VR
SPEED VARIATORS
with dry friction ring

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The variators series VR have a continuous and adjustable 5:1 speed range performed by a patented motor sliding mechanism on cylindrical ways avoiding backlash and vibrations.

A unique fully-sealed inner arrangement prevents foreign matter from entering the variator housing and allowing the protection grade IP66 as standard.

The speed ratio can be changed whether the motor is running or not.

On the contrary of other types of variators, no “tracking” or wearing of cone surface occurs also when speed is kept constant over a long period of time.

The variator mechanism is dry running (pack greased cam and roller bearings), while gearboxes coupled to the variator are oil filled before despatch, the lubricant type is marked on name plate.

All Varvel products are guaranteed for 12 months from delivery date against manufacturing defects.

**Speed ratios**

VR variators are manufactured without fixed reduction as standards but all the types of Varvel gearboxes can be directly plugged in.

Incorporation of 2 or 3 stage helical, parallel shaft, bevel/helical (in-line or right-angle) and worm gearboxes is easily done with input flange to match IEC motors giving a wide choice of speed ranges.

Output speeds listed in selection tables are rounded and referred to the input speed of 1500 rpm.

Actual values are depending on real reduction ratio, motor size and load, and mains conditions.

**Variator operation**

The speed is adjusted by a manually operated hand wheel, fitted on the top of the casing.

Versions with fixed reduction: the hand wheel position can be easily set to either sides by a 90° rotation of the variator on its centre line.

A two-stage worm-servomotor fitted to the variator, including limit switches for speed ratio control, provides a convenient alternative at little extra cost.

**Working principle**

The cone (A) is driven by the input shaft at constant speed and held in contact with the graphite ring (B) by the spring force when idling or starting up.

The force between the two parts is then adjusted, smoothly and automatically, by the cam (C) as soon as the load torque requirements at output shaft are modified.

To vary the speed, the cone (A) is moved between position (01)
- output speed = input speed
  and position (02)
- output speed = 0.2 times the input speed.
## Variators VR

### General specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Gearboxes RD 7 sizes - 28 reduction ratios - 2300 Nm max. torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR</td>
<td>63, 71, 80, 90</td>
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<tr>
<td>Gearboxes RN</td>
<td>6 sizes - 42 reduction ratios - 3400 Nm max. torque</td>
</tr>
<tr>
<td>Gearboxes RO/RV</td>
<td>6 sizes - 33 reduction ratios - 3400 Nm max. torque</td>
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<tr>
<td>Gearboxes RS/RT</td>
<td>RS - 9 sizes and RT - 7 sizes - 55 reduction ratios - 3020 Nm max. torque</td>
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<tr>
<td>Housing Covers</td>
<td>Pressure die cast aluminium AlSi12Cu2Fe till size VR071 and cast iron from VR080.</td>
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<tr>
<td>Friction ring</td>
<td>Graphite</td>
</tr>
<tr>
<td>Toothed parts</td>
<td>Helical gears: case hardened, ground or shaved. Wormshafts: case hardened with ground ZI profile. Bronze gears: CuSn12 on cast iron hub.</td>
</tr>
<tr>
<td>Shafts Keys</td>
<td>Steel C43, Shafts h7 - Bores E8, Keys according to DIN6885 B1</td>
</tr>
<tr>
<td>Bearings</td>
<td>Ball or roller bearings according to sizes and technical requirements</td>
</tr>
<tr>
<td>Oil seals</td>
<td>Type NB - nitril-butadiene with additional anti-dust lip according to DIN 3760</td>
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<tr>
<td>Lubricant</td>
<td>- SHELL Retinax Grease: variator’s cam zone. - SHELL Omala S4 WE320: gearboxes.</td>
</tr>
<tr>
<td>Powder coating</td>
<td>VR63 and VR71: real aluminium, not painted, VR80 and VR90: Epoxy powder paint, RAL7012</td>
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</tbody>
</table>

### Service Factors

Service factor FS1.0 is meant as typical of 8-10 hours/day operation, with uniform load and starts/ stops lower than 6 per hour and ambient temperature between 15 and 35 Celsius.

The ratio between the drive’s maximum output torque $M_2$ and application torque $M_{(app)}$ defines the drive’s Duty Factor that must be equal or bigger than the Service Factor SF.

For max. ambient temperature exceeding 40 °C or below 0 °C, please ask our Customer Service.

For other operation conditions, the service factors of the two tables have to be multiplied accordingly.

