

## Form 6 microprocessor-based recloser control automatic source transfer (AST) application instructions



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## Safety for life



Eaton meets or exceeds all applicable industry standards relating to product safety in its Cooper Power™ series products. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Eaton employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment, and support our “Safety For Life” mission.

## Safety information

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as arc flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

### Hazard Statement Definitions

This manual may contain four types of hazard statements:

#### DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

#### WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

#### CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

**CAUTION:** Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

### Safety instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

#### DANGER

**Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment.**

G103.3

#### WARNING

**Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage.**

G101.0

#### WARNING

**This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage.**

G102.1

#### WARNING

**Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage.**

G122.3

## Product information

### Introduction

*Service Information MN280013EN* provides automatic source transfer application instructions for Form 6 microprocessor-based pole, rack, and yard mount recloser controls equipped with Automatic Source Transfer (AST) functionality.

These instructions are to be used in conjunction with the appropriate installation and operation instructions that were provided with the Form 6 recloser control:

- *S280-70-1 Form 6 Rack Mount*
- *S280-70-2 Form 6 Yard Mount*
- *S280-70-3 Form 6 Pole Mount*
- *S280-70-7 Form 6-TS Pole Mount*
- *S280-70-14 Form 6-TS Rack Mount*
- *S280-70-15 Form 6-TS YardMount*
- *S280-70-21 Form 6 Control Programming Guide*
- *S280-70-23 Form 6-TS Control Programming Guide*

### Read this manual first

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment.

### Additional information

These instructions cannot cover all details or variations in the equipment, procedures, or process described, nor provide directions for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, contact your Eaton representative.

### Standards

Eaton's reclosers are designed and tested in accordance with the following standards: ANSI C37.60, ANSI C37.85 and ANSI Guide C37.61.

## Quality standards

ISO 9001-Certified Quality Management System

### Acceptance and initial inspection

Each Form 6 recloser control is completely assembled, tested, and inspected at the factory. It is carefully calibrated, adjusted and in good condition when accepted by the carrier for shipment.

Upon receipt, inspect the carton for signs of damage. Unpack the control and inspect it thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

### Handling and storage

Refer to the installation and operation instructions that were provided with the Form 6 recloser control for specific handling and storage information.

### Description of AST function

The Form 6 control with AST functionality operates with two Eaton's Cooper Power series reclosers, including NOVA™, VSA, VWE, NOVA-TS, and NOVA STS, and requires source-side voltage sensing on the recloser.

Two Form 6 controls equipped with the AST application scheme are required with one control designated preferred and the other control designated alternate.

The system requires different AST schemes to be downloaded to each device. See Tables 1 and 2 for the scheme names and functionality. The 5.1 UGW works to upgrade 5.0 AST schemes.

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### IMPORTANT

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AST schemes are only tested as pairs as identified in Tables 1 and 2. Do not mismatch the scheme pairs as the resulting performance cannot be anticipated.

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### IMPORTANT

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Do not use the ProView™ 5.0 software Upgrade Wizard or Application Launcher tools with the AST application as it is not compatible.

The two controls communicate via PeerComm™ protocol over radios, fiber optic cable, or twisted pair wire.

The AST function of the Form 6 control automatically transfers to an alternate source for critical loads when a loss of voltage, overvoltage, or voltage unbalance event occurs. When the preferred voltage source passes a pre-determined threshold, the control automatically switches the critical load to the alternate source. Each voltage transfer AST function can be enabled or disabled.

**Table 1. Scheme Names and functionality for PV5.0 Rev 5**

Scheme Name	Communications	Control type	Device Number	PV5.0 Rev 5 Custom Engineering Number	PV5.0 Rev 5b Custom Engineering Number	Scheme Pairs
F6-5.0 default Serial AST Device 1.f6s	Serial	Three Phase	1	6B15004001	6B15004009	X
F6-5.0 default Serial AST Device 2.f6s	Serial	Three Phase	2	6B15004002	6B15004010	
F6-5.0 default Ethernet AST Device 1.f6s	Ethernet	Three Phase	1	6B15004003	6B15004011	X
F6-5.0 default Ethernet AST Device 2.f6s	Ethernet	Three Phase	2	6B15004004	6B15004012	
F6TS-5.0 default Serial AST Device 1.f6s	Serial	Triple-Single	1	6B15004005	6B15004013	X
F6TS-5.0 default Serial AST Device 2.f6s	Serial	Triple-Single	2	6B15004006	6B15004014	
F6TS-5.0 default Ethernet AST Device 1.f6s	Ethernet	Triple-Single	1	6B15004007	6B15004015	X
F6TS-5.0 default Ethernet AST Device 2.f6s	Ethernet	Triple-Single	2	6B15004008	6B15004016	

**Table 2. Scheme Names and functionality for PV5.1 Rev 1**

Scheme Name	Communications	Control Type	Device Number	PV5.1 Rev 1 Custom Engineering Number	Scheme Pairs
F6-5.1 default Serial AST Device 1.f6s	Serial	Three Phase	1	6B15100005	X
F6-5.1 default Serial AST Device 2.f6s	Serial	Three Phase	2	6B15100006	
F6-5.1 default Ethernet AST Device 1.f6s	Ethernet	Three Phase	1	6B15100003	X
F6-5.1 default Ethernet AST Device 2.f6s	Ethernet	Three Phase	2	6B15100004	
F6TS-5.1 default Serial AST Device 1.f6s	Serial	Triple-Single	1	6B15108004	X
F6TS-5.1 default Serial AST Device 2.f6s	Serial	Triple-Single	2	6B15108005	
F6TS-5.1 default Ethernet AST Device 1.f6s	Ethernet	Triple-Single	1	6B15108002	X
F6TS-5.1 default Ethernet AST Device 2.f6s	Ethernet	Triple-Single	2	6B15108003	

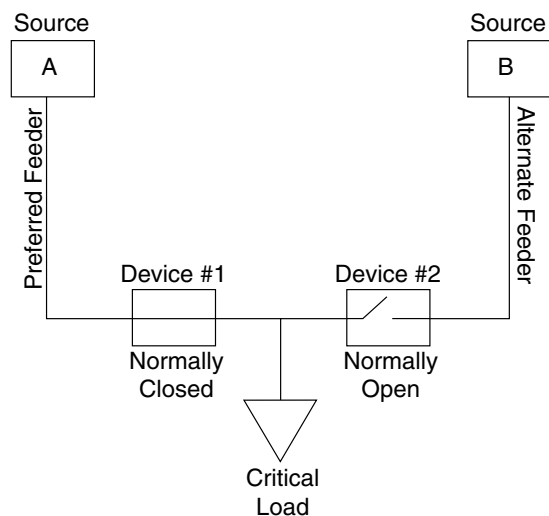
The control monitors the source voltages and provides the timing and control logic required to perform the automatic load transfer in the event of a voltage event. The control commands the operations of the reclosers during auto transfer. Front panel TRIP and CLOSE pushbuttons enable manual tripping and closing. The AST functionality is ALWAYS a three-phase ganged operation, even for triple-single devices.

Once an AST event occurs, three restoration modes are available to return the system to normal:

- Manual Restoration / Manual Initiation: Each control is operated from the front panel.
- Automatic Restoration / Manual Initiation: Automatic restoration to the preferred source is manually initiated from either control.
- Automatic Restoration / Automatic Initiation: Automatic restoration occurs once the preferred feeder voltage returns.

The restoration mode is the same for both controls and can be selected from either control. This is accomplished through PeerComm communications.

Refer to Figure 1 for a simplified AST one-line diagram.



**Figure 1. Simplified AST one-line diagram.**

## AST disable

These items can disable the AST functionality:

- AST Enable setting (Device #1)
- PeerComm Invalid condition (either device)
- Disable AST Toggle
  - SCADA
  - Front Panel Option Button
  - Application Diagram
- Underfrequency (only if enabled in Device 1# settings)
- Hot Line Tag, Supervisory Off, and/or Failure to Close alarms (either device)
- Fault condition (either device)
  - Above Minimum Trip
  - Overcurrent Trip
- WB (Disable AST) Workbench Output signal (either device)

Multiple items can disable AST functionality at any given time. For AST functionality to be enabled, all signals must allow it.

## Voltage sensing

Voltage sensing can be accomplished using Potential Transformers (PTs).

**Note:** Voltage sensing can also be accomplished with Form 6 pole mount controls equipped with internal or external voltage sensors. Contact your Eaton representative for additional information.

Voltage sensing can be operated with one PT or three PTs on the source sides of the reclosers. If three PTs are used, then losing any single phase will trigger a source transfer. If one PT is used, the Phantom Phase function in the Form 6 control must be used to simulate the other two phases.

## Form 6 control voltage settings

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### IMPORTANT

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Enabling the undervoltage or overvoltage options inherent in the standard Form 6 control could cause conflicts with the AST scheme. It is recommended that the standard Form 6 control undervoltage or overvoltage functions not be enabled when the AST functionality is enabled.

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## Voltage unbalance

There are two possible methods to calculate Voltage unbalance: NEMA® (National Electrical Manufacturers Association) and IEC (International Electrotechnical Commission).

- NEMA® method\*: Voltage unbalance is defined by NEMA as 100 times the absolute value of the maximum deviation of the line voltage from the average voltage on a three-phase system, divided by the average voltage. For example, if the measured line voltages are 462, 463, and 455 volts, the average is 460 volts. The voltage unbalance is:

$$\frac{(460 - 455) \times 100}{460} = 1.1\%$$

It is recommended that the voltage unbalances at the motor terminals not exceed 1%.

\*Source: [www.eere.energy.gov/industry/bestpractices](http://www.eere.energy.gov/industry/bestpractices) (DOE/GO-102005-2061, September 2005, Motor Systems Tip Sheet #7)

- IEC method: Voltage unbalance is defined as the ratio of the negative sequence voltage to positive sequence voltage.

The AST scheme allows the user to select the desired method. The NEMA® method is set as the default.

## Form 6 AST recloser control description

### Control front panel

The front panel of the Form 6 control with AST functionality is illustrated in Figure 2.

The front panel is separated into two clearly identified, color-coded sections:

- The top portion of the front panel is used for programming the control and providing LED status indication.
- The lower portion of the front operating panel is used for operating the control and recloser.

The control includes a Power Save feature that will turn off the backlit LCD display and all LEDs (except Hot Line Tag) if no front panel keypad is pressed within ten minutes. Pressing the LAMP TEST key will re-activate the display and LEDs.

**Note:** The ten minute and Power Save feature is a ProView interface software default setting. This feature can be disabled via the ProView interface software.

The control includes a Reset Menu feature that will cause the LCD display to revert to the root menu after ten minutes of inactivity.

**Note:** The ten minute timer and MMI Reset Menu is a ProView interface software default setting. The menu selection and timer can be changed via the ProView interface software.

### Programming panel

The Programming panel has the following sections:

#### One-touch analysis keys

There are eight analysis keys that allow one-button access to a variety of control and monitoring functions that appear in the LCD display.

**Note:** When pressing a membrane pushbutton, always press and hold for 0.5 seconds to ensure the button press is recognized by the device.

#### LCD display

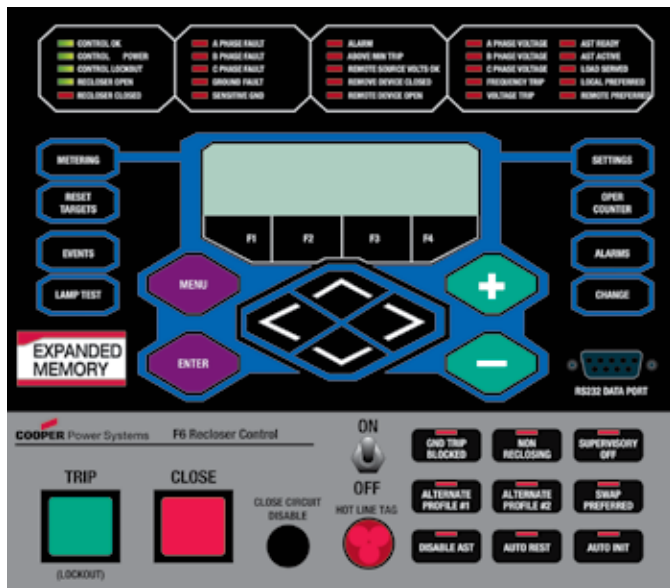
The LCD Display is a backlit 4-line, 20-character display that provides extensive distribution system, recloser, and control status information using eight navigation keypads.

There are four LCD navigation buttons, LCD menu function keys, and cursor movement arrows.

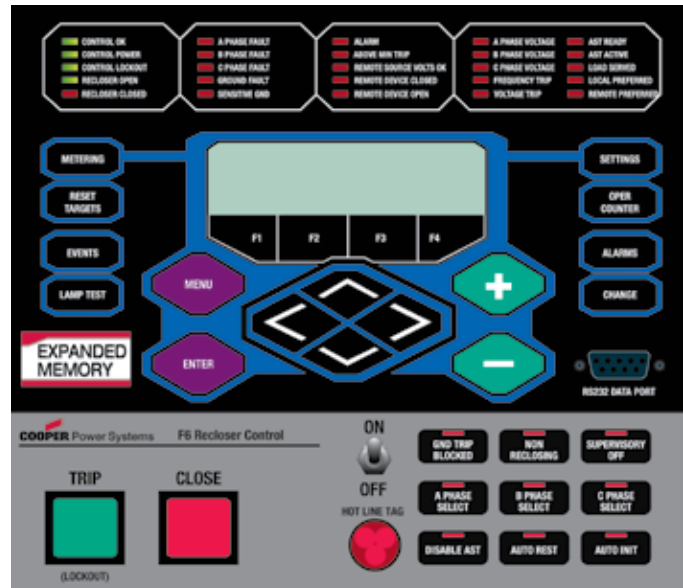
#### RS-232 configuration data port

The RS-232 connector on the front operating panel allows direct connection to a personal computer. This port is used only for configuring the control with ProView application software. All settings, metering, events, and oscillography data are available from this port. The port is Data Communication Equipment (DCE) wired for direct connection to a personal computer.

A 9-pin RS-232 cable (Catalog Number KME5-66) to connect from the PC to the RS-232 data port is available as an accessory.



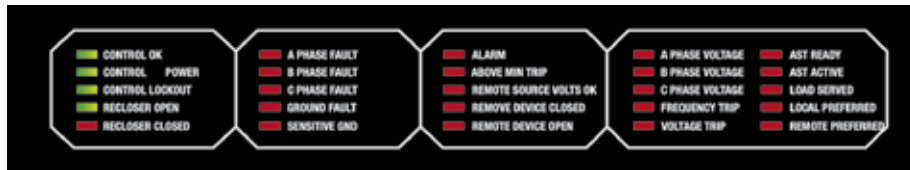
Form 6 AST



Form 6-TS AST

Figure 2. Front panel of the Form 6 recloser control with AST functionality.





**Figure 3. Default AST status indicator LEDs.**

### **Default status indicator LEDs**

The status indicator LEDs (Figure 3) in the Programming section of the Operator Panel provide the following status information:

#### **Column 1**

**CONTROL OK:** The green LED indicates this control is operating normally and not in an alarm state.

**CONTROL POWER:** The green LED indicates there is adequate charge (voltage) on the trip circuit capacitor to trip or close the recloser this control is connected to. This LED does not indicate the presence of AC power.

**CONTROL LOCKOUT:** The green LED indicates the control is in a locked out state, i.e. a reclosing sequence is not in progress. This LED does not indicate that the recloser is open.

**RECLOSER OPEN:** The green LED indicates the recloser this control is connected to is in the open position.

**RECLOSER CLOSED:** The red LED indicates the recloser this control is connected to is in the closed position.

**Note:** There are several conditions that will cause the alternate blinking of the CONTROL LOCKOUT, RECLOSER OPEN, and RECLOSER CLOSED LEDs: Failure to Trip, Failure to Close, Interrupter Malfunction, and 52a/b Disagreement.

The LED blinking pattern for these conditions is the CONTROL LOCKOUT green LED and RECLOSER CLOSED red LED alternating with the RECLOSER OPEN green LED.

In addition to the above LED blinking pattern, the red ALARM LED will also be illuminated for these alarms: Failure to Trip, Failure to Close, and Interrupter Malfunction.

#### **Column 2**

**A PHASE FAULT, B PHASE FAULT, C PHASE FAULT:** The red LEDs indicate A, B, and/or C phase current was either the maximum phase current or within 80% of the maximum when a trip signal was issued.

**GROUND FAULT, SENSITIVE GROUND FAULT:** The red LEDs indicate that a Ground and/or Sensitive Earth Fault tripping function was asserted at the time the trip signal was asserted.

#### **Column 3**

**ALARM:** The red LED indicates an alarm has been issued from this control. Review the alarm status and log on the

LCD display for the specific alarm.

**ABOVE MINIMUM TRIP:** The red LED indicates the current exceeds the level set for minimum trip.

**REMOTE SOURCE VOLTS OK:** The red LED indicates source voltage is present and within thresholds on the other control.

**REMOTE DEVICE CLOSED:** The red LED indicates that the recloser operated by the other control is in the closed position.

**REMOTE DEVICE OPEN:** The red LED indicates that the recloser operated by the other control is in the open position.

#### **Column 4**

**A PHASE VOLTAGE, B PHASE VOLTAGE, C PHASE VOLTAGE:** The red LED indicates a presence of voltage on the respective phases. The Single-Phase Undervoltage Pickup setting controls the voltage indication for the front panel LEDs as defined in the Voltage setting dialog box for the active setting profile.

