ABB Power T&D Company Inc.
Power Automation and Protection Division
Coral Springs, FL 33065

Instruction Leaflet

I.L. 41-201S

Type CV Voltage Relay

Effective: January 1997

Supersedes I.L. 41-201R, Dated April 1995

(|) Denotes Change Since Previous Issue

This instruction leaflet applies to the following types of relay:

- **CV-1 Long Time Undervoltage Relay**
- **CV-2 Short Time Undervoltage Relay**
- **CV-4 Long Time Overvoltage Relay**
- **CV-5 Short Time Overvoltage Relay**
- **CV-6 Long Time Over or Undervoltage Relay**
- **CV-7 Short Time Over or Undervoltage Relay**
- **CV-8 Low Voltage Pickup Overvoltage 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.

1. APPLICATION

The Type CV Relays are single-phase induction disc type relays operating either on under or overvoltage or both. These relays are applied as a voltage fault detector operating in conjunction with other protective relays. The relays are also used as timing devices for various automatic operations.

2. CONSTRUCTION AND OPERATION

The types CV-1, CV-2 CV-4, CV-5, CV-6, and CV-7 relays consist of a voltage unit and an indicating contactor switch (ICS). The principal component parts of the relay and their location are shown in Figures 1, 2, and 3.

The Type CV-8 relay in addition to the above components also has a capacitor which is series tuned with the main coil of the electromagnet. This tuned circuit offers a low impedance to fundamental current and a high impedance to third harmonic currents. Hence, the relay has a low pickup value for fundamental voltage and a much higher value of pickup for third harmonic voltage. At rated voltage the electromagnet is saturated causing the circuit to be detuned. The impedance of the circuit is increased and limits the fundamental current to a safe value.

2.1. Voltage Unit (CV)

The overvoltage unit operates on the induction disc principle. A main tapped coil located on the center leg of an “E” type laminated structure produces a flux which divides and returns through the outer legs. A shading coil causes the flux through the left leg (front view) to lag the main pole flux. The out-of-phase fluxes thus produced in the air gap causes a contact closing torque.

The undervoltage unit operates on the same principle as the overvoltage unit except the shading coil is on the right leg (front view). This causes the out-of-phase fluxes to produce a contact opening torque.

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 Power T&D Company Inc. representative should be contacted.

Printed in U.S.A.

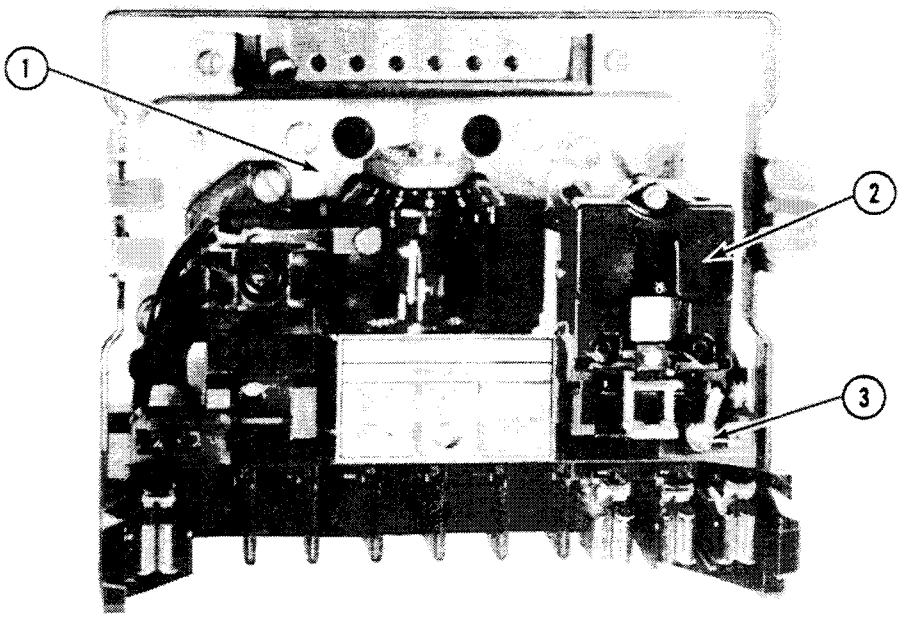


Figure 1. Type CV-2 Relay without case. 1 – Voltage Unit (CV). 2 – Indicating Contactor Switch (ICS) 3 – Indicating Contactor Switch Tap Block

