Instruction Leaflet

41-101.3A

Effective: June 1991
Supersedes I.L. 41-101.3 Dated April 1997

Type CKO Overcurrent Relay

(|) Denotes Change Since Previous Issue.

CAUTION

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

1.0 APPLICATION

The CKO relay is a time delayed overcurrent relay equipped with a cylinder unit instantaneous trip. It is used in applications where negligible response by the instantaneous unit to the dc component of fault current and/or high dropout ratio is required. Transient overreach will not exceed 5 percent for this instantaneous trip unit for circuit angles up to 80 degrees. The instantaneous unit may be "torque controlled" by an external contact where desired. Closure of the external contact prevents operation of the instantaneous unit. Dropout ratio of the instantaneous unit is 97 percent or greater.

2.0 CONSTRUCTION AND OPERATION

The various types of relays consist of a time-overcurrent unit (CO), an instantaneous over-current unit (I), an instantaneous overcurrent unit transformer, and two indicating contactor switches (ICS/I) and (ICS/T).

2.1 Time-Overcurrent Unit (CO)

The electromagnets for the types CKO-5, CKO-6, CKO-7, CKO-8 and CKO-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 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 electromagnet for the type CKO-2 and CKO-11 relays has 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.

The CO torque control terminals (4 and 5) are internally jumpered, but the jumper may be removed if external torque control is desired.

2.2 Indicating Contactor Switch Units (ICS/I) and ICS/T)

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

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 or maintenance of this equipment, the local ABB representative should be contacted.

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 Instantaneous Overcurrent Unit

2.3.1 Construction

The instantaneous overcurrent unit consists of an induction cylinder unit, capacitor, varistor, and a transformer. The components are connected such that a contact closing torque is produced when the current exceeds a specified value.

2.3.2 Induction Cylinder Unit

Mechanically, the cylinder unit is composed of four basic components: a diecast 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, and a capacitor is connected in series with one pair of coils. In addition, there are two locating pins. The locating pins are used to accurately position the lower 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 bearings, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing 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 contact 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.

2.3.3 Saturating Transformer

The transformer is a saturating type consisting of a tapped primary winding and a secondary winding. A varistor is connected across the secondary winding to reduce the voltage peaks applied to the induction cylinder unit and phase shifting capacitor.

2.4 Operation

Operation of the instantaneous overcurrent unit occurs when the primary current of the transformer exceeds a value as marked on the tap plate. Upon application of current to the transformer, a voltage is induced in the secondary winding. This voltage is impressed upon the parallel connected pairs of cylinder unit coils. The capacitor connected in series with one pair of coils shifts the current flowing in these coils in reference to the current flowing in the other pair of coils. As a result, the air gap fluxes of the cylinder unit are out of phase and a contact closing torque is produced.

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 pickup current for any tap setting, resulting in one time curve throughout the range of the relay.

Two terminals, 6 and 7, across one pair of pole windup are brought out so that operating current can be short circuited around the pole windings preventing the unit from developing torque.

3.0 CHARACTERISTICS

The time characteristics of the overcurrent relays are designated by specific numbers as indicated below (e.g., CKO-8).

Time Characteristic	Designation
Short Time	2
Long Time	5
Definite Time	6
Moderately Inverse Time	7
Inverse Time	8
Very Inverse Time	9
Extremely Inverse Time	11

The relays are available in the following current ranges:

INSTANTANEOUS OVERCURRENT UNIT (1)

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
20 - 80	20	30	40	48	60	80

The tap value is the minimum current required to just close the overcurrent relay contacts. For pickup settings in between taps refer to the section under adjustments. The pickup and dropout time curves for the instantaneous overcurrent units is shown in Figure 9.

TIME OVERCURRENT UNIT

Range	Taps						
.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 tap value is the minimum current required to just close the relay contacts.

This time vs. current characteristics for the time-overcurrent unit are shown in Figures 2 to 8. 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 Trip Circuit

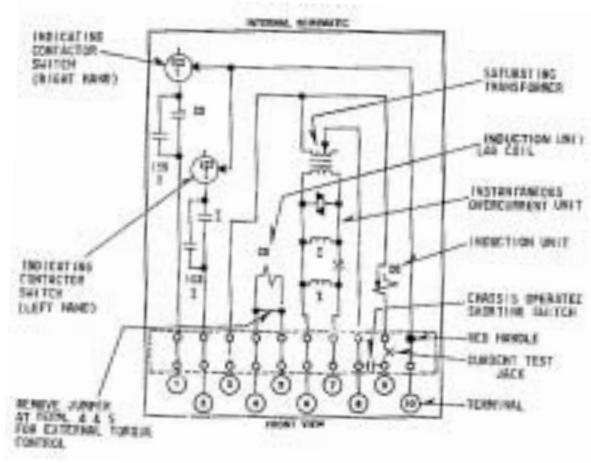
The relay contacts will safely close 30 amperes at 250 Vdc and the seal-in contacts of the indicating contactor switches will safely carry this current long enough to trip a circuit breaker.

The indicating contactor switch has two taps that provide 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.

3.2 Contacts

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

The set screw in each stationary contact has been shop adjusted for optimum follow and this adjustment should not be disturbed.



Sub 4
880A450

Figure 1. Internal Schematic of the Type CKO Relay in the Type FT31 Case.

3.2.1 Trip Circuit Constants

Indicating 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 Time Overcurrent Unit (CO)

The time 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

ENERGY REQUIREMENTS

INSTANTANEOUS OVERCURRENT UNIT OPERATING CURRENT CIRCUIT- 60 HERTZ

AMPERE RANGE	TAP	†† VA AT TAP VALUE	Ø P.F. ANGLE	†† VA AT 4 AMPS	Ø P.F. ANGLE
	.5	.37	39	2	46
	.75	.38	36	1	37
	1	.39	35	8.5	34
.5-2	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
	2	.47	30	3.0	29
1-4	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
	4	1.3	38	2.1	37
2-8	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	0.43	28
	15	2.4	21	0.27	21
	20	3.1	16	0.20	17
10-40	24	3.6	15	0.15	15
	30	4.2	12	0.11	13
	40	4.9	11	0.08	12
	20	6.6	31	0.40	31
	30	9.3	24	0.25	24
20-80	40	12.0	20	0.18	20
	48	13.5	18	0.14	18
	60	15.9	16	0.10	16
	80	19.2	15	0.07	15

RANGE	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING †(AMPERES)
0.5 - 2	5	100
1 - 4	8	140
2 - 8	8	140
4 - 16	10	200
10 - 40	10	200
20 - 80	10	200

† 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.

Ø Degrees current lags voltage.

†† Voltages taken with Rectox type voltmeter.

ENERGY REQUIREMENTS

TYPE CKO-2 TIME OVERCURRENT UNITS

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING† (AMPERES)	POWER FACTOR ANGLEØ	AT TAP VALUE CURRENT	VOLT AMPERES†† AT 3 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 10 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 20 TIMES TAP VALUE CURRENT
	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
0.5-2.5	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
	2.0	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	*40.8	312	1008
2-6	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
	4.0	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
4-12	7.0	9.6	230	46	5.53	45.8	364	1260
	8.0	10.4	230	43	5.86	49.9	400	1408
	10.0	11.2	230	37	6.60	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 maybe calculated on the basis of time being inversely proportional to the square of the current.***

