



Effective: September 1999
Supersedes I.L. 41-102E, dated June 1979

Type COM Overcurrent Relay

(|) Denotes Change Since Previous Issue

CONTENTS

This instruction leaflet applies to the following types of relays:

COM-2	Short Time Relay
COM-5	Long Time Relay
COM-6	Definite Minimum Time Relay
COM-7	Moderately Inverse Time Relay
COM-8	Inverse Time Relay
COM-9	Very Inverse Time Relay
COM-11	Extremely Inverse Time Relay

Each of these is available with or without a 5-6 cycle (85 to 100 millisecond) time-delay unit.



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. Operate the relay to check the settings and electrical connections.

1.0 APPLICATION

COM relays may be applied wherever two instantaneous overcurrent units are required in addition to the time overcurrent unit. For example, figure 20 shows how the COM-5 (long time) relay is used for

motor protection, with the CO-5 unit alarming just above motor full load and tripping at higher overloads, through the low set instantaneous unit; the high set instantaneous unit is set above locked rotor current to provide high speed tripping of heavy faults. Figure 21 shows how another variation of COM-5 provides improved fault protection for a motor by delaying ITH tripping by 5 to 6 cycles to override the asymmetrical current following fast transfer.

The relay with auxiliary time-delay unit is also available with the IT Unit (Clapper type) rather than the ITH (Plunger type). The highest range available in the ITH design is 16-32 amperes.

The COM without the auxiliary time-delay unit may also be utilized for distribution line protection, with the low set instantaneous locked-out by the reclosing relay, and with the high set unit left in service to provide high speed clearing of close-in-faults. See figure 14 for the connections of this application.

2.0 CONSTRUCTION AND OPERATION

The type COM relays consist of a time-overcurrent unit (CO), two indicating contactor switches (ICS), a indicating instantaneous trip unit (IIT) and a high drop out instantaneous unit (ITH). The principal component parts of the relay are shown in Figures 1-6.

2.1 ELECTROMAGNET

The electromagnets for the types COM-5, COM-6, COM-7, COM-8 and COM-9 relays have a main tapped coil located on the center leg of an "E" type laminated structure that produces a flux which divides and returns through the outer legs. A shading

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 this instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Power T&D Company Inc. representative should be contacted.

coil causes the flux through the left leg to lag the main pole flux. The out-of-phase fluxes thus produced in the air gap cause a contact closing torque.

The electromagnets for the types COM-2 and COM-11 relays have a main coil consisting of a tapped primary winding and a secondary winding. Two identical coils on the outer legs of the lamination structure are connected to the main coil secondary in a manner so that the combination of all the fluxes produced by the electromagnet result in out-of-phase fluxes in the air gap. The out-of-phase air gap fluxes produced cause a contact closing torque.

2.2 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.

2.3 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.

A core screw accessible from the top of the switch provides the adjustable pickup range. The minimum and maximum pick-up points are indicated on the scale which is located to the rear of the core screw.

2.4 HIGH DROP-OUT INSTANTANEOUS TRIP UNIT (ITH)

The high drop-out instantaneous trip unit is a small solenoid type device (figure 4). A plunger assembly (figure 5) rides up and down on a vertical guide rod in the center of the solenoid coil. The plunger assembly consists of a steel plunger which is threaded on the moving plunger and locked in place by a nut, an a silver disc which rests on a helical compression spring at the lower end of the plunger. The guide rod is fastened to the stationary core which in turn is held in place by the insulating plate on which the stationary contacts are mounted. The stationary core consists of two steel sections separated by a non-magnetic ring. This non-magnetic ring provides an air gap in which the plunger steel floats. When the coil is energized, the plunger assembly moves upward carrying the silver disc which bridges three spring type conical-shaped stationary contacts. In this position the helical spring is compressed and the plunger is free to move while the contact disc remains stationary. Thus, ac vibrations of the plunger assembly are prevented from causing contact chattering. A Micarta disc which acts as a shield for the contact plate, screws on the bottom of the guide rod and is locked in position by a small nut. The adjustable core screw in the top of the frame provides the principal means for adjusting the current operating values.

The ITH unit is a current operated device which will pick-up within the range stamped on the side of the frame and drop-out at 90% of the pick-up current value. The position of the core screw determines the pick-up value for a particular contact gap. The 90% drop-out ratio is accomplished through the right combination of plunger steel setting, electrical pull and spring strength. The most important factor in the adjustment of the unit is the correct positioning of the plunger steel with respect to the stationary core air gap.

2.5 AUXILIARY TIME-DELAY UNIT (T) - (WHERE USED)

This slugged telephone type unit, in conjunction with a tapped resistor, provides a 5-6 cycle delay on pickup. The resistor in the rear of the relay is tapped for use with 24, 48, 125 or 250 volt dc supply, as shown in the internal schematics of figures 17 and 18.

3.0 CHARACTERISTICS

The relays are generally available in the following current ranges:

Range	Taps						
0.5 – 2.5	0.5	0.6	0.8	1.0	1.5	2.0	2.5
2 – 6	2	2.5	3	3.5	4	5	6
4 – 12	4	5	6	7	8	10	12

The time vs. current characteristics are shown in figures 7 to 13. These characteristics give the contact closing time for the various time dial settings when the indicated multiples of tap value current are applied to the relay.

3.1.1 IIT UNIT

Current ranges available for this unit are: 2-8, 4-16, 10-40, 20-80, and 40-160.

3.2.2 ITH UNIT

The unit has a 2 to 1 range of pick-up adjustment with a 90% or greater drop-out ratio. Current ranges available are 2-4, 4-8, 16-32. The only adjustment necessary when making settings within the nominal range is the positioning of the core screw. At the maximum end of the range of the drop-out ratio will be greater than 90% and it may be desirable to lower the contact shield to increase the contact gap and follow. The range may be increased by lowering the plunger after the core screw has been set at its maximum rated position. If the plunger is lowered to increase the pick-up current value, then at 300% of minimum trip the drop-out ratio is 60% of the pick-up current. AT 400% of minimum trip the drop-out ratio is 45% of the pick-up current.

The burden of this unit at minimum pick-up is 0.44 VA at 60 cycles.

Continuous current rating of the coil is 2 times minimum pick-up value.

One second rating is approximately 30 times minimum pickup.

Characteristic operating times for the unit over its nominal range are:

Less than 1 cycle at 200% of trip value
1/2 cycle at 500% of trip value
1/4 cycle at 1000% of trip value

3.3.3 TRIP CIRCUIT

The main contacts will safely close 30 amperes at 250 volts dc and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker.

The IIT and ITH contacts will safely close 30 amperes at 250 volts dc, and will carry this current long enough to trip a breaker.

The indicating contactor switch has two taps providing a pickup setting of 0.2 or 2 amperes. To change taps requires connecting the lead located in front of the tap block to the desired setting by means of a screw connection.

3.4.4 TRIP CIRCUIT CONSTANTS

Contactor Switch –

0.2 ampere tap - 6.5 ohms dc resistance

2.0 ampere tap - 0.15 ohms dc resistance

4.0 SETTINGS

4.1 CO UNIT

The overcurrent unit settings can be defined either by tap setting and time dial position or by tap setting and a specific time of operation at some current multiple of the tap setting (e.g. 4 tap setting, 2 time dial position or 4 tap setting, 0.6 seconds at 6 times tap value current).

To provide selective circuit breaker operation, a minimum coordinating time of 0.3 seconds plus circuit breaker time is recommended between the relay being set and the relays with which coordination is to be effected.

The connector screw on the terminal plate above the time dial makes connections to various turns on the operating coil. By placing this screw in the various terminal plate holes, the relay will respond to multiples of tap value currents in accordance with the various typical time-current curves.



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

4.2 INSTANTANEOUS RECLOSING

The factory adjustment of the CO unit contact provides a contact follow. Where instantaneous circuit breaker reclosing will be initiated upon the closure of the CO contact, this contact follow must be eliminated by loosening the stationary contact mounting screw, removing the contact plate and then replacing the plate with the bent end resting against the contact spring. With this change and the contact mounting screw tightened, the stationary contact will rest solidly against its backstop.

4.3 INDICATING CONTACTOR SWITCH (ICS)

No setting is required on the ICS unit except the selection of the 0.2 or 2.0 ampere tap setting. This selection is made by connecting the lead located in the front of the tap block to the desired setting by means of the connecting screw. When the relay energizes a 125 or 1250 volt dc type WL relay switch, or equivalent, use the 0.2 ampere tap; for 48 volt dc applications set in 2 tap and use Type WL relay coil Style number 304C209G01 or equivalent.

4.4 INDICATING INSTANTANEOUS TRIP (IIT)

The core screw must be adjusted to the value of pickup current desired.

The nameplate data will furnish the actual current range that may be obtained from the IIT unit.

4.5 ITH UNIT

The unit, prior to shipment is adjusted for minimum pick-up value, that is, the lower value marked on the side of the frame. The following procedure is used when changing this setting over the indicated range

where a 90% or higher drop-out ratio is desired. Connect the coil of the unit in series with a ammeter and adjustable load. Apply the desired pick-up current, then adjust the core screw until the plunger just picks up. Lock core screw securely in place.

If it is desired to set the unit for either a different drop-out ratio over the nominal range or for pick-up values above the nominal range, then the following procedure should be followed.

When the unit in series with an ammeter and adjustable load, apply the desired drop-out current. Adjust the core screw until the plunger assembly just drops out. Then apply the desired pick-up current and adjust the Micarta contact shield until the plunger assembly just picks up. It is recommended that the contact gap should not be made less than 0.13 of an inch. The contact gap may be determined by turning up the contact shield from the setting position until the contacts just close. One turn of the shield is equal to 0.18 of an inch contact gap.

4.6 TAPPED RESISTOR (WHEN USED)

The relay is shipped with the resistor tapped for 125 volt dc service. See Figure 17 or 18 for the proper positions for other dc ratings. When viewed from the rear of the relay the red dot on terminal 1 of the resistor is on the extreme left.

5.0 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.

6.0 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.

The indicating Instantaneous Trip unit (IIT) used in some relays requires a much higher current for tripping than is required by the other units. For this reason, the junction of the CO unit coil and the IIT unit coil is brought out to switch jaw no. 3 (whenever it is available) to permit the testing of these units separately.

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 control 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.

6.1 ACCEPTANCE CHECK

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

1. Contact

- a) By turning the time dial, move the moving contacts until they deflect the stationary contact to a position where the stationary contact is resting against its backstop. The index mark located on the movement frame should coincide with the "0" mark on the time dial. For double trip relays, the follow on the stationary contacts should be approximately $1/64"$.
- b) For relays identified with a "T", located at lower left of stationary contact block, the index mark on the movement frame will coincide with the "0" mark on the time dial when the stationary contact has moved through

approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "0" mark by approximately $.020"$. The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves. For double trip relays, the follow on the stationary contacts should be approximately $1/32"$.

2. Minimum Trip Current – Set the time dial to position 6. Using lowest tap setting, alternately apply tap value current plus 3% and tap value current minus 3%. The moving contact should leave the backstop at tap value plus 3% and should return to the backstop at tap value current minus 3%.
3. Time Curve – Table 1("Time Curve Calibration Data 50 & 60 Cycles" on page 8) shows the time curve calibration points for the various types of relays. With the time dial set to the indicated position and on the lowest top setting, apply the current specified by Table 1, (e.g. for the COM-2, 2 and 20 times tap value current) and measure the operating time of the relay. The operating times should equal those of Table 1("Time Curve Calibration Data 50 & 60 Cycles" on page 8) plus or minus 5%. For type COM-11 relay only, the 1.30 times tap value operating time from the number 6 time dial position is $54.9 \pm 5\%$ seconds. It is important that the 1.30 times tap value current be maintained accurately. The maintaining of this current accurately is necessary because of the steepness of the slope of the time-current characteristic (figure 13). A 1% variation in the 1.30 times tap value current (including measuring instrument deviation) will change the nominal operating time by approximately 4%.
4. Indicating Instantaneous Trip Unit (IIT) – The core screw which is adjustable from the top of the trip unit determines the pickup value. The trip unit has a nominal ratio of adjustment of 1 to 4 and an accuracy within the limits of 10%. The making of the contacts and target indication should occur at approximately the same instant. Position the stationary contact for a minimum of $1/32"$ wipe. The bridging moving contact should touch both stationary contacts simultaneously.

