User Instructions
MAN-02-04-60-0352-EN Rev. 5
October 2023

Operating Manual for Bettis RTS FL Series

Fail-Safe Linear Electric Actuator

BETTIS™

EMERSON™

This page intentionally left blank.

Table of Contents

Section 7: Control Unit

Section 8: Parameter Menu

Section 9: Status Area

Section 10: Infrared Connection

Section 11: Bluetooth Connection

Section 12: Maintenance

Section 13: Troubleshooting

Section 14: Fuses

Section 15: Spare Parts

Section 16: Lubricant Recommendations and Requirements

Section 17: Modes of Operation

Section 18: Technical Data and Certifications

Section 19: Characteristic Curves

Appendix A: Handwheel Force

This page intentionally left blank.

Section 1: Introduction

Bettis RTS FL Fail-Safe electric actuators are designed to operate appropriate valves when a fail-safe functionality is required.

Appropriate valves are all kind of valves that require a linear movement to operate (globe valve, gate valves, etc.).

In the event of a power failure or if the fail-safe function is triggered deliberately, the linear RTS FL actuator shifts the valve to the fail-safe position, using the built-in energy storage device to do so.

Figure 1. Bettis RTS FL Fail-Safe Electric Actuator

Section 2: Functional Description of the RTS FL Fail-Safe Linear Actuator

In normal operation, the actuator is operated by a PM motor (1). Via a worm gear stage (2) and a planetary gear train (3), the motor drives the spindle nut of a ball screw (4). The sun gear shaft of the planetary gear train is fixed in place by an operating current brake (5).

The ball screw converts the rotational movement of the gear unit into linear motion, which, on the one hand, charges the spring packet (6), which acts as an energy storage device. On the other hand, the linear motion is transmitted to the valve stem (8) via a spring-loaded spindle pin (7).

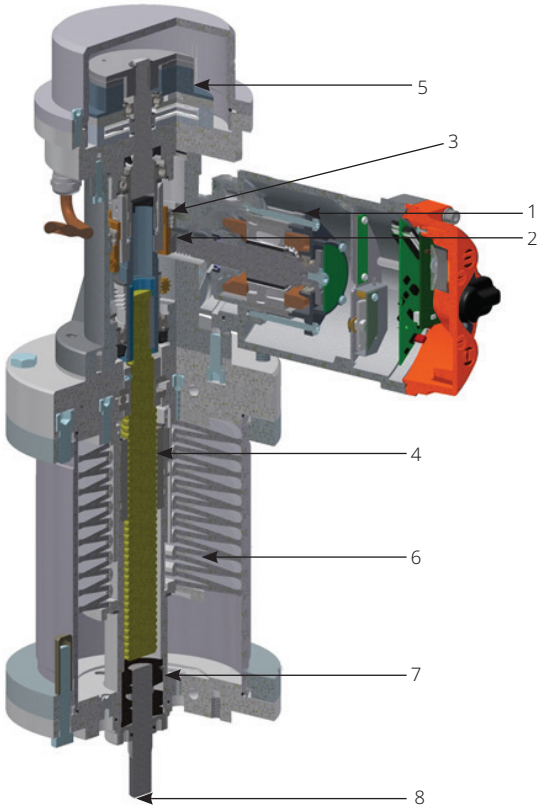
There are no engaging or disengaging elements between the motor, the energy storage device and the fitting shaft in the actuator. All the gear unit components are permanently engaged.

While moving against the fail-safe direction, the electric motor has to move both the valve and the energy storage device (disk spring assembly) for the fail-safe stroke.

If the supply for the operating current brake is interrupted (by a power failure, or intentionally to trigger a fail-safe stroke, the actuator will no longer be held, and the energy stored in the disk spring packet will be converted into kinetic energy so as to move the actuator and thus the valve to the fail-safe position. In this situation, the entire gear chain of the actuator with the exception of the worm gear stage will be moved until the end stop of the valve is reached. The spring-loaded spindle pin (7) dampens the stop and thus protects the valves seat.

Owing to this operating principle, neither an initializing stroke nor resetting of the drive is required after a fail-safe stroke. As soon as the power supply is restored, the actuator is immediately ready for operation.

Figure 2. Cutaway View of RTS FL Fail-Safe Linear Actuator



Parts Overview:

1. Motor
2. Worm Gear Stage
3. Planetary Gear Train
4. Ball Screw
5. Operating Current Brake
6. Spring Packet
7. Spring Loaded Spindle Pin
8. Valve Stem

2.1 Fail-Safe Direction

This type of fail-safe actuator can be built in a version for "Fail-Safe: Stem Move Out“ or "Fail-Safe: Stem Move In“.

NOTE:
A subsequent change of fail-safe direction is not possible.

2.2 Moving Behavior of the Actuator

How the actuator moves to the end limits depends on whether the actuator is in fail-safe mode or in electrical mode.

2.2.1 Moving Behavior Electrical Mode

2.2.1.1 Moving in Fail-Safe Direction

In this case, the actuator moves in fail-safe direction electrically by motor till the adjusted electrical end position. If the end limit is set travel dependent, the actuator stops at this point. If the end limit is set force dependent, the actuator moves electrically till the end position. In the end position, the electrical holding brake is released and the actuator builds up the force by the tensioned spring.

NOTE:

For force dependent end limit, the end position should be set in a sufficient range before the mechanical end position to avoid damage on the valve.

2.2.1.2 Moving Counter Fail-Safe Direction

The actuator moves to the end position electrically by motor. If the end limit is set force dependent, the force is build up by the motor.

NOTE:

For force dependent end limit, the end position should be set in a sufficient range before the real end position to avoid damage on the valve.

2.2.2 Moving Behavior Fail-Safe Mode

2.2.2.3 Moving in Fail-Safe Direction

In fail-safe mode, the actuator can only move in fail-safe direction. When the electrical holding brake is released, the actuator moves against the end limit by spring. In this case, the end limit is generally force dependent. The force in end position is build up by the residual spring force. If the end limit should be travel dependent, this is only possible by changing the mechanical connection to the valve so the actuator reaches the internal end stop before the end stop of the valve.

⚠ CAUTION

The mechanical end stops in the actuator are not designed to move against them by torque regularly.

Section 3: General Information

3.1 Safety Instructions

⚠ CAUTION

When operating electrical devices, certain parts are inevitably under dangerous voltage. Work on the electrical systems or components may only be carried out by electricians or by individuals who have been instructed how to do so. Working under the guidance and supervision of an electrician in accordance with electrotechnical regulations.

⚠ WARNING

When working in potentially explosive areas, pay attention to European Standards EN 60079-14 “Installing Electrical Systems in Explosion Endangered Areas” and EN 60079-17 “Inspection and Maintenance of Electrical Installations in Explosion Endangered Areas”. Working in potentially explosive areas is subject to special regulations (European Standard EN 60079-17), which must be complied with. Any additional national regulations must be needed.

⚠ WARNING

Working on the opened and energized actuator may only be carried out if it is ensured that there is no risk of explosion for the duration of the work.

3.2 Serial Number and Type Label

Each actuator of the RTS Fail-Safe Linear FL series carries a serial number. The serial number begins with the year and that can be read from the type label (see Figure 3) of the actuator (the type label is located next to the handwheel, see Figure 4).

Using this serial number, Emerson can uniquely identify the actuator (type, size, design, options, technical data and test report).

Figure 3. Bettis RTS Tag and Serial Number

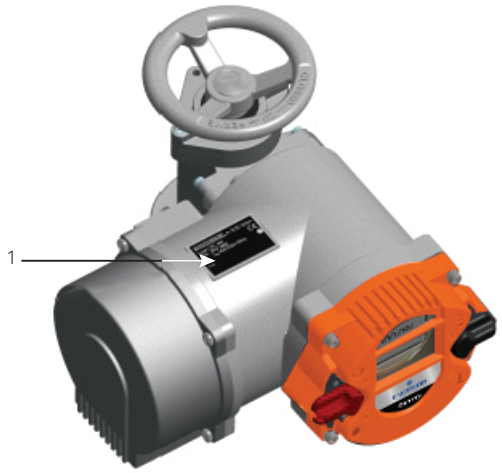
Type: FL-15B-1MHHB
No.: 18113E04559
Close: 15,0kN
Open: 15,0kN

EMERSON

CE 1026 2018

Tamb-40..+60°C
50,0mm 8,3-240sec
II 2 G Ex de IIC T4 Gb
0,21-6,0mm/sec IP68
TÜV-A16ATEX0007X
I_N: 0,84-0,67A
LC16.13198-1S
3x380-480V 50/60Hz
AEx de IIC T4 Gb
IECEx LC 17.0003X
Ex de IIC T4 Gb
S2-15min
S4-1200c/h - 40%ED
Class 1 Div 1 & 2 Group A
19200 Northwest Fwy, Houston, TX 77065
181148/1

Figure 4. Label 1 - Type Label



3.3 Protection Class

RTS Fail-Safe Linear FL actuators come by default with IP68 (EN 50629) protection.

⚠ CAUTION

The protection class specified on the type label is only effective when cable glands also provide the required protection class, the cover of the connection compartment is carefully secured and the mounting position (see Section 3.4) is observed.

We recommend metallic threaded cable glands with a metrical thread. Unused cable inlets must be closed with stopping plugs. On explosion proof actuators, cable glands with protection class **EEx e according EN60079-7** must be used. After removing covers for assembly purposes or adjustment work, take special care upon reassembly so that seals are not damaged and remain properly fastened. Improper assembly may lead to water ingress and to failures of the actuator.

NOTE:
The cover of the control unit - the operating unit - (see Figure 1) must not be opened.

Allow a certain sag in the connector cables before reaching the screwed cable glands so that water can drip off from the connector cables without running to the screwed cable glands. As a result, forces acting on the screwed cable glands are also reduced, see Section 3.4.

3.4 Mounting Position

Generally, the installation position is irrelevant. However, based on practical experience, it is advisable to consider the following for outdoors use or in splash zones:

- Mount actuators with cable inlet facing downwards
- Ensure that sufficient cable slack is available

3.5 Direction of Rotation

⚠ CAUTION

The standard direction of rotation for the actuator is:

- Clockwise = actuator stem to be retracted (move in).
- Counterclockwise = actuator stem to be extended (move out).

All the information in this Operating Manual refer to the standard direction of rotation.

3.6 Protection Devices

3.6.1 Torque

RTS Fail-Safe Linear FL actuators provide electronic torque monitoring. The switch-off torque can be modified in the menu of the controller for each direction separately. By default, switch-off torque is set to the ordered value. If no torque was specified with the order, the actuator is supplied from the factory with the maximum configurable torque. For more information, see Section 8.2.

3.6.2 Motor Temperature

All RTS Fail-Safe Linear FL actuators are normally equipped with motor winding temperature sensors, which protect the motor against excessive winding temperature. The display will show the corresponding error upon exceeding the permissible motor temperature, see Section 13.1.

3.6.3 Input Fuse, Thermal Fuse

The frequency inverter is protected by an input fuse and the explosion proof version by a thermal fuse. If one of the fuses releases, a serious defect occurs and the frequency inverter must be replaced**.**

3.7 Ambient Temperature

Unless otherwise specified upon ordering, the following operating temperatures apply:

- On/off duty (open-loop control) -25 to +60 °C
- Modulating duty (closed-loop control) -25 to +60 °C
- Explosion proof version -20 to +40 °C (according to EN60079-0)
- Explosion proof version with extended temperature range -40 to +60 °C

⚠ CAUTION

The maximum operating temperature can also depend on further order-specific components. Please refer to the technical data sheets to confirm the as-delivered product specifications.

3.8 Delivery Condition of the Actuators

For each actuator, an inspection report is generated upon final inspection.
In particular, this comprises a full visual inspection, calibration of the torque measurement in connection with an extensive run examination and a functional test of the microcontroller.

These inspections are conducted and documented according to the quality system and can be made available if necessary. The basic setting of the end position must be performed after assembly on the actuator.

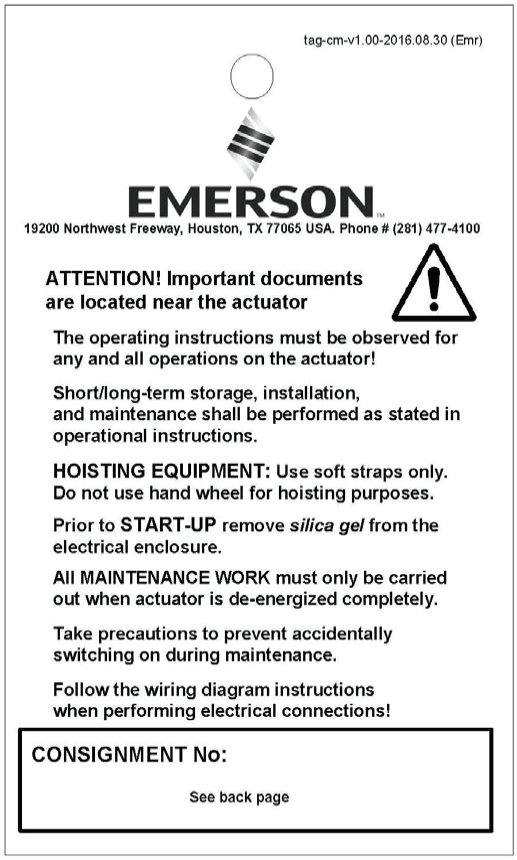
⚠ CAUTION

Commissioning instructions (see Section 6) must be strictly observed. During assembly of the supplied valves at the factory, end positions are set and documented by attaching a tag (see Figure 5). During commissioning at the plant, these settings must be verified.

3.9 Information Notice (Tag)

Each actuator is provided with a bilingual tag containing key information, which is attached to the handwheel after final inspection. This tag also shows the internal commission registration number, see Figure 5.

Figure 5. Tag



Section 4: Packaging, Transport and Storage

Depending on the order, actuators may be delivered packed or unpacked. Special packaging requirements must be specified when ordering. Please use extreme care when removing or repackaging equipment.

⚠ CAUTION

Use soft straps to hoist the equipment; do not attach straps to the handwheel. If the actuator is mounted on a valve, attach the straps to the valve and not to the actuator.

4.1 General

The connection compartment of RTS Fail-Safe Linear FL actuators contains 5 g of factory supplied silica gel.

⚠ CAUTION

Please remove the silica gel before commissioning the actuator, see Section 6.

4.2 Storage

⚠ CAUTION

- Store actuators in well-ventilated, dry premises
- Protect against floor dampness by storing actuators on wooden grating, pallets, mesh boxes or shelves
- Protect the actuators against dust and dirt with plastic wrap
- Actuators must be protected against mechanical damage
- The storage temperature must be between -20 to +40 °C

It is not necessary to open the controller of the actuator for servicing batteries or similar operations.

4.3 Long-term Storage

⚠ CAUTION

If you intend to store the actuator for over 6 months, also follow the instructions below:

- The silica gel in the connection compartment must be replaced after 6 months of storage (from date of delivery).
- After replacing the silica gel, brush the connection cover seal with glycerin. Then, carefully close the connection compartment again.
- Coat screw heads and bare spots with neutral grease or long-term corrosion protection.
- Repair damaged paint work arising from transport, improper storage, or mechanical influences.
- For explosion proof actuators, it is not allowed to extensively overpaint the actuator.
  According to the standard, in order to avoid electrostatic charge, the maximum thickness of the varnish paint is limited to 200 µm.
- Every 6 months. all measures and precautions for long term storage must be checked for effectiveness and corrosion protection and silica gel renewed.
- Failure to follow the above instructions may lead to condensation which can damage to the actuator.

Section 5: Installation Instructions

Installation work of any kind of actuator may only be performed by qualified personnel.

5.1 Mechanical Connection

Check:

- Whether valve flange and actuator base match-up.
- If the bore of the coupling piece coincides with the spindle pin and sufficient thread engagement is available.

Make sure the fitting is in the same position as the actuator:

- For a "fail-safe opener" actuator, the valve has to be completely open.
- For a "fail-safe closer" actuator, the valve has to be completely closed.

In general, refer to the following instructions:

- Clean the bare parts on the actuator coated with rust protectant.
- Clean the mounting surface for the fitting thoroughly.
- Lightly grease the valve stem.
- Set the actuator in place.
- Make sure of centered positioning and that the contact surface of the flange is full.
- Fasten the actuator with suitable bolts:
  - Minimum strength grade: 8.8 or A2-70
  - Ensure sufficient thread engagement (min. 1xd)

⚠ CAUTION

Screws that are too long may go against the thread root, creating the risk of the actuator moving radially in relation to the fitting. This may lead to the bolts shearing off.

NOTE:
Unsuitable bolts may result in the actuator falling off.

- Tighten bolts to the correct torque, alternating between bolts on opposite sides.

Table 1. Thread Table

Thread	Tightening Torque (Nm) for Bolts with Strength Grade	
	8.8	A2-70/A4-70
M6	11	8
M8	25	18
M10	51	36
M12	87	61
M16	214	150
M20	431	294
M30	1489	564

⚠ CAUTION

Valve or piping may be damaged due to high actuating speed.

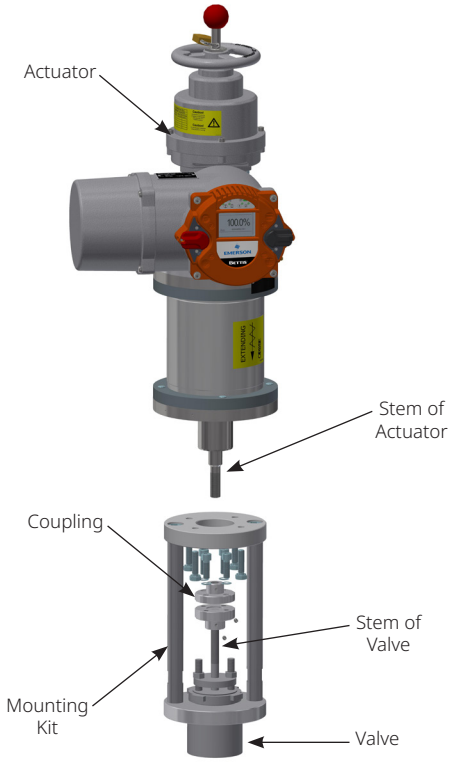
5.2 Mounting of Linear Fail-Safe Actuator

Emerson Bettis RTS FL Fail-Safe Linear electric actuators move the stem of valve to the fail-safe position in case of fail-safe event. In general, stem of actuator is at fail-safe position at delivery, depending on valve has to be closed or opened by force (sealing force is required in fail-safe position) or by travel (actuator shall stop before touching the seat), mounting procedure has to be done different.

5.2.1 Mounting Procedure for Valve Without Required Sealing Force

- Connect mounting kit to valve and fix according to valve producer specification.
- Be sure stem of valve is exact in desired fail-safe end position.
- Be sure stem of actuator is in fail-safe position: actuator must not be electrically connected. Handwheel must not be engaged (if applicable, refer to Section 6.2, Manual Operation).
- Mount actuator to mounting kit and fix with 4 screws.
- Check distance between end of stem of actuator and end of stem of valve: allowed range of distance is 2 to 25 mm.
- Connect both stems with coupling and note symmetrical engagement of both threads.
- Fix coupling with 4 screws and note both halves of coupling have to be parallel after tightening the screws.

Figure 6. Linear Fail-Safe



5.2.2 Alternative Procedure for Valve with Required Sealing Force

- Connect mounting kit to valve and fix according to valve producer specification.
- Be sure stem of valve is exact in desired fail-safe end position: actuator must not be electrically connected. Handwheel must not be engaged (if applicable, refer to Section 6.2, Manual Operation).
- Mount actuator to mounting kit and fix with 4 screws.
- Check distance between end of stem of actuator and end of stem of valve, allowed range of distance is 2 to 25 mm.
- Move the Actuator electrically or by the handwheel 3 to 5 mm out of the fail-safe position.
- Connect both stems with coupling and note symmetrical engagement of both threads.
- Fix coupling with 4 screws and note both halves of coupling have to be parallel after tightening the screws.

NOTE:

Actuator must not be electrically connected, and handwheel must not be engaged. If applicable, refer to Section 6.2, Manual Operation.

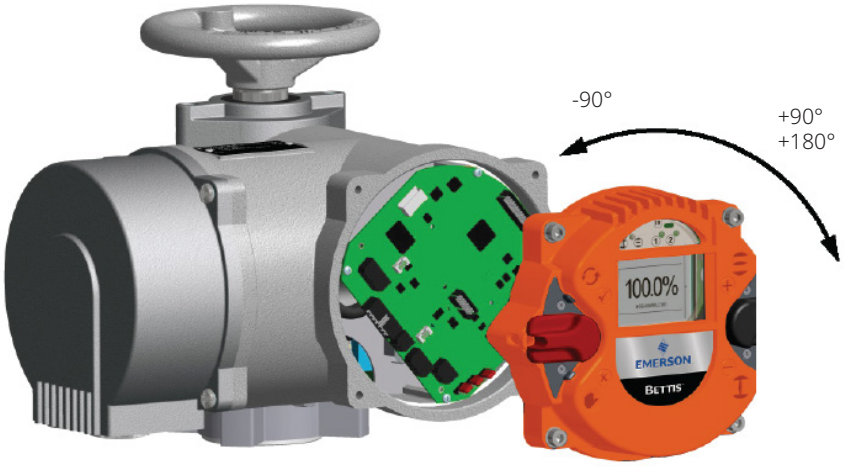
5.3 Mounting Position of the Operating Unit

The mounting position of the operating unit can be rotated in 90° steps.

⚠ CAUTION

During installation, the position of the control unit in relation to direct sunlight must be observed. It is recommended to protect the unit from direct sunlight (roof, installation position) to avoid possible malfunctions.

Figure 7. RTS FL Fail-Safe Control Unit



- Disconnect the actuator and control system from the power supply.
- To prevent damage to the electronic components, both the control system and the person have to be grounded.
- Undo the bolts for the interface surface and carefully remove the service cover.
- Turn service cover to new position and put back on.
  - Ensure correct position of the O-ring.
  - Turn service cover by maximum of 180°.
  - Put service cover on carefully so that no cables get wedged in.
- Tighten bolts evenly in a crosswise sequence.

NOTE:
Maximum torque of 5 Nm.

5.4 Electrical Connection

⚠ CAUTION

Electrical connections may only be carried out by qualified personnel. Please observe all relevant national security requirements, guidelines, and regulations. The equipment should be de-energized before working on electrical connections. As a first step, connect the ground screw and confirm the absence of electrostatic discharge during connection.

The line and short circuit protection must be done on the system side.

The ability to unlock the actuator is to be provided for maintenance purposes. For the dimensioning the rated current is to be used (see Technical Data).

Check whether the power supply (voltage, frequency) is consistent with the connection data (see Figure 3).

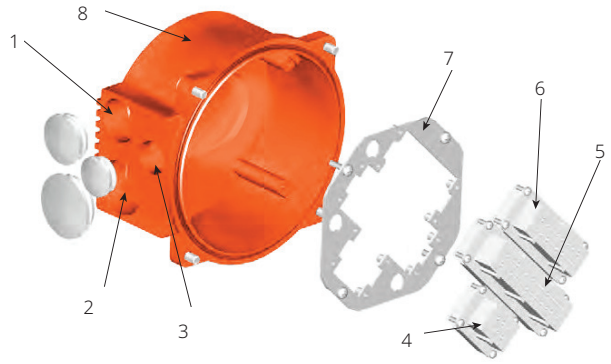
The connection of electrical wiring must follow the circuit diagram. This can be found in the appendix of the documentation. The circuit diagram can be ordered from Emerson by specifying the serial number.

When using options, such as a Profibus connection, the relevant guidelines must be followed.

5.4.1 Power Supply Connection

RTS Fail-Safe Linear FL actuators feature an integrated motor controller, i.e., only a connection to the power supply is required. In non-explosion proof actuators, the wiring uses a connector independent from control signals, see Figure 8.

Figure 8. Enclosure Parts

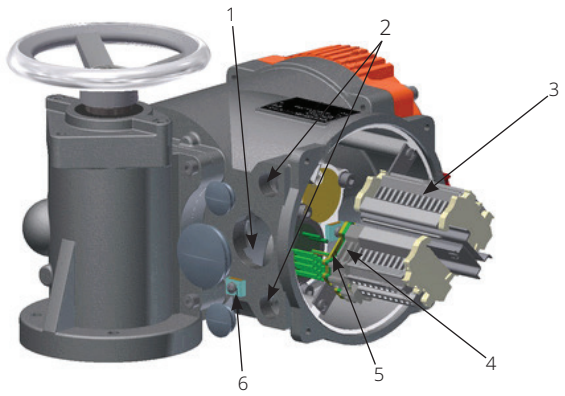


Parts Overview:

1. Metric screw M32x1.5
2. M40x1.5, 3 - M25x1.5
3. M25x1.5
4. Plug insert (for power supply)
5. Plug insert (for control cables)
6. Connector for options
7. Connector Plate
8. Connecting Housing

Explosion proof actuators or on special request the connection will be made via terminals, see Figure 9.

Figure 9. Bettis RTS Terminal Box



Terminal Box Overview:

1. Metric screw M40x1.5
2. 2 x M20x1.5
3. M25x1.5
4. Terminals for the power supply
5. Terminal for ground connection
6. Outside ground connection

⚠ CAUTION

If during outdoor installation, commissioning is not carried out immediately after electrical connection, the power supply must be connected at a minimum to achieve a heating effect. In this case, the silica gel may remain in the connection compartment until commissioning, See Section 4.3.

Section 6: Commissioning

It is assumed that the actuator has been installed and electrically connected correctly, see Section 5.

NOTE:
Remove silica gel from the alarm cover.

6.1 General Information

Table 2. Technical Data

Type	Maximum Actuators Torque (Nm)		Revolutions on the Base Actuator			
	In fail-safe direction	Counter fail-safe direction	Nominal (mm)	Revolutions (U)	Maximal (mm)	Revolutions (U)
FL05	8	16	30	6	35	7
FL15	16	32	50	10	55	11
FL25	16	32	100	20	105	21
FL40	24	64	100	25	105	26.25

NOTE:
When commissioning and each time after dismounting the actuator, the electrical end positions have to be reset, see Section 6.8.

