

lococube[®]
Motor Controller MC-850

MANUAL

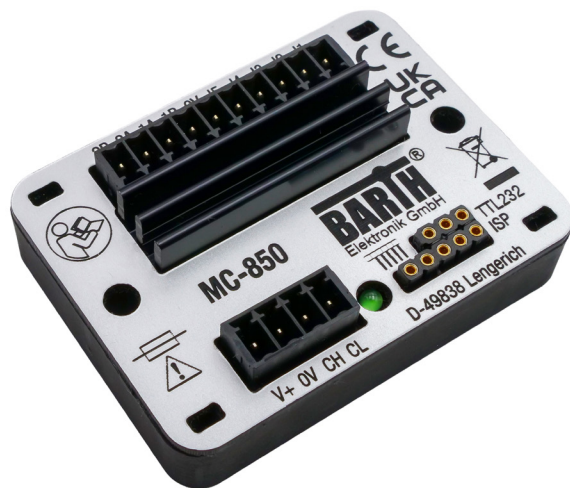


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SAFETY INSTRUCTIONS

This manual contains instructions which you should observe to ensure your own personal safety, as well as to protect the product and the connected equipment. These instructions are highlighted in the manual by a warning symbol and are marked as follows according to the level of danger:



Only qualified personnel should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground and to tag circuits, equipment and systems in accordance with established safety practices and standards.



Turn off the power supply before performing any wiring operations! Short circuits can be harmful, critical and can cause explosions and serious burns!



Please read this manual carefully and observe all safety instructions!

INTENDED USE

The **Motor Controller MC-850** is designed as **stepper motor controller for universal motion & control applications**. It must under no circumstances be used for **life critical, medical or fail safe applications**.

DISCLAIMER

BARTH[®] Elektronik GmbH assumes no liability for usage and functionality of the MC-850 in case of disregarding this manual. The strict accordance of this manual is important since the installation methods, peripheral connections, usage and maintenance can not be controlled by BARTH Elektronik GmbH. Therefore BARTH Elektronik GmbH assumes no liability for any claim.

1 Product Description

The picture below shows the Motor Controller MC-850 lococube[®] (Art. No. 0890-0850).



1.1 Features

- Ultracompact CAN motor controller up to 2.8 A
- Open & Closed Loop Operation
- Reworked parameter communication via CAN
- Dynamic motor current adjustment via CAN
- Speed and ramps freely configurable
- Step and stop modes dynamically adjustable
- Inputs for Encoder and limit switches
- Wide operating voltage range 7 to 32 VDC
- Engineered and manufactured in Germany

1.2 Applications

- Universal motion & control
- Robotics and CNC systems
- Industrial process control
- X-by Wire systems
- Technical education / university

1.3 General Description

The MC-850 is a highly integrated CAN motor controller to directly drive one bipolar stepper motor up to 2.8 A. It has never been easier to realize simple motion & control or pick & place applications without the need of programming.

The integrated CAN 2.0A/B interface provides easiest plug & play interfacing to a lococube[®] mini-PLC without the need to program the MC-850. All motor parameters are communicated via CAN Bus between the mini-PLC and MC-850.

These outstanding features open up a variety of application fields in industrial, automotive and 12/24 V battery-powered applications. Also robotic systems can be easily controlled using the powerful and easy-to-use MC-850.

1.4 Connection and Operation

The Motor Controller MC-850 can be directly connected to any BARTH® lococube® mini-PLC using the standard CAN interface. There is no need to program the MC-850 separately because all settings and parameters are communicated via CAN between the mini-PLC and motor controller.

1.5 Delivery Content

- 1x lococube® Motor Controller MC-850
- 1x Connector for supply and CAN
- 1x Connector for I/O and stepper motor

2 Installation

2.1 Mounting



The MC-850 must be installed and wired by a trained technician who knows and complies with both the universally applicable engineering rules and the standards that apply in specific cases.

Fastening the MC-850 follows using either the integrated mounting holes for screws or the holes for cable ties. The cable tie installation method is recommended for fastening the MC-850 on wiring harness, tubes or other mechanical parts.



