SGC

Negative Sequence Overcurrent

Static negative sequence time-overcurrent tripping for DC voltages.

Features and Benefits

- K setting selection from K = 2 to 40
- Reset function approximates machine cooling
- Remote I2 readout meter available
- Alarm function available
- Electrically operated target seal-in
- Alarm level LED available
- Drawout case

Applications

- Generator negative sequence heating protection

Protection and Control

- Negative sequence time overcurrent

Description

The SGC relay is a static negative time overcurrent relay. It is intended primarily for the protection of generators against possible damage from unbalanced currents resulting from prolonged faults or unbalanced load conditions. The SGC features high sensitivity and dial selection of K setting from K = 2 to K = 40. A reset memory approximates machine cooling following intermittent negative-sequence overcurrent. The SGC comes in a standard M2 draw out case.

Application

When a generator is subjected to an unbalanced fault or load, its stator current includes a negativesequence component (I_2). This current sets up a counter-rotating flux field in the machine which causes double frequency currents to flow in the rotor iron and slot wedges, resulting in local heating. This heating will not be excessive if I_2^2t is less than K, a constant of the machine, where I_2^2t is the integrated product of negative sequence current squared (I_2^2) and the duration of the fault (t) in seconds. The time characteristic of the trip circuit of the SGC relay is I_2^2t = K, with K being continuously adjustable from 2 to 40 (see figure 1, next page). This permits matching the characteristics of the relay with the I_2^2t capability of the machine to be protected.

The SGC relay is designed to protect the generator from damage due to abnormal conditions on the system rather than from damage caused by internal faults. The SGC is thus in a sense providing backup protection for system relays. Hence, while it is essential that the time characteristic (value of K) be selected so that the machine will be cleared before suffering damage from an external unbalanced condition, it is also necessary that the relaying schemes responding to system faults be selected so that their correct operation will remove the fault before the SGC operates.

Operation

Input Sensing

The SGC has a negative-sequence network which accepts inputs from the three CT phase currents and develops the negative-sequence component (I_2) of the generator current. The output of the network is adjusted by the input tap setting to establish a per unit reference level as close as possible to full load generator current. Taps are provided in 0.2 A steps from 3.1 to 4.9 (5 A relay) and 0.62 to 0.98 (1 A relay) for matching to the CT secondary current corresponding to the rated full load generator current.

Trip Function

The per unit negative-sequence component (I_2) is integrated, with respect to time, to achieve the operating time characteristic of I_2^2t = K, where K is continuously adjustable from 2 to 40. The integrator is enabled by a Trip Level Detector which has an adjustable set point of 0.04 to 0.40 per unit of tap setting. (Corresponding closely to 0.04 to 0.40 of full load generator current). When I_2 exceeds the set point, integration commences and a timer also starts. The timer causes operation after 10-990 sec, however the unit will not operate in less than 0.2 sec.

Reset Function

The dropout of the trip-level detector is close to its pickup. Thus if I_2 were to fall below pickup value before the timing cycle were completed, the integrator would stop and a linear ramp resetting of the integrator would commence at the rate of 2.5 sec for each percent of full time (250 sec) achieved in the timing cycle at dropout. This approximates machine cooling following intermittent current. If I_2 were to increase again above pickup, the integrator would again be initiated, beginning at whatever value the reset function had reduced it to.

Alarm Function

The alarm circuit is initiated by the per unit negative-sequence component (I_2) with a pickup adjustment range of 0.02 to 0.20 per unit of generator current. An inherent time delay of 3 sec is provided to eliminate nuisance alarms on transient conditions.

Indication

Visual indication of the Alarm Level Detector is provided by a light-emitting diode (LED). Similarly an LED indicates power supply operation.

Remote Readout

The SGC21A, B, & C relays provide an output point which permits monitoring the negative-sequence current (I_2) level by means of a switchboard instrument supplied with the relay for remote mounting. The instrument is a GE Type DB-40 DC microammeter calibrated to indicate I_2 as a percentage of input tap block setting. Full scale is 20 percent.

