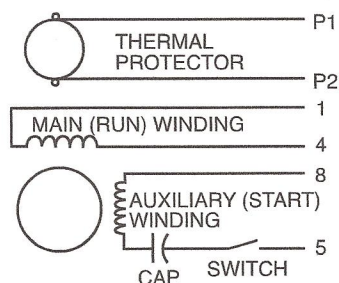


2.5 STANDARD TERMINAL MARKINGS AND CONNECTIONS

Note: All terminal markings and connections in this section are based on NEMA Std. MG 1-2009, Rev. 1-2010, 2.41 or IEC Std. 60034-8.

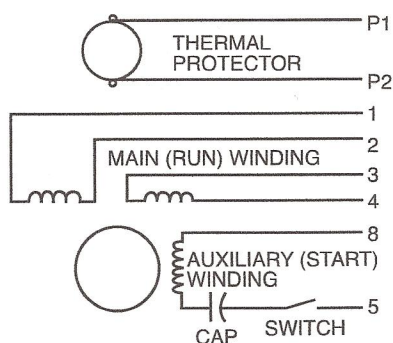
SINGLE-PHASE MOTORS—CAPACITOR-START NEMA NOMENCLATURE

SINGLE VOLTAGE



ROTATION	L1	L2
CCW	1,8	4,5
CW	1,5	4,8

DUAL VOLTAGE (MAIN WINDING ONLY)

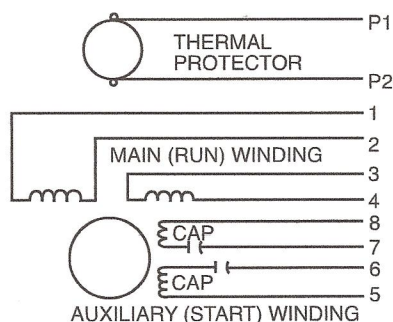


Auxiliary winding is always at low-voltage rating; capacitor should be rated accordingly.

Voltage	Rotation	L1	L2	Join
High	CCW	1	4,5	2&3&8
	CW	1	4,8	2&3&5
Low	CCW	1,3,8	2,4,5	—
	CW	1,3,5	2,4,8	—

DUAL VOLTAGE

(MAIN AND AUXILIARY WINDING)



Capacitors in auxiliary windings are rated for lower voltage.

Voltage	Rotation	L1	L2	Join
High	CCW	1,8	4,5	2&3,6&7
	CW	1,5	4,8	2&3,6&7
Low	CCW	1,3,6,8	2,4,5,7	—
	CW	1,3,5,7	2,4,6,8	—

The switch in the auxiliary winding circuit has been omitted from this diagram. The connections to the switch must be made so that *both* auxiliary windings become de-energized when the switch is open.

Rotation: CCW – Counterclockwise
CW – Clockwise

The direction of shaft rotation can be determined by facing the end of the motor opposite the drive.

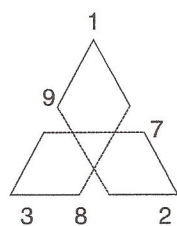
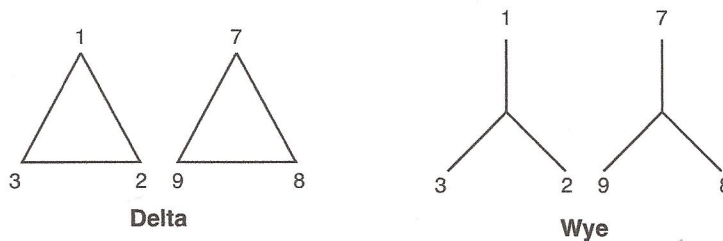
TERMINAL MARKINGS IDENTIFIED BY COLOR

1-Blue 5-Black P1-No color assigned
2-White 6-No color assigned P2-Brown
3-Orange 7-No color assigned
4-Yellow 8-Red

Reference: NEMA Std. MG 1-2009, Rev. 1-2010, 2.41.
Note: May not apply for some definite-purpose motors.

