Percentage \ Differential with Harmonic Restraint

BDD



Features and Benefits

- No auxiliary CT's are required
- Ratio matching taps
- Harmonic restraint prevents incorrect tripping upon transformer energization
- Self-contained target indicator
- Inherently selective
- Drawout case

Applications

- Power and autotransformer protection
- Current differential single phase

Protection and Control

- High speed percentage differential
- Phase and ground fault detection
- Current restraint circuits available
- Percent differential slope selection



Description

BDD relays are for the protection of transformers rated 2000 kVA and above and for transformers with windings rated 15 kV or above. However, the importance of the transformer to the system, not its size alone, should be the basis for the decision on this quality of protection.

Applications

The BDD differential relays should be used for all applications where high-speed operation and system stability are important. These relays have a percentage slope operating characteristic which prevents operation unless the differential current is greater than a certain percentage of the through current. A tap plug on the front of the relay provides slope percentages of 15, 25, or 40 which is usually adequate even for inphase tap changing under load. Current transformer errors should not exceed 20 percent at 8 times tap value.

Six different forms of the BDD relay are available. Each relay is a single-phase unit with one differential circuit. Three relays are required for three-phase protection. The six different forms are provided with two, three, four, five, six or seven through-current restraint circuits for the protection of power transformers with two or more windings or circuits.

The BDD15B, -16B, -17B, -18B, -19B and -20B with two, three, four, five, six and seven throughcurrent restraint circuits, respectively, also have provision for accommodating one additional circuit connection to the transformer without a throughcurrent restraint in the relay. This application can safely be made only when the additional circuit has no in-feed or is at best a very weak source and needs no through-current restraint.

Connection Diagram

(+) DC trip bus F 87-2 87-3 87-1 87-I Similar to Aux 86 :86 **±**86 : 86 phase 1 52-1 5 52-2 <u>87-1</u> DHR 87-1 Phase 2 Phase 3 52-3 DCT same as same as 87-1 87-1 Aux phase 1 phase 1 ξ 2 87-1 TCT & Winding Ę Moveable 13 5<u>2-2</u> TC 52-4 lead TC TC 125 VDC 250 vdc 86 3 86 10 52-4 Weakest source, no restraint (-) 52-3 provided by this line - Aux switch, open when breaker is open тс - Trip coil DCT - Differential current transformer TCT - Through current transformer Instantaneous overcurrent unit DHR- Differential unit with harmonic restraint - Type HEA hand-reset relay 52 - Power circuit breake 87 - Type BDD differential relay

Fig. 1. Typical elementary diagram for Model No. 12BDD16B11 relays for four-circuit transformer protection with three restraints (0264B0499-1)

- ① Burden of operating coil is zero under normal conditions.
- 2 Burden of 50 Hz relay is the same or slightly lower.
- ③ It should be recognized that pickup current flows not only through the differential current transformer but also through one of the primary windings of the through current transformer producing some restraint. However, compared to the operating energy, this quantity of restraint is so small that it may be assumed to be zero.

Contacts

The BDD15B relay is provided with two sets of open contacts and the BDD16B, -17B, -18B, -19B and -20B are provided with one set of open contacts. The currentclosing rating of the contacts is 30 A for voltages not exceeding 250 V. If more than one circuit breaker per set of contacts is to be tripped, or if the tripping current exceeds 30 A, an auxiliary relay must be used with the BDD relay. After tripping occurs, it is necessary that the tripping circuit of these relays be opened by an

auxiliary switch on the circuit breaker or by other automatic means. A hand-reset relay is recommended and normally used.

Burdens

NOTE: Burdens and minimum pickup values are substantially independent of the percent slope settings and are approximately 100 percent power factor. Figures given are burdens imposed on each current transformer at 5.0 A.

Polay	Tap Setting (A)	Zero Restraint Pickup® (A) 0.87	Operatin 60 Hz F	g Circuit® Relays®	Restraint Circuit 60 Hz Relays ∞	
Kelay			Burden VA	Imped Ohms	Burden VA	Imped Ohms
BDD 15B 16B 17B 18B 19B 20B	2.9 3.2 3.5 3.8 4.2 4.6 5.0	0.96 1.05 1.14 1.26 1.38 1.50 2.61	3.2 2.7 2.4 2.0 1.9 1.6 1.5	0.128 0.108 0.096 0.080 0.076 0.064 0.060	1.3 1.2 1.1 1.0 0.9 0.8 0.7	0.052 0.048 0.044 0.040 0.036 0.032 0.028
	8.7		0.7	0.028	0.5	0.020

Selection Guide

Single-phase (3 Relays Required for 3-phase Protection); RATINGS Single-phase 5 A 1.5 A minimum pick-up: 15/25/40 percent slope.

