



489 Distance Element – Principle of Operation

GE Publication Number: GET-8472

Copyright © 2004 GE Multilin

INTRODUCTION

The 489 phase distance element is intended to provide backup protection for uncleared phase-to-phase faults on the electric power system. This element uses the phase-to-phase voltages measured at the generator terminals and phase currents measured at the neutral side of the generator. As such this element will provide coverage for the generator step-up transformer and will also provide a degree of protection for stator phase-to-phase faults.

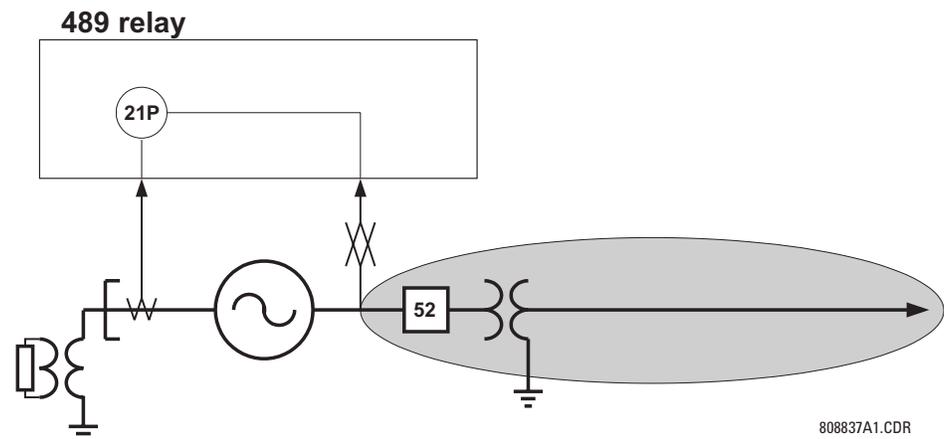


FIGURE 1. Measuring Point of Distance Element

CHARACTERISTIC

The element has a mho characteristic as shown in Figure 2. The element includes a separate measurement for AB, BC, and CA faults. There is a setting for specification of the step-up transformer connection. If this setting is chosen as “None” then it is assumed that the transformer is Wye-Wye connected or that there is no step-up transformer. In this case the element will use the following operating quantities.

Element	Voltage	Current
AB	V_{ab}	$I_a - I_b$
BC	V_{bc}	$I_b - I_c$
CA	V_{ca}	$I_c - I_a$

If this setting is chosen as “Delta/Wye” then it is assumed that the transformer is Yd1 or Yd11. In this case the following operating quantities are used.

Element	Voltage	Current
AB	$(V_{ab} - V_{ca}) / \sqrt{3}$	$\sqrt{3} \times I_a$
BC	$(V_{bc} - V_{ab}) / \sqrt{3}$	$\sqrt{3} \times I_b$
CA	$(V_{ca} - V_{bc}) / \sqrt{3}$	$\sqrt{3} \times I_c$

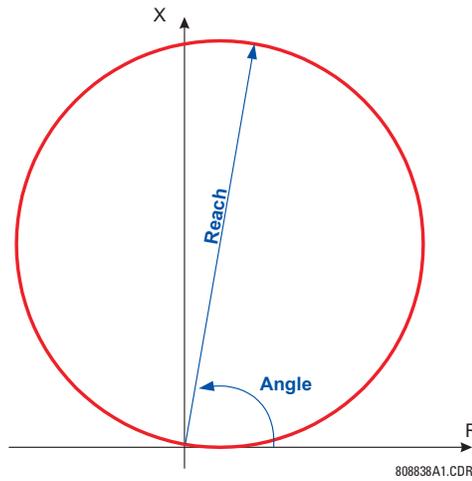


FIGURE 2. 489 Mho Characteristic

SETTING CRITERION

The reach is typically set to cover longest transmission line or feeder leaving the generating station. Care must be taken to include for possible under-reaching effects due to the fault contribution from other lines or generators. The measuring point of the element is defined by the location of the VT as shown in Figure 1. Therefore the impedance of the step-up transformer should be included but the impedance of the generator should not be included. Care should also be taken that the apparent impedance seen by the element when the machine is operating at worst case load and power factor does not encroach into the operating characteristic. The reach setting is in secondary ohms.

The element is intended for backup protection and therefore some time delay should always be included. Typically this element is set to coordinate with the longest operating time of the system distance relays. The element should also be set longer than the VTFF operating time (99 ms).

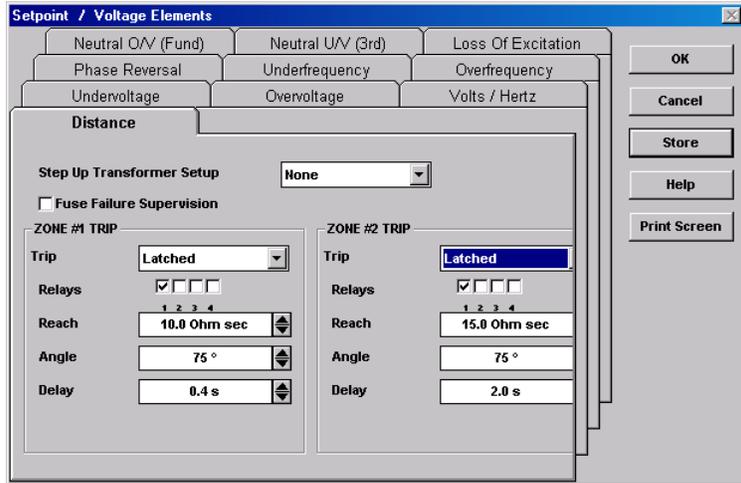


FIGURE 3. Distance Settings

TESTING

A test procedure is included in the instruction manual. When testing the element for very low reach settings, the applied current should be large enough such that the pickup voltage is several volts. Also note that the element may exhibit a slight reach in the reverse direction. This is not considered a problem since faults cannot occur behind the generator.