spaces onboard surface ships.

## Features

Type II FCAs are used when no duct sections are to be attached to the unit when it is placed in service.

Type III FCAs should be specified when one or more duct sections are to be attached to the air inlet or to the air outlet of the FCA when it is placed in service.

## When ordering specify

- Size (21 - 25)
- Type:
  - Type II – Three section unit: cooling coil, fan-motor, and air distribution plenum
  - Type III – Two section unit: cooling coil and fan-motor section
- Grade:
  - High impact shock
  - Type X – (Non-hi shock)
- Composition:
  - M – Magnetic
- Hand:
  - Left or right hand
  - (Left if not specified)
- Motor
  - Sealed
  - Non-Sis (Not sealed)
  - 1EEE45 MARINE DUTY
- Grille requirements
  - Inlet
  - Outlet
- Cover plate requirements
  - Inlet
  - Outlet
- Hull number for replacement Applications

## Specifications

- MIL-SPEC ..... MIL-A-23798
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167
- Cooling Media ..... Chilled water

**Approximate Dimensions in Inches and Weights**

| | Model | Capacity BTU/Hr ❶ | Cabinet Size L" x W" x D" | Air Flow CFM | Weight (Lbs) | |
|---|---|---|---|---|---|---|
| | | | | | Dry | Wet |
| Type II | FCA 21 | 36,700 | 44 x 28 x 75 | 760 | 1190 | 1203 |
| | FCA 22 | 59,900 | 44 x 28 x 75 | 1260 | 1260 | 1289 |
| | FCA 23 | 90,900 | 48 x 32 x 75 | 1880 | 1429 | 1472 |
| | FCA 24 | 117,700 | 51 x 37 x 75 | 2550 | 1546 | 1590 |
| | FCA 25 | 178,400 | 56 x 37 x 75 | 3800 | 1770 | 1836 |
| Type III | FCA 21 | 36,700 | 44 x 28 x 50 | 760 | 990 | 1003 |
| | FCA 22 | 59,900 | 44 x 28 x 50 | 1260 | 1060 | 1089 |
| | FCA 23 | 90,900 | 48 x 32 x 75 | 1880 | 1210 | 1253 |
| | FCA 24 | 117,700 | 51 x 37 x 50 | 2550 | 1305 | 1349 |
| | FCA 25 | 178,400 | 56 x 37 x 50 | 3800 | 1520 | 1586 |

❶ BTU rating based on the following conditions:
Entering air: 80°F DB, 67F WB
Entering water: 45F
Water flowrate: 3.6 GPM per Ton

# Type FCU H/V Fan Coil Units

## General

HVAC Fan Coil Units (FCU) are used as an alternative to built-up air conditioning recirculation systems of a ship's heating, ventilating and air conditioning (HVAC) system. They provide heating, cooling, and air recirulation required to satisfy compartment environmental design conditions with a savings in space and wight over built-up systems.

The units consist of fans and two speed motors, air filters, operational controls, thermostat, cooling coil, thermal and acoustical insulation and optional electric heaters.

## When ordering specify

- Size (1-8)
- Type:
  - H: Horizontal – Overhead mounting
  - V: Vertical – Bulkhead mounting
- Composition:
  - M – Magnetic
  - N – Nonmagnetic
- Chilled water (CHW) connections:
  - Left or right hand (Left if not specified)
- Heater options:
  - Heating in Kilowatts (kW) as listed in table on the right
- Grade:
  - High impact shock
  - Type X – (Non-hi shock)
- Motor
  - Sealed
  - Non-SIS (Not sealed)
- Motor protection
  - LVP – Low voltage protection
  - LVR – Low voltage release
- Hull number for replacement applications

## Specifications

- MIL-SPEC ..... MIL-A-24775
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167

