ADVANCED POWER TECHNOLOGIES

SBU-Series Automatic Transfer Switchgear With Bypass Isolation

AOM967-970 Operations Manual

Revision 01

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SAFE SMART SERVICEABLE SWITCHGEAR & ENGINEERED POWER SYSTEM SOLUTIONS

MADE IN THE USA

AOM: 967-970 Rev. 01

Table of Contents

1 Overview of Operation

1.1 General Information

Advanced Power Technologies (APT) switchgear contains various control circuits to accomplish the following major functions:

- Provide independent electrical fault protection for all sources:
  - 27/59 – Three-phase under/over voltage
  - 81O/U – Over/under frequency (Optional)

1.2 Automatic Transfer – Overview

If there is a total loss of utility power, this mode of operation will cause the generator to automatically start, come on-line, and assume site load. After utility power returns, a sequence of functions may be executed to return the breakers to their normal positions in an open transition. After the return to normal, the generator automatically comes off-line, cools down, and is ready for the next start.

1.3 Manual Control – Overview

The APT switchgear is designed to control the power system in a very simplified and automated manner. Should higher levels of functionality fail, or should the power system not have been properly set up for automatic operation, lower levels of manual control are available. The manual controls allow an operator to accomplish the following:

- Manually trip/close the breakers as required with breaker status indication

2 Primary Devices, Control Switches, and Annunciation Lamps

2.1 Ground Fault Lamp (GFL) / Ground Fault Reset Pushbutton (GFRS) / Horn (Horn)

This lamp flashes on a ground fault condition as detected by the ground fault protective relay. It must be cleared by pressing the Ground Fault Reset Pushbutton. The horn will sound upon detection of a ground fault and can be silenced with the Ground Fault Reset Pushbutton.

2.2 Auto Standby Lamp (ASBL) / Auto Standby Mode Switch (ASBS)

This lamp will illuminate upon activation of an automatic standby situation.

Used to invoke automatic standby operation.

In 'Auto' position, if there is a loss of utility power, controls cause the generator to automatically start, come on-line, and assume site load. When utility power returns and after the Time Delay Emergency to Normal has expired, a return to normal sequence is automatically initiated and normal utility power is restored in an open transition fashion.

In 'Off / Manual' position, automatic standby operation is disabled.

2.3 System "Not In Auto" Lamp (NIAL)

This lamp flashes if any control switch is taken out of its 'Auto' position. Switches monitored include the Auto Standby Switch and the Circuit Breaker Control Switches.

2.4 Primary Source Switch (P*SS)

These switches select the primary normal source and primary emergency source circuit breakers to be used during transfers.

2.5 Circuit Breaker Open / Closed Lamps (BOL, BCL)

These lamps indicate the position of the circuit breaker. A circuit breaker in the open position is indicated by a green lamp (BOL). A circuit breaker in the closed position is indicated by a red lamp (BCL).

2.6 Circuit Breaker Control Switch (CBS)

This switch has primary control of tripping and closing the circuit breaker. In 'Auto' position, circuit breaker is permitted to automatically trip and close as conditions dictate. In 'Open' position, breaker is immediately tripped open if closed and breaker closing is otherwise inhibited. In 'Close' position, breaker will manually close if: bus is dead or bus is live and interlock conditions are correct.

3 Human Machine Interface (HMI)

The HMI provides a means of programming setpoints and diagnosing fault conditions. The HMI is touchscreen and allows an operator to select from the following menus:

- Alarms – Shows all monitored alarm and fault conditions
- Event Log – Provides event log
- Metering – Provides simultaneous metering of generator and bus/utility
- Normal Source Setpoints – Provides protection setpoints (under/overvoltage, etc.)
- Emergency Source Setpoints – Provides protection setpoints (under/overvoltage, etc.)
- Automatic Standby Setpoints – Provides time delays for operation of auto standby
- Testing Status / Setpoints – Provides controls for operation of generator testing
- Advanced Setpoints – Password protected menu of higher level functionality setpoints
- About – Project information, date, time

The 'Main Menu' can be activated at any time, from any screen, by pressing the home button.

