



The Vector Shift and ROCOF protection relay is designed for applications where a generator is running parallel with a mains supply either from a utility or other generators. The relay will detect disconnection of a generator from the network, (islanding of an embedded generator) and trip the generator's circuit breaker. It is specifically designed to protect the mains from the potential damaging effects of reconnection whilst out of synchronism, and the supply of power to local lines without authority. The relay is available in two case styles, both of which simultaneously sense Vector shift and a Rate Of Change Of Frequency (R.O.C.O.F) as measurement parameters in compliance with G.59/1 and ETR 13. For optimum safety each generator should have its own Vector Shift and ROCOF protection relay.

## Description

The Vector Shift and ROCOF relays provide continuous simultaneous supervision of vector shift and rate of change of frequency functions. The relay monitors power quality and disconnections, allowing fast, reliable and accurate mains failure detection to protect the network, load and the generator. This highly innovative relay can additionally be used to measure the actual conditions at the generator site, thus facilitating the setting of the correct trip point, trip logging, and the provision of simple and reliable commissioning.

## Features

- Compliant with utility industry requirements
- Unique algorithm
- Continuous self supervision
- Controlled power up/down
- Status and fault indication
- PC logging and indicating software
- Digital data and status output
- External input for "holding off"
- Internal self check functions
- Change over relay contacts
- User selectable settings

## Benefits

- Fast, reliable and accurate mains failure detection
- Power quality and disconnection monitoring
- Protection of grid, load and generator
- DIN rail or panel front mounted options
- Vector shift and ROCOF functions housed in one unit
- Improved discrimination
- Nuisance tripping avoidance
- Simple installation and operation

## Applications

- G.59/1 protection
- Generator sets
- Co-generation
- Uninterruptible power supplies (UPS)
- Base load
- Peak lopping
- Combined heat and power (CHP)
- Utility power monitoring

## Compliant With

- G.59/1, ETR 113
- EMC, LVD and safety standards

## Vector Shift Relay

The Vector Shift relay measures the length of each cycle of the voltage wave. At the moment a genset becomes disconnected, the sudden change in load causes a sudden change in cycle length. The single cycle becomes shifted with time: it takes longer or shorter. The speed of sensing is fast enough to complete the opening of the genset main circuit breaker before the auto recloser completes reclosing. Hence the Vector Shift relay is an excellent method of detecting disconnection from the grid.

## ROCOF Relay

The R.O.C.O.F. relay senses stability of the frequency. A genset in routine operation will have a normal frequency excursion due to changing loads and the compensated fuel inlet. These frequency excursions are small. The rate at which the frequency changes inside these excursions is relatively high compared with those of a large network. The speed of sensing is fast enough to complete the opening of the genset main circuit breaker before the auto reclosers complete reclosing. Hence a R.O.C.O.F. relay adjacent to the genset is also an excellent method of detecting disconnection from the grid.

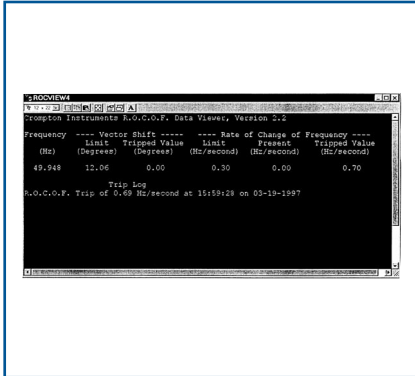
## Operation

### Health Monitoring

The unit incorporates additional circuitry to continuously monitor its own operation. This is essential to maintain confidence in the protection system itself. It monitors conditions such as correct software execution, correct voltages within the hardware and functionality of the microprocessor core. If any faults are detected the unit will indicate an error condition and restart.

### Dependability

The relay uses sophisticated change detection algorithms to avoid spurious trips. These can occur during normal grid switching. The Vector Shift algorithm includes a unique routine which analyzes the cycles immediately before and after a possible event. This results in a response only to a true phase step or Vector Shift condition. To allow for a step change of up to 20% of rated load, a limit setting of 16 electrical degrees is typical. This can be reduced to 6 electrical degrees on low impedance networks, but is user selectable between 2 and 24 electrical degrees.



