SLIMLINE & A-LINE

POWER MONITORS

Section A

Our comprehensive range of Slimline and A-line Power Monitors cover a wide range of applications. They are units that monitor single or three phase power supplies for over and/or under voltage, current or frequency, or for any phase irregularities. The feature of being fully programmable allows stockholders to carry less stock on their shelves. The Slimline is our 11-pin plug-in range and the A-Line is our Din-rail alternative.

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SP-100/SP-103

Current Monitor Single Phase 1A/5A AC(RMS)/DC

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	100	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Overload protection on cranes and hoists.
- Underload detection on conveyors. Conveyor belt slip-tear alarm or simple load control of conveyors.
- Simple and inexpensive load control on small industrial or agricultural installations.
- Monitoring and controlling loads on generator sets.
- Detection of blocked extruders on plastic moulding machines.
- Overload detection of single phase motors.
- Lift door control. Quickly responds to lift doors closing on foreign objects.

Features

- Failsafe feature.
- Internal shunt for direct in-line current sensing (AC or DC).
- Adjustable response delay of 0,1 to 10 seconds on SP-103.
- 1A or 5A, AC or DC input range (programmable).
- Direct interface with conventional current transformers.
- Trip point adjustable on percentage scale.
- Hysteresis adjustable 5-30%.
- Programmable for overload or underload detection.
- Latching on overload or underload (programmable).
- Start-up delay.
- 10A SPDT relay output.

Description of Operation

The **SP-100** and **SP-103** are precision current monitors for both AC and DC applications. It can be programmed for either overload sensing or underload sensing. The internal shunt facilitates direct connection into a current loop up to 5A (continuous).

AC Monitoring: The units interfaces readily with conventional current transformers (1A or 5A secondary rating). For applications with current to voltage transformers refer to the SP-101.

DC Monitoring: The units are polarity sensitive and will not respond to current in the reverse direction. To monitor currents in excess of 5A DC, refer to the SP-101.

Start-up Delay: When power is applied to the module, the relay energises immediately, ignoring abnormal load conditions experienced during start-up.

Overload Sensing: When programmed for overload sensing, the relay will de-energise if the current exceeds the setpoint. The relay will switch on again if the current drops by a certain percentage below the set overload threshold. This percentage hysteresis is adjustable.

Underload Sensing: When programmed for minimum load sensing, the relay will de-energise if the current drops below the setpoint. The relay will switch on again if the current rises by a certain percentage above the set underload threshold. This percentage hysteresis is adjustable.

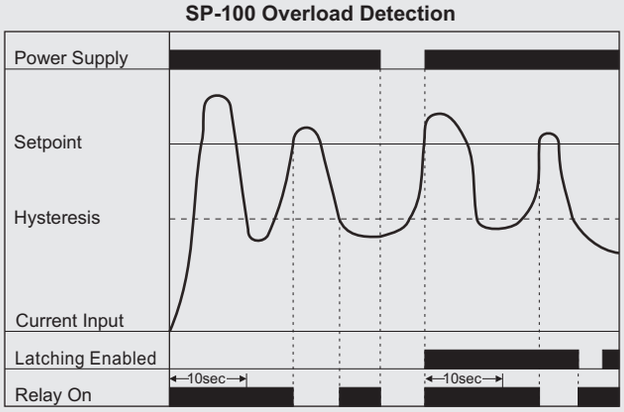
Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis can be adjusted as a percentage of set-point to prevent relay chatter or hunting when the load current fluctuates around the setpoint.

Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either breaking and re-applying power supply to the unit or by momentarily disabling the latching circuit (e.g. Push-to-open switch). During the start-up delay, the latching circuit is disabled automatically (see wiring and connection diagram).

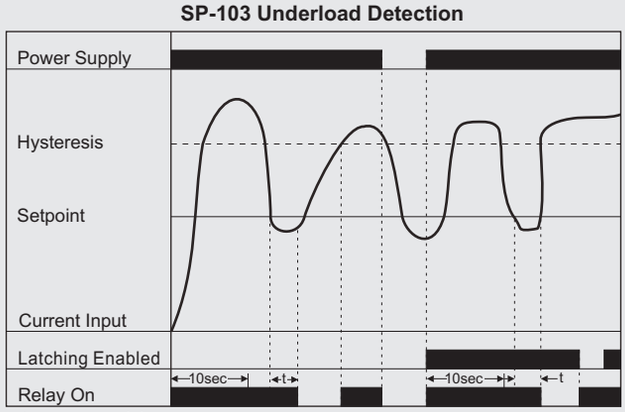
Adjustable Response (SP-103): Response delay can be adjusted from 0,1 to 10 seconds. When a trip condition is detected, the relay will only de-energise after the set response time (a delayed recovery is also available on special order).

Operational Diagrams

SP-100 Overload Detection

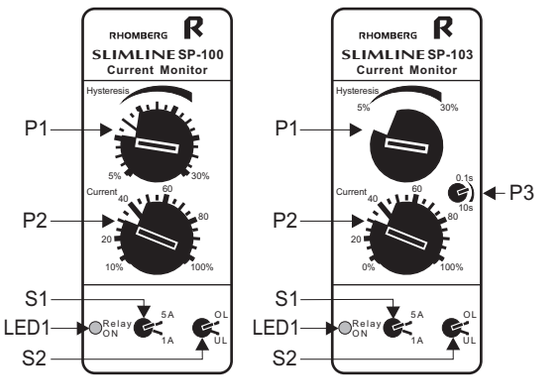


SP-103 Underload Detection



t = response delay

Description of Controls



P1: **Hysteresis** i.e. The difference between the tripping point and the recovery point is set between 5% and 30% on P1 (hysteresis relates to the setpoint of P2).

P2: The **Current Threshold** (tripping point) is adjusted on P2. Maximum setting of 100% corresponds with a current level of 1A or 5A (depending on the setting of S1).

P3: Adjustable **Response Delay** from 0.1 to 10 seconds (SP-103).

S1: The **Current Range** is set for 1A or 5A applications on S1.

S2: **Function Selection** is provided by S2. If set to "OL" the unit operates as an overload detector. If set to "UL" the unit operates as an underload (minimum load) detector.

LED 1: The red LED illuminates to indicate that the relay is energised. The LED will be off if the unit registers a fault condition (overload/underload) or the power supply to the unit is interrupted.

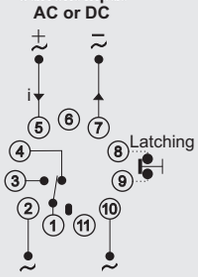
Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

Latching
Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)

Current Input AC or DC

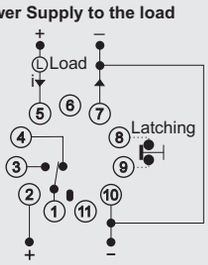


APPLICATION 1

Direct In-line Sensing: Connect the sensing input pin 5 and pin 7 in series with the current loop. For DC monitoring, the polarity must be observed (pin 5 positive, pin 7 negative).

Note: *NOT suitable for DC supply on pin 2 and pin 10.)*

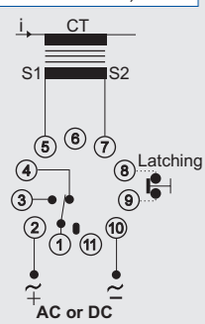
DC Power Supply to the load



APPLICATION 2

DC Current Sensing: DC power supply on pin 2 and pin 10: In this mode, the DC power supply and current sensing input share a common negative connection, since no galvanic isolation is provided.
Therefore, the current input, pin 5 and pin 7, has to be connected in series between the negative lead and the load.

Note: *Pin10 and pin7 are to be externally linked.*
DO NOT CONNECT THE LOAD BETWEEN PIN 7 AND PIN 10.



APPLICATION 3

AC Current Sensing with a Current Transformer: Connect the secondary terminals of the current transformer (S1 and S2) to the current input pin 5 and pin 7. Other devices such as ammeter, may be connected in series with the current loop, provided the VA rating of the CT is not exceeded.

Note: *Do not unplug the unit while the current loop is energised, since this will cause an open circuit of the current loop and may damage the current transformer (see "CT protection" in the general section of the catalogue on page 121).*

Technical Specifications

POWER SUPPLY

AC: Supply voltage:12, 24, 110, 230, 400, 415, 525V ±15%
Isolation (current input to power supply): 2kV
Power consumption: 3VA (approx.)
6VA for 415, 525V (approx.)

DC: Supply voltage: 10-30V, 48, 60, 110V ± 15%
Isolation: no galvanic isolation.
Power consumption: 100mA (10-30V),
30mA for 48V and higher

CURRENT INPUT

Trip point: 0.1 to 1A or 0.5 to 5A AC/DC (adjustable)
Repetitive accuracy: 1%
Hysteresis: 5% to 30% (adjustable)
Maximum input current (continuous): 6A
Peak short-term over-current (10 seconds): 20A
Current input impedance: 50 milliohms.

RESPONSE

Start-up delay: approximately 10 seconds, standard.
(0.1 to 15 seconds also possible on special order)

Response:
Start-up delay: approximately 10 seconds, standard.
(0.1 to 15 seconds also possible on special order)
Response Delay: SP-100 - 1 second
SP-103 - adjustable from 0.1 to 10 seconds
(other ranges on special order).

Additional information in Section J, page 131.

SP-101/SP-104
Current Monitor
0-200mA AC (RMS)/DC
60 mV/150mV (DC Shunt)
0-5V AC(RMS)/DC

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	101	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Protection for DC Motors against over-current.
- Supervision of 4-20mA control loops for open circuit or short circuit.
- Supervision of mA outputs from Rhomberg SC-320 Relay.
- Load monitoring DC winders in conjunction with DC shunt.
- AC Current control interfacing with current-to-voltage transducers.
- DC Current control of electroplating processes.

Features

- Failsafe feature.
- Internal shunt for direct in-line sensing of currents up to 200mA (AC or DC).
- Adjustable response delay of 0.1 to 10 seconds on SP-104.
- Direct interface with DC shunt resistors.
- Trip point adjustable on calibrated scale 0-100%.
- Hysteresis adjustable 5-30%.
- Programmable for overload or underload detection.
- Latching on overload or underload (programmable).
- Start-up delay.
- 10A SPDT relay output.

Description of Operation

The **SP-101** and **SP-104** are precision current monitors for both AC and DC applications. They can be programmed for either overload sensing or underload sensing. The internal shunt facilitates direct connection into a current loop up to 200mA. The units can also be used in conjunction with external DC shunt resistors (60mV, 150mV) or current-to-voltage transformers (5V secondary).

AC Monitoring: The units are suitable for direct-in-line sensing of current up to 200mA AC. The unit interfaces readily with current-to-voltage transformers (5V secondary rating) such as CT5.

DC Monitoring: The units are suitable for direct-in-line sensing of DC current. The internal shunt provides sensing up to 200 mA. For higher current, a suitable shunt (60mV or 150mV) is to be connected. The units are polarity sensitive and will not respond to current/voltage in the reverse direction.

Start-up Delay: When power is applied to the module, the relay energises immediately, ignoring abnormal load conditions experienced during start-up.

Overload Sensing: When programmed for overload sensing, the relay will de-energise if the current exceeds the setpoint. The relay will switch on again if the current drops by a certain percentage below the set overload threshold. This percentage hysteresis is adjustable.

Underload Sensing: When programmed for minimum load sensing, the relay will de-energise if the current drops below the setpoint. The relay will switch on again if the current rises by a certain percentage above the set underload threshold. This percentage hysteresis is adjustable.

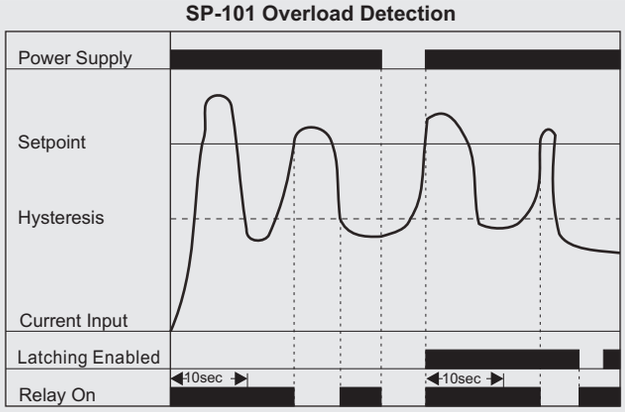
Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis can be adjusted as a percentage of set point to prevent relay chatter or hunting when the load current fluctuates around the setpoint.

Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either breaking and re-applying power supply to the unit or by momentarily disabling the latching circuit (e.g. Push-to-open switch). During the start-up delay, the latching circuit is disabled automatically. (See wiring and connection diagram on page 5)

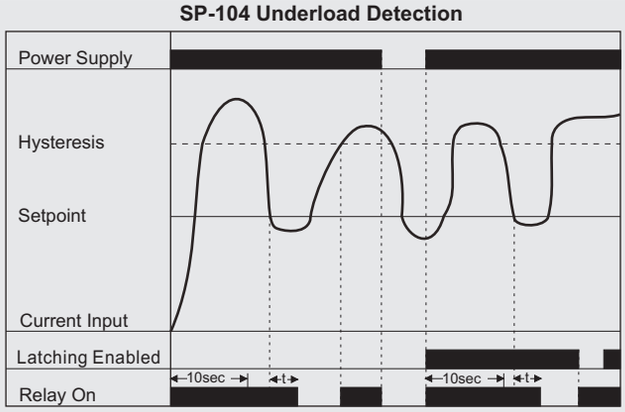
Adjustable Response (SP-104): Response delay can be adjusted from 0.1 to 10 seconds. When a trip condition is detected, the relay will only de-energise after the set response time (a delayed recovery is also available on special order).

Operational Diagrams

SP-101 Overload Detection

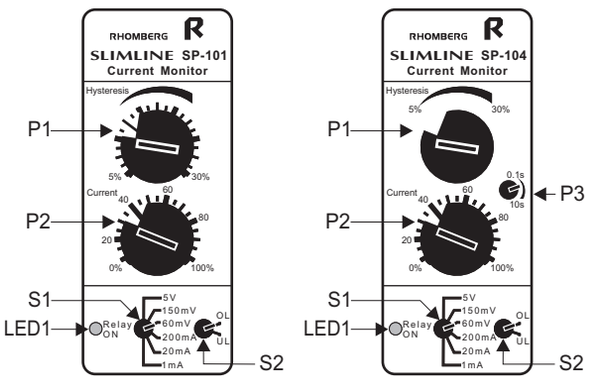


SP-104 Underload Detection



t = response delay

Description of Controls



P1: **Hysteresis** ie. The difference between the tripping point and the recovery point is set between 5% and 30% on P1. (Hysteresis relates to set-point P2)

P2: **The Current Threshold** (tripping point) is adjusted on P2. Maximum setting of 100% corresponds with a current (millivolt) level selected on S1.

