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

September, 1990
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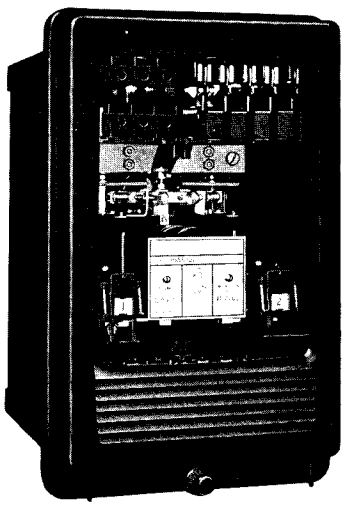
dated December, 1987
Mailed to: E, D, C/41-200A

Device Number: 32

Type H-3 Three-Phase High Speed Directional Relay

Type H-3



Application

This relay operates from three-phase voltage and current to provide high-speed directional discrimination during faults on power systems.

The direction of power flow for both phase and ground faults can be detected by the H-3. To assure correct operation during ground faults, it is necessary that the minimum line-to-ground current be at least three times the maximum load current. Thus, if the fault and load current flow is in opposition, the fault current will produce sufficient net torque to assure correct relay operation.

Low ground current occurs most frequently on impedance grounded systems. If positive directional indication cannot be obtained under all system conditions, a separate ground directional relay is recommended.

The H-3 relay can be supplied with either a watt characteristic (applied voltage and current in phase for maximum torque) or with a 45° characteristic (applied voltage lagging current by 45° for maximum torque).

The H-3 relay with watt characteristic is frequently used to detect reverse power conditions and prevent "motoring" of generators, or to trip a circuit breaker when power flow is in the undesired direction.

Application Guide①

Relay	Application and Maximum Torque Angle	Rating: Ac			Operation Indicator	Contactor Switch (CS)	Indicating Contactor Switch (ICS)
		Amps	Volts Line-Line	Line-Neutral			
H-3	Line Protection I leads V by 45°	5	120 208	... ...	1.0 amp dc	1.0 amp dc	...
	Generator Projection (Watt Relay) I in phase with V		... ...	70 120			

① Single-pole double-throw contacts, 60 hertz, relay has electrically independent contacts, circuit-opening and circuit-closing.

High Speed Directional Relay

H-3 Relay

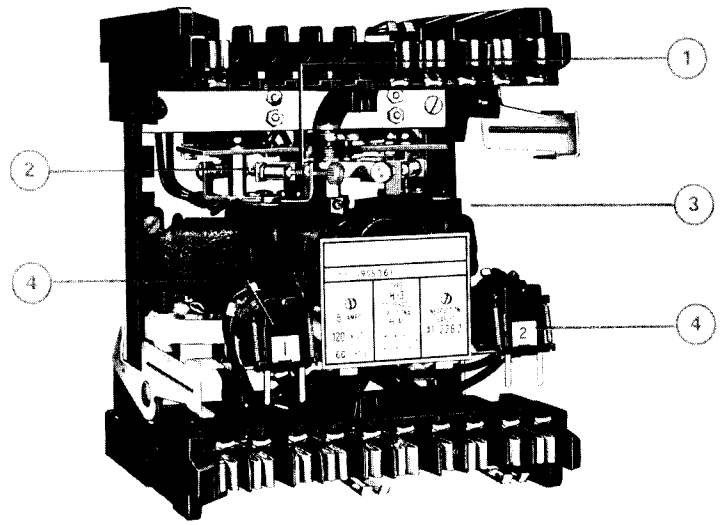


Fig. 1

Construction and Operation

Type H-3
Consists of a polyphase directional unit (with current coil applied to the center leg of each electromagnet in the H-3). Two seal-in contactor switches (CS1 and CS2) and two operation indicators. (See figure 1)

(1) Stationary Contact

(2) Moving Contact

Will close 30 amperes at 250 volts dc Normally closed (front view) on H-3.

(3) Polyphase Directional Unit

(4) Operation Indicators

Targets drop to indicate tripping operation.