**Approximate Dimensions in Inches and Weights**

| Model H or V | Capacity BTU/ Hr ❶ | Heat Options kW Option1 /Option2 / Option3... | Cabinet Size L" x W" x D" | Air Flow CFM | Weight (Lbs) | |
|---|---|---|---|---|---|---|
| | | | | | Dry | Wet |
| **FCU H1 / V1** | 5850 | 0 / 1.2 / 2.2 / 3.3 | 50 x 25 x 10 | 145 | 261 | 264 |
| **FCU H2 / V2** | 9690 | 0 / 1.2 / 2.2 / 3.3 | 50 x 25 x 10 | 240 | 268 | 271 |
| **FCU H3 / V3** | 15,280 | 0 / 1.75 / 3.5 / 5.25 | 52 x 27 x 14 | 350 | 343 | 348 |
| **FCU H4 / V4** | 22,890 | 0 / 2.0 / 4.0 / 6.0 | 52 x 36 x 14 | 530 | 393 | 401 |
| **FCU H5 / V5** | 30,500 | 0 / 2.0 / 4.0 / 6.0 | 52 x 44 x 14 | 690 | 478 | 488 |
| **FCU H6 / V6** | 39,910 | 0 / 3.0 / 6.0 / 9.0 | 52 x 39 x 17 | 950 | 513 | 524 |
| **FCU H7 / V7** | 45,560 | 0 / 3.0 / 6.0 / 9.0 | 52 x 52 x 17 | 1100 | 652 | 664 |
| **FCU H8 / V8** | 72,920 | 0 / 3.0 / 6.0 / 9.0 | 52 x 62 x 17 | 1650 | 774 | 793 |

❶ BTU rating based on the following conditions:
Entering air: 80°F DB, 67F WB
Entering water: 45F
Water flowrate: 3.6 GPM per Ton

# Type FCU 1-9
# Spruance Class Fan Coil Units


## When ordering specify

- Size (1-9)
- Class:
  - Left or right hand (Left if not specified)
- Heater options:
  - Heating in Kilowatt (kW) as listed in table below
- Hull number for replacement applications

## General

Spruance Class HVAC Fan Coil Units sizes 1-5 are designed for overhead mounting, sizes 6-9 are designed for either overhead or bulkhead mounting.

The units consist of direct drive fans and single speed motors, cleanable air filters, thermostat, cooling coil, thermal and acoustical insulation and optional electric heaters with high temperature thermal cut-out switch.

This series of HVAC Fan Coil Units have been supplied for use on the Spruance Class Destroyers (DD-963 to 992 & 997) and Kidd Class Destroyers (DD-993 to 996).

## Features

- Designed as a replacement for Spruance and Kidd Destroyer fan coil units
- Cleanable aluminum air filters
- Coper tube and fin coil
- Designed for chilled water service
- Coil connections interchangeable from let to right hand
- Optional electric heater
- Complete specification and selection data available

## Specifications

- MIL-SPEC (Heater)..... MIL-H-22577
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167

**Approximate Dimensions in Inches and Weights**

| Model | Capacity BTU/Hr ❶ | Heat Options (kW) Option1 / Option2 / Option3... | Cabinet Size L" x W" x D" | Air Flow CFM | Weight (Lbs) | |
|---|---|---|---|---|---|---|
| | | | | | Dry | Wet |
| **FCU-1** | 6000 | 0 / 1.0 / 1.5 / 2.5 | 42 x 21 x 10 | 214 | 170 | 175 |
| **FCU-2** | 8500 | 0 / 0.6 / 1.0 / 1.5 / 2.0 / 2.5 | 42 x 28-1/2 x 8-1/4 | 305 | 205 | 210 |
| **FCU-3** | 12,300 | 0 / 0.6 / 1.0 / 1.5 / 2.0 / 2.5 / 3.0 | 42 x 35-1/2 x 8-1/4 | 358 | 238 | 243 |
| **FCU-4** | 17,900 | 0 / 0.6 / 1.0 / 1.5 / 2.0 / 2.5 / 3.0 / 3.5 | 42 x 49-1/2 x 8-1/4 | 472 | 306 | 311 |
| **FCU-5** | 22,200 | 0 / 0.5 / 1.0 / 1.5 / 2.0 / 2.5 / 3.5 | 42 x 62-1/2 x 8-1/4 | 565 | 348 | 453 |
| **FCU-6** | 21,500 | 0 / 1.65 / 2.5 / 6.0 | 61 x 22-1/2 x 17 | 976 | 360 | 365 |
| **FCU-7** | 34,000 | 0 / 1.0 / 1.5 / 2.0 / 2.5 / 3.0 / 4.0 | 61 x 30-1/2 x 17 | 1236 | 395 | 400 |
| **FCU-8** | 45,000 | 0 / 0.5 / 1.0 / 3.5 / 5.0 / 7.5 | 61 x 38-1/2 x 17 | 1764 | 515 | 520 |
| **FCU-9** | 56,500 | 0 / 0.5 / 1.0 / 1.5 / 2.5 / 4.0 / 4.5 | 61 x 49-1/2 x 17 | 1988 | 575 | 580 |

❶ BTU rating based on the following conditions:
Entering air: 80°F DB, 67F WB
Entering water: 45F
Water flowrate: 3.6 GPM per Ton

# Type 11-16
# Unit Heaters

## General

Unit Heaters are designed for overhead mounting. The units consist of a fan and motor, steam/hot water heating coil, fan guard and directional louvers built as a single unit. Electric heating elements are available in lieu of the standard steam/ hot water coil.