Ø ***Degrees current lags voltage at tap value current.***

†† ***Voltages taken with Rectox type voltmeter.***

ENERGY REQUIREMENTS

TYPE CKO-5 AND TYPE CKO-6 TIME OVERCURRENT UNITS

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING† (AMPERES)	POWER FACTOR ANGLE Ø	AT TAP VALUE CURRENT	VOLT AMPERES†† AT 3 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 10 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 20 TIMES TAP VALUE CURRENT
	0.5	2.7	88	69	3.92	20.6	103	270
	0.6	3.1	88	68	3.96	20.7	106	288
	0.8	3.7	88	67	3.96	21.0	114	325
0.5-2.5	1.0	4.1	88	66	4.07	21.4	122	360
	1.5	5.7	88	62	4.19	23.2	147	462
	2.0	6.8	88	60	4.30	24.9	168	548
	2.5	7.7	88	58	4.37	26.2	180	630
	2	8.0	230	67	3.88	21.0	110	308
	2.5	8.8	230	66	3.90	21.6	118	342
	3	9.7	230	64	3.93	22.1	126	381
2-6	3.5	10.4	230	63	4.09	23.1	136	417
	4	11.2	230	62	4.12	23.5	144	448
	5	12.5	230	59	4.20	24.8	162	540
	6	13.7	230	57	4.38	26.5	183	624
	4	16.0	460	65	4.00	22.4	126	376
	5	18.8	460	63	4.15	23.7	143	450
	6	19.3	460	61	4.32	25.3	162	531
4-12	7	20.8	460	59	4.35	26.4	183	611
	8	22.5	460	56	4.40	27.8	204	699
	10	25.0	460	53	4.60	30.1	247	880
	12	28.0	460	47	4.92	35.6	288	1056

CKO-7 TIME OVERCURRENT UNITS

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING† (AMPERES)	POWER FACTOR ANGLE Ø	AT TAP VALUE CURRENT	VOLT AMPERES†† AT 3 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 10 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 20 TIMES TAP VALUE CURRENT
	0.5	2.7	88	68	3.88	20.7	103	278
	0.6	3.1	88	67	3.93	20.9	107	288
	0.8	3.7	88	66	3.93	21.1	114	320
0.5-2.5	1.0	4.1	88	64	4.00	21.6	122	356
	1.5	5.7	88	61	4.08	22.9	148	459
	2.0	6.8	88	58	4.24	24.8	174	552
	2.5	7.7	88	56	4.38	25.9	185	640
	2	8.0	230	66	4.06	21.3	111	306
	2.5	8.8	230	63	4.07	21.8	120	342
	3	9.7	230	63	4.14	22.5	129	366
2-6	3.5	10.4	230	62	4.34	23.4	141	413
	4	11.2	230	61	4.34	23.8	149	448
	5	12.5	230	59	4.40	25.2	163	530
	6	13.7	230	58	4.62	27.0	183	624
	4	16.0	460	64	4.24	22.8	129	392
	5	18.8	460	61	4.30	24.2	149	460
	6	19.3	460	60	4.62	25.9	168	540
4-12	7	20.8	460	58	4.69	27.3	187	626
	8	22.5	460	55	4.80	29.8	211	688
	10	25.0	460	51	5.20	33.0	260	860
	12	28.0	460	46	5.40	37.5	308	1032

† *Thermal capacities for short times other than one second maybe calculated on the basis of time being inversely proportional to the square of the current.*

ø *Degrees current lags voltage at tap value current.*

†† *Voltages taken with Rectox type voltmeter.*

ENERGY REQUIREMENTS

TYPE CKO-8 AND TYPE CKO-9 TIME OVERCURRENT UNITS

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING† (AMPERES)	POWER FACTOR ANGLE Ø	AT TAP VALUE CURRENT	VOLT AMPERES†† AT 3 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 10 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 20 TIMES TAP VALUE CURRENT
	0.5	2.7	88	72	2.38	21.0	132	350
	0.6	3.1	88	71	2.38	21.0	134	365
	0.8	3.7	88	69	2.40	21.1	142	400
0.5-2.5	1.0	4.1	88	67	2.42	21.2	150	440
	1.5	5.7	88	62	2.51	22.0	170	530
	2.0	6.8	88	57	2.65	23.5	200	675
	2.5	7.7	88	53	2.74	24.8	228	800
	2	8.0	230	70	2.38	21.0	136	360
	2.5	8.8	230	66	2.40	21.1	142	395
	3	9.7	230	64	2.42	21.5	149	430
2-6	3.5	10.4	230	62	2.48	22.0	157	470
	4	11.2	230	60	2.53	22.7	164	500
	5	12.5	230	58	2.64	24.0	180	580
	6	13.7	230	56	2.75	25.2	198	660
	4	16.0	460	68	2.38	21.3	146	420
	5	18.8	460	63	2.46	21.8	158	480
	6	19.3	460	60	2.54	22.6	172	550
4-12	7	20.8	460	57	2.62	23.6	190	620
	8	22.5	460	54	2.73	24.8	207	700
	10	25.0	460	48	3.00	27.8	248	850
	12	28.0	460	45	3.46	31.4	292	1020

CKO-11 TIME OVERCURRENT UNITS

AMPERE RANGE	TAP	CONTINUOUS RATING (AMPERES)	ONE SECOND RATING† (AMPERES)	POWER FACTOR ANGLE Ø	AT TAP VALUE CURRENT	VOLT AMPERES†† AT 3 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 10 TIMES TAP VALUE CURRENT	VOLT AMPERES†† AT 20 TIMES TAP VALUE CURRENT
	0.5	1.7	56	36	0.72	6.54	71.8	250
	0.6	1.9	56	34	0.75	6.80	75.0	267
	0.8	2.2	56	30	0.81	7.46	84.0	298
0.5-2.5	1.0	2.5	56	27	0.89	8.30	93.1	330
	1.5	3.0	56	22	1.13	10.04	115.5	411
	2.0	3.5	56	17	1.30	11.95	136.3	502
	2.5	3.8	56	16	1.48	13.95	160.0	610
	2.0	7.0	230	32	0.73	6.30	74.0	264
	2.5	7.8	230	30	0.78	7.00	78.5	285
	3.0	8.3	230	27	0.83	7.74	84.0	309
2-6	3.5	9.0	230	24	0.88	8.20	89.0	340
	4.0	10.0	230	23	0.96	9.12	102.0	372
	5.0	11.0	230	20	1.07	9.80	109.0	430
	6.0	12.0	230	20	1.23	11.34	129.0	504
	4.0	14.0	460	29	0.79	7.08	78.4	296
	5.0	16.0	460	25	0.89	8.00	90.0	340
	6.0	17.0	460	22	1.02	9.18	101.4	378
4-12	7.0	18.0	460	20	1.10	10.00	110.0	454
	8.0	20.0	460	18	1.23	11.10	124.8	480
	10.0	22.0	460	17	1.32	14.90	131.6	600
	12.0	26.0	460	16	1.80	16.30	180.0	720

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

Ø Degrees current lags voltage at tap value current.

†† Voltages taken with Rectox type voltmeter.

