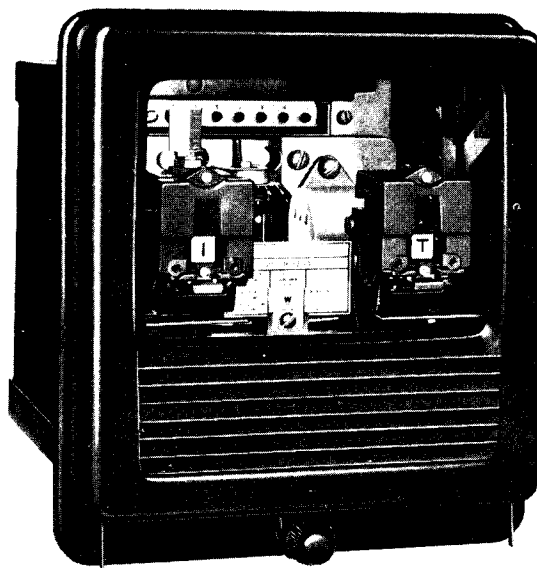


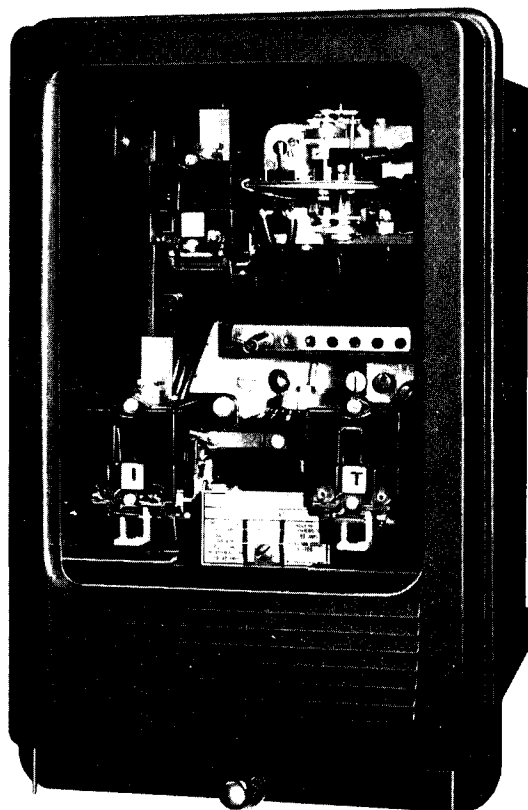
September, 1990
Supersedes DB 41-100A, pages 1-12,
dated November, 1988
Mailed to: E, D, C/41-100A

Non-directional, Single Phase,
Adjustable Time Delay
Device Number: 51 or 50/51

Type CO Overcurrent Relays



CO-2



CO-4

Application

CO relays, a complete coordinated line, assure accurate and reliable primary or backup protection against phase or ground faults. They provide the back-bone of any protective relaying system, from generator to load.

For selective coordination between relays, seven different time curve characteristics are available. All are designed to operate faster at higher fault currents.

Each type has a wide range of current tap settings and time dial positions.

Properly applied, CO relays will provide maximum service continuity by tripping the fewest possible circuit breakers required to disconnect a faulted section.

For fast clearing of heavy faults, CO relays can be equipped with adjustable instantaneous overcurrent units.

Where cold load pickup presents a problem due to heavy inrush currents to devices such as refrigerators, water heaters, etc., type CO relays can be equipped with high dropout instantaneous trip units (ITH) which will provide instantaneous trip protection for the protective line when initial load current is dropped to 90% of the ITH unit setting.

When ac current is necessary in the control-trip circuit, the indicating contactor switch (ICS) dc unit is replaced by the type ACS indicating contactor switch sealed-in unit. The ACS unit is similar in construction to the IIT unit, and has an adjustable range of .25 to .9 amperes ac.

Both non-torque and torque controlled designs are available.

Advantages

Low burden, high thermal capacity, negligible temperature error.

Accurate pickup, continuous "between tap" adjustment.

Simplified settings, ease of accessibility, lower maintenance cost.

Space saving Flexitest® universal cases, for semi-flush or projection mounting.

Device Number: 51

Selector Guide

Relay Type	Time Curve	Comparative Operating Time ^①	Basic Application
CO-2	Short	0.47 Sec.	Differential protection of bus or generators where restraint windings are not required. Straight over-current protection where short operating time is necessary for system stability.
CO-4	Long (step)	25 Sec.	Designed primarily to provide effective relay coordination with the selective trip characteristics of DS breakers. Step-time operating characteristic coordinates with selective trip curve of DS breaker and associated fuses.
CO-5	Long	25 Sec.	Motor protection. Long time setting (150% of full load) prevents tripping due to motor starting currents, and allows motor to carry moderate overloads for safe periods. Inverse characteristic provides faster tripping at higher overloads.
CO-6	Definite	2 Sec.	For use where generating capacity and fault currents vary over a wide range. Relay has fixed operating time (per time dial setting) from approximately 10 to 20 times tap current, thus providing definite selective operation for sequential tripping.
CO-7	Moderately Inverse	2.48 Sec.	Overcurrent phase and/or ground fault detection on transmission or feeder lines where moderate changes in generating capacity occur, or on parallel lines where one line may be called on to carry both loads. Relay approaches definite time characteristics at high currents, allowing wide changes in fault current magnitude with little change in operating time.
CO-8	Inverse	2.52 Sec.	Phase and/or ground fault detection of subtransmission lines or feeders. Also supplied as primary protection or back-up for other relays. Wide range in time lever settings and slope of curves facilitate coordination and assure selective operation. Degree of inverseness required is determined by fault current magnitude, operating time desired, and the characteristics of nearby relays on the system.
CO-9	Very Inverse	1.53 Sec.	
CO-11	Extremely Inverse	0.8 Sec.	Used on feeder circuit breakers which must coordinate with main and branch line sectionalizing fuses. Also used where long time delay is required for light overload, such as where feeder is energized after extended outage.

① Values shown are with #10 time dial setting, and with 10 times tap value current applied.

Factors to Consider in Selecting Proper Relay Type

Apparatus or Circuit to be Protected: In general, the application will indicate the use of a specific relay. Short-time relays act fast to avoid equipment damage. Long-time relays hold off tripping on heavy initial overloads or more extended moderate overloads.

At higher fault currents, definite-time and moderately inverse relays maintain constant operating time, despite variation in connected generation and fault currents. Inverse and extremely inverse relays operate respectively faster on higher fault currents.

Selective Operation, Sequential Tripping: To maintain maximum continuity of service, as small a section as possible should be removed from a system during a fault. A common method is to set each successive relay, progressing from the generator, to operate 0.3 second sooner (exclusive of circuit breaker operating time) so that the relay nearest the fault will operate first to remove the faulted section. See figure 1.

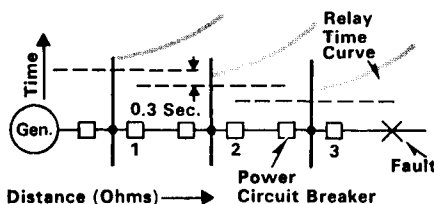


Fig. 1
Coordination With Adjacent Relays: To assure selective operation, relays in all sections of the protected line should have similar operating curves. Otherwise, curves may intercept, resulting in incorrect relay operation. See figure 2.

