3 Appendix

3.1 Technical Data

3.1.1 Generic technical data for all MAC motors generation III

Type of product	
Technology and concept	AC-servomotor (Brushless) with built-in magnetic encoder, and 3 phase servo amplifier/controller
Communication	
Basic Communication (all models)	Purpose: Monitoring, setup and dynamic change of internal parameters during motor operation. Interface type 2 wire RS485 Modbus 115 kbit/sec. (115kBaud). Address range 1-254
Industrial Ethernet - (optional)	Available now: EthernetIP, ProfiNET, EtherCAT, ModbusTCP. Upcoming: SercosIII, Powerlink.
Control Modes	
Modes available	Position mode, Velocity mode, Homing mode, Gear mode (follow ext. Encoder), Torque mode, Various modes controlled by analogue input or external I/O's.- Please see Mode descriptions in other chapter in this user manual.
Feedback / resolution:	
Internal incremental Encoder resolution	8192 counts per motor revolution. Higher resolutions may be possible on request.
Absolute Multiturn Encoder (optional)	Resolution ±262144 revolutions.
Encoder Technology	Magnetic and energy harvesting (no battery or mechanics = long lifetime)
Servo regulator	
Regulator Technology	Filter 6.th. order filter with only one inertia load factor parameter to be adjusted depending at load inertia
Sample rate (Update frequency)	Default 1.0 ms (1000 Hz) and optionally 1.3 ms, 2.0 ms or 2.6 ms
Amplifier Control System	Sinusoidal current PWM control. Sampling rate 10kHz and PWM switching frequency 10kHz.
Safety functions (optional)	
Type of safety and level	STO input (physical input) according to SIL3 - TÜV certification pending. Support for functional safety protocols: PROFIsafe - in development / CIPsafety - planned / FSoE - planned. Various FuSa functions in development for release in 2026 such as **"Stopping functions"**: STO, SS1-t, SS2-t. **"Monitoring functions"**: SS1-r, SOS, SS2-r, SLS, SSM, SDI, SLP. **"Output functions"**: SBC. All meets SIL3 / PLe.
Digital resolutions and ranges	
Positioning	Position range ±134.217.728 (±2^27) counts (default) and ±2.147.483.648 (±2^31) counts (high resolution mode)
Velocity	Speed range Nominal: ±3000 RPM. Can be set up to ±3600 RPM but triggers an over speed error if 3600 RPM is reached. The internal unit correspond to (factory default): **0.45776 RPM** (1.0ms sample rate) and **0.35211 RPM** (1.3ms sample rate). If "high resolution mode" is activated the internal unit for velocity is as follows: **0.0071256 RPM** (1.0ms sample rate) and **0.0055018 RPM** (1.3ms sample rate) Accuracy: ±0,005% (±50ppm) at ambient temperature 0-40°C: Velocity dependency of supply voltage fluctuations = ±0,0% (no influence)
Acceleration Range	Default: **458 - 732422 RPM/s** (1.0ms sample rate) and **271 - 433353 RPM/s** (1.3ms sample rate) If "high resolution mode" is activated the range is **7.15 - 732422 RPM/s** (1.0ms sample rate) and **4.23 - 433353 RPM/s** (1.3ms sample rate).
Motor Torque	Resolution when internally controlled = 10 bit = 1024 steps (0-300% torque). Resolution if controlled from Analogue input. 10bit (no sign). Sign can be introduced by adding a value in the input offset register. Scale: Torque set to 100% = Nominal motor load. 300% = Full motor peak torque (highest possible torque that can be produced). Torque control accuracy ≤10% @ 20°C (Reproducibility)
Digital I/O's (optional)	
Purpose and function	Can be used in general for digital signals in or out such as external sensors or activating external solonoids etc.
Number of I/O's	Up to 8 I/O (incl. 4 analogue inputs). Each can be either input or output
Input activation level	When a given I/O is used as digital input: Logic low = max. 2.5V / Logic high = min. 2.6V
Output current	When a given I/O is used as digital output: Output current up to 350 mA per output at 24V. Short circuit protected.
Multifunction I/O's (optional)	
Purpose and function	Dual RS422 port can be used as input for external encoder, or output from internal encoder, or data communication.
Max. frequency/data rate	Input frequency 0-8 MHz (8 Mbit/sec). 0-1 MHz (1 Mbit/sec.) with input filter.
Analogue Inputs (optional)	
Purpose and function	Can be setup to control velocity, torque or any other internal parameter in the motor.
Number of inputs	Up to 4 inputs. Notice that these are sharing terminals with the up to 8 digital I/O's.
Resolution	10bit (no sign). Range 0.00 -5.00V. Not galvanically isolated.
Input voltage range	Nom. input voltage IN1 to IN4 (option dependant). Voltage range max. -10 to +32VDC.
Input offset and impedance	Offset typical ±50mV and input impedance to ground = 30kOhm @0-5V
Various	
Electromechanical brake (optional)	The brake is activated automatically when the motor is passive.and not able to control the motor in position in case of i.e. error.
Default rotation direction	Positive direction -> Motor shaft rotate clockwise (Seen from shaft end). Can be inverted by motor parameter.
Protective functions	Error trace back, Overload (I^2T) - Load exceed maximum for too long time, Regenerative overload, follow error, function error, regenerative overload (over voltage), position limit exceeded. Abnormality in flash memory, under voltage, over current, temperature too high. and many others.
LED Indicators (all motor types)	The motor is equipped with 5 Bi-colour LED's: See LED chapter for explanation. LED function depends on installed motor options
Leakage current to earth	Leakage current to earth: Less than 3 mA @ 50/60 Hz
Protection Class	IP55 (standard) or IP66 (extended)
Homing Methods	1: Automatic *Homing* with sensor connected to input (2 formats) 2: Mechanical *Homing* without sensor. (Torque controlled)
Certifications and approvals	Conforms to CE regulations - find EU - Declaration of Conformity in appendix of user manual. UL File: Pending
Usage / Storage Temperature and Humidity	Ambient 0 to +40°C (32-104°F)/ Storage (power not applied): -20 to +85°C. (-4 to 185°F). Humidity Max. 90% non condensing. Temperature shut down and error message generated at 95°C (203F).

Data in red are under evaluation by JVL's R&D department

3.1 Technical Data

3.1.2 Individual technical data for each motor size/type.

Below data tables for each individual type and motor size in the MAC motor family generation III.