**FREQUENCY TRIP:** The red LED indicates the recloser tripped due to a frequency trip.

**VOLTAGE TRIP:** The red LED indicates the recloser tripped due to a voltage trip.

#### **Column 5**

**AST READY:** The steady red LED indicates both controls are ready to respond to an AST event. If this LED is not illuminated an automatic source transfer cannot occur. This LED will blink while the device is timing to begin an AST action. The following conditions must be met before this LED will illuminate:

- The preferred recloser is in the closed position.
- The alternate recloser is in the open position.
- Voltage is present on both sources and within thresholds.
- No overload condition on either device.
- AST is enabled.

**AST ACTIVE:** The steady red LED indicates that an automatic source transfer occurred and the critical load is served by the alternate source. This LED will blink when the device is timing to make an Auto Restore Auto Initiate.

**LOAD SERVED:** The red LED indicates that all three phases of the critical load are being served by either device.

**LOCAL PREFERRED:** The red LED indicates that this control

is the preferred source. When this LED is illuminated on this control, the REMOTE PREFERRED LED is illuminated on the other control.

REMOTE PREFERRED: The red LED indicates that this control is the alternate source. When this LED is illuminated on this control, the LOCAL PREFERRED LED is illuminated on the other control.

**Note:** The LOCAL PREFERRED and REMOTE PREFERRED LEDs respond to the SWAP PREFERRED Operator Panel one-touch function key. Refer to **One-Touch Function** Keys in this section of this manual for additional information regarding the Swap Preferred function.

## Operating panel

The Operating Panel includes the following sections:

### **HOT LINE TAG ON/OFF Toggle Switch and LED Indicator**

#### **WARNING**

**Hazardous voltage. Do not use Hot Line Tag as a substitute for a visible disconnect. Always establish a visible disconnect prior to performing any work requiring a de-energized line. Failure to comply may cause death, severe personal injury, or equipment damage.** T276.0

#### **IMPORTANT**

All AST functionality is blocked when Hot Line Tag is Active on either control. When Hot Line Tag is active, the AST Ready and AST Active Status Indicator LEDs will not be illuminated. If AST is Active and Hot Line Tag is enabled, the AST Active mode will be reset and will not return when Hot Line Tag is disabled.

Hot Line Tag is provided for live-line work applications. All closing operations are disabled when the Hot Line Tag feature is activated.

#### **IMPORTANT**

Hot Line Tag activation does not cause the recloser to trip open. It only prevents the recloser from closing.

#### **IMPORTANT**

Hot Line Tag is intended solely for live-line work applications, such as maintenance, repairs or improvements to the distribution system, that occur while the line remains energized.

Hot Line Tag prevents all closing attempts from the control and shifts protection to one trip-to-lockout on the composite curve of the Hot Line Tag definite time and the TCC1 curve (whichever is faster). Hot Line Tag takes precedence over Cold Load Pickup, Non-Reclosing, and Fast Trips Disabled.

Hot Line Tag is activated from either the operator panel toggle switch, serial communications, or a discrete SCADA function. All sources must be off to de-activate Hot Line Tag.

To activate the function from the operator panel, flip toggle switch up to the ON position. See Figure 4. The LED indicator illuminates when the function is active.

The Hot Line Tag function may only be reset by the source which initiates it. For example, if Hot Line Tag is activated at the operator panel, the reset function is only possible at the operator panel, and not via SCADA command.

### **Close circuit disable**

Close Circuit Disable (Figure 4) is a removable fuse that, when removed from the front operating panel, disables the close circuit from the control to the recloser.

**Note:** The Form 6-TS control does not have this fuse.

Removing the cartridge from the control disables all electrical closing of the recloser and provides a physical disconnect to the recloser closing circuit. As a result, the control cannot perform a close operation. This disconnect overrides all close functions and makes a remote or manual close operation impossible.

**Note:** When the Close Circuit Disable fuse is removed, the trip circuit remains active and will trip per the programmed time current curve for a faulted condition.

#### **IMPORTANT**

If the CLOSE button is pressed after the Close Circuit Disable fuse is removed, do not reinstall the fuse until after the ALARM LED illuminates (within approximately five seconds) to indicate CLOSE MALFUNCTION. Re-installing the Close Circuit Disable fuse prior to the CLOSE MALFUNCTION ALARM indication will cause the control to close the recloser.

#### **WARNING**

**Hazardous Voltage. Operation of the trip pushbutton on one AST control may remotely close the other recloser in the pair, depending upon the Auto Restoration Mode setting. Therefore, the line section between AST devices may remain energized. Failure to use appropriate safety procedures and equipment before performing work on the line may result in death or severe personal injury.** T385.0

#### **CAUTION**

**Paralleled voltage sources. Operation of the close pushbutton on one AST control may not trip the other recloser in the pair, depending upon the Auto Restoration Mode setting. Therefore, the line section between AST devices may be energized by both sources. The paralleling of independent sources may result in equipment damage.** T386.0

### **TRIP (lockout) pushbutton**

The TRIP pushbutton (Figure 4) provides front-panel access to trip (lockout) the recloser. When pressed, the TRIP pushbutton opens the recloser and locks out the control. The TRIP pushbutton operates independent of the microprocessor.

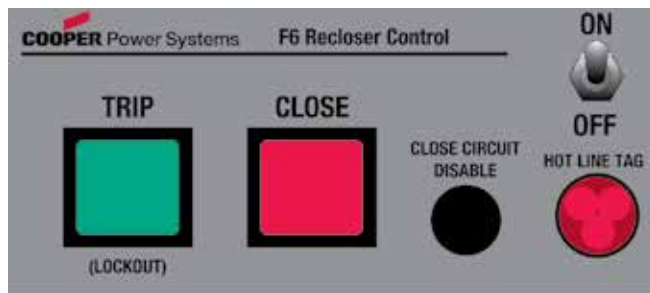
**Note:** In the event of microprocessor failure, the trip circuit can operate independent of the main microprocessor.

### **CLOSE pushbutton**

When pressed, the CLOSE pushbutton (Figure 4) returns the control to the initial or home sequence position, closing the recloser. The control is ready for the start of a new trip/close sequence.

**Note:** The Close Malfunction alarm must be reset before Closing will be allowed.

**Note:** Pressing the CLOSE pushbutton from the Lockout position initiates Cold Load Pickup (CLPU) protection, if the feature is enabled.



**Figure 4. Form 6 AST control (non-TS) front panel TRIP (Lockout) pushbutton; CLOSE pushbutton; Close Circuit Disable removable fuse; and Hot Line Tag switch and Hot Line Tag red indicator LEDs.**

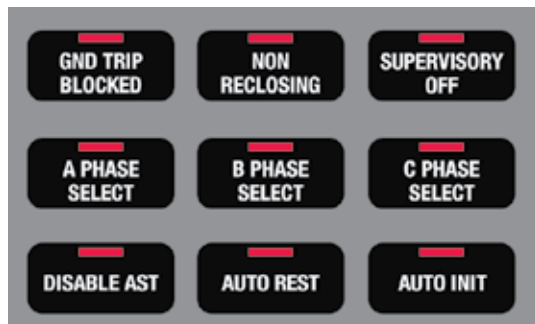
### One-touch function keys

Quick access to frequently operated Form 6 control features is provided with nine function key pushbuttons on the control operator panel.

The Form 6 AST control operator panel one-touch function keys are illustrated in Figure 5.



**Form 6 AST**



**Form 6-TS AST**

**Figure 5. Form 6 (top) and Form 6-TS (bottom) AST Control Operator panel function keys.**

Red LEDs located on each function key indicate the status of the function, regardless of local or remote activation. For example, if Ground Trip Blocked is activated from a SCADA signal, the red indicator will illuminate even though it was not activated from the operator panel.

**Operator panel function key activation or de-activation** requires the operator to first press the CHANGE key to enter the CHANGE mode. A function must then be selected or de-selected within ten seconds to activate or de-activate the function. Once selected, the control returns to normal operation until prompted for another change request. This prevents accidental changing of functions or features.

**Note:** Only one function can be changed per each CHANGE mode activation.

### GND TRIP BLOCKED

The GND TRIP BLOCKED function blocks all ground sensing in the control for the active profile. This red indicator is illuminated when GND TRIP BLOCKED is activated from the serial port, I/O, the interface software, or locally (via the front panel) causing the control to block all ground sensing.

### NON RECLOSING

The control is operating in a non-reclosing mode when the NON RECLOSING red indicator is illuminated. Non-reclosing mode disables any automatic reclosing operations. Non-reclosing does not alter the active TCC. Activation is possible from the SCADA port, I/O, the interface software, or locally (via the front panel). This functionality does not supervise AST.

## IMPORTANT

All AST functionality is blocked when SUPERVISORY OFF is Active on either control. When SUPERVISORY OFF is active the AST Ready and AST Active indicator LEDs will not be illuminated. If AST is Active and SUPERVISORY OFF is enabled, the AST Active mode will be reset and will not return when SUPERVISORY OFF is disabled.

### SUPERVISORY OFF

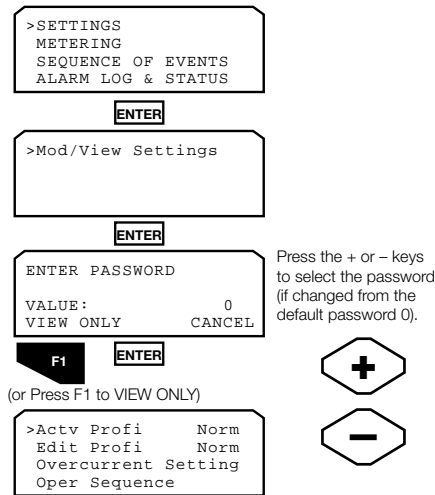
When the SUPERVISORY OFF red indicator is illuminated, supervisory commands are blocked. Supervisory functions through the back panel serial communication ports and the discrete I/O are blocked. Serial communications through the front panel RS-232 port remain active independent of the status of the SUPERVISORY OFF switch. Activation of this function key is restricted to the operator panel and is accomplished by pressing the CHANGE key and then pressing the SUPERVISORY OFF key. Operational data and metering information are available while the control is in the SUPERVISORY OFF position. The TRIP and CLOSE pushbuttons and Hot Line Tag are active independent of the SUPERVISORY OFF function.

### ALTERNATE PROFILE #1 and #2

The Form 6 control has four separate protection profiles; a Normal profile, and Alternate Profiles 1, 2, and 3. Each profile changes all protection parameters for the control. Only Alternate Profile #1 and Alternate Profile #2 have indication/selection keys on the control front panel. When the operator panel display lights are active and these two indicators are not illuminated, either the Normal Profile or Alternate Profile #3 is active. Only one profile can be active.

Since all profiles are not indicated on the front panel always

verify the active profile (Figure 6) prior to programming or interrogating the control.



**Figure 6. Menu path to verify active profile from Form 6 AST control front panel.**

### IMPORTANT

Unused alternate profiles should be programmed with the same settings as one of the applicable profiles. Default settings on unused alternate profiles can cause unnecessary outages if they are below normal system requirements.

### IMPORTANT

Check minimum trip values prior to changing an alternate profile to avoid misoperation of the control under load conditions.

### SWAP PREFERRED

When the SWAP PREFERRED button is pressed, the LED will briefly illuminate to indicate that the Local and Remote Preferred control designations have been switched. The Preferred control is now the Alternate control and the Alternate control is now the Preferred control. If the SWAP PREFERRED button is pressed while the AST READY indicator LED is illuminated and AUTO RESTORATION is selected, the OPEN recloser will change from OPEN to CLOSED and the CLOSED recloser will change from CLOSED to OPEN. This ensures the system remains in an AST Ready state. The order of operation follows the status of the parallel or non-parallel setting.

**Note:** For the triple-single version of the control, the Swap Preferred function is located in the front panel LCD menu structure under WORKBENCH>WORKBENCH SWITCHES>SWAP PREFERRED.

### DISABLE AST

Pressing the DISABLE AST button will disable all automatic transfers based on undervoltage, overvoltage, or voltage

unbalance conditions. The Form 6 control will still operate based on its TCC curves. When the LED is illuminated, AST functionality is disabled.

### AUTO/MANUAL RESTORATION and AUTO/MANUAL INITIATION

**Note:** Auto Restoration and Auto Initiation are control modes and are not settings in the scheme file. They are persistent and will remain in the same state through a power cycle of the control. If a new control program is loaded, the modes will be reset.

These two LED mode indicators are related to each other. One of three restoration/initiation modes is always active: Manual Restoration/Manual Initiation, Auto Restoration/Manual Initiation, and Auto Restoration/Auto Initiation.

**Note:** Manual Restoration/Auto Initiation is not a valid option; if Manual Restoration is selected, Manual Initiation will automatically be selected also. If the button LED is illuminated, the mode is auto.

The same LED is illuminated on both controls because both controls are always in the same restoration mode. Changing the mode on either control will automatically change the mode on the other control and the LED will respond accordingly.

Three automatic source transfer response modes are available:

- Manual Restoration/Manual Initiation: This is the default AST response setting for the two controls. When the controls are in Manual Restoration/Manual Initiation mode, pressing the TRIP or CLOSE pushbuttons will only affect that one control. This removes the control from AST Active mode and no automatic switching will occur until the system is returned to Normal. Both controls must be manually Tripped or Closed from their respective front panel as appropriate to transform the system back to normal and achieve AST Ready status.
- Automatic Restoration, Manual Initiation: After an AST event has occurred (AST Active status) and voltage has been restored, one of these actions must occur to return the controls to AST Ready status:
  - From the Preferred Device: Press the CLOSE button or send a SCADA Close command to manually close the preferred recloser. This action will automatically trip open the alternate recloser. Action is parallel.
  - From the Alternate Device: Press the TRIP button or send a SCADA Trip command to manually trip open the alternate recloser. This will automatically close the preferred recloser. Action is non-parallel.
- Automatic Restoration, Automatic Initiation: If the critical load has switched over to the alternate source due to an AST event, the controls will automatically switch back to

the primary source once voltage has been restored for a time exceeding the user-selected Restore Time.

**Note:** When the controls are in this fully automatic source restoration mode, manually initiating a TRIP or CLOSE from the front panel will prevent the control from automatically returning to AST Ready status (if voltage is not present):

- Pressing the TRIP button will trip the CLOSED recloser. AST will no longer be active, but the control will not be AST Ready either.
- Pressing the CLOSE button will not close the OPEN recloser. A Failure to Close alarm will assert.

## Additional AST information

### Sync check

Sync Check is an underlying function of the Form 6 Control. Sync Check parameters define the conditions required to close a mechanism that has two potentially independent sources on either side of it.

If the Sync Check function is enabled, it takes precedence over AST functionality. If the AST initiates a Close, but Sync Check determines the conditions are not appropriate, the Form 6 control will not Close. If the Sync Check Fail to Close Timer expires before appropriate closing conditions occur, the Form 6 control will transition to Lockout, cancel the closing attempt, and issue a Sync Close Alarm.

### Fast AST

When using the Fast AST Mode, use of the High Current Trip feature in the Form 6 control is recommended - in addition to use of TCC curves.

If the Automatic Restoration mode of the AST system is used in the Fast AST Mode, it is recommended that the Restoration Delay be set for a minimum of ten seconds.

### Sequence of events (SOEs)

In addition to the standard Form 6 control events, the Sequence of Events log will record the following AST state changes:

- **AST READY:** Indicates the device either transitioned from an AST ACTIVE state back to an AST READY state or the device went from an AST NOT READY state to an AST READY state.
- **AST NOT READY:** Indicates the device either transitioned from an AST READY state to an AST ACTIVE state or the device is not AST READY.
- **AST ACTIVE:** Indicates the device either transitioned from an AST READY state to an AST ACTIVE state or the device went from an AST NOT ACTIVE state to an AST ACTIVE state.

- **AST NOT ACTIVE:** Indicates the device either transitioned from an AST ACTIVE state to an AST READY state or the device is not AST ACTIVE.
- **LOAD SERVED:** Indicates the load is being served by either device.
- **LOAD NOT SERVED:** Indicates the load is not being served by either device.
- **LOCAL PREFERRED:** Indicates the device is the preferred device.
- **REMOTE PREFERRED:** Indicates the device is not the preferred device.
- **DEVICE 1 VALID:** Device #2 is receiving information from Device #1 via the PeerComm protocol. This is a Device #2 event only.
- **DEVICE 1 INVALID:** Device #2 is not receiving information from Device #1 via the PeerComm protocol. This is a Device #2 event only.
- **DEVICE 2 VALID:** Device #1 is receiving information from Device #2 via the PeerComm protocol. This is a Device #1 event only.
- **DEVICE 2 INVALID:** Device #1 is not receiving information from Device #2 via the PeerComm protocol. This is a Device #1 event only.
- **SIMULATOR ON:** Indicates that the voltage simulator was turned on.
- **SIMULATOR OFF:** Indicates that the voltage simulator was turned off or timed out due to inactivity.
- **AST DISABLED:** Indicates that AST functionality is disabled.
- **AST ENABLED:** Indicates that AST functionality is enabled.
- **AUTO REST MODE:** Indicates that the AST restoration mode was changed to Auto restoration.
- **MANUAL REST MODE:** Indicates that the AST restoration mode was changed to manual restoration.
- **AUTO INIT MODE:** Indicates that the AST restoration initiation mode was changed to auto initiation.
- **MANUAL INIT MODE:** Indicates that the AST restoration initiation mode was changed to manual initiation.
- **OVRLD COND ON:** Indicates conditions are set, so that a transfer cannot occur due to overload conditions.
- **OVRLD COND OFF:** Indicates conditions are set, so that a transfer can occur.

Refer to *Form 6 Recloser Control Programming Guide* for a complete list of all standard Form 6 control events and definitions.

### **PeerComm protocol text message**

If PeerComm protocol communications are not valid between the two devices, this text message will appear on both Form 6 front panel MMIs:

PeerComm  
Communications  
Not  
Valid

An event will also be recorded in the SOE log (Device 1 Invalid or Device 2 Invalid).

