1.2 Overall description

Motor Type	Continuous Torque	Peak Torque	Power (cont.)	Nom. Speed	Flange	Total length
MAC050	0.11Nm	0.32 Nm	46 Watt	4000 RPM	NEMA23 57x57mm (2.3"x2.3")	111.2 mm
MAC95	0.22 Nm	0.62 Nm	92 Watt	4000 RPM	NEMA23 57x57mm (2.3"x2.3")	130.5 mm
MAC140	0.32 Nm	0.9 Nm	134 Watt	4000 RPM	NEMA23 57x57mm (2.3"x2.3")	152.5 mm
MAC141	0.48 Nm	1.59 Nm	134 Watt	2700 RPM	NEMA23 57x57mm (2.3"x2.3")	172.0 mm
MAC400	Future product				60x60mm	-
MAC800	2.40 Nm	7.2 Nm	750 Watt	3000 RPM	80x80mm	175 mm

The MAC motor is available in 6 different sizes: MAC050, MAC95, MAC140, MAC141, MAC400 and MAC800, with continuous power ratings from 46W to 750W. The basic functions and I/O features are the same for all models.

1.2.1 Basic modes / functions in the MAC motor.

The MAC motor offers the following functions.

- **Passive mode.**
  The motor will be in complete passive state but communication is active and internal registers can be setup.

- **Velocity mode.**
  The motor velocity can be controlled using MacTalk software or by sending commands via the serial interface.

- **Position mode**
  The motor position can be controlled using MacTalk or by sending position commands via the serial interface.

- **Gear mode**
  The position of the motor is controlled by the multifunction I/O, which is configured as input. Either a pulse and direction signal can be applied or a quadrature A and B signal from, for example, an incremental encoder.
  This mode is very powerful if the MAC motor is used to upgrade a step motor system or if the motor is used in electronic gear applications such as a flying saw where an external encoder tracks the position of a moving object.

- **Analogue Velocity Mode.**
  The motor velocity is controlled by a voltage applied at the ±10V analogue input. This mode can be used in several applications but typical applications include maintaining variable but constant speed in feeding mechanisms or as a slave driver in multi-axis systems with a master position controller for several axes.

(continued next page)