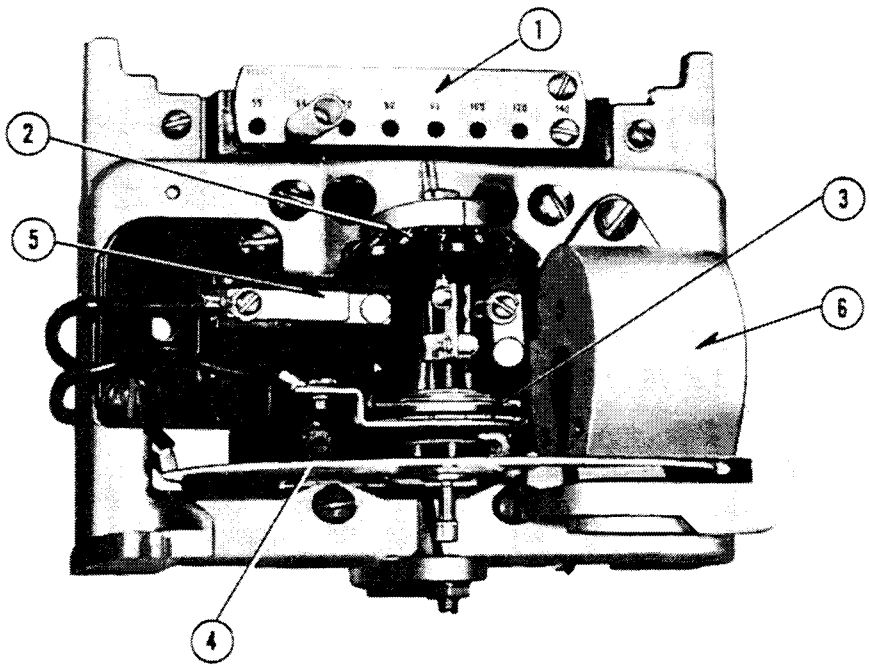


Figure 2. Voltage Unit (CV) 1 – Tap Block 2 – Time Dial 3 – Control Spring Assembly 4 – Disc 5 – Stationary Contact Assembly 6 – Permanent Magnet

Figure 3. Indicating Contactor Switch (ICS)

2.2. Indicating Contactor Switch (ICS)

The indicating contactor switch is a small dc 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 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 target is reset from the outside of the case by a push-rod located at the bottom of the case.

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

3. CHARACTERISTICS

The CV-1 and CV-2 undervoltage relays, CV-4 and CV-5 overvoltage relays, and CV-6 and CV-7 over or undervoltage relays are available in the following voltage ranges:

Range	Taps
55-140	55 64 70 82 93 105 120 140
110-280	110 128 140 164 186 210 240 280

3.1. CV-1 and CV-2 Undervoltage Relay – CV-4 and CV-5 Overvoltage Relays

Tap value voltage is the minimum voltage required to just close the relay contacts. At this value of voltage, the moving contacts will leave the backstop of the dial and move to close the front contacts. Normal operation of the two relays is such that the CV-1 and CV-2 under-voltage relay will open its contacts with application of voltages greater than tap value voltage, while the CV-4 and CV-5 overvoltage relay closes its contacts with voltages greater than tap value voltage. Thus, the operating curves of Figures 11 and 12 of the undervoltage relays apply when the voltage is originally higher than tap value voltage and is suddenly reduced to a value shown on the curves. The operating curves of Figures 13 and 14 of the overvoltage relays apply when the voltage is initially below tap value voltage and is suddenly raised to a value shown on the curves.

3.2. CV-6 and CV-7 Over or Undervoltage Relays

Tap value voltage is the value of voltage at which the stationary front contact closes. The stationary back contact will close within 5% of this value.

When the relay is used as an overvoltage relay, the moving contact is made with the stationary back contact for values of applied voltage less than tap value