Contactor Switch
Seal-in the relay trip circuit after the main contact has closed. Will carry 30 amperes at 250 volts dc until the breaker is tripped and the auxiliary "a" switch opens.

Directional Unit
H-3
Upon occurrence of a fault, causes rotation of the relay contact shaft in accord with the direction of system power flow.

High Speed Directional Relay

H-3 Directional Unit Phase Angle Characteristics

Figure 2 shows typical phase angle curve of the directional unit for 45° characteristic, 60 hertz relays with balanced three-phase power with no spring restraint applied. Zero torque line at various three-phase current values and at 2 volts and 115 volts of applied delta voltage is shown along the two voltage reference lines. Maximum torque occurs when applied current leads applied voltage by 45°, using the 90° connection.

For the 45° relay characteristic, the standard 90° connection is used to provide wye current and delta voltage. Maximum torque occurs when system fault current lags its unity power factor position by 45°.

The watt relay characteristic utilizes wye current and wye voltage, and maximum torque occurs when voltage and current are in phase.

H-3 relay has adjustable spring restraint to hold relay contacts in non-trip position when relay is de-energized, prohibiting incorrect operation upon loss of load.

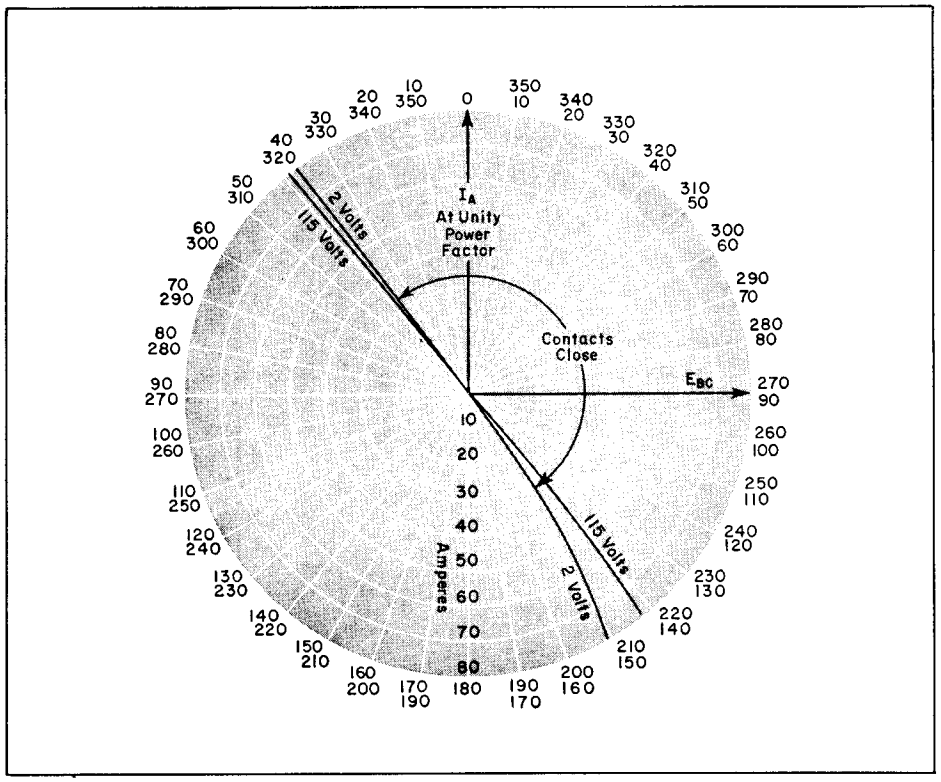


Fig. 2

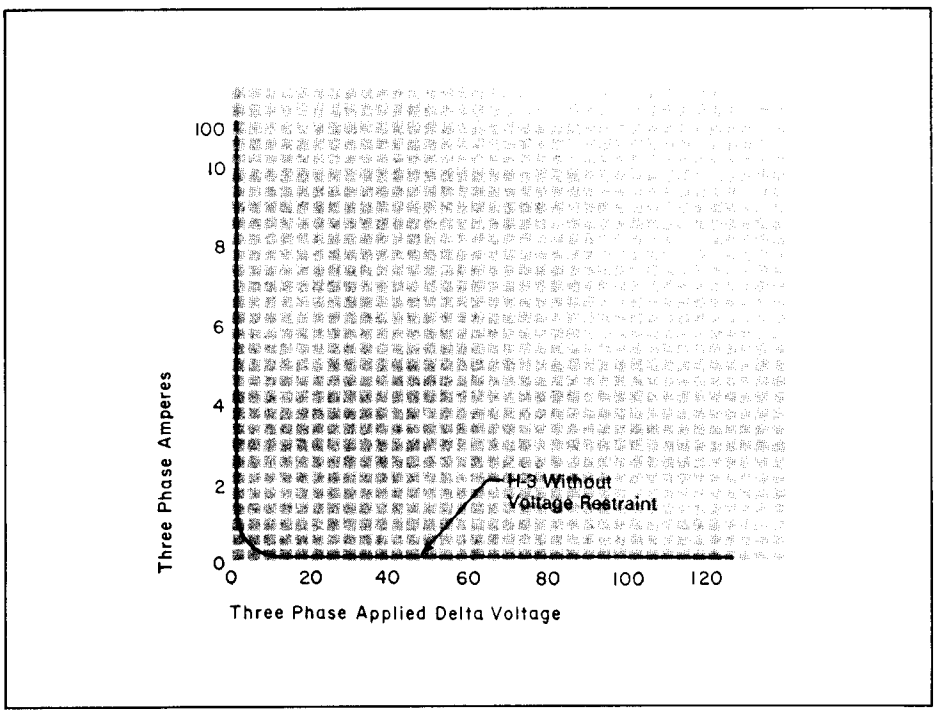


Fig. 3

252147

High Speed Directional Relay

Time Curves For 50 and 60 Hz H-3 Relay (Based on Relay Contact Opening of .035 Inch)①

For Both Watt and 45° Characteristic Relays At Maximum Torque Angle

H-3 Relay at Maximum Torque Angle, For Three-Phase Faults

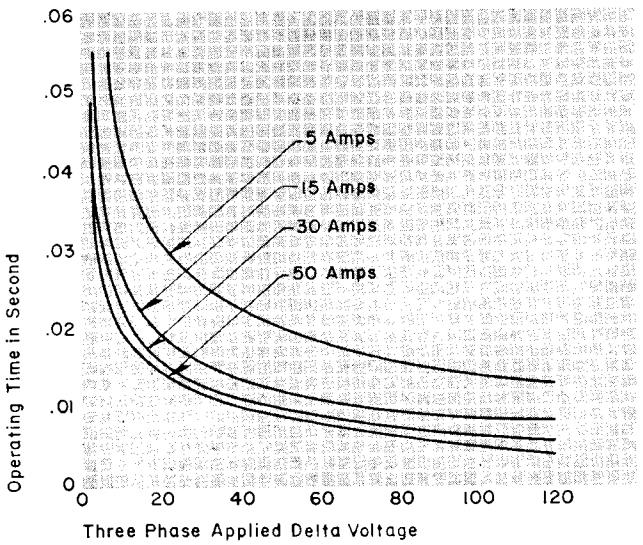


Fig. 4 252133

H-3 Relay at Maximum Torque Angle, Without Voltage Restraint, For Phase-to-Phase Faults (Full Voltage Collapse on Faulted Phase, 86% Voltage on Unfaulted Phase)

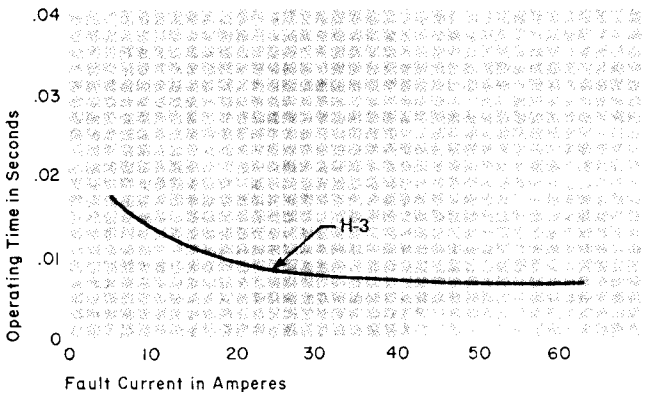


Fig. 5 252146

① Refer to figures 7 through 9 for applications involving . .
(a) phase-fault parallel line protection
(b) torque control of overcurrent relays
(c) directional discrimination H-3

