The MAC series of brushless servo motors with integrated electronics represents a major step forward. All the necessary electronics in a servo system are integrated in the motor itself.

In the past, a traditional motor system has typically been based on a central controller unit located remote from the motor. This configuration however has the negative effect that installation costs are a major part of the total expense of building machinery.

The basic idea of the MAC motors is to minimize these costs but also to make a component that is much better protected against electrical noise which can be a typical problem when using long cables between the controller and motor.

The servo motor, hall sensor, encoder and electronics are specially developed by JVL so that together they form a closed unit in which the power driver and controller are mounted inside the motor in a closed section.

The advantages of this solution are:

- De-central intelligence.
- Simple installation. No cables between motor and driver.
- EMC safe. Switching noise remains within motor.
- Compact. Does not take space in cabinet. Typically a 3/5 core cable is used from PLC or similar to MAC motor.
- 1x115/230 or 3x400VAC for driver voltage.
- 24VDC for control circuits.
- Option for built-in brake and/or multiturn absolute encoder.
- Uses the same expansion modules as the MAC 50-141 series.
- CE approved/UL approved (400,800) or pending (1500-3000).

Interface possibilities to the MAC motor:

- From PC/PLC with drive commands via RS232/RS485/RS422
- 2 x analogue inputs ±10V input for speed or torque control – 11 bit + sign.
- Pulse/dir. or quadrature inputs.
- A+B encoder output.
- Module option for Ethernet, Profibus-DP, CanOpen, Devicenet, High-speed serial bus etc.

The MAC motor can be controlled with ±10V for speed or torque control with encoder feedback to one master motion controller.
Furthermore the MAC motor can replace an arbitrary step or servo system, being based on pulse and direction signals. There is a built-in electronic gear so that the MAC motor can simulate all possible step resolutions. The MAC motor can thus replace all step- and servo-systems without change in the PLC/PC/controller software. Adaptation/replacement of existing step motor/servo systems can therefore be achieved quickly. Parameters are set up via the RS232 port from a Windows program. The supply voltage is 115 or 230VAC for the drive MAC400 and MAC800 and 3x400VAC for MAC1500 and 3000 and 24VDC for the control circuit. The motors offer a power of 400, 750, 1500 or 3000W. Standard flanges so that the MAC motor can replace other servo motors directly without mechanical changes. The connectors for the modules can be chosen as D-SUB, M12 plug or cable glands. Backlash free and planetary gears in different ratios can be delivered from stock.

System and feature overview

- **PC**
- **PLC**
  - I/O and serial data
  - Pulse input and outputs
  - ±10V analogue input
  - In position and Error output
  - RS232 and RS485 interface for setup and monitoring
  - High-efficiency Power Mos-Fets in motor driver
  - Optical encoder (8000 CPR) for precise positioning and speed regulation
  - Hall sensors for initializing and maintaining motor in a stationary position after powering up
- **Sensor**
- **Power Supply**
- Expansion Module for adapting to a broad range of applications
- 115/230VAC
- 24V/0.25A DC for control circuit
- Solid aluminium housing which protects and shields the internal components
- Ball bearings for maintenance free operation
- Standard servo flange
- TT2014GB

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**ELECTROMATE**

Toll Free Phone (877) SERVO98
www.electromate.com
sales@electromate.com
Modes of Operation (Basic Motor)

Gear Mode
In this mode the MAC motor functions as in a step motor system. The motor moves one step each time a voltage pulse is applied to the step-pulse input. Velocity, acceleration and deceleration are determined by the external frequency. Use of an encoder enables monitoring and adjustment during motor operation — a feature that is not possible with a standard step motor system. In addition, the MAC motor also provides a facility for electronic gearing at a keyed-in ratio with analogue speed offset.

Positioning Mode
In this mode the MAC motor positions the motor via commands sent over the RS422 or serial interface. Various operating parameters can be changed continuously while the motor is running. This mode of operation is used primarily in systems where the Controller is permanently connected to a PC/PLC via the interface. This mode is also well suited for setting up and testing systems.

Serial Mode (FastMac)
In this mode the MAC motor’s registers contain the parameter sets, positions, velocities, etc., required for the actual system. The registers can be selected and executed by a single byte sent via the serial interface. This mode provides maximum utilisation of the MAC motor’s features since the MAC motor itself takes care of the entire positioning sequence.

Velocity / Torque Mode
In this mode the MAC motor controls the motor velocity/torque via the analogue input. This mode is typically used for simple tasks or for applications in which an overall unit, such as a PC-board or PLC, controls velocity and positioning. Encoder A and B signals can be connected to the overall controller to close the servo loop.

Safe Torque Off (STO)
The STO function is the most common and basic drive-integrated safety function. It ensures that no torque-generating energy can continue to act upon a motor and prevents unintentional starting, without the need to remove the mains power from the motor.

