# INSTRUCTIONS

## For Installation and Operation

## INTRODUCTION

**CAUTION: The equipment covered by this publication must be selected for a specific application and it must be installed, operated, and maintained by qualified persons who are thoroughly trained and who understand any hazards that may be involved. This publication is written only for such qualified persons and is not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.**

The S&C Automatic Control Device—Type UPR provides protection of *ungrounded*, wye-connected shunt reactors.★‡ It is a solid-state electronic control device of modular construction which detects developing turn-to-turn faults in the windings of such shunt reactors (the most common mode of reactor failure). See Figure 1.

When a developing turn-to-turn fault occurs in any phase winding, the shunt reactor is protected from further damage by automatic switching—initiated by the S&C Type UPR Automatic Control Device—which

★ Either three-phase reactors or three-phase banks of single-phase reactors.

‡ For applications where the source is a delta-connected tertiary transformer winding, a grounded-wye broken-delta voltage-transformer "bank" with shunt resistor—referred to as a high-impedance grounding transformer (normally required for ground-fault detection)—is required to maintain the stability of phase-to-ground voltage relationships for all but fault conditions. Otherwise spurious signal voltages could appear at the neutral of, and result in isolation of, the reactor. However, if the S&C Type UPR Automatic Control Device includes the plug-in unbalance compensation module (connected to compensate for both system voltage unbalance and inherent reactor unbalance), up to 10% unbalance among system phase-to-ground voltages will be automatically compensated for.


**Figure 1. S&C Automatic Control Device—Type UPR.**

isolates and locks out the entire shunt reactor when a predetermined neutral-to-ground voltage is exceeded.

The Type UPR Automatic Control Device incorporates a *gross overvoltage* circuit which functionally bypasses the lockout-level and timing-control circuits to achieve fast isolation of the reactor in the event of a fault which open circuits an entire phase winding. This circuit is activated, after a field-adjustable short-time delay, when the neutral-to-ground voltage exceeds a field-adjustable level.

An optional plug-in alarm module set (catalog number suffix "-H") may be furnished to provide an alarm signal at a predetermined reactor neutral-to-ground voltage level less than that for which automatic switching is desired.

The Type UPR Automatic Control Device, with the precision, flexibility, and compactness of solid-state electronics, offers matchless design features and proven circuits that withstand the rigors of power equipment application.

The Type UPR Automatic Control Device utilizes plug-in modules featuring glass-reinforced epoxy circuit boards, with all components applied at levels well below MIL-STD guidelines to minimize component stress, power-supply requirements, and internal heating. "Enhanced quality" integrated circuits and gold-over-nickel plated connector pins and receptacle contacts are used throughout for increased reliability. Voltage-sensing input circuits are transformer isolated, and output circuits are relay isolated; these relays have contacts of gold-flashed silver-cadmium oxide to ensure long service life.

Metal-oxide surge protectors at critical points in the control circuits provide the optimum in surge protection. S&C's unique surge-control techniques have been field proven through years of successful application in hostile utility-substation environments. The capability of every S&C electronic device to withstand voltage surges is confirmed by two factory quality-check tests: The ANSI Surge Withstand Capability Test (ANSI Standard C37.90a, 1974); plus a much more severe (5-kv, 3.75-joule) capacitive-discharge test specially developed by S&C to duplicate or exceed voltage surges measured in EHV power substations. The specified surges are applied at all terminals of the device. Additional factory tests include a dielectric test; screening procedures with the device energized—including vibration, temperature-cycling, and maximum-operating-temperature tests; and functional tests (both before and after the screening tests).

The Type UPR Automatic Control Device is suitable for mounting in a standard 19-inch relay rack. External control-wiring connections are made to numbered terminal strips at the rear of the device. See Figure 2. Customer-installed fuses and fuse blocks for the control source are provided. For flush-mounting of the control device on switchboards, control consoles, or other enclosures, an optional mounting bezel (catalog number suffix "-L") is available.

The Type UPR Automatic Control Device may be furnished in a weatherproof enclosure suitable for mounting on a substation structure. In this instance, a prewired, auxiliary, front-access, covered terminal strip is provided, in addition to a space heater suitable for 120-volt ac or 240-volt ac operation. The space heater is controlled by a nonadjustable 90°F thermostat. Factory-installed fuses and fuse blocks for the control source and for the space heater are included. External connections to the automatic control device are made through a conduit-entrance plate located at the bottom of the enclosure.