Data for only MAC404			
Motor data	Motor sub types	**MAC404-M1 to M3** (w/o brake)	**MAC404-M4 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	400 W	
	Rated Torque RMS / Peak Torque	1.27 Nm / 3.8 Nm	
	Inertia (kg/cm²)	0.52 kg/cm²	0.54 kg/cm²
	Maximum radial / axial force at motor shaft	Fr 245 / Fa 74 N	
	Length	170 mm ±2 mm	206 mm ±2 mm
	Weight	2 kg	2.4 kg
	Electrical / Mechanical motor time constant	2.03 / 1.23 ms	2.03 / 1.26 ms
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T6.3A@230VAC or T10A@115VAC if automatic use class D	
Brake resistor	Regenerative power dump (brake resistor circuit)	Internal 4W average / External output 25A peak	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	**YES**
	Backlash (when brake is activated)	(not relevant)	< ±1 degree
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	TBD dB(A)
Speed range	0-3000RPM with nom. torque. (maximum 4000RPM short-term). Speed protection trips at >4300RPM the motor will shut down.		
Input power supply	115 or 230AC (±10%), 47-63Hz for main power circuit. 18-32VDC for control circuit. Inrush current < 5A at 115/230VAC. Consumption at 115-230VAC up to 470W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC404M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC404M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Frontflange: 60x60mm. Shaft diameter Ø14mm - see also the chapter "Physical dimensions" in this user manual		

Data for only MAC604			
Motor data	Motor sub types	**MAC604-M2 to M3** (w/o brake)	**MAC604-M5 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	600 W	
	Rated Torque RMS / Peak Torque	1.91 Nm / 5.73 Nm	
	Inertia (kg/cm²)	0.84 kg/cm²	0.86 kg/cm²
	Maximum radial / axial force at motor shaft	Fr 245 / Fa 74 N	
	Length	188 mm ±2 mm	224 mm ±2 mm
	Weight	TBD kg	TBD kg
	Electrical / Mechanical motor time constant	4.86 / 1.10 ms	4.86 / 1.15 ms
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T8A@230VAC or T15A@115VAC if automatic use class D	
Brake resistor	Regenerative power dump (brake resistor circuit)	Internal 4W average / External output 25A peak	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	**YES**
	Backlash (when brake is activated)	(not relevant)	< ±1 degree
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	TBD dB(A)
Speed range	0-3000RPM with nom. torque. (maximum 3400RPM short-term). Speed protection trips at >3600RPM the motor will shut down.		
Input power supply	115 or 230AC (±10%), 47-63Hz for main power circuit. 18-32VDC for control circuit. Inrush current < 5A at 115/230VAC. Consumption at 115-230VAC up to 705W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC604M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC604M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Frontflange: 60x60mm. Shaft diameter Ø14mm - see also the chapter "Physical dimensions" in this user manual		

Data for only MAC802			
Motor data	Motor sub types	**MAC802-M2 to M3** (w/o brake)	**MAC802-M5 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	750 W	
	Rated Torque RMS / Peak Torque	2.39 Nm / 7.17 Nm	
	Inertia (kg/cm²)	1.36 kg/cm²	TBD kg/cm²
	Maximum radial / axial force at motor shaft	Fr 392 / Fa 147 N	
	Length	156 mm ±2 mm	TBD mm ±2 mm
	Weight	TBD kg	TBD kg
	Electrical / Mechanical motor time constant	2.03 / 1.23 ms	2.03 / 1.26 ms
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T80A@24VDC if automatic use class D	
Brake resistor	No internal brake resistor	Use external brake resistor device if needed	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	**YES**
	Backlash (when brake is activated)	(not relevant)	< ±1 degree
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	TBD dB(A)
Speed range	0-3000RPM with nom. torque. (maximum 3400RPM short-term). Speed protection trips at >3600RPM the motor will shut down.		
Input power supply	12-48VDC for main power circuit. **≥24VDC** is mandatory to run nominal speed and power. Maximum speed will be proportionally deducted with a supply lower than 24VDC. Secondary supply 8-32VDC for the control circuit (terminal CVI). Consumption at 24VDC up to 880W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC802M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC802M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Front: 80x80mm. Shaft diameter Ø19mm - see also the chapter "Physical dimensions" in this user manual		

3.1 Technical Data

Technical data for each motor size/type (continued)

Data for only MAC804			
Motor data	Motor sub types	**MAC804-M2 to M3** (w/o brake)	**MAC804-M5 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	750 W	
	Rated Torque RMS / Peak Torque	2.39 Nm / 7.17 Nm	
	Inertia (kg/cm²)	1.63 kg/cm²	1.73 kg/cm²
	Maximum radial / axial force at motor shaft	Fr 392 / Fa 147 N	
	Length	188 mm ±2 mm	227 mm ±2 mm
	Weight	TBD kg	TBD kg
	Electrical / Mechanical motor time constant	4.6 / 0.96 ms	4.6 / 1.02 ms
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T10A@230VAC or T15A@115VAC if automatic use class D	
Brake resistor	Regenerative power dump (brake resistor circuit)	Internal 10W average / External output 40A peak	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	**YES**
	Backlash (when brake is activated)	(not relevant)	< ±1 degree
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	TBD dB(A)
Speed range	0-3000RPM with nom. torque. (maximum 3400RPM short-term). Speed protection trips at >3600RPM the motor will shut down.		
Input power supply	115 or 230AC (±10%), 47-63Hz for main power circuit. 18-32VDC for control circuit. Inrush current < 5A at 115/230VAC. Consumption at 115-230VAC up to 880W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC804M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC804M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Frontflange: 60x60mm. Shaft diameter Ø14mm - see also the chapter "Physical dimensions" in this user manual		

Data for only MAC1004			
Motor data	Motor sub types	**MAC1004-M2 to M3** (w/o brake)	**MAC1004-M5 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	1000 W	MAC1004 with integrated brake is not available - use MAC804 or MAC1404
	Rated Torque RMS / Peak Torque	3.18 Nm / 9.55 Nm	
	Inertia (kg/cm²)	1.81kg/cm²	
	Maximum radial / axial force at motor shaft	Fr 392 / Fa 147 N	
	Length	198 mm ±2 mm	
	Weight	3.8 kg	
	Electrical / Mechanical motor time constant	4.86 / 1.10 ms	
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T10A@230VAC / T15A@115VAC If automatic use class D	
Brake resistor	Regenerative power dump (brake resistor circuit)	Internal 10W average External output 40A peak	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	
	Backlash (when brake is activated)	(not relevant)	
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	
Speed range	0-3000RPM with nom. torque. (maximum 3400RPM short-term). Speed protection trips at >3600RPM the motor will shut down.		
Input power supply	115 or 230AC (±10%), 47-63Hz for main power circuit. 18-32VDC for control circuit. Inrush current < 5A at 115/230VAC. Consumption at 115-230VAC up to 1175W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC1004M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC1004M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Frontflange: 60x60mm. Shaft diameter Ø14mm - see also the chapter "Physical dimensions" in this user manual		

Data for only MAC1202			
Motor data	Motor sub types	**MAC1202-M2 to M3** (w/o brake)	**MAC1202-M5 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	1200 W	
	Rated Torque RMS / Peak Torque	3.82 Nm / 11.46 Nm	
	Inertia (kg/cm²)	2.47 kg/cm²	TBD kg/cm²
	Maximum radial / axial force at motor shaft	Fr 392 / Fa 147 N	
	Length	189.5 mm ±2 mm	223.5 mm ±2 mm
	Weight	TBD kg	TBD kg
	Electrical / Mechanical motor time constant	9.2 / 0.96ms	9.2 / TBD ms
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T100A@24VDC if automatic use class D	
Brake resistor	No internal brake resistor or circuitry	Use external brake resistor device if needed	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	**YES**
	Backlash (when brake is activated)	(not relevant)	< ±1 degree
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	TBD dB(A)
Speed range	0-3000RPM with nom. torque. (maximum 3400RPM short-term). Speed protection trips at >3600RPM the motor will shut down.		
Input power supply	12-48VDC for main power circuit. **≥24VDC** is mandatory to run nominal speed and power. Maximum speed will be proportionally deducted with a supply lower than 24VDC. Secondary supply 8-32VDC for the control circuit (terminal CVI). Consumption at 24VDC up to 1400W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC1202M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC1202M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Front: 80x80mm. Shaft diameter Ø19mm - see also the chapter "Physical dimensions" in this user manual		

