

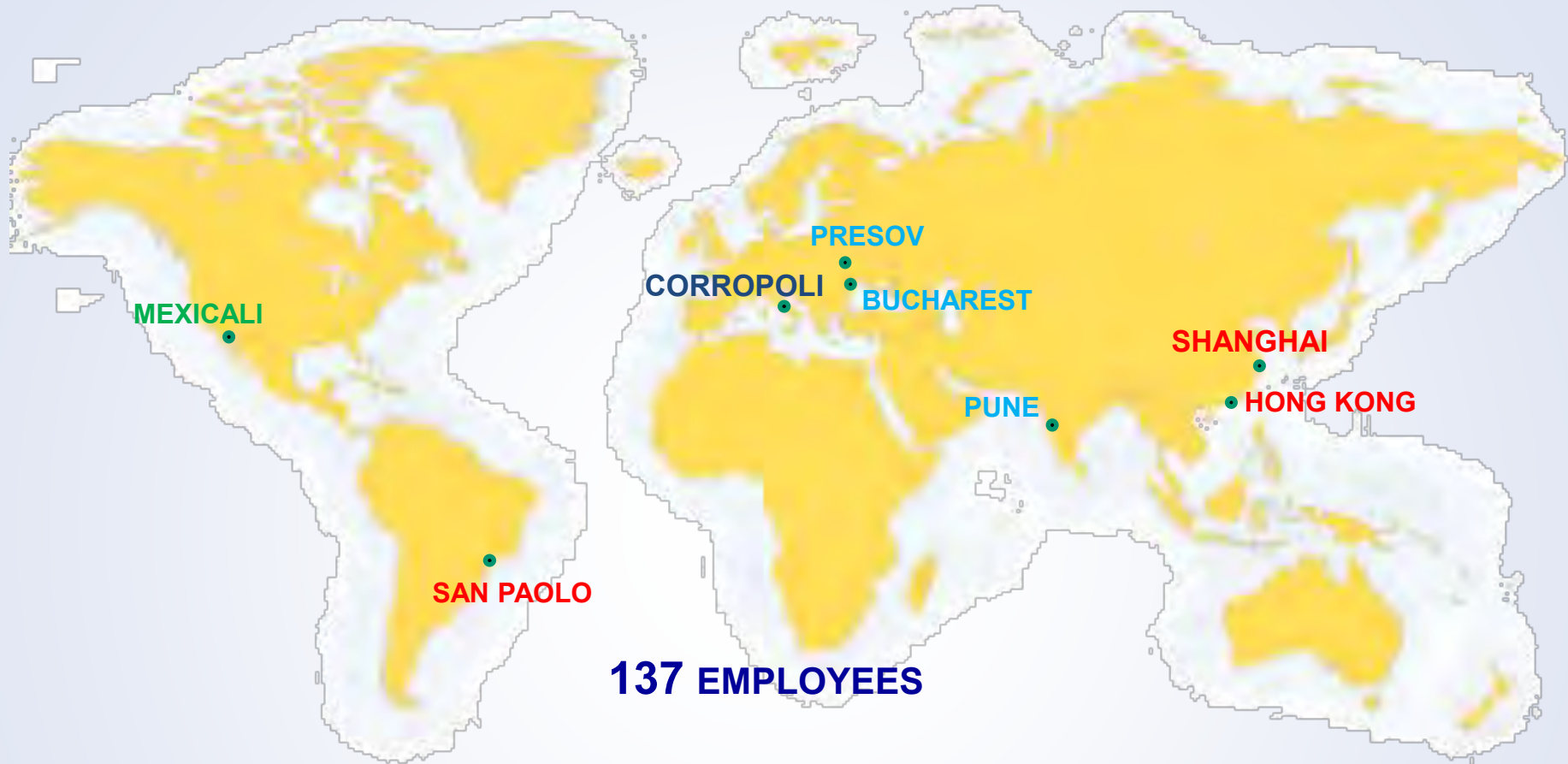
# INNOVATIVE PARTNER IN DESIGN AND MANUFACTURING

**MOTOR WORKSHOP 2017  
EUROPEAN COPPER INSTITUTE**

**BRUSSELS - BELGIUM      2017 MAR 07<sup>TH</sup>**



# WORLDWIDE LOCATION AND MANPOWER



Headquarters: R & D, Production & Service

Sales

Service

Technical Agreement NAFTA Market

112 Employees

2 Employees

8 Employees

15 Employees

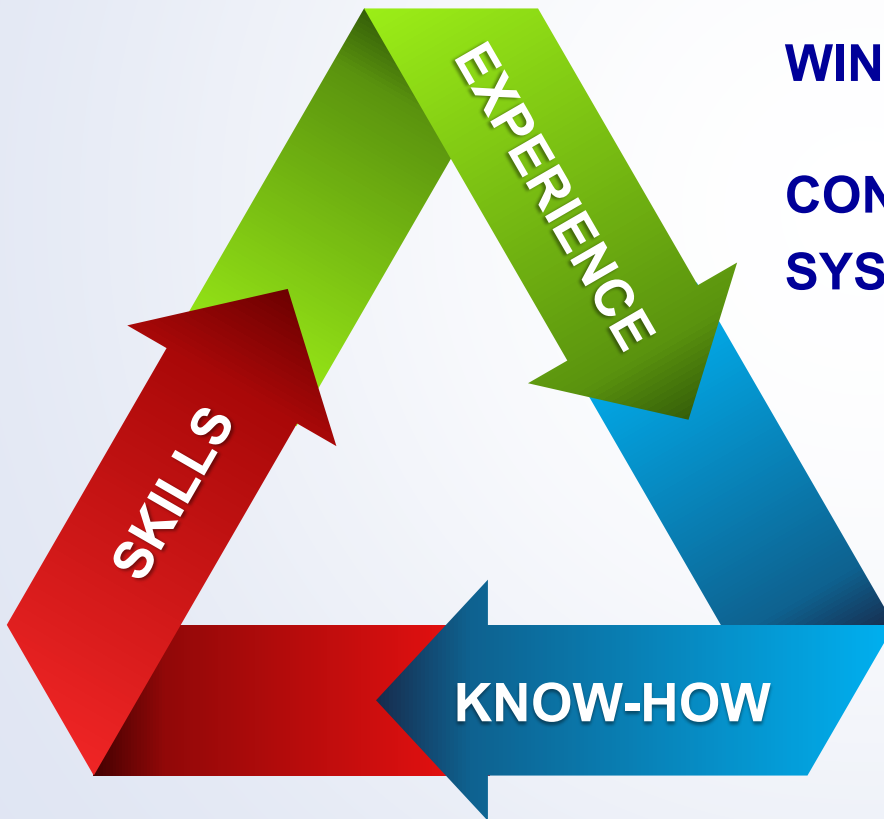


