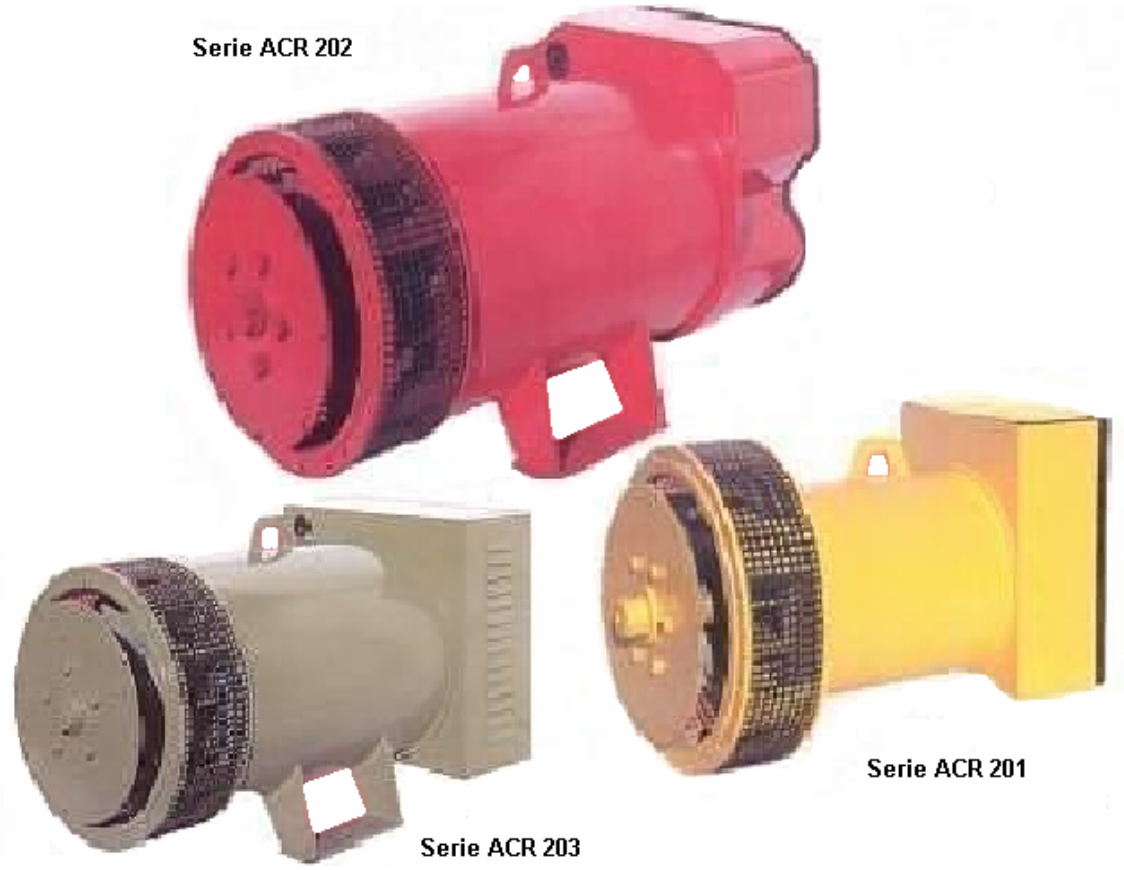
CRAM GENERATOR MANUAL



CONTENTS

GENERATOR CHARACTERISTICS

1- DESCRIPTION

The synchronic generators of the series 201, 202 and 203 of the ACR line, are units which do not have brushes, i.e. BRUSHLESS type units, of SHUNT excitation, self excited, self regulated, including an electronic voltage regulator, with frequency control, self ventilated.

They are manufactured according to the requirements of the CEI 34-1 norms of 1996 (Commission Electrotechnique Internationale), ISO 8528-3 of 1993 (International Organization for Standardization)

2- MECHANIC CHARACTERISTICS

Steel frame, shields of high quality smelting aluminum, ball bearing, with wide dimensions and self-lubricated. TWO BEARINGS constructive shapes (double bearing), or SINGLE BEARING (only one bearing), with SAE adaptor for driving to the IP-21standard mechanic protection, optionally other protections.

Ventilation: axial type with air inlet from opposite drive end. Machines can operate in both directions.

3- FUNCTIONING CONDITIONS

F/H class isolation; height under 2000 M.S.N.M; relative room humidity under 70%; room temperature under 40ºC, for power factors between 0.8 inductive and 1.

4- CRITICAL LIMIT FOR FUNCTIONING

20% overspeed for a 60 Hz and 40% frequency, for 50 Hz. The chart below indicates the admissible overcharge limits:

Duration	1 Hs.	30 Min.	15 Min.	5 Min.	30 Sec.	10 Sec.	3 Sec.
Overcharge	10%	11%	14%	25%	100%	200%	SHORT-CIRCUIT

5- ADVANTAGES

Below we enumerate the main advantages of the regulating system of the ACR line, series 201, 202 and 203, generator:

- Its huge overcharge capacity allows starting big electric engines, whose starting voltage is higher than the nominal voltage of the generator.
- Voltage regulation between no load and full load, at a 0.8 power factor and constant speed is +/- 1%.

6- INSTALLATION

a- **Ventilation**:

The room or power plant where the unit is installed, must keep the climate conditions according to the indication in 3 in this manual, it must be properly ventilated so as to avoid the return of high temperature air coming from the driving engine.

b- **Cleaning**:

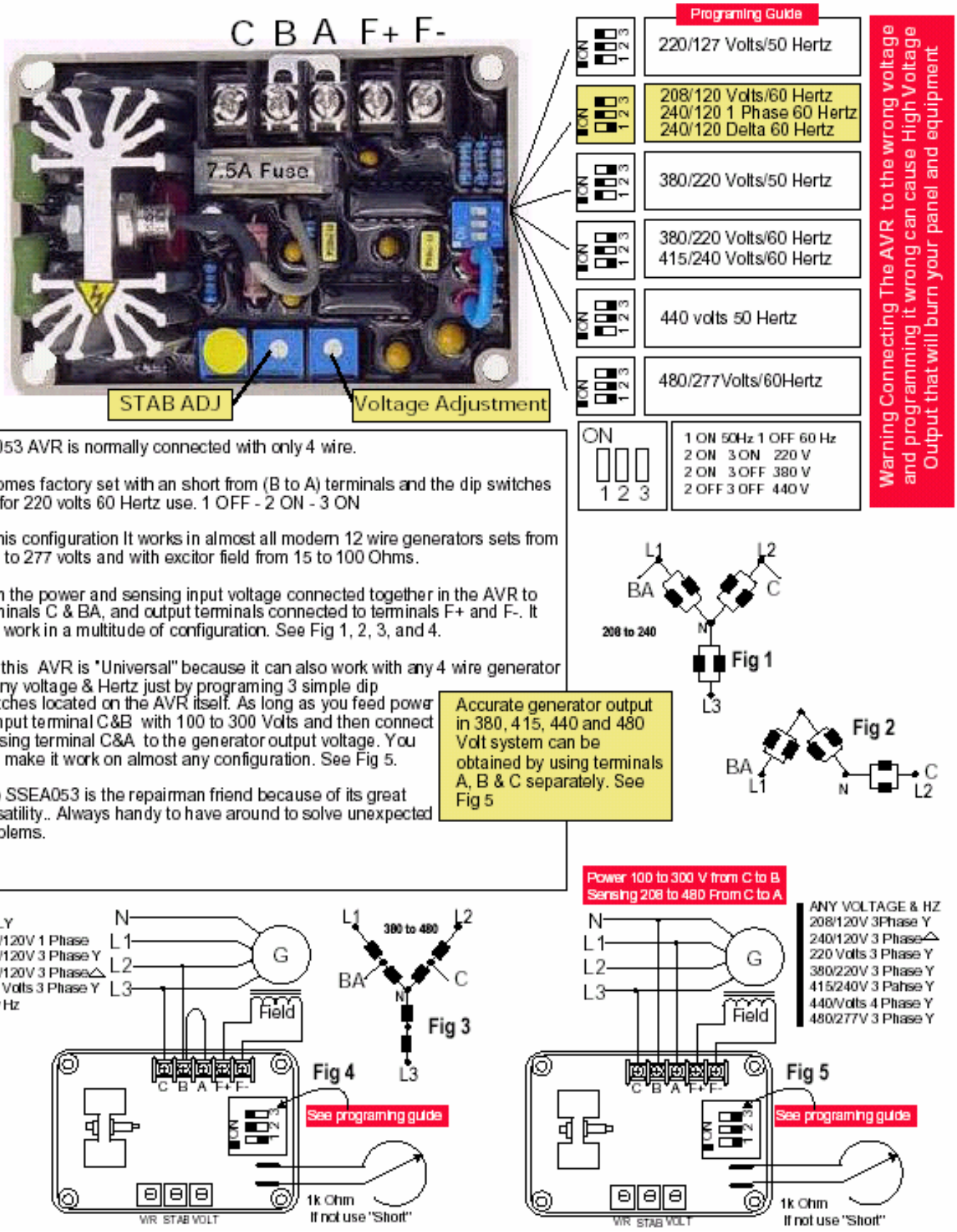
All the ventilation screens must be free from any obstruction.