## Specifications

- MIL-SPEC ..... MIL-U-17293
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167

## When ordering specify

- Size (11-16)
- Hull number for replacement applications

**Approximate Dimensions in Inches and Weights**

| Model | Power (AC) Volts / Ph | Capacity BTU/Hr | Cabinet Size L" x W" x D" | Air Flow CFM | Weight (Lbs) |
|---|---|---|---|---|---|
| **Size 11** | **115 / 1** | 18,000 | 23 x 15.5 x 29 | 300 | 98 |
| **Size 12** | **115 / 1** | 30,000 | 25 x 18.5 x 29 | 500 | 112 |
| **Size 13** | **115 / 1** | 46,000 | 28 x 21.5 x 30 | 790 | 127 |
| **Size 14** | **115 / 1** | 74,500 | 34 x 23.5 x 30 | 1330 | 167 |
| **Size 15** | **440 / 3** | 116,000 | 28 x 22 x 31 | 2060 | 183 |
| **Size 16** | **440 / 3** | 186,500 | 36 x 22 x 31 | 3310 | 250 |

# Type GW/GF 1, 3 & 5
# Gravity Cooling Coils

## General

Navy Gravity Water / Refrigerant Coils (GW/GF Series) use chilled water or refrigerant for the cooling and dehumidification of air. The gravity coils shall be built as a single unit consisting of supporting framework, drain pans, and cooling element. Each gravity coil is ready for installation and connection to the appropriate water/refrigerant supply and return lines and condensate drainage piping.

## When ordering specify

- Size (1, 3 or 5)
- Class
  - GW - Chilled water, gravity
  - GF – Refrigerant, gravity
- Composition:
  - Standard ASTM A569 steel construction
  - Copper fin, copper tube core available with either paintedcarbon steel frame or SST frame
  - ASTM A240 316 corrosion resistent stainless steel

## Specifications

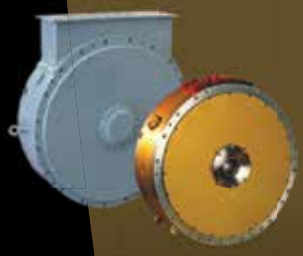
- MIL-SPEC ..... MIL-C-2939
- Qualified products list ..... QPL-2939
- Shock qualification ..... MIL-S-901
- Vibration qualification ..... MIL-STD-167

**Approximate Dimensions in Inches and Weights**

| Model Water / R-12 | Weight (Lbs) | | Capacity BTU/Hr ❶ | Coil Face Size L" x W" | Frame Size L" x W" x D" |
|---|---|---|---|---|---|
| | Dry | Wet | | | |
| **GW1 / GF1** | 42 | 96 | 1,000 - 1,100 | 22 x 11-5/8 | 26 x 14-5/8 x 10 |
| **GW3 / GF3** | 98 | 108 | 2,800 - 3,300 | 44 x 17-5/8 | 48 x 20-5/8 x 10 |
| **GW5 / GF5** | 146 | 162 | 4,500 - 5,500 | 54 x 23-5/8 | 58 x 26-5/8 x 10 |

❶ BTU rating based on the following conditions:
Entering air: 80°F DB, 67F WB
Entering water: 45F
Water flowrate: 3.6 GPM per Ton

# PERMANENT MAGNET MOTORS



## Efficient Motor/Generator Solutions Wherever Variable Speed is Needed

Turn to DRS Permanent Magnet (PM) motors and generators for dimension and/or weight constrained applications where significant torque, high efficiency and precise control across load and speed variations are essential. They provide reliable solutions for pumps, fans, portable generators, electro-mechanical actuators and other shipboard auxiliaries.

At DRS our customer-focused approach and our unique set of core competencies enable us to develop PM machines in a range of radial and axial-field topologies that meet tough standards for military and commercial applications. Our motors, generators and drives can support the electrification of the naval and marine forces of today and tomorrow.

