BankGuard PLUS™ Control

Setup Instructions



S&C Electric Company 6601 North Ridge Blvd. Chicago, Illinois 60626 USA

1011-530 5-17-04

Instruction Sheets Include:

Product Description	1011-500 explains important product features.
Installation	1011-510 describes how to install and connect the BankGuard PLUS Control.
Setup	1011-530 describes how to use the Setup software to configure the BankGuard PLUS Control, check the present settings, and view real-time data.
Operations	1011-540 describes how to view historical data, how to generate reports, and how to update the Control software. This instruction sheet also explains how the BankGuard PLUS Control works during normal operation.
Troubleshooting	1011-550 describes how to diagnose and correct various BankGuard PLUS Control problems.

Latest Release of This Document

The latest release of this instruction sheet is available online at <u>www.sandc.com</u>.

Select: Support/ Product Support Documents. Documents are posted in PDF format.

Safety Information

🛆 WARNING 🖄

The equipment covered by this publication must be installed, operated, and maintained by qualified persons who are knowledgeable in the installation, operation, and maintenance of overhead electric power distribution equipment along with the associated hazards. A qualified person is one who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from non-live parts of electrical equipment.
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed.
- The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment.

These instructions are intended only for such qualified persons. They are *not* intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read this Instruction Sheet

Thoroughly and carefully read this instruction sheet before programming, operating, or maintaining your S&C BankGuard PLUS Control. Familiarize yourself with "SAFETY INFORMATION" on pages 3 through 5.

Retain this Instruction Sheet

This instruction sheet is a permanent part of your BankGuard PLUS Control. Designate a location where you can easily retrieve and refer to this publication.

Warranty

The standard warranty contained in S&C's standard conditions of sale, as set forth in Price Sheet 150, is applicable to the BankGuard PLUS Control.

Understanding Safety-Alert Messages

There are several types of safety-alert messages which may appear throughout this instruction sheet as well as on labels attached to the BankGuard PLUS Control. Familiarize yourself with these types of messages and the importance of the various signal words, as explained below.

"DANGER" identifies the most serious and immediate hazards which *will likely* result in serious personal injury or death if instructions, including recommended precautions, are not followed.

A WARNING A

"WARNING" identifies hazards or unsafe practices which *can* result in serious personal injury or death if instructions, including recommended precautions, are not followed.

"CAUTION" identifies hazards or unsafe practices which can result in minor personal injury or product or property damage if instructions, including recommended precautions, are not followed.

"NOTICE" identifies important procedures or requirements that, if not followed, can result in product or property damage if instructions are not followed.

Following Safety Instructions

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or call S&C Headquarters at (773) 338-1000, Monday through Friday between 8:30 AM and 5:00 PM Central Standard Time. (In Canada, call S&C Electric Canada Ltd. at (416) 249-9171.)

Thoroughly and carefully read this instruction sheet before programming and operating your S&C BankGuard PLUS Control.

Replacement Instructions and Labels

If you need additional copies of this instruction sheet, contact your nearest S&C Sales Office, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting your nearest S&C Sales Office, S&C Headquarters, or S&C Electric Canada Ltd.

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Setup

Introduction

This instruction sheet explains how to:

- Establish the settings for ungrounded wye capacitor banks (page -6)
- Establish the settings for grounded wye capacitor banks (page -17)
- Establish the settings for ungrounded wye shunt reactors (page -27)
- Set up the control device from the faceplate LCD (page -30)
- Install, start, and use the IntelliLINK software (page -35)
- Specify the setpoint values for this BankGuard PLUS control device (page -39)
- Set up communications for this BankGuard PLUS control device, if applicable (page -51)
- Verify the calculated lockout and alarm levels (page -55)

Applicable Software

This instruction sheet was prepared for use with software UPPD105S or later releases.

You can find the release date on the Setup disk label. For questions regarding the applicability of information in this instruction sheet to future software releases, please contact S&C.

Establishing the Settings - Ungrounded Wye Banks

You must establish the settings for each control device installation, using either graphs or formulas. Both methods are described in this section *for ungrounded wye-connected shunt capacitor banks only*. It also describes how to calculate the gross overvoltage level and when to use unbalance compensation.

Before you begin, you will need on the following information:

- The number of series groups per phase
- The number of capacitor units in parallel per series group
- The highest anticipated continuous system line-to-neutral voltage (in kV)
- The nameplate rating of the capacitor units (in kV)

This section uses the following variable names:

- S = Number of series groups per phase
- P = Number of capacitor units in parallel per series group
- V_{L-n} = Highest anticipated continuous system line-to-neutral voltage
- V_r = Nameplate rating of the capacitor units
- V_o = Voltage applied to surviving capacitor units, per unit of capacitor-unit normal voltage
- V_n = Capacitor bank neutral-to-ground voltage, per unit of line-to-neutral voltage
- F = Number of isolated capacitor units
- F_c = The "critical step" the number of isolated capacitor units at which V_o exceeds the capacitor manufacturer's recommended maximum working voltage (which is generally 1.1 per unit)

Graphical Method

shows the per-unit voltage applied to surviving capacitor units in a series group (V_o) , versus the percentage of capacitor units isolated from the same series group (F/P). shows the per-unit capacitor bank neutral-to-ground voltage (V_n) , versus the percentage of capacitor units isolated from the same series group (F/P).

A. Using , find the V_o for a series of steps corresponding to increasing values of F, up to and including F_c .

•IMPORTANT: If the capacitor units are operating at a voltage other than the rated voltage, multiply these F/P values by V_{L-n}/V_r .

- B. Using , find the V_n for the same series of steps corresponding to increasing values of F, up to and including F_c .
- C. Convert V_n to an actual voltage by multiplying the values found in Step B by V_{L-n} .
- D. Determine the desired lockout level: the midpoint between the V_n (actual voltage) for the critical step F_c and the V_n (actual voltage) for F_{c-1} .



Figure 1 V_o versus F/P (Ungrounded Wye Capacitor Bank)



Figure 2 V_n versus *F/P* (Ungrounded Wye Capacitor Bank)

Graphical Method – Example 1

An installation has the following profile:

- Highest anticipated continuous system line-to-neutral voltage (V_{L-n}) : 20 kV
- Nameplate rating of the capacitor units (V_r) : 9.96 kV
- Number of series groups per phase (*S*): 2
- Number of capacitor units in parallel per series group (*P*): 10

For F = 1, enter at 10 on the horizontal scale (1/10 = 10% of capacitor units isolated from a series group). Follow this up to the curve for S = 2 (2 series groups per phase). Here on the vertical scale, $V_o = 1.072$ per unit.

Similarly, for F = 2, enter the graph at 20 on the horizontal scale (2/10 = 20% of capacitor units isolated from the same series group). Follow this up to the curve for S = 2. Here, $V_o = 1.16$ per unit. Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2.

With $V_{L-n} = 20$ kV and 2 series groups per phase, the capacitor units are normally operated at 10 kV. Therefore:

$$V_o = \frac{1.072 \times 10 \text{kV}}{9.96 \text{kV}} = 1.076 \text{ per unit}$$

For F = 2,

For F = 1,

$$V_o = \frac{1.16 \times 10 \text{kV}}{9.96 \text{kV}} = 1.16 \text{ per unit}$$

For F = 1, enter at 10 on the horizontal scale. Follow this up to the curve for S = 2 (2 series groups per phase). Here, $V_n = 0.018$ per unit.

Similarly, for F = 2, enter the graph at 20 on the horizontal scale. Follow this up to the curve for S = 2. Here, $V_n = 0.038$ per unit.

To convert V_n to an actual voltage, multiply by the system voltage V_{L-n} :

For F = 1, $V_n = 0.018 \times 20000$ volts = 360 volts For F = 2,

 $V_n = 0.038 \times 20000$ volts = 760 volts

To determine the lockout level, calculate the midpoint value between V_n for F = 1 and V_n for F = 2 (= F_c):

 $\frac{360 \text{ volts} + 760 \text{ volts}}{2} = 560 \text{ volts}$

Thus, the desired lockout level for this capacitor bank is 560 volts.

Graphical Method – Example 2

An installation has the following profile:

- Highest anticipated continuous system line-to-neutral voltage (V_{L-n}): 139.44 kV
- Nameplate rating of the capacitor units (V_r) : 19.92 kV
- Number of series groups per phase (*S*): 7
- Number of capacitor units in parallel per series group (*P*): 12

For F = 1, enter at 8.33 on the horizontal scale (1/12 = 8.33% of capacitor units isolated from a series group). Follow this up to a point corresponding to 7 series groups per phase (interpolate between the curves for S = 6 and S = 8). Here on the vertical scale, $V_o = 1.085$ per unit.

Similarly, for F = 2, enter the graph at 16.67 on the horizontal scale (2/12 = 16.67% of capacitor units isolated from the same series group). Follow this up to a point corresponding to 7 series groups per phase. Here, $V_o = 1.18$ per unit. Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2.

With $V_{L-n} = 139.44$ kV and 7 series groups per phase, the capacitor units are normally operated at 19.92 kV, their rated voltage. Therefore, no correction factor is needed.

For F = 1, enter at 8.33 on the horizontal scale. Follow this up to a point corresponding to 7 series groups per phase (interpolate between the curves for S = 6 and S = 8). Here, $V_n = 0.0043$ per unit.

Similarly, for F = 2, enter the graph at 16.67 on the horizontal scale. Follow this up to a point corresponding to 7 series groups per phase. Here, $V_n = 0.0093$ per unit.

To convert V_n to an actual voltage, multiply by the system voltage V_{L-n} :

For F = 1,

 $V_n = 0.0043 \times 139440$ volts = 600 volts

For F = 2,

 $V_n = 0.0093 \times 139440$ volts = 1297 volts

To determine the lockout level, calculate the midpoint value between V_n for F = 1 and V_n for F = 2 (= F_c):

$$\frac{600 \text{ volts} + 1297 \text{ volts}}{2} = 949 \text{ volts}$$

Thus, the desired lockout level for this capacitor bank is 949 volts.

