

# 857 Protection System

For Feeder and Motor Protection  
Bulletin 857, Series A



## Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication [SGI-1.1](#) available from your local Rockwell Automation sales office or online at <http://www.rockwellautomation.com/literature/>) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.



**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.



**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.



**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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### IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

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# 857 Protection System

## Introduction

The management relay shall provide primary protection and management for medium voltage motors and feeders within one hardware platform without hardware changes. This protection selection will be made only using a software selection. The main features of the device will be:

- Fully digital signal handling utilizing a 16-bit microprocessor with high measuring accuracy on all the setting ranges through the utilization of a 16-bit A/D conversion technique.
- Wide setting ranges for the protection functions can reach sensitivities up to 0.5% accuracy
- Capable to disable certain Functions and Protection Elements for specific applications.
- The control of up to six external objects (e.g. circuit-breakers, contactors disconnects)
- Ability to actively display the status of eight objects on the local display panel (e.g. MIMIC for circuit breakers, contactors disconnects, switches, etc.)
- Capable of freely configuring of the Local Display with six selectable measurement values
- All settings, events and indications are stored in non-volatile memory
- Easily configuration from the Local Display or with the free SetPointPS user software
- Include a built-in, self-regulating, AC/AC power Supply with an operating range from 40...265 VDC or VAC.

## Protective Features

The relay shall provide the following protective features:

### Synchrocheck Protection (25)

The device will monitor voltage amplitude, frequency and phase angle difference between two voltages.

### Undervoltage Protection (27)

This function measures the three line-to-line voltages and whenever the smallest of them drops below the user's pick-up setting of a particular stage, this stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation time delay setting a trip signal is issued.

### **Reverse Power and Underpower Protection (32)**

This function is sensitive to active power. For reverse power function the pick-up is negative and for underpower function a positive pick-up value is used.

### **Undercurrent Protection (37)**

Undercurrent protection shall be provided to measure the fundamental frequency component for the phase currents.

### **Motor/Load Bearing Over temperature Protection (38)**

The Motor Bearing Over Temperature Protection protects the motor bearings by monitoring up to 12 bearing via bearing mounted RTDs.

### **Broken Line Protection (46R)**

The relay shall provide broken line protection to detect unbalanced load conditions.

The unbalanced protection has definite time operation characteristics.

### **Current Unbalance Protection (46)**

Current unbalance protection will be based on the negative sequence of the based frequency phase currents.

Both definite time and inverse time characteristics are available.

### **Incorrect Phase Sequence Protection (47)**

Phase sequence protection stage protection shall be provided to prevent the motor from running in the wrong direction.

### **Stall Protection (48)**

Stall protection shall be provided to protect the motor against prolonged starts caused by such things as a stalled rotor.

## **Motor Bearing Thermal Overload Protection (49)**

The thermal overload function protects the motor in the motor mode or cables in the feeder mode against excessive heating. The temperature is calculated using RMS values of phase currents and a thermal model according to IEC 60255-8.

## **Winding Over Temperature Protection (49R)**

The Winding Over Temperature Protection protects the motor stator windings by monitoring up to 12 motor mounted RTDs.

## **Arc Fault Protection (50ARC/50NARC) (Optional)**

The arc protection is used for fast arc protection. The function is based on simultaneous light and current measurement. Special arc sensors are used to measure the light of an arc.

## **Overcurrent Stage (50/51)**

The overcurrent protection shall be used against short circuit faults and heavy overloads.

The relay will have at least three separately adjustable over current stages:

- The first stage can be configured for definite time or inverse time operation characteristic.
- The remaining two stages have definite time operation characteristics.

Detailed information shall be available on the last eight faults: time stamp, fault type, fault current, load current before the fault, elapsed delay and setting group.

## **Earth Fault Protection (50N/51G,N)**

Unidirectional earth fault protection shall be used to detect earth faults in low impedance earthed networks.

## **Circuit-breaker Failure Protection (50BF)**

The circuit breaker failure can be used to trip any upstream circuit breaker if the fault has not disappeared within a give time after the initial trip command.