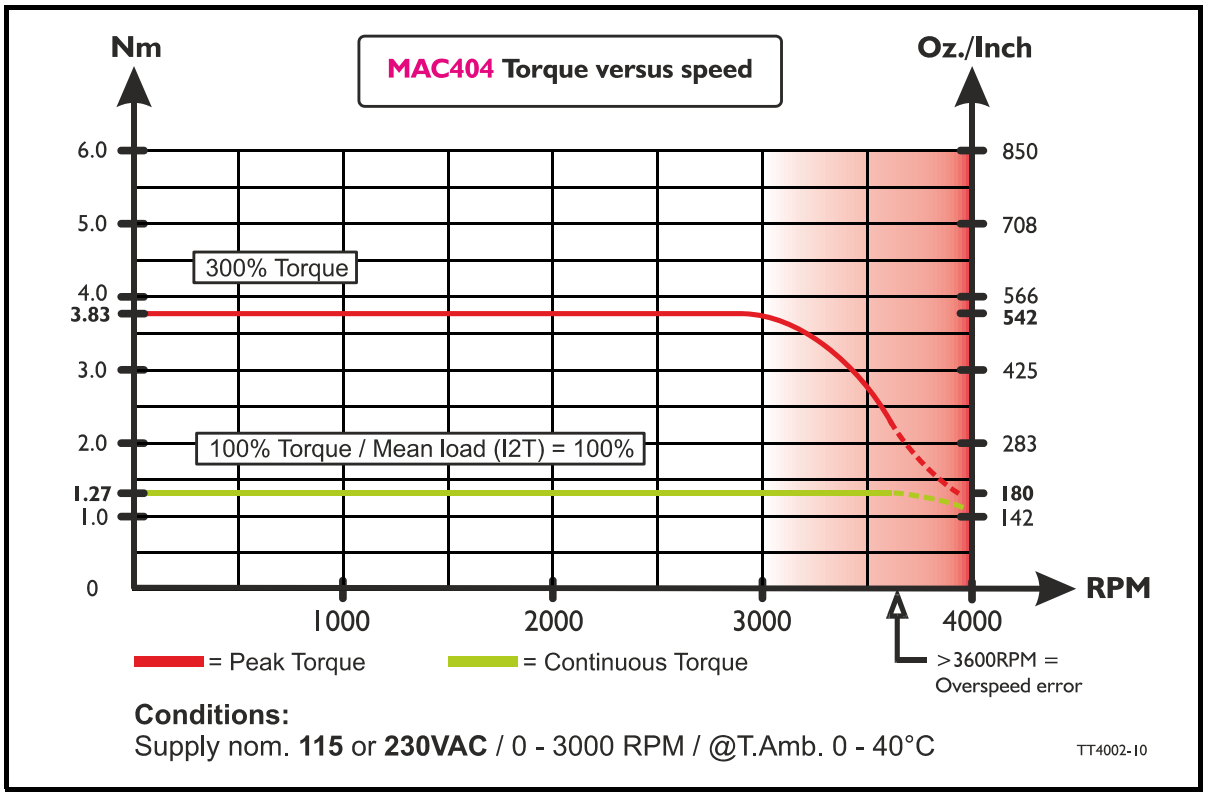
3.1 Technical Data

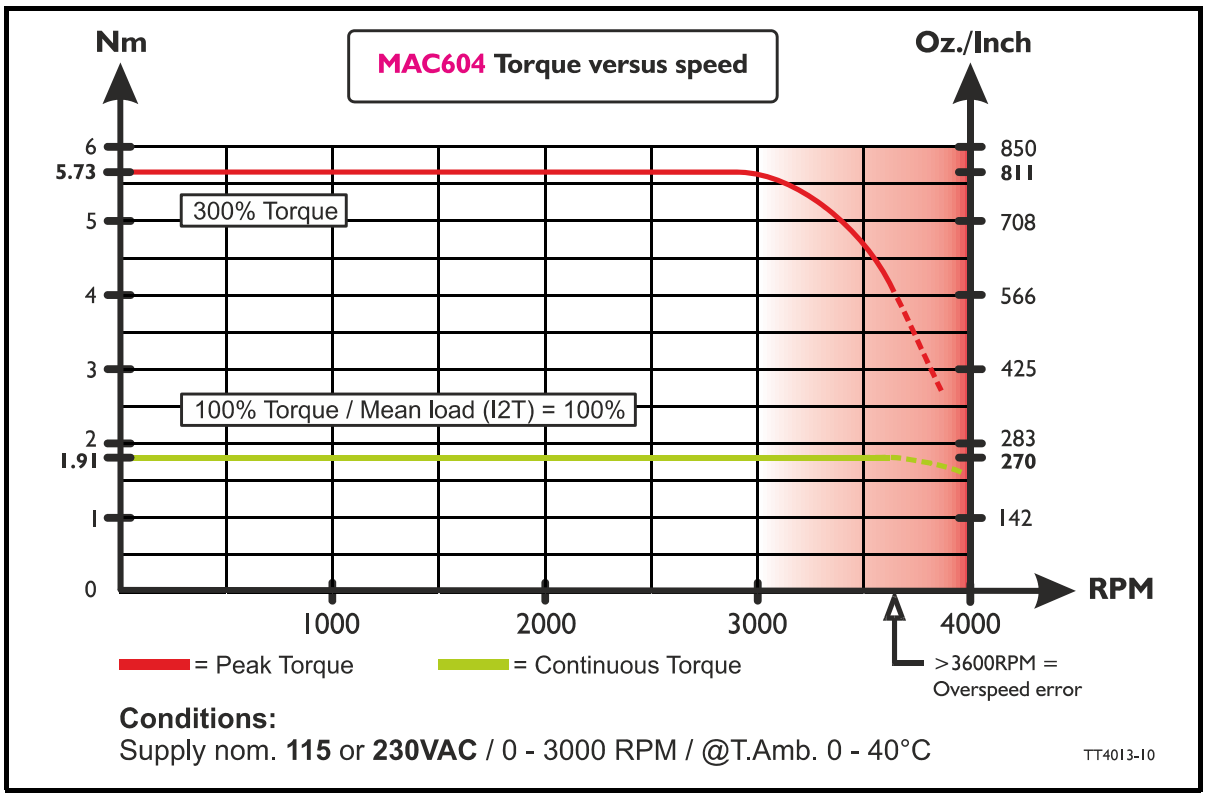
Technical data for each motor size/type (continued)

