TRIBHUVAN UNIVERSITY

KHWOPA COLLEGE OF ENGINEERING

An undertaking of Bhaktapur Municipality

Libali-2, Bhaktapur

Nepal

A

REPORT ON

"INDUSTRILA ILLUMINATION &POWER DISTRIBUTION "

SUBMITTED BY

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Acknowledgement

First of all, I would like to thank **Er. Rakesh Gwachha** sir, Department Head of Electrical Engineering for helping us build a strong background of both theoretical and practical methods on Industrial Power Distribution and Illumination. I believe that knowledge of Power Distribution and Illumination is a basic skill that every electrical engineer must possess and I am very thankful that I got learn from the experienced instructors.

I am also highly thankful towards **Er. Nakul Gyawamaru** sir for helping us to understand the underlying concepts and techniques used in power distribution and illumination and providing proper guidelines and methods on computer Aided Design (AUTOCAD) for drafting our design. His work experience on illumination design was a great help for our learning.

Finally, I would like to express my sincere thanks to all my friends and those who are directly or indirectly involved in making this report a success.

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1. Introduction

Power system distribution and illumination is a very basic skill for every electrical engineer. Power illumination is necessary for every building and business complex. Improper installation of luminaries and electrical equipment may cause serious disaster when a fault occurs. Improper lighting may cause discomfort to the people and the customers of the commercial complex. Proper study and planning of power distribution and illumination helps to save power and ultimately minimize the electricity bill. Protection devices would act efficiently on occurrence of fault and prevent accidents. Thus, proper lighting design, placement of generators, transformer, power socket distribution and reliable three phase power supply, protection schemes are to be well studied beforehand.

2.Description of the Building

The building taken in this report is hospital. It has 4 floor and a roof top terrace. In the report the illumination of all floors is designed with lighting sub circuit and power sub circuit design.

The various floors of the hospital are:

i. **Basement:** It is the lowest floor of the building and it has 3 general wards and other store rooms.
ii. **Ground Floor:** This floor contains operation theaters, opd room and staffs rooms .
iii. **First Floor :** In this floors , there are different room for patient and there is living room and a kitchen .
iv. **Second Floor:** This is the topmost floor of the building and this floor contains meeting hall, waiting room and a terrace.

3.Methods of lighting Calculation

A number of methods have been employed for lighting calculations, among which may have mentioned:

I. Watts per square meter method
II. Lumen or light flux Method
III. Point to point or Inverse square Method

3.1 Watts per square meter method

This is principally a "rule of thumb" method, very handy for rough calculations or checking. It consists in making an allowance of watts per square meter of area to be illuminated according to the illuminations desired on the assumptions of an average figure of overall efficiency of the system.

3.2 Lumen or light flux Method

This method is applicable to those cases where the sources of light area such to produce an approximate uniform illuminations over the working plane or where an average value is required.

Total no. of lamp or fixture in any room are calculated by following formula

$$\text{No of lamp or fixture} = \frac{E * A}{Ø * U.F * M.F}$$

where,

E= illumination level required in room (Lumen/m^2 or Lux)

A= total area of desired room (m^2)

Ø= total flux output from the lamp or fixture (Lumen)

U.F= utilization factor

M.F = maintenance factor

Utilization Factor

It is defined as the ratio of total lumens reaching the working plane to the total lumens given out by lamp.

i.e. utilization factor = $\frac{\text{Total lumens reaching the the working plane}}{\text{Total lumen given out by the lamp}}$

Maintenance factor

It is the ratio of illumination under normal working conditions to the illumination when the things are perfectly clean is known as maintenance factor.

i.e. maintenance factor = $\frac{\text{Illumination under normal working conditions}}{\text{Illumination when every thing is perfectly clean}}$

Depreciation Factor

It is the inverse of the maintenance factor.

3.3 Point to point or inverse square method:

This method is applicable where the illumination at a point is due to one or more sources light is required, the candle power of the sources in the particular direction under consideration being known.

