ELTORQUE



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User Manual QT series generation 2.5

Table 1: Document history for User Manual QT series generation 2.5

Revision	Author	Changes	Approved by	Date
3.2	**DB**	**Added Dual Power option**	**JMG**	**14.01.2022**
3.3	**VL**	**Added Modbus/Profibus** **Added French translation on all warnings and caution text.**	**PE**	**30.04.2024**
3.4	**JMF**	**Updated techincal information for UL specific requirements**	**KR**	**29.04.2026**

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Chapter 1 Introduction

1.1 System Overview

The Eltorque Lifelong Intelligent control concept provides maintenance-free, configurable, eco-friendly, and fully electric actuators with real-time feedback.

- **QT-series of actuators is ideal for quarter-turn valves such as butterfly and ball-valves.**

The Eltorque electric actuators can be connected in series. They offer a plug and play solution with low installation costs and a high level of security. By combining the Eltorque actuators with the Eltorque Hybrid Marine Cable, the installation cost is further reduced.

The bus connected actuator eliminates the cable clutter, transportation loss and air or oil leakage associated with conventional actuators.

The use of permanent magnet-based motor technology and efficient electric, mechanical and firmware design, guarantees eco-friendly and cost-efficient ownership.

Eltorque actuators have a proven track record of maintenance-free operation with 15+ years operation.

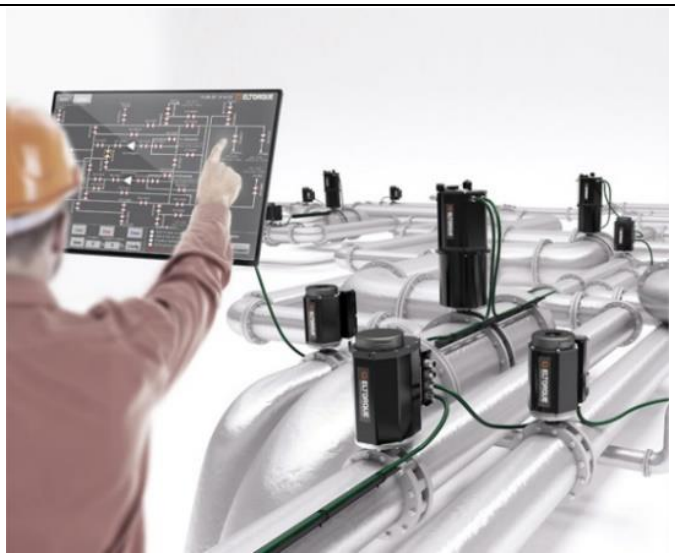


Figure 1: System overview example

1.2 Description

The QT-series with self-lock is characterized by quarter-turn movement and low energy consumption, along with their small footprint. The QT series is suitable for butterfly, ball and other quarter-turn valves.

QT series consist of many sales articles with different functionality.

Feature	Configuration Description
Analog/Digital/CAN	An actuator with Analog/Digital and CAN interfaces, see Product Description in Chapter 3
Failsafe*	An actuator configured as Failsafe is functional extension with additional battery of Analog/Digital/CAN actuator, see Product Description in chapter 12.2
CANOnly	An CAN actuator contains only the CAN bus interface. CAN bus interface can be configured as Single CAN or Dual CAN. See Product description in chapter 9.1
Modbus/Profibus	An Modbus/Profibus actuator contains only an RS485 interface. The interface can be configured as Modbus or Profibus.
Dual Power*	An actuator with main AC and backup DC power inputs. Dual Power has Analog/Digital and CAN interfaces. See Product description in chapter 11.1

See article number keying for configuration details in Chapter 13 Ordering Information and accessories

**** The Failsafe and Dual Power options are not UL certified for QT series actuators.***

1.3 Features

The Eltorque actuators provide a wide range of attractive features:

- **Optimized single-axis architecture, ensuring a compact and low-weight actuator.**
- **Accurate real-time magnetic position control with no mechanical limit switches, ensuring maintenance-free operation.**
- **Few spare parts - low lifetime costs.**
- **Easy setup and commissioning – low installation cost.**
- **Specific alarms, including over-torque and temperature – providing high operational safety.**
- **Robust implementation of CANbus and Modbus/profibus protocol ensuring a reliable bus connection.**
- **Reduced power consumption that gives a greener profile.**
- **The self-lock feature allows movements from the motor but immediately locks movements from the valve side.**
- **Fast and precise motor that reduces the closing time.**
- **Low start-up load enables a high number of actuators per power fuse.**
- **Remote programming via the CAN bus protocol via the Hybrid Marine Cable.**
- **Option for Dual CAN see *Chapter 8* on page 67.**
- **Option for CANOnly see Chapter 9 on page 69.**
- **Option for Modbus/Profibus see Chapter 10 on page 71.**
- **Option for Dual Power see Chapter 11 on page 73.**
- **Option for Failsafe operation see Chapter 12 on page 75.**

1.4 Technical support information

If you require technical support outside of this manual, we recommend that you use the support functions available on our website or contact us via e-mail.

If you have feedback on this manual, that should also be routed through e-mail.

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1.5 Reader groups

The following reader groups have been defined for this User Manual:

- **Project and engineering personnel**
- **Installation personnel**
- **Operators**
- **Supervisors**
- **Technical support personnel**
- **Technical management personnel**

1.6 The notation used in this manual

The following notations have been used in this manual:

Bold is used for commands and menu selection.

***Italic* is used to emphasize information. It is also used for names of documents referred to in the manual.**

Note! ***A note is used to draw attention to important or helpful information.***

Caution! Caution is used when there is a danger that the equipment is damaged if you do not follow the instructions.

Attention! La mise en garde est utilisée lorsqu'il y a un risque d'endommager l'équipement si vous ne suivez pas les instructions.



A warning is used to draw attention to information of very high importance, for example, to avoid injuries to personnel.

Un avertissement est utilisé pour attirer l'attention sur une information de très grande importance, par exemple pour éviter des blessures au personnel.

1.7 Related documentation

This User Manual QT series generation 2.5 are related to the following documentation:

Table 2: Related documentation

Document	Document ID
Eltorque Hybrid Cable datasheet	**Eltorque document ID 1982**
E3C User Manual	**Eltorque document ID 1687**
Guidelines for earthing in maritime installations	**Published by the Norwegian Electrical Safety Directorate. Available in Appendix B in this document.**
System Integrators Manual CANopen	**Eltorque document ID 1691**
System integrators Manual Modbus	**Eltorque document ID 2297**

1.8 Disclaimer

The information contained in this document is subject to change without prior notice. Eltorque AS shall not be liable for errors contained herein or for incidental or consequential damages about the furnishing, performance, or use of this document. It is the customer's responsibility to verify that he has the latest revision available by checking the document area of www.eltorque.com.

1.9 Terms and abbreviations

Table 3: Terms and abbreviations

Term	Description
ABS	**American Bureau of Shipping.**
AFD	**Asbestos Free Declaration.**
Analog Control	**Step-less control utilizing analog signals, e.g., 4-20 mA. Allows positioning of the valve actuator between Open and Closed.**
BTO	**Break to open. The torque required to unseat the closed valve.**
CAN/CAN bus	**Controller Area Network.**
CANopen	**CANopen is a higher-level protocol running on top of the CAN bus.**
CCS	**Central Control System.**
Communication Interface Box	**Electronic device controlling the actuator according to signals from an overall control system such as a PLC or other type of electronic controller.**
Configuration	**The set-up of parameters, which affects the actuator's performance and behavior.**
Det Norske Veritas	**Accredited registrar and classification society**
Digital Control	**Simple control utilizing general purpose relays, on/ off switches, and indicators. Allows only Open or Closed functionality for a valve actuator.**
DNV GL	**Det Norske Veritas Germanischer Lloyd.**
Dual CAN	**Each unit acts as a repeater.**

Term	Description
E3C	Eltorque Common Configuration Controller.
E-VCI	Eltorque Valve Control Interface
E-VCS	Eltorque Valve Control System
Fail	A single failure causing power loss and/or signal loss. One or more failures are detected, and the failsafe protocol is initiated (programmable time delay before initiation).
Failsafe actuator	An actuator that performs a pre-programmed failsafe procedure when a failure is detected.
Failsafe protocol	The security protocol initiated after an actuator failure to enter what has been pre-set as the safest position. The different failsafe protocols are described in section 12.3.3 on page 78.
Hazardous area	Area in which the permanent or periodical presence of explosive substances causes a risk of explosion.
HMI	Human Machine Interface.
HSE	Health, Safety and Environment.
HVAC	Heath, ventilation, and air condition
IACS	International Association of Classification Societies
IAS	Integrated Automation System.
ICS	Integrated Control System.
IMO	International Maritime Organization
LR	Lloyd's Register.
MAST	Maximum allowable stem torque/thrust.
MD	Material Declaration.
MEPC	The Marine Environment Protection Committee
Modbus	Modbus communication protocol.
OSI model	Open Systems Interconnection model. The model is a conceptual model that standardizes communication systems without regard to the underlying internal structure. The model partitions a communication system into abstraction layers.
Out of range	Definition of position. The outgoing shaft is outside the defined position area.
PF	Power factor
PCB	Printed circuit board.
PLC	Programmable Logic Controller
Power-loss	The power supply is below the critical level due to a power supply failure or a cable failure.
Profibus	Profibus communication protocol.
RSW	Refrigerated sea water system
SDoc	Supplier Declaration of Conformity.
Signal-loss	The signal heartbeat is lost for "heart-beat bad timeout" due to controller failure or cable failure.
SOC	State of charge (shows the current Stat of Charge for the internal battery).
SOH	State of health (shows the last tested State of Health for the internal battery).

Term	Description
SOLAS	**Safety of Life At Sea – conversion under IMO concerning safety for personnel and ships at sea.**
SPC	**Statistical process control**
VA	**Voltampere**
UPS	**Uninterruptable power supply.**
Valve	**A valve is a device that controls the flow of materials (gases, fluidized solids, slurries, or liquids) by opening, closing, or partially obstructing various passageways.**
Actuator	**A device for control of valves in various process control systems.**
Valve top flange	**The flange on top of the valve which integrates with the actuator.**
Within range	**Definition of position. The outgoing shaft is within the defined position area.**

1.10 About this user manual

This user manual describes the guidelines for installation, setup, and operation of QT series generation 2.5 in a valve control system.

Chapter 1 introduces the product and this manual.
This chapter is intended for all reader groups.

Chapter 2 informs on health, safety, and environmental issues.
The reader group for this chapter is for supervisors, technical support, and technical management personnel.

Chapter 3 gives a product description, including the mechanical construction of the actuator, technical specifications, and a functional definition. There is also an overview of technical issues that should be considered in the design and planning phase for the installation.
The reader group for this chapter is supervisors, project, and planning personnel.

Chapter 4 covers the mechanical installation on valves and the electrical installation of power and control signal.
The reader group for this chapter is installation personnel.

Chapter 5 covers the use of the actuator, such as how to use the manual emergency operation. There is also an overview of error messages and a troubleshooting overview.
The reader group for this chapter is operators.

Chapter 6 covers maintenance, inspection, and repair of the actuator.
The reader group for this chapter is operators, technical support and management personnel.

Chapter 7 gives more in-depth technical information on the product.
The reader group for this chapter is technical support and management personnel.

Chapter 8 describes the Dual CAN option, how to install and operate an actuator with this option. The reader group for this chapter is installation personnel, operators, support personnel and management personnel.

Chapter 9 CANOnly Option describes the CANOnly option.

Chapter 10 Modbus/Profibus Option describes the Modbus/Profibus option.

Chapter 11 describes the Dual Power option. Installation recommendation and consideration.

Chapter 12 describes the Failsafe option, how to install and operate an actuator with this option. The reader group for this chapter is installation personnel, operators, support personnel and management personnel.

Chapter 13 gives ordering information. The reader group for this chapter is technical support and management personnel.

Appendix A gives an overview of torque recommendations for actuator bolts. The reader group for this chapter is installation personnel.

Appendix B includes the document "Earthing Methodology in Maritime Installations" The reader group for this chapter is installation personnel, technical support and technical management personnel.

Chapter 2 HSE Information

This chapter includes safety information that the user needs to know to operate the equipment without harming personnel or the environment.

	The operation of the equipment is safe provided that the recommended operating procedures are followed. There are specific hazards however that need to be addressed so that the user knows how to deal with them. L'utilisation de l'équipement est sûre à condition que les procédures d'utilisation recommandées soient respectées. Il existe toutefois des risques spécifiques qui doivent être abordés afin que l'utilisateur sache comment y faire face.

	**Electrical installations shall be designed and installed by personnel with certifications according to applicable laws and regulations. Ensure that all such work is done according to applicable laws and regulations.** **Les installations électriques doivent être conçues et installées par du personnel certifié conformément aux lois et réglementations en vigueur. Veillez à ce que tous ces travaux soient effectués conformément aux lois et réglementations en vigueur.**

	Service must always be performed by trained personnel. L'entretien doit toujours être effectué par du personnel qualifié.

	If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Si l'équipement est utilisé d'une manière non précisée par le fabricant, la protection fournie par l'équipement peut être altérée.

2.1 Care and cleaning of the actuator

Caution! Do not use ammonia, alkaline cleaners, lye or strong acid for cleaning as this can damage the protective anodized layer of the product surface.

Attention! Ne pas utiliser d'ammoniaque, de nettoyants alcalins, de lessive ou d'acide fort pour le nettoyage, car cela pourrait endommager la couche protectrice anodisée de la surface du produit.

Caution! Do not use high pressure power washer directly on the actuators, as the product is not IP69K rated.

Attention! Ne pas utiliser de nettoyeur haute pression directement sur les actionneurs, car le produit n'est pas conforme à la norme IP69K

2.2 Disposal and waste handling

All batteries and electronic equipment may contain substances harmful to the environment. Therefore, after removing used equipment, return it for disposal according to local governmental guidelines.

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Chapter 3 Product Description

The QT-series is the most sold product series in the Eltorque portfolio. The QT series generation 2.5 consists of five products with maximum torque ranging from 70 to 1000Nm. The QT series is equipped with a position sensor that gives correct position feedback, even after a power outage. All products can be manually operated utilizing a fixed hand wheel located under the cover on top of the actuator, without external tools.

3.1 QT series generation 2.5

The QT series generation 2.5 is fragmented in to five products QT70, QT250, QT400, QT800, and QT1000. The series is suitable for valves with torque requirements of 70 – 1000 Nm and can be delivered with CANopen, Analog, digital and Modbus communication.

Remember to have the actuator checked by Eltorque after all submerged situations to keep the warranty.

Attention! Pensez à faire vérifier l'actionneur par Eltorque après toute situation d'immersion pour maintenir la garantie.



Figure 2: Actuator mounted on a valve

3.2 Single CAN control system examples

The actuator must be integrated with the main control system in one of two ways:

- **Directly to the main control system. In this case it is important to consider the communication protocol.**

- **Through a stand-alone sub-system delivered by Eltorque. This is a standardized hardware and software platform tailored for Eltorque actuators.**

The solutions illustrated below show a bus connection with the Eltorque Hybrid Marine Cable. This cable can be used with the CANopen and Dual CAN communication and Modbus/Profibus interface. In addition, Eltorque actuators support Digital and Analog connections.

Figure 3 shows Eltorque actuators connected to a cabinet with an Eltorque valve control system (E-VCS). In this example, pump starters are also connected to the E-VCS. Other equipment, such as sensors, can also be connected to the E-VCS. The E-VCS includes an HMI interface on the cabinet and can also support an HMI interface on the main control level.

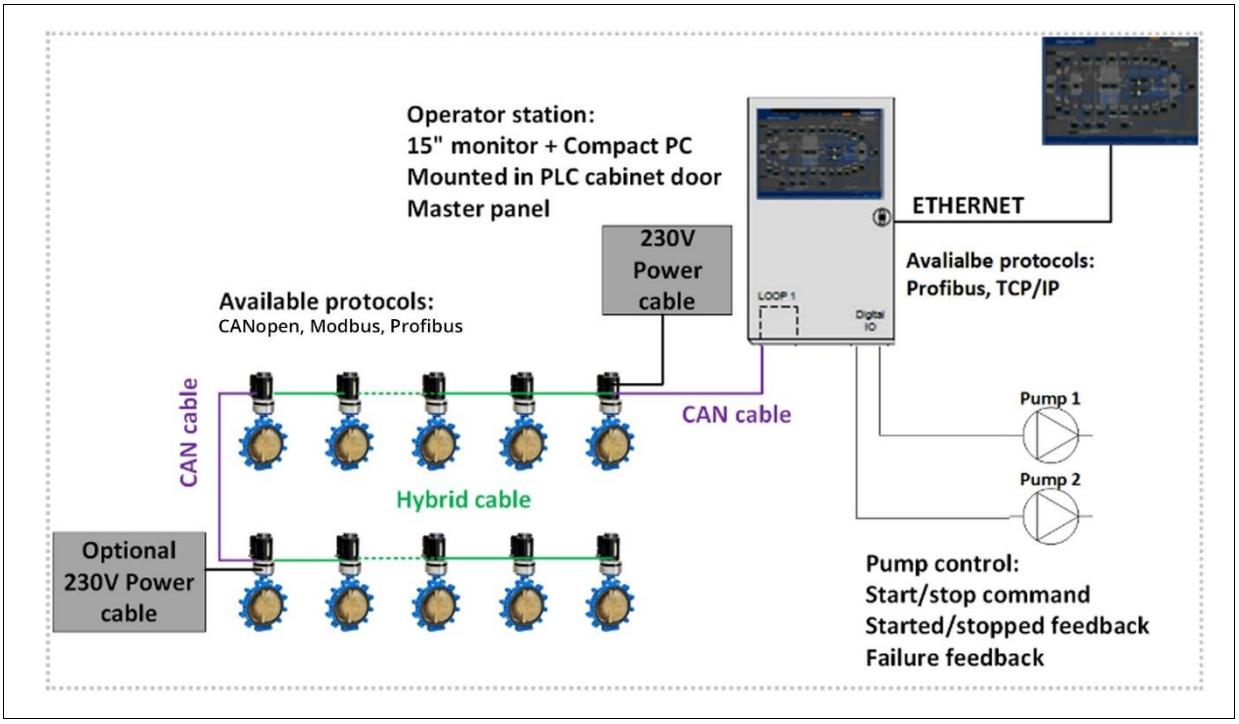


Figure 3: Eltorque Valve Control System (E-VCS) with valve and pump control.

Figure 4 shows Eltorque actuators connected directly to customer-specific PLC, PC, or other control units. In addition, Eltorque actuators support digital and analog connections. At a system level, the PLC, PC or Controller must be compliant with Eltorque communication protocol according to *Eltorque System Integrators Manual CANopen Interface* and *System Integrators Manual Modbus interface*.

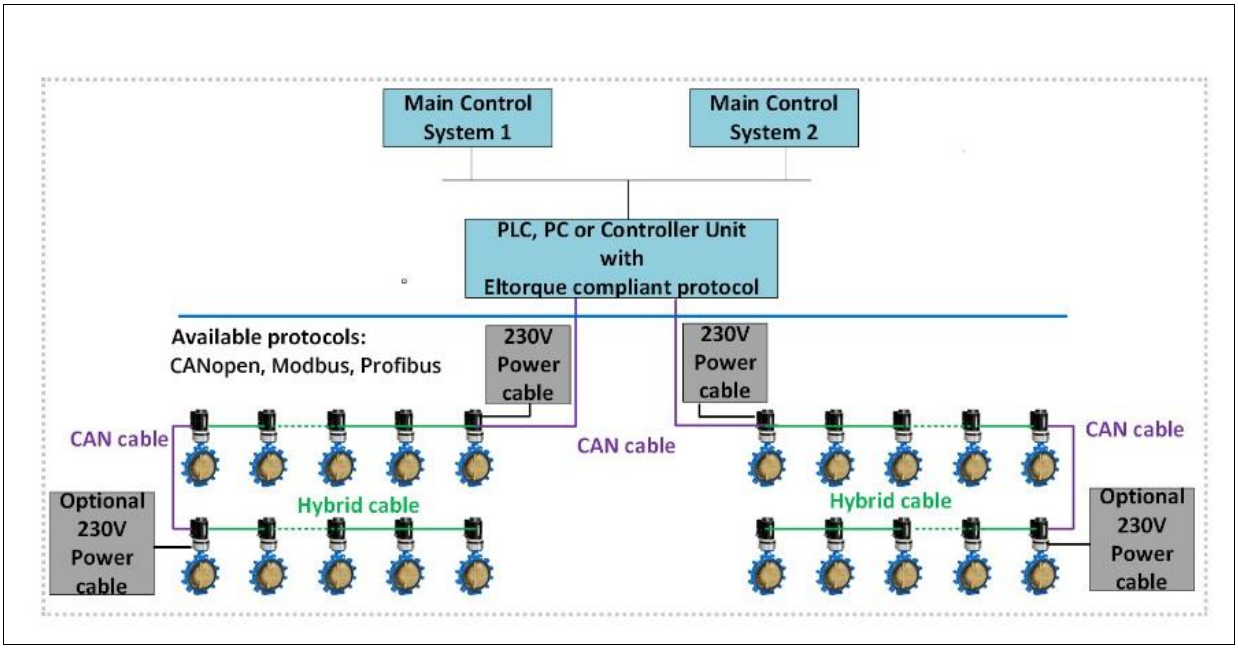


Figure 4: Eltorque actuator loop connected to Integrated Automation Control System (IAS or ICS)

3.3 Dual CAN control system examples

The Dual CAN option opens new solutions on a system level. Below is an example of a system with improved redundancy compared with a standard system. The actuators should be integrated through a stand-alone sub-system delivered by Eltorque.

The solution illustrated in Figure 5 shows a ring connection with the Eltorque Hybrid Marine Cable and Dual CAN communication from two sides. The Eltorque Dual CAN actuators are connected to two cabinets with an Eltorque valve control system (E-VCS). In this example, pump starters are also connected to the E-VCS. Other equipment, such as sensors can also be connected to the E-VCS. The E-VCS includes an HMI interface on the cabinet and can also support an HMI interface on the main control level. The power to the system should be connected to a UPS(uninterruptible power supply) for redundancy.

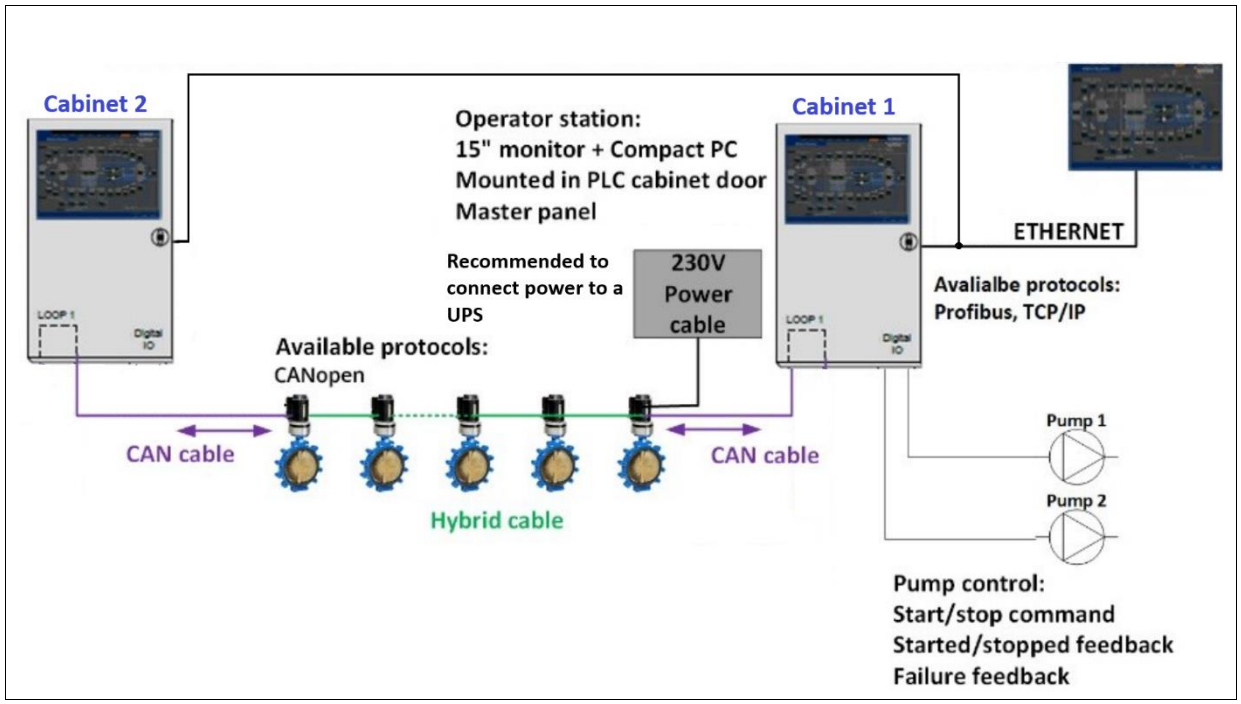


Figure 5: Eltorque Dual CAN Valve Control System (E-VCS) with valve and pump control.

