Instruction Leaflet
41-201.4H

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(|) Denotes changes since previous issue

Type CV Voltage Relay

Class 1E Application

CONTENTS

This instruction leaflet applies to the following types of relays:

- **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.

1.0 APPLICATION

These relays have been specially designed and tested to establish their suitability for Class 1E applications in accordance with the ABB Inc. program for Class 1E Qualification Testing as detailed in bulletin STR-1.

"Class 1E" is the safety classification of the electric equipment and systems in nuclear power generating stations that are essential to emergency shutdown of the reactor, containment isolation, cooling of the reactor, and heat removal from the containment and reactor, or otherwise are essential in preventing significant release of radioactive material to the environment.

The type CV relays are single-phase induction-disc type relays operating either on under or over voltage 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.

2.0 CONSTRUCTION and OPERATION

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

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

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.

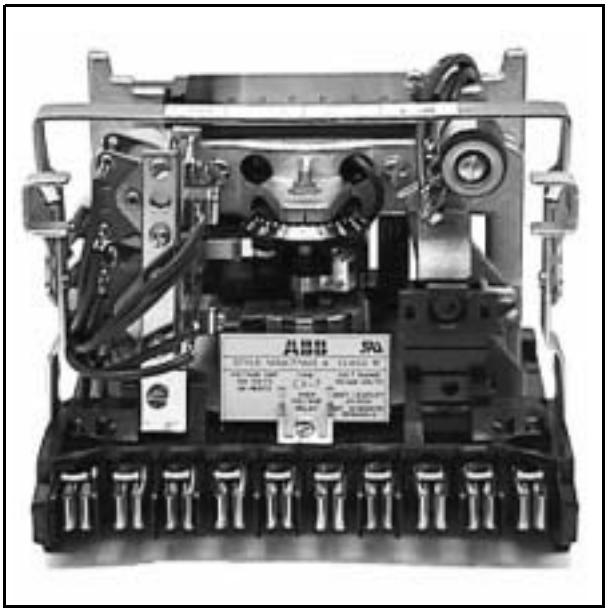

Figure 1: Type CV Relay Without FT11 Case

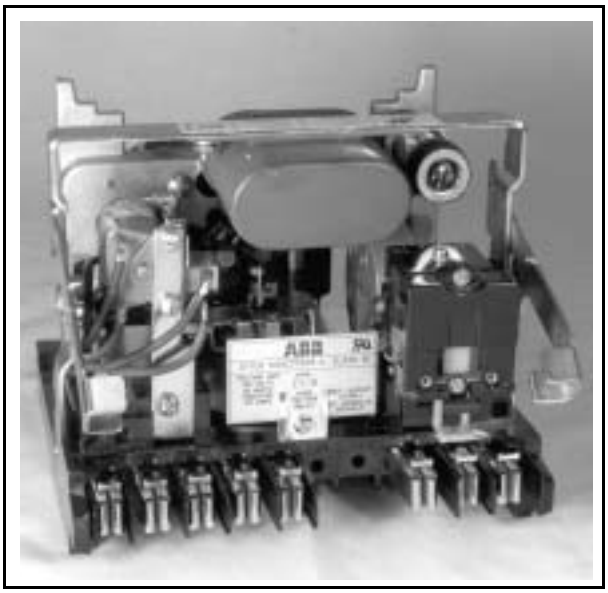

Figure 2: 199 Volt Type CV-8 Relay With Adjustable Pickup Without FT11 Case

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 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. Figure 2 and 3 show CV-8 relays with adjustable pickup.

Internal schematics are shown in Figures 4 through 10 (beginning on page 9).

Photo not available at this time

Figure 3: 67 Volt Type CV-8 Relay with Adjustable Pickup without FT-21 Case

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. This causes the out-of-phase fluxes to produce a contact opening 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.

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. For double circuit closing contacts, the moving contacts bridge three stationary contacts. 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 same unit is also used as a Trip Indicator (OI) except there are no stationary contacts, or the stationary contacts are moved upward out of reach of the moving contacts.

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

3.0 CHARACTERISTICS

The low pickup CV-8 Overvoltage Relay is available with the following continuous voltage ratings.

Type Relay	2 Minute Rating
67 volts 199 volts	140 volts 300 volts

The minimum 60 Hertz voltage 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 on Figure 11 (page 13). 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 for the adjustable CV-8 relay will differ from Figure 11 and will depend on the pickup setting. Figure 12 (page 14) applies when the resistor is set for maximum pickup. Pickup changes with frequency as shown in Figure 13 (page 15).

The CV-1 and CV-2 Undervoltage Relays, CV-4 and CV-5 Overvoltage Relays, and CV-6 and CV-7 Over or Under voltage Relays are available in the following voltage ranges.

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

3.1. CV-1 AND CV-2 UNDERVOLTAGE RELAYS 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 time dial and move to close the front contacts. Normal operation of the two relays is such that the CV-1 and CV-2 undervoltage 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 14 and 15 (page 16) 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 16 and 17 (page 19) 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 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 18 or 19 (page 20).

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 contact moves to close the back contact in a time as shown on the left-hand curves of either Figures 18 or 19 (page 20).

3.2.1. Auxiliary Relays (T)

Power Requirements
- Per Unit: 1.3 watts at 48 volts dc; 3.3 watts at 125 volts dc

Operate Time
- Pick Up: 3 to 6 milliseconds
- Drop Out: 90 to 130 milliseconds
- Contact Rating:
  - A. 20 amperes noninterrupting for less than 200 milliseconds
  - B. 1.3 amperes resistive at 125Vdc
  - C. Will control MG-6, SG, or AR relays at 125Vdc

3.2.2. Trip Circuit

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

3.2.3. Trip Circuit Constants

Indicating Contactor Switch Coil, or Indicator Coil.

Ampere Pickup	Ohms dc Resistance
0.2	8.5
1.0	0.37
2.0	0.10

3.3. 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 Δ Voltage	Taps				
	120 Volt Relay	240 Volt Relay	Volt-Amps	Power Factor	Watts
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

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

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

Continuous Voltage	Range	Setting	Applied Voltage	VA	Power Factor	Watts
67	5.4 to 20V	5.4 20	67 67	30 15	.342	10
199	16 to 40V	16 40	199 199	30 20	.342	10
The CV-8 short time (15 seconds) rating is 240V and 510V respectively for the 67 and 199V relays.						

4.0 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 relay being set and the relays with which coordination is to be effected.

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 it in the terminal plate hole.

4.2. CV-8 SETTINGS

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 11 (page 13) apply only when the resistor is shorted out. 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. Figure 12 (page 14) shows operate time when the resistor is set for maximum pickup.

4.3. INSTANTANEOUS RECLOSING

The factory adjustment of the voltage unit contacts provides a contact follow. Where circuit breaker reclosing will be initiated immediately after a trip by the over voltage 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.

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

4.4. INDICATING CONTACTOR SWITCH (ICS)

There are no settings to make on the indicating contactor switch (ICS) or the Trip indicator, (OI).

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 four mounting holes on the flange for the semi-flush type FT case. 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 and the relay panel. Ground wires should be affixed to the mounting screws 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.

For detail information on the FT case refer to Instruction Leaflet. 41-076 for semi-flush mounting.

6.0 ADJUSTMENTS

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.

6.1. PERFORMANCE CHECK

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

6.1.1. CV Unit

Contact Check – 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 relays, the follow on the stationary contacts should be approximately 1/64”.

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 “O” 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 “O” mark by approximately.020.” (For the type CV-6 and CV-7 relays, the follow on the back contact should be approximately 1/64”). The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective curves. For double trip relays, the follow on the stationary contacts should be approximately 1/32”.

Minimum Trip Voltage (See Figures 20 and 21 for test diagrams.) – Set the time dial to position 6. Alternately apply tap value voltage plus 3% and tap value voltage minus 3%.

CV-4 and CV-5 Overvoltage Relays, CV-6 and CV-7 Over or Undervoltage Relays – The moving contact 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.

CV-1 and CV-2 Undervoltage Relays – The moving contacts 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.

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 this measurement.

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 11 (page 13) apply only when the resistor is shorted out. 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.

Time Curve – Table 1 (page 7) 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, where used in CV-8 should be shorted when making this adjustment.

6.1.2. 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 nameplate rating. The indicator target should drop freely.

Repeat above except pass 85% of ICS nameplate rating current. Contacts should not pickup and target should not drop.

6.1.3. Trip Indicator (OI)

Pass sufficient dc current through the trip circuit to operate the OI. This value of current should not be greater than the particular OI nameplate rating. The indicator target should drop freely.

Repeat above except pass 85% of OI nameplate rating current. Target should not drop.

7.0 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.

All contacts should be periodically cleaned. A contact burnisher Style 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.

7.1. 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”).

7.1.1. CV Unit

Note: A spring shield covers the reset spring of the CV unit. To remove the spring shield, requires that the damping magnet be removed first. The screw connection holding the lead to the moving contact should be removed next. The second screw holding the moving contact assembly should then be loosened not removed.

This screw terminates into a nut held captive beneath the molded block. If screw is removed, difficulty will be experienced in the re-assembly of the moving contact assembly. Slide the spring shield outward and remove from relay. Tighten the screw holding the moving contact assembly to the molded block.

Contact – 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 relays, the follow on the stationary contacts should be approximately 1/64”.

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 “O” 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 “O” mark by approximately.020”. (For the type CV-6 and CV-7 relays, the follow on the back contact should be approximately 1/64”). 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”.

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 “O”, 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.

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 plus 1.0% and will return to the backstop at tap value voltage minus 1.0%.

CV-1 and CV-2 Undervoltage Relays — Adjust the control spring tension so that the moving contact will leave the backstop of the time dial at tap voltage minus 1.0% and will return to the backstop at tap value plus 1.0%.

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 11 apply only when the resistor is shorted out. 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.

Time Curve Calibration — Install the permanent magnet.

CV-1 and CV-2 Undervoltage Relays — Use test circuit of Figure 20. 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.

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 inTable 1.

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.

Table 1:

Type Relay	Percent Tap Value Voltage or Pickup Voltage	Time Dial Setting	Operating Time in Sec.	Reset Time in Sec.
CV-1	50	6	68	
CV-2	50	6	8.6	
CV-4	140	6	37.5	
CV-5	140	6	6.8	
CV-6	140	6	33	32.5
CV-7	140	6	5.9	5.7
CV-8	800	6	3.0	

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.

7.1.2. Indicating Contactor Switch (ICS)

Initially adjust unit on the pedestal so that armature fingers do not touch the yoke in the rest position, (viewed from top of switch between cover and frame). This can be done by loosening the mounting screw in the molded pedestal and moving the ICS in the downward position.

Contact Wipe — Adjust the stationary contacts so that both stationary contacts make with the moving contacts simultaneously and wipe is 1/64” to 3/64” when the armature is against the core.

Target — Manually raise the moving contacts and check to see that the target drops at the same time as the contacts make or up to 1/16” ahead. The cover may be removed and the tab holding the target reformed slightly if necessary. However, care should be exercised so that the target will not drop with a slight jar.

Pickup — The unit should pickup at 98% rating and not pickup at 85% of rating. If necessary, the cover leaf springs may be adjusted. To lower the pickup current use a tweezer or similar tool and squeeze each leaf spring approximate equal by applying the tweezer between the leaf spring and the front surface of the cover at the bottom of the lower window.

If the pickup is low, the front cover must be removed and the leaf spring bent outward equally.

7.1.3. Trip Indicator (OI)

Initially adjust unit on the pedestal so that armature fingers do not touch the yolk in the rest position, (viewed from top of switch between cover and frame). This can be done by loosening the mounting screw in the molded pedestal and moving the unit in the downward position.

Target — Manually raise the armature and check to see that the target drops when the gap between the armature and the core residual pin is not less than 1/64". The cover may be removed and the tab holding the target reformed slightly if necessary. However, care should be exercised so that the target will not drop with a slight jar.

Pickup — The unit should pickup at 98% rating and not pickup at 85% of rating. If necessary, the cover leaf springs may be adjusted. To lower the pickup current use a tweezer or similar tool and squeeze each leaf spring approximate equal by applying the tweezer between the leaf spring and the front surface of the cover at the bottom of the lower window.

