

## Drive Systems

# Drive Systems IndraDrive and IndraDyn



1

Electric Drives and Controls | 2015-07-21 | DC-IA/SPC1 | © Bosch Rexroth AG 2015. All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.

**Rexroth**  
Bosch Group

Sidex Suministros, S.L: Polígono Industrial El Tiro, s/n. 30100 Murcia. Teléfono: 968 306 000. E-mail: [info@sidex.es](mailto:info@sidex.es)

## Content

### IndraDrive

- Drive systems at a glance
- Converters, supply units, single- and double-axis inverters
- Control units, integration, visualization
- Compact converters
- Decentralized drive technology
- Firmware functions, motion logic, safety technology, engineering, drive sizing, productivity agent, smart energy mode

### IndraDyn

- Synchronous and asynchronous servo motors, linear and rotary direct drives, planetary gearboxes








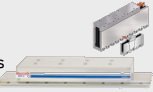










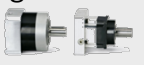


### Rexroth 4EE

- Rexroth for Energy Efficiency

# IndraDrive and IndraDyn












- Continuous drive platform with modular inverters and compact converters
- Unified control units and firmware
  - scalable functionality
  - integrated motion-logic with PLC (IEC 61131-3)
  - parameterizable technology functions
  - open interface concept
- Certified, drive-integrated safety technology "Safety on Board"
- Complete program of motors
  - servo motors synchronous and asynchronous
  - direct drive technology rotary and linear
  - wide range of options and accessories
- Powerful engineering tools for user support

# IndraDrive and IndraDyn drive systems

Motors	Power units	Control units	Firmware	Accessories
<b>Servo</b> MSK/MSM/MKE synchronous 	<b>Compact converter</b> HCS01 Ethernet-based communication 	Continuously in all converters and inverters Economy CSE02.1A fixed configuration Closed LOOP Sercos III, EtherCAT 	<b>Basic package</b> Open Loop Closed Loop Contains all functions for standard applications	<b>Engineering</b> IndraWorks IndraSize Open Core Interface 
<b>MAD/MAF</b> asynchronous 	<b>Converter</b> HCS02/03 		Basic CSB02.1A CSB02.1B CDB02.1B configurable UNIVERSAL * single-axis double-axis 	<b>Extension package</b> Servo Friction torque and backlash compensation, axis and encoder fault correction, touch probe etc. Synchronization Electronic gearbox, electronic cam disk, real and virtual master etc.
<b>Linear</b> MLF/MCL synchronous 	<b>Inverter</b> HMS/HMD/HMU 	Advanced CSH02.1B configurable UNIVERSAL * 	Main spindle Spindle positioning, gearbox shifting, drive-controlled gearbox swivelling	IndraControl VR21/VH21 
<b>Torque</b> MBT synchronous 	<b>Supply unit</b> HMV/HMU feeding/regenerating 	* SERCOS CANopen EtherNet/IP POWERLINK 	Motion Logic IndraMotion MLD Single-axis and multi-axis, motion-Logic acc. to IEC 61131	<b>EMV</b> Line choke, Line filter Motor filter, Shielding 
<b>High-Speed</b> MBS/1MB synchronous asynchronous 	<b>Motor-integrated drive system</b> KMS, KSM, KCU 		Technology Based on IndraMotion MLD: winder, tension control, register control, Productivity Agent, synchronized machining etc.	<b>Energy</b> Brake unit Brake resistor Add. capacitor 
<b>Planetary gearbox</b> GTE/GTM 			Connection Power cable Encoder cable Bus connection 	<b>I/O modules</b> IndraControl S20/S67 Block I/O High Speed 
				<b>Periphery</b> Via Sercos, EtherNet/IP, Modbus, Ethernet

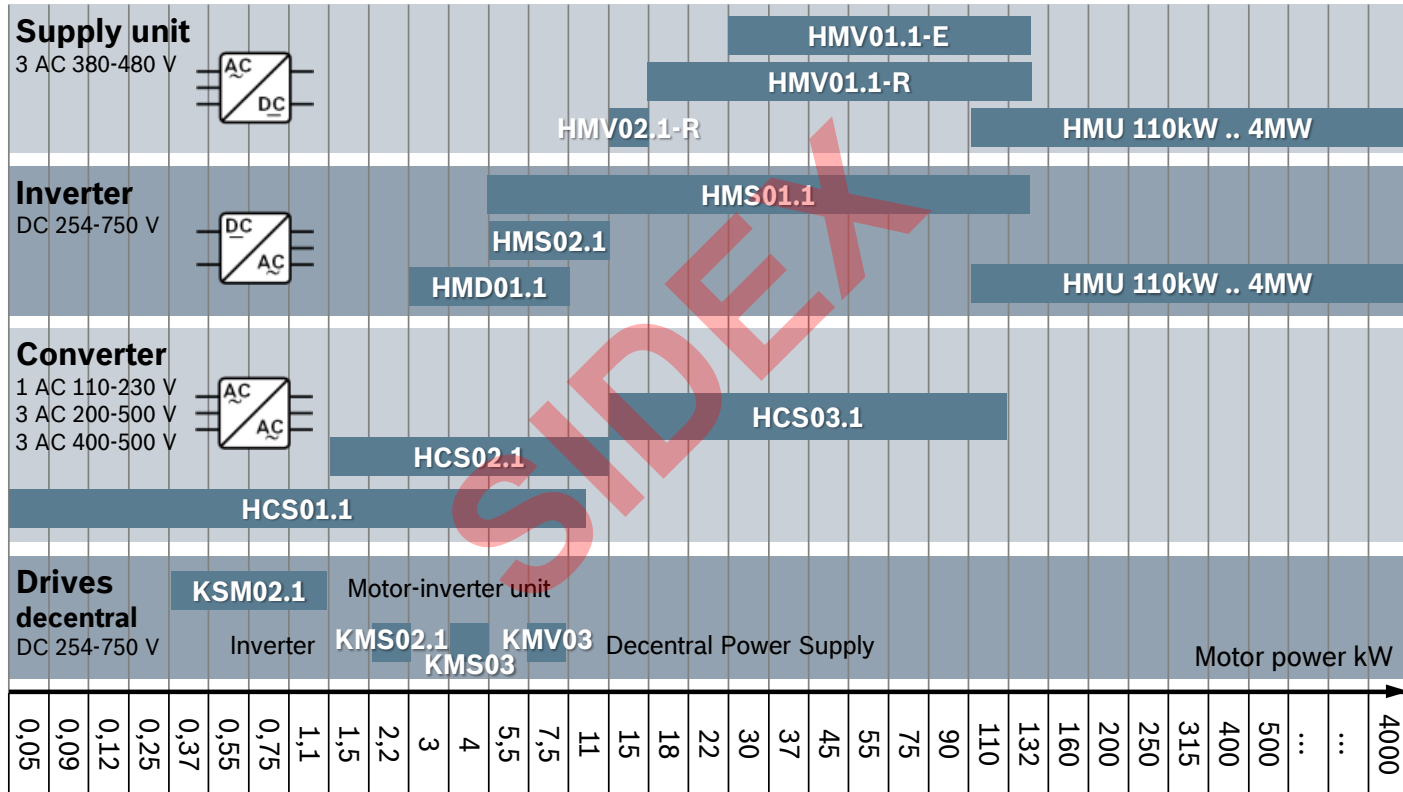
# IndraDrive and IndraDyn drive systems

## Drives overview

IndraDrive Cs HCS01	IndraDrive C HCS02	IndraDrive C HCS03	EFC x610	IndraDrive Mi	
				KSM	KMS
					
Feeding converter integrated control unit up to 14 kW	Feeding converter up to 11 kW	Feeding converter up to 110 kW	Frequency converter up to 18,5 kW	Motor-integrated inverter in IP65 up to 1,2 kW	Decentral inverter IP65 up to 2,2 kW
IndraDrive M HMOV1 -E	IndraDrive M HMOV1/02 -R	IndraDrive M HMS01/02	IndraDrive M HMD01	IndraDrive ML HMU05	
					
Feeding supply unit up to 120 kW	Regenerating supply unit up to 120 kW	Single-axis inverter up to 132 kW	Double-axis inverter up to 7,5 kW	Regenerating supply unit up to 4 MW	Single-axis inverter up to 4 MW

# IndraDrive and IndraDyn drive systems

## IndraDrive power range

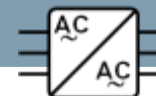




## Converter HCS02, HCS03

- 2 product lines for direct connection to mains from 200 to 500 VAC
- Power range from 1,5 kW to 110 kW
- Max. current from 12 A to 350 A
- High overload capacity
- Compact design for single-axis applications
- Direct connection of inverters for cost-saving solutions
- Wide range of accessories