STANDARD TERMINAL MARKINGS AND CONNECTIONS THREE-PHASE MOTORS—PART-WINDING START

NEMA NOMENCLATURE—6 LEADS



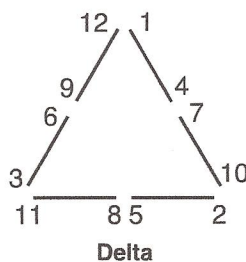
**Double Delta
(Extended Delta)**

Operating mode	L1	L2	L3	Open
Start	1	2	3	7,8,9
Run	1,7	2,8	3,9	—

NEMA NOMENCLATURE—9 LEADS WYE-CONNECTED (LOW VOLTAGE ONLY)

	T1	T2	T3	T7	T8	T9	Together
Motor leads	1	2	3	7	8	9	4&5&6

NEMA NOMENCLATURE—12 LEADS



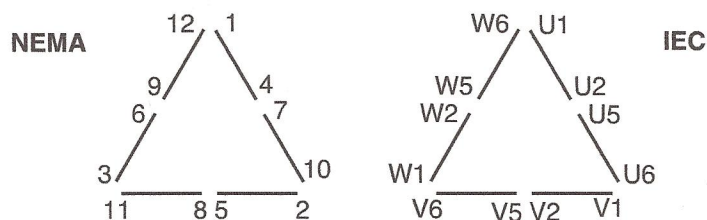
Voltage	T1	T2	T3	T7	T8	T9	Open
High*	1	2	3	12	10	11	4-7, 5-8, 6-9
Low	1,12	2,10	3,11	6,7	4,8	5,9	—

*Not suitable for one-circuit internal connections.

STANDARD TERMINAL MARKINGS AND CONNECTIONS
THREE-PHASE MOTORS—PART-WINDING START (CONTINUED)

NEMA AND IEC NOMENCLATURE—12 LEADS

SINGLE VOLTAGE OR LOW VOLTAGE OF DUAL-VOLTAGE MOTORS



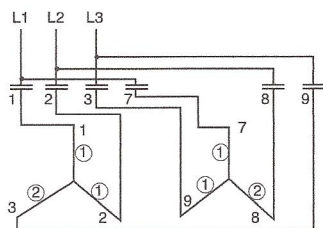
	T1	T2	T3	T7	T8	T9
NEMA	1,6	2,4	3,5	7,12	8,10	9,11
IEC	U1,W1	V1,U2	W1,V2	U5,W6	V5,U6	W5,V6

STANDARD TERMINAL MARKINGS AND CONNECTIONS

THREE-PHASE MOTORS—REDUCED-CURRENT STARTING

NEMA NOMENCLATURE—6 LEADS

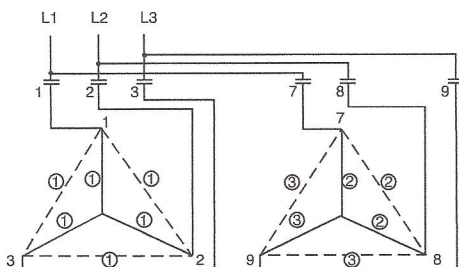
WYE-CONNECTED



2-step starting (2/3—1/3)
4- and 2-pole contactors

Operating mode	L1	L2	L3	Open
Start	1,7	2	3	8&9
Run	1,7	2,8	3,9	—

WYE- OR DELTA-CONNECTED

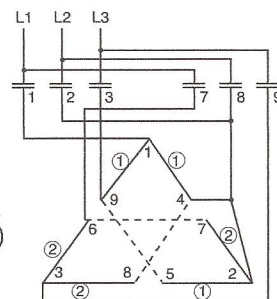


3-step starting
(1/2—1/3—1/6)—wye connected
(1/2—1/6—1/3)—delta connected
3-, 2- and 1-pole contactors

Operating mode	L1	L2	L3	Open
Start	1	2	3	8&9
Mid-step	1,7	2,8	3	9
Run	1,7	2,8	3,9	—