Data for only MAC1403			
Motor data	Motor sub types	**MAC1403-M2 to M3** (w/o brake)	**MAC1403-M5 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	1500 W	
	Rated Torque RMS / Peak Torque	4.78 Nm / 14.33 Nm	
	Inertia (kg/cm²)	3.15 kg/cm²	3.25 kg/cm²
	Maximum radial / axial force at motor shaft	Fr 392 / Fa 147 N	
	Length	199.5 mm ±2 mm	236.5 mm ±2 mm
	Weight	4.0 kg	5.1 kg
	Electrical / Mechanical motor time constant	10.3 / 0.85ms	10.3 / TBD ms
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T50A@48VDC if automatic use class D	
Brake resistor	No internal brake resistor or circuitry	Use external brake resistor device if needed	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	**YES**
	Backlash (when brake is activated)	(not relevant)	< ±1 degree
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	TBD dB(A)
Speed range	0-3000RPM with nom. torque. (maximum 3400RPM short-term). Speed protection trips at >3600RPM the motor will shut down.		
Input power supply	12-48VDC for main power circuit. **48VDC** is mandatory to run nominal speed and power. Maximum speed will be proportionally deducted with a supply lower than 48VDC. Secondary supply 8-32VDC for the control circuit (terminal CVI). Consumption at 48VDC up to 1760W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC1403M1, M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC1403M4, M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Front: 80x80mm. Shaft diameter Ø19mm - see also the chapter "Physical dimensions" in this user manual		

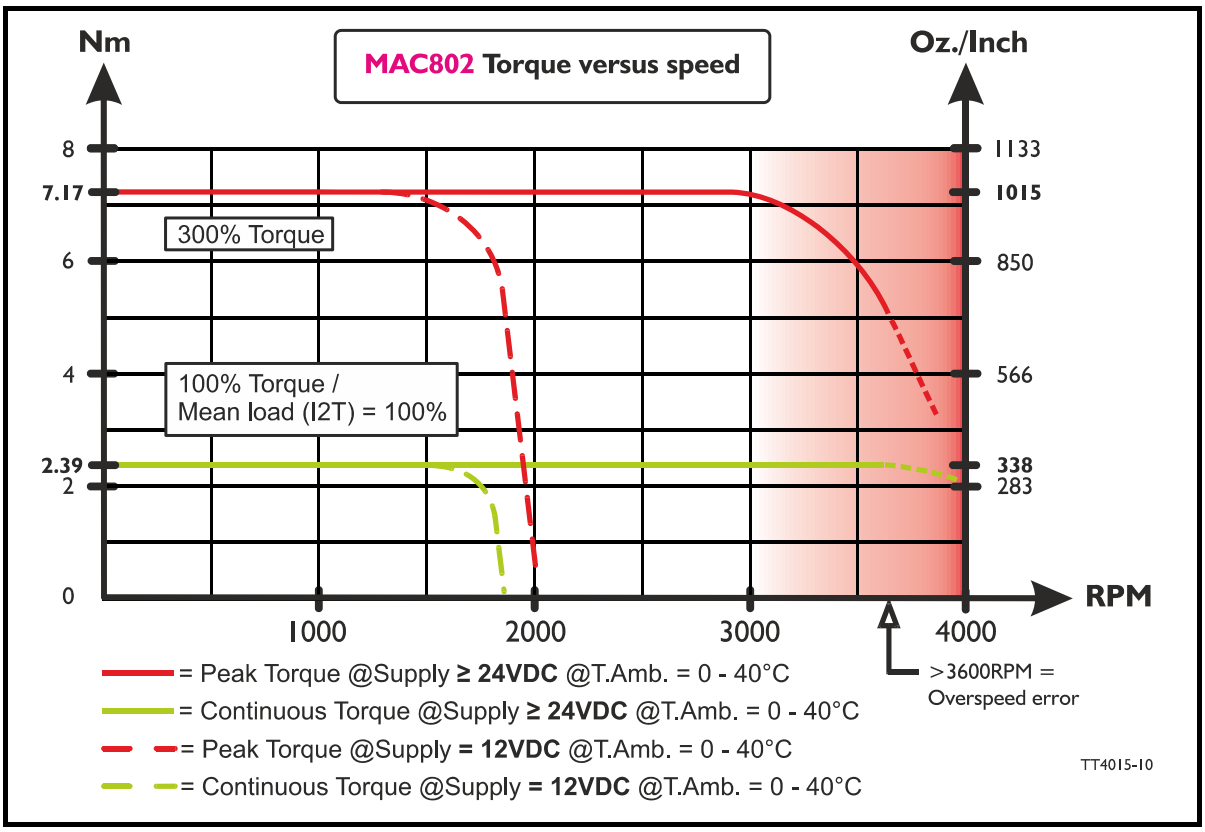
Data for only MAC1404			
Motor data	Motor sub types	**MAC1404-M1 to M3** (w/o brake)	**MAC1404-M4 to M6** (w/brake)
	Rated output @3000 RPM cont. in rated temp. range	1500 W	
	Rated Torque RMS / Peak Torque	4.78 Nm / 14.33 Nm	
	Inertia (kg/cm²)	3.15 kg/cm²	3.25kg/cm²
	Maximum radial / axial force at motor shaft	Fr 335 N/ Fa 167 N	
	Length	231 mm ±2 mm	268 mm ±2 mm
	Weight	TBD kg	TBD kg
	Electrical / Mechanical motor time constant	7.44 / 0.76 ms	7.44 / 0.78 ms
Pre-fuse	Recommended rating of the connected pre-fuse in supply	T12A@230VAC or T20A@115VAC if automatic use class D	
Brake resistor	Regenerative power dump (brake resistor circuit)	Internal 10W average / External output 40A peak	
Brake (optional)	Integrated electromagnetic safety brake	**NO**	**YES**
	Backlash (when brake is activated)	(not relevant)	< ±1 degree
	Audible brake noise level (measured in 30 cm distance)	(not relevant)	TBD dB(A)
Speed range	0-3000RPM with nom. torque. (maximum 3400RPM short-term). Speed protection trips at >3600RPM the motor will shut down.		
Input power supply	115 or 230AC (±10%), 47-63Hz for main power circuit. 18-32VDC for control circuit. Inrush current < 5A at 115/230VAC. Consumption at 115-230VAC up to 1760W average. See also power supply chapter in this user manual. Control circuitry consumption (typical): MAC1404M2 or M3 (wo/brake) = Typical 0.22A @ 24VDC(5.3W). Control circuitry consumption (typical): MAC1404M5 or M6 (w/brake) = Typical 0.54A @ 24VDC(13W).		
Flange and shaft	Front: 80x80mm. Shaft diameter Ø19mm - see also the chapter "Physical dimensions" in this user manual		