The heatsink of the MC-850 may reach temperatures up to 100°C.

Take care to not cover the MC-850's heat-sink ensuring proper heat dissipation and protect your peripheral components against damage due to heat!



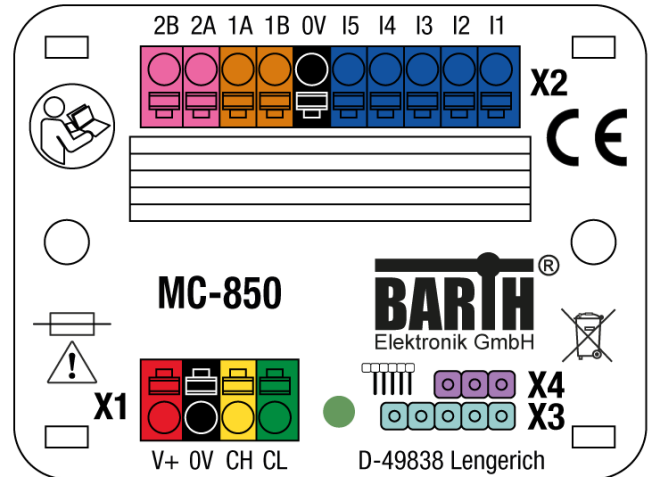
The MC-850 is intended to be mounted in enclosed cabinets (indoor use) and the like, that afford protection against fire hazards, environmental conditions and mechanical impact.

Take care to meet the environmental conditions of the MC-850 and ensure proper heat dissipation of its heatsink.

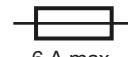
2.2 Wiring

2.2.1 Overview

The picture below shows the connection layout of the lococube® Motor Controller MC-850.



X1: Power supply and CAN connector

1	V+	Positive Supply Terminal	 6 A max.
2	0V	Ground Terminal	
3	CH	CAN High	 Add termination resistor 2x120R
4	CL	CAN Low	

X2: Motor, input and output connector

1	I1	Input 0-30 VDC	Analog
2	I2		
3	I3		
4	I4		Digital/Encoder
5	I5		
6	0V	Encoder Ground	Ground Terminal
7	1B	Coil 1B – A/	Bipolar Stepper Coils
8	1A	Coil 1A – A	
9	2A	Coil 2A – B	
10	2B	Coil 2B – B/	

X3: Open Source ISP (via VK-46)

1	+3V3	Positive Power Supply (Pin 1)
2	GND	Ground Terminal
3	SYS_SWDIO	System Data IO
4	SYS_SWCLK	System Clock
5	SYS_RESETN	System Reset (inverted)

X4: TTL232 Interface (via VK-16 or VK-46)

1	GND	Ground Terminal
2	TX	3V3 TTL TX Terminal
3	RX	3V3 TTL RX Terminal



Both X3 and X4 connectors are reserved for factory programming only. Connecting these terminals may cause irreversible damage of the MC-850!

2.2.2 Connecting the Power Supply

The MC-850 features an outstanding wide supply voltage range from 7 to 32 VDC at lowest stand-by current consumption. So the MC-850 can be integrated within battery supplied 12 or 24 VDC systems (cars, trucks, battery powered cars, forklifts and digger, for example).



Turn off the power supply before performing any wiring operations!



False electrical connection, voltage reversal or disregarding the electrical specifications may cause irreversible damage to the MC-850!

Connect the supply voltage of 7 to 32 VDC to the 4-pole terminal of the MC-850. Wire the positive supply to the 'V+' marked connection. The negative (ground) will be wired to the '0V' connection. All terminals may be used within a wire gauge from 0.25 to 1.5mm².



Ensure correct power supply voltage range and polarisation! External fusing of 3 A max. is mandatory! Disregarding may cause irreversible damage of the MC-850!

2.2.3 Connecting the CAN Interface

The 4-pole connector of the MC-850 also contains the CAN-specific pins 'CH' (-> CAN high) and 'CL' (-> CAN low).



