ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL
Allentown, PA

February 1995
Supersedes Descriptive Bulletin 41-201S, pages 1-4, dated September 1990
Mailed to: E, D, C/41-100B

For Motor Protection
Device Number: 49/50/51

CIRCUIT SHIELD®

Type 49/50/51, Type 49/50, and Type 49 Overload Relays

Features

- Overload, locked rotor, and fault protection, each independently adjustable.
- Memory of previous overloads.
- Easily made, accurate settings.
- Minimizes fuse replacement in motor starters.
- UL recognized
- Pickup and operation indicators.
- Built-in test
- High seismic capability
- Transient immunity (IEEE test)
- 2 year warranty

Application

The Type 49/50/51 Overload Relay provides three important functions for the protection of a motor. Packaged in one case, the three functions are individually adjustable, allowing optimum protection without compromise among the various elements.

Overload Protection (Function 49)
The overload function with advanced design, solid state circuitry, has time-current curves which closely match the allowable heating times of motors. This allows use of the full overload capability of the machine, without the risk of damage or reduced life due to the continuous or repetitive overloads.

Unlike bimetals or other thermal type relays, the Type 49/50/51 has memory of previous overloads with long reset time; long enough to ensure proper protection in applications involving repetitive overloads and hard starts. The reset characteristic is described on page 3.

Both pickup current and time delay are field-adjustable, allowing just one relay to be used with any motor. The time-current characteristics are shown in Figure 1. The time delay is continuously adjustable, from 1 to 5 minutes at an overload corresponding to 200% of the ampere-tap setting. Ampere-taps are provided at 2.5, 2.8, 3.1, 3.5, 4, and 4.5 amps. A vernier adjustment allows continuous adjustment from 2.5 to 5 amps.

Locked Rotor Protection (Function 51)
This element has its pickup current fixed at 300% of the tap setting. Designed especially for stall and high overload protection, the shape of this curve accommodates both full and reduced voltage starts. The time delay is continuously adjustable from 5 to 30 seconds at six times the overload setting, allowing its use even with motors having very long starting times. The time-delay curves for this function are shown in Figure 2.

