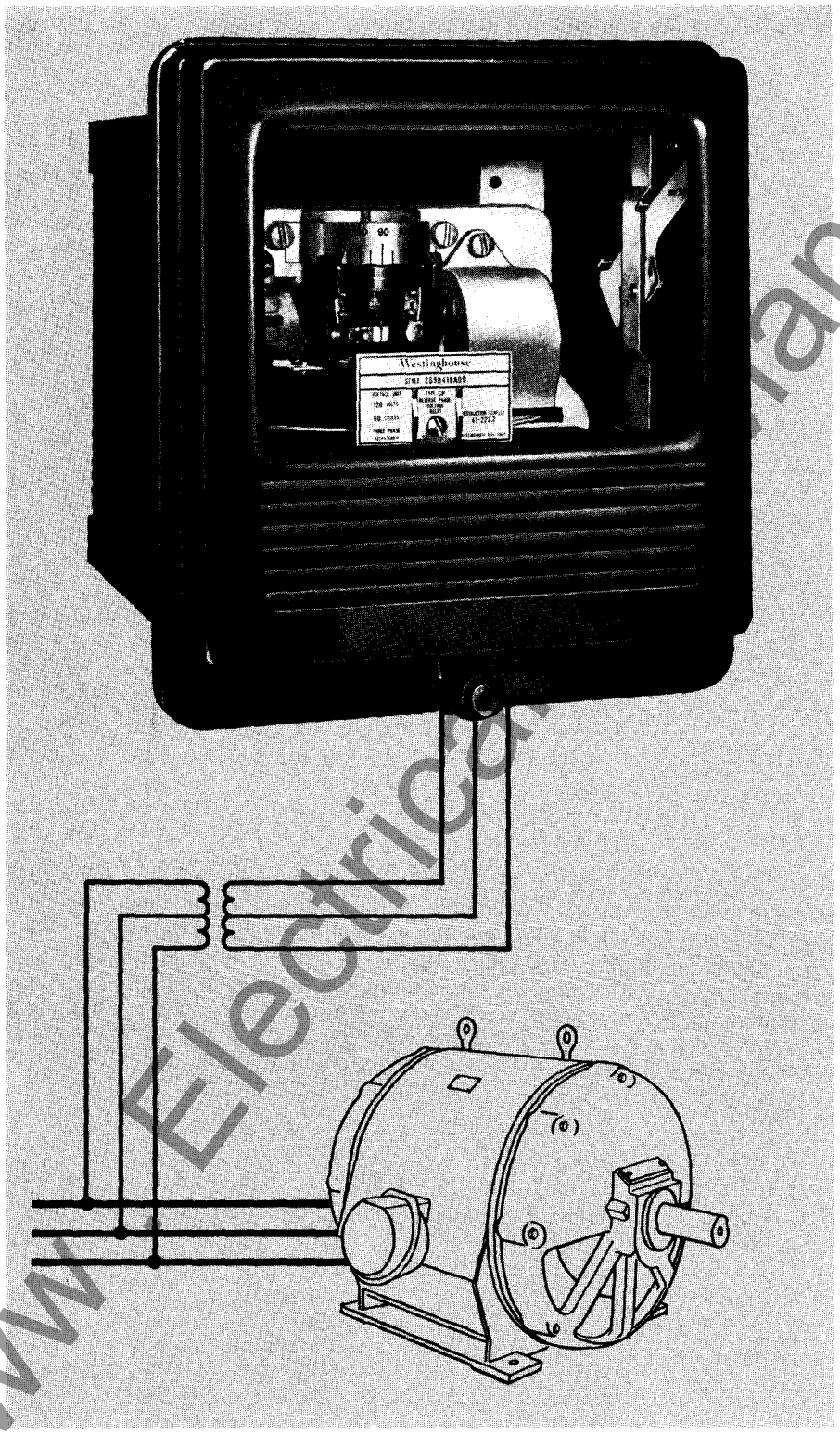
Westinghouse

Type CP Reverse Phase Voltage Relay

For Protection of Motors, Generators, Transformers, and Station Bus



Application

The CP relay is a three-phase contact-making voltmeter which is used to detect reverse phase connections of lines, transformers, motors, generators, or synchronous condensers. It is commonly used in automatic transfer schemes to assure connection of proper phase rotation. For example, one CP relay is used to initiate trip of a source breaker, while another is used to supervise closing of the alternate source breaker.

One set of relay contacts close on three-phase overvoltage conditions, whereas the other set of contacts close on three-phase undervoltage, loss of voltage, reverse phase connection, or serious phase unbalance.