Tecnomatic achieves its Clients' goals and needs with unparalleled 360° support, thanks to its **GREATER THAN 40 YEARS** of Experience, Expertise, and Skills.

## BUSINESS UNITS:

WINDING PRODUCTION SYSTEMS

CONTROL & ASSEMBLY PRODUCTION  
SYSTEMS







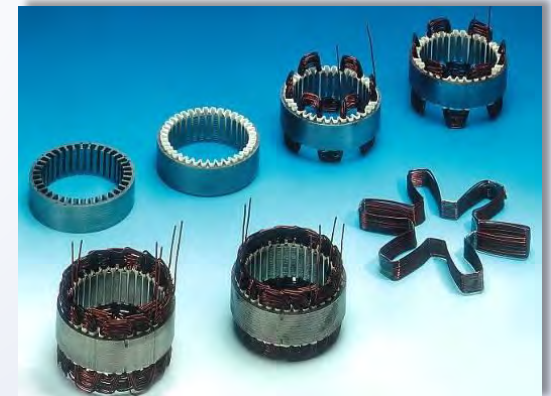
# BUSINESS UNIT: WINDING SYSTEMS



ARMATURES FOR STARTER MOTORS

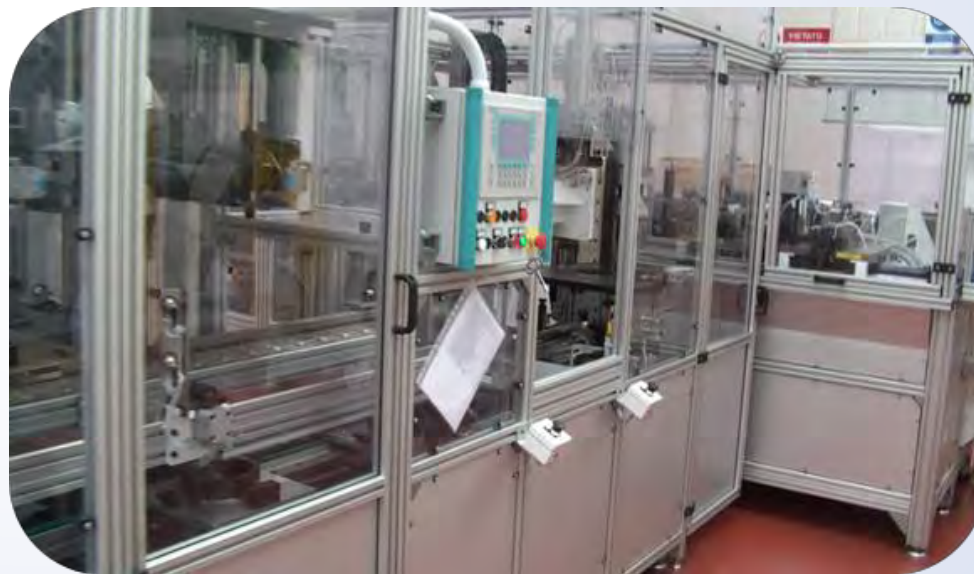
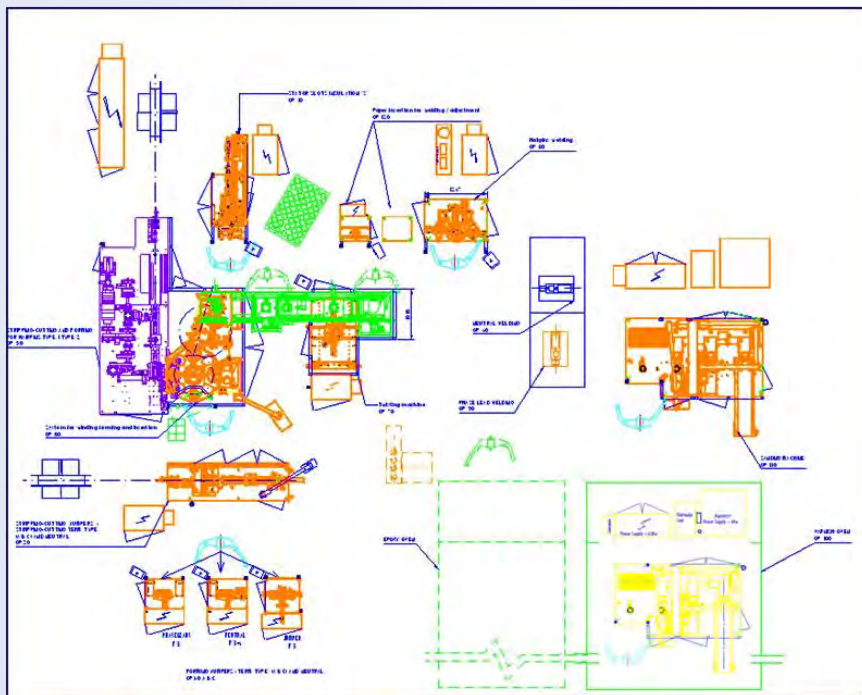
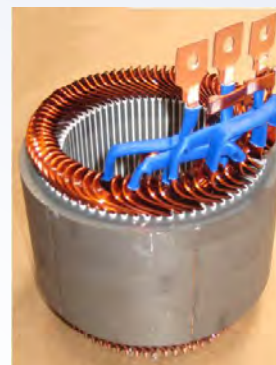


