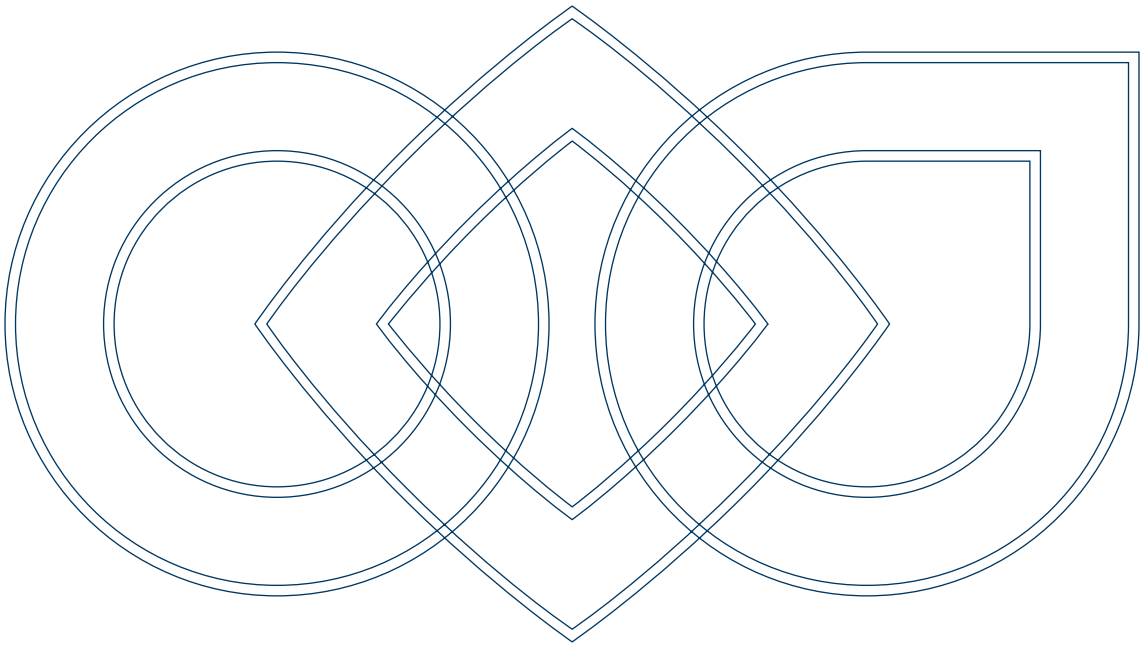
Bonfiglioli
Forever Forward

BSR Series

IE2-IE3-IE4

Synchronous Reluctance Motors

PRODUCTS &
SOLUTIONS



Index

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.

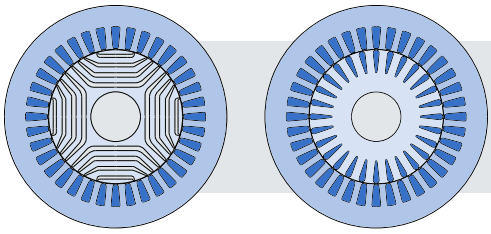


Illustration of the section of a Bonfiglioli synchronous reluctance motor BSR (left) in comparison with the one of an induction motor (right).

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.

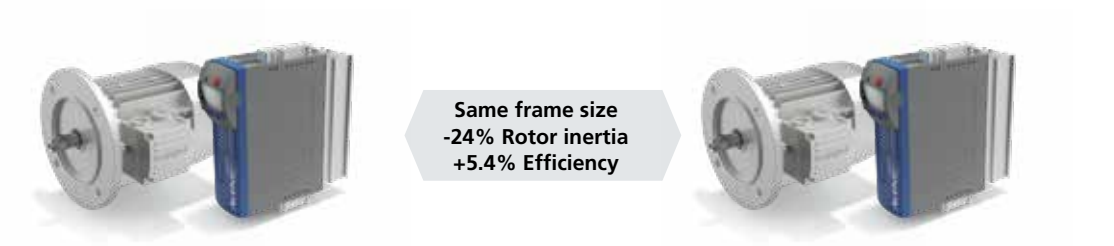
Areas of application:

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:

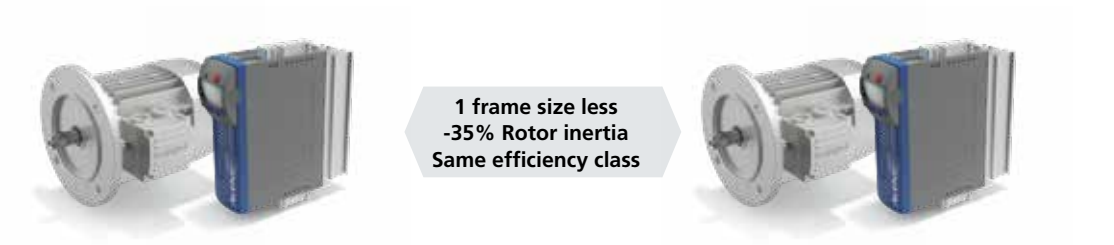
- **High Efficiency Package:** higher efficiency class (up to IE4) compared to an induction motor with the same power and frame size
  Thanks to its Premium Efficiency class IE4, this package ensures a remarkable decrease in the energy consumption, while ensuring higher dynamics in comparison with induction 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

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 stardard 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

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

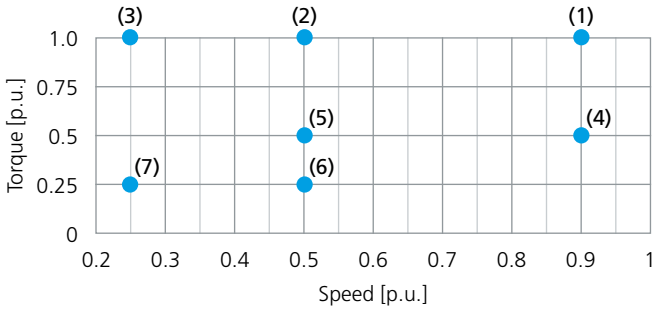
BSR motors meet the requirements of Directives 2006/95/EC (Low Voltage Directive CE mark is applied to this product).

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(1). 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.

STANDARDIZED OPERATING POINT

	n	T	P
P_1	0.9	1	0.9
P_2	0.5	1	0.5
P_3	0.25	1	0.25
P_4	0.9	0.5	0.45
P_5	0.5	0.5	0.25
P_6	0.5	0.25	0.125
P_7	0.25	0.25	0.0625



p.u. values refer to the nominal values

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 21st 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

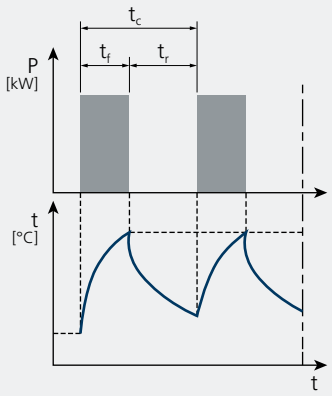
SYMBOL	U.M.	DESCRIPTION
$\eta_{4/4}$	[-]	Efficiency at P_n
f_H	[-]	Altitude adjustment factor
f_n	[Hz]	Rated frequency
f_T	[-]	Temperature adjustment factor
I_n	[A]	Rated current
I_{ol}	[A]	Overload current
I_p	[A]	Peak current
J_m	[kgm^2 x10^{-4}]	Motor moment of inertia
$m_{IM\ B5}$	[kg]	Mass with 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^{-1}]	Rated speed
n_{max}	[min^{-1}]	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.



Intermittence:

$$I = \frac{t_f}{t_f + t_r} \cdot 100$$

t_f Work time under constant load
t_r Rest time

Electric time constant [τ_{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_{ol}]: is the RMS current to produce the overload torque (M_{ol}) at rated speed (n_n).

Overload torque [M_{ol}]: 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_{ol}) 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 [τ_{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.

