

# BSR SERIES

IE2-IE3-IE4

Synchronous Reluctance Motors

 **Bonfiglioli**



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# BSR SERIES

## Synchronous Reluctance motor Economically and environmentally sustainable innovation

The synchronous reluctance motor is an electric motor that combines a conventional three phase induction motor stator with an innovative rotor design.

The rotor is designed with a magnetic anisotropy resulting in the reluctance principle for the electromagnetic energy conversion without using permanent magnets or rotor windings. The rotor design with the lamination holes yields a lower inertia and better dynamics in comparison with an induction motor of the same size.

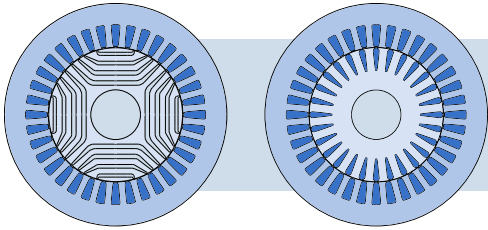


Illustration of the section of a Bonfiglioli synchronous reluctance motor BSR (left) in comparison with the one of an induction motor (right).

The reduction of rotor losses allows an increase of motor ratings in comparison with an induction motor in terms of both efficiency and power density. Taking the advantage of this essential feature, Bonfiglioli is able to offer two distinctive versions in BSR synchronous reluctance motor series.

The High Efficiency (E) version is characterized by the Super Premium IE4 Efficiency Class level at all the rated operating points, including those in the partial load range. The High Output (O) version allows to reduce the motor size in comparison with an induction motor of the same output power, maintaining an efficiency level equal or higher than the IE2 Efficiency Class. When compared to high efficiency induction motors, the dynamic performances are significantly higher, thanks to the lower rotor inertia.

### Key benefits

- **Efficient and Reliable:**
  - **Competitive advantages** in terms of Total Cost of Ownership
  - **Highest energy efficiency** system IES2 and environmentally friendly solution
  - High levels of **reliability** due to our production quality processes and internal know-how
- **Dedicated to your application:**
  - BSR motors are designed to replace induction motors in variable speed applications, ensuring:
    - > **Energy efficiency increase up to class IE4** if compared with induction motors
    - > **A reduction of the motor frame** up to two sizes with the same power of an induction motor
  - BSR motors, in combination with Active Cube (ACU) 410, provide **accurate speed, torque control**
  - **Suitable for any variable speed applications**, whether quadratic or constant torque  
Typical applications are: pumps, fans, compressors, conveyors and winding machines
- **Wide power range:**
  - 0.37...18.5 kW
- **Accurate sensorless speed control:**
  - BSR in combination with Active Cube 410 provides excellent motor control without encoder feedbacks

### Key features

- **High energy efficiency** of the motor up to class IE4 that lead to a remarkable energy saving.
- Extremely **high efficiency** from the partial load range up to the rated operating point
- **Higher torque density** in comparison with an induction motor of the same size
- **High dynamic response** through optimized control and low intrinsic moment of inertia
- **High reliability and longer bearings life** thanks to lower operating temperature
- **High overload capability:** Up to 300% of rated torque
- **Effective torque and speed control** (also at low speed) without encoder
- Perfect for **retrofit** thanks to IEC mechanical dimensions
- Optimized compatibility with **Active Cube 410** drive series.

### Areas of application:



FOOD &  
BEVERAGE



TEXTILE



MATERIAL  
HANDLING

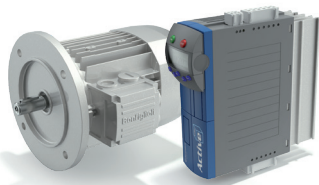


PACKAGING

# BSR POWER DRIVE SYSTEM

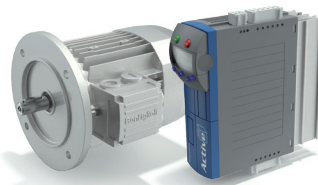
The BSR series has been specifically coordinated and harmonized with Active Cube 410 frequency inverters to develop two synchronous reluctance packages, one focused on energy efficiency and the other one focused on high power density. When comparing the synchronous reluctance motor technology and the induction motor technology, the main advantages of the two packages proposed by Bonfiglioli are:

- High Efficiency Package:** higher efficiency class (up to IE4) compared to an induction motor with the same power and frame size. Thanks to its Premium Efficiency class IE4, this package ensures a remarkable decrease in the energy consumption, while ensuring higher dynamics in comparison with induction motors due to lower rotor inertia. This solution contributes to the increase of the machine reliability, thanks to the absence of rotor losses and less heating dissipation, leading also to a longer lifetime of bearings. This package is also suitable for induction motors replacement since the BSR motors are designed with the same frame size as an IE2 induction motor of the same power. Hence, upgrading to the highest efficiency level results in an easy and smooth process, without the need for mechanical modifications. The High Efficiency package is particularly suited for the replacement of induction or PM motors in Variable Speed Drive applications and for basic applications such as Pumps, Fans, Conveyors, Mixers, Dozers.



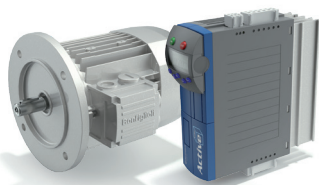
BSR 90L E 15 - 1.5 kW IE4 Efficiency Class

Same frame size  
-24% Rotor inertia  
+5.4% Efficiency



BE 90LA 4 - 1.5 kW IE2 Efficiency Class

- High Output Package:** smaller frame for same output power and efficiency class of an induction motor. The High Output motor-drive package enables the reduction of the motor size up to two frame sizes, or optionally, the increase of the power rating between 20 and 100% for the same motor frame. The High Output motors have IEC design frame and matches with standard IEC gearboxes on the market. The High Output package is particularly suited for the replacement of induction or PM motors in Variable Speed Drive applications and for applications which require accurate sensorless speed and torque control.



BSR 80C O 15 - 1.5 kW IE2 Efficiency Class

1 frame size less  
-35% Rotor inertia  
Same efficiency class



BE 90LA 4 - 1.5 kW IE2 Efficiency Class

The two different packages ensure the right solution for high efficiency and compact application requirements.

# STANDARD AND DIRECTIVES

BSR motors are manufactured in accordance with applicable Standards and Directive listed on this page.

## Standard

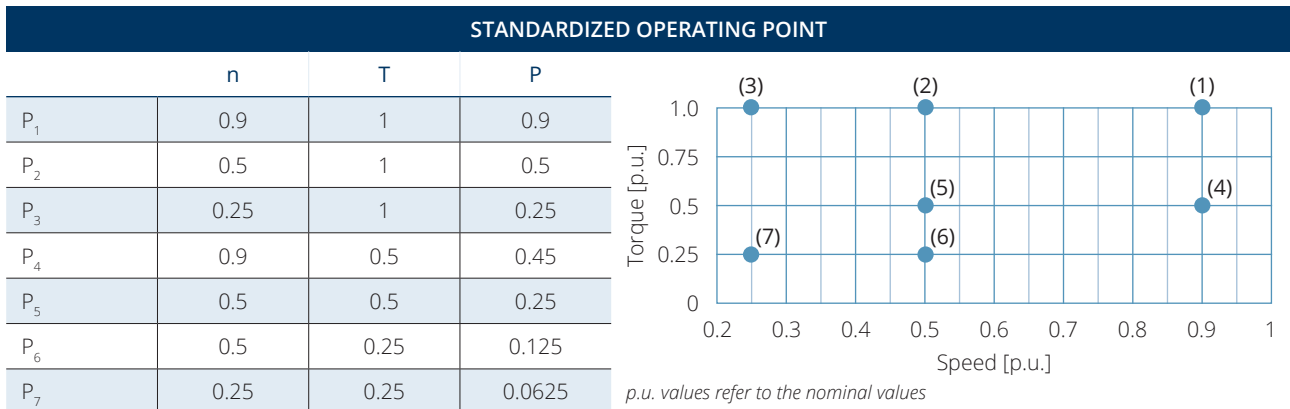
STANDARD TITLE	STANDARD TITLE
General requirements for rotating electrical machines	IEC 60034-1
Terminal marking and direction of rotation of rotating machines	IEC 60034-8
Methods of cooling for electrical machines	IEC 60034-6
Dimensions and output ratings for rotating electrical machines	IEC 60072
Classification of degree of protection provided by enclosures for rotating machines	IEC 60034-5
Noise limits	IEC 60034-9
Classification of type of constructing and mounting arrangements	IEC 60034-7
Vibration level of electric machines	IEC 60034-14
Efficiency classes of variable speed AC motors (IE code)	IEC TS 60034-30-2
Specific test methods for determining losses and efficiency of converter-fed AC motor	IEC 60034-2-3

## Directives

BSR motors meet the requirements of Directives 2006/95/EC (Low Voltage Directive CE mark is applied to this product).

# EFFICIENCY CLASSES AND TEST METHOD

The standard IEC 60034-2-3 defines the test methods for determining total losses including high frequency motor losses and efficiency of frequency inverter driven motors<sup>(1)</sup>. For inverter driven motors like the BSR motor series, the input-output method is applied. The standard defines seven standardized operation points to characterize motor losses and efficiency along the complete torque-speed range. Furthermore, the IEC 60034-2-3 provides an interpolation procedure for the loss determination in any operating point.



The standard IEC 60034-30-2 defines the international energy-efficiency class of variable speed AC motors. The efficiency classes (IE code) range from IE1 (Standard efficiency) to IE5 (Ultra Premium efficiency).

## European Commission regulation 640/2009

IEC standard 60034-30-2 establishes technical guidelines for efficiency classification but does not impose any legal requirements for the adoption of any particular efficiency class. These are laid down by European Directives and national laws.

The EC Regulation applying Directive 2009/125/EC was adopted on the 21<sup>st</sup> October 2009. This establishes the legal requirements and eco-compatible design criteria for induction motors, and imposes minimum efficiency limits according to the following schedule:

- **16/06/2011:** Induction motors must have a minimum efficiency level equivalent to class **IE2**
- **01/01/2015:** Induction motors with a rated power output between 7.5 kW and 375 kW must have a minimum efficiency level corresponding to **IE3**, or to **IE2** if controlled by a frequency inverter
- **01/01/2017:** Induction motors with a rated power output between 0.75 kW and 375 kW must have a minimum efficiency level corresponding to **IE3**, or to **IE2** if controlled by a frequency inverter

BSR motors in combination with Active Cube 410 frequency inverter series meet or exceed the legal requirements for energy efficiency and are classified up to class IE4.

BSR motors are not subject to any minimum efficiency requirements for specific countries.

(1) IEC 60034-2-3 uses "converter" as a term for frequency inverters.

