Instruction Book

I.L. 14-900-1

FIXED VOLTAGE

STATIC POWER SUPPLIES

FOR SYNCHRONOUS MOTOR

FIELD EXCITATION

Westinghouse Electric Corporation

March 7, 1975

INSTRUCTIONS FOR STATIC POWER SUPPLY FOR SYNCHRONOUS MOTOR FIELD EXCITATION

General Information:

The static field supply is shown as an open panel for mounting within low or high voltage enclosures near the Slipsyn field application panel.

This leaflet has been prepared for guidance in adjustment, operation and maintenance of standard static excitation supplies. The information in this leaflet may also be used to advantage for special and non-standard designs which differ only in minor electrical or mechanical modifications. This industrial type control is designed to be installed, operated, and maintained, by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check-out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

The basic type, covered in this leaflet, is transformer with fixed secondary taps adjustable in 4% steps. The exciter taps have been set for minimum D.C. output unless otherwise specified and must be adjusted by user or customer to obtain proper field current stamped on the motor nameplate. The output voltage of the supply can be adjusted by the several taps on the power transformer which are brought out to terminal blocks mounted on the transformer. Coarse taps A, B, C, and D provide approximately 12% per step, while the fine taps 1, 2 and 3 provide approximately 4% per step, and when making a tap change be sure to change all three phases identically to keep down

circulating currents and undesirable heating. Generally, connections on (A) and (1) terminals produce the lowest output.

The Power Supply consists of a basic transformer, rectifier for converting A.C. power into a fixed D.C.. The transformer is a two-winding type with the primary and secondary windings electrically isolated from each other. The rectifier consists of hermetically sealed silicon rectifier cells mounted on cooling fins and connected into a full wave bridge circuit.

Upon starting, an alternating voltage is induced in the D.C. field winding of a synchronous motor, and the frequency varies from line frequency to zero frequency when the motor synchronizes with the line. A starting-discharge resistor provides a path for the A.C. current to flow, which affects the accelerating torque and at the same time keeps the induced voltage at a safe value. When the motor reaches synchronizing speed the field contactor opens the discharge resistor circuit and applies D.C. voltage to the field from the static supply. It is during this part of the cycle that a high A.C. voltage may be induced, at low frequency, and it appears across the supply terminals. The rectifier blocks one half cycle of voltage, and current flow since it is in a reverse direction to the normal current flow and the Voltrap must take the surges. The Voltrap is designed to withstand four successive motor pole slippages at 10% slip with an off time of 15 minutes before it can be repeated.

To protect the rectifier the following features are provided:

A) Rectifier cells with (PIV) ratings three or more times the output terminal voltage are used.

B) A Voltrap surge suppressor which clamps the induced field voltage, by zener principle, below the peak inverse voltage rating of the diodes.

C) An (RC) resistor capacitor surge suppressor network to reduce the stress on the diodes imposed by high frequency transients on switching.

D) Current limit fuses in each leg of the transformer secondary.

The static field supply consists of the following basic components:

1. High voltage primary fuses.
2. Secondary fuses for diode protection.
3. Power transformer.
4. Full wave silicon rectifier.
5. Voltrap and (RC) network for surge protection.
6. Optional devices on special negotiation.

Installation and Operation:

Mount the control in a location which will not obstruct the air flow or the ambient temperature does not exceed 40°Centigrade.

Make all connections as indicated on the wiring diagram. Connect the D.C. load leads and observe the polarity with (F1) positive.

Closing the starter contactor generally energizes the transformer and power is available at the D.C. terminals.

Tap selection to get correct field current is a required adjustment by customer or user and it is well to keep in mind when the motor field is cold the current may be 20% high and as the field heats the current will reduce. Refer to the tap table on the diagram for tap progression. When making a tap change be certain to change all three phases identically.

Taps for voltage adjustment are on the power transformer and refer to the table for tap progression. When making adjustments observe the motor nameplate current and voltage ratings and do not exceed either with full load on the machine. Increase or decrease the field current by moving a tap and observe the motor line amperes under same load conditions. Unity power factor is where the line current cusp is a minimum. Reactive line current increases each side of unity power factor. With the field current slightly on the high side the machine provides some power factor correction.

Maintenance:

There are few moving parts and maintenance is quite simple. Over a period of time an accumulation of dust and grime may build up on the rectifier assembly and transformer which may reduce their cooling. A periodic cleaning is recommended and the dust may be removed by a light blast of air from a filtered air supply.

Occasionally inspect for loose connections and watch for heated joints which may have worked loose due to vibrations.

Trouble Shooting:

The following general outline may be useful in isolating trouble in event the output is low or lost:

1. Remove all power.
2. Use an ohmmeter to check for blown fuses.

Westinghouse

—37 LINE—
MINIATURE PANEL INSTRUMENTS
FOUR AND ONE-HALF-INCH CLASSIFICATION
INSTRUCTIONS

Cases

The first letter in type designates the form of case used.

N—Round Flush Case $4\frac{1}{16}$" dia.

R—Rect. Flush Case $3\frac{11}{16}$" x $4\frac{1}{16}$".

S—Round Proj. Case $4\frac{1}{16}$" dia.

Q—Rect. Flush Case $4\frac{1}{16}$" x $3\frac{11}{16}$".

U—Rect. Proj. Case $3\frac{11}{16}$" x $3\frac{1}{16}$"

All cases are moulded plastic composition.

Mechanisms

The second letter in type designates the principle of operation.