Formula Method

To calculate the lockout level for the capacitor bank:

A. Calculate V_o for a series of steps corresponding to increasing values of F (up to and including F_c) using the following formulas:

$$V_o \text{ (volts)} = \frac{(3P)V_{L-n}}{2F + (3S)(P-F)}$$
$$V_o \text{ (per unit)} = \frac{V_o \text{ (volts)}}{V_r}$$

B. For each value of F used in Step A, calculate V_n :

$$V_n \text{ (volts)} = \frac{(F)V_{L-n}}{2F + (3S)(P-F)}$$

C. Determine the desired lockout level: the midpoint between the V_n (actual voltage) for the critical step F_c and the V_n (actual voltage) for F_{c-1} .

Formula Method – Example 1

An installation has the following profile:

- Highest anticipated continuous system line-to-neutral voltage (V_{L-n}) : 20 kV
- Nameplate rating of the capacitor units (V_r) : 9.96 kV
- Number of series groups per phase (*S*): 2
- Number of capacitor units in parallel per series group (P): 10

For F = 1,

$$V_o$$
 (volts) = $\frac{3 \cdot 10 \cdot 20000}{2(1) + (3 \cdot 2)(10 - 1)}$ = 10714 volts

$$V_o$$
 (per unit) = $\frac{10714}{9960}$ = 1.0757 per unit (or 7.57% overvoltage)

For F = 2,

$$V_o$$
 (volts) = $\frac{3 \cdot 10 \cdot 20000}{2(2) + (3 \cdot 2)(10 - 2)}$ = 11538 volts

$$V_o$$
 (per unit) = $\frac{11538}{9960}$ = 1.1585 per unit (or 15.85% overvoltage)

Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2.

Now calculate V_n :

 V_n (volts) = $\frac{(1) \cdot 20000}{2(1) + (3 \cdot 2)(10 - 1)}$ = 357 volts

For F = 2,

For F = 1,

$$V_n$$
 (volts) = $\frac{(2) \cdot 20000}{2(2) + (3 \cdot 2)(10 - 2)}$ = 769 volts

To determine the lockout level, calculate the midpoint value between V_n for F = 1 and V_n for F = 2 (= F_c):

$$\frac{357 \text{ volts} + 769 \text{ volts}}{2} = 563 \text{ volts}$$

Thus, the desired lockout level for this capacitor bank is 563 volts.

Formula Method – Example 2

An installation has the following profile:

- Highest anticipated continuous system line-to-neutral voltage (V_{L-n}): 139.44 kV
- Nameplate rating of the capacitor units (V_r) : 19.92 kV
- Number of series groups per phase (*S*): 7

• Number of capacitor units in parallel per series group (P): 12 For F = 1,

$$V_o$$
 (volts) = $\frac{3 \cdot 12 \cdot 139440}{2(1) + (3 \cdot 7)(12 - 1)}$ = 21544 volts

$$V_o$$
 (per unit) = $\frac{21544}{19920}$ = 1.0815 per unit (or 8.15% overvoltage)

For F = 2,

$$V_o \text{ (volts)} = \frac{3 \cdot 12 \cdot 139440}{2(2) + (3 \cdot 7)(12 - 2)} = 23457 \text{ volts}$$
$$V_o \text{ (per unit)} = \frac{23457}{19920} = 1.1776 \text{ per unit (or 17.76\% overvoltage)}$$

Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2.

Now calculate V_n :

For F = 1, V_n (volts) $= \frac{(1) \cdot 139440}{2(1) + (3 \cdot 7)(12 - 1)} = 598$ volts

For F = 2,

$$V_n$$
 (volts) = $\frac{(2) \cdot 139440}{2(2) + (3 \cdot 7)(12 - 2)}$ = 1303 volts

To determine the lockout level, calculate the midpoint value between V_n for F = 1 and V_n for F = 2 (= F_c):

$$\frac{598 \text{ volts} + 1303 \text{ volts}}{2} = 951 \text{ volts}$$

Thus, the desired lockout level for this capacitor bank is 951 volts.

Gross Overvoltage

You can calculate the capacitor bank neutral-to-ground voltage (V_n) resulting from a fault within the capacitor bank that would short out an entire series group:

$$V_n = \left[\frac{1}{3S-2}\right] V_{L-n}$$

The desired gross overvoltage lockout level is the midpoint between the V_n for the critical step and the V_n resulting from shorting out a series group.

For Example 1 above, the V_n for the critical step ($F_c = 2$) was 769 volts. The V_n resulting from shorting out a series group is:

$$V_n = \left[\frac{1}{3(2) - 2}\right] 20000 \text{ volts} = 5000 \text{ volts}$$

Therefore, the desired gross overvoltage lockout level is:

$$\frac{769 \text{ volts} + 5000 \text{ volts}}{2} = 2885 \text{ volts}$$

For Example 2 above, the V_n for the critical step ($F_c = 2$) was 1303 volts. The V_n resulting from shorting out a series group is:

$$V_n = \left[\frac{1}{3(7) - 2}\right] 139440$$
 volts = 7339 volts

Therefore, the desired gross overvoltage lockout level is:

$$\frac{1303 \text{ volts} + 7339 \text{ volts}}{2} = 4321 \text{ volts}$$

♦NOTE: If the calculated gross overvoltage lockout level is more than 65,536 volts, set the setpoint value to its maximum level.

Unbalance Compensation

A certain amount of error voltage is always present between the capacitor bank neutral and ground. This voltage comes from system voltage imbalances and/or inherent capacitor bank imbalances (from manufacturing tolerance variations among capacitor units in the bank). Because it is impossible to predict how these error voltages will combine vectorially, it is important that the magnitude of the error voltage remain low compared to the magnitude of the bank neutral-to-ground voltage resulting from isolation of one capacitor unit.

For example, the error voltage may be additive with respect to the neutral-to-ground voltage resulting from isolation of capacitor in one phase leg, but subtractive with respect to the neutral-to-ground voltage resulting from isolation of capacitor units in another leg.

In general, you should use the unbalance compensation feature if the magnitude of the error voltage approaches 50% of the value of the neutral-to-ground voltage calculated for one isolated capacitor unit.

If the capacitor bank manufacturer can supply an estimate of the per-unit imbalances between phases, and if you know the per-unit system voltage imbalances between phases, you can calculate an estimate of the error voltage:

Error Voltage
from Capacitor Bank =
$$\frac{\begin{pmatrix} \text{Per-unit} \\ \text{Capacitor Bank} \\ \text{Imbalance} \end{pmatrix} \begin{pmatrix} \text{System} \\ \text{Line-to-Neutral} \\ \text{Voltage} \end{pmatrix}}{3}$$

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Example 1

Assume a per-unit capacitor bank imbalance of 0.01 and a per-unit system voltage imbalance of 0.005.

Error Voltage from Capacitor Bank = $\frac{(0.01)(20000 \text{ volts})}{3} = 66.7 \text{ volts}$ Imbalance

Error Voltage from System Voltage = $\frac{(0.005)(20000 \text{ volts})}{3}$ = 33.3 volts Imbalance

If these error voltages are additive, the total error voltage could be as high as 100 volts - 28% of the neutral-to-ground voltage resulting from the isolation of one capacitor unit (357 volts in this example). Therefore, you do not need to use unbalance compensation (and the required additional potential devices) unless field experience indicates otherwise.

Example 2

Assume a per-unit capacitor bank imbalance of 0.01 and a per-unit system voltage imbalance of 0.005.

Error Voltage from Capacitor Bank = $\frac{(0.01)(139440 \text{ volts})}{3} = 464.8 \text{ volts}$ Imbalance Error Voltage from System Voltage = $\frac{(0.005)(139440 \text{ volts})}{3} = 232.4 \text{ volts}$ Imbalance

If these error voltages are additive, the total error voltage could be as high as 697.2 volts. This *does* require unbalance compensation, since the neutral-to-ground voltage resulting from the isolation of one capacitor unit in this example is 598 volts.

Field determine of need for Unbalance Compensation.

Close the capacitor bank switching device to energize the capacitor bank.

Verify that no capacitor units have been isolated from the capacitor bank (check for blown fuses).

The LCD should display a voltage that is essentially zero, or at most 50% of the capacitor bank neutral-to-ground voltage calculated to result from the isolation of one capacitor unit. If the voltage reading exceeds the 50% guideline, it will be necessary to either increase the alarm level setting or to utilize the optional Unbalance Compensation feature.

Coordinating Bank Lockout and Individual Capacitor Unit Fuses

It is important to coordinate capacitor bank isolation and lockout with the individual capacitor unit fuses. The control device should not lock out before the fuse of the last-failing capacitor unit has had sufficient time to operate. If the fuse does not operate, there will be no indication of which capacitor unit was in the process of failing.

In general, bank lockout and the individual capacitor unit fuses will be coordinated if all of the following are true:

- The lockout and alarm levels are set as described above (graphical method or formula method.
- The lockout delay time is adequate.
- The individual capacitor unit fuses use a fusing ration of 1.25 or less.

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

For example, if the capacitor-bank switching device is a 230-kV S&C Circuit-Switcher, the minimum gross overvoltage circuit time delay setting should be 0.5 seconds plus 0.6 seconds, or 1.1 seconds total. The elapse 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.

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

Establishing the Settings - Grounded Wye Banks

You must establish the settings for each control device installation, using either graphs or formulas. Both methods are described in this section *for grounded wye-connected shunt capacitor banks only*. It also describes how to calculate the gross overvoltage and alarm levels, and how to coordinate capacitor bank isolation with the individual capacitor unit fuses.

Both the graphical and formula methods assume that the intermediate tap point for each phase of the bank is located as follows:

- For capacitor banks with an even number of series groups per phase, the number of series groups between the tap point and ground should equal the number of series groups between the tap point and the line.
- For capacitor banks with an odd number of series groups per phase, the number of series groups between the tap point and ground should be one less than the number of series groups between the tap point and the line.

