ABB

# Type BL-1
# Thermal Overload Relay
## Class 1E Application

Effective: December 1985
Supersedes I.L. 41-553.2A dated February 1979

✪ Denotes Change Since Previous Issue

**CAUTION:** Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

## APPLICATION

These relays have been specially designed and tested to establish their suitability for Class 1E applications. Materials have been selected and tested to insure that the relays will perform their intended function for their design life when operated in a normal environment as defined by ✪ ANSI standard C37.90-1978, when exposed to radiation levels up to $10^4$ rads, and when subjected to seismic events producing a Shock Response Spectrum within the limits of the relay rating.

"Class 1E" is the safety classification of the electric equipment and systems in nuclear power generating stations that are essential to emergency shutdown of the reactor, containment isolation, cooling of the reactor, and heat removal from the containment and reactor, or otherwise are essential in preventing significant release of radioactive material to the environment.

The type BL-1 relay is used primarily for thermal overload and instantaneous overcurrent protection of motors and generators, but it may also be used for the protection of transformers or any other apparatus if the temperature-rise under overload is similar to that of motors. The thermal element is the "replica type" and has a time-current characteristic closely approximating the average moderate overload heating curves of motors. Its characteristics prevent the protected equipment from being subjected to overloads of such magnitude or duration as to cause them to reach dangerous temperatures, but at the same time permit the utilization of the inherent thermal capacity of the apparatus.

As its operation depends upon the rate of heat generation in a heater element within the relay, it may be used for either ac or dc application. It is ordinarily connected in the secondary circuit of a suitable current transformer in ac applications. Since the voltage drop across the relay must be within a range of about 0.49 to 0.88 volts at full load on the protected machine, customary shunts rated in millivolts are unsuited for dc applications. However, the drop across a portion of the protected circuit, such as the interpole field winding of a machine, sometimes can be utilized as a source of energy for the relay.

## CONSTRUCTION AND OPERATION

The double element type BL-1 relay Figures 1 & 2 contains two heater units, two indicating instantaneous trip units (IIT), an indicating contractor switch (ICS), and a slow dropout telephone type relay.

### THERMAL UNIT

The thermal unit consists of a housing of molded material which encloses a coiled thermostatic

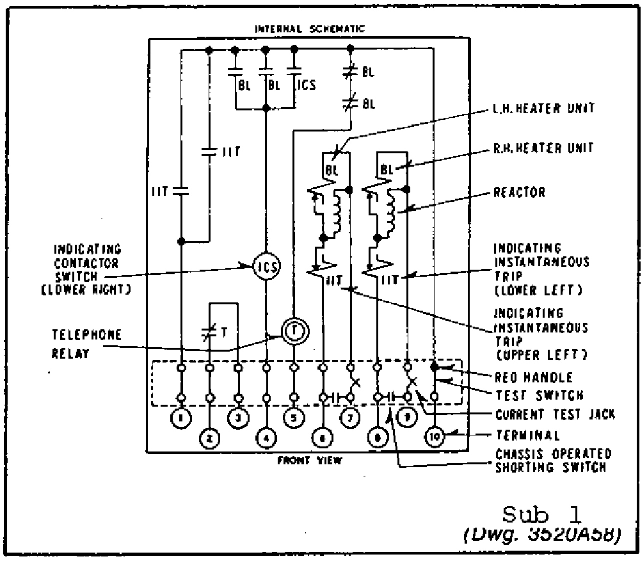



*Fig. 1. Internal Schematic of the Type BL-1 Double Unit Relay, with Front and Back Contacts in the Type FT 31 Case. (Auxiliary "T" Unit with Form "b" Contacts). Relays with Front Contacts Only have the Circuits Associated with Terminals 2, 3, and 5 omitted.*

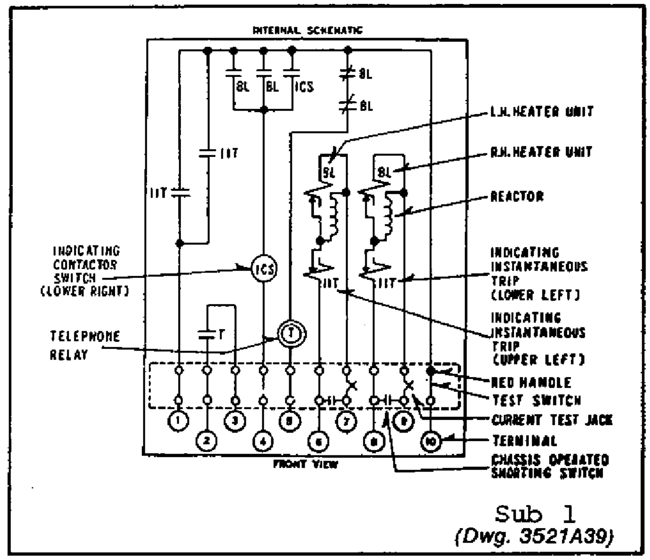



*Fig. 2. Internal Schematic of the Type BL-1 Double Unit Relay, with Front and Back Contacts, in the type FT 31 Case. (Auxiliary "T" Unit with Form "a" Contacts.) Relays with Front Contacts Only Have the Circuits Associated with Terminals 2, 3, and 5 omitted.*

metal spring mounted on a shaft, two die-cut heater elements made of resistance material, metal heat storage blocks, and bearings for the shaft; and, external to the molded housing, a second thermostatic metal spring fastened to the shaft extension and carrying the moving contact at its outer end, the stationary contacts, and scales for setting the stationary contacts at suitable positions for obtaining various time-overload operating curves under specified operating conditions.

The external and internal thermostatic metal springs have identical temperature-angular rotation characteristics, and the external spring is mounted so that its rotation is in the opposite direction to that of the internal spring. Consequently, a change in ambient temperature will not produce an appreciable permanent change in the position of the moving contacts, although the enclosure of the internal spring will cause it to respond more slowly than the external spring and a temporary change in contact position would result from a large and rapid change in ambient temperature. This would not need to be considered in normal applications, however.

The internal spring is housed within ceramic discs having high thermal-shock resistance, and the two heater elements are mounted against the outer surfaces of these discs. The outer end of the spring is held fixed by a notch in the discs. Openings in the centers of the discs expose the springs to the heaters with only air separation. Thus heat is transferred to the spring by convection as well as by conduction through the ceramic, and (particularly at high overloads) by radiation also. The heater elements are connected in series and to terminals on the molded housing. In addition, a tap on each element is connected to a terminal, and a link is provided by which the two tap terminals can be connected together and thus bypass a portion of each heater. The portions of the heaters remaining in the circuit have a larger cross section also, so that they will withstand the same percentage overload based on a higher full load current.

Metal heat storage discs, with intervening insulation, are clamped against the outer surfaces of the heaters, and this assembly of spring and shaft, ceramic insulation, heaters, and heat storage discs is mounted so that it has a minimum of direct contact with the molded housing. The proportions and spacings of the components have been designed to provide fast operation at overloads of several hundred percent or higher, and to provide long operating times at low overloads so that the inherent thermal capacity present in the usual motor design can be fully utilized. A high permeability reactor is provided in shunt with the heaters for ac application. This reactor has no effect on the time curve of the relay up to 1000% of pointer setting, but provides additional protection for extremely high currents of short duration. The reactor should be removed from the circuit for dc application. This is readily accomplished by removing the heavier lead from the two left hand terminals of each thermal unit.

The contacts are silver and are of the bridging type so that flexible leads are unnecessary. The moving contact consists of a silver plate constructed so that it can pivot on its mounting and be self-aligning with the stationary contacts. The stationary make contacts are supported in molded insulation fastened to a plate which can be rotated around the shaft by means of a gear sector on its edge and a pinion attached to the scale pointer. This serves to expand the scales and permit increased accuracy of setting.

Stationary break contacts are provided. These are similar to the make contacts and are mounted on a second rotatable plate in front of the plate which supports the make contacts. This plate is held in position by spring pressure, but can be moved to any desired position with reference to the make contacts. A scale on the supporting plate for the make contacts is used in locating the break contacts at a definite position. Rotation of the make contacts by means of the scale pointer does not change in the spacing between the make and the break contacts. When no alarm circuit is used, these break contacts are not connected electrically but are adjusted to provide a backstop for the moving contact. When an alarm circuit is used, these break contacts are connected electrically to control the Auxiliary Time - Delay Unit.

### Indicating Contactor Switch Unit (ICS)

The dc indicating contactor switch is a small clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

### Indicating Instantaneous Trip Unit (IIT)

The instantaneous trip unit is a small ac operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts completing the trip circuit. Also, during the operation, two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop.

Taps on the coil and a core screw accessible from the top of the switch provides the adjustable pickup range.

