Halton Max Ultra Circular (MUC) - Installation, commissioning and maintenance guide

Contents

1 Introduction

1.1 About this document

This document provides the instructions on how to install, commission, and maintain the product. This document is intended for properly trained persons performing these tasks.

Note: Project-specific variations are possible.

1.2 Copyright and disclaimers

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1.3 Summary of changes

Release	Date	Description
2.3	07-Mar-2023	▪ Duct connection size 630 mm added. ▪ Chapter *Commissioning* updated.
2.2	25-Nov-2022	▪ Modbus RTU communication added.
2.1	23-Sept-2022	▪ Duct connection size 500 mm added. ▪ Modbus device number updated.
2.0	12-Apr-2022	▪ Duct connection size 400 mm added. ▪ New actuator models added. ▪ Chapter *Commissioning* updated. ▪ Chapter *Troubleshooting* added. ▪ Editorial changes.
1.1	18-Feb-2022	Editorial changes: content reorganised and clarified.
1.0	18-Mar-2021	First release.

1.4 Safety notes

All information in this section is important and relevant for your safety. Please pay special attention to these icons and the accompanying messages when used later in context in this manual.

Warnings

Warning signs indicate a risk of personal injury including death. There is also a potential risk of material damage. Pay attention to the following signs when performing any tasks or moving in the area:

WARNING!

This symbol indicates a potential hazard, obstacle or condition requiring special attention.

DANGER OF ROTATING UNIT PARTS!

This symbol indicates a hazardous location with a risk of personal injury including death and material damage.

DANGER OF OVERHEAD LOADS!

This symbol indicates a hazardous location with a risk of personal injury including death and material damage.

DANGER OF PERSONAL INJURY!

This symbol indicates a hazardous location (excluding the above-mentioned danger areas) with a risk of personal injury including death and material damage.

Cautions

Caution signs indicate a risk of personal injury or material damage. To ensure your own safety, consider the following cautions:

CAUTION!

This symbol indicates a hazardous location with a risk of material damage that can also lead to personal injury.

CAUTION! HEAVY OBJECT

Do not lift objects over 20kg (44lbs) alone. Use a lift or seek assistance.

CAUTION!

Risk of personal injury or material damage.

Notes

Note: Notes are statements to which you should pay special attention.

1.5 Contact information

For contact information, see ***www.halton.com***.

2 Product description

2.1 Overview

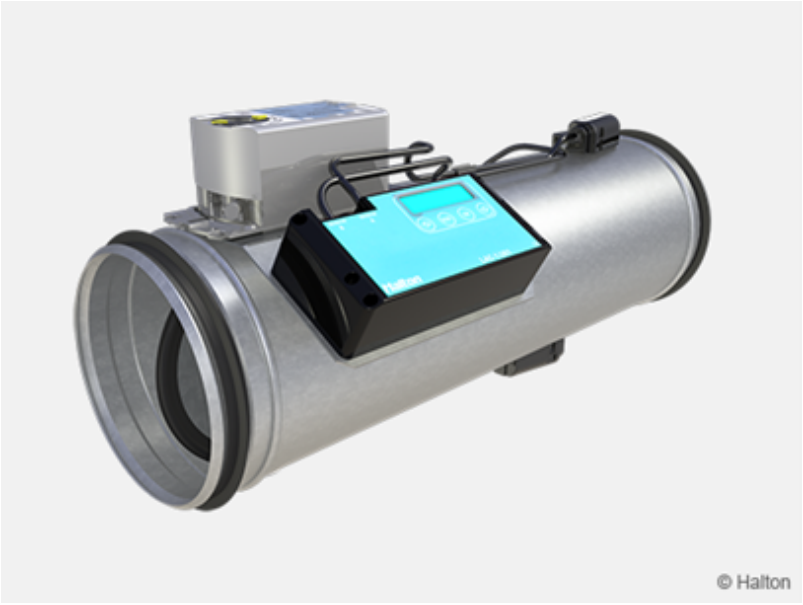


Fig. 1. Halton Max Ultra Circular (MUC)

Circular airflow management damper using the ultrasound technique for airflow measurement.

Application areas

- Variable (VAV) and constant (CAV) airflow control applications
- Supply and exhaust installations
- Available also for Halton Workplace applications

Key features

- Insensitive to dust collection
- Enables flexibility in terms of space layout
- Individually calibrated for higher accuracies
- Low pressure loss for reducing the noise level
- Can be connected to Building Management System (BMS)

2.2 Operating principle

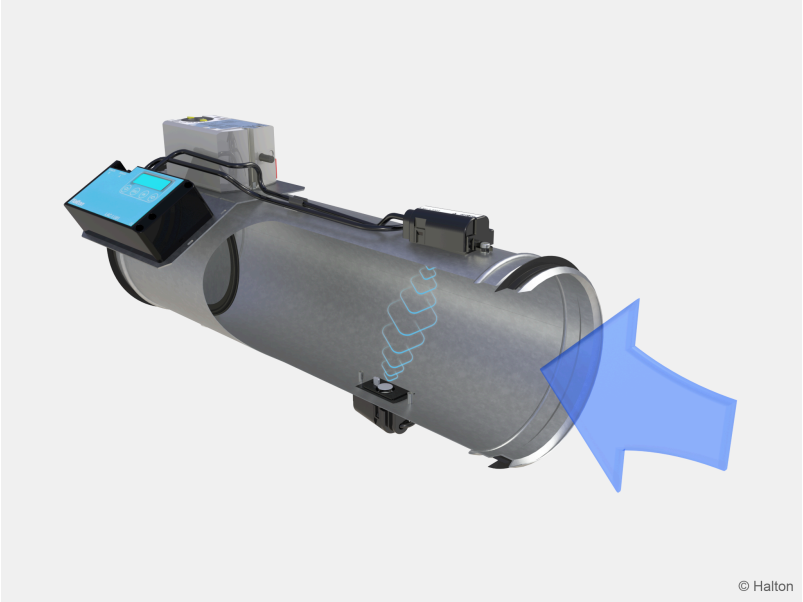


Fig. 2. Halton Max Ultra Circular (MUC) has two ultrasound sensors for airflow measurement.

The damper can function either as a supply or exhaust unit. It maintains the required airflow through ultrasound measurement, regardless of airflow and pressure variations in the ductwork.

The damper has an airflow controller, two ultrasound sensors for airflow measurement, airflow temperature sensor and an actuator for controlling the damper blade. The airflow controller has a control panel for displaying the measurement values and setting the operation parameters.

The airflow controller can receive the airflow control signal via

- Modbus RTU network variable,
- the control panel input,
- an analog standard signal.

All three control modes are synchronised between each other. The airflow measurement includes temperature and duct type compensations, providing accurate and reliable airflow measurements even at short distances from airflow disturbances in the ductwork.