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

5. Indicating Contactor Switch (ICS) – Close the main relay contacts 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 tap setting being used. The operation indicator target should drop freely.

The contact gap should be approximately 0.47" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

6. High Drop-out Instantaneous Unit (ITH) – The plunger assembly should pickup and seal within $\pm 5\%$ and dropout at 90% or higher of the minimum pickup current value stamped on the frame. The unit should maintain at least 90% drop out ratio over the nominal range.

The contact gap should not be less than .013 of an inch. Contact gap is determined as described under "SETTINGS".

7. Auxiliary Time-Delay Unit (T) – For relays wired per figure 17 or 18, apply 100 volts dc to terminals 5 and 7. Manually close the contacts of the ITH or IT unit in the top right-hand corner of the relay. The T unit should operate.

7.0 ROUTINE MAINTENANCE

All relays should be inspected and checked periodically 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. Then release the contacts and observe that the reset is smooth and positive.

If an additional time check is desired, pass secondary current through the relay and check the time of operation. It is preferable to make this at several times pick-up current at an expected operating point for that particular application. For the 0.5 ampere range COM-5 and COM-6 induction units use the dashed test circuit in figure 19 as these relays are affected by a distorted wave form. With this connection the 25/5 ampere current transformers should be worked well below the knee of the excitation curve (i.e., use a 10L50 or better).

All contacts should be periodically cleaned. A contact burnisher style number 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.

8.0 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")

8.1 CO UNIT

1. Contact

- a) By turning the time dial, move the moving contacts until they deflect the stationary contact to a position where the stationary contact is resting against its backstop. The index mark located on the movement frame should coincide with the "0" mark on the time dial. For double trip relays, the follow on the stationary contacts should be approximately 1/64".
- b) For relays identified with a "T", located at lower left of stationary contact block, the index mark on the movement frame will coincide with the "0" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "0" mark by approximately .020".

2. Minimum Trip Current – The adjustment of the spring tension in setting the minimum trip current value of the relay is most conveniently made with the damping magnet removed.

With the time dial set on "0", wind up the spiral spring by means of the spring adjuster until approximately 6-3/4 convolutions show.

Set the relay on the lowest tap setting, the time dial to position 6.

Adjust the control spring tension so that the moving contact will leave the backstop at tap value current +1.0% and will return to the backstop at tap value current - 1.0%.

3. Time Curve Calibration – Install the permanent magnet.

Apply the indicated current per Table 1 for permanent magnet adjustment (e.g. COM-8, 2 times tap value) and measure the operating time. Adjust the permanent magnet keeper until the operating time corresponds to the value of Table 1 ("Time Curve Calibration Data 50 & 60 Cycles" on page 8) .

For Type COM-11 Relay only, the 1.3 times tap value operating time from the number 6 time dial position is $54.9 \pm 5\%$ seconds. It is important that the 1.30 times tap value current be maintained accurately. The maintaining of this current accurately is necessary because of the steepness of the slope of the time-current characteristic (figure 13). A 1% variation in the 1.30 times tap value current (including measuring instrument deviation) will change the nominal operating time by approximately 4%. If the operating time at 1.3 times tap value is not within these limits, a minor adjustment of the control spring will give the correct operating time without any undue effect on the minimum pick-up of the relay. This check is to be made after the 2 times tap value adjustment has been completed.

Apply the indicated current per Table 1 ("Time Curve Calibration Data 50 & 60 Cycles" on page 8) for the electromagnet plug adjustment (e.g. COM-8, 20 times tap value) and measure the operating time. Adjust the proper plug until the operating time corresponds to the value in Table 1 ("Time Curve Calibration Data 50 & 60 Cycles" on page 8) . (Withdrawing the left-hand plug, front view, increases the operating time and withdrawing the right-hand plug, front view, decreases the time.) In adjusting the plugs, one plug should be screwed in completely and the other plug run in or out until the proper operating time has been obtained.

Recheck the permanent magnet adjustment. If the operating time for this calibration point has changed, readjust the permanent magnet and then recheck the electromagnet plug adjustment.

4. Indicating Contactor Switch (ICS) – Close the main relay contacts 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 tap setting being used. The operating indicator target should drop freely.

5. Indicating Instantaneous Trip Unit (IIT) – 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.

6. High Drop-out Instantaneous Unit (ITH) – The factory adjustment of the position of the plunger steel provides a drop-out ratio of 90% over the nominal range. But, in the event a considerable amount of material is removed from the contacts, due to repeated operations, burnishing, etc., the drop-out ratio may fall below 90%. If this occurs, then the plunger steel should be turned down to compensate. If the plunger steel setting is changed for the above or any other reasons, the following procedure should be used to recalibrate the relay.

Set the core screw at ten turns up from its bottom position. Adjust the plunger steel position on the plunger until the current value at which the plunger drops-out is 90% of the maximum rated current. Then set the contact gap at 3/4 of a turn-down, and adjust the core screw for pick-up. Drop-out value will normally be above 90% of this setting. If desired, the contact gap and follow may be increased by lowering the contact shield and readjusting the core screw for pickup.

9.0 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.

Table 1:
Time Curve Calibration Data
50 & 60 Cycles

PERMANENT MAGNET ADJUSTMENT				ELECTROMAGNET PLUGS	
RELAY TYPE	TIME DIAL POSITION	CURRENT (MULTIPLES OF TAP VALUE)	OPERATING TIME SECONDS	CURRENT (MULTIPLES OF TAP VALUE)	OPERATING TIME SECONDS
COM-2	6	3	0.57	20	0.22
COM-5	6	2	37.80	10	14.30
COM-6	6	2	3.46	20	1.19
COM-7	6	2	4.27	20	1.11
COM-8	6	2	13.35	20	1.11
COM-9	6	2	8.87	20	0.65
COM-11	6	2	11.27	20	0.24 [†]

[†] For 50 cycle CO-11 relay 20 times operating time limits are 0.24+ 20%, - 5%.

Table 2:
TYPE COM-2 RELAY

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING [†] (AMPERES)	POWER FACTOR ANGLE [‡]	VOLT AMPERES ^{††}			
					AT TAP VALUE CURRENT	AT 3 TIMES TAP VALUE CURRENT	AT 10 TIMES TAP VALUE CURRENT	AT 20 TIMES TAP VALUE CURRENT
0.5/2.5	0.5	0.91	28	58	4.8	39.6	256	790
	0.6	0.96	28	57	4.9	39.8	270	851
	0.8	1.18	28	53	5.0	42.7	308	1024
	1.0	1.37	28	50	5.3	45.4	348	1220
	1.5	1.95	28	40	6.2	54.4	435	1740
	2.0	2.24	28	36	7.2	65.4	580	2280
	2.5	2.50	28	29	7.9	73.6	700	2850
2/6	2.0	3.1	110	59	5.04	38.7	262	800
	2.5	4.0	110	55	5.13	39.8	280	920
	3.0	4.4	110	51	5.37	42.8	312	1008
	3.5	4.8	110	47	5.53	42.8	329	1120
	4.0	5.2	110	45	5.72	46.0	360	1216
	5.0	5.6	110	41	5.90	50.3	420	1500
	6.0	6.0	110	37	6.54	54.9	474	1800
4/12	4.0	7.3	230	65	4.92	39.1	268	848
	5.0	8.0	230	50	5.20	42.0	305	1020
	6.0	8.8	230	47	5.34	44.1	330	1128
	7.0	9.6	230	46	5.35	45.8	364	1260
	8.0	10.4	230	43	5.86	49.9	400	1408
	10.0	11.2	230	37	6.6	55.5	470	1720
	12.0	12.0	230	34	7.00	62.3	528	2064

[†] Thermal capacities for short times other than one second may be calculated on the basis of time being inversely proportional to the square of the current.

[‡] Degrees current lags voltage at tap value current.

^{††} Voltages taken with high impedance type voltmeter.

Table 3:

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING ^a (AMPERES)	POWER FACTOR ANGLE ^b	VOLT AMPERES ^c			
					AT TAP VALUE CURRENT	AT 3 TIMES TAP VALUE CURRENT	AT 10 TIMES TAP VALUE CURRENT	AT 20 TIMES TAP VALUE CURRENT
0.5/2.5	0.5	2	56	69	3.92	20.6	103	270
	0.6	2.2	56	68	3.96	20.7	106	288
	0.8	2.5	56	67	3.96	21	114	325
	1.0	2.8	56	66	4.07	21.4	122	360
	1.5	3.4	56	62	4.19	23.2	147	462
	2.0	4.0	56	60	4.30	24.9	168	548
	2.5	4.4	56	58	4.37	26.2	180	630
2/6	2.0	8	230	67	3.88	21	110	308
	2.5	8.8	230	66	3.87	21.6	118	342
	3.0	9.7	230	64	3.93	22.1	126	381
	3.5	10.4	230	63	4.09	23.1	136	417
	4.0	11.2	230	62	4.08	23.5	144	448
	5.0	12.5	230	59	4.20	24.8	162	540
	6.0	13.7	230	57	4.38	26.5	183	624
4/12	4.0	16	460	65	4.00	22.4	126	376
	5.0	18.8	460	63	4.15	23.7	143	450
	6.0	19.3	460	61	4.32	25.3	162	531
	7.0	20.8	460	59	4.27	26.4	183	611
	8.0	22.5	460	56	4.40	27.8	204	699
	10.0	25	460	53	4.60	30.1	247	880
	12.0	28	460	47	4.92	35.6	288	1056

Table 4:

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING [†] (AMPERES)	POWER FACTOR ANGLE [‡]	VOLT AMPERES ^{††}			
					AT TAP VALUE CURRENT	AT 3 TIMES TAP VALUE CURRENT	AT 10 TIMES TAP VALUE CURRENT	AT 20 TIMES TAP VALUE CURRENT
0.5/2.5	0.5	2	56	68	3.88	20.7	103	278
	0.6	2.2	56	67	3.93	20.9	107	288
	0.8	2.5	56	66	3.93	21.1	114	320
	1.0	2.8	56	64	4.00	21.6	122	356
	1.5	3.4	56	61	4.08	22.9	148	459
	2.0	4.0	56	58	4.24	24.8	174	552
	2.5	4.4	56	56	4.38	25.9	185	640
2/6	2.0	8	230	66	4.06	21.3	111	306
	2.5	8.8	230	63	4.07	21.8	120	342
	3.0	9.7	230	63	4.14	22.5	129	366
	3.5	10.4	230	62	4.34	23.4	141	413
	4.0	11.2	230	61	4.34	23.8	149	448
	5.0	12.5	230	59	4.40	25.2	163	530
	6.0	13.7	230	58	4.62	27	183	624
4/12	4.0	16	460	64	4.24	22.8	129	392
	5.0	18.8	460	61	4.30	24.2	149	460
	6.0	19.3	460	60	4.62	25.9	168	540
	7.0	20.8	460	58	4.69	27.3	187	626
	8.0	22.5	460	55	4.80	29.8	211	688
	10.0	25	460	51	5.20	33	260	860
	12.0	28	460	46	5.40	37.5	308	1032

[†] Thermal capacities for short times other than one second may be calculated on the basis of time being inversely proportional to the square of the current.

[‡] Degrees current lags voltage at tap value current.

^{††} Voltages taken with high impedance type voltmeter.