### **PeerComm protocol status indication**

The status of the following indicators are mirrored across PeerComm protocol:

- AST READY
- AST ACTIVE
- LOCAL PREFERRED
- REMOTE PREFERRED
- SWAP PREFERRED
- AUTO RESTORATION
- AUTO INITIATION

### **Service information**

Refer to the Service Information that was provided with the Form 6 AST recloser control for additional information regarding control features, communications, back panel, installation, accessories, and testing.

*Service Information MN280013EN Form 6 Recloser Control Automatic Source Transfer (AST) Application Instructions* are to be used in conjunction with the instructions included with the control. When additional information is desired to satisfy a question not covered sufficiently for the user's purpose, contact your Eaton representative.

## Programming the automatic source transfer settings

### AST configuration settings

These user-adjustable AST settings can be set via the ProView application software or Form 6 control front panel menu option.

Refer to Figure 7 for the Device #1 and Device #2 AST Form 6 control front panel menu paths and setting options.

Figure 8 displays the ProView application software menu path to access the AST Configuration dialog box.

Figure 9 displays the AST Configuration dialog box for Device #1.

Figure 10 displays the AST Configuration dialog box for Device #2.

**Note:** All of these settings can only be set on Device #1. Even if you SWAP PREFERRED devices, and the designated Device #1 control becomes the Alternate device, you can still only set all of these settings on Device #1 (even though it is not the preferred device).

**Note:** These four settings must be set separately on Device #1 and Device #2: Overvoltage Threshold, Undervoltage Threshold, Overload Threshold, and Voltage Unbalance Threshold.

Figure 11 and 12 display the PeerComm Communication Settings dialog boxes: Ethernet and Serial.

---

### IMPORTANT

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The same ProView AST scheme types must be loaded on each device. Verify the ProView AST scheme corresponds with the Form 6 control device designation. Refer to Table 1.

• **TRANSFER DELAY:** This is the amount of time the preferred control waits after losing voltage before initiating the AST action.

**Note:** If Fast AST is enabled, this time is ignored.

• **RESTORATION DELAY:** When the control is in an automatic setting mode, this is the amount of time after the preferred voltage is restored before the source is switched back to the preferred control.

**Note:** The Transfer Time and Restore Time settings are the same for both controls and are set on Device 1.

• **FAST AST ENABLE:** This mode of operation ignores any intentional transfer time delay and non-parallel transfer.

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### WARNING

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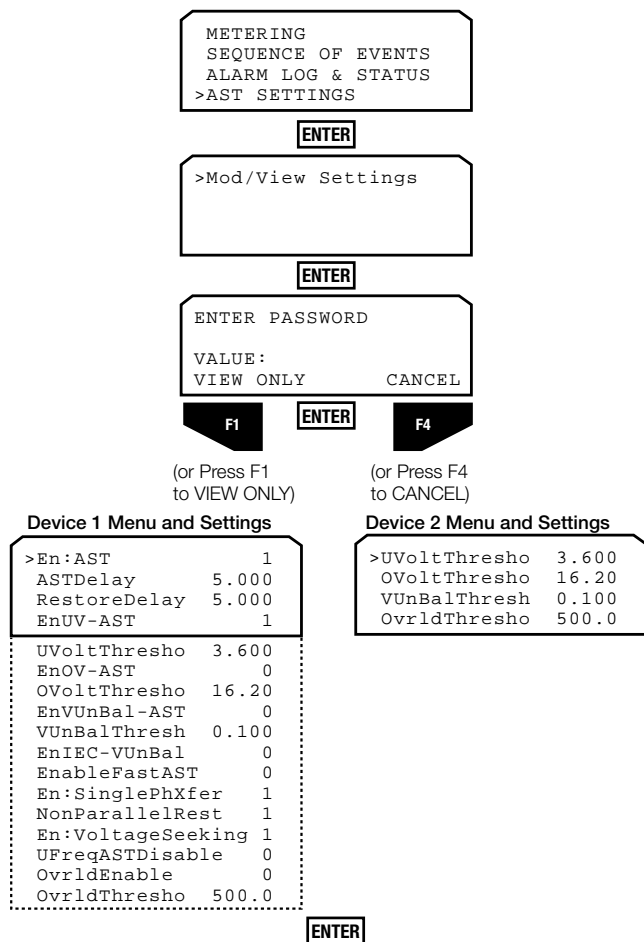
**Explosion hazard. Do not parallel substations that are electrically out of phase with each other as this may result in excessive overcurrents. Paralleling substations that are out of phase may result in explosion or other equipment damage that can cause death, severe personal injury, and additional equipment damage.**

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- **NON-PARALLEL RESTORATION:** When the setting is checked, the two sources will not be paralleled during restoration.
- **VOLTAGE SEEKING:** When enabled, allows for limited automatic reconfiguration in a system set for manual restoration or automatic restoration manual initiation. The device that senses loss of voltage will transfer to the device that has voltage. This will continue without manual intervention
- **AST ACTION ON SINGLE PHASE VOLTAGE EVENT:** This setting causes the AST to transfer if there is a voltage event (loss of voltage, voltage unbalance, overvoltage) on any one phase, or any combination of phases.
- **OVERVOLTAGE TRANSFER ENABLE:** When activated, AST will check for overvoltage condition in the preferred source before transfer is initiated.
- **OVERVOLTAGE THRESHOLD:** The voltage above which source transfer is initiated. This is set independently for each control. Setting range is 0.5 kV to 200.0 kV (line-to-neutral).
- **UNDERVOLTAGE TRANSFER ENABLE:** When activated, AST will check for undervoltage condition before transfer is initiated.
- **UNDERVOLTAGE THRESHOLD:** The voltage below which source transfer is initiated. This is set independently for each control. Setting range is 0.5 kV to 200.0 kV (line-to-neutral).
- **OVERLOAD SUPERVISION ENABLE:** When activated, AST will check for overload condition in the alternate source before transfer is initiated.
- **OVERLOAD THRESHOLD:** This is the current threshold in the alternate source which, when exceeded, source transfer is not permitted. Setting range is 20 A to 2500 A.
- **UNDERFREQUENCY DISABLE:** When activated, AST will check for underfrequency condition. If an underfrequency condition is detected, AST functionality will be disabled.
- **UNDERFREQUENCY PICKUP:** AST uses the Form 6 control Frequency setting for this functionality.
- **VOLTAGE UNBALANCE ENABLE:** When activated, AST will check for voltage unbalance condition before transfer is initiated.
- **IEC VOLTAGE UNBALANCE ENABLE:** When activated, voltage unbalance transfers will be initiated using the IEC method for calculation. When the setting is not enabled, the NEMA method is used. Refer to **Description of AST Function in Product Information** section for additional information.
- **VOLTAGE UNBALANCE THRESHOLD:** This is the voltage unbalance factor in the preferred source which, when exceed, source transfer is initiated. The threshold will range between 0-1. (Enter percentages in decimal form.)

Refer to *Form 6 Recloser Control Programming Guide* for additional instructions to program the Form 6 control and ProView interface software.





**Figure 7. Form 6 Device #1 and Device #2 front panel menu paths and setting options.**

**WARNING**

**Explosion hazard. Do not parallel substations that are electrically out of phase with each other as this may result in excessive overcurrents. Paralleling substations that are out of phase may result in explosion or other equipment damage that can cause death, severe personal injury, and additional equipment damage** T350.0

This user-adjustable AST setting can only be set via the ProView application software.

- VOLTAGE SIMULATOR TIMEOUT: This setting is provided to allow for the Voltage Simulator to be automatically disabled after a period of inactivity. This will prevent the Voltage Simulator from being inadvertently left active.

**Note:** Activity is defined as the clicking any of the three AST Voltage Simulator buttons in the ProView software for either control (Toggle Source 1, Toggle Source 2, Toggle Simulator).

**IMPORTANT**

The Voltage Simulator Timeout setting is not setting-group dependent.

**PeerComm communication network settings**

User-adjustable PeerComm Communication settings can be accessed via the ProView application software Automatic Source Transfer dialog boxes by clicking the Edit PeerComm Settings button.

**Serial AST (Figure 11)**

- PeerComm Arbitration Timeout – This setting relates to the amount of time the device waits before declaring another device as having invalid PeerComm communications. It is recommended that this setting not be changed unless otherwise directed by factory personnel. The default is 20.
- PeerComm Baud Rate – This setting selects the baud rate for PeerComm messaging from this device. Both devices need to be set to the same baud rate. The default is 5 (57600 baud).
- PeerComm Port – This setting selects the rear communications port that will be used for the PeerComm communications. This setting **MUST** be set to a different port than the SCADA protocol in the Communications Workbench. The default is 1 (RS-485/Fiber).
- PeerComm Transmit Disable Delay – PeerComm Transmit Disable Delay (msec). It is recommended that this setting not be changed unless otherwise directed by factory personnel. The default is 0.
- PeerComm Transmit Enable Delay – PeerComm Transmit Enable Delay (msec). It is recommended that this setting not be changed unless otherwise directed by factory personnel. The default is 0.

**Ethernet AST (Figure 12)**

- Device 1 Name – This should be a unique name to identify Device 1. This setting **MUST** match “Device 1 Name” in the other device (case sensitive). The default is “AST Device 1”.
- Device 2 Name – This should be a unique name to identify Device 2. This setting **MUST** match “Device 2 Name” in the other device (case sensitive). The default is “AST Device 2”.
- Enable VLAN Tagging – Changing this setting to 1 will enable VLAN tagging. The default is 0.
- VLAN ID – If VLAN tagging is enabled, this will set the ID number for outbound packets from this device. Both devices must have the same VLAN ID. The default is 10.
- PeerComm Transmit Delay – Increasing this time (in seconds) will delay transmission of new PeerComm Ethernet Packets when there is no change in the devices (excluding analog values). The default is 30.



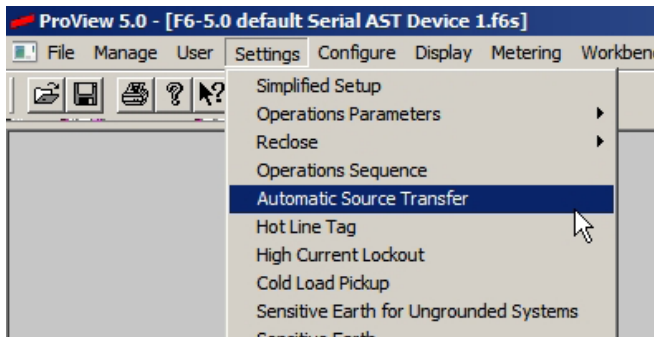


Figure 8. Menu path to access the AST configuration dialog box via the ProView application software.

**WARNING**

Explosion hazard. Do not parallel substations that are electrically out of phase with each other as this may result in excessive overcurrents. Paralleling substations that are out of phase may result in explosion or other equipment damage that can cause death, severe personal injury, and additional equipment damage

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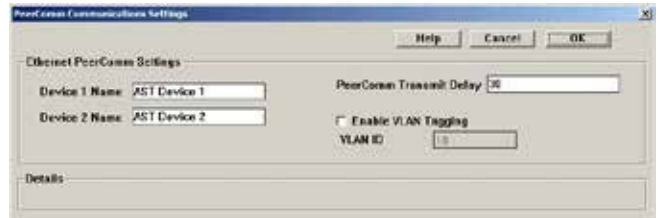


Figure 11. PeerComm Communications Network Ethernet settings dialog box.



Figure 12. PeerComm Communications Network Serial settings dialog box.

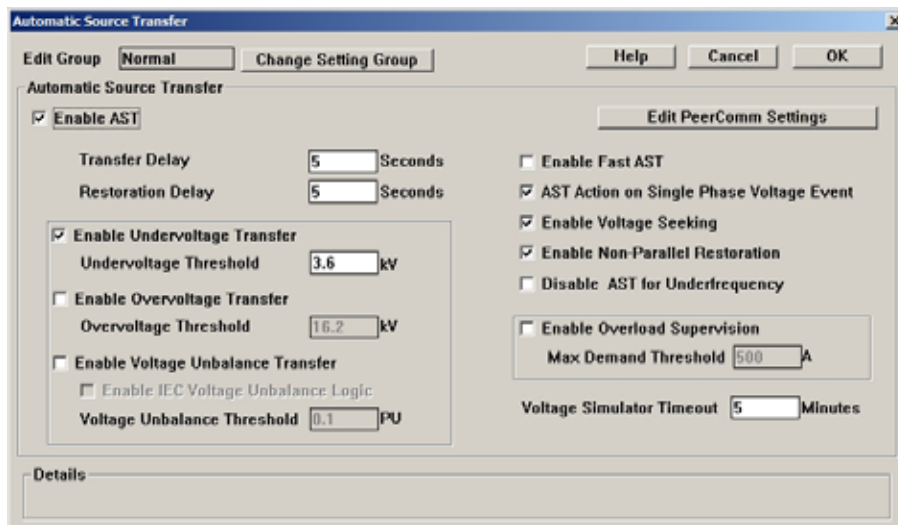


Figure 9. Device #1 AST Configuration dialog box.

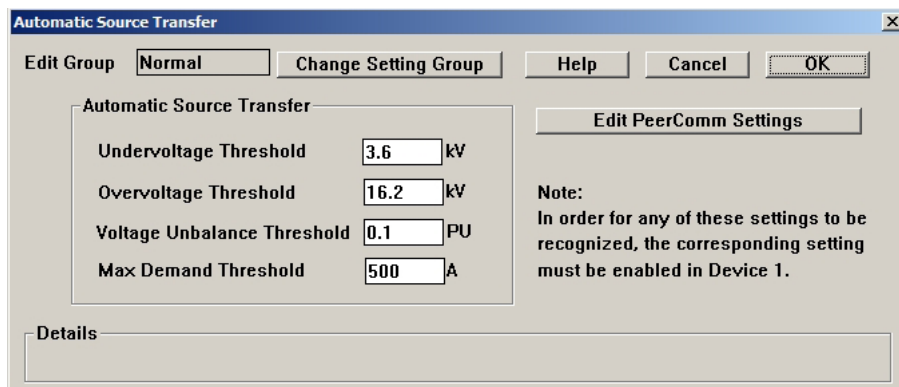


Figure 10. Device #2 AST Configuration dialog box.

**IMPORTANT**

Enabling the undervoltage or overvoltage options inherent in the standard Form 6 control could cause conflicts with the AST scheme. It is recommended that the standard Form 6 control undervoltage or overvoltage functions not be enabled when the AST functionality is enabled.

# AST application diagram

The AST Application Diagram (Figures 13 and 14) provides a display of the voltages, currents, and AST status of the two connected Form 6 AST recloser controls (Preferred source and Alternate source). When connecting online, this live display of the connected reclosers provides a quick summary of the distribution system and the AST functions. The application diagram provides a quick system overview via ProView software connection.

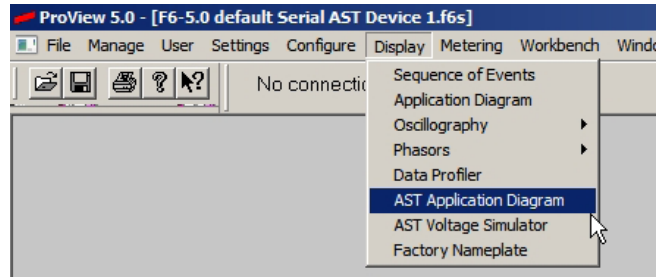


Figure 13. Menu path to access the AST Application Diagram.

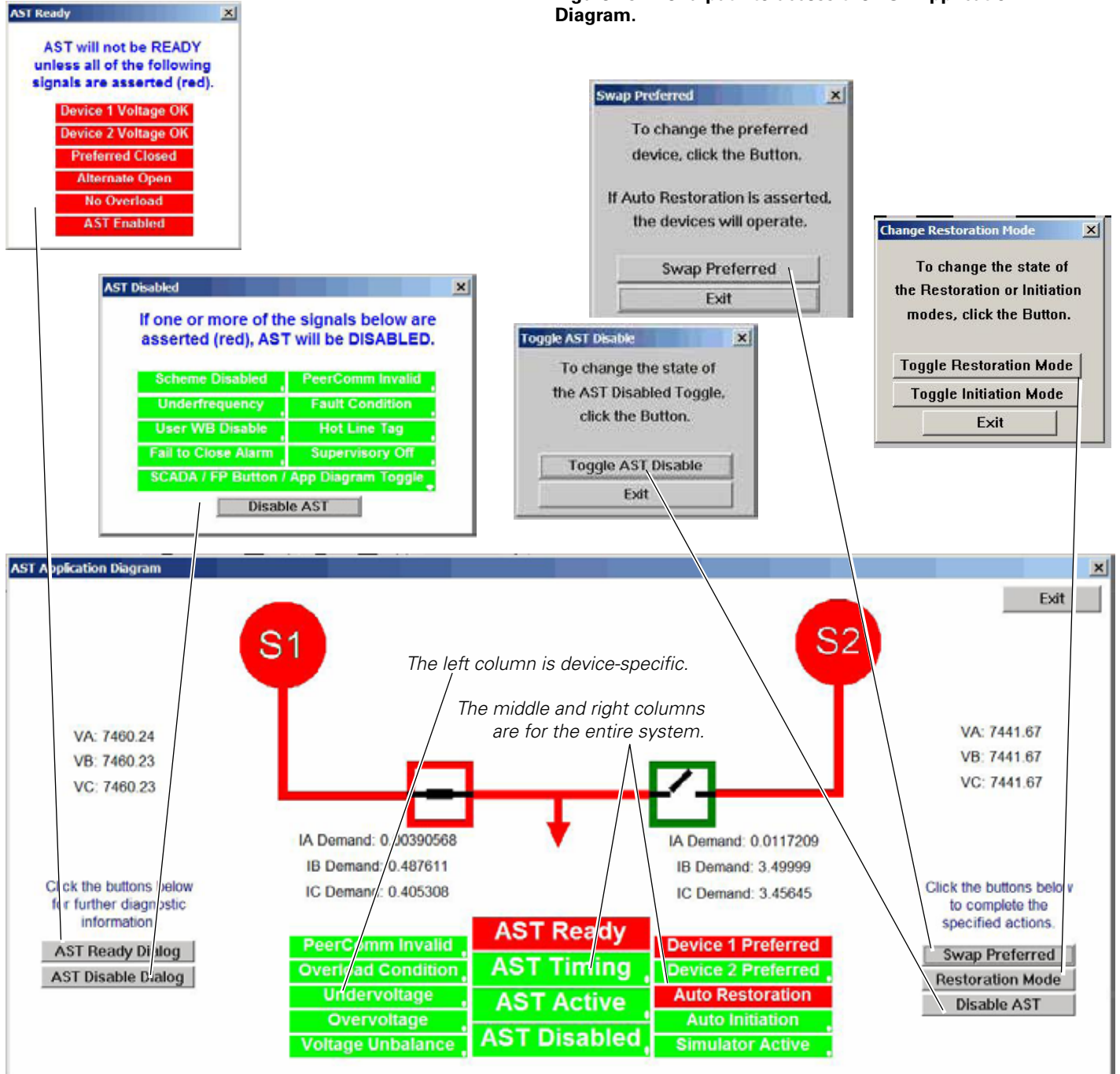


Figure 14. Appearance of Form 6 AST Application Diagram.