If the pickup is low, the front cover must be removed and the leaf spring bent outward equally.

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.

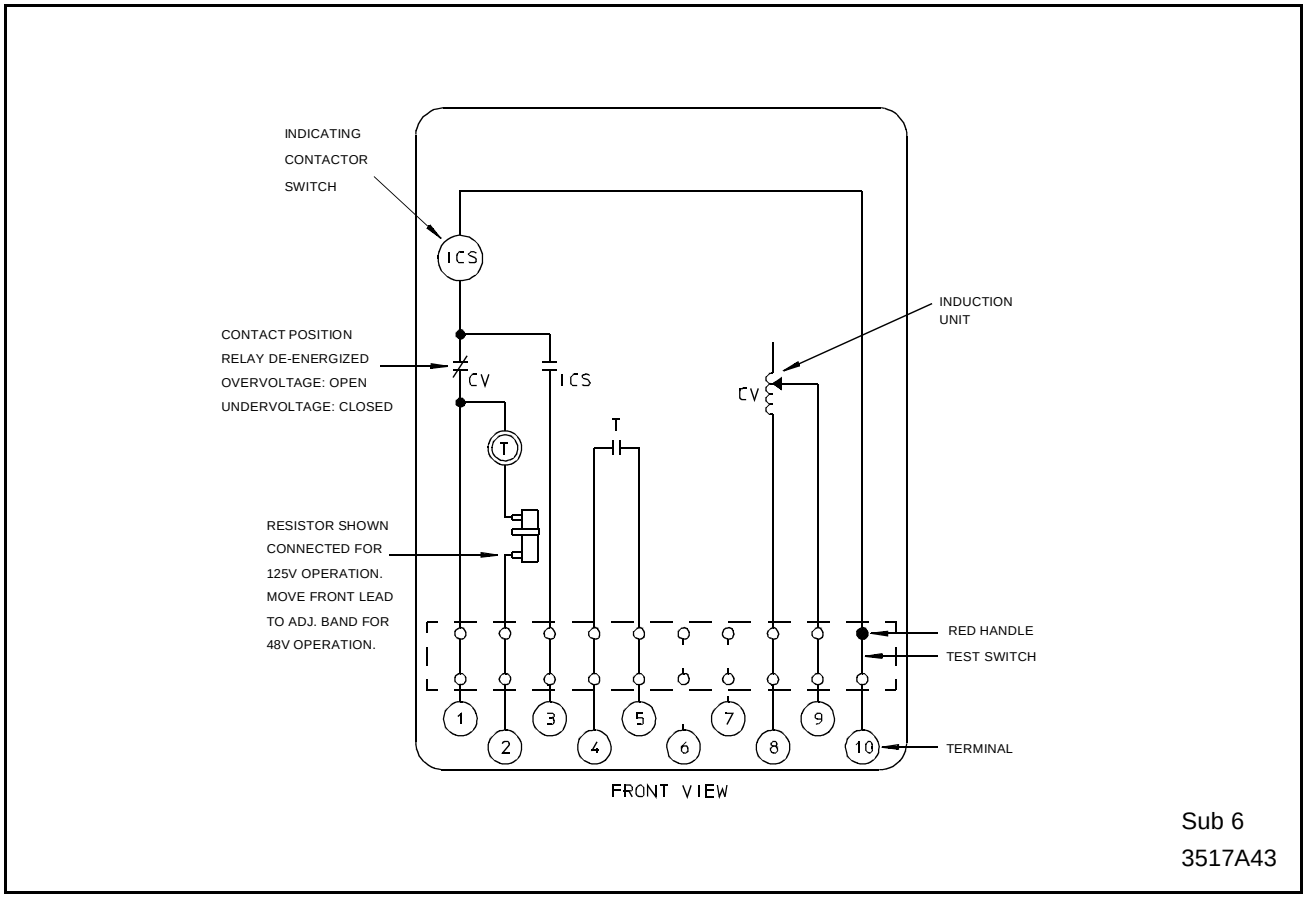

Figure 4: Internal Schematic ofType CV Undervoltage or Overvoltage Relay in FT11 Case

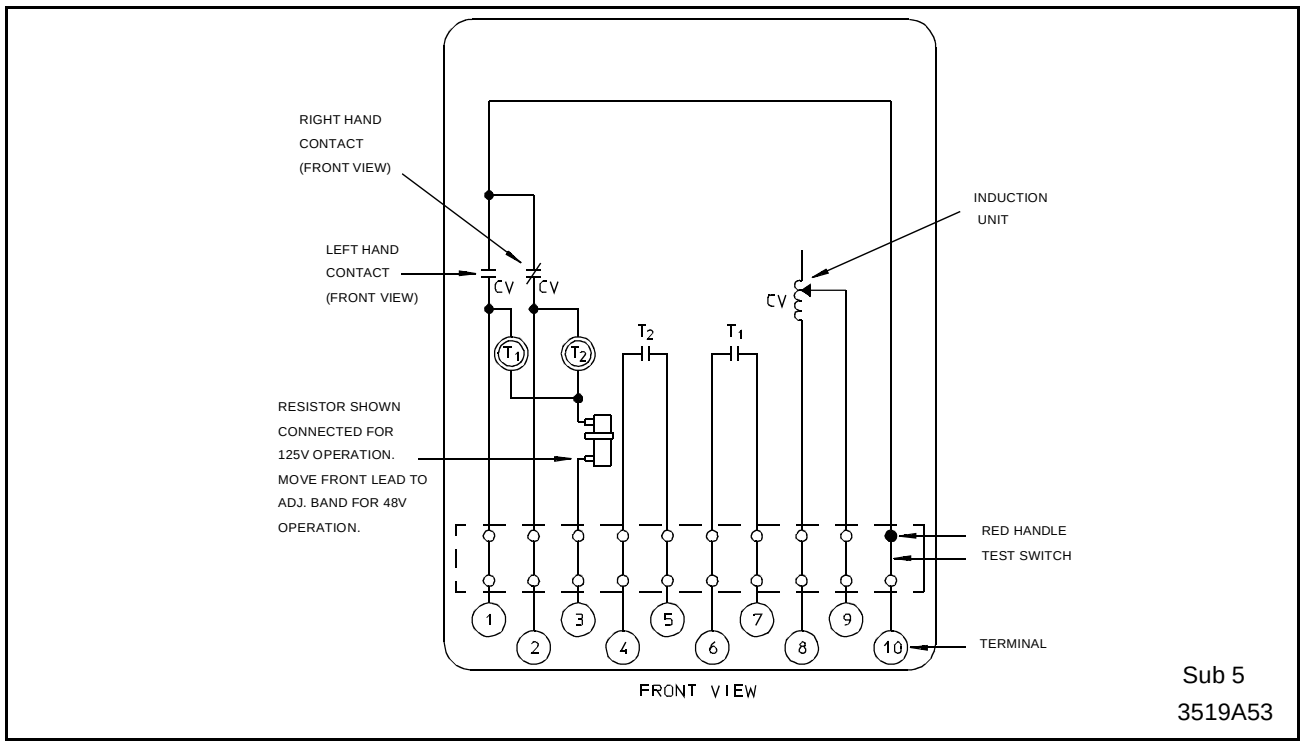

Figure 5: Internal Schematic ofType CV Over or Undervoltage Relay, Without ICS Unit, in FT11 Case

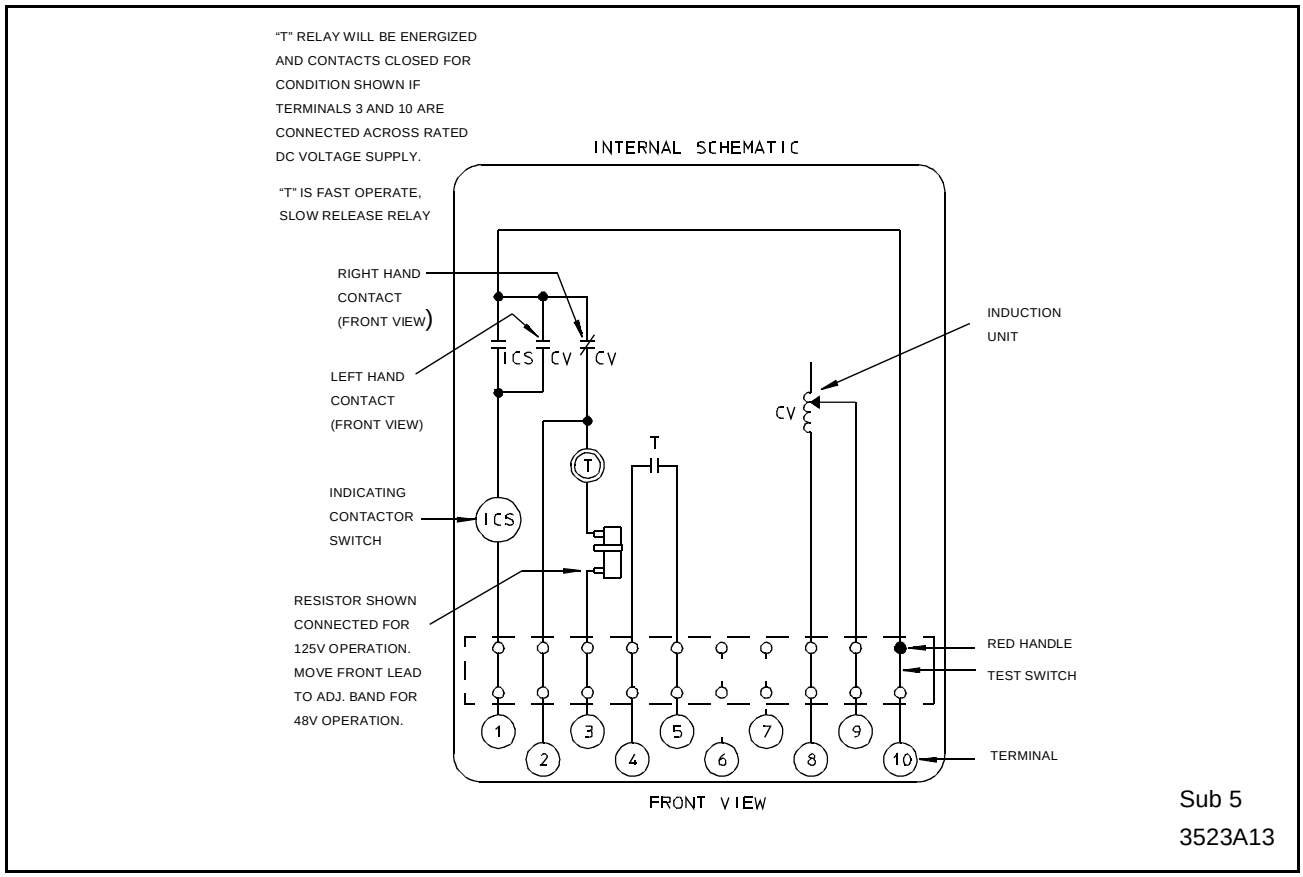

Figure 6: Internal Schematic of Type CV Over or Undervoltage Relay, With ICS in Overvoltage Circuit, in FT11 Case