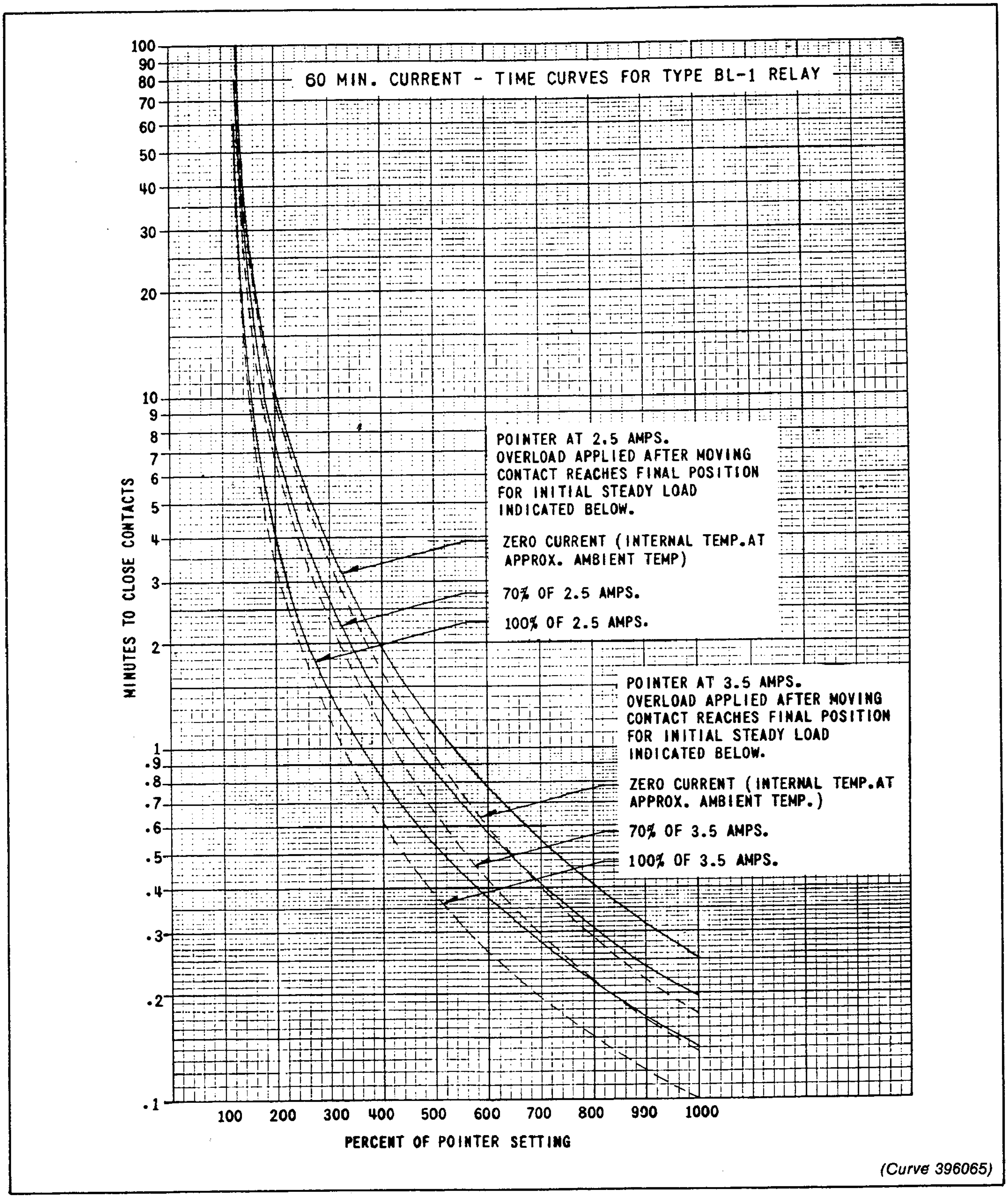
### Auxiliary Time-Delay Unit (T) – When Used

This is a slugged telephone type relay with two sets of form "c" contacts. Only one set of contacts are used and they are connected as either Form "a" or as Form "b" contacts. The relay is normally energized through the "break" contacts of the BL Units and while energized, Form "a" contacts are closed or Form "b" contacts are open. When the T unit is deenergized either by the BL break contacts opening or by a loss of dc supply, the Form "a" T contacts will open or the Form "b" T contacts will close in approximately 115 ms after having been energized at 125 volts dc rated voltage.

## CHARACTERISTICS

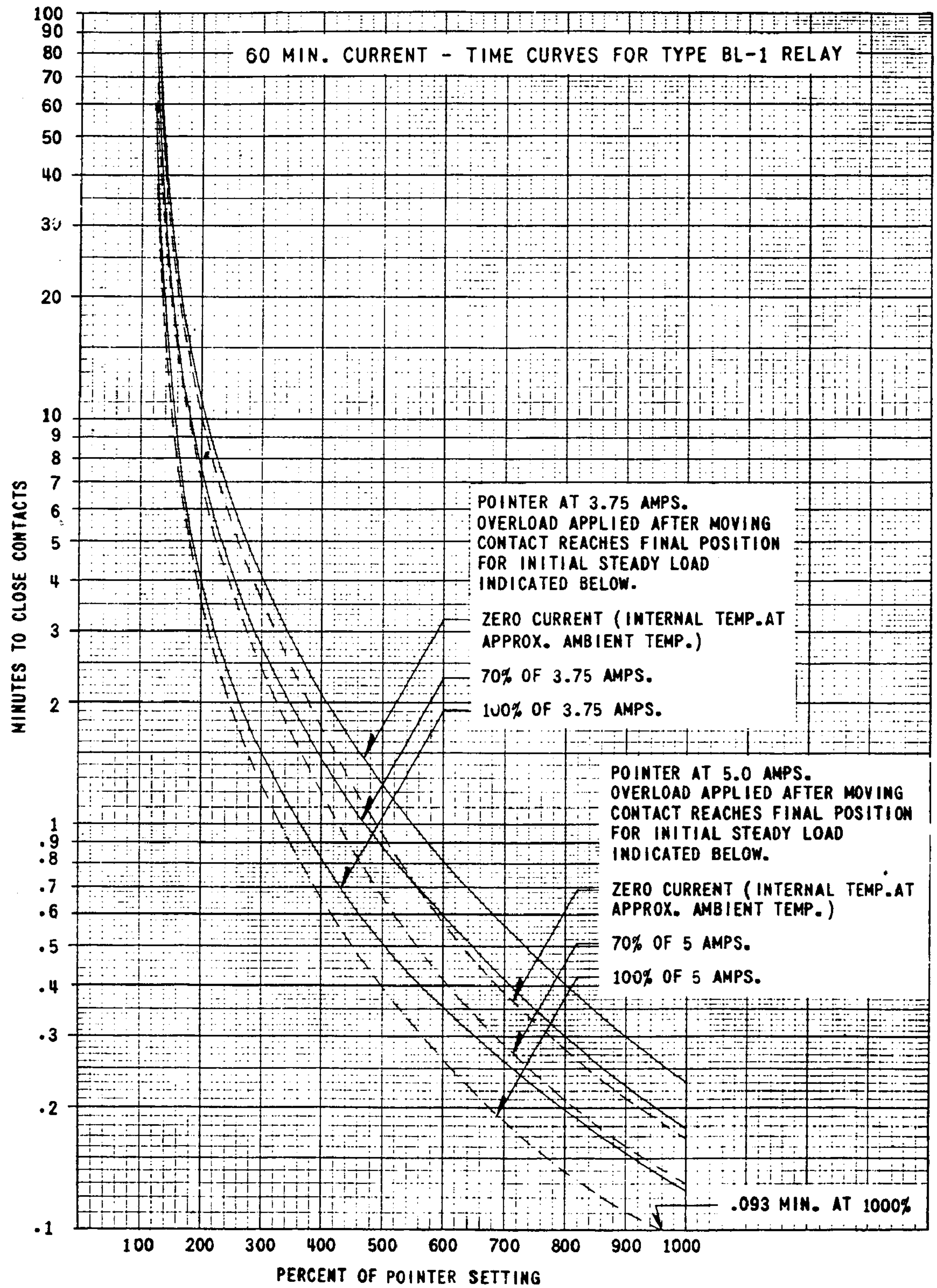
### THERMAL UNIT

The type BL-1 relay is designed for use in applications where the current transformer ratio is such that with 100 percent of full load on the protected machine the relay will receive a current within the limits of 2.5 to 5.0 amperes. For full load currents within this range, the relay can be set to operate in accordance with the characteristic curves shown in Figs. 3 and 4. Note that there are three initial current conditions shown in each figure: 0%, 70% and 100% of pointer setting. The curves are based upon having the initial current




*(Curve 396065)*

*Fig. 3. Current-Time Curves for Normal Applications of the Type BL-1 Relay Covering Range of Full-Load Currents from 2.5 to 3.5 amperes, Using Pointer Settings marked on Dial. 60-Minute Time-Delay for 125% Load Occuring after Steady Full-Load. Shorting Link Open.*




(Curve 396066)

*Fig. 4. Current-Time Curves for Normal Applications of the Type BL-1 Relay Covering Range of Full Load Currents from 3.75 to 5.0 Amperes, using Pointer Settings marked on Dial. 60-Minute Time-Delay for 125% Load Occuring after Steady Full-Load. Shorting Link Closed.*

