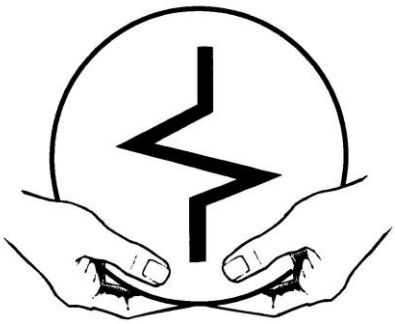
INC77N



SCOPE

This test procedure covers the testing and maintenance of the GE INC77N negative sequence overcurrent relay. Refer to IL GEI-44208 and GEH-2026 for testing support information and component level identification.

SAFETY

Do not apply more than 5 amps continuous or 200 amps for 1 second to the relay.

INTRODUCTION

The GE INC77N is a negative phase sequence time overcurrent relay used primarily to protect generators from unbalanced phase currents. The relay consists of and induction disk overcurrent unit connected with a negative phase sequence component connected to the generator load.

TOOLS, EQUIPMENT, AND MATERIALS

- Three variable ac voltage / current, variable phase-angle sources
- Variable dc current source
- Multimeter

INSPECTION

1. Remove the cover from the relay, taking care to not shake or jar the relay or other relays around it.

2. Pull the relay connecting plug to disable the trip circuit and remove the current inputs. Lift the relay from the case.

3. Visually check the relay for any obvious problems and clean the relay thoroughly.

4. Burnish the surfaces of all contacts, making sure to remove any tarnish.

5. Check that all relay connections are tight.

6. Check that there is end play in the shaft of the overcurrent unit. Total end play should not be more that 1/64 inch. The lower jewel screw bearing should be screwed in firmly and the top pivot locked in place by its set screw.

7. Check that the moving contact arm rotates freely and that the control spring provides enough opening torque toward the right hand backstop to hold the contact definitely open.

The INC77N is sensitive to the negative sequence component of the current applied. 3 phase, phase to phase, or single phase current quantities can be used for testing but the amplitude of current will change due to the negative sequence calculation. Table 1 shows the conversion factors when using different test hook ups.

Table 1

THREE PHASE connection:	Three currents 120° from each other and reverse phase sequence		
PHASE TO PHASE connection:	Two currents 180° from each other		
SINGLE PHASE connection:	One current connected phase to neutral		
Multiply the desired level of negative sequence current by the factor below for actual test currents			
	THREE PHASE	PHASE TO PHASE	SINGLE PHASE
Negative Sequence Current Multiplier	1	√3	3

CHECKING THE SEQUENCE CIRCUIT BALANCE

1. Connect the variable ac current sources to terminals 3 and 4 (AØ), terminals 5 and 6 (BØ), and terminals 7 and 8 (CØ).

2. Connect the multimeter to terminals 9 and 10 and monitor AC voltage.

3. Set the relay on the 3.0 taps.

4. Apply 4 amps of balanced three phase current in normal sequence (ABC). The voltage developed across terminals 9 and 10 should be less than 0.25 Vac.
   NOTE: If the voltage developed does not meet specifications, adjust rheostats R1 and R2 located at the rear upper right of the relay looking from the front. Starting with R1, adjust until a minimum voltage is developed then adjust R2 until a minimum voltage is developed. Continue adjusting both R1 and R2 in sequence until a minimum voltage is reached.

TESTING THE MINIMUM OVERCURRENT PICKUP

1. Connect the variable ac current sources to terminals 3 and 4 (AØ), terminals 5 and 6 (BØ), and terminals 7 and 8 (CØ).

2. Calculate the minimum overcurrent pickup by multiplying the tap value by 0.63 (factory design) and by the Negative Sequence Current Multiplier in Table 1.

3. Monitor contact continuity at Terminals 1 and 2.

4. Apply sufficient current above tap value to close the contacts. Watch the disk movement throughout the pickup to ensure that there is a smooth unhindered travel of the disk.

5. Decrease the current until the contacts flicker.
   NOTE: This is the minimum pickup current; it should be equal to the calculated minimum pickup +/− 5%. The dropout current should be, at minimum, 90% of the tap setting. If the pickup current does not meet specifications, adjust resister R3 located at the rear upper left of the relay looking from the front. Increasing the resistance increases pickup current, decreasing the resistance decreases the pickup current.

6. Remove the current and allow the disc to reset to the back stop. Watch the disk movement throughout the reset to ensure that there is a smooth unhindered travel of the disk.

7. Check the time that it takes the disk to reset itself from pickup position to the backstop with the test current removed.
   NOTE: The reset time average is between 8 and 10 seconds per time dial position.

TESTING THE TIME-CURRENT CHARACTERISTIC

1. Check the Time Current Curve in Figure 1 and calculate the expected response time at a minimum of two points on the timing curve at the desired time dial setting and per-unit of tap.
   NOTE: Calculate the timing test current by multiplying the tap value by the desired per-unit of tap from Figure 1 and by the Negative Sequence Current Multiplier in Table 1.

2. Configure a timer start latch so the timer will start when the current is initiated.

3. Connect the variable ac current sources to terminals 3 and 4 (AØ), terminals 5 and 6 (BØ), and terminals 7 and 8 (CØ).