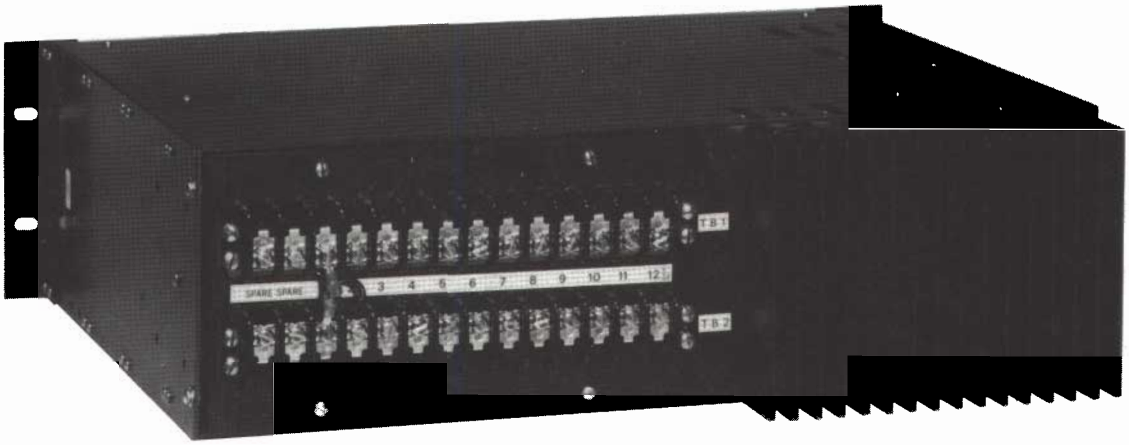


Figure 2. Terminal strips for external control-wiring connections.

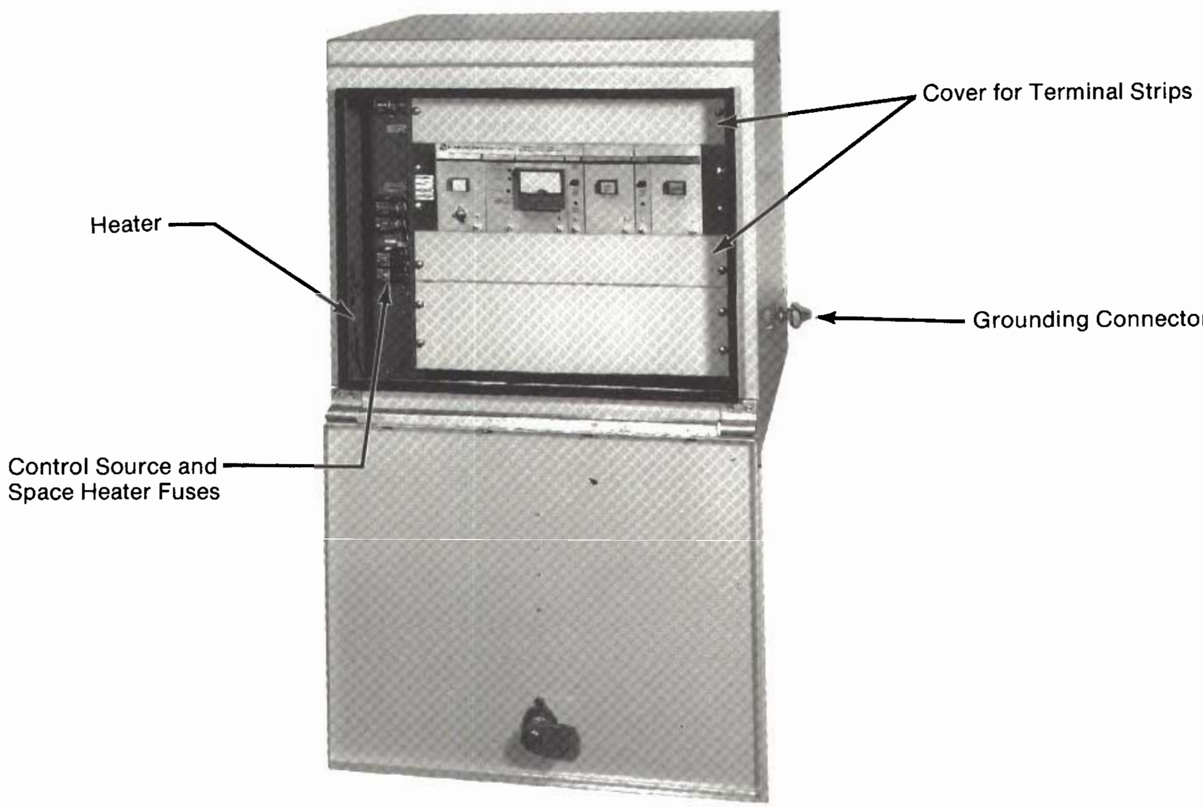


Figure 3. S&C Automatic Control Device—Type UPR mounted in weatherproof enclosure.

