SETTING CALIBRATION OF TOSHIBA 2E MOTOR PROTECTOR (For 7AT Rating)

To calibrate the pick-up (P.U.) setting of the 2E device, the following methods are described:

I. Set P.U. only.

1. Connect as in Figure 1. A timer is not necessary.

   A. Set the 2E time to max CCW.

   B. Set the 2E current to max. CW.

   C. Have the trip-reset in the reset position.

2. With 2 turns per window in the CT's:

   A. All three windows must have same number of turns.

   B. All turns must be in the same direction.

3. With the current source at zero, turn the current source "On" and increase it to the desired P.U. current.

4. Reduce the current P.U. % to an approximate value just above expected trip value (desired P.U. current).

5. Reduce the current % setting approximately 2^{o} and allow ten seconds for a trip operation.

6. If there is no trip, repeat 5 until a trip occurs.

The desired current pick-up is at this present setting and should be locked in with scotch tape across the dial.

A check of this setting can be made by the following procedure:

II. To check a setting or unknown setting of P.U.:

1. Connect as in Figure 1. A timer is not necessary.

   A. Leave the current % exactly as is.

   B. Have the time setting max. CCW.

2. With the current source at zero, turn the current source "On" and increase it to a value approximately 10% less than current % dial reading and leave for 10 seconds.

3. Increase the test current approximately 1% and wait for 10 seconds for a trip.

Setting Calibration of Toshiba
2E Motor Protector (for 7AT rating)

4. If no trip occurs, repeat 3 until a trip occurs. This is the pick-up value of the 2E device.

III. To determine the P.U. setting of a 2E utilizing a more definite calibration method:

1. Connect as in Figure 1 except with the cover off as in Figure 2.

   A. Set the current % approximately at 100.

   B. Set the time dial at max. CCW.

2. Connect a high impedance input voltmeter (digital) across the note capacitor of Figure 2E.

3. Apply test source current at zero and increase to approximately 3.2 amperes. Increase this current only slightly and note the voltmeter reading and ammeter reading each time. Increase the current only after the voltmeter no longer increases. The 2E will finally trip with a voltmeter reading that will always be the same for trip regardless of the current % setting. Only the input test current will be different respective to current % at P.U.

4. Now any setting desire can be adjusted for the voltmeter trip level just determined as follows:

   A. Turn the current % to max. CW.

   B. Set the desired P.U. current (test current) to the desired value.

   C. Slowly decrease the current %, the meter reading will increase, toward the voltmeter trip current level. Do not decrease the current % faster than the meter can keep-up.

   D. The desired pick-up when the current % is decreased to the voltmeter value of know trip level. The 2E should also trip at this same time or very little less on the current %.

   Care must be taken to prevent movement of the current % when the 2E cover is reapplied.

Setting Calibration of Toshiba
2E Motor Protector (for 7AT rating)

To check the starting time the following should be done:

1. The starting time and starting current should be known, if not, the motor should be started once with the time dial set higher when 2E is first applied.

2. With the P.U. set as determined, set the time for the starting time of the curve that meets the expected starting current.

3. Set the test current at starting current and turn off test current and set the timer to zero.

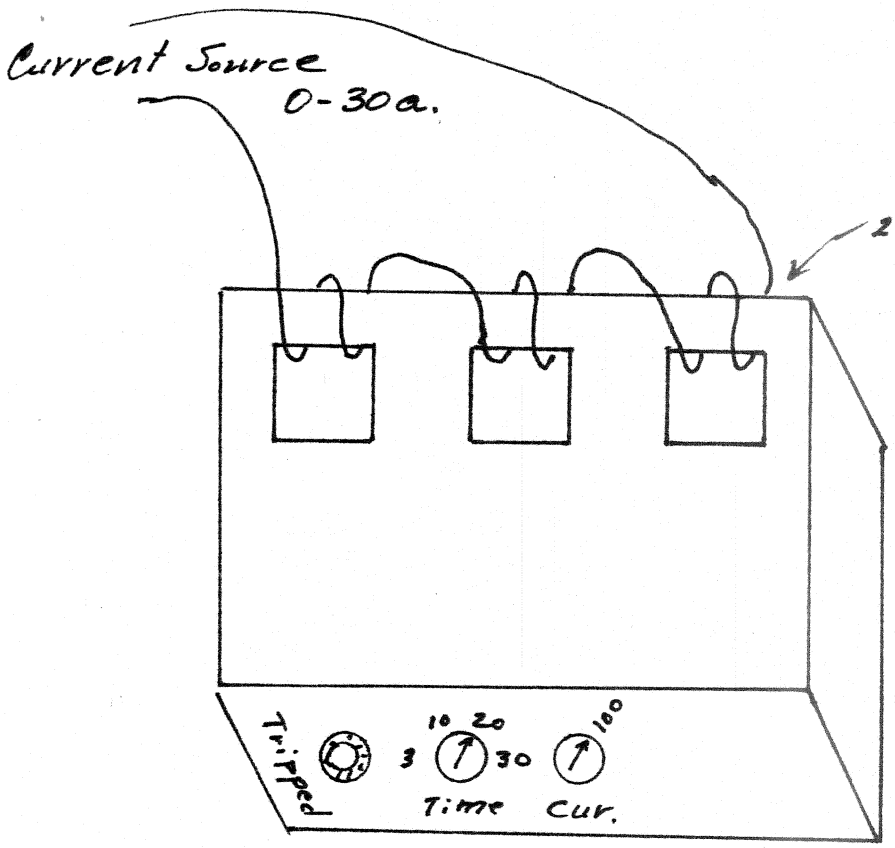
4. Apply test current and measure trip time which should comply with the 2E time-current curves.

To check the motor overload trip time, do the following:

1. With P.U. as determined set test current for 200% of P.U.

2. Apply test current and immediately reduce it to below P.U.

3. Reset the timer and increase test current to 200% P.U. at the same time. Measure the trip time which should coincide with the running characteristic.



Terminal
1-2 120v a.c.

6-7-8 Timer when checking Time

Fig 1

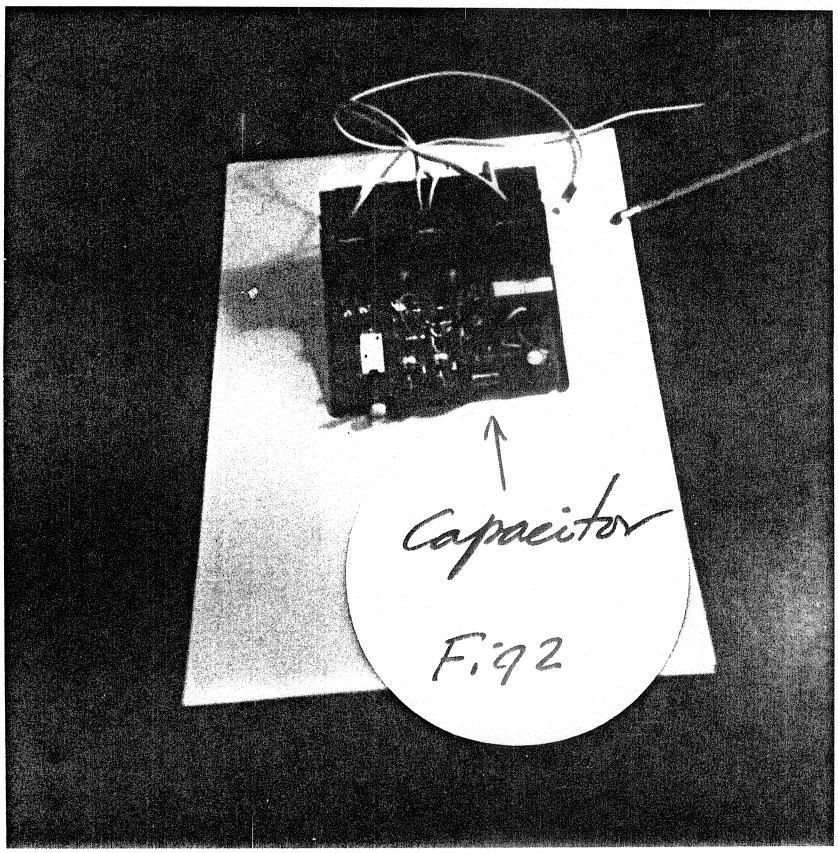


Fig 2

6F9E0035

TOSHIBA

INSTRUCTIONS FOR

STATIC 2E RELAY

RC810-HP1XU
RC810-HP2XU
RC810-HP3XU
RC810-HP1YU
RC810-HP2YU
RC810-HP3YU
RC81A
RC81B
RC81C

TOSHIBA CORPORATION
TOKYO JAPAN

CODE 2ER

D-L90331(7871)

OUTLINE

The 2E Relay (static relay for three-phase induction motors) is widely used in various industrial field to protect induction motor against burning caused by overload and other abnormal conditions due to open-phase failure or unbalanced phase failure, and also can install another plug-in type additional module, which is RC81A, ground fault module, or RC81B, negative phase module, or RC81C, ground fault and negative phase module.