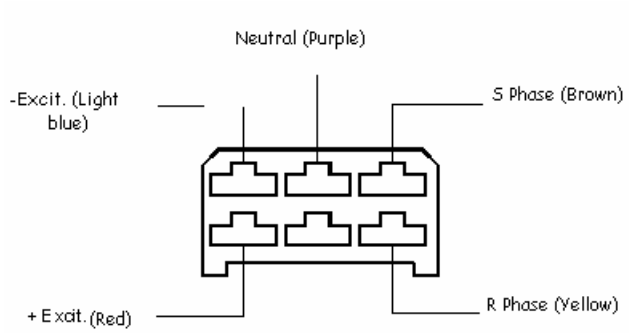
c- **Cautions**:

Before starting the unit, it is necessary to verify the fittings of the wire terminals and the phase sequence.

7- VOLTAGE REGULATOR

- **MODEL SS053 Universal Voltage Regulator**





* NOTE:

In the case of a regulator with different color code in the conductors, the connection indicated in the corresponding diagram must be respected.

e- Fuses

Install fuses of 6 A, 250 V, fuses we a high interruption capacity in the 3 and 4 lines. See the interconnection diagram.

f- Voltage Adjustment.

The screw adjustable of the potentiometer adjusts the voltage of the output of the generator. Turning clockwise it increases voltage.

When a remote voltage adjustment is used, the rheostat (VAR) is adjusted, the wires of the 6 and 7 terminals are removed and the rheostat is connected to those terminals.

g- V/Hz Low Frequency Cut – Selection Point

For a 60 Hz system, the regulator is prepared to cut at 55 Hz. For a 50 Hz system, it cuts at a 45 Hz frequency value, this is activated moving the 60 HZ terminal wire up to the 50 Hz one.

h- System Operation

Before proceeding with the starting of the system follow the steps below.

Preliminary Start

Verify that the voltage governor specifications are in accordance with those of the generator system.

Make sure that the voltage governor is connected to the generator system appropriately see interconnection diagram.

Install fuses according to the indications in fuse paragraph.

The voltage regulator tuning is completely controlled with the adjustment rheostat of remote voltage (if used) to center it.

i- System Start.

Turn on the generator and set it at rated speed. The voltage builds-up. If a 6V minimum residue is not present execute voltage built-up by field flashing.

Adjust the voltage control very slowly until the generator output voltage reaches the rated value. If it is used, adjust the generator to reach the desired value.

j- Voltage build-up by field flashing

When the regulator is operated for the first time, the residual polarity of magnetism may not be the correct one or magnitude may not be enough. If the generator does not generate after being started, turn off the set and proceed with the following steps:

a. With the generator off, apply a direct source (non-ground) no higher than 12 V, to the F+ (positive) and F- (negative) terminals in series with a limit resistance of 3-5 ohm.
b. Allow for approximately 3 seconds before removing the direct source.
c. With the input of the regulator governor (3 and 4 terminals) disconnected, start the generator and measure the voltage in the generator terminals, if voltage is over 6 Volts, the generation voltage will be successful. This should be carried out at rated speed.
d. Repeat the field flashing procedure if the residual voltage measured is below 6 V.

8- CONSTRUCTION DETAILS OF THE ALTERNATOR

a- **Panel Box**: Built with steel sheet folded in one piece for the series 203 ACR units and in aluminum smelting with a plastic protective cover for the series 201 and 202 ACR models. Such cover serves as a protective cover for the exciter, output terminal block and the electronic regulator.

b- **Rotor**: Four poles, class F isolation, impregnated and covered by epoxidic resin, with windings that are fixed through ventilated locks, allowing for critical rotation speeds of 2200 R.P.M without spinning risk.

c- **Estator**: Class F isolation, lamination with perimetrical ventilation with the purpose of increasing the dissipation surface, mounted

d- **Exciter**: Rotating type without brushes, three phase, fixed multipoles, rotating wound mounted on the shaft, together with rectifying diode bridge mounted outside the main body of the generator.

e- **Optional**: Manual voltage control, measuring panels, regulating modifications, parallelism, other voltages, other frequencies and protections.

9- MEASUREMENTS

a- **Temperature**: Measured through rotor and stator resistance variation, it reaches a maximum of 105º C and 130º C in the case of permanent and emergency service respectively.

b- **Regulation**: Measured at 0.8 power factor, between empty and full charge (at constant speed) the regulation is of +/- 1 %. The power regulation preset allows for an adjustment in +/- 10 % of the nominal tension.

10- FAILURE CONTROL

a- **Preliminary Verifications**: Before a deeper verification, find out if the failure cannot be assigned to an evident cause, such as loose connections, cut wires, disassembled protections or deteriorated instruments or wrong reading.

b- **Speed Influence**: Frequency and voltage depend directly on speed that is why it is important that they maintain their nominal value whatever the charge. The generator voltage governor has a regulating frequency control device, to avoid having the unit working under nominal speed.

c- The speed regulating systems of driving engines, normally present a fall between empty and full charge, therefore we recommend regulating the initial speed at a 3% or 4% over nominal.

d- **Diode Control**: Using a multimeter in ohmmeter scale, after disconnecting the diode bridge, the two wires that sent rectified voltage to the main inductor fields of the generator (wires that come out of the center of the rear end of the shaft), proceed to alternatively apply the multimeter ends to the base and the connection wire of each diode, if the diode is not being deteriorated that there is continuity with one resistance in one direction and (the hand does not reach the end of the scale), and there is no continuity in the opposite direction. If this does not happen the measured diode is deteriorated.

e- **Electronic Regulator Check-up**: Disconnect the field male-female plug of two terminals that connects the regulator to the exciter poles. With the generator rotating at 1500 R.P.M (1800 RPM), apply voltage provided by a 12 Vcc battery (respecting the pole polarity), if the generator generates a voltage that is approximately the same as the nominal one, the exciter is functioning correctly. In this case the cause of the failure must be searched in the regulator, otherwise, the exciter must be checked according to what was indicated in point 11 (trouble shooting and repairs) in this manual.

f- **Excitation Current Measurement**: To carry out such measure an ammeter must be intercalated (mobile iron) in the wire that feeds the exciter, verifying that its reading remains within the following ranges:

From 16,5 to 40 KVA: Open circuit current under or equal to 0,8 A (to 52 Hz)

From 52 to 140 KVA: Open circuit current under or equal to 1,1 A (to 52 Hz)

From 160 to 300 KVA: Open circuit current under or equal to1,8 A (to 52 Hz)

When the values resulting from the measurement are not the correct ones, check the following components:

1- **Exciter Rotor**: (Disconnected diode bridge)

a- Measure ground

b- Measure resistance (according to the chart on page 13)

2- **Exciter Stator:** (Disconnected from the voltage governor)

a- Measure ground

b- Measure resistance (according to the chart on page 13)

3- **Principal Rotor**: (Disconnected from the diode bridge)

a- Measure ground

b- Measure resistance (according to the chart on page 13)

11- TROUBLE SHOOTINGS AND REPAIRS

Inconvenience	Probable Causes	How to Proceed
Generator does not excite	A) Insufficient residual Voltage B) Open Circuit residual voltage	A) Increase generator speed in 15%, or apply a charge. B) Disconnect the exciter field plug and apply battery voltage with the generator on.
It does not de-excite after excitation	A) Interruptions in the connection B) Failure in the voltage regulator	A) Control the connection wires using the diagram of the electronic regulator connection. B) Substitute the voltage regulator.
Voltage lowers without load	A) Voltage Potentiometer Unset B) Intervention of protection. C) Winding failure.	A)Rotate potentiometer until the voltage reaches the rated value. B) Verify speed. C) Control winding.
High voltage without load	A) Unset voltage potentiometer B) Failure in voltage regulator.	A)Rotate potentiometer until voltage reaches the rated value. B) Substitute the voltage regulator.
Below nominal voltage with load	A) Unset voltage potentiometer. B) Protection intervention. C) Failure in voltage regulator. D) Failure in the rotating rectifying bridge. E) Defect in rotor or excitation stator. F) Principal rotor in short circuit	A)Rotate potentiometer until voltage reaches the rated value. B) Very high current, inferior cosφ in more than 4 %. C) Substitute the voltage regulator. D) Control diodes disconnecting wires. E y F) Measure excitation current according to f paragraph on page ???
Above nominal voltage with load	A) Unset Voltage Potentiometer. B) Failure in voltage regulator. C) Protection intervention.	A)Rotate voltage potentiometer until reaches rated value. B) Substitute the voltage regulator. C) Superior cosφ at 0.8
Unstable voltage	A) Variable speed in the engine. B) Regulator failure.	A) Control engine speed until it is uniform. B) Substitute voltage regulator.