## FUNCTIONAL PERFORMANCE

The Type UPR Automatic Control Device utilizes a voltmeter module which detects the reactor neutral-to-ground voltage, as monitored by an S&C 15-Volt-Ampere Potential Device. When a developing turn-to-turn fault occurs in one of the phase windings, the shunt reactor is protected from further damage by automatic switching—initiated by the S&C Type UPR Automatic Control Device—which isolates and locks out the entire shunt reactor when the predetermined neutral-to-ground voltage value set on the lockout level module is exceeded.

A field-adjustable 0.3- to 4-second§ time delay is incorporated in the lockout level module, to assure that transient disturbances will not initiate a nuisance reactor isolation.

A gross overvoltage circuit responds to faults within the reactor producing a neutral-to-ground voltage in excess of a field-adjustable level of 1000 to 5000 volts by initiating isolation and lockout after a field-adjustable time delay of 0.5 to 5 seconds.⊕

The Type UPR Automatic Control Device may be furnished with an optional alarm module set, which provides an alarm signal when the reactor neutral-to-ground voltage exceeds a predetermined level less than the lockout-level setting. The alarm module set, further, responds to loss of control power to the Type UPR Automatic Control Device and provides an alarm signal. A field-adjustable time delay of 0.3- to 4-seconds§ is incorporated in the alarm level module to avoid false alarms due to transient disturbances.

The Type UPR Automatic Control Device also incorporates an auxiliary relay (33X) which is actuated through an "a" contact of the reactor switch-operator auxiliary switch. This auxiliary relay prevents nuisance lockouts of the automatic control device (as well as nuisance activation of the alarm circuit in installations which include the optional alarm module set) resulting from neutral-to-ground voltages of several kilovolts being induced during periods when the reactor has been routinely de-energized.

When required, an optional plug-in unbalance compensation module may be added (along with required additional voltage-monitoring devices) to detect and compensate for the error voltage appearing between the reactor neutral and ground caused by system voltage unbalance★ and/or inherent reactor unbalance resulting from manufacturing-tolerance variations among the phase windings.

§ Factory-set at 0.5 second.

⊕ Factory-set at 2500 volts, for a time delay of 2 seconds.

★ For proper unbalance compensation, the system-derived voltages monitored by the S&C Automatic Control Device must be obtained by means of S&C 30-Volt-Ampere Potential Devices—or voltage transformers—connected to the segment of station bus to which the shunt reactor is tapped. Connecting circuits from the potential devices or voltage transformers to the S&C Type UPR Automatic Control Device must be free of variable loads, variable voltage drops, and ground loops so that the voltages monitored accurately represent the magnitude and phase angle of the bus voltages.

## General Installation Requirements

To prevent damage to the Type UPR Automatic Control Device in the event that surges which exceed factory-tested levels are encountered, S&C's control-circuit fusing recommendations must be followed. The required fuse blocks and fuses are furnished with the control device. If frequent surges in excess of factory-tested levels are anticipated, S&C should be advised as to the severity of the surges so that special recommendations can be made.

In designing the installation, consideration should be given to provision of adequate ventilation for the control device to limit the temperature adjacent to the unit to 160°F maximum. This is particularly important in instances where the control device is installed in a cabinet or where several control devices are installed in close proximity to each other.

For applications where the source is a delta-connected tertiary transformer winding, it is necessary to provide a means of stabilizing phase-to-ground voltage relationships for all but fault conditions. (Otherwise, spurious signal voltages could appear at the neutral of, and result in isolation of, the reactor.) A grounded-wye, broken-delta voltage-transformer "bank" with shunt resistor—referred to as a high-impedance grounding transformer—normally required for ground-fault detection will provide the required stabilization. See Figure 4.