6.2 Manual Operation

The manual operation is only possible if the actuator is delivered with the optional handwheel. This option allows an adjustment of the valve in de-energized state.

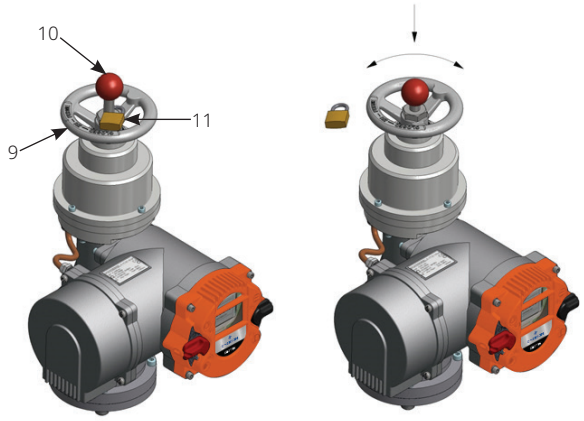
⚠ CAUTION

- The manual mode can be activated only when the drive is in the fail-safe position.
- By activating the manual drive, the fail-safe function is disabled.

NOTE:

By activating the manual drive, the electrical function of the drive is disabled. In normal operation, the handwheel (9) has no effect, it rotates idly by.

Figure 10. RTS FL Fail-Safe Actuator Handwheel Rotation



Parts Overview:

9. Handwheel
10. Coupling Rod
11. Padlock

6.2.1 Activate Manual Operation

To activate manual mode:

- The padlock has to be removed.
- The coupling rod has to be be pushed all the way into the actuator.

For easier clutch engagement, move the hand wheel easily back and forth. Through the engagement the actuator is automatically electrically disabled and the display shows “manual operation”.

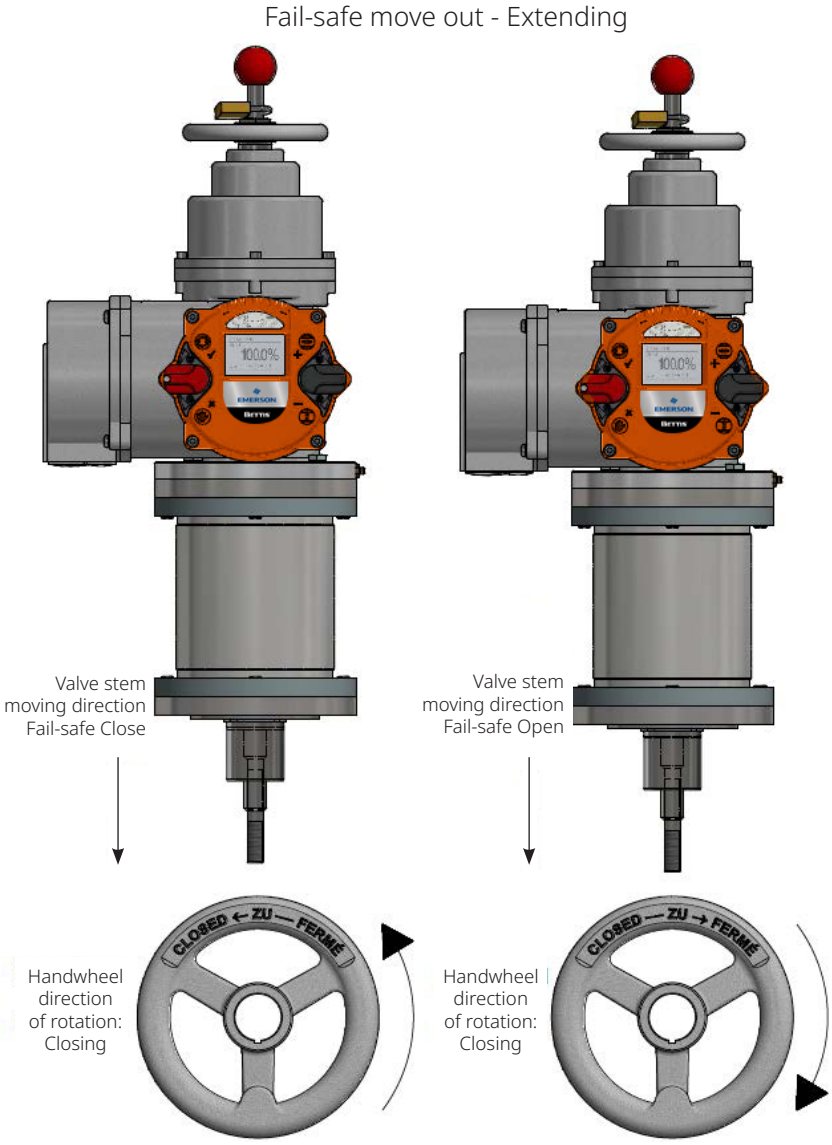
6.2.2 Deactivate Manual Operation

To exit the manual mode and enable the actuator again for the automatic mode must:

- The actuator to be driven in the fail-safe position by handwheel.
- The coupling rod to be pulled up at the fail-safe stop position of the actuator.
- The coupling rod to be secured again with the padlock.

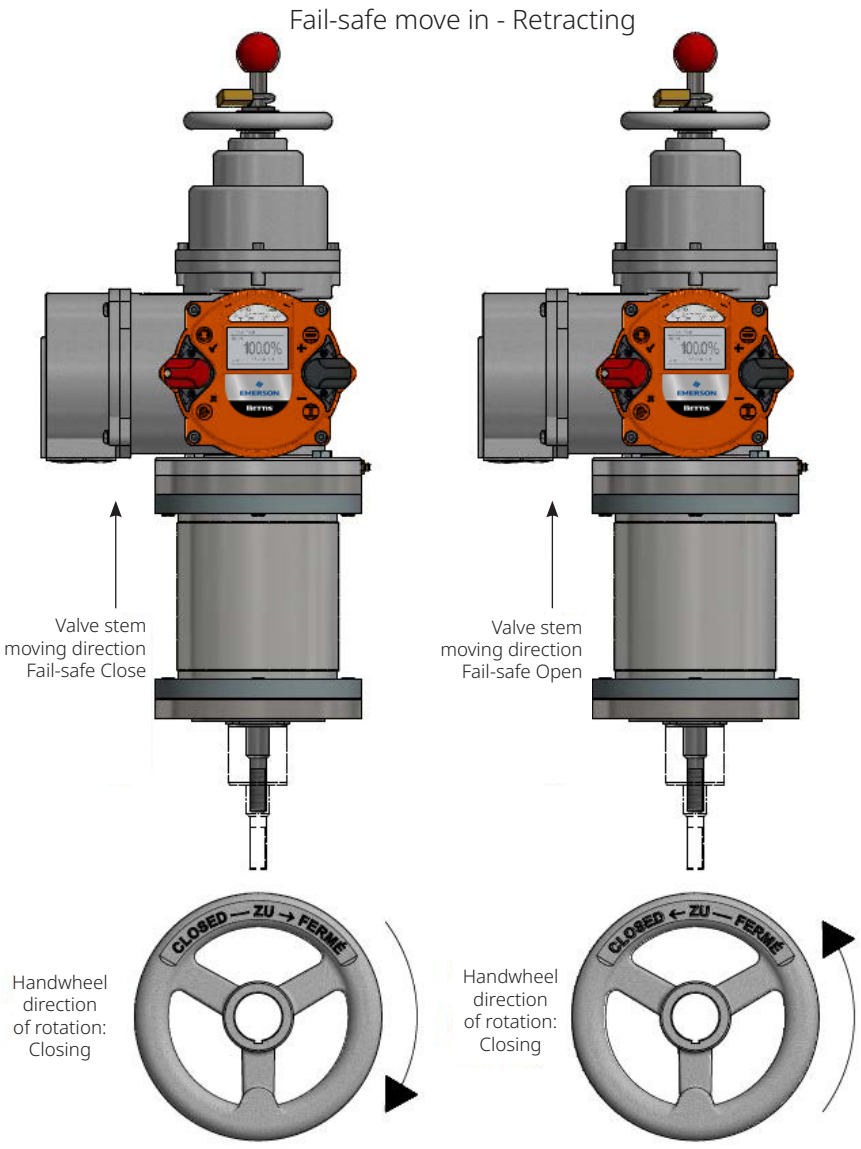
6.2.3 Direction of Rotation Handwheel for Closing the Valve, Fail-safe "Move Out"

Figure 11. Rotation of Direction for Fail-Safe Direction "Move Out"



6.2.4 Direction of Rotation Handwheel for Closing the Valve, Fail-Safe "Move In"

Figure 12. Rotation of Direction for Fail-Safe Direction "Move In"



6.2.5 Required Force on the Handwheel

Table 3 shows the maximum force applied to the handwheel for the different actuator sizes.

Table 3. Required Force on the Handwheel

Type	Maximum handwheel torque (Nm)		Handwheel diameter (mm)
	In fail-safe direction	Counter fail-safe direction	
FL05	4	8	140
FL15	8	16	140
FL25	8	16	140
FL40	12	32	200

The force on the handwheel was calculated for one-handed operation. With two-hand operation, the value per hand is halved. The maximum force may be exceeded by 20% in manual mode. The direction of rotation and the maximal handwheel torque are written on the handwheel label.

6.3 Mechanical Default Settings and Preparation

The use of multi-turn sensors makes mechanical settings unnecessary.

⚠ CAUTION

Before the motorized operation of the valve, it is essential to check and adjust torque settings.

6.4 User Level and Permissions

In order to edit and/or show certain parameters, a user level with the necessary permissions has to be set as current user level. The current user level may be set temporarily in the "U User Level" menu item. It is also possible to set the default user level, which will be set as the current user level until set otherwise ("U User Level" or default user level). Please refer to Section 8.6 for more information about the user levels.

6.5 End Limit Setting

A detailed description of the operation of the RTS Fail-Safe Linear FL controller can be found in Section 7.3.

6.5.1 End Limit OPEN

Step 1 - Set the selector switch and control switch to the center position.

Figure 13. Switches in Center Position

Terminal Box Overview:

1. Selector Switch (Red)
2. Control Switch (Black)

Step 2 - Scroll through the menu with the control switch. Move the control switch towards the first menu item “P1.1 End limit - Open”.

Figure 14. Control Switch End Limit Open

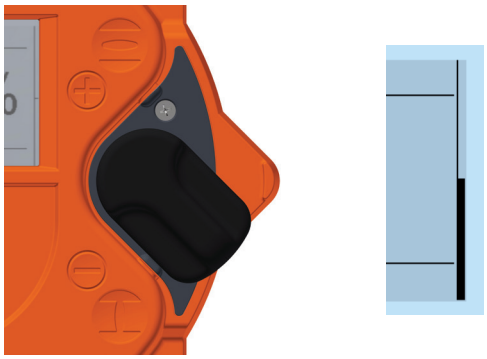
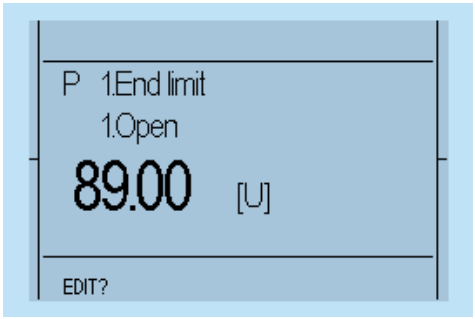


Figure 15. Front Display for End Limit Open



Step 3 - Afterwards, flip up the selector switch slightly and let it snap back to its neutral position.

Figure 16. Selector Switch Setting (1)

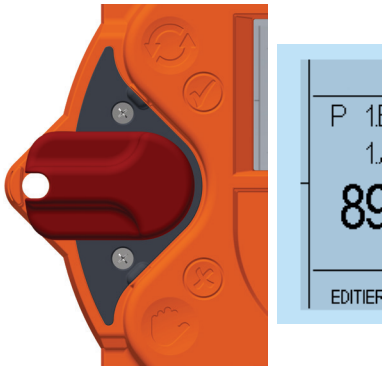


Figure 17. Selector Switch Setting (2)

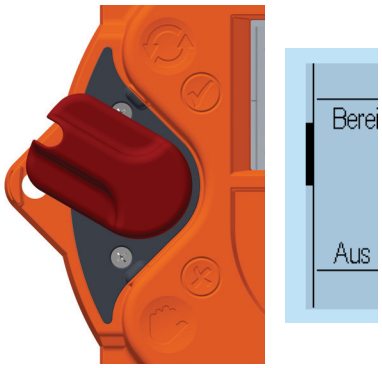
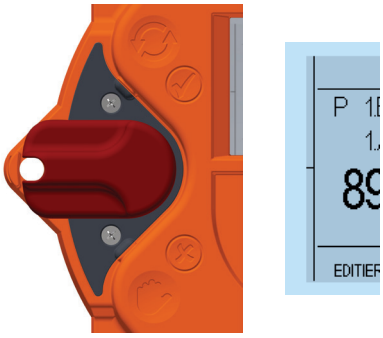


Figure 18. Selector Switch Setting (3)



Step 4 - This changes the bottom line of the display from “EDIT?” to “SAVE?”.

Figure 19. Edit and Save

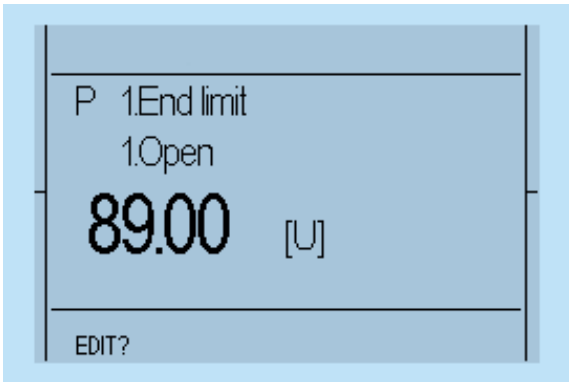
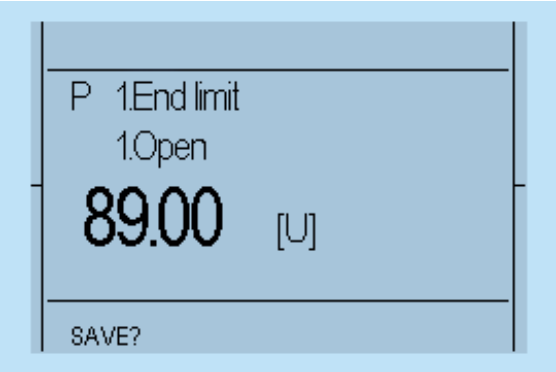


Figure 20. Save Settings



Step 5 - Then, push down the selector switch until it snaps into place. In doing so, the bottom right now on the display will show “TEACHIN” ⊗.

⚠ CAUTION

Once the display shows “TEACHIN”, use the control switch (black switch) to start the motorized operation of the actuator. In this mode, no travel-dependent switch-off occurs in the end position.

⚠ CAUTION

Please note that, during motor operation, only torque monitoring remains active, as travel adjustment will happen subsequently. Therefore, please check beforehand whether the maximum torque has already been parameterized.

Step 6 - Absolute and relative values on the display will change continuously along with position changes.

Figure 21. Position Change Selector Setting

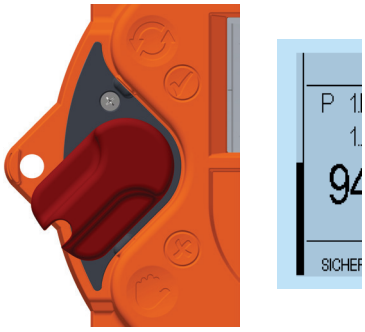
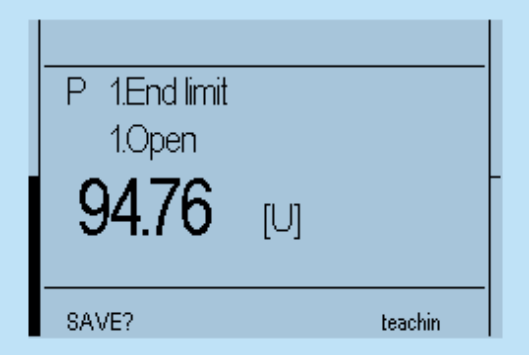


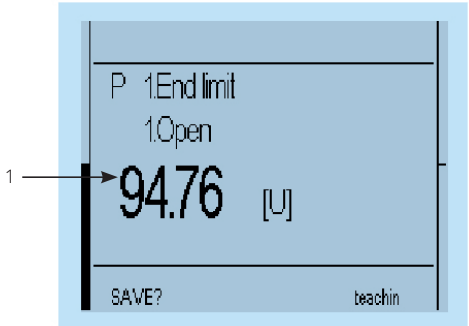
Figure 22. Position Change Display



Step 7 - Manually move the actuator with the handwheel (see Section 3.5) or by motor via the control switch (black button) to the end position OPEN of the valve.

- Absolute value: absolute value of the position feedback
- Relative value: the value to the other end position

Figure 23. Absolute Value



Display Overview:

1. Absolute value

Step 8 - When the desired end position OPEN of the valve is reached, move the selector switch back to the middle position. Thus, the line “TEACHIN” disappears.

Figure 24. Selector for End Position (Save)

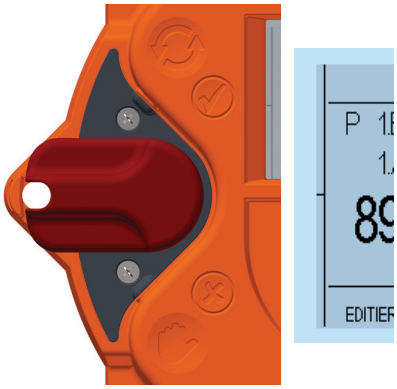
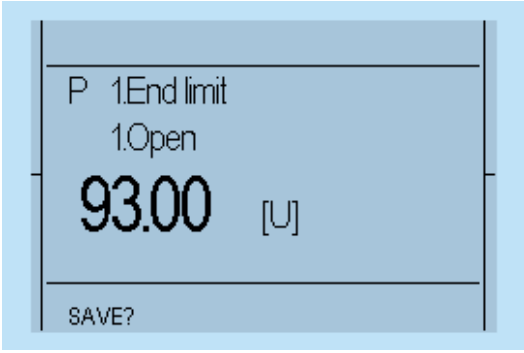


Figure 25. End Position Display



Step 9 - In order to confirm the end position (save), slightly flip up the selector switch towards ⊘ and let it snap back to its neutral position.

Figure 26. Selector Setting Save (1)

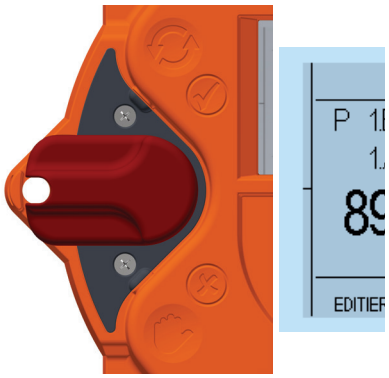


Figure 27. Selector Setting Save (2)

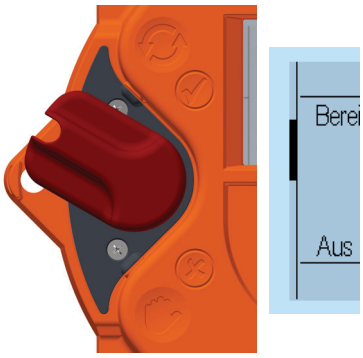
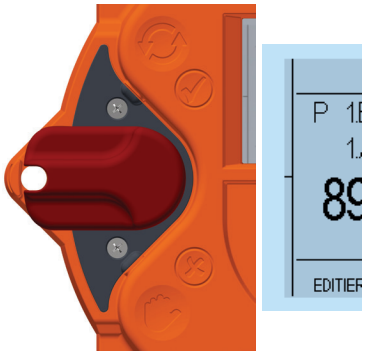


Figure 28. Selector Setting Save (3)



Step 10 - This changes the bottom line of the display for “SAVE?” to “EDIT?” and the end position is stored.

Figure 29. Selector Setting Display (1)

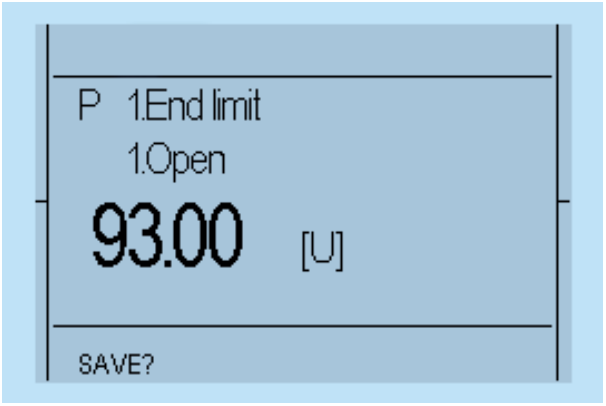
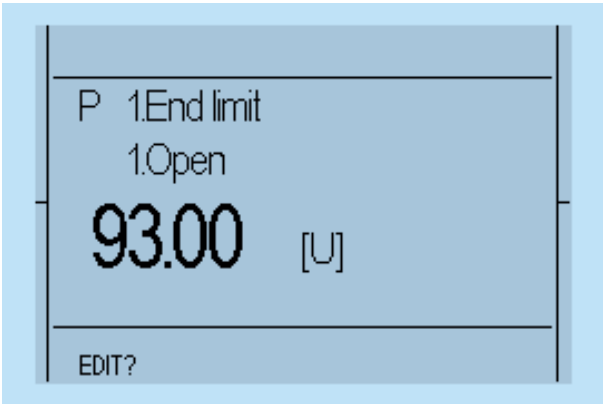


Figure 30. Selector Setting Display (2)



6.5.2 End Limit CLOSE

Repeat 5.4.1 but select “P 1.2 End limit - End limit CLOSE”.

6.6 Adjusting of Fail-Safe Speed

General

Bettis RTS FL fail-safe actuators are equipped with an adjustable passive eddy current brake, by which it is possible to change the fail-safe speed. When delivered, the fail-safe speed is set to minimum.

After mounting the actuator to valve and test run, fail-safe speed can be increased if necessary.

⚠ CAUTION

Valve or piping may be damaged due to high actuating speed.

⚠ WARNING

All adjustment work may only be performed with the actuator disconnected from the power supply. Due to this requirement, the actuator has to be in the fail-safe position. Any powering up must be ruled out during maintenance.

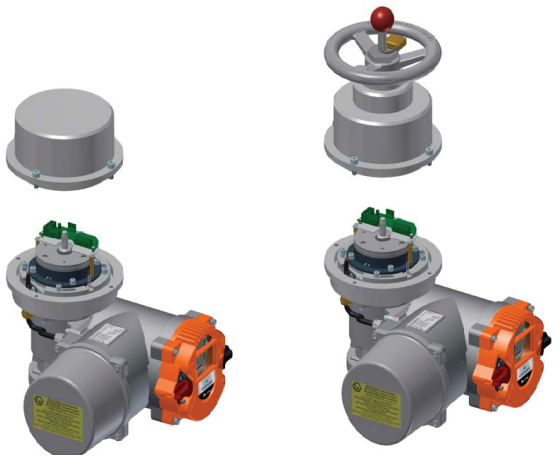
⚠ WARNING

When working in potentially explosive areas, heed European Standards EN 60079-14 "Installing Electrical Systems in Explosion Endangered Areas" and EN 60079-17 "Inspection and Maintenance of Electrical Installations in Explosion Endangered Areas".

6.6.1 Setting Procedure

Remove cover according to Figure 31.

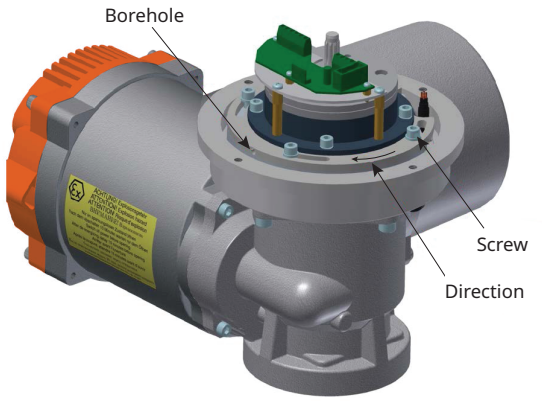
Figure 31. Removing the Cover



NOTE:
In the version with handwheel, there is a cable connection which has to be unplugged.

1. Loosen but do not remove 4 pieces of screws according to Figure 32.
2. Insert 3 mm Allen key into radial borehole of flange.
3. Turn flange by use of Allen key in direction according to Figure 32. Half of possible rotating angle will approximately double fail-safe speed of actuator. While holding flange with key in desired position, retighten the screws.
4. In the version with handwheel, reconnect the cable to the cover.
5. Remount the cover and be aware of correct position of the O-ring sealing.
6. Retest the actuator to check for correct fail-safe speed.

Figure 32. Adjusting Speed



6.7 Final Step

Following commissioning, ensure covers are sealed and cable inlets are closed. Also, check the actuator for damaged paint (by transportation or installation) and take necessary steps to repair if needed.

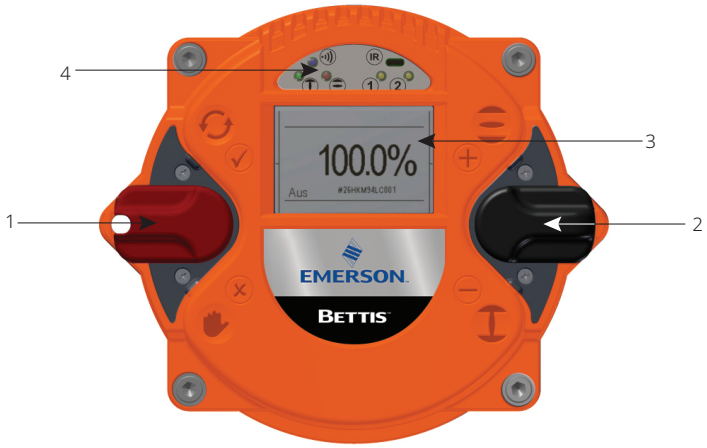
Section 7: Control Unit

The controller is intended to monitor and control the actuator and provides the interface between the operator, the control system and the actuator.