Table 5:

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING ^a (AMPERES)	POWER FACTOR ANGLE ^b	VOLT AMPERES ^c			
					AT TAP VALUE CURRENT	AT 3 TIMES TAP VALUE CURRENT	AT 10 TIMES TAP VALUE CURRENT	AT 20 TIMES TAP VALUE CURRENT
0.5/2.5	0.5	2	56	72	2.38	21	132	350
	0.6	2.2	56	71	2.38	21	134	365
	0.8	2.5	56	69	2.40	21.1	142	400
	1.0	2.8	56	67	2.42	21.2	150	440
	1.5	3.4	56	62	2.51	22	170	530
	2.0	4.0	56	57	2.65	23.5	200	675
	2.5	4.4	56	53	2.74	24.8	228	800
2/6	2.0	8	230	70	2.38	21	136	360
	2.5	8.8	230	66	2.40	21.1	142	395
	3.0	9.7	230	64	2.42	21.5	149	430
	3.5	10.4	230	62	2.48	22	157	470
	4.0	11.2	230	60	2.53	22.7	164	500
	5.0	12.5	230	58	2.64	24	180	580
	6.0	13.7	230	56	2.75	25.2	198	660
4/12	4.0	16	460	68	2.38	21.3	146	420
	5.0	18.8	460	63	2.46	21.8	458	480
	6.0	19.3	460	60	2.54	22.6	472	550
	7.0	20.8	460	57	2.62	23.6	190	620
	8.0	22.5	460	54	2.73	24.8	207	700
	10.0	25	460	48	3.00	27.8	248	850
	12.0	28	460	45	3.46	31.4	292	1020

Table 6:

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING [†] (AMPERES)	POWER FACTOR ANGLE [‡]	VOLT AMPERES ^{††}			
					AT TAP VALUE CURRENT	AT 3 TIMES TAP VALUE CURRENT	AT 10 TIMES TAP VALUE CURRENT	AT 20 TIMES TAP VALUE CURRENT
0.5/2.5	0.5	2	56	36	0.72	6.54	71.8	250
	0.6	2.2	56	34	0.75	6.80	75.0	267
	0.8	2.5	56	30	0.81	7.46	84.0	298
	1.0	2.8	56	27	0.89	8.30	93.1	330
	1.5	3.4	56	22	1.13	10.04	115.5	411
	2.0	4.0	56	17	1.30	11.95	136.3	502
	2.5	4.4	56	16	1.48	13.95	160.0	610
2/6	2.0	8	230	32	0.73	6.30	74.0	264
	2.5	8.8	230	30	0.78	7.00	78.5	285
	3.0	9.7	230	27	0.83	7.74	84.0	309
	3.5	10.4	230	24	0.88	8.20	89.0	340
	4.0	11.2	230	23	0.96	9.12	102.0	372
	5.0	12.5	230	20	1.07	9.80	109.0	430
	6.0	13.7	230	20	1.23	11.34	129.0	504
4/12	4.0	16	460	29	0.79	7.08	78.4	296
	5.0	18.8	460	25	0.89	8.00	90.0	340
	6.0	19.3	460	22	1.02	9.18	101.4	378
	7.0	20.8	460	20	1.10	10.00	110.0	454
	8.0	22.5	460	18	1.23	11.1	124.8	480
	10.0	25	460	17	1.32	14.9	131.6	600
	12.0	28	460	16	1.8	16.3	180.0	720

[†] Thermal capacities for short times other than one second may be calculated on the basis of time being inversely proportional to the square of the current.

[‡] Degrees current lags voltage at tap value current.

^{††} Voltages taken with high impedance type voltmeter.

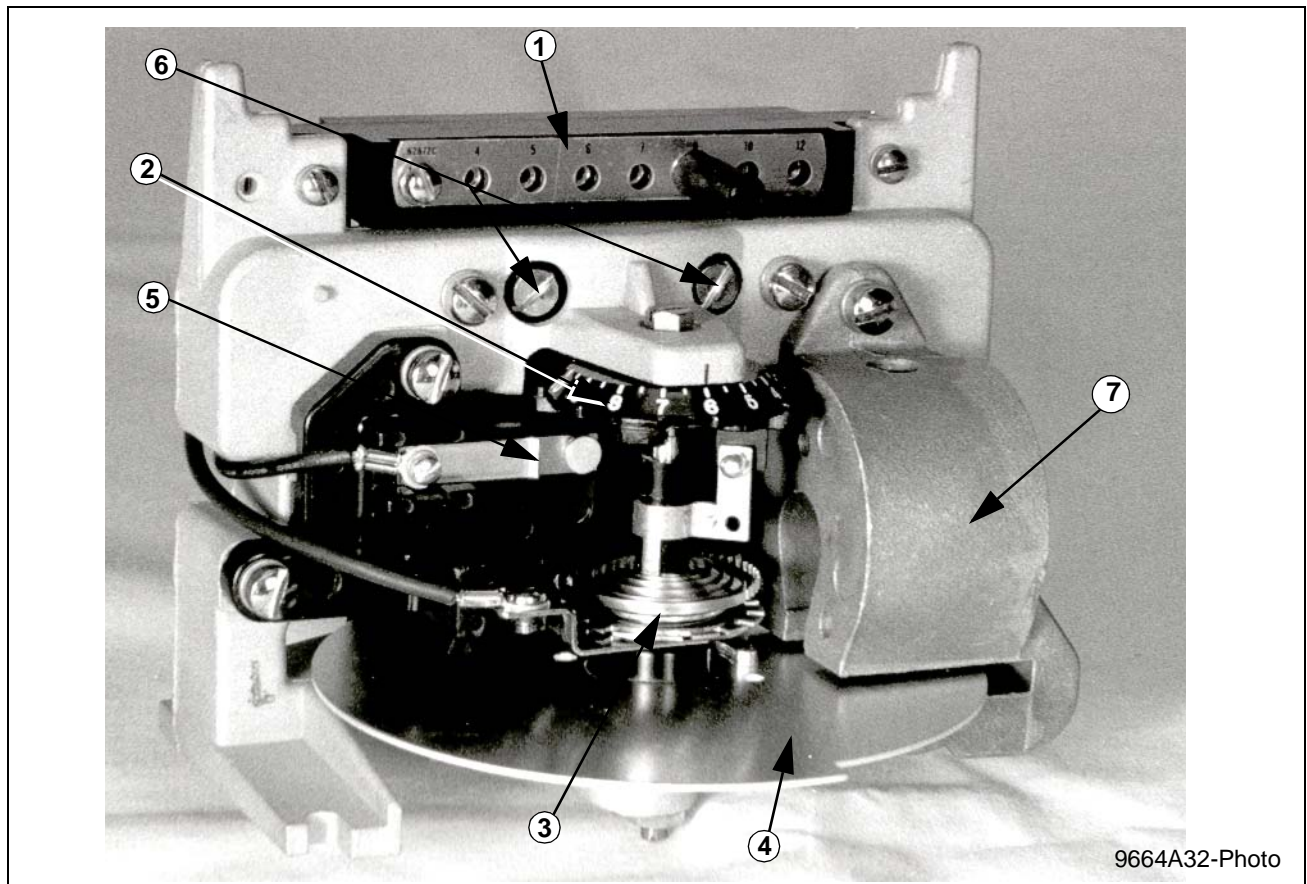


Figure 1: Time Overcurrent Unit (Front View) 1. Tap Block 2. Time Dial 3. Control Spring Assembly
4. Disc 5. Stationary Contact Assembly 6. Magnetic Plugs 7. Permanent Magnet

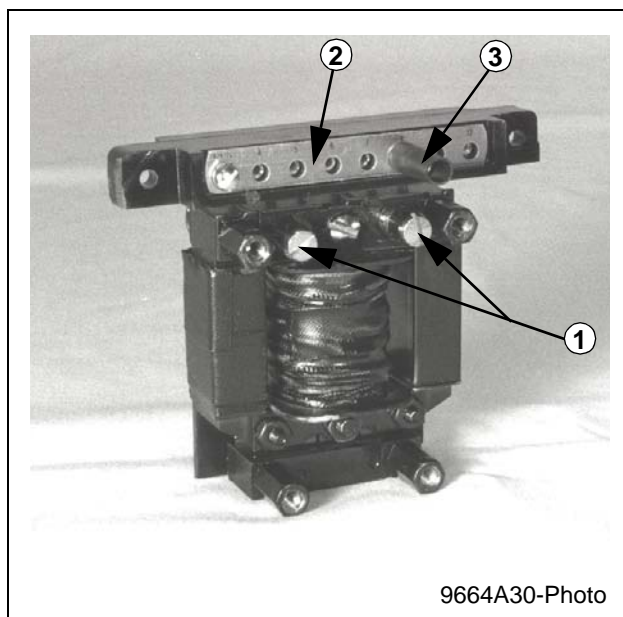


Figure 2: "E" Type Electromagnet. 1. Magnetic Plugs.
2. Tap Block. 3. Tap Screw.

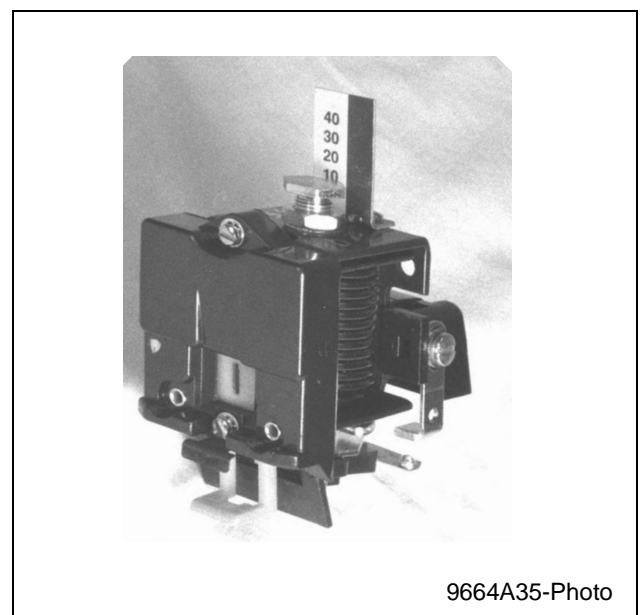


Figure 3: Indicating Instantaneous Trip Unit (IIT).

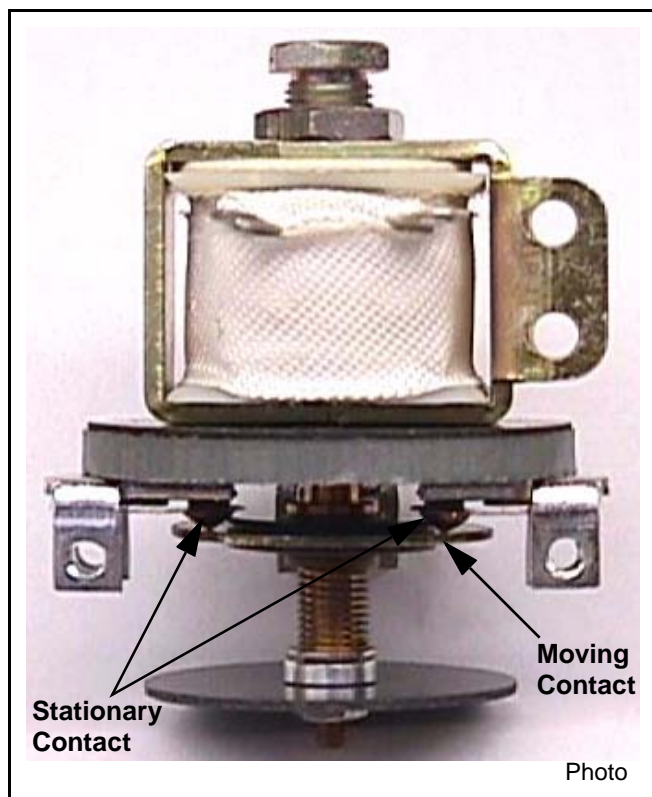


Figure 4: High Drop-Out Instantaneous Trip Unit (ITH).

