

# Change from Motion Controllers V2.5 to V3.0 – CANopen interface

## Summary

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This Application Note accompanies the change from Motion Controllers of generation 2.5 to Motion Controllers of generation 3.0.

The present document is intended for customers familiar with Motion Controllers V2.5 with CANopen interface who are transitioning to Motion Controllers V3.0 in a new machine.

First of all, benefits of changing from generation 2.5 to 3.0 are mentioned, followed by some hints for the selection of a suitable Motion Controller.

Afterwards the Application Note takes a look at the most relevant adaptations of generation 3.0 by analyzing the object dictionary.

For more information please refer to the [drive functions](#) and [communications](#) manual or ask our experts in the [Motion Control Support](#).

## Applies To

Motion Controllers V2.5	Motion Control Systems V2.5
MCBL/MCDC/MCLM 3002 F/P/S	2232/2250 ... BX4 COD
MCBL/MCDC/MCLM 3003 P	3242/3268 ... BX4 CO
MCBL/MCDC/MCLM 3006 S	3564 ... B CO

The family of Motion Controllers and Motion Control Systems V2.5 with CANopen interface is described as MC V2.5 CO in the following.

Motion Controllers V3.0	Motion Control Systems V3.0
MC 3001 B/P	2232/2250 ... BX4 IMC CO
MC 3603 S	MCS 3242/3268 ... BX4 CO
MC 5004 P	MCS 3274 ... BP4 CO
MC 5005 S	
MC 5010 S	

The family of Motion Controllers and Motion Control Systems V3.0 with CANopen interface is described as MC V3.0 CO in the following.

## Benefits of changing from Motion Controllers V2.5 to V3.0

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### **Power range and dynamic behavior:**

The new MC V3.0 family offers a significantly higher power range compared to MC V2.5. Starting with a rated power of 30W for small motors, there are Controllers available up to a rated power of 500W for larger motors.

Not only the rated power is extended, but also the maximum power for short-term operation. Combined with an improvement in the feedback control loop, MC V3.0 are able to operate a motor much more dynamically. Also applications with higher load inertia can now be operated.

### **One Controller for all types of motors and sensor systems:**

While for MC V2.5 different Controllers are necessary for operating either a DC-Motor, a BLDC-Motor or a linear motor, MC V3.0 are now able to operate all FAULHABER motor technologies with the same hardware.

Furthermore, the extended amount of inputs and outputs allows the usage of many different sensor systems. MC V3.0 can evaluate digital and linear Hall sensors, as well as incremental and absolute encoders.

### **Extended diagnostic and protection functions:**

MC V3.0 are monitoring the state of the connected motor and the Motion Controller itself on a cyclical basis. The handling of the monitoring results is significantly expanded. There are different error codes available, combined with more options how to react on an error like e.g. switching off the drive automatically.

One purpose of the monitoring is to protect the connected motor from overheating by calculating the actual winding temperature. The thermal model is improved, leading to a more precise calculation of the temperature. This allows the power of the motor to be better utilized.







### **Fast and easy commissioning with the FAULHABER Motion Manager:**

The configuration software Motion Manager from FAULHABER is used to configure the connected motor and sensor system and to integrate the drive system into the application. When the commissioning of an MC V3.0 is performed, many of the tools in Motion Manager 6 will be recognized from the commissioning of an MC V2.5. Beyond that, the software offers various improvements and extensions in order to make the commissioning of an MC V3.0 as easy as possible.

All of the operating modes covered from an MC V2.5 are available at an MC V3.0 as well. In addition, an MC V3.0 comes with enhanced operating modes and further functionality.

## Selection of a suitable Motion Controller V3.0

The following figure shows an extract of Motion Controllers and Motion Control Systems of both, generation 2.5 and 3.0.

<p><b>Generation 2.5</b></p>			
	<p><b>Motion Control Systems</b></p> <ul style="list-style-type: none"> <li>• 22xx ... BX4 CxD</li> <li>• 32xx ... BX4 Cx</li> <li>• 3564 ... B Cx</li> </ul>	<p><b>Motion Controllers with pin header (P-Version)</b></p> <ul style="list-style-type: none"> <li>• MCxx 3002 P</li> <li>• MCxx 3003 P</li> </ul>	<p><b>Motion Controllers with connectors (F/S-Version)</b></p> <ul style="list-style-type: none"> <li>• MCxx 3002 F/S</li> <li>• MCxx 3006 S</li> </ul>
<p><b>Generation 3.0</b></p>			
	<p><b>Motion Control Systems</b></p> <ul style="list-style-type: none"> <li>• 22xx ... BX4 IMC RS/CO</li> <li>• MCS 32xx BX4 RS/CO/ET</li> <li>• MCS 3274 BP4 RS/CO/ET</li> </ul>	<p><b>Motion Controllers with pin header (B/P-Version)</b></p> <ul style="list-style-type: none"> <li>• MC 3001 B/P</li> <li>• MC 5004 P</li> </ul>	<p><b>Motion Controllers with connectors (S-Version)</b></p> <ul style="list-style-type: none"> <li>• MC 3603 S</li> <li>• MC 5005 S</li> <li>• MC 5010 S</li> </ul>

**Figure 1: Overview on FAULHABER Motion Controllers and Motion Control Systems**

For the selection of a suitable MC V3.0, the following aspects must be taken into consideration:

**Rated power:**

The rated power (defined by maximum supply voltage and maximum continuous output current) of the MC V3.0 must fit the motor and further requirements of the application.