When used on motor applications, the relay may not operate due to an open phase, such as caused by an open fuse. The motor will tend to maintain normal voltage across the relay terminals unless heavily loaded. However, the relay will operate as soon as the motor is stopped, and will prevent motor starting with one phase open.

The CP relay is also used to block generator voltage regulator "raise" circuits during malfunction of the regulator, thereby avoiding system overvoltage.

The relay has high torque (assuring positive contact action), low burden, and is easily adjustable. Being self-contained, it does not require external resistors.

Device Number: 47

August, 1975
Supersedes DB 41-220 dated July, 1966
E, D, C/2014/DB

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Construction

(1) Calibrated Scale

Has indexed marking of 70-120 volts, 140-240 volts, or 240-480 volts. Range of contact adjustment is as follows:

120 volt relay . . . . . 70-120 volts

240 volt relay . . . . . 140-240 volts

480 volt relay . . . . . 240-480 volts

(2) Adjustable Low Voltage Contact

(3) Adjustable High Voltage Contact

Both adjustable contacts are made of silver, and both have a vernier screw to provide adjustable contact wipe and assure positive contact.

(4) Die Cast Aluminum Frame

Assures correct alignment of disc, bearings, and electromagnet assembly.

(5) Moving Contact

The moving contact is also made of silver. It provides common connection between the high and low voltage contacts. CP relay designs which provide independent contact circuits are available. See figure 8. It floats between the stationary contacts for intermediate values of relay voltage between overvoltage and undervoltage stationary contact settings.

(6) Spiral Spring

A strong spiral spring assures good contact action when the relay is de-energized. Adjustment of the spring tension determines the minimum pickup of the relay.

(7) Damping Magnet

High strength Alnico, with adjustable keeper to damp the induction disc, and thus control operating time of the relay according to published time curves.

Indicating Contractor Switch (ICS)

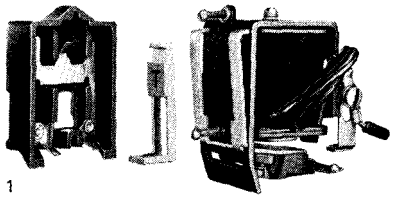

Fig. 1

The CP relay can be supplied with an additional seal-in type ICS auxiliary unit rated 0.2/2.0 amps dc. This unit (mounted on the terminal jaw block) is a small clapper type device having a magnetic armature to which leaf-spring mounted contacts are attached. The armature is attracted to the core when the coil is energized at or above pickup value, causing the moving contacts to bridge two stationary contacts, and complete the trip circuit.

The ICS contacts are connected in parallel with the main relay contacts, and relieve them of carrying heavy trip currents.

The main relay contacts will close 30 amperes at 250 volts dc, and the ICS contacts will safely carry this current long enough to trip a circuit breaker.

When the ICS is energized, two fingers on the armature yoke deflect a leaf-spring located on the front of the switch, allowing the operation indicator target to drop. The target is reset external to the case by a push-rod located at the bottom of the relay case cover.

Taps on the front of the relay provide connection for either 0.2 (left) or 2.0 (right) ampere dc minimum pickup setting. When the CP relay energizes a WL relay rated 125 or 250 volts dc, the 0.2 tap is recommended. The 2.0 ampere tap is used on 24 or 48 volt dc circuits.

Indicating Voltage Switch (IVS)

CP relays can also be supplied with an Indicating Voltage Switch which is similar in construction to the ICS unit, except that it has a series connected resistor.

The IVS unit will operate when 80% of dc rated voltage is applied.

Voltage Operating Electromagnet

Located at the rear of the relay, the type "E" electromagnet is a laminated structure with a coil winding on each of the three legs. When the wye-connected coils are energized by three-phase voltage, a flux is induced in each leg of the electromagnet. These out-of-phase fluxes create torque on the induction disc so that positive sequence voltage tends to close the high voltage contact, and negative sequence voltage tends to close the low voltage contact. Design of the electromagnet creates high operating torque to provide positive contact action.

Burden Data

120, 240, and 480 Volt Relays

When energized at nominal rated line-to-line balanced three-phase voltage, CP relay burden is as follows:

Phase	Watts	Vars	Volt Amperes	Power Factor Angle
A	.25	2.82	2.83	85° lag
B	.37	1.92	1.96	79° lag
C	1.11	2.50	2.73	66° lag

Ratings

Relay Voltage Unit

The CP relay will withstand 110% of rated voltage, continuously.