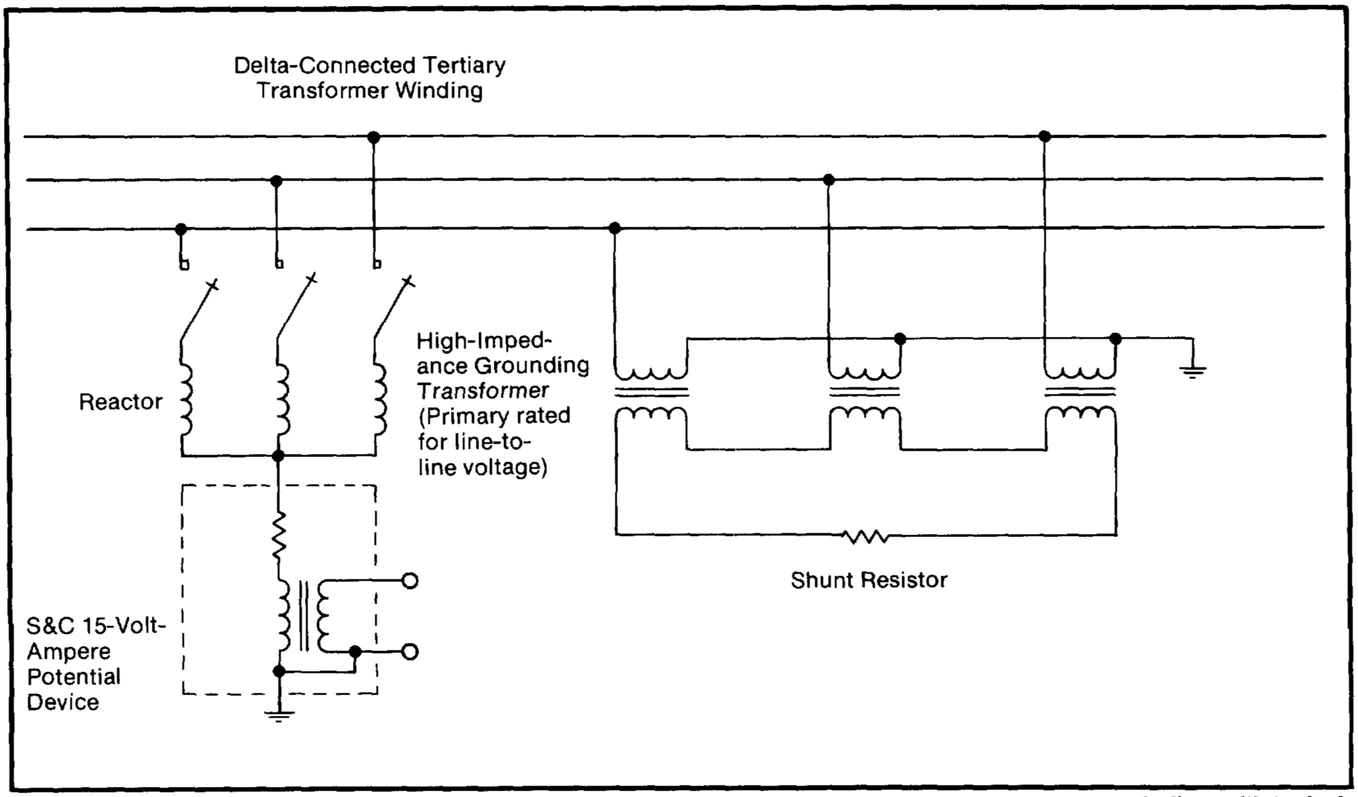


**Figure 4. Ungrounded-wye connected shunt reactor supplied from delta-connected tertiary transformer winding, with typical high-impedance grounding transformer. The shunt resistor is selected to supply ground current equal to or greater than the capacitive ground current due to source-circuit capacitance to ground.**

## Making the Connections

IMPORTANT: The voltmeter module has been calibrated at the factory to provide direct reactor neutral-to-ground voltage reading for a specific-voltage-rated S&C 15-Volt-Ampere Potential Device connected between the reactor neutral and ground—as indicated on the label affixed to the back of the module faceplate.

When the optional unbalance compensation module has been specified, it has been calibrated at the factory for a specific-voltage-rated S&C 15-Volt-Ampere Potential Device connected between the reactor neutral and ground, and for a specific primary-to-secondary voltage ratio S&C 30-Volt-Ampere Potential Device(s) or voltage transformer(s) connected between the station bus and ground—as indicated on the label affixed to the back of the module faceplate.

If other voltage-monitoring devices are utilized, recalibration is required. Refer to the recalibration instructions contained in S&C Reference Drawing RD-3227 for the voltmeter module, or RD-3225 for the unbalance compensation module. The appropriate drawing(s) is furnished as part of the detailed instruction manual which can be ordered for the Type UPR Automatic Control Device.

The Type UPR Automatic Control Device is equipped with numbered terminal strips for external control-wiring connections at the rear of the device. See Figure 2. Using the connection drawing in the instruction manual furnished with the device, make the following connections:

1. Control source (48 volts dc, 125 volts dc, 120 volts 60 hertz, or 240 volts 60 hertz, as appropriate).
2. Output terminals of the S&C 15-Volt-Ampere Potential Device, having a system voltage rating as follows:

| Nominal Source Voltage, Kv | Potential-Device System Voltage Rating, Kv, Nominal |
|---|---|
| below 23 | 23 |
| 23 | 23 |
| 34.5 | 23 |
| 46 | 23 |
| 69 | 34.5 |
| 115 | 69 |
| 138 | 69 |
| 161 | 138 |
| 230 | 138 |

3. Opening circuit of the switch operator.
4. Closing circuit of the switch operator.
5. "a" contact of switch-operator auxiliary switch. This contact should be set to close near the fully closed position of the reactor switching device.
6. Station ground.
7. Space heater source, where applicable (120 volts 60 hertz, or 240 volts 60 hertz).
8. Alarm circuit (optional).