NEMA NOMENCLATURE—9 LEADS

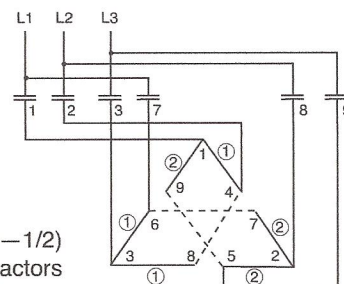
DELTA-CONNECTED



2-step starting (1/2—1/2)
Two 3-pole contactors

Operating mode	L1	L2	L3	Open
Start	1,7	2	3	8&9
Run	1,7	2,8	3,9	—

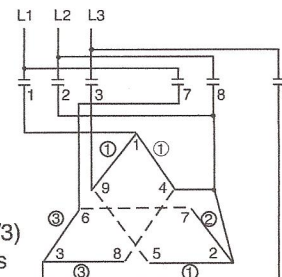
DELTA-CONNECTED



2-step starting (1/2—1/2)
4- and 2-pole contactors

Operating mode	L1	L2	L3	Open
Start	1,7	2	3	8&9
Run	1,7	2,8	3,9	—

DELTA-CONNECTED



3-step starting (1/2—1/6—1/3)
3-, 2- and 1-pole contactors

Operating mode	L1	L2	L3	Open
Start	1	2,8	3	7&9
Mid-step	1,7	2,8	3	9
Run	1,7	2,8	3,9	—

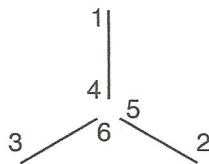
STANDARD TERMINAL MARKINGS AND CONNECTIONS

THREE-PHASE MOTORS— SINGLE-SPEED

NEMA NOMENCLATURE—6 LEADS

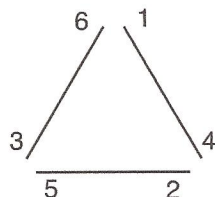
SINGLE VOLTAGE EXTERNAL WYE CONNECTION

L1	L2	L3	Join
1	2	3	4&5&6

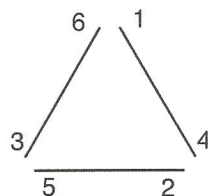
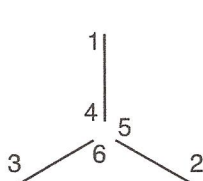


SINGLE VOLTAGE EXTERNAL DELTA CONNECTION

L1	L2	L3
1,6	2,4	3,5



SINGLE AND DUAL VOLTAGE WYE-DELTA CONNECTIONS



Single voltage

Operating mode	Connection	L1	L2	L3	Join
Start	Wye	1	2	3	4&5&6
Run	Delta	1,6	2,4	3,5	—

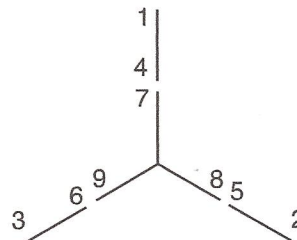
Dual voltage*

Voltage	Connection	L1	L2	L3	Join
High	Wye	1	2	3	4&5&6
Low	Delta	1,6	2,4	3,5	—

*Voltage ratio: 1.732 to 1.

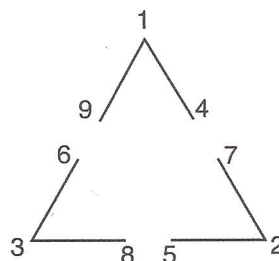
NEMA NOMENCLATURE—9 LEADS

DUAL VOLTAGE WYE-CONNECTED



Voltage	L1	L2	L3	Join
High	1	2	3	4&7,5&8,6&9
Low	1,7	2,8	3,9	4&5&6

DUAL VOLTAGE WYE-CONNECTED



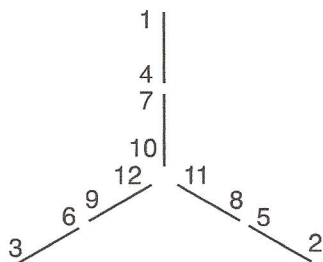
Voltage	L1	L2	L3	Join
High	1	2	3	4&7,5&8,6&9
Low	1,6,7	2,4,8	3,5,9	—