STATORS FOR ALTERNATORS  
(ROUND WIRE)



## HAIRPINS WITH FLAT CONDUCTORS

# STATORS PRODUCTION SYSTEM FOR ELECTRIC MOTORS







# INTELLECTUAL PROPERTY



**P**atent **C**ooperation **T**reaty

Tecnomatic got several worldwide patents and filed several applications with simultaneous IT and PCT filing.  
Worldwide coverage is already effective.



UNITED STATES PATENT  
AND  
TRADEMARK OFFICE



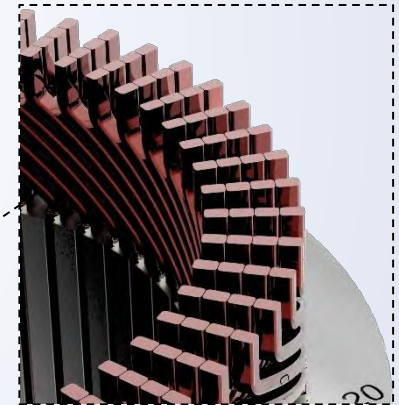
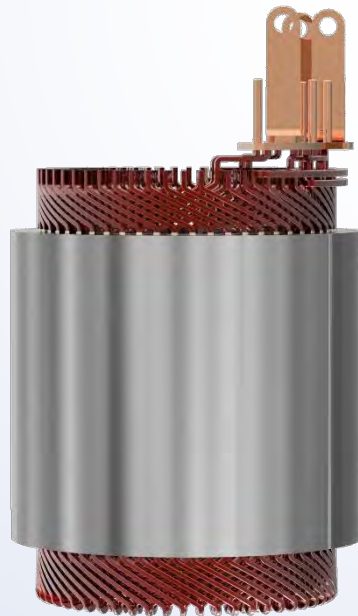


# HAIRPIN TECHNOLOGY - EXPERTISE AND KNOW-HOW

During the past decade, in addition to its work in the automated Assembly Industry, Tecnomatic – thanks to its greater than 40 years of experience and knowhow in the Winding Sector - has concentrated on designing and developing Hybrid and Pure Electric innovative motor technology for the global manufacture and E-motor Industry.

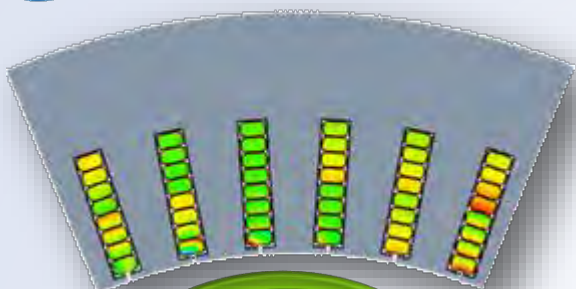
## Hairpin

- ✓ High slot fill factor
- ✓ Joule losses reduction
- ✓ Decrease in winding overhead height
- ✓ Better heat dissipation





# FLAT CONDUCTOR WINDING PROCESS BY TECNOMATIC



## R & D

Simulation &  
Modelling

Optimization

## Product Industrialization & Prototyping

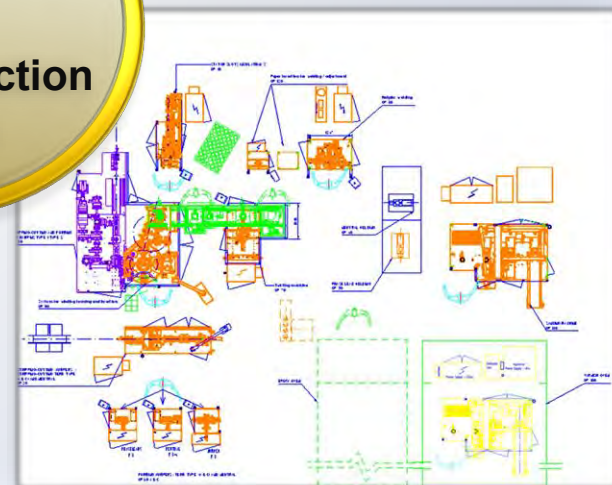
Prototyping tools  
Prototype samples



## Process development

Mass production  
system

# PROCESS





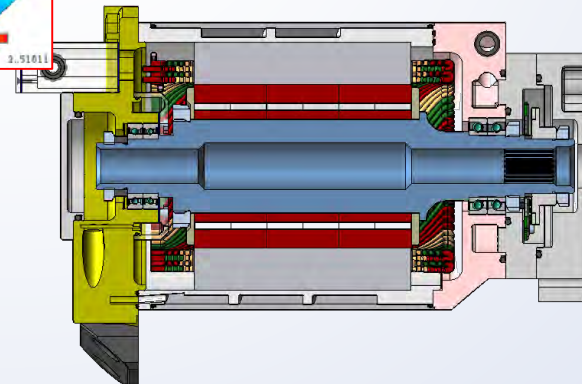
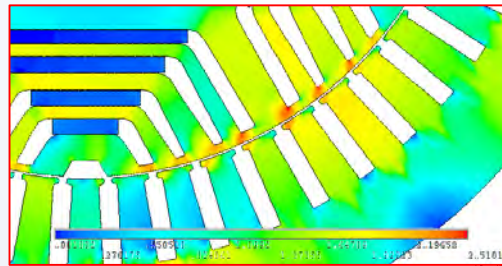