2.3 Structure and materials

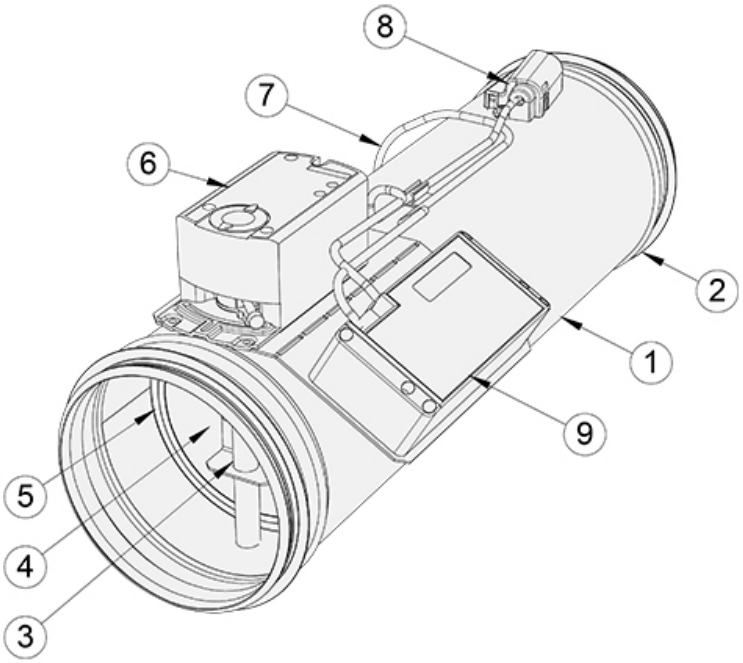


Fig. 3. Halton Max Ultra Circular (MUC) structure

No.	Part	Material
1	Casing	Galvanised steel or stainless steel *(EN 1.4404, AISI 316L)*
2	Duct seal gasket	Rubber
3	Shaft	Galvanised steel or stainless steel *(EN 1.4404, AISI 316L)*
4	Blade	Galvanised steel or stainless steel *(EN 1.4404 / AISI 316L)*
5	Blade gasket	EPDM Rubber
6	Actuator	Plastic, steel, PVC cable
7	Cable	Ethernet cable (LSZH)
8	Ultrasound sensor and temperature sensor	Plastic ABS
9	Airflow controller	Plastic ABS

2.4 Dimensions and weight

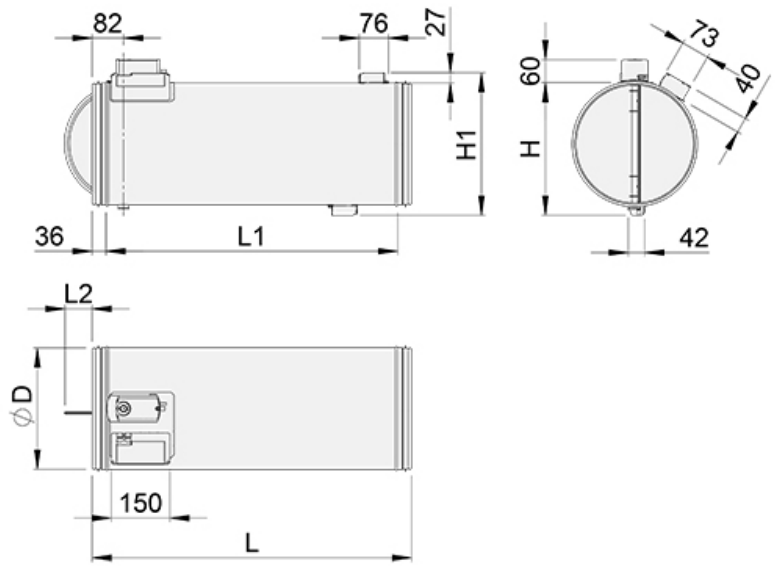


Fig. 4. Halton Max Ultra Circular (MUC) dimensions, D=100-315

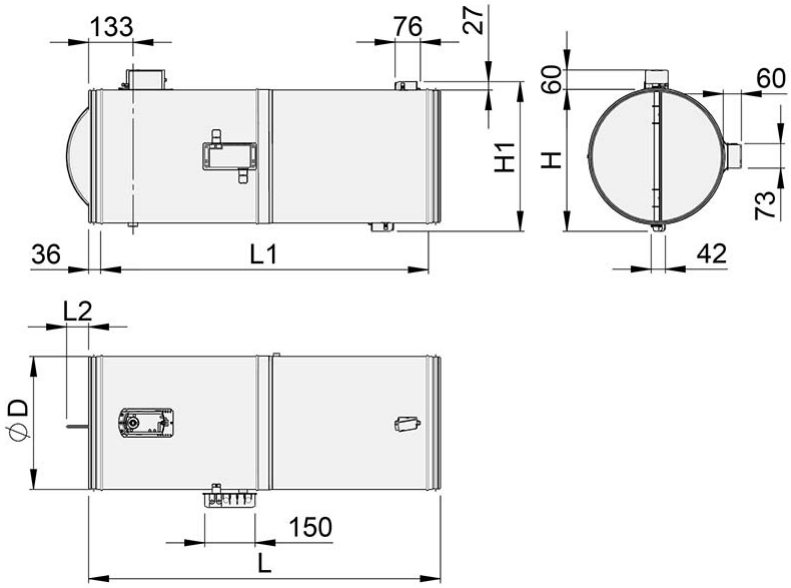


Fig. 5. Halton Max Ultra Circular (MUC) dimensions, D=400

NS	øD	L	L1	L2	H	H1	Weight (kg)
100	99	427	355	-	127	153	1.9
125	124	474	402	-	153	178	2.2
160	159	540	468	-	187	213	2.7
200	199	612	540	15	227	253	3.3
250	249	705	633	38	277	303	4.3
315	314	825	753	70	342	368	5.8

