LOW VOLTAGE CIRCUIT BREAKER DESIGNING

Compiled by: Er. SADIQ HUSSAIN | INDIA

Table of content

Introduction

- A Circuit Breaker is an automatically operated electro-mechanical switch designed to protect an electrical circuit from damage caused by an overload or a short-circuit.
  "A short circuit is an over-current but not an overload"

- Basically used to detect fault condition and immediately cut the power supply.
- Unlike fuse, which operates once and then has to be replaced, a circuit breaker can reset to resume normal operation.

Operations of Circuit Breaker

- The Circuit breaker should detect the fault only when fault occurs.
- Once the fault is detected, contacts within the circuit breaker must open to interrupt the circuit.
- The circuit breaker contacts must carry the load current without excessive heating, and must also withstand the heat of the arc produced when interrupting the circuit.
- Finally, after the fault clearance, the contacts must again be closed to restore power to the interrupted circuit.

Types of Circuit Breakers

1. Miniature Circuit Breaker (MCB)
   - MCB is an automatic electro-mechanical switch, used to protect an electric circuit under abnormal condition.

- MCB is available in Single Pole, Double Pole, Triple Pole & Four Pole MCBs
- Operating current range 6A to 63A
- Thermal or thermo magnetic trip operation
- Trip setting cannot be adjusted
- MCB is more sensitive to over current than fuse

2. Moulded Case Circuit Breaker (MCB)

- The working principle for MCB and MCCBs is almost same, but both may have different applications
- Operating Current range- 64A to 800A
- Trip setting can be adjusted
- Thermal or thermo magnetic trip operation

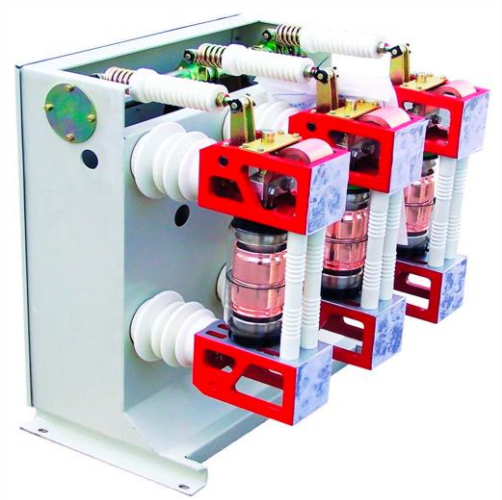
3. Air Blast Circuit Breaker (ACB)

- Operating current Range: Up to 10,000A
- Trip setting is fully adjustable
- Electronically and microprocessor controlling
- Used in Low as well as High voltage and Currents applications
- Used for protection transformer, generators, capacitors & for main power distribution in large industrial plant