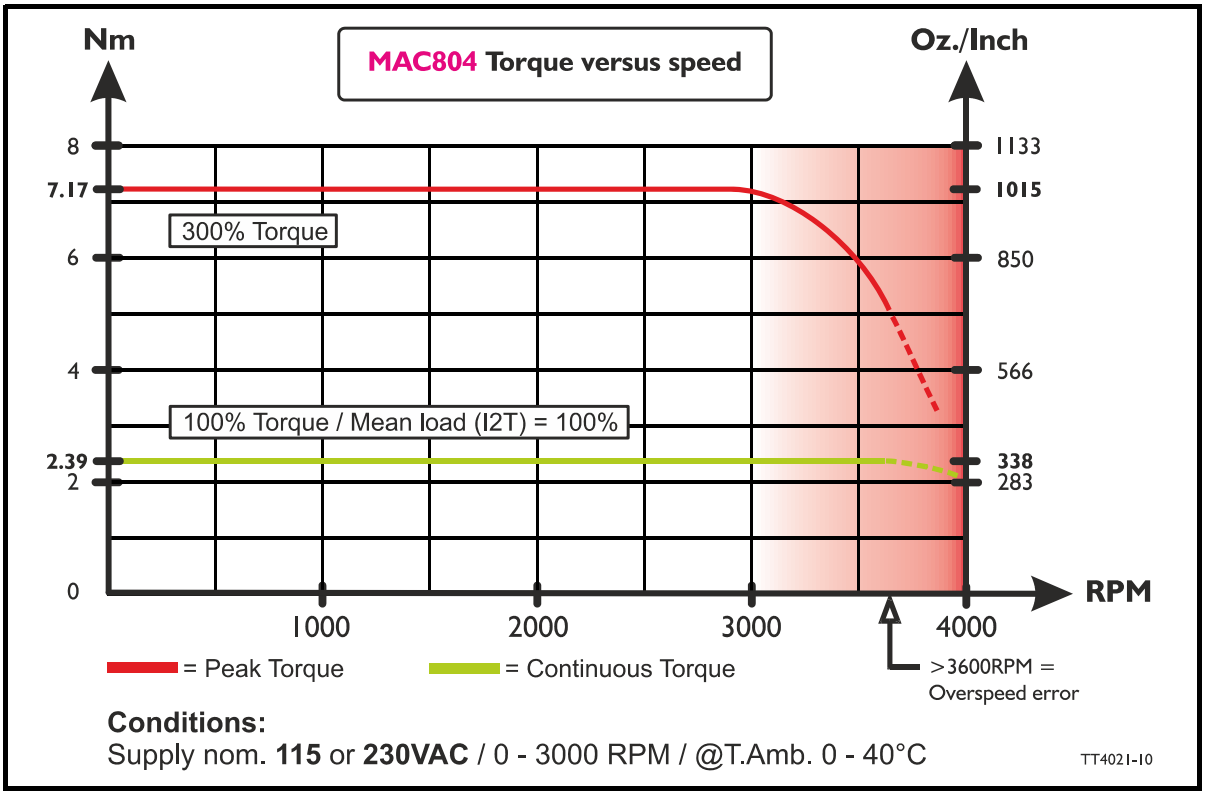
3.2 Torque Performance Curves



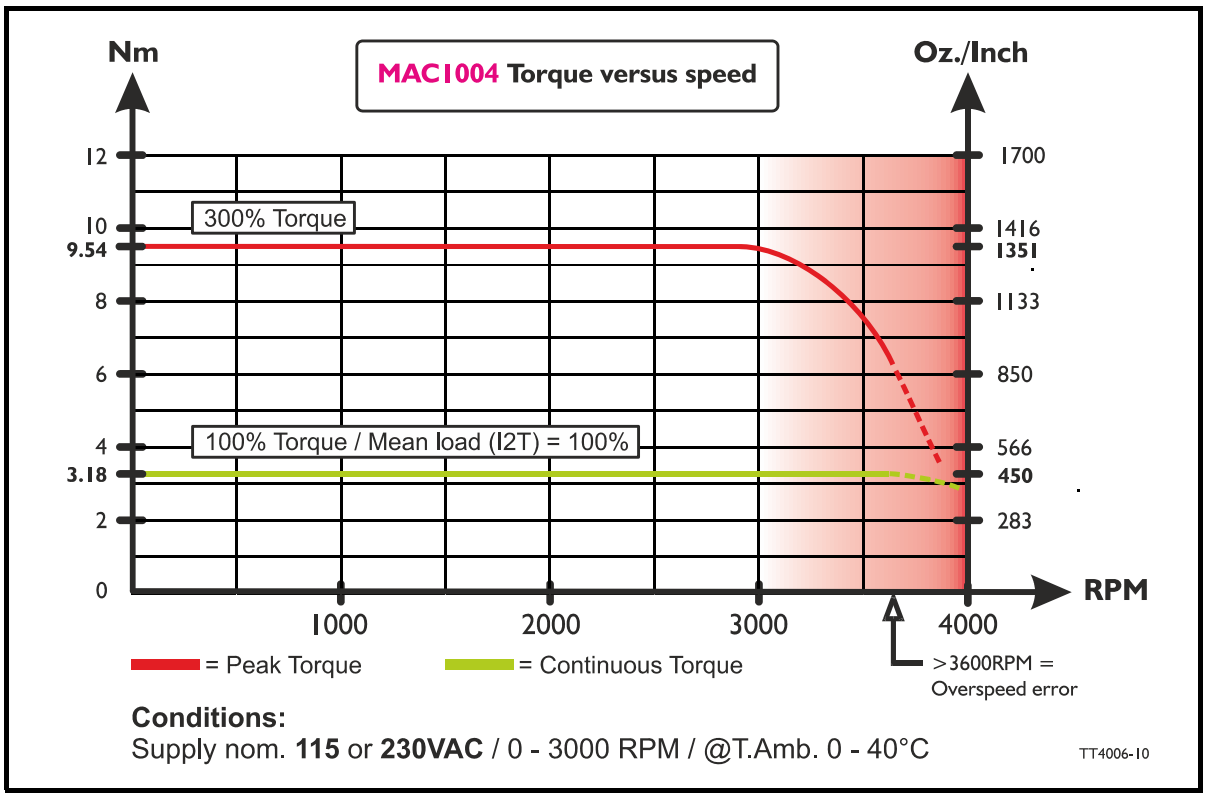


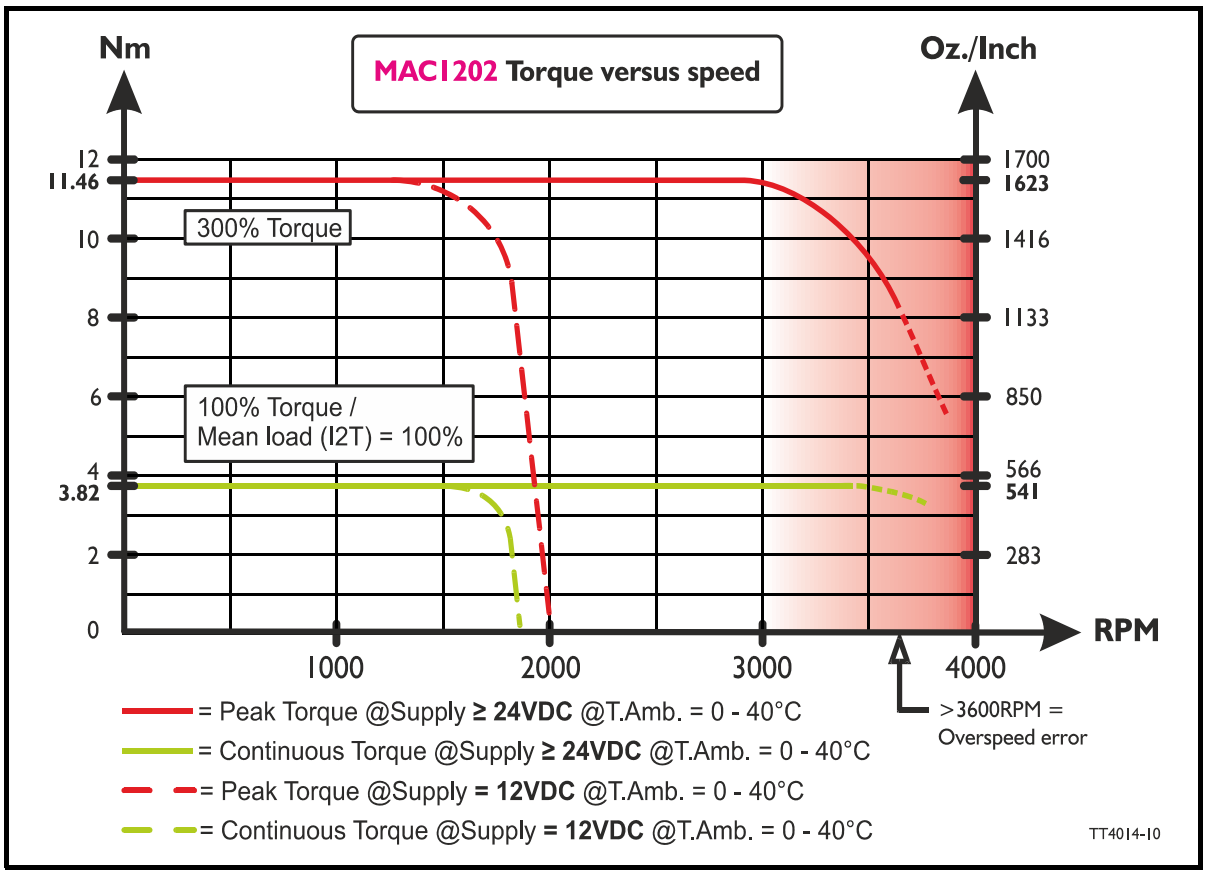
3.2 Torque Performance Curves



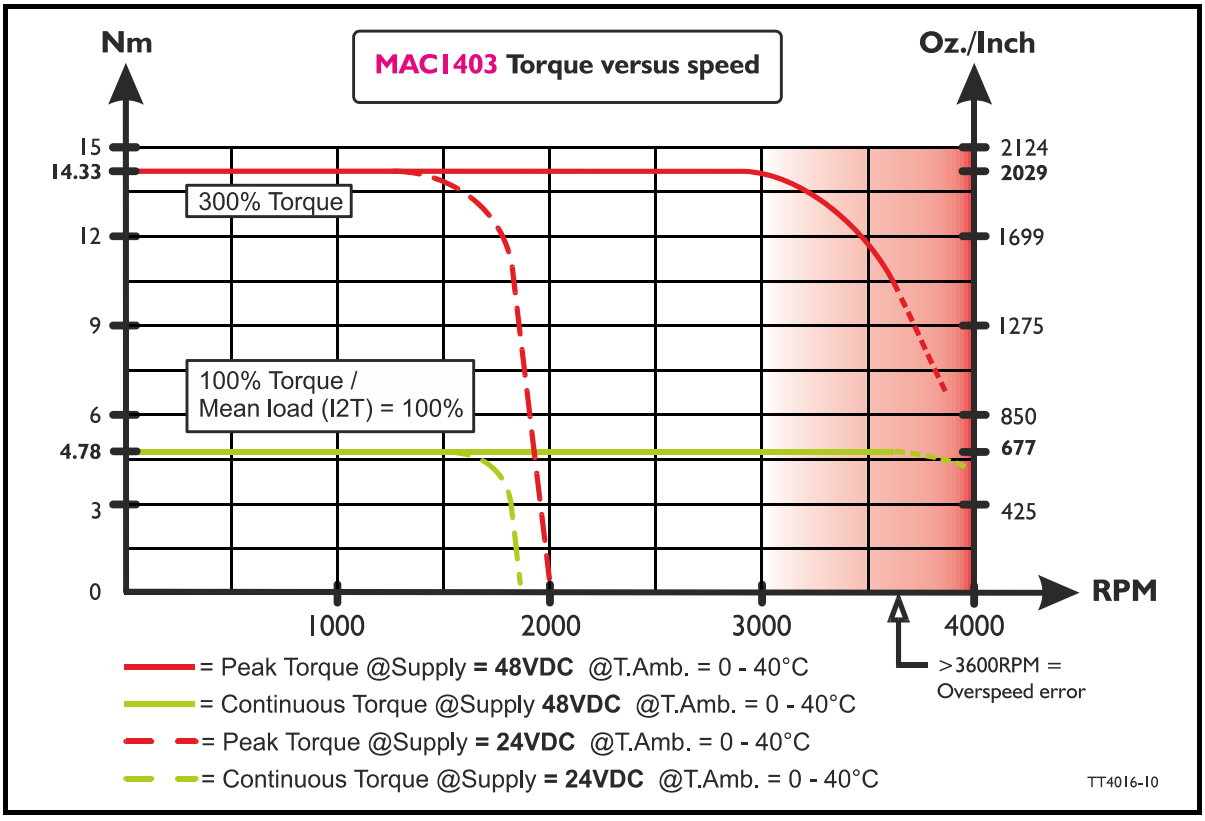