A—Repulsion Moving Iron.

X—Permanent Magnet Moving Coil

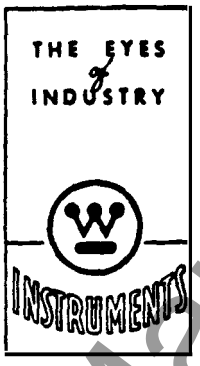
T—Thermocouple plus X

C—Rectifier plus X

Dial Notes

References to type, style number, use of external shunts, etc., are marked on the dial.

Magnetic Panels—Instruments are calibrated for use on non-magnetic panels unless otherwise specified. Types with mechanisms A read about 1% high and types with mechanisms X, T or C read from 1% to 6% low when mounted on $\frac{1}{16}$ to $\frac{1}{8}$ inch magnetic panels unless calibrated for such panels.



Field Influence—These instruments being unshielded, certain precautions must be taken to prevent undue influence from external fields.

1. With type A mechanism above 15 amperes, the leads should be brought straight down from the terminals at least 6 inches before bending. All leads carrying currents of the order of 50 amperes or more should be spaced at least 6 inches from the instruments.
2. All instruments should be mounted at least 5 inches between centers. Instruments with very high sensitivity have very strong permanent magnets and should be spaced at least 8 inches from other instruments.

Special Precautions

All type 37 instruments with moulded plastic cases are insulated for 750 volts. Above this voltage one terminal should be kept at ground potential.

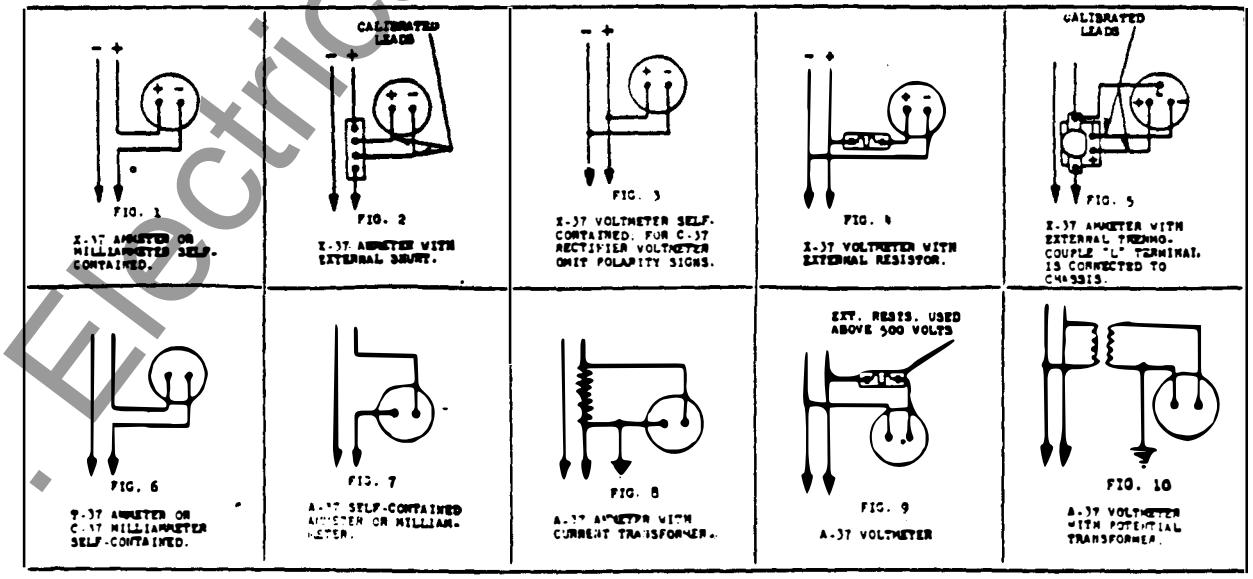
Ammeters with external shunts must use specified leads.

If the circuit voltage exceeds the insulation rating, the ammeter or shunt should be connected in the grounded side of the circuit.

Radio Frequency instruments, particularly those with external thermocouples should be arranged with effective R.F by-pass and ground connections to minimize capacity currents.

Repairs and Renewal Parts

Orders for renewal parts should include the name of the part, and the complete identification data. Repair work can be done most satisfactorily at the factory, small instruments being readily shipped by Parcel Post. When returning an instrument for repairs obtain a returned material tag from your dealer or our Sales Office so as to facilitate identification of the shipment when received



WESTINGHOUSE ELECTRIC CORPORATION

INSTRUMENT DEPARTMENT **NEWARK, N. J.**

Printed in U S A.