Relay Contacts

The main contacts of the relay will close 30 amperes at 250 volts dc, and will carry this current for sufficient time to trip a circuit breaker.

Trip Circuit Data

ICS Tap, Amps Dc	Coil Rating In Amps Dc		Resistance In Ohms
	Continuous	1-Second	
0.2	0.4	11.5	6.5
2.0	3.2	88.0	0.15

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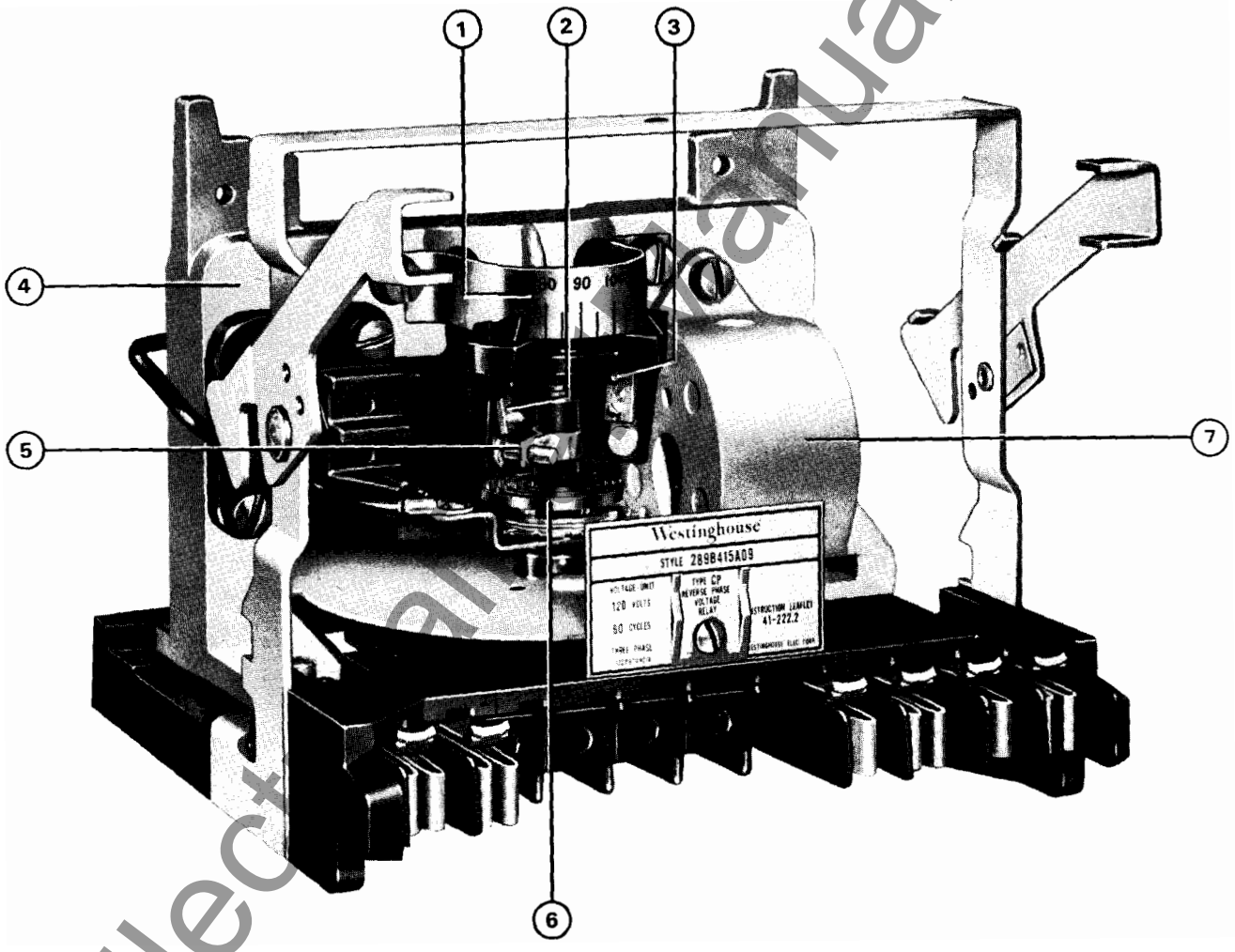

Fig. 2

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Operation

When energized with three-phase positive sequence voltage, the high voltage contacts tend to close.

A reversed phase (negative sequence phase rotation) will close the low voltage contact. The low voltage contact will also close on unbalanced voltages which contain a sufficient negative sequence component to reduce the net relay torque to its low voltage trip point.