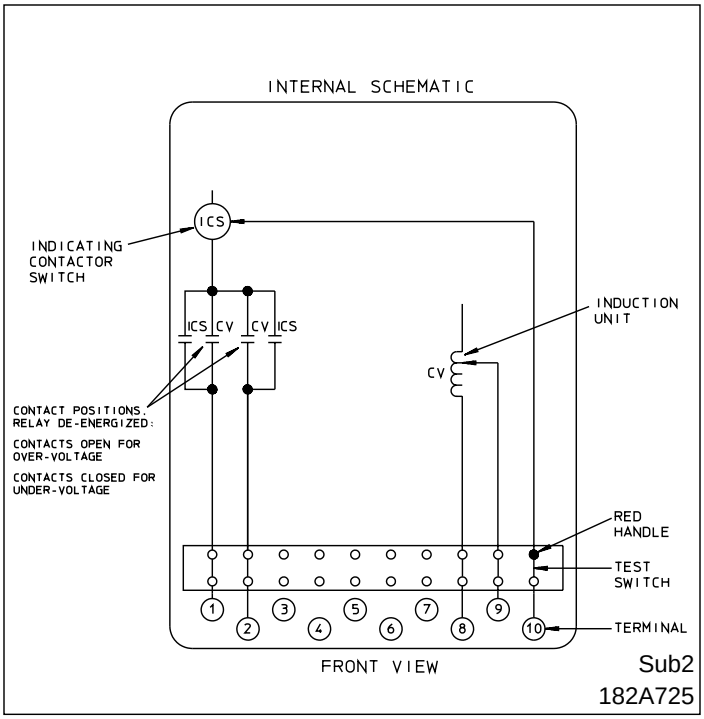


Figure 4. Internal Schematic of the Double Trip Type CV Undervoltage Relays in Type FT-11 Case. For the Single Trip Relays the circuits associated with Terminal 2 are omitted.

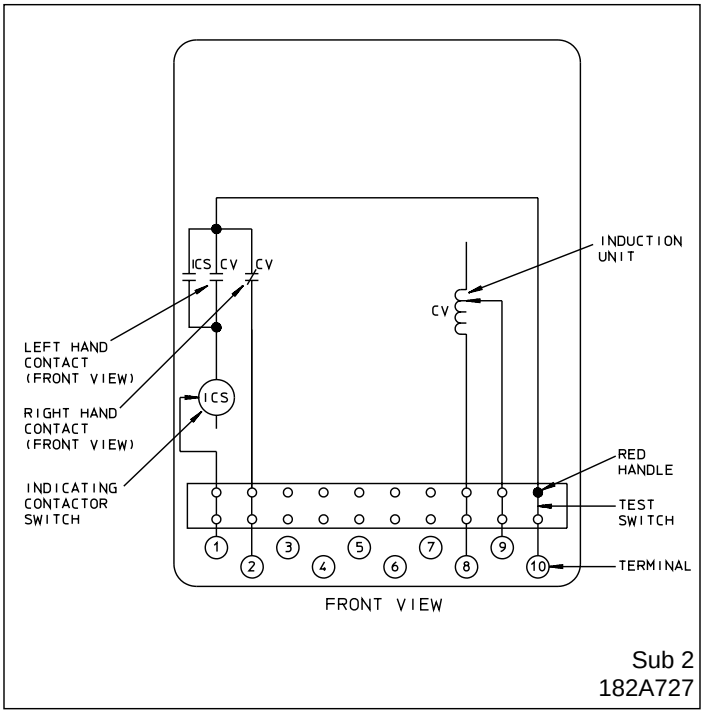


Figure 5. Internal Schematic of the Type CV Over or Undervoltage Relay in Type FT-11 Case.

voltage. With application of voltages greater than tap value voltage, the moving contact moves to close the front contact in a time as shown by the right-hand curves of either Figures 15 or 16.

When the relay is used as an undervoltage relay, the moving contact is made with the stationary front contact for values of applied voltage greater than tap value voltage. With the application of voltages less than tap value voltage, the moving contacts moves to close the back contact in a time as shown on the left-hand curves of either Figures 15 or 16.

3.3. CV-8 Overvoltage Relay

The low pickup CV-8 overvoltage relay is available with the following ratings.

Continuous Rating	2 Minute Rating
67 volts 199 volts	140 volts 300 volts

The minimum voltage required to just close the CV-8 contacts is typically 8% of the continuous voltage. Typical operating times of the type CV-8 relay are shown in Figure 10a and Figure 10b. An adjustable 5.4 to 20 volt relay with a 67 volt continuous and a 16 to 40 volt relay with a continuous of 199 volts is also available. However, the operate times of the adjustable CV-8 relay will differ from Figure 10a and will depend on the pickup setting. Figure 10b applies when the resistor is set for 30% of continuous voltage rating.

3.4. Trip Circuit

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

The indicating contactor switch (ICS) has two taps that provide a pickup setting of 0.2 or 2 A. To change taps requires connecting the lead located in front of the desired setting by means of a screw connection.