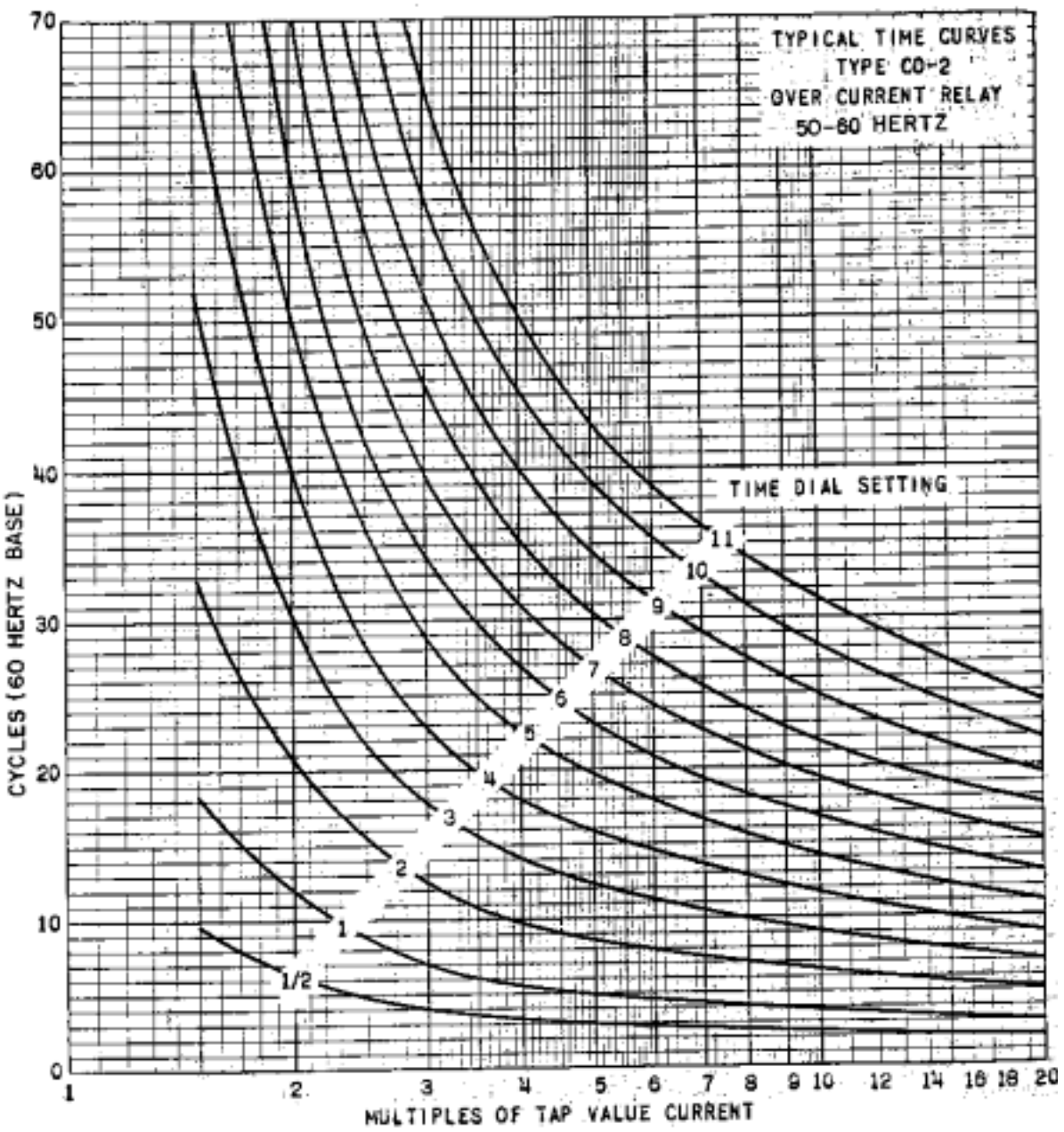


Figure 2. Typical Time Curves of the Time-Overcurrent Unit of the Short Time (2) Relays.

