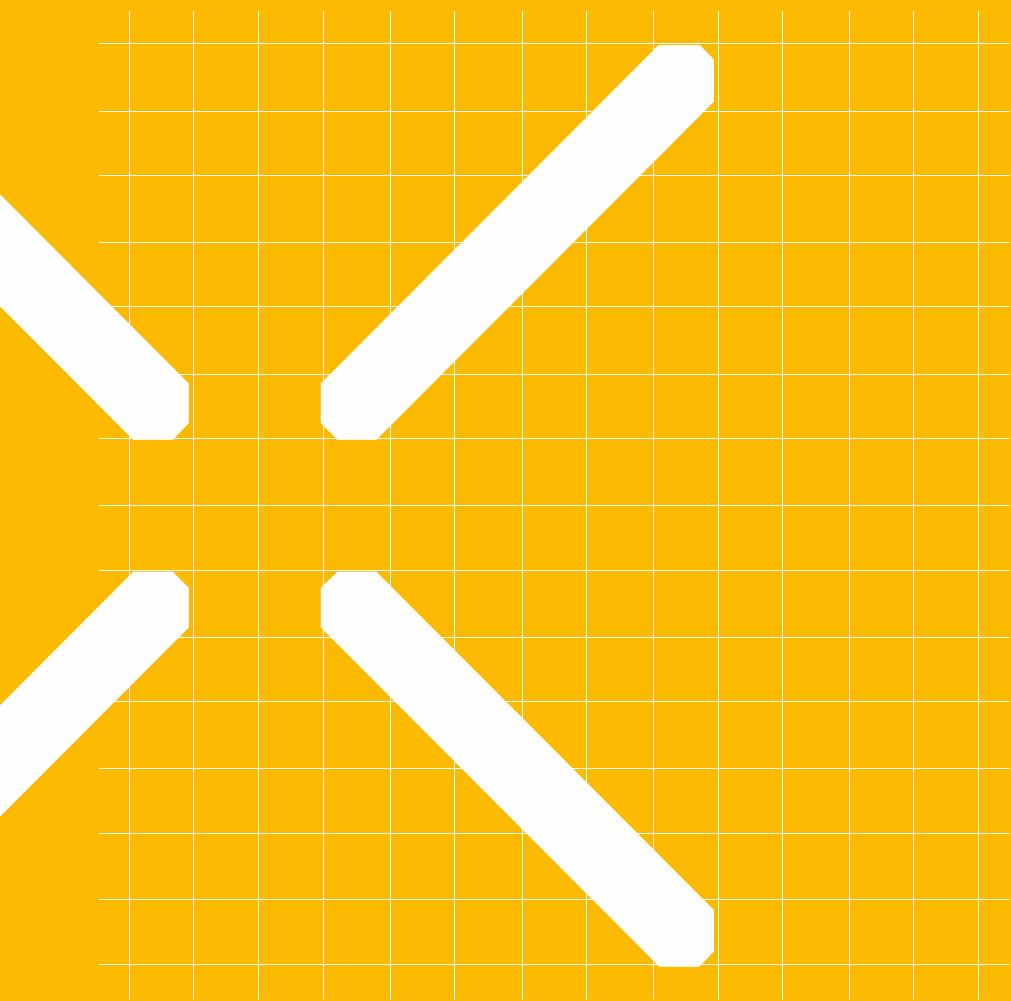


EWELLIX
MAKERS IN MOTION

**Compact ElectroMechanical Cylinders
New Generation of CEMC**

December 2019



01

Introduction

01. CEMC redesign project

The goals:

Create the « best-in-class » actuator for spot welding, delivering customer value as:

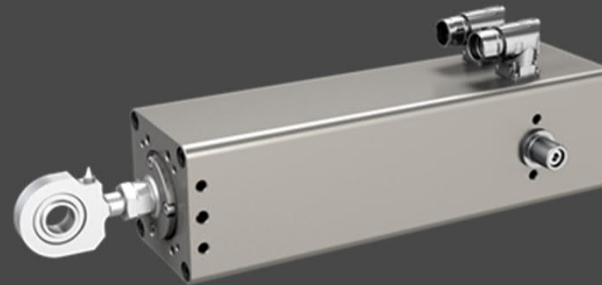
- Improved productivity
- Higher output quality
- Easy integration
- Cost competitive solution

The product:

- Linear electro-mechanical actuator equipped with 21x5 and 21x10 (coming / Q4-2020) inverted roller screws
- Load up to 25 kN and linear speed of 600 mm/s
- Integrated hollow shaft servomotor
- Modular design with several attachment, position and force feedback options

CEMC NMO

NEW



02. CEMC history in spot welding

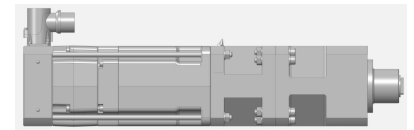
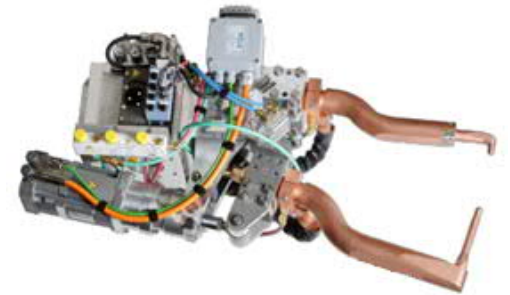
**Robots manufacturers:
Kuka, ABB, Fanuc, ...**

System integrators

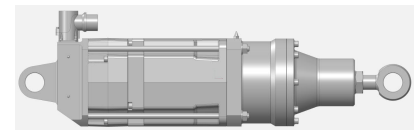
**2000: CEMC development
based on inverted roller
screw**

