

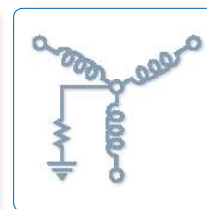
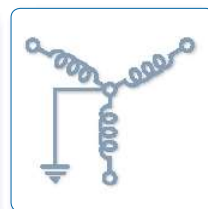
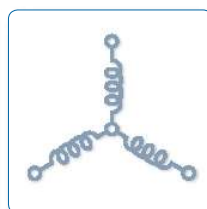
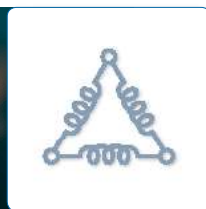
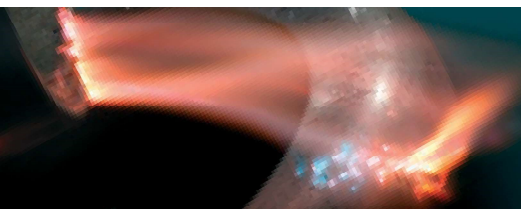


*Unparalleled Protection*



## SIGMA

RESISTOR MONITOR  
GROUND FAULT RELAY



C-453EM Instruction Manual, April 2015

When the NGR current measured by the ZSCS is above 1% of the NGR let-through current setting, an NGR fault will be detected if the measured current and voltage indicates that the NGR resistance has increased to more than 150% or has decreased to less than 70% of its nominal value.

When the ZSCS current is below 1% of the NGR let-through current setting, the Sigma monitor relay simply monitors the NGR resistance for continuity, i.e. whether the NGR is open or presents some resistance.

The Sigma monitor relay has three output relays:

- The trip relay can be programmed for shunt operation (not failsafe) or undervoltage operation (failsafe) in a main breaker trip circuit. The trip relay will energize on either an NGR fault or a ground fault.
- The NGR fault auxiliary trip relay can be used to give a door/panel mounted or remote indication of an NGR Fault.
- The ground fault auxiliary trip relay can be used to give a door/panel mounted or remote indication of a ground fault.

The Sigma monitor relay provides a current source output for connection to a 1mA full scale ammeter (either analog or digital). The output signal is proportional to the measured current and is expressed as a percentage of the NGR let-through current.

## 3. METHOD OF OPERATION

### 3.1 COMPONENTS OF THE SYSTEM

The zero sequence current sensor is an I-Gard type T2A, T3A, TxA or any Rx-yA zero sequence current sensors.

The NGRS-XX sensing resistor is selected to match the line-to-line voltage of the system in which the Sigma monitor relay will be used.

The NGR will be sized for a let-through current according to the specifications of the system in which it will be installed.

A DIP switch array on the Sigma monitor relay permits selection of trip relay operational mode, trip memory, ground fault trip time delay, ground fault trip current level and the NGR let-through current.

### 3.2 NGR MONITORING

The sigma monitor relay is designed to be used with an I-Gard type "A" (TxA Rx-yA) zero sequence current sensor, an NGRS-XX sensing resistor and an NGR sized for a let-through current according to the specifications of the system in which it will be installed.

DIP switches on the Sigma monitor relay are used to set the NGR let-through current to one of thirty two settings as shown in TABLE 5.

Refer to TABLE 9.6 for DIP switch settings for the NGR let-through current.

Measurement mode:  
uses "leakage current"

The Sigma monitor relay monitors the NGR using one of two methods, a measurement mode of operation where the NGR resistance is measured using the leakage current through the NGR and a continuity mode of operation where the continuity of the NGR is checked, which is used when the leakage current is too low for the measurement mode to accurately gauge the resistance of the NGR.

The measurement mode of operation is used when the combination of current through the ZSCS and neutral-to-ground voltage indicates that the resistance of the NGR has increased to more than 150% of its nominal value or has decreased to less than 70% of its nominal value. If these limits are exceeded, the Sigma monitor relay will indicate an NGR failure and trip within 3.5 seconds. A fast response is necessary as failure of the NGR implies that there is limited ground fault protection on the system. It also ensures fast tripping when a transformer is energized and the resistor is faulty.

By measuring the leakage values of current and voltage the Sigma monitor relay recognizes when the resistance of the NGR cannot be measured accurately. If the NGR current is less than 1% of the let-through current the NGR integrity monitor detects whether the NGR resistance is present or the NGR has failed such that it presents an open circuit.

In the event that the NGR opens completely when the Sigma monitor relay is in the measurement mode described above, the appearance of the open circuit will cause the Sigma monitor relay to switch from the measurement mode to the continuity mode described above. The continuity mode will recognize that the NGR circuit is open and indicate an NGR failure within 3.5 to 10 seconds.

**If leakage current is not present, Sigma can only detect an open NGR.**

The Sigma monitor relay measures ground faults by measuring the current through the NGR. The relay compares the measured values against the field settings of the relay and provides relay outputs and LED indications when an abnormal condition is detected.

NGR current is measured using the zero sequence current sensor (ZSCS). The trip level of the ground fault circuit is DIP switch selectable as a percentage of the set NGR let-through current with ground fault trip settings of: 5%, 10%, 15%, 20%, 25%, 30%, 40% and 50%.

The ground fault trip time setting defines the length of time a ground fault must persist before a fault is qualified and reported by the relay by operating the ground fault output relay and the main trip relay.

This setting can also be used to delay the indication by the Sigma monitor relay of a ground fault. The ground fault trip time is DIP switch selectable from its minimum setting of 60 milliseconds to 3.15 seconds.

DIP switches on the Sigma monitor relay must be set for the required ground fault time delay and ground fault trip current level.

Refer to TABLE 9.3 for DIP switch settings for the GROUND FAULT TRIP TIME DELAY.

Refer to TABLE 9.4 for DIP switch settings for GROUND FAULT CURRENT LEVEL.