

July, 1991  
Supersedes DB 41-331, pages 1-4,  
dated March, 1972  
Mailed to: E, D, C/41-300A

Single Phase  
Device Number: 87G

## Type CA Generator Differential Relay

### Application

The Westinghouse CA generator differential relay is a single phase, induction disc type with inverse timing characteristics. It is provided with one operating winding and two restraining windings without taps.

The type CA has a constant percentage differential characteristic, with either 10% or 25% sensitivity, which represents the percentage of the smaller of the two restraining currents required to trip the relay.

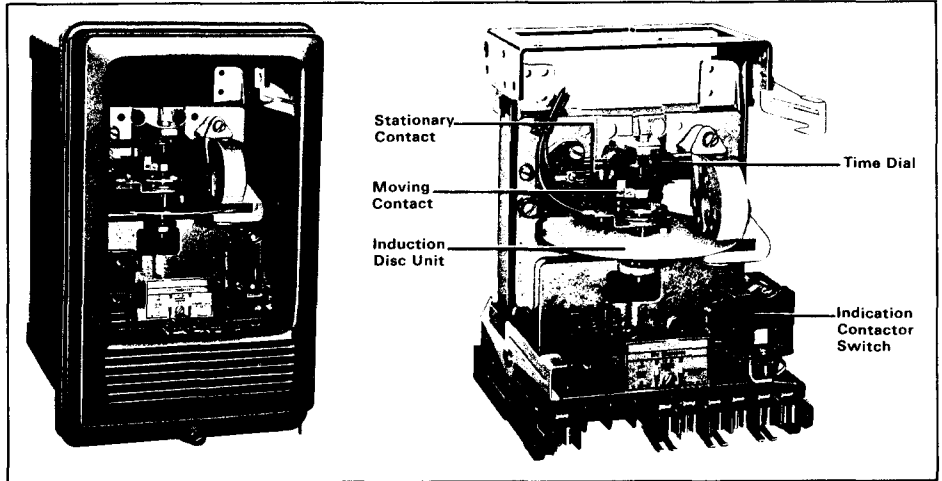
The 10% relay is used where current transformer ratio errors are small. The 25% relay is used where the current transformer performance may produce error currents in excess of the pickup of the 10% type. A study of current transformer performance under fault conditions will indicate whether the 10% or the 25% relay should be applied.

Figure 2 shows the differential characteristic of the 10% relay, and Figure 3 shows that of the 25% relay. Note in Figure 2 that 10% of the smaller restraining current must flow in the operating coil to cause tripping when the restraining currents are in phase. Similarly, in Figure 3, 25% of the smaller restraining current is required for the relay to close its contacts. Thus this relay is relatively insensitive to error currents flowing in the operating winding as a result of high external fault currents.

Inverse time characteristics are shown in Figures 4 and 5, with restraint currents 180° out of phase. These curves also apply where current flows in only one restraint coil and the operating coil.

### Construction

The CA generator differential relay consists of an induction disc type differential unit and an Indicating Contactor Switch. Referring to Figure 1, the differential unit is an induction disc element with an electromagnet that has poles both above and below the disc. Two restraining coils, connected in series, are placed on the lower left-hand pole. The series connection junc-



tion point is connected to the operating coil which is mounted on the lower right-hand pole. A transformer winding is also supplied on both the left-hand and right-hand lower poles, and these are connected in parallel to supply current to the upper pole windings.

The magnetic flux generated by the upper pole windings is in quadrature with the lower pole resultant flux, and these two fluxes react to produce a torque on the disc.

Current in the operating coil circuit produces a contact closing-closing torque. Conversely, current flowing in the two restraining windings in the same direction produces contact opening torque.

### Operation

Under normal operating conditions current will flow in the restraining coil circuits and very little, if any, current will flow in the operating coil circuit.

Under external fault conditions, the restraining coil currents will increase but will be in the same direction and will produce a strong restraining torque. The current

that flows in the operating coil circuit under this condition would be due to the unbalance in current transformer performance under fault current conditions. In applications where this unbalance current would exceed 10% of the smaller restraint current, the less sensitive 25% relay should be used.

