



directional overcurrent relays

descriptive
bulletin

41-130

page 1

basic types { CR, CRC, CRP, CRD
IRC, IRP, IRD

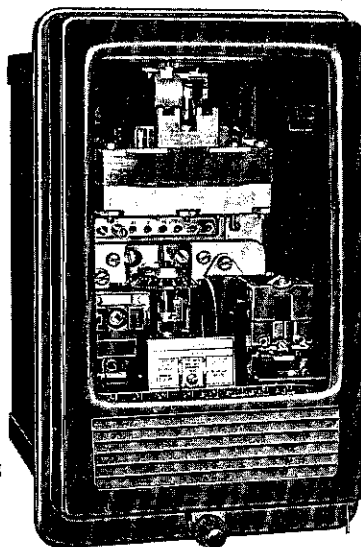
for protection of transmission lines and feeder circuits
from damage due to phase and ground faults

CR line

IR line

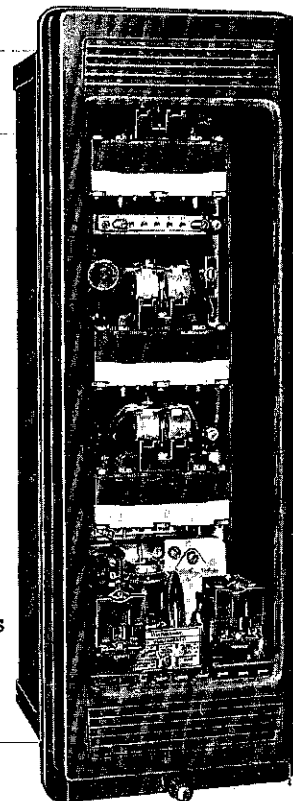
for phase
and ground
fault
detection

without
instantaneous
trip



for ground
fault
detection
only

with
instantaneous
trip



selector guide and types available

protection	directional unit polarization	time characteristics							Flexitest case type	time unit range: amps	device number
		short	long	definite	moderately inverse	inverse	very inverse	extremely inverse			
phase	voltage polarized by system line-to-line voltage	CR-2	CR-5	CR-6	CR-7	CR-8	CR-9	CR-11	FT-21	0.5-2.5 2-6 4-12	67
ground	current polarized by residual current	CRC-2	CRC-5	CRC-6	CRC-7	CRC-8	CRC-9	CRC-11	FT-21	0.5-2.5 2-6 4-12	67N
		IRC-2	IRC-5	IRC-6	IRC-7	IRC-8	IRC-9	IRC-11	FT-31	4-12	
	voltage polarized by residual voltage	CRP-2	CRP-5	CRP-6	CRP-7	CRP-8	CRP-9	CRP-11	FT-21	0.5-2.5 2-6 4-12	67N
		IRP-2	IRP-5	IRP-6	IRP-7	IRP-8	IRP-9	IRP-11	FT-31	4-12	
	voltage and/or current polarized by volt- age source, or local ground current source; or both simultaneously	CRD-2	CRD-5	CRD-6	CRD-7	CRD-8	CRD-9	CRD-11	FT-31	0.5-2.5 2-6 4-12	67N
		IRD-2	IRD-5	IRD-6	IRD-7	IRD-8	IRD-9	IRD-11	FT-41	4-12	

in this bulletin	CR line		IR line		all types	
	construction	page	construction	page	time curves	page
	operation	2	internal wiring	8	characteristics (burden, etc.)	14
	internal wiring	4	external wiring	11	ordering information	16
	external wiring	5		12	dimensions	19
		6				23

December, 1959

supersedes descriptive bulletin 41-130 dated August, 1957
mailed to: E/320/DB; D65-5A; C/371/DB; C29-5B

**CR line****operation****selection of characteristic time curve**

When the generation is fixed at a constant value and fault current variation is primarily due to the location of the fault along a line, the selection of a relay with a more inverse time characteristic is desirable to obtain selective coordination with adjacent relays.

settings**a. tap range**

taps available

0.2	0.6	0.8	1.0	1.5	2.0	2.5
2	2.5	3	3.5	4	5	6
4	5	6	7	8	10	12

The current range selected depends upon the fault current available at the protected line, as determined by a system study. The lower tap range, 0.5-2.5 amperes, is usually applied for ground fault protection since phase faults result in higher fault currents requiring the 2-6 or 4-12 amp range.

example of settings for a loop protection

Fig. 8 illustrates a loop system with one generating station equipped with overcurrent relays and four substations equipped with directional overcurrent relays. Arrows indicate the direction overcurrent must flow to trip the relays, and the time values represent the operating time of the relays as determined by the time dial position.

When the generation fluctuates within large limits such as day-time peak and night time low, the tripping time of a relay with an inverse characteristic becomes too dependent on the magnitude of the fault current to permit a smooth coordination so that the relay with definite minimum time is the preferred choice.

b. time dial

The effect of the time dial adjustment is shown on the curves, fig. 33-39. Time dial settings determine the operating time of the relay. See page 14.

c. spring adjuster

By rotation of the spring adjuster it is possible to obtain continuous pick-up current values between the tap settings, thus permitting a very selective time coordination.

Considering a fault at M, current will flow to the fault from substations B and C. The 0.35 second relay will trip at substation C and the 0.85 second relay will trip at substation B. While the same fault current flows through the 0.6 second relay at station D, and the 0.85 second relay at station E, the 0.35 second relay at station C will operate and close its contacts before the 0.6 relay at D or the 0.85 relay at E can trip.

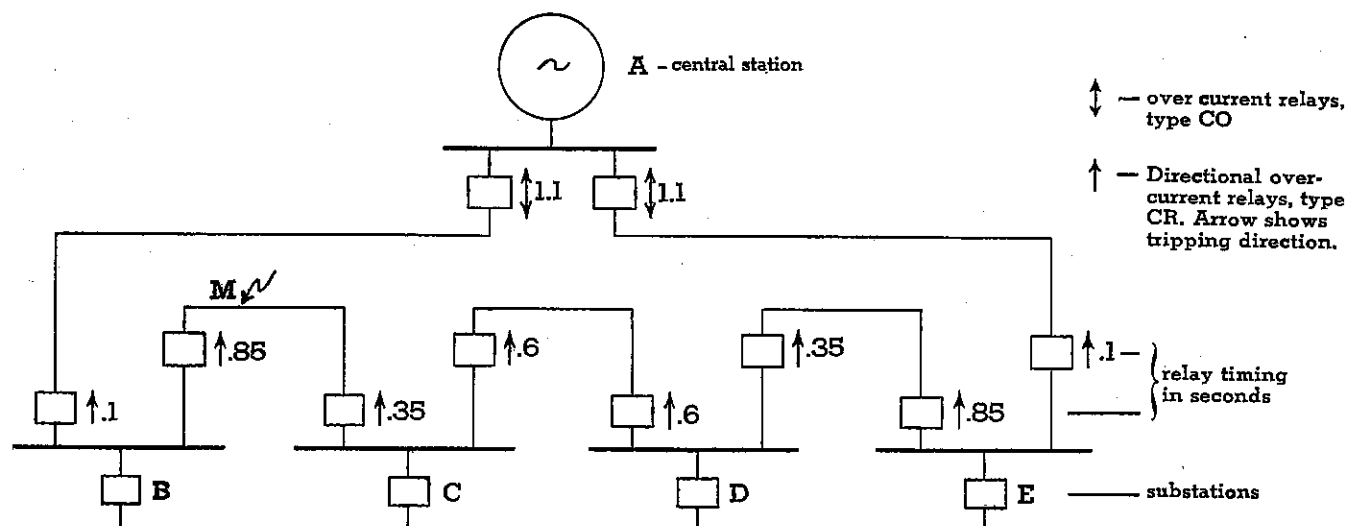


fig. 8

basic { *CR, CRC, CRP, CRD*
types { *IRC, IRP, IRD*

internal wiring front view

CR-2, CR-5, CR-6, CR-7, CR-8, CR-9, CR-11 for
phase fault detection

FT-21 case

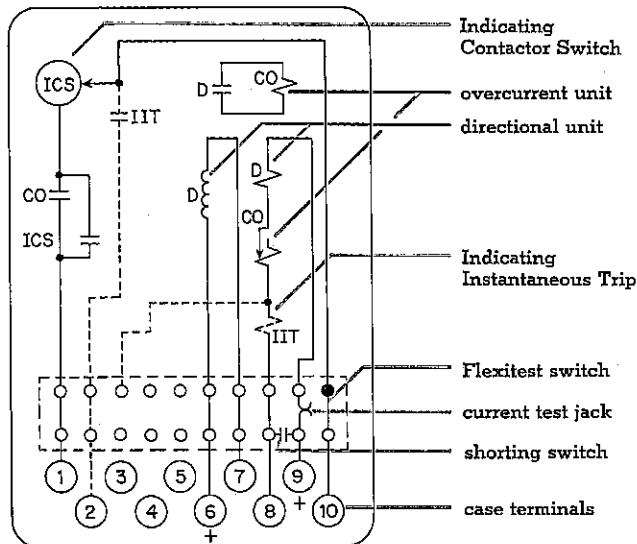


fig. 9

* solid line: spst relays (standard); dash line: with Indicating Instantaneous Trip (special).