STANDARD TERMINAL MARKINGS AND CONNECTIONS

THREE-PHASE MOTORS— SINGLE-SPEED

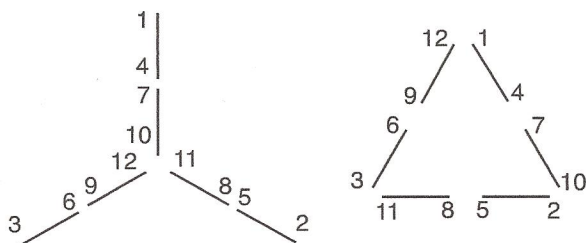
NEMA NOMENCLATURE—12 LEADS

DUAL VOLTAGE EXTERNAL WYE CONNECTION



Voltage	L1	L2	L3	Join
High	1	2	3	4&7,5&8,6&9, 10&11&12
Low	1,7	2,8	3,9	4&5&6, 10&11&12

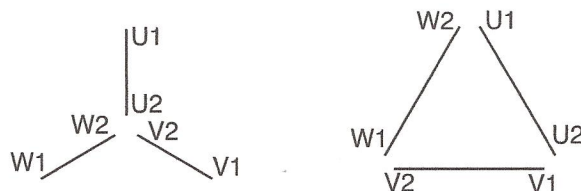
DUAL VOLTAGE WYE-CONNECTED START DELTA-CONNECTED RUN



Volt.	Conn.	L1	L2	L3	Join
High	Wye	1	2	3	4&7,5&8,6&9, 10&11&12
	Delta	1,12	2,10	3,11	4&7,5&8,6&9
Low	Wye	1,7	2,8	3,9	4&5&6, 10&11&12
	Delta	1,6,7,12	2,4,8,10	3,5,9,11	—

IEC NOMENCLATURE—6 LEADS

SINGLE AND DUAL VOLTAGE WYE-DELTA CONNECTIONS



Single voltage

Operating mode	Conn.	L1	L2	L3	Join
Start	Wye	U1	V1	W1	U2&V2&W2
Run	Delta	U1,W1	V1,U2	W1,V2	—

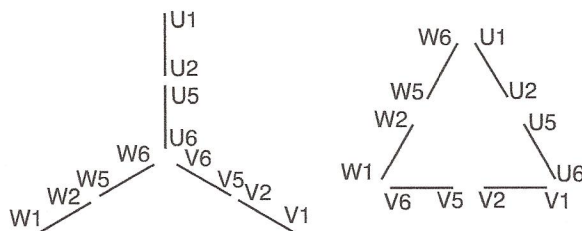
Dual voltage*

Voltage	Conn.	L1	L2	L3	Join
High	Wye	U1	V1	W1	U2&V2&W2
Low	Delta	U1,W2	V1,U2	W1,V2	—

*Voltage ratio: 1.732 to 1.

IEC NOMENCLATURE—12 LEADS

DUAL VOLTAGE WYE-CONNECTED START DELTA-CONNECTED RUN

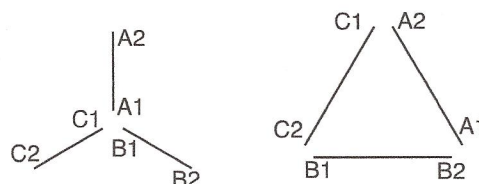


Volt.	Conn.	L1	L2	L3	Join
High	Wye	U1	V1	W1	U2&U5, V2&V5, W2&W5, U6&V6&W6
	Delta	U1,W6	V1,U6	W1,V6	U2&U5, V2&V5, W2&W5
Low	Wye	U1,U5	V1,V5	W1,W5	U2&V2&W2, U6&V6&W6
	Delta	U1,U5, W2,W6	V1,V5, U2,U6	W1,W5, V2,V6	—

NON-STANDARD TERMINAL MARKINGS AND CONNECTIONS **THREE-PHASE MOTORS— SINGLE-SPEED**

NOMENCLATURE FORMERLY USED IN GREAT BRITIAN—6 LEADS

SINGLE AND DUAL VOLTAGE WYE-DELTA CONNECTIONS



Single voltage

Operating mode	Connection	L1	L2	L3	Join
Start	Wye	A2	B2	C2	A1&B1&C1
Run	Delta	A2,C1	B2,A1	C2,B1	—