Effect
This function is a mechanism that prevents the motor from restarting unexpectedly. The STO function safely disrupts vital pulses of the control system necessary to the motor to generate torque. The motor is reliably torque-free. This state is monitored internally in the motor. In the event of an error in the STO circuitry the motor is pacified via the control system, and will refuse to start again before the error is fixed.

Applications
STO has the immediate effect that the motor cannot supply any torque-generating energy. STO can be used wherever the motor will be brought to a standstill in a sufficiently short time by the load torque, friction or optionally via a build in electromechanical brake, or where coasting down of the motor is not relevant to safety. STO enables safe working when one or both of the “STO enable signals” are disconnected. It has a wide range of use in machines/systems with moving axes, e.g. handling, conveyor technology.

Customer benefits
The advantage of the integrated STO safety function compared with standard safety technology using electromechanical switch gear is the elimination of separate components thereby reducing setup and maintenance costs. No electromechanical components are utilized in this solution thereby eliminating wear issues.

IT MUST BE NOTED THAT THIS SOLUTION IS NOT CERTIFIED BY ANY THIRD PARTY.
Torque versus speed

Supply: 115 or 230VAC
Supply: Nominal 48VDC
Supply: 400 to 480VAC (3 phases)

Conditions:
Supply voltage = See individual plot
Ambient temperature = 20°C
Torque setting = 100%
Load setting = 1.0
Operation above 3000 RPM can be done, but losses in the motor make it impossible to operate in this area continuously

- Peak Torque
- Average Torque

Software, MacTalk

Setup save/open
The complete setup can be either saved or reloaded from a file using these buttons.

Startup mode
The basic functionality of the MAC motor is set up in this field.

Profile Data
All the main parameters for controlling the motor behaviour are set up in this field.

System control
Use these buttons to save data permanently, reset the motor etc.

Error Handling
Use these fields to define error limits for the position range etc.

Input/Outputs
The functionality of the I/Os is specified here.

Motor status
This field shows the actual motor load, position and speed etc.

Inputs
This field shows the actual supply voltage, the speed at the pulse input and the voltage at the analogue input.

Errors
If a fatal error occurs, information will be displayed here.

Zero Search
All the parameters regarding the position zero search can be specified here.

Undervoltage handling
Determine what happens if the supply voltage gets too low.

MAC motor connection information Always shows if the motor is on line or not.
The MAC402 motor is a 400W motor with Battery Supply 12-48VDC. Peak power up to 1200W. Choose between model with or without Brakes. IP55 standard. IP66 optional. Wireless, Industrial Ethernet or PLC built-in. Motor versions:
- MAC402-D2, standard version
- MAC402-D5, with built-in brake

Features:
You have the exact same features as in the AC-version, MAC400. Only difference is that MAC402 do not have an extra M16 connector for external power dump, since the breaking power is used for charging the battery supply (alternatively the DC power supply must be able to handle return power from the motor). In many applications it is not necessary to choose a 750W or larger motor as the 400W (1200W peak) motor will be sufficient, thereby reducing cost and saving space. MAC402 options include: Brake, absolute multi turn encoder, and planetary & cycloidal gearheads.

Power Supplies
The Integrated MAC400 and MAC800 motors have a complete 90-240VAC power supply built in and furthermore only requires an 18 to 30 VDC for the control circuitry. Having 2 independent supply circuits offer the feature that the supply voltage for the power circuitry (90-240VAC) can be removed for safety reasons while the control circuitry can keep operating and thereby keep the position counter updated and keep other vital functions.

External Power Supplies
For external low voltage supply JVL can deliver a wide variety of high quality switchmode powersupplies. Power Supply PSU24-075 is recommended for control power supply. For detailed information ask for separate datasheets.
## MAC selection chart

### MAC Motors feature overview including expansion modules

<table>
<thead>
<tr>
<th>Type</th>
<th>Feature</th>
<th>Unbalanced async. serial interface</th>
<th>Balanced async. serial interface</th>
<th>±10V Analog input</th>
<th>Pulse inputs</th>
<th>Pulse outputs</th>
<th>Digital user inputs</th>
<th>Digital user outputs</th>
<th>Ext. connector type</th>
<th>Protection class</th>
<th>Integrated brake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic MAC motors</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>MAC400-D2 (-D3)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>MAC400-D5 (-D6)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
<td></td>
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<tr>
<td>MAC402-D2 (-D3)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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<tr>
<td>MAC402-D5 (-D6)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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<tr>
<td>MAC800-D2 (-D3)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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<tr>
<td>MAC800-D5 (-D6)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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<tr>
<td>MAC1500-D2 (-D3)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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</tr>
<tr>
<td>MAC1500-D5 (-D6)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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</tr>
<tr>
<td>MAC3000-D2 (-D3)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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<tr>
<td>MAC3000-D5 (-D6)</td>
<td>Basic MAC motor IP55 (IP66)</td>
<td>Full Duplex</td>
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</tr>
</tbody>
</table>