CRC-2, CRC-5, CRC-6, CRC-7, CRC-8, CRC-9,
CRC-11 for ground fault detection

FT-21 case

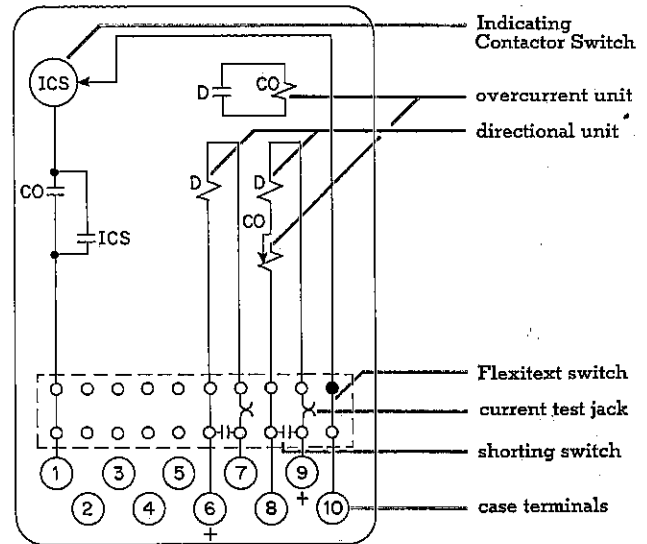


fig. 10

CRP-2, CRP-5, CRP-6, CRP-7, CRP-8, CRP-9,
CRP-11 for ground fault detection

FT-21 case

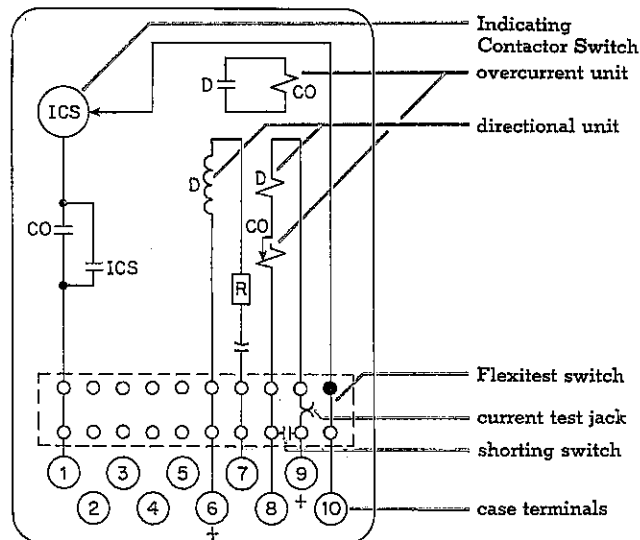


fig. 11

CRD-2, CRD-5, CRD-6, CRD-7, CRD-8, CRD-9,
CRD-11 for ground fault detection

FT-31 case

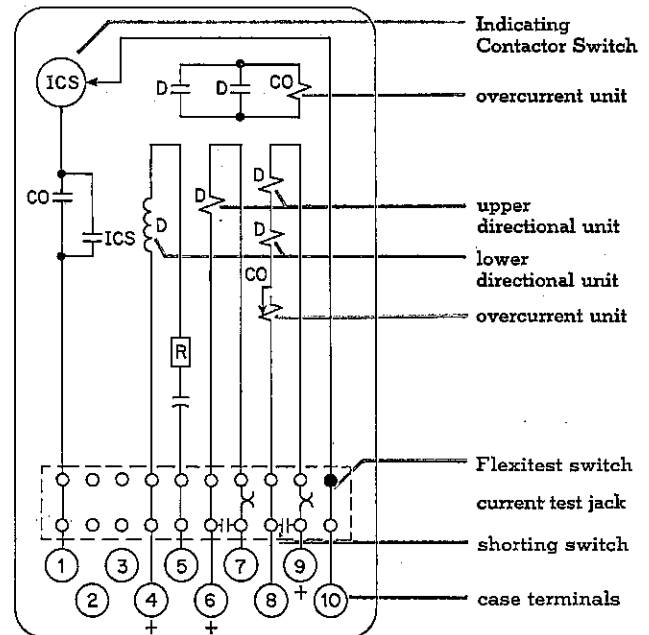
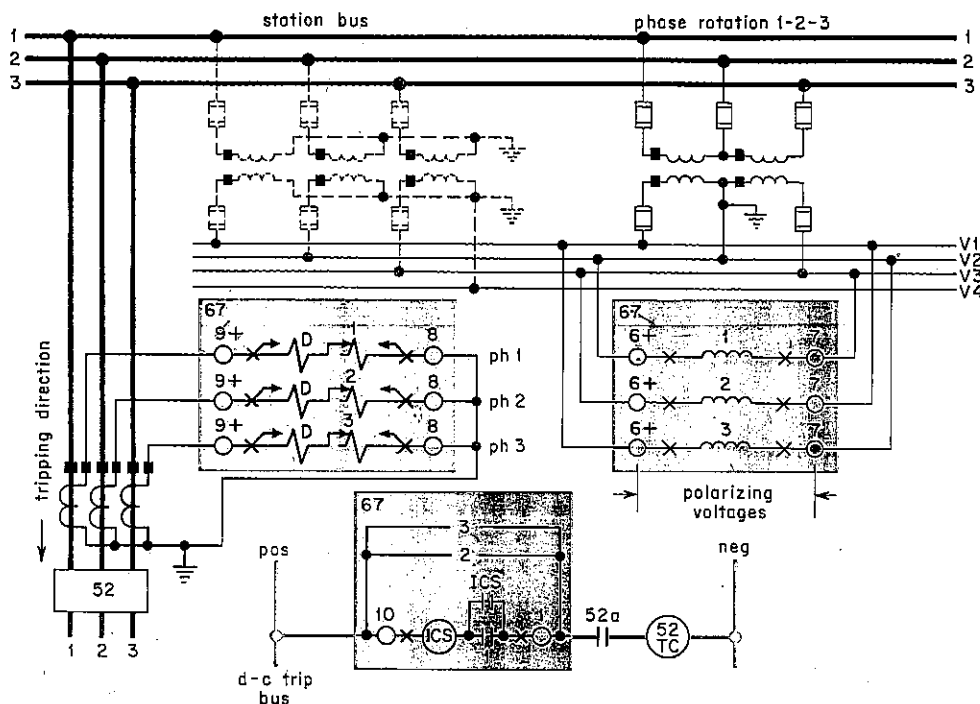
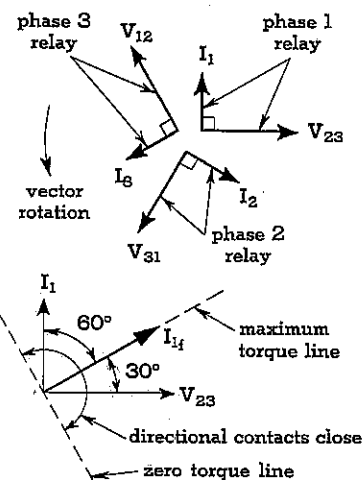


fig. 12

with instantaneous polarity as shown (+) directional contacts close

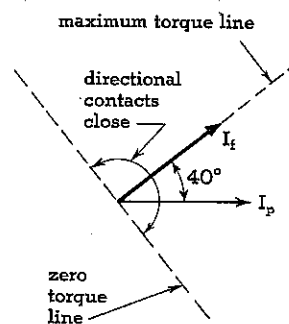
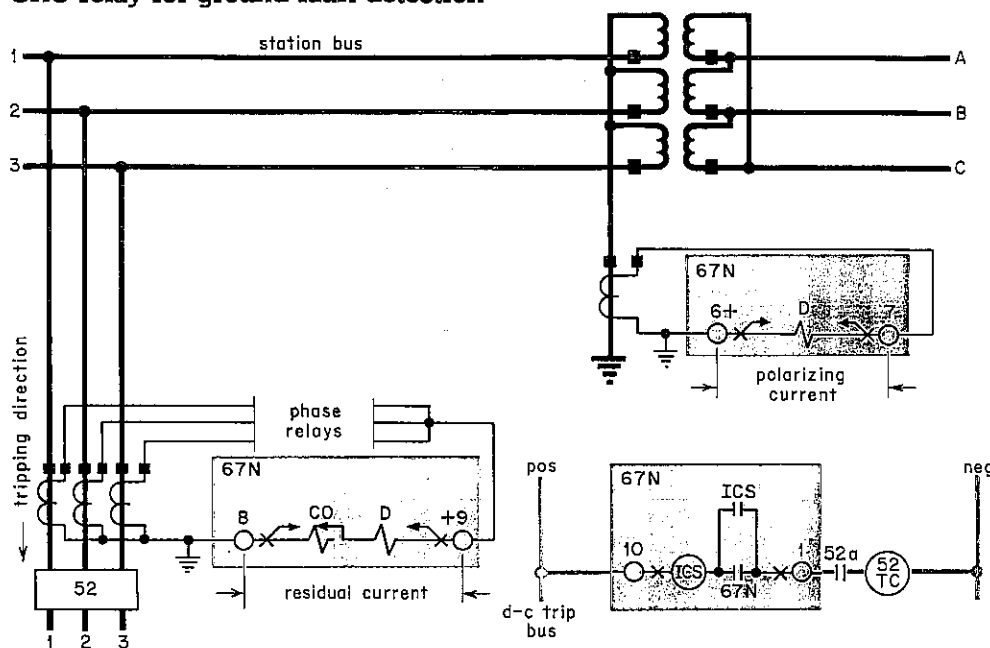
**CR line external wiring****CR relay for phase fault detection****100% p f conditions:**

90° connection, current I_1 leads corresponding voltage V_{23} by 90°

**fault conditions:**

maximum torque occurs when fault current I_f lags 100% p f current I_1 by 60° — i. e., leads corresponding polarizing voltage by 30°

fig. 13

CRC relay for ground fault detection**fault conditions:**

maximum torque occurs when ground current I_f leads polarizing current I_p by 40°