5.1 Technical Data

Only MAC050 to 141

General					
Technology	AC-servomotor with built-in 1024 PPR encoder, hall sensors and 3 phase servo amplifier/controller				
Controller capacity		MAC050	MAC095	MAC140	MAC141
	Rated output @4000 RPM	46W	92W	134W	134W
	Rated Torque RMS (Nm)	0.11Nm	0.22Nm	0.32Nm	0.48Nm
	Peak Torque (Nm)	0.32Nm	0.62Nm	0.90Nm	1.59Nm
	Torque @200RPM with 20:1 gear	2.0Nm	4.1Nm	6.0Nm	9.0Nm
	Inertia (kgcm²)	0.075	0.119	0.173	0.227
	Maximum angular acceleration	40000rad/sec	40000rad/sec	40000rad/sec	40000rad/sec
	Length (mm)	112	131	153	172
	Weight (kg) (without expansion module)	0.60	0.85	1.10	1.33
Speed range	0-4000RPM with full torque @48VDC. Max 4000 RPM (0-2700RPM for MAC141)				
Amplifier control system	Sinusoidal wave PWM control. 15.75kHz switching				
Filter	4.th. order filter with only one inertia load factor parameter to be adjusted. Expert tuning also available				
Feedback	Incremental A and B encoder 4096 CPR. (Physical 1024 PPR)				
Input power supply	Single supply 12-48VDC (absolute max=50VDC. Power consumption with no load: Active/not active = 10/8W				
Current consumption		MAC050	MAC095	MAC140	MAC141
	Avg. current consump. @ 48VDC/Nom. load (ADC)	2 (4000RPM)	4 (4000RPM)	6 (4000RPM)	6 (2700RPM)
	Avg. current consump. @ 24VDC/Nom. load (ADC)	2 (2000RPM)	4 (2000RPM)	6 (4000RPM)	6 (1350RPM)
	Peak supply current (worst case)	6A peak	12A peak	16A peak	16A peak
Control modes	* ±10V Speed and Torque. A+B encoder outputs * Pulse/direction and 90° phase shifted A++B (Incremental) * RS422 or RS232 (5V) position and parameter commands * Gear mode with analogue input speed offset + different options * Sensor zero search or mechanical zero search				
Flange and shaft dimension	NEMA23 compatible. Front: 58 x 58mm. Rear: Ø58. Shaft Ø6.35mm				
POSITION (pulse inputs)					
Command input pulse	Pulse/direction or 90° phase shifted A+B. RS422. Logic 0=<2.0V. Logic 1=>3.0V. Max voltage at A+, A-, B+ and B- = 5.5V				
Input frequency	0-2.5MHz or 0-150kHz with input filter				
Electronic gear	A/B: A=-10000 to 10000, B=1 to 10000. Simulation of all step resolutions for easy replacement of step motor systems.				
Follow error register	32 bit				
In position width	0-32767 pulses				
Position range	32 bit. Infinity, Flip over at $\pm 2^{31}$ pulses.				
POSITION (serial communication)					
Communication facility	From PLC, PC etc via RS422 or asynchronous serial port RS232 with special cable. MacTalk JVL commands, special commands with high security.				
Communication baud rate	19200 bit/sec. (19.2kBaud)				
Position range	±67.000.000				
Speed range	0-4000 RPM. Digital resolution 0.477 RPM				
Acceleration range	248 - 397.364 RPM/sec				
Addressing	Point to point on RS422. Up to 32 units on the same serial RS232/RS485 interface with built-in expansion module. Address range 1-254				
Number of parameters.	Standard 85. With MacRegIO software 156 (Only for experts)				
Speed variance	Max. ±4 RPM variance between command and actual speed.				
SPEED/ TORQUE					
Analogue speed/torque input.	9 bit + sign. Nom. inputvoltage ±10V. 10kOhm input resistance. Voltage range max. -10 to +32VDC. Offset typical ±50mV.				
Analogue input tolerance	Typical ±1%. Max. 5% (Possible to make software adjustment to minimize gain and offset errors)				
Sampling rate at analogue input	521 Hz				
Encoder output signals	A+,A-,B+,B-, RS422. Line driver 5V outputs (SN75176). 90° Phase shifted.				
Analogue speed input	+voltage -> CW rotation. Shaft view				
Zero speed determination.	0 - rated speed.				
Speed variance at rated speed	Initial error @20°C: ±0,5%	Power Supply: ±10%: 0.0%			
	Load 0-300%: ±0.0%	Ambient temperature 0-40°C: ±0,1%			
Torque limit in speed mode	0-300% by parameter				
Analogue torque input	+voltage (positive torque) -> CW rotation. Shaft view				
Torque control accuracy	±10% @ 20°C (Reproducibility)				
VARIOUS					
Fatal error brake	Controlled deceleration by fatal error.				
Regenerative	Integrated power dump. 3W can be absorbed continuously. External attachment is possible				
Protective functions.	Error trace back.Overload (I^2T), Regenerative overload, follow error, function error, regenerative overload (over voltage), software position limit. Abnormality in flash memory, under voltage, over current.				
LED functions	Power (Green LED), Error (Red LED)				
Output signals	2 general purpose NPN <32V/25 mA outputs. Error and In position.				
Zero search	1: Automatic zero search with sensor connected to input (2 formats) 2: Mechanical zero search without sensor. (Torque controlled)				
Shaft load maximum	Radial load: 75N (20mm from flange). Axial load: 15N.				
Standards	CE approved/UL pending				
Protection	IP42 or IP67 (IP55 on request)				
Usage / Storage Temperature	Ambient 0 to +40°C / -20 to +85°C. (Humidity 90%)				

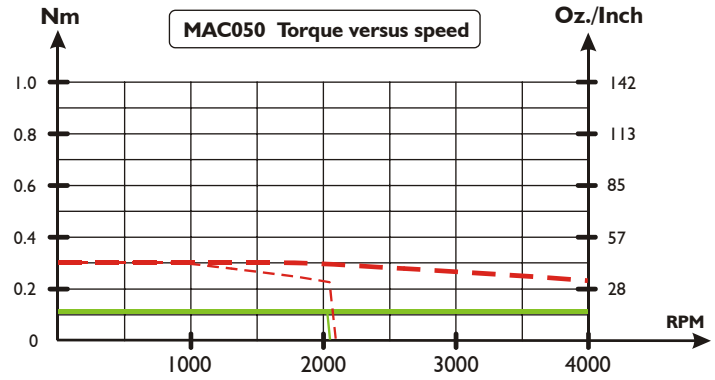
All data are specified for the basic MAC motor only, i.e. without any expansion module mounted.

