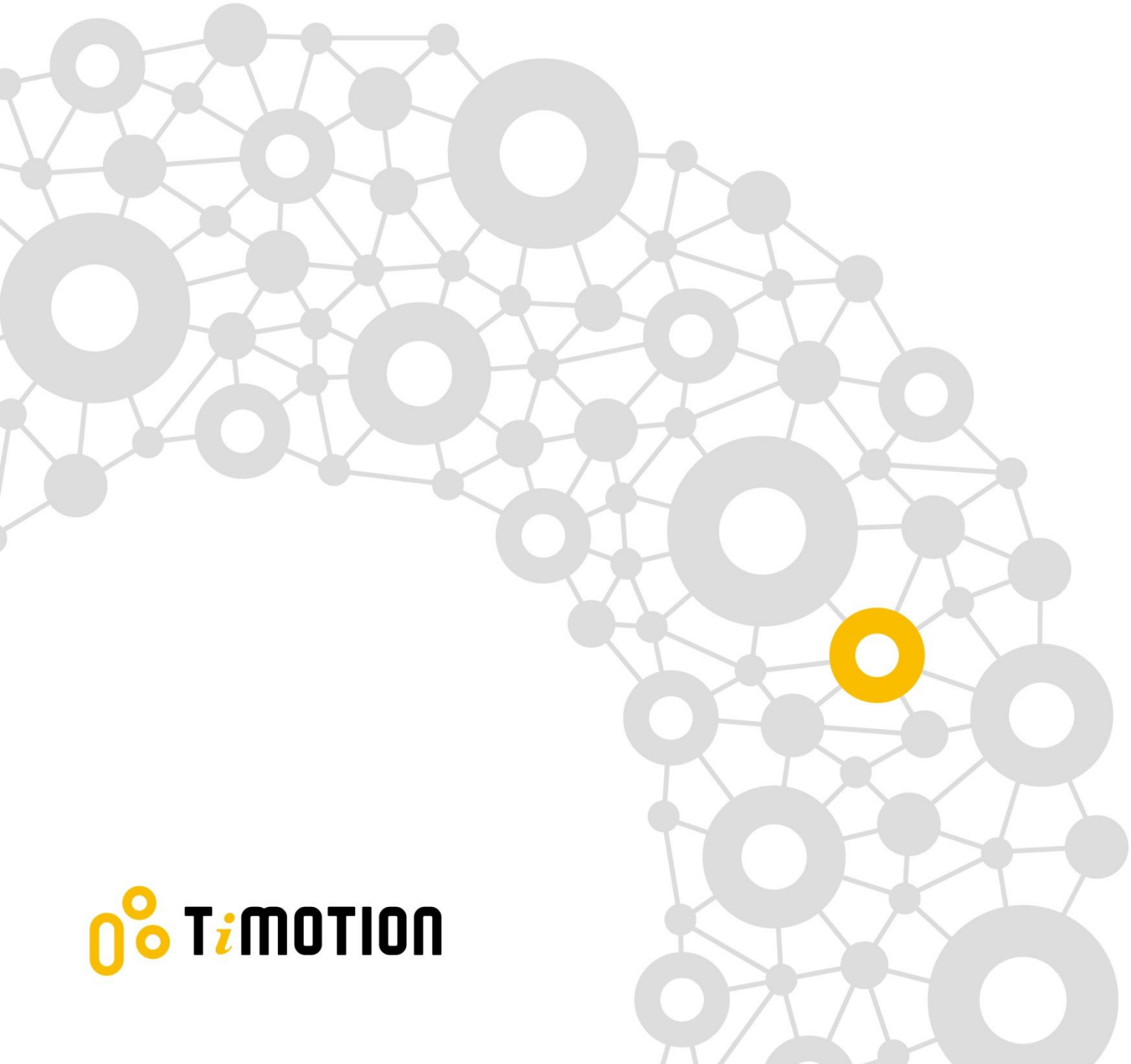
User Manual

MA2T



TiMOTION

Contents

Glossary

The following table lists the specific terms and acronyms that are used in this document.

AWG	American wire gauge. The smaller the number, the larger the diameter.
Primary	The actuator that is connected to PGMA in a sync. communication group and responsible for giving commands.
Secondary	The actuator(s) that follow(s) the command of the primary actuator.
EOS	End of stroke.
EMF	Electromotive force.
GND	Ground.
Hall-Pot.	Hall potentiometer. It provides analog voltage feedback.
MCU	Microcontroller unit.
N.C.	The pin of the limit switch that is a normally closed circuit, only changing to open when the switch is triggered.
N.O.	The pin of the limit switch that is a normally open circuit, only changing to closed when the switch is triggered.
PWM	Pulse width modulation. It can be either analog feedback or a method controlling the speed of the motor.
RPM	Number of turns per minute.
TAD1	The TiMOTION dongle for connecting the actuator to the computer.
$V_{AUX.}$	Auxiliary voltage output.
V_{CC}	Power supply voltage.
V_{DC}+	The positive pole of power input.
V_{DC}-	The negative pole of power input.

1 General

1.1 About this manual

This document contains instructions on how to install, use and maintain the TiMOTION product as well as its technical data. It is designed for the manufacturer of the equipment or system rather than the end users. Manufacturers should provide a user guide to the end users using the relevant safety information obtained from this document.

Carefully read through each section of this document before the equipment is unpacked, installed, or operated. Please pay attention to all the warnings, cautions and notes stated in this document, and follow the instructions provided in this document to ensure safe and reliable operation.

1.2 Target personnel

Only qualified mechanical and electrical professionals should perform the installation, maintenance, and replacement of the TiMOTION products. Please keep the products away from personnel who do not have the required experience or knowledge of the product.

1.3 Warranty

In general, TiMOTION provides a 24-month warranty on all Industrial Motion actuators starting from the manufacturing date. Note that the warranty is only valid if the equipment is properly maintained and operated correctly. The application of the product is the responsibility of the buyer and the user. TiMOTION makes no representation or warranty as to the product's suitability for any specific use or purpose.

1.4 Support

If any technical support or additional information for the product is needed, please contact TiMOTION. For product or contact information, visit https://www.TiMOTION.com.

1.5 Disclaimer

This document has been created based on TiMOTION's current technical knowledge. TiMOTION is continuously working on updating product information, and reserves the right to carry out technical modifications.

2 Safety

- Please read through the notification and warnings before working on any equipment in which the TiMOTION actuator is incorporated.
- Please adhere to all the information contained in this document and on the product label.

2.1 Notification and warnings

2.1.1 Mounting or dismounting

- Be sure the actuator is not connected or in operation.
- Be sure the actuator has no load applied to it that can be released during mounting or dismounting.
- Do not use the actuator if it appears faulty or damaged. Immediately notify TiMOTION so corrective actions may be taken.
- Do not disassemble the actuator. This will compromise the sealing and can impact its function. Any form of disassembly of the actuator will automatically void warranty.
- Grease may be present on the extension tube. Contact with grease is non-hazardous. Please refrain from removing the film.

2.1.2 Before operation

- Be sure the actuator is correctly mounted as instructed in this document.
- Be sure the equipment can operate unobstructed throughout the actuator's whole working area.
- Be sure the actuator is properly connected to a main power supply, or transformer, with the correct voltage specified on the actuator label.
- Be sure the connection bolts are safely secured and can withstand wear.
- Be sure to use the actuator only within the specified working limits.

2.1.3 During operation

- Stop the actuator immediately if anything unusual is observed. Contact TiMOTION so corrective actions can be taken.
- Please refrain from unplugging any cables or connectors during operation or while power is applied.

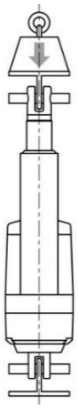
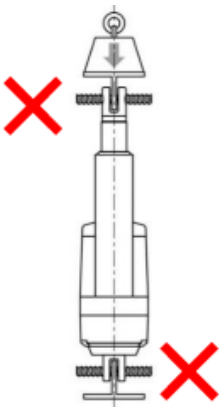
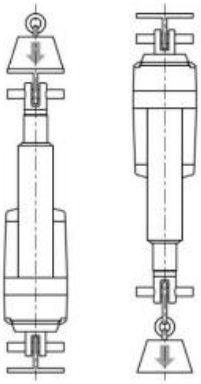
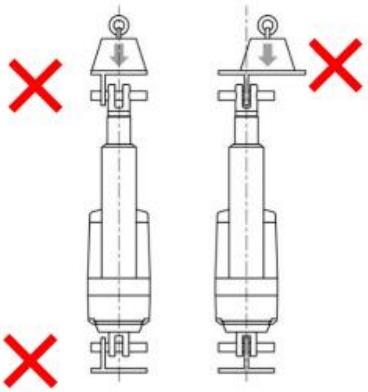
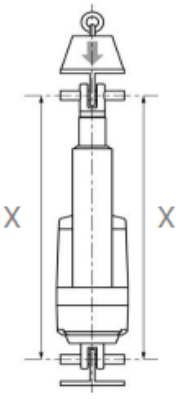
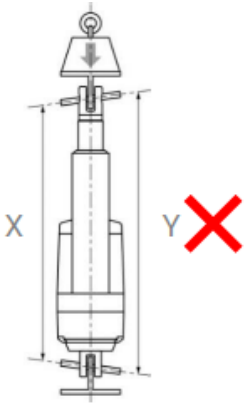
2.1.4 Power off

- Be sure the main power supply is properly switched off to prevent any unintentional operation.
- Please regularly check for extraordinary wear or abnormal wear.

3 Installation

3.1 Mechanical installation

3.1.1 Important notice

Note	Correct	Wrong
Please mount the actuator with unthreaded mounting pins in the correct dimension, and support them properly at both ends of the attachments.		
Do not mount the actuator with pins in different orientations, as this will apply stress on the nut during operation. Please note that the load should be pushed or pulled along the stroke axis of the actuator. Off-center or side loads can cause the actuator to bend and lead to failure.		
Be sure the mounting pins are parallel to each other. If the pins are not in parallel, the actuator can be bent and subsequently damaged.		

3.2 Electrical installation

3.2.1 Important notice

- Be sure the leads or cables leading to the motor are rated to handle the maximum current.
- An emergency stop is highly recommended to reduce the chance of a crushing hazard.
- If a DC motor is used without soft stop, a short peak of high voltage will be endured by the power supply. Therefore, when selecting power supplies, please ensure it can withstand the peak of high voltage.
- To reduce the chance of interference, please refrain from placing signal cables along power cables.
- Please use shielded signal cables with applications that can be sensitive to, or have risk of interference.
- Please note that using long cables in combination with small lead cross-sections and low voltages can lead to a malfunction due to voltage drop.
- Please use spark protection on relays and other coil operated devices.
- Be sure that the power to the actuator is off before performing any work on the wiring.

3.2.2 Fuse size

Please protect the actuator and wiring by using a slow blow fuse between the actuator and the power supply.

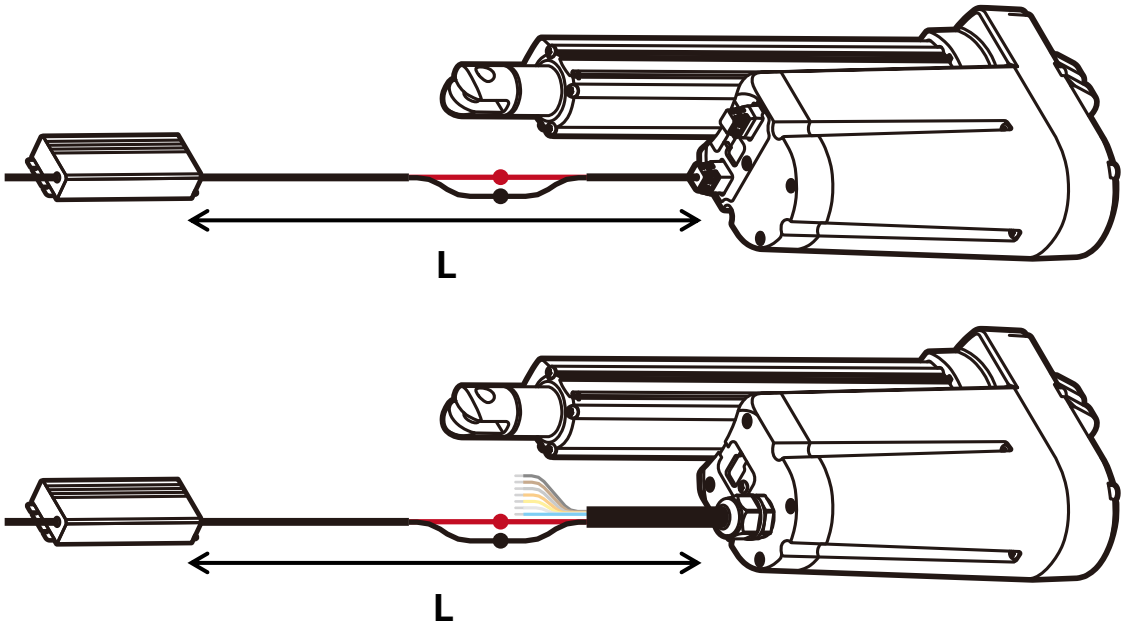
Recommended fuse size	
Actuator supply voltage	Fuse size
12 V DC	40 A
24 V DC	20 A
48 V DC	10 A

3.2.3 Power extension cable(s)

The actuator is supplied with a power cable and/or signal cable(s). Each cable has flying leads on one end to connect with the user's equipment. On the other end, the cable is integrated into the connector cover on the actuator. This plug-in connector allows the user to replace the actuator without having to disconnect the flying leads.