**Close and long lasting  
relationship with**



**UNIVERSITÀ  
DEGLI STUDI  
DE L'AQUILA**

***EM design,  
simulation &  
optimization***



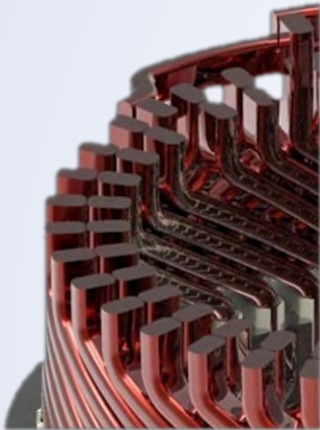
***Mechanical  
design***



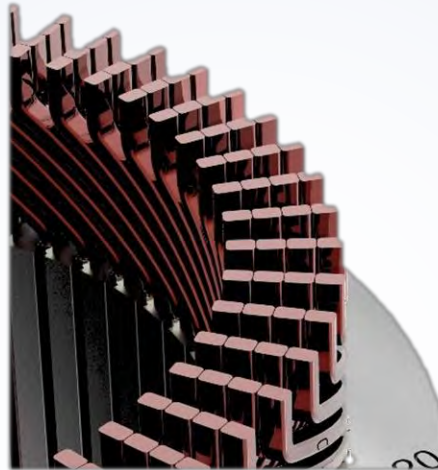
# WINDING SYSTEM VERSATILITY

Number of flat wires per slot

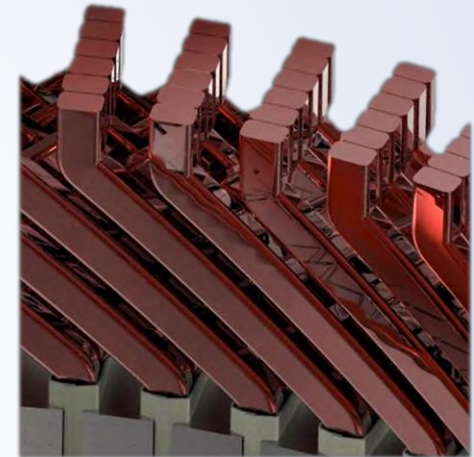
Two



Four



Six



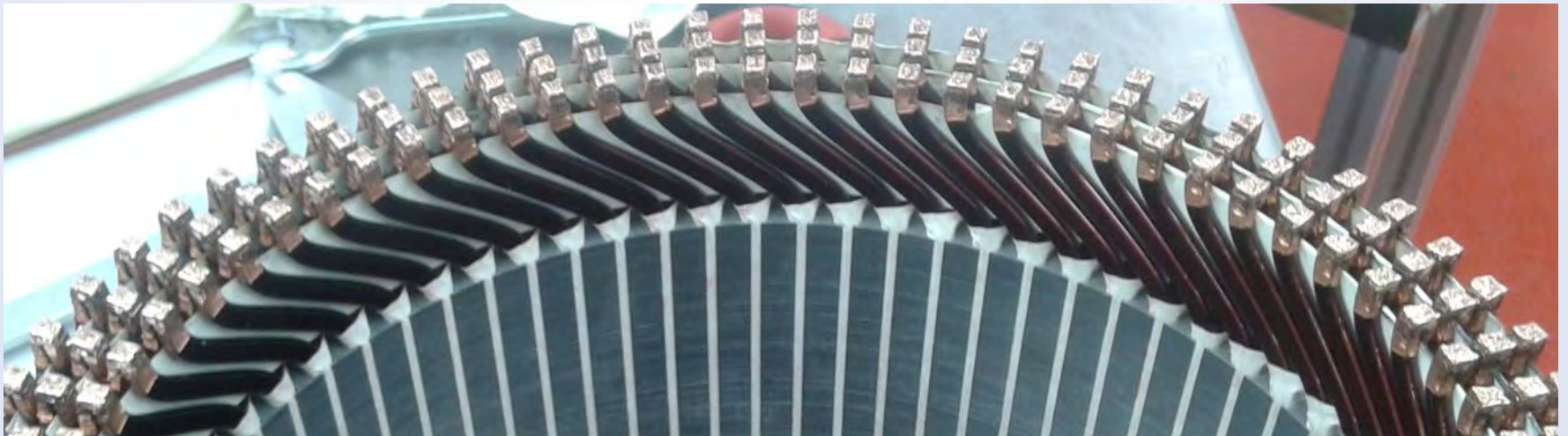
*N.8 flat wires per slot in progress*

*C, S or B shape insulation paper available*

*Both full and short pitch distributed winding achievable*



## N.6 FLAT WIRES PER SLOT PROTOTYPE

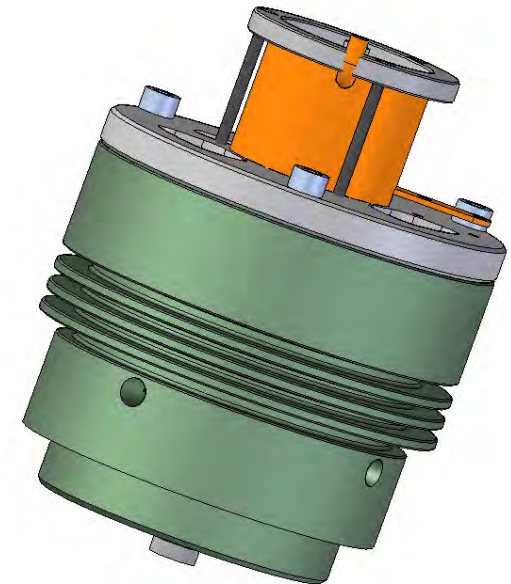






SynRM

Nominal speed	5900 rpm
Nominal load torque	0.5 Nm (continuous duty)
Nominal mechanical power	309 W
Minimum efficiency @ 90°C	80%
Max torque (non-continuous)	1.0 Nm
Nominal operational voltage	11.5 V