P3: **Adjustable response** delay from 0.1 to 10 seconds on P3 (SP-104).

S1: **The input Range** is set on S1 (1mA, 20mA, 200mA, 60mV, 150mV, 5V).

S2: **Function Selection** is provided by S2. If set to “OL” the unit operates as an overload detector. If set to “UL” the unit operates as an underload detector.

LED 1: The LED1 illuminates to indicate that the relay is energised. The LED will be off if the unit registers a fault condition (overload/underload) or the power supply to the unit is interrupted.

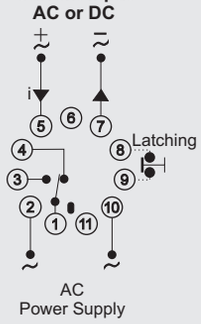
Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

Latching:
Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)

Current Input AC or DC



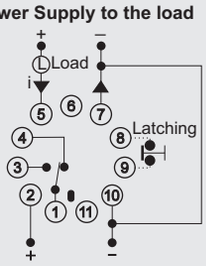
AC
Power Supply

APPLICATION 1

Direct In-line Sensing: Connect the sensing input pin 5 and pin 7 in series with the current loop. For DC monitoring, the polarity must be observed (pin 5 positive, pin 7 negative).

Note: *NOT suitable for DC supply on Pin 2 and pin 10.*

DC Power Supply to the load



DC
Power Supply

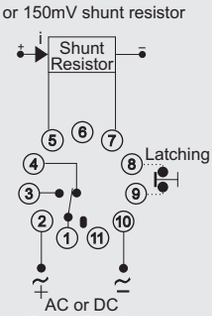
APPLICATION 2

DC Current Sensing: DC power supply on pin 2 and pin 10:
In this mode, the DC power supply and current sensing input share a common negative connection, since no galvanic isolation is provided.

Therefore, the current input, pin 5 and pin 7, has to be connected in series between the negative lead and the load.

Note: *Pin10 and pin7 are to be externally linked.*
DO NOT CONNECT THE LOAD BETWEEN PIN 7 AND PIN 10.

60 or 150mV shunt resistor



AC or DC
Power Supply

APPLICATION 3

DC Current Sensing with External Shunt: Connect the shunt between pin 5 (+) and pin 7 (-) observing the correct polarity.
For extended wiring between the shunt and the module, screened wire is recommended to prevent induction of hum or noise on the sensing inputs. The screen should be connected to pin 7 or earth.

Note: *For DC supply on pin 2 and pin 10, pin 7 and pin 10 are to be externally linked, (refer to application 2).*

Technical Specifications

POWER SUPPLY

AC: Supply voltage:12, 24, 110, 230, 400, 415, 525V ±15%
Isolation (current input to power supply): 2kV
Power consumption: 3VA (approx.)
6VA for 415, 525V (approx.)

DC: Supply voltage: 10-30V, 48, 60, 110V ± 15%
Isolation: no galvanic isolation.
Power consumption: 100mA (10-30V),
30mA for 48V and higher

CURRENT INPUT

Repetitive accuracy: 1%
Hysteresis: 5% to 30% (adjustable)

Range	Input Impedance	Maximum Input (Continuous)
1mA	60 Ohm	60mA
20mA	3 Ohm	350mA
200mA	0.7 Ohm	800mA
60mV	10k	50V
150mV	10k	50V
5mV	10k	50V

RESPONSE

Start-up delay: approximately 10 seconds, standard.
(0.1 to 15 seconds also possible on special order)

Response delay: SP-101 - 1 second.
SP-104 - adjustable from 0.1 to 10 seconds
(other ranges on special order).

Additional information in Section J, page 131.

SP-120/SP-123

Current Window Comparator Single Phase 1A/5A AC(RMS)

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	120	230V	AC	DP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Submersible pumps, clogging or running dry.
- Conveyor belts tearing or overloading.
- Jamming or loss of hydraulic fluid in ship steering motors.
- Jamming or shaft breaking on screw conveyors.
- Overload and underload detection on generator sets.
- Detection of mixture densities on a variety of industrial mixers.
- Detection of jammed dampers in either closed or open positions on fans.

Features

- Failsafe feature.
- Direct in-line current sensing.
- Combined overload and underload detection.
- Internal shunt for direct in-line current sensing.
- Adjustable response delay of 0,1 to 10 seconds on SP-123.
- 1A or 5A AC input range (programmable).
- Direct interface with conventional current transformers.
- Separate adjustment of overload and underload thresholds.
- Latching in both modes.
- LED indications for overload, underload and normal load.
- Start-up delay.
- 10A SPDT relay output.

Description of Operation

The **SP-120** and **SP-123** are precision current comparators for single phase AC applications. They respond to both under-current as well as over-current conditions. The internal shunt facilitates direct connection into a current loop up to 5A (continuous). The units interface readily with conventional current transformers (1A or 5A secondary rating).

Start-up Delay: When power is applied to the module, the relay energises immediately, ignoring abnormal load conditions experienced during start-up.

Load Sensing: The relay remains energised when the current is maintained between the overload and underload setpoint. If the current rises above the overload setpoint or drops below the underload setpoint, the relay de-energises and the appropriate LED indicates “overload” or “underload” conditions respectively. The relay energises again if the current recovers to within the set overload/underload window.

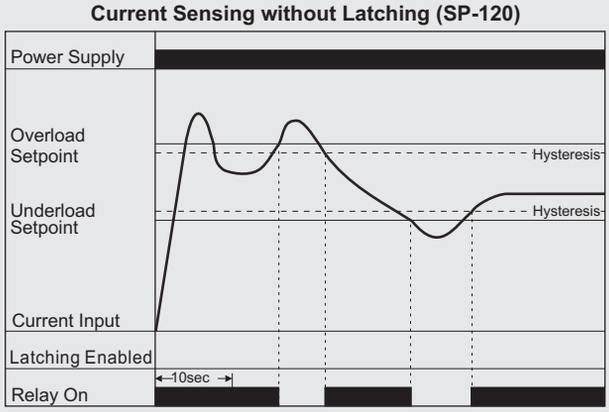
Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis is fixed to 2%t to prevent relay chatter when the load current fluctuates around the setpoint.

Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The appropriate LED will indicate the type of fault which caused the tripped condition. The unit can be reset by either breaking and re-applying power supply to the unit or by momentarily disabling the latching circuit (e.g. Push-to-open switch). During the start-up delay, the latching circuit is disabled automatically.

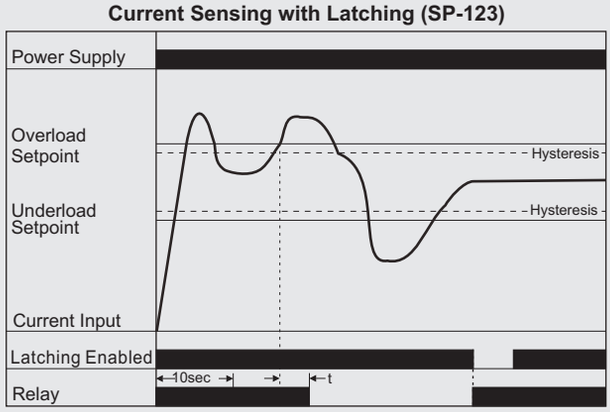
Adjustable Response (SP-123): Reponse delay can be adjusted from 0,1 to 10 seconds. When a trip condition is detected, the relay will only de-energise after the set response time (a delayed an recovery is also available on special order).

Operational Diagrams

Current Sensing without Latching (SP-120)

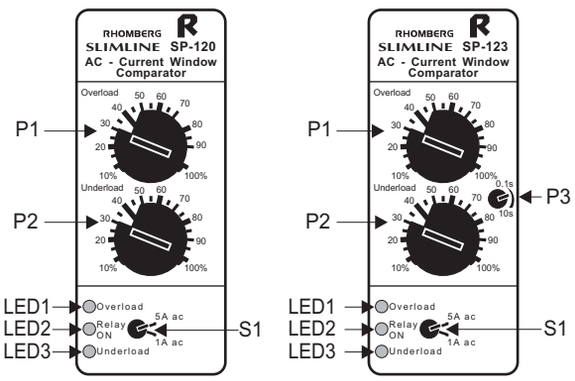


Current Sensing with Latching (SP-123)



t = response delay

Description of Controls



P1: **The Overload Threshold** is adjusted on P1. Maximum setting of 100% corresponds with a current level of 1A or 5A (depending on setting of S1).

P2: **The Underload Threshold** (tripping point) is adjusted on P2. Maximum setting of 100% corresponds with a current level of 1A or 5A (depending on the setting of S1).

Note: *P2 should be set to a level below that of P1, i.e. The overload threshold and the underload threshold must not overlap.*

P3: **Adjustable Response Delay** from 1 to 10 seconds (SP-123).

S1: The **Current Range** is set for 1A or 5A application on S1 (1A, 5A).

LED 1: The red LED marked "**Overload**" will illuminate whenever the current exceeds the set overload threshold.

LED 2: The green LED marked "**Relay ON**" will illuminate when the relay is energised.

LED 3: The red LED marked '**Underload**" will illuminate whenever the current drops below the set underload threshold.

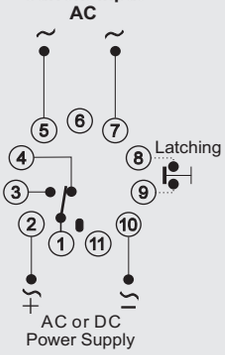
Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

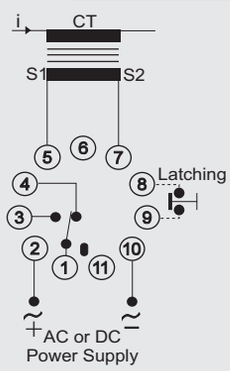
Latching
Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)

Current Input AC



APPLICATION 1

Direct In-Line AC Current Sensing: Connect the sensing pin 5 and pin 7 input in series with the AC current loop.



APPLICATION 2

AC Current Sensing with a Current Transformer: Connect the secondary terminals of the current transformer (S1 and S2) to the current input pin 5 and pin 7. Other devices, such as amperemeters, may be connected in series with the current loop, provided the VA rating of the CT is not exceeded. Power supply can be AC or DC.

Note: *Do not unplug the unit while the current loop is energised, since this will cause an open circuit of the current loop and may damage the current transformer (see "CT protection" in the general section of the catalogue on page 121.)*

Technical Specifications

POWER SUPPLY

AC: Supply voltage:12, 24, 110, 230, 400, 415, 525V ±15%
Isolation (current input to power supply): 2kV
Power consumption: 3VA (approx.)
6VA for 415, 525V (approx.)

DC: Supply voltage: 10-30V, 48, 60, 110V ± 15%
Isolation: no galvanic isolation.
Power consumption: 100mA (10-30V),
30mA for 48V and higher

CURRENT INPUT

Trip point: 0.1 to 1A or 0.5 to 5A AC (adjustable)
Repetitive accuracy: 1%
Hysteresis: 2% Fixed (relative to trip point setting)
Maximum input current (continuos): 6A
Peak short-term over-current (10 seconds): 20A
Current input impedance: 50 milliohms

RESPONSE

Start-up delay: approximately 10 seconds, standard (1 to 15 seconds also possible on special order)
Response delay: SP-120 - 1 second.
SP-123 - adjustable from 1 to 10 seconds (other ranges on special order).

Additional information in Section J, page 131.

SP-121/SP-124

DC Current Window Comparator 0-200mA DC 60mV/150mV (DC SHUNT)

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	121	230V	AC	DP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Level control used in conjunction with a 4-20mA transducer.
- Monitoring and protection of 4-20mA current loops.
- Synchronising the “take up”and “roll-off” rollers for tension control on paper machines.
- DC current control for electroplating processes.
- Cable fault detection (short or open circuit).
- Charge failure or overcharge detection on battery chargers.

Features

- Failsafe feature.
- Combined overload and underload detection.
- Internal shunt for direct in-line sensing of currents up to 200mA DC.
- Adjustable response delay of 1 to 10 seconds on SP-124.
- Direct interface with DC shunt resistors.
- Separate adjustment of overload and underload thresholds.
- Latching in both modes.
- Range selector switch for 1mA, 20mA, 200mA, 60mV, 150mV and 5V.
- LED indication for overload, underload and normal load.
- Start-up delay.
- 10A SPDT relay output.

Description of Operation

The **SP-121** and **SP-124** are precision current window comparators for DC applications. They respond to both under-current and over-current conditions. The internal shunt facilitates direct interconnection into a current loop up to 200mA. The units can also be used in conjunction with external DC shunt resistors (60mV or 150mV) for high current applications.

Start-up Delay: When power is applied to the module, the relay energises immediately, ignoring abnormal load conditions experienced during start-up.

Load Sensing: The relay remains energised when the current is maintained between the overload and underload setpoint. If the current rises above the overload setpoint or drops below the underload setpoint, the relay de-energises and the appropriate LED indicates ‘overload” or “underload” respectiverly. The relay energises again if the current recovers to within the set overload/underload window.

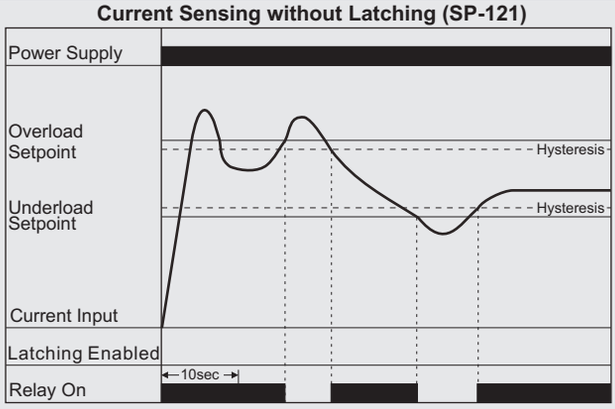
Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis is fixed 2% to prevent relay chatter or hunting when the load current fluctuates around the setpoint.

Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The appropriate LED will indicate the type of fault responsible for the tripped condition. The unit can be reset by either breaking and re-applying power supply to the unit or by momentarily disabling the latching circuit (e.g. Push-to-open switch). During the start-up delay, the latching circuit is disabled automatically.

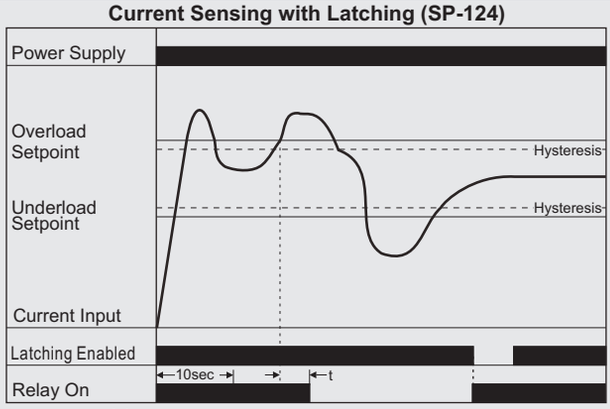
Adjustable Response (SP-124): Response delay can be adjusted from 1 to 10 seconds. When a trip condition is detected, the relay will only de-energise after the set response time (a delayed recovery is also available on special order).

Operational Diagrams

Current Sensing without Latching (SP-121)

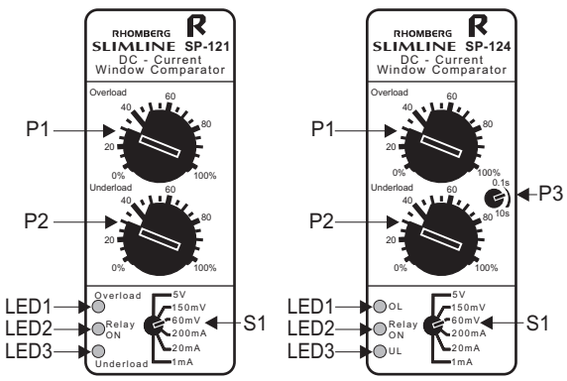


Current Sensing with Latching (SP-124)



t = response delay

Description of Controls



P1: The **Overload Threshold** is adjusted on P1. Maximum setting of 100% corresponds with a current level set on S1.

P2: The **Underload Threshold** is adjusted on P2. Maximum setting of 100% corresponds with a current level set on S1.

Note: *P2 should be set to a level below that of P1, ie. The overload threshold and the underload threshold must not overlap.*

P3: **Adjustable reponse delay** from 0.1 to 10 seconds is set in P3.

S1: The **Input Range** is set on S1(1mA, 20mA, 200mA, 60mV, 150mV and 5V).

LED 1: The red LED marked "**Overload**" will illuminate whenever the current exceeds the set overload threshold.

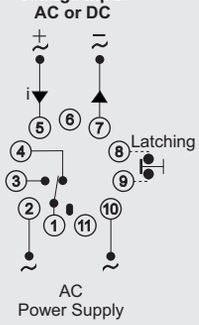
LED 2: The green LED marked "**Relay ON**" will illuminate when the relay is energised.

LED3: The red LED marked '**Underload**" will illuminate whenever the current drops below the set underload threshold.

Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

Voltage Input AC or DC



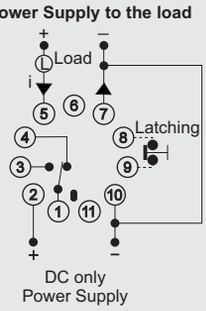
APPLICATION 1

Direct In-line Sensing: Connect the sensing input pin 5 and pin 7 in series with the current loop. For DC monitoring, the polarity must be observed (pin 5 positive, pin 7 negative).

Note: *NOT suitable for DC supply on pin 2 and pin 10.)*

Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

DC Power Supply to the load



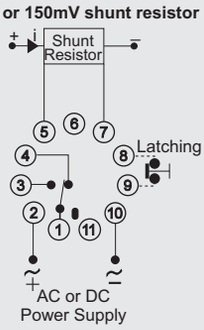
APPLICATION 2

DC Current Sensing: DC power supply on pin 2 and pin 10:
In this mode, the DC power supply and current sensing input share a common negative connection, since no galvanic isolation is provided.
Therefore, the current input, pin 5 and pin 7, has to be connected in series between the negative lead and the load.

Note: *Pin10 and pin7 are to be externally linked. DO NOT CONNECT THE LOAD BETWEEN PIN 7 AND PIN 10.*

Latching
Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)

60 or 150mV shunt resistor



APPLICATION 3

DC Current Sensing with External Shunt: Connect the shunt between pin 5 (+) and pin 7 (-) observing the correct polarity.
For extended wiring between the shunt and the module, screened wire is recommended to prevent induction of hum or noise on the sensing inputs. The screen should be connected to pin 7 or earth.

Note: *For DC supply on pin 2 and pin 10, pin 7 and pin 10 are to be externally linked, (refer to application 2).*

Technical Specifications

POWER SUPPLY

AC: Supply voltage: 12, 24, 110, 230, 400, 415, 525V ±15%
Isolation (current input to power supply): 2kV
Power consumption: 3VA (approx.)
6VA for 415, 525V (approx.)

DC: Supply voltage: 12, 24, 48, 60, 110V ± 15%
Isolation: no galvanic isolation.
Power consumption: 100mA (12, 24V),
30mA for 48V and higher

CURRENT INPUT

Repetitive accuracy: 1%
Hysteresis: 2% Fixed (relative to sensitivity setting)

Range	Input Impedance	Maximum Input (continuous)
1mA	60 Ohm	60mA
20mA	3 Ohm	350mA
200mA	0.7 Ohm	800mA
60mV	10k	50V
150mV	10k	50V
5V	10k	50V

RESPONSE

Start-up delay: approximately 10 seconds, standard (1 to 15 seconds also possible on special order)

Response delay: SP-121 - 1 second.
SP-124 - adjustable from 0.1 to 10 seconds (other ranges on special order).

Additional information in Section J, page 131.

SP-200/SP-201

Voltage Monitor
Single Phase AC(RMS)/DC

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	200	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Providing automatic control for the charging cycle of battery chargers.
- Monitoring voltage on Tacho-generators for over-speed conditions.
- Monitoring the discrimination voltage between neutral and earth to ensure that the neutral does not 'float'.
- Monitoring voltage supplies from voltage transformers in control panels.
- Monitoring the battery voltage on underground locomotives for recharging purposes.
- Monitoring the system trip circuits on high voltage switchgear.
- Monitoring the conditions of fuses which are not accessible or easy to inspect.

Features

- Failsafe feature.
- Programmable input voltage range 0V to 600V AC(RMS) or DC.
- Adjustable response delay from 0,1 to 10 seconds on SP-101.
- Voltage threshold adjustable on calibrated scale, 0-100%.
- Trip point adjustable on calibrated scale 0-100%.
- Adjustable hysteresis 5-30%.
- Programmable for over-voltage or under-voltage detection.
- Latching on over-voltage or under-voltage.
- 10A SPDT relay output.

Description of Operation

The **SP-200** and **SP-201** are precision voltage comparators for both AC and DC applications. They can be programmed for either over-voltage detection or under-voltage detection. The input voltage range is selectable from 0V to 600V in six overlapping ranges. The unit is calibrated for both AC(RMS) and DC.

AC Monitoring: The voltage monitor is connected directly across the voltage to be monitored and trips on the RMS value (assuming no AC waveform distortion).

DC Monitoring: The voltage monitor is polarity sensitive and will not respond to a voltage input with reversed polarity.

Over-voltage Sensing: When programmed for over-voltage sensing, the relay will de-energise if the voltage exceeds the setpoint. The relay will switch on again if the voltage drops by a certain percentage below the set over-voltage threshold. This percentage hysteresis is adjustable.

Under-voltage Sensing: When programmed for under-voltage sensing, the relay will de-energise if the voltage drops below the setpoint. The relay will switch on again if the voltage rises by a certain percentage above the set under-voltage threshold. This percentage hysteresis is adjustable.

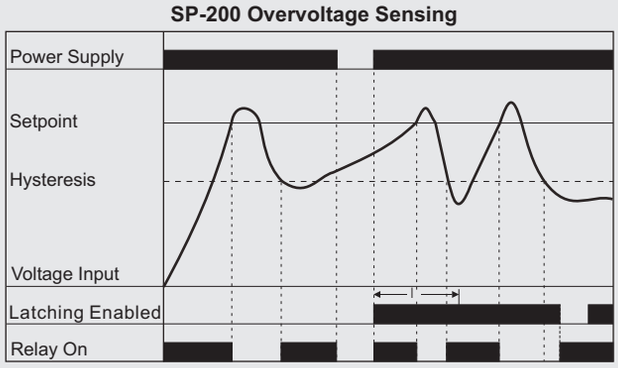
Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis can be adjusted as a percentage of setpoint to prevent relay chatter or hunting when the monitored voltage fluctuates around the setpoint.

Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either breaking and re-applying power supply to the unit or by momentarily disabling the latching circuit (e.g. push-to-open switch). On power-up of the module, the latching is inactive for approximately 10 seconds.

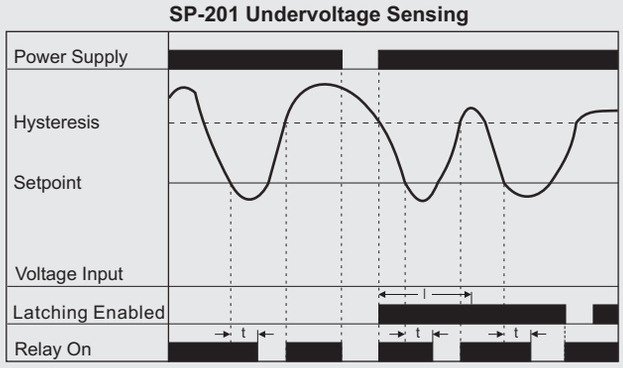
Adjustable Response (SP-201): Response delay can be adjusted from 0,1 to 10 seconds. When a trip condition is detected, the relay will only de-energise after the set response time (a delayed on recovery is also available on special order).

Operational Diagrams

SP-200 Overvoltage Sensing

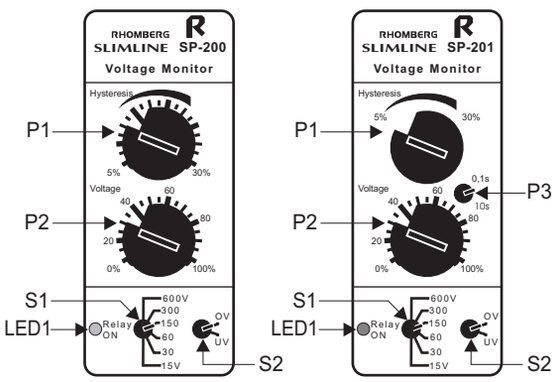


SP-201 Undervoltage Sensing



l = Latching disabled for approximately 10 seconds at power up.
t = response delay

Description of Controls



P1: **Hysteresis** i.e. The difference between the tripping point and the recovery point is set between 5% and 30% on P1. (Hysteresis relates to setpoint P2)

P2: The **Voltage Threshold** (tripping point) is adjusted on P2.

P3: **Adjustable response delay** from 0.1 to 10 seconds (SP-201).

S1: The **Voltage Range** is set on S1.

S2: **Function Selection** is provided by S2. If set to "OV" the unit operates as an over-voltage detector. If set to "UV" the unit operates as an under-voltage detector.

LED 1: The LED illuminates to indicate that the relay is energised. The LED will be off if the unit registers a fault condition (over-voltage/under-voltage) or the power supply to the unit is interrupted.

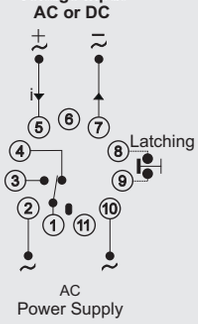
Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

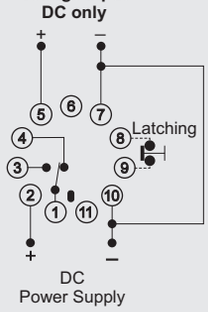
Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

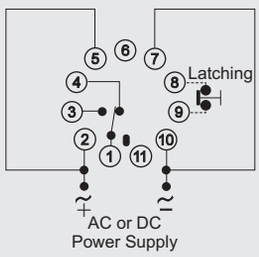
Latching
Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)

Voltage Input AC or DC



Voltage Input DC only





APPLICATION 1

AC/DC voltage sensing, AC supply: Connect the voltage to be monitored to pin 5 and pin 7. For DC monitoring, the polarity must be observed (pin 5 positive, pin 7 negative).

APPLICATION 2

DC voltage sensing, DC supply: Connect the voltage to be monitored to pin 5 (positive) and pin 7 (negative). Link pin 7 and pin 10.

Note: *For DC supply, the voltage input and power supply share a common negative (pin 7 and pin 10). There is, therefore, no galvanic isolation.*

APPLICATION 3

AC/DC voltage, monitoring own supply voltage. Connect the power supply to pin 2 and pin 10. On DC supply observe polarity. Interconnect pin 5 and pin 2. Interconnect pin 7 and pin 10.

Technical Specifications

POWER SUPPLY

AC: Supply voltage: 12, 24, 110, 230, 400, 415, 525V ±15%
Isolation (current input to power supply): 2kV
Power consumption: 3VA (approx.)
6VA for 415, 525V (approx.)

DC: Supply voltage: 10-30V, 48, 60, 110V ± 15%
Isolation: no galvanic isolation.
Power consumption: 100mA (10-30V),
30mA for 48V and higher

VOLTAGE INPUT

Repetitive accuracy: 1%
Hysteresis: 5% to 30% (adjustable)

Range	Input Impedance	Maximum Input Voltage
0-15V	500k Ohm	700V
0-30V	500k Ohm	700V
0-60V	500k Ohm	700V
0-150V	500k Ohm	700V
0-300V	500k Ohm	700V
0-600V	500k Ohm	700V

Response delay: SP-200 - 1 second.
SP-201 - adjustable from 0.1 to 10 seconds (other ranges on special order).
Latching disabled during power-up: approx. 10 seconds

Additional information in Section J, page 131.