Before you begin, you will need on the following information:

- The number of series groups per phase
- The number of capacitor units in parallel per series group
- The highest anticipated continuous system line-to-neutral voltage (in kV)
- The nameplate rating of the capacitor units (in kV)

This section uses the following variable names:

- S = Number of series groups per phase
- P = Number of capacitor units in parallel per series group
- V_{L-n} = Highest anticipated continuous system line-to-neutral voltage
- V_{L-g} = Highest anticipated continuous system line-to-ground voltage
- V_r = Nameplate rating of the capacitor units
- V_o = Voltage applied to surviving capacitor units, per unit of capacitor-unit normal voltage
- U_{tp} = Tap-point voltage percent imbalance
- F = Number of isolated capacitor units
- F_c = The "critical step" the number of isolated capacitor units at which V_o exceeds the capacitor manufacturer's recommended maximum working voltage (which is generally 1.1 per unit)

•IMPORTANT: The values of U_{tp} that you find in this section (whether using the graphs or the formulas) are valid for the isolation of capacitor units in any series group of a

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capacitor bank with an *even* number of series groups per phase. When the total number of series groups per phase is *odd*, the values of U_{tp} are also valid for the isolation of capacitor units in any series located *between the tap point and the line*.

When the total number of series groups per phase is *odd*, and the capacitor unit is located *between the tap point and ground*, you must multiply U_{tp} by the following adjustment factor:

Adjustment factor = $\frac{S+1}{S-1}$

Graphical Method

shows the per-unit voltage applied to surviving capacitor units in a series group (V_o) , versus the percentage of capacitor units isolated from the same series group (F/P). shows the tap-point voltage percent imbalance (U_{tp}) , versus the percentage of capacitor units isolated from the same series group (F/P).

A. Using , find the V_o for a series of steps corresponding to increasing values of F, up to and including F_c .

•IMPORTANT: If the capacitor units are operating at a voltage other than the rated voltage, multiply these F/P values by V_{L-n}/V_r .

- B. Using , find the U_{tp} for the same series of steps corresponding to increasing values of F, up to and including F_c .
- C. Determine the desired lockout level: the midpoint between the U_{tp} for the critical step F_c and the U_{tp} for F_{c-1} . (For capacitor banks with an odd number of series groups per phase, compute alternate values of U_{tp} using the adjustment factor, then choose a lockout level that provides the best overall response.)



V_o versus F/P (Grounded Wye Capacitor Bank)

Graphical Method – Example 1

An installation has the following profile:

- Highest anticipated continuous system line-to-neutral voltage (V_{L-n}) : 20 kV
- Nameplate rating of the capacitor units (V_r) : 9.96 kV
- Number of series groups per phase (*S*): 2
- Number of capacitor units in parallel per series group (*P*): 10

For F = 1, enter at 10 on the horizontal scale (1/10 = 10% of capacitor units isolated from a series group). Follow this up to the curve for S = 2 (2 series groups per phase). Here on the vertical scale, $V_o = 1.053$ per unit.

Similarly, for F = 2, enter the graph at 20 on the horizontal scale (2/10 = 20% of capacitor units isolated from the same series group). Follow this up to the curve for S = 2. Here, $V_o = 1.11$ per unit. Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2.



Figure 4 U_{tp} versus *F/P* (Grounded Wye Capacitor Bank)

With $V_{L-n} = 20$ kV and 2 series groups per phase, the capacitor units are normally operated at 10 kV. Therefore:

For F = 1,

$$V_o = \frac{1.053 \times 10 \text{kV}}{9.96 \text{kV}} = 1.057 \text{ per unit}$$

For F = 2,

$$V_o = \frac{1.11 \times 10 \text{kV}}{9.96 \text{kV}} = 1.114 \text{ per unit}$$

For F = 1, enter at 10 on the horizontal scale. Follow this up to the curve for S = 2 (2 series groups per phase). Here, $U_{tp} = 5.2\%$.

Similarly, for F = 2, enter the graph at 20 on the horizontal scale. Follow this up to the curve for S = 2. Here, $U_{tp} = 11\%$.

To determine the lockout level, calculate the midpoint value between U_{tp} for F = 1 and U_{tp} for F = 2 (= F_c):

$$\frac{5.2\% + 11\%}{2} = 8.1\%$$

Thus, the desired lockout level for this capacitor bank is 8.1%.

Graphical Method – Example 2

An installation has the following profile:

- Highest anticipated continuous system line-to-neutral voltage (V_{L-n}): 139.44 kV
- Nameplate rating of the capacitor units (V_r) : 19.92 kV
- Number of series groups per phase (*S*): 7
- Number of capacitor units in parallel per series group (*P*): 12

For F = 1, enter at 8.33 on the horizontal scale (1/12 = 8.33% of capacitor units isolated from a series group). Follow this up to a point corresponding to 7 series groups per phase (interpolate between the curves for S = 6 and S = 8). Here on the vertical scale, $V_o = 1.076$ per unit.

Similarly, for F = 2, enter the graph at 16.67 on the horizontal scale (2/12 = 16.67% of capacitor units isolated from the same series group). Follow this up to a point corresponding to 7 series groups per phase. Here, $V_o = 1.17$ per unit. Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2.

With $V_{L-n} = 139.44$ kV and 7 series groups per phase, the capacitor units are normally operated at 19.92 kV, their rated voltage. Therefore, no correction factor is needed.

For F = 1, enter at 8.33 on the horizontal scale. Follow this up to a point corresponding to 7 series groups per phase (interpolate between the curves for S = 6 and S = 8). Here, $U_{tp} = 1.3\%$.

Similarly, for F = 2, enter the graph at 16.67 on the horizontal scale. Follow this up to a point corresponding to 7 series groups per phase. Here, $U_{tp} = 2.8\%$.

Because the number of series groups per phase in this example is odd, you must compute alternate values of U_{tp} using the adjustment factor for isolation of capacitor units in a series group between the tap point and ground. In this example, the adjustment factor is (7 + 1)/(7 - 1) = 1.33.

For F = 1, $U_{tn} = 1.3\% \times 1.33 = 1.7\%$ For F = 2,

$$U_{tn} = 2.8\% \times 1.33 = 3.7\%$$

In this example, the desired tap-point voltage imbalance lockout level is the midpoint between the *higher* value of U_{tp} for F = 1 and the *lower* value of U_{tp} for F = 2 (= F_c):

$$\frac{1.7\% + 2.8\%}{2} = 2.25\%$$

Thus, the desired lockout level for this capacitor bank is 2.25%.

Formula Method

To calculate the lockout level for the capacitor bank:

A. Calculate V_o for a series of steps corresponding to increasing values of F (up to and including F_c) using the following formulas:

$$V_o \text{ (volts)} = \frac{P(V_{L-g})}{S(P-F) + F}$$
$$V_o \text{ (per unit)} = \frac{V_o \text{ (volts)}}{V_r}$$

B. For each value of F used in Step A, calculate U_{tp} :

$$U_{tp} \text{ (volts)} = \frac{100F}{S(P-F)+F}$$

C. Determine the desired lockout level: the midpoint between the U_{tp} for the critical step F_c and the U_{tp} for F_{c-1} . (For capacitor banks with an odd number of series groups per phase, compute alternate values of U_{tp} using the adjustment factor, then choose a lockout level that provides the best overall response.)

Formula Method – Example 1

An installation has the following profile:

- Highest anticipated continuous system line-to-ground voltage (V_{L-g}) : 20 kV
- Nameplate rating of the capacitor units (V_r) : 9.96 kV
- Number of series groups per phase (*S*): 2
- Number of capacitor units in parallel per series group (*P*): 10

For F = 1,

$$V_o \text{ (volts)} = \frac{10 \cdot 20000}{2(10 - 1) + 1} = 10526 \text{ volts}$$
$$V_o \text{ (per unit)} = \frac{10526}{9960} = 1.0568 \text{ per unit (or 5.68\% overvoltage)}$$

For F = 2,

$$V_o$$
 (volts) = $\frac{10 \cdot 20000}{2(10-2)+2}$ = 11111 volts

$$V_o$$
 (per unit) = $\frac{11111}{9960}$ = 1.1156 per unit (or 11.56% overvoltage)

Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2. Now calculate U_{tp} :

For F = 1,

$$U_{tp} = \frac{100 \cdot 1}{2(10 - 1) + 1} = 5.26\%$$

For F = 2,

$$U_{tp} = \frac{100 \cdot 2}{2(10 - 2) + 2} = 11.11\%$$

To determine the lockout level, calculate the midpoint value between U_{tp} for F = 1 and U_{tp} for F = 2 (= F_c):

$$\frac{5.26\% + 11.11\%}{2} = 8.19\%$$

Thus, the desired lockout level for this capacitor bank is 8.19%.

Formula Method – Example 2

An installation has the following profile:

- Highest anticipated continuous system line-to-ground voltage (V_{L-g}): 139.44 kV
- Nameplate rating of the capacitor units (V_r) : 19.92 kV
- Number of series groups per phase (*S*): 7
- Number of capacitor units in parallel per series group (*P*): 12

For F = 1,

$$V_o$$
 (volts) = $\frac{12 \cdot 139440}{7(12 - 1) + 1}$ = 21452 volts
 V_o (per unit) = $\frac{21452}{19920}$ = 1.0769 per unit (or 7.69% overvoltage)

For F = 2,

$$V_o$$
 (volts) = $\frac{12 \cdot 139440}{7(12-2)+2}$ = 23240 volts

$$V_o$$
 (per unit) = $\frac{23240}{19920}$ = 1.1667 per unit (or 16.67% overvoltage)

Because we are looking for a V_o of 1.1 or less per unit, our F_c in this example is 2. Now calculate U_{tp} :

For F = 1,

$$U_{tp} = \frac{100 \cdot 1}{7(12 - 1) + 1} = 1.28\%$$

For F = 2,

$$U_{tp} = \frac{100 \cdot 2}{7(12 - 2) + 2} = 2.78\%$$

Because the number of series groups per phase in this example is odd, you must compute alternate values of U_{tp} using the adjustment factor for isolation of capacitor units in a series group between the tap point and ground. In this example, the adjustment factor is (7 + 1)/(7 - 1) = 1.33.

For F = 1,

$$U_{tp} = 1.28\% \times 1.33 = 1.70\%$$

For F = 2,

$$U_{tn} = 2.78\% \times 1.33 = 3.70\%$$

In this example, the desired tap-point voltage imbalance lockout level is the midpoint between the *higher* value of U_{tp} for F = 1 and the *lower* value of U_{tp} for F = 2 (= F_c):

$$\frac{1.70\% + 2.78\%}{2} = 2.24\%$$

Thus, the desired lockout level for this capacitor bank is 2.24%.