# SYMBOLS AND UNITS OF MEASURE

SYMBOL	U.M.	DESCRIPTION
$\eta_{4/4}$	[-]	Efficiency at $P_n$
$f_H$	[-]	Altitude adjustment factor
$f_n$	[Hz]	Rated frequency
$f_T$	[-]	Temperature adjustment factor
$I_n$	[A]	Rated current
$I_{ol}$	[A]	Overload current
$I_p$	[A]	Peak current
$J_m$	[kgm <sup>2</sup> x10 <sup>-4</sup> ]	Motor moment of inertia
$m_{IM B5}$	[kg]	Mass with IM B5 mounting
$M_{EQU}$	[Nm]	Equivalent torque
$M_n$	[Nm]	Rated torque
$M_{ol}$	[Nm]	Overload torque at $n_n$
$M_p$	[Nm]	Peak torque
$n_n$	[min <sup>-1</sup> ]	Rated speed
$n_{max}$	[min <sup>-1</sup> ]	Maximum speed
$P_n$	[kW]	Rated power

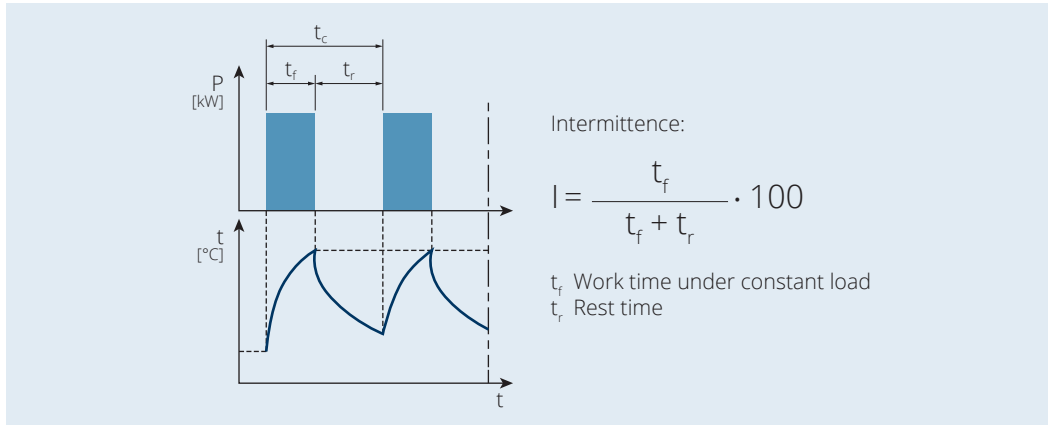
*Unless otherwise specified, all dimensions are expressed in millimeters.*



# TERMS AND DEFINITIONS

**Duty type S1:** Operation at constant load maintained for sufficient time to allow the machine to reach thermal equilibrium.

**Duty type S3:** sequence of identical duty cycles, each including a time of operation at constant load and a time de-energized and at rest. If not specified the cycle time is fixed equal to 10 minutes.



**Electric time constant  $[\tau_{el}]$ :** is the time taken for the current to reach 63.2% of its steady state value when a step input voltage is applied while the rotor is stationary. It is calculated by dividing the winding phase-to-phase inductance ( $L_{pp}$ ) by the winding phase-to-phase resistance ( $R_{pp}$ ) at 20°C.

$$\tau_{el} = L_{pp} / R_{pp}$$

**Peak current  $[I_p]$ :** is the current used to produce the peak torque ( $M_p$ ). It is the current limit of the machine, and if exceeded, even for a short period, an irreversible damage to the machine can occur.

**Peak torque  $[M_p]$ :** is the absolute maximum torque that can be produced by a motor for a short time.

**Rated current  $[I_n]$ :** is the RMS current to produce the rated torque ( $M_n$ ).

**Overload current  $[I_{o1}]$ :** is the RMS current to produce the overload torque ( $M_{o1}$ ) at rated speed ( $n_n$ ).

**Overload torque  $[M_{o1}]$ :** is the overload torque at rated speed ( $n_n$ ).

**Rated frequency  $[f_n]$ :** is the frequency of the fundamental component of the output voltage corresponding at the rated speed ( $n_n$ ) according to the following equation where  $p$  is the pole pairs.

$$f_n = p \cdot n_n / 60$$

**Rated power  $[P_n]$ :** is the mechanical power available at shaft at rated speed  $n_n$ .

$$P_n = 2\pi \cdot M_n \cdot n_n / 60$$

**Rated speed  $[n_n]$ :** is the speed at which the motor has been designed to operate with a reasonable level of control, in terms of overload torque ( $M_{o1}$ ) and overspeed.

**Rated torque  $[M_n]$ :** is the thermally permissible continuous torque for S1 duty at the rated motor speed ( $n_n$ ).

**Thermal equilibrium:** is the state reached when the temperature rise of the several parts of the machine do not vary by more than a gradient of 2 K per hour.

**Thermal time constant  $[\tau_{therm}]$ :** is the time for the temperature to reach 63.2% of this final value between the motor housing and the ambient after a step-wise current change.

**Winding temperature rise  $[dT]$ :** is the temperature rise, in specified service conditions, of the motor windings above the maximum ambient reference temperature.

# THE SYNCHRONOUS RELUCTANCE DRIVE SYSTEM

## Smart motor control for your application

The BSR motors are optimized for operating with Active Cube 410 inverter series. Thanks to the motor data integration in the inverter software VPlus, the set up is extremely fast and easy.

The resulting power drive system meets all the requirements for the IES2 top efficiency classification.

### Active Cube 410 Series

#### Power range:

from 0.25 kW to 400 kW

#### Overload capacity

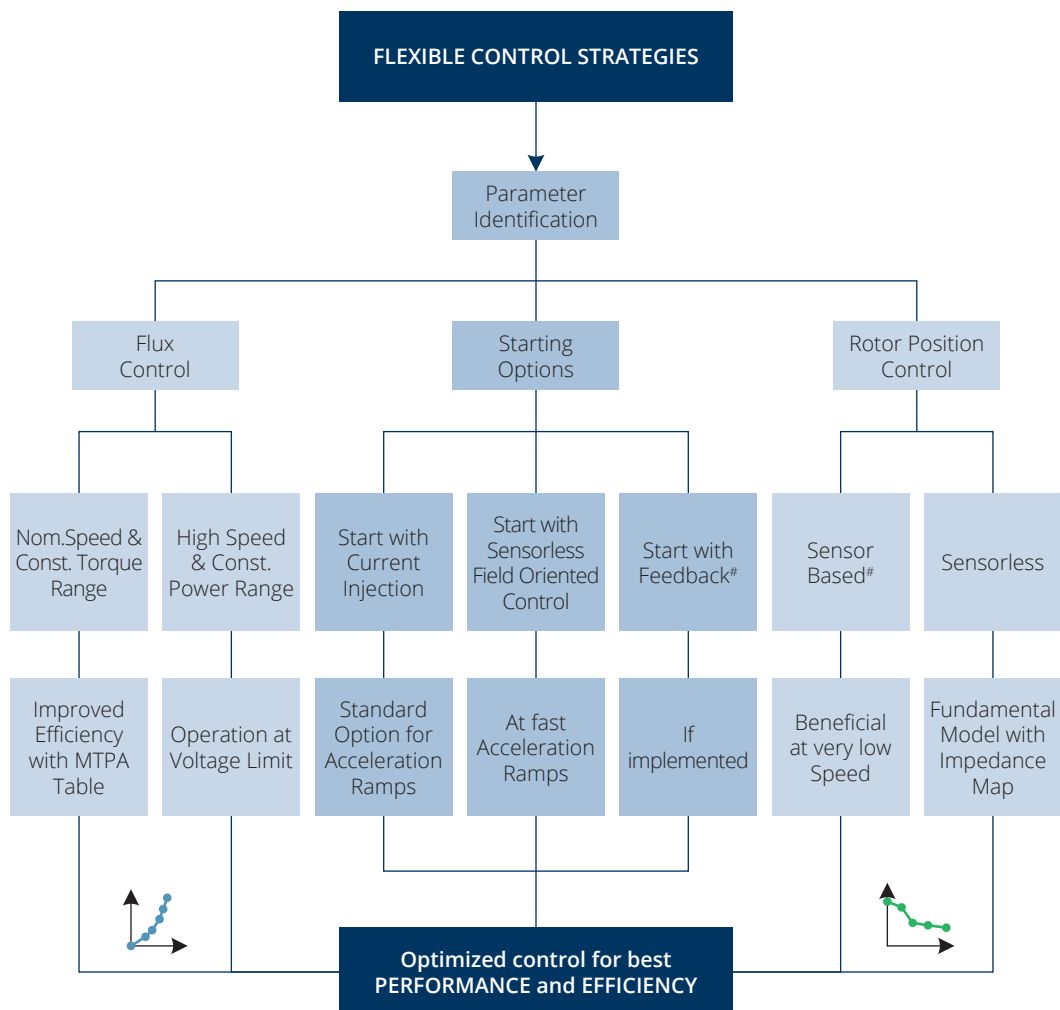
- up to 150% for 60 seconds
- up to 200% for 1 second

#### Motor Control (open loop or optional closed loop):

- Asynchronous AC motors
- Synchronous reluctance motors
- Permanent magnet synchronous (brushless) motors

#### Communication modules

- Different field bus options like CANopen, PROFIBUS, Modbus, EtherCAT, PROFINET, Varan
- Optional I/O extensions for additional digital and analogue inputs & outputs



# on request



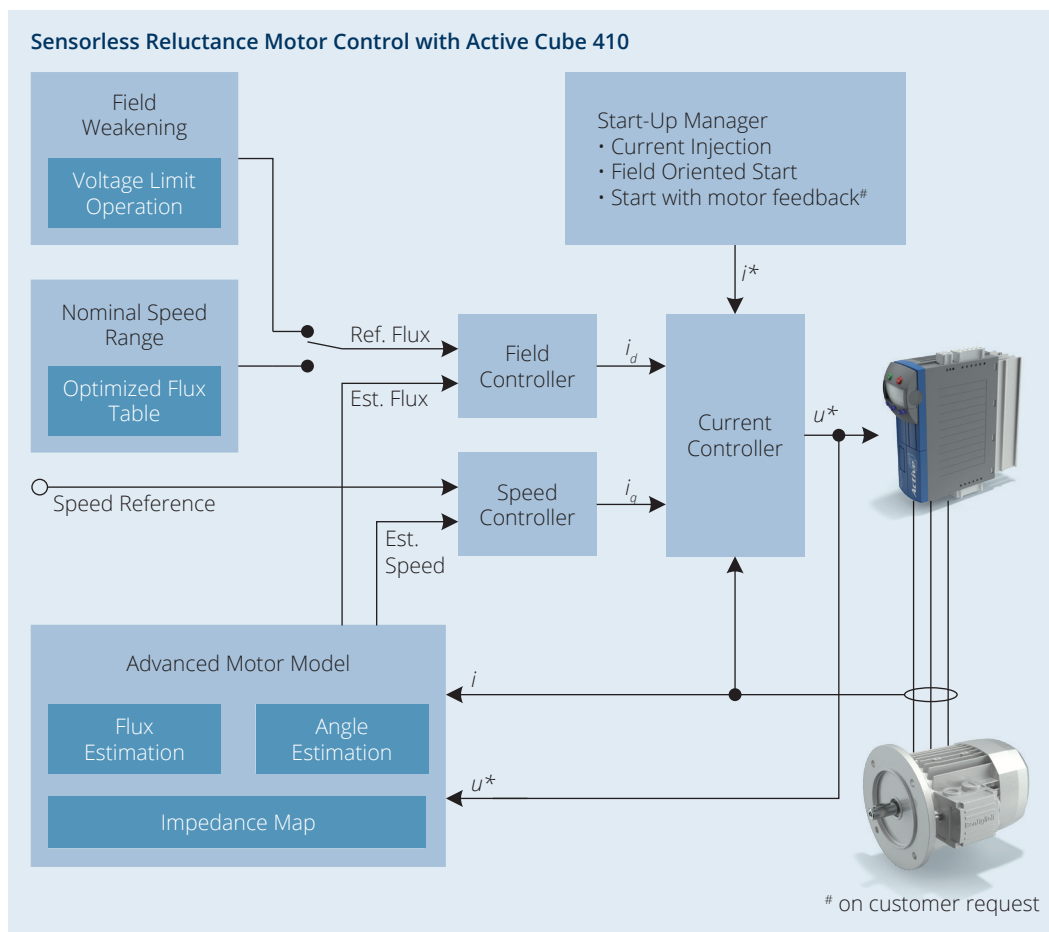
# THE SYNCHRONOUS RELUCTANCE DRIVE SYSTEM

## Increase your machine productivity

The synchronous reluctance drive system guarantees excellent control performance thanks to optimized, model-based sensorless control.