It is important to use a power extension cable with the proper size to avoid a significant voltage drop. The further away the power supply is, the larger the power extension cable should be. Please refer to the table below for the recommendation of the power extension cable size.

Extension cable type	Length of cable (L)	Cross-section	AWG
Power extension cable	0~4 m	2.08 mm^2	14 AWG
	4~10 m	3.31 mm^2	12 AWG



3.2.4 Inrush current

When starting the actuator, there is an inrush current to the motor that will last between 75 to 150 milliseconds (up to four times the rated current).

Please make sure the power supply is appropriately sized to handle the inrush current (batteries typically have no issue handling the inrush current.) Furthermore, be sure all contacts, switches, and relays are sized appropriately to handle the inrush current.

With the MA2T, it is recommended not to change the soft-start function to hard-start (i.e. setting soft start at 0 seconds in PGMA) to avoid unnecessary damage to the actuator.

3.2.5 Back EMF

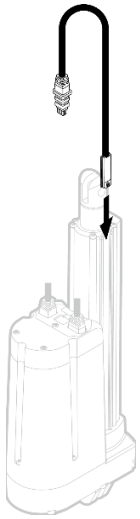
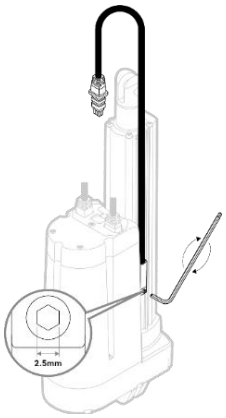
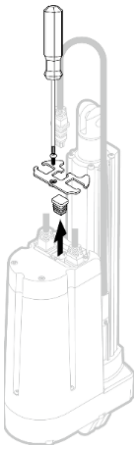
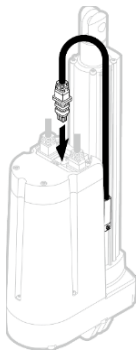
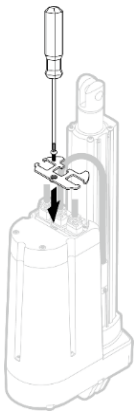
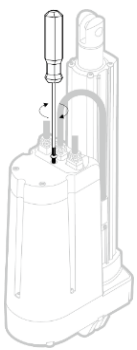
With the MA2T, it is recommended not to change the soft-stop function to hard-stop (i.e. setting soft stop at 0 seconds in PGMA) to lower the effect of back EMF as the motor decelerates.

3.3 Functions

3.3.1 Stroke adjustment

3.3.1.1 Stroke adjustment via adjustable reed switch

The stroke length of the actuator can be limited by an adjustable reed switch. Please see the instructions below for the installation of the reed switch.

			
1. Install the reed switch into the slot of the outer tube.	2. Use a 2.5-mm hex key to lock the screw of the reed switch at the designated position. (Torque: approx. 1.5 Nm.)	3. Unscrew the cover with a screwdriver.	4. Remove the cover and unplug the protective plug.
			
5. Plug the connector of the reed switch into P2.	6. Re-install the cover.	7. Re-screw the cover.	

- Be sure the plug is in the right location and fully pressed in before re-screwing the cover.
- Be sure the reed switch is not in contact with other magnetic parts, as this can cause incorrect measurements.

3.3.1.2 Stroke adjustment via PGMA

The stroke length of the actuator can also be configured in PGMA. The user can set the desired end-of-stroke position in either extending or retracting direction. For more information, please refer to the user manual of PGMA.

3.3.2 Movement

3.3.2.1 Speed adjustment

The extension and retraction speed of the actuator can be adjusted separately as a percentage of the maximum speed. For more information on how to configure this parameter, please refer to the user manual of PGMA.

3.3.2.2 Soft start and soft stop

Soft-start or soft-stop time is the time interval for the actuator to accelerate or decelerate to the nominal speed (0 mm/s). The longer the soft-start and soft-stop time, the flatter the slope of acceleration or deceleration. Soft start and soft stop can help lower unwanted inrush current and back EMF, respectively. They can also prolong the service life of the actuator and power electronics. Soft-start and soft-stop time are adjustable in both extending and retracting directions, ranging from 0 to 3 seconds. However, to avoid adverse effects, it is not suggested to set either soft-start or soft-stop time to 0 seconds. For more information on how to configure this parameter, please refer to the user manual of PGMA.

3.3.3 Feedback

3.3.3.1 End of stroke voltage signal

When the actuator reaches the end of stroke (fully extended or fully retracted), it can output voltage signal to indicate its position. Output voltage can be either high or low logic level.

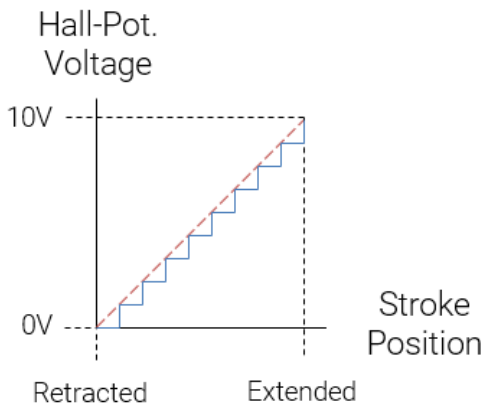
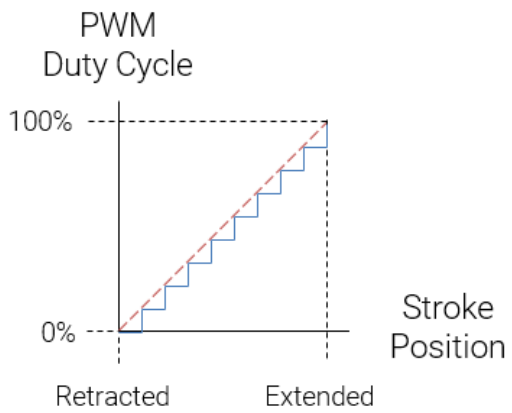
The default setting is as shown below:

Wire	**Actuator position**		
	Fully retracted	In the middle of stroke	Fully extended
Orange	Low	Low	High
Yellow	Low	High	High

3.3.3.2 Position feedback

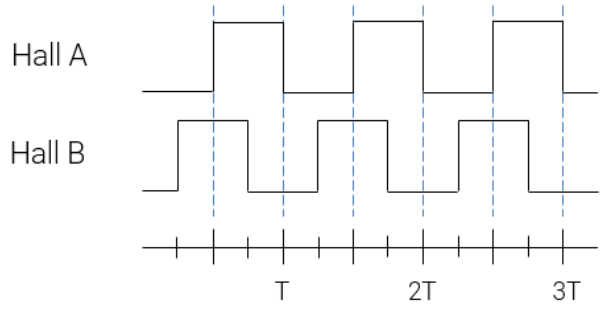
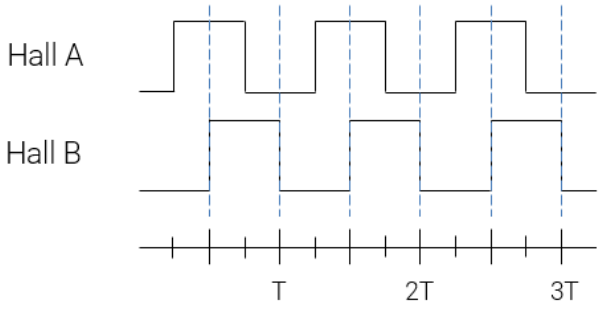
- **Hall-Pot. or PWM signal**

When the actuator extends or retracts, it can output either Hall-Pot. or PWM signal to indicate its absolute proportional position. The value of the output signal can be configured in PGMA. The value shown in the graphs below is the maximum range.

Hall-Pot.	**PWM**
	

- **Hall sensor signal**

When the actuator extends or retracts, it can output Hall sensor signal to indicate relative position. The Hall sensor signal output is an incremental encoder consisted of two square waves with high and low logic level. Hall A and Hall B have a ±90° phase difference, as shown in the graphs below.

Extending actuator	**Retracting actuator**
	

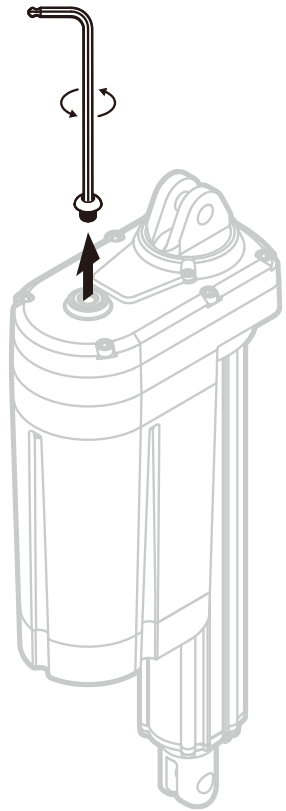
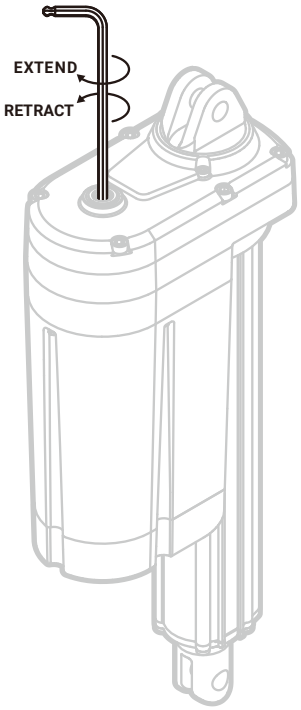
3.3.4 Protection

The actuator has built-in mechanisms to protect itself from abnormal events. Abnormal voltage protection ensures the actuator will not be damaged by overvoltage or undervoltage. The actuator also comes with overcurrent protection, which prevents it from being damaged by overload. Moreover, the actuator is equipped with a temperature sensor that adjusts the current limit according to the characteristics of the motor under different temperatures.

3.3.5 Manual drive

Manual drive is a default function that allows the user to manually extend or retract the actuator in the case of power failure. Please see the operation guidance below.

- Before performing the manual drive operation, be sure that the power supply is disconnected.
- Please use a 5-mm hex key for both the IP protection screw and the manual drive shaft inside.

	
1. Remove the IP protection screw, then insert the hex key into the manual drive shaft.	2. Turn the hex key to extend or retract the actuator. Note that the torque required to manually move the actuator is within 1.7 Nm, max. 65 RPM. Please do not run the actuator to the end of stroke as this can damage the actuator.

➢ When mounting the actuator, make sure there is enough space around the rear attachment so that in case of a power failure, the manual drive operation can be easily performed.

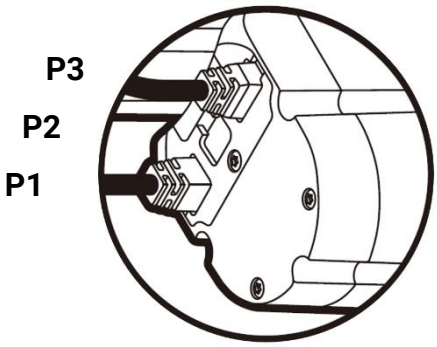
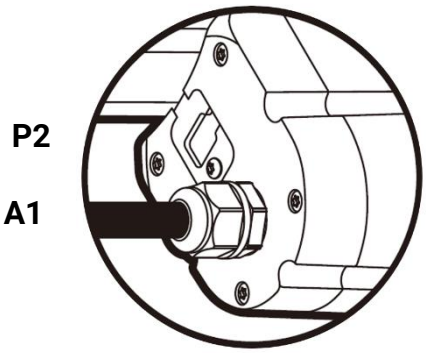
3.4 Wiring definition

There are different alternatives for T-Smart actuators. Each alternative has its corresponding integrated driver board and MCU. Certain functions can be configured in PGMA.

The table below states the main functions of the different alternatives. If the actuator is ordered with customized wiring, please contact TiMOTION for more detailed information.