The voltage values indicated on the calibrated scale of the relay are the balanced, three-phase, line-to-line voltages required to close the relay contact when the adjustable stationary contact is set at that point on the scale. The CP relay has inverse timing, i.e., the greater the change in voltage, the faster it will operate.

The only setting required is the selection of the adjustable low and high voltage stationary contact positions. These positions are the desired voltage values at which contact closing operation is desired.

Relay Operating Time

Simultaneous Change in Three-Phase Voltage

Timing of the relay is not adjustable, since it is dependent upon the position of the stationary contacts.

The curves shown in figures 4 and 5 indicate relay operating time for a simultaneous change in three-phase voltage.

Reduced Phase-to-Phase Voltage Conditions

The relay contact closing time for a given variation in phase-to-phase voltage can be determined by reference to the conversion curve shown in figure 3, and use of the time curves in figures 4 and 5.

To determine the contact closing time for a reduced phase-to-phase voltage, it is necessary to convert the reduced delta voltage triangle AB'C' to three-phase voltage or equilateral triangle A''B''C''.

Voltage triangle ABC represents the normal three-phase delta voltage; 120 volts phase-to-phase.

Assume BC voltage is reduced 50% and the CP relay high voltage contact is set to close at 110 volts, and the low voltage contact at 90 volts.

Reference to the curve in figure 3 indicates that for a 50% reduction in phase-to-phase voltage, the equivalent three-phase voltage triangle area, A''B''C'', is 71% of the normal voltage area ABC; i.e., 71% of 120 volts or 85.2 volts phase-to-phase. (85.2 ÷ 90 × 100% = 94.7% of low voltage contact setting.)

Since the 85.2 volt value is below the 90 volt low voltage contact setting, the low voltage contact will close in 8.25 seconds. This time value is read from figure 4.

This equivalent three-phase voltage A''B''C'' is made up of 75% positive sequence voltage (.75 × 120 = 90 volts) and 25% negative sequence voltage (.25 × 120 = 30 volts). These values are read from figure 3.

Conversion Curve

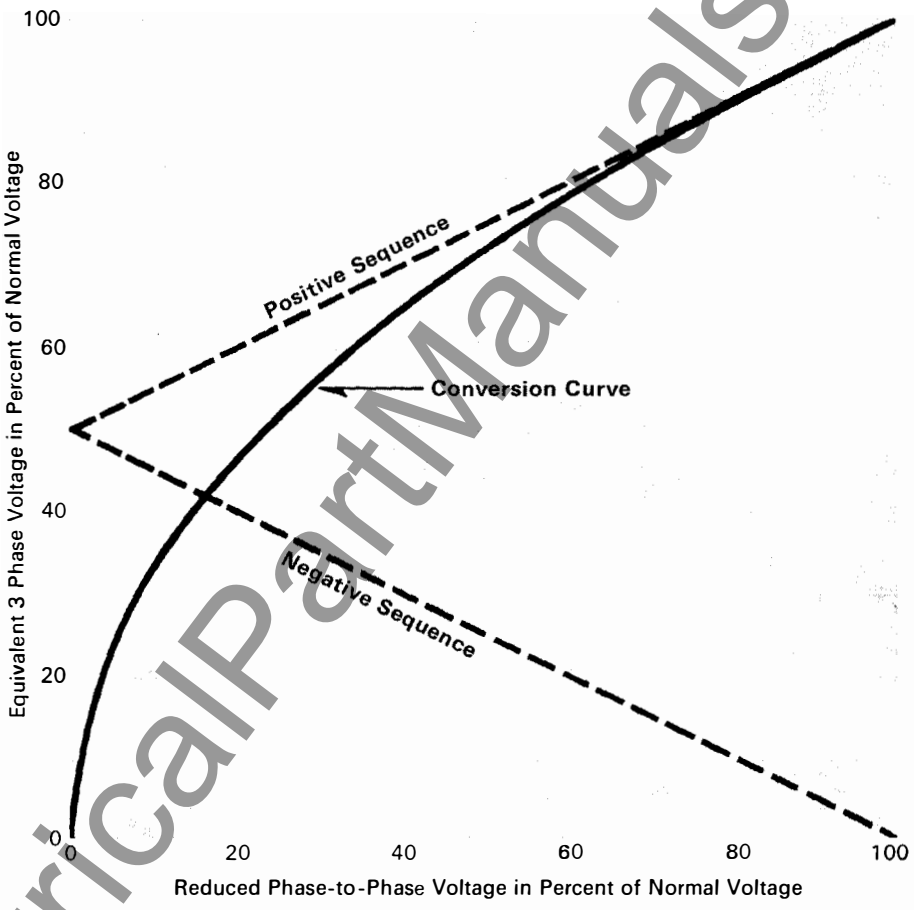
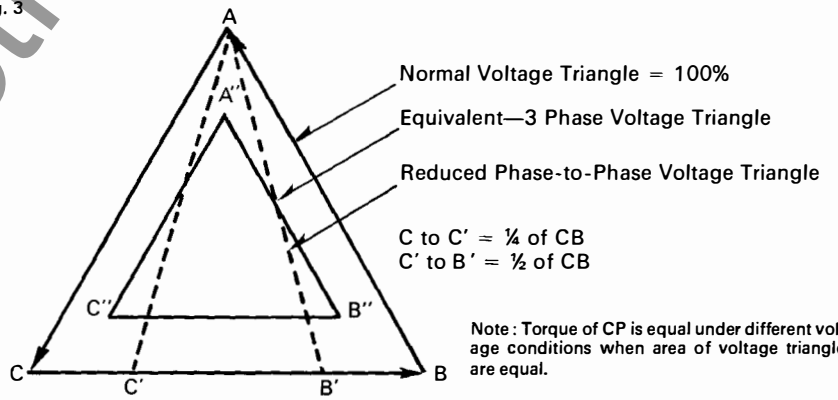