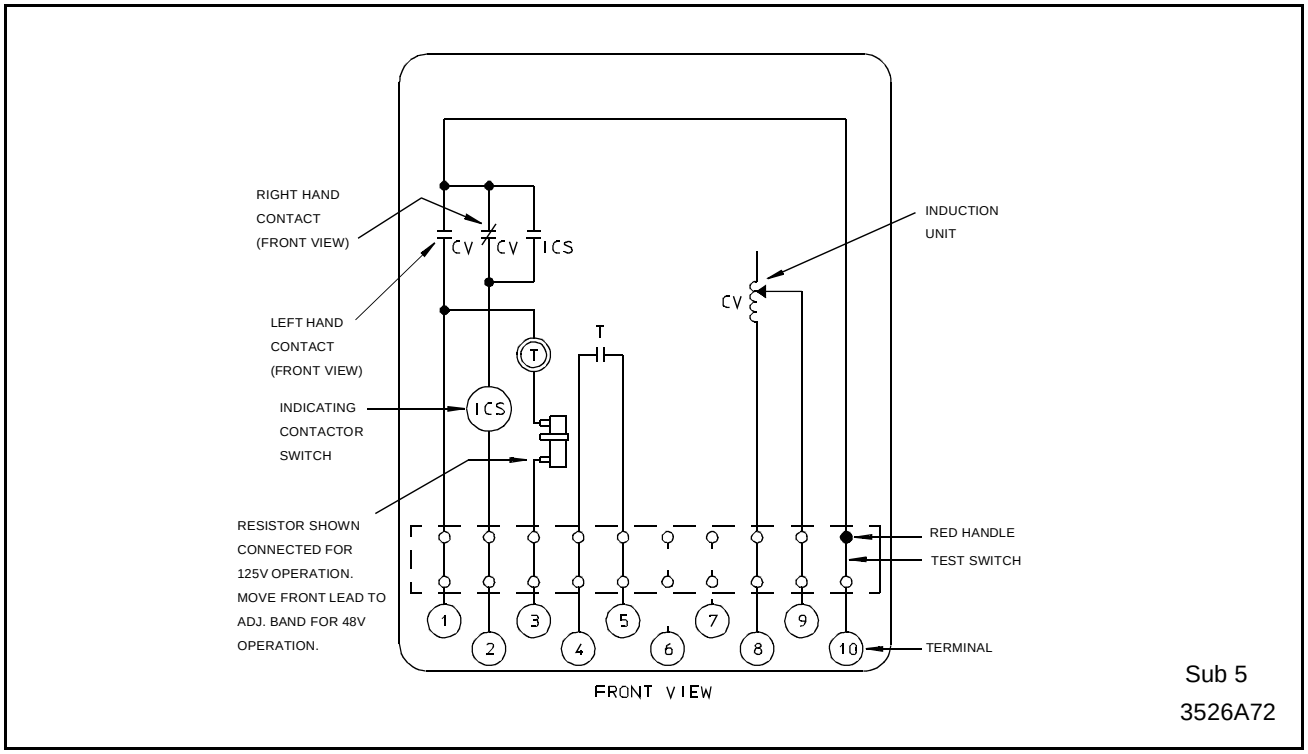

Figure 7: Internal Schematic ofType CV Over or Undervoltage Relay, With ICS in Undervoltage Circuit, in FT11 Case

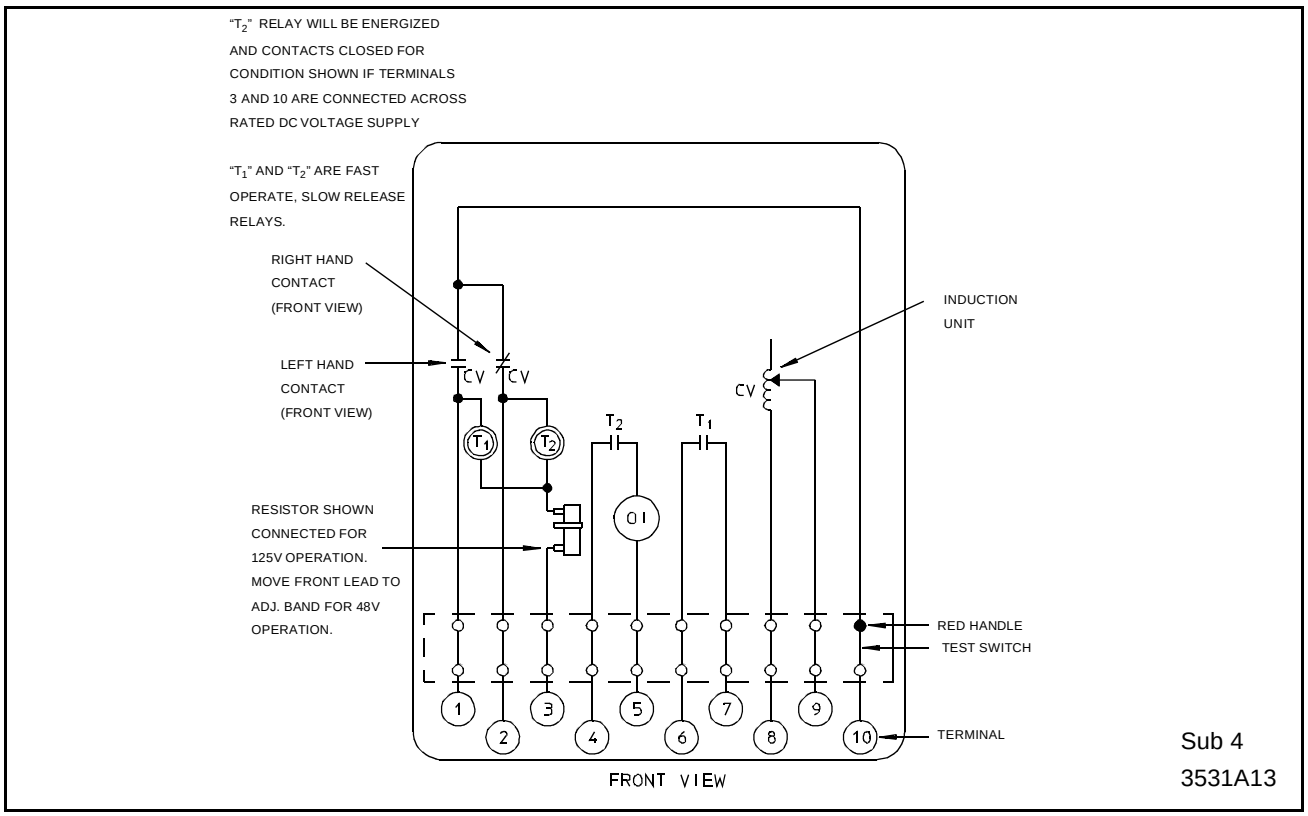

Figure 8: Internal Schematic of Type CV Over or Undervoltage Relay, Without ICS, With O.I. Unit in Undervoltage Circuit, in FT11 Case

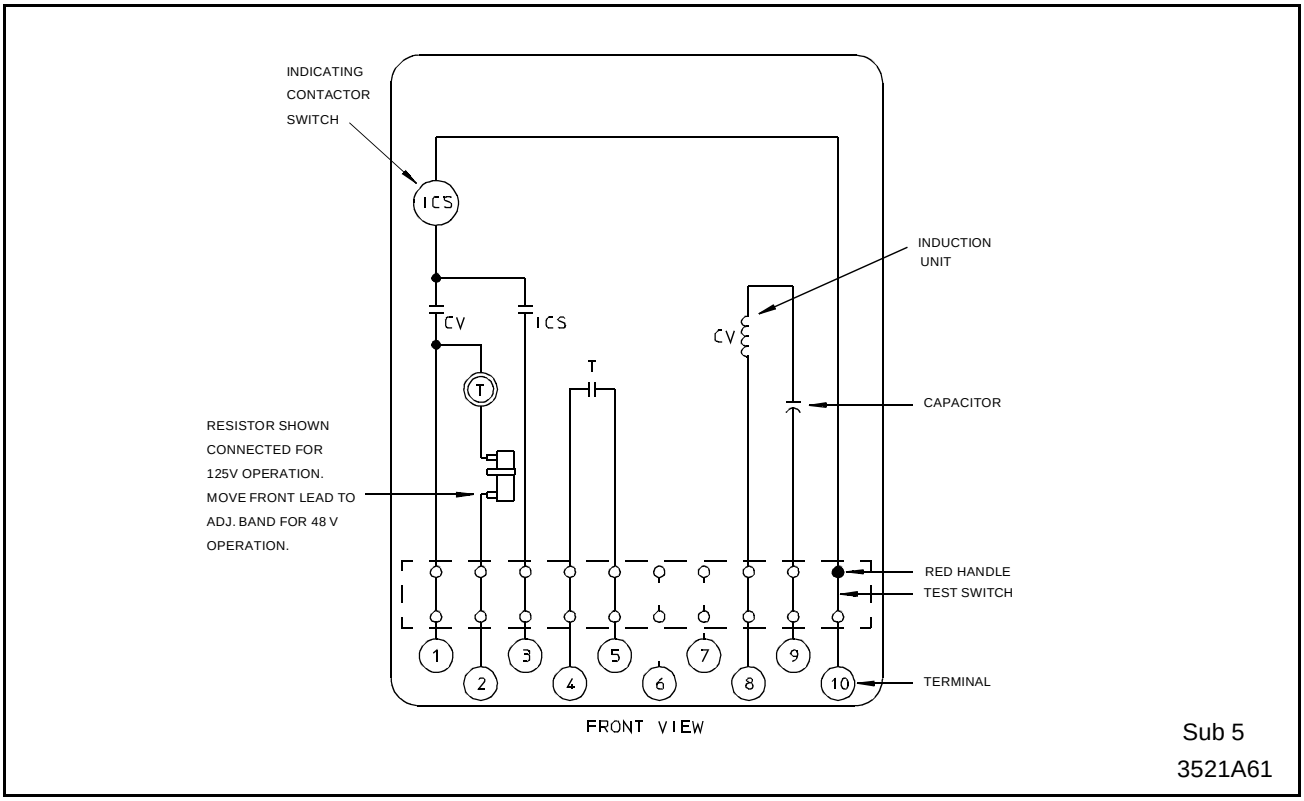

Figure 9: Internal Schematic of Type CV-8 Low Voltage Fixed Pickup in FT11 Case

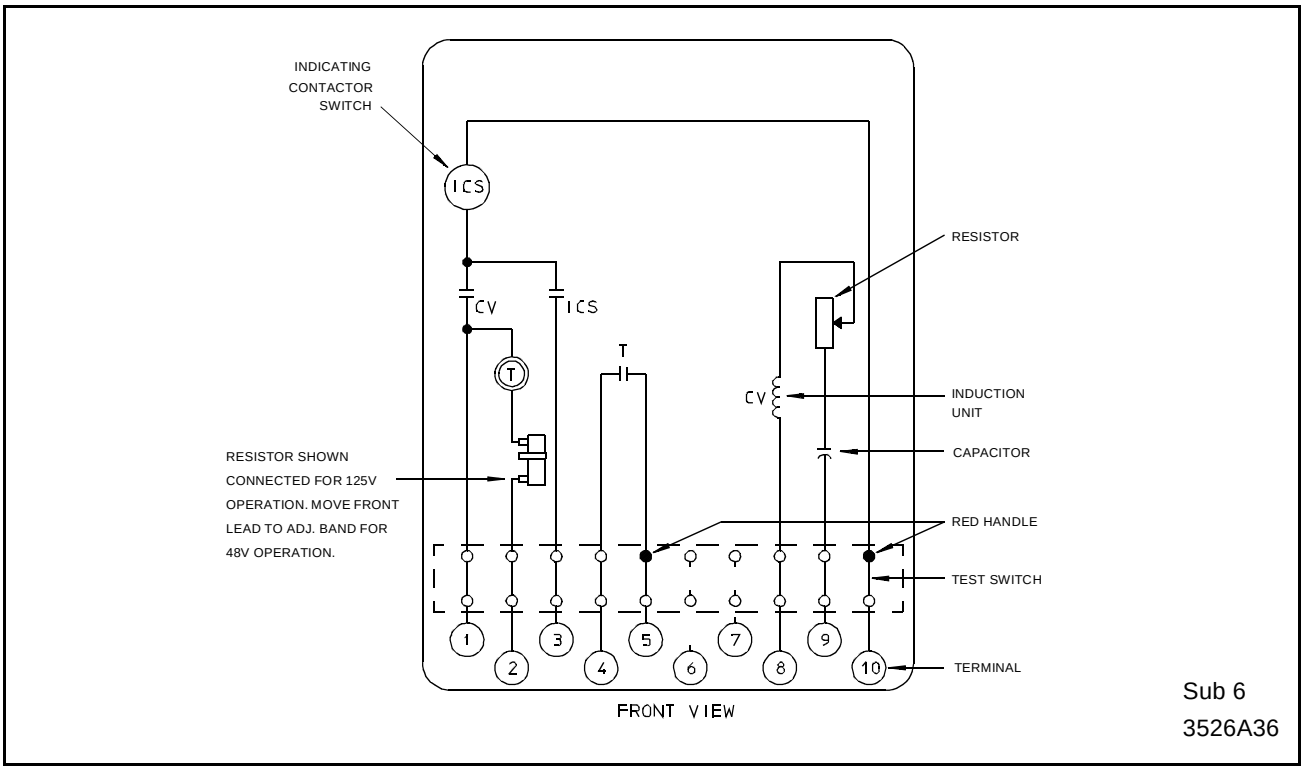

Figure 10: Internal Schematic ofType CV-8 Low Voltage Adjustable Pickup in FT21 Case

