

# SPECIFICATIONS

## Conditions of Sale

STANDARD: Seller's standard conditions of sale set forth in Price Sheet 150 apply.

## SPECIAL TO THIS PRODUCT:

### INCLUSIONS:

The S&C BankGuard PLUS Control protects substation shunt capacitor banks from overvoltage stress and provides turn-to-turn winding fault protection for shunt reactors. The BankGuard PLUS has the sensitivity to detect and alarm on the loss of individual capacitor units or developing winding faults.

With the capability to detect and alarm upon the loss of the first failed capacitor unit in a bank, the BankGuard PLUS offers users a major advantage: The failed unit can be replaced at a convenient, planned time. . . not on an urgent basis, after subsequent capacitor units have failed and the bank has been locked out. An adjustable time delay is utilized to avoid false alarms due to transient disturbances. Nuisance alarms and lockouts due to the induction of high voltages during routine bank de-energization are also eliminated.

The BankGuard PLUS can detect—and compensate for—system voltage and capacitor-bank or reactor unbalance resulting from manufacturing-tolerance variations among the individual capacitor units and reactor phase windings. In large-size capacitor banks, such unbalance voltages can introduce significant errors in, or even over-power, the voltage signal created by the loss of individual capacitor units. The BankGuard PLUS includes filtering to attenuate spurious transients and harmonics.

The BankGuard PLUS further includes gross-overvoltage logic which bypasses the lockout-level and timing-control logic to achieve fast capacitor-bank or reactor isolation in the event of a flashover of a series group in the bank or flashover of a significant portion of a phase winding.

The BankGuard PLUS is suitable for standard 19-inch relay rack mounting. An optional bezel is available for flush mounting in a switchboard or control console. The BankGuard PLUS is a direct replacement for S&C Automatic Control Devices—Types UP, GP, and UPR. Terminal strip connections are identical with those of the Type UP and all connections for Types GP and UPR are accommodated.

## *Protection of Ungrounded, Wye-Connected Shunt Capacitor Banks, Including Double-Wye Banks◆*

In these applications, the BankGuard PLUS monitors the voltage between the neutral (common) connection of the capacitor bank and ground with a 15-volt-ampere S&C Potential Device. As successive individual capacitor units in a series group of the bank are isolated by their respective fuses, the surviving capacitor units in the group are protected against cascading voltage overstress by the BankGuard PLUS, which isolates and locks out the entire bank when a predetermined neutral-to-ground voltage value is exceeded.

## *Protection of Grounded, Wye-Connected Shunt Capacitor Banks Consisting of Two or More Series Groups per Phase*

In these applications, the BankGuard PLUS monitors, for each phase of the capacitor bank, the voltage between an intermediate tap point and ground with a 30-volt-ampere S&C Potential Device. As successive individual capacitor units in a series group of the bank are isolated by their respective fuses, the surviving capacitor units in the group are protected against cascading voltage overstress by the BankGuard PLUS, which isolates and locks out the entire bank when a predetermined tap point-to-ground voltage value is exceeded.

## *Protection of Ungrounded, Wye-Connected Shunt Reactors◆*

In these applications, the BankGuard PLUS monitors the voltage between the neutral (common) connection of the reactor and ground with a 15-volt-ampere S&C Potential Device. If a turn-to-turn fault develops in a phase winding, the BankGuard PLUS isolates and locks out the entire reactor when a predetermined neutral-to-ground voltage value is exceeded.

■ For proper unbalance compensation, the system-derived voltages monitored by the BankGuard PLUS must be obtained by means of 30-volt-ampere S&C Potential Devices—or voltage transformers—connected to the segment of station bus to which the capacitor bank or reactor is tapped. Connecting circuits from the potential devices or voltage transformers to the BankGuard PLUS 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.

◆ 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 capacitor bank or reactor. The BankGuard PLUS includes an unbalance compensation function that detects and compensates for up to 10% error voltage appearing between the neutral and ground.

**Conditions of Sale—Continued**

**SPECIFICATION NOTES:** S&C BankGuard PLUS Controls have been tested to verify their capability to withstand, without misoperation or damage, surge-voltage tests as follows:

1. The ANSI Surge Withstand Capability Test (ANSI Standard C37.90a, 1974). The specified surges are applied at all control device terminals.
2. A 5-kV, 3.75-joule capacitive-discharge test with surge applied at all control device terminals. This additional test represents a surge level well in excess of those normally encountered in control wiring in utility environments.

To prevent damage to the 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 devices. 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.