Additionally, if the Type UPR Automatic Control Device is equipped with optional plug-in unbalance compensation module, connections are required to the output terminals of other voltage-monitoring devices as follows:

1. *For detection and compensation of inherent reactor unbalance only, in applications where the source is grounded*, connection must be made to either:
   a. A single, fully system-voltage-rated S&C 30-Volt-Ampere Potential Device equipped with factory-adjusted calibration device (catalog number suffix "-T"), connected to any phase of the station bus from which the reactor is tapped, or
   b. A single voltage transformer, connected to the station bus from which the reactor is tapped—either line-to-line across any two phases or line-to-ground on any phase.
2. *For detection and compensation of inherent reactor unbalance only, in applications where the source is a delta-connected tertiary transformer winding*, connection must be made to a 1:1-ratio voltage transformer which is then to be connected to any secondary of a high-impedance grounding transformer; the voltage transformer should have a voltage rating equal to the secondary voltage rating of the grounding transformer. (The grounding transformer—which should be connected to the station bus from which the reactor is tapped—maintains the stability of phase-to-ground voltage relationships for all but fault conditions.)
3. *For detection and compensation of inherent reactor unbalance plus detection and compensation of system voltage unbalance, in applications where the source is grounded*, connection must be made to either:
   a. Three fully system-voltage-rated S&C 30-Volt-Ampere Potential Devices equipped with factory-adjusted calibration device (catalog number suffix "-T"), each connected to a phase of the station bus from which the reactor is tapped, or

b. Three voltage transformers, connected to the station bus, grounded-wye grounded-wye.

4. *For detection and compensation of inherent reactor unbalance plus detection and compensation of system voltage unbalance, in applications where the source is a delta-connected tertiary transformer winding*, connections must be made to three 1:1-ratio voltage transformers each of which is then to be connected to a secondary of a high-impedance grounding transformer; the voltage transformers should have a voltage rating equal to the secondary voltage rating of the grounding transformer. (The grounding transformer—which should be connected to the station bus from which the reactor is tapped—maintains the stability of phase-to-ground voltage relationships for all but fault conditions.)

When the unbalance compensation module is used to compensate for system voltage unbalance, it is factory-calibrated in accordance with information furnished at the time of ordering. Such information includes the catalog number of the associated S&C 30-Volt-Ampere Potential Devices, the primary- and secondary-voltage ratings and the turns ratio of the associated voltage transformers, or the secondary voltage rating and turns ratio of the associated grounding transformers, as applicable.

Connecting circuits from the voltage-monitoring devices to the Type UPR Automatic Control Device must be free of variable loads, variable voltage drops, and ground loops so that the voltages monitored accurately represent the magnitude and phase angle of the bus voltages. Some possible errors affecting unbalance compensation are:

- Differences in effective voltage ratio among the three S&C 30-Volt-Ampere Potential Devices or the three voltage transformers used to obtain system-derived voltages, as applicable.
- Unbalanced or variable loading of the voltage-monitoring devices used to obtain system-derived voltages. (Station-service transformers are thus not suitable sources for this purpose.)
- Control-wiring voltage drops between the voltage-monitoring devices and the automatic control device. (For example, a 1-ampere current flowing through 1000 feet of number 10 AWG wire will result in a 1-volt drop in the voltage-level signal, which may be sufficient to produce undesirable performance of the protection scheme.) Adequately sized dedicated connecting circuits between the voltage-monitoring devices and the automatic control device will minimize voltage drops.
- Induced voltages in control wiring. Proper shielding is important.
- Ground loops caused by differences in voltage between the grounding points for the reactor neutral-to-ground voltage-monitoring device and those for the voltage-monitoring devices used to obtain system-derived voltages. Preferably, the secondaries of all the voltage-sensing devices should be grounded at one point—at the control house, as per proposed ANSI C57.13.3, "Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases."

## Lockout Level

This lockout level should be set at the minimum value permissible without incurring nuisance lockouts.

## Step-by-step Procedures

1. Collect application data, including:
   a. Highest anticipated continuous system line-to-neutral voltage, $V_{L-n}$ (volts);
   b. Anticipated inherent reactor unbalance expressed as $\triangle X$, the maximum per-unit reactance variation (due to manufacturing tolerance) of any one phase from the average of the reactances of the three phases;★
   c. Estimated inherent system voltage unbalance expressed as $\triangle V_{L-n}$, the maximum per-unit system line-to-neutral voltage variation of any one phase from the average of the line-to-neutral voltages of the three phases. (Typically $\triangle V_{L-n}$ will be less than 0.01 per unit.)
2. Calculate the reactor neutral-to-ground voltage, $V_n$, due to inherent source voltage unbalance and inherent reactor unbalance. Use the formula:

$$V_n \text{ (volts)} = \left(\frac{\triangle X + \triangle V_{L-n}}{3}\right) V_{L-n}$$

3. Determine the lockout level as twice the reactor neutral-to-ground voltage calculated above.

★ From ANSI Standard C57.21-1971: "In the case of a three-phase shunt reactor or a bank made of three single-phase shunt reactors, the maximum deviation of impedance in any one phase shall be within 2 percent of the average impedance ohms of the three phases. For dry-type shunt reactors without magnetic field shielding this tolerance applies only when units are arranged in an equilateral triangle configuration and isolated from any external magnetic influences."