Trip Circuit Constants	
Indicating Contactor Switch	
0.2 A tap:	6.5 ohms dc resistance
2.0 A tap:	0.15 ohms dc resistance

4. SETTINGS

4.1. CV Unit

The setting of the CV unit can be defined either by tap setting and time dial position or by tap setting and a specific time of operation at some percentage of tap value voltage (e.g. on CV-4 120 tap setting, 2 time dial position or 120 tap setting, 12 seconds at 140 percent of tap value voltage).

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

The connector screw on the terminal plate above the time dial connects various turns of the operating coil. By placing this screw in the various terminal plate holes, the relay will just close its contacts at the corresponding voltage of 55-64-70-82-93-105-120-140 volts or as marked on the terminal plate.

The nylon screw on the terminal plate holds the tap plate in position when taps are being changed. To use the position on the terminal plate in which the nylon screw is used, remove the nylon screw and place it in one of the unused holes. Then remove the tap screw and insert in the terminal plate hole.

The CV-8 relay has no taps. Its minimum pickup of approximately 8% of continuous voltage is set by adjusting the restraint spring. For this setting, the adjustable resistor, where used, should be shorted out.

Where the resistor is used, the pickup setting can be adjusted from approximately 8% to 30% of the continuous voltage rating. This setting is made by adjusting the resistor. Note, however, that the CV-8 time curves shown in Figure 10a apply only when the resistor is shorted out. Timing tests should be conducted after the resistor is used to change the pickup. This will insure proper coordination time for the desired pickup setting. Figure 10b applies when the resistor is set for pickup of 30% of continuous voltage rating.

4.1.1. Instantaneous Reclosing

The factory adjustment of the voltage unit contacts provides a contact follow. When circuit breaker reclosing will be initiated immediately after a trip by the overvoltage contact, the time of the opening of the contacts should be a minimum. This condition is obtained by loosening the contact plate and then replacing the plate with the bent end resting against the contact spring.

For double trip relays, the upper stationary contact is adjusted such that the contacts rest solidly against the backstop. The lower stationary contact is then adjusted such that both stationary contacts make contact simultaneously with their respective moving contact.

4.2. Indicating Contactor Switch (ICS)

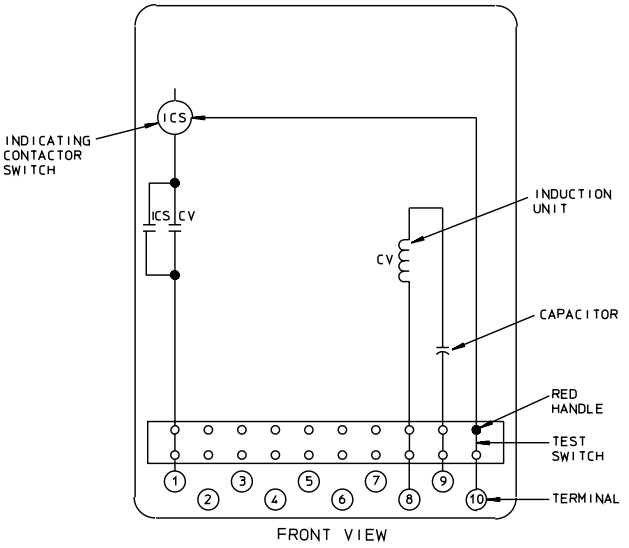
No setting is required on the ICS unit except the selection of the 0.2 to 2.0 ampere tap setting. This selection is made by connecting the lead located in front of the tap block to the desired setting by means of the connecting screw.

5. ENERGY REQUIREMENTS

The 60 Hz burdens of the CV-1, CV-2, CV-4, CV-5, CV-6, CV-7 relays at rated voltage are as follows: (for 50 Hz, multiply volt-amperes by 1.18, multiply watts by 1.38.)

Rated Voltage	Taps		Volt Amps	Power Factor	Watts
	120 V Relay	240V Relay			
120 or 240 Volts	55	110	10.0	.38	3.8
	64	128	7.0	.35	2.5
	70	140	5.8	.34	2.0
	82	164	4.0	.33	1.3
	93	186	3.1	.31	1.0
	105	210	2.4	.29	.7
	120	240	1.8	.28	.5
	140	280	1.3	.26	.3

The 50 Hz and 60 Hz burdens of the CV-8 relays at continuous voltage do not exceed the following:



Sub 3
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Figure 6. Internal Schematic Of The Type CV-8 199 Volt Relay In Type FT-11 Case

