Instruction Leaflet
41-553.1G

Effective: February 1978
Supersedes I.L. 41-553.1F datedd January 1976

✪ Denotes Change Since Previous Issue

Type BL-1 Thermal Overload Relay

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

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 single element type BL-1 relay consists of a heater unit, an instantaneous overcurrent unit, ✪ two operation indicators, and a contactor switch. (Figures 1 & 3).

The double element type BL-1 relay contains two heater units, two instantaneous units, three ✪ operation indicators, and a contactor switch. (Figures 2 & 4).

THERMAL UNIT

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

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation of maintenance of this equipment, the local ABB representative should be contacted.

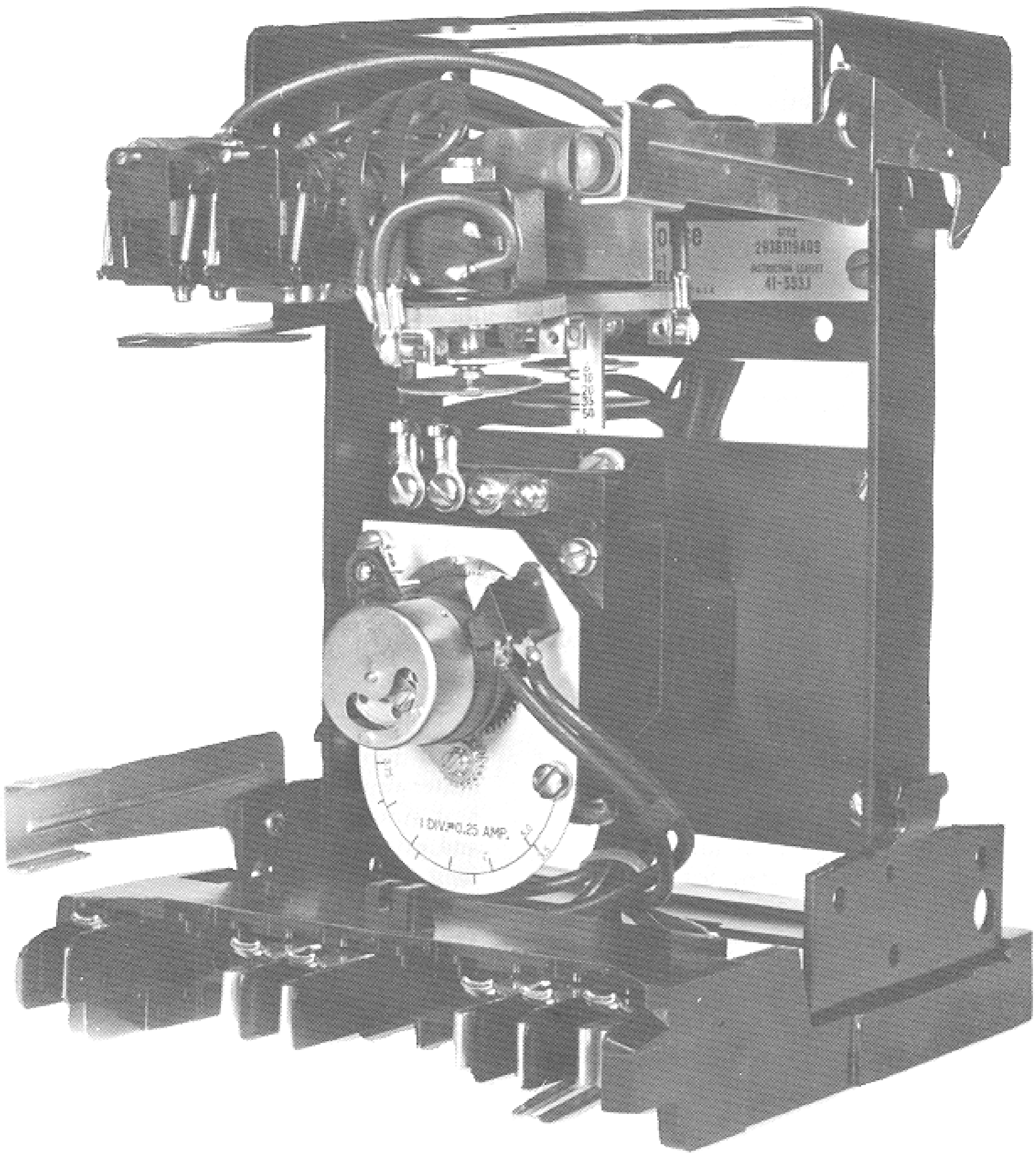

Fig. 1 Type BL-1 Single Unit Relay without case (Front View)

