Overload Relays

Freedom Series

Definition: An overload relay is an overcurrent relay which functions at a predetermined value of overcurrent to cause disconnection of the load from the power supply. A device used to protect motors from overheating due to overcurrent not exceeding locked rotor current.

Types: There are various types of overloads. There are thermal, magnetic and solid-state overload relays. The Advantage starter line and the IQ500 utilize an electronic overload relay while the Freedom Series C306 and C316 overload relays are thermal (bimetallic) type relays. In this document we will discuss the Freedom Series C306 and the C316 overload relays. The C306 relay has interchangeable, Class 10 & 20 heater packs with +/-24% FLA adjustability. The C316 relay is of the adjustable, fixed heater design and is Class 10 only.

NEMA/IEC Standard: Both NEMA and IEC have specific requirements when it comes to overload relays. NEMA sets general standards and definitions for the manufacturer to follow while IEC, using the same characteristics, sets more specific standards. The following overload relay features are inherent in both NEMA and IEC devices but may vary in their specific requirements. Both the C306 and C316 are UL Listed, CSA Certified, conform to IEC 947 and have the CE mark.

Time-Current Characteristics: The time-current characteristics of an overload relay is an expression of performance which defines its operating time at various multiples of its current rating. ❶

NEMA requires the following performance:

1. When tested at 100 percent of its current rating, the relay shall function (trip) ultimately.
2. When tested at 200 percent of its current rating, the relay shall function (trip) in not more than 8 minutes.
3. When tested at 600 percent of its current rating, the relay shall function (trip) in not more than 10, 20 or 30 seconds, depending on the Class of the relay.

All tests run with overload cold (40°C ambient) initially.

IEC requires the following performance:

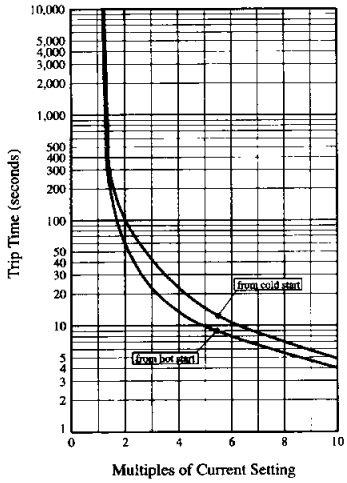
1. When tested at 105 percent of its current setting, the relay shall not function (trip) in less than 2 hours. Test run with overload cold (20°C ambient) initially.
2. When tested at 120 percent of its current setting, the relay shall function (trip) in less than 2 hours. Test run with overload cold (20°C ambient) initially.
3. For Class 10A relays: When tested at 150 percent of its current setting, the relay shall function (trip) in less than 2 minutes. Test run with overload hot (preheated with 100% rated current at 20°C ambient initially).
4. For Class 10, 20 and 30 relays: When tested at 150 percent of its current setting, the relay shall function (trip) in less than 4, 8 or 12 minutes respectively. Test run with overload hot (preheated with 100% rated current at 20°C ambient initially).
5. When tested at 720 percent of its current setting, the relay shall function (trip) according to its specific Trip Class. Test run with overload cold (20°C ambient) initially.

❶ **Note:** Current rating is defined as the current at which the relay will trip. Per NEC, an overload must ultimately trip at 125% of FLA heater setting for a 1.15 service factor motor and 115% of FLA for a 1.0 service factor motor. Therefore, the C306 trip curves reflect trip points at 600% of 125%, or 750% for a 1.15 service factor motor.

