

# MOTECK Actuator with CAN bus J1939



Revision	2025.10_V1.0
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Technical changes may be made to improve the product without notice !

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## 1. Overview

This manual contains information and instruction for readers to operate the MOTECK actuator with CAN bus J1939 control option. These actuators with control board inside the housing are designated as J00 control option which are developed on the base of signal control option and can be physically connected to CAN bus than communicate through CAN bus J1939 protocol.

As part of MOTECK intelligent actuator series, the CAN bus J1939 actuators receive the commands to control the motion of actuator including the position, speed and the related setting relies on SAE J1939 standard and transmit immediate position, current, speed... and other status information to system. These actuators are focus on agriculture, construction, industrial automation and other application operated through CAN bus J1939 network.

## 2. Warning



This manual assumes that the reader is familiar with the SAE J1939 and ISO 11898 standards. Therefore, the terminology in these standards are used but not described in detail. The users who choose the J00 option must have already established or well prepared to establish the CAN bus J1939 system to apply this actuator.

## 3. Introduction to CAN bus J1939

CAN bus J1939 is one of the higher-layer CAN (Controller Area Network) protocols. The application is defined in SAE J1939 standard which is released by SAE International (formerly the Society of Automotive Engineers). With the following features:

Base: Bosch CAN Specification 2.0B

Data Frame: Extended Frame

Identifier: 29 bits

Max. number of nodes in bus: 254

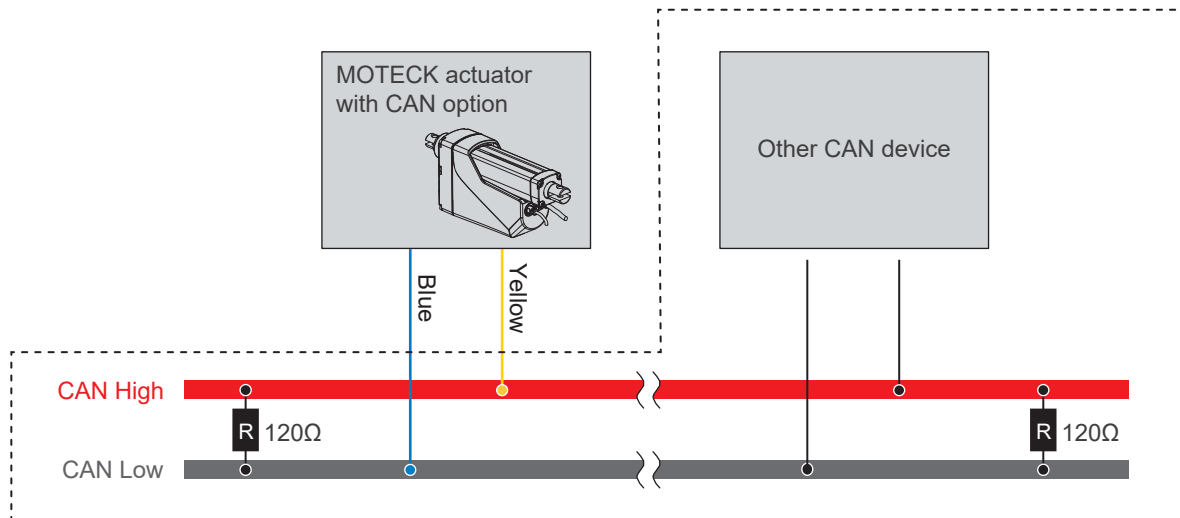
MOTECK CAN bus J1939 actuator is compliant with the J1939 standards, which includes a command set for controlling the actuator and providing the feedback status.



## 4. Physical layer

### 4.1 Bus connection

Please follow the wiring guidelines of ISO-11898-1/11898-2 standard. The two ends of the CAN High / CAN Low harness should be connected with a 120Ω terminal resistor, as shown in the figure below. The wiring topology of a CAN network should be as close as possible to a single line structure in order to avoid cable-reflected waves.



