INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KO-3 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 KO-3 is a high speed overcurrent relay used to control the transmission of carrier at a load tap on a transmission line protected at its two main terminals with carrier relays. For proper operation there must be no backfeed into the line from the tap. The KO-3 relay starts carrier for a fault on the tap beyond the relay and the carrier is transmitted to the two main terminals which blocks tripping. For a fault on the line, the KO-3 relay does not receive any current; consequently, it does not operate and the two main terminals trip to clear the fault.

CONSTRUCTION AND OPERATION

The type KO-3 relay consists of three high speed overcurrent units whose contacts are connected in series. Therefore, the operation of any one unit will start carrier.

The overcurrent unit is a product induction cylinder type unit. The time phase relationship of the two air gap fluxes necessary for the development of torque is achieved by means of a capacitor connected in series with one pair of pole windings.

Mechanically, the overcurrent unit is composed of four basic components: a die-cast aluminum frame, an electromagnet, a moving element assembly, and a molded bridge.

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The frame serves as the mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame.

The electromagnet has two pairs of coils. The coils of each pair are mounted diametrically opposite one another. In addition, there are two locating pins. The locating pins are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing, which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing which is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp.

With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

When the current in the overcurrent unit exceeds the pick-up value the contacts open, allowing positive potential to be applied to the carrier transmitter.

A transformer and varistor assembly is used in conjunction with the overcurrent unit. The transformer is of the saturating type which limits the energy to the overcurrent unit and reduces the burden on the operating CT.

The primary of the transformer is tapped and brought out to a tap connector block for ease in changing the pickup current

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of the relay. The use of a tapped transformer provides approximately the same energy level at a given multiple of pick-up current for any tap setting, resulting in one time curve throughout the range of the relay.

Across the secondary is connected a non-linear resistor known as a varistor. The effect of the varistor is to reduce the voltage peaks applied to the overcurrent unit and phase shifting capacitor.

CHARACTERISTICS

The relays are available in the following current ranges:

Range	Taps					
0.5 - 2 amps	0.5	0.75	1.0	1.25	1.5	2
1 - 4	1.0	1.5	2.0	2.5	3.0	4.0
2 - 8	2	3	4	5	6	8
4 - 16	4	6	8	9	12	16
10 - 40	10	15	20	24	30	40

The tap value is the minimum current required to just open the overcurrent relay contacts. For pick-up settings in between taps refer to the section under adjustments.

SETTINGS

The only setting required is made by inserting the tap screw in the tap to give the required pick-up of the overcurrent unit.

CAUTION

Since the tap block connector screw carries operating current, be sure that the screw is turned tight. In order to avoid the current transformer circuits when changing taps under load, connect the spare tap screw in the desired tap position before removing the other tap screw from the original tap position.

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

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four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

ADJUSTMENTS AND 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.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order:

Overcurrent Unit

With the tap screw in the desired tap hole, pass rated alternating current through the relay terminals. The contact should pick up within $\pm$ 5% of tap value.

ROUTINE MAINTENANCE

All relays should be inspected periodically and the operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application.

All contacts should be periodically cleaned. 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.

Calibration

Use the following procedure for calibrating the relay is the relay has been taken apart for repairs or the adjustments

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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").

Overcurrent Unit (1)

1. The upper pin bearing should be screwed down until there is approximately 1/64" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

   With the moving contact in the normally closed position, i.e., against the right side of the bridge, screw in the stationary contact until both contacts just close. Then screw in the stationary contact approximately one-half turn farther to provide the correct amount of follow.

   The clamp holding the stationary contact housing need not be loosened for the adjustment since the clamp utilizes a spring-type action in holding the stationary contact in position.

   With the tap screws in the desired tap hole, pass rated a-c through the relay terminals.

   The sensitivity adjustment is made by varying the tension of the spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   Adjust the spring until the contacts just open. With this adjustment, the pick-up of the relay for any other tap setting should be within ± 5% of tap value.

   If adjustment of pick-up current is between tap settings is desired insert the tap screw in the next lowest tap setting and adjust the spring as described. It should

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be noted that this adjustment results in a slightly different time characteristic curve and burden.

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. When ordering parts, always give the complete nameplate data.