INITIAL INSPECTION

(1) Check the 2E Relay and/or additional module for ordering specifications.

(2) Check the 2E Relay and/or additional module for damage, deformation, dirt, and others incurred during shipment.

APPLICATIONS

The 2E relay and/or additional module is popularly used to protect three phase induction motors and other three-phase loads not only from overload and open phase failure but also from negative phase failure and ground fault. The typical applications are followings.

To protect induction motor

To protect transformer

To protect capacitor

RATINGS AND PERFORMANCES

Table 1, listed the ratings and performance of the 2E Relay.

Table 1. Ratings and Performances of 2E Relay

Items \ Type-Form			RC810		
			HP1□□U	HP2□□U	HP3□□U
Applicable circuit			Three-phase circuits rated up to 600V AC, 50/60Hz (Also, applicable to high-voltage circuits, combining with high-voltage CTs)		
Protective functions			Dual functions (2E relay)....Overload and open-phase failure protection		
Rated current	Rated ampere-turns		7AT	55AT	110AT
	Setting range		75~150% of rated AT		
Overload operating characteristics	Ultimate operating current		120% of setting current		
	Operating time setting range		3~30 sec. for starting characteristics at 600% of setting current		
(Note 1) Open-phase failure operating characteristics	Minimum operating current		85% of setting current under one-phase completely loss state (when measured on either remaining phase.) ..... See Fig. 5		
	Operating time		Within 4 sec.		
(Note 2) Rated control voltage	RC810-HP□YU		100~120V/200~240V AC, 1ø		50,60 Hz
	RC810-HP□XU		480V AC, 1ø		
Output contact specifications	Contact arrangement		1NO-NC (1SPDT)		
	Contact capacity	RC810-HP□YU	250V AC-2.5A (Resistive load) 250V AC-2.0A (Inductive load, pf=0.75) 125V DC-0.2A (L/R=7 ms) 250V DC-0.1A (L/R=7 ms)		
		RC810-HP□XU	500V AC-3.0A (Resistive load) 500V AC-2.5A (Inductive load) 125V DC-0.2A (L/R=7mS) 250V DC-0.1A (L/R=7mS)		

Power consumption	Control power circuit	2VA
	Detecting circuit	0.3VA/phase at rated current
Application conditions	Altitude	Lower than 2000 m (6600 ft)
	Ambient temperature	-10~ +60°C
	Relative humidity	45~85% at 20°C

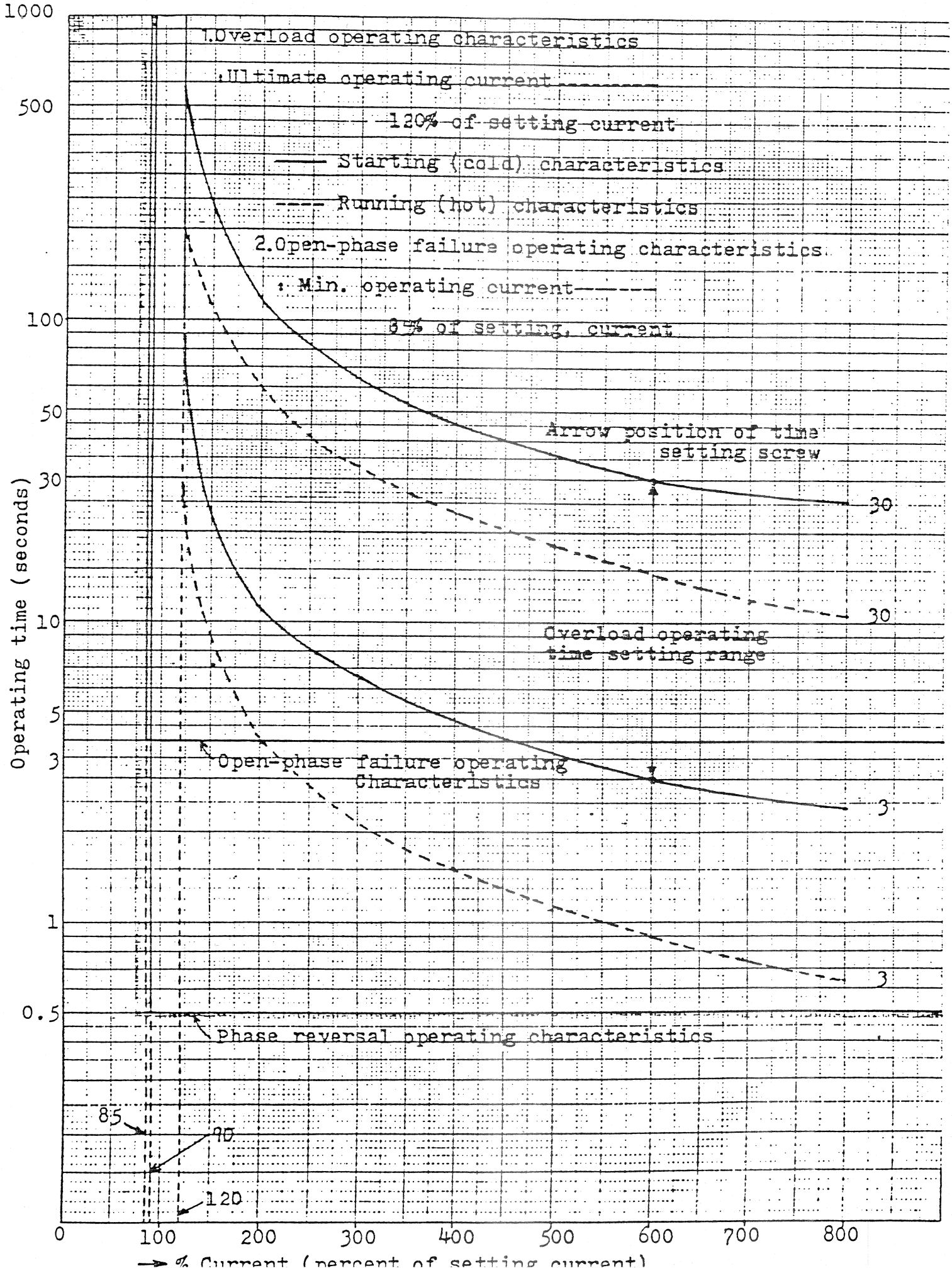
Notes : 1. Phase unbalanced failure operating characteristics is the same of open-phase failure characteristics.

2. Tolerance of the fluctuation of control voltage is from -15 to +10%.

Additional module is connected to the 2E relay with the gold plated plugs and its principal ratings are the same of that of 2E Relay.In Table. 2 is listed its eigen ratings and parformances.