Here we prefer Lumen or light flux method.

3.4 Selection of Conductor Size

Area of conductor is calculated by using the following formula

Area of conductor (A) = $\frac{I*K*L*1.5}{\text{Permissible voltage drop}}$

Where,

I= Ampere Rating of TPMCCB

L=length of conductor, generally (10 to 20)% greater length is taken

A= Size or Area of conductor

K= Resistivity

= 0.02 Ω sqmm/m for copper

=0.032Ω sqmm/m for Aluminum

Permissible voltage drop = 2% of V

3.5. Transformer Rating

3- phase KVA power = 3×Vph×Iph

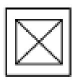
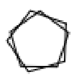
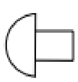
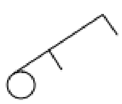
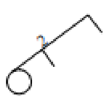
4.Types of Luminaries Used

In our design , we have used different lights of the Philip company and different product used are listed below:

SN	Product no.	Wattage (W)	Output Lumen
1	42719-5	22.5	2500
2	43221-1	19	1780
3	42875-5	15	1180
4	42935-7	4	320

4.1 legends

LEGEND

Symbol	Description	Remarks
	4 Watt LED	Ceiling
	15 Watt LED	Ceiling
	19 Watt LED	Ceiling
	22.5 Watt LED	Ceiling
	15 Watt Wall Lamp	Wall
	1 gang 1 way switch	1.5m from floor
	2 gang 1 way switch	1.5m from floor
	1 gang 2 way switch	1.5m from floor
	16A power socket	11" from floor

5.Electrical System Design

5.1 Basement :

The detailed calculation of number of luminaries, along with their wattage, product no. and lumens used in ground floor is shown in the table below.

i. Lighting Sub Circuit:

S.N	Room Description	Area (Sq m)	Req Lux(E)	U.F	M.F	watt(w)	Lumen	No of fixture	Actual no of bulbs
1	Toilet	2.32128568	100	0.8	0.8	4	320	1.133440273	2
2	Ward1	60.28891168	150	0.8	0.8	22.5	2500	5.65208547	6
3	Electrical Room	5.51031156	200	0.6	0.8	15	1180	1.945731483	2
4	Duty Room	12.4548138	300	0.7	0.8	19	1780	3.748439145	4
5	Ward 2	50.23602856	150	0.8	0.8	22.5	2500	4.709627678	6
6	Varandah	24.17995164	150	0.7	0.8	15	1180	5.488790475	6
7	corrider1	15.18190512	150	0.7	0.8	15	1180	3.446255702	4
8	corrider2	23.57866252	150	0.7	0.8	15	1180	5.352299301	6

Calculation of Lighting Loads for SDB 1

LSC	Watt	Voltage(V)	Current(A)
1L	151	220	0.49534
2L	90	220	0.295236
3L	151	220	0.49534
4L	151	220	0.49534
5L	60	220	0.196824
6L	60	220	0.196824
7L	76	220	0.24931
8L	30	220	0.098412
9L	30	220	0.098412

ii. Power Sub Circuit:

power sub circuits scheme in Basement is shown in following:

Number of power circuits used = 12 (10+2 SPARE)

Rating of MCB =16A

iii. Calculation of TPMCCB 1 Rating

The number of lighting lines in one phase =3

No. of power lines in one phase =4

Rating of TPMCCB = (3×6) + (4×16×2/3) A =66 A

The nearest rating available = 80A

iv. Calculation of Area of Conductor

Lighting Circuit

PVC insulated copper conductor of area 1.5 mm^2(3/22), can carry 11A current safely.

Power Circuit

PVC insulated copper conductor of area 4 mm^2.

For MDB to SDB1:

Main Distribution Board is placed at basement.

