EEL3060

Power Engineering Lab

Motor Protection Relay

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By:

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I. Objective

To study various types of electrical faults in three-phase induction motors and analyze how the Motor Protection Relay Trainer detects and responds to faults like

- Phase Break
- Phase Unbalance
- Line-to-Line Fault
- Line-to-Ground Fault

using corresponding fault switches.

II. Apparatus

- Motor Protection Relay Trainer (Model: TS-MPRT)
- 3 Phase, 3 HP Induction Motor with drum brake pulley
- Patch Chords (Short & Long)
- Rheostat (100 Ohm)
- Fault switches (S1, S2, S3, S4)
- Control Panel with:
  - MCB (16A)
  - Indicator lights
  - Start/Stop switch
  - Trip Indicator

III. Theory

Electric motors are susceptible to various types of faults during operation. Protection systems are used to prevent motor damage from internal or external electrical anomalies. The Motor Protection Relay Trainer simulates real-time faults and helps understand relay response mechanisms.

Types of Faults Studied:

- **Phase Break (S2):** Disconnection of one stator phase.
- **Phase Unbalance (S1):** Unequal voltage in one or more phases.
- **Line-to-Line Fault (S3):** Short-circuit between two phases.
- **Line-to-Ground Fault (S4):** One phase connected to ground.

Protection Mechanism: The relay monitors motor currents and trips the circuit upon detecting abnormal conditions. Currents (Ia, Ib, Ic), sequence components (I0, I1, I2), and neutral currents (IN1, IN2) are observed.

IV. Experimental Procedure

Circuit Diagram

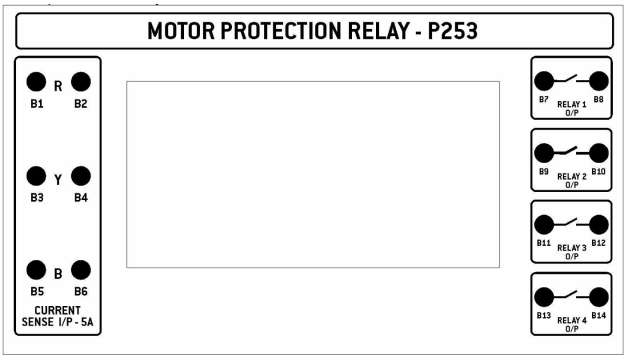

Figure 1: Motor Protection Relay

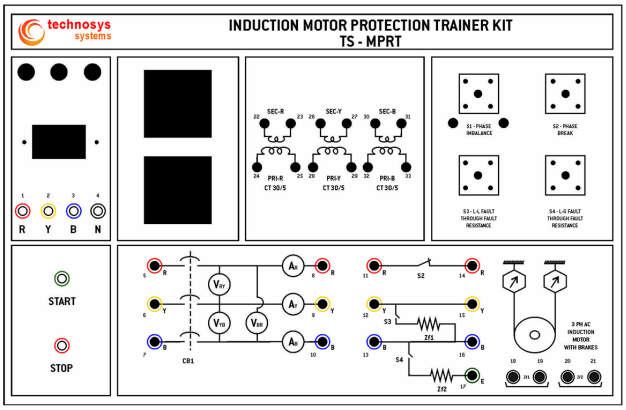

Figure 2: Induction Motor Protection Trainer Kit

Connection Sequence

S.N.		FROM	TO	S.N.			FROM	TO
SHORT PATCH CHORDS				LONG PATCH CHORDS				
1	MCB to Ex. Circuit	1	5	1	To MOTOR Terminals		14	Motor R Ph
2		2	6	2			15	Motor Y Ph
3		3	7	3			16	Motor B Ph
4	O/P of Meters to CT Primary	8	24	4	Earthing		17	Earthing
5		9	28	5	To Relay	CT Sec. to Relay Inputs	22	B1
6		10	32	6			23	B2
7	CT Sec. to EX. Circuit	25	SWITCH SW1 (IP1)	7			26	B3
8		SWITCH SW1 (IP2)	11	8			27	B4
9		29	12	9			30	B5
10		33	13	10			31	B6
				11		Relay trip Circuit	34	B7
				12			35	B8
				13	Rheostat	For Ph Imbalance	Across S1	
				14		For L-L Fault	18	19
				15		For L-G Fault	20	21

Figure 3: Connection Sequence

Steps

Common Steps for all Faults:

1. Connect the motor to the panel and ensure all power/fault switches are in OFF position.
2. Apply power and turn on the MCB. Wait 5 seconds for the relay power-on delay.
3. Press the green button to start the motor.
4. Introduce the fault by toggling the appropriate switch.
5. Observe the current values and relay trip behavior.

Specific Steps per Fault:

1. **Phase Break(S2):**
   - Turn S2 OFF (break R phase).
   - Observe relay trip due to phase loss.
2. **Phase Unbalance (S1):**
   - Connect a 100Ω resistor across S1.
   - Turn S1 OFF (creates imbalance).
   - Relay trips due to current deviation.
3. **Line-to-Line Fault (S3):**
   - Connect 100Ω resistor between terminals 18 & 19.
   - Turn S3 ON (simulate short between Y & B).
   - High current results in relay trip.
4. **Line-to-Ground Fault (S4):**

- Connect 100Ω resistor between terminals 20 & 21.
- Turn S4 ON (simulate ground fault on B phase).
- Observe increased current and relay trip.

Observations Table

Type of Fault	Fault Switch	$I_a(A)$	$I_b(A)$	$I_c(A)$	$I_{N1}(A)$	$I_{N2}(A)$	$I_0(A)$	$I_1(A)$	$I_2(A)$	Trip Time (s)
Phase Unbalanced	S1	12	11	11	0	1	3	3	1	1.975
Phase Break	S2	14	8	11	0	1	3	3	1	1.975
Line-to-Line Fault	S3	13	9	11	0	8	4	3	8	1.975
Line-to-Ground Fault	S4	12	10	12	0	6	2	4	6	1.975

V. Results & Conclusion

- The Motor Protection Relay Trainer successfully detected all simulated faults.
- Each type of fault led to a measurable change in current values and was reflected by trip action of the relay.
- The system effectively prevents motor damage by timely isolating the motor under fault conditions.
- The trip time depends on the fault severity and relay configuration.
- This experiment enhanced understanding of:
  - Sequence components (I_0, I_1, I_2).
  - Real-world motor fault simulation.
  - Importance of protection in industrial applications.