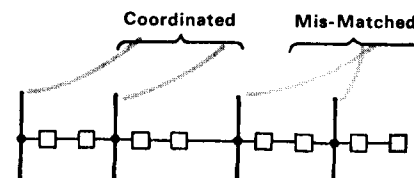


Fig. 2

Relay Tap Range: Magnitude of fault current available at a given location is usually determined by system studies. Tap range selection depends on the fault current as seen by the relay, which is determined by the current transformer ratio and its operating characteristics under fault conditions.

Ac or Dc Trip Circuit: Where a dc control source (24 to 250 volts) is available, circuit closing relays are used. If dc is not available, circuit opening relays are used with

ac tripping, using the output of a current transformer to energize the circuit breaker trip coil. Under normal conditions, the normally closed contacts of the relay shunt the breaker trip coil.

High Speed Short Circuit Fault Protection: Relays equipped with instantaneous overcurrent IIT or ITH units provide instantaneous overcurrent tripping, in addition to tripping with time delay on moderate overloads.

Construction and Operation^①

Two basic designs are available:

Non-torque Controlled

This, the most widely used type, is designed so that the relay contacts close when tap value is applied. See figure 9.

Torque Controlled

This type has the lag coil connections of the "E" induction unit electromagnet brought out to separate terminals. This permits control of the time-overcurrent unit from an external relay contact, such as a directional or distance relay. See figure 13.

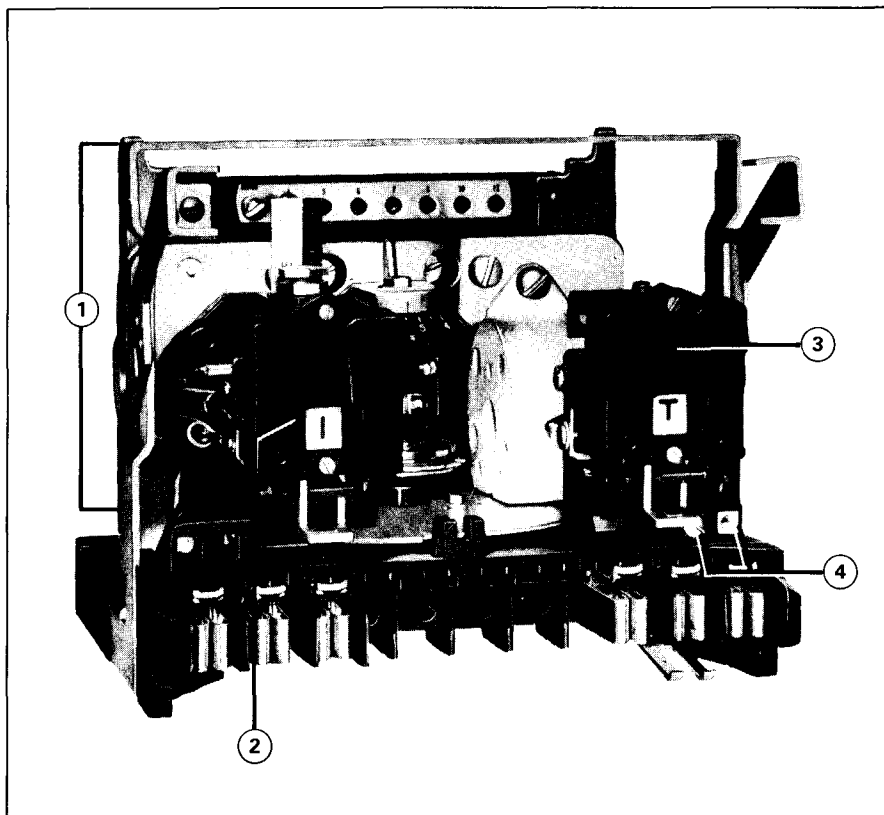


Fig. 3

① Time Delay Overcurrent Unit (CO)

See page 4.

② Indicating Instantaneous Trip (IIT)

See page 5.

③ Indicating Contactor Switch (ICS)

See page 5.

④ ICS Taps

See page 5.

① CO-4 relay for relay coordination with 600 volt air circuit breaker is described on pages 10 and 11.

Circuit Opening Types

Circuit opening CO relays in conjunction with an ac series trip coil are used to trip circuit breakers when a suitable station battery is not available.

As shown in figures 10 and 11, closing of the CO unit contacts energizes a De-ion® contactor switch (CS) whose contacts shunt the ac trip current through the breaker trip coil.

The circuit opening relay is recommended only in the 4 to 12 ampere range. A lower range relay is not desirable due to the excessive burden of a low current range trip coil.

Burden of the auxiliary current transformer (figures 10 and 11) with 4 amperes applied is 4.6 volt-amperes with the CO contacts closed, and 5.7 volt-amperes with the contacts open.

See page 5 for description and illustration of the De-ion contactor switch.

"Cold Load" Pickup Protection Types

Standard CO relays, equipped with a high dropout instantaneous unit (ITH) used in conjunction with reclosing relays, provide completely coordinated distribution feeder protection where "cold load" pickup is involved.

The ITH unit has a dropout ratio of 90% of pickup. With this unit set at minimum fault current on the protected feeder, when a fault occurs, the ITH picks up and, in conjunction with the reclosing relay, the breaker is tripped and immediately reclosed. The reclosing relay at the same time takes over control and locks out the ITH contact circuit.

After the fault has been cleared, the feeder is re-energized and, after a slight time delay in the recloser circuit, the ITH contact circuit is restored. However, under normal cold load pickup conditions, the line current has dropped to less than 90% of minimum fault current before this contact circuit is re-established and the ITH unit has dropped out, permitting the time delay necessary to pickup the cold load.

See page 5, for description of the ITH unit.