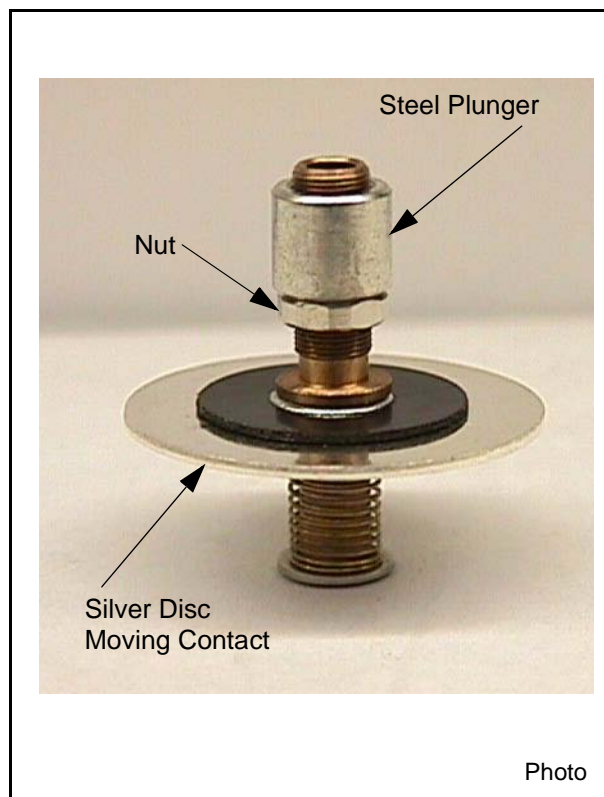


Figure 5: Plunger Assembly for ITH Unit.

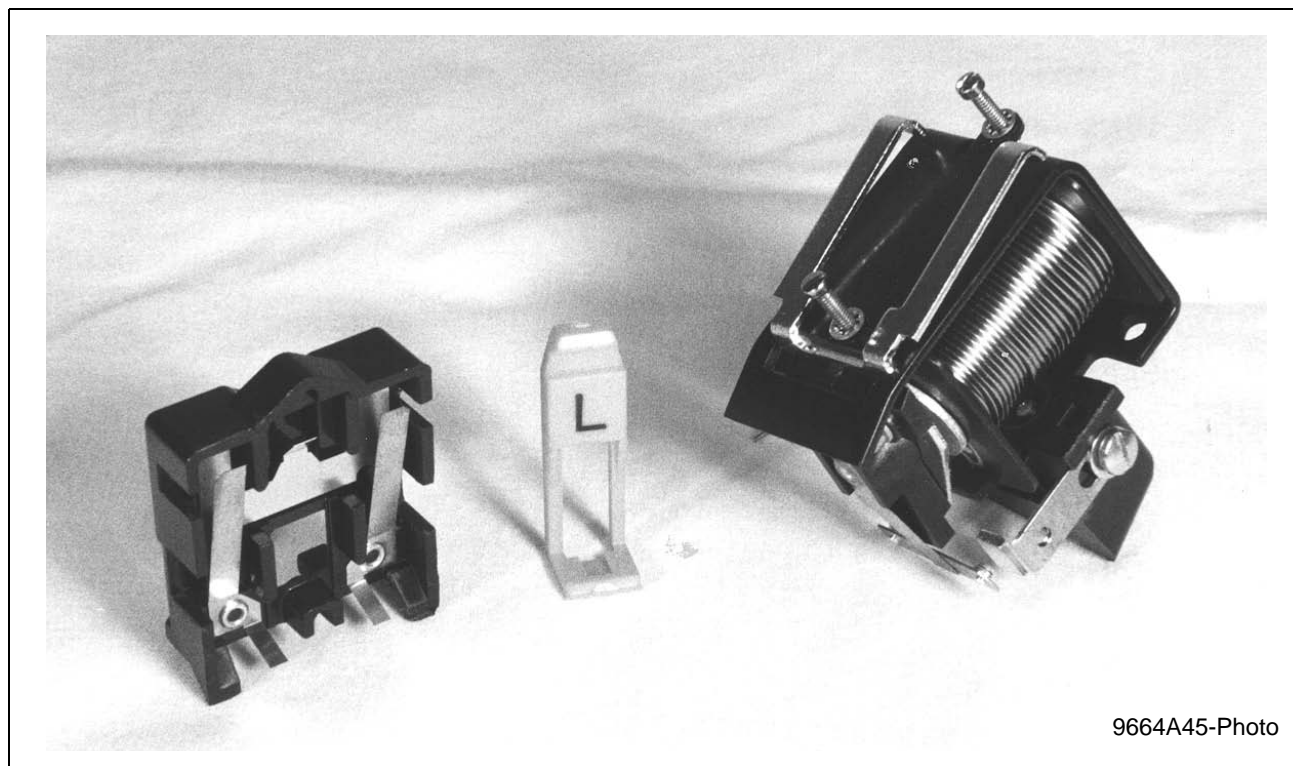


Figure 6: Indicating Contactor Switch (ICS).

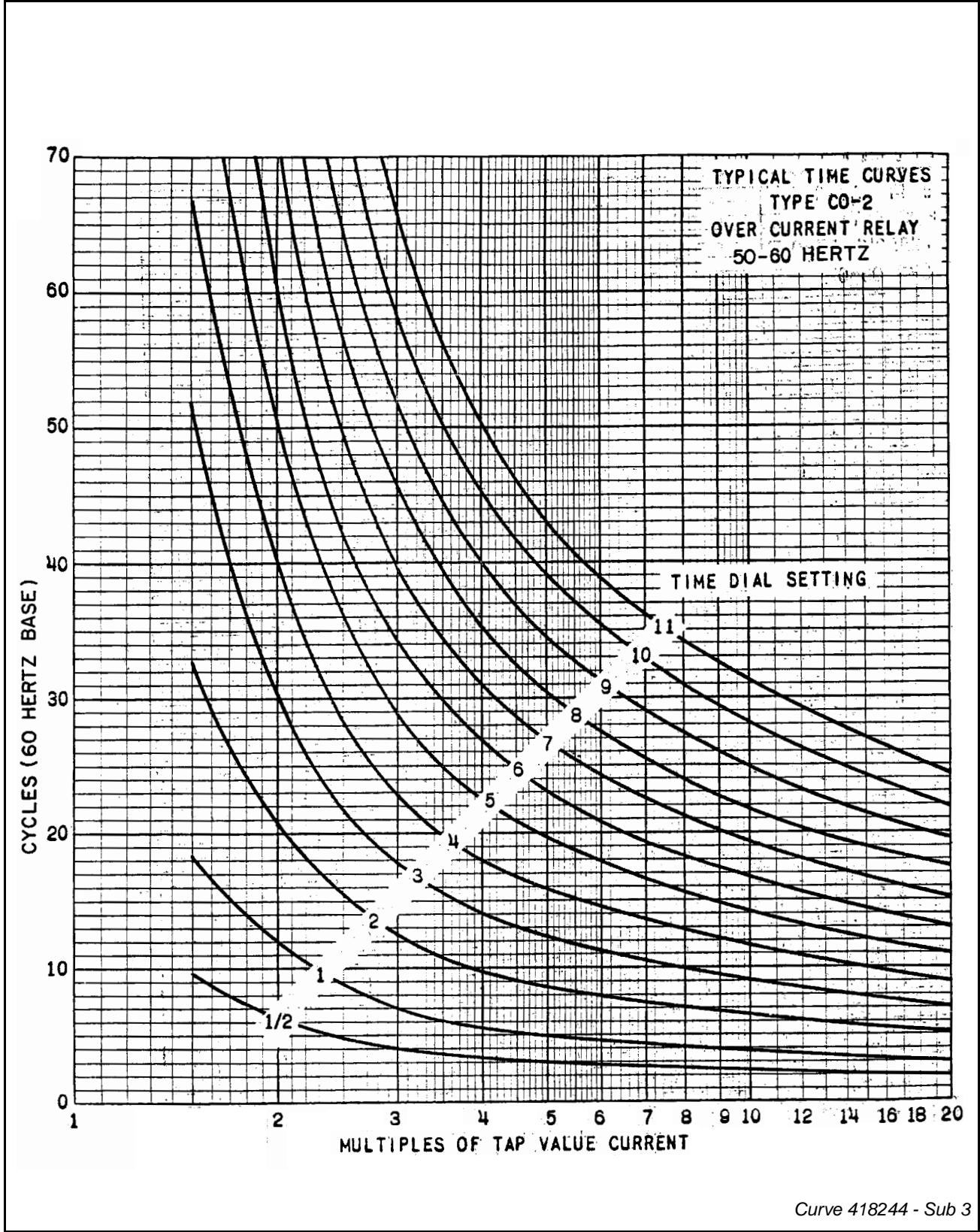
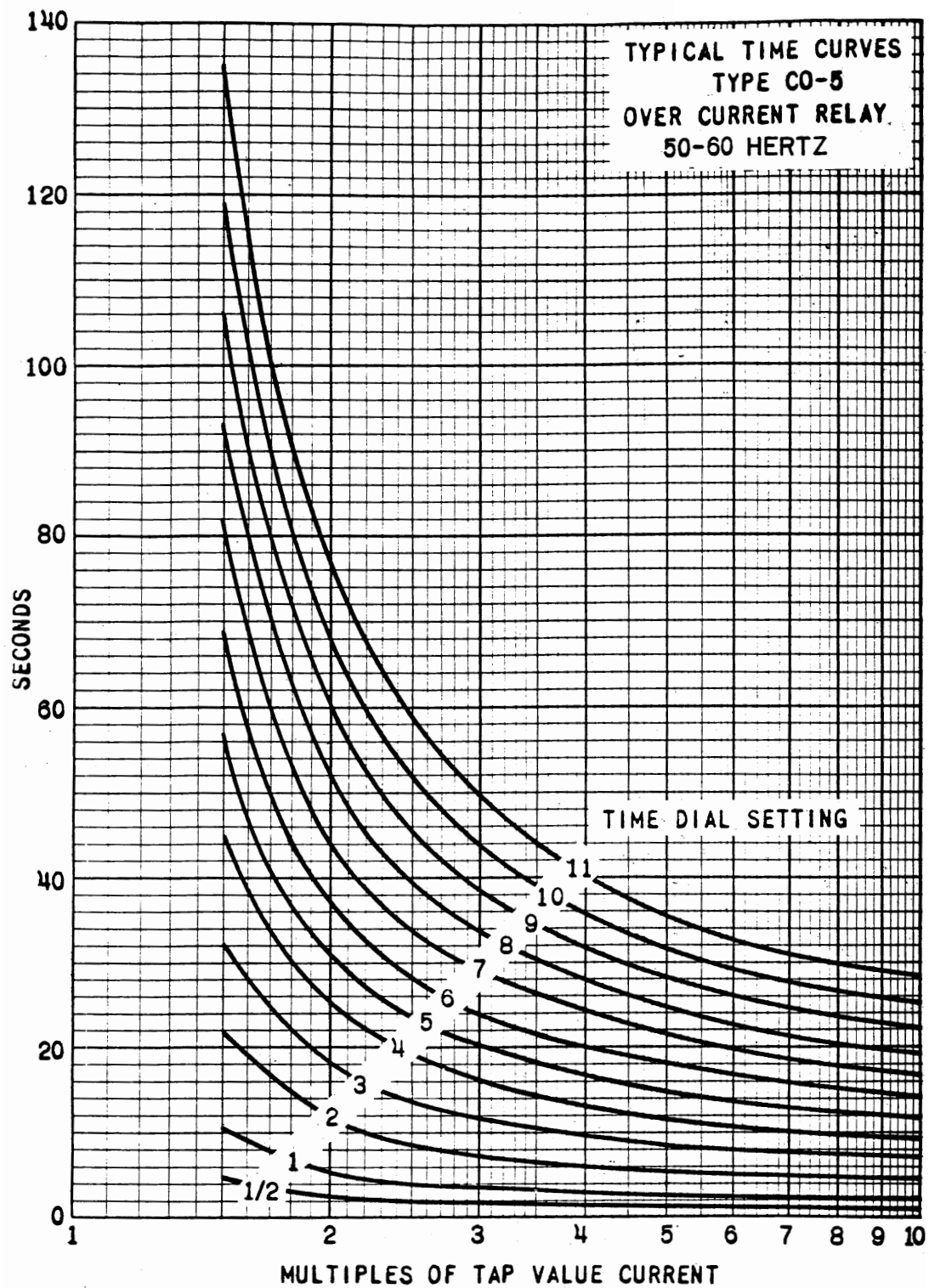


Figure 7: Typical Time Curves of the Type COM-2 Relay



Curve 418245 - Sub 2

Figure 8: Typical Time Curves of the Type COM-5 Relay.