SP-220/SP-221

Voltage Window Comparator Single Phase AC/DC

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	220	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Monitoring of the line supply in rural areas for over-voltage and under-voltage protection.
- Monitoring of supply voltage from standby generator sets.
- System supervision for voltage regulators in AC and DC systems.
- Supervision of voltage levels on solar panels.
- Monitoring the voltage output of UPS systems.

Features

- Failsafe feature.
- Combined over-voltage and under-voltage detection.
- Adjustable response delay of 0.1 to 10 seconds on SP-221.
- Monitoring of own supply voltage.
- High precision and repetitive accuracy.
- Independent setting of over-voltage and under-voltage tripping points.
- LED indication for type of fault and status of the relay.
- Latching facility.
- 10A SPDT relay output.

Description of Operation

The **SP-220** and **SP-221** are precision voltage window comparators for single phase AC or DC applications. The voltage to be monitored is tapped off internally from the supply to the comparator. It responds to both over-voltage as well as under-voltage conditions.

Voltage Sensing: The relay is energised when the voltage is maintained between the set over-voltage and under-voltage thresholds. If the voltage rises above the over-voltage setpoint or drops below the set under-voltage setpoint, the relay de-energises and the appropriate LED indicates “over-voltage” or “under-voltage” respectively. The relay energises again if the voltage recovers to within the set voltage bandwidth.

Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis is fixed to 2% to prevent relay chatter when the voltage fluctuates around the set limits.

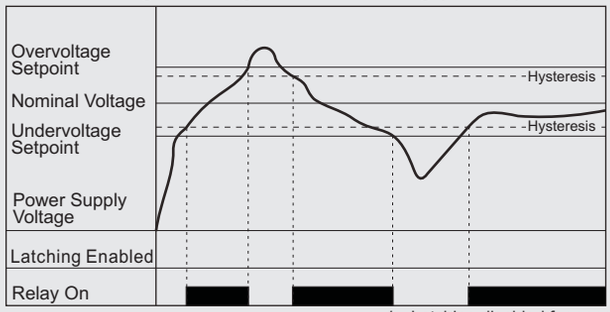
Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The appropriate LED will indicate the type of fault responsible for the tripped condition. The unit can be reset by either breaking and re-applying power supply to the unit, or by momentarily disabling the latching circuit (e.g. Push-to-open-switch). On power-up of the module, the latching is inactive for approximately 10 seconds.

Adjustable Response (SP-201): Response delay can be adjusted from 1 to 10 seconds. When a trip condition is detected, the relay will only de-energise after the set response time (a delayed recovery is also available on special order).

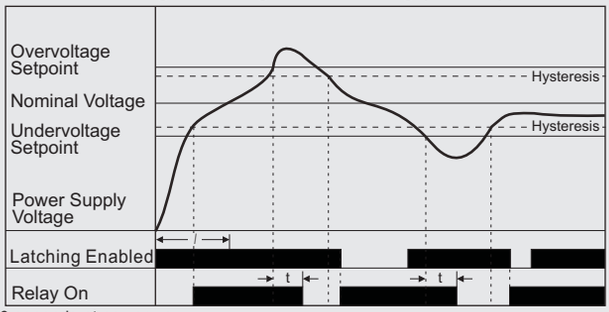
Note: *In conditions of excessive undervoltage, trip response would be immediate (i.e. no delay).*

Operational Diagrams

Voltage Sensing Without Latching (SP-220)

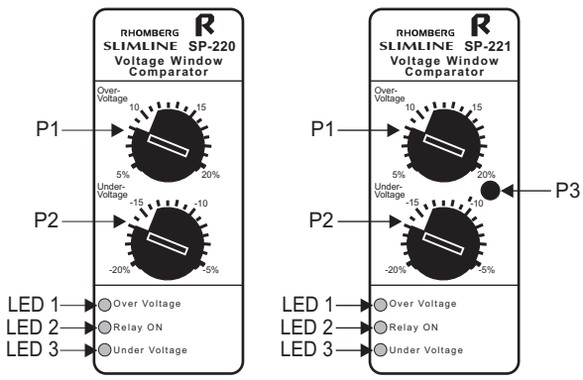


Voltage Sensing With Latching (SP-221)



l = Latching disabled for approximately 10 seconds at power up.
t = response delay

Description of Controls



P1: The **Over-voltage Threshold** is adjusted on P1.

P2: The **Under-voltage Threshold** is adjusted on P2.

Note: *The scales for over-voltage and under-voltage threshold settings are calibrated in percentage deviation from nominal (ideal) supply voltage.*

P3: **Adjustable response delay** from 0.1 to 10 seconds.

LED 1: The red LED marked "**Over-voltage**" illuminates whenever the supply voltage exceeds the set over-voltage threshold.

LED 2: The green LED marked "**Relay ON**" illuminates when the relay is energised, .ie. Under normal supply conditions.

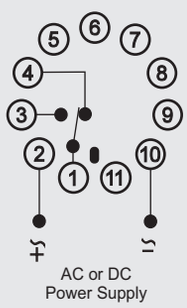
LED 3: The red LED marked "**Under-voltage**" illuminates whenever the supply voltage drops below the set under-voltage threshold.

Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

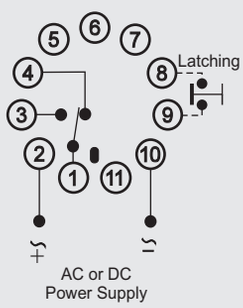
Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

Latching
Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)



APPLICATION 1

Without latching



APPLICATION 2

With latching

Technical Specifications

POWER SUPPLY

AC: Supply voltage: 12, 24, 110, 230, 400, 415, 525V ±20%
Isolation (current input to power supply): 2kV
Power consumption: 3VA (approx.)
6VA for 415, 525V (approx.)

DC: Supply voltage: 12, 24, 48, 60, 110V ± 20%
Isolation: no galvanic isolation.
Power consumption: 100mA (12, 24V),
30mA for 48V and higher

VOLTAGE SENSING:

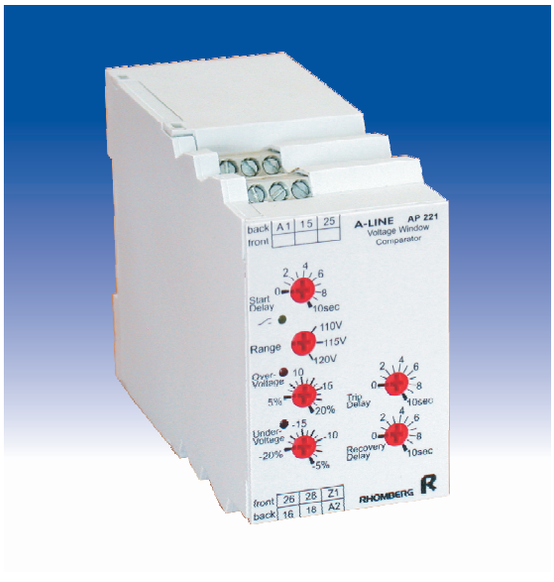
Calibrated to respond to the RMS of a sinusoidal waveform.
Repetitive accuracy: 1%
Hysteresis: 2% fixed (relative to its supply voltage)
Response delay: SP-230 - 1 second.
SP-231 - adjustable from 0.1 to 10 seconds
(other ranges on special order).
Latching disabled during power-up: approx. 10 seconds

Additional information in Section J, page 131.

AP-221

Voltage Window Comparator, Single Phase AC/DC Application

A-LINE
MONITORING RELAYS



ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
AP	221	230V	A	D

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Monitoring of the line supply in rural areas for overvoltage and undervoltage protection.
- Monitoring of supply voltage from standby generator sets.
- System supervision for voltage regulators in AC and DC systems.
- Supervision of voltage levels on solar panels.
- Monitoring the voltage output of UPS systems.

Features

- Fail-to-safe design.
- DIN rail format.
- Combined over-voltage and under-voltage monitoring.
- Monitoring of own supply voltage.
- Selectable power supply voltages.
- High precision and repetitive accuracy.
- Independent adjustment of over-voltage and under-voltage setpoints.
- Adjustable response times available on trip and/or recovery (0,1-10 seconds).
- Adjustable start-up delay (0-10 seconds).
- Latching on over-voltage or under-voltage fault conditions (programmable).
- LED indication for Relay On, over-voltage and under-voltage.
- 10A SPDT relay output.
- 5A DPDT relay output.

Description of Operation

The **AP-221** is a precision voltage window comparator for single phase AC and DC applications. The voltage to be monitored is tapped off internally from the supply to the comparator. The unit responds to both over-voltage and under-voltage conditions.

Voltage Sensing: The relay is energised when the voltage is maintained between the overv-oltage and under-voltage setpoints. If the voltage rises above the over-voltage setpoint or drops below the under-voltage setpoint, the relay de-energises and the appropriate LED indicates “Over-voltage” and “Under-voltage” respectively. The relay energises again if the voltage recovers to within the set voltage window (i.e. between the two setpoints).

Hysteresis: Hysteresis represents the difference between the setpoint and the recovery point of the unit. The hysteresis is fixed at 2% to prevent relay chatter when the voltage fluctuates around either of the setpoints.

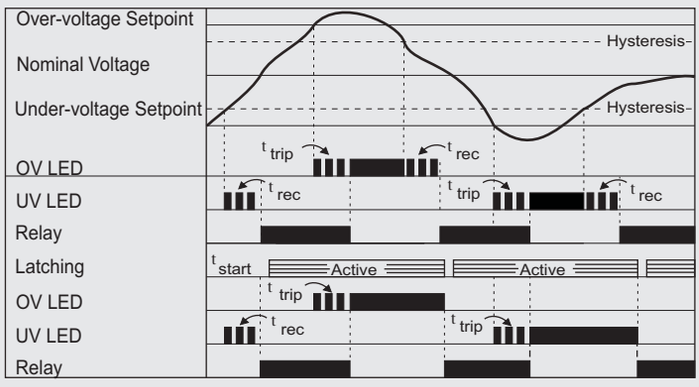
Latching: When latching is enabled, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either interrupting its power supply or by momentarily disabling the latching circuit (e.g. push-to-open switch).

Start-up delay: The latching circuit is inhibited at start-up for a period of time which is adjustable from 0 to 10 seconds.

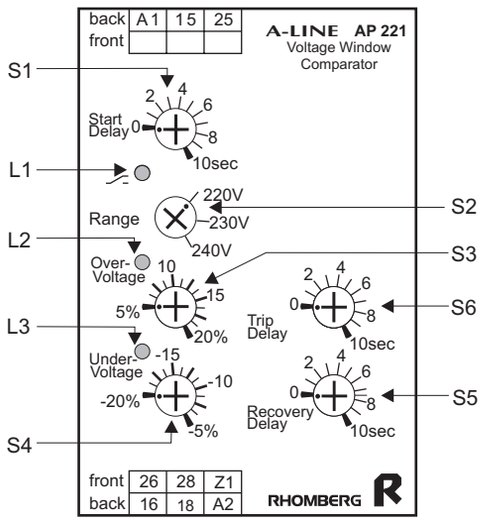
Delay on Trip: Response time on trip for over-voltage and under-voltage is adjustable from 0,1 to 10 seconds. When a trip condition is detected the relay will de-energise after the set trip delay time.

Delay on Recovery: Response time on recovery for over-voltage and under-voltage is adjustable from 0.1 to 10 seconds. When a recovery condition is detected the relay will energise after the set recovery delay time.

Operational Diagram



Description of Controls



L1: The yellow **"Relay ON"** LED marked ⏦ illuminates when the relay is energised.

L2: The red **"Over-voltage"** LED illuminates if the supply voltage exceeds the over-voltage setpoint. It also flashes during an over-voltage response time for trip and recovery.

L3: The red **"Under-voltage"** LED illuminates if the supply voltage drops below the under-voltage setpoint. It also flashes during an under-voltage response time for trip and recovery.

S1: **Start-up delay** (for disabling latching) is set on S1. This time is adjustable from 0 to 10 seconds.

S2: **Supply voltage** is set on S2. (eg. 220, 230 and 240 single phase AC supply).

S3: **Over-voltage** setpoint is adjusted on S3. (5 to 20% of nominal voltage).

S4: **Under-voltage** setpoint is adjusted on S4. (-20 to -5% of nominal voltage).

S5: **Recovery Delay** response time for the over-voltage and under-voltage is set on **S5**. This time is adjustable from 0,1 to 10 se-conds.

S6: **Trip Delay** response time for the over-voltage and under-voltage is set on S6. This time is adjustable from 0,1 to 10 seconds.

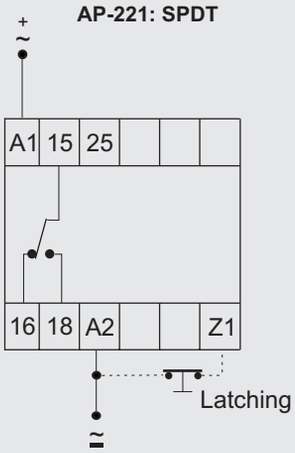
Wiring and Connection

Power Supply	
Phase / Positive	A1
Neutral / Negative	A2

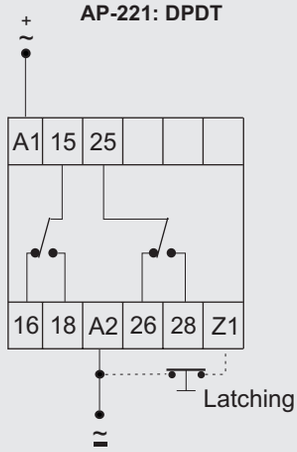
Relay Contacts - SPDT	
Normally open	15 + 18
Normally closed	15 + 16

Relay Contact -DPDT		
Normally open	15 + 18	25 + 28
Normally closed	15 + 16	25 + 26

AP-221: SPDT



AP-221: DPDT



Note: *Position of relay contacts are shown in the de-energised state.*

Technical Specifications

POWER SUPPLY		
Supply Tyoe	**AC Transformer Supply**	**DC Supply**
Supply voltage	12, 24, 115 (110, 115, 120), 230 (220, 230 or 240), 400 (380, 400 or 415), 525V AC	12, 24, 48, 60, 110V DC
Housing width	45mm	45mm
Power consumption	2VA (approx.)	30mA (approx.)
Isolation	Galvanic (without latching)	No galvanic isolation
Voltage tolerance	±20%	±20%

VOLTAGE SENSING	
Setpoints	The unit is calibrated to trip on the RMS value of the supply voltage (assuming no AC waveform distortion).
Repetitive accuracy	1%
Hysteresis	2% (fixed). Hysteresis relates to the supply voltage.