Figure 6 below shows Eltorque actuators connected directly to a customer specific PLC, PC, or other control unit. In addition, Eltorque actuators support digital and analog connections. On system level, the PLC, PC or Controller must be compliant with Eltorque communication protocol according to *Eltorque System Integrators Manual CANopen Interface.*

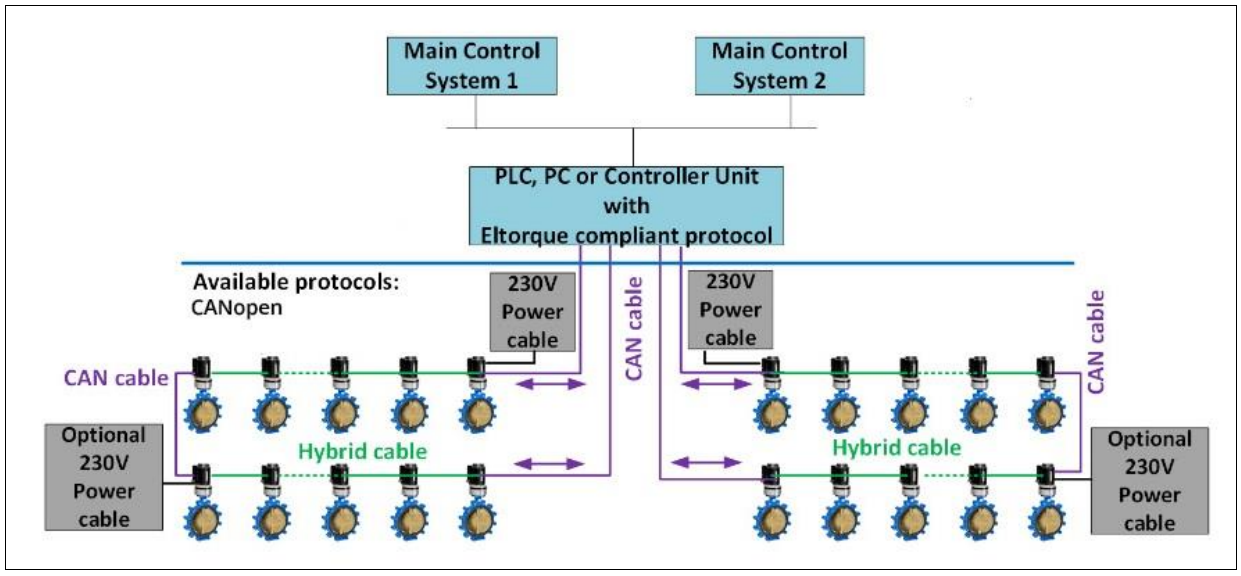


Figure 6: Eltorque actuator dual CAN loop connected to Integrated Automation Control System (IAS or ICS)

3.4 Technical Specifications

Feature	Value	
	QT70/250/400	QT800/1000
Weight (kg) / (lb.)	12 / 26.5	21 / 44.1
Dimensions, HxWxD (mm)	229x156x209 / 9.01x6.14x8.23	333x200x239 / 13.11x7.87x9.41
Housing	IP68* (10m / 72 h) and UL type 4. Corrosion protected aluminum and steel enclosure.	
color	Black	
Operating conditions according to IEC 61010-1	Temperature: - 25 ˚C - 55 ˚C	
	Not designed for use on Open deck of ships, outdoor or exposure to corrosive chemicals.	
	Altitude rating: 2000 m	
	Relative humidity: up to 100% at all relevant temperatures	
	Mains supply voltage fluctuations: ± 10 %	
	Overvoltage category III	
	Pollution degree 2	
Temperature protection	Motor current is switched off in case of over-heating. Stator coils serve as heating elements in case of low temperatures.	
Storage temperature	5 ˚C to 35 ˚C / 41 ˚F to 95 ˚F	
Power supply	110 - 240V AC, 50-60 Hz, Max 100 VA	
Cable glands	Up to five M20 glands allow serial connection of power supply and fieldbus wiring. Threaded holes in the actuator capsule. Use IP68 glands for all wires, EMC type for fieldbus wiring.	
Power consumption opening and closing with max torque[1]	100 VA, PF 0.79	
Power consumption standby[1]	9 VA, PF 0.37	
Duty performance according to 15714-1 / IEC 60034-1	Class A - 10 cycles per hour / S2-15 min.	
Position sensor	Resolution 0.39% / 0.35 ˚ & range 360 ˚	
Configuration	Connection to PC with Eltorque E3C software. Configuration cable is needed, see E3C User Manual.	
Configuration parameters	Open and Closed positions. Actuator speed, torque and valve position regions.	
Manual operation	Standard feature using fixed hand-wheel. Mechanical valve position indicator.	
Number of turns	7.3(QT70) / 21(QT250) / 29(QT400) / 74(QT800) / 103(QT1000) for 0-100%/ 0-90 ˚ valve operation	
Self-lock	The actuators are equipped with a mechanical self-locking device that locks the valve to target position when the actuator movement command is completed.	

* IP rating not evaluated by UL.

3.5 Actuator components

Figure 7 and Figure 8 show describes exterior of the QT70, QT70, QT250 and QT400 external construction and QT800 and QT1000 external construction respectively.

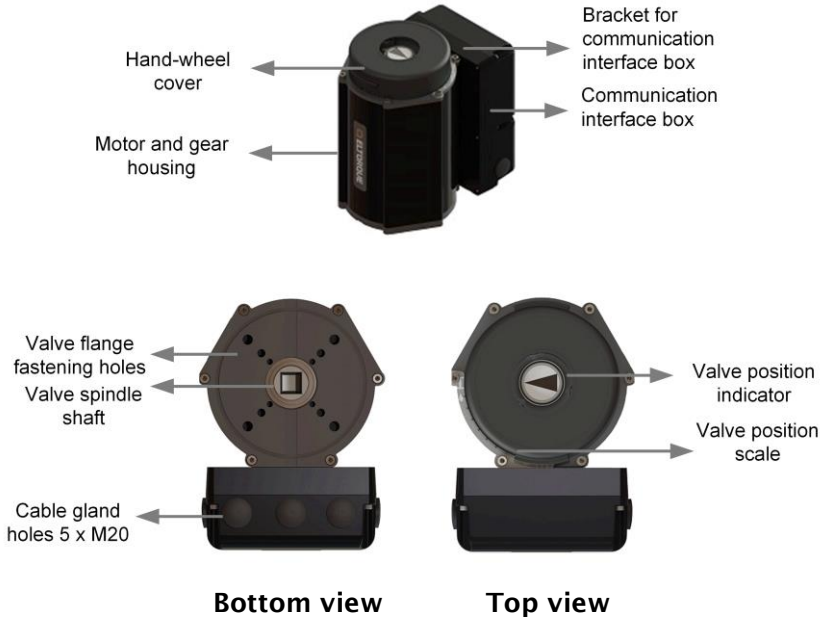


Figure 7: QT70, QT250 and QT400 external construction

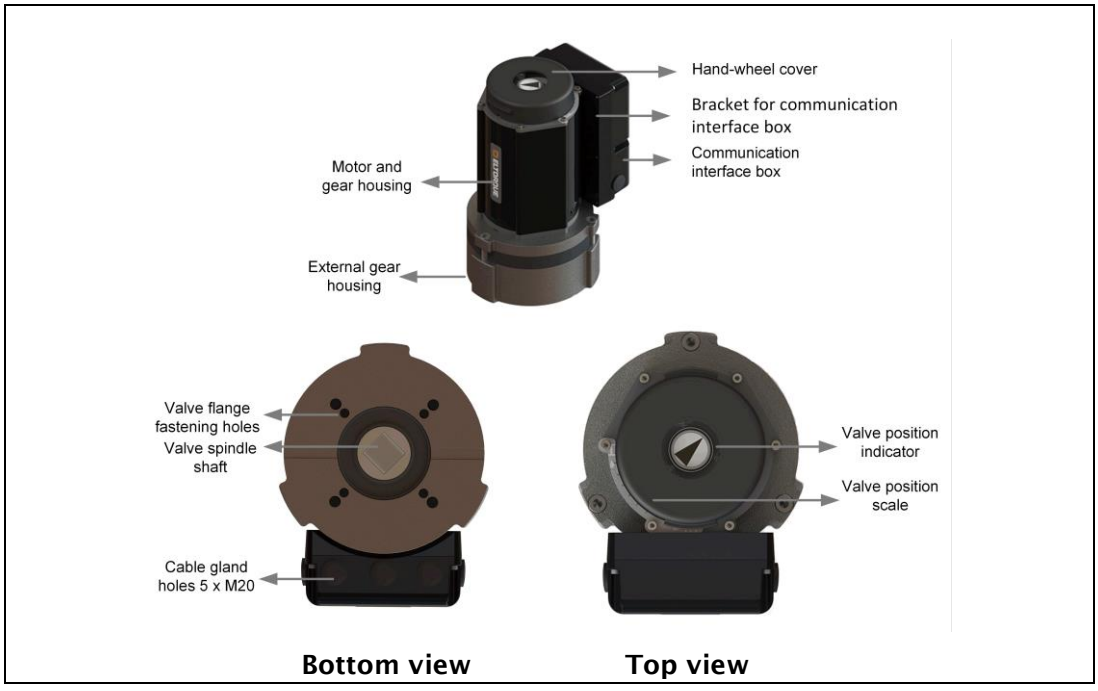


Figure 8: QT800 and QT1000 external construction

3.6 Communication interface box

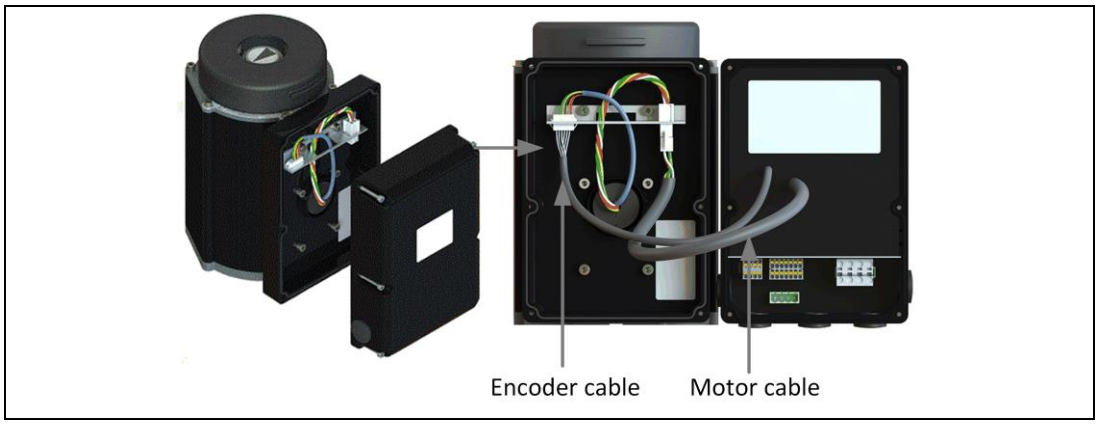


Figure 9: Communication interface box – CANopen

The communication interface box provides connectors for power, control signals and configuration media.

The interface box is delivered in four versions:

- **CANopen – interface using the CAN (Controller Area Network) communications standard. Eltorque recommends a maximum of 80 nodes on 500m/1660ft. cable.**
  The actuator can also be delivered with Dual CAN. Standard CANopen is described in the main parts of this User Manual, while Dual CAN is described in Chapter 8 on page 67 and onwards.
- **Modbus/Profibus - interface using RS485 physical communication. The actuator can be delivered with Modbus or Profibus, both using RS485. Eltorque recommend a maximum of 31 nodes on 250m/820ft cable.**
- **Digital – interface allowing simple Open and Close operation of valves. Actuators with Digital Interface can be controlled directly from a conventional panel with buttons/switches and indicator lamps. Alternatively, it can be controlled from a PLC with digital inputs and outputs.**
- **Analog – interface allowing regulating valves where positioning of the valve is needed. The actuator provides continuous feedback of its actual position, for comparison between desired and actual position. Both positioning and feedback signals are analog 4 - 20mA. The Analog Interface also has a digital Alarm output, which is trigged by failures in both actuator and valve.**

More technical details on the different communication interfaces are given in *Chapter 7 Technical Details* on page 63.

3.7 Labelling

The Product ID label on the actuator housing shown in Figure 10 (In orange rectangle) states the actuator family, generation, torque, power supply requirement, IP rating, type approval, the production serial number, and the production date. In the red rectangle is a computer readable QR code containing a serial number.



Figure 10: Product ID label.

Labels within the communication interface box are shown in Figure 11. The labels describe HW/FW version at delivery time, signals on terminal X1 for CAN or Modbus/Profibus option, digital terminal X2, analog terminal X3, placement of label for X5 terminal and Terminal Block Connections. The last label is placed on the separation plate.

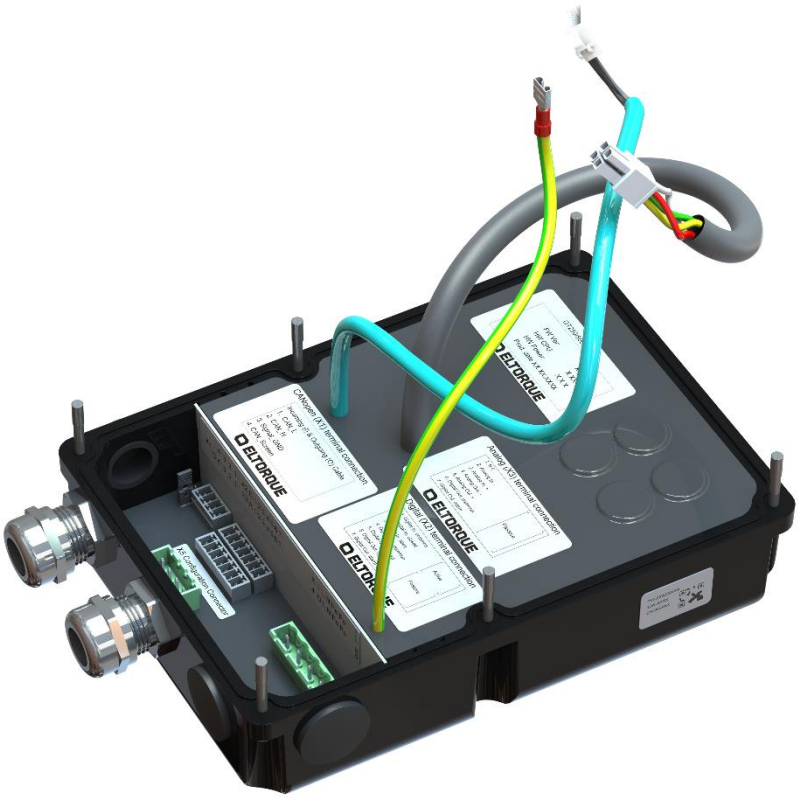


Figure 11: Label overview inside the communication interface box.

3.8 Cabling

The QT-series control box features five M20 threaded holes for cable glands or conduit fittings. When ordering, ensure the cable type and size match the entry range of the selected glands or fittings. For example, Eltorque standard cable glands accommodate cables from 8–14mm (0.32–0.55in). If using conduit fittings, verify that they are rated for M20 holes and suitable for a Type 4 environment to maintain the enclosure's protection.

To preserve the Eltorque actuator's IP rating, always use correctly rated cable glands or conduit fittings with flexible conduit. The actuators come with EMC Class A approval (DNVGL-CG-0339) and are shipped with non-EMC glands by default. If EMC glands are required, please specify this when placing your order.

For detailed information on default glands, conduit fitting options, and ordering instructions, refer to Chapters 4.5 and Chapter 13.

3.9 Storage

If your actuator cannot be installed immediately, it must be stored in a dry place until you are ready to install and connect cables. The actuator does not come prepared for long time outdoors storage when arriving from Eltorque.

If the actuator can be mechanically installed but not cabled, please ensure that all glands and gland holes are thoroughly tightened to avoid moisture ingress. The actuator's IP rating is not valid until correctly installed.

Eltorque cannot accept responsibility for deterioration caused on-site if the actuator has been opened in ways not described in this manual. In principle, the product should be powered within three years after production to prevent components from deteriorating. All actuators are thoroughly tested before shipping to give trouble-free operation if installed and commissioned properly.

3.10 Engineering information



Electrical installations shall be designed and installed by personnel with certifications according to applicable laws and regulations. Ensure that all such work is done according to applicable laws and regulations.

Les installations électriques doivent être conçues et installées par du personnel certifié conformément aux lois et réglementations en vigueur. Veillez à ce que tous ces travaux soient effectués conformément aux lois et réglementations en vigueur.

It is important to consider the number of actuators in both the power loop and the signal loop when using CAN bus or Modbus/Profibus. Therefore, the loop list should be finalized and approved before the installation of the cable is started.

In case of power loss, none of the actuators in that power loop can be remotely operated. Manual operation is, however, possible in both scenarios.

With the Dual CAN, Dual Power, and the Failsafe options, system security in case of a power or signal loss is significantly enhanced. More details are found in chapters: 8 *Dual CAN Option*, 11 *Dual Power Option, and 12 Failsafe Option.*

3.10.1 Power circuit design

Power consumption

The power consumption varies depending on whether the actuator is in standby mode or is running, see product datasheet.

3.10.2 Duty performance

Eltorque actuators may be used according to IEC 60034-1 duty type S2.

Duty performance as defined by EN 15714-2

Industrial Valves – Actuators, chapter 4.7:

For class A – ON/OFF operation, duty performance is defined as the minimum number of cycles per hour, where "one cycle consists of nominal 90° angular travel in both directions (i.e. 90° to open + 90° to close), based on an average load of at least 30% of the rated torque with the ability to transmit 100% of the rated torque for at least 5% at each end of travel, with a cumulative operating time not exceeding 15 minutes in one hour." (EN 15714-2, chapter 4.7.2.2, a.).

For class B – inching/positioning, duty performance is defined as the minimum number of starts per hour, where "one start consists of a movement of at least 1° in either direction, with a load of at least 30 % of the rated torque. The cyclic duration factor (i.e. the ratio between the running period and total period) shall be not less than 25 % (e.g. 1 s. running and 3 s. resting)" (EN 15714-2, chapter 4.7.2.2, b.)

For classes C and D – modulating and continuous modulating, duty performance is defined as the minimum number of starts per hour, where "one start consists of a movement of at least 1°. In either direction, with a load of at least 30% of the rated torque" (EN 15714-2, chapter 4.7.2.2, c.).

Duty performance as defined by IEC 60034-1

Rotating electrical machines, chapter 4.2:

Duty type S2: "Operation at a constant load for a given time, less than that required to reach thermal equilibrium, followed by a time de-energized and at rest of sufficient duration to re-establish machine temperatures within 2 K of the coolant temperature." (IEC 60034-1, chapter 4.2.2)

3.10.3 Endurance

Eltorque actuators may be used in classes A and B – 10 000 cycles per lifetime.

Endurance is defined according to EN 15714-2, chapter 4.1 and Annex A.

For classes A and B – ON/OFF operation and inching/positioning, endurance defines the minimum number of cycles to be endured per lifetime, where "one cycle consists of nominal 90°. Angular travel in both directions (i.e., 90° to open + 90° to close), based on an average load of at least 30 % of the

rated torque with the ability to transmit 100% of the rated torque for at least 5% at each end of travel, with a cumulative operating time not exceeding 15 minutes in one hour." (EN 15714-2, chapter 4.1.2, b.)

For class B – inching/positioning, duty performance is defined as the minimum number of starts per hour, where "one start consists of a movement of at least 1° in either direction, with a load of at least 30 % of the rated torque. The cyclic duration factor (i.e. the ratio between the running period and total period) shall be not less than 25 % (e.g. 1-sec running and 3-sec resting)" (EN 15714-2, chapter 4.7.2.2, b.)

3.10.4 Shielding considerations

Shielded cables and appropriate cable glands should be used if the actuator is installed near or connected in the same network as equipment emitting high levels of disturbance.

3.10.5 Communication interface considerations

CANopen system

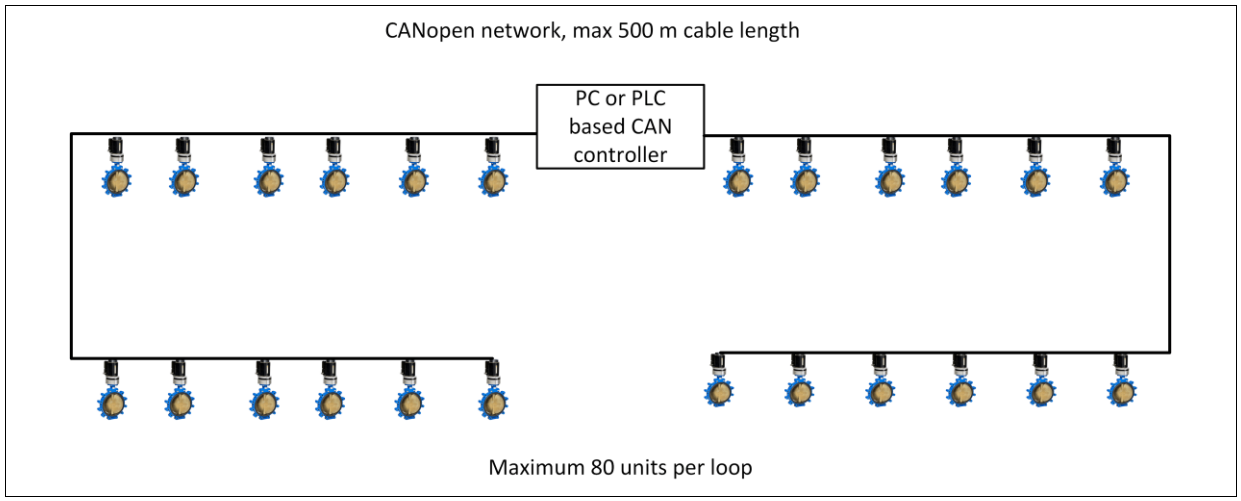


Figure 12: CANopen bus network

Note! ***Eltorque recommends a maximum of 80 nodes on 500m/1660ft cable.***

Note! ***For the Dual CAN configuration, Eltorque recommends no more than 75 nodes on 500m Hybrid marine cable.***

Note! ***The cable between the nodes can be maximum 500m with bus speed with the Eltorque Hybrid Marine Cable. For other data rates and cable lengths check with Eltorque service department.***

Table 4: Cable requirements and recommendations for CANopen system

Cable parameter	Cable requirements and recommendations
Number of conductors	**1 (GND) + twisted pair for CAN_H and CAN_L signals**
Length related resistance / Cross section	**Length related resistance; typical 70mΩ/m Max 100mΩ/m 70mΩ/ 3ft 3.37 in Max 100 mΩ/3ft 3.37 in Normally equivalent to 0.5 – 1.5mm²/20 – 16 AWG**

Cable parameter	Cable requirements and recommendations
Cable length (affects communication speed)	**Maximum 500m/1650ft.**
Shield	**EMC glands are not mandatory but are recommended in case the actuator is placed in conjunction with equipment emitting high levels of disturbance.**
Termination resistor	**Nominal 120 Ω Both ends of the signal loop must have the correct impedance. See chapter 4.8.2 for Single CANopen interface connection or 4.8.3 for Dual CANopen interface connection.**

Modbus/Profibus system

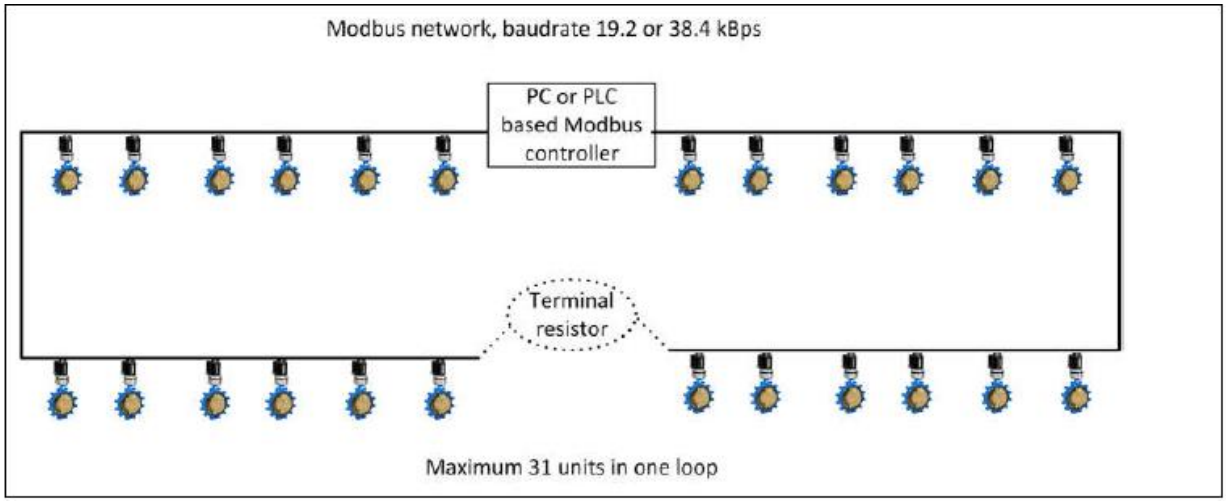


Figure 13: Modbus network

Eltorque recommends a maximum of 31 nodes on 250m at baud rate 38.4kbit/s.