Construction and Operation, Continued

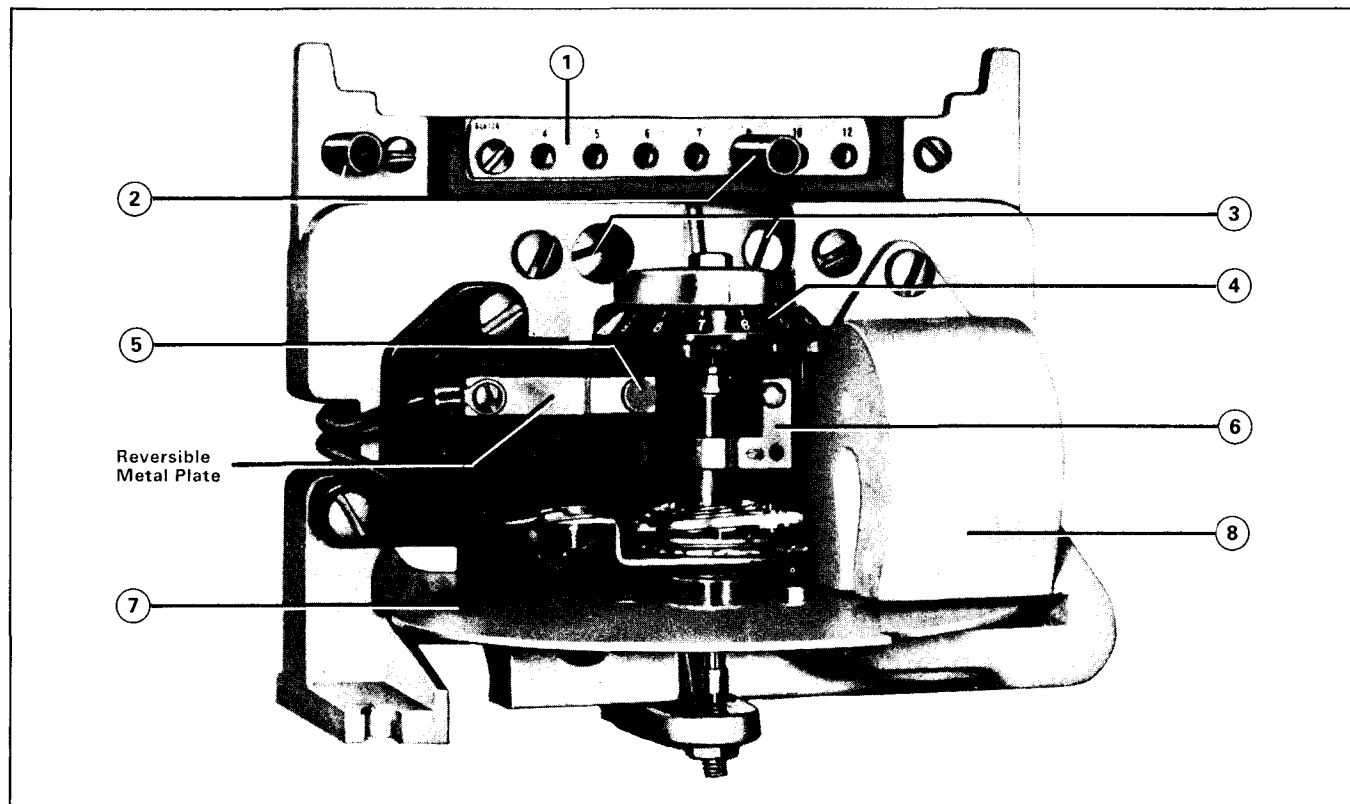


Fig. 4

Time Delay Overcurrent Unit (CO)

On CO-4, CO-5, CO-6, CO-7, CO-8, and CO-9 relays a main tapped coil is placed in the center leg of an "E" type laminated magnetic structure. Flux produced by this coil returns through the two outer legs of the electromagnet. A shading coil on the left leg of the electromagnet creates an out-of-phase flux which reacts with the main coil flux in the electromagnet's air gap to cause disc rotation in the contact closing direction.

CO-2 and CO-11 electromagnets are similar in construction, except that both outer legs have windings to produce the necessary out-of-phase fluxes required for contact closing rotational torque.

① Tap Block

Indicates minimum current required to just close the relay contacts.

② Tap Screw

The tap screw is used to select the desired tap setting.

③ Magnetic Plugs

May be screwed in or out of the magnetic circuit to control saturation and adjust calibration at high currents. A damping magnet and spring adjustment permits calibration at low currents.

④ Time Dial

Indicates initial position of the moving contact over a 270° range. Indexes from ½ (minimum time) to 11 (maximum time).

⑤ Stationary Contact

Made of pure silver. Will close 30 amperes at 250 volts dc. Has sufficient wipe to assure positive contact. In fast breaker reclosing schemes which require quick-opening relay contacts, the metal plate is reversed, holding the stationary contact fixed against the back-stop. On double-trip relays, adjustment of ¼" contact follow (or wipe) is obtained by use of a vernier adjusting screw on the stationary contact plate.

⑥ Moving Contact

Also made of pure silver, the moving contact is clamped to the insulated section of the disc shaft. Electrical connection is made from the moving contact through a spiral spring to the spring adjuster frame, then to the relay terminal. Moving contacts will close 30 amperes at 250 volts dc.

⑦ Induction Disc

Spiral shaped to compensate for the spring windup which occurs throughout the moving contact travel. Provides accurate pickup at any disc position. A spring adjuster is provided to permit in-between tap pickup adjustment when desired.

⑧ Damping Magnet

Made of high strength Alnico. Controls relay operating time at low current values. A keeper screw permits micrometer adjustment of the damping magnet without shifting the location of the magnet, and allows the relay to be accurately calibrated at low currents.

Indicating Contactor Switch (ICS) (Partially Disassembled)

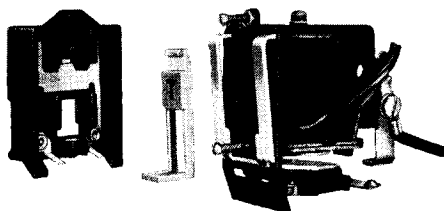


Fig. 5

The dc operated Indicating Contactor Switch has a clapper type magnetic armature to which leaf-spring contacts are attached.

When the switch is energized, the moving contacts bridge the stationary contacts, completing the trip circuit. The ICS contacts are connected in parallel with the main relay contacts, relieving them of carrying heavy trip currents.

During operation, two fingers on the armature deflect a spring, which allows the operation indicator target to drop. The target is orange color and readily visible.

Taps on the front of the unit provide connection for either 0.2 (left) or 2.0 (right) amperes dc pickup operation.

When using a 125 or 250 volt dc auxiliary WL auxiliary relay, the 0.2 ampere tap is recommended. The 2.0 ampere tap is used on 24 or 48 volt dc circuits.

Indicating Instantaneous Trip (IIT)

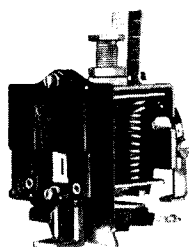


Fig. 6

Used for high speed protection against heavy fault currents. Construction is similar to that of the Indicating Contactor Switch, except that it is ac operated, and adjustable over a range of 1 to 4 times minimum pickup. Variable pickup is obtained by a core screw adjustment on the top of the unit.

When the IIT is energized above pickup setting, the target drops. Operating time is approximately one-half cycle above 250% of setting.

The IIT unit has a calibrated scale on which are marked the four divisional points of pickup range.

De-ion® Contactor Switch (CS)

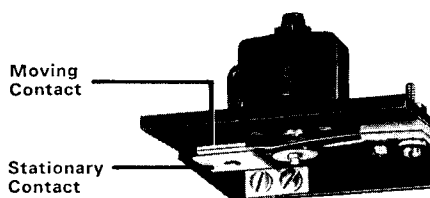


Fig. 7

Used in circuit opening type CO relays as shown schematically in figures 10 and 11. This scheme is applied where ac trip coils are used on the circuit breakers, energized by the line current transformers. When the CS coils energized by a small transformer located within the relay case, its normally closed contacts open to remove the by-pass around the breaker trip coil, thus tripping the breaker.

The CS switch will pick up at 4 amperes ac and will safely by-pass 100 amperes ac through its contacts.

High Dropout Instantaneous Unit (ITH)

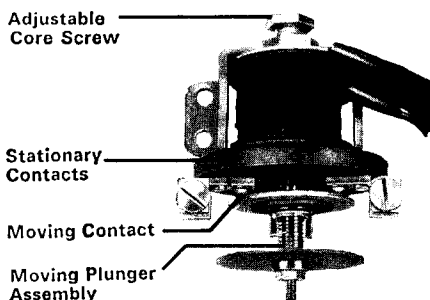


Fig. 8

The ITH unit is a solenoid operated device with an adjustable core screw which adjusts the ac current pickup of the device over a 2 to 1 range.

When the ITH coil is energized above pickup setting, the moving plunger assembly moves upward, carrying the silver disc which bridges three conical-shaped stationary contacts. The device opens its contacts when the coil current is reduced to 90% of its pickup value.

Operating range of the ITH unit can be increased to a 4 to 1 ratio, or four times the minimum pickup setting obtainable, by lowering the plunger after the core screw has been set at its maximum rated position.