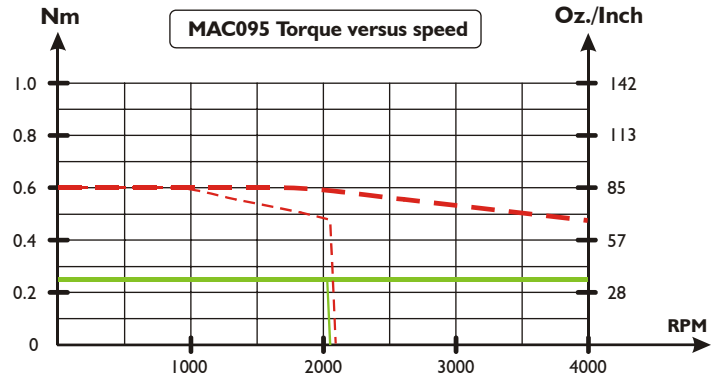
5.1 Technical Data

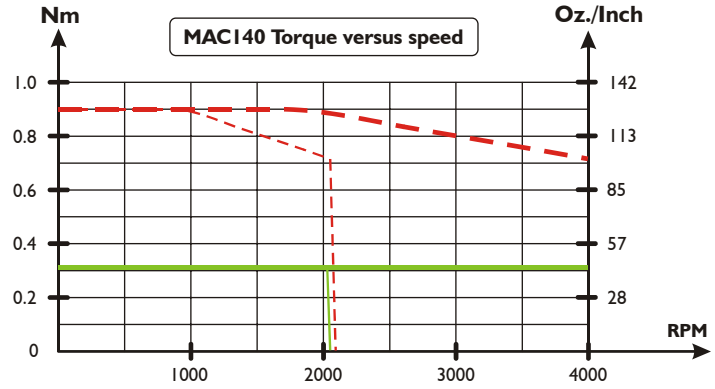
Only MAC800

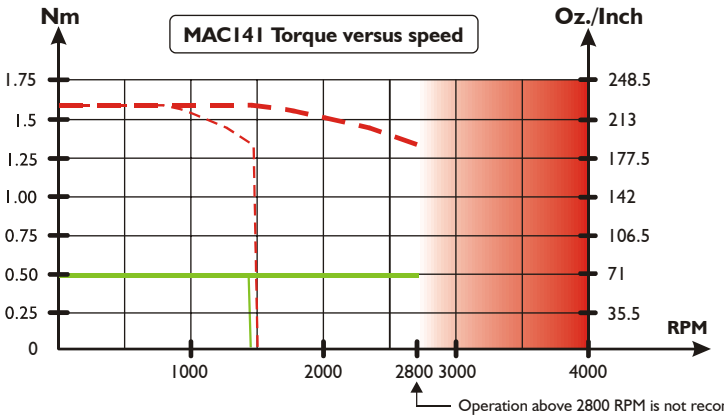
General				
Technology	AC-servomotor with built-in 2000 PPR encoder, hall sensors and 3 phase servo amplifier/controller			
Controller capacity		-	MAC800-D2	MAC800-D5 (w. brake)
	Rated output @3000 RPM	-	750W	750W
	Rated Torque RMS (Nm)	-	2.38Nm	2.38Nm
	Peak Torque (Nm)	-	6.8Nm	6.8Nm
	Inertia (kgcm²)	-	0.91	1.13
	Maximum angular acceleration	-	40000rad/sec	40000rad/sec
	Length (mm)	-	170	210
	Weight (kg) (without expansion module)	-	3.5	4.3
Speed range	0-3000RPM with full torque. Max 3500 RPM. Overspeed protection if speed >3600 = Motor will go in passive mode			
Amplifier control system	Sinusoidal wave PWM control. 20kHz switching			
Filter	6.th. order filter with only one inertia load factor parameter to be adjusted. Expert tuning also available for professionals.			
Feedback	Incremental A and B encoder 8000 CPR. (Physical 2000 PPR)			
Input power supply	12-32VDC for control circuit and 115/230/240VAC for driver. (0.25A @ 24VDC) Power consumption at the logic supply (@24VDC) with no load: Active/not active = 10/8W			
Control modes	* ±10V Speed and Torque. A+B encoder outputs * Pulse/direction and 90° phase shifted A++B (Incremental) * RS422 or RS232 (5V) position and parameter commands * Gear mode with analogue input speed offset + different options * Sensor zero search or mechanical zero search			
Flange and shaft dimension	Front: 80x80mm. Rear: 80x113mm. Shaft Ø19mm			
POSITION (pulse inputs)				
Command input pulse	Pulse/direction or 90° phase shifted A+B. RS422			
Input frequency	0-8 MHz. 0-1 MHz with input filter			
Electronic gear	A/B: A= -10000 to 10000, B=1 to10000. Simulation of all step resolutions.			
Follow error register	32 bit			
In position width	0-32767 pulses			
Position range	32 bit. Infinity, Flip over at $\pm 2^{31}$ pulses.			
POSITION (serial communication)				
Communication facility	From PLC, PC etc via RS422 or asynchronous serial port RS232 with special cable. MacTalk JVL commands, special commands with high security.			
Communication baud rate	19200 bit/sec. (19.2kBaud)			
Position range	±67 000 000			
Speed range	0-3000 RPM.			
Digital resolution	0.3606 RPM			
Acceleration range	250 - 444.675 RPM/sec			
Addressing	Point to point on RS422. Up to 32 units on the same serial RS232/RS485 interface with built-in expansion module. Address range 1-254			
Number of parameters.	Standard 85. With MacRegIO software 156 (Only for experts)			