### Basic modules

| MAC00-05S (2)         | Conn. module w/cable glands                                           | Full Duplex                        |                                  |                                |              |               |                     |                     |                   |                 |                 |
| MAC00-B1              | Connector module w/DSUB connectors                                    | Full Duplex                        |                                  |                                |              |               |                     |                     |                   |                 |                 |
| MAC00-B2              | Connector module w/cable glands (2)                                   | Full Duplex                        |                                  |                                |              |               |                     |                     |                   |                 |                 |
| MAC00-B4              | Connector module w/M12 connectors                                     | Full Duplex                        |                                  |                                |              |               |                     |                     |                   |                 |                 |
| MAC00-B41             | Connector module w/M12 connectors                                     | Full Duplex                        |                                  |                                |              |               |                     |                     |                   |                 |                 |

### Industrial Ethernet modules

| MAC00-E4             | Ethernet module Basic version                                        | Full Duplex                        |                                  |                                |              |               |                     |                     |                   |                 |                 |
| MAC00-E41            | Ethernet module Extended version                                     | Full Duplex                        |                                  |                                |              |               |                     |                     |                   |                 |                 |
Expansion module overview.

### Wireless modules

- **MAC00-FB4**
  - Bluetooth module
  - RS232 19.2k baud
  - No
  - 4 Inputs Opto isol. 5-30V
  - 2 Outputs PNP 10-32V 25mA
  - M12 Conn.
  - IP67 (1)

- **MAC00-FZ4**
  - Zigbee module - IEEE 802.15.4
  - RS232 19.2k baud
  - No
  - 4 Inputs Opto isol. 5-30V (4)
  - 2 Outputs PNP 10-32V 25mA (4)
  - M12 Conn.
  - IP67 (1)

- **MAC00-EW4**
  - WLAN module
  - RS232 19.2k baud
  - No
  - 4 Inputs Opto isol. 5-30V
  - 2 Outputs PNP 10-32V 25mA
  - M12 Conn.
  - IP67 (1)

### Fieldbus modules

- **MAC00-FC2**
  - CAN-Open module w/cable glands
  - RS232 19.2k baud
  - No
  - 6 Inputs 5-30V
  - 2 Outputs 10-32V 25mA
  - Cable Gland
  - IP67 (1)

- **MAC00-FC4**
  - CAN-Open module w/M12 connectors
  - RS232 19.2k baud
  - No
  - 4 Inputs Opto isol. 5-30V (4)
  - 2 Outputs PNP 10-32V 25mA (4)
  - M12 Conn.
  - IP67 (1)

- **MAC00-FD4**
  - DeviceNet module w/M12 connectors
  - RS232 19.2k baud
  - No
  - 4 Inputs Opto isol. 5-30V (4)
  - 2 Outputs PNP 10-32V 25mA (4)
  - M12 Conn.
  - IP67 (1)

- **MAC00-FP2**
  - Profinet DP w/cable glands
  - RS232 19.2k baud
  - No
  - 6 Inputs Opto isol. 5-30V
  - 2 Outputs PNP 10-32V 25mA
  - Cable Gland
  - IP67 (1)

- **MAC00-FP4**
  - Profinet DP w/M12 connectors
  - RS232 19.2k baud
  - No
  - 4 Inputs Opto isol. 5-30V (4)
  - 2 Outputs PNP 10-32V 25mA (4)
  - M12 Conn.
  - IP67 (1)

### Multiaxis modules

- **MAC00-FS1**
  - RS485 High Speed. w/DSUB connectors. Multiaxis control
  - RS485 19.2k baud
  - Yes
  - 8 Inputs 5-30V
  - 4 Outputs PNP 10-32V 300mA
  - DSUB Plugable
  - IP42

- **MAC00-FS4**
  - RS485 High Speed. w/M12 connectors. Multiaxis control
  - RS485 19.2k baud
  - Yes
  - 8 Inputs 5-30V
  - 4 Outputs PNP 10-32V 300mA
  - M12 Conn.
  - IP67 (1)

### Programmable modules

- **MAC00-R1**
  - Nano PLC w/ DSUB connect.
  - RS485 19.2k baud
  - Yes
  - 8 Inputs 5-30V
  - 4 Outputs PNP 10-32V 300mA
  - DSUB Plugable
  - IP42

- **MAC00-R3**
  - Nano PLC w/cable glands (2)
  - RS485 19.2k baud
  - Yes
  - 8 Inputs 5-30V
  - 4 Outputs PNP 10-32V 300mA
  - Cable Gland
  - IP67 (1)

- **MAC00-R4**
  - Nano PLC w/M12 circular connectors
  - RS485 19.2k baud
  - Yes
  - 8 Inputs 5-30V
  - 4 Outputs PNP 10-32V 300mA
  - M12 Conn.
  - IP67 (1)