### Type of Load

<table>
<thead>
<tr>
<th>Type of Load</th>
<th>Start- Stops per hour</th>
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<tr>
<td>hours</td>
<td>uniform SF$_1$</td>
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<td>&lt; 8</td>
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</table>

Service Factor $SF = SF_1 \times SF_2$
VR Variators

Torque selection

Selection and torque limitations

The values as listed in the selection tables are worked out considered that

- the torque given by the variator is limited by the max. value transmissible by the friction ring;
- the torque delivered by variator-gearbox matches the uniform load conditions throughout the variation range.

In any case, the max. transmissible torque \( M_{t\text{max}} \) must be assumed as the transmissible torque at max. speed according the formula

\[
M_{t\text{max}} [\text{Nm}] = \frac{9550 \times kW_{\text{max}}}{rpm_{\text{max}}}
\]

- the variator works at full load only at max. speed and that the transmissible power at other speeds is lower as follows

\[
kW_{\text{max}} = \frac{kW_{\text{max}} \times rpm_{\text{min}}}{rpm_{\text{max}}}
\]

**Graph (A):** Selection with three values of torque/speeds

- \( M_{t\text{min}} \): max. torque value at the lowest speed \( M_{t\text{lim}} \)
- \( M_{t\text{lim}} \): top speed max. limit torque (a torque limiter set to \( M_{t\text{lim}} \) should be provided for enhanced safety purposes)
- \( M_{t\text{max}} \): top speed max. torque value
- \( rpm_{\text{min}} \): lowest speed
- \( rpm_{\text{lim}} \): speed giving the limit value of the torque
- \( rpm_{\text{max}} \): top speed

On speed decreasing, torque is increasing from \( M_{t\text{max}} \) and \( M_{t\text{lim}} \) and constant from \( M_{t\text{lim}} \) and \( M_{t\text{min}} \).

**Graph (B):** Selection with two values of torque and speed

- \( M_{t\text{max}} \): lowest speed max. torque
- \( M_{t\text{max}} \): top speed max. torque
- \( rpm_{\text{max}} \): lowest speed
- \( rpm_{\text{max}} \): top speed

On speed decreasing, torque is increasing all over the variation range from \( M_{t\text{max}} \) to \( M_{t\text{min}} \).

It is recommended the max. speed selection of the variator matches the max. speed of the driven machine.

All the reduction ratios of the selection tables of

- helical gearboxes RD,
- parallel shaft RN,
- bevel/helical RO, RO-2 and RV,
- and worm boxes RS and RT

are available to get lower speed ratios and it is recommended to check the speed value \( rpm_{\text{min}} \), if needed.

The max. torque available may in some cases be limited by the capacity of gears to transmit it. It is then essential to check the required torque against the figures given in the performance tables.
Variators VR

Mounting and External loads

Manufacturing forms
Two constructions are available for all the sizes and manufacturing forms:

- **MVR**: variable speed drive with electric motor
- **FVR**: variator ready to IEC-B5 electric motor coupling.

Unless differently stated at order, the variators are manufactured for horizontal operation and with B5 flange mounting for coupling to a helical or worm gearbox.

Variator only output loads
The listed output radial loads (OHL) refer to the variator only without any gearbox fitted.
No axial load can be admitted at the output shaft, to avoid damages to the bearings and to the torque adjusting cam.
In case of variator/gearbox unit, please refer to relative gearbox catalogue.

<table>
<thead>
<tr>
<th>Just the variator</th>
<th>Radial loads (OHL)</th>
<th>Axial loads</th>
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<tbody>
<tr>
<td></td>
<td>300 rpm</td>
<td>1500 rpm</td>
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<tr>
<td>MVR063</td>
<td>250 N</td>
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<td>MVR071</td>
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<td>300 N</td>
</tr>
<tr>
<td>MVR090</td>
<td>800 N</td>
<td>500 N</td>
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</table>
VR Variators

Versions

**MRV**
- Variable speed motors without fixed reduction
  Powers: 0.09 kW to 1.5 kW, 4 poles
  Output speed: 300 rpm to 1500 rpm

**MVR/FRS**
- Variable speed motors with worm speed reducer (conventional type)
  Output torques: 1.6÷0.5 Nm to 25÷8 Nm
  Reduction ratios: 5:1 to 50:1

**MVR/FRT**
- Variable speed motors with worm speed reducer (universal type)
  Variator only output torques: 1.6÷0.5 Nm to 25÷8 Nm
  Reduction ratios: 5:1 to 50:1

**MVR/FRD**
- Variable speed motors with helical speed reducer
  Variator only output torques: 1.6÷0.5 Nm to 25÷8 Nm
  Reduction ratios: 2.25:1 to 630:1 (2 and 3 stages)
Variators VR

Versions

MRV/FRN
- Variable speed motors with parallel shaft gearbox (2 and 3 stages)
  Variator only output torques: 1.6÷0.5 Nm to 25÷8 Nm
  Reduction ratios: 6.3:1 to 630:1