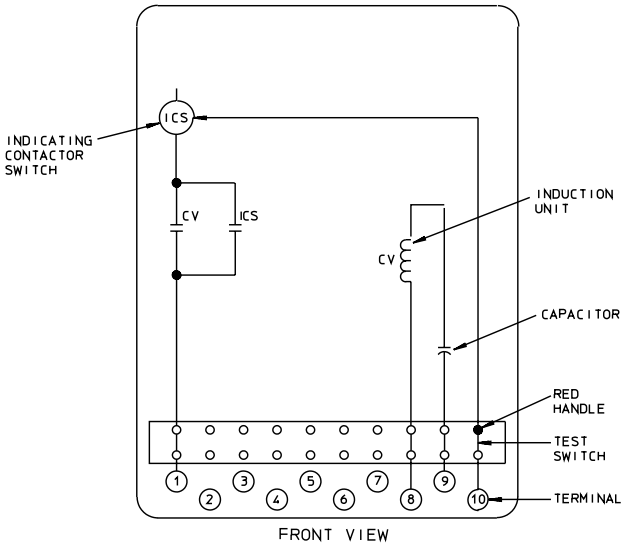

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Figure 7. Internal Schematic Of The Type CV-8 67 Volt Relay In Type FT-21 Case

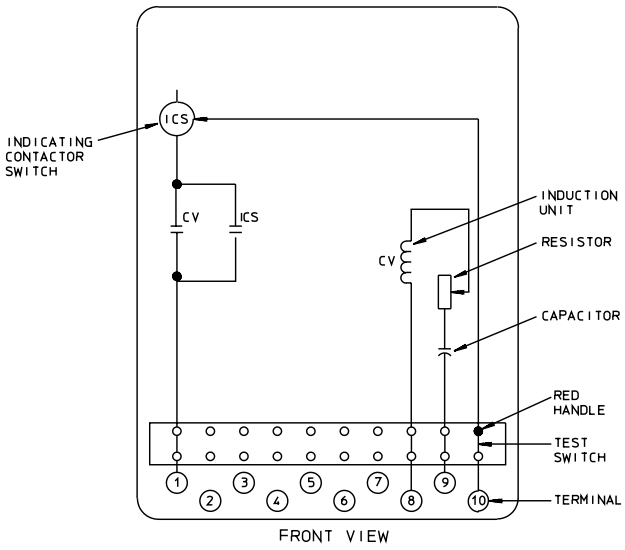

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Figure 8. Internal Schematic Of The Type CV-8 199 Volt Relay In Type FT-21 Case With Adjustable Pickup

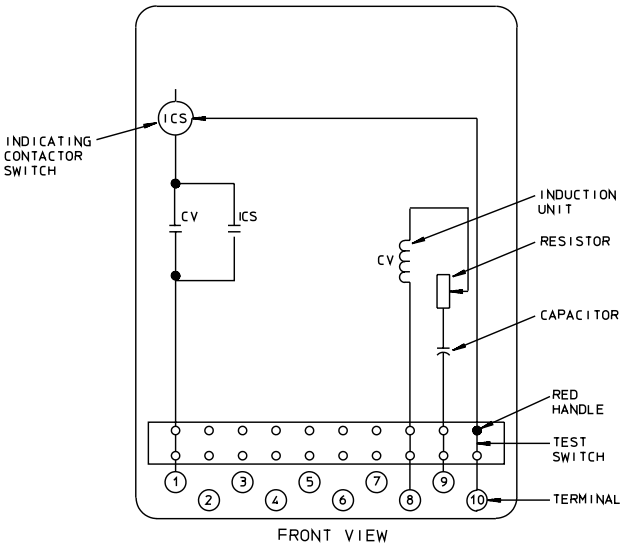

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Figure 9. Internal Schematic Of Type CV-8 67 Volt Relay In Type FT-21 Case With Adjustable Pickup

Continuous Voltage*	Volt Amps	Power Factor	Watts
199	30	.342	10
67	30	.342	10

The short time (15 seconds) rating is 240V and 510V respectively for the 67 and 199V relay.

* *These relays will continuously stand either 110% of rated voltage or tap value voltage, whichever is higher.*

CV-8 With Adjustable Pickup

Range	Setting	Applied Voltage	VA
5.4 to 20V	5.4 20	67 67	30 15
16 to 40V	16 40	199 199	30 20

6. INSTALLATION

The relays should be mounted on switch board panel or their equivalent in a location free from dirt, moisture, excessive vibrating, 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.