Area of conductor $(A) = \frac{1.5*k*I*L}{V\ permissible}$

L= 14+10% of 14 = 15.4m

k = 0.02

I = 66 A

Permissible voltage = 2% of 220 = 4.4 V

Hence, A≥6.93mm^2

From table, nearest conductor size is 10 mm$^{2\cdot}$ Therefore the cable of 10 mm^2 is used.

5.2 Ground floor:

The detailed calculation of number of luminaries, along with their wattage, product no. and lumens used in FIRST floor is shown in the table below :

i. lighting Sub Circuit:

S.N	Room Description	Area (Sq m)	Req Lux(E)	U.F	M.F	watt(w)	Lumen	No of fixture	Actual no of bulbs
1	OPD	11.02320376	200	0.8	0.7	15	1180	3.336320751	4
2	Office	16.1419032	200	0.8	0.7	15	1180	4.885563923	6
3	Attached toilet	2.17031824	150	0.6	0.8	15	1180	0.574766483	1
4	Staff	9.41481988	150	0.8	0.7	15	1180	2.137141317	4
5	Sterlize	9.23159444	250	0.7	0.8	15	1180	3.492582642	4
6	OT	21.1870544	300	0.7	0.8	22.5	2500	4.540083086	6
7	Anesteria	14.76061564	300	0.7	0.7	19	1780	5.077028998	6
8	Small OT	11.68320244	300	0.7	0.8	19	1780	3.516212612	4
9	Dark Room	5.30708616	50	0.8	0.7	4	320	1.480771808	2
10	Register Room	5.49740836	150	0.8	0.7	15	1180	1.247898387	2
11	Store	2.68257528	100	0.6	0.6	15	1180	0.631491356	2
12	Male and Female	3.03612296	150	0.7	0.8	15	1180	0.689192561	2
13	Waiting	13.67481136	150	0.8	0.7	15	1180	3.104149068	4
14	Pharmacy Room	12.53932976	200	0.8	0.7	19	1780	2.515916886	4
15	Varandah	19.84447644	150	0.7	0.6	15	1180	6.00619747	6
16	A1	11.65675088	150	0.8	0.7	15	1180	2.646054225	4
17	A2	18.91802668	150	0.8	0.7	15	1180	4.29434625	6
18	A3	14.86577672	150	0.8	0.7	15	1180	3.374495321	4
19	A4	14.17997164	150	0.8	0.7	15	1180	3.218819228	4
20	A5	2.85676848	150	0.8	0.7	15	1180	0.648479528	2
21	A6	4.81418392	150	0.8	0.7	15	1180	1.092808093	2
22	A7	2.14064088	150	0.8	0.7	15	1180	0.485920297	2
23	A8	3.42967056	150	0.8	0.7	15	1180	0.778526913	2
24	A9	3.07547772	150	0.8	0.7	15	1180	0.698125996	2
25	A10	4.07934668	150	0.8	0.7	15	1180	0.926001819	2
26	MD1	6.39289044	150	0.8	0.7	15	1180	1.451170651	2

27	MD	8.8257888	150	0.8	0.7	15	1180	2.003432688	2
28	SRD	4.2290238	150	0.8	0.7	15	1180	0.959978163	2
29	Store	2.48902728	150	0.8	0.7	15	1180	0.565003166	2

Calculation of Lighting Loads for SDB 2:

LSC	Watt	Voltage	Current
1L	45	220	0.147618
2L	60	220	0.196824
3L	60	220	0.196824
4L	60	220	0.196824
5L	60	220	0.196824
6L	30	220	0.098412
7L	60	220	0.196824
8L	30	220	0.098412
9L	45	220	0.147618
10L	90	220	0.295236
11L	76	220	0.24931
12L	30	220	0.098412
13L	135	220	0.442854
14L	135	220	0.442854
15L	105	220	0.344442
16L	8	220	0.026243
17L	75	220	0.24603
18L	135	220	0.442854
19L	60	220	0.196824
20L	114	220	0.373966
21L	76	220	0.24931
22L	60	220	0.196824
23L	60	220	0.196824
24L	135	220	0.442854

ii. Power Sub Circuit :

power sub circuits scheme in Ground Floor is shown in following:

Number of power circuits used = 18

Rating of MCB =16A

iii. Calculation of TPMCCB 2 Rating

The number of lighting lines in one phase =8

No. of power lines in one phase =6

Rating of TPMCCB = (8×6) + (6×16×2/3) A =112A

The nearest rating available = 125A

iv. Calculation of Area of Conductor

Lighting Circuit

PVC insulated copper conductor of area 1.5 mm^2(3/22), can carry 11A current safely.

Power Circuit

PVC insulated copper conductor of area 4 mm^2.

For MDB to SDB2:

Main Distribution Board is placed at Basement floor.

Area of conductor $(A) = \frac{1.5*k*I*L}{V\ permissible}$

L= 12+10% of 12 =13.2m

k = 0.02

I = 112 A

Permissible voltage = 2% of 220 = 4.4 V

Hence, A≥10.08mm^2

From table, nearest conductor size is 10 $mm^{2.}$ Therefore the cable of 10 mm^2 is used.

5.3 First floor:

The detailed calculation of number of luminaries, along with their wattage,product no. and lumens used in second floor is shown in the table below:

v. Lighting Sub circuit

S.N	Room Description	Area (Sq m)	Req Lux(E)	U.F	M.F	watt(w)	Lumen	No of fixture	Actual no of bulbs
1	Living	29.43800564	150	0.8	0.7	15	1180	6.682356002	8
2	Room 1,2,3	27.23478424	150	0.8	0.7	15	1180	6.182230079	8
3	room 4	18.64447884	150	0.8	0.7	15	1180	4.232251553	6
4	room 5	21.49737636	150	0.8	0.7	15	1180	4.879852382	6
5	room 6	22.67350304	150	0.8	0.7	15	1180	5.146830291	6
6	Attached toilet 1	4.43612016	150	0.8	0.7	15	1180	1.006988535	2
7	Attached toilet 2	2.9774134	150	0.8	0.7	15	1180	0.675865633	2
8	Attached toilet 3	3.03483264	150	0.8	0.7	15	1180	0.688899661	2
9	Attached toilet 4	2.6709624	150	0.7	0.7	15	1180	0.692916569	2
10	Kitchen Din	20.44253976	150	0.8	0.6	15	1180	5.413808199	6
11	Passage	25.91994816	250	0.6	0.7	22.5	2500	6.171416229	8
12	Terrace4	22.73801904	250	0.7	0.9	22.5	2500	3.609209371	4
13	Terrace5	20.9741516	250	0.7	0.9	22.5	2500	3.329230413	4
14	Terrace6	20.72511984	250	0.7	0.9	22.5	2500	3.289701562	4

Calculation of Lighting Loads for SDB 3:

LSC	Watt	Voltage	current
1L	45	220	0.147618
2L	30	220	0.098412
3L	30	220	0.098412
4L	150	220	0.49206
5L	180	220	0.590472
6L	150	220	0.49206
7L	135	220	0.442854
8L	150	220	0.49206
9L	60	220	0.196824
10L	30	220	0.098412
11L	120	220	0.393648
12L	120	220	0.393648
13L	105	220	0.344442
14L	90	220	0.295236
15L	90	220	0.295236
16L	90	220	0.295236

vi. Power Sub Circuit:

Number of power circuits used = 15

Rating of MCB =16A

vii. Calculation of TPMCCB 3 Rating

The number of lighting lines in one phase = 6

No. of power lines in one phase = 5

Rating of TPMCCB = (6×6) + (5×16×2/3) A =96 A

The nearest rating available = 100A

viii. Calculation of Area of Conductor

Lighting Circuit

PVC insulated copper conductor of area 1.5 mm^2(3/22), can carry 11A current safely.

Power Circuit

PVC insulated copper conductor of area 4 mm^2.