fig. 14

device number chart

67 — directional overcurrent relays type CR

67N — directional overcurrent ground relay, types CRC, CRD, CRP

67N CO — overcurrent unit of types CRC, CRD, CRP

67N D — directional unit of types CRC, CRP

67N DL — lower directional unit of type CRD

basic { CR, CRC, CRP, CRD
types { IRC, IRP, IRD

CRP relay for ground fault detection

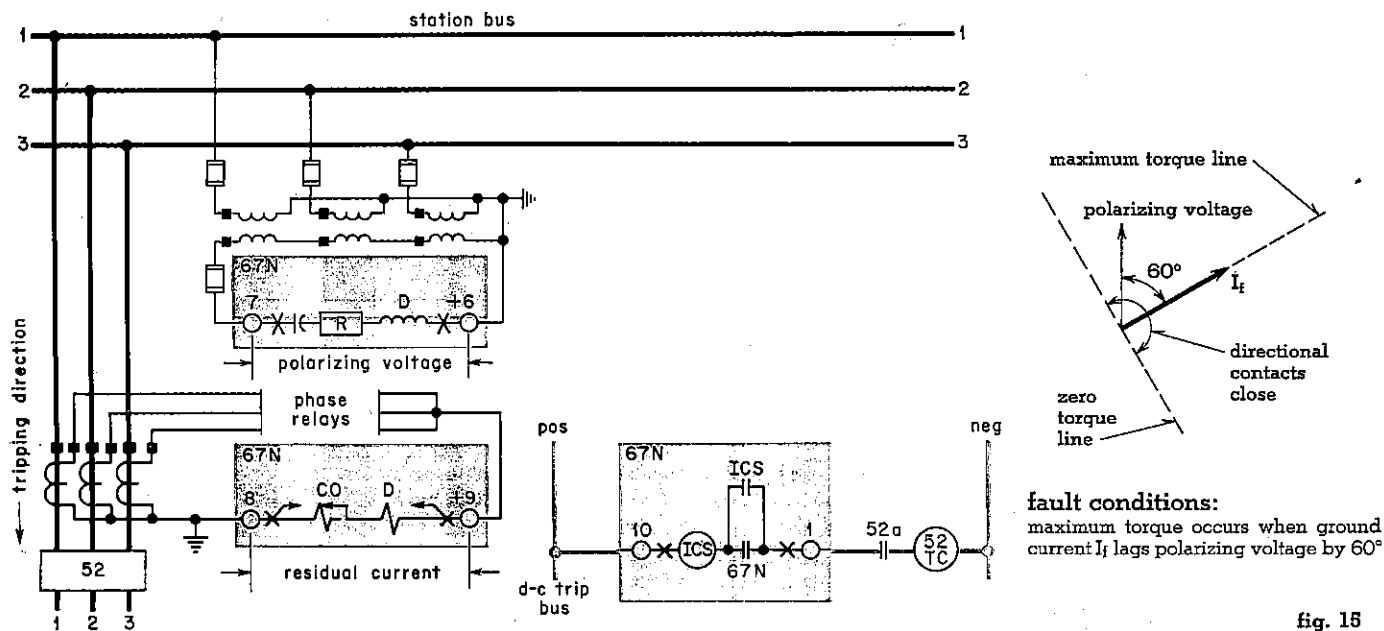


fig. 15

CRD relay for ground fault detection

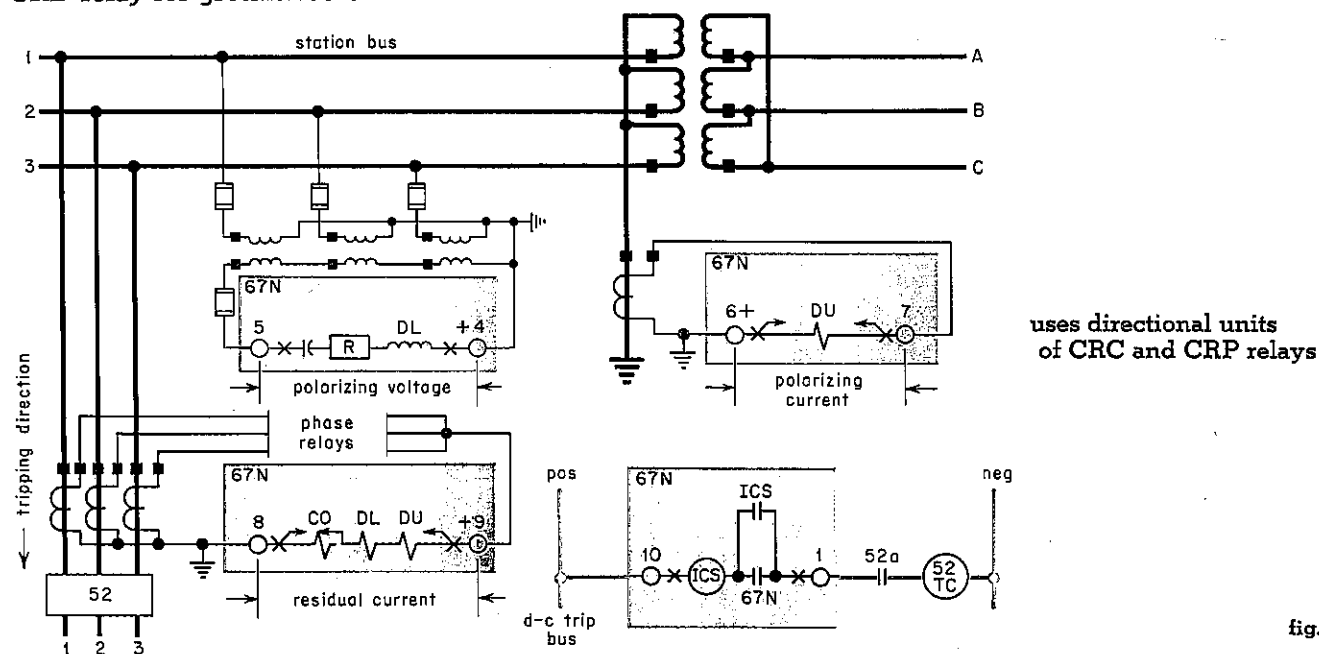


fig. 16

When not used, terminals 4 and 5 are jumpered at relay.

67N — upper directional unit of type CRD
DU — power circuit breaker
52 — power circuit breaker
52a — breaker auxiliary contact

52TC — breaker trip coil
ICS — Indicating Contactor Switch
— — fuse



IR line

construction

type IRD-9 chassis front view

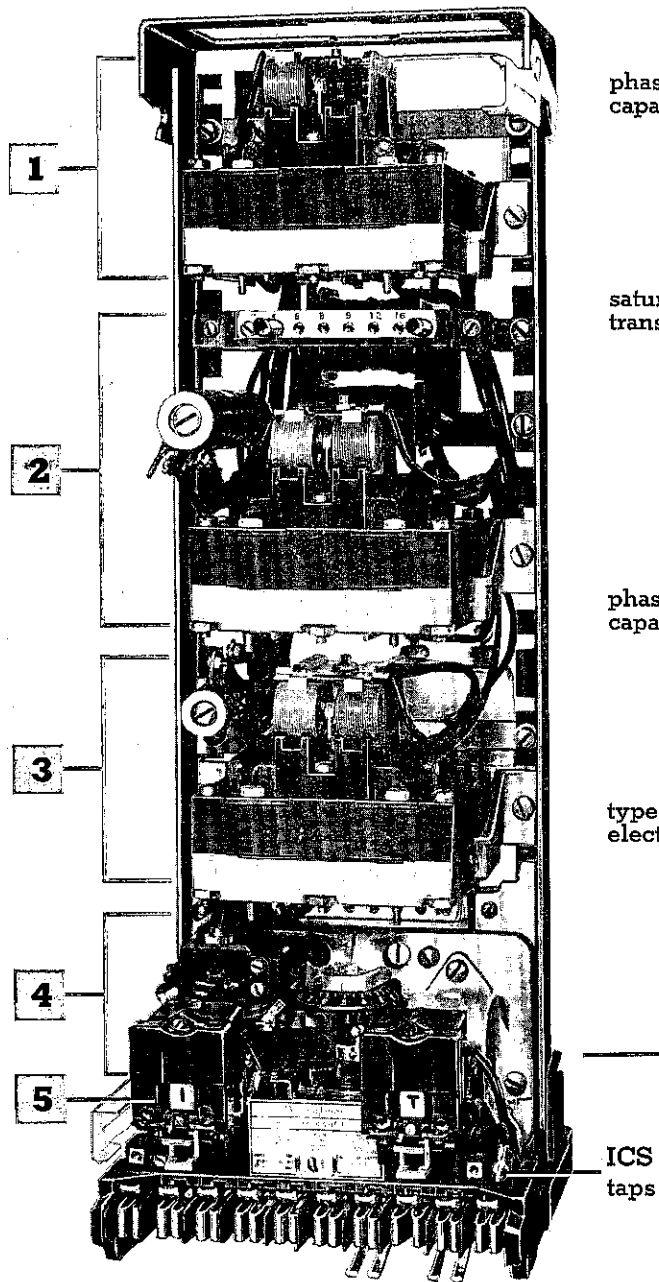


fig. 17

type IRD-9 chassis rear view

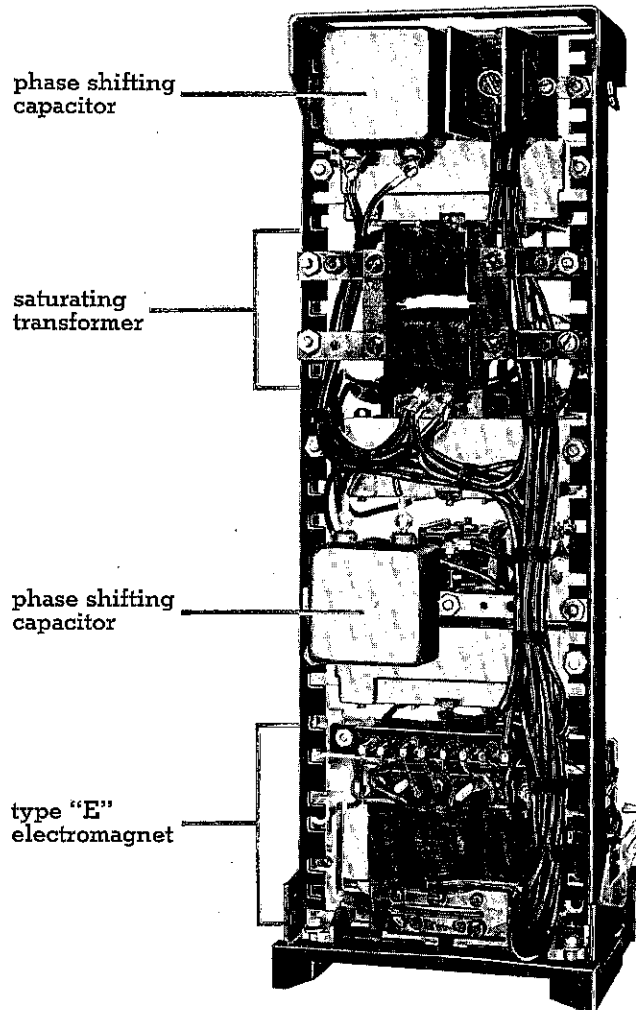


fig. 18

type IRD-9
in FT-41 case



fig. 19.

type IRC-8
in FT-31 case

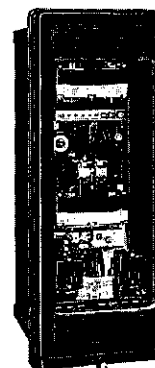


fig. 20.

basic { CR, CRC, CRP, CRD
types { IRC, IRP, IRD

1 instantaneous overcurrent unit (I)

This cylinder-design unit is similar in construction to the directional unit except that it has one circuit closing contact. Each pair of pole windings is energized by ground current from the operating circuit. A capacitor is series-connected with one pair of pole windings to obtain the desired time-phase relationship between the current in the two pairs of coils, in order to develop the necessary rotational torque. As shown in figures 26 and 27, one of the directional unit contacts (D) is connected across one pair of pole windings of the instantaneous overcurrent unit. This contact shunts the operating current around the pole windings, preventing the instantaneous overcurrent unit from developing rotational torque. However, when the directional unit picks up under fault conditions, the short on the instantaneous overcurrent unit coils is removed, allowing the instantaneous overcurrent unit to commence closing its contact almost simultaneously with the directional unit . . . thus providing high speed operation.

A saturating transformer is used to feed the instantaneous overcurrent unit. This transformer limits the energy applied to the unit at high current values and reduces the burden on the current transformer. The primary winding of the saturating transformer has taps connected to a tap block to facilitate changing the current pickup values of the unit. Tap value current is the minimum current required to just close the relay contacts. Pickup in between tap values can be obtained by varying the position of the spiral spring adjuster. This tapped transformer arrangement supplies the same amount of energy to the overcurrent unit for any tap setting at a given multiple of tap current. Thus, the unit has a constant burden level throughout its entire range.

A non-linear resistor (varistor) is connected across the secondary winding of the transformer and overcurrent unit coils to reduce the voltage peaks applied to the phase shifting capacitor and the overcurrent unit.

2 current polarized directional unit (D)

3 voltage polarized directional unit (D)

The directional unit is a product type induction cylinder which operates as a result of the interaction of polarizing and operating current flux. The moving element consists of a spiral spring, a contact-carrying arm and an aluminum cylinder which rotates in the air gap formed by the electromagnet and the magnetic core. The unit is free of vibration at heavy currents. It provides fast, trouble free reliable operation and requires no setting. The electro-magnet has two series connected polarizing coils and two series-connected operating coils mounted opposite each other. The interaction of the fluxes generated results in rotation of the cylinder. At 20 amperes operating current with 120 volts, 60 cycles applied, the operating time of the directional unit is approximately 10 milliseconds.

4 time-overcurrent unit

The types CO-5, CO-6, CO-7, CO-8, and CO-9 electromagnets consist of an "E" shaped laminated magnetic core which has a main tapped coil on the center leg of the "E" structure. The flux produced by this main coil divides and returns through the two outer legs. A shading coil located on the left leg of the electromagnet shifts the flux in that leg out of phase with respect to the flux in the right leg. The out-of-phase flux thus produced in the air gap of the electromagnet interacts with the main coil flux to create contact closing torque on the induction disc.

The CO-2 and CO-11 electromagnets are similar in construction, except that they have shading coils on both outer legs of the "E" shaped electromagnet. Disc rotation is opposed by the spiral spring which resets the moving contact to its initial position when applied current is below the tap value setting.