12- CRAM ELECTRO S.A. Generator Characteristics

TABLE 1

With cosφ = 0.8 V= 400 V (50 Hz) V= 480 V (60 Hz) T= 40 ºC

Type	Power		50 Hz Eficiency %			60 Hz Eficiency %			Weight [Kg.]
	Kva 50 Hz	Kva 60 Hz	4/4	3/4	2/4	4/4	3/4	2/4	
ACR 201 S1	15	18	83.3	84.3	84.4	84.2	85.0	85.1	115
ACR 201 S2	20	25	84.7	85.5	85.6	86.0	86.7	86.6	128
ACR 201 M1	30	38	86.7	86.9	87.0	87.5	87.9	87.8	157
ACR 201 L1	40	50	87.0	87.5	87.6	88.0	88.6	88.5	199
ACR 202 S1	50	62	88.2	88.6	88.6	89.0	89.3	89.1	225
ACR 202 S2	60	72	88.8	89.2	89.1	89.5	89.8	89.6	250
ACR 202 S3	80	96	89.2	89.6	89.7	90.0	90.3	90.1	269
ACR 202 M1	100	120	89.0	89.4	89.2	89.5	89.9	89.7	305
ACR 202 M2	112	138	89.2	89.6	89.4	90.0	90.4	90.2	376
ACR 203 L1	137	170	90.0	90.3	90.2	90.6	90.8	90.7	485
ACR 203 S1	160	200	90.7	91.0	90.9	91.1	91.4	91.2	498
ACR 203 S2	180	225	91.3	91.6	91.5	91.8	92.1	91.9	584
ACR 203 S3	200	250	91.5	91.8	91.6	92.4	92.6	92.4	670
ACR 203 S4	235	295	91.7	92.0	91.8	92.6	92.8	92.6	740
ACR 203 S5	250	312	91.7	92.0	91.9	92.6	92.8	92.6	770
ACR 203 M1	280	350	91.8	92.0	92.0	92.6	92.8	92.5	830
ACR 203 M2	300	375	91.9	92.2	92.1	92.4	92.9	92.6	870

TABLE 2

With cosφ = 0.8 V= 400 V (50 Hz) V= 480 V (60 Hz) T= 20 ºC

Type	Power		Short-circuit ratio	Direct-axis synchronous reactance	Quadrature-axis synchronous reactance	Direc-axis transient reactance	Quadrature-axis transient reactance	Direct-axis subtransient reactance	Quadrature-axis subtransient reactance	Negative-sequence reactance	Zero sequence reactance	Open cirtuit time constant	Transient time constant	Subtransient time constant	Armature time constant
	KVA 50Hz	KVA 60Hz	pcc	Xd%	Xq%	X´d%	X´q%	X"d%	X"q%	X_2%	X_0%	T´do(s)	T´d(ms)	T"d(ms)	Ta(ms)
ACR 201 S1	15	18	0.61	255	105	20	105	8.5	9.5	9	1.1	0.45	35	8	5
ACR 201 S2	20	25	0.58	275	110	19	110	8	9	8.5	1	0.52	36	8	5
ACR 201 M1	30	38	0.52	280	115	19	115	7	8.5	8	0.9	0.66	45	8	6
ACR 201 L1	40	50	0.69	195	90	21	85	8.5	10.5	9.5	1.3	0.49	52	10	9
ACR 202 S1	50	62	0.62	210	95	19	95	8	9.5	8.5	1.2	0.65	58	10	9
ACR 202 S2	60	72	0.57	235	105	20	105	8	9.5	8.5	1.2	0.73	62	10	10
ACR 202 S3	80	96	0.59	220	100	19	100	7.5	9	8	1.1	0.83	70	10	11
ACR 202 M1	100	120	0.49	265	129	26	129	13	13.9	13.4	2.7	0.74	70	11	12
ACR 202 M2	112	138	0.47	275	131	27	131	13	13.8	13.4	2.7	0.77	73	11	12
ACR 203 L1	137	170	0.43	290	135	26	135	12	12.7	12.4	2.5	0.93	80	11	12
ACR 203 S1	160	200	0.46	272	126	23	126	10.5	11.2	10.8	2.3	0.95	83	11	12
ACR 203 S2	180	225	0.47	262	122	22	122	9.5	10.2	9.8	2.5	0.99	87	11	12
ACR 203 S3	200	250	0.48	259	121	22	121	9.4	9.9	9.6	2.9	1.02	92	11	13
ACR 203 S4	235	295	0.46	274	127	22	127	9.9	10.6	10.2	2.9	1.02	98	11	13
ACR 203 S5	250	312	0.43	294	137	25	137	11.4	12.1	11.7	3.5	1.09	104	12	14
ACR 203 M1	280	350	0.37	336	158	32	158	15.2	16.2	15.7	4.8	1.28	124	13	16
ACR 203 M2	300	375	0.35	354	167	34	167	16.5	17.5	17	5.3	1.36	131	14	17

TABLE 3

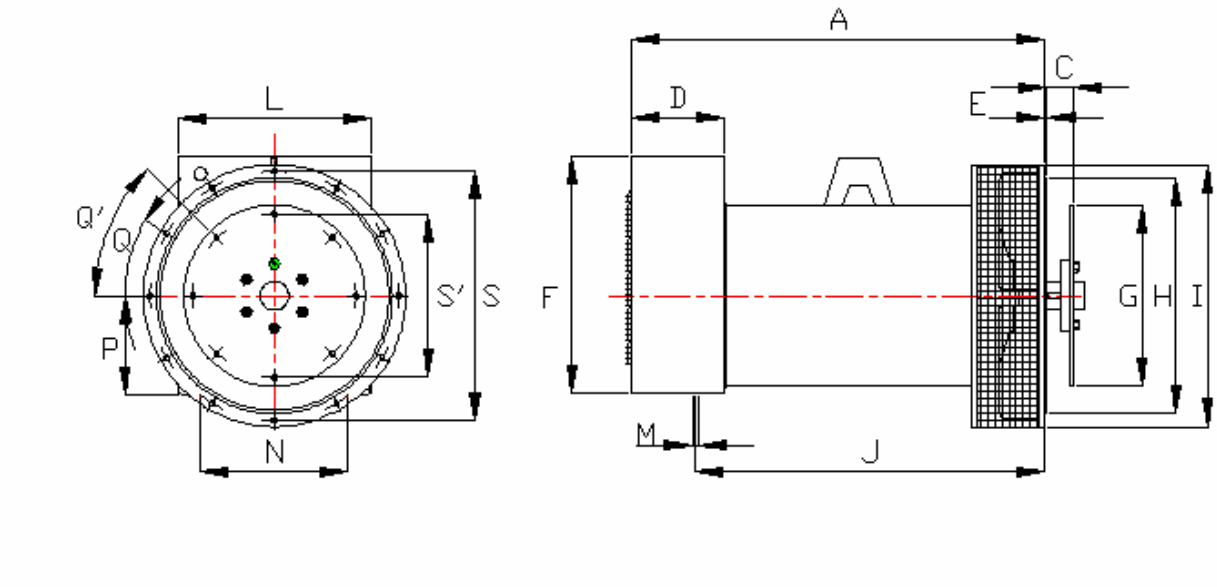
With cosφ = 0.8 V= 400 V (50 Hz) V= 480 V (60 Hz) T= 20 ºC

Type	Power		Resistance [Ω]			
	Kva 50 Hz	Kva 60 Hz	Excitation Rotor	Excitation Stator	Principal Rotor	Principal Stator
ACR 201 S1	15	18	0.08	16.68	0.50	0.63
ACR 201 S2	20	25	0.08	16.68	0.60	0.38
ACR 201 M1	30	38	0.08	16.68	0.73	0.22
ACR 201 L1	40	50	0.08	16.68	0.86	0.14
ACR 202 S1	50	62	0.10	19.97	0.79	0.15
ACR 202 S2	60	72	0.10	19.97	0.89	0.10
ACR 202 S3	80	96	0.10	19.97	1.03	0.09
ACR 202 M1	100	120	0.10	19.97	1.16	0.06
ACR 202 M2	112	138	0.10	19.97	1.30	0.06
ACR 203 L1	137	170	0.21	7.09	0.37	0.03
ACR 203 S1	160	200	0.21	7.09	0.28	0.03
ACR 203 S2	180	225	0.21	7.09	0.28	0.03
ACR 203 S3	200	250	0.21	7.09	0.28	0.03
ACR 203 S4	235	295	0.21	7.09	0.40	0.03
ACR 203 S5	250	312	0.21	7.09	0.40	0.03
ACR 203 M1	280	350	0.21	7.09	0.40	0.03
ACR 203 M2	300	375	0.21	7.09	0.40	0.03

13 - Exterior Dimensioning

Typical One Bearing Generator – 201 Series

MD 35 Constructive Form



Type	A	B	D	F	J	K	L	M	N	P
15/20 KVA	568	-----	160	410	458	------	345	M 10	255	172
30 KVA	638	-----	160	410	528	------	345	M 10	255	172
40 KVA	688	-----	160	410	578	------	345	M 10	255	172