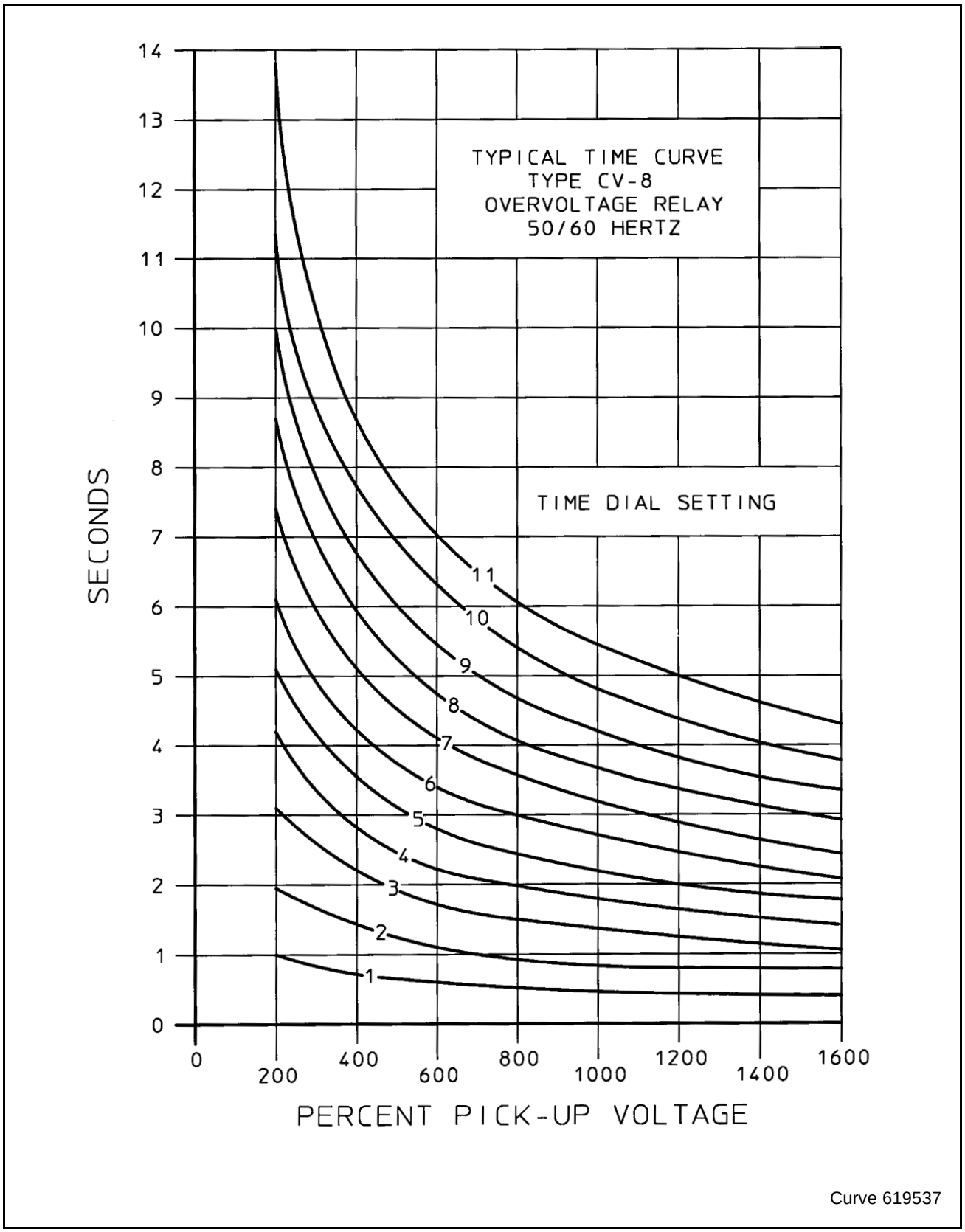

Figure 11: Typical Time Curves forType CV-8 Low Pickup Overvoltage Relay

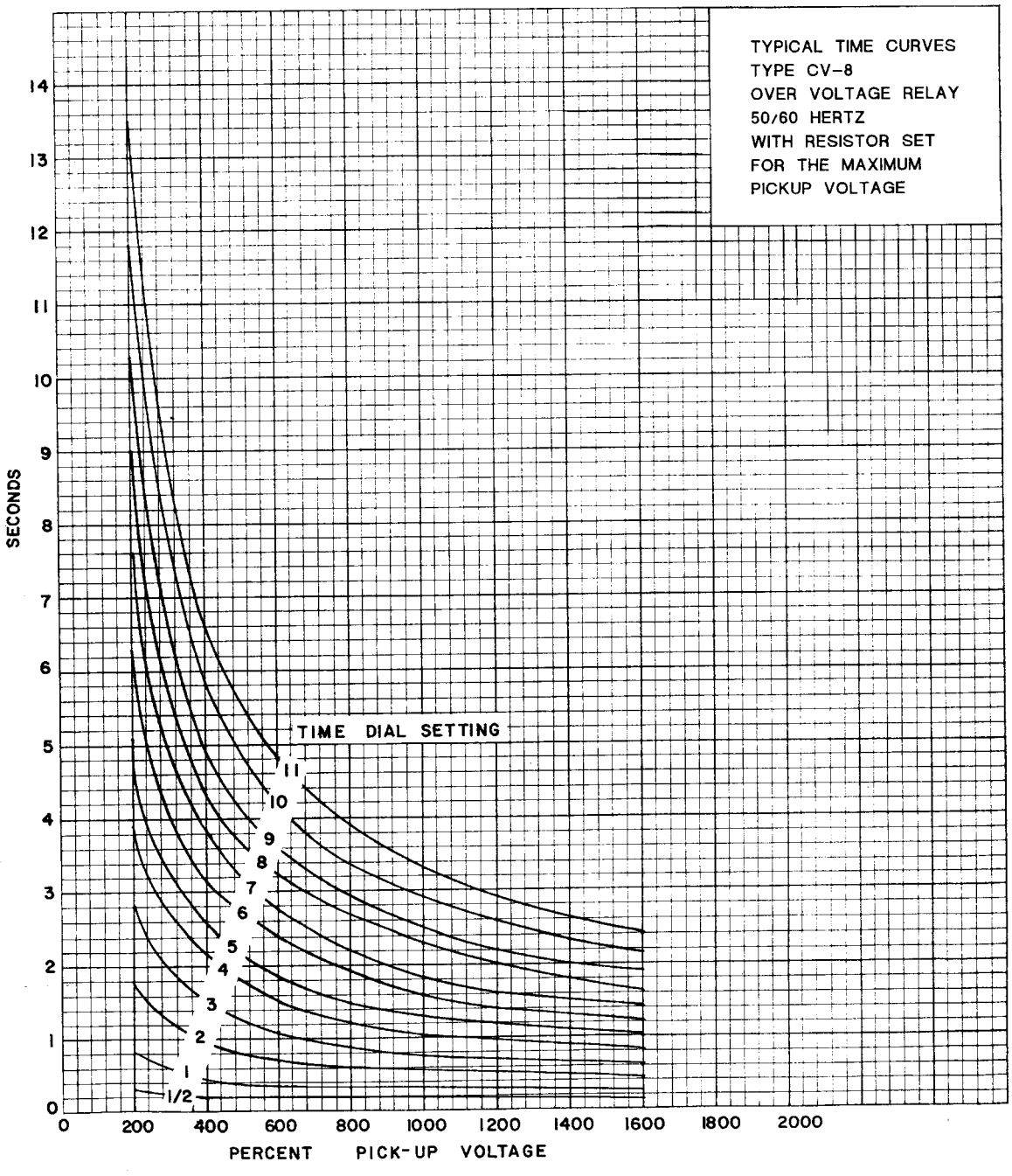

Figure 12: Typical Time CurvesType CV-8 Over Voltage Relay with Resistor Set for Maximum Pickup Voltage

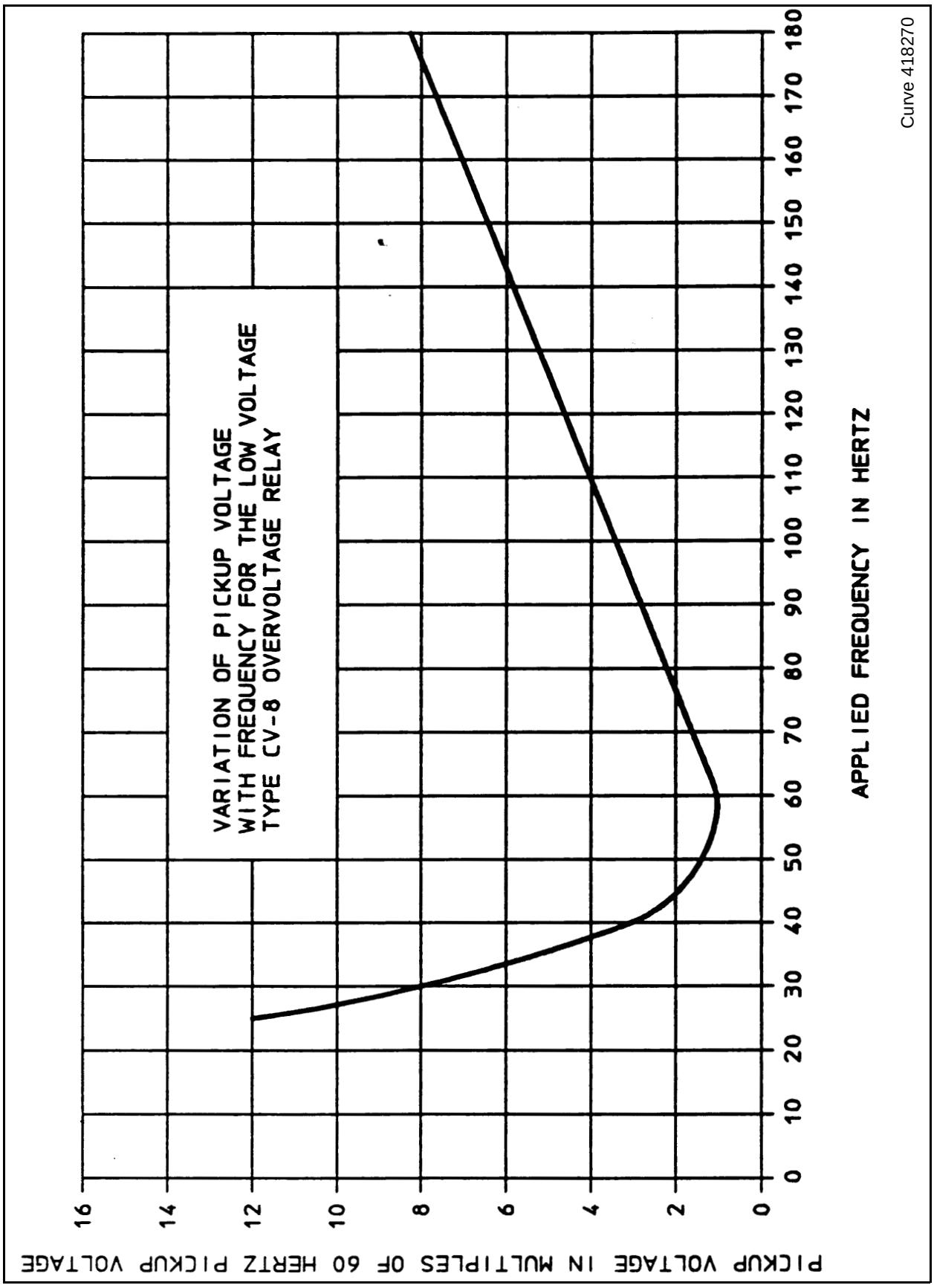

Figure 13: Typical Sensitivity vs. Frequency Curve for Type CV-8 Low Pickup Overvoltage Relay