Characteristics

Minimum Pickup Values

H-3: 60 hertz three-phase minimum pickup without spring restraint is 0.08 ampere at 115 volts; 0.15 ampere at 10 volts; and 5.0 amperes at 1 volt. Single-phase minimum pickup currents are approximately three times of those of the three-phase values.

Burden and Rating Data

45° Characteristic Values For 120 Volts, 5 Amperes, 60 Hertz

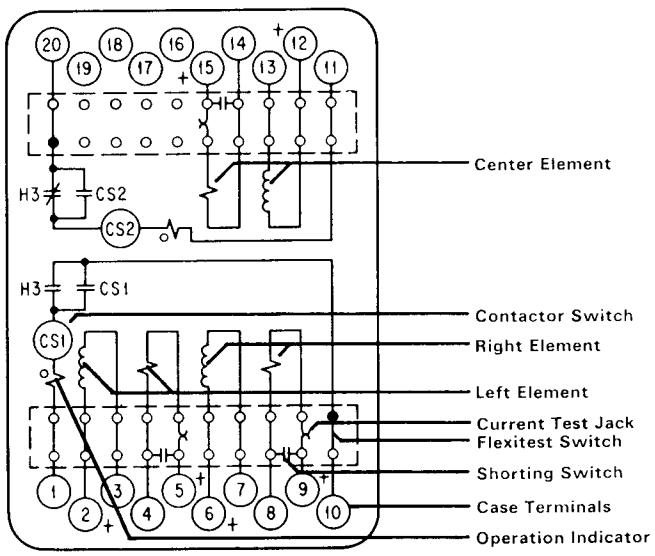
	H-3	
	Current Circuit	Voltage Circuit
Resistance: Ohms	0.050	2070
Reactance: Ohms	0.052	1530
Impedance: Ohms	0.072	2580
Watts	1.25	4.59
Vars	1.29	3.40
Volt-Amperes	1.82	5.71
Power Factor	46° lag	36.5° lag
Continuous Rating (Amperes or Volts)	5	120
One-Second Current (Amperes)	240	...

Trip-Circuit Data

Coil Only	Relay Type	Rating: Amps, Dc	Resistance: Ohms, Dc	Amps	
				Continuous	1 Second
Operation Indicator	H-3	1.0	.16	2.5	70
Contactor Switch (CS)	H-3	1.0	.84	1.9	28

Internal Wiring (Front View)