7.1 Operating Unit

Operation relies on two switches: the control switch and a padlock-protected selector switch. Information visualization is provided by 4 integrated indicator lights, as well as the graphic display. For better visibility, switch symbols (✓, ✗, +, −) are on the cover.

Figure 33. Operating Unit Controls



Display Overview:

1. Selector Switch
2. Control Switch
3. Graphic Display
4. LED Display

The control switch has dual function.

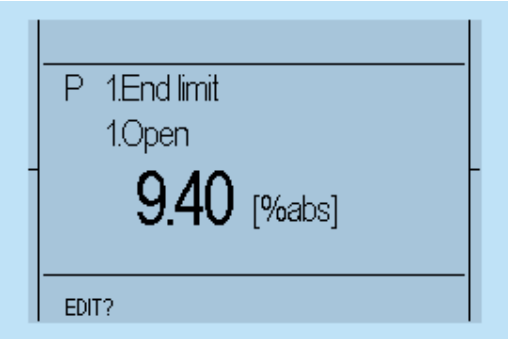
The controller cover may be wiped clean with a damp cloth. The mounting position of the control unit can be turned in 90° steps, see Section 4.2.

7.2 Display Elements

7.2.1 Graphic Display

The graphic display used in the controller allows text display in different languages.

Figure 34. Display (1)



During operation, the display shows the position of the actuator as a percentage, operation mode and status. When using the option “identification”, a customer-specific label is shown at the bottom of the display (e.g., PPS Number).

Figure 35. Display (2)

Display Overview:

1. Status
2. Operation Mode
3. Position

⚠ CAUTION

The display should not be exposed to direct sunlight over a long period - risk of a defect in combination with very high temperatures.

7.2.2 LED Display

To provide users with better status information, basic status data is displayed using 4 color LEDs. As the device powers up, it undertakes a self-test whereby all 4 LEDs briefly lit up simultaneously.

Figure 36. LED Display

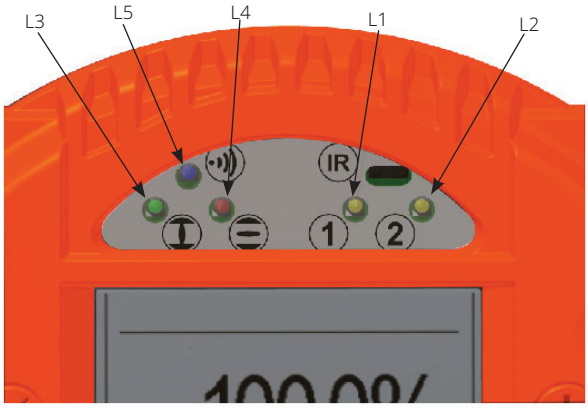


Table 4. LED Color Legend

Description	Color	Lits up	Flashes quickly	Flashes slowly	Does not light up
L1	Yellow	No torque error	Torque fault	-	-
L2	Yellow	Ready (operational readiness)	Path error (no operational readiness)	-	Error (no operational readiness) motor temperature, supply voltage absent, internal error
L3[(1)]	Green	CLOSE	Moving to CLOSE position	Applies upon torque-dependent closing: Occurs when the end position CLOSED is reached but the cut-out torque has not yet been reached	Actuator is not in the close position
L4[(1)]	Red	OPEN	Moving to OPEN position	Applies upon torque-dependent opening: Occurs when the end position OPEN is reached but the cut-out torque has not yet been reached	Actuator is not in the open position
L5	Blue	Bluetooth® enabled	Bluetooth data transmission	Bluetooth ON, no data transmission	Bluetooth/Infrared OFF
	Red	Infrared ON	Infrared data transmission	Infrared ON	

7.3 Operation

The actuator is operated via the switches located on the controller (selection and control switch). All actuator settings can be entered with these switches. Furthermore, configuration is also possible via the IR interface or the Bluetooth Interface, see Section 10. Flip the switch up or down to regulate the parameter menu scrolling speed.

Figure 37. Neutral Position

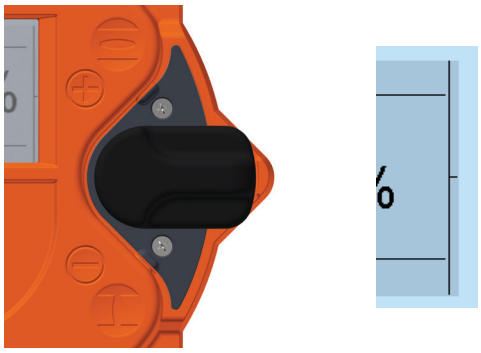


Figure 38. Slight Switch Flip (It Will Move to the Next Parameter)

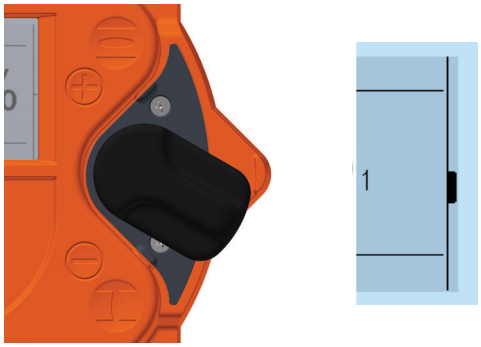


Figure 39. Halfway Switch Flip (Jump to the Next Parameter Category)

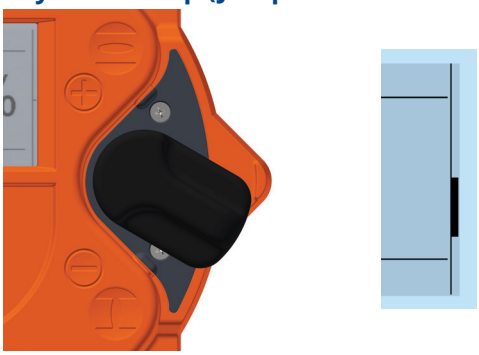
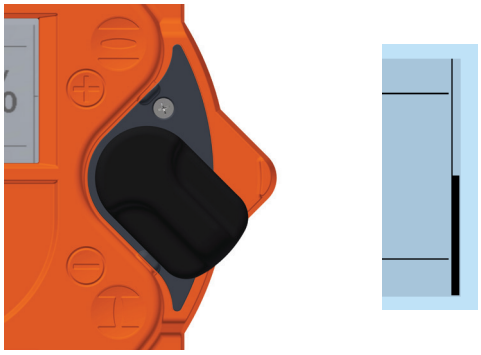


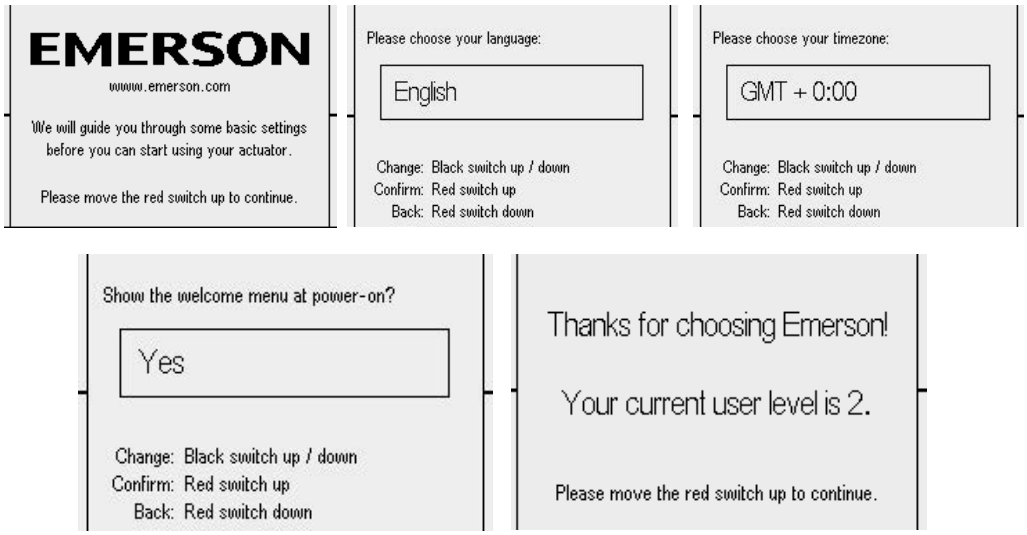
Figure 40. Full Switch Flip (Jump to the End of the Menu)



7.4 Welcome Menu

The welcome menu presents the user a welcome message, and guides the user through some basic settings. Some basic settings include the language and time zone. Please follow the instructions shown on the display.

Figure 41. Welcome Menu



7.4.1 Operation Mode

Use the selector switch (red) to determine the various operating states of the actuator. In each of these positions, it is possible to block the switch by means of a padlock and thus protect the actuator against unauthorized access.

The selector switch has the following positions:

Table 5. Selector Positions

Position	Function
OFF	The actuator can be neither operated via the remote control nor via the control switches of the controller.
Local	It is possible to operate the actuator by motor via the control switch. Control via the remote inputs may be possible with appropriate configuration (superimposed control commands, emergency commands).
Remote	The actuator is ready to process control commands via input signals. The control switch for the motor operation of the actuator is disabled.

Besides defining the operational status, the selector switch is used in configuration mode to confirm or cancel parameter inputs.

Depending on the selector switch position, the control switch performs different functions:

Table 6. Control Switch Positions

Position	Function
Selector switch in the OFF position	The control switch is used to scroll up or down through the menu according to internal symbolism. From the neutral position towards ⊕ you reach the status and history data areas. Towards the ⊖ symbols you reach the parameter menu. Here, the selection switch either confirms ✓ or rejects ✗ the current input according to associated symbolism.
Selector switch in the REMOTE position	The control switch gives you access to status, history data and parameter area.
Selector switch in the LOCAL position	With the control switch, the actuator can be operated by motor. You may also operate the actuator in inching and self-hold mode. Switches are spring-loaded to snap back automatically into their neutral position. (To confirm a control command, the control switch must be pushed all the way into its mechanical locking position.)

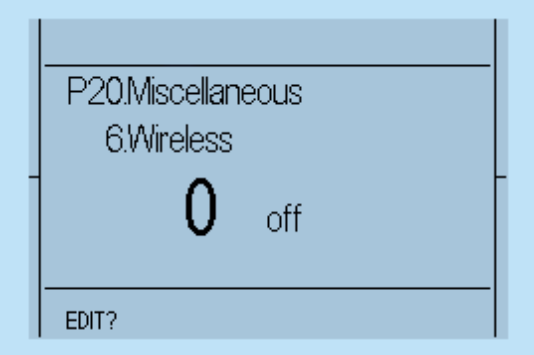
7.4.2 Configuration

In principle, all parameters are shown as numbers in the corresponding parameter point. From the actuator menu, use the control switch to access different menu points. The lower left corner of the display shows the “EDIT” option.

NOTE:

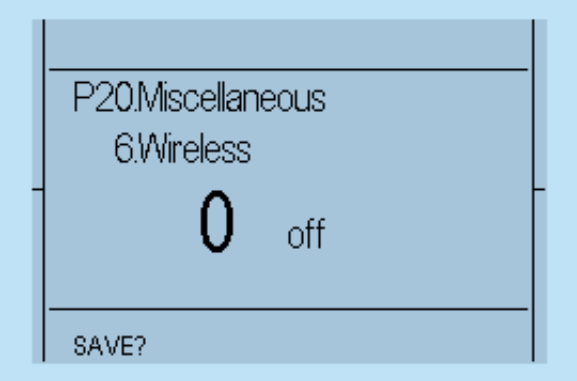
Please make sure, that the set user level has permission to read/write the parameters.

Figure 42. Configuration Display (1)



Confirm the selector switch (with a slight flip upwards, towards ✓, (see Figure 26 to Figure 30) to change the selected parameter. To confirm this input readiness, the display changes from “EDIT” to “SAVE”.

Figure 43. Configuration Display (2)



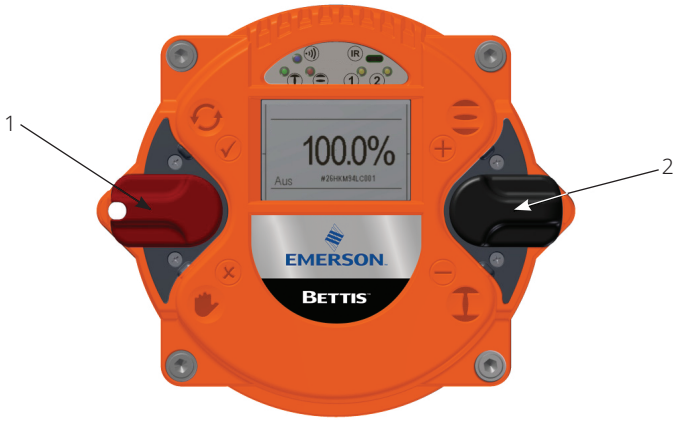
Move the control switch towards to the characters to change the parameter. ⊕ or ⊖ (see Figures 37 to 40). After reaching the desired parameter value, confirm the value with the selector switch (again, flip it slightly towards ✓, (see Figures 26 to 28).

7.4.3 Configuration Example

As an example, we will change parameter P20.6 (wireless) from 0 (wireless off) to 2 (Bluetooth communication on). Thus, the Bluetooth connection is activated for a short time and then deactivated again automatically:

Step 1 - The operating and control switch must be in the neutral position.

Figure 44. Selector Switch (1, Red); Control Switch (2, Black)



Step 2 - Now, move the control switch down (towards) until the menu item "P20.6 Miscellaneous - Wireless" is displayed.

Figure 45. Control Switch Flipped Down

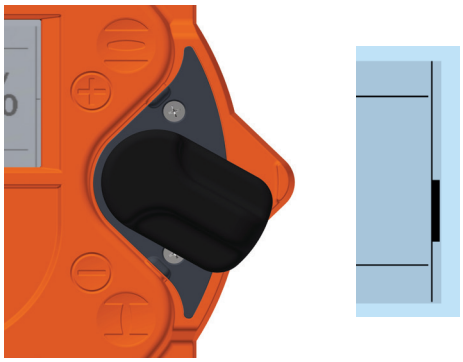
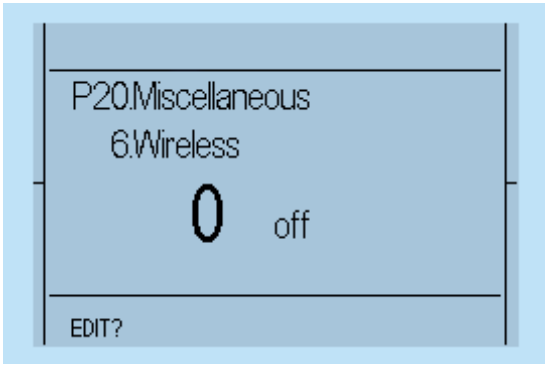


Figure 46. Display (1)



Step 3 - Afterwards, flip up slightly the selector switch (towards) and let it snap back to its neutral position.

Figure 47. Selector Switch in Neutral Position

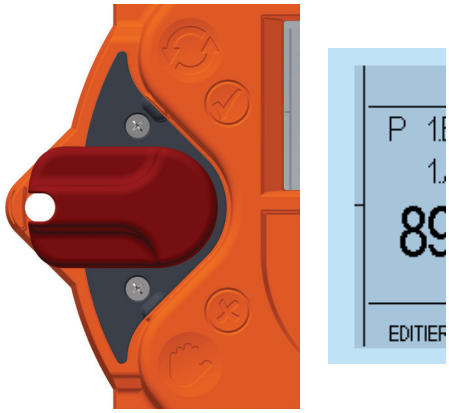


Figure 48. Selector Switch in Neutral Position

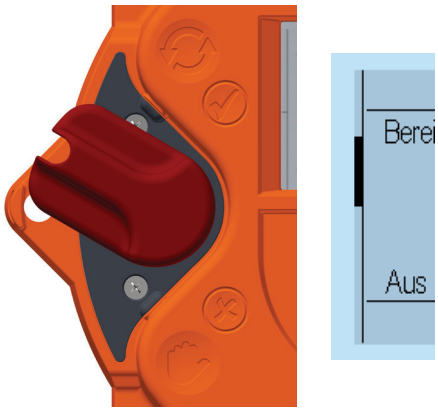
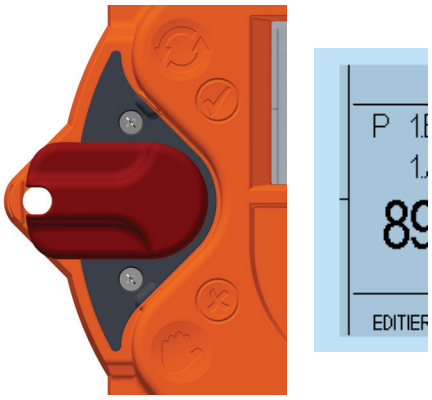


Figure 49. Selector Switch in Neutral Position



Step 4 - This changes the bottom line of the display from “EDIT?” to “SAVE?”.

Figure 50. Display (2)

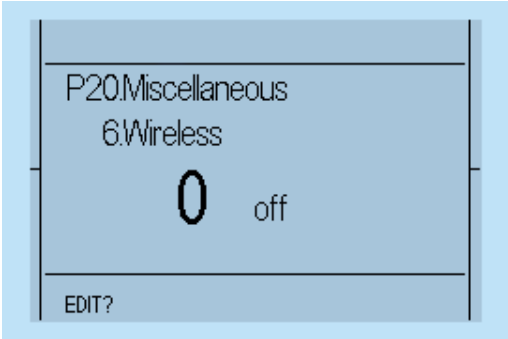
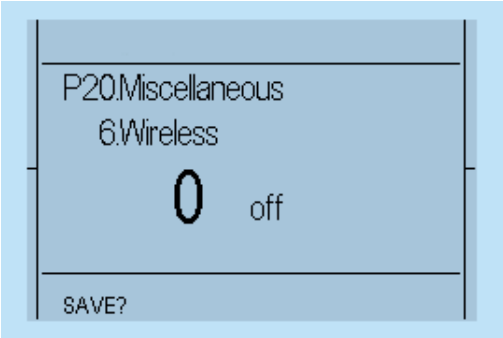


Figure 51. Display (3)



Step 5 - Flip up the control switch (towards) to change the value from 0 (off) to 2 (Bluetooth).

Figure 52. Control Switch Flipped Up

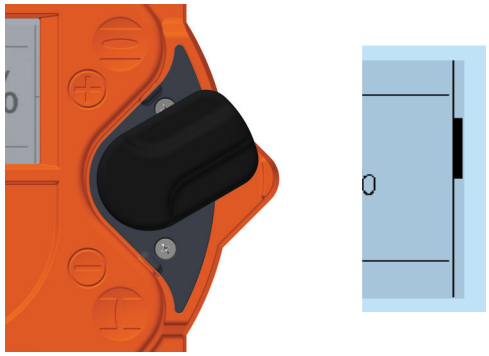
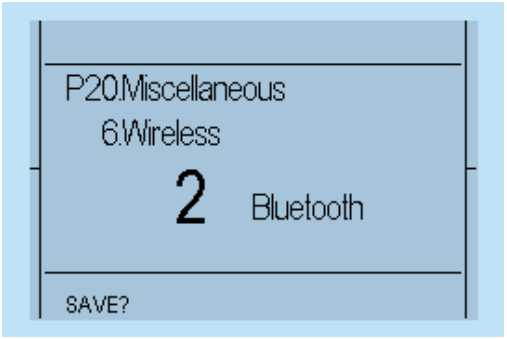


Figure 53. Switch to One



Step 6 - If the value changes to 1, confirm the selection by flipping halfway up the selector switch (towards) and letting it snap back to its neutral position, see Figures 38 to 41.

Figure 54. Selector Switch Flipped Halfway Up

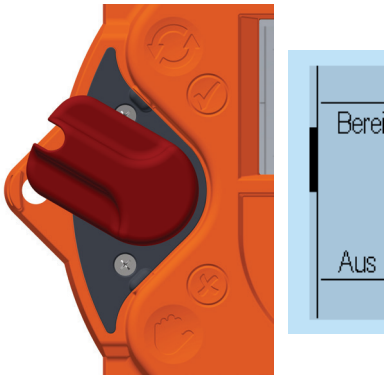
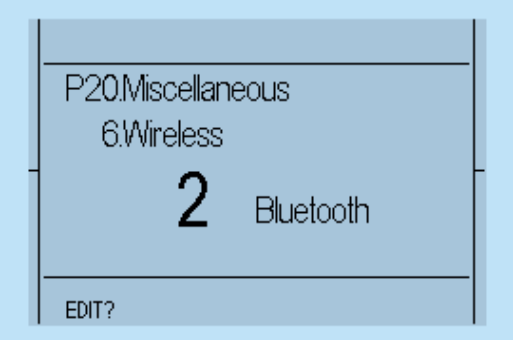


Figure 55. Display After Confirming Selection

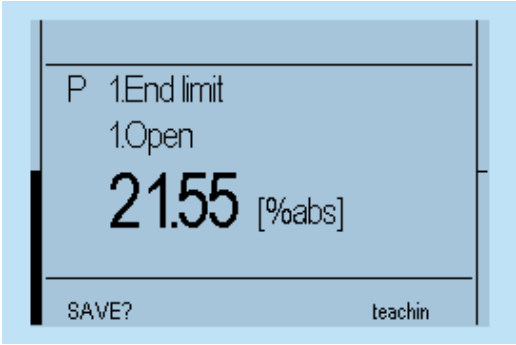


Step 7 - This changes the bottom line of the display from “SAVE?” to “EDIT?” and the parameter is stored.

7.4.4 “**TEACHIN**”

Furthermore, certain parameters (end positions, intermediate positions), can be set using “TEACHIN”. Thus, their configuration is greatly simplified.
After selecting the appropriate menu item (for example: End position) and changing the input type from “EDIT?” to “SAVE?”, move the selector switch (red) to “manual mode” and lock it into place. As you do so, the display will show the message “TEACHIN” and the current position value will be applied continuously to the parameter value. In this mode, further to manual operation by hand wheel, the actuator can be motor-driven with the control switch to the desired position, see Section 6.5.1.

Figure 56. “TEACHIN” on Display



⚠ CAUTION

Please note that, during motor operation, only torque monitoring remains active, as travel adjustment will happen subsequently. Therefore, please check beforehand whether the maximum torque has already been set.

After reaching the desired, position, move the selector switch back to the neutral position. Finally, the parameter value must still be saved by flipping the selector switch halfway up and letting it snap back to the neutral position, see Figures 47 to Figure 51.

Section 8: Parameter Menu

For each parameter group, you can find a description, tabular overview of the menu items and possible configurations. The parameter list, see Tables 7 and 8, also includes all possible options per menu item. Please note that some of the menu items listed and described may not be available with your configuration.

8.1 Parameter Group: End Limit

These parameters are used to configure the end position and switch-off behavior of the actuator. It is important to ensure that the basic mechanical configuration described in Section 6.5 has already been made.

NOTE:
Ensure that these parameters are set during commissioning before operating the actuator. In addition, the settings in the "Torque" menu (see Section 8.2) must be compared with the permissible values of the valve and corrected as appropriate.

⚠ CAUTION

100% stands for fully open and 0% for fully closed. Please note that these values cannot be changed.

Table 7. End Limit Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P1.1	End limit	Open	TEACHIN; 0 to 100U(1)	The parameter value can be set using "TEACHIN". With a known travel, the second end position can be entered after setting the first end position.
P1.2	End limit	Close	TEACHIN; 0 to 100U(1)	The parameter value can be set using "TEACHIN". With a known travel, the second end position can be entered after setting the first end position.
P1.3	End limit	Switch-off Open	by travel (0)	The actuator uses end position signals to switch-off and report the end position. Attention: For fail-safe actuators in fail-safe direction not applicable. End limit by travel in fail-safe position only possible by changing the mechanical connection to the valve.
			by torque (1)	The actuator signals the end position or stops the motor only after reaching the specified torque with the provision that it has reached the end position. If the end position signal is not reached, the actuator reports an error. Attention: For fail-safe actuators in fail-safe direction not applicable. Torque/ Force in fail-safe position depends on residual spring torque/force.
			by torque1 (2)	Like torque, but in the end position range, this is also extended when the positioning command is released, until the torque is reached. Attention: For fail-safe actuators in fail-safe direction not applicable. Torque/Force in fail-safe position depends on residual spring torque/force.
			by torque2 (3)	Like torque1, however, an actuating command is automatically generated additionally in the end position range so that the end position in the end position range is approached even without a positioning command. Attention: For fail-safe actuators in fail-safe direction not applicable. Torque/Force in fail-safe position depends on residual spring torque/force.
			By travel1 (4)	Like travel, however, the actuator still continues to drive the set Overrun time after reaching the end position, even when the positioning command is released. Only relevant if overrun time (P1.10, P1.11) is greater than 0. Attention: For fail-safe actuators in fail-safe direction not applicable.

NOTES:
(1) Representative for CM32.
U - number of revolutions.

Table 8. End Limit Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P1.4	End limit	Switch-off Close	by travel (0)	See P1.3
			by torque (1)	See P1.3
			by torque1 (2)	See P1.3
			by torque2 (3)	See P1.3
			by torque3 (4)	See P1.3
P1.5	End limit	Closing directing	right (0)	Actuator is designed for clockwise = closing.
			left (1)	Reverse direction of rotation. Counterclockwise = closing. The crossing of all signals and commands are performed by the controller.
P1.6	End limit	Rotate sense position	0	Rotation sense of the Potentiometer. No function in RTS Fail-Safe Linear FL Series.
			1	
P1.7	End limit	LED function	Close = green (0)	Definition of the LED color of the CLOSED or OPEN end position indication.
			Close = red (1)	
			Close = green, yellow inv. (2)	Definition of the LED color of the CLOSED or OPEN end position signalization. Yellow LEDs (1 and 2) are inverted.
			Close = red, yellow inv. (3)	
P1.8	End limit	End limit hysteresis	0.1 to 10.0%	Hysteresis range for end position signals: Example: End position hysteresis 1% means that the End position OFF is reached when closing 0%, and will be left when opening only at 1%, i.e., a re-closing can only take place after leaving this hysteresis.
P1.9	End limit	Ramp	0.1 to 10.0%	When approaching the end position, the speed is reduced.
P1.11	End limit	Overrun Open	0 to 60 seconds	Switch-off delay after reaching the end position, see travel1 (P1.3, P1.4).
P1.12	End limit	Overrun Close	0 to 60 seconds	Switch-off delay after reaching the end position travel1 (P1.3, P1.4).