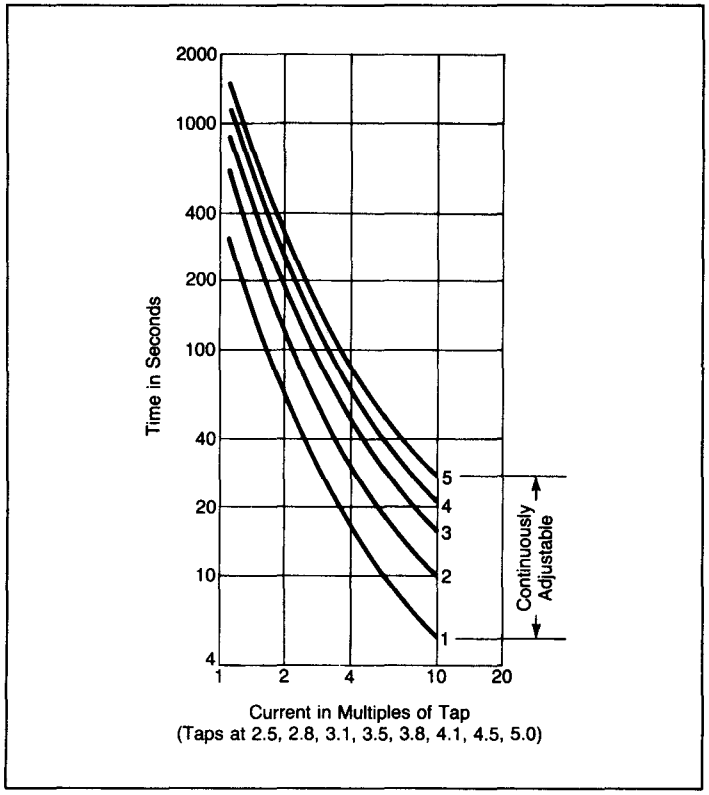


Figure 1. Overload Unit Time-Current Characteristics

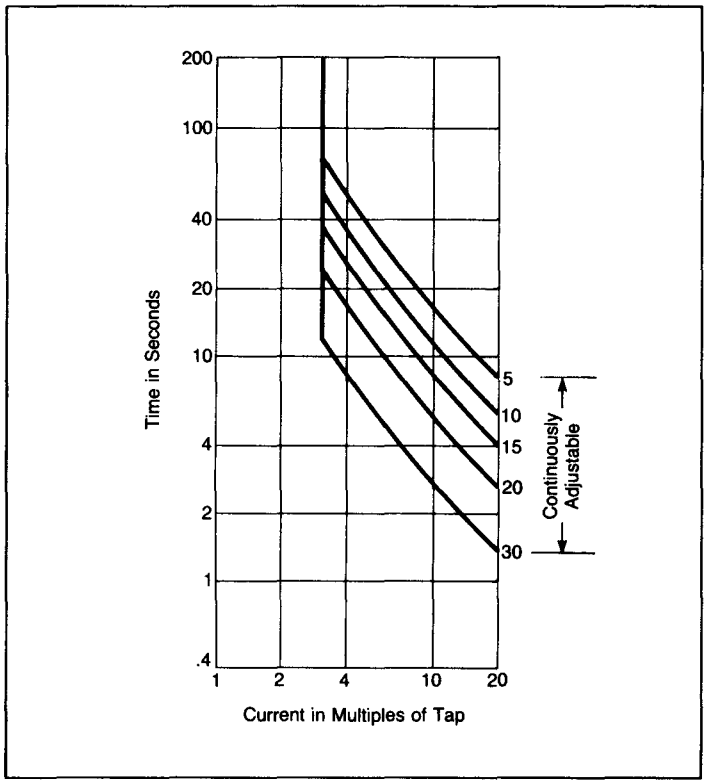


Figure 2. Locked Rotor Unit Time-Current Characteristics

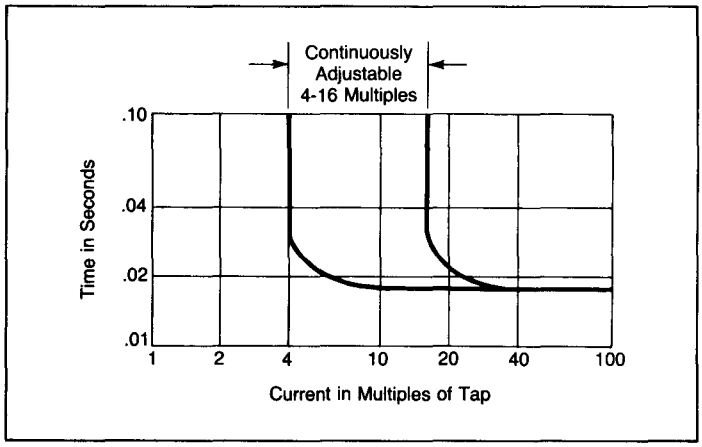


Figure 3. Phase Fault Unit Time-Current Characteristic

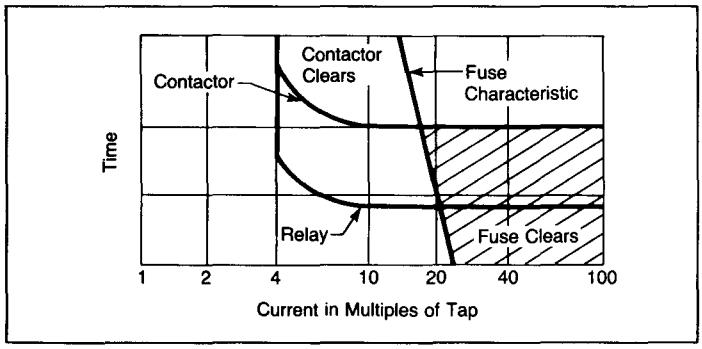


Figure 4. Phase Fault Unit Coordination With A Fuse

Phase Fault Protection (Function 50)

As shown in Figure 3, this unit is continuously adjustable from 4 to 16 multiples of the overload unit setting. The characteristic curve is especially designed with a definite minimum time characteristic which is particularly useful when the relay is applied with fused motor starters. As shown in Figure 4, the minimum delay guarantees that the fuse will beat the contactor for high-level faults beyond the rating of the starters, but allows the relay to beat the fuse for low-grade faults, thus saving fuse replacement. Also, fuse selection is simplified since the only coordination point that needs consideration is the interrupting capacity of the starter.

Settings

Proper application of the Type 49/50/51 can best be described by an example. In the example all settings and currents will be expressed as percentages of the full load amperes (FLA) of the motor.

Assume: A motor with an allowable heating curve and starting characteristic as shown in Figure 5. Full load amperes at the CT secondary of 2.9 amperes. Locked rotor amps (LRA) = 600% FLA, and starting time is 3 seconds.