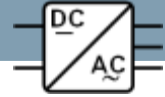




## Product data

	$P_{Cont}$	$P_{Max}$	$I_{Cont}$	$I_{Max}$	H x W x D (mm)
HCS02 Single-axis	2,1 kW	5 kW	4,5 A	11,5 A	290 x 65 x 252
	5 kW	10 kW	11 A	28 A	352 x 65 x 252
	10 kW	16 kW	20 A	54 A	352 x 105 x 252
	14 kW	19 kW	28 A	70 A	352 x 105 x 252
HCS03 Single-axis	25 kW	40 kW	45 A	70 A	440 x 125 x 309
	42 kW	59 kW	73 A	100 A	440 x 225 x 309
	56 kW	89 kW	95 A	150 A	440 x 225 x 309
	85 kW	124 kW	145 A	210 A	440 x 350 x 309
	100 kW	170 kW	165 A	280 A	440 x 350 x 309
	120 kW	210 kW	200 A	350 A	440 x 350 x 309

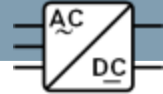




## Inverter HMS, HMD and HMU

- Single-axis inverter with max. current from 20 A up to 350 A
- Double-axis inverter with max. current from 12 A bis 36 A
- Large drive HMU up to 4MW
- Space-saving modular design for multi-axis applications
- Feeding by supply unit or cost-saving by converter
- Energy exchange over common DC-bus
- Wide range of accessories





## Supply unit HMV and HMU

- Feeding units HMV-E and energy saving regeneration by HMV-R and HMU
- Power range HMV from 15 kW to 120 kW
  - mains connection from 400 V to 480 V
- Power Range HMU from 110kW to 4MW
  - mains connection from 400 V to 500 V
- Integrated mains contactor \*
- Integrated brake resistor \*
- Wide range of accessories



*\* not in regenerating HMV-R with 120 kW and HMU*



## Product data H MV / H MS

	$P_{Cont}$	$P_{Max}$	H x W x D (mm)		$I_{Cont}$	$I_{Max}$	H x W x D (mm)
H MV01 feeding	30 kW	45 kW	440 x 150 x 309	H MS01 Single-axis	12 A	20 A	440 x 50 x 309
	75 kW	112 kW	440 x 250 x 309		21 A	36 A	440 x 50 x 309
	120 kW	180 kW	440 x 350 x 309		35 A	54 A	440 x 75 x 309
H MV01 feeding regenerating	18 kW	45 kW	440 x 175 x 309		42 A	70 A	440 x 100 x 309
	45 kW	112 kW	440 x 250 x 309		69 A	110 A	440 x 125 x 309
	65 kW	162 kW	440 x 350 x 309		100 A	150 A	440 x 150 x 309
	120 kW	180 kW	440 x 350 x 309		150 A	210 A	440 x 200 x 309
H MV02 feed./regen.	15 kW	29 kW	352 x 150 x 252		150 A	300 A	440 x 200 x 309
					250 A	350 A	440 x 350 x 309
H MS02 Single-axis					14 A	28 A	352 x 50 x 252
				25 A	54 A	352 x 75 x 252	
H MD01 Double-axis				7 A	12 A	440 x 50 x 309	
				10 A	20 A	440 x 50 x 309	
				20 A	36 A	440 x 75 x 309	

## Product data HMU – technical Design

HMU05.1-X		0140-0350	0170-0430	0220-0510	0270-0660	0340-0820	0430-1040	0540-1300	0680-1690
Continuous DC-bus power	[kW]	145	174	219	273	342	435	540	679
Maximum current	[A]	357	427	515	660	825	1037	1297	1686
water cooled design		●	●	●	●	●	●	●	●
air cooled design		●	●	●	⊙	⊙	⊙	⊙	⊙
parallel operation						●			
						up to 8 piece			
brake chopper / - resistor						○			
						external			
contactor						external			
Height <sup>1)</sup> , water (air)	mm	687 (790)	687 (790)	791 (790)	895 (tbd.)	973 (tbd.)	1181 (tbd.)	1389 (tbd.)	1393 (tbd.)
Width <sup>1)</sup> , water (air)	mm	200 (390)	200 (390)	200 (390)	200 (tbd.)	200 (tbd.)	200 (tbd.)	220 (tbd.)	330 (tbd.)
Depth <sup>1)</sup> , water (air)	mm	440 (400)	440 (400)	440 (400)	440 (tbd.)	440 (tbd.)	440 (tbd.)	440 (tbd.)	440 (tbd.)
degree of protection, device (connectors)									IP20 (IP00)

● : standard   ⊙ : internal water cooled + water-air head exchanger   ○ : option   1) : corpus dimensions

## Product data HMU – Motor Inverter

HMU05.1-X		0140-0350	0170-0430	0220-0510	0270-0660	0340-0820	0430-1040	0540-1300	0680-1690
data (at high overload) <sup>1)</sup>									
rated motor power <sup>3)</sup>	[kW]	110	132	160	200	250	315	400	500
basic current	[A]	209	251	303	388	485	610	763	992
maximum current	[A]	314	377	454	582	727	915	1144	1488
data (at high continuous load) <sup>2)</sup>									
rated motor power <sup>3)</sup>	[kW]	132	160	200	250	315	400	500	630
basic current	[A]	251	303	388	485	610	763	992	1173
maximum current	[A]	276	333	427	533	671	839	1091	1291
continuous current	[A]	254	306	392	490	616	771	1002	1185
maximum current	[A]	357	427	515	660	825	1037	1297	1686
rated PWM frequency	[kHz]	4				2			
cable length shielded / unshielded	[m]	100 / 150							

1) : 1,5-fold overload for 1 min during 10 min possible

2) : 1,1-fold overload for 1 min during 10 min possible

3) : mechanical continuous power of 4-pole asynchronous motor at 400 V, 50 Hz

## Product data HMU – Power Supply

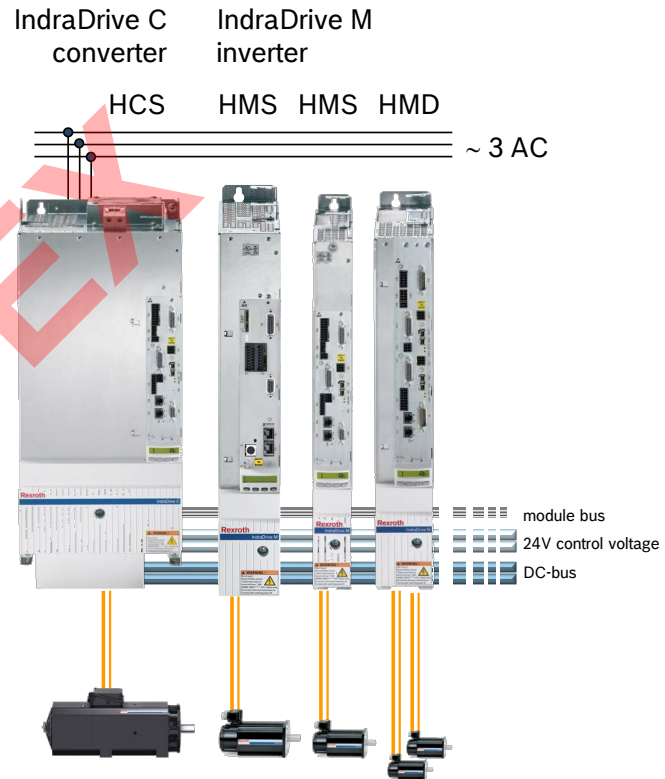
HMU05.1-X		0140-0350	0170-0430	0220-0510	0270-0660	0340-0820	0430-1040	0540-1300	0680-1690
data (at high overload) <sup>1)</sup>									
DC-bus basic power	[kW]	120	144	173	216	270	339	430	535
DC-bus maximum power	[kW]	180	216	260	324	405	509	645	803
data (at high continuous power) <sup>2)</sup>									
DC-bus basic power	[kW]	144	173	216	270	339	430	535	672
DC-bus maximum power	[kW]	158	190	238	297	373	473	589	739
DC-bus continuous power	[kW]	145	174	219	273	342	435	540	679
mains voltage	3AC 380 - 500 V (-15...+10 %)								
mains frequency	50-60 Hz								
mains type	TT, TN, IT								
DC-bus voltage	1,5 x U <sub>mains</sub> - 750 V								
rated PWM frequency	[kHz]	4,2							

1) : 1,5-fold overload for 1 min during 10 min possible

2) : 1,1-fold overload for 1 min during 10 min possible




## Combination converter / inverter

- Combination of converter and inverter
  - converter HCS instead of supply unit HMV
  - converter HCS is the first drive and simultaneously the supply unit for other drives
  - connection of inverters HMS and HMD via DC-bus, module bus and 24 V bus
- Benefits:
  - significantly reduced cabinet volume
  - reduced costs



# IndraDrive control units

## Control units overview

Economy CSE02	Basic CSB02   CDB02	Advanced CSH02
		
Fixed configuration Single-axis	Configurable Single-axis   Double-axis	Configurable Single-axis
Sercos III, EtherCAT	UNIVERSAL *	UNIVERSAL *