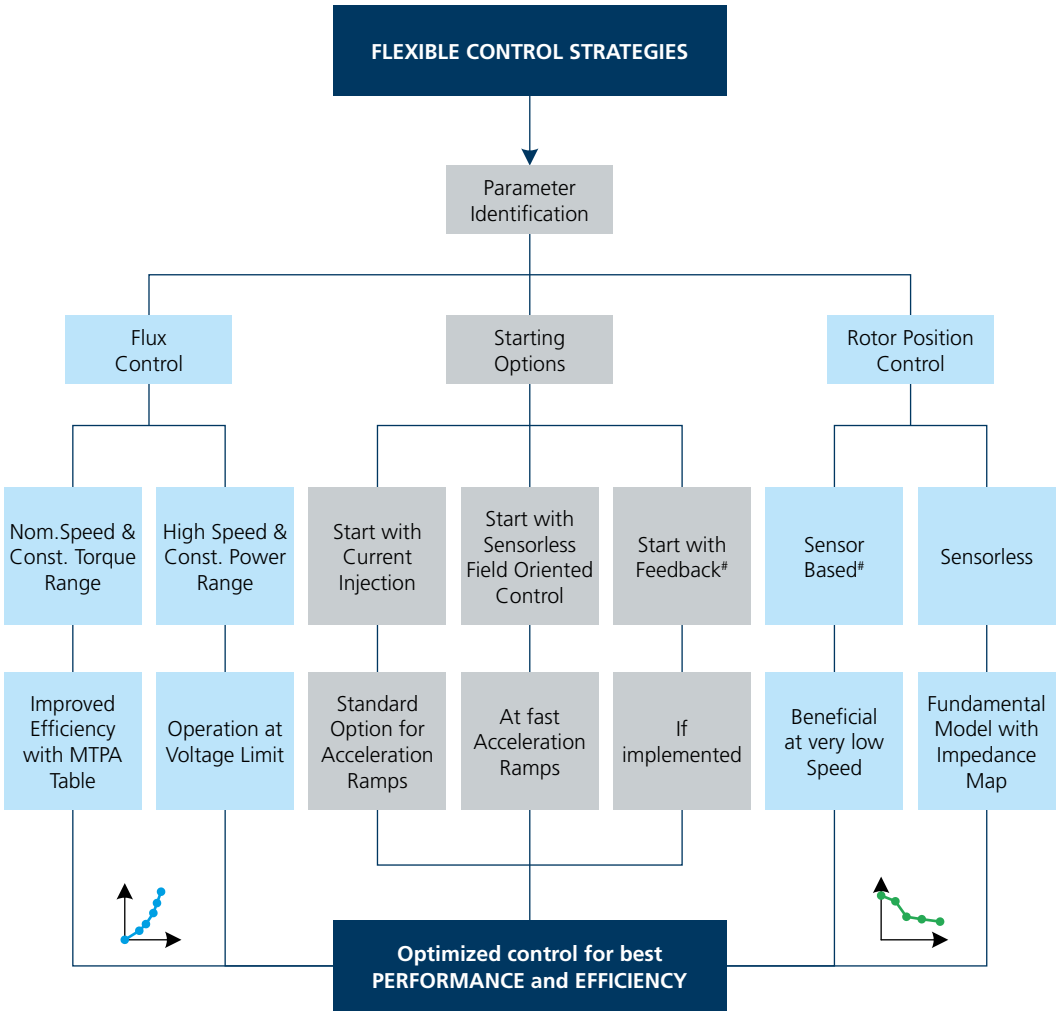
Active Cube 410 Series

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 addtional digital and analogue inputs & outputs



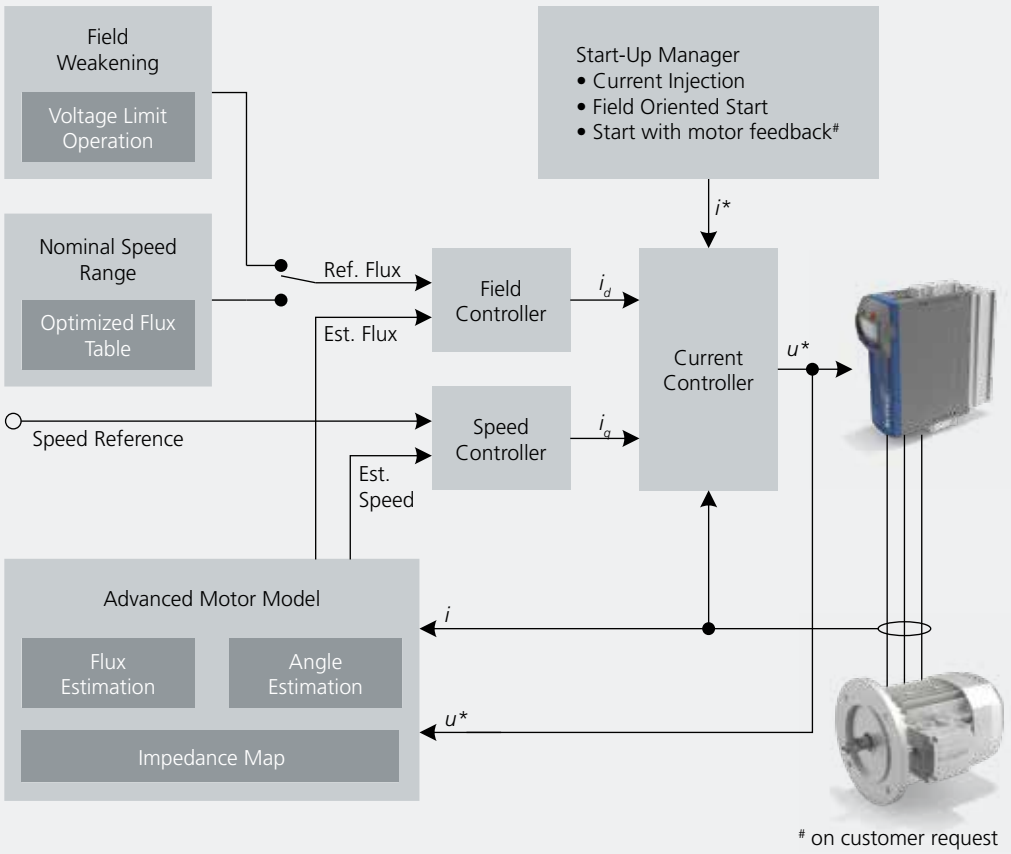
 # on request

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.

Sensorless Reluctance Motor Control with Active Cube 410



on customer request

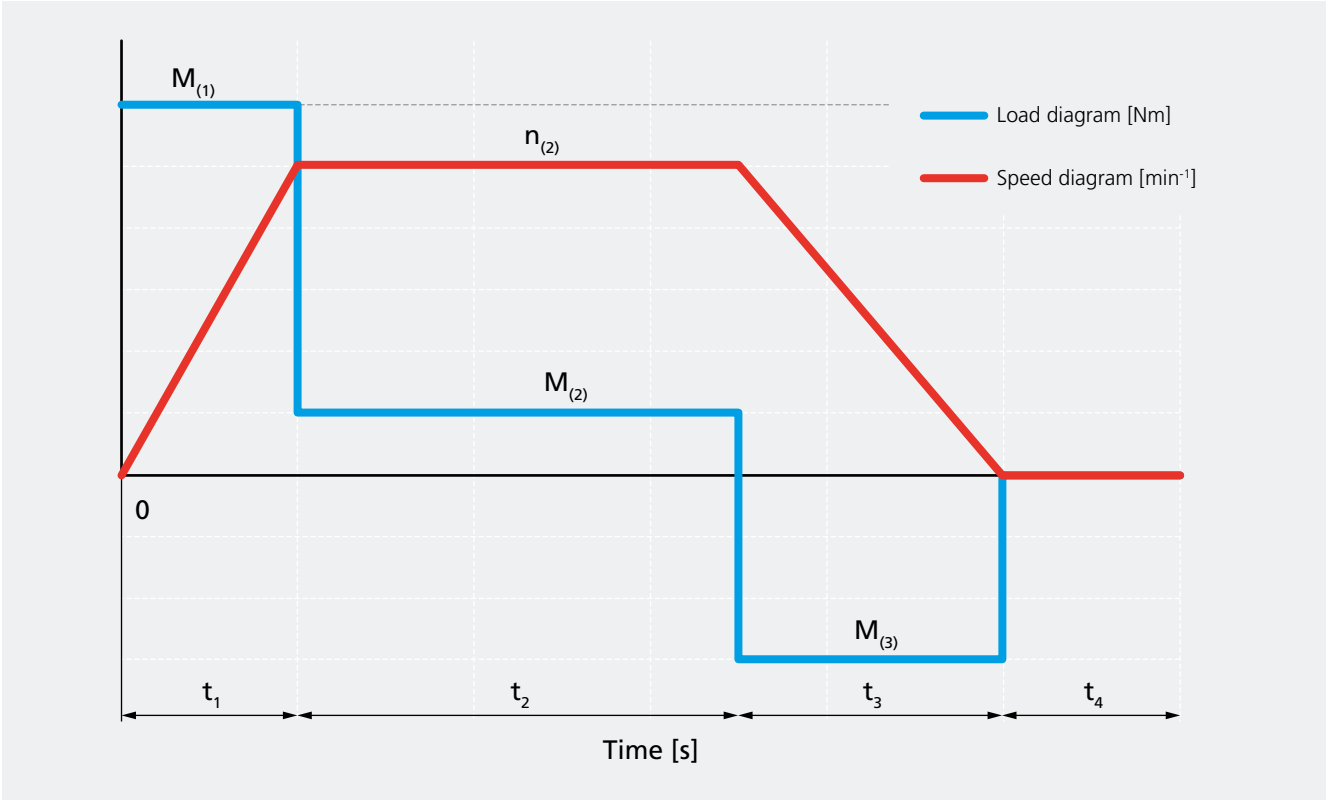
Flux Control Benefits:
➔ Extracting Maximum Torque Capability
- Efficiency Optimisation
- Field Weakening