**Main end users:
AUDI, Daimler, ...**

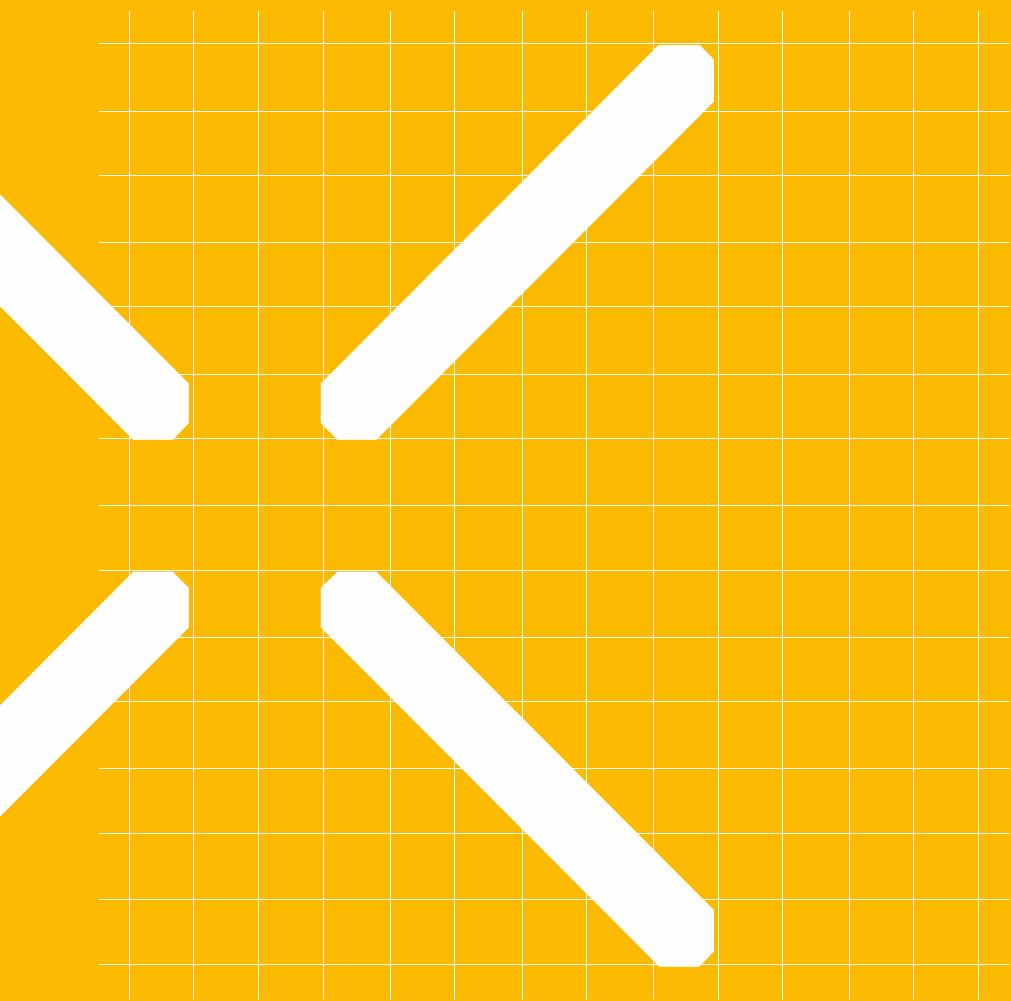
**Production: > 5000
units**



Type: C / □ 90mm
Welding force : 7 kN



Type: X / □ 120mm
Welding force : 14 kN

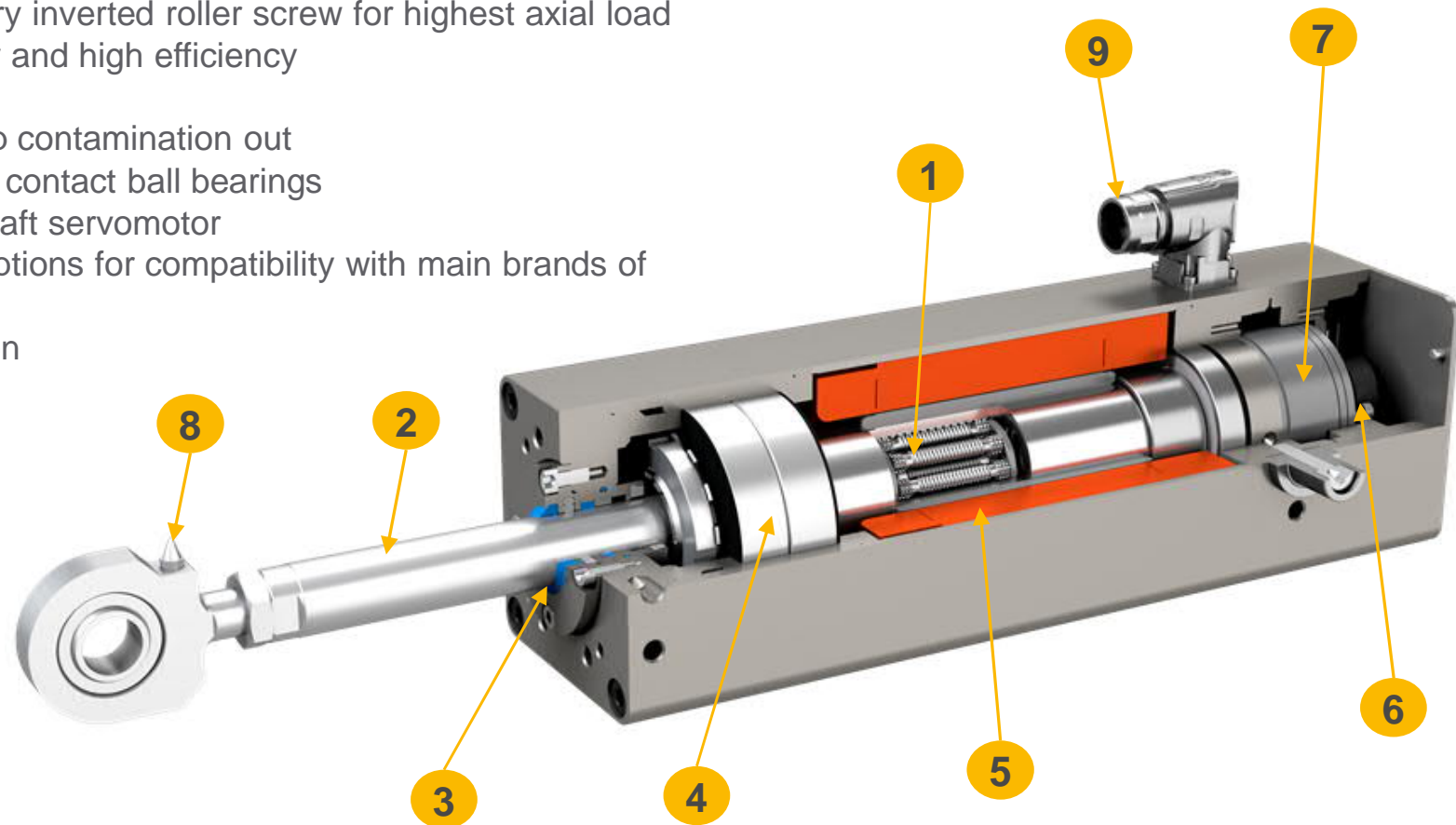


02

Technical proposal

03. Design overview

1. High quality planetary inverted roller screw for highest axial load rating, low axial play and high efficiency
2. Push tube
3. Scraper seal to keep contamination out
4. High quality angular contact ball bearings
5. Integrated hollow shaft servomotor
6. Position feedback options for compatibility with main brands of robots/controllers
7. Fail safe brake option
8. Lubrication nipple
9. Motor connectors



04. Features and benefits

Features

Very **compact** and fully integrated design

Long service life thanks to **inverted roller screw** technology

High power density

High speed and **acceleration** capabilities

High resolution of position feedback

Low maintenance requirements

Benefits

Space saving & easy replacement of existing solutions

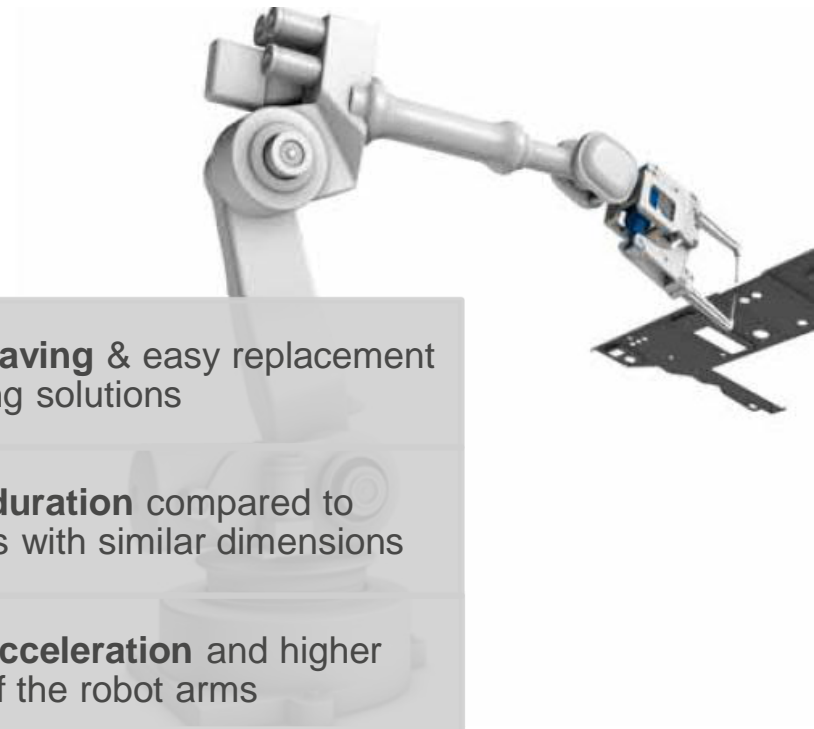
Higher duration compared to actuators with similar dimensions