## Example

1. Installation Data
   a. Highest anticipated continuous system line-to-neutral voltage . . . . . . . . . . . . . . 7200
   b. Anticipated inherent reactor unbalance, $\triangle X$ . . . . . . . . . . . . . . . . . . 0.015
   c. Estimated inherent system voltage unbalance, $\triangle V_{L-n}$ . . . . . . . . . . . . . . . . . 0.01
2. Calculate $V_n$:

$$V_n = \left(\frac{0.015 + 0.01}{3}\right) 7200 \text{ volts} = 60 \text{ volts}$$

3. Determine lockout level:

The lockout level is 2 (60 volts) = 120 volts

## Gross Overvoltage Circuit

Calculate the reactor neutral-to-ground voltage, $V_n$, resulting from a fault which would open circuit an entire phase winding. Use the formula:

$$V_n = 1/2\,(V_{L-n})$$

where $V_{L-n}$ = Highest anticipated continuous system line-to-neutral voltage

For the example given under "Establishing the Settings," the desired gross overvoltage lockout level is the midpoint between $V_n$ calculated above and the lockout-level setting, or

$$\frac{1/2\,(7200 \text{ volts}) + 120 \text{ volts}}{2} = 1860 \text{ volts}$$

Should the calculated gross overvoltage lockout level exceed 5000 volts, the detector should be set at its maximum value.

## IS UNBALANCE COMPENSATION NEEDED?

A certain amount of error voltage is always present between the reactor neutral and ground, due to system voltage unbalance and/or inherent reactor unbalance resulting from manufacturing-tolerance variations among the phase windings of the reactor. Since it is not possible to predict how the two components of the error voltage will combine vectorially, it is important that the magnitude of the error voltage be kept low in relation to the magnitude of the reactor neutral-to-ground voltage level for which automatic switching is desired (the lockout-level setting). For example, the error voltage may be additive with respect to the reactor neutral-to-ground voltage resulting from a developing turn-to-turn fault in one phase winding but subtractive with respect to the reactor neutral-to-ground voltage resulting from a developing turn-to-turn fault in another phase winding.

As a rule, unbalance compensation should be provided if the magnitude of the error voltage, $V_n$, calculated as shown on page 8, exceeds 50% of the desired lockout-level setting.

For the example given under ESTABLISHING THE SETTINGS, the lockout level is 120 volts. If the reactor neutral-to-ground voltage exceeds 60 volts under normal operating conditions, either the source of the voltage unbalance must be reduced or eliminated, or unbalance compensation must be provided.

## LOCKOUT- AND ALARM-LEVEL ADJUSTMENTS

**Step 1**

Place the on-off toggle switch on the power supply module in the *on* position. The presence of control-source voltage will be signified by a lighted indicator.

If an alarm indicator or lockout indicator lamp should light, press the appropriate button to reset the circuit.

**Step 2**

Adjust the lockout level by pressing the "push-to-read lockout level" button on the lockout level module while turning the "lockout level adjust" screw to attain the required voltmeter reading.

**Step 3**

*If the optional alarm module set is furnished*: Adjust the alarm level by pressing the "push-to-read alarm level" button on the alarm level module while turning the "alarm level adjust" screw to attain the required voltmeter reading.

The alarm level setting should be a value lower than the lockout-level setting but above a value which would result in too many nuisance alarms caused by variations in system voltage unbalance.

**Step 4**

Record, for future reference, the lockout-level and alarm-level settings arrived at in the preceding steps, as indicated on the voltmeter.

**Step 5**

Adjust the gross overvoltage circuit neutral-to-ground voltage by setting the 1000-5000 volt single-turn potentiometer, located on the lockout control module printed circuit board, for the required value.

## LOCKOUT- AND ALARM-CONTROL TIMER ADJUSTMENTS

### Step 6

Adjust the lockout time delay by setting the 0.3-4 second single-turn potentiometer, located on the lockout level module printed circuit board, for the desired value. The scale on the potentiometer is accurate to ±20%.

### Step 7

*If the optional alarm module set is furnished*: Adjust the alarm time delay by setting the 0.3-4 second single-turn potentiometer, located on the alarm level module printed circuit board, for the desired value. The scale on the potentiometer is accurate to within ±20%.

### Step 8

Adjust the gross overvoltage circuit time delay by setting the 0.5-5 second single-turn potentiometer, located on the lockout control module printed circuit board, for the desired value. The scale on the potentiometer is accurate to ±20%.