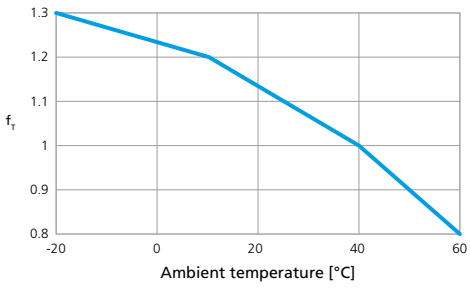
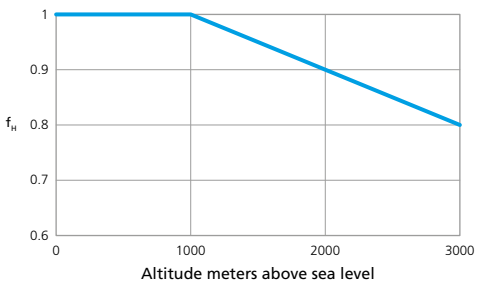
Field Oriented Sensorless Control:
- Precise control with accurate machine model
- Achieving Dynamics with Advanced Motor Model

Start-Up Manager:
- Nominal Torque available at f = 0 Hz
- Various Options for any Application

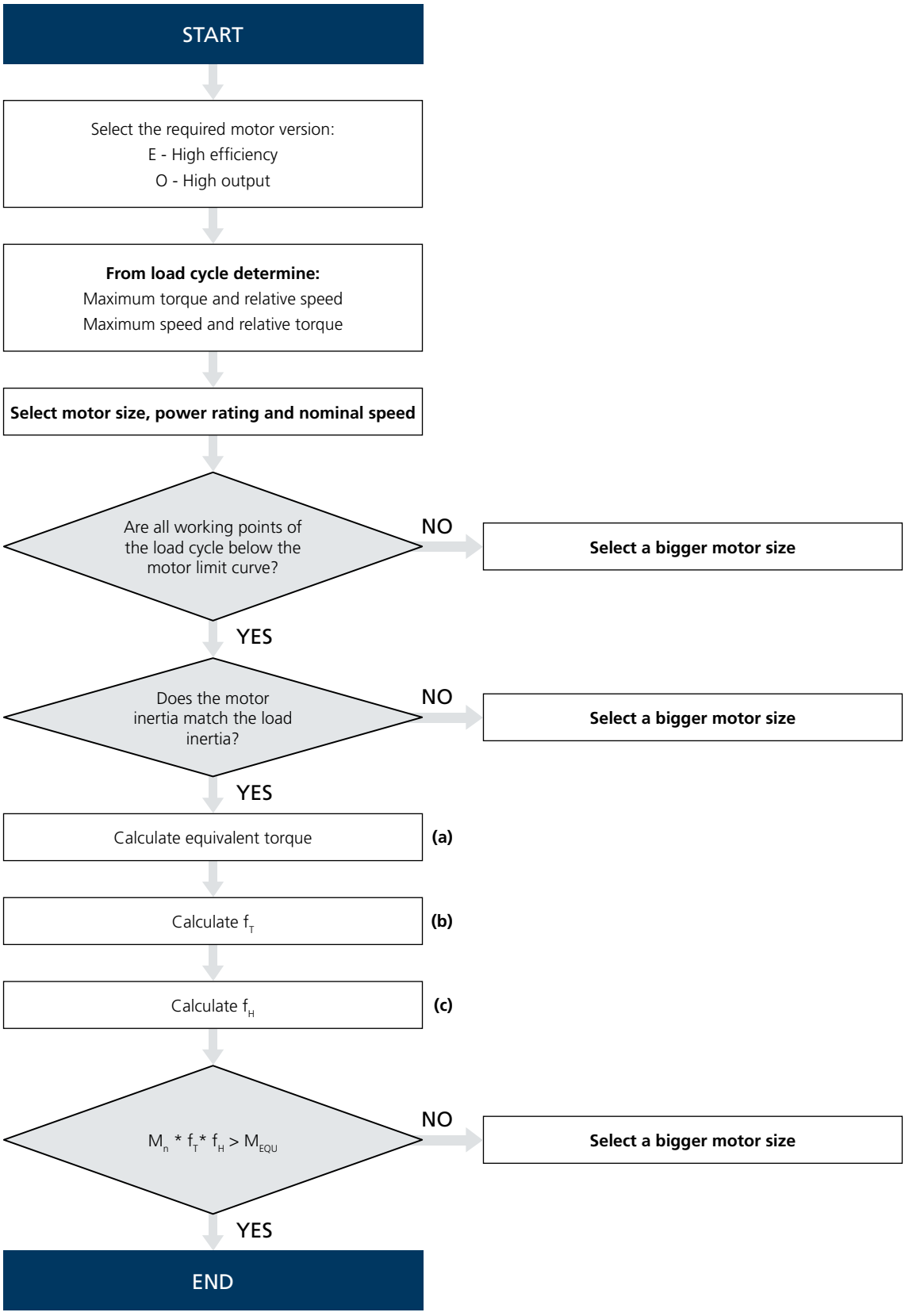
➔ Comprehensive Control Structure
for Flexible Adaption to Countless Applications