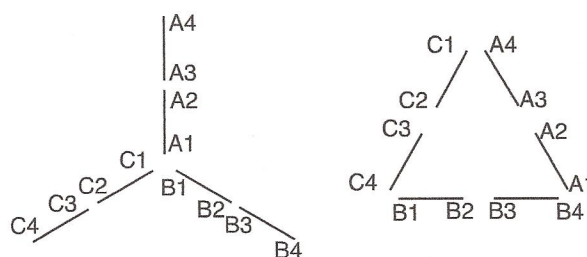
Dual voltage*

Voltage	Connection	L1	L2	L3	Join
High	Wye	A2	B2	C2	A1&B1&C1
Low	Delta	A2,C1	B2,A1	C2,B1	—

*Voltage ratio: 1.732 to 1.

NOMENCLATURE FORMERLY USED IN GREAT BRITIAN—12 LEADS

DUAL VOLTAGE WYE-CONNECTED START, DELTA-CONNECTED RUN



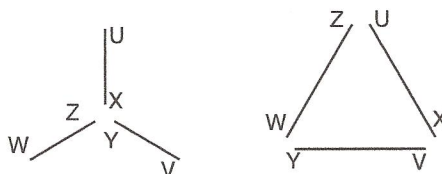
Voltage	Connection	L1	L2	L3	Join
High	Wye	A4	B4	C4	A3&A2,B3&B2,C3&C2,A1&B1&C1
	Delta	A4,C1	B4,A1	C4,B1	A3&A2,B3&B2,C3&C2
Low	Wye	A4,A2	B4,B2	C4,C2	A3&B3&C3, A1&B1&C1
	Delta	A4,A2,C1,C3	B4,B2,A1,A3	C4,C2,B1,B3	—

NON-STANDARD TERMINAL MARKINGS AND CONNECTIONS

THREE-PHASE MOTORS—SINGLE-SPEED

NOMENCLATURE FORMERLY USED IN EUROPE—6 LEADS

SINGLE AND DUAL VOLTAGE WYE-DELTA CONNECTIONS



Single voltage

Operating mode	Connection	L1	L2	L3	Join
Start	Wye	U	V	W	X&Y&Z
Run	Delta	U,Z	V,X	W,Y	—

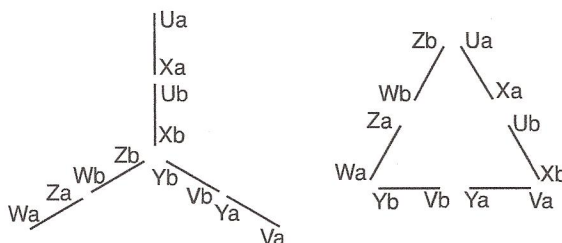
Dual voltage*

Voltage	Connection	L1	L2	L3	Join
High	Wye	U	V	W	X&Y&Z
Low	Delta	U,Z	V,X	W,Y	—

*Voltage ratio: 1.732 to 1.

NOMENCLATURE FORMERLY USED IN GERMANY—12 LEADS

DUAL VOLTAGE WYE-CONNECTED START, DELTA-CONNECTED RUN

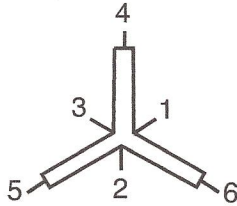


Voltage	Connection	L1	L2	L3	Join
High	Wye	Ua	Va	Wa	Xa&Ub, Ya&Yb, Za&Wb, Xb&Yb&Zb
	Delta	Ua,Zb	Va,Xb	Wa,Yb	Xa&Ub, Ya&Vb, Za&Wb
Low	Wye	Ua,Ub	Va,Vb	Wa,Wb	Xa&Ya&Za, Xb&Yb&Zb
	Delta	Ua,Ub,Za,Zb	Va,Vb,Xa,Xb	Wa,Wb,Ya,Yb	—

STANDARD TERMINAL MARKINGS AND CONNECTIONS THREE-PHASE MOTORS—TWO-SPEED, SINGLE WINDING

NEMA NOMENCLATURE—6 LEADS

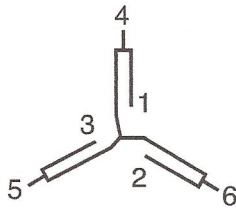
CONSTANT TORQUE CONNECTION



Low-speed horsepower is half of high speed horsepower.*

Speed	L1	L2	L3		Typical connection
High	6	4	5	1&2&3 Join	2 wye
Low	1	2	3	4-5-6 Open	1 delta

