

Motor Insight Overload and Monitoring Relay



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C441 Overload Relays

Product Description

Eaton's Motor Insight, the first product in the Intelligent Power Control Solutions family, is a highly configurable motor, load and line protection device with power monitoring, diagnostics and flexible communications allowing the customer to save energy, optimize their maintenance schedules and configure greater system protection, thus reducing overall costs and downtime.

Motor Insight is available in either a line-powered or 120 Vac control powered design, capable of monitoring voltages up to 660 Vac. Each of these units is available in a 1–9 amp or a 5–90 amp FLA model. With external CTs, Motor Insight can protect motors up to 540 amps FLA. Available add-on accessories include communication modules for Modbus RTU, DeviceNet, PROFIBUS, Modbus TCP, EtherNet/IP and HTTP web services all with I/O options. For ease-of-use and operator safety, Motor Insight offers a remote display that mounts easily with two 30 mm knockouts.

The Motor Insight family also offers a high voltage relay option, capable of providing overload and current protection on systems up to 1200 Vac.

Features and Benefits

Features

Size/Range

- Broad FLA range of 1–540 A
- Selectable trip class (5–30)
- Four operating voltage options
 - Line-powered from 240 Vac, 480 Vac, 600 Vac
 - Control-powered from 120 Vac

Motor Control

- Two output relays
 - One B300 Form C fault relay and one B300 ground fault shunt relay
 - Other relay configurations are available, including one Form A and one Form B SPST (fault and auxiliary relays) allowing programmable isolated relay behavior and unique voltages
- One external remote reset terminal
- Trip status indicator

Motor Protection

- Thermal overload
- Jam protection
- Current imbalance
- Current phase loss
- Ground fault
- Phase reversal

Load Protection

- Under current
- Low power (kW)
- High power (kW)

Standards and Certifications

- cULus listed NKCR, NKCR7, 508
- UL® 1053 applicable sections for ground fault detection

Line Protection

- Over voltage
- Under voltage
- Voltage imbalance
- Voltage phase loss

Monitoring Capabilities

- Current—average and phase rms
- Voltage—average and phase rms
- Power—motor kW
- Power factor
- Frequency
- Thermal capacity
- Run hours
- Ground fault current
- Current imbalance %
- Voltage imbalance %
- Motor starts
- Motor run hours

Options

- Type 1, 12 remote display
- Type 3R remote display kit
- Communication modules
 - Modbus
 - Modbus with I/O
 - DeviceNet with I/O
 - PROFIBUS with I/O
 - Modbus TCP with I/O
 - EtherNet/IP with I/O

Benefits

Reliability and Improved Uptime

- Advanced diagnostics allows for quick and accurate identification of the root source of a motor, pump or power quality fault; reducing troubleshooting time and the loss of productivity, reducing repeat faults due to misdiagnosis, and increasing process output and profitability
- Provides superior protection of motors and pumps before catastrophic failure occurs
- Increases profitability with greater process uptime and throughput, reduced costs per repair, reduced energy consumption and extended equipment life
- Adjustments to overload configuration can be made at any time

Safety

- IP20 rated terminal blocks
- Terminal blocks are set back from the display to reduce operator shock hazard
- Remote display (optional) does not require that the operator open the panel to configure the device

Flexibility

- Communications modules
 - Offered in a variety of configurations
 - External snap-on modules provide support for multiple communications protocols
- Advanced power, voltage and current monitoring capabilities
- Communications modules and remote display can be used simultaneously
- Highly configurable fault and reset characteristics for numerous applications
- Fully programmable isolated fault and auxiliary relays

Ease of Use

- Bright LED display with easy-to-understand setting and references
- Powered from line voltage or 120 Vac control power
- Remote display powered from base unit
- Full word descriptions and units on user interface

