

## Capacitor Protection Relay

### FEATURES

- Capacitor unbalance protection
- Line current unbalance protection
- Overvoltage protection
- Overheating protection
- Ground fault protection
- Overcurrent protection
- Undercurrent protection
- Capacitor bank discharge timer

### APPLICATIONS

Protection of capacitor bank in double star or bridge connection.



### QUICK REFERENCE DATA

|                  |  |
|------------------|--|
| Type             | Capacitor protection relay   |
| Description      | Capacitor bank protection relay: unbalance, line current unbalance, overvoltage, overcurrent, undercurrent, overheating, ground fault, discharge timer               |
| Rated data       | Supply voltages: 100 V <sub>AC</sub> to 240 V <sub>AC</sub> , 50 Hz to 60 Hz / 100 V <sub>DC</sub> to 375 V <sub>DC</sub> / 18 V <sub>DC</sub> to 75 V <sub>DC</sub> |
| Current data     | 4 current inputs: 1 A or 5 A   |
| Protecting level | IP54   |

### TECHNICAL DATA

|                           |   |
|---------------------------|---|
| Thermal current withstand | 15 A continuous / 100 A, 1 s  |
| Power consumption         | 1 VA per measuring circuit  |
| Measurement accuracy      | Class 1   |
| Rated frequency           | 50 Hz / 60 Hz   |
| Galvanic separation       | Via current voltage transformer, dielectric strength of 2 kV  |
| Signal outputs            | Potential-free change-over switch contacts for alarm and switch-off                                 |
|                           | Position of relay can be selected, picked up, or released   |
|                           | Contact rating 8 A / 265 V <sub>AC</sub> or 0.3 A / 300 V <sub>DC</sub> or 8 A / 30 V <sub>DC</sub> |
| Interfaces                | Front: RS232 (9600 Bd)<br>Rear: RS485 and RS232   |
| Temperature               | Operation: -10 °C to +60 °C<br>Storage: -20 °C to +70 °C  |
| Dimensions                | 135 mm x 135 mm x 121 mm  |
| Standards                 | EN 50178 class 2, EN 61010-1, EN 50081-1, EN 50082-2  |

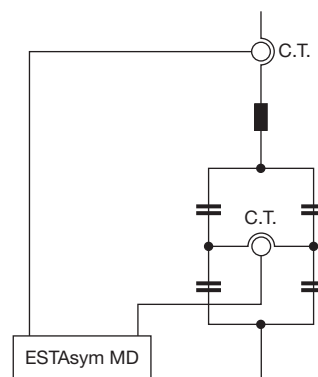
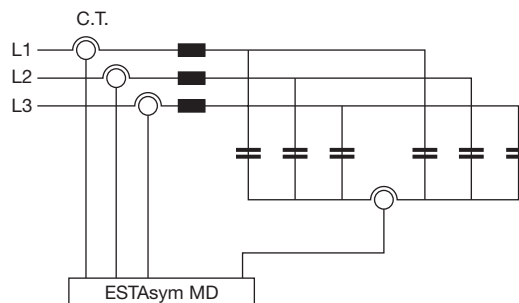
#### Note

- Complete mounting instructions / manual available at [www.vishay.com/doc?13173](http://www.vishay.com/doc?13173)

## APPLICATION

The double star circuit generates a sum current the size and phase of which result from the three unbalance currents. Using the reference current, the ESTAsym MD can analyze the sum current into the three unbalanced currents. Each change of the sum current can take place only in the same phase of the capacitor current. Thus the ESTAsym MD can reveal the partial path in which the defective capacitor unit is located. This means that only 1/6 of the capacitors need to be checked.

Within the bridge circuit, the phase position of the unbalance current L1, L2, and L3 in relation to the reference current is 0, +120, or +240 degrees. The ESTAsym MD can reveal the fault phase and the bridge circuit branch in which the faulty capacitor unit is located.



It is possible to configure the four current inputs of the ESTAsym MD for different applications. For a YY- or bridge connection, inputs 1-3 will be the three line currents, and the fourth input would be the unbalance current. It is also possible to use the first input to measure the line current and inputs 2-4 can be used for the unbalance measurements. Thus it is possible to control three individual YY or bridge connections with different unbalance settings for each bank.

## CHARACTERISTICS

The microprocessor-based ESTAsym MD capacitor protection relay uses a versatile integrated current measuring multifunction relay design to enable the protection of medium and high voltage capacitor banks. Using FFT techniques, the ESTAsym MD calculates the fundamental and harmonic currents from measured line and unbalance currents, and uses these values to implement individual protection functions.

