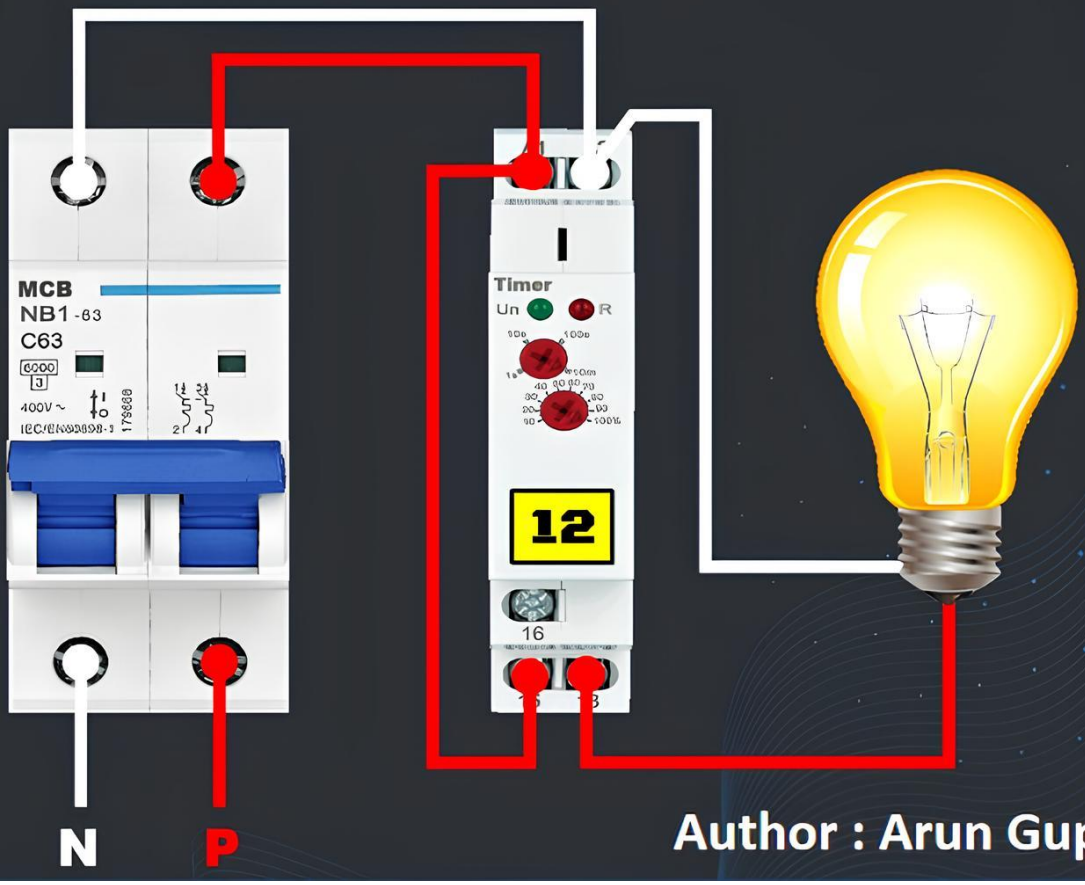
ELECTRICIAN A2Z WIRING BOOK

Empowering Electrician With Every Wire

100+
Circuit Diagram

All Starter Wiring Explained

Home Appliance Working and Wiring Explained



Author : Arun Gupta

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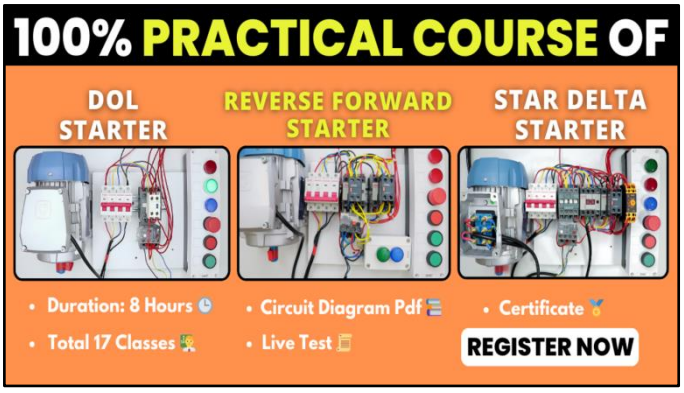

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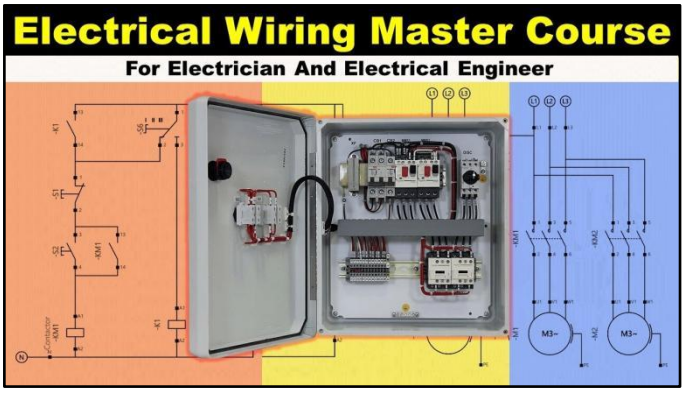
Motor Starter



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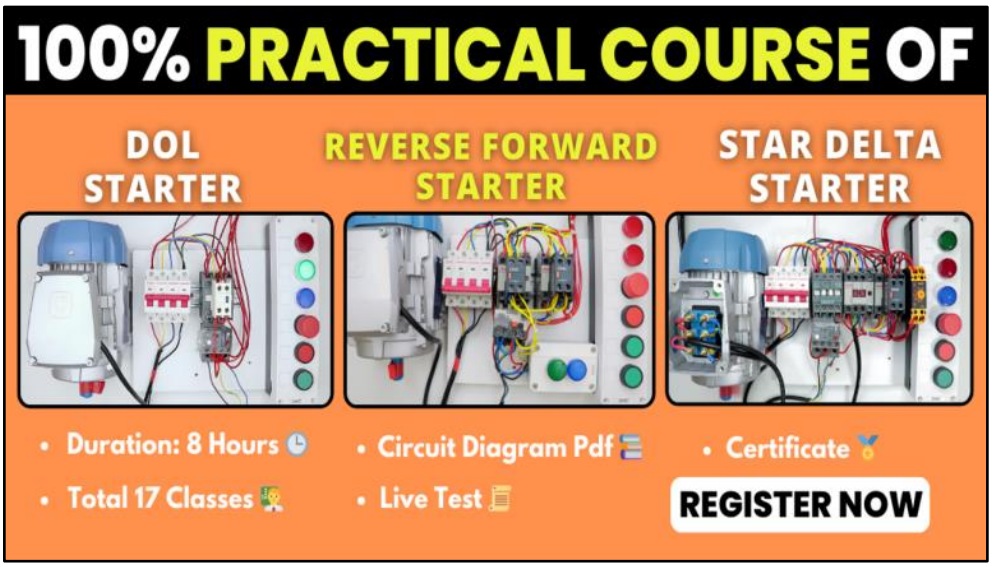

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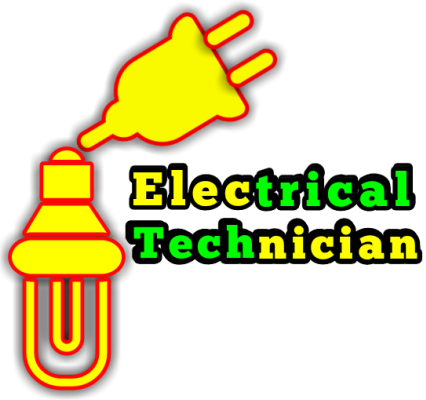
Module 1: Introduction to Motor and Motor Starters • Basics of Motor Starters • Motor Terminal Connection • How to Change Motor Running Direction • Basic Motor Starter Test	**Module 2: Direct-On-Line (DOL) Starter** • Working, Wiring and Testing of Electrical Device • DOL Wiring Diagrams • Practical Wiring of a DOL Starter • DOL Starter Circuit Diagram Pdf. • Troubleshooting and Maintenance • DOL Starter Test
Module 3: Reverse Forward Starter • Reverse Forward Starter Wiring Diagrams • Practical Wiring of a Reverse Forward Starter • Reverse Forward Starter Circuit Diagram Pdf • Troubleshooting and Maintenance • Reverse Forward Starter Test	**Module 4: Star Delta Starter** • Why we use Star Delta Starter • Power Wiring Diagrams of a Star Delta Starter • Practical Power Wiring and Testing of Star Delta Starter • Control Wiring Diagrams of a Star Delta Starter • Practical Control Wiring and Testing of Star Delta Starter • Star Delta Starter Circuit Diagram Pdf. • Troubleshooting of a Star Delta Starter • Overload Relay Current Setting • Star Delta Starter Test

Warning:



In this entire PDF, if you find any diagram you do not understand, you can watch its video by clicking on that diagram. The Video is Available in Hindi and Some Video are also Available in English.

Welcome to Electrical Technician E-Book

Basic of Electrical

1. Electrical Thumb Rules:

For Copper Wire Current Capacity (Up to 30 Sq.mm)	6X Size of Wire in Sq.mm Example 2.5 Sq.mm= 6x2.5=15 A 1 Sq.mm= 6x1=6 A 1.5 Sq.mm=6x1.5=9 A
For Copper Wire Cable Current Capacity	4X Size of Cable in Sq.mm, Example 2.5 Sq.mm= 4x2.5=10 Amp
KW Rating of Motor	HPx0.75
Full Load Current of 1 Phase Motor	HPx6
Full Load Current of 3-Phase Motor	HPx1.5
1 Phase Motor draws Current	6 Amp/HP.
No Load Current of 3-Phase Motor	30% of FLC
3 Phase Motor draws Current	1.25 Amp/HP.
Earthing Resistance =	Single Pit = 5Ω, Earthing Grid=0.5Ω
Voltage between Neutral and Earth	Less then or Equal to 2 Volts
The resistance between Neutral and Earth	Less then or Equal to 1Ω
Current Rating of Transformer	KVAx1.4
Capacitor Current	KVAR/1.732 x Volt (Phase to Phase)
No Load Current of Transformer	Less then 2 % of Transformer Rated current
Approximate Current of KVA Load	1.39xKVA (for 3 Phase 415Volt)
Approximate Current Kw load	1.74xKW (for 3 Phase 415Volt)
DC Meggering Voltage	2 x Name Plate Voltage
AC Meggering Voltage	(2 x Name Plate Voltage) + 1000
Size of Lighting Arrestor	1.5x Phase to Earth Voltage or 1.5x (System Voltage/1.732)
Size of Capacitor	1/3 Hp of Motor (0.12x KW of Motor)

2. Useful Measuring Unit:

1HP = 0.746KW	1Foot = 30.48 cm	1Tone = 3530 BTU
1KW = 1.36HP	1Foot = 12 inch	1Tone = 12000 BTU/Hr
1 kilowatt hour (kWh) = 3.6 x 106 joules (J)	1inch = 2.54 cm	1Tone = 3.5 KW

1 watt (W) = 1 joule per second (J/s)	1Meter = 39.3 Inch	85 Sq. ft Floor Area = 1200 BTU
Fahrenheit to Celsius: C = (F - 32) x 5/9	1Yard = 3 feet	
Celsius to Fahrenheit: F = (C x 9/5) + 32	1Yard = 36 inch	
Celsius to Kelvin: K = C + 273.15	1Gaj = 36 inch	

3. Electrical Unit Conversions

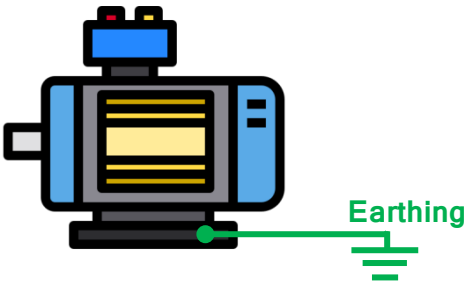
VALUE	1-PHASE	3-PHASE
WATTS (W)	I X E X PF	I X E X 1.73 X PF
KILOWATTS (kW)	$\frac{E \times L \times PF}{1000}$	$\frac{E \times I \times 1.73 \times PF}{1000}$
AMPERES (I)	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{E \times 1.73 \times PF}$
KILOVOLT AMPERES (kVA)	$\frac{I \times E}{1000}$	$\frac{I \times E \times 1.73}{1000}$
FREQUENCY (Hertz or f)	$\frac{Rotor\ Poles \times RPM}{120}$	$\frac{Rotor\ Poles \times RPM}{120}$
RPM (n)	$\frac{Hertz \times 120}{Rotor\ Poles}$	$\frac{Hertz \times 120}{Rotor\ Poles}$
NUMBER OF ROTOR POLES (P)	$\frac{Hertz \times 120}{RPM}$	$\frac{Hertz \times 120}{RPM}$
POWER FACTOR (PF)	$\frac{Actual\ Watts}{I \times E}$	$\frac{Actual\ Watts}{I \times 1.73 \times E}$
HORSEPOWER (HP)	$\frac{I \times E \times PF}{746 \times EFF}$	$\frac{I \times E \times 1.73 \times PF}{746 \times EFF}$
AMPERES (when kW is known)	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{E \times 1.73 \times PF}$
AMPERES (when kVA is known)	$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{E \times 1.73}$

I	current in amperes
E	voltage in volts
W	watts
kW	power in kilowatts
kVA	apparent power in kilo-volt-amperes
HP	output power in horsepower
RPM (n)	motor speed in revolutions per minute (RPM)
ns	synchronous speed in revolutions per minute (RPM)
Rotor Poles (P)	number of poles
Hertz (f)	frequency in cycles per second (CPS)
T	torque in pound-feet
EFF	efficiency as a decimal
PF	power factor as a decimal
HP	horsepower

Motor Earthing Wire / Strip Size:

Earthing, also known as grounding, is a safety measure in electrical systems where conductive materials are connected to the Earth or a large conductive body to provide a safe path for fault currents to flow. It helps protect against electric shocks, and ensures compliance with safety standards in electrical installations.

Click to Watch Hindi Video

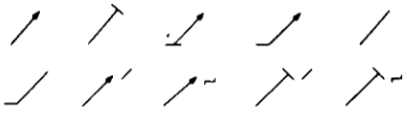


Size of Motor	Body Earthing
< 5.5 KW	4 Sq mm Copper Wire
5.5 KW to 22 KW	25×6 mm GI Strip
22 KW to 55 KW	40×6 mm GI Strip
>55 KW	50×6 mm GI Strip

Electrical Symbols:

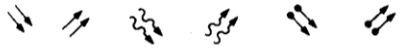
1. Qualifying Symbols

1.1 Adjustability
Variability



1.2 Special-Property Indicators

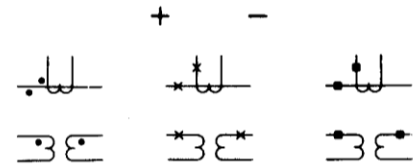
1.3 Radiation Indicators



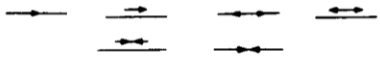
1.4 Physical State Recognition Symbols

1.5 Test-Point Recognition Symbol

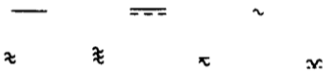
1.6 Polarity Markings



1.7 Direction of Flow of Power, Signal, or Information

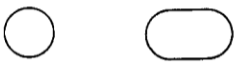


1.8 Kind of Current



1.9 Connection Symbols

1.10 Envelope
Enclosure



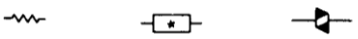
1.11 Shield
Shielding

1.12 Special Connector or Cable Indicator

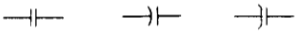
1.13 Electret

2. Fundamental Items

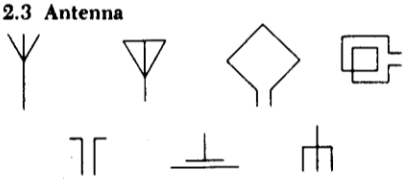
2.1 Resistor



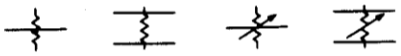
2.2 Capacitor



2.3 Antenna



2.4 Attenuator



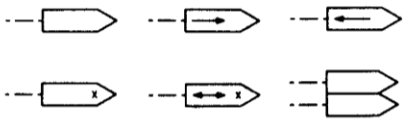
2.5 Battery

2.6 Delay Function
Delay Line
Slow-Wave Structure

2.7 Oscillator
Generalized Alternating-Current Source

2.8 Permanent Magnet

2.9 Pickup
Head



2.10 Piezoelectric Crystal Unit

2.11 Primary Detector
Measuring Transducer

2.12 Squib, Electrical

2.13 Thermocouple

2.14 Thermal Element
Thermomechanical Transducer

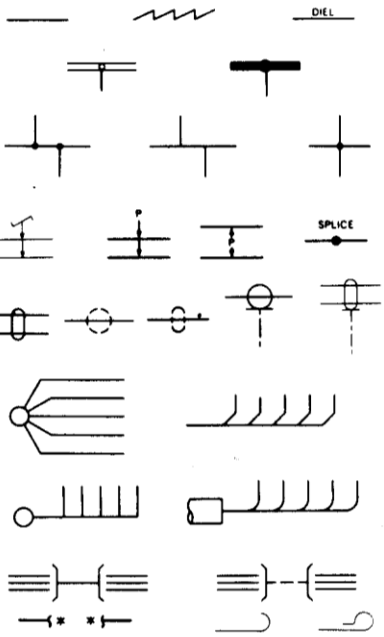
2.15 Spark gap
Igniter gap

2.16 Continuous Loop Fire Detector (temperature sensor)

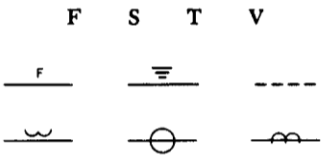
2.17 Ignitor Plug

3. Transmission Path

3.1 Transmission Path
Conductor
Cable
Wiring



3.2 Distribution lines
Transmission lines

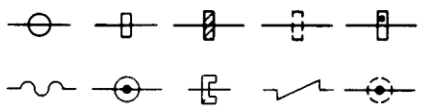


3.3 Alternative or Conditioned Wiring

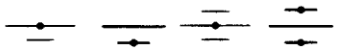
3.4 Associated or Future

3.5 Intentional Isolation of Direct-Current Path in Coaxial or Waveguide Applications

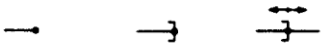
3.6 Waveguide



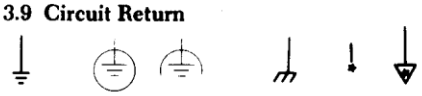
3.7 Strip-Type Transmission Line



3.8 Termination



3.9 Circuit Return

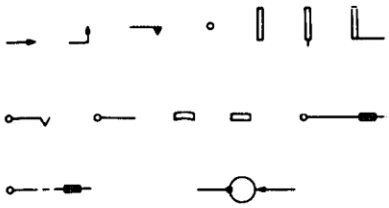


3.10 Pressure-Tight Bulkhead Cable Gland
Cable Sealing End

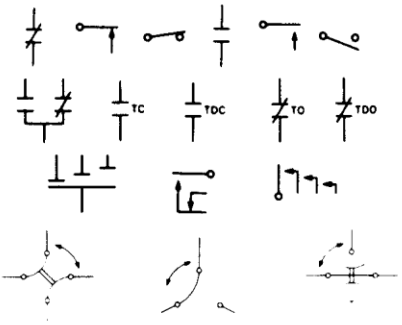
4. Contacts, Switches, Contactors, and Relays

4.1 Switching Function

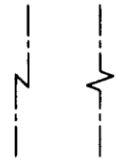
4.2 Electrical Contact



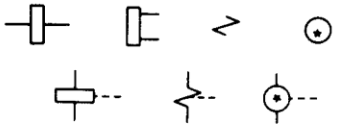
4.3 Basic Contact Assemblies



4.4 Magnetic Blowout Coil



4.5 Operating Coil
Relay Coil

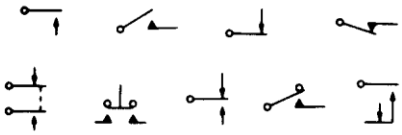


4.6 Switch

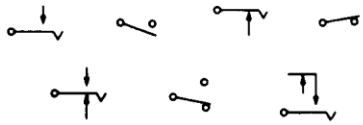
4.7 Pushbutton, Momentary or Spring-Return

4.8 Two-Circuit, Maintained or Not Spring-Return

4.9 Nonlocking Switch, Momentary or Spring-Return

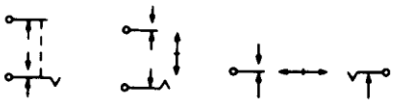


4.10 Locking Switch

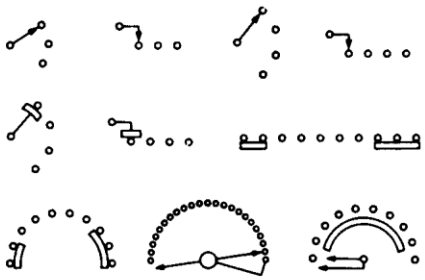


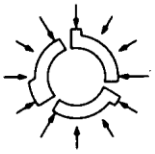
4.11 Combination Locking and Nonlocking Switch

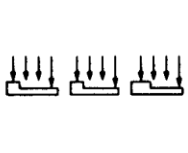
4.12 Key-Type Switch
Lever Switch



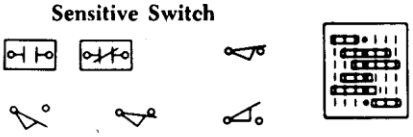
4.13 Selector or Multiposition Switch





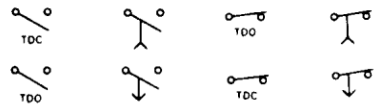


4.14 Limit Switch
Sensitive Switch



4.15 Safety Interlock

4.16 Switches with Time-Delay Feature



4.17 Flow-Actuated Switch

4.18 Liquid-Level-Actuated Switch

4.19 Pressure- or Vacuum-Actuated Switch

4.20 Temperature-Actuated Switch

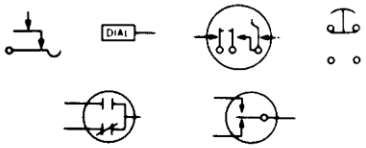
4.21 Thermostat

4.22 Flasher
Self-interrupting switch

4.23 Foot-Operated Switch
Foot Switch

4.24 Switch Operated by Shaft Rotation and Responsive to Speed or Direction

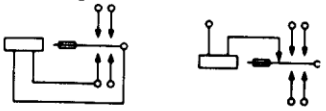
4.25 Switches with Specific Features



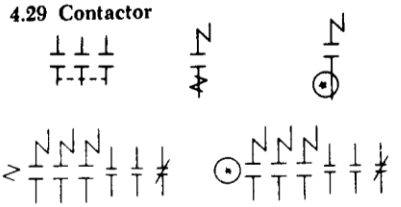
4.26 Telegraph Key

4.27 Governor
Speed Regulator

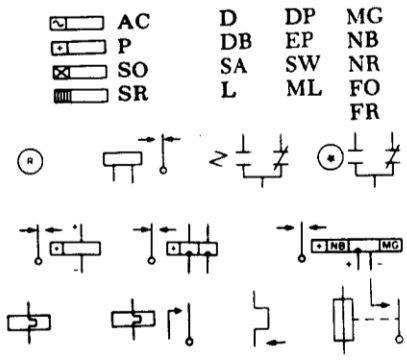
4.28 Vibrator
Interrupter



4.29 Contactor



4.30 Relay



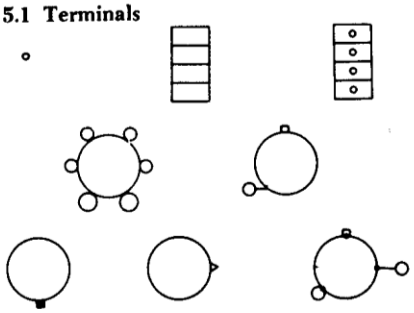
4.31 Inertia Switch

4.32 Mercury Switch

4.33 Aneroid Capsule

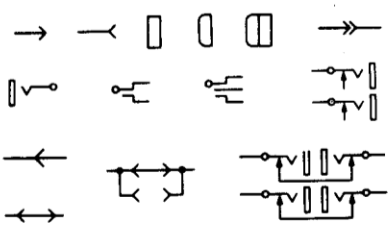
5. Terminals and Connectors

5.1 Terminals

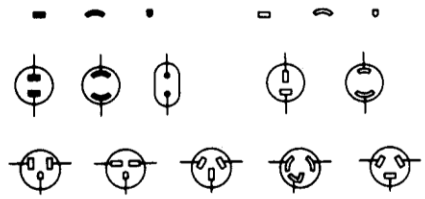


5.2 Cable Termination

5.3 Connector
Disconnecting Device

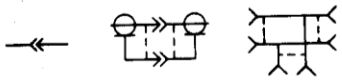


5.4 Connectors of the Type Commonly Used for Power-Supply Purposes



5.5 Test Blocks

5.6 Coaxial Connector

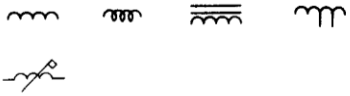


5.7 Waveguide Flanges
Waveguide junction

6. Transformers, Inductors, and Windings

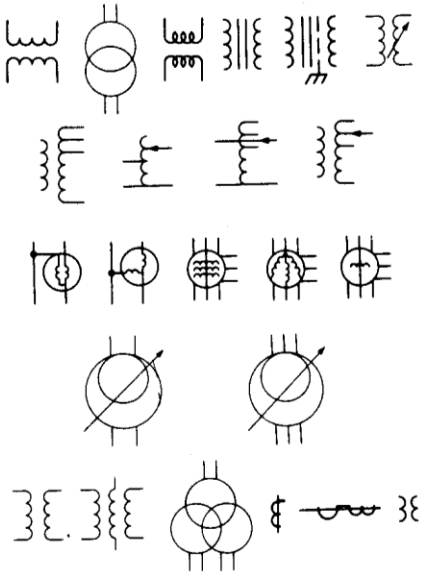
6.1 Core

6.2 Inductor
Winding
Reactor
Radio frequency coil
Telephone retardation coil



6.3 Transductor

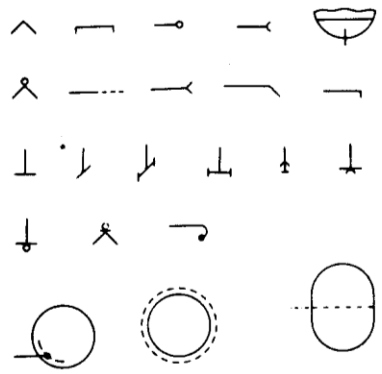
6.4 Transformer
Telephone induction coil
Telephone repeating coil



6.5 Linear Coupler

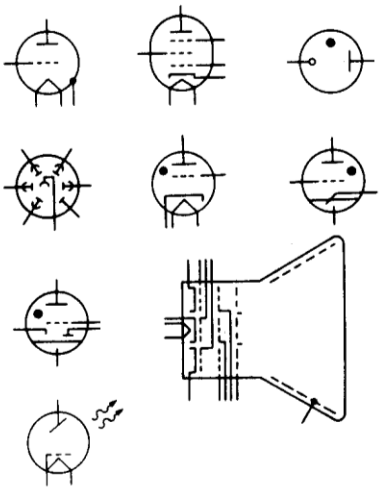
7. Electron Tubes and Related Devices

7.1 Electron Tube

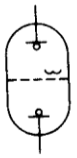


7.2 General Notes

7.3 Typical Applications



7.4 Solion
Ion-Diffusion Device



7.5 Coulomb Accumulator
Electrochemical Step-Function Device

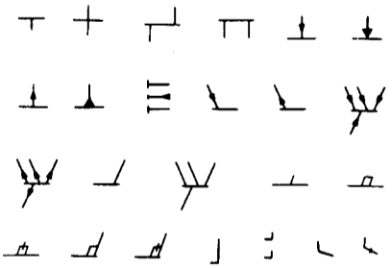
7.6 Conductivity cell

7.7 Nuclear-Radiation Detector
Ionization Chamber
Proportional Counter Tube
Geiger-Müller Counter Tube

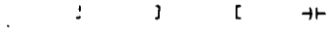
8. Semiconductor Devices

8.1 Semiconductor Device
Transistor
Diode

8.2 Element Symbols

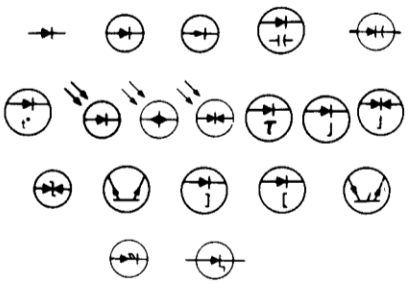


8.3 Special Property Indicators

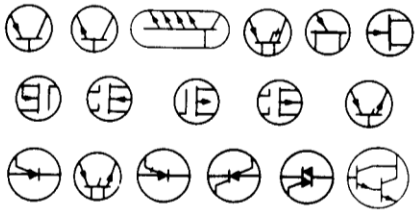


8.4 Rules for Drawing Style 1 Symbols

8.5 Typical Applications: Two-Terminal Devices



8.6 Typical Applications: Three- (or More) Terminal Devices

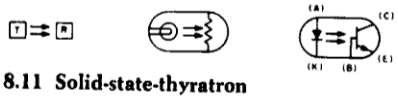


8.7 Photosensitive Cell

8.8 Semiconductor Thermocouple

8.9 Hall Element
Hall Generator

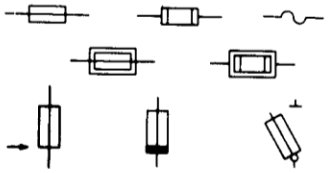
8.10 Photon-coupled isolator



8.11 Solid-state-thyratron

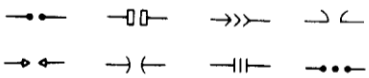
9. Circuit Protectors

9.1 Fuse

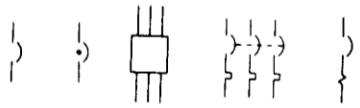


9.2 Current Arrester

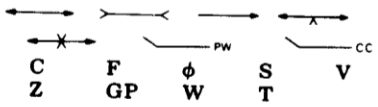
9.3 Lightning Arrester
Arrester
Gap



9.4 Circuit Breaker

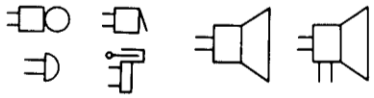


9.5 Protective Relay



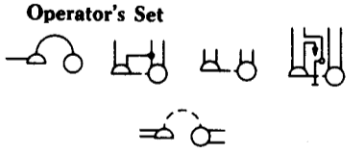
10. Acoustic Devices

10.1 Audible-Signaling Device



10.2 Microphone

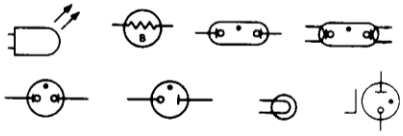
10.3 Handset
Operator's Set



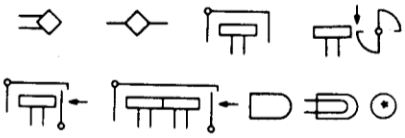
10.4 Telephone Receiver
Earphone
Hearing-Aid Receivers

11. Lamps and Visual-Signaling Devices

11.1 Lamp



11.2 Visual-Signaling Device

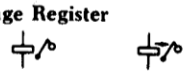


12. Readout Devices

12.1 Meter
Instrument

A	DB	I	OP	RF	VA
AH	DBM	INT	OSCG	SY	VAR
C	DM	μA	PH	TLM	VARH
CMA	DTR	UA	PI	t°	VI
CMC	F	MA	PF	THC	VU
CMV	G	NM	RD	TT	W
CRO	GD	OHM	REC	V	WH

12.2 Electromagnetically Operated
Counter
Message Register



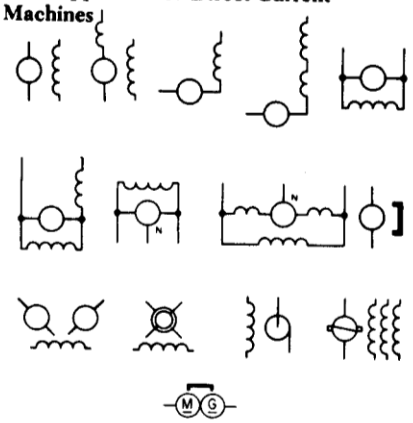
13. Rotating Machinery

13.1 Rotating Machine

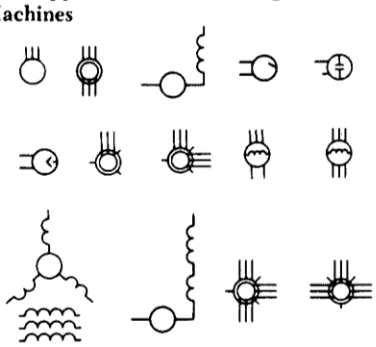
13.2 Field, Generator or Motor

13.3 Winding Connection Symbols

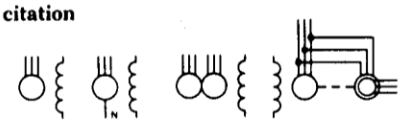
13.4 Applications: Direct-Current Machines



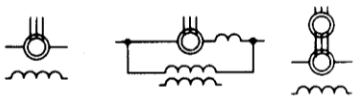
13.5 Applications: Alternating-Current Machines



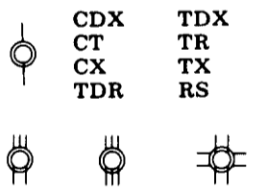
13.6 Applications: Alternating-Current Machines with Direct-Current Field Excitation



13.7 Applications: Alternating- and Direct-Current Composite



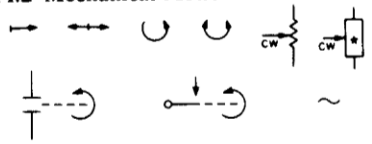
13.8 Synchro



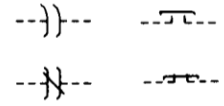
14. Mechanical Functions

14.1 Mechanical Connection
Mechanical Interlock

14.2 Mechanical Motion



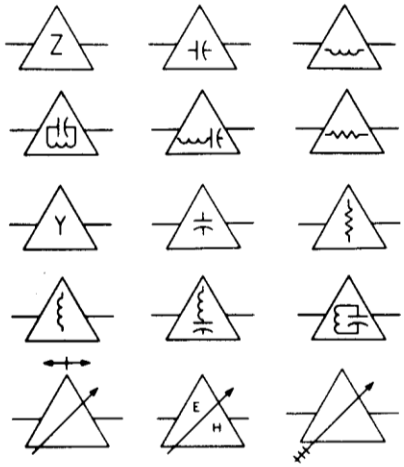
14.3 Clutch
Brake



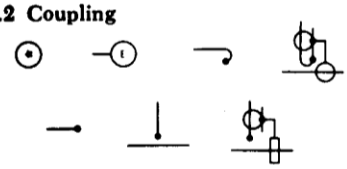
14.4 Manual Control

15. Commonly Used in Connection with VHF, UHF, SHF Circuits

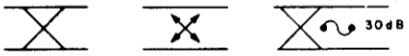
15.1 Discontinuity



15.2 Coupling



15.3 Directional Coupler



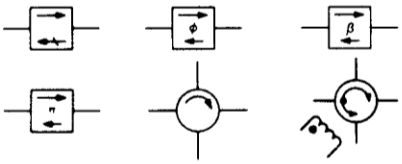
15.4 Hybrid
Directionally Selective
Transmission Devices

15.5 Mode Transducer

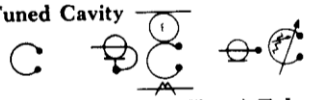
15.6 Mode Suppression

15.7 Rotary Joint

15.8 Non-reciprocal devices



15.9 Resonator
Tuned Cavity

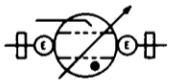


15.10 Resonator (Cavity Type) Tube

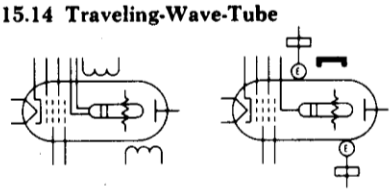
15.11 Magnetron

15.12 Velocity-Modulation (Velocity-Variation) Tube

15.13 Transmit-Receive (TR) Tube



15.14 Traveling-Wave-Tube

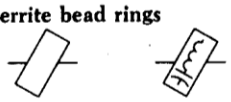


15.15 Balun

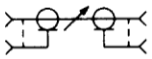
15.16 Filter

15.17 Phase shifter

15.18 Ferrite bead rings



15.19 Line stretcher



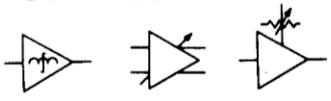
16. Composite Assemblies

16.1 Circuit assembly
Circuit subassembly
Circuit element

EQ	FL-BP	RG	TPR
FAX	FL-HP	RU	TTY
FL	FL-LP	DIAL	CLK
FL-BE	PS	TEL	IND
ST-INV			

16.2 Amplifier

BDG	EXP	PRE
BST	LIM	PWR
CMP	MON	TRQ
DC	PGM	



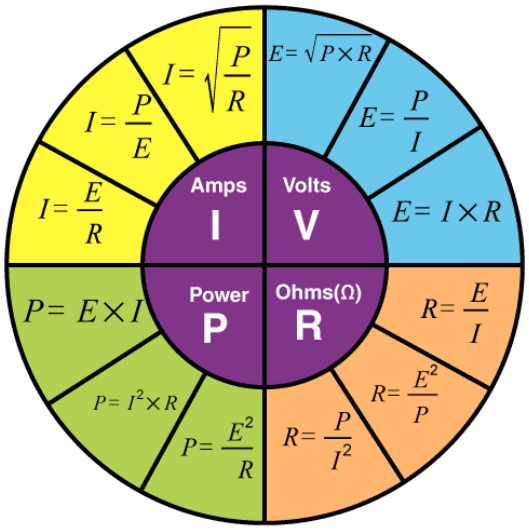
3. PVC Flexible Copper Wire/Cable Amp Capacity (Make: Havells)

Sq. mm	Amp	Sq. mm	Amp
0.5	4	10	46
0.75	7	16	62
1.0	11	25	80
1.5	15	35	102
2.5	19	50	138
4.0	26	70	214
6.0	35	95	254
10	46	120	300

4. Electrical Formulas:

These are the Basic Electrical Formulas followed by Ohm's Law. The variables used in these formulas are as follows:

$I = \frac{V}{R}$	$V = IR$	$R = \frac{V}{I}$
$P = VI$	$P = V^2 \div R$	$P = I^2R$



V = Voltage in Volts

I = Current in Amperes

R = Resistance in Ohms

P = Power in Watts

Quantity	Measuring Unit	Unit Symbol	Denoted By	Relation Formula
Charge	Coulomb	Q	Q	Q = I ÷ t
Capacitance	Farad	F	C	C = Q ÷ V
Inductance	Henry	H	L	L = (μ_0 N^2 A) ÷ l
Impedance	Ohm	Z	Z	Z = $\sqrt{(R^2 + X^2)}$
Conductance	Siemen or Mho	℧	G or S	G = 1 ÷ R
Frequency	Hertz	Hz	f	f = 1 ÷ T
Period	Second	S	T	T = 1 ÷ f

T = Time (Second)	Z = Impedance	**G** = Conductance
Q = Charge	C = Capacitance	**I = Current**
f = Frequency	S = Second	**V = Voltage**
H = Henry	**L** = Inductance	**R = Resistance**

House Wiring and Home Appliances

5. Electrical Reference for Copper & Aluminium wire/Cable Current:

- **Single Core**

1.1 KV PVC Insulated Cable (Ref: IS 1554) (Make: Havells) ,AYY/YY														
Conductor Area (Sq.mm)	Aluminium		Copper		Aluminum			Copper			Overall Dia	Overall Weight	Short Circuit Current Rating for 1Sec	
	Resi	React	Resi	React	Ground	Duct	Air	Ground	Duct	Air			Alu	Cu
	Ω/km	Ω/km	Ω/km	Ω/km	Amp	Amp	Amp	Amp	Amp	Amp	mm	Kg/Km	K.A	K.A
1cX4	8.8	0.158	5.52	0.015	—	—	—	39	38	35	9	150	0.30	0.46
1cX6	5.53	0.148	3.69	0.148	39	37	35	49	48	44	10	180	0.45	0.69
1cX10	3.7	0.138	2.19	0.138	51	51	47	65	64	60	11	230	0.76	1.15
1cX16	2.29	0.128	1.38	0.128	66	65	64	85	83	82	11	370	1.22	1.84
1cX25	1.44	0.12	0.87	0.12	86	84	84	110	110	110	12	460	1.90	2.88
1cX35	1.04	0.114	0.627	0.114	100	100	105	130	125	130	13	460	2.66	4.03
1cX50	0.77	0.11	0.463	0.11	120	115	130	155	150	165	15	610	3.80	5.75
1cX70	0.53	0.103	0.321	0.103	140	135	155	190	175	205	17	800	5.32	8.05
1cX95	0.38	0.101	0.231	0.101	175	155	190	220	200	245	19	1100	7.22	10.90
1cX120	0.3	0.096	0.184	0.096	195	170	220	250	220	280	21	1350	9.12	13.80
1cX150	0.25	0.094	0.149	0.094	220	190	250	280	245	320	23	1650	11.4	17.30
1cX185	0.2	0.092	0.12	0.092	240	210	290	305	260	370	25	2000	14.10	21.30
1cX240	0.15	0.09	0.091	0.09	270	225	335	345	285	425	27	2550	18.20	27.30
1cX300	0.12	0.088	0.074	0.088	295	245	380	375	310	475	30	3200	22.8	34.50
1cX400	0.094	0.088	0.059	0.088	325	275	435	400	335	550	34	4000	30.40	46.00
1cX 500	0.072	0.087	0.046	0.087	345	295	480	425	355	590	38	5100	38.00	57.50
1cX 630	0.056	0.086	0.037	0.086	390	320	550	470	375	660	43	6550	47.90	72.50
1cX800	0.044	0.083	0.031	0.083	450	380	610	530	425	725	46	8220	60.80	92.00
1cX1000	0.034	0.082	0.03	0.082	500	415	680	590	740	870	50	10150	76.00	115.0

- **Double Core**

1.1 KV PVC Insulated Cable (Ref: IS 1554) (Make: Havells) ,AYY/YY														
Conductor Area (Sq.mm)	Aluminium		Copper		Aluminum			Copper			Overall Dia	Overall Weight	Short Circuit Current Rating for 1Sec	
	Resi	React	Resi	React	Ground	Duct	Air	Ground	Duct	Air			Alu	Cu
	Ω/km	Ω/km	Ω/km	Ω/km	Amp	Amp	Amp	Amp	Amp	Amp	mm	Kg/Km	K.A	K.A

2cX1.5	21.72	0.126	14.5	0.126	18	16	16	23	20	20			0.3	0.4
2cX2.5	14.52	0.119	8.87	0.119	16	21	21	32	27	27			0.3	0.4
2cX4	8.89	0.116	5.52	0.116	32	27	27	41	35	35	14	320	0.30	0.46
2cX 6	5.53	0.11	3.69	0.11	40	34	35	50	44	45	16	370	0.45	0.69
2cX10	3.7	0.1	2.19	0.1	55	45	47	70	58	60	18	520	0.76	1.15
2cX16	2.29	0.097	1.38	0.097	70	58	59	90	75	78	18	550	1.22	1.84
2cX25	1.44	0.097	0.87	0.097	90	76	78	115	97	105	20	800	1.90	2.88
2cX35	1.04	0.097	0.627	0.097	110	92	99	140	120	125	22	980	2.660	4.03
2cX50	0.77	0.094	0.463	0.094	135	115	125	165	145	155	24	1300	3.800	5.75
2cX70	0.53	0.09	0.321	0.09	160	140	150	205	180	195	26	1700	5.320	8.05
2cX95	0.38	0.09	0.231	0.9	190	170	185	240	215	230	30	2300	7.220	10.9
2cX120	0.3	0.087	0.184	0.087	210	190	210	275	235	265	32	2750	9.120	13.8
2cX150	0.25	0.087	0.149	0.087	240	210	240	310	270	305	34	3350	11.40	17.30
2cX185	0.2	0.087	0.12	0.087	275	240	275	350	300	350	37	4150	14.10	21.28
2cX240	0.15	0.087	0.091	0.087	320	275	325	405	345	410	42	5350	18.20	27.60
2cX300	0.12	0.086	0.073	0.086	355	305	365	450	385	465	46	6650	22.80	34.50
2cX400	0.09	0.086	0.059	0.086	385	345	420	490	485	530	52	8450	30.40	46.00
2cX500	0.09	0.086	0.059	0.086	425	380	475	540	460	605	58	10700	38.00	57.50
2cX630	0.09	0.086	0.059	0.086	465	415	540	640	550	785	65	13800	47.90	72.55

- **Three Core**

1.1 KV PVC Insulated Cable (Ref: IS 1554) (Make: Havells) ,AYY/YY														
Conductor Area (Sq.mm)	**Aluminium**		**Copper**		**Aluminum**			**Copper**			**Overall Dia**	**Overall Weight**	**Short Circuit Current Rating for 1Sec**	
	Resi	**React**	**Resi**	**React**	**Ground**	**Duct**	**Air**	**Ground**	**Duct**	**Air**			**Alu**	**Cu**
	Ω/km	**Ω/km**	**Ω/km**	**Ω/km**	**Amp**	**Amp**	**Amp**	**Amp**	**Amp**	**Amp**	**mm**	**Kg/Km**	**K.A**	**K.A**

3cX1.5	21.72	0.126	14.5	0.126	16	14	13	21	17	17			0.3	0.4
3cX2.5	14.52	0.119	8.87	0.119	21	18	18	27	24	24			0.3	0.4
3cX4	8.89	0.116	5.52	0.116	28	23	23	36	30	30	15	360	0.304	0.460
3cX 6	5.53	0.11	3.69	0.11	35	30	30	45	38	39	16	450	0.456	0.690

3cX 10	3.7	0.1	2.19	0.1	46	39	40	60	50	52	18	620	0.760	1.150
3cX 16	2.29	0.097	1.38	0.097	60	50	51	77	64	66	19	740	1.220	1.840
3cX 25	1.44	0.097	0.87	0.097	76	63	70	99	81	90	22	1100	1.900	2.880
3cX 35	1.04	0.097	0.627	0.097	92	77	86	120	99	110	24	1400	2.660	4.030
3cX 50	0.77	0.094	0.463	0.094	110	95	105	145	125	135	27	1800	3.800	5.750
3cX 70	0.53	0.09	0.321	0.09	135	115	130	175	150	165	30	2500	5.320	8.050
3cX 95	0.38	0.9	0.231	0.09	165	140	155	210	175	200	34	3300	7.220	10.90
3cX 120	0.3	0.087	0.184	0.087	185	155	180	240	195	230	36	4000	9.120	13.80
3cX 150	0.25	0.087	0.149	0.087	210	175	205	270	225	265	40	4900	11.40	17.30
3cX 185	0.2	0.087	0.12	0.087	235	200	240	300	255	305	44	6065	14.10	21.30
3cX 240	0.15	0.087	0.091 2	0.087	275	235	280	345	295	355	50	7850	18.20	27.60
3cX 300	0.12	0.086	0.074	0.086	305	260	315	385	335	400	55	9750	22.80	34.50
3cX 400	0.09	0.086	0.059	0.086	335	290	375	425	360	435	62	12400	30.40	46.00
3cX 500	0.09	0.086	0.059	0.086	370	320	425	470	390	520	70	15800	38.00	57.50
3cX 630	0.09	0.086	0.059	0.086	405	350	480	555	470	675	78	20200	47.90	72.50

- **3.5 Core**

1.1 KV PVC Insulated Cable (Ref: IS 1554) (Make: Havells) ,AYY/YY														
Conductor Area (Sq.mm)	Aluminium		Copper		Aluminum			Copper			Overall Dia	Overall Weight	Short Circuit Current Rating for 1Sec	
	Resi	React	Resi	React	Ground	Duct	Air	Ground	Duct	Air			Alu	Cu
	Ω/km	Ω/km	Ω/km	Ω/km	Amp	Amp	Amp	Amp	Amp	Amp	mm	Kg/Km	K.A	K.A
3.5X16	1.44	0.097	0.73	0.097	70	65	62	99	81	90			1.8	2.5
3.5X25	0.77	0.094	0.387	.0.094	76	63	70	99	81	90	23	1250	1.90	2.88
3.5X35	0.53	0.09	0.268	0.09	92	77	86	120	99	110	26	1600	2.66	4.03
3.5X50	0.38	0.09	0.193	0.09	110	95	105	145	125	135	28	2100	3.80	5.75
3.5X70	0.3	0.087	0.153	0.087	135	115	130	175	150	165	32	2850	5.32	8.05
3.5X95	0.2	0.087	0.099	0.087	165	140	155	210	175	200	37	3800	7.22	10.90
3.5X120	0.15	0.087	0.075	0.087	185	155	180	240	195	230	40	4750	9.12	13.80
3.5X150	0.12	0.086	0.06	0.086	210	175	205	270	225	265	44	5650	11.40	17.30
3.5X185	0.09	0.086	0.047	0.086	235	200	240	300	255	305	48	7050	14.10	21.30
3.5X240	0.08	0.085	0.046	0.085	275	235	280	345	295	355	55	9150	18.20	27.60
3.5X300	0.08	0.085	0.046	0.085	305	260	315	385	335	400	60	11300	22.80	34.50
3.5X400	0.08	0.084	0.045	0.084	335	290	375	425	360	435	68	14300	30.40	46.00
3.5X500	0.08	0.084	0.045	0.084	370	320	425	470	390	520	77	18300	38.00	57.50
3.5X630	0.08	0.084	0.045	0.084	405	350	480	555	470	675	87	23300	47.90	72.50

6. MCB Selection According to House Appliances

Appliance	Capacity / watt	MCB Rating	MCB Class
Air Conditioner	1.0 Tone	10A	C Class
	1.5 Tone	16A	C Class
	2.0 Tone	20A	C Class
Freeze	165 Liter	3A	C Class
	350 liter	4A	C Class
Washing Machine	300Watt	2A	C Class
	1300Watt	8A	C Class

Room Heater	**1000Watt**	**6A**	**B Class**
	2000Watt	**10A**	**B Class**
Iron	**750Watt**	**6A**	**B Class**
	1250Watt	**8A**	**B Class**
Toaster	**1200Watt**	**8A**	**B Class**
	1500Watt	**10A**	**B Class**
Water Heater	**1000Watt**	**6A**	**B Class**
	2000Watt	**10A**	**B Class**
	3000Watt	**16A**	**B Class**
	6000Watt	**32A**	**B Class**

7. How to select MCB for House wiring & types of MCB:

MCB stands for "**Miniature Circuit Breaker**", and is an electrical device used to protect electrical operations. MCB is installed in the electrical panel, and it protects the power line from fault, over current, and short circuit. The main purpose of MCB is to switch off the power supply when there is any fault or signal in the electrical operation, thereby ensuring the safety of electrical operation.

MCBs are used in homes, commercial places, and industrial sites to ensure protection against overload and short circuit that occur during electrical operations. If there is an over current in any power line, the MCB switches it off immediately, thereby shutting off the power immediately and ensuring safety that no damage occurs.

Here's a basic overview of how MCBs handle overload and short circuit conditions and how to understand MCB specifications:

➢ Overload Protection:

- An overload occurs when the current flowing through a circuit exceeds its rated capacity for an extended period.

- MCBs are equipped with thermal-magnetic tripping mechanisms to protect against overloads.

- The thermal element inside the MCB responds to prolonged overcurrent by heating up, causing the breaker to trip and disconnect the circuit.

- Overload protection is crucial for preventing overheating and damage to wiring, appliances, and equipment.

➢ Short Circuit Protection:

- A short circuit occurs when there is a direct, low-resistance path between the live and neutral or ground wires, causing a sudden surge of current.
- MCBs use magnetic tripping mechanisms to quickly respond to short circuits.

- The magnetic element inside the MCB detects the rapid increase in current characteristic of a short circuit and trips the breaker almost instantly to isolate the fault.