NS	øD	L	L1	L2	H	H1	Weight (kg)
400	398	1054	982	65	424	447	9.6

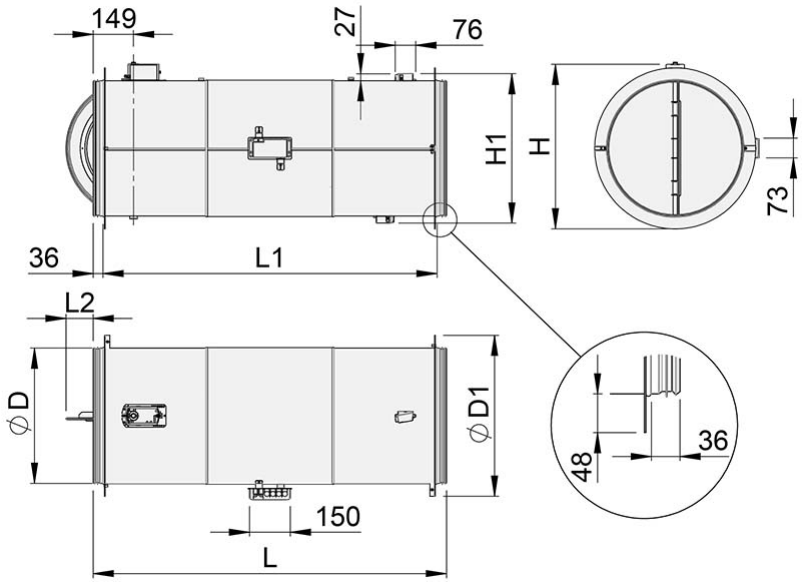


Fig. 6. Halton Max Ultra Circular (MUC) dimensions, D=500-630

NS	øD	øD1	L	L1	L2	H	H1	Weight (kg)
500	499	595	1295	1235	100	552	608	20.5
630	629	725	1532	1476	167	740	682	27

3 Installation

3.1 Before you start

3.1.1 Installation process

The main steps in the installation process are the following:

- Determining the installation place.
- Checking the safety distances.
- Connecting the damper to the ductwork.
- Connecting the wiring.

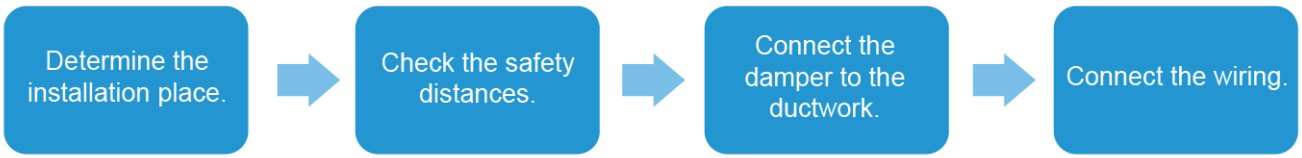


Fig. 7. Halton Max Ultra Circular (MUC) installation process

3.1.2 Installation information

Installation options

There are three possible positions of the damper: the sensors can be directed outwards, side, or inwards. A tolerance of +/- 10 degrees is acceptable.

Fig. 8. Damper positions 'outwards' and 'side'

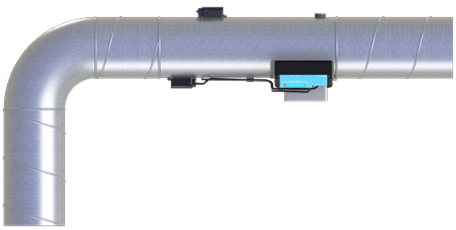


Fig. 9. Damper position 'inwards'

Wiring

The wiring must only be carried out by qualified personnel following the local regulations. For the power supply, a safety isolating transformer must be used.

The bus must be implemented according to standard EIA/TIA-485.

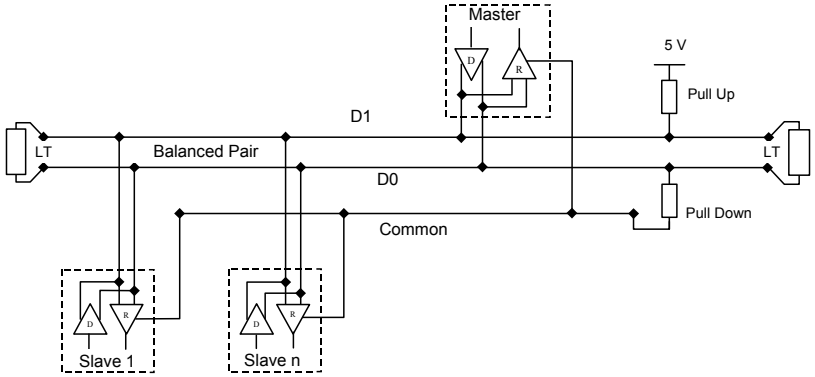


Fig. 10. Example: General RS-485 2-wire Topology

For connection and wiring diagrams, see ***Controller connections*** and ***Wiring diagrams*** in *Technical reference data*.

Cabling requirements

Field devices:

- The wires connected to the terminals have a cross-sectional area of at least 0.5 mm^2.
- Twisted-pair cables, shielding recommended.

Modbus RTU cable:

- Shielding twisted-pair. For example, Belden 3105A or Nomak 2x2x0.5+0.5.
- Max. bus length 1000 m.
- To avoid signal reflections, a 120 Ohm termination resistance must be added at the end of the main cable line.

3.1.3 Safety distances and accuracy

Disturbances in the ductwork such as duct bends, T-branches and sound attenuators cause turbulence and an uneven airflow. This can lead to fluctuation and inaccuracy in measurement values.

Note: The recommended safety distance is longer than or equal to three duct diameters (3D), to ensure optimal accuracy.

Halton Max Ultra Circular (MUC) technical performance

- **Velocity range** 0.5 - 10.0 m/s
- General Measurement Uncertainty
  - Accuracy ±5%
  - The minimum allowed safety distance is 1D.
- **Expected Measurement Uncertainty** when the correct installation case is selected ± % or l/s depending, which is the greatest of the percentage or the absolute value for the specific product size.

- Dim. 100 = ±5% or ±1.00 l/s
- Dim. 125 = ±5% or ±1.25 l/s
- Dim. 160 = ±5% or ±2.5 l/s
- Dim. 200 = ±5% or ±4.0 l/s
- Dim. 250 = ±5% or ±6.5 l/s
- Dim. 315 = ±10% or ±10 l/s
- Dim. 400 = ±10% or ±15 l/s
- Dim. 500 = ±10% or ±25 l/s
- Dim. 630 = ±15% or ± 93 l/s *

Note: The measurement uncertainty is defined in laboratory conditions and may be greater in practical installations, where non-optimal installation situations or multiple consequent disturbances may exist.

*Dim. 630 velocity range 0.5 – 8.0 m/s

Minimum safety distance

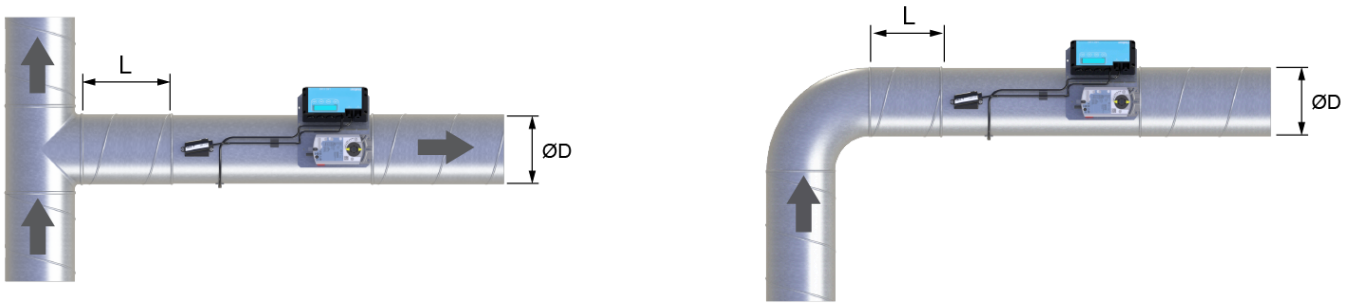


Fig. 11. Minimum safety distance

If the straight duct between the damper and disturbance is shorter than five duct diameters (5D), the correct installation case needs to be selected during commissioning. The minimum allowed safety distance is 1D.