If the plunger is lowered to increase the pickup current value, then at 300% of minimum trip the dropout ratio is 60% of the pickup current. At 400% of minimum trip the dropout ratio is 45% of the pickup current.

Operating speed of the ITH unit over nominal range (60 cycle base) is as follows:

- at 200% of trip setting: less than 1 cycle
- at 500% of trip setting: ½ cycle
- at 1000% of trip setting: ¼ cycle

ACS Unit

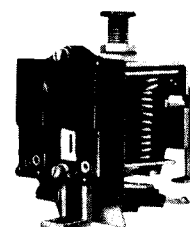


Fig. 9

Operating Range.....	.25 to .9 amps ac
Burden.....	.73 ohms ac
Coil Rating:	
Continuous.....	.25 amp
1-Second.....	7.0 amps



Internal Wiring Diagrams (Front View)
Without External Torque Control

Spst-co Contacts, FT-21 Case
Without Indicating Instantaneous Trip (IIT)

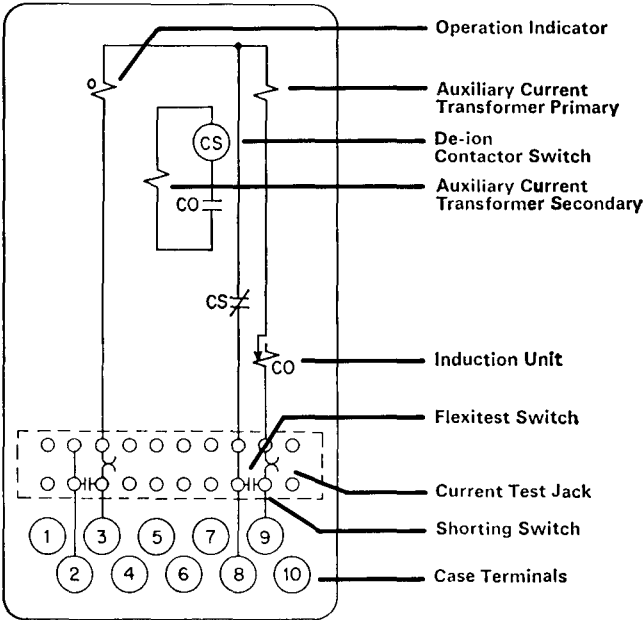


Fig. 10

183A055

Spst-co Contacts, FT-21 Case
With Indicating Instantaneous Trip (IIT)

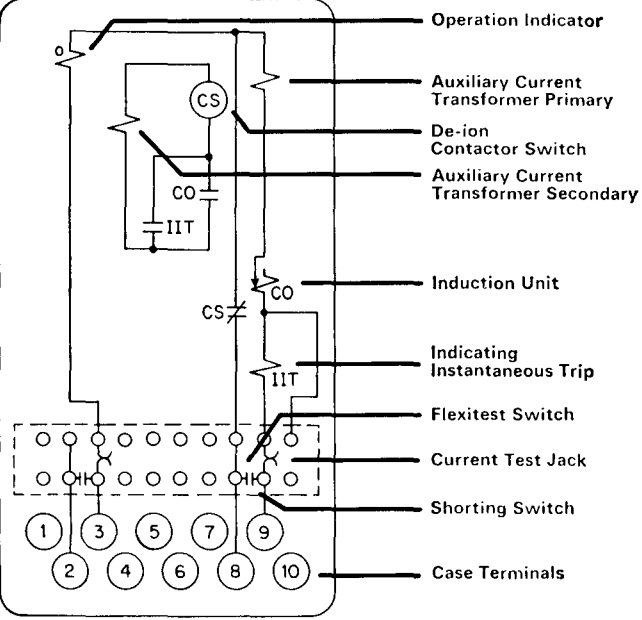


Fig. 11

183A054

With High Dropout Instantaneous Unit (ITH)

Spst-cc Contacts, FT-11 Case

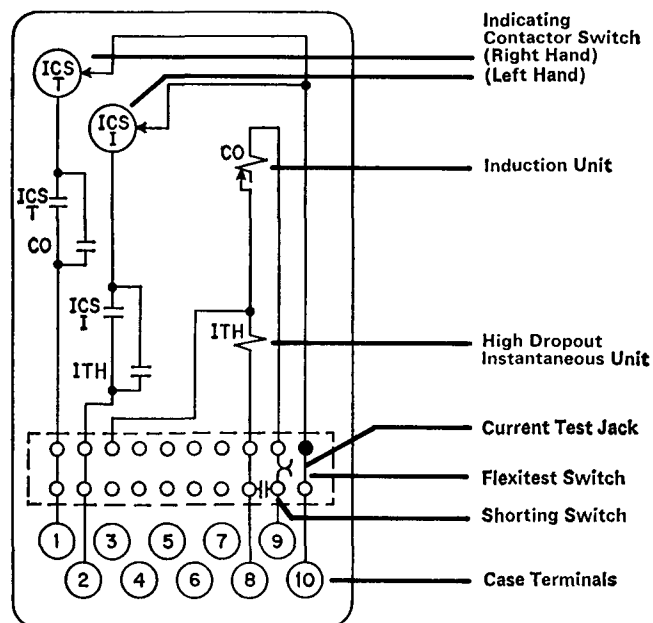


Fig. 12

183A786

Contact Legend

Spst-cc: single pole single throw – circuit closing

Spst-co: single pole single throw – circuit

External Schematic of Type CO Relay For Phase and Ground Protection on a Three Phase System

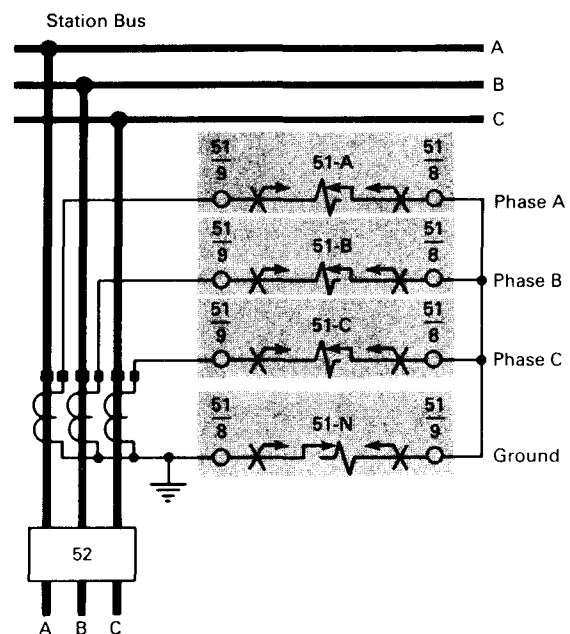
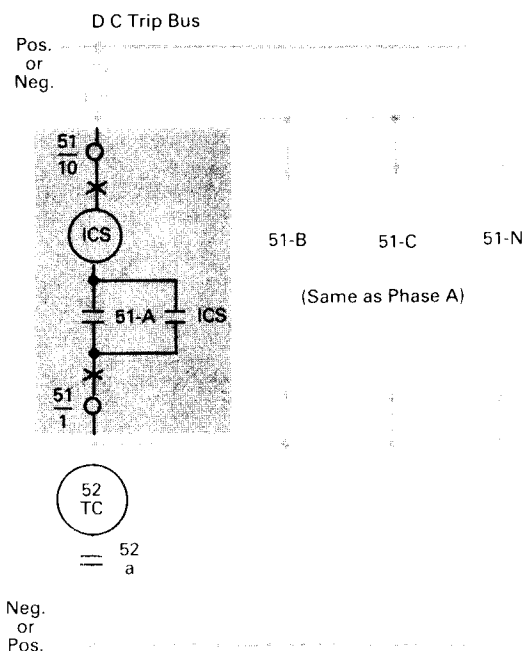