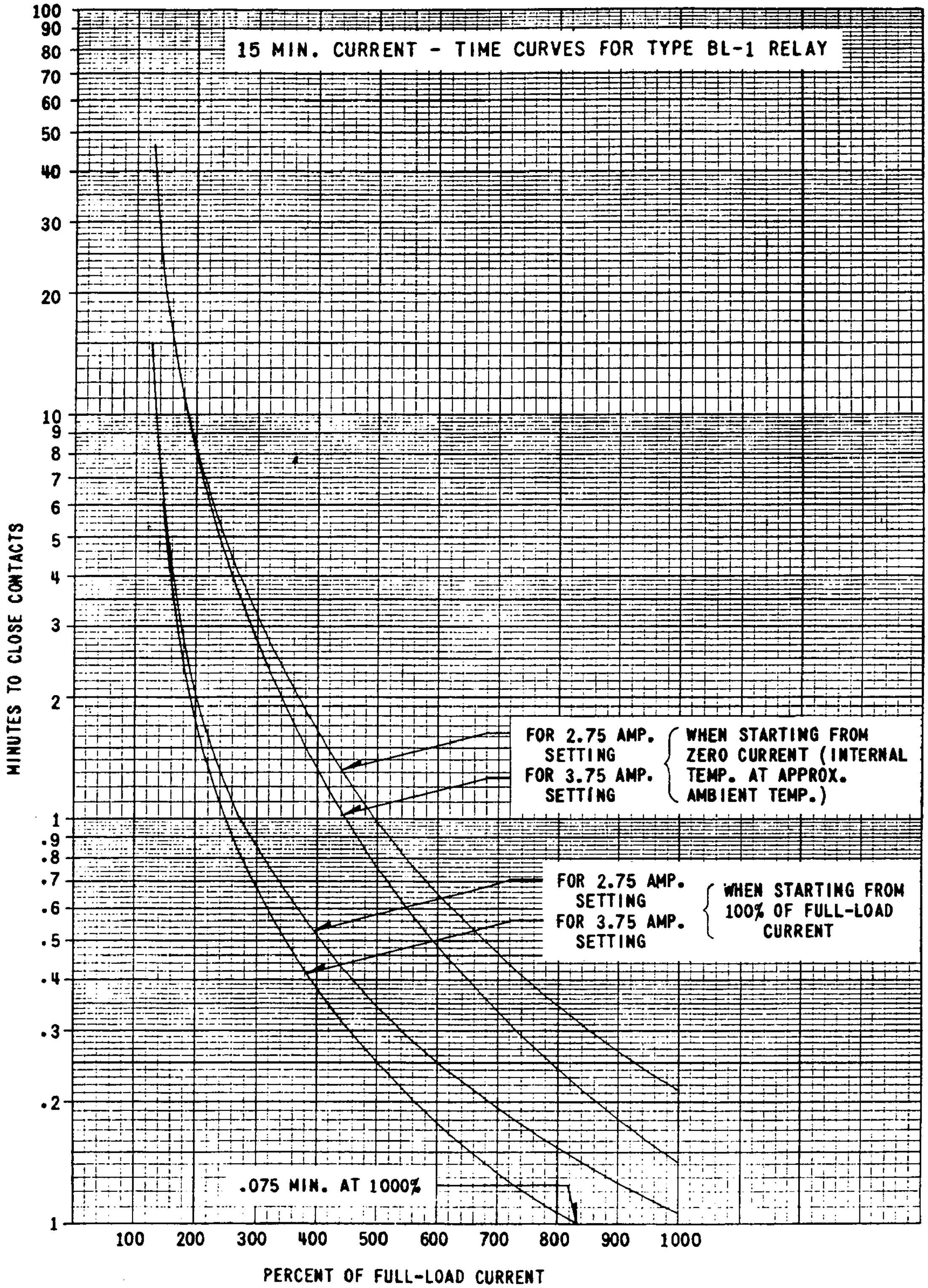
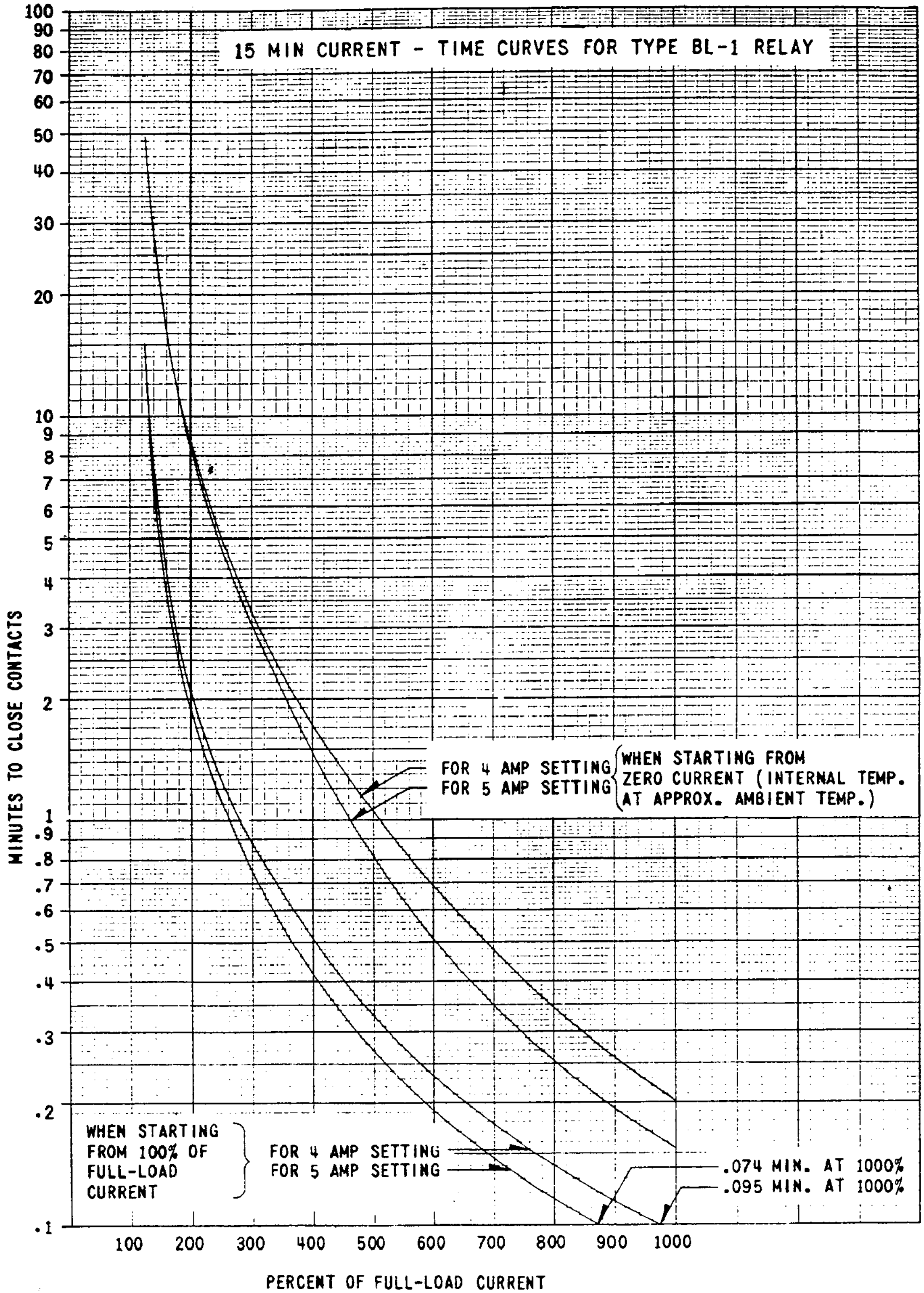
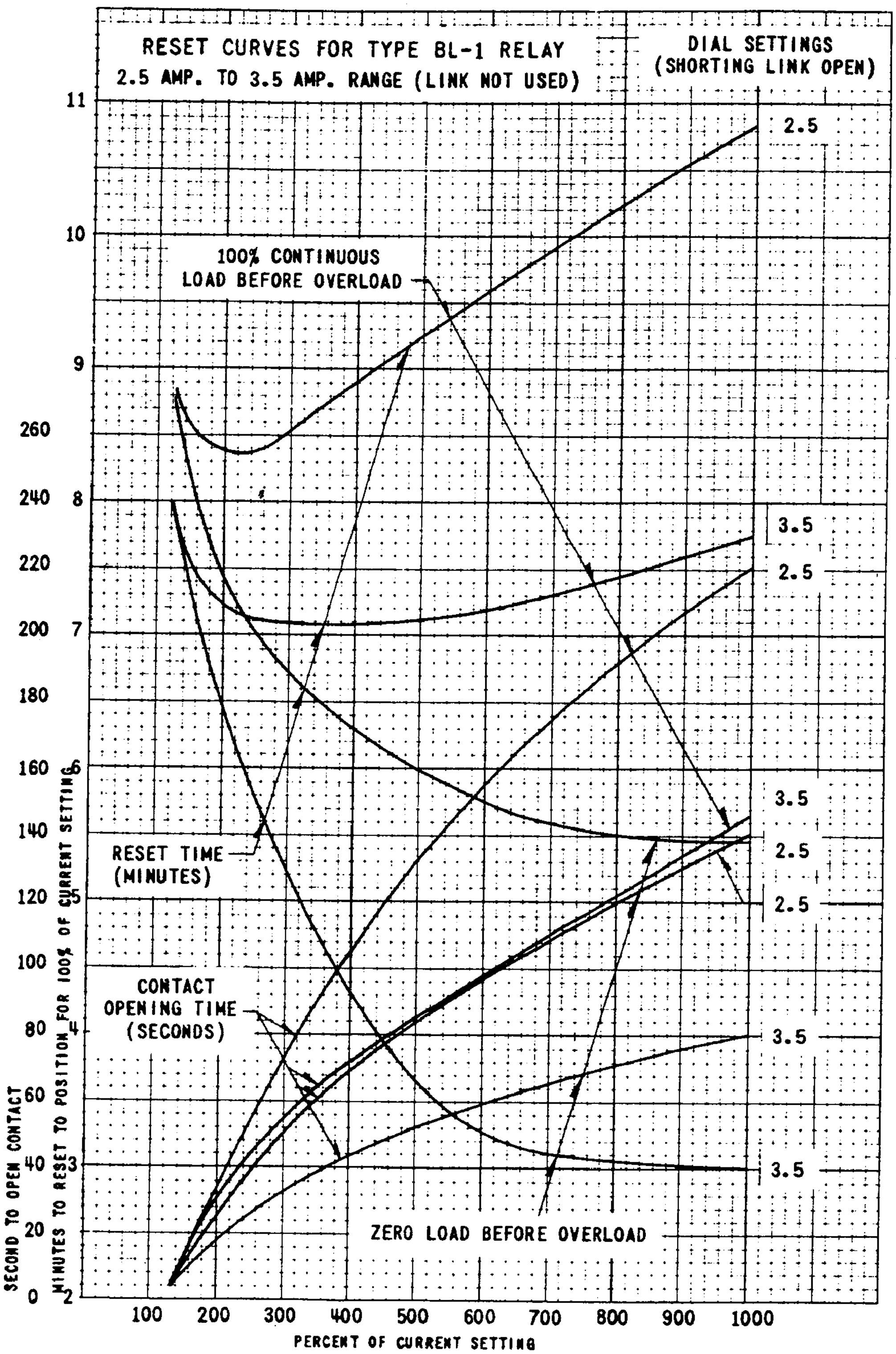