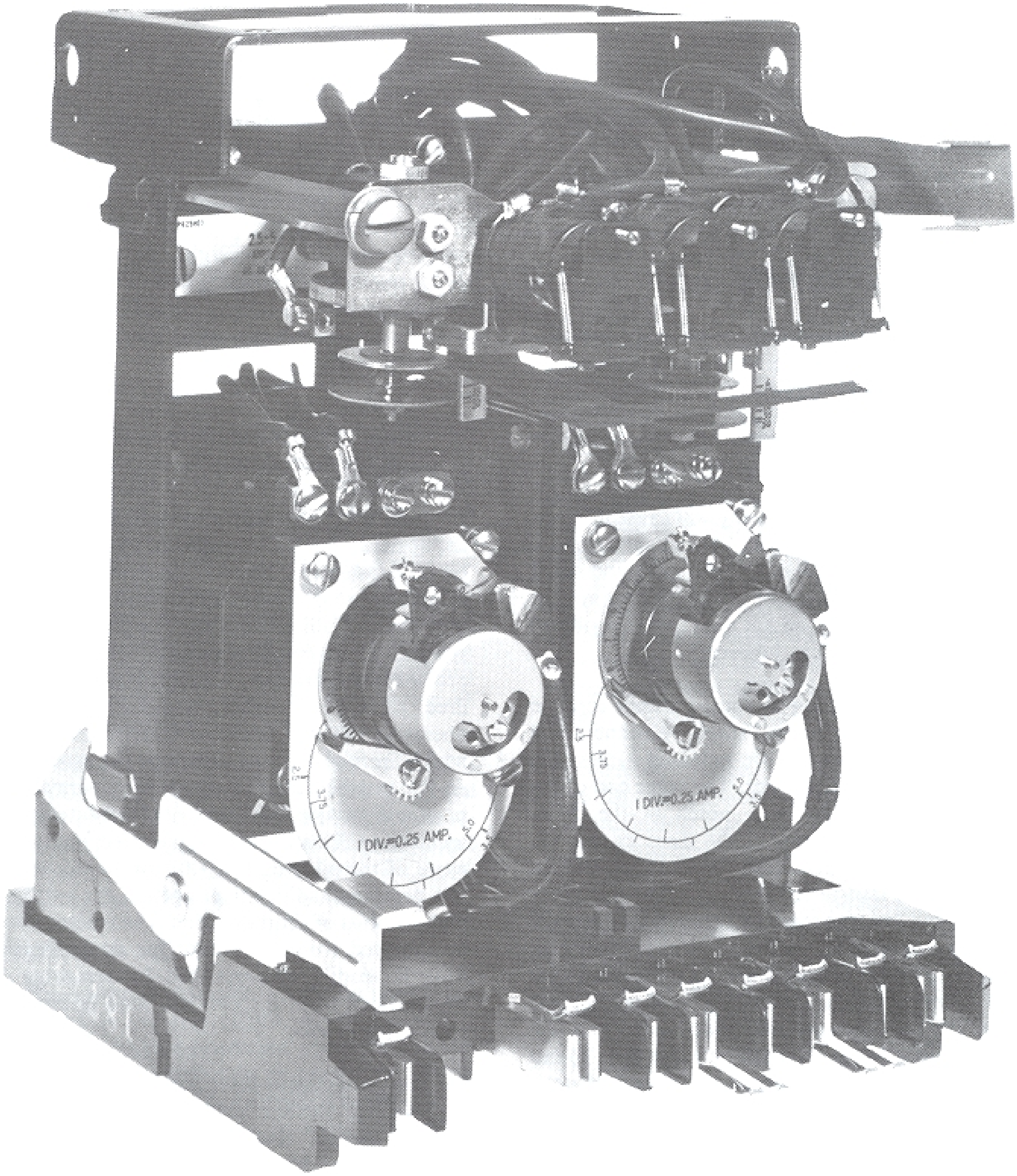

Fig. 2. Type BL-1 Double Unit Relay without case (Front View)

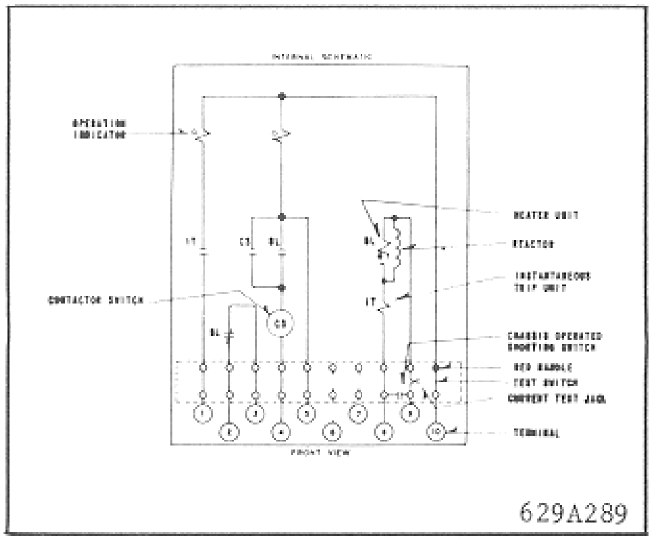

Fig. 3. Internal Schematic of the Type BL-1 Single Unit Relay, with Front and Back Contacts, in the Type FT21 Case. Relays with a Front Contact Only Have the Circuits Associated with Terminals 2 and 3 Omitted.

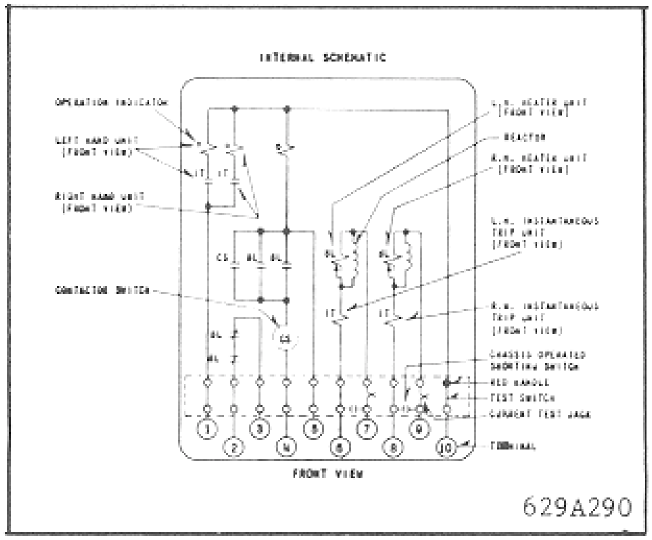

Fig. 4. Internal Schematic of the Type BL-1 Double Unit Relay, with Front and Back Contacts, in the Type FT21 Case. Relays with Front Contacts Only Have the Circuits Associated with Terminals 2 and 3 Omitted.

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. 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 full 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 can be provided when required. 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 the spacing between the make and the break contacts.

INSTANTANEOUS UNIT

This is a small solenoid type unit. A cylindrical plunger moves up and down on a vertical guide rod in the center of the solenoid coil. This guide rod is fastened to the stationary core which in turn screws into the element frame. A silver disc is fastened to the moving plunger thru a helical spring. When the coil is energized, the plunger moves upward carrying the silver disc which bridges three conical shaped stationary contacts. After the contacts close the plunger moves slightly farther before seating against the stationary core. This assures positive contact pressure.

A Micarta disc on a threaded bushing is assembled on the lower portion of the guide rod and is locked in place by a nut. Its position determines the de-energized position of the plunger and therefore the pickup current of the element, as indicated by the graduated scale beside the disc.

OPERATION INDICATOR

The operation indicator is a small solenoid coil connected in the trip circuit. When the coil is energized, a spring-restrained armature releases the white target which falls by gravity to indicate the completion of the trip circuit. The indicator is reset from outside the case by a push rod in the cover or cover stud.

CONTACTOR SWITCH

The dc contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch contacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. These contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker.