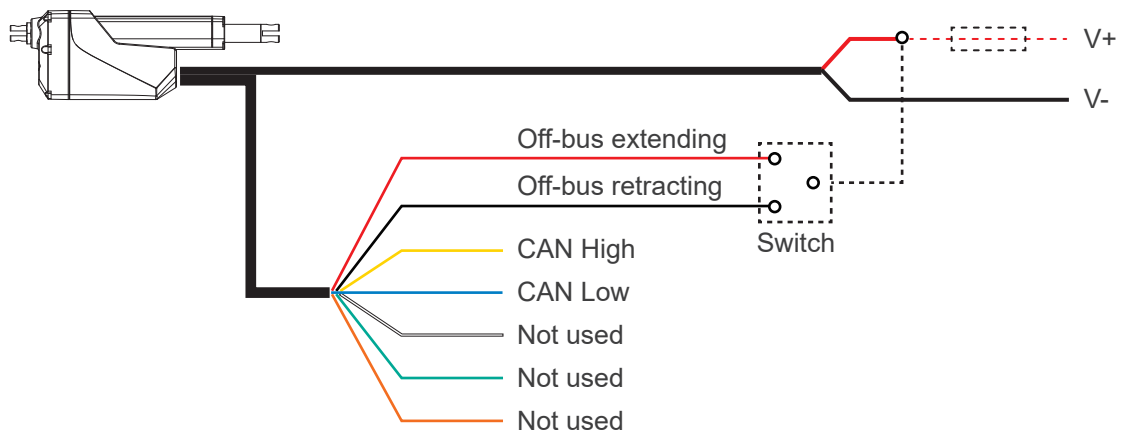
### 4.2 Bit rate and bus length

Three bit rates can be set for MOTECK CAN bus J1939 actuator: 250Kbps, 500Kbps, 1Mbps.

Default value: 250Kbps

- (1) ISO 11898-2 describes that the max. bus length 40M and max. stub length 0.3M at bit rate 1Mbps.
- (2) SAE J1939-15 states that bit rate 250Kbps with max. bus length 40M and max. stub length 3M which is Included in the bus length. The wire cross-section of bus cable would be 20AWG at least. Max. number of nodes is 10. However, the max. number is 30 in J1939-11.
- (3) For longer bus length, lower bit rate and larger wire cross-section are considered.
- (4) MOTECK actuator tests are limited to consist of 3-meter bus cables and stub wires.

### 4.3 Wiring



**Note:** All dashed lines are connected by the customer.

### 4.4 Wire definitions

	Wire color	Definition	Description
Power cable	Red	V+	<ul style="list-style-type: none"> <li>Connect Red to positive</li> <li>Connect Black to negative</li> <li>Do not swap the polarity</li> <li>Input voltage: According to actuator voltage specification <math>\pm 10\%</math></li> </ul>
	Black	V-	
Signal cable	Red	Off-bus extending	Connect Red to positive (V+) to extend, input current <10mA.
	Black	Off-bus retracting	Connect Black to positive (V+) to retract, input current <10mA.
	Yellow	CAN High	
	Blue	CAN Low	
	White	Not used	
	Green	Not used	
	Orange	Not used	

**Notes:** Please ensure that unused wires are well insulated to avoid damaging the internal circuit of the actuator.

### 4.5 Off-bus operation

- (1) When the actuator has the need to repair, maintain or test without the CAN commands. There are 2 separate wires to perform the off-bus operation which is the same as the SOL option for extending or retracting the actuator but without the EoS signal output.
- (2) It is not necessary to disconnect the CAN High and CAN Low wires when the off-bus operation is required. The priority of CAN commands and off-bus control is that whose command comes first, it will be executed first, and the next command will be accepted after the execution is completed.

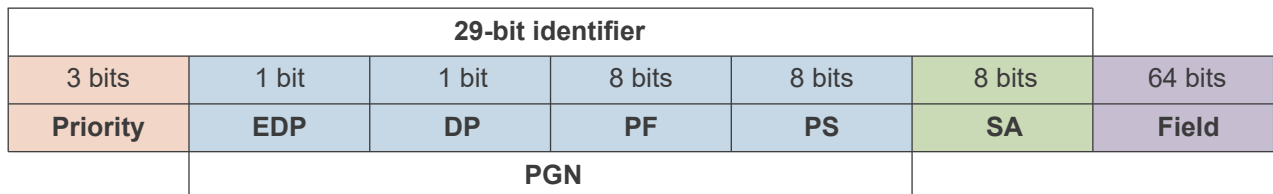


## 5. Data link and application

### 5.1 PDU and PGN

A message transferred by data frame through CAN bus J1939 protocol is called Protocol Data Unit (PDU) which consists of 29-bit identifier and 8-Byte (64 bits) data field.

The PGN (Parameter Group Number) uniquely identifies a particular Parameter Group and is a 3-Byte value that has the following constituent components: 6 MSB set to zero, EDP bit, DP bit, PF field, PS field.