The dedicated Active Cube 410 motor control allows to operate the BSR motor with these features and benefits:

- Exploit the maximum peak torque and dynamic thanks to a precise flux control,
- Maximize the motor efficiency even at partial load thanks to the implemented motor model,
- Take advantage of the field weakening control at high speed.



### Flux Control Benefits:

- ➔ Extracting Maximum Torque Capability
- Efficiency Optimisation
- Field Weakening

### Field Oriented Sensorless Control:

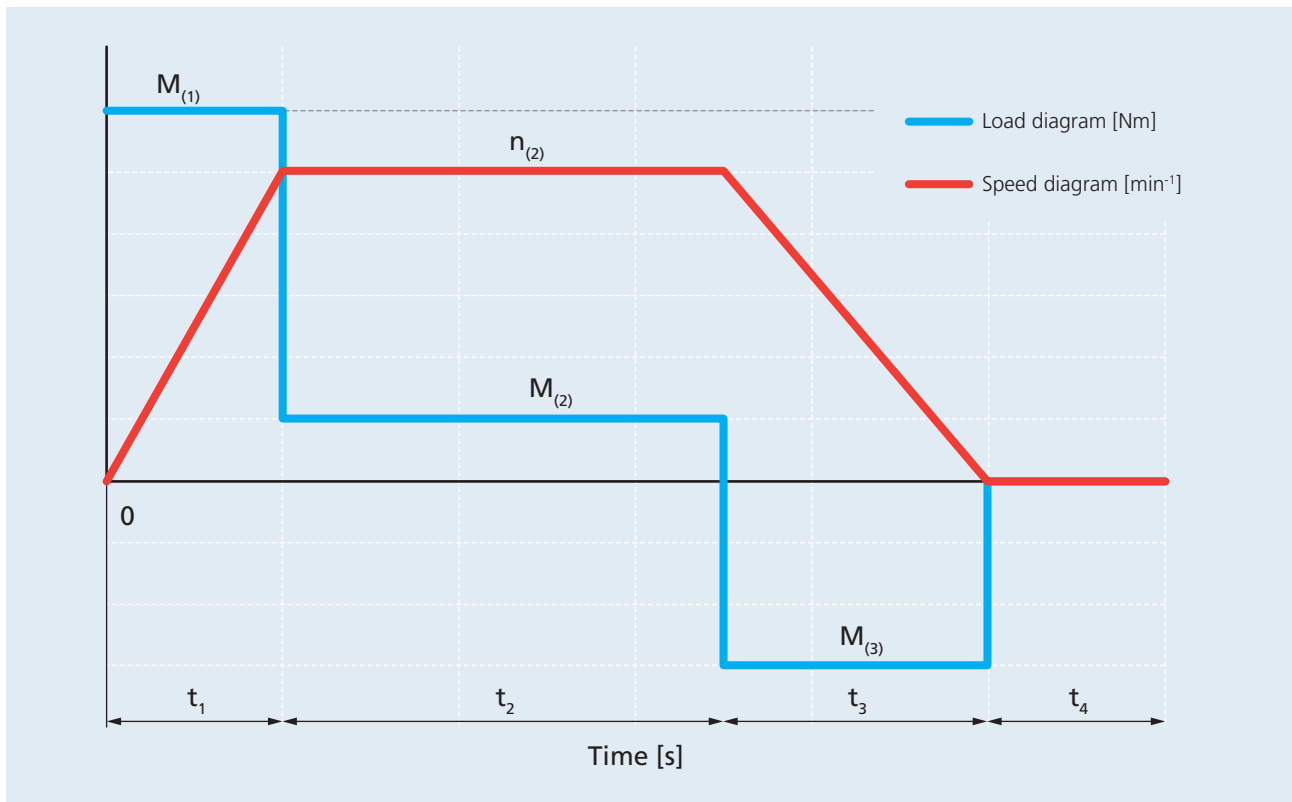
- Precise control with accurate machine model
- Achieving Dynamics with Advanced Motor Model

### Start-Up Manager:

- Nominal Torque available at  $f = 0$  Hz
- Various Options for any Application

➔ Comprehensive Control Structure  
for Flexible Adaption to Countless Applications

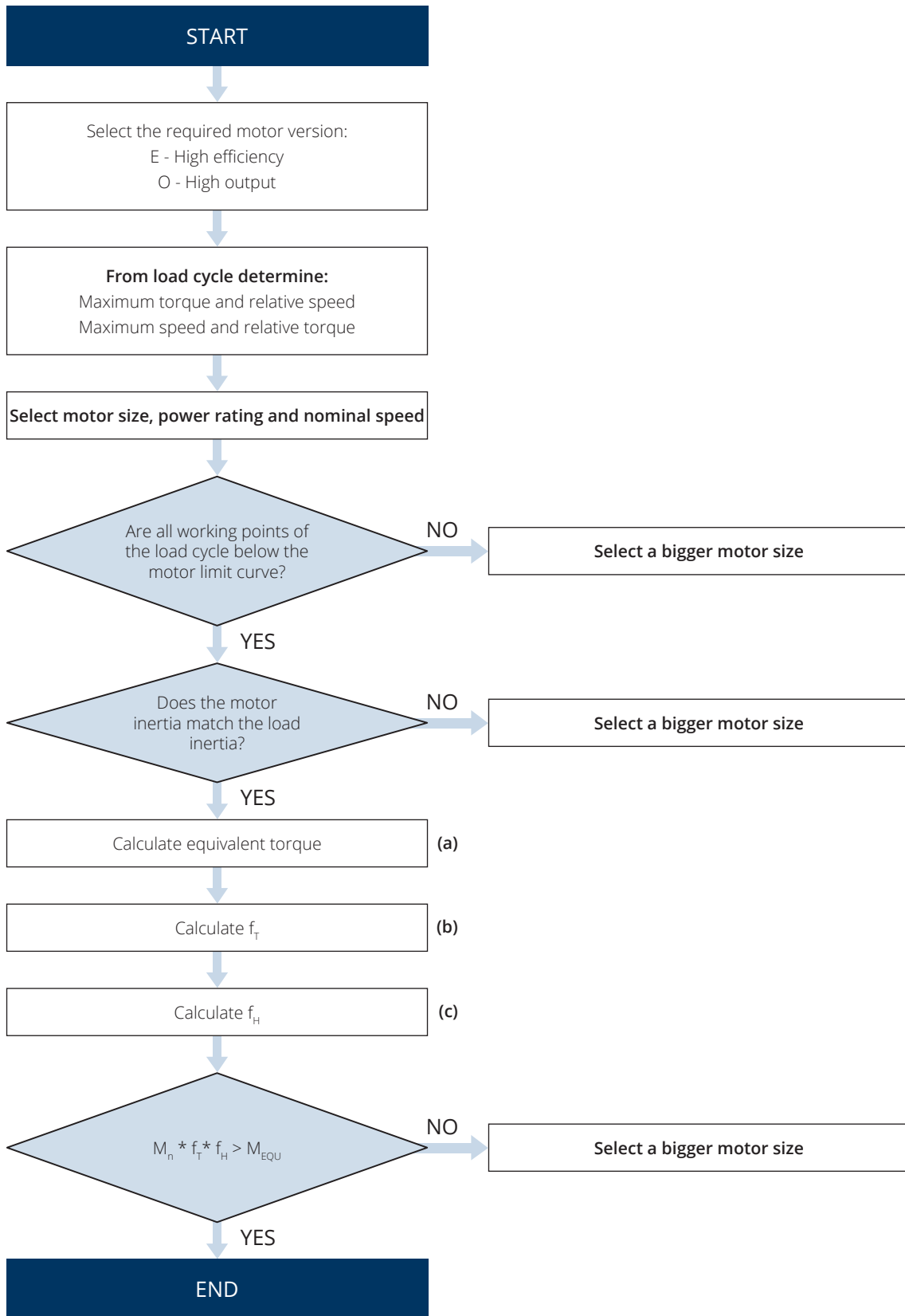
# SELECTING THE BSR MOTOR



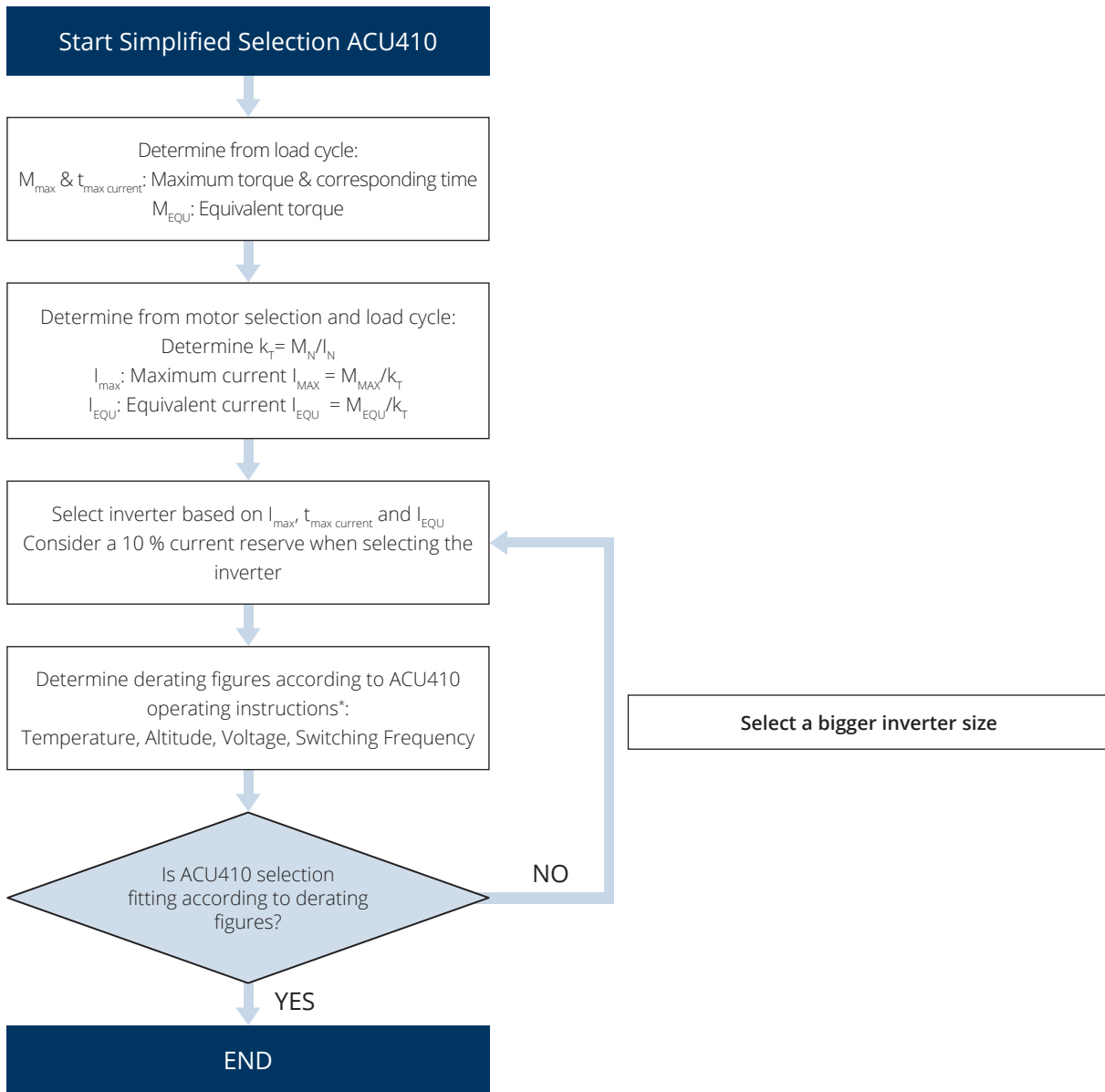
(a)	Equivalent torque	$M_{\text{EQU}}$	[Nm]	$M_{\text{EQU}} = \sqrt{\frac{M_{(1)}^2 \cdot t_1 + M_{(2)}^2 \cdot t_2 + \dots + M_{(n)}^2 \cdot t_n}{t_1 + t_2 + \dots + t_n}}$
(b)	Temperature adjusting factor	$f_T$	-	
(c)	Altitude adjustment factor	$f_H$	-	



# SELECTING THE BSR MOTOR



# SELECTING ACTIVE CUBE 410 FOR BSR MOTOR



\*: Derating has to be considered in these cases:  
 More than 40°C  
 More than 1000 m altitude  
 More than 3~ 400 V mains supply  
 PWM switching frequency & kHz or higher






# RATING PLATE

In accordance with IEC 60034-1, the motor rating plate summarizes the motor rating including the total weight. Example of rating plate and field's description are reported hereafter.

