Three-phase asynchronous generators

for low voltage
with squirrel-cage rotor
Product specification

Series G21R

Introduction

The industrial development is bound up with the improvement of large power systems. But in this connection, there will be given more and more priority to the environmental-friendly and regenerative power generation, resulting so in the acceptance of power plants with low and medium output. Regenerative power sources are among other things, wind and water power.

Here, the asynchronous generator has its preferred field of application; being reliable, low-cost and easy to maintain, the asynchronous generator is an alternative to the classical synchronous generator. According to the special case of application, asynchronous generators are operated onto their own mains or parallely with a mains still existing.

The type series G11R / G22R, developed by VEM, excels by:

- Economical performance, due to high generator efficiencies
- Versatility and reduction of stock due to series version in IP 55 degree of protection (higher degree of protection on request)
- Optional terminal box right-hand / on top / left-hand
- Increased lifetime, reliability and thermal overload capacity by series version insulation class F with thermal reserve (special version insulation class H on request)
- Environmental acceptability due to use of a low-noise bi-directional ventilation system
- Supply option complying with Eastern European standards
- Performance option of a classic IEC/DIN series and a progressive one based on the IEC 72 for attachment dimensions and frame sizes
- Attachment options for components as impulse sensors, tacho-generators, brakes, speed sensors and forced-ventilation units for accomplishment with recent control methods

Standards and regulations

The motors comply with the relevant standards and regulations and specifically with the following:

Title	DIN EN / DIN VDE	IEC
Rotating electrical machines, rating and performance	DIN EN 60034-1/11.95	IEC 34-1 IEC 85
Rotating electrical machines, methods for determining losses and efficiency	VDE 0530 p. 2	IEC 34-2
Totally enclosed three-phase induction motors with squirrel-cage rotor, type IM B3	DIN 42673	(IEC 72)
Totally enclosed three-phase induction motors with squirrel-cage rotor, type IM B5, B35 and B14	DIN 42677	(IEC 72)
Rotating electrical machines, terminal markings and direction of rotation	DIN VDE 0530 p. 8	IEC 34-8
Rotating electrical machines, symbols for types of construction and mounting arrangements	DIN EN 60034-7	IEC 34-7
Rotating electrical machines, built-in thermal protection	-	IEC 34-11
Rotating electrical machines, methods of cooling	DIN EN 60034-6	IEC 34-6
Rotating electrical machines, classification of degrees of protection provided by enclosures	DIN VDE 0530 p. 5	IEC 34-5
Rotating electrical machines, mechanical vibrations of certain machines	DIN EN 60034-14	IEC 34-14
Cylindrical shaft ends for rotating electrical machines	DIN 748 p. 3	IEC 72
Rotating electrical machines, Noise limits	DIN EN 60034-9	IEC 34-9
Rotating electrical machines, starting performance	DIN EN 60034-12	IEC 34-12
IEC standard voltages	DIN IEC 38	IEC 38

Furthermore, VEM motors comply with various foreign regulations which have been adapted to IEC 34-1

NF C 51	France	NBNC 51-101	Belgium
ÖVE M10	Austria	CEI 2-3, V1	Italy
SS 426 0101	Sweden	NEK-IEC 34-1	Norway
SEV 3009	Switzerland	BS 5000 BS 4999	United Kingdom of Great Britain

and the series KPER/K11R and, derived from the latter the series G11R, are also tested and available according to the regulations of Classification Authorities

Germanischer Lloyd	Det Norske Veritas
Lloyd's Register of Shipping	Russisches Register
American Bureau of Shipping	Bureau Veritas

With these standards and regulations, the following limits for temperature rise are valid:

Regulations	Temperature of cooling air	Permissible limits of temperature rise in K (measured by resistance method) Insulation class				
	°C	A	E	B	F	H
DIN EN 60034-1/ 11.95	40	60	75	80	105	125
IEC 34-1	40	60	75	80	105	125
Great Britain BS	40	60	75	80	105	125
Italy CEI	40	60	70	80	105	125
Sweden SEN	40	60	70	80	105	125
Norway NEK	40	60	-	80	105	125
Belgium NBN	40	60	75	80	105	125
France NF	40	60	75	80	105	125
Switzerland SEV	40	60	75	80	105	125
Germanischer Lloyd	45	55	70	75	100	100
American Bureau of Shipping	50	55	65	75	100	125
Bureau Veritas	50	50	65	70	90	110
Norske Veritas	45	50	65	70	90	115
Lloyds Register	45	50	65	70	95	110
Russ. Register [3)]	40/45	60	75	85	110	125

Progressive correspondence between output and size

VEM three-phase motors with squirrel-cage rotor are available in two type series, both based on IEC 72 as regards dimensions and frame sizes (type co-ordination see tables of Motor selection data). The **G11R / G22R** series is designed as a classic IEC/DIN series, i.e. fixing dimension and correspondence of output as specified in DIN 42673 / DIN 42677.
The **G10R** series is based on a progressive output correspondence in comparison to these DIN standard. With the same frame size, it offers an output up to two stages higher.
The variations of the output correspondence derived from both series can also be supplied as a special series.