## IndraDrive control units

# Control units CSE, CSB, CDB and CSH

### ECONOMY - CSE

- Economic solution for all standard applications

### BASIC - CSB, CDB

- Economic solution for all standard applications
- Wide range of communication interfaces \* (e.g. Sercos)
- Free slot for optional interfaces
- Single- and double-axis versions

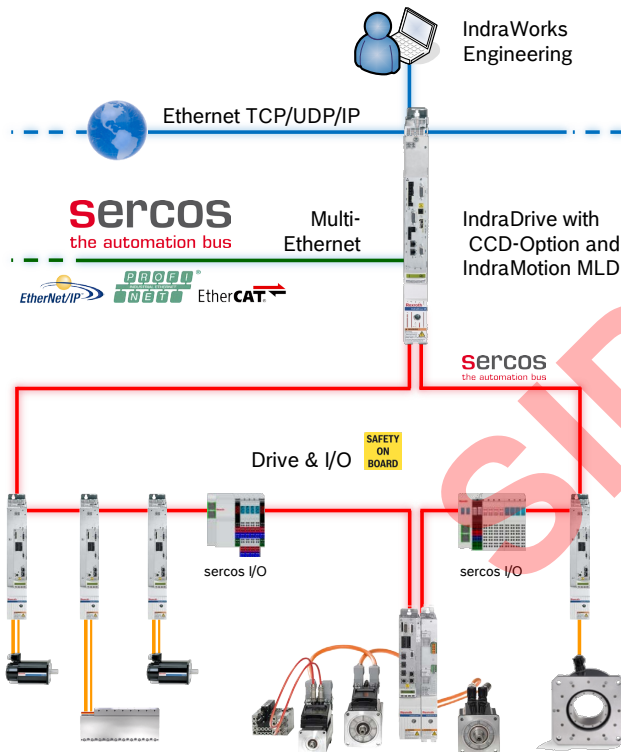
### ADVANCED - CSH

- Maximum flexibility and performance
- Superior control quality and performance
- Wide range of communication interfaces \* (e.g. Sercos)
- Encoder Hiperface®, EnDat 2.1/2.2, 1 Vss, 5 V TTL, SSI, Resolver
- Freely programmable Motion-Logic IndraMotion MLD



ANALOG

# Network with Sercos and Multi-Ethernet



- High drive performance through Fast Ethernet and shortest cycle times with Sercos
- Continuous networking of entire system peripherals through Sercos
- Simple and economic hardware installation without switches/hubs
- Full TCP/IP continuity via NRT-channel
- Maximized availability by redundancy for cable break

## Software module, Visualization



### Software module PFM

- Data carrier for drive firmware
- Simple parameter transfer

### Small operator panels VCP / VR21

- Simplified machine visualization with software tool VI-Composer (VCP) or WinStudio (VR21)
- Communication over Ethernet TCP/IP

### Mobile operator panel VCH / VH21

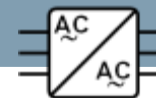
- Safety functions for protection of man and machine
- Enabling and stop switches



## Compact converter HCS01

- Extremely compact converter with full IndraDrive functionality
- 2 product lines for direct mains connection on 110 to 230 VAC and 200 to 500 VAC
- for motors from 50 W up to 9 kW continuous power
- Ethernet-based multi-protocol communication
- Innovative Multi-encoder interface
- Intelligent operator panel with personality module function for drive unit change without PC
- IEC-compliant Motion-Logic IndraMotion MLD
- Integrated safety technology with
  - Safe Torque Off
  - Safe Motion (Selection via 24V I/O, CIP Safety on Sercos or Safety over EtherCAT)





## Product data

	$P_{Cont}$	$P_{Max}$	$I_{Cont}$	$I_{Max}$	H x W x D* (mm)
<b>HCS01</b> 3 AC 110...230 V	0,15 kW	0,45 kW	1,4 A	3,3 A	215 x 50 x 220
	0,25 kW	0,75 kW	2,4 A	6,0 A	215 x 50 x 220
	0,46 kW	1,38 kW	3,0 A	9,0 A	215 x 50 x 220
	0,80 kW	2,40 kW	4,4 A	13,0 A	215 x 50 x 220
	1,80 kW	4,80 kW	7,6 A	18,0 A	268 x 70 x 220
<b>HCS01</b> 3 AC 200...500 V	0,46 kW	1,38 kW	2,0 A	5,0 A	215 x 50 x 220
	0,86 kW	2,58 kW	2,7 A	8,0 A	215 x 50 x 220
	1,70 kW	5,10 kW	7,6 A	18,0 A	268 x 70 x 220
	4,00 kW	9,70 kW	11,5 A	28,0 A	268 x 70 x 220
	14,00 kW	19,00 kW	21,0 A	54,0 A	268 x 130 x 220

\* incl. installation space, for exact dimensions see manual

## IndraDrive Mi

- Decentralized drive system in IP65 for flexible and modular machine and plant concepts
- Open and flexible communication by integrated Multi-Ethernet-interface \*
- High machine safety and productivity with safety options Safe Torque Off, Safe Motion and independent safety zones
- Significant reduction of
  - cabinet volume and cooling, up to 100 %
  - wiring efforts, up to 90 % by innovative hybrid cable
- Simple integration of external I/O-, pneumatic and hydraulic components



\* **sercos**  
the automation bus

**EtherNet/IP**

**PROFINET**

**EtherCAT**

**ETHERNET POWERLINK**

## System components

- KSM02.1
  - Motor-integrated inverter in 4 sizes up to 1,2 kW
  - 4 digital I/O, uncoupled communication, safety technology
- KMS02.1 / KMS03.1
  - Decentral inverter in 2 sizes up to 4 kW
  - 4 digital I/O, uncoupled communication, safety technology
- KMV03: Power Supply Module
  - Decentral power supply up to 7,5 kW cont.
- KCU02.1
  - Control unit for up to 30 IndraDrive Mi
  - Supplied by DC-bus from IndraDrive M or IndraDrive C



## Product data

KSM02.1

Size	$M_{Cont}^*$	$M_{Max}$	$n_{Max}$	H x W x D (mm)
B-041C-42N	2,2 Nm	9,2 Nm	5500 min <sup>-1</sup>	194 x 92 x 282
B-061C-35N	6 Nm	25 Nm	4300 min <sup>-1</sup>	219 x 115 x 311
B-061C-61N	5,5 Nm	18 Nm	6000 min <sup>-1</sup>	219 x 115 x 311
B-071C-24N	10,5 Nm	35 Nm	3400 min <sup>-1</sup>	247 x 140 x 365
B-071C-35N	10 Nm	28 Nm	4700 min <sup>-1</sup>	247 x 140 x 365
B-076C-35N	8,7 Nm	29 Nm	4700 min <sup>-1</sup>	247 x 140 x 340

KMS02.1

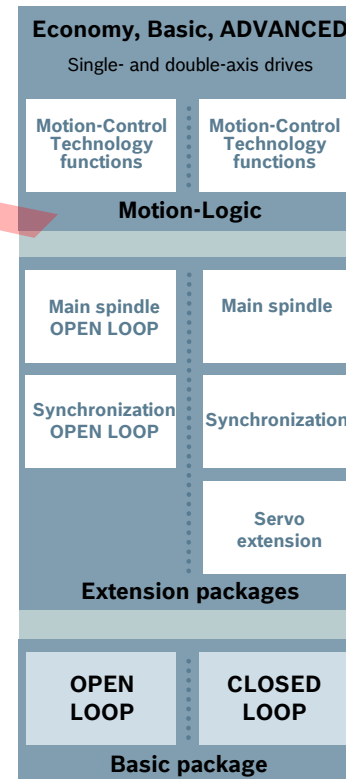
Size	$I_{Cont}$	$I_{Max}$	$V_{DC}$	H x W x D (mm)
B-A018	6 A	18 A	540...750 V	276 x 87 x 147 **