**PATENTED  
TECHNOLOGIES**

No. of slot		36
No. of wire per slot		2
Stator stack height	mm	30
Outer stator diameter	mm	78,2
Inner stator diameter	mm	51,4
Overhang chignon side	mm	24
Overhang welding side	mm	24



# BRUSHLESS AC 10kW – 48 VDC

INSULATION CLASS	H
Line voltage	45 Vmax (31.8 Vrms)
Phase voltage	26 Vmax (18.4 Vrms)
Pole numbers	6
Stator slot numbers	54
Slot type	Rectangular
Number of slot per pole per phase	3
Stator external diameter	192 mm
Stator internal diameter	127 mm
Rotor external diameter	126 mm
Shaft diameter	40 mm
PM type	NdFeB
Magnetic steel	400-50 A
Stack lenght	78 mm
Winding	Flat wire, distributed, full pitched
Phase connection	STAR
Number of turns in series per phase	9
Number of conductor per slot	1
Number of parallel paths	4
Flat wire bare cross sectional area	7.74 mm <sup>2</sup>
Winding overhead	25 mm
Slot fill factor	0.73
Motor control	Vectorial
Cooling	Liquid
Weight	32 kg

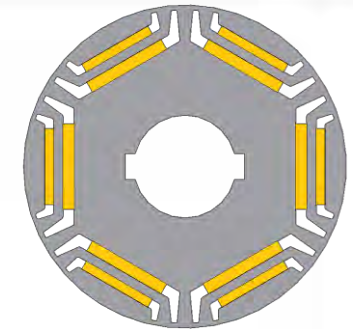
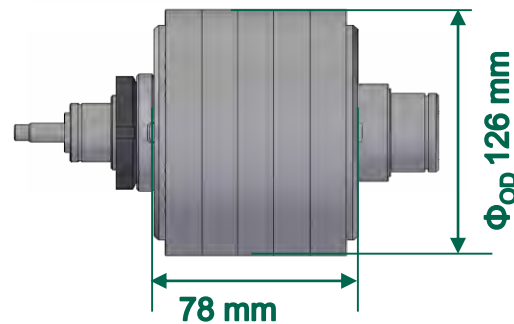
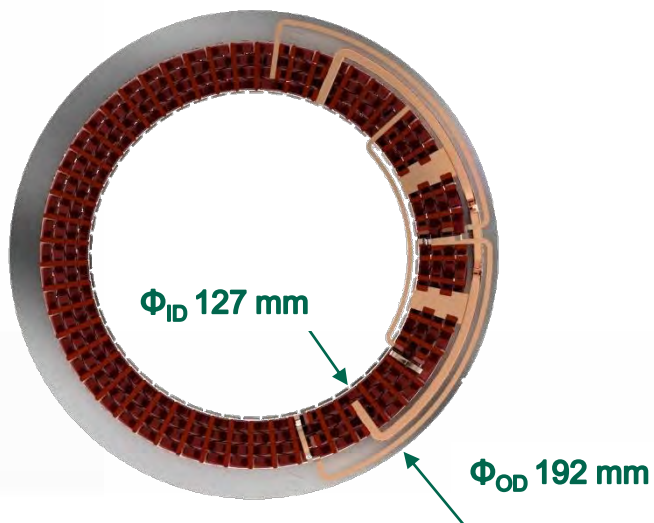
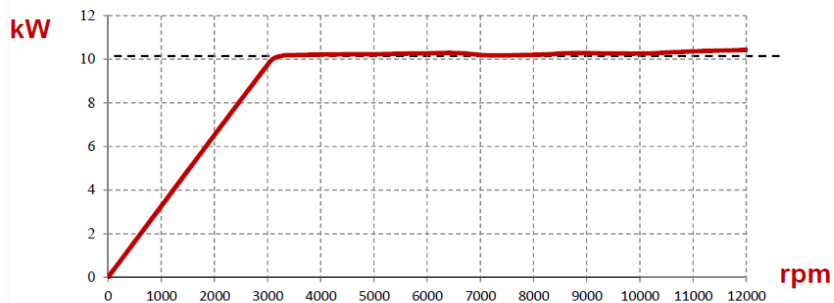
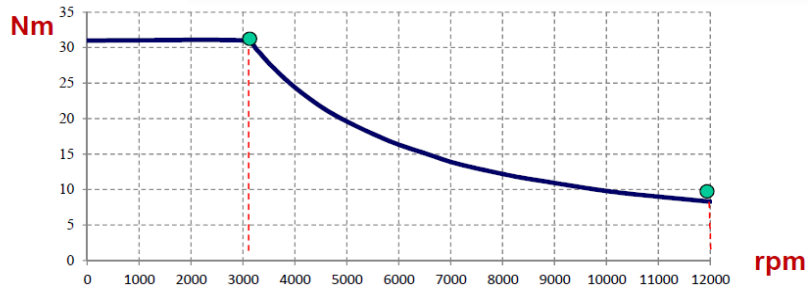
IPMSM