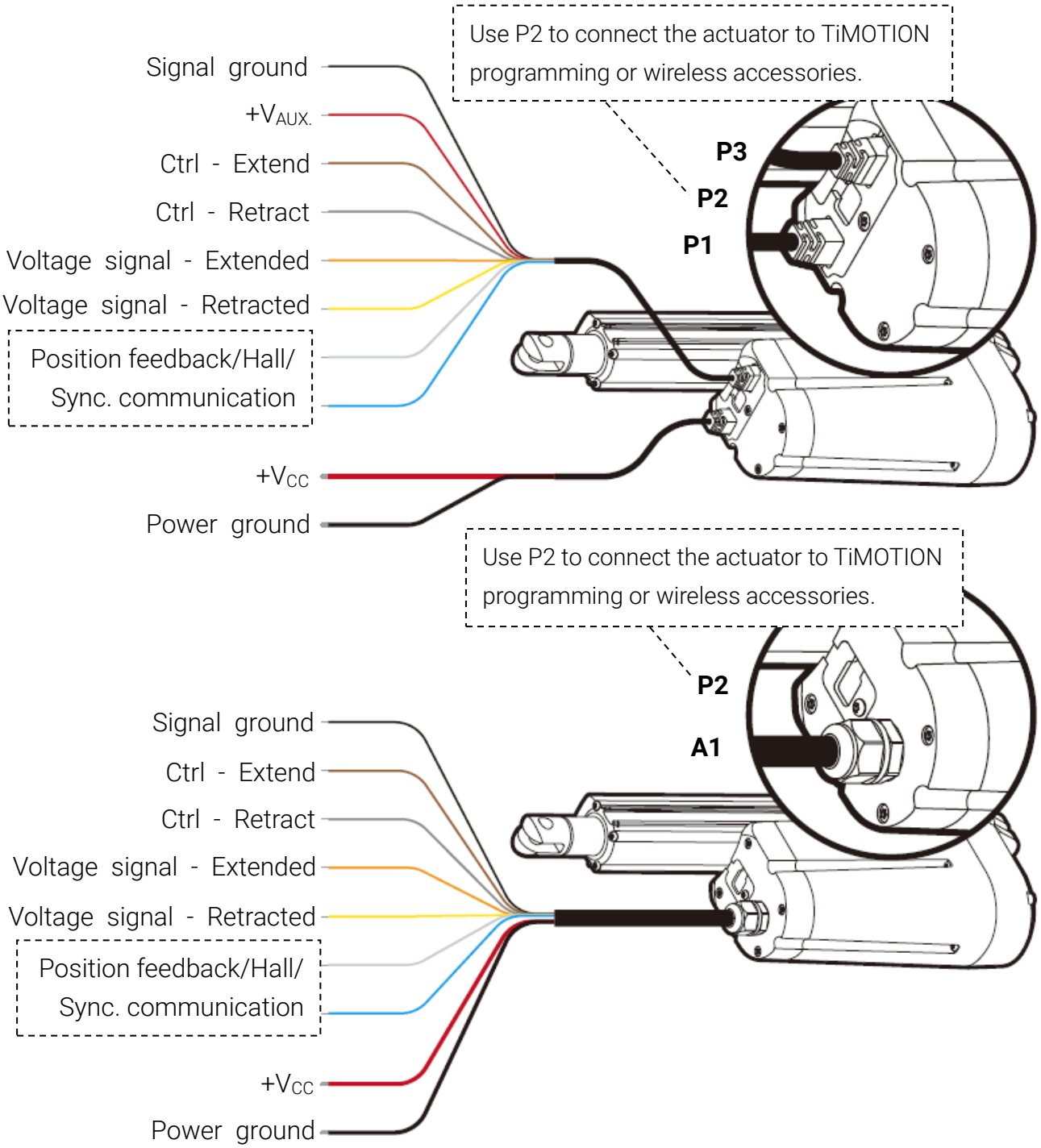
Alternatives	**Main functions**
T-Smart Advanced	- H-bridge - Signal type switch to control the movement - Position feedback or EOS signal output to control box or PLC - Synchronization of up to 8 actuators
T-Smart SAE J1939	- H-bridge - Signal type switch to control the movement - EOS signal output - CAN bus SAE J1939 communication protocol

MA2T offers two kinds of cable exit:

3 sockets, with replaceable extension cable		**1+1, direct cable out**	
P1	1*2P socket (power wires)	A1	1*direct cable out, 9 wires (power + signal wires)
P2	1*6P socket, for programming/wireless accessories	P2	1*6P socket, for programming/wireless accessories
P3	1*8P socket (signal wires)	N/A	
			

3.4.1 T-Smart Advanced

For this alternative, the MA2T actuator is equipped with a T-Smart standard driver board, capable of providing position feedback (single Hall, double Hall, PWM, Hall-Pot.) and EOS feedback. Additionally, the T-Smart standard driver board also offers synchronization of up to 8 actuators.



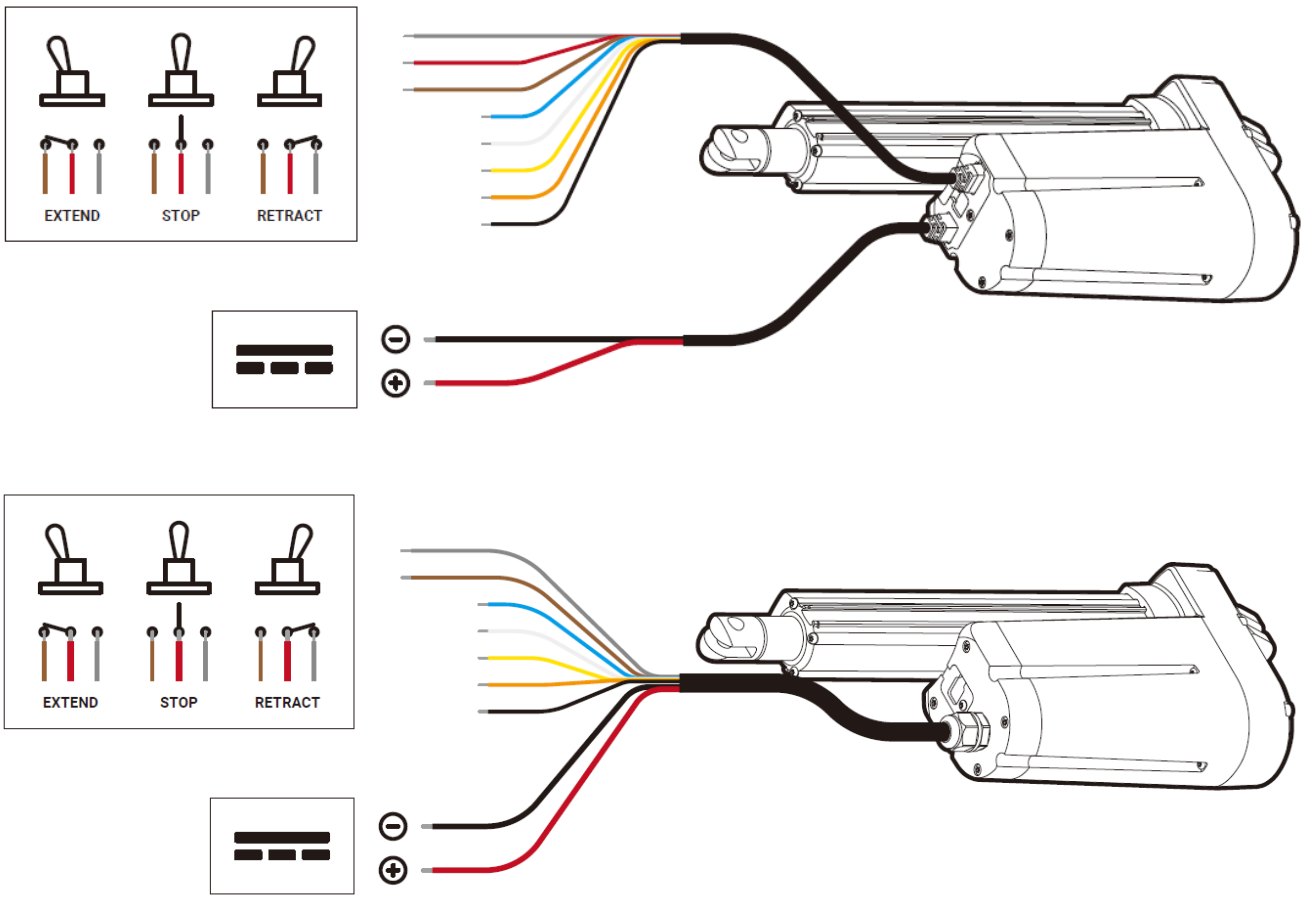
<table>
<tr><th colspan="2">Port</th><th rowspan="2">Wire</th><th rowspan="2">AWG</th><th rowspan="2">Signal</th><th rowspan="2">Description</th></tr>
<tr><th>3 sockets</th><th>1+1</th></tr>
<tr><td rowspan="2">P1</td><td rowspan="2">A1</td><td>Red</td><td>14</td><td>+V_{CC}</td><td rowspan="2"><table><tr><td colspan="2">Power supply voltage</td></tr><tr><td>Nominal</td><td>Absolute (min. / max.)</td></tr><tr><td>12 V DC</td><td>9 V DC / 18 V DC</td></tr><tr><td>24 V DC</td><td>18 V DC / 34 V DC</td></tr></table>➢ Do not change the power supply polarity on the Red and Black wires.</td></tr>
<tr><td>Black</td><td>14</td><td>Power ground</td></tr>
<tr><td>P2</td><td>P2</td><td>-</td><td>-</td><td>-</td><td>Use P2 to connect the actuator to TiMOTION programming or wireless accessories, i.e. the adjustable reed switch or TAD1 dongle.</td></tr>
<tr><td rowspan="8">P3</td><td>N/A</td><td>Red</td><td>20</td><td>$V_{AUX.}$</td><td>Output voltage: ≥ V_{CC} – 2 V
Output current: 100 mA</td></tr>
<tr><td rowspan="7">A1</td><td>Brown</td><td>20</td><td>Ctrl - Extend</td><td rowspan="2">Connect +V_{CC} / $V_{AUX.}$ to the Brown wire to extend the actuator and to the Gray wire to retract it.</td></tr>
<tr><td>Gray</td><td>20</td><td>Ctrl - Retract</td></tr>
<tr><td>Orange</td><td>20</td><td>Voltage signal - Extended</td><td rowspan="2">The output voltage signal of the T-Smart actuator when it reaches fully extended or fully retracted position.
Output voltage: ≥ V_{CC} – 2 V
Max. output current: 100 mA</td></tr>
<tr><td>Yellow</td><td>20</td><td>Voltage signal - Retracted</td></tr>
<tr><td>White</td><td>20</td><td>Position feedback (Hall-Pot.) / Hall A / Communication A</td><td rowspan="2">The characteristics of the White and Blue wires can be configured in PGMA. There are three modes in total for the two wires.
Mode 1: Position feedback
◆ Hall-Pot.:
- Output voltage: 0~10 V, configurable
- Max. output current: 50 mA
◆ PWM:
- Output voltage: ≥ V_{CC} – 2 V
- Max. output current: 50 mA
- PWM duty cycle: 0~100%, configurable
- Frequency: 75 Hz, customizable
Mode 2: Hall sensor signal</td></tr>
<tr><td>Blue</td><td>20</td><td>Position feedback (PWM) / Hall B / Communication B</td></tr>
</table>

					- Output voltage: ≥ V_{CC} – 2 V - Max. output current: 50 mA **Mode 3: Sync. communication** - Synchronization, up to 8 T-Smart actuators.
		Black	20	Signal ground	Ground reference for output signal.

- The White and Blue wires can be configured in PGMA. For Mode 1 (position feedback), the two wires can be configured individually or concurrently. In both cases, the configured wire can function properly. For Mode 2 and 3 (Hall sensor signal and sync. communication), the two wires must be configured as the same mode to function properly.
- If using a PLC, please contact TiMOTION to determine the compatibility of T-Smart products with the desired communication protocol (e.g. T-Smart synchronization or SAE J1939).
- Please refer to *3.5 Synchronization* for detailed instructions on how to activate the synchronization function.