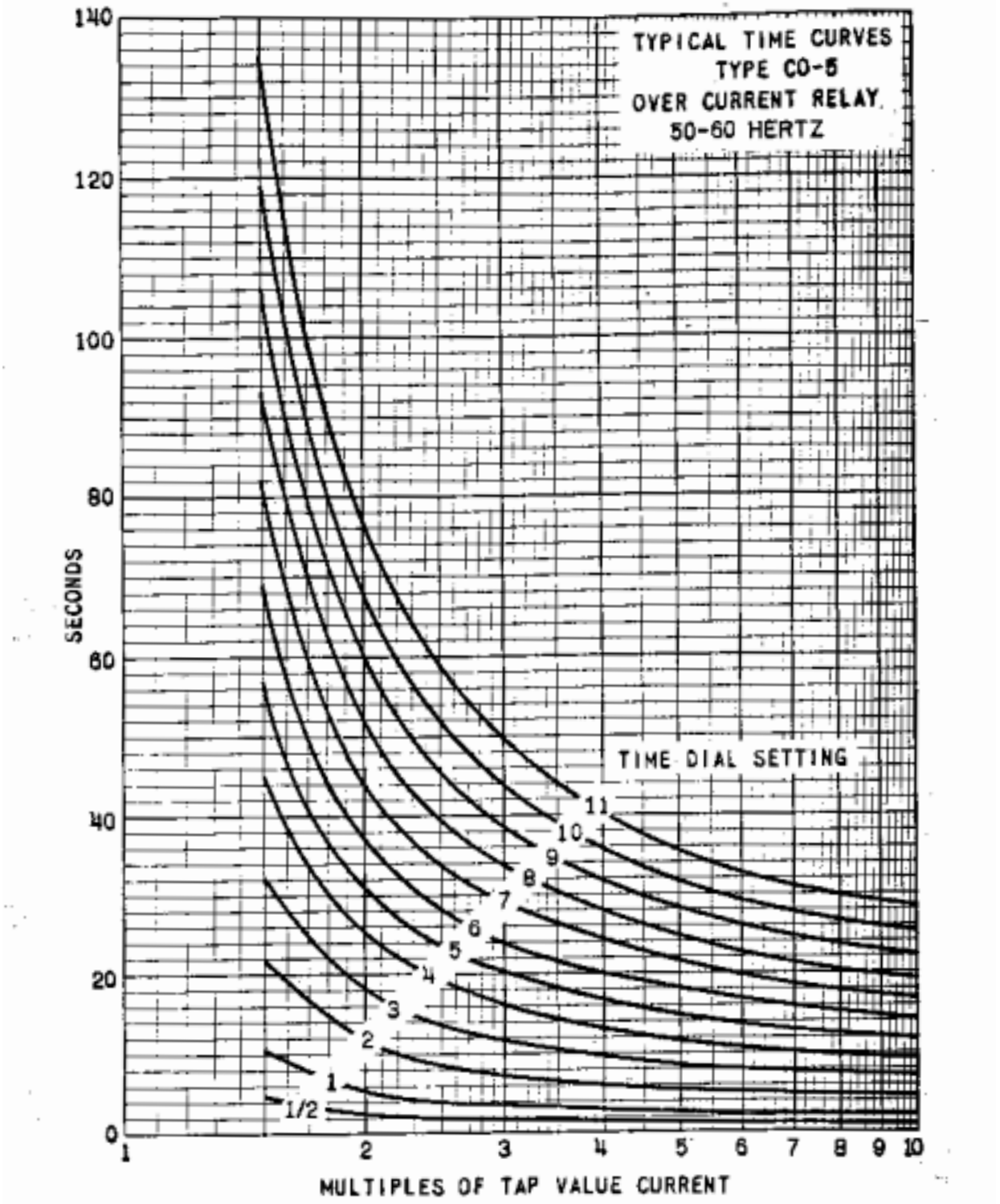
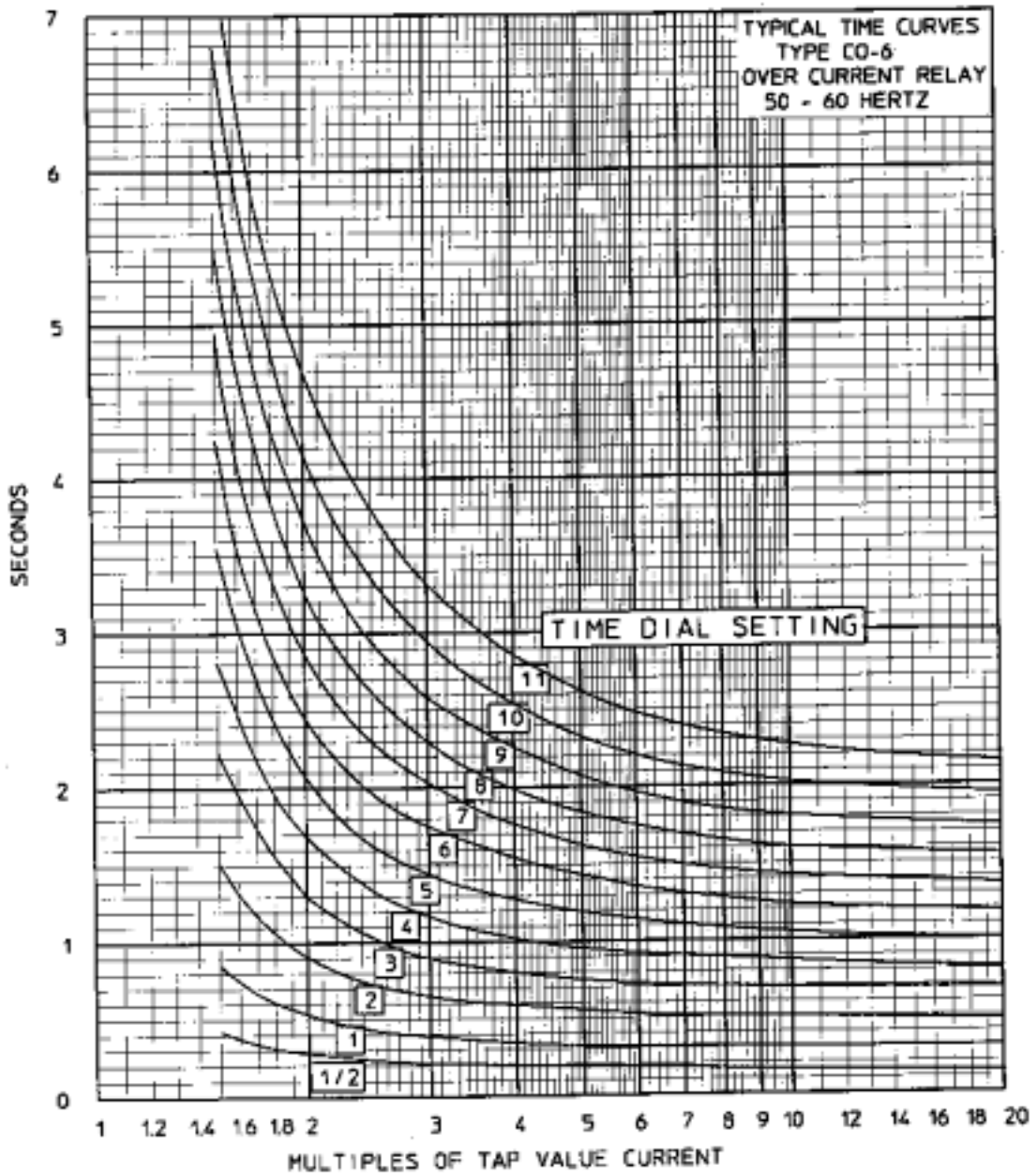
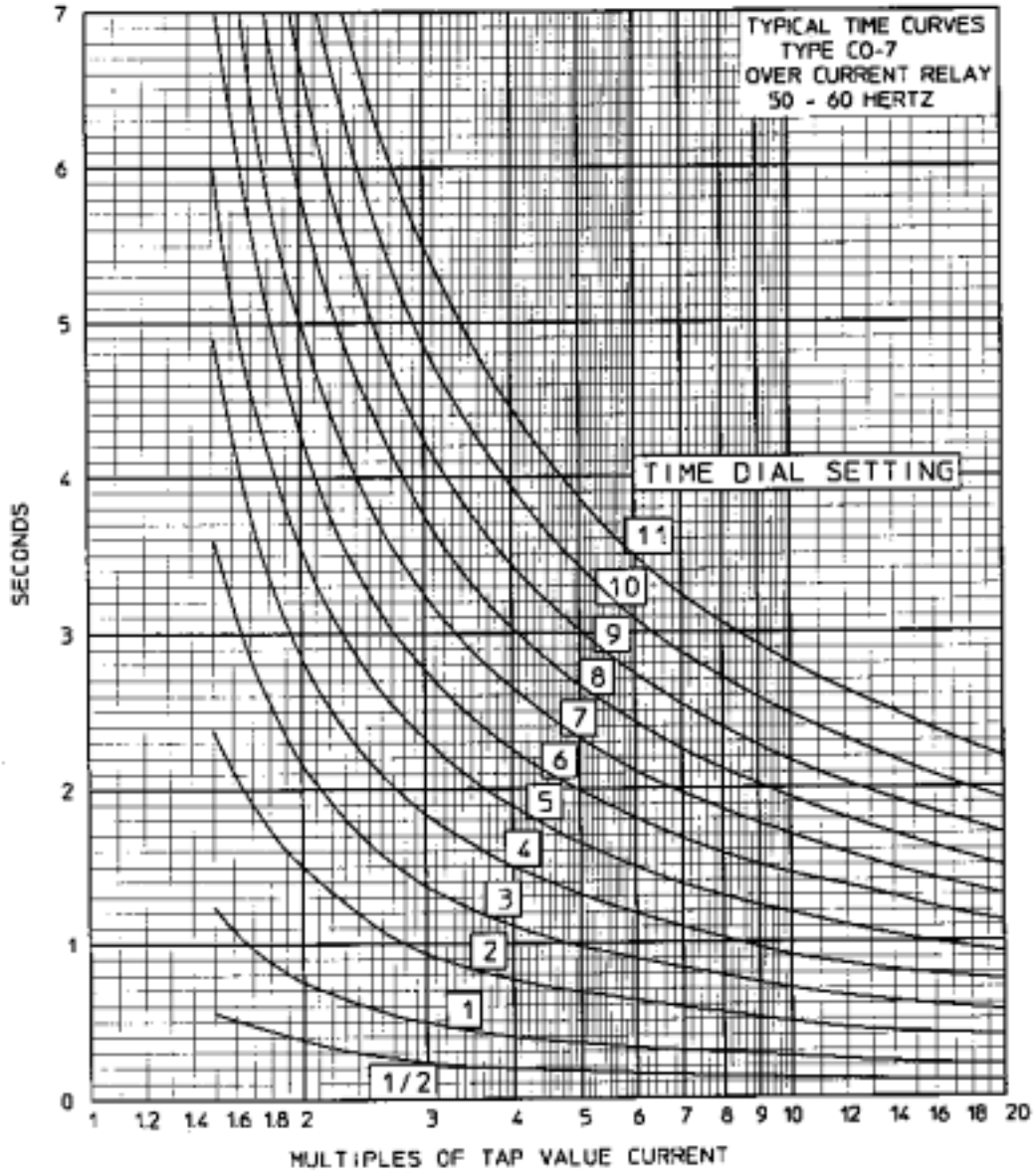


Figure 3. Typical Time Curves of the Time-Overcurrent Unit of the Long Time (5) Relays.



*Sub 3
418246

Figure 4. Typical Time Curves of the Time-Overcurrent Unit of the Definite Time (6) Relays.



*Sub 3
418247

Figure 5. Typical Time Curves of the Time-Overcurrent Unit of the Moderately Inverse (7) Relays.