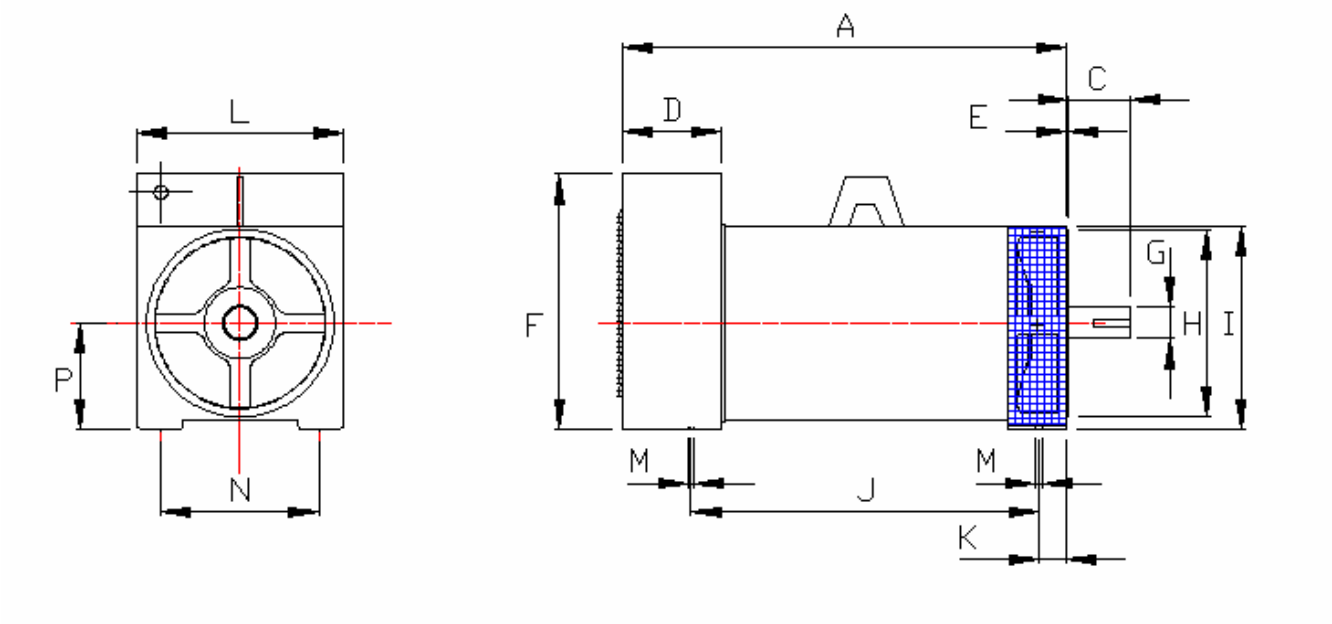
SAE Nº	FLANGE							COUPLING					
	I	H	S	E	Quant	∅	Q	C	G	S´	Quant	∅	Q´
SAE 3	451	409.6	428.6	4.8	12	11	15º	53.8	314.32	295.27	8	11	45º

Values are expressed in millimeters

Exterior Dimensioning

Typical Two Bearing Generator – 201 Series

B3 –B14 Constructive Form



Type	A	C	D	E	F	G	H	I	K	L
15/20 KVA	535	110	160	7	410	50	305	328	42	330
30 KVA	535	110	160	7	410	50	305	328	42	330
40 KVA	655	110	160	7	410	50	305	328	42	330

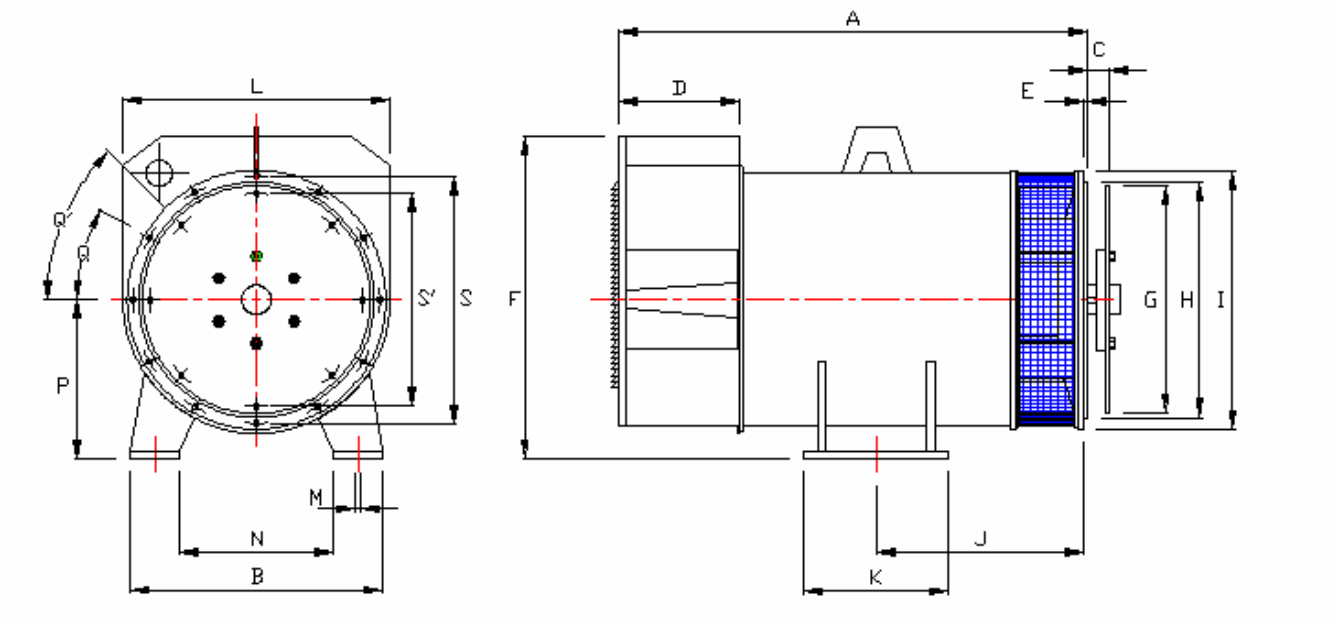
Type	M	N	P	J
15/20 KVA	12	255	165	380
30 KVA	12	255	165	380
40 KVA	12	255	165	500

Values are expressed in millimeters

Exterior Dimensioning

Typical One Bearing Generator – 202 Series

MD 35 Constructive Form



Type	A	B	D	F	J	K	L	M	N	P
45/80 KVA	825	430	210	560	385	250	460	M 15	350	275
85/100 KVA	885	430	210	560	415	250	460	M 15	350	275

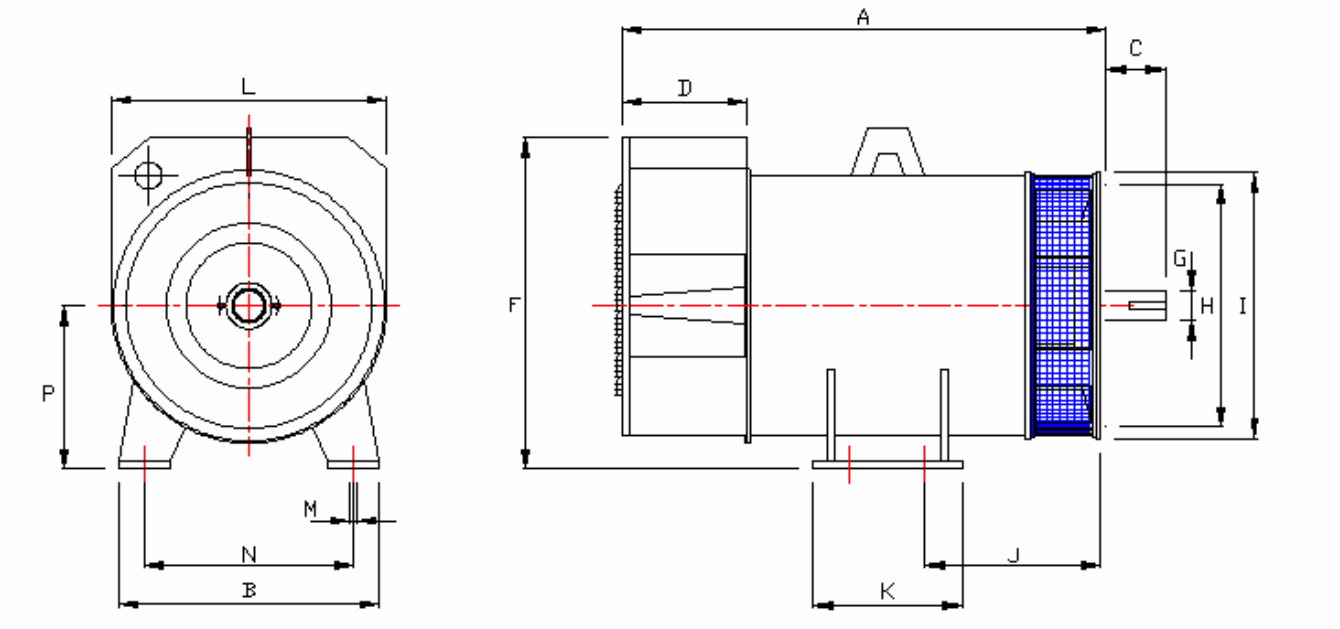
SAE Nº	FLANGE							COUPLING					
	I	H	S	E	Cant.	∅	Q	C	G	S´	Quant.	∅	Q´
SAE 2	489	447.7	466.7	6	12	11	30º	39.6	352.42	333.37	8	11	45º
SAE 1	552	511.2	530.2	6	12	11	30º	25.4	466.72	438.15	8	11	45º