Table 2 Ratings and Performances of optional modules

Items \ Type-Form		RC81A	RC81B	RC81C
Negative phase failure characteristics	Operating current		90% of 2E relay setting current	90% of 2E relay setting current
	Operating time		Within 0.5s	Within 0.5s
Ground fault characteristics	Ground fault current setting	4A ~ 12A		4A ~ 12A
	Maximum ground fault current	60A		60A
	Ground fault time setting	0.1s ~ 1.0s		0.1s ~ 1.0s
Output signal		The same of 2E relay	The same of 2E relay	The same of 2E relay
Trip indication		LED (manual reset)	LED (manual reset)	LED (manual reset)
Z C T		12A : 40mA Connected Impedance ; 300Ω		12A : 40mA Connected Resistance ; 300Ω


1.Overload operating characteristics
Ultimate operating current
120% of setting current
Starting (cold) characteristics
Running (hot) characteristics
2.Open-phase failure operating characteristics
Min. operating current
85% of setting current
Arrow position of time setting screw
30
30
Overload operating time setting range
Open-phase failure operating Characteristics
3
3
Phase reversal operating characteristics
85
90
120
1000
500
100
50
30
10
5
3
1
0.5
0
100
200
300
400
500
600
700
800
Operating time (seconds)
% Current (percent of setting current)

PRECAUTIONS ON APPLICATION

When planning to use Toshiba Static 2E Relays, be sure to give full consideration to the following precautions:

(1) Control power source supply

Power circuit system must be arranged so that control power must always be supplied before main circuit is switched ON.

(2) Limit of CT secondary burden when combining with CT.

When the relay is intended for use with high-voltage circuit, an excessive CT secondary burden may cause secondary current waveform distortion.

Since extremely large waveform distortion may be detected as unbalanced current, limit the CT secondary burden according to the overcurrent constant while referring to table 3.

Table 3 Limit of CT secondary burden

CT overcurrent constant	Recommended secondary burden
3	Not greater than 50% of rating
5	Not greater than 85% of rating
10 or above	Up to rated burden

(3) Application to phase control-system

See Fig.2

In phase control system current does not flow sinusaidaly, on the other hand negative phase module realizes the characteristics according to sinusoidal current. So, 2E Relay and/or additional module are not applicable.

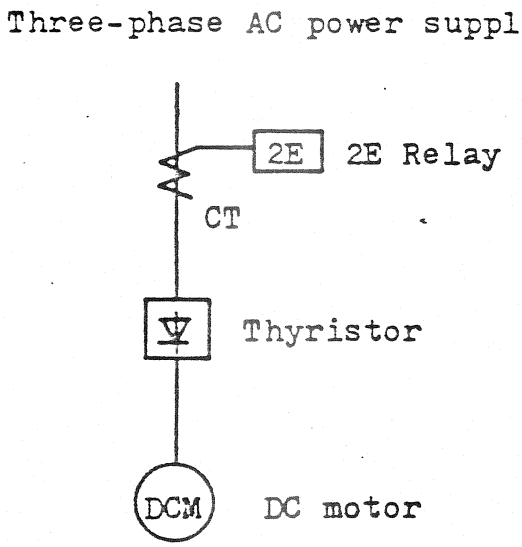


Fig.2 Example of unapplicable circuit

(4) Application to the system, where single circuit breaker protects plural motors.

Applying the 2E Relays to the system like Fig.3, control power voltage decrease smoothly and primary current pulsates at CB interruption which ill operates 2E Relay. To prevent the relay from such operations, see Fig. 4. to determine the momentary service interruption interval.

Another way to prevent the relay from ill operation, supply control power from upstream of circuit breaker.

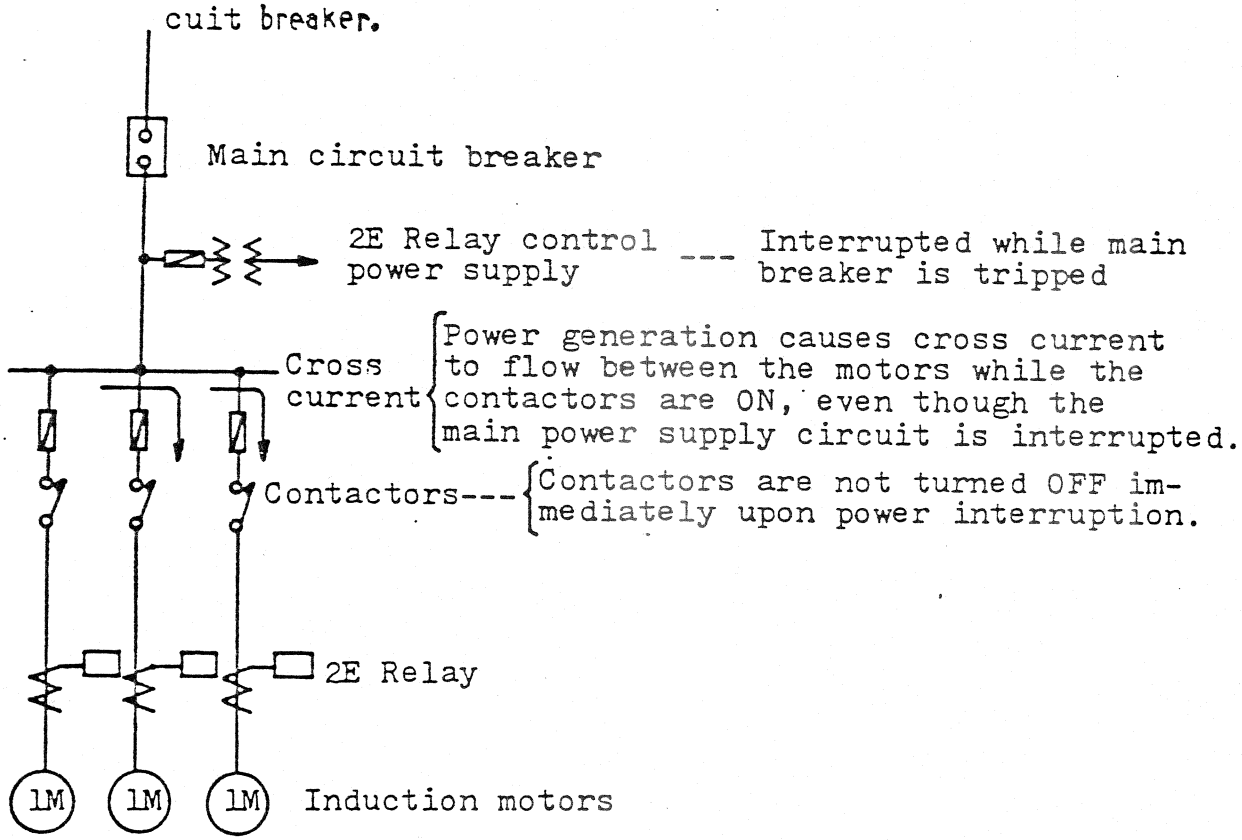


Fig. 3 Cross-current flowing through the motors even after interrupting the control power source