RATINGS OF OVERCURRENT UNIT

Range	Continuous Rating Amps	One Second Rating Amps
.5 - 2	5	100
1 - 4	5	140
2 - 8	5	140
4 - 16	5	200
10 - 40	5	200

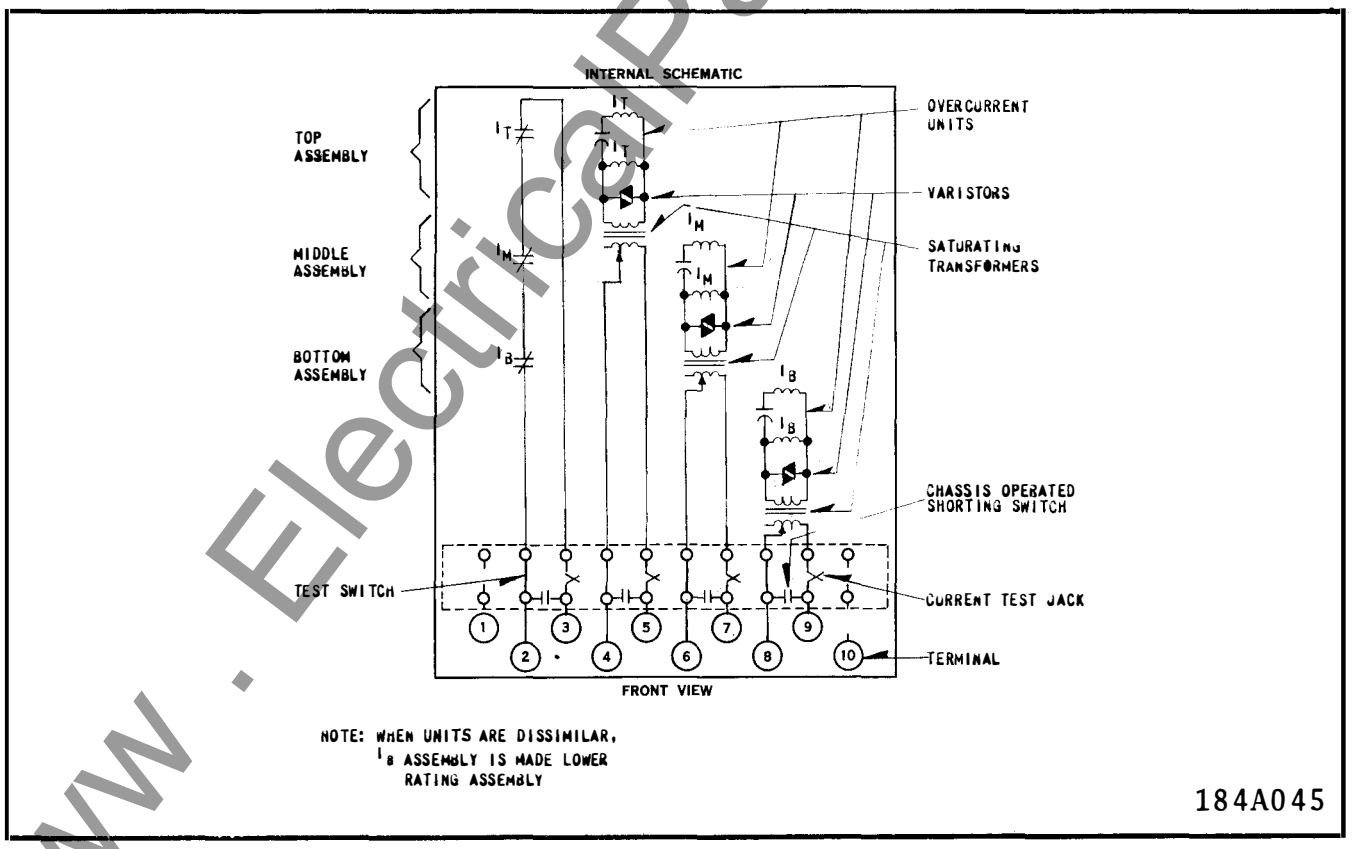

Fig. 1 Internal Schematic

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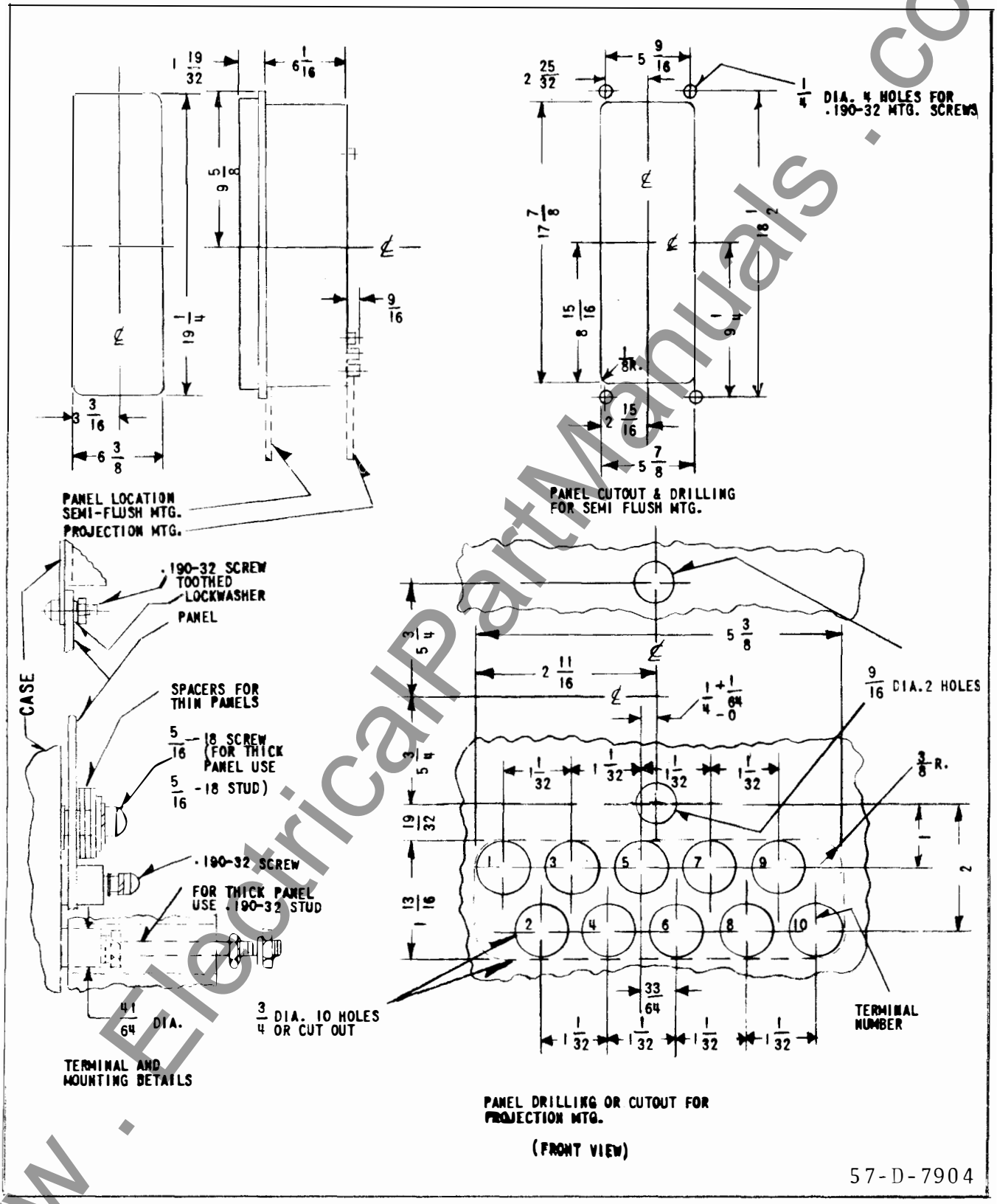

Fig. 2 Outline & Drilling (Type FT41 Case)

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ENERGY REQUIRMENTS

BURDEN DATA OF OPERATING CURRENT CIRCUIT - 60 CYCLES

RANGE AMPS	TAPS	VOLT - AMPERES FOR POWER CURRENT	POWER FACTOR ANGLE ϕ°	VOLT AMPERES AT 5 AMPERES	POWER FACTOR ANGLE ϕ°
	.5	.37	39	24	46
	.75	.38	36	13	37
.5-2	1	.39	35	8.5	34
	1.25	.41	34	6.0	32
	1.5	.43	32	4.6	31
	2	.45	30	2.9	28
	1	.41	36	9.0	36
	1.5	.44	32	5.0	32
1-4	2	.47	30	3.0	29
	2.5	.50	28	2.1	27
	3	.53	26	1.5	26
	4	.59	24	0.93	24
	2	1.1	49	6.5	48
	3	1.2	43	3.3	42
2-8	4	1.3	38	2.1	37
	5	1.4	35	1.4	35
	6	1.5	33	1.1	33
	8	1.8	29	0.7	29
	4	1.5	51	2.4	51
	6	1.7	45	1.2	45
4-16	8	1.8	40	0.7	40
	9	1.9	38	0.6	38
	12	2.2	34	0.37	34
	16	2.5	30	0.24	31
	10	1.7	28	.43	28
	15	2.4	21	.27	21
10-40	20	3.1	16	.20	17
	24	3.6	15	.15	15
	30	4.2	12	.11	13
	40	4.9	11	.08	12

FOR TYPE KO OVERCURRENT RELAY

184A093

Fig. 3 Burden Data

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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KO-3 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.

