



SCOPE

This test procedure covers the testing and maintenance of GE JBCG directional ground overcurrent relays. Refer to IL GEI-98345 for testing support and component level identification.

SAFETY

Current-shortening test switches used for the JBCG relay may malfunction and develop high voltage levels. Use caution when using the test switches; make sure they are functioning properly.

INTRODUCTION

JBCG relays provide directional ground overcurrent protection of transmission lines and feeder circuits. Directional control of the time overcurrent and instantaneous units is provided by one directional unit that can be zero sequence voltage-polarized and/or zero sequence current-polarized. *Figures 1 through 3* provide illustrations and schematics for the JBCG relay. Removing JBCG relays for testing may leave a transmission line unprotected for phase-to-ground faults. If removing a relay leaves a transmission line unprotected, then the relay should be replaced with another one during testing.

Table 1

Various JBCG models and their associated time/current characteristics.

Model	Time/Current Characteristics
JBCG51K	Inverse Time
JBCG52K	Inverse Time
JBCG53K	Very Inverse Time
JBCG54K	Very Inverse Time
JBCG61K	Inverse Time
JBCG63K	Very Inverse Time
JBCG70K	Long Time
JBCG77K	Extremely Inverse Time
JBCG78K	Extremely Inverse Time

TOOLS, EQUIPMENT, AND MATERIALS

- Two variable ac voltage/current, variable phase-angle sources
- Variable dc voltage/current source and latch timer
- Variable high ac current source (for spurious torque adjustments only)

INSPECTION

1. Take the cover off the relay, taking care to not shake or jar the relay or other relays around it.
2. Pull the relay connecting plugs to disable the trip circuit and remove the voltage and current inputs.
3. Lift the relay out of the case.
4. Visually check the relay for any obvious problems.
5. Clean the relay thoroughly.
6. Burnish the surfaces of all contacts, making sure to remove any tarnish.
7. Check that all relay connections are tight.
8. Check that the contact gap on the instantaneous unit (upper unit) is between 0.028 and 0.036 inch and shaft end play is between 0.015 and 0.020 inch. There should be no noticeable friction in the rotation and when at rest should be open and against the backstop.
9. Check that the disk shaft end play on the time overcurrent unit (middle unit) is between 0.005 - 0.015 inch. The disk should be centered in the air gaps of the electromagnet and drag magnet, should rotate freely throughout its travel and the moving contact should just touch the stationary contacts when the time dial is at the zero position.
10. Check that the front contact gap on the directional unit (lower unit) is between 0.015 and 0.025 inch and shaft end play is between 0.015 and 0.020 inch. The front contact should close approximately 0.005 to 0.010 inch before the rear contact.

TESTING THE TIME OVERCURRENT UNIT

Prerequisites

1. Connect the variable ac current source to Terminals 2 and 4.
2. Verify that the front contacts on the directional unit (lower unit) are open.
3. At currents up to 20 times the tap setting verify that the time overcurrent unit does not pick up.
4. Block the contacts on the directional unit to the pickup position.

Testing Minimum Pickup

1. Monitor contact continuity at Terminals 1 and 11.
2. 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.
3. Decrease the current until the contacts flicker.
NOTE: This is the minimum pickup current; it should be equal to $\pm 5\%$ of the tap setting. The dropout current should be at least 85% of the tap setting. If the pickup current does not meet specifications, adjust the tension on the spiral spring.
NOTE: Tightening the spring (turning it counterclockwise [CCW] from the top) increases pickup current. Loosening the spring (turning it clockwise [CW] from the top) decreases pickup current.
4. Remove the current and allow the disc to reset to the back stop. Observe the disk movement throughout to ensure that there is a smooth unhindered travel of the disk.
5. 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 5 and 6 seconds per time dial position.
6. Apply minimum pickup current and verify that the movable contact just starts to move away from the back stop.
NOTE: The pickup current should be equal to the tap setting $\pm 5\%$. The dropout current should be at least 85% of the tap setting.

Testing the Time-Current Characteristic

1. Check the published time curve and relay settings to determine the expected response time at a minimum of two points on the timing curve.
2. Configure a timer start latch so the timer will start when the current is initiated.
3. Connect the current inputs to Terminals 2 and 4.
4. Monitor contact continuity at Terminals 1 and 11 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 slug and time dial. Ensure the drag magnet slug or debris in the drag magnet air gap is not touching the relay disk.
NOTE: The drag magnet is used for coarse adjustment. Moving the magnet in (away from the front of the relay) decreases the response time. Moving the magnet out (towards the front of the relay) increases response time. The outer edge of the magnet should not extend beyond the cutout in the disk.

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 4 and 5 for the second timing test.
7. Remove the directional unit contact block.

TESTING THE INSTANTANEOUS UNIT

1. Connect the variable ac current source to Terminals 2 and 3. Monitor contact continuity at Terminals 12 and 19.
2. Block the front contacts on the directional unit (lower unit) to the pickup position.
3. Check relay nameplate to determine the appropriate pickup current range.
4. Pulse initiate current below the expected pickup current. Continue initiating current at successively higher levels until the contact on the instantaneous unit just picks up.