⚠ CAUTION

When installing the actuator on a gear or a thrust unit, please take into account the limits and ratio of the gear/thrust unit at parameterization.

When using end limit switch-off by torque, the end position limit must be set before reaching the torque limit. Accordingly, the actuator will only signal the final end position if the configured torque and the associated end position are reached. If the end position is not reached, a torque error is reported, see Section 7.2.2.

8.2 Parameter Group: Torque

If torque was not specified with the order, the actuator is supplied from the factory with the maximum configurable torque.

Table 9. Torque Table

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P2.1	Torque	Open	8 to 32 Nm [2]	Switch-off torque in OPEN direction CAUTION: The range can be restricted via the menu item P2.3
P2.2	Torque	Close	8 to 32 Nm [2]	As P2.1 but in CLOSED direction

NOTE:
[2] Representative for CM32

⚠ CAUTION

When installing the actuator on an additional gear, please take into account the corresponding values of the gear/thrust unit as you enter the actuator parameters. To achieve an effective output torque (including gear)/output power (including thrust unit) ratio, the ratio of gear/thrust unit must be considered.

8.3 Parameter Group: Speed

Table 10. Speed Table

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P4.1	Speed	Local Open	1.0 to 72.2 rpm	Output speed for local operation in direction OPEN
P4.2	Speed	Local Close	1.0 to 72.2 rpm	As P4.1 but in direction CLOSE
P4.3	Speed	Remote Open	1.0 to 72.2 rpm	Output speed for remote operation in direction OPEN
P4.4	Speed	Remote Close	1.0 to 72.2 rpm	As P4.3 but in direction CLOSE
P4.5	Speed	Emergency Open AUF	1.0 to 72.2 rpm	Output speed for emergency operation in direction OPEN
P4.6	Speed	Emergency Close	1.0 to 72.2 rpm	As P4.5 but in direction CLOSE
P4.7	Speed	Torque-dependent	1.0 to 72.2 rpm	Seal-tight speed. Speed at which the actuator runs near the end position at torque-dependent switch-off (see P1.3 and P1.4)
P4.8	Speed	Minimum	1.0 to 72.2 rpm	Minimum speed

⚠ CAUTION

The maximum speed for the 24 V DC actuator version is reduced to 20 rpm.

8.4 Parameter Group: Ramp (Optional)

The start ramp can be set separately for each operation mode. Thus, a 100% start ramp means that the motor attains its maximum speed in about a second. Higher speeds (see Section 8.3) lead to shorter run times. If the ramp is set below 100%, the starting time increases in an inversely proportional fashion.

Table 11. Ramp Table

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P5.1	Ramp	Local	1 to 100%	Start ramp for local operation
P5.2	Ramp	Remote	1 to 100%	Start ramp for remote operation
P5.3	Ramp	Emergency	1 to 100%	Start ramp for emergency operation

8.5 Parameter Group: Control

Table 12. Control Table

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P6.2	Control	Ready delay	0 to 10 s	Drop-out delay for the ready signal (Binary outputs)
P6.5	Control	24 V output	0	24 V auxiliary output is deactivated, see Section 18.5. The function of the auxiliary input is still activated.
			(1)	24 V auxiliary output is activated (see Section 18.5).
P6.6	Control	Min. impulse	0.1 to 2.0 s	Minimum switch-on time of the motor.
P6.17	Control	Remote Display	0: off	The remote display is deactivated.
			1: Menu	Access to parameter menu is possible on the remote display. Motor control is deactivated on the remote display, i.e., LOCAL and REMOTE operating modes are handled by the main display.
			2: Menu/Control	Access to parameter menu and motor control is possible on the remote display and the main display. In case of a communication loss with the remote display, the actuator will be in operating mode OFF.
			2: Menu/Control (Fallback)	Access to parameter menu and motor control is possible on the remote display and the main display. In case of communication loss with the remote display, the actuator will fall back to the set operating mode on the main display.

8.6 Parameter Group: User Level

From the Display firmware version 1600 and upward, the parameter group number 7 allows to set the default user levels accessed locally or via bus.

The user levels allow access restrictions to certain parameters. Depending on the user level read/write setting per parameter, the menu items can only be seen or edited, if the current user level is equal or higher than the required user level. Parameters are assigned default user levels. These may be changed with the SmartTool2, if the set user level in the SmartTool2 is equal or higher than the current user level-setting of the parameter (group).

Parameter user level can be set by clicking the button as marked below.

Figure 57. Actuator Parameters on the SmartTool2

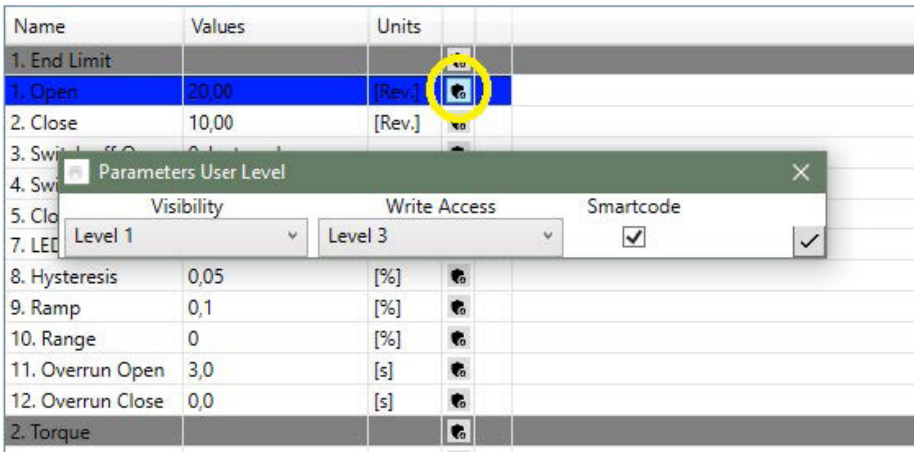


Table 13 shows the default passwords for the user levels:

Table 13. Default Passwords for User Levels

User Level	Password Local	Password Wireless
1	LLVL1	WLVL1
2	LLVL2	WLVL2
3	LLVL3	WLVL3
4	LLVL4	WLVL4

The default passwords can be changed with the SmartTool2 (Adjust Wizard - Access tab, see Figure 58 or directly on the actuator control unit (“P7.3 - Change Password”).

NOTE:
Editing the parameter “P7.4 - Change Password” will change the password for the current user level.

Figure 58. SmartTool2 Adjust Wizard - Access Tab

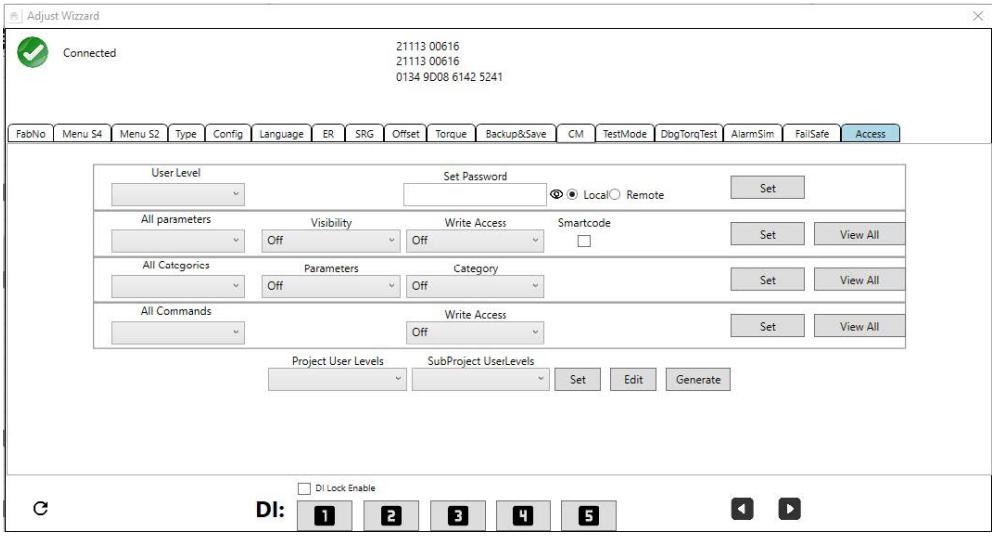


Table 14. User Level Parameter Group

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P7.1	User Level	Local	0 to 6	Sets the default user level on the RTS CM control unit. The set user level will revert back to this user level, if the user level was changed with menu item "U - User level" after 3 minutes of inactivity or upon restarting the actuator. Password will be prompted, if the set user level is higher than the currently active user level.
P7.2	User Level	Bus	0 to 6	Sets the user level on access via Bus.
P7.3	User Level	Remote Display	0 to 6	Sets the user level on the remote display.
P7.4	User Level	Change Password	6-digit	Changes the password of the current active user level.

NOTE:

The parameters have preset user level settings. The tables in Section 8.19 shows an overview of the default user level settings for all parameters.

8.7 Parameter Group: Position

In addition to OPEN and CLOSED end positions, you can define intermediate positions. These can be used as feedback signals for the binary outputs or as target value for fix position approach.

⚠ CAUTION

If you change the end positions (see Section 8.1) intermediate positions are retained percentage-wise, i.e., the absolute positions of the intermediate positions change.

Table 15. Position Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P8.1	Position	Intermediate position 1	TEACHIN 0 to 100%	Position value of intermediate position 1
P8.2	Position	Intermediate position 2	TEACHIN 0 to 100%	See above
P8.3	Position	Intermediate position 3	TEACHIN 0 to 100%	See above
P8.4	Position	Intermediate position 4	TEACHIN 0 to 100%	See above
P8.5	Position	Emerge position	TEACHIN 0 to 100%	Position value of the emergency position.
P8.6	Position	Hysteresis	0.1 to 10.0%	Hysteresis range of intermediate positions. Within this hysteresis, no repositioning occurs upon reaching the intermediate positions (option: fix position approach). Furthermore, the output functions for position = intermediate position are active within this range (see P10.1).
P8.7	Position	Intermediate position 5	TEACHIN 0 to 100%	See above
P8.8	Position	Intermediate position 6	TEACHIN 0 to 100%	See above
P8.9	Position	Intermediate position 7	TEACHIN 0 to 100%	See above
P8.10	Position	Intermediate position 8	TEACHIN 0 to 100%	See above
P8.11	Position	Deadband	0 to 10%	Tolerance range for the position deviation (intermediate position - actual position), where no adjustment occurs. The deadband should not be set too low, to prevent actuator oscillation.
P8.12	Position	Gain	0 to 100%	The gain (gradient) affects the positioning to the target intermediate position. The smaller the gain selected (e.g. 20%), the earlier the actuator starts reducing its speed in case of speed variable actuators on approaching the target position. This leads to better positioning (smaller reachable deadband). A 100% setting disables this gradient.
P8.13	Position	Hysteresis	0 to 100%	This hysteresis value applies to the set value in “P8.11 - Deadband”.

Table 16. Position Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P8.14	Position	Intermediate position 9	TEACHIN 0 to 100%	See above
P8.15	Position	Intermediate position 10	TEACHIN 0 to 100%	See above
P8.16	Position	Intermediate position 11	TEACHIN 0 to 100%	See above
P8.17	Position	Intermediate position 12	TEACHIN 0 to 100%	See above
P8.18	Position	Intermediate position 13	TEACHIN 0 to 100%	See above
P8.19	Position	Intermediate position 14	TEACHIN 0 to 100%	See above
P8.20	Position	Intermediate position 15	TEACHIN 0 to 100%	See above
P8.21	Position	Intermediate position 16	TEACHIN 0 to 100%	See above

Figure 59. Function Principle of the Deadband and Hysteresis in Conjunction with Intermediate Positions

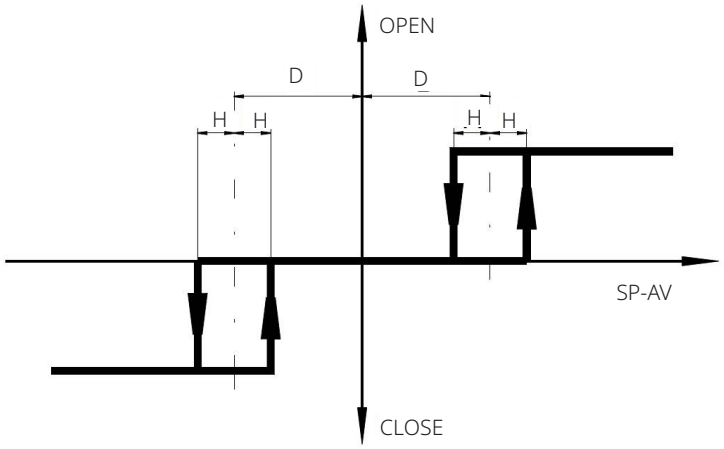


Figure 59 shows the working principle of the parameters “P8.11 - Deadband” and “P8.13 - Hysteresis”. The set deadband thresholds are added and subtracted from the intermediate positions. The hysteresis sets the threshold on the deadband thresholds. E.g. if the intermediate position is 50%, deadband is 1% and hysteresis is 50%, the deadband thresholds will be at 49% and 51%. On top of that, the hysteresis for the 49% threshold will be at 50% of the deadband value, which is ±0.5%; thus the hysteresis on the 49% deadband threshold is at 48.5% and 49.5%. The actuator will move toward 50%, if the actual position is below 48.5% and stop, if the actual position is between 49.5% and the “outer” hysteresis mirrored on the ordinate, which is 51.5% in this case.

NOTE:

Please be aware, that a 100% setting for hysteresis will cause oscillation due to overlapping thresholds.

8.8 Parameter Group: Binary Inputs

The controller is equipped with 5 freely configurable binary inputs. Please find further information on technical data of the binary inputs in Section 18.2. Binary inputs are also effective during actuator control via Profibus (option).

Default binary inputs are as follows:

Input 1: OPEN

Input 2: CLOSED

Input 3: STOP

Input 4: EMERGENCY OPEN

Input 5: EMERGENCY CLOSED

Table 17. Binary Inputs Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P9.1	Binary Input	Input 1	-1: Not activated	This input is not active, i.e., it is not shown in the status S2 - Binary Inputs.
			0: No Function	This input has no function.
			1: Open	OPEN command in REMOTE mode (selector switch in position REMOTE).
			2: Closed	CLOSED command in REMOTE mode (selector switch in position REMOTE).
			3: Stop	STOP command in REMOTE mode (selector switch in position REMOTE).
			4: Open Self-hold	Self-hold for OPEN, i.e., a short pulse is sufficient and the actuator moves then into the end position. Use the STOP command to stop the actuator.
			5: Closed Self-hold	Self-hold for CLOSED, see OPEN SELF-HOLD
			6: Emergency Open	Superimposed run command; run the actuator in direction OPEN regardless of whether the selection switch is set to REMOTE or LOCAL operation.
			7: Emergency Closed	Superimposed run command; run the actuator in direction CLOSED regardless of whether the selection switch is set to REMOTE or LOCAL operation.
			8: Release	The actuator may be operated only with a switched signal. Both in LOCAL and REMOTE operation.
			9: Open/Closed	The actuator moves towards OPEN if input is active and towards CLOSED otherwise.
			10: Close Open	The actuator moves towards CLOSED if input is active and towards OPEN otherwise.
			11: Positioner	Release of the positioner.
			12: Open inv.	As OPEN but active low.
			13: Close inv.	As CLOSED but active low.

Table 18. Binary Inputs Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P9.1	Binary Input	Input 1	14: Stop inv.	As STOP but active low.
			15: Open Self-Hold inv.	As Open Self-Hold but active low.
			16: Closed Self-Hold inv.	As Closed Self-Hold but active low.
			17: Emergency-Open inv.	As Emergency-Open but active low.
			18: Emergency-Closed inv.	As Emergency-Closed but active low.
			19: Block	With activated (switched) signal, the actuator is locked for operation also in local mode.
			20: Controller lock	Positioner lock.
			21: Release Local	The actuator may be operated only with a switched signal.
			22: Block Local	As Release Local but active low.
			23: Lock Open	Trigger lock OPEN (in LOCAL and REMOTE mode). Actuator moves with the highest priority to OPEN; command continues internally active after reaching the end position OPEN. Dropping only with LOCK OFF, Supply OFF or operating mode OFF.
			24: Lock Closed	Trigger lock CLOSED (in LOCAL and REMOTE mode). Actuator moves with the highest priority to CLOSED; command continues internally active after reaching the end position CLOSED. Dropping only with LOCK OFF, Supply OFF or operating mode OFF.
			25: Lock Off	Drop the lock.
			26: Fail-safe	Trigger the Fail-safe function in all operating modes (only functional in fail-safe actuators).
			27: Fail-safe inv.	As Fail-safe, but active low.
			28: Lock Open inv.	As Lock Open, but active low.
			29: Lock Closed inv.	As Lock Open, but active low.
			30: Lock Off inv.	As Lock Off, but active low.
			31: Intermediate position 1	Approach intermediate position 1 (P8.1) in REMOTE mode (fix position approach). There is no repositioning upon reaching the intermediate position within the hysteresis (see P8.6). Higher priority than intermediate positions 2, 3 and 4.

Table 19. Binary Inputs Table (3)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P9.1	Binary Input	Input 1	32: Intermediate position 2	As intermediate position 1 but with higher priority than intermediate positions 3 and 4.
			33: Intermediate position 3	As intermediate position 1 but with higher priority than intermediate position 4.
			34: Intermediate position 4	As intermediate position 1 but with lowest priority.
			35: Emergency position	Approach emergency position (P8.5). As intermediate position 1 but with higher priority than intermediate positions 1, 2.
			36: Intermediate position 1 inv.	As Intermediate position 1 but active low.
			37: Intermediate position 2 inv.	As Intermediate position 2 but active low.
			38: Intermediate position 3 inv.	As Intermediate position 3 but active low.
			39: Intermediate position 4 inv.	As Intermediate position 4 but active low.
			40: Emergency position inv.	As Emergency position but active low.
			41: Travel Open	Reserved for future use.
			42: Travel Close	Reserved for future use.
			43: Travel Open inv.	Reserved for future use.
			44: Travel Close inv.	Reserved for future use.
			45: Fail-safe lock	Reserved for future use (only for Fail-safe actuators)
			46: Fail-safe lock inv.	Reserved for future use (only for Fail-safe actuators)
			47: Intermediate position Bit0	Intermediate position Bit0 to Intermediate position Bit3 allow to signal intermediate positions 1 to 16 through a bit pattern (binary to decimal; decimal value + 1 corresponds to the Intermediate position). Bit3 is the MSB. E.g. to move to Int.position1, all Bits should be 0; to move to Intermediate position3, Bit 1 should be 1.
			48: Intermediate position Bit1	See 47: Intermediate position Bit0
			49: Intermediate position Bit2	See 47: Intermediate position Bit0
			50: Intermediate position Bit0 inv.	As 47: Intermediate position Bit0 but active low
			51: Intermediate position Bit1 inv.	See 50: Intermediate position Bit0 inv.
			52: Intermediate position Bit2 inv.	See 50: Intermediate position Bit0 inv.
			53: PVST Start	Start PVST (optional, see PVST section)
			54: PVST Start inv.	As 53: PVST Start, but active low.
			55: Intermediate position Bit3	See 47: Intermediate position Bit0
			56: Intermediate position Bit3 inv.	See 50: Intermediate position Bit0 inv.
P9.2	Binary Input	Input 2	See Input 1	-
P9.3	Binary Input	Input 3	See Input 1	-
P9.4	Binary Input	Input 4	See Input 1	-
P9.5	Binary Input	Input 5	See Input 1	-

8.9 Parameter Group: Binary Outputs

The controller is equipped with 8 freely configurable binary outputs. Please find further information on technical data of the binary outputs in Section 17.1. Provided with external supply, binary outputs are optically isolated from the rest of the controller.

Default binary outputs are as follows:

Output 1: Ready

Output 2: End position OPEN

Output 3: End position CLOSED

Output 4: Run OPEN

Output 5: Run CLOSED

Output 6: Torque

Output 7: LOCAL

Output 8: REMOTE

Table 20. Binary Outputs Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P10.1	Binary Output	Output 1	0: No Function	The output has no function
			1: Ready	Actuator is ready
			2: Fault	General fault; actuator is not ready
			3: Open	Actuator is in open position
			4: Closed	Actuator is in closed position
			5: Running Open	Actuators runs in direction Closed
			6: Running Closed	Actuators runs in direction Closed
			7: Running	Actuator is running in either Open or Closed
			8: Torque Open	Switch-off torque was reached in Open direction-actuator has been switched off
			9: Torque Closed	Switch-off torque was reached in Closed direction-actuator has been switched off
			10: Torque	Switch-off torque was reached in either Closed or Open direction
			11: Travel Open	The Open end position has been reached
			12: Travel Closed	The Closed end position has been reached
			13: Position > Intermediate 1	Position > Intermediate position 1
			14: Position < Intermediate 1	Position < Intermediate position 1
			15: Position > Intermediate 2	Position > Intermediate position 2

Table 21. Binary Outputs Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P10.1	Binary Output	Output 1	16: Position < Intermediate 2	Position < Intermediate position 2
			17: Position < Intermediate 3	Position > Intermediate position 3
			18: Position < Intermediate 3	Position < Intermediate position 3
			19: Position < Intermediate 4	Position > Intermediate position 4
			20: Position < Intermediate 4	Position < Intermediate position 4
			21: Local	Local operating mode (selector switch in position)
			22: Remote	Remote operating mode (selector switch in position Remote)
			23: Off	Off operating mode (selector switch in the Off position)
			24: Motor Temperature Warning	The motor temperature is above the warning threshold
			25: Motor Error	The motor temperature sensor has reported an error
			26: Always	Signal is always on
			27: Never	Signal is always off
			28: Binary Input 1	Forwarding of binary input to output
			29: Binary Input 2	Forwarding of binary input to output
			30: Binary Input 3	Forwarding of binary input to output
			31: Binary Input 4	Forwarding of binary input to output
			32: Binary Input 5	Forwarding of binary input to output
			33: Torque Open masked	As Torque OPEN although it will suppress (mask) this signal in the end position upon torque-dependent switch-off
			34: Torque Closed masked	As Torque CLOSED although it will suppress (mask) this signal in the end position upon torque-dependent switch-off
			35: Ready Remote	Ready and Remote operating mode
			36: Ready Local	Ready and Local operating mode
			37: Ready Local/Remote	Ready and Local or Remote mode
			38: Lock Open	Lock OPEN is enabled. OPEN command is internally queued with the highest priority and will not be dropped even in the end position
			39: Lock Closed	Lock CLOSED is enabled. CLOSED command is internally queued with the highest priority and will not be dropped even in the end position

Table 22. Binary Outputs Table (3)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P10.1	Binary Output	Output 1	40: Fail-safe OK 1	Fail-safe OK (only for fail-safe actuators)
			41: Fail-safe OK 2	Fail-safe OK and Ready (only for fail-safe actuators)
			42: Fail-safe OK 3	Fail-safe OK, Ready and Remote (only for fail-safe actuators)
			43: Lock	Lock Open or Lock Closed is enabled
			44: Ready/Torque OK	Actuator is ready and no torque switch-off
			45: Ready/Remote/ Torque OK	Actuator is ready for operation in REMOTE mode and no torque switch-off
			46: Position=Int1	Position = Intermediate position 1. The width of the interval is set with the parameter P8.6
			47: Position=Int2	Position = Intermediate position 2. The width of the interval is set with the parameter P8.6
			48: Position=Int3	Position = Intermediate position 3. The width of the interval is set with the parameter P8.6
			49: Position=Int4	Position = Intermediate position 4. The width of the interval is set with the parameter P8.6
			50: Position = Emergency Position	Position = emergency position. The width of the interval is set with the parameter P8.6
			51: Bus Bit 1	In existing bus interface (hardware option) the output is set according to the selected bit bus
			52: Bus Bit 2	
			53: Bus Bit 3	
			54: Bus Bit 4	
			55: Bus Bit 5	
			56: Bus Bit 6	
			57: Bus Bit 7	
			58: Bus Bit 8	
			59: Virtual 1	Configurable output function
			60: Virtual 2	
			61: Virtual 3	
			62: Virtual 4	
			63: Line voltage OK	Supply voltage for the motor is OK
			64: Control voltage OK	The auxiliary voltage for the RTS control is OK. This function is only available if the auxiliary voltage output is not switched on (P6.5 to 0)
			65: PVST OK	The PVST was successful
			66: PVST Failure	The PVST was not successful
			67: PVST Active	A PVST was triggered. The actuator is running a PVST
			68: Emerg. OPEN	Emergency OPEN command is active. The signal remains active, as long as the emergency command is active, even if the end limit is reached
			69: Emerg. CLOSE	Emergency CLOSE command is active. The signal remains active, as long as the emergency command is active, even if the end limit is reached

Table 23. Binary Outputs Table (4)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P10.1	Binary Output	Output 1	70: Analog Input 1 Fault	There is no or a faulty signal on the analog input 1
			71: Analog Input 2 Fault	There is no or a faulty signal on the analog input 2
			72: Phase Sequence Fault	Cause on basis: Active phase sequence detection on single phase actuators, loss of main power while connected to external 24 V DC auxiliary voltage, or loss of phase 2
			73: Power Supply Fault	No power supply to the power electronics (when the controller is powered from the auxiliary power input). Defect of power electronics
			74: Inverter Fault	The inverter is defective or the wiring is faulty (Only for CM.V1.2 actuator series)
			75: Manual Override	Manual override is active (For Fail-Safe Actuators); see the fail-safe section for more information about the manual override
			76: Travel Sensor Fault	The travel measurement is out of range or the wiring is defective for AB CSC.V1.2 actuators. The travel sensor is not calibrated for CM actuators
			77: Torque Sensor Fault	Potentiometer fault on Basis, or cable is broken
			78: Bus Fault	No communication with the optional bus
			79: Bus Watchdog	Watchdog for bus communication has reacted
			80: Undervoltage Warning	The input voltage is below the regular voltage range, but motor operation is still possible
			81: Battery Low	Battery on display board is empty, loss of time/date or counter values possible
			83: Undervoltage Fault	The input voltage is too low, The motor is switched off, until the input voltage is in the regular voltage range
			84: Undervoltage Switchoff	The input voltage dropped below the lower threshold multiple times. The motor is turned off for 5 minutes. This error can be acknowledged by switching the selector switch to OFF or by turning the actuator off and on
			85: Overvoltage Warning	The input voltage is over the regular voltage range, but motor operation is still possible
			86: Internal Fault	Internal communication error between electrical components, i.e. Internal Communication E error, or Internal Communication L error or Internal Communication D error
			87: Torque Masked	Is set, if 33: Torque Open Mask or 34: Torque Close Mask is set

Table 24. Binary Outputs Table (5)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
4 - 5 P10.2	Binary Output	Output Configuration 1	Normal	Output 1 is set to normal, i.e., if the condition in point P10.1 is met, Output 1 is set to HIGH (active HIGH)
			Inverted	If the condition in point P10.1 is met, Output 1 is set to LOW (active LOW)
			Normal Flashing	If the condition in point P10.1 is met, Output 1 starts blinking (active HIGH)
			Inv. Flashing	If the condition in point P10.1 is not met, Output 1 starts blinking (otherwise it is set to HIGH)
P10.3	Binary Output	Output 2	See Output 1	-
P10.4	Binary Output	Output 2 Configuration	See Output 1 Configuration	-
P10.5	Binary Output	Output 3	See Output 1	-
P10.6	Binary Output	Output 3 Configuration	See Output 1 Configuration	-
P10.7	Binary Output	Output 4	See Output 1	-
P10.8	Binary Output	Output Configuration 4	See Output 1 Configuration	-
P10.9	Binary Output	Output 5	See Output 1	-
P10.10	Binary Output	Output Configuration 5	See Output 1 Configuration	-
P10.11	Binary Output	Output 6	See Output 1	-
P10.12	Binary Output	Output Configuration 6	See Output 1 Configuration	-
P10.13	Binary Output	Output 7	See Output 1	-
P10.14	Binary Output	Output Configuration 7	See Output 1 Configuration	-
P10.15	Binary Output	Output 8	See Output 1	-
P10.16	Binary Output	Output Configuration 8	See Output 1 Configuration	-

⚠ CAUTION

When using the point torque-dependent OPEN or torque-dependent CLOSED (see Section 8.1, Menu P1.3 and P1.4) the actuator will only be open or closed when the set torque and the associated end position is reached. If the end position is not reached, a torque error is reported, see Section 7.2.2.