## **Overvoltage Protection (59)**

The overvoltage function measures the fundamental frequency component of the line-to-line voltages regardless of the voltage measurement mode. By using the line-to-line voltages and phase-to-ground over-voltages during earth faults have no effect.

## **Zero Sequence Voltage Protection (59N)**

The zero sequence voltage protection is used as an unselective backup for earth faults and also for selective earth fault protections for motors having a unit transformer between the motor and the bus.

## **Frequent Start Protection (66)**

The Frequent Start Protection functions shall allow only a specified number of operations of a given device or equipment, or a specified number of successive operations within a given time of each other.

## **Directional Overcurrent (67)**

Directional overcurrent protection shall be used for directional short circuit protection. The relay will allow four separately adjustable stages: two of the stages can be configured for definite time or inverse time characteristics. The final two stages can be configured for definite time (DT) operation delay.

Thirty-seven different statuses, measuring and warning parameters must be provided. Detailed information is available on the eight latest faults: time stamp, fault type, fault current, load current before the fault, elapsed delay and setting group.

## **Directional Earth Fault Protection (67N)**

The direction earth fault protection is used for earth faults in networks or motors where a selective and sensitive earth fault protection is needed and in applications with varying network structure and length.

## **Intermittent Transient Earth Fault Protection (67NT)**

The directional intermittent transient earth fault protection is used to detect short intermittent transient faults in compensated cable networks.



## **Inrush Current Detection**

The inrush current of all the three phase currents shall be monitored for idle values and the inrush currents exceeding a give pick-up level. It will provide condition monitoring for second harmonics relative content of the currents.

## **Overfrequency and Underfrequency Protection (81H/81L)**

Frequency protection is used for load sharing, loss of mains detection and as a back up protection for over-speeding.

## **Rate of Change of Frequency Protection (81R)**

Rate of change of frequency ( $df/dt$ ) function is user for fast load shedding, to speed up operation time in over and under frequency situations and to detect loss of grid.

## **Programmable Stages (99)**

For special applications, the user can build custom protection stages by selecting the supervised signal and the comparison mode.

## **Capacitor Bank Unbalance Protection**

This device will be capable of capacitor, filter or reactor bank protection using one of the five current measurement inputs.

## **Inverse Time Operation**

The device will be configurable for definite time or inverse time protection characteristic.

## **Measuring and Monitoring**

The relay shall also provide the following measurement and monitoring functions:

### **Event Logs**

The event log buffer should have enough room to record the last 200 events. For each trip function, a total of 8 historic events shall also be logged.

## Graphical Display on Power Quality Elements (Waveforms)

The unit shall be capable of graphically displaying, on the Local Panel User Interface, the following power quality elements;

- Power Quality Phasor Diagram
- Power Quality Waveforms for:
  - All Line Currents
  - Average Active Power
  - Average Reactive Power
  - Average Apparent Power

The unit shall also be capable of graphically displaying, on the Local Panel User Interface, individual waveforms for each current and voltage phase”

- Including an individual waveform diagram for each phase current and voltage
- Average current waveform diagram for each phase current and voltage
- Average current waveform diagram
- Phasor diagram
- Bar graph of Total Harmonic Distortion, up to 15<sup>th</sup> harmonic

## Harmonics and Total Harmonic Distortion (THD)

The device will calculate the Total Harmonic Distortion as a percentage of the base frequency for each line currents and line voltages. The device will calculate the harmonics from the 2<sup>nd</sup> to the 15<sup>th</sup> of phase for each phase current and voltage. (The 17<sup>th</sup> harmonic component will also be shown partly in the value of the 15<sup>th</sup> harmonic component). The unit will graphically display the harmonic contents for each phase and voltage input.

## Disturbance Recorder

A 12-channel disturbance recorder will record all the measured signals, such as: currents, voltages and the status information of digital inputs and outputs. The maximum sample rate shall be 32 samples per cycle. A possible recording time of 200 hours shall be available (dependant on sample rate).

## **Cold Load Pick-up Monitoring Voltage Sag and Swells**

The relay is to have the ability to separately monitor logs for system voltage sag and swells.