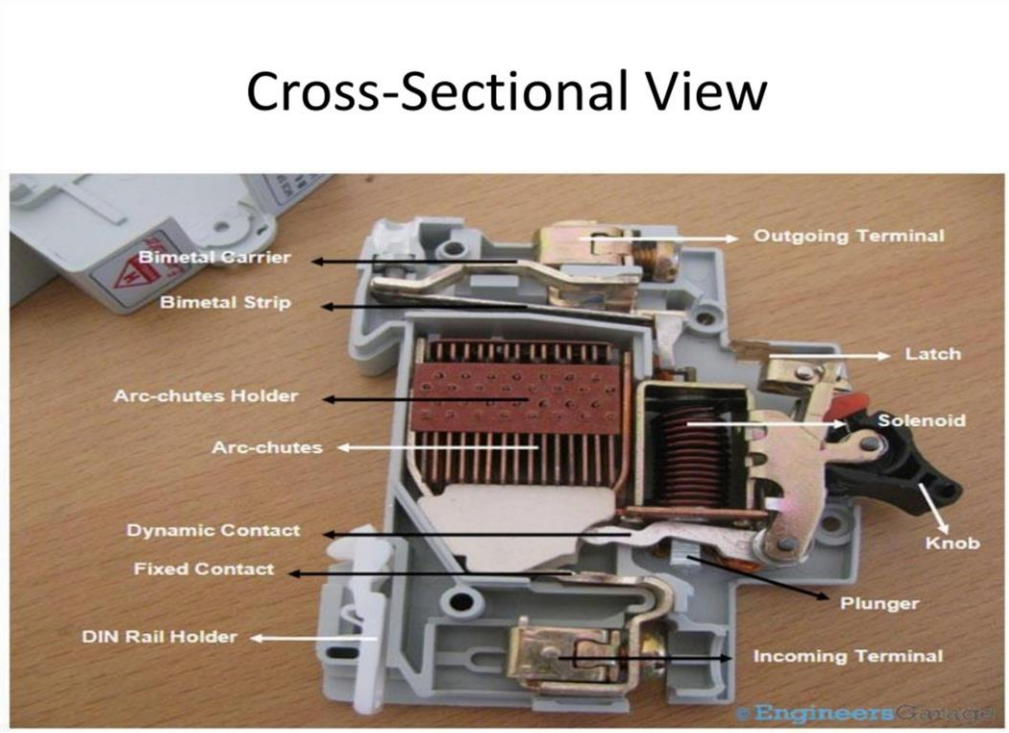

11
12
5
1
2
14
13
3
4
6
17
7
9
8
15
10
16

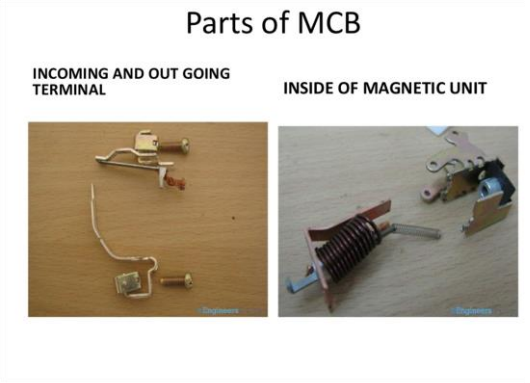
4. Vacuum Circuit Breaker (VCB)

- These breakers interrupt arc in a vacuum tube
- These can be applied at up to 33KV
- VCB has longer life



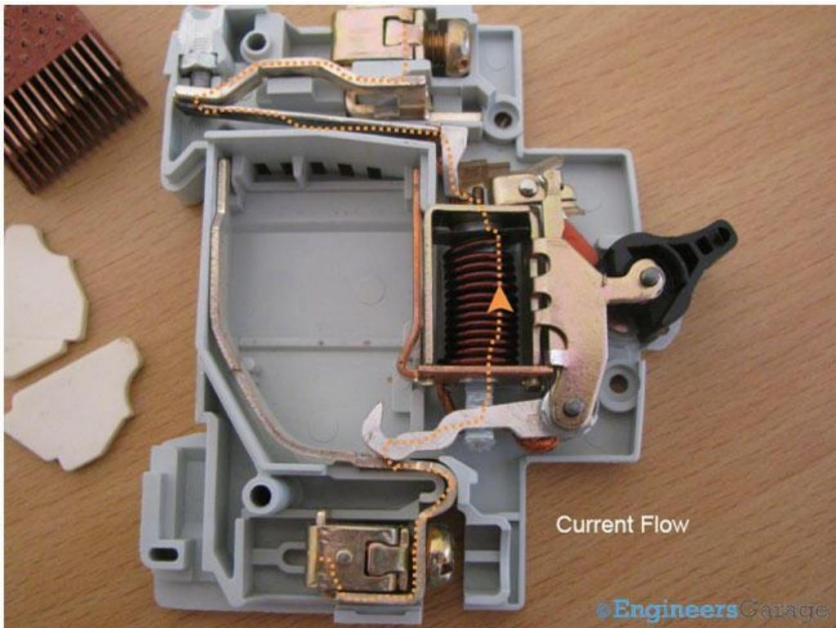
Parts of MCB


Cross-Sectional View
Bimetal Carrier
Bimetal Strip
Arc-chutes Holder
Arc-chutes
Dynamic Contact
Fixed Contact
DIN Rail Holder
Outgoing Terminal
Latch
Solenoid
Knob
Plunger
Incoming Terminal
EngineersGarage