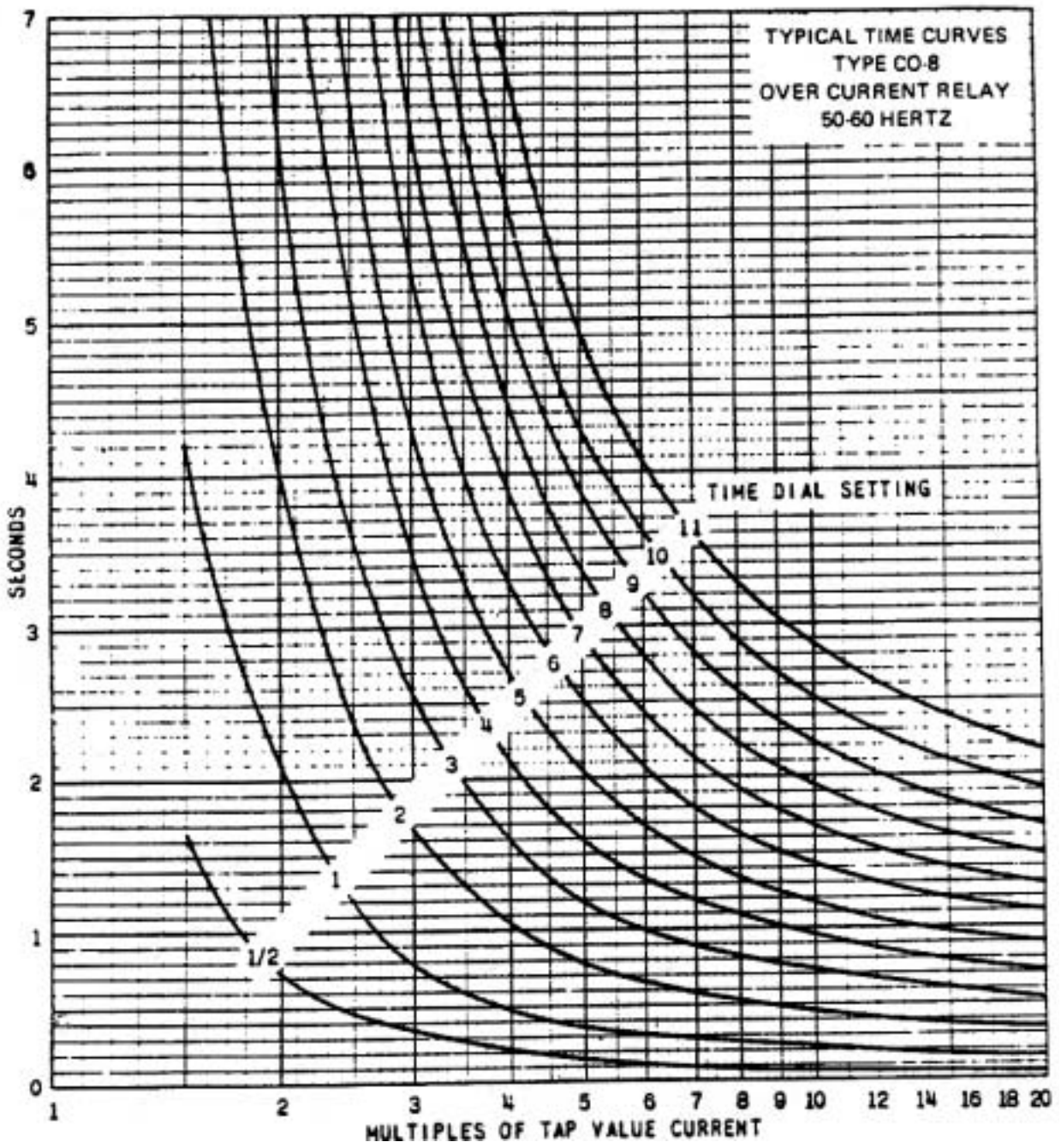


Figure 6. Typical Time Curves of the Time-Overcurrent Unit of the Inverse (8) Relays.

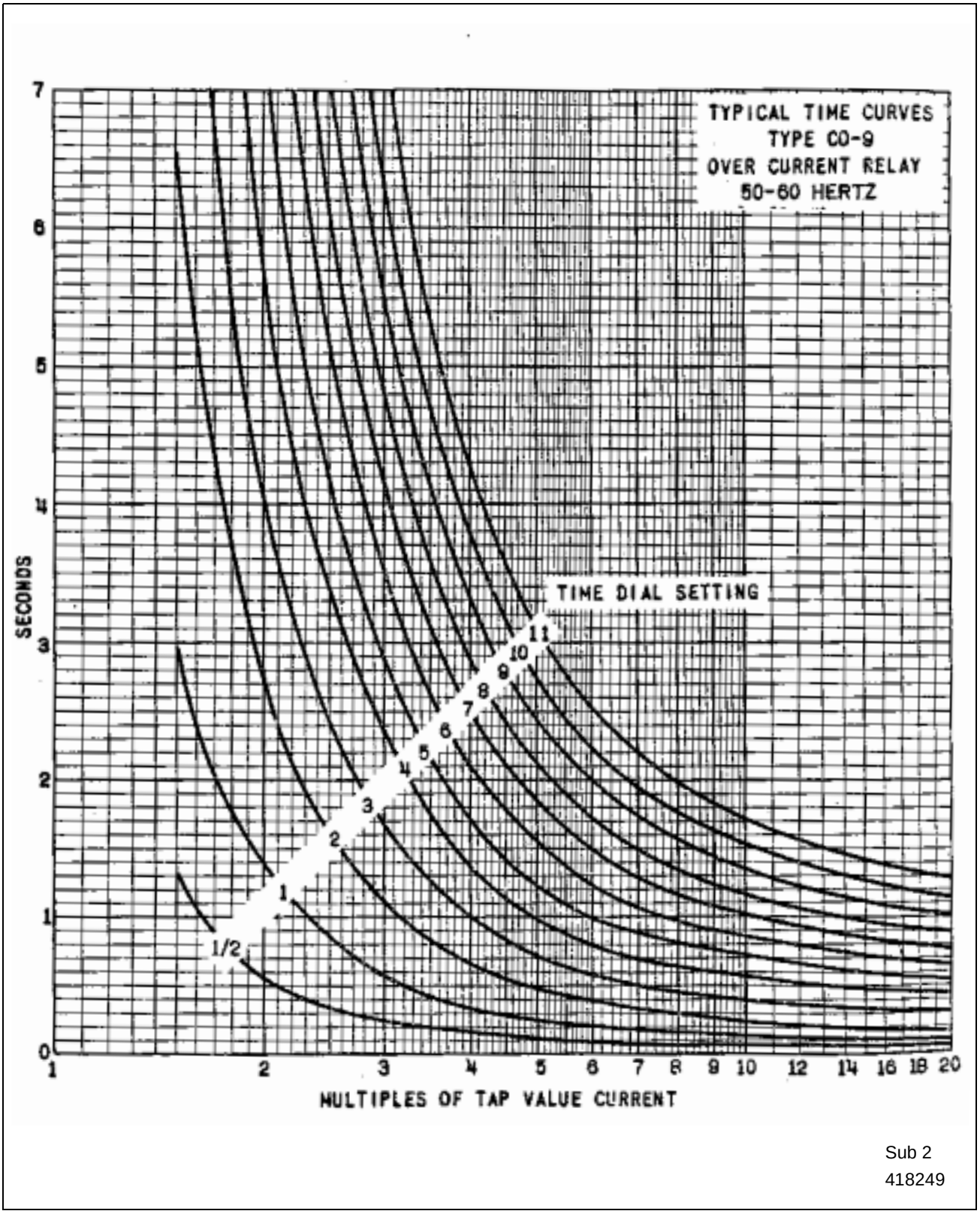


Figure 7. Typical Time Curves of the Time-Overcurrent Unit of the Very Inverse (9) Relays.