*Fig. 5. Current-Time Curves for Special Applications of the Type BL-1 Relay covering Range of Full-Load Currents from 2.75 to 3.75 Amperes. Contact Settings Determined by Test for 15-Minute Delay with 125% Load Occuring after Moving Contact reaches Final Position for Steady Full-Load. Shorting Link Open.*



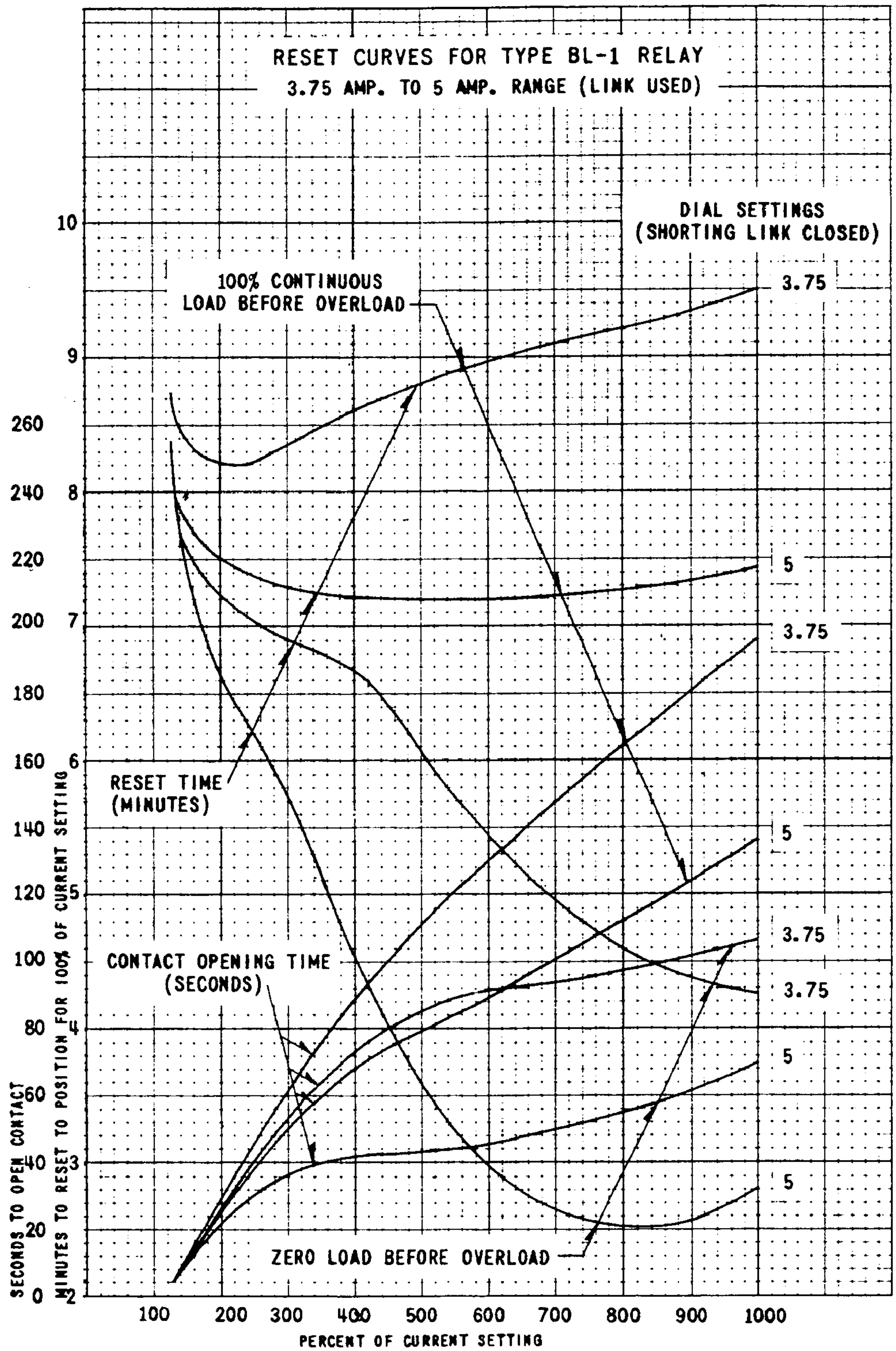

(Curve 396064)

*Fig. 6. Current-Time Curves for Special Applications of the Type BL-1 Relay Covering Range of Full-Load Currents from 4.0 to 5.0 Amperes. Contact Settings Determined by Test for 15-Minute Delay with 125% Load Occurring after Moving Contact reaches Final Position for Steady Full Load. Shorting Link Closed.*




(Curve 396061)

*Fig. 7. Contact-Opening and Reset Time Curves for the Type BL-1 Relay for Full-Load Settings of 2.5 to 3.5 Amperes as marked on Dial. Shorting Link Open.*




(Curve 396062)

*Fig. 8. Contact-Opening and Reset Time Curves for the Type BL-1 Relay for Full-Load Settings of 3.75 to 5.0 Amperes as marked on Dial. Shorting Link Closed.*