Table 5: Cable requirements and recommendations for Modbus/Profibus system

Cable Parameter	Required / recommended
Number of conductors	**1 + 2 Twisted pair for A(-) and B(+) signals**
Cross section	**0.5-1.5mm^2 / 20 – 16 AWG. The transmission range increases with larger cable cross-section and lower capacitance.**
Shield EMC	**EMC glands not mandatory but is recommended in case the actuator is placed in conjunction with equipment emitting high levels of disturbances.**
Terminal resistor	**Nominal 120Ω Connect resistor to both ends of bus. Internal resistors are recommended used.**

3.10.6 Cabling considerations

CAN systems

Table 6: Cable requirements and recommendations for Dual CAN system

Cable parameter	Cable requirements and recommendations

Cable length **With Hybrid Marine Cable**	**Maximum 500m/1650ft.** **For other cable lengths and number of nodes contact your local Eltorque representative and we will help you to get the correct set-up.**
Cable termination	**For Hybrid Marine cable nominal 120Ω.** **Both Dual CAN inputs on the actuator must be impedance matched to the characteristic impedance of the cable used. When projected by Eltorque, this is handled by our project personnel.**

Analog systems

For the analog interfaces, both the input and the outputs are passive. Analog has two outputs. One digital alarm output and one analog position output (4 to 20mA) (see *Table 7* for details).

Table 7: General purpose relay output – analog interfaces

Function	Value
Rated voltage	**48V AC/DC**
Max. switching voltage	**48V AC/DC**
Rated current	**1A**
Limiting continuous current	**1A**
Breaking capacity	**Max. 48 W (1A)**

Digital systems

For the digital interfaces, the digital outputs are passive general purpose relays, and the digital inputs are active with a 5V/20mA rating. The digital output must be powered (see *Table 8* for details).

Table 8: General purpose relay outputs – digital interfaces

Function	Value
Rated voltage	**48V AC/DC**
Max. switching voltage	**48V AC/DC**
Rated current	**1A**
Limiting continuous current	**1A**
Breaking capacity	**Max. 48 W (1A)**

Table 9: Cable requirements and recommendations digital and analog systems

Cable parameter	Required/ Recommended
Number of conductors	**6 recommended twisted pair.**
Cross section	**0.5 – 1.5mm²/ 20 – 16 AWG**
Shield	**Not mandatory but is recommended in case the actuator is placed in conjunction with equipment emitting high levels of disturbances.**

3.10.7 Installations with Eltorque Hybrid Marine Cable

Bus connection of actuators is undoubtedly the most cost-effective installation method. Eltorque has developed a ground-breaking Hybrid CAN bus/Power cable especially designed for maritime applications.

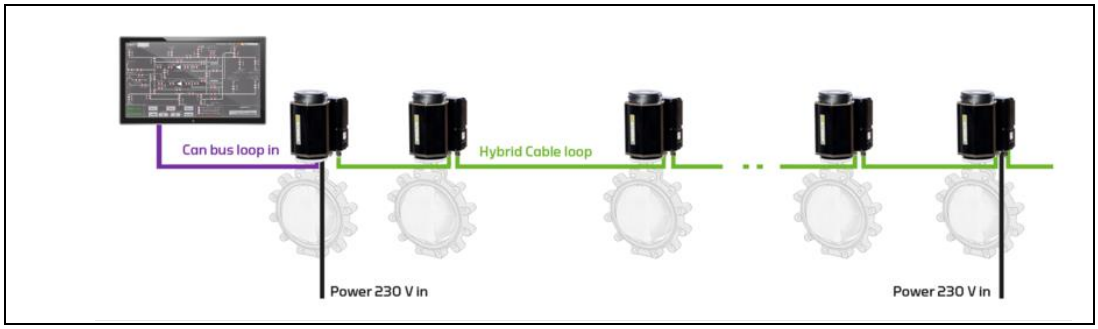


Figure 14: Bus connection of actuators

The Eltorque Hybrid Marine Cable combines signal and power cable in a hybrid cable with maritime type approval. The cable can only be used for installations with CANopen or Modbus/Profibus communication interface box. When this cable is used, only two cable glands are required, see Chapter 13 Ordering Information and accessories



Figure 15: Hybrid Marine Cable

Further description of the Hybrid Marine Cable is found in the Hybrid Marine Cable datasheet, Eltorque document ID 1982. The datasheet is available on www.eltorque.com – Products – System components.

Installation with traditional cabling

With traditional cabling, four cable glands are required to accommodate both power and signal cables. When ordering, please inform if you intend to use the Hybrid Marine cable or a standard cable.

3.10.8 Orientation

The actuator can freely be mounted both vertically standing or horizontally lying to the side. An upside-down hanging position should be avoided.

3.10.9 Space requirements

Actuator dimensions

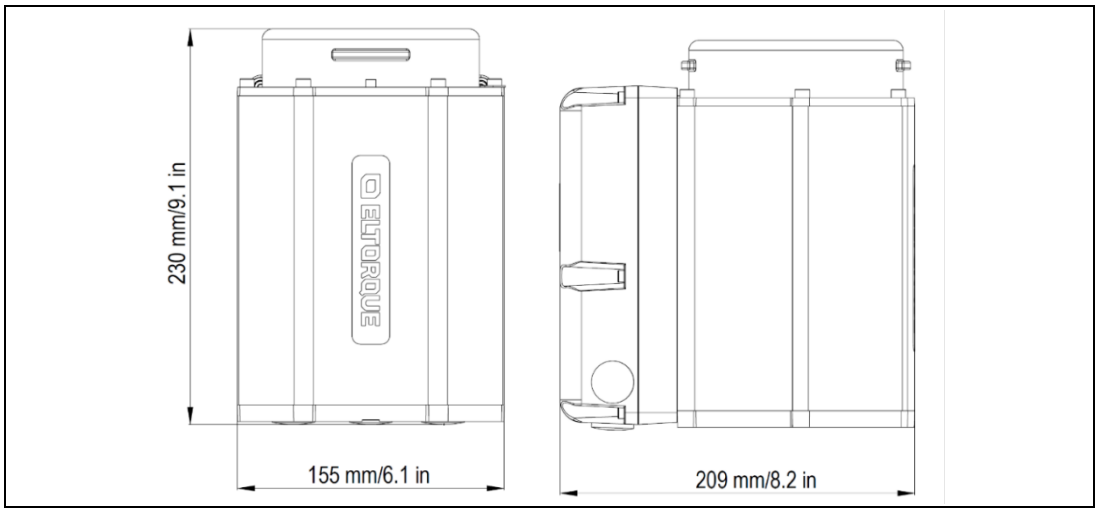


Figure 16: QT70, QT250 and QT400 dimensions

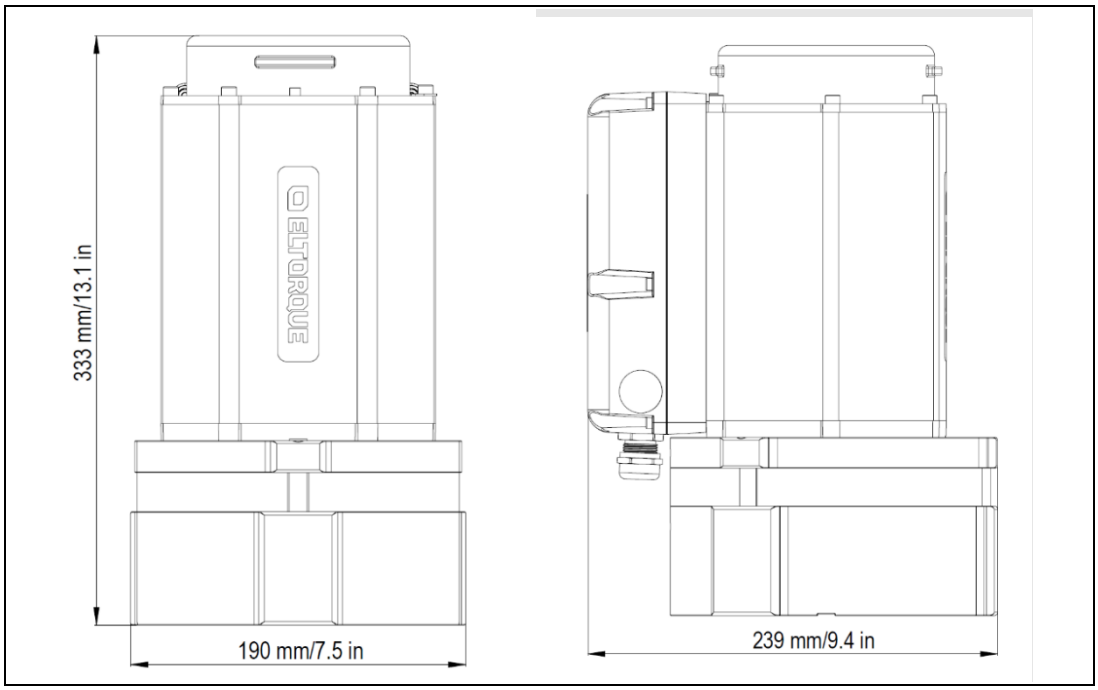


Figure 17: QT800 and QT1000 dimensions

Service space

During planning, please ensure enough space above and around the actuator for installation, service, and manual operation.

There must be a minimum of 150mm/5.9in space above and to the sides of the actuator to accommodate room for installation, operation, and service. In front of the communication interface box there should be at least 200mm/7.9in.

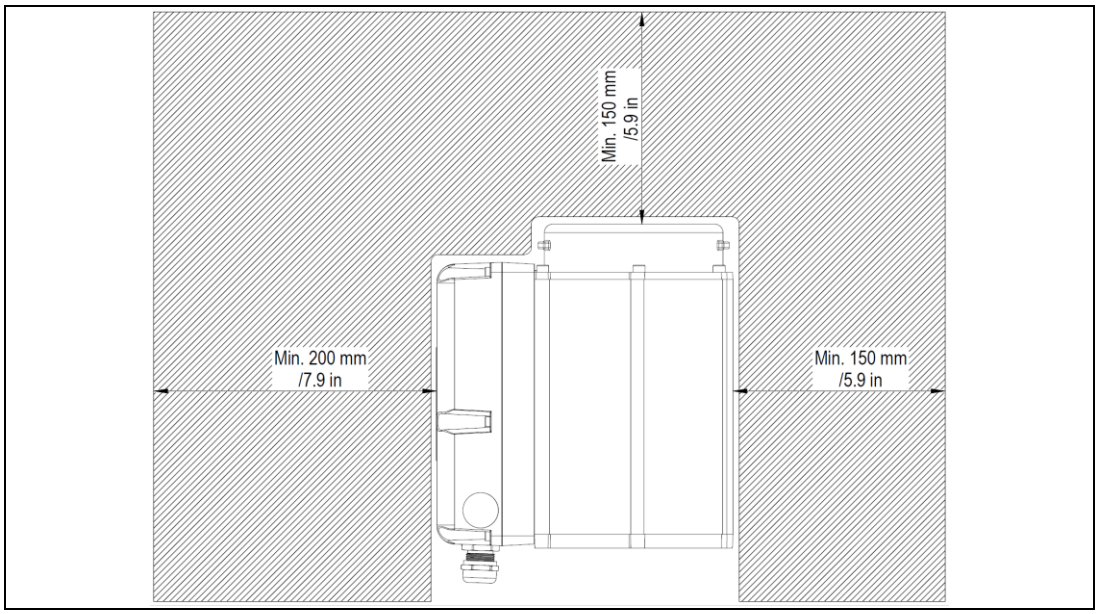


Figure 18: QT70, QT250 and QT400 Space requirements for installation, service and manual operation - side view

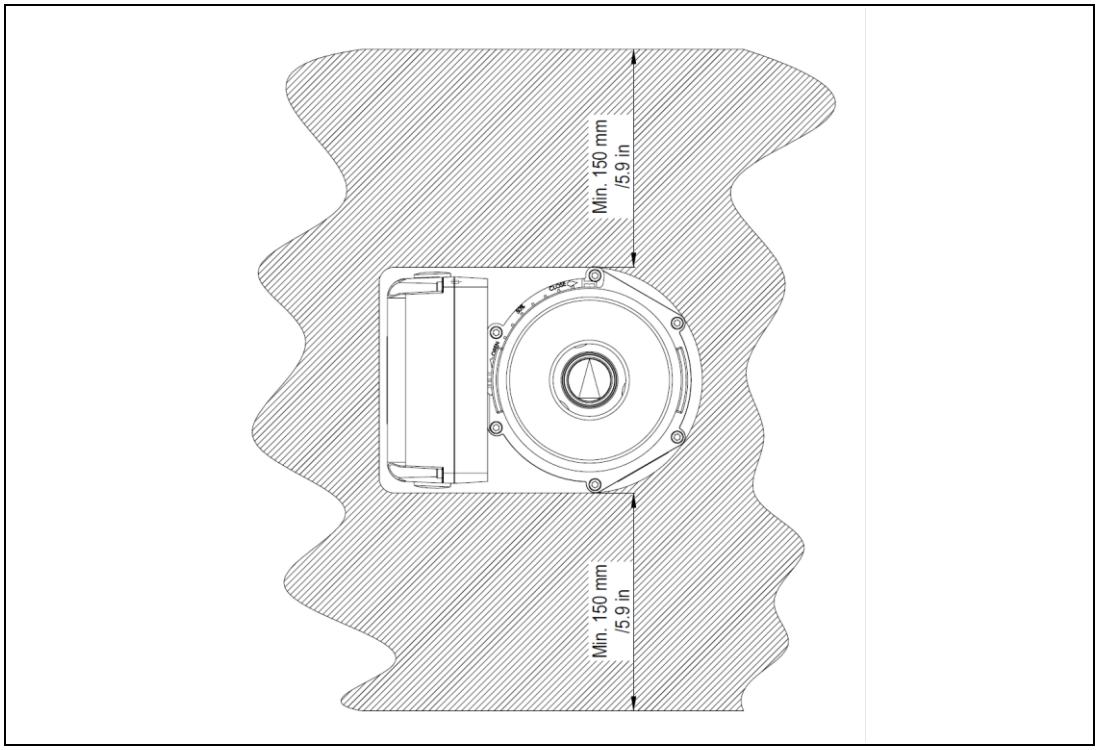


Figure 19: QT70, QT250 and QT400 Space requirements for installation, service and manual operation – top view

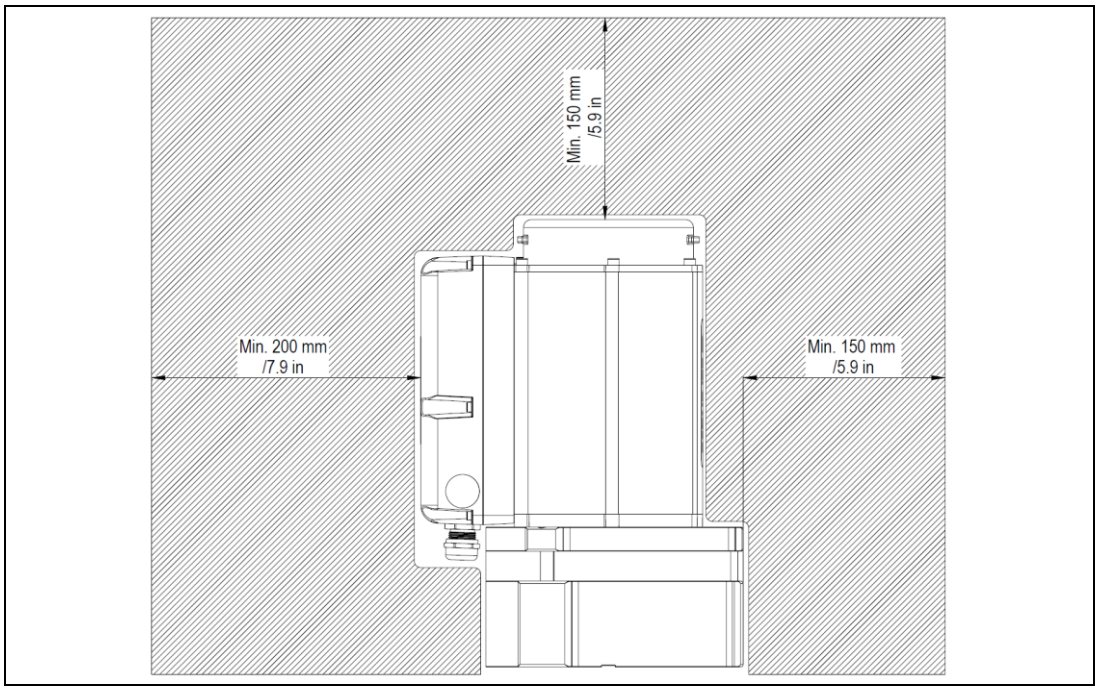


Figure 20: QT800 and QT1000 Space requirements for installation, service and manual operation – side view

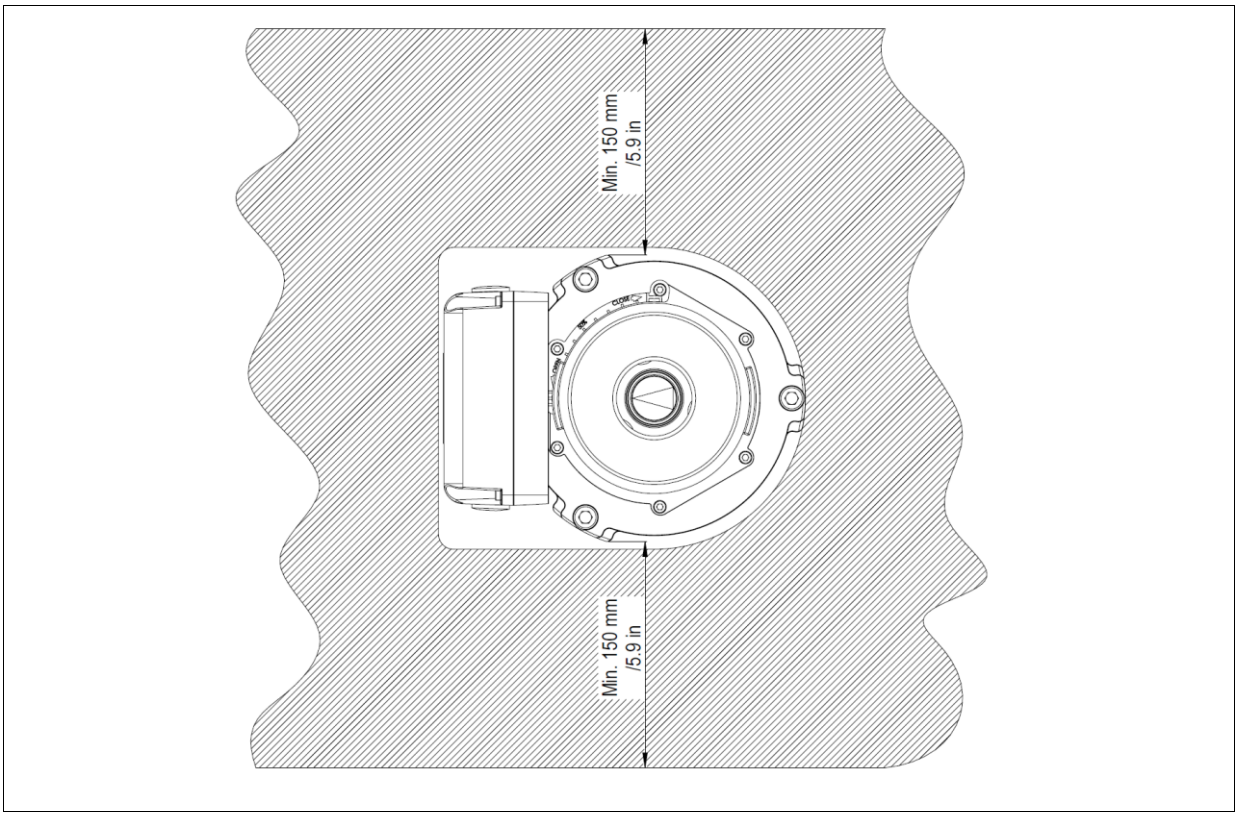


Figure 21: QT800 and QT1000 Space requirements for installation, service and manual operation – top view

3.10.10 Mounting

The actuators provide fastening holes of different dimension to facilitate mounting on different types of valves, see details in *Figure 24* on page 39 and *Figure 25* on page 40.

3.10.11 Additional information adaption actuator/valve

When the actuator and valve do not have a natural match, it is necessary to use an adaptor. Various adapters are available, but the two most common ones are the square reducer and the flange + stem adapter. When buying actuator and valves together from Eltorque, this is handled by our project personnel. If you order just the actuator, take care to verify the critical dimensions and whether the valve has a parallel or standard configuration. Square reducers might be necessary. Always use two pieces with QT250. The QT800 only has room for one. The type of reducer to be used depends on the valve type - please contact your Eltorque representative or Eltorque support for further details.

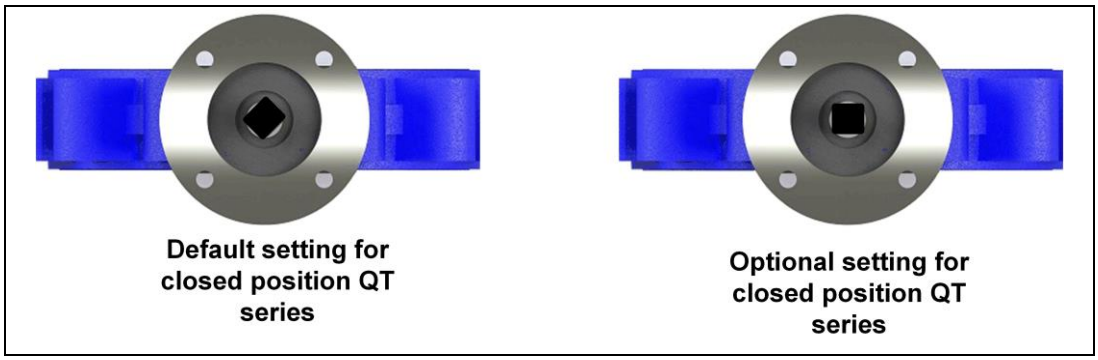


Figure 22: QT-series Settings for closed position.

The setting for closed position can be changed by using E3C, see *Eltorque E3C Manual*.