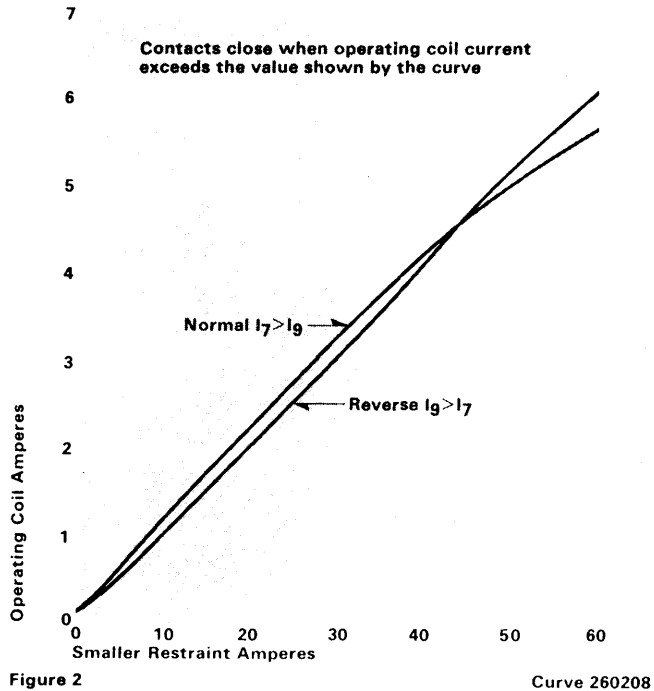
Under internal fault conditions, the current in one restraint circuit will reverse and a relatively larger current will flow in the operating coil circuit, producing contact closing torque and tripping the relay.

Time of operation is inversely proportional to the current in the operating and restraint circuits, as shown in Figures 4 and 5.

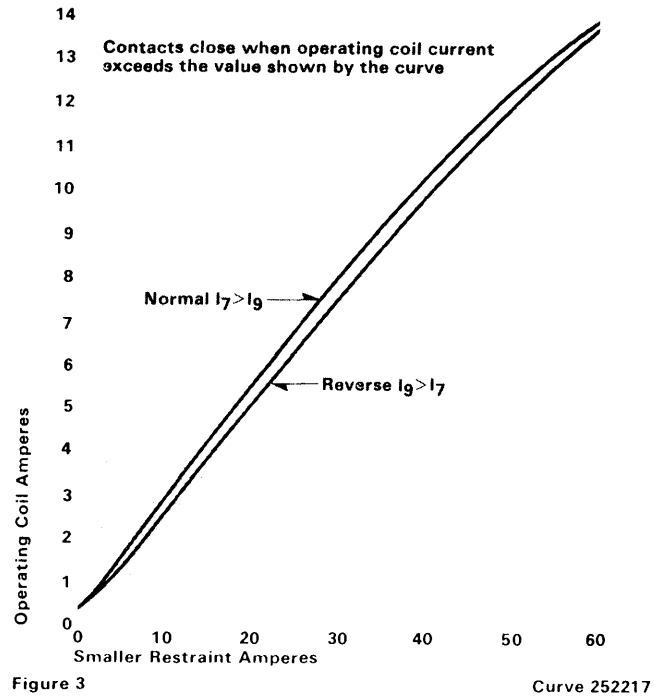
When the relay trips, the dc Indicating Contactor Switch is energized, bridging the main relay contacts and relieving them of carrying the relatively large trip coil current. When the Indicating Contactor Switch closes, its armature deflects a spring which allows an operation indicating target to drop. This target is reset manually from the outside of the relay case.

### Characteristic Curves

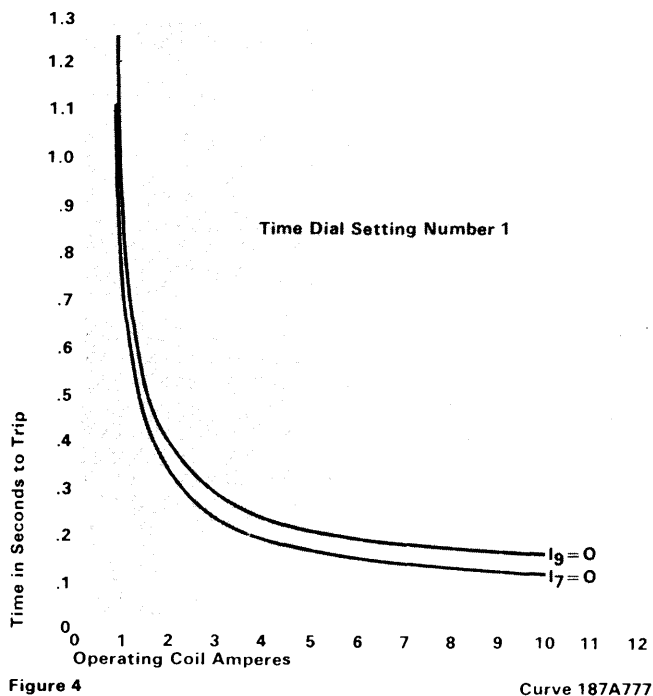
#### Differential Characteristic: 10% Relay