H-3 Relay, FT-22 Case



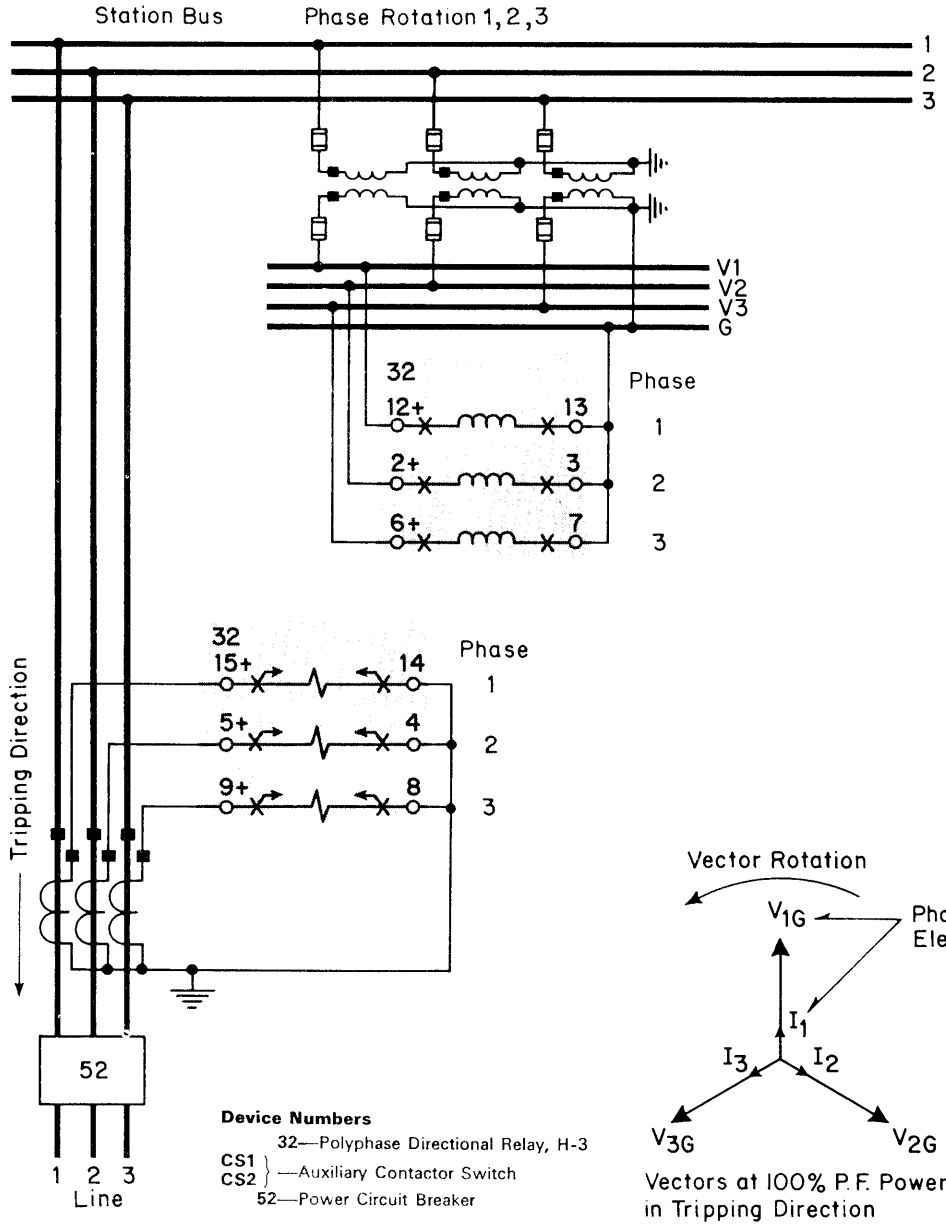
With relative instantaneous polarities as shown, the make contact closes and the moving element rotates counter clockwise (top view).

Fig. 6 183A355

High Speed Directional Relay

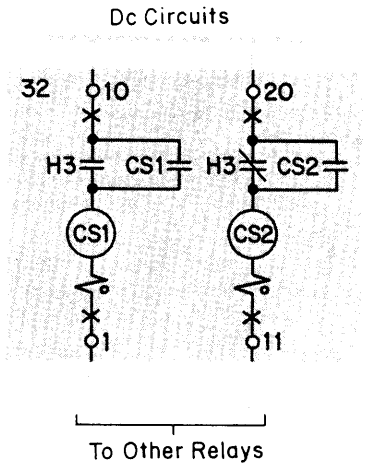
External Wiring

H-3 Relay, Watt Connection



Device Numbers

32—Polyphase Directional Relay, H-3
CS1, CS2—Auxiliary Contactor Switch
52—Power Circuit Breaker