## Dual Functionality

The unit performs two distinct operations from the same basic information. The zero crossover points of the voltage waveform are monitored to establish the running average system frequency. This information then forms a reference for the two monitored parameters:

- Vector Shift:** This algorithm responds to a single cycle of incorrect duration, as caused by a Vector Shift, and will qualify this by monitoring the next cycle. If the Vector Shift is not qualified the "near trip" LED is illuminated and no further action is taken. The response time for this operation is typically 40 ms in a 50 Hz system.
- Rate of Change of Frequency (R.O.C.O.F):** The second algorithm performs a continuous comparison of the instantaneous frequency and the running average system frequency. This equates to the rate at which the generator is changing speed.

## Output Latching

The alarm signal from either of the algorithms will cause the trip relay contacts to close. Should the out of range conditions return to normal, the relay will remain in the alarm state until the unit is manually or remotely reset. The control system can therefore be configured to ensure that the normal synchronization procedure is followed before the generator is reconnected.



## ROC-SOFT Trip Logging and Indicating Software

ROC-SOFT software functions as a simple meter and logger, and is available free on request. It enables three functions:

- It becomes an effective R.O.C.O.F. meter and Vector Shift meter.
- It enables the setting of the trip point, justified by actual site measurements.
  - Running the generator (optionally with site load) whilst islanded, the R.O.C.O.F. value will be displayed. R.O.C.O.F. is caused by the generators own control dynamics and by the demands from load changes.
  - Running the generator (optionally with site load) during a disconnection from the grid at a trip setting of 2°, the Vector Shift value will be displayed on tripping. Vector Shift is caused by a change in current, which will also cause a R.O.C.O.F.

The values obtained by measurement form a justified basis for setting the trip levels.

- It is a simple trip logger, as every trip is logged, date and time stamped, and nature of trip. The following values are displayed:
  - Vector Shift trip levels set
  - Vector Shift trip level actual measured on trip
  - R.O.C.O.F. trip level set
  - R.O.C.O.F. trip level actual measured on trip
  - R.O.C.O.F. level actual measured at present.

As the measurements are so much faster than is practical to display, the display is updated once per second with the value at that time. Full data is available from the opto data socket, please see the User Manual. To print a log, press Alt and Print Screen on the PC keyboard. Then in Word select the clipboard contents and print.

## Optical to RS232 Serial Converter

The Vector Shift and R.O.C.O.F. relay can be used in conjunction with our optical to digital adaptor, which converts optical fibre to RS232 digital signal levels for use with a PC. Crompton offer a 25 way or 9 way D socket adaptor to suit the PC, and a polymer fiber-optic cable to ensure the avoidance of electrical interference.



Model 246



Model 256

## Specification

Input Supply	110, 120, 220, 230, 240, 380, 400, 415V
Input Range	-50%, +50%
Frequency	40 to 70 Hz
Harmonics	The monitored waveform must be free from harmonic oscillations near the zero crossover points
Burden	Input: 0.1VA Auxiliary: 4VA
Voltage Withstand (overload)	+50% continuous
Output	Volt free relay contacts
Relays	1x status, 1x fault
Contacts	Single pole changeover
Rating	250V, 5A A.C., resistive
Operations	0.2 million
Baud Rates	9600, 8 bit data, 1 stop bit. No parity
Auxiliary Supply	110, 120, 220, 230, 240, 380, 400, 415V
Auxiliary Range	±20%
Setting Accuracy	Vector Shift better than 1° R.O.C.O.F 0.05 Hz/s
Response Time	Phase angle shift: up to 2 cycles +5ms relay time Frequency rate change: 3 to 32 cycles + 5ms relay time
Isolation	BS 142, Section 1.3
Delay Range	0.1s
Phase Angle Shift	0.5 degree at 50/60 Hz
Frequency Rate Change	0.1Hz/s
Vibration	BSEN60068-2-6
User Adjustments	Initial auxiliary supply switch-on delay: 1 to 10 seconds Phase Angle Shift Adjustment: 2 to 24° Frequency Rate Change Adjustment: 0.1 to 1Hz/s
Indication	Green LED indicates auxiliary power presence Yellow LED indicates near trip Red LED indicates Vector/ROCOF trip and relay energized
Enclosure Style	Model 246: Front of panel mounting Model 256: DIN rail mounting
Compliant With	EMC and LVD, G.59/1 & ETR 113, BSEN 61010-1993 AMD 8961 1996, BSEN 50081-1, BSEN 50082-2,
Material	Flame retardant UL94V0
Operating Temperature	0°C to 50°C normal -10°C to 50°C extended. Performance may not meet published specification but the unit will not sustain permanent damage in this range
Storage Temperature	-10°C to +70°C
Relative Humidity	<95% non condensing
Weight	Model 246: 1.1kg Model 256: 0.8kg
Model 246 Dimensions	147mm (5.8") high x 147mm (5.8") wide x 146mm (5.7") deep. Panel Cut Out: 138mm (5.4") x 138mm (5.4")
Model 256 Dimensions	70mm (2.8") high x 150mm (5.9") wide x 113mm (4.4") deep