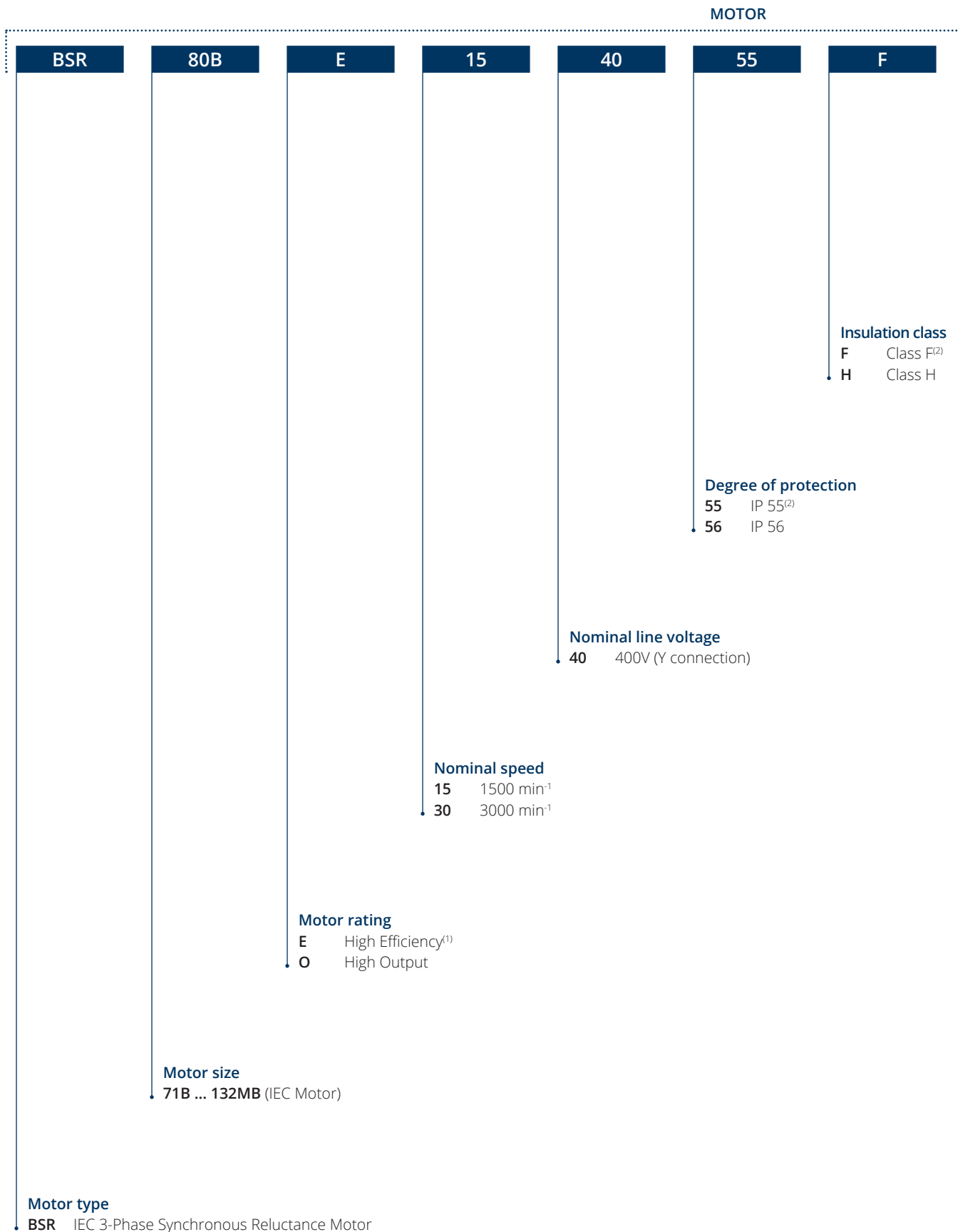
Fields:

- 1) Product designation
- 2) Product code
- 3) Serial number
- 4) Insulation class
- 5) Nominal power
- 6) Total weight
- 7) Degree of protection
- 8) Motor mounting
- 9) Duty cycle
- 10) Nominal frequency
- 11) Nominal voltage and winding connection
- 12) Nominal current
- 13) Nominal efficiency at full load
- 14) Nominal speed
- 15) Maximum speed
- 16) Maximum ambient temperature
- 17) Option data (e.g. fan unit data)
- 18) Efficiency class (IE code)
- 19) Drive end bearing type
- 20) Non drive end bearing type
- 21) Serial number as barcode

Example of BSR rating plate:

IEC - EN 600034		 Bonfiglioli		CE	
3~ Mot. ①					
Cod. ②		No. ③			CL ④
kW ⑤	⑥ kg	IP ⑦	IM ⑧	S ⑨	
	Hz ⑩	V ⑪	A ⑫	% ⑬	min <sup>-1</sup> ⑭
		Y ⑪		nom ⑬	max ⑮
					Amb max ⑯
INVERTER DUTY ONLY ⑰					
EFFICIENCY CLASS ⑱					
DE ⑲			⑳		
NDE ⑳			㉑		
Made in Italy - Bonfiglioli Mechatronic Research S.p.a.					

# BSR SERIES DESIGNATION





## OPTIONS

### B5

#### Motor mounting

<b>B3</b>	IM B3, IM B6, IM B7, IM B8, IM V5, IM V6
<b>B5</b>	IM B5, IM V1, IM V3
<b>B14</b>	IM B14, IM V18, IM V19
<b>B5R</b>	IM B5 not standardized <sup>(3)</sup>
<b>B14R</b>	IM B14 not standardized <sup>(4)</sup>

...

#### Thermal protective devices

<b>K1<sup>(5)</sup></b>	Silicon sensor type KTY 84-130
<b>E3</b>	Thermistor PTC
<b>P1</b>	Platinum sensor PT1000

#### Forced ventilation

**U1<sup>(6)</sup>** Power supply 1~230V (71-100), 3~400V Y (112-132)

#### Anti-condensate heaters

**H1** Power supply 1~230V

#### Double-extended shaft

**PS<sup>(6)</sup>**

#### External mechanical protection

**TC<sup>(6)</sup>**

#### Rotor balancing grade B

**RV**

#### Notes:

(1) Not available with nominal speed 3000min<sup>-1</sup>

(2) Default value

(3) Flange with through holes with reduced coupling dimensions

(4) Flange with tapped holes with reduced coupling dimensions. Not available for motor size 112 and 132

(5) Not compatible with insulation class H

(6) Options U1, PS and TC are mutually exclusive

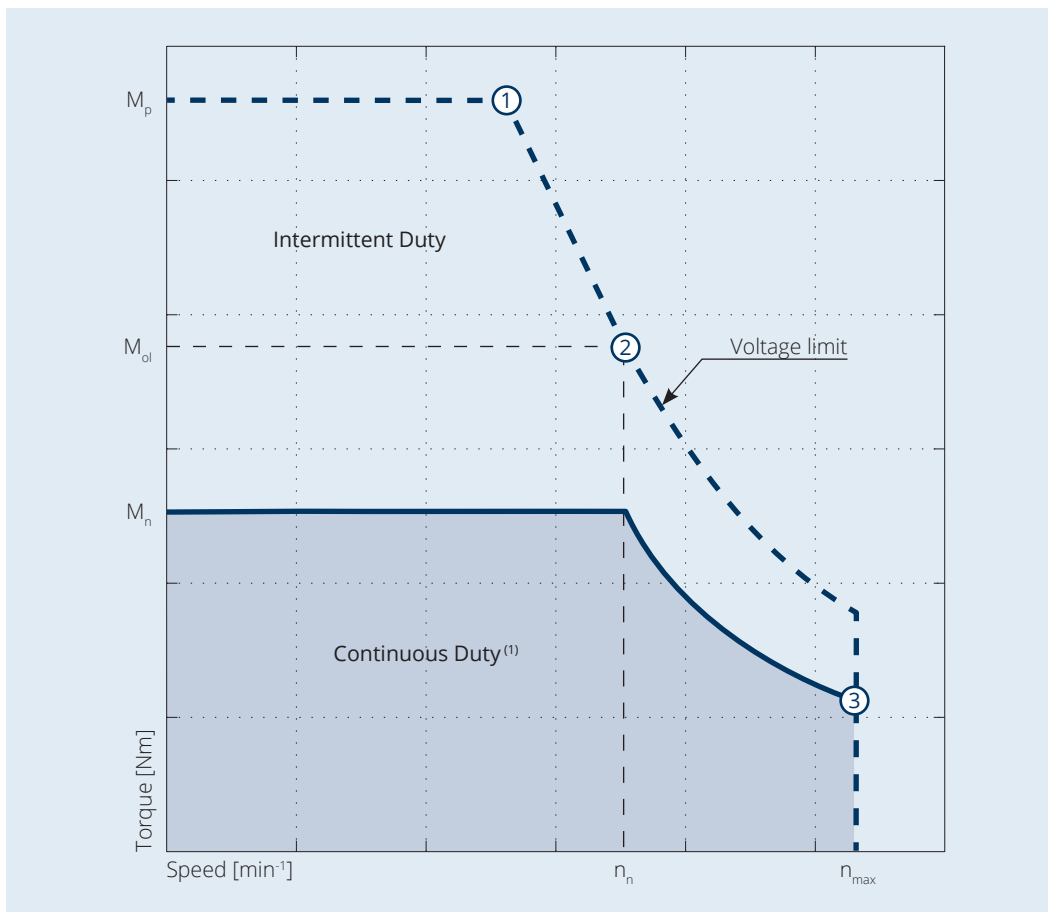




# TORQUE-SPEED CHARACTERISTIC

The permissible operating range of a Synchronous Reluctance motor is defined by thermal, mechanical and sensorless control limit.

The behavior of the BSR synchronous reluctance motor is described by a torque-speed operating area obtained by the combination of the BSR motor series and the Active Cube 410 frequency inverter series. Exceeding the nominal speed the continuous torque curve decreases according to the constant power limit. The continuous duty zone is limited by the maximum continuous torque curve and the voltage limit curve. Continuous duty in the area above the S1 curve is not permitted. The intermittent periodic duty zone is limited by the peak torque line and the voltage limit curve.