3.4.1.1 Wiring example

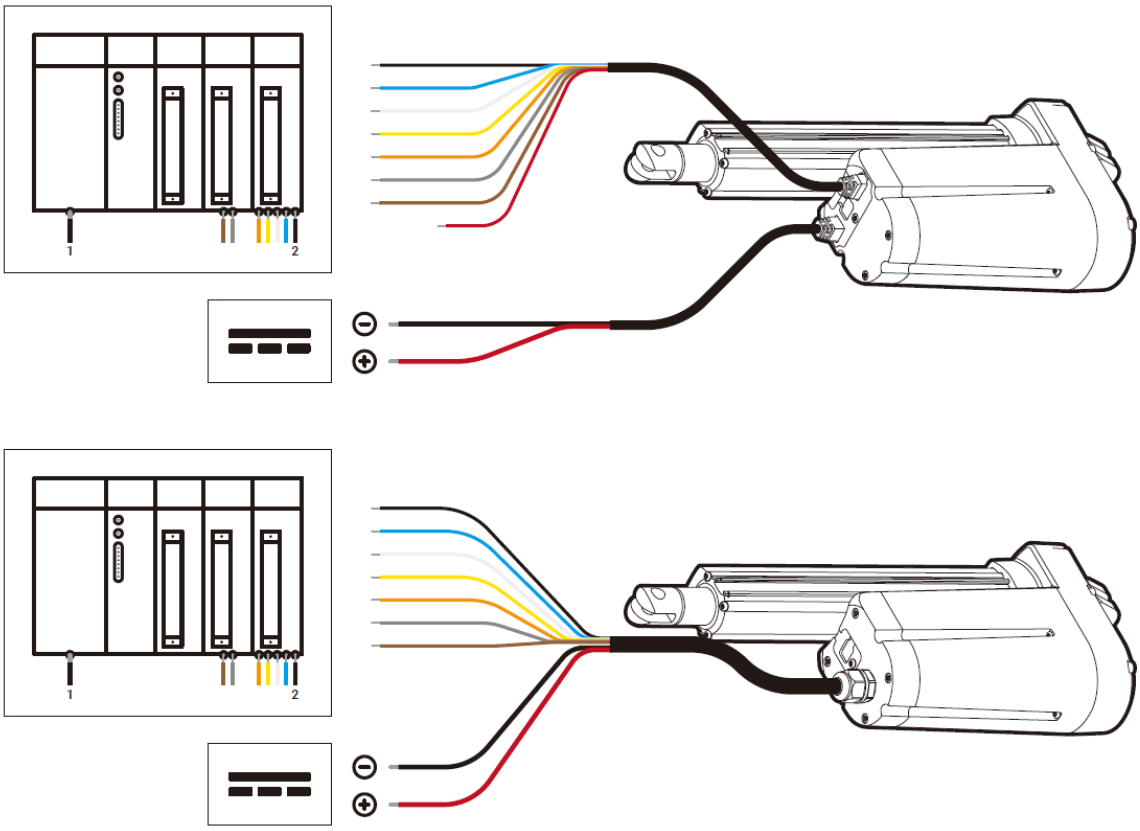
- **MA2T with single-pole double-throw switch**



Description
Connect the MA2T to a fixed polarity power supply (12/24 V): Red (14 AWG) to $+V_{CC}$, Black (14 AWG) to GND.
Connect the Brown wire to the output module, and provide $+V_{DC}$ to extend the actuator. (Current must be ≤ 50 mA.) Connect the Gray wire to the output module, and provide $+V_{DC}$ to retract the actuator. (Current must be ≤ 50 mA.) $+V_{DC}$ must be > +2.5 V to activate the actuator, or simply provide $+V_{CC}/V_{AUX.}$ to the Brown/Gray wire. (Current must be ≤ 50 mA.)

➢ Do not change the polarity of the power connection to ensure safe operation and optimal performance.

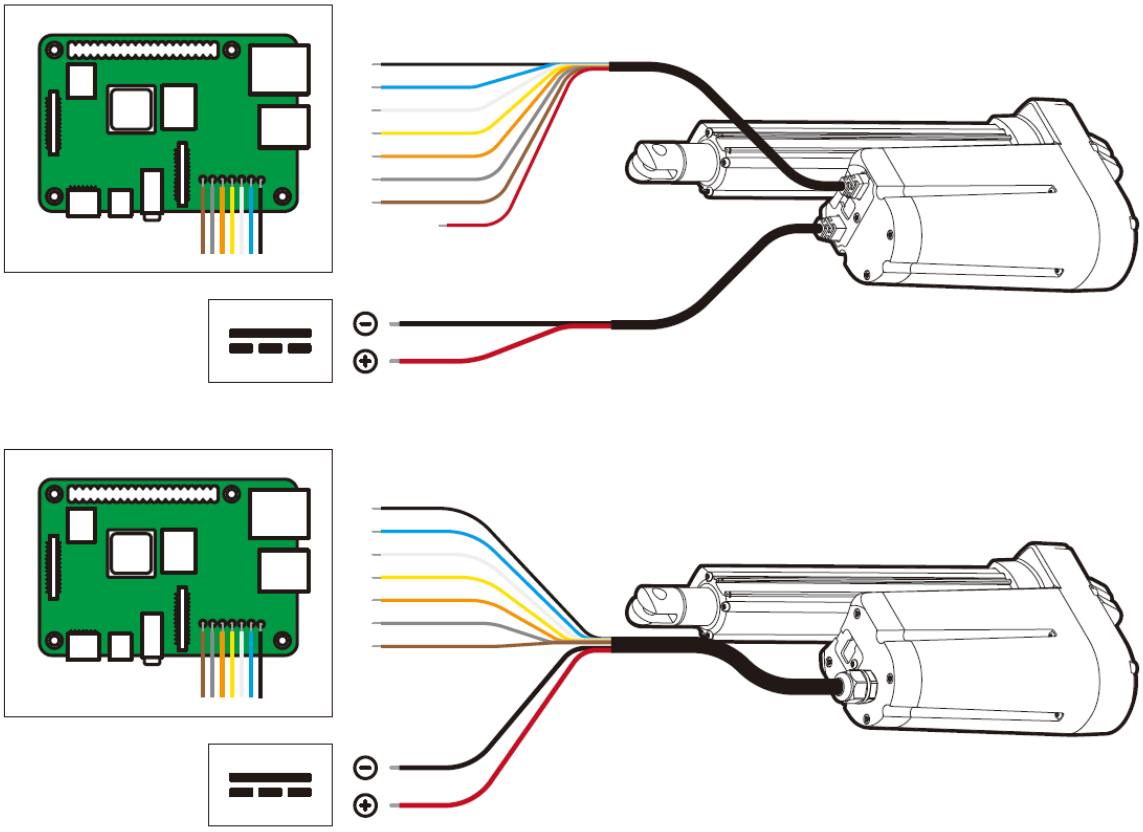
■ **MA2T with PLC**



Description
Connect the MA2T to a fixed polarity power supply (12/24 V): Red (14 AWG) to $+V_{CC}$, Black (14 AWG) to GND.
Connect the Brown wire to the output module, and provide $+V_{DC}$ to extend the actuator. (Current must be ≤ 50 mA.) Connect the Gray wire to the output module, and provide $+V_{DC}$ to retract the actuator. (Current must be ≤ 50 mA.) $+V_{DC}$ must be > +2.5 V to activate the actuator, or simply provide $+V_{CC}/V_{AUX}$. to the Brown/Gray wire. (Current must be ≤ 50 mA.)
Connect the White/Blue wire(s) to the input module to receive position feedback (Hall-Pot./PWM). Use either Power ground or Signal ground as reference.
Connect the Orange and/or Yellow wire(s) to the input module to receive voltage signal – extended/retracted. Use either Power ground or Signal ground as reference.

➢ The White and Blue wires can be configured in PGMA to different signal output modes (e.g. position feedback, Hall sensor signal, sync. communication). For detailed instructions on how to configure them, please refer to the user manual of PGMA.

■ **MA2T with single-board microcontroller**



Description
Connect the MA2T to a fixed polarity power supply (12/24 V): Red (14 AWG) to +V_{CC}, Black (14 AWG) to GND.
Connect the Brown wire to the output module, and provide +V_{DC} to extend the actuator. (Current must be ≤ 50 mA.) Connect the Gray wire to the output module, and provide +V_{DC} to retract the actuator. (Current must be ≤ 50 mA.) +V_{DC} must be > +2.5 V to activate the actuator, or simply provide +V_{CC}/$V_{AUX.}$ to the Brown or Gray wire. (Current must be ≤ 50 mA.)
Connect the White/Blue wire(s) to the input module to receive position feedback (Hall-Pot./PWM). Use either Power ground or Signal ground as reference.
Connect the Orange and/or Yellow wire(s) to the input module to receive voltage signal – extended/retracted. Use either Power ground or Signal ground as reference.

➢ The White and Blue wires can be configured in PGMA to different signal output modes (e.g. position feedback, Hall sensor signal, sync. communication). For detailed instructions on how to configure them, please refer to the user manual of PGMA.

3.4.2 T-Smart SAE J1939

<table>
<tr><th colspan="2">Port</th><th rowspan="2">Wire</th><th rowspan="2">AWG</th><th rowspan="2">Signal</th><th rowspan="2">Description</th></tr>
<tr><th>3 sockets</th><th>1+1</th></tr>
<tr><td rowspan="2">P1</td><td rowspan="2">A1</td><td>Red</td><td>14</td><td>+V_{CC}</td><td rowspan="2"><table><tr><td colspan="2">Power supply voltage</td></tr><tr><td>Nominal</td><td>Absolute (min. / max.)</td></tr><tr><td>12 V DC</td><td>9 V DC / 18V DC</td></tr><tr><td>24 V DC</td><td>18 V DC / 34 V DC</td></tr></table>➢ Do not change the power supply polarity on the Red and Black wires.</td></tr>
<tr><td>Black</td><td>14</td><td>Power ground</td></tr>
<tr><td>P2</td><td>P2</td><td>-</td><td>-</td><td>-</td><td>Use P2 to connect the actuator to TiMOTION programming or wireless accessories.</td></tr>
<tr><td rowspan="8">P3</td><td>N/A</td><td>Red</td><td>20</td><td>$V_{AUX.}$
(Aux. voltage output)</td><td>Output voltage: ≥ V_{CC} – 2 V
Output current: 100 mA</td></tr>
<tr><td rowspan="7">A1</td><td>Brown</td><td>20</td><td>Ctrl - Extend</td><td rowspan="2">Connect +V_{CC}/$V_{AUX.}$ to the Brown wire to extend the actuator and connect to the Gray wire to retract it.</td></tr>
<tr><td>Gray</td><td>20</td><td>Ctrl - Retract</td></tr>
<tr><td>Orange</td><td>20</td><td>Voltage signal - Extended</td><td rowspan="2">The output voltage signal of the T-Smart actuator when it reaches fully extended or fully retracted position.
Output voltage: ≥ V_{CC} – 2 V
Max. Output current: 100 mA</td></tr>
<tr><td>Yellow</td><td>20</td><td>Voltage signal - Retracted</td></tr>
<tr><td>White</td><td>20</td><td>CAN_H</td><td rowspan="2">The CAN bus interface is in obedience to the physical layer specified in SAE J1939-15.<table><tr><td>Default bit rate</td><td colspan="3">250 kbit/s</td></tr><tr><td>Physical media</td><td colspan="3">Unshielded twisted pair</td></tr><tr><td>Parameter</td><td>Min.</td><td>Max.</td><td>Unit</td></tr><tr><td>Bus length</td><td>0</td><td>40</td><td>m</td></tr><tr><td>Node stub length</td><td>0</td><td>3</td><td>m</td></tr><tr><td>Stub distance</td><td>0.1</td><td>40</td><td>m</td></tr><tr><td>Number of Nodes</td><td>-</td><td>10</td><td>-</td></tr></table></td></tr>
<tr><td>Blue</td><td>20</td><td>CAN_L</td></tr>
</table>

					➢ Max. number of nodes can be 30 in certain scenarios. A T-Smart actuator has an embedded 120Ω termination resistor to eliminate the need for external resistors, switchable through PGMA.
		Black	20	Signal ground	Ground reference for output signal.

➢ Please refer to the user manual of the T-Smart SAE J1939 actuator for more information on its hardware system, software interface, and communication protocol.

3.4.3 PGMA connection

Unless the customer specifically requests to ship the items separately, all cables are fixed onto the actuator under the default installation procedure.

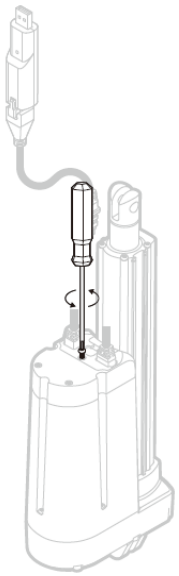
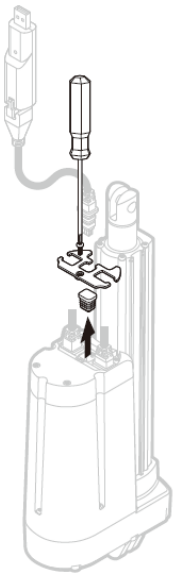
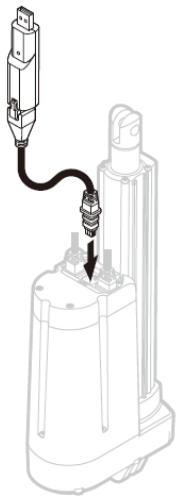
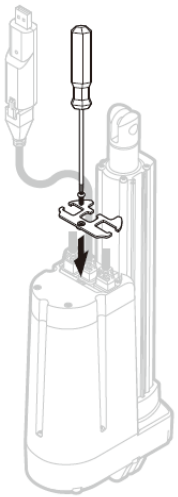
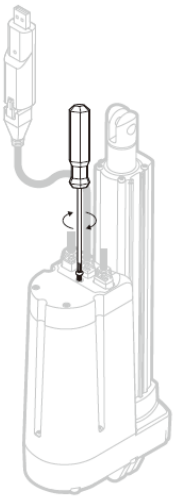
By default, P2 is sealed by a rubber plug. It can be replaced by either a reed switch cable or a TAD1 extension cable. For PGMA settings, it is required to replace the rubber plug on P2 with the TAD1 extension cable.