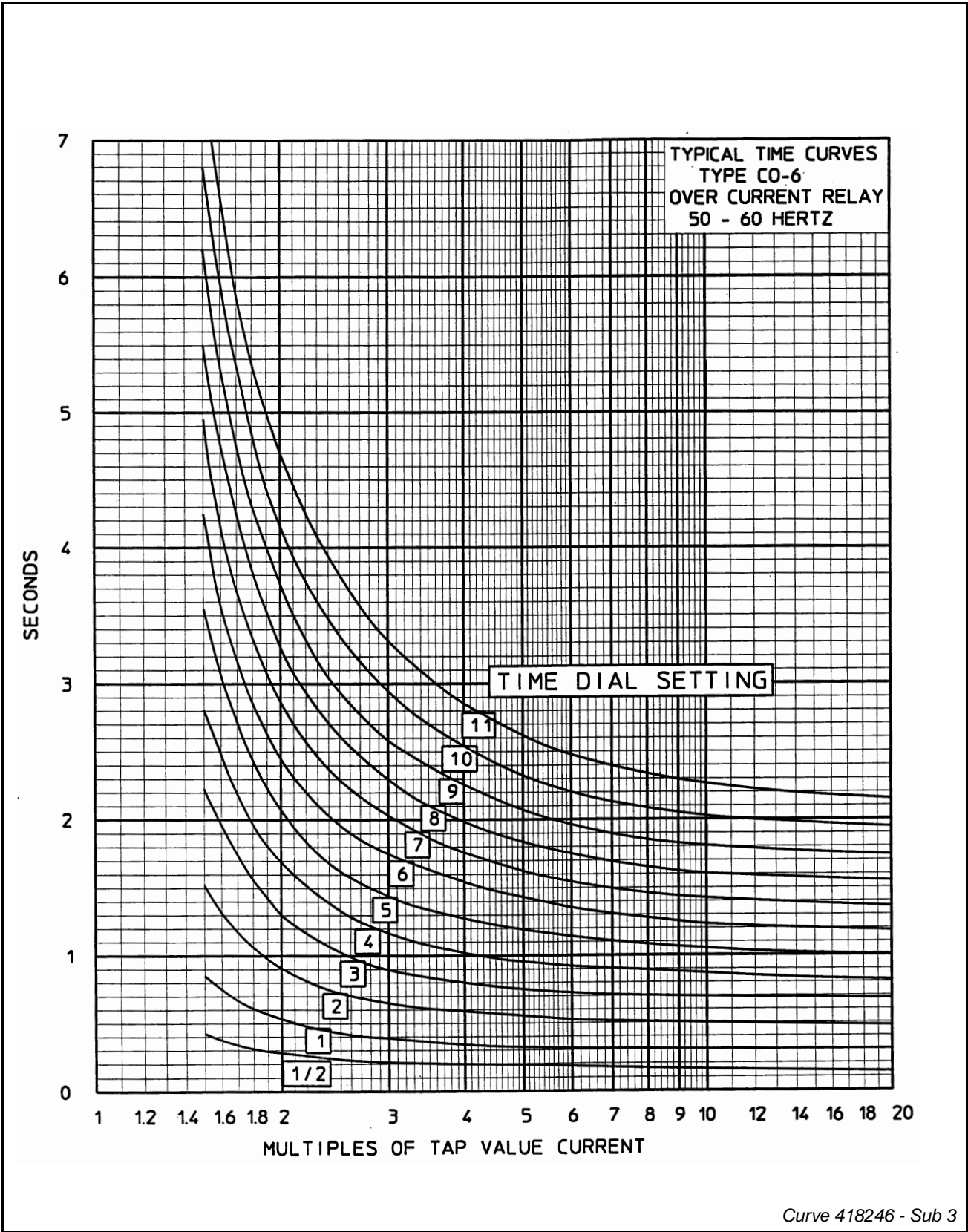
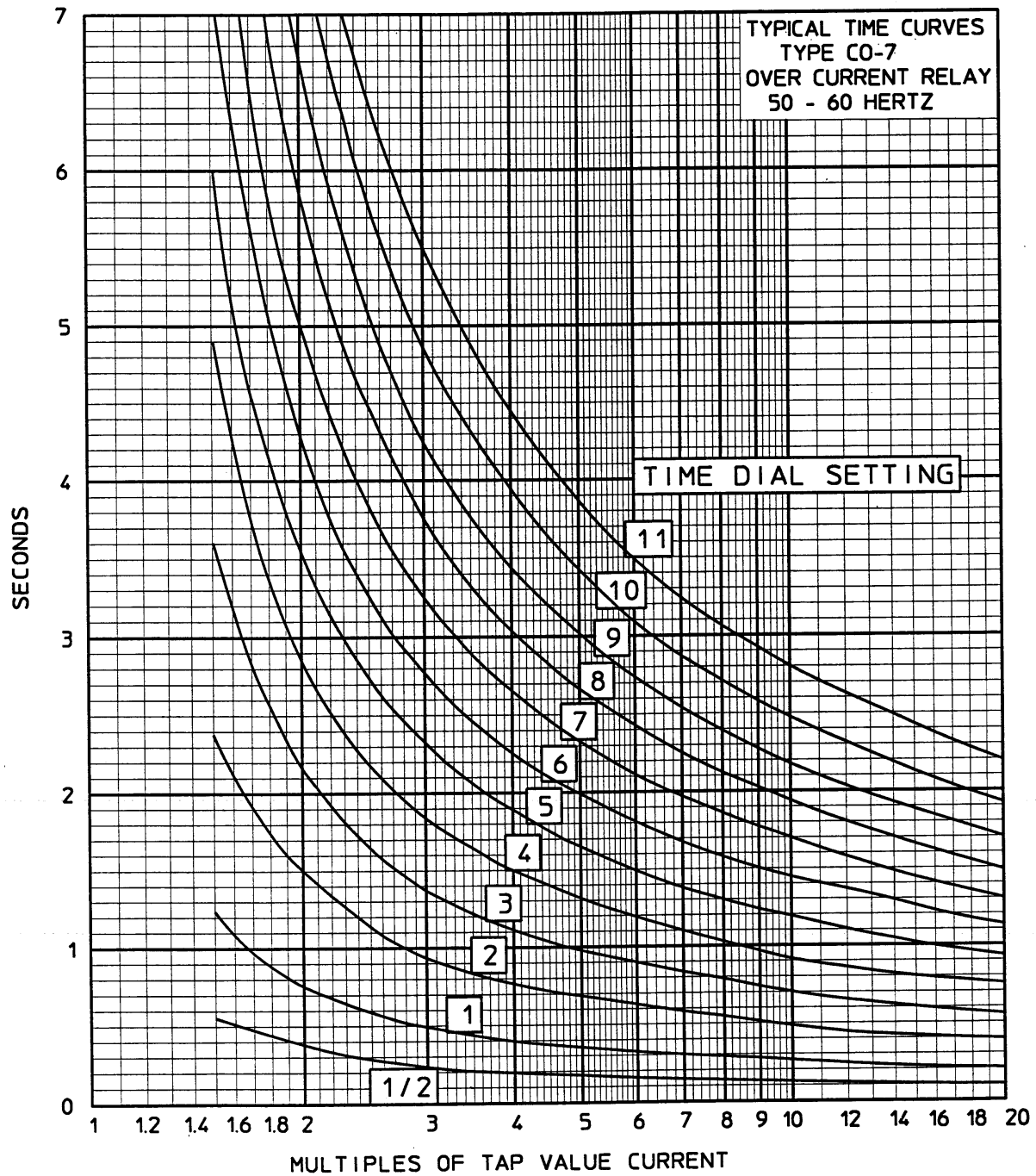


Figure 9: Typical Time Curves of the Type COM-6 Relay.



Curve 418427 - Sub 3

Figure 10: Typical Time Curves of the Type COM-7 Relay.

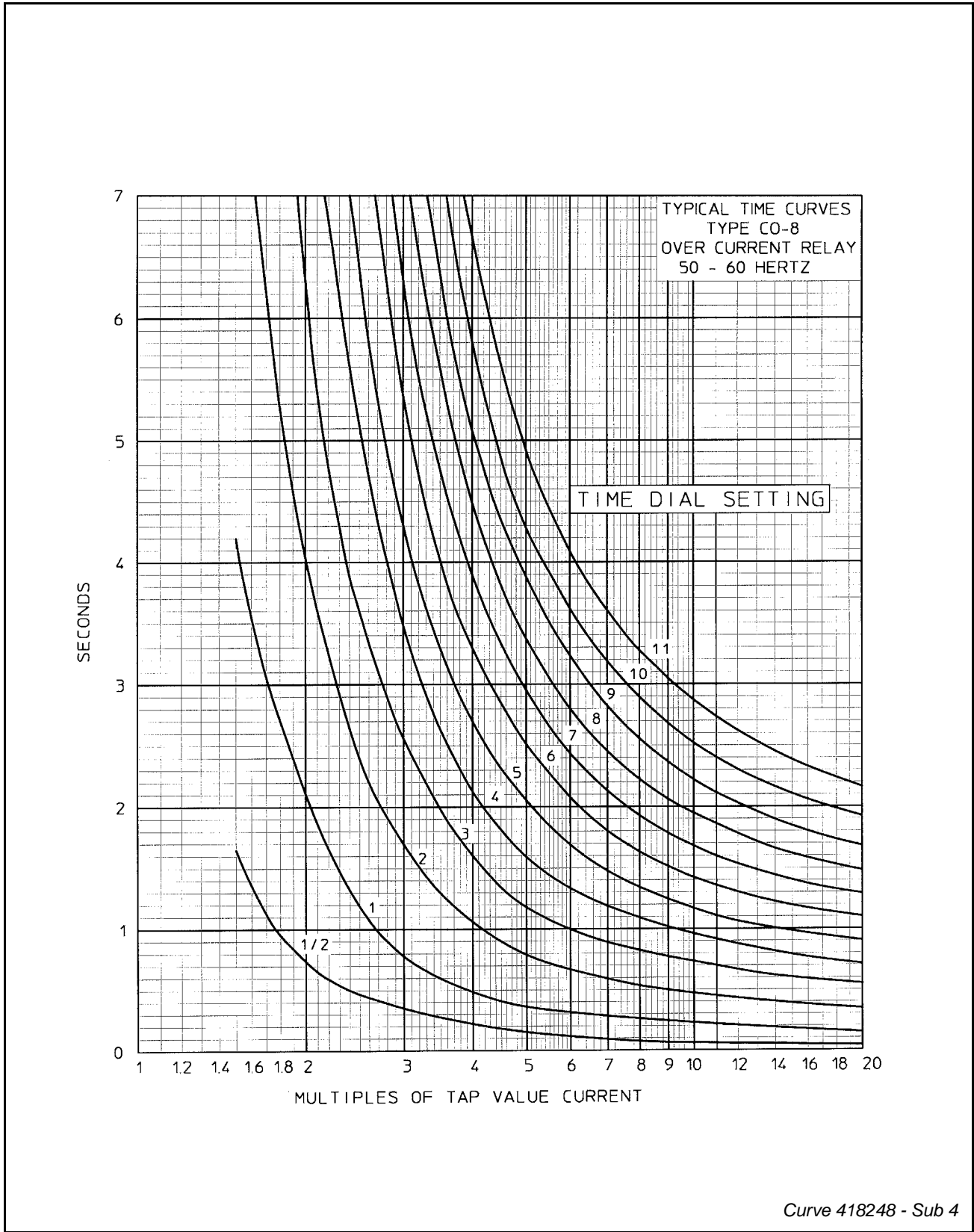
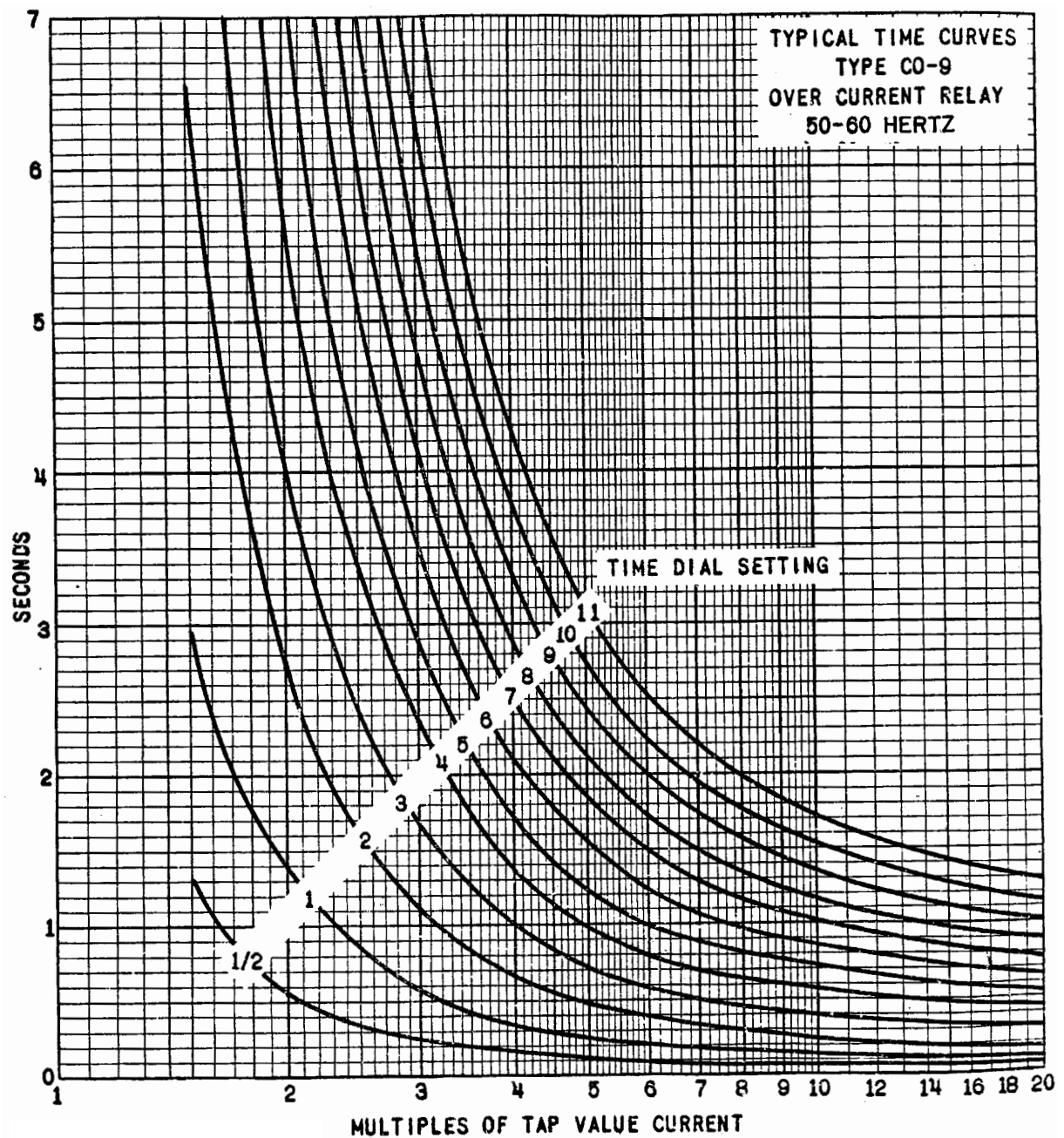