For MDB to SDB3:

Main Distribution Board is placed at Basement floor.

Area of conductor $(A) = \frac{1.5*k*I*L}{V\ permissible}$

L= 19+10% of 19 = 20.9m

k = 0.02

I = 96 A

Permissible voltage = 2% of 220 = 4.4 V

Hence, A≥13.68mm^2

From table, nearest conductor size is 16 mm^2. Therefore the cable of 16 mm^2 is used.

5.4 Second floor:

The detailed calculation of number of luminaries, along with their wattage, product no. and lumens used in second floor is shown in the table below.

i. Lighting sub circuit

S.N	Room Description	Area (Sq m)	Req Lux(E)	U.F	M.F	watt(w)	Lumen	No of fixture	Actual no of bulbs
1	Waiting	22.74253516	200	0.6	0.6	15	1180	10.70740827	10
2	Meeting hall	89.61465948	300	0.6	0.7	22.5	2500	25.60418842	28
3	Meeting	22.42705192	300	0.7	0.7	22.5	2500	5.492339246	6
4	Kitchen Din	20.8418938	150	0.7	0.7	15	1180	5.406925061	6
5	Toilet	8.01546784	250	0.7	0.9	15	1180	2.695543395	4
6	Upper Terrace	90.68885088	250	0.7	0.9	22.5	2500	14.3950557	16
7	Lower Terrace	60.73923336	250	0.7	0.9	22.5	2500	9.641148152	10

Calculation of Lighting Loads for SDB 4:

LSC	Watt	Voltage	Current
1L	45	220	0.147618
2L	30	220	0.098412
3L	150	220	0.49206
4L	60	220	0.196824
5L	60	220	0.196824
6L	135	220	0.442854
7L	157.5	220	0.516663
8L	157.5	220	0.516663
9L	157.5	220	0.516663
10L	157.5	220	0.516663
11L	180	220	0.590472
12L	180	220	0.590472
13L	225	220	0.73809
14L	90	220	0.295236

ii. Power Sub Circuit:

Number of power circuits used = 12

Rating of MCB =16A

iii. Calculation of TPMCCB 4 Rating

The number of lighting lines in one phase	= 5
No. of power lines in one phase	= 4
Rating of TPMCCB = (5×6) + (4×16×2/3) A	=78A
The nearest rating available	= 80A

ix. Calculation of Area of Conductor

Lighting Circuit

PVC insulated copper conductor of area 1.5 mm^2(3/22), can carry 11A current safely.

Power Circuit

PVC insulated copper conductor of area 4 mm^2.

For MDB to SDB4:

Main Distribution Board is placed at Basement floor.

Area of conductor $(A) = \frac{1.5*k*I*L}{V\ permissible}$

L= 24+10% of 24 = 26.4m

k = 0.02

I = 78 A

Permissible voltage = 2% of 220 = 4.4 V

Hence, A≥14.04mm^2

From table, nearest conductor size is 16 mm$^{2.}$ Therefore the cable of 16 mm^2 is used.

5.Transformer selection

Current through MDB = (66+112+96+78)*3/4= 264 A

The three phase KVA power = 3×Vph×Iph = 3×220×264 =174.24 KVA

Standard value of transformer for this power is 200 KVA.

Thus, 3 phase transformer of 160 KVA is to be installed for the building.

6.Conclusion:

Hence, design of lighting sub circuits and power sub circuits along with the ratings of protection scheme and distribution boards were done in the design of Dhangadi Hospital.