CHARACTERISTICS

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 the range, the relay can be set to operate in accordance with the characteristic curves shown in Figs. 5 and 6. 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 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.

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. 5 and 6 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.

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.

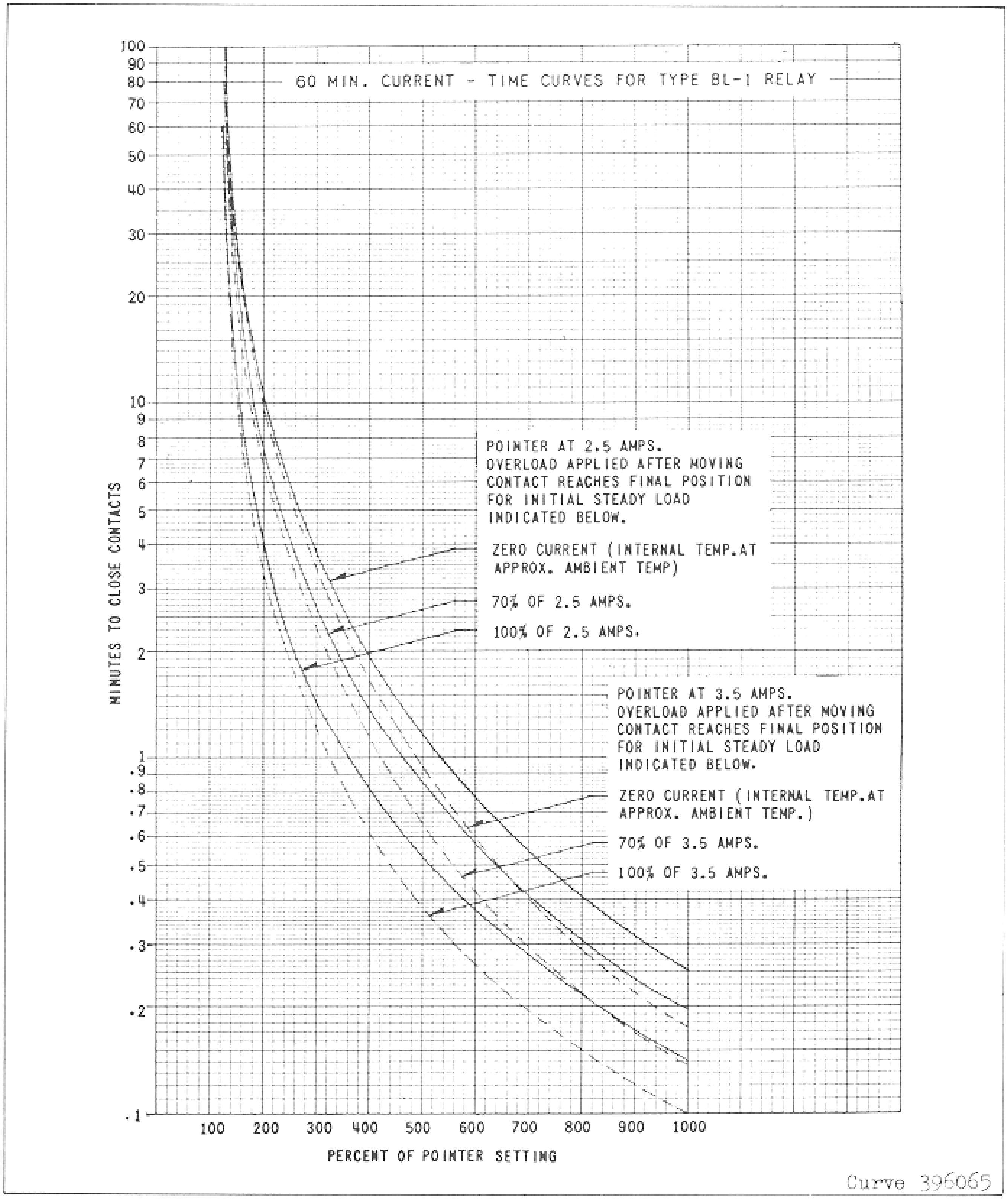

Fig. 5. Current-Time Curves for Normal Applications of the Type BL-1 Relay Covering Range of Full-Load Currents from 2.5 to 3.5 Amperes, Using Pointer Settings marked on Dial. 60-Minute Time-Delay for 125% Load Occurring after Steady Full-Load. Shorting Link Open.