Vibration behaviour

The permissible vibration intensities of electric motors are specified in DIN EN 60034-14.
The vibration intensity stage N (normal) is achieved or bettered by VEM motors in the basic version. The vibration intensity stages R (reduced) and S (special) are available at extra charge and depending on the type. Please consult the manufacturer.

According to DIN EN 60034-14 the following intensities are recommended:

Vibration intensity stage	Speed range rpm	Limits of vibration velocity (mm/s) in frequency range 10 up to 1000 Hz sizes		
		80 - 112	132 - 200	225 - 400
N (normal)	600-3600	1,8	2,8	3,5
R (reduced)	600-1800	0,71	1,12	1,8
	> 1800-3600	1,12	1,8	2,8
S (special)	600-1800	0,45	0,71	1,12
	> 1800-3600	0,71	1,12	1,8

All rotors are dynamically balanced with the half key inserted. This balancing is documented on the rating plate with the letter H after motor No., balancing with full key inserted on request, designation in then F after motor No.

Bearings / bearing lubrication

VEM motors are equipped with bearings from excellent manufacturers. The bearings have a nominal service life of at least 20.000 h for maximum permissible load conditions. Without additional axial loading, for coupling service the nominal bearing service life is 40.000 h.

The versions
- fixed bearing N-end
- without fixed bearing
- life lubrication
- relubrication device
- heavy bearing arrangement D-end (for increased lateral forces)
- easy bearing arrangement

and the
- bearing schedule
- disc spring and wave washer schedule
- V-Ring schedule
- figures of bearing arrangements
- flat grease nipples

are shown in the bearing arrangement tables. Fixed bearing D-end is possible on request. Any grooved ball bearings have disc springs and wave washers, respectively, thus they are pre-loaded. This is not true for versions with cylindrical roller bearings.
The version ”fixed bearing N-end” is possible for motors ”without fixed bearings”.
Motors with life lubrication are also available with a degree of protection IP 56.

Motor sizes 132 – 160 are fitted with life-lubricated bearings. For motors from size 180, depending on the useful life of grease, bearings must be regreased in good time so that the scheduled bearing service life is reached. Under normal operating conditions, the grease packing will last for 10.000 hours of operation with 2-pole version and for 20.000 hours of operation with versions from 4-pole upwards without being renewed. For motors fitted with relubrication device and working under normal operating conditions, the grease will last for 2.000 hours of operation with 2-pole version and 4.000 hours of operation with 4- and more-pole version. The standard grease is a KE2N-50 type according to DIN 51825.

Use of cylindrical roller bearings

Using cylindrical roller bearings (heavy bearing arrangement), relatively high radial forces or masses can be accepted at the motor shaft end, e.g. belt drives, pinions or heavy couplings.
The minimum radial force at the shaft end must be at least a quarter of the permissible one. Account must be taken of permissible shaft end loading. Both these values are found in the diagrams.

Important to note:
Radial forces below the minimum value can lead to bearing damage within a few hours. Test runs in no-load state are only permissible for a short period.

If the specified minimum radial forces cannot be met, we recommend the use of grooved ball bearings (easy bearing arrangement). Bearing change on request.

Noise behaviour

Noise measurement is carried out according to DIN EN 23741/23742 at design output, design voltage and design frequency. In accordance with DIN EN 60034-9, the spatial mean value of the measurement area sound pressure level L_{pA} measured at a distance of 1 m from the machine outline is stated as noise intensity in dB (A).

The A-sound power level L_{WA} across the measurement area dimension L_S (d = 1 m) is also quoted with

$$L_{WA} = L_{pA} + L_S \quad \text{(dB)}$$

The measurement area dimensions are independent from the machine geometry and are for

		L_S (dB)
size	63 - 132	12
	160 - 225	13
	250 - 315	14
	355	15

The tabular value + 4 dB (A) applies as an approximate value for motors in 60 Hz version. Binding data for 60 Hz are available on request. The noise values for basic types are quoted in tabular form. For special versions, please refer to the manufacturer.

Paint finish

Normal finish
- Adapted for climate group ”moderate” according to IEC 721-2-1
  - Weather-protected and non-weather-protected locations, open-air conditions, short-time up to 100 % relative humidity at temperatures up to + 30 °C, continuously up to 85 % relative humidity at temperatures up to + 25 °C

Finish system
- prime coat plastic resin / zinc phosphate, layer thickness ≥ 30 µm
- finish coat 2K-(separate-application) polyurethane varnish, layer thickness ≥ 30 µm

Special finish
- Adapted for group of climates "world wide" according to IEC 721-2-1
  Non-weather-protected locations, open-air conditions, in aggressive atmospheres (chemical industries, sea environments), short-time up to 100 % relative humidity at temperatures up to +35 °C, continuously up to 98 % relative humidity at temperatures up to +30 °C.