For detailed FT Case information refer to I.L. 41-076.

7. ADJUSTMENTS AND MAINTENANCE

The proper adjustments for 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.

7.1. Performance Check

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

7.1.1. CV Unit

7.1.2.1 Contacts

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 “O” mark on the time dial. For double trip relay, 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-voltage curves. For double trip relays, the follow on the stationary contacts should be approximately 1/32”.

7.1.3.2 Minimum Trip Voltage

Set the time dial to position 6. Alternately apply tap value voltage plus 3% and tap value voltage minus 3%.

a) CV-4 and CV-5 Overvoltage Relays, CV-6 and CV-7 Over or Undervoltage Relays.

The moving contacts should leave the backstop for the tap value voltage plus 3% condition and should return to the backstop for the tap value voltage minus 3% condition.

b) CV-1 and CV-2 Undervoltage Relays

The moving contact should leave the backstop for the tap value voltage minus 3% condition and should return to the backstop for the tap value voltage plus 3% condition.

c) CV-8 Overvoltage Relays

The moving contact should leave the backstop between 8.3% and 7.7% of continuous voltage. Note that the resistor, where used, should be shorted when making these measurements.

Where the resistor is used, the pickup setting can be adjusted from approximately 8% to 30% of the continuous voltage rating. This setting is made by adjusting the resistor. Note, however, that the CV-8 time curves shown in Figure 10a apply when the resistor is shorted out. Figure 10b applies when the resistor is set for 30% of continuous voltage rating. Timing tests should be conducted after the resistor is used to change the pickup. This will verify proper coordination time for the desired pickup setting.

7.1.4.3 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 voltages specified in Table 1 (e.g. for the CV-4, 140 percent of tap value voltage) and measure the operating time of the relay. The operating time should equal those of Table 1 plus or minus 5%. Note that the resistor, when used in the CV-8, should be shorted when making this measurement.

7.1.5.4 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 setting being used. The indicator target should drop freely.

7.2. 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 indicated by experience to be suitable to the particular application. Phantom loads should not be used in testing induction-type relays because of the resulting distorted current wave form which produces an error in timing.

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 contact and thus impairing the contact.

8. 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 until it is apparent that the relay is not in proper working order (See “Performance Check”).

8.1. CV Unit

8.1.1. Contacts

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 “O” mark on the time dial. For double trip relay, 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-voltage curves. For double trip relays, the follow on the stationary contacts should be approximately 1/32”.

8.1.2. Minimum Trip Voltage

The adjustment of the spring tension in setting the minimum trip voltage 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 and the time dial to position 6.

a) CV-4 and CV-5 overvoltage, CV-6 and CV-7 over or undervoltage

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

b) CV-1 and CV-2 Undervoltage Relays

Adjust the control spring tension so that the moving contacts will leave the backstop of the time dial at tap value voltage -1.0% and will return to the backstop at tap value voltage +1.0%.

c) CV-8 Low Pickup Overvoltage Relay

Adjust the control spring so that the moving contact will close at 8.2% or more of continuous voltage and return to the backstop at 7.8% or less of continuous voltage. The fixed, or adjustable resistor, where used, should be shorted during these measurements and the short removed when completed.

Where the resistor is used, the pickup setting can be adjusted from approximately 8% to 30% of the continuous voltage rating. This setting is made by adjusting the resistor. Note, however, that the CV-8 time curves shown in Figure 10a, apply only when the resistor is shorted out. Timing tests should be conducted after the resistor is used to change pickup. This will verify proper coordination time for the desired pickup setting.

8.2. Time Curve Calibration

Install the permanent magnet.

a) CV-1 and CV-2 Undervoltage Relay

Use test circuit of Figure 18. With switch “S” opened, adjust resistor “A” until voltmeter reads tap value voltage or higher. Close switch “S” and adjust resistor “B” until the voltmeter reads 50 percent of tap value voltage. Open switch “S” and allow the moving contact to move to the backstop of the time dial. Close switch “S” and measure operating time.

Adjust the permanent magnet gap until the operating time corresponds to the value given in Table 1.

b) CV-4 and CV-5 Overvoltage Relay, CV-8 Low Pickup Overvoltage Relay

Apply the indicated voltage of Table 1 and measure the operating time. Adjust the permanent magnet keeper until the operating time corresponds to the value given in Table 1.

c) CV-6 and CV-7 Over or Undervoltage Relay

Apply the indicated voltage of Table 1 and measure the operating time. Adjust the permanent magnet keeper until the operating time corresponds to the value given in Table 1.