Selecting the BSR motor

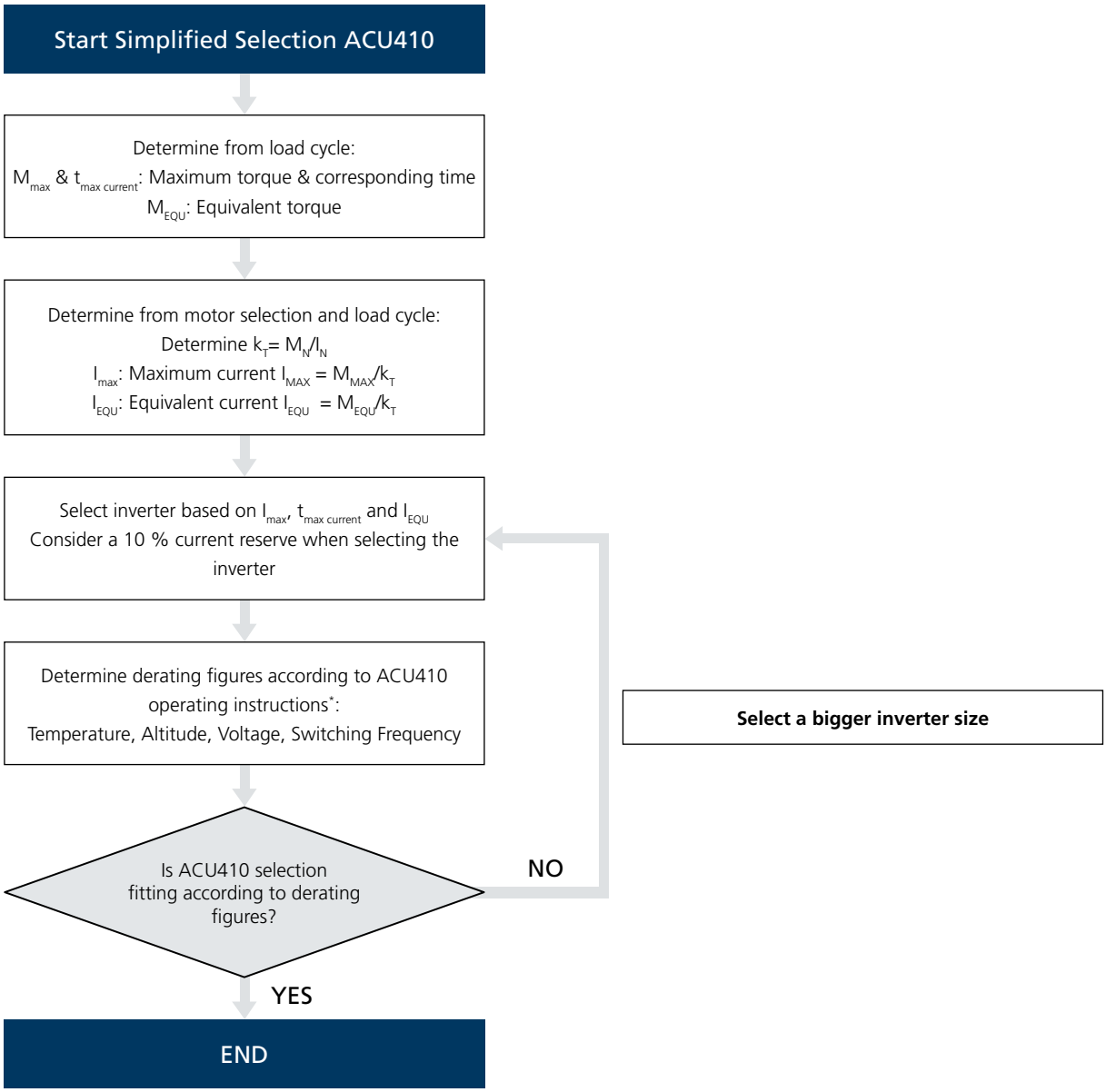


(a)	Equivalent torque	M_{EQU}	[Nm]	$M_{EQU} = \sqrt{\frac{M_{(1)}^2 \cdot t_1 + M_{(2)}^2 \cdot t_2 + \ldots + M_{(n)}^2 \cdot t_n}{t_1 + t_2 + \ldots + t_n}}$
(b)	Temperature adjusting factor	f_T	-	
(c)	Altitude adjustment factor	f_H	-	
(d)	Equivalent current	I_{EQU}	[A]	$I_{EQU} = \sqrt{\frac{M_{(1)}^2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

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 8 kHz or higher

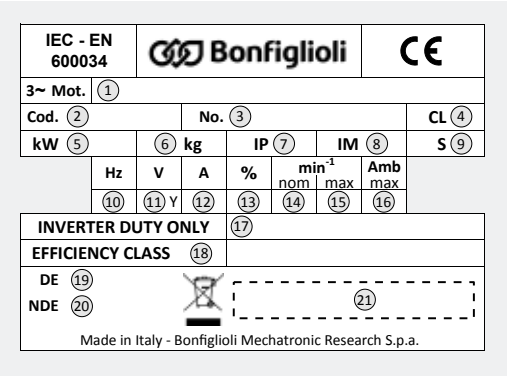
Rating plate

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:



BSR Series designation

MOTOR

BSR	80B	E	15	40	55	F

Insulation class
F Class F(2)
H Class H

Degree of protection
55 IP 55(2)
56 IP 56

Nominal line voltage
40 400V (Y connection)

Nominal speed
15 1500 min^{-1}
30 3000 min^{-1}

Motor rating
E High Efficiency(1)
O High Output

Motor size
71B ... 132MB (IEC Motor)

Motor type
BSR IEC 3-Phase Synchronous Reluctance Motor

B5

Motor mounting

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

OPTIONS

...

Thermal protective devices

K1(5)	Silicon sensor type KTY 84-130
E3	Thermistor PTC
P1	Platinium sensor PT1000

Forced ventilation

U1(6)	Power supply 1~230V (71-100), 3~400V Y (112-132)

Anti-condensate heaters

H1	Power supply 1~230V

Double-extended shaft

PS(6)

External mechanical protection

TC(6)

Rotor balancing grade B

RV

Notes:
(1) Not available with nominal speed 3000min^{-1}
(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

Technical data

Operation with ACU410 frequency inverter series - rated voltage 400V - 1.5xM_n overload at nominal speed (M_{ol}) - 3xM_n Peak overload (M_p)

4-pole | 50 Hz | 1500rpm | Y Connection

P_n	Size - Rating - Speed			$\eta_{4/4}$	IE	M_n	I_n	I_{ol}	I_p	n_{max}	J_m	$m_{IM\ B5}$	Suggested ACU410 inverter with 150% overload for max. 60 s
High Efficiency (E) - S1 duty cycle													
kW				%	Code	Nm	A	A	A	min^{-1}	kgm^2 x10^{-4}	kg	
0,37	BSR 71B	E	15	81,5	IE4	2,4	1,1	1,5	2,9	2250	8	5,7	ACU 410 03 1 F…
0,55	BSR 71C	E	15	83,9	IE4	3,5	1,6	2,2	4,1	2250	10	7,1	ACU 410 03 1 F…
0,55	BSR 80B	E	15	83,9	IE4	3,5	1,6	2,2	3,6	2250	17	9,5	ACU 410 03 1 F…
0,75	BSR 80C	E	15	87,0	IE4	4,8	2,2	2,9	5,1	2250	22	12,2	ACU 410 07 1 F…
1,1	BSR 90S	E	15	88,3	IE4	7,0	3,0	3,9	7,0	2250	22	13,1	ACU 410 09 1 F…
1,5	BSR 90L	E	15	88,2	IE4	9,5	4,0	5,5	9,5	2250	26	14,5	ACU 410 12 2 F…
2,2	BSR 100LA	E	15	89,5	IE4	14,0	5,8	8,0	14,3	2250	45	22	ACU 410 13 2 F…
3	BSR 100LB	E	15	90,4	IE4	19,1	7,8	11,3	19,8	2250	50	24	ACU 410 15 2 F…
4	BSR 112M	E	15	91,1	IE4	25	9,7	13,5	24,7	2250	82	31	ACU 410 19 3…
5,5	BSR 132S	E	15	92,1	IE4	35	13,5	18,8	36	2250	220	51	ACU 410 19 3…
7,5	BSR 132MA	E	15	92,7	IE4	48	17,8	25,5	52	2250	255	57	ACU 410 21 3…
9,2	BSR 132MB	E	15	93,0	IE4	59	21,6	32	64	2250	280	67	ACU 410 22 3…
High Output (O) - S1 duty cylce													
kW				%	Code	Nm	A	A	A	min^{-1}	kgm^2 x10^{-4}	kg	
0,55	BSR 71B	O	15	80,8	IE3	3,5	1,7	2,4	4,4	2250	8	5,7	ACU 410 05 1 F…
0,75	BSR 71C	O	15	82,5	IE3	4,8	2,1	3,4	6,2	2250	10	7,1	ACU 410 07 1 F…
0,75	BSR 80A	O	15	79,6	IE2	4,8	2,1	3,5	5,9	2250	13	8,0	ACU 410 07 1 F…
1,1	BSR 80B	O	15	81,4	IE2	7,0	3,1	4,5	9,5	2250	17	9,5	ACU 410 09 1 F…
1,5	BSR 80C	O	15	82,8	IE2	9,5	3,9	6,9	10,9	2250	22	12,2	ACU 410 12 2 F…
2,2	BSR 90S	O	15	85,9	IE2	14,0	5,6	8,2	16,8	2250	22	13,1	ACU 410 13 2 F…
3	BSR 90L	O	15	85,5	IE2	19,1	7,6	11,7	24,0	2250	26	14,5	ACU 410 15 2 F…
4	BSR 100LB	O	15	88,6	IE3	25	10,5	15,3	30	2250	50	24	ACU 410 19 3…
5,5	BSR 112M	O	15	89,6	IE3	35	13,5	19,5	42	2250	82	31	ACU 410 19 3…
7,5	BSR 132S	O	15	91,3	IE3	48	18,4	25,3	52	2250	220	51	ACU 410 22 3…
9,2	BSR 132MA	O	15	91,6	IE3	59	22,0	33	66	2250	255	57	ACU 410 23 3…
11	BSR 132MB	O	15	91,5	IE3	70	24,7	32	77	2250	280	67	ACU 410 23 3…