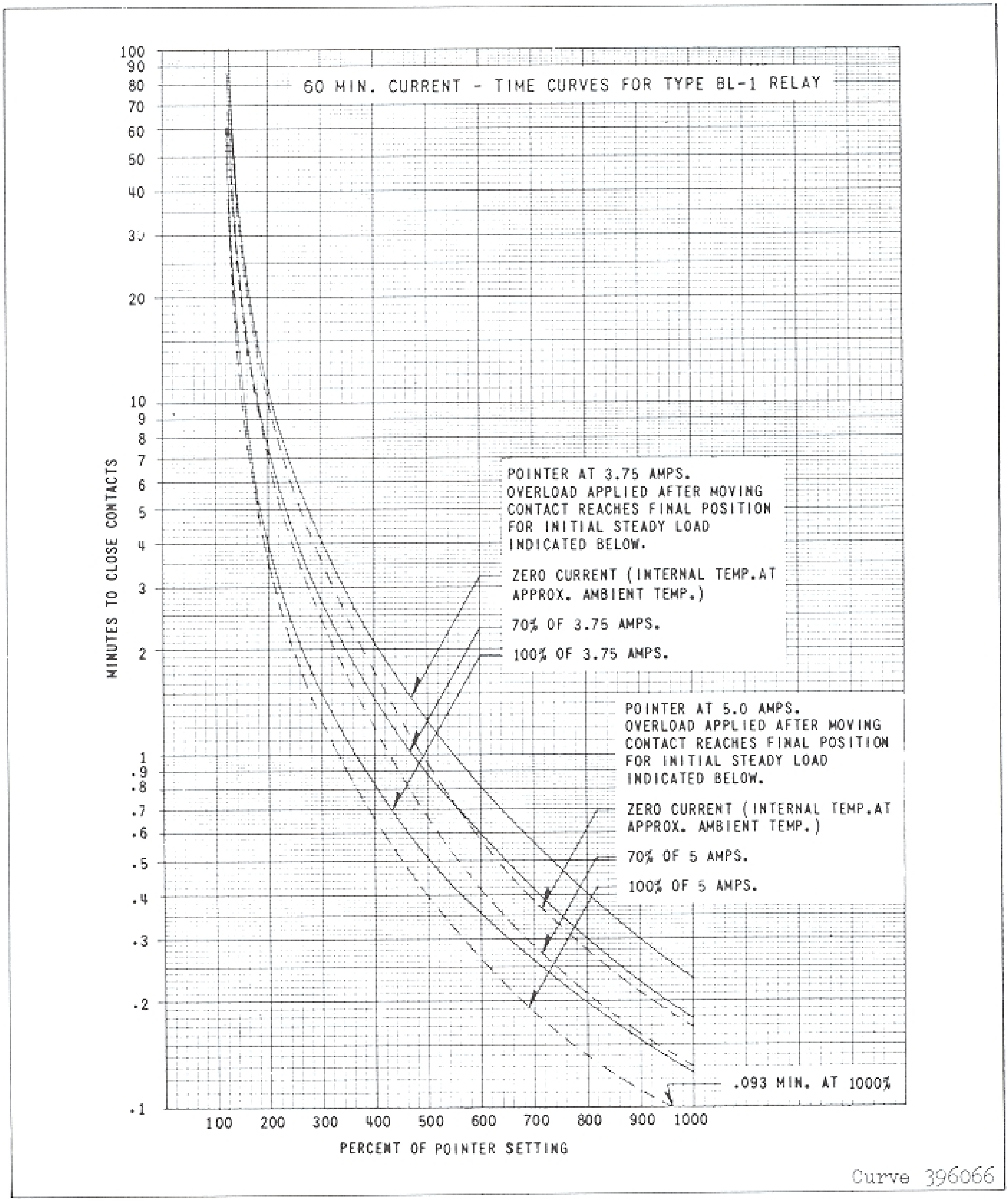

Fig. 6. Current-Time Curves for Normal Applications of the Type BL-1 Relay Covering Range of Full Load Currents from 3.75 to 5.0 Amperes, using Pointer Settings marked on Dial. 60-Minute Time-Delay for 125% Load Occurring after Steady Full-Load. Shorting Link Closed.

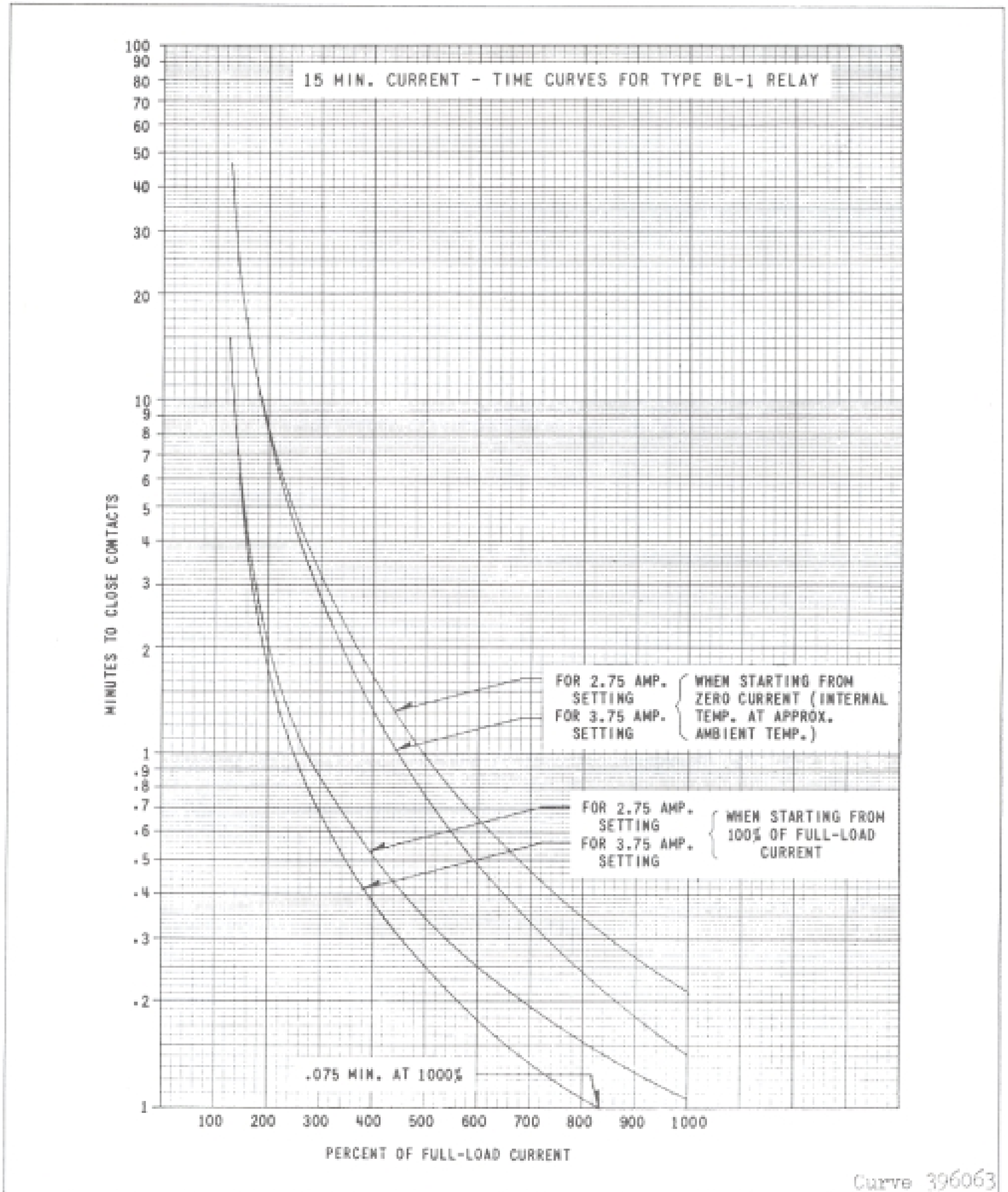

Fig. 7. Current-Time Curves for Special Applications of the Type BL-1 Relay covering Range of Full-Load Currents from 2.75 to 3.75 Amperes. Contact Settings Determined by Test for 15-Minute Delay with 125% Load Occurring after Moving Contact reaches Final Position for Steady Full-Load. Shorting Link Open.