Fig. 3



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Time Curves (For 120 Volt Relays)①

Undervoltage

Voltage suddenly dropped from rated 120 voltage to voltages indicated on the abscissa of curve plot.

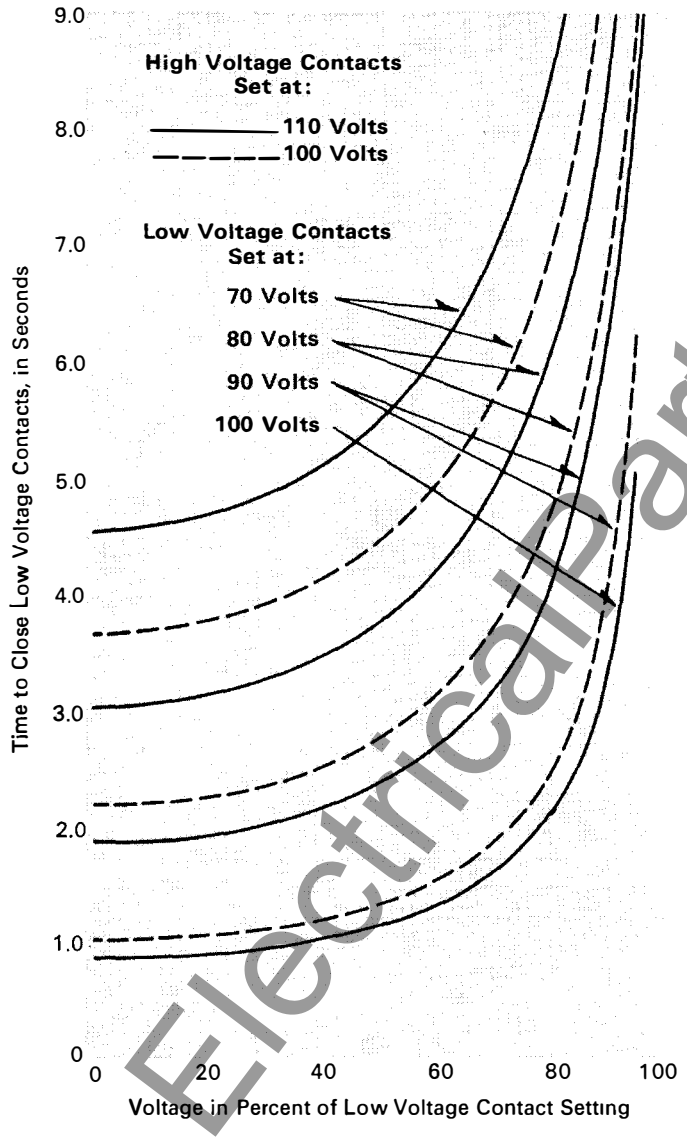

Fig. 4 471071

Overvoltage

Voltage suddenly raised from zero volts to voltage indicated on abscissa of curve plot.