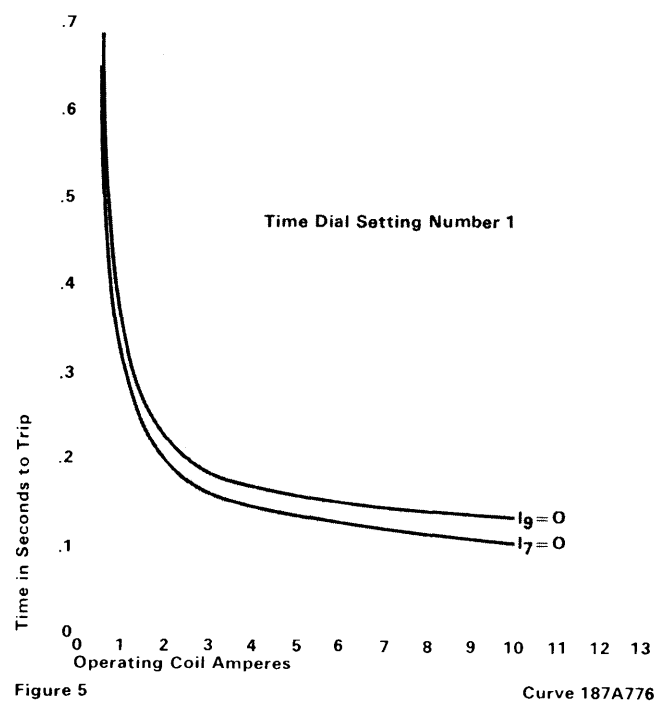
#### Differential Characteristic: 25% Relay