5 Indicating Contactor Switch (ICS)

Two are used (see page 3 for description), one designated ICS/I to indicate completion of the trip circuit due to closing of the instantaneous (I) unit contacts; the other ICS/T which operates when the time-overcurrent (CO) unit operates.

type IRC-8
front view

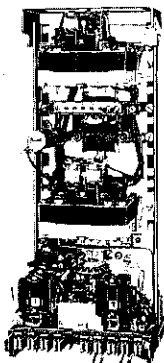


fig. 21.

type IRP-8
in FT-31 case

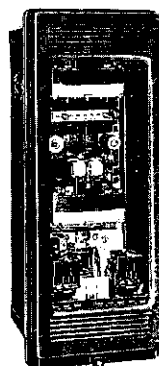


fig. 22.

type IRP-8
front view

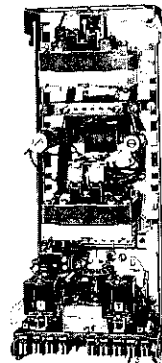


fig. 23.

type IRP-8
rear view

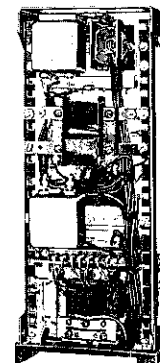


fig. 24.

construction continued

**IR line****construction****Indicating Instantaneous Trip (IIT)**

when used with CR phase relays (see figure 9)

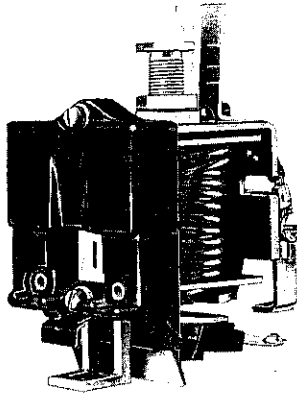


fig. 25

The Indicating Instantaneous Trip unit is similar in construction to the ICS unit except that it is a-c operated and is adjustable over a range of 1 to 4 times minimum pickup. Variable pickup is provided by the core screw adjustment on the top of the unit.

Each unit has a calibrated scale on which are marked four divisional points of the unit's pickup range (such as 10-20-30-40 for the 10-40 amp unit). A calibrated scribe mark on the scale plate indicates the exact position of these current pickup values.

The IIT unit has an operating accuracy of ± 10 percent of setting. Ratio of dropout to pickup varies from 65 percent at minimum setting to 90 percent at maximum setting.

relay settings

The instantaneous and time-overcurrent units require setting, whereas the directional unit does not.

On both overcurrent units, the tap selected determines the minimum pickup or contact-closing current of the unit. Selective time dial settings on the time-overcurrent unit can be determined by referring to the time current curves on pages 14 and 15.

Stationary contacts are adjusted as noted on page 3.

The Indicating Contactor Switch (ICS) tap is selected as stated on page 3.

tap ranges

range	taps
time-overcurrent unit (CO)	
.5—2.5	.5—.6—.8—1—1.5—2—2.5
2—6	2—2.5—3—3.5—4—5—6
4—12	4—5—6—7—8—10—12

instantaneous overcurrent unit (I)	
.5—2.0	.5—.75—1—1.25—1.5—2
1—4	1—1.5—2—2.5—3—4
2—8	2—3—4—5—6—8
4—16	4—6—8—9—12—16
10—40	10—15—20—24—30—40

directional overcurrent relays

descriptive
bulletin

41-130

page 11

basic { CR, CRC, CRP, CRD
types { IRC, IRP, IRD

internal wiring front view

type IRC-2, IRC-5, IRC-6, IRC-7, IRC-8, IRC-9,
and IRC-11 for ground fault detection
FT-31 case

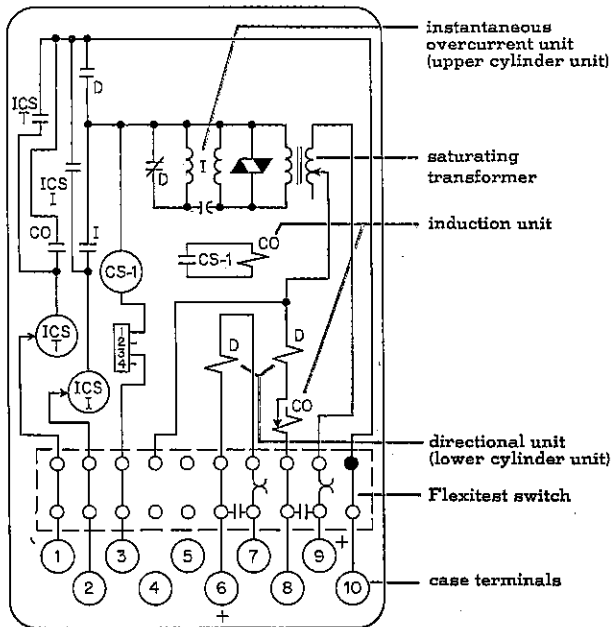


fig. 26

type IRP-2, IRP-5, IRP-6, IRP-7, IRP-8, IRP-9,
and IRP-11 for ground fault detection
FT-31 case

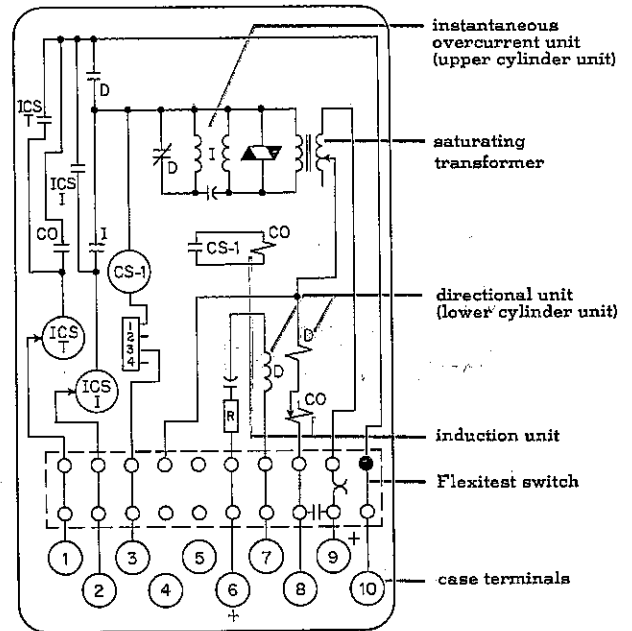


fig. 27

type IRD-2, IRD-5, IRD-6, IRD-7, IRD-8, IRD-9,
and IRD-11 for ground fault detection

FT-41 case

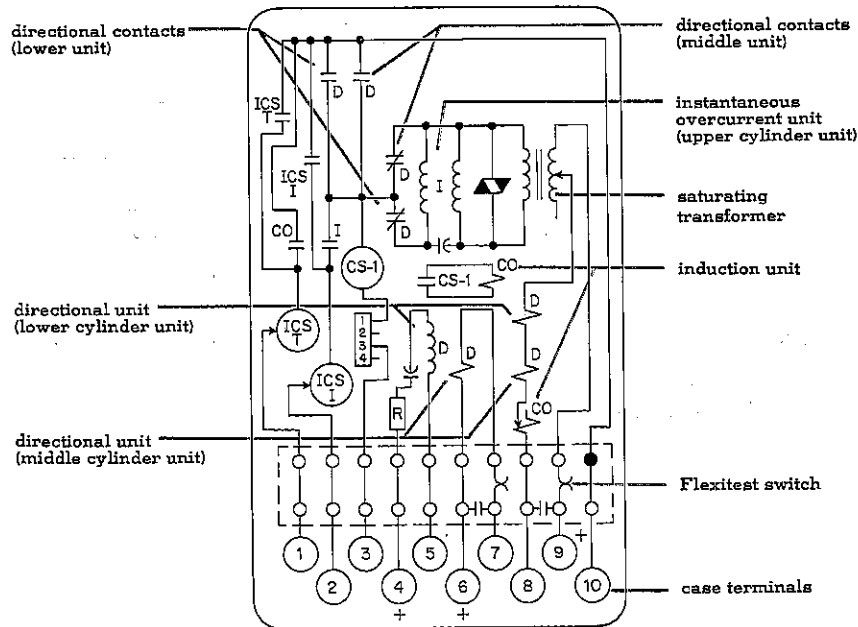


fig. 28

legend

- $\frac{1}{D}$ left hand contacts
- $\frac{2}{D}$ right hand contacts
- CS-1 auxiliary switch
- ICS Indicating Contactor Switch (right)
- ICS Indicating Contactor Switch (left)
- varistor
- chassis operated shorting switch
- current test jack

With instantaneous polarity as shown (+), open directional contacts close.
CS-1 resistor values, page 13. Relay shipped suitable for 125-volt d-c service.



IR line

external wiring

type IRC for ground fault detection

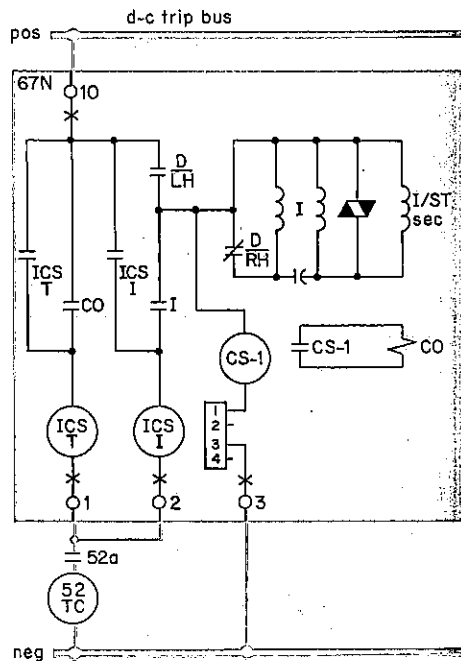
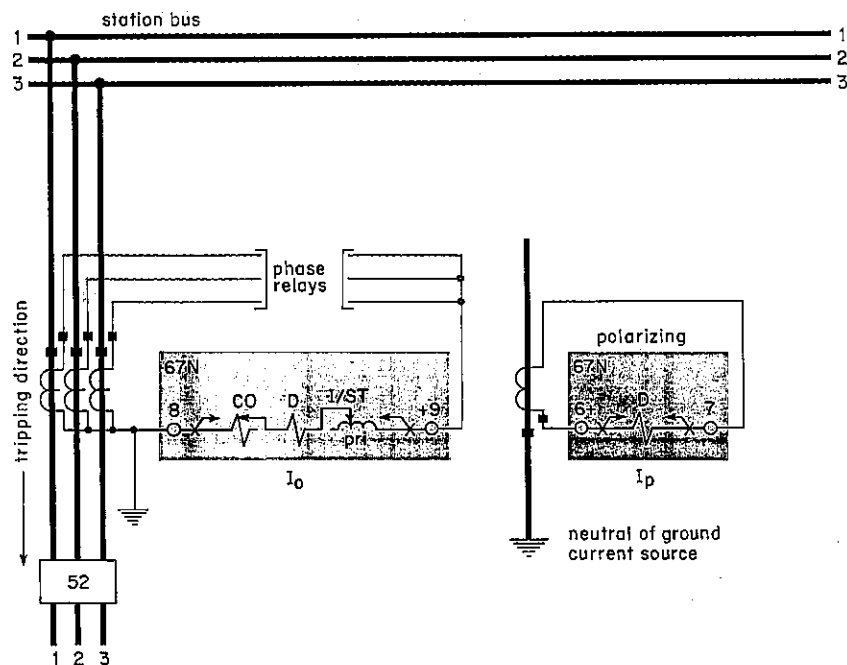