START-UP DELAY	
Start-up delay	0 - 10 seconds (Adjustable)

RESPONSE TIMES	
Response time on trip	0.1 - 10 seconds (Adjustable)
Response time on recovery	0.1 - 10 seconds (Adjustable)

Additional information in Section J, page 131.

AP-224

Combined Over-voltage and Under-voltage Monitor with 2 Independent Relays

A-LINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
AP	224	230V	A	S

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Phase monitoring of voltage transformers to ensure the voltage integrity of control circuits in high voltage panels.
- Monitoring of the line supply in rural areas for overvoltage and undervoltage protection.
- Monitoring of supply voltage from standby generator sets to ensure a constant supply.

Features

- Fail-to-safe design.
- DIN rail format.
- Combined over-voltage and under-voltage monitoring.
- Monitoring of own supply voltage.
- Selectable power supply voltages.
- High precision and repetitive accuracy.
- Independent adjustment of over-voltage and under-voltage setpoints.
- Adjustable response times - available on trip and / or recovery (0.1 to 10 seconds).
- LED indication of Over-voltage Relay ON, and Under-voltage Relay ON (Power LED flashes when timing).
- 8A SPDT Over-voltage Relay output.

Description of Operation

The **AP-224** is a combined over-voltage and under-voltage monitor for single phase AC and DC applications. It has separate relay outputs for indicating over-voltage and under-voltage tripping. The voltage to be monitored is tapped off internally from the supply to the unit.

Voltage Sensing: The relays are energised when the voltage is maintained between the over-voltage and under-voltage setpoints. If the voltage rises above the over-voltage setpoint, the over-voltage relay de-energises. If the voltage drops below the under-voltage setpoint, the under-voltage relay de-energises.

Hysteresis: Hysteresis represents the difference between the setpoint and the recovery point of the unit. The hysteresis is fixed at 2% to prevent relay chatter when the voltage fluctuates around either of the setpoints.

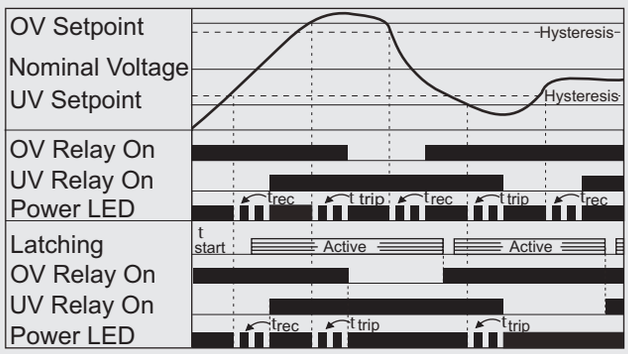
Latching: When latching is enabled, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either interrupting its power supply to the unit or by momentarily disabling the latching circuit (e.g. push to open switch).

Start-up delay: The latching circuit is inhibited at start-up for a period of time which is adjustable from 0 to 10 seconds.

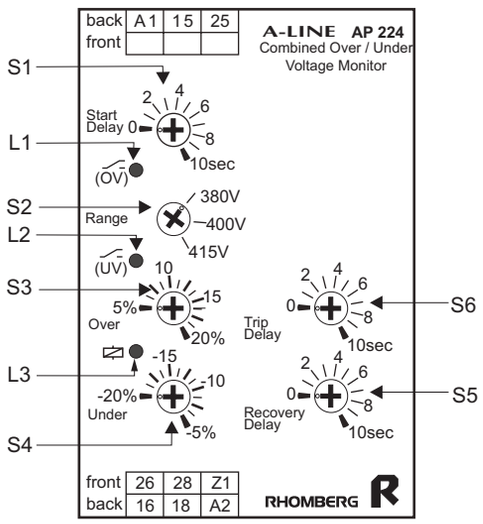
Delay on Trip: Response time on trip for over-voltage and under-voltage is adjustable from 0.1 to 10 seconds. When a trip condition is detected the relevant relay will de-energise after the set response time.

Delay on Recovery: Response time on recovery for over-voltage and under-voltage is adjustable from 0.1 to 10 seconds. When a recovery condition is detected the relevant relay will energise after the set recovery time.

Operational Diagram



Description of Controls



L1: The yellow **"Over-voltage"** LED marked (OV) illuminates when the over-voltage relay is energised.

L2: The yellow **"Under-voltage"** LED marked (UV) illuminates when the under-voltage relay is energised.

L3: The red **"Power On"** LED marked illuminates when power is supplied to the unit. It also flashes during the response time for trip and recovery.

S1: **Start-up delay** (for disabling latching) is set on S1. This time is adjustable from 0 to 10 seconds.

S2: **Supply voltage** is set on S2 (e.g. 380, 400 or 415V).

S3: **Over-voltage** setpoint is adjusted on S3 (5 - 25%).

S4: **Under-voltage** setpoint is adjusted on S4 (-20 to -5%).

S5: **Recovery Delay** response time for the over-voltage and under-voltage is set on S5.

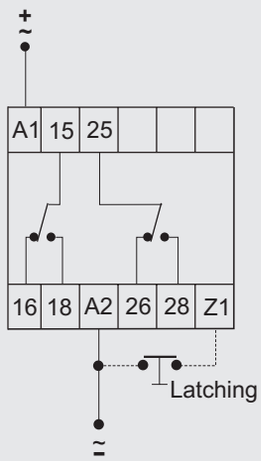
S6: **Trip Delay** response time for over-voltage and under-voltage is set on S6.

Wiring and Connection

Power Supply	
Phase/Positive	A1
Neutral/Negative	A2

Undervoltage Relay Contacts	
Normally Open	15 + 18
Normally Closed	15 + 16

Overvoltage Relay Contacts	
Normally Open	25 + 28
Normally Closed	25 + 26



NOTE: *Position of relay contacts are shown in the de-energised state.*

Technical Specifications

POWER SUPPLY		
Supply type	**AC Transformer Supply**	**DC Supply**
Supply voltage	12, 24,115(110,115 or120),230 (220, 230 or 240),400(380, 400 or 415), 525VAC	12, 24, 48, 60, 110VDC
Housing width	45mm	45mm
Power consumption	2VA (approx.)	30mA (approx.)
Isolation	Galvanic (without latching)	No galvanic isolation
Voltage tolerance	±20%	±20%

START-UP DELAY	
Start-up delay	0 - 10 seconds (Adjustable)

RESPONSE TIMES	
Response time on trip	0,1 - 10 seconds (Adjustable)
Response time on recovery	0,1 - 10 seconds (Adjustable)

VOLTAGE SENSING	
Setpoints	The unit is calibrated to trip on the RMS value of the supply voltage (assuming no AC waveform distortion).
Repetitive accuracy	1%
Hysteresis	2% (fixed). Hysteresis relates to the supply voltage.

Additional information in Section J, page 131.

SP-230/SP-231 /SP-232

Voltage Window Comparator Three Phase

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	230	230V	AC	DP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Detection of Phase Failure.
- Phase monitoring of voltage transformers to ensure the voltage integrity of control circuits in high voltage panels.
- Monitoring of the line supply in rural areas for over- and under-voltage protection.
- Monitoring of supply voltage from standby generator sets to ensure a constant voltage supply.
- Monitoring the voltage output of UPS systems.

Features

- Failsafe feature.
- Combined over-voltage and under-voltage detection.
- Monitoring of own supply voltage.
- Adjustable response delay on SP-231
- SP-232 available with neutral.
- High precision and repetitive accuracy.
- Independent setting of over- and under-voltage tripping points.
- LED indication for type of fault and status of the relay.
- Latching facility.
- 10A SPDT relay output.

Description of Operation

The **SP-230**, **SP-231** and **SP-232** are precision voltage window comparators for three phase AC applications, monitoring phase-to-phase voltage. They respond to both over-voltage as well as under-voltage conditions. Power supply to the unit is tapped off the voltage sensing inputs.

Voltage Sensing: The relay is energised when the voltage is maintained between the set over-voltage and under-voltage thresholds. If the voltage between any two phases rises above the over-voltage setpoint or drops below the under-voltage setpoint, the relay de-energises and the appropriate LED indicates “over-voltage” or under-voltage” respectively. The relay energises again if the voltage recovers to within the set voltage window bandwidth.

Note: *The SP-230 is calibrated to respond to the RMS of sinusoidal waveform. In exceptional circumstances where voltages are not sinusoidal in nature, scale inaccuracies may be experienced.*

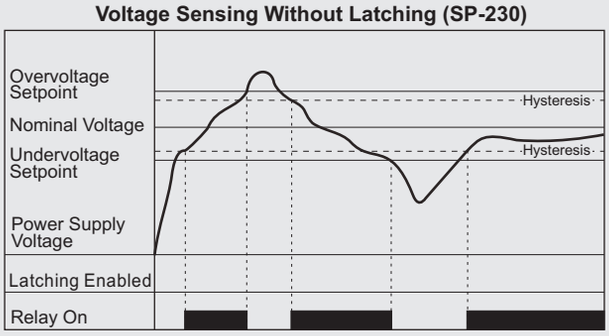
Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis is fixed to 2% to prevent relay chatter when the voltage fluctuates around the setpoint.

Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The appropriate LED will indicate the type of fault responsible for the tripped condition. The unit can be reset by either breaking and re-applying power supply to the unit or by momentarily disabling the latching circuit (e.g. push-to-open switch). On power-up of the module, the latching is inactive for approximately 10 seconds.

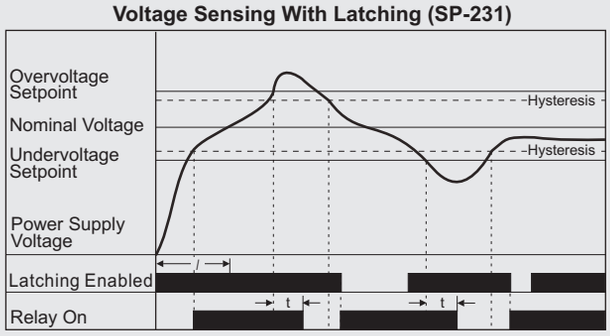
Adjustable Response (SP-231): Response delay can be adjusted from 1 to 10 seconds. When a trip condition is detected, the relay will only de-energise after the set response time (a delayed on recovery is also available on special order).

Operational Diagram

Voltage Sensing Without Latching (SP-230)

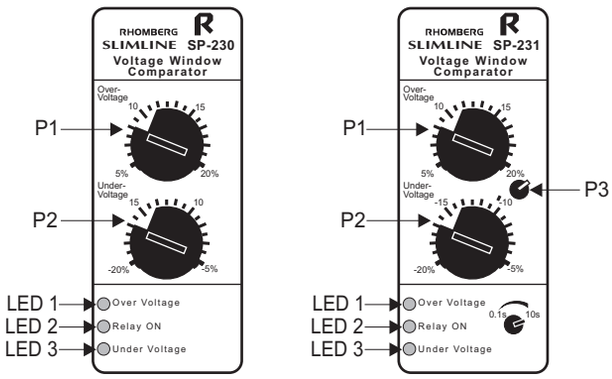


Voltage Sensing With Latching (SP-231)



I = Latching disabled for approximately 10 seconds at power up.
t = response delay

Description of Controls



P1: The **Over-voltage Threshold** is adjusted on P1.

P2: The **Under-voltage Threshold** is adjusted P2.

Note: *The scales for over-voltage and under-voltage threshold settings are calibrate in percentage deviation from nominal supply voltage.*

P3: **Adjustable Response Delay** from 0.1 to 10 seconds.

LED 1: The red LED marked "**Over-voltage**" will illuminate whenever the current exceeds the set over-voltage threshold.

LED 2: The green LED marked "**Relay ON**" will illuminate when the relay is energised, i.e. under normal supply conditions.

LED 3: The red LED marked '**Under-voltage**" will illuminate whenever the current drops below the set under-voltage threshold.

Wiring and Connection

Power Supply

The three phase R, S and T are to be connected to pins 5,6 and 7 respectively.

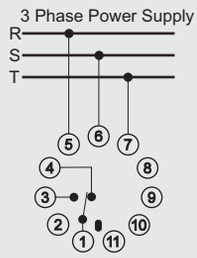
Relay Contacts

Normally Open	1 + 3
Normally Closed	1 + 4

Latching

Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)

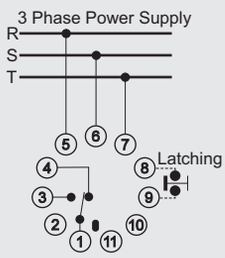
SP-230/SP-231



APPLICATION 1

Without latching

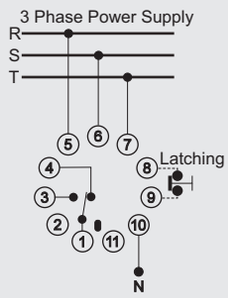
SP-230/SP-231



APPLICATION 2

With latching

SP-232



APPLICATION 3

Technical Specifications

POWER SUPPLY

Supply voltage (phase-to-phase): 12, 24, 110, 230, 400, 415, 525V AC ±15%
Power consumption: 3VA (approx.)
6VA for 415, 525V AC (approx.)

VOLTAGE SENSING

Calibrated to respond to the RMS of a sinusoidal waveform.
Repetitive accuracy: 1%
Hysteresis: 2% fixed (relative to its supply voltage).
Response delay: 1 second.
Latching disabled during power-up: approx. 10 seconds.

Additional information in Section J, page 131.

AP-231/AP-232

Voltage Window Comparator 3 Phase

A-LINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
AP	231	230V	A	D

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Detection of phase failure.
- Detection of incorrect phase sequence.
- Detection of neutral failure (AP-232).
- Phase monitoring of voltage transformers to ensure the voltage integrity of control circuits in high voltage panels.
- Monitoring of the line supply in rural areas for over-voltage and under-voltage protection.
- Monitoring of supply voltage from standby generator sets to ensure a constant voltage supply.
- Monitoring the voltage output of UPS systems.
- Initiation of generator sets.