NOTE:

For optional functions such as a relay board or virtual outputs, please refer to the corresponding Installation, Operation and Maintenance Manual.

8.10 Parameter Group: Position Output (Optional)

Position output is used to indicate the current position of the actuator using 0/4 to 20 mA; it can retrofitted using software code. If this option is not enabled, the menu point shows the message “inactive”. No adjustment to the end positions or the travel is required. Adjustment is automatically performed during the configuration of travel limit positions, see Section 8.1. No further settings are necessary for torque-dependent switch-off, because the controller exclusively uses travel limit positions for the calculation. Regardless of whether this is defined by the torque or the travel limit positions.

The factory default settings are:

- 4 mA at 0% position
- 20 mA at 100% position

Table 25. Position Output Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P11.1	Position Output	Function 1	0: off	mA output disabled
			1: Position	mA output corresponds to the actual position value
			2: Position Valve Characteristic	mA output corresponds to the actual position value taking into account the valve characteristic
			3: Torque 1	mA output corresponds to the actual torque value
				torque = 100% Close: mA output = start
				torque = 0%: mA output = center
				torque = 100% Open: mA output = end
			4: Torque 2	mA output corresponds to the actual torque value
				Torque = 100% Close: mA output = end
				Torque = 0%: mA output = start
				Torque = 100% Open: mA output = end
			5: Torque 3	mA output corresponds to the actual torque value
				Torque = 150% Close: mA output = start
				Torque = 0%: mA output = center
				Torque = 150% Open: mA output = end
			6: Torque 4	mA output corresponds to the actual torque value
				Torque = 150% Close: mA output = end
				Torque = 0%: mA output = start
				Torque = 150% Open: mA output = end
			7: External Setpoint 1	Passes on the mA input signal on external setpoint input
			8: External Setpoint 2	Passes on the raw mA input signal on external setpoint input
P11.2	Position Output	Start (at 0%)	0 to 20.5 mA (4 mA)	mA value for the Closed (0%) position
P11.3	Position Output	End (at 100%)	0 to 20.5 mA (20 mA)	mA value for the ON (100%) position
P11.4	Position Output	Calibration 20 mA	-10% to +10%	Calibrating the output position during the setting of this parameter will output a 20 mA (100%) signal. Use this parameter to calibrate accurately the 20 mA output signal. (e.g., if you measure 19.8 mA at the output, just add 1% (0.2 mA to 1% of 20 mA) to the displayed value.

Table 26. Position Output Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P11.5	Analog Output	Function 2	See Function 1	-
P11.6	Analog Output	Start 2 (at 0%)	See Start	-
P11.7	Analog Output	End 2 (at 100%)	See End	-
P11.8	Analog Output	Calibration 20 mA 2	See Calibration 20 mA 1	-

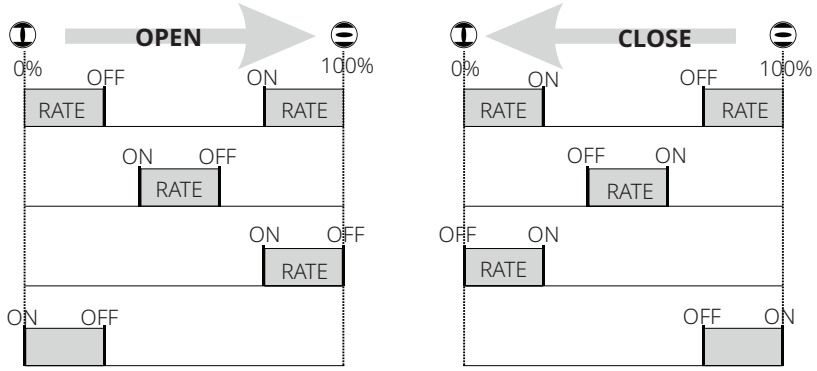
8.11 Parameter Group: Step Mode

Step mode operation can be used to extend the operating time in certain ranges or for the whole travel; it is available in local, remote and emergency mode. Step mode operation can be activated individually for the directions OPEN and CLOSED. Cycle start, cycle end, cycle duration and interval time can be set separately for both directions.

Table 27. Step Mode Table

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P12.1	Step Mode Function	Mode	Disabled	Step mode operation is disabled.
			Enabled	Step mode operation is enabled in LOCAL, REMOTE and EMERGENCY operation.
			Local only	Step mode is only enabled in LOCAL mode.
			Remote only	Step mode is only enabled in REMOTE mode.
			Local + Remote only	Step mode is enabled in REMOTE and LOCAL mode.
P12.2	Step Mode Function	Start Open	0 to 100%	In OPEN direction, position in % from which the step mode operation should start.
P12.3	Step mode Function	End Open	0 to 100%	In OPEN direction, position in % of which the step mode operation should end.
P12.4	Step Mode Function	Runtime Open	0.1 to 60	Runtime in OPEN direction.
P12.5	Step Mode Function	Pause Time Open	0.2 to 60	Pause time in OPEN direction.
P12.6	Step Mode Function	Start Closed	0 to 100%	In CLOSED direction, position in % from which the step mode operation should start.
P12.7	Step Mode Function	End Closed	0 to 100%	In CLOSED direction, position in % of which the step mode operation should end.
P12.8	Step Mode Function	Runtime Closed	0.1 to 60	Runtime in Closed direction.
P12.9	Step Mode Function	Pause Time	0.2 to 60	Pause time in Closed direction.
P12.10	Step Mode Function	Time base	0: Seconds	Time basis for run and pause times.
			1: Minutes	
P12.11	Step mode function	Speed adaption	0	Speed adaption not activated. Normal step mode function.
			1	Speed adaption is activated. The speed is reduced according to the runtime and pause time in the step mode range. (Example: Running time 1 second and pause time 1 second results in half the speed). If the minimum speed is undershot, the actuator clocks in the converted ratio with the minimum speed. The speed adjustment is only applicable to actuators of the type CM.

Figure 60. Step Mode Operation



NOTE:
It is important to ensure that the mode of operation is not exceeded. The running information on the actuator (see Section 7.2.2) only flashes while the drive is running, i.e., during the break, no flash.

8.12 Parameter Group: Positioner (Optional)

The positioner SR option is used to control the electric actuator by means of a setpoint input 0/4 to 20 mA signal. The SR helps control the position of the actuator, i.e., the positioner ensures that the actual value and thus the position of the actuator matches the desired setpoint.

Table 28. Positioner Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P13.1	Positioner	Function	Off	Positioner disabled.
			1: Position	mA input for the position setpoint.
			2: Position valve characteristic	mA input for the position setpoint, taking into account the valve characteristic.
P13.2	Positioner	Begin (at 0%)	0 to 20.5 mA (4 mA)	mA value of the setpoint for the CLOSED (0%) position.
P13.3	Positioner	End (at 100%)	0 to 20.5 mA (20 mA)	mA value of the setpoint for the OPEN (100%) position.
P13.4	Positioner	Deadband	0.1 to 10.0% (1%)	Tolerance range for the control deviation (setpoint position - actual position) where no adjustment occurs. The deadband should not be set too low to prevent actuator oscillation.
P13.5	Positioner	Gain	1 to 100% (100%)	The gain (gradient) affects the positioning close to the target position. The smaller the gain selected (for example, 20%), the earlier the actuator starts reducing its speed in case of speed variable actuators on approaching the target position. In case of actuators with fixed speed (reversing starters) the speed reduction is done by pulsing (also see parameters P13.9 and P13.10). This provides a better positioning (smaller reachable deadband). A 100% setting disables this gradient.
P13.6	Positioner	Live zero detect	0: Ignore	The setpoint monitoring (monitoring the setpoint to below approximately 2 mA = loss of signal) is disabled.
			1: Stop	Actuator stops on signal failure.
			Open	Actuator moves to OPEN position.
			2: Close	Actuator moves to CLOSED position on signal failure.
			3: Emergency Position	On signal failure, the actuator moves to defined emergency position (see parameter P13.7).
			4: Emergency PID	Reserved for future use.
			5: Emergency Open	Emergency open on signal failure.
			6: Emergency Close	Emergency close on signal failure.
			7: Last valid value	Moves to the last valid value after signal failure; relevant for setpoints over bus. The actuator will move to the 4 mA position, in case of an analog input signal failure.
			8: Fail-safe	Fail-safe operation on signal failure.
P13.7	Positioner	Emergency position	0 to 100% (50%)	Determination of the emergency position. (It can also be set in the menu P8.5).

Table 29. Positioner Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P13.8	Positioner	Calibration setpoint	-10% to +10%	Calibration value for the mA setpoint. Calibration process: By applying 20 mA on the setpoint input, this parameter is corrected until the readout matches 20 mA.
P13.9	Positioner	Minimum Impulse	(0.2 second)	Minimum activation time of the reversing contactors. For very small activation times (<0.3 to 0.5 s), the motor will be switched off during start-up process, which increases significantly reversing contactors mechanical wear. With frequent periods of very small activation times (restless loop, small dead zone, clocking near to the target value), we therefore recommend electronic reversing contactor.
P13.10	Positioner	Period	(2.0 seconds)	This parameter is only relevant when step mode is enabled and when approaching the target position (parameter gain smaller than 100%) and determines the period of a run/pause cycle.
P13.11	Positioner	Begin position (a0)	0.0 to 25.0% (2.0%)	Smallest controllable position other than the end position CLOSED. The range 0% to a0 will be just passed through. Use the parameter a0 to define the beginning of the allowable control range of the valve (e.g., blind spot for ball segment valves, etc.).
P13.12	Positioner	End Position (e0)	75.0 to 100.0% (98.0%)	Largest controllable position other than the end position OPEN. The area e0 to 100% is just passed through. Use the parameter e0 to define the end of the allowable control range of the valve.
P13.13	Positioner	Begin Setpoint (a1)	0.0 to 25.0% (2.0%)	Below this value, the end position CLOSED is controlled. In the range 0% to a1 cannot be controlled (end position tolerance). The initial setpoint a1 is associated with a small hysteresis (1/4 of the deadband).
P13.14	Positioner	End Setpoint (e1)	75.0 to 100.0% (98.0%)	Above this value, the end position OPEN is controlled. The range e1 to 100% cannot be controlled (end position tolerance). The final setpoint e1 is associated with a small hysteresis (1/4 of the deadband).
P13.15	Positioner	Calibration setpoint offset	-10% to +10%	Calibration of zero for the input setpoint, 1% = 0.2 mA.
P13.16	Positioner	Hysteresis	0 to 100%	Hysteresis range for setpoint signal, with regard to the deadband. Setting 0 equals to a hysteresis of 25%.

Figure 61. Assigning the Position to the Setpoint

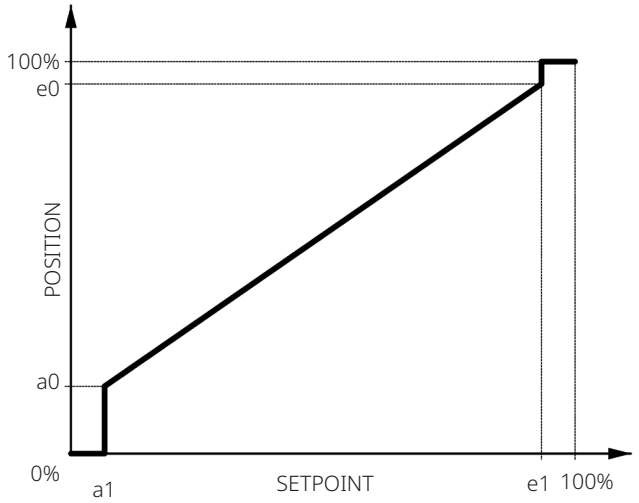


Figure 62. Function Principle of the Deadband, and Hysteresis in Conjunction with the Positioner

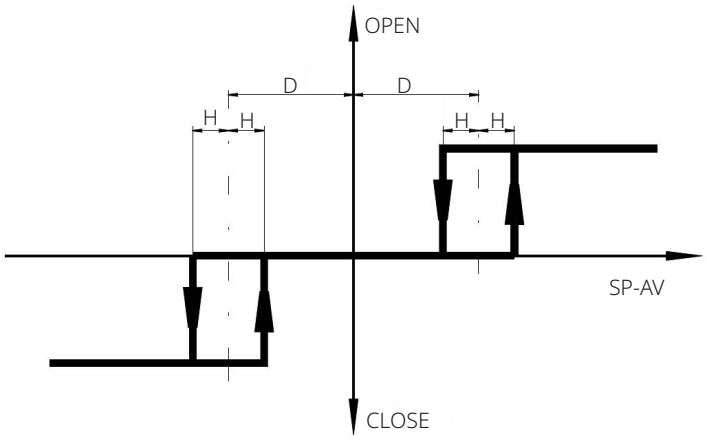


Figure 62 shows the working principle of the parameters “P13.4 - Deadband” and “P13.16 - Hysteresis”. The set deadband thresholds are added and subtracted from the setpoint. The hysteresis sets the threshold on the deadband thresholds. E.g. if the setpoint is 50%, deadband is 1% and hysteresis is 50%, the deadband thresholds will be at 49% and 51%. On top of that, the hysteresis for the 49% threshold will be at 50% of the deadband value, which is ±0.5%; thus the hysteresis on the 49% deadband threshold is at 48.5% and 49.5%. The actuator will move toward 50%, if the actual position is below 48.5% and stop, if the actual position is between 49.5% and the “outer” hysteresis mirrored on the ordinate, which is 51.5% in this case.

NOTE:

Please be aware, that a 100% setting for hysteresis will cause oscillation due to overlapping thresholds.

8.13 Parameter Group: Bus Systems (Optional)

The manuals for Bus Systems are available at www.emerson.com, Bettis RTS Electric Actuator under Manuals and Guides tab.

8.14 Parameter Group: PID-Controller (Optional)

The optional PID-controller is used for controlling an external actual value (process variable) to a setpoint using 0/4 to 20 mA signal by readjusting the actuator.

Table 30. PID-controller Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P14.1	PID-controller	Function	0: disabled	PID-controller disabled.
			1: Position	The output of the PID-controller corresponds to the position setpoint of the actuator. The positioning (tracking of the actual position to the setpoint) is done by the positioner (see Section 8.12).
			2: Speed	The output of the PID-controller corresponds to the speed of the actuator (speed mode is only possible for RTS CM). There is no adjustment with the positioner.
			3: Speed	The output of the PID-controller corresponds to the change of the position setpoint (speed) of the actuator. The positioning (tracking of the actual position to the setpoint) is done by the positioner (see Section 8.12). Hence a control mode similar to the Speed mode (see Setting 2, above) is possible also for actuators with constant speed.
P14.2	PID-controller	External Setpoint	0: Fixed	The PID-controller uses an internal, fixed setpoint (see parameter P14.3).
			1: External	The PID-controller uses the external setpoint. The adjustment of this setpoint is done with the parameters P13.2 and P13.3 (see Section 18.12).
P14.3	PID-controller	Fixed setpoint	0 to 100%	Specification of the internal fixed setpoint.
P14.4	PID-controller	Start (at 0%)	0 to 20.5 mA	mA value at 0% of the external actual value.
P14.5	PID-controller	End (at 100%)	0 to 20.5 mA	mA value at 100% of the external actual value.
P14.6	PID-controller	Gain (P)	+50.0 to 50.0	Gain (proportional value) of the PID-controller. A negative value reverses the effective direction of the PID-controller, e.g.: Positive gain: The actuator opens when the desired value is greater than the external actual value. Negative gain: The actuator closes when the desired value is greater than the external actual value.

Table 31. PID-controller Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P14.7	PID-controller	Reset time (I)	0 to 100.0 seconds	The shorter the reset time (integral time, integral value), the stronger is the effect of the integral component of the PID-controller. Values below 1.0 will disable the integral component.
P14.8	PID-controller	Lead Time (D)	0 to 100.0 seconds	The larger the lead time (differential/derivative value), the stronger is the effect of the dervative component of the PID-controller. To reduce the influence of noise a first-order lag element with 1 second time constant is added (DT_1) .
P14.9	PID-controller	Offset	-200 to 200%	The offset value will be added to the output value of the PID-controller.
P14.10[3]	PID-controller	Inverse operation	0: Off	The output of the PID-controller is not inverted.
			1: On	The output of the PID-controller is inverted.
P14.12	PID-controller	Live zero detect.	Ignore	The monitoring of the external actual value is disabled.
			Stop	Actuator stops on signal failure of external. Actual value.
			Open	On signal failure of external actual values, actuator moves to the OPEN position.
			Closed	On signal failure of external actual values, actuator moves to the CLOSED position.
			Emergency position	On signal failure of external actual values, actuator moves to the EMERGENCY position, see parameter P13.7.
			Emergency PID	Reserved for future use.
P14.13	PID-controller	Calibration of External Actual Value	-10.0 to 10.0%	Calibration process: By applying 20 mA to the external actual value input, this parameter is corrected until the readout matches to 20 mA.
P14.14	PID-controller	Process start	32768 to 32767	Mantissa of the real process variable (beginning of external actual value)
P14.15	PID-controller	PID-controller	32768 to 32767	Mantissa of the real process variable (end of external actual value)
P14.16	PID-controller	Process comma shift	-3 to 3	Position of the comma for process begin/end (P14.14, P14.15), e.g.: mantissa = 200, comma shift = -2/2, process value = 2.00/20000
P14.17	PID-controller	Process unit	-	Unit of the real process variable.
P14.18	PID-controller	Deadband	0.1 to 10.0% (1.0%)	Tolerance range for the control deviation (setpoint – external actual value) where no adjustment occurs.

NOTE:
[3] from firmware 1.609.

8.15 Parameter Group: Characteristic Curves (Optional)

With this option, customers can enable travel-dependent torque, speed and valve characteristic curves.

8.15.1 Torque Characteristic

With this characteristic curve, torque limits already set under menu item P2-torque (see Section 8.2) can be further reduced depending on travel. Characteristics can be configured with the SMARTTOOL software, see Figure 63.

Figure 63. Torque Characteristic Curve Display

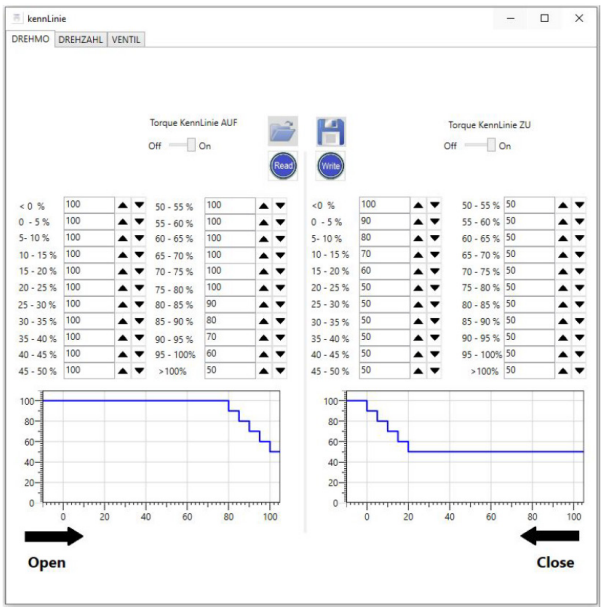


Table 32. Torque Characteristic Curve Parameter Group

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P17.1	Characteristic	Torque Open	0: Off	The torque characteristic curve is disabled for the OPEN direction.
			1: On	The torque characteristic curve is enabled for the OPEN direction.
P17.2	Characteristic	Torque Closed	0: Off	The torque characteristic curve is disabled for the CLOSED direction.
			1: On	The torque characteristic curve is enabled for the CLOSED direction.

8.15.2 Speed Characteristic

With this characteristic curve, speed limits already set under menu item P4-speed (see Section 8.3) can be further reduced depending on travel. Characteristics can be configured via the SMARTTOOL software, see Figure 64.

Figure 64. Speed Characteristic Curve Display

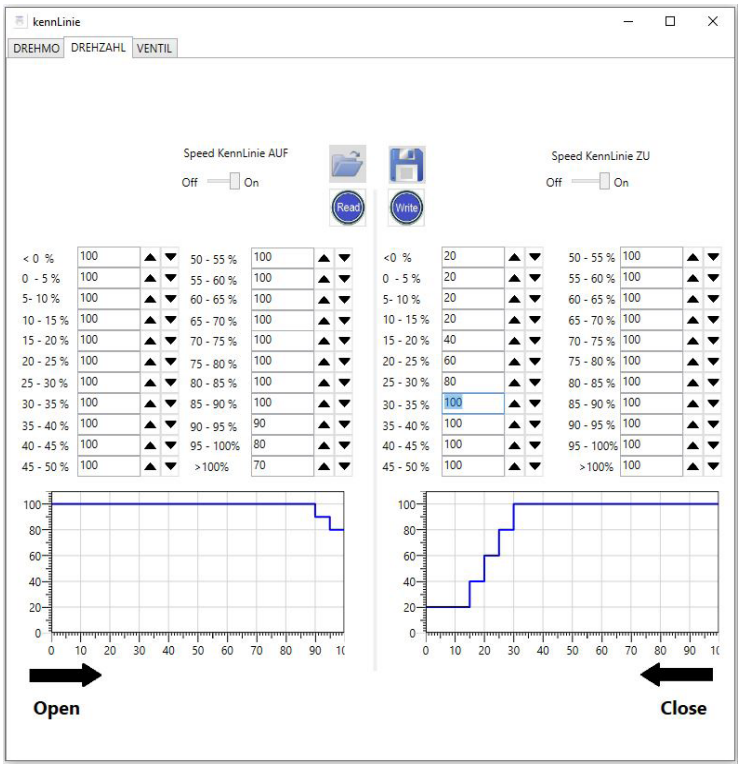


Table 33. Speed Characteristic Curve Parameter Group

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P17.3	Characteristic	Speed Open	0: Off	The speed characteristic curve is disabled for the OPEN direction.
			1: On	The speed characteristic curve is enabled for the OPEN direction.
P17.4	Characteristic	Speed Closed	0: Off	The speed characteristic curve is disabled for the CLOSED direction.
			1: On	The speed characteristic curve is enabled for the CLOSED direction.

8.15.3 Valve Characteristic

With this characteristic curve, the mapping between the actuator position and the setpoint of the valve can be adjusted. Hence, it is possible to compensate and linearize the general non-linear characteristic curves of valves. Characteristics can be configured via the SMARTTOOL software, see Figure 65.