fig. 29

type IRP for ground fault detection

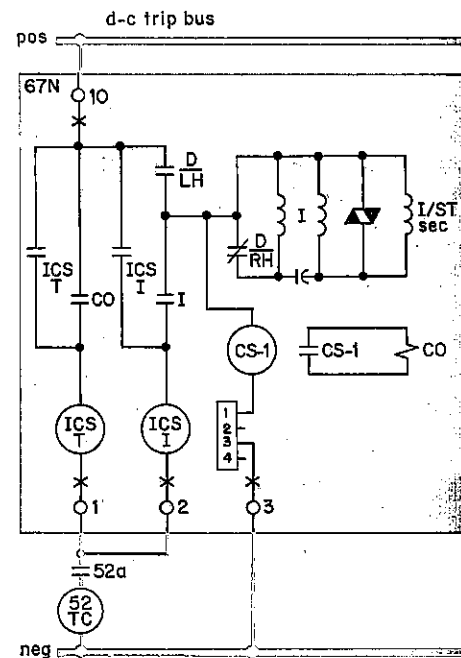
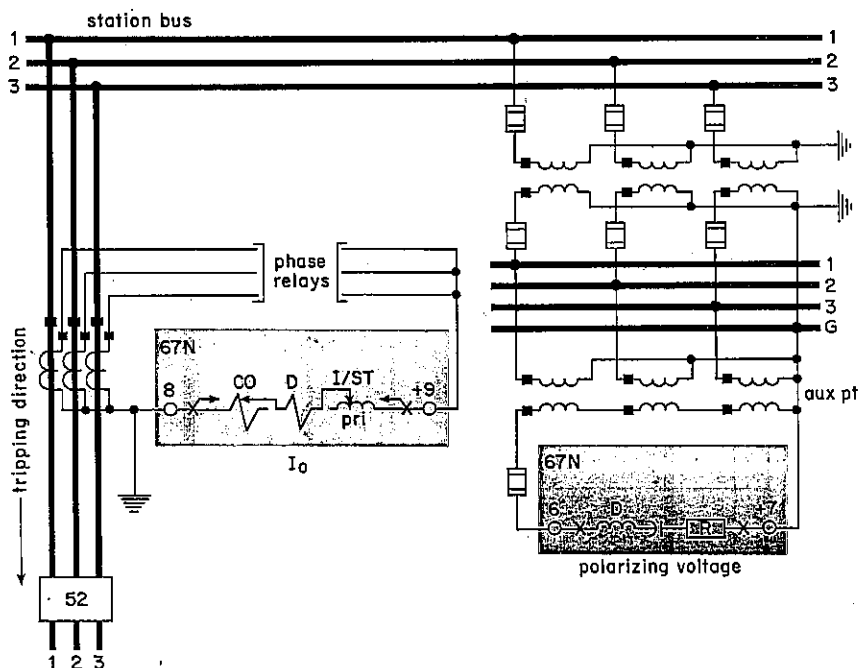


fig. 30

device number chart

67N —directional overcurrent relay, type IRC, IRD or IRP
D —directional unit
D/U —upper directional unit
D/L —lower directional unit

CO —time-overcurrent unit
I —instantaneous-overcurrent unit
I/ST —saturating transformer for instantaneous-overcurrent unit
ICS —Indicating Contact Switch

52 —power circuit breaker
52a —breaker auxiliary contact
52TC —breaker trip coil
I₀ —operating current
I_p —polarizing current

directional overcurrent relays

descriptive
bulletin

41-130

page 13

basic { CR, CRC, CRP, CRD
types { IRC, IRP, IRD

type IRD for ground fault detection

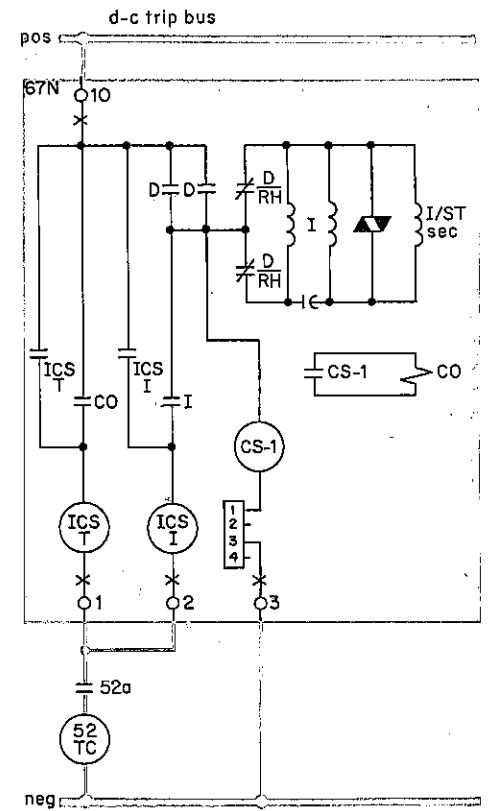
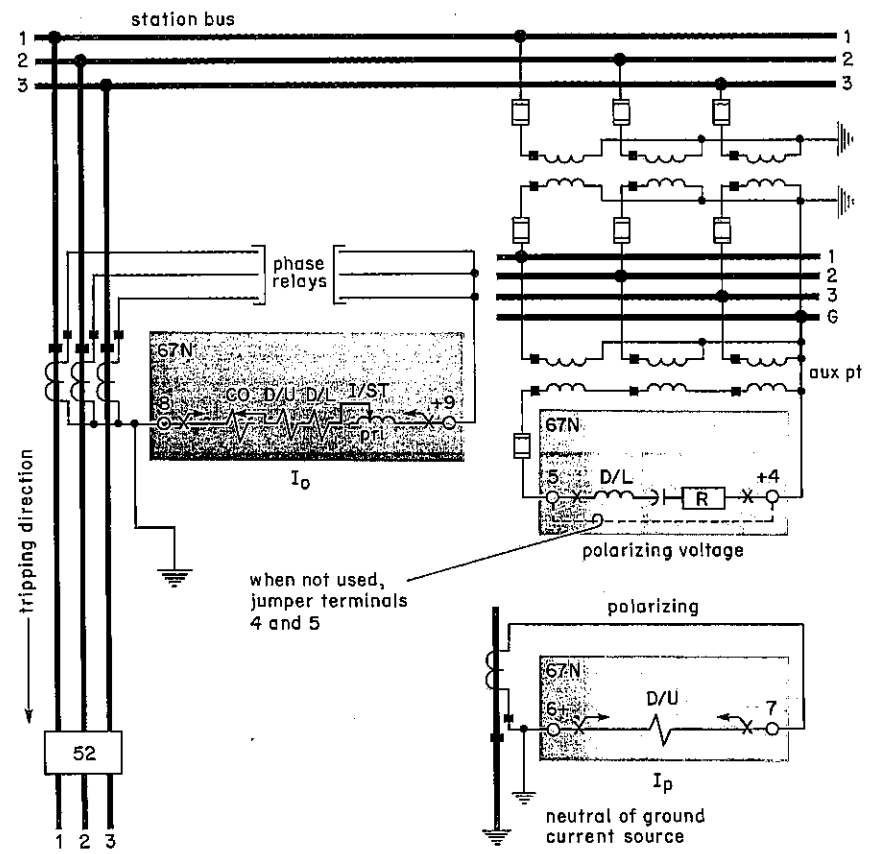
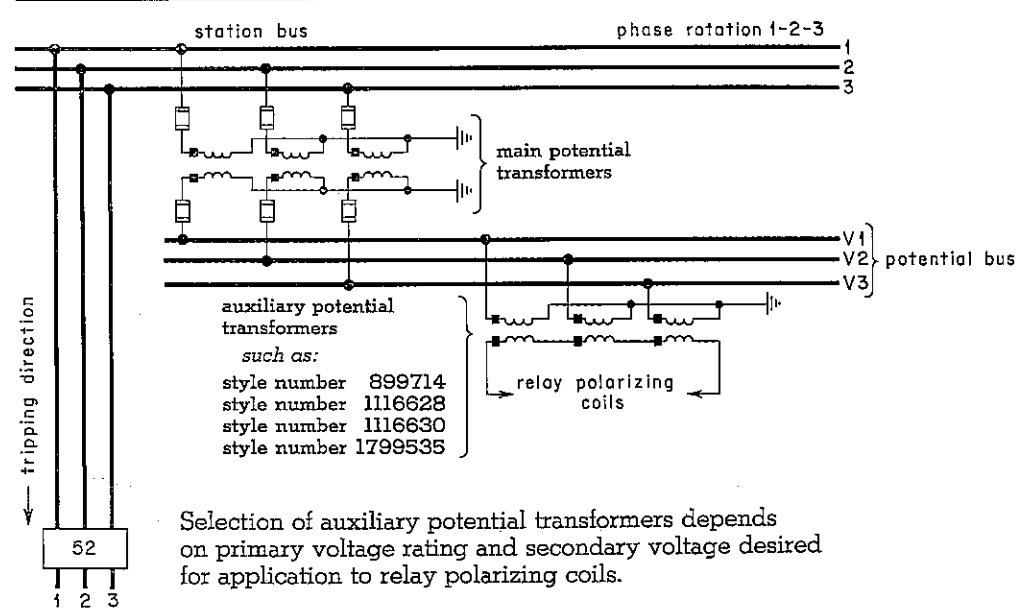


fig. 31

typical external wiring using auxiliary potential transformers



CS-1 resistor values

d-c volts	lead position	resistance value: ohms
24	1	0
48	2	300
125	3	2700
250	4	6500

Selection of auxiliary potential transformers depends on primary voltage rating and secondary voltage desired for application to relay polarizing coils.