The voltage at CANH or CANL must not exceed -32 or +32 VDC referred to ground (GND). Higher voltages may cause irreversible damage to the mini-PLC!

There is no termination resistor integrated in the MC-850. **Please refer to the appendix for detailed electrical specification of the CAN interface.**

2.2.4 Connecting the Inputs

You can connect sensors, switches or buttons to the inputs. The types may be limit switches, encoder, temperature, flow, pressure, photoelectric sensors or proximity switches, for example.

Features of I1 to I3

- I1 to I3 are analog inputs from 0 to 30 VDC (12 Bit)
- I4 and I5 are digital inputs, also for encoder (A/B)
- Wide input voltage range from 0 to 32 VDC
- Comprehensive integrated protection circuits
- Outstanding electromagnetic compatibility (EMC)
- Electrostatic discharge protection (ESD)

Due to the pull-down resistors integrated in the MC-850 any switch (NO/NC) can simply be connected between the positive supply (V+) of the MC-850 and the desired input.



The voltage at any input must not exceed 32 VDC referred to ground (GND). Higher voltages or reverse voltage lower than -32 VDC may cause irreversible damage of the MC-850!

The 10-pole connector named X2 contains the inputs of the motor controller. While I1 to IN3 are analog inputs, I4 and I5 are pure digital inputs. Please only use I4 and I5 for encoder connection (I4->'A', I5->'B', encoder ground->0 V). Please only use the X2.6 terminal to refer any input to GND. **Please refer to the appendix for detailed electrical specification of the inputs.**

2.2.5 Connecting the Stepper Motor

The MC-850 is capable to directly drive one bipolar stepper motor up to 2.8 A. Depending on load and motor frequency the maximum allowable current may be lower than 2.8 A. The internal temperature monitor will limit the maximum current.



Choosing the right motor type:

- bipolar stepper
- voltage up to supply voltage
- nominal phase current <3 A

The 10-pole connector X2 contains the motor outputs for on bipolar stepper motor. To properly connect the stepper motor to the MC-850 please use '1A' and '1B' terminals for the first phase of your motor. The second phase will be connected to '2A' and '2B' terminals of the MC-850.



Take care to not set phase current above 2 A for continuous operation. For intermediate operation current up to 2.8 A is allowed.



The heatsink of the MC-850 may reach temperatures up to 100°C.

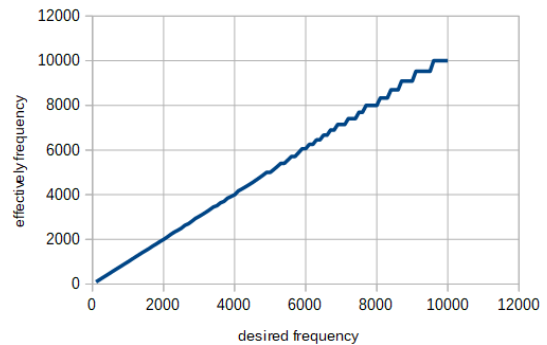
Take care to not cover the MC-850's heat-sink ensuring proper heat dissipation and protect your environment against damage due to heat!

3 CAN Communication

There is no programming necessary to operate the MC-850. The MC-850 will be parameterized using a common 2-wired CAN2.0A/B interface using a standard baud rate of 250 kBit/s.

The MC-850 uses 8 sequenced CAN-IDs. Default CAN-IDs are 0x200 to 0x205, 0x208 and 0x209. The standard base CAN-ID is **0x200**.

The MC-850 receives all CAN message types with 11 or 29 Bit identifier. Messages from 0x000 to 0x7FF will be send with 11 Bit identifier – anything bigger than that with 29 Bit identifier.



The effective frequency gets increasingly inaccurate at higher frequencies.

3.1 Set CAN ID

With this message, it's possible to change the base CAN ID of the MC-850. This message will only work, if the new CAN ID is exactly the same between byte 0–3 and byte 4–7.