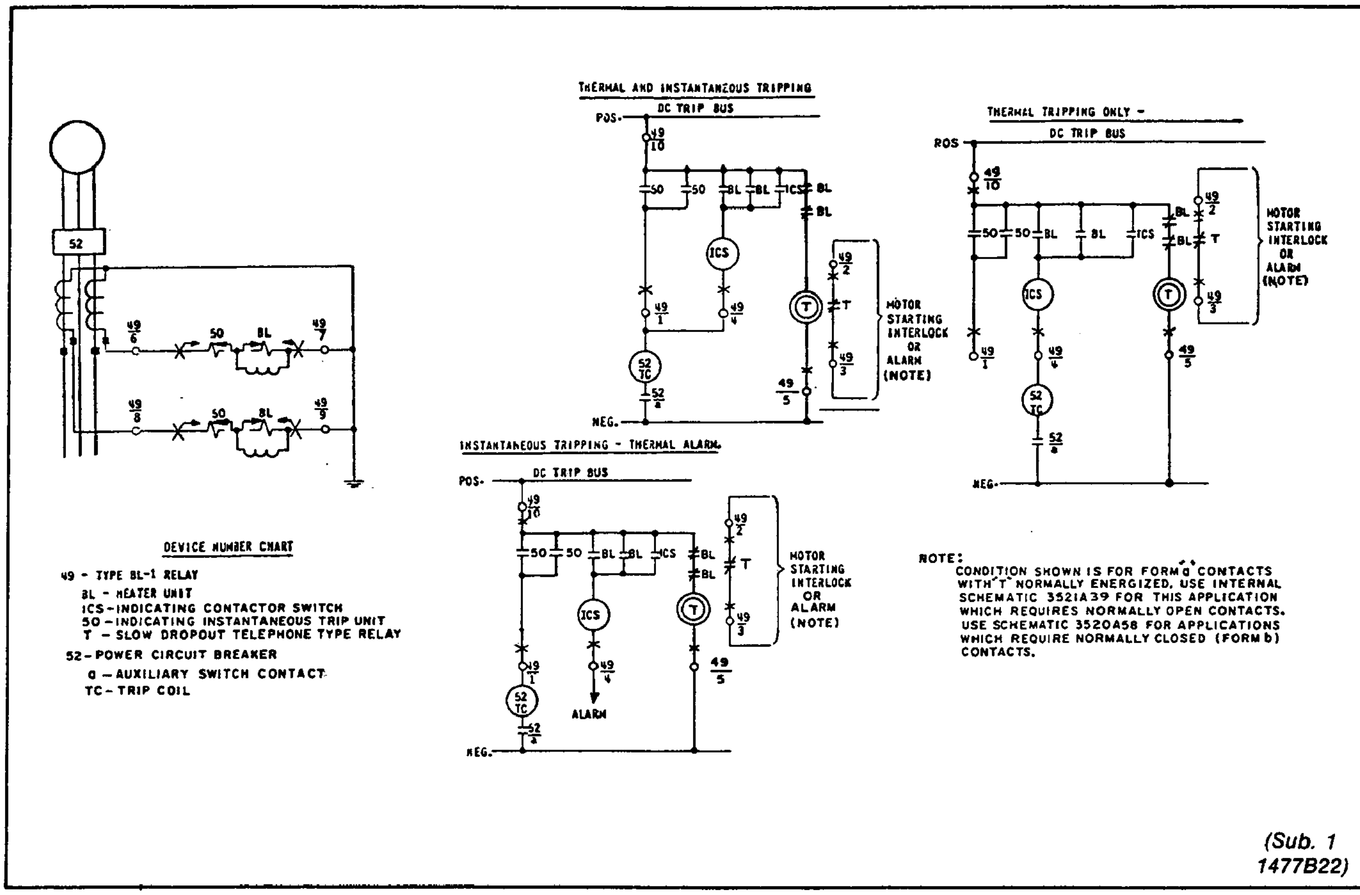



*Fig. 9. External Schematic of the Type BL-1 Double Unit Relay, with Front and Back Contacts in the Type FT 31 Case.*

maintained long enough for the moving contact to stop moving. Then the current is increased to some percent of pointer setting to obtain the operating time.

It will be observed that the curves for the 2.5 and the 3.5 ampere settings diverge somewhat as the overload increases. The amount of divergence will not seriously affect any application of the relay. For full load current settings greater than 2.5 amperes but less than 3.5 amperes, the operating time at any of the higher values of overload can readily be obtained by interpolation.

Since an overload might occur at or shortly after the time a motor is started, or after a motor has reached a constant temperature rise while carrying less than full load, Figs. 3 and 4 show how the operating time will be affected for a zero initial load and for a 70 percent initial load. As would be expected, the operating time is somewhat longer for these conditions, but the protected motor could carry the overload longer before reaching a dangerous temperature.

The entire heaters are in the circuit for the curves of Fig. 3. The outer scale markings range from 2.5 to 3.5 amperes in 0.25 ampere steps, and when the scale pointer is set to one of the indicated current values the relay contacts will close in approximately 60 minutes if the current increases to 125 percent of the full load value after the full load current has been flowing long enough for the temperature rise to reach a constant value. These curves represent the primary performance requirements of the type BL-1 relay. While there are no uniform standards for the overload capacities of all types of motors, these relay characteristics will permit full utilization of the overload capacity of most motors at light overloads while providing rapid operation under heavy overloads.

For the curves of Fig. 4, the short-circuiting link is closed on the two right-hand terminals, thus leaving only a portion of each heater in the circuit. The inner scale markings, which range from 3.75 to 5.0 amperes in 0.25 ampere steps, have the same significance as the outer scale markings which are used for the full heater, as described for Fig. 6. The

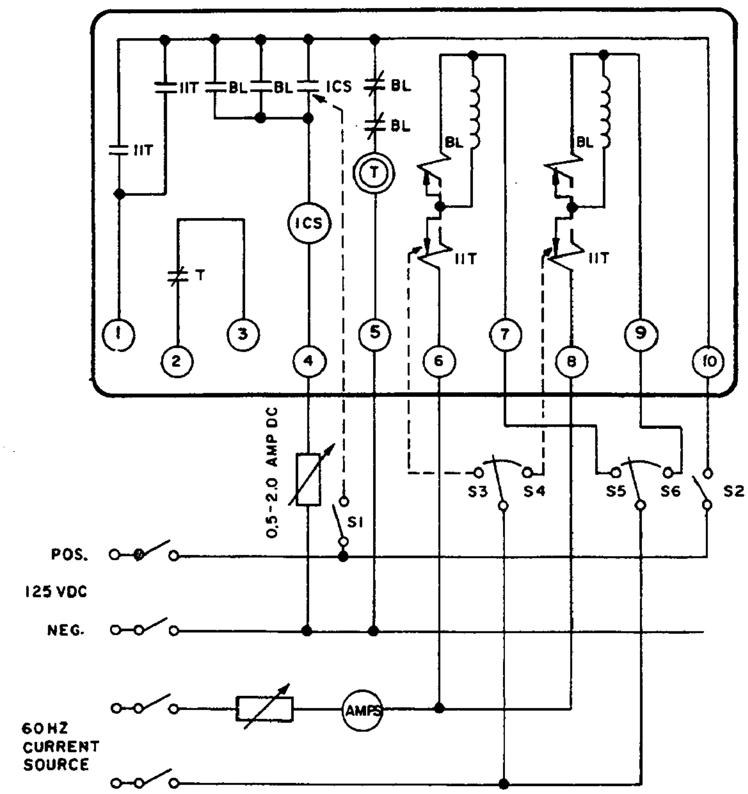



*Fig. 10. Test Diagram for Type BL-1 Double Unit Relay.*

curves for Fig. 4 are for the 3.75 and 5.0 ampere settings, and time values at high overloads at intermediate settings can be obtained by interpolation. The curves of Figs. 3 and 4 will be found to be very nearly identical if one set is superimposed on the other.

The heater element will not be injured by carrying a current of 35 amperes with the shorting link open, or 50 amperes with the link closed, for a length of time sufficient to close the contacts from a cold start with the pointer set at 3.5 to 5.0 amperes respectively. One-second ratings for the heater are twenty times the maximum full load current setting for the open and closed link positions, or 70 and 100 amperes respectively. On ac the reactor allows the above rating $I^2t$ ($70^2$ x 1 sec and $100^2$ x 1 sec) be extrapolated down to $I^2$ x 0.1 sec.

In certain applications it might be desirable to have faster operation at high values of overload. This can be accomplished by a change in the contact setting, but the operating time at light overloads will be reduced to a still greater extent and thus the full overload capacity of the motor at light overloads may be made unavailable. Fig. 5 shows time-overload characteristics for the limits of the adjustment range when the short-circuiting link is open and when the contact spacing has been reduced so that the contacts will close in 15 minutes on an overload of 125 percent after constant temperature has been reached on full load. For this combination of load and overload, at the end of the 15-minute period the pointer should be moved clockwise to a position where the contacts just close. It will not be possible to move the pointer sufficiently beyond the 2.5 ampere point to obtain a 15-minute setting for this value of full load, so Fig. 5 shows 2.75 amperes as being one end of the range for the accelerated operation. The upper end of the range when the shorting link is not used has been shown as 3.75 amperes, since the pointer position for a 15-minute setting at 125 percent of a 3.75 ampere full load current will be near or somewhat to the left of the 3.5 ampere scale marking.

It is not expected that these faster operating curves will be used for general application. They are presented to show how the relay characteristics may be modified to meet special conditions. Since the pointer position must be determined by test, it could be located to give a time other than 15 minutes at 125 percent overload. If the time were between 15 and 60 minutes, an approximate operating curve could be estimated by interpolation between Fig. 3 and 5.

Fig. 6 is similar to Fig. 5 but shows faster time-overload curves for full load currents that require the use of the shorting link.

It will be observed that the curves of Figs. 3 and 4 are approaching an asymptotic position at 125% of full load, and that the Figs. 5 and 6 are farther from their asymptotic position at 125% of full load, as would be expected because of the shorter time delay. Prior conditions of load (between zero and full load) will not affect the value of current that will ultimately close the relay contacts, but variables such as friction and discrepancies in calibration prevent precise location of the asymptotic value. However, after making some allowance for such variables, a value of 118% of full load current can be considered as the maximum current that will not produce eventual closing of the relay contacts when settings are made as described for Figs. 3 and 4. For settings made per Figs. 5 and 6 this current value will be 110% of full load.

Figs. 7 and 8 show resetting times for the type BL-1 relay for the shorting link opened or closed. The complete resetting time is considered to be the time measured from the moment the relay current is interrupted until the contacts return to the position they would occupy for the steady state condition of 100 percent of full load current. This complete time composed of the time required for the contacts to part and the time for them to travel back to 100 percent postion, and separate curves are shown for these two components of the complete time. The time will vary depending upon whether the overload occurs after the motor has been carrying 100 percent load or from a cold start, and curves are shown for the two conditions. The curves are shown for a relay setting at either end of the adjustment range, and intermediate values may be obtained by interpolation.

The ambient temperature compensation provided in the type BL-1 relay causes its operating time for a given current to remain approximately the same regardless of changes in the ambient temperature at the relay. If the ambient temperature at the motor location varies, the motor of course will carry a higher overload safely when the ambient temperature is low. However, a replica type relay cannot respond to the ambient temperature compensating means and unless it is mounted either adjacent to the motor or, if at a distance, in a location where there is assurance that the ambient temperature will vary in exactly the same way as at the motor. This condition frequently cannot be met. Also, the relay temperature at the operating point should be very close to that of the motor at its maximum safe operating temperature. The type BL-1 relay was designed for a minimum operating temperature much lower than the safe operating temperature of a motor, but with a similar rate of rise when the rise is expressed as a percentage of the total change in the relay temperature. This was done to obtain a low relay burden and to increase the amount of overload that the relay can carry without injury. With the low operating temperature of the type BL-1 relay, it would not be satisfactory to block or render inoperative the ambient temperature compensation, as even moderate changes in ambient temperature would cause appreciable changes in the relay operating time.