MINIATURE PANEL INSTRUMENTS—Continued

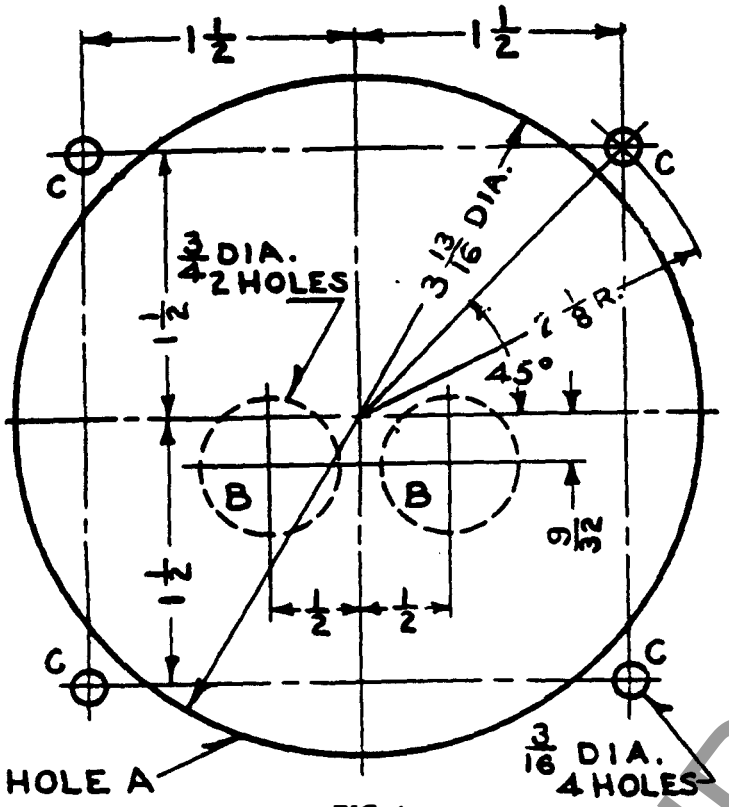


FIG. 1

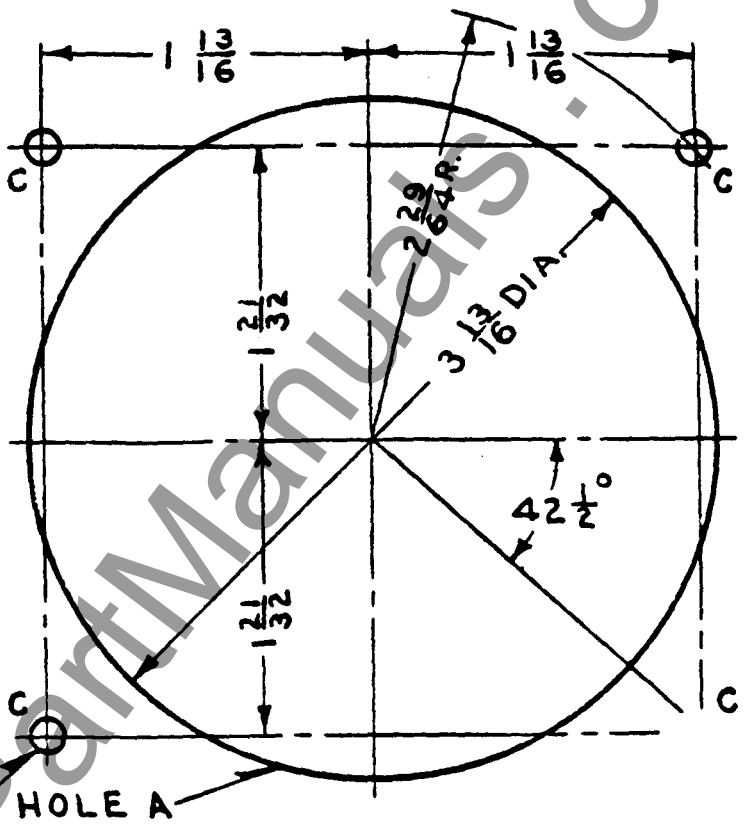


FIG. 2

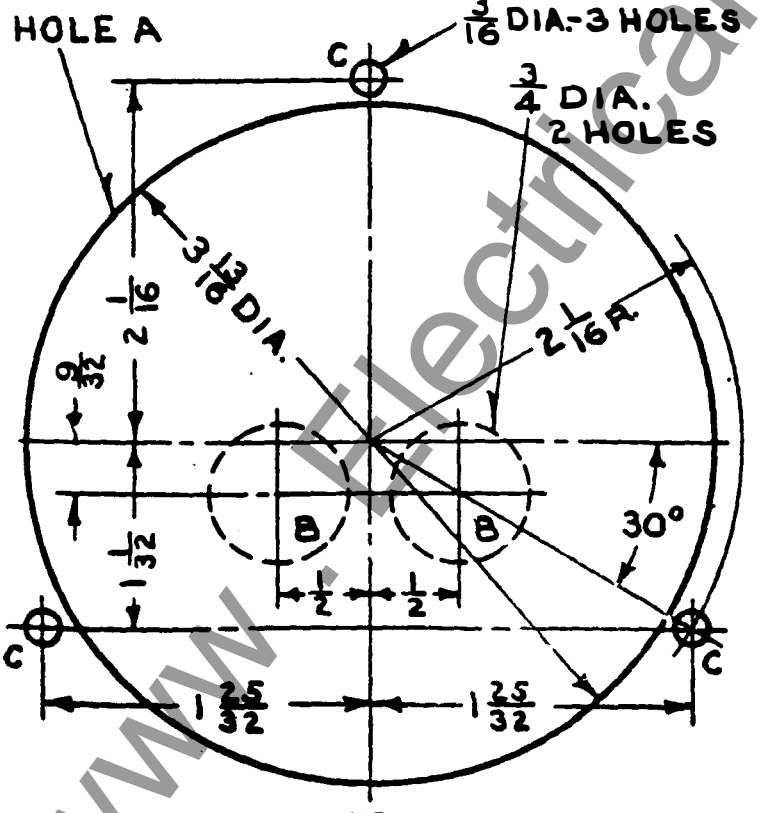


FIG. 3

Case Type	Panel	Remark	Drill Holes	Fig. No.
R-37 U-37	Any Insul.	All Inst. *	A & C B & C	1 1
U-37	Metal	All Inst.	A & C	1
Q-37	Any	All Inst.	A & C	2
N-37	Any	All Inst.	A & C	3
S-37	Insul.	△	B & C	3
S-37	Metal	All Inst.	A & C	3

* = Holes B & C to be used for all Type U-37 inst. mtd. on insul. panels, except A.C. Ammeters of 25 amps. or higher, in which case holes A & C must be used.