Figure 65. Valve Characteristic Curve Display

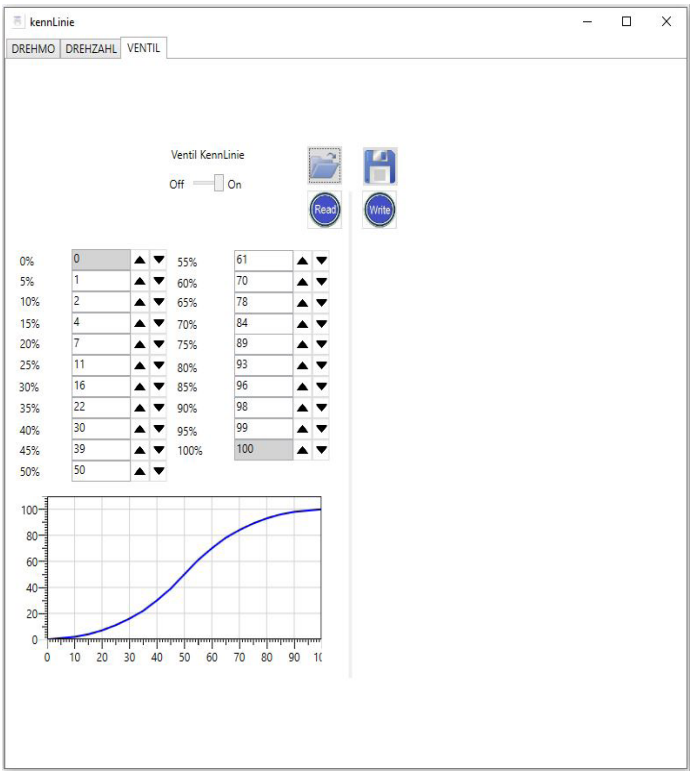


Table 34. Valve Characteristic Curve Parameter Group

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P17.5	Characteristic	Valve	0: Off	The valve characteristic curve is disabled.
			1: user defined	The valve characteristic curve is enabled as configured in the SMARTTOOL.

8.16 Parameter Group: Identification (Optional)

This option allows entering further custom-identification parameters.

Table 35. Identification Table

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P18.1	Identification	PPS number	15-digit	Used to enter a PPS number. This is displayed in the bottom line. CAUTION: point P20.5 must be set to 0.

8.17 Parameter Group: System Parameters

Used for actuator configuration. Most of these parameters are used to display crucial information about the actuator configuration for servicing, thus, only visible for user level service or higher.

Table 36. System Parameter Group

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P19.6	System Parameters	Calibration IST	-10 to +10%	This value is used to offset the output signal of the RTS CM control unit's analog output. The mA-signal may be calibrated with a current measurement device.
P19.7	System Parameters	Calibration Setpoint 20 mA	-10 to +10%	This value is used to offset the input signal on analog input 1 measured by the RTS CM control unit. The measured mA-signal may be calibrated with an external setpoint generator.
P19.8	System Parameters	Calibration External Actual Value 20 mA	-10 to +10%	This value is used to offset the input signal on the external analog input 2 measured by the RTS CM control unit. The measured mA-signal may be calibrated with an external setpoint generator.
P19.12	System Parameters	LCD Contrast	80 to 150	The display contrast may be set with this parameter.
P19.15	System Parameters	Welcome Menu	0; 1	Starts the actuator with the welcome menu on startup, if set to 1.
P19.21	System Parameters	LED Function	-	See "P1.7 - LED function" in Section 8.1.
P19.33	System Parameters	MUSE-Detection	0: -	MUSE-Detection is not executed.
			1: Execute	MUSE-Detection is executed.
P19.56	System Parameters	LCD Inverse	0; 1	Inverts the display pixels.

8.18 Parameter Group: Miscellaneous

Table 37. Miscellaneous Table (1)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P20.1	Miscellaneous	Language	0: German	Defines the menu language.
			1: English	
			2: Russian	
			3: Czech	
			4: Spanish	
			5: French	
			6: Italian	
			7: Danish	
			8: Hungarian	
			9: Turkish	
			10: Greek	
			11: Polish	
			12: Serbian	
			13: Croatian	
			14: Bulgarian	
			15: Dutch	
			16: Romanian	
			17: Swedish	
P20.2	Miscellaneous	Smartcode	-	Enables additional features by entering a Smartcode.
P20.3	Miscellaneous	Load Configuration	Customer Configuration -	By saving this setting, all parameters except the end positions are reset to the customer parameters.
			Customer Configuration +	By saving this setting, all parameters are reset to the customer parameters.
			Backup Parameters -	By saving this setting, all parameters except the end positions are reset to the factory settings.
			Backup Parameters +	By saving this setting, all parameters are reset to the factory settings.
			5: Workshop -	Restores all parameters to the workshop backup parametrization, without changing the end limits (P1.1 and P1.2) and the switch-off torques and torque limit (P2.1, P2.2 and P2.3).
			6: Workshop +	Restores all parameters to the workshop backup parametrization, including the end limits (P1.1 and P1.2) and the switch-off torques and torque limit (P2.1, P2.2 and P2.3).
P20.4	Miscellaneous	Backup Parameters	Customer Configuration	By saving this setting, the currently set parameters are adopted as customer parameters.
			2: Service	By saving this setting, the current parameters are adopted as service parameters.
			3: Workshop	By saving this setting, the current parameters are adopted as workshop parameters.
P20.5	Miscellaneous	Information line	0 to 15	The fourth line of the display shows various diagnostic values.

Table 38. Miscellaneous Table (2)

	Menu Item	Sub Menu Item	Position Setting	Notes/Comments
P20.6	Miscellaneous	Infrared	Off	The infrared connection is disabled.
			1: Infared	The infrared connection is activated for about 3 minutes.
			2: Bluetooth	The Bluetooth connection is active for about 3 minutes unless communication is detected.
			3: Infared +	The infrared connection is activated.
			4: Bluetooth +	The Bluetooth connection is activated.
P20.7	Miscellaneous	Menu style	0 to 2	Different menu styles.
P20.9	Miscellaneous	Time	-	Sets the date and time on the actuator. Move the red selector switch to highlight the next value, and down to highlight the prior value.
P20.10	Miscellaneous	Time zone	-840 to 840 min.	Sets the time zone; offsets the shown time in minutes.
P20.11	Miscellaneous	Daylight saving time	Off	Normal time is activated.
			On	Daylight saving time is activated.
			Auto	The actuator switches automatically between Daylight saving time and Normal time.

NOTE:

Backups are prioritized; the higher the number, the higher the priority. For example, if parameters are backed up as service, the customer parameters will be overwritten.

8.19 Default User Level Settings

Tables 39 to 42 shows the default user level settings for all parameters on a brand new actuator.

Table 39. Default User Level Settings (1)

Parameter	Menu Item	Sub Menu Item	Default UL Read	Default UL Read Write
P1.1	End Limit	Open	1	3
P1.2	End Limit	Close	1	3
P1.3	End Limit	Switch-off Open	2	4
P1.4	End Limit	Switch-off Close	2	4
P1.5	End Limit	Closing direction	2	4
P1.7	End Limit	LED Function	1	3
P1.8	End Limit	Hysteresis	2	4
P1.9	End Limit	Ramp	2	4
P1.11	End Limit	Overrun Open	2	4
P1.12	End Limit	Overrun Close	2	4
P2.1	Torque	Open	2	4
P2.2	Torque	Close	2	4
P4.1	Speed	Local Open	2	4
P4.2	Speed	Local Close	2	4
P4.3	Speed	Remote Open	2	4
P4.4	Speed	Remote Close	2	4
P4.5	Speed	Emergency Open	2	4
P4.6	Speed	Emergency Close	2	4
P4.7	Speed	Torque-depended operation	2	4
P4.8	Speed	Minimal	2	4
P5.1	Ramp	Local	2	4
P5.2	Ramp	Remote	2	4
P5.3	Ramp	Emergency	2	4
P6.2	Control	Ready delay	2	4
P6.5	Control	24 V Output	2	4
P6.6	Control	Minimum Impuls	2	4
P6.17	Control	Remote Display	2	4
P7.1	User Level	Local	2	4
P7.2	User Level	Bus	2	4
P7.3	User Level	Remote Display	2	4
P7.4	User Level	Change Password	1	1
P8.1	Position	Intermediate position 1	1	3
P8.2	Position	Intermediate position 2	1	3
P8.3	Position	Intermediate position 3	1	3
P8.4	Position	Intermediate position 4	1	3
P8.5	Position	Emergency position	1	3
P8.6	Position	Hysteresis	1	3
P8.7	Position	Intermediate position 5	1	3
P8.8	Position	Intermediate position 6	1	3
P8.9	Position	Intermediate position 7	1	3
P8.10	Position	Intermediate position 8	1	3

Table 40. Default User Level Settings (2)

Parameter	Menu Item	Sub Menu Item	Default UL Read	Default UL Read Write
P8.11	Position	Deadband	1	3
P8.12	Position	Gain	1	3
P8.13	Position	Hysteresis	1	3
P8.14	Position	Intermediate position 9	1	3
P8.15	Position	Intermediate position 10	1	3
P8.16	Position	Intermediate position 11	1	3
P8.17	Position	Intermediate position 12	1	3
P8.18	Position	Intermediate position 13	1	3
P8.19	Position	Intermediate position 14	1	3
P8.20	Position	Intermediate position 15	1	3
P8.21	Position	Intermediate position 16	1	3
P9.1	Binary Input	Input 1	2	4
P9.2	Binary Input	Input 2	2	4
P9.3	Binary Input	Input 3	2	4
P9.4	Binary Input	Input 4	2	4
P9.5	Binary Input	Input 5	2	4
P10.1	Binary Output	Output 1	2	4
P10.2	Binary Output	Output Configuration 1	2	4
P10.3	Binary Output	Output 2	2	4
P10.4	Binary Output	Output Configuration 2	2	4
P10.5	Binary Output	Output 3	2	4
P10.6	Binary Output	Output Configuration 3	2	4
P10.7	Binary Output	Output 4	2	4
P10.8	Binary Output	Output Configuration 4	2	4
P10.9	Binary Output	Output 5	2	4
P10.10	Binary Output	Output Configuration 5	2	4
P10.11	Binary Output	Output 6	2	4
P10.12	Binary Output	Output Configuration 6	2	4
P10.13	Binary Output	Output 7	2	4
P10.14	Binary Output	Output Configuration 7	2	4
P10.15	Binary Output	Output 8	2	4
P10.16	Binary Output	Output Configuration 8	2	4
P11.1	Analog Signal	Function 1	2	4
P11.2	Analog Signal	Begin 1 (at 0%)	2	4
P11.3	Analog Signal	End 1 (at 100%)	2	4
P11.4	Analog Signal	Calibration 20 mA 1	2	4
P11.5	Analog Signal	Function 2	2	4
P11.6	Analog Signal	Begin 2 (at 0%)	2	4
P11.7	Analog Signal	End 2 (at 100%)	2	4
P11.8	Analog Signal	Calibration 20 mA 2	2	4
P12.1	Step mode	Function	2	4
P12.2	Step mode	Start Open	2	4
P12.3	Step mode	End Open	2	4
P12.4	Step mode	ON time Open	2	4
P12.5	Step mode	OFF time Open	2	4
P12.6	Step mode	Start Close	2	4
P12.7	Step mode	End Close	2	4
P12.8	Step mode	ON time Close	2	4

Table 41. Default User Level Settings (3)

Parameter	Menu Item	Sub Menu Item	Default UL Read	Default UL Read Write
P12.9	Step mode	OFF time Close	2	4
P12.10	Step mode	Time base	2	4
P12.11	Step mode	Speed adaption	2	4
P13.1	Positioner	Function	2	4
P13.2	Positioner	Begin (at 0%)	2	4
P13.3	Positioner	End (at 100%)	2	4
P13.4	Positioner	Deadband	2	4
P13.5	Positioner	Gain	2	4
P13.6	Positioner	Live zero detect.	2	4
P13.7	Positioner	Emergency position	1	3
P13.8	Positioner	Calibration setpoint	2	4
P13.9	Positioner	Minimum Impuls	2	4
P13.10	Positioner	Period	2	4
P13.11	Positioner	Begin position (a0)	2	4
P13.12	Positioner	End position (e0)	2	4
P13.13	Positioner	Begin setpoint (a1)	2	4
P13.14	Positioner	End setpoint (e1)	2	4
P13.15	Positioner	Calibration setpoint offset	2	4
P13.16	Positioner	Hysteresis	2	4
P14.1	PID-controller	Function	2	4
P14.2	PID-controller	External setpoint	2	4
P14.3	PID-controller	Setpoint value	2	4
P14.4	PID-controller	Begin (at 0%)	2	4
P14.5	PID-controller	End (at 100%)	2	4
P14.6	PID-controller	Proportional	2	4
P14.7	PID-controller	Integral	2	4
P14.8	PID-controller	Differential	2	4
P14.9	PID-controller	Offset	2	4
P14.12	PID-controller	Live zero detect.	2	4
P14.13	PID-controller	Calibration external actual value	2	4
P14.14	PID-controller	Process begin	2	4
P14.15	PID-controller	Process end	2	4
P14.16	PID-controller	Process comma shift	2	4
P14.17	PID-controller	Process unit	2	4
P14.18	PID-controller	Deadband	2	4
P16.1	Stroketest	Stroketest	2	4
P16.2	Stroketest	Start position	2	4
P16.3	Stroketest	Test range	2	4
P16.4	Stroketest	Resting time	2	4
P16.5	Stroketest	Speed Open	2	4
P16.6	Stroketest	Speed Close	2	4
P16.7	Stroketest	Time trigger	2	4
P16.8	Stroketest	Maximum time	2	4
P16.9	Stroketest	Start Time	2	4
P16.10	Stroketest	Start Test	2	4

Table 42. Default User Level Settings (4)

Parameter	Menu Item	Sub Menu Item	Default UL Read	Default UL Read Write
P17.1	Characteristic	Torque Open	2	4
P17.2	Characteristic	Torque Close	2	4
P17.3	Characteristic	Speed Open	2	4
P17.4	Characteristic	Speed Close	2	4
P17.5	Characteristic	Valve	2	4
P18.1	Identification	KKS-Number	2	4
P19.6	System	Calibration IST	2	4
P19.7	System	Calibration SOLL	2	4
P19.8	System	Calibration EIST	2	4
P19.12	System	LCD Contrast	2	4
P19.15	System	Welcome Menu	4	4
P19.21	System	LED Function	1	3
P19.56	System	LCD Inverse	2	4
P20.1	Miscellaneous	Language	1	3
P20.2	Miscellaneous	Smartcode	1	1
P20.3	Miscellaneous	Restore	4	4
P20.4	Miscellaneous	Backup	4	4
P20.5	Miscellaneous	Information display	1	3
P20.6	Miscellaneous	Wireless	1	3
P20.7	Miscellaneous	Menu Style	1	3
P20.9	Miscellaneous	Time	1	3
P20.10	Miscellaneous	Timezone	1	3
P20.11	Miscellaneous	Daylight saving time	1	3

Section 9: Status Area

The status area presents current process and diagnostic data. Here, data is read-only. To access the status area, move the control switch in the direction where the selector switch should be in the neutral position or in the remote position.

The status area is divided into 2 sub-areas:

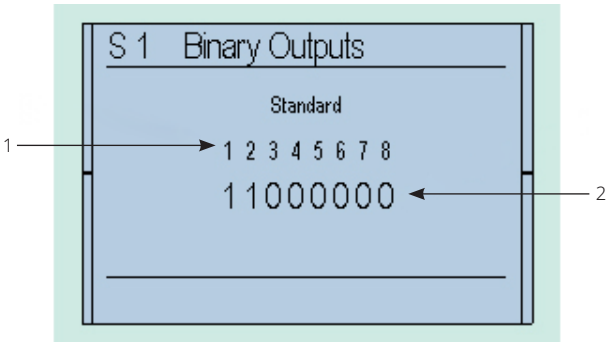
- Status
- History

9.1 Status

9.1.1 Status - Binary Outputs

Display of binary outputs: The display shows output control as opposed to output status, i.e., the supply of the binary outputs is ignored. A switched output is represented by 1.

Figure 66. Binary Outputs Display



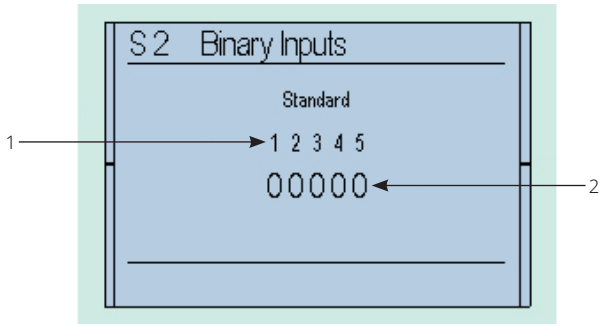
Display Overview:

1. Output Number
2. Signal (0=LOW; 1=HIGH)

9.1.2 Status - Binary Inputs

Display of binary inputs: A set input is represented by 1.

Figure 67. Binary Inputs Display



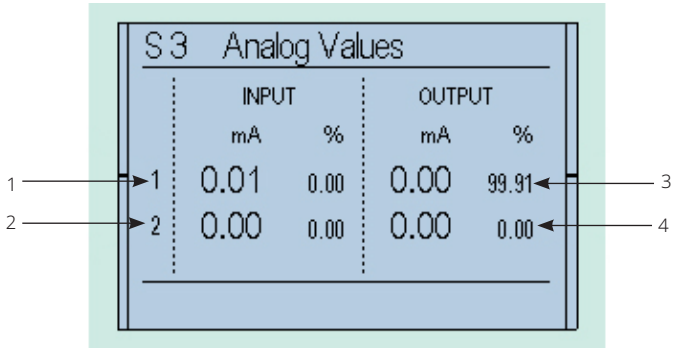
Display Overview:

1. Input Number
2. Signal (0=LOW: 1=HIGH)

9.1.3 Status - Analog Values

Display of analog values: Input 1 (In1) is used by the positioner as the setpoint; Input 2 (In2) serves as an external value for the optional PID-controller. In the analogue output (out), only the control signal is shown, regardless of whether the output current actually flows or not (interruption of the current loop).

Figure 68. Analog Values Display



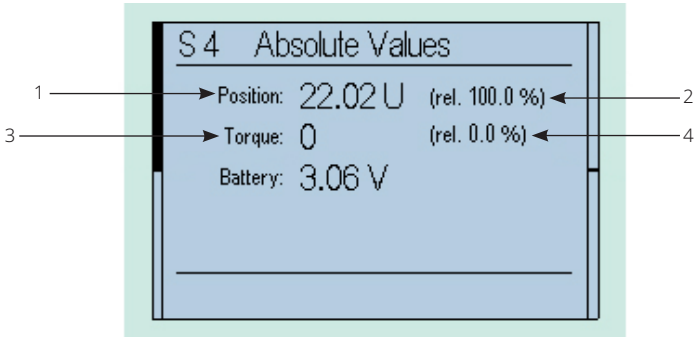
Display Overview:

1. Input 1
2. Input 2
3. Output
4. All values in mA

9.1.4 Status - Absolute Values

This status displays the absolute position of the actuator.

Figure 69. Absolute Value Display

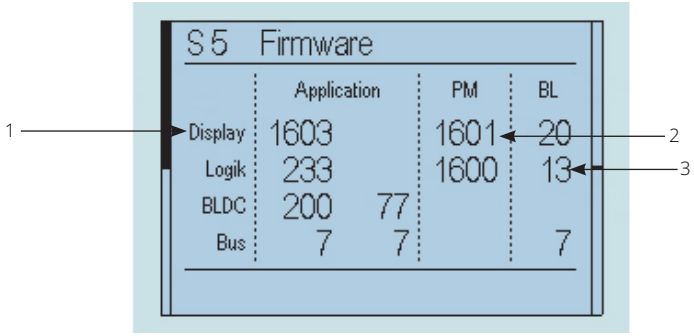


Display Overview:

1. Absolute value of the position unit
2. Relative value of the position unit
3. Absolute value of the torque unit (calibrated in factory)
4. Relative value of the torque unit (calibrated in factory)

9.1.5 Status - Firmware

Figure 70. Firmware Display

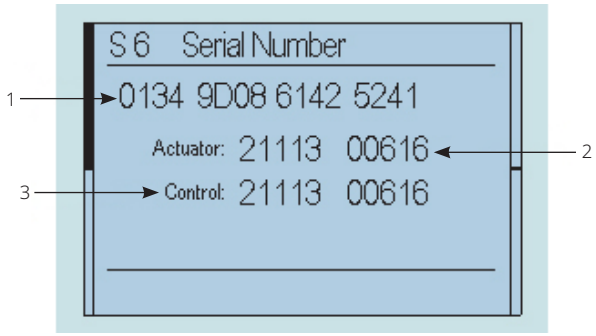


Display Overview:

1. Firmware version
2. Parameter set version
3. Bootloader version

9.1.6 Status - Serial Number

Figure 71. Serial Number Display

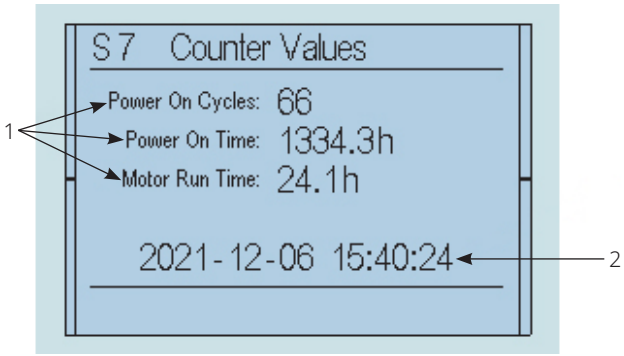


Display Overview:

1. Serial Number of the Electronics
2. Serial Number of the Actuator
3. Serial Number of the Control Unit

9.1.7 Status - Meter Readings

Figure 72. Meter Readings Display



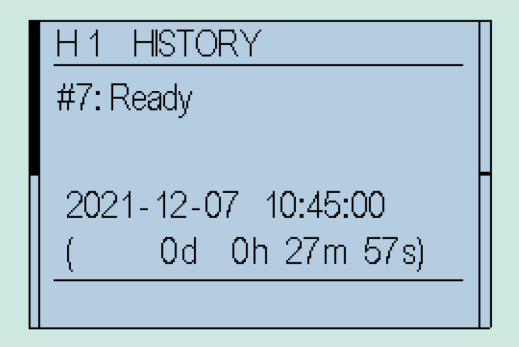
Display Overview:

1. Counters for power on cycles, power on time and motor run time
2. Actual date and time

9.2 History

History shows the last 20 history entries. In addition to the plain text entry, the time since the last history entry is also provided. Please note that the actuator can only calculate time if energized. For error analysis, please refer to Section 13.1.

Figure 73. History Display



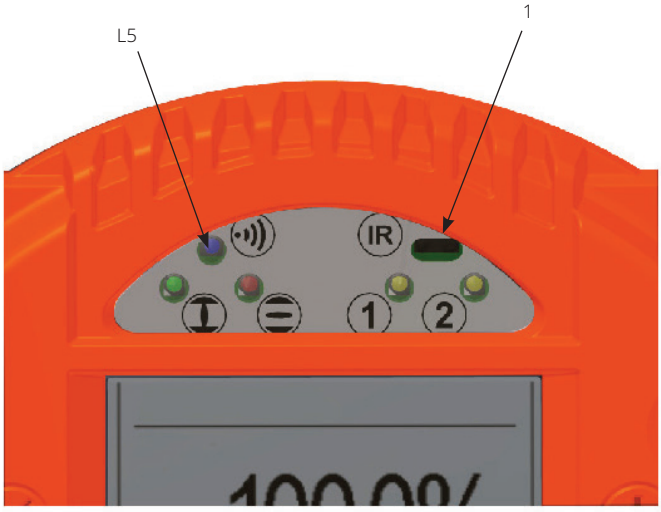
NOTE:
Up to 500 history entries are saved, and can be viewed with the SmartTool2.

Section 10: Infrared Connection

For easier communication and better visualization of the menu options, the unit provides an infrared port for connection to a PC. The required hardware (connection cable to the PC's RS-232 or USB connectors) and the corresponding software are available as options. The SMARTTOOL software, in addition to communication with the actuator, allows the management of multiple actuators to transfer the configuration to different actuators. This approach can greatly simplify operation. Please refer to the SMARTTOOL software operating instructions manual for further information.

During operation, ensure that the IR interface surface is protected from strong disturbances which may compromise the communication. Before mounting the infrared adapter, clean the surface of the infrared interface with a damp cloth. When the infrared interface is enabled, it is indicated by Light-emitting diode (LED), see Figure 74. The infrared interface can be enabled in the menu item P20.6.

Figure 74. LED IR Indicator



Display Overview:

1. Infrared connection

L5. Bluetooth connection

Section 11: Bluetooth Connection

In addition to the infrared interface, it is also possible to configure the Control System using a Bluetooth interface. Software required for Android equipment is available as an option.

In addition to communication with the actuator, the Android software also enables management of multiple actuators, allowing easy transfer of parameter sets to various actuators.

This approach can simplify commissioning significantly.

When the Bluetooth interface is enabled, this is indicated by the LED L5, see Figure 74. The Bluetooth interface can be enabled in menu item P20.6.

Section 12: Maintenance

All maintenance work may only be performed with the actuator powered-off. Due to this requirement, the actuator has to be in the fail-safe position. If this is not the case, it may be because of a fault in the fitting (stuck fitting shaft).

⚠ CAUTION

The actuator has a preloaded disk spring assembly. When loosen the flange mounting bolts, the spring force against the valve can cause the actuator to come loose from the valve. Adequate safety measures must be taken.

Any powering up must be ruled out during maintenance. Work on the electrical systems or components may only be carried out by electricians or by individuals who have been instructed how to do so. Working under the guidance and supervision of an electrician in accordance with electrotechnical regulations. After completing their commissioning, the actuators are ready for use. The actuator is filled with oil as standard when shipped.

Routine checks:

- Be mindful of increased running noises. In cases of long downtimes, operate the actuator at least every three months.
- Check the fail-safe function (check the operating time and smoothness of running in fail-safe operation). Lengthening in the running time may also be caused by an increased torque requirement for the fitting after long down times.

⚠ CAUTION

The actuator has a prestressed coil spring or disk spring assembly. Improper dismounting may lead to both damage to the actuator as well as serious injuries. If maintenance work is needed requiring the actuator to be dismounted, contact Emerson regarding detailed instructions and/or any special purpose tools for relaxing the spring assembly.

The actuators are designed for any mounting position (see Section 3.4), which is why there is neither a filling level indicator nor a drain plug on the main casing.

Depending on the stressing subjected to, do the following approximately every 10,000 to 20,000 hours (about 5 years; see Section 16):

- Oil change
- Replace seals
- Check all the roller bearings and the worm gear assembly and replace if necessary.