Operation with ACU410 frequency inverter series - rated voltage 400V - 1.5xM_n overload at nominal speed (M_{ol}) - 3xM_n Peak overload (M_p)

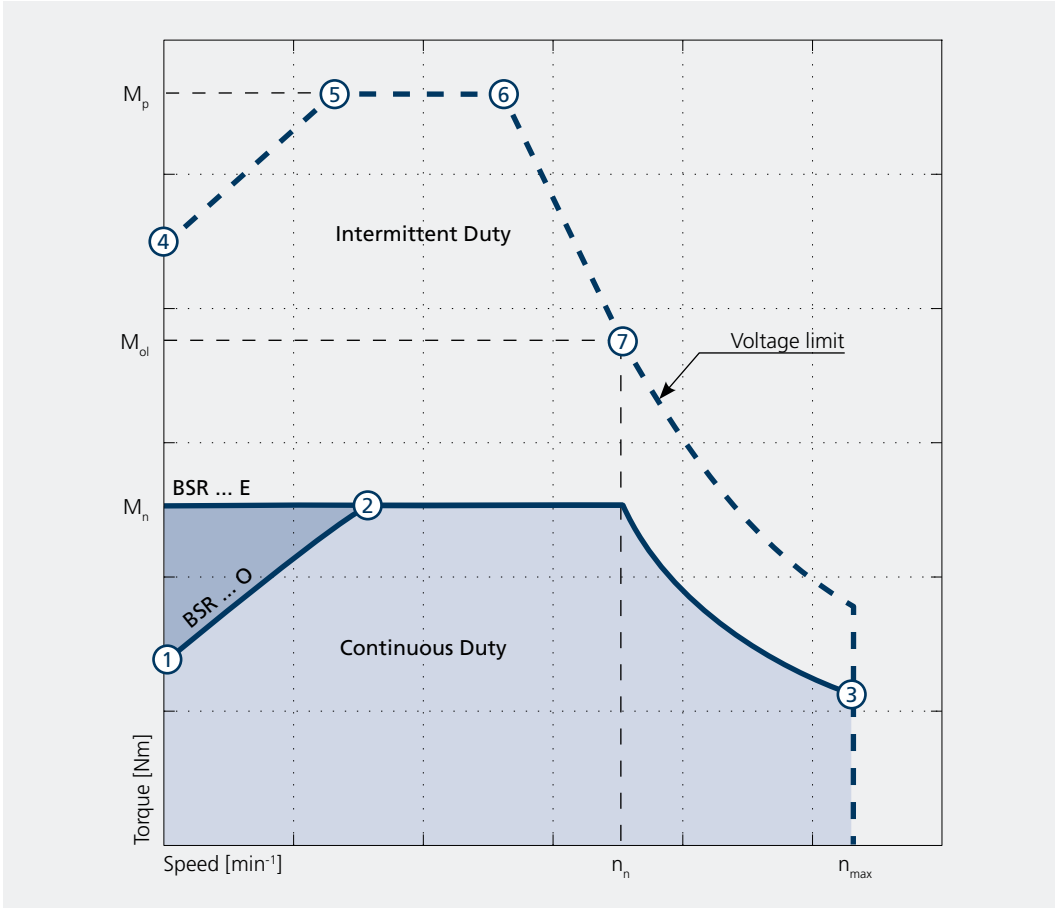
4-pole | 100 Hz | 3000rpm | Y Connection

P_n	Size - Rating - Speed			$\eta_{4/4}$	IE	M_n	I_n	I_{ol}	I_p	n_{max}	J_m	$m_{IM\ B5}$	Suggested ACU410 inverter with 150% overload for max. 60 s
High Output (O) - S1 duty cylce													
kW				%	Code	Nm	A	A	A	min^{-1}	kgm^2 x10^{-4}	kg	
1,1	BSR 71B	O	30	85,2	IE4	3,5	3,1	4,5	8,5	4500	8	5,7	ACU 410 09 1 F…
1,5	BSR 71C	O	30	87,1	IE4	4,8	4,2	6,2	11,7	4500	10	7,1	ACU 410 12 2 F…
1,5	BSR 80A	O	30	84,7	IE3	4,8	4,1	5,9	11,2	4500	13	8,0	ACU 410 12 2 F…
2,2	BSR 80B	O	30	86,3	IE3	7,0	5,8	8,5	16,0	4500	17	9,5	ACU 410 13 2 F…
3	BSR 80C	O	30	88,3	IE3	9,5	7,8	11,6	19,7	4500	22	12,2	ACU 410 15 2 F…
4	BSR 90S	O	30	90,2	IE3	12,7	9,9	15,2	27,3	4500	22	13,1	ACU 410 19 3…
5,5	BSR 90L	O	30	90,9	IE4	17,5	13,5	20,6	43	4500	26	14,5	ACU 410 19 3…
7,5	BSR 100LB	O	30	91,7	IE4	24	20,0	27,8	56	4500	50	24	ACU 410 22 3…
11	BSR 112M	O	30	91,9	IE3	35	24,5	36	77	4500	82	31	ACU 410 23 3…
15	BSR 132S	O	30	92,0	IE3	48	36	53	107	4500	220	51	ACU 410 27 3…
18,5	BSR 132MA	O	30	92,4	IE3	59	43	62	126	4500	255	57	ACU 410 29 3…

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,

SYMBOL	U.M.	DESCRIPTION						
		1	2		3	4	5	6	7
Torque	[p.u.]	0.4	1		0.4	1.5	3	3	1.5
Speed	[p.u.]	0	0.4(1)	0.2(2)	1.5	0	0.3	0.8	1
Duty	-	Continuous				Intermittent			

(1) The value is valid only for BSR motor with nominal speed 1500 min-1
(2) The value is valid only for BSR motor with nominal speed 3000 min-1

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.

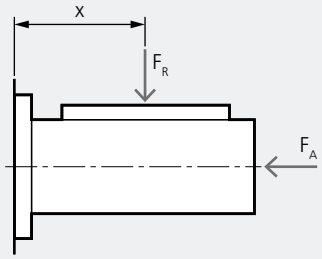
SIZE	PROTECTION DEGREE IP55			PROTECTION DEGREE IP56		
	DRIVE END		NON DRIVE END	DRIVE END		NON DRIVE END
BSR 71	6202 2Z C3	6203 2Z C3[1]	6202 2Z C3	6202 2RS C3	6203 2RS C3[1]	6202 2RS C3
BSR 80	6204 2Z C3		6204 2Z C3	6204 2RS C3		6204 2RS C3
BSR 90	6205 2Z C3		6205 2Z C3	6205 2RS C3		6205 2RS C3
BSR 100	6206 2Z C3	6207 2Z C3[1]	6206 2Z C3	6206 2RS C3	6207 2RS C3[1]	6206 2RS C3
BSR 112	6306 2Z C3		6306 2Z C3	6306 2RS C3		6306 2RS C3
BSR 132	6308 2Z C3		6308 2Z C3	6308 2RS C3		6308 2RS C3

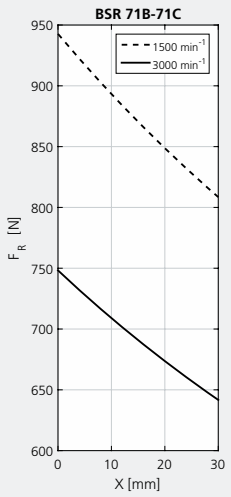
[1] *Only for the B5R motor mounting variant.*

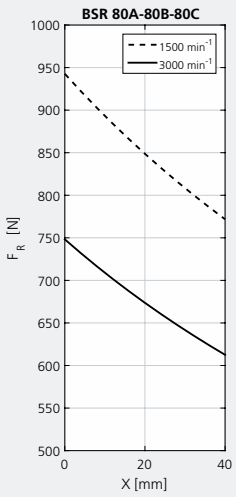
Shaft loads

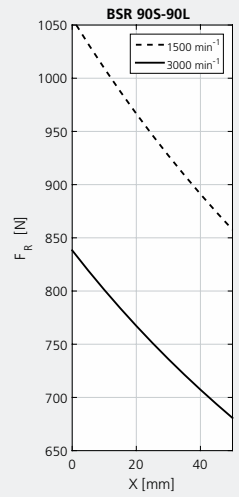
The maxium radial load (F_R) and maximum axial load (F_A) are computed using ISO 281 calculation L_{10h} assuming a bearing life of 20.000h. The load and the speed are assumed to be constant throughout the bearing life.