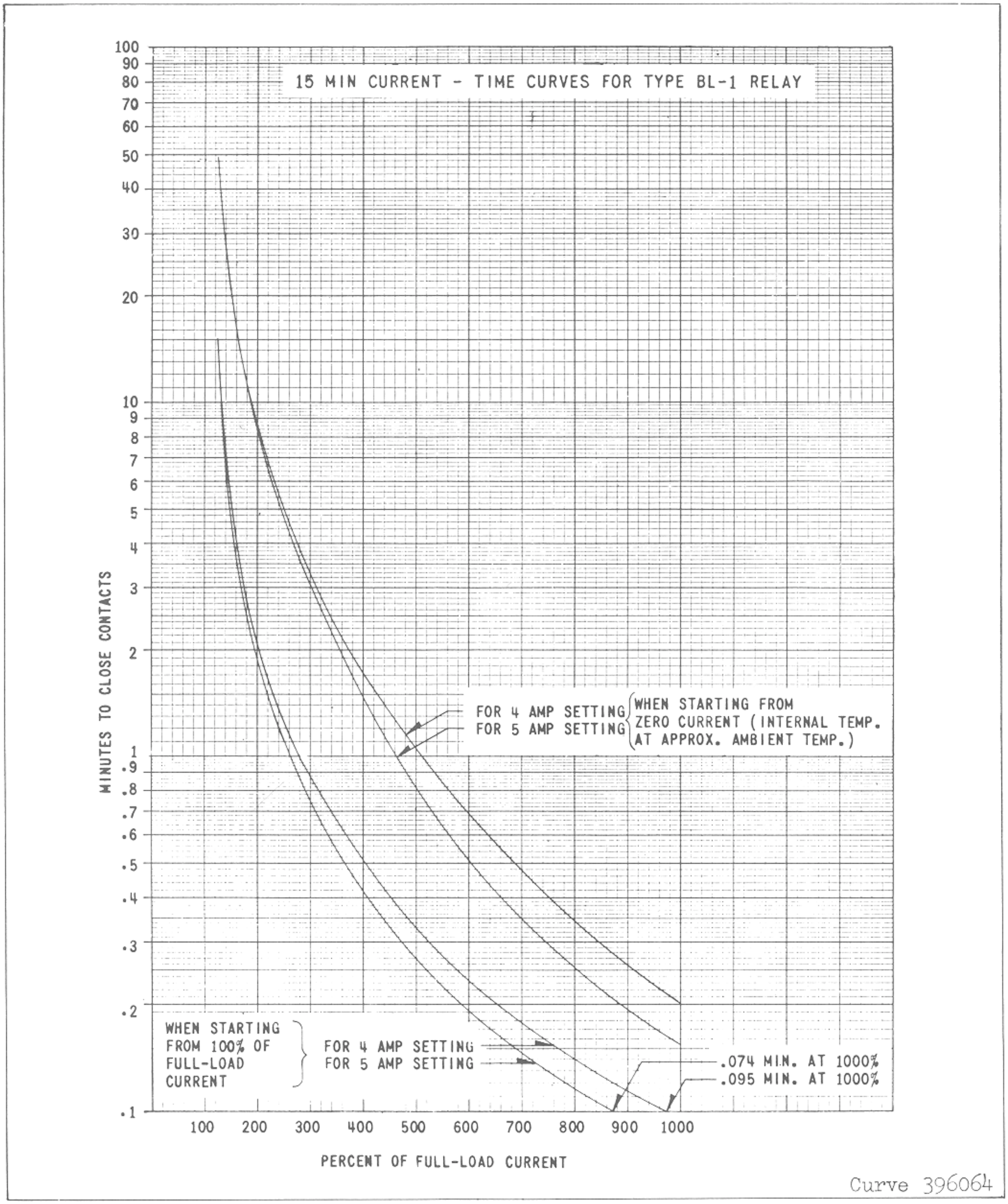

Fig. 8. Current-Time Curves for Special Applications of the Type BL-1 Relay Covering Range of Full-Load Currents from 4.0 to 5.0 Amperes. Contact Settings Determined by Test for 15-Minute Delay with 125% Load Occurring after Moving Contact reaches Final Position for Steady Full Load. Shorting Link Closed.