3.1 Alarms

This screen displays the status of all monitored system alarms and fault conditions. This allows the operator to identify the fault that occurred or any fault condition that exists that inhibits automatic operation.

3.1.1 Normal Source Undervoltage

Normal undervoltage (27) -- see 'Protection Menu' section for details.

3.1.2 Normal Source Overvoltage

Normal overvoltage (59) -- see 'Protection Menu' section for details.

3.1.3 Normal Source Underfrequency

Normal underfrequency (81U) -- see 'Protection Menu' section for details.

3.1.4 Normal Source Overfrequency

Normal overfrequency (81O) -- see 'Protection Menu' section for details.

3.1.5 Normal Source Monitor Failure

This condition means that the APT door-mounted normal source power sensor has had a failure.

3.1.6 Emergency Source Undervoltage

Emergency undervoltage (27) -- see 'Protection Menu' section for details.

Probable causes: genset overload, engine, generator, governor, voltage regulator, air intake or fuel system failure.

3.1.7 Emergency Source Overvoltage

Emergency overvoltage (59) -- see 'Protection Menu' section for details.

Probable causes: generator voltage regulator, governor failure, substantial load rejection.

3.1.8 Emergency Source Underfrequency

Emergency underfrequency (81U) -- see 'Protection Menu' section for details.

Probable causes: genset overload, engine, generator, governor, voltage regulator, air intake or fuel system failure.

3.1.9 Emergency Source Overfrequency

Emergency overfrequency (81O) -- see 'Protection Menu' section for details.

Probable causes: generator set governor or speed sensing failure, substantial load rejection.

3.1.10 Emergency Source Monitor Failure

This condition means that the APT door-mounted generator source power sensor has had a failure.

3.1.11 52-** Overcurrent

This condition inhibits automatic control and results in tripping of the circuit breaker and removal of the automatic start signal.

3.2 Event Log

The HMI includes an event log which timestamps all events and front panel switch operations. The event log can be scrolled through with the up and down arrow buttons.

3.3 Metering

The metering screen brings most normal source and emergency source electrical parameters to a common screen for visualization. Parameters included are Frequency (Hz) and Phase to Phase Voltages (VAC).

3.4 Normal Source Setpoints

APT paralleling control panel includes various protective functions that are integrated into the HMI. The Normal Source Setpoints menu provides viewing and adjustment of those protective functions.

Use the HMI keypad to adjust the value of the protective function setpoints as required. Enter a new desired value for a setpoint and then press the 'ENTER' key. Each setpoint can be adjusted within the allowed setpoint range (i.e. between LOW and HIGH limits). If the entered setpoint value is outside the allowed setpoint range, the new entry will be rejected by the HMI and the previous setpoint will remain active and reappear on the display.

Also see 'Alarms' section for additional, applicable information.

3.4.1 Three-Phase Undervoltage (27)

Undervoltage Setpoint (Setpoint in Volts)
Undervoltage Time Delay (Time Delay in Seconds)

This function provides three-phase normal source undervoltage protection and is set in volts with an associated time delay set in seconds. This condition means that the normal source voltage in at least one of the phases has dropped below the undervoltage setpoint for a time period that exceeded the undervoltage time delay.

Example of entering setpoint:

Assume: desired undervoltage setpoint is 432 V

Enter '432' as setpoint.

3.4.2 Three-Phase Overvoltage (59)

Overvoltage Setpoint (Setpoint in Volts)
Overvoltage Time Delay (Time Delay in Seconds)

This function provides three-phase normal source overvoltage protection and is set in Volts with an associated time delay set in seconds. This condition means that the normal source voltage in at least one of the phases has achieved the overvoltage setpoint for a time period that exceeded the overvoltage time delay.

Example of entering setpoint:

Assume: desired overvoltage setpoint is 528 V

Enter '528' as setpoint.