APPLICATIONS

The type KO-3 is a high speed overcurrent relay used to control the transmission of carrier at a load tap on a transmission line protected at its two main terminals with carrier relays. For proper operation there must be no backfeed into the line from the tap. The KO-3 relay starts carrier for a fault on the tap beyond the relay and the carrier is transmitted to the two main terminals which blocks tripping. For a fault on the line, the KO-3 relay does not receive any current; consequently, it does not operate and the two main terminals trip to clear the fault.

CONSTRUCTION & OPERATION

The type KO-3 relay consists of three high speed overcurrent units whose contacts are connected in series. Therefore, the operation of any one unit will start carrier.

The overcurrent unit is a product induction cylinder type unit. The time phase relationship of the two air gap fluxes necessary for the development of torque is achieved by means of a capacitor connected in series with one pair of pole windings.

Mechanically, the overcurrent unit is composed of four basic components: a die-cast aluminum frame, an electromagnet, a moving element assembly, and a molded bridge.

The frame serves as the mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame.

The electromagnet has two pairs of coils. The coils of each pair are mounted diametrically opposite one another. In addition, there are two locating pins. The locating pins are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing, which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearing. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing which is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp.

With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

When the current in the overcurrent unit exceeds the pick-up value the contacts open, allowing positive potential to be applied to the carrier transmitter.

A transformer and varistor assembly is used in conjunction with the overcurrent unit. The trans-

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*Denotes change from superseded issue.

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former is of the saturating type which limits the energy to the overcurrent unit and reduces the burden on the operating CT.

The primary of the transformer is tapped and brought out to a tap connector block for ease in changing the pickup current of the relay. The use of a tapped transformer provides approximately the same energy level at a given multiple of pick-up current for any tap setting, resulting in one time curve throughout the range of the relay.

Across the secondary is connected a non-linear resistor known as a varistor. The effect of the varistor is to reduce the voltage peaks applied to the overcurrent unit and phase shifting capacitor.

CHARACTERISTICS

The relays are available in the following current ranges:

Range	Taps					
0.5 – 2 amps	0.5	0.75	1.0	1.25	1.5	2
1 – 4	1.0	1.5	2.0	2.5	3.0	4.0
2 – 8	2	3	4	5	6	8
4 – 16	4	6	8	9	12	16
10 – 40	10	15	20	24	30	40

The tap value is the minimum current required to open the overcurrent relay contacts. For pick-up settings in between taps refer to the section under adjustments.

SETTINGS

The only setting required is made by inserting the tap screw in the tap to give the required pick-up of the overcurrent unit.

CAUTION

Since the tap block connector screw carries operating current, be sure that the screw is turned tight. In order to avoid the current transformer circuits when changing taps under load, connect the spare tap screw in the desired tap position before removing the other tap screw from the original tap position.

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 semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

ADJUSTMENTS & 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.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order:

Overcurrent Unit

With the tap screw in the desired tap hole, pass rated alternating current through the relay terminals. The contact should pick up within ±5% of tap value.

ROUTINE MAINTENANCE

All relays should be inspected periodically and the operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application.

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Calibration

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Overcurrent Unit (1)

1. The upper pin bearing should be screwed down until there is approximately 1/64" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

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   The clamp holding the stationary contact housing need not be loosened for the adjustment since the clamp utilizes a spring-type action in holding the stationary contact in position.

   With the tap screws in the desired tap hole, pass rated a-c through the relay terminals.

   The sensitivity adjustment is made by varying the tension of the spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

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RENEWAL PARTS

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RATINGS OF OVERCURRENT UNIT

Range	Continuous Rating Amps	One Second Rating Amps
.5 – 2	5	100
1 – 4	8	140
2 – 8	8	140
4 –16	10	200
10 –40	10	200