\* 60K \*\* additional installation space required



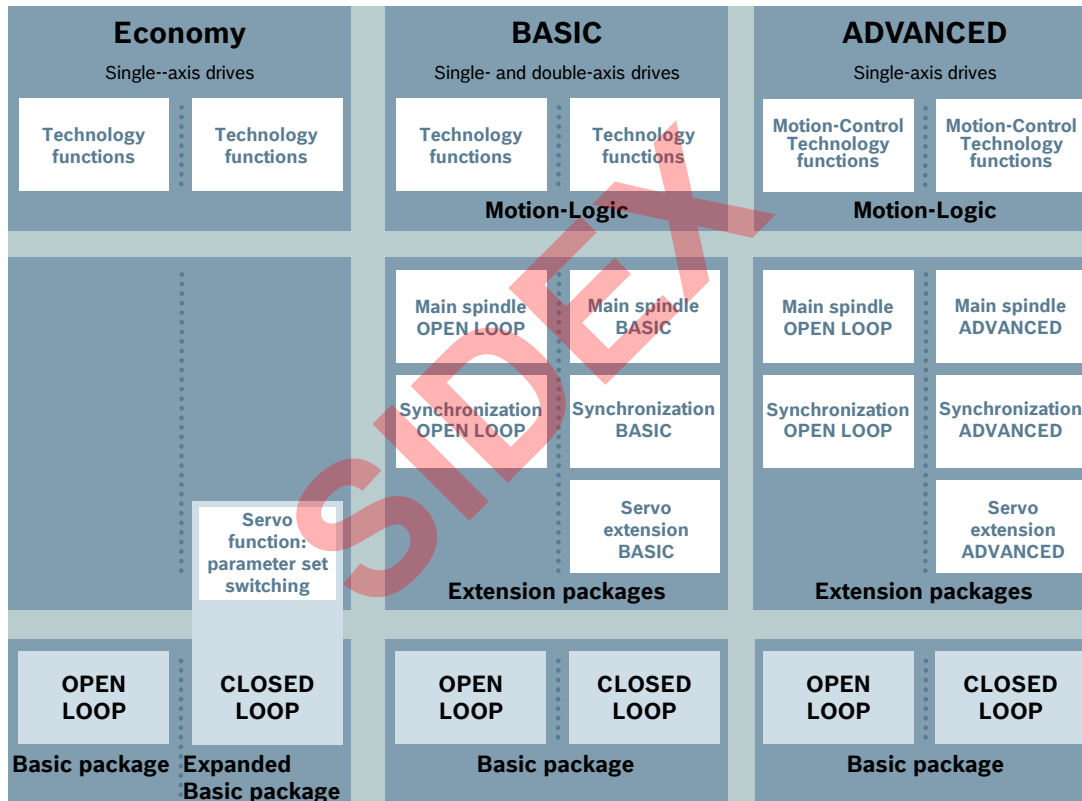
## Firmware FWA

- Basic packages CLOSED LOOP and OPEN LOOP for servo and frequency converter applications
- Standard functions already included in basic packages
- Tailored functionality, individually extendable
- Optional Motion-Logic control IndraMotion MLD with integrated PLC and ready-to-use technology functions



# IndraDrive Firmware

## Firmware FWA



## IndraMotion MLD

- Drive-integrated Motion-Logic Control compliant to IEC 61131-3
- Economic multi-axes-applications with up to 10 servo axes
- Function block library compliant to IEC or PLCopen
- Integrate valuable own know-how directly into the drive
- Intuitive engineering with software framework IndraWorks
- Integration of decentral I/O



## IndraMotion MLD

	MLD-S BASIC	MLD-S ADVANCED	MLD-M ADVANCED
Number of axes	1	1	up to 10
IndraDrive Cs	■	■	■
IndraDrive M/C	■	■	■
IndraDrive Mi	■	—	—
Optional Hardware	Digital I/O modul, bus coupler, function and communications modules, mobile operator panels, visualization panels, embedded-PC or industry-PC (IndraControl V), etc.		
Extensions	IndraMotion For Metal Forming, IndraMotion For Handling, IndraMotion For Packaging, IndraMotion For Printing & Converting, Productivity Agent, Easy Handling, Sytronix, etc.		

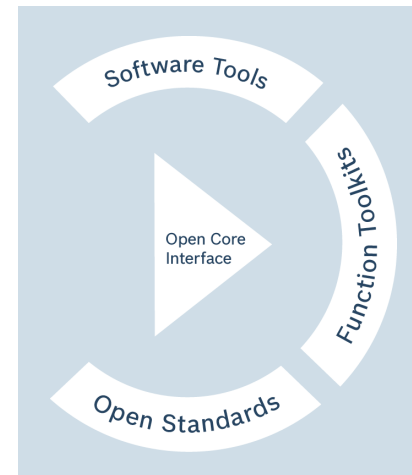
*Permissible combinations and technical data s. product catalog and manuals*

# Discover new levels of flexibility and efficiency

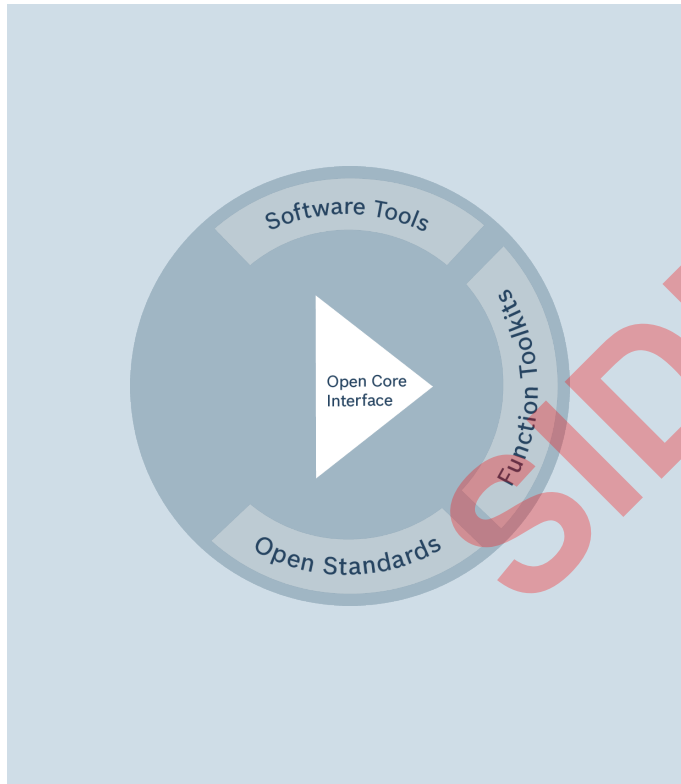
### Open Core Engineering for Drives

combines in all phases of the machine lifecycle the efficiency of motion-based engineering with

- **Software Tools** (Project management, Motion toolboxes, Programming, HMI project planning, Diagnosis)
- **Function Toolkits** (Technology, Handling, Visualization, Energy management, Condition monitoring, Open Connectivity, Enhanced Axis Coupling)
- **Open Standards** (Sercos, Ethernet, OPC, Open Fieldbus Standards, ISO Automation Standards, IEC Automation Standards)



# Open Core Interface...



... for new levels of freedom in automation










- More efficiency in engineering
- Direct access to drive functions
- Bridge between PLC and IT-based automation

... addresses different application areas using IT technologies such as

- **Smart devices** in automation
- **PC based IT Automation**
- **Rapid control prototyping**

# Open Core Engineering for Drives

## Technical solutions with Open Core Interface

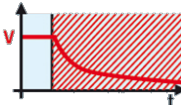
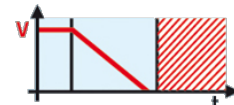
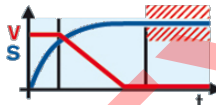
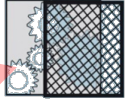
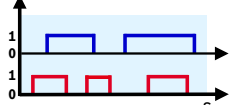
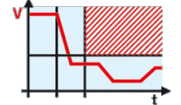
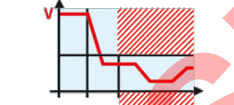
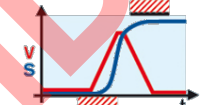
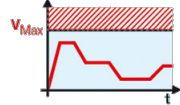
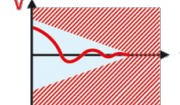
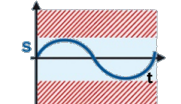
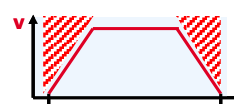

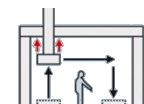

Application	Smart Device	IT Automation					Rapid Control Prototyping		
Device Platform	Smart Device	PC					cRIO	PC	
Operating System	Windows	Windows			Linux		Linux vxWorks	Windows	
Development Environment	 Visual Studio	 Visual Studio	 Excel, Word, PowerPoint	 Eclipse	 Mono	 Eclipse	 LabVIEW	 LabVIEW	 MATLAB
High level language	C#, C++, C	C/C++, C#, VB	VBA	Java	C/C++	Java	G	G	MATLAB
Toolbox	.NET	.NET	.NET	Java	Linux	Java	CoE-LabVIEW*	S/IP-LabVIEW	MATLAB
IndraDrive Support	In preparation	+	+	In preparation	In preparation	In preparation	+	+	In preparation

\* CoE: CANopen over EtherCAT

S/IP: Sercos Internet Protocol

# Safety on Board

## Safety functions up to category 4, PL e, SIL 3 <sup>1)</sup>

<b>STO</b> Safe Torque Off 	<b>SS1 / SS1-ES</b> Safe Stop 1 / Safe Stop 1 Emergency Stop 	<b>SS2 (SOS)</b> Safe Stop 2 with Safe Operating Stop 	<b>SDL <sup>2)</sup></b> Safe Door Locking 	<b>SCA</b> Safe Cam 
<b>SLS</b> Safely Limited Speed 	<b>SDI</b> Safe Direction 	<b>SLI</b> Safely Limited Increment 	<b>SMS <sup>2)</sup></b> Safe Maximum Speed 	<b>SMD <sup>2)</sup></b> Safely Monitored Deceleration 
<b>SMP <sup>2)</sup></b> Safely Monitored Position 	<b>SLP, SLE <sup>2)</sup></b> Safely Limited Position 	<b>SIO <sup>2)</sup></b> Safe Inputs / Outputs 	<b>SBS <sup>2)</sup></b> Safe Braking and Holding System 	<b>SBC</b> Safe Brake Control 