Speed variance	Max ±4 RPM variance between command and actual speed.			
SPEED/ TORQUE				
Analogue speed/torque input.	11bit + sign. Nom. inputvoltage ±10V. 10kOhm input resistance. Voltage range max. -10 to +32VDC. Offset typical ±50mV.			
Sampling rate at analogue input	750 Hz			
Encoder output signals	A+,A-,B+,B-, RS422. Line driver 5V outputs (SN75176). 90° Phase shifted.			
Analogue speed input	+voltage -> CW rotation. Shaft view			
Zero speed determination.	0 - rated speed.			
Speed variance at rated speed	Initial error @20°C: ±0,5%	Power Supply: ±10%: 0.0%		
	Load 0-300%: ±0.0%	Ambient temperature 0-40°C: ±0,1%		
Torque limit in speed mode	0-300% by parameter			
Analogue torque input	+voltage (positive torque) -> CW rotation. Shaft view			
Torque control accuracy	±10% @ 20°C (Reproducibility)			
VARIOUS				
Fatal error brake	Controlled deceleration by fatal error. Adjustable 250 - 444.675 RPM/sec			
Regenerative	Integrated power dump. External attachment is possible			
Protective functions.	Error trace back.Overload (I²T), Regenerative overload, follow error, function error, regenerative overload (over voltage), software position limit. Abnormality in flash memory, under voltage, over current, temperature too high.			
LED functions	Power (Green LED), Error (Red LED)			
Output signals	3 general purpose NPN 30V/25 mA outputs. Error and In position.			
Zero search	1: Automatic zero search with sensor connected to input (2 formats) 2: Mechanical zero search without sensor. (Torque controlled)			
Shaft load maximum	Radial load: 18kg (20mm from flange). Axial load: 11kg.			
Optional brake(-D4 option)	Controlled automatic or from input. 3.25Nm, inertia 0.22cm2, turn on time: 50ms, turn off time: 15ms			
Rated power rate. (motor)	62.8 kW/s			
Mechanical time constant. (motor)	0.428±10% ms			
Electrical time constant. (motor)	4.122±10% ms			
Standards	CE approved/UL pending			
Protection	IP55 (IP42 and IP67 on request)			
Usage / Storage Temperature	Ambient 0 to +40°C / -20 to +85°C. (Humidity 90%)			

All data are specified for the basic MAC motor only, i.e. without any expansion module mounted.









Operation above 2800 RPM is not recommended.

Conditions:
Supply voltage = 24 or 48VDC
Ambient temperature = 20°C
Torque setting = 100%
Load setting = 1.0

Operation above 4000 RPM can be done, but the losses in the motor make it impossible to operate in this area cyclicly Please note that 2800 RPM is the maximum recommended speed for the MAC141.