Features

- Fail-to-safe design.
- Combined over-voltage and under-voltage monitoring.
- Monitoring of own supply voltage.
- AP232 available with neutral.
- Selectable power supply voltages.
- High precision and repetitive accuracy.
- Independent adjustment of over-voltage and under-voltage setpoints.
- Separately adjustable response times on trip and recovery (0.1 to 10 seconds.)
- Adjustable start-up delay (0 to 10 seconds) to inhibit latching at start-up.
- Latching on over-voltage or under-voltage (programmable).
- Led indication for type of fault and status of the relay.
- Microprocessor technology incorporated.
- 5A DPDT relay as standard.
- Din rail mounting.

Description of Operation

The **AP-231** and **AP-232** are precision voltage window comparators for three phase AC applications. Both units also detect and protect against incorrect phase sequence. The **AP-231** monitors phase-to-phase voltages, the **AP-232** monitors phase-to-neutral voltages. They respond to both over-voltage and under-voltage conditions. The voltage to be monitored is tapped off internally from the supply to the comparator.

Voltage Sensing Inputs: The relay is energised when the voltage is maintained between the over-voltage and under-voltage setpoints. If the voltage between any two phases rises above the over-voltage setpoint or drops below the under-voltage setpoint, the relay de-energises and the appropiate LED indicates “Over-voltage” or ”Under-voltage” respectively. The relay energises again if the voltage recovers to within the set voltage window (i.e. between the two setpoints).

Incorrect Phase Sequence: When an incorrect phase sequence is detected the relay de-energises and the Over-voltage and Under-voltage LED’s flash alternately.

Loss of neutral detection: The AP-232 will detect loss of neutral where the three phase supply is connected to an unbalanced load.

Hysteresis: Hysteresis represents the difference between the setpoint and the recovery point of the unit. The hysteresis is fixed at 2% to prevent relay chatter when the voltage fluctuates around either of the setpoints.

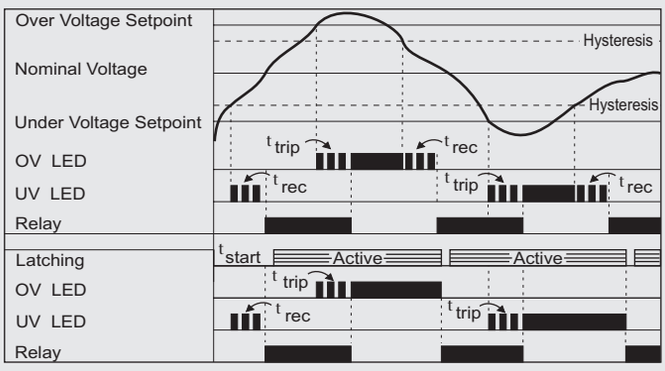
Latching: When latching is enabled, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either interrupting the power supply to the unit or by momentarily disabling the latching circuit (e.g. push-to-open switch).

Start-up delay: The latching circuit is inhibited at start-up for a period of time which is adjustable from 0 to 10 seconds.

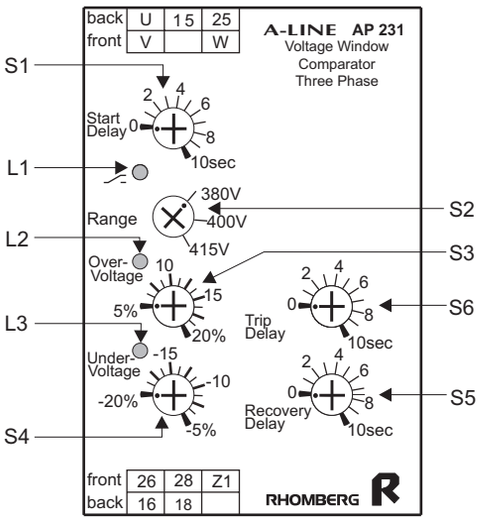
Delay on Trip: Response time on trip for over-voltage and under-voltage is adjustable from 0.1 to 10 seconds. When a trip condition is detected the relay will de-energise after the set trip delay time.

Delay on Recovery: Response time on recovery for over-voltage and under-voltage is adjustable from 0.1 to 10 seconds. When a recovery condition is detected the relay will energise after the set recovery delay time.

Operational Diagram



Description of Controls



L1: The yellow "**Relay ON**" marked illuminates when the relay is energised.

L2: The red "**Over-voltage**" LED illuminates if the supply voltage exceeds the over-voltage setpoint. It flashes during an over-voltage response time for trip and recovery, and flashes alternately with **L3** to indicate a phase sequence error.

L3: The red "**Under-voltage**" LED illuminates if the supply voltage drops below the under-voltage setpoint. It flashes during an under-voltage response time for trip and recovery, and flashes alternately with **L2** to indicate a phase sequence error.

S1: **Start-up delay** (for disabling latching) is set on **S1**. This time is adjustable from 0 to 10 seconds.

S2: **Supply voltage** is set on **S2** (e.g. 380, 400 or 415V).

S3: **Over-voltage** setpoint is adjusted on **S3** (5 to 20%).

S4: **Under-voltage** setpoint is adjusted on **S4** (-5 to -20%).

S5: **Recovery Delay** response time for the over-voltage and under-voltage is set on **S5**. This time is adjustable from 0.1 to 10 seconds.

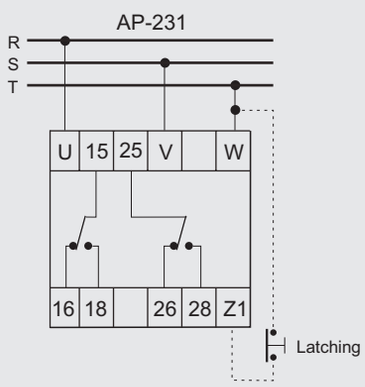
S6: **Trip Delay** response time for the over-voltage and under-voltage is set on **S6**. This time is adjustable from 0.1 to 10 seconds.

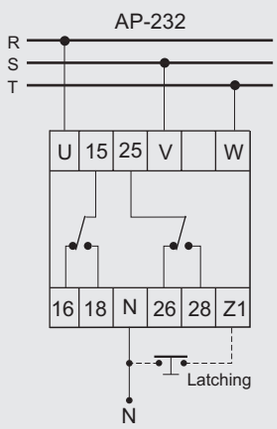
Wiring and Connection

Power Supply	
R Phase	U
S Phase	V
T Phase	W
N Neutral (AP-232 only)	N

Relay Contacts SPDT	
Normally Open	15 +18
Normally Closed	15 +16

Relay Contacts DPDT		
Normally Open	15 + 18	25 + 28
Normally Closed	15 + 16	25 + 26





Technical Specifications

POWER SUPPLY	
Supply type	AC transformer supply only
Supply voltage	115(110,115 or 120), 230(220, 230 or 240), 400(380, 400 or 415), 525V
Housing width	45mm
Power consumption	2VA (approx.)
Isolation	Galvanic
Voltage tolerance	±20%

VOLTAGE SENSING	
Setpoints	The unit is calibrated to trip on the RMS value of the supply voltage(assuming no AC waveform distortion).
Repetitive accuracy	1%
Hysteresis	2% (fixed). Hysteresis relates to the supply voltage.

START-UP DELAY	
Start-up delay	0 - 10 seconds (Adjustable)

RESPONSE TIMES	
Response time on trip	0.1 - 10 seconds (Adjustable)
Response time on recovery	0.1 - 10 seconds (Adjustable)

Additional information in Section J, page 131.

AP-234/AP-235
Combined Over and Under Voltage Monitor Three Phase (Separate Relays)

A-LINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
AP	234	230V	A	S

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Detection of phase failure (AP-234).
- Detection of phase or neutral failure (AP-235).
- Phase monitoring of voltage transformers to ensure the voltage integrity of control circuits in high voltage panels.
- Monitoring of the line supply in rural areas for over-voltage and under-voltage protection.
- Monitoring of supply voltage from standby generator sets to ensure a constant supply.

Features

- Fail-to-safe design.
- DIN rail format.
- Combined over-voltage and under-voltage monitoring.
- Monitoring of own supply voltage.
- Selectable power supply voltages.
- High precision and repetitive accuracy.
- Independent adjustment of over-voltage and under-voltage setpoints.
- Adjustable response times - available on trip and/or recovery (0.1 to 10 seconds).
- LED indication of Over-voltage Relay ON, and Under-voltage Relay ON (Power LED flashes when timing).
- 8A SPDT Over-voltage Relay output.

Description of Operation

The A-line **AP-234** and **AP-235** are combined over-voltage and under-voltage monitors for three phase AC applications. Both units also detect and protect against incorrect phase sequence. They have separate relay outputs for indicating over-voltage and under-voltage faults. The voltage to be monitored is tapped off internally from the supply to the comparator.

Voltage Sensing: The relays are energised when the voltage is maintained between the over-voltage and under-voltage setpoints. If the voltage rises above the over-voltage setpoint, the over-voltage relay de-energises. If the voltage drops below the under-voltage setpoint, the under-voltage relay de-energises.

Incorrect Phase Sequence: When an incorrect phase sequence is detected both relays de-energise and the power LED will flash to indicate the fault.

Loss of Neutral: The **AP-235** will detect loss of neutral when the three phase supply is connected to an unbalanced load.

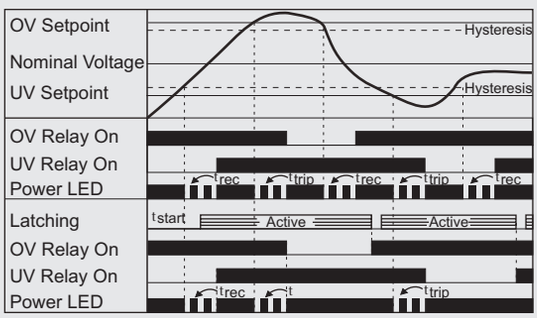
Hysteresis: Hysteresis represents the difference between the setpoint and the recovery point of the unit. The hysteresis is fixed at 2% to prevent relay chatter when the voltage fluctuates around either of the setpoints.

Latching: When latching is enabled, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either interrupting its power supply to the unit or by momentarily disabling the latching circuit (e.g. push-to-open switch).

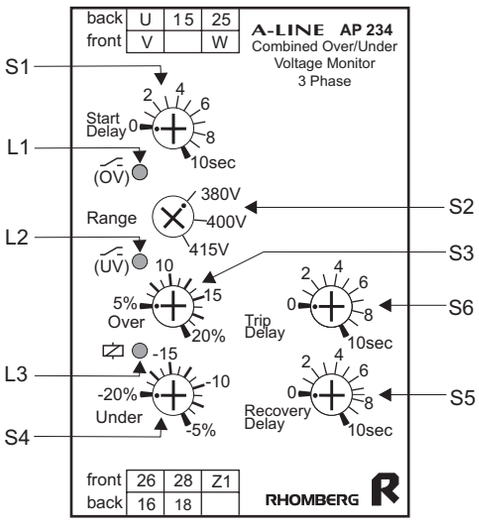
Start-up delay: The latching circuit is inhibited at start-up for a period of time which is adjustable from 0 to 10 seconds.

Delay on Trip: Response time on trip for over-voltage and under-voltage is adjustable from 0.1 to 10 seconds. When a trip condition is detected the relevant relay will de-energise after the set response time.

Operational Diagram



Description of Controls



L1: The yellow **"Over-voltage"** LED marked (OV) illuminates when the over-voltage relay is energised.

L2: The yellow **"Under-voltage"** LED marked (UV) illuminates when the under-voltage relay is energised.

L3: The red **"Power On"** LED marked illuminates when power is supplied to the unit. It also flashes to indicate a phase sequence error and during response time for trip and recovery.

S1: **Start-up delay** (for disabling latching) is set on **S1**. This time is adjustable from 0 to 10 seconds.

S2: **Supply voltage** is set on **S2** (e.g. 380, 400, 415V).

S3: **Over-voltage** setpoint is adjusted on **S3** (5 - 20%).

S4: **Under-voltage** setpoint is adjusted on **S4** (-20 to -5%).

S5: **Recovery Delay** response time for the over-voltage and under-voltage is set on **S5**. This time is adjustable from 0.1 to 10 seconds.

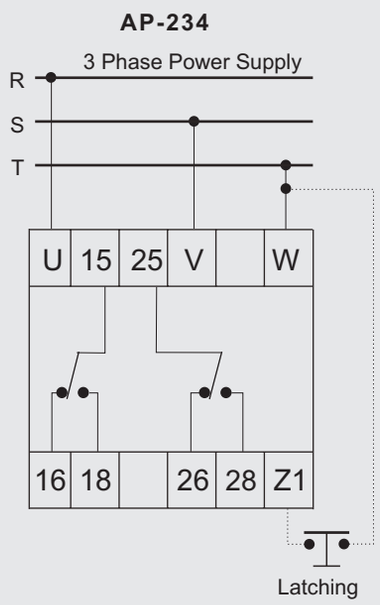
S6: **Trip Delay** response time for over-voltage and under-voltage is set on **S6**. This time is adjustable from 0.1 to 10 seconds.

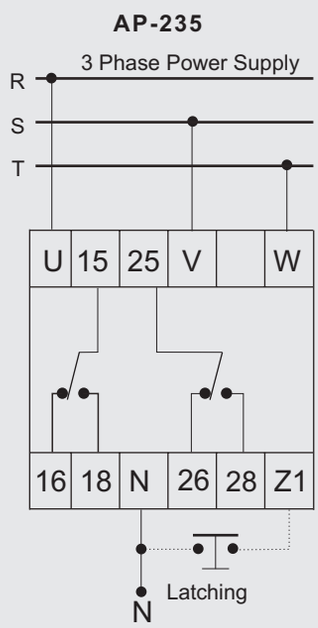
Wiring and Connection

Power Supply	
Phase R	U
Phase S	V
Phase T	W
Neutral N (AP235 only)	N

Under-voltage Relay Contacts	
Normally Open	15+18
Normally Closed	15+16

Over-voltage Relay Contacts	
Normally Open	25+28
Normally Closed	15+16





Note: *Position of relay contacts are shown in the de-energised state.*

Technical Specifications

POWER SUPPLY	
Supply type	AC transformer supply only
Supply voltage	115(110, 115 or 120), 230(220, 230 or 240), 400(380, 400 or 415), 525V AC
Housing width	45mm
Power consumption	2VA (approx.)
Isolation	Galvanic (without latching)
Voltage tolerance	±20%

VOLTAGE SENSING	
Setpoints	The unit is calibrated to trip on the RMS value of the supply voltage(assuming no AC waveform distortion).
Repetitive accuracy	1%
Hysteresis	2% (fixed). Hysteresis relates to the supply voltage.