CAUTION: The current should be removed from the relay as soon as the instantaneous unit picks up. Leaving the current on the relay for an extended period of time may cause damage.

If the measured pickup current varies more than 5% (+/-) from the expected pickup current, loosen the quarter-inch hex clamping bolt on the rear of the spiral spring assembly and adjust the spiral spring on the instantaneous unit.

5. Remove the directional unit contact block.
6. Apply currents up to 20 times the pickup and verify that instantaneous unit does not pick up.

NOTE: Problems with the instantaneous unit may indicate that the clutch needs to be adjusted.

TESTING THE INSTANTANEOUS CLUTCH

1. Connect the variable ac current source to Terminals 2 and 3.
2. Block the front contacts on the directional unit (lower unit) to the pickup position.
3. Pulse initiate current and verify that the clutch on the instantaneous unit begins to slip at between 6 and 8 times the instantaneous pickup current.

If necessary, adjust the clutch-adjusting screw on the right-hand side of the instantaneous unit assembly.

NOTE: Turning the screw in increases the amount of current required to make the clutch slip. Turning the screw out decreases the amount required.

TESTING THE DIRECTIONAL UNIT

Testing the Current Polarizing

1. Jumper Terminal 6 to Terminal 7. Jumper Terminal 9 to Terminal 10.
2. Connect the variable ac current source to Terminals 5 and 8. Monitor contact continuity at Terminals 1 and 19.
3. Initiate current. Continue initiating current at successively higher levels until the contacts on the directional unit just pick up.
 - a. **NOTE:** The pickup current should be 0.5 A +/- 5%. If the pickup current does not meet the specifications, loosen the quarter-inch hex clamping screw and adjust the spiral spring on the directional unit.
4. Remove the Terminal jumpers.

Testing the Potential Polarizing

1. Verify that Terminals 7 and 8 are open.
2. Connect the variable ac current source to Terminals 5 and 6 with the polarity lead going to Terminal 5.
3. Connect the variable ac voltage source to Terminals 9 and 10 with the polarity lead going to Terminal 9.
4. Monitor contact continuity at Terminals 1 and 19.
5. Apply 5 Vac to the relay voltage input.
6. Initiate current below 0.75 A. Continue initiating current at successively higher levels until the contacts on the directional unit just pick up.

NOTE: The directional unit should pick up between 0.75 and 1.65 A +/- 10%. If the pickup current does not meet the specifications, loosen the hex clamping bolt at the rear of the spiral spring assembly and adjust the spiral spring on the directional unit.

TESTING THE DIRECTIONAL UNIT CLUTCH

1. Jumper Terminal 6 to Terminal 7. Jumper Terminal 9 to Terminal 10.
2. Connect the variable ac current source to Terminals 5 and 8.
3. Initiate current and verify that the clutch on the instantaneous unit begins to slip between 8 A and 18 A.

If necessary, adjust the clutch-adjusting screw on the right-hand side of the directional unit assembly until the clutch slips between 8 and 18 A.

NOTE: Turning the screw in increases the amount of current required to make the clutch slip. Turning the screw out decreases the amount required.

TESTING THE TARGET AND SEAL IN

Pick up both target units manually. Ensure that the contacts have a 1/32-inch wiper and that the targets drop freely when the contacts pick up.

If necessary, adjust the target unit so the target drops freely when the unit picks up.

Testing the Time Overcurrent Target

1. Manually rotate the relay disk until the contacts just close.
2. Raise the dc current until the time target unit picks up. Verify that the target latches properly.

NOTE: The pickup current should meet the specifications listed in *Table 2*.

3. Release the relay disk and verify that the target unit remains sealed in.
4. Lower the dc current until the target unit drops out.

NOTE: The dropout current should meet the specifications listed in *Table 2*.

Testing the Instantaneous Target

1. Connect the variable dc current source to Terminals 1 and 12.
2. Block the front contacts on the directional unit (lower unit) to the pickup position.
3. Manually close the contacts on the instantaneous unit.
4. Raise the dc current until the instantaneous target unit picks up. Verify that the target latches properly.

NOTE: The pickup current should meet the specifications listed in *Table 2*.

5. Release the contact on the instantaneous unit and verify that the target unit remains sealed in.

6. 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

TESTING FOR SPURIOUS TORQUE

1. Jumper Terminal 9 to Terminal 10.
2. Check that Terminals 7 and 8 are open.
3. Connect the variable ac current source to Terminals 5 and 6.
4. Initiate 30 A of current and adjust the relay core to compensate for spurious torque on the directional unit.

NOTE: The relay core is adjusted by loosening the nut at the bottom of the directional unit and turning the slotted bearing screw.

CAUTION: The current should be removed from the relay as soon as possible. Leaving the current on the relay for an extended period of time may cause damage.

Figure 1
JBCG Internal Schematic