The gross overvoltage circuit time delay should be a minimum of 0.5 second★ *plus* the elapsed time between energization of the reactor switching device opening circuit and opening of the switching device "a" contact (which is coincident with mechanical parting of the disconnect blades, if an S&C Circuit-Switcher is furnished).

For example, if the reactor switching device is a 230-kv S&C Circuit-Switcher, the minimum gross overvoltage circuit time delay setting should be 0.5 second plus 0.6 second, or 1.1 seconds total. The elapsed time between energization of the opening circuit and mechanical parting of the disconnect blades can be approximated as 40% of the maximum operating time of the particular S&C Circuit-Switcher used.

### Step 9

Record, for future reference, the time-delay settings selected in Steps 6 through 8.

★ Required to prevent gross overvoltage lockout due to transient system voltage.

## FIELD DETERMINATION OF NEED FOR UNBALANCE COMPENSATION

### Step 10

Close the reactor switching device to energize the reactor.

The voltmeter should read essentially zero or, at most, 50% of the lockout-level setting. Record, for future reference, this voltmeter reading. If the voltmeter reading exceeds 50% of the lockout-level setting, it will be necessary to either reduce or eliminate the source of the voltage unbalance, or to utilize the optional unbalance compensation module, adjusted as described in Step 11.

## ADJUSTMENT OF UNBALANCE COMPENSATION

### Step 11

If the voltmeter reading taken in Step 10 exceeds 50% of the lockout-level setting, unbalance compensation is required. Assuming that the plug-in unbalance compensation module is installed, calibrated,† and connected, proceed as follows: Turn the "amplitude adjust" screw five full turns clockwise from its fully counterclockwise position. Then turn the "phase-fine adjust" screw three full turns clockwise from its fully counterclockwise position. Next, turn the "phase-coarse adjust" screw to operate the four-position rotary switch (at random) to attain a minimum reading on the voltmeter. Turn the "amplitude adjust" screw to further reduce the voltmeter reading. Turn the "phase-fine adjust" screw to attain a minimum reading on the voltmeter. Turn the "amplitude adjust" screw to further reduce the voltmeter reading and then turn the "phase-fine adjust" screw to attain a final minimum reading on the voltmeter. Record, for future reference, this voltmeter reading.

† The unbalance compensation module is factory calibrated in accordance with information furnished by the purchaser at the time of ordering.



S&C ELECTRIC COMPANY • Chicago
S&C ELECTRIC CANADA LTD. • Rexdale

## MAINTENANCE

No routine maintenance is recommended for the Type UPR Automatic Control Device other than an occasional exercising (about once per year) to verify that it is operational. This can be done by temporarily adjusting the lockout level downward until lockout of the reactor occurs.

At installations utilizing an S&C Circuit-Switcher as the reactor switching device, the associated S&C Switch Operator, Type CS-1A or Type CS-2A, may be conveniently decoupled from the Circuit-Switcher. This capability makes it possible to check out the Type UPR Automatic Control Device without actually switching the reactor.

It is advisable, for the first few days after start-up, to compare day-to-day voltmeter readings with those recorded in Step 10 or Step 11. It is possible for changes to occur due to irregularities in the voltage-monitoring devices or to aberrations (developing faults) in the phase windings. When it has been determined that the reactor neutral-to-ground voltage is remaining constant, voltmeter readings may be compared at convenient intervals. If a small increase in reactor neutral-to-ground voltage is then observed, it can be an indication of a developing fault.

Use the "push-to-read" buttons on the appropriate modules to occasionally check the alarm level (if applicable) and lockout level—as indicated on the voltmeter—against the settings recorded in Step 4.

Finally, it may be prudent to confirm that the time-delay settings, as recorded in Step 9, have not been altered.

## SPECIFICATIONS

### Automatic Control Device

| Catalog Number Suffix | Control-Source Voltage | | Current |
|---|---|---|---|
| | Nominal | Operating Range | |
| A | 48 v dc | 38.5—56 v dc | 1 amp |
| B | 125 v dc | 100—140 v dc | 1 amp |
| D | 120 v, 60 hz | 102—132 v, 60 hz | ½ amp |
| E | 240 v, 60 hz | 204—264 v, 60 hz | ¼ amp |

### Operating Temperature Range

Ambient adjacent to device . . . . . . -40°F to + 160°F

### Neutral-to-Ground Voltage Input Circuit

Normal operating voltage range . . . . . 0 to 10 v, 60 hz
Frequency range . . . . . . . . . . . . . . 60 ± 0.3 hertz§
Burden . . . . . . . . . . . . . . . . . . . . . 1 va maximum