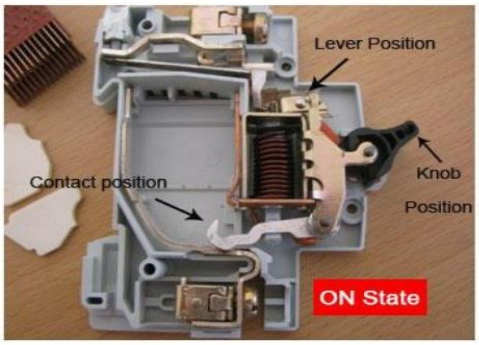

Parts of MCB
INCOMING AND OUT GOING TERMINAL
INSIDE OF MAGNETIC UNIT

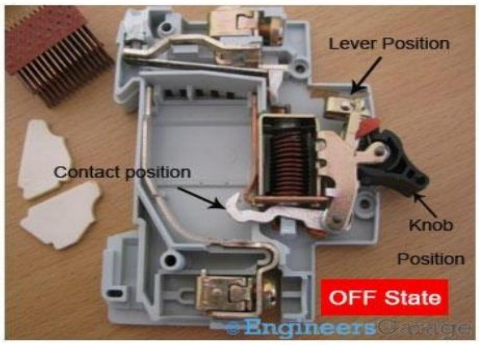

Parts of MCB
ARC-CHUTES
KNOB

Working Principle



On/Off Positions





Specifications/Name plate of MCB or MCCB

Following specifications are required to select an appropriate MCB or MCCB.

Technical Information of MCB & MCCB	
Type/Series	B, C, D
Rated Current (A)	**-**
Rated Voltage (V_{AC})	**230V/415V**
Rated Frequency (Hz)	**50/60**
No. of Poles	**SP, SP+N, DP, TP, TP+N, FP**
SC breaking capacity	**-**
Rated Insulation Voltage (V)	**-**
Electrical/Mechanical life	**No. of operations**
Terminal capacity (sq. mm)	
Installation Position	**Vertical/Horizontal**

Types of MCB/MCCB

Type	Operating Current	Suitability
B	**[3-5]*I_{rated}**	**Resistive load**
C	**[5-10]*I_{rated}**	**Inductive load**
D	**(10-20]*I_{rated}**	**Inductive-Capacitive load**

Calculation of Circuit Breaker

Classification of CB according to Ratings:

MCB	**6A - 63A**
MCCB	**64A - 800A**
ACB	**Above 800A**

***Standard Sizes of CB*:-**

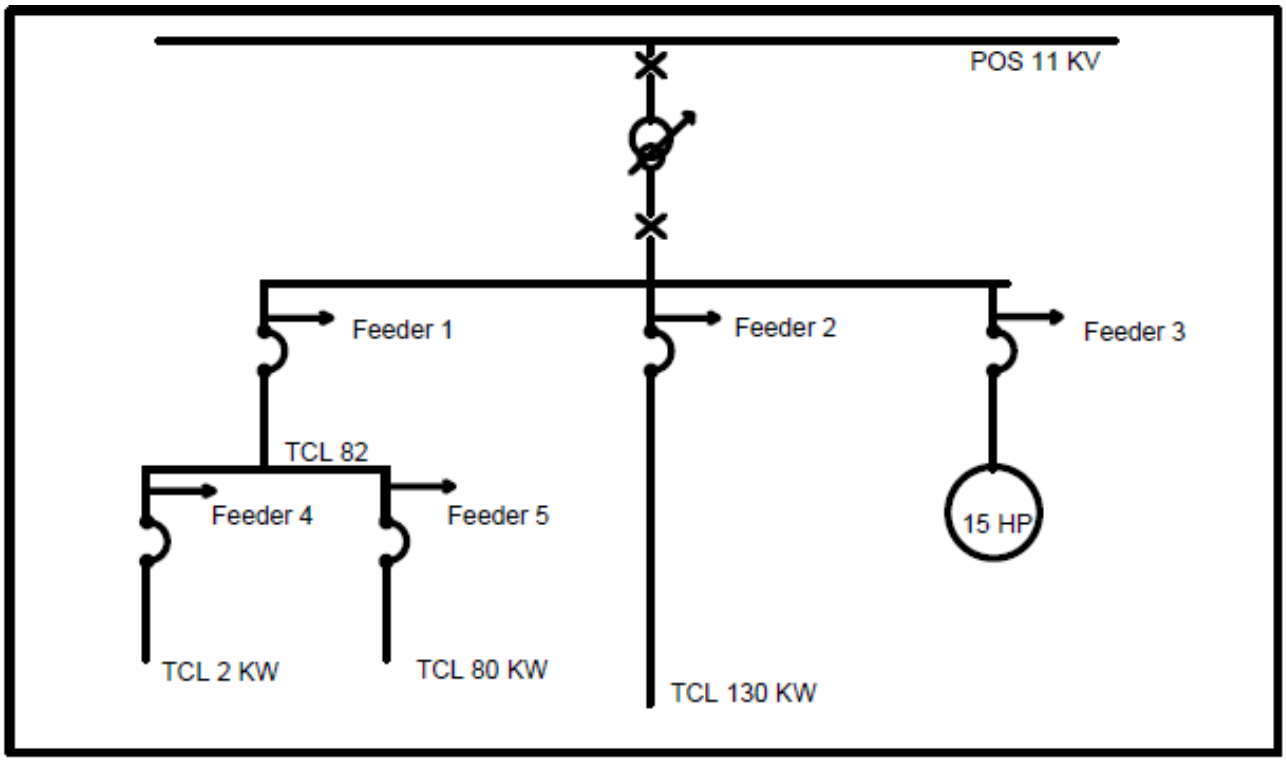
6A, 10A, 16A, 20A, 25A, 32A, 40A, 50A, 63A, 80A, 100A, 125A, 160A, 180A, 200A, 250A, 300A, 350A, 400A, 630A, 800A, 1000A, 1500A 1600A, 2000A, 2500A, 3000A, 3500A, 4000A, 4500A & 5000A