Measure the reset time of the disc from the stationary front contact to the stationary back contact. This time should be as shown in Table 1.

Table 1:

Type Relay	Percent Tap Value Voltage or pickup Voltage	Time Dial Setting	Operating Time in Sec.	Reset Time in Sec.
CV1	50	6	68	---
CV2	50	6	8.6	---
CV4	140	6	37.5	---
CV5	140	6	6.8	---
CV6	140	6	33	32.5
CV7	140	6	5.9	5.7
CV8	800	6	3.0	---

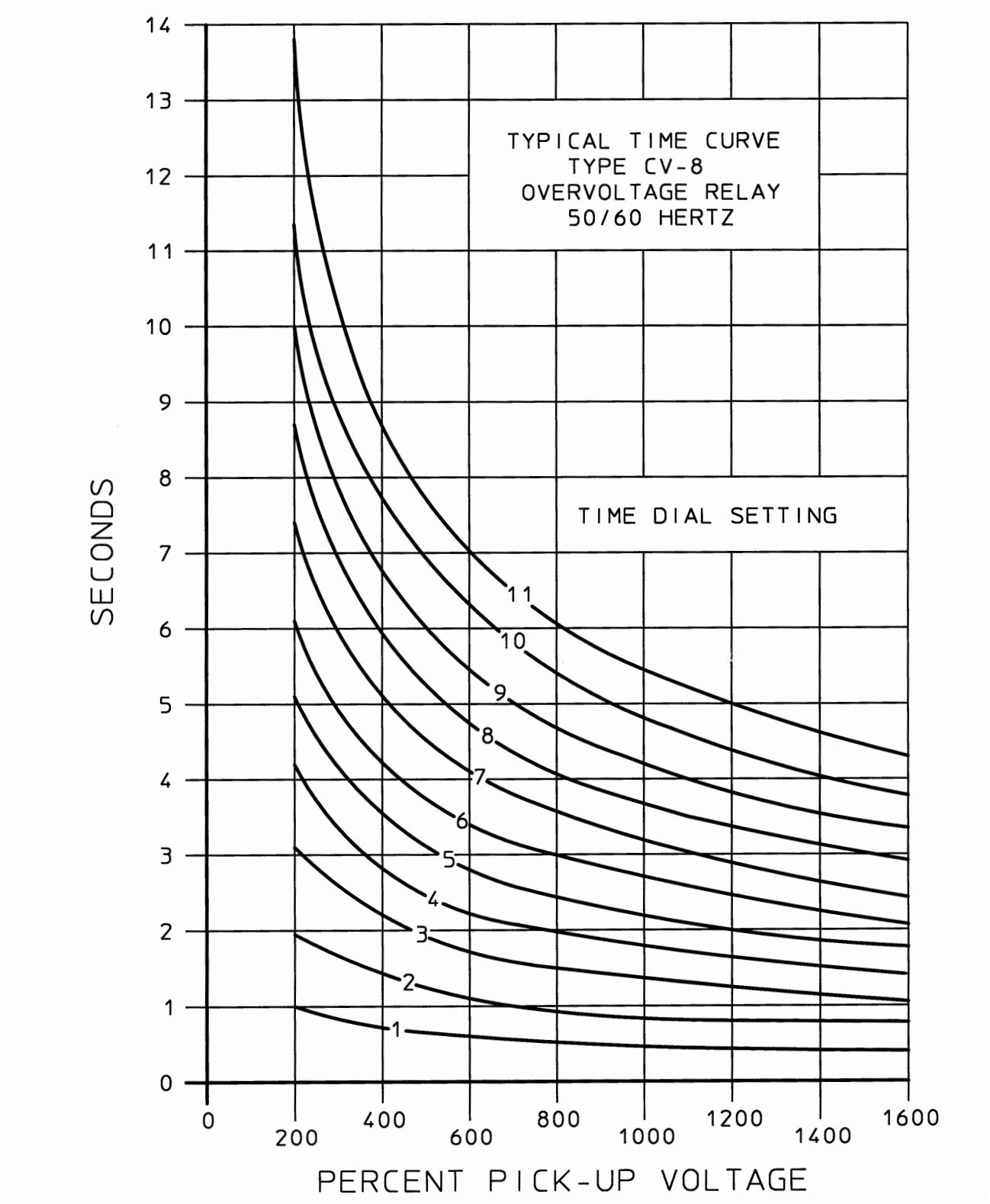
8.3. Indicating Contactor Switch (ICS)

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 setting being used. The indicator target should drop freely.