- CSA® certified (Class 3211-02)
- CE
- NEMA®

- IEC EN 60947-4-1
- RoHS



Advanced Overload Education

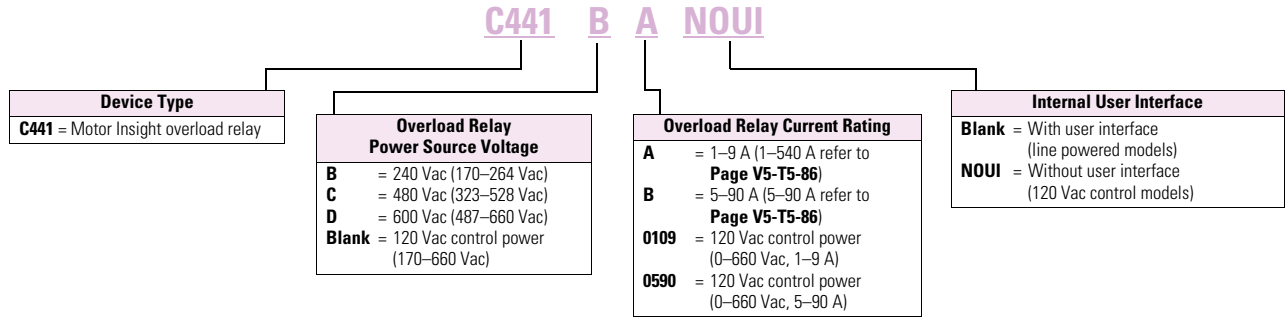
Description	Definition	Source	Result	Motor Insight Protection
Motor Protection				
Thermal overload	Overload is a condition in which current draw to a motor exceeds 115% of the full load amperage rating over a period of time for an inductive motor.	<p>An increase in the load or torque that is being driven by the motor.</p> <p>A low voltage supply to the motor would cause the current to go high to maintain the power needed.</p> <p>A poor power factor would cause above normal current draw.</p>	Increase in current draw. Current leads to heat and insulation breakdown, which can cause system failure. Additionally, an increase in current can increase power consumption and waste valuable energy.	<p>Thermal trip behavior is defined by UL, CSA and IEC standards.</p> <p>Trip class is settable from 5–30 by 1</p> <p>Provides power factor monitoring and low voltage protection features.</p>
Jam	Jam is similar to thermal overload in that it is a current draw on the motor above normal operating conditions.	Mechanical stall, interference, jam or seizure of the motor or motor load.	The motor attempts to drive the load, which has more resistive force due to the mechanical interference. In order to drive the load, the motor draws an abnormal amount of current, which can lead to insulation breakdown and system failure.	<p>Provides a configurable Jam setting that is active during “motor run state” to avoid nuisance trips.</p> <p>Trip Threshold 150–400% of FLA.</p> <p>Trip Delay 1–20 seconds.</p>
Ground fault	A line to ground fault.	A current leakage path to ground.	An undetected ground fault can burn through multiple insulation windings, ultimately leading to motor failure.	<p>Motor Insight has ground fault protection capability down to 0.15 amps estimated from the existing three-phase CTs using the residual current method. That is, the three-phase current signals should sum to zero unless a ground fault (GF) condition is present. In the case of a GF, Motor Insight can alarm, trip the starter, or trip an alternative relay that can be used to shunt trip a breaker or light up a warning light. GF current can also be monitored in real-time through the advanced monitoring capabilities.</p> <p>Note: GF settable thresholds vary with motor FLA. 0.15 amps may not be available in all cases.</p>
Imbalanced phases (voltage and current)	Uneven voltage or currents between phases in a three-phase system.	When a three-phase load is powered with a poor quality line, the voltage per phase may be imbalanced.	Imbalanced voltage causes large imbalanced currents and as a result this can lead to motor stator windings being overloaded, causing excessive heating, reduced motor efficiency and reduced insulation life.	Provides two protection settings that address this problem. The user can choose to set current imbalance thresholds or voltage imbalance thresholds, each of which can trip the starter. Additionally, both of these may be monitored through Motor Insight’s advanced monitoring capabilities, allowing the customer to notice in real-time when and where a condition is present.
Phase loss—current (single-phasing)	One of the three-phase current is not present.	Multiple causes, loose wire, improper wiring, grounded phase, open fuse, and so on.	Single-phasing can lead to unwanted motor vibrations in addition to the results of imbalanced phases as listed above.	Fixed protective setting that takes the starter offline if a phase drops below 60% of the other two phases.
Phase rotation (phase-reversal)	Improper wiring, leading to phases being connected to the motor improperly.	A miswired motor. Inadvertent phase-reversal by the utility.	Phase-reversal can cause unwanted directional rotation of a motor. In the event that the load attached to the motor can only be driven in one direction, the result could be significant mechanical failure and/or injury to an operator.	Configurable phase protection, allowing the user to define the phase sequencing intended for that application. If no phase sequence is required, the user has the ability to disable this feature.
Frequency variance	When line frequency is inconsistent.	Malfunctioning alternator speed regulator, or poor line quality caused by an overload of a supply powered by individual sources.	Variations in frequency can cause increases in losses, decreasing the efficiency of the motor. In addition, this can result in interference with synchronous devices.	Advanced monitoring capabilities allow the user to monitor frequency in real-time.

