

## **SPACE-RATED MOTORS**

*Servomotors, linear & rotary direct drives, LATs*



- Servo-motors
- Torque and limited-angle torque motors
- Stepper motors
- Reluctance motors (without magnets)
- Hollow-shaft and thin-ring designs
- Linear motors and voice-coil actuators
- Rotary and linear solenoids
- Motors, complete with housings, gear-boxes and bearings (lubrication to space standards)
- Position feedback systems
- Scaled designs (winding, length and diameter)
- Redundant designs (main and back-up)
- Position feedback systems
- Full In-house design, analysis, test and qualification by MACCON

*Rotary Actuator for ISS Berthing Mechanism*

MACCON supplies all types of electric motors and electro-magnetic designs for space applications. Typically these motors are PM-BLDC 3- phase, multi-pole, brushless designs with inner rotors. However we also supply outer rotor motors and the other technologies listed below in our space program survey.

### ***Engineering Design & Qualification Services***

- Electro-magnetic design services
- Magnetic stray-field studies
- Servo-system analysis & simulation
- Design analyses
  - Reliability incl. parts count, parts stress, and FMEA
  - Interface
  - Mechanical
  - Thermal
  - Radiation.
- In-house qualification:
  - Temperature-vacuum
  - Shock and vibration
  - EMC etc.

The table below lists some of the motors we have built, qualified and deployed in space. Over five new applications are being added to this list every year. For new programs modified or scaled solutions (winding, length and diameter) can be easily generated and will still exhibit proven space heritage.

## Selection of Space Programs employing MACCON Motors

Satellite Mission	Experiment	Application	Type	Nom. Torque	Stator Length	Stator OD	Redundancy comment
Ariane 6	FLPP-HCV	Valve actuator	PM-BLDC	1.5 Nm	35mm	75mm	
Ariane 6	FLPP-OCV	Valve actuator	PM-BLDC	1.4 Nm	25mm	120mm	
Bepi Columbo	ADM Actuator	Antenna, de-spin	PM-BLDC	700Nm	5mm	174mm	Dual stator
Bepi Columbo	STR	Shutter	LAT 45°	40mNm	10mm	50mm	housed
Bepi Columbo	Simbio-SYS	Shutter	LAT 20°	10mNm	9mm	18mm	housed
Chang'e 5	Drill actuator	Lunar mission	PM-BLDC	15 Nm	69mm	56mm	w. gearbox
Columbis/ISS	Biolab micro-gravity	Centrifuge	DC	600mNm	10mm	51mm	housed
Cosmo 2 <sup>nd</sup> .Gen	AU1, AU2		PM-BLDC	600mNm	7/37mm	148/70mm	
EnMap	FHD Actuator	Shutter	PM-BLDC	15Nm	113mm	42mm	w. gearbox
FY-3	MHS	Scanner	PM-BLDC	700mNm	5mm	174mm	Dual stator
FY-3	DCBM		PM-BLDC	20mNm	15mm	36mm	housed
FY-3	DGBBA	Interferometer	PM-BLDC	80mNm	12mm	60mm	housed
FY-3	Ionosphere Photom.	Filter wheel	Stepper	20mNm	40mm	32mm	Dual winding
LEMA	IDBM Actuator	Docking	PM-BLDC	800mNm	42mm	76mm	Dual winding
MeteoSAT		Dual-scanner	PM-BLDC	1.0 Nm	25mm	127mm	Dual winding
MetOp NG	MWS, MWI/ICI	Scanner	PM-BLDC	3.5 Nm	22mm	174mm	Dual winding
MetOp NG	METimage	Scanner	PM-BLDC	2.2 Nm	22mm	169mm	Dual winding
OPTEL	TESLA Motor	Scanner	PM-BLDC	100mNm	6mm	83mm	
PRISMA	Small	Shutter	LAT 21°	50mNm	12mm	24mm	Dual winding
PRISMA	Main Port	Shutter	LAT 90°	300mNm	30mm	60mm	Dual winding
PRISMA	Solar Port	Shutter	LAT 47°	80mNm	16mm	32mm	Dual winding
Sciamachy	Main	Scanner	PM-BLDC	100mNm	34mm	38mm	
Sentinel 3	SLSTR OME, SDM	Scanner	PM-BLDC	800mNm	5mm	174mm	Dual winding
Sentinel 3	SLSTR OME, FMM	Shutter	LAT 10°	20mNm	19mm	24mm	Dual winding
TerraSAR-X	LCTSX	Laser comm.	PM-BLDC	1.0 Nm	10mm	182mm	
	MWRI SCM	Scanner	PM-BLDC	300mNm	6mm	136mm	Dual stator
	MWRI SDM	Scanner	PM-BLDC	700mNm	5mm	174mm	Dual stator
	LiQuard	Scanner	LAT 13°	400mNm	17mm	46mm	
	CPA Azimuth	Laser comm.	PM-BLDC	350mNm	7mm	135mm	Dual winding
	CPA Elevation	Laser comm.	LAT 13°	100mNm	8mm	46mm	

### Important characteristics:

- Manufacture to ESA standards
- Most models are kit-motors for direct integration into client mechanics
- Designs are selected to minimize mass and energy requirements
- Operating voltages typically 5 to 28 V
- Peak torques normally >3 times nominal torque (ESA derating requirement)
- Maximum speeds vary from 5 to 3,000rpm (reaction wheel motors up to 8,000rpm)
- Stator winding redundancy, if required
- Cryogenic & high-temperature designs also possible

### Position sensors & feedback devices:

- Integrated Hall-effect commutation sensors
- Absolute Position Sensors from MACCON, Inductosyn and Netzer, also 3<sup>rd</sup> party encoders
- Typically hollow-shaft (flexible ID); low-profile, redundant reading heads possible

### Control Electronics:

- Motor power and control electronics for space programs
- Support digital commence interfaces (e.g. SpaceWire) and position feedback devices