The connection between the relay terminal and the remote meter should be made with a shielded twisted pair number 18 AWG or larger with the shield grounded at the relay.

Ambient Temperature

-20°C to +65°C.

Burden

The AC current burden is less than 0.20 Ω per phase.

Contact Outputs

One normally open contact is provided for the trip function with a target seal-in unit. One normally open contact is provided for the alarm function.

Power Supply

The SGC relays in this section have a regulated DC power supply and will perform properly over a range of DC control from 80 percent to 110 percent of rated voltage. The DC power supply presents a burden of less than 8 W untripped or less than 12 W tripped for 48 V or 110/125 VDC.

Tripping Contact Rating

The tripping contact will make and carry 30 A DC for tripping duty at control voltages of 125 VDC or less. However, the circuit breaker trip circuit must be opened by an auxiliary switch contact or other suitable means.

CT Secondary Circuits

5 A relay: Continuous current—10 A on any or all CT secondaries. One sec current—250 A on any or all CT secondaries.

1 A relay: Continuous current—2 A on any or all CT secondaries. One sec current—50 A on any or all CT secondaries.

Accessory

A card extender (catalog number 184B5645G1) is available for testing the printed circuit cards. It should be listed as a separate item on an order.

Alarm Contact Ratings

The alarm function contact (1 N.O.) will make and carry 3 A continuously or 30 A for 2 sec. Interrupting ratings are:

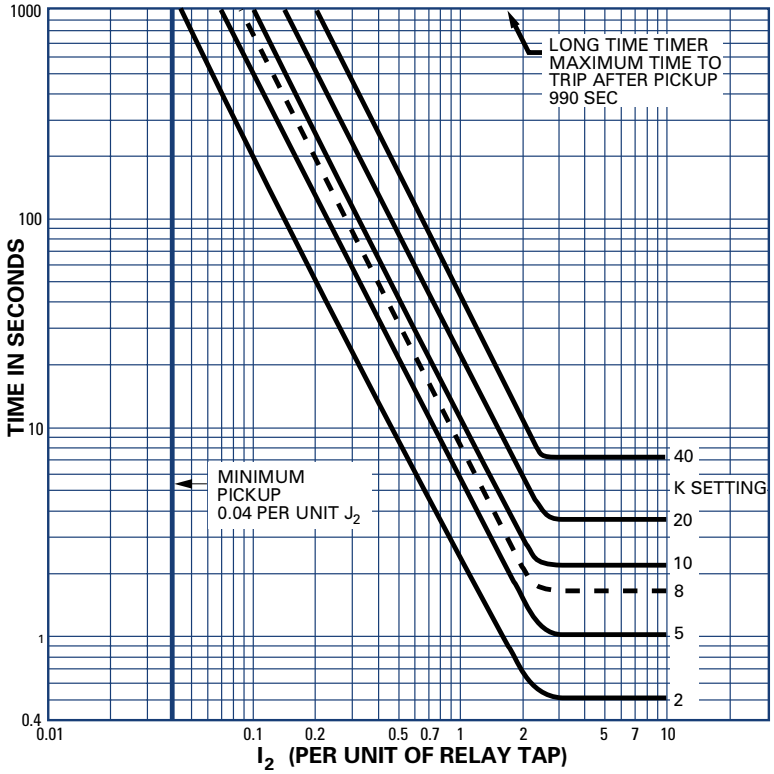
Voltage	Amps Inductive ①	Amps Non-inductive
AC		
115	0.75	2.0
230	0.5	1.5
DC		
48	1.0	3.0
125	0.5	1.5

① The inductive rating is based on the inductance of a coil having an L/R ratio of approximately 3 to 1.