fig. 32



time curves

50/60 cycles • time-overcurrent unit

short time

CR-2, CRC-2, CRP-2, CRD-2,
IRC-2, IRP-2, IRD-2

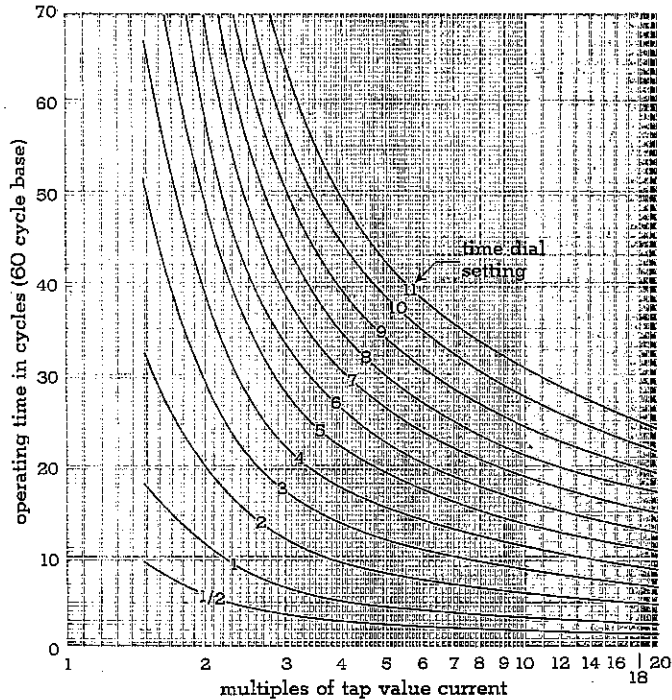


fig. 33

long time

CR-5, CRC-5, CRP-5, CRD-5,
IRC-5, IRP-5, IRD-5

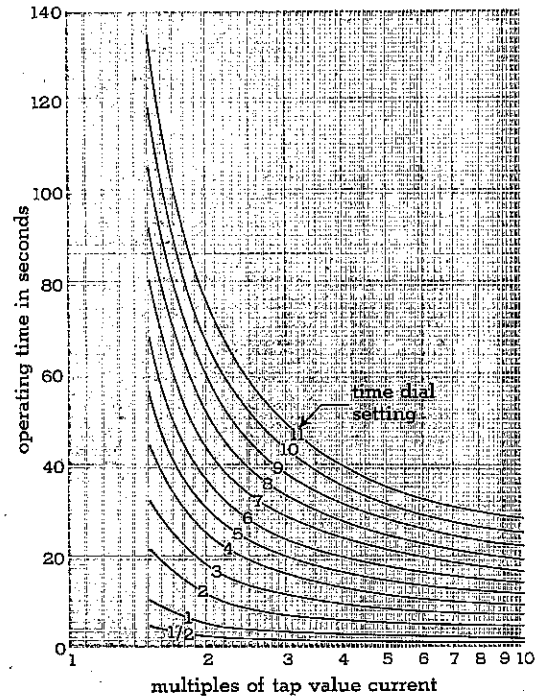


fig. 34

inverse time

CR-8, CRC-8, CRP-8, CRD-8,
IRC-8, IRP-8, IRD-8

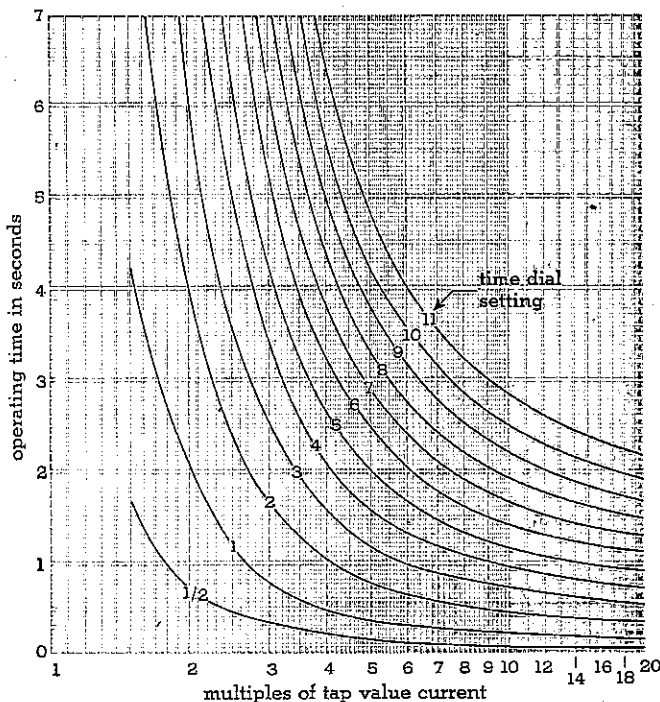


fig. 37

very inverse time

CR-9, CRC-9, CRP-9, CRD-9,
IRC-9, IRP-9, IRD-9

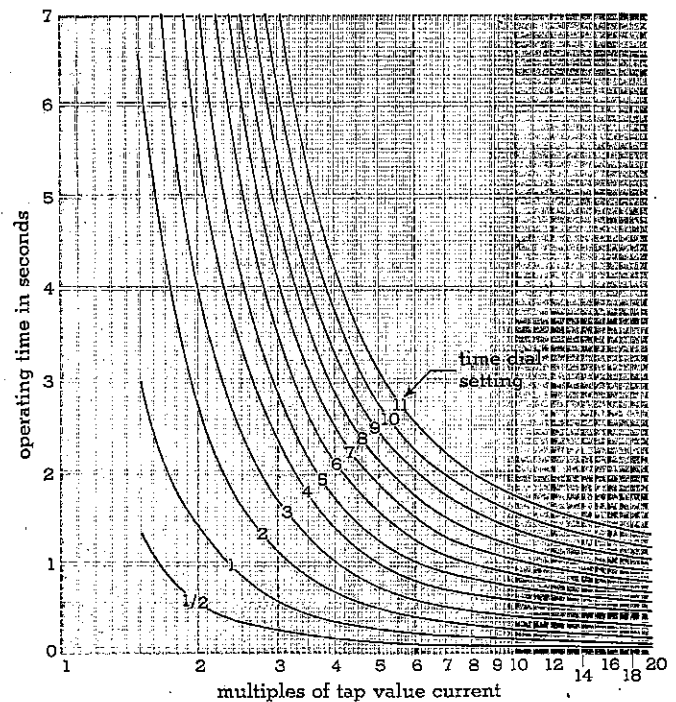


fig. 38

directional overcurrent relays

descriptive
bulletin

41-130

page 15

basic { CR, CRC, CRP, CRD
types { IRC, IRP, IRD

definite time

CR-6, CRC-6, CRP-6, CRD-6,
IRC-6, IRP-6, IRD-6

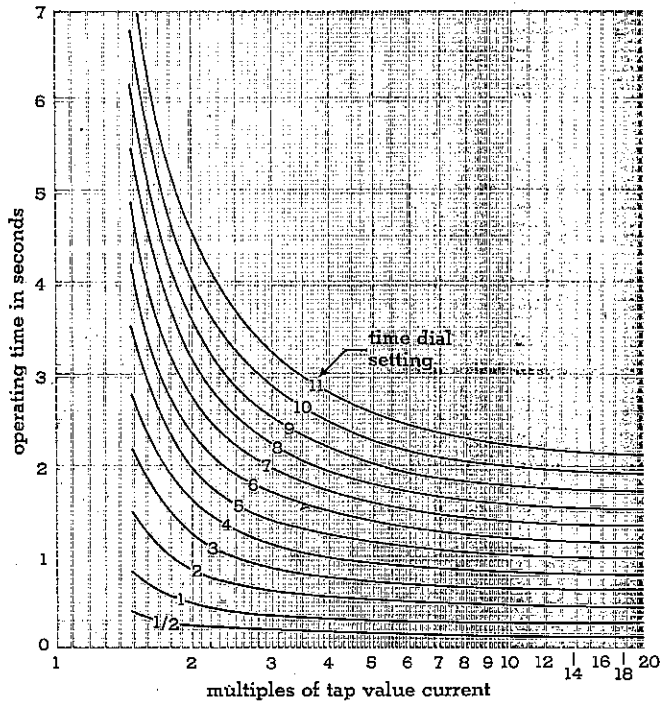


fig. 35

moderately inverse time

CR-7, CRC-7, CRP-7, CRD-7,
IRC-7, IRP-7, IRD-7

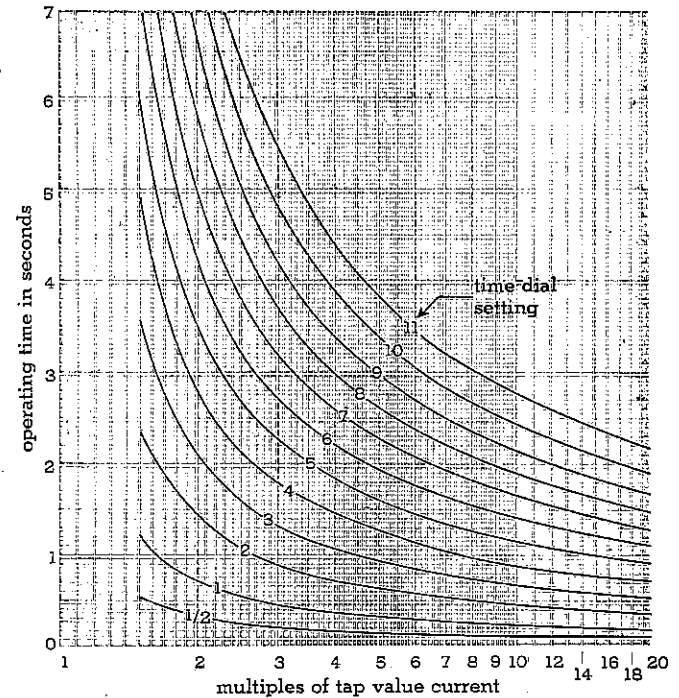


fig. 36

extremely inverse time

CR-11, CRC-11, CRP-11, CRD-11,
IRC-11, IRP-11, IRD-11

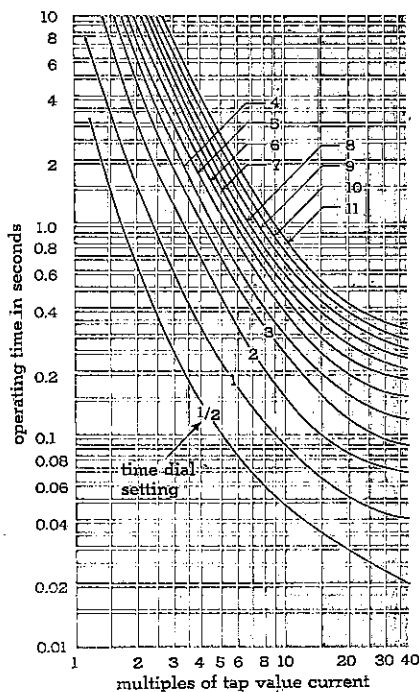


fig. 39

◆ Curves on these pages are available on 8 1/2" x 11" paper or Log-Log paper. Consult nearest Westinghouse office.

**characteristics** burden data and thermal capacities**time-overcurrent unit (CR, CRC, CRP, CRD, IRC, IRP, IRD types)**

ampere range:		0.5 to 2.5							2 to 6							4 to 12							
tap setting:		0.5	0.6	0.8	1.0	1.5	2.0	2.5	2	2.5	3	3.5	4	5	6	4	5	6	7	8	10	12	
short time: CR-2, CRC-2, CRP-2, CRD-2, IRC-2, IRP-2, IRD-2																							
coil ratings, amperes		cont 1 sec①	0.91 28	0.96 28	1.18 28	1.37 28	1.95 28	2.24 28	2.50 28	3.1 110	4.0 110	4.4 110	4.8 110	5.2 110	5.6 110	6.0 110	7.3 230	8.0 230	8.8 230	9.6 230	10.4 230	11.2 230	12.0 230
pf angle, lag②			58°	57°	53°	50°	40°	36°	29°	59°	55°	51°	47°	45°	41°	37°	65°	50°	47°	46°	43°	37°	34°
v-a burden ③		@ tap	4.8	4.9	5.0	5.3	6.2	7.2	7.9	5.04	5.13	5.37	5.53	5.72	5.90	6.54	4.92	5.20	5.34	5.53	5.86	6.6	7.00
		3 x tap	39.6	39.8	42.7	45.4	54.4	65.4	73.6	38.7	39.8	42.8	42.8	46.0	50.3	54.9	39.1	42.0	44.1	45.8	49.9	55.5	62.3
		10 x tap	256	270	308	348	435	580	700	262	280	312	329	360	420	474	268	305	330	364	400	470	528
		20 x tap	790	851	1024	1220	1740	2280	2850	800	920	1008	1120	1216	1500	1800	848	1020	1128	1260	1408	1720	2064

long time: CR-5, CRC-5, CRP-5, CRD-5, IRC-5, IRP-5, IRD-5**definite time: CR-6, CRC-6, CRP-6, CRD-6, IRC-6, IRP-6, IRD-6**