PATENTED  
TECHNOLOGIES



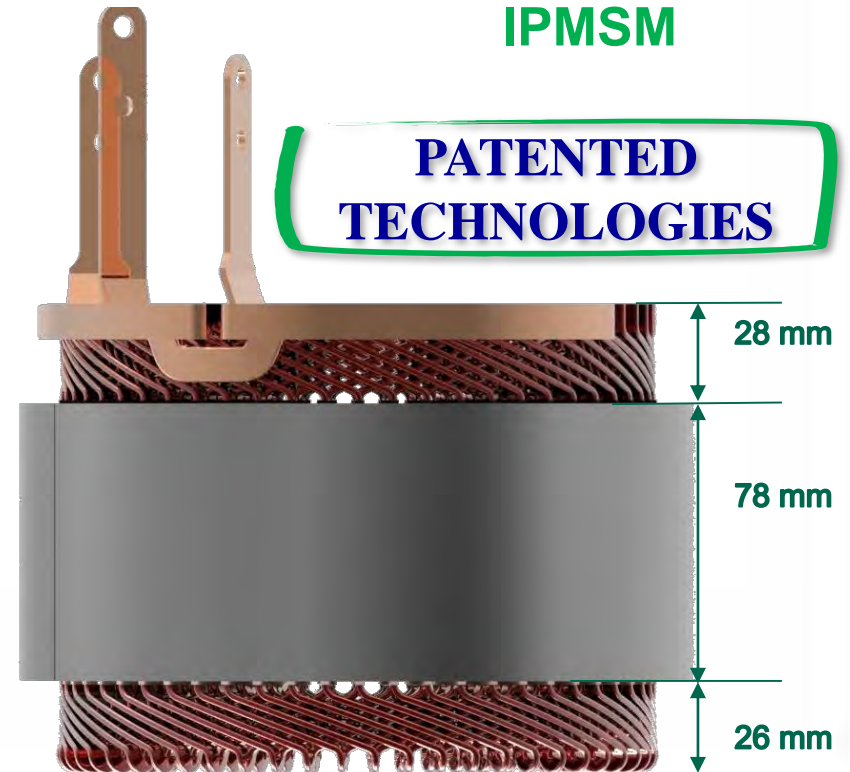


# BRUSHLESS AC 10kW – 48 VDC



IPMSM

**PATENTED  
TECHNOLOGIES**







# BRUSHLESS AC 50kW – 630 VDC

INSULATION CLASS	H
Line voltage	550 Vmax (386 Vrms)
Phase voltage	316 Vmax (223 Vrms)
Pole numbers	6
Stator slot numbers	54
Slot type	Rectangular
Number of slot per pole per phase	3
Stator external diameter	240 mm
Stator internal diameter	165 mm
Rotor external diameter	164 mm
Shaft diameter	60 mm
PM type	Ferrite
Magnetic steel	M350 - 50 A
Stack lenght	140 mm
Winding	Flat wire, distributed, full pitched
Phase connection	STAR
Number of turns in series per phase	36
Number of conductor per slot	4
Number of parallel paths	1
Flat wire bare cross sectional area	10.65 mm <sup>2</sup>
Winding overhead	26 mm welding side 27 mm chignon side
Slot fill factor	0.79
Motor control	Vectorial
Cooling	Liquid

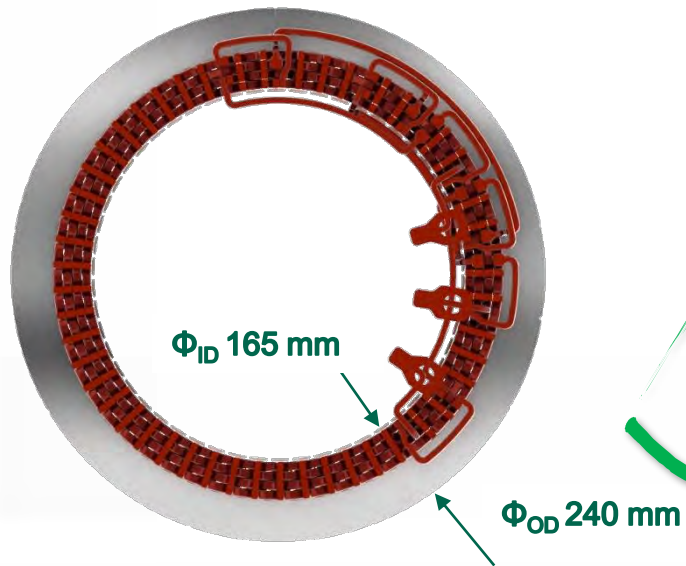
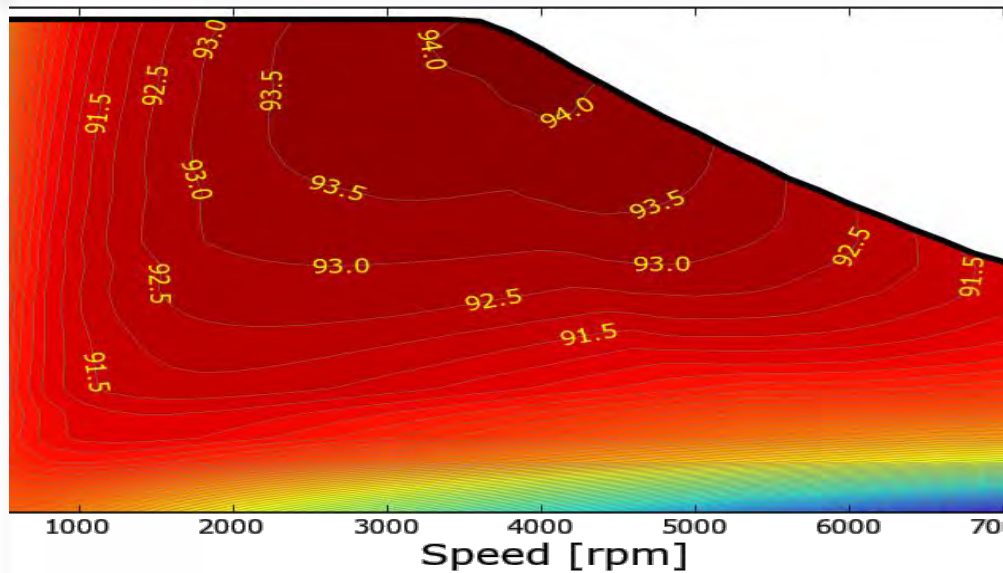
PMa\_SynRM