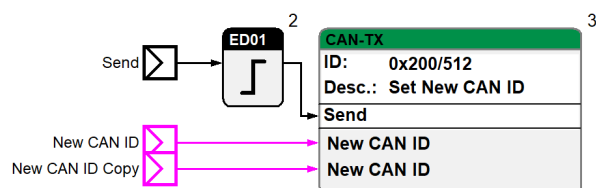
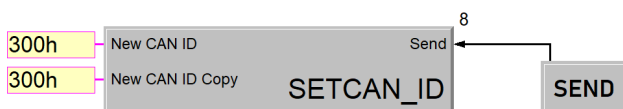
Default ID	Base ID+0x00
DLC	8 Bytes
Direction	Transmit to MC-850
Format	Intel (Byte 0=LSB)

Byte 0	New CAN ID
Byte 1	
Byte 2	
Byte 3	
Byte 4	New CAN ID
Byte 5	
Byte 6	
Byte 7	

EXAMPLE

New CAN ID: 0x300

B0	B1	B2	B3	B4	B5	B6	B7
0x00	0x03	0x00	0x00	0x00	0x03	0x00	0x00



3.2 Set Baudrate

With this message, it's possible to change the CAN baudrate of the MC-850. This message will only work, if the new baudrate is exactly the same between byte 0–3 and byte 4–7.

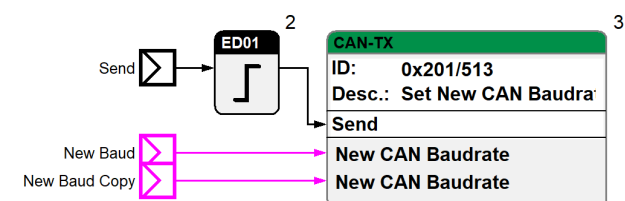
Default ID	Base ID+0x01
DLC	8 Bytes
Direction	Transmit to MC-850
Format	Intel (Byte 0=LSB)

Byte 0	New baudrate
Byte 1	
Byte 2	
Byte 3	
Byte 4	New baudrate
Byte 5	
Byte 6	
Byte 7	

EXAMPLE

New baudrate: 500 kBit

B0	B1	B2	B3	B4	B5	B6	B7
0xF4	0x01	0x00	0x00	0xF4	0x01	0x00	0x00



CHANGING THE BAUDRATE REQUIRES A POWER CYCLE FOR ACTIVATION!

3.3 Set Mode

This message sets the mode of the MC-850.

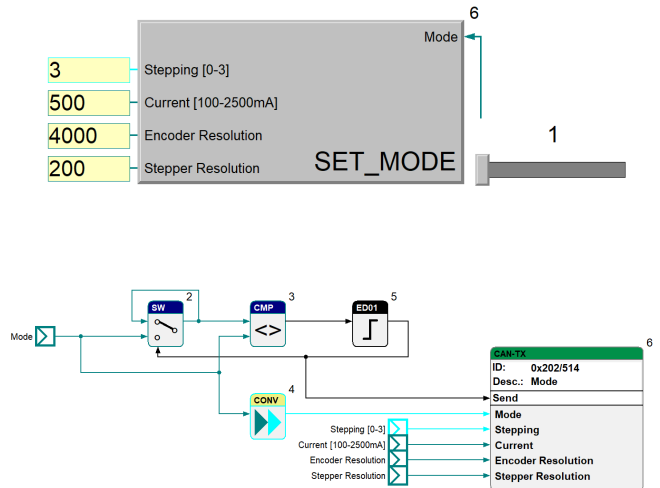
Default ID	Base ID+0x02
DLC	8 Bytes
Direction	Transmit to MC-850
Format	Intel (Byte 0 = LSB)

Byte 0	Mode: 1: Off 2: Hold 3: Velocity 4: PositionOL 5: PositionCL 6: HomingIn1LH_P 7: HomingIn1HL_P 8: HomingIn1LH_M 9: HomingIn1HL_M 10: ResetPosition
Byte 1	Stepping: 0: Full 1: Half 2: Quarter 3: Eighth
Byte 2	Current:
Byte 3	100 ... 2 800 mA
Byte 4	Encoder Resolution:
Byte 5	100 ... 10 000 CPR (Closed loop only)
Byte 6	Motor Steps
Byte 7	100 ... 10 000 SPR

