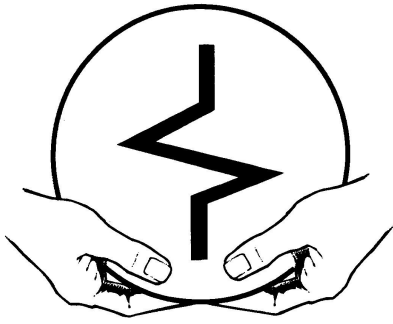


BDD15B / BDD16B



SCOPE

This test procedure covers the testing and maintenance of GE BDD15B and BDD16B transformer differential relays. Refer to IL GEH-2057 for testing support information and component level identification.

DESCRIPTION

The BDD relays are specifically designed for transformer protection and include a sensitive polarized operating element and an instantaneous unit. The relay compensates for through fault current by the restraint action of a slope element. Transformer magnetizing inrush current is accounted for with a harmonic restraint unit. The BDD relay provides single phase protection of two winding transformers with the BDD15B and three winding transformers with the BDD16B.

RECOMMENDED TESTS

1. Minimum Pickup and Dropout Tests
2. Harmonic Restraint
3. Percent Slope
4. Instantaneous

Table 1

Testing Hookup Guide

TEST	I1 CONN	I2 CONN	DC	SENSING	
Winding 1 Pickup	6 – 5		BDD15B 1 (+) - 7 (-) BDD16B 1 (+) - 10 (-) Check DC tap block for proper voltage level	1 – 2	
Winding 1 Dropout	6 – 5			1 – 2	
Winding 2 Pickup	4 – 5			1 – 2	
Winding 2 Dropout	4 – 5			1 – 2	
Winding 3 Pickup ¹	3 – 5			1 – 2	
Winding 3 Dropout ¹	3 – 5			1 – 2	
Winding 1 Harmonic Restraint	6 – 5	6 – 5		1 – 2	
Winding 2 Harmonic Restraint	4 – 5	4 – 5		1 – 2	
Winding 3 Harmonic Restraint ¹	3 – 5	3 – 5		1 – 2	
Through Restraint W1 - W2	6 – 4			1 – 2	
Percent Slope W1 - W2	5 – 4	6 – 4		1 – 2	
Through Restraint W1 - W3 ¹	6 – 3			1 – 2	
Percent Slope W1 - W3 ¹²	5 – 3	6 – 3		1 – 2	
Through Restraint W2 - W3 ¹	4 – 3			1 – 2	
Percent Slope W2 - W3 ¹²	5 – 3	4 – 3		1 – 2	
Winding 1 Instantaneous	6 – 5			1 – 2	
Winding 2 Instantaneous	4 – 5			1 – 2	
Winding 3 Instantaneous ¹	3 – 5			1 – 2	
¹ BDD16B Only ² Slope tests assume equal taps. If taps are not the same, inject I2 lower tap winding to larger tap winding and I1 common return to larger tap winding					

The following checks are assuming a periodic maintenance check with relay at normal taps and settings.

TESTING THE MINIMUM PICKUP (TEST 1 - TEST 6)

1. Pickup = 30% * tap setting
Tolerance = $\pm 10\%$
Adjustment is R₁ (top left back of relay looking from the front)
NOTE: Slide forward to lower pickup
Run several tests to stabilize
2. Dropout = 0.1 amp or more
3. Repeat Test 1 for winding 2
4. Repeat Test 2 for winding 2
5. Repeat Test 1 for winding 3
6. Repeat Test 2 for winding 3

NOTE: If multiple tests are inconsistent, demagnetizing the polar unit may correct the problem. Demagnetize with winding 1 on the 2.9 amp tap. Inject 30 amps through winding 1 for 0.25 seconds, then drop current to 15 amps for 0.5 seconds, then 7.5 amps for 1 second, then 3.75 amps for 2 seconds, then 1.9 amps for 4 seconds, then 0.95 amps for 8 seconds, then 0.48 amps for 16 seconds and then off. Repeat the pickup tests.