For all grounded-wye capacitor-bank installations the following steps must be taken to ensure that the control device is not subjected to surges in excess of the level defined in ANSI Standard C37.90a:

1. Adequate shielding must be provided for control-circuit wiring.
2. For installations involving two or more grounded-wye capacitor banks in the same station, their neutrals must be interconnected and grounded at a single point only. Additionally, it is recommended (although not required) that the capacitor-bank switching devices be equipped with pre-insertion impedances for reduction of inrush current and transient voltage disturbances associated with capacitor-switching applications.

**EXCLUSIONS:** BankGuard PLUS Controls do not include voltage-monitoring devices. Refer to Specification Bulletin 581-31 for information on S&C Potential Devices.

**SPECIFICATION DEVIATIONS:** Refer to "OPTIONS" table on page 3.

**How to Order****1. Control**

- a. Select the catalog number of the desired control from the table on page 3.
- b. Add Suffix "-B" to the catalog number if the optional bezel is desired. See the "OPTIONS" table on page 3.
- c. For calibration purposes, include information on the neutral-, tap-, and/or system-voltage sensing devices used, i.e., catalog number of S&C Potential Device(s), or primary voltage rating and turns ratio of voltage transformer(s) plus nominal voltage of voltage-transformer secondary circuit.▲

**2. Example**

For an S&C BankGuard PLUS Control for application on an ungrounded capacitor bank connected to a system rated 138 kV nominal, specify: "Catalog Number 238062, for use with one S&C 15-volt-ampere S&C Potential Device, Catalog Number 81576R1, and, for unbalance compensation, three 30-volt-ampere S&C Potential Devices, Catalog Number 81349R6-T (or three voltage transformers with a primary rating of 80,500 volts, turns ratio of 1200:1, and secondary circuit rated 67.08 volts), for application on a system rated 138 kV nominal."

▲ If no information on the neutral-, tap-, and/or system-voltage sensing devices is specified, the device will be shipped marked "for field calibration."

## BANKGUARD PLUS CONTROLS

Application <sup>①</sup>	Diagram			Control-Source Voltage	Control		
	Switch Operator	Potential Device	BankGuard PLUS Control		Catalog Number	Page Reference for Dimensional Information	Net Wt., Lbs. (Kg.)
For protection of ungrounded, wye-connected shunt capacitor banks <sup>②</sup>				48 to 250 Vdc or 120 to 240 Vac, 50 or 60 Hz	238062	4	11 (4.95)
For protection of grounded, wye-connected shunt capacitor banks							
For protection of ungrounded, wye-connected shunt reactors <sup>②</sup>							

① For installations in the vicinity of 345-kV or 500-kV circuits, refer to the nearest S&C Sales Office.

② 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 capacitor bank or reactor. S&C BankGuard PLUS Controls include an unbalance compensation function that detects and compensates for up to 10% error voltage appearing between the neutral and ground.

▼ S&C Potential Device rated 15 volt-amperes having a system voltage rating as follows:

Nominal Source Voltage, kV	below 23	23	34.5	46	69	115	138	161	230
S&C Potential Device System Voltage Rating, kV, Nom.	23	23	23	23	34.5	69	69	138	138

◆ S&C Potential Device rated 30 volt-amperes equipped with factory-adjusted calibration device, Catalog Number Suffix "-T." The minimum system voltage rating of the potential device is derived by calculating the voltage appearing between the intermediate tap points and ground and multiplying this value by  $\sqrt{3}$ .

Since S&C Potential Devices are not of instrument-class accuracy, their

performance in intermediate-tap-point voltage-monitoring applications on very-large-sized grounded, wye-connected shunt capacitor banks may not be entirely satisfactory, especially if it is desired to obtain an alarm signal upon the loss of a single capacitor unit. Specifically, this alarm signal setting on banks consisting of more than 150 capacitor units or more than 5 series groups per phase (often the case where system voltage is higher than 138 kV) may possibly lead to nuisance alarms under severe rainfall conditions. In cases where such false operations are of especial concern, higher-accuracy devices such as voltage transformers or capacitor-coupled voltage transformers are recommended. The minimum system voltage rating of these devices is derived by calculating the voltage appearing between the intermediate tap points and ground and multiplying this value by  $\sqrt{3}$ . Adequate damping resistance must be connected across each voltage-transformer secondary circuit; viz., a resistance load equal to at least 2% of the transformer thermal rating.

★ S&C Potential Device rated 30 volt-amperes (or voltage transformer) having a system voltage rating equal to the voltage of the system to which the capacitor bank or reactor is connected. If capacitor-unit or reactor phase-winding manufacturing tolerance variations are of specific concern, a single potential device or voltage transformer is required. If system voltage unbalance is also of concern in ungrounded capacitor bank or reactor applications, three potential devices or voltage transformers are required.

## OPTIONS

Item	Suffix to be Added to Control Catalog Number
Mounting Bezel for Flush Mounting of BankGuard PLUS Control	-B



**BankGuard PLUS**  
Dimensions in Inches