Figure 11: Typical Time Curves of the Type COM-8 Relay.



Curve 418249 - Sub 2

Figure 12: Typical Time Curves of the Type COM-9 Relay.

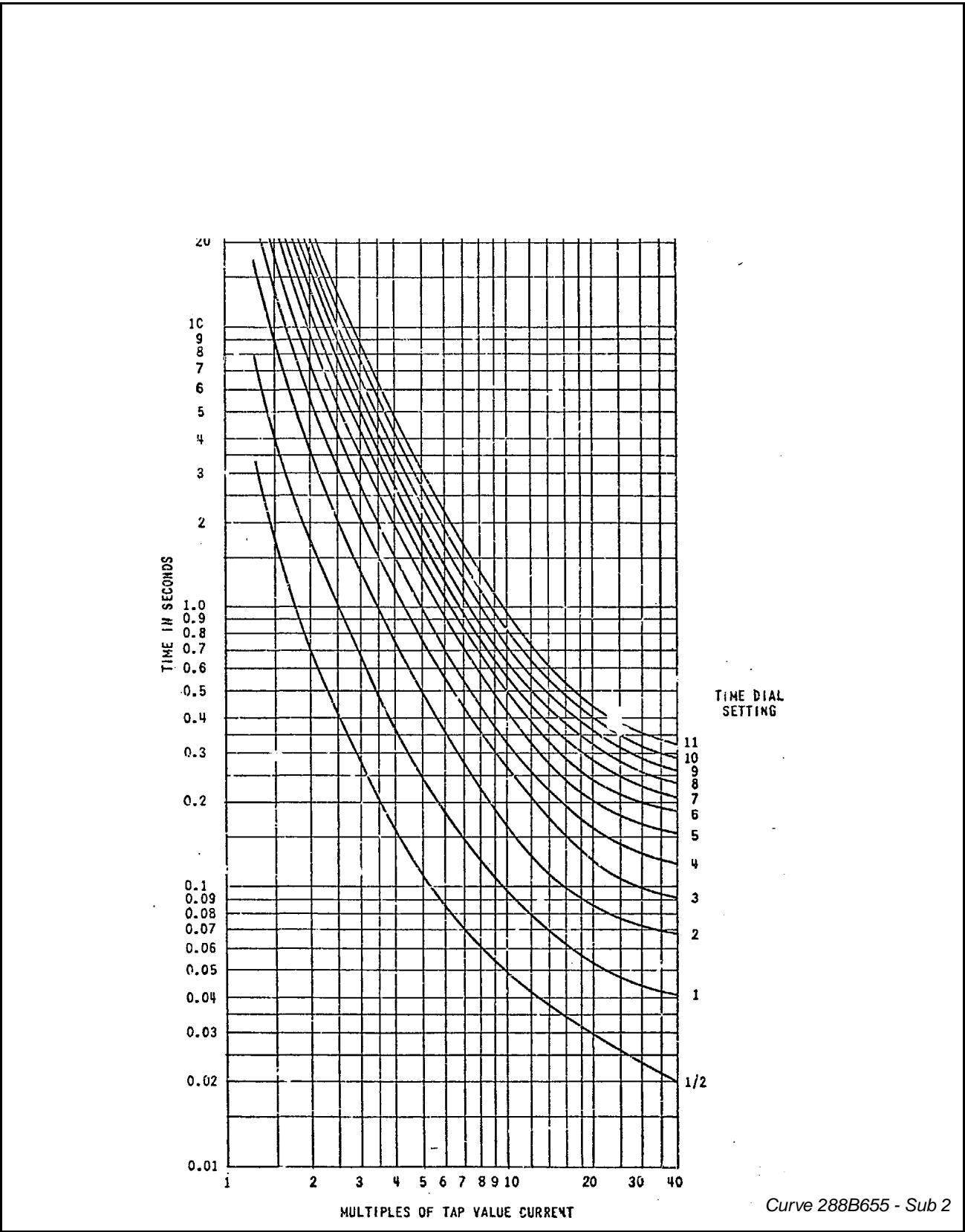
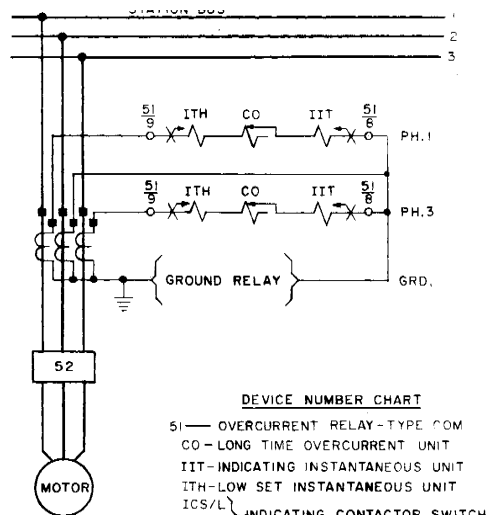


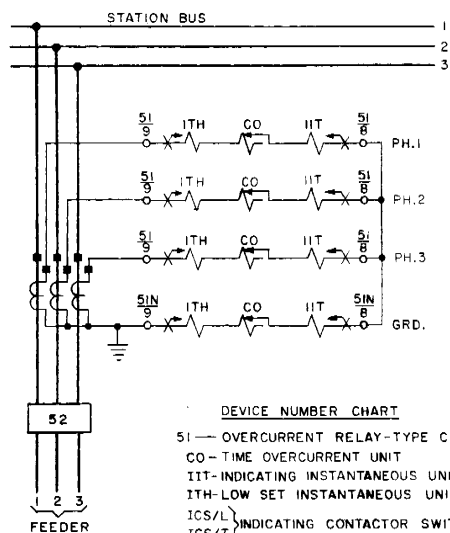
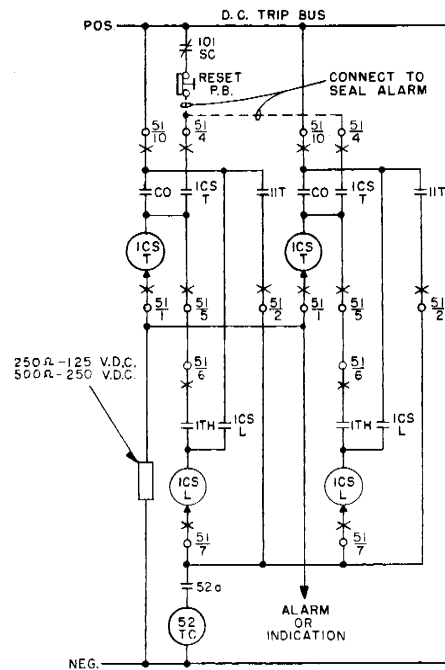
Figure 13: Typical Time Curves of the Type COM-11 Relay.