TESTING THE HARMONIC RESTRAINT (TEST 7 - TEST 9)

7. Use I₂ = 2nd harmonic current and I₁ = fundamental current. The factory calibration of the harmonic restraint was performed with dc for I₂. For a discussion of using a ½ wave rectifier for I₂ see HARMONIC CURRENT RESTRAINT page 26 of IL GEH-2057. When using a power system simulator (Doble 6150 or equivalent) use the following calculations.

Calculate I₂ = 0.212 x winding tap

Assuming a winding tap of 4.2 then

$$I_2 = 0.212 * 4.2 = 0.8904 \text{ amp}$$

$$I_1 = 0.90 * 4.2 \text{ to } 1.10 * 4.2 = 3.78 \text{ to } 4.62 \text{ amps (assumed pickup)}$$

Set I₂ to calculated value and begin ramp I₁ * .80 to pickup.

The approximate percent harmonic can be seen on Figure 15, page 44 of bulletin GEH-2057 computed at 4 amp dc. Otherwise:

$$\% \text{ harmonic} = \frac{I_2}{\sqrt{(I_1)^2 + (I_2)^2}} * 100$$

Tolerance is +/- 10%

Adjust R₂ (second resistor from the left, back of the relay as seen from the front)

NOTE: Slide forward = lower percent

SAFETY NOTE: TURN OFF I₁, I₂ AND DC WHILE MAKING ADJUSTMENTS

NOTE: Depending upon your test set, I₂ values below 1 amp may be less accurate. If the calculated percent harmonic is out of tolerance, use a higher value for I₂ (i.e., 2 amps) and calculate the expected pickup of I₁ with percent harmonic formula.

8. Repeat Test 7 for winding 2 test
9. Repeat Test 7 for winding 3 test (BDD16B only)

TESTING THE THROUGH RESTRAINT AND PERCENTAGE SLOPE

10. For calibration purposes, change all windings to 5A taps
Set I_2 to 25A (5 * tap) and verify no pickup for through current condition
11. Set $I_2 = 20A$
Ramp I_1 up to pickup (3A = 15% slope, 5A = 25% slope, 8A = 40%)
 $\% \text{ Slope} = (I_1/I_2) * 100$ (when on same taps)
Tolerance is 0 / + 10% (this ensures slope characteristic never falls below tap value)
Adjust R_3 (behind front plate)
Left Slider is for the 15% tap, center slider is for the 25% tap, right slider is for the 40% tap
Slide to left to lower percent slope
SAFETY NOTE: TURN OFF I1, I2 AND DC WHILE MAKING ADJUSTMENTS

Slope tests can be performed on the in-service taps by ensuring injection of I2 lower tap winding to larger tap winding and I1 common return to larger tap winding.

Use Table IV, Page 28 of IL GEH-2057 to determine pickup tolerances or calculate using the following formulas:

$$\% \text{SLOPE} = [(T1 / T2) * (I_1 / I_2 + 1) - 1] * 100$$

T1 = smaller restraint winding tap value.

T2 = larger restraint winding tap value.

I_2 = restraint current

I_1 = operate current

$$I_1 = [(\% \text{SLOPE} / 100 + 1) * I_2 * (T2 / T1)] - I_2$$

12. Repeat Test 10 for W1 – W3 test (BDD16B only)
13. Repeat Test 11 for W1 – W3 test (BDD16B only)
14. Repeat Test 10 for W2 – W3 test (BDD16B only)
15. Repeat Test 11 for W2 – W3 test (BDD16B only)
NOTE: Demagnetize the polar unit if test results are inconsistent

TESTING THE INSTANTANEOUS PICKUP

16. Return taps to normal position
Block TSI (left) unit open
Instantaneous pickup = 8 * tap (tap may need to be changed for test set compliance)
NOTE: Pulse current to avoid overheating
Tolerance is +/- 5%
Adjust instantaneous core screw as necessary to adjust pickup
17. Repeat Test 16 for winding 2 test
18. Repeat Test 16 for winding 3 test (BDD16B only)
NOTE: Demagnetize the polar unit after the instantaneous testing

TESTING THE AUXILIARY RELAY

19. Test requires a variable DC voltage supply be used in place of the constant DC supply

Place 0.5 * winding tap amps on winding 1 so that the polar unit picks up and then ramp DC Voltage up on the AUXILIARY RELAY until its contact closes.