△ = Holes B & C to be used for all Type S-37 inst. mtd. on insul. panels, except A.C. ammeters of 25 amps. or higher, in which case holes A & C must be used.

Westinghouse

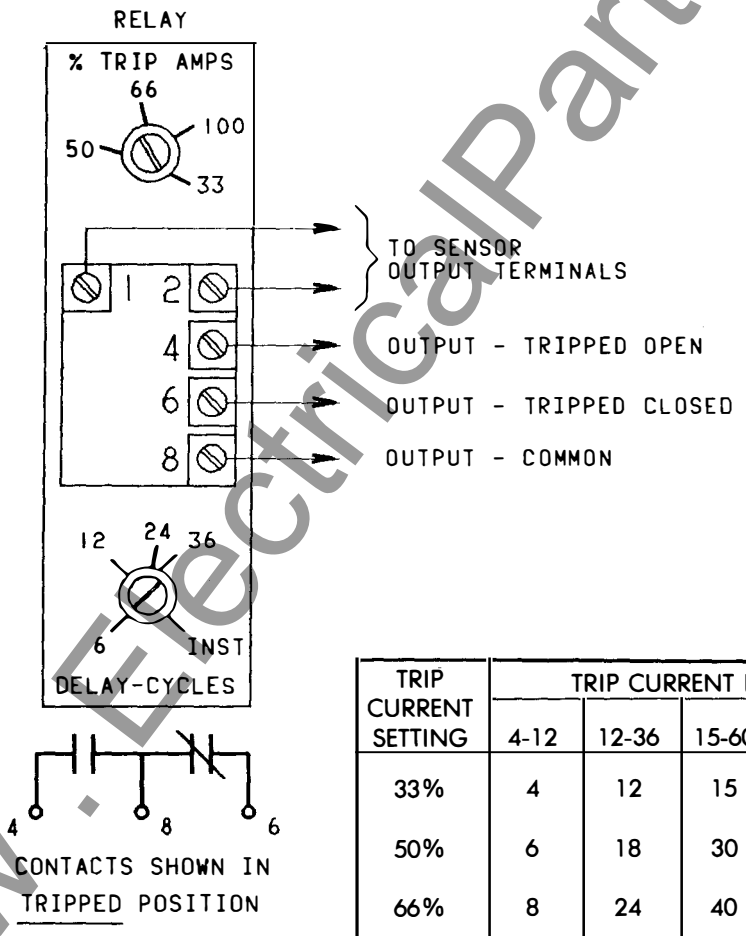
"GROUNDGARD" T PROTECTION SYSTEM

The Westinghouse "GROUNDGARD" T protection system is designed to protect electrical equipment from destructive arcing ground faults. The system consists of a "GROUNDGARD" T Sensor and a "GROUNDGARD" T Relay.

"GROUNDGARD" T RELAY
Style No. - 5264C09H02 - Without time delay
Style No. - 5264C09H03 - With time delay

The Groundgard Relay monitors the output of the Groundgard Sensors. When the output of the sensor reaches a predetermined level, the realy trips, displaying a red target and transferring contacts to signal that a groundfault exists. The contacts may be used to disconnect the faulted circuit or to signal the condition to a remote location.

The level of groundfault current required to cause the relay to trip is established by the style of sensor employed, its connection arrangement, and the setting of the percent of TRIP AMPS control on the rear of the relay. One hundred percent of trip amps equals the highest current yielded by the transformer for a given connection; i.e., if wired for 12-36 amperes, 36 amperes equals 100 percent. The Style No. 5264C09H03 relay also has a DELAY-CYCLES control which may be adjusted to cause the unit to delay operation for a specific period of cycles. The DELAY-CYCLES Control is calibrated from INSTANTANEOUS, at which its delay is approximately one cycle, to 36 cycle delay.