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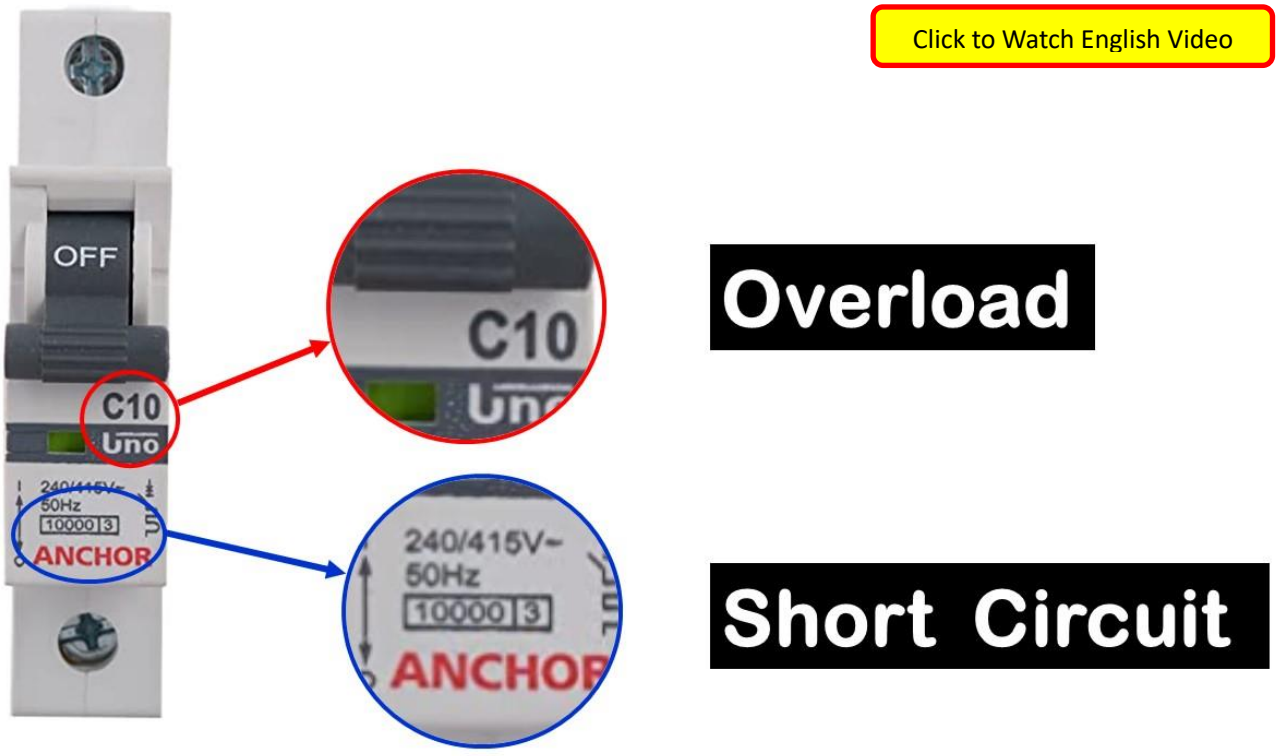
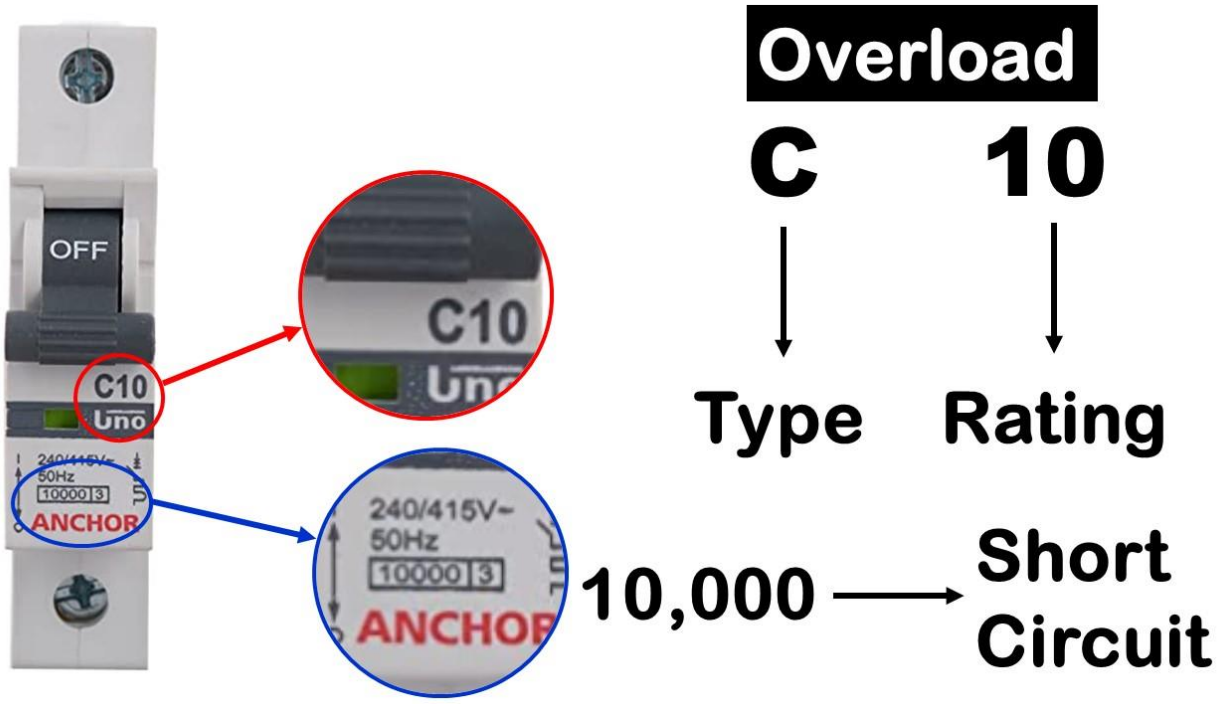


➢ Understanding MCB Specifications:

- MCBs are rated based on their current-carrying capacity (measured in amperes, or amps) and their tripping characteristics.

- The rated current of an MCB indicates the maximum continuous current it can safely carry without tripping under normal operating conditions.
    - Example: C10
    - Meaning: The "C" indicates the tripping characteristic (in this case, Type C), and "10" represents the rated current in amperes (A).
- MCBs also have a tripping curve, which shows how quickly they respond to over currents. Common tripping curves include B, C, and D types, each suited for different applications with varying levels of inrush current tolerance.
    - Example: B, C, D
    - Meaning: Different types of MCBs have distinct tripping characteristics.
- **Breaking Capacity (Icn or Ics):**
    - **Example:** 10 kA
    - **Meaning:** The breaking capacity represents the maximum fault current (in kilo-amps, kA) that the MCB can safely interrupt without sustaining damage.
    - **Interpretation:** A breaking capacity of 10 kA means the MCB can safely handle fault currents up to 10,000 amps, protecting the circuit and connected devices from damage in case of a short circuit.



All Type of MCB

B Type

C Type

D Type

K Type

Z Type

Type	Tripping Current	Operating Time
Type B	3 – 5 times of FLC	0.04 to 13 Sec
Type C	5 – 10 times of FLC	0.04 to 5 Sec
Type D	10 – 20 times of FLC	0.04 to 3 Sec
Type K	8 - 12 times of FLC	Less than 0.1 Sec
Type Z	2 – 3 times of FLC	Less than 0.1 Sec

B Type

3 – 5 times of FLC

0.04 to 13 Sec

Where there is no Surge Current

Resistive Load (Light, Heater), Domestic Applications

C Type

5 – 10 times of FLC

0.04 to 5 Sec

Where there is Low Surge Current

Low HP Motor, AC, Washing Machine, Water Pump

D Type

10 – 20 times of FLC

0.04 to 3 Sec

High Starting Current - Motor

K Type

8 - 12 times of FLC

Less than 0.1 Sec

Battery Charger, X Ray Machines
Welding, Transformer

Z Type

2 – 3 times of FLC

Less than 0.1 Sec

Highly Sensitive Device

Semi Conductor, Control Circuit, SCR Diode, MOSFET, Power Electronics

Friends, generally for domestic purposes we use Type-B and Type-C MCB.

Type B

It can be used in most home appliances. Like can be used for lights, bulbs, Switchboards, fans, TVs, room heaters, irons, toasters, water heaters, etc.

Type C

It can be used in most home appliances like submersible Starter, tullu pumps, air conditioners, fridges, washing machines, stabilizers, printers, etc.

Why does MCB trip again and again?

There can be two to three possibilities, either one of the neutral or phase wires has melted due to excessive load on the joint and somewhere the phase or neutral wires are touching each other. If the wire starts heating due to overloaded running of the connected device for a long time and the current reaches 2-3 times of the rated current, it will trip. Also, selection of wrong type of MCB causes of tripping, like motor requires high starting current so you have to select Type-C MCB for it and if you have selected Type-B MCB then it will take high starting current, there are frequent trips during.

MCB Brands (Manufacturers) in India and World

There are many local and global manufacturers available in the Indian market with variation in design and cost, however the following products of MCB are good and best in customer support like Havells, Siemens, L&T, ABB, Schneider, Polycab, Legrand, Sigma, Hager,etc.

Friends, keep in mind, I am not promoting any brand here. I am just giving you suggestion. If you want, you can buy some of these good brands for your home.

Proper MCB Rating & Type Selection for Motor

Step 1: Determine the Motor Full Load Current (FLC)

Step 2: Calculate the MCB Ampere Rating

Step 3: Determine the Type of MCB

Step 1: Determine the Motor Full Load Current (FLC)

The Full Load Current (FLC) of an induction motor is the maximum current that the motor is designed to draw under normal operating conditions. This information is typically available from the motor's nameplate or manufacturer's data sheet.

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FLC of 10 Amps

Step 2: Calculate the MCB Ampere Rating

MCB Ampere Rating = 1.25 x FLC or 1.5 x FLC

MCB Ampere Rating = 1.25 x 10 Amp = 12.5 Amp

MCB Ampere Rating = 1.5 x 10 Amp = 15 Amp

Step 3: Determine the Type of MCB

C Type MCB

MCB Rating 15 Amp

C Type MCB with 16 Amp Rating

B Type

C Type

D Type

K Type

Z Type

8. What is the MCB, MCCB, ELCB/RCCB, RCBO, AFDD/AFCI

MCB Breaker

Friends, you have understood yourself well in detail about MCB. The rating of MCB comes from 0.5 Amp to 100 Amp.

use of MCB

It protects us and the equipment by automatically tripping in case of overload or short circuit faults. For this reason, it is also called Circuit Breaker

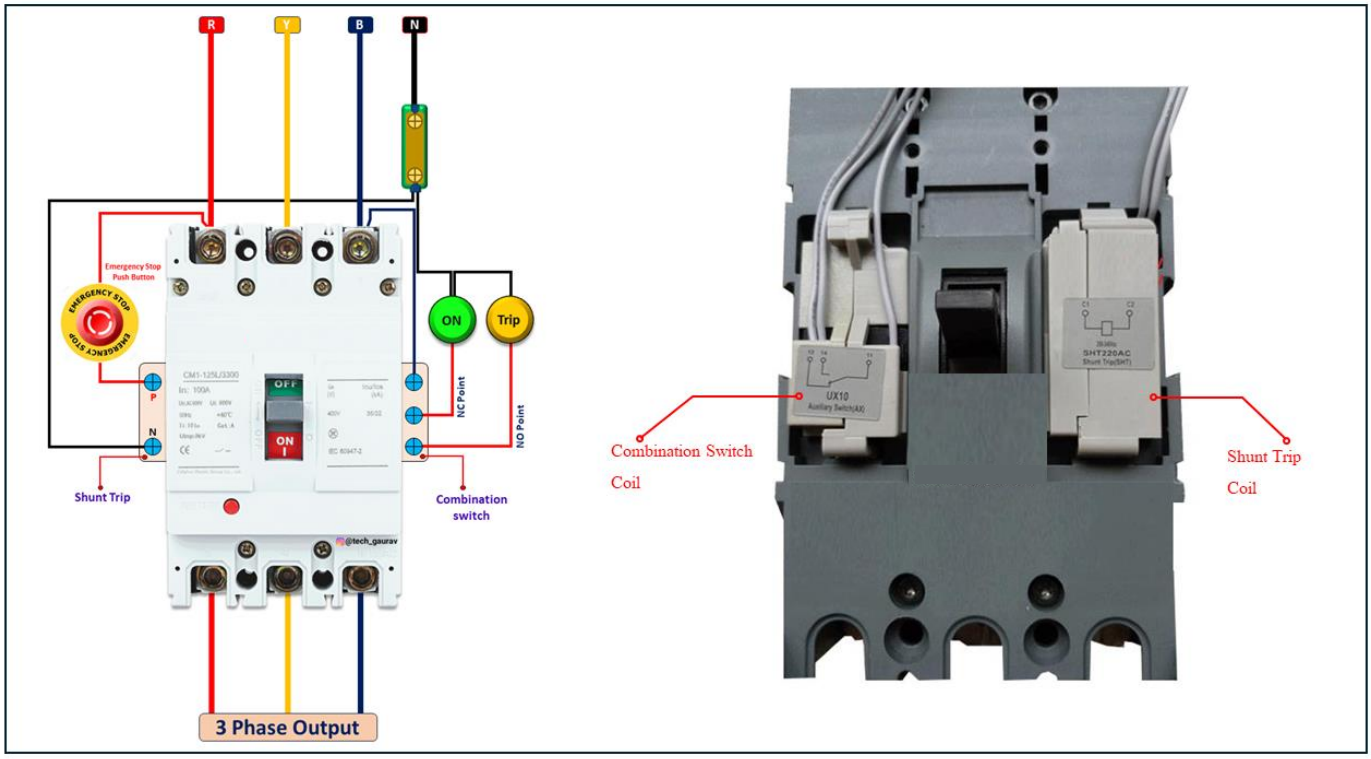
MCCB Breaker

You understand that this is the elder brother of MCB, MCCB. Its full form is a Molded Case Circuit Breaker. It has been made by updating MCB, meaning it works in the same way as MCB. It protects the circuit from overload and short circuits. In this, a port is provided to adjust the current. And its rating is more than 63 Amp.

Another specialty of MCCB is that we get the option to install two coils inside it, with the help of which coil (Shunt Trip) we can trip the MCCB remotely. With the help of a second coil (Combination Switch), we can turn on our indicator in feedback or can also send feedback to PLC or Relay. MCCB is also used for automation.

I am showing you sme MCCB Photos and MCCB automation-related images below.

MCCB Use For Automation and Heavy Load



ELCB/RCCB Breaker

ELCB (Earth-leakage circuit breaker) And RCCB (Residual current circuit breaker) Both of these are the names of the same device. It is a current sensing device. It is an important safety measure that protects the electrical circuits. It is capable of sensing electrical leakage currents and protecting low-voltage circuits. The operating principle of RCCB is like ELCB (Earth Leakage Circuit Breaker), although ELCB is the oldest version.

The main function of ELCB/RCCB is to sense current leakage and protect against electric shock. You can say that the main reason for using it is human safety.

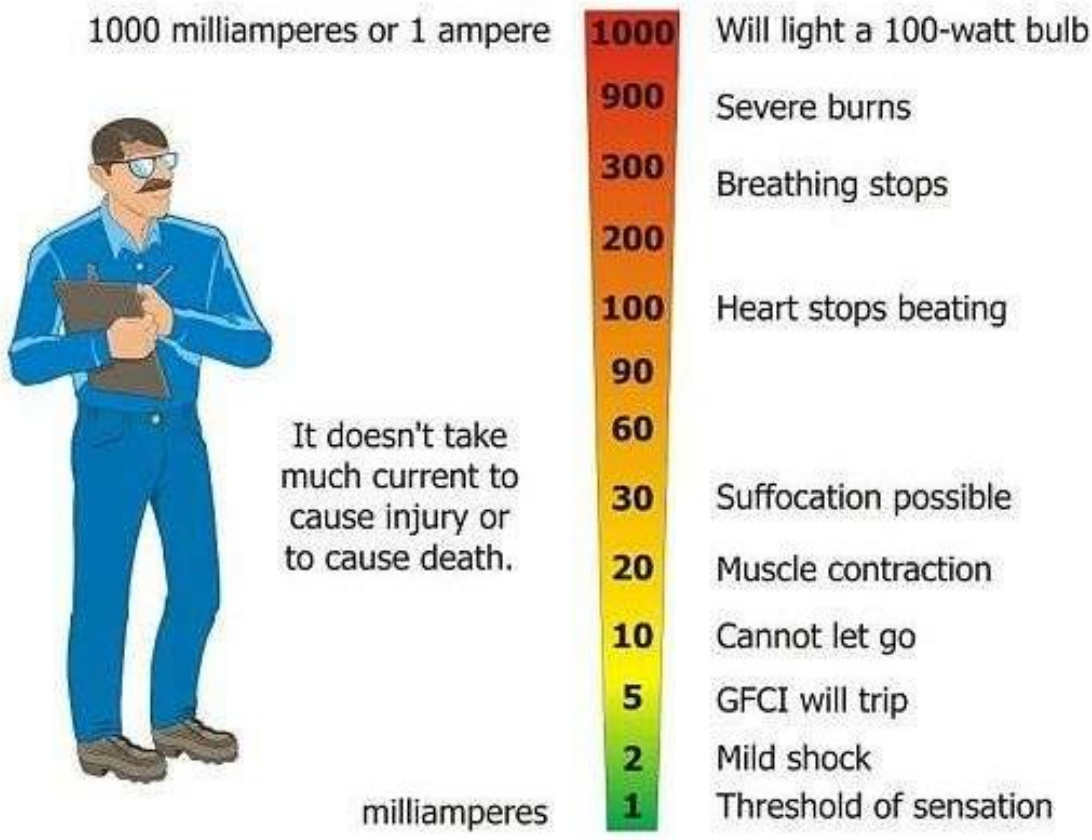
It is widely used for protection against leakage currents of 30mA, 100mA, and 300mA. This is a highly effective form of shock protection.

RCCB It ensures 100% detection of leakage current and is available to sense AC as well as DC leakage current.

RCCB has no connection with earth wire and hence it can trip when both the currents (phase and neutral) are different and it withstands till both the currents are equal.

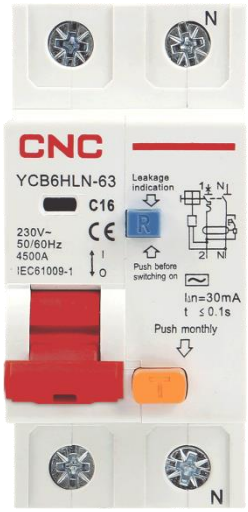
Now a day ELCB is Not Available in Market.

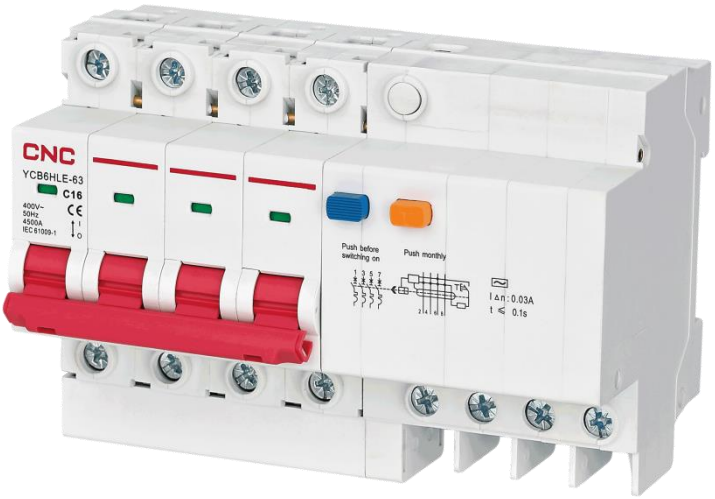
I have shown you a chart below which is the chart of ampere. There are 1000 milliamperes in 1 ampere. I have tried to show you how much current our body can withstand. I would request all of you to use RCCB whenever you make a connection anywhere.



RCBO Breaker

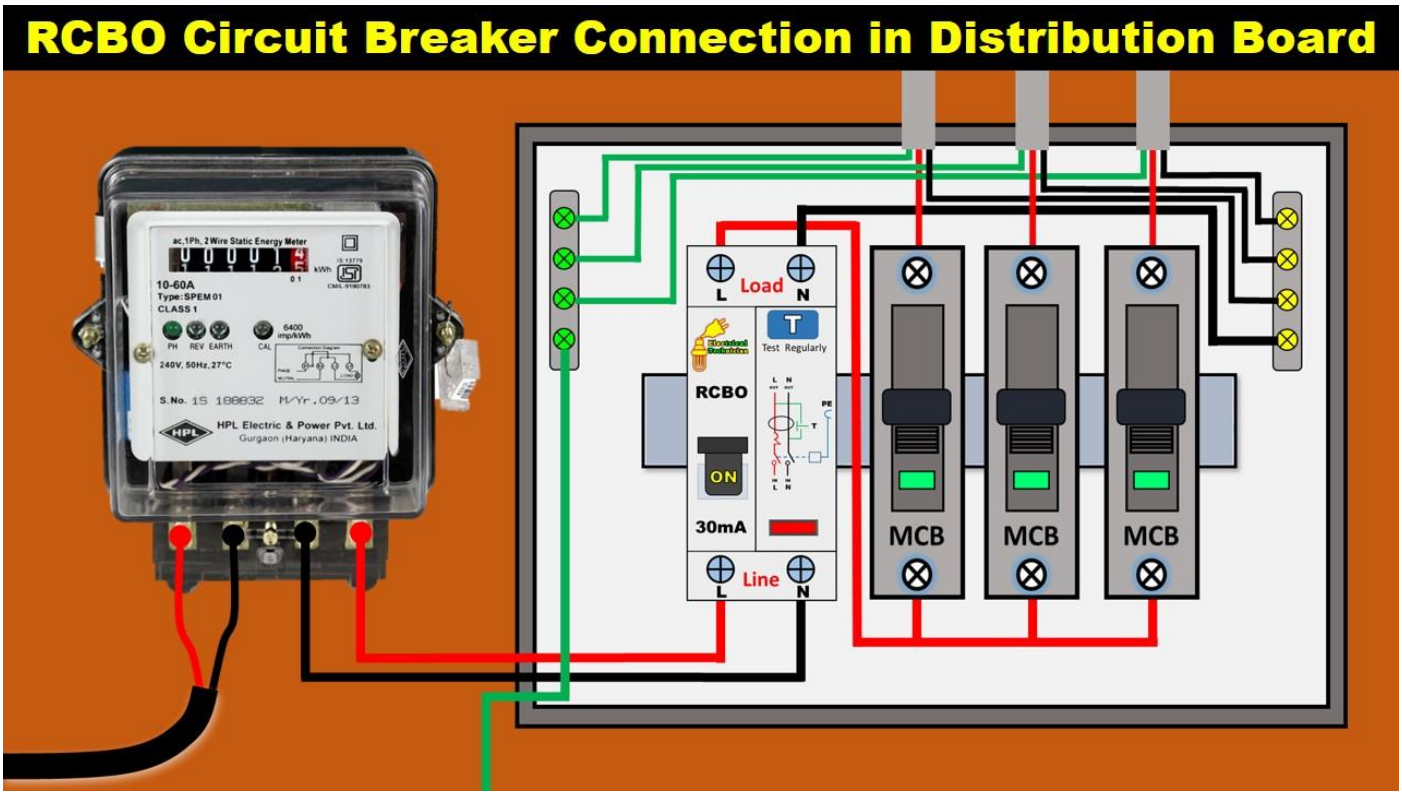
Its full form is a Residual Current Circuit Breaker with Over current protection. Friends, this is a type of advanced circuit breaker. In this, we also get short circuit protection and overload protection. It can do the work of both MCB and RCCB simultaneously. If we install the RCCB breaker then we do not need to install MCB and RCCB. I am sharing some photos with you. By looking at these you can find out what this breaker looks like.





If you want to do main distribution board wiring by using RCB and MCB then you can do connection as per this circuit diagram.

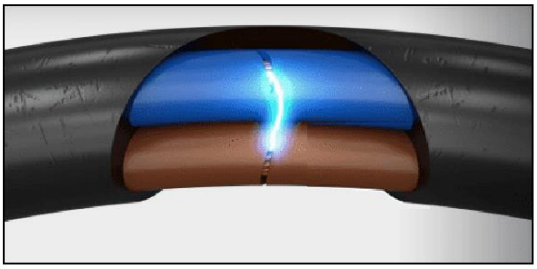
You can Click on this image to Learn the wiring of RCBO by watching video



AFDD/AFCI Breaker

Arc fault detection device (AFDD), also called arc fault circuit interrupter (AFCI), is a type of circuit breaker to protect against arc fault. Many times, when we drill with a drill machine, many wires get cut a little and the wire becomes thin at that point or a wire gets cut a little due to being pressed by some metal, then the current passes but we do not realize it. That our wire has been cut somewhere. Where the wire remains very thin, there is generated heat and after some time due to heating, it starts burning and this fire later becomes very big and houses and shops or showrooms also get burnt. To avoid such problems, the (AFDD) breaker trips the circuit immediately.

I am sharing some photos with you. By looking at these you can find out what this breaker looks like.



You can Click on this two link to Learn More About this Device by watching video

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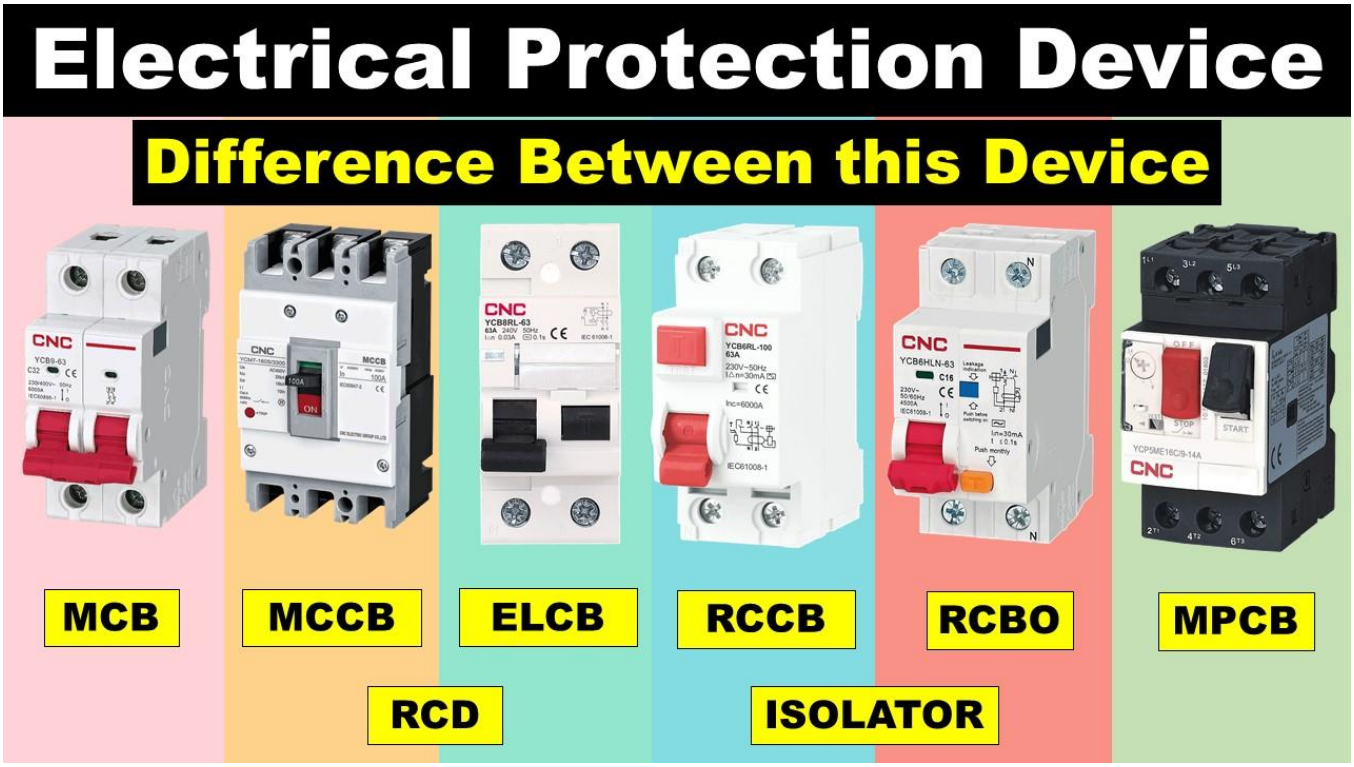

9. House wiring:

Friends, house wiring is a very easy task. I hope that if you have come to this page then you must have read all the above pages thoroughly, how to select MCB for house wiring. You must have learned properly how to select wires, yet here I show you a chart that you can use for wire selection in-house wiring.

Friends, here I am showing you a basic chart that I have made with a lot of hard work. By looking at this chart you can do wiring in any house and do the wiring.

Electrical Wiring Wire Colour Code as per India

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Red Wire For Phase

Black Wire For Neutral

Green Wire For Earthing

Three Phase Line (L1)	
Three Phase Line (L2)	
Three Phase Line (L3)	
Three Phase Neutral (N)	
Three Phase Protective Earth or Ground (PE)	

Function	*India Color Code (Old)*	*India Color Code (New)*
Single Phase Line		
Single Phase Neutral		
Single Phase Protective Ground or Earth		

In house wiring proper wire size for earthing and neutral

Location	Wire size in sq. mm
Switch Board	1.0
Main Distribution Board	4.0, 6.0, 10
Home Appliances	2.5

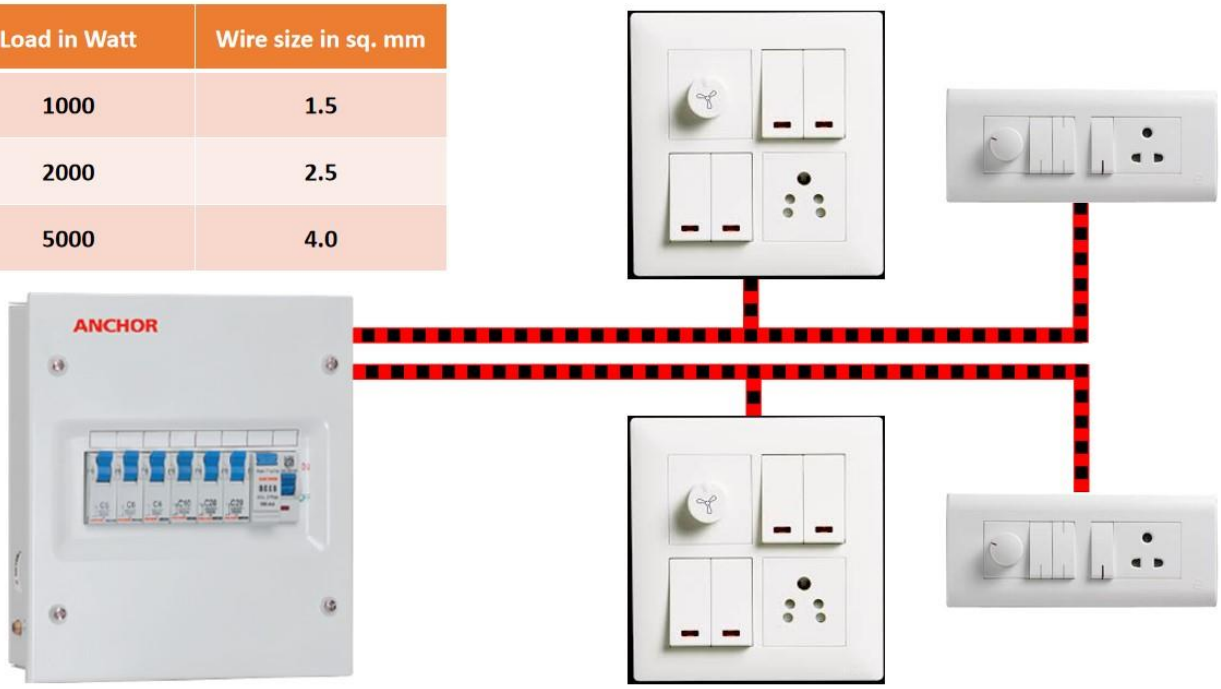
Watt	Wire size in sq. mm
1500	1.5
4500	2.5
8000	4.0

Energy meter to Distribution board wiring proper wire size

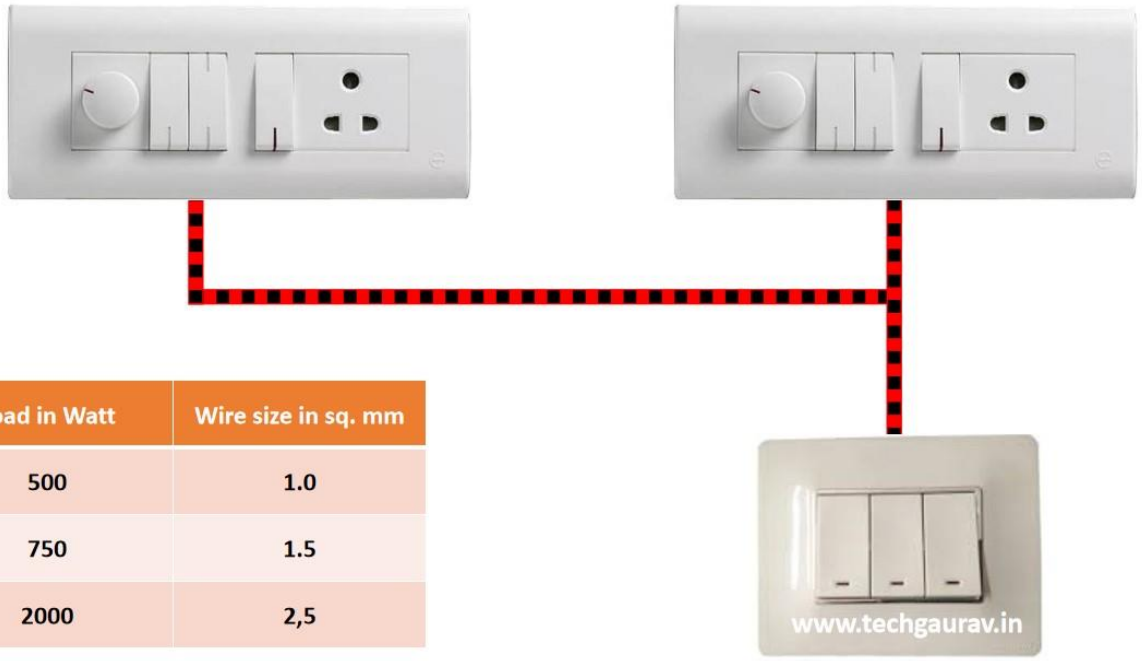
Load in Watt	Wire size in sq. mm
4000	4.0
6000	6.0
10,000	10

Distribution board to Room board wiring wire size

Load in Watt	Wire size in sq. mm
1000	1.5
2000	2.5
5000	4.0

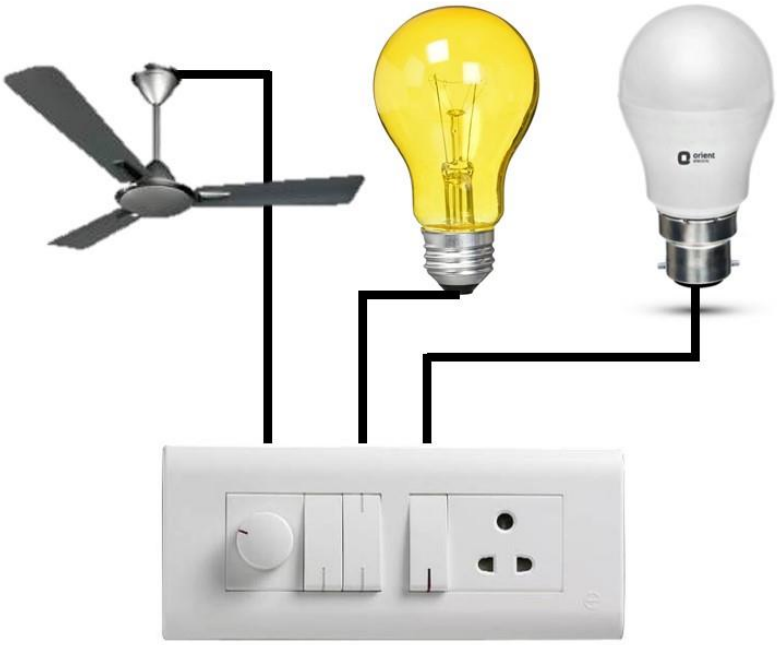


Wire loop from One Switchboard to Another Switchboard



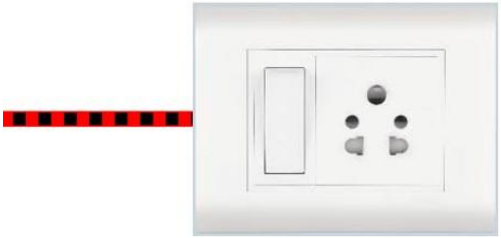
Load in Watt	Wire size in sq. mm
500	1.0
750	1.5
2000	2,5

Wiring from Switchboard to home appliance with proper wire



Load in Watt	Wire size in sq. mm
250	0.5
375	0.75
500	1.0
750	1.5

In-house wiring Power Socket wire Size



Load in Watt	Wire size in sq. mm
1500	1.5
4500	2.5
6000	4.0

Wire Size for Home Appliances

Home Appliances	Wire size in sq. mm
Heater	1.5
Geyser	1.5
1.5 Ton AC	2.5
2.0 Ton AC	4.0
Washing Machine	2.5

Friends, I hope from all of you that according to the chart given above, you can select the size of wire for house wiring. Now I will show you how to make a distribution board, which is the first important thing in house wiring which is called the main panel.

Friends, to make the main panel, you should know the connecting load of your house. Even if you do not know the connecting load of your house, there is nothing to worry about. I am sharing with you a list which contains all the electrical equipment used in the house.

According to the list, you can also see which equipment has how many watts and you can find out the connecting load of your house.

Sr. No.	Home Appliances Name	Power Rating in watt
1	AIR CONDITIONER 1 ROOM	1100
2	AIR CONDITIONER CENTRAL	5000
3	AMPLIFIER	20-70
4	AUTOMATIC DEFROST FRIDGE	700
5	BLENDER	300
6	BOILER	1200-2000
7	CD PLAYER	10
8	CLOCK	1
9	CLOCK RADIO	1
10	CLOTHES DRYER	2000-4000
11	CLOTHES DRYER GAS HEATED	300-400

Sr. No.	Home Appliances Name	Power Rating in watt
12	CLOTHING IRON	1100
13	COFFEE MACHINE/ ESPRESSO MACHINE	1000-1500
14	COFFEE MAKER	800
15	COMPUTER DESKTOP VARIANT	50-200
16	COMPUTER MONITOR LCD OR LED	50
17	CURLING IRON	90
18	DEEP FAT FRYER	1500
19	DISHWASHER	1200-1500
20	DRILL	250-1000
21	DVD PLAYER	15
22	ELECTRIC BLANKET	100-200

Sr. No.	Home Appliances Name	Power Rating in watt
23	ELECTRIC KETTLE	2000
24	ELECTRIC SHAVER	15-20
25	FAN ATTIC	370
26	FAN CEILING OR CIRCULATING	40-80
27	FAN FOR TABLE	40-60
28	FAN PORTABLE	100
29	FAN ROLLAWAY	170
30	FAN WINDOW	200
31	FLOOR POLISHER	305
32	FOOD BLENDER	300
33	FOOD MIXER	127

Sr. No.	Home Appliances Name	Power Rating in watt
45	HEDGE TRIMMER	450
46	HOT PLATE	1200
47	JACUZZI/SPA PUMP	1300
48	LAPTOP	20-100
49	MICROWAVE	600-1500
50	OVEN	2000-3000
51	POPCORN POPPER	250-1400
52	PORTABLE HEATER	1500
53	POWER SHOWER	240
54	PRINTER	100
55	ROASTER	1500

5

Sr. No.	Home Appliances Name	Power Rating in watt
34	FREEZER NEW	135
35	FREEZER OLD	330
36	FRIDGE NEW	60
37	FRIDGE OLD	115
38	FRYING PAN	1200
39	FURNACE BLOWER	300-1000
40	GARAGE DOOR OPENER	350
41	GARBAGE DISPOSAL	445
42	HAIR BLOW DRYER	1000-1500
43	HEAT LAMP	250
44	HEATING PAD	65

4

Sr. No.	Home Appliances Name	Power Rating in watt
56	ROUTER WIFI	24
57	SATELLITE DISH	30
58	SEWING MACHINE	75-100
59	SINK WASTE DISPOSAL	450
60	SLOW COOKER	200
61	STOCK TANK HEATER	100
62	STRIMMER	300-400
63	SUBMERSIBLE POOL PUMP	400
64	TELEVISION, REAR PROJECTION	200
65	TOASTER	800-1500
66	TOASTER OVEN	1000-1500

Sr. No.	Home Appliances Name	Power Rating in watt
67	TOOTHBRUSH	1
68	TV LCD	100-250
69	TV LCD 19 INCH	50
70	TV LCD 32 INCH	55
71	TV LCD 45 INCH	133
72	TV LED 19 INCH	50
73	TV LED 32 INCH	61
74	TV LED 45 INCH	88
75	TV PLASMA 19 INCH	100
76	TV PLASMA 32 INCH	119
77	TV PLASMA 45 INCH	288

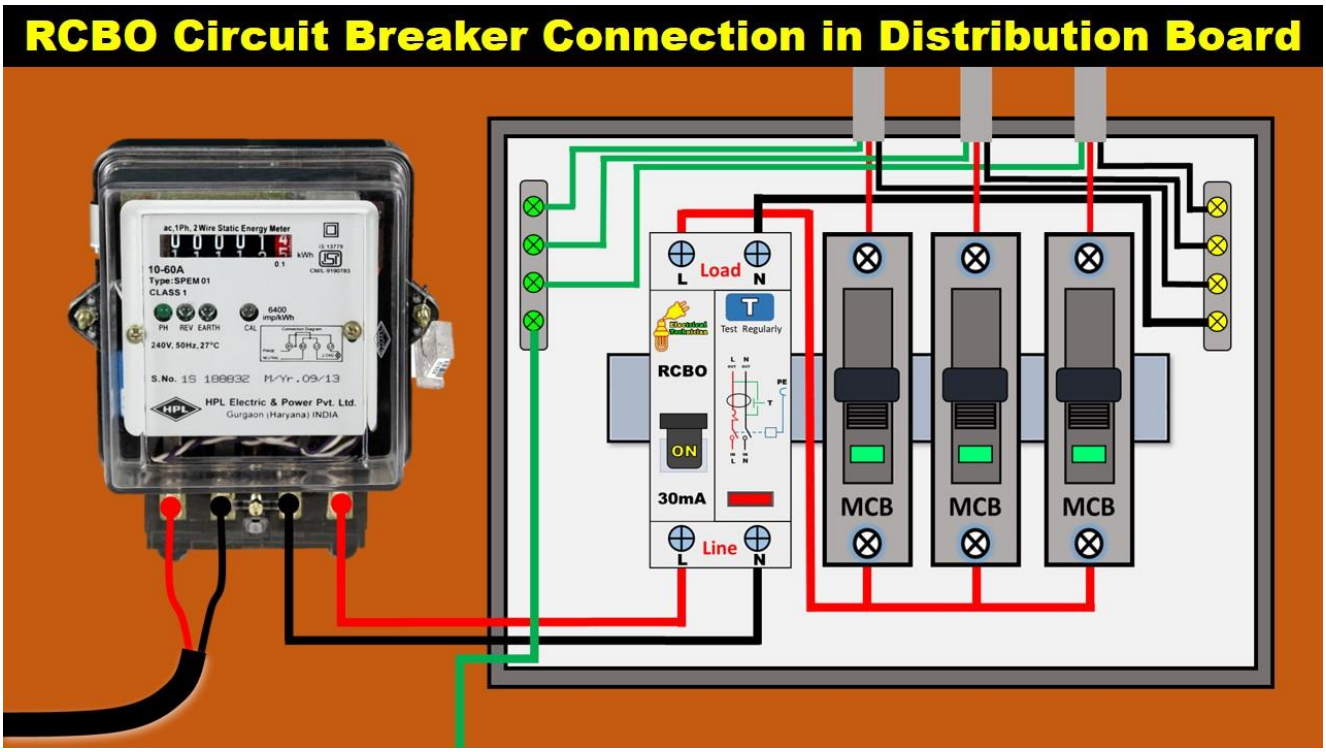
Sr. No.	Home Appliances Name	Power Rating in watt
78	VACUUM CLEANER	200-700
79	WAFFLE IRON	1200
80	WASHING MACHINE	500
81	WATER HEATER	2500
82	WATER HEATER WITH QUICK RECOVERY	4500

Friends, I hope that now neither will you face any problem in selecting the size of the wire nor will you face any problem in finding out the connecting load of the house.

To do the wiring, we will take wires from the main board and install an MCB box on one side of the wall outside or inside the room, in which a double pole main MCB and RCCB will be installed as per the load rating of that room. From where the lights of the entire room will be cut off, we will install a separate single pole MCB for all the power sockets we have.

Click to Watch Hindi

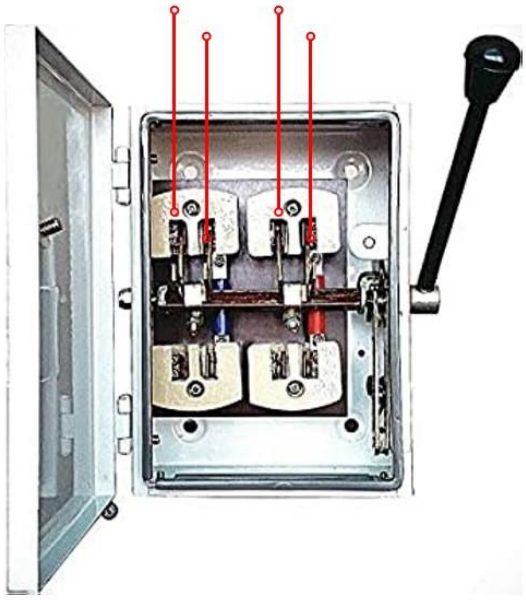
Click to Watch English Video



Friends, to make a main board, we will have to take a changeover, ampere meter, voltmeter, and indicator. We will use the changeover inside the main board because in the future, if there is a wedding ceremony or any other function in the house, the generator will come, and we will use the output supply of the generator. Can connect inside changeover. If you must work on the lights anywhere in the house in the future, then you can cut off the lights with the changeover.

Friends, there are two types of changeovers. You can use any changeover, one mechanically and one electrically. Here I am showing you photos of both the changeovers. Which is electrical changeover, it automatically shifts to the other supply as soon as the light is cut.

2 Wire for the Main Supply and 2 wires for the Generator/UPS Supply



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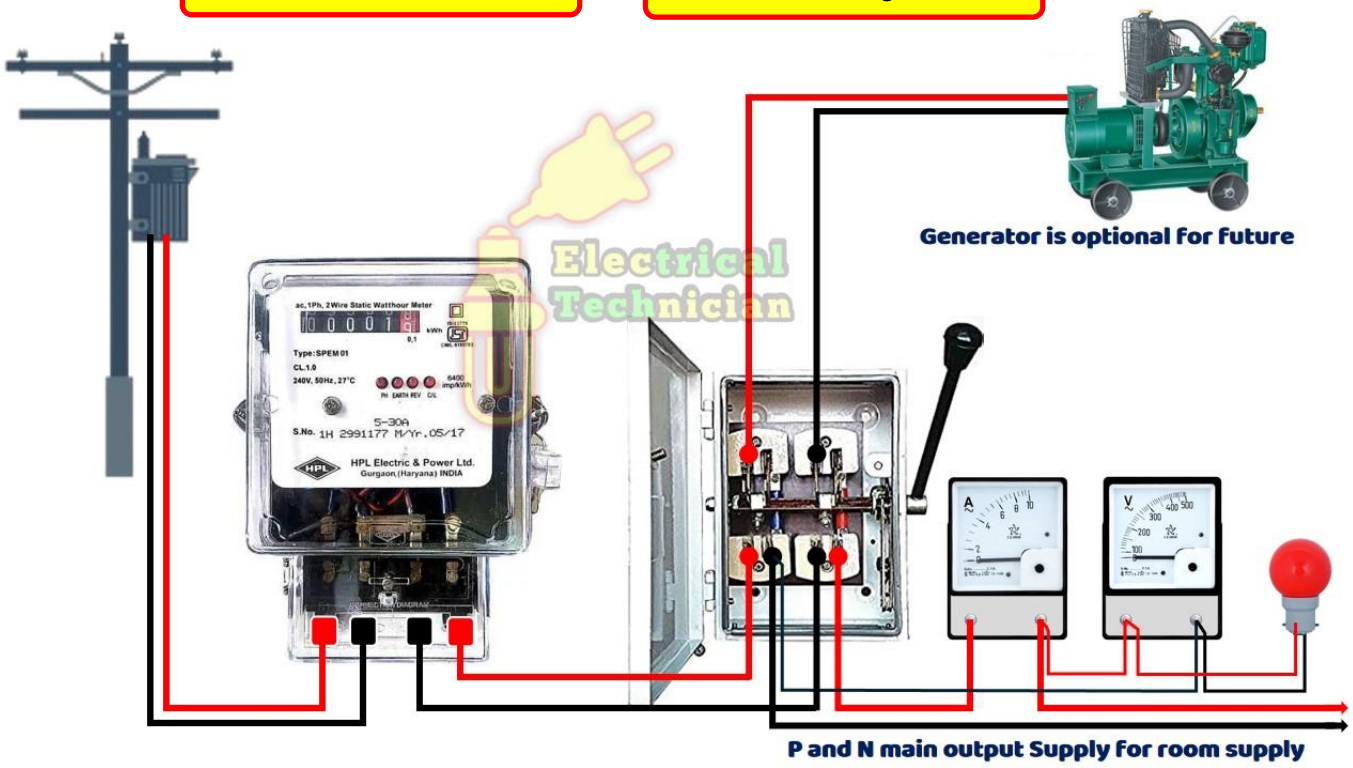
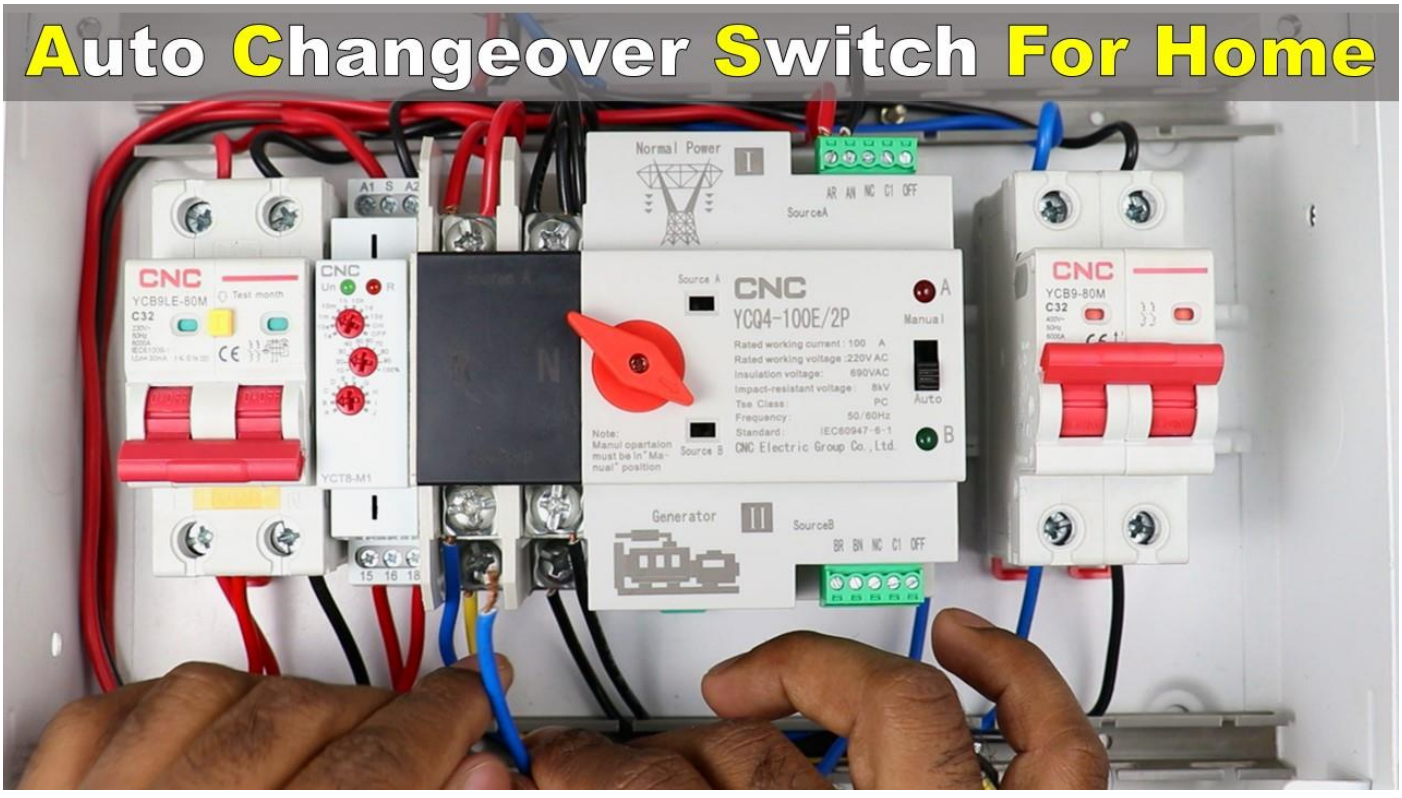


Here you must have noticed that I have taken the supply from above the terminal for a bulb and voltmeter. I have not made any cut anywhere in the wire. In the same way, friends, you also must make the connection. Do not make any cuts anywhere inside the wire. I have a request from you.