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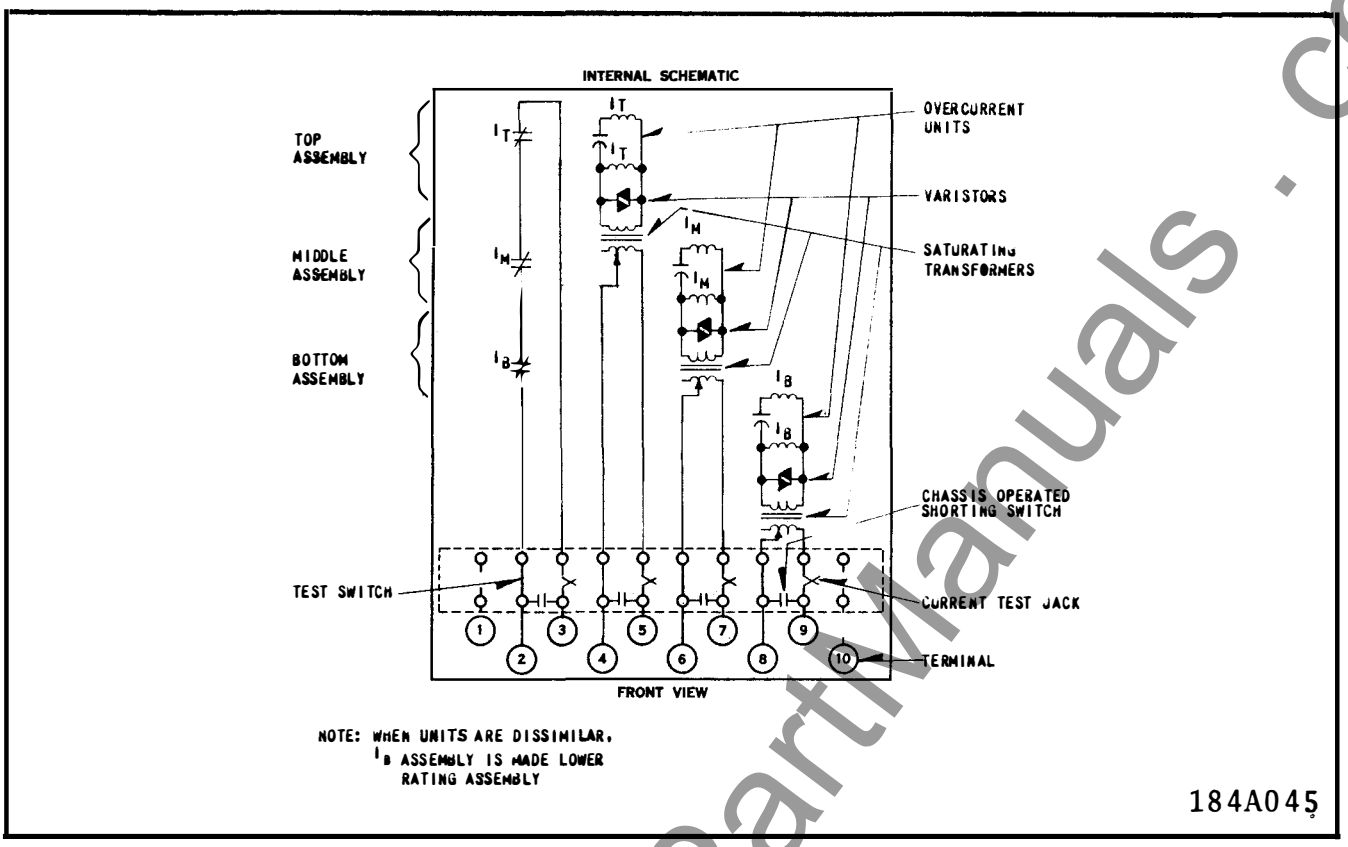