**SAFETY  
ON  
BOARD**

<sup>1)</sup> acc. to EN 13849-1, EN 61800-5-2, EN 62061, EN 61508 <sup>2)</sup> Not defined in EN 61800-5-2



# Benefits of a drive-integrated solution

- Economic package with independent drive-integrated system
  - saves additional measuring devices and sensors
  - saves cabinet space, hardware limit switches, etc.
  - saves certification efforts and costs for customers
- Minimized motion in case of emergency due to extremely fast fault detection within 1 ms
- Increased productivity by reduction of special operation times
  - no downtime waiting for mains breaker or synchronization of coupled axes
  - online-testing (failure detection) during runtime
- High reliability by complete and integrated solution

# IndraWorks – the innovative engineering tool



- Intuitive operation with context-sensitive wizards and online help
- One engineering framework for IndraMotion, IndraLogic, IndraDrive
- Faster commissioning through „Easy Startup Mode“
- Quick cam disk and motion profile building by integrated CamBuilder
- Simple integration of sercos by network scanning and automatic address assignment
- Seamless integration of open FDT/DTM standards

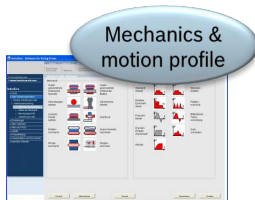
FDT/DTM = Field-Device-Tool/Device-Type-Manager

## IndraSize – the turbo for drive sizing

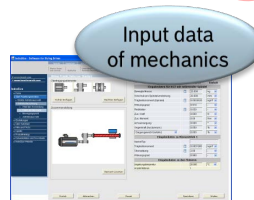


Free download  
[www.boschrexroth.com/indrasize](http://www.boschrexroth.com/indrasize)

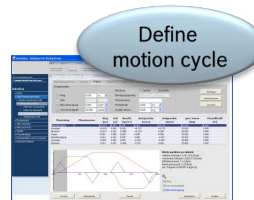
- Contains all common drive mechanisms
- Visual guidance for replication of machine kinematic
- Build motion profiles with simple parameter values
- Data base with all Rexroth motor-drive-combinations
- Optimized drive selection without oversizing



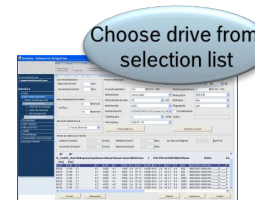
Mechanics & motion profile



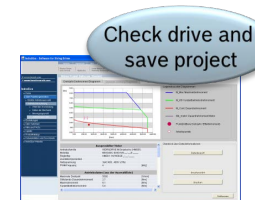
Input data of mechanics



Define motion cycle



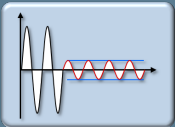
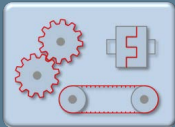
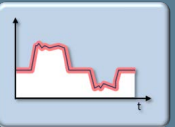
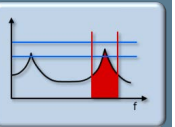
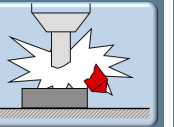
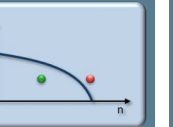

Choose drive from selection list



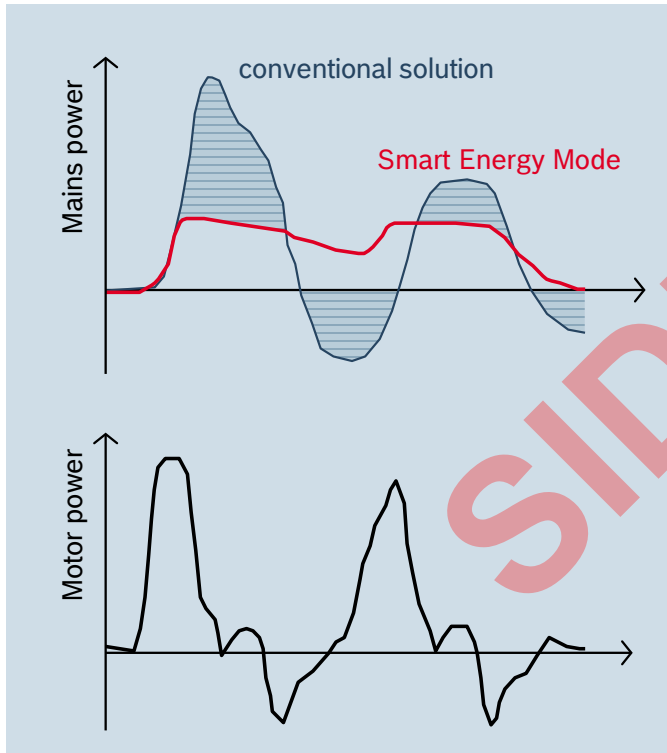
Check drive and save project

## Productivity Agent

- Improving product quality and product quantity with minimized transient time → higher precision and dynamics
- Optimizing machine availability with maintenance in time instead of unexpected machine downtime
- Reducing life-cycle costs by condition-oriented monitoring instead of fixed replacement intervals
- Extending machine lifetime → prevent consequential damage with early detection of wear

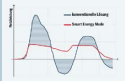
<p><b>Active Vibration Damping</b></p> <p>reduced transient time and higher accuracy</p> 	<p><b>Mechanical Analysis</b></p> <p>simple and quick check of axis mechanics</p> 	<p><b>Envelope Curve Monitoring</b></p> <p>online monitoring of machining process</p> 	<p><b>Frequency Response Analysis</b></p> <p>detailed analysis of mechanics</p> 	<p><b>Collision Monitoring</b></p> <p>configurable online-recorder</p> 	<p><b>S1 Characteristic Analysis</b></p> <p>configurable monitoring of operating point</p> 	<p><b>Process Controller</b></p> <p>controlling with reference to external signal</p> 
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------

## Supply units with Smart Energy Mode



- Reduces energy consumption but keeps level of performance
  - up to 30 % less energy
  - up to 50 % less peak power
  - mechanical output power remains unchanged
- Higher energy efficiency and productivity with IndraDrive

## Supply units with Smart Energy Mode

	Conventional supply unit		Supply unit with Smart Energy Mode	
	feeding	regenerating		
High DC-bus voltage	—	+	+	<ul style="list-style-type: none"> <li>allows higher speeds with smaller drives</li> <li>lower currents → reduced losses in power stage and allows using smaller drive controllers</li> </ul>
Controlled bus voltage	—	+	+	<ul style="list-style-type: none"> <li>decouples drive from mains voltage fluctuations → no influence on performance</li> <li>allows use in wide voltage range → simplified engineering for global applications</li> </ul>
Using energy storage on DC-bus	+	—	+	<ul style="list-style-type: none"> <li>prevents unnecessary pulse operation → reduces energy consumption and peak loads in mains</li> </ul>

Supply units with Smart Energy Mode combine the benefits from both principles:

- Energy buffering of feeding supply units
- Independency from mains voltage and high DC-bus voltage of controlled regenerating supply units

# IndraDrive and IndraDyn drive systems

## Content

### IndraDrive

- Drive systems at a glance
- Converters, supply units, single- and double-axis inverters
- Control units, integration, visualization
- Compact converters
- Decentralized drive technology
- Firmware functions, motion logic, safety technology, engineering, drive sizing, productivity agent, smart energy

### IndraDyn

- Synchronous and asynchronous servo motors, linear and rotary direct drives, planetary gearboxes