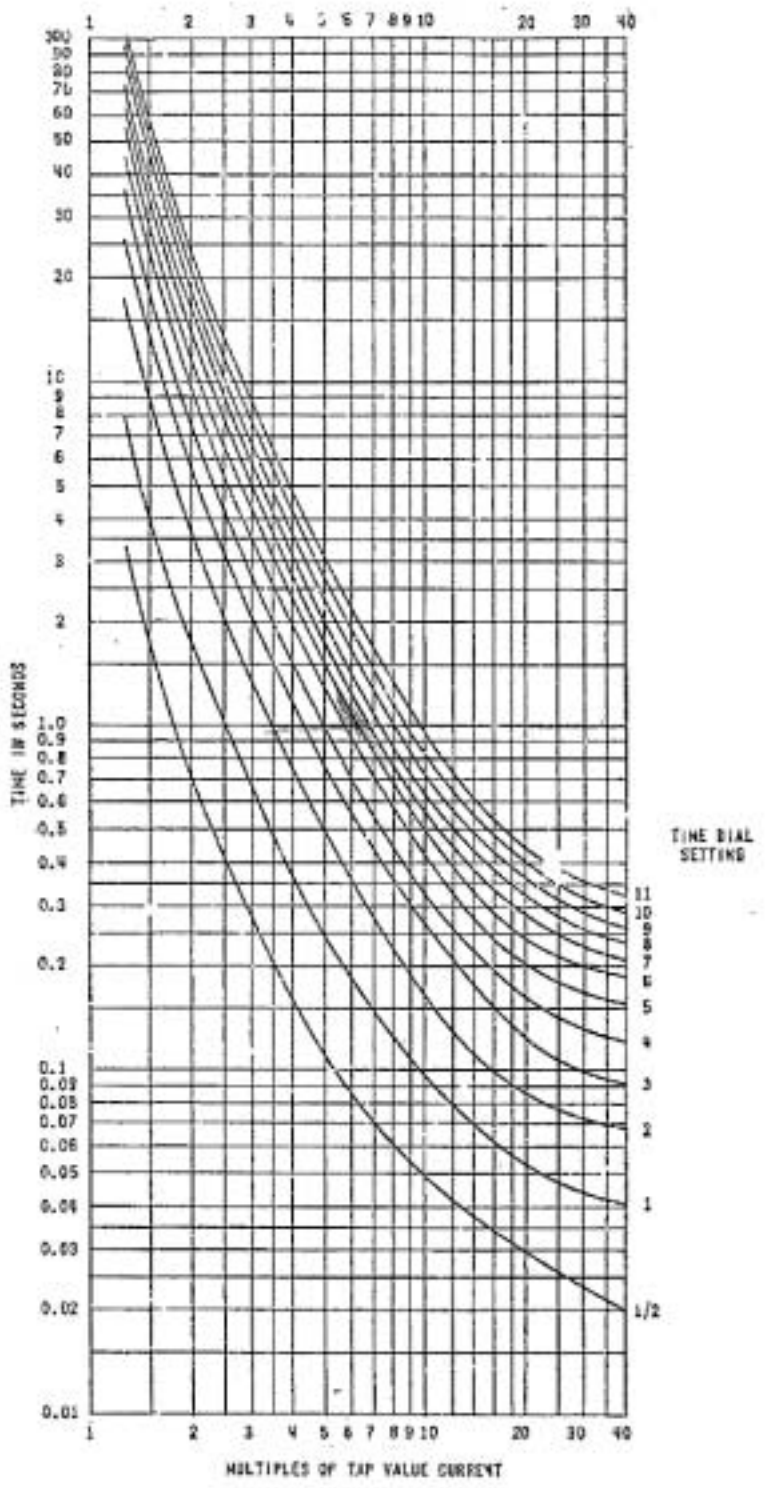
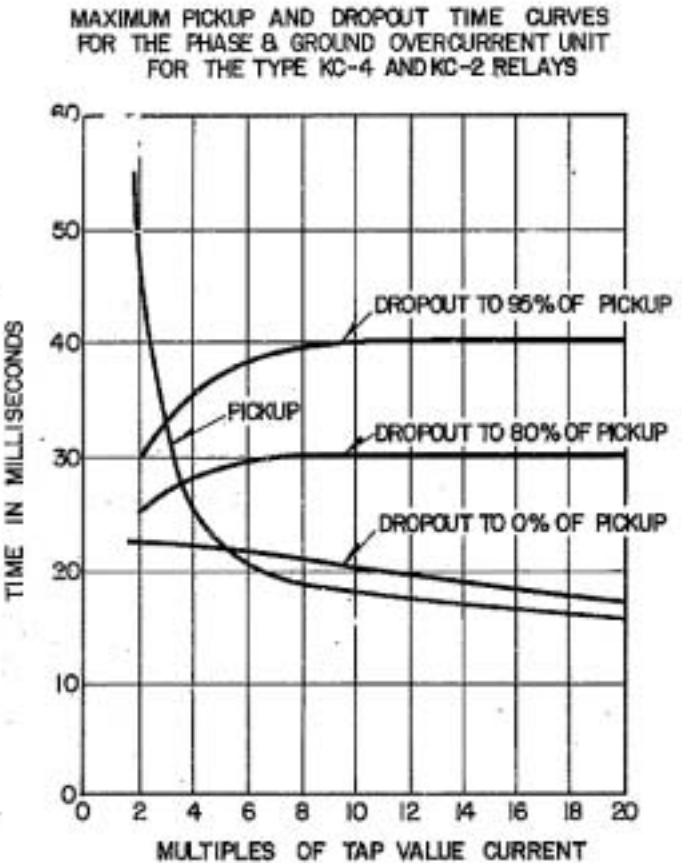


Figure 8. Typical Time Curves of the Time-Overcurrent Unit of the Extremely Inverse (11) Relays.



*Sub 4
629A576

Figure 9. Maximum Pickup and Dropout Time Curves for Instantaneous Overcurrent Unit.

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 screws on the tap plate above the time dial makes connections to various turns on the operating coil. By placing this screw in the various tap plate holes, the relay will just close its contacts at the corresponding current 4, 5, 6, 7, 8, 10, 12 amperes, or as marked on the tap plates.

CAUTION

Since the tap block screw carries operating current, be sure that the screws are turned tight.

In order to avoid opening current transformer circuits when changing taps under load, the relay must first be removed from the case. Chassis operating shorting switches on the case will short the secondary of the current transformer. The taps should then be changed with the relay outside of the case and then reinserted into the case.

4.2 Instantaneous Reclosing

The factory adjustment of the CO unit contacts provides a contact follow. Where circuit breaker reclosing will be initiated immediately after a trip by the CO contact, the time of the opening of the contacts should be a minimum. This condition is obtained 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 Instantaneous Overcurrent Unit (I)

The only setting required is the pickup current setting which is made by means of the connector screw located on the tap plate. By placing the connector screw in the desired tap, the relay will just close its contacts at the tap value current.

CAUTION

Since the tap block connector screw carries operating current, be sure that the screw is turned tight.

In order to avoid opening current transformer circuits when changing taps under load, the relay must first be removed from the case. Chassis operating shorting switches on the case will short the secondary of the current transformer. The taps should then be changed with the relay outside of the case and then reinserted into the case.

4.4 Indicating Contactor Switch (ICS/I and ICS/T)

The setting required on the ICS units is the selection of the 0.2 or 2.0 ampere tap setting. This selection is made by connecting the lead located in front of the tap block to the desired setting by means of the connecting screw.

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 screw or studs, and the relay panel. Ground wires should be affixed to the mounting screws or studs as required for poorly grounded or insulating panels. Other electrical connections may be made directly to the terminal 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 Section 4, Settings, should be required.

6.1 Performance Check

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

6.1.1 Instantaneous Overcurrent Unit (I)

a. Contact Gap

The gap between the stationary and moving contacts with the relay in the de-energized position should be approximately .020".

b. Minimum Trip Current

The pick-up of the overcurrent unit can be checked by inserting the tap screw in the desired tap hole and applying rated tap value current. The contact should close within ±5% of tap value current.

6.1.2 Time Overcurrent Unit (CO)

a. Contacts

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.

b. Minimum Trip Current

Set the time dial to position 6, alternately apply tap value current plus 3% and tap value current minus 3%. The moving contact should leave the backstop at tap value current plus 3% and should return to the backstop at tap value current minus 3%.

c. Time Curve

Table 1 shows the time curve calibration points for the various types of relays. With the time dial set to the indicated position, apply the currents specified by Table 1 (e.g., for the CKO-2, 3 times and 20 times tap value current) and measure the operating time of the relay. The operating times should equal those of Table 1 plus or minus 5 percent.