Note: For information on the installation cases and their corresponding *SelectDuctType* parameter values, see chapter ***Halton Max Ultra Circular (MUC) installation cases*** in *Technical reference data*.

3.2 Step by step instructions

3.2.1 Connecting the damper to the ductwork

Context

CAUTION!

Risk of personal injury or material damage.

Note: The fixing material is not included in the delivery.

Steps

1. Before you start, do the following:
   a. Check the inside of the damper for damage and loose parts.
   b. Remove any contamination from the ductwork.
   c. Support the installation with a suitable suspension system. Load suspension systems only with the weight of the unit. Adjacent components and connecting ducts must be supported separately.
   d. Wear protective gloves.
2. Position the damper so that the display is visible.
   There are three possible positions of the damper: the sensors can be directed outwards, side, or inwards. A tolerance of +/- 10 degrees is acceptable.

Fig. 12. Damper positions 'outwards' and 'side'

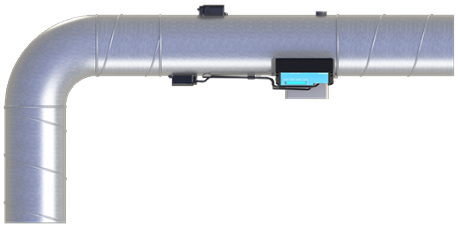
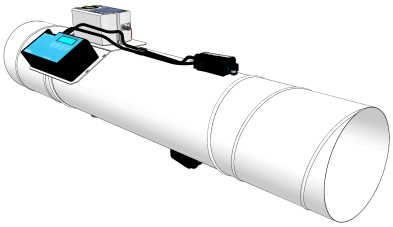


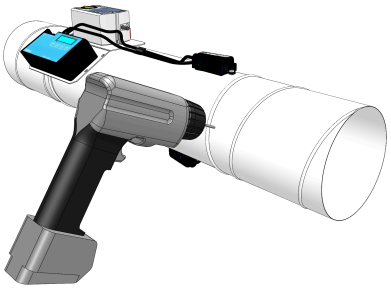
Fig. 13. Damper position 'inwards'

Note: For information on the safety distances, see ***Safety distances and accuracy*** .

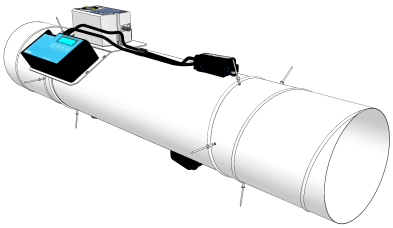
3. Push the ducts onto the damper. The damper is fitted with seal gaskets.



4. Drill the holes for pop rivets.

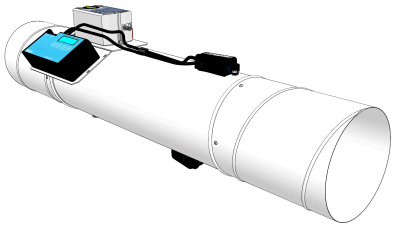


5. Fix the duct to the damper with pop rivets such that it cannot be moved.



Results

The damper is installed. Use tape to ensure tightness, if necessary.



3.2.2 Connecting the wiring

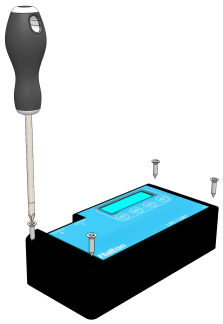
Context

ELECTRICAL HAZARD!

Before carrying out any work, turn off the power supply to avoid injury from electrical current.

Steps

1. Unscrew the controller cover and remove it.



2. Connect the input, output, and communication wires.
   Note: See ***Installation information*** and ***Wiring diagrams***.
3. Replace the controller cover and fasten the screws.
4. Switch on the power supply.

4 Commissioning

4.1 Before you start

4.1.1 Commissioning process

The main steps in the commissioning process are the following:

- Configuring the basic controller settings (including: selecting the installation case)
- Setting the Modbus communication parameters (optional)

4.1.2 Commissioning information

Before the system start-up, the controller settings (including the correct installation case) and optionally the Modbus communication parameters have to be set.

Factory settings

The airflow range for Halton Max Ultra Circular (MUC) is preset at the factory. The factory settings for the control signal and feedback signal are the same, but they can be configured individually. If the airflow range is not specified by the customer, the default factory settings are the following:

- Minimum airflow rate: 0 l/s
- Maximum airflow rate corresponds to an airflow velocity of 10 m/s

The maximum airflow rates in the following table are given with an airflow velocity of 10 m/s.

NS	Max. airflow [l/s] @ 10 m/s (Vnom)	Max. airflow [m^3/h] @ 10 m/s (Vnom)
100	79	283
125	123	441
160	201	723
200	314	1130
250	491	1767
315	779	2805
400	1257	4524
500	1963	7068
630	3117	11222

Table 1. Halton Max Ultra Circular (MUC) factory settings

4.1.3 Airflow control panel

Halton Max Ultra Circular (MUC) airflow controller has a control panel with a display and four pushbuttons.