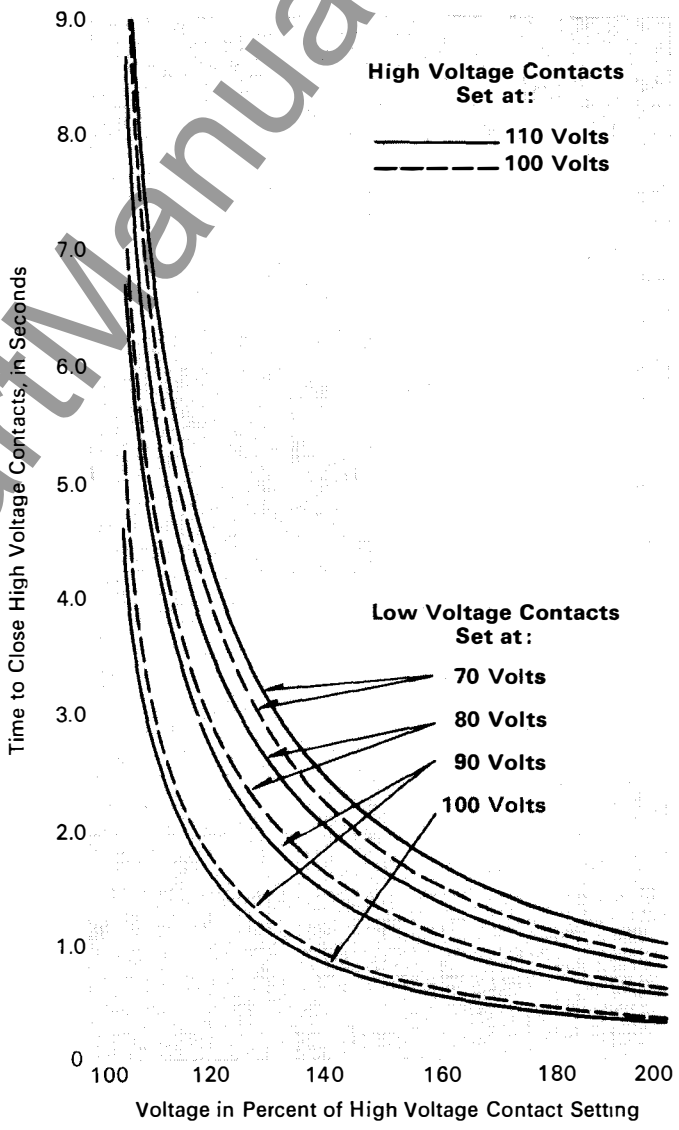

Fig. 5 471072

① For 240 volt relays, double the indicated voltage values on above curves. For 480 volt relays, multiply indicated voltage by 4.

Curves are also valid for simultaneous change of three-phase voltage.

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Internal Wiring: Front View, FT-11 Case, 3 or 4 Wire Service