6.1.3 Indicating Contactor Switches (ICS/I) and (ICS/T)

a. Close the contacts of the CO and pass sufficient dc current through the trip circuit to close the contacts of (ICS/T). This value of current should not be greater than the particular (ICS/T) tap setting being used. The operation indicator target should drop freely, bringing the letter "T" into view.

b. Close the contacts of the instantaneous over-current unit (I) and pass sufficient dc current through the trip circuit to close the contacts of (ICS/I). This value of current should not be greater than the particular (ICS/I) tap setting being used. The operation indicator target should drop freely, bringing the letter "I" into view.

c. For proper contact adjustment, insert a .030" feeler gauge between the core pin and the armature. Hold the armature closed against the core pin and guage and adjust the stationary contacts such that they just make with the moving contact. Both stationary contacts should make at approximately the same time. The contact follow will be approximately 1/64" to 3/64".

6.2 ROUTINE MAINTENANCE

All relays should be inspected periodically and the time of 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. The use of phantom loads, in testing induction-type relays, should be avoided, since the resulting distorted current wave form will produce an error in timing.

All contacts should be periodically cleaned. A contact burnishing tool #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.

6.3 CALIBRATION

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See Section 6.1, Performance Check.)

6.4 INSTANTANEOUS OVERCURRENT UNIT (I)

a. The upper pin bearing should be screwed down until there is approximately 0.025 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.

b. The contact gap adjustment for the overcurrent unit is made with the moving contact in the reset position, i.e., against the right side of the bridge. Move in the left-hand stationary contact until it just touches the moving contact then back off the stationary contact 2/3 of one turn for a gap of approximately .020". The clamp holding the stationary contact in position.

c. The sensitivity adjustment is made by varying the tension of the spiral 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.

Insert the tap screw in the minimum value tap setting and adjust the spring such that the contacts will close as indicated by a neon lamp in the contact circuit when energized with the required current. The pick up of the overcurrent unit with the tap screw in any other tap should be within ±5% of tap value.

If adjustment of pick-up current in between tap settings is desired insert the tap screw in the next lowest tap setting and adjust the spring as described. It should be noted that this adjustment results in a slightly different time characteristic curve and burden.

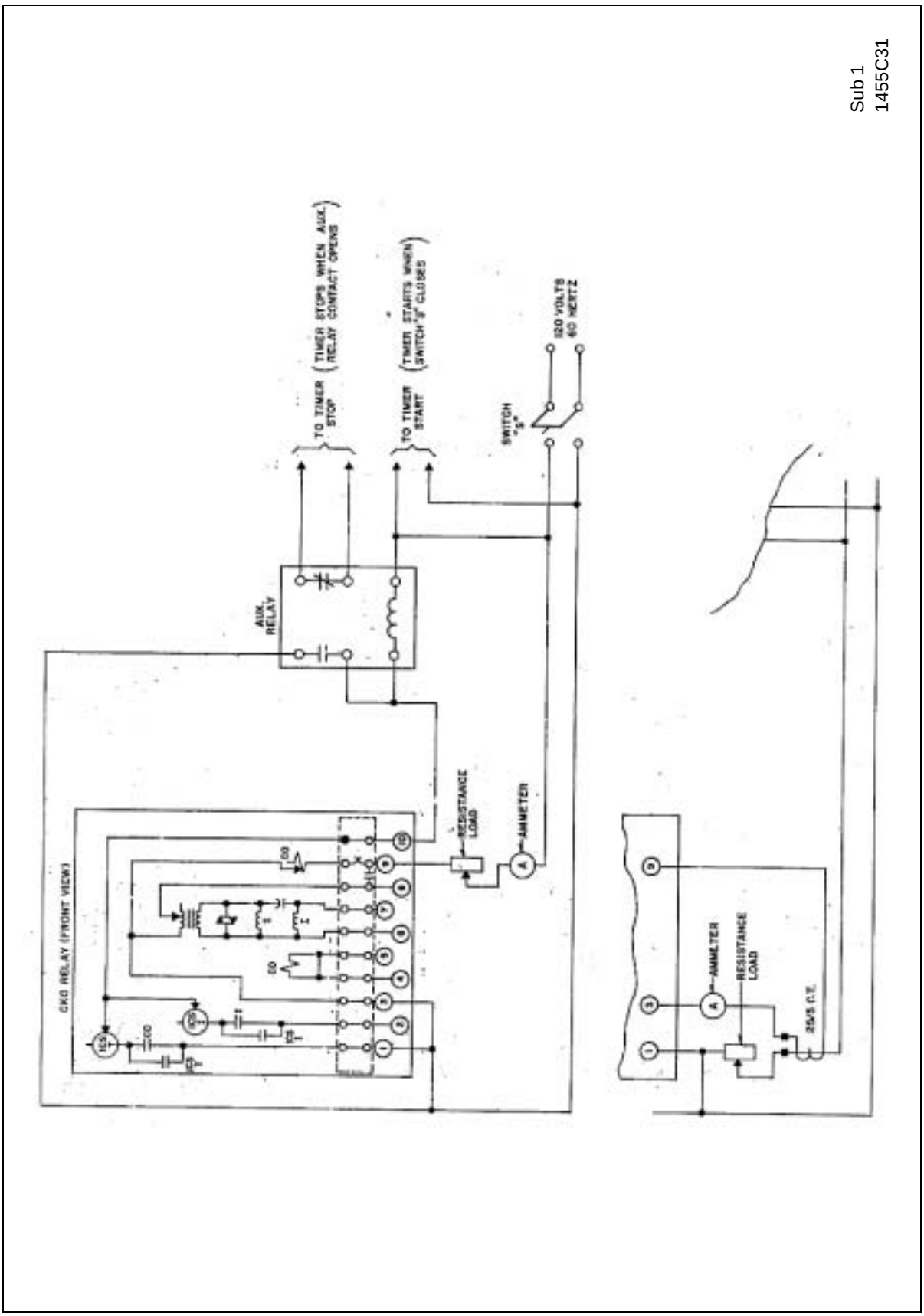


Figure 10. Diagram of Test Connections of the Time-Overcurrent Unit.