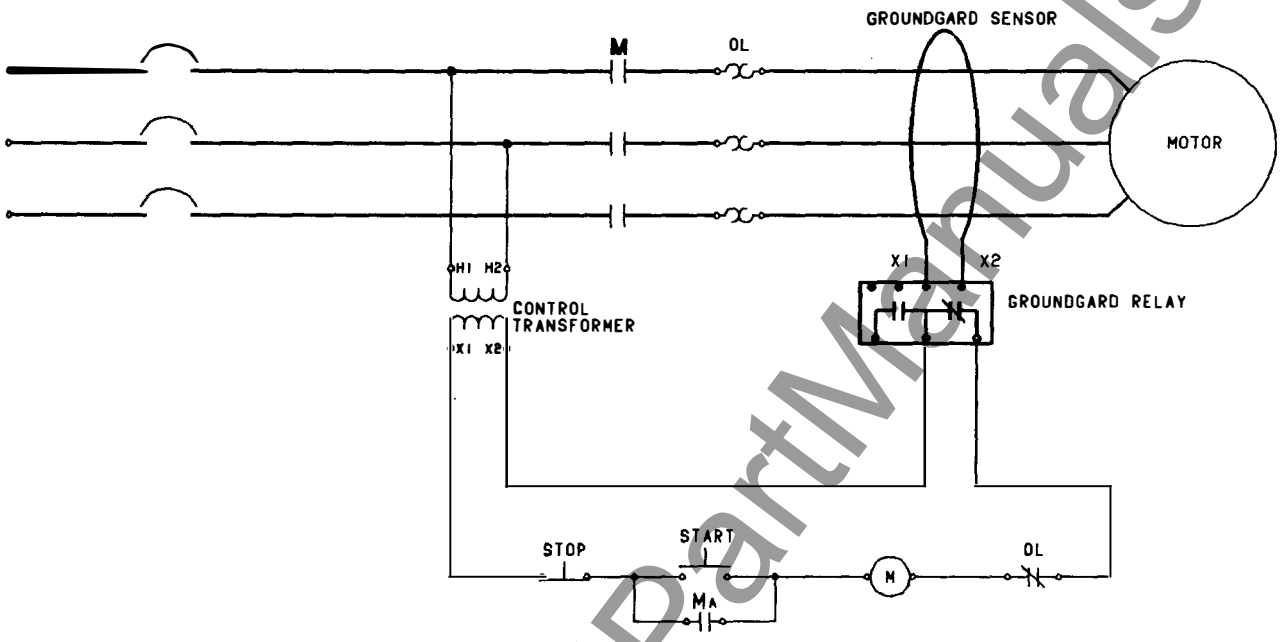
TRIP CURRENT SETTING	TRIP CURRENT RANGE OF SENSOR AMPS							
	4-12	12-36	15-60	8-28	12-33	12-39	2.5-11	2.5-9
33%	4	12	15	8	12	12	2.5	2.5
50%	6	18	30	14	16.5	19.5	5.5	4.5
66%	8	24	40	19	22	26	7	6
100%	12	36	60	28	33	39	11	9

Groundgard Sensor - Installation Instructions

"Groundgard" current sensors are window type current transformers. All phase conductors *including the neutral* if used, are run through the sensor. Any ground fault current will be monitored by the sensor and passed on to the "Ground Fault Relay".

The Sensor is so designed that its output is proportional to ground fault currently only. It is not responsive to phase to phase or phase to neutral current.

Selection of the proper current sensor is dependent upon two factors, the conductor size and the required trip current.



SENSOR WITH TEST TERMINAL

SENSOR STYLE	WIRING STEPS	AMPS 4-12	AMPS 12-36
5264C10H04	1. Connect test unit if used to sensor terminal	T&X1	
	2. Connect relay terminal 1 & 2 to sensor	T&X1	
	3. Jumper sensor terminal	X1&X2	
	1. Connect test unit if used to sensor terminal		T&X1
	2. Connect relay terminals 1&2 to sensor		T&X1
	3. Jumper sensor terminal		X2&X3

Westinghouse Electric Corporation
Control Division
Asheville, N.C. 28813

Revision C Aug. 16, 1982

Instructions for Size 3 or 4 Type A Thermal Overload Relay, 3 Pole, Ambient Compensated or Non-Compensated

I.L. 14570D
Model J

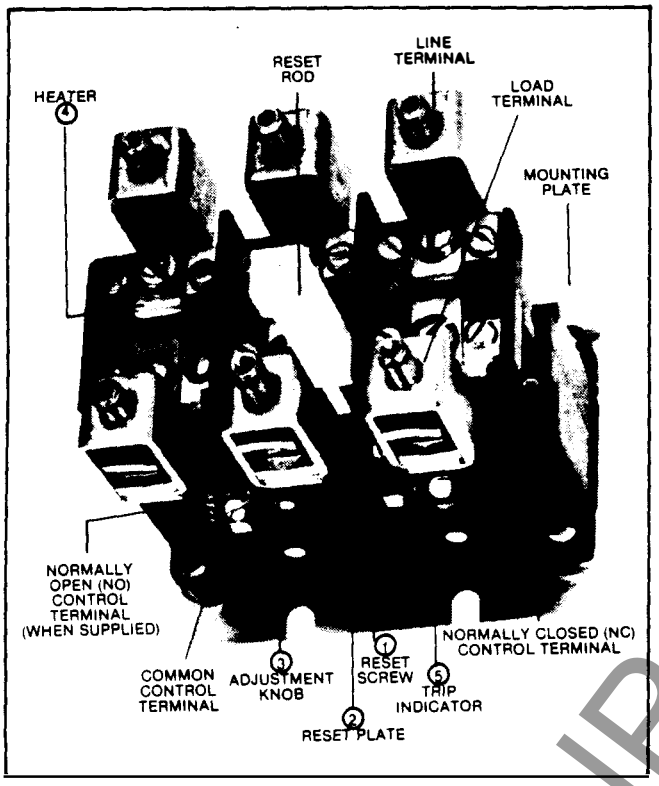


Fig. 1 Size 4 Overload Relay for Panel Mounting

THE RELAY

The Type A thermal overload relay (OLR) is a bimetallic device which, with the properly selected wire and heaters, will provide motor protection for running and stalled rotor overloads in motor circuits not exceeding 600 volts. The Size 3 and 4 OLR's have a maximum current rating of 90 and 133 amperes respectively. Ambient compensated OLR's are readily distinguishable by light gray reset rods. Non-ambient compensated OLR's have red reset rods.