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# Electric Ship Propulsion Motors

**Specifications: 36.5 MW PM Machine for Electric Ship Propulsion**

| Performance | |
|---|---|
| Output | 50,000 HP (36.5 MW) |
| Speed | 1-127 RPM |
| Torque | >2 M ft. lbs. (2.7M Nm) |
| Motor Efficiency | 97.5% |
| **Mechanical** | |
| Motor Length | 202 inches (5.1 meters) |
| Motor Width | 214 inches (5.4 meters) |
| Motor Height | 209 inches (5.3 meters) |
| Motor Weight | 280,000 lbs. (127 tonnes, 127,000 kg) |
| Cooling Method | Fresh water |
| **Electrical** | |
| Voltage | 1450 VAC |
| Phases | Doubly-fed, 3-phase |
| Insulation Class | R (220° C) |
| Temperature Rise | H (180° C) |

Content Approved for Public Release, Dept. of the Navy 1-8-2009

## General

**Supporting requirements for electric propulsion and growing power efficiency demands on future ships.**

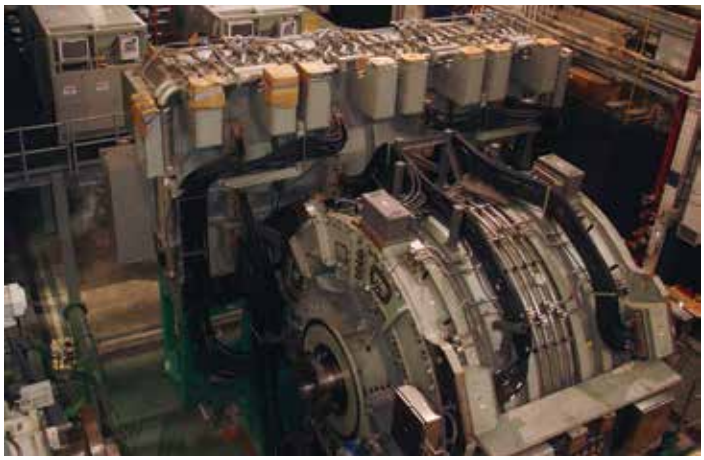
DRS Technologies offers a superior direct drive ship propulsion solution using Permanent Magnet (PM) motor technology. PM motors have significant advantages in size, weight and power over conventional motors. Because the high-strength magnets provide the rotor flux instead of wire-wound rotor poles PM motors produce more torque with the same amount of supplied current.

The smaller footprint of our propulsion PM motors allows more flexibility in engine room design and increased cargo space, and the simpler construction results in increased reliability and durability.

Our 35.6 MW PM machine illustrated here is an example of the advantages this technology offers for electric ship propulsion. Ongoing developments in permanent magnet propulsion motor design offer greater power density, increased energy efficiency, and reduced manufacturing cost.

## Highlights

- Space & Weight limits – Offers high torque in a compact package and minimal engine room impact
- Fuel Savings – High efficiency performance at full and part load
- Life Cycle Costs – Reduced maintenance costs



*The DRS 36.5 MW Permanent Magnet Motor System (PMMS) at the U.S. Navy Land Based Test Site (LBTS) in Philadelphia, PA*

# Hybrid Electric Ship Propulsion Motors/Generators

## General

**Supporting initiatives for increased energy efficiency on today's naval and marine platforms.**

The combination of high fuel costs and inefficient propulsion make gas turbine driven ships an ideal candidate for hybrid propulsion. The hybrid system allows the propulsion gas turbines to be shut down for low speeds, driving the ship with a variable speed hybrid electric PM propulsion motor instead. The PM machine can either be directly mounted to the propulsion shaft or mounted to a reduction gear.

On a ship with a diesel propulsion system using a hybrid electric drive system to propel ship at low speeds reduces the accumulation of coking deposits over time. This can significantly reduce the mean time between repairs, lowering the risk of damage to the diesel and expense of repairs.

Our 1.5 MW machine illustrated here is an example of the advantages this technology offers for hybrid electric ship propulsion.

For existing ships or those under development the adaptation of an innovative DRS hybrid electric drive using power-dense permanent magnet (PM) technology can significantly reduce total ownership costs.