Spdt ① Contacts, ICS in Low Voltage Circuit

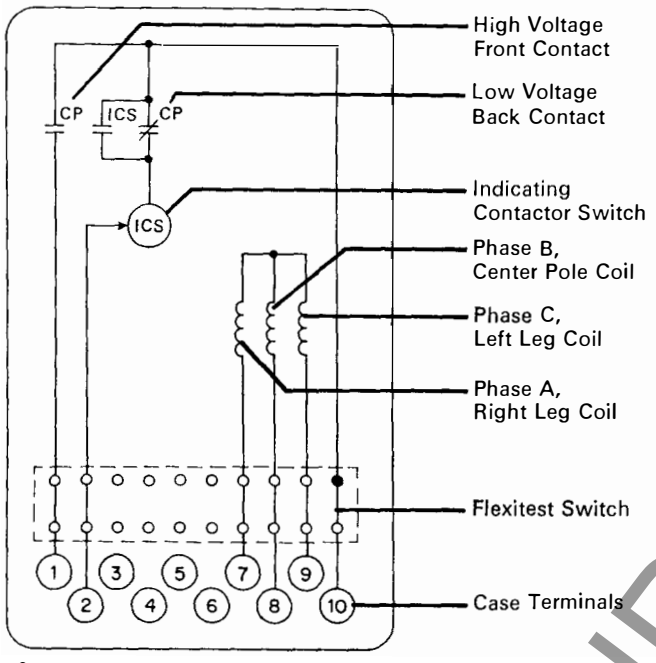

Fig. 6 183A960

Spdt Contacts, ICS in High Voltage Circuit

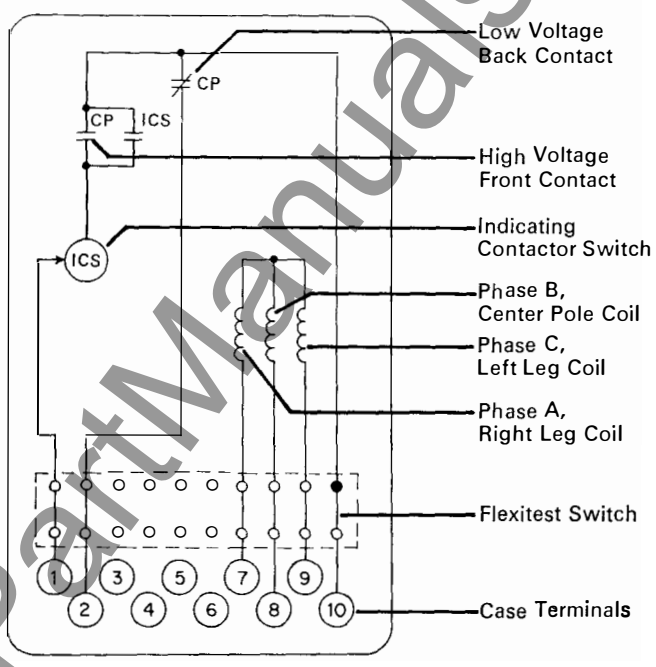

Fig. 7 183A961

Spdt Contacts, Without ICS

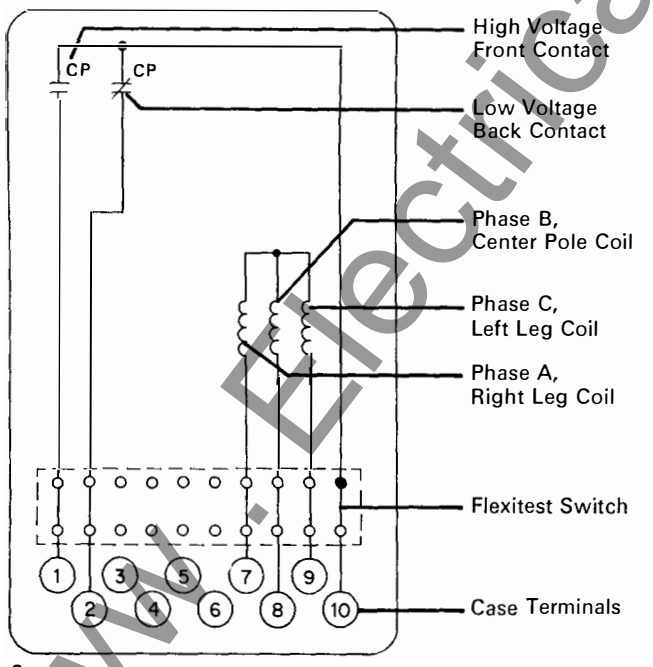

Fig. 8 183A962

Independent Contacts, With IVS

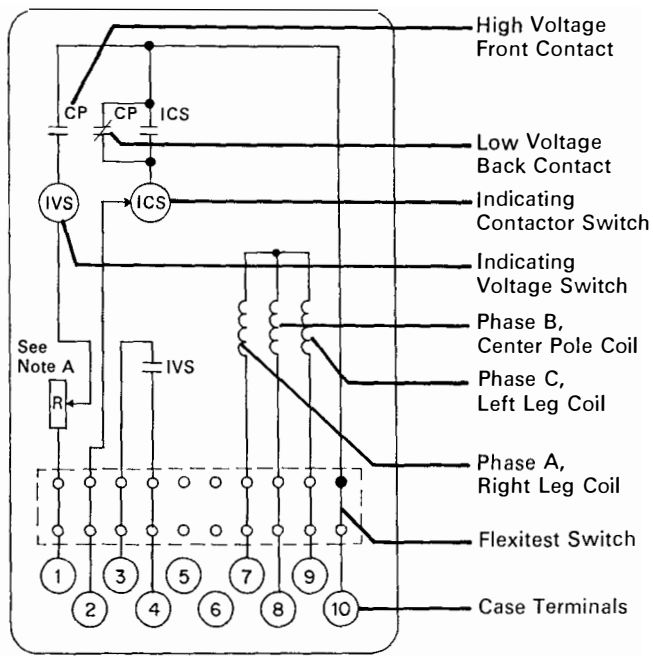

Fig. 9 184A202

Note A: R = 250 ohms, 24 volts dc; 700 ohms, 48 volts dc; 2000 ohms, 125 volts dc; 4000 ohms, 250 volts dc

① Single pole double throw.