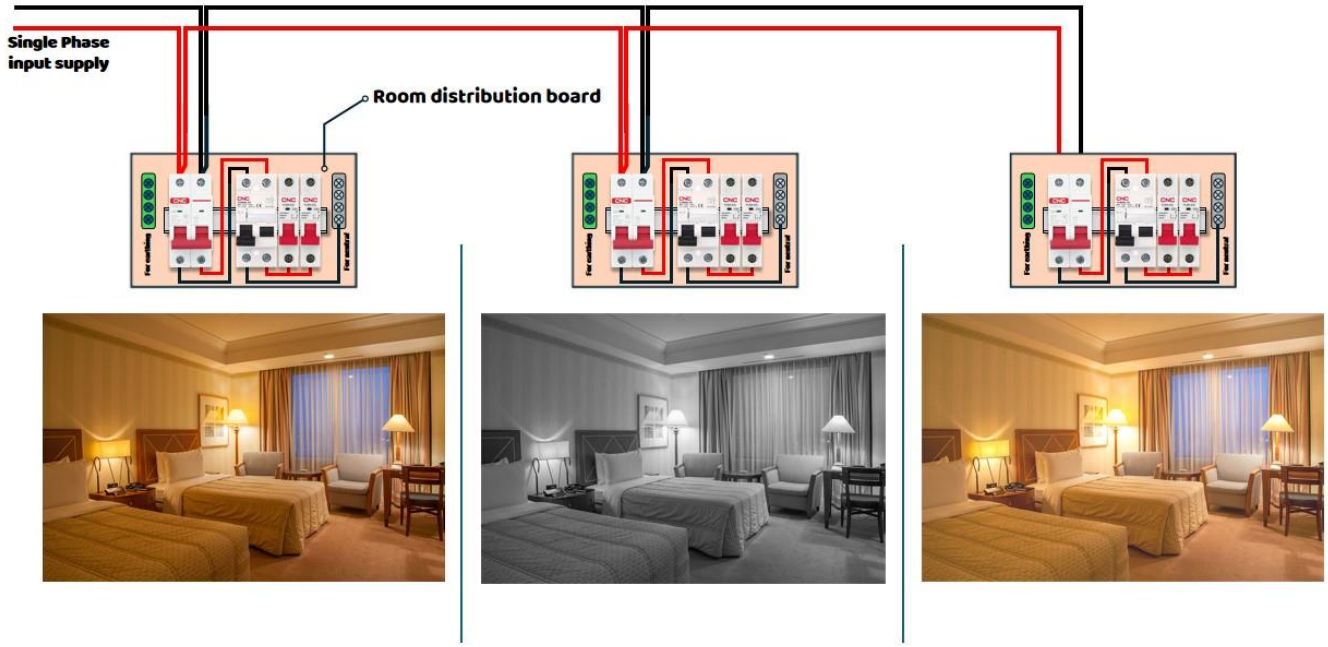
- **Main Distribution Board Connection with Auto Change Over Switch**



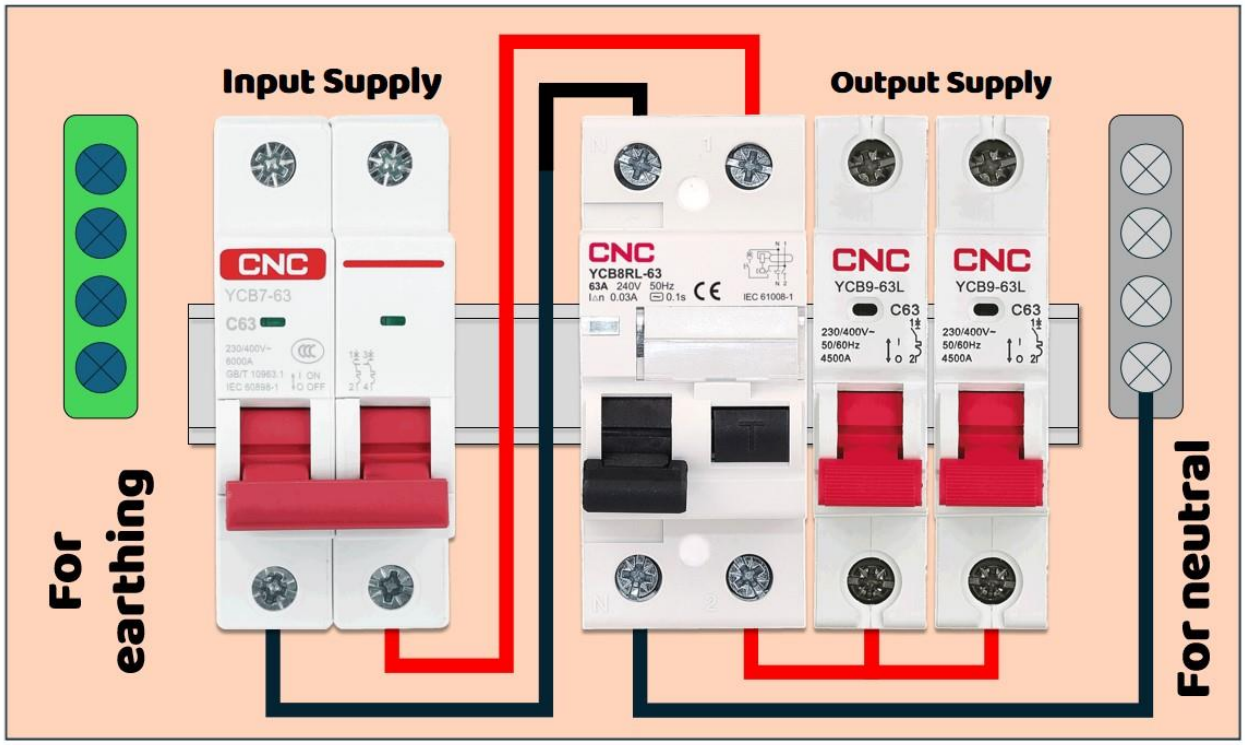
Click to Watch Hindi Video

Click to Watch English Video

This is the standard for house every room wiring



Friends, here also you must have noticed that I have taken the wire from the MCB from the main distribution board of one room to the main distribution board of the other room. Similarly, friends, you too should not put any joint inside the wiring. Do not think that it is too much. It will be installed properly if you take the wiring from the MCB to the MCB box of the other room. You do not have to cut the wire anywhere in between. If you cut, then the joint where the cut is made starts getting heated slowly and after a time. After that, the wiring gets damaged and gets burnt.

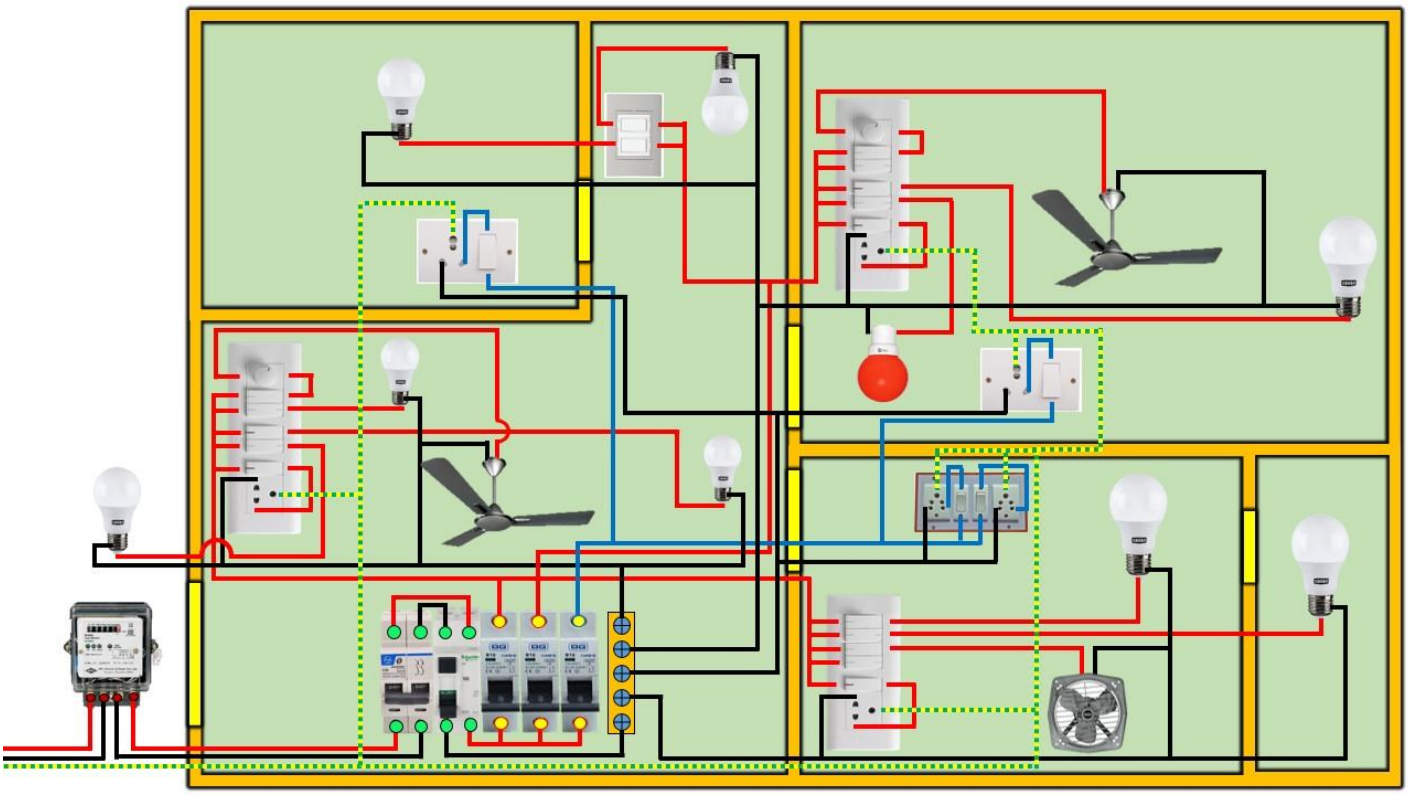


Friends, I am also sharing a video with you about house wiring. By clicking on this video, you can go to YouTube and watch this video. The video is in Hindi language. This

Video has a well step by step explanation, so that u can learn the connection diagram very easily.

10. 1 BHK House Wiring

By clicking on this Image, you can go to YouTube and watch this video



11. Inverter connection:

Here's a step-by-step explanation of how to connect an inverter:

- Select Location: Choose a suitable location for the inverter installation, preferably near the battery bank to minimize cable length and voltage drop.

- Turn Off Power: Ensure that the main power supply to the electrical panel is switched off to prevent any electrical hazards during the installation.

- Mount Inverter: Install the inverter securely on a flat, stable surface using mounting brackets or screws provided with the inverter. Make sure there is ample ventilation around the inverter to prevent overheating.

- Connect Battery: Connect the positive (+) terminal of the battery bank to the positive terminal on the inverter and the negative (-) terminal of the battery bank to the negative terminal on the inverter using appropriately sized battery cables.

- Connect AC Output: If the inverter has built-in AC outlets, you can directly plug in devices to these outlets. For larger inverters or grid-tied inverters, connect the AC output terminals of the inverter to the electrical panel using suitable gauge AC wiring and a circuit breaker.

- Check Connections: Double-check all connections to ensure they are secure and properly tightened to prevent any loose connections that could lead to electrical issues.

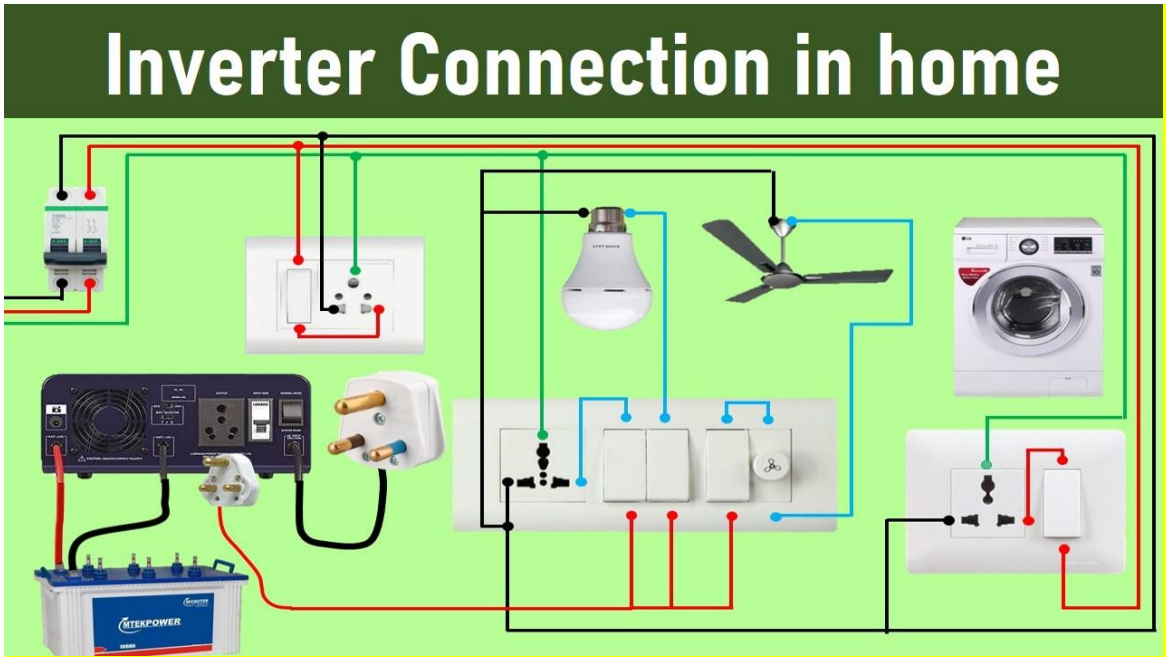
- Turn on Power: After completing the connections, turn on the main power supply to the electrical panel and then turn on the inverter. Follow the manufacturer's instructions for initializing and configuring the inverter settings, if required.

- Test Operation: Test the operation of the inverter by powering up connected devices or appliances to verify that the inverter is functioning correctly and providing the expected AC power output.

- Safety Precautions: Always follow safety guidelines and local electrical codes when installing and operating inverters to ensure safe and reliable operation.

Click on This to Learn Practically How to do Inverter

By clicking on this image, you can go to YouTube and watch this video



12. Complete House Wiring with Inverter Connection

House wiring with an inverter connection refers to the electrical setup in a residential building that includes provisions for backup power from an inverter during mains power outages. Here's a brief overview of the key aspects:

- **Main Distribution Board (MDB):** The MDB is the central point where the incoming power supply from the utility company enters the building. It distributes power to various circuits throughout the house.

- **Circuit Breakers or Miniature Circuit Breakers (MCBs):** MCBs are installed to protect individual circuits from overloads and short circuits. They automatically trip and disconnect the circuit in case of a fault.

- **Wiring Layout:** The house wiring layout includes routing electrical cables from the MDB to different rooms, areas, and appliances. Properly organized wiring ensures efficient power distribution.

- **Inverter Connection:** An inverter is integrated into the house wiring to provide backup power during mains power failures. It is connected to essential circuits like lighting, fans, and some sockets to ensure basic functionality during outages.

- **Earthing and Grounding:** The electrical system includes an earthing and grounding setup to ensure safety by diverting excess current to the ground and preventing electric shocks.

By clicking on this Image, you can go to YouTube and watch this video

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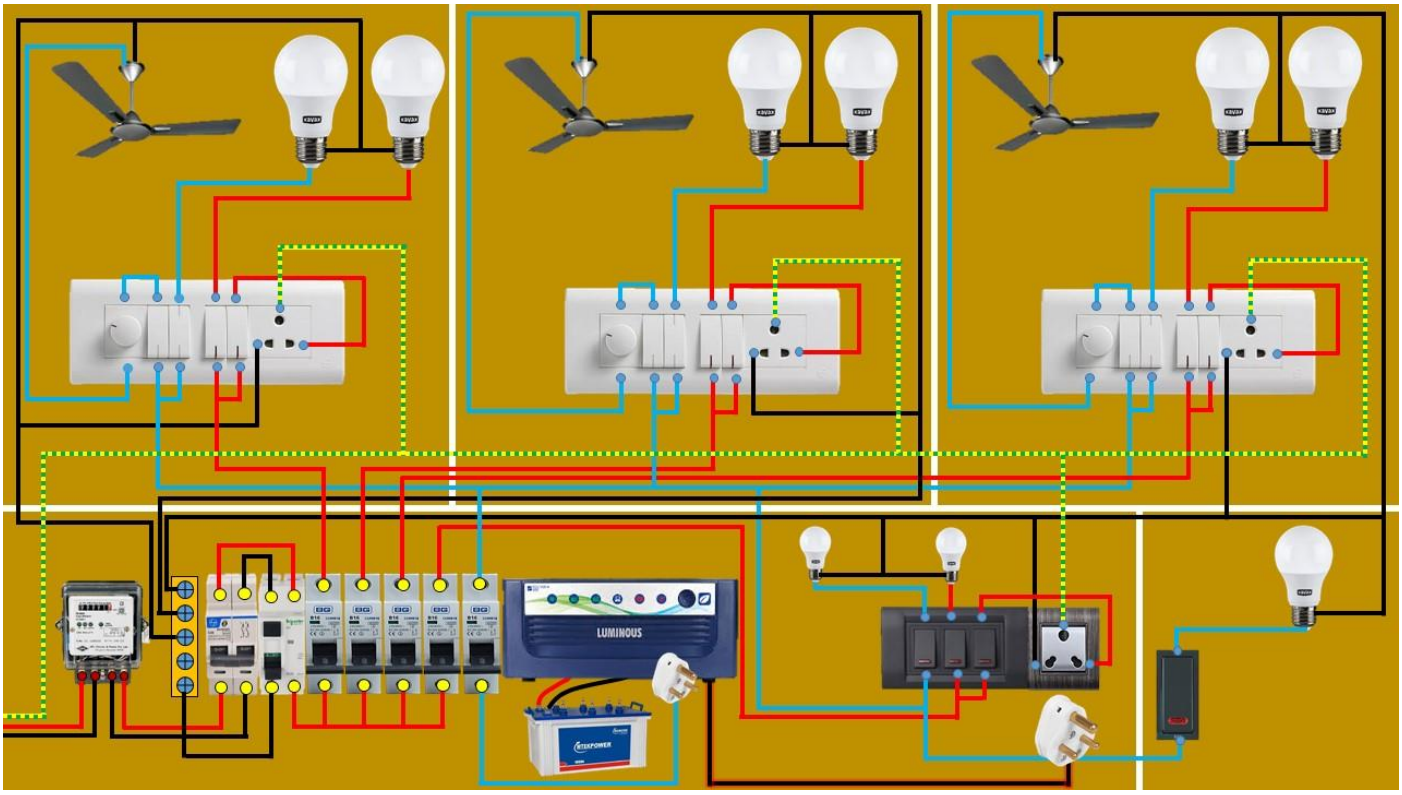
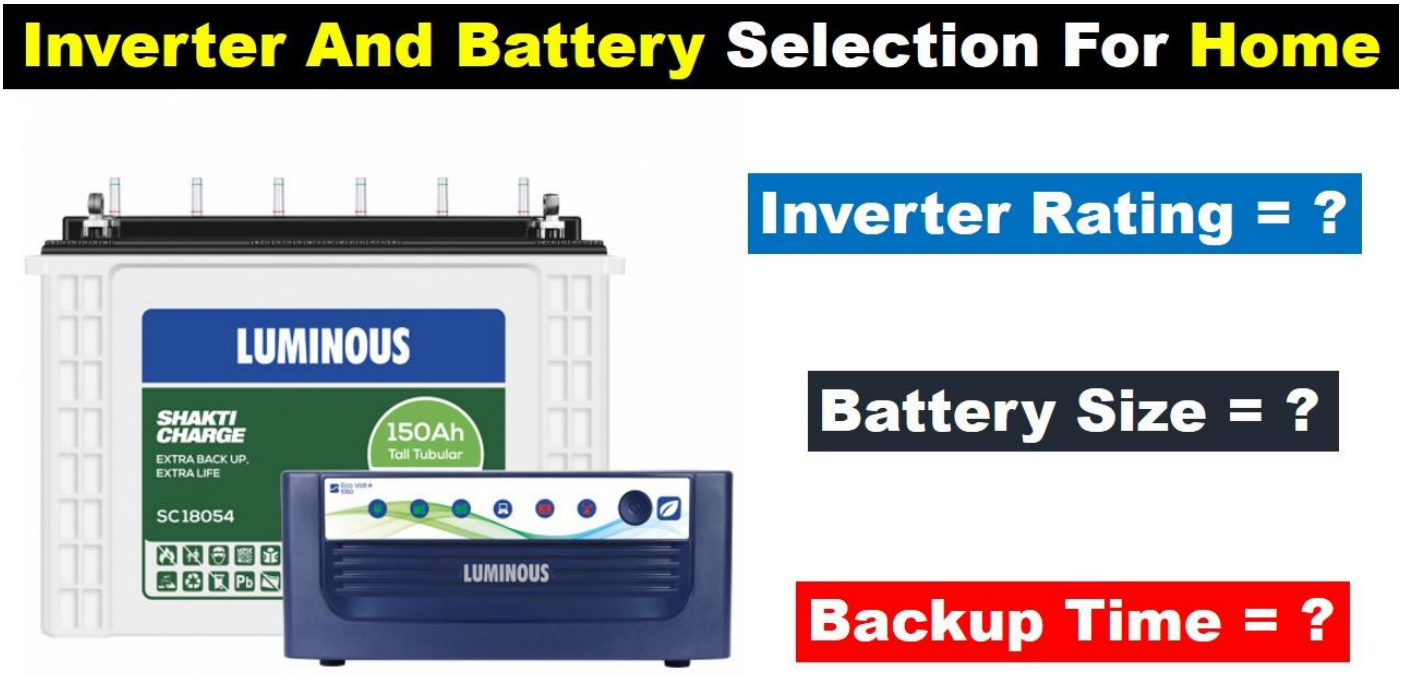


13. How to select Battery and Inverter for home:

By clicking on this video, you can go to YouTube and watch this video.



Inverter Rating Selection For Home

3 No's	Fan	×	75 Watts	225 Watt
2 No's	Tube light	×	20 Watts	40 Watt
5 No's	LED Bulb	×	9 Watts	45 Watt
1 No's	Television	×	60 Watts	60 Watt

Total 370 Watt + 25 % Safety Factor

370 Watt × 1.25 = **462 Watt total Load**

Inverter Rating is in Volt Amp (VA)

$$VA = \frac{Watt}{P.F} \qquad VA = \frac{462}{0.8} = 578 \text{ VA inverter} \qquad VA = \frac{578 \times 100}{80}$$

Inverter Rating = 722 *VA*

Battery Size Selection For Home

Fan	75 Watts	×	3 No's	225 Watt
Tube light	20 Watts	×	2 No's	40 Watt
LED Bulb	9 Watts	×	5 No's	45 Watt
Television	60 Watts	×	1 No's	60 Watt

Total 370 Watt × 25 % Safety Factor

405 Watt × 1.25 = **462 Watt total Load**

Battery Capacity is in Amp Hour (AH)

$$\text{Battery Capacity} = \frac{\text{Watt} \times \textit{Backup Time}}{\text{Battery Voltage} \times \textit{Battery Eff} \times \text{Inverter Eff}}$$

$$AH = \frac{462 \times 3}{12 \times 0.8 \times 0.8} = 180 \text{ AH}$$

Battery Capacity = 180 *AH*

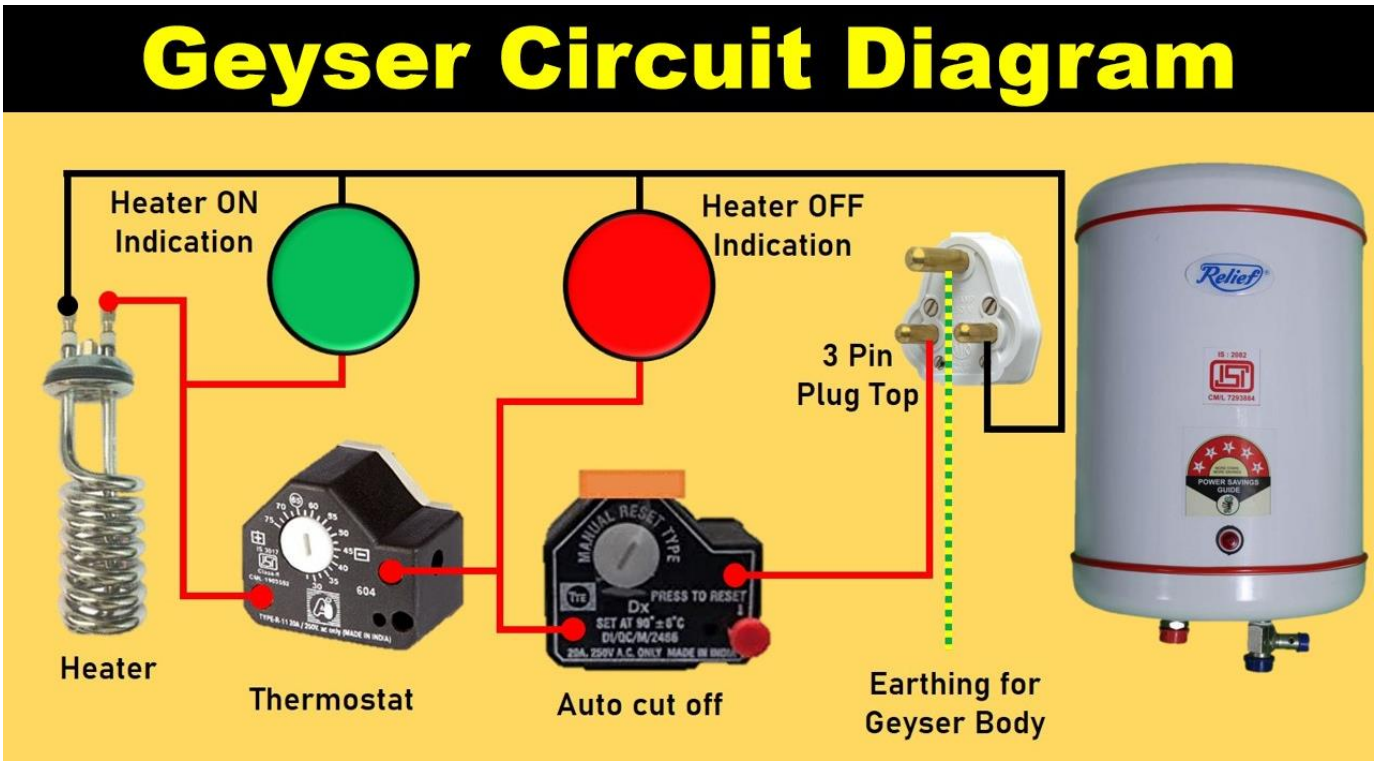
14. Geyser connection:

Electrical connections in appliances like geysers involve several safety features, including thermostats, auto cut-off mechanisms, and indicators, for various reasons:

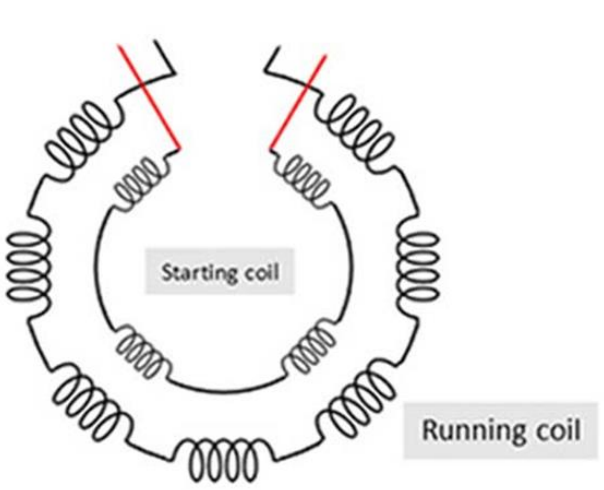
- Thermostat: A thermostat is used to regulate the temperature of the water inside the geyser. It automatically switches off the heating element when the water reaches the desired temperature, preventing overheating and saving energy.
- Auto Cut-Off: An auto cut-off feature is crucial for safety. It shuts off power to the heating element if the water temperature exceeds a safe limit or if there's a malfunction in the system, preventing the risk of the water boiling over or the geyser catching fire.
- Indicator Lights: Indicator lights, such as power on/off lights and heating element indicators, provide visual feedback about the geyser's status. They indicate whether the geyser is operational, heating water, or if there's a fault that needs attention.

In summary, thermostats regulate temperature, auto cut-off mechanisms prevent overheating and malfunctions, indicator lights provide feedback, safety compliance ensures adherence to standards, and user convenience is enhanced by these features in electrical connections for appliances like geysers.

By clicking on this video, you can go to YouTube and watch this video.

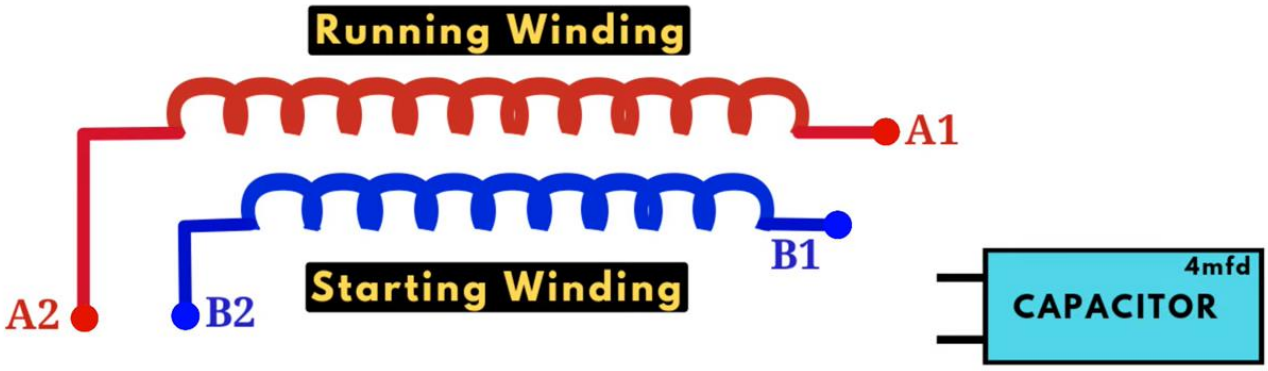


15. Ceiling fan Connection:

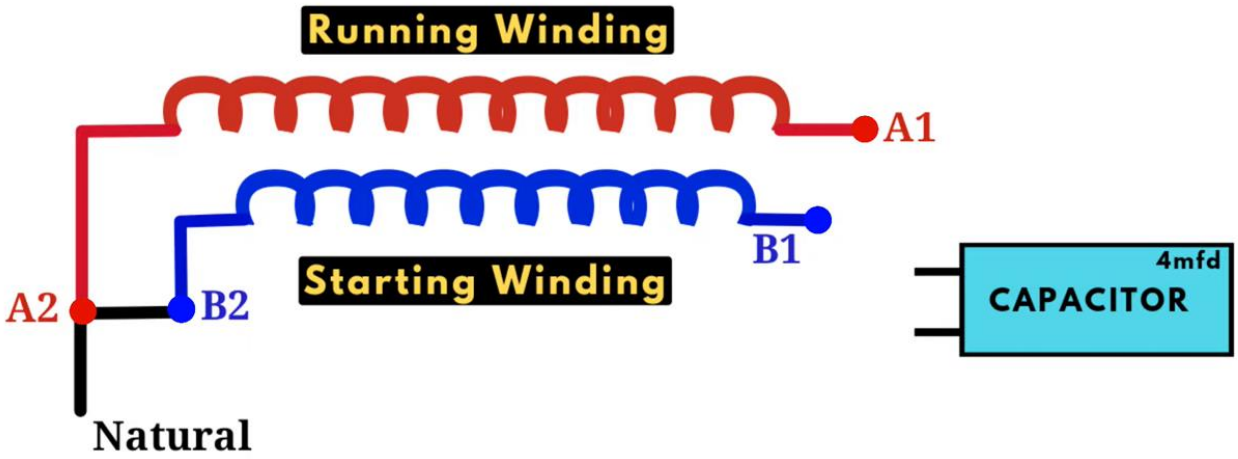


3 or 4 connection wires are coming out from the coil of the ceiling fan. In this, the capacitor and power supply must be connected. You must be aware from the above image that in ceiling fan there are two types of coils, the one coil which is inside is called Starting Coil and the one which is on the outside is called Running Coil. Sometimes only three wires come out from inside the fan. If both the wires on either side of the coil (starting coil and running coil) are joined in one place, it becomes neutral. Take out one wire for each of the starting coil and running coil. Two capacitor wires are attached to both the running and starting coil wires, one is taped to the capacitor wire, and the other wire, which is connected to the running winding capacitor, is connected to the phase supply.

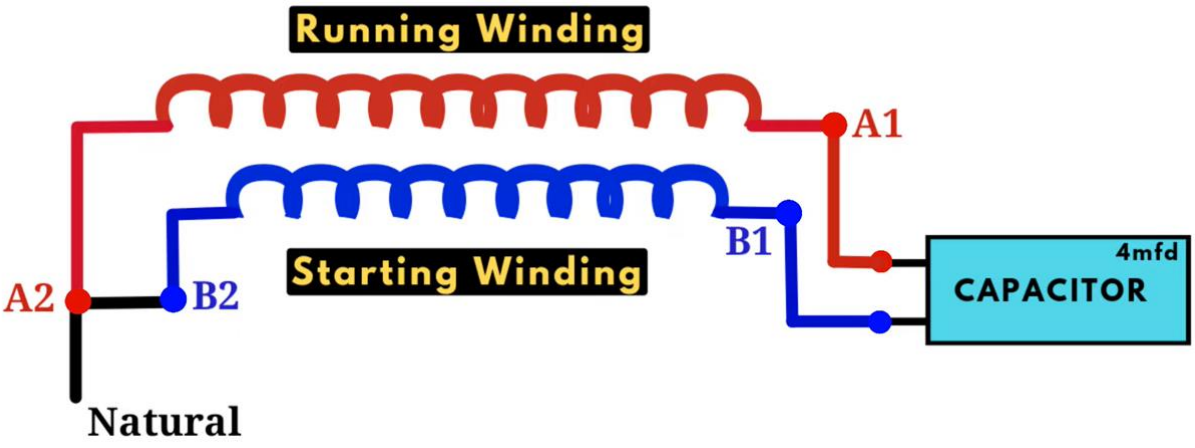
Step 1: Identify the Winding



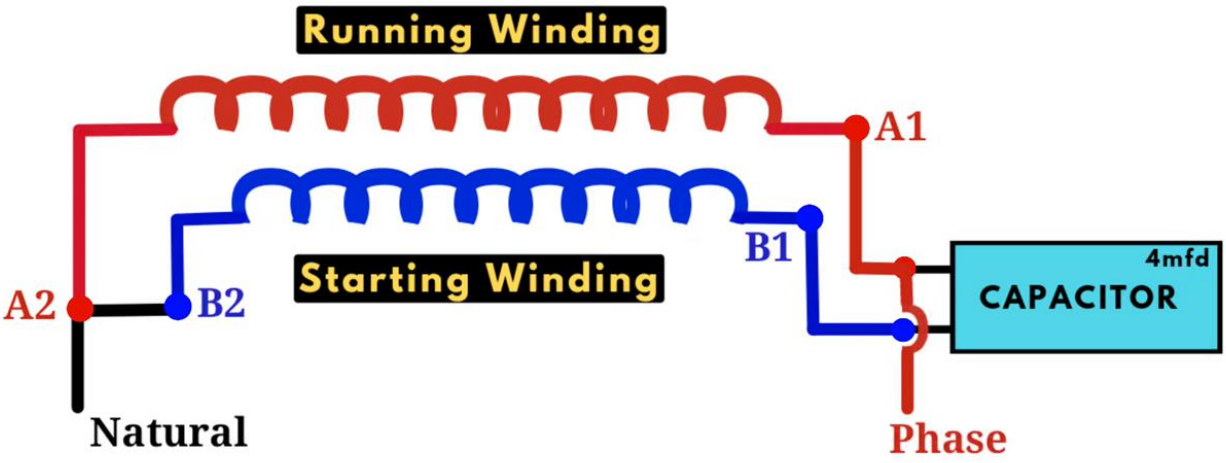
Step 2: Connect one end of both winding together



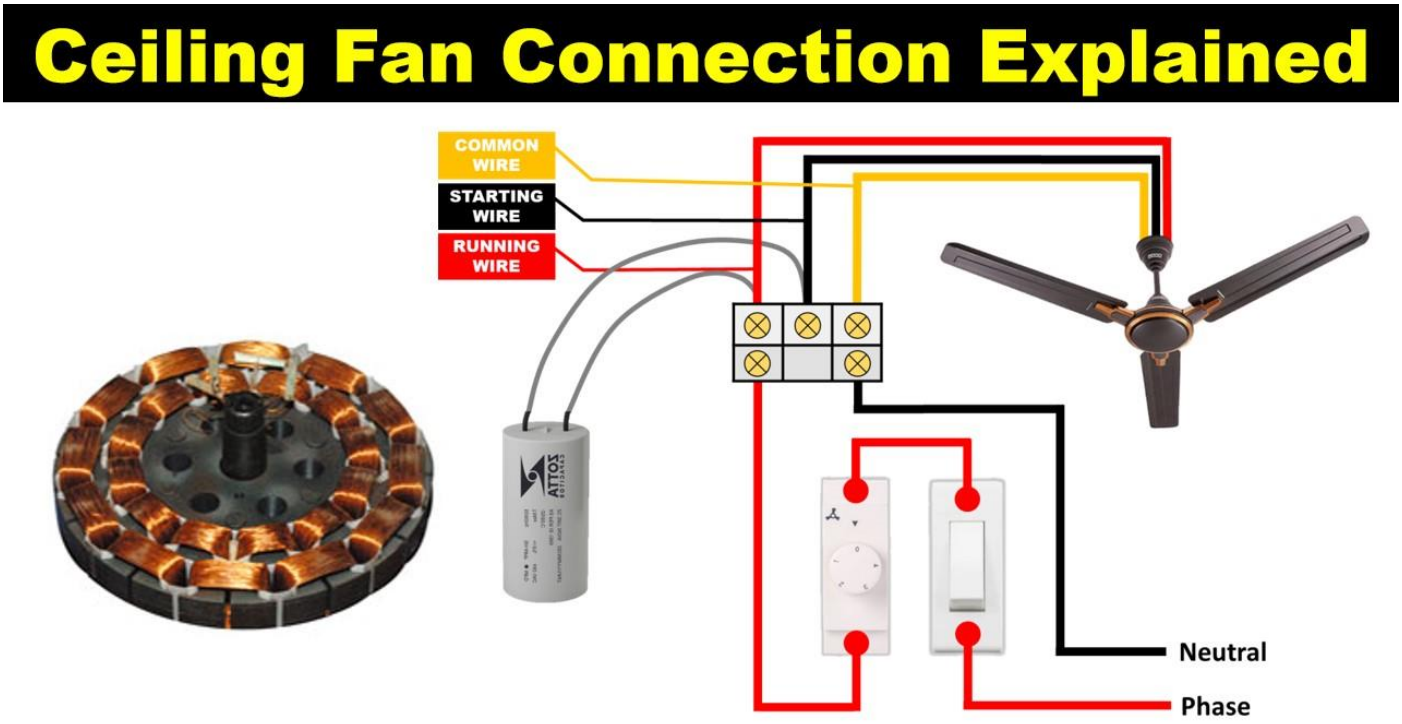
Step 3: Connect the Capacitor



Step 4: Connect Power Supply



The Above Diagram has shown how u can do the connection of the Ceiling fan winding, I am providing you the Pictorial circuit diagram also by looking at the diagram you can understand the whole connection of the ceiling fan. If you want to learn the wiring by watching video then please click on the picture.

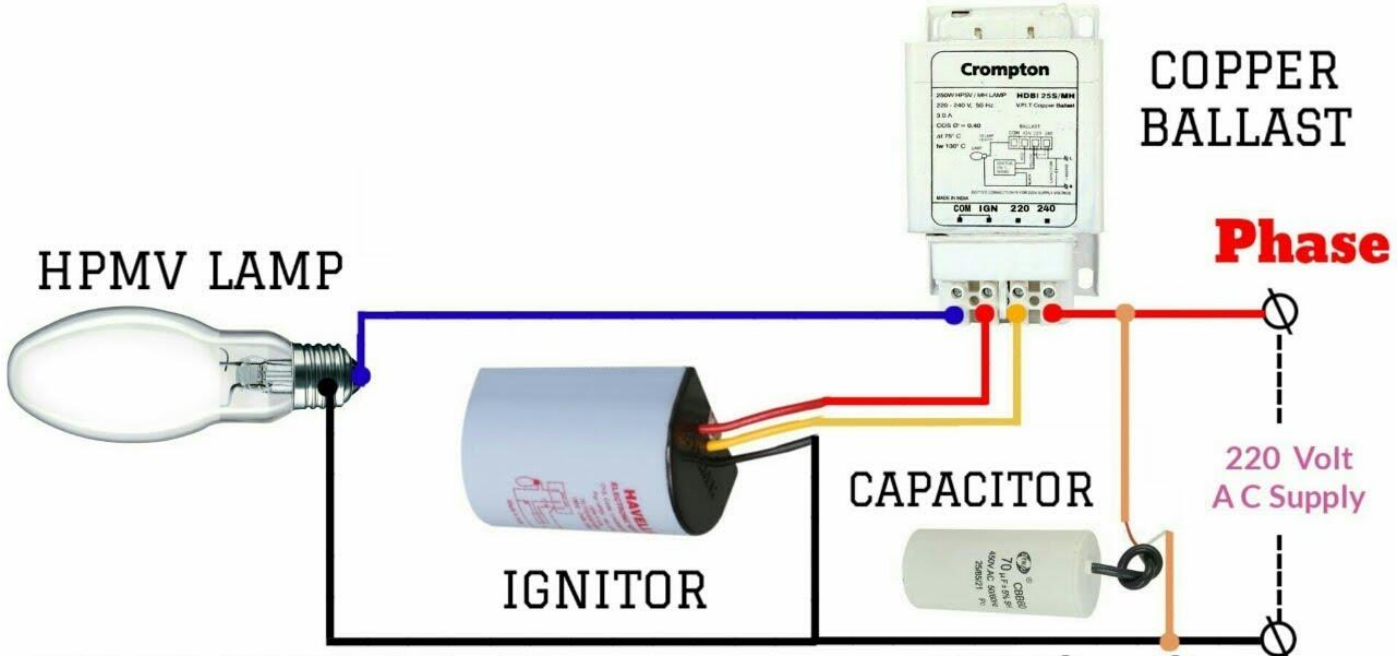


Click to Watch Hindi Video

Click to Watch English Video

16. HPMV Lamp Wiring Diagram

For Connection of HVMV Lamp we need an HPMV Lamp, copper ballast, a capacitor, and an Ignitor. And we have to do the connection as per the Diagram.



17. Fridge connection single door & Double door:

The electrical connection in a refrigerator involves several key components working together:

- **Thermostat:** The thermostat is connected to the main power supply and controls the temperature inside the refrigerator. When the temperature rises above the set threshold, the thermostat signals the compressor to start cooling.

- **Compressor:** The compressor is the main power-consuming component in the refrigerator. It is connected to the thermostat and receives signals to start or stop based on temperature requirements. The compressor is powered through the relay.

- **Relay:** The relay is an electrical switch connected between the thermostat and the compressor. It controls the power supply to the compressor, turning it on or off as directed by the thermostat.

- **Door Switch:** The door switch is connected in series with the interior light and sometimes with the compressor circuit. When the refrigerator door is opened, the door switch breaks the circuit, turning off the interior light and, in some models, temporarily disabling the compressor to save energy and prevent cold air loss.

- **OLP (Overload Protector):** The overload protector is connected in series with the compressor circuit. It monitors the current flowing through the compressor. If the current exceeds a safe limit, indicating an overload or fault, the OLP disconnects the power to the compressor, protecting it from damage.

Overall, these components work together in the electrical connection of a refrigerator to ensure efficient cooling, temperature control, energy savings, and safety.

By clicking on this Diagram, you can go to YouTube and watch this video. This is the wiring of a single door refrigerator.

The wiring in a double door fridge involves connecting several electrical components to ensure proper functioning and temperature control:

- **Thermostat:** The thermostat is wired to control the temperature inside the fridge. It sends signals to the compressor and other components based on the temperature settings.

- **Compressor:** The compressor is connected to the thermostat and power supply. It compresses the refrigerant to cool the fridge and is controlled by the thermostat.

- **Relay:** The relay is an electrical switch that controls power to the compressor based on signals from the thermostat.

- **Door Switches:** Each door of the fridge has a door switch. These switches turn off the interior light and sometimes the compressor when the doors are opened to prevent energy loss.

- **OLP (Overload Protector):** The OLP is connected to the compressor to protect it from electrical overload. It disconnects power to the compressor if it detects excessive current.

- **Lamp:** The lamp provides interior lighting when the fridge door is opened. It is connected to the door switch to turn on and off accordingly.

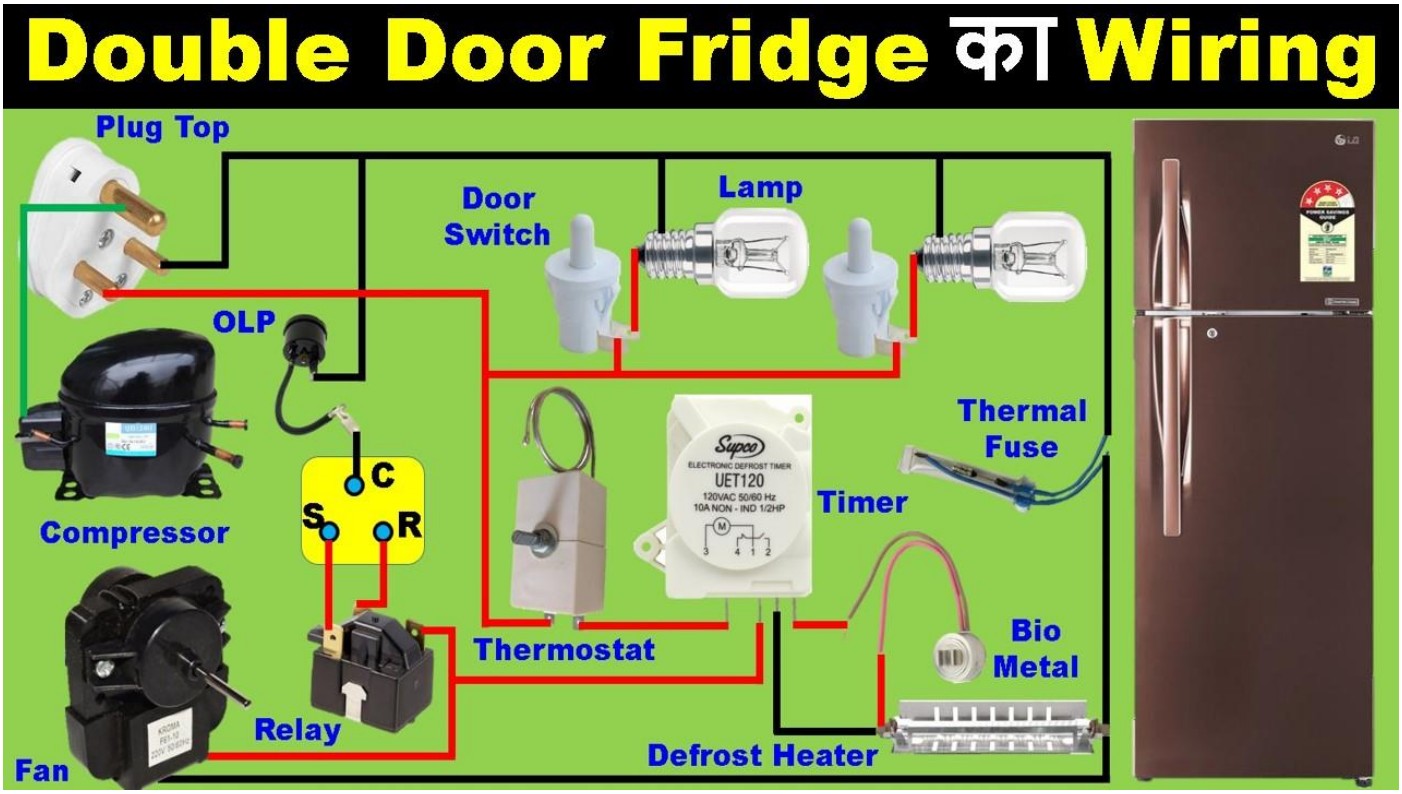
- **Thermal Fuse:** The thermal fuse is a safety device connected to the compressor or other high-current components. It cuts off power if the temperature exceeds a safe limit, preventing overheating.

- **Bi-Metal:** The bi-metal strip is used in the defrost system. It is connected to the defrost timer and heater to regulate defrost cycles based on temperature.

- **Defrost Heater:** The defrost heater is connected to the bi-metal strip and defrost timer. It melts ice buildup on the evaporator coils during defrost cycles.

- **Fan:** The fan circulates air inside the fridge to maintain even cooling. It is connected to the thermostat or a separate control mechanism.

By clicking on this Diagram, you can go to YouTube and watch this video. This is the wiring of a Double door refrigerator.