MVR/FRO
- Variable speed motors with bevel helical gearbox (in-line version, 3 stages)
  Variator only output torques: 1.6÷0.5 Nm to 25÷8 Nm
  Reduction ratios: 6.3:1 to 315:1

MVR/FRO-2
- Variable speed motors with bevel helical gearbox (right angle version, 2 stages)
  Variator only output torques: 1.6÷0.5 Nm to 25÷8 Nm
  Reduction ratios: 5:1 to 54.7:1

MVR/FRV
- Variable speed motors with bevel helical gearbox (right angle version, 3 stages)
  Variator only output torques: 1.6÷0.5 Nm to 25÷8 Nm
  Reduction ratios: 6.3:1 to 315:1
<table>
<thead>
<tr>
<th>Motor [kW]</th>
<th>Type</th>
<th>Output speed [rpm] min + max</th>
<th>Output torque [Nm] min + max</th>
<th>Efficiency [η] min + max</th>
<th>Weight MVR [kg]</th>
<th>Weight FVR [kg]</th>
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<tr>
<td>MVR063</td>
<td>0.09</td>
<td>300 + 1500</td>
<td>1.6 + 0.5</td>
<td>0.55 + 0.82</td>
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4-poles motor powers
## Variators VR
### Overall dimensions

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<th>MVR - B5</th>
<th>063 IEC56/B5</th>
<th>063 IEC63/B5</th>
<th>071 IEC71/B5</th>
<th>080 IEC80/B5</th>
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Not binding dimensions and weights
### VR Variators

#### Overall dimensions

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</tbody>
</table>

Not binding dimensions and weights
01 Screw
02 Flange
03 Screw
04 Seal plate
05 Bearing
06 Spacer
07 Cone
08 Bush
09 Housing
10 Cylindrical slide
11 Oil seal
12 Washer
13 Screw
14 Hand wheel
15 Control lock
16 Control shaft
17 Oil seal
18 Screw
19 Output shaft
20 Key
21 Bearing
22 Seeger ring
23 Seeger ring
24 Oil seal
25 Screw
26 Output flange
27 Spacer
28 Bearing
29 Seeger ring
30 Oil seal
31 Index scale
32 Washer
33 Spring
34 Driving flange
35 Friction ring
36 Cone support
37 Bellow seal
38 Index
39 Screw
40 Washer
41 Nut
Please ask for the individual catalogues of the gearboxes:
- RD helical,
- RN parallel,
- RO and RO2 in-line bevel/helical,
- RV right-angle bevel/helical,
- RS original worm,
- RT universal worm

to select the needed reduction ratios and torques of the motor-variator-gearbox combinations:

Abstract of
OPERATION AND MAINTENANCE INSTRUCTIONS
(complete manual on www.varvel.com)

Under the terms of the Machine Directive 2006/42/EC and relevant Guidelines, the speed gearboxes and variators are considered as “machines’ separate elements not having a specific application and meant for being incorporated onto the machine. The complete machine and equipped with such components must comply with the essential and relevant requisites for safety and health preservation” of the mentioned Directive.

Installation
Check if the unit to be installed is properly selected to perform the required function and that its mounting position complies with the order.
The nameplate reports such information.
Check mounting stability to ensure the unit runs without vibrations or overloads.

Running
The unit may be connected for clockwise or counter-clockwise rotation.
The unit must be stopped as soon as defective running or unexpected noise occur. remove the faulty part or return the unit to the factory for checking.
If the faulty part is not replaced, other parts can also be affected. causing more severe damage and making the identification of initial cause more difficult.

Maintenance
Although the units are no-load run tested in the factory before despatch. it is recommended not to run them at maximum load for the first 20-30 running hours to allow the proper running in.
The gearboxes are delivered already filled with long-life synthetic oil and, in case of replacement or topping, do not mix with mineral lubricants.

Handling
When hoisting, use relevant housing locations or eyebolts if provided, or foot or flange holes
Never hoist on any moving part.

Painting
Carefully protect oil seals, coupling faces and shafts when units are re-painted.

Long-term storage
For storages longer than three months. apply anti-oxidants onto shafts and machined surfaces, and protective grease on oil seal lips.

Product’s Environmental Management
In conformity with Environmental Certification ISO 14001. we recommend the following to dispose of our products:
- scraped components of the units to be delivered to authorized centres for metal object collection;
- oils and lubricants drained from the units to be delivered to Exhausted Oil Unions;
- packages (pallets, carton boxes, paper, plastic, etc...) to lead into regeneration/recycling circuits as far as possible, by delivering separate waste classes to authorized companies.