The significant working points used to define the operation zone of the BSR motors are highlighted in the graph above and the following table. The values refer to rated torque ( $M_n$ ) and rated speed ( $n_n$ ) as “per unit (p.u.)” expression,

PARAMETER	UNIT	WORKING POINT		
		1	2	3
Torque	[p.u.]	3	1.5	0.4
Speed	[p.u.]	0.8	1	1.5
Duty	-	Intermittent		Continuous

<sup>(1)</sup> For continuous duty in low speed region U1 forced ventilation option is mandatory

# DIMENSIONAL TOLERANCES

Dimensions and tolerances of shaft end, key and flange are in accordance with IEC 60072-1. Shaft ends feature an axial threaded hole in accordance with UNI 3221, DIN 332 and a key inserted in the suitable keyway. The following table reports the tolerances for the different parts:

COUPLING DIMENSION	DIMENSIONS	RANGE	TOLERANCE
Shaft end	D - DA	Ø 11-28	j6
		Ø 38-48	k6
Key	F - FA	-	h9
Flange	N	Ø < 250	j6

# BEARINGS

BSR motors use radial ball bearings, lubricated for life with grease and axially pre-loaded. The type of bearings in use are listed in the following table.

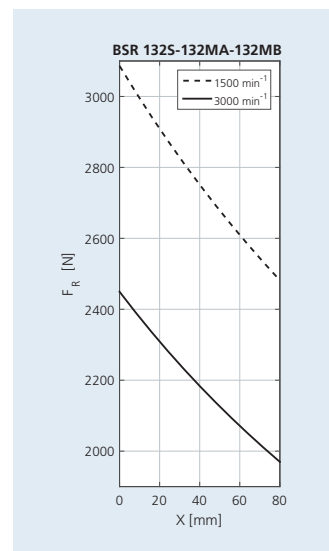
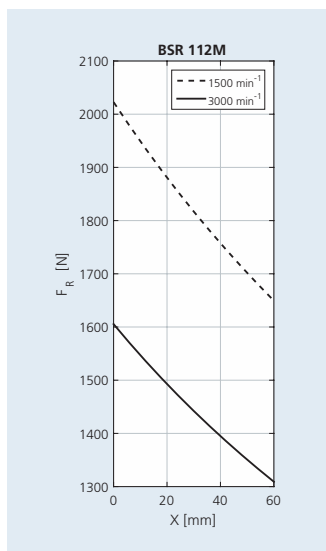
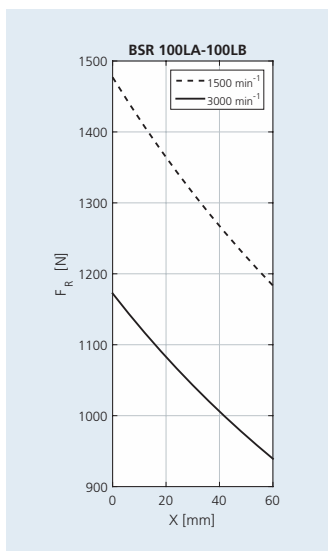
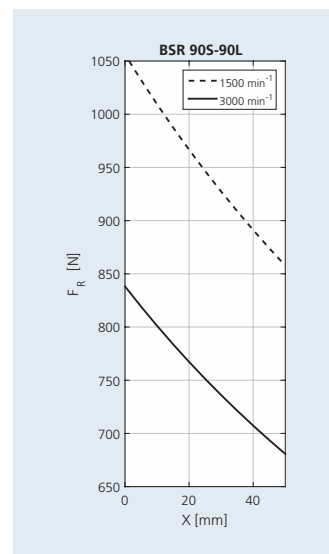
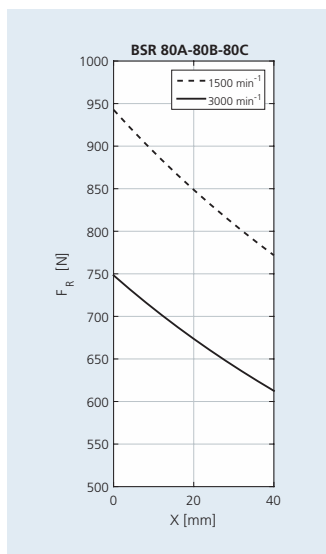
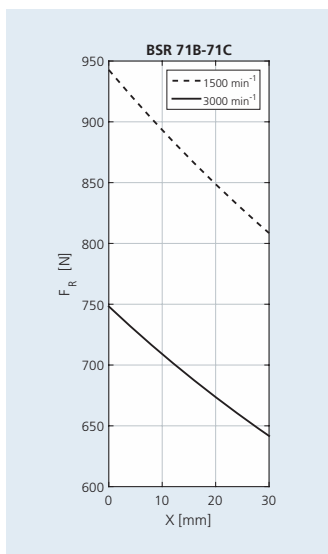
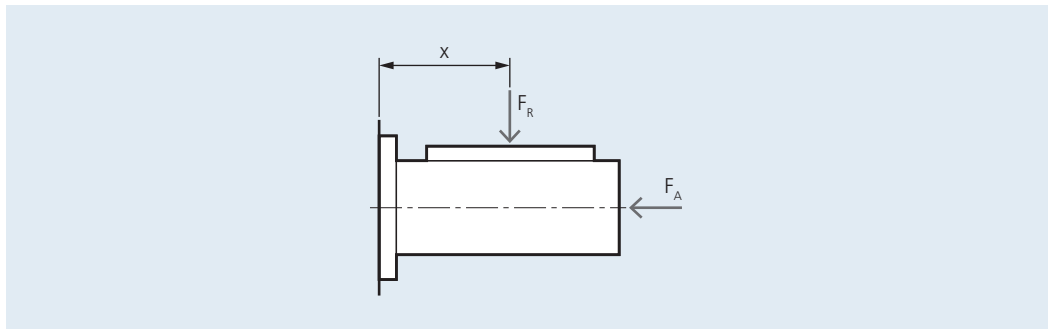
SIZE	PROTECTION DEGREE IP55		PROTECTION DEGREE IP56	
	DRIVE END	NON DRIVE END	DRIVE END	NON DRIVE END
BSR 71	6202 2Z C3	6203 2Z C3 <sup>(1)</sup>	6202 2RS C3	6203 2RS C3 <sup>(1)</sup>
BSR 80	6204 2Z C3		6204 2RS C3	
BSR 90	6205 2Z C3		6205 2RS C3	
BSR 100	6206 2Z C3	6207 2Z C3 <sup>(1)</sup>	6206 2RS C3	6207 2RS C3 <sup>(1)</sup>
BSR 112	6306 2Z C3		6306 2RS C3	
BSR 132	6308 2Z C3		6308 2RS C3	

<sup>(1)</sup> Only for the BSR motor mounting variant.

# SHAFT LOADS

The maximum radial load ( $F_R$ ) and maximum axial load ( $F_A$ ) are computed using ISO 281 calculation  $L_{10h}$  assuming a bearing life of 20.000h. The load and the speed are assumed to be constant throughout the bearing life.

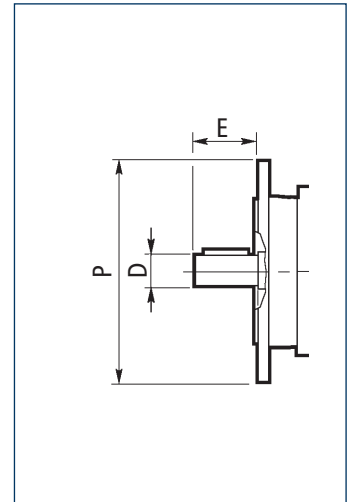
The maximum radial load is reported as a function of the distance (X) between flange plane and the point of force applicaton. The maximum radial loads  $F_R$  are valid only for the horizontal installation of the motor without additional axial load.



# FLANGE VERSIONS

Flange output motors are available with reduced coupling dimensions corresponding to product variants B5R (with through holes) and B14R (with tapped holes). Dimensions are indicated in the table below:

SIZE		D	E	M	N	P
BSR 71	B5R	11	23	115	95	140
	B14R	11	23	75	60	90
BSR 80	B5R	14	30	130	110	160
	B14R	14	30	85	70	105
BSR 90	B5R	19	40	165	130	200
	B14R	19	40	100	80	120
BSR 100	B5R	24	50	165	130	200
	B14R	24	50	115	95	140
BSR 112	B5R	24	50	165	130	200
BSR 132	B5R	28	60	215	180	250



# VENTILATION

The standard BSR motor is equipped with a self-cooling fan (IC 411 in accordance with CEI EN 60034-6). The fan and the resulting cooling is optimized for rated speed. Installation must take into account a minimum distance of the fan cover from the nearest wall to ensure unobstructed air circulation.

For machines operating frequently or for long periods of time at small speeds the BSR motor can be equipped with the optional fan unit U1 (referred to as IC 416 in standard CEI EN60034-6). The terminals of the U1 fan unit are housed in a separate terminal box.

The following table summarizes the electrical data of the fan unit U1 and the increase of motor length.















MOTOR SIZE	ELECTRICAL DATA OF FAN UNIT U1				$\Delta_{LB}^{(1)}$
	$V_{AC} \pm 10\%$	Hz	P [W]	I [A]	[mm]
BSR 71	1 ~ 230	50/60	22	0.12	93
BSR 80			22	0.12	127
BSR 90			40	0.30	131
BSR 100			50	0.25	119
BSR 112	3 ~ 230 $\Delta$ / 400 Y		50	0.26 / 0.15	130
BSR 132			110	0.38 / 0.22	161

<sup>(1)</sup> Dimension variation compared to length LB of the corresponding standard motor.

# DEGREE OF PROTECTION

IP55 is used as default protection class for the BSR motor configuration. Optionally the protection class IP56 is available as variant, please check the product designation.

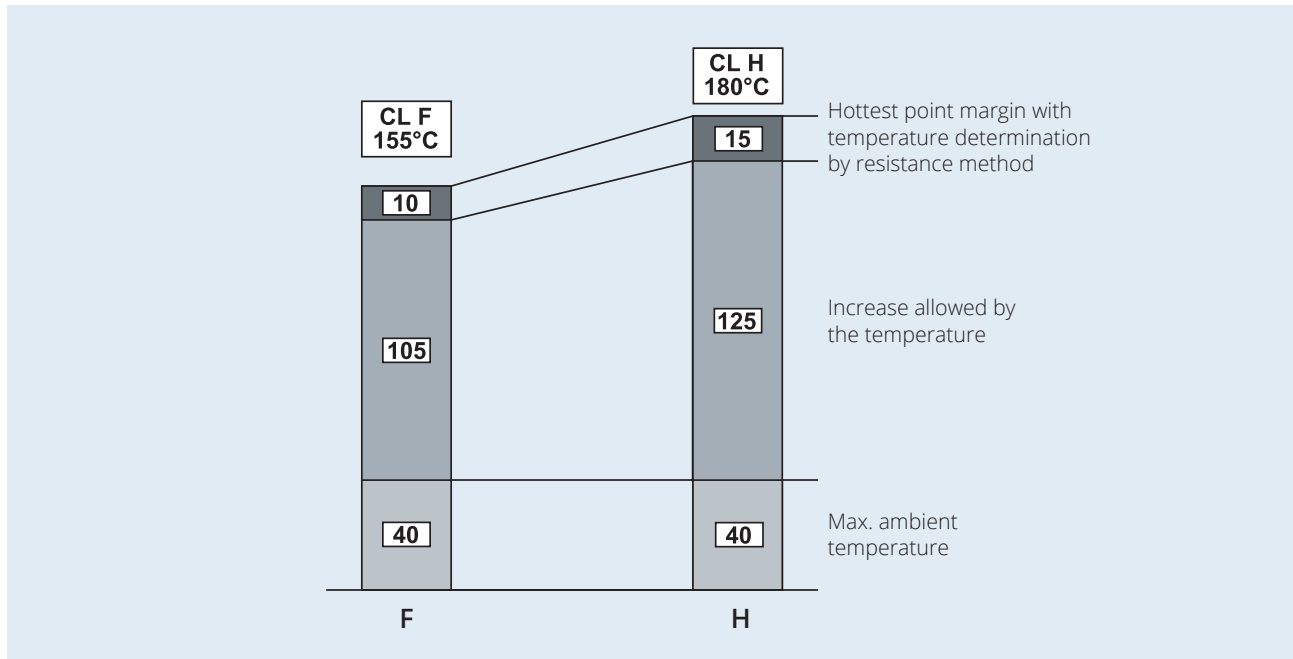
In accordance with IEC 60034-5:

IP		5	5		
<b>0</b>		Not protected	<b>0</b>		Not protected
<b>1</b>	 $\varnothing 50 \text{ mm}$	Protected against extraneous solid bodies having $\varnothing \geq 50 \text{ mm}$	<b>1</b>		Protected against vertical water drips
<b>2</b>	 $\varnothing 12 \text{ mm}$	Protected against extraneous solid bodies having $\varnothing \geq 12.5 \text{ mm}$	<b>2</b>	 15°	Protected against vertical water drips inclined up to 15°
<b>3</b>	 $\varnothing 2,5 \text{ mm}$	Protected against extraneous solid bodies having $\varnothing \geq 2.5 \text{ mm}$	<b>3</b>	 60°	Protected against rain
<b>4</b>	 $\varnothing 1 \text{ mm}$	Protected against extraneous solid bodies having $\varnothing \geq 1.0 \text{ mm}$	<b>4</b>		Protected against water splashes
<b>5</b>		Protected against dust	<b>5</b>		Protected against jets of water
<b>6</b>		No dust ingress	<b>6</b>		Protected against powerful jets of water
			<b>7</b>		Protected against the effects of temporary immersion
			<b>8</b>		Protected against the effects of continuous immersion

# INSULATION CLASS

BSR motors are designed according to class F insulating materials as standard variant. Optionally the insulation class H is available for BSR motors.

For application involving the presence of aggressive chemicals or high humidity, please contact Bonfiglioli.



# THERMAL PROTECTION

During the commissioning of the Active Cube 410 frequency inverter, the connected BSR motor is set up. During this setup a software Pt monitoring is activated offering an inexpensive solution for thermal monitoring with the possibility to set up a fault switch off inside the frequency inverter.

Optionally the BSR motor can be equipped with a hardware thermal switch that can be evaluated with the Active Cube 410.

A hardware monitoring is especially recommended for motors with forced ventilation (U1 option). The available thermal switches are:

OPTION	THERMAL SWITCH	DESCRIPTION
K1	Type KTY 84-130	A KTY silicon semi-conductor resistance sensor is placed in contact with the motor winding. The working temperature range is from 0°C to 170°C. This sensor cannot be used in combination with insulation class H.
E3	PTC	3 PTC thermistors are placed in contact with the motor winding. The thermistor switch temperature is in accordance with the insulation class of the motor. For the PTC thermistor resistance curve please refer to the Standard DIN 44081-82.
P1	PT1000	A platinum resistance temperature sensor is placed in contact with the motor winding. The PT1000 characteristic is in accordance with IEC 60751 : 2008, tolerance class B. The working temperature is from -40°C to 250°C.



# MOUNTING POSITIONS

EC-normalised BSR motors are available in the design versions as indicated in the following table according to Standards EN 60034-7.

BSR is available with the following mounting versions:

**IM B3** (basic)

IM B6, IM B7, IM B8, IM V5, IM V6 (derived)

**IM B5** (basic)

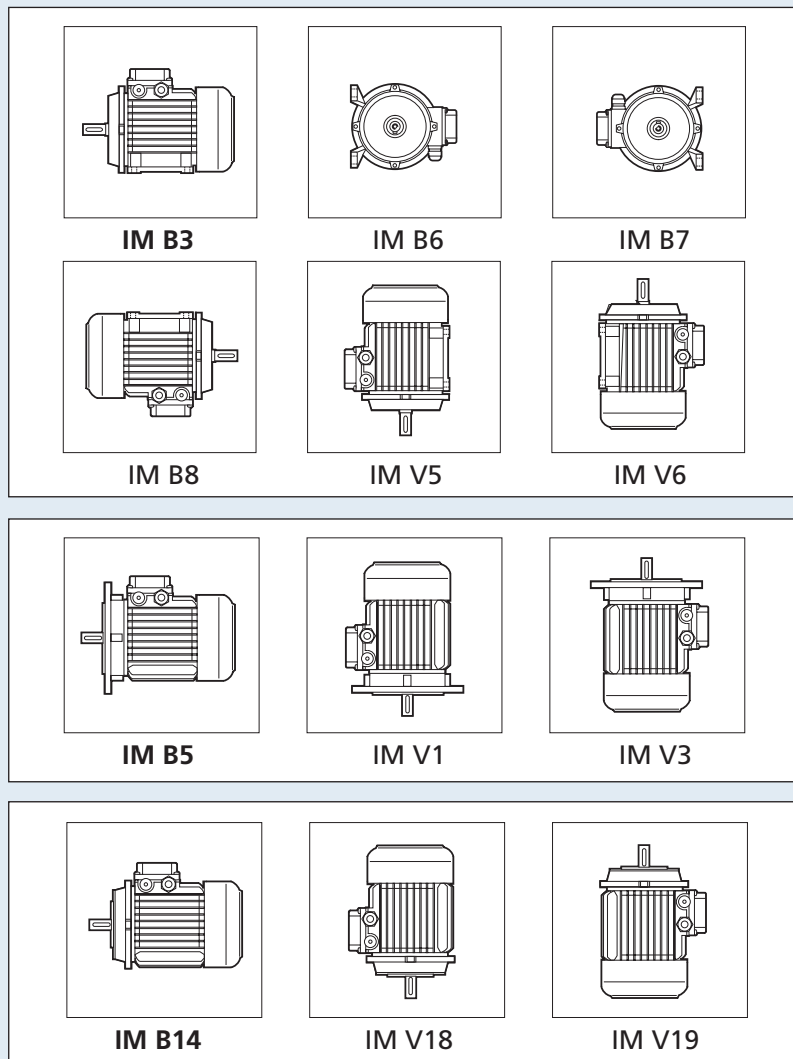
IM V1, IM V3 (derived)

**IM B14** (basic)

IM V18, IM V19 (derived)

IM B3 design motors can be installed in positions IM B6, IM B7, IM B8, IM V5 and IM V6; IM B5 design motors can be installed in positions IM V1 and IM V3; IM B14 design motors can be installed in positions IM V18 and IM V19.

In such cases, the basic design IM B5 or IM B14 is indicated on the motor name plate.



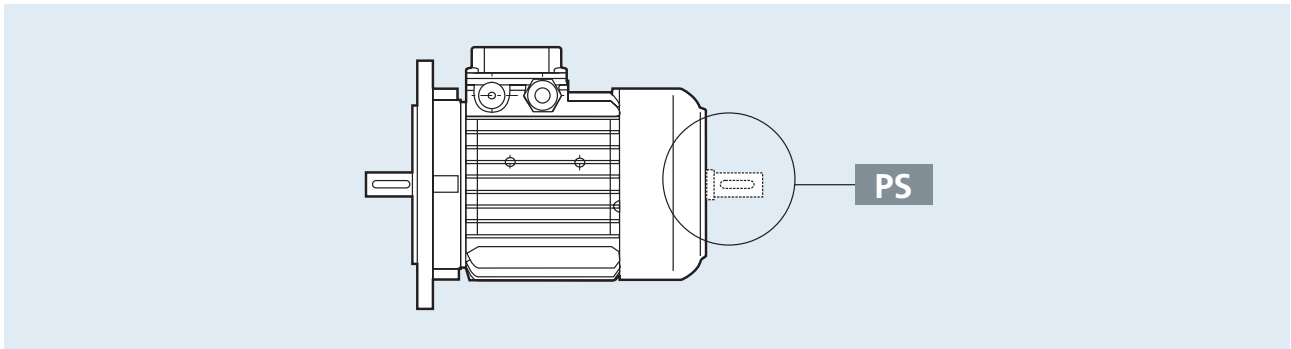
# ANTI-CONDENSATION HEATERS

Where an application involves high humidity or extreme temperature fluctuations, motors can be equipped optionally with an anti-condensation heater (option H1). A single-phase power supply is available in the auxiliary terminal board inside the main terminal box. The following table summarizes the electrical properties of the anti-condensation heater.

	VOLTAGE	POWER
	[V]	[W]
BSR 71 - BSR 80	1 ~ 230 ±10%	10
BSR 90 ... BSR 132		25

# SECOND SHAFT EXTENSION

A second shaft extension is available selecting the option PS. This option cannot be used in combination with options U1 or TC. The shaft dimensions correspond to the first shaft and are summarized in the dimensions table in this catalogue.

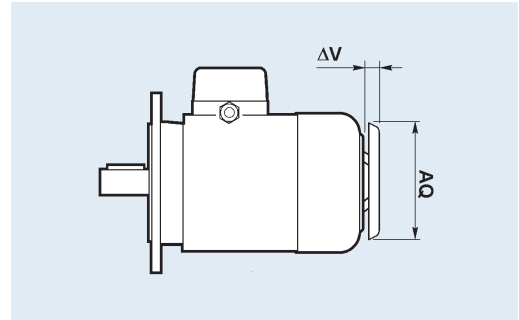


# EXTERNAL MECHANICAL PROTECTION

In applications with high risk of obstructions of the fan (i.e. flying lints in textile industry environments) the option TC (textile canopy) can be added as option.

The following table summarizes the dimensions per motor size.

	AQ	$\Delta V$
BSR 71	134	27
BSR 80	152	25
BSR 90	168	30
BSR 100	190	28
BSR 112	211	32
BSR 132	254	32



# TERMINAL BOX

Terminal board features 6 studs for eyelet terminal connections. A ground terminal is also supplied for heating of the equipment. Terminal number and dimension are shown in the following table. In motor design IM B3, the terminal box is on the top (side opposite to feet).

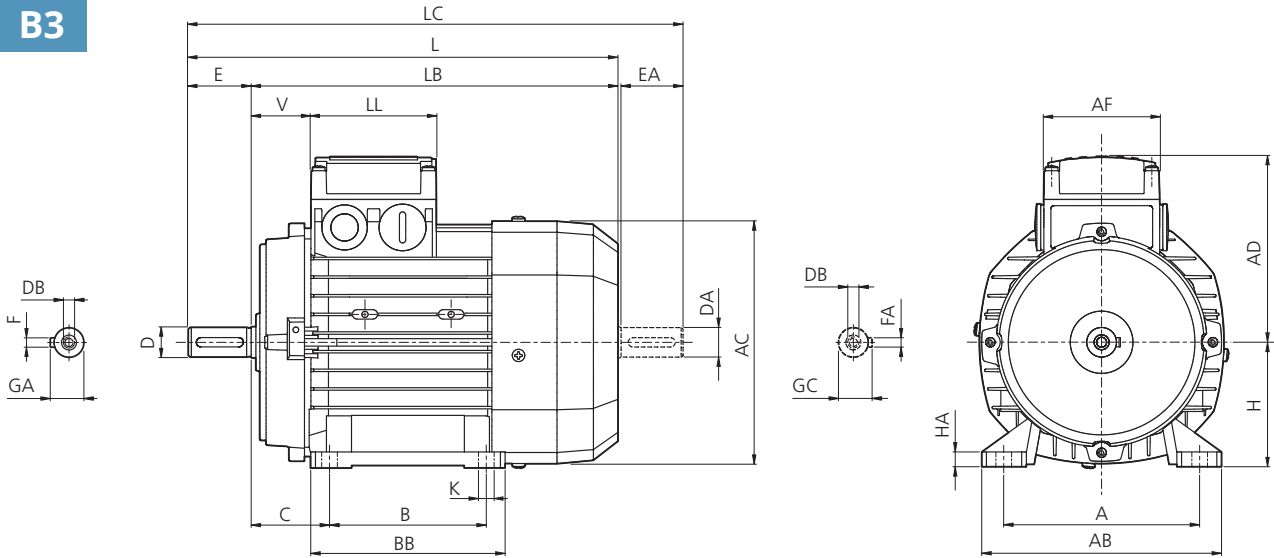
BSR SIZE	NUMBERS OF TERMINALS	TERMINAL THREADS	WIRE CROSS SECTION AREA
			[mm <sup>2</sup> ]
BSR 71 ... BSR 90	6	M4	2.5
BSR 100 ... BSR132		M5	6

The cable entries of the terminal boxes use metric threads in accordance with standard EN 50262 as indicated in the following table.