Fig. 13



182A755

[illegible]

Fig. 14

- 51 – Overcurrent Relay, Type CO
- 51N – Ground Overcurrent Relay, Type CO
- CS – De-ion Contactor Switch
- 32 – Directional Relay, Type H-3
- 32X – Auxiliary Relay, Type MG-6
- CS1 – Auxiliary Contactor Switches
- CS2 – Auxiliary Contactor Switches
- ICS – Indicating Contactor Switch
- IIT – Indicating Instantaneous Trip
- 52 – Power Circuit Breaker
- 52a – Breaker Auxiliary Contact
- TC – Breaker Trip Coil
- TO – Operation Indicator

183A213

Three Phase Overcurrent Detection: Using Type H-3 Directional Relay and Torque Controlling Type CO Relays with MG-6 Auxiliary Relay, 90 Degree Connection

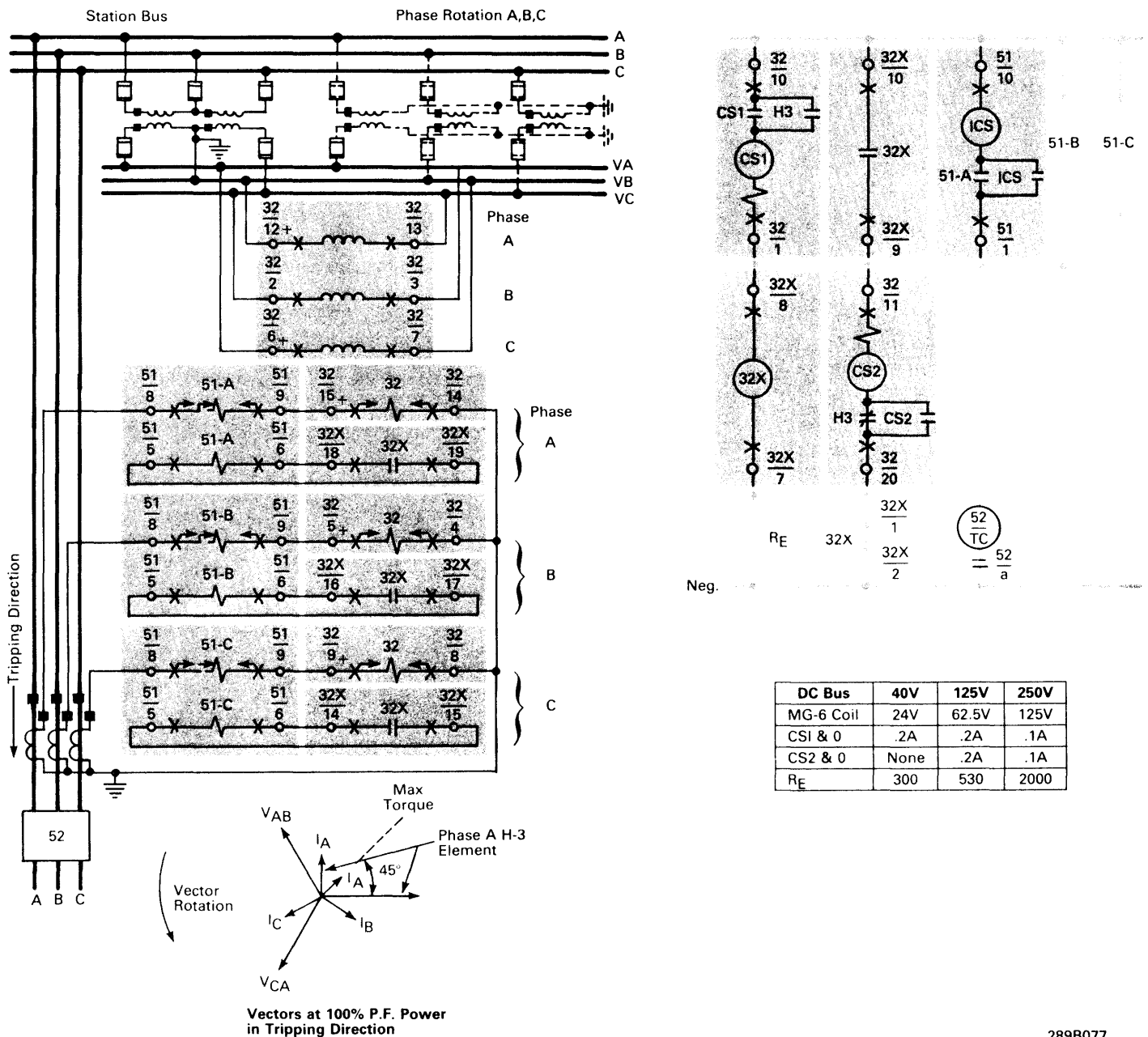


Fig. 15

CO-4 Relay For Relay Coordination with 600 Volt Air Circuit Breakers

In 600 volt class equipment, protection is generally obtained through the use of overcurrent tripping devices which are an integral part of the circuit breakers.

Two types of air circuit breakers are generally used in low voltage applications for industrials and power plants. One type, such as the AB breaker, uses a thermal magnetic tripping device. The other is the DB type which uses series overcurrent tripping units that employ a dashpot device to obtain time delay.

The tripping characteristic of the DS breaker has a pronounced bend as shown in figure 16. The use of standard CO relays would necessitate a high current pickup setting in order to keep the relay time-current characteristic beyond the bend of the breaker operating curve. This high current pickup setting in turn, makes coordination with other relays near the source difficult or impossible.

Inasmuch as it is not practical to sacrifice coordination and proper protection of the primary system merely to obtain selectivity on the low voltage system, the CO-4 relay was developed.

The CO-4 has a step-time characteristic which is obtained by the combination of the CO-5 long time induction disc overcurrent unit, two instantaneous overcurrent units, and one timer. The resultant curve is illustrated by figure 18.

The induction disc-overcurrent unit is set to coordinate with the overload portion of the breaker curve.

The instantaneous unit (IT) energizes the timer (T) to provide .25-3 seconds delay, and the IIT unit trips directly.

Consequently, the CO-4 step-time characteristic effects selective coordination with other relays nearer to the power source.