3.10.12 Torque considerations for valve and actuator

The actuator must have enough torque to operate the valve in all situations with an acceptable safety margin. Valve type, temperature, operating pressure, medium density and viscosity and the medium's effect on the valve friction are among the variables that need to be evaluated. A change in any of these variables may change the required operating torque. Preferably, a torque table with all parameters should be used, but for an electrical actuator, the output torque is constant, reducing the considerations to be made. The break to open (BTO) value usually indicates the most suitable actuator to use. The break to open torque is defined as the torque required to move the valve out of the seat.

Be aware that the MAST of the valve needs to be verified to prevent damage to the stem. Eltorque can assist in selecting the correct actuator size for the valve.

3.10.13 Closing time

For the QT-series, the closing time is configurable within a predesigned interval. The opening and closing profiles are shown in the product datasheet.

3.10.14 Configuration

The actuator is configured from a computer, and it is delivered with the configuration specified by the customer. Eltorque provides the *E3C configuration software,* which runs on a standard PC and the corresponding *User Manual E3C Software.*

The software can be downloaded from the Eltorque website www.eltorque.com – Technical Support – Software.

The Eltorque Configuration Cable is required to connect the actuator to the configuration PC/PLC. Therefore, it must be ordered separately, see *Chapter 8 Ordering Information and Recommended Spare Parts* on page 93.

Chapter 4 Mounting and Installation

4.1 Lifting and carrying the actuator

	Keep hands away from the valve flanges Ne pas approcher les mains des brides de la vanne.

Caution! Do not lift the actuator by the top cover.

Attention! Ne pas soulever l'actionneur par le couvercle supérieur.

1. **Always confirm the weight of the actuator from the specification sheet before lifting and ensure personnel can safely handle the load.**
2. **Use proper lifting posture and grip the main body of the actuator or the communications interface box firmly with two hands.**

4.2 Mounting procedure QT-series

3. **Apply multi-purpose corrosion protection grease on the valve spindle to ease mounting and avoid corrosion.**
4. **Make sure that the valve and actuator are placed in the same position (closed).**
5. **Lift the actuator onto the valve; align its valve adapter with the valve spindle and lower the actuator onto the valve flange.**
6. **Ensure that the spindle, and valve mounting holes fit directly into the actuator.**
7. **In cases where square reducers are needed, always insert two pieces with QT250 and QT400. The QT70, QT800, and QT1000 only have room for one.**
8. **Check that the actuator is correctly positioned on the valve. The actuator's interface box should be placed in the same direction as the piping (see *Figure 23*).**
   If square reducers are needed, see section *3.10.11 Additional information adaption actuator/*valve on page 36.
9. **Remove the top cover and use the handwheel to turn the actuator and align the valve flanges' fastening holes (see section *5.1Manual operation).***
10. **Insert the fastening screws and use washers according to specifications. For screw dimensions, see *Figure 24* and *Figure 25*.**
11. **Tighten fastening screws to the specified torque. See *Table 17: Screw torque* on page 95.**

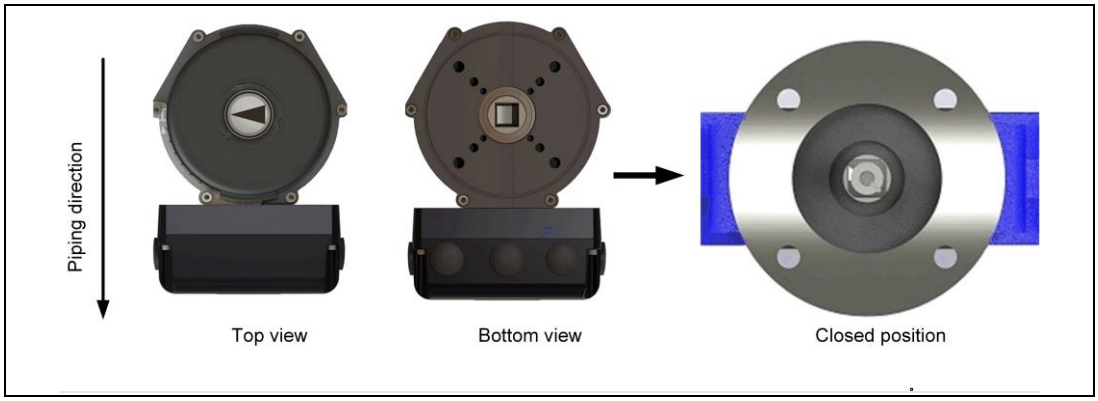


Figure 23: Piping direction

4.3 Valve flange fastening holes

The actuator provides fastening holes of different dimensions to facilitate mounting on different types of valves.

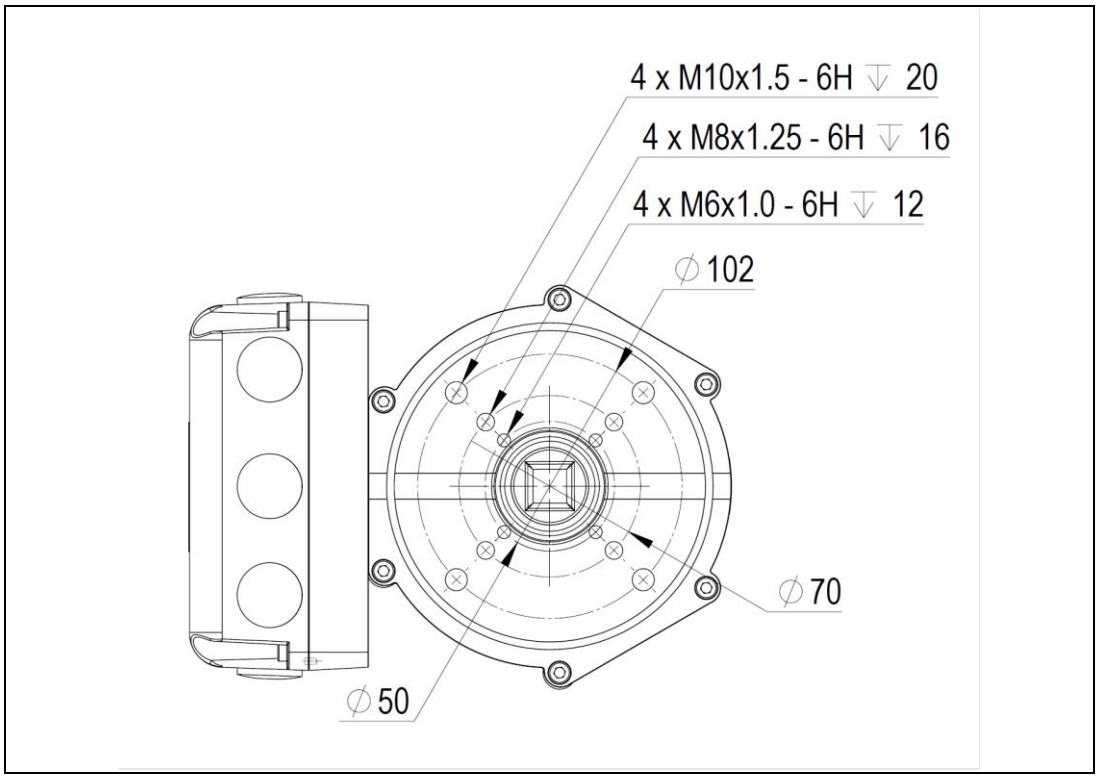


Figure 24: QT70, QT250 and QT400 Valve flange fastening holes

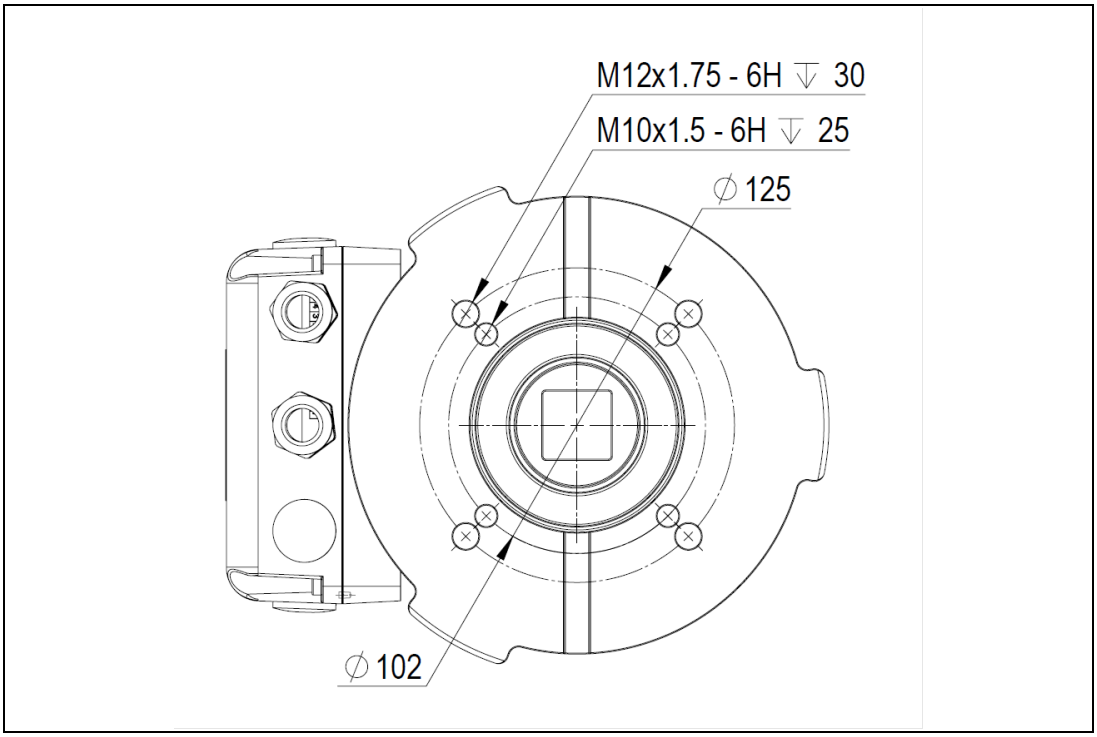


Figure 25: QT800 and QT1000 Valve flange fastening holes

4.4 Cable connection overview

	Ensure that electricians have certifications according to applicable laws and regulations before being allowed to do any work on installations. Assurez-vous que les électriciens possèdent les certifications requises par les lois et réglementations en vigueur avant d'être autorisés à effectuer des travaux sur les installations.

	The supply voltage must be 1-phase, 110 – 240V AC, 50-60Hz, Max 100 W. La tension d'alimentation doit être monophasée, 110 - 240V AC, 50-60 Hz, Max 100 W.

	Make sure the fuses are disconnected before you open the Communication Interface Box. Assurez-vous que les fusibles sont déconnectés avant d'ouvrir le boîtier d'interface de communication.

Caution! When using stranded wires, make sure that all wire strands are properly fastened in the spring connector. Using ferrules is not recommended.

Attention! Lorsque vous utilisez des fils torsadés, assurez-vous que tous les fils sont correctement fixés dans le connecteur à ressort. L'utilisation d'embouts n'est pas recommandée.

If ferrules are used the sole responsibility for a correct installation lies on the installing party.

Si des embouts sont utilisés, la responsabilité d'une installation correcte incombe exclusivement à l'installateur.

Caution! Use Copper wire only. The temperature rating of the cable connected to the terminal shall be suitable for 55˚C.

Attention! Utiliser uniquement du fil de cuivre. La température nominale du câble raccordé au terminal doit être de 55˚C.

1. **Loosen the six fastening screws (three on each side) on the communication interface box, see *Figure 26*.**

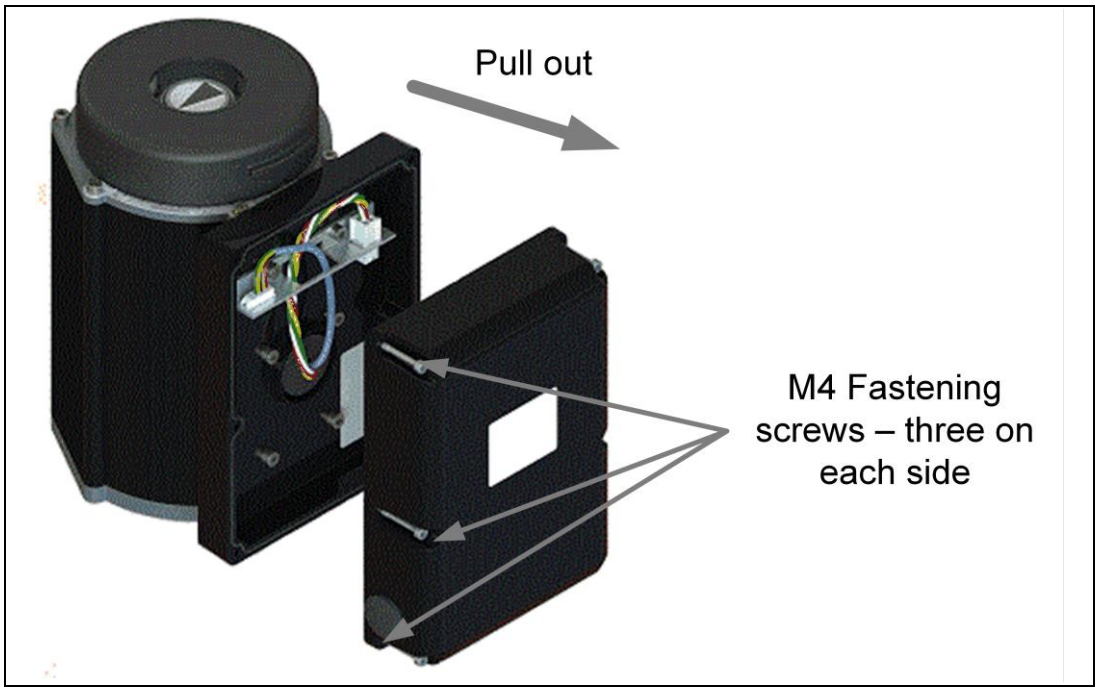


Figure 26: Removing the communication interface box

2. **Remove the box by pulling it straight out.**
3. **Install the required cable glands, see section 4.5.**
4. **Strip all wire-ends to 8 – 9mm/0.31 – 0.35in.**

5. **Install the power supply cables through the cable glands on the right side and connect them to the L, N and G/ PE terminals, see *section 4.6.***

6. **Install the control signal cables through the cable glands on the left and connect them according to the type of communication interface box used. See *section 4.8*.**

7. **Connect the configuration medium to X5 configuration connector, if applicable.**

Note! ***When re-assembling the communication interface box with the actuator, make sure that no wires are jammed between the surfaces and that the screws are cross tightened. It is also recommended to apply some seal lubrication on the gasket to ensure that the actuator remains waterproof.***

8. **Replace the box and tighten the fastening screws to the specified torque. See *Table 17: Screw torque* on page 95. Also, see the note above.**

4.5 Installation steps for Cable glands

For trouble-free operation, it is important to install the glands or conduit fittings and cable correctly. Failure to follow the manufacturer's instructions for installation may void the certification.

Note! ***Support the cable to prevent it from twisting.***

- **Ensure that the correct cable and gland are at hand.**
- **Be sure to allow enough length stripped cable.**
- **Pass the cable through the cable gland and ensure that the cable is correctly positioned in the gland. Eltorque recommends having a 5mm cable edge over the end of the gland.**
- **Hold the body of the gland in position with a spanner (24mm / 0.94in.) or wrench to prevent rotation and tighten the back-nut to min 5Nm, maximum 15Nm.**
- **Finalize the gland installation with a visual verification to ensure correct positioning of all parts.**
- **For other glands follow the instructions from the supplier.**

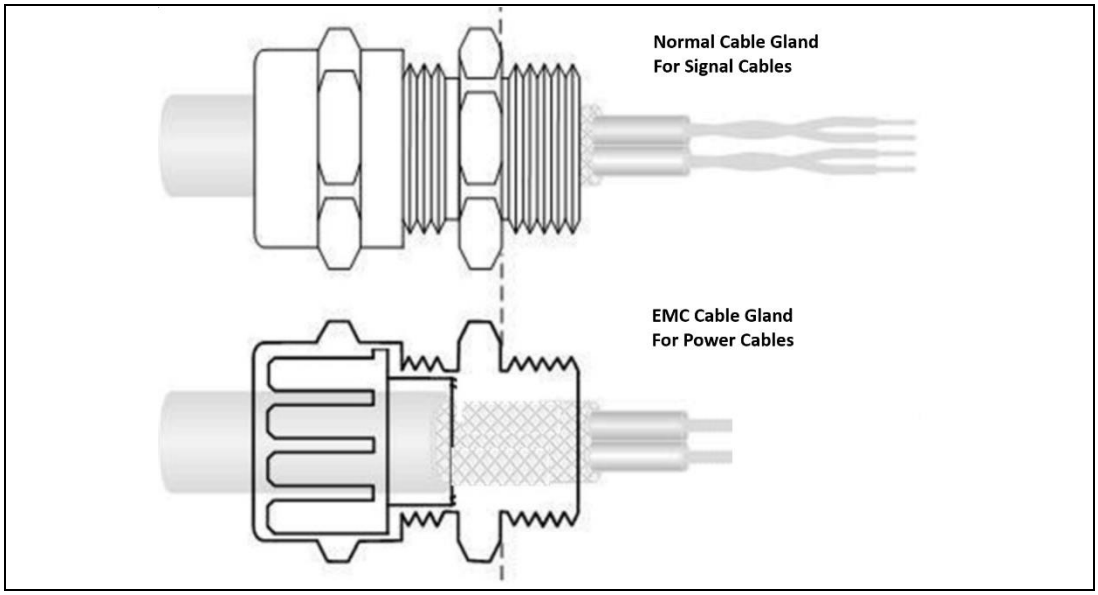


Figure 27: Mounting of cable gland

4.6 Power supply connection

An external switch or circuit breaker must be included in the installation. It must be suitably located and easily reached and must be marked as the disconnecting device for the equipment.

Note! ***The connection of the power supply is identical for all types of communication interface boxes for QT-series actuators.***

Figure 28 shows the location of terminal X4 with a pinout for incoming and outgoing power cables. Each actuator has a double power supply connector enabling serial powering of multiple actuators.

Verify that the voltage levels are following the product's requirements.

To maintain electrical safety, the user must supply a UL Listed copper cable rated for a minimum of 250 V and 90 ˚C, minimum 0.25mm²/24AWG, for connection to the terminal plug. Use of a lower-rated cable may result in fire or electric shock.

The power terminal can accommodate wires of cross-section 0.25 – 2.5mm²/24 – 14AWG.

4.6.1-- Connection procedure

- **Strip the wire-end to 9 – 10mm (0.35in – 0.39in).**
- **Insert the wires according to the labeling.**

	If ferrules are used the sole responsibility for a correct installation lies on the installing party. Si des embouts sont utilisés, la responsabilité d'une installation correcte incombe exclusivement à l'installateur.

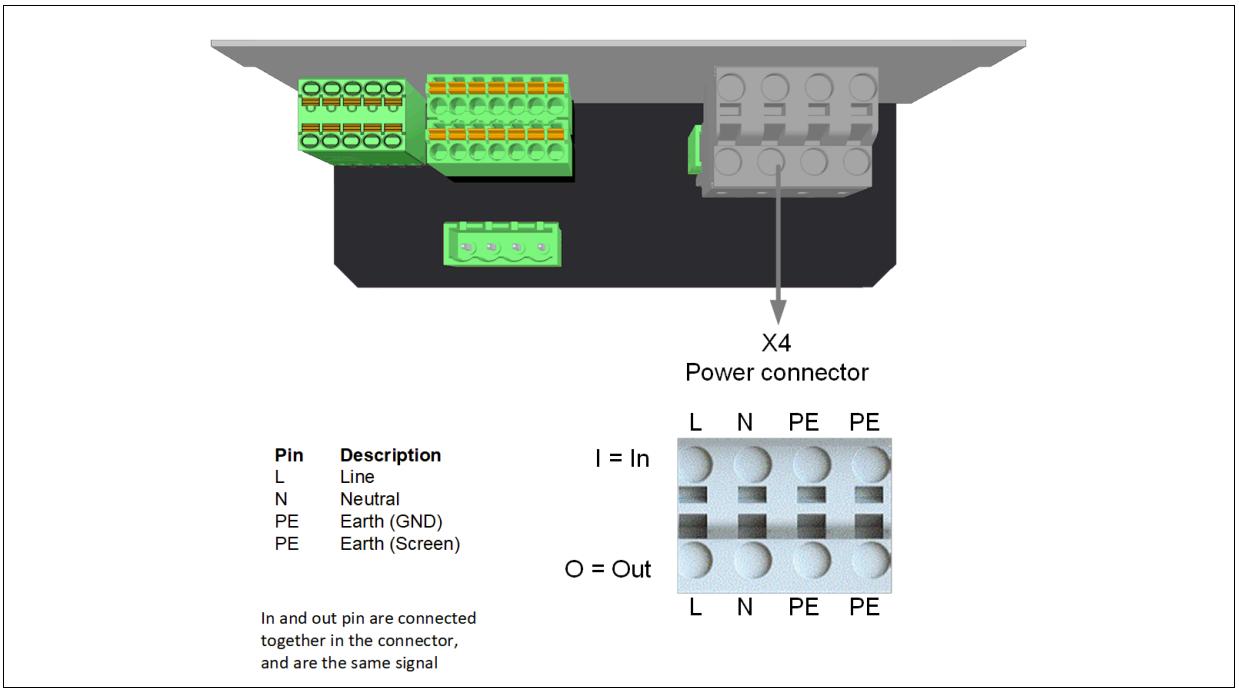


Figure 28: Power supply connection QT-series

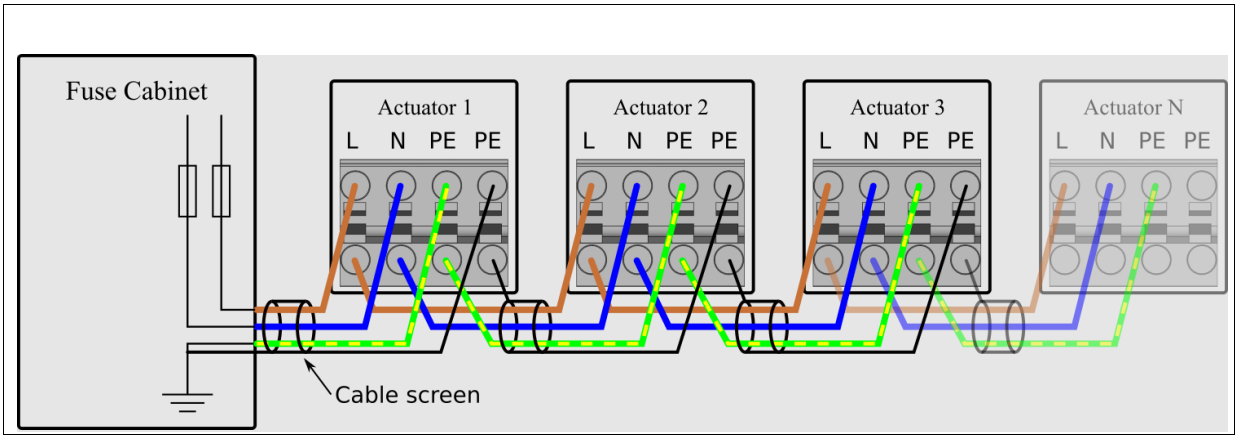


Figure 29: Multiple actuators with bus power connection

Refer to Appendix B Earthing Methods in Maritime Installations on page 97 for information on the connection of screen for the last actuator in the loop (actuator N).

4.7 Grounding (earthing)

	For maximum personnel and equipment protection, the installation shall comply with "*Guidelines for earthing in maritime installations*" published by The Norwegian Electrical Safety Directorate. Failing to do so may void the warranty. Exception: Field equipment shall be grounded through the supply cable.

	Pour une protection maximale du personnel et de l'équipement, l'installation doit être conforme aux "Directives pour la mise à la terre dans les installations maritimes" publiées par la Direction norvégienne de la sécurité électrique. Le non-respect de cette règle peut entraîner l'annulation de la garantie. Exception : L'équipement de terrain doit être mis à la terre par le câble d'alimentation.

All bare metal wires, screens or others not covered by the terminal shall be thoroughly covered in a shrink tube to avoid unintended contact between wires, housing or similar.

Only one conductor is allowed in each terminal of a terminal block/row for external connections. This is not related to terminals that are integrated parts of internal components of the equipment (such as relays and contactors).