3.4.3 Underfrequency (81U)

Underfrequency Setpoint (Setpoint in 0.01 Hz)
Underfrequency Time Delay (Time Delay in Seconds)

This function provides normal source underfrequency protection and is set in terms of 0.01 of hertz (Hz) with an associated time delay set in terms of seconds. This condition means that the normal source frequency has dropped below the underfrequency setpoint for a time period that exceeded the underfrequency time delay.

Example of entering setpoint:

Assume: desired underfrequency setpoint is 58.01Hz

Enter '58.01' as setpoint.

3.4.4 Overfrequency (81U)

Overfrequency Setpoint (Setpoint in 0.01 Hz)
Overfrequency Time Delay (Time Delay in Seconds)

This function provides normal sourse overfrequency protection and is set in terms of 0.01 of hertz (Hz) with an associated time delay set in terms of seconds. This condition means that the normal source frequency has achieved the overfrequency setpoint for a time period that exceeded the overfrequency time delay.

Example of entering setpoint:

Assume: desired overfrequency setpoint is 62.01Hz

Enter ’62.01’ as setpoint.

3.5 Emergency Source Setpoints

APT paralleling control panel includes various protective functions that are integrated into the HMI. The Emergency Source setpoints menu provides viewing and adjustment of those protective functions.

Use the HMI keypad to adjust the value of the protective function setpoints as required. Enter a new desired value for a setpoint and then press the ‘ENTER’ key. Each setpoint can be adjusted within the allowed setpoint range (i.e. between LOW and HIGH limits). If the entered setpoint value is outside the allowed setpoint range, the new entry will be rejected by the HMI and the previous setpoint will remain active and reappear on the display.

Also see ‘Alarms’ section for additional, applicable information.

3.5.1 Three-Phase Undervoltage (27)

Undervoltage Setpoint (Setpoint in Volts)
Undervoltage Time Delay (Time Delay in Seconds)

This function provides three-phase emergency source (generator) undervoltage protection and is set in volts with an associated time delay set in seconds. This condition means that the emergency source voltage in at least one of the phases has dropped below the undervoltage setpoint for a time period that exceeded the undervoltage time delay.

Example of entering setpoint:

Assume: desired undervoltage setpoint is 432 V

Enter ‘432’ as setpoint.

3.5.2 Three-Phase Overvoltage (59)

Overvoltage Setpoint (Setpoint in Volts)
Overvoltage Time Delay (Time Delay in Seconds)

This function provides three-phase emergency source (generator) overvoltage protection and is set in Volts with an associated time delay set in seconds. This condition means that the emergency source voltage in at least one of the phases has achieved the overvoltage setpoint for a time period that exceeded the overvoltage time delay.

Example of entering setpoint:

Assume: desired overvoltage setpoint is 528 V

Enter '528' as setpoint.

3.5.3 Underfrequency (81U)

Underfrequency Setpoint (Setpoint in 0.01 Hz)
Underfrequency Time Delay (Time Delay in Seconds)

This function provides emergency source (generator) underfrequency protection and is set in terms of 0.01 of hertz (Hz) with an associated time delay set in terms of seconds. This condition means that the emergency source frequency has dropped below the underfrequency setpoint for a time period that exceeded the underfrequency time delay.

Example of entering setpoint:

Assume: desired underfrequency setpoint is 58.01Hz

Enter '58.01' as setpoint.

3.5.4 Overfrequency (81U)

Overfrequency Setpoint (Setpoint in 0.01 Hz)
Overfrequency Time Delay (Time Delay in Seconds)

This function provides emergency source (generator) overfrequency protection and is set in terms of 0.01 of hertz (Hz) with an associated time delay set in terms of seconds. This condition means that the emergency source frequency has achieved the overfrequency setpoint for a time period that exceeded the overfrequency time delay.

Example of entering setpoint:

Assume: desired overfrequency setpoint is 62.01Hz

Enter '62.01' as setpoint.