DB Breaker Tripping Characteristics

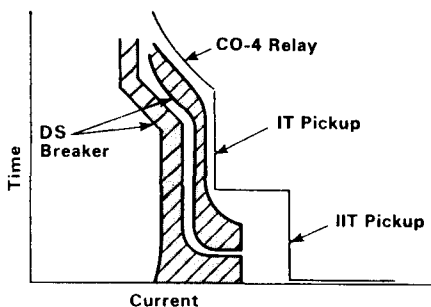


Fig. 16

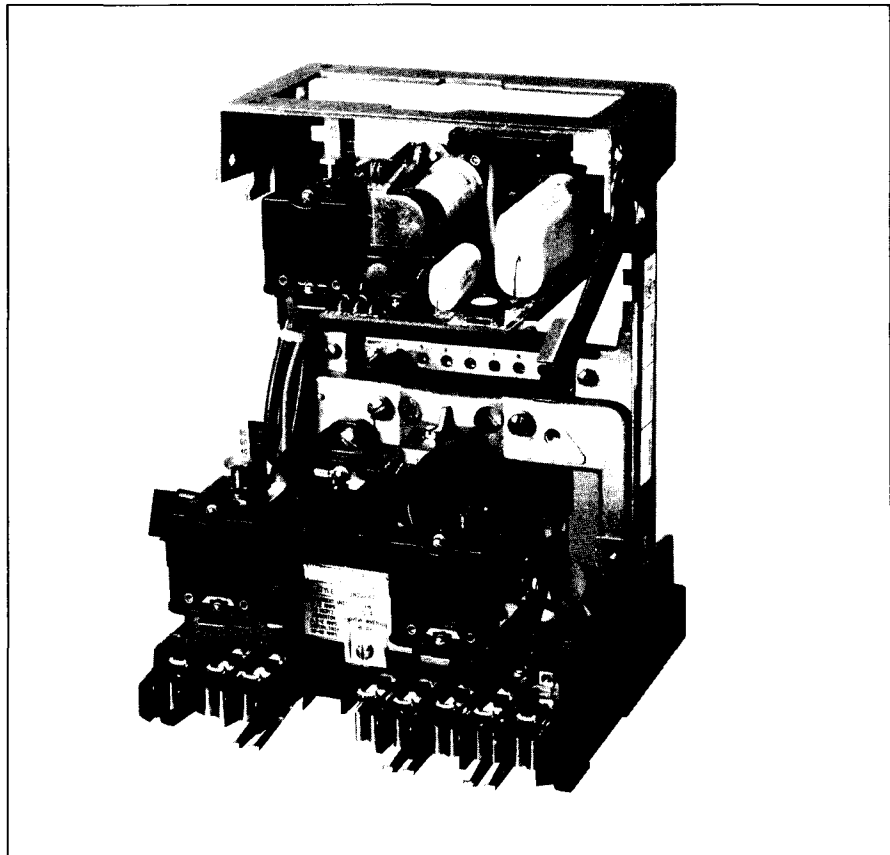


Fig. 17

① Instantaneous Trip Unit (IT)

Ac operated. An adjustable core varies the current pickup of the unit. When the IT contacts close, the timer circuit is completed, providing an adjustable time delay before tripping.

The timer will operate satisfactorily over a range of 10 to 100 amperes ac. Timing accuracy is $\pm 5\%$ of setting.

③ Indicating Instantaneous Trip (IIT)

④ Time Delay Overcurrent Unit (CO)

⑤ Indicating Contactor Switch (ICS)

See page 5.

② Timer Unit(T)

The solid state timer unit consists of a printed circuit board with an RC circuit and an output telephone relay.

Maximum setting of the timer is 3 seconds, indexed at 10 cycle points.

Typical CO-4 Time-Current Curve Bands

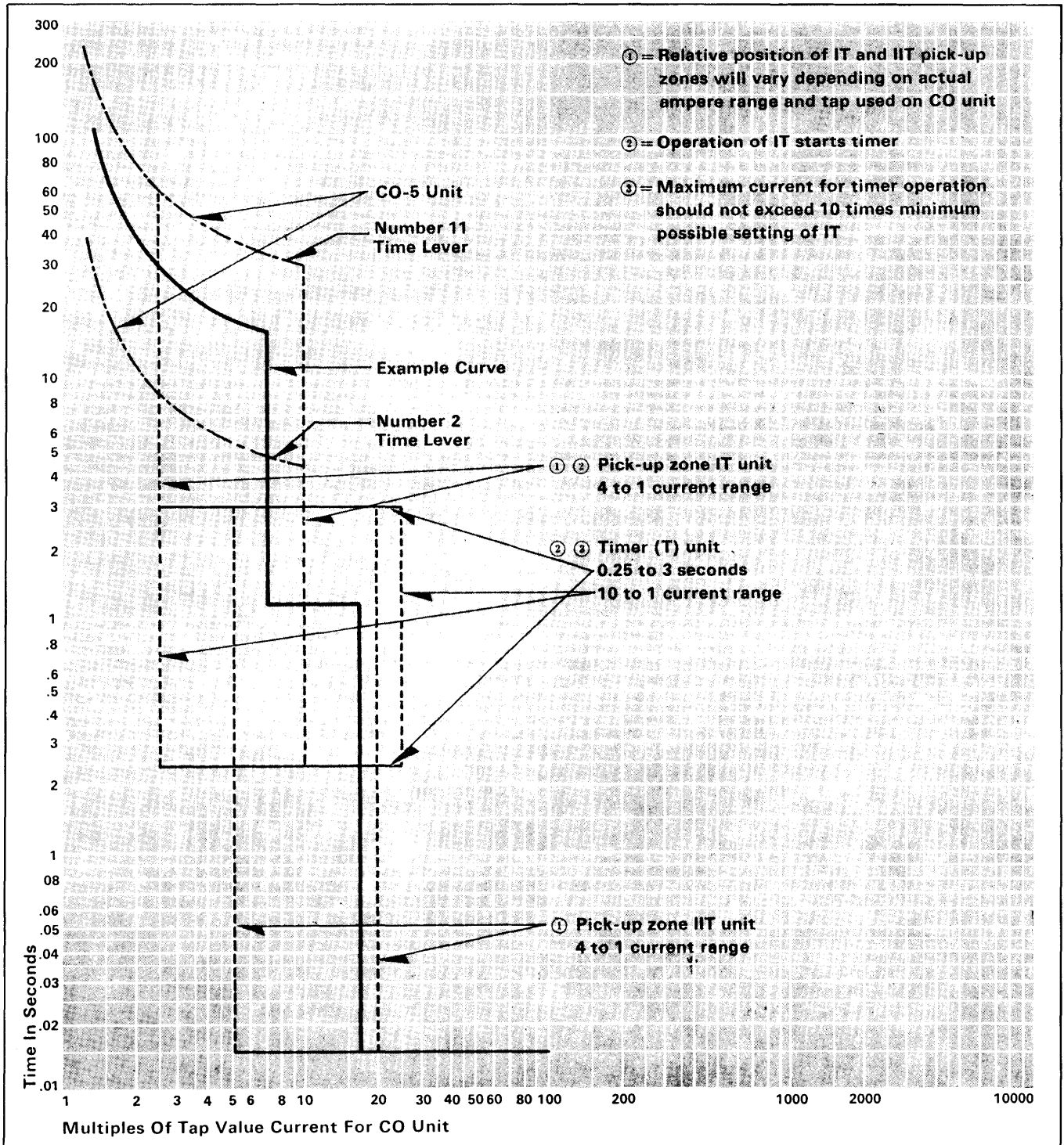


Fig. 18

406C935

CO-4 Internal Wiring, Spst-cc Contacts, FT-21 Case

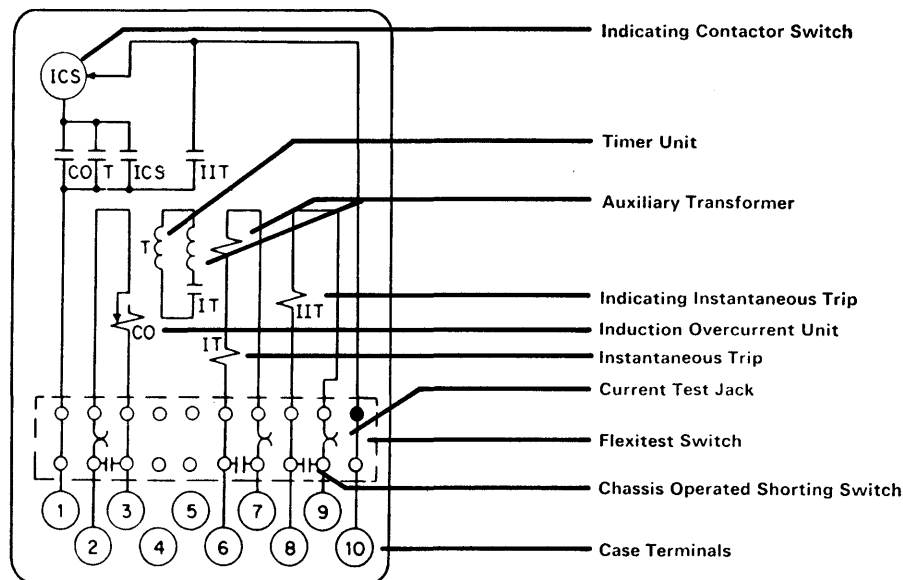


Fig. 19

183A115

Burden Data and Thermal Characteristics (All Types)