PATENTED  
TECHNOLOGIES



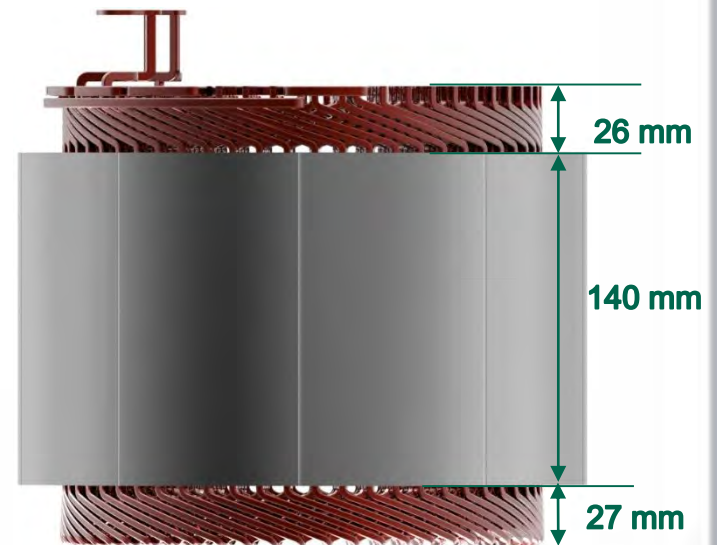
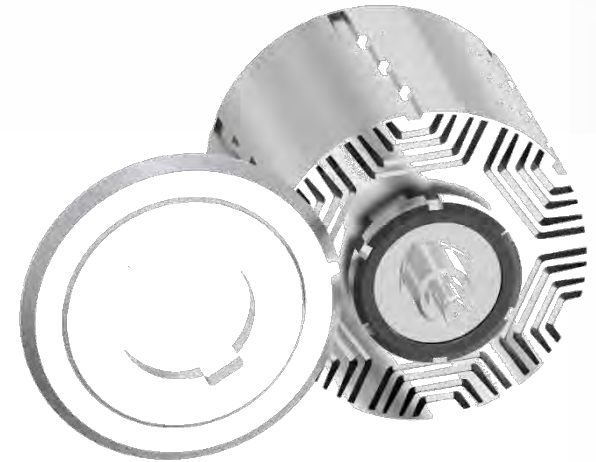


# BRUSHLESS AC 50kW – 630 VDC

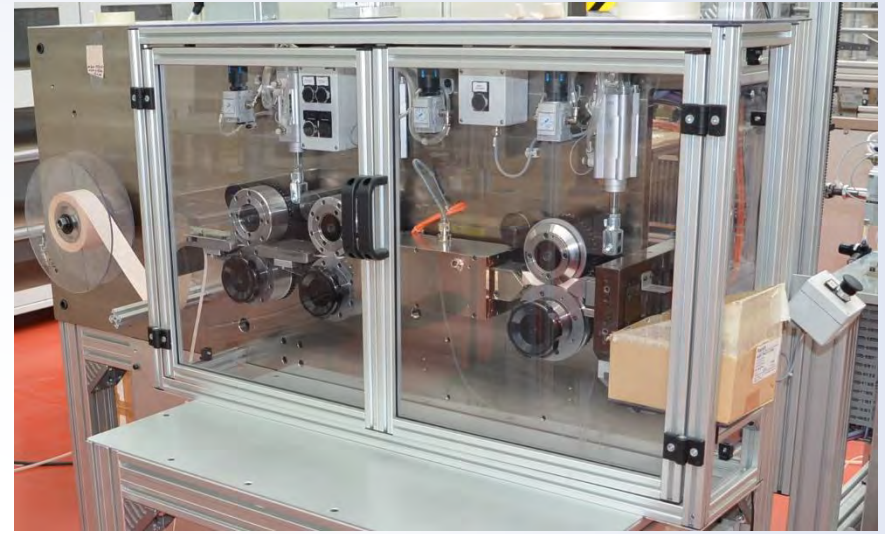
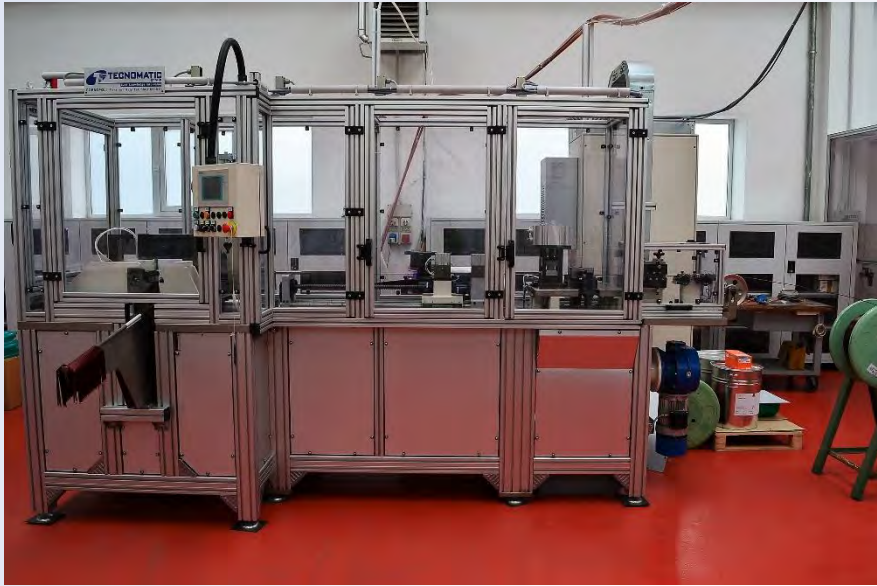