Gross Overvoltage

You can calculate the tap-point voltage percent imbalance (U_{tp}) resulting from a fault within the capacitor bank that would short out an entire series group:

$$U_{tp} = \frac{100}{S-1}$$

The desired gross overvoltage lockout level is the midpoint between the V_n for the critical step and the V_n resulting from shorting out a series group.

♦NOTE: If the calculated gross overvoltage lockout level is more than 65,536 volts, set the setpoint value to its maximum level.

For Example 1 above, the U_{tp} for the critical step ($F_c = 2$) was 11.11%. The U_{tp} resulting from shorting out a series group is:

$$U_{tp} = \frac{100}{2-1} = 100\%$$

Therefore, the desired gross overvoltage lockout level is:

$$\frac{11.11\% + 100\%}{2} = 55.56\%$$

For Example 2 above, the U_{tp} for the critical step ($F_c = 2$) was 3.70%. The U_{tp} resulting from shorting out a series group is:

$$U_{tp} = \frac{100}{7-1} = 16.67\%$$

Therefore, the desired gross overvoltage lockout level is:

$$\frac{3.70\% + 16.67\%}{2} = 10.19\%$$

Alarm Level

The alarm lets you choose a voltage level below lockout. When an alarm becomes active, you can choose whether to continue operating the bank (deferring replacement of the failed unit until a convenient time) or to replace the failed unit sooner (minimizing the time that the surviving capacitor units are exposed to overvoltage and thus reducing the likelihood that marginal units will fail prematurely).

You should set the alarm level to approximately half of the value of the tap-point voltage percent imbalance resulting from the isolation of one capacitor unit (U_{tp}) ; if the number of series groups is odd, set the value to half of the lower U_{tp} .

For Formula Method – Example 1 on page -22, the alarm setting would be:

$$\frac{5.26\%}{2} = 2.63\%$$

For *Formula Method – Example 2* on page -23, the alarm setting would be:

$$\frac{1.28\%}{2} = 0.64\%$$

Coordinating Bank Lockout and Individual Capacitor Unit Fuses

It is important to coordinate capacitor bank isolation and lockout with the individual capacitor unit fuses. The control device should not lock out before the fuse of the last-failing capacitor unit has had sufficient time to operate. If the fuse does not operate, there will be no indication of which capacitor unit was in the process of failing.

In general, bank lockout and the individual capacitor unit fuses will be coordinated if all of the following are true:

- The lockout and alarm levels are set as described above (graphical method or formula method).
- The lockout delay time is adequate.
- The individual capacitor unit fuses use a fusing ratio of 1.25 or less.

Establishing the Settings - Ungrounded Wye Shunt Reactors

You must establish the settings for each control device installation. The method described in this section is *for ungrounded wye-connected shunt reactors only*. It also describes how to calculate the gross overvoltage level and when to use unbalance compensation.

Before you begin, you will need on the following information:

- The highest anticipated continuous system line-to-neutral voltage (in volts)
- The estimated inherent system voltage imbalance, expressed as the maximum perunit system line-to-neutral voltage variation of any one phase from the average of the line-to-neutral voltages of the three phases (typically less than 0.01 per unit)
- The anticipated inherent reactor imbalance, expressed as the maximum per-unit reactance variation (due to manufacturing tolerance) of any one phase from the average of the reactances of the three phases

This section uses the following variable names:

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

 ΔV_{L-n} = Estimated inherent system voltage imbalance

 ΔX = Anticipated inherent reactor imbalance

 V_n = Reactor neutral-to-ground voltage

To calculate the lockout level for the reactor:

A. Calculate the V_n due to inherent source voltage imbalance and inherent reactor imbalance:

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

B. To determine the desired lockout level, multiply V_n by 2.

Formula Method – Example 1

An installation has the following profile:

- Highest anticipated continuous system line-to-neutral voltage (V_{L-n}) : 7200 volts
- Estimated inherent system voltage imbalance (ΔV_{L-n}) : 0.01
- Anticipated inherent system voltage imbalance (ΔX): 0.015

Calculate V_n :

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

Thus, the lockout level is 2 (60 volts) = 120 volts.

Gross Overvoltage

You can calculate the reactor neutral-to-ground voltage (V_n) resulting from a fault which would open an entire phase winding:

$$V_n = \frac{1}{2} V_{L-n}$$

♦NOTE: If the calculated gross overvoltage lockout level is more than 5000 volts, set the detector to its maximum level.

In the example above, the V_n was 120 volts. The V_n resulting from a fault which would open an entire phase winding is:

$$V_n = \frac{1}{2}(7200)$$
 volts = 3600 volts

Therefore, the desired gross overvoltage lockout level is:

$$\frac{3600 \text{ volts} + 120 \text{ volts}}{2} = 1860 \text{ volts}$$

Should the calculated gross over voltage lockout level exceed 9,999 volts, the setpoint should be set at its maximum value.

Set the "Gross Overvoltage Time Delay" to a minimum of 0.5 second, plus the elapsed time between the energizing of the opening circuit of the reactor switching device and the opening of the switching device "a" contact.

For example, if the reactor switching device is a 230kV S&C Circuit-Switcher, the minimum "Gross Overvoltage Time Delay" is 0.5 second plus 0.6 second, or 1.1 seconds total. You can estimate the elapsed time between the energizing of the opening circuit and the mechanical parting of the disconnect blades as 40% of the maximum operating time for the particular S&C Circuit-Switcher in use.

Unbalance Compensation

A certain amount of error voltage is always present between the reactor neutral and ground. This voltage comes from system voltage imbalances and/or inherent reactor imbalances (from manufacturing tolerance variations among the phase windings of the

reactor). Because it is impossible to predict how these error voltages will combine vectorially, it is important that the magnitude of the error voltage remain low compared to the magnitude of the reactor neutral-to-ground voltage level for which automatic switching is desired.

For example, the error voltage may be additive with respect to the reactor neutral-toground 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.

In general, you should use the unbalance compensation feature if the magnitude of the error voltage exceeds 50% of the desired lockout level.

In the installation example above, the lockout level is 120 volts. If the reactor neutral-toground voltage exceeds 60 volts under normal operating conditions, you must either use the unbalance compensation feature or reduce/eliminate the source of the voltage imbalance.

Field determine of need for Unbalance Compensation.

Close the reactor switching device to energize the reactor.

The LCD should display essentially a zero voltage, or at most 50% of the lockout-level setting. If the displayed voltage is greater than 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 feature.

Using the LCD to Setup the Control Device

The BankGuard PLUS Automatic Control Device includes a 2-line LCD that gives you access to information about the control device and the capacitor bank/reactor. Table 1 gives you an overview of all of the faceplate buttons used to set up the control device from the LCD.

When the LCD reads **[N-G Voltage]**, the control device is in display mode. This mode lets you view the real-time neutral-to-ground voltage and, using the shortcut buttons, the present setpoint values.

If you press the **NEXT** button while the LCD reads **[N-G Voltage]**, you enter setup mode, which lets you change setpoint values from the faceplate.

◆NOTE: If you enter setup mode and password protection is enabled, the top line of the LCD reads **[SETUP]** and the bottom line reads **[Password 0000]**, with the first digit blinking. Use the + and – buttons to enter the correct number for the first digit, then press **ENTER**. Repeat for each digit of the password. When you have entered the entire password, the display stops blinking and the LCD is in setup mode. If you have entered an invalid password, the bottom line reads **[Invalid]**. Press the ESC button and then the NEXT button, to retry entering the password.

If you press **NEXT** without entering a valid password, the LCD will display the setpoints, but you cannot change them.

To enter a new password or to disable the password see "Password Selection" on page 45.

<u>Button</u>	Description
NEXT	Press this button to enter setup mode or to move to the next setpoint.
PREV	Press this button to move to the previous setpoint. If you press it while unbalance compensation is showing, the LCD returns to dis- play mode.
ENTER	<i>When the control device is in display mode,</i> press this button to test the faceplate LEDs (all LEDs turn ON for 2 seconds).
	When the control device is in setup mode, press this button to enable the changing of a setpoint value. The value shown on the LCD will blink to indicate that you can change it with the $+$ or $-$ button.
+	In setup mode, press this button after pressing the ENTER button to increase a setpoint value.
_	In setup mode, press this button after pressing the ENTER button to decrease a setpoint value.
ESC	When the control device is in display mode and the display is blinking, press this button to cancel a setpoint change. The LCD then shows the original, unchanged value. If the display is not blinking, pressing this button returns the LCD to [N-G Voltage].
UNBALANCE COMPENSA- TION	When the control device is in display mode, press this button to display the unbalance compensation value presently in use by the control device. Press this button a second time to calculate and display a new value for unbalance compensation. This value is for information only. You can change the unbalance compensation value only in the Setup Mode. (See .) When the control device is in setup mode and the LCD reads [UBC in use], press this button to calculate a new unbalance compensation value. Press it again to accept the new value, or press
	ESC to cancel the change. Installation type and unbalance compensation setpoints must be set to their proper values before changing the value.
LOCKOUT LEVEL	Press this button to scroll through the lockout setpoints, compare the "Lockout Level" setpoint to the neutral-to-ground voltage, and compare the "Gross Overvoltage Level" setpoint to the neutral-to-ground voltage. (See .)

<u>Button</u>	Description
ALARM LEVEL	Press this button to scroll through the alarm setpoints, compare the "Alarm Level" setpoint to the neutral-to-ground voltage, and compare the "Gross Overvoltage Level" setpoint to the neutral-to-ground voltage. (See .)

Table 1 Faceplate Buttons

Display Mode "Shortcut" Buttons

When line 1 of the LCD displays "N-G Voltage" the control is in the display mode. If you press one of the faceplate "shortcut" buttons in display mode – UNBALANCE COMPENSATION, LOCKOUT LEVEL, or ALARM LEVEL – you can view the setpoints for that feature. Press the button again to move to the next setpoint in that category. See Table 2.

Example – You want to view the lockout time delay set in a control device. Press the **LOCKOUT LEVEL** button once to display the "Lockout Level" setpoint. To display the "Lockout Time Delay" setpoint, press the **LOCKOUT LEVEL** button again. Press **ESC** to return to **[N-G Voltage]** on the LCD.