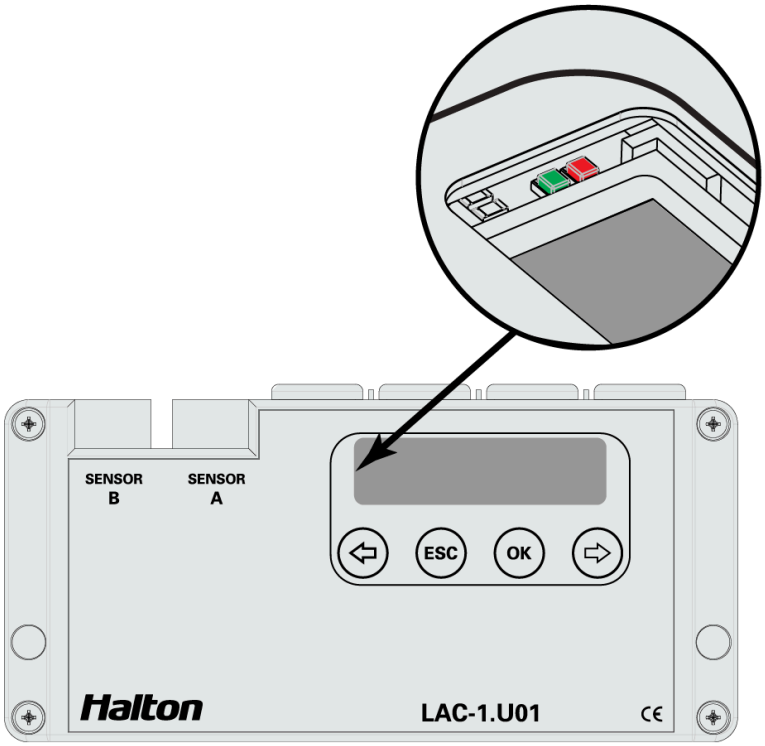
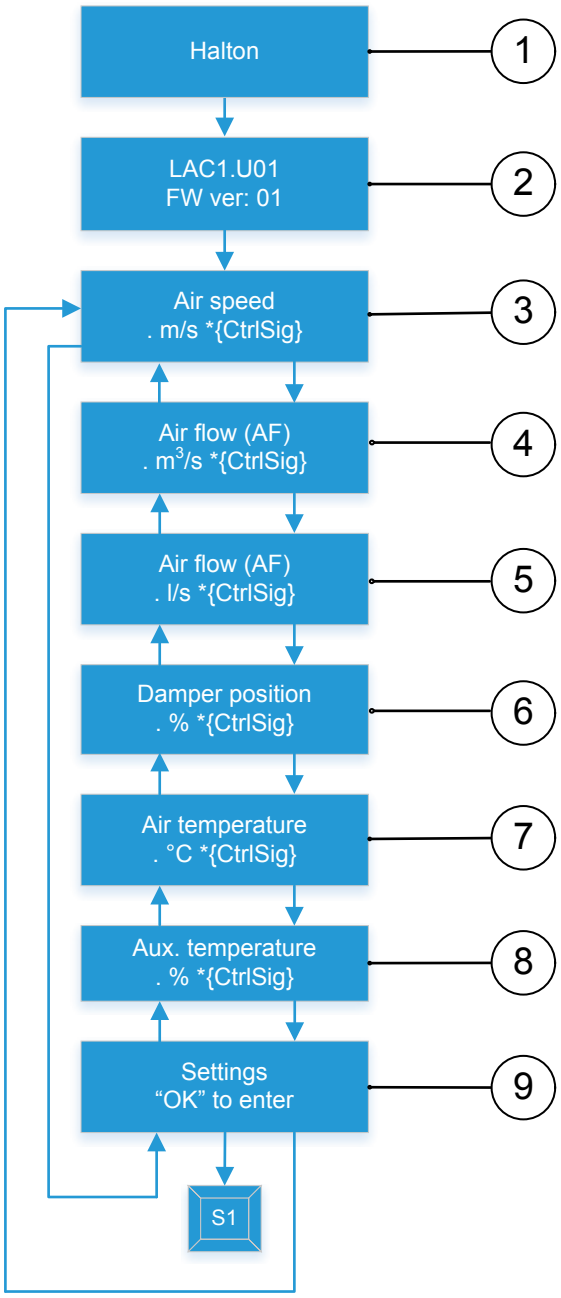


Fig. 14. Control panel

The LCD display can show 16 characters in 2 lines.

- Press the OK button to move to the next view. Press the ESC button to move to the previous view.
- Press the left or right arrow buttons to move between different parameter settings.
- When the 'Settings' view is displayed, press the OK button to see the controller parameter menu.
- If no button is pressed, the display goes back into the default view.
- LED signal lights indicate Modbus communication:
  - The red light indicates RS-485 Rx communication packet from master.
  - The green light indicates RS-485 Tx communication packet to master.

4.1.4 Airflow control panel: start-up views



No.	Description
1	Default view
2	Software version
3	Measured airflow in m/s
4	Measured airflow in m^3/h
5	Measured airflow in l/s
6	Damper blade position (0-100%)
7	Measured temperature
8	Measured room temperature
9	Settings view

Fig. 15. Halton Max Ultra Circular (MUC) start-up views

- Press the OK button to move to the next view. Press the ESC button to move to the previous view.
- Press the left or right arrow buttons to move between different parameter settings.
- When the 'Settings' view is displayed, press the OK button to see the controller parameter menu.

4.1.5 Modbus RTU communication

The Halton Max Ultra Circular (MUC) airflow control damper can communicate with the Building Management System (BMS) via Modbus RTU. With the Modbus register, you can read and configure parameter values. For a Modbus RTU parameter list, see ***Halton Max Ultra Circular (MUC) Modbus RTU parameters***.

The default communication settings are Slave-ID 1, 115200bsp, O (Odd), 8 (bit), 1 (stop bit).

You can change the communication settings on the correct parameter pages of the Halton Max Ultra Circular (MUC) controller:

- Controller support slave ID: 1..247
- Communication speed: 4k8 / 9k6 / 14k4 / 19k2 / 38k4 / 56k0 / 57k6 / 115k2
- Parity: None / Even / Odd

There can be up to 32 devices in one Modbus RTU bus. The length and quality of the bus cable as well as other disturbances can affect the maximum number of devices. The shortest poll time of the controller is 200 ms.

To configure parameters using Modbus, you need to send a password to MUC before it approves the changes. When configuring the Holding register or Coils, first send the register value you want to change. After that, send value 9055 to Holding register 40905, then send value 0 to Holding register 40905.

4.1.6 Self-diagnosis function

Halton Max Ultra Circular (MUC) includes an advanced self-diagnosis function for monitoring the controller's own performance.

If the controller is installed in a location where the airflow is highly turbulent and the air velocity is high (approximately 10 m/s), it can cause a wrong kind of measurement action to the sensor. In cases like this, the self-diagnosis function restarts the measurement sensors. During the restart process, the damper blade goes into the close position for 1 second, then continues normal operation.

4.2 Step by step instructions

4.2.1 Configuring basic controller settings in analog mode

Steps

1. Go to the controller parameter menu.
2. Set parameter *CtrlMode* to 'Analog'.
3. Check the values of the following parameters. If needed, modify the values.
   - Control signal range (*AI1rg*)
     - Possible values: 0..10V / 2..10V
     - Default: 0..10V
   - Minimum flow setting Vmin (*AI1min*)
     - Default: Vmin=0
   - Maximum flow setting Vmax (*AI1max*)
     - Default: Vmax=Vnom
   - Feedback signal range (*AO1rg*)
     - Possible values: 0..10V / 2..10V
     - Default: 0..10V
4. To ensure accurate measurement results, select the correct installation case and set the value of parameter *SelectDuctType* accordingly.
   - Possible values: #0..#51
   - Default: #0
   - For information on the installation cases and their corresponding *SelectDuctType* parameter values, see chapter ***Halton Max Ultra Circular (MUC) installation cases*** in *Technical reference data*.