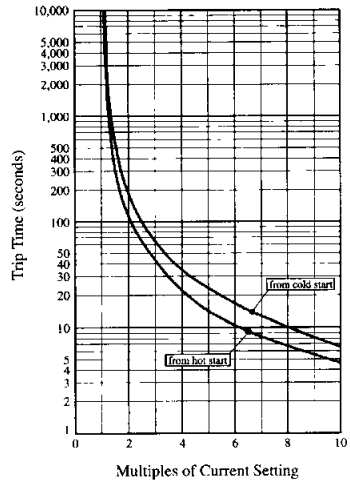
NEC (National Electrical Code) requires the following:
430-32. Continuous-Duty Motors.
(a) More than 1 Horsepower. Each continuous-duty motor rated more than 1 horsepower shall be protected against overload by one of the following means:

(1) A separate overload device that is responsive to motor current. This device shall be selected to trip or rated at no more than the following percent of the motor nameplate full-load current rating.
Motor with a marked service factor not less than 1.15 . . . . . 125%
Motors with a marked temperature rise not over 40°C. 125%
All other motors 115%
Modification of this value shall be permitted as provided in Section 430-34.
430-34. Selection of Overload Relay. Where the overload relay selected in accordance with Section 430-32(a)(1) and (c)(1) is not sufficient to start the motor or to carry the load, the next higher size overload relay shall be permitted to be used, provided the trip current of the overload relay does not exceed the following percentage of motor full-load current rating.
Motors with marked service factor not less than 1.15 . . . . . 140%
Motors with a marked temperature rise of over 40°C. 140%
All other motors 130%

Trip Curves: The time-current characteristics (trip curves) for the Freedom Series C306 overload relay are shown below. See your IEC 8211 TIP sheet for the entire range of trip curves for the C316 fixed heater overload relay.



C306 Overload Relays Class 10, 3 Phase Trip Curve



C306 Overload Relays Class 20, 3 Phase Trip Curve

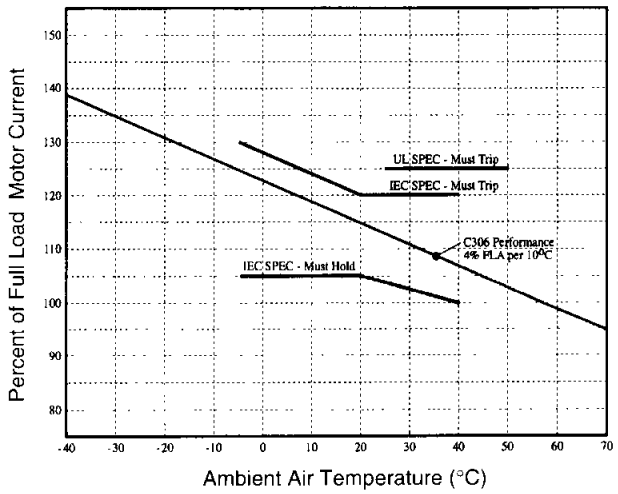
Trip Class: The trip class of an overload relay is the maximum time in seconds at which the relay will function (trip) when carrying a current equal to 600 percent of its current rating. (See note ❶ on page 1.)The typical Classes are 10, 20 and 30. For example, a Class 20 relay will function (trip) in 20 seconds or less at 600 percent of its current rating. The trip classes, according to IEC, are as follows:

Trip Class	Tripping Time Tp (seconds)
10A	2 < Tp <= 10
10	4 < Tp <= 10
20	6 < Tp <= 20
30	9 < Tp <= 30

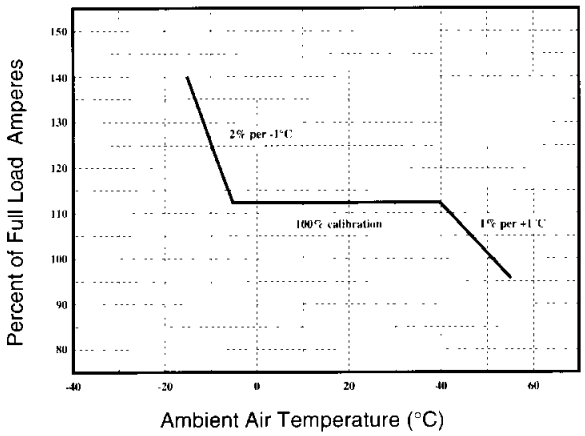
Ambient Temperature: The Freedom C306 and the fixed heater C316 overload relay are ambient temperature compensated as standard. An overload relay is designed to prevent the motor from overheating. The heat comes from two sources, that generated within the motor due to current and magnetic effects, and the ambient conditions in which the motor operates. Ambient temperature has a significant effect on the operation of the overload relay bimetals. A properly designed ambient compensating element reduces the effect on the overload relay caused by ambient temperature change. This allows an overload relay of this configuration to properly protect the motor in a varying ambient.