### Rexroth 4EE

- Rexroth for Energy Efficiency

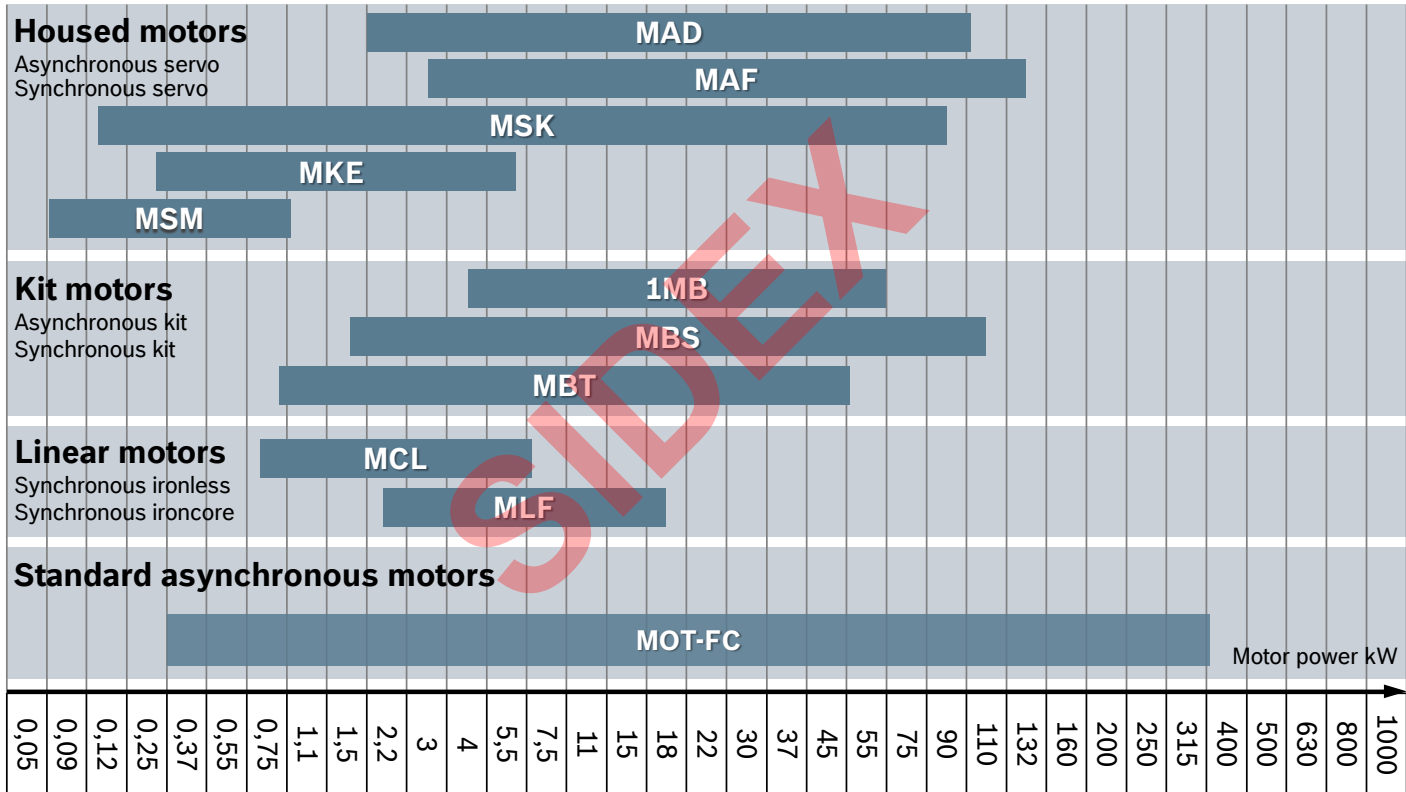
# IndraDrive and IndraDyn drive systems

## Motors and gear boxes overview

IndraDyn S MSK	IndraDyn S MKE	IndraDyn S MSM	IndraDyn A MAD, MAF	IndraDyn E MOT-FC	Gear box GTE, GTM
					
Synchronous servo $M_{\max}$ up to 631 Nm	Synchronous servo Ex d ATEX, UL/CSA $M_{\max}$ up to 187 Nm	Synchronous servo for IndraDrive Cs $P_N$ up to 750 W	Asynchronous servo $P_N$ up to 120 kW	Asynchronous standard IE2 $P_N$ up to 315 kW	Planetary servo gearbox $\eta$ up to $\geq 97\%$
IndraDyn L MLF	IndraDyn L MCL	IndraDyn T MBT	IndraDyn H MBS	IndraDyn H 1MB	
					
Synchronous linear ironcore $F_{\max}$ up to 21,500 N	Synchronous linear ironless $F_{\max}$ up to 3,320 N	Synchronous torque $M_{\max}$ up to 13,800 Nm	Synchronous high-speed $n_{\max}$ up to 22,500 rpm	Asynchronous high-speed $n_{\max}$ up to 20,000 rpm	



## IndraDyn power range



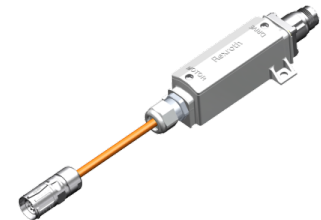
# Synchronous servo motors MSK

- Wide product range in one modular product line with 7 basic sizes
  - MSK030, 040/043, 050, 060/061, 070/071/075/076, 100/101/103, 131/133
- Compact design with high torque density
- Practice-oriented grading of geometric dimensions
- Many combinable options
- Scalable functionality from Standard to High-End
  - Hiperface encoder with 16 or 128 signal periods, single- and multiturn, flange accuracy and run-out class „N“
  - EnDat-Geber with 2048 signal periods, single- and multiturn, improved flange accuracy and run-out „R“, functional safety SI



# Synchronous servo motors MSM

- High power density and dynamics with short motor length and minimized flange dimensions
- 3 sizes from 50 W to 750 W permanent power
  - MSM019A/B – 0,16/0,32 Nm / □ 38
  - MSM031B/C – 0,64/1,3 Nm / □ 60
  - MSM041B – 2,40 Nm / □ 80
- Compact design
- Degree of protection IP54
- Improved 20bit multiturn-absolute encoder
- Brake and keyway optional
- Metal plugs M17
- New improved battery-box



# Synchron-Servomotoren MKE

- Product line with 4 motor sizes
  - MKE037, MKE047, MKE098, MKE118
- Flameproof encapsulation for use in hazardous areas with inflammable gases, vapors and dust
- Certified acc. to world-wide acknowledged standards ATEX, UL, KCS\*
- Certified drive system MKE with IndraDrive and cables RKG/RKS
- Electrical connections acc. to Ex-standards



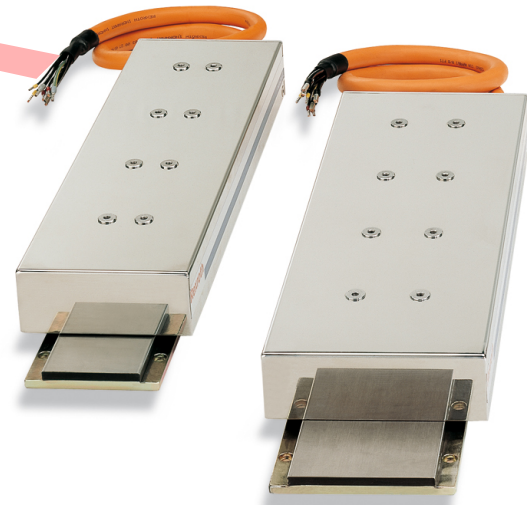
# Asynchronous servo motors MAD and MAF

- Wide product range in one modular product line with 7 sizes
  - MAD/MAF100, 130, 160, 180, 225
- Compact design with high power density
- Scalable functionality from Standard to High-End
  - fan cooling or water cooling
  - wide range of options for drive shaft, bearings, electrical connection, vibration severity, brake, motor mounting, encoder, etc.
- Service-friendly motor design



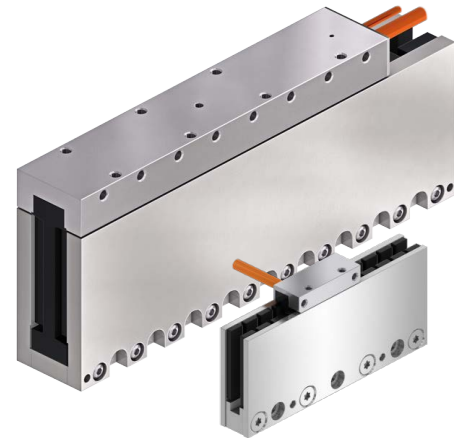
# Synchronous linear ironcore motors MLF

- Wide product range with 6 motor sizes
  - primary parts MLP040, 070, 100, 140, 200, 300 each with several individual motor length
  - secondary parts with 150, 450, 600 mm
  - maximum force up to 21,500 N
  - maximum velocity up to 600 m/min
- Practice-oriented features
  - stainless-steel encapsulation
  - liquid cooling of primary part
- Optional accessories:  
Hall-sensor box, profiled rail systems, integrated measuring system



# Synchronous linear ironless motors MCL

- Scalability within a kit system of 5 sizes
  - primary parts 015, 020, 030, 040, 070 each with several lengths
  - secondary parts in 120, 180, 300 mm (size 015: 66 and 99 mm)
  - maximum force up to 3320 N
  - maximum speed up to 1,400 m/min
- Low weight, high acceleration and dynamics
- No saturation effect, perfect control quality
- Simple integration through individual mounting possibilities
- Optional accessories:  
Hall-sensor units, profiled rail systems, integrated measuring system



# Synchronous torque motor MBT

- Modular kit system with 7 sizes
  - 130,160,210,290,360,450,530 each with various lengths
  - maximum torque up to 13.800 Nm
  - maximum speed up to 4.000 rpm
  - very low torque ripple
  - high overload capacity > 2
- Liquid cooling of stator
  - cooling jacket open or encapsulated
  - operation without liquid cooling possible (approx. 40% remaining torque)
- Extremely resistant protective stator coating and bandaged rotors
- Simple integration in individual machine designs