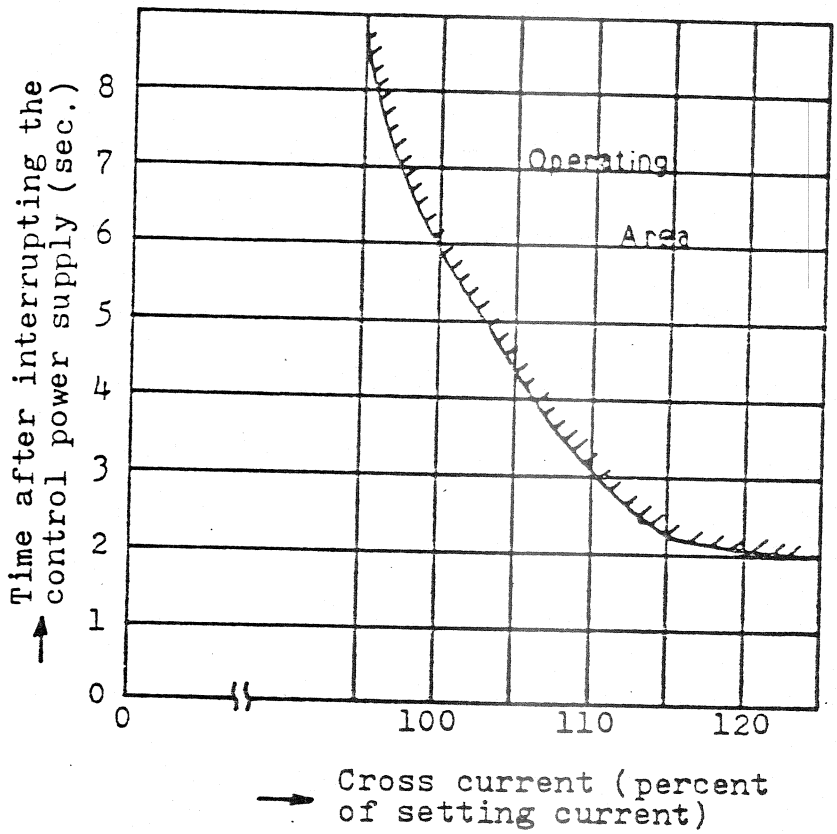


Fig.4 Operating characteristics when interrupting control power supply by main circuit breaker

(5) Unbalanced current-detecting characteristics

The 2E Relay has unbalanced current-detecting characteristics associated with open-phase protective characteristics. Figure 5 shows the unbalanced current-detecting characteristics. As shown in Fig. 5, the operating current unbalanced rate depends upon the current-setting values.

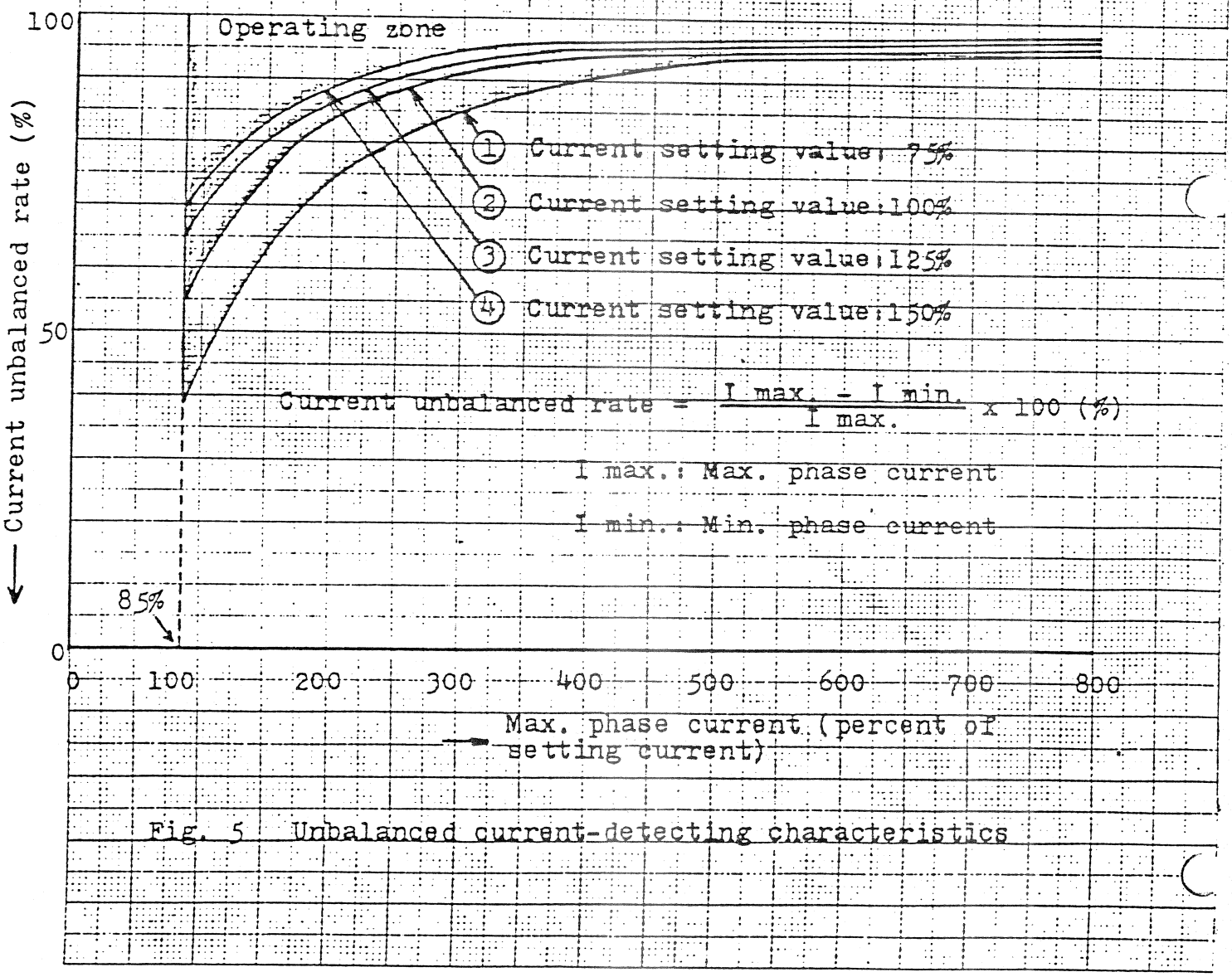


Fig. 5 Unbalanced current-detecting characteristics

INSTALLATION

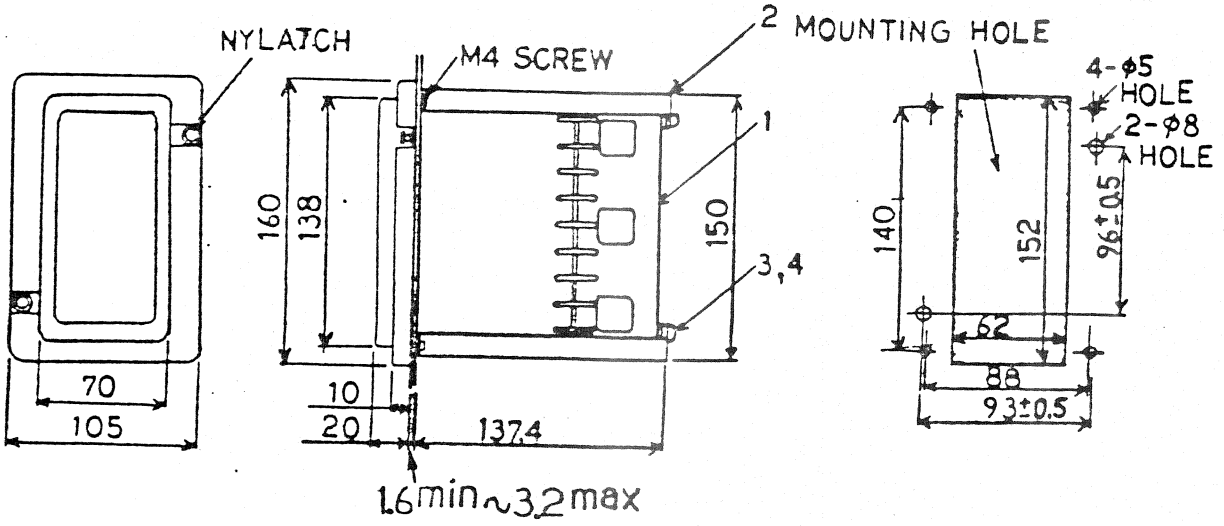
The 2E Relay and additional module are constructed totether. But mounting parts, screws and supports, must be assembled. The mounting methode is drawn in Fig.6 and mounting parts are listed in Parts List.