Fridge Compressor Connection all Method

The connection methods for refrigerator compressors can be broadly categorized into Permanent Split Capacitor (PSC) and Capacitor Start-Run (CSR) types:

- **Permanent Split Capacitor (PSC):**

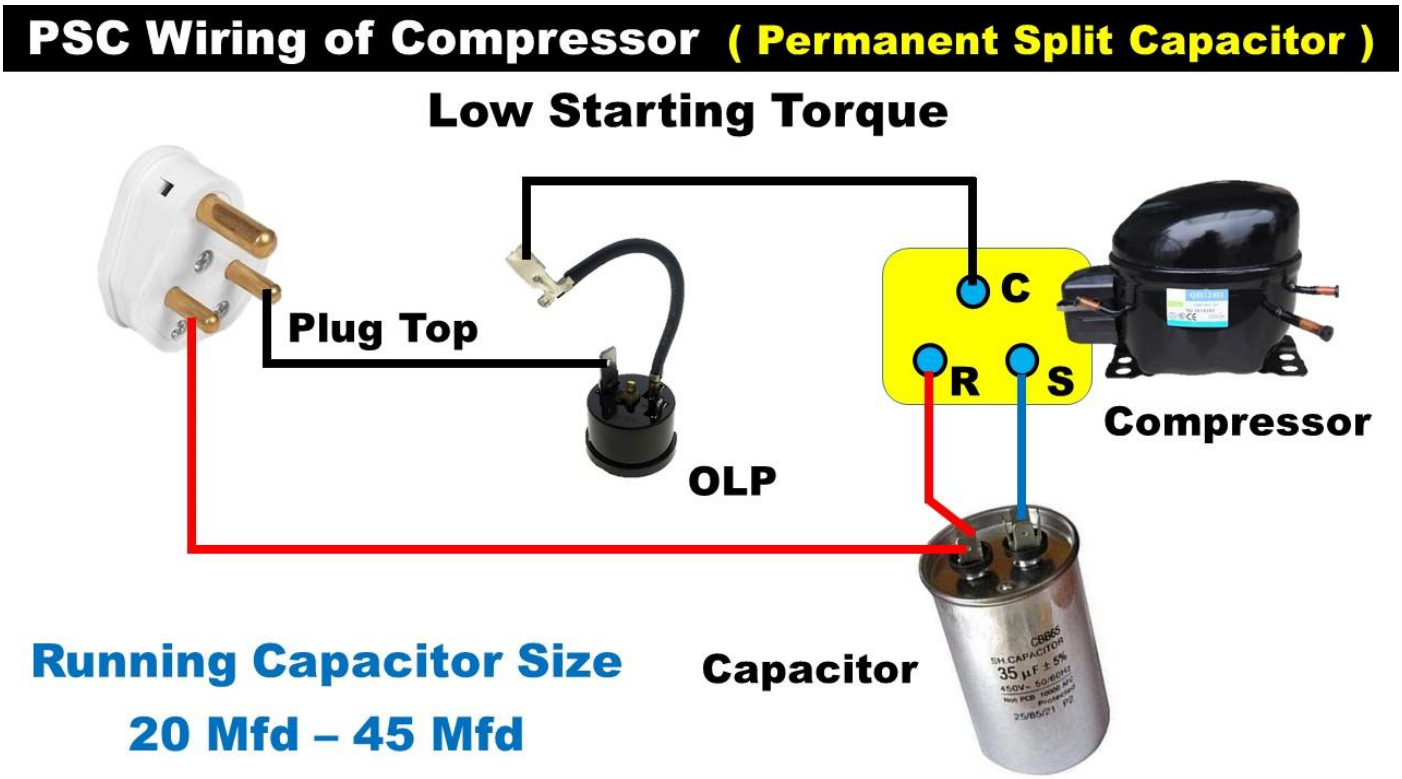
- In a PSC compressor, a permanent split capacitor is used to start and run the motor.
- The electrical connection involves connecting one end of the capacitor to the start winding and the other end to the run winding of the motor.
- When power is supplied, the capacitor creates a phase shift in the start winding, creating a rotating magnetic field that starts the motor.
- Once the motor is running, the capacitor remains in the circuit to improve motor efficiency during operation.

- **Capacitor Start-Run (CSR):**

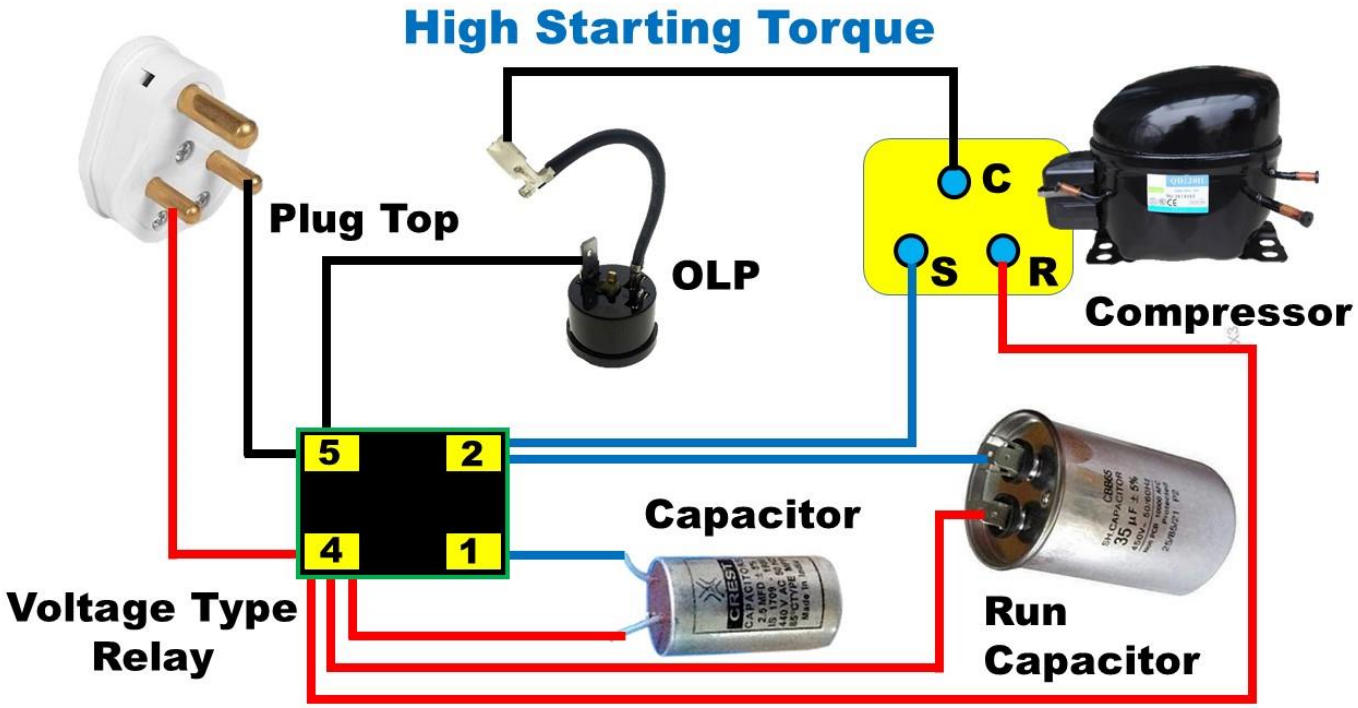
- A CSR compressor uses both a start capacitor and a run capacitor to start and run the motor.
- The start capacitor is connected in series with the start winding and is used only during startup to provide extra torque.
- The run capacitor is connected in parallel with the start winding and remains in the circuit during motor operation to improve efficiency and power factor.
- The start capacitor is disconnected by a centrifugal switch once the motor reaches a certain speed, while the run capacitor continues to operate.

In summary, PSC compressors use a single capacitor for starting and running, while CSR compressors use separate capacitors for starting and running, providing enhanced starting torque and operational efficiency.

By clicking on this Diagram, you can go to YouTube and watch this video.



CSR Wiring of Compressor (Capacitor Start Capacitor Run)



18. Washing machine connection:

The electrical connection in a washing machine involves several key components:

- **Motor:** The motor is responsible for driving the washing machine's agitator or drum. It is connected to the power supply and controlled by the wash timer and other control mechanisms.

- **Wash Timer:** The wash timer is a control device that determines the duration and sequence of washing machine cycles, such as wash, rinse, and spin. It is connected to the motor, spin motor, and other components to regulate their operation.

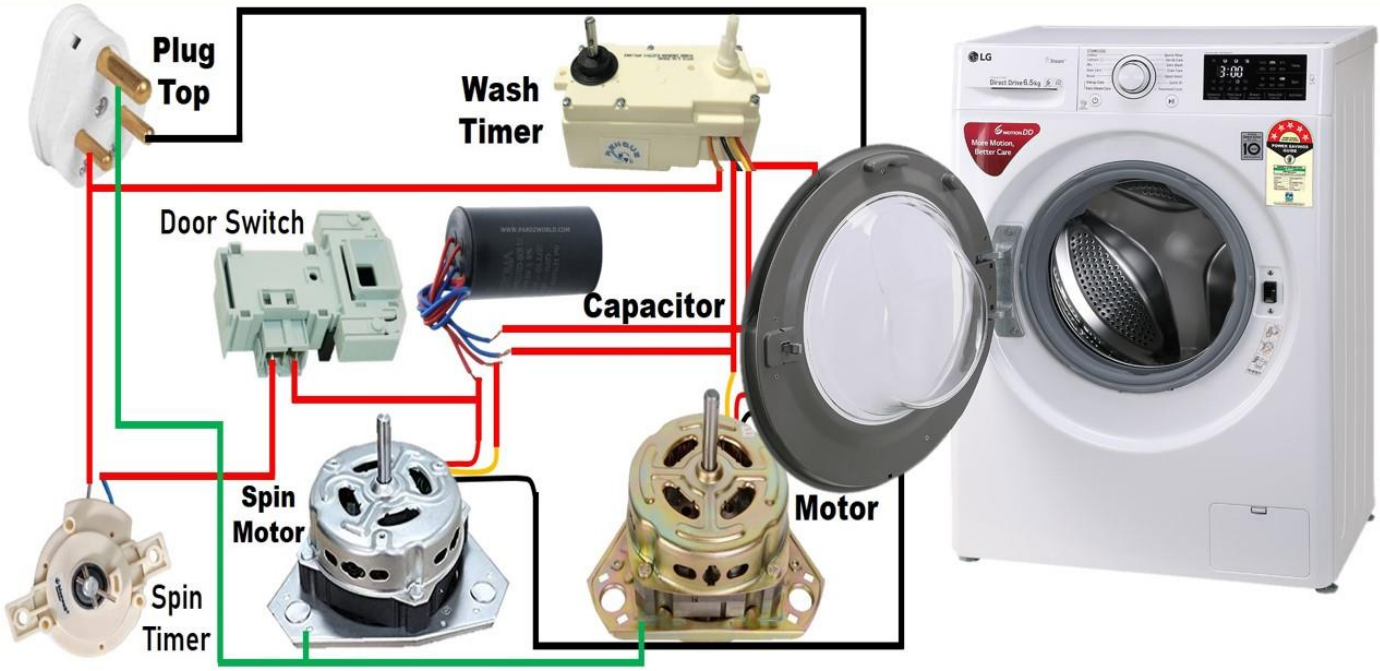
- **Spin Motor:** In addition to the main motor, some washing machines have a separate spin motor dedicated to spinning the drum at high speeds during the spin cycle.

- **Spin Timer:** The spin timer is specifically responsible for controlling the spin cycle duration and speed. It activates the spin motor to achieve the desired spin speed for clothes drying.

- **Capacitor:** A capacitor is often used in washing machines to provide an extra boost of power to start the motor and spin motor, especially for heavy loads. It helps in smooth starting and running of these motors.

- **Door Switch:** The door switch is a safety feature that ensures the washing machine operates only when the door is securely closed. It is connected to the control circuit and interrupts power if the door is opened during operation.

Washing Machine Electrical Connection



Click to Watch Hindi Video

Click to Watch English Video

Washing Machine Connection can be done as per the diagram above. You can also watch the video to learn in details about the connection.

19. Submersible automatic Starter single Phase

The electrical connection of a single-phase submersible pump starter involves several essential components, including:

- **MCB (Miniature Circuit Breaker):** The MCB is used as a protective device to protect the circuit against overload and short circuits. It is connected to the power supply and the rest of the starter components.

- **Contactor:** The contactor is a magnetic switch that controls the power supply to the pump motor. It is connected in series with the MCB and other components.

- **Starting Capacitor:** The starting capacitor is connected to the contactor and provides an extra boost of power to start the motor, especially when it is under load. It receives power through the second NO (Normally Open) contact of the start push button.

- **Running Capacitor:** A run capacitor is used in single-phase motors to maintain a running torque on an auxiliary coil while the motor is loaded. These capacitors are considered continuous duty while the motor is powered.

- **Start Push Button:** The start push button has two NO elements. The first NO contact turns on the contactor when pressed, allowing power to flow to the motor. The second NO contact provides power to the starting capacitor only while the start push button is held down, aiding in the motor's starting process.

- **Stop Push Button:** The stop push button is used to stop the motor's operation. Pressing this button interrupts the power supply to the contactor, stopping the motor.

- **Voltmeter and Ammeter:** These instruments are used to monitor the voltage and current in the motor circuit, providing valuable information about the motor's performance and electrical parameters.

- **Indication Lamp:** An indication lamp is used to visually indicate the status of the motor, such as whether it is running or stopped.

Overall, these components work together in the single-phase submersible pump starter to control the motor's operation, provide protection against electrical faults, and monitor the motor's performance. The start push button's NO contacts play a crucial role in initiating the motor's start sequence and providing power to the starting capacitor during startup.

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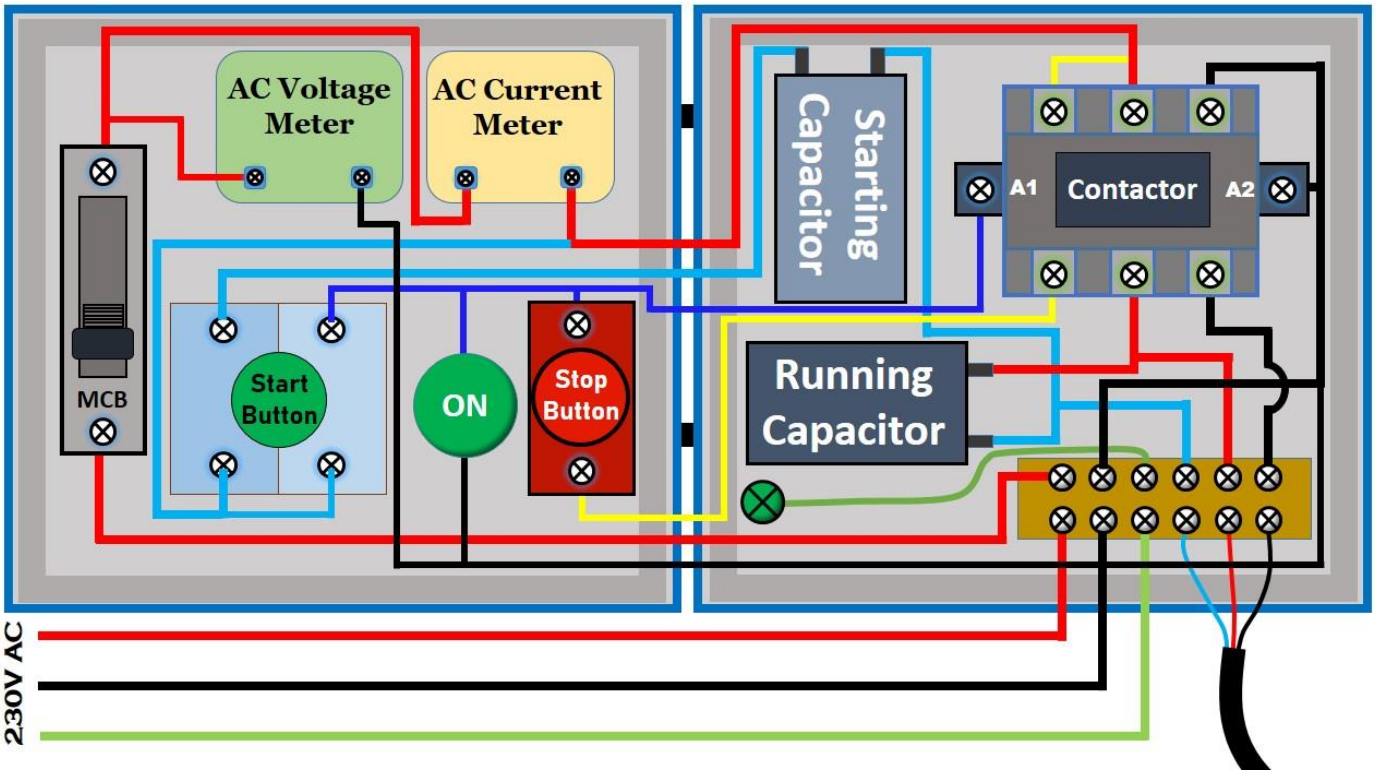
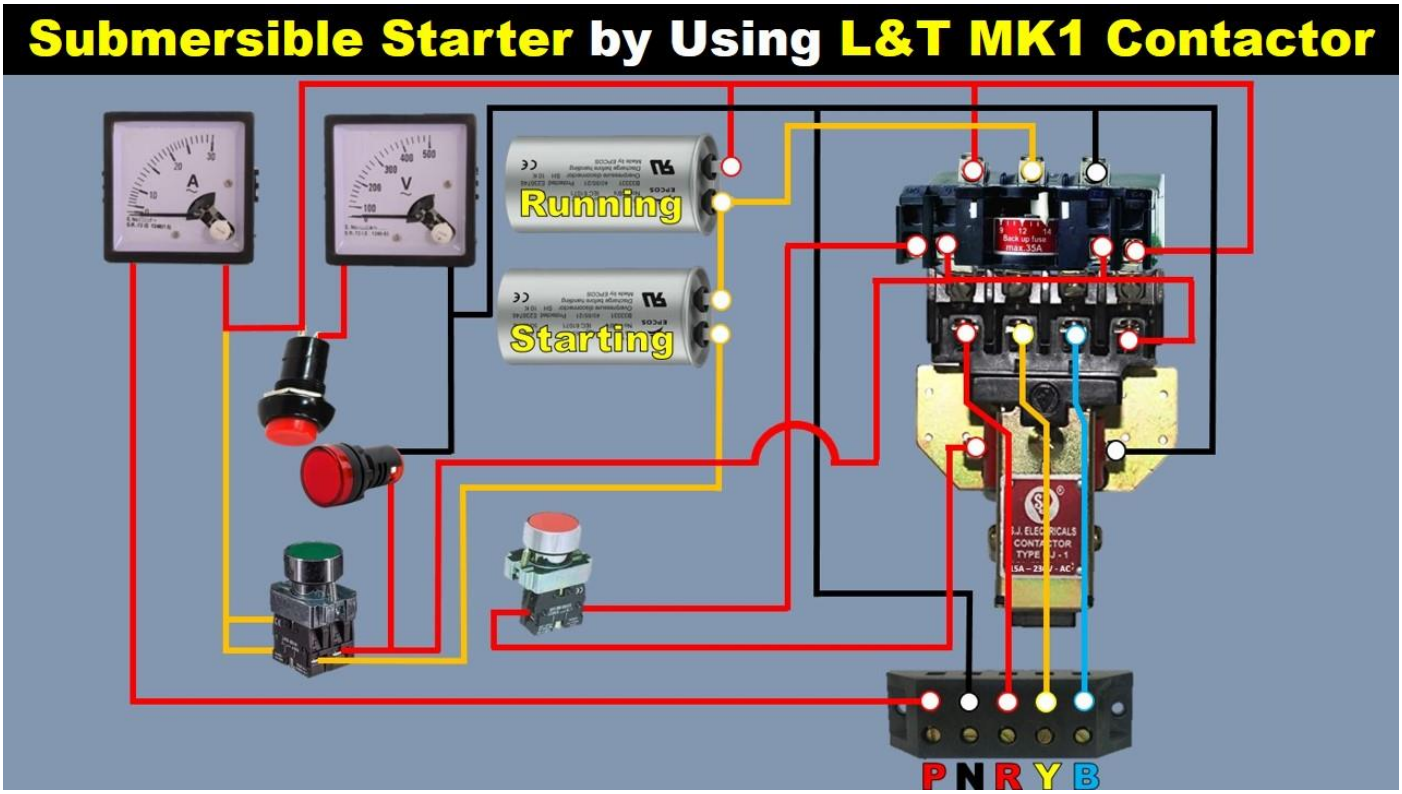




Automatic Single phase Submersible Pump Starter with Float Switch

In a submersible pump starter with a float switch for automatic on/off control, the following components and their functions are involved:

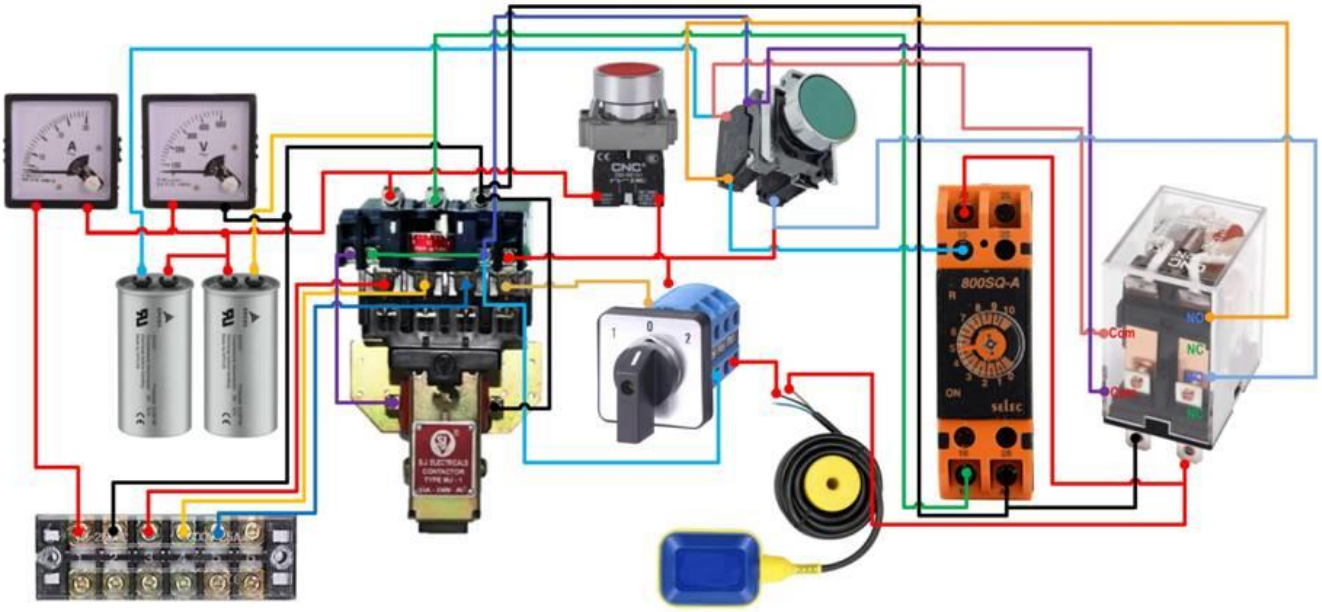
- **Float Switch:** The float switch is used to detect water level in the tank. When the water level drops below a certain level, the float switch is triggered to turn on the pump motor. When the water level reach to tank full level, the float switch turns off the motor.

- **On Delay Timer:** An on delay timer is incorporated into the circuit to control the duration for which the motor receives power from Starting Capacitor after the float switch is triggered. This timer activate the relay for a set period, ensuring the motor receives power from starting capacitor for only for the desired time.

- **Relay:** The relay acts as a switch that is controlled by the on delay timer. When the float switch triggers the circuit, the on delay timer activates the relay, allowing power to flow from the starting capacitor to the motor for the specified duration.

- **Starting Capacitor:** The starting capacitor provides an extra boost of power to start the motor efficiently. During the time when the relay is activated by the on delay timer, the power supply from the starting capacitor is connected to the motor, enabling it to start and run.

Capacitor वाली Starter के साथ Float Switch का Connection करना सीखे



By clicking on this video, you can go to YouTube and watch this video.

20. Ammeter & Voltmeter

An ammeter is an instrument used to measure current in a circuit. It is also called an ampere meter. Electric currents are measured in amperes (A), hence it is given this name. The ammeter is connected in series with the circuit in which the current is to be measured.

There are two types of ammeters, **analog ammeter, and digital ammeter.**

A voltmeter is a measuring instrument. It is used to measure the potential difference between two points in an electrical or electronic circuit. It is called a voltmeter in English. The voltmeter is connected in parallel to the circuit that we want to measure.

A voltmeter has two terminals. These terminals are connected to the two points where the potential difference is to be measured. The resistance between the two ends of the voltmeter should be very high (ideally infinite).

There are two types of voltmeters, **analog meter, and digital meter.**

21. What are NO and NC Button & how to use it:

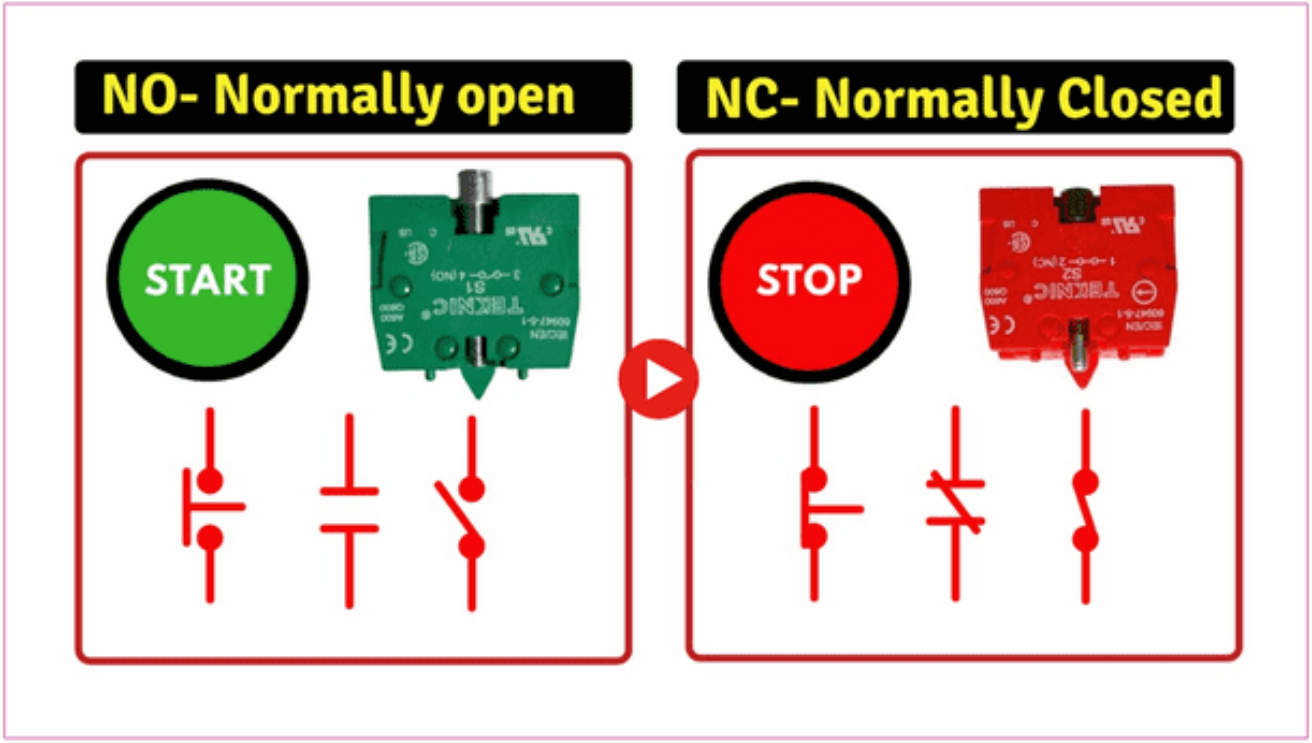
- **Full name of NO- (Normally Open)**
  This means, that these two points will remain far from each other in normal conditions, if we provide an electrical supply at one point of NO, we will not get it at the other point.

  Suppose we start the electrical contactor by giving supply to A1 and A2 points of the electrical contactor. Then this is not a normal condition. Meaning, that after the electrical contractor starts, the condition will not be normal and at that time the supply from one contact of our NO will be available with the other contact.

- **Full name of NC- (Normally Close)**
  This means that if our electrical contactor is in normal condition, both our contacts will be connected.

  For example, if we provide electric supply at one point in NC, we will continue to get it at other points. But when we start the electrical contactor, our NC contacts which are connected will move apart.

  Friends, if you want, you can also watch its video by clicking on this diagram.



22. What is Contactor & how to use:

A contactor is an electrical switch. We can stop or start by providing an electrical supply. For example, you must have seen the switches installed in the switchboard of your house, they are mechanically controlled, which means we have to go near them to turn that switch on or off.

All types of electrical contactors have A1 and A2 terminals, these terminals are used to start the electrical contactor.

It is written on every contactor what is the coil voltage of that contactor. Example: if it is written on any contactor (A1 A2- 240AC)

This means we have to give supply 240 voltage at A1, and A2 points. And as soon as 240 voltage is applied to A1 and A2, our contactor will start.

I am sharing some photos with you. By looking at these you can find out what it looks like.

Friends, if you want, you can also watch its video by clicking on this diagram.

In a three-phase contactor, the power terminals consist of

Power Terminals:

- The power terminals (L1, L2, L3 and T1, T2, T3) are where the main power supply lines are connected.
- These terminals handle high current and voltage, typically from the electrical grid or power source, and distribute it to the load, such as a motor or compressor.
- The power terminals are critical for delivering electrical power to the connected equipment and are designed to withstand the load's power requirements.

Auxiliary Terminals:

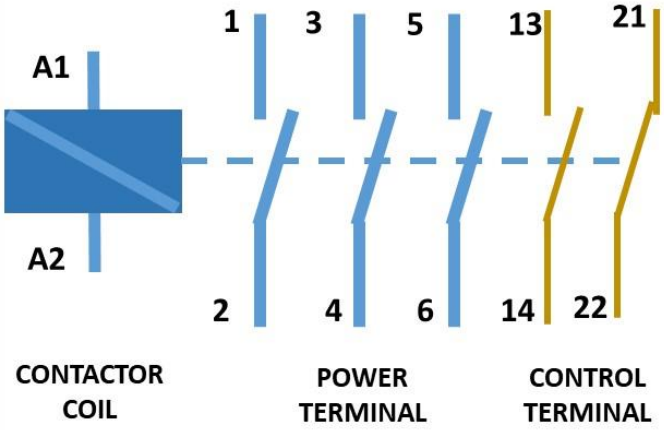
The auxiliary terminals of a contactor can include both Normally Open (NO) and Normally Closed (NC) contacts, offering additional control and flexibility in electrical circuits:

- Normally Open (NO) Contact: When the contactor coil is not energized (i.e., in its normal state), the NO contact is open. It closes and allows current to flow through when the contactor coil is energized. NO contacts are commonly used for functions that need to activate when the contactor is energized, such as starting a motor or turning on a light.

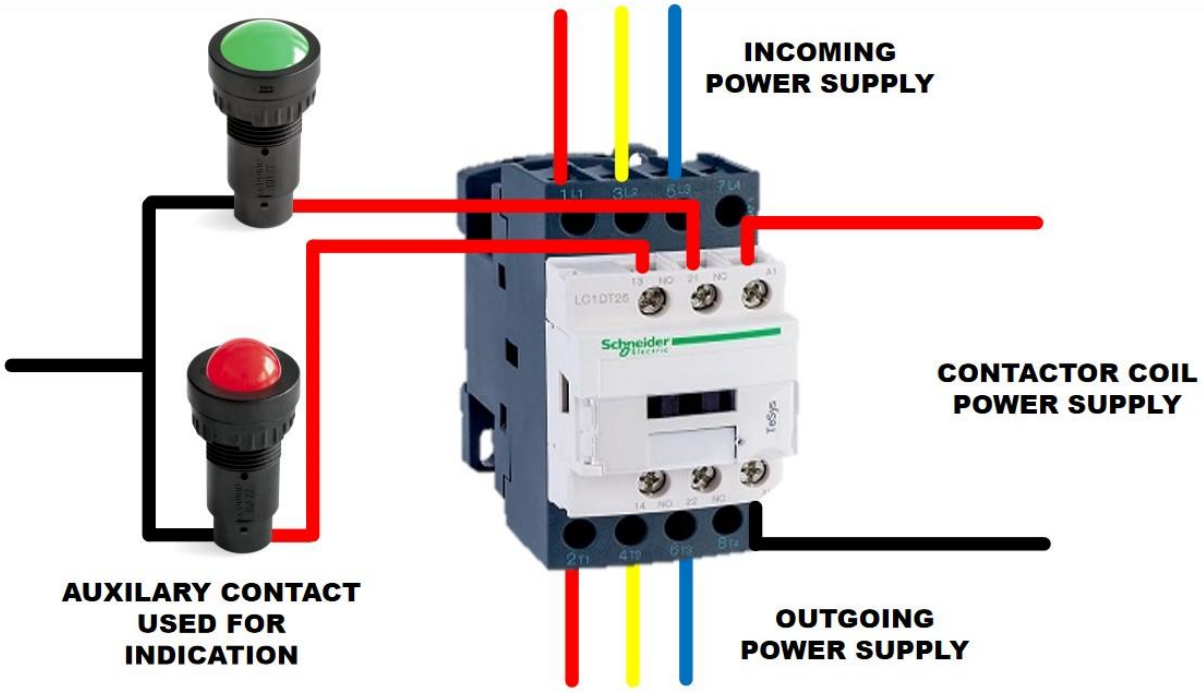
- Normally Closed (NC) Contact: Conversely, the NC contact is closed in its normal state (when the contactor coil is not energized) and opens when the coil is energized. NC contacts are often used for safety features or functions that should deactivate when the contactor is energized, such as stopping a motor or shutting off a circuit.

Coil Terminals:

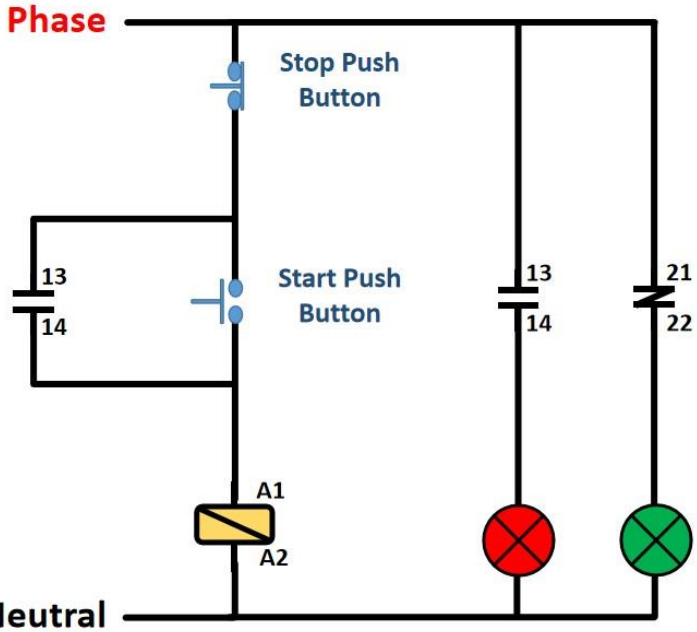
- The coil terminals (A1, A2) are specifically for connecting the coil of the contactor.
- When voltage is applied to the coil terminals, the electromagnetic coil inside the contactor generates a magnetic field.
- This magnetic field causes the contactor's turn ON.
- The coil terminals are essential for controlling the contactor's switching action, such as turning a motor on or off, based on the control circuit's input.



CONTACTOR WIRING



Contactor Connection Diagram



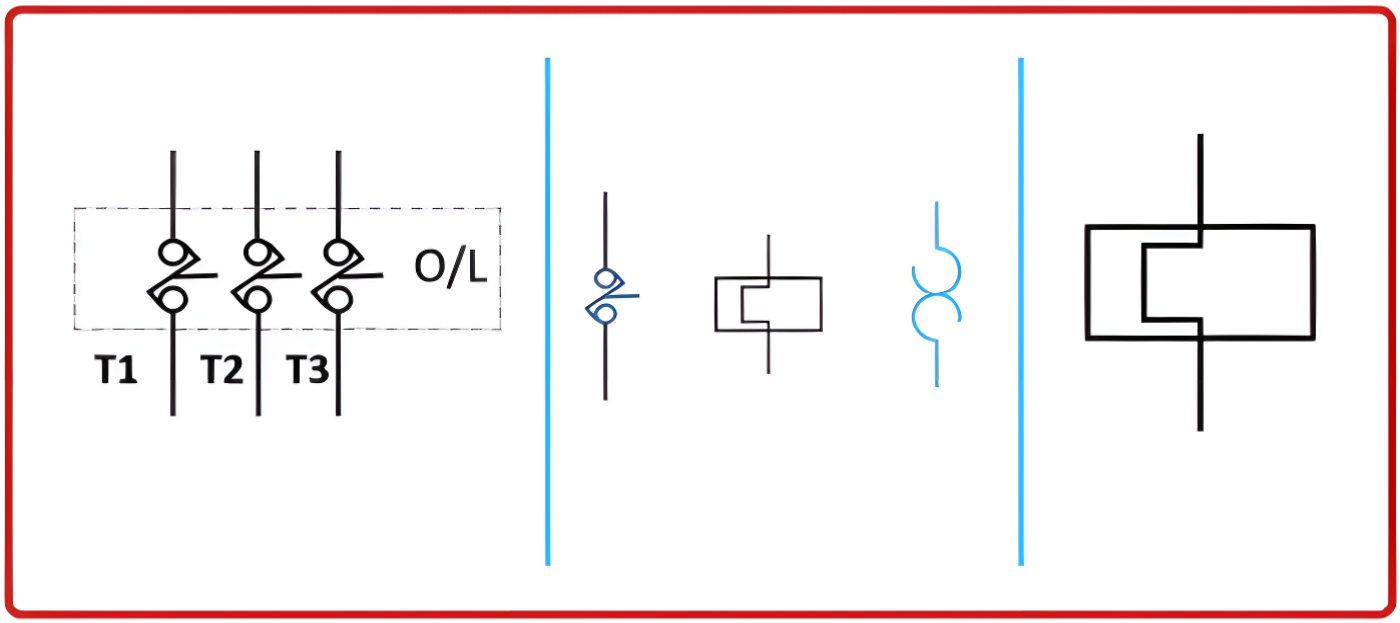
23. What is OLR (Overload relay)

Click to Watch English Video

Click to Watch Hindi Video

You must have always seen an overload relay installed inside almost all motor starters. Full name of OLR – **Overload Relay**. It is also called a **thermal overload relay.** Overload relay is an electrical device, which we use to provide safety to the motor. Its working is quite easy. It senses the current going to the motor. And if the motor draws more amperes than the current set on the relay, it trips the OLR circuit. In this way the motor becomes safe. There are bi-metallic elements inside the overload relay. The current going into the motor passes through these bi-metallic elements. Now if the motor takes too much current, then these bi-metallic elements get heated and bend. As soon as this happens, the circuit breaks and the motor stops.

Overload Relay Symbol



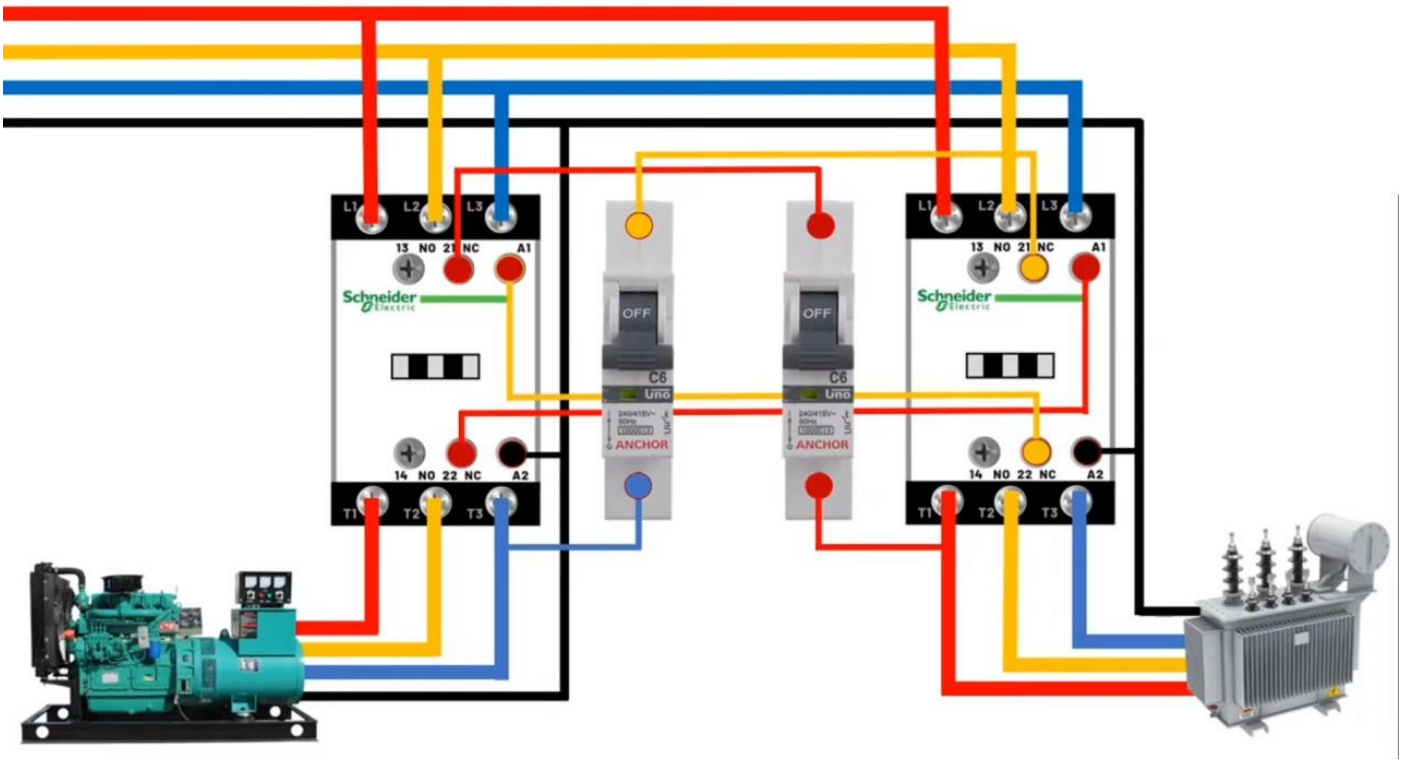
24. What is Interlocking:

When there is a house, factory, showroom, or office where two power supplies have been used, one from the grid and the other from the generator, UPS, solar, etc we use interlocking.

The interlocking system ensures that when only one contactor is on, the other will be in the closed position, even if we try to turn it on manually. If kept interlocked, only one contactor will be on at a time. For interlocking we use NO and NC contacts.

For example: interlocking is also done in star delta starters, diesel generators, and for grid supply.

I'm also sharing a video with you. By clicking on this video, you can go to YouTube and watch this video.



Click to Watch English Video

Click to Watch Hindi Video

25. What is an Analog and digital timer & how to use it

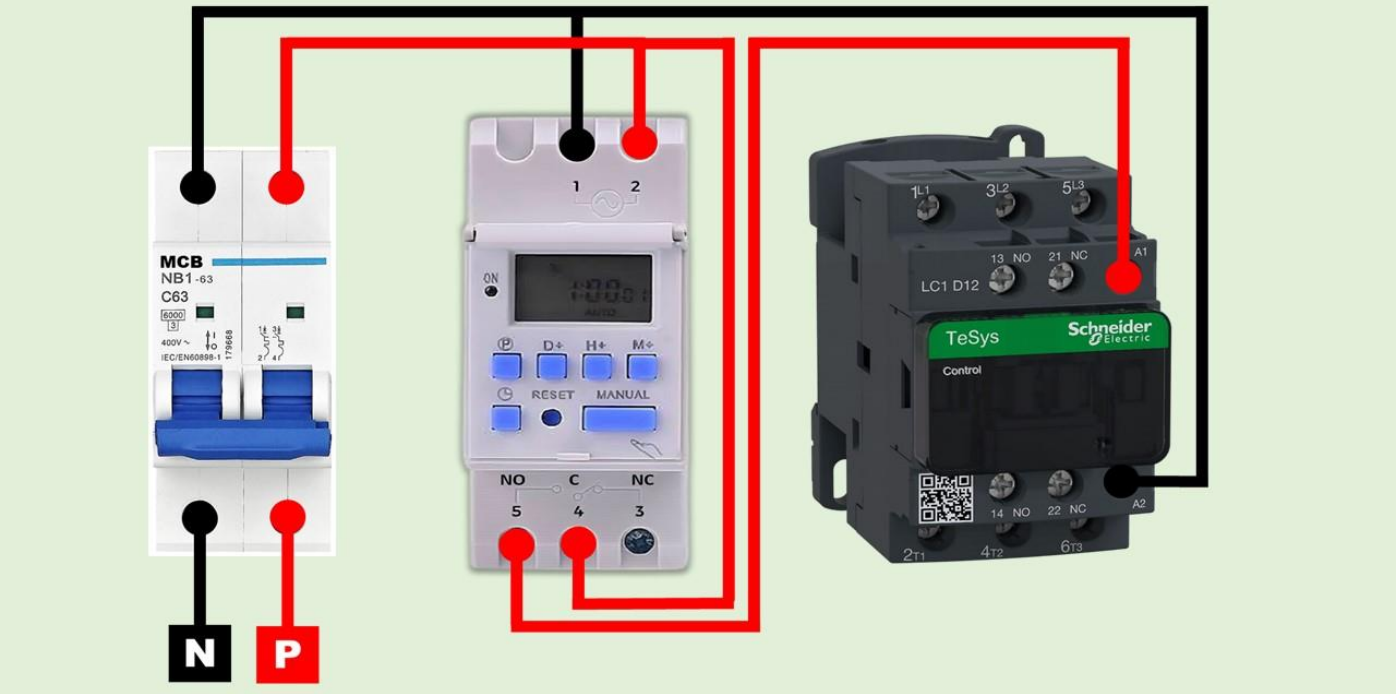
A timer is a device that can turn on or off any machine after some time. For example, in a star-delta starter, the motor is first run in star and then after a few seconds in delta. In this, the work of the timer is to switch off the star contactor and switch on the delta contactor.

Timers are used for automation. There are many types of timers according to their working, however, the most popular ones are analog timers are ON Delay Timer and Programmable Timer, Now there are many types of digital timers. I have made some videos on timers.

➢ Digital Programmable Timer

A digital programmable timer is an advanced electronic device used to automate the timing of electrical appliances or systems. Here are key points about digital programmable timers:

Digital Timer Connection with Contactor



Friends, if you want, you can also watch its video by clicking on this diagram

- **Functionality:** These timers allow users to set specific time intervals for turning electrical devices on or off automatically. They can be programmed to operate multiple times a day or week, offering flexible scheduling options.

- **Digital Interface:** They feature a digital display and controls for setting time, days of the week, and programming modes. Some timers also include LCD screens for easy viewing of settings.

- **Programmable Options:** Users can program timers to activate or deactivate connected devices at precise times, making them ideal for controlling lighting, heating/cooling systems, water pumps, and more.

- **Memory Backup:** Many digital timers have memory backup capabilities, retaining programmed settings even during power outages.

- **Accuracy:** Digital timers offer high accuracy in timekeeping, ensuring precise control over scheduled operations.

- **Versatility:** They come in various designs and configurations, including plug-in timers for household use and panel-mounted timers for industrial applications.

- **Benefits:** Digital programmable timers help save energy by automating device operation based on usage schedules. They also enhance convenience by eliminating the need for manual switching and monitoring of devices.

Overall, digital programmable timers are efficient, user-friendly tools that bring automation and energy efficiency to electrical systems in homes, businesses, and industrial settings.

➢ ON Delay Timer

An ON delay timer is a type of timer used in electrical circuits to delay the activation of a device or function after a trigger signal is received. Here's a short note on its connection, terminals, and working:

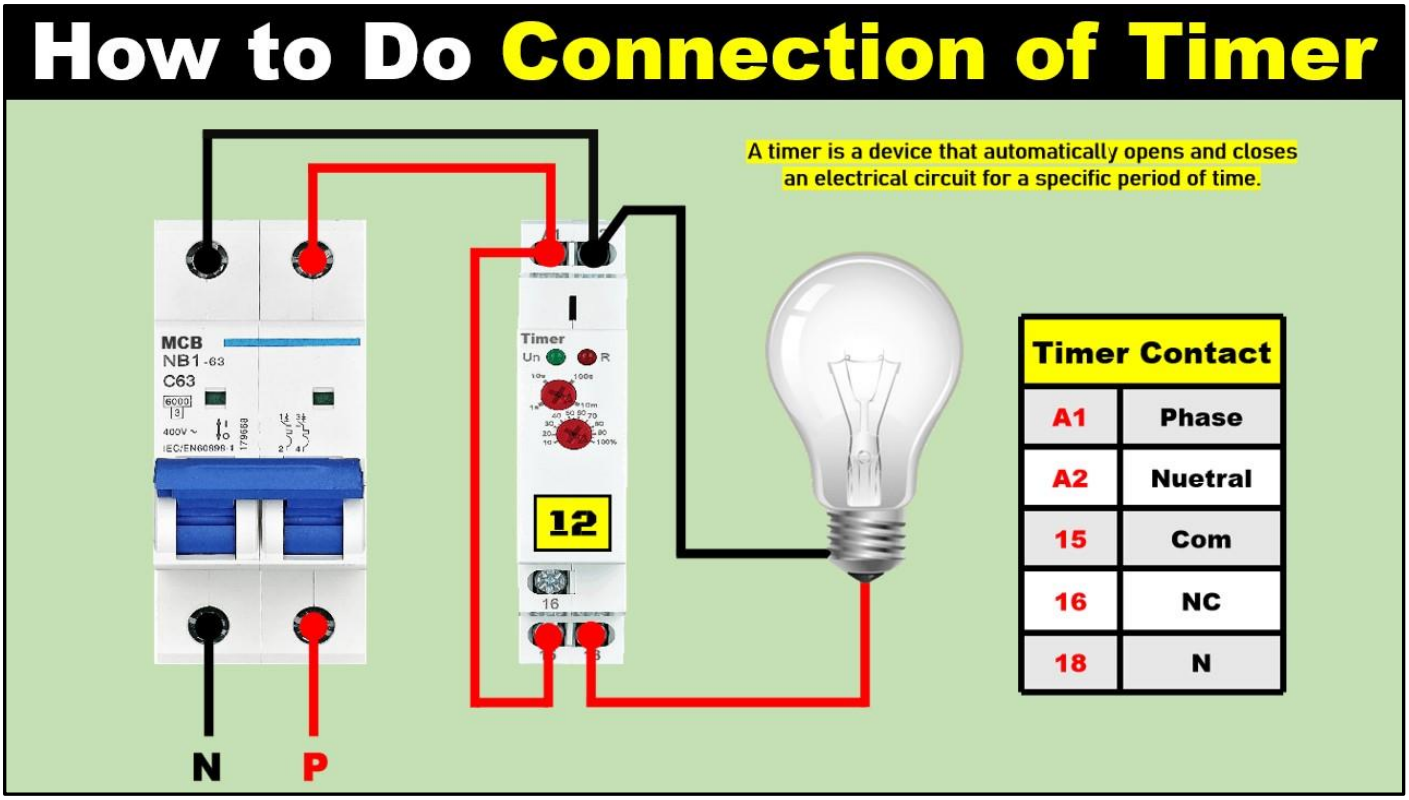
The ON delay timer is typically connected in series with the control circuit of the device or function it is controlling. This means that the power supply to the device passes through the ON delay timer. An ON delay timer usually has two type of terminals:

- **Control Input Terminals** (often labeled as + and - or A1 and A2): These terminals receive the trigger signal to start the timer's delay cycle.
- **Output Terminals:** output terminal are often labeled as C (Common), NO (Normally Open), and NC (Normally Closed)): The output terminals connect to the device or function being controlled. The NO and NC terminals act as switch contacts that change state based on the timer's operation.
- **Working:** When power is applied to the ON delay timer, the timer is energized and ready to operate. When a trigger signal is received at the control input terminals, the timer starts its delay cycle.

  - ➢ During the delay period, the timer's internal mechanism counts down the set time delay (e.g., in seconds or minutes).
  - ➢ After the delay time elapses, the timer's output terminals change state. For example, the NO contact may close (if normally open), or the NC contact may open (if normally closed).

- This change in state of the output contacts activates or deactivates the device or function connected to the timer, depending on the application.
- Once the delay cycle is complete and the output contacts change state, they remain in that state until the next trigger signal is received, starting the delay cycle again.

In summary, the ON delay timer delays the activation or deactivation of a device or function after receiving a trigger signal, providing a configurable delay period for control purposes in electrical circuits.