Expected value is approximately 50% of rated voltage.

Figure 1

BDD15B Internal Schematic

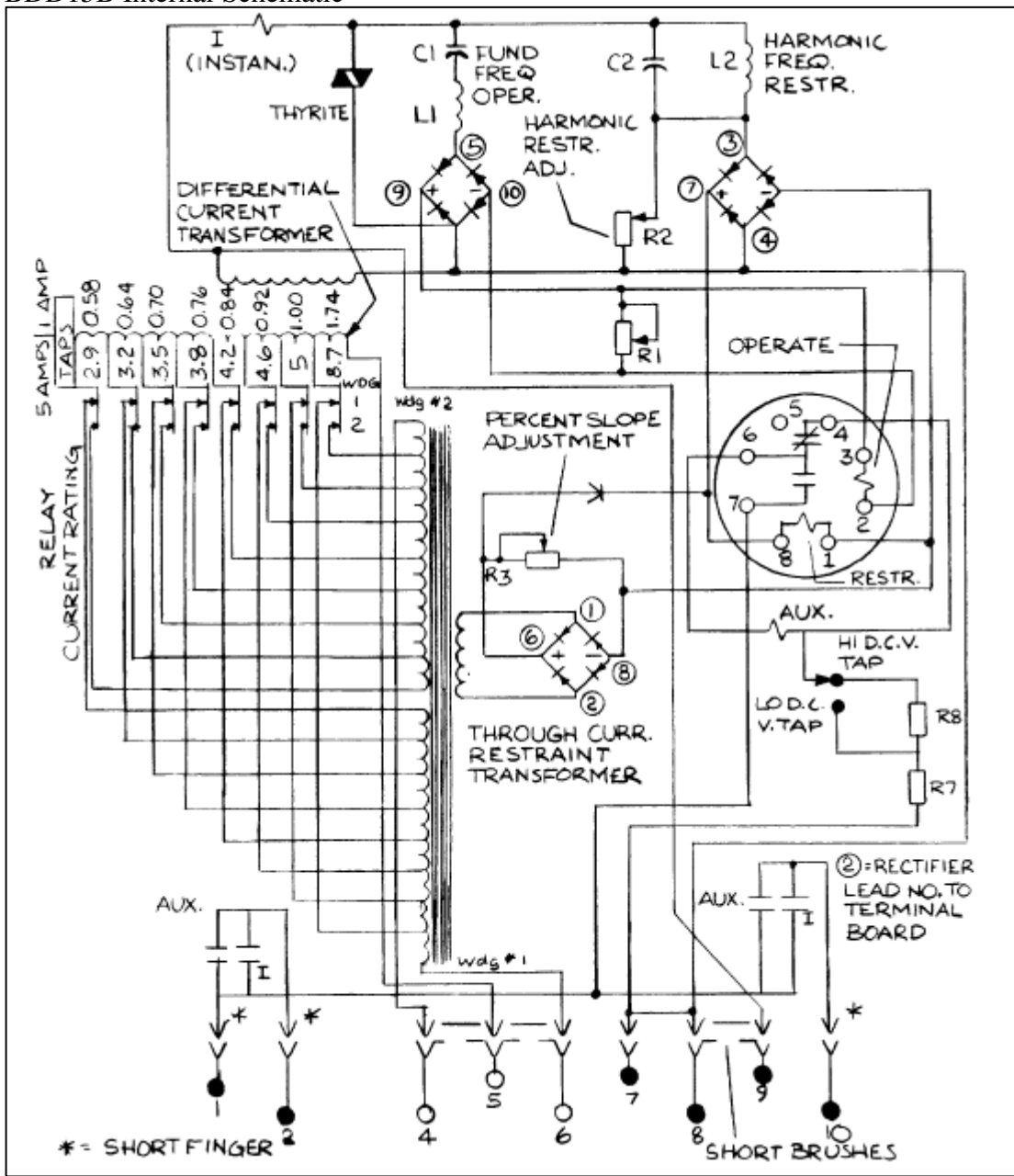


Figure 2

BDD15B Internal Schematic