BSR SIZE	CABLE GLAND AND DIMENSIONS	MAXIMUM CABLE DIAMETER ALLOWED
		[mm]
BSR 71	2 x M25 x 1.5	17
BSR 80 ... BSR 90	2 x M25 x 1.5	
BSR 100 ... BSR 112	2 x M32 x 1.5	21
	2 x M25 x 1.5	
BSR 132	4 x M32 x 1.5	21

# DIMENSIONS

**B3**



**HOUSING B3**

	B	A	HA	BB	AB	K	C	H
<b>BSR 71</b>	90	112	8	112	135	10	45	71
<b>BSR 80</b>	100	125	8	124	153		50	80
<b>BSR 90 S</b>		140	8	155	174		56	90
<b>BSR 90 L</b>	125							
<b>BSR 100</b>	140	160	10	175	192	12	63	100
<b>BSR 112</b>		190			224		70	112
<b>BSR 132</b>	178	216	12	218	254			89

**SHAFT**

	D	DA	E	EA	DB	GA	GC	F	FA
<b>BSR 71</b>	14	30	M5	16	5				
<b>BSR 80</b>	19	40	M6	21,5	6				
<b>BSR 90</b>	24	50	M8	27	5				
<b>BSR 100</b>	28	60	M10	31					
<b>BSR 112</b>									
<b>BSR 132</b>	38	80	M12	41	10				

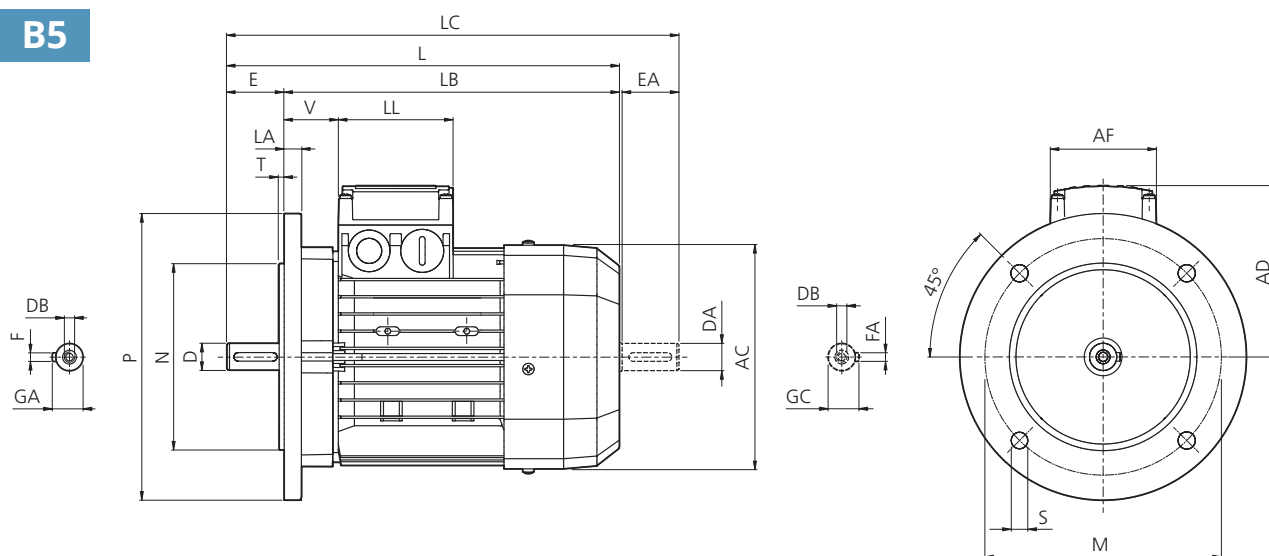
**MOTOR**

	AC	L	LB	LC	AD	AF	LL	V
<b>BSR 71</b>	138	249	219	281	108	74	80	37
<b>BSR 80</b>	156	274	234	315	119			38
<b>BSR 90</b>	176	326	276	378	133	98	98	44
<b>BSR 100</b>	195	367	307	429	142			50
<b>BSR 112</b>	219	385	325	448	157			52
<b>BSR 132</b>	258	493	413	576	193	118	118	58

EA: Second shaft available as option



# B5



## HOUSING B5

	M	N	P	S	T	LA
<b>BSR 71</b>	130	110	160	9.5	3.5	10
<b>BSR 80</b>	165	130	200	11.5		11.5
<b>BSR 90</b>						
<b>BSR 100</b>	215	180	250	14	4	14
<b>BSR 112</b>						15
<b>BSR 132</b>						20

## SHAFT

	D	DA	E	EA	DB	GA	GC	F	FA
<b>BSR 71</b>	14	30	M5	16	5				
<b>BSR 80</b>	19	40	M6	21,5	6				
<b>BSR 90</b>	24	50	M8	27	5				
<b>BSR 100</b>	28	60	M10	31					
<b>BSR 112</b>									
<b>BSR 132</b>	38	80	M12	41	10				

## MOTOR

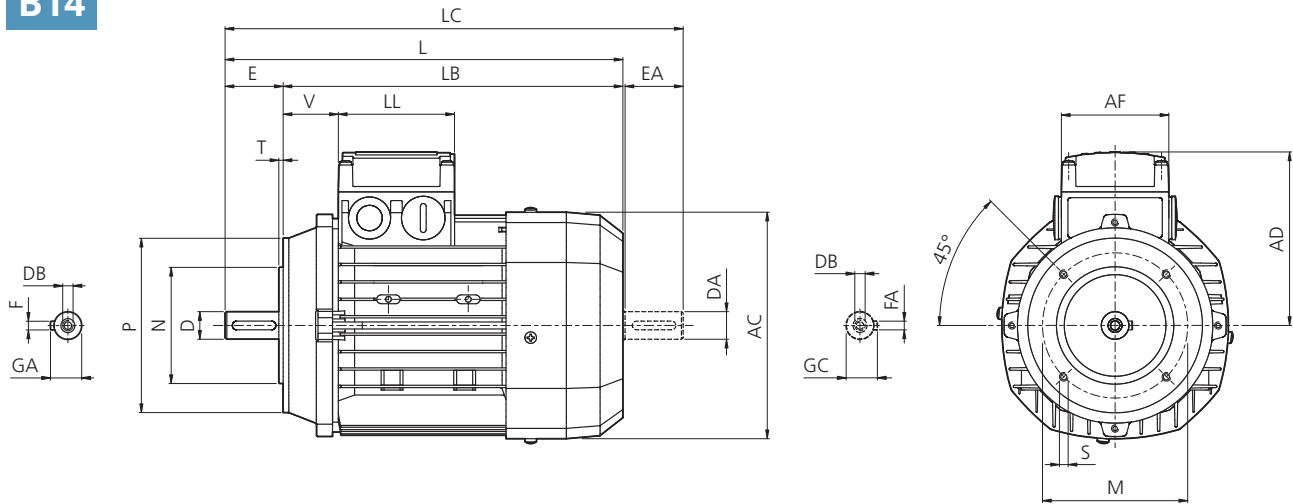
	AC	L	LB	LC	AD	AF	LL	V
<b>BSR 71</b>	138	249	219	281	108	74	80	37
<b>BSR 80</b>	156	274	234	315	119			38
<b>BSR 90</b>	176	326	276	378	133	98	98	44
<b>BSR 100</b>	195	367	307	429	142			50
<b>BSR 112</b>	219	385	325	448	157			52
<b>BSR 132</b>	258	493	413	576	193	118	118	58

EA: Second shaft available as option



# DIMENSIONS

## B14



HOUSING B14					
	M	N	P	S	T
BSR 71	85	70	105	M6	2.5
BSR 80	100	80	120		3
BSR 90	115	95	140	M8	3,5
BSR 100	130	110	160		
BSR 112					
BSR 132	165	130	200	M10	4

SHAFT									
	D	DA	E	EA	DB	GA	GC	F	FA
BSR 71	14	30	M5	16	5				
BSR 80	19	40	M6	21,5	6				
BSR 90	24	50	M8	27	5				
BSR 100	28	60	M10	31					
BSR 112									
BSR 132	38	80	M12	41	10				

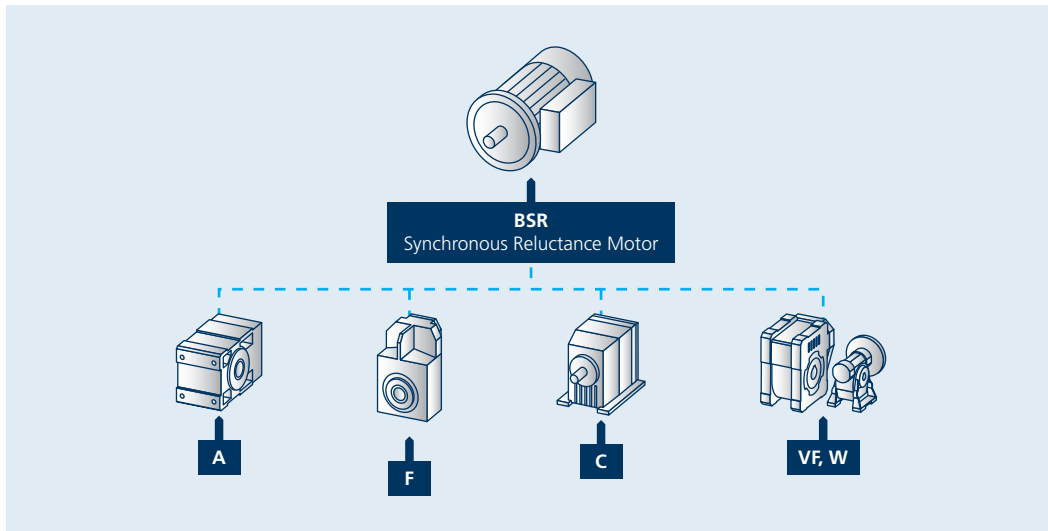
MOTOR								
	AC	L	LB	LC	AD	AF	LL	V
BSR 71	138	249	219	281	108	74	80	37
BSR 80	156	274	234	315	119			38
BSR 90	176	326	276	378	133	98	98	44
BSR 100	195	367	307	429	142			50
BSR 112	219	385	325	448	157			52
BSR 132	258	493	413	576	193	118	118	58

EA: Second shaft available as option



# THE BSR GEARMOTOR PACKAGE

Control, flexibility, efficiency and compactness are fundamental characteristics in a wide range of industrial processes and applications. To match these needs Bonfiglioli has developed a new solution, represented by the Bonfiglioli synchronous reluctance motor (BSR), combined with the helical or worm technology of Bonfiglioli A, C, F, S and VF-W gear units. The synergy between BSR motors and A, C, F, S and VF-W gearboxes allows to exploit the robustness and wide torque range of Bonfiglioli industrial gear units, as well as the flexibility and efficiency of Bonfiglioli reluctance motors.