## Highlights

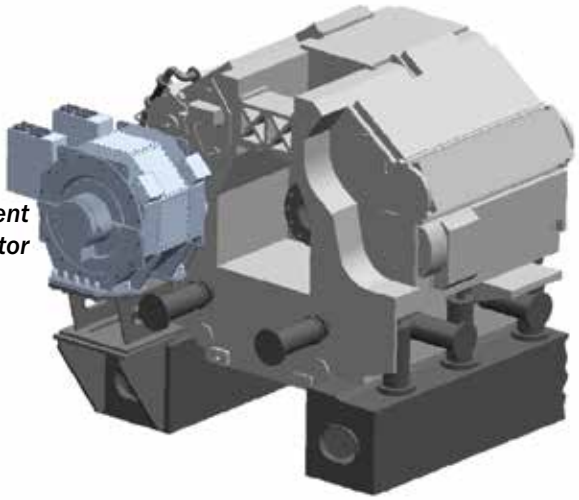
- Space & weight benefits –High torque in a compact package means minimal engine room impact
- Fuel savings – Using PM power at low speeds can save thousands of barrels of fuel
- Life cycle costs – Reduced gas turbine or diesel motor operation time saves on maintenance costs
- Easy integration and minimum impact to engine room
- DRS PM machines provide a mature technology: evolved from a lineage of fielded permanent magnet motors with a history of performance in extreme operating conditions

**Specifications: 1.5MW PM Machine for Hybrid Electric Ship Propulsion**

| Performance | |
|---|---|
| Output | 2,010 HP (1.5 MW) |
| Speed | 498 RPM |
| Motor Efficiency | 98% |

*DDG 51 Main Reduction Gear (MRG)*

*DRS Permanent Magnet (PM) Motor*



# Permanent-Magnet Axial Air Core (PAAC) Motors and Generators

*This 10 HP PAAC motor is 1/3 the size and weight of a comparable induction motor.*

## Highlights

- Space and weight limits - PAAC machines are among the most power dense in the world - 30-50% more power dense than induction motors
- Critical applications - Ideal for applications requiring high precision and/or high torque
- Life cycle costs - Compact and simple design provides superior reliability & low production costs
- Acoustic advantages - Few moving parts and sinusoidal BEMF make the PAAC inherently quiet

## General

**A light-weight, rugged, acoustically superior solution for applications ranging from fans, to portable generators, to throttle and other electro-mechanical actuators.**

The PAAC series Permanent Magnet (PM) brushless motors and generators for military applications are designed to provide exceptional versatility at low cost. PM machines feature high-strength magnets mounted to the rotor to provide the magnetic field that interacts with the electrical windings. Since the magnets have no electrical losses, more electrical power is converted to mechanical torque, increasing both power density and efficiency.

The PAAC series takes the advantages of PM technology one step further by using Printed Circuit Board (PCB) technology to increase power density and efficiency in the stator as well. The result is an extremely power dense, efficient, and versatile machine that can be utilized across a vast array of applications requiring variable speed control.

### Specifications

| Performance | |
|---|---|
| Output | Ranges from 1/3HP (0.25KW) to 1000HP (746KW) |
| Speed | Depending on application |
| Motor Efficiency | Depending upon size and application |

# Permanent-Magnet Axial (PA) Series PM Motors and Generators

## General

**Combining rugged construction, high torque and precise control for demanding applications where reliability is key and downtime is not an option.**

The DRS PA series Permanent Magnet (PM) motors and generators are built to last under the world's most demanding applications. Lightweight and compact , the PA design delivers more power per pound than other electric motors and continuous high torque, even at stall. Since the PA rotor uses permanent magnets it works equally well as a generator, making it the ideal choice for mobile generator sets, traction systems, cranes, elevators and lifts.

## Highlights

- Space and weight – Power density of existing models greater than 1 horsepower/lb
- Critical applications - Ideal for applications requiring high precision and/or high torque
- Reliability – Proven to survive four times longer than conventional motors in demanding applications

The DRS PA series motors/generators have been developed for use in oil and gas drilling, transit, marine and other applications.