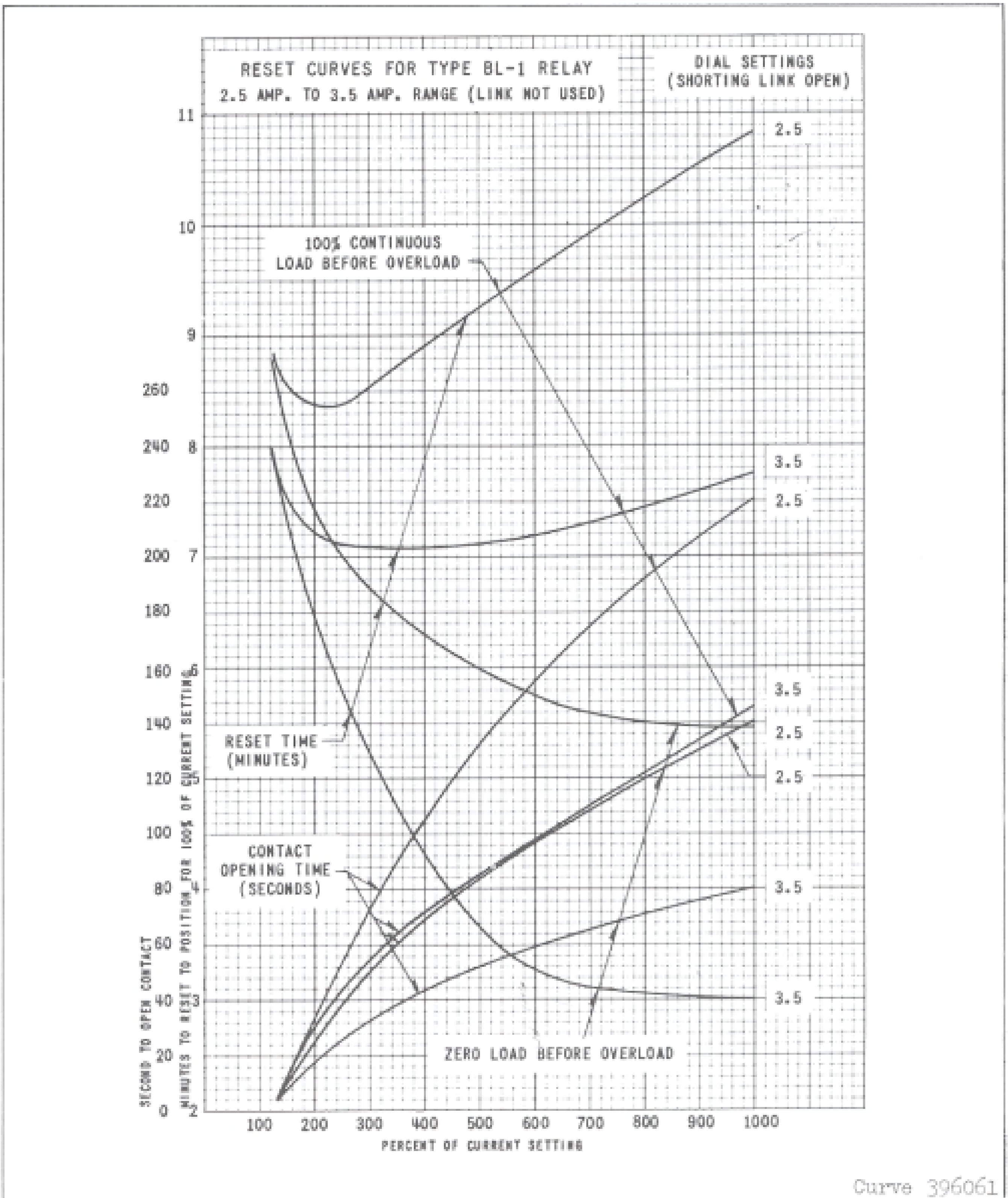

Fig. 9. Contact-Opening and Reset Time Curves for the Type BL-1 Relay for Full-Load Settings of 2.5 to 3.5 Amperes as marked on Dial. Shorting Link Open.

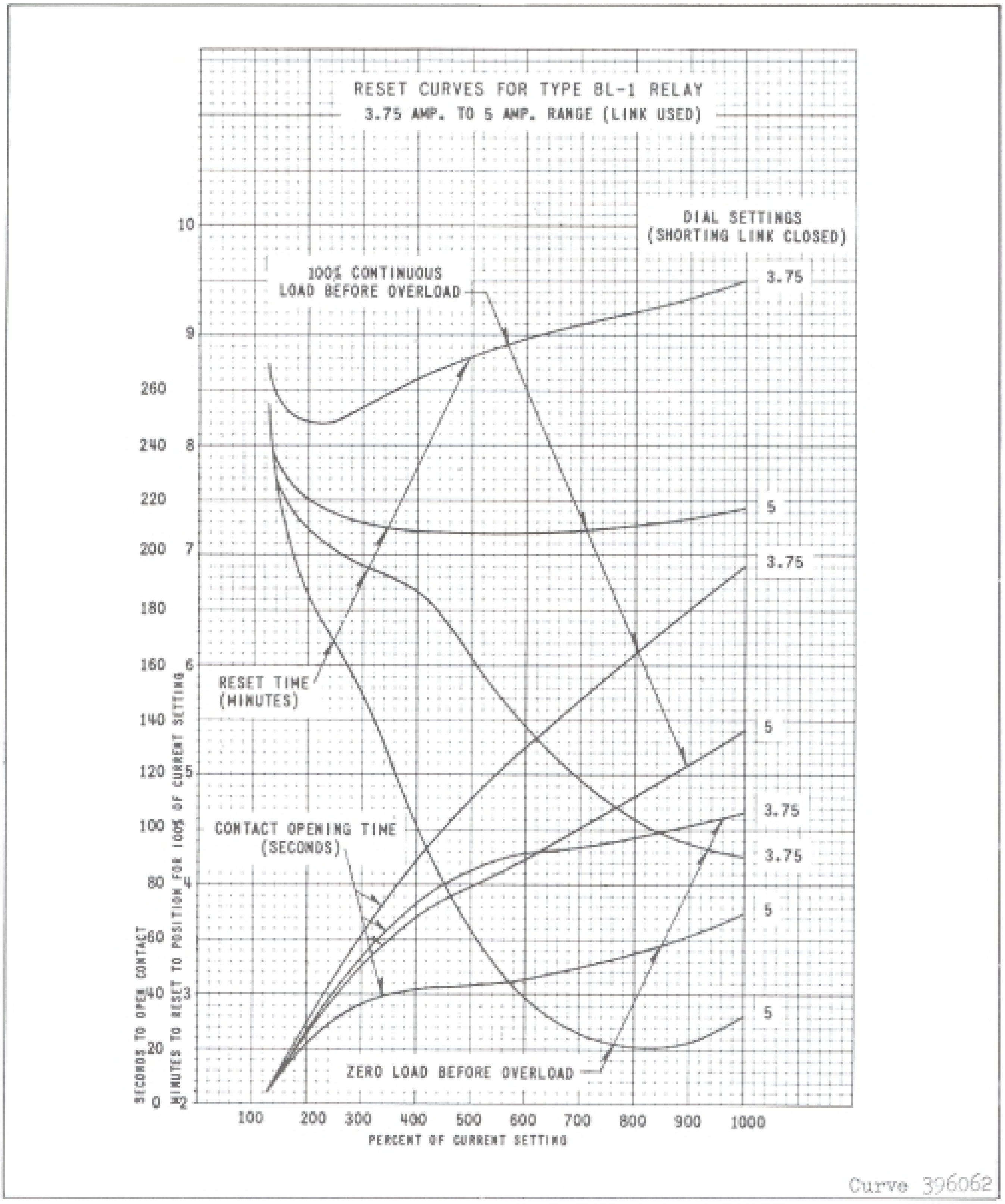

Fig. 10. Contact-Opening and Reset Time Curves for the Type BL-1 Relay for Full-Load Settings of 3.75 to 5.0 Amperes as marked on Dial. Shorting Link Closed.