Parts List

Item No.	Name of parts	Quantity
1	2E Relay RC810-HP	1
2	Mounting supports	2
3	Machine screws M4 x 6	4
4	Spring washers M4	4

Note : Do NOT use a screw-locking agent when tightening the screws.

Fig. 6 Flash mount type 2E relay



How to equip additional module to 2E Relay

The additional module is only applicable to surface mounting type of 2E Relay. If ordering 2E relay and additional module at the same time, the former shall be equiped with the latter. On the other hand, ordering them separately, read the following and assemble them by yourself. The first, connect control wires to the terminals, and next insert the connector pins to 2E Relay and the last fasten the mounting screws according to Fig. 7 and Fig. 8.

Parts List

Item No.	Name of parts	Quantity
1	2E Relay RC810-HP	1
2	Mounting supports	2
3	Machine screws M4 x 6	4
4	Spring washers M4	4

NOTE : Do NOT use a screw-locking agent when tightening the screws.

Fig. 8 , Surface mounting with optional module , are as follows.

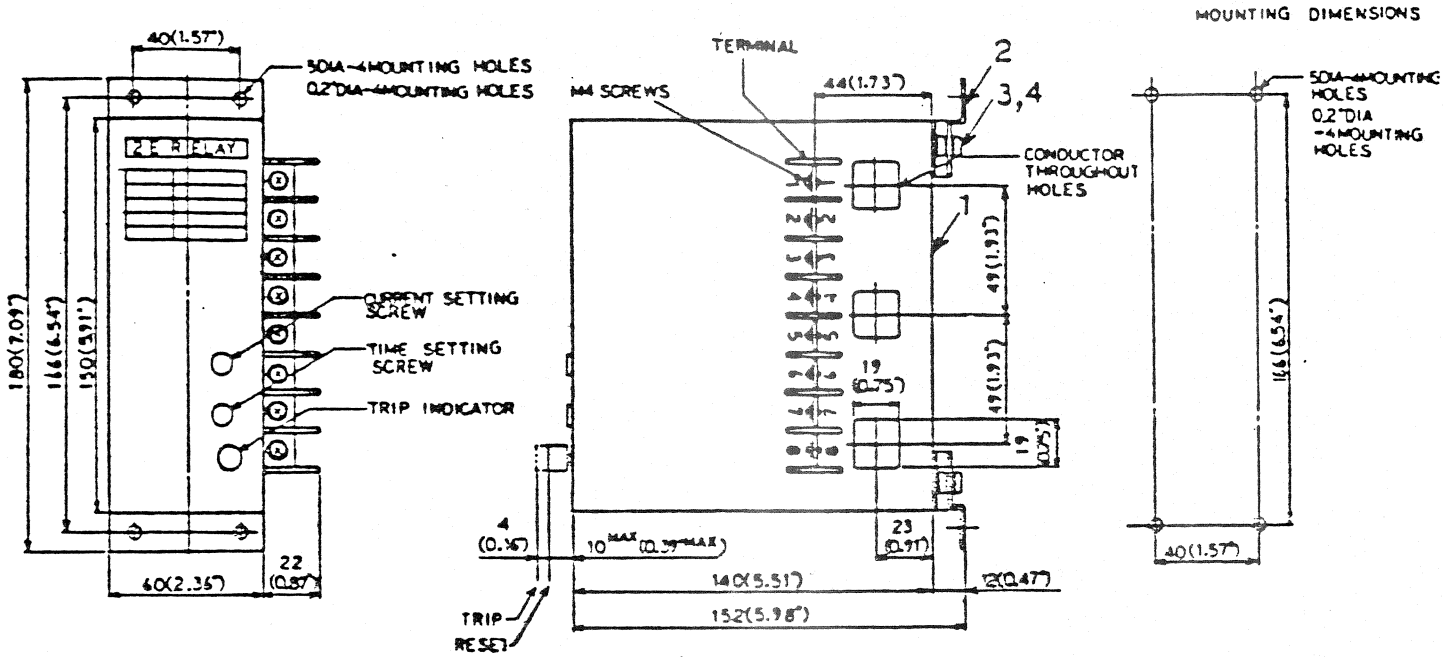


Fig. 7 Surface mount type 2E relay.

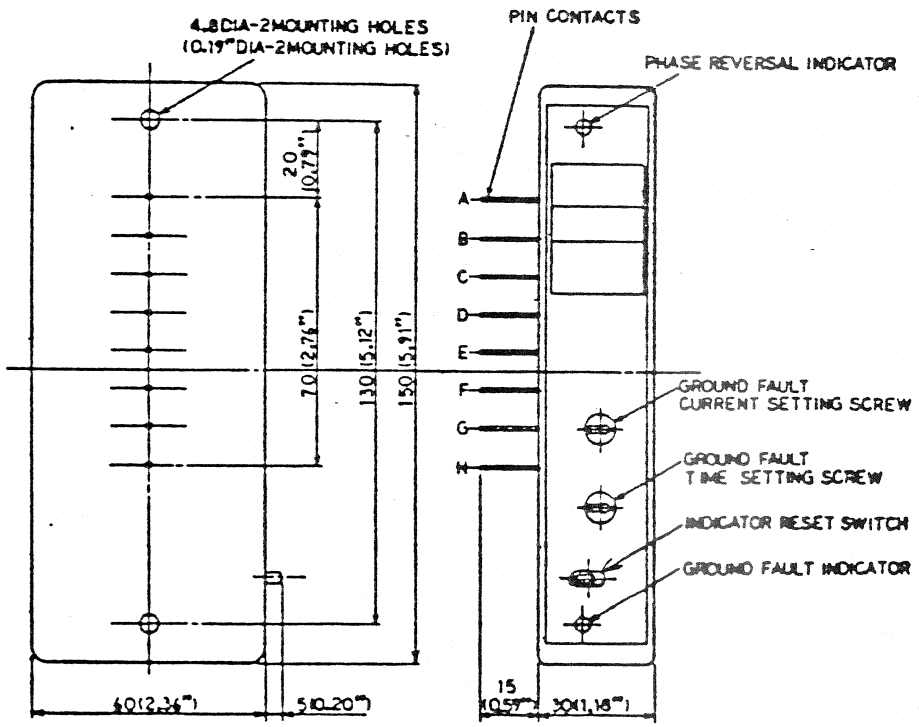


Fig. 8A Additional module

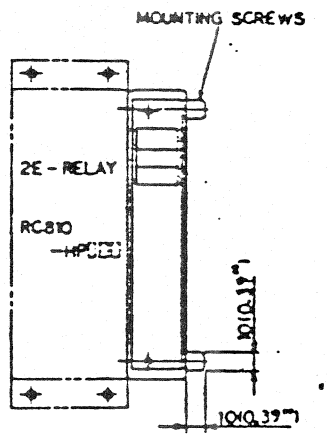


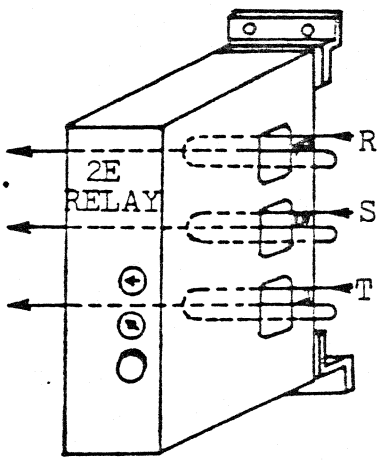
Fig. 8B Combination of 2E relay and additional module

CIRCUIT CONSTRUCTIONS

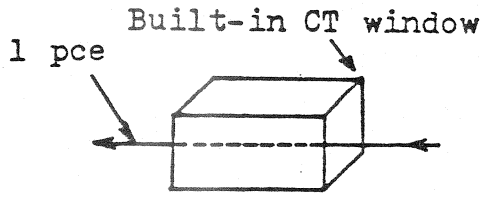
When wiring primary wires through CT windows, see Fig. 9 and take care of followings. 1) Primary wires must go through correct CT windows. 2) Primary wires must go through the same direction.
3) Primary wires must turn the same number each other.