## Maximum Flexibility

Two different solutions available:

- High Efficiency Package: BSR in IE4 efficiency class combined with A, C, F, S gearboxes
- High Output Package: BSR in IE2, IE3, IE4 efficiency class combined with A, C, F, S and VF-W gearboxes

## Modularity

The modular coupling between BSR and Bonfiglioli gearboxes guarantees extended customization capability. Indeed, the full range of versions and options of the A, C, F, S and VF-W gearboxes, can be used to customize the solution and perfectly match customers' needs.

## One stop shop

All the components of the drive package are manufactured by Bonfiglioli. This ensures the highest level of performances and compatibility. At the same time our customers can rely on a unique supplier for all gearboxes, motors and inverters.

## Areas of Application



MATERIAL HANDLING



PACKAGING



ROTARY TABLE



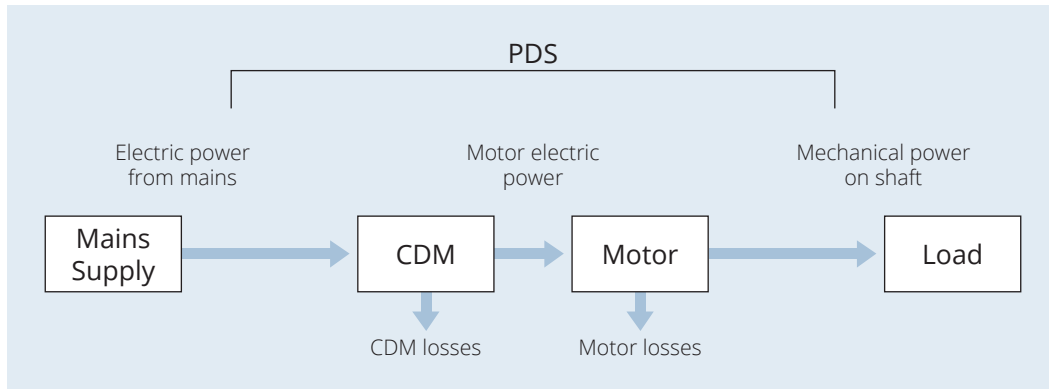
ROTARY MACHINES



PICK & PLACE SOLUTIONS

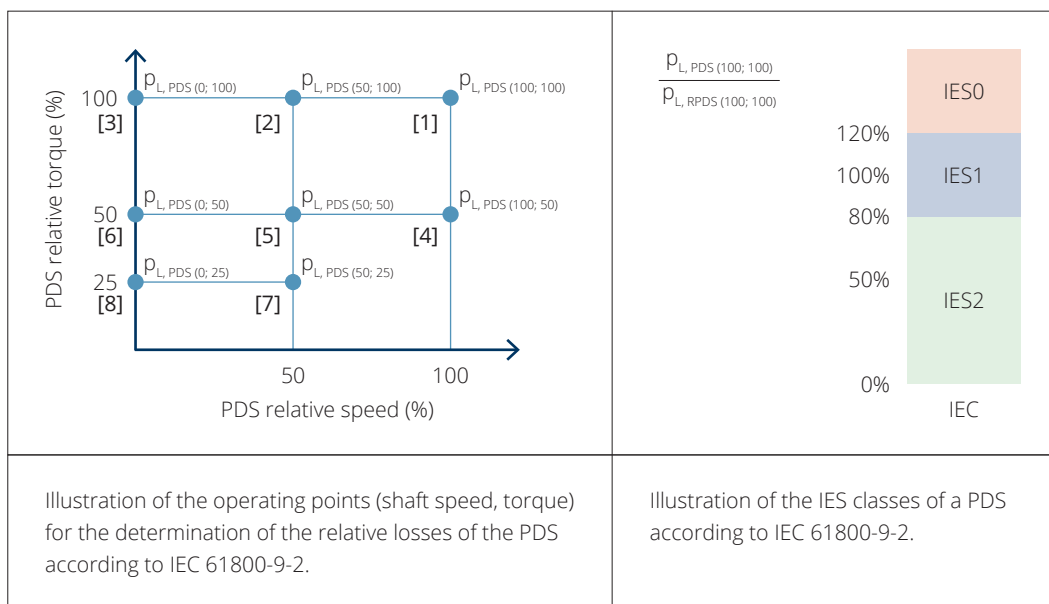
# POWER DRIVE SYSTEM ENERGY EFFICIENCY

The international standard IEC61800-9 deals with the energy efficiency of complete drive modules (CDM) and power drive systems (PDS). The standard IEC 61800-9 is harmonized in Europe as EN 61800-9 and replaces the earlier standard EN 50598 (-1 and -2). As represented in the following diagram, the power drive system consists of the complete drive module and the electrical motor, including the motor cable. The standard defines the IE classes for CDM and the IES classes for PDS.



The IEC standard 61800-9-2 specifies the procedure for determining the losses of the PDS in 8 application-relevant operating points for motor drive applications in the power range from 0.12 kW to 1,000 kW.

Losses of the reference power drive system (RPDS) are defined for the 8 specific operating points and the international efficiency of systems classes (IES) for the PDS. The PDS energy efficiency is classified in the range of IES0 - IES2 as described in the following illustration.





# POWER DRIVE SYSTEM ENERGY EFFICIENCY

The following tables summarize the relative losses in the operating points defined in the standard IEC 61800-9-2. The tables shows the losses for the suggested combinations of BSR and Active Cube 410.

P <sub>n</sub>	Size - Rating - Speed			IES	RPDS IES1	Operating points							
	kW	Class	Point 1			1	2	3	4	5	6	7	8
0,37	BSR 71B	E	15	IES2	79,7%	32,1%	29,2%	26,1%	24,1%	19,4%	15,2%	14,9%	13,1%
0,55	BSR 71C	E	15	IES2	61,4%	29,1%	27,7%	24,1%	19,7%	14,7%	15,1%	11,2%	10,1%
0,55	BSR 80B	E	15	IES2	61,4%	31,1%	28,5%	25,9%	23,0%	18,9%	16,7%	14,7%	12,5%
0,75	BSR 80C	E	15	IES2	51,7%	24,6%	22,0%	19,9%	16,0%	14,1%	13,1%	10,3%	9,5%
1,1	BSR 90S	E	15	IES2	44,0%	21,0%	18,0%	15,2%	14,3%	11,6%	10,3%	8,0%	7,3%
1,5	BSR 90L	E	15	IES2	39,1%	20,6%	17,4%	15,2%	13,5%	10,2%	9,0%	7,2%	6,2%
2,2	BSR 100LA	E	15	IES2	34,6%	18,9%	15,9%	15,0%	11,8%	9,1%	8,5%	6,1%	5,5%
3	BSR 100LB	E	15	IES2	31,6%	16,9%	16,1%	15,1%	10,1%	8,3%	7,6%	5,0%	4,4%
4	BSR 112M	E	15	IES2	29,1%	13,9%	11,8%	10,4%	7,5%	6,1%	5,4%	4,7%	3,2%
5,5	BSR 132S	E	15	IES2	26,6%	12,9%	11,4%	9,8%	7,4%	5,1%	4,9%	3,5%	2,8%
7,5	BSR 132MA	E	15	IES2	24,1%	11,4%	10,1%	8,5%	6,8%	4,7%	3,9%	2,6%	2,8%
9,2	BSR 132MB	E	15	IES2	-	9,7%	7,8%	7,1%	4,8%	4,1%	3,2%	2,0%	1,9%
0,55	BSR 71B	O	15	IES2	61,4%	36,6%	45,0%	48,9%	20,8%	18,4%	16,6%	12,2%	11,4%
0,75	BSR 71C	O	15	IES2	51,7%	32,4%	30,2%	22,2%	15,4%	12,7%	10,2%	9,6%	9,1%
0,75	BSR 80A	O	15	IES2	51,7%	36,6%	35,1%	29,1%	20,8%	18,4%	16,6%	12,2%	11,4%
1,1	BSR 80B	O	15	IES2	44,0%	32,5%	31,2%	24,8%	16,3%	13,1%	11,1%	9,4%	8,8%
1,5	BSR 80C	O	15	IES2	39,1%	28,0%	30,0%	25,1%	13,1%	12,0%	10,9%	12,0%	7,0%
2,2	BSR 90S	O	15	IES2	34,6%	21,8%	22,0%	22,6%	11,1%	9,3%	9,0%	5,6%	5,0%
3	BSR 90L	O	15	IES2	31,6%	21,4%	21,5%	20,5%	10,0%	8,5%	8,1%	4,9%	4,6%
4	BSR 100LB	O	15	IES2	29,1%	18,4%	19,3%	19,6%	9,1%	7,8%	7,1%	4,6%	4,1%
5,5	BSR 112M	O	15	IES2	26,6%	17,1%	18,3%	17,9%	8,1%	7,0%	6,2%	4,0%	3,6%
7,5	BSR 132S	O	15	IES2	24,1%	15,3%	17,0%	16,4%	7,1%	6,3%	5,3%	3,4%	3,2%
9,2	BSR 132MA	O	15	IES2	-	13,6%	15,7%	14,9%	6,1%	5,5%	4,4%	2,9%	2,7%
11	BSR 132MB	O	15	IES2	21,7%	11,9%	14,3%	13,4%	5,1%	4,7%	3,4%	2,4%	2,3%
1,1	BSR 71B	O	30	IES2	44,0%	26,1%	23,1%	19,4%	17,5%	11,1%	10,1%	8,1%	6,9%
1,5	BSR 71C	O	30	IES2	39,1%	24,9%	21,4%	20,1%	17,4%	10,1%	9,8%	8,4%	6,1%
1,5	BSR 80A	O	30	IES2	39,1%	25,3%	22,1%	19,3%	16,2%	11,5%	9,3%	7,5%	5,5%
2,2	BSR 80B	O	30	IES2	34,6%	21,8%	18,7%	15,9%	13,5%	9,6%	7,9%	5,7%	4,4%
3	BSR 80C	O	30	IES2	31,6%	17,6%	16,8%	12,7%	11,0%	7,5%	12,2%	4,8%	11,7%
4	BSR 90S	O	30	IES2	29,1%	15,4%	13,2%	9,7%	9,7%	6,5%	5,1%	4,1%	3,1%
5,5	BSR 90L	O	30	IES2	26,6%	14,6%	13,1%	12,7%	8,3%	5,6%	5,0%	3,3%	2,7%
7,5	BSR 100LB	O	30	IES2	24,1%	14,8%	11,7%	9,8%	8,9%	5,7%	7,7%	3,4%	6,6%
11	BSR 112M	O	30	IES2	21,7%	10,2%	8,4%	5,7%	6,3%	4,1%	3,1%	3,1%	3,0%
15	BSR 132S	O	30	IES2	19,9%	11,0%	7,5%	4,9%	6,0%	4,0%	3,0%	2,8%	2,9%
18,5	BSR 132MA	O	30	IES2	18,9%	9,0%	6,5%	4,7%	5,9%	3,9%	2,7%	2,6%	2,4%

# OUR GLOBAL PRESENCE

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Thanks to an international network of closely interconnected commercial and production sites, we can guarantee the same high standards of Bonfiglioli quality anywhere at any given time. We know that our direct presence in local markets is the key to long-lasting success, so our family includes 18 production sites, 23 commercial sites and more than 550 distributors around the world.

Our organization is always close by, offering complete and efficient solutions and supporting our customers with dedicated services, co-engineering and after-sales assistance.



**18**

PRODUCTION SITES



**23**

COMMERCIAL SITES



**80**

COUNTRIES



**550**

DISTRIBUTORS



**~4,700**

PEOPLE

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We have a relentless commitment to excellence, innovation & sustainability. Our team creates, distributes and services world-class power transmission & drive solutions to keep the world in motion.

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