Values are expressed in millimeters

Exterior Dimensioning

Typical Two Bearing Generator – 202 Series

B3 –B14 Constructive Form



Type	A	B	C	D	F	G	H	I	J	K
45/80 KVA	795	430	83	210	560	58	393	443	260	250
85/100 KVA	855	430	83	210	560	58	393	443	260	250

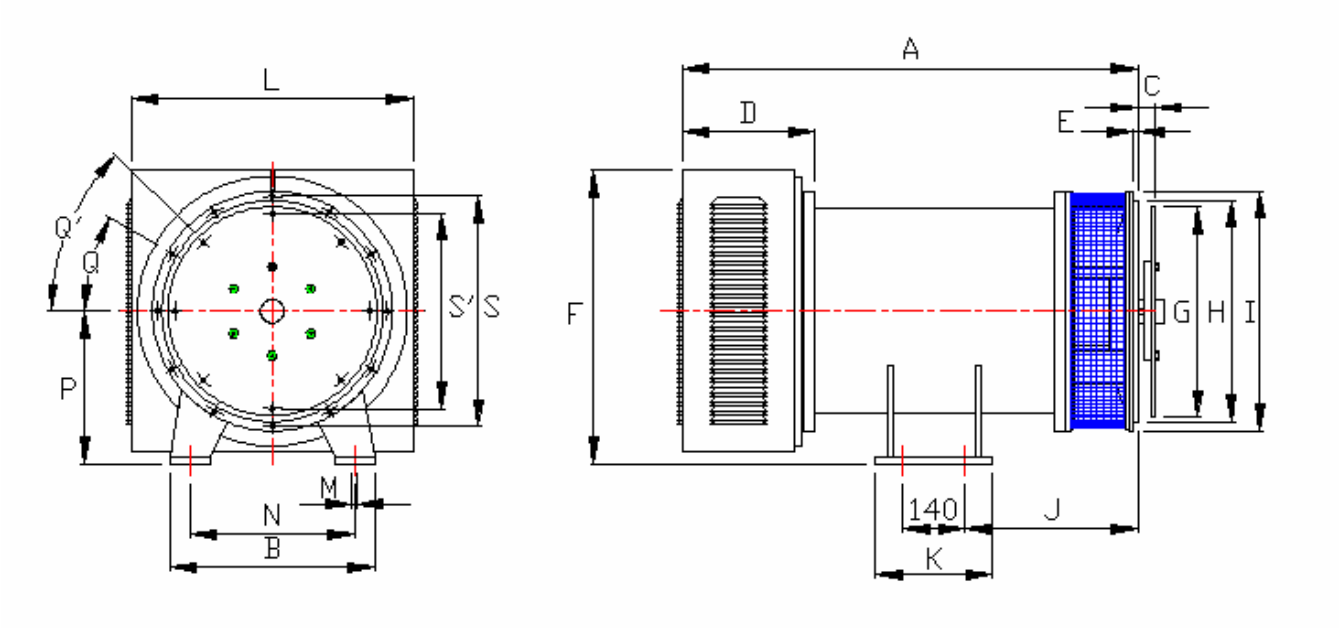
Type	L	M	N	P
45/80 KVA	450	16	350	290
85/100 KVA	450	16	350	290

Values are expressed in millimeters

Exterior Dimensioning

Typical One Bearing Generator – 203 Series

MD 35 Constructive Form

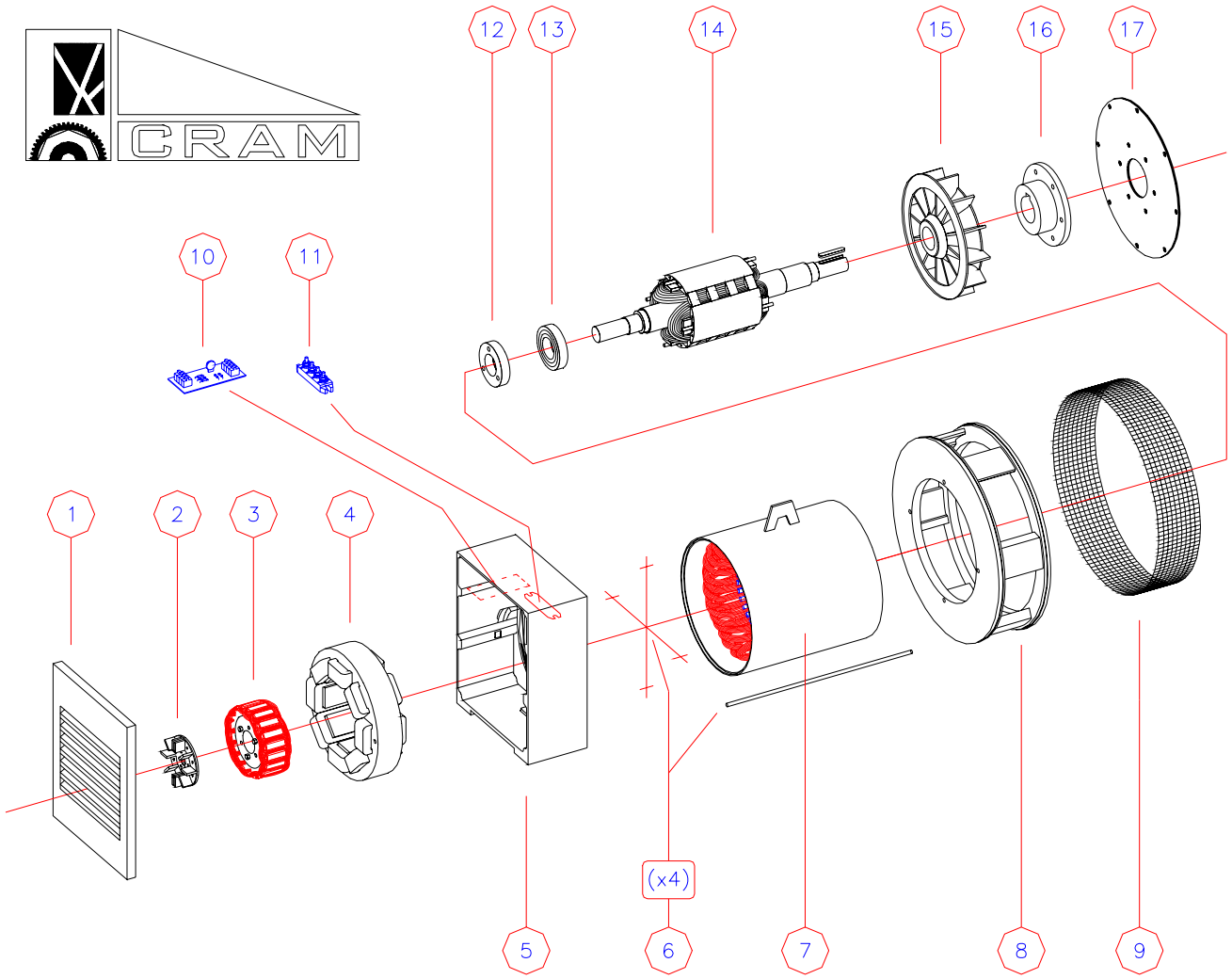


Type	A	B	D	F	J	K	L	M	N	P
150/220 KVA	1000	570	275	670	370	250	600	M 18	470	325
330 KVA	1100	570	275	670	420	250	600	M 18	470	325

SAE Nº	FLANGE							COUPLING					
	I	H	S	E	Quant	∅	Q	C	G	S´	Quant.	∅	Q´
SAE 2	489	447.7	466.7	6	12	11	30º	39.6	352.42	333.37	8	11	45º
SAE 1	552	511.2	530.2	6	12	11	30º	25.4	466.72	438.15	8	11	45º