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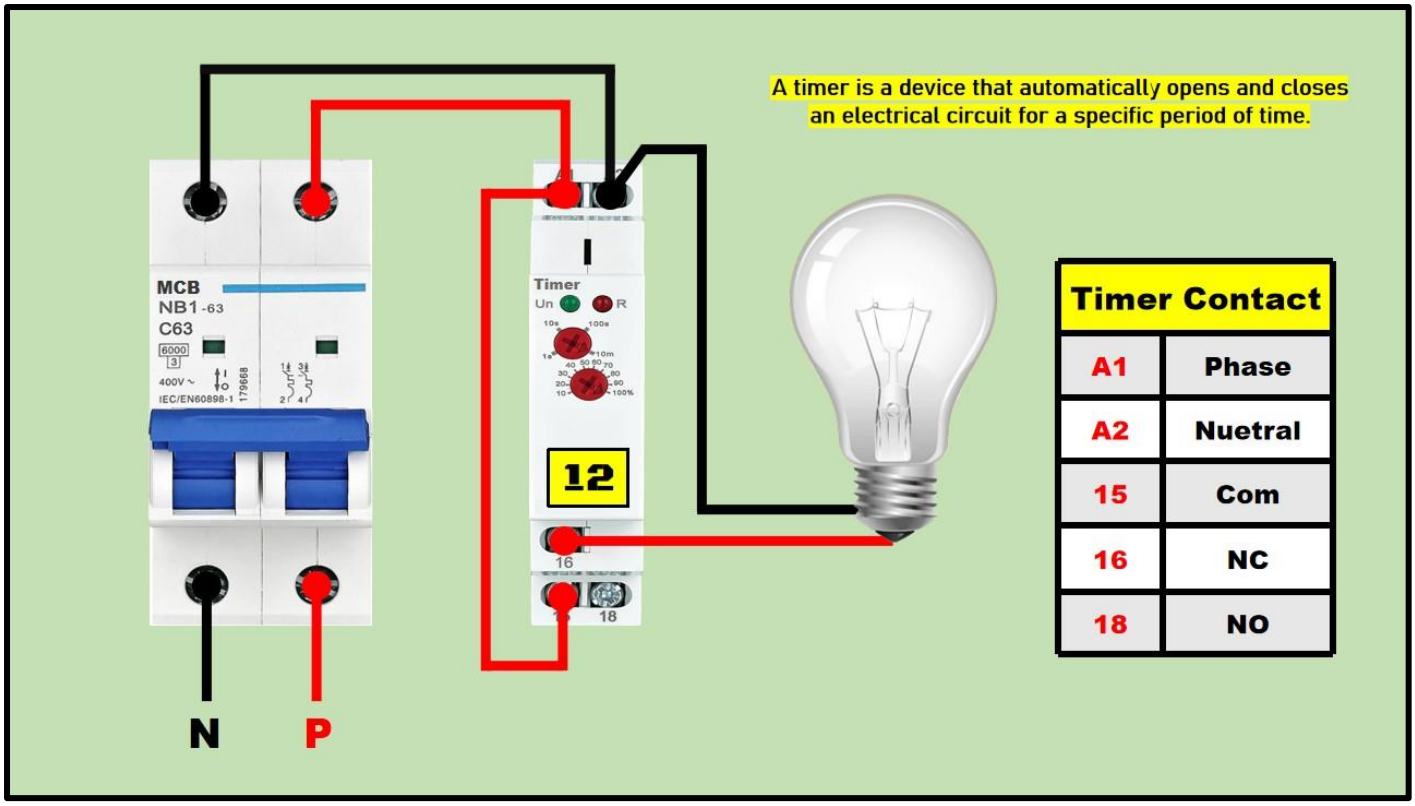
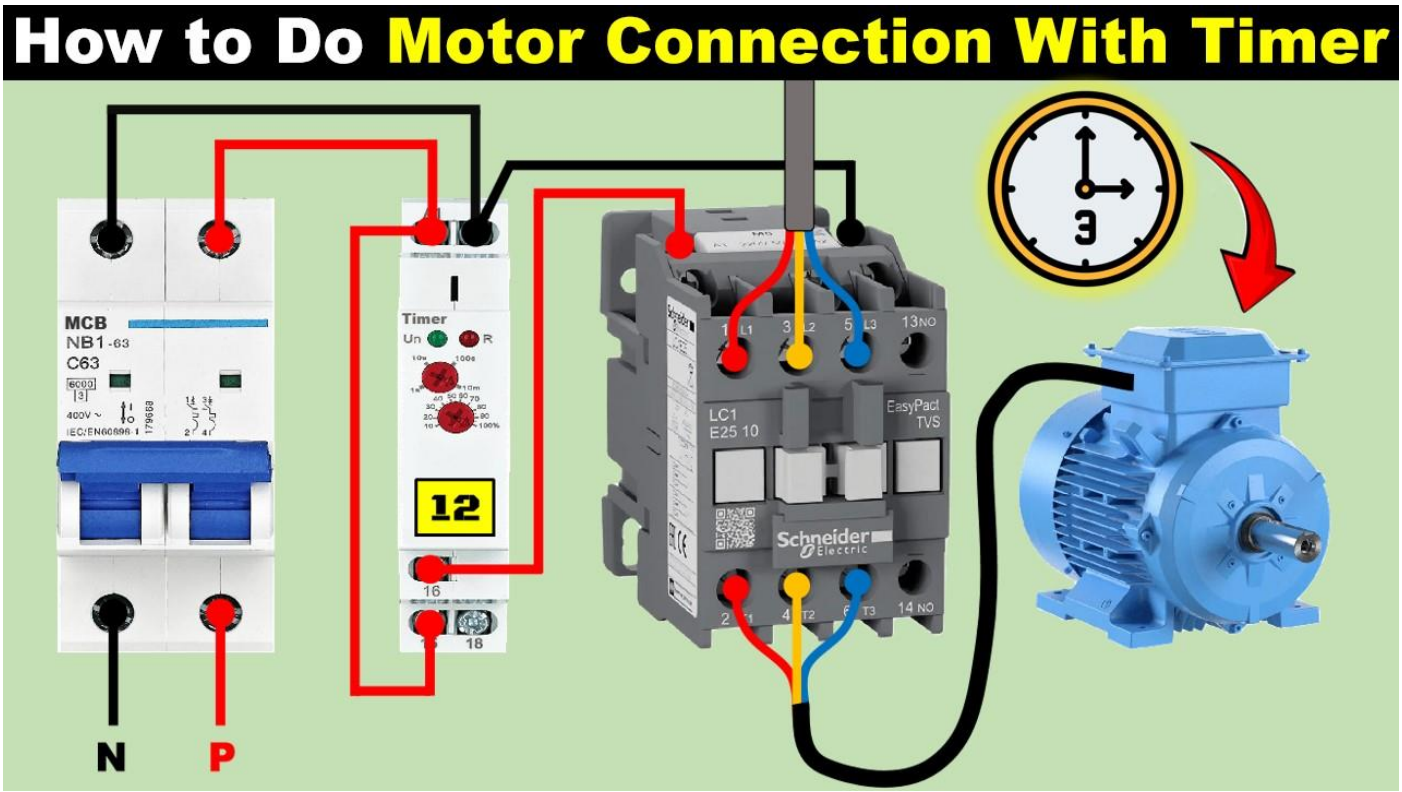
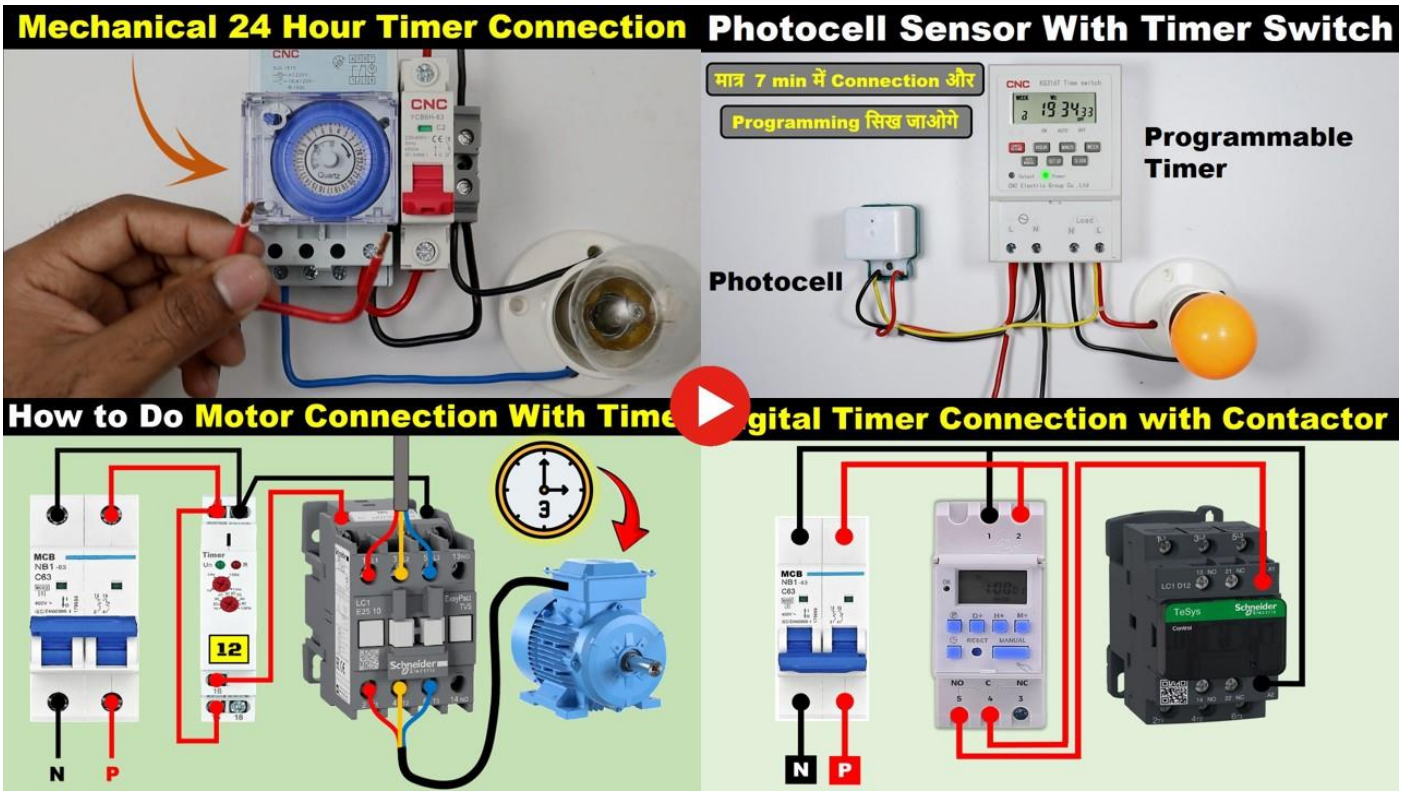

A timer is a device that automatically opens and closes an electrical circuit for a specific period of time.
MCB
NB1-63
C63
Timer
12
16
18
N
P
Timer Contact
A1 Phase
A2 Nuetral
15 Com
16 NC
18 NO


How to Do Motor Connection With Timer
MCB
NB1-63
C63
Timer
12
16
18
LC1
E25 10
EasyPact
TVS
Schneider
Electric
N
P

You can watch all my timer's video playlists by clicking on the video below.



Basic of Motor Starter's

26. What is a Starter:

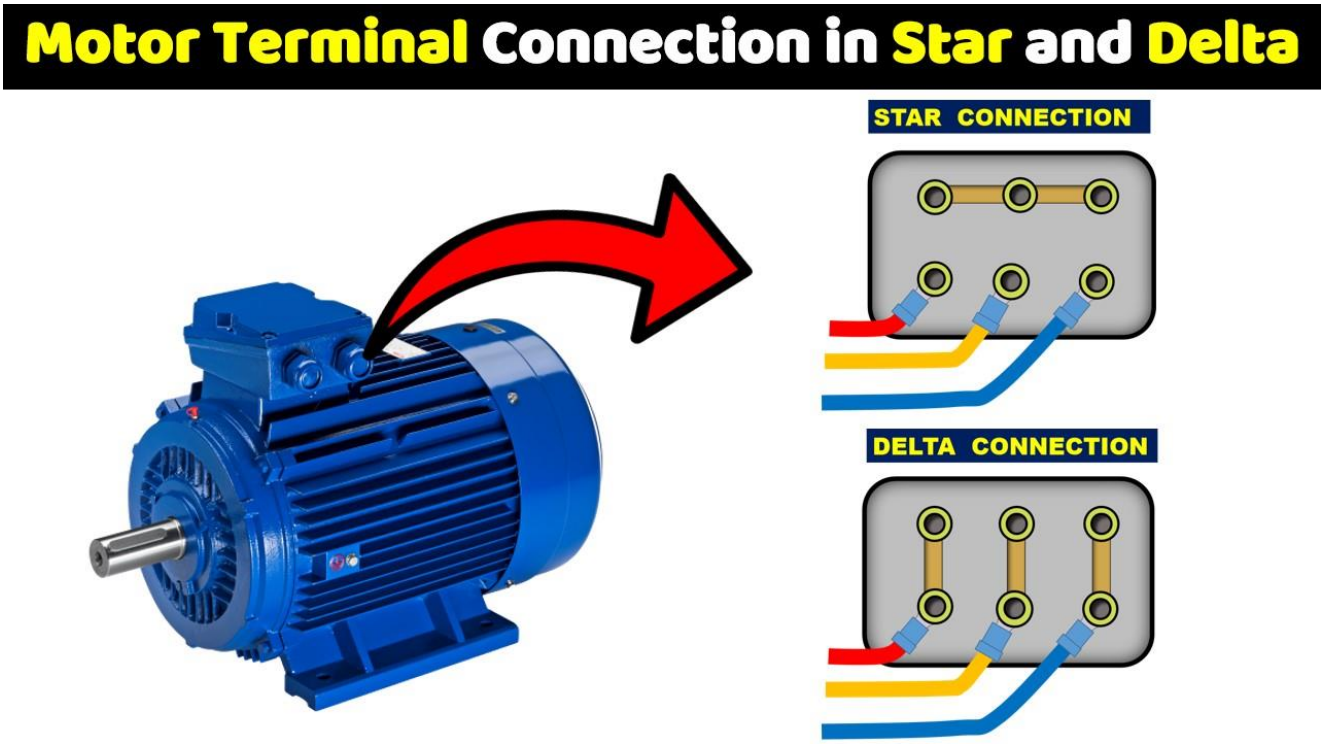
The starter controls the on or off of the motor or any electric machine and also protects the equipment from overloading. It is a type of controller and protection switch.

27. Different Types of the Motor Starter:

- **Direct-On-Line (DOL) Starter**
- **Auto Transformer Starter**
- **Star Delta Starter**
- **Reverse Forward Starter**
- **Soft Starter**
- **VFD Starter**

28. Motor Winding Connection

Motors can be connected in various configurations depending on the motor type and application requirements. Here are the common types of motor terminal connections:



Delta (Δ) Connection: In a delta connection, the motor windings are connected in a triangular configuration. Each winding is connected between two phase terminals, forming a closed loop. Delta connections are commonly used for motors with high starting torque requirements.

Star (Y) Connection: In a star connection, the motor windings are connected between phase terminals and a common neutral point. This configuration reduces the voltage across each winding compared to a delta connection. Star connections are often used for motors with lower starting torque requirements and where reduced starting current is beneficial.

29. Star Connection Wiring:

When a motor winding is connected in a star (Y) configuration, the following characteristics and effects can be observed:

- **Voltage:** The voltage across each motor winding in a star connection is reduced compared to the voltage across the winding in a delta (Δ) connection. This reduction in voltage is by a factor of √3 (square root of 3), which is approximately 1.732.

Star Connection	
Line Voltage=√3 Phase Voltage	Line Current=Phase Current

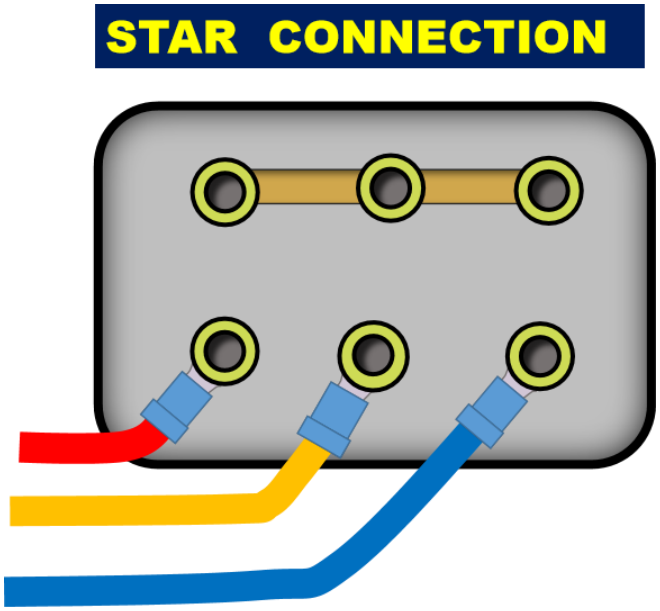
- **Current:** The line current (current flowing through the supply lines) in a star-connected motor is lower than the line current in a delta-connected motor for the same power output. This reduction in current can lead to reduced power losses and improved efficiency.

- **Phase Angle:** In a star connection, the phase angle between the line current and the phase voltage is 30 degrees, whereas in a delta connection, it is 0 degrees. This difference in phase angle affects the motor's performance characteristics, such as torque and speed.

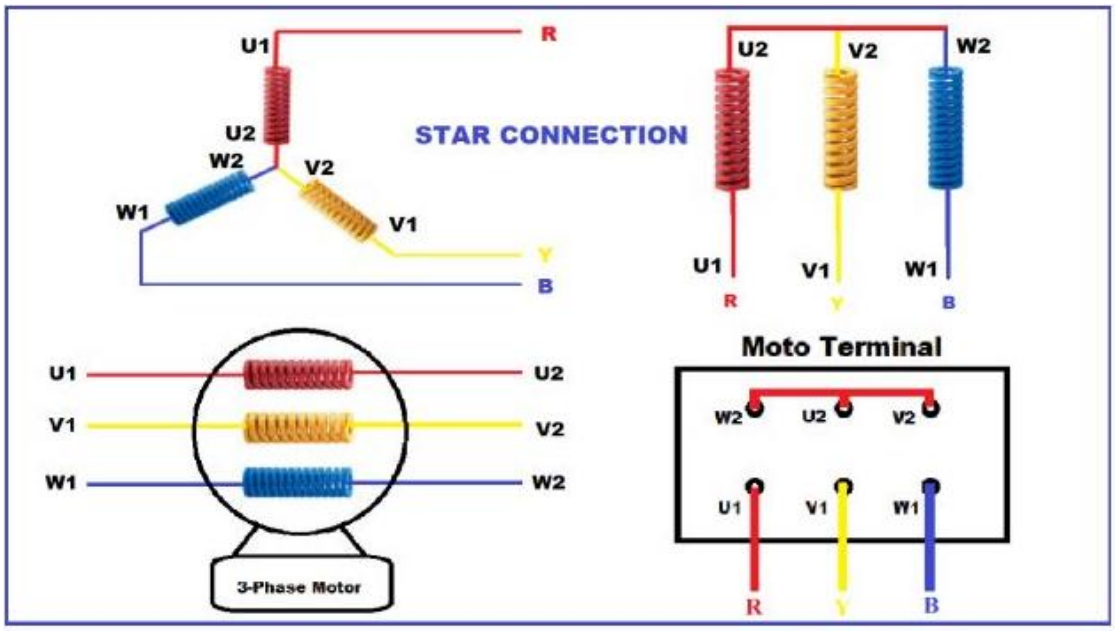
- **Starting Torque:** Star-connected motors typically have lower starting torque compared to delta-connected motors. However, they also have lower starting current, which can be advantageous in certain applications, especially where starting under load is not critical.

- **Winding Configuration:** In a star connection, the motor winding's are connected between phase terminals and a common neutral point. This configuration allows for

easy identification and connection of the winding's, simplifying motor wiring and maintenance.



Overall, connecting a motor winding in a star configuration offers advantages such as reduced line current, improved efficiency, simplified wiring, and lower starting current. However, it may result in lower starting torque compared to delta-connected motors, making it suitable for applications where starting torque requirements are moderate and efficiency is a priority.



30. Delta Connection Wirings:

When a motor winding is connected in a delta (Δ) configuration, several effects and characteristics can be observed:

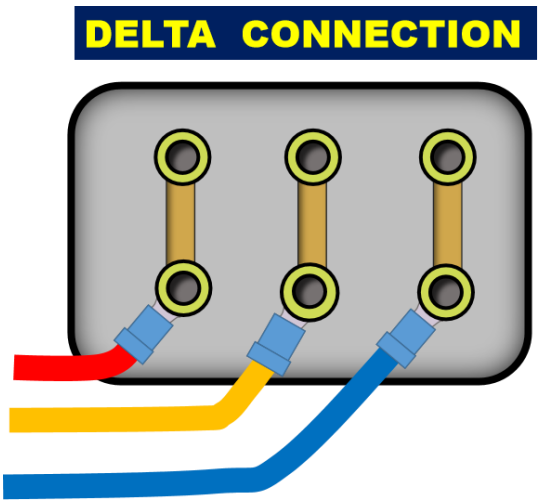
- **Voltage:** The voltage across each motor winding in a delta connection is the same as the supply voltage. This means that each winding experiences the full voltage of the power supply, which can be advantageous for motors requiring higher voltage levels.

Delta Connection	
Line Voltage=Phase Voltage	Line Current=√3 Phase Current

- **Current:** The line current (current flowing through the supply lines) in a delta-connected motor is higher than in a star-connected motor for the same power output. This higher current can result in increased power losses but may also provide higher starting torque, making delta connections suitable for applications requiring robust starting capabilities.

- **Phase Angle:** In a delta connection, the phase angle between the line current and the phase voltage is 0 degrees. This means that the current is in phase with the voltage, leading to certain operational characteristics such as high starting torque and consistent speed regulation.

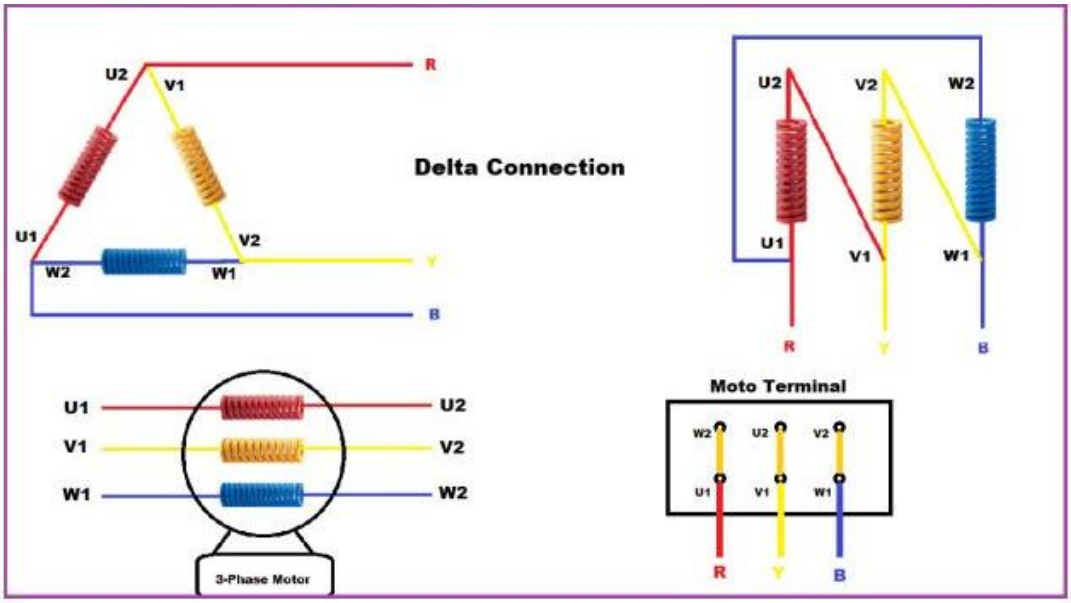
- **Winding Configuration:** In a delta connection, the motor windings are connected in a closed loop triangular configuration, with each winding connected between two phase terminals. This configuration simplifies motor wiring and allows for efficient power distribution.



- **Starting Torque:** Delta-connected motors typically have higher starting torque compared to star-connected motors. This can be advantageous in applications where

high torque is required during startup, such as in pumps, compressors, or conveyor systems.

Overall, connecting a motor winding in a delta configuration offers advantages such as higher voltage utilization, higher starting torque, and simplified wiring. However, it may also result in higher line currents and increased power losses compared to star-connected motors, making it suitable for applications where robust performance and starting capabilities are essential.



31. How to Select OLR Relay for DOL Starter

Min Thermal Overload Relay Selection =70% x Full Load Current
Max Thermal Overload Relay Selection =120% x Full Load Current
Thermal overload Relay setting =100% x Full Load Current (Line)

Suppose one of our motors takes 10 amps of current or the full load current of the motor is 10 amps, now we will select an overload relay of 7-12 amps for it.

When we connect the overload relay for the DOL starter, we will select an OLR Relay of minimum 70% and a maximum of 120% rating of the full load current of the motor.

You must have noticed that the overload relay installed in the DOL starter is installed before the contactor after the MCB and in some starters it is also installed below the contactor. Before our motor, the current is equal in both conditions.

Which is the set point of our relay, we cannot keep it more than FLC, either you can set it at full load current or check the current of the motor with a multimeter to see what is the running current and add a factor of x 1.15 on the running current, Like this we do the setting of the relay.

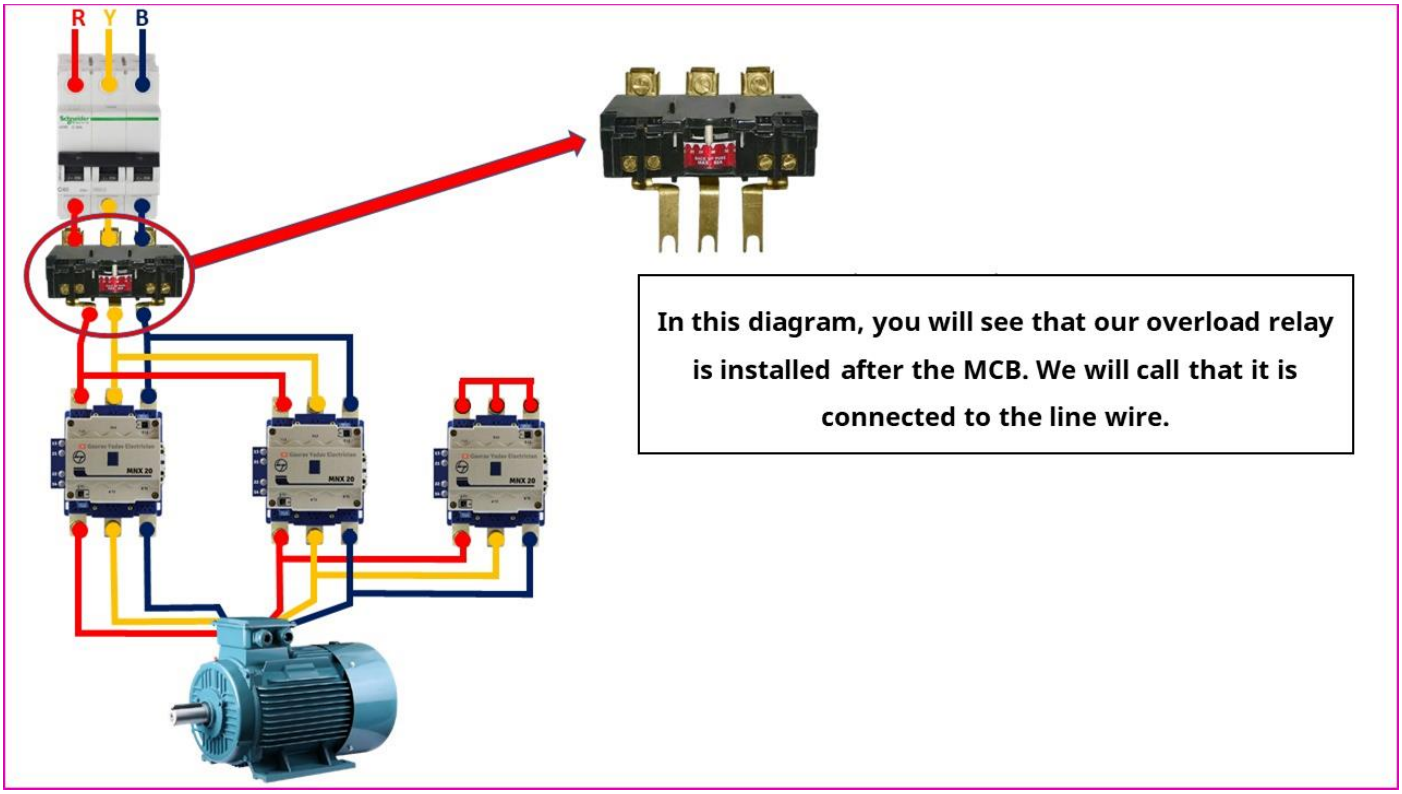
For example: let us assume that the running current of a motor is 15 Amps running current and FLC is 20 Amps, then we will multiply our factor by x 1.15 On running current 15A (15×1.15 = 17.25) and now the setting of our relay will come out to be **17.25Amp.**

32. How to Select OLR Relay for Star Delta Starter

Min Thermal Overload Relay Selection = 70% x Full Load Current
Max Thermal Overload Relay Selection = 120% x Full Load Current

For the star delta starter, we select the overload relay in two ways, either by installing the overload relay after MCB or by installing OLR below the Main contactor. The setting of the relay will be different in both the positions, I show you below.

Possibility No.1:



The set point for setting this relay will be set at the full load current of the motor, just like we set the overload relay in a DOL starter.

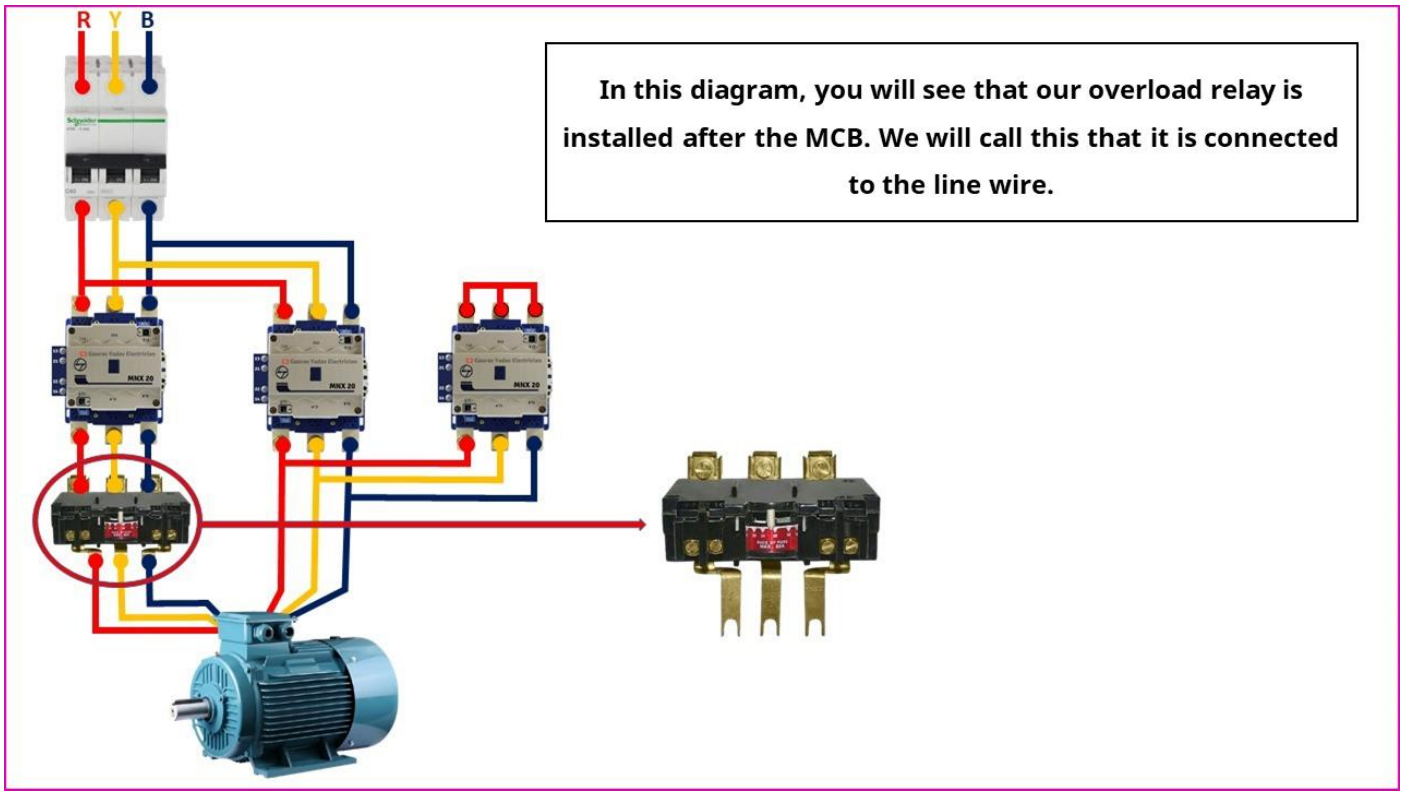
Either you can check the running current of the motor on time with a multimeter add a factor of x 1.15 to the running current and set your overload relay.

Possibility No.2:

If the overload is placed after the Point where the wiring Split into the main and delta Contactor, the Size of the overload relay at 58% (1/1.732) of the motor Full Load Current because we use 6 leads going to the motor, and only 58% of the current goes through the main set of conductors (connected to the main contractor)

In whichever star delta starter our relay is connected on the phase wire, to set the relay, we divide the full load current of the motor by √3 or (1.732), and the value that comes out is based on that value. We set up our relay.

For example: The full load current of a motor is 100A and our overload relay is set in the phase wire, so now we will divide 100A by √3 / 1.732 and the value that comes out will be 58A, so we have to set our overload relay at 58A have to set.



33. How to Select Contactor for DOL Motor Starter:

Size of Contactor = 100% X Full Load Current (Line)

When we select the contactor for Direct Online Starter (DOL), we have to check the full load current of the motor. Whatever is the full load current of our motor, we install the contactor of the same rating for our motor.

Example: There is a 10kW motor

10kW = 415 × √3 ×0.8

= 415 × 1.732 × 0.8
= 17.39 Amp

We saw that the full load current of a 10kW motor would be 17.39 Amps. Now whatever contactor we get that is bigger than this rating, we will install it on our direct online starter.

Here below I am showing you a chart of a direct online starter, by looking at this chart, you can also select the contactor MCB and wire/cable for the starter.

DOL STARTER								
H.P	KW	FLC	Contactor Size (Amp)	Relay setting		Fuse	Cable (mm2)	
				Min	Max		Cu	Allu
0.5	0.37	1	-	0.8	1.17	4	1	1.5
0.75	0.55	1.3	9	1	1.5	4	1	1.5
1	0.74	1.9	9	1.6	2.3	6	1.5	2.5
1.5	1.11	2.6	9	2	3	6	1.5	2.5
2	1.49	3.7	9	2.5	3.7	10	1.5	2.5
3	2.2	4.8	9	4	5.9	16	1.5	2.5
5	3.73	7.8	9	6.3	9.4	20	1.5	2.5
7	5.22	11.2	12	8	11.7	25	2.5	4
10	7.46	16	16	12.5	18.7	25	4	6
12.5	9.32	19	32	16	23.4	32	4	6
15	11.19	20.8	32	16	23.4	50	6	10
20	14.92	28	32	20	30	50	6	10

Calculate Size of Contactor, Fuse, Circuit Breaker and Overload Relay for DOL Starter

Calculate Size of each Part of DOL starter for The System Voltage 415V ,5HP Three Phase House hold Application Induction Motor ,Code A, Motor efficiency 80%,Motor RPM 750 ,Power Factor 0.8 , Overload Relay of Starter is Put before Motor.

Basic Calculation of Motor Torque & Current:

- Motor Rated Torque (Full Load Torque) = 5252 x HP / RPM
  = 5252 × 5 / 750 = 35 lb-ft.
- Motor Rated Torque (Full Load Torque) = 9500 x KW / RPM
  = 9500 x (5×0.746) / 750 = 47 Nm

- If Motor Capacity is less than 30 KW than Motor Starting Torque is 3xMotor Full Load Current or 2X Motor Full Load Current.

- Motor Starting Torque = 3 x Motor Full Load Current.
  = 3 × 47 = 142Nm.

- Motor Lock Rotor Current = 1000 x HP x figure from below Chart/1.732×415

Locked Rotor Current		
Code	**Min**	**Max**
A	1	3.14
B	3.15	3.54
C	3.55	3.99
D	4	4.49
E	4.5	4.99
F	5	2.59
G	2.6	6.29
H	6.3	7.09
I	7.1	7.99
K	8	8.99
L	9	9.99
M	10	11.19

N	11.2	12.49
P	12.5	13.99
R	14	15.99
S	16	17.99
T	18	19.99
U	20	22.39
V	22.4	

- As per above chart Minimum Locked Rotor Current = 1000 x 5 x 1/1.732 × 415
  = 7 Amp
- Maximum Locked Rotor Current =1000x5x3.14/1.732×415
  =22 Amp.
- Motor Full Load Current (Line) =KWx1000/1.732×415
  = (5×0.746)x1000/1.732×415
  =6 Amp.
- Motor Full Load Current (Phase)=Motor Full Load Current (Line)/1.732
  =6/1.732
  =4Amp
- Motor Starting Current = 6 to 7xFull Load Current.
  =7×6
  =45 Amp

(1) Size of Fuse:

Fuse as per NEC 430-52		
Type of Motor	Time Delay Fuse	Non-Time Delay Fuse
Single Phase	300%	175%
3 Phase	300%	175%

Synchronous	300%	175%
Wound Rotor	150%	150%
Direct Current	150%	150%

- Maximum Size of Time Delay Fuse = 300% x Full Load Line Current.
  = 300%x6
  = 19 Amp.

- Maximum Size of Non Time Delay Fuse = 1.75% x Full Load Line Current.
  =1.75%6
  =11 Amp.

2) Size of Circuit Breaker:

Circuit Breaker as per NEC 430-52		
Type of Motor	Instantaneous Trip	Inverse Time
Single Phase	800%	250%
3 Phase	800%	250%
Synchronous	800%	250%
Wound Rotor	800%	150%
Direct Current	200%	150%

- Maximum Size of Instantaneous Trip Circuit Breaker =800% x Full Load Line Current.
  =800%x6
  = 52 Amp.

- Maximum Size of Inverse Trip Circuit Breaker =250% x Full Load Line Current.
  =250%x6
  = 16 Amp.

(3) Thermal over Load Relay:

Thermal over Load Relay (Phase):

- Min Thermal Over Load Relay setting =70%xFull Load Current(Phase)
  =70%x4
  = 3 Amp

- Max Thermal Over Load Relay setting =120% x Full Load Current(Phase)
  =120%x4
  = 4 Amp

Thermal over Load Relay (Line):

- Thermal over Load Relay setting = 100% x Full Load Current (Line).
  =100%x6
  = 6 Amp

(4) Size and Type of Contactor:

Application	Contactor	Making Cap
Non-Inductive or Slightly Inductive ,Resistive Load	AC1	1.5
Slip Ring Motor	AC2	4
Squirrel Cage Motor	AC3	10
Rapid Start / Stop	AC4	12
Switching of Electrical Discharge Lamp	AC5a	3
Switching of Electrical Incandescent Lamp	AC5b	1.5
Switching of Transformer	AC6a	12
Switching of Capacitor Bank	AC6b	12
Slightly Inductive Load in Household or same type load	AC7a	1.5
Motor Load in Household Application	AC7b	8
Hermetic refrigerant Compressor Motor with Manual O/L Reset	AC8a	6
Hermetic refrigerant Compressor Motor with Auto O/L Reset	AC8b	6
Control of Restive & Solid State Load with opto coupler Isolation	AC12	6
Control of Restive Load and Solid State with T/C Isolation	AC13	10

Control of Small Electro Magnetic Load (<72VA)	AC14	6
Control of Small Electro Magnetic Load (>72VA)	AC15	10

As per above Chart

- Type of Contactor = AC7b
- Size of Main Contactor = 100%X Full Load Current (Line).
  =100%x6
  = 6 Amp.

- Making/Breaking Capacity of Contactor = Value above Chart x Full Load Current (Line).
  =8×6
  = 52 Amp.

34. How to Select Contactor for Star Delta Motor starter:

Main and Delta Contactor

The Current of main Contactor and delta contactor is similar to the current rating of DOL Starter Contactor Current rating. So in star delta starter you can find the contactor current rating by similar method by which you find current rating of DOL Starter Contactor.

Star Contactor

The third contactor is the star contactor, which only carries star current while the motor is connected to the star in starting. The current in star winding is 1/√3= (58%) of the current in delta, so this contactor can be rated at 1/3 (33%) of the motor rating. The star contactor can be selected smaller than the others, provided the star contactor pulls first before the main Contactor. Then no current flows when the third contactor pulls.

The rating of the star contactor is 33% of the full load current of the motor.

Here below I am showing you a chart of a direct online starter, by looking at this chart, you can also select the contactor MCB and wire/cable for the starter.

Selection of Motor Starter -Contactor-Relay- Fuse -Cable										
Motor Rating (3 Phase,415 V)		Full Load Current (Amp	Phase Current (Amp)	Contactor Capacity (Amp)		Relay Scale (Amp)		Back up Fuse HRC (Amp)	Cable Size (Sq.mm)	
HP	KW			Main/ Delta	Star	Min	Max		Supply Side	Motor Side
3	2.25	5	2.88	12	12	1.5	4	10	1.5/2.5	1.5/2.5
5	3.75	7.5	4.32	12	12	3	6	20	1.5/2.5	1.5/2.5
7.5	5.5	11	6.34	12	12	6	10	25	2.5	1.5/2.5
10	7.5	14	8.1	16	16	6	12	25	4	1.5/2.5
12.5	9.3	18	10.02	16	16	8	12	35	4	2.5
15	11	21	12.1	16	16	11	16	50	6	2.5
20	15	28	16	30	30	14	20	63	10	4
25	18.5	35	20.2	30	30	17	25	63	16	6
30	22	40	23	30	30	17	25	100	16	6
35	26	47	27	38	30	22	32	100	25	10
40	30	55	30.3	38	30	22	32	100	25	16
45	33.5	60	34.6	70	30	25	40	125	35	16
50	37	66	35	70	70	25	40	125	35	16
60	45	80	45	70	70	38	63	125	50	25
65	28.5	87	50	70	70	38	63	160	70	35
70	52	94	54	70	70	38	63	160	70	35
75	56	100	57.5	70	70	38	63	160	70	35
90	67.5	120	69	105	70	50	90	200	95	50
100	75	135	78	105	70	50	90	200	95	50

35. How to Select Right Circuit Breaker for Motor starter:

When we select an MCB for our motor, we have to see what is the full load current of the motor. After that, we take an MCB of 250% rating of the full load current of our motor. Mostly we use it in our starter. Use C Type MCB.

Because the tripping current of C Type MCB is 5-10 times.

Here below I'm showing you a chart, you can select your MCB by looking at this chart.

Maximum Inverse Trip Circuit Breaker Size =250% x Full Load Line Current.

Types of Motor	Circuit Breaker of FLC
Single Phase Motor	250%
3 Phase Motor	250%
Synchronous	250%
Direct Current	150%

For example: A 5HP motor is connected to a DOL starter. Now we will first find its full load current.

Power = √3 × Voltage × Current ×Cos ϕ
5HP to kW = 5 × .75kW
3.75kW = 1.732×415×I×0.8
3750Watt = 575×I
I = 3750/575
I = 6.6 Amp

Now the starting current of our motor will be 6 to 7 times more, meaning the starting current of a 5HP motor will be approximately 42-50 Amp.
Now what we will do is take out 150% of 6.6 Amp (6.6*150%/100) which will be 9.9 Amp. Now whatever MCB we have available in the market that is bigger than this rating, we will install the same MCB on our motor.

36. How to Select the Right Cable size for the motor starter:

Size of Cable for Single Motor

- The size of the Cable for the Branch circuit which has a motor connection is 125% of the Motor's Full Load Current Capacity.

Example: what is the minimum rating in amperes for Cables supplying 1 No of 5 hp, 415-volt, 3-phase motor at 0.8 Power Factor. Full-load currents for 5 hp = 7Amp.

- Min Capacity of Cable= (7X125%) =8.75 Amp.

Size of Cable for Group of Motors or Electrical Load

Calculating the minimum Ampere Capacity of the Main feeder and Cable is 125% of the Highest Full Load Current + the Sum of the Full Load Current of the remaining Motors.

Example: -

- Full-load currents for 5 hp = 7Amp.
- Full-load currents for 10 hp = 13Amp.
- Full-load currents for 15 hp = 19Amp.
- Full-load currents for 10 hp (1 Ph) = 21Amp.
- Here Capacity wise Large Motor is 15 Hp but the Highest Full Load current is 21Amp of 5hp Single Phase Motor so 125% of the Highest Full Load current is 21X125%=26.25Amp
- **Min Capacity of Cable= (26.25+7+13+19) =65.25 Amp**

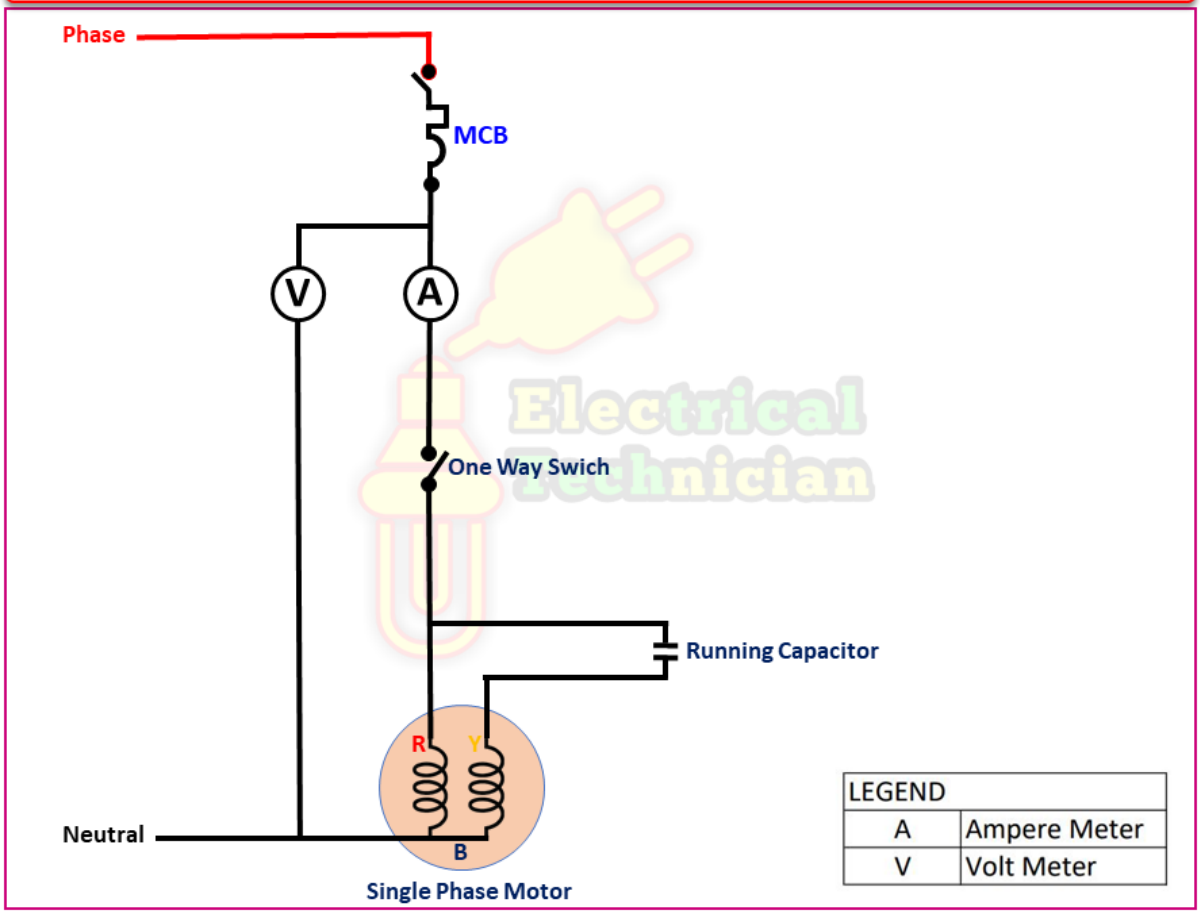
Single Phase Starter

37. Single Phase Starter with One Capacitor and with One way Switch Single Line diagram:

This starter is used to start and stop a motor up to 1HP, we use it in those places where the water level is above 40 to 50 feet, so there is not much load on the motor, in those places we use only one capacitor. And with the help of the 16-ampere switch, the motor can be switched on and off.

I have shown you the single-line diagram of the starter, where the supply comes out from the MCB and goes to our ampere meter. After the ampere meter, the supply goes inside our one-way switch installed and then the supply is connected to the terminals of the motor. And we connect both the wires of our capacitor, which we call the running capacitor **and connect it to the R and Y ends of the motor.**

Single Phase Motor Connection With Capacitor & With One Way Switch



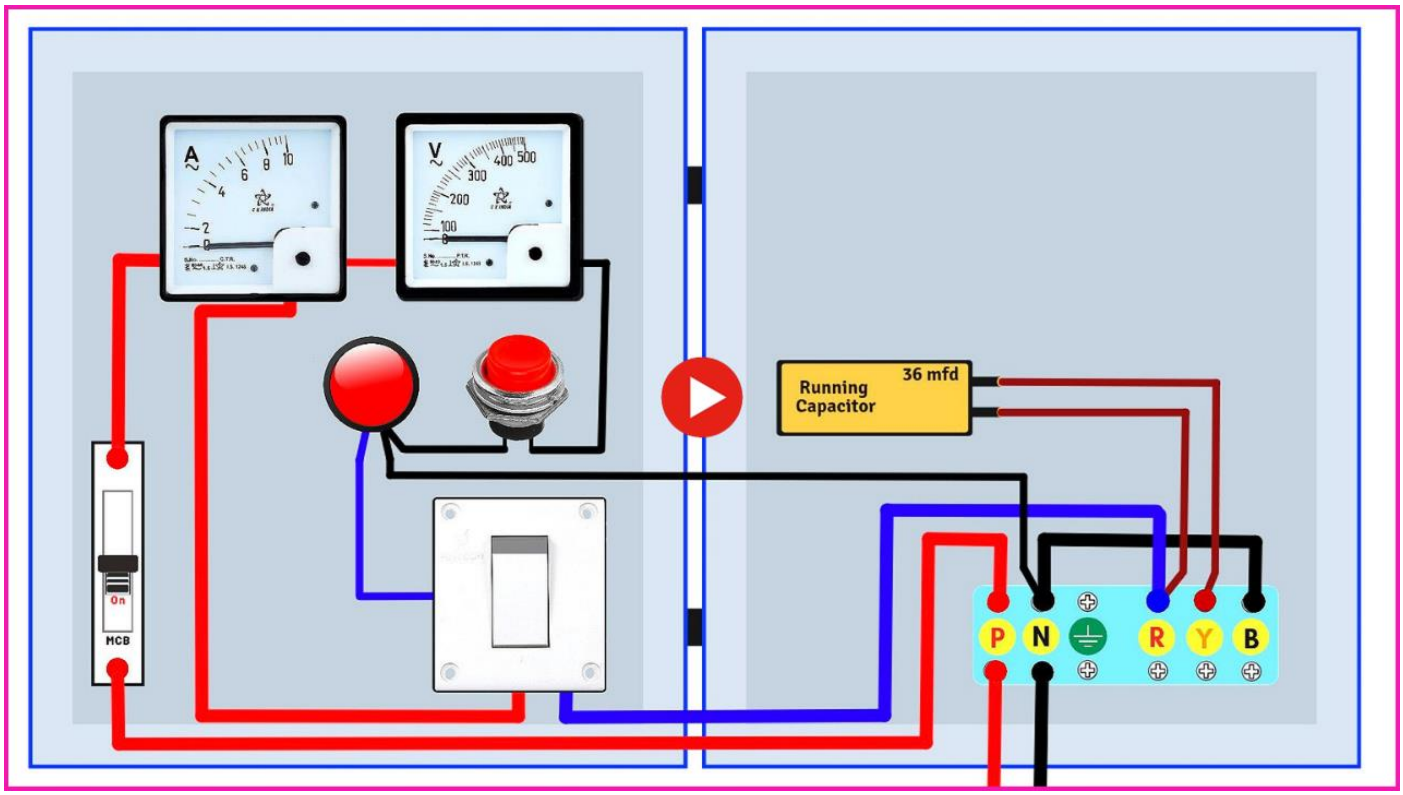
Friends, you must have noticed here that I have shown you three RYB terminals inside the single-phase motor. B terminal I have considered neutral and on the RY terminal I have connected the capacitor wires. But here you do not need to worry, this is not a three-phase motor, it is a single-phase motor and there are two windings inside the single-phase motor, one running winding and the other starting winding. Connect one end of the running winding and the starting winding. Which is called B point and we give neutral in it. One point left of the running winding is named R and the second point left of the starting winding is named Y. On which the wires of both the capacitors are connected. Now our single-phase supply is connected to the R point. The Y point remains empty. I am sharing with you some practical photos of a single-phase starter or single-phase motor. So that you never get confused in the future whether it is a three-phase motor or a signal phase motor, here in RYB three wires come out of the motor but the supply is connected only to B and R wires.