coil ratings, amperes		cont 1 sec ^①	2 88	2.2 88	2.5 88	2.8 88	3.4 88	4.0 88	4.4 88	8 230	8.8 230	9.7 230	10.4 230	11.2 230	12.5 230	13.7 230	16 460	18.8 460	19.3 460	20.8 460	22.5 460	25 460	28 460
pf angle, lag ^②			69°	68°	67°	66°	62°	60°	58°	67°	66°	64°	63°	62°	59°	57°	65°	63°	61°	59°	56°	53°	47°
v-a burden ^③		@ tap	3.92	3.96	3.96	4.07	4.19	4.30	4.37	3.88	3.87	3.93	4.09	4.08	4.20	4.38	4.00	4.15	4.32	4.27	4.40	4.60	4.92
		3 x tap	20.6	20.7	21	21.4	23.2	24.9	26.2	21	21.6	22.1	23.1	23.5	24.8	26.5	22.4	23.7	25.3	26.4	27.8	30.1	35.6
		10 x tap	103	106	114	122	147	168	180	110	118	126	136	144	162	183	126	143	162	183	204	247	288
		20 x tap	270	288	325	360	462	548	630	308	342	381	417	448	540	624	376	450	531	611	699	880	1056

moderately inverse time: CR-7, CRC-7, CRP-7, CRD-7, IRC-7, IRP-7, IRD-7

coil ratings, amperes		cont 1 sec ^①	2 88	2.2 88	2.5 88	2.8 88	3.4 88	4.0 88	4.4 88	8 230	8.8 230	9.7 230	10.4 230	11.2 230	12.5 230	13.7 230	16 460	18.8 460	19.3 460	20.8 460	22.5 460	25 460	28 460
pf angle, lag ^②			68°	67°	66°	64°	61°	58°	56°	66°	63°	63°	62°	61°	59°	58°	64°	61°	60°	58°	55°	51°	46°
v-a burden ^③		@ tap	3.88	3.93	3.93	4.00	4.08	4.24	3.48	4.06	4.07	4.14	4.34	4.34	4.40	4.62	4.24	4.30	4.62	4.69	4.80	5.20	5.40
		3 x tap	20.7	20.9	21.1	21.6	22.9	24.8	25.9	21.3	21.8	22.5	23.4	23.8	25.2	27	22.8	24.2	25.9	27.3	29.8	33	37.5
		10 x tap	103	107	114	122	148	174	185	111	120	129	141	149	163	183	129	149	168	187	211	260	308
		20 x tap	278	288	320	356	459	552	640	306	342	366	413	448	530	624	392	460	540	626	688	860	1032

inverse time: CR-8, CRC-8, CRP-8, CRD-8, IRC-8, IRP-8, IRD-8**very inverse time: CR-9, CRC-9, CRP-9, CRD-9, IRC-9, IRP-9, IRD-9**

coil ratings, amperes		cont 1 sec ^①	2 88	2.2 88	2.5 88	2.8 88	3.4 88	4.0 88	4.4 88	8 230	8.8 230	9.7 230	10.4 230	11.2 230	12.5 230	13.7 230	16 460	18.8 460	19.3 460	20.8 460	22.5 460	25 460	28 460
pf angle, lag ^②			72°	71°	69°	67°	62°	57°	53°	70°	66°	64°	62°	60°	58°	56°	68°	63°	60°	57°	54°	48°	45°
v-a burden ^③		@ tap	23.8	2.38	2.40	2.42	2.51	2.65	2.74	2.38	2.40	2.42	2.48	2.53	2.64	2.75	2.38	2.46	2.54	2.62	2.73	3.00	3.46
		3 x tap	21	21	21.1	21.2	22	23.5	24.8	21	21.1	21.5	22	22.7	24	25.2	21.3	21.8	22.6	23.6	24.8	27.8	31.4
		10 x tap	132	134	142	150	170	200	228	136	142	149	157	164	180	198	146	158	172	190	207	248	292
		20 x tap	350	365	400	440	530	675	800	360	395	430	470	500	580	660	420	480	550	620	700	850	1020

extremely inverse time: CR-11, CRC-11, CRP-11, CRD-11, IRC-11, IRP-11, IRD-11

coil ratings, amperes		cont 1 sec ^①	1.7 56	1.9 56	2.2 56	3.5 56	3.0 56	3.5 56	3.8 56	7.0 230	7.8 230	8.3 230	9.0 230	10.0 230	11.0 230	12.0 230	14 460	16 460	17 460	18 460	20 460	22 460	26 460
pf angle, lag ^②			36	34	30	27	22	17	16	32	30	27	24	23	20	20	29	25	22	20	18	17	16
v-a burden ^③		@ tap	0.72	0.75	0.81	0.89	1.13	1.30	1.48	0.73	0.78	0.83	0.88	0.96	1.07	1.23	0.79	0.89	1.02	1.10	1.23	1.32	1.8
		3 x tap	6.54	6.80	7.46	8.30	10.04	11.95	13.95	6.30	7.00	7.74	8.20	9.12	9.80	11.34	7.08	8	9.18	10	11.1	14.9	16.3
		10 x tap	71.8	75	84	93.1	115.5	136.3	160	74	78.5	84	89	102	109	129	78.4	90	101.4	110	124.8	131.6	180
		20 x tap	250	267	298	330	411	502	610	264	285	309	340	372	430	504	296	340	378	454	480	600	720

① Thermal capacities for short times other than one second may be calculated on the basis of time being inversely proportional to the square of the current. For instance, on the 0.5/2.5 amp range, one second rating being 88 amps, the half-second rating x would be obtained from:

$$\frac{1}{0.5} = \frac{X^2}{88^2} \times \sqrt{15488} \approx 124 \text{ amps}$$

② Degrees current lags voltage at tap value current.

③ Voltages taken with Rectox type voltmeter.

directional overcurrent relays

descriptive
bulletin

41-130

page 17

basic { *CR, CRC, CRP, CRD*
types { *IRC, IRP, IRD*

instantaneous-overcurrent unit (IRC, IRP, IRD types only)

ampere range	tap setting	volt-ampere burden:			
		at top value	power factor angle	at 5 amperes	power factor angle
0.5-2	0.5	.37	39	24	46
	0.75	.38	36	13	37
	1.0	.39	35	8.5	34
	1.25	.41	34	6.0	32
	1.5	.43	32	4.6	31
	2.0	.45	30	2.9	28
1-4	1.0	.41	36	9.0	36
	1.5	.44	32	5.0	32
	2.0	.47	30	3.0	29
	2.5	.50	28	2.1	27
	3.0	.53	26	1.5	26
	4.0	.59	24	0.93	24
2-8	2	1.1	49	6.5	48
	3	1.2	43	3.3	42
	4	1.3	38	2.1	37
	5	1.4	35	1.4	35
	6	1.5	33	1.1	33
	8	1.8	29	0.7	29
4-16	4	1.5	51	2.4	51
	6	1.7	45	1.2	45
	8	1.8	40	0.7	40
	9	1.9	38	0.6	38
	12	2.2	34	0.37	34
	16	2.5	30	0.24	31
10-40	10	1.7	28	0.43	28
	15	2.4	21	0.27	21
	20	3.1	16	0.20	17
	24	3.6	15	0.15	15
	30	4.2	12	0.11	13
	40	4.9	11	0.08	12

characteristics, continued

**characteristics** burden data and thermal capacities**directional unit (all types)****(a) polarizing circuit**

relay type	burden in volt-amperes ^③		power factor angle ^④	rating		
	at 120 volts	at 5 amps		continuous	1-second	30-second
CR	11.5	....	58° lag	132 volts	....	....
CRC, CRD, IRC, IRD	....	1.45	8° lag	....	230 amp	....
CRP, CRD, IRP, IRD	11.2	....	28° lead	....	....	208 volts

↓ current unit
♦ voltage unit

(b) operating circuit

relay type	ampere range	burden in volt-amperes ^③				power factor angle ^②	continuous rating in amps	1-second rating in amps ^①
		at min. tap value current	at 3 times min. tap value current	at 10 times min. tap value current	at 20 times min. tap value current			
CR	0.5-2.5	0.03	0.23	2.8	11.5	34.5	10	230
	2-6	0.44	4.08	48.0	182.0	34.5	10	230
	4-12	0.53	5.0	59.2	236.0	25.0	12	280
CRC, IRC	0.5-2.5	0.033	0.30	3.3	14.2	44.0	10	230
	2-6	0.58	5.28	58.0	240.0	42.5	10	230
	4-12	0.64	6.12	70.0	272.0	....	12	280
CRP, IRP	0.5-2.5	0.03	0.23	2.8	11.5	34.5	10	230
	2-6	0.44	4.08	48.0	182.0	34.5	10	230
	4-12	0.48	4.62	53.6	216.0	....	12	280
CRD, IRD	0.5-2.5	0.07	0.59	6.6	26.0	45.0	10	230
	2-6	1.04	9.9	106.0	420.0	45.0	10	230
	4-12	1.16	10.8	121.2	472.0	....	12	280

① Thermal capacities for short times other than one second may be calculated on the basis of time being inversely proportional to the square of the current. For instance, on the 0.5/2.5 amp range, one second rating being 88 amps, the half-second rating x would be obtained from:

$$\frac{1}{0.5} = \frac{x^2}{88^2} \times \sqrt{15488} \approx 124 \text{ amps}$$

② Degrees current lags voltage at tap value current.

③ Voltages taken with Rectox type voltmeter.

④ Degrees operating current leads or lags (as indicated) polarizing voltage or polarizing current.

minimum pick-up values**directional unit**

relay type	tap range in amps	minimum pickup		phase angle
		volts	amps	
CR voltage unit	0.5-2.5	1	2	I leading V by 30°
	2-6	1	2.3	I in phase with V
	4-12	1	4	I leading V by 30°
		1	4.6	I in phase with V
CRC, IRC, CRD, IRD current unit	0.5-2.5	.	0.5	I ₀ leading I _p by 40°
	2-6	.	.65	in phase
	4-12	.	1.0	I ₀ leading I _p by 40°
		.	1.3	in phase
CRP, IRP, CRD, IRD voltage unit	0.5-2.5	1	2	I lagging by 60°
	2-6	1	4	I in phase with V
	4-12	1	4	I lagging V by 60°
		1	8	I in phase with V

time-overcurrent unit**trip circuit data**

ICS tap amps, d-c	coil rating in amps d-c		resistance in ohms
	continuous	1-second	
0.2	0.4	11.5	6.5
2.0	3.2	88.0	0.15

instantaneous-overcurrent unit (I) ratings

range	amps	
	1-second	continuous
0.5-2	5	100
1-4	5	140
2-8	5	140
4-16	5	200
10-40	5	200

directional overcurrent relays

descriptive
bulletin

41-130

page 19

basic { CR, CRC, CRP, CRD
types { IRC, IRP, IRD

ordering information order by style number

without instantaneous trip unit • single phase • 60 cycles.