### Process Control modules

- **MAC00-P4**
  - Process module 4-20mA w/ only M12
  - RS485 19.2k baud
  - Yes
  - 3 Inputs NO iso. 5-30V
  - 2 Outputs PNP 10-32V 100mA
  - M12 Conn.
  - IP67 (1)

- **MAC00-P5**
  - Process module 4-20mA w/M12+Hart connectors
  - RS485 19.2k baud
  - Yes
  - 1 Output PNP 10-32V 100mA
  - M12 + Hart, Conn.
  - IP67 (1)

---

1) All these modules offer IP67 protection class. Please notice that the final protection class is limited by the actual motor used.
2) Can be ordered without cable (e.g. MAC00-C5) or with cable in lengths of 2, 10 or 20 metres (e.g. MAC-C5-10).
3) Either pulse input, pulse output or serial must be chosen. Not all of them at the same time.
4) Only a total of 4 I/O terminals are available.
Expansion modules

The JVL Integrated motors utilizes the unique module concept. Plug in expansion modules adapt the motor to the application. You can choose connector type, D-Sub (IP42), cable glands (IP67) or M12 connectors (IP67) and you can choose freely between Profibus, DeviceNet, CANopen or nano PLC communication. A High Speed and wireless module add to the possibilities. This means that you have possibilities as with no other motors on the market, and also important, you only pay for what you need. Moreover, if you do not find the feature you need, please contact us, and we will develop your own module. All modules can be delivered with or with cables of up to 20m length.

<table>
<thead>
<tr>
<th>Basic modules</th>
<th>DSUB Connectors</th>
<th>Cable glands</th>
<th>M12 Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC00-B1, B2, B4</td>
<td>MAC00-B1</td>
<td>MAC00-B2</td>
<td>MAC00-B4</td>
</tr>
<tr>
<td>Connector module w/RS232 RS485 (non isolated) and LED’s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAC00-B41</td>
<td>Not planned</td>
<td>Not planned</td>
<td>MAC00-B41</td>
</tr>
<tr>
<td>Connector module with Optical isolated RS232, Rs485 6 General digital I/O Support 2 multifunction I/O ports.</td>
<td></td>
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</tr>
<tr>
<td>MAC00-E14, E14, E14, E4, E4, EP4</td>
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<tr>
<td>EtherCAT® module EthernetIP®module Powerlink®module Modbus®module Profinet®module</td>
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<tr>
<td>Industrial Ethernet modules extended I/O</td>
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<tr>
<td>MAC00-EC41, EL41, EM41, EL41, EM41, EP41</td>
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<tr>
<td>EtherCAT® module EthernetIP®module Powerlink®module Modbus®module Profinet®module</td>
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<tr>
<td>Wireless modules</td>
<td></td>
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<tr>
<td>MAC00-FB4, E4, EZ4 and EW4</td>
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<tr>
<td>Wireless Bluetooth module Wireless Zigbee (IEEE 802.15.4) module Wireless WLAN module</td>
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<tr>
<td>Fieldbus modules</td>
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<tr>
<td>MAC00-FC2, FC4</td>
<td>MAC00-FC2</td>
<td>MAC00-FC4</td>
<td></td>
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<tr>
<td>CANopen Supports DS402</td>
<td></td>
<td></td>
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<tr>
<td>MAC00-FD4</td>
<td>MAC00-FD4</td>
<td>MAC00-FD4</td>
<td></td>
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<tr>
<td>DeviceNet</td>
<td></td>
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<tr>
<td>MAC00-FP2, FP4</td>
<td>MAC00-FP2</td>
<td>MAC00-FP4</td>
<td></td>
</tr>
<tr>
<td>Profinet DP 12Mbit with (6) Inputs and (2) outputs</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
### Product Data

#### Multiaxis modules
- **MAC00-FS1, FS4**
  - High speed serial RS485
  - Multiaxis 460kbaud

#### Programmable modules
- **MAC00-R1, R3, R4**
  - Nano PLC with graphic programming interface
  - 8 input and 4 outputs.