Before applying the 2E Relay and/or additional module for low voltage induction motor protection, see Fig. 10, which illustrates the typical wiring.

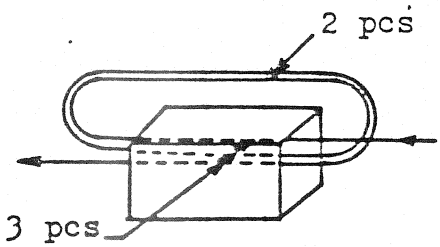
On the other hand applying the 2E Relay for high voltage or low voltage and large capacity system, see Fig. 11 to wire high voltage cables with two auxiliary CTS. It is necessary to balance CT secondary load, that is, CT secondary wire length.



Number of wires: 2 pcs

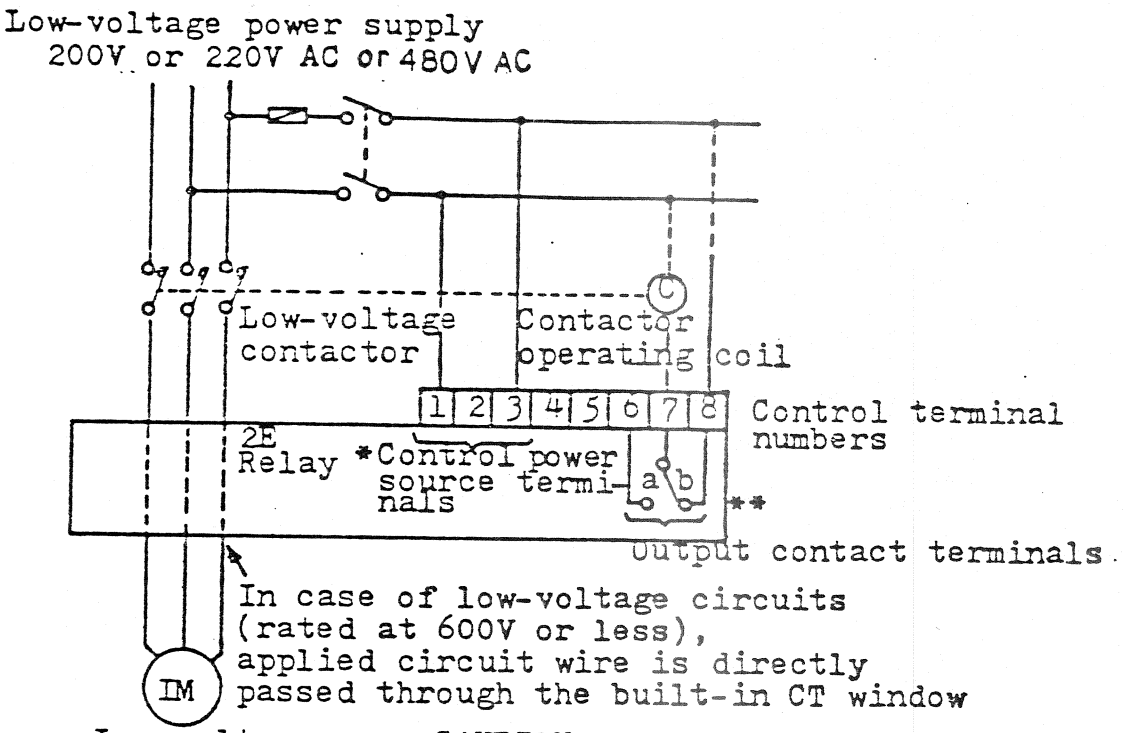


Number of wire: 1 pce.



Number of wires: 3 pcs

Fig. 9 Installation of wire passing through the built-in CT



CAUTION:

* Connections of control power source.
AC100-120V --- Terminals 1 - 2
AC200-240V --- Terminals 1 - 3

** Connections of output contacts
NC-contact (opened when the 2E Relay operated) --- Terminals 7 - 8
NO-contact (closed when the 2E Relay operated) --- Terminals 6 - 7

*** Connections of control power source
AC480V --- Terminal 1 - 3

Fig. 10 Typical application to low-voltage induction motor circuit

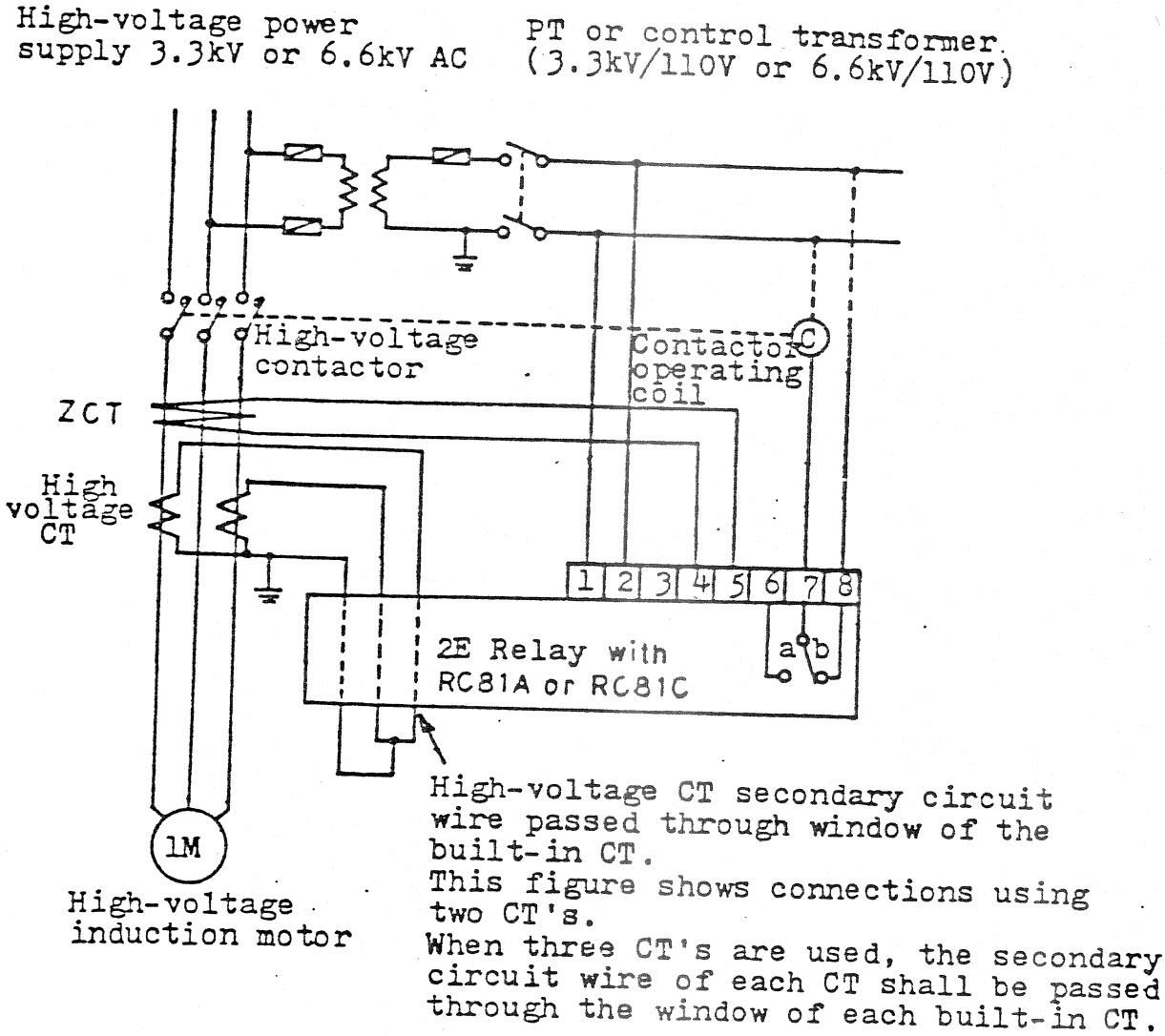


Fig. 11 Typical application to high-voltage induction motor circuit with ground fault protection

HOW TO SET

(1) Current Setting

Culculate the number of turns of wire passing through the built-in CT with following formula.