4. Monitor contact continuity at Terminals 1 and 2 for the timer stop latch.

5. Initiate current for the first timing test and observe the response time. If the measured response time varies by more than 5% (+/−) from the expected response time, adjust the drag magnet and time dial.
   NOTE: Adjusting the drag magnet is considered coarse adjustment. Sliding the magnet in, decreases the response time. Sliding the magnet out, increases response time.
   The time dial is used for fine adjustment. Increasing the time setting on the time dial increases response time; decreasing the time setting decreases response time.

   CAUTION: The current should be removed from the relay as soon as the timer stops. Leaving the current on the relay for an extended period of time may damage the time overcurrent unit.

6. Repeat Step 1 through 5 for the second timing test.

TESTING THE TIME OVERCURRENT TARGET

1. Connect the variable dc current source to Terminals 1 and 2.

2. Manually rotate the relay disk until the contacts just close.

3. Raise the dc current until the time target unit picks up. Verify that the target drops smoothly.
   NOTE: The pickup current should meet the specifications listed in Table 2.

4. Release the relay disk and verify that the target unit remains sealed in.

5. Lower the dc current until the target unit drops out.
   NOTE: The dropout current should meet the specifications listed in Table 2.

Table 2

Target Unit Specifications

Tap Setting	Pickup Current	Dropout Current
0.2	0.15 to 0.195 A	0.05 A or more
2.0	1.50 to 1.95 A	0.55 A or more

Figure 1

INC77N Time Current Curve

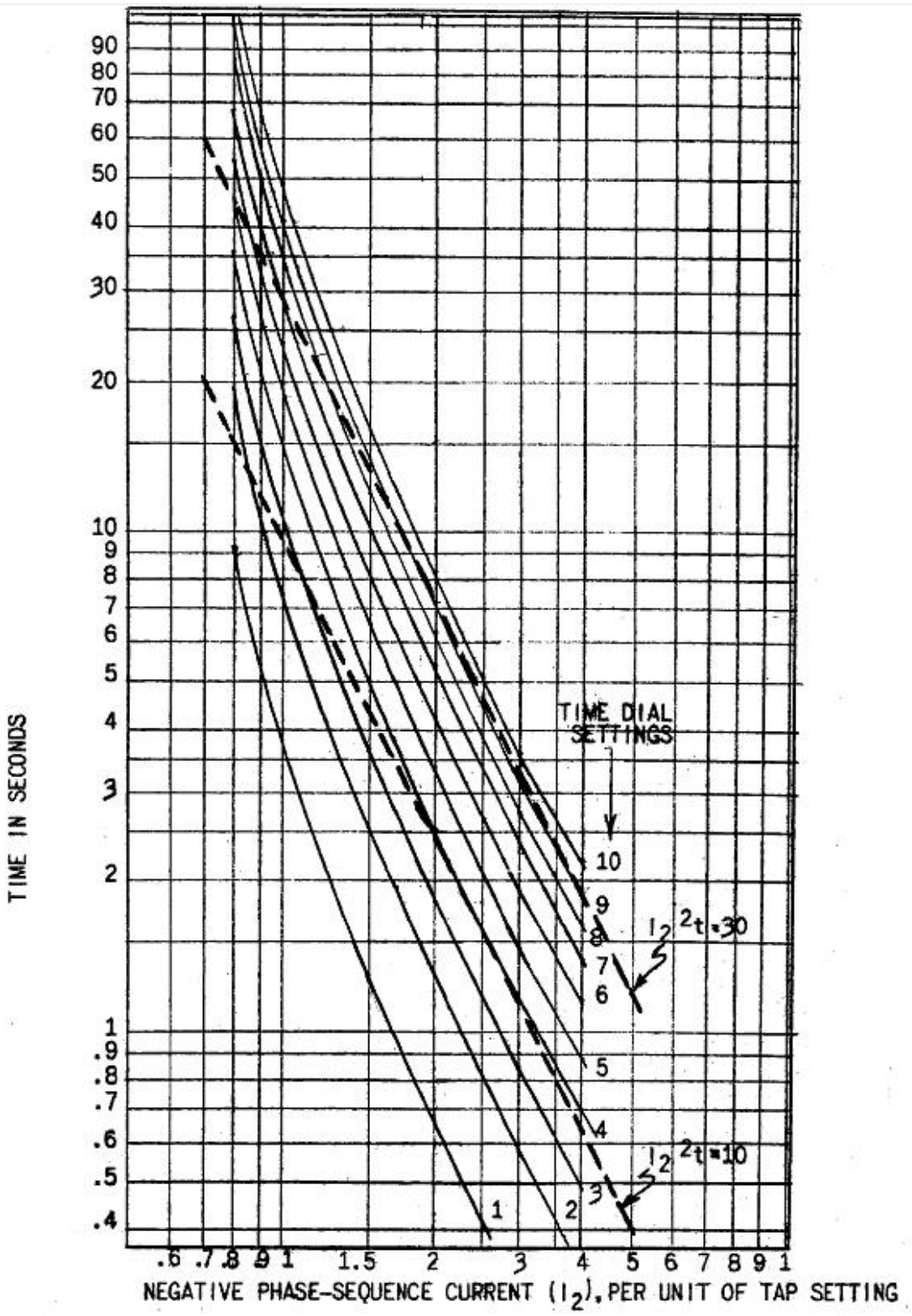


Figure 2

INC77N Internal Schematic