38. Single Phase Starter with One Capacitor and with One way Switch-3D View:

Components: -

Quantity	Device Name
1 Pc	One Way Switch 16Amp
1 Pc	Single Pole MCB
1 Pc	Indicator Lamp On
1 Pc	NO Push Button for Voltage test
1 Pc	Running Capacitor
Wire	As per motor Rating
1 Pc	Ammeter
1 Pc	Voltmeter

Below I have shown the 3D view of the starter, seeing which you can make connections to the starter. If you want to watch the video of this starter, then you will click on the icon of this starter and you will be able to watch the video.



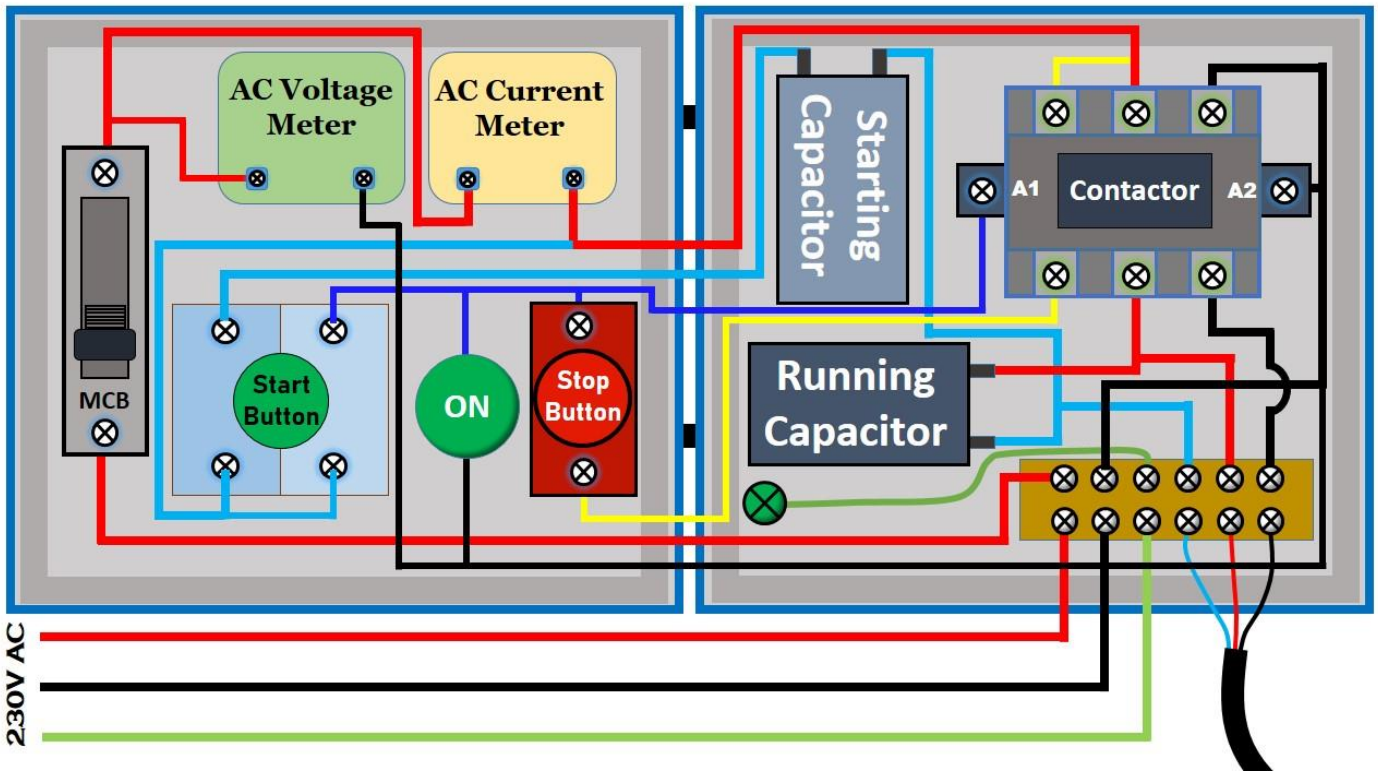
39. Single Phase starter with Double Capacitor & With Contactor – 3D View:

Our green push button installed in this starter has four terminals inside it. As soon as we press our green push button, the supply from one point goes to our contactor and from the other point the supply goes to our starting capacitor. In this we have to press and hold the green push button for 3/5 seconds.

Components: -

Quantity	Device Name
1 Pc	3Pole/ 2Pole Contactor & Over-Load Relay
1 Pc	Single Pole MCB
1 Pc	NC Push button for Motor Off
1 Pc	2 Pole NO push Button for Motor ON
1 Pc	NO Push Button for Voltage test
1 Pc	Running Capacitor
1 Pc	Starting Capacitor
Wire	As per motor Rating
1 Pc	Ammeter
1 Pc	Voltmeter

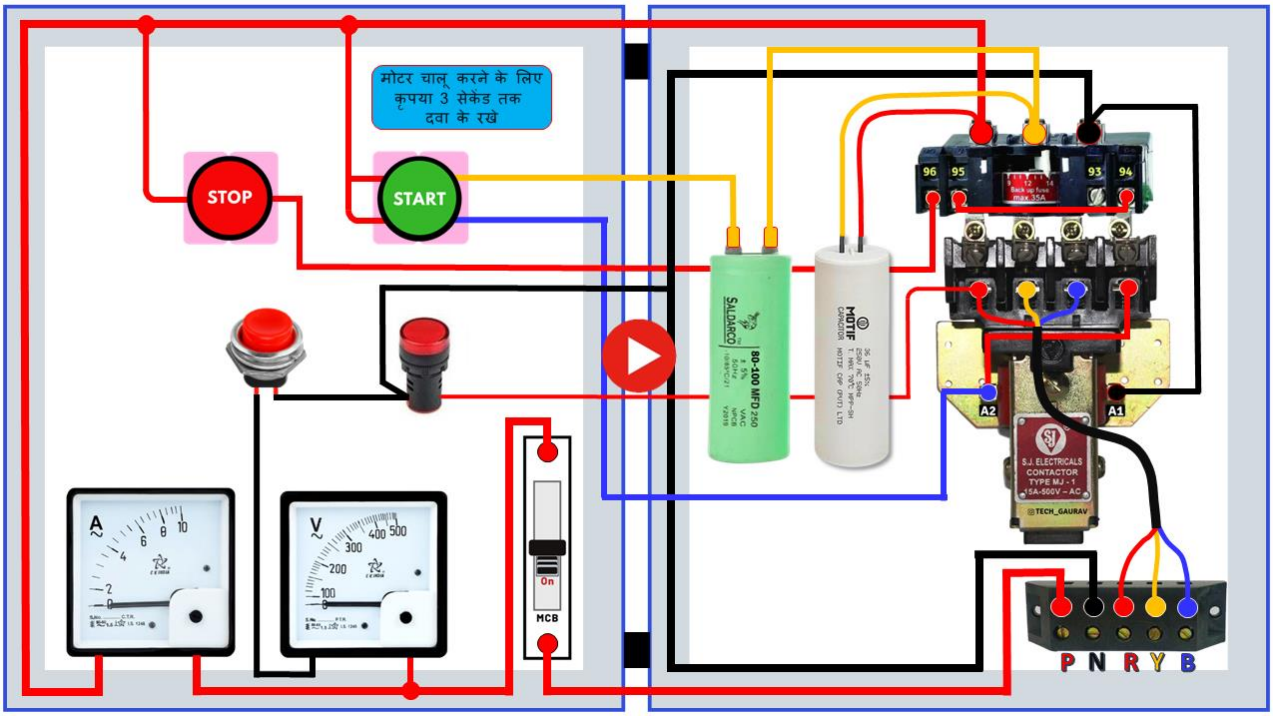
Dear, By clicking on the Image of this starter, you can watch the video how to do Connection



40. Single Phase MK1 starter (Double Capacitor)– 3D View:

This starter is our old type of starter, we use it in a phase starter or single-phase starter. There are two capacitors installed in this starter, one running capacitor and the other starting capacitor. In this starter also have to press the green push button for 3 seconds. It has to be done and maintained.

Dear, you will click on the icon of this starter, and you will be able to watch the video.

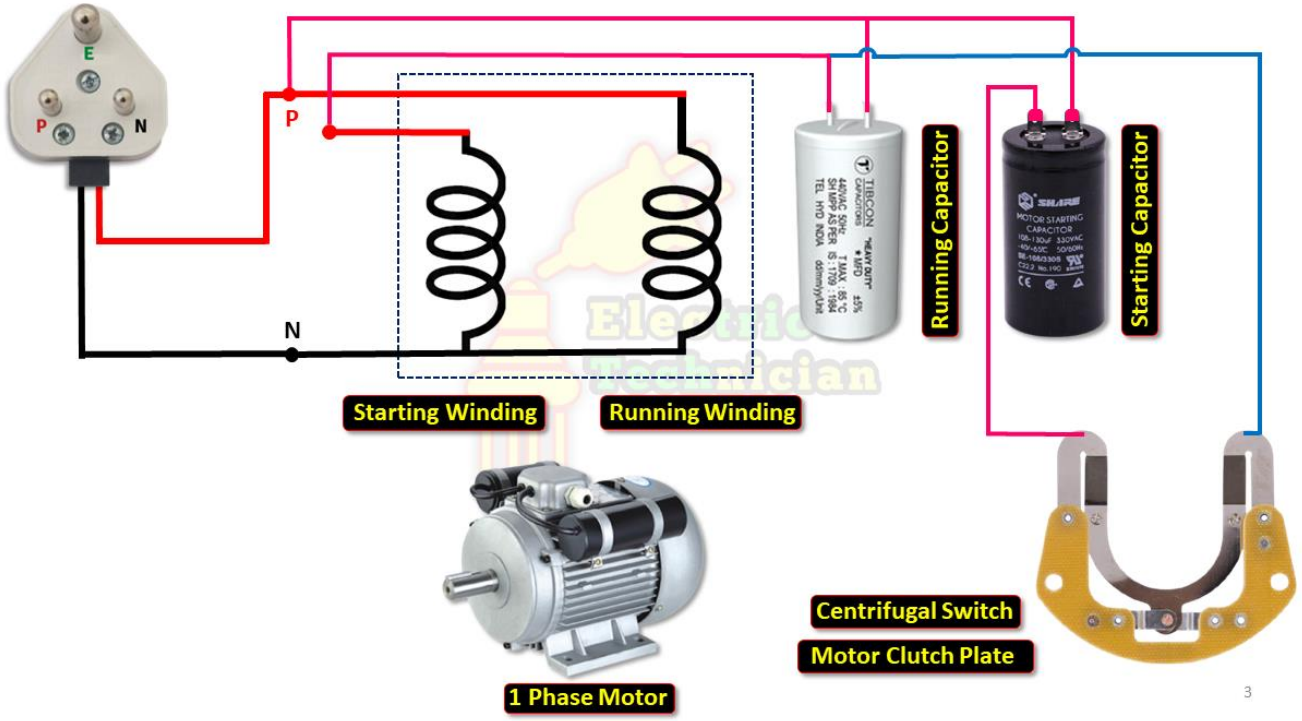


41. Single Phase Motor both Capacitor Connection & Control wiring with Plug Top/MCB:

There are 2 capacitors installed in a single-phase motor because a single-phase motor does not start itself, so to provide the starting torque, a starting capacitor is also installed there. A clutch plate is also used to connect the starting capacitor. Which is called a centrifugal switch.

In some single-phase motors, you get to see only one capacitor, like our ceiling fan has become a fan, in all the small motors of single phase, only one capacitor is installed in them, which we call a permanent capacitor which is used for starting. It also gives torque and remains in the circuit continuously because you must have seen that if we remove the capacitor of the fan while the fan is running, the speed of the fan reduces, from this you can clearly understand that the capacitor installed is our constant power. Remains in the circuit.

If you want to watch this video, then click on the icon of this video and you will be able to watch the video.



42. Automatic Water level Controller.

An Automatic Water Level Controller is a device designed to automate the process of maintaining water levels in the tank. Here's a brief overview of its functionality and benefits:

- **Functionality:** The controller uses sensors or probes to detect the water level inside the tank. Based on the water level readings, it automatically controls the water inlet valve or pump to maintain the desired water level.

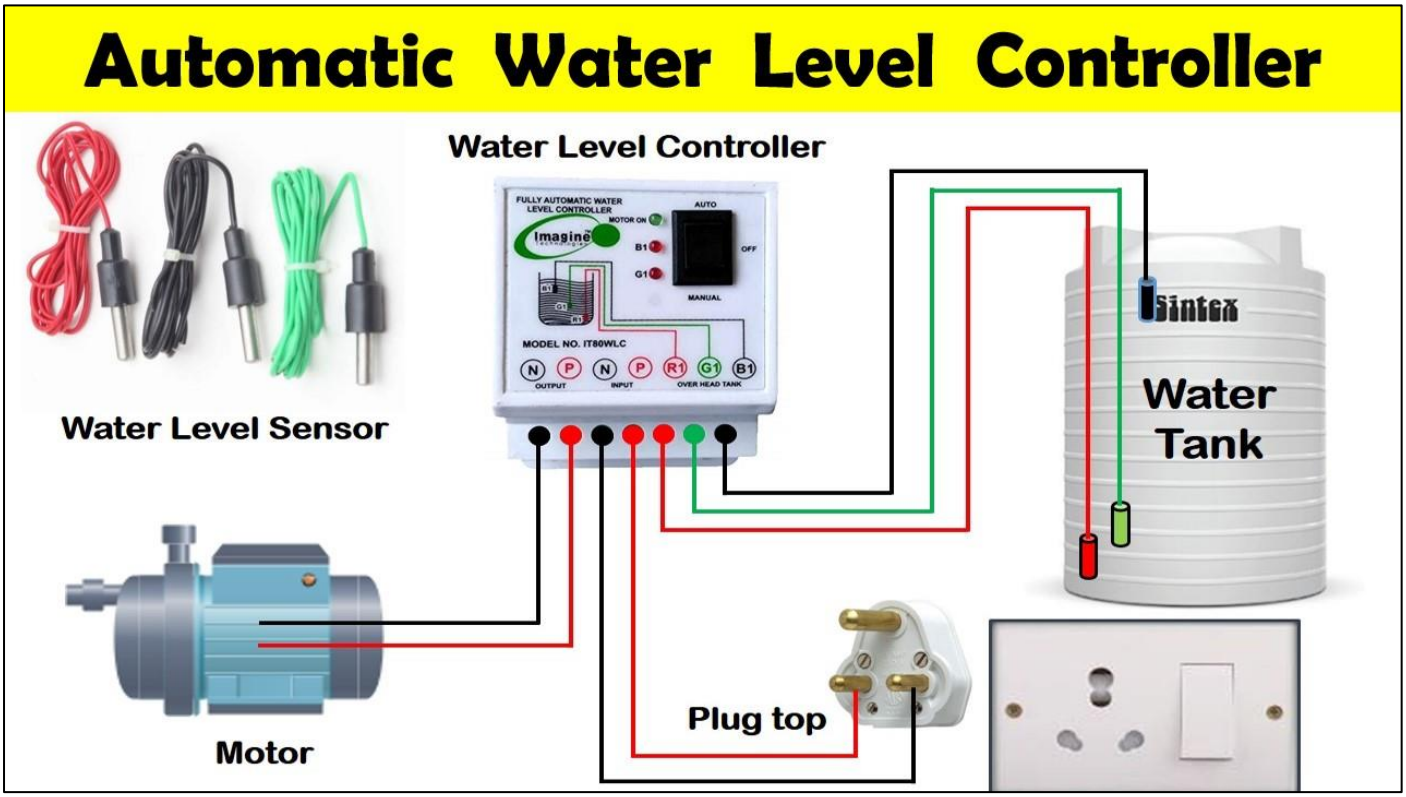
- **Components:** The key components of an Automatic Water Level Controller include:
  - **Water Level Sensors/Probes:** These sensors are placed at different levels in the tank to monitor the water level.
  - **Control Unit:** The control unit processes the input from the sensors and controls the water inlet valve or pump.
  - **Indicator Lights/Display:** Some controllers feature indicator lights or a display to show the current water level status and system operation.

- **Working Principle:** When the water level drops below a certain point (low-level threshold), the controller activates the water inlet valve or pump to refill the tank. Conversely, when the water level reaches a high-level threshold, the controller shuts off the valve or pump to prevent overfilling.

- **Benefits:**
  - **Water Conservation:** By maintaining precise water levels, the controller helps conserve water by avoiding unnecessary overflow or wastage.
  - **Convenience:** It eliminates the need for manual monitoring and operation of the water supply, providing convenience to users.
  - **Prevents Overflow:** The automatic control prevents the tank from overflowing, reducing the risk of water damage and wastage.
  - **Energy Savings:** By controlling the water pump operation based on demand, the controller can contribute to energy savings.

- **Applications: Automatic Water Level Controllers are commonly used in residential, commercial, and industrial settings where there is a need to automate water level management in overhead tanks, sumps, or reservoirs.**

Click on the diagram below and practice in your proper way. You can watch the video.



Direct Online Starter (DOL)

43. DOL Starter Working Principle

DOL Starter There is a simple starter that we use to start and stop the motor. It's made through with a contactor and overload relay. It’s useful for motors having a rating of 5HP or less than 5HP.

If we start a motor once and do not turn it off or on again and again, it means that we have started the motor once and it runs continuously for 10-12 hours still, we can install a DOL starter in the motor up to 10kW or even bigger.

Direct On Line Starter does not reduce the starting current. It connects the motor directly with the line, and an overload relay is used to protect the motor. In case of any kind of fault in the motor, the Overload Relay automatically stops the supply from the Contactor.

To start and stop the supply from the contactor, two buttons Red and Green are provided in the starter, and an Auxiliary contactor is used to hold the supply to the contactor.

Materials used in Direct On-Line Starter:

Components: -

Quantity	Device Name
1 Pc	3Pole Contactor & Over-Load Relay
1 Pc	3 Pole MCB/ MCCB
1 Pc	Single Pole MCB 6Amp for Controlling
1 Pc	NC Push button
1 Pc	NO Push Button
3 Pc	Indicator On, Off & Trip
Wire	1/1.5 Sq. mm

Disadvantages of DOL Starter:

- **The starting current of DOL Starter is very high and the starting current cannot be reduced.**

- **When the starter is started, the line voltage becomes very low and this affects all the equipment connected to the line.**

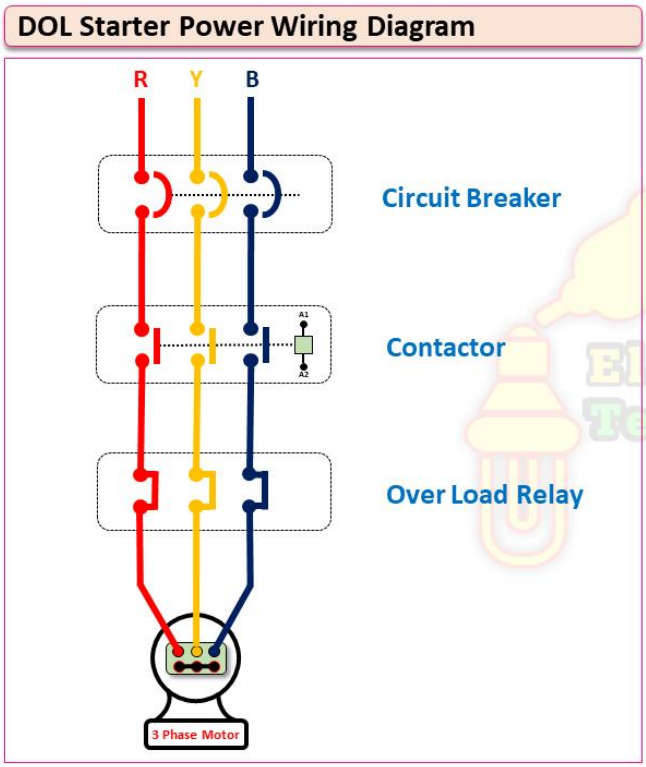
Precautions while connecting Direct On-Line Starter:

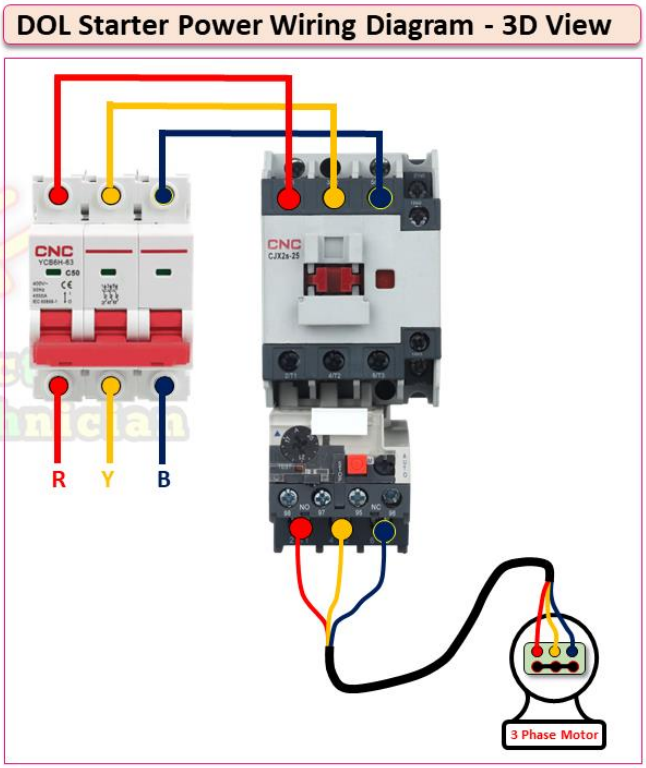
1. Tighten the NC and NO switches in the push button properly so that there is no problem in pressing the push button.
2. While making the connection, take only as much wire as is required for the wiring. Taking more wire will spoil the dressing of the wiring.

After connecting the motor, run the motor and see that the motor is rotating in a straight direction. Or not, if the motor is not rotating in a straight direction, then the wire which is connected to the contactor. Interchange any two wires of RYB so that the motor will start rotating straight.

44. DOL Power Wiring Diagram & Power Wiring-3D View.

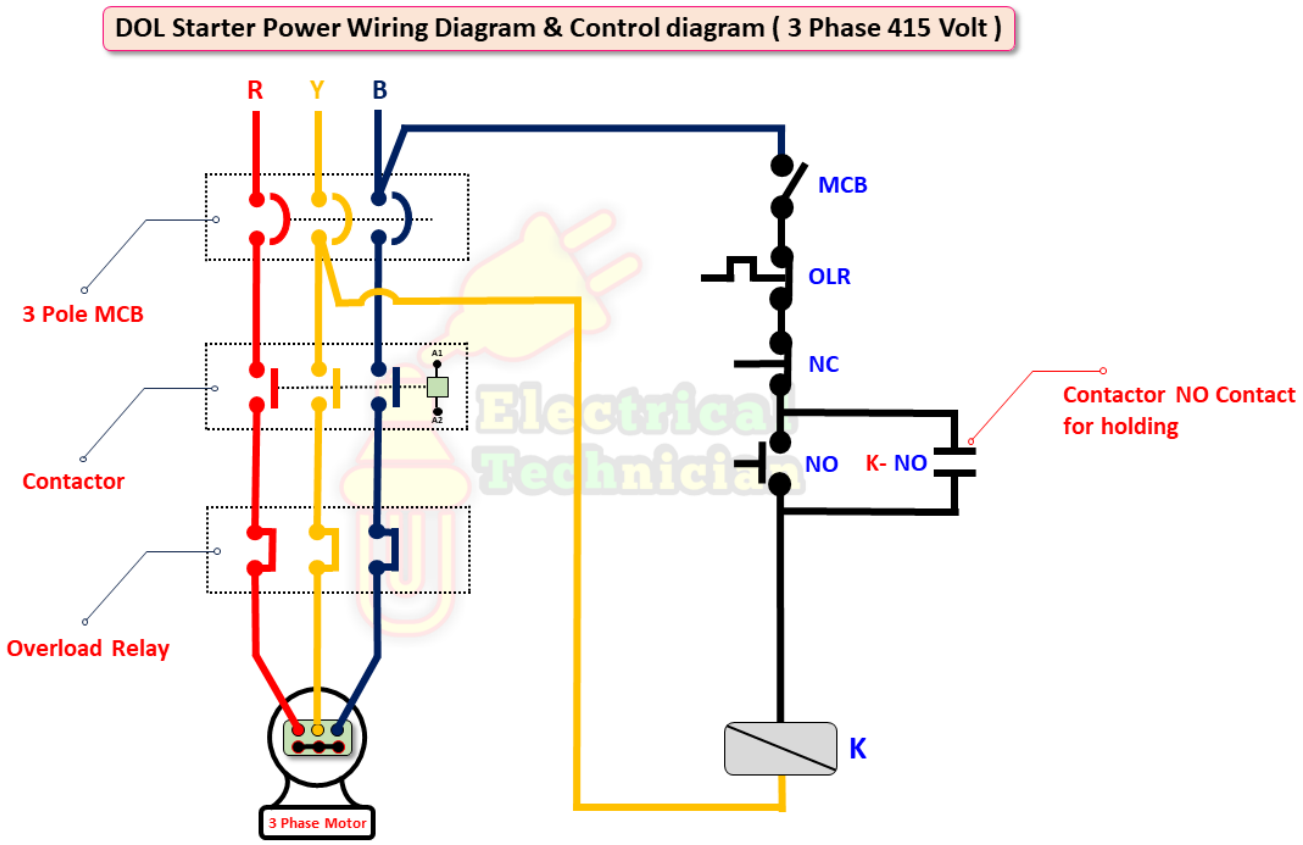
Making the power circuit diagram of a DOL starter is quite simple. First, we will take a three-pole or four-pole MCB, after that we will take the supply to the contactor and after that, our overload relay is installed below the contactor. Below the overload relay, we have the terminals of our motor. Which can be connected to a star or a delta.





45. DOL Single line Control wiring 3 Phase 415 Volt

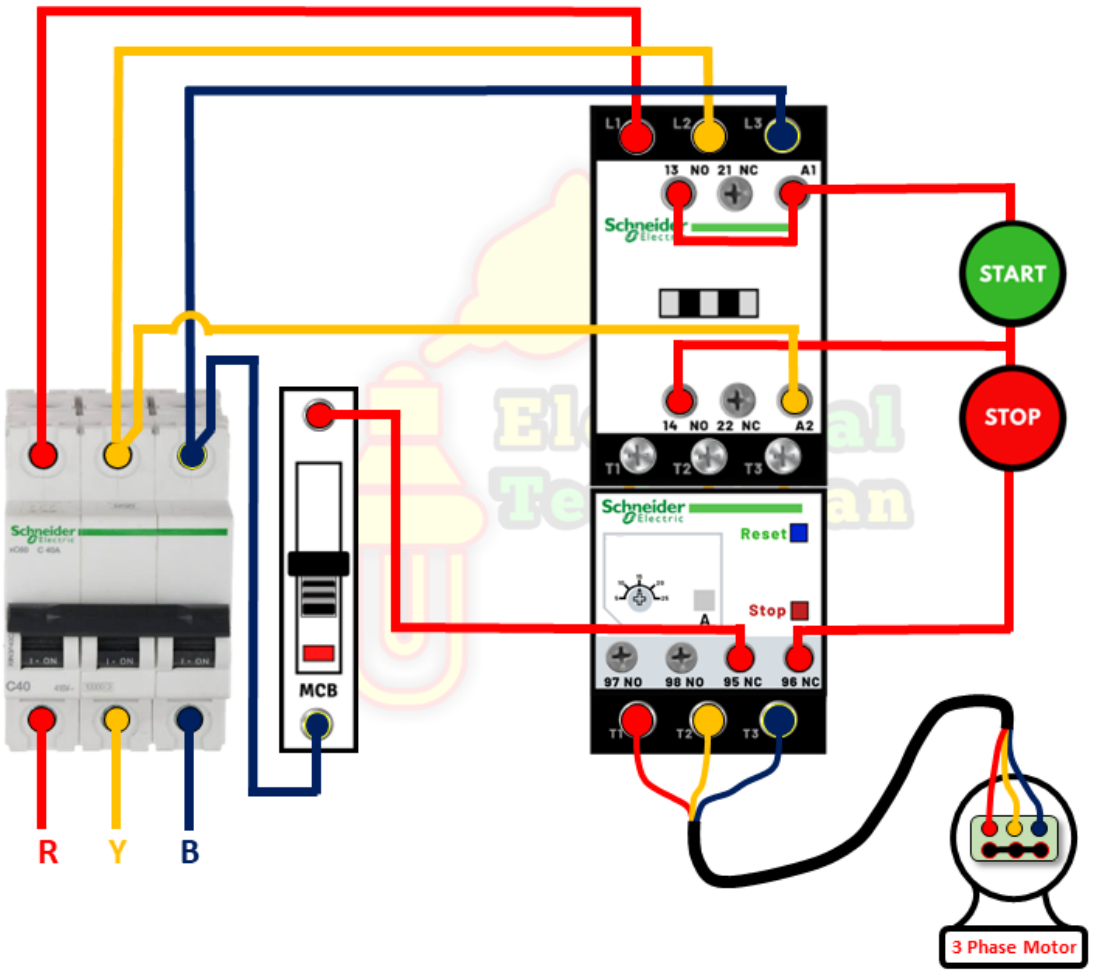
The control wiring in this starter will operate from 415/440 volts which is **B Phase.** From there we took out the supply and gave it to the single pole MCB, after that our supply was supplied to the **overload relay**. After coming out from the overload relay, the red push button is NC. The supply from the NC button has gone into the NO button and the supply from the NO push button has gone into the coil of the contactor. From the other side, which is our **Y Phase**, the supply has gone into the coil of the contactor.



46. DOL Control wiring 3D View (3 Phase 415 Volt):

You must have seen that at some places we do not have neutral in the DOL starter, so we control our contactor with the help of two phases. We direct one phase to the A2 point of the contactor or can also direct the other phase to the A1 point. We control it with the help of a push button which turns our starter on and off.

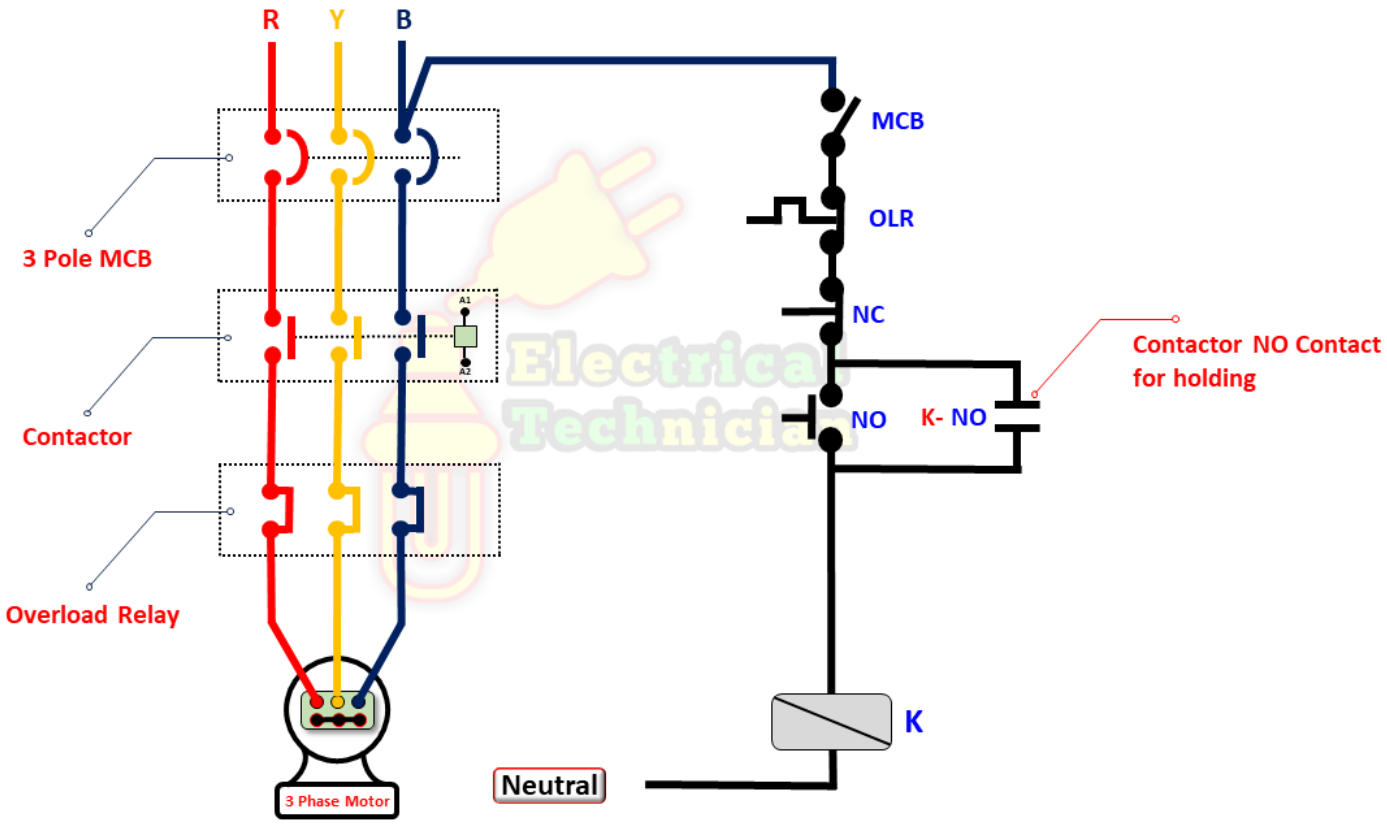
DOL Starter Power Wiring & Control diagram, 3D View (3 Phase 415 Volt)



47. DOL Single line Control wiring (Single Phase 230 Volt):

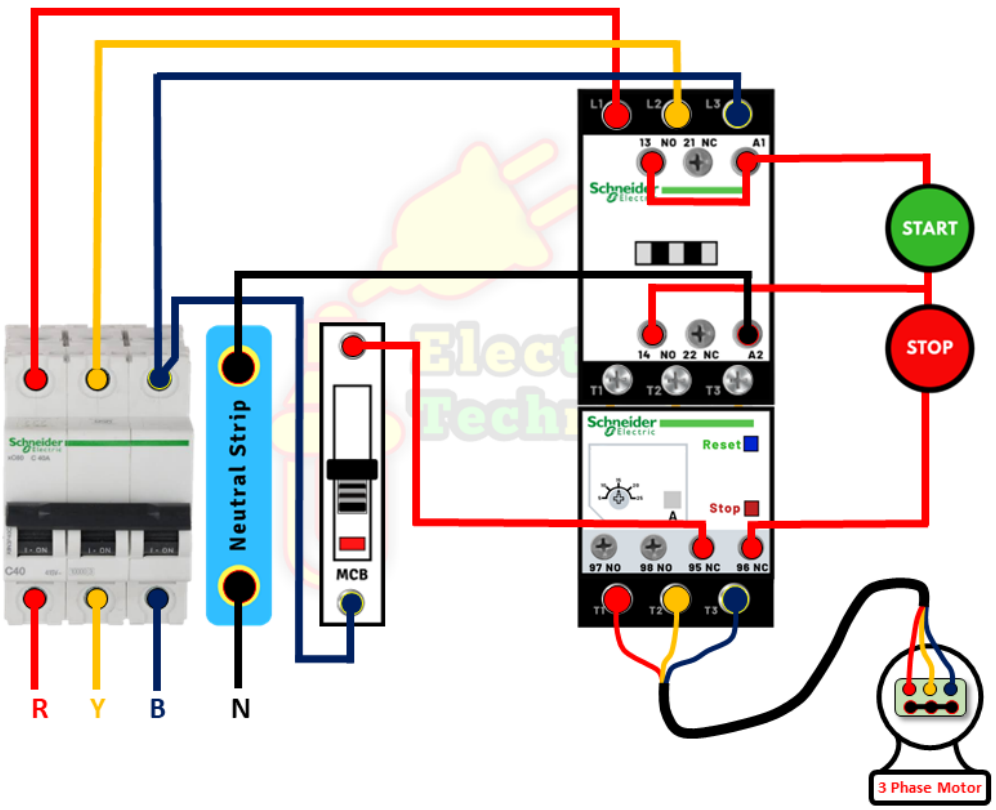
The control wiring in this starter will operate on 230 Volts, everything else will be wired the same as in the above starter. In the above starter, phase was given from both sides in the contactor coil, but in this circuit, **one neutral and one phase** will be given in the contactor coil.

DOL Starter Power Wiring Diagram & Control diagram (1 Phase 230 Volt)



48. DOL Control wiring (Single Phase 230 Volt) – 3D View:

DOL Starter Power Wiring & Control Diagram - 3D View, Single Phase 230 Volt



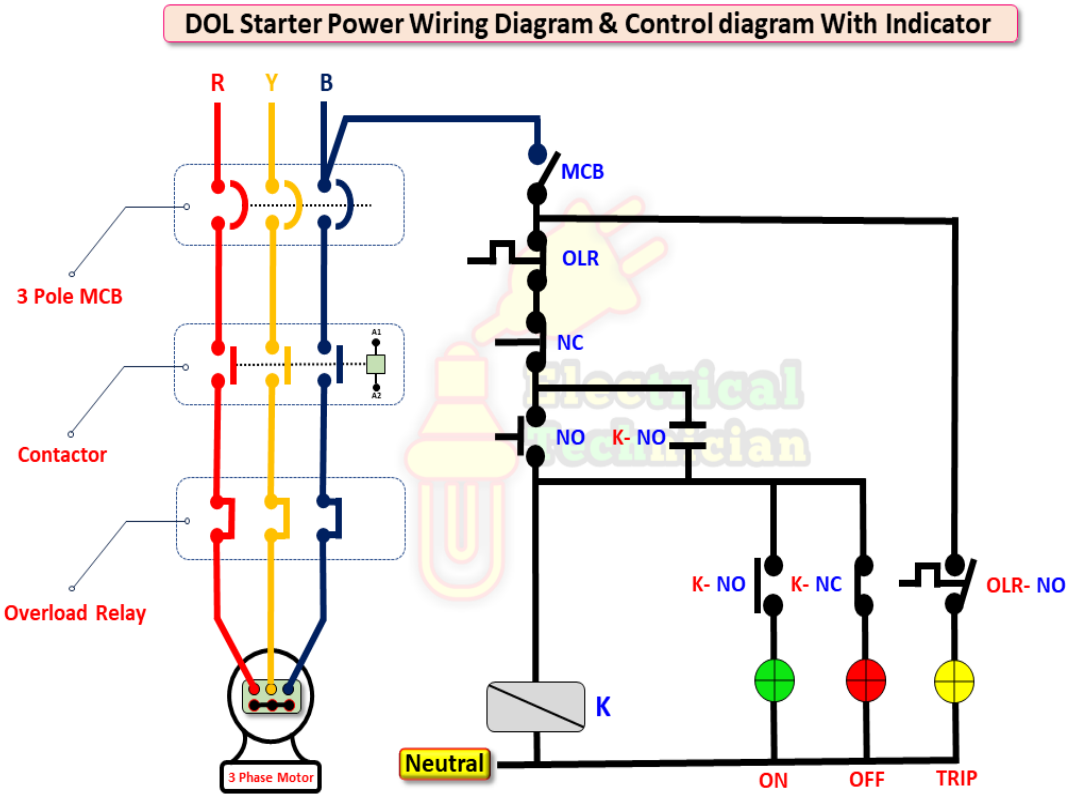
Direct Online Starter with Indicator

Components: -

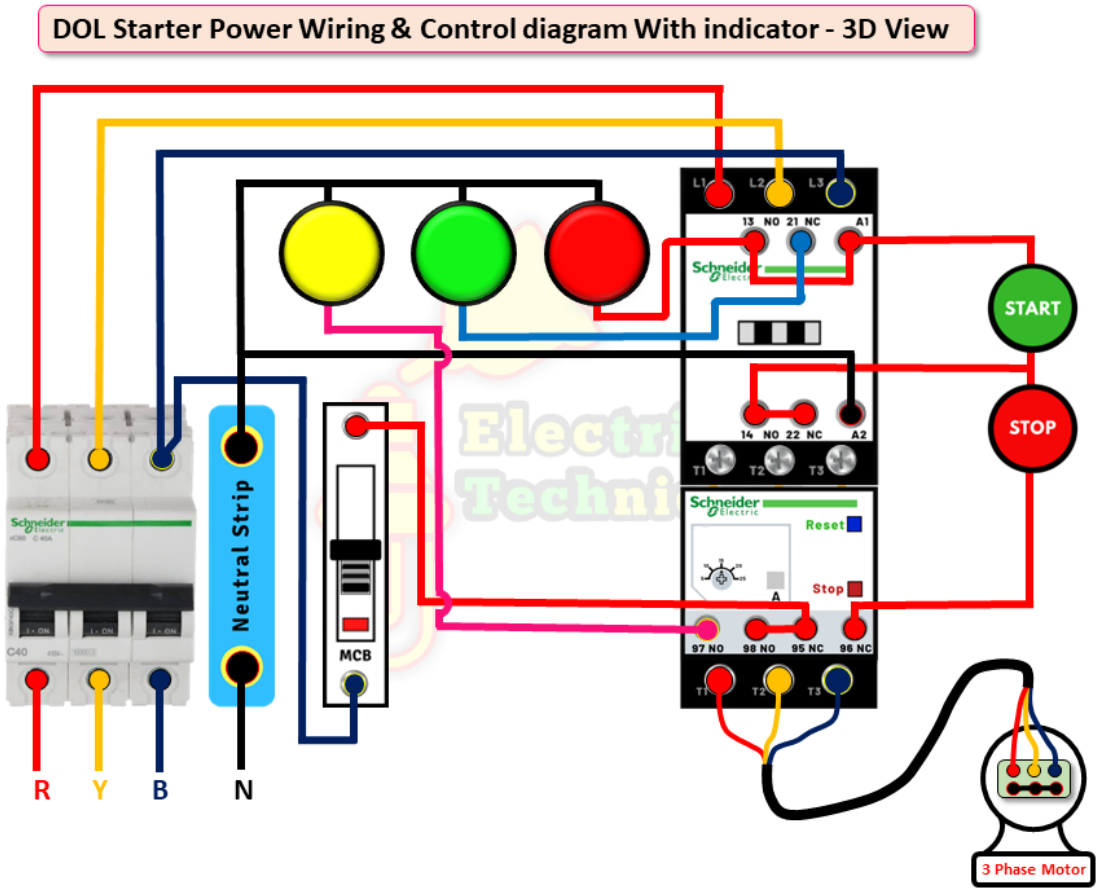
Quantity	Device Name
1 Pc	3Pole Contactor & Over-Load Relay
1 Pc	3 Pole MCB/ MCCB
1 Pc	Single Pole MCB 6Amp for Controlling
1 Pc	NC Push button
1 Pc	NO Push Button
3 Pc	Indicator On, Off & Trip
Wire	1/1.5 Sq. mm

49. DOL Starter Single line diagram with indicator:

To connect the indicator, we take a wire from the A1 point of our contactor and connect it to the ON indicator and to connect the OFF indicator, to the NC point of our contactor. We give supply in because whenever our contactor is on, only the NC points become NO and the off indicator will go off, which is our trip indicator, to connect it to the points (97,98) of the Overload relay NO Point.



50. DOL Starter Control wiring with indicator - 3D View:



Direct Online Starter Local & Remote wiring

Materials used in Direct On-Line Starter:

Components: -

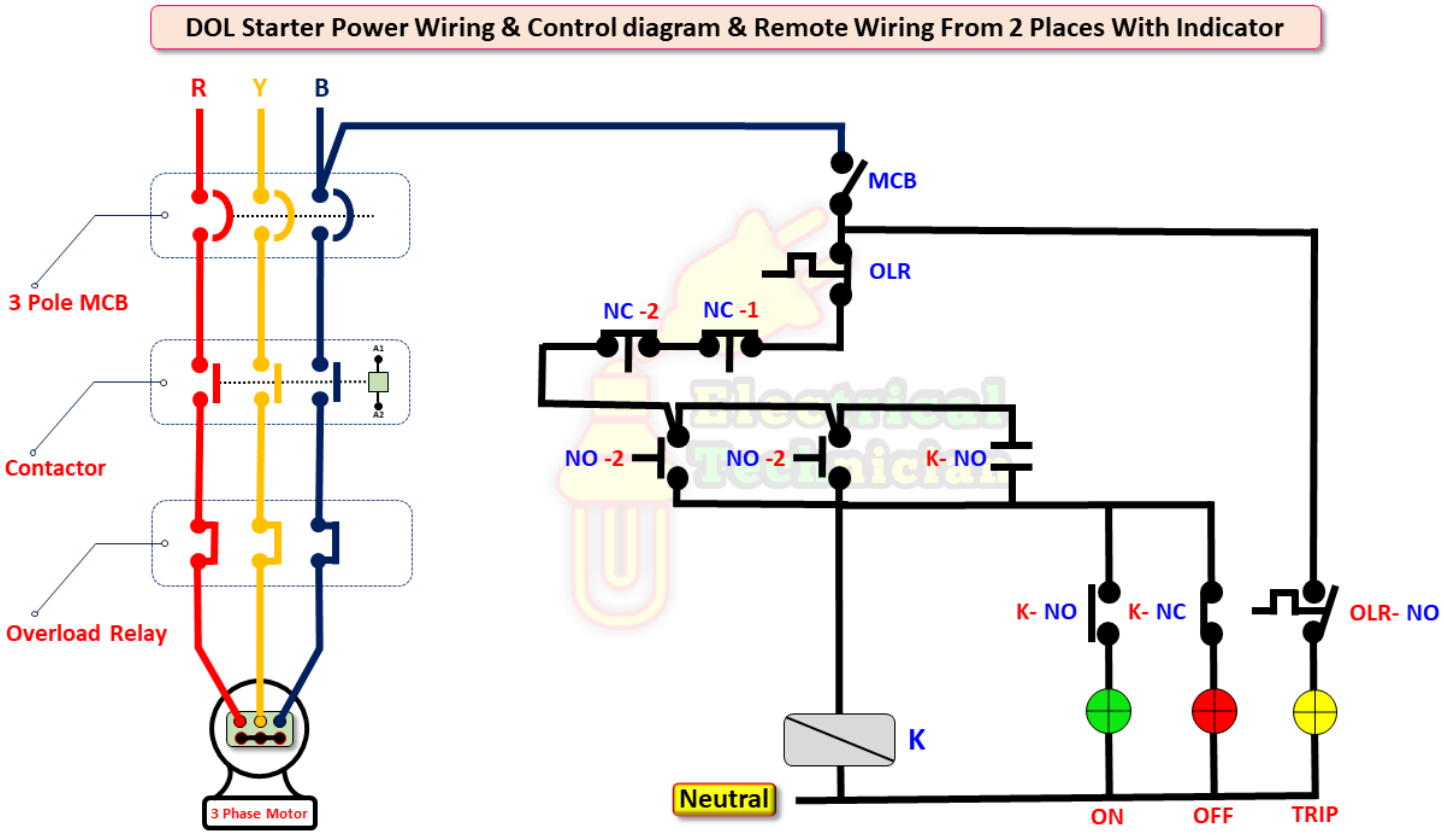
Quantity	Device Name
1 Pc	3Pole Contactor & Over-Load Relay
1 Pc	3 Pole MCB/ MCCB
1 Pc	Single Pole MCB 6Amp for Controlling
2 Pc	NC Push button
2 Pc	NO Push Button
3 Pc	Indicator On, Off & Trip
Wire	1/1.5 Sq. mm

51. Single line diagram Remote wiring from 2 Places

The equipment in our kitchen like fresh air or kitchen exhaust is controlled from two places, one is controlled from the kitchen, and the other is controlled from the area where they are installed. To do the work, we control a starter from two places.

To control any starter from two places, we put as many NC switches in series as the output of our overload relay, which is to be controlled from two places, if we control this starter from two places then NC-1 and NC. -2 We have installed two push buttons in series.

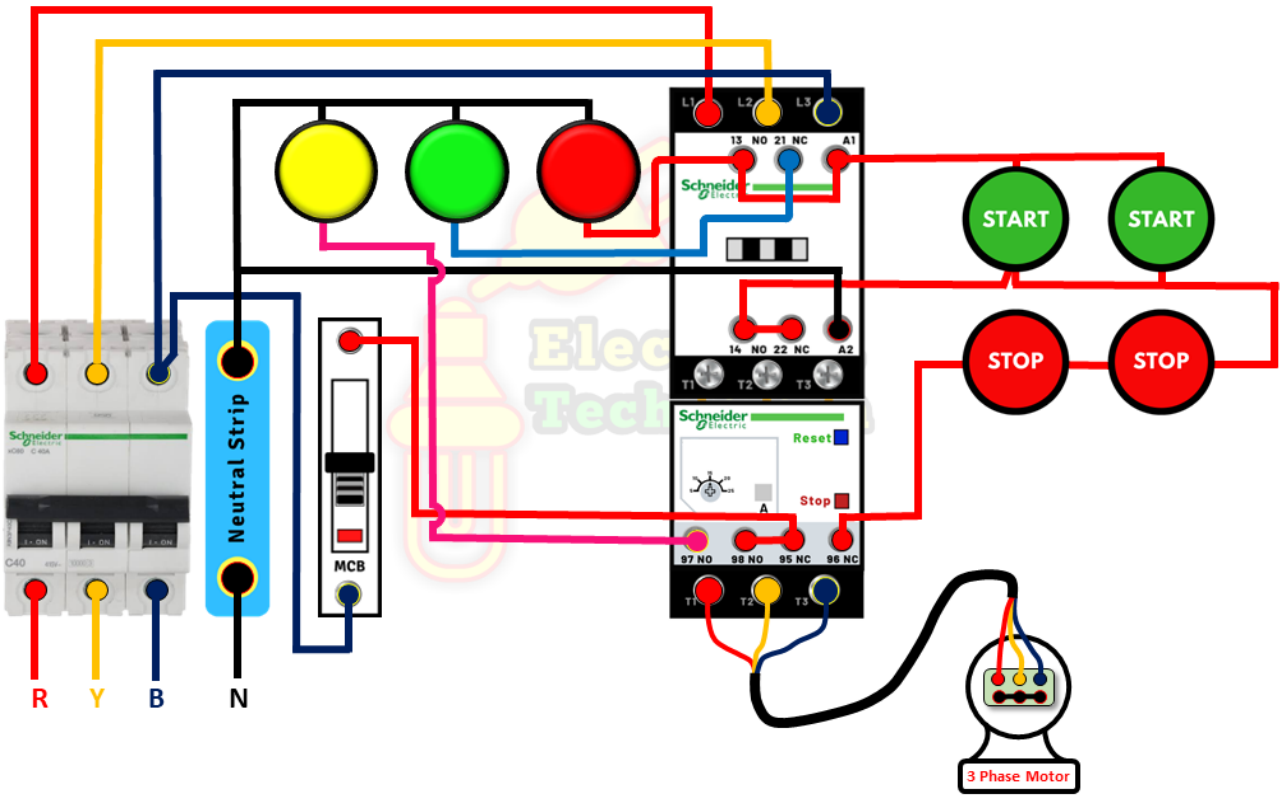
The output of the NC push button is connected to the input of the NO push button and the output of the NO point is connected to the coil of the contactor.