The instantaneous unit used in the type BL-1 relay has three taps covering a range from 6 to 144 amperes. The core screw must be adjusted for the desired trip current within a given range.

The Indicating Contactor Switch (ICS) Unit normally supplied in the type BL-1 relay will pick-up at 1.0 amperes direct current.

## CONTACT RATINGS

| Unit | Control Voltage | Control Capacity in Amperes Will Break | Will Close |
|---|---|---|---|
| Heater | 125 Vdc | 0.8 | 3.0 † |
| Heater | 250 Vdc | 0.6 | 3.0 † |
| ● Heater | 120 Vac | 5.0 | 5.0 † |
| Instantaneous | 125 Vdc | 1.5 | 30.0 †† |
| ● Instantaneous | 120 Vac | 15.0 | 30.0 †† |

† These values apply where the contactor switch is not used to seal around the heater unit contact or contacts. For tripping duty, the heater unit contacts can close 30 amperes at 125 or 250 volts dc if these contacts are sealed around by the ICS units.

†† The IIT unit contacts will carry 30 amperes for 1 second.

### ICS

Three different operate level ratings are available.

#### Trip Circuit Constants

| | |
|---|---|
| 0.2 ampere dc rating | 8.5 ohms dc resistance |
| 1.0 ampere dc rating | 0.37 ohm dc resistance |
| 2.0 ampere dc rating | 0.10 ohm dc resistance |

### IIT

Time of operation of the IIT unit at twice pickup is 35 milliseconds or less.

## INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the four mounting holes on the flange for the semi-flush type FT case. The mounting screws may be utilized for grounding the relay. External toothed washers are provided for use in the locations shown on the outline and drilling plan to facilitate making a good electrical connection between the relay case, its mounting screws and the relay panel. Ground Wires should be affixed to the mounting screws as required for poorly grounded or insulating panels. Other electrical connections may be made directly to the terminals by means of screws for steel panel mounting.

For detail information on the FT case refer to I.L. 41-076 for semi-flush mounting.

## SETTINGS

There are two settings to be made on the relay. They are the IIT Unit and the BL Heater Unit.

### IIT UNIT

Set the element for a pick-up current slightly above the maximum current which the apparatus may receive in normal service, as for example, the starting current of motor or the magnetizing inrush current of a transformer. The proper tap must be selected and the core screw must be adjusted to the value of pick-up current desired.

The nameplate data will furnish the actual current range that may be obtained from the IIT unit. It is recommended that the IIT be set on the higher tap where there is a choice of tap settings. For example, for a 20 ampere setting use the 20 to 50 tap rather than the 6 to 20 tap.

**CAUTION:** Since the tap block connector screw on the IIT unit carries operating current, be sure that the screw is turned tight. To avoid opening the current circuits under load, do not change tap position without first opening the case mounted test switches starting with the red handle switch first. Close the red handle switch last, after all tap changes have been completed, to put the relay back into service.

### BL HEATER UNIT

For the usual case, setting the thermal element involves only locating the scale pointer at a position corresponding to the full load secondary current of the protected equipment, and opening or closing the shorting link depending upon whether the pointer is being set in accordance with the upper or the lower scale markings. The relay then will have the characteristics shown in Figs. 3 and 4. This method of setting the relay for various full load currents affords greater flexibility in application and precision in setting than is provided by multi-tapped heater units or by interchangeable heater units of various ratings.

It is desirable to have a time-current heating curve for the protected equipment, or to know the lengths of time that the equipment will stand several different values of overload. These time should be as high or higher than the relay times for the same load and overload conditions, as shown by Figs. 3 and 4.

For full load currents which lie between any two values marked on the scale, the pointer can be moved to a readily estimated intermediate position with negligible error. Even if the pointer were left at the nearest scale marking the maximum deviation in pointer position from the actual load current would be only 2.5% at the 5.0 ampere setting, increasing to 5% at the 2.5 ampere setting. The scale lengths will vary somewhat in different relays due to variations in the thermally sensitive springs. However, some movement of the pointer will be possible counterclockwise from the 3.5 ampere point or clockwise from the 3.75 ampere point, so that for a full load current between 3.5 and 3.75 amperes the scale pointer can be set in a corresponding position without appreciable error.

If the safe operating time of the equipment at some high value of overload should be less than the corresponding relay time, and if the instantaneous unit cannot be set as low as this value of overload, either some additional relay must be used to provide a shorter operating time at this overload but with a pickup setting higher than the lesser overloads, or the type BL-1 relay must have its settings changed for faster operation. This rarely should be necessary, but if it is required the contact setting must be determined by test. It would be undersirable to complicate and confuse the scale by adding markings for special operating conditions, and the added calibrating time would increase the cost of the relay unnecessarily. Also, no single special condition would be likely to occur more frequently than others.

Figs. 5 and 6 illustrate the reduction in operating time obtained by decreasing the contact travel, but these curves also show that the time at low overloads is reduced by a much greater percentage than the time at high overloads. Since in general this will prevent the overload capacity of a motor at low overloads (which probably will occur most frequently) from being fully utilized, the characteristic curves should not be lowered more than necessary below those of Figs. 3 and 4.

If it is determined that the relay should be set by test to obtain faster operation, it should be allowed to stand de-energized for several hours if the check is to made from a cold start. The cover should be on the relay when the check is made, of course. It is recommended that the check be made at 125 percent of the current setting, or that this point be included in case more than one overload is checked. Set the adjustable break contacts to their preferred position before setting the pointer in its final position. After energizing the relay for the required time with required value of overload, which should be carefully regulated or adjusted throughout the run, the pointer should be moved clockwise until the adjustable contacts just touch the moving contact. Due to a slight amount of play in the gearing, if the pointer is moved counterclockwise until the contacts just part, its position may differ slightly from its position when moved clockwise until the contacts just touch. The calibration points on the scale are determined by moving the pointer clockwise until the contacts just touch and the same procedure should be followed when making subsequent setting.

The adjustable break contacts control the slow dropout telephone type relay "T", when supplied which can be used to prevent re-starting a motor until some desired time interval has elapsed after the motor has been disconnected due to overload. By setting the break contacts close to the make contacts, they can be used to initiate an alarm on opening, thus giving warning of the existence of an overload before the motor reaches a temperature at which it should be disconnected (by the make contacts) and possibly permitting readjustment of the load so that it does not become necessary to disconnect the motor. A scale having ten major divisions and fifty minor divisions is provided on the plate on which the make contacts are mounted. The scale is intended as a position reference only and has no affixed relation to opening times.

### "Preferred Position of Break Contacts"

The vertical edge of the plate for mounting the make contacts should be positioned between the fourth minor division from the right and the first major division of the scale. See Fig. 11. This setting will provide "make" contacts with a seismic fragility of greater than 5.9g ZPA as defined in IEEE Standard C37.98-1978. It will also provide sufficient force between the break contacts at rated load to enable an external alarm or prevent logic to work properly. **The break contacts are not seismically rated.**

The vertical edge setting may be set for a larger contact gap but should not be set for more than six minor divisions if the break contacts are to be in a closed position at full load.

External diagram in Fig. 9 show several combinations for applying these units.

## ADJUSTMENT & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

### ROUTINE MAINTENANCE,

All relays should be inspected and checked once a year or at other time intervals as dictated by experience to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. If an additional time check is desired, pass test current through the relay and check the time of operation.

All contacts should be periodically cleaned. A contact burnisher #182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

## ACCEPTANCE CHECK AND CALIBRATION

### ICS ACCEPTANCE CHECK

Refer to test diagram shown in Fig. 10. Connect an adjustable dc current source to relay terminal 4 as shown with a jumper type connection made inside the relay. Connect the jumper to the right hand (facing the front of the relay) stationary contact of the ICS located in the lower right position.

Close switch S1 and pass sufficient dc current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS nameplate rating. The indicator target should drop freely.

Repeat above except to pass 85% of ICS nameplate rating current. Contacts should not pick up and target should not drop. Open switch S1 when checking is completed.

### ICS CALIBRATION

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustment have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See "Acceptance Check").

Initially adjust unit on the pedestal so that armature fingers do not touch the yoke in the reset position. This can be done by loosening the mounting screw in the molded pedestal and moving the ICS in the downward position.

1. Contact Wipe: Adjust the stationary contacts so that both stationary contacts make with the moving contacts simultaneously and wipe 1/64" to 3/64" when the armature is aganist the core.

   For double trip type units, adjust the third contact so that it makes with its stationary contacts at the same time as the two main contacts or up to 1/64" ahead.

2. Target: Manually raise the moving contacts and check to see that the target drops at the same time the contacts make or up to 1/16" ahead. The cover may be removed and the tab holding the target reformed slightly if necessary. However, care should be exercised so that the target will not drop due to a slight jar.