#### Process control modules
- **MAC00-P4**
  - Process module 4-20mA input and output
galvanic isolated. Only M12 Connectors

- **MAC00-P5**
  - Process module 4-20mA input and output
galvanic isolated. Harting and M12 Connectors

#### Rear plates
- **MAC00-00/01/02 and MAC00-CS**
  - Rear plates with or without
cable glandsConn.
  - No electronic features included

<table>
<thead>
<tr>
<th>DSUB Connectors</th>
<th>Cable glands</th>
<th>M12 Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC00-FS1</td>
<td></td>
<td>MAC00-PS1</td>
</tr>
<tr>
<td>MAC00-PS1</td>
<td></td>
<td>MAC00-PS4</td>
</tr>
<tr>
<td>MAC00-PS4</td>
<td></td>
<td>MAC00-PS5</td>
</tr>
</tbody>
</table>

**TT1176-03GB**

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**Sold & Serviced By:**

**ELECTROMATE**

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sales@electromate.com
### Technical Data

**GENERAL**
All data are specified for the MAC400-3000 motor only, i.e. without any expansion module mounted.

**Technology**
AC-servomotor with built-in 2000 PPR encoder, hall sensor and 3 phase servo amplifier/controller.

<table>
<thead>
<tr>
<th>Controller Type</th>
<th>MAC400-D2 and D3 w. brake</th>
<th>MAC400-D5 and D6 w. brake</th>
<th>MAC402-D2 and D3</th>
<th>MAC402-D5 and D6 w. brake</th>
<th>MAC800-D2 and D3 w. brake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated output @ 3000RPM</strong></td>
<td>400W (0.54hp)</td>
<td>400W (0.54hp)</td>
<td>400W (0.54hp)</td>
<td>400W (0.54hp)</td>
<td>750W (1.00hp)</td>
</tr>
<tr>
<td><strong>Rated Torque RMS</strong></td>
<td>1.28Nm (181.26oz-in)</td>
<td>1.28Nm (181.26oz-in)</td>
<td>1.28Nm (181.26oz-in)</td>
<td>1.28Nm (181.26oz-in)</td>
<td>2.3Nm (337.04oz-in)</td>
</tr>
<tr>
<td><strong>Peak Torque</strong></td>
<td>3.8Nm (538.13oz-in)</td>
<td>3.8Nm (538.13oz-in)</td>
<td>3.8Nm (538.13oz-in)</td>
<td>3.8Nm (538.13oz-in)</td>
<td>6.8Nm (962.96oz-in)</td>
</tr>
<tr>
<td><strong>Inertia (kgm²)/(oz-in-s)²</strong></td>
<td>0.34/0.004815</td>
<td>0.36/0.005098</td>
<td>0.34/0.004815</td>
<td>0.36/0.005098</td>
<td>0.91/0.01289</td>
</tr>
<tr>
<td><strong>Max. angular acceleration -rad/sec²</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>191mm (7.52&quot;)</td>
<td>225mm (8.86&quot;)</td>
<td>191mm (7.52&quot;)</td>
<td>225mm (8.86&quot;)</td>
<td>174mm (6.85&quot;)</td>
</tr>
<tr>
<td><strong>Weight (without expansion module)</strong></td>
<td>2.3kg (5.11lb)</td>
<td>2.8kg (6.17lb)</td>
<td>2.3kg (5.11lb)</td>
<td>2.8kg (6.17lb)</td>
<td>3.5kg (7.71lb)</td>
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<tr>
<td><strong>Audible noise level (measured in 30cm distance)</strong></td>
<td>- (to be defined) dB(A)</td>
<td>- (to be defined) dB(A)</td>
<td>- (to be defined) dB(A)</td>
<td>- (to be defined) dB(A)</td>
<td>- (to be defined) dB(A)</td>
</tr>
<tr>
<td><strong>Backlash (when brake is activated)</strong></td>
<td>&lt;±1 degree</td>
<td>&lt;±1 degree</td>
<td>&lt;±1 degree</td>
<td>&lt;±1 degree</td>
<td>&lt;±1 degree</td>
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</table>