3.4.3.1 Notice for cable replacement

- Be sure to protect the plugs and pins during the replacement process.
- Be sure the cable end is properly protected to guarantee high IP protection.
- Please refrain from picking up or carrying the actuator by the cables.

3.4.3.2 Steps for TAD1 installation

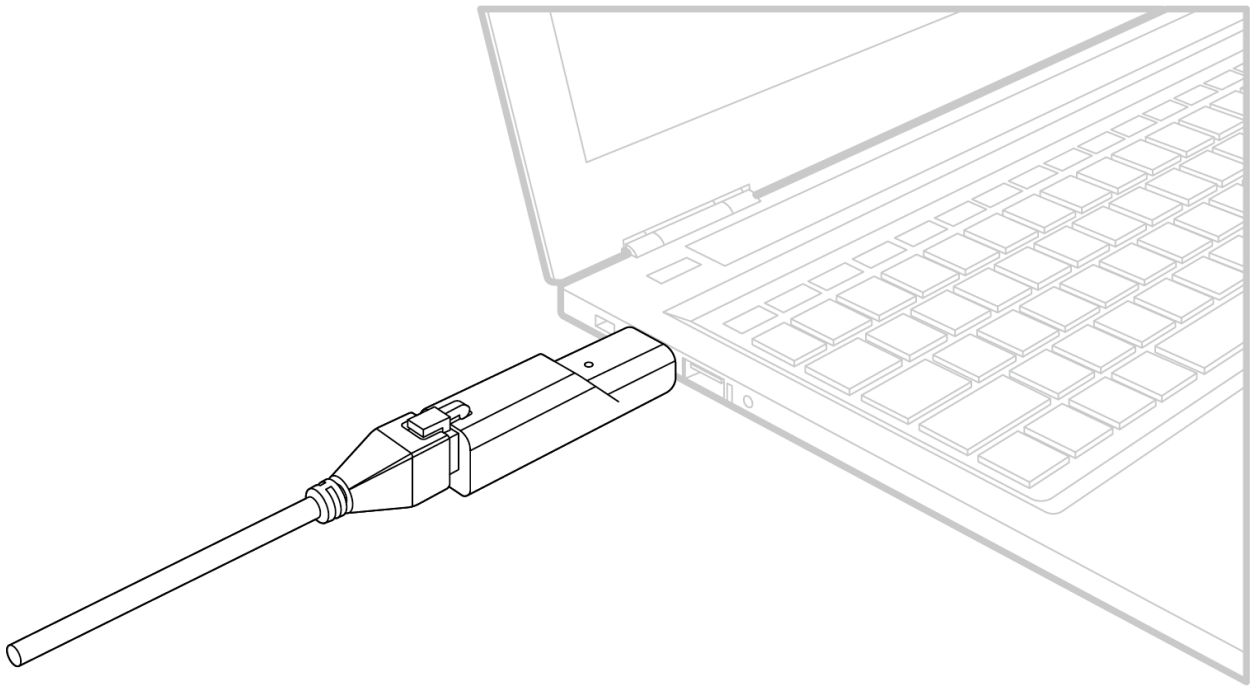
Follow the instructions below to properly replace the default rubber plug on P2 with the TAD1 extension cable for PGMA connection.

		
1. Unscrew the cover with a torque of approximately 1.5 Nm.	2. Remove the cover and unplug the rubber plug.	3. Plug the TAD1 into P2.
		
4. Re-install the cover.	5. Re-screw the cover with a torque of approximately 1.5 Nm.	

➢ Be sure the TAD1 extension cable is in the right location and fully pressed in before re-screwing the cover.

3.4.3.3 Steps for PGMA connection

1. Install PGMA on the computer and close the program after completing installation.
2. Make sure the TAD1 has replaced the original rubber plug or cable fixed on P2, and connect it to the computer. If the connection is successful, the LED on the TAD1 will be illuminated.
3. Connect the A1/P1 cable of the actuator to a fixed polarity power supply and turn on the power.
4. Execute PGMA.



➢ For configuration only, power connection is not necessary.

3.5 Synchronization

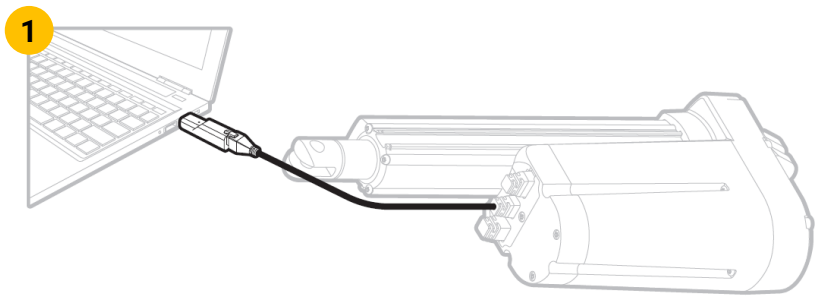
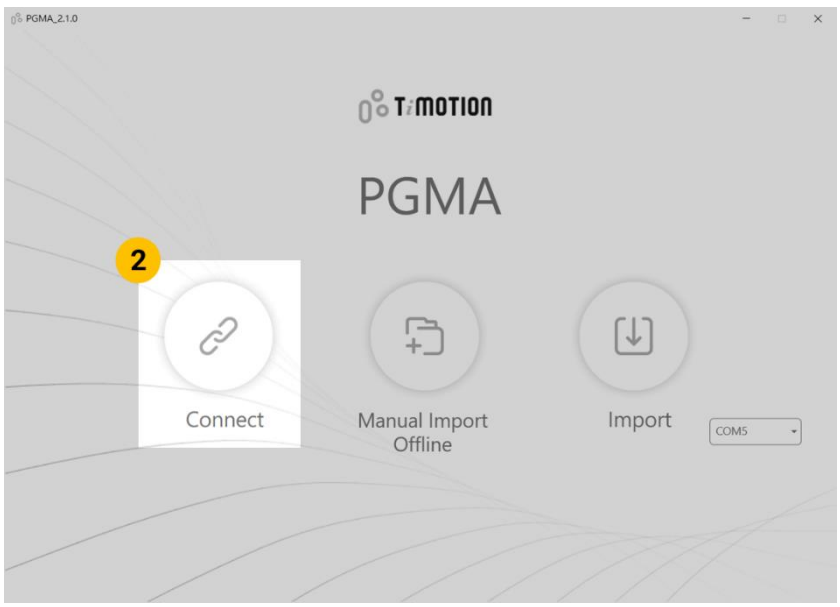
3.5.1 Activation of synchronization

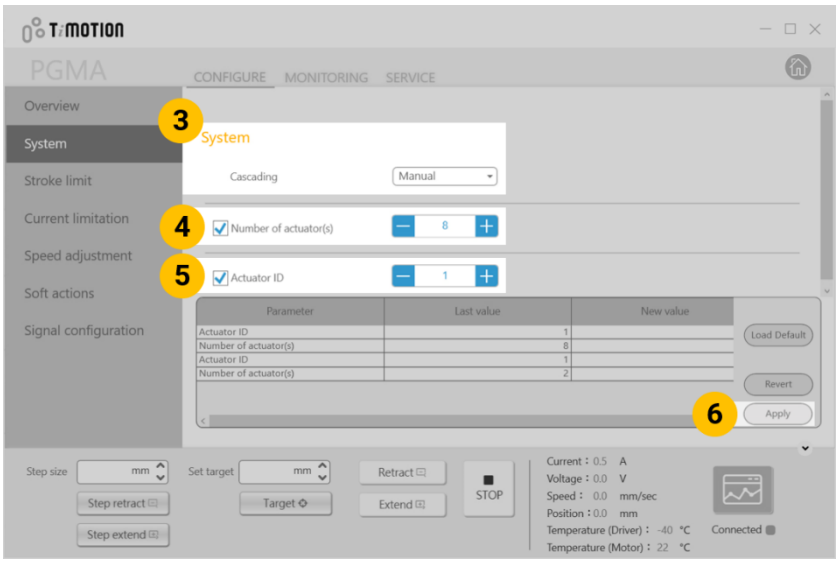
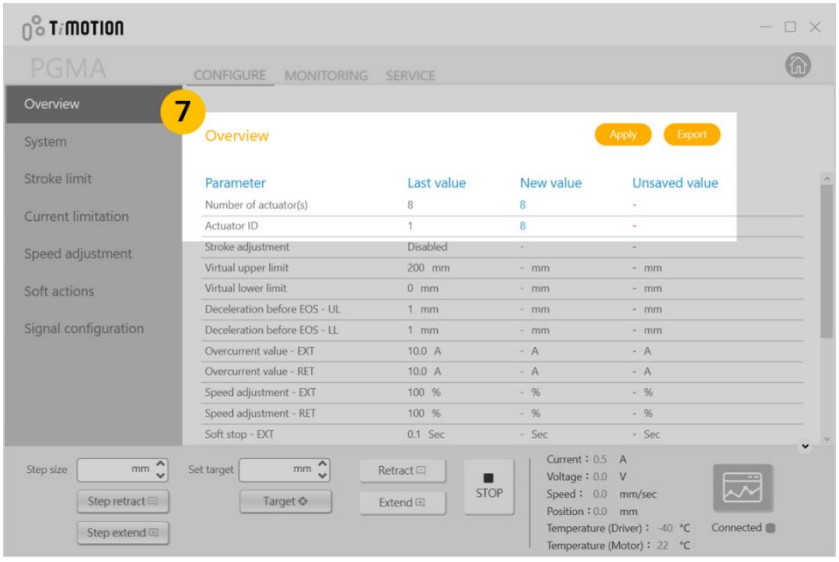
To enable synchronization, please use the program PGMA. Certain cables can be configured in PGMA, please refer to the user manual of PGMA for more information.

For clarity, we will refer to the actuator that will be designated as primary as Actuator 1. The actuators designated as secondary will be referred to as Actuators 2 to 8.

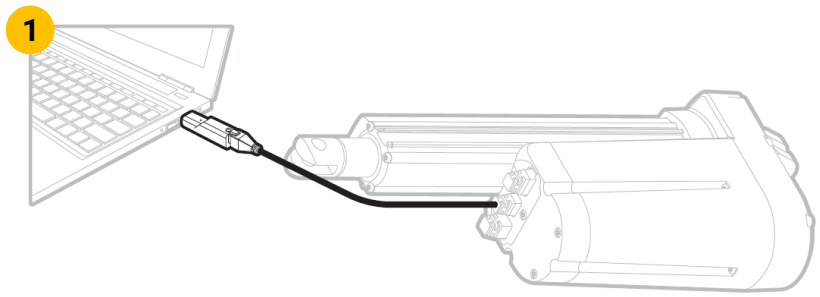
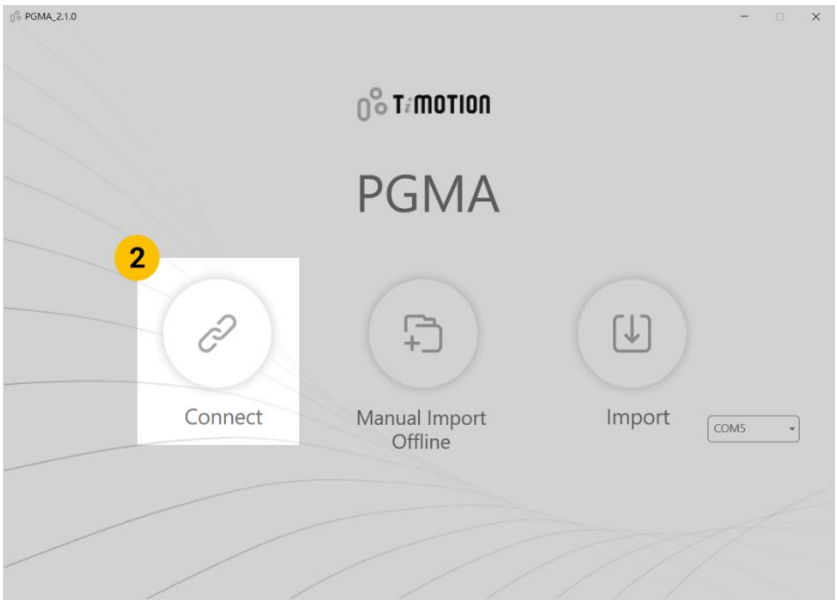
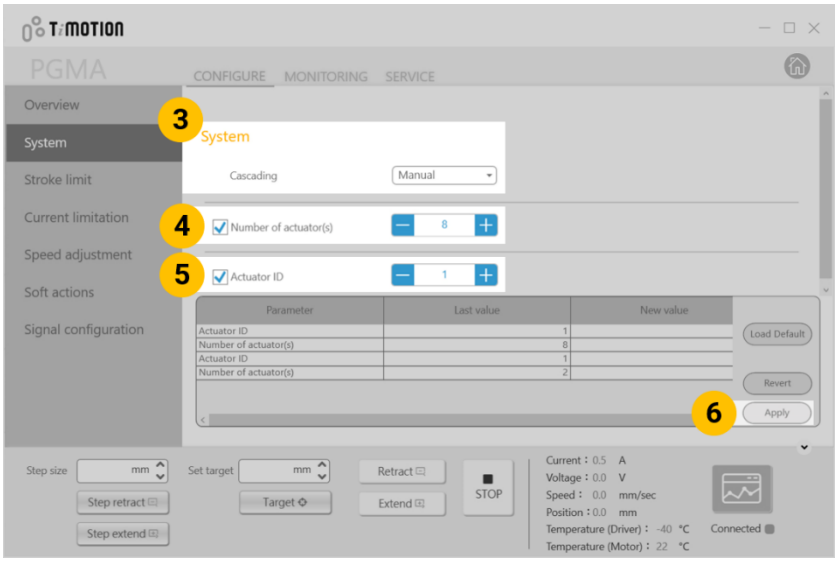
3.5.1.1 Designation of primary and secondary actuator(s)