Circuit Breaker Size:-

- CB size is depends on the load current.
- Tripping time for HT side CB <3 sec
- Tripping time for LT side CB =(0.01 to 1) sec
- NEC -80% of the rated current is a safe current limit to flow though the CB

CB Size = 1.25*Full load current

Circuit Breaker Size Calculation



At Feeder 1

TCL:- 82 KW

Calculate current for the load of 82KW

Since, 82KW > 5KW therefore go with 3- ϕ system

Then, P= √3*V*I*Cos ϕ

V=415V, Cos ϕ=0.8, P=82KW

I= 142.77A

CB Size = 1.25*Full load current

CB Size = 1.25* 142.77

CB Size = 178.46A

So, proposed size of the **CB= 180A, MCCB**

At Feeder 2

TCL:- 130 KW

Calculate current for the load of 130KW

Since, 130KW > 5KW therefore go with 3- ϕ system

Then, P= √3*V*I*Cos ϕ

V=415V, Cos ϕ=0.8, P=130KW

I= 226.34A

CB Size = 1.25*Full load current

CB Size = 1.25* 226.34

CB Size = 282.92A

So, proposed size of the **CB= 300A, MCCB**

At Feeder 3

TCL:- 15HP

Calculate current for the load of 15HP

Since, 15HP > 6HP therefore go with 3- ϕ system

Then, P= √3*V*I*Cos ϕ

V=415V, Cos ϕ=0.8,

P=15HP

P=15*746

P=11.19KW

I= 19.48A

CB Size = 1.25*Full load current

CB Size = 1.25* 19.48

CB Size = 24.35A

So, proposed size of the **CB= 25A, MCB**

At Feeder 4

TCL:- 2 KW

Calculate current for the load of 2 KW

Since, 2KW < 5KW therefore go with 1- ϕ system

Then, P= V*I*Cos ϕ

V=230V, Cos ϕ=0.8, P=2KW

I= 10.87A

CB Size = 1.25*Full load current

CB Size = 1.25* 10.87

CB Size = 13.59 A

So, proposed size of the **CB= 16A, MCB**

At Feeder 5

TCL:- 80 KW

Calculate current for the load of 80KW

Since, 80KW > 5KW therefore go with 3- ϕ system

Then, P= √3*V*I*Cos ϕ

V=415V, Cos ϕ=0.8, P=80KW

I= 139.28A

CB Size = 1.25*Full load current

CB Size = 1.25* 139.28

CB Size = 174.1 A

So, proposed size of the **CB= 180A, MCCB**