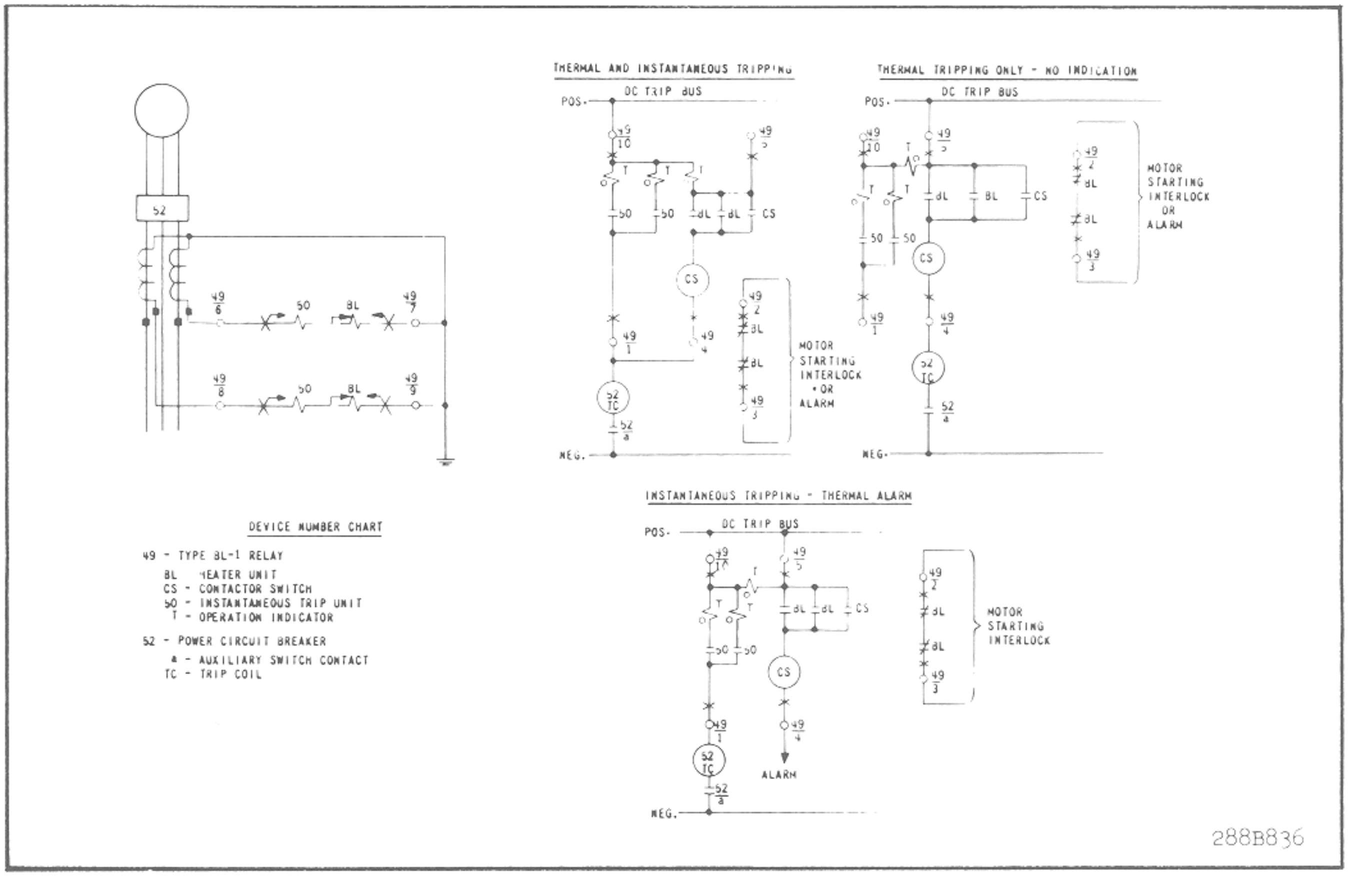

Fig. 11. ***External Schematic of the Type BL-1 Double Unit Relay, with Front and Back Contacts in the Type FT21 Case.***

The entire heaters are in the circuit for the curves of Fig. 5. 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. 6, 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. 8. The curves for Fig. 6 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. 5 and 6 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 maximun full load current setting for the open and closed link positions, or 70 and 100 amperes respectively. On ac the reactor allows the above ratings 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. 7 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 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. 7 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. 5 and 7.

Fig. 8 is similar to Fig. 7 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. 5 and 6 are approaching an asymptotic position at 125% of full load, and that the curves of Figs. 7 and 8 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. 5 and 6. For settings made per Figs. 7 and 8 this current value will be 110% of full load.

Figs. 9 and 10 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 is composed of the time required for the contacts to part and the time for them to travel back to 100 percent position, 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 as 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 at the motor unless it has no 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 a vertical scale graduated from 6 to 50 amperes. The scale markings indicate the pick-up current when the Micarta disc is opposite the scale division and when the element is in correct adjustment.

The operation indicator normally supplied in the type BL-1 relay will pick-up at 1.0 ampere direct current.

CONTACT RATINGS

Unit	Control Voltage	Control Capacity Will Break	In Amperes Will Close
Heater	125 Vdc	0.8	3.0 †
Heater	250 Vdc	0.6	3.0 †
Heater	120 Vdc	5.0	5.0 †
Instantaneous	125 Vdc	1.5	30.0 ††
Instantaneous	120 Vdc	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 contactor switch.

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

✪ 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 rear mounting stud or studs for the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either the stud or 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 or studs, and the relay panel. Ground Wires are affixed to the mounting screws or studs 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 or to the terminal stud furnished with the relay for thick panel mounting. The terminal stud may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detail information on the FT case refer to I.L. 41-076.

SETTINGS

There are two settings to be made on the relay. They are as follows:

1. INSTANTANEOUS 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. This setting is made by moving the Micarta disc to a point opposite the desired pick-up current value indicated on graduated scale. After the setting is made lock the disc in place by means of the locknuts.

2. 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. 5 or 6. 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 desireable 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 times should be as high or higher than the relay times for the same load and overload conditions, as shown by Figs. 5 and 6.

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 undesirable 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. 7 and 8 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. 5 and 6.