Higher **acceleration** and higher **speed** of the robot arms

Faster production cycles

Better process control and stability vs fluid-powered actuation

Higher productivity



05. Technical data – natural convection cooling

Technical data

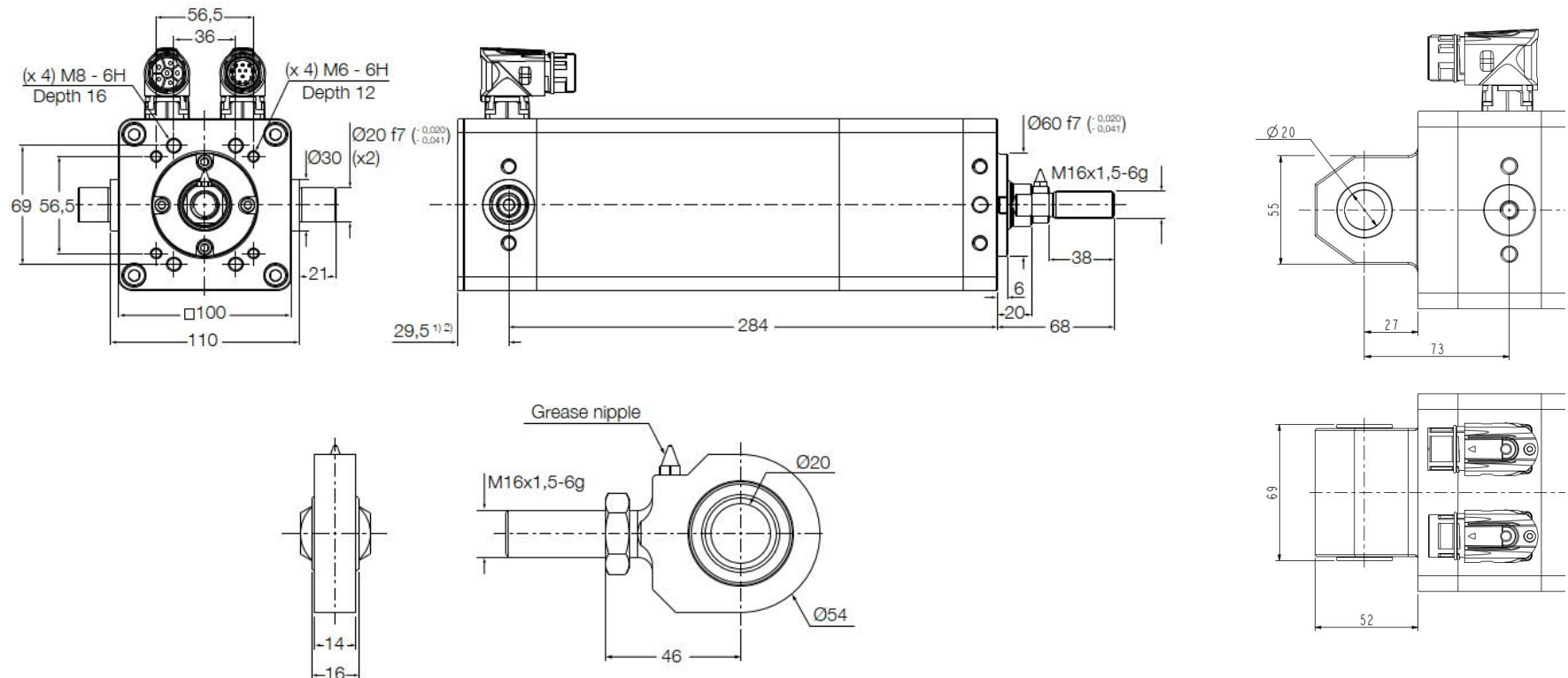
Designation	Symbol	Unit	A3N	B3N	A5N	B5N
Performance data						
Continuous force @ zero speed	F_{z0}	kN	6,9	6,8	10,4	10,4
Peak force @ zero speed	F_{z0}	kN	14,0	13,7	25	25
Dynamic load capacity	C	kN	59	59	59	59
Holding force (motorbrake option)	F_{brake}	kN	15,8	15,8	15,8	15,8
Max linear speed	v_{max}	mm/s	300	300	300	300
Max linear acceleration	a_{max}	m/s ²	7	7	7	7
Duty cycle	D	%	100	100	100	100
Mechanical data						
Screw type	-	-	IRS	IRS	IRS	IRS
Screw diameter	d_{screw}	mm	21	21	21	21
Screw lead	p_{screw}	mm	5	5	5	5
Lead accuracy	-	-	G5	G5	G5	G5
Stroke	s	mm	180	180	180	180
Internal overstroke each side	s_0	mm	1	1	1	1
Backlash	$s_{backlash}$	mm	0,04	0,04	0,04	0,04
Gear reduction	i	-	1	1	1	1
Inertia	J	10 ⁻⁴ kgm ²	8	8	8	8
Inertia of optional brake	J_{brake}	10 ⁻⁴ kgm ²	0,6	0,6	0,6	0,6
Weight	m	kg	11,4	11,4	12,8	12,8
Weight of optional brake	m_{brake}	kg	1,1	1,1	1,1	1,1
Electrical data						
Motor type	-	-	servo	servo	servo	servo
Drive voltage supply (nominal)	U	V _{AC}	400	230	400	230
DC bus voltage supply (minimum)	U	V _{DC}	540	325	540	325
Nominal speed	n_{nom}	rpm	3 600	3 430	3 485	3 600
Max speed	n_{max}	rpm	3 600	3 600	3 600	3 600
Nominal torque @ slow speed ¹⁾	T_{z0}	Nm	7,8	7,7	11,8	11,8
Nominal current @ slow speed ¹⁾	I_{z0}	A _{max}	5,1	8	7,3	12,5
Peak torque @ slow speed ¹⁾	T_{z0}	Nm	15,9	15,6	28,4	28,4
Peak current @ slow speed ¹⁾	I_{z0}	A _{max}	11	17	19	32
Nominal power	P	kW	2,7	2,6	3,9	4,0
Torque constant (K _t at 25 °C)	K _t	Nm/A _{max}	1,67	1,06	1,76	1,02
Back emf constant at 1 000 rpm (K _e at 25 °C)	K _e	V _{max}	0,96	0,61	1,02	0,59
Winding resistance (at 20 °C) ²⁾	R	Ω	4,33	1,74	2,41	0,81
Winding inductance (at 20 °C) ²⁾	L	mH	14,97	6	10,01	3,35
Water flow (max pressure 5 bars)	-	l/min	-	-	-	-
Water temperature	-	°C	-	-	-	-
Pole number	-	-	8	8	8	8
Insulation class	-	-	H	H	H	H
Thermoswitch	-	-	PTC130	PTC130	PTC130	PTC130
Temperature sensor	-	-	PT1000	PT1000	PT1000	PT1000
Environment						
Ambient temperature	T _{ambient}	°C	0...+40	0...+40	0...+40	0...+40
Degree of protection	IP	-	54S	54S	54S	54S

¹⁾ Slow speed < 1% max actuator speed
²⁾ Phase to phase



06. Technical data – natural convection cooling

Dimensional drawing



¹⁾ For brake option, add 46 mm

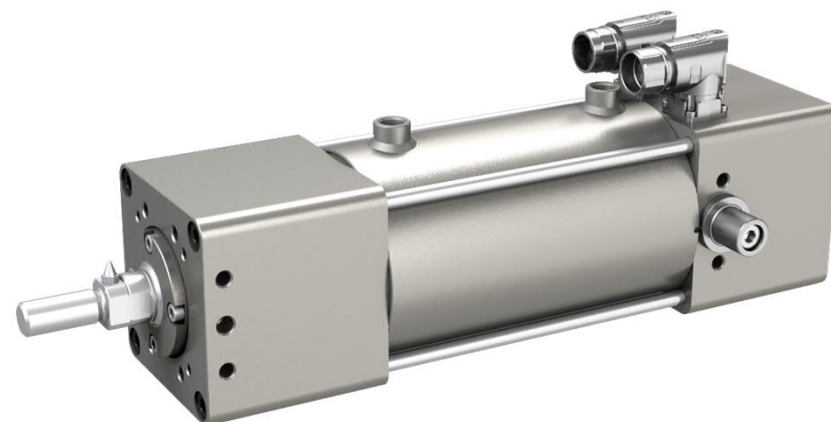
²⁾ Addition length varies depending on the type of feedback device. Please contact Ewellix.