### Controller capacity

<table>
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<tr>
<th>Controller Type</th>
<th>MAC800-D5 and D6 w. brake</th>
<th>MAC1500-D2 and D3 w. brake</th>
<th>MAC1500-D5 and D6 w. brake</th>
<th>MAC3000-D2 and D3 w. brake</th>
<th>MAC3000-D5 and D6 w. brake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated output @ 3000RPM</strong></td>
<td>750W (1.00hp)</td>
<td>1500W (2.04hp)</td>
<td>1500W (2.04hp)</td>
<td>3000W (4.08hp)</td>
<td>3000W (4.08hp)</td>
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<tr>
<td><strong>Rated Torque RMS</strong></td>
<td>2.38Nm (337.04oz-in)</td>
<td>5.0Nm (708.06oz-in)</td>
<td>9.55Nm (1352.39oz-in)</td>
<td>9.55Nm (1352.39oz-in)</td>
<td>9.55Nm (1352.39oz-in)</td>
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<tr>
<td><strong>Peak Torque</strong></td>
<td>6.8Nm (962.96oz-in)</td>
<td>15.0Nm (2124.18oz-in)</td>
<td>28.7Nm (4064.26oz-in)</td>
<td>28.7Nm (4064.26oz-in)</td>
<td>28.7Nm (4064.26oz-in)</td>
</tr>
<tr>
<td><strong>Inertia (kgm²)/(oz-in-s)²</strong></td>
<td>1.13/0.016</td>
<td>13.36/0.198</td>
<td>14.10/0.200</td>
<td>27.83/0.394</td>
<td>27.98/0.396</td>
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<tr>
<td><strong>Max. angular acceleration -rad/sec²</strong></td>
<td>40000rad/sec²</td>
<td>40000rad/sec²</td>
<td>40000rad/sec²</td>
<td>40000rad/sec²</td>
<td>40000rad/sec²</td>
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<tr>
<td><strong>Length</strong></td>
<td>209mm (8.23&quot;)</td>
<td>234mm (9.21&quot;)</td>
<td>250mm (9.84&quot;)</td>
<td>305.86mm (12.04&quot;)</td>
<td>312mm (12.28&quot;)</td>
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<tr>
<td><strong>Weight (without expansion module)</strong></td>
<td>4.3kg (9.48lb)</td>
<td>10.95kg (23.7lb)</td>
<td>13.96kg (30.9lb)</td>
<td>17.1kg (37.70lb)</td>
<td>19.5kg (42.8lb)</td>
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<tr>
<td><strong>Audible noise level (measured in 30cm distance)</strong></td>
<td>6.8Nm (962.96oz-in)</td>
<td>9.55Nm (1352.39oz-in)</td>
<td>13.96Nm (30.9lb)</td>
<td>17.1kg (37.70lb)</td>
<td>19.5kg (42.8lb)</td>
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<tr>
<td><strong>Backlash (when brake is activated)</strong></td>
<td>&lt;±1 degree</td>
<td>-65 dB(A)</td>
<td>&lt;±1 degree</td>
<td>-65 dB(A)</td>
<td>&lt;±1 degree</td>
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</table>

**Speed range for MAC400-402**
0-3000RPM with full torque. Max 3500 RPM. Overspeed protection trips at 4300RPM. Motor will shut down.

**Speed range for MAC800-3000**
0-3000RPM with full torque. Overspeed protection if speed>3600 RPM. MAC800 will go in passive mode.

**Amplifier control system**
MAC400-800: Sinusoidal wave PWM control. 20kHz switching.
MAC1500-3000: Sinusoidal wave PWM control. 5kHz switching.

**Feedback Standard incremental:**
MAC400, MAC402, MAC1500 and MAC3000: Incremental A and B encoder 8192 CPR. (Physical 2048 PPR)
MAC800: Incremental A and B encoder 8000 CPR. (Physical 2000PPR)

**Optional absolute multiturn encoder:**
Encoder 65535 CPR and 4096 rev.

**Input power supply for MAC400**
115/230/240VAC (±10%) for main power circuit. 18-32VDC for control circuit.
Consumption at 115-240VAC – see power supply section.
Control circuitry consumption: MAC400D1, 2 and 3 (w/brake) = Typical 0.22A @ 24VDC(5.3W).
Control circuitry consumption: MAC400D4, 5 and 6 (w/brake) = Typical 0.58A @ 24VDC(14W).

**Input power supply for MAC402**
Nominal 12-48VDC (±10%) for main power circuit. Recommended also for 12V battery applications.
Consumption at 12-48VDC – see power supply section.
Control circuitry consumption: MAC400D1, 2 and 3 (w/brake) = Typical 0.22A @ 24VDC(5.3W).
Control circuitry consumption: MAC400D4, 5 and 6 (w/brake) = Typical 0.58A @ 24VDC(14W).

**Input power supply for MAC800**
115/230/240VAC (±10%) for main power circuit. 18-32VDC for control circuit.
Consumption at 115-240VAC – see power supply section.
Control circuitry consumption: MAC800D1, 2 and 3 (w/brake) =0.25A @ 24VDC(6W).
Control circuitry consumption: MAC800D4, 5 and 6 (w/brake) =0.75A @ 24VDC(18W).

**Input power supply for MAC1500 and 3000**
3 phase supply 400 to 480AC for driver circuit. Absolute max 550VAC ! 18-32VDC for control circuit.
Control circuitry consumption: MAC1500 and 3000-D1, 2 and 3 (w/brake) =0.3A @ 24VDC(7.2W).
Control circuitry consumption: MAC1500 and 3000-D4, 5 and 6 (w/brake) =1.2A @ 24VDC(28W).

**Control mode**
- ± 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 analog input speed offset + various options.
- Sensor zero search or mechanical zero search.

**Range and shaft dimension**
MAC400 and 402:
MAC1500 and 3000:
MAC800:
Front: 60x60mm. Rear: 63x115mm. Shaft Ø14mm
Front: 80x80mm. Rear: 80x113mm. Shaft Ø19mm
Front: 130x130mm. Rear: 130x203mm (excl. connectors). Shaft Ø24.0mm +0/-0.013mm
## Technical Data (continued)

### POSITION (pulse inputs)
- **Command input pulse:** Pulse/direction or 90° phase shifted A+B. RS422
- **Input frequency:** 0-8 MHz, 0-1MHz 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 pulse
- **Position range:** 32 bit. Infinity, Flip over at ±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 – 444675 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
- **Speed variance:** Max ±4 RPM variance between command and actual speed.