EXAMPLE

Mode: 5 = Position Closed Loop
Stepping: Eighth
Current: 500 mA
Encoder Resolution: 4 000 CPR
Motor Steps: 200 SPR

B0	B1	B2	B3	B4	B5	B6	B7
0x05	0x03	0xF4	0x01	0xA0	0x0F	0xC8	0x00



3.3.1 Modes

- Off**
No holding torque
- Hold**
Only holding torque, no movement
- Velocity**
Constant velocity with accelerate and decelerate ramp
- PositionOL**
Open loop position mode with accelerate and decelerate ramp, no encoder required
- PositionCL**
Closed loop position mode with accelerate and decelerate ramp, encoder required
- HomingIn1LH_P**
Drive slow in positive direction until input 1 goes from L to H, set position to 0 at transition, mode will switch to Hold
- HomingIn1HL_P**
Drive slow in positive direction until input 1 goes from H to L, set position to 0 at transition, mode will switch to Hold
- HomingIn1LH_M**
Drive slow in negative direction until input 1 goes from L to H, set position to 0 at transition, mode will switch to Hold
- HomingIn1HL_M**
Drive slow in negative direction until input 1 goes from H to L, set position to 0 at transition, mode will switch to Hold
- ResetPosition**
Set position to 0, mode will switch to Hold

3.4 Set Parameter

This message sets the parameters for the selected mode.

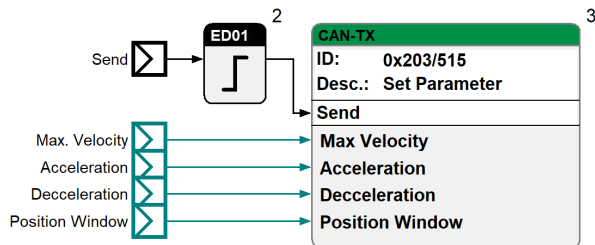
Default ID	Base ID+0x03
DLC	8 Byte
Direction	Transmit to MC-850
Format	Intel (Byte 0 = LSB)

Byte 0	Max velocity
Byte 1	10 ... 10 000 steps/s
Byte 2	Acceleration
Byte 3	10 ... 10 000 Steps/s
Byte 4	Deceleration
Byte 5	10 ... 10 000 Steps/s
Byte 6	Position Window
Byte 7	± ... 10 000 Steps

EXAMPLE

Max velocity: 5,000
Acceleration: 1,500
Deceleration: 1,000
PositionWindow: 25

B0	B1	B2	B3	B4	B5	B6	B7
0x88	0x13	0xDC	0x05	0xE8	0x03	0x19	0x00



3.5 Set Position

This message sets the target position or the speed, depending on whether velocity or position mode is active.

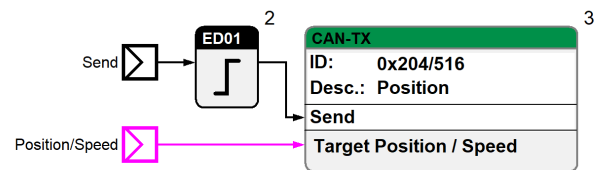
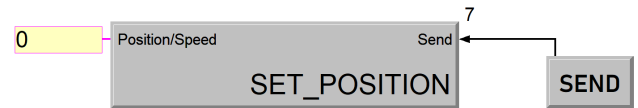
Default ID	Base ID+0x04
DLC	4 Byte
Direction	MC-850
Format	Intel (Byte 0=LSB)

Byte 0	Target Position: -999,999,999 ... 999,999,999 (Position mode)
Byte 1	
Byte 2	Speed: -MaxVelocity ... MaxVelocity (Velocity mode)
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	