3.6 Automatic Standby Setpoints

If there is a total loss of utility power, this mode of operation will cause the generator to automatically start, come on-line, and assume site load. After utility power returns, a sequence of functions may be executed to return the breakers to their normal positions in an open transition fashion. After the return to normal, the generator automatically comes off-line, cools down, and is ready for the next start. The 'Automatic Standby Setpoints' configures the parameters for automatic standby.

3.6.1 Auto Standby Emergency Start Time Delay

Emergency Start (Setpoint in Seconds)

* This setpoint is only active when the 'Mode Of Operation' switch is set to 'Auto' position.

When configured for Automatic Standby operation and there is a total loss of utility power, this setpoint defines the time delay prior to automatically starting the generator set for the purpose of providing emergency back-up power. By utilizing this time delay, automatic utility reclosers are given a chance to reestablish utility power prior to transferring to generator power.

3.6.2 Auto Standby Standby Commit Time Delay

Standby Commit (Setpoint in Seconds)

* This setpoint is only active when the 'Mode Of Operation' switch is set to 'Auto' position.

Once the 'Emergency Start' time delay has expired, the 'Standby Commit' time delay will begin counting. This time delay allows the load to transfer to the generator even upon the utility being restored. In the event the utility is only restored for a short time, committing to the transfer of the generator will eliminate multiple outages to the load.

3.6.3 Auto Standby Emergency To Normal Time Delay

Emergency To Normal (Setpoint in Seconds)

* This setpoint is only active when the 'Mode Of Operation' switch is set to 'Auto' position.

When utility returns to acceptable levels this setpoint defines the time before switchgear executes re-transfer to utility power. This delay provides time for the utility source to stabilize prior to transferring to it.

3.6.4 Auto Standby Time Delay Neutral

Time Delay Neutral (Setpoint in Seconds)

* This setpoint is only active when the 'Mode Of Operation' switch is set to 'Auto' position.

During a time when there are multiple live sources (utility or generator) and one or more of the sources is lost, resulting in a dead load bus being created (either the entire load bus or a segment of the load bus), this setpoint determines the time delay prior to closing an appropriate breaker to re-energize the dead load bus. This time delay allows motor loads time to decay prior to being re-energized.

3.7 Testing Status / Setpoints

The testing status and setpoints screens allow adjustments to the systems automatic testing feature. With the testing feature enabled automatic generator exercising in a loaded or unloaded manner can occur on a set schedule.

3.7.1 System Time

Displays current time of control panel.

3.7.2 System Date

Displays current date of control panel.

3.7.3 Days Between Runs

Displays current setpoint, in days, of the amount of time before the control panel starts a generator test run.

3.7.4 Days Until Next Run

Displays current time, in days, left before the control panel starts the generator for a test run.

3.7.5 Day of Week to Run

Displays current setpoint of what day of the week the control panel will start the generator test run.

3.7.6 Time of Day to Run

Displays current setpoint of what time of day the control panel will start the generator test run.

3.7.7 Test Time Remaining

Displays current amount of time, in minutes, left in the current generator test run. This display also indicates the mode of the test run, either with or without load.

3.7.8 Scheduler (Pushbutton)

Pushing this button will toggle between enabling of disabling the automatic generator test runs. Disabling the scheduler will also reset the “Days Between Generator Runs” counter.

3.7.9 Days Between Generator Runs

This setpoint is the number of days the control panel will wait before running a generator test.

3.7.10 Time of Day to Run

This setpoint selects the hour and minute of the day the control panel will initiate the generator test.

3.7.11 Day of Week (Pushbutton)

This setpoint selects the hour and minute of the day the control panel will initiate the generator test.

3.7.12 Day of Week to Run

This setpoint selects a specific day of the week for the scheduler to run the generator test. It is used in conjunction with the "Days Between Generator Runs" setpoint. The setpoint is set in a numerical format (Monday = 1, Tuesday = 2, …, Sunday = 7). If this setpoint is enabled the control panel will wait the "Days Between Generator Runs" and then wait until the "Day of Week to Run" setpoint has been matched as well. With this in mind it is possible to set the "Days Between Generator Runs" to 14 on a Wednesday and the "Day of Week to Run" to 6 (Saturday). The controller will count down the 14 days ending on a Wednesday and then wait until Saturday to issue the start. After this the controller will run every other Saturday per the "Days Between Generator Runs" setting of 14.