## Product Codes

Description	Inputs	Catalog No.
Model 246 Panel Front Mount	230V, 40/70 Hz	246-ROCL-RQBX-C2-RQ
Model 246 Panel Front Mount	400V, 40/70 Hz	246-ROCL-SCBX-C2-RQ
Model 256 DIN Rail Mount	230V, 40/70 Hz	256-ROCL-RQBX-C2-RQ
Model 256 DIN Rail Mount	400V, 40/70 Hz	256-ROCL-SCBX-C2-RQ
PC Trip Logging and Indicating Software		ROC-SOFT
25D Optical to Digital Adaptor		25D-ODA
9D Optical to Digital RS232 Adaptor		9D-ODA
20 Meter Coil Polymer Fibre Optic Cable		O-A359

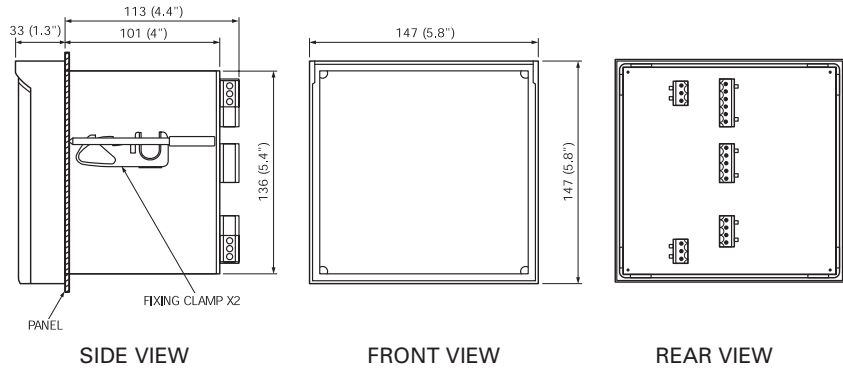
# Vector Shift and ROCOF Relay



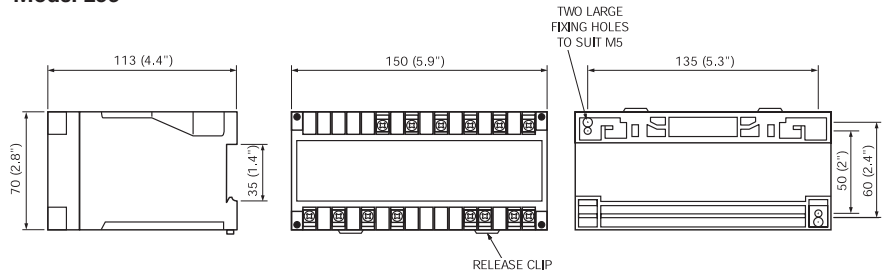
**Model 246**

## Dimensions

**Model 246**



**Model 256**



**Model 256**

## Connections

Terminals 11 & 14 close on trip.  
Terminals 21 & 24 close when the signal is monitored. (Self test O.K. LED lit)