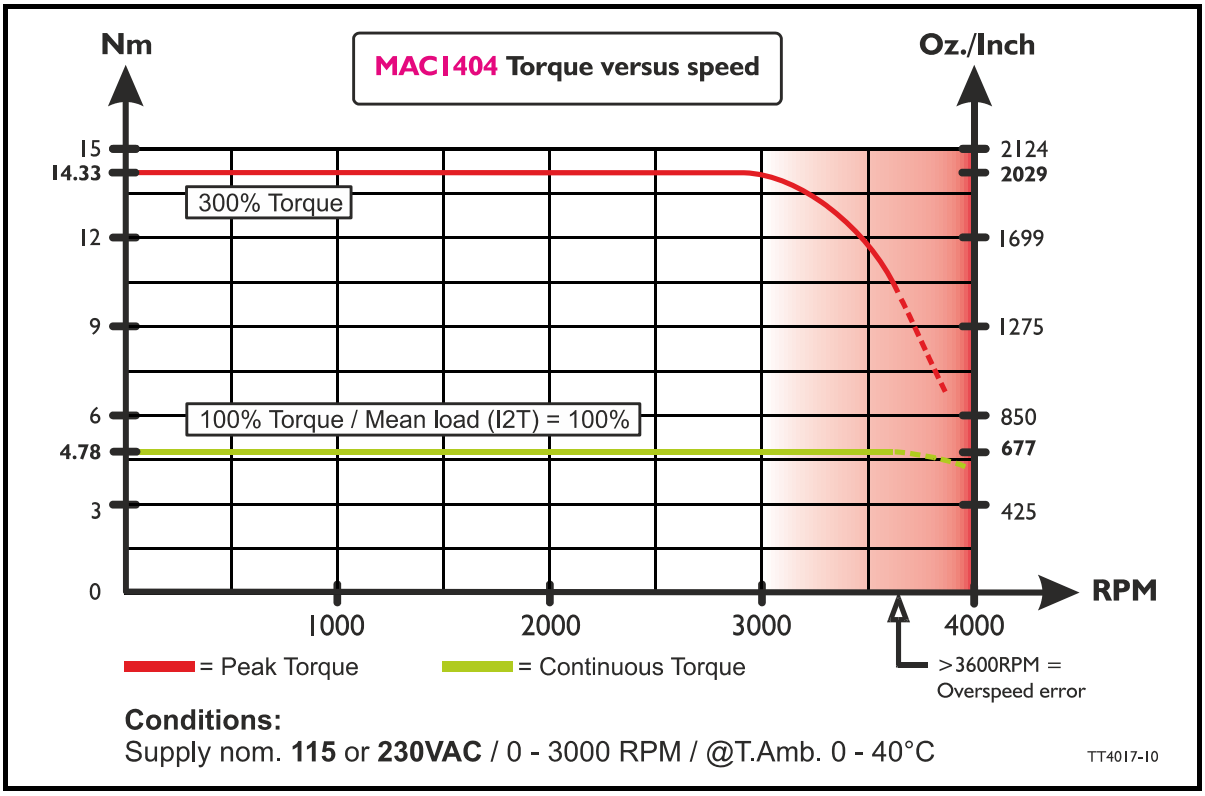
3.2 Torque Performance Curves





3.2 Torque Performance Curves

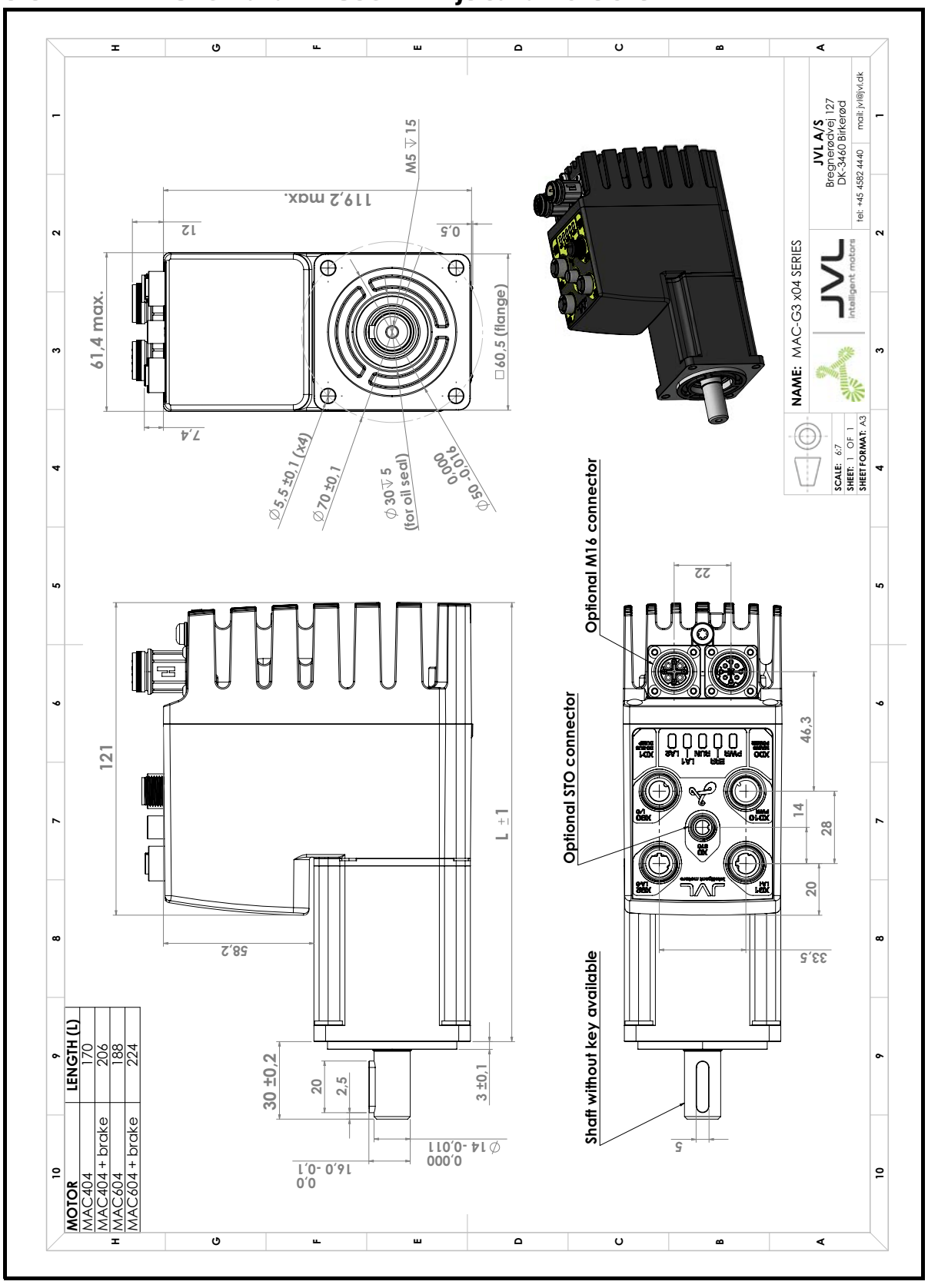




3.3 Physical dimensions

Only MAC404 and 604

3.3.1 MAC404 and MAC604 - Physical dimensions