#### Inverse Time Characteristic: 25% Relay



#### Inverse Time Characteristic: 10% Relay



## Burden Curves: 10% Relay

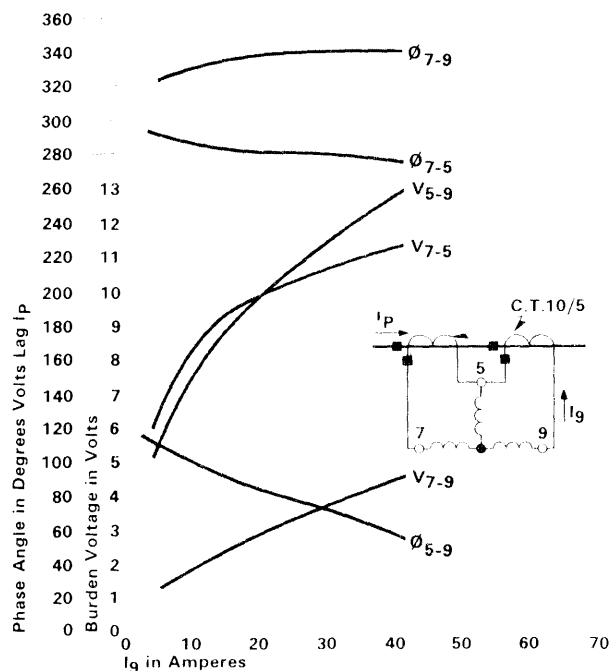


Figure 6

Curve 282554

## Burden Curves: 25% Relay

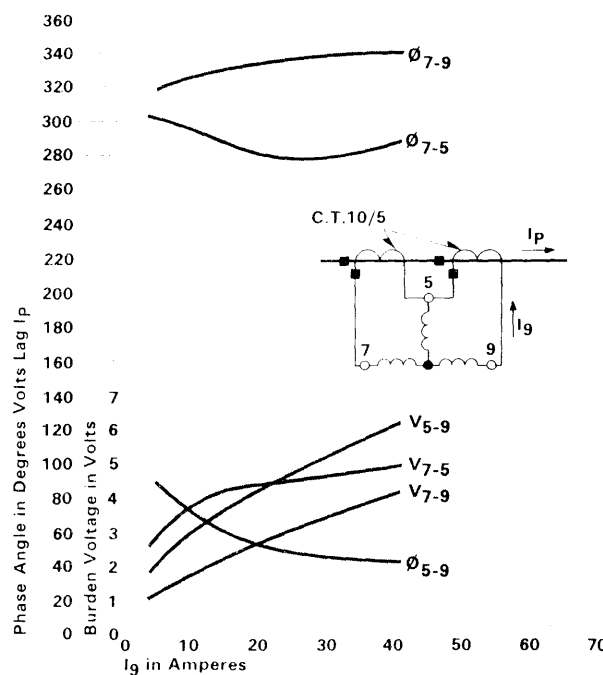


Figure 7

Curve 282555

## Saturation Curves

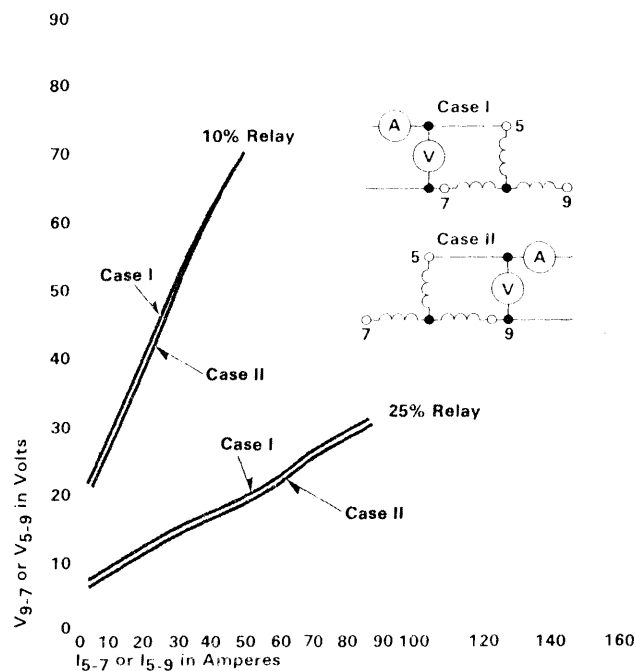
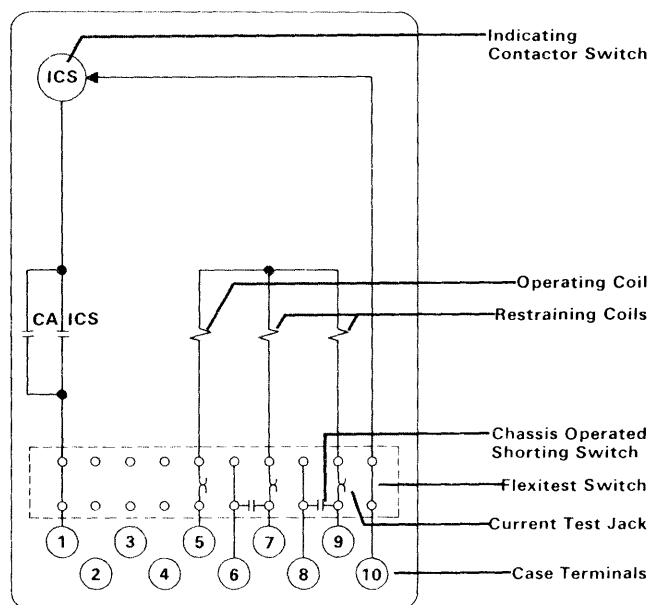