= Peak Torque @48V

= Average Torque @48V

= Peak Torque @24V

= Average Torque @24V

Speed versus supply voltage

Operation below 12V is not recommended

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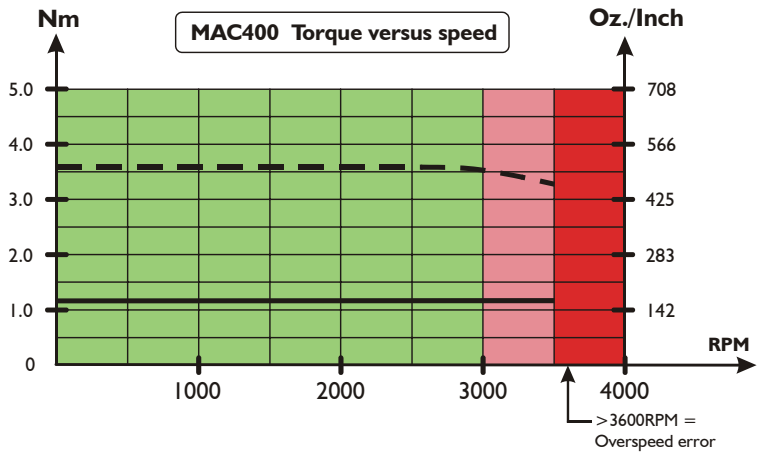
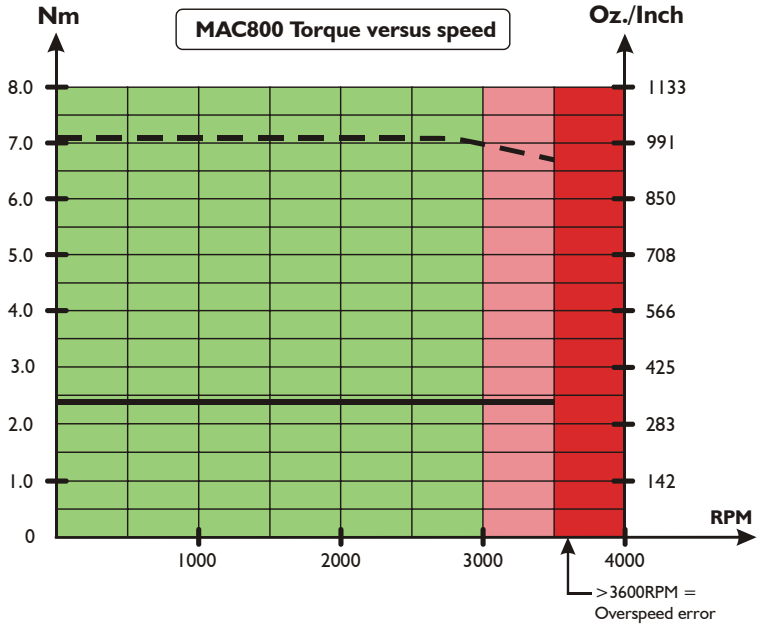


Conditions:
Supply voltage = 115-240VAC
Ambient temperature < 40°C
Torque setting = 300% (max)
Load setting = 1.0

Operation above 3000 RPM can be done, but the losses in the motor makes it impossible to operate in this area cyclicly.

Please be aware that an overspeed error will occur if the speed gets equal or higher than 3600 RPM.



= Peak torque

= Average torque

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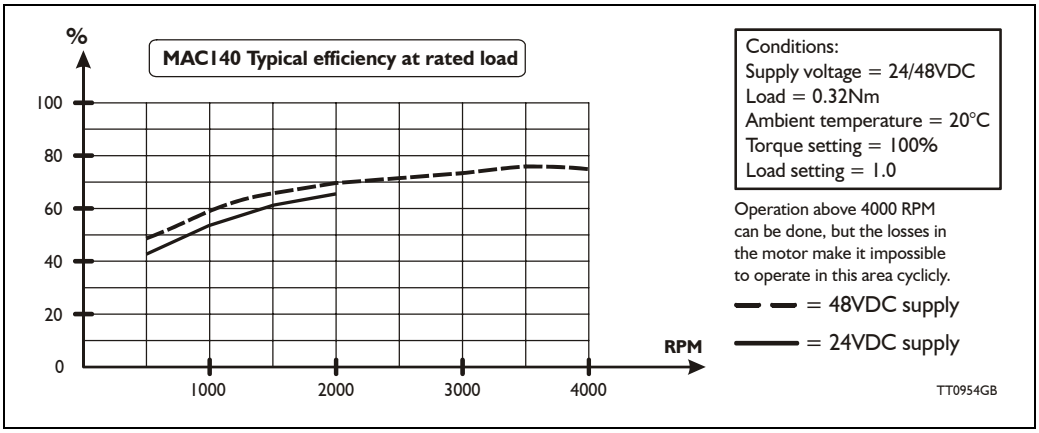
5.3 Efficiency curve

Only MAC050 to 141

5.3.1 Motor efficiency curve

The curve below shows the efficiency of the MAC140 motor as a function of speed. The efficiency is based on the difference in the total amount of electrical power applied to the motor compared with the mechanical output power on the shaft.