4.2.2 Configuring basic controller settings in Modbus mode

Context

See also ***Modbus RTU communication***.

Steps

1. Go to the controller parameter menu.
2. Set parameter *CtrlMode* to 'Modbus'.
3. To ensure accurate measurement results, select the correct installation case and set the value of parameter *SelectDuctType* accordingly.
   - Possible values: #0..#51
   - Default: #0
   - For information on the installation cases and their corresponding *SelectDuctType* parameter values, see chapter ***Halton Max Ultra Circular (MUC) installation cases*** in *Technical reference data*.
4. Check the values of the following Modbus RTU parameters. If needed, modify the values.
   - Slave ID (*SlvID*)
     - Possible values: 1..247

        - Default: 1
    - Baud rate (*Baud*)
        - Possible values: 4k8 / 9k6 / 14k4 / 19k2 / 38k4 / 56k0 / 57k6 / 115k2
        - Default: 115k2
    - Parity (*Pr*)
        - Possible values: None / Even / Odd
        - Default: Odd

4.2.3 Configuring basic controller settings in console mode (service or testing)

Steps

1. Go to the controller parameter menu.
2. Set parameter *CtrlMode* to 'Console'.
3. Set the value of the setpoint parameter *SP*.
    - Default: Vnom
4. To ensure accurate measurement results, select the correct installation case and set the value of parameter *SelectDuctType* accordingly.
    - Possible values: #0..#51
    - Default: #0
    - For information on the installation cases and their corresponding *SelectDuctType* parameter values, see chapter ***Halton Max Ultra Circular (MUC) installation cases*** in *Technical reference data*.

4.2.4 Calculating the airflow control and feedback signals

With these formulas, you can calculate the airflow control and feedback signals when using the analog mode.

Steps

1. Calculate the airflow control signal.
    - If you use a 0-10 DC control signal, use the following formula:

      $$V_{sp} = V_{min} + \frac{Y}{10DC} \times (V_{max} - V_{min})$$

    - If you use a 2-10 DC control signal, use the following formula:

      $$V_{sp} = V_{min} + \frac{Y - 2DC}{8DC} \times (V_{max} - V_{min})$$

2. Calculate the airflow feedback signal.
    - If you use a 0-10 DC feedback signal, use the following formula:

      $$V_{act} = V_{nom} \times \frac{U}{10DC}$$

    - If you use a 2-10 DC feedback signal, use the following formula:

$$V_{act} = V_{nom} \times \frac{U - 2DC}{8DC}$$

4.2.5 Rebooting the controller

Context

Steps

1. Go to the controller parameter menu.
2. Press the left arrow button, the right arrow button, and the OK button at the same time for 2 seconds. The second level of the controller parameter menu opens.
3. Set parameter *Recal. Pos* to 'Yes'.

Results

The controller restarts.

4.2.6 Configuring the scheduled restart function

You can set the controller to restart at scheduled intervals.

Context

For more information, see ***Self-diagnosis function***.

Steps

1. Go to the controller parameter menu.
2. Press the left arrow button, the right arrow button, and the OK button at the same time for 2 seconds. The second level of the controller parameter menu opens.
3. Select parameter *Actuator param.* > *Recal.*, then set a value (hours between restarts).
   - Value range: 0-999 hours
   - Default value: 0 hour (no scheduled restarts)

5 Maintenance

ELECTRICAL HAZARD!

Before carrying out any work, turn off the power supply to avoid injury from electrical current.

Clean the ultrasound damper during the periodic cleaning of the ductwork. Set the damper blade in an open position using the actuator release button. Do not change the position of the sensors. Use soft, non-metal brushes. No other maintenance is needed.

6 Troubleshooting

Problem	Possible cause	Possible solution
No values on the controller display	Missing power	Check the power supply.
Measured airflow values are out of tolerance	Installation location	Check the installation case and make sure the correct parameter value is used. See ***Halton Max Ultra Circular (MUC) installation cases***.
Fault 7 showing on the controller display	The controller is in 'Service request' mode. For more information, see ***Self-diagnosis function***.	Reboot the controller. For instructions, see ***Rebooting the controller***.
Modbus RTU communication not working fluently	External disturbance causes noise to communication bus.	Check bus end resistors and bias resistors.

7 Technical reference data

7.1 Halton Max Ultra Circular (MUC) actuator

Description

The Halton Max Ultra Circular (MUC) airflow controller LAC-1.UO1 controls the airflow using ultrasound technology. It provides accurate airflow measurements with two ultrasound sensors.

Technical data

Feature	Description
Control concept	▪ Modbus RTU ▪ Airflow controller user interface ▪ Analog signal
Power supply	▪ 18...32 V DC ▪ 20...26.4 V AC
Cables	▪ Length (sensors): 1000 mm
Dimensions	▪ Controller: 73 x 150 x 40 mm ▪ Sensors: 42 x 76 x 37 mm
Protection class	▪ Controller: IP52 ▪ Sensors inside duct: IP65 ▪ Sensors outside duct: IP52

Actuator

The actuator includes an integrated dynamic differential pressure sensor. The pressure sensor has a low bypass airflow rate through the sensor element. Depending on the model, airflow rate limits are adjusted on site with a mobile application or a dial for manual adjustment.

Code	Actuator	Torque	Damper size	Communication interface	Order code
G2	Siemens actuator	5	100-315	Siemens GDB 161.1E 0..10V/2..10V	G2=GDB 161.1E
G3	Siemens actuator	10	400-630	Siemens GLB 161.1E	G3=GLB 161.1E
G4	Belimo actuator	5	100-315	Belimo LM24A-SR 0..10V/2..10V	G4=LM24A-SR
G5	Belimo actuator	10	400-630	Belimo NM24A-SR	G5=NM24A-SR