### SPEED/ TOrQUE
- **Analogue speed/torque input:** 11bit + sign. Nom. input voltage ±10V. 10kOhm input resistance. Voltage range max. -10 to +32VDC. Offset typical ±50mV.
- **Sampling rate at analogue input:** 750 Hz
- **Analogue speed input:** +voltage -> CW rotation. Shaft view
- **Zero speed determination.** 0 - rated speed.
- **Speed variance at rated speed:** Initial error @20°C: ±0,0%  Power Supply: ±10%: 0,0% Load 0-300%: ±0,0% Ambient temperature 0–40°C: ±0,0005% (±50ppm)
- **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
- **Electromechanical brake:** Optional feature. The brake is activated automatically when an unrecoverable error situation occur.
- **Regenerative:** Integrated power pump. External attachment is possible
- **Protective functions.** Error trace back. Overload I²t, 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). Note that the LED’s are only visible when no module is mounted.
- **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:**
  - MAC400 and 402: Radial load: 24.5kg (13.5mm from flange). Axial load: 9.8kg.
  - MAC800: Radial load: 18kg (20mm from flange). Axial load: 11kg
- **Optional brake (-D5 or D6):**
  - MAC400-800: Controlled automatic or from input. 3.25Nm, inertia 0.22cm2, turn on time: 50ms, turn off time: 15ms
  - MAC800: Controlled automatic or from input. xxNm, turn on time: 50ms, turn off time: 15ms
- **Rated power rate. (motor):**
  - MAC400 and 402: 50.0 kW/s
  - MAC800: 62.8 kW/s
  - MAC1500-3000: xxx kW/s
- **Mechanical time constant. (motor):**
  - MAC400 and 402: 0.59±10% ms
  - MAC800: 0.42±10% ms
  - MAC1500-3000: ?
- **Electrical time constant. (motor):**
  - MAC400 and 402: 3.5±10% ms
  - MAC800: 4.12±10% ms
  - MAC1500-3000: ?
- **Standards:**
  - MAC400 and 402: CE approved/UL pending
  - MAC800: CE approved/UL recognized file number E254947
  - MAC1500: CE approved/UL recognized file number E254947 - 20130525 Pending
  - MAC3000: CE approved/UL recognized file number E254947 - 20130524 Pending
- **Protection:**
  - MAC400: IP65 and IP68
  - MAC402: IP65 (IP68 on request)
  - MAC800: IP55 (IP42 and IP67 on request)
  - MAC1500 and 3000: IP55 (-D2 or D6 version). IP67 (D3 or D6 version)
- **Usage / Storage Temperature:**
  - Ambient 0 to +40°C (32–104°F) Storage (power not applied): -20 to +85°C (-4 to 185°F) (Humidity 90%). Temperature warning is given before reaching max. Temperature shut down and error message generated at 84°C (183F). The heatsink fan in MAC800-3000 starts at 55°C (131°F).
Mechanical dimensions MAC400

Mechanical dimensions MAC402
**Mechanical dimensions MAC800**

![Diagram of MAC800 mechanical dimensions](image)

- **Dimensions**: Various dimensions are listed, including lengths, widths, and diameters, measured in millimeters and inches.
- **Key Points**: The diagram shows the layout and dimensions of the MAC800 motor, including size specifications and tolerances.

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**Mechanical dimensions MAC1500 and 3000**

![Diagram of MAC1500 and 3000 mechanical dimensions](image)

- **Dimensions**: Similar to MAC800, these diagrams illustrate the mechanical specifications of MAC1500 and MAC3000 motors, detailing their sizes and tolerances.
- **Key Points**: The diagrams provide a clear visual representation of each motor's dimensions, useful for understanding their physical properties.

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**Table of Dimensions**

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC800</td>
<td>D2</td>
<td>L = 174 [6.85], W = 13.0 [0.51]</td>
</tr>
<tr>
<td>MAC800</td>
<td>D3</td>
<td>L = 202 [7.95], W = 20.2 [0.80]</td>
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<tr>
<td>MAC800</td>
<td>D5</td>
<td>L = 209 [8.23], W = 49.8 [1.96]</td>
</tr>
<tr>
<td>MAC800</td>
<td>D6</td>
<td>L = 234 [9.21], W = 54.8 [2.16]</td>
</tr>
</tbody>
</table>

---

**Notes**

- All dimensions are in millimeters unless specified otherwise.
- Dimensions are provided with tolerances where applicable.