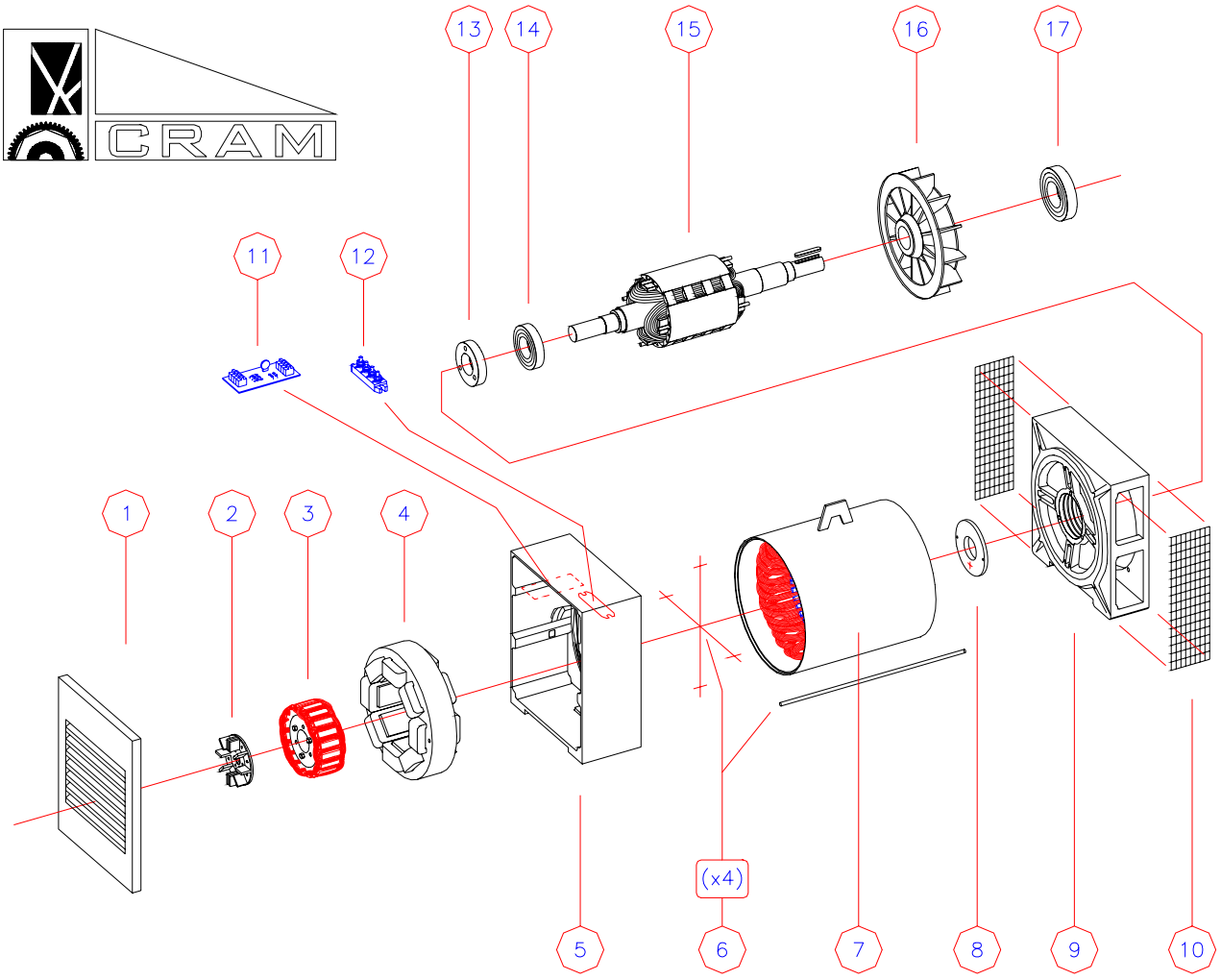
Values are expressed in millimeters

14 – PART MANUAL
TYPICAL ONE BEARING GENERATOR– 201 SERIES



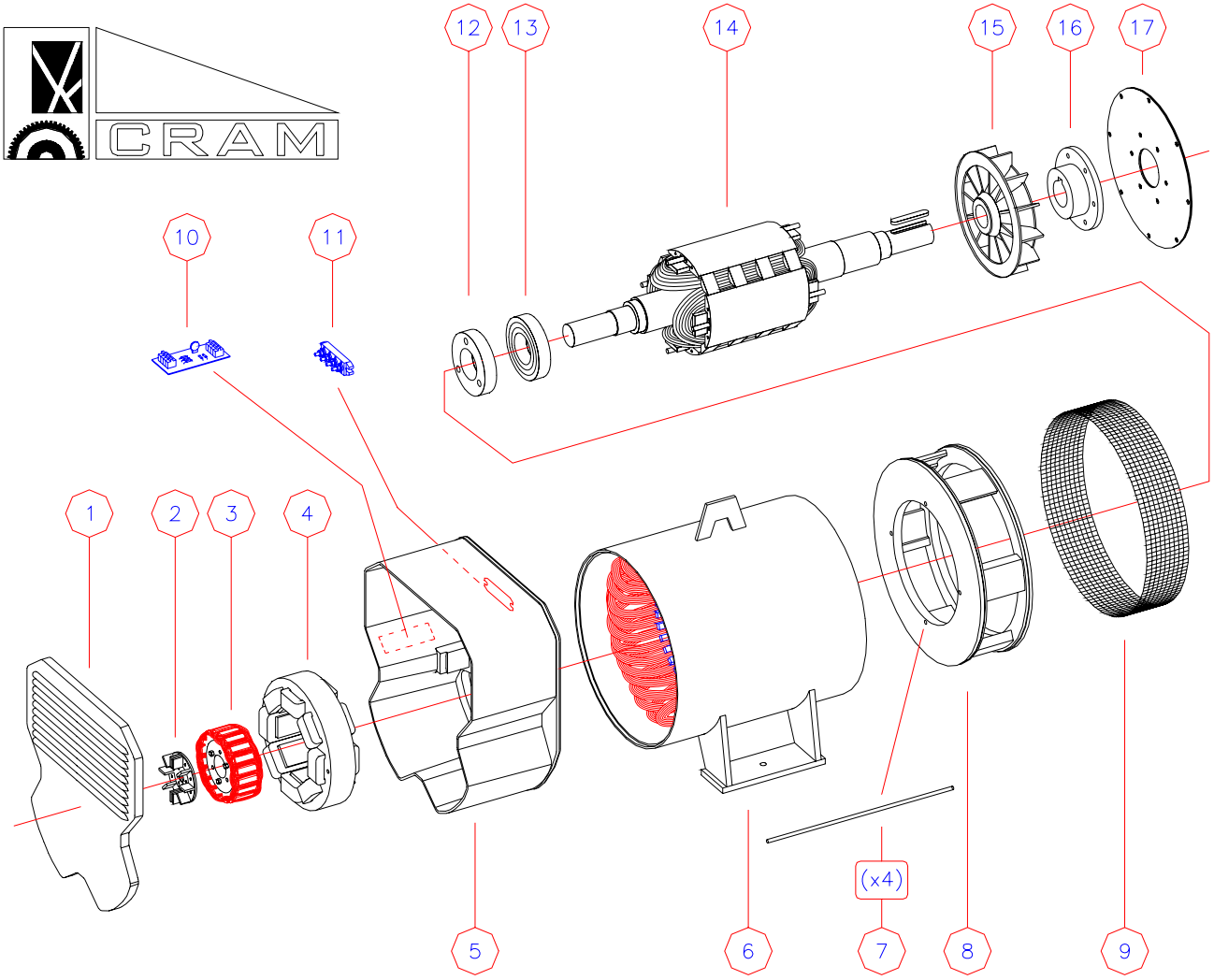
Ref.	Description
1	Air inlet screen
2	Rotating diodes bridge
3	Wound exciter armature
4	Wound exciter field
5	Rear cover
6	Tapper rod of retaining
7	Wound stator assembly
8	Front cover
9	Air exit screen
10	Voltage governor
11	Terminal block of AC output
12	Induced exciter fastening collar
13	Rear bearing (6210-2RS)
14	Wound rotor assembly
15	Fan
16	Driving hub
17	Driving discs