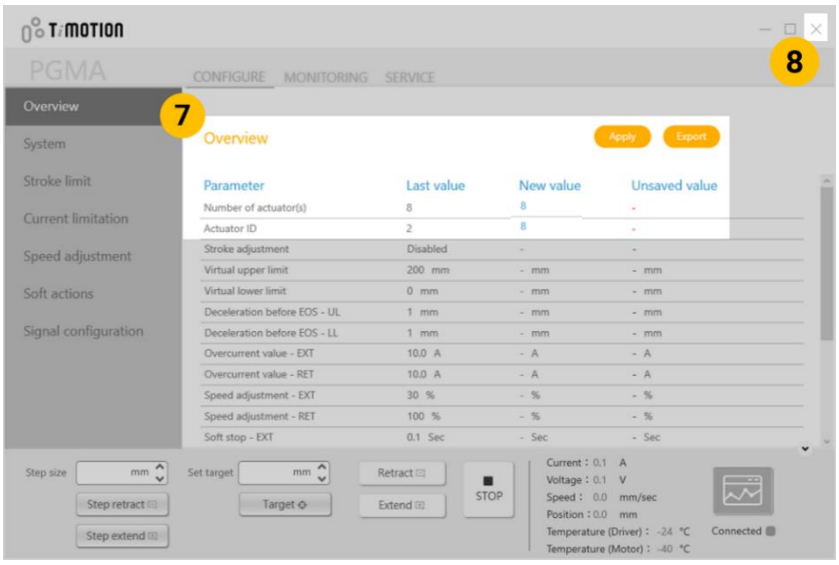
- **Designate primary actuator**

	1. Use the TAD1 on P2 to connect Actuator 1 to PGMA.
	2. Open PGMA and click “Connect” to connect to Actuator 1.

	3. Go to System > Cascading and select “Manual”. 4. Set Number of actuator(s): set the total amount of synchronizing actuators (2 to 8). 5. Set Actuator ID to 1 (1=primary). 6. Click “Apply”.
	7. Go to Overview to review the previous settings (Number of actuator(s), Actuator ID). 8. Close PGMA and disconnect the actuator.

3.5.1.2 Designate secondary actuator(s)

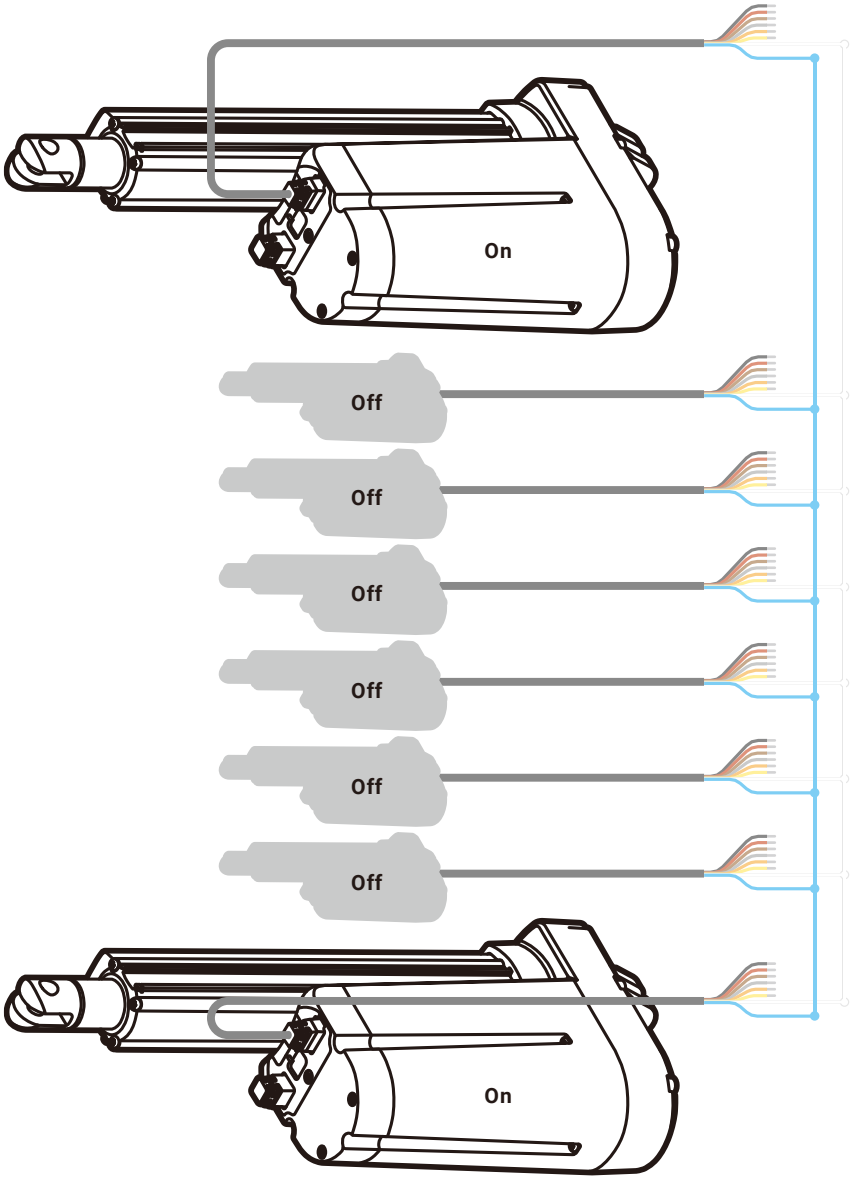
	1. Use the TAD1 on P2 to connect Actuator 2 (to 8) to PGMA.
	2. Open PGMA and click “Connect” to connect to Actuator 2 (to 8).
	3. Go to System > Cascading and select “Manual”. 4. Set Number of actuator(s): set the total amount of synchronizing actuators (2 to 8). 5. Set Actuator ID to 2 (to 8), or 0 for automatic designation. 6. Click “Apply”.

	7. Go to Overview to review the previous settings (Number of actuator(s), Actuator ID). 8. Close PGMA and disconnect the actuator.

Repeat the steps described above for every actuator that will be designated as secondary.

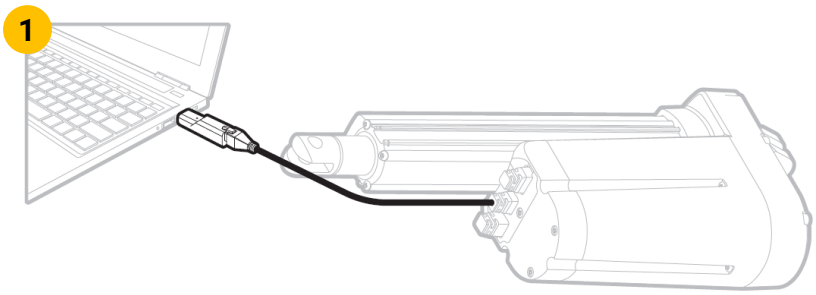
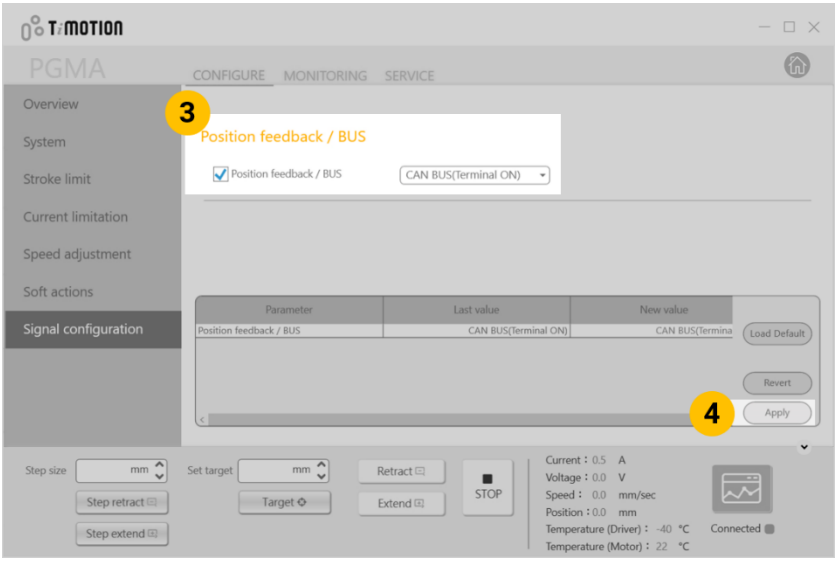
- Make sure to set the correct total number of actuators that will be used in synchronization, and that each actuator has a different Actuator ID.

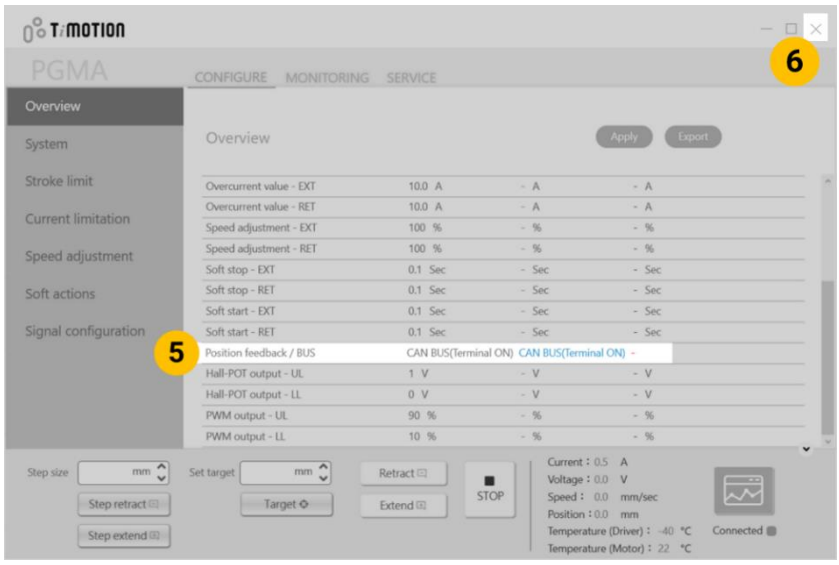
3.5.1.3 Activation of termination resistors



The sync. communication group must have terminals for the synchronization to function properly. The terminals are the first and last actuators of the sync. communication group. To set up the terminals, use either external resistors or the termination resistors embedded in the actuators. The embedded termination resistors can be turned on or off through PGMA. To activate them, please follow the instructions detailed below:

- Only the termination resistors in the first and last actuators of the sync. communication group need to be activated. Do not activate the termination resistor in any other actuator, otherwise the synchronization will not function.