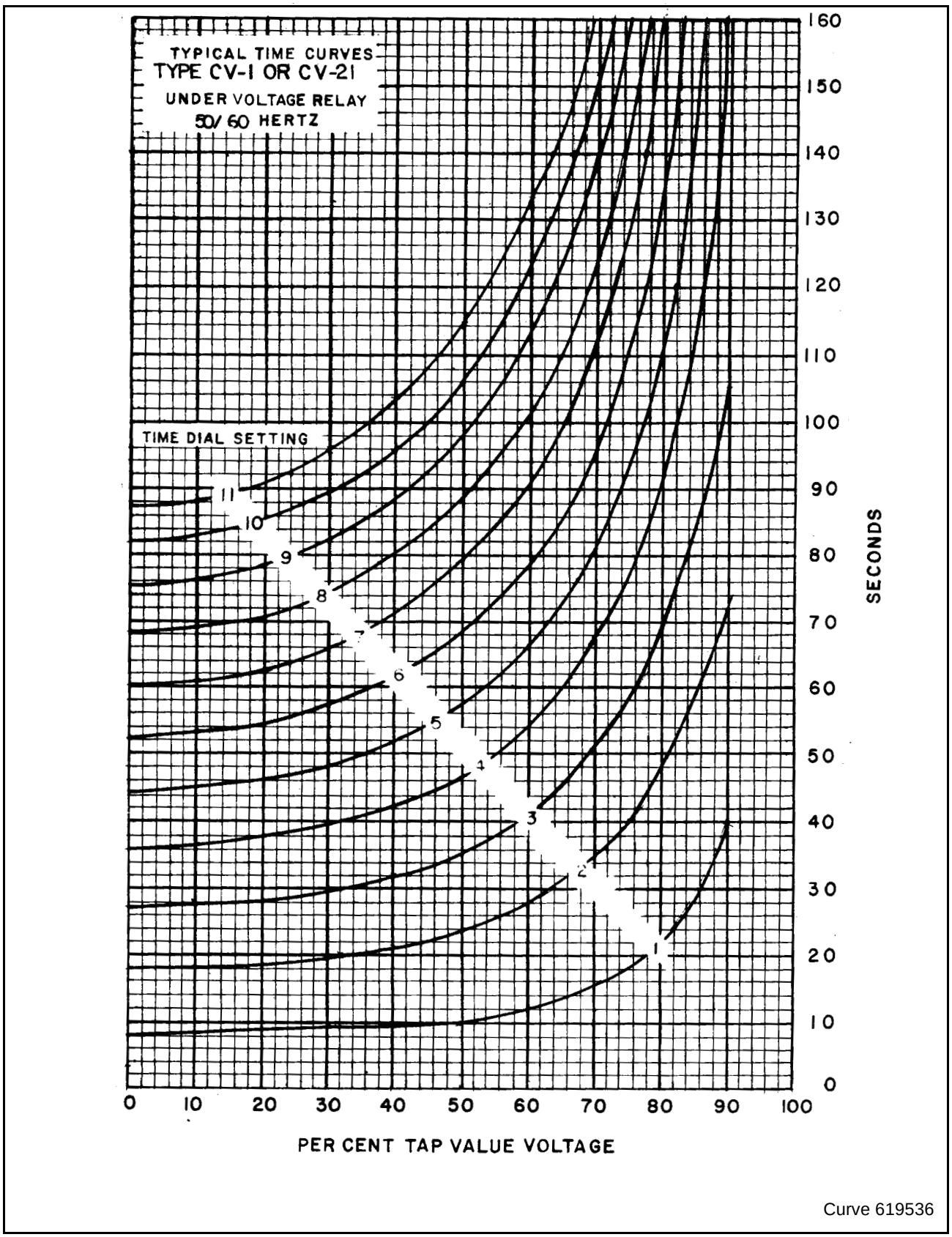

Figure 14: Typical Time Curves for Type CV-1 Long Time Undervoltage Relay

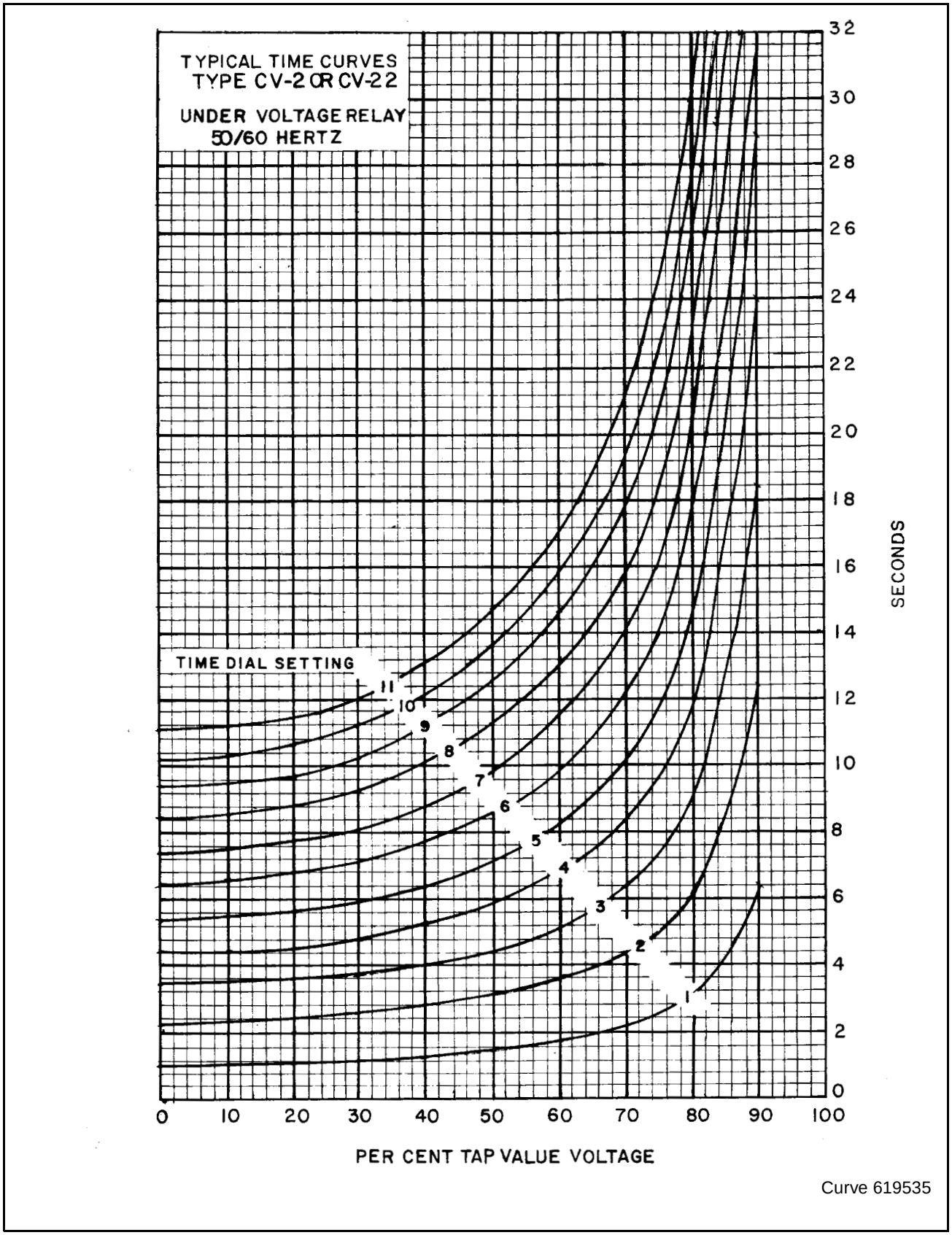

Figure 15: Typical Time Curves forType CV-2 Short Time Undervoltage Relay

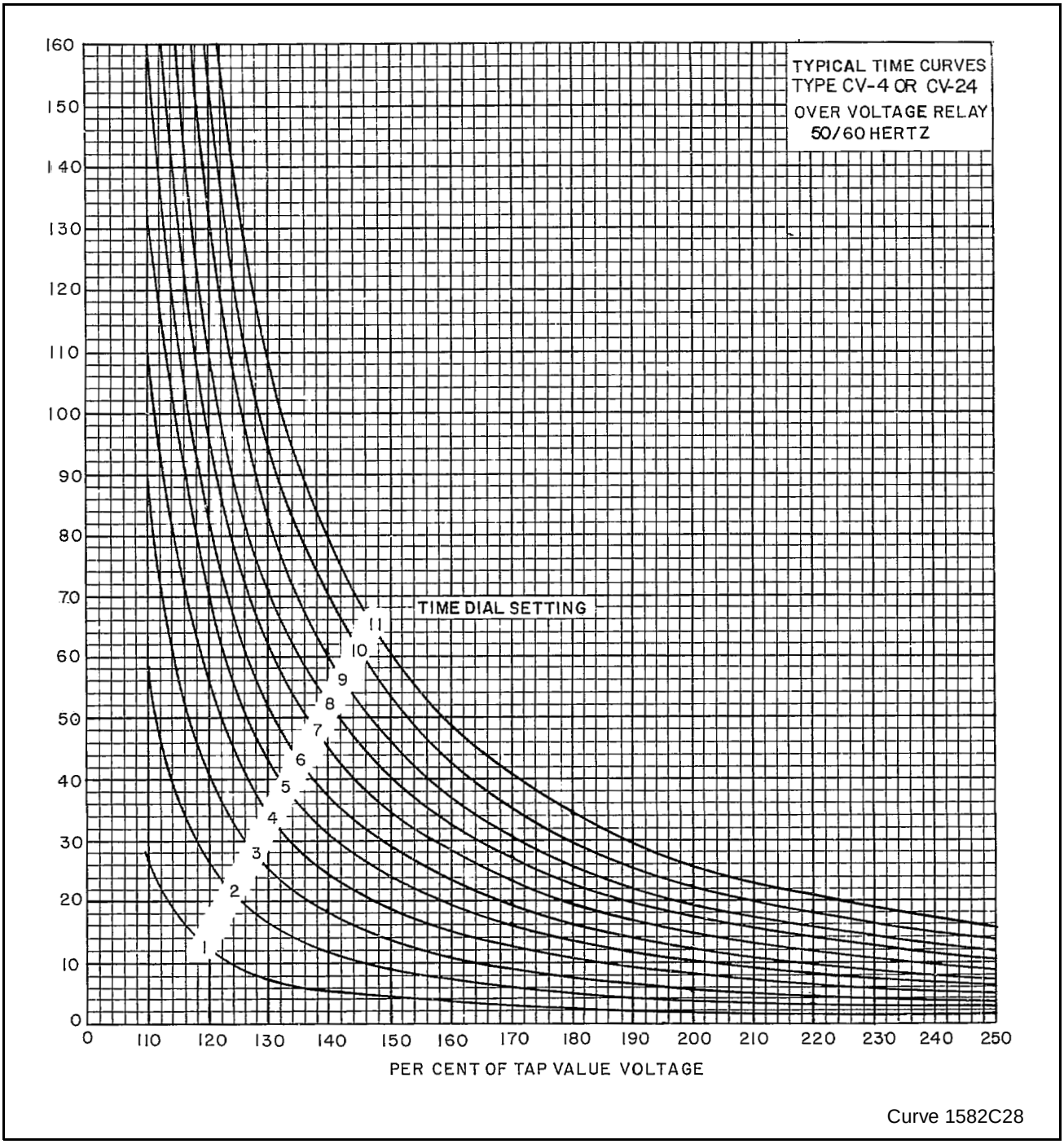

Figure 16: Typical Time Curves forType CV-4 Long time Overvoltage Relay