Also see Appendix B Earthing Methods in Maritime Installations on page 97.

Note! ***Not following the recommended earthing guidelines may result in unwanted system behavior.***

4.8 Communication connection interface

This product provides multiple electrical interfaces for connection to external equipment:

- **Analog Interface**
- **Digital Interface**
- **Modbus/Profibus [RS485] Interface**
- **CAN Interface**

All interfaces are intended for connection to user-supplied circuits that meet the requirements specified in this manual.

The Analog, Digital, Modbus/Profibus and CAN interfaces are isolated from mains using reinforced insulation. Connection to these interfaces must be made only to circuits that provide Safety Extra Low Voltage (SELV) / limited-energy circuits or are otherwise insulated from mains according to UL requirements. Failure to follow these instructions may impair the protection provided by the equipment.

To maintain electrical safety, the user must supply a UL Listed copper cable rated for a minimum of 150 V and 90 ˚C, minimum 0.25mm²/24AWG, for connection to the terminal plug. Use of a lower-rated cable may result in fire or electric shock.

All interface terminals can accommodate wires of cross-section 0.25 – 1.5mm²/24 – 16AWG.

The cable for CAN & Modbus/Profibus must be compliant with ISO 11898-2 standard. Use of non-compliant cables may result in faulty or unstable bus communication.

4.8.1-- Connection procedure

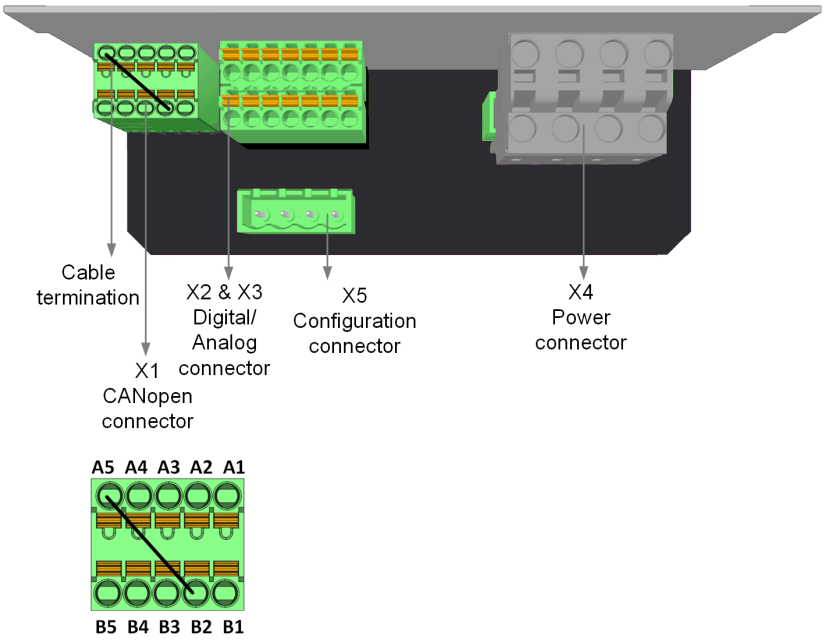
- **Strip the wire-end to 8 – 9mm (0.3in – 0.35in).**
- **Insert the wires according to the labeling.**

	If ferrules are used the sole responsibility for a correct installation lies on the installing party. Si des embouts sont utilisés, la responsabilité d'une installation correcte incombe exclusivement à l'installateur.

4.8.2-- Single CANopen interface connection

Figure 30 shows the location of the CANopen connector X1 with signal termination on the last unit and signal pinout.

Note! ***The cable termination is set on the last unit in the loop by using a 0.75mm2 wire and connect pin A5 with pin B2 on the CANopen connector, see Figure 30.***



Connection between A5 and B2 Enables cable termination on the last unit in the loop

In pin	Out pin	Description
A5	B5	Termination connectors
A4	B4	CAN screen
A3	B3	CAN GND
A2	B2	CAN_H
A1	B1	CAN_L

Figure 30: CANopen connection interface terminals

An example of a CAN installation for n+2 nodes with a CANopen controller is shown in Figure 31.

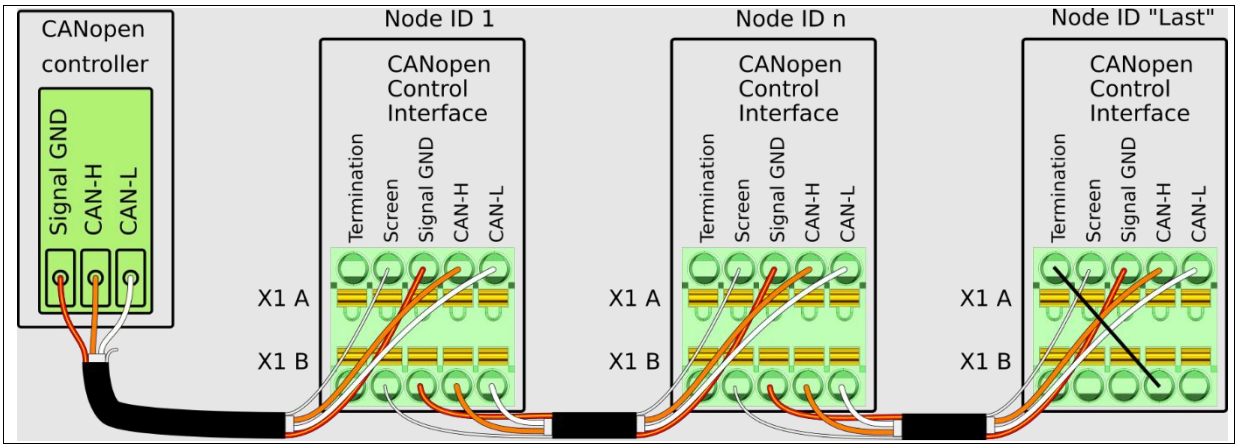


Figure 31: Example of CANopen network connections

4.8.3-- Dual CANopen interface connection

Figure 32 shows CANopen connector placement with signal description.

Note! ***There must be a termination between pins A5 and B5 on the Dual CAN connector X1, see Figure 32. The termination must be present on all Dual CAN nodes.***
Actuators with incorrect termination might cause communication errors.

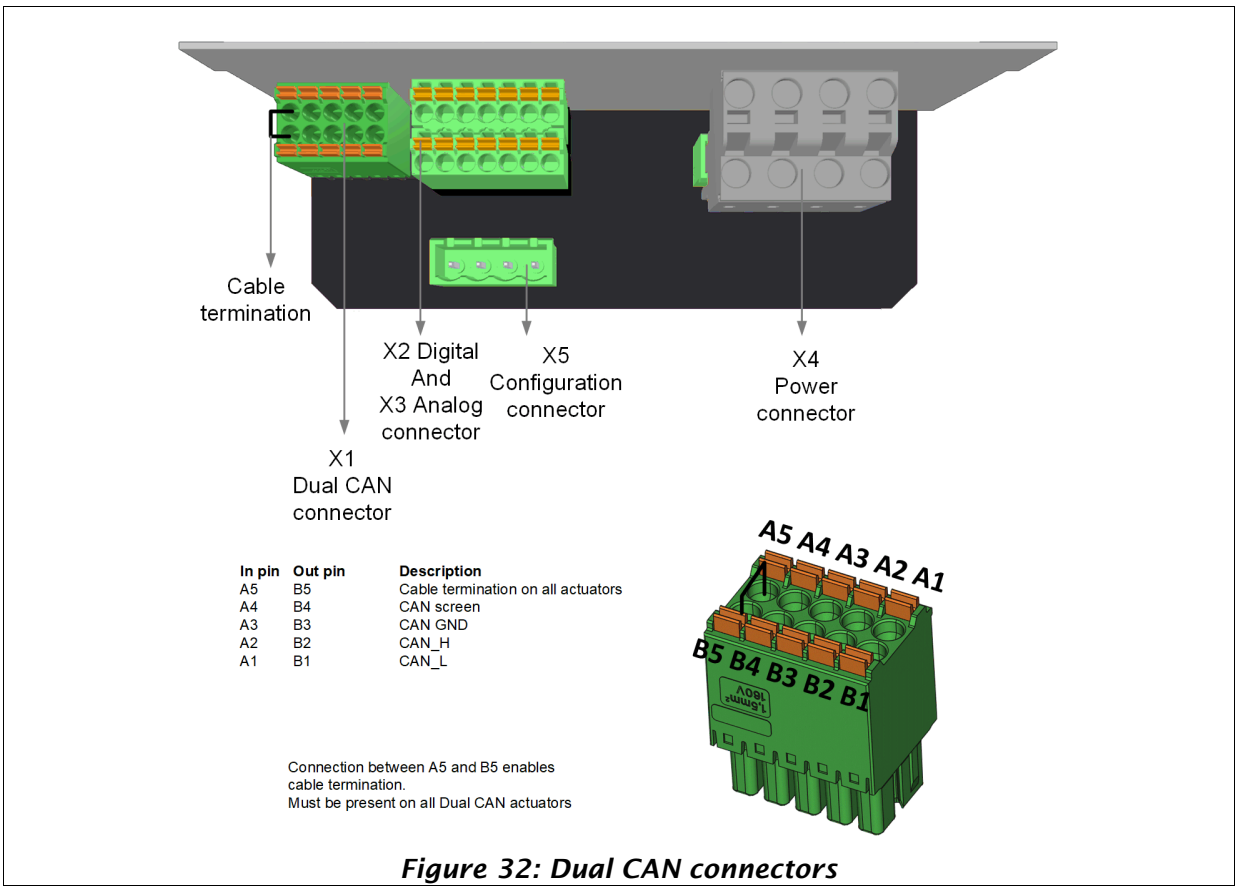


Figure 32: Dual CAN connectors

Figure 33 shows a typical dual CAN network with termination for n+2 nodes and two CAN controllers.

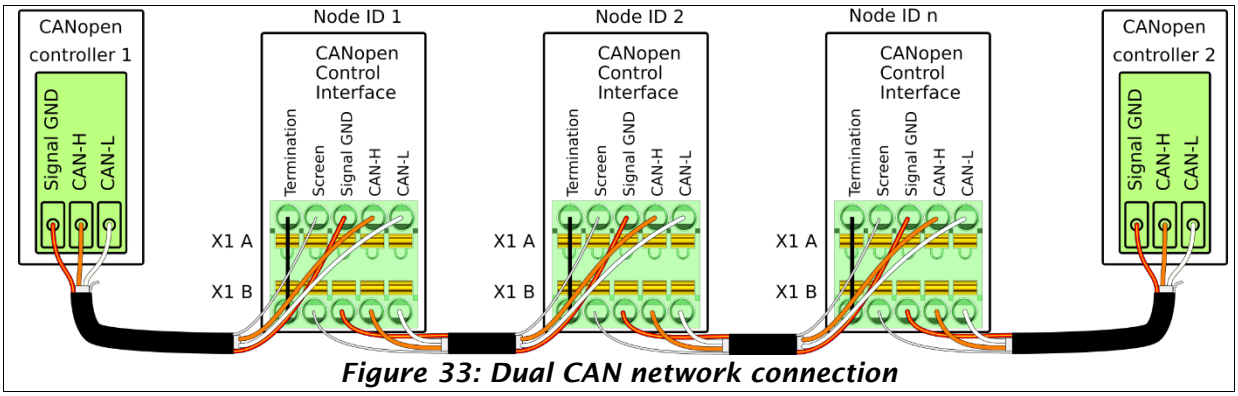


Figure 33: Dual CAN network connection

For information on how to set the node ID, please consult the *Eltorque E3C Manual.*

4.8.4-- Modbus/Profibus interface connection

Figure 34 shows Modbus/Profibus connector placement with signal description.

For more technical information about the Eltorque Modbus communication, refer to the "*System Integrators Manual Modbus interface*" ID 2297.

Note! ***There must be a termination between pins A5 and B5 on connector X1 on the last node in the loop. Actuators with incorrect termination might cause communication errors.***

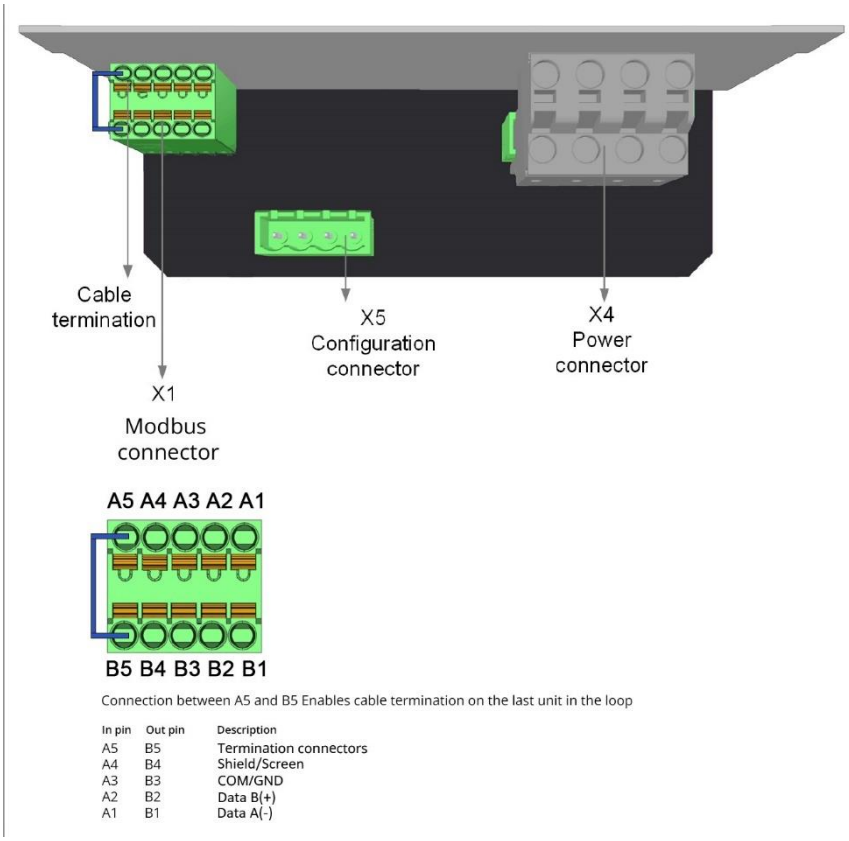


Figure 34: Modbus/Profibus connectors.

Figure 35 shows a typical Modbus/Profibus network with termination for n+1 nodes with one controller/master.

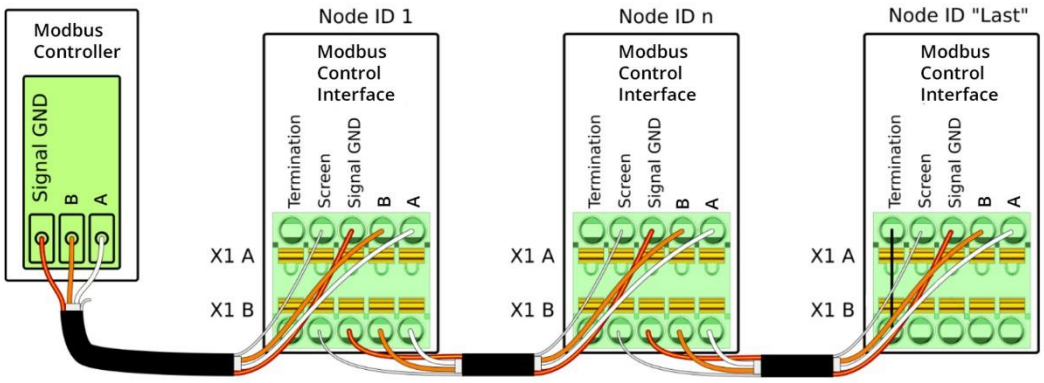


Figure 35: Modbus/Profibus network connection

For information on how to set the node ID, please consult the *Eltorque E3C Manual.*

4.8.5-- Digital interface connection

Figure 36 shows the location of the Digital Interface connector X2 and signal pinout. Specifications for IOs are given in section 7.2.2 Modbus/Profibus

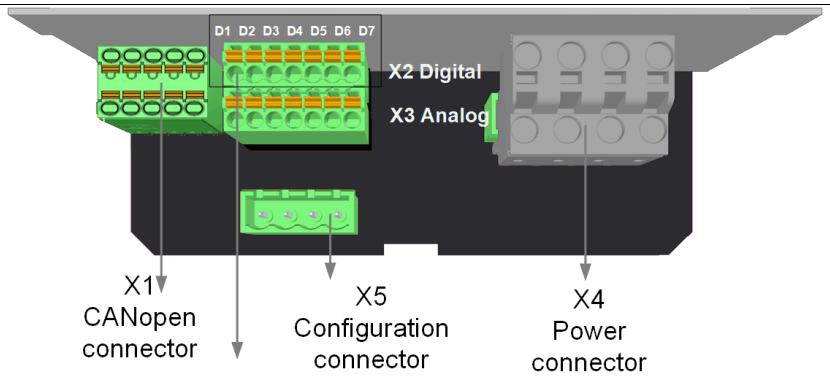
For more technical information about the Eltorque Modbus communication, refer to the "*System Integrators Manual Modbus interface*" ID 2297.

Digital interface on page 63.

Caution! The Common input terminal (D1 on X2) is active and has an internal power supply of 5 V/ 50 mA. Do not attempt to connect an external supply to this terminal as it can damage the communication interface box. Digital outputs are passive and need an external power supply to operate.

Attention! La borne d'entrée commune (D1 sur X2) est active et dispose d'une alimentation interne de 5 V/50 mA. N'essayez pas de connecter une alimentation externe à cette borne, car cela pourrait endommager le boîtier d'interface de communication. Les sorties numériques sont passives et nécessitent une alimentation externe pour fonctionner.

Note! ***This chapter doesn't apply to CANOnly.***



Pin#	X2 Digital connector signal
D1	IN com
D2	IN closed
D3	IN open
D4	OUT com
D5	OUT closed
D6	OUT open
D7	OUT alarm

Figure 36: Digital connection interface terminals

The digital interface can be used in various control circuits. Two examples are shown in Figure 37.

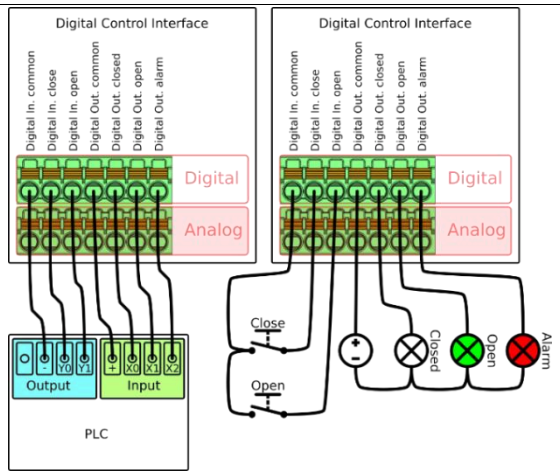
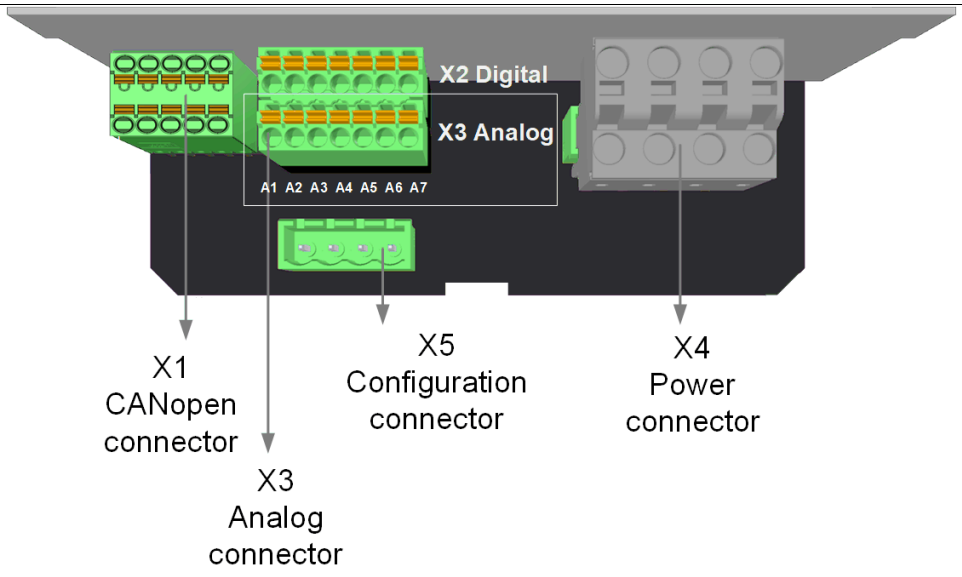


Figure 37: Digital interface options

4.8.6-- Analog interface connections

Figure 38 shows the location of the Analog Interface connector X3 and signal pinout. Specifications for IOs are given in section 3.7.1

Note! ***This chapter does not apply to CANOnly.***



Pin#	X3 Analog connector signal
A1	Not connected
A2	Analog IN -
A3	Analog IN +
A4	Analog OUT -
A5	Analog OUT +
A6	Digital Alarm
A7	Digital Alarm

Figure 38: Analog connection interface terminals

An example of using the analog interface is shown in Figure 39

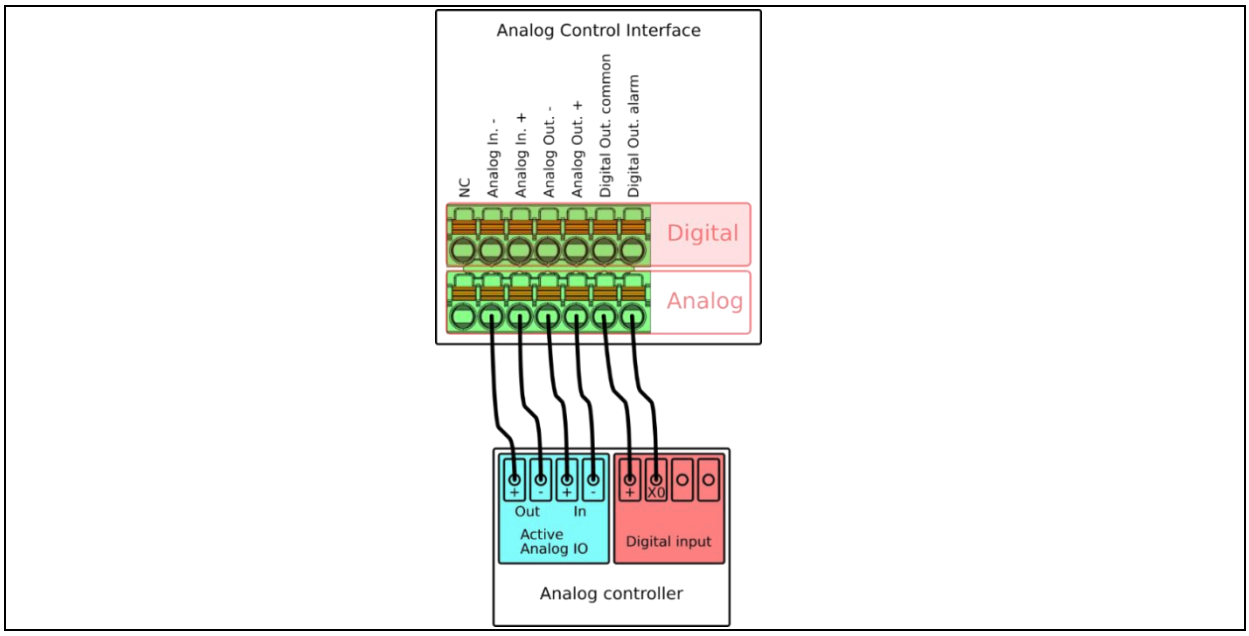


Figure 39: Example of 4-20mA analog control circuit.

Chapter 5 Operation

Eltorque actuators can be operated in several ways:

- **As part of a system directly via IAS.**
- **Via an Eltorque E-VCS, which controls the unit.**
- **Using the E3C tool, which is described in the *EC3 Manual.***
- **Emergency operation where you can operate the actuator manually.**
- **Failsafe operation is described in Chapter 8.**

The control commands and procedures depend on the type of control system that is used. In this chapter the manual emergency operation is described.

5.1 Manual operation

In case of power failure, control system error, or another fault preventing normal operation of the actuator, it is possible to operate the actuator without the need for additional tools manually.