7.Appendix:

LED Lamps

LED A-Type and Candle Lamps

Watts	Bulb Type	Base	Product Number	Symbols, Footnotes	Ordering Code	Volts	Description	Case Qty.	Rated Avg. Life (Hrs.) (501,502)	Approx. MBCP	CRI	MOL (In.)	Approx. Lumens (503)	Life (Yrs.) (446)	Energy Cost (445)	Color Temp. (K)
LED A-Type Lamps													FTC REQUIREMENTS¥			
7	A-Type	Med	42348-3	■	8A19/END/2700 DIM 6/1	120	A19 Dim*	6	25,000	—	81	4	470	22.8	$0.84	2700
11	A-Type	Med	42349-1	■	11A19/END/2700 DIM 6/1	120	A19 Dim*	6	25,000	—	81	4	830	22.8	$1.32	2700
10.5	A-Type	Med	43051-2	■	10.5A19/COREPRO/3000 6/1	120	A19 Dim*	6	25,000	—	81	4	800	22.8	$1.26	2700
15	A-Type	Med	42875-5	■	15A21/2700 DIM 6/1	120	A21 Dim*	6	25,000	—	80	4⅘	1180	22.8	$1.81	2700
	A-Type	Med	43218-7	■	15A21/2700-WHT DIM 6/1	120	A21 Dim*	6	25,000	—	80	4½	1180	22.8	$1.81	2700
19	A-Type	Med	43221-1	■	19A21/2700-WHT DIM 6/1	120	A21 Dim*	6	25,000	—	80	4½	1780	22.8	$2.65	2700
22	A-Type	Med	42352-5	■	22A21/END/2700 DIM	120	A21 Dim*	6	25,000	—	80	4⅘	1780	22.8	$2.65	2700
LED Candle Lamps																
3.5	BA11	Cand.	42778-1		3.5BA11/END/2700-E12 DIM 8/1	120	BA11 Clear Candle Dim*	8	25,000	—	80	4	180	22.8	$0.42	2700
	B11	Cand.	42779-9		3.5B11/END/2700-E12 DIM 8/1	120	B11 Candle Dim*	8	25,000	—	80	4	180	22.8	$0.42	2700
	B12	Cand.	42781-5		3.5B12/END/2700-E12 DIM 8/1	120	B12 Candle Dim*	8	25,000	—	80	4⅒	180	22.8	$0.42	2700
	F15	Med.	42780-7		3.5F15/END/2700-E12 DIM 8/1	120	F15 Clear Postlight Dim*	8	25,000	—	80	4⅗	180	22.8	$0.42	2700
4	F15	Med.	42935-7		4.5F15/END/2700-150 E26 DIM 10/1	120	F15 Frosted Postlight Dim*	8	25,000	—	80	4⅗	320	22.8	$0.54	2700

For the most current product information, go to the e-catalog on **www.philips.com**
LED symbols and footnotes located on page 13

Watts	Bulb Type	Base	Product Number	Symbols, Footnotes	Ordering Code	Volts	Description	Pkg. Qty.	CRI	Rated Avg. Life (Hrs.) (501,502)	Nom. Length (In.)	Approx. Lumens (504)	Life (Yrs.) (446)	Energy Cost (445)	Color Temp. (K)
LED T8 Specifier Series Lamp*												FTC REQUIREMENTS			
10	T8	G13	42182-6	U	10T8/END/24-3500 UNV 10/1	100–277	Linear LED T8 Tube, 3500K	10	85	40,000	24	825	36.5		3500
			42186-7	U	10T8/END/24-4000 UNV 10/1	100–277	Linear LED T8 Tube, 4000K	10	85	40,000	24	825	36.5		4000
19	T8	G13	42183-4	U	19T8/END/48-3500 UNV 10/1	100–277	Linear LED T8 Tube, 3500K	10	85	40,000	48	1650	36.5		3500
			42187-5	U	19T8/END/48-4000 UNV 10/1	100–277	Linear LED T8 Tube, 4000K	10	85	40,000	48	1650	36.5		4000
LED T8 Specifier Series T8 External Driver															
22.5	T8		42719-5	U	22T8/EXT/48-3500K UNV	100–277		10	85	50,000	24	2500	xx		3500
			42720-3	U	22T8/EXT/48-4000K UNV	100–277		10	85	50,000	24	2500	xx		4000
			42721-1	U	22T8/EXT/48-6500K UNV	100–277		10	85	50,000	24	2500	xx		6500