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 be 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. After energizing the relay for the required time with the 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 settings.

The adjustable break contacts, when supplied, 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 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, and an index mark on the plate which supports the break contacts is used for setting the break contacts at any desired position along the scale. The scale is intended as a position reference only and has no fixed relation to operating times. In many cases no great accuracy is required in the setting of the break contacts, and when closer settings are desired they should be made by test.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. Contact or pickup settings must be made as required by the application, but alteration of assembly adjustments should be avoided. If the adjustments have been changed, if the relay has been taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, instructions below should be followed.

All contacts should be cleaned periodically. A contact burnisher S#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.

INSTANTANEOUS UNIT

Remove the plunger core and see that the top of the plunger is clean. Reassemble the plunger, and adjust the position of the core screw so that when the contacts are closed the plunger butts against the stop with the spring half compressed. With a 1/32 inch contact separation, the contacts should pick-up at 6 amperes, 60 cycles. If the plunger does not pickup and seal in at this current, adjust the core screw so that it will and yet have sufficient compression of the spring to prevent sticking. Test for sticking after 50 amperes has been passed through the coil.

OPERATION INDICATOR

Adjust the indicator to operate at 1.0 ampere direct current gradually applied by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. If the two helical springs which reset the armature are replaced by new springs they should be weakened slightly by stretching to obtain the 1 ampere calibration. The coil resistance is approximately 0.16 ohm.

CONTACTOR SWITCH

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core of 1/64" when the switch is picked up. This can be done by turning the relay up-side-down or by disconnecting the switch and turning it up-side-down. Then screw up the core screw until the moving core starts rotating. Now, back off the core screw until the moving core stops rotating. This indicates the points where the play in the assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the core screw approximately one turn and lock in place. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 3/32" by means of the two small nuts on either side of the the Micarta disc. The switch should pick up at 2 ampere dc. Test for sticking after 30 amperes have been passed through the coil.

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 instantaneous unit, measured at the case terminals, should be 0.25 ohm when the shorting link is open and 0.13 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 swtichboard 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 satisfactorily 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 heater unit plus the 6-50 ampere instantaneous unit in series at 5 amperes 60 cycles is as follows:

Heater Tap Link Position	Continuous Rating Amp	Watt	Volt-Amp	Power Factor
Open	3.5	6.25	6.25	1.0
Closed	5.0	3.25	3.25	1.0

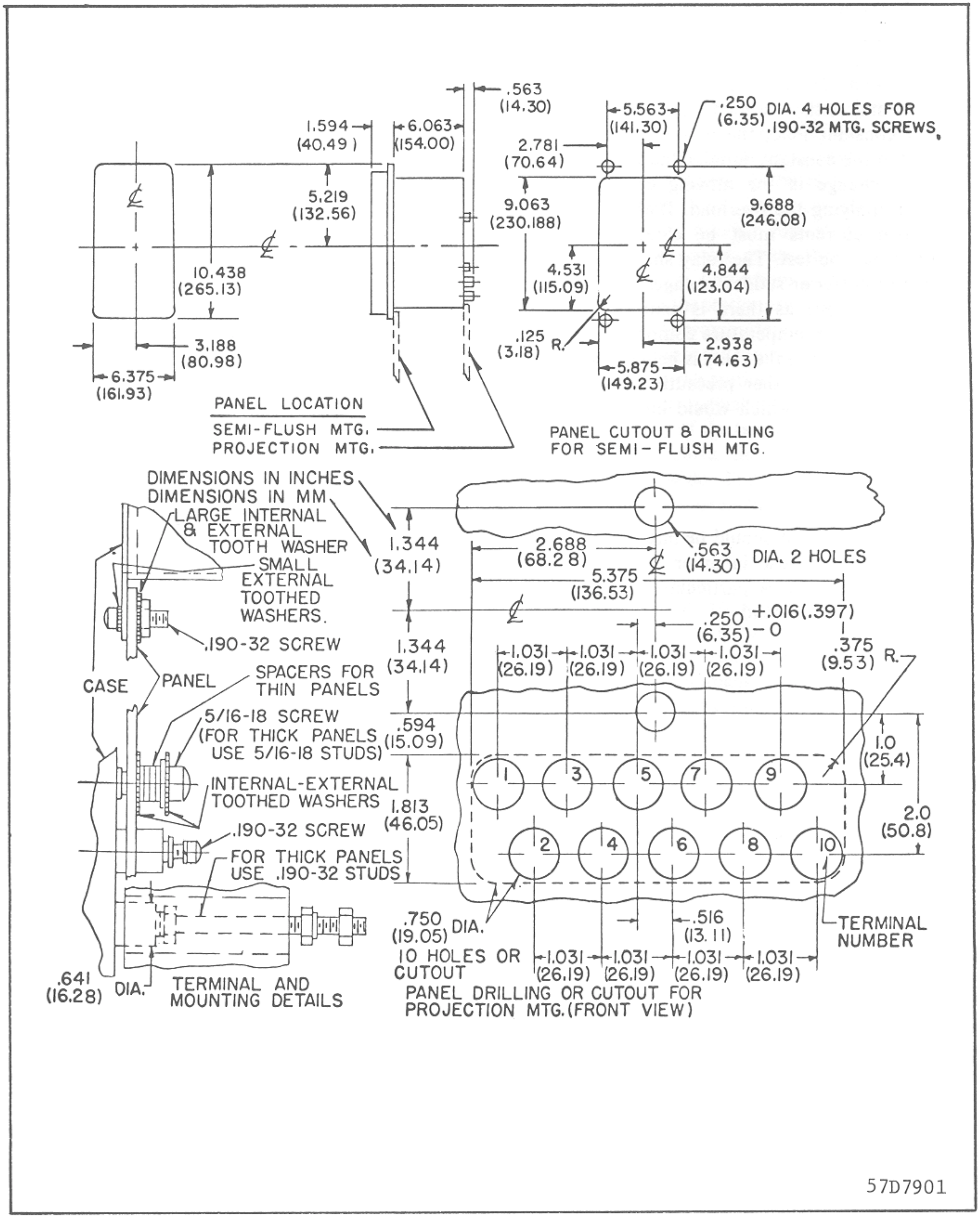

Fig. 12. Outline and Drilling Plan for the BL-1 Relay in Type FT21 Case.

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