Finish system
- prime coat plastic resin / zinc phosphate, layer thickness ≥ 30 µm
- second coat on separate-application base, layer thickness 30 ≥ µm
- finish coat 2K (separate-application) polyurethane varnish, layer thickness ≥ 30 µm

Standard colour:
RAL 7031 blue grey

Ambient temperature

All VEM motors in the basic version can be used at ambient temperatures from -35 °C up to +40 °C.

Overload capacity

In compliance with DIN EN 60034-1, all motors can be exposed to the following overload conditions:
- 1,5 times the rated current for 2 min,
- 1,6 times the rated torque for 15 s (1,5 times for $I_A / I_N > 4,5$)

Both conditions apply to design voltage and design frequency.

Generator protection

The following motor protection versions are available as an option:
- motor protection with PTC thermistor sensors in the stator winding
- bimetallic temperature sensor as NC contact or NO contact in the stator winding
- resistance thermometer for monitoring the winding or bearing temperature on request

Asynchronous generators for parallel operation with the mains

If a three-phase motor is driven over-synchronously through a driving machine, the direction of energy will be changed because of the negative slip. The motor passes over to generator operation and supplies the mains with energy. In this case, the generator takes the necessary reactive power from the mains, and additional excitation systems are not necessary.
The mains maintains voltage and frequency so that separate regulators are not necessary.

Asynchronous generators for isolated operation

When using asynchronous generators in isolated operation, the excitation is realized through the parallel connection of a capacitor bank.
Its dimensioning depends on the generator power and on the generator parameters.
The operating mode is considerably more expensive than the parallel operation with the mains and is only used for lower outputs.
Furthermore, there is to be emphasized that an isolated generator reacts sensitively to inductive consumer units and speed variations.

Explications of the letter symbols

P	electrical active output in kW
P_{auf}	mechanical power input in kW
S	electrical apparent power output in kVA
n	speed in rpm
•	efficiency in %
cos••	power factor
M_K / M_N	relative generator pull-out torque
Q_N	reactive power absorption in kVA
Q_0	reactive power absorption in kVA
J	moment of inertia in kgm^2
m	weight in kg
n_{max}	mechanical limit speed in min^{-1}
I_N	generator current
I_A / I_N	relative starting current (motor value)

Tolerances - electrical parameters

According to DIN EN 60034-1/11.95 the following tolerances are permissible:

Efficiency (indirect calculation)	-0,15 (1-η) for $P_N \leq 50$ kW -0,1 (1-η) for $P_N > 50$ kW
Power factor	$\frac{1-\cos\varphi}{6}$ at least 0,02 maximum 0,07
Slip (at rated load and operating temperature)	± 20 % for $P_N \geq 1$kW
Starting current (in the planned starting connection)	+ 20 % without restrictions downwards
Starting torque	- 15 % and + 25 %
Pull-up torque	- 15 %
Pull-out torque	- 10 % (after the application of this tolerance M_K/M at least 1,6)
Moment of inertia	± 10 %
Noise level (sound pressure level)	+ 3 dB (A)

These tolerances are permissible for the values assured for three-phase asynchronous motors, taking the necessary manufacturing tolerances and material variations of the raw material into account.

The standard contains the following notes on this:

1. A guarantee for all or any of the values shown in the table is not mandatory. In tender, the guaranteed value for which permissible deviations should apply must be expressly specified. The permissible variations must correspond to those stated in the table.
2. ”Guarantee”: In some countries, a distinction is drawn between guaranteed values and typical or declared values.
3. If a permissible deviation applies only in one direction then the value in other direction is not limited.

Tolerances - mechanical parameters

Dimensional short sign acc. to DIN 42939	Meaning of the dimension	Fit or tolerance
a	Spacing of feet fixing holes in axial direction	• 1 mm
a_1	Diameter or width across corners of attachment flange	- 1 mm
b	Spacing of feet fixing holes across axial direction	• 1 mm
b_1	Diameter of flange spigot	up to diameter 230 mm j6 up to diameter 250 mm h6
d, d_1	Diameter of the cylindrical shaft end	up to diameter 48 mm k6 from diameter 55 mm m6
e_1	Pitch circle diameter of attachment flange	• 0,8 mm
f, g	Maximum width of the motor (without terminal box)	+ 2 %
h	Shaft height (lower edge foot to shaft centre line)	up to 250 mm -0,5 > 250 mm -1
k, k_1	Overall length of the motor	+ 1 %
p	Overall height of the motor (lower edge foot, housing or flange to highest point of the motor)	+ 2 %
s, s_1	Diameter of fixing holes of foot of flange	+ 3%
t, t_1	Lower edge shaft end to upper edge key	+ 0,2 mm
u, u_1	Key width	h9
w_1, w_2	Centre of first attachment hole to shaft end shoulder	• 3,0 mm
	Distance shaft shoulder – flange face, fixed bearing D-end	• 0,5 mm
	Distance shaft shoulder – flange face	• 3,0 mm
	Motor weight	-5 up to +10 %