Do not subject the hand wheel to more than the valve MAST or maximum 4Nm on the handwheel, as you may damage the actuator or valve. Below is a table showing approximate output torque on input torque.

Ne pas soumettre le volant à un couple supérieur au MAST de la vanne ou à un maximum de 4Nm sur le volant, sous peine d'endommager l'actionneur ou la vanne. Le tableau ci-dessous indique le couple de sortie approximatif en fonction du couple d'entrée.

Table 10: Input and output torque for handwheel

Input torque on the handwheel [Nm]	Output torque on the actuator [Nm]				
	QT70	QT250	QT400	QT800	QT1000
1	**19**	**75**	**90**	**225**	**311**
2	**38**	**150**	**180**	**450**	**622**
3	**57**	**225**	**270**	**675**	**933**
4	**76**	**300**	**360**	**900**	**1244**

Note! ***A manual operation will most likely result in an error message in the system.***

1. **Remove the hand-wheel cover by grabbing the tabs and pulling it straight up.**
2. **Turn the hand-wheel clockwise to close or counter-clockwise to open the valve. The valve position can be seen on the visual indicator in the center of the hand-wheel, and reference is made to the scale. See *Figure 41: Position scale.***
3. **When the manual operation is completed, refit the hand-wheel cover by pressing it down until it stops against the actuator's top cover.**



Figure 40: Manual operation of the actuator

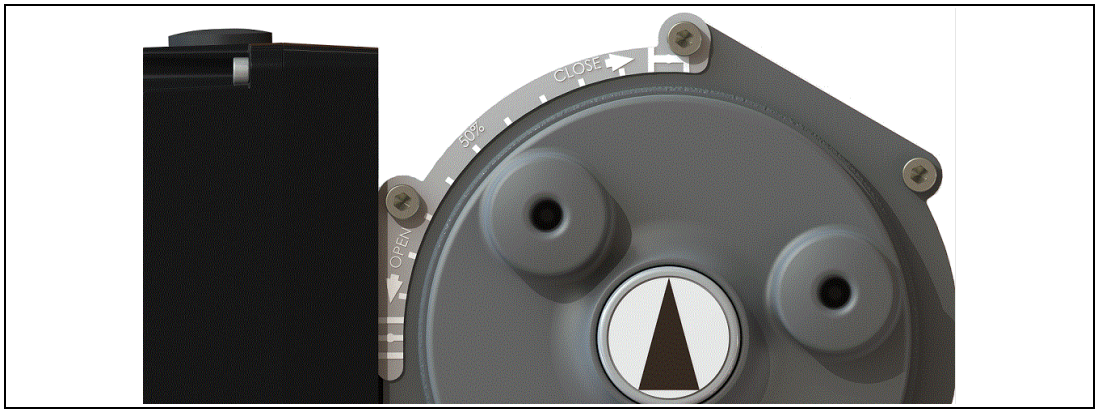


Figure 41: Position scale

5.2 Error alarms and error handling

The following subsections describe what triggers an alarm, reactions from the actuator and how the alarm is reset.

5.2.1-- GENERAL alarm

- **Trigger conditions: One or more of the alarms POSITION UNDEFINED, TEMPERATURE or, TORQUE is active.**
- **Reaction from actuator: None for the GENERAL alarm itself, but the other active alarms that are active have reactions.**
- **Reset conditions: The alarms POSITION UNDEFINED, TEMPERATURE and TORQUE must be inactive.**

5.2.2-- POSITION UNDEFINED alarm

- **Trigger conditions: The outgoing shaft of the actuator is out of range.**
- **Reaction from actuator: None besides an active alarm.**
- **Reset conditions: The outgoing shaft must be run back within range.**

Valve percent position

Valve percent position is a [0%, 100%] value. A value of 0% corresponds to the *CLOSED position*, while a value of 100% corresponds to the *OPEN position*. Seen from the top of the actuator, the outgoing shaft moves in a counter-clockwise (CCW) direction from the *CLOSED position* to the *OPEN position* (see *Figure 41: Position scale* on page 56.

Position encoder

A position encoder is connected to the outgoing shaft of the actuator and maps positions from 0° to 359° on the outgoing shaft. For each unit, correct *CLOSED* and *OPEN positions* for the valve must be configured in the firmware of the actuator for proper functionality.

The position encoder reads out the absolute positional information. This means that if the outgoing shaft is moved while the actuator is powered off, the correct position is still shown when the actuator is powered on again.

5.2.3-- TEMPERATURE alarm

- **Trigger conditions: The alarm is activated when the temperature of the actuator is near the maximum operating temperature of the internal electronics. This may happen if the environmental temperature is higher than the maximum rated temperature for the actuator or if the actuator has been run with a higher duty cycle than specified in section 3.3.**
- **Reaction from actuator: The voltage to the motor is cut off if the temperature increases above the maximum operating temperature of the internal electronics. The motor can run again when the temperature alarm is inactive.**
- **Reset conditions: The temperature must decrease well below the maximum operating temperature of the internal electronics.**

5.2.4-- TORQUE alarm

- **Trigger conditions: The actuator has been running but has stopped unexpectedly. This may be caused by too high braking torque on the outgoing shaft or failure in the motor control and feedback system.**
- **Reaction from actuator: The actuator stops running.**
- **Reset conditions: A new position command (OPEN, CLOSE, GOTO, STOP). The motor can then run again, given that the trigger conditions for the alarm have disappeared.**

5.3 Troubleshooting

The Eltorque actuator is a robust and normally maintenance-free product, but you might still encounter some issues with the unit. Below is a list of the most common issues that may occur and how to solve them. If you still have problems, please contact *Eltorque support* for further help.

Table 11: Troubleshooting overview

Problem description	Cause and solution
No response from the actuator either on the control system or if you connect with E3C. **No change in resistance on the hand wheel if you cycle the power supply.**	**No power supply; check fuses and wiring.** **Supply voltage can be checked using a voltage meter.** **L-N voltage should be 1-phase,110 – 240V AC, 50-60 Hz.**
The actuator's alarm output is active, on a bus system it gives torque alarm. **The actuator attempts to move valve when a control signal is given.**	**The valve operation torque is too high, please check the torque by manual operation.** **Be aware that foreign objects in the pipe can block the valve and that valve torque changes over time.** **OR** **The actuator torque has been set too low, increase it by using the E3C configuration software as described in the Eltorque E3C Manual.** **On bus control systems, torque can be adjusted via the bus communication.**
The actuator can operate the valve, but the operation time is longer or shorter than desired.	**Change the actuator's speed by using the E3C configuration software as described in the *Eltorque E3C Manual*.** **On bus control systems, speed can be adjusted via the bus communication.**
The actuator's alarm output is active, on a bus system it gives temperature alarm. **The actuator responds normally to control signals.**	**The actuator's internal temperature is 10° C/50° F or less from the motor current shut-down limit.** **If possible, allow the actuator to cool down by leaving it in standby mode for 15 minutes or more.**
The actuator's alarm output is active, on a bus system it gives torque alarm. **The actuator responds only with a small position change**	**The encoder cable is not properly connected or could be damaged. Check the cable and connector for corrosion or damage.**
The actuator's alarm output is active, on a bus system it gives temperature alarm. **The actuator does not respond to control signals.**	**The actuator has over-heated, and the motor current is shut down to prevent damage.** **Make sure the surrounding temperature is within limits and that the duty type requirements are followed**
The actuator with bus interface does not respond to control signals. **The actuator responds normally when tested with E3C.**	**Incorrect bus settings, please check the configuration described in the Eltorque E3C Manual.** **OR** **Bus control system is not wired or configured correctly.**

Problem description	Cause and solution
The actuator with digital or analog interface does not respond normally to control signals. **The actuator responds normally when tested with E3C.**	**Incorrect digital or analog inversion settings, please check the configuration described in the *Eltorque E3C Manual*.** **OR** **The digital or analog control system is not wired or configured correctly.**
The actuator does not respond either to control signals or when tested with E3C.	**Restart the actuator (power on/off).** **Verify the power supply with a voltage meter. If the power is OK, the communication interface box is defect and must be replaced.**
After replacement of interface, the actuator does not operate correctly.	**The interface has not been configured correctly, please refer to section 3.8 Configuration.** **Contact the local Eltorque agent for support if required.**

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Chapter 6 Maintenance

The QT-series actuators are, in principle, maintenance-free. All bearings and gears are lifetime lubricated, and components are designed to last throughout the actuator's lifetime. However, it is recommended that the actuator is inspected regularly to reveal any damages caused by mechanical impact or corrosion.

6.1 Maintenance overview

- **Inspection**
- **Lubrication**
- **Care and cleaning of anodizing**
- **Maintenance of battery in a Failsafe system. See section 12.8 Maintenance plan on page 79.**

6.2 Inspection

- **The actuators should be inspected yearly:**
    - **Check that the bolts connecting the actuator and valve are fastened according to the required torque.**
    - **Check that the top cover gasket and operation shaft are lubricated. If they seem to be dry, follow the procedure in 6.4.**
    - **Check for corrosion or other physical damage.**
    - **Perform a test run for each actuator from the control unit.**

- **Eltorque recommends that the unit is inspected for damage by Eltorque qualified personnel if the actuator has been submerged in seawater.**

6.3 Tightening of bolts

See Appendix A Torque and Screw Recommendations on page 95.

6.4 Lubrication

The top cover gasket and manual operation shaft seal should be lubricated if they appear to be dry. Use suitable silicone lubricants for O-rings, such as MOLYKOTE 55 O-RING grease or Super Lube silicone lubricating compound.

6.5 Care and cleaning of anodizing

Caution! Do not use ammonia, alkaline cleaners, lye, or strong acid for cleaning

Attention ! Ne pas utiliser d'ammoniaque, de nettoyants alcalins, de lessive ou d'acide fort pour le nettoyage

For cleaning purposes use organic solvents such as mild soap or detergent, alcohol, acetone or MEK (methyl ethyl ketone).

Caution! Do not use high pressure power washer directly on the actuators as the product is not IP69K rated.

Attention ! Ne pas utiliser de nettoyeur haute pression directement sur les actionneurs, car le produit n'est pas conforme à la norme IP69K.

Chapter 7 Technical Details

7.1 Surface treatment

Eltorque actuators have been designed to withstand harsh environments. All products have undergone and passed salt mist tests according to DNVGL-CG-0339. Different types of surface treatments have been used. Aluminum parts are typically anodized, CED coated, and steel parts treated with Dacromet and painted.

7.2 Communication interface

The Eltorque communication interface consists of three main modules:

- **Power supply**
- **Motor control**
- **Interface**

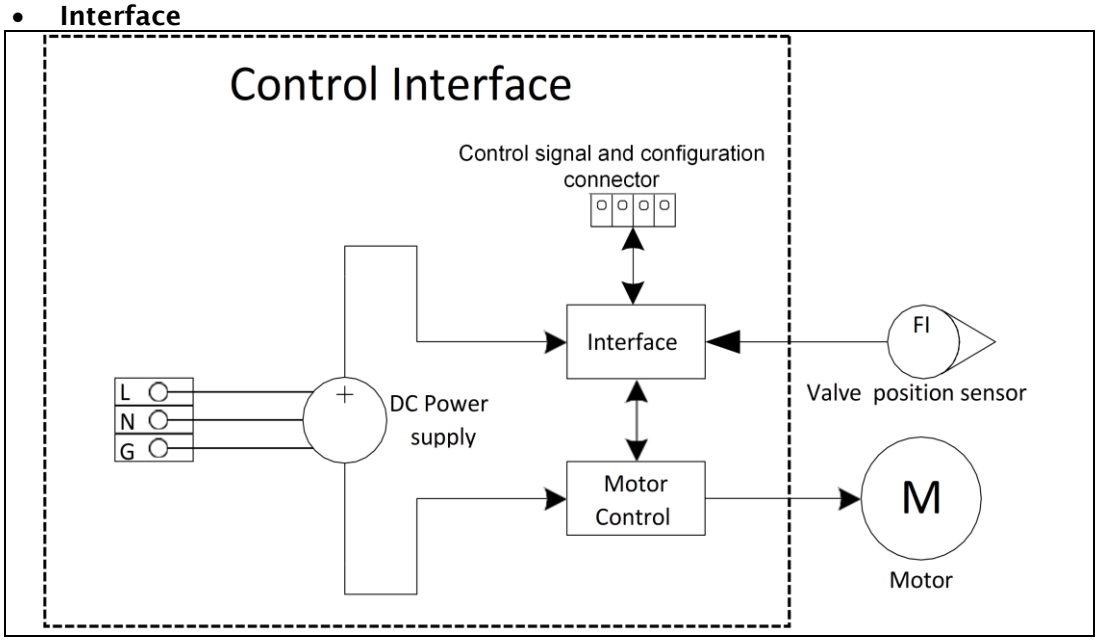


Figure 42: Communication interface schematics

7.2.1-- CANopen interface

For more technical information about the Eltorque CANopen communication, refer to the "*System Integrators Manual CANopen interface*" ID 1691.

7.2.2-- Modbus/Profibus

For more technical information about the Eltorque Modbus communication, refer to the "*System Integrators Manual Modbus interface*" ID 2297.

7.2.3-- Digital interface

Note! ***This chapter does not apply to CANOnly.***

The following functions are available:

- **CLOSE and OPEN command (inputs):**
    - **Is triggered by a positive edge followed by an active signal for at least 100ms.**
    - **The actuator stops and sets ALARM status if the OPEN signal is activated during a CLOSE command, or the CLOSE signal is activated during an OPEN command.**
- **CLOSED signal and OPEN signal (outputs)**
- **ALARM signal (output)**
    - **Activated if GENERAL ALARM is triggered.**

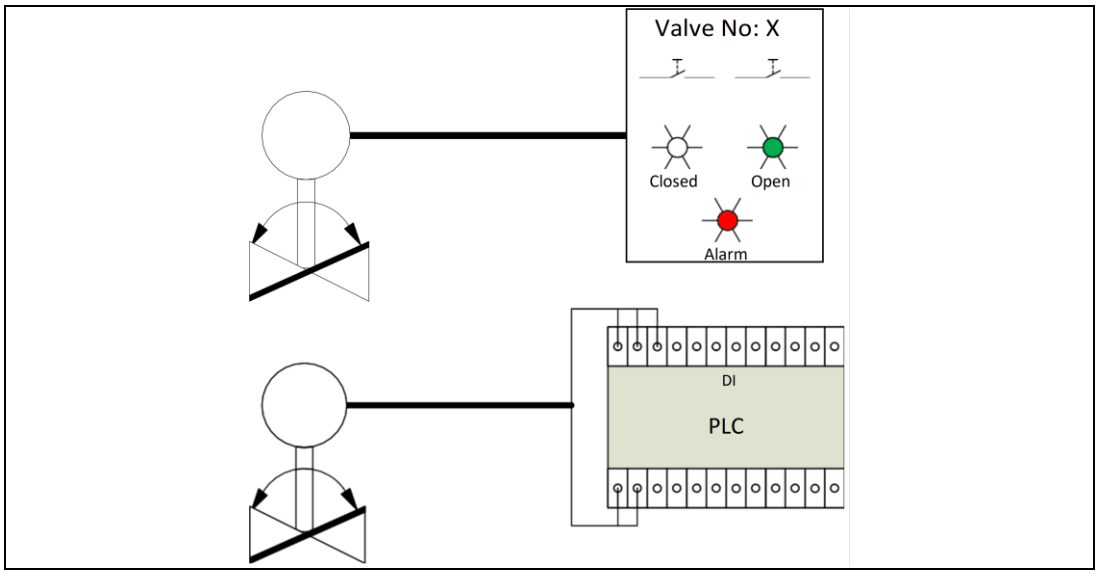


Figure 43: Digital control using buttons and lamps or PLC

As shown in the illustration above, actuators with the digital interface can be controlled directly from a conventional panel with buttons/ switches and indicator lamps. Alternatively, it can be controlled from a controller with Digital inputs and outputs. This allows extended functionality in terms of automatic control and visual user interface on display.

In case both the Close and Open signals are active simultaneously, the actuator opens. Both input and output signals can use pulses of minimum 100ms length or constant signals.

The outputs provide feedback of the actuator's status, such as Closed, Open and/or Alarm.

The following failure scenarios trigger an alarm:

- **Manual emergency operation**
- **Valve position out of defined operation area**
- **Valve blocked**

- **High temperature**
- **Power failure (if alarm output is inverted)**
- **4 – 20mA control signal is lost (Only Analog Interface)**

7.2.4-- Analog interface

Note! ***This chapter does not apply to CANOnly.***

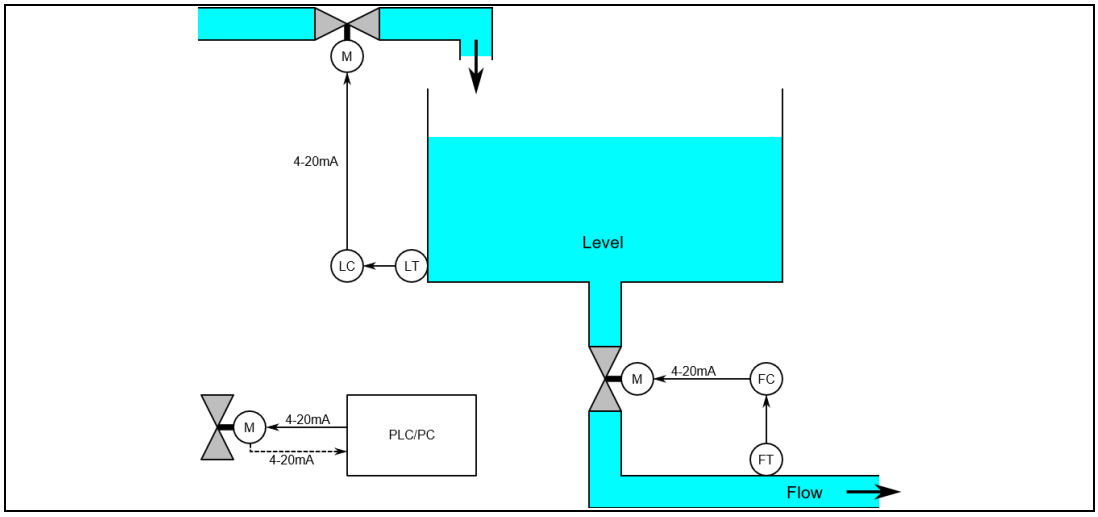


Figure 44: Analog level and flow control.

Note! ***The accuracy of an actuator with an analog interface is +/- 5%, (if the control signal is 12mA/ 50%, the valve position is in the range of 45-55%).***

Default definition of Analog control signal is:
4mA = Close
20mA = Open
The analog output requires an active supply for the 4-20mA interface.

If calibration between PLC and actuator is needed. The calibration should be done according to document *ID: 3571*.

If higher accuracy is needed, please contact Eltorque for support.

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Chapter 8 Dual CAN Option

This chapter describes the Dual CAN option.

8.1 Product description

With the Dual CAN option, redundancy support is improved, making the actuator system more robust to errors.

The Dual CAN interface improves system redundancy communication and makes a loop of actuators more robust to short circuits and break in the cable. The actuators can be connected in a bus topology like before. In addition, the system installations utilizing Dual CAN allow a redundant PLC to be connected at the other end of the CAN bus. This introduces a possibility to retain full control of all actuators in the event of a single signal cable failure (short circuit, breakage, etc.).

Note! ***Due to its design, some latency will occur in each node. This results in a lower number of nodes per loop compared to a standard CAN node.***

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Chapter 9 CANOnly Option

This chapter describes the CANOnly option.

9.1 Product description

The CANOnly supports only the CAN interface and can't be combined with the failsafe option. The CANOnly can be configured as Single CAN or Dual CAN interface.

This configuration shall be used in the situation where a customer doesn't require digital and/or analog interfaces.

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Chapter 10 Modbus/Profibus Option

This chapter describes the Modbus/Profibus option.

10.1 Product description

With the Modbus/Profibus interface option, compatibility with both the Modbus RTU - and Profibus DP protocols is ensured.

Due to its design, this option cannot be combined with the functional Failsafe option, and it does not contain an analog or digital communication interface.

For detailed configuration and data specification, please refer to "*System Integrators Manual Modbus interface*" ID 2297.

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Chapter 11 Dual Power Option

This chapter describes the differences between a standard actuator and one with a Dual Power option.

11.1 Product description

The Dual Power option is a functional extension of an actuator adding 24V DC power input to standard 115V - 230V AC. This feature might be combined with Single and Dual CAN configuration or Modbus/Profibus.

To operate reliably the Dual Power actuator requires a minimum of 21V DC on the terminals. Maximal current consumption is max 3A.

11.2 Installation consideration

To utilize actuators with the Dual Power feature requires thorough system analysis. The focus of the analysis is voltage drop. Factors contributing, but not limited to the voltage drop are the following:

- **cross-section of the backbone cable,**
- **length of the backbone cable,**
- **cross-section of the cable stub,**
- **length of the cable stub,**
- **maximum of actuators active simultaneously.**

The critical system parameter to consider is the lowest allowed battery voltage. Figure 45 shows a draft of an installation utilizing Eltorque's hybrid cable. The orange lines represent the battery power supply distribution network. From a battery backup goes backbone to a junction box, located as close to the actuator(s) as reasonable. From the junction box, a star connection is established to power the individual actuator.

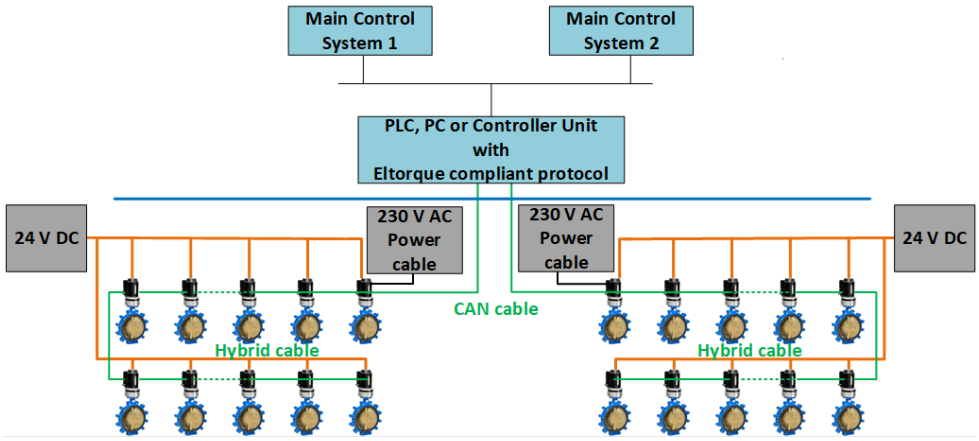


Figure 45 An example of an installation with Dual Power actuators

Eltorque recommends using 10 mm² / 8 AWG for the backbone as a minimum.

11.3 Dual Power supply connection

Open the interface box as described in chapter 4.4 Cable connection overview.

There is a pair of WAGO 221-412 (or similar) splicing connectors, one for the ground conductor and one for the hot conductor. Leads in the interface box are black and red for ground and hot conductors respectively. The splicing connector accepts 0.14 mm² - 4 mm² / 24 AWG to 12 AWG conductor sizes.

Strip conductor to 11mm insert the conductor in the splicing connector and secure it.

For connecting the main power supply follow the description in chapter 4.6 Power supply connection.

Chapter 12 Failsafe Option*

The Eltorque QT-series actuators are available with more than one safety/emergency solution.

The standard product comes with:

- **An emergency hand wheel for manual operation.**
- **A self-lock function that ensures that the actuator is kept in position.**

Additionally, the following options are available:

- **A Dual CAN option, providing a more robust CAN network.**
- **A Failsafe option, providing and UPS back-up battery.**

This appendix describes the Failsafe option. The Dual CAN option is described in *Chapter 8 Dual CAN* on page 67.

Note! ***The failsafe actuator supports CAN, digital and analog interfaces.***



Figure 46: Actuator with Failsafe option

**** The Failsafe option is not UL certified for QT series actuators.***

12.1 Disposal and waste handling

All batteries and electronic equipment may contain substances harmful to the environment. Therefore, after removing used equipment, return them for disposal according to local governmental guidelines.

12.2 Product Description

The failsafe electrical actuator is a functional extension of QT series generation 2.5 actuators. Physically, the difference is the added failsafe module between the interface box and the motor unit, also found on the standard version. This module contains the battery (Lead acid) and the UPS management system.