The AST Application Diagram also provides access to diagnostic information and three AST functions that are also available via control front panel pushbutton.

**AST Ready Dialog button:** Clicking on this button will help to diagnose possible reasons why the AST Ready functionality is or is not asserted.

**AST Disable Dialog button:** Clicking on this button will help to diagnose possible reasons why the AST functionality is or is not disabled.

**Swap Preferred button:** The SWAP PREFERRED button can be used to change the Preferred and Alternate device designations. If the SWAP PREFERRED button is pressed while the AST READY indicator LED is illuminated and AUTO RESTORATION is selected, the OPEN recloser will change from OPEN to CLOSED and the CLOSED recloser will change from CLOSED to OPEN. This ensures the system remains in an AST Ready state. The order of operation follows the status of the parallel or non-parallel setting.

**Restoration Mode button:** When the Restoration Mode button is clicked on, the user can choose to toggle the restoration mode and/or initiation mode.

One of three restoration/initiation modes is always active: Manual Restoration/Manual Initiation, Auto Restoration/Manual Initiation, and Auto Restoration/Auto Initiation.

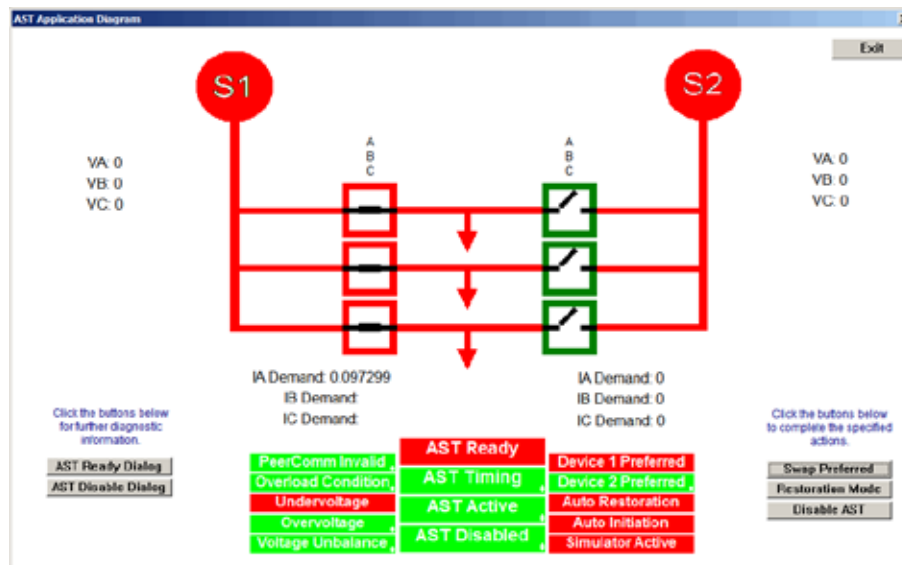
**Note:** Manual Restoration/Auto Initiation is not a valid option; if Manual Restoration is selected, Manual Initiation will automatically be selected also. If the Auto Restoration block in the AST Application Diagram is red, the mode is auto. If the Auto Initiation block in the AST Application Diagram is red, the mode auto.

Both controls are always in the same restoration mode. Changing the mode on either control will automatically change the mode on the other control and the AUTO REST and AUTO INIT statuses will respond accordingly.

Three automatic source transfer response modes are available:

- **Manual Restoration/Manual Initiation:** This is the default AST response setting for the two controls. When the controls are in Manual Restoration/Manual Initiation mode, pressing the TRIP or CLOSE pushbuttons will only affect that one control. This removes the control from AST Active mode and no automatic switching will occur until the system is returned to Normal. Both controls must be manually Tripped or Closed from their respective front panel as appropriate to transform the system back to normal and achieve AST Ready status.
- **Automatic Restoration, Manual Initiation:** After an AST event has occurred (AST Active status) and voltage has been restored, one of these actions must occur to return the controls to AST Ready status:
  - From the Preferred Device: Press the CLOSE button to manually close the preferred recloser. This action will automatically trip open the alternate recloser. Action is parallel.
  - From the Alternate Device: Press the TRIP button to manually trip open the alternate recloser. This will automatically close the preferred recloser. Action is non-parallel.
- **Automatic Restoration, Automatic Initiation:** If the critical load has switched over to the alternate source due to an AST event, the controls will automatically switch back to the primary source once voltage has been restored for a time exceeding the user-selected Restore Time.

**Note:** When the controls are in this fully automatic source restoration mode, manually initiating a TRIP or CLOSE from the front panel will prevent the control from automatically returning to AST Ready status (if voltage is not present):



- Pressing the TRIP button will trip the CLOSED recloser. AST will no longer be active, but the control will not be AST Ready either.
- Pressing the CLOSE button will not close the OPEN recloser. A Failure to Close alarm will assert.

**Disable AST button:** When the Disable AST button is clicked on, the user toggles between enabling or disabling all automatic transfers based on undervoltage, overvoltage, or voltage unbalance conditions. If AST functionality is disabled, the Form 6 control will still operate based on its TCC curves.

Figure 15. Appearance of Form 6-TS AST Application Diagram.

## AST voltage simulator

The AST Voltage Simulator is provided to simulate undervoltage conditions during testing and commissioning of the AST system.

**Note:** To use the AST Voltage Simulator, actual reclosers or a recloser test set (i.e. Type MET Electronic Recloser Control Tester) must be connected to the controls.

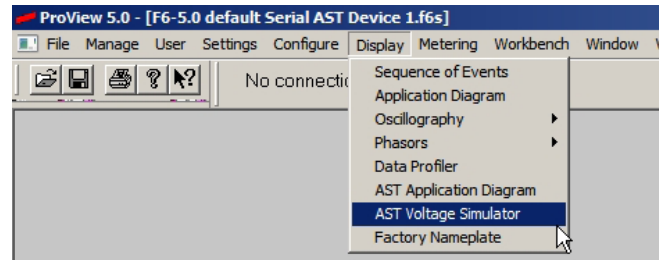
When the simulator is active, actual source voltages are not monitored. The simulator overrides all enable settings and directly controls the "Voltage Ok" signal.

Press the Toggle Simulator button to enable or disable the AST Voltage Simulator function. When the AST Voltage Simulator is active, press the corresponding button on the AST Voltage Simulator diagram to toggle Source 1 and/or Source 2 ON and OFF. The system will react as if there were an actual voltage loss on the specified source by opening the preferred device and closing the alternate device.

### IMPORTANT

When ProView software is connected to the device, the recloser(s) will respond to any command issued from the AST Voltage Simulator regardless of the Online or Offline status of the ProView Software. ProView must be Online to see confirmation of the response to a voltage event.

Always ensure that the two feeders can be paralleled together. To avoid nuisance outages while using the AST Voltage Simulator, the reclosers should be bypassed.



**Figure 16. Menu path to access the AST Voltage Simulator via ProView software connection.**

### IMPORTANT

When the AST Voltage Simulator is active, the ability for trip commands to be sent via PeerComm protocol due to actual voltage events is disabled.

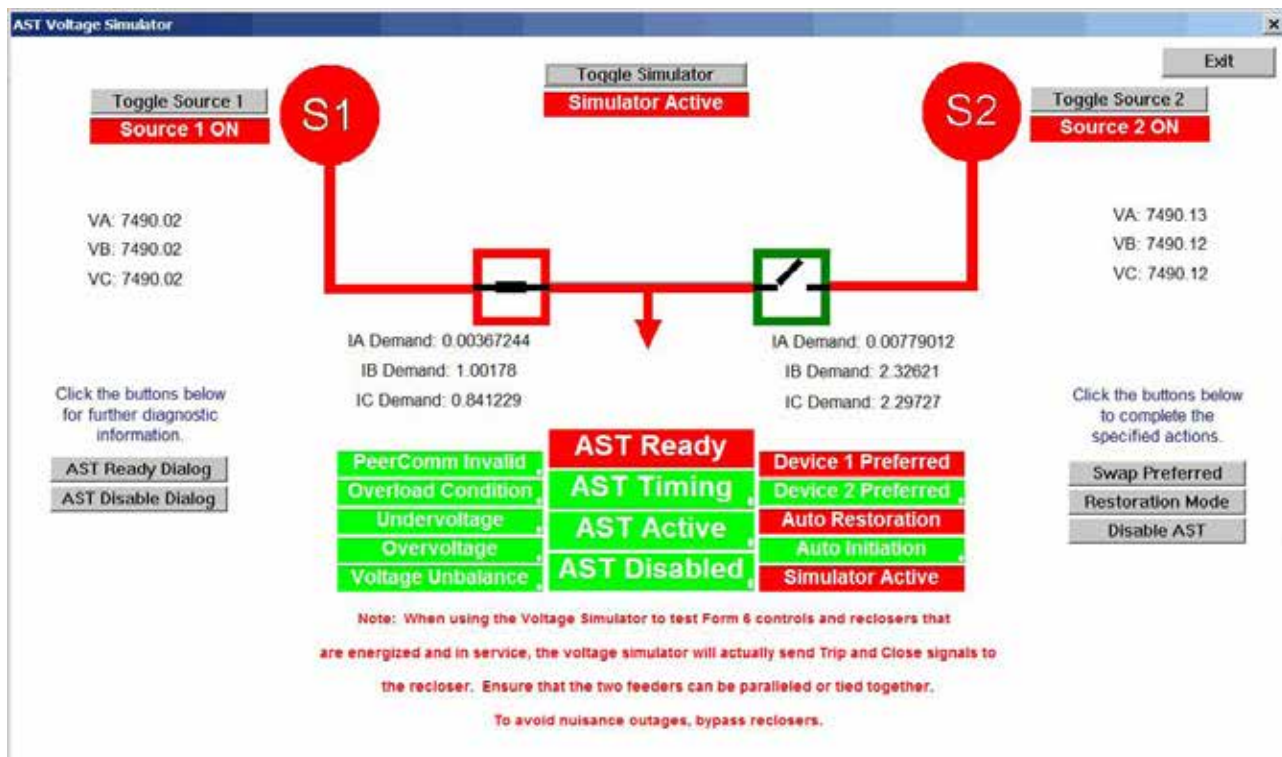
Figure 16 displays the ProView application software menu path to access the AST Voltage Simulator.

Figures 17 and 18 display the AST Voltage Simulator.

### WARNING

**Explosion hazard. Do not parallel substations that are electrically out of phase with each other as this may result in excessive overcurrents. Paralleling substations that are out of phase may result in explosion or other equipment damage that can cause death, severe personal injury, and additional equipment damage**

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**Figure 17. Example of appearance of Form 6 AST Voltage Simulator. The Voltage Simulator view is only "live" when the Form 6 AST ProView software scheme is connected to the Form 6 control.**



The AST Ready Dialog, AST Disable Dialog, Swap Preferred, Restoration Mode, and Disable AST buttons respond the same way as they do in the Application Diagram. Refer to the AST Application Diagram section of this manual for additional information.

A Voltage Simulator Timeout setting in the ProView software Device #1 AST Configuration dialog box is provided to allow for the Voltage Simulator to be automatically disabled after a period of inactivity. This will prevent the Voltage Simulator from being inadvertently left active.

**Note:** Activity is defined as the clicking any of the three AST Voltage Simulator buttons in the ProView software for either control (Toggle Source 1, Toggle Source 2, Toggle Simulator).

### IMPORTANT

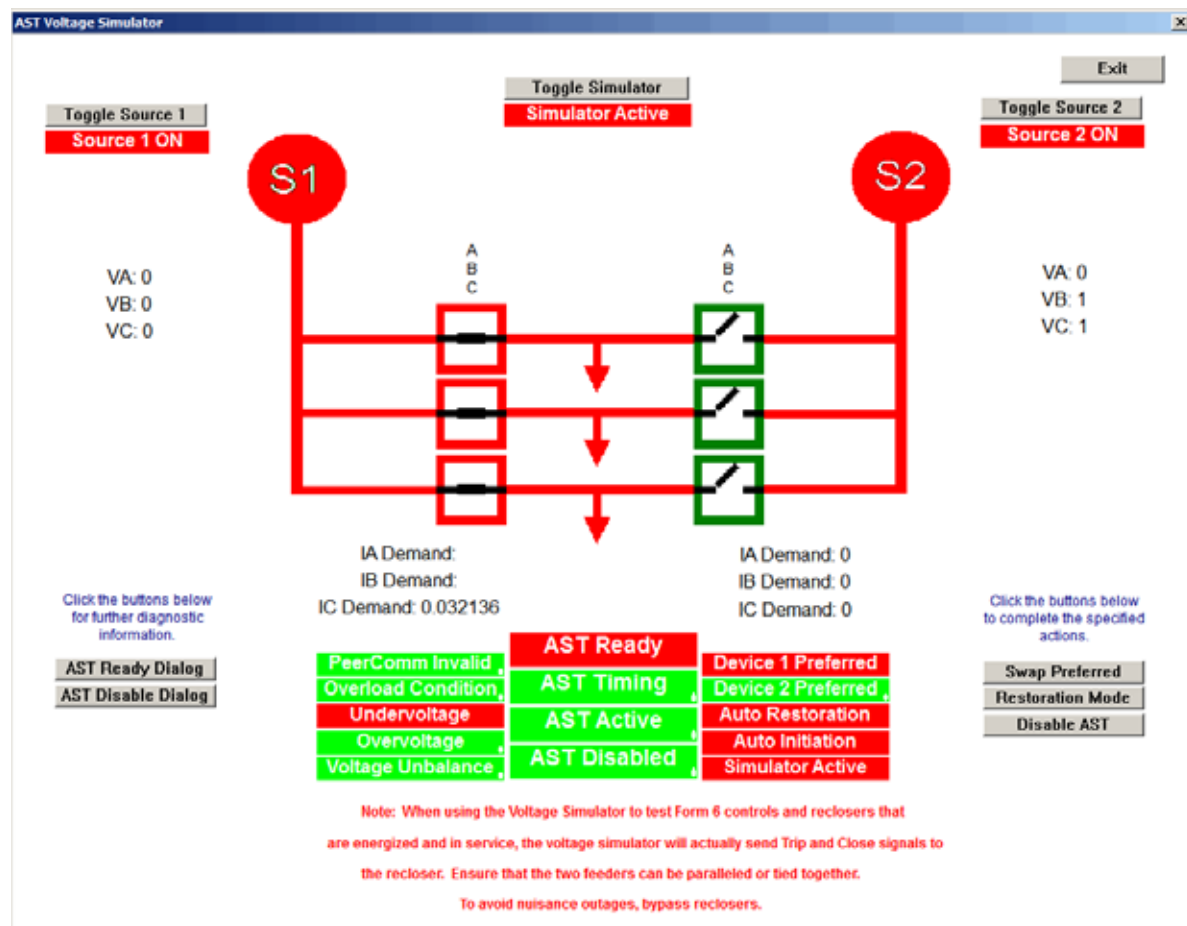
The Voltage Simulator Timeout setting is not setting-group dependent.

## Automatic source transfer Idea Workbench container

The Automatic Source Transfer Idea Workbench container (Figures 19, 20, and 21) consists of three sections: Editable Logic, Viewable Logic, and Factory Logic.