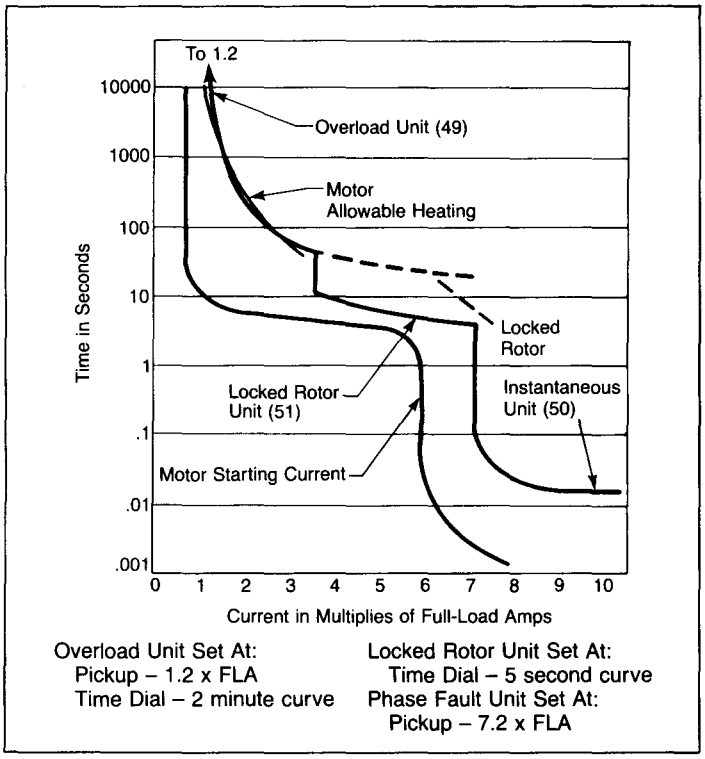


Figure 5. Composite Motor Protection

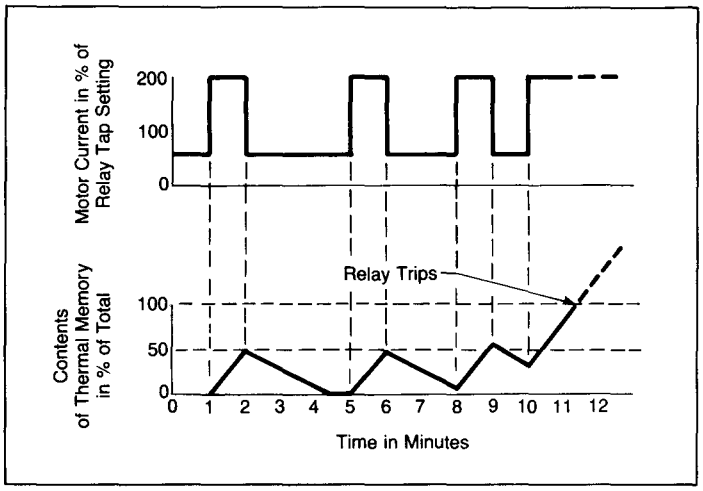


Figure 6. Typical Overload Memory Operation

Choose the 49/50/51 relay options. For a 40°C continuous duty machine with 115% service factor, a (49) setting of 115 to 125% FLA is appropriate. With FLA of 2.9 amperes, choose the 3.5 ampere tap setting (120% FLA). Select time dial 2 to match (49) curve to allowable heating curve. Since pickup for the (51) function is fixed at 3 times the tap setting, the (51) pickup is 10.5 amperes or 360% FLA. Set the (51) operating time to 5 seconds. Set the (50) pickup at 6 multiples; this gives a pickup current of 6 x 3.5 ampere tap setting = 21 amperes = 720% FLA.

The Type 49/50/51 time-current characteristics for this example are shown in Figure 5.

Allowable Time Between Successive Overloads

The (49) element of the relay has memory of prior overloads; therefore, if a second overload occurs before the expiration or full reset of the memory, the relay will trip in a time shorter than shown by the time-current curves. This relationship may be expressed by:

$$T_2 = 1 - T_1 + \frac{T_{12}}{T_R} \text{ (valid when } T_2 \leq 1)$$

where: T_R is the time in minutes required for full reset:

Time Dial	1	2	3	4	5
T_R	2.4	4.8	7.2	9.6	12

T_2 is the time required for the second overload to cause the relay to trip, as a fraction of the value read from the time-current curve.