When adding this module, the certified temperature rating is reduced, and the overall size is increased. Still, it enables the internal power source for a pre-defined operation after a signal or power loss. Both these interruptions are individually adjustable by a predefined time delay.

12.2.1 Failsafe actuator components

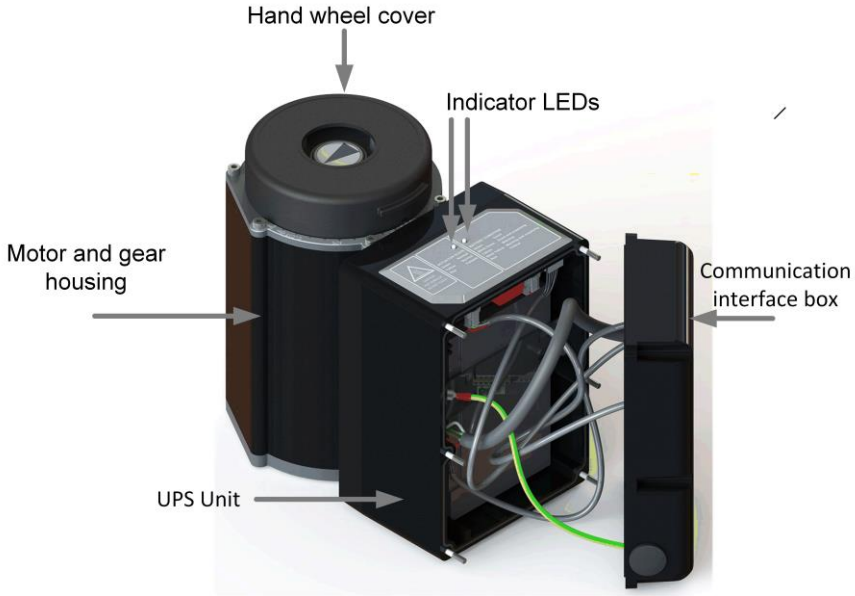


Figure 47: Actuator with Failsafe option

The bottom views for the motor and gear housing and the communication interface box are identical to the standard version shown in Figure 7 and Figure 8 on pages 24.

12.3 Planning

Due to the introduction of both a battery and a security protocol (the failsafe protocol), the product installation needs to be planned well to avoid unwanted behavior/accidents. This chapter covers Eltorque's input for planning. Eltorque can also quote assistance for both the planning activities and the installation activities if requested.

12.3.1 Technical differences between standard and failsafe actuator

The failsafe module introduces changes to the overall actuator appearance and function. The following limitations are important to consider during planning.

- **Certified temperature location class is reduced from class D to class A when the option failsafe is selected.**
- **The actuator's overall size is increased, see section 12.3.6 Space requirements on page 79.**
- **A battery maintenance plan must be established to ensure that the battery has enough energy to perform the required task(s) and that the battery SOH is within acceptable levels. See section *12.8* Maintenance on page 86.**
- **Storage conditions and charging of batteries in storage. If the actuator and or battery is not installed and externally powered within a reasonable time after the reception, a storage and or charging plan needs to be established. Please refer to section 12.3.5 Storage on page 79.**

12.3.2 Considerations for products with batteries during installation

Note! ***If the intended storage time is longer than 3 months after reception, please refer to section 12.3.5 for input on proper storage conditions.***

Caution! Battery warranty may be voided if the battery is damaged and there is no installation plan available

Attention! La garantie de la batterie peut être annulée si la batterie est endommagée et qu'aucun plan d'installation n'est disponible

It is important to consider the information below when planning the installation of the failsafe actuators. Due to it being a solution with a battery, it cannot sit without external power for an unlimited time due to self-draining. See Table 12: Battery lifetime below for details on expected battery lifetime. It is important to both select an installation strategy for the actuators, and to respect the battery lifetime estimates during the installation.

Based on this information, Eltorque has made the following input on how the products can be handled from reception to fully commissioned.

The actuator is shipped with the battery installed in the module, but without the battery connected to the UPS management card. When received one can choose between installation method A or B. Installation method A can be installed in either way 1 or 2.

A. **Install the actuator with the battery mounted in the module of the installed product. This installation method can be divided into two options:**

   1. **Connect the battery when installing (see *Table 12, pos 4* for estimated battery lifetime)**

   2. **The battery is Not connected until a later stage (see *Table 12, pos 3* for estimated battery lifetime)**

B. **Install the actuator without the battery mounted in the module of the installed product. The battery is removed from the product, following the procedure in section *12.8.2 steps 1-9* and stored as described in section *12.3.5* Storage on page 79. The battery needs to be installed at a later stage when external power is available. The battery needs to be charged according to the required specifications.**

Table 12: Battery lifetime

State	Battery lifetime
Battery not connected:	
1) Shipping from Eltorque AS	**Up to 6 months**
2) External Storage	**Up to 6 months**
3) Installed on vessel	**Up to 3 months**
Battery Connected:	
4) Deep sleep state	**Up to 50 days**
5) Service state	**Up to 12 days**
6) Failsafe State	**Up to 36 hours**

Note! ***Estimated battery lifetime is calculated based on the most common scenario but will vary based on factors such as temperature.***

12.3.3 Available Failsafe protocols

The failsafe option offers a safety aspect in terms of operation after a failure. As there is an internal battery and onboard management, it is possible to preprogram the actuator to move to the predefined safest position when contact with the actuator is lost.

The failsafe function supports the following protocols:

- **Fail-maintain: The actuator keeps the position.**
- **Fail-to-open: The actuator moves to the valve open position.**
- **Fail-to-close: The actuator moves to the valve closed position.**

It is not possible to have different protocols for different types of errors.

Note! ***The actuator cannot activate any other command when the failsafe protocol has been initiated, even during the pre-set timeout counter.***

12.3.4 Maintenance plan

The product is certified with a yearly required battery discharge test. To keep the product in a certified state, a plan for both performing and executing this discharge test must be created. Due to the possibility that the class and the certificate have different requirements, the strictest of the two shall be followed and testing performed according to those requirements.

The purpose of this discharge test is to establish the real battery capacity (SOH) safely. Please refer to section 12.8.1 Battery discharge and charge on page 86 for instructions on how to perform this test.

Eltorque recommends that independent of the battery health status, the battery is replaced every five years during vessel classifications to secure proper functioning when needed.

All deviations to ideal conditions will reduce the battery lifetime.

12.3.5 Storage

The following storing conditions are recommended for the product (actuator and/or battery)

- **The storing temperature should be 5˚C to 35˚C.**
- **The battery must be fully charged before storage.**

If the planned storage of the battery is above the limits for storage set by Eltorque, maintenance charging needs to be done. The below instruction is the Eltorque recommendation when charging is needed:

- **The battery should be charged with CC/CV charging algorithm 900mA constant current (CC) up to 14.7V. When the charging voltage reaches 14.7V keep the voltage constant (CV) and stop charging when the charging current reaches 90mA or after 32 hours total CC/CV charging time.**

12.3.6 Space requirements

Actuator dimensions

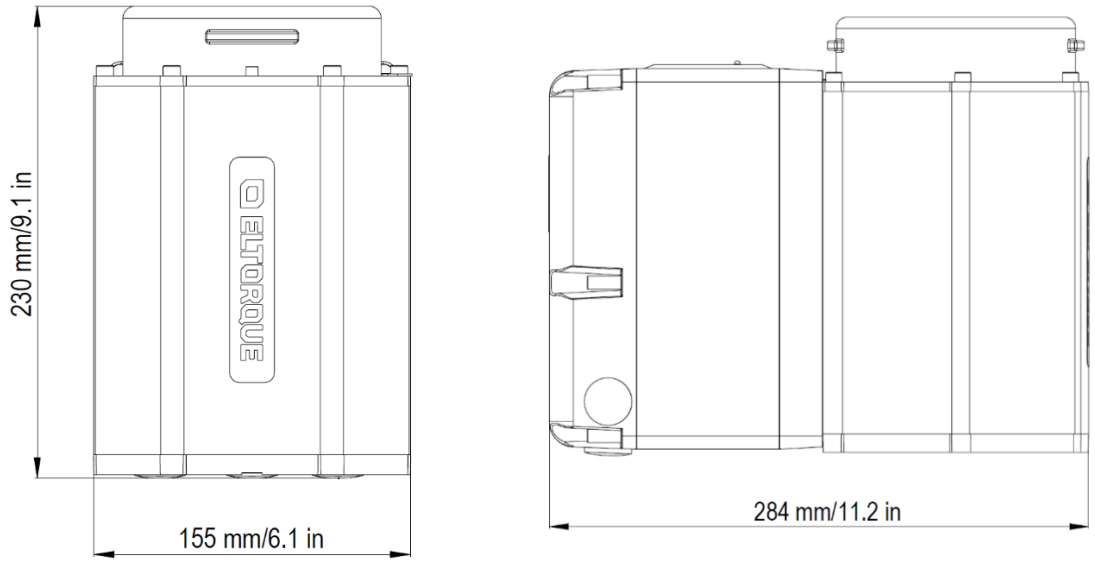


Figure 48: QT70, QT250 and QT400 Dimensions with Failsafe option

Service space

During planning, please ensure there is enough space above and around the actuator for installation, service and manual operation.

There must be a minimum of 150mm/5.90in space above and to the sides of the actuator to accommodate room for installation, operation and service. In front of the communication interface box there should be at least 200mm/7.9in.

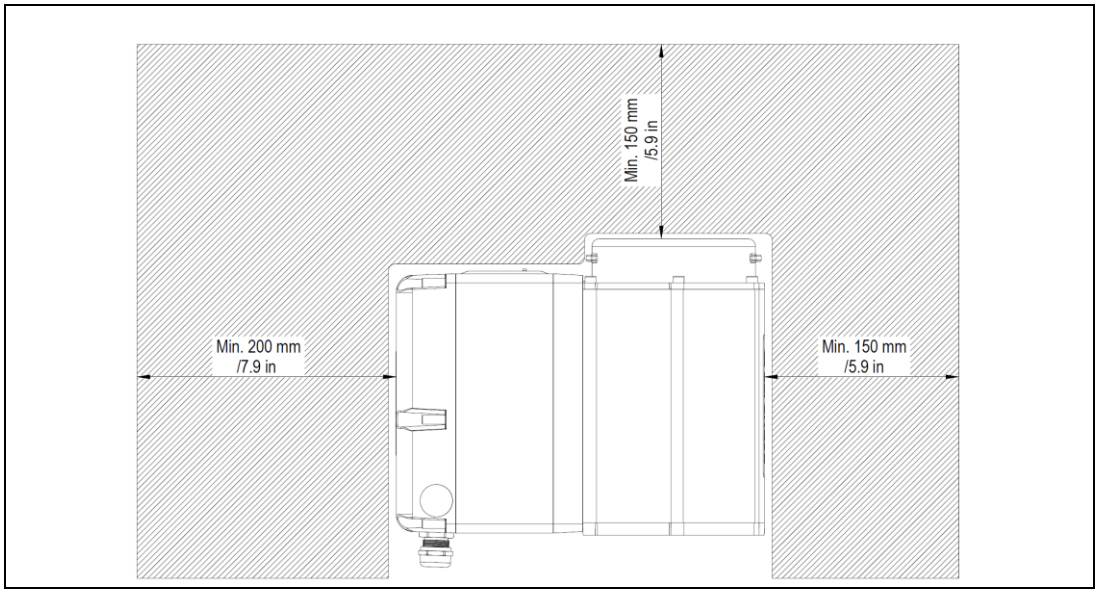


Figure 49: QT-series with Failsafe – Space requirements for installation, service and manual operation

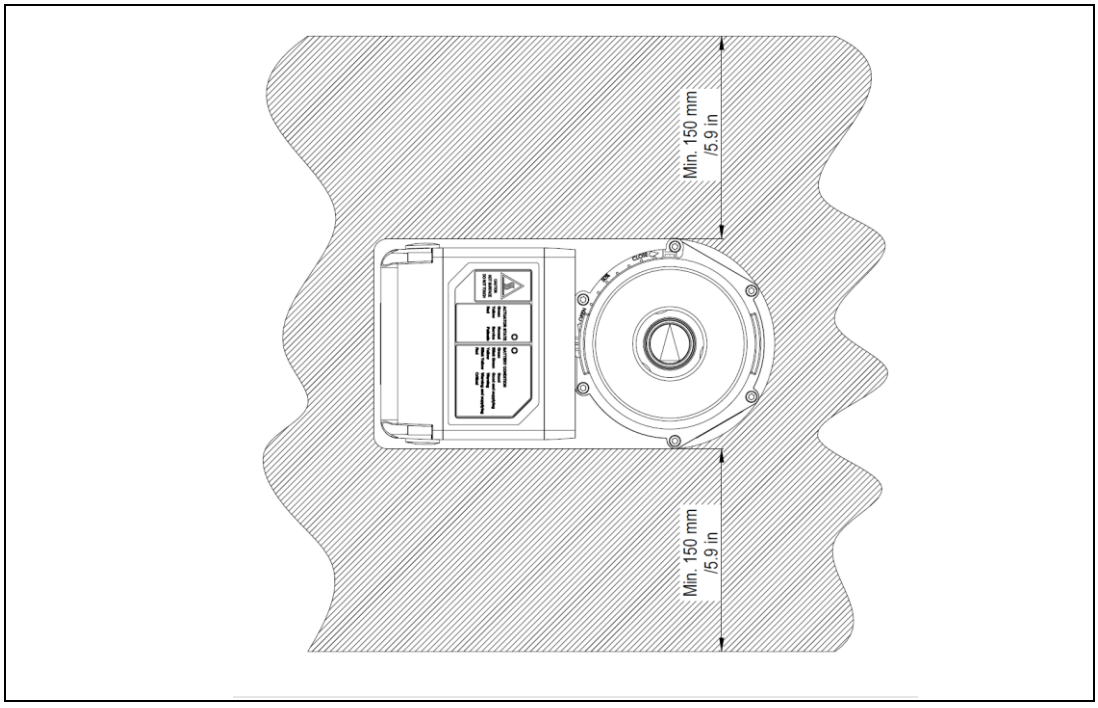


Figure 50: QT-series with Failsafe – Space requirements for installation, service, and manual operation

12.4 Configurable Parameters

The failsafe actuator has several configurable parameters. The tables below show the parameters that trigger the failsafe protocol and other important parameters necessary to adjust for correct error behavior.

Note! ***For all available parameters, see System Integrators Manual CANopen Interface.***

Table 13: Failsafe triggers

Parameter	Action / Purpose	Adjustable Range
Set Failsafe from IAS/E3C	**Manually setting Failsafe for test or other scenarios**	**NA**
Heartbeat Bad timeout	**Initiate Failsafe protocol if the signal is lost after the predefined time delay.**	**0-255 seconds**
PSU Critical Timeout	**Initiate the failsafe protocol if external power is below critical after the predefined time delay.**	**0-255 seconds**
UPS Error Timeout triggered by one or more of the following	**The UPS Error Timeout is a common timer for all internal errors before triggering of the failsafe protocol.**	**Disabled (65535) or adjustable between 0-65534 seconds**
UPSCOMERR	**PSU Communication error**	
TEMPERR	**Temperature above critical**	
SOHERR	**State of Health below minimum**	
SOCERR	**State of Charge below minimum**	

Table 14: Other important configurable parameters

Parameter	Action / Purpose	Adjustable Range
Heartbeat Good Timeout	**Timer for ensuring that the heartbeat is present for the requested time period before reporting all OK to IAS**	**0-255 seconds**

12.5 Mounting and installation

The Failsafe actuator is mounted and installed in the same way as a standard actuator, with the following exceptions:

- **There are routines to follow for the storage and installation caused by battery considerations, see information in section *12.3.2 on page 77.***
- **There are considerations to make when you open the actuator, see *12.5.2* below.**
- **The interface communication box is fastened to the failsafe module with nuts instead of screws.**
- **Connection of the battery cable sees *12.8.2* on page 86, steps 12 – 16.**

See *Chapter 4 Mounting and Installation* on page 38 on how to connect the external power and signal cables to the communication interface unit.

12.5.1 Installation considerations

Due to the different states the product might be operating in, considerations should be made to ensure the battery is not drained below the levels necessary to keep the battery suitable for use.

If there are planned power outages, the following rules should apply:

If 230 VAC power is expected to be unavailable for >36 hours:

- **Activate Service mode**
- **Disconnect the 230 VAC power**

If 230 VAC power is expected to be unavailable for >12 days:

- **Disconnect the 230 VAC power**
- **Disconnect the battery on each unit**

12.5.2 Opening the actuator to access connectors

Depending on the selected installation plan the necessary operations will be different. Below is a summary of both options. See section *12.8.2 Changing battery* on page 72.

- **Installation method A: Follow step 1-4 and 12-16**
- **Installation method B: Follow step 1-16**

Caution!	The interface and failsafe module will after disassembly of the nuts still hang on the stud bolts. Be aware not to lose the nuts.
Attention!	Après avoir retiré les écrous, l'interface et le module de sécurité restent fixes aux goujons. Soyez conscient de ne pas perdre les noix.

Remove the six hexagon socket cap nuts holding the interface to the actuator. The nuts and bolts are circled in red in the illustration below. Remove the nuts by turning them counterclockwise. Place the nuts in a secure location.

Required equipment:

- **4mm Hexagon Key**

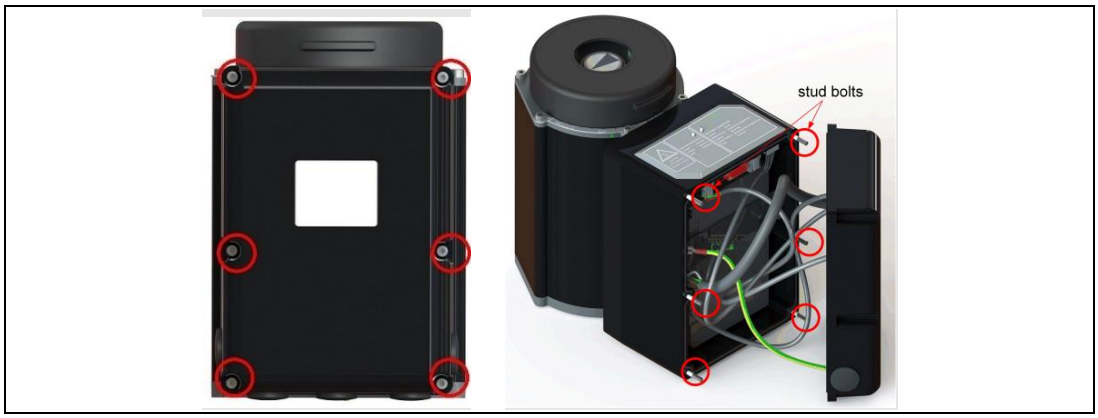


Figure 51: QT Series generation 2.5 – opening the failsafe actuator Installation

12.6 Configuration

Configuration of the actuator nodes needs to be done by E3C to ensure all parameters are as intended. We recommend that Eltorque Qualified Personnel are present at commissioning larger systems to ensure correct settings for all nodes. See *section 12.4* for an overview of these parameters.

Before the actuator can be operated, the deep sleep state must be cleared. The deep sleep state is cleared by connecting with E3C and the clear Service function.

12.7 Operation

12.7.1 Powered actuator states

The following section gives an overview of the different states the product can be in and how the state can be set.

Refer to Table 12 on page 78 for battery lifetime estimates for the different states.

Deep Sleep state

This is a non-operative state, and the state needs to be cleared to have the actuator enter an operative state. It is recommended to carefully review table 8-21 before clearing this state.

This state is automatically activated when the product is attached and powered the first time. This will be confirmed by three blinks (Red, Yellow, Green). After clearing this state, the actuator is NOT able to go back to deep sleep mode unless the battery and power are detached for min 30 seconds before attaching again. It is not possible to access this state from IAS/E3C.

Normal state

In normal state, the actuator works as a standard QT Series generation 2.5 and can receive commands from IAS/E3C. However, if the failsafe state or service state has been activated, the normal state is only resumed if failsafe or service is cleared from the IAS or E3C.

Normal state cannot be set by IAS/E3C but is the standard state when all other states are cleared.

Failsafe state

This is the state where the product will move to its pre-defined position. All errors have a timer which can delay the execution of the failsafe protocol. If the error causing the trigger of failsafe is cleared before the countdown has finished, the product will go back to normal state. When a failsafe trigger is active (section B4.vii), the actuator will not react to other commands even during the pre-configured time delay.

The failsafe protocol must be triggered (see *Table 13: Failsafe triggers* on page 81) or manually set from IAS/E3C. The failsafe state can only be reset from the IAS or E3C, and only when the error causing the trigger of the protocol is cleared. For example, if the power is lost, the power must be restored to clear failsafe.

Note! ***Be aware that during commissioning minor or major power outtakes can occur on the vessel.***

Service state

The service state will make the actuator non-responsive to commands and failsafe triggers blocking commands to be executed. If any work is to be done to the product, this state needs to be activated to avoid possible personnel injuries or material damage. When cleared, the actuator resumes normal or failsafe state, whichever was active before the initiating of service state. Once the service state is no longer required, it is cleared remotely via the IAS or E3C.

Service state may be set by manually operating the handwheel or from the IAS/E3C. The state must be reset from the IAS/E3C.

For information on how to operate the handwheel, please see *Manual operation* on page 55.

12.7.2 LED indication

The indicator LEDs are positioned at the top of the UPS unit. There are two LEDs, one for the actuator status and one for the battery status. Table 12-15 shows the different status conditions for both the battery and the actuator.

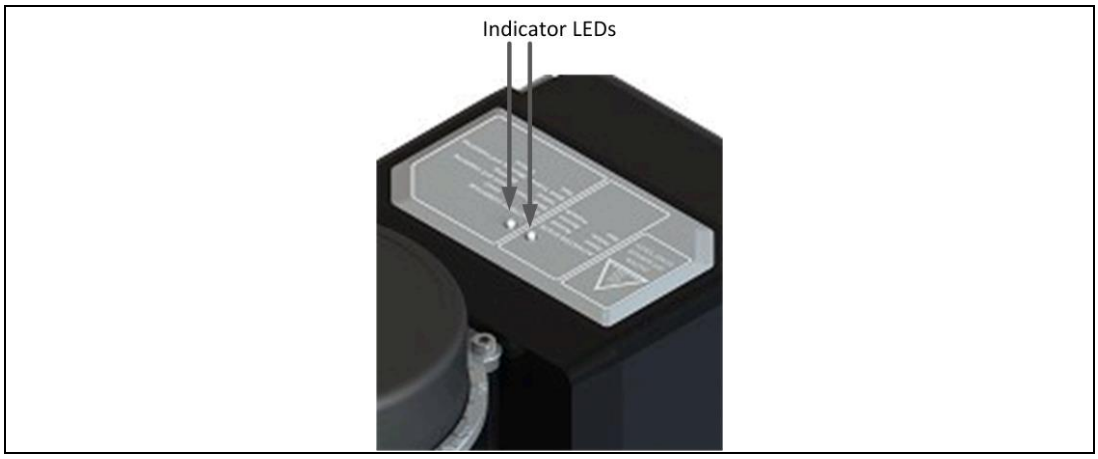


Figure 52: QT-series –indicator LEDs

Table 12-15: LED indication.

Message	LED1(battery status)	LED2 (Actuator status)
Battery Health Good	Green	-
Battery Health Good and supplying	Blink Green	-
Battery Health Under Warning	Yellow	-
Battery Health Under Warning and supplying	Blink Yellow	-
Battery Health Under Critical	Red	-
Battery Health Under Critical and supplying	Blink Red	-
Actuator Normal	-	Green
Actuator Service	-	Yellow
Actuator Failsafe	-	Red

12.7.3 Troubleshooting overview

Problem description	Cause and solution
230 VAC power has been lost for >36 hours while in Failsafe mode, 230 VAC power has been lost for >12 days while in service mode (not deep sleep)	The battery must be recharged, see 12.8.1 below.

12.8 Maintenance

12.8.1 Battery discharge and charge

A battery test and maintenance plan must be implemented according to the certification requirements or the class requirements (whichever is the strictest). For the failsafe product, this implies that the battery must be completely discharged regularly.