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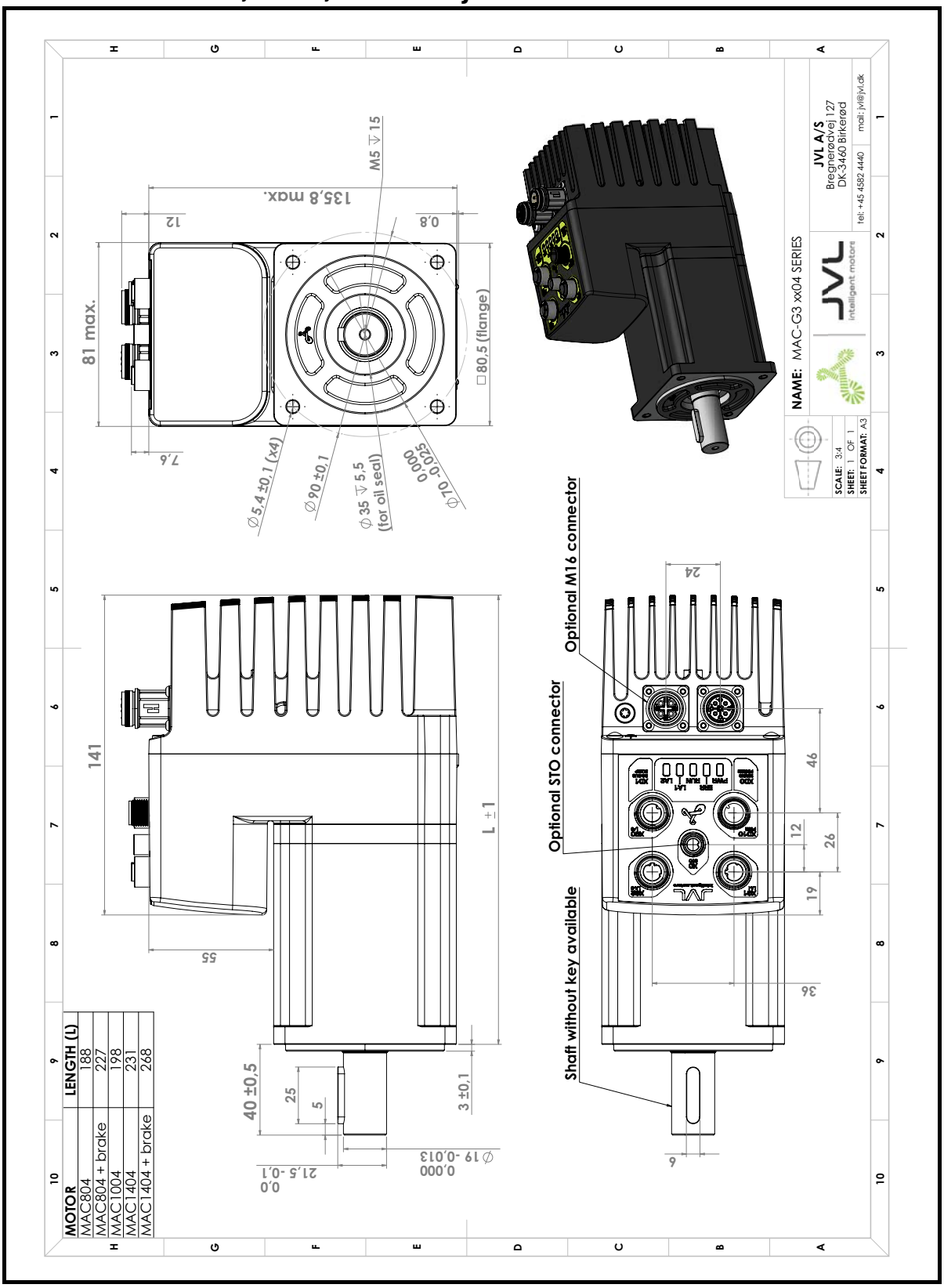
3.3 Physical dimensions

Only MAC08xx and 1xxx

3.3.2 MAC804, 1004, 1404 - Physical dimensions