52. DOL Starter Remote wiring from 2 Places - 3D View

In the below circuit diagram, I have shown how we control our starter from two places, that is its control diagram. Now I will show you how we make our connection directly to the starter with the help of this control diagram.

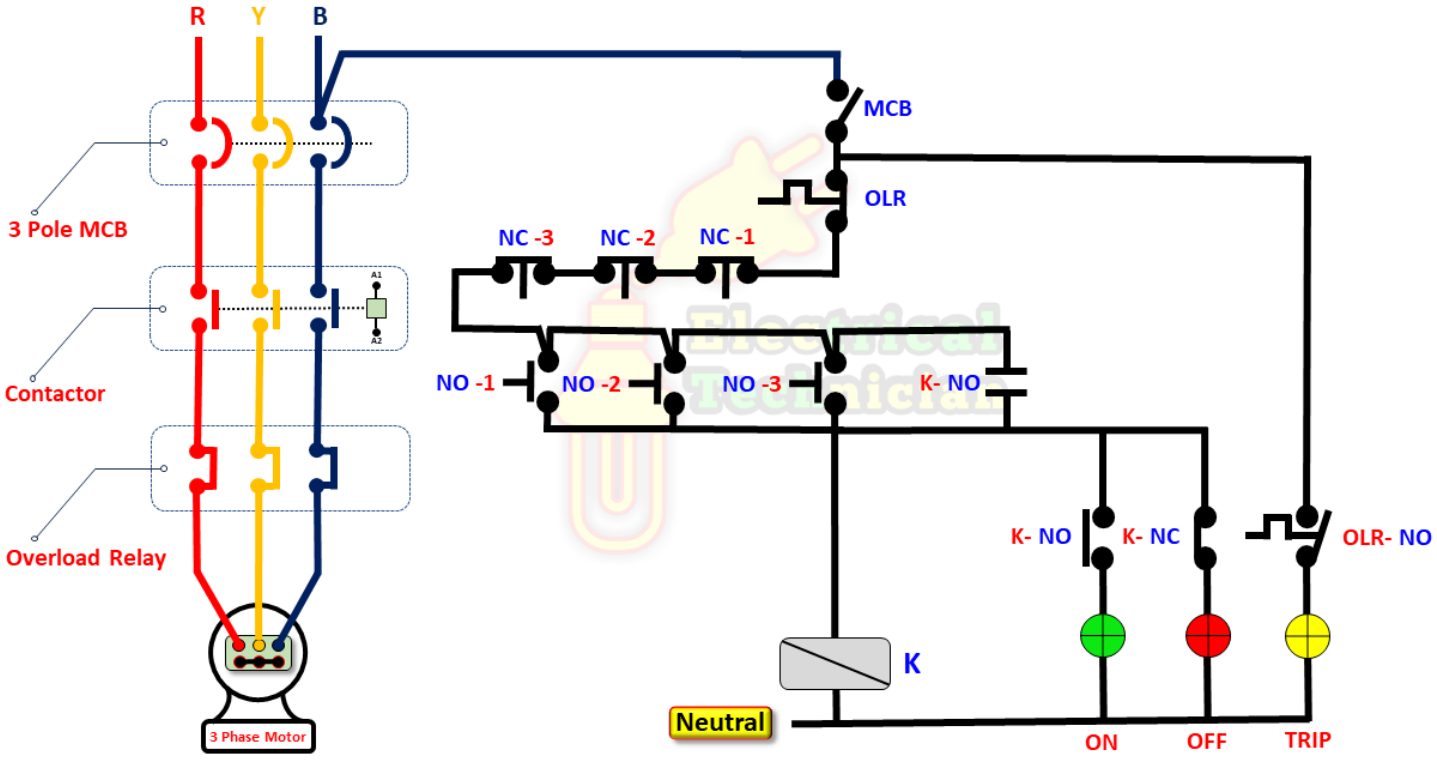
DOL Starter Power Wiring & Control Wiring & Remote Wiring From 2 Places With Indicator - 3D View



53. DOL Starter Single line diagram Remote wiring from 3 Places

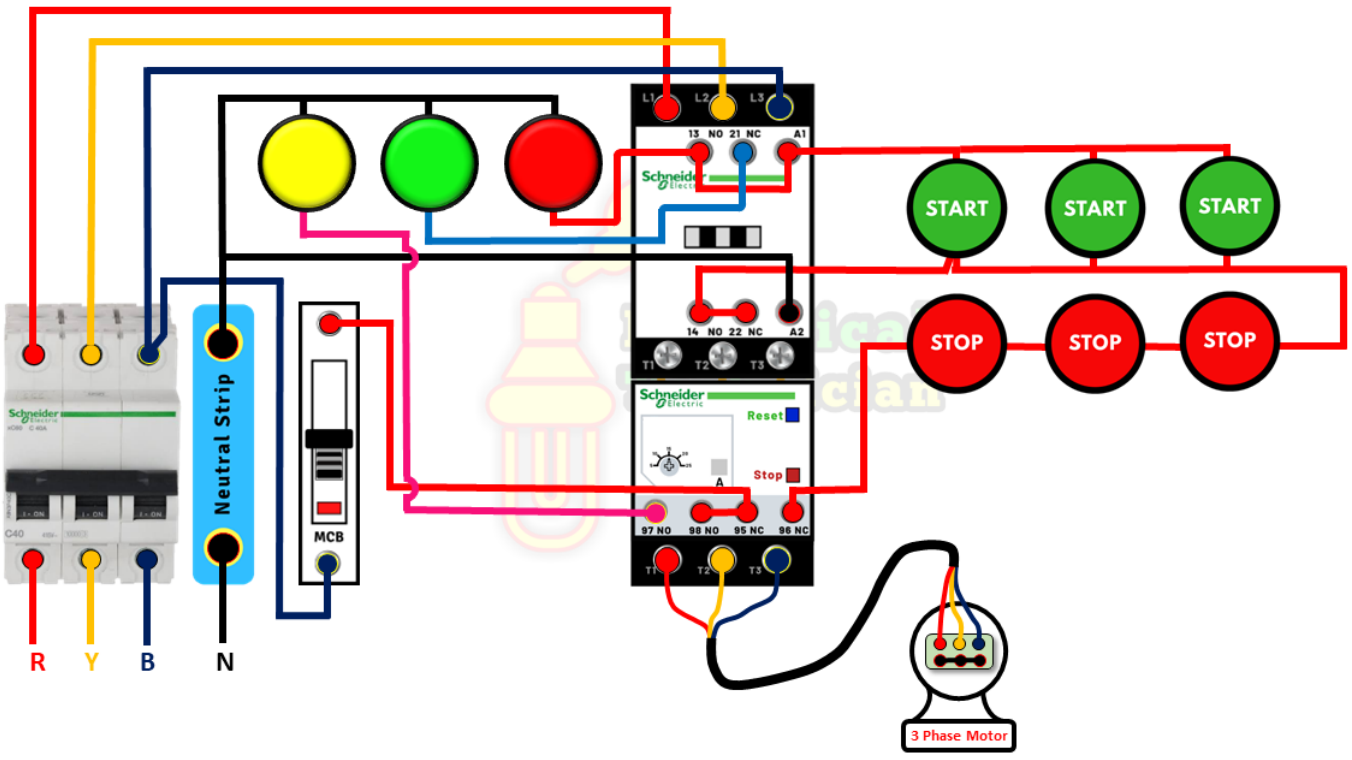
In this drawing, I have shown you the control circuit diagram of how we can switch on and off a starter from three places. I have shown you the control circuit diagram of how we can turn a starter on and off from three places in this drawing.

DOL Starter Power Wiring & Control diagram & Remote Wiring From 3 Places With Indicator



54. DOL Starter Remote wiring from 3 Places - 3D View:

DOL Starter Power Wiring & Control diagram & Remote Wiring From 3 Places With Indicator 3D View



Direct Online Starter with float switch

Materials used in Starter:

Components:-

Quantity	Device Name
1 Pc	3Pole Contactor & Over-Load Relay
1 Pc	3 Pole MCB/ MCCB
1 Pc	Float Switch
1 Pc	Selector Switch for Auto & Manual
1 Pc	Single Pole MCB 6Amp for Controlling
1 Pc	NC Push button
1 Pc	NO Push Button
3 Pc	Indicator On, Off & Trip
Wire	1/1.5 Sq. mm

55. DOL Starter Single line diagram with float switch and With Selector Switch:

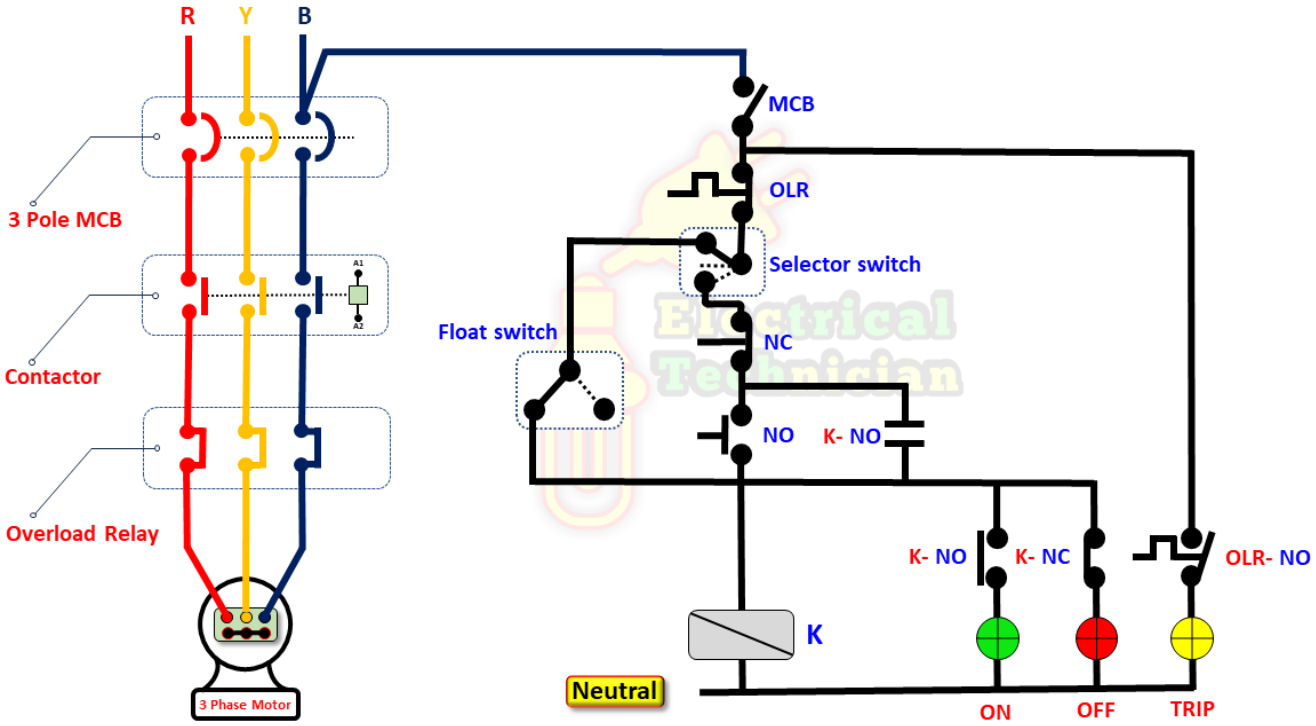
This starter is used in most industries that have sump pumps, meaning where there are pits below the ground and there is water inside them, a float switch is used to drain that water. When the pit is filled with water, the float switch gives the command to the contactor in our starter.

Because we use the NO point of the float switch, when the float switch moves upwards due to water, that NO point becomes NC, and the starter comes on. When the water runs out, the float switch moves downwards. It will bend and our NC point of plot size will become NO again, and our starter will stop.

Float switches are also used to fill the tanks installed on the roof because whenever the water runs out inside the tank, the float switch automatically operates the motor.

If the float switch gets damaged, then we use a selector switch so that we can switch the motor on and off in auto and manual mode.

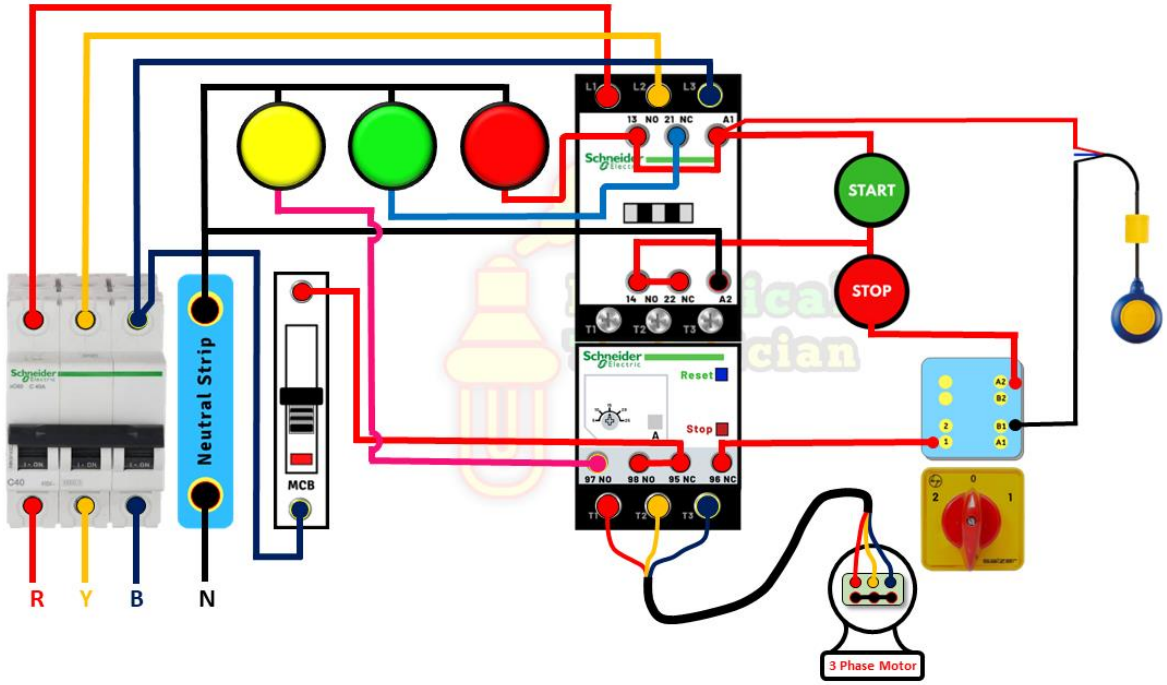
DOL Starter Power Wiring Diagram & Control diagram With Indicator and with float switch



56. DOL Starter diagram with float switch and With Selector Switch- 3D View:

Inside the float switch, we see 3-wires. We give the supply phase to any one wire and let's say turn the float switch downwards. Now what we will see is that out of the two wires that are left, we will get the output of the supply in any one wire. If we are getting the output in one wire, after that we will lift the float switch up and then we should get the output in the other point or the other wire. If we are not getting the output then What will we do where we have connected the phase supply, first remove the one in which the phase supply is given and connect it to another wire and then see the float switch once up and then down and see if the supply is coming alternately from both the wires. We have connected the common supply on the right wire, or we can also check the same way with the help of a multimeter.

DOL Starter Power Wiring Diagram & Control diagram With Indicator and with float switch 3D



Direct Online Reverse Forward Starter

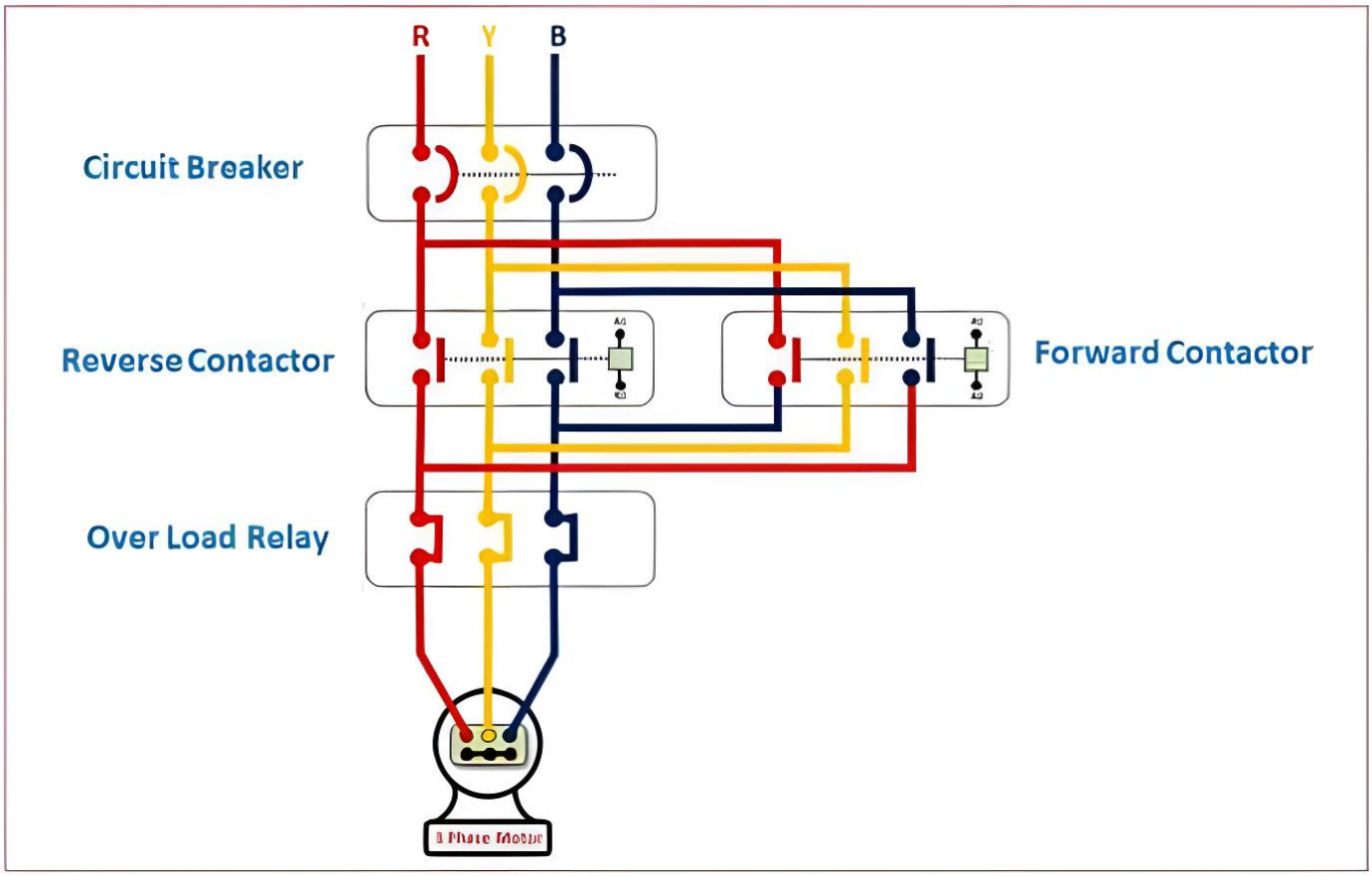
57. DOL Starter Reverse Forward Single Line Power diagram:

Materials used in Starter:

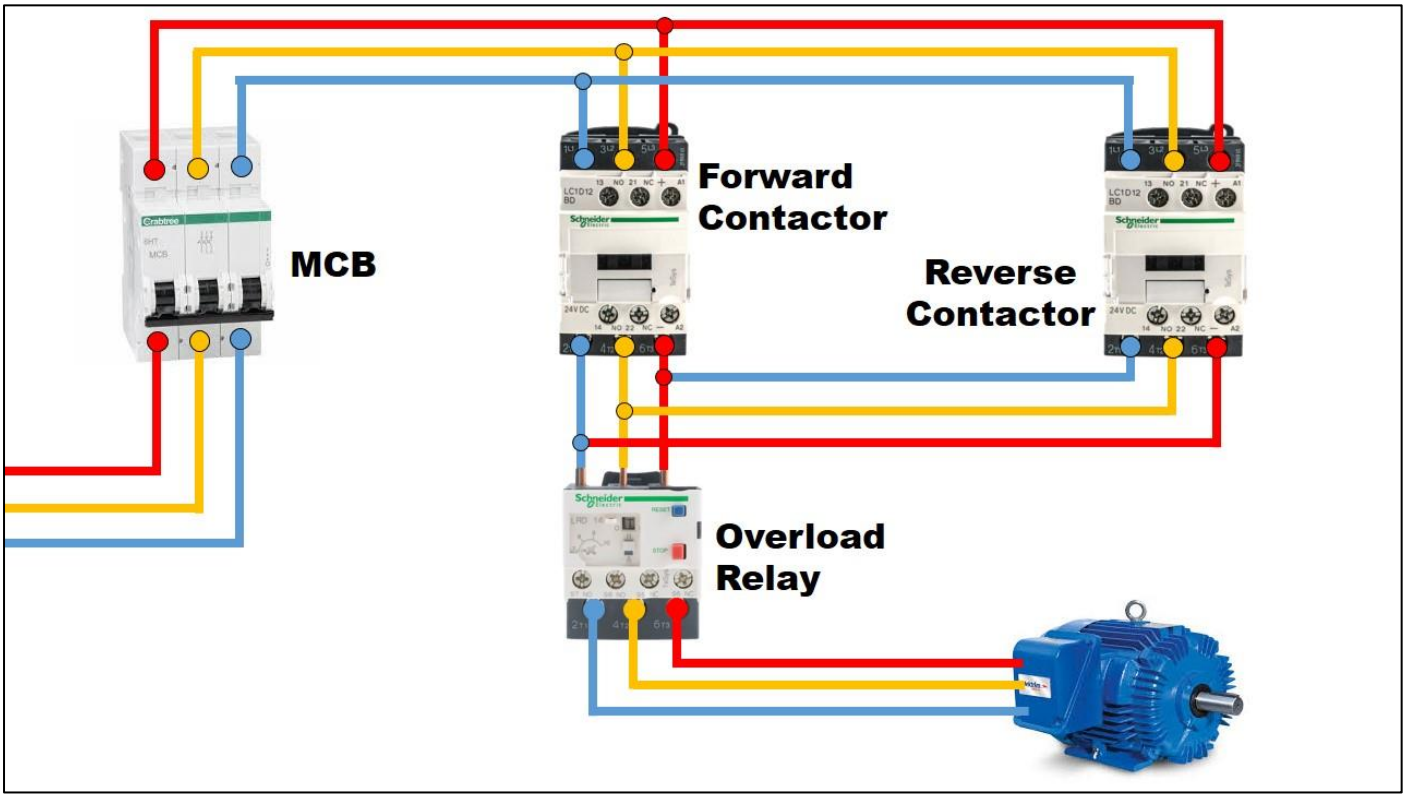
Components: -

Quantity	Device Name
2 Pc	3Pole Contactor
1 Pc	Over-Load Relay
1 Pc	3 Pole MCB/ MCCB
1 Pc	Single Pole MCB 6Amp for Controlling
1 Pc	NC Push button
1 Pc	NO Push Button
3 Pc	Indicator On, Off & Trip
Wire	1/1.5 Sq. mm

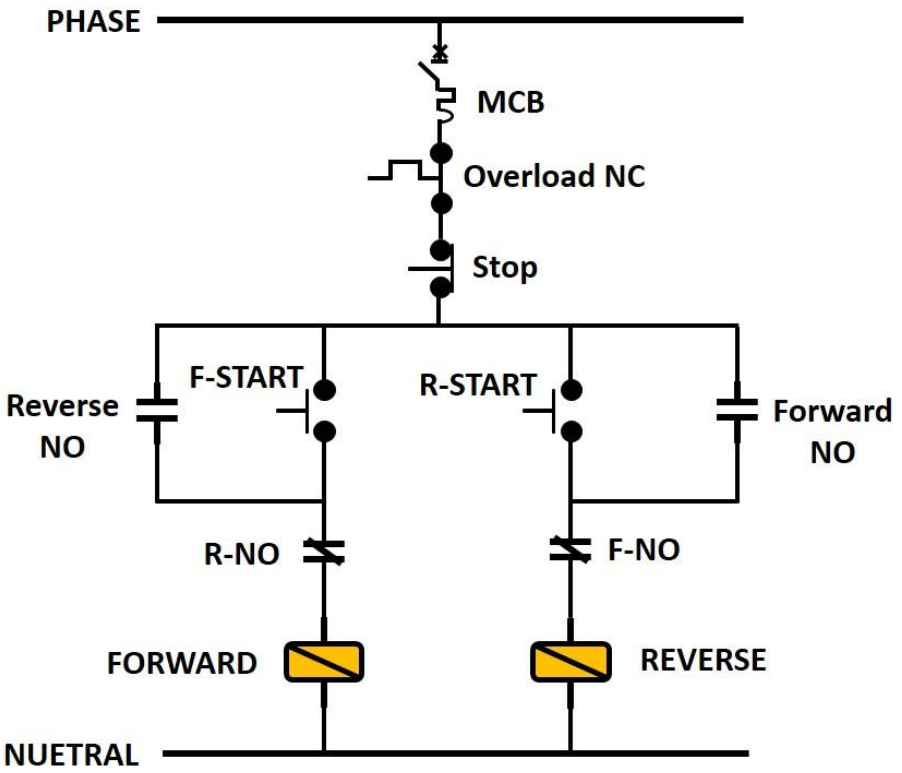
DOL Reverse Forward Starter Power Wiring

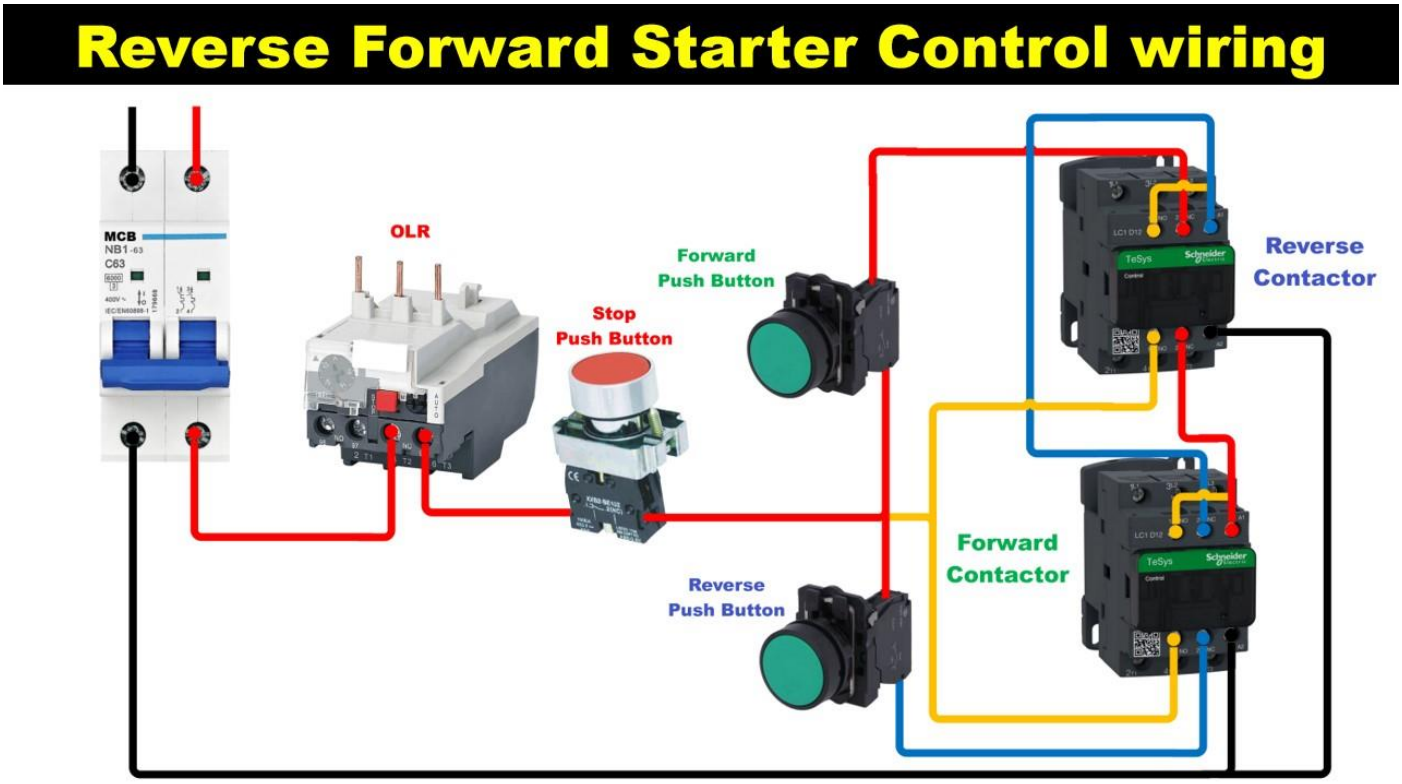


58. Reverse Forward Power diagram -3D View:

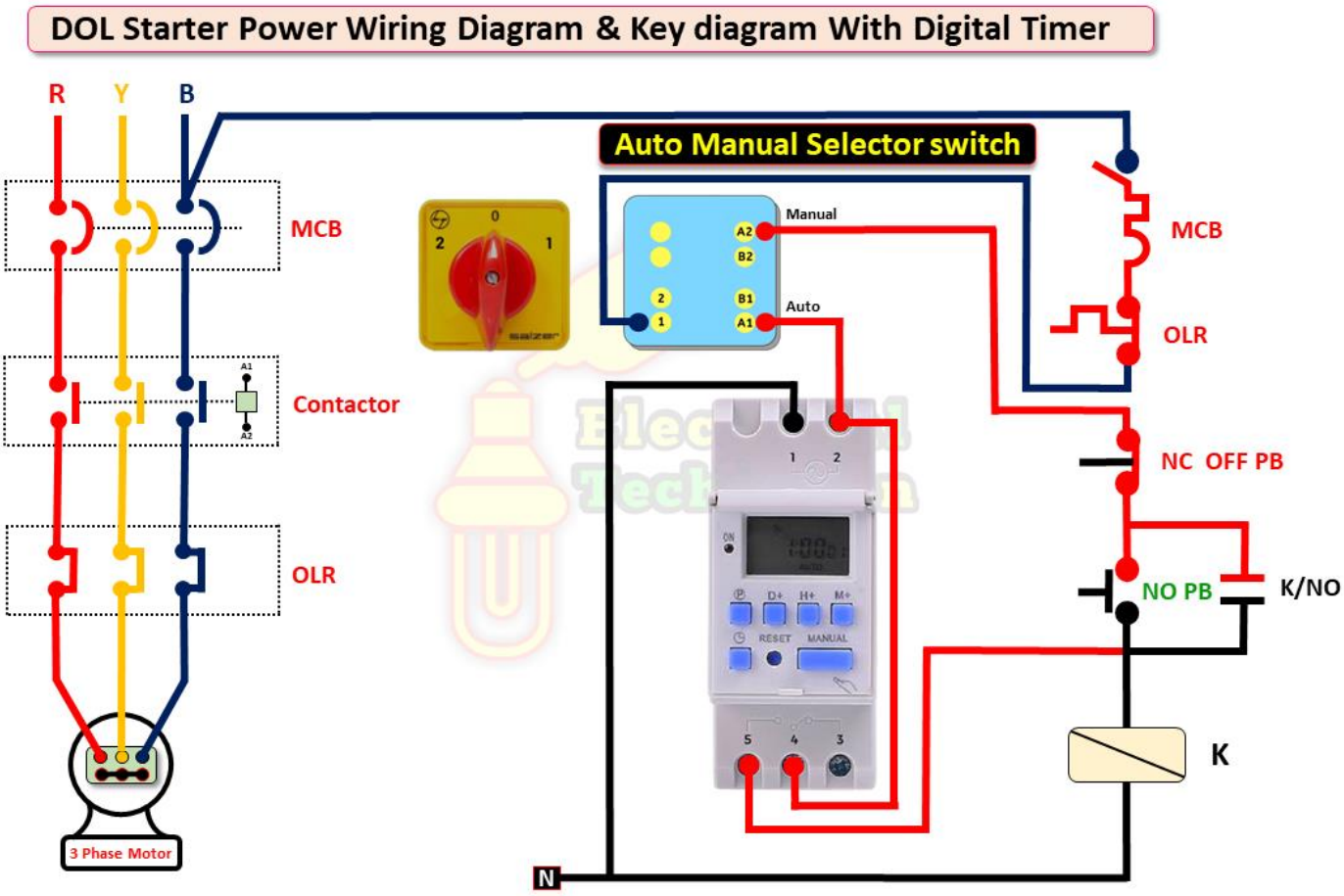


59. Reverse Forward Control Wiring diagram :





60. DOL Starter Power wiring and control wiring with timer:



Star Delta Starter

We install Star Delta Starter for 7.5 KW or larger motors. 7.5 KW means 10HP. Keep one thing in mind, many people say that it is necessary to install Star Delta starter on motors larger than 5 HP. Friends, this is wrong, it is not so, we can run motors up to 7.5KW/10HP on DOL starters. Or you can install a DOL starter on a motor larger than 10HP or even on a 15HP or 20HP motor if it operates only one or two days a week.

Why install Star Delta Starter?

We use a star delta starter to reduce the starting current (inrush current) of the motor. This is very important, if too much current passes through the motor winding the motor winding may burn and the motor may damage. So, we use star delta starter.

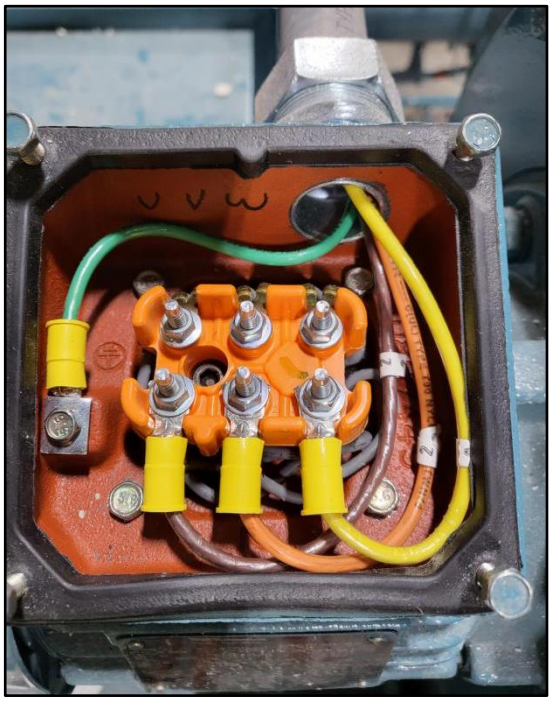
What is starting current? (Inrush Current)

Friends, we also call inrush current in other words as starting current. It is quite easy to understand this.

For example- We have a motor. To start this motor, a 3-phase electrical supply was given to it. Now as soon as this motor starts, how much current will my motor take at the time of starting, this is called the starting current of the motor i.e. inrush current.

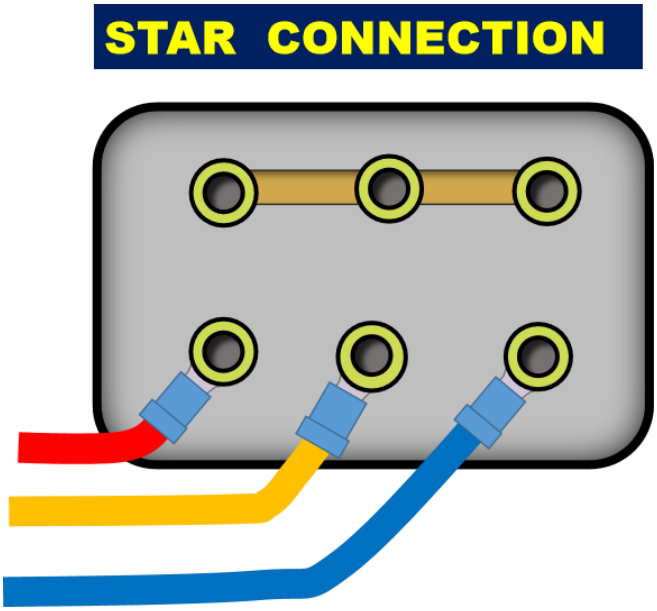
We use a star delta starter to reduce the starting current (inrush current) of the motor. While initially running the motor, we run it in star, and when the RPM of our motor comes to 70% to 80%. Then we remove our motor from the star and connect it to the delta. So that the winding of our motor does not get damaged due to the starting current.

Now let us understand how the current of our motor is reduced by installing a star delta starter. Whenever you see the connection plate of the motor, you will see 6 points inside it. At the time of connection, it is connected to the supply in two ways.



Star Connection:

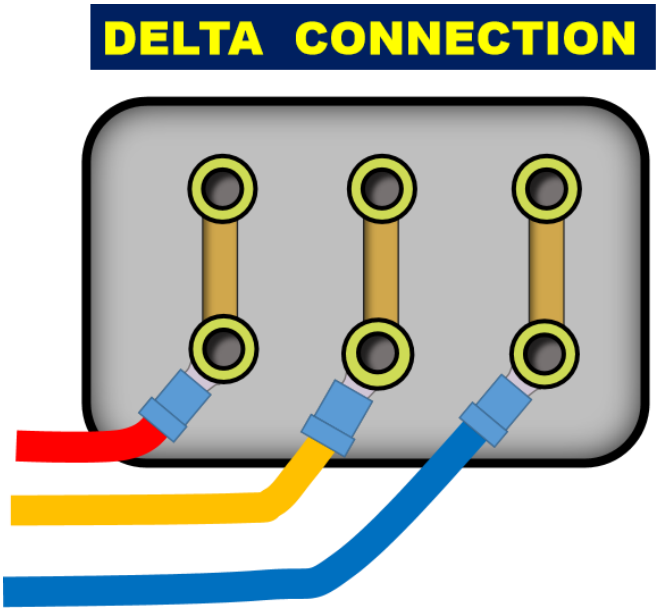
When we connect the motor to the star, we connect its three points on one point and connect our electrical supply L1, L2, and L3 to the remaining three points.



In the terminal box of the motor, three end of winding is connected at one place, and then we provide electrical supply to all the 3 points. Meaning, that at the time of the Star connection, each winding of the motor is getting single phases, which means at a time 230/240 voltage goes to each winding.

Delta Connection:

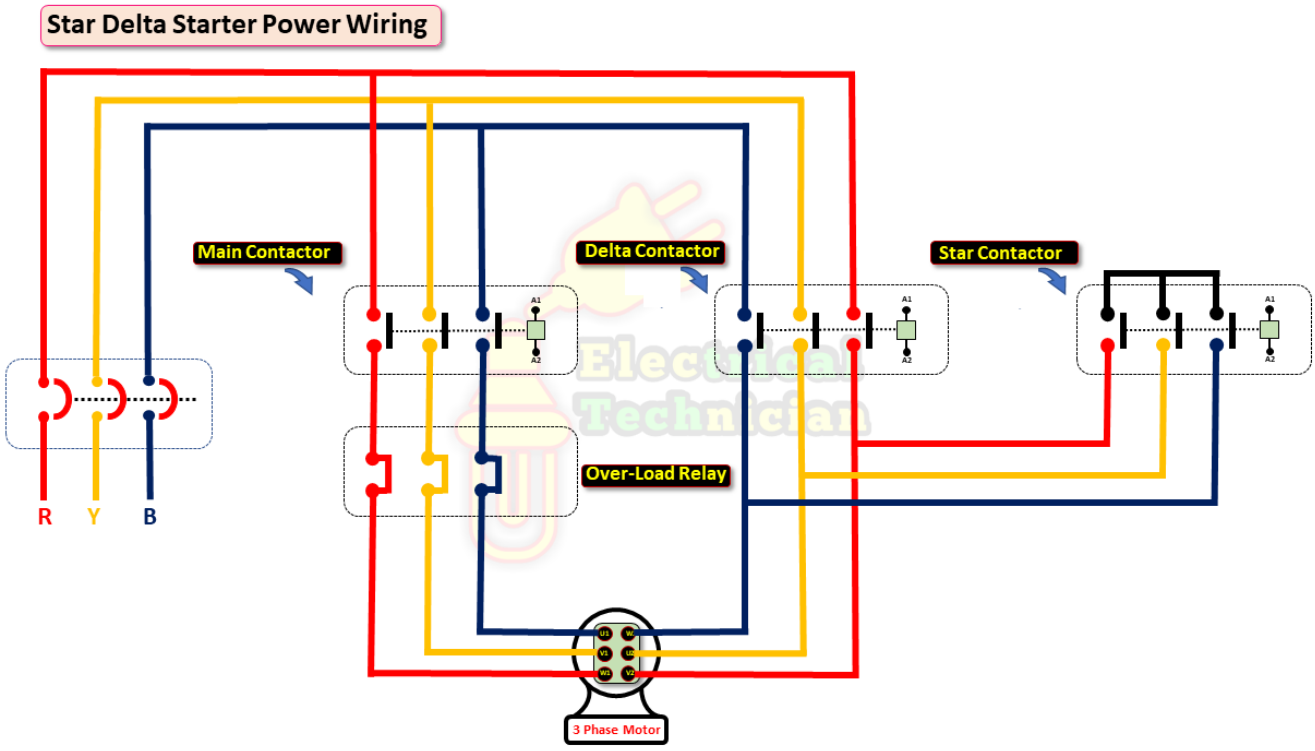
In the terminal box of the motor, one end of each winding is connected at one place, or you can say that the ends of opposite windings are joined in One wire. And then we provide electrical supply to all the 3 points. Meaning, that at the time of the delta connection, each winding of the motor is getting 2 phases, which means at a time 415/440 voltage goes to each winding.



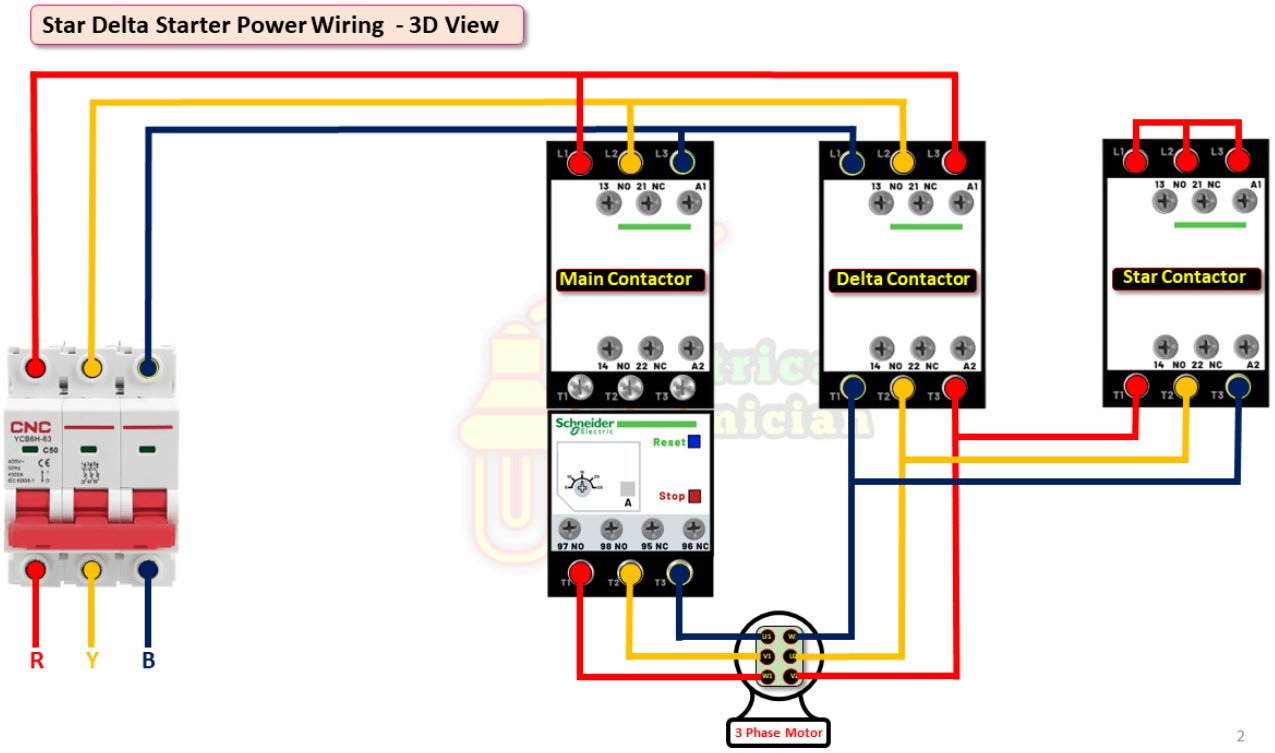
Starter Power Wiring Required Components: -

Quantity	Device Name
1 Pc	Single Pole MCB 6A
1 Pc	Neutral Strip/ MCB
3 Pc	Auxiliary Contactor
3 Pc	Indicator On, Off, Trip
1 Pc	NC Push button Normally Open
1 Pc	NO Push button Normally Closed
1 Pc	Timer Relay Star Delta Timer
Wire	1/1.5 Sq.mm For Controlling

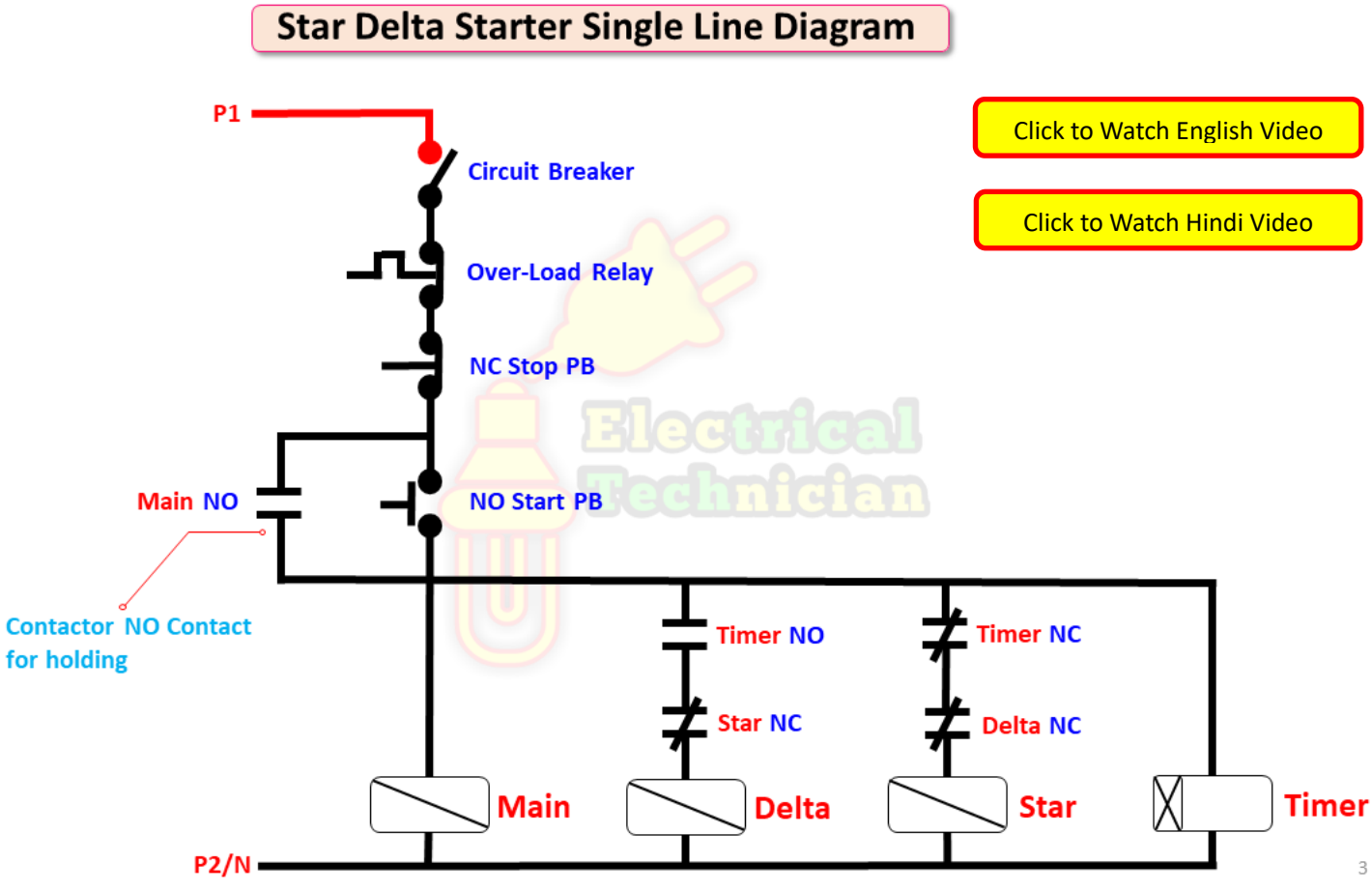
61. Star Delta Starter Power Wiring Single Line Diagram