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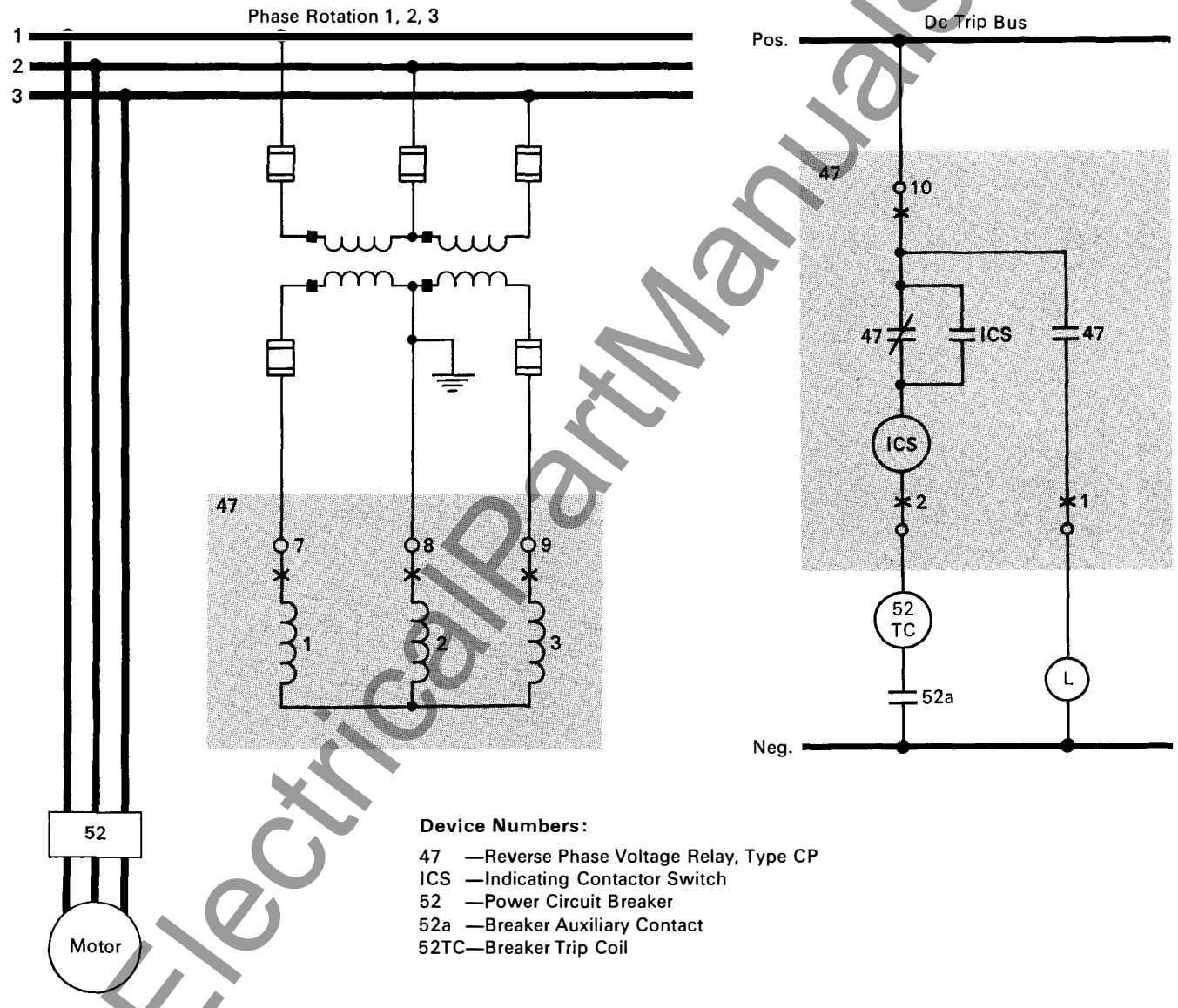
External Wiring



Device Numbers:

47 —Reverse Phase Voltage Relay, Type CP
ICS —Indicating Contactor Switch
52 —Power Circuit Breaker
52a —Breaker Auxiliary Contact
52TC—Breaker Trip Coil

Fig. 10

184A200

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Shipping Weights and Carton Dimensions

Relay Type	Case Type	Weight, Lbs. Net	Shipping	Domestic, Shipping Carton Dimensions, Inches
CP	FT-11	7	10	9 x 9 x 10

Further Information

Prices: PL 41-020
Ordering Information: 41-020 T WE A Technical Data
Instructions: IL 41.222.2
Flexitest Case: DB 41-075
Other Protective Relays: Selector Guide 41-000

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