UNBALANCE COMPENSATION Button	LOCKOUT LEVEL Button	ALARM LEVEL Button
Unbalance compensation value in use	"Lockout Level" setpoint	"Alarm Level" setpoint
A new calculated unbalance compensation value	"Lockout Time Delay" setpoint	"Alarm Time Delay" setpoint
	Comparison between the "Lockout Level" setpoint and the neutral-to-ground/ unbalance voltage	Comparison between the "Alarm Level" setpoint and the neutral-to-ground/ unbalance voltage
	Comparison between the "Gross Overvoltage Level" setpoint and the neutral-to- ground/unbalance voltage	Comparison between the "Gross Overvoltage Level" setpoint and the neutral-to- ground/unbalance voltage

 Table 2

 Setpoints Available from Faceplate "Shortcut" Buttons

LCD Setup Mode

Once you are in setup mode, you can change setpoint values from the faceplate. shows the names and order of setpoints and real-time data displayed on the LCD. To move to the next item on the list, press the **NEXT** button. To move to the previous item on the list, press the **PREV** button.

To change a setpoint value, press **ENTER** when it is displayed. The value shown on the LCD will blink to indicate that you can change it. Use the + and – buttons to enter the desired value. Press **ENTER** to accept the new value or **ESC** to cancel.

◆NOTE: If you press **ESC** when a value is not blinking, the LCD returns to display mode and reads **[N-G Voltage]**.

LCD	Description		
[N-G Voltage]	Present neutral-to-ground voltage		
[Password]	Password, if required		
[UBC In Use]	Unbalance compensation value in use		
[Lckout Lvl]	"Lockout Level" setpoint		
[Lockout Delay]	"Lockout Time Delay" setpoint		
[Alarm Level]	"Alarm Level" setpoint		
[Alarm Delay]	"Alarm Time Delay" setpoint		
[Gross OvrV Level]	"Gross Overvoltage Level" setpoint		
Gross Ovr Delay] "Gross Overvoltage Time Delay" setpoint			
[N-G/L. Ref. Ratio]	"Neutral-to-Ground Ratio" setpoint		
[Ph/TapPt-N Ratio =]	"Phase/Tap-Point-to-Neutral Ratio" setpoint		
[InstallType]	"Installation Type" setpoint		
[Unbal. Comp.]	"Unbalance Compensation" setpoint		
[Aux Contact]	"Auxiliary Contact" setpoint		
[Output Contact Mode =]	"Output Contact Pulse Time" setpoint		
[Alarm Config]	"Alarm Contacts Configuration" setpoint		
[Nominal Freq.]	"Nominal Operating Frequency" setpoint		
[Primary kV]	"Rated Primary Phase Voltage" setpoint		
[Convert UP to %]	"Convert Setpoint Voltages to Percent" setpoint		
[Close Timer]	"Reclose Analog Processing Delay" setpoint		

Table 3 Faceplate abbreviations on the LCD

IntelliLINK Software

This section provides an introduction to the IntelliLINK software and how to install and use it on your computer.

IntelliLINK Hardware & Software Requirements

Before you can use the IntelliLINK software to set up the control device, you must have the following:

- *Portable IBM/PC-compatible Computer* The computer must be transportable to the installation site and must include:
 - Microsoft Windows 95/98/2000 or Windows NT
 - Microsoft Internet Explorer, version 5.0 or higher
 - 32 MB of RAM
 - A serial communications port
 - A 3.5" high-density disk drive (If you do not have a 3.5" drive, contact S&C for other options.)
- *RS232 Serial Communications Cable* This cable must have a DB9-pin plug connector at one end (to plug into the local communications port on the control device) and a connector at the other end which fits the serial port on your computer. The cable should be long enough to reach comfortably from the control device to your computer after the control device is installed at the site. It must be a "straight-through" cable, NOT a null-modem cable.
- *Setup Disks* Two S&C Setup disks are provided with the BankGuard PLUS control device.

◆IMPORTANT: S&C ships several types of software-controlled products. Make sure you have the correct software disks for this control device.

Install the IntelliLINK Software

To install the IntelliLINK software:

- A. If necessary, turn on your computer and start Windows.
- B. Insert Setup Disk 1 for this control device into the floppy disk drive.
- C. On the Windows Start menu, choose Run.

The Run dialog box appears.

D. Type the letter of the drive in which you put the disk, followed by SETUP (for example, A:\SETUP), then click OK.

The Installer will guide you through the software installation process.

E. When installation is complete, you can turn off your computer or go directly to the following section, *To Start the IntelliLINK Software*, and begin using the software.

To Start the IntelliLINK Software

The steps below explain how to start the IntelliLINK software when you want to work with the setpoints or stored data in the BankGuard PLUS control device. If you want to edit a snapshot (virtual memory file) or simply view the software without data, see *Using Snapshots (VM Files)* in the *Operations* Instruction Sheet 1011-540.

If you use a 2-wire, ungrounded extension cord to power either your computer OR the control device while they are connected, you may damage the serial port on your computer. ALWAYS use a grounded, 3-wire extension cord or battery power.

1. Connect your computer to the control device.

Plug one end of the communications cable into the serial port on your computer. Then attach the other end to the local communications port on the control device.

2. Double-click the IntelliLINK icon in the open EnergyLine folder on the Windows desktop.

If the EnergyLine folder is not open, open the Windows Start menu, the click Start > Programs > EnergyLine > IntelliLink to start the software.

3. Wait while the IntelliLINK title box appears and the IntelliLINK software attempts to open communications with the control device.

When the IntelliLINK software establishes communications with the control device, the *Operation* screen (Figure 5) opens. You can now set up the software in the control device, view and save the "live" data that is in the control device, load settings into the control device, and perform maintenance and troubleshooting.

S&C IntelliLINK® Setup Software - [Ope File Connection Data Tools Window I	ration] Help				
<u>S</u> etup O	peration	eration <u>P</u> roduct Info <u>C</u> omm			
c /			2000		Model Number
S&C BankGuard PI US [™]					asdfgh
					Control Software Revision
					UPPD105S
UNBALANCE LOCKOUT LOCKOUT ALARM ALARM					Serial Number
					12345678
SET READ	RESI	ET) READ	RESET		Bank State
					N.A.
Installation Type		N-G / Unbalan	ice Voltage	Unbal	ance Compensation In Use
Ungnd Wye Cap		5 N	I-G		Disabled
Lockout Level		Alarm L	evel	G	ross Overvoltage Level
0 volts		0 volts			2500 volts
Lockout Time Delay	<u>}</u> }	Alarm Time	e Delay	Gros	ss Overvoltage Time Delay
10.0		10.0			2.0
Unbalance Compensation	Auxi	liary Contact	Neutral-to-Ground Ratio		Nominal Operation Frequency
Disabled	C	Disabled	111 :1		60.0 Hz
Alarm Contacts Configuration	Output Co	ontact Pulse Time	Phase/Tap-Point-to-N	eutral Ratio	Password
Separate Contacts		Latched	120 :1		Disabled
Location		112850			
		Spanshokunods VM	16:19 Refrech: Opro	Lindates	416:19:25

Figure 5 Operation Screen for the BankGuard PLUS IntelliLINK Software

◆NOTE: If the IntelliLINK software does NOT establish communications with a functioning control device, it displays the following dialog box.



If this dialog box appears, or if the *Operation* screen opens but the software does not operate properly, see *Software Troubleshooting and Error Messages* in the *Troubleshooting* Instruction Sheet 1011-550.

About the IntelliLINK Screens

The IntelliLINK software includes a series of screens and dialog boxes which enable you to set up the control device for proper operation, view data, and troubleshoot control device problems.

To access the top level screens, click the corresponding button in any IntelliLINK screen. To jump to any screen directly, click Window > Show Tree, then double-click the name of the screen you want to view. (If necessary, first click the "+" to reveal the names of lower level screens.)

♦NOTE: The exact appearance and content of the IntelliLINK screens depend on which version of the software is installed. The screen arrangements shown below apply to all IntelliLINK versions for the BankGuard PLUS control devices (except where noted).

To Change Data Values on IntelliLINK Screens

To add or change a value on a setup screen (for example, the *Setup* screen shown in Figure 6 on page 40):

- Move the mouse cursor onto the value you want to change. When the cursor changes to a double-arrow, click the left mouse button to open a Change Value dialog box.
- If the dialog box accepts typed input, use the keyboard keys to enter the new value. If the dialog box does not accept typed input, click the Up or Down arrow to change the value, or click the radio button for the correct value.
- Click OK to record the new value (or click Cancel to leave the dialog box without changing the value).
- Repeat this process for each value you want to add or change.
- To view Help text for all the fields on the screen, press <F1>.

IntelliLINK Software Menu Tree (BankGuard PLUS – standard version)

Operation

Setup (2 pages)

Product Information

Communications

- Communications Setup [2 pages]
- Communications Troubleshooting [DNP version]

Unbalance Setup

Control Device Setup

To set up the control device for normal operations, you must:

- 1. Connect your portable computer to the control device and start the IntelliLINK software as described in *To Start the IntelliLINK Software* on page -36.
- 2. Enter the setup parameters for this particular control device as described in *Enter Setup Information*, which begins on page -40.
- 3. Disconnect your computer from the control device.
- 4. Use the faceplate buttons to set the desired operating mode, as described in *Enable Normal Control Device Operation* on page -58.

The values you enter on the setup screens depend on your electrical distribution system and details specific to each individual capacitor bank.

A WARNING

These instructions do NOT replace the need for utility operation standards. Any conflict between the information in this document and utility practices should be reviewed by appropriate utility personnel and a decision made as to the correct procedures to follow.

Serious risk of personal injury or death may result from contact with electric distribution equipment when electrical isolation and grounding procedures are not followed. The equipment described in this document must be operated and maintained by qualified persons who are thoroughly trained and understand any hazards that may be involved. This document is written only for such qualified persons and is not a substitute for adequate training and experience in safety procedures for accessing high voltage equipment.

The control device is connected to electrical devices operating at primary voltage levels. High voltage may be present in the wiring to the control device or the control device itself during certain failures of the capacitor bank wiring or grounding system, or due to a failure of the capacitor bank itself. For this reason, access to the control device should be treated with the same safety precautions as would be applied when accessing other high voltage lines and equipment. Follow all locally-approved safety procedures when working on or around this control device.