T_1 is the time for which the first overload lasted, expressed s a fraction of the time allowed by the time-current curve. For example, with the relay set on time dial #1, if the first overload was 2 times pickup and lasted 20 seconds:

$$T_1 = \frac{20}{60} = \frac{1}{3} \text{ (for Time Dial \#1)}$$

T_{12} is the time between removal of first overload and application of the second, in minutes.

Solutions to the equation yielding values greater than 1 are not valid, and should be set equal to 1.

Note that the solution is in terms of the time required for a trip. There is no requirement that the second overload be the same amplitude as the first. For example, if the second overload is 2X pickup, and T_2 was calculated as 100% then the second overload can last as long as 60 sec. (using time dial 1), before a trip occurs. However, if the second overload happens to be 4X pickup, it can only last 16 seconds or a trip will occur.

The minimum interval between overloads may be calculated by setting $T_2 = 1$.

then: $T_{12} = T_1 T_R$

Another example is shown graphically in Figure 6.

Fast Reset Control

The operator may defeat the memory action of the overload element of the relay by using a momentary contact closure to fully reset the memory. This feature is useful when testing the relay. Fast reset could also be used in emergency situations where continuity of service takes precedence over protection of the motor. See Instruction Book 7.2.1.7-4 for wiring details.

Output Contacts

The output contacts may be selected in one of two arrangements. (1) Self-reset: the contacts will reset upon removal of the overcurrent condition which caused the trip operation. (2) Hand-reset: the contacts are reset by pushing the target reset button on the front panel of the relay.

Specifications

Pickup (49): (overload) Tap settings at 2.5, 2.8, 3.1, 3.5, 4, 4.5 amperes with vernier to give continuous adjustment 2.5-5.0 amperes.

Pickup (50): (fault) Continuously adjustable 4 to 16 multiples of tap setting.

Pickup (51): (stall) Fixed at 3 multiples of tap setting.

Input Circuit Rating: Continuous – 3 multiples of tap setting.
200 amperes – 1 second
50/60 Hz

Burden: 0.020 ohms, resistive
Models available for:
120 Vac 50/60 Hz at .08 amperes.
48, 110, 125, 220, 250 Vdc at 0.8 amperes

Output Circuit Rating:

	@ 120 Vac	@ 125 Vdc
Tripping Duty	30A	30A
Continuous	5A	5A
Break Resistive	3A	1A
Break Inductive	2A	0.3A

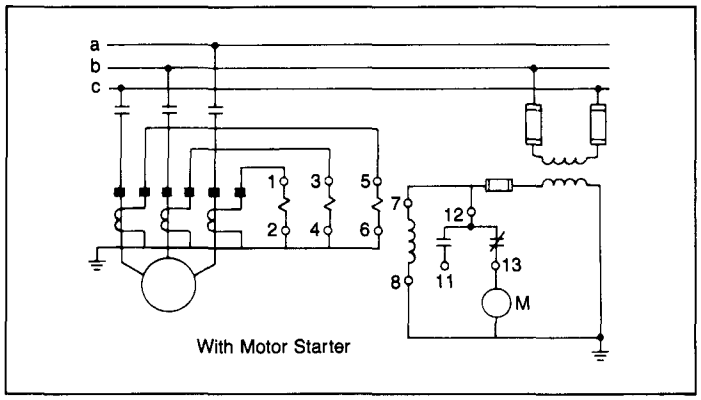
Temperature: Minus 20°C to plus 70°C

Seismic Capability: More than 6g's ZPA either axis, biaxial, broadband multifrequency without damage or malfunction. (ANSI/IEEE C37.98)

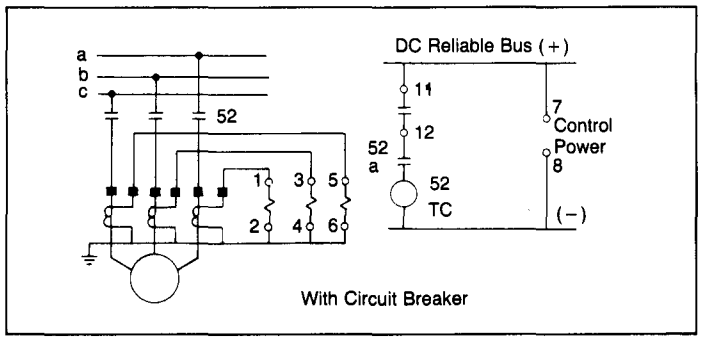
Transient Immunity: More than 2500V, 1 MHz bursts at 400Hz repetitive rate, continuous. (ANSI C37.90.1 SWC); Fast Transient Test; EMI Test