CS De-ion Switch (Ac Operated)
(Used in contact opening CO relays)

4 amps ac pickup. Will bypass 100 amps ac in trip circuit.

Timer
(Used in CO-4 relay).

Burden of the timer unit and auxiliary current transformer at 5 amps, 60 cycles, with an IT range of 10 to 40 amps is:

IT contacts open: 0.7 volt-ampere at 80° lag
IT contacts closed: 0.6 volt-ampere at 65° lag

Current Tap Ranges (Ac)

Range	Taps
0.5 - 2.5	0.5, 0.6, 0.8, 1.0, 1.5, 2.0, 2.5
2 - 6	2, 2.5, 3, 3.5, 4, 5, 6
4 - 12	4, 5, 6, 7, 8, 10, 12

Contact Closing Relays

0.5 - 2.5	0.5, 0.6, 0.8, 1.0, 1.5, 2.0, 2.5
2 - 6	2, 2.5, 3, 3.5, 4, 5, 6
4 - 12	4, 5, 6, 7, 8, 10, 12

Contact Opening Relays

4 - 12	4, 5, 6, 7, 8, 10, 12
--------	-----------------------

Shipping Weights and Dimensions

Relay Type	Flexitest Case Type	Weight, Lbs.: Approx.		Domestic Shipping Carton Dimensions: Inches
		Net	Shipping	
CO-2, 5, 6, 7, 8, 9, 11 Circuit Closing	FT-11	8	11	9 x 9 x 10
CO-6, CO-8, CO-9, CO-11 Circuit Opening	FT-21	10	13	9 x 12 x 13
CO-4	FT-21	12	16	9 x 12 x 13

Further Information

List Prices: PL 41-020

Technical Data: TD 41-025

Instructions:

Circuit Closing CO Relays: IL 41-101

Circuit Opening CO Relays: IL 41-103

CO-4 Relays: IL 41-106

Renewal Parts: RPD 41-915

Flexitest Case Dimensions: DB 41-076

Contactor Switches: DB 41-081

Other Protective Relays:

Application Selector Guide, TD 41-016



December, 1990
Supersedes TD 41-020, Type CO on
pages 6-9, dated November, 1987
Mailed to: E, D, C/41-100A

Non-Directional, Single Phase,
Adjustable Time Delay

Type CO Overcurrent Relays

Non-Standard CO Overcurrent, Non-Directional, Single Phase, 60 Hertz (Device Number: 51 & 50/51)

Type	Time Curve	Contacts	Operation Indicator or Indicating Contactor Switch ^③	Current Range: Amps Ac		Relay Data		
				Time Unit	Instantaneous Unit ^④	Internal Schematic	Style Number	Case Size
CO-2 ^① Torque controlled	Short	Spst-cc	0.2/2.0 amp dc	0.5-2.5	None	57D4527	289B093A09 289B093A10 289B093A11	FT-11
				2-6				
				4-12				
				0.5-2.5	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	289B093A13 289B093A14 289B093A15 289B093A16	
				2-6	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80		289B093A17 289B093A18 289B093A19 289B093A20	
				4-12	IIT 4-16 IIT 10-40 IIT 20-80 IIT 40-160		289B093A21 289B093A22 289B093A23 289B093A24	
CO-2 ^① ② with high dropout ITH	Short	Spst-cc	0.2/2.0 amp dc 2 ICS units per relay	0.5-2.5	ITH .25-.5 ITH .5-1.0 ITH 1-2 ITH 2-4 ITH 4-8 ITH 6-12	183A786	183A801A05 183A801A06 183A801A07 183A801A08 183A801A09 183A801A10	FT-11
				2-6	ITH 2-4 ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32		183A801A21 183A801A17 183A801A18 183A801A19 183A801A20	
				4-12	ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32		183A801A25 183A801A26 183A801A27 183A801A28	
CO-4 ^① Non-torque controlled	Long (step)	Spst-cc	One 0.2/2.0 amp dc	4-12	IIT 20-80 IT 10-40	183A115	1876 247	FT-21

① 50 Hertz relays and auxiliaries can be supplied at same price. Order "Similar to Style Number., except 50 Hertz".

② ITH: High dropout Instantaneous Trip rated per ranges shown in price tables. Unit has a dropout to pickup ratio of 90% over entire 2 to 1 pickup range. Contacts close when ITH coil is energized at or above pickup setting.

③ ICS: Indicating Contactor Switch (dc current operated) having seal-in contacts and indicating target which are actuated when the ICS coil is energized at or above pickup current setting. Suitable for dc control voltages up to and including 250 volts dc. Two current ranges available:

- (1) 0.2/2.0 amps dc, with tapped coil.
- (2) 1.0 amp dc, without taps.

Rating of ICS unit used in specific types of relays is shown in price tables. All other ratings must be negotiated.

When ac current is necessary in a control trip circuit, the ICS unit can be replaced by an ACS unit.

The ACS unit may be supplied in place of an ICS unit at no additional cost. Specify system voltage rating on order.

④ IIT: Indicating Instantaneous Trip rated per ranges shown in price tables. Unit is nondirectional, adjustable, and has target actuated when coil is energized at or above pickup setting. Unit has a dropout ratio of 65% at minimum setting and 90% at maximum setting.