START-UP DELAY	
Start-up delay	0 - 10 seconds (Adjustable)

RESPONSE TIMES	
Response time on trip	0.1 - 10 seconds (Adjustable)
Response time on recovery	0.1 - 10 seconds (Adjustable)

Additional information in Section J, page 131.

SP-320

Frequency Monitor

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	320	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Frequency supervision on AC generator sets.
- Over-frequency/under-frequency detection.
- Protection of frequency-sensitive equipment.
- Detection of over frequency on generator sets to prevent over heating.

Features

- Failsafe feature.
- Monitoring frequency of own power supply.
- High precision and repetitive accuracy.
- Independent setting of over and under-frequency tripping point.
- LED indication of type of fault and relay status.
- Programmable for over-frequency, under-frequency or frequency window detection.
- Start-up delay.
- 10A SPDT relay output.

Description of Operation

The **SP-320** monitors the frequency of an AC power supply and is programmable to respond to either over-frequency or under-frequency or both (frequency window).

Start-up Delay: When the start-up delay is enabled and power is applied to the module, the relay energises immediately, ignoring abnormal frequency conditions for approximately 10 seconds.

Over-frequency Sensing (OS): If programmed for over-frequency sensing, the relay de-energises when the frequency exceeds the over-frequency setpoint and the appropriate LED indicates the over-frequency condition. The relay will switch on again if the frequency drops below the over-frequency setpoint.

Under-frequency Sensing (US): When programmed for under-frequency sensing, the relay de-energises when the frequency drops below the under-frequency setpoint and the appropriate LED indicates the under-frequency condition. The relay will switch on again if the frequency rises above the under-frequency setpoint.

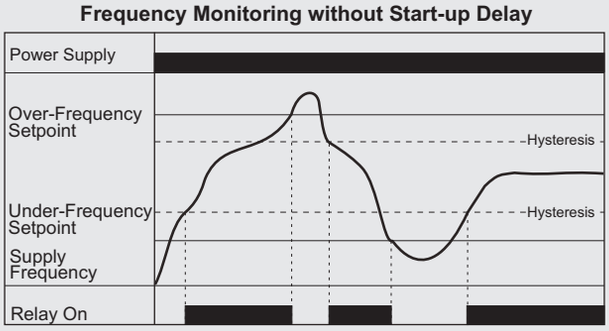
Frequency Window Sensing: The relay remains energised when the frequency is maintained within the frequency setpoint. If the frequency deviates beyond these setpoints, the relay de-energises and the appropriate LED indicates “over-frequency” or “under-frequency”. The relay will energise again if the frequency recovers to within the set over-frequency/under-frequency window.

Hysteresis: Hysteresis represents the difference between the tripping point and the recovery point of the unit. The hysteresis is fixed to 0,5 Hz to prevent relay chatter when the frequency fluctuates around the set threshold.

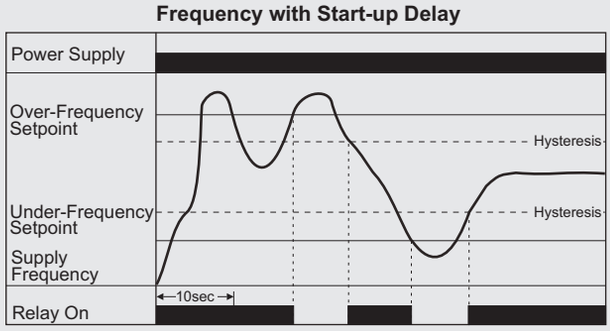
Adjustable between 42Hz to 58Hz (60Hz to 400Hz on request)

Operational Diagrams

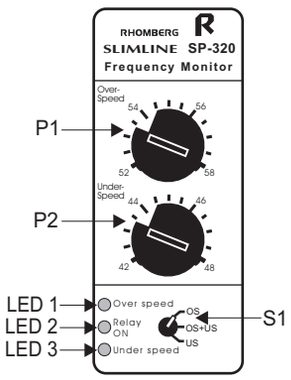
Frequency Monitoring without Start-up Delay



Frequency with Start-up Delay



Description of Controls



P1: The **Over-frequency** setpoint is adjusted on P1.

P2: The **Under-frequency** setpoint is adjusted on P2.

S1: With the function **Selector Switch** the unit can be programmed to:
- respond to over-frequency only (S1 set to “OS”).
- respond to under-frequency only (S1 set to “US”).
- respond to both over-frequency as well as under-frequency (S1 set to “OS + US”).

LED 1: The red LED marked “**Over-speed**” illuminates whenever the frequency exceeds the set over-frequency threshold.

LED 2: The green LED marked “**Relay ON**” illuminates when the relay is energised, i.e. under normal frequency conditions.

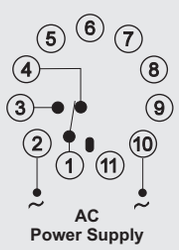
LED 3: The red LED marked “**Under-speed**” illuminates whenever the frequency drops below the set under-frequency setpoint.

Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

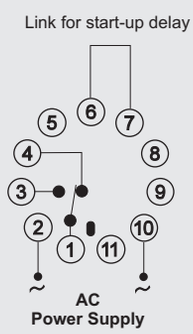
Start-up Delay
Start-up delay to be enabled by interconnecting pin 6 and 7.



APPLICATION 1

Without start-up delay

Link for start-up delay



APPLICATION 2

With start-up delay

Technical Specifications

POWER SUPPLY

Supply voltage:12, 24, 110, 230, 400, 415, 525V AC ±15%
Power consumption: 3VA (approx.)
6VA for 415, 525V (approx.)
Supply frequency: 42Hz - 58Hz.
(60Hz and 400Hz versions available on special order)

FREQUENCY SENSING

Repetitive accuracy: 1%
Hysteresis: 0.5 Hz fixed

RESPONSE

Start-up delay: Approximately 10 seconds standard
(1 to 15 seconds available on special order)
Response delay: 1 second.

Additional information in Section J, page 131.

SP-430/SP-431

Phase Sequence, Phase Failure Phase Assymetry Detector

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	430	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Detection of phase failure and phase reversal on voltage transformers of HT switchgear.
- Protection of 3 phase motors against single phasing.
- Overhead line supervision in rural areas.
- Protection against reverse phase sequence on forward and reverse operating machines.
- Protection against phase reversal on 3 phase compressor motors.
- Protection against phase reversal on 3 phase fan motors.
- Detection of phase angle errors.
- Detection of unbalanced supply voltage.
- Detection of loss of neutral.

Features

- Failsafe feature.
- Detection of phase asymmetry.
- Adjustable sensitivity.
- Insensitive to regenerated EMF.
- High stability under harmonic distortion.
- Insensitive to balanced supply voltage variations.
- Fast response to reversed phase sequence.
- SP-431 available with neutral.
- 10A SPDT relay output.

Description of Operation

The **SP-430** and **SP-431** monitors the negative phase sequence (NPS) voltage component on a three phase power supply, thus providing reliable detection of phase imbalance, phase failure or reversed phase sequence. Power supply to the unit is tapped off the voltage sensing inputs for the SP-430 and between phase and neutral for the SP-431.

Fault Detection: When power is applied, the relay energises after approximately one second, provided all three phases are balanced and in the correct sequence. The relay will de-energise when any one of the following faults occur:

- Reversal of phase sequence.
- Excessive imbalance between phases.
- Excessive phase angle error.
- Failure of one or more phases (”single phasing”).
- Loss of neutral.

The relay will energise again when proper power supply conditions are established. Imbalance sensitivity, i.e. percentage NPS voltage tolerance is adjustable between 5% and 15%.

Note: *The unit will not react to a balanced under-voltage or ove voltage condition on all three phases. For over-voltage and under-voltage protection refer to SP-230.*

Negative Phase Sequence (NPS) Voltage: The negative phase sequence voltage component is a measure of the imbalance of a three phase supply. Any imbalance due to unequal voltage amplitude of the three phases or a phase angle error between phases, results in the generation of NPS voltage. A completely balanced system with positive phase sequence, generates 0% NPS voltage. Complete loss of one phase results in 50% NPS voltage, a 100% NPS voltage would result from a balanced system with reversed phase sequence. For installations where significant regenerated EMF may occur, a sensitivity of 5% - 7% is recommended.

Calculation of NPS Voltage (approximate):

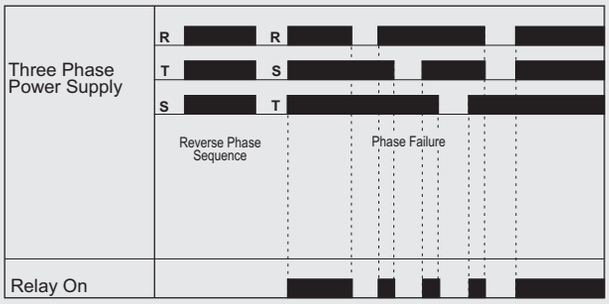
$$\% \text{ NPS Voltage} = \frac{71}{V_{average}} \quad (V_{high} - 1/4V_{middle} - 3/4V_{low})$$

E.g.: Measured voltages, 400V, 380V, 360V

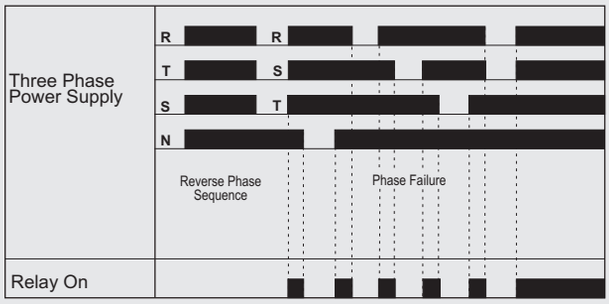
$$\%NPS = \frac{71}{1/3(400+380+360)} \quad (400 - 1/4 \times 380 - 3/4 \times 360) = 6{,}5\%$$

Operational Diagrams

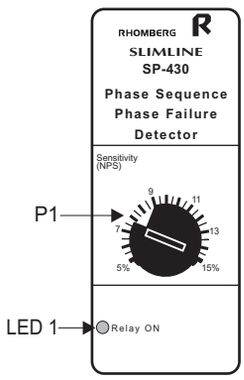
SP-430



SP- 431



Description of Controls



P1: **The Sensitivity** to 3-phase voltage imbalanced is adjusted on P1. The scale is calibrated in percentage NPS voltage. For general applications, a setting of between 5% and 7% is recommended.

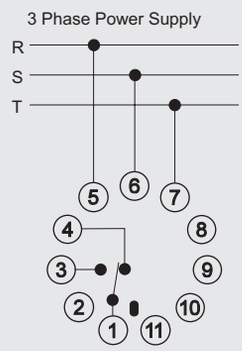
LED 1: The green LED marked "**Relay ON**" illuminates when the relay is energised, i.e. The power supply is balanced and in the correct sequence.

Wiring and Connection

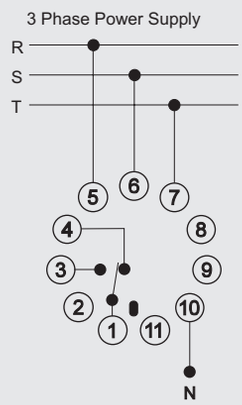
Power Supply
The three phases R, S and T are to be connected to pins 5, 6 and 7 respectively (and neutral to pin 10 on SP-431). The correct sequence is to be observed.

Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

SP- 430



SP- 431



Technical Specifications

POWER SUPPLY

Supply voltage phase-to-phase):110, 230, 400, 415, 525V AC ±20%
Power consumption: 3VA (approx.)
6VA for 415, 525V AC (approx.)

VOLTAGE SENSING:

Repetitive accuracy: 1%
Hysteresis: 2% fixed (relative to supply voltage).
Response delay: 1 second (approx).

Additional information in Section J, page 131.

AP-430/AP-432

Phase Sequence
Phase Failure
Phase Asymmetry Monitor

A-LINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
AP	430	230V	A	D

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Detection of phase failure and phase reversal on voltage transformers of HT switchgear.
- Protection of 3 phase motors against single phasing.
- Overhead lines supervision in rural areas.
- Protection against reverse phase sequence on forward and reverse operating machines.
- Protection against phase reversal on 3 phase motors.
- Detection of phase angle errors.
- Detection of unbalanced supply voltage.
- Detection of loss of neutral (AP-432 only).

Features

- Failsafe feature.
- DIN rail mount.
- Detection of phase asymmetry.
- Adjustable Negative Phase Sequence (NPS) sensitivity.
- Insensitive to regenerated EMF.
- High stability under harmonic distortion.
- Insensitive to balance supply voltage variations.
- Fast response to reversed phase sequence.
- AP-432 available with neutral.
- Power ON and Relay On LEDs.
- 10A SPDT or 5A DPDT relay output.

Description of Operation

The **AP-430** and **AP-432** monitors the negative phase sequence (NPS) voltage component on a three phase power supply, thus providing reliable detection of phase imbalance, phase failure or reversed phase sequence. Power supply to the unit is tapped off the voltage sensing inputs.

Fault Detection: When power is applied, the relay energises after approximately one second, provided all three phases are balanced and in the correct sequence. The relay will de-energise when any of the following faults occur:

- Reversal of phase sequence.
- Excessive imbalance between phases.
- Excessive phase angle error.
- Failure of one or more phases (”single phasing”).
- Loss of neutral (AP-432 only).

The relay will energise again when proper power supply conditions are established. Imbalance sensitivity, ie percentage NPS voltage tolerance, is adjustable between 5% and 15%.

Note: *The unit will not react to a balanced under-voltage or over-voltage condition on all three phases. For over-voltage and under-voltage protection refer to AP-230.*

Negative Phase Sequence (NPS) Voltage: The negative phase sequence voltage component is a measure of the imbalance of the three phase supply. Any imbalance due to unequal voltage amplitude of the three phases or phase angle error between phases, results in the generation of NPS voltage. A completely balanced system with positive phase sequence, generates 0% NPS voltage. Complete loss of one phase results in 33.3% NPS voltage, a 100% NPS voltage would result from a balanced system with reversed phase sequence.
For installations where significant regeneration EMF may occur, a sensitivity of 5% - 7% is recommended.