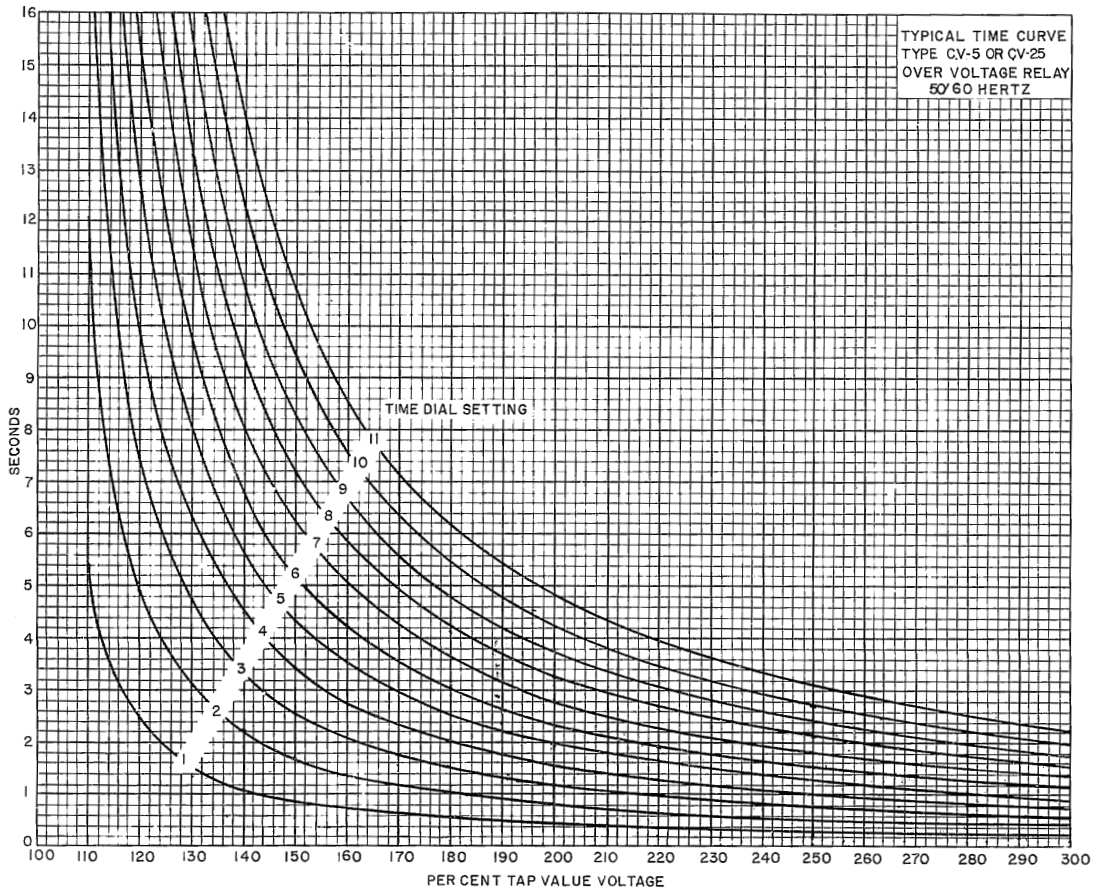

Figure 17: Typical Time Curves forType CV-5 Short Time Overvoltage Relay

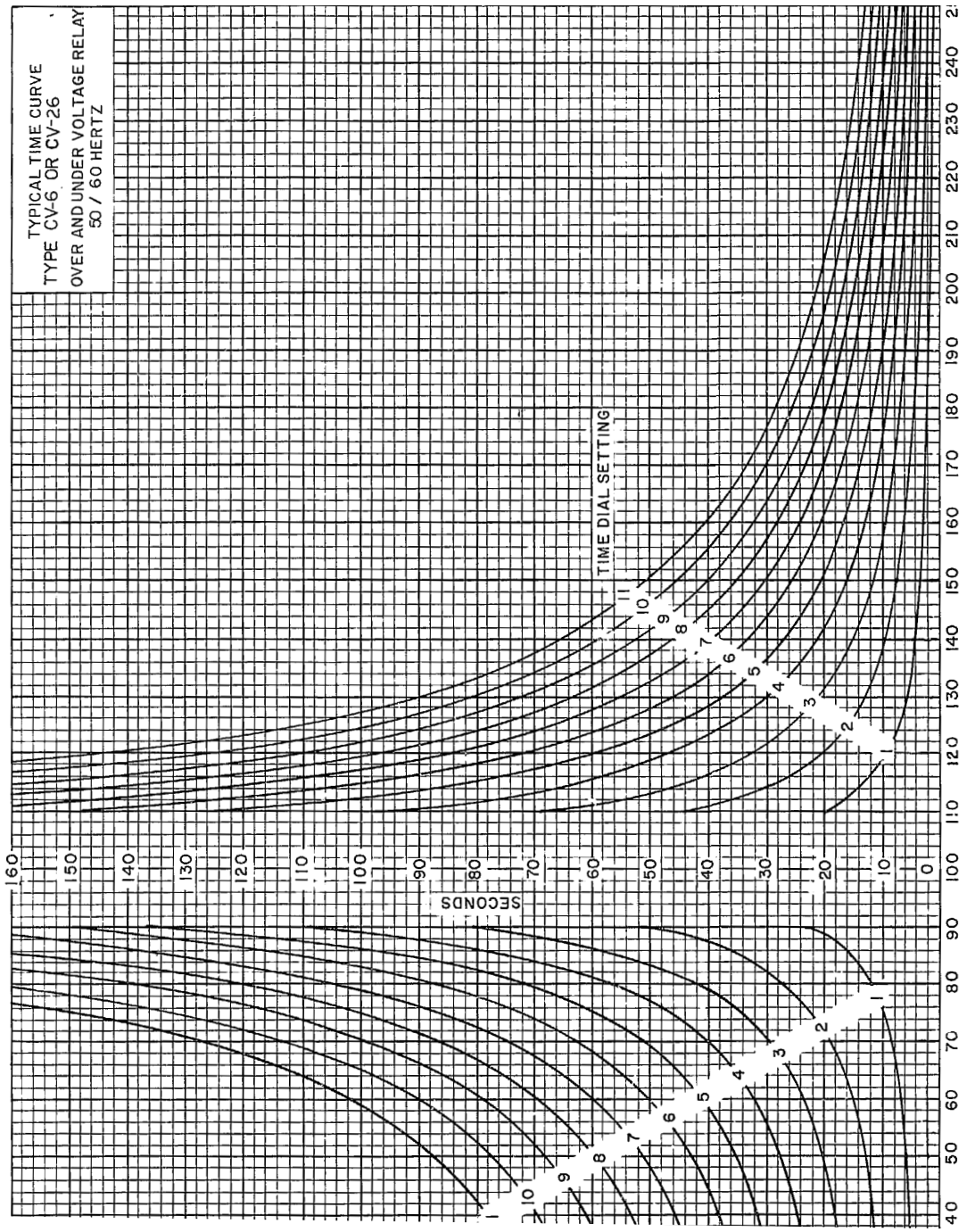

Figure 18: Typical Time Curves for Type CV-6 Long Time Over or Undervoltage Relay

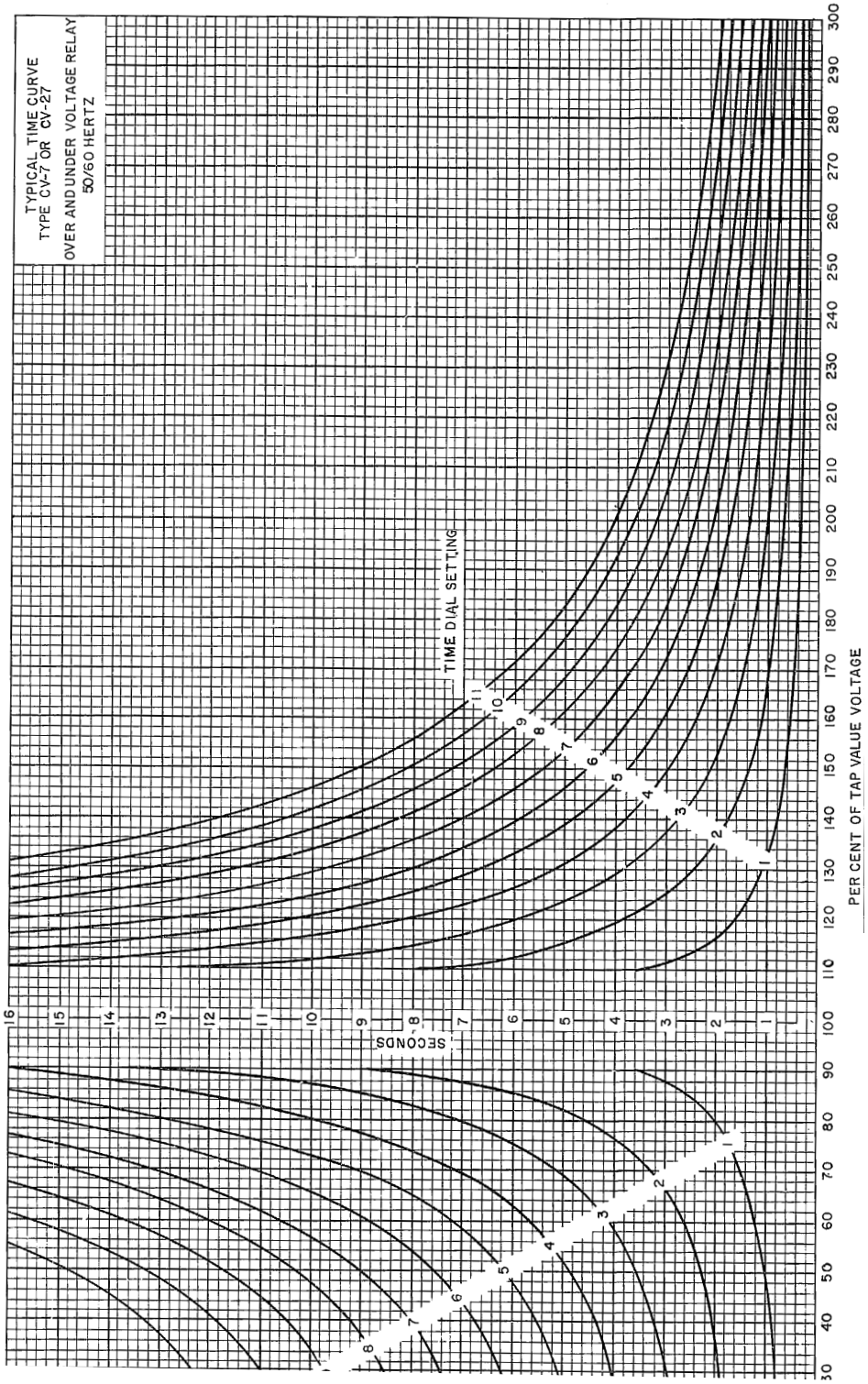

Figure 19: Typical Time Curves for Type CV-7 Short Time Over or Undervoltage Relay