Fig. 1 Internal Schematic

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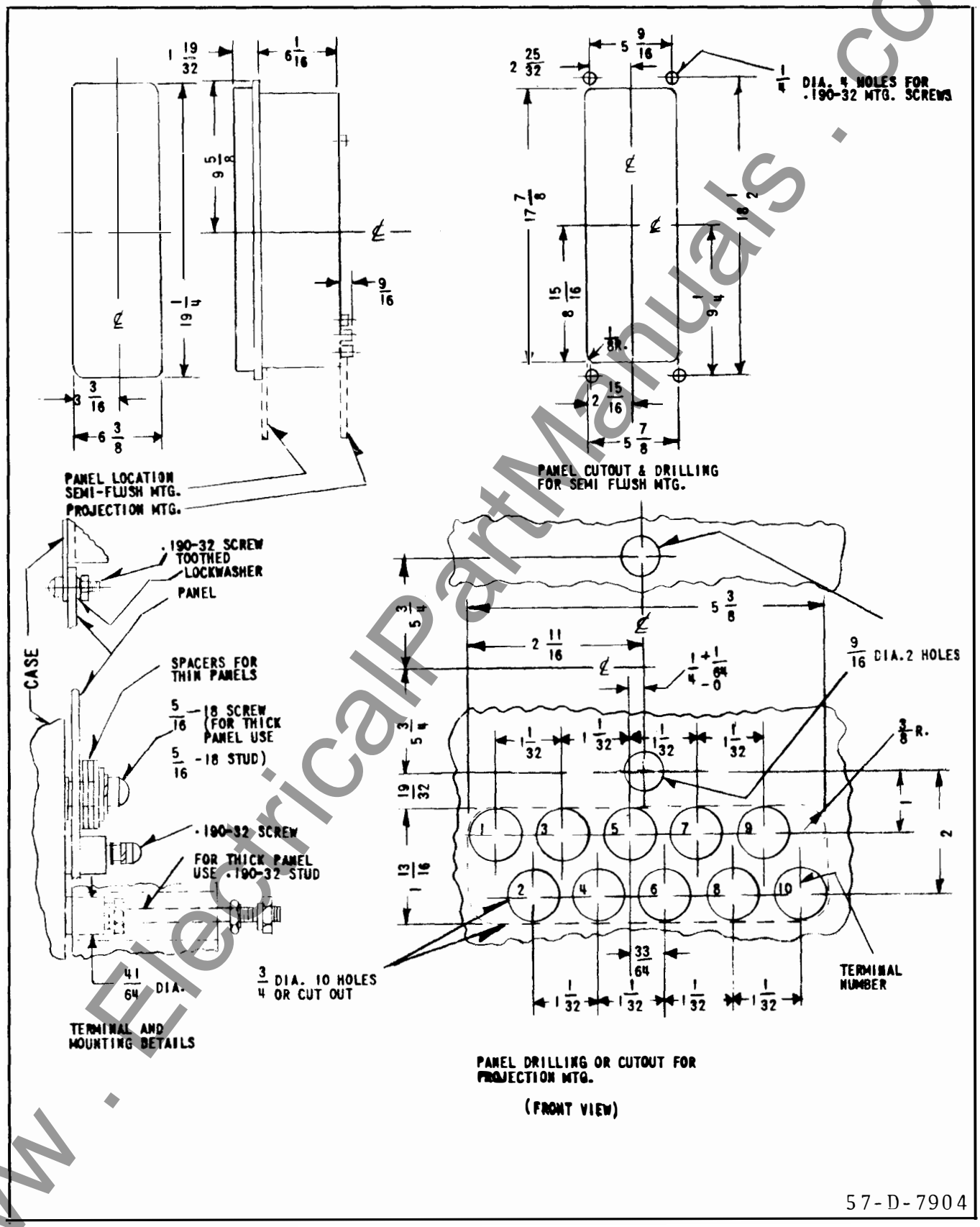

Fig. 2 Outline and Drilling (Type FT41 Case)

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ENERGY REQUIREMENTS
BURDEN DATA OF OPERATING CURRENT CIRCUIT – 60 CYCLES

RANGE AMPS	TAPS	VOLT – AMPERES TAP VALUE CURRENT	POWER FACTOR ANGLE ϕ°	VOLT AMPERES AT 5 AMPERES	POWER FACTOR ANGLE ϕ°
	.5	.37	39	24	46
	.75	.38	36	13	37
.5-2	1	.39	35	8.5	34
	1.25	.41	34	6.0	32
	1.5	.43	32	4.6	31
	2	.45	30	2.9	28
	1	.41	36	9.0	36
	1.5	.44	32	5.0	32
1-4	2	.47	30	3.0	29
	2.5	.50	28	2.1	27
	3	.50	26	1.5	26
	4	.59	24	0.93	24
	2	1.1	49	6.5	48
	3	1.2	43	3.3	42
2-8	4	1.3	38	2.1	37
	5	1.4	35	1.4	35
	6	1.5	33	1.1	33
	8	1.8	29	0.7	29
	4	1.5	51	2.4	51
	6	1.7	45	1.2	45
4-16	8	1.8	40	0.7	40
	9	1.9	38	0.6	38
	12	2.2	34	0.37	34
	16	2.5	30	0.24	31
	10	1.7	28	.43	28
	15	2.4	21	.27	21
10-40	20	3.1	16	.20	17
	24	3.6	15	.15	15
	30	4.2	12	.11	13
	40	4.9	11	.08	12

For Type KO Current Relay

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Fig. 3 Burden Data

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