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 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”.

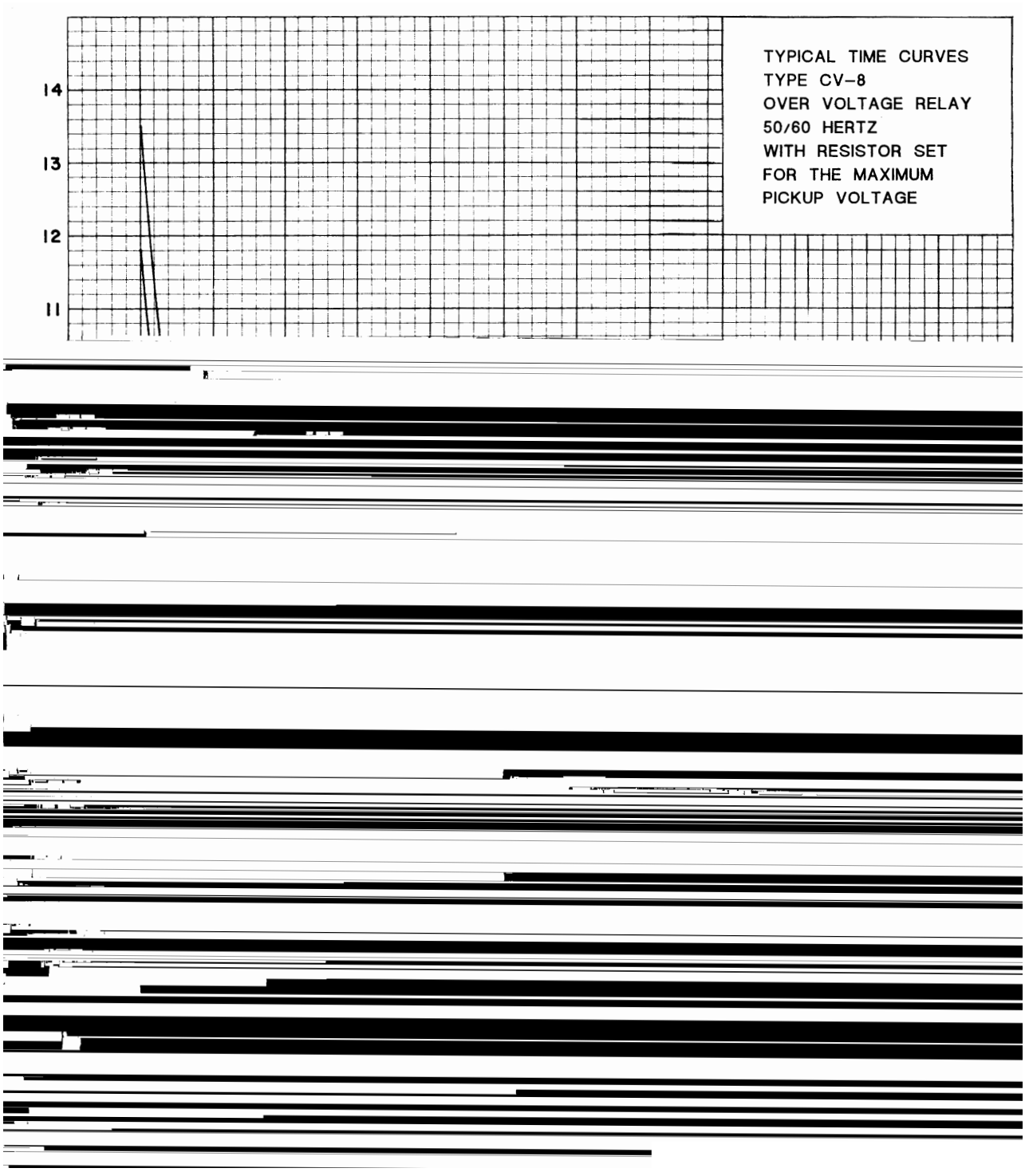
9. RENEWAL PARTS

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.



Curve 619537

Figure 10a. Typical Time Curves Of The Type CV-8 Low Pickup Overvoltage Relay



Curve 619541

Figure 10b. Typical Time Curves For Type CV-8 Overvoltage Relay With Resistor Set For Maximum Pickup