**Figure 19. Location of Automatic Source Transfer Idea Workbench container.**



**Figure 18. Example of appearance of Form 6-TS AST Voltage Simulator. The Voltage Simulator view is only "live" when the Form 6-TS AST ProView software scheme is connected to the Form 6-TS control.**

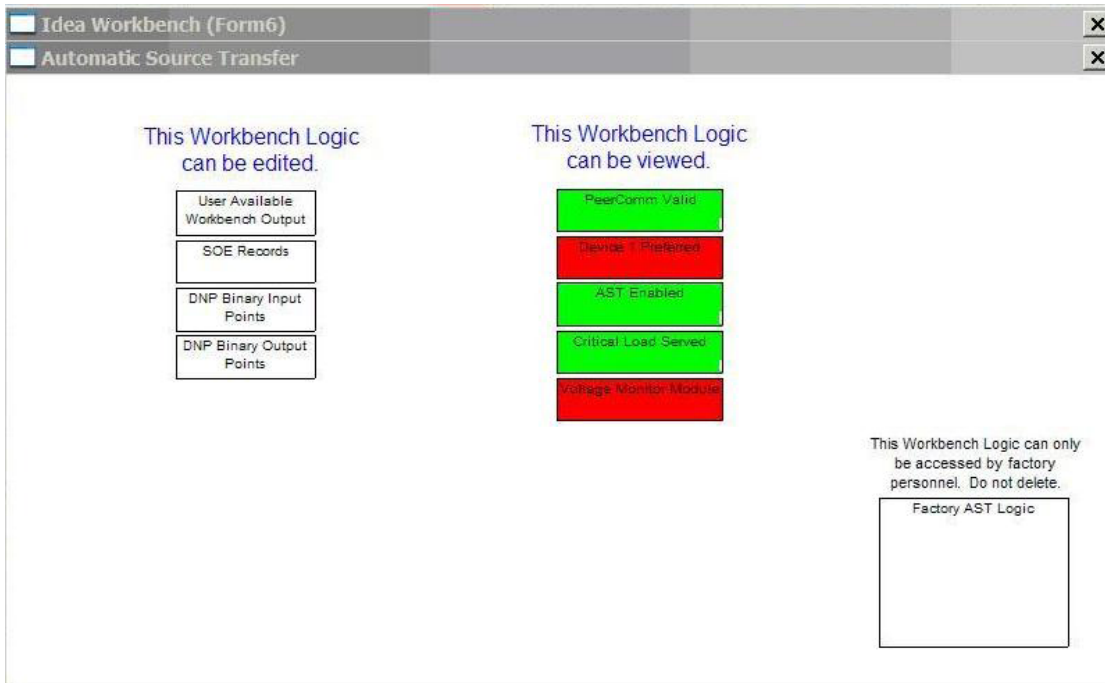


Figure 20. Device #1 Automatic Source Transfer Idea Workbench container.

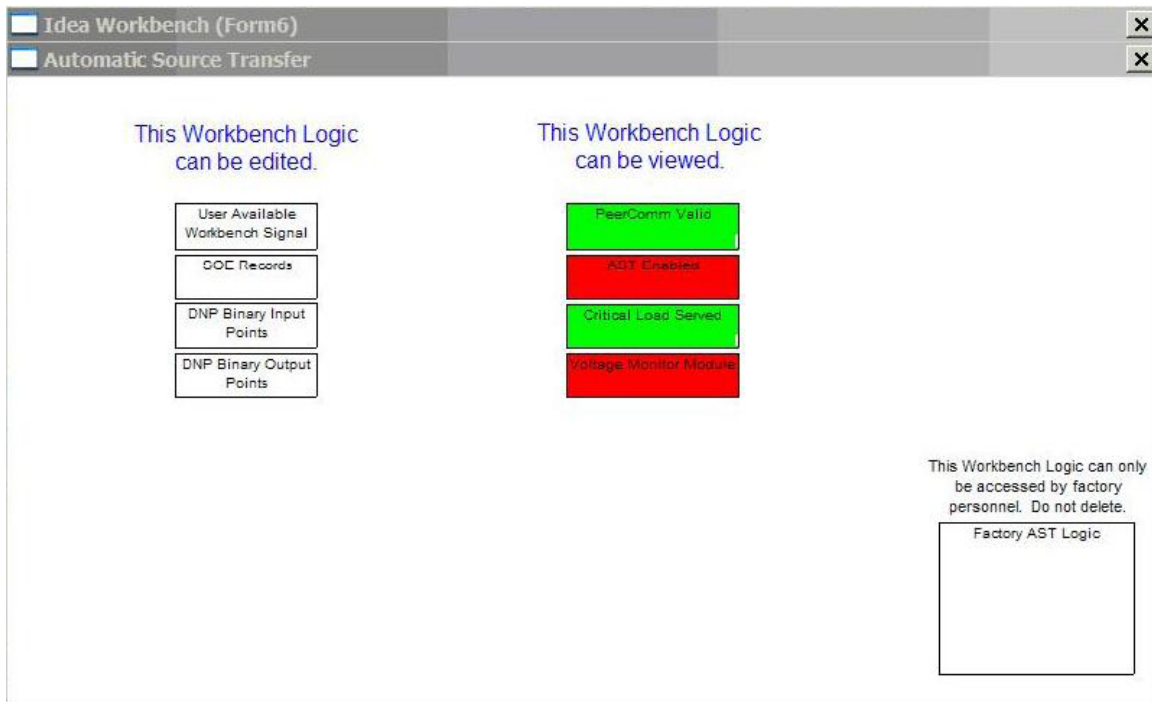


Figure 21. Device #2 Automatic Source Transfer Idea Workbench container.

### Editable Logic

This Workbench logic can be edited (Figure 22).

### User available Workbench output

The User Available Workbench Output block (Figure 23) contains a signal named WB(Disable AST). This signal is available in both controls and can be used to Disable the AST from the Workbench. To use the signal, connect another input to the input port of the WB(Disable AST) signal. The global input zero-byte can then be deleted.

This Workbench Logic can be edited.

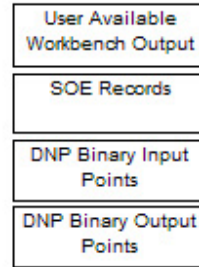


Figure 22. Workbench logic blocks that can be edited.

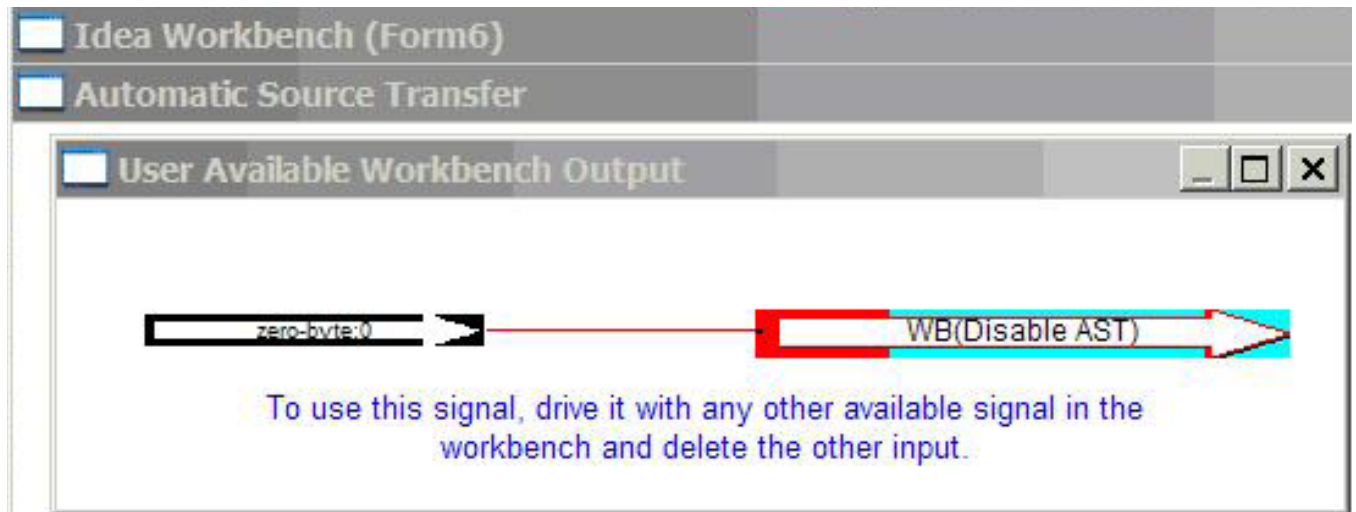


Figure 23. User Available Workbench Output block.

## SOE records

The SOE Records block contains the logic for the SOE (Sequence of Event) records related to the Automatic Source Transfer scheme. The input signals are different in the two schemes, but the SOE records are the same (Figures 24 and 25).

This logic can be modified as desired. The SOE signals can be deleted or new signals can be added. The signals correspond to the ProView software Workbench> Workbench Status Output to MMI and SOE settings menu. Refer to Sequence of Events (SOEs) in the Additional AST Information section of these instructions for additional information. For additional information regarding programming new SOE records refer to Form 6 Control ProView Programming Guide.

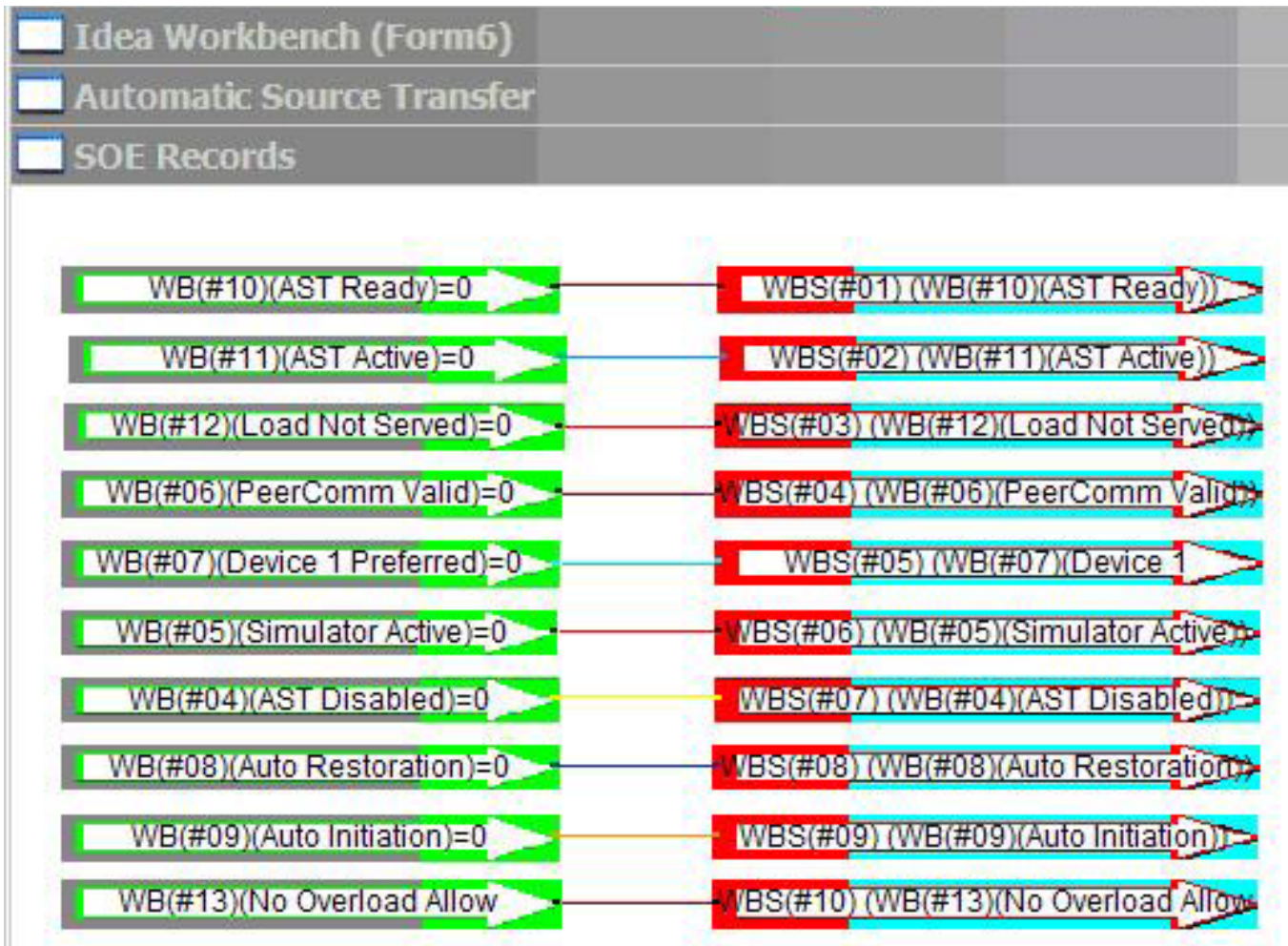


Figure 24. Device #1 SOE Records logic.



- Idea Workbench (Form6)
- Automatic Source Transfer
- SOE Records



Figure 25. Device #2 SOE Records logic.

### DNP binary input points

The DNP Binary Input Points block contains the logic for the DNP Binary Input Points related to the Automatic Source Transfer scheme. The input signals are different in the two schemes, but the binary input points list is the same (Table 3).

These signals are user-customizable (add/delete as desired):

- AST Disabled
- PeerComm Valid
- Simulator Active
- AST Ready
- AST Active
- Load NOT Served
- Local Device Preferred
- Auto Restoration
- Auto Initiation
- No Overload Condition

### DNP binary output points

The DNP Binary Output Points block contains the logic for the DNP Binary Output points related to the Automatic Source Transfer scheme (Table 4). The logic is the same and the points are available in both devices.

These are the default points:

- Swap Preferred
- Toggle Auto Restoration
- Toggle Auto Initiation
- Toggle AST Disable

These points are user-customizable, but the output point must not be deleted. When a point is removed from the DNP point list (BO input deleted), a logic (byte) setting with the value of zero should be connected to the Workbench Output. If the Workbench Output is deleted, the scheme will not compile.

**Table 4. Binary Output Points**

Index Number	Point Name	Point Description
32	Swap Preferred	
33	Toggle Auto Rest	Refer to Option buttons descriptions
34	Toggle Auto Init	
35	Toggle AST Disable	

**Table 3. Binary Input Points**

Three-Phase AST Index Number	Triple-Single AST Index Number	Point Name	Point Description
60	73	AST Disabled	AST functionality is disabled.
61	74	PeerComm Valid	PeerComm communications are valid at this device.
62	75	Simulator Active	The voltage simulator is active and the AST will respond only to events initiated by the simulator. Actual source voltages are not being monitored.
63	76	AST Ready	Indicates both controls are ready to respond to an AST event.
64	77	AST Active	Indicates an automatic source transfer occurred and the critical load is served by the alternate source.
65	78	Load Not Served	Indicates all three phases of the critical load are not being served by either device.
66	79	Local Device Preferred	Indicates the device is the preferred device used to power the critical load.
67	80	Auto Restoration	Automatic Restoration mode is active.
68	81	Auto Initiation	Automatic Restoration with automatic initiation mode is active.
69	82	No Overload Condition	Conditions are set such that a transfer will not be blocked due to overload conditions.

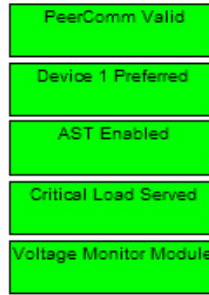
**Viewable logic**

This Workbench logic can be viewed (Figure 26), but not modified. When viewed in online mode, the block colors will change as the control updates. If the logic is green, the output is de-asserted. If the logic is red, the output is asserted. These blocks can help diagnose various system conditions.

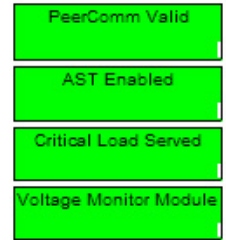
**PeerComm valid**

The PeerComm Valid block contains the logic for the PeerComm Valid signal (Figures 27 and 28). If the Device Valid signal is de-asserted for the length of time in the PeerComm Invalid Timeout (40 seconds), the control will 'say' PeerComm is not valid until communications have returned. When PeerComm becomes invalid, a text message will be displayed on the front panel. When communications return, that text message will no longer be displayed.

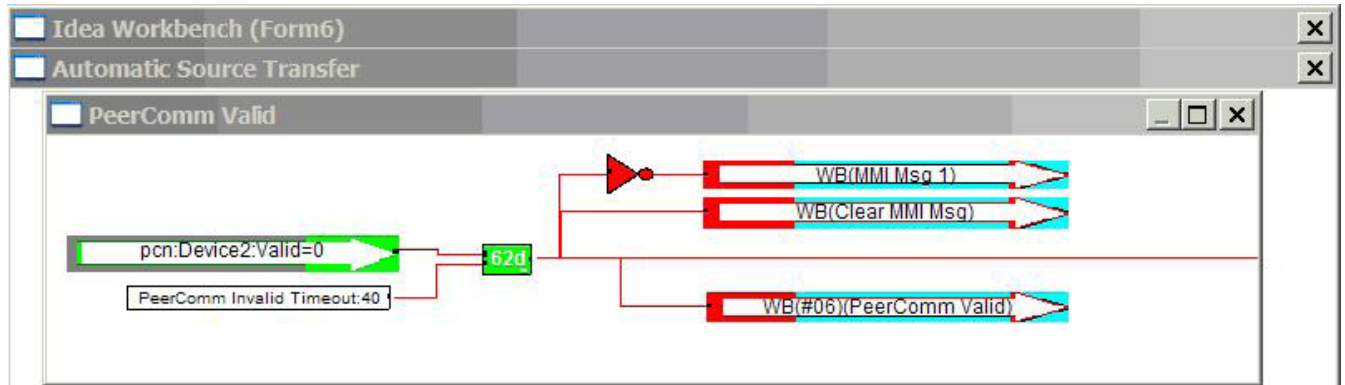
This Workbench Logic can be viewed.