Before attempting to access an existing installation, check carefully for visible or audible signs of electrical or physical malfunction (do this *before* touching or operating the control device or any other part of the installation). These warning signs include such things as smoke, fire, open fuses, crackling noises, loud buzzing, etc. If a malfunction is suspected, treat all components of the installation, including the control device and associated mounting hardware, as if they were elevated to primary (high) voltage.

Enter Setup Information

Once communication is established between the IntelliLINK software and the control device, the *Operation* screen opens. You can now enter the setup information for this control device. There are two ways to do this:

- Follow the steps in this section to enter all the required values for this control device, beginning at Step 1 below.
- Load the contents of a CFG file (which was saved from a snapshot or another control device) into this control device, then make any adjustments that are needed for this control device. (For details, see *Load a Saved Configuration into a Control Device* in the *Operations* Instruction Sheet 1011-540.)
- At the IntelliLINK Operation screen, click the Setup button to display the Setup screen (Figure 6). Enter all required information (as described below). Go to the next step

peration	Setup	Product Info	Co <u>m</u> m				
			Setup		(Page 1 of 2)		
[Present		Factory		
	Installation T	уре	Ungnd W	lye Cap	Ungnd Wye Cap		
	Unbalance C	ompensation	Disabled		Disabled		
	Lockout Lev	el	0 volts		0 (Disabled)	0 (Disabled)	
[Lockout Tim	e Delay	10.0		10.0 Seconds		
	Alarm Level		0 volts		0 (Disabled)	0 (Disabled)	
	Alarm Time	Delay	10.0	-	10.0 Seconds	10.0 Seconds	
	Gross Over Voltage Level		2500 vol	ts	2500 (0 Disabled)		
	Gross Over Voltage Time		2.0	64 co.	2.0 Seconds		
	N-G/Line Reference Ratio		111:1		111:1		
	Phase/Tap Ratio		120 :1		120:1		
	Auxiliary Contact		Disabled		Disabled		
[Close Time Delay		Disabled		Disabled		
	Output Conta	act Mode	Latched		Latched		
	Alarm Conta	cts Config	Separate	Contacts	Separate Contacts		
	Nominal Frequency		60.0 Hz		60 Hz		
	Password Selection		0		0 (None)		

Figure 6 Setup Screen Page 1

The *Setup* screen allows you to enter the setpoint values for this installation. This screen includes the following fields:

Installation Type

Set this to the type of installation with which this control device is used: ungrounded wye-connected shunt capacitor bank ("Ungnd Wye Cap Bank"), grounded wye-connected shunt capacitor bank ("Gnd Wye Cap Bank"), or ungrounded wye-connected shunt reactor ("Ungnd Wye Reactor").

Unbalance Compensation

This setpoint enables or disables unbalance compensation. The choice of values displayed by this setpoint is dependent on the **Installation Type** setpoint value. Therefore, the **Installation Type** setpoint must be set to the correct value before setting the **Unbalance Compensation Setpoint**. When enabled, you can choose whether the control device compensates an ungrounded wye capacitor/reactor bank for the system voltage imbalance plus the inherent capacitor bank imbalances ("Cap Line" / "Reactor Line"), or for inherent capacitor bank imbalances only ("Cap Only" / "Reactor Only"). For grounded wye capacitor banks, unbalance compensation may be "Enabled" or "Disabled". The default value is "Disabled."

Lockout Level (Volts or %)

This is the voltage level or tap-point voltage percent imbalance at which the control device isolates and locks out the bank or reactor after capacitor unit or reactor turn failures. This protects the surviving capacitor units or the reactor from overvoltage which exceeds their rating. (For more information on setting this value, see *Establishing the Settings* earlier in this instruction sheet for your installation type.)

For an ungrounded, wye-connected capacitor bank or reactor, the setpoint value range is 0 to 9999 Volts, in increments of one volt. The default value is zero volts.

For a grounded, wye-connected capacitor bank, the setpoint range is 0 to 655.39% of the tap-point-to-neutral voltage in increments of 0.01%.

Lockout Time Delay (seconds)

This is the amount of time the neutral-to-ground voltage must exceed the "Lockout Level" setpoint before the control device isolates and locks out the bank or reactor. The setpoint value range is from 0.2 to 30 seconds, in 0.1 second increments. The default value is 10 seconds.

Alarm Level (Volts or %)

This is the voltage level or tap-point voltage percent imbalance at which the control device issues an optional alarm. The alarm is based on the loss of fewer capacitor units or reactor turns than the number for lockout. (For more information on setting this value, see *Establishing the Settings* earlier in this instruction sheet for your installation type.)

For an ungrounded, wye-connected capacitor bank or reactor, the setpoint value range is 0 to 9999 Volts, in increments of one volt. The default value is zero volts.

For a grounded, wye-connected capacitor bank, the setpoint range is 0 to 655.39% of the tap-point-to-neutral voltage in increments of 0.01%.

Alarm Time Delay

This is the amount of time the neutral-to-ground voltage must exceed the "Alarm Level" before the control device issues an alarm. The setpoint value range is from 0.2 to 30 seconds, in 0.1 second increments. The default value is 10 seconds.

Gross Overvoltage Level (Volts or %)

This is the voltage level or tap-point voltage percent imbalance considered a gross overvoltage. If a flashover of series groups within the capacitor bank or a failure of an entire reactor phase occurs, the gross overvoltage logic lets the control device react more quickly than the normal lockout process.

For an ungrounded, wye-connected capacitor bank or reactor, the setpoint value range is 0 to 9999 volts, in increments of one volt. The default value is 2500 volts.

For a grounded, wye-connected capacitor bank, the setpoint range is 0% to 655.35% of the tap-point-to-neutral voltage, in increments of 0.01%. The default value is 25%.

Gross Overvoltage Time Delay

This is the amount of time that the neutral-to-ground voltage must exceed the "Gross Overvoltage Level" before the control device locks out the capacitor bank or reactor. The setpoint value range is 0.2 to 5 seconds, in 0.1 second increments. The default value is 2 seconds.

Neutral-to-Ground Ratio

This is the voltage ratio of the potential device used to measure wye-point neutral-toground voltage for an ungrounded capacitor bank/reactor. The setpoint range is 1:1 to 1200:1. The default value is 111:1.

Phase/Tap-Point-to-Neutral Ratio

This is the voltage ratio of the potential device used to measure the line voltage for an ungrounded, wye-connected capacitor bank or reactor. The setpoint range is 1:1 to 1200:1. The default value is 120:1. (For a grounded, wye-connected capacitor bank, this is the voltage ratio of the potential devices used to measure the intermediate point voltages.)

Auxiliary Contact

This field displays whether the device is configured to accept an "a" or "b" contact from the capacitor bank or reactor switching device, or disabled. The default value is "Disabled".

Close Time Delay

When the "a" or "b" contact is enabled and the control senses the capacitor bank/ reactor circuit switcher or circuit breaker has closed, the control will halt neutral voltage processing for the duration of the timer to ignore switching transients. Setpoint value ranges are 0.1 to 6.0 seconds, 7 to 60 seconds, and 2 to 60 minutes, or disabled.

Lockout Contact Pulse Time (seconds)

This is the amount of time (in seconds) that the control device maintains its lockout contacts. The range is: 1 to 30 seconds, and latched. The default value is "Latched".

Alarm Contacts Configuration

The BankGuard PLUS has two sets of normally open and normally closed (a & b) contacts called <u>Alarm</u> and <u>2nd Alarm</u>. Alarm contacts change state when control power is applied to the BankGuard PLUS, and when control power is off all alarm contacts are in the active state. Any active alarm lights the faceplate ALARM INDICATOR LED. Alarms are latched, maintained across a software reset, and remain active until the ALARM INDICATOR RESET button or a SCADA command resets them.

Alarm contacts can be configured in one of three options, using IntelliLINK Setup Software. See Figure 7, and Table 4.

Separate Alarm Contacts

Bank Neutral Over-voltage and Relay Trouble (new default)

When this setpoint is selected:

<u>Alarm</u> contacts operate capacitor bank or reactor neutral over-voltage only. If the neutral over-voltage alarm was active at the last BankGuard PLUS power-down, this alarm will remain active at power-up.

<u>2nd Alarm</u> contacts operate for relay trouble and loss of BankGuard PLUS control power. This contact will always remain active following power-up.

NOTE: Separate alarm contacts require a hardware revision implemented after Serial Number BGP200405000450. The software is backward compatible, but the new Separate Alarm Contacts feature will not work on the previous hardware, however the Dual (Redundant) Alarm Contacts settings will perform as expected.

Dual (Redundant) Alarm Contacts

When either of these two setpoints is selected all <u>Alarm</u> and <u>2nd Alarm</u> contacts indicate simultaneously for neutral over-voltage or relay trouble. To determine which condition caused the alarm the user must connect to the BankGuard PLUS device with their PC using IntelliLINK Setup Software and review the event logs.

Alarmed at Power-Up

When this setpoint is selected:

<u>Alarm</u> and <u>2nd Alarm</u> contacts indicate simultaneously for neutral over-voltage, or relay trouble, or loss of control power. The contacts will remain active following power-up of the BankGuard PLUS.

Unalarmed at Power-Up (old default)

When this setpoint is selected:

<u>Alarm</u> and <u>2nd Alarm</u> contacts indicate simultaneously for neutral over-voltage or relay trouble, or loss of control power to the BankGuard PLUS.

Make a Selection:	×
 Separate Contacts 	
C Redundant Alarmed	
C Redundant Un-alarmed	
OK Cancel	
Separate Contacts Configuration: Alarm at Power-up with trou over-voltage contacts separate, Redundant Alarmed Configu Alarm at Power-up with Contacts Redundant, Redund. Un-a Configuration: No Alarm at Power-up with Contacts Redu	ble and Iration: larmed Ind.