07. Technical data – water cooling

Technical data

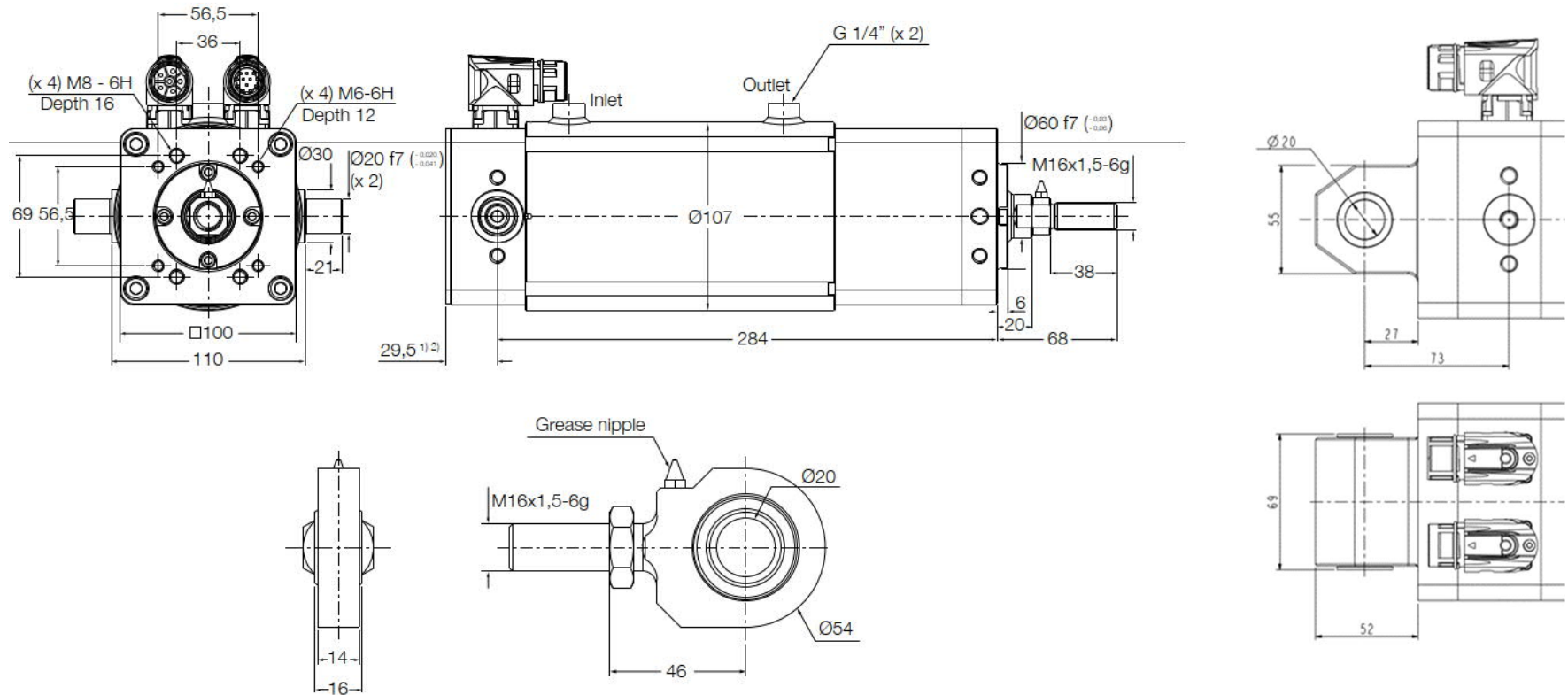
Designation	Symbol	Unit	A3W	B3W	A5W	B5W
Performance data						
Continuous force @ zero speed	F_{z0}	kN	10,3	10,3	18,2	18,4
Peak force @ zero speed	F_{z0}	kN	20,1	20,1	25	25
Dynamic load capacity	C	kN	59	59	59	59
Holding force (motorbrake option)	F_{brake}	kN	15,8	15,8	15,8	15,8
Max linear speed	v_{max}	mm/s	300	300	300	300
Max linear acceleration	a_{max}	m/s ²	7	7	7	7
Duty cycle	D	%	100	100	100	100
Mechanical data						
Screw type	-	-	IRS	IRS	IRS	IRS
Screw diameter	d_{screw}	mm	21	21	21	21
Screw lead	p_{screw}	mm	5	5	5	5
Lead accuracy	-	-	G5	G5	G5	G5
Stroke	s	mm	180	180	180	180
Internal overstroke each side	s_0	mm	1	1	1	1
Backlash	$s_{backlash}$	mm	0,04	0,04	0,04	0,04
Gear reduction	i	-	1	1	1	1
Inertia	J	10 ⁻⁴ kgm ²	8	8	8	8
Inertia of optional brake	J_{brake}	10 ⁻⁴ kgm ²	0,6	0,6	0,6	0,6
Weight	m	kg	12,8	12,8	14,2	14,2
Weight of optional brake	m_{brake}	kg	1,1	1,1	1,1	1,1
Electrical data						
Motor type	-	-	servo	servo	servo	servo
Drive voltage supply (nominal)	U	V _{AC}	400	230	400	230
DC bus voltage supply (minimum)	U	V _{DC}	540	325	540	325
Nominal speed	n_{nom}	rpm	3 275	3 110	3 090	3 230
Max speed	n_{max}	rpm	3 600	3 600	3 600	3 600
Nominal torque @ slow speed ¹⁾	T_{10}	Nm	11,7	11,7	20,7	20,9
Nominal current @ slow speed ²⁾	I_{10}	A _{rms}	7,8	12,3	13,2	23,1
Peak torque @ slow speed ¹⁾	T_{z0}	Nm	22,8	22,8	28,4	28,4
Peak current @ slow speed ²⁾	I_{z0}	A _{rms}	18	28	19	32
Nominal power	P	kW	4,0	3,8	6,6	7,0
Torque constant (K _t at 25 °C)	K _t	Nm/A _{rms}	1,67	1,06	1,76	1,02
Back emf constant at 1 000 rpm (K _e at 25 °C)	K _e	V _{rms}	0,96	0,61	1,02	0,59
Winding resistance (at 20 °C) ²⁾	R	Ω	4,33	1,74	2,41	0,81
Winding inductance (at 20 °C) ²⁾	L	mH	14,97	6	10,01	3,35
Water flow (max pressure 5 bars)	-	l/min	2	2	2	2
Water temperature	-	°C	20...30	20...30	20...30	20...30
Pole number	-	-	8	8	8	8
Insulation class	-	-	H	H	H	H
Thermoswitch	-	-	PTC130	PTC130	PTC130	PTC130
Temperature sensor	-	-	PT1000	PT1000	PT1000	PT1000
Environment						
Ambient temperature	T _{ambient}	°C	0...+40	0...+40	0...+40	0...+40
Degree of protection	IP	-	54S	54S	54S	54S

¹⁾ Slow speed < 1% max actuator speed
²⁾ Phase to phase



08. Technical data – water cooling

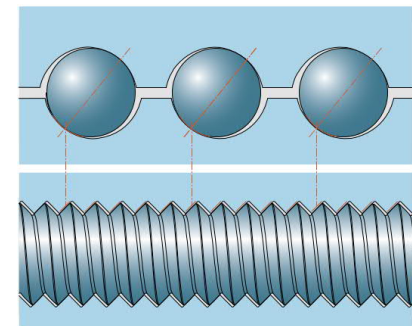
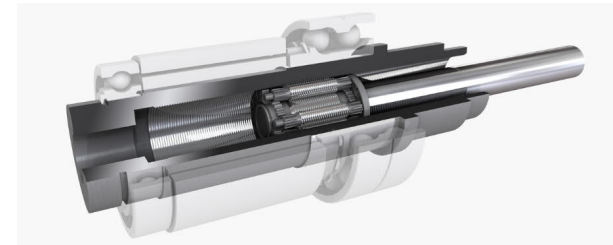
Dimensional drawing



¹⁾ For brake option, add 46 mm
²⁾ Addition length varies depending on the type of feedback device. Please contact Ewellix.

09. Inverted roller screw

Design features	User benefits
Large number of contact points	High load carrying capacity and up to 10 times longer service life vs ball screw
Planetary roller screw concept without recirculation with increased thread strength for a given pitch	Long service life and reliability improving productivity
Either nut or shaft can be driven, the non-rotating and translating component acting directly as the push tube	Design flexibility, easier to seal the shaft (with turning nut)
Custom screw-to-motor attachments for easy integration	Compact, light weight solution with fewer parts for easy installation



10. Modularity

Motor: 8 possibilities

- 2 motor length : 3 or 5 magnet stacks
- 2 motor DC bus voltage : 325 or 540 VDC
- 2 cooling : natural convection or water cooling

Feedback: 7 possibilities

Resolver:

- Kuka
- ABB
- Comau

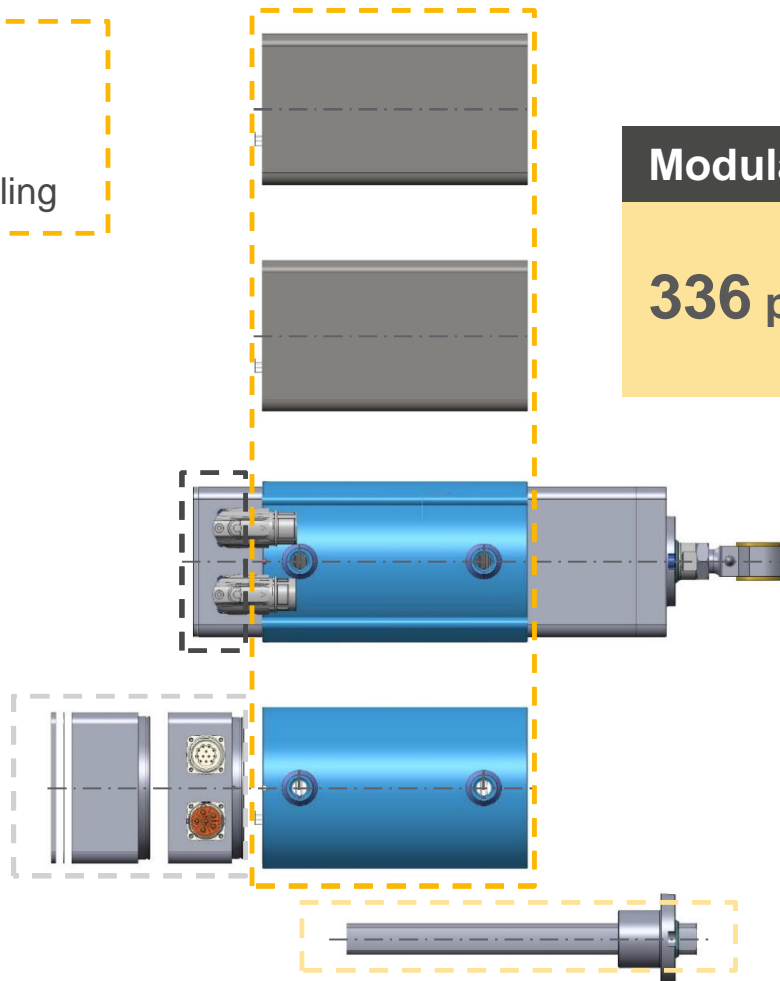
Absolute encoder:

- Sick Stegmann (Hiperface)
- Heidenhain (EnDat)
- Fanuc
- Yaskawa

Brake: 2 power supply possibilities

- 24VDC
- 90VDC

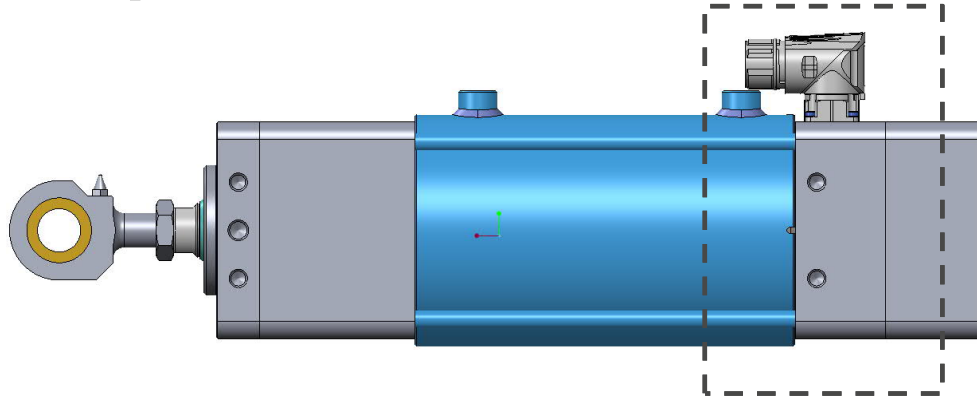
Anti-rotation



Modularity

336 possible configurations !

11. Brake option

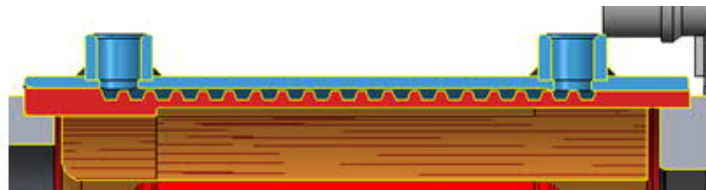
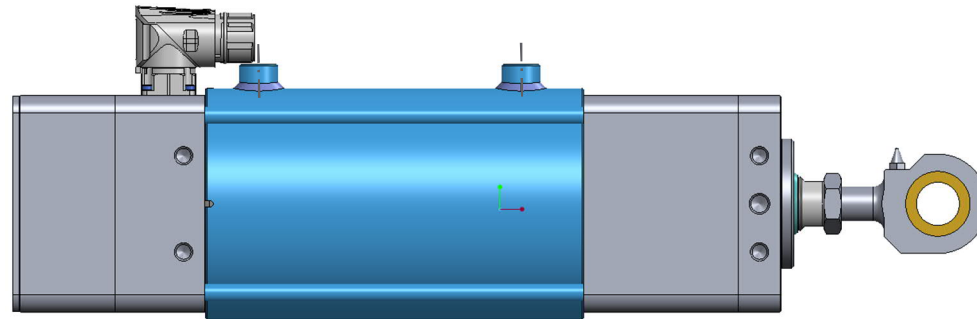
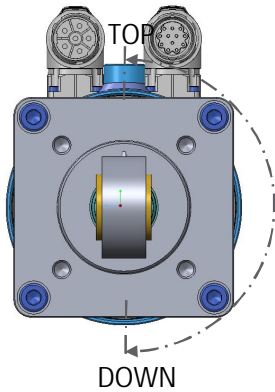


Safety brake:

- Permanent magnet brake technology
- Supply (standard): 24 VDC +6%/-10%
- Power: 18 W
- Holding torque (at 20°C): 9 Nm
- Holding torque (at 100°C): 8 Nm
- Additional weight: 1,1 kg
- Additional length: 46 mm



12. Modularity – water cooling option



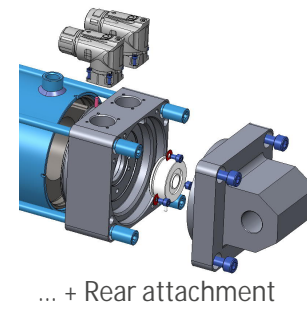
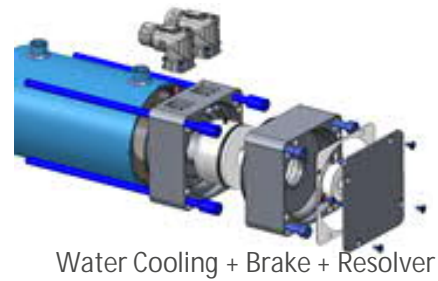
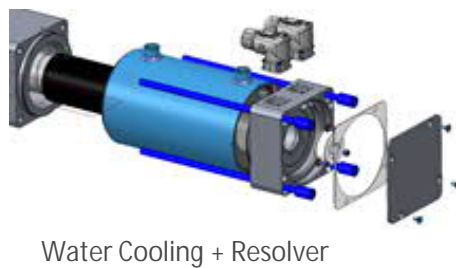
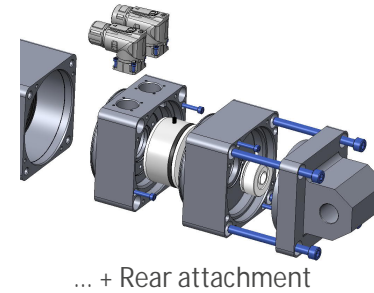
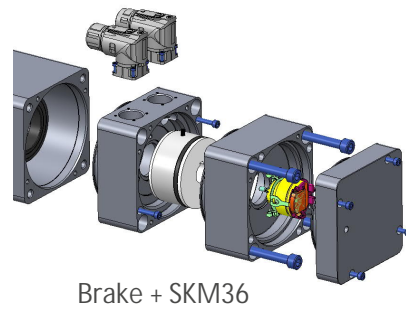
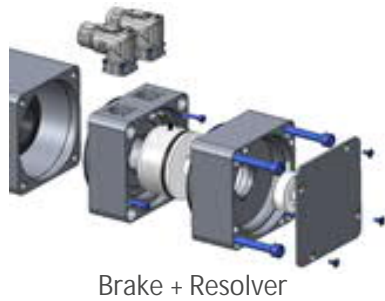
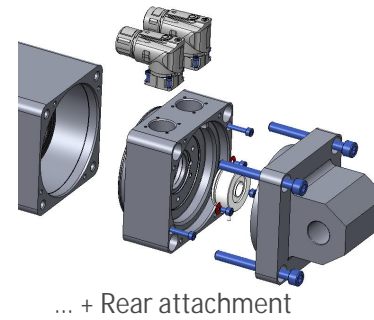
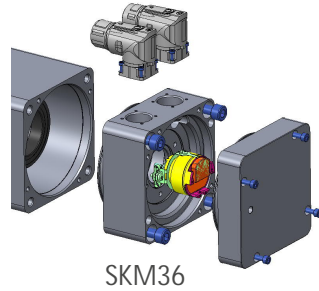
Technical specs:

- Max pressure: 5 bars
- Water flow: 2 l/min
- Water temperature: 20 to 35°

Features:

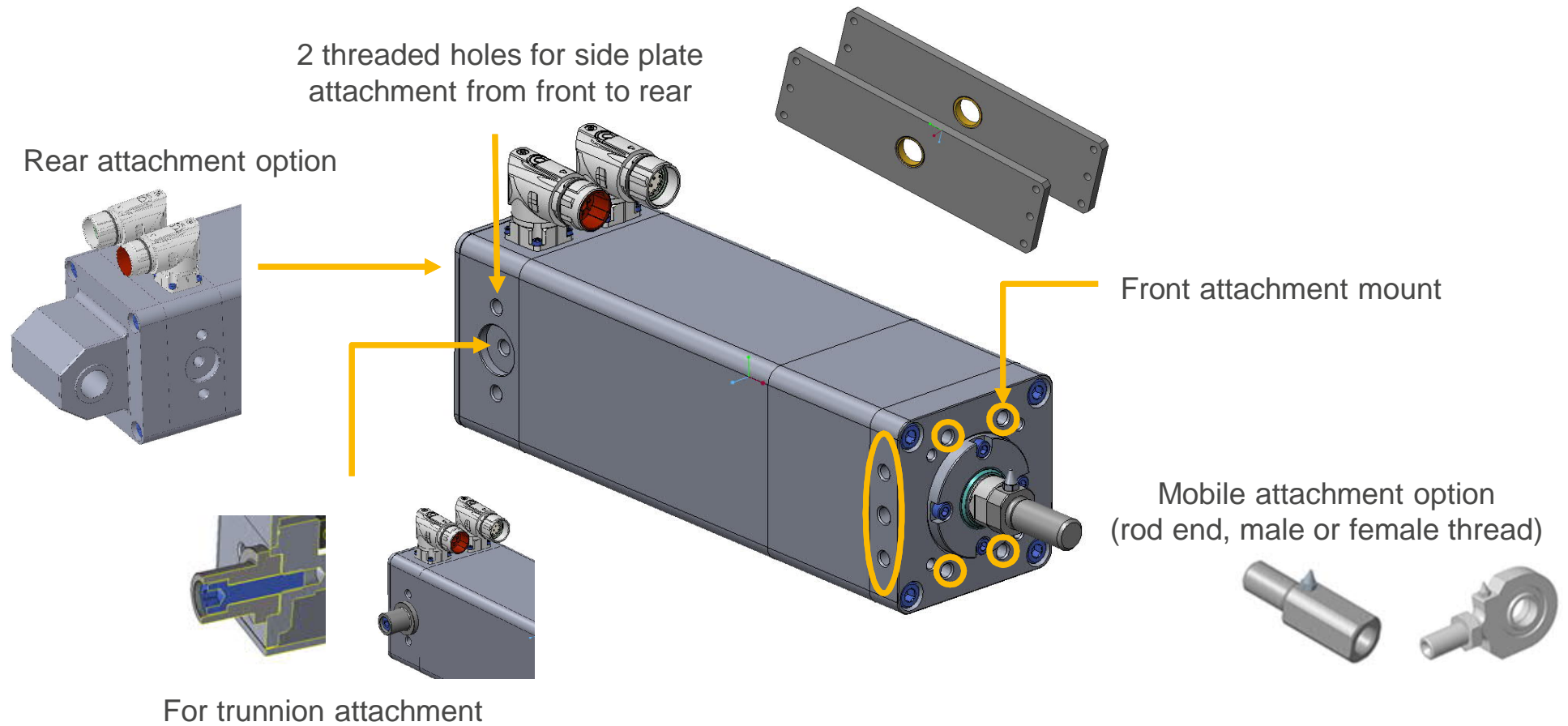
- Stainless steel body
- Cooling system all around the stator
- Same actuator length as natural cooling
- Additional weight 1.4 kg
- Top or bottom water connections

13. Modularity – rear side



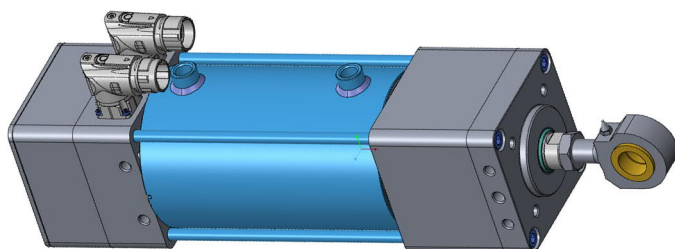
Modularity
336 possible configurations !

14. Modularity - attachments



15. Standard plugs

Rotatable connector (330° angle)





Power connector:

- Supplier Intercontec
- Number of pins 6
- Reference (rotatable angled) BEDC106 MR 14 00 1216

Resolver connector:

- Supplier Intercontec
- Number of pins 12
- Reference (rotatable angle) AEDC110 MR 04 00 1215

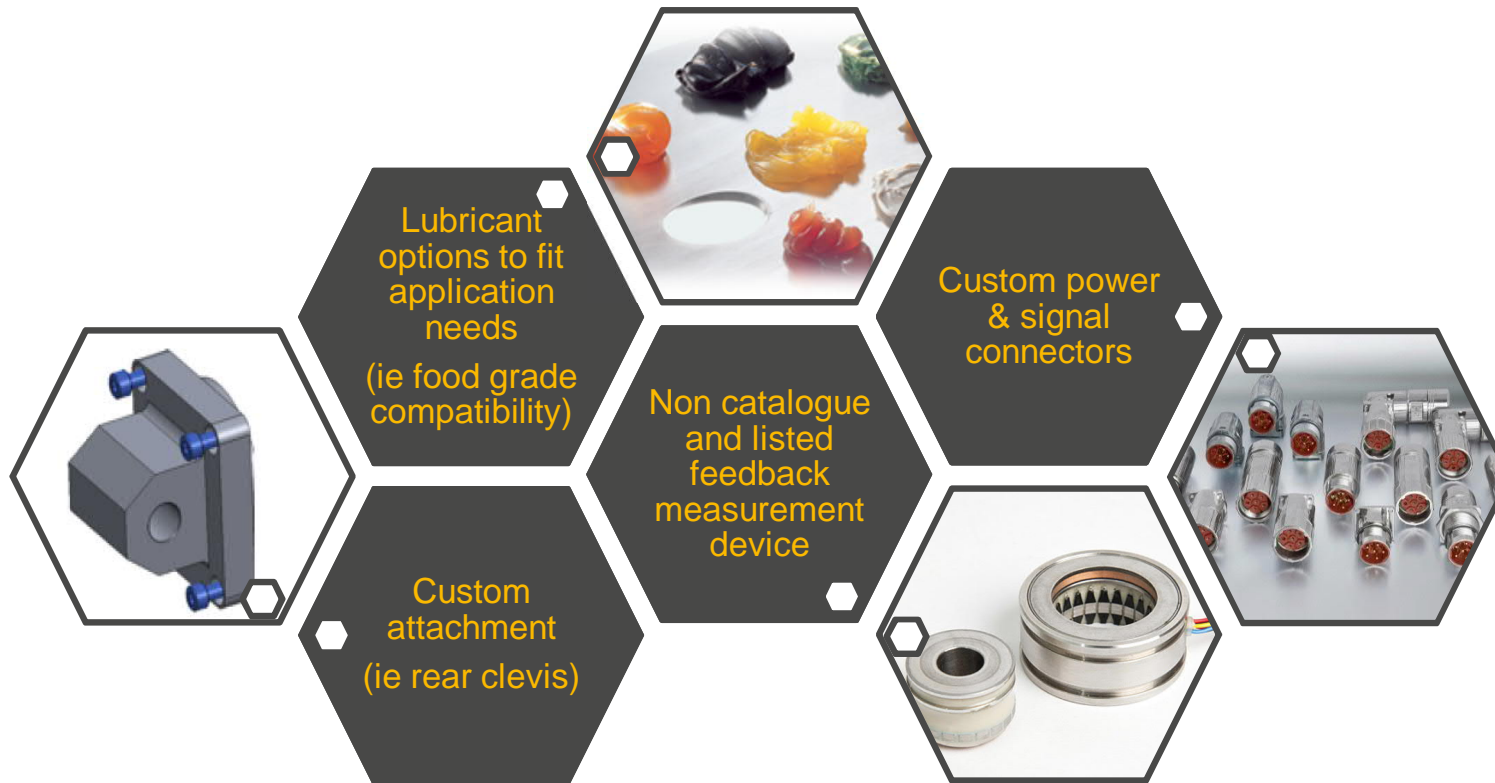
Standard	R1 - R2	
Power connector pin out		
M23 connector 6 pins	Data/signal	Intercontec BEDC106 MR 14 00 1216
1	U	Pin side view 
2	V	
3	PE	
4	W	
5	Brake +	
6	Brake -	
Housing	Shield	
optional		

Standard	R1 - R2	
Feedback connector pin out		
M23 connector 12 pins	Data/signal	Intercontec AEDC110 MR 04 00 1215
1	Sin +	Pin side view (insert at 20°) 
2	Sin -	
3	-	
4	Cos +	
5	Cos -	
6	-	
7	Err +	
8	Err -	
9	-	
10	PT1000	
11	PT1000	
12	-	
Housing	Shield	

Draft definition (for information only)

16. Customization possibilities

Here's a list of possible customizations, that are all project dependent.