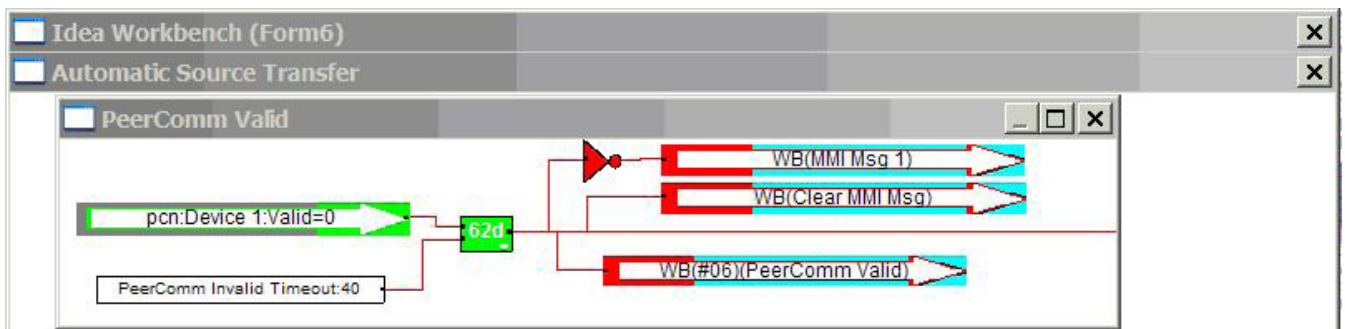
This Workbench Logic can be viewed.



**Figure 26. Workbench logic blocks that can be viewed, but not edited. (Device #1 left; Device #2 right.)**



**Figure 27. Device #1 PeerComm Valid logic.**



**Figure 28. Device #2 PeerComm Valid logic.**

### Device 1 preferred

The Device 1 Preferred block logic is viewable in Device 1 only and shows the status of the Preferred device (Figure 29). The default setting is Device 1 preferred. When the status is changed, the new state is stored in non-volatile memory. The state can be changed using any of three methods in either control: Application Diagram, Front Panel Option Pushbutton, or DNP Binary Output.

### AST enabled

The AST Enabled block contains the logic for AST Enabled/ Disabled (Figures 30 and 31). If AST is Disabled, it will be shown in this block if it is viewed in online mode. A majority of the logic resides in Device 1, but the signals are shared between the two devices through the PeerComm network and the AST scheme will be disabled in both controls if it is disabled in one.

The Check for HLT or SO modes and failure to close alarms (Figure 32) and No Fault Condition Present (Figure 33) blocks can be viewed by clicking on them. This can help to further diagnose what signal and which device has caused AST functionality to be disabled.

Multiple items can disable the AST scheme simultaneously. For AST to be enabled, all signals must allow it.

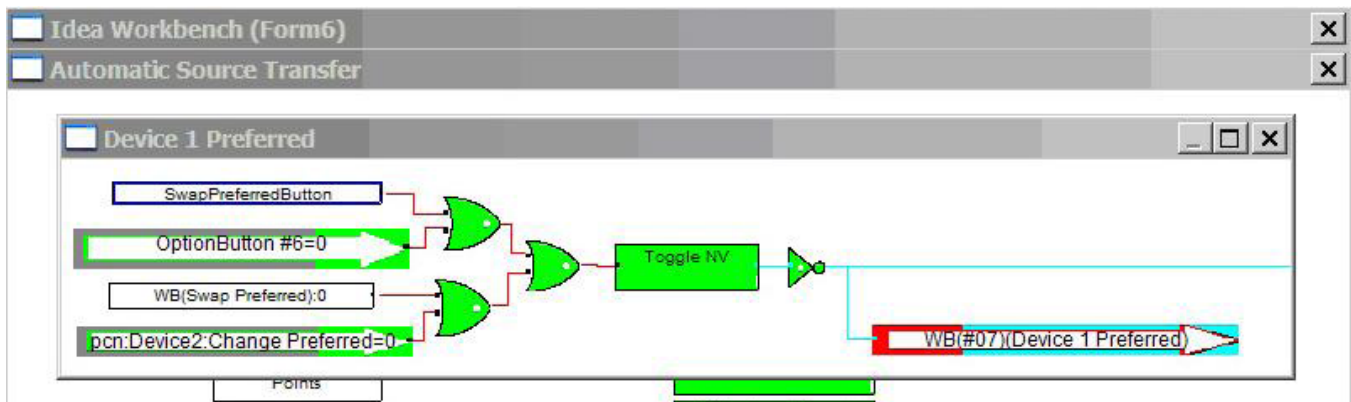


Figure 29. Device 1 Preferred logic.

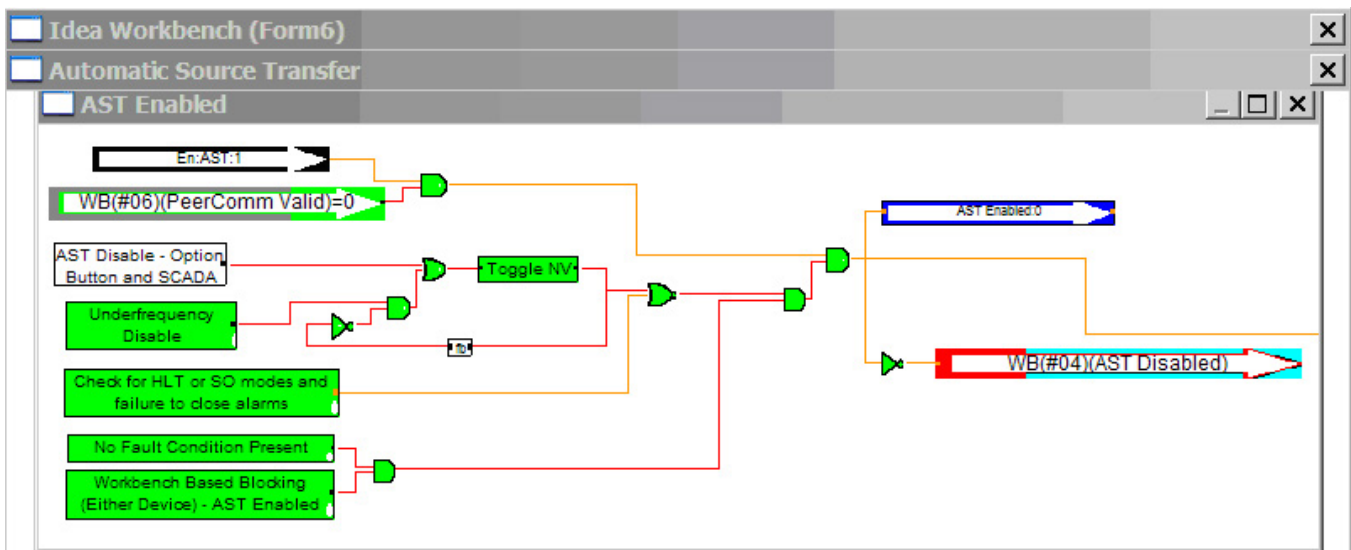


Figure 30. Device #1 AST Enabled logic.

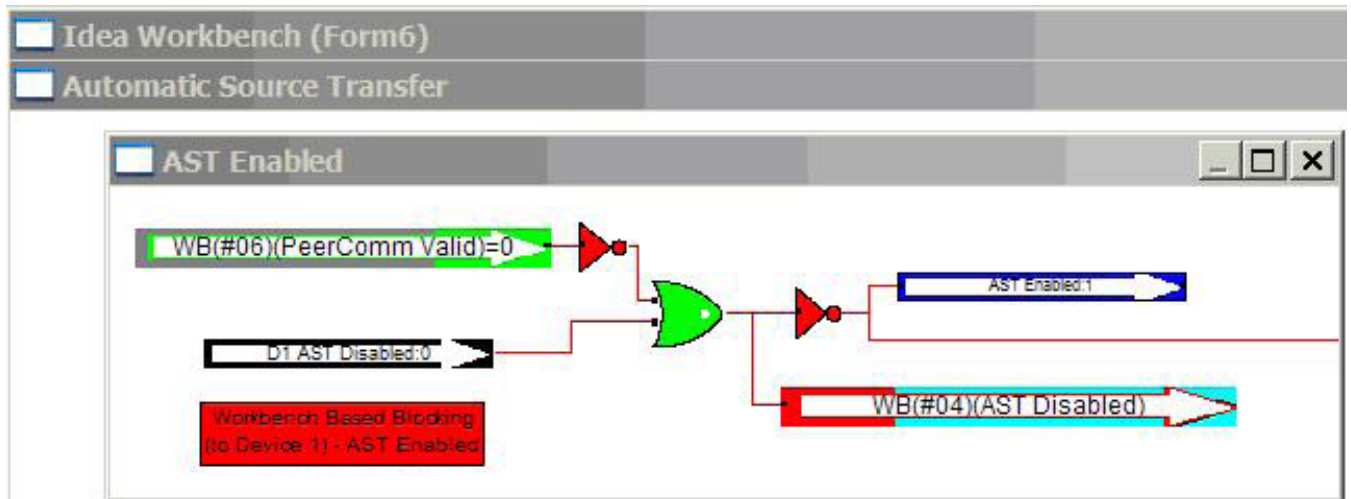


Figure 31. Device #2 AST Enabled logic.

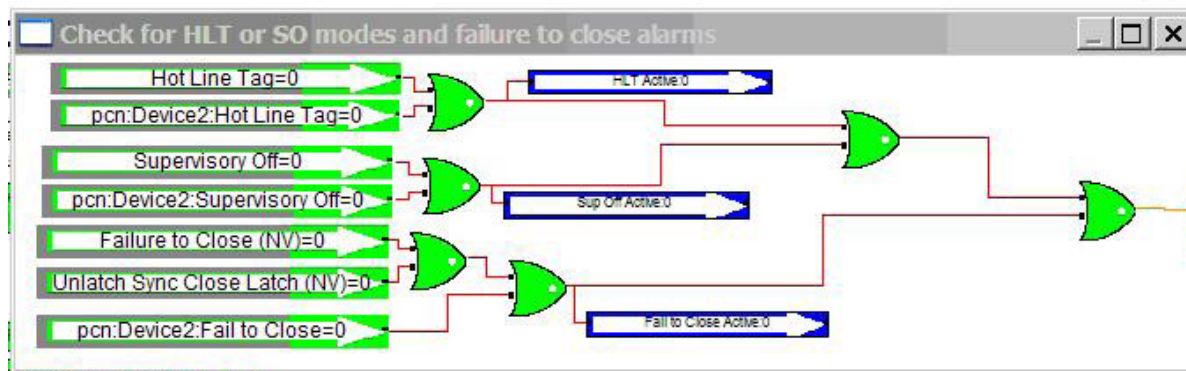


Figure 32. Check for HLT or SO modes and failure to close alarms logic.

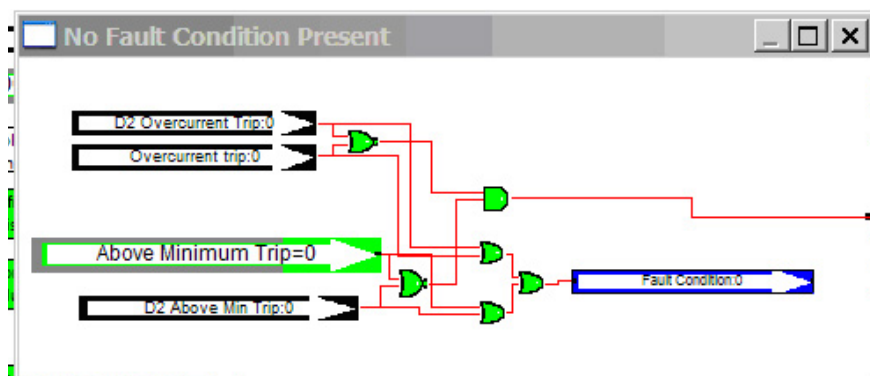


Figure 33. No Fault Condition Present logic.

### Critical load served

The Critical Load Served block contains logic that determines whether the critical load is being served (Form 6 AST: Figures 34 and 35; Form 6-TS AST: Figures 36 and 37).

If Voltage is OK and the device is closed on either device, the control determines that the load has power.

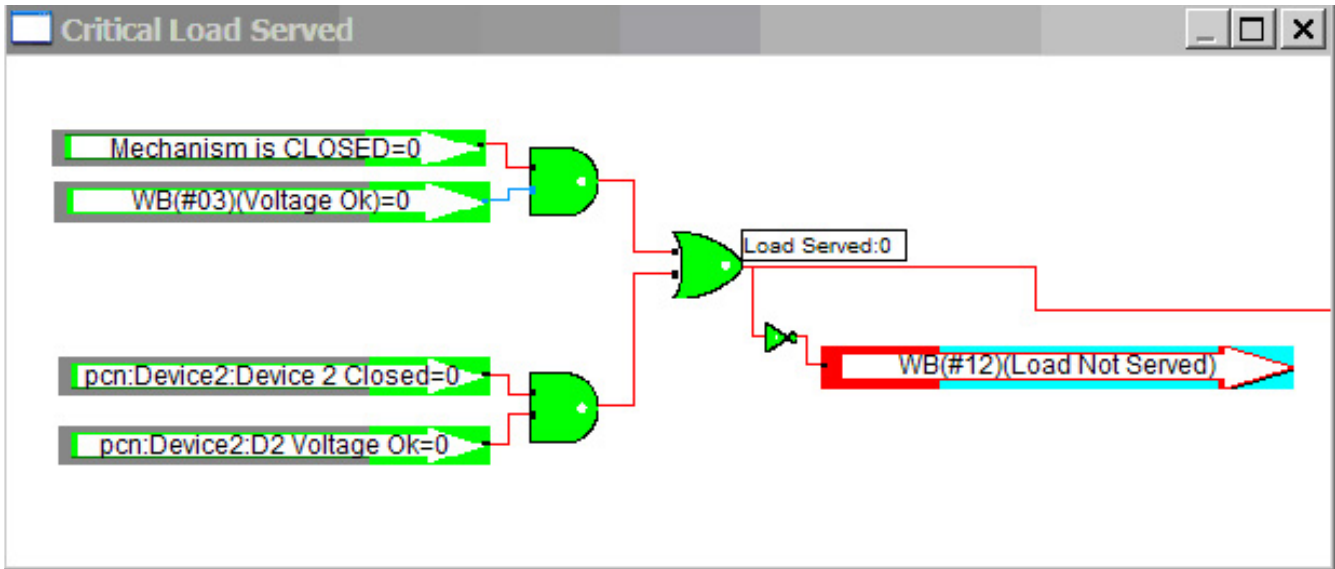


Figure 34. Form 6 AST Device #1 Critical Load Served logic.

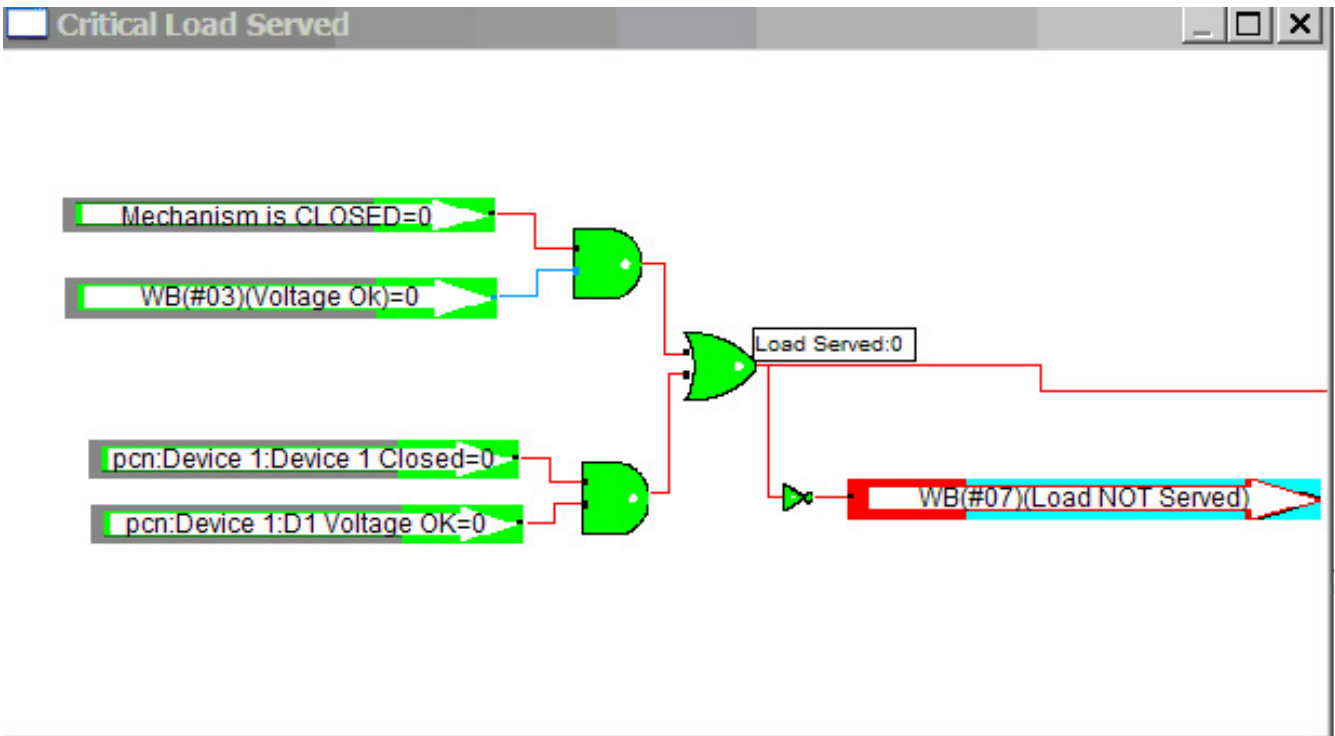


Figure 35. Form 6 AST Device #2 Critical Load Served logic.