type	type of protection	time curve	contacts	Indicating Contactor Switch	current range amps: a-c time unit	Flexitest Universal case		
						relay style no.	case size	wired per fig.
CR-2	phase protection 132 volts a-c continuous	short	spst—cc	0.2/2.0 amp d-c one unit per relay	0.5-2.5 2-6 4-12	289B423A09 289B423A10 289B423A11	FT-21	9
CR-5		long			0.5-2.5 2-6 4-12	289B424A09 289B424A10 289B424A11		
CR-6		definite			0.5-2.5 2-6 4-12	288B563A12 1875 593 1875 596		
CR-7		moderately inverse			0.5-2.5 2-6 4-12	288B571A12 1875 567 1875 568		
CR-8		inverse			0.5-2.5 2-6 4-12	288B574A12 1875 579 1875 580		
CR-9		very inverse			0.5-2.5 2-6 4-12	288B576A12 1875 591 1875 592		
CR-11		extremely inverse			0.5-2.5 2-6 4-12	288B940A09 288B940A10 288B940A11		
CRC-2	ground protection current polarized 230 amps/ 1 second	short			0.5-2.5 2-6 4-12	289B425A09 289B425A10 289B425A11		10
CRC-5		long			0.5-2.5 2-6 4-12	289B426A09 289B426A10 289B426A11		
CRC-6		definite			0.5-2.5 2-6	1876 952 1876 953		
CRC-7		moderately inverse			0.5-2.5 2-6	1875 597 1875 598		
CRC-8		inverse			0.5-2.5 2-6	1875 601 1875 602		
CRC-9		very inverse			0.5-2.5 2-6	1875 605 1875 606		
CRC-11		extremely inverse			0.5-2.5 2-6 4-12	1955 390 1955 391 1955 392		
CRP-2	ground protection voltage polarized 208 volts/30 seconds	short			0.5-2.5 2-6 4-12	289B427A09 289B427A10 289B427A11		11
CRP-5		long			0.5-2.5 2-6 4-12	289B428A09 289B428A10 289B428A11		
CRP-6		definite			0.5-2.5 2-6	1876 958 1876 959		
CRP-7		moderately inverse			0.5-2.5 2-6	1875 561 1875 562		
CRP-8		inverse			0.5-2.5 2-6	1875 573 1875 574		
CRP-9		very inverse			0.5-2.5 2-6	1875 583 1875 586		
CRP-11		extremely inverse			0.5-2.5 2-6 4-12	1878 843 1955 393 1955 394		
CRD-2	ground protection current and voltage polarized 208 volts/30 seconds 230 amps/ 1 second	short			0.5-2.5 2-6 4-12	289B429A10 289B429A11 289B429A12	FT-31	12
CRD-5		long			0.5-2.5 2-6 4-12	289B430A09 289B430A10 289B430A11		
CRD-6		definite			0.5-2.5 2-6 4-12	1876 796 1876 797 1876 798		
CRD-7		moderately inverse			0.5-2.5 2-6 4-12	1876 805 1876 806 1876 807		
CRD-8		inverse			0.5-2.5 2-6 4-12	1876 814 1876 815 1876 816		
CRD-9		very inverse			0.5-2.5 2-6 4-12	1876 823 1876 824 1876 825		
CRD-11		extremely inverse			0.5-2.5 2-6 4-12	1955 395 1955 396 1955 397		

* 50-cycle relays can be supplied. Order "similar to style number except for 50 cycles".

continued

**ordering information** order by style number

with instantaneous trip unit • single phase • 60 cycles.

type	application	time curve	contacts	Indicating Contactor Switch	current range amps: a-c		Flexitest universal case		
					time unit	instan- taneous unit	relay style no.	case size	wired per fig.
IRC-2	ground detection current polarized 230 amps/ 1 second	short	spst—cc	0.2/2.0 amp d-c two units per relay	0.5-2.5	2-8 4-16 10-40 20-80	289B435A09 289B435A10 289B435A11 289B435A12	FT-31	26
					2-6	4-16 10-40 20-80	289B435A13 289B435A14 289B435A15		
					4-12	10-40 20-80	289B435A17 289B435A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B523A09 289B523A10 289B523A11 289B523A12		
IRC-5		long			2-6	4-16 10-40 20-80	289B523A13 289B523A14 289B523A15		
					4-12	10-40 20-80	289B523A17 289B523A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B523A09 289B523A10 289B523A11 289B523A12		
					2-6	4-16 10-40 20-80	289B523A13 289B523A14 289B523A15		
IRC-6		definite			4-12	10-40 20-80	289B523A17 289B523A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B436A09 289B436A10 289B436A11 289B436A12		
					2-6	4-16 10-40 20-80	289B436A13 289B436A14 289B436A15		
					4-12	10-40 20-80	289B436A17 289B436A18		
IRC-7		moderately inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B437A09 289B437A10 289B437A11 289B437A12		
					2-6	4-16 10-40 20-80	289B437A13 289B437A14 289B437A15		
					4-12	10-40 20-80	289B437A17 289B437A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B438A09 289B438A10 289B438A11 289B438A12		
IRC-8		inverse			2-6	4-16 10-40 20-80	289B438A13 289B438A14 289B438A16		
					4-12	10-40 20-80	289B438A17 289B438A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B439A09 289B439A10 289B439A11 289B439A12		
					2-6	4-16 10-40 20-80	289B439A13 289B439A14 289B439A15		
IRC-9		very inverse			4-12	10-40 20-80	289B439A17 289B439A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B931A09 289B931A10 289B931A11 289B931A12		
					2-6	4-16 10-40 20-80	289B931A13 289B931A14 289B931A15		
					4-12	10-40 20-80	289B931A17 289B931A18		
IRC-11		extremely inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B931A09 289B931A10 289B931A11 289B931A12		
					2-6	4-16 10-40 20-80	289B931A13 289B931A14 289B931A15		
					4-12	10-40 20-80	289B931A17 289B931A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B445A09 289B445A10 289B445A11 289B445A12	FT-41	28
IRD-2	ground detection current and voltage polarized 230 amps/1 sec. 208 volts/30 sec.	short	spst—cc	0.2/2.0 amp d-c two units per relay	2-6	4-16 10-40 20-80	289B445A13 289B445A14 289B445A15		
					4-12	10-40 20-80	289B445A17 289B445A18		
					0.5-2.5	2-8 4-16 10-40 20-80	289B445A09 289B445A10 289B445A11 289B445A12		
					2-6	4-16 10-40 20-80	289B445A13 289B445A14 289B445A15		

* 50-cycle relays can be supplied. Order "similar to style number except for 50 cycles".

directional overcurrent relays

descriptive
bulletin

41-130

page 21

basic { CR, CRC, CRP, CRD
types { IRC, IRP, IRD

type	application	time curve	contacts	Indicating Contactor Switch	current range amps: a-c		Flexitest universal case		
					time unit	instan- taneous unit	relay style no.	case size	wired per fig.
IRD-5	ground detection current and voltage polarized 230 amps/ 1 second 208 volts 30 seconds	long	spst--cc	0.2/2.0 amp d-c two units per relay	0.5-2.5	2-8 4-16 10-40 20-80	289B525A09 289B525A10 289B525A11 289B525A12	FT-41	28
					2-6	4-16 10-40 20-80	289B525A13 289B525A14 289B525A15		
					4-12	10-40 20-80	289B525A17 289B525A18		
IRD-6		definite			0.5-2.5	2-8 4-16 10-40 20-80	289B446A09 289B446A10 289B446A11 289B446A12		
					2-6	4-16 10-40 20-80	289B446A13 289B446A14 289B446A15		
					4-12	10-40 20-80	289B446A17 289B446A18		
IRD-7		moderately inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B447A09 289B447A10 289B447A11 289B447A12		
					2-6	4-16 10-40 20-80	289B447A13 289B447A14 289B447A15		
					4-12	10-40 20-80	289B447A17 289B447A18		
IRD-8		inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B448A09 289B448A10 289B448A11 289B448A12		
					2-6	4-16 10-40 20-80	289B448A13 289B448A14 289B448A15		
					4-12	10-40 20-80	289B448A17 289B448A18		
IRD-9		very inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B449A09 289B449A10 289B449A11 289B449A12		
					2-6	4-16 10-40 20-80	289B449A13 289B449A14 289B449A15		
					4-12	10-40 20-80	289B449A17 289B449A18		
IRD-11		extremely inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B932A09 289B932A10 289B932A11 289B932A12		
					2-6	4-16 10-40 20-80	289B932A13 289B932A14 289B932A15		
					4-12	10-40 20-80	289B932A17 289B932A18		
IRP-2	ground detection voltage polarized 208 volts/ 30 seconds	short	spst--cc	0.2/2.0 amp d-c two units per relay	0.5-2.5	2-8 4-16 10-40 20-80	289B440A09 289B440A10 289B440A11 289B440A12	FT-31	27
					2-6	4-16 10-40 20-80	289B440A13 289B440A14 289B440A15		
					4-12	10-40 20-80	289B440A17 289B440A18		
IRP-5		long			0.5-2.5	2-8 4-16 10-40 20-80	289B524A09 289B524A10 289B524A11 289B524A12		
					2-6	4-16 10-40 20-80	289B524A13 289B524A14 289B524A15		
					4-12	10-40 20-80	289B524A17 289B524A18		

continued

**ordering information** order by style number**with instantaneous trip unit • single phase • 60 cycle.**

type	application	time curve	contacts	Indicating Contactor Switch	current range amps: a-c		Flexitest universal case		
					time unit	instan- taneous unit	relay style no.	case size	wired per fig.
IRP-6	ground detection voltage polarized 208 volts/ 30 seconds	definite	spst—cc	0.2/2.0 amp d-c two units per relay	0.5-2.5	2-8 4-16 10-40 20-80	289B441A09 289B441A10 289B441A11 289B441A12	FT-31	27
					2-6	4-16 10-40 20-80	289B441A13 289B441A14 289B441A15		
					4-12	10-40 20-80	289B441A17 289B441A18		
IRP-7		moderately inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B442A09 289B442A10 289B442A11 289B442A12		
					2-6	4-16 10-40 20-80	289B442A13 289B442A14 289B442A15		
					4-12	10-40 20-80	289B442A17 289B442A18		
IRP-8		inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B443A09 289B443A10 289B443A11 289B443A12		
					2-6	4-16 10-40 20-80	289B443A13 289B443A14 289B443A15		
					4-12	10-40 20-80	289B443A17 289B443A18		
IRP-9		very inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B444A09 289B444A10 289B444A11 289B444A12		
					2-6	4-16 10-40 20-80	289B444A13 289B444A14 289B444A15		
					4-12	10-40 20-80	289B444A17 289B444A18		
IRP-11		extremely inverse			0.5-2.5	2-8 4-16 10-40 20-80	289B933A09 289B933A10 289B933A11 289B933A12		
					2-6	4-16 10-40 20-80	289B933A13 289B933A14 289B933A15		
					4-12	10-40 20-80	289B933A17 289B933A18		

‡ 50-cycle relays can be supplied. Order "similar to style number except for 50 cycles".

directional overcurrent relays

descriptive
bulletin

41-130

page 23

basic types { *CR, CRC, CRP, CRD*
IRC, IRP, IRD

dimensions in inches

case type	case dimensions (inches)		panel cutout dimensions (inches) front view		terminal and mounting hardware
	front view	side view	semi-flush	projection	
FT-21					semi-flush mounting $\frac{3}{16}$ " panels projection mounting $\frac{3}{16}$ " panels
					$\frac{3}{16}$ " to $2\frac{1}{2}$ " panels



further information:

prices	price list 41-020
Flexitest case	descriptive bulletin 41-075
instructions: CR line IR line	instruction leaflet 41-131 instruction leaflet 41-133
other relay literature	protective relay index 41-000
renewal parts data CR line IR line	renewal parts data 41-131A1
inquiries	nearest Westinghouse sales office

shipping weights and carton dimensions

relay type	Flexitest case type	weight: lbs		domestic shipping carton dimensions: inches
		net	shipping	
CR-2,5,6,7,8,9,11	FT-21			9 x 12 x 13
CRC-2,5,6,7,8,9,11		....	....	
CRP-2,5,6,7,8,9,11		....	....	
CRD-2,5,6,7,8,9,11	FT-31			13 x 13 x 21
IRC-2,5,6,7,8,9,11		....	....	
IRP-2,5,6,7,8,9,11		....	....	
IRD-2,5,6,7,8,9,11	FT-41			11 x 17 x 24