The ambient compensation curves are shown below for the Freedom Series C306 and the C316 overload relays.

C316 Overload Relays
Ambient Temperature Compensation



C316 Overload Relays
Ambient Temperature Compensation



Limit of Self Protection: Per UL and CSA, the overload relay shall be suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical amperes at 600 volts maximum. Both the C306 and C316 relays meet this requirement.

Resetting: The overload relay shall be capable of being reset. Resetting may be accomplished by an integral automatic function or by manual operation. Both the C306 and C316 have both manual and automatic reset capabilities.

Phase Loss Protection

How it works:

The Freedom Series C306 overload relay is designed to provide phase loss protection. This protection allows the relay to provide overcurrent protection under phase loss conditions. If power from one of the lines should be lost, one of the bimetal elements is not heated. The force it contributes toward operating the overload relay is also lost. The C306 overload relay includes a mechanical means to compensate for this loss of force and heat. As two bimetals push forward, being heated by current, they push slide bar A (see Fig. I). The unheated bimetal starts to return to its unheated position and thus holds slide bar B back. This causes the switch actuator to operate the overload relay contacts, without having to move slide bar B to the stop, thus tripping the contacts at or near the normal 3 phase current, protecting the motor from damage. The C306 and C316 overload relays meet the UL 508 , part 45.9 single phasing requirements. The C306 and C316 overload relays conform to IEC 947 when FLA dial setting is adjusted for 1.0 service factor motors (rotating FLA dial setting 1/2 position counter-clockwise. The C316 overload relay conforms to IEC 947 as standard.

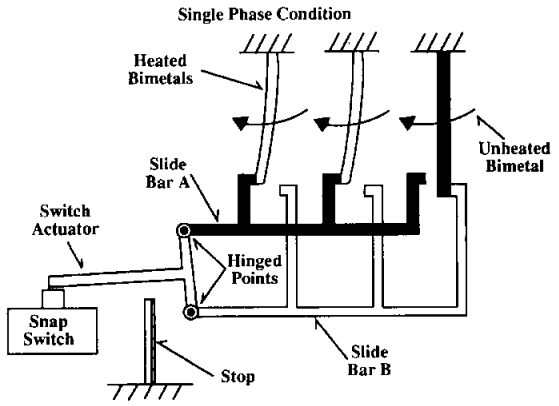
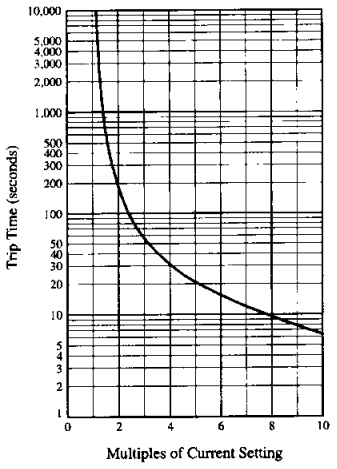
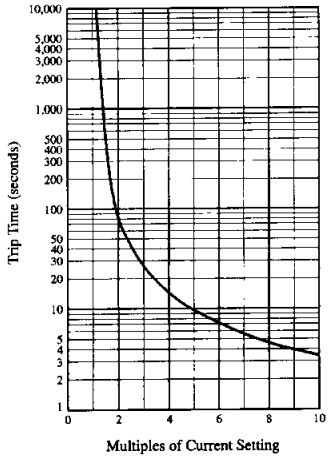


Figure I



C306 Overload Relays Class 10, Phase Loss Trip Curve



C306 Overload Relays Class 20, Phase Loss Trip Curve

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