Non-Standard CO Overcurrent, Non-Directional, Single Phase, 60 Hertz, Continued

Type	Time Curve	Contacts	Operation Indicator or Indicating Contactor Switch ^③	Current Range: Amps Ac		Relay Data		
				Time Unit	Instantaneous Unit ^② ④	Internal Schematic	Style Number	Case Size
CO-5^① Torque controlled	Long	Spst-cc	0.2/2.0 amp dc	0.5-2.5	None	57D4527	289B432A21 289B432A09 289B432A10	FT-11
				2-6				
				4-12				
				0.5-2.5	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	289B432A22 289B432A23 289B432A24 289B432A25	
				2-6	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	289B432A12 289B432A13 289B432A14 289B432A15	
				4-12	IIT 4-16 IIT 10-40 IIT 20-80 IIT 40-160	57D4529	289B432A16 289B432A17 289B432A18 289B432A19	
				0.5-2.5	ITH 25-5 ITH 5-1.0 ITH 1-2 ITH 2-4 ITH 4-8 ITH 6-12	183A786	183A802A05 183A802A06 183A802A07 183A802A08 183A802A09 183A802A10	FT-11
				2-6	ITH 2-4 ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A802A21 183A802A17 183A802A18 183A802A19 183A802A20	
				4-12	ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A802A25 183A802A26 183A802A27 183A802A28	
				4-12	None	183A055	1876 248	FT-21
					IIT 10-40 IIT 20-80	183A054	1876 249 1876 250	
CO-6^① Non-torque controlled	Definite	Spst-co	3 amp ac	4-12				
CO-6^① Torque controlled	Definite	Spst-cc	0.2/2.0 amp dc	0.5-2.5	None	57D4527	288B715A21 288B715A09 288B715A10	FT-11
				2-6				
				4-12				
				0.5-2.5	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B715A22 288B715A23 288B715A24 288B715A25	
				2-6	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B715A12 288B715A13 288B715A14 288B715A15	
				4-12	IIT 4-16 IIT 10-40 IIT 20-80 IIT 40-160	57D4529	288B715A16 288B715A17 288B715A18 288B715A19	
				0.5-2.5	ITH 25-5 ITH 5-1.0 ITH 1-2 ITH 2-4 ITH 4-8 ITH 6-12	183A786	183A803A05 183A803A06 183A803A07 183A803A08 183A803A09 183A803A10	FT-11
				2-6	ITH 2-4 ITH 4-8 ITH 6-12 ITH 12-16 ITH 16-32	183A786	183A803A21 183A803A17 183A803A18 183A803A19 183A803A20	
				4-12	ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A803A25 183A803A26 183A803A27 183A803A28	

① ② ③ ④ Footnotes, see page 13.

Non-Standard CO Overcurrent, Non-Directional, Single Phase, 60 Hertz, Continued

Type	Time Curve	Contacts	Operation Indicator or Indicating Contactor Switch ^③	Current Range: Amps Ac		Relay Data		
				Time Unit	Instantaneous Unit ^{②④}	Internal Schematic	Style Number	Case Size
CO-7^① Torque controlled	Moderately inverse	Spst-cc	0.2/2.0 amp dc	0.5-2.5	None	57D4527	288B716A09 288B716A10 288B716A11	FT-11
				2-6				
				4-12				
				0.5-2.5	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B716A13 288B716A14 288B716A15 288B716A16	
				2-6	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B716A17 288B716A18 288B716A19 288B716A20	
				4-12	IIT 4-16 IIT 10-40 IIT 20-80 IIT 40-160	57D4529	288B716A21 288B716A22 288B716A23 288B716A24	
				0.5-2.5	ITH 25-5 ITH 5-1.0 ITH 1-2 ITH 2-4 ITH 4-8 ITH 6-12	183A786	183A804A05 183A804A06 183A804A07 183A804A08 183A804A09 183A804A10	
				2-6	ITH 2-4 ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A804A21 183A804A17 183A804A18 183A804A19 183A804A20	
				4-12	ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A804A25 183A804A26 183A804A27 183A804A28	
CO-8^① Non-torque controlled	Inverse	Spst-co	3 amp ac	4-12	None IIT 10-40 IIT 20-80	183A055 183A054 183A054	1876 251 1876 252 1876 253	FT-21
CO-8^① Torque controlled	Inverse	Spst-cc	0.2/2.0 amp dc	0.5-2.5	None	57D4527	288B717A09 288B717A10 288B717A11	FT-11
				2-6				
				4-12				
				0.5-2.5	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B717A13 288B717A14 288B717A15 288B717A16	
				2-6	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B717A17 288B717A18 288B717A19 288B717A20	
				4-12	IIT 4-16 IIT 10-40 IIT 20-80 IIT 40-160	57D4529	288B717A21 288B717A22 288B717A23 288B717A24	
				0.5-2.5	ITH 25-5 ITH 5-1.0 ITH 1-2 ITH 2-4 ITH 4-8 ITH 6-12	183A786	184A004A05 184A004A06 184A004A07 184A004A08 184A004A09 184A004A10	
				2-6	ITH 2-4 ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	184A004A21 184A004A17 184A004A18 184A004A19 184A004A20	
				4-12	ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	184A004A25 184A004A26 184A004A27 184A004A28	

① ② ③ ④ Footnotes, see page 13.



Non-Standard CO Overcurrent, Non-Directional, Single Phase, 60 Hertz, Continued

Type	Time Curve	Contacts	Operation Indicator or Indicating Contactor Switch ^③	Current Range: Amps Ac		Relay Data		
				Time Unit	Instantaneous Unit ^{②④}	Internal Schematic	Style Number	Case Size
CO-9 ^① Non-torque controlled	Very inverse	Spst-co	3 amp ac	4-12	None IIT 10-40 IIT 20-80	183A055 183A054 183A054	1876 254 1876 255 1876 256	FT-21
CO-9 ^① Torque controlled	Very inverse	Spst-cc	0.2/2.0 amp dc	0.5-2.5 2-6 4-12	None	57D4527	288B718A09 288B718A10 288B718A11	FT-11
				0.5-2.5	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B718A13 288B718A14 288B718A15 288B718A16	
				2-6	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	288B718A17 288B718A18 288B718A19 288B718A20	
				4-12	IIT 4-16 IIT 10-40 IIT 20-80 IIT 40-160	57D4529	288B718A21 288B718A22 288B718A23 288B718A24	
CO-9 ^{①②} with high dropout ITH	Very inverse	Spst-cc	0.2/2.0 amp dc 2 ICS units per relay	0.5-2.5	ITH 25-5 ITH 5-1.0 ITH 1-2 ITH 2-4 ITH 4-8 ITH 6-12	183A786	183A805A05 183A805A06 183A805A07 183A805A08 183A805A09 183A805A10	FT-11
				2-6	ITH 2-4 ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A805A21 183A805A17 183A805A18 183A805A19 183A805A20	
				4-12	ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A805A25 183A805A26 183A805A27 183A805A28	
CO-11 ^① Non-torque controlled	Extremely inverse	Spst-co	3 amp ac	4-12	None IIT 10-40 IIT 20-80	183A055 183A054 183A054	1876 257 1876 258 1876 259	FT-21
CO-11 ^① Torque controlled	Extremely inverse	Spst-cc	0.2/2.0 amp dc	0.5-2.5 2-6 4-12	None	57D4527	289B094A09 289B094A10 289B094A11	FT-11
				0.5-2.5	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80	57D4529	289B094A13 289B094A14 289B094A15 289B094A16	
				2-6	IIT 2-8 IIT 4-16 IIT 10-40 IIT 20-80		289B094A17 289B094A18 289B094A19 289B094A20	
				4-12	IIT 4-16 IIT 10-40 IIT 20-80 IIT 40-160		289B094A21 289B094A22 289B094A23 289B094A24	
CO-11 ^{①②} with high dropout ITH	Extremely inverse	Spst-cc	0.2/2.0 amp dc 2 ICS units per relay	1-5 0.5-2.5	ITH 5-1.0 ITH 25-5	183A786	1961 555 183A806A05 183A806A06	FT-11
				0.5-2.5	ITH 5-1.0 ITH 1-2 ITH 2-4		183A806A07 183A806A08 183A806A09	
				0.5-2.5	ITH 4-8 ITH 6-12		183A806A10	
				2-6	ITH 2-4 ITH 4-8 ITH 6-12 ITH 12-16 ITH 16-32	183A786	183A806A21 183A806A17 183A806A18 183A806A19 183A806A20	
				4-12	ITH 4-8 ITH 6-12 ITH 8-16 ITH 16-32	183A786	183A806A25 183A806A26 183A806A27 183A806A28	

① ② ③ ④ Footnotes, see page 13.

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