Advanced Overload Education, continued

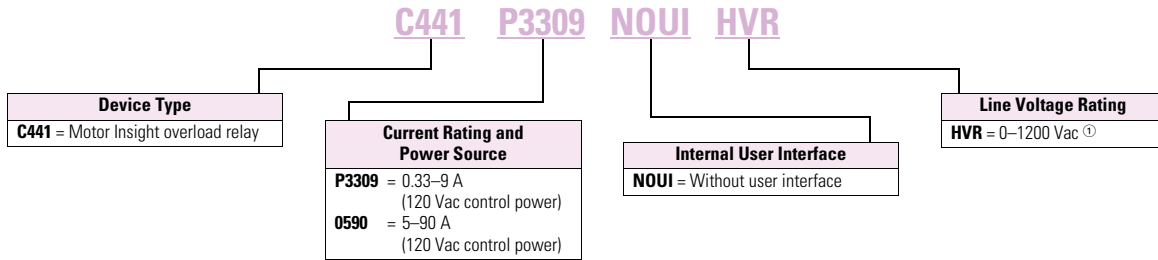
Description	Definition	Source	Result	Motor Insight Protection
Load Protection				
Under current or low power	Average rms current provided to the motor falls below normal operating conditions.	Under current is usually associated with a portion of the user's load disappearing. Examples of this would be a broken belt, a dry-pump (low suction head) or a dead-headed centrifugal pump.	If under current goes undetected, a mechanical failure can and has occurred. In the case of a pump, running a pump dry or running a pump in a dead-headed condition can cause excessive heating, damaging expensive seals and breaking down desired fluid properties.	Motor Insight has two protection settings to detect this: under current and low power. Low power is a more consistent way of ensuring detection as power is linear with motor load, where as current is not. An unloaded motor may draw 50% of its rated current, but the power draw will be less than 10% of rated power due to a low power factor.
High power	The motor load is drawing more power than it should at normal operating conditions.	This is typical of batch processing applications where several ingredients flow into a mixer. When a substance's consistency changes and viscosity increases from what is expected, the motor may use more power to blend the mixture. Out-of-tolerance conditions can be detected using the High Power and Low Power settings.	If a high-power fault goes undetected, the result may be a batch of material that does not meet specification.	Monitors the three-phase real power. If the real power value is estimated above the set threshold for the set length of time, a fault is detected and the overload will trip the starter. Additionally, power can be monitored in real-time.
Line Protection				
Over voltage	When the line voltage to the motor exceeds the specified rating.	Poor line quality.	An over voltage condition leads to a lower than rated current draw and a poor power factor. A trip limit of 110% of rated voltage is recommended. Over voltage can also lead to exceeding insulation ratings.	Monitors the maximum rms value of the three-phase voltages. If the rms value rises above the set threshold for the set length of time, a fault is detected and the overload can trip the starter or send and display an alarm of the condition. All line-related faults have an "alarm-no-trip" mode.
Under voltage	When the line voltage to the motor is below the specified rating.	Poor line quality.	An under voltage condition leads to excessive current draw. This increases the heating of the motor windings and can shorten insulation life. A trip limit set to 90% of rated voltage is recommended.	Monitors the minimum rms value of the three-phase voltages. If the rms value drops below the set threshold for the set length of time, a fault is detected and the overload can trip the starter or send and display an alarm of the condition. All line-related faults have an "alarm-no-trip" mode.
Power-up delay	Allows for starting motors and loads in a deliberate fashion.	When there is a power failure, or power cycle, multiple loads come online simultaneously.	Multiple loads starting simultaneously can cause sags affecting the operation of devices that may prevent successful startup. If power is lost to a motor driving a pump, it may be necessary to delay a restart to allow the pump to come to a complete stop to prevent starting a motor during backspin.	Configurable to delay closing the fault relay on power-up. For each Motor Insight controlling a motor, a different setting can be programmed, helping to maintain the integrity of your line power.