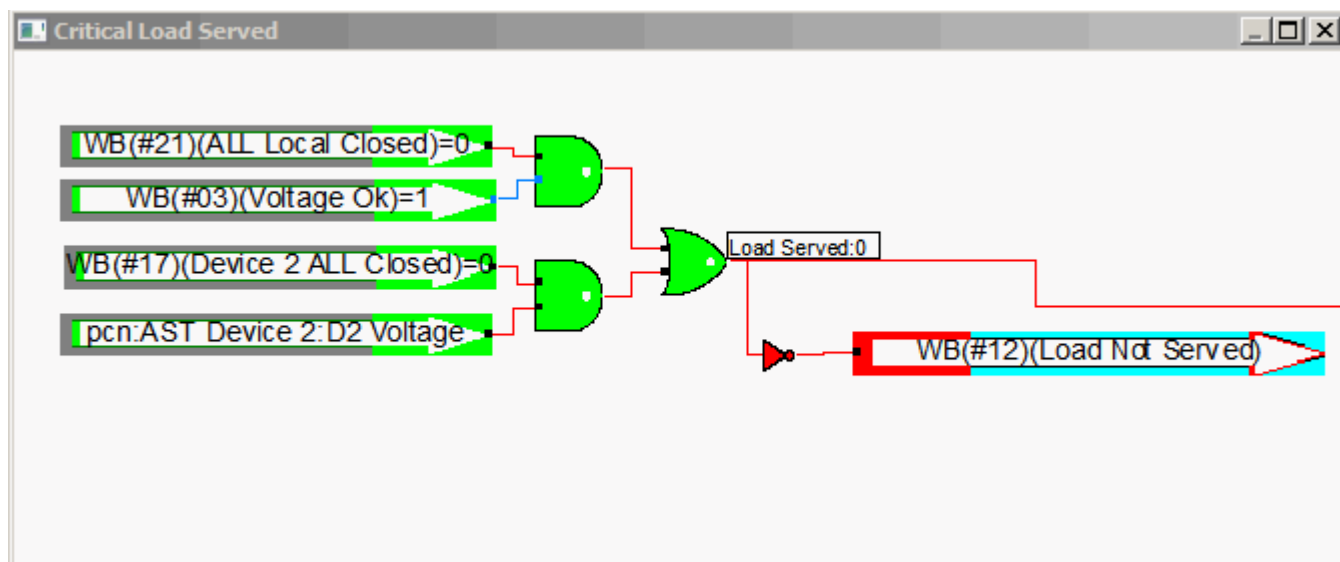


Figure 36. Form 6-TS AST Device #1 Critical Load Served logic.

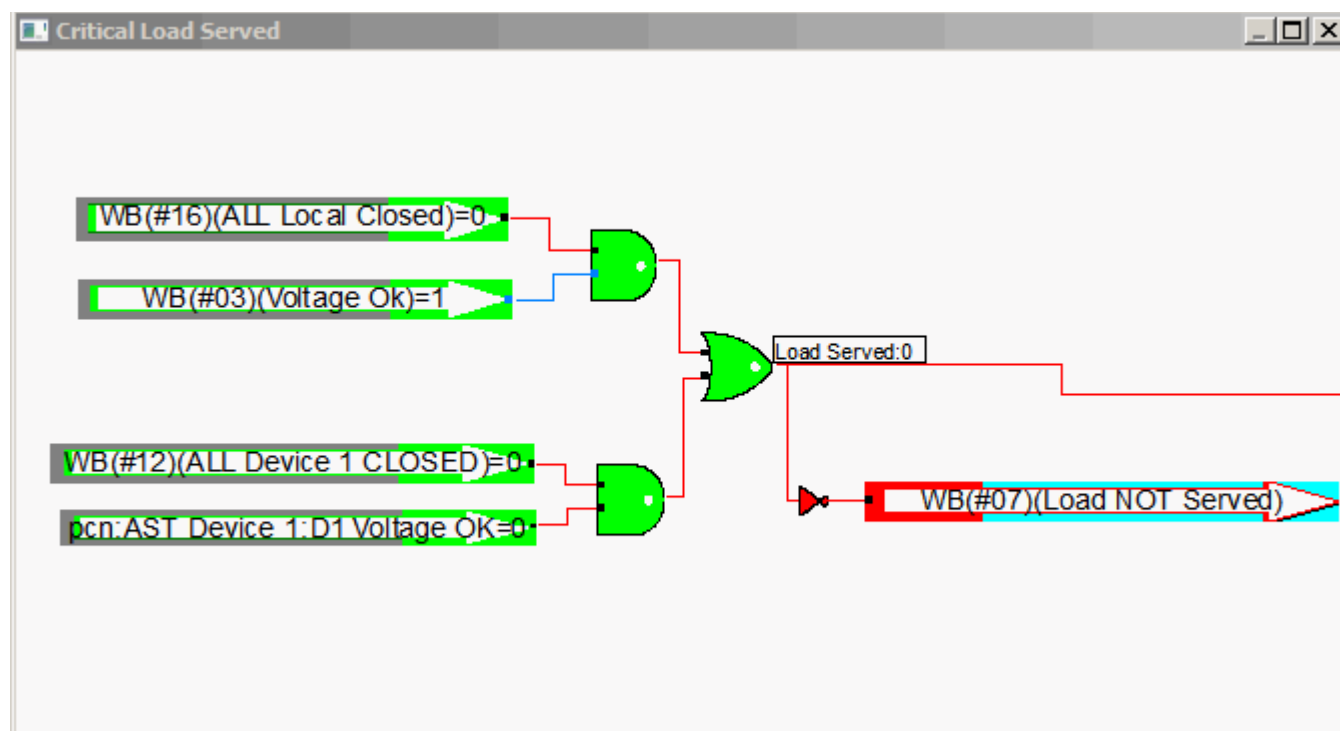


Figure 37. Form 6-TS AST Device #2 Critical Load Served logic.

## Voltage monitor module

The Voltage Monitor Module block contains the logic to monitor the voltage (Figure 38). Each device monitors its own voltage and thresholds. If the voltage goes above or below a threshold, the 'Voltage Condition' signal is asserted and sent to the other device.

There are three possibilities for a voltage event: undervoltage (Figure 39), overvoltage (Figure 40), and voltage unbalance (Figure 41). Each of these can be enabled or disabled independently (Device 1 settings) and have an associated threshold setting in each device. The Voltage Simulator overrides those settings and controls the "Voltage Ok" and "Voltage Condition" signals directly.

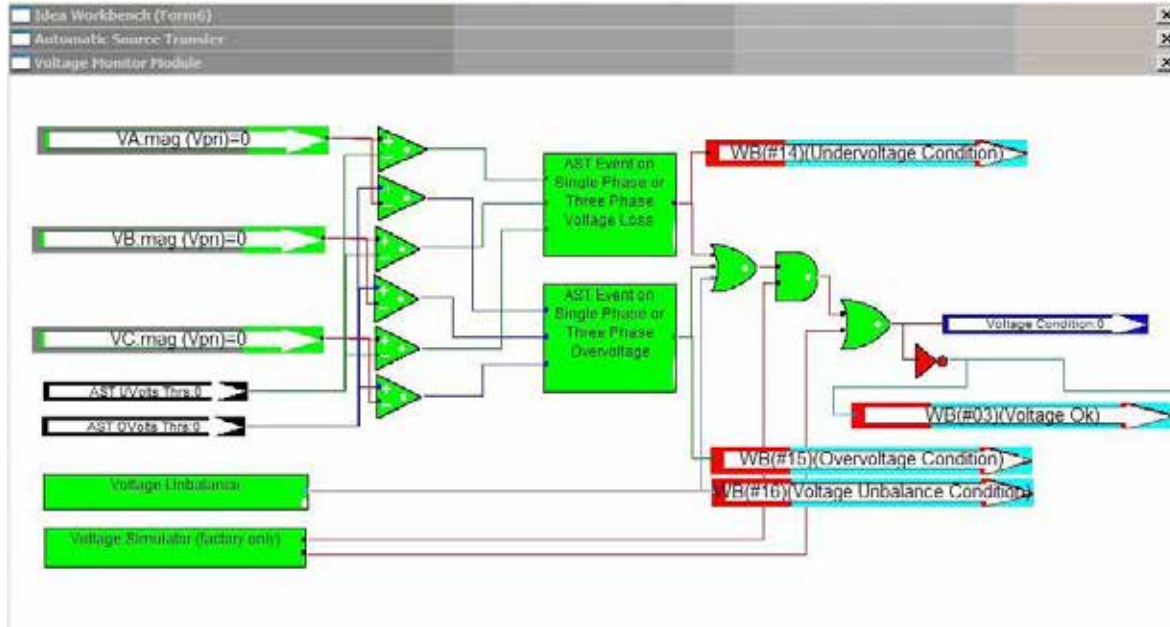


Figure 38. Voltage Monitor Module logic.

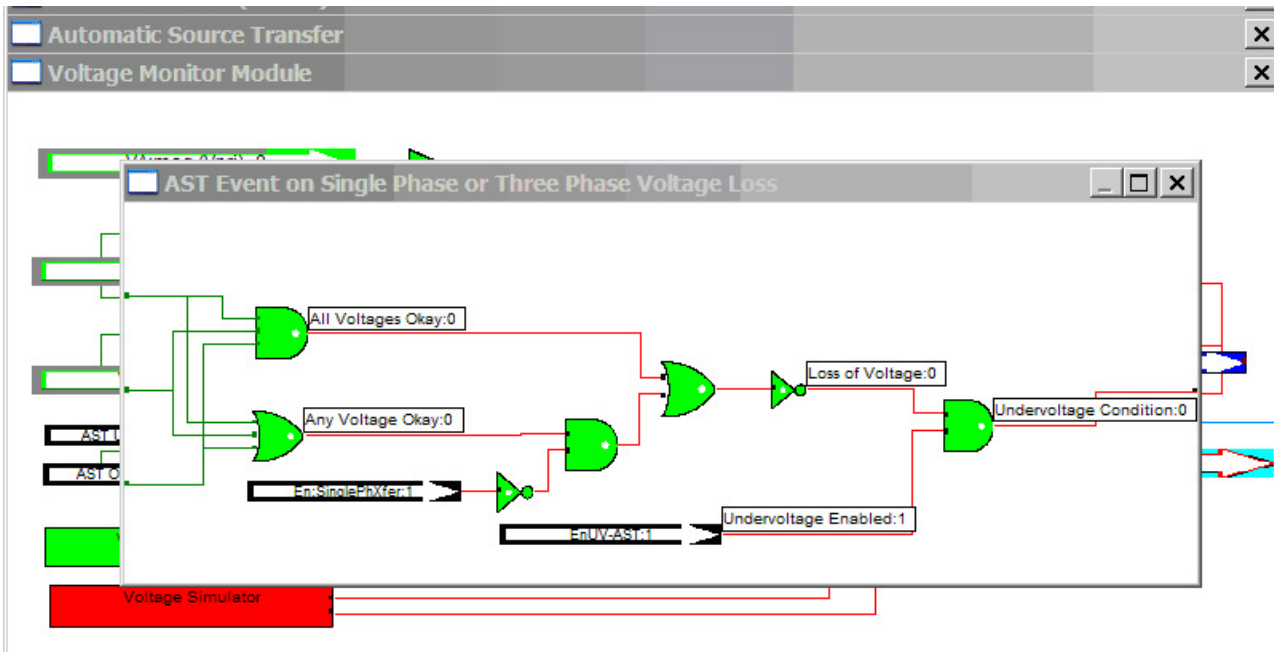


Figure 39. AST Event on Single-Phase or Three-Phase Voltage Loss logic.



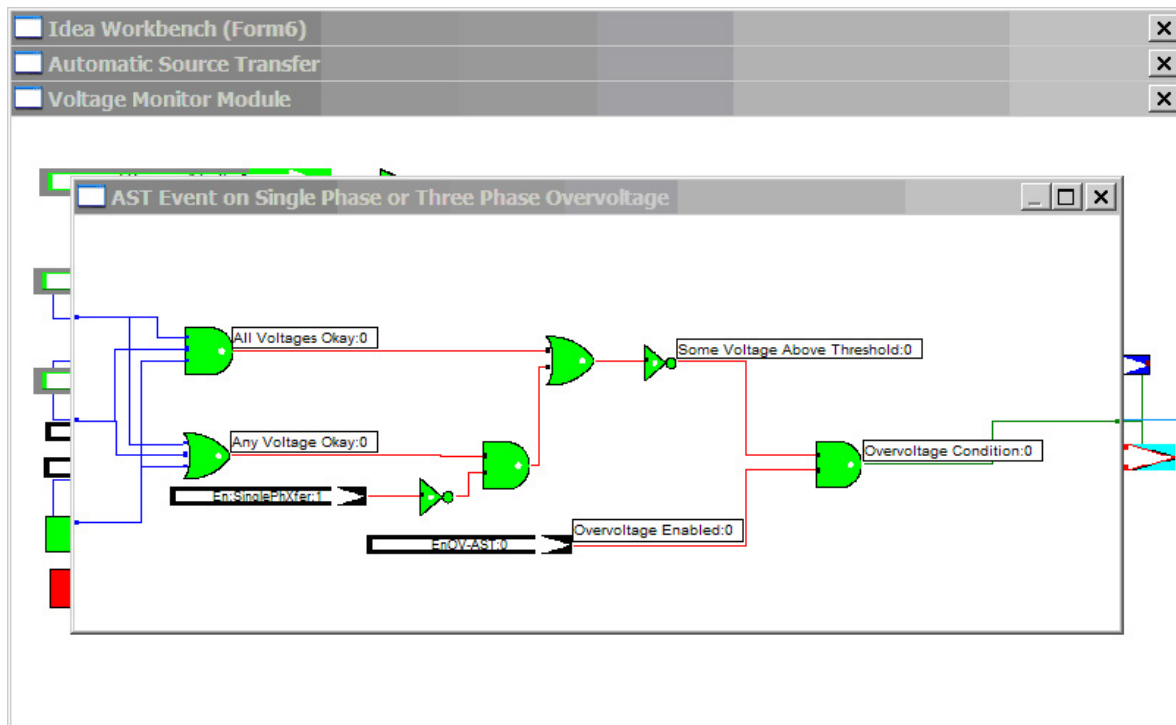


Figure 40. AST Event on Single Phase or Three Phase Overvoltage logic.

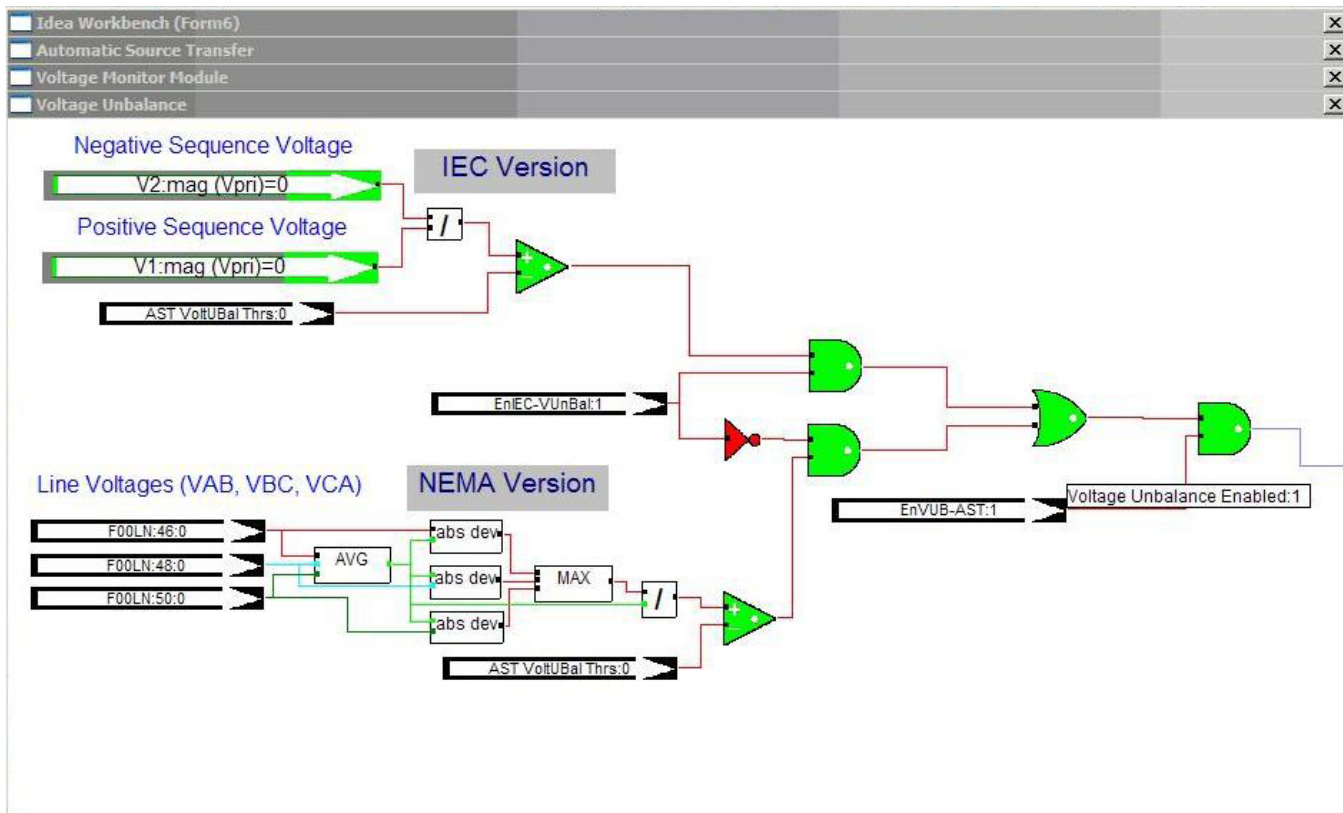
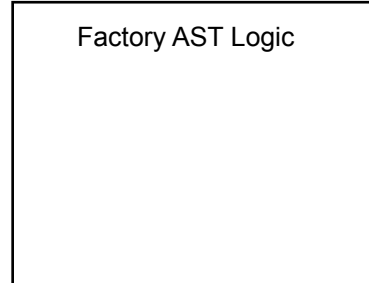


Figure 41. Voltage Unbalance logic.