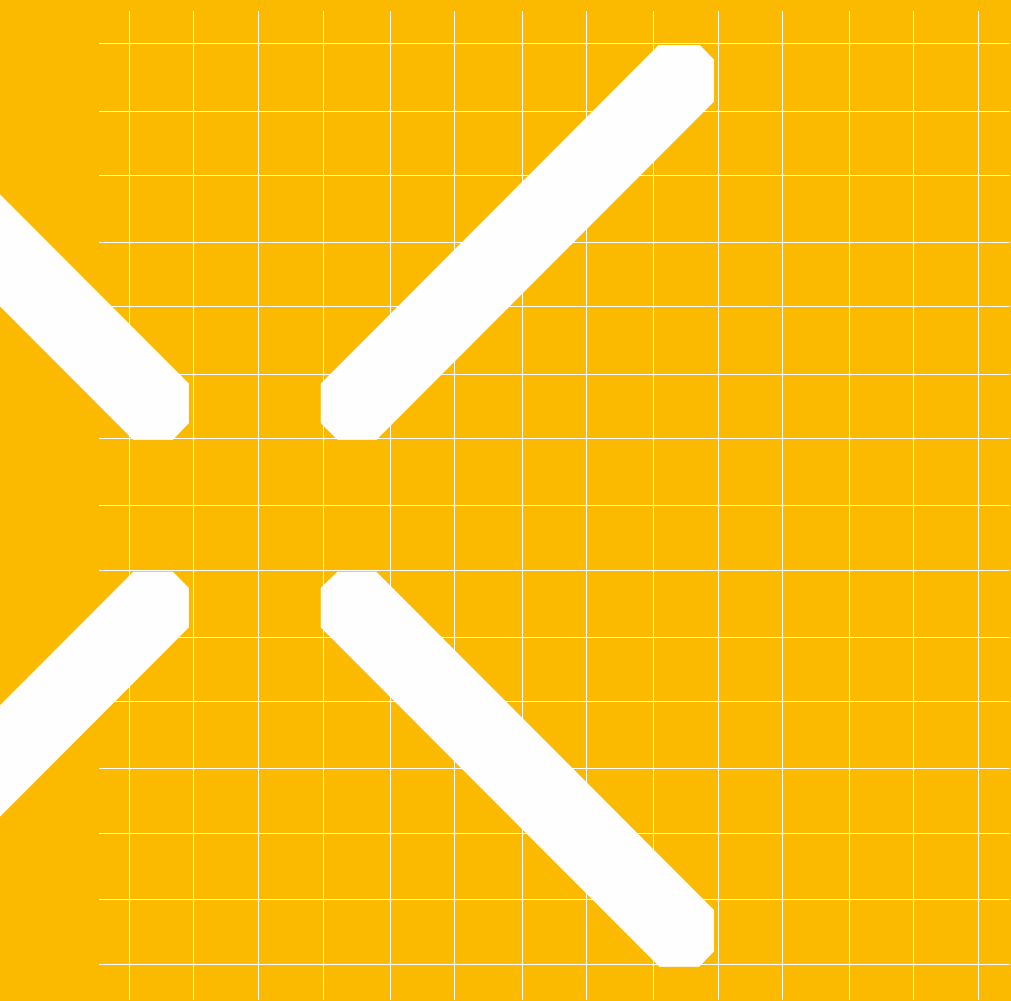




17. Actuator, testing status

Test n°	Option/version tested	Start	End	Status	Comments
1	CEMC2105-180-FMN-A5N-BR1xxx Roller screw lifetime under 14kN load First proto tested	12/2018	10/2019	Finished 100% 20 mio cycles	Speed of 250 mm/s Working force not maintained 5 spots over 4.3 s – 70 spots/min Stator T° = 78°
2	CEMC2105-180-FMN-A5W-BR1xxx Water cooling and lifetime test under 22kN load	02/2019	07/2019	Finished 100% 6.5 mio cycles	Speed of 250 mm/s Working force not maintained 2 spots over 2.75 s – 21 spots/min Stator T° = 45°
3	CEMC2105-180-TRA-A5W-BR1xxx Trunnions + anti-rotation testing under 22kN load	10/2019	Q1/2020	45% achieved 4.5 mio cycles	Speed of 250 mm/s Working force not maintained 2 spots over 2.75 s - 21 spots/min Stator T° = 45°
4	CEMC2105-180-TRN-A5N-BR1xxx Lubrication interval and force accuracy over lifetime with 14kN load	11/2019	Q3/2020	Not yet started	Speed of 250 mm/s Working force not maintained 5 spots over 4.3 s – 70 spots/min
5	CEMC2105-180-FMN-A5N-BR1xxx-F1 Jedi testing under 14kN load	Q1/2020	Q4/2020	Not yet started	Speed of 250 mm/s Working force not maintained 5 spots over 4.3 s – 70 spots/min

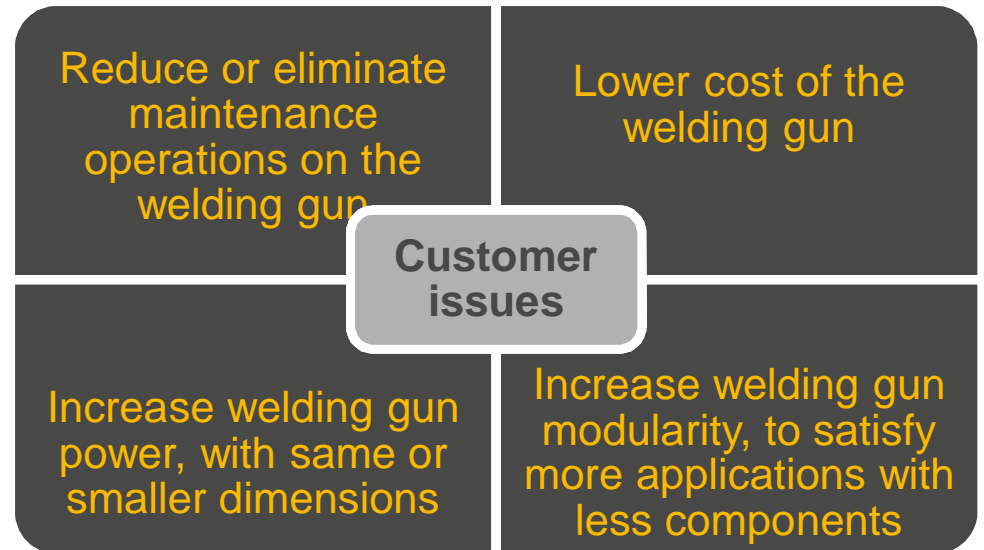
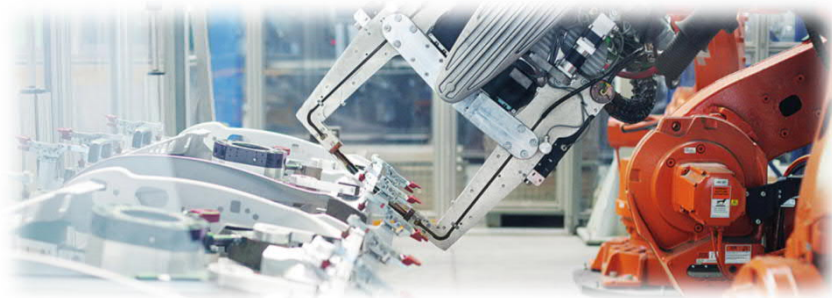
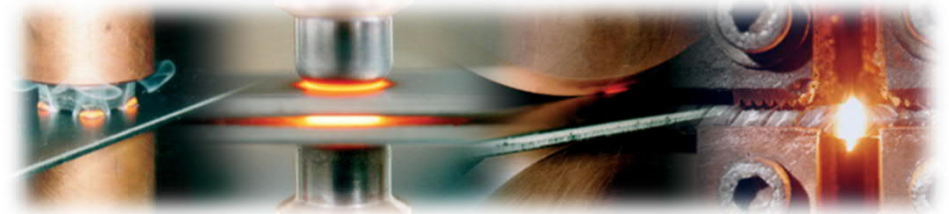
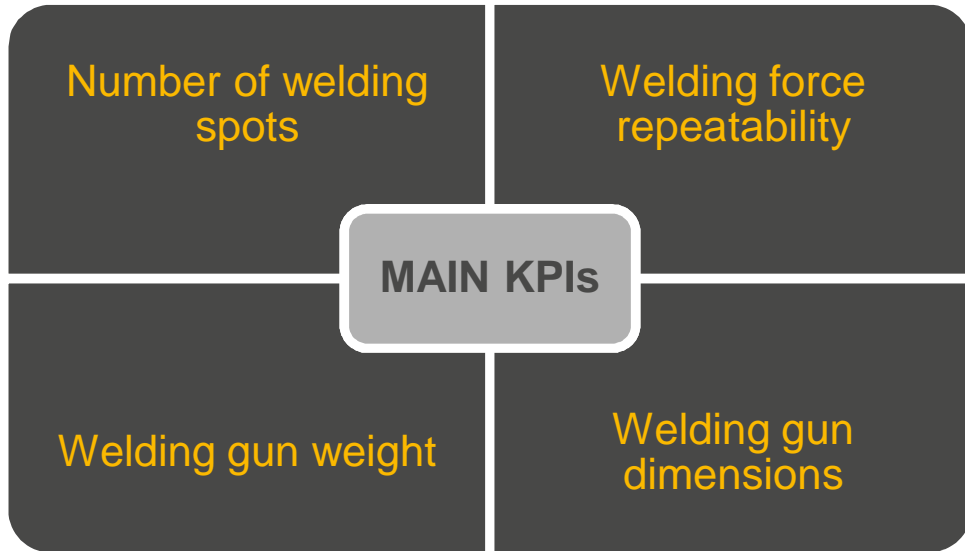
By now **2 test rigs** available.