### System-Voltage Input Circuit (for optional unbalance compensation module)

Voltage range . . . . . . . . . . . . . . . 60 to 140 v, 60 hz
Frequency range . . . . . . . . . . . . . . 60 ± 0.3 hertz§
Burden . . . . . . . . . . . . . . . . . . . . . 1 va maximum

### Neutral-to-Ground Voltmeter

Accuracy . . . . . . . . . . . . ± 2% of full-scale reading
Range . . . . . . . . . . . . . . . . . . . . . . . . 0-500 volts

### Lockout Level Module

Level Detector
Adjustment range . . . . . . . . . . . . . 0 to 500 volts
Accuracy . . . . . . . . . . . . . . . . ± 1% of setting‡

Time Delay—To Initiate Lockout
Factory setting . . . . . . . . . . . . . . . . . 0.5 second
Adjustment range . . . . . . . . . . . 0.3 to 4 seconds
Accuracy . . . . . . . . . . . . . . . . ± 3% of setting‡

§ For 50-hertz applications, refer to the nearest S&C Sales Office.

‡ For any combination of control-source voltage and ambient temperature within specified range.

## Optional Alarm Module Set

Level Detector
- Adjustment range . . . . . . . . . . . . . 0 to 500 volts
- Accuracy . . . . . . . . . . . . . . . . ± 1% of setting‡

Time Delay—To Initiate Alarm
- Factory setting . . . . . . . . . . . . . . . . . 0.5 second
- Adjustment range . . . . . . . . . . . 0.3 to 4 seconds
- Accuracy . . . . . . . . . . . . . . . . ± 3% of setting‡

## Gross Overvoltage Circuit

Level Detector
- Adjustment range . . . . . . . . . . 1000 to 5000 volts
- Accuracy . . . . . . . . . . . . . . . . ± 5% of setting‡

Time Delay—To Initiate Lockout
- Factory setting . . . . . . . . . . . . . . . . . . 2 seconds
- Adjustment range . . . . . . . . . . . 0.5 to 5 seconds
- Accuracy . . . . . . . . . . . . . . . . ± 5% of setting‡

## Output-Relay Contact Ratings

Current Carrying
- Continuous . . . . . . . . . . . . . . . . . . . 10 amperes
- 1-Second . . . . . . . . . . . . . . . . . . . . 50 amperes

Interrupting . . . . . . . . . . . . . 1.0 ampere at 48 v dc,
0.5 ampere at 125 v dc,
10 amperes at 120 v, 60 hz,
or 5 amperes at 240 v, 60 hz

## Approximate Shipping Weight

Type UPR Automatic Control Device only . . . 26 lbs.
Type UPR Automatic Control Device in Weatherproof Enclosure . . . . . . . . . . . . 186 lbs.

## Options

Options which have been included with the Type UPR Automatic Control Device are signified by the addition of one or more suffixes to the catalog number of the control device, as indicated in the following table:

| Item | Suffix Added to Automatic Control Device Catalog Number |
|---|---|
| Plug-in alarm module set, consisting of one alarm level module and one alarm control module Provides an alarm signal at a predetermined reactor neutral-to-ground voltage level less than that for which automatic switching is desired | -H |
| Plug-in unbalance compensation module. Compensates for system voltage unbalance plus inherent reactor unbalance,① or for inherent reactor unbalance only.② | -K |
| Mounting bezel for flush mounting of Type UPR Automatic Control Device | -L |
| Card extender for Type UPR Automatic Control Device Permits positioning of any module for test. Required for field calibration | -N |

① Additional connections are required to output terminals of three S&C 30-Volt-Ampere Potential Devices, each equipped with factory-adjusted calibration device (catalog number suffix "-T") and having a system voltage rating equal to the voltage of the system to which the reactor is connected (or three voltage transformers). Specify catalog number of S&C Potential Devices (or primary voltage rating and turns ratio of voltage transformers, plus nominal voltage of voltage-transformer secondary circuit, i.e., whether 115—120 volts or 65.71—69.3 volts). Alternately, where a high-impedance grounding transformer is used for line-to-ground voltage stabilization, connections may be made to the secondaries of the grounding transformer (specify turns ratio and voltage of secondary circuit of grounding transformer), using three 1:1-ratio voltage transformers (furnished by user)

② Additional connections are required to output terminals of one S&C 30-Volt-Ampere Potential Device equipped with factory-adjusted calibration device (catalog number suffix "-T"), and having a system voltage rating equal to the voltage of the system to which the reactor is connected (or one voltage transformer). Alternately, where a high-impedance grounding transformer is used for line-to-ground voltage stabilization, connections may be made to any secondary of the grounding transformer, using a 1:1-ratio voltage transformer (furnished by the user).

## Accessories

| Item | Catalog Number |
|---|---|
| Detailed instruction manual for Type UPR Automatic Control Device | RD-3356 |

‡ For any combination of control-source voltage and ambient temperature within specified range.