### **Voltage Interruptions**

The relay calculates the number of voltage interruptions and the total time of the voltage-off time within a give calendar period.

### **Current Transformer Supervision**

The device supervises the external wiring between the device terminal and current transformers (CT) and the CT themselves.

### **Voltage Transformer Supervision**

The device supervises the voltage transformer (VT) wiring between the device terminals and the VTs.

### **Circuit Breaker Condition Monitoring**

The relay will have a condition monitoring function that supervises the wearing of the circuit breaker. The condition monitoring can give an alarm for the need of circuit-breaker maintenance before the circuit-breaker condition is critical.

### **Energy Pulse Outputs**

The device shall be configured to send a pulse whenever certain amounts of energy has been imported or exported.

### **System Clock and Synchronization**

The synchronizing is based on the difference of the internal time and the synchronizing message or pulse. This deviation is filtered and the internal time is corrected softly towards a zero deviation.

## Running Hour Counter

This function calculates the total active time of the selected digital input, virtual I/O or output matrix output signal.

## Programmable Timers

The relay is to include four programmable timers that can be used together with the user's programmable logic or to control setting groups and other applications that require actions based on calendar time.

## Combined Overcurrent Status

The relay shall include the function to collect faults, fault types and registered fault current of all enabled overcurrent stages.

## Self Supervision

The relay will also have the functions of micro controller and the associated circuitry, as well as the program executions are supervised by means of a separate watchdog circuit.

## Earth-Fault Location

The relay will include an algorithm that can locate an earth-fault accurately in radically operated compensated earthed networks.

## Communication

The relay shall also have the following optional added features:

- Expandable Communications Protocols
  - Ethernet
  - Modbus TCP
  - Modbus RTU
  - Ethernet I/P
  - Profibus DP
  - IEC 61850
  - SPA-Bus
  - DNP 3.0

## Optional Arc Flash Protection

The relay shall have the following Arc Flash protection features:

- Expandable Arc Flash Protection
  - Personal Sensors
  - Fixed Mount Sensors

## Load Panel User Interface

The relay is to provide a Local Panel User Interface, and shall include the following:

- A backlit 128X64 LCD dot matrix display. The display enables showing 21 characters in one row and eight rows at the same time. The display will be capable of showing a single line diagram of the relay with the object status, measurement values, identification etc.
- Eight LED type indicators on the front panel which shall provide a quick visual indication unit status.
- Three user programmable LED type indicators on the front panel.
- A front and back panel RS232 serial port for communications with a PC using SetPointPS PS software.
- The Local Panel User Interface will have a keypad to navigate in the menu and see the required parameter values used for the keypad and the guidance given in the display.
- The relay will come with a three level password protected for these operating levels: User Level, Operator Level and Configuration Level.
- The relay will be capable of being set up with a free issue user friendly software package.

## General Information

The relay shall have full digital signal handling capabilities with a 16-bit microprocessor and high measuring accuracy on all setting ranges using a 16-bit A/D conversion technique. The relay shall also be capable in controlling up to six different objects at the same time. The relay shall also be able to indicate the status of eight objects at the same time.

The motor protection relay shall have a minimum of six programmable output relays and eighteen programmable digital inputs. Six of the eighteen inputs shall be 48V wetted contacts.

**Notes:**



## Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.

At <http://www.rockwellautomation.com/support>, you can find technical manuals, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools. You can also visit our Knowledgebase at <http://www.rockwellautomation.com/knowledgebase> for FAQs, technical information, support chat and forums, software updates, and to sign up for product notification updates.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect<sup>SM</sup> support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://www.rockwellautomation.com/support/>.

## Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the <a href="http://www.rockwellautomation.com/rockwellautomation/support/overview.page">Worldwide Locator</a> at <a href="http://www.rockwellautomation.com/rockwellautomation/support/overview.page">http://www.rockwellautomation.com/rockwellautomation/support/overview.page</a> , or contact your local Rockwell Automation representative.

## New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

## Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication [RA-DU002](#), available at <http://www.rockwellautomation.com/literature/>.

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