---

**Further Information**

- For more detailed specifications, refer to the product data sheet.
- Contact Electromate for sales and service information.
Planetary and cycloidal (robot) gearheads

JVL offers a wide range of both worm, planetary and cycloidal (robot) gears. They fit either directly or by means of adaptors on the MAC motors. Gear ratios can be from 1:3 to 1:1000. See separate datasheets for detailed information on our website: www.jvl.dk

**HTRG type gears:**

The advantages of using gearboxes:
- Strong, Caged Roller Bearings
- Precision Input Pinion with Balanced Clamping Collar

**HSPG type gears:**

Planetary and cycloidal (robot) gearheads

JVL offers a wide range of both worm, planetary and cycloidal (robot) gears. They fit either directly or by means of adaptors on the MAC motors. Gear ratios can be from 1:3 to 1:1000. See separate datasheets for detailed information on our website: www.jvl.dk

**Model, HTRG**

<table>
<thead>
<tr>
<th>Model, HTRG</th>
<th>Gear ratio</th>
<th>Efficiency</th>
<th>Rated Torque</th>
<th>Emerg. Torque</th>
<th>Inertia at motor shaft</th>
<th>Noise (dB(A))</th>
<th>Radial Load</th>
<th>Axial Load</th>
<th>Weight [L1]</th>
<th>D1</th>
<th>D2</th>
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<tbody>
<tr>
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Backlash is 15 arcmin for all above HTRG gearboxes

**Model, HSPG**

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<thead>
<tr>
<th>Model, HSPG</th>
<th>Gear ratio</th>
<th>Efficiency</th>
<th>Rated Torque</th>
<th>Emerg. Torque</th>
<th>Inertia at motor shaft</th>
<th>Noise (dB(A))</th>
<th>Radial Load</th>
<th>Axial Load</th>
<th>Weight [L1]</th>
<th>D1</th>
<th>D2</th>
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<td>62,83,125,169</td>
<td>&lt;82</td>
<td>890</td>
<td>4450</td>
<td>2.6</td>
<td>-</td>
<td>21100</td>
<td>31700</td>
<td>17.23</td>
<td>-</td>
<td>200</td>
</tr>
</tbody>
</table>

Backlash is <1 arcmin for all above HSPG gearboxes

These gearboxes are some examples of the types we often use. For other requests please contact JVL.dk.
Optional absolute multiturn encoder

The absolute multi-turn encoder is an option with the MAC400, MAC800, MAC1500 and MAC3000 motors. The option offers the advantage that once the mechanical zero point is defined there will be no need for any Zero search or initialization sequence after power up since the motor always knows where it is with reference to the original defined zero point regardless.

The built-in multi-turn encoder is using a mechanical technology with the advantage that no battery is used to hold the position after power off. A battery needs replacement after a certain operating time or a certain number of charging and recharging cycles.
## AC servo motors MAC400 -3000

### Ordering information

> MAC400 - D2 - XXXX

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Housing and IP protection</th>
<th>Optional features*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC-brushless</td>
<td>2: IP55</td>
<td>(1): Encoder type</td>
</tr>
<tr>
<td></td>
<td>3: IP65</td>
<td>(2): Flange</td>
</tr>
<tr>
<td></td>
<td>5: IP55 w. brake</td>
<td>(3): Painting</td>
</tr>
<tr>
<td></td>
<td>6: IP65 w. brake</td>
<td>(4): Shaft</td>
</tr>
</tbody>
</table>

*Available combinations: (1): Encoder type
MAC400 and
MAC402: CAGM and FAGM
MAC800: BAAJ and FAAJ
MAC1500 and
MAC3000: CAAL and FAAL

For other options please contact JVL.

### Accessories

- **RS232-9-1**: Cable for PC
- **RS232-9-1-Mac**: Cable for PC with built in RS232 converter
- **MacTalk**: Software for set-up of Mac motor
- **MacRegIO**: Expert tool for programmers
- **MacCommOCX**: OCX/ActiveX driver for Windows
- **MAC00-xx**: Expansion modules. See page 5
- **PSU24-075**: 24VDC Power Supply for control circuit
- **WP0203**: Mains supply cable - 3m, 230VAC for MAC400
- **WP0303**: Mains supply cable - 3m, 115VAC for MAC400
- **WP0102**: Brake cable - 2m for MAC400
- **WP4102**: MAC1500/3000 DC-bus/PD cable 2m 180°
- **WP4105**: MAC1500/3000 DC-bus/PD cable 5m 180°
- **WP4110**: MAC1500/3000 DC-bus/PD cable 10m 180°
- **RP1008**: Power Dump resistor 47 Ohm/270W(18kW).
- **RS485**: RS485 cables for different modules.

*Available combinations: (1): Encoder type
MAC400 and
MAC402: CAGM and FAGM
MAC800: BAAJ and FAAJ
MAC1500 and
MAC3000: CAAL and FAAL

For other options please contact JVL.

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**Mac1500-D5 with brake**

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