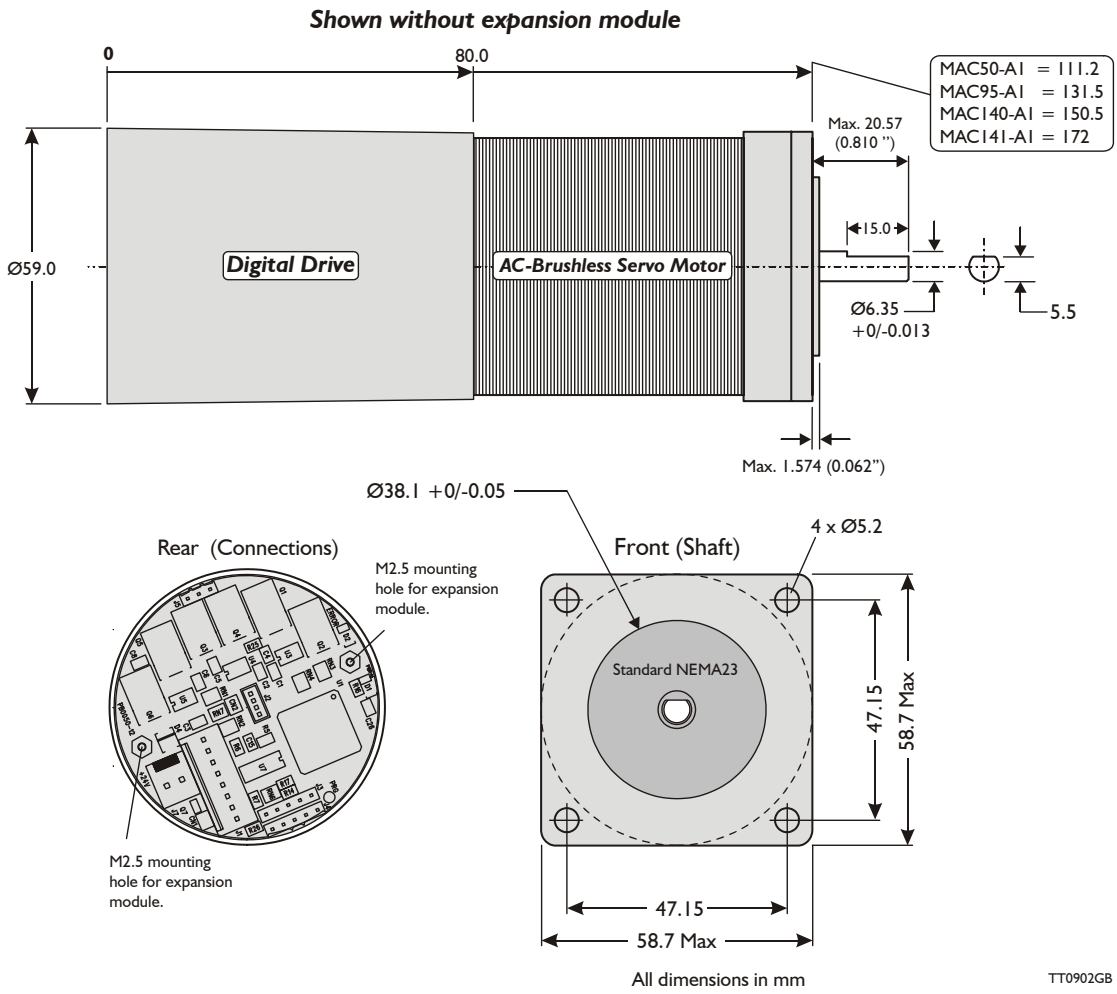


The power consumption for the internal circuitry (microprocessor etc.) is typically < 3.5W. In the speed range from 0 to 500 RPM this internal power consumption starts to be a dominant part of the total power consumption which explains that the efficiency starts to be lower.