3. Pickup: Unit should pickup at 98% of rating and not pickup at 85% or rating. If necessary the cover leaf springs may be adjusted. To lower the pickup current, use a tweezer or similar tool and squeeze each

leaf spring approximate equally by applying the tweezer between the leaf spring and the front surface of the cover at the bottom of the lower window.

If the pickup is low the front cover must be removed and the leaf springs bent outward equally.

Open Switch S1 when testing is completed.

## IIT ACCEPTANCE CHECK

The IIT Unit requires a higher level of current for testing than is required by the BL thermal unit. Fig. 10 shows connections by which the IIT units may be checked without passing current through the BL unit. When applying current in excess of 50 amperes to test the IIT, the current should **not** be left on while adjusting it to the trip level. Instead, apply the current in short burst, not more than 2 seconds long, to check for tripping. Make adjustments in the current controls while the current is off.

High currents left on for excessive time periods can result in the softening and possible melting of insulation on the interconnecting wires.

Connect a 60 Hz current source to relay terminals 6 and 8 as shown. Switch S3 is connected by a jumper to the upper left IIT tap screw. Switch S4 is connected by a jumper to the lower left IIT tap screws. Close S3 to check the upper left IIT, close S4 to check the lower left IIT. Open the switch when check is complete.

The core screw which is adjustable from the top of the trip unit and the tap located on the top of the IIT determine the pickup value. The trip unit has a nominal ratio of adjustment of 1 to 24.

The indication should occur within 1/16" before, or at the same time, the contacts make.

The moving contact should provide 1/64" to 3/64" wipe of the stationary contact. This should provide a minimum of 3 grams contact pressure with the armature held against the core.

Apply sufficient current to operate the IIT. The operation indicator target should drop freely.

## IIT CALIBRATION

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments disturbed. This procedure should not be used until it is apparent that the relay is not in proper working order (See "Acceptance Check").

Initially adjust unit on the pedestal so that the armature fingers do not touch the yoke in the reset position. This can be done by loosening the mounting screw in the molded pedestal and moving the IIT in the downward direction.

1. Contact Wipe: Adjust the stationary contacts so that both stationary contacts make with the moving contacts simultaneously and wipe 1/64" to 3/64" when the armature is held against the core. This can be accomplished by inserting a .0125 thickness gauge between the armature and core and adjusting the stationary contacts until they just touch the moving contacts.

   For double trip types adjust the third contact until it makes with its stationary contact at the same time as the two main contacts or up to 1/64" ahead.

2. Target: Manually raise the moving contacts and check to see that the target drops at the same time the contacts make or up to 1/16" ahead. If necessary, the cover may be removed and the tab holding the target reformed slightly. However, care should be exercised so that the target will not drop due to a slight jar.

3. Pickup: Place tap screw in the 6 to 20 tap and turn the core screw all the way in. Contacts should pickup between 5.1 and 5.7 amperes. If pickup is above this range it may be reduced by using a tweezer or similar tool and squeezing each leaf spring approximately equally by applying the tweezer between the leaf spring and the front surface of the cover at the bottom of the lower window. If the pickup is below this range it may be increased by removing the front cover and bending the leaf springs

outward equally. An approximate adjustment would be where the end of the leaf spring is in line with the edge of the molded cover.

The desired pickup is obtained by setting the tap screw in the proper range and adjusting the core screw.

## "T" TELEPHONE TYPE RELAY CHECK

The T unit has a copper slug located on the core at the end away from the clapper type armature. This construction provides a fast-pick-up and a slow-drop-out characteristic. The purpose of this unit is to "ride through" momentary openings of the BL break contacts which might occur during vibrating conditions which might be produced during a seismic event.

Connect relay terminals 5 and 10 to a 125 Vdc source as shown in Fig. 10. Close switch S2 and observe that T contacts connecting relay terminals 2 and 3 change state. Open S2 and observe that T contacts return to their deenergized condition in 105 ms to 125 ms.

## HEATER UNIT

The assembly and adjustment of the thermal unit requires alignment fixtures and other special tools, as well as special test equipment for locating the position of the compensating spring assembly on the shaft and determining the calibration points. Any dismantling or alteration of the adjustments should be avoided, as this may result in excessive bearing friction or calibration errors. However, the construction and overload capacity of the thermal unit is such that very little maintenance should be required.

The resistance of the heater and the IIT set for 6-20 range measured at the case terminals, should be within 10% of 0.25 ohm when the shorting link is open and 0.20 ohm when the link is closed.

The moving contact should rotate without noticeable friction, and when displaced manually and released it should return to its original position. The shaft should have about 0.010 inch end play.

If the calibration of the thermal unit is to be checked at one or more points, the precautions mentioned in previous sections should be observed. Testing should be done with the relay in its case and the cover in place, and preferably with the case mounted on a switchboard panel. If the relay time is to be checked from a cold start, the relay should have been de-energized for several hours beforehand. If the overload is to be applied following a constant load, the current must be maintained at the constant initial value until there is no further change in the moving contact position before applying the overload. Both the load and overload currents must be carefully regulated throughout the test. The relay should not be subjected to drafts or sudden changes in temperature during the test, as there is some delay in the response of the temperature compensation. In the factory calibration the relay is held in a controlled temperature and other precautions are taken to minimize factors which would introduce calibration errors.

The test current should be interrupted as soon as the contacts close in order to avoid possible damage to the heaters, particularly when testing at high values of overload.

## RENEWAL PARTS

Repair work can be done most satisfactory at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. Completely assembled and calibrated thermal elements can be furnished, but individual parts for the thermal element should not be ordered since factory fixtures and equipment are necessary for satisfactory assembly and calibration. When ordering parts, always give the complete nameplate data.

## ENERGY REQUIREMENTS

The burdens of the BL heater unit and the IIT unit are listed separately below. Total impedance may be determined by adding the two together for the settings selected.

## BL UNIT

| Heater Tap Link Position | Amps For Burden Test | Ohms At Test Amperes | | Continuous Rating Amps |
|---|---|---|---|---|
| | | $Z/\theta$ | R + jX | |
| Open | 3.5 | 0.266/0.2° | 0.265+j0.001 | 3.5 |
| Open | 5.0 | 0.266/0.2° | 0.265+j0.001 | 3.5 |
| Closed | 5.0 | 0.138/0.2° | 0.138+j0.0005 | 5.0 |

## IIT UNIT

| ● Ampere Range Of IIT | Tap Setting Amperes | Ohms At 5 Amperes And Minimum Pickup Current | | Continuous Rating Amps |
|---|---|---|---|---|
| | | $Z/\theta$ | R + jX | |
| 6–144 | 6–20 | 0.18 /37° | 0.144+j0.108 | 6 |
| | 20–50 | 0.026/27° | 0.023+j0.012 | 13 |
| | 50–144 | 0.009/13° | 0.009+j0.002 | 20 |