EXAMPLE

Target Position (Position mode): -10,000

B0	B1	B2	B3	B4	B5	B6	B7
0xF0	0xD8	0xFF	0xFF				



3.6 Get Data

With this message, it is possible to change the base CAN-ID

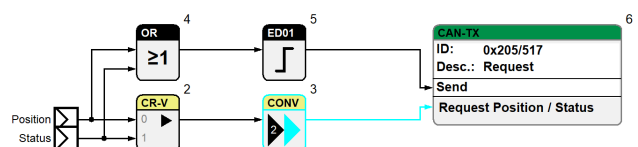
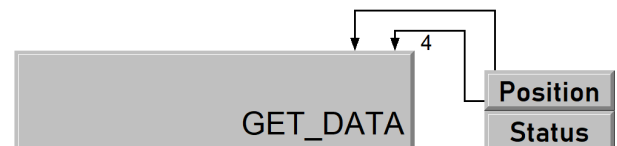
Default ID	Base ID+0x05
DLC	1 Byte
Direction	Transmit to MC-850
Format	Intel (Byte 0=LSB)

Byte 0	Bit0: Request Position Bit1: Request Status
Byte 1	
Byte 2	
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	

EXAMPLE

Request position: 0
Request status: 1

B0	B1	B2	B3	B4	B5	B6	B7
0x02							



3.6.1 Special Function: Get Version

This variant of the Get Data message returns the current hardware and software version.

Default ID	Base ID+0x05
DLC	1 Byte
Direction	Transmit to MC-850
Format	Intel (Byte 0=LSB)

Byte 0	Get Version
Byte 1	
Byte 2	
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	

USAGE

The Get Version command requires 0xFF to be sent in byte 0.

B0	B1	B2	B3	B4	B5	B6	B7
0xFF							

3.7 Position

This message shows the encoder and stepper position.

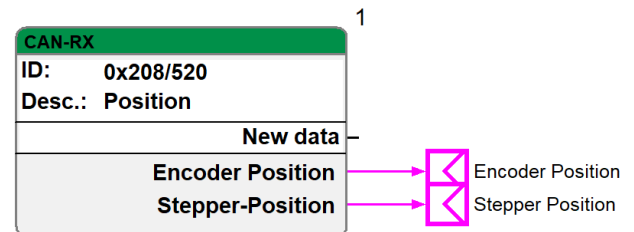
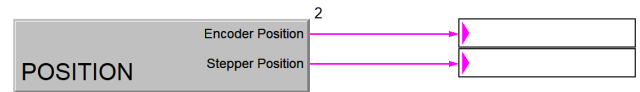
Default ID	Base ID+0x08
DLC	8 Byte
Direction	Receive from MC-850
Format	Intel (Byte 0=LSB)
Timing	100 ms or at Get Data

Byte 0	Encoder position
Byte 1	
Byte 2	
Byte 3	
Byte 4	Stepper position
Byte 5	
Byte 6	
Byte 7	

EXAMPLE

Encoder: -26,478
Stepper: 29,473

B0	B1	B2	B3	B4	B5	B6	B7
0x92	0x98	0xFF	0xFF	0x21	0x73	0x00	0x00



3.8 Status

This message shows status of the inputs.

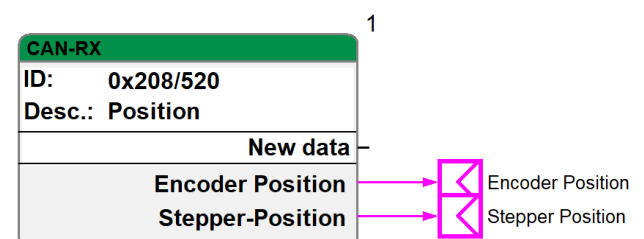
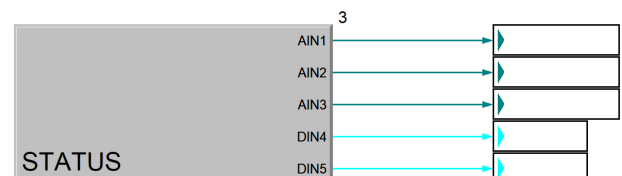
Default ID	Base ID+0x09
DLC	8 Byte
Direction	Receive from MC-850
Format	Intel (Byte 0=LSB)
Timing	100 ms or at Get Data