5.4 Physical Dimensions

Only MAC050 to 141

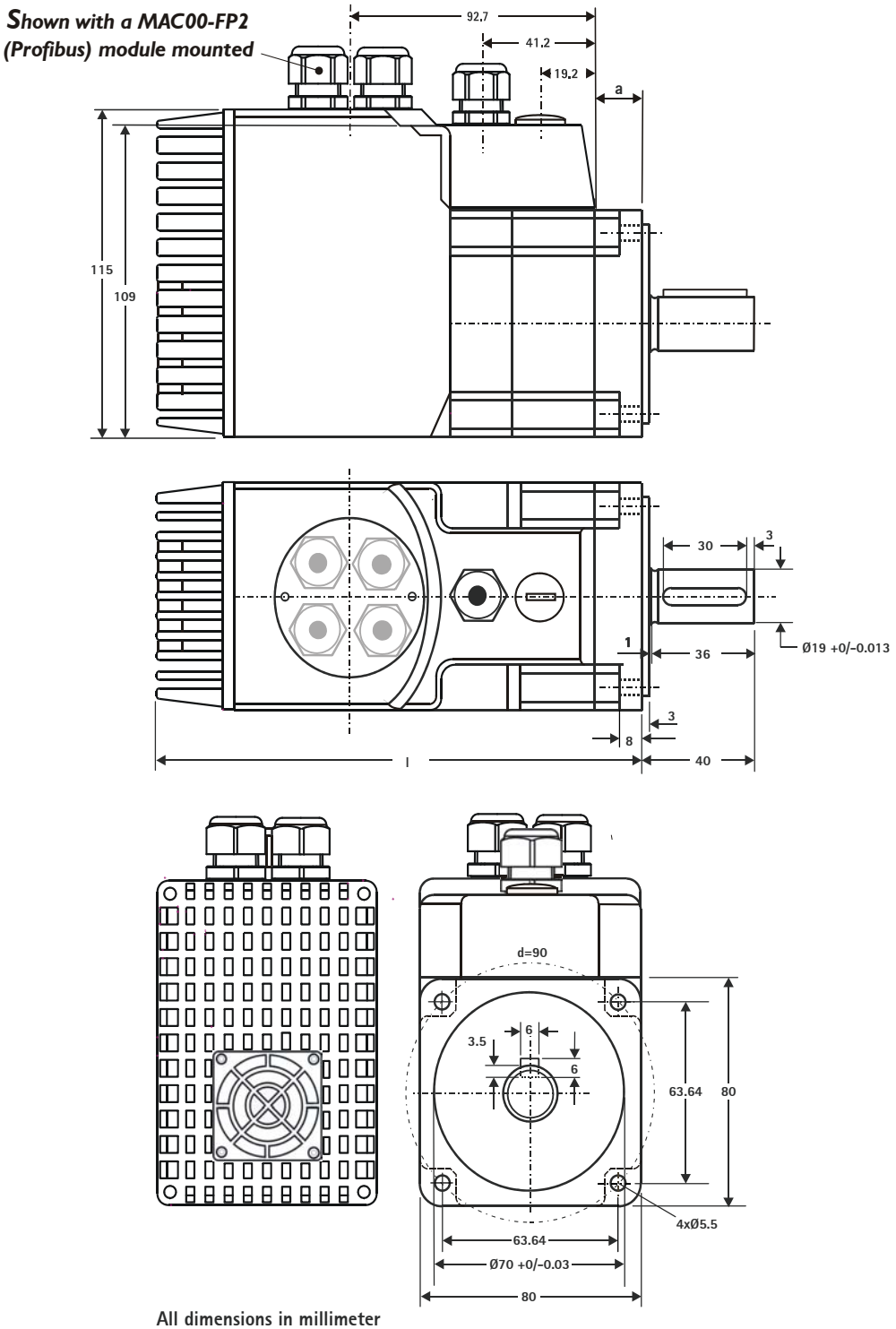
5.4.1 Physical dimensions MAC050 to MAC141



5.4 Physical Dimensions

Only MAC400 and 800

5.4.2 Physical dimensions MAC800



All dimensions in millimeter

Model	l	a
MAC800-D1/D2	175	13.8
MAC800-D4/D5	207	48.8

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