7.2 Controller connections

Connection diagram

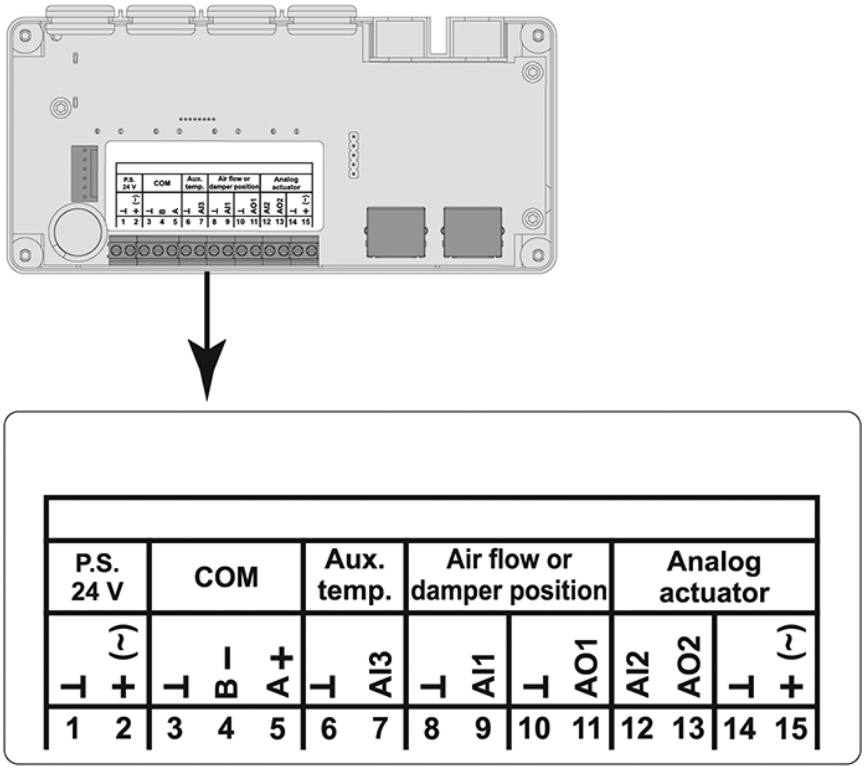


Fig. 16. Halton Max Ultra Circular (MUC) connection diagram

Terminals

Terminal	Name	Comment
1	GND	Ground
2	24 V DC/AC	Power supply input
3	GND	Ground
4	Standard RS-485 B	Data receive/send line B -
5	Standard RS-485 A	Data receive/send line A +
6	GND	Ground
7**	AI3	Input for NTC 10k temperature sensor
8	GND	Ground
9	AI1	Input for airflow or damper control signal
10	GND	Ground
11	AO1	Output for airflow or damper feedback signal
12*	AI2	Analog actuator feedback signal

Terminal	Name	Comment
13*	AO2	Analog actuator reference signal
14*	GND	Ground
15*	24 V DC/AC	Power supply output for the analog actuator

* Connected to Siemens GDB 161.1E actuator or Belimo LM24A-SR actuator

** Not included in delivery

7.3 Wiring diagrams

Wiring diagram: Analog control

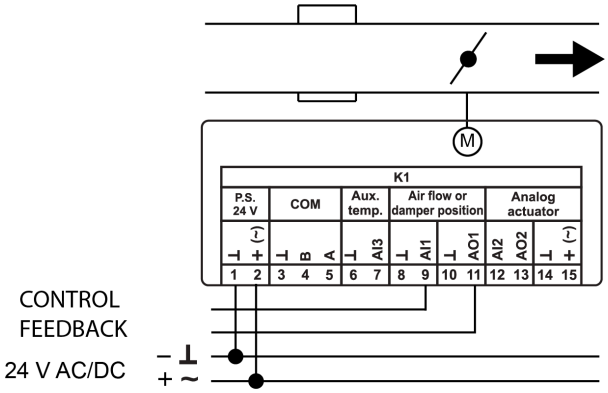


Fig. 17. Wiring diagram: Analog control

Wiring diagram: Modbus communication

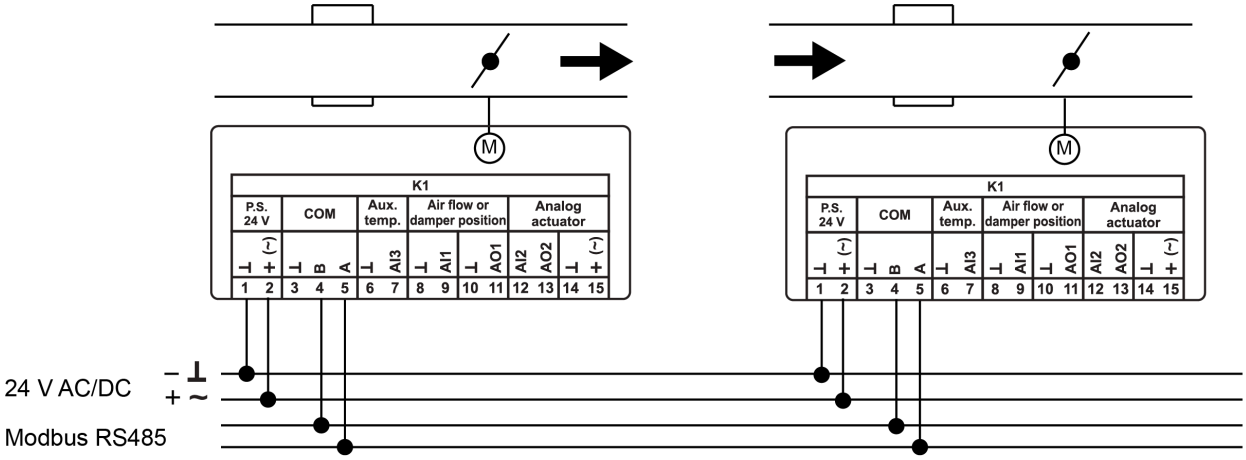


Fig. 18. Wiring diagram: Modbus communication

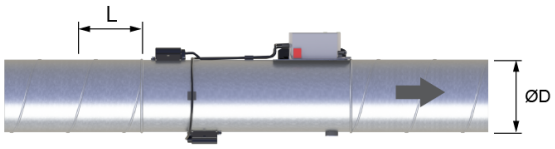
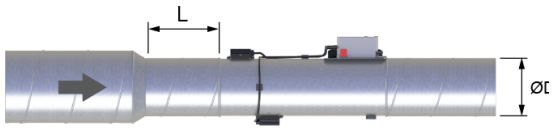
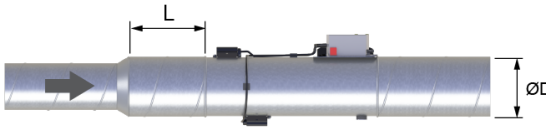
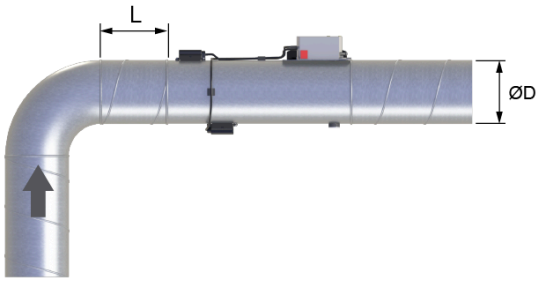
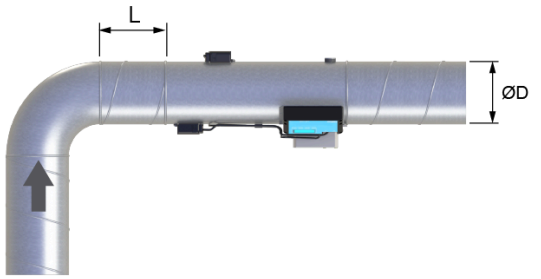
7.4 Parameters