$N(T) = \frac{U(AT)}{I_N(A)}$ where U(AT) is rated ampereturn of the 2E Relay, $I_N(A)$ is primary load current of 2E Relay and N(T) is number of turns of wire through CT window.

Determine N(T) in integer to turn the wire through CT window. To culculate the current setting ε (%), take the following formula.

$$\varepsilon(\%) = \frac{I_N(A) \times N(T)}{U(AT)} \times 100$$

where U(AT) is rated ampere-turn of 2E relay. Adjust current setting knob at ε (%).

Table 4 indicates setting data of typical application.

Table 4 Number of wires and current-setting values (Calculating example)

Type-Form indentification		Rated ampere-turn U(AT)	(Note) Applied motor		Number of turn(s) N(T)	Ampere-turn U_N(AT) ($U_N = I_N \times N$)	Current-setting value ε (%) ($\varepsilon = \frac{U_N}{U} \times 100$)
Type	Form		Capacity (kW)	Rated current I_N(A)			
RC810	HP1Y	7	0.4	2.8	3	(2.8x3=)8.4	($\frac{8.4}{7}$x100=)120
			0.75	4.2	2	(4.2x2=)8.4	($\frac{8.4}{7}$x100=)120
	HP2Y	55	5.5	24	2	(24 x2=)48	($\frac{48}{55}$ x100=) 87
			15	61	1	(61 x1=)61	($\frac{61}{55}$ x100=)111
	HP3Y	110	30	117	1	(117x1=)117	($\frac{117}{110}$x100=)106

(Note) JIS C 4210 (Lower-voltage, three-phase squrirrel-cage induction motors for general use) Totally enclosed, 200V AC, 50Hz, 4P, Class E insulation.

(2) Time setting

To determine the protection curve from 2E Relay operating curve drawn at Fig. 1 and read operatingtime at 600% of setting current. Adjust time setting knob at above operating time. If culculated time is between graduated point, set the knob at the point which devides graduated point in adequete proportion.
When equiping RC81A or RC81C with 2E Relay, determine and set its knobs with the same manner mentioned above.

(3) Indication and Reset

Indicator bar not only actuates output relay but also indicates operation mechanically. It pops up with fault detection and holds mechanically. 2E Relay doesn't install any electrical indicator. On the other hand optional module equips electrical indicators (LED) for each function operated. When 2E Relay detects overload or open phase failure to pop up the indicator bar, push indicator bar to reset the relay. On the otherhand, 2E relay equiped with optional module detect negative phase failure or ground fault failure to actuate LED. Push indicator bar of 2E relay and reset toggle switch of optional module to reset them both electrically and mechanically.

INSPECTION AND MAINTENANCE

Before inspection and maintenance, read following items to determine the maintenance interval.

Intervals of inspection

(1) When the 2E Relay and/or additional module in an ordinary electric room is operated under relatively good environmental conditions ..... Approx. annually

(2) When the 2E Relay and/or additional module is operated under adverse environmental conditions..... Approx. semiannually

Items to be inspected

(1) Dust accumulation ..... When dust adhesion or contamination is observed near the current-conducting components, wipe them clean with a soft, dry cloth. Do NOT use gasoline, bengine, or other organic solvents.

(2) Loose screws

(3) Preset points of the current-setting screw and the time-setting screw

(4) Operation of the test knob, if necessary

(5) Operating characteristics, if necessary

(6) Damage or other defects

TROUBLE-SHOOTING

In case of trouble, determine the cause of the trouble in accordance with the sequence shown in Fig. 12 or Fig. 13. After clarifying the cause, take actions shown in Figure to start the operation.

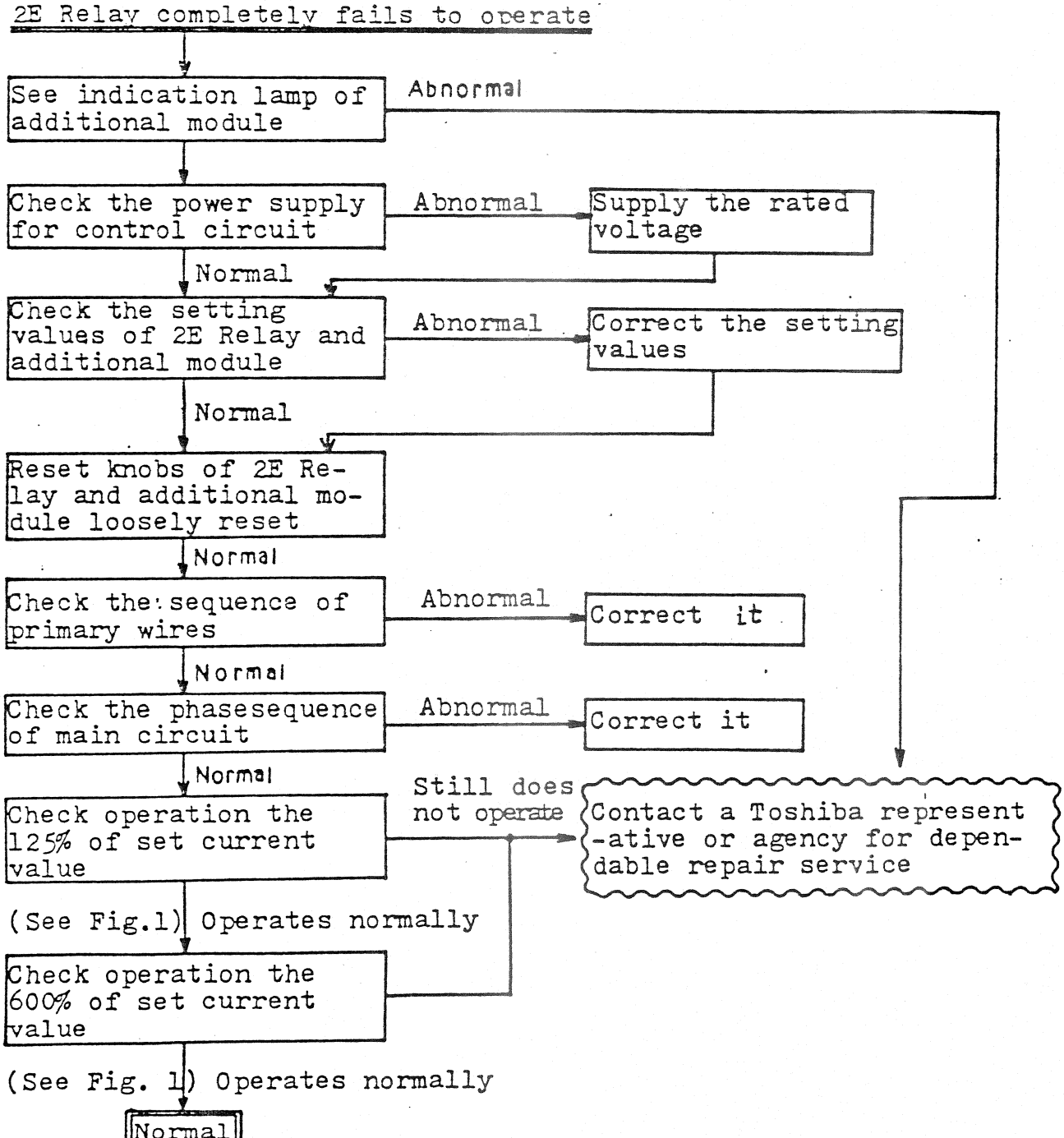


Fig. 12 Trouble-shooting table (When 2E Relay fails to operate)