Tap Block Setting

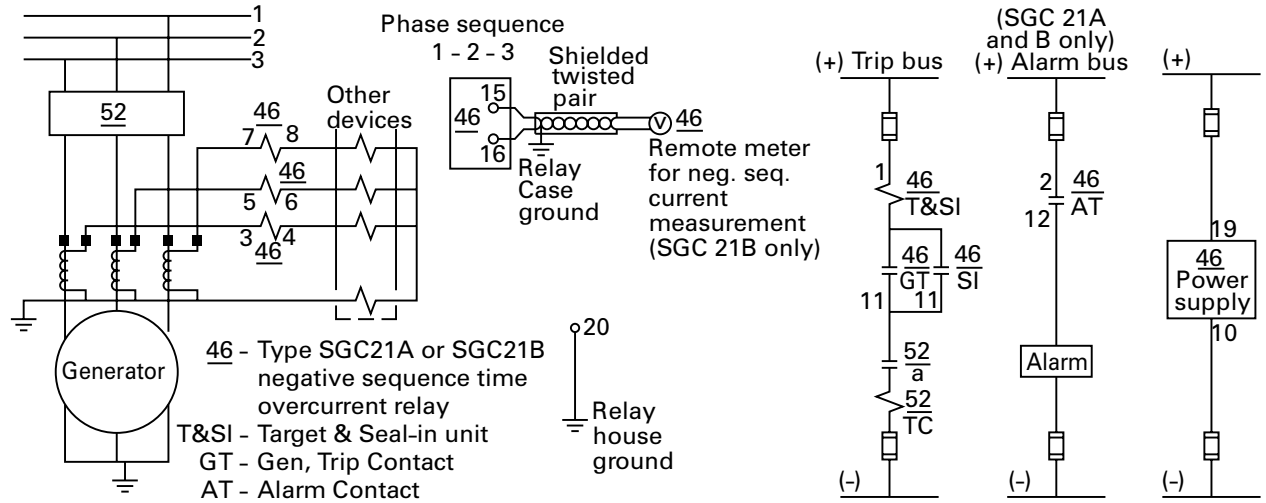
Taps are available in 0.2 A steps between 3.1 and 4.9 A and cover the normal load current range from 3.0 - 5.0 A on 5 A relays. On the 1 A relays taps are available in 0.04 A steps between 0.62 - 0.98 and cover the normal load current from 0.6 - 1.0 A.

Fig. 1. Type SGC typical time-current characteristics $I_2^2t = K$



Connection Diagram

Fig. 2. Typical external connections for SGC relay



Selection Guide

1 N.O. TRIPPING CONTACT AND 1 N.O. ALARM CONTACT

AC Rating		Power Supply Voltage (DC)	Target Seal-in (DC A)	I_2 Remote ① Readout	Minimum I_2 Sensitivity (P.U.) ②		I_2^2t Range	Model Number	Case Size	Approx. Wt. in lbs (kg)	
					Trip Function	Alarm Function				Net	Ship
Hz	(DC A)										
60	5	48/110/125	0.2/2.0	NO ①	0.0.4-0.40	0.02-0.20	2-40	SGC21A1A	M2	20 (9.1)	28 (12.7)
50	5	48/110/125						A2A			
50	1	48/110/125						A3A			
60	5	125/250 ③						A4A			
60	5	48/110/125	0.2/2.0	YES	0.0.4-0.40	0.02-0.20	2-40	SGC21B1A	M2	24 (10.9)	32 (14.5)
50	5	48/110/125						B2A			
50	5	125/250 ③						B3A			
60	5	125/250 ③						B4A			
60	5	48/110/125	0.2/2.0	NO ①	0.0.4-0.40		2-40	SGC21C1A	M2	20 (9.1)	28 (12.7)
50	5	48/110/125						C2A			
60	5	125/250 ③						C3A			

① Includes remote readout circuitry but no external DB-40 instrument.
② Measured in per unit (P.U.) of tap setting which closely corresponds to full load generator current.
③ Includes an external pre-regulator to allow use of higher voltage.