Miniature circuit breakers S200

S200U-K, 240 VAC
Branch circuit protection
UL 489, CSA 22.2 No. 5

K

S201U-K

No. of poles	Rated current	Catalog number	No. of poles	Rated current	Catalog number
1	0.2	S201U-K0.2	3	0.2	S203U-K0.2
	0.3	S201U-K0.3		0.3	S203U-K0.3
	0.5	S201U-K0.5		0.5	S203U-K0.5
	0.75	S201U-K0.75		0.75	S203U-K0.75
	1	S201U-K1		1	S203U-K1
	1.6	S201U-K1.6		1.6	S203U-K1.6
	2	S201U-K2		2	S203U-K2
	3	S201U-K3		3	S203U-K3
	4	S201U-K4		4	S203U-K4
	5	S201U-K5		5	S203U-K5
	6	S201U-K6		6	S203U-K6
	8	S201U-K8		8	S203U-K8
	10	S201U-K10		10	S203U-K10
	15	S201U-K15		15	S203U-K15
	16	S201U-K16		16	S203U-K16
	20	S201U-K20		20	S203U-K20
	25	S201U-K25		25	S203U-K25
	30	S201U-K30		30	S203U-K30
	32	S201U-K32		32	S203U-K32
	40	S201U-K40		40	S203U-K40
	50	S201U-K50		50	S203U-K50
	60	S201U-K60		60	S203U-K60

1 Pole

2 Pole

3 Pole

A1 - 100A Frame TMF, thermal magnetic fixed - fixed mount (F), front terminals (F)

Breaker	IC at 240VAC	Rating (A)	Magnetic trip	1 pole catalog number	2 pole catalog number	3 pole catalog number
A1A	10kA	15	400	A1A015TW-1	A1A015TW-2	A1A015TW
		20	400	A1A020TW-1	A1A020TW-2	A1A020TW
		25	400	A1A025TW-1	A1A025TW-2	A1A025TW
		30	400	A1A030TW-1	A1A030TW-2	A1A030TW
		40	400	A1A040TW-1	A1A040TW-2	A1A040TW
		50	500	A1A050TW-1	A1A050TW-2	A1A050TW
		60	600	A1A060TW-1	A1A060TW-2	A1A060TW
		70	700	A1A070TW-1	A1A070TW-2	A1A070TW
		80	800	A1A080TW-1	A1A080TW-2	A1A080TW
		90	900	A1A090TW-1	A1A090TW-2	A1A090TW
		100	1000	A1A100TW-1	A1A100TW-2	A1A100TW

1 Pole

2 Pole

3 Pole

A2 - 250A Frame TMF, thermal magnetic fixed - fixed mount (F), front terminals (F)

Breaker	IC at 240VAC	Rating (A)	Magnetic trip	1 pole catalog number	2 pole catalog number	3 pole catalog number
A2A	10kA	125	1250	A2A125TW-1	A2A125TW-2	A2A125TW
		150	1500	A2A150TW-1	A2A150TW-2	A2A150TW
		175	1750	A2A175TW-1	A2A175TW-2	A2A175TW
		200	2000	A2A200TW-1	A2A200TW-2	A2A200TW
		225	2250	A2A225TW-1	A2A225TW-2	A2A225TW
		250	2500	A2A250TW-1	A2A250TW-2	A2A250TW
A1N	1 pole 18kA 2-3 pole 25kA	125	1250	A2N125TW-1	A2N125TW-2	A2N125TW
		150	1500	A2N150TW-1	A2N150TW-2	A2N150TW
		175	1750	A2N175TW-1	A2N175TW-2	A2N175TW
		200	2000	A2N200TW-1	A2N200TW-2	A2N200TW
		225	2250	A2N225TW-1	A2N225TW-2	A2N225TW