**Form factor and mounting situation:**

In general it can be distinguished between Motors with integrated Drive Electronics (Motion Control Systems) and Motion Controllers. Motion Control Systems V2.5 will most likely be replaced with the MCS-series. If the pin-header version of an MC V2.5 was used, the pin-header version of an MC V3.0 might be the right choice. For the connector version of an MC V2.5 the connector version of an MC V3.0 might be a suitable replacement.

**Communication interface:**

The MC V3.0 family offers controllers with EtherCAT, CANopen or RS232 interface. An USB interface is available for configuration.

## Most relevant adaptations of the object dictionary

Both Motion Controller V2.5 and V3.0 with CANopen interface comply with the CANopen standards CiA 301 and CiA 402. That is why the basics of the interaction with the device are already known and can be applied to the new Motion Controller. Of course, the new generation of Motion Controllers comes with improvements and enhanced functionalities. Therefore the object dictionary is adapted. The following description covers the most important differences.

Index	Category	MC V2.5 CO vs. MC V3.0 CO
0x1000 to 0x1FFF	Communication objects	Device identification is adapted
0x2000 to 0x5FFF	Manufacturer-specific objects	New manufacturer-specific objects
0x6000 to 0x6FFF	Objects of the drive profile according to CiA 402	A few objects are adapted according to the standard

### Communication objects (0x1000 to 0x1FFF)

In the range of communication objects, the content of a few objects is adapted to identify the new Motion Controller V3.0. This concerns e.g. the objects 0x1009 (Manufacturer hardware version), 0x100A (Manufacturer software version) and 0x1018 (Identity object).

### Manufacturer-specific objects (0x2000 to 0x5FFF)

The manufacturer-specific objects include e.g. the configuration of inputs and outputs, the thermal model for protection, as well as control parameters for the feedback control loop. Due to the improvements and enhanced functionality of an MC V3.0, the manufacturer-specific objects differ compared to generation 2.5. For a fast and easy commissioning those objects are configured by the software Motion Manager.



#### Commissioning of the MC V3.0:

It is recommended to configure the MC V3.0 using the Motion Manager software from FAULHABER. Copying and transferring any configuration from the MC V2.5 is not possible due to the differences in the object dictionary. For more information on how to configure a Motion Controller there are [How-to-videos](#) available on our website.



#### Integration of the Motion Controller into a master controlled system:

For customers familiar with MC V2.5 CO the most relevant adaptations of MC V3.0 CO can be found in the objects of the drive profile according to CiA 402 (0x6000 to 0x6FFF). They are described on the next page.

## Objects of the drive profile according to CiA 402 (0x6000 to 0x6FFF)

The objects of the drive profile of an MC V3.0 CO are in compliance with the CiA 402 standard. Customers familiar with MC V2.5 CO should take the following characteristics into consideration.

### Controlword:

In operating mode Profile Position (PP) a new target position is loaded at a rising edge of Bit 4 in the Controlword. It can be distinguished between an immediate and a not immediate move by help of Bit 5. In comparison, MC V2.5 CO offered immediate moves only.

Controlword Bits of an MC V3.0	15...6	5	4	3	2	1	0
Immediate move	...	1	1	1	1	1	1
Not immediate move	...	0	1	1	1	1	1

A new target position is acknowledged with Bit 12 in the Statusword set to 1. Only then Bit 4 of the Controlword can be reset to 0 again.

Applying this handshake is recommended in a CANopen system for a robust interaction between master and slave.

### Statusword:

The Statusword offers the possibility to use a Voltage enabled Bit (Bit 4). It can be activated via Bit 7 in the Operation mode options (0x233F).

### Position encoder resolution:

The position encoder resolution of motors with linear Hall sensors amounts 3000 increments per mechanical revolution when using an MC V2.5. For MC V3.0, this resolution is increased, having now 4096 increments per mechanical revolution. This improvement must be taken into consideration for position controlled applications.

### Units of current:

Actual, target and limit values of the current are specified in mA for MC V2.5. In compliance with the CiA 402, the unit changed to 1/1000 of the motors nominal current for MC V3.0. This difference must be taken into account for torque controlled applications or e.g. the analysis of the current during operation.

Following example emphasizes the meaning of the unit:

Motor: 2232S024BX4 (I <sub>nom</sub> : 540 mA)	
Current in [I <sub>nom</sub> /1000]	Current in mA
1000	540 mA
500	270 mA

### Homing methods:

Compared to MC V2.5 CO, the Homing method for Homing at the actual position changed. It is now represented by method 37, instead of 35. Attention must also be paid to the sign of the Homing Offset (0x607C), which differs between MC V2.5 and MC V3.0.

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