Select recommended types of oils and greases to be used from Section 16.

NOTE:

Check the cable glands at regular intervals (annually) for tightness of the cables and retighten if necessary.

If the visual inspection (e.g. dust or water penetration) indicates that the effectiveness of the Sealing elements of the cable entry has suffered damage or aging, such elements have to be replaced preferably by using the original spare parts from the manufacturer of the equipment or through cable entries of comparable quality as well as the same ex- or IP protection class.

Section 13: Troubleshooting

Upon warning or error, the bottom line of the display will show the corresponding plain text description. This event will also be entered into the history, see Section 9.2.

13.1 History Entries

Listed below are all possible history entries. In case of a warning, the alarm will be visualized on the left side of the main display. If an alarm occurs, the display background light will be red, and the main display will show, that the actuator is not ready.

NOTE:
Each error has a unique error number. Each error also has its separate “OK” message in the history after the fault has gone.

Table 43. History Entries and their Descriptions (1)

Error	LED Indicators	Description
#3: Motor temperature warning #19: Motor temperature warning OK	Warning	The motor temperature is in the critical range although the actuator remains fully functional.
#4: Motor temperature trip. #20: Motor temperature OK.	Alarm	Overtemp in motor, fault on Basis or BLDC, On Basis: loss of main power (3x400V) or cable break between CSC and motor; on BLDC: cable break between BLDC and motor.
#5: Phase sequence error #6: Phase sequence OK	N/A	Cause on Basis: Active phase sequence detection on single phase actuators, loss of main power while connected to external 24 V DC auxiliary voltage, or loss of phase L2.
#7: Ready	Information	Written to the history after all errors are gone.
#8: Power On	Information	Is written to the history after power on the actuator, even if there are some errors.
#9: Power supply error #21: Power supply OK	Alarm	No power supply to the power electronics (when the controller is powered from the auxiliary power input). Defect of power electronics – please contact the manufacturer.
#11: Fail-safe error #12: Fail-safe OK	Alarm	Communication error between Fail-safe board and Logic, loss of external 24 V fail-safe Voltage, or overtemp. on fail-safe brake.
#13: Manual override #14: Manual override off	Alarm	Manual override on Fail-safe activate (visible in status S4), cable/switch broken.
#17: Travel Sensor Fault #18: Travel Sensor OK	Alarm	The travel unit is outside the permitted range (potentiometer fault on Basis), cable broken, or multi-turn sensor calibration lost on CM - please contact the manufacturer.
#22: Torque Sensor Fault #23: Torque Sensor OK	N/A	Potentiometer fault on Basis, or cable broken.
#24: Bus error #25: Bus OK	Warning	No communication with the optional bus system.
#26: Bus Watchdog #27: Bus Watchdog OK	Warning	Watchdog for bus communication has reacted.
#28: Undervoltage #29: Voltage OK	Warning	The input voltage is below the regular voltage range, but motor operation is still possible.
#32: Internal Commumication L> error #33 Internal Commumication L> OK	Alarm	Communication error between Logic and Basis/BLDC, cable broken between boards, or board defect.
#34: Internal Commumication D> error #35: Internal Commumication D> OK	Alarm	Communication error between Display and Logic, cable broken between boards, boards defect, or firmware update on Logic not properly done.

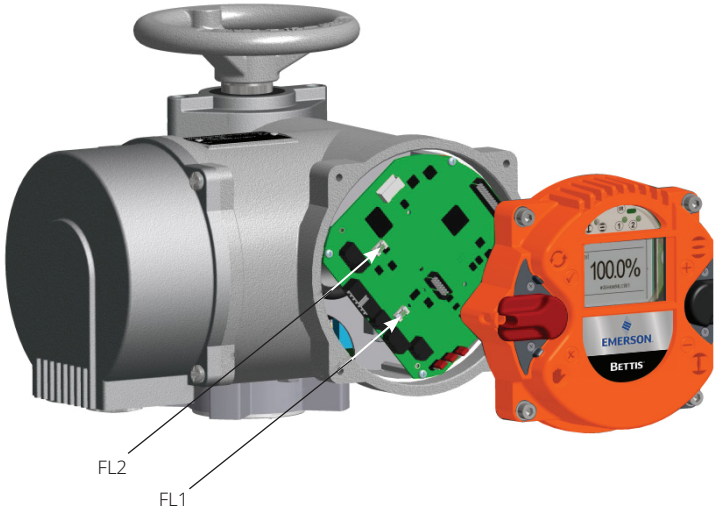
Table 44. History Entries and their Descriptions (2)

Error	LED Indicators	Description
#36: Fail-safe not ready #37: Fail-safe ready	N/A	Fail-safe voltage OK and Fail-safe not initialized (LUS not tensioned).
#38: RTC Battery low #39: RTC Battery OK	Warning	Battery on Display board is empty, loss of time/date or counter values possible.
#44: Inverter Fault #45 Inverter OK	Alarm	BLDC parameter error or defective BLDC. Please contact the manufacturer.
#46: Analog Input 1 Signal Loss #47: Analog Input 1 OK	Warning	SRG active, Positioner live zero detection activated, no setpoint value recognized.
#48: Analog Input 2 Failure #49: Analog Input 2 OK	Warning	External setpoint active, external setpoint live zero detection activated, no external setpoint value recognized.
#50: End Limits Are The Same #51: End Limits OK	Alarm	The End limits for OPEN and CLOSE are the same values.
#52: User Input Switches Error #53: User Input Switches OK	Alarm	The selector switches are not calibrated. Please use the calibration function in the wizard in the SmartTool2.
#54: PVST Error #55: PVST OK	Information	The last PVST was not successful.
#56: Internal Communication Fault E>Error #57: Internal Communication Fault E>OK	Warning	Communication error between remote display and main display. Cable to from remote display to EB2_2, EB2_2 to EB2_1, or EB2_1 to main display broken. Also, one of the boards may be faulty.
#58: Undervoltage Error	Alarm	The input voltage is below the minimum threshold voltage; motor operation is not given. May appear in the history, if the actuator was turned off, in which case no #29: Voltage OK entry will be registered.
#59: Undervoltage Switch. Off	Alarm	The input voltage line caused the actuator to turn off 6 times, indicating an unstable power supply.
#60: Overvoltage Warning	Warning	The input voltage is over the regular supply voltage range. Motor operation is possible.
#61: PVST Start	Information	A PVST procedure was started.
#62: Parameter Write Access	Information	Shows information about, which value was written on a parameter. The values for N, L and S are internal values and useful for diagnosing.
#63: Restore	Information	A restore procedure via P20.3 was undertaken.
#64: Password Change	Information	A password change has been undertaken.
#65: History Cleared	Information	The complete history entry memory was cleared by the manufacturer.

Section 14: Fuses

The logic board of the controller cover (see Figure 75) features two miniature fuses for the control lines.

Figure 75. Control Lines Fuses



Parts Overview:

1. Fuse FL1 for auxiliary supply
2. Fuse FL2 for the Binary Outputs

Table 45. Fuses on the Logic Board

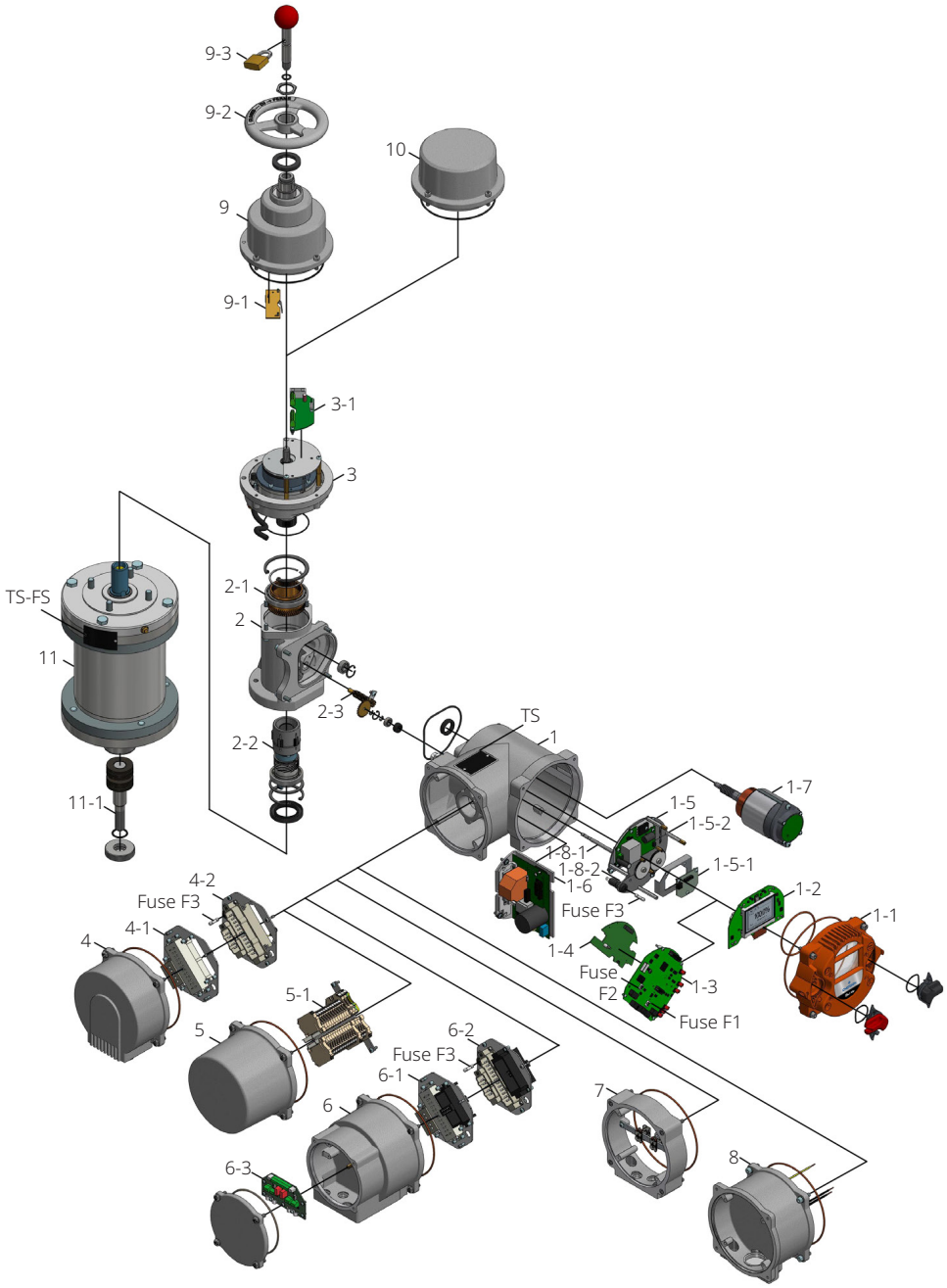
Fuse	Value	Manufacturer	List of Spare Parts
FL1	1AT	Littelfuse 454 NANO²® Slo-Blo® slow	FUSE-F1
FL2	4AT	Littelfuse 454 NANO² Slo-Blo slow	FUSE-F2

The frequency inverter is protected by an input fuse and the explosion proof version also has a thermal fuse, see Section 3.6.3.

Section 15: Spare Parts

When ordering spare parts, please provide the serial number of the actuator. Check the separate break-down image and separate list of spare parts.

Figure 76. Spare Parts Bettis RTS FL Fail-Safe (ex) CM32



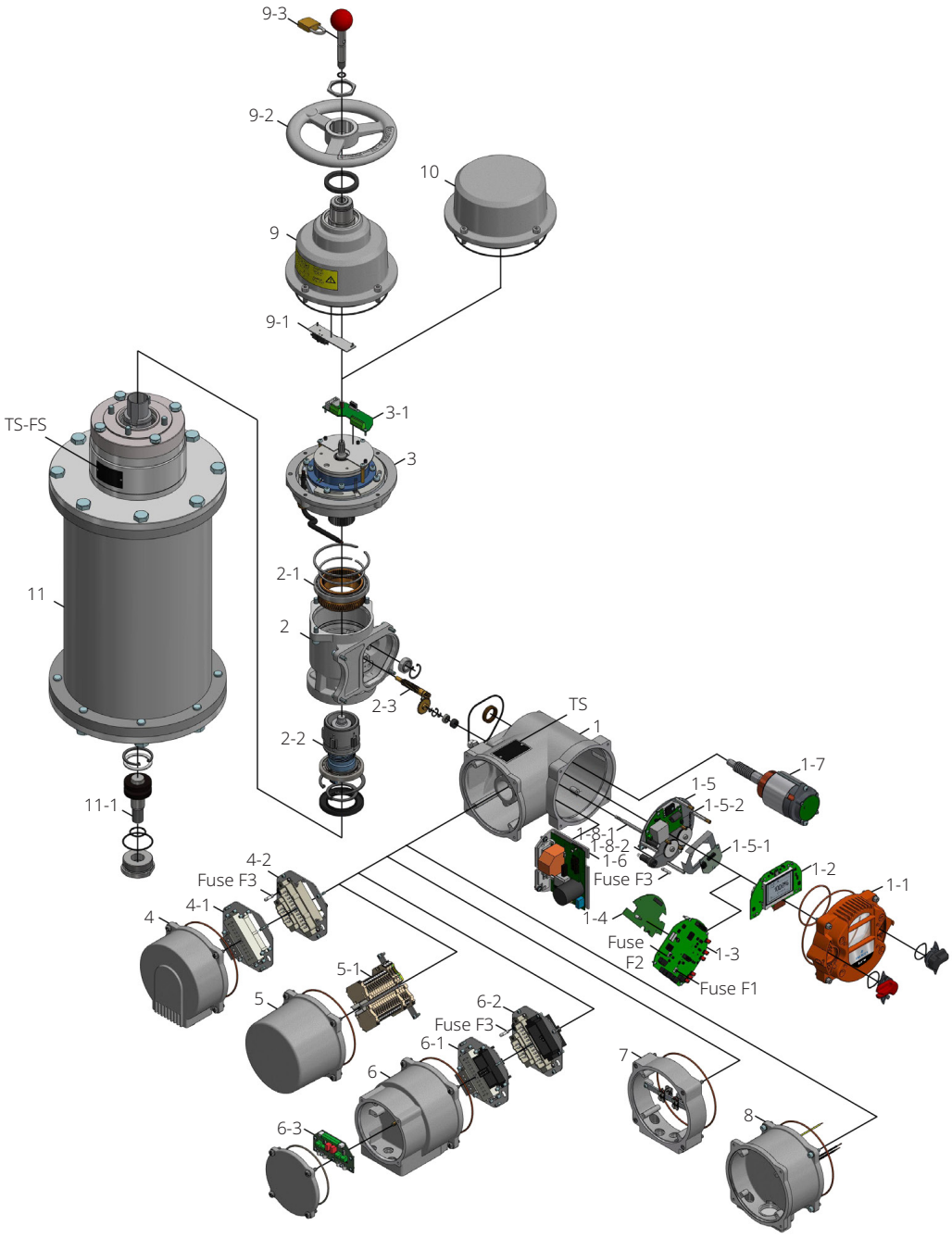
⚠ CAUTION

When ordering spare parts, you must provide the serial number (look type shield or status menu S6). Use only original spare parts supplied by Emerson. Using other parts will render the warranty void. Illustrations may differ from actual spare parts.

Table 46. Parts List RTS FL Fail-Safe (ex) CM32

Asm.	No.	Description
1	-	**E-case**
	1-1	Control unit cover
	1-2	Display circuit board
	1-3	Logic circuit board
	Fuse-F1	Micro fuse 1 A
	Fuse-F2	Micro fuse 4 A
	1-4	Expansion board (bus, relay)
	1-5	Multi-turn sensor assembly
	1-5-1	Multi-turn sensor
	1-5-2	24 V DC step-down converter
	1-6	BLDC power electronics
	Fuse-F3	Fuse 5 A
	1-7	Motor
	1-8-1	Sensor shaft
	1-8-2	Gear
2	-	**Mechanical case**
	2-1	Worm gear
	2-2	Output shaft
	2-3	Helical cut pinion gear
3	-	**Fail-safe brake assembly**
	3-1	Fail-safe PCB
4	-	**Plug cover**
	4-1	Plug frame customer side (socket)
	4-2	Plug frame actuator side (pins)
5	-	**Terminal box cover**
	5-1	Terminal block
6	-	**Entire bus plug cover with plugs and circuit board**
	6-1	Bus plug frame customer side (socket)
	6-2	Bus plug frame actuator side (pins)
	6-3	Bus connection board
7	-	**Additional ring bus (Ex)**
8	-	**400 V module**
TS	-	**Type plate**
9	-	**Handwheel cover**
	9-1	Switch for manual mode
	9-2	Handwheel
	9-3	Padlock
10	-	**Fail-safe brake cover**
11	-	**Fail-safe unit**
	11-1	Spindle pin
TS-FS	-	**Type plate fail-safe unit**

Figure 77. Spare Parts Bettis RTS FL Fail-Safe (ex) CM64



⚠ CAUTION

When ordering spare parts, you must provide the serial number (look type shield or status menu S6). Use only original spare parts supplied by Emerson. Using other parts will render the warranty void. Illustrations may differ from actual spare parts.

Table 47. Parts List RTS FL Fail-Safe (ex) CM64

Asm.	No.	Description
1	-	**E-case**
	1-1	Control unit cover
	1-2	Display circuit board
	1-3	Logic circuit board
	Fuse-F1	Micro fuse 1 A
	Fuse-F2	Micro fuse 4 A
	1-4	Expansion board (bus, relay)
	1-5	Multi-turn sensor assembly
	1-5-1	Multi-turn sensor
	1-5-2	24 V DC step-down converter
	1-6	BLDC power electronics
	Fuse-F3	Fuse 5 A
	1-7	Motor
	1-8-1	Sensor shaft
	1-8-2	Gear
2	-	**Mechanical case**
	2-1	Worm gear
	2-2	Output shaft
	2-3	Helical cut pinion gear
3	-	**Fail-safe brake assembly**
	3-1	Fail-safe PCB
4	-	**Plug cover**
	4-1	Plug frame customer side (socket)
	4-2	Plug frame actuator side (pins)
5	-	**Terminal box cover**
	5-1	Terminal block
6	-	**Entire bus plug cover with plugs and circuit board**
	6-1	Bus plug frame customer side (socket)
	6-2	Bus plug frame actuator side (pins)
	6-3	Bus connection board
7	-	**Additional ring bus (Ex)**
8	-	**400 V module**
TS	-	**Type plate**
9	-	**Handwheel cover**
	9-1	Switch for manual mode
	9-2	Handwheel
	9-3	Padlock
10	-	**Fail-safe brake cover**
11	-	**Fail-safe unit**
	11-1	Spindle pin
TS-FS	-	**Type plate fail-safe unit**

Section 16: Lubricant Recommendations and Requirements

16.1 Main Body: -40 to +60 °C

Operating oil: DIN 51 517-CLP-HC

i.e. fully synthetic high-performance gear oils based on Polyalphaolefin (PAO):

Viscosity class:	68 ISO VG
Pour point:	< -54 °C (according to DIN ISO 3016)
Lubricant requirement CM32:	200 to 250 ml
Lubricant requirement CM64:	300 to 350 ml

16.2 Output Type A and Spindle Drives (Linear Actuators): -40 to +60 °C

Grease DIN 51825-K(P) R -40

i.e. water repellent complex grease on Al-soap base with high resistance to acids and alkalis:

Penetration 0.1 mm:	310 to 340
Dropping point:	about 260 °C
NLGI No.:	1

Acid-free, little or not water-reactive

16.3 Alternate Lubricants

16.3.1 Main Body (CM): -40 to +60 °C

- **Operating Oil**

i.e. synthetic gear lubricant based on Polyalphaolefin (PAO)

Viscosity class:	68 ISO VG
Pour point:	< -48 °C / -55 °F
Lubricant requirement CM32:	200 to 250 ml
Lubricant requirement CM64:	300 to 350 ml

16.3.2 Fail-safe (FQ, FL) and Non-fail-safe (QT, L, TB): -40 to +60 °C

- **Grease**

i.e. high-viscosity-index synthetic base grease with calcium sulfonate thickener that increases load-carrying performance and reduces wear and resistance to water washout and oxidation.

Penetration 0.1 mm:	265 to 295
Dropping point:	318 °C / 605 °F
NLGI No.:	2

16.4 Basic Lubricant Service Interval

⚠ CAUTION

In Emerson, the service interval for the Bettis RTS actuators is ten years from the shipping date. However, the functionality and service life of the lubricants depends on the operating conditions. Reduction factors must be taken into consideration if applicable.

Table 48. Reduction Factors

Operating Condition(s)	Definition	Reduction Factor (Multiplier)
Duty time DT	(Total engine running time)	-
Extremely high DT	Over 1250 hours/year	0.5
High DT	Over 500 hours/year	0.7
Extremely low DT	Less than 0.5 hours/year	0.8
Ambient temperature	(Permanent or long-term)	-
Extremely changeable	Between -10 and +50 °C	0.5
Extremely high	Above +50 °C	0.7
Extremely low	Below -25 °C	0.9
Output speed	(On actuator main shaft)	-
High speed	Over 80 U/min	0.8
Utilization	(Relative to rated power)	-
Very high	Over 90%	0.8
High	Between 80 and 90%	0.9

Example of application:

Extremely low DC + extremely low ambient temperature + high speed + 87% degree of utilization: 0.8 x 0.9 x 0.8 x 0.9 = 0.51 Reduction factor
Lubricant maintenance interval: 10 years x 0.51= 5.1 years (62 months)

⚠ CAUTION

This calculated maintenance interval does neither apply to the maintenance of output type A (threaded bushing) units nor to the maintenance of linear and spindle drive units. These units must periodically lubricated (at least every 6 months) via the grease nipples (see Section 16.2).

During maintenance of our actuators, remove and replace old grease with new one. **Mixing of different lubricant types is NOT permitted.**

Quantities needed for lubricant service are listed in Section 16.

16.5 Lubricant Points FL

The table values given apply to relubrication in accordance with the relubrication intervals in the operating instructions. After relubrication has been carried out, 2 to 3 full strokes must be performed. If torque switch-off occurs, the grease nipples must be removed and the strokes repeated.

NOTE:
Lubricant can leak out of the lubrication points.

After that, the grease fittings should be installed.

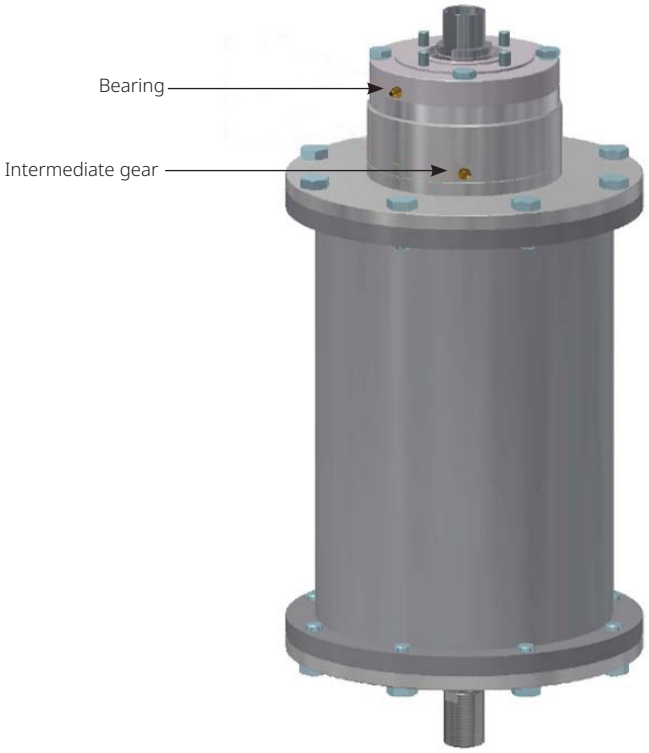
At initial assembly or upon complete disassembly of the spindle nut is filled, all gears and bearings pocketed filling. All moving parts, as well as internal surfaces are coated to cover them.