DEVICE NUMBER CHART

- 51 — OVERCURRENT RELAY-TYPE COM
 CO — LONG TIME OVERCURRENT UNIT
 IIT — INDICATING INSTANTANEOUS UNIT
 ITH — LOW SET INSTANTANEOUS UNIT
 ICS/L } INDICATING CONTACTOR SWITCH
 ICS/T }
 52 — CIRCUIT BREAKER
 a — BREAKER AUXILIARY CONTACT
 TC — BREAKER TRIP COIL
 IOI — BREAKER CONTROL SWITCH

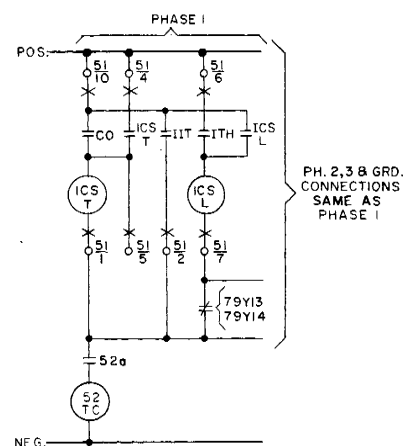
MOTOR PROTECTION



DEVICE NUMBER CHART

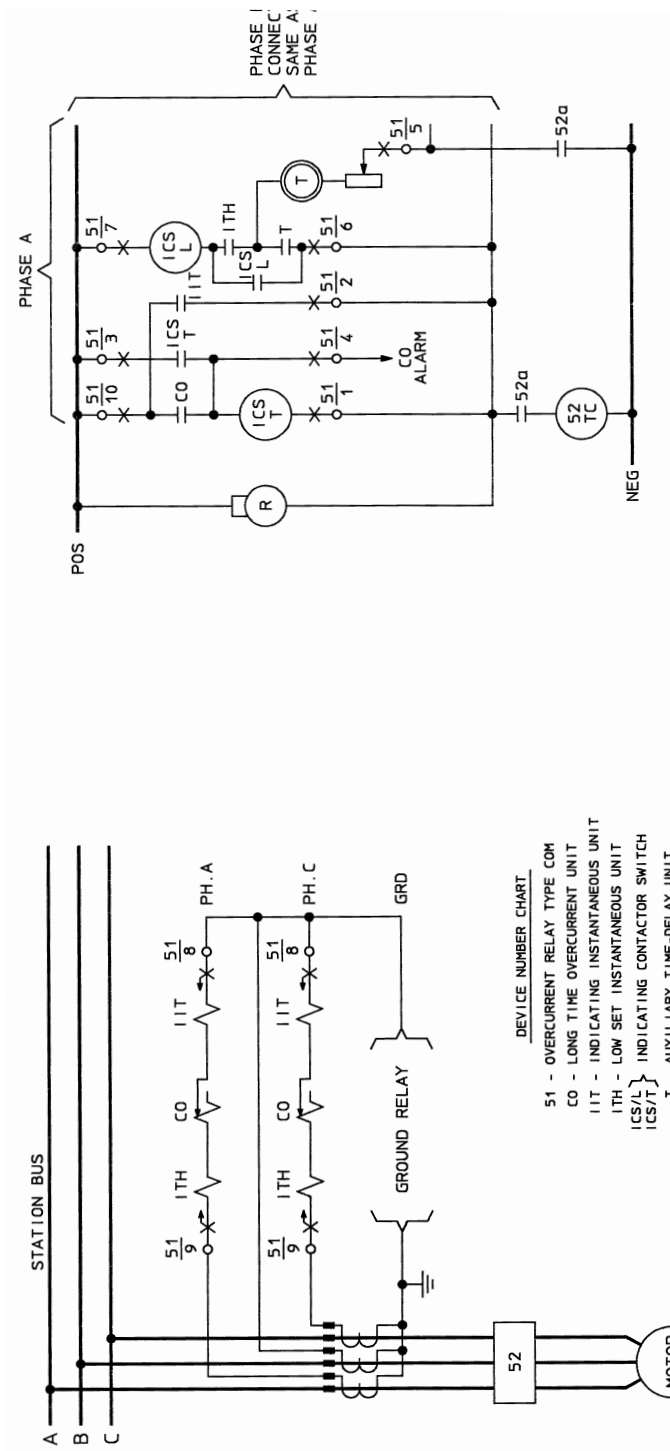
- 51 — OVERCURRENT RELAY-TYPE COM
 CO — TIME OVERCURRENT UNIT
 IIT — INDICATING INSTANTANEOUS UNIT
 ITH — LOW SET INSTANTANEOUS UNIT
 ICS/L } INDICATING CONTACTOR SWITCH
 ICS/T }
 52 — CIRCUIT BREAKER
 a — BREAKER AUXILIARY CONTACT
 TC — BREAKER TRIP COIL
 79Y13 } RECLOSING RELAY LOCKOUT CONTACTS
 79Y14 }

DISTRIBUTION FEEDER PROTECTION



407C261 - Sub 4

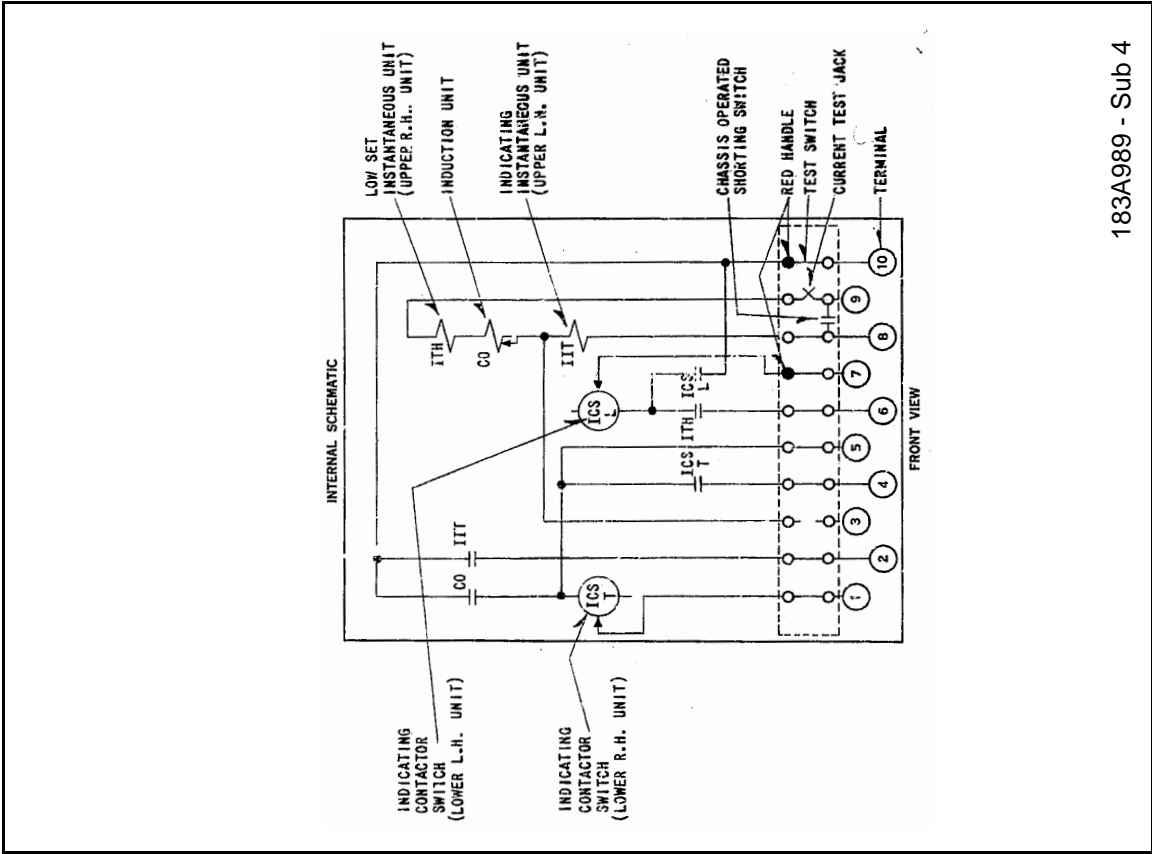
Figure 14: External Schematic of COM Relays without Auxiliary Time-Delay Unit.



290B741 - Sub 4*

Figure 15: External Schematic of COM Relays with Auxiliary Time-Delay Unit and ITH Unit.

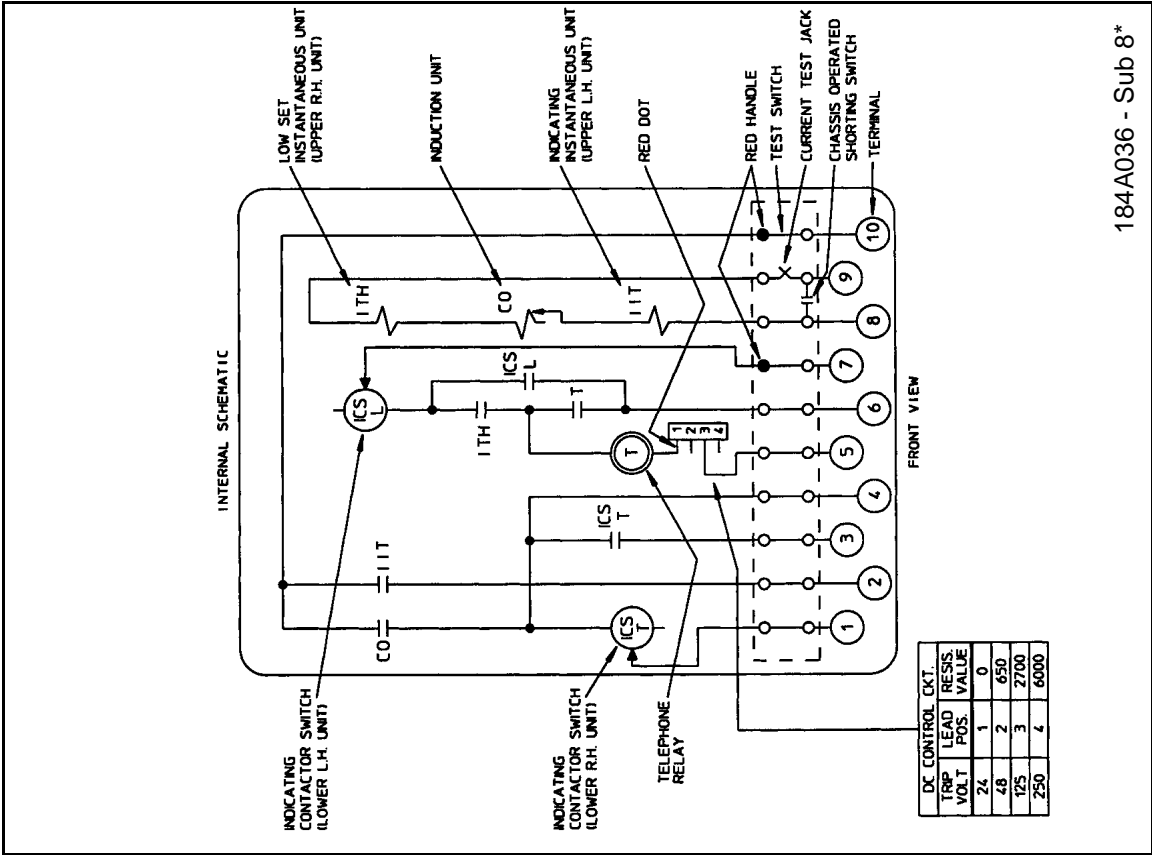
* Denotes Change



183A989 - Sub 4

Figure 16: Internal Schematic of the Type COM Relay, without Auxiliary Time-Delay Unit, in FT-21 Case. (For Style 289B355A – Series of COM-5 Relays).

* Denotes Change



184A036 - Sub 8*

Figure 17: Internal Schematic of the Type COM relay with Auxiliary Time-Delay Unit and ITH Unit, in FT-21 Case. (For Style 289B456A – Series of COM-5 Relays).