**Specifications: PA44-450**

| Performance | |
|---|---|
| Rated Power | 450 HP (336KW) |
| Rated Speed | 3600 RPM |
| Rated Torque | 1,475 ft. lbs. (2,000 Nm) |
| Efficiency at Rated Speed | 95% |
| **Mechanical** | |
| Length | 8.8 inches (224 mm) |
| Diameter | 25.5 inches (648 mm) |
| Mounting | 24.6 inches (625mm) bolt circle |
| Standard Shaft Type | DIN 5480 Spline<br>(W60 x 2 x 30 x 28 x 9g) |
| Motor Weight | 395 lbs (195 kg) |
| Cooling Method | Liquid (water/glycol) |
| **Electrical** | |
| Rated Current | 425 A rms |
| Voltage Constant | 800 V peak |

**Specifications: PA57-1000**

| Performance | |
|---|---|
| Rated Power | 1,000 HP (746 kW) |
| Rated Speed | 4,000 rpm |
| Rated Torque | 2,712 Nm (2,000 lb-ft) |
| Efficiency at Rated Speed | 96% |
| **Mechanical** | |
| Length | 10.20 inches (259.1 mm) |
| Diameter | 31 inches (787 mm) |
| Mounting | 30 inches (762 mm) bolt circle |
| Standard Shaft Type | ANSI 5480 Spline<br>(W60 x 2 x 30 x 28 x 9g) |
| Motor Weight | 750 lbs. (340 kg) |
| Cooling Method | Liquid ( water/glycol) |
| **Electrical** | |
| Rated Current | 335 A rms |
| Voltage Constant | 0.24 V/rpm<br>(240 V amplitude @1,000 rpm) |

# Permanent-Magnet Radial Field Embedded Magnet (PRE) Series Motors

## General

**Designed for superior performance in severe environments.**

The rugged DRS Permanent Magnet, Radial field, Embedded Magnet (PRE) series of brushless motors delivers more torque per pound than other electric motors in its class.

In addition to impressive power density the simpler construction of PM machines versus induction machines means they are highly reliable and durable. DRS PRE PM motors are designed to operate in harsh duty cycles and with most commercially available variable frequency drives.

## Highlights

- Retrofit – PRE machines built to industry standard frames
- Critical applications – Ideal for harsh duty applications where reliability is important
- Life cycle costs – 3 year warranty
- High efficiency – Superior performance at full and part load

**Specifications: PRE34-600**

| **Performance** | |
|---|---|
| Rated Power | 600 HP (447KW) |
| Rated Speed | 1200 RPM |
| Rated Torque | 1,475 ft. lbs. (2,000 Nm) |
| Efficiency at Rated Speed | 97% |
| **Mechanical** | |
| Length | 52.9 inches (1343 mm) |
| Vertical Mounting | 24.4 inches (621 mm) bolt circle diameter using 4 x 1 inch (25.4 mm) bolts |
| Horizontal Mounting | NEMA 5011 |
| Standard Drive Options | Customizable (up to 4 inch, 100 mm, diameter) Example: SAE External |
| Shaft Side Load | 5000 lbs. (22.2KN) lateral |
| Motor Weight | 3500 lbs. (1588 kg) with blower 3300 lbs. (1497 KG) without blower |
| Cooling Method | External blower |
| **Electrical** | |
| Rated Current | 732 Arms |
| Voltage Constant (line to line) | 0.31 Vrms/RPM |
| Connections | Stator: 3 Phase Wye, floating ground Interface Box: NEMA IP 54 |

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# ROTATING MACHINERY PACKAGING — STEAM TURBINE DESIGN, ASSEMBLY AND REPAIR

## Rotating Machinery Packaging

As a full-service equipment packager we have designed and/or assembled aero-derivative gas turbine packages using each major engine manufacturers' products. These units are in service in naval and ground power applications around the world. Many were specifically designed for extreme environments. In other applications, stringent specifications required the use of skilled design techniques to minimize noise and vibration while enhancing the unit's robustness and survivability.

Our extensive capabilities include developing composite enclosures, performing system shock analyses (applying design adjustments if needed), precision assembly of large equipment, and obtaining full naval qualification to MIL-SPEC or ABS NVR standards.

Whether you require build-to-print production or more extensive systems packaging DRS is ready to meet the needs of any machinery packaging project.

## Steam Turbine Design, Assembly and Repair

Evolving from our GE heritage, DRS is one of the foremost steam turbine design companies. Our exceptional steam turbine team supports commercial power producers, steam turbine OEMs and the U.S. Navy by developing new turbine designs and redesigning and upgrading old equipment to meet today's efficiency and reliability standards.

With a full array of engineering and design capabilities, including computational fluid dynamics (CFD), rotor dynamics, acoustics, shock and vibrations analysis, and heat balance assessment, DRS is ready and able to solve your most challenging steam turbine design and repair problems.



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