Calculation of NPS Voltage in terms of Amplitude for 3 phase voltage A, B and C:

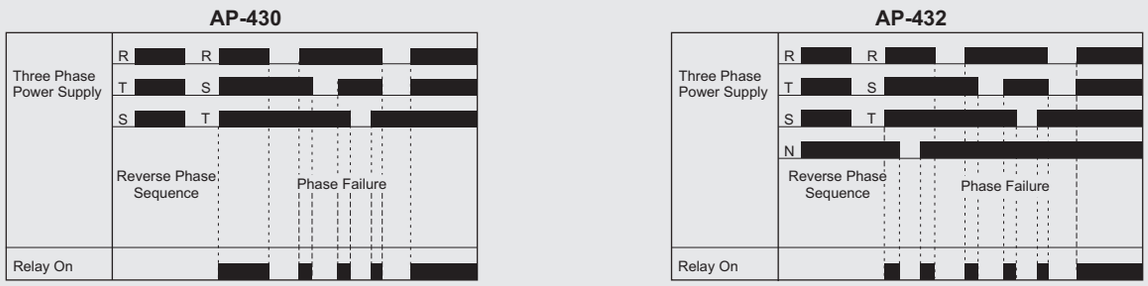
$$\text{\% NPS} = \frac{33\sqrt{A^2 + B^2 + C^2 - AB - AC - BC}}{\text{Nominal Voltage}}$$

Example: measured voltage, 220V, 200V, 180V in a 220V system:

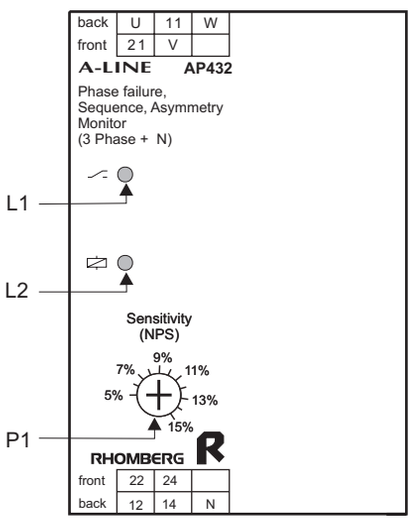
$$\text{\% NPS} = \frac{33\sqrt{220^2 + 200^2 + 180^2 - (220)(200) - (220)(180) - (200)(180)}}{220}$$

$$= 5.2\%$$

Operational Diagrams



Description of Controls



L1: The yellow **"Relay ON"** LED marked illuminates when the relay is energised i.e. the power is balanced and in the correct sequence, and switches off when the unit registers a fault condition.

L2: The green **"Power ON"** LED marked illuminates when power is supplied to the unit.

P1: The **Sensitivity** to Three Phase voltage imbalance is adjusted on P1. The scale is calibrated in percentage NPS voltage. For general applications a settings of between 5% and 7% is recommended.

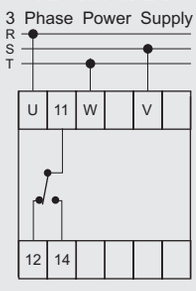
Wiring and Connection

Power Supply	
Phase R	U
Phase S	V
Phase T	W
Neutral N (AP-432 only)	N

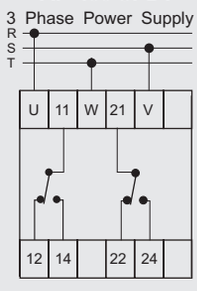
Relay Contacts - SPDT	
Normally Open	11 + 14
Normally Closed	11 + 12

Relay Contacts - DPDT		
CONTACT 1	Normally Open	11 + 14
	Normally Closed	11 + 12
CONTACT 2	Normally Open	21 + 24
	Normally Closed	21 + 22

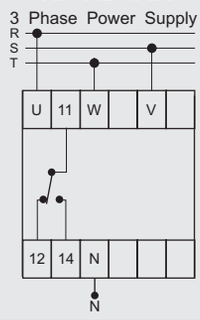
AP-430 SPDT



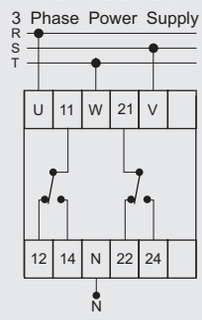
AP-430 SPDT



AP-432 SPDT



AP-432 DPDT



Technical Specifications

POWER SUPPLY			
Type	**Voltage**	**Tolerance**	**Consumption**
AC Transformer (2kV galvanic isolation)	110, 115, 190, 200, 380, 400-415, 525, 550V	±20%	2VA (approx.)

VOLTAGE SENSING	
Repetitive Accuracy	1%
Hystersis	2% fixed (relative to supply voltage)
Response Delay	1 second (approx.)

RELAY	
Relay Options (250V)	10A SPDT or 5A DPDT

HOUSING		
Voltage	250V and below	Above 250V
Housing Width	22.5mm	45mm

Additional information in Section J, page 131.

SP-510

Single Phase Reverse Power Monitor

SLIMLINE
MONITORING RELAYS

ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	510	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Protection of an engine-driven AC generator in the event of failure when feeding an AC bushbar, in parallel with other generators.
- Monitoring of AC power flow in one direction only.

Features

- Failsafe feature.
- Reverse current tripping level adjustable up to 20% of maximum forward current.
- Current monitoring through internal shunt.
- Response time adjustable up to 10 seconds.
- Start-up delay adjustable up to 10 seconds.
- Insensitive to changes in power factor.
- LED indication for reverse power.
- LED indication for relay on.
- Latching facility.
- 10A SPDT relay output.

Description of Operation

The **SP-510** is a precision current monitor for AC applications detecting an overload when the current flows in the reverse direction (i.e. reverse power). The unit interfaces with conventional current transformers (5A secondary rating). The internal shunt permits the SP-510 to be connected directly to loads drawing less than 5 amps.

Start-up Delay: When power is applied to the module, the relay energises immediately, ignoring abnormal load conditions experienced during power up. This time delay is adjustable up to 10 seconds.

Forward Power: Under normal conditions (i.e. forward power) the relay remains energised and the “relay ON” LED illuminates.

Forward Current: Forward current is the current that flows through the internal shunt during forward power flow.

Reverse power: When the power flow changes direction (i.e. reverse power) the “reverse power” LED illuminates.

Reverse current: Reverse current is the current that flows through the internal shunt during reverse power flow.

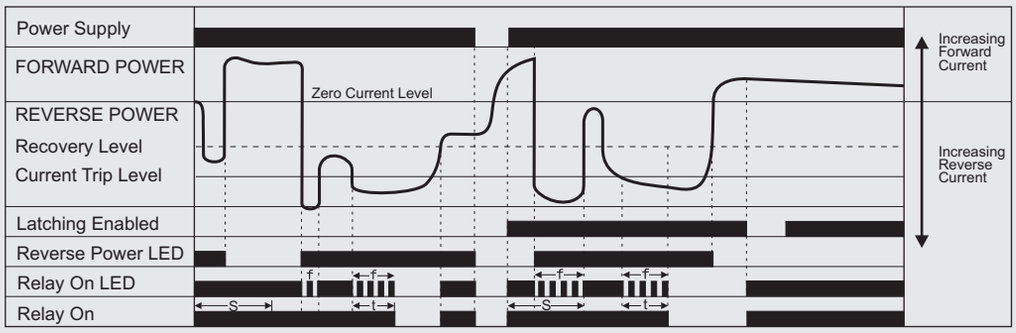
Overload sensing: The tripping level for reverse current is adjustable from 2% to 20% of maximum forward current (i.e. 100mA to 1A for 5 amp forward current).

Hysteresis: Hysteresis represents the difference between the tripping level and the recovery level of the unit. The hysteresis is fixed at 5% below the tripping level to prevent relay chatter when the load fluctuates around the set level.

Response delay: The relay de-energises when the reverse current exceeds the tripping level for longer than the response delay time period. The response delay is adjustable up to approximately 10 seconds. The “relay ON” LED flashes when the reverse current level is exceeded until the time delay expires (at which time the relay de-energises). If forward power is restored or the reverse current level drops below the hysteresis level before the response delay expires, the LED illuminates constantly and the relay remains energised.

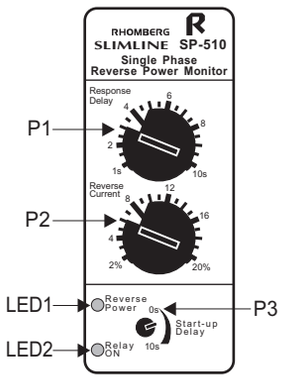
Latching: When latching is armed, the relay will not recover from a tripped condition, but will remain de-energised until reset. The unit can be reset by either breaking and re-applying power to the unit or by momentarily disabling the latching circuit (e.g. push-to-open switch). During the start-up delay, the latching circuit is disabled automatically. (See wiring and connection diagrams).

Operational Diagram



S = adjustable start-up delay (1 second)
t = adjustable response delay (1 second)
f = flashing LED to indicate response delay

Description of Controls



P1: The **Response Delay** is adjusted on P1. This can be set from 1 to 10 seconds to delay the tripping of the relay.

P2: The **Reverse Current** (tripping level) is adjusted on P2 and is set as a percentage of a forward current of 5A. Maximum setting of 20% corresponds with a current level of 1A.

P3: The **Start-up Delay** is adjusted on P3. This can be set from 0 to 10 seconds to ignore abnormal load conditions experienced during power up.

LED 1: The red LED marked **"Reverse Power"** will illuminate when the unit senses power flowing in the reverse direction regardless of whether the current tripping level set on P2 has been exceeded or not.

LED 2: The green LED marked **"Relay ON"** will illuminate when the relay is energised. The LED flashes if the reverse current tripping level is exceeded and the response delay time has not expired. The LED is off when the relay is de-energised.

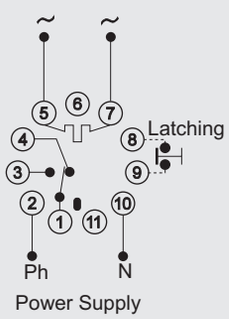
Wiring and Connection

Power Supply	
Phase/ Positive	Pin 2
Neutral/ Negative	Pin 10

Relay Contacts	
Normally Open	1 + 3
Normally Closed	1 + 4

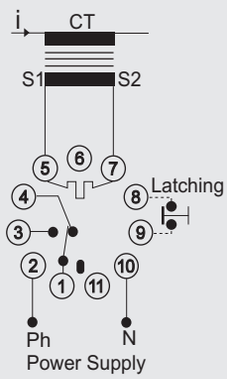
Latching
Latching to be enabled by interconnecting pin 8 and pin 9 (e.g. Push-to-open reset switch)

Current Input AC



APPLICATION 1

Direct In-Line AC Current Sensing: Connect the sensing pin 5 and pin 7 input in series with the AC current loop.



APPLICATION 2

AC Current Sensing with a Current Transformer: Connect the secondary terminals of the current transformer (S1 and S2) to the current input pin 5 and pin 7. Other devices, such as ampere meters, may be connected in series with the current loop, provided the VA rating of the CT is not exceeded.

Note: *Do not unplug the unit while the current loop is energised, since this will cause an open circuit of the current loop and may damage the transformer (see "CT protection" in the general section of the catalogue).*

Detecting Reverse Power: *Ensure that the unit is powered from the same phase as the phase in which the current is being measured. If the "reverse power" LED illuminates under normal operation, it means that the polarity is incorrect and the leads to the current transformer should be exchanged.*

Technical Specifications

POWER SUPPLY

Supply voltage:110, 230, 400, 415, 525V AC ±15%
Power consumption: 3VA (approx.)
6VA for 415, 525V AC (approx.)

RESPONSE

Start-up delay: 0 to 10 seconds (adjustable)
Response delay: 1 to 10 second (adjustable)

CURRENT INPUT

Input current range: 0 to 5A AC
Reverse current sensitivity: 100mA to 1A AC (adjustable)
Repetitive accuracy: 1%
Hysteresis: 5% (fixed)
Maximum input current (continuous): 6A
Peak short-term over-current (10 seconds): 20A
Current input impedance: 50 milliohms

Additional information in Section J, page 131.

HOW TO ORDER
POWER MONITORS

Slimline Ordering Code

SP **100** **230V** **AC** **DP**

RELAY CONTACTS

Code	Relay Contacts
SPDT	Single pole double throw
DPDT	Double pole double throw

POWER SUPPLY

Code	Power Supply
AC	AC
DC	DC

VOLTAGE

Code	Voltage
030V	10-30V
048V	48V
060V	60V
110V	110V
012V	12V
024V	24V
230V	230V
380V	380V
400V	400V
415V	415V
525V	525V

MODEL

Code	Power Supply
100/103	Current Monitor, Single Phase, 1A/5A AC/DC
101/104	Current Monitor, 1mA/20mA/200mA/60mV.150mV/5V AC/DC
120/123	Current Window Comparator, Single Phase, 1A/5A AC
121/124	Current Window Comparator, 1mA/20mA/200mA/60mV.150mV/5V AC/DC
200/201	Voltage Monitor, Single Phase, 15V/30V/60V/150V/300V/600V AC/DC
220/221	Voltage Window Comparator, Single Phase
230/231/232	Voltage Window Comparator, Three Phase
320	Frequency Monitor
430/431	Phase Sequence, Phase Failure, Phase Asymmetry Monitor
510	Single Phase Reverse Power Monitor

TYPE

Code	Type
SP	Slimline Power Monitor, 11 pin plug-in

A-line Ordering Code

AP **221** **230V** **A** **D**

RELAY CONTACTS

Code	Relay Contacts
S	Single pole double throw
D	Double pole double throw

POWER SUPPLY

Code	Power Supply
AC	AC
DC	DC

VOLTAGE

Code	Voltage
012V	12V
024V	24V
048V	48V
060V	60V
110V	110V
115V	110V, 115V & 120V
230V	220V, 230V & 240V
400V	380V, 400V & 415V
525V	525V

MODEL

Code	Power Supply
221	Voltage Window Comparator for AC/DC
224	Combined Over & Under voltage Monitor
231/232	Voltage Window Comparator, Three Phase
234/235	Combined Over & Under Voltage Monitor, Three phase (separate Relay)
430/432	Phase Sequence, Phase Failure, Phase Asymmetry Monitor

TYPE

Code	Type
AP	A-line Power Monitor, DIN Rail Mount