- Lubricant quantity according to expenditure
- Lubricant specification according to the operating instructions depending on the temperature range

Table 49. Lubrication Points

Type	Lubrication point (Quantity)	
	Bearing (cm³)	Intermediate gear (cm³)
FL-05	4	-
FL-15	5	-
FL-25	8	-
FL-40	12	35

Figure 78. Lubrication Points



Section 17: Modes of Operation

17.1 CM32/FL

Table 50. On-Off and Inching Operation

CM32/FL-05	CM32/FL-15	CM32/FL-25
S2 - 15 minutes according to IEC 60034	S2 - 15 minutes according to IEC 60034	S2 - 15 minutes according to IEC 60034
1 to 72 RPM	1 to 72 RPM	1 to 72 RPM
F_{max} = 8.2 kN	F_{max} = 19.4 kN	F_{max} = 16,4 kN
F_{avg} = 5 kN	F_{avg} = 8 kN	F_{avg} = 12 kN

Table 51. Modulating Operation

CM32/FL-05	CM32/FL-15	CM32/FL-25
S4 - 1.200 c/h - maximum 50% DC according to IEC 60034	S4 - 1.200 c/h - maximum 50% DC according to IEC 60034	S4 - 1.200 c/h - maximum 50% DC according to IEC 60034
1 to 36 RPM	1 to 36 RPM	1 to 36 RPM
F_{max} = 8.2 kN	F_{max} = 19.4 kN	F_{max} = 16.4 kN
F_{avg} = 5 kN	F_{avg} = 10 kN	F_{avg} = 12 kN

Table 52. Continuous Modulating Operation

CM32/FL-05	CM32/FL-15	CM32/FL-25
S9 - 1.800 c/h according to IEC 60034	S9 - 1.800 c/h according to IEC 60034	S9 - 1.800 c/h according to IEC 60034
1 to 20 RPM	1 to 20 RPM	1 to 20 RPM
F_{max} = 8.2 kN	F_{max} = 19.4 kN	F_{max} = 16.4 kN
F_{avg} = 3 kN	F_{avg} = 7 kN	F_{avg} = 8 kN

17.2 CM64/FL

Table 53. On-Off and Inching Operation

CM64/FL-40
S2 - 15 minutes according to IEC 60034
1 to 60 RPM
F_{max} = 22.4 kN
F_{avg} = 15 kN

Table 54. Modulating Operation

CM64/FL-40
S4 - 1.200 c/h - maximum 50% DC according to IEC 60034
1 to 30 RPM
F_{max} = 22.4 kN
F_{avg} = 15 kN

Table 55. Continuous Modulating Operation

CM64/FL-40
S9 - 1.800 c/h according to IEC 60034
1 to 20 RPM
F_{max} = 22.4 kN
F_{avg} = 10 kN

Section 18: Technical Data and Certifications

18.1 Binary Outputs

Figure 79. Control Unit

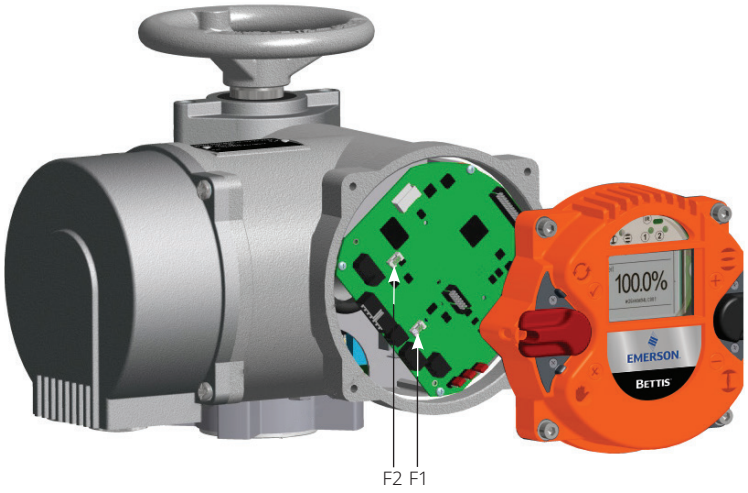


Figure 80. Logic Board

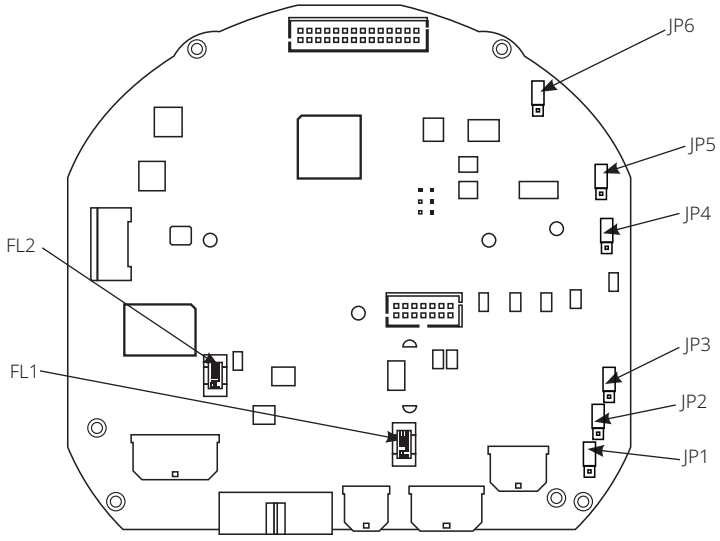


Table 56. Binary Outputs

Characteristic	Value
Count	8
Power supply	24 V DC nominal range: 11 to 35 V DC (either from internal or external)
Maximum voltage drop at set output	1 V
Output voltage at non-set output	<1 V
Maximum current per output	500 mA (short circuit proof)
Maximum permissible total current for all outputs	4 A
Fuse (Fuse F2)	4 A slow (Littelfuse 454 NANO² Slo-Blo)

Binary outputs with external supply are separated from other controllers via optocouplers.

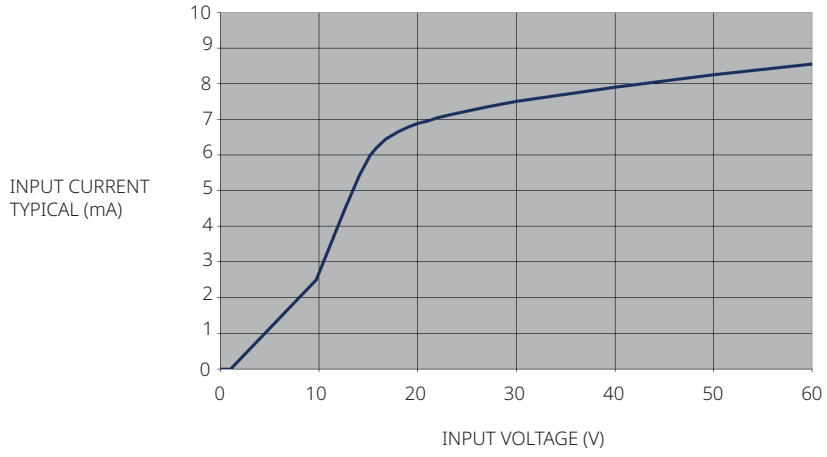
18.2 Binary Inputs

Table 57. Binary Inputs

Characteristic	Value
Count	5
Nominal voltage	24 V DC towards common ground
Threshold voltage for input set	>10 V maximum (8.5 V typical)
Threshold voltage for input not set	<10 V
Maximum voltage	30 V DC
Current consumption at 24 V DC	10.5 mA typical

Binary inputs are separated from other controllers via optocouplers.

Figure 81. Current/Voltage Relation



Jumpers JP1 - JP3 can be used to interconnect the binary inputs to groups with separate earths.

Figure 82. 5 Inputs with Same Common

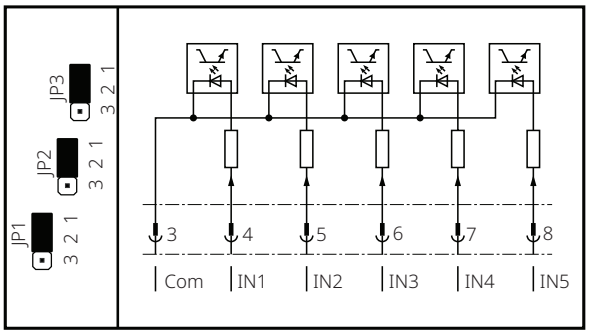


Figure 83. 2 Separated Groups of 2 Inputs with Same Ground Input IN3 is Disabled

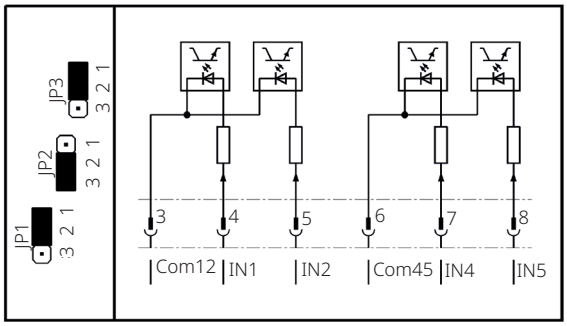


Figure 84. 3 Separated Inputs; Inputs IN2 and IN4 are Disabled

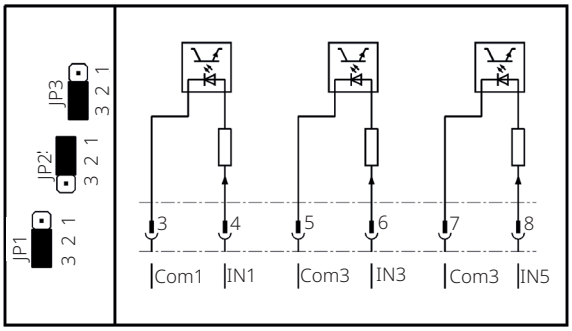


Figure 85. 3 Inputs with Same Common and 1 Separated Input IN4 is Disabled

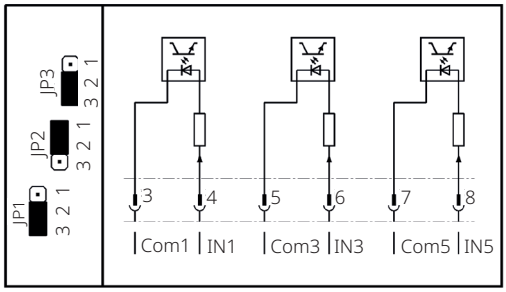


Figure 86. 1 Separated Input and 3 Inputs with Same Common Input IN2 is Disabled

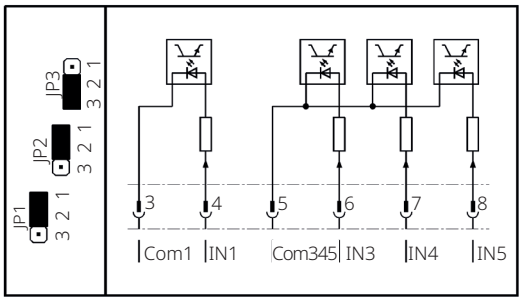


Figure 87. 5 inputs with Common = "-" Using External 24 V

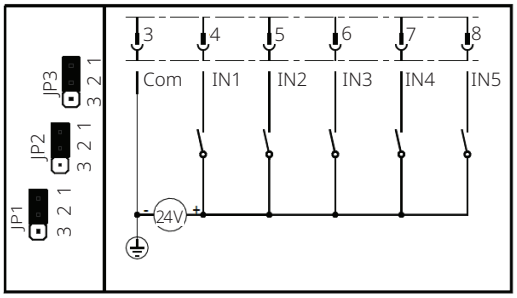


Figure 88. 5 Inputs with Common = "-" Using Internal 24 V (e.g., for dry contacts)

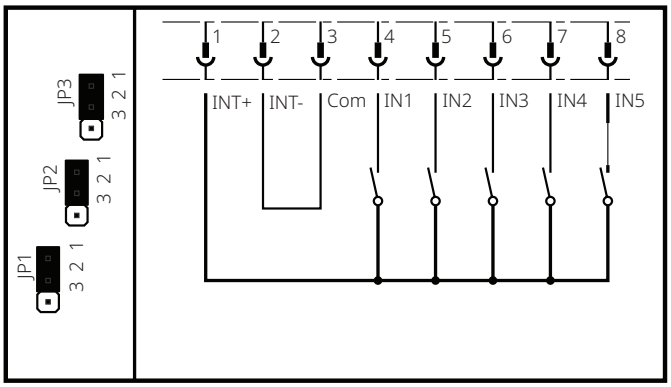


Figure 89. 3 Separated Inputs Using 3 Separated External 24 V

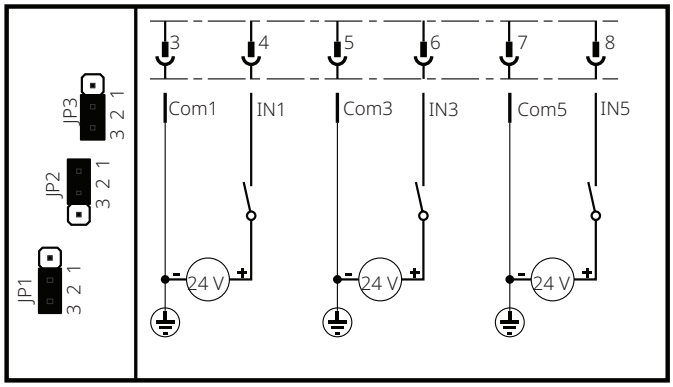
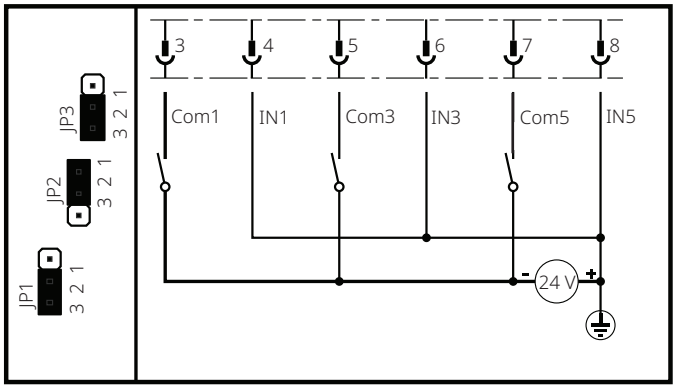


Figure 90. 3 separated Inputs with Common = "+" Using External 24 V



18.3 Analog Inputs

Table 58. Input 1: Setpoint Value

Characteristic	Value
Current range	0 to 25 mA
Resolution	14 Bit
Accuracy	0.5%
Input resistance	60 Ω

Analog input 1 is electrically isolated from the rest of the electronic system.

Table 59. Input 2: External Actual Value Only in Conjunction with the PID-Controller

Characteristic	Value
Current range	0 to 20.8 mA
Resolution	10 Bit
Accuracy	0.5%
Input resistance	120 Ω

Jumper JP6 can be used to switch analog input 2 from a passive input (default) to an input with internal 24 V power supply (for 4 to 20 mA, two-wire transmitters).

Figure 91. Passive Input (Default)

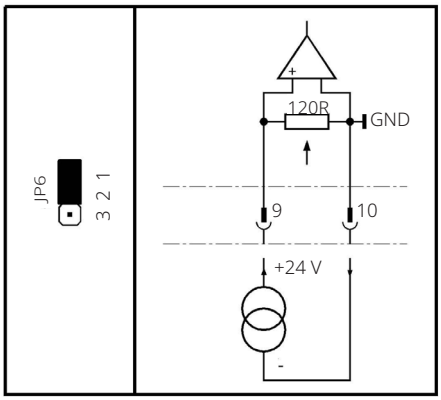
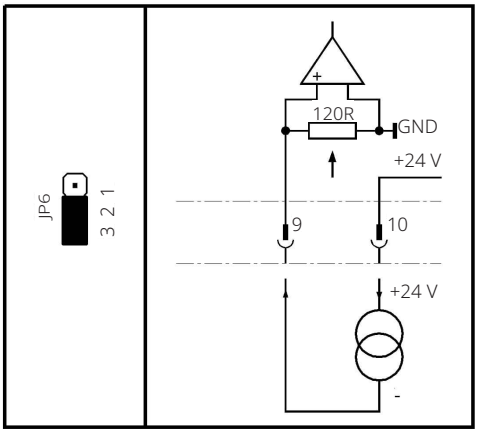


Figure 92. Input with Internal Supply (Active Input)



NOTE:
The analog input 2 is referenced to common of the electronic system and the auxiliary power supply.

18.4 Analog Output

Table 60. Analog Output

Characteristic	Value
Current range	0 to 20.8 mA
Resolution	12 Bit
Accuracy	0.5%
Input resistance	600 Ω

The analog output is galvanically isolated from the rest of the electronic system.

Jumper JP4 can be used to switch the analog output from an active power source (default) to a current sink, allowing the output to simulate a 4 to 20 mA, two-wire transmitter.

Figure 93. Current Source

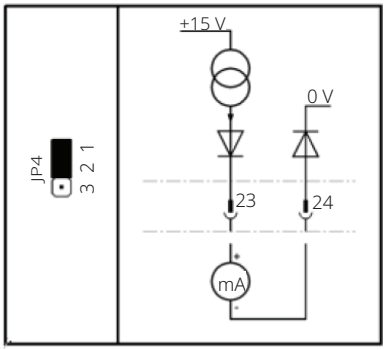
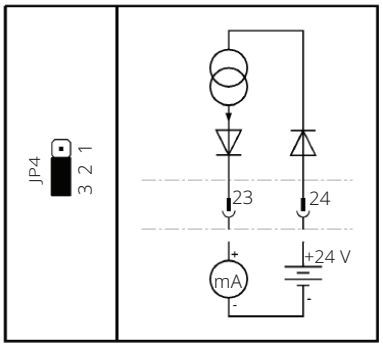


Figure 94. Current Sink



Ground potential is the potential of the control unit and the auxiliary supply, see Section 8.5.

18.5 Auxiliary Voltage Input and Output

Table 61. Auxiliary Voltage Input and Output

Characteristic	Value
Input voltage range (auxiliary voltage input)	20 to 30 V DC
Maximum current consumption (auxiliary voltage input)	500 mA
Maximum current consumption in power-save mode (auxiliary voltage input)	120 mA
Output voltage (auxiliary voltage output)	typical 23 V
Maximum output current (auxiliary voltage output)	200 mA
Resistance of common ground vs earth	typical 500 kΩ
Resistance of common ground vs earth (floating version)	> 10 mΩ
Capacitance of common ground vs earth	typical 100 nF
Maximum allowed voltage of common ground vs earth	maximum 40 V
Fuse (Fuse F1)	1 A slow (Littelfuse 454 NANO² Slo-Blo)

Ground potential is the common ground of the controller and the analog inputs and outputs.

The auxiliary voltage output can be set in menu P6.5, see Section 8.5.

The power-save mode is defined as follows:

- No power supply (the controller is powered exclusively through the 24 V auxiliary voltage input).
- The backlight of the LCD display switches off automatically.
- No additional hardware options included (Profibus Interface, DeviceNet Interface, relay board, etc.).
- Binary outputs and the mA output are not enabled; when activating, the respective currents must be added to the total current consumption.

18.6 Connections

18.6.1 Connections for Non-Explosion Proof Version

Table 62. Non-Explosion Proof Connections

Connection	Value
Power/motor	Industrial plug with 6 pins Screw connection 16 A, maximum 2.5 mm^2, AWG14
Control signals	Industrial plug with 24 pins Screw connection 16 A, maximum 2.5 mm^2, AWG14

Optionally, contacts are available in crimp or cage clamp designs.

18.6.2 Connections for Explosion Proof Version

Table 63. Explosion Proof Connections

Connection	Value
Power/motor	Terminals with screw connection 16 A, 0.5 to 4 mm^2, AWG20 - AWG12
Control signals	Terminals with screw connection 4 A, 0.5 to 2.5 mm^2, AWG20 - AWG14

18.7 Miscellaneous

Table 64. Miscellaneous

Characteristic	Value
Ambient temperature	-
Non-explosion proof version	-25 to +60 °C
Explosion proof version	-20 to +40 °C (according to EN 60079-0)
Ex version with extended temperature range	-40 to +60 °C
Protection according to EN 60529	IP67
Standard color	RAL7012

NOTE:
If the actuator is exposed to excessive UV-light, color deviations of the painting might occur.

Section 19: Characteristic Curves

19.1 Characteristic Curves - CM32

Figure 95. Current Draw of the Standard Version

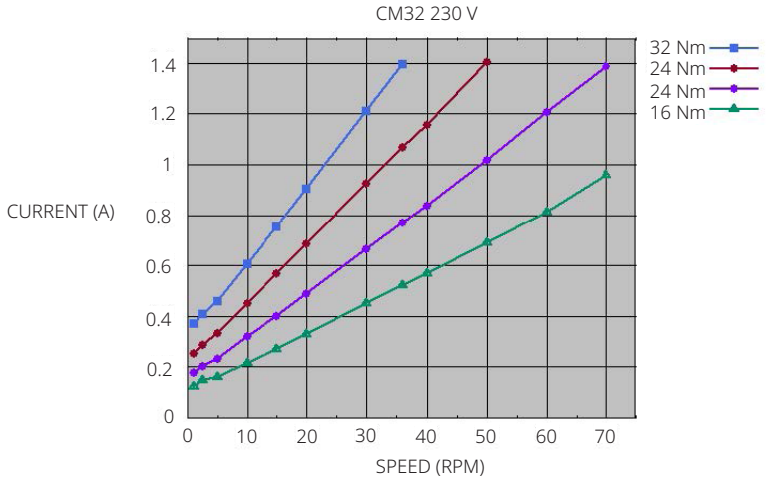


Figure 96. Current Draw of the 24 V DC Version

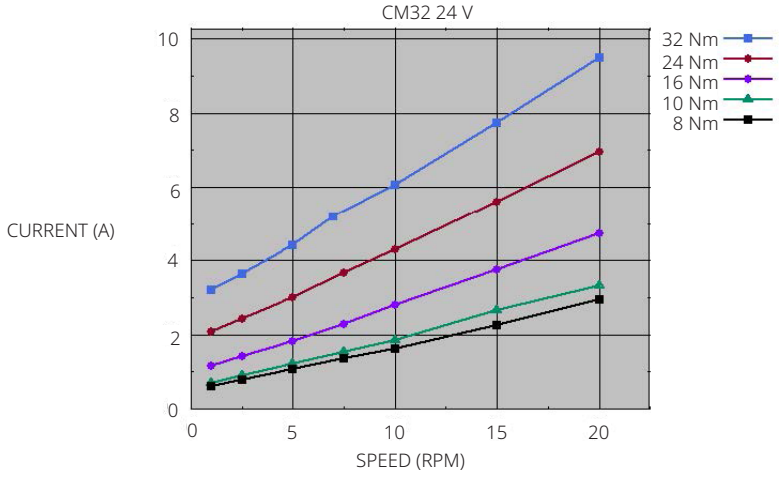
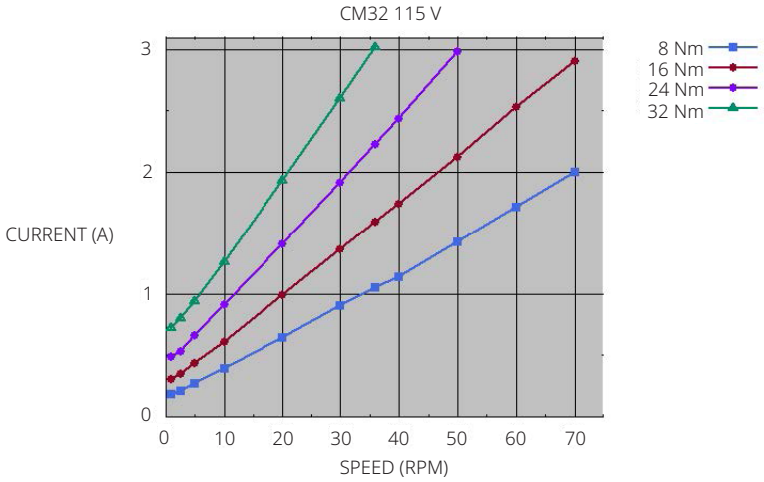


Figure 97. Current Draw of the Standard Version



19.2 Characteristic Curves - CM64

Figure 98. Current Draw of the Standard Version

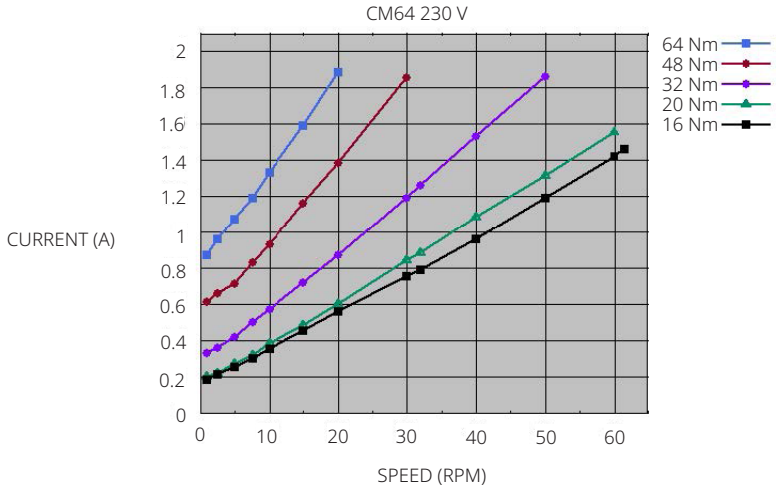
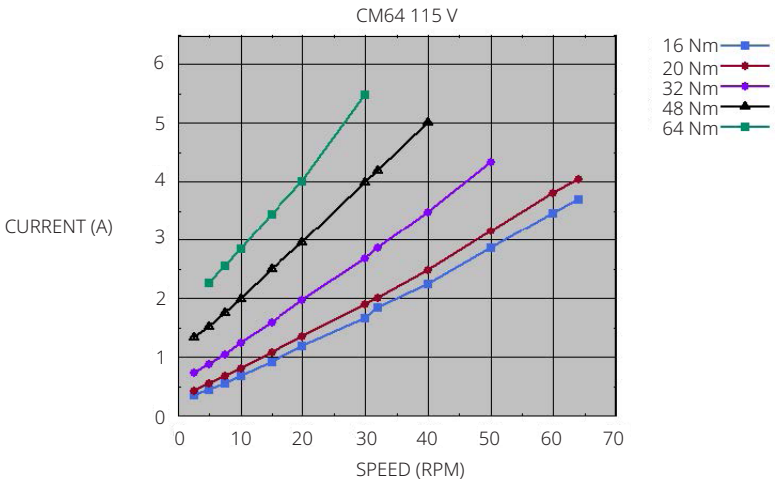


Figure 99. Current Draw of the Standard Version



Appendix A: Handwheel Force

Table 65. Required Force on the Handwheel

Type	Emerson Type	Maximum Actuators Torque		Maximum Handwheel Torque		Handwheel diameter (Nm)	Maximum Force	
		In fail-safe direction (Nm)	Counter fail-safe direction (Nm)	In fail-safe direction (Nm)	Counter fail-safe direction (Nm)		In fail-safe direction (N)	Counter fail-safe direction (N)
CM03FS30_5	FL05	8	16	4	8	140	57.1	114.3
CM03FS50_8	FL15	16	32	8	16	140	114.3	228.6
CM03FS100_12	FL25	16	32	8	16	140	114.3	228.6
CM03FS100_30	FL40	24	64	12	32	200	120.0	320.0

Table 66. Revolutions on the Basic Actuator

Type	Emerson Type	Travel	Revolutions	Travel	Revolutions
		Nominal	(U)	Maximal	(U)
CM03FS30_5	FL05	30 mm	6	35 mm	7
CM03FS50_8	FL15	50 mm	10	55 mm	11
CM03FS100_12	FL25	100 mm	20	105 mm	21
CM03FS100_30	FL40	100 mm	25	105 mm	26.25

NOTE:
The force on the handwheel was calculated for one-handed operation. With two-hand operation, the value per hand is halved. The maximum force may be exceeded by 20% in manual mode.

www.emerson.com/bettis

BETTIS™

EMERSON™