Vectors at 100% P.F. Power in Tripping Direction

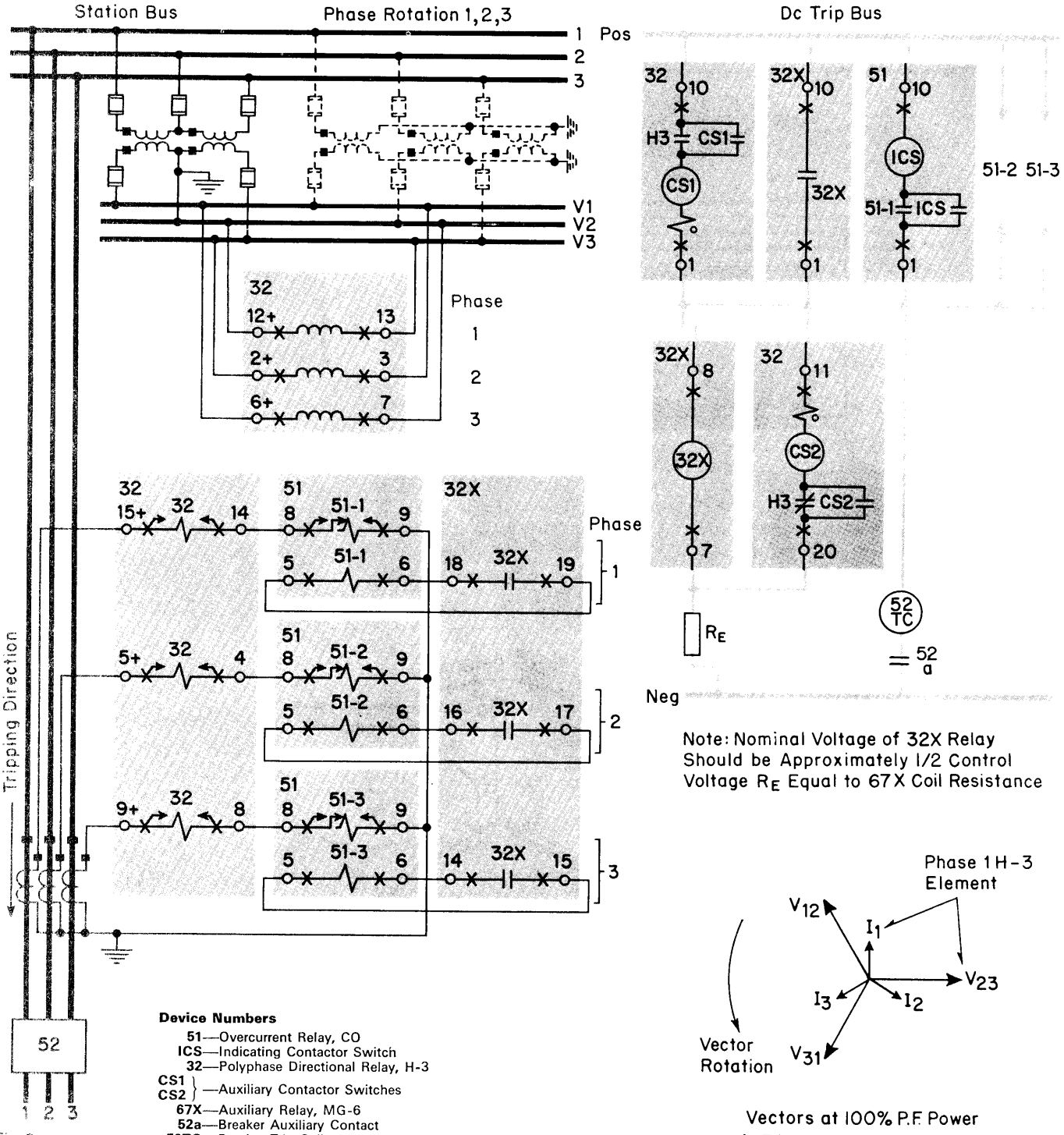
Fig. 7

289B079

High Speed Directional Relay

External Wiring

H-3 Relay, Directional Overcurrent Phase Protection Of A Three Phase Line Using Three Type CO Torque Controlled Relays, Directionally Controlled By One Type H-3 And One Type MG-6 Relay



Device Numbers

51—Overcurrent Relay, CO
ICS—Indicating Contactor Switch
32—Polyphase Directional Relay, H-3
CS1, **CS2**—Auxiliary Contactor Switches
67X—Auxiliary Relay, MG-6
52a—Breaker Auxiliary Contact
52TC—Breaker Trip Coil