03

Value proposition

18. Spot welding process details



19. CEMC value proposition





Why would customers buy this?

TECHNICAL

1. Highest number of welding spots over actuator lifetime
2. Outstanding force repeatability for constant welding quality
3. Light-weight construction to reduce welding robot power and size
4. Easy integration and fast assembly
5. High reliability to minimize downtime



Key benefits for spot welding

	Value	vs previous generation
 Highest number of welding spots	>20 million spots	+100%
 Lightweight construction to reduce welding robot power and size	12,5 kg	-10%
 High reliability to minimize downtime	10 million spots without relubrication	+500%
 Modularity with various feedback options	336 configurations	Limited feedback options

How do we achieve that?

TECHNICAL





1. High quality ISR with high dynamic load capacity value
2. High quality custom-designed hollow shaft motor
3. Limited number of components, smart design features, high power density
4. Modular feedback and option system to integrate any type of encoder or resolver, and options like manual override, custom attachments, water cooling
5. Interchangeable dimensions with competitors
6. High quality key components



20. Actual technologies used on welding gun



1. Servo-pneumatic actuator
2. Electro-mechanical actuator either equipped with :
 - Ball screw
 - Standard planetary roller screw
 - Planetary inverted roller screw

	P	BS	RS	ISR
Features				
Positioning precision	-	+	+	+
Power consumption / efficiency	--	++	+	+
Power density / load capacity vs size	--	-	+	++
Compactness / weight	+	-	-	++
System integration on the gun & line	--	-	-	+
System noise	--	-	+	++
Contamination sensitivity	-	+	++	++

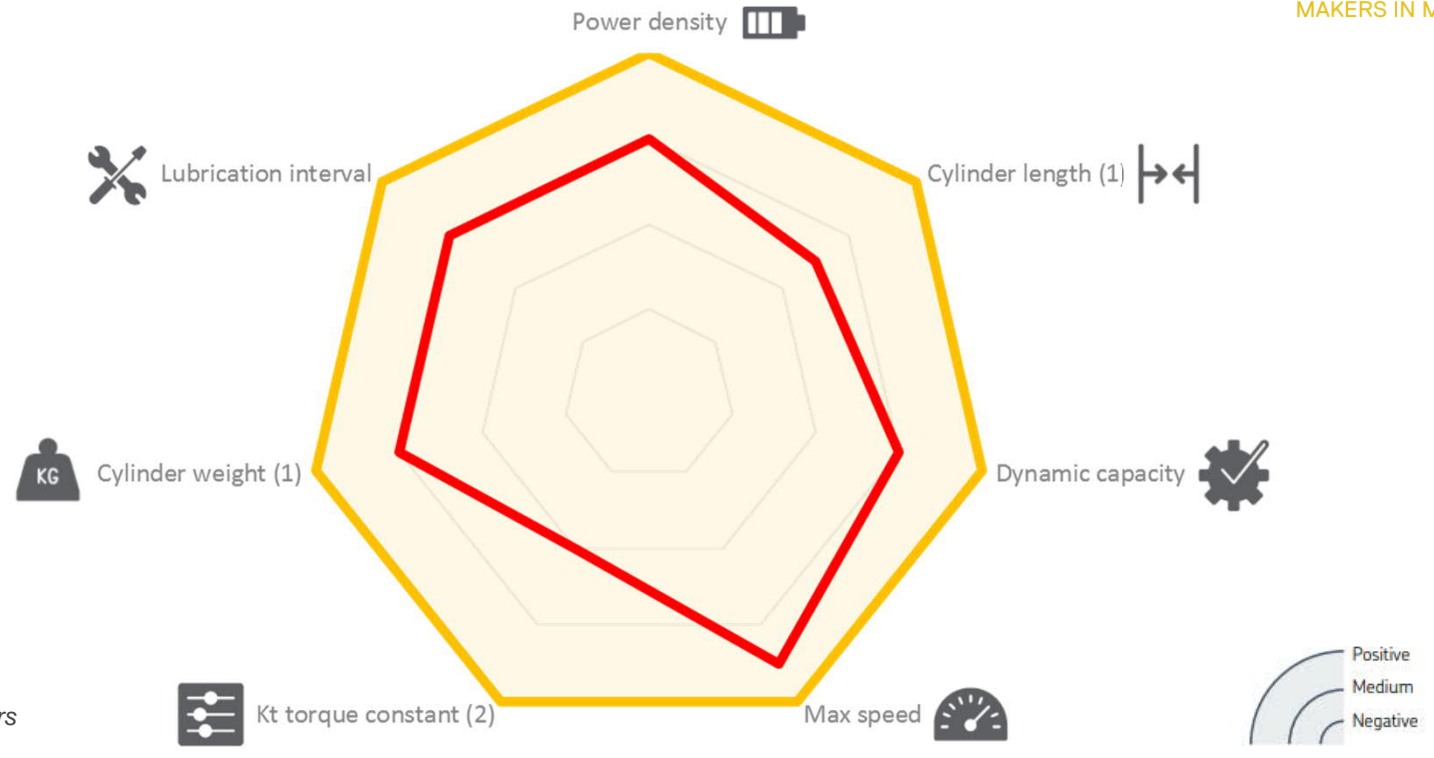
P = Pneumatic
BS = Ball Screw
RS = Roller Screw
ISR = Inverted Roller Screw

21. New CEMC vs market offer

On compact version meaning motor integrated

Considering **CEMC2105-180-FMN-A5N-NR1xxx-00** with :

- Natural cooling
- 5 magnet stacks length
- Resolver
- No brake
- Standard attachments



(1) Basic unit without options
 (2) K_t value at 25° C and 400 VAC
 (3) Ewellix assumptions based on competitors output performances (average values)

22. Other applications

CEMC is the ideal solution for **fluid power replacement** where **extreme compactness, high power density** and **high stiffness** is a must. Thanks to its flexible design, it can be adopted in other applications, including:

Industrial Automation

- ✓ Test benches
- ✓ Small E-M presses
- ✓ Dosing & dispensing
- ✓ Simulators

Metals – Continuous casting

- ✓ Air flow regulation
- ✓ Cooling spray water valves reg.
- ✓ Vent and hatches adjustment



EWELLIX

MAKERS IN MOTION