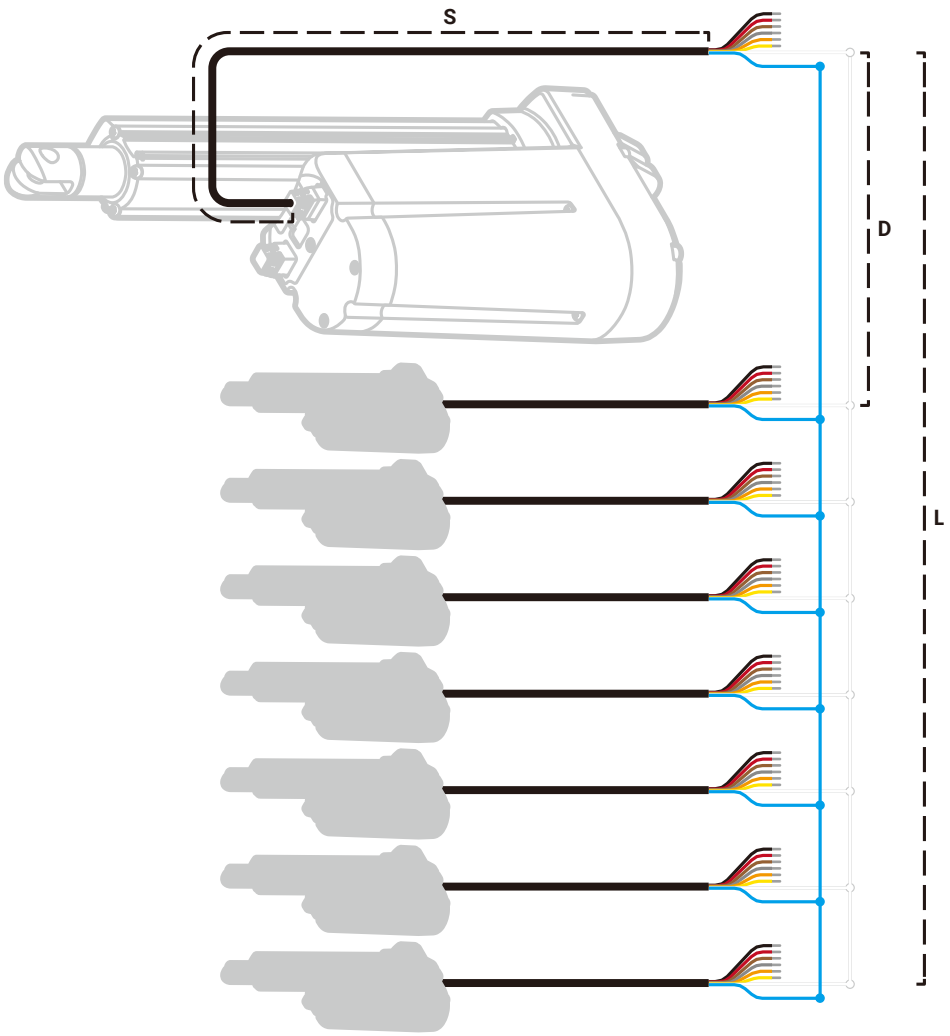
	1. Use the TAD1 to connect one of the two actuators that will act as terminals to PGMA.
	2. Open PGMA and click “Connect” to connect to the actuator that will act as a terminal.
	3. Go to Signal configuration > Position feedback / BUS and select “CAN BUS (Terminal On)”. 4. Click “Apply”.

	5. Go to Overview to review previous settings (Position feedback / BUS – CAN BUS (Terminal ON)). 6. Close PGMA and disconnect the actuator.

Repeat the same steps with the other actuator that will act as a terminal.

➢ The actuators' function as terminals is unrelated to their designation as primary or secondary.

3.5.1.4 Sync. communication connection (P2/3)

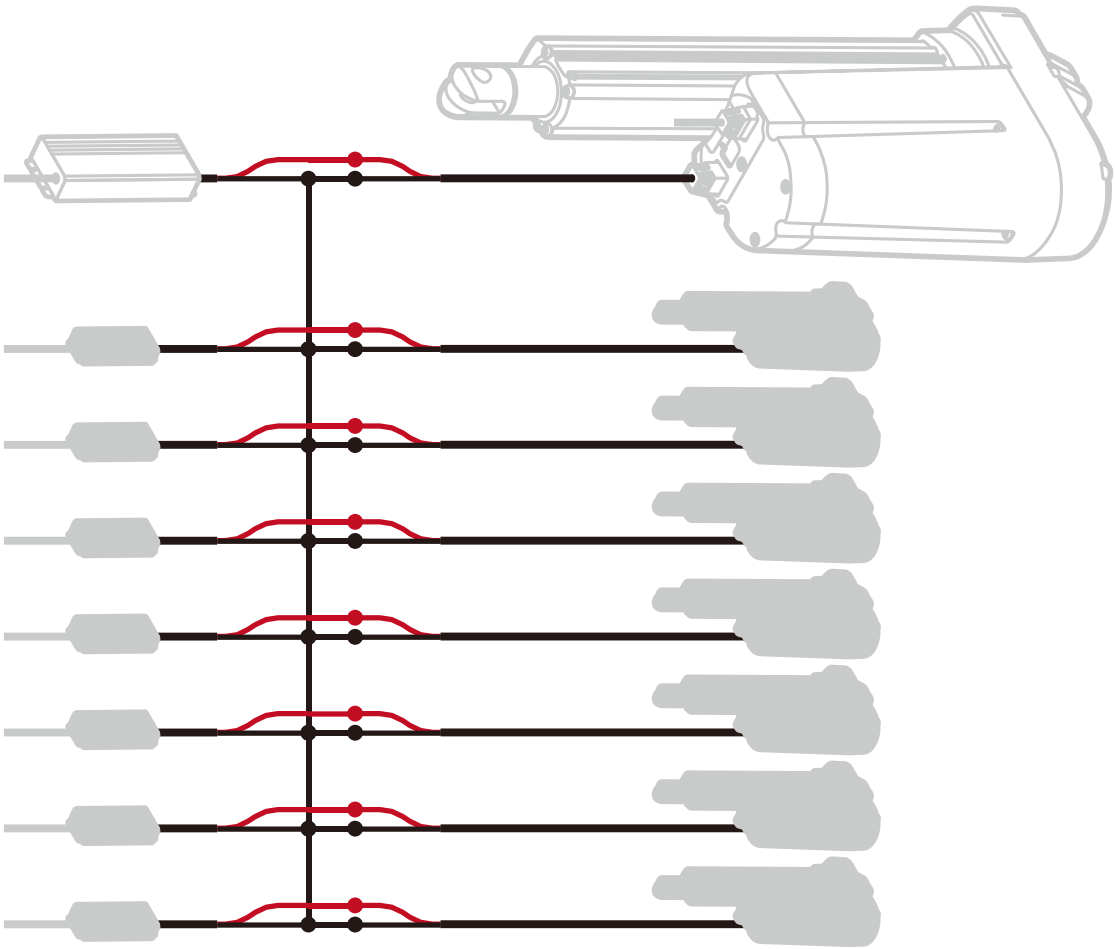


1. Connect White to White (Communication A).
2. Connect Blue to Blue (Communication B).

Physical media	Unshielded twisted pair		
Parameter	**Min.**	**Max.**	**Unit**
L: sync. communication cable length	0	45	m
D: node distance	0	45	m
S: stub cable length	0	10	m

- The maximum cable length in the sync. communication group is 45 meters in total.
- When the sync. communication mode is selected, position feedback and Hall sensor signal will not be available. The modes of the White and Blue wires can be configured in PGMA.

3.5.1.5 Power connection (A1/P1)

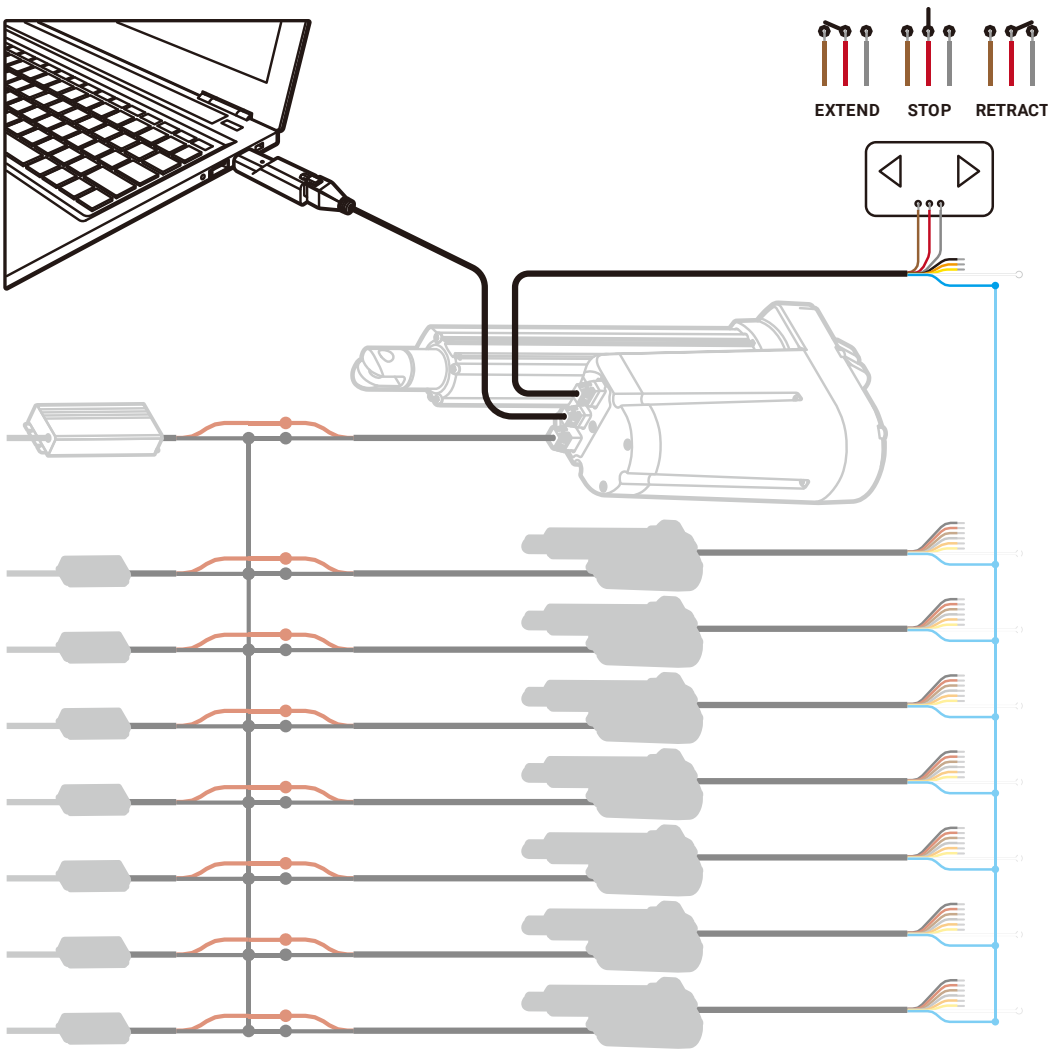


1. Connect Red to V_{DC}+.
2. Connect Black to V_{DC}-.

➢ It is possible to run the synchronized actuators on the same power supply or on separate ones. If the latter, the individual power supplies should have common ground to achieve optimal performance.

3.5.1.6 Control

There are two main methods to give commands to synchronized actuators; one is via switches or control, the other is via PGMA.



- **Via switch(es)**

Commands via this method can be given by either the primary actuator or one of the secondary actuators. However, command from the primary is recommended.

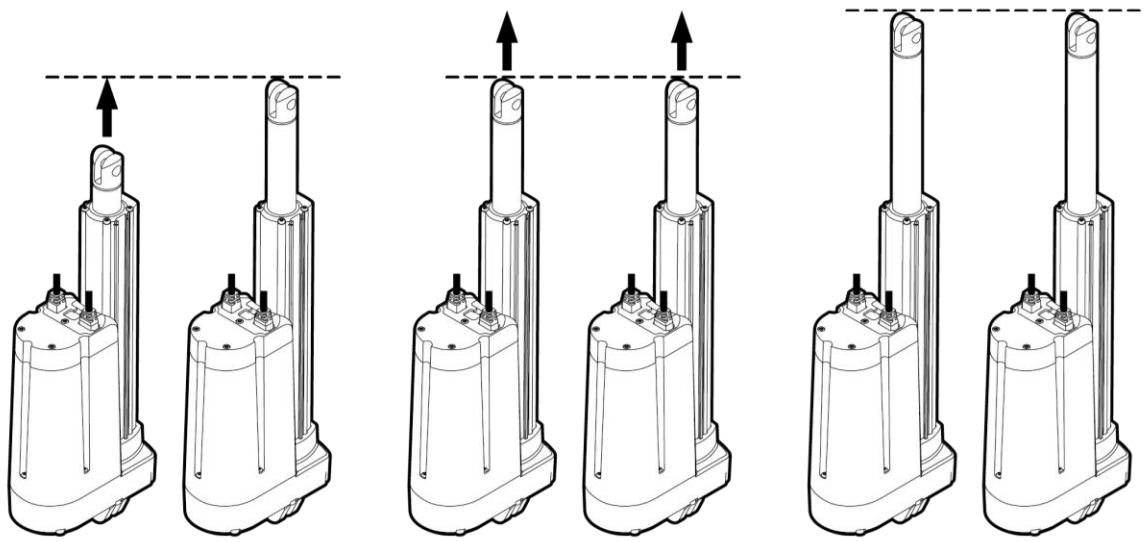
- Connect Red to Brown to extend the actuator.
- Connect Red to Gray to retract the actuator.
- Motion stops when the wires are disconnected.