EDP: Extended Data Page

DP: Data Page

PF: PDU Format

PS: PDU Specific

SA: Source Address of the controller application (Hereinafter referred to as CA) sending the message.

### 5.2 MOTECK supported PGNs

	Message name	PGN
J1939-21 Data link layer	Proprietary A	61184 (0x00EF00)
	Proprietary B	65280 (0x00FF00)
J1939-81 Network management	Address Claimed / Cannot Claim	60928 (0x00EE00)
	Commanded Address	65240 (0x00FED8)



## 6. Network management

### 6.1 J1939 NAME

The J1939 NAME is a 64-bit data provided by MOTECK for identification and arbitration CA on the network<sup>(1)</sup>. The 64 bit value is composed of 10 parameters.

Parameter	Data bits	Length	Default value	Note
Identity number	b0~b20	21	Number	Unique number set by MOTECK
Manufacture code	b21~b31	11	967	Assigned by SAE to MOTECK
ECU instance	b32~b34	3	0	Cannot be changed
Function instance	b35~b39	5	0	Cannot be changed
Function	b40~b47	8	255	Cannot be changed
Reserved	b48	1	0	J1939 reserved
Vehicle system	b49~b55	7	0	Non-specific system
Vehicle system instance	b56~b59	4	0	Cannot be changed
Industry group	b60~b62	3	0	Apply to all
Arbitrary Address Capable	b63	1	1	Accept the assigned address

#### Notes:

<sup>(1)</sup> Definitions by J1939-81

A controller is made up of the software and the hardware within an Electronic Control Unit (ECU) that performs a particular control function. The software within a particular controller is the "Controller Application" (CA). An ECU may serve as one or more controllers and hence may contain one or more CAs. Each CA on a network should have one NAME so the CA may be uniquely identified.



## 6.2 Address

The address is the basis for sending messages in the J1939 network, values from 0 to 253 are allowed as valid addresses in the same network. The address of each CA in the same network must be unique. The J1939 protocol defines that if the declared address is the same as other CA's, it will be judged by NAME (section 6.1), and the 64-bit data will be converted into a decimal value. The smaller value takes precedence in obtaining the declared address. The default address of MK35 and MK35L is 16 (0x10).

## 6.3 Hardware address selection for MK35 and MK35L

If multiple MK35/MK35L actuators will be used in a CAN bus network, there is a DIP switch for Address selection. Up to 16 MK35/MK35L actuators can be connected and preset addresses.

Before connecting the actuators to the bus, please follow the steps below.

- (1) Loosen the screw of the anti-pull lid, and then remove the lid.
- (2) Pull out the power cable, you can see the red DIP switch as shown in the figure below.



- (3) Use a non-conductive stick to slide the 4 DIP switches. The hardware ID settings are shown below, which represent values from 16 (Preset) to 31.

Address Value					
16 (Preset)	17	18	19	20	21
22	23	24	25	26	27
28	29	30	31		

- (4) Plug in the power cable back.
- (5) Put the anti-pull lid back correctly and tighten the screw to ensure that the cable plugs are secured and sealed.



## 7. Command and status feedback

### 7.1 Proprietary A message

All CAs in the same network can send actions or setting command to MOTECK actuator through PGN 61184 (0x00EF00).

- (1) Recommended data repetition rate: 100~250ms
- (2) Priority: default value 6
- (3) PS field contains the destination address (DA) i.e. the address of MOTECK actuator.
- (4) Data field: 8 Bytes (64 bits) are divided into 5 parameters as following definition

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
<b>Action</b>	<b>Position</b>		<b>Current limit</b>	<b>Speed or Ramp setting</b>		<b>Reserved</b>	<b>Reserved</b>