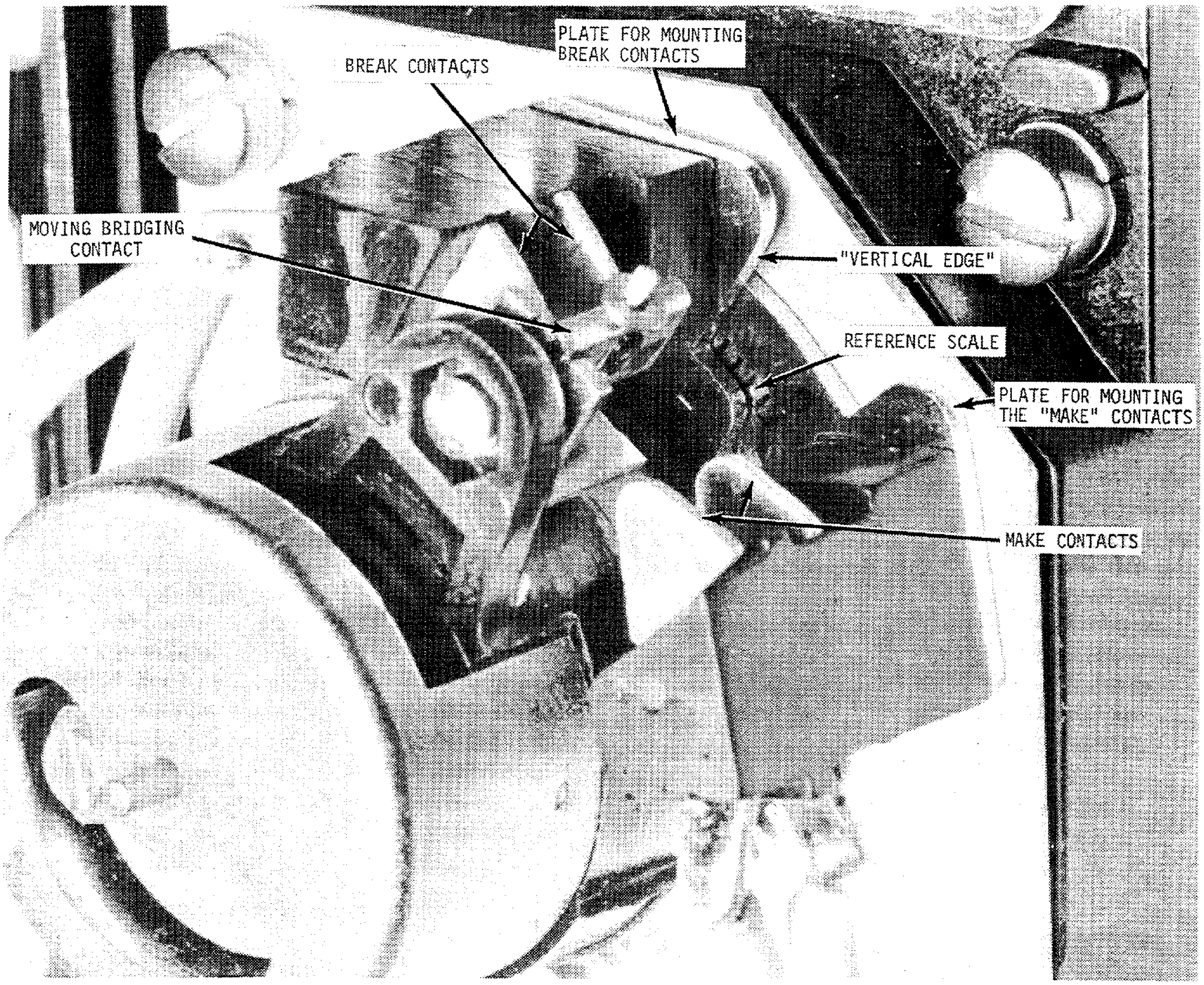



*Figure 11. "Setting for make contacts"*

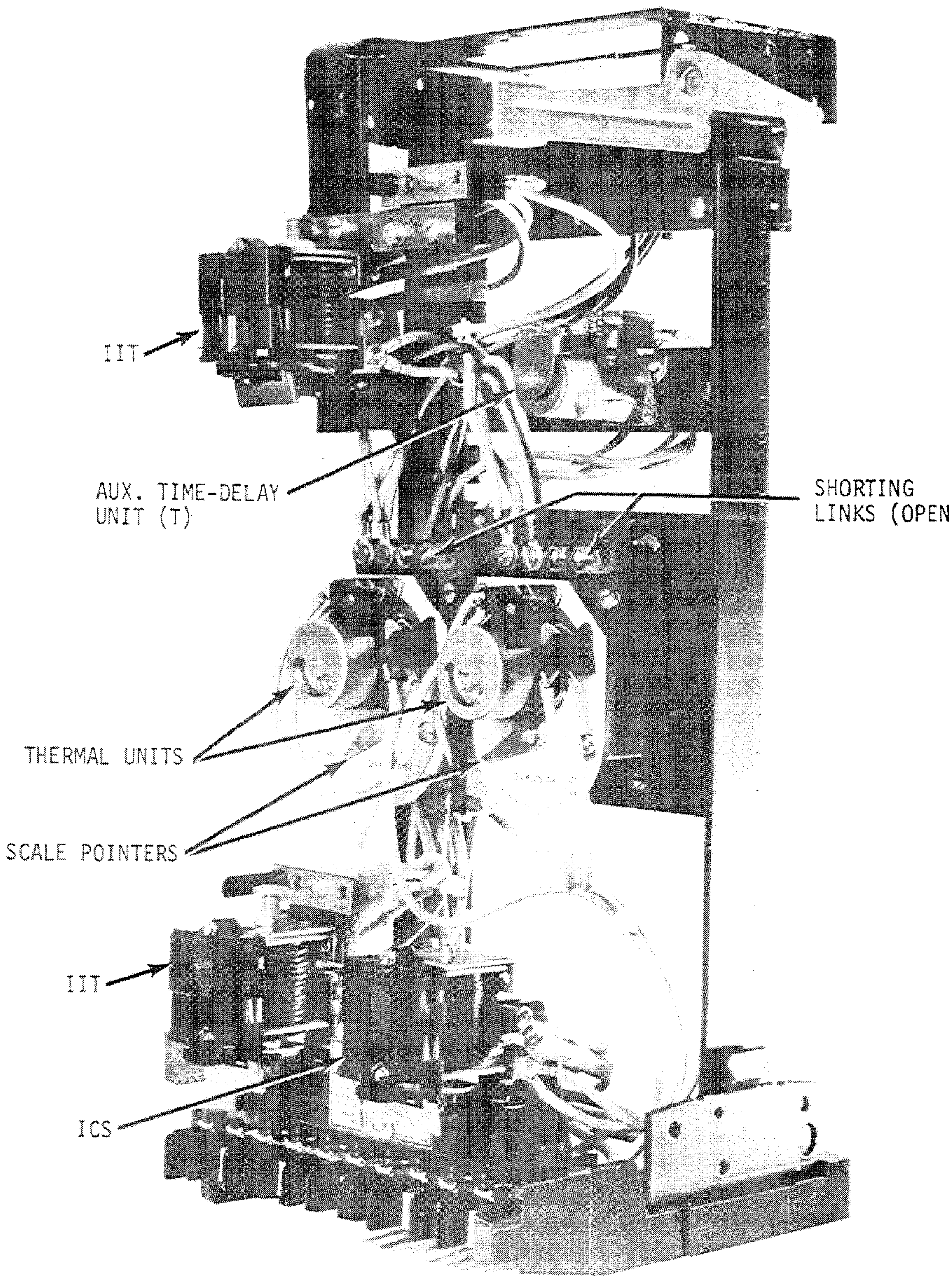



*Figure 12. BL-1 Relay-front view.*

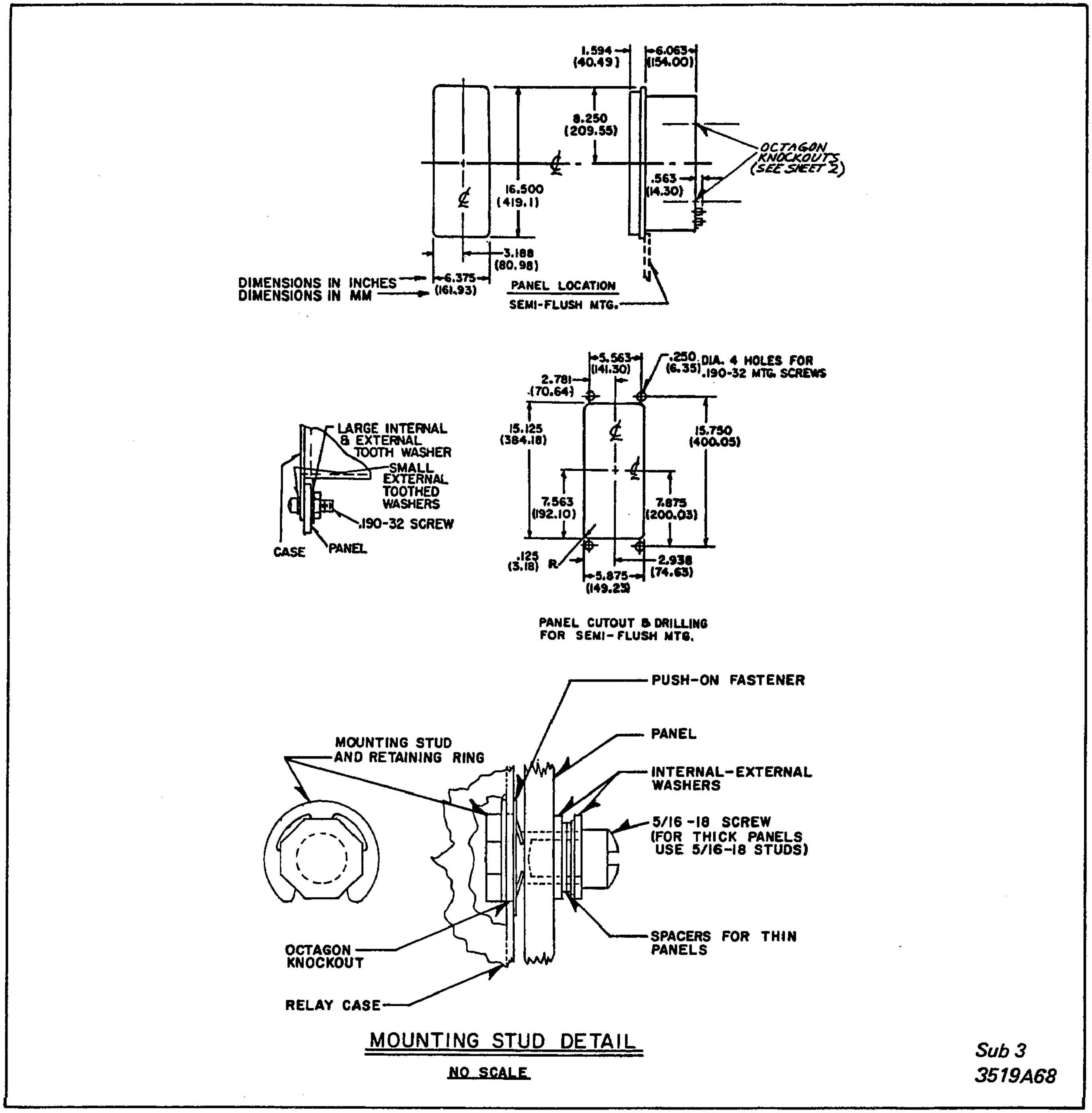



*Fig. 13. Outline and Drilling Plan for the BL-1 Relay in Type FT 31 Case.*

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