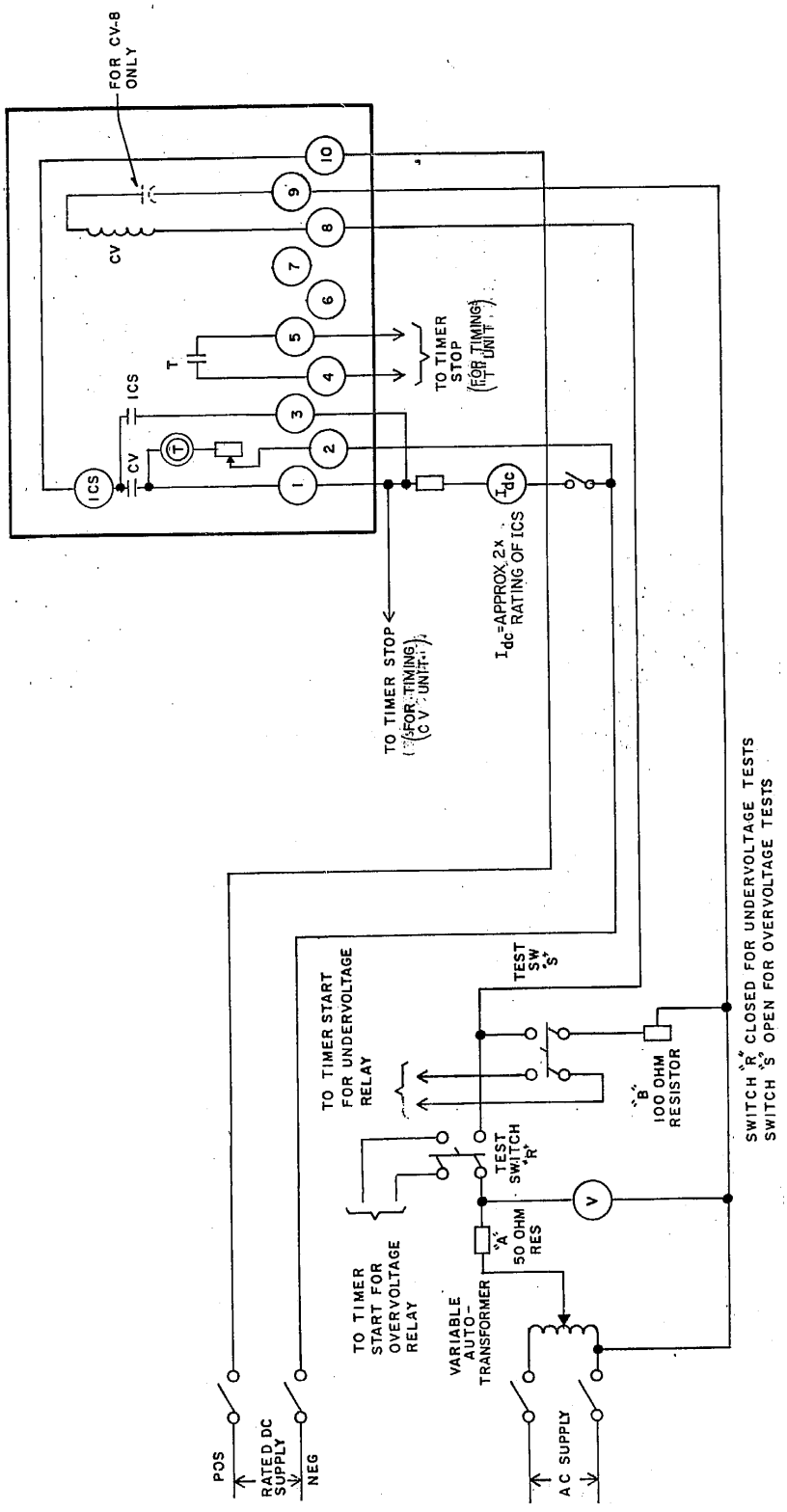

Figure 20: Diagram of Test Connections for Type CV Undervoltage or Overvoltage Relay

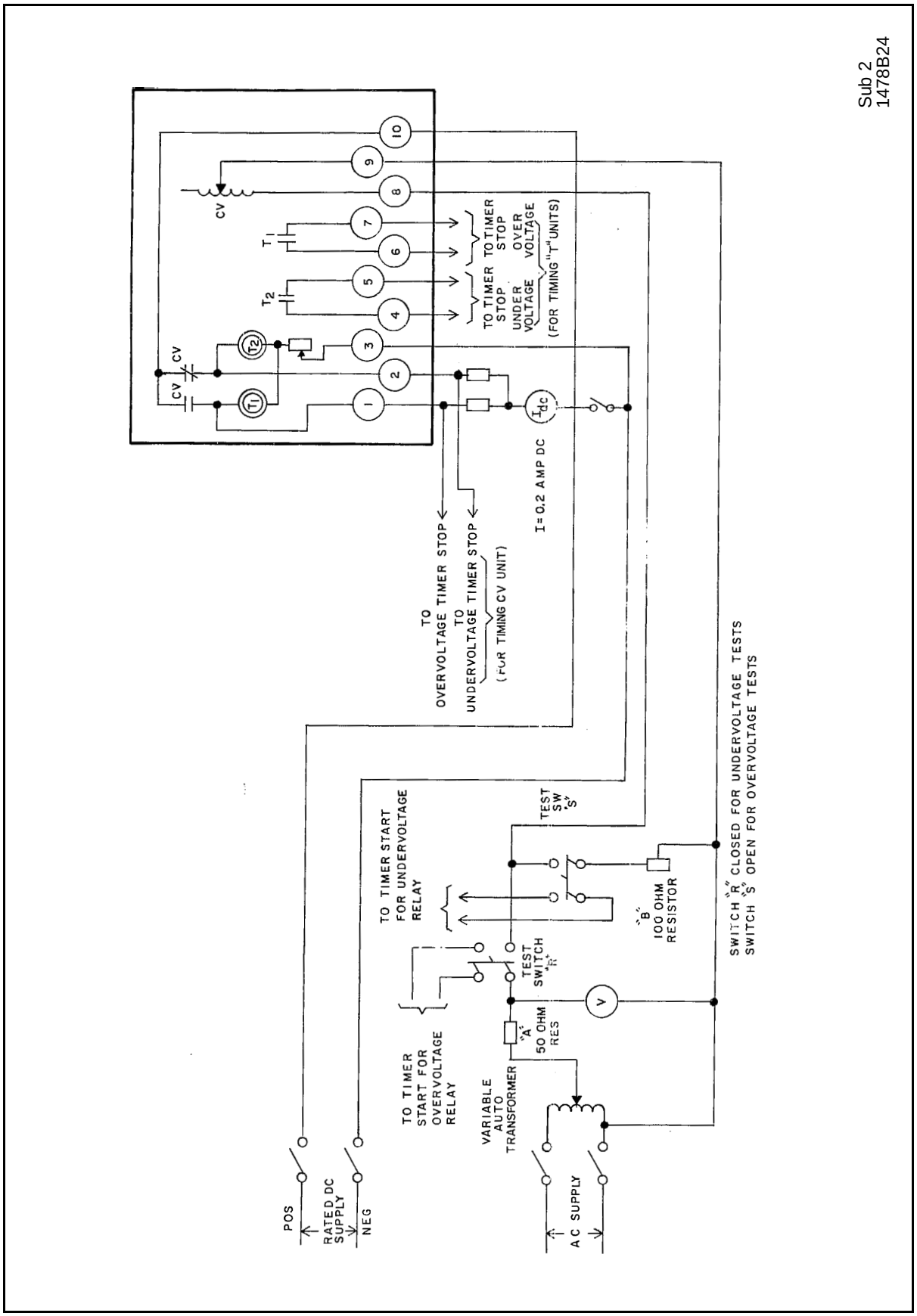

Figure 21: Diagram of Test Connections for Type CV Over or Undervoltage Relay

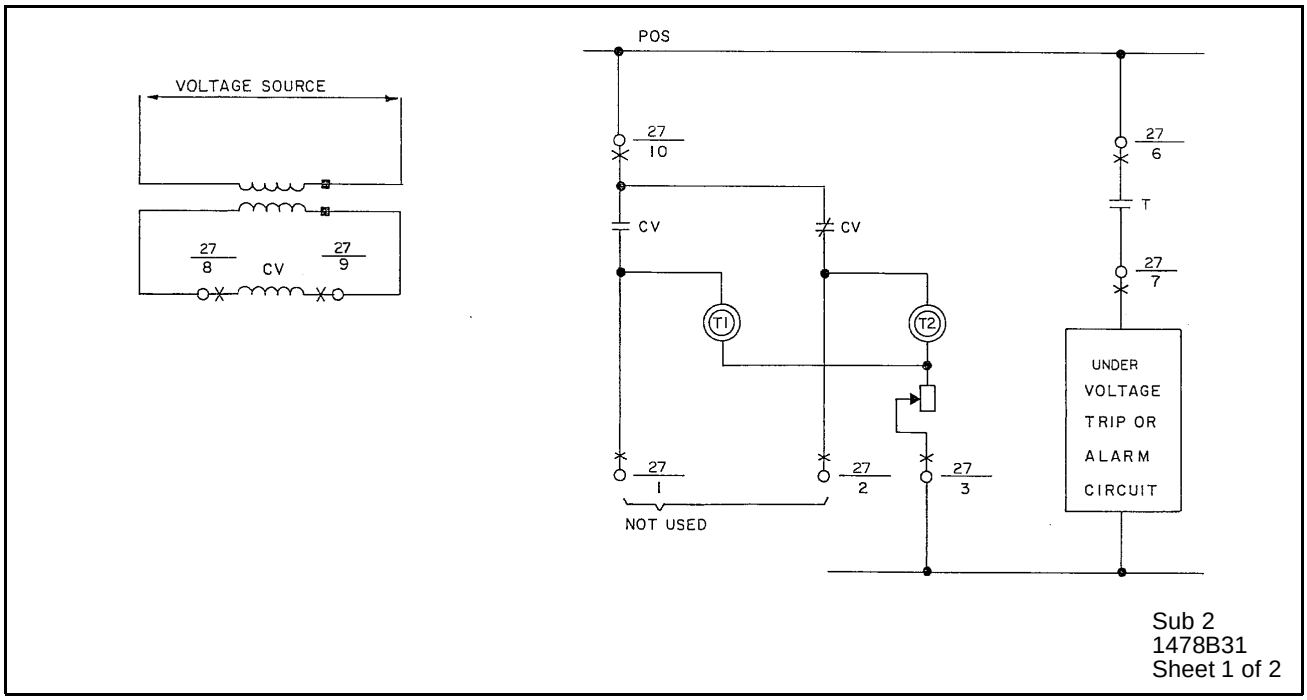

Figure 22a: Typical External Schematic forType CV Overvoltage or Undervoltage Relays

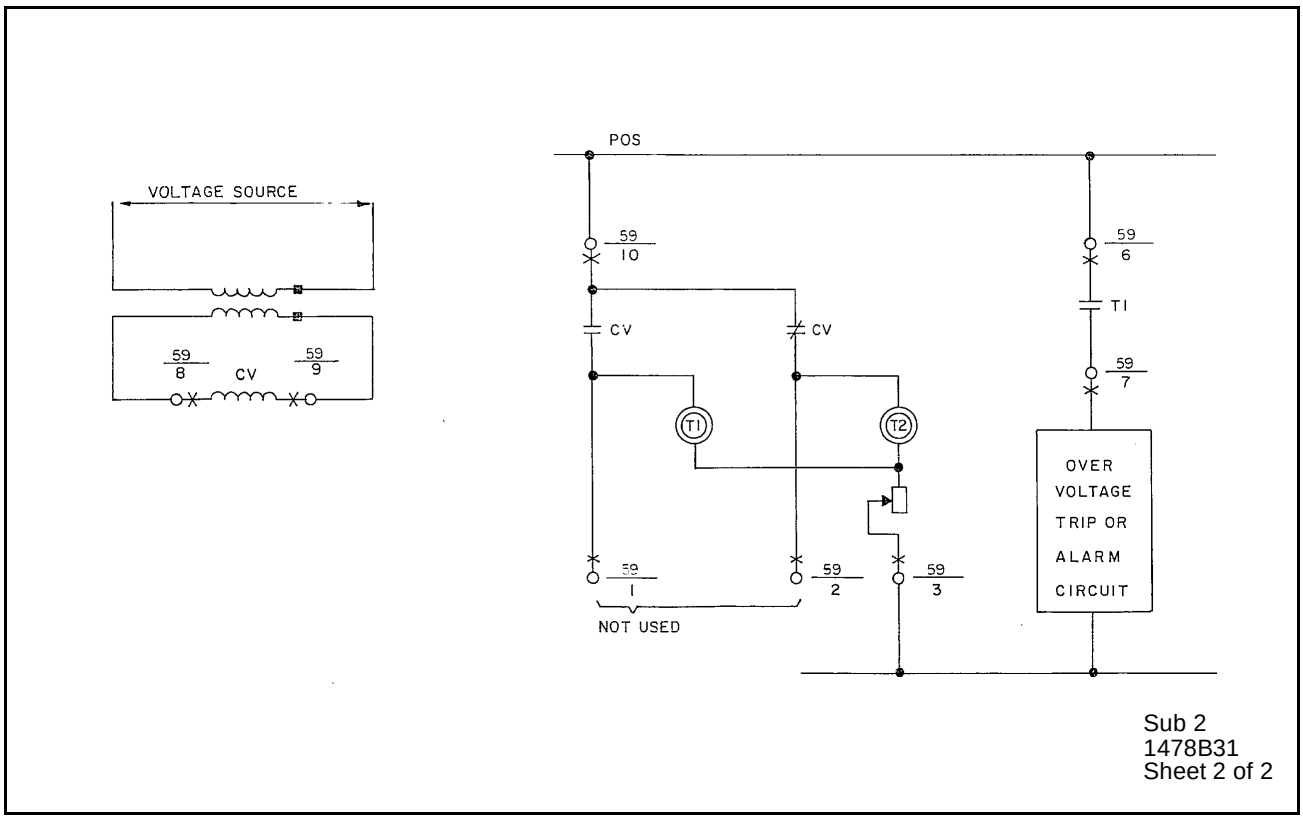

Figure 22b: Typical External Schematic forType CV Overvoltage or Undervoltage Relays