3.7.13 Generator Test Runtime

This setpoint is the amount of time the controller will run the generator test.

3.7.14 Load / No Load (Pushbutton)

Pushing this button toggles the controller between a load test and a no load test of the generator. During a no load test the generator is started but no loads are transferred. During a load test the generator is started and once up to speed and voltage an open transfer from utility power to generator power is initiated. After the expiration of the "Generator Test Runtime" timer the unit will open transfer back to the utility and then shut the generator down.

3.7.15 Manual Generator Testing (Pushbuttons)

Pushing the Start/Stop pushbuttons for the Generator No Load/Load test will bring up a confirmation popup allowing for acceptance or cancellation of the test. Once initiated the test will continue to run until manually stopped.

3.8 Advanced Setpoints

The 'Advanced Setpoints' screen is password protected. In the event that advanced troubleshooting is required an APT representative may provide the password and instruct the user as to the parameters in question. These settings usually require no adjustment once the system has been commissioned.

3.9 About

The about screen provides the project name and number associated with the piece of equipment as well as the configured date and time. In the event contact with APT becomes necessary providing this information will speed the process in which a representative can assist.

Operating Instructions



Advanced Power Technologies (APT) is on the cutting edge of the latest engineered power system smart technologies, as it relates to microgrid & storage management, renewable & conventional energy source deployment, demand peak shaving, and facility back-up and co-generation power systems. Located in the central United States and headquartered in Lafayette, Indiana with solutions development engineers around the country, APT provides domestic and international products and services to industry leading companies from around the world. APT engineers have decades of power system experience from working with some of the largest companies in industry. Over the last two decades, we have produced successful solutions for hundreds of large-scale electric power projects involving utility/generator paralleling, transfer, peak shaving, and distribution. We pride ourselves in providing electrical power systems that are engineered and custom built, utilizing state-of-the-art technologies to fit our customer's exact needs. The core of our business is low & medium voltage engineered power systems for a wide range of indoor & outdoor applications, such as:

- Utility(ies) and Generator(s) Paralleling/Transfer/Peak Shaving/Distribution Switchgear
- Microgrids, Microgrid Master Control Panels, SCADA systems
- Containerized Battery Energy Storage Systems (BESS)
- Photovoltaic (PV) Solar Power Collection/Distribution & Renewable Energy Storage Systems
- Low & High Resistance Grounding Systems, Grounding Systems for Photovoltaic Effective Grounding
- High Efficiency Combined Heat and Power Switchgear & Control Systems (CHP, Co-generation)
- Outdoor Walk-In electrical houses (e-houses) & Skid-Mounted Switchgear
- Motor Control Centers & Motor Control Switchgear
- Automatic & Manual Load Transfer Switchgear
- Bypass/Isolation & Power Distribution Circuit Breaker Switchboards
- Generator/Loadbank Quick Connection Switchgear, Switchboards, & Tap boxes
- Industrial Control Panels

Please see our product webpages on www.apt-power.com for product brochures and relevant information. Actual products may look different from images shown on the website and in brochures, based on actual specifications.
APT cares and understands that each power system is different. We will evaluate various solutions in order to develop the best solution for a site. APT focuses on our ability to a combine several traditional pieces of equipment/functionality into as little of a footprint possible. This saves on space, the cost of equipment, cost of installation, and accomplishes the most optimal/state-of-the-art design your facilities. APT's desires to foster and grow a culture of continued open communication with each customer. Let APT be your source to provide fully engineered power system equipment solutions for the full customer facility on time, on or under budget, and in the smallest footprint possible. We are always available to assist customers and engineers representing customers in the development of complex power solutions for all facility types.