OPERATION

The strip bimetals in the OLR are indirectly heated by the replaceable heater elements (Item 4 in Figure 1) which carry the motor current. Excess heat is generated in these heater elements by an overloaded motor. The heated bimetals deflect to open the normally closed contact, thereby opening the coil circuit of a magnetic contactor which disconnects the overloaded motor from the line. After approximately 2 minutes, the relay if hand reset may be reset by pressing the reset rod. For relays in the auto position, resetting occurs automatically.

TABLE I — CATALOG NUMBERS

Type	Panel Mounted		A200 Controller Mounted	
	Size 3	Size 4	Size 3	Size 4
Ambient Compensated	AA33P	AA43P	AA33A	AA43A
Non-ambient Compensated	AN33P	AN43P	AN33A	AN43A
For NO/NC contacts add suffix B				

INSTALLATION

The OLR must be installed on a vertical surface with the control terminals at the bottom. The relay is accurately calibrated at the factory and should not be tampered with. Installation should be made with the proper wire size (see heater selection table) for the application and all wires must be securely fastened. Preferably, the OLR should be located in the same ambient as the motor to be protected and in an area free of drafts. Heater elements are supplied separately and must be properly selected and securely mounted. Three heaters must be used for either single or three phase applications.

This industrial type control is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

CONTROL CIRCUIT CONTACTS

The normally closed (NC) control circuit contact is to be connected in series with the coil of a magnetic contactor. This NC contact is equipped with a follow contact which provides reliable electrical continuity during a tripping condition. A factory installed normally open (NO) control circuit contact (single pole double throw — Form C) is available for remote trip indication applications. AC contact ratings are listed in Table II.

TABLE II — CONTROL CONTACT RATINGS

AC	NORMALLY CLOSED		NORMALLY OPEN	
VOLTS	MAKE	BREAK	MAKE	BREAK
24-120	20A	2A	5A	.5A
120-600	2400 VA	240 VA	600 VA	60 VA

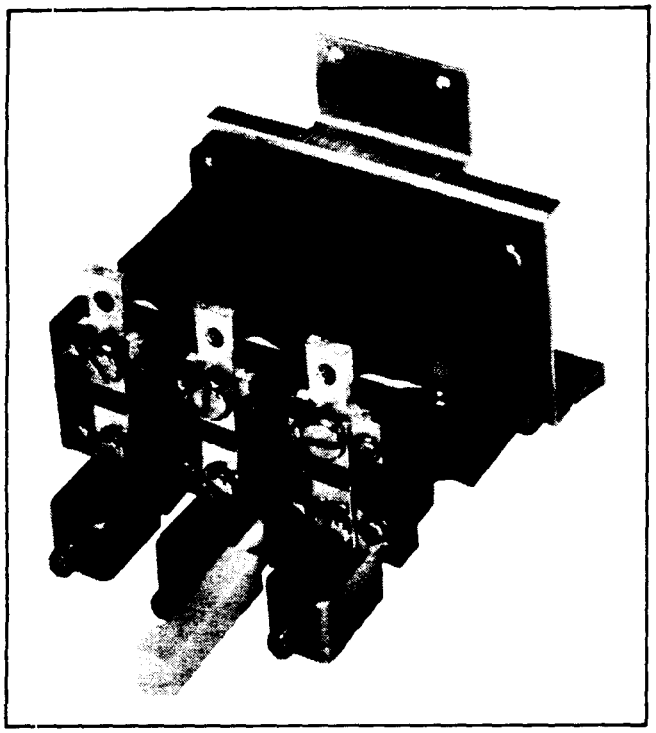


Fig. 2 Size 4 Overload Relay for A200 Controller Mounting

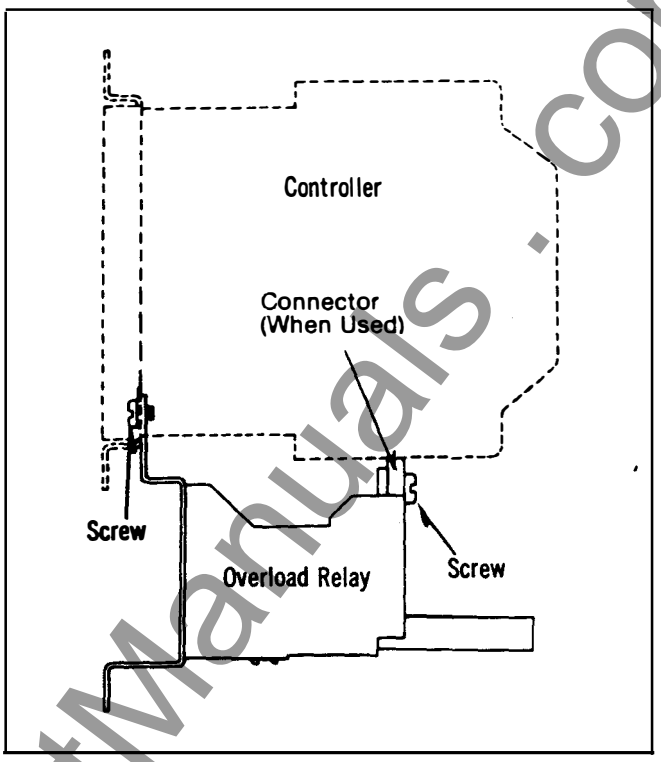


Fig. 3 Overload Relay Mounted on A200 Controller

MANUAL OR AUTOMATIC RESET

The overload relay is normally furnished set for "HAND" reset operation. The relay may be set for either "HAND" or "AUTO" reset by slightly loosening the screw (1) holding the reset plate (2), moving the plate to the proper position marked on the molded case (away from the panel for "Hand" reset and toward the panel for "Auto" reset) and retightening the screw. (See Figure 1).