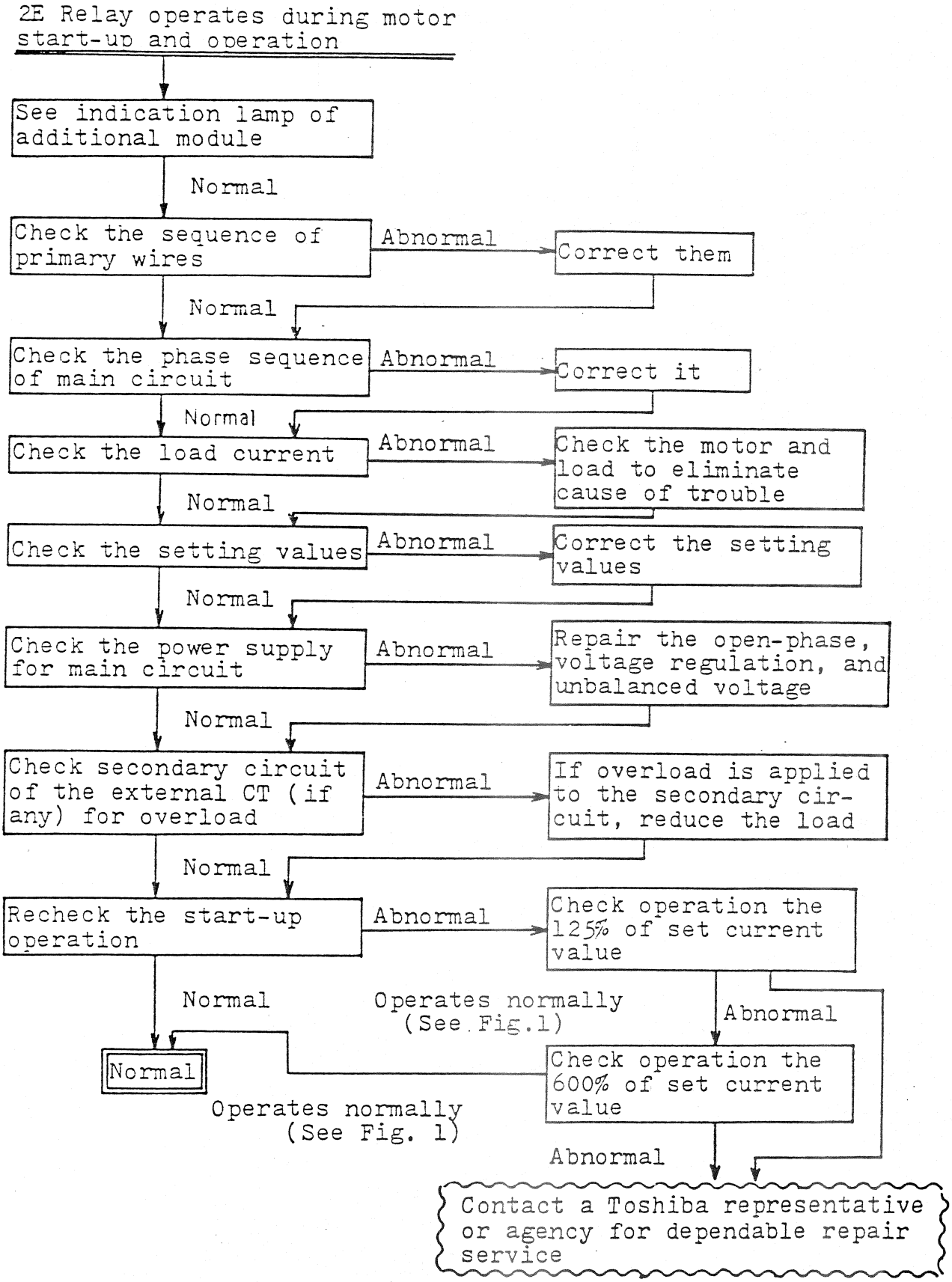


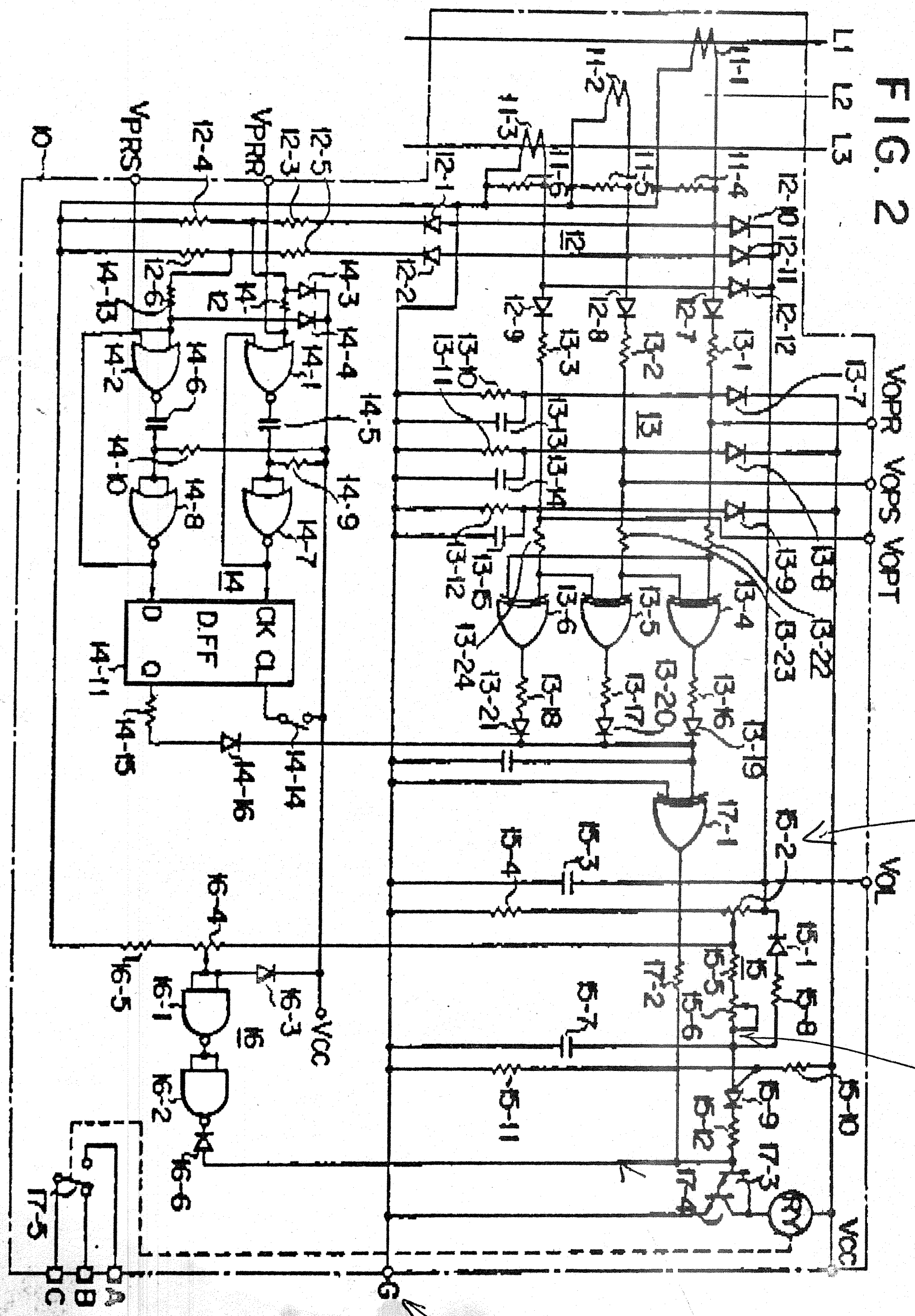
Fig. 13 Trouble-shooting table

(When 2E Relay operates during motor start-up and operating)

Toshiba

503-344-0090
Phil Phillips

FIG. 2



Auto Reset

803 over & under

%

Conrad Magnafit

Time