Note: Nominal Voltage of 32X Relay Should be Approximately 1/2 Control Voltage R_E Equal to 67X Coil Resistance

Vectors at 100% P.F. Power in Tripping Direction

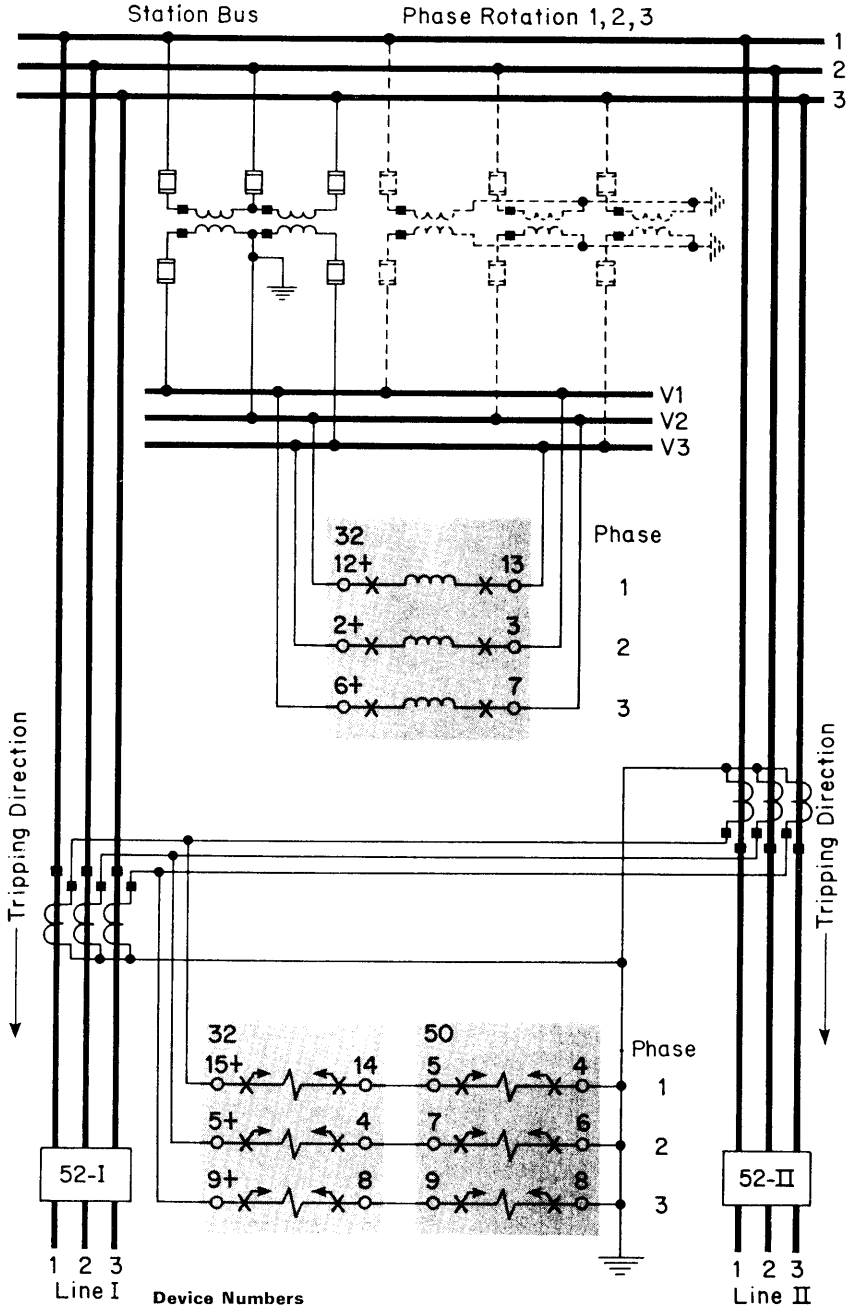
289B077

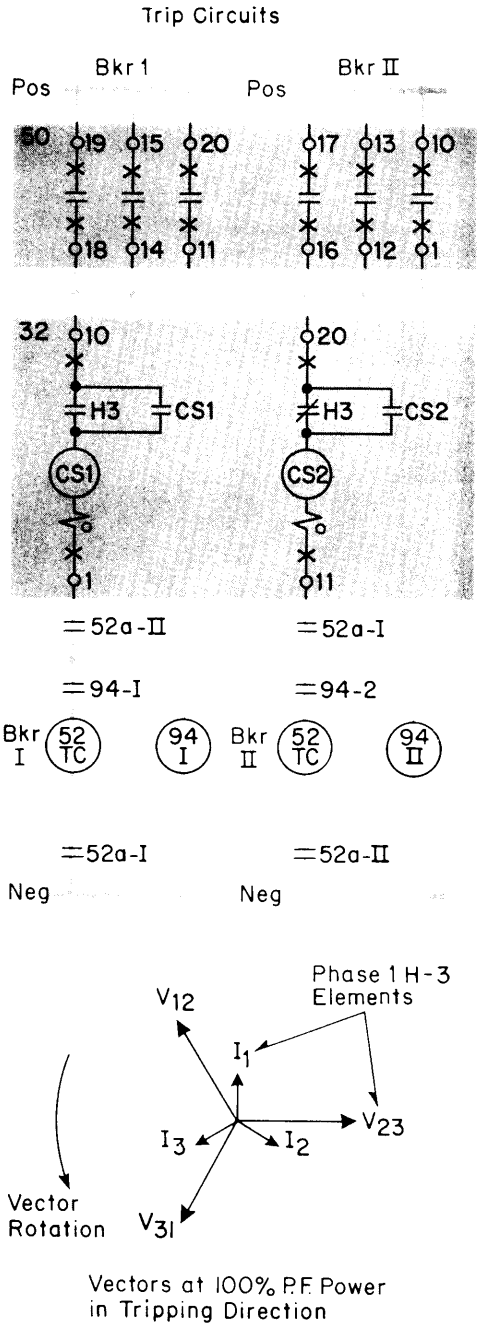
Fig. 8

High Speed Directional Relay

External Wiring

H-3 Relay and 3-Unit SC, For Phase Fault Parallel Line Protection, 90° Connection





Vectors at 100% P.F. Power in Tripping Direction

Device Numbers

50—Instantaneous Overcurrent Relay, SC (3-Unit)
32—Polyphase Directional Relay, H-3
CS1, **CS2**—Auxiliary Contactor Switches
94—Auxiliary Tripping Relay, SG
52—Power Circuit Breaker
52a—Breaker Auxiliary Contact
52TC—Breaker Trip Coil

Fig. 9

289B076

High Speed Directional Relay

Weights and Carton Dimensions

Relay Type	Case Type	Weight: Lbs, Approx.		Domestic Shipping Carton Dimensions: Inches
		Net	Shipping	
H-3	FT-22	12	15	9 x 12 x 13

Further Information

List Prices: PL 41-020
Technical Data: TD 41-025
Instructions: IL 41-226.2
Renewal Parts: RPD 41-935
Flexitest Case Dimensions: DB 41-076
Contactor Switches: DB 41-081
Other Protective Relays:
Application Selector Guide, TD 41-016

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Type H-3 Three Phase High Speed Directional Relay

Power Flow, Directional, Three Phase (Device Number: 32)

Type	Application	Rating: Ac			Operation Indicator	Contactor Switch (CS)	Indicating Contactor Switch③	**Relay Data**		
		Amps	Volts					Internal Schematic	Style Number	Case Size
			Line-to-Line	Line-to-Neutral						
H-3①②	Line protection I leads V by 45°	5	120 208	... ...	1.0 amp dc	1.0 amp dc	None	183A335	1955 361 1955 363	**FT-22**
	Generator protection I in phase (watt relay)	5	... ...	70 120				183A335	1956 200 1955 515	

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

② H-3 relays have electrically independent contacts, circuit opening and circuit closing.

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.