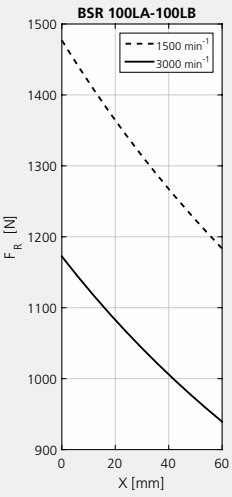
The maximum radial load is reported as a function of the distance (X) between flange plane and the point of force applicaton. The maximum radial loads F_R are valid only for the horizontal installation of the motor without additional axial load.

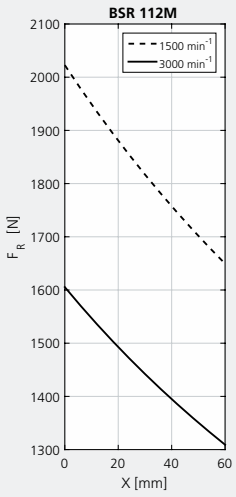


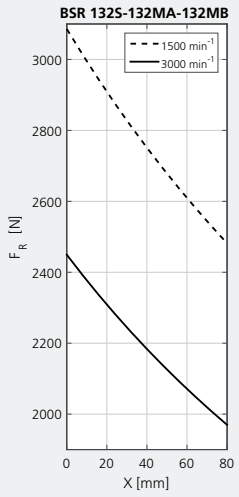








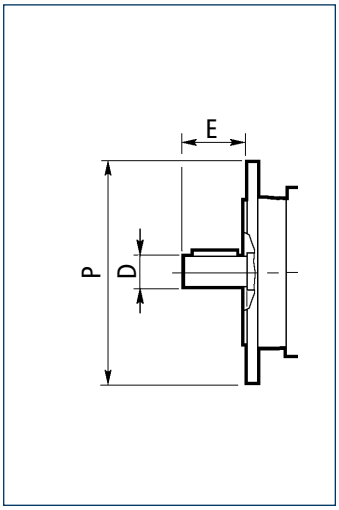




Flange versions

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				Δ_{LB} [1]
	V_{AC} ±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 Δ / 400 Y		50	0.26 / 0.15	130
BSR 132			110	0.38 / 0.22	161

[1] 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:

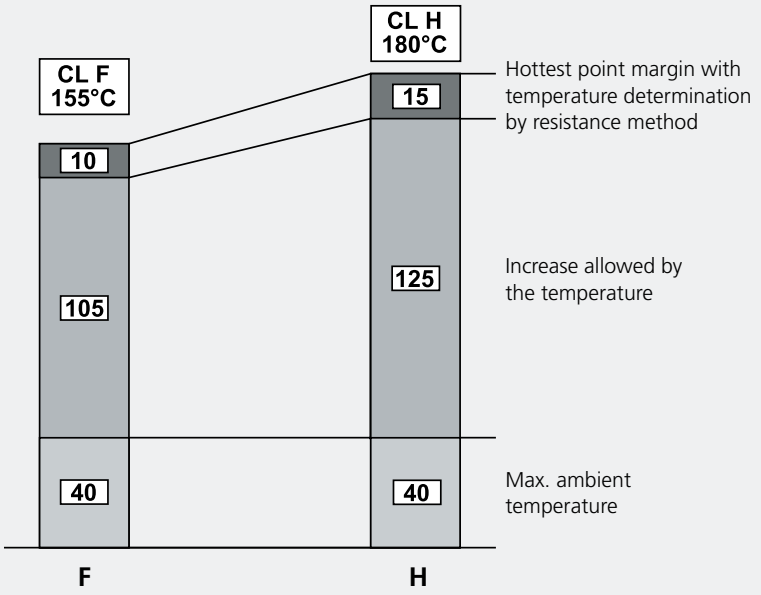
IP	5	5

0		Not protected
1		Protected against extraneous solid bodies having Ø ≥ 50 mm
2		Protected against extraneous solid bodies having Ø ≥ 12.5 mm
3		Protected against extraneous solid bodies having Ø ≥ 2.5 mm
4		Protected against extraneous solid bodies having Ø ≥ 1.0 mm
5		Protected against dust
6		No dust ingress

0		Not protected
1		Protected against vertical water drips
2		Protected against vertical water drips inclined up to 15°
3		Protected against rain
4		Protected against water splashes
5		Protected against jets of water
6		Protected against powerful jets of water
7		Protected against the effects of temporary immersion
8		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 I^2t 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:

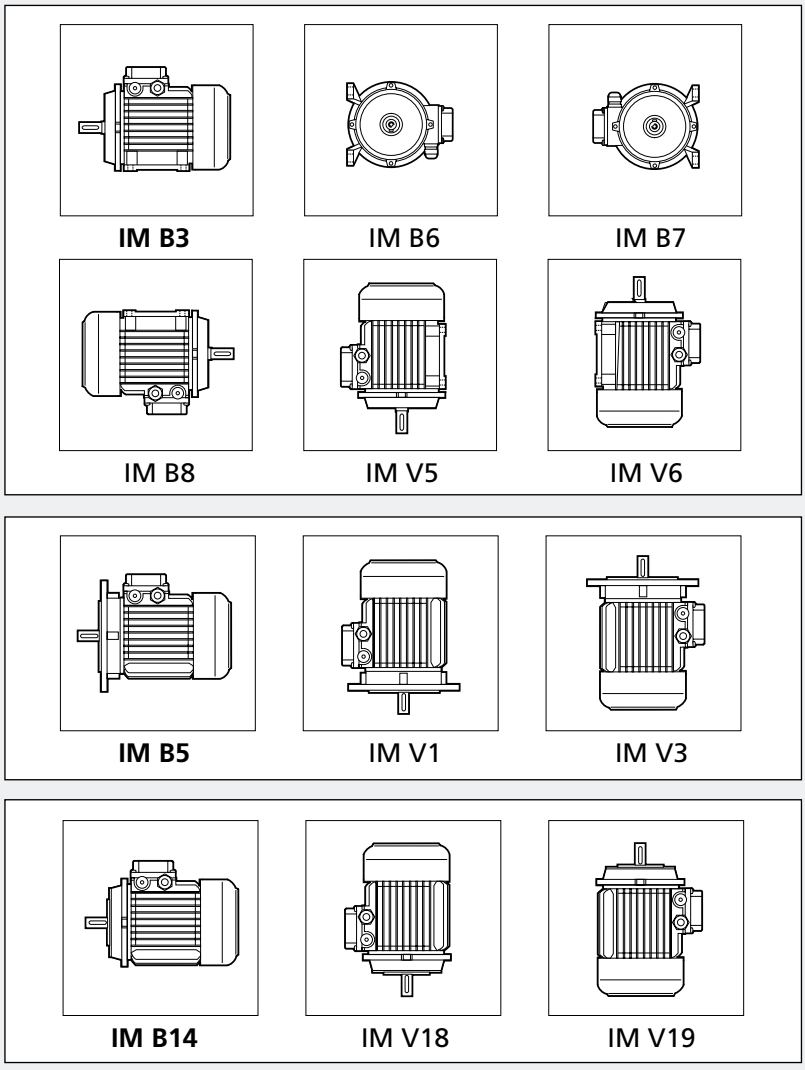
OPTION	THERMAL SWITCH	DESCRIPTION
K1	Type KTY 84-130	A KTY silicon semi-conductor resistance sensor is placed in contact with the motor winding. The working temperature range is from 0°C to 170°C. This sensor cannot be used in combination with insulation class H.
E3	PTC	3 PTC thermistors are placed in 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 V63; 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.