- **Via PGMA**

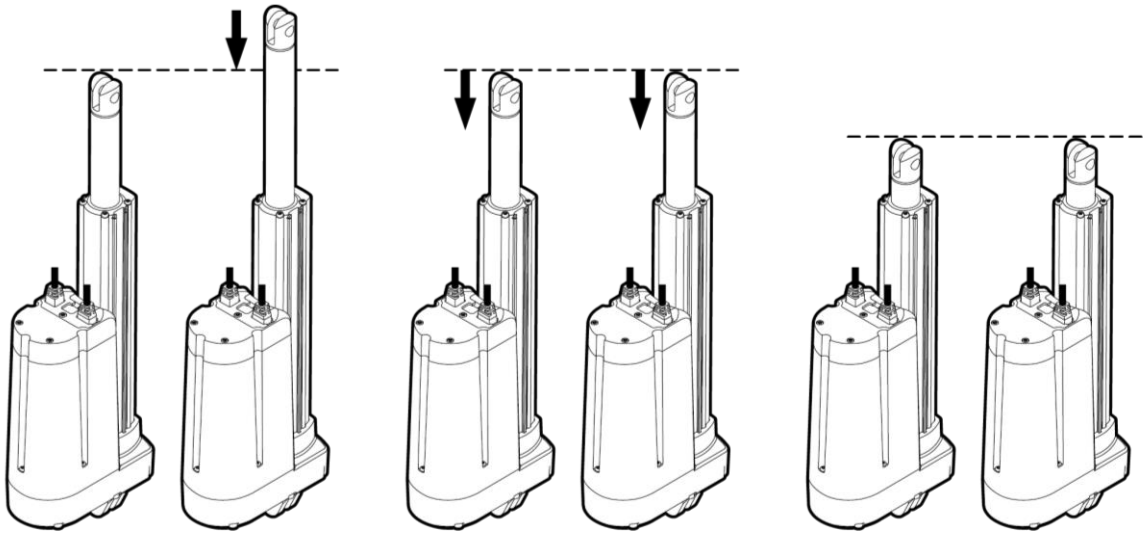
For more information on this method of command, please refer to the user manual of PGMA.

3.5.2 Realignment of synchronized actuators

If the actuators in the sync. communication group do not have the same length at the starting point, the following sequence will occur:



- If extending, the longest actuator will remain static while the other synchronized actuators extend to the same length. Once arriving at the same length, the synchronized actuators will continue to extend in sync without pause.



- If retracting, the sequence is similar, with exception of the shortest actuator remaining static, while the other actuators retract to the same length before continuing to retract in sync without pause.

4 Troubleshooting

4.1 General troubleshooting

The table below lists symptoms that may appear during actuator operation, as well as potential causes and possible solutions. If the problem remains unresolved, please contact TiMOTION.

Symptom	Potential cause	Possible solution
The motor is running but the spindle is not moving.	The gear system or the spindle is damaged.	Contact TiMOTION.
No motor sound or movement.	The actuator is not properly connected to the power supply and/or the external control unit.	Check the connection to the power supply and/or the external control unit.
	Blown fuse.	Check the fuse.
	The cable is damaged.	Contact TiMOTION.
Excessive power consumption.	Misalignment or overload in the application.	Align the load properly or reduce the load. Try running the actuator without load.
The actuator cannot lift the full load, or the motor runs too slowly.	Insufficient voltage from power supply.	Make sure the power supply is properly connected. Check the power supply, make sure the input voltage is within the rated range.
	The load is higher than the rated load.	Reduce the load.
No signal or incorrect feedback output.	The cable is damaged.	Contact TiMOTION.
	The cable is not connected properly.	Check the wiring. See *3.4 Wiring Definition* for detailed information.
	The signal is constantly too high or too low in relation to the actual position.	Run the actuator to full extension or retraction. Connect the actuator to PGMA and make sure the correct feedback mode is selected.
The actuator runs in small steps.	Insufficient voltage from power supply.	Make sure the power supply is properly connected.

		Check the power supply, make sure the input voltage is within the rated range.
	The load is higher than the rated value.	Reduce the load.
	The internal safety procedure is activated.	Connect the actuator to PGMA and check the following: - Reason for last stop (detailed in the user manual of PGMA). - Current cut-off levels in both directions.
The actuator cannot hold the selected load.	The load is higher than the rated load.	Reduce the load.

4.2 Troubleshooting for synchronization

The table below lists symptoms that may appear during actuator operation, as well as potential causes and possible solutions. If the problem remains unresolved, please contact TiMOTION.

Symptom	Potential cause	Possible solution
The synchronized actuators are not moving.	Excessive voltage from power supply.	Check power supply, make sure the input voltage is within the rated range.
	Insufficient voltage from power supply.	Check power supply, make sure the input voltage is within the rated range.
	The load has exceeded the rated value.	Check the load, make sure it does not exceed the rated value.
	Actuators have worked beyond the rated duty cycle.	Operate the actuators within the rated duty cycle.
	The ambient temperature is too high.	Make sure the ambient temperature is within range.
	Sync. communication is not connected correctly.	Make sure each actuator is properly connected.
	The termination resistors are not properly activated.	Use PGMA to check the first and the last actuators, make sure the termination resistors in both actuators are activated. If the problem remains, check the other actuators to make sure their termination resistor is not activated. Please refer to *3.5.1.2 Activation of Synchronization* for instructions on setting termination resistors.
	Actuator ID is not set properly: - There is more than one actuator designated as primary. - Multiple secondary actuators share the same Actuator ID.	Use PGMA to check the ID of the actuators. Make sure there is only one actuator designated as primary, and that each actuator has a different ID.

	The total number of actuators is set incorrectly.	Use PGMA to check if the setting of total amount of actuators corresponds to the number of actuators that are actually in the sync. communication group. Make sure they are the same amount.
The synchronized actuators run too slowly or in small steps.	Insufficient voltage from power supply.	Check the power supply, make sure the input voltage is within the rated range.
Not all synchronized actuators are moving.	The termination resistors are not properly activated.	Connect the first and the last actuators to PGMA. Make sure the termination resistors in both actuators are turned on. Please refer to *3.5.1.2 Activation of synchronization* for instructions on activating termination resistors.
The synchronized actuators cannot lift the full load.	Insufficient voltage from power supply.	Check the power supply, make sure the input voltage is within the rated range.
	The load has exceeded the rated value.	Check the load, make sure it does not exceed the rated value.
The synchronized actuators are unable to realign.	The position tracking of certain actuator(s) is off, rendering them unable to align properly.	Recalibrate each actuator's position before synchronization. Please refer to the notes below for more information on the recalibration function.

- To recalibrate the actuator's position, fully retract the actuator, then continue to retract for 10 more seconds. The actuator will track its position correctly after this procedure. The recalibration function is not limited to sync. communication.

5 Maintenance

5.1 Packaging

The standard order packaging contains the product and a QR code that links directly to this document. For orders of large quantity, packaging may vary. Kindly note, packaging is subject to change at the sole and exclusive discretion of TiMOTION.

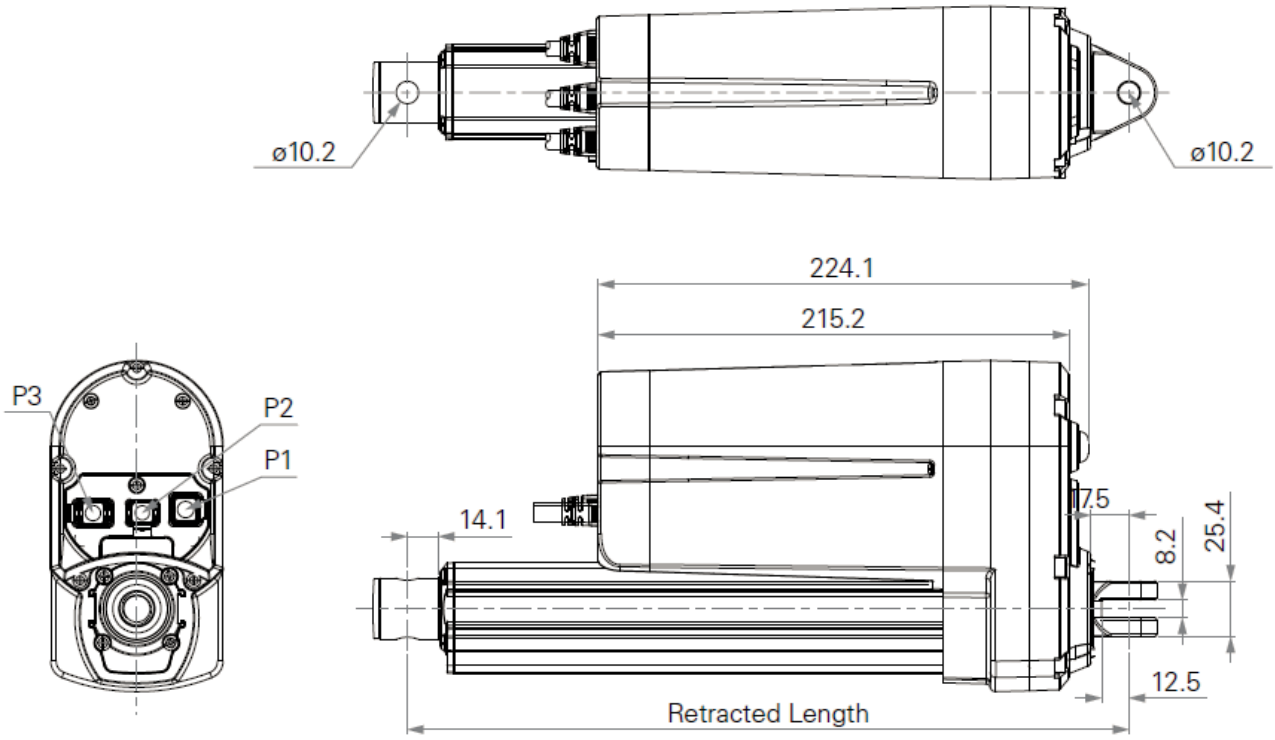
5.2 Transport and storage

The actuator should only be transported and stored in the original TiMOTION packaging. The temperature during transportation and storage should be between -40°C to +85°C (-40°F to +185°F). Please avoid shock or impact to the package. If the package is damaged, check the actuator for visible damage, and notify the carrier and TiMOTION immediately.

6 Specifications

6.1 Dimensional drawings

Unit: mm



6.2 Ordering key

MA2T

Version: 20221130-H

Hardware System	T = Standard driver board			
Voltage	1 = 12V DC	2 = 24V DC		
Load and Speed	See page 2			
Stroke (mm)	See page 2			
Retracted Length (mm)	See page 5			
Rear Attachment (mm) See page 5	1 = Aluminum, U clevis, slot 8.2, depth 12.5, hole 10.2 2 = Aluminum, U clevis, slot 8.2, depth 15.0, hole 10.2	3 = Aluminum, U clevis, slot 8.2, depth 15.0, hole 12.8 4 = Aluminum, U clevis, slot 8.2, depth 15.0, hole 12.2		
Front Attachment (mm) See page 6	1 = Steel inner tube with punched hole, slotless, hole 10.2 2 = Steel inner tube with punched hole, slotless, hole 12.2 3 = Steel inner tube with punched hole, slotless, hole 12.8	4 = Aluminum, U clevis, slot 8.2, depth 15.0, hole 10.2 5 = Aluminum, U clevis, slot 8.2, depth 15.0, hole 12.2 6 = Aluminum, U clevis, slot 8.2, depth 15.0, hole 12.8 K = Rod end bearing, hole 12.8		
Installation Direction (Counter-Clockwise) See page 6	1 = 0°	3 = 90°		
Functions for Limit Switches	T = Two limit switches send signal at end of stroke to T-Smart (T-Smart dedicated option)			
Adjustable Reed Switch	0 = Without			
Position Feedback	T = Hall sensor*2 for T-Smart (T-Smart dedicated option)			
IP Rating	2 = IP54	3 = IP66 (static)	6 = IP66 (dynamic)	8 = IP69K
Output Cable See page 7	3 = 3 sockets with extension cable		T = Direct cable out, 1+1 type	
P1 Connector See page 6	1 = Tinned leads			
P1 Cable Length (mm)	1000 = 1000	2000 = 2000		
P2 Connector See page 6	1 = Tinned leads	P = Dummy plug		
P2 Cable Length (mm)	0000 = Without	1000 = 1000	2000 = 2000	
P3 Connector See page 6	0 = Without	1 = Tinned leads		
P3 Cable Length (mm)	0000 = Without	1000 = 1000	2000 = 2000	
Bus Interface	C = CAN bus			

➢ TiMOTION continuously updates the functions of its products to ensure they satisfy the needs of customers. Please contact TiMOTION for the latest ordering key.