Figure 8

Curve 282553

## Internal Wiring: 10% or 25% CA Relay FT-21 Case

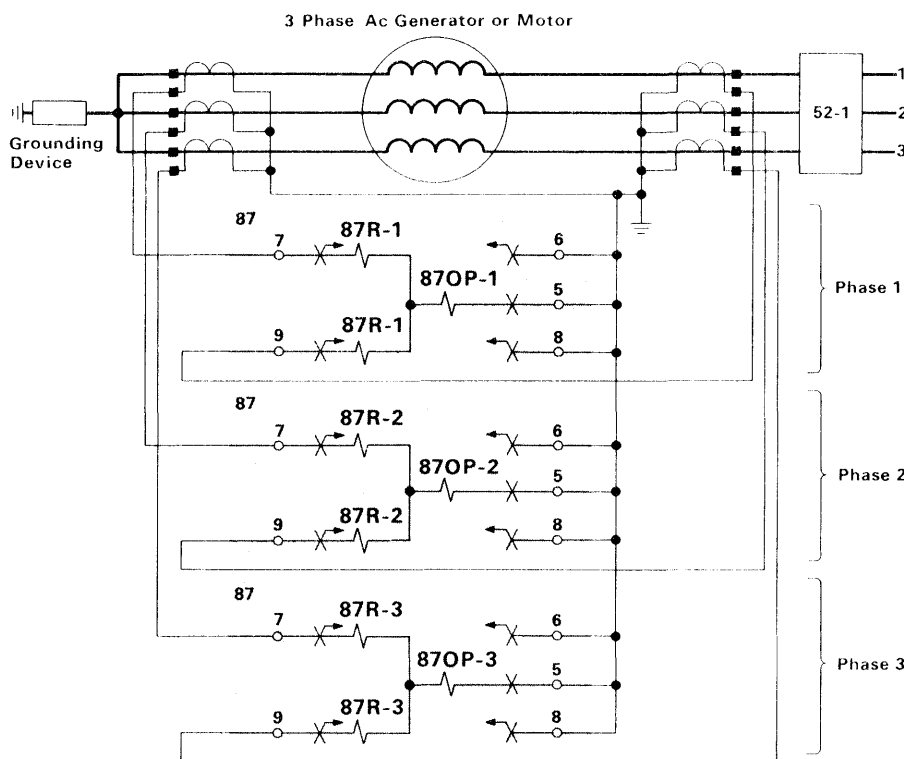


Note: Terminals 5, 6 and 8 are to be Jumped at Relay Case

Figure 9

57D4553

## External Wiring



## Characteristics

Operating Time  
See Figures 4 and 5.

Sensitivity  
10% or 25% (no ratio taps).

Differential Characteristics  
See Figures 2 and 3.

Minimum Trip  
0.18 amps for 10% relay.  
0.45 amps for 25% relay.

Burden  
See Figures 6 and 7.

Thermal Capacity  
Restraint circuits: 10 amps continuous

Operating circuits:

	Continuous	For 1 second
10% relay	2.5 amps	70 amps
25% relay	5.0 amps	140 amps

Saturation Characteristics  
See Figure 8.

## Relay Settings

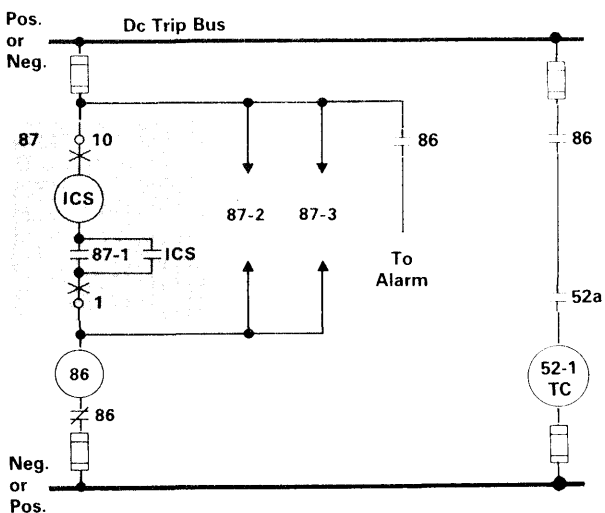
No setting is required for the percentage differential unit except that of the time dial, which should be set to the number 1 position.

Each relay is designed for its specific sensitivity and once the correct relay is chosen for a given application, no further adjustment is necessary. However, the spring tension controlling minimum operating current may be altered slightly if required.

In general, the aforementioned study of the current transformer characteristic curves under short circuit conditions should indicate whether the high sensitivity (10%) or low sensitivity (25%) relay should be used. If ac saturation causes more than 1% ratio error in either set of current transformers, use the 25% relay.

## Further Information

List Prices: PL 41-020  
Technical Data: 41-025  
Application Data: AD 41-301E  
Instructions: IL 41-331.2  
FT-21 Case Dimensions: DB 41-076  
Other Protective Relays:  
Application Selector Guide, TD 41-016



## Device Number Chart

- 87—Generator Percentage Differential Relay Type CA
- 87R—Restraining Coil of Type CA Relay
- 87OP—Operating Coil of Type CA Relay
- 86—Auxiliary Tripping Relay, Type WL
- 52—Power Circuit Breaker
- a—Breaker Auxiliary Contact
- TC—Breaker Trip Coil
- ICS—Indicating Contactor Switch

Figure 10



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

Technical Data  
**41-302E**

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July, 1991

Supersedes TD 41-020, Type CA on  
page 67, dated November, 1987  
Mailed to: E, D, C/41-300A

Single Phase

## Type CA Generator Differential Relay

### Percentage Differential, Inverse Time, Single Phase (Device Number: 87G) With 0.2/2.0 Amps Dc Indicating Contact or Switch<sup>③</sup>

Type	Application	Contacts	Frequency, Hertz	Amperes, Ac			Sensitivity	Relay Data			
				Minimum Trip	Instantaneous Trip (IIT)	Fault Detector		Internal Schematic	Style Number	Case Size	
CA	Generator	Spst-cc	25 to 60	0.18	None	None	10%	57D4553	290B892A09® 290B892A10	FT-21	
				0.45			25%				
		Dpst-cc		0.18			10%	183A649	290B892A17 290B892A18		
				0.45			25%				

③ Denotes item available from stock.

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.