Automatic reset should not be used with 2-wire control circuits where automatic starting of the motor may be hazardous.

ADJUSTABLE TRIP

The trip rating of a specific heater element can be adjusted over a range of approximately 85% to 115%. This is accomplished by turning the adjustment knob (3) on the bottom of the realy to the respective stop position. This to alleviate nuisance tripping; or conversely, to gain closer protection when desired.

TRIP INDICATION

An immediate visible indication of trip is standard on the Type A overload relay. When an overload occurs, which causes the relay to operate, a trip indicator (5) projects out through a small opening at the bottom of the relay. (See Figure 1.)

IMPORTANT: Do not tamper with this trip indicator as it is an integral part in the calibration and tampering therewith may causes changes in trip characteristics.

AMBIENT COMPENSATION

Ambient compensated OLR's have substantially the same trip characteristics for ambient temperatures from —40°C to 75°C (—40°F to 167°F). Because of a compensating bimetal, which maintains a constant travel to trip distance independent of ambient conditions, operation of this bimetallic relay is responsive only to heat generated by the motor overcurrent passing through the heater element. The compensating feature is fully automatic and no adjustments are required over normal fluctuations in ambient temperatures. Overload relays having ambient compensation can be identified by light gray reset rods whereas non-compensated overload relays have red reset rods.

TABLE III — POWER CIRCUIT TERMINALS

NEMA Size	Wire Size
3	#12 — 2/0 AWG
4	#12 — 4/0 AWG

Wire with copper conductors only

TABLE IV — RECOMMENDED DRIVING TORQUE

Location (Qty.)	Driving Torque (lb.-in.)
Main Power Connections (6)	90 — 100
Control Connections (2)	8 — 9
Heater Mtg. Screws (2/pole)	45 — 50

HEATERS

Heaters are not included with the overload relay and must be ordered separately per the heater selection table and the information listed below. When installing heaters be sure that connecting surfaces are clean and heaters are attached securely to the relay in the proper location with the screws provided. The trip rating of a heater in a 40°C Ambient is 125% of the minimum full load current shown in Table V. When tested at 600 percent of its trip rating, the relay will trip in 20 seconds or less (class 20).

Heaters should be selected on the basis of the actual full load current and service factor as shown on the motor nameplate or in the manufacturer's published literature. When the service factor of the motor is 1.15 to 1.25, select heaters from the heater application table. If the service factor of the motor is 1.0, or there is no service factor shown, or a maximum of 115% protection is desired, select one size smaller heater than indicated. When motor and overload relay are in different ambients and when using non-compensated overload relays, select heaters from the table using adjusted motor currents as follows: decrease rated motor current 1% for each °C motor ambient exceeds controller ambient. Increase rated motor current 1% for each °C controller ambient exceeds motor ambient. For ambient compensated overload relays no adjustment in heater selection is necessary for normal variations in ambient temperatures.

TABLE V — F SERIES HEATER SELECTION

For compensated OLR's in any size enclosure, and non-compensated OLR's in enclosures with volume not less than 5500 cu. in. Wire with 75°C wire.

For Use With Three Heaters Only

Code Marking	Full Load Current of Motor (Amperes) (40°C Ambient)	Max. Protect. Device (Amp)	Load Wire Size
FH72	19.0 — 20.8	80	#10
FH73	20.9 — 22.9	90	#10
FH74	23.0 — 25.2	100	#10
FH75	25.3 — 27.8	100	#10
FH76	27.9 — 30.6	110	#8
FH77	30.7 — 33.5	125	#8
FH78	33.6 — 37.5	150	#8
FH79	37.6 — 41.5	150	#6
FH80	41.6 — 46.3	175	#6
FH81	46.4 — 50	200	#6
FH82	51 — 55	200	#4
FH83	56 — 61	225	#4
FH84	62 — 66	250	#4
FH85	67 — 73	250	#3
FH86	74 — 78	250	#3
FH87	79 — 84	300	#2
FH88	85 — 92	350	#2
ABOVE HEATERS FOR USE ON SIZE 3 (90 AMPS MAX.)			
FH89	93 — 101	350	#00
FH90	102 — 110	350	#00
FH91	111 — 122	400	#000
FH92	123 — 129	400	#000
FH93	130 — 133	400	#0000
ABOVE HEATERS FOR USE ON SIZE 4			

SHORT CIRCUIT PROTECTION

The relay will provide protection against abnormal load conditions to current values exceeding normal locked rotor current; however, to protect the relay from short circuit currents, branch circuit protection must be provided per the National Electric Code. Protective device ratings should not exceed the maximum values listed in the heater application table. The relays, as protected, are suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes (10000 amps for Size 4), 600 volts maximum.

MAINTENANCE

Other than the normal tightening of all wire and heater connections, no maintenance should be attempted on the unit. Complete replacement of the unit must be made in the event of damage.

WARNING: To provide continued protection against fire and shock hazard, the complete overload relay must be replaced if burnout of a current element occurs. See Table I.