Operating Times: See curves, page 2.
Weight: Unboxed – 3.6 lbs. (1.6 Kg)
Boxed – 4.3 lbs. (1.9 Kg)
Volume: Boxed – 0.26 cubic feet

Wiring Diagrams

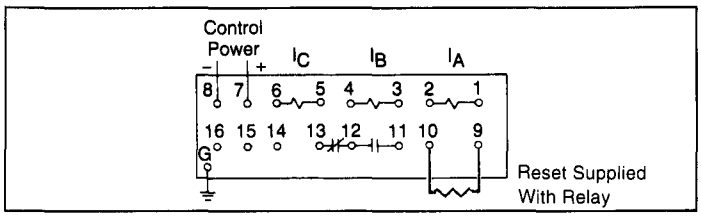


With Motor Starter



With Circuit Breaker

NOTE: C.T. polarities must be observed for proper relay operation.



Reset Supplied With Relay

How To Specify

Relay shall be Asea Brown Boveri Type 49/50/51 or approved equal. Relay shall be equipped with overload, locked rotor, and phase fault protective functions. Overload element shall include memory to provide long reset time. Each function shall be independently adjustable. A pickup indicating light shall be provided for the 49 function. Separate operation indicators shall be provided for the 50 and 51 functions. Relay shall be capable of 6g (ZPA) seismic stress without malfunction. Built-in means shall be provided to allow operational tests without additional equipment. The output contacts shall be self-resetting or hand-reset.

Types 49/50 and 49 may be specified similarly by referencing only the functions appropriate to the relay.

How To Order

For a complete listing of available overcurrent relays, including the Type 49/50/51 series, see TD 41-025. To place an order, or for further information, contact the nearest ABB Representative.

Further Information

List Prices: PL 41-020
Technical Data: TD 41-025
Instruction Book: 7.2.1.7-4
Motor Protection Paper: TP 18.0.3
Motor Protection Relays:
Application Guide, 41-205M
Other Protective Relays:
Application Selector Guide, TD 41-016

Printed in U.S.A.

February 1995
Supersedes Descriptive Bulletin 41-201S,
page 5, dated September 1990
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For Motor Protection
Three Phase, Suitable for 50/60 Hz

CIRCUIT SHIELD ®

Type 49/50/51, Type 49/50, and Type 49 Overload Relays

	Overload Unit (49)		Stall Unit (51)		Fault Unit (50)	Catalog Number⑤
Type	Pickup Range (amperes)	Time Delay Range (minutes)①	Pickup② (multiples)	Time Delay Range (seconds)③	Instantaneous Range (multiples)④	
49/50/51	2.5-5.0	1-5	3	5-30	4-16	414C00X6
49/50						414B00X6
49						414A00X6

Internal Connections: 16D414A

① Time delay range shown is at 2 multiples of the pickup tap setting — see time current curves for complete characteristic.

② Pickup for stall unit is fixed in three multiples of the overload unit tap setting.

③ Time delay range shown is at 6 multiples of the overload unit tap setting — see time current curves for complete characteristic.

④ Pickup range for the instantaneous unit is listed as multiples of the overload unit tap setting.

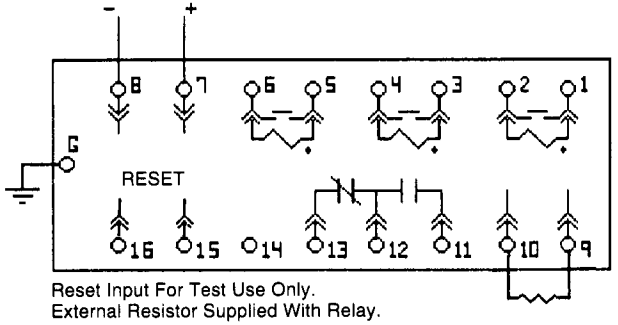
⑤ Each of the listed catalog numbers contains an X for the control voltage designation.

To complete the catalog number replace the X with proper control voltage code digit:

110 Vdc	0
220 Vdc	2
48 Vdc	3
125 Vdc	4
250 Vdc	5
120 Vac	6
24 Vdc	9

Internal Connection Diagram

16D414A Motor Overload Relay
Types 49, 49/50, 49/50/51
Drawout Test Case



Reset Input For Test Use Only.
External Resistor Supplied With Relay.