**Factory AST logic**

The Factory AST Logic block (Figure 42) consists of the logic that allows the AST to operate. It is not viewable or editable by the user and should not be deleted.

This Workbench Logic can only be accessed by factory personnel. Do not delete.



**Figure 42. Factory AST logic block.**

## Automatic source transfer state transition tables

Tables 4, 5, 6, 7, 8, and 9 identify several AST conditions and describe control and recloser responses based on various settings. Refer to Figure 43.

### Table Key

Device 1 = Preferred Source

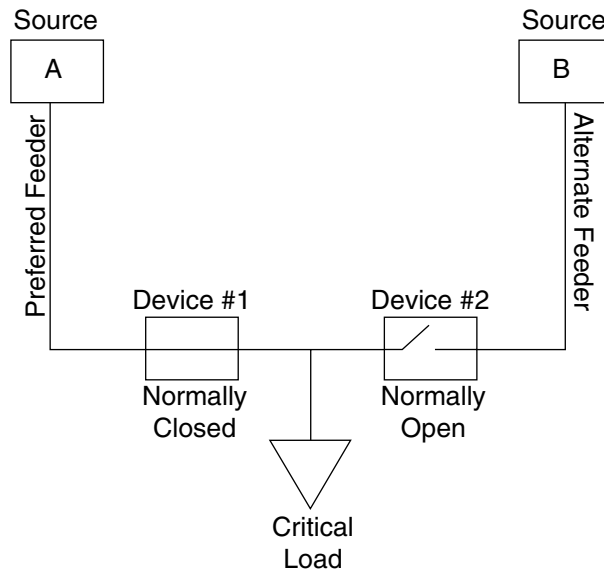
Device 2 = Alternate Source

Restoration Settings:

- Manual/Manual= Each device is operated by the front panel.
- Auto/Manual = Automatic Restoration, Manually initiated from either device
- Automatic = Automatic Restoration once the preferred feeder voltage returns (user-settable time delay)

Switching Orders:

- Parallel = Make-before-Break (close device, then open other device)
- Non-Parallel = Break-before-Make (open device, then close the other device)
- One = Only one device switches (B>M or M>B are irrelevant)



**Figure 43. Simplified AST one-line diagram.**

**TABLE 5 Initial Conditions**

**Mode:** AST Ready

**Device #1:** Closed

**Device #2:** Open

**Preferred Source:** A

**Alternate Source:** B

**Restoration Setting:** Irrelevant

**Critical Load Served:** Yes

Action	New Device 1 State	New Device 2 State	AST Ready	AST Active	Pref. Source	Alt. Source	Critical Load Served	Switching Order	Condition & Result
Loss of Source A	Open	Closed	---	Y	A	B	Y	Non-Parallel*	If B has source voltage, Break before Make (open Device #1, then close Device #2).
Loss of Source A	Closed	Open	---	---	A	B	N	n/a	If B has no source voltage, no change. Monitor sources, if B voltage returns for a time period that exceeds the AST Delay Time and A is still down, perform AST to restore power to the load through B.
Loss of Source B	Closed	Open	---	---	A	B	Y	n/a	No Change
Fault Down-line of Device #1	Open	Open	---	---	A	B	N	One	Device #1 opens on overcurrent. Fault between devices requires them both to remain open.
Manually Open Device #1	Open	Open	---	---	A	B	N	One	Manually select to open Device #1, AST will no longer be in a READY state. Close either device to restore power to load. (Consider the Alternate / Preferred status of the devices.)
Manually Close Device #2	Closed	Closed	---	---	A	B	Y	One	Manually select to close Device #2, AST will no longer be in a READY state. Open either device to return to AST functionality. (Verify the Alternate / Preferred status of the closed device.)
Manually Close Device #1	Closed	Open	Y	---	A	B	Y	n/a	No Change (Device #1 is already closed).
Manually Open Device #2	Closed	Open	Y	---	A	B	Y	n/a	No Change (Device #2 is already open).
"Swap Preferred" Button Pressed	Open	Closed	Y	---	B	A	Y	Setting	If AST is Ready and Auto Restoration mode is enabled, transfer occurs. based on setting "non-parallel." Retains full AST functionality by switching the preferred source. Since everything is normal, the preferred and alternate source change places. Switching order will be based on setting "non-parallel."
"Swap Preferred" Button Pressed	Closed	Open	---	---	B	A	Y	n/a	If B has no source voltage or Auto Restoration is not enabled, no action.

\* Faster transfer times can be achieved by removing the short communications delay that guarantees the Break before Make switching order. With this delay removed, Device #1 opens and Device #2 closes as quickly as possible. With fiber optic or hard wired communications, it is possible to achieve transfer times of less than 5 cycles.

**TABLE 6 Initial Conditions**

**Mode:** AST Active

**Device #1:** Open

**Device #2:** Closed

**Preferred Source:** A

**Alternate Source:** B

**Restoration Setting:** Manual Restoration

**Critical Load Served:** Yes

Action	New Device 1 State	New Device 2 State	AST Ready	AST Active	Pref. Source	Alt. Source	Critical Load Served	Switching Order	Condition & Result
Loss of Source A	Open	Closed	---	Y	A	B	Y	n/a	No Change (presumably this has already occurred, causing the AST).
Loss of Source B	Open	Closed	---	Y	A	B	N	n/a	No Change. Customer loses power.
Fault Down-line of Device #2	Open	Open	---	---	A	B	N	One	Device #2 opens on overcurrent. Fault between devices requires them both to remain open.
Manually Open Device #1	Open	Closed	---	---	A	B	Y	n/a	No Change (Device #1 is already open).
Manually Close Device #2	Open	Closed	---	---	A	B	Y	n/a	No Change (Device #2 is already closed).
Manually Close Device #1	Closed	Closed	---	---	A	B	Y	One	Manual mode allows individual front panel control. Close Device #1.
Manually Open Device #2.	Open	Open	---	---	A	B	N	One	Manual mode allows individual front panel control. Open Device #2
"Swap Preferred" Button Pressed	Open	Closed	Y	---	B	A	Y	n/a	No switching action. Source B becomes the preferred source. Full AST functionality is restored

**TABLE 7 Initial Conditions****Mode:** AST Active**Device #1:** Open**Device #2:** Closed**Preferred Source:** A**Alternate Source:** B**Restoration Setting:** Automatic Restoration / Manual Initiation**Critical Load Served:** Yes

Action	New Device 1 State	New Device 2 State	AST Ready	AST Active	Pref. Source	Alt. Source	Critical Load Served	Switching Order	Condition & Result
Loss of Source A	Open	Closed	---	Y	A	B	Y	n/a	No Change (presumably this has already occurred, causing the AST).
Loss of Source B	Open	Closed	---	Y	A	B	N	n/a	No Change.
Fault Down-line of Device #2	Open	Open	---	---	A	B	N	One	Device #2 opens on overcurrent. Fault between devices requires them both to remain open.
Manually Open Device #1	Open	Closed	---	Y	A	B	Y	n/a	No Change (Device #1 is already open).
Manually Close Device #2	Open	Closed	---	Y	A	B	Y	n/a	No Change (Device #2 is already closed).
Manually Close Device #1	Closed	Open	Y	---	A	B	Y	Parallel	If A has source voltage, Auto/Manual mode considers this a Restore command. Make-before-Break (close Device #1, open Device #2).
Manually Close Device #1	Open	Closed	---	Y	A	B	Y	n/a	If A does not have source voltage, no change. Device will not close.
Manually Open Device #2	Closed	Open	Y	---	A	B	Y	Non-Parallel	If A has source voltage, Auto/Manual mode considers this a Restore command. Must be Break before Make (open Device #2, close Device #1) because Trip button is hardwired.
Manually Open Device #2	Open	Open	---	---	A	B	N	One	If A does not have source voltage, Trip button is hardwired to open.
"Swap Preferred" Button Pressed	Open	Closed	Y	---	B	A	Y	n/a	No switching action. Source B becomes the preferred source. Full AST functionality is restored provided both sources have voltage. Note: Press "Swap Preferred" a second time to restore the system to Normal.

**TABLE 8 Initial Conditions**

**Mode:** AST Active

**Device #1:** Open

**Device #2:** Closed

**Preferred Source:** A

**Alternate Source:** B

**Restoration Setting:** Automatic Restoration / Automatic Initiation

**Critical Load Served:** Yes

Action	New Device 1 State	New Device 2 State	AST Ready	AST Active	Pref. Source	Alt. Source	Critical Load Served	Switching Order	Condition & Result
Loss of source A	Open	Closed	---	Y	A	B	Y	n/a	No Change (presumably this has already occurred, causing the AST).
Return of Source A	Closed	Open	Y	---	A	B	Y	Setting	After Source A has source voltage for programmed restoration time, automatically restore to AST Ready mode. Switching order will be based on setting "non-parallel."
Loss of Source B	Closed	Open	---	---	A	B	Y	Non-Parallel	If A has source voltage Break before Make (open Device #2, then close Device #1).
Loss of Source B	Open	Closed	---	Y	A	B	N	n/a	If A does not have source voltage, no Source B change. Monitor both sources, when either comes back for programmed, restoration time switch to that source.
Fault Down-line of Device #2	Open	Open	---	---	A	B	N	One	Device #2 opens on overcurrent. Fault between devices requires both to remain open. Automatic restoration will not occur after a fault between the devices regardless of Restoration Setting.
Manually Open Device #1	Open	Closed	---	Y	A	B	Y	n/a	No Change (Device #1 is already open).
Manually Close Device #2	Open	Closed	---	Y	A	B	Y	n/a	No Change (Device #2 is already closed).
Manually Close Device #1	Closed	Open	Y	---	A	B	Y	Parallel	If A has source voltage, Auto/Manual mode considers this a Restore command. Make-before-Break (close Device #1, open Device #2).
Manually Close Device #1	Open	Closed	---	Y	A	B	Y	n/a	If A does not have source voltage, no change. Device will not close.
Manually Open Device #2	Closed	Open	Y	---	A	B	Y	Non-Parallel	If A has source voltage Auto/Manual mode considers this a Restore command. Must be Break before Make (open Device #2, close Device #1) because Trip button is hardwired. Instead of manually opening Device #2, recommend waiting until preferred source has source voltage for a time exceeding the programmed restoration time then autotransfer will occur.
Manually Open Device #2	Open	Open	---	---	A	B	N	One	If A does not have source voltage, both devices will remain open. Trip button is hardwired to open.
"Swap Preferred" Button Pressed	Open	Closed	Y	---	B	A	Y	n/a	No switching action. Source B becomes the preferred source. Full AST functionality is restored provided both sources have voltage. Note: Press "Swap Preferred" a second time to restore the system to Normal.

**TABLE 9 Initial Conditions**

**Mode:** Irrelevant (assumes both sources are in a Normal state)

**Device #1:** Closed

**Device #2:** Closed

**Preferred Source:** A

**Alternate Source:** B

**Restoration Setting:** Irrelevant

**Critical Load Served:** Yes

Action	New Device 1 State	New Device 2 State	AST Ready	AST Active	Pref. Source	Alt. Source	Critical Load Served	Switching Order	Condition & Result
Fault Anywhere	Open	Open	---	---	A	B	N	Same	Both devices will open on overcurrent for a fault on either feeder or between the devices.
Manually Open Device #1	Open	Closed	---	---	A	B	Y	One	Opening the preferred device will not restore to AST Ready mode.
Manually Close Device #2	Closed	Closed	---	---	A	B	Y	n/a	No Change (Device #2 is already closed).
Manually Close Device #1	Closed	Closed	---	---	A	B	Y	n/a	No Change (Device #1 is already closed).
Manually Open Device #2	Closed	Open	Y	---	A	B	Y	One	Opening the non-preferred device restores the system to AST Ready mode.
"Swap Preferred" Button Pressed	Closed	Closed	---	---	B	A	Y	n/a	No switching action. Source B becomes the preferred source. AST functionality is NOT restored until returned to Normal.



**TABLE 10 Initial Conditions**

**Mode:** Irrelevant

**Device #1:** Open

**Device #2:** Open

**Preferred Source:** A

**Alternate Source:** B

**Restoration Setting:** Irrelevant

**Critical Load Served:** No

Action	New Device 1 State	New Device 2 State	AST Ready	AST Active	Pref. Source	Alt. Source	Critical Load Served	Switching Order	Condition & Result
Loss of Source A	Open	Open	---	---	A	B	N	n/a	No Change
Loss of Source B	Open	Open	---	---	A	B	N	n/a	No Change
Fault Anywhere	Open	Open	---	---	A	B	N	n/a	No Change
Manually Open Device #1	Open	Open	---	---	A	B	N	n/a	No Change
Manually Close Device #2	Open	Closed	---	---	A	B	Y	One	Closing the non-preferred device will not restore to AST Ready mode.
Manually Close Device #1	Closed	Open	Y	---	A	B	Y	One	Assuming both sources have voltage, closing the preferred device returns the system to Normal condition and returns to AST Ready mode.
Manually Open Device #2	Open	Open	---	---	A	B	N	n/a	No Change
"Swap Preferred" Button Pressed	Open	Open	---	---	B	A	N	n/a	No switching action. Source B becomes the preferred source. AST functionality is NOT restored until returned to Normal.

## AST frequently asked questions

### What value should I use for the undervoltage threshold?

It is recommended that the starting point for your undervoltage threshold be 50% of your nominal voltage. A setting of a higher threshold (i.e. 80%) can trigger an AST event for a cold load pickup (motor starting) that draws down the voltage momentarily.

### What is AST Ready?

If AST is in the Ready state, both controls are ready to respond to a voltage event.

### What is AST Active?

If AST is in the Active state, the controls have already responded to a voltage event.

### Explain Preferred Device/Alternate Device.

The Preferred device is the device that is closed when the system is in the normal state. The Alternate device is the device that is open when the system is in the normal state. The device designations can be changed by sending a command through SCADA or pressing the SWAP PREFERRED button on the front panel or in the application diagram in the ProView software.

### Am I required to enable Phantom Phase?

If you have only one PT connected to the control, you must enable Phantom Phase. The AST scheme monitors all three phase voltages. If phantom phase is enabled, the device will not respond to voltage events on the phases that are not directly connected to the control.

### How do I know if communications are valid?

There are several options available to check if communications are valid.

- Option 1: If a text message appears on the front panel that reads "PeerComm Communications Not Valid", then communications are not valid.
- Option 2: If communications are valid, the status of the Restoration/Initiation buttons/LEDs can be changed from Device 2. Attempt to change the Restoration/Initiation mode and verify the status changes in Device 1.
- Option 3: Connect to either device with ProView, click Go Online, and open the AST Application Diagram. Click the AST Disable Dialog button and view the PeerComm Invalid status. If the block is asserted (red) communications are not valid at that device. If the block is de-asserted (green) communications are valid at that device.

### Why isn't AST Ready asserted?

Connect to either device with ProView software, click Go Online, and open the AST Application Diagram. Click the AST Ready Dialog button and look at the signals listed there. If one or more are de-asserted (green), then AST is not in the Ready state. Resolve the issue(s) to make AST Ready.

### Why is the Voltage OK status not asserted in the AST Ready dialog?

Close the AST Ready dialog and view the voltage signals on the main AST Application Diagram. Compare those voltage readings to your voltage threshold setting(s) in the AST Settings Menus for both devices. If the voltage readings are not in the designated ranges (above the undervoltage threshold and/or below the overvoltage threshold), the Voltage OK status will not be asserted.

### Why is AST Disabled (not Enabled)?

Connect to either device with ProView software, click Go Online, and open the AST Application Diagram. Click the AST Disable Dialog button and look at the signals listed there. If any of the signals are asserted (red), the AST system is disabled. Resolve the issue(s) to enable AST.

### Can I test the system to verify operation?

The AST Voltage Simulator is provided for testing and commissioning of the AST system. Refer to the **AST Voltage Simulator** section of this manual for additional information.

### How do I return the system to normal after an AST event?

There are three restoration modes: Manual Restoration/Manual Initiation, Automatic Restoration/Manual Initiation, and Automatic Restoration/Automatic Initiation. For a complete description of each restoration mode, refer to the **Operating Panel** section of this manual.

### Can I manually operate the devices?

Yes. Manually operating the devices will take the system out of AST Ready or AST Active mode until they are returned to the normal configuration. It is recommended that if you plan to manually open or close the devices (for maintenance, etc.), you change the restoration mode to Manual.

### **Why can't I manually close one or both devices?**

If the restoration mode is set for automatic, there are two possibilities:

- If there is a voltage condition on the device, the system will prevent the device from closing and issue a Failure to Close Alarm. The alarm must be reset and voltage restored to normal before the device can be closed.
- The second possibility to prevent closing is if the system is set for non-parallel restoration and the other device is closed.

For both situations, changing the restoration mode to manual (and resetting the alarm) will allow closing.

### **Why can't I set the control to Automatic Restoration / Manual Initiation mode on my triple-single AST?**

If the triple-single control is configured for Single-Phase Trip, Single-Phase lockout mode, then Automatic Restoration / Manual Initiation mode is not allowed.

### **How do I get the system back to normal (AST Ready) after manually operating the devices?**

There are two options, assuming voltage is normal and AST is enabled:

- Option 1: Manually operate both devices until the preferred device is closed and the alternate device is open.
- Option 2: If the preferred device is open and the alternate device is closed and the system is set for automatic restoration and automatic initiation, but AST is not Active (due to the previous manual operations), pressing the Swap Preferred button twice will return the system to the normal state.



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Publication No. MN280013EN  
KA2048-639 Rev: 06

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