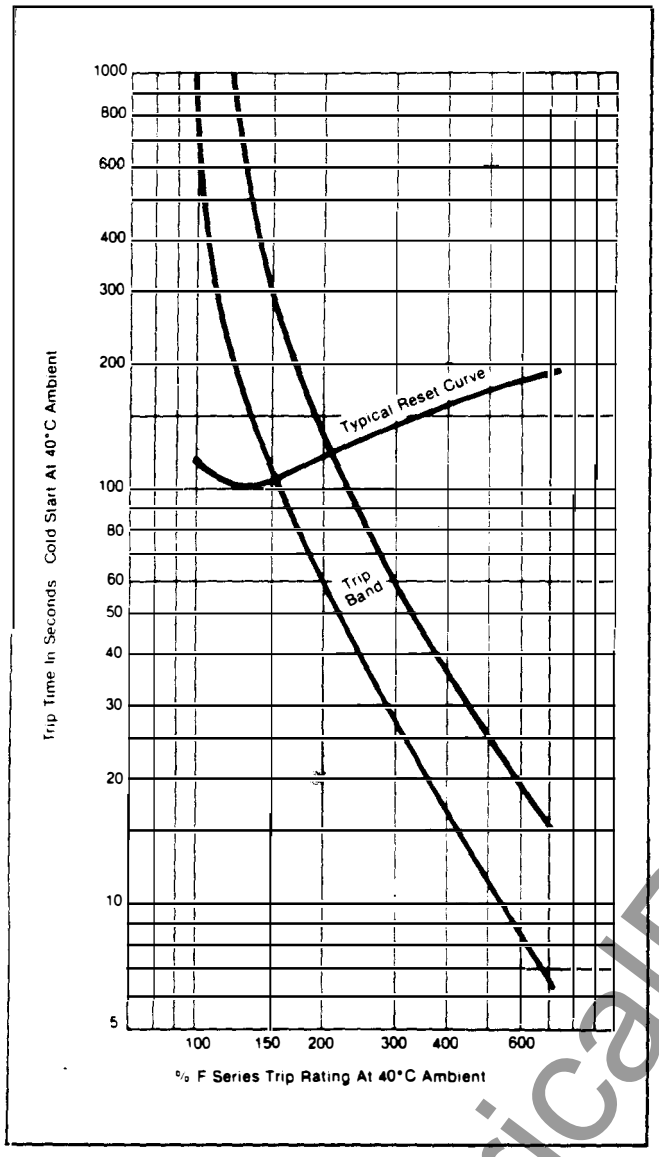


Fig. 4 Time/Current Trip and Reset Curves

The trip rating of a heater in a 40°C ambient is 1.25 times the minimum value of full load current listed for each heater.

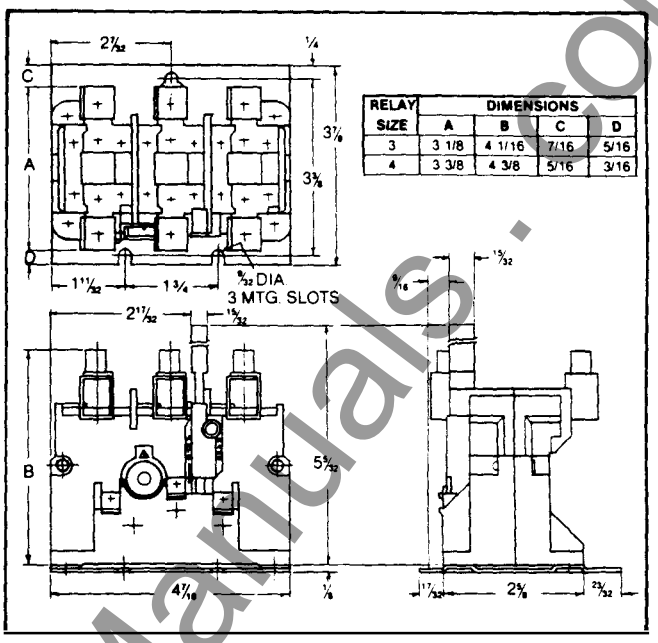


Fig. 5 Dimension Drawing (Dim. in inches)

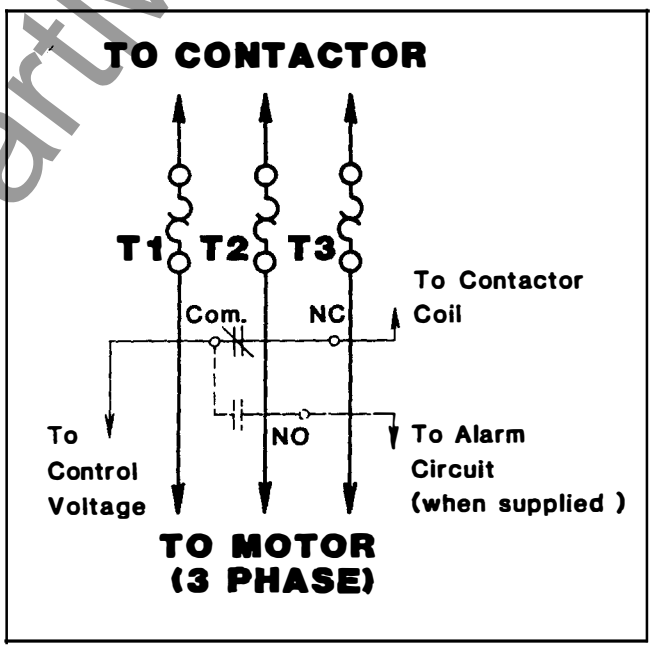


Fig. 6 Connection Diagram