TYPICAL TWO-BEARING GENERADOR – SERIES 201



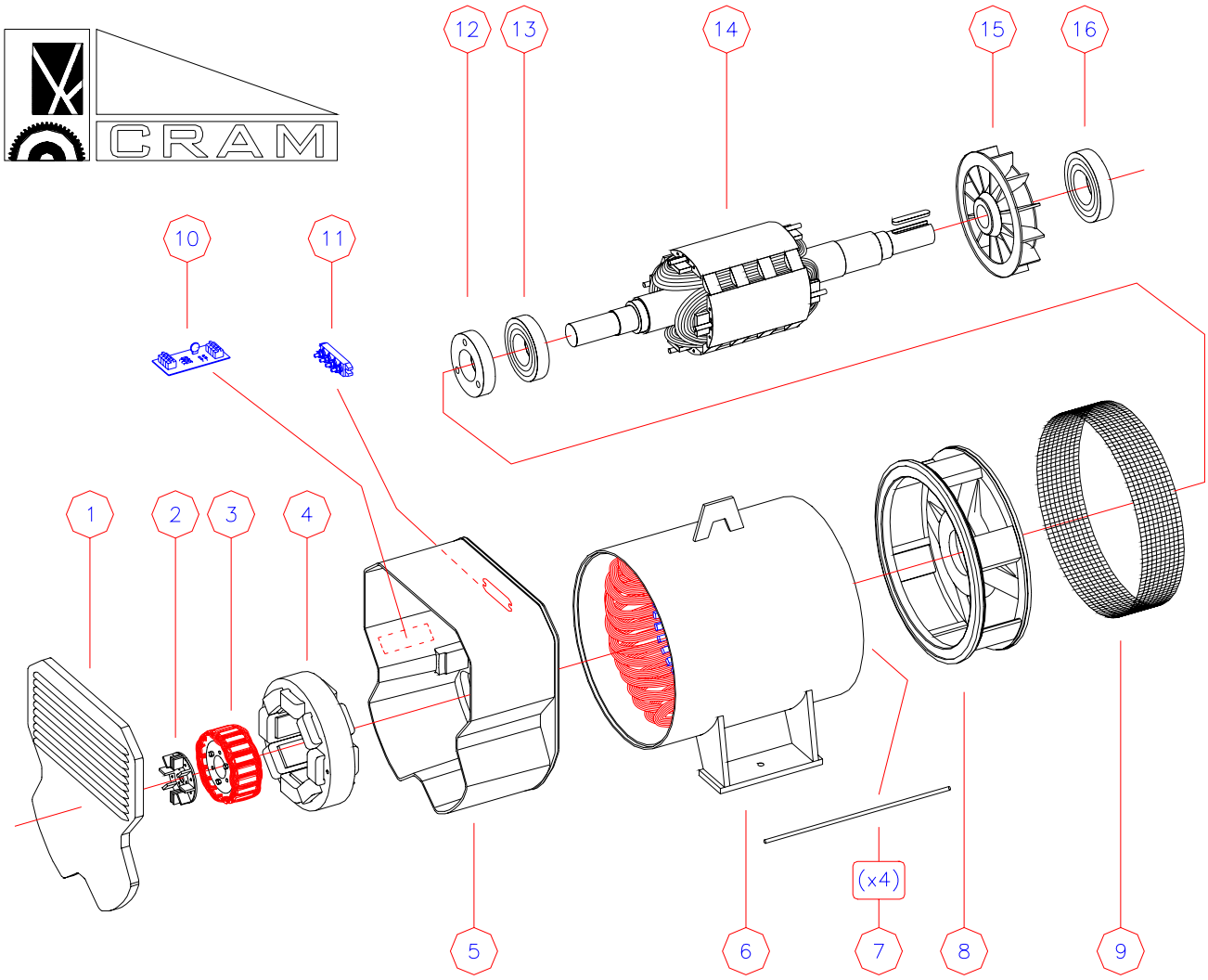
Ref.	Description
1	Air inlet screen
2	Rotating diodes bridge
3	Wound exciter armature
4	Wound exciter field
5	Rear cover
6	Tapper rod of retaining
7	Wound stator assembly
8	Bumper sheet billet of front bearing
9	Front cover
10	Air exit screen
11	Voltage governor
12	Terminal block of AC output
13	Induced exciter fastening collar
14	Rear bearing (6210-2RS)
15	Wound rotor assembly
16	Driving hub
17	Front bearing (6211-2RS)

TYPICAL ONE-BEARING GENERATOR – 202 SERIES



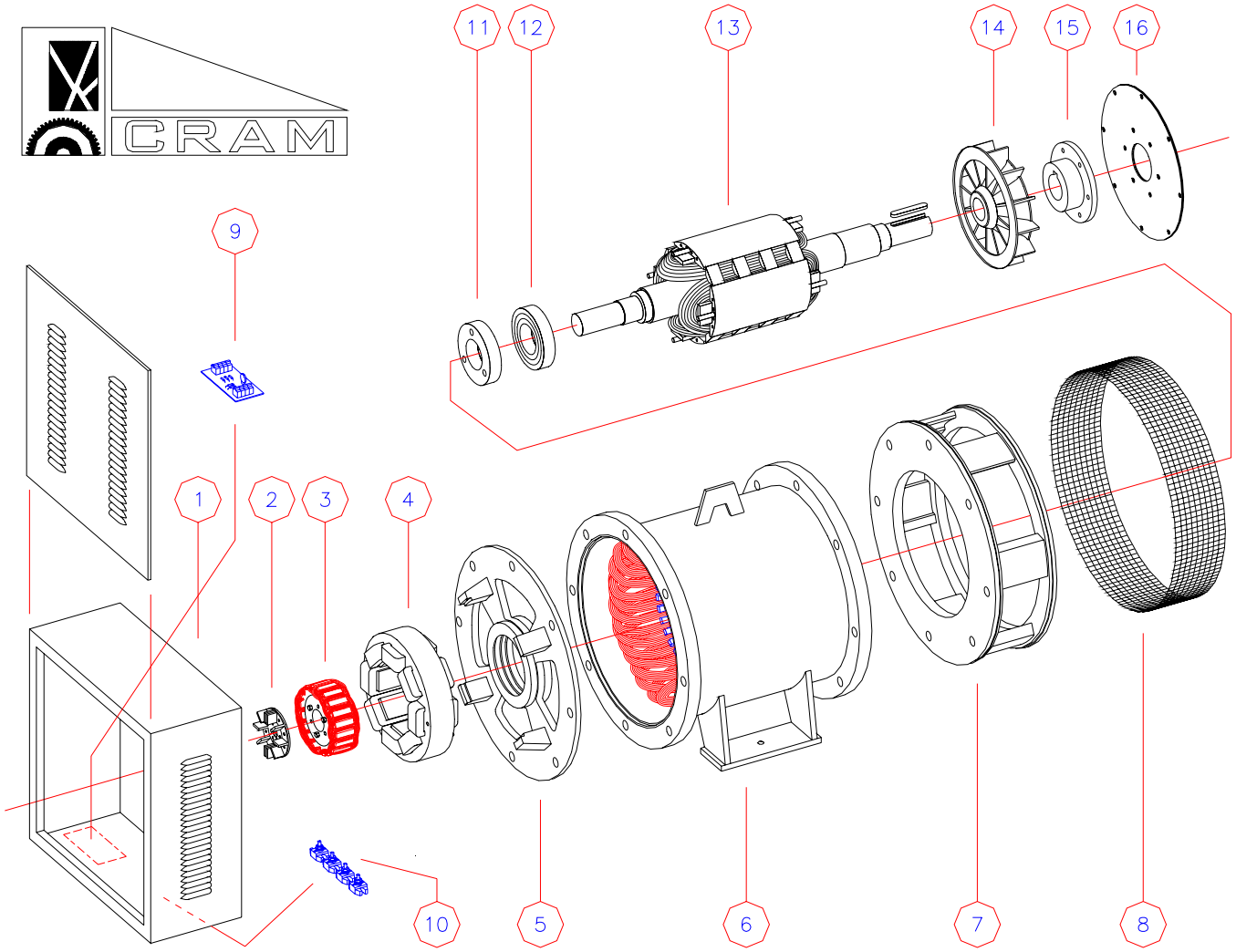
Ref.	Description
1	Air inlet screen
2	Rotating diodes bridge
3	Wound exciter armature
4	Wound exciter field
5	Rear cover
6	Wound stator assembly
7	Tapper rod of retaining
8	Front cover
9	Air exit screen
10	Voltage governor
11	Terminal block of AC output
12	Induced exciter fastening collar
13	Rear bearing (6210-2RS)
14	Wound rotor assembly
15	Fan
16	Driving hub
17	Driving discs

TYPICAL TWO-BEARING GENERATOR – 202 SERIES



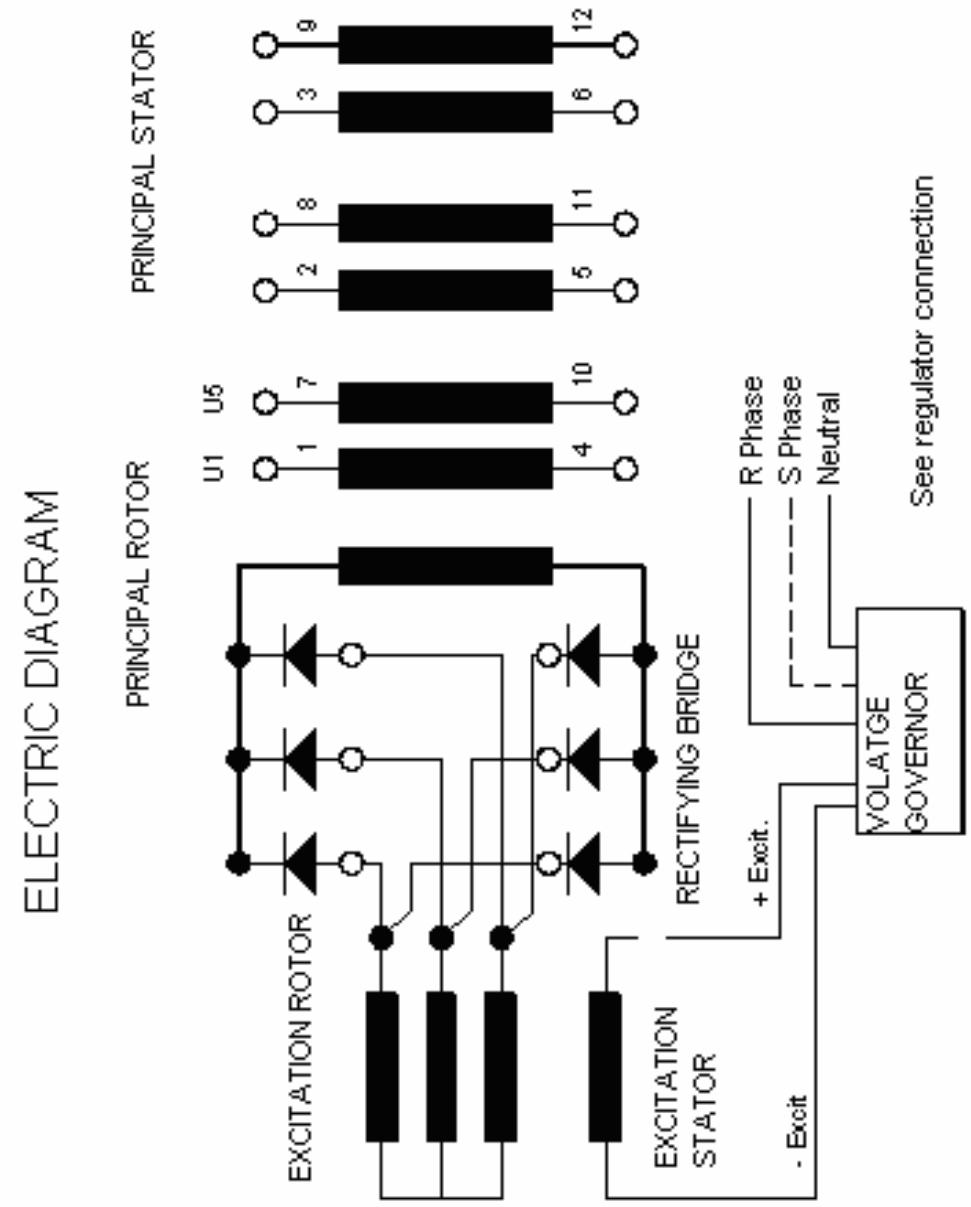
Ref.	Description
1	Air inlet screen
2	Rotating diodes bridge
3	Wound exciter armature
4	Wound exciter field
5	Rear cover
6	Wound stator assembly
7	Tapper rod of retaining
8	Front cover with Bumper sheet billet of bearing
9	Air exit screen
10	Voltage governor
11	Terminal block of AC output
12	Induced exciter fastening collar
13	Rear bearing (6210-2RS)
14	Wound rotor assembly
15	Fan Driving hub
16	Front bearing (6211-2RS)