Byte 0	Analog IN1 [mV]
Byte 1	
Byte 2	Analog IN2 [mV]
Byte 3	
Byte 4	Analog IN3 [mV]
Byte 5	
Byte 6	Bit0: Digital IN4
Byte 7	Bit0: Digital IN5

EXAMPLE

AIN1: 1,526
AIN2: 28,010
AIN3: 26
DIN4: 0
DIN5: 1

B0	B1	B2	B3	B4	B5	B6	B7
0xF6	0x05	0x6A	0x6D	0x1A	0x00	0x00	0x01



3.8.1 Special function: Version

This message shows the hard- & software version.

Default ID	Base ID+0x09
DLC	8 Byte
Direction	Receive from MC-850
Format	Intel (Byte 0=LSB)
Timing	At Get Data 10 s cooldown

Byte 0	Hardware version
Byte 1	
Byte 2	
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	

EXAMPLE

Hardware version: 100 == 1.00

Software version: 103 == 1.03

B0	B1	B2	B3	B4	B5	B6	B7
0x64	0x00	0x67	0x00				

4 Operation and Programming

To operate the MC-850 with a CAN Bus equipped lococube® mini-PLC, please refer to the manual of the mini-PLC you want to use for your project. The related manual also shows all programming options available for your mini-PLC to properly control the motor controller MC-850 via CAN communication. A miCon-L example program is available for the STG-850 below.

1



miCon-L

Fast, easy and intuitive programming by connecting functions blocks.

[lococube® STG-800](#)

[miCon-L V7.1.4 EN](#)

[Example program for STG-800](#)

The miCon-L example program may not be used for productive use and strictly serves as an example to showcase the MC-850's functions!

4.1 Blink Code

The Status LED on the MC-850 indicates the operating mode it's currently in:

Nr. of flashes	Operating mode
1	Off
2	Hold
3	Velocity
4	PositionOL
5	PositionCL
6	HomingIn1LH_P
7	HomingIn1HL_P
8	HomingIn1LH_M
9	HomingIn1HL_L
10	ResetPosition

4.2 Factory Default

The MC-850 can be factory reset by shorting the RX and TX pin on the TTL232 interface. **This change requires a power cycle!**



This will reset the base CAN-ID to **0x200** and the baudrate to **250 kBit/s**.

5 Appendix

5.1 Specifications

5.1.1 General

Hardware design	BARTH® CAN motor controller with pluggable spring terminal connectors
Interfaces	CAN 2.0A/B

5.1.2 Power supply

Operating voltage	7 to 32 VDC
Current consumption	depending of the connected stepper motor, 2.8 A max
Fusing	3 A max. (external) mandatory for voltage reversal protection
Voltage reversal protection	yes (combined with external fuse)
ESD/TVS protection	yes, integrated
Heat dissipation air (at full load)	normally < 5 W

5.1.3 Inputs

Number analog	3
Number digital (encoder)	2
Analog input IN1 - IN3	$U_{IN} = 0..30 \text{ VDC}$ $R_{IN} > 11 \text{ k}\Omega$ $f_{IN} \leq 11 \text{ kHz}$ $t_{IN} \geq 1 \text{ ms}$
Digital input IN4 - IN5	$U_{IN} = 0..30 \text{ VDC}$ $R_{IN} > 20 \text{ k}\Omega$ $U_{LOW} \leq 3 \text{ VDC}$ $U_{HIGH} \geq 5 \text{ VDC}$ $f_{IN} \leq 25 \text{ kHz}$ $t_{IN} \geq 40 \mu\text{s}$
Accuracy ADC IN1 - IN3	< 0.15 VDC
ADC resolution (internal)	12 Bit
Potential isolation	no (common GND)
ESD/TVS protection	yes