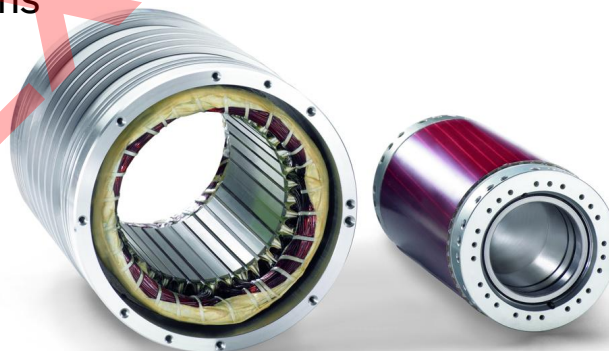
# Synchronous high-speed motors MBS

- Wide product range with 10 motor sizes
  - 102, 142, 162, 182, 202, 242, 272, 312, 382, 482 each with several individual motor length
  - practice-oriented scaling of dimensions
  - maximum torque up to 4,500 Nm
  - maximum speed up to 22,500 rpm
  - field weakening range 1 : 4...6
- In comparison to asynchronous motors:
  - power improved by min. 40%
  - wider range of constant power
  - higher efficiency, lower rotor temperature
- With IndraDrive no ext. voltage protection module necessary



# Asynchronous high-speed motors 1MB

- Wide product range with 10 motor sizes
  - 105, 140, 160, 200, 240/241/242, 270, 310, 375, each with several individual motor length
  - practice-oriented scaling of dimensions
  - Permanent power up to 55 kW
  - Permanent torque up to 875 Nm
  - Maximum speed up to 20,000 rpm
- Options
  - electrical connection on both sides
  - rotor with hydraulic loosening bush
  - optional multiple temperature sensors
- Kit motor for individual machine concepts



# Planetary servo gearboxes

- GTE
  - economic and compact
  - backlash 6...25'
  - $M_{OutN}$  up to 800 Nm
  - $n_{InN}$  up to 5,000 rpm
- GTM
  - for high-end applications
  - backlash 2...6'
  - $M_{OutN}$  up to 6,000 Nm
  - $n_{InN}$  up to 6,000 rpm
- Delivered individually or mounted ex works, no charge for assembly



*Permissible combinations and technical data s. Product Catalog and Documentation*

## Content

### IndraDrive

- Drive systems at a glance
- Converters, supply units, single- and double-axis inverters
- Control units, integration, visualization
- Compact converters
- Decentralized drive technology
- Firmware functions, motion logic, safety technology, engineering, drive sizing, productivity agent, smart energy

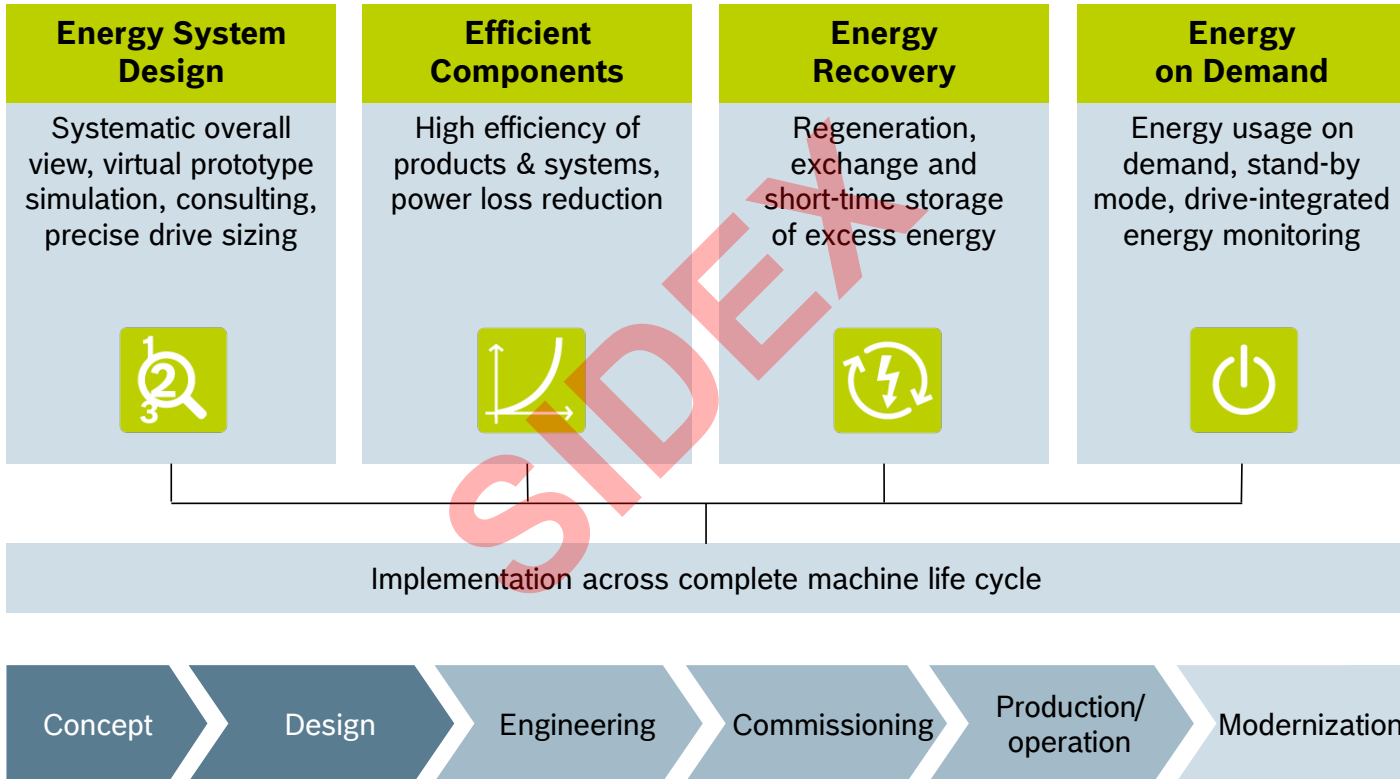
### IndraDyn

- Synchronous and asynchronous servo motors, linear and rotary direct drives, planetary gearboxes

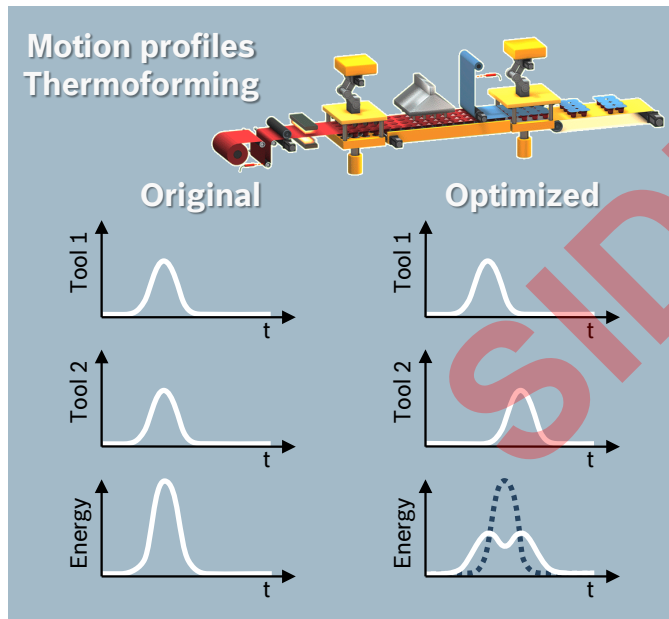
### Rexroth 4EE

- Rexroth for Energy Efficiency

## Rexroth 4EE – 4 levers for a systematic approach



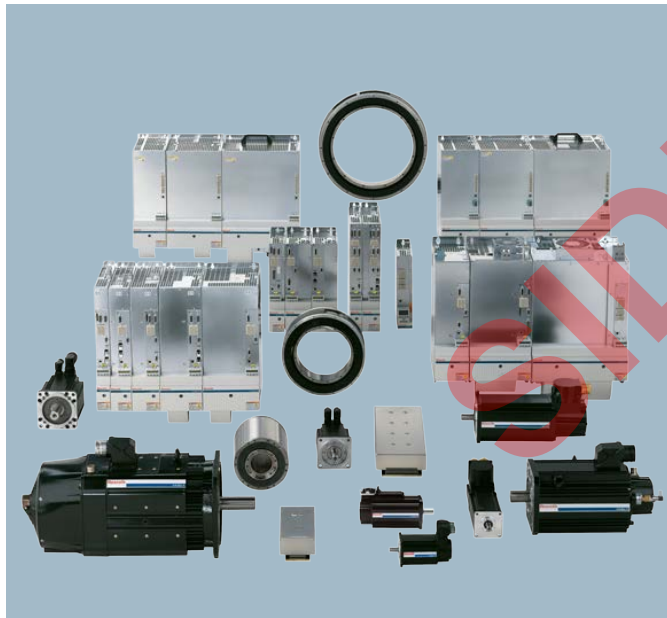
## Energy System Design



The best machine concept  
for your tasks

- Consulting and engineering support in concept phase
- Sizing optimized motor-controller combinations with IndraSize
- Simulation of entire system
- Virtual optimization of process and energy consumption
- Generation of energy-efficient motion profiles
- Reduction of peak power demand (Smart Energy Mode)