62. Star Delta Starter Power wiring 3D View:

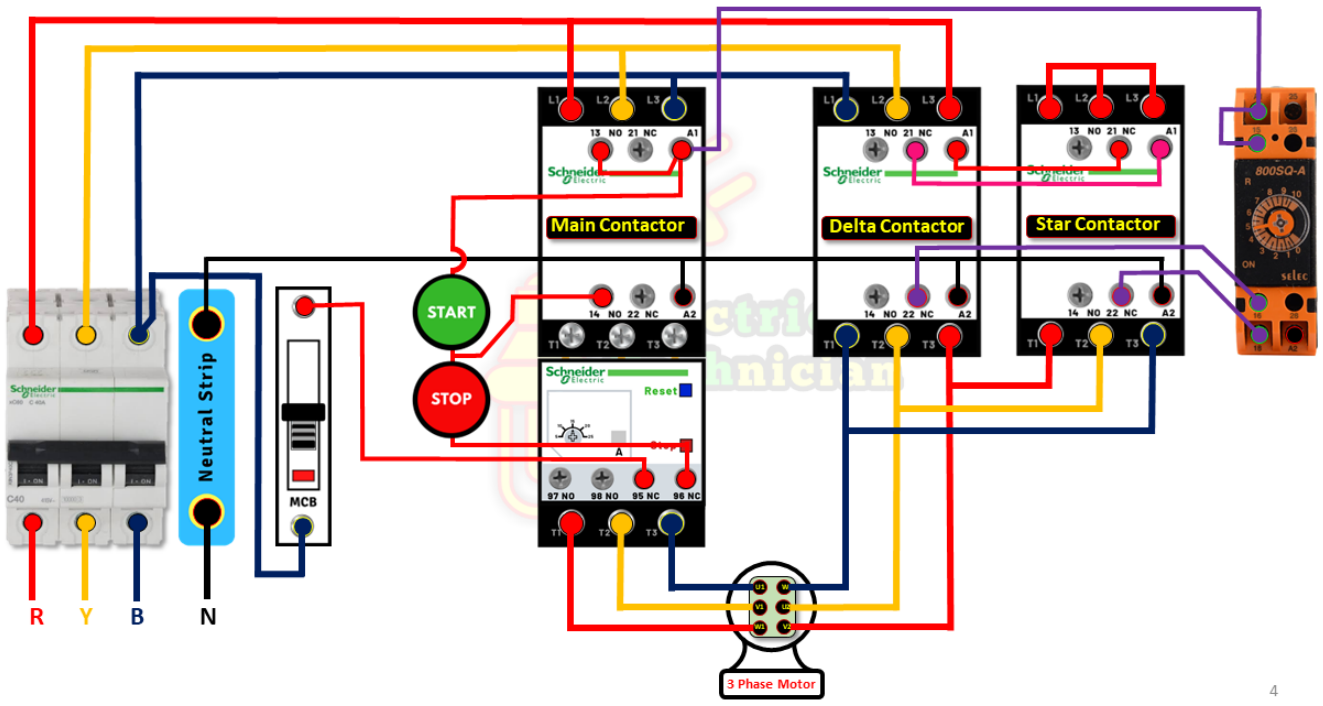


63. Star Delta Starter Control single line diagram:



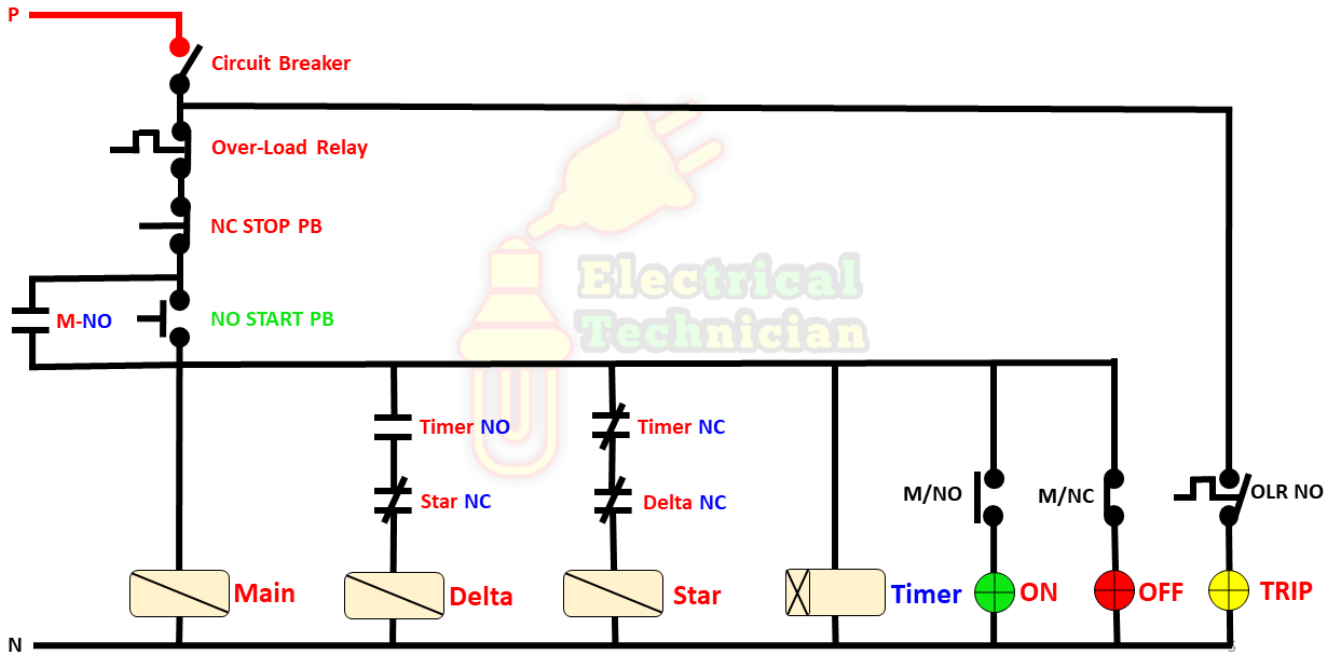
64. Star Delta Starter Power & Control wiring 3D View:

Star Delta Starter Power Wiring & Control Wiring - 3D View



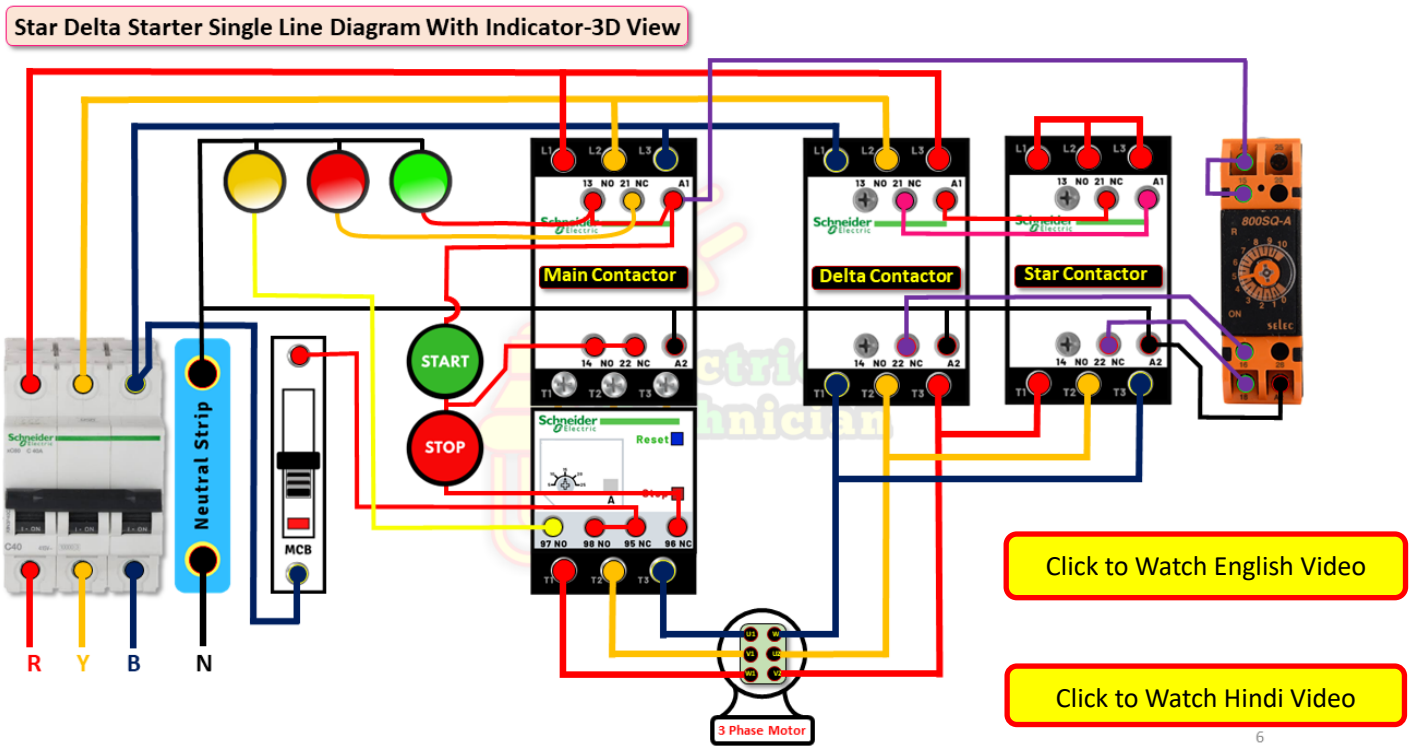
65. Star Delta Starter single line diagram with Indicator:

Star Delta Starter Single Line Diagram With Indicator

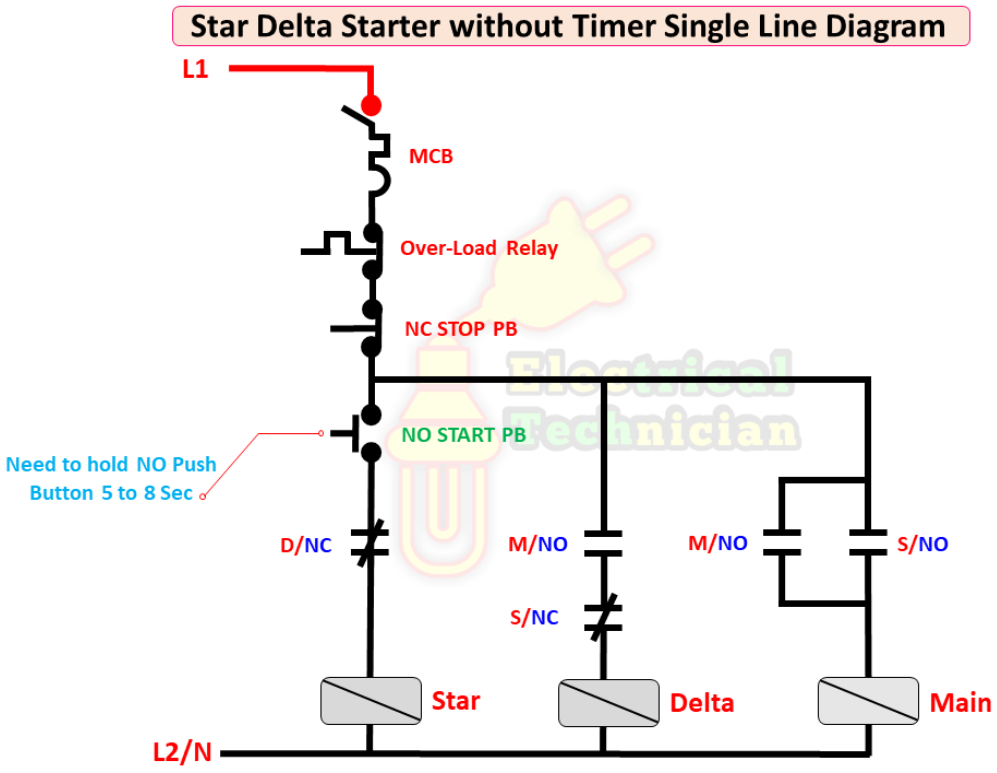


66. Star Delta Starter Power & Control Wiring With indicator 3D

Friends, if you want, you can also watch its video by clicking on this diagram

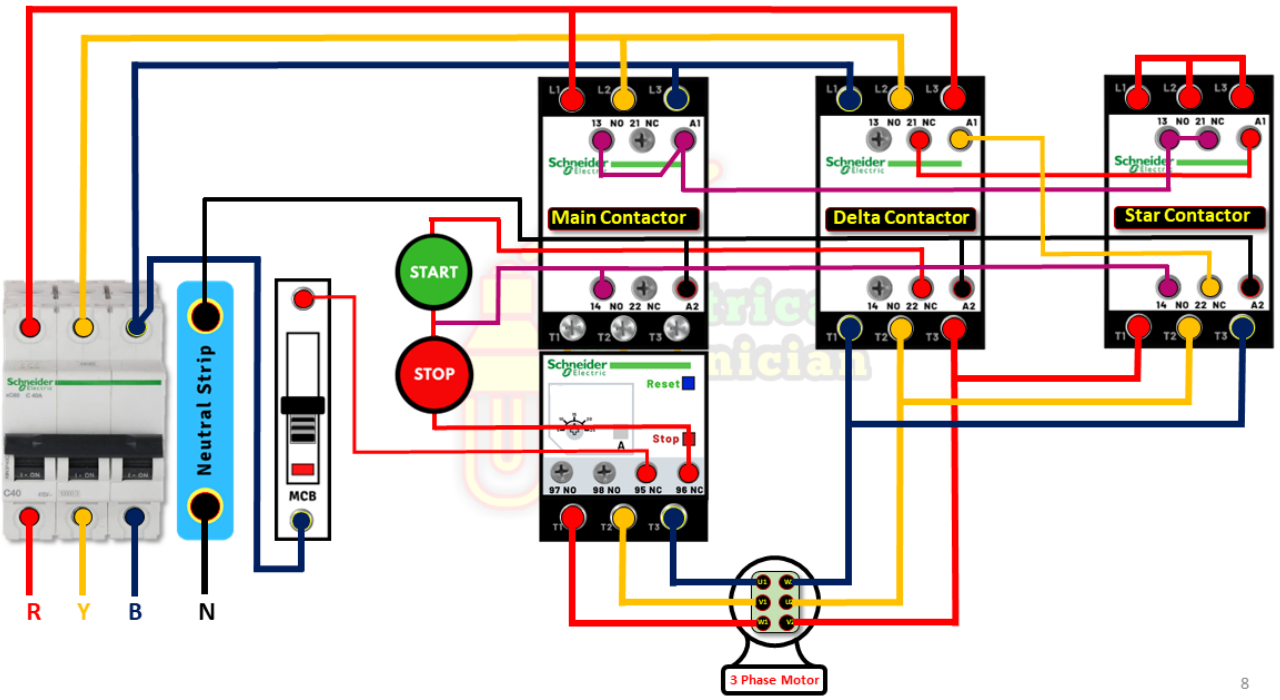


67. Star Delta Starter without Timer single Line Diagram:

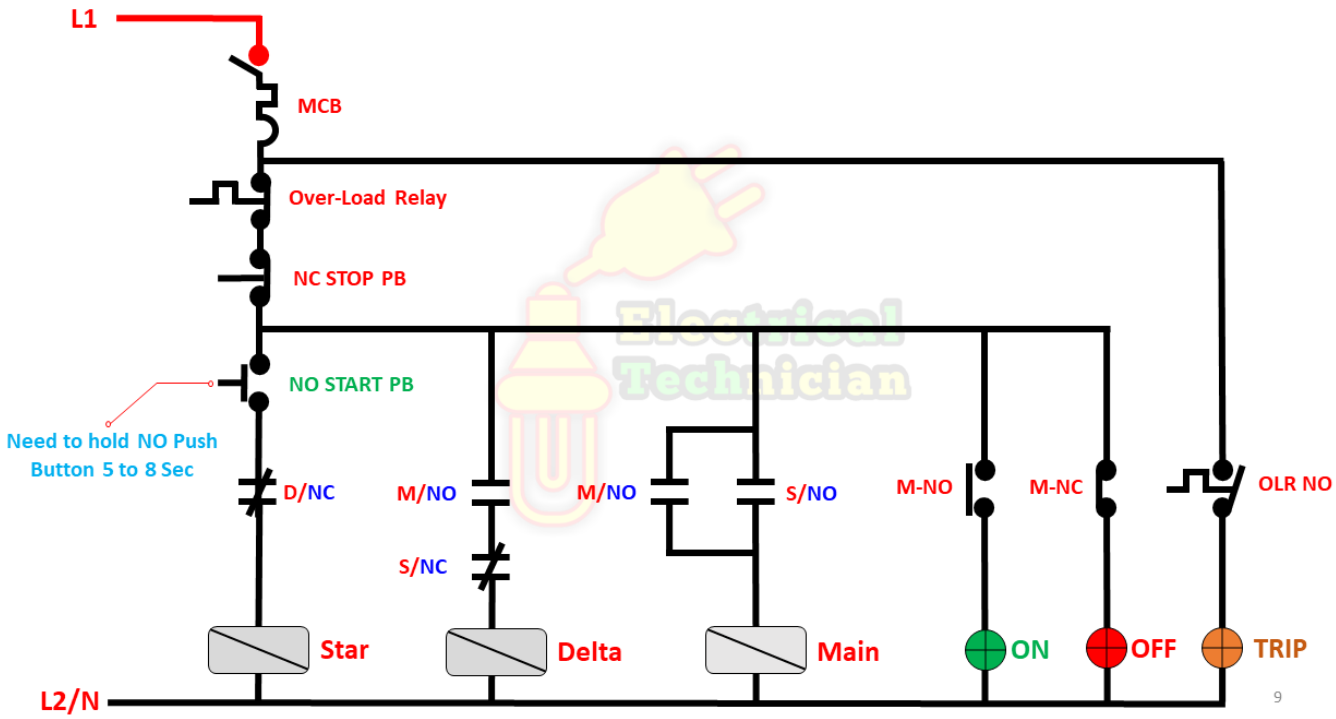


68. Star Delta Starter without Timer-3D View:

Star Delta Starter Without Timer Power Wiring & Control Wiring - 3D View



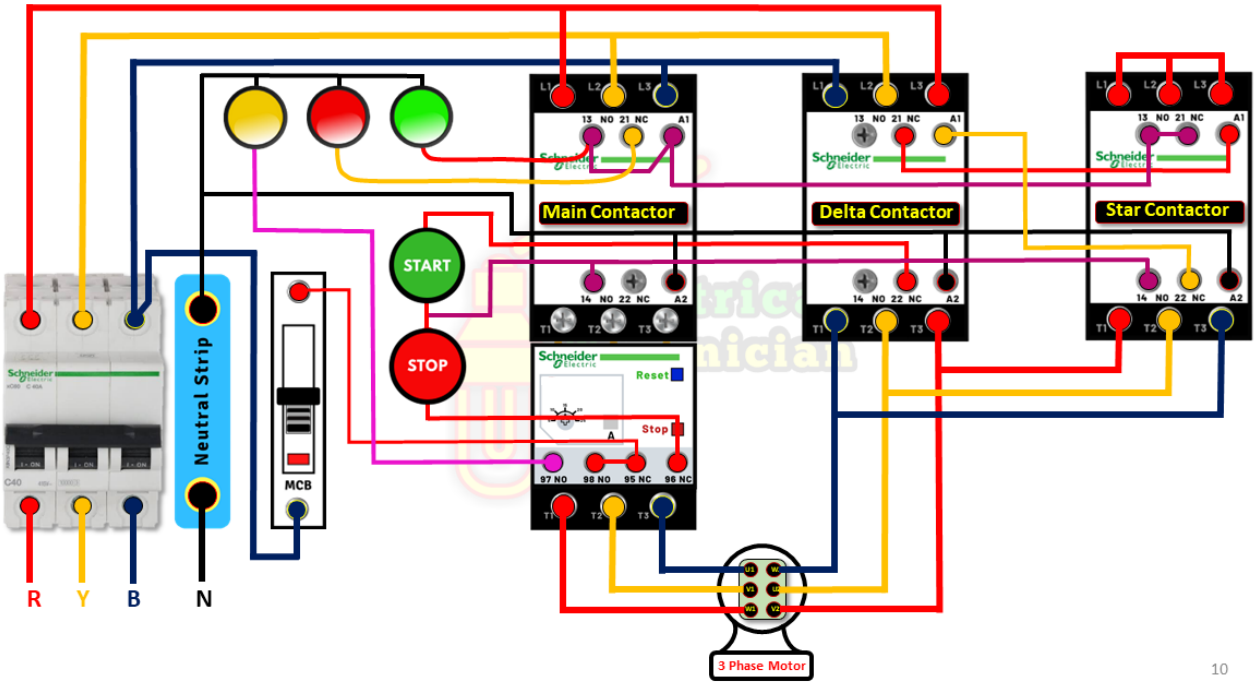
Star Delta Starter without Timer Single Line Diagram with indicator



69. Star Delta Starter without Timer with Indicator- 3D View:

Friends, if you want, you can also watch its video by clicking on this diagram. You can learn in a better way through videos.

Star Delta Starter Without Timer Power Wiring & Control Wiring - 3D View



Star Delta Starter Remote Wiring

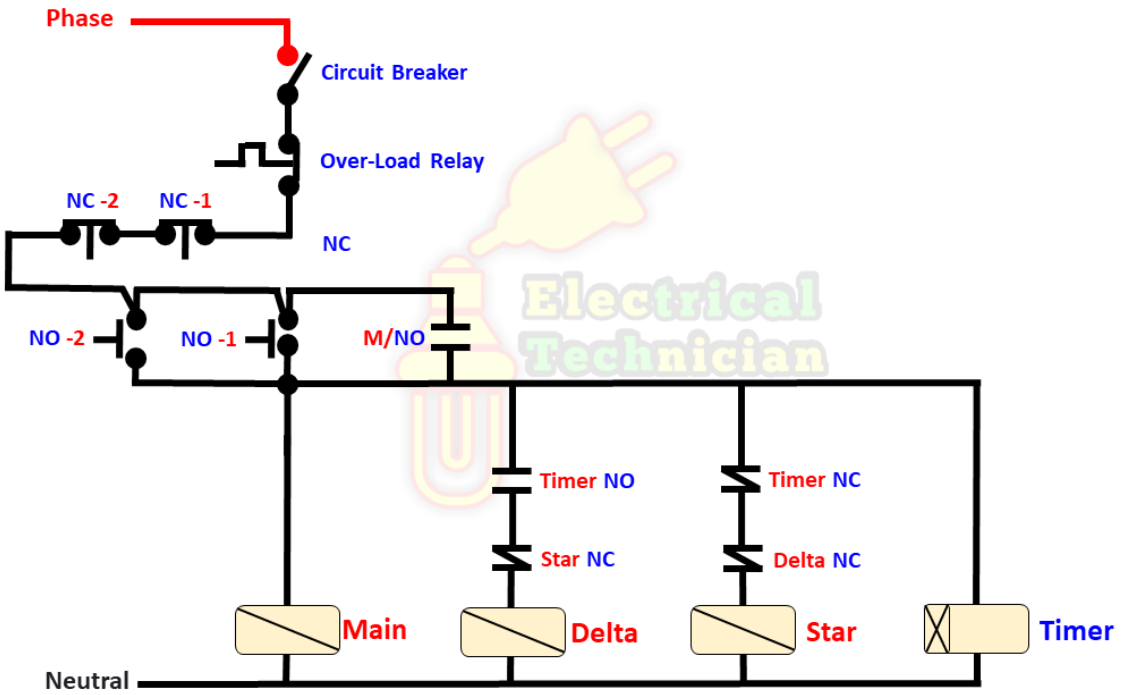
70. Star Delta Starter Control from 2 Places Single Line Diagram

Materials used in Starter.

Components: -

Quantity	Device Name
3 Pc	3Pole Contactor
1 Pc	Over-Load Relay
1 Pc	Single Pole MCB 6A
1 Pc	3Pole/ 4Pole MCB/MCCB
1 Pc	Neutral Strip/ MCB
3 Pc	Auxiliary Contactor
3 Pc	Indicator On, Off, Trip
1 Pc	NC Push button Normally Open
1 Pc	NO Push button Normally Closed
1 Pc	Timer Relay Star Delta Timer
Wie	1/1.5 Sq.mm For Controlling

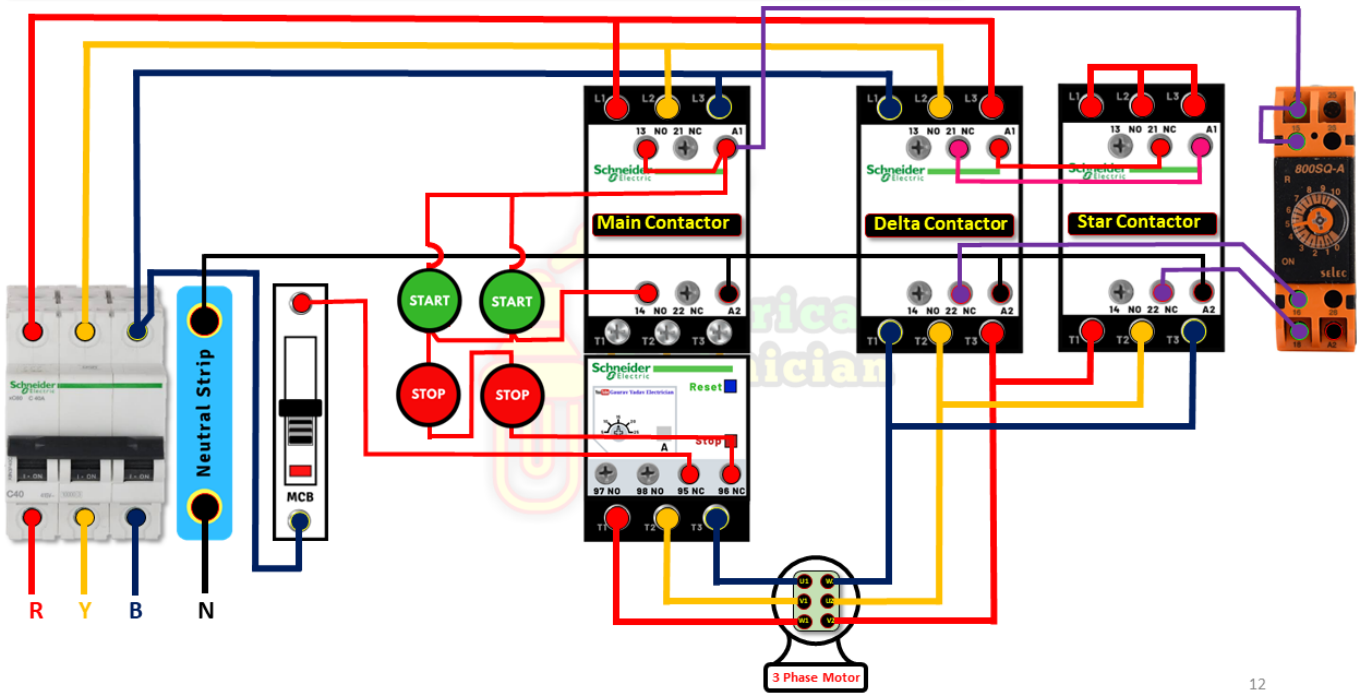
Star Delta Starter Control from 2 Places Single Line Diagram



11

71. Star Delta Starter Control from 2 Places -3D View:

Star Delta Starter Control from 2 Places Single Line Diagram - 3D View



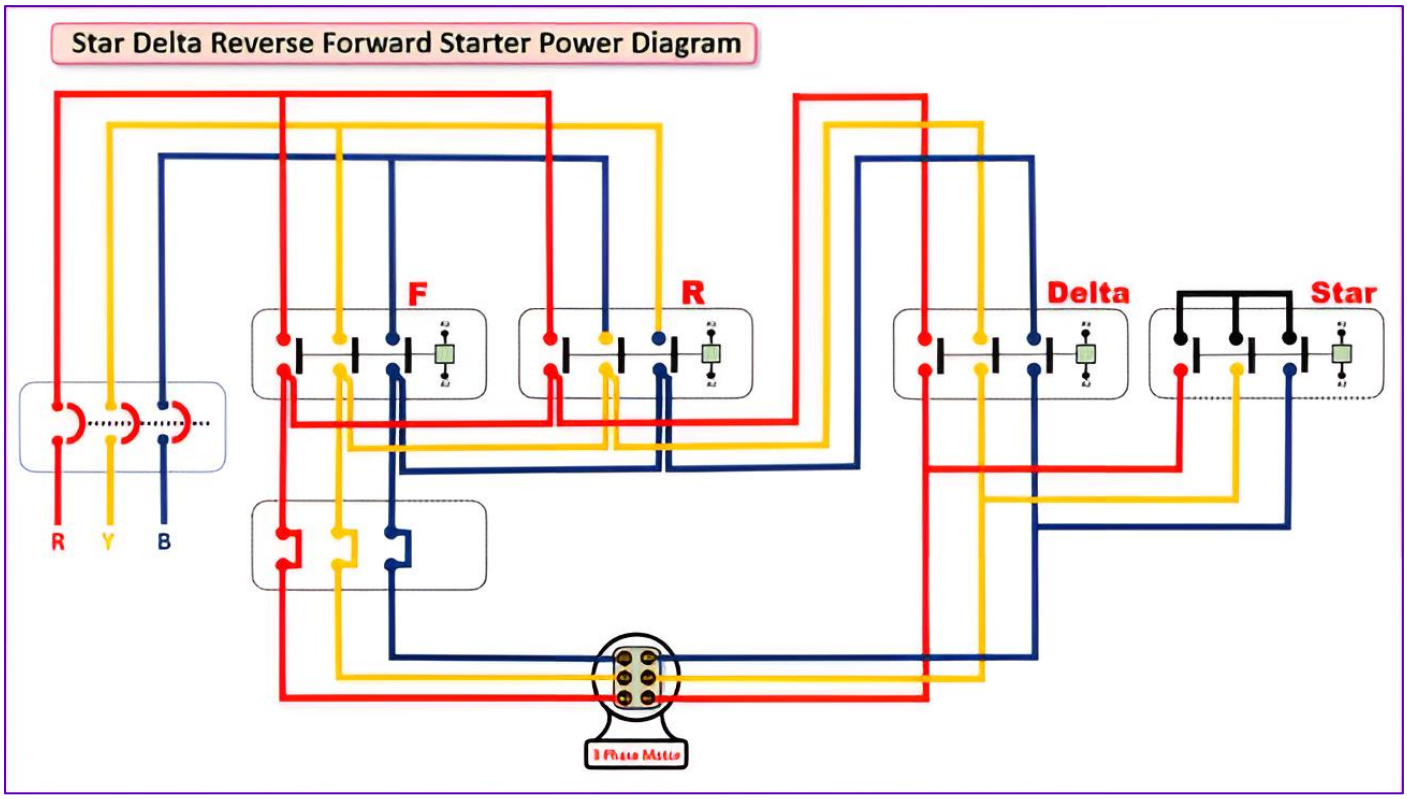
12

Star Delta Starter Reverse Forward

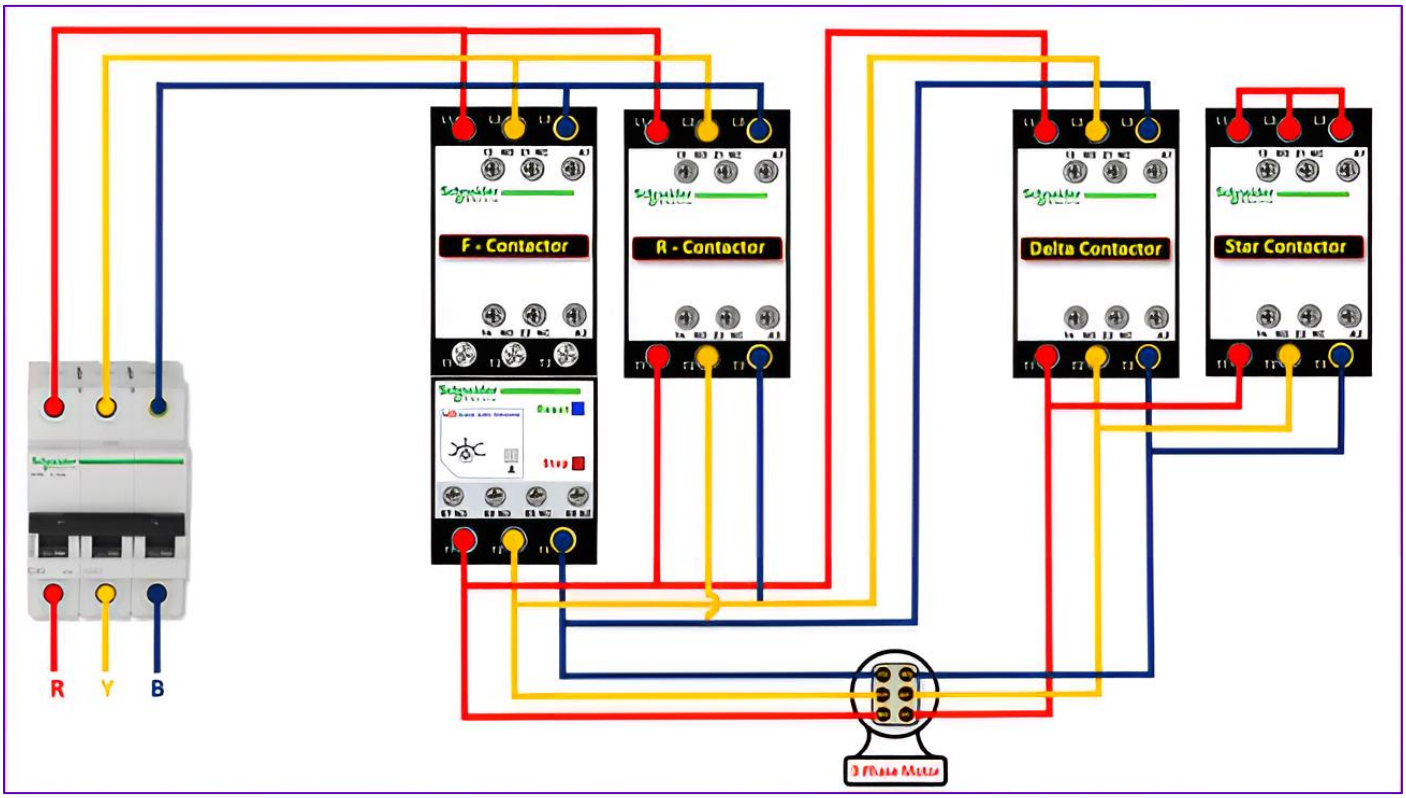
72. Star Delta Reverse Forward Starter Power Wiring Single Line Diagram:

Materials used in Starter.

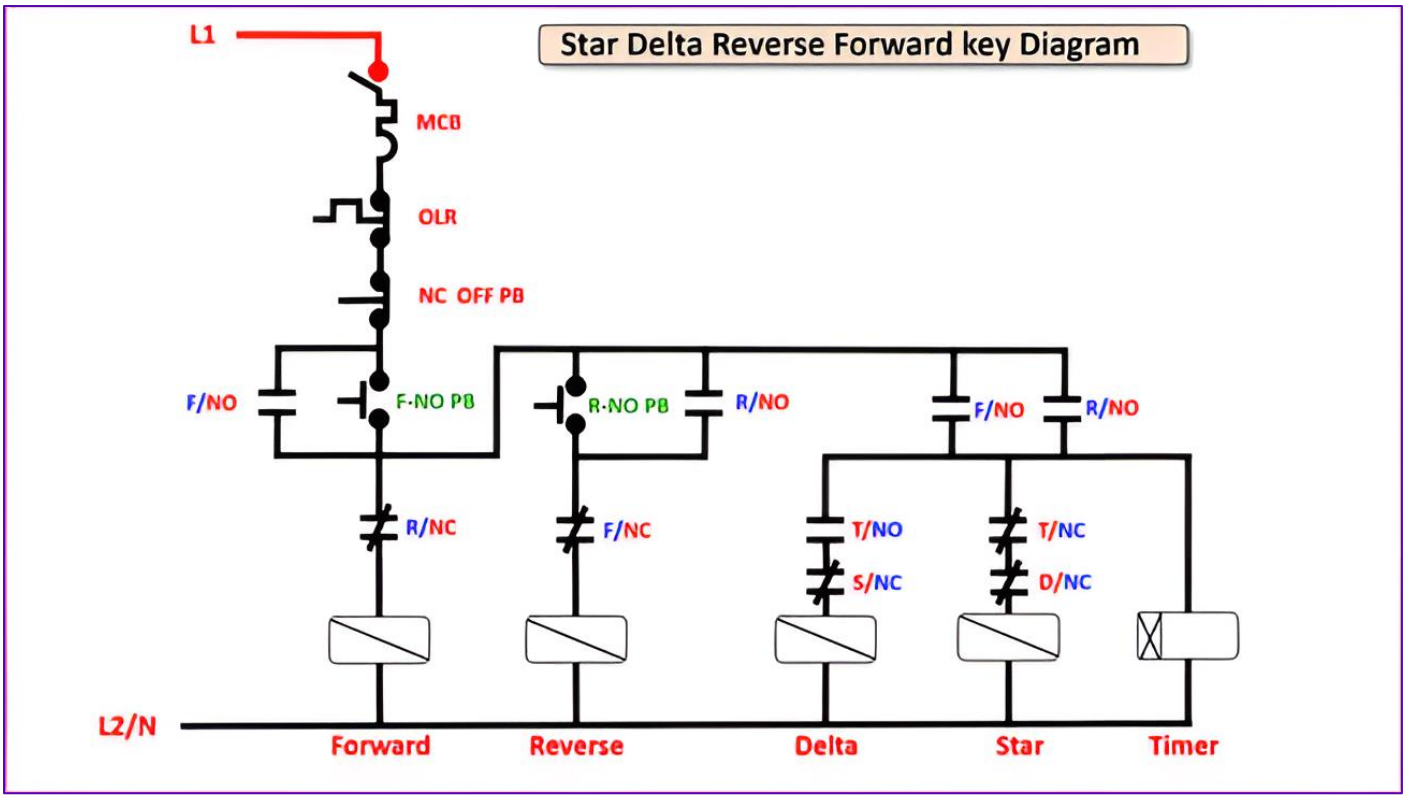
Quantity	Device Name
4 Pc	3Pole Contactor
2 Pc	Over-Load Relay
1 Pc	Single Pole MCB 6A
1 Pc	3Pole/ 4Pole MCB/MCCB
1 Pc	Neutral Strip/ MCB
4 Pc	Auxiliary Contactor
4 Pc	Indicator On(2Pc), Off, Trip
2 Pc	NC Push button Normally Open
2 Pc	NO Push button Normally Closed
1 Pc	Timer Relay Star Delta Timer
Wire	1/1.5 Sq.mm For Controlling



73. Star Delta Reverse Forward Starter Power Wiring - 3D View:

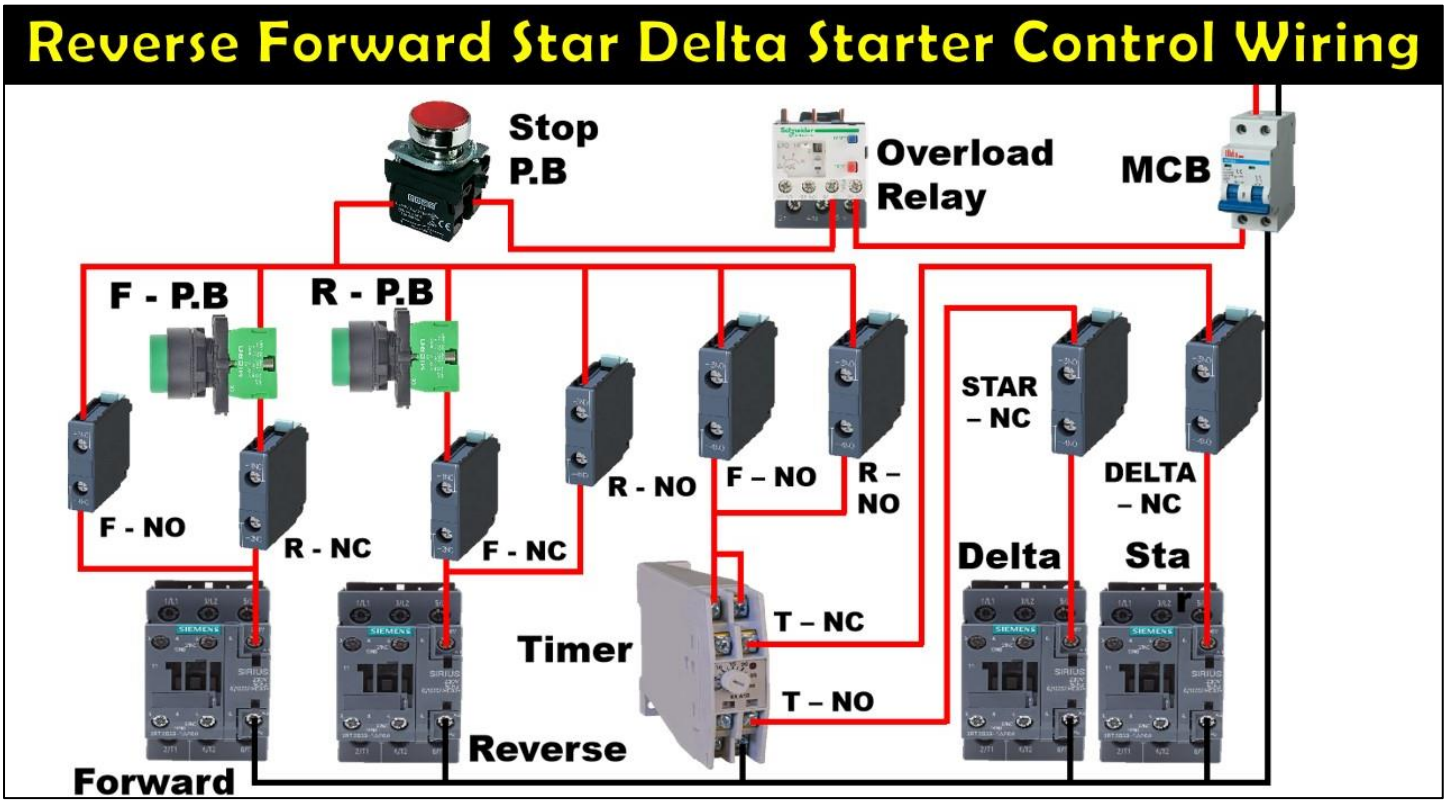


74. Star Delta Reverse Forward Control Wiring Single Line Diagram:



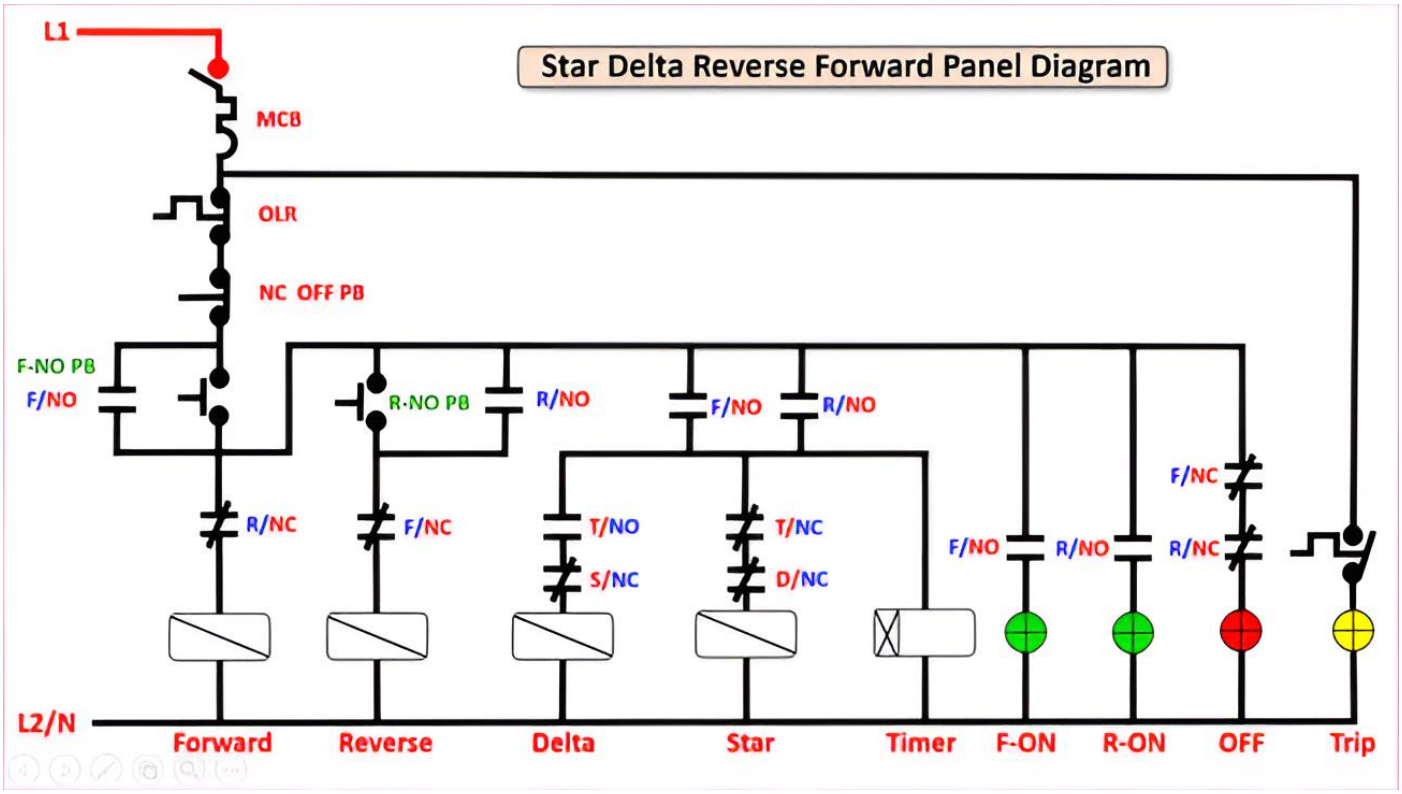
75. Star Delta Reverse Forward Control Diagram -3D View:

Friends, if you want, you can also watch its video by clicking on this diagram.



76. Star Delta Reverse Forward Control Wiring with indicator

Single Line Diagram:



Soft Starter

77. Soft Starter working principle:

If we talk about the main components of a soft starter, then there are 3 SCRs installed in the soft starter. These are connected in parallel inside the soft starter. The basic function of a soft starter is to start the drive motor smoothly during starting, with the help of which we could eliminate mechanical jerk.

If we talk about soft starter controlling, then the entire controlling of soft starter is like VFD. But there is a rectifier, filter, and inverter unit for controlling the VFD. Similarly, a microprocessor controller is installed inside the soft starter, which controls the entire process. Apart from this, there is no harmonic generation in soft starters. This is a huge advantage of the soft starter. There is no case called harmonics in soft starter, hence soft starter is considered very good.

Soft Starter Applications: -

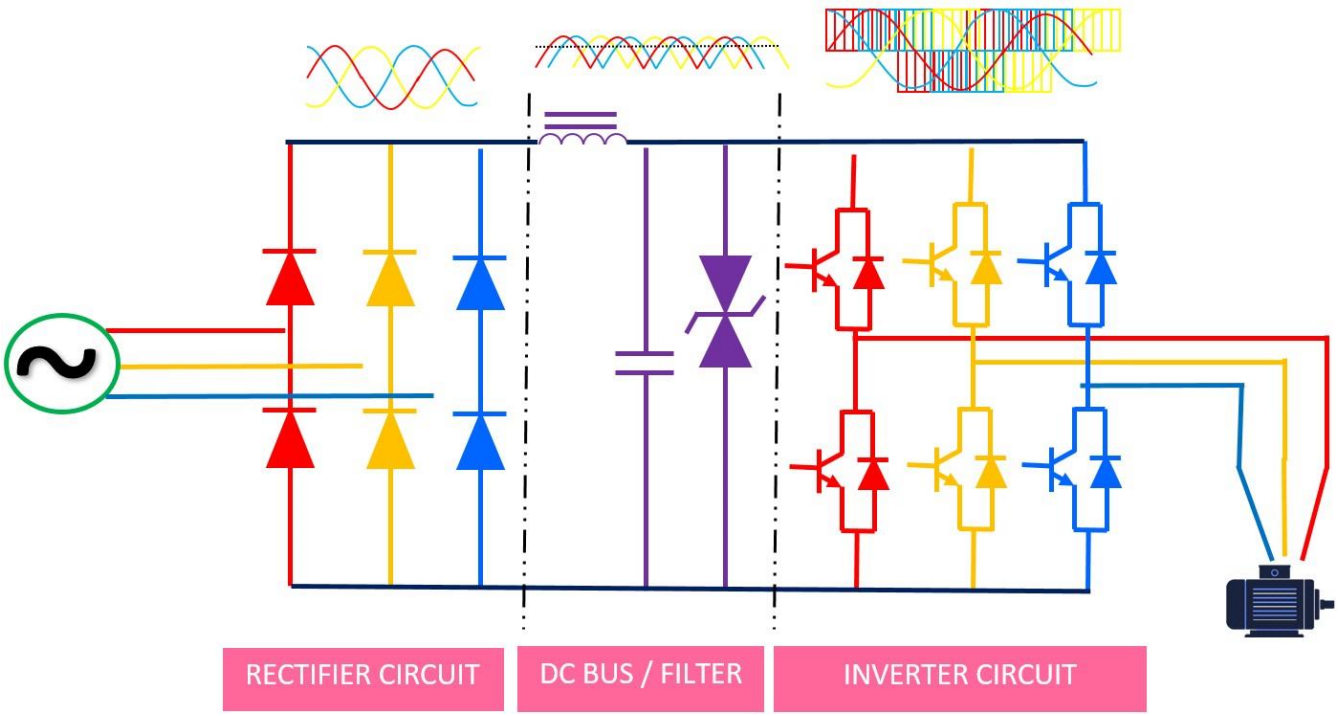
1. **Blowers/ Fans**
2. **Vacuum Pump**
3. **Compressor**
4. **Conveyors**
5. **Etc**

VFD Starter

78. Variable frequency drive (VFD) working principal:

VFD have three main components.

1. **Rectifier**
2. **Filter**
3. **Inverter**



Rectifier- The basic function of a rectifier circuit is to convert AC voltage into DC voltage. Once the AC voltage is converted into DC voltage, the filter unit works. This filter unit filters the DC voltage which is generated from the rectifier.

Filter Unit- The DC voltage in the filter unit is filtered from the rectifier circuit. It is checked whether DC voltage has some properties of AC voltage. In the filter unit, the DC voltage gets filtered and becomes pure DC voltage.

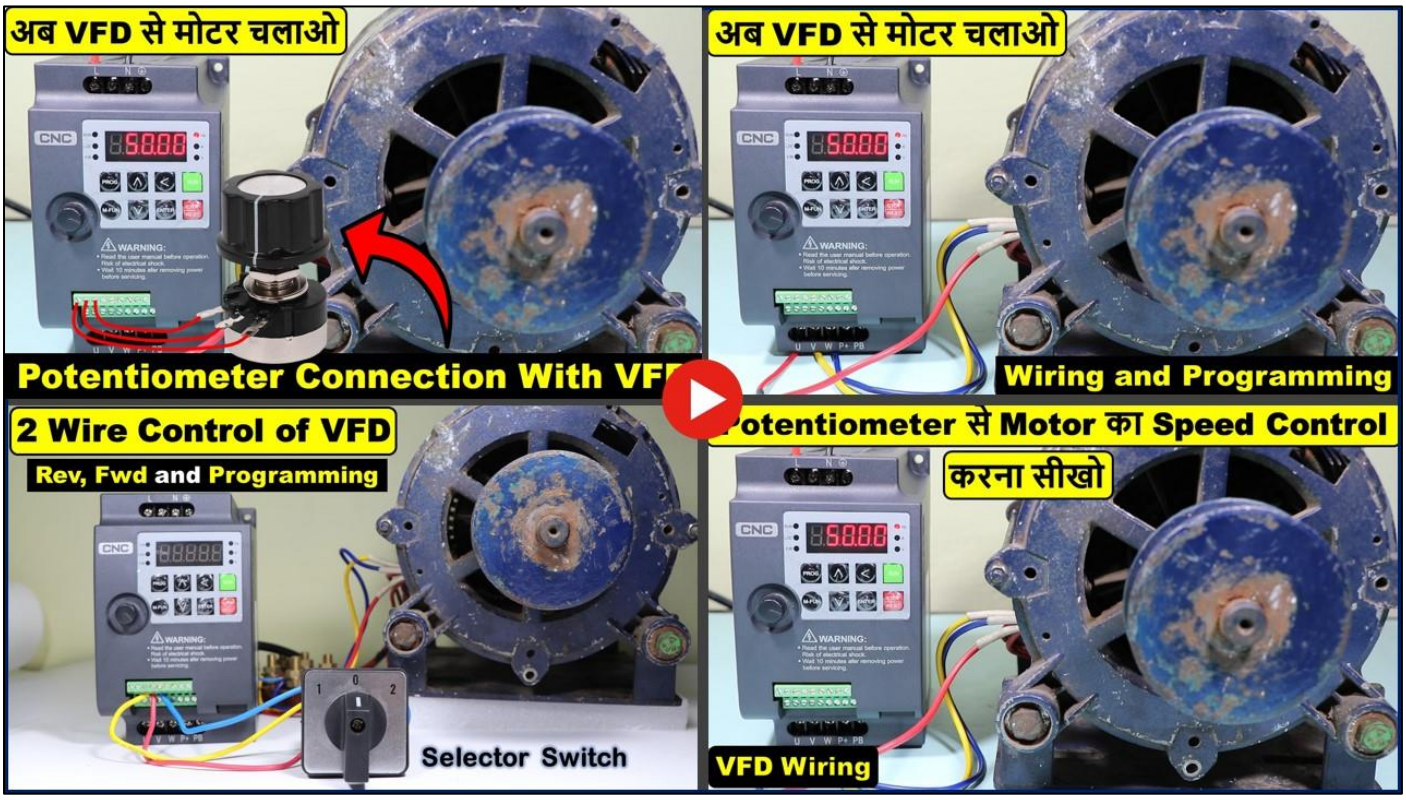
Inverter Unit- Once the DC voltage is filtered by the filter unit, it is the job of the inverter unit to convert that DC voltage back to AC voltage. Now the AC voltage that we have received from the VFD will be in a rectified form, meaning we can change this AC voltage as per our desired

output. And the speed of the motor can be easily reduced with the AC voltage received from the VFD.

VFD Applications: -

6. **Blowers**
7. **Cooling Towers**
8. **Compressor**
9. **Pumping Stations**
10. **Modern Lift System**
11. **Boilers**
12. **Etc**

79. How to use VFD Starter, VFD Remote wiring with push button:



Thanks...!