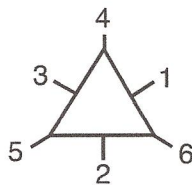
VARIABLE TORQUE CONNECTION



Low-speed horsepower is one-fourth of high speed horsepower.*

Speed	L1	L2	L3		Typical connection
High	6	4	5	1&2&3 Join	2 wye
Low	1	2	3	4-5-6 Open	1 delta

CONSTANT HORSEPOWER CONNECTION

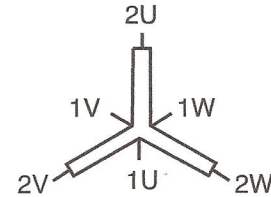


Low-speed horsepower is one-fourth of high speed horsepower.*

Speed	L1	L2	L3		Typical connection
High	6	4	5	1-2-3 Open	1 delta
Low	1	2	3	4&5&6 Join	2 wye

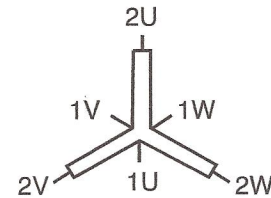
IEC NOMENCLATURE—6 LEADS

CONSTANT TORQUE CONNECTION



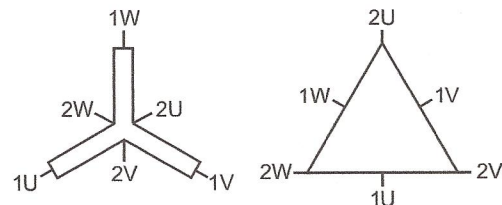
Speed	L1	L2	L3		Typical connection
High	2W	2U	2V	1U&1V&1W Join	2 wye
Low	1U	1V	1W	2U-2V-2W Open	1 delta

VARIABLE TORQUE CONNECTION



Speed	L1	L2	L3		Typical connection
High	2W	2U	2V	1U&1V&1W Join	2 wye
Low	1U	1V	1W	2U-2V-2W Open	1 wye

CONSTANT POWER, SIX TERMINALS



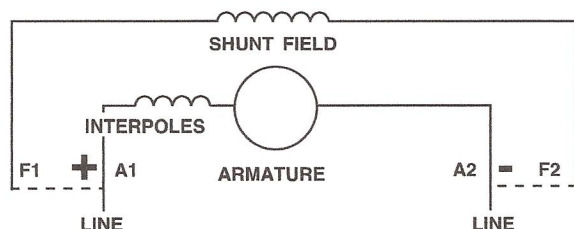
Speed	L1	L2	L3		Typical connection
High	2U	2V	2W	1U&1V&1W Open	Series delta
Low	1U	1V	1W	2U&2V&2W Join	Parallel wye

3.3 STANDARD TERMINAL MARKINGS AND CONNECTIONS

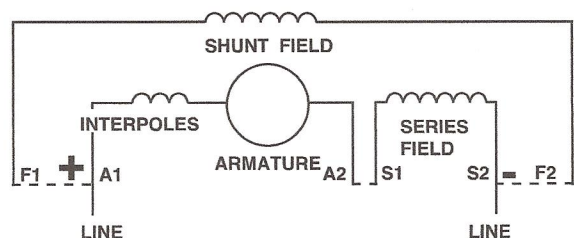
STANDARD TERMINAL MARKINGS AND CONNECTIONS (NEMA NOMENCLATURE)

DC MOTORS

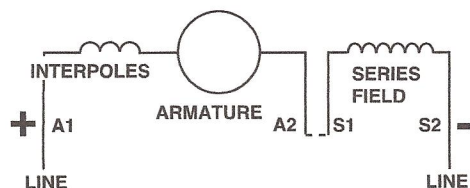
SHUNT MOTOR



COMPOUND MOTOR



SERIES MOTOR



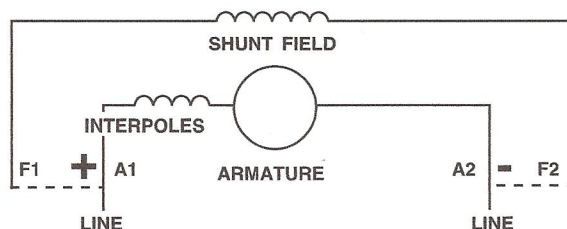
All connections are for counterclockwise rotation facing the end opposite the drive. For clockwise rotation, interchange A1 and A2.