Figure 7 Alarm Configuration Dialog Box

	Contacts			
Terminals	Power Is Off	At Power-Up No Over-Voltage Present	At Power-Up Over-Voltage Present	
TB1-2&3 Over-voltage Alarm	Open	State at last power-down. If open; closed by reset.	Open; closed by reset *	
TB1-4&5 Over-voltage Alarm	Closed	State at last power-down. If closed; opened by reset.	Closed; opened by reset *	
Terminals	Power Is Off	At Power-Up	Software Reset Occurs While Power Is On	
TB1-7&8 Trouble Alarm	Open	Open; closed by reset	Open; closed by reset	
TB2-7&8 Trouble Alarm	Closed	Closed; opened by reset	Closed; opened by reset	

Unalarmed at Power-Up With Dual (Redundant) Contacts				
	Contacts			
Terminals	Power Is Off	At Power-Up No Over-Voltage Present	At Power-Up Over-Voltage Present	
TB1-2&3 Alarm	Open	Closed	Open; closed by reset *	
TB1-4&5 Alarm	Closed	Open	Closed; opened by reset *	
TB1-7&8 2nd Alarm	Open	Closed	Open; closed by reset *	
TB2-7&8 2nd Alarm	Closed	Open	Closed; opened by reset *	
			* after condition is cleared	

Alarmed at Power-Up	With Dual (Re	dundant) Contacts			
	Contacts				
Terminals	Power Is Off	At Power-Up No Over-Voltage Present	At Power-Up Over-Voltage Present		
TB1-2&3 Alarm	Open	Open; closed by reset	Open; closed by reset *		
TB1-4&5 Alarm	Closed	Closed; opened by reset	Closed; opened by reset *		
TB1-7&8 2nd Alarm	Open	Open; closed by reset	Open; closed by reset *		
TB2-7&8 2nd Alarm	Closed	Closed; opened by reset	Closed; opened by reset *		
			* after condition is cleared		



Nominal Operating Frequency (Hz)

This is the nominal operating frequency (in Hz) for your distribution system. The default value is "60.0."

Password Selection

When enabled, this setpoint requires a password to make changes from the faceplate. To enable faceplate protection, enter a 4-digit password. The range of passwords is 1 to 9999. The default value is 0 - no password enabled.

eration	<u>S</u> etup	Product Info	Comm		
			Setup		(Page 2 of 2)
				Present	Factory
Convert	UP Volts to	Percent	No	No	
Rated P	rimary Phas	e Voltage		23.00	23.00 kV
Data Lo	gging Interv	al	5-Minute	5 Minutes	
Date/Ti	me Fri	, May 7 , 200	04 16: 02: 25		
1 agation	112950				
Location	112850				
Locato	112850				



Converts UP Volts to Percent

The default for the Control is all related setpoints and the neutral to ground voltage is displayed in Volts. Setting this setpoint value to "Yes" will convert these voltages to a percentage. The percentage is calculated: the sensed voltage divided by "V₀", where "V₀" is the primary phase voltage divided by the square root of three. For a grounded wye capacitor installation, the display is always in percent.

Rated Primary Phase Voltage

Enter the nominal primary phase voltage of the system. This value will be used to express voltages in percent.

Data Logging Interval

This is the interval (in minutes) used for logging voltage and temperature data. Logged data is averaged over this interval. The intervals available are 1, 5, 10, 15, 30, and 60 minutes.

◆NOTE: If you change the data logging interval, previously stored data will be overwritten. To save older data, generate a report before changing the interval. (See the *Operations* Instruction Sheet 1011-540 for details.)

Date / Time

The correct time and date are set at the factory before shipment, If the control device is installed in a different time zone, you may need to reset the time.

Daylight Savings Time corrections must be made manually.

The control device uses this information for data logging and event recording.

Location

Enter your company's standard location identification information. This information may help identify the control device to the SCADA master station operator and appears on all reports generated from the control device. You can enter up to 100 characters.

2. Setup of the Unbalance Compensation Feature

The Unbalance Compensation (UBC) feature compensates for variances which result in an error voltage existing between the capacitor bank neutral point and ground. The variances may be due to manufacturing tolerances of the capacitor units or fixed system voltage unbalances. The type of variance which may be compensated depends on the setting of the control's setpoints and the number of potential monitoring devices which are installed. The setting and sensor configuration for each type of installation is listed in Table 4.

Installation Type	Unbalance Compensation Type	Potential Device Configuration	Unbalance Compensation Provided
Ungnd Wye Cap	Disabled	One neutral-point-to-ground 15- Volt-Ampere Potential Device.	No unbalance compensation pro- vided.
Ungrd Wye Cap	Cap Only	One neutral-point-to-ground 15- Volt-Ampere Potential Device and one line 30-Volt-Ampere Potential Device.	Provides approximate unbalanced compensation for inherent capacitor unit unbalance.
Ungrd Wye Cap	Cap/Line	One neutral-point-to-ground 15- Volt-Ampere Potential Device and Phase A, B, and C line 30-Volt- Ampere Potential Devices.	Provides unbalance compensation for fixed system voltage unbalance and/or inherent capacitor bank unbalance.
Gnd Wye Cap	Disabled	Phase A, B, and C tap-point-to-neu- tral 30-Volt-Ampere Potential Devices.	Provides approximate unbalance compensation for fixed system volt- age unbalance and/or inherent capacitor bank unbalance.
Gnd Wye Cap	Cap Only	Phase A, B, and C tap-point-to-neu- tral 30-Volt-Ampere Potential Devices and one line 30-Volt- Ampere Potential Device.	Provides approximate unbalanced compensation for inherent capacitor bank unbalance.
Ungnd Wye Reactor	Disabled	One neutral-point-to-ground 15- Volt-Ampere Potential Device.	Provides unbalanced compensation for inherent reactor bank unbal- ances.
Ungnd Wye Reactor	Reactor Only	One neutral-point-to-ground 15- Volt-Ampere Potential Device and one line 30-Volt-Ampere Potential Device.	Provides approximate unbalanced compensation for inherent reactor bank unbalance.
Ungnd Wye Reactor	Reactor/Line	One neutral-point-to-ground 15- Volt-Ampere Potential Device and Phase A, B, and C line 30-Volt- Ampere Potential Devices.	Provides unbalance compensation for fixed system voltage unbalance and/or inherent reactor bank unbal- ance.

Table 5 Unbalance Compensation Choices

Using IntelliLink to Setup the Unbalance Compensation Feature

The unbalance compensation feature may be set by IntelliLink using the following procedure:

1. From the IntelliLink Setup screen, set the "Installation Type" setpoint value to be compatible with the installation.

"Ungnd Wye Cap" for an ungrounded wye capacitor bank, "Ungnd Wye Reactor" for an ungrounded wye reactor bank, or "Gnd Wye Cap" for a grounded wye capacitor bank.

- 2. Set the "Unbalance Compensation" setpoint value to be compatible with the "Installation Type" setpoint value and the installation's potential device configuration. See Table 5.
- 3. From the IntelliLink Operation screen, select the UNBALANCE COMPENSATION SET faceplate button. The applicable unbalance compensation setup screen will appear. The control will continuously calculate a new compensation value based upon the real-time neutral to ground voltage. The calculated value is displayed in the "Real-Time Calculated UBC Value" field.
- 4. To set a new value, select the "Set New UBC Value?" setpoint value. Select "Set UBC" in the window that appears. The unbalance compensation feature is now set to the value appearing in the "Real Time Calculated UBC Value" field.
- 5. The Operation screen's "N-G/Unbalance Voltage" field now displays the corrected, real-time neutral to ground voltage value and the "Unbalance Compensation in Use" field displays the correction factor presently being used.

Using the Faceplate LCD to Setup the Unbalance Compensation Feature

The unbalance compensation feature may be set by the faceplate LCD using the following procedure:

- 1. Using the NEXT button scroll the LCD to the "InstallType" display.
- 2. Press the ENTER button and Line 2 of the LCD will blink to indicate that the setpoint will accept a new value.
- 3. Using the + button, scroll Line 2 of the LCD to the desired value: Ungnd Wye Cap (ungrounded wye capacitor bank), Gnd Wye Cap (grounded wye capacitor bank), or to Ungnd Wye Reactor (ungrounded wye reactor bank).
- 4. Press the ENTER button to accept the new "InstallType" setpoint value.
- 5. Using the NEXT button, scroll the LCD to the "Unbal. Comp." display.
- 6. Press the ENTER button and Line 2 of the LCD will blink to indicate that the setpoint will accept a new value.
- 7. Using the + faceplate button, select the "Unbal. Comp." setpoint value required. See Table 5.

- 8. Press the ENTER button to accept the new value. The unbalance compensation feature is now enabled, but the stored correction value is still zero and must be set.
- 9. Press the ESC button to return to the "N-G Voltage" display.
- 10. Press the NEXT button to scroll to the "UBC In Use" display.
- 11. Press the UNBALANCE COMPENSATION SET button and the LCD displays "Calc UBC" in Line 1 and the calculated value in Line 2.
- 12. Pressing the UNBALANCE COMPENSATION button a second time sets the unbalanced compensation feature and "UBC In Use" is displayed in Line 1 of the LCD and the new correction factor in Line 2. The UBC feature is now enabled and set.

NOTE: If the UNBALANCE COMPENSATION SET button is pressed, the LCD displays "UBC In Use" in Line 1 and its correction factor in Line 2. If the unbalance compensation feature has not been previously set, the control has not calculated and stored a UBC correction factor, and the displayed value will be zero. When the unbalance compensation feature is enabled, the value displayed is the correction factor currently being used. When the unbalance compensation feature is disabled, the value displayed in Line 2 is "Disabled".

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Click the Comm button to display Page 1 of the Communications Setup screen (Figure 9).
 Enter all required information (as described below).

Go to the next step.

eration	Setup	Product Info	Comm		
		Commu	nications		(Page 1 of 3)
				Present	Factory
Cor	mmunication	s RTU Address	3	0	0
Apr	plication Laye	er Confirmatio	ns	Enabled	Enabled
Nur	nber of Confi	irmation Attem	pts	3	3
Tim	Time Delay Between Attempts		10 Sec	Sec 10 Sec	
Uns	solicited-Res	ponse Mode		Enabled-V3	Enabled-V3
Tim	ne Delay Betv	veen Restart M	essages	60 Sec	60 Sec
Ma	ster Station F	TU Address		0	0
Det	vice Restart N	Aessage Trans	mit Delay	10 Sec	10 Sec

Figure 9 Page 1 of the Communications Setup Screen (DNP Version)

This screen includes the following fields:

Communications RTU Address

If this control device will be accessed via SCADA communications, enter the network address for this installation.

\triangle CAUTION \triangle

If you move an already-configured control device to a new location, be sure to enter the NEW address into the control device. (If you leave the old address in the control device, it may respond to instructions meant for a different location.)