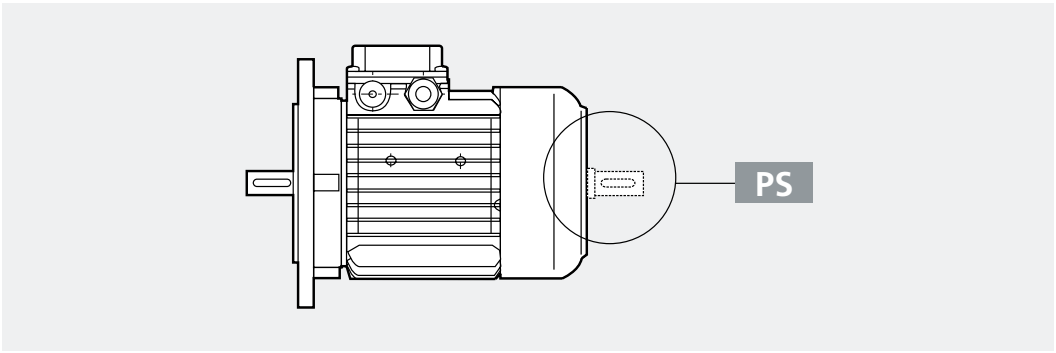
Anti-condensation heaters

Where an application involves high humidity or extreme temperature fluctuations, motors can be equippen 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

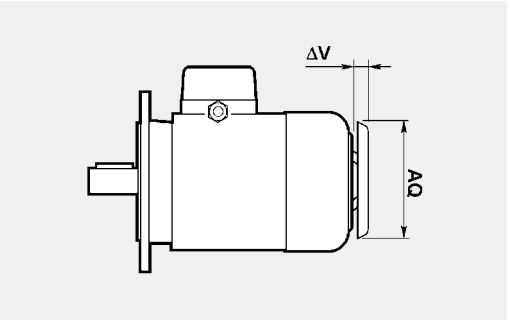
A second shaft extension is available selecting the option PS. This option cannot be used in combination with options U1 or TC. The shaft dimensions correspond to the first shaft and are summarized in the dimensions table in this catalogue.



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	ΔV
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 hearting 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).

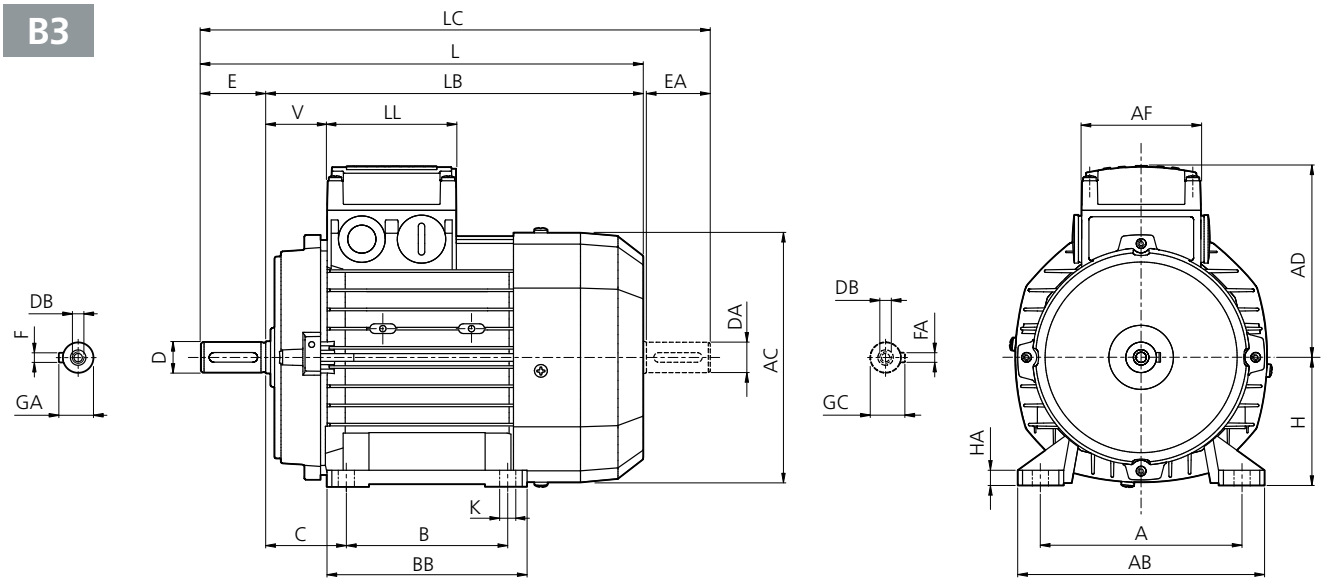
BSR SIZE	NUMBERS OF TERMINALS	TERMINAL THREADS	WIRE CROSS SECTION AREA
			[mm²]
BSR 71 … BSR 90	6	M4	2.5
BSR 100 … BSR132		M5	6

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	1 Hole on each side	17
BSR 80 ... BSR 90	2 x M25 x 1.5		17
BSR 100 ... BSR 112	2 x M32 x 1.5 2 x M25 x 1.5	2 Holes on each side	21 17
BSR 132	4 x M32 x 1.5		21

Dimensions

B3



HOUSING B3								
	B	A	HA	BB	AB	K	C	H
BSR 71	90	112	8	112	135		45	71
BSR 80	100	125	8	124	153	10	50	80
BSR 90 S		140	8	155	174		56	90
BSR 90 L	125							
BSR 100	140	160	10	175	192	12	63	100
BSR 112		190			224		70	112
BSR 132	178	216	12	218	254		89	132

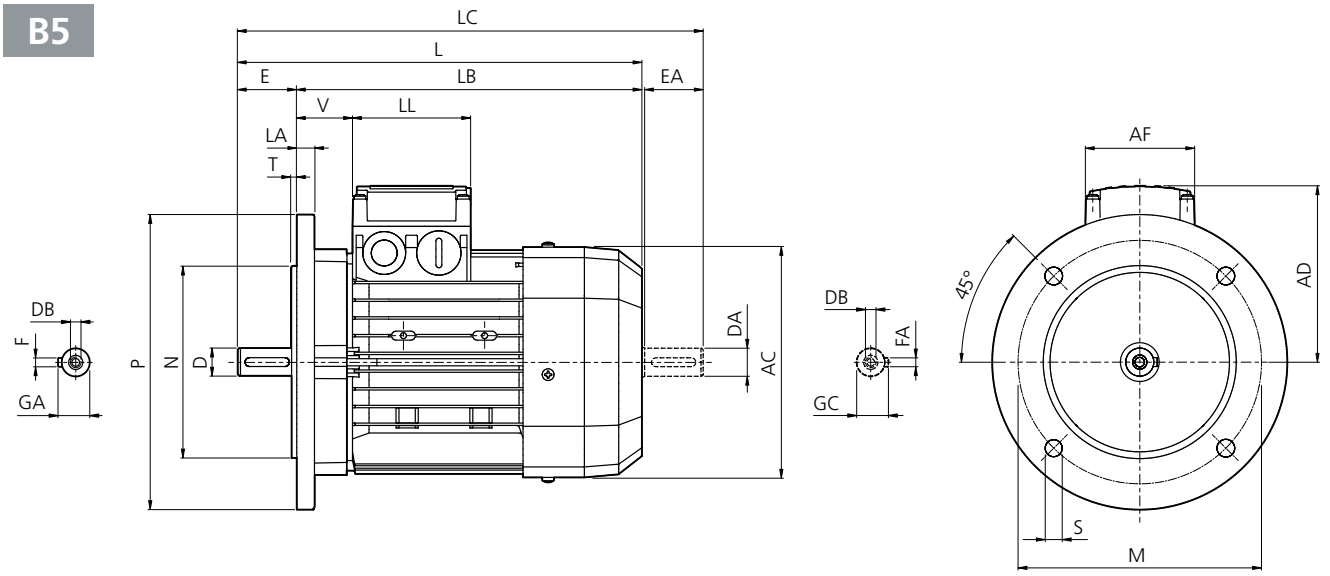
SHAFT					
	D DA	E EA	DB	GA GC	F FA
BSR 71	14	30	M5	16	5
BSR 80	19	40	M6	21,5	6
BSR 90	24	50	M8	27	5
BSR 100	28	60	M10	31	
BSR 112					
BSR 132	38	80	M12	41	10

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

Dimensions

B5



HOUSING B5						
	M	N	P	S	T	LA
BSR 71	130	110	160	9.5	3.5	10
BSR 80	165	130	200	11.5		11.5
BSR 90						
BSR 100	215	180	250	14	4	14
BSR 112						15
BSR 132	265	230	300			20