PATENTED  
TECHNOLOGIES

PMa\_SynRM







- SLOT INSULATION MACHINE
- HAIRPINS FORMING MACHINE
- TWISTING MACHINE
- EPOXY COATING
- VARNISH COATING
- PROTOTYPE TEST IN PROGRESS
- PROTOTYPE ASSEMBLY IN PROGRESS





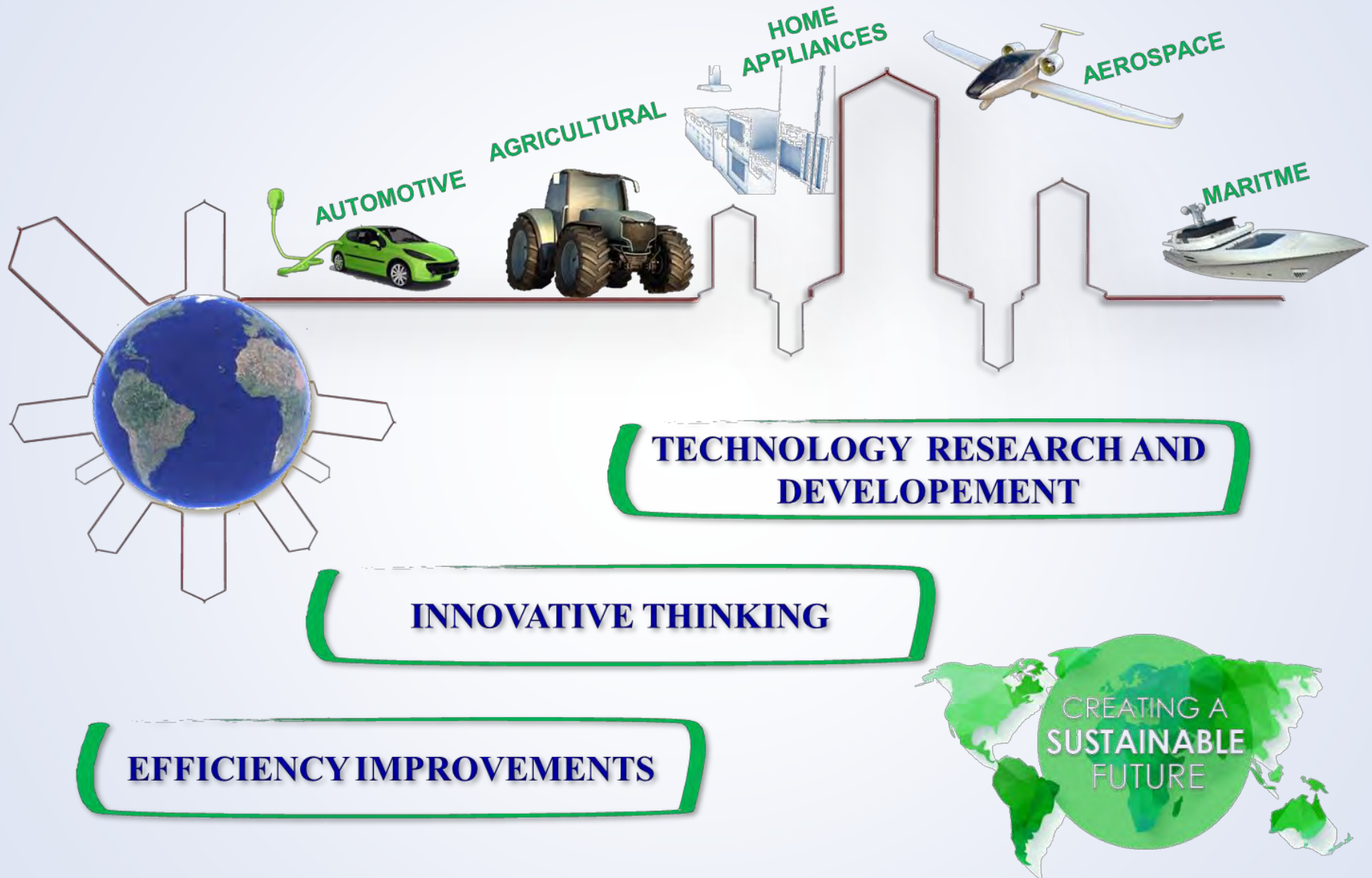


## **TEST BENCH WITH BRAKING POWER RECOVERING**, equipped also with:

- ✓ Battery simulator, max output voltage 1000V
- ✓ WT3000 Watt-meter, with 4 elements 30A 1000V
- ✓ MCTS System, with 4 TA of 700A
- ✓ Torque measurement system CoMo Torque
- ✓ Temperature DAC Picolog ADC 24
- ✓ Multimeter ROHDE & SCHWARZ HM8118
- ✓ Hipot tester for IR / Hipot AC / Hipot DC test Sentry 30 Plus



# EVERY UNDERTAKING IS A CHALLENGE TO REACH TOGETHER





## PRESENCE AND PROJECTS







# MAKE AGRICULTURAL APPLICATIONS EVEN MORE GREENER



**MOTOR TYPE** *BLAC PMA-SYNRM*

**WEIGHT** *65 KG*

**NOMINAL PHASE VOLTAGE** *255 V RMS*

**NOMINAL POWER** *51 kW*

**NOMINAL TORQUE** *145 Nm*

**PEAK TORQUE** *400 Nm*

**NOMINAL SPEED** *3380 RPM*

**PEAK SPEED** *7500 RPM*

**NOMINAL EFFICIENCY** *94%*



- Automotive
  - E-tractor
  - Commercial EVs
  - Agricultural applications





**THANK YOU VERY MUCH FOR  
YOUR ATTENTION**