Some manufacturers connect the interpole winding on the A2 side of the armature.

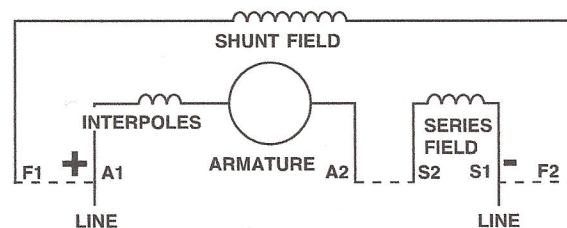
When the shunt field is separately excited, the same polarities must be observed for a given rotation.

DC GENERATORS

SHUNT GENERATOR



COMPOUND GENERATOR



All connections are for counterclockwise rotation facing the end opposite the drive. For clockwise rotation, interchange A1 and A2.

Some manufacturers connect the interpole winding on the A2 side of the armature.

For the above generators, the shunt field may be either self-excited or separately excited. When it is self-excited, connections should be made as shown by the dotted lines. When the shunt field is separately excited, it is usually isolated from the other windings of the machine, but the polarity or the voltage applied to the shunt field should be as shown for the particular rotation and armature polarity.

Reference: NEMA MG 1-2009, Rev. 1-2010, 2.13 and 2.14.

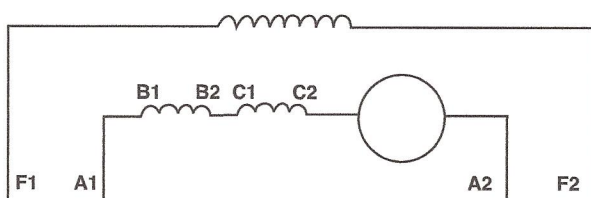
STANDARD TERMINAL MARKINGS AND CONNECTIONS (IEC NOMENCLATURE)

DC COMMUTATOR MACHINES

- A Armature winding
- B Commutating winding
- C Compensating winding
- D Series excitation winding
- E Shunt excitation winding
- F Separately excited winding
- H Direct-axis auxiliary winding
- J Quadrature-axis auxiliary winding

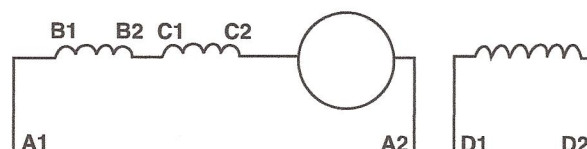
Reference: IEC Std. 60034-8, 4.2.

SHUNT MOTOR OR GENERATOR (4 TERMINALS)



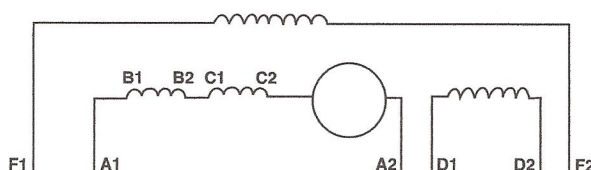
ROTATION	L+	L-
Clockwise	F1, A1	F2, A2
Counterclockwise	F1, A2	F2, A1

SERIES-WOUND MOTOR (2 TERMINALS)



ROTATION	L+	L-
Clockwise	A1	A2, D2
Counterclockwise	A1	A2, D1

SHUNT MOTOR OR COMPOUND GENERATOR WITH CUMULATIVE SERIES AND COMMUTATING WINDINGS (6 TERMINALS)



ROTATION	L+	L-
Clockwise	F1, A1, D1	F2, A2, D2
Counterclockwise	F1, A2, D2	F2, A1, D1

Reference: IEC Std. 60034-8, A.4.