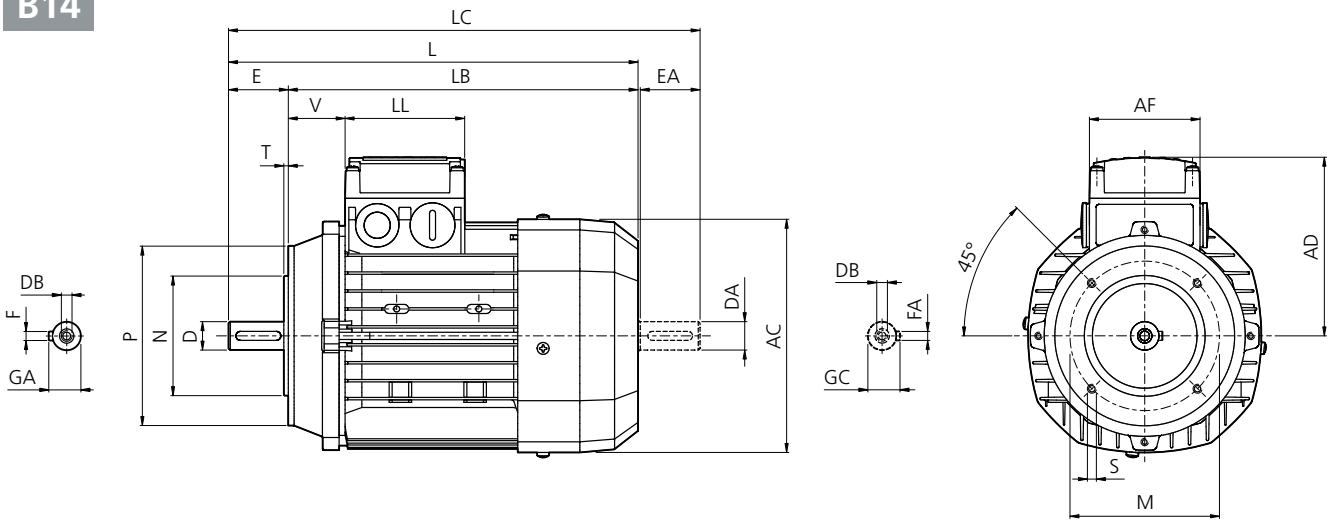
SHAFT					
	D DA	E EA	DB	GA GC	F FA
BSR 71	14	30	M5	16	5
BSR 80	19	40	M6	21,5	6
BSR 90	24	50	M8	27	5
BSR 100	28	60	M10	31	
BSR 112					
BSR 132	38	80	M12	41	10

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

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	
BSR 100	130	110	160		3,5
BSR 112					
BSR 132	165	130	200	M10	4

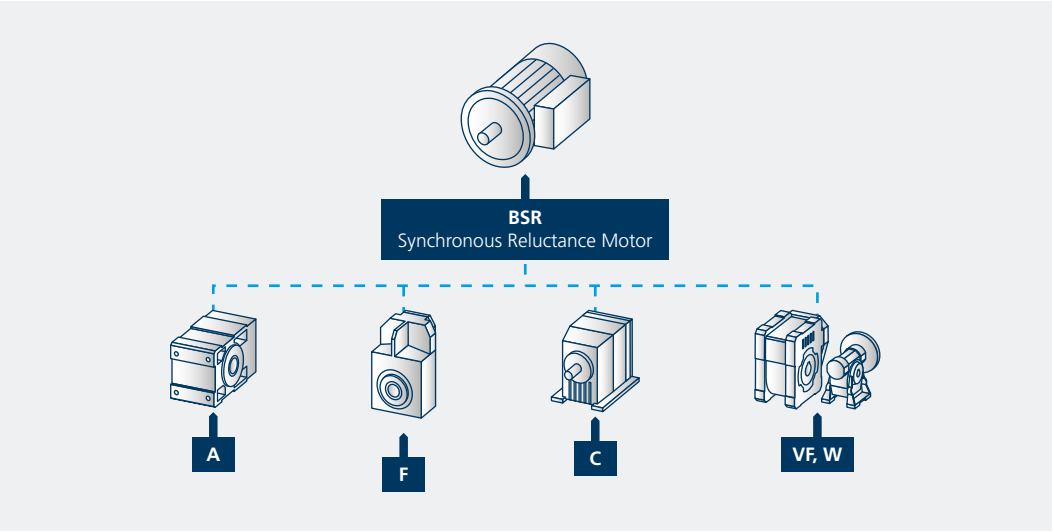
SHAFT					
	D DA	E EA	DB	GA GC	F FA
BSR 71	14	30	M5	16	5
BSR 80	19	40	M6	21,5	6
BSR 90	24	50	M8	27	5
BSR 100	28	60	M10	31	
BSR 112					
BSR 132	38	80	M12	41	10

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.

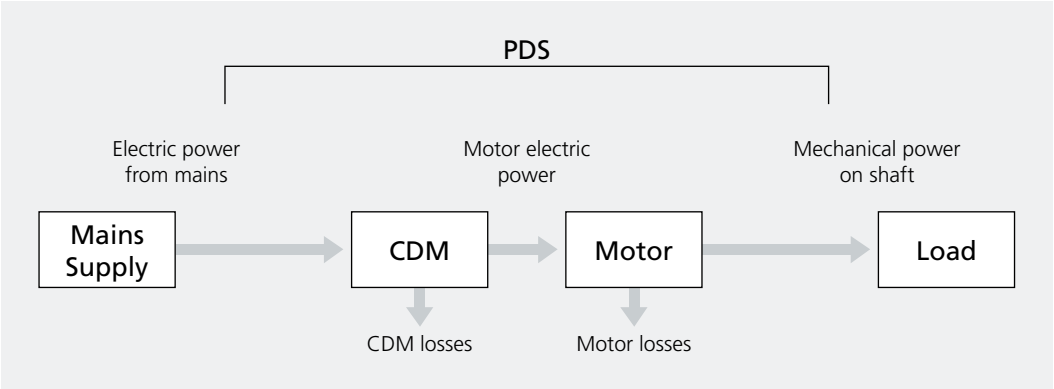
One stop shop
All the components of the drive package are manufactured by Bonfiglioli. This ensures the highest level of performances and compatibility. At the same time our customers can rely on a unique supplier for all gearboxes, motors and inverters.

Areas of Application

MATERIAL HANDLING | PACKAGING | RORATY 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.

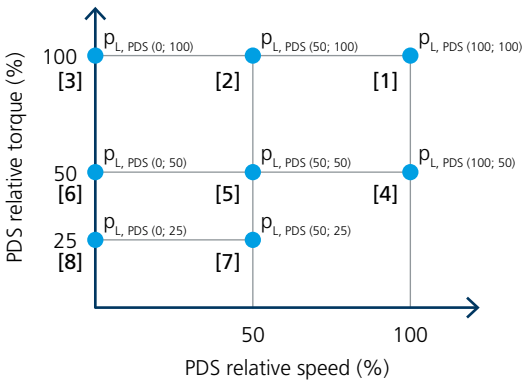


Illustration of the operating points (shaft speed, torque) for the determination of the relative losses of the PDS according to IEC 61800-9-2.

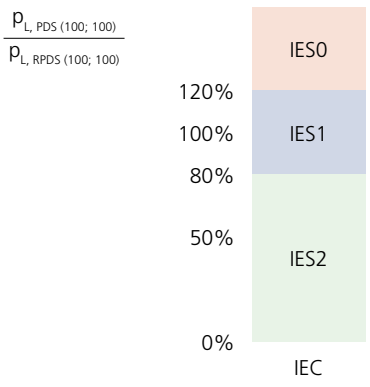


Illustration of the IES classes of a PDS according to IEC 61800-9-2.

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_n	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%

Global Presence

With a broad and extensive presence in 22 countries and 5 continents, Bonfiglioli is one of the international market leaders. Our organization makes the most of geographic proximity to offer complete solutions combining efficiency and competence.

3700 EMPLOYEES	20 BRANCHES	14 PLANTS	550 DISTRIBUTORS	80 COUNTRIES

We Are a Global Company

Thanks to an international network of sales branches and closely interconnecting production plants, we can guarantee the same high standards of Bonfiglioli quality anywhere at any given time. Aware that our direct presence in local markets is the key to long-lasting success, our family includes 20 sales branches, 14 production plants and more than 500 distributors around the world.

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

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Bonfiglioli
Forever Forward

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

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