Catalog Number Selection

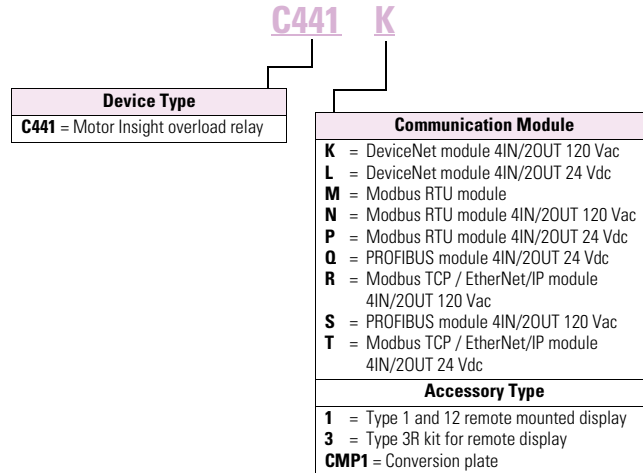
Motor Insight Overload Relays



Motor Insight High Voltage Overload Relays



Motor Insight Overload Relays—Communications Modules and Accessory Types



Note

① The C441 High Voltage Relay (-HVR models) can be used on systems up to 1200 Vac to provide overload and current based protections. Voltage and power based protections and monitoring listed in this catalog for C441 Motor Insight are not available in -HVR models. Please consult IL04209007E-HVR for technical information on -HVR models.

Accessories

Modbus Communication Module

The Motor Insight Modbus Communication Module is a side-mounted device providing Modbus communication capability to the Motor Insight overload relay.

The Modbus Communication Module with I/O provides communication, monitoring and control for the Motor Insight overload relay.

Features and Benefits

- The Modbus communication module is capable of baud rates up to 115K
- The Modbus address and baud rate configuration can be easily changed using the Motor Insight user interface (C441M only)
- Modbus address and baud rate are set via convenient DIP switches (C441N and C441P); LEDs are provided to display Modbus traffic
- Configuration with common Modbus configuration tools
- Terminals
 - Unique locking mechanism provides for easy removal of the terminal block with the field wiring installed
 - Each terminal is marked for ease of wiring and troubleshooting
- Selectable I/O assemblies
 - 4IN/2OUT
 - Signal types include 24 Vdc I/O and 120 Vac I/O
- Each I/O module is optically isolated between the field I/O and the network adapter to protect the I/O and communication circuits from possible damage due to transients and ground loops
- Input Module features a user-definable input debounce, which limits the effects of transients and electrical noise
- Output Module supports a user-definable safe state for loss of communication; hold last state, ON or OFF

Modbus Communication Module

	Description	I/O	Catalog Number
Modbus Module	Modbus Communication Module	None	C441M
Modbus with I/O Module	Modbus Communication Module 4IN/2OUT	120 Vac	C441N
	Modbus Communication Module 4IN/2OUT	24 Vdc	C441P