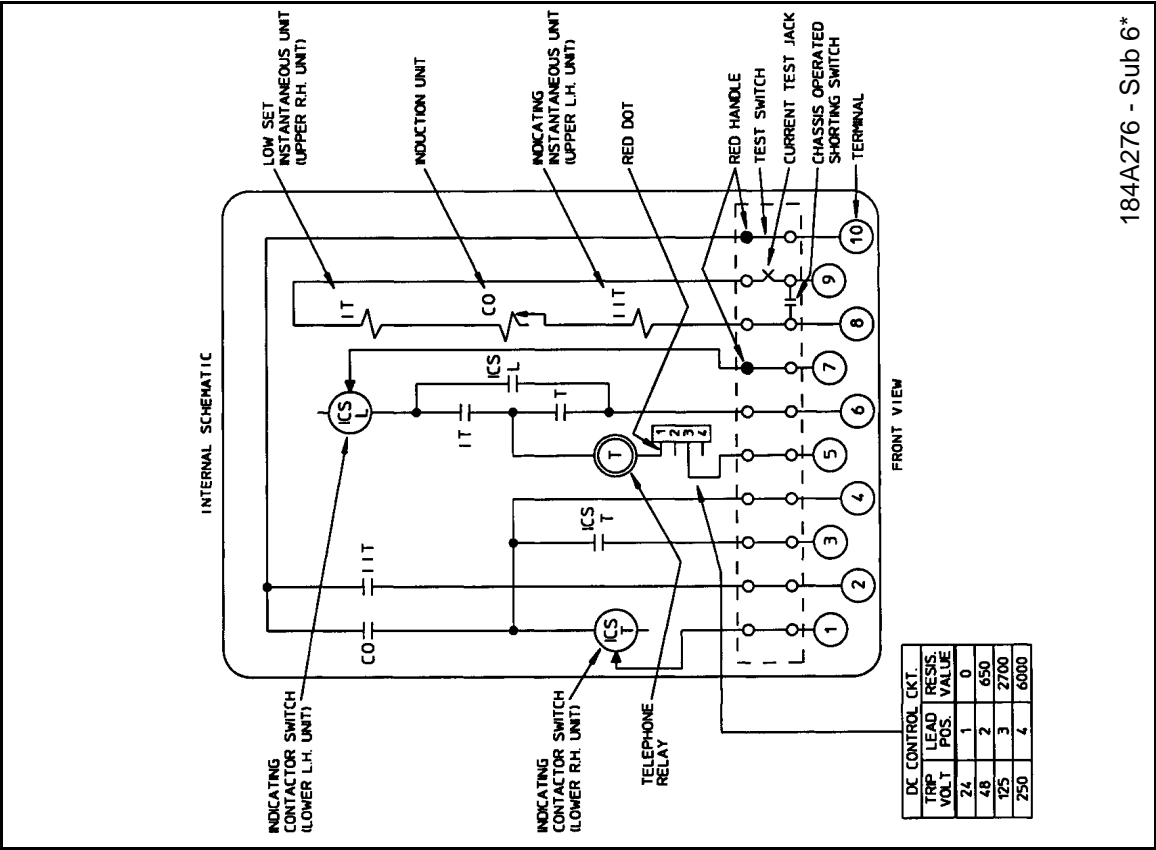


Figure 18: Internal Schematic of the Type COM Relay, with Auxiliary Time-Delay Unit and IT Unit, in FT-21 Case. (For Style 289B511A - Series of COM-5 Relays).

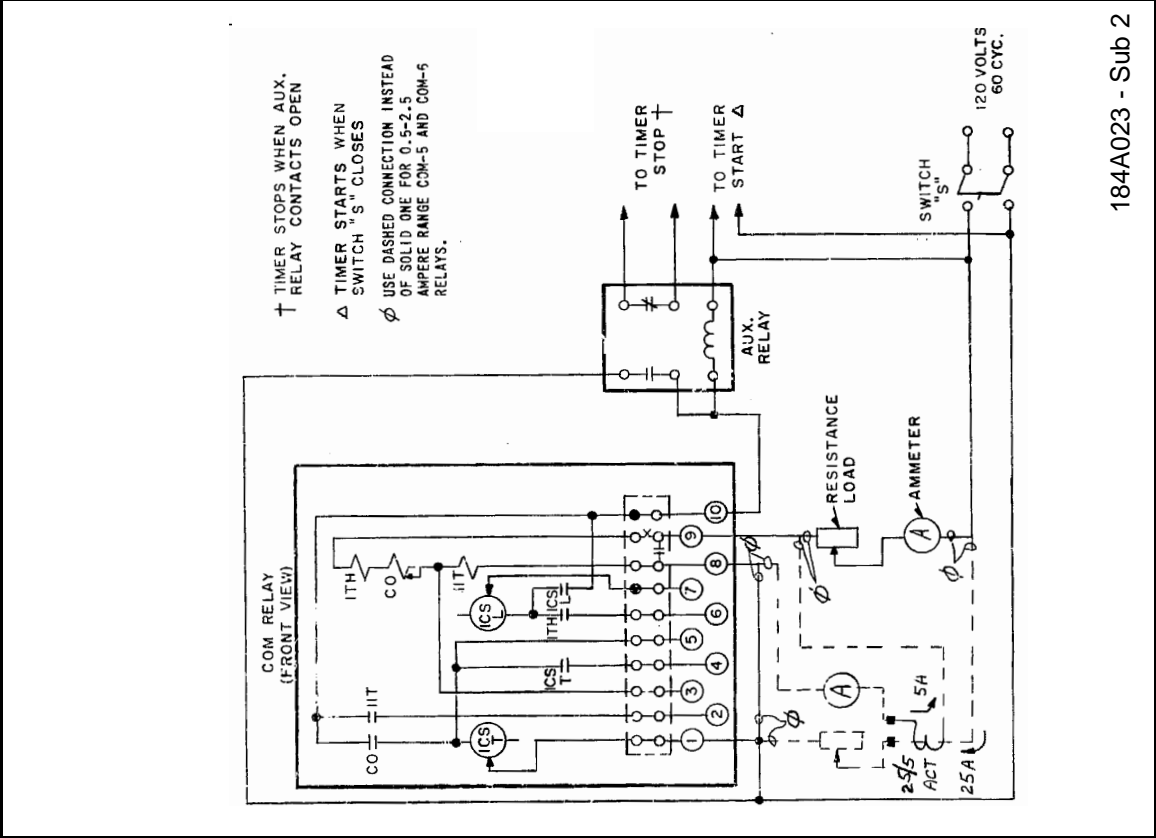


Figure 19: Diagram of Test Connections for CO Unit of COM Relays.

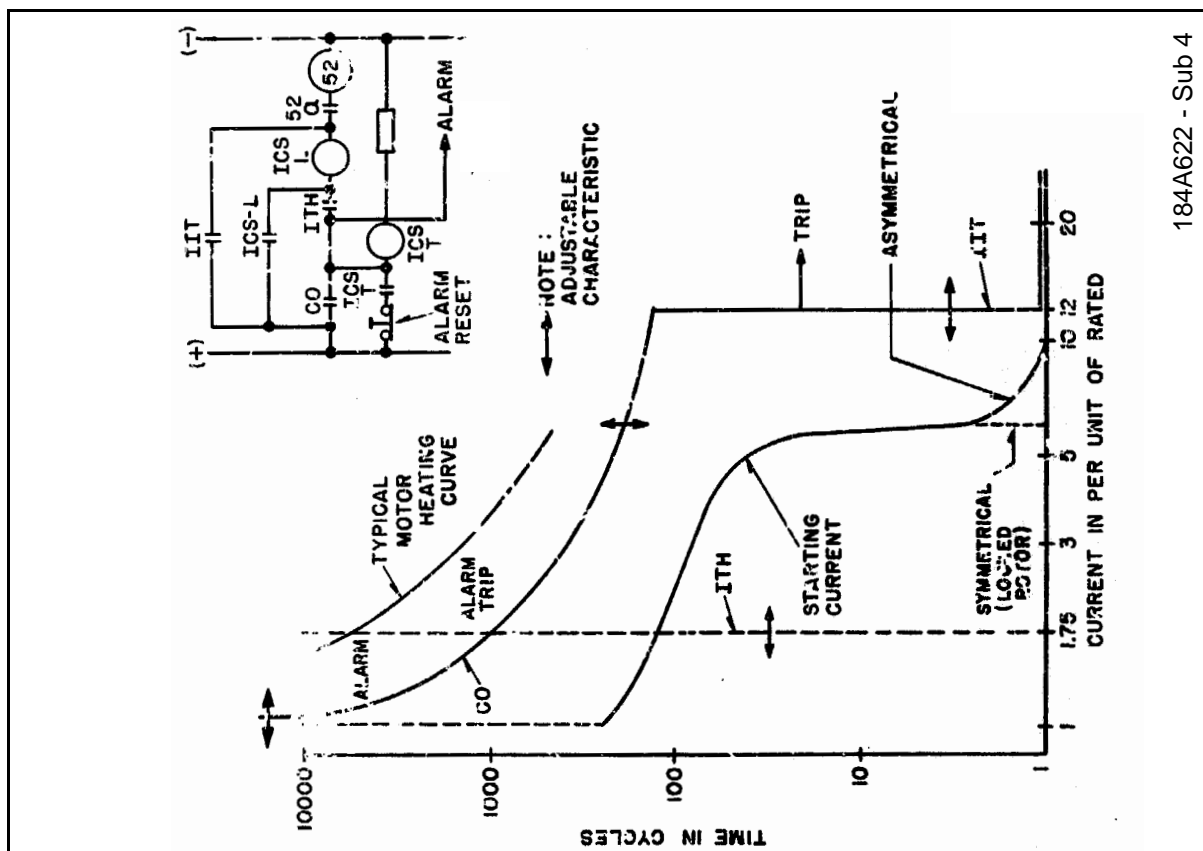


Figure 20: Setting Example for Motor Protection Using S#289B355A – Relays without Auxiliary Time-Delay Unit.

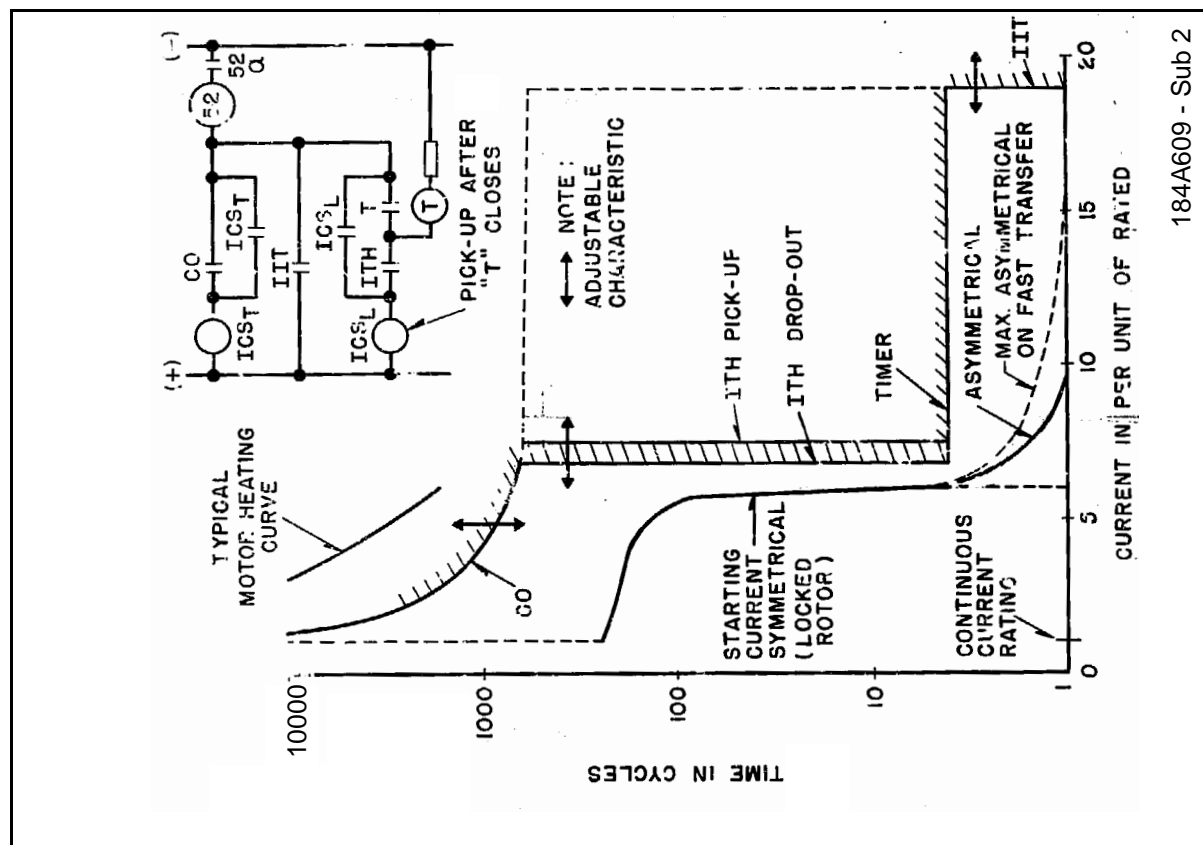


Figure 21: Setting Example for Motor Protection Using S#289B456A – or S# 289B51 1A – Relays with Auxiliary Time-Delay Unit.

This area reserved for notes

This area reserved for notes

This area reserved for notes

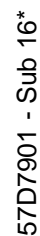


Figure 1: Outline and Drilling Plan for the Type COM Relay in the FT-21 Case

* Denotes Change