Application Layer Confirmations

When this setpoint is enabled, the control device requests a confirmation from the SCADA master station every time a message is delivered. If the control device does

not receive a confirmation within a specified time period ("Time Delay Between Attempts"), it retransmits the response with a request for another confirmation.

♦ NOTE: Enabling this feature may add significant communications traffic to your communications network.

Number of Confirmation Attempts

This is the number of times the control device asks for a confirmation when the "Application Layer Confirmations" setpoint is enabled. This number includes the initial response transmission.

Time Delay Between Attempts

If the control device did not receive a confirmation within this time period, it retransmits the response with a request for another confirmation (unless the "Number of Confirmation Attempts" has been reached).

Unsolicited-Response Mode

When this setpoint is enabled, the control device sends a message to the SCADA master station every time a status point changes state. If this feature is enabled, you must also enter a master station RTU address on this screen (see "Master Station RTU Address" below).

"Enabled-V3" mode conforms to the latest DNP Level-2 requirements. For example, at power up, null unsolicited responses are sent until the master station confirms them. The data-filled responses are sent only when the master station issues an EnaUns command (application function code 14x). "Enabled-V2" mode conforms to the past approach.

♦NOTE: Enabling this feature may add significant communications traffic to your communications network.

Unsolicited-Retry Time Interval

If the control device did not receive a confirmation (following an unsolicited response) within this time period, it retransmits the response with a request for another confirmation (unless the "Number of Confirmation Attempts" has been reached).

Master Station RTU Address

This is the master station RTU address to which the control device sends all unsolicited responses. Leaving this address at zero prevents the control device from generating any unsolicited responses, whether or not the "Unsolicited Responses to Master Station" has been enabled.

Device Restart Message Transmit Delay

This is the delay between the restart of the control device and the transmission of the Device Restart unsolicited message. If your communications system needs time for acquisition following a restart, you can adjust this value to match the requirements.

 At Page 1 of the Communications Setup screen, click the PgDn button to display Page 2 of the Communications Setup screen (Figure 10). Enter all required information (as described below).

eration	Setup	Product Info	Co <u>m</u> m			
		Commu	nications	(Page 2 of 3)	
				Present	Factory	1
SCADA	A Communica	ation Baud Rate	e, Port A	9600	9600	
SCADA	A Communica	ation Baud Rate	e, Port B	9600	9600	
Half/Fu	III Duplex, Po	ort A		Full	Full	
Half/Fu	III Duplex, Po	rt B		Full	Full	
Conne	ction Type, F	Port A		SCADA	SCADA	
Conne	ction Type, F	Port B		SCADA	SCADA	
RTS A	ctive Before	Xmit Duration,	Port A (ms)	19	19	
RTS A	ctive Followi	ng Xmit Duratio	on, Port A (ms)	19	19	
RTS A	ctive Before	Xmit Duration,	Port B (ms)	19	19	
RTS Active Following Xmit Duration, Port B (ms)			19	19		
Output Block Point Select Timeout			10 Sec	10 Sec		
Time Synchronization Request Interval			Disabled	Disabled		
					1	



This screen includes the following fields:

SCADA Communication Baud Rate, Port A SCADA Communication Baud Rate, Port B

This is the baud rate between the control device and the directly-connected communications device (radio, modem, etc.). This baud rate must be identical to the baud rate for the communications device.

Half/Full Duplex, Port A Half/Full Duplex, Port B

Set this value to match the value selected for the communications device (modem, radio, etc.) that is directly connected to this port.

Connection Type, Port A Connection Type, Port B

This is the type of connection for this port, which defines how the control device handles communications.

• *None* – There is no connection to this port.

- *Non-Relay* Messages received on this port are not intended for other control devices. This setting also prevents the control device from recording errors if this port receives a message not addressed to the local control device.
- *SCADA* This port is connected to a SCADA master station.
- *Direct* This port is connected directly to another control device and is intended to relay messages to it.

RTS Active Before Xmit Duration, Port A RTS Active Before Xmit Duration, Port B

This is the amount of time (in milliseconds) that RTS ("request to send") is active for this port before a transmission takes place. You can usually leave this at the factory-default value.

RTS Active Following Xmit Duration, Port A RTS Active Following Xmit Duration, Port B

This is the amount of time (in milliseconds) that RTS ("request to send") is active after a transmission has taken place. You can usually leave this at the factory default value.

Output Block Point Select Timeout

This is the timeout duration of the Select function on control points. If the timeout duration is too short between the Select and the Operate functions during a Select-Before-Operate sequence, the control device disables the point and reports a failure to the master station.

\land WARNING 🖄

These instructions do NOT replace the need for utility operation standards. Any conflict between the information in this document and utility practices should be reviewed by appropriate utility personnel and a decision made as to the correct procedures to follow.

Serious risk of personal injury or death may result from contact with electric distribution equipment when electrical isolation and grounding procedures are not followed. The equipment described in this document must be operated and maintained by qualified persons who are thoroughly trained and understand any hazards that may be involved. This document is written only for such qualified persons and is not a substitute for adequate training and experience in safety procedures for accessing high voltage equipment.

This control is connected to capacitors operating at primary voltage levels. High voltage may be present in the wiring to the control or the control itself during certain failures of the capacitor bank wiring or system grounding, or due to a failure of the capacitor bank itself. For this reason, access to the control should be treated with the same safety precautions that would be applied when accessing other high voltage lines and equipment. Follow all locally approved safety procedures when working on or around this control.

Do not energize the control power source entering the control enclosure until all wiring is complete.

Verify the Calculated Lockout Level (capacitor banks only)

1. Check that no capacitor units have been isolated from the bank.

2. De-energize the capacitor bank.

Open the capacitor bank switching device. Then ground the bank, observing established operating procedures and safety precautions.

3. Isolate the number of capacitor units calculated to lock out the bank.

To isolate the number of capacitor units (all in the same series group) previously calculated to lock out the bank, remove their respective fuses.

For grounded wye-connected banks where the number of series groups per phase is odd, you will not have to isolate as many capacitor units in a series group located between the tap point and ground as in a series group located between the tap point and the line.

4. Remove the temporary grounds, re-energize the bank, and record the voltage.

If the voltage is greater than the lockout level, an automatic switching operation will occur once the "Lockout Time Delay" ends and the **LOCKOUT INDICATOR** LED will turn ON.

As soon as you read the voltage, open the capacitor bank switching device to avoid shortening the life of the capacitor units. Verify that no other capacitor units have been isolated.

◆NOTE: After automatic lockout of the capacitor bank, you must press the **LOCKOUT INDICATOR** button to return the bank to service. This permits closing of the capacitor bank switching device.

5. De-energize and ground the capacitor bank, then reconnect the fuses.

Observe established operating procedures and safety precautions to de-energize and ground the capacitor bank. Reconnect the fuses you previously removed to isolate the capacitor units.

6. Repeat Step 1 through Step 5 for each remaining phase leg of the capacitor bank.

For ungrounded wye capacitor banks, compare the calculated lockout level and the measured voltages.

Check that the calculated lockout level is lower than the lowest voltage just measured. If the calculated level is higher than one or two of the voltage readings, then the system voltage imbalance and/or inherent capacitor bank imbalance is creating an error voltage between the bank neutral and ground. This error is large enough to obscure the neutral-to-ground voltage resulting from the isolation of successive capacitor units.

Do one of the following:

- Set the lockout level to a value lower than the lowest voltage just measured. Note that this means that lockout may occur with fewer capacitor units removed from service.
- Set up the unbalance compensation feature, as described in *Unbalance Compensation* on page -14.

Verify the Calculated Alarm Level (capacitor banks only – optional)

1. Check that no capacitor units have been isolated from the bank.

2. De-energize the capacitor bank.

Open the capacitor bank switching device. Then ground the bank, observing established operating procedures and safety precautions.

3. Isolate the number of capacitor units calculated to set the alarm.

To isolate the number of capacitor units (all in the same series group) previously calculated to set the alarm, remove their respective fuses.

For grounded wye-connected banks where the number of series groups per phase is odd, you will not have to isolate as many capacitor units in a series group located between the tap point and ground as in a series group located between the tap point and the line.

4. Remove the temporary grounds, re-energize the bank, and record the voltage.

If the voltage is greater than the alarm level, the control device will generate an alarm once the "Alarm Time Delay" ends. The **ALARM INDICATOR** LED will also turn ON.

As soon as you read the voltage, open the capacitor bank switching device to avoid shortening the life of the capacitor units. Verify that no other capacitor units have been isolated.

♦NOTE: You must press the ALARM INDICATOR button to clear the alarm.

5. De-energize and ground the capacitor bank, then reconnect the fuses.

Observe established operating procedures and safety precautions to de-energize and ground the capacitor bank. Reconnect the fuses you previously removed to isolate the capacitor units.

6. Repeat Step 1 through Step 5 for each remaining phase leg of the capacitor bank.

7. For ungrounded wye capacitor banks, compare the calculated alarm level and the measured voltages.

Check that the calculated alarm level is lower than the lowest voltage just measured. If the calculated level is higher than one or two of the voltage readings, then the system voltage imbalance and/or inherent capacitor bank imbalance is creating an error voltage between the bank neutral and ground. This error is large enough to obscure the neutral-to-ground voltage resulting from the isolation of successive capacitor units.

Do one of the following:

- Set the alarm level to a value lower than the lowest voltage just measured. Note that this means that an alarm may occur with fewer capacitor units removed from service.
- Set up the unbalance compensation feature, as described in *Unbalance Compensation* on page -14.

Enable Normal Control Device Operation

1. If desired, review the present status of the control device on the Operation screen.

To display the *Operation* screen, click the Operation button at any other IntelliLINK screen. (For a detailed explanation of the *Operation* screen, see *View the Operations Information* in the *Troubleshooting* Instruction Sheet 1011-550.)

2. If desired, generate a report.

Generate a report if you want a printed record of the control device settings or if you have a problem that requires help from S&C. (For details, see *Generating Reports* in the *Operations* Instruction Sheet 1011-540.)

3. Exit the IntelliLINK software.

Select Exit from the File menu at any IntelliLINK screen, then click OK.

4. Turn off your computer, then disconnect it from the control device.

This completes the control device setup operation.