Name	Function	Data bits	Values in decimal
<b>Action</b>	Move	b0-b1	<ul style="list-style-type: none"> <li>• 0 = Stop actuator moving</li> <li>• 1 = Extend the actuator</li> <li>• 2 = Retract the actuator</li> <li>• 3 = Move to designated position</li> </ul>
	Clear error code	b2	<ul style="list-style-type: none"> <li>• 0 = Do not clear error code</li> <li>• 1 = Clear the last error code</li> </ul>
	Mode switch (Speed / Ramp setting)	b3	<ul style="list-style-type: none"> <li>• 0 = Speed mode (default value)</li> <li>• 1 = Ramp setting mode (the 'Move' bits must be 0, i.e. Stop moving)</li> <li>• This value will be retained until the next change</li> </ul>
	Reserved	b4-b7	Not used. (suggest 0)
<b>Position</b> <sup>(1)</sup>	Go to position	Byte 1 & Byte 2	<ul style="list-style-type: none"> <li>• 0~65535</li> <li>• Resolution: 0.1mm/s per bit</li> <li>• Valid only when Move command = 3</li> </ul>
<b>Current limit</b> <sup>(2)</sup>	Set current limit	Byte 3	<ul style="list-style-type: none"> <li>• 0~254</li> <li>• Resolution: 0.25A/ bit</li> <li>• 255 = Factory default</li> </ul>
<b>Speed</b> <sup>(3)</sup>	Set run speed (Mode switch = 0)	Byte 4 & Byte 5	<ul style="list-style-type: none"> <li>• 0~65534</li> <li>• Resolution: 0.1mm/s per bit</li> <li>• 65535 = Factory default</li> </ul>
<b>Soft start</b> <sup>(4)</sup>	Set the ramp time of soft start (Mode switch = 1)	Byte 4	<ul style="list-style-type: none"> <li>• 0~254</li> <li>• Resolution: 50ms/ bit</li> <li>• 255 = Factory default</li> </ul>
<b>Soft stop</b> <sup>(4)</sup>	Set the ramp time of soft stop (Mode switch = 1)	Byte 5	<ul style="list-style-type: none"> <li>• 0~254</li> <li>• Resolution: 50ms/ bit</li> <li>• 255 = Factory default</li> </ul>
<b>Reserved</b>	Reserved	Byte 6 & Byte 7	

#### Notes:

- (1) The actual stop position is still limited by the mechanical stroke of the actuator. If the move command is not 3, the value for position is neglect.
- (2) The factory default value of current limit depends on actuator model. If this parameter is set exceeding the factory default, the default value will be executed.
- (3) The run speed is limited to the speed/load curve showed in the data sheet of actuator if the parameter is set exceeding the curve.
- (4) Although 0 offset of the soft start/stop setting. There will be a little lag up to 100ms from command to the motor start due to firmware process.



## 7.2 Proprietary B message

The feedback of MOTECK actuator will be provided through PGN 65280 (0x00FF00) in response to control or setting commands (Proprietary A)

- (1) Priority: default value 6
- (2) PS field contains the group extension (GE) value 0
- (3) Data field: 8 Bytes (64 bits) are divided into 6 parameters as following definition

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
<b>Status flag</b>	<b>Position</b>		<b>Current</b>	<b>Speed</b>		<b>Error flag</b>	<b>Reserved</b>

Name	Function description	Data bits	Values in details
<b>Status flag</b>	Retracted EOS limit switch is triggered	b0	<ul style="list-style-type: none"> <li>• 6 independent status bit indicators</li> <li>• 1 = Valid for the described situation</li> <li>• 0 = Otherwise</li> </ul>
	Extended EOS limit switch is triggered	b1	
	Retracting	b2	
	Extending	b3	
	In soft starting	b4	
	In soft stopping	b5	
	Action mode	b6	
	Reserved	b7	Always 0
<b>Position</b> <sup>(1)</sup>	The present stroke position	Byte 1 & Byte 2	<ul style="list-style-type: none"> <li>• 0~65535</li> <li>• Resolution: 0.1mm/s per bit</li> </ul>
<b>Current</b>	The present electrical current	Byte 3	<ul style="list-style-type: none"> <li>• 0~255</li> <li>• Resolution: 0.25A/ bit</li> </ul>
<b>Speed</b>	The present speed	Byte 4 & Byte 5	<ul style="list-style-type: none"> <li>• 0~65535</li> <li>• Resolution: 0.1mm/s per bit</li> </ul>
<b>Error flag</b> <sup>(2)</sup>	Detected over current is lasted for 300ms	b0	<ul style="list-style-type: none"> <li>• 6 independent error bit indicators</li> <li>• 1 = Valid for the described situation and the actuator will stop immediately</li> <li>• 0 = Otherwise</li> </ul>
	Position error (position unchanged while the actuator is moving status)	b1	
	Under voltage	b2	
	Over voltage	b3	
	Under temperature	b4	
	Over temperature	b5	
	Reserved	b6-b7	Always 0
<b>Reserved</b>	Reserved	Byte 7	Always 0

### Notes:

- (1) The 0 position was preset by MOTECK when the retracted EOS limit switch is triggered.
- (2) The allowable range of voltage and temperature depends on actuator model and listed in data sheet.

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