The ESTAsym MD capacitor protection relay is particularly appropriate for capacitor banks connected in double star and bridge circuit configurations. The following protective functions are provided by the ESTAsym MD:

- Capacitor unbalance protection
- Line current unbalance protection
- Overvoltage protection
- Overheating protection
- Ground fault protection
- Overcurrent protection
- Undercurrent protection
- Capacitor bank discharge timer

## CAPACITOR UNBALANCE PROTECTION

The relay measures the circuit's natural unbalance at its fundamental frequency and compensates for both amplitude and phase to zero shifts, to enable detection of further changes in both amplitude and phase angle. The phase current input  $I_{L1}$  is used as the synchronizing input for the compensation. The phase angle indicates the leg in which the change in capacitance has occurred. The protection has two stages, warning and tripping, both with an adjustable definite timer. A trip signal is initiated if the associated threshold is exceeded for the definite time setting. The trip values obtained mathematically relate to the nominal voltage of the capacitor equipment. Therefore, accurate protection is not maintained in case of voltage fluctuation - especially with decreased voltage.



## **LINE CURRENT UNBALANCE PROTECTION**

The relay calculates the fundamental frequency line current unbalance due to faults or failures within the capacitor bank. The line current unbalance is calculated from three-phase line currents. The protection includes two stages, warning and tripping, both with an adjustable definite timer. A trip signal is initiated if the value of the line unbalance current exceeds the selected setpoint value for the definite time.

## **OVERVOLTAGE PROTECTION**

The purpose of the overvoltage protection is to protect the capacitor bank against overload due to fundamental and harmonics currents, which may lead to dielectric breakdown, i.e. short-circuit in a capacitor element. The capacitor bank voltage is calculated from the three-phase line fundamental frequency component current and from the harmonic currents. The overvoltage factor is calculated and continuously compared with a variable threshold. The user may select between a definite time characteristic and an inverse time characteristic according to the ANSI curve. A trip signal is output if the setpoint value is exceeded for the definite time.

## **OVERHEATING PROTECTION**

The overheating protection function is intended to be used for the protection of series reactance coils used within capacitor banks. This protection works by measuring the RMS three-phase line currents and comparing them with an adjustable threshold. The protection feature has two stage options, warning and tripping, both with adjustable definite-time delay, or the user can select the tripping time depending on the ratio of the actual current to the nominal current. The warning time is half of the tripping time. If the current exceeds the relevant setpoint value for the definite-time delay, a tripping or warning signal is initiated.

## **GROUND FAULT PROTECTION**

The protection calculates the fundamental frequency ground fault current, as the value of the vector sum of the three-phase line currents. The protection has two stages, warning and tripping, both with adjustable definite time. A trip signal is initiated if the amplitude of the ground fault current exceeds the selected setpoint value for the definite time.

## **OVERCURRENT PROTECTION**

The protection stage measures the fundamental frequency of three-phase currents and compares them with an adjustable threshold. This function may be used for short-circuit protection. A trip signal is initiated if the value of the line current exceeds the selected setpoint value for the definite time.

## **UNDERCURRENT PROTECTION**

The undercurrent protection function is intended for the detection of capacitor bank disconnection. In case of voltage loss in the feeding bus, the capacitor bank has to be disconnected from the system to prevent reapplication of the voltage on the capacitors before they are fully discharged. The stage starts if all the three-phase currents fall below the set level. If the undercurrent condition persists for an interval longer than the set operating time, the trip signal is initiated.

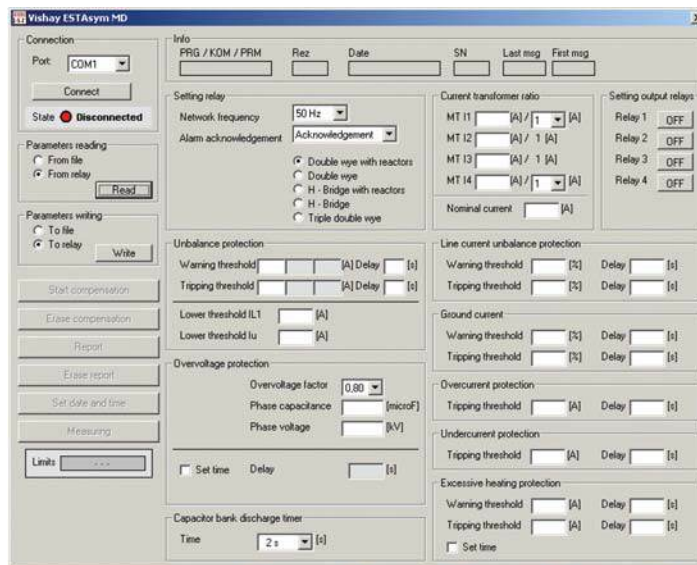
## **CAPACITOR BANK DISCHARGE TIMER**

The relay includes an adjustable timer, started by the circuit breaker auxiliary contacts, which stops the breaker from reclosing until the capacitor bank is discharged to an acceptable voltage level for switching in.



## PC SOFTWARE

The PC software provided with ESTAsym MD allows all settings to be made easily. All setting data is stored in a setup file.



## DATA STORAGE

The ESTAsym MD stores all data, including date and time information, in a report file. The included PC software provides you with convenient access to this data.

## FFT ANALYSIS AND REALTIME MEASURING

The PC software allows users to see the actual current values of the four measuring inputs up to the thirteenth harmonic.



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