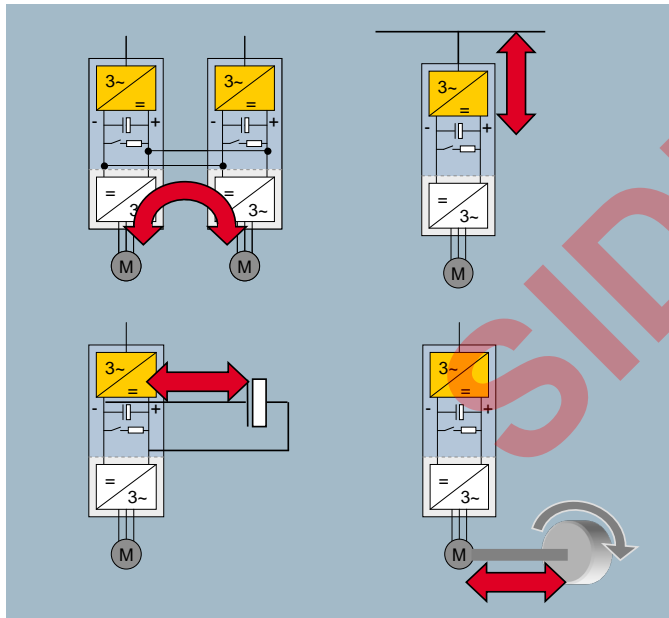
## Efficient Components



Energy-efficient components for perfect interaction

- High efficiency
  - drive controllers up to 98%
  - synchronous motors with optimized windings up to 97%
  - planetary gearboxes up to 97 %
- Decentralized drive technology with reduced energy loss in the cabinet and shorter cables

## Energy Recovery



Recover, use and store excess energy

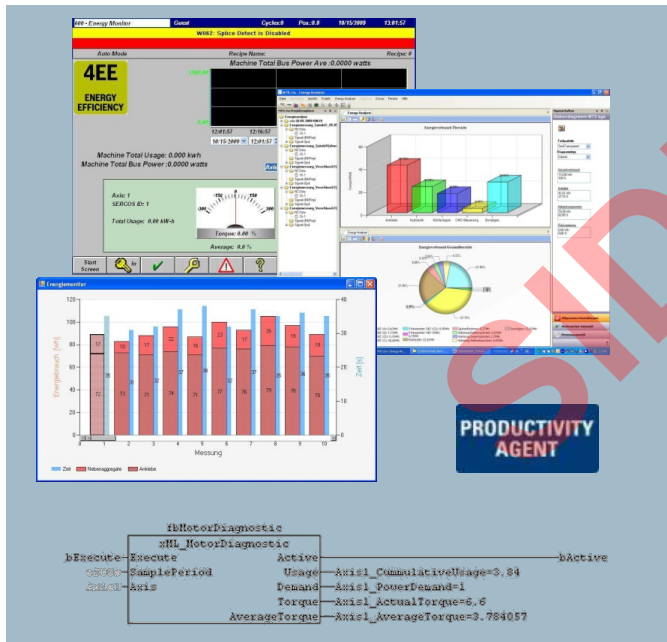
- Energy exchange over DC-bus between axes in motor mode and generator mode
- Sinusoidal regeneration of excess energy into the grid
- Short-time buffering of valuable energy by
  - capacitors (Electric Buffering)
  - flywheel mass (Kinetic Buffering)



## Energy on Demand



### Energy usage on demand



- Use only as much energy as really needed
- Temperature-dependent fan control
- Reduce magnetizing current of an asynchronous motor in part-load operation ( $I^2R$  losses)
- Sercos energy profile for energy-efficient stand-by mode
- Drive-integrated energy monitoring
  - power consumption / output
  - kWh-meter

# IndraDrive and IndraDyn drive systems

## Public Information Sources

- IndraDrive product catalog and downloads

<http://www.boschrexroth.com/indradrive>

- IndraDyn product catalog and downloads

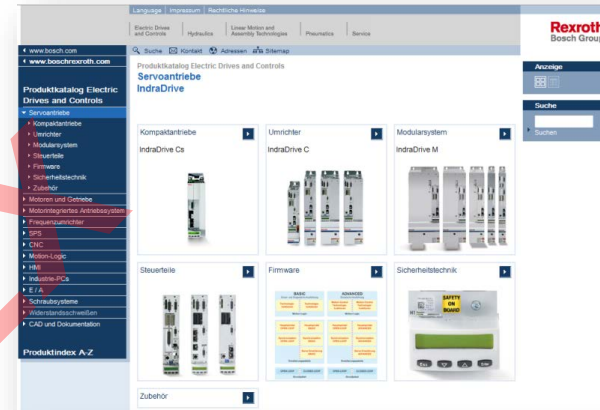
<http://www.boschrexroth.com/indradyn>

- CAD download

<http://www.boschrexroth.com/dcc/ElektrischeAntriebe/DownloadExplorer.cfm>

- Printed catalogs, manuals, etc.. (PDF)

<http://www.boschrexroth.com/mediadirectory>



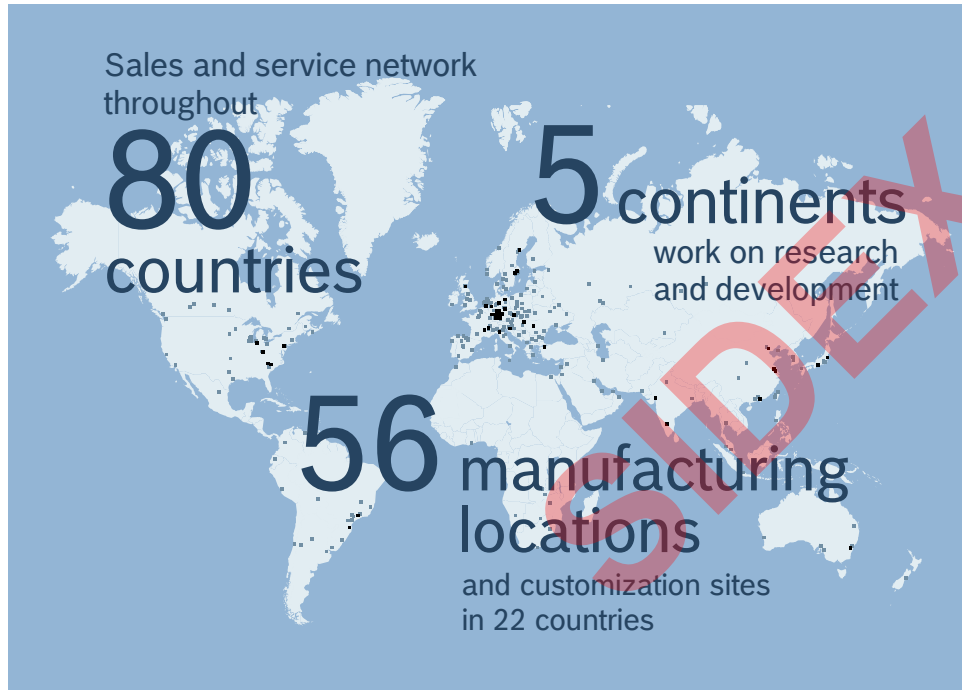
# Why IndraDrive and IndraDyn?

- Drive platform from 0,05 kW to 4MW kW with continuous functionality and usability
- Unique, parameterizable functional diversity with open interface architecture
- Valuable additional functions includable in the drive unit, such as certified safety technology, Motion-Logic, application-oriented technology packages, etc.
- Complete motor portfolio with wide range of servo motors and direct-drive technology
- Powerful and user-oriented engineering tools
- Active global service network with product trainings, technical support on-site, Engineering Network, repair service and 24/7 hotline



## We are the Drive & Control Company

### To be global



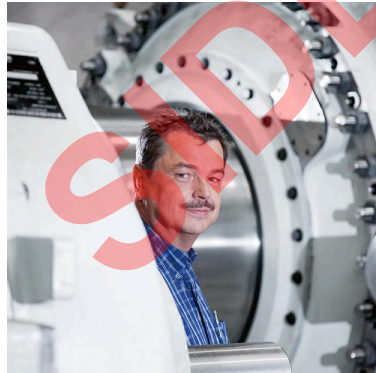
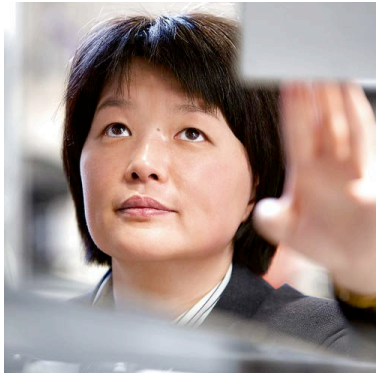
- Global expertise
- At home in every country
- Solve unique challenges in local markets
- International project management



### We go local

We are the Drive & Control Company

We never give up until the right solution is found



Thank you for your attention!