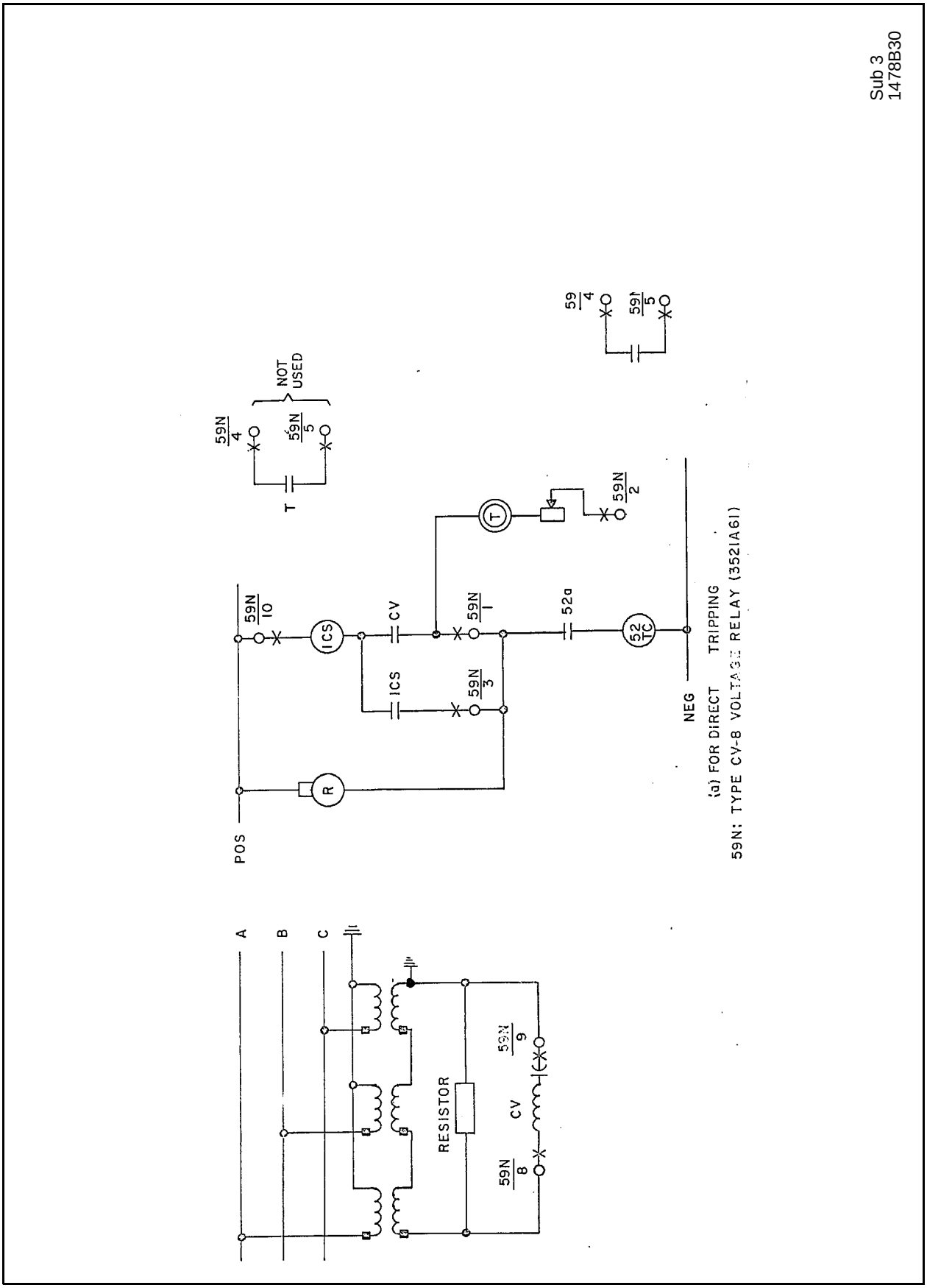

Figure 23: Typical External Schematic for Type CV-8 Voltage Relay

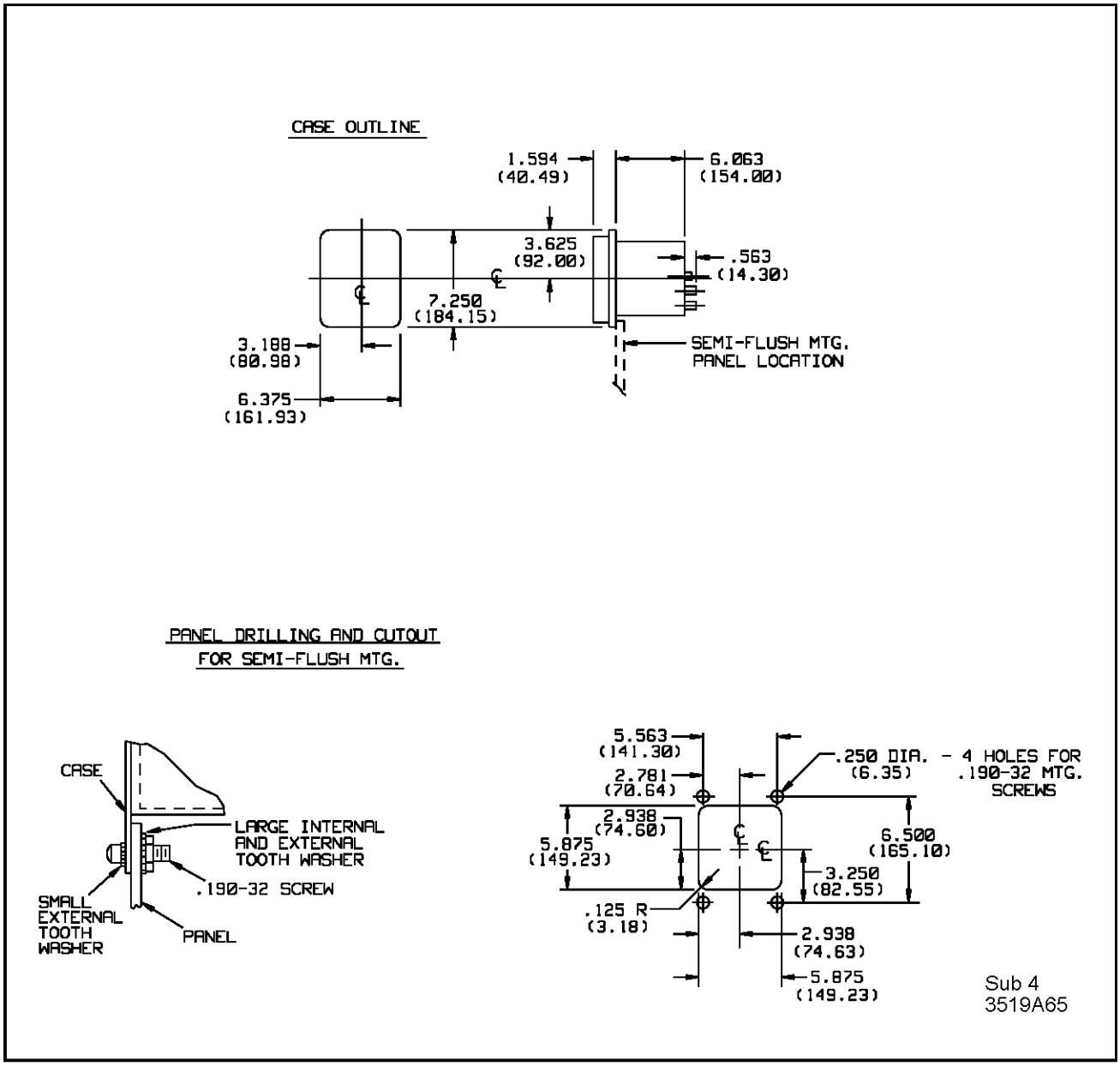

Figure 24: Outline and Drilling Plan for the Type CV Relay in the FT-11 Case

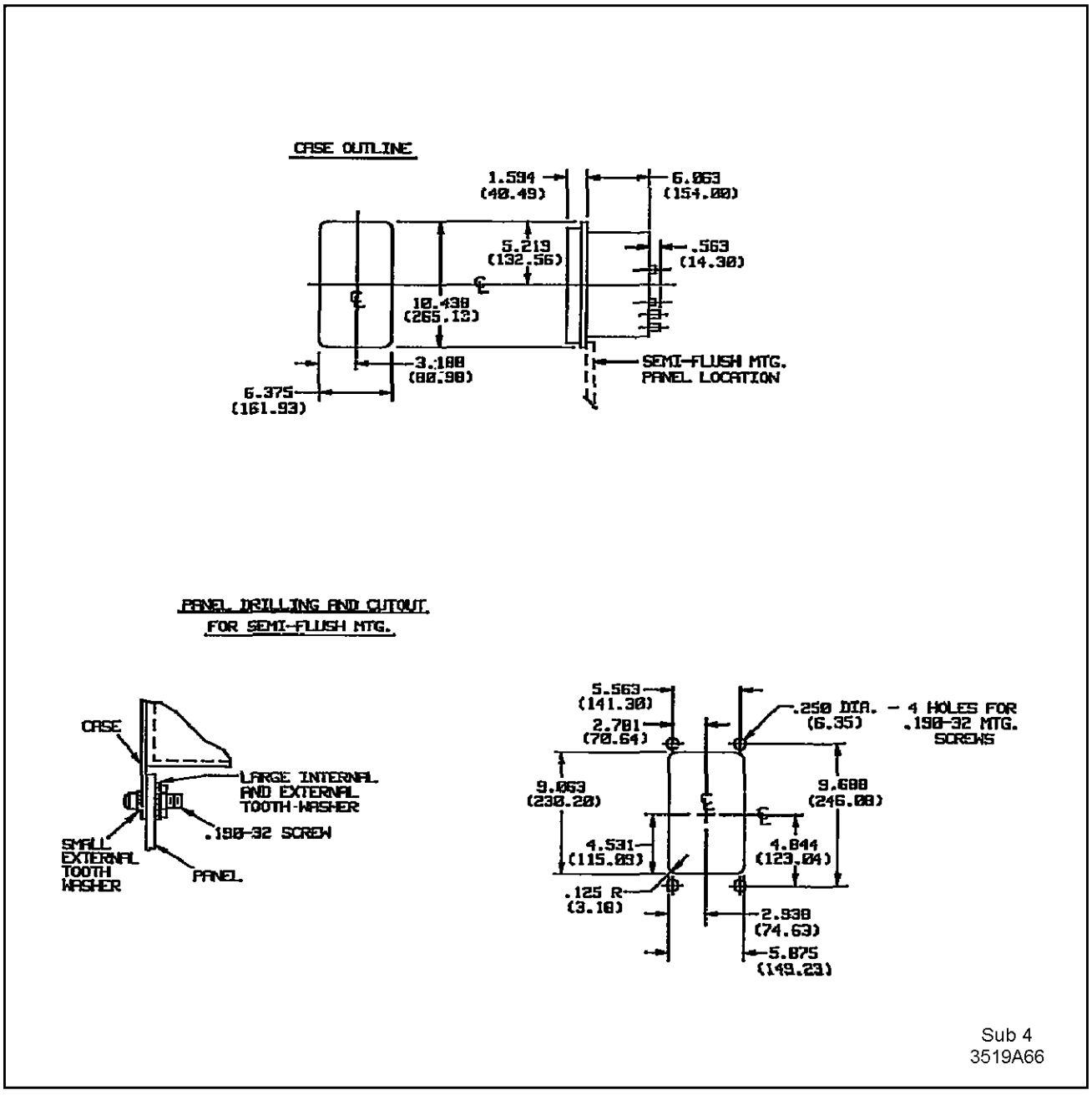

Figure 25. Outline and Drilling Plan for CV Relay in FT-21 Case

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