Battery discharge of lead-acid batteries must only take place while the ship is at port, for example, during system revision shutdowns or as part of ship maintenance routines. It implies that the actuator is non-operational during this procedure. The discharge routine may take up to 24 hours, depending on the battery status when the routine is started.

Reference is made to the *System Integrators Manual CANopen Interface* for the correct register/index.

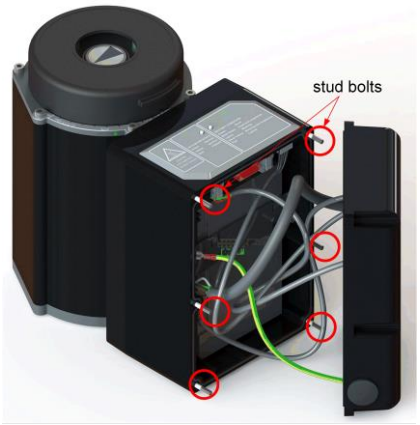
1. **Set the actuator in service mode.**
2. **Send the command "Start Battery Deep Cycle Test"**
3. **The actuator automatically charges the battery to 100%.**
4. **The bit "BATTDIS" indicates that the test is performed.**
5. **When the battery reaches 0%, the "BATTDIS" is automatically cleared, the SOH value is updated, and the battery is recharged.**
6. **When the battery has reached the lower limit for SOC, service mode can be cleared, and the actuator resumes normal operation.**

12.8.2 Changing battery on the failsafe module

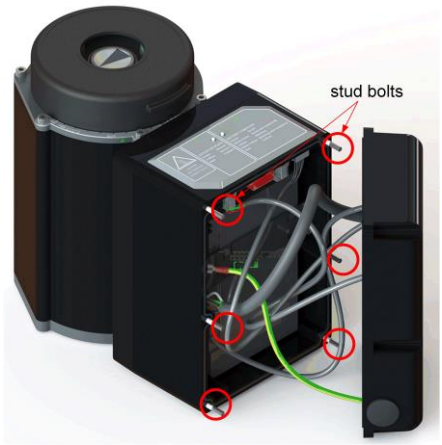
This procedure describes how to change the battery in the failsafe module.

Parts of this procedure also applies to first time installation the Failsafe actuator as the battery cable must be connected - see steps 12 – 16.

Procedure		
Step	***Description***	***Illustration***
1	**Enable service mode either from the actuator control panel, or by rotating the handwheel of the actuator.** **Make sure that the actuator service indicator light is yellow on all actuators that the battery change procedure is going to be performed on before proceeding to the next step.**	
2	**Turn off the power going to all actuators that the battery change procedure is going to be performed on. (Be aware of failsafe triggers for the rest of the loop.)**	

Procedure		
Step	***Description***	***Illustration***
3	**Remove the six hexagon socket cap nuts holding the interface to the actuator.** **The nuts are marked by red circles in the illustration.** **Remove the nuts by turning them counterclockwise. Place the nuts in a secure location.** **The interface and failsafe module are loose when the nuts are removed: Make sure that the interface and failsafe module does not fall off.** **Required equipment:** **4mm Hexagon Key**	
4	**Remove the interface as shown in the illustration.** **Make sure to not drop the interface, or to let it hang by the cables.**	
5	**Disconnect the battery cable connector marked by a yellow circle in the illustration.**	

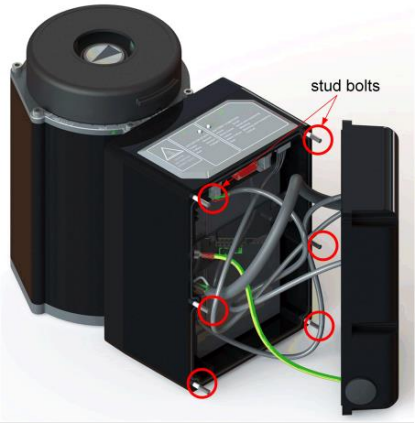
Procedure		
Step	***Description***	***Illustration***
6	**Disconnect the rest of the cable connectors marked by yellow circles in the illustration.**	
7	**Place the interface in a secure location to avoid any damage to it.**	
8	**Remove the four M3 hex socket head screws holding the battery bracket by turning them counterclockwise. The screws are circled red in the illustration.** **Place the screws and connector in a secure location.** **Required equipment:** **2,5mm Hexagon Key.**	
9	**Remove the battery by sliding it out of the frame.** **Replace the battery and slide the new battery into the frame.**	
10	**Fasten the battery holding bracket with the four M3 hex socket head screws by turning them clockwise. Tighten the screws to 1,2Nm and lubricate the threads using Molykote 1000 or similar lubricant containing MoS2. Make sure that the grounding connectors are placed as shown in the illustration before tightening the screws. The screws are circled red in the illustration.** **Required equipment:** **2,5mm Hexagon Key.**	

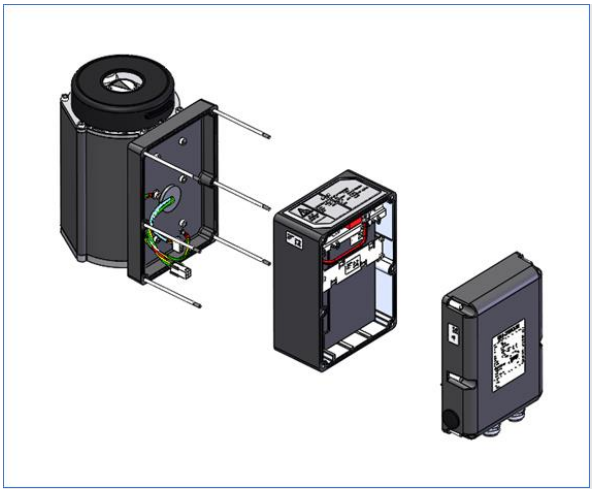
Procedure		
Step	***Description***	***Illustration***
11	**Hold the interface close to the actuator and connect the connectors marked by yellow circles in the illustration. The two equal connectors are distinguished by the color on the cable sleeve. The cable with the blue sleeve connects to the cable with the blue sleeve, and the cable with the black sleeve connects to the PCB.**	
12	**Connect the battery connector marked by a yellow circle in the illustration.**	
13	**Place the interface back on the actuator. Make sure no cables get caught on the sealing surface between the interface and the actuator. Make sure to not drop the interface, or to let it hang by the cables.**	
14	**Fasten the interface with the six hexagon socket cap nuts by turning them clockwise. Note the correct sequence for tightening the nuts. See *Appendix A Torque and Screw Recommendations* on page 95.**	
15	**Turn on the power going to the actuators.**	
16	**Disable service mode from the actuator control system. Make sure that the actuator state indicator light is green on all actuators that have received a new battery.**	

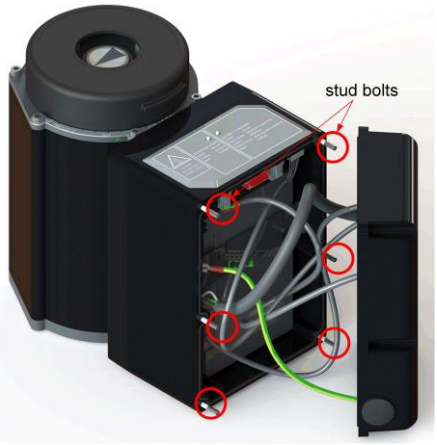
12.8.3 Changing the failsafe module

This procedure describes how to change the failsafe module in the Eltorque QT Series generation 2.5 Failsafe actuator.

Parts of this procedure also apply to first time installation of the Failsafe actuator as the battery cable must be connected - see steps 12 – 16.

Procedure		
Step	***Description***	***Illustration***
1	**Enable service mode either from the actuator control panel or by rotating the handwheel of the actuator.** **Make sure that the actuator service indicator light is yellow on all actuators that the battery change procedure is going to be performed on before proceeding to the next step.**	
2	**Turn off the power going to all actuators that the battery change procedure is going to be performed on. (Be aware of failsafe triggers for the rest of the loop.)**	
3	**Remove the six hexagon socket cap nuts holding the interface to the actuator.** **The nuts are marked by red circles in the illustration.** **Remove the nuts by turning them counterclockwise. Place the nuts in a secure location.** **The interface and failsafe module are loose when the nuts are removed: Make sure that the interface and failsafe module do not fall off.** **Required equipment:** **4mm Hexagon Key**	
4	**Remove the interface as shown in the illustration.** **Make sure to not drop the interface, or to let it hang by the cables.**	

Procedure		
Step	***Description***	***Illustration***
5	**Disconnect the cables between the failsafe unit and the communication interface.**	
6	**Place the interface in a secure location to avoid any damage to it.**	
7	**Disconnect all cables between the actuator and the failsafe module.** **Remove the failsafe module by sliding it out.** **Slide the new module onto the studs and reconnect the cables.**	
8	**Hold the interface close to the actuator and reconnect the cables. The two equal connectors are distinguished by the color on the cable sleeve. The cable with the blue sleeve connects to the cable with the blue sleeve, and the cable with the black sleeve connects to the PCB.**	

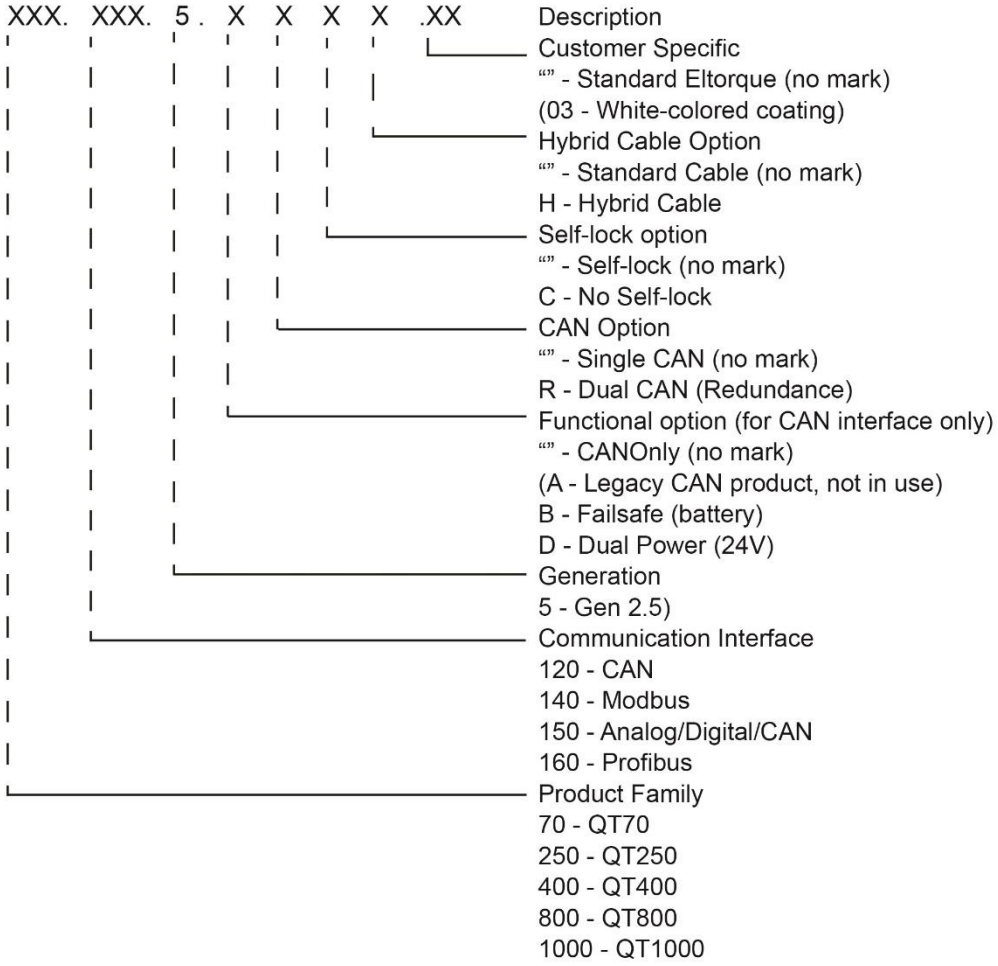
Procedure		
Step	***Description***	***Illustration***
9	**Place the interface back on the actuator. Make sure no cables get caught on the sealing surface between the interface and the actuator. Make sure to not drop the interface, or to let it hang by the cables.**	
10	**Fasten the interface with the six hexagon socket cap nuts by turning them clockwise. Note the correct sequence for tightening the nuts. See *Appendix A Torque and Screw Recommendations* on page 95.**	
11	**Turn on the power to the actuators.**	
12	**Disable service mode from the actuator control system. Make sure that the actuator state indicator light is green on all actuators that have received a new battery.**	

Chapter 13 Ordering Information and accessories

For availability and spare parts, please contact sales office. Use the article number key noted in this chapter for creating an article number.

Customer might identify existing product by using following article key:

Article number keying:



Examples of an article number:
250.120.5 – a QT250 in Single CAN interface and self-lock configuration.
800.120.5BRH – a QT800 in Failsafe, Dual CAN interface and self-lock configuration.

Available accessories are listed in the Table 16.

Table 16: Accessories

Part No.	Description	Comment (text in BOM)
30003	**QT Series Protective Cover for handwheel.**	**QT Series Protective Cover**
900.000	**Service kit with Configuration Cable**	**Service kit QT-series**
900.001	**Eltorque Configuration cable for QT-series actuators**	**Config. Cable QT-series**
35036	**QT Series Actuator label**	**Label 60 x 80mm Premium Extra**

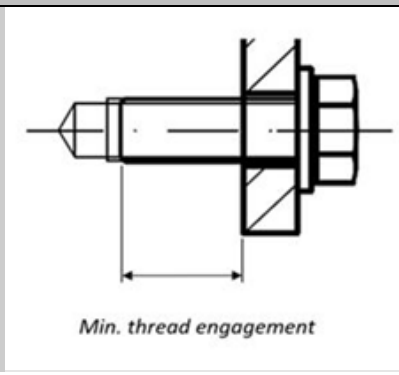
For availability contact your sales representative.

Appendix A Torque and Screw Recommendations

A.1 Eltorque torque recommendations

The following table lists recommended torque values and minimum thread engagement when mounting the Eltorque actuators.

Table 17: Screw torque

Thread size	*Tightening torque. (Nm)*	*Min. thread engagement. (mm/in.)*	
M4	*3.4*	*NA*	
M5	*5.1*	*7.5/0.30*	
M6	*8.9*	*9.0/0.35*	
M8	*21.1*	*12/0.47*	
M10	*41.5*	*15/0.59*	
M12	*70.7*	*18/0.70*	
M16	*172.6*	*24/0.94*	
M20	*336.2*	*30/1.18*	

A.2 Mounting screws and lubrication

- **Use A4-80 screw material and quality.**
- **Use a washer between the bolt head and the mounting flange. Requirements: DIN 125A, minimum 200HV, A4.**
- **Lubricate washer surface and underside of the bolt head with a lubricant resulting in a friction coefficient of 0.08 to 0.14 between bolt head and washer. The lubricant must not contain aluminum, zinc or copper. To prevent galling when using stainless steel fasteners, a lubricant containing MoS_2 is recommended.**
- **Use thread lock Loctite 222 or similar on bolt threads. Be sure that the amount applied is enough, so no water can get into thread holes after the bolt is inserted. The thread-locks main purpose in this application is to serve as a barrier, preventing seawater from acting as a catalyst between bolts and threads in the actuator base.**

A.3 M4 screws on communication interface box

Lubricate threads with a lubricant giving friction coefficient between 0.08 to 0.14. To prevent galling when using stainless steel fasteners, a lubricant containing MoS2 is recommended.

Stainless steel fasteners tend to gall while being tightened. The risk of galling or thread seizing can be reduced by:

- **Using recommended lubrication.**
- **Tighten the screws in the sequence indicated in the figure below.**
- **Tighten fasteners with low rpms, without interruptions.**
- **Apply only light pressure.**



Figure 53: Tightening sequence for M4 screws

Appendix B Earthing Methods in Maritime Installations

All bare metal wires, screens or others not covered by the terminal shall be fully covered in shrink tube to avoid unintended contact between wires, housing or similar.

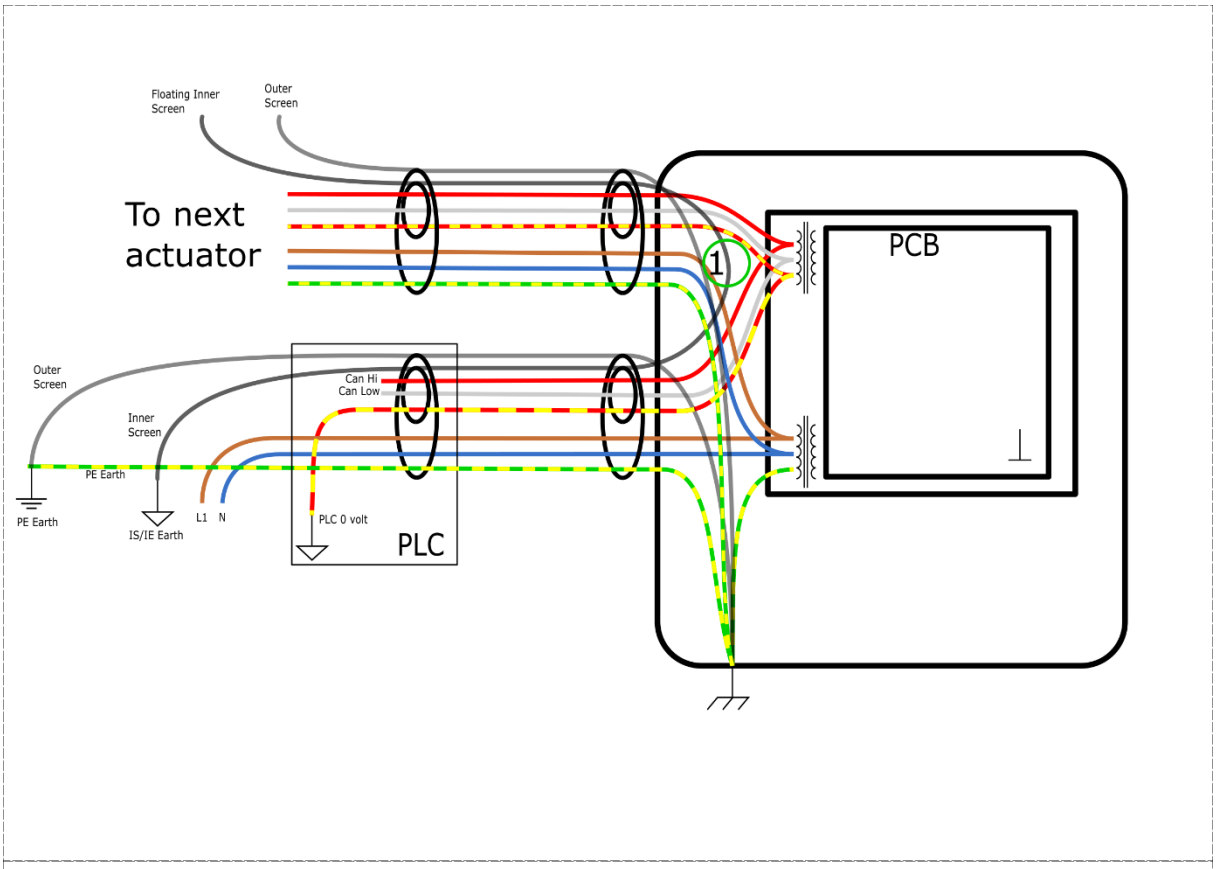
Only one conductor is allowed in each terminal of a terminal block/row for external connections. This is not related to terminals as an integrated part of internal components (e.g. relays, contactors) of the equipment. Two conductors may in certain cases be used in one approved type ferrule connected to one terminal. Contact Eltorque for approval.

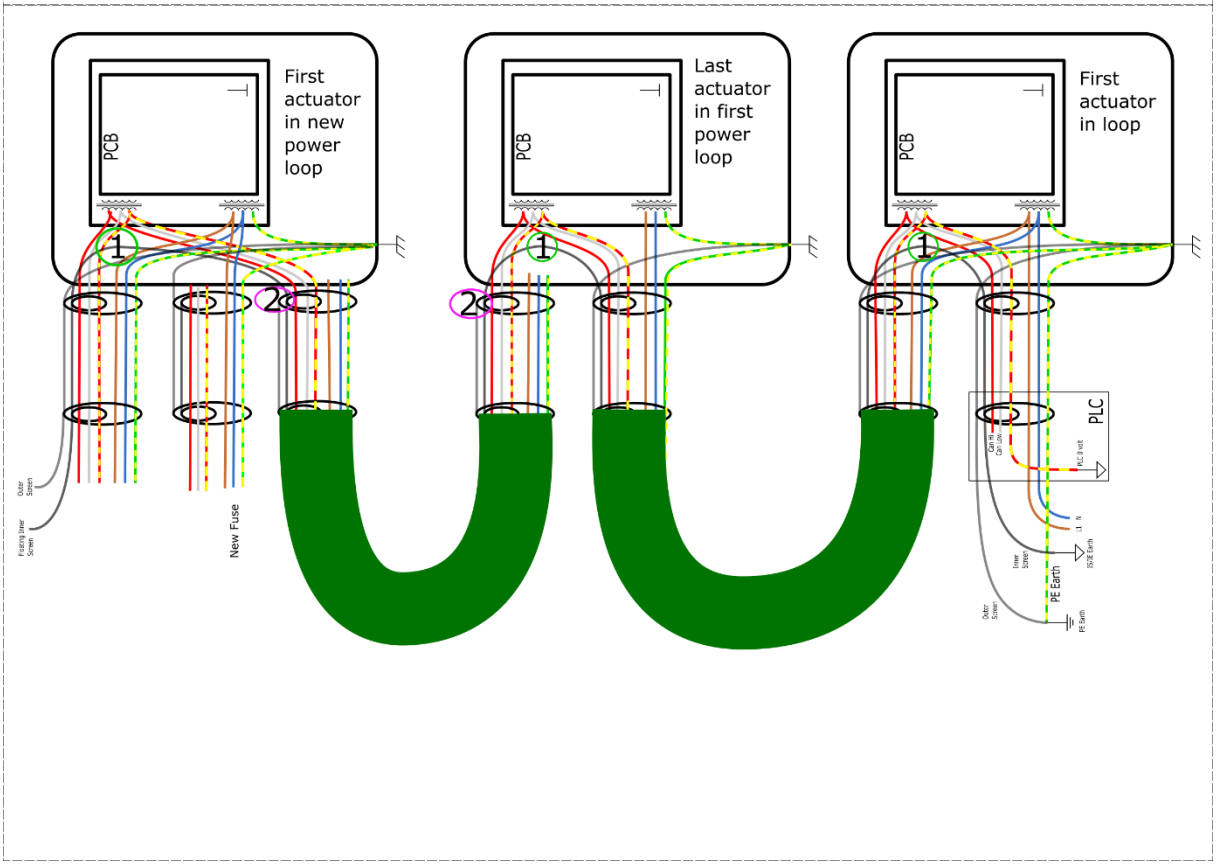
Summary:

- **PE Earth shall be connected to the PE Earth bar in the cabinet and at the actuator housing. PE earth shall preferably not be routed via the PCB to the housing but go directly. The PCB shall be earthed to the actuator housing from its own cable.**
- **Outer braided screen shall be connected to PE earth at both ends. Heat Shrink Tubing shall be used on visible wires inside the actuator.**
- **Inner Screen shall be connected to IE/IS earth in the control cabinet. The other end shall be floating in the actuator (electrically connected through all actuators in the same loop). Heat Shrink Tubing shall isolate the inner screen and make sure that it is not in direct contact with anything inside the actuator.**

Drawing references:

1. **The inner screen needs to be terminated inside the actuator housing. Products that don't have enough terminals available in the connector. need a separate connector. We recommend using Wago 221 or equivalent.**
2. **The outer screen must be cut and not connected to the housing for the connection between two actuators on different power loops. A shrink tube shall be used to cover all bare wires.**


Floating Inner Screen
Outer Screen
To next actuator
PCB
1
Outer Screen
Inner Screen
PE Earth
PE Earth
IS/IE Earth
L1
N
Can Hi
Can Low
PLC 0 volt
PLC


PCB
First actuator in new power loop
Last actuator in first power loop
First actuator in loop
1
2
New Fuse
PLC
PE Earth



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