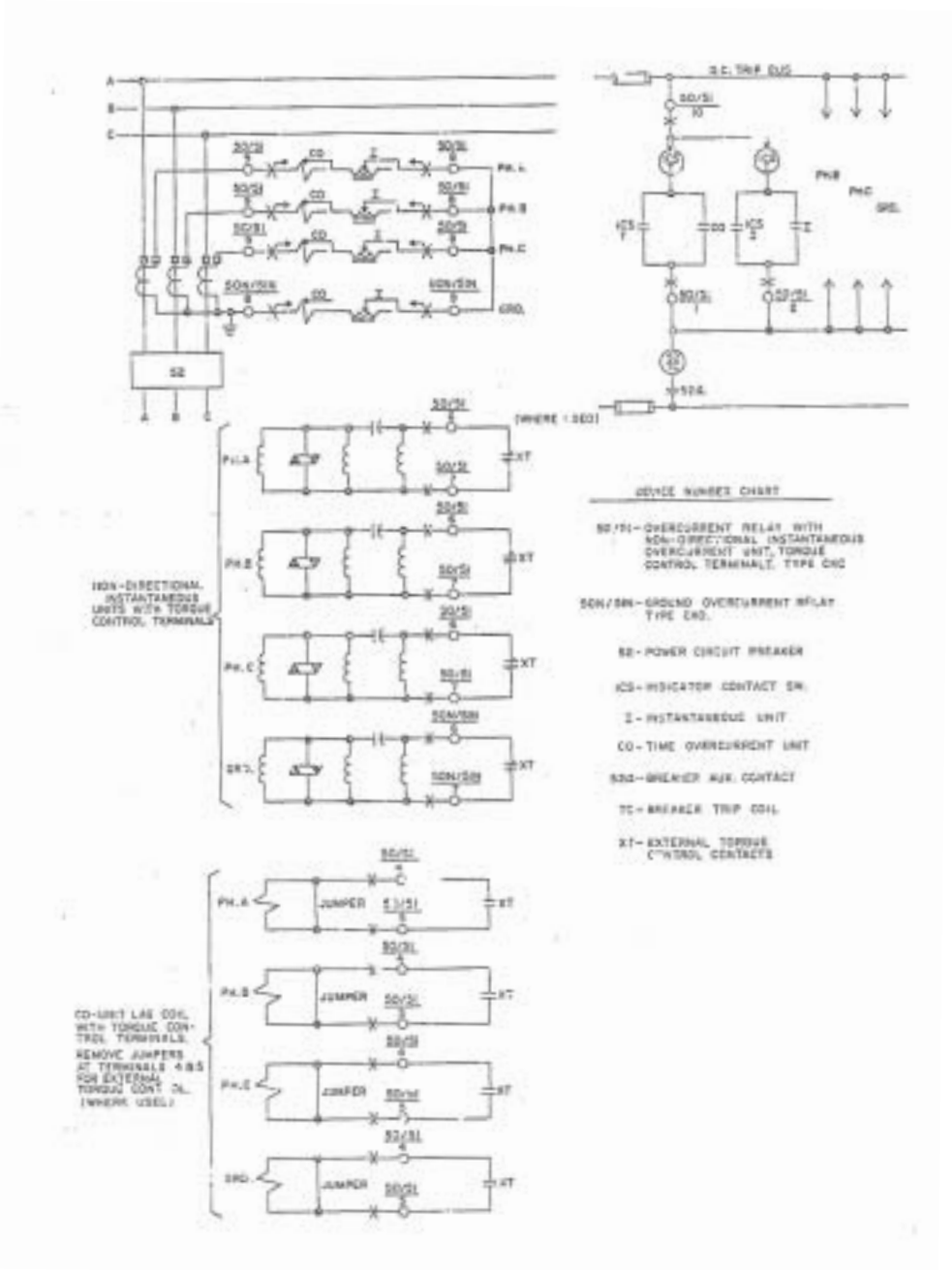


Figure 11. External Schematic of the CKO Relay

7.0 TIME OVERCURRENT UNIT (CO)

a. Contacts

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.

b. 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 minimum 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%.

c. Time Curve Calibration

Install the permanent magnet. Apply the indicated current per Table 1 for permanent magnet adjustment (e.g., CKO-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.

Apply the indicated current per Table 1 for the electromagnet plug adjustment (e.g., CKO-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. (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.

7.1 Indicating Contactor Switches (ICS/I) AND (ICS/T)

For proper contact adjustment, insert a .030" feeler gauge between the core pin and the armature. Hold the armature closed against the core pin and gauge and adjust the stationary contacts such that they just

TABLE 1

TIME CURVE CALIBRATION DATA - 60 HERTZ

PERMANENT MAGNET ADJUSTMENT			ELECTROMAGNET PLUGS		
TIME-OVERCURRENT UNIT TYPE	TIME DIAL POSITION	CURRENT (MULTIPLES OF TAP VALUE)	OPERATING TIME SECONDS	CURRENT MULTIPLES OF TAP VALUE)	OPERATING TIME SECONDS
2	6	3	0.57	20	0.22
5	6	2	37.80	10	14.30
6	6	2	2.46	20	1.19
7	6	2	4.27	20	1.11
8	6	2	13.35	20	1.11
9	6	2	8.87	20	0.65
11	6	2	11.27	20	0.24

make with the moving contact. Both stationary contacts should make at approximately the same time. The contact follow will be approximately 1/64" to 3/64".

a. Close the contacts of the CO and pass sufficient dc current through the trip circuit to close the contacts of the (ICS/T). This value of current should not be greater than the particular (ICS/T) tap setting being used. The operation indicator target should drop freely bringing the letter "T" into view.

b. Close contacts of instantaneous overcurrent unit (I). Pass sufficient dc current through the trip circuit to close contacts of the (ICS/I). This value of current should not be greater than the particular (ICS/I) tap setting being used. The operation indicator target should drop freely bringing the letter "I" into view.

8.0 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.

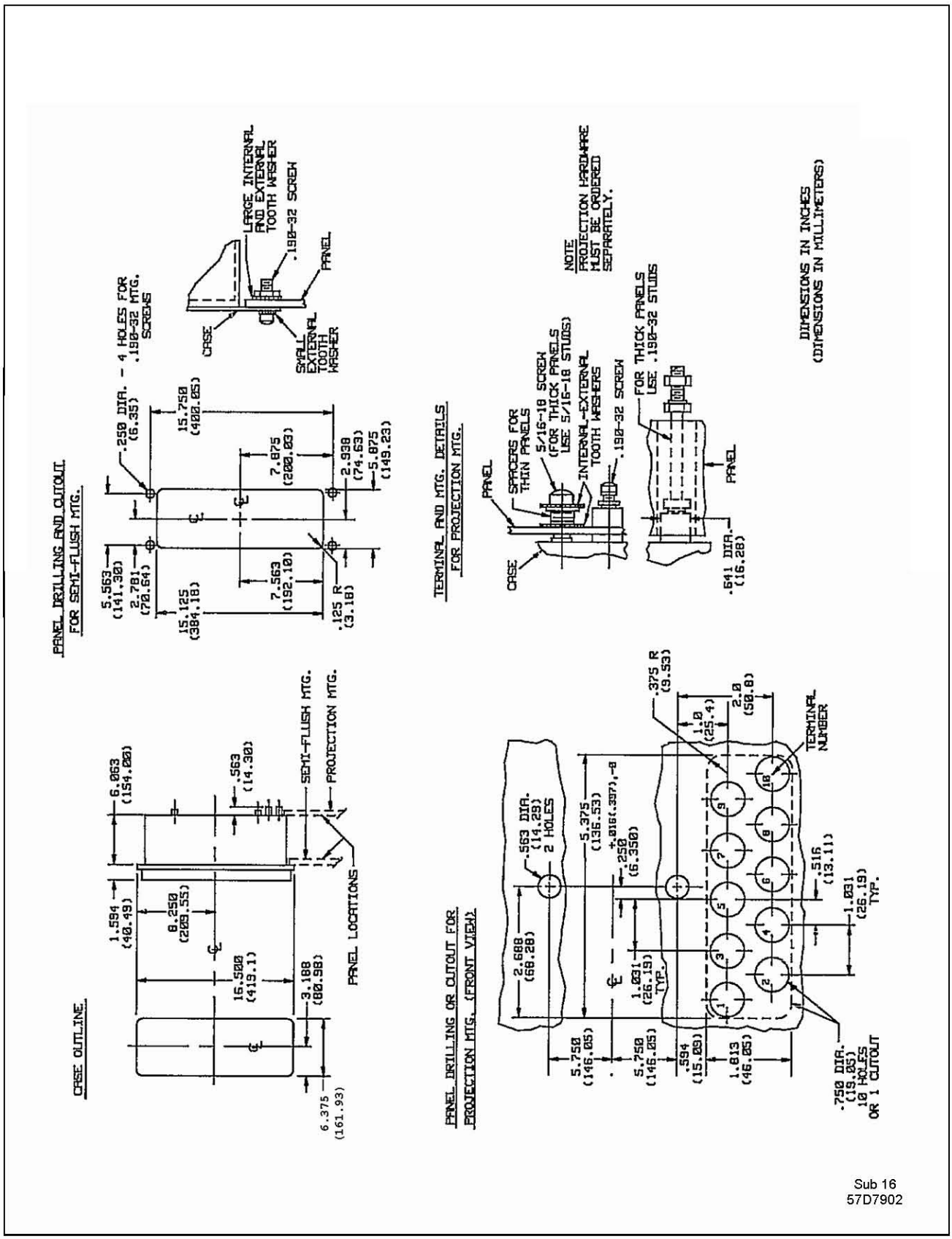


Figure 12. Outline and Drilling Plan for the CKO Relay in the type FT31 Case

THIS SPACE RESERVED FOR NOTES

IL 41-101.3 - Revision A

ABB Inc.

4300 Coral Ridge Drive
Coral Springs, Florida 33065

Telephone: +1 954-752-6700
Fax: +1 954-345-5329

www.abb.com/substation automation