Ratings		DC Control Volts			_	Approx. Wt.						
Amps Frequency (Hz)	of Contacts	125/250	148/125	24/48	Case Size	in Ibs (kg)						
		Model Number			5120	Net	Ship					
FOR TRANSFORMER PROTECTION REQUIRING 2 RESTRAINTS												
60	2 N.O.	BDD15B11A	BDD15B16A	BDD15B13A	M1	22 (10)	34 (15.4)					
50		BDD15B12A	BDD15B17A	BDD15B14A								
FOR TRANSFORMER PROTECTION REQUIRING 3 RESTRAINTS												
60	1 N.O.	BDD16B11A	BDD16B16A	BDD16B13A	M1	24 (10.9)	36 (16.3)					
50		BDD16B12A	BDD16B18A	BDD16B14A								
FOR TRANSFORMER PROTECTION REQUIRING 4 RESTRAINTS												
60	1 N O	BDD17B1A	BDD17B3A		L2	26 (11.8)	39 (17.7)					
50	TN.U.	BDD17B2A										
FOR TRANSFORMER PROTECTION REQUIRING 5 RESTRAINTS												
60	1 N O	BDD18B3A	BDD18B5A		L2	28 (12.7)	42 (19)					
50	TN.U.	BDD18B1A	BDD18B6A									
FOR TRANSFORMER PROTECTION REQUIRING 6 RESTRAINTS												
60	1 N.O.	BDD19B1A	BDD19B2A		L2	28 (12.7)	42 (19)					
FOR TRANSFORMER PROTECTION REQUIRING 7 RESTRAINTS												
60	1 N.O.	BDD20B1A			L2	28 (12.7)	42 (19)					
	ngs Frequency (Hz) MER PROTECT 60 MER PROTECT 60	ngs Number of contacts Frequency (Hz) Of contacts MER PROTECTION REQUIRING 60 2 N.O. 50 2 N.O. MER PROTECTION REQUIRING 60 1 N.O. 50 1 N.O. MER PROTECTION REQUIRING 60 1 N.O. 50 1 N.O. MER PROTECTION REQUIRING 60 1 N.O. 50 1 N.O. MER PROTECTION REQUIRING 60 1 N.O.	Number of Contacts 125/250 Image: Memory (Hz) 1000 Ima	Number of ContactsDC Control VoltsFrequency (Hz)Of Contacts125/250148/125MARP PROTECTION REQUIRING 2 RESTRAINTSModel Number60 502 N.0.BDD15B11ABDD15B16A60 502 N.0.BDD15B11ABDD15B16A700 7001 N.0.BDD16B11ABDD16B16A60 501 N.0.BDD16B11ABDD16B16A60 501 N.0.BDD17B1ABDD16B18A700 700 7001 N.0.BDD17B1ABDD17B3A700 700 700 700 7001 N.0.BDD18B3ABDD18B5A700 	Number of ContactsDC Control VoltsFrequency (Hz)Number of Contacts125/250148/12524/48Model NumberModel NumberModel NumberMer PROTECTION REQUIRING 2 RESTRAINTS60 502 N.O.BDD15B11ABDD15B16ABDD15B13A502 N.O.BDD15B12ABDD15B16ABDD15B14AMer PROTECTION REQUIRING 3 RESTRAINTS60 501 N.O.BDD16B11ABDD16B16ABDD16B13A60 501 N.O.BDD17B1ABDD16B18ABDD16B14AMer PROTECTION REQUIRING 4 RESTRAINTS60 60 501 N.O.BDD17B1ABDD17B3A60 501 N.O.BDD18B3ABDD18B5A60 60 501 N.O.BDD18B1ABDD18B6AMer PROTECTION REQUIRING 6 RESTRAINTS60 60<	Number of contactsDC Control VoltsCase SizeFrequency (Hz)200148/12524/48Case SizeMREP PROTECTION REQUIRING 2 RESTRAINTS60 502 N.0.BDD15B11ABDD15B16ABDD15B13A BDD15B12AM160 502 N.0.BDD16B11ABDD15B17ABDD15B14AM160 501 N.0.BDD16B11ABDD16B16ABDD16B13A BDD16B1AM160 501 N.0.BDD16B1ABDD16B16ABDD16B13A BDD16B1AM160 501 N.0.BDD17B1ABDD17B3A SIDD17B2AL260 501 N.0.BDD17B1ABDD18B5A SIDD17B2AL260 501 N.0.BDD18B3ABDD18B5A SID18B1AL260 601 N.0.BDD18B1ABDD19B2AL260 601 N.0.BDD19B1ABDD19B2AL2601 N.0.BDD19B1ABDD19B2AL2601 N.0.BDD19B1ABDD19B2AL2601 N.0.BDD19B1ABDD19B2AL2601 N.0.BDD20B1AL2601 N.0.BDD19B1ABDD19B2AL2	Number of ContactsDC Control VoltsCase SizeAppr In ItFrequency (Hz)125/250148/12524/48Case SizeNetMER PROTECTION REQUIRING 2 RESTRAINTSModel NumberNetNet60 502 N.0.BDD15B11ABDD15B16ABDD15B13A BDD15B12AM122 (10)60 502 N.0.BDD16B11ABDD16B16ABDD15B14AM122 (10)MER PROTECTION REQUIRING 3 RESTRAINTSBDD16B16ABDD16B13A BDD16B12AM124 (10.9)60 501 N.0.BDD17B1ABDD16B16ABDD16B14AM124 (10.9)60 501 N.0.BDD17B1ABDD17B3A L226 (11.8)60 501 N.0.BDD18B3ABDD18B5A L228 (12.7)60 601 N.0.BDD18B1ABDD19B2A L228 (12.7)60 601 N.0.BDD19B1ABDD19B2AL228 (12.7)601 N.0.BDD19B1ABDD19B2AL228 (12.7)601 N.0.BDD19B1ABDD19B2AL228 (12.7)601 N.0.BDD19B1AADD19B2AL228 (12.7)601 N.0.BDD19B1AL228 (12.7)601 N.0.BDD19B1AL228 (12.7)					

[®] Minimum pickup is 1.5 A with tap plugs in the 5 A and the 25 percent slope positions.