5.1.4 Interfaces

CAN	CAN 2.0A/B: 11/29 Bit ID, base frame format supported baud rates: 10, 20, 50, 100, 125, 250, 500, 1000 kBit/s
	no internal termination resistor (120 R)
	Meets or exceeds the requirements of applications ISO 11898-2, loss of ground protection from -32 V to +32 V, thermal shutdown protection

5.1.5 Security features

Security Features	System and independent watchdog Fail safe oscillator Power on/down reset Supply voltage supervisor
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5.1.6 Timebase (oscillator)

Primary Oscillator	Crystal quartz MEMS unit (precise ,micro-electro-mechanical system')
Nominal Frequency	16 MHz
Frequency tolerance	$\pm 50 \times 10^{-6}$
Frequency aging	$\pm 5 \times 10^{-6} / \text{year max.}$

5.1.7 Electrical connection

Electrical Connection	pluggable screw type connector 0.25 to 1.5 mm² Manufacturer: Phoenix Contact Series: COMBICON Type: MC1,5/4-ST-3,5(-BK)
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5.1.8 Electromagnetic compatibility (EMC)

Electrostatic discharge (ESD) at supply terminals	20 kV air discharge 30 kV contact discharge (IEC/EN 61 000-4-2, level 3)
Electromagnetic fields	Field strength 10 V/m (IEC/EN 61000-4-3)
CAN bus terminals (CANH, CANL to GND)	IEC 61000-4-2: Unpowered contact discharge ±15000 V IEC 61000-4-2: Powered contact discharge ±8000 V

5.1.9 Environmental conditions

Operation temperature	-20 to +50 °C (IEC 60068-2-1/2)
Storage temperature	-30 to 70 °C (IEC 60068-2-1/2)
Relative humidity	5 to 80% non-condensing (IEC 60068-2-30)
Air pressure (in operation)	500 to 1500 hPa
Shock resistance	min. 50 m/s ² (IEC 60068-2-27)
Vibration resistance	min. 10 m/s ² @ 10..100 Hz (IEC 60068-2-6)
Degree of protection	IP 20 (not evaluated by UL) (EN 50178, IEC 60529)
Free fall (packaged)	1000 mm (IEC 60068-2-32)

5.1.10 Weight and dimensions

Weight	50 g (without connectors)
Dimensions	60 x 45 x 18 mm (LxWxH) (without connectors)
Mounting	via two M4 screws or 3.6 mm cable ties

5.1.11 Ordering information

Ordering information	Motor Controller MC-850 Art. No. 0890-0850 GTIN 4251329401566
Ordering information accessory	mini-PLC STG-800 Art. No. 0850-0800 GTIN 4251329401207
	Connection Cable VK-16 (graphical programming) Art. No. 0091-0016 GTIN 4251329400187
	Programming adaptor VK-46 (graphical & open source programming) Art. No. 0091-0046 GTIN 4251329406226
	Harness KS-85 (Developer wiring harness) Art. No. 0036-0085 GTIN 4251329406165

5.2 Disposal

	If you wish to dispose of the product, ask your local recycling centre or dealer for details about how to do this in accordance with the applicable disposal regulations.
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5.3 Conformity declaration

For the following designated product it is hereby confirmed, that the construction in that technical design brought by us in traffic corresponds to the standards specified below. In the event of any alternation which has not been approved by us being made to any device as designated below, this statement shall thereby be made invalid.

Description	Motor Controller
Type	MC-850
Art. No.	0890-0850
Directive 2004/108/EG relating to-electromagnetic compatibility (EMC) 	Applied norms: 2004/108/EG 2004/108/EC 2014/30/EU
RoHS Directive 2011/65/EU	We hereby declare that our product is compliant to the RoHS Directive on restriction of the use of certain hazardous substances in electrical and electronic appliances.
	BARTH Elektronik GmbH declares conformity of the product for which this manual is intended with the UKCA equivalent of the aforementioned CE regulations. We therefore deem the product to be in full compliance with the UKCA regulations and take full legal responsibility for it. This declaration was issued on 30.11.2021.

BARTH® Elektronik GmbH
Lengerich, 10.12.2025


Dipl.-Ing. (FH) D. Barth
Managing Director