TYPICAL ONE-BEARING GENERATOR – 203 SERIES



Ref.	Descripción / Description
1	Back side box
2	Rotating diodes bridge
3	Wound exciter armature
4	Wound exciter field
5	Rear cover
6	Wound stator assembly
7	Front cover
8	Air exit screen
9	Voltage governor
10	Terminal block of AC output
11	Induced exciter fastening collar
12	Rear bearing (6313 / 6315-2RS)
13	Wound rotor assembly
14	Fan
15	Driving hub
16	Driving discs

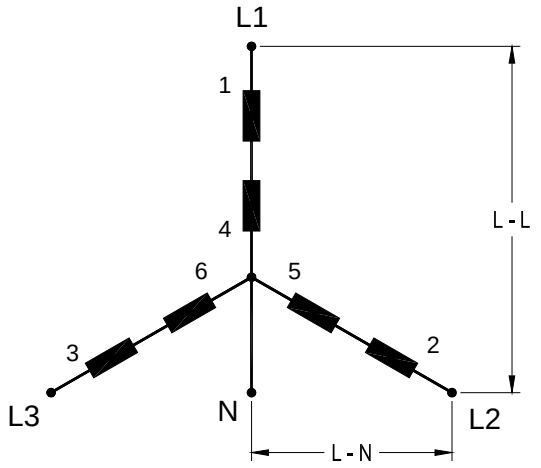
15 – ELECTRICAL DIAGRAM



16 - INTERNAL WIRING DIAGRAMS

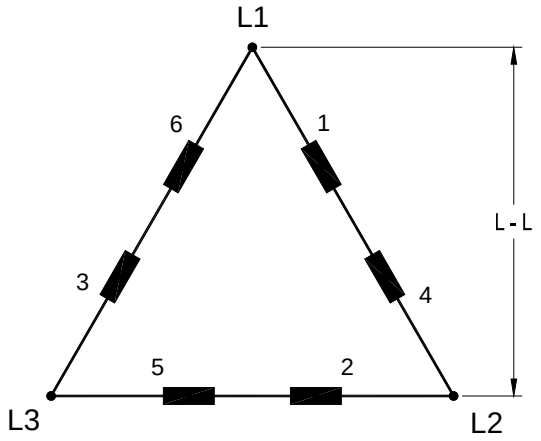
Possible connections for 6 terminal generators

Three Phase Low Wye



		VOLTAGE (V)		
50 HZ	**L - L**	380 - 400		
	L - N	220 - 230		
60 HZ	**L - L**	220 - 240	380 - 415	440 - 480
	L - N	127 - 138	220 - 239	254 - 227

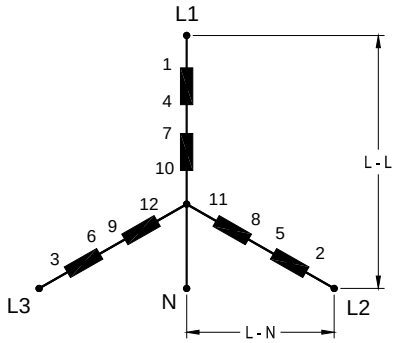
Three Phase Delta



		VOLTAGE (V)
50 HZ	**L - L**	190 - 220
	L - N	–
60 HZ	**L - L**	220 - 240
	L - N	–

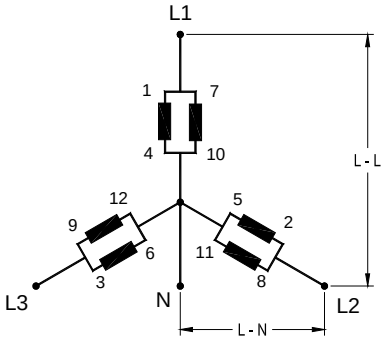
Possible connections for 12 terminal generators

Three Phase Hi Wye



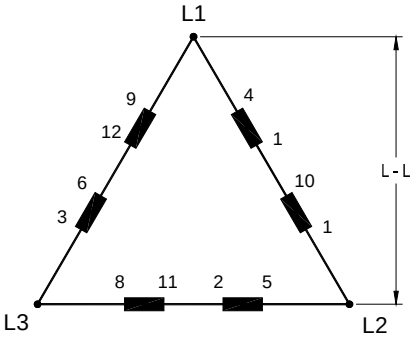
		VOLTAGE (V)	
50 HZ	**L - L**	380 - 400	
	L - N	220 - 230	
60 HZ	**L - L**	380 - 415	440 - 480
	L - N	220 - 240	245 - 277

Three Phase Low Wye



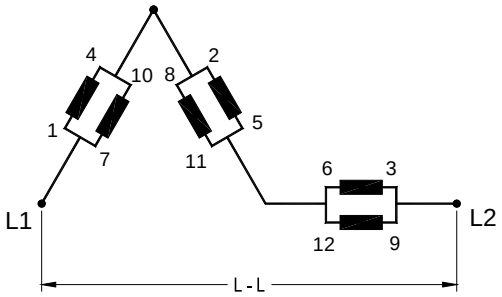
		VOLTAGE (V)
50 HZ	**L - L**	190 - 200
	L - N	110 - 115
60 HZ	**L - L**	220 - 240
	L - N	127 - 139

Three Phase Delta



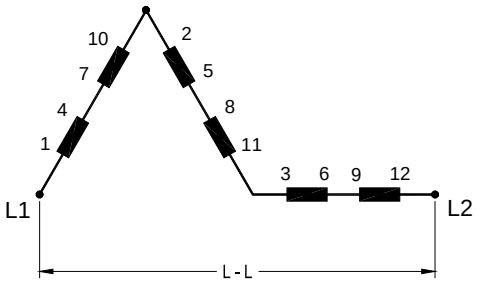
		VOLTAGE (V)
50 HZ	**L - L**	200 - 220
	L - N	–
60 HZ	**L - L**	220 - 240
	L - N	–

Single Phase Low Zig - Zag



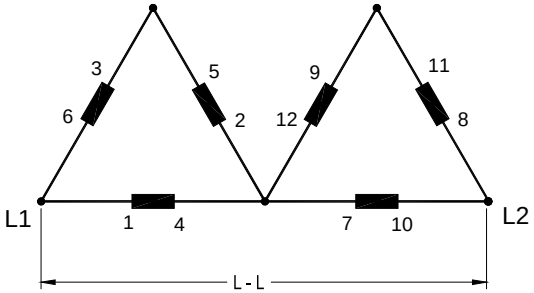
		VOLTAGE (V)
50 HZ	**L - L**	190 - 220
	L - N	–
60 HZ	**L - L**	200 - 240
	L - N	–

Single Phase Hi Zig - Zag



		VOLTAGE (V)
50 HZ	**L - L**	380 - 400
	L - N	–
60 HZ	**L - L**	440 - 480
	L - N	–

Single Phase Delta



		VOLTAGE (V)
50 HZ	**L - L**	190 - 220
	L - N	–
60 HZ	**L - L**	220 - 240
	L - N	–

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