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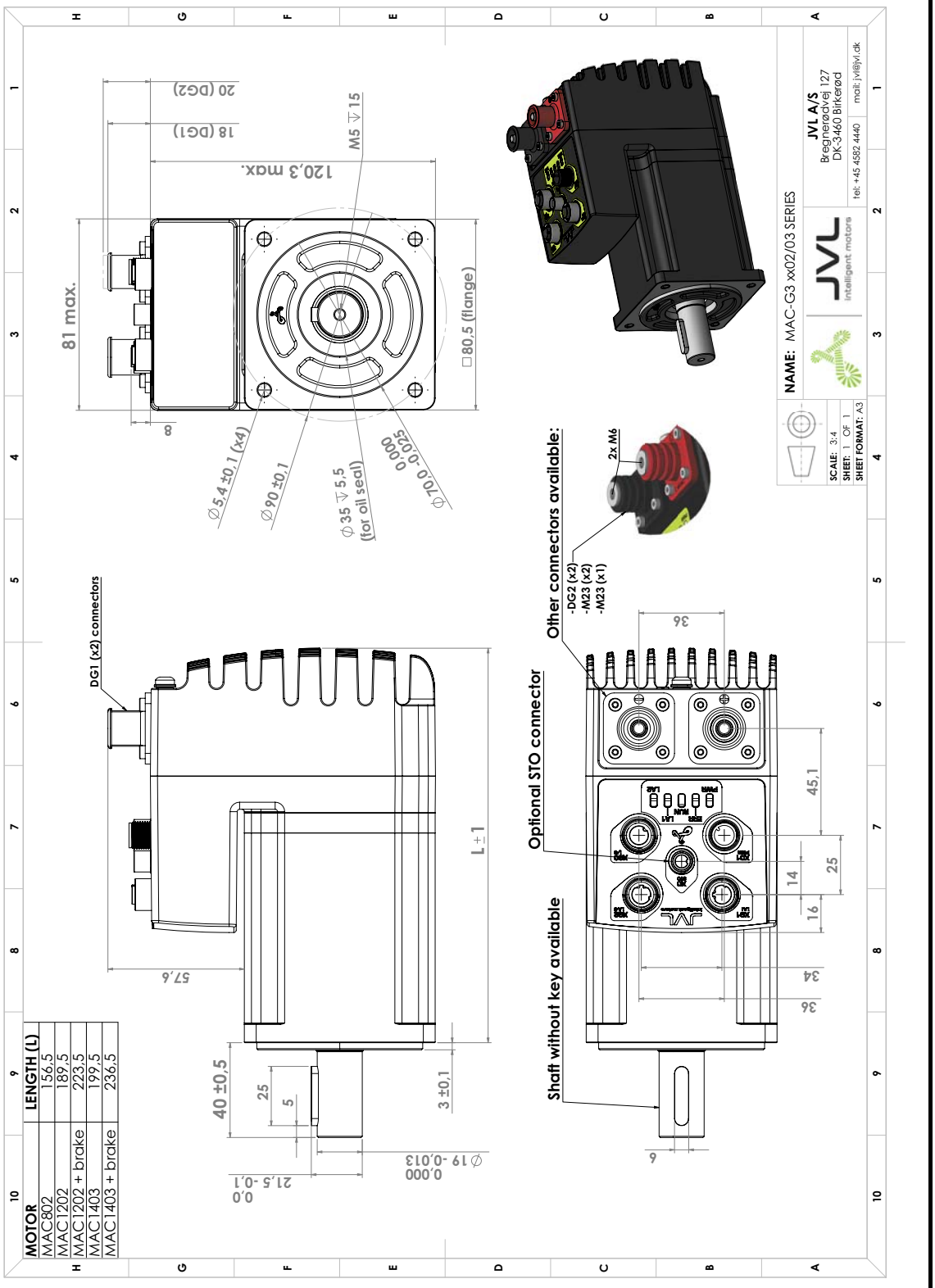
3.3 Physical dimensions

Only MACxxx2 and xxx3

3.3.3 MAC802, 1202, 1403 - Physical dimensions



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