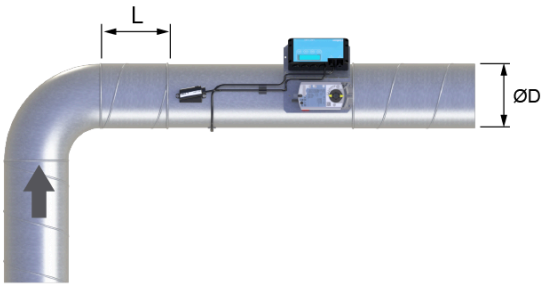
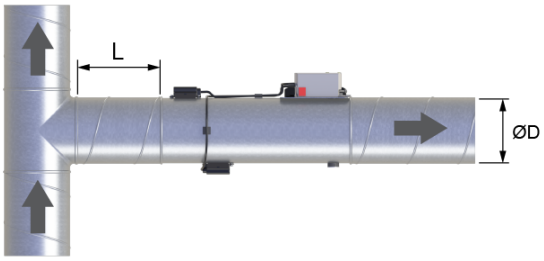
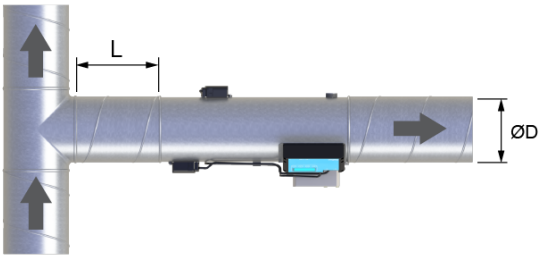
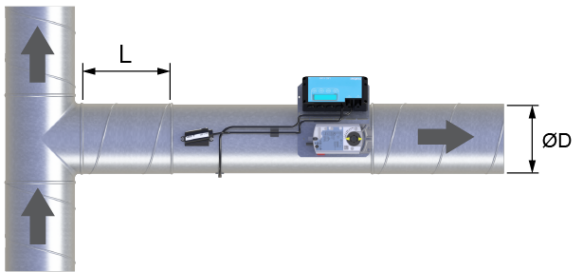
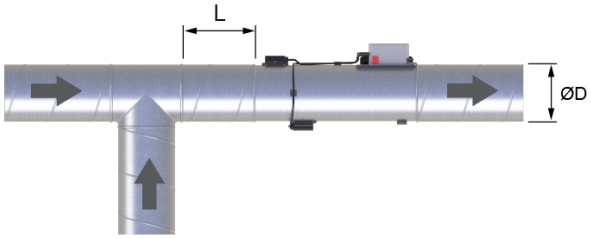
7.4.1 Halton Max Ultra Circular (MUC) controller parameters

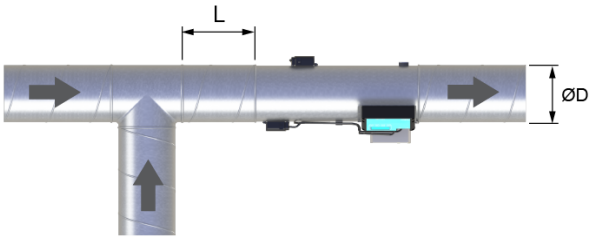
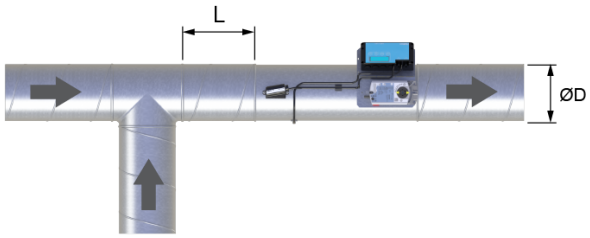
Parameter	Description	Values	Default value
CtrlMode	Control mode	Console / Modbus / Analog	Analog
CtrlSig	Control signal	AF / Damper	AF
SelectDuctType	Installation case	#0..#51 For information on the values, see ***Halton Max Ultra Circular (MUC) installation cases***.	#0
SP	Setpoint: airflow or damper position		-
Modbus RTU parameters			
SlvID	Slave ID	1..247	1
Baud	Baud rate	4k8 / 9k6 / 14k4 / 19k2 / 38k4 / 56k0 / 57k6 / 115k2	115k2
Pr	Parity	None / Even / Odd	Odd
Airflow or damper control signal parameters			
AI1type	Type of analog input 1 (AI1)	Voltage / Current	Voltage
AI1rg	Range of AI1	▪ 0..10V / 2..10V (if *AI1type* = Voltage) ▪ 0..20mA / 4..20mA (if *AI1type* = Current)	0..10V
AI1min	Minimum flow setting Vmin [m^3/h]		Vmin=0
AI1max	Maximum flow setting Vmax [m^3/h]		Vmax=Vnom
Feedback signal parameters			
AO1sig	System control based on airflow or damper position	Airflow / Damper	Airflow
AO1actSP	Actual measured airflow or setpoint values	Actual / SP	Actual
AO1type	Type of analog output 1 (AO1)	Voltage / Current	Voltage
AO1rg	Range of AO1	▪ 0..10V / 2..10V (if *AO1type* = Voltage) ▪ 0..20mA / 4..20mA (if *AO1type* = Current)	0..10V

Parameter	Description	Values	Default value
AO1min	Feedback Vmin m^3/h		
AO1max	Feedback Vmax m^3/h		
Actuator type parameter			
ActType		Analog / LAC1.MA1	Analog
Analog actuator feedback signal parameters			
AI2type	Type of analog input 2 (AI2)	Voltage / Current	Voltage
AI2rg	Range of AI2	▪ 0..10V / 2..10V (if *AI2type* = Voltage) ▪ 0..20mA / 4..20mA (if *AI2type* = Current)	0..10V
Analog actuator control signal parameters			
AO2type	Type of analog output 2 (AO2)	Voltage / Current	Voltage
AO2rg	Range of AO2	▪ 0..10V / 2..10V (if *AO2type* = Voltage) ▪ 0..20mA / 4..20mA (if *AO2type* = Current)	0..10V
PI regulator parameters			
kp	K factor of PI regulator	0..100.0	
ki	I factor of PI regulator	0..100.0	

7.4.2 Halton Max Ultra Circular (MUC) installation cases

Installation case	Sensor position	Safety distance (L)	Value of parameter *SelectDuctType*
	-	> 7D	#0
	-	1D	#1
		1D..7D	#2
	-	1D	#3
		2D	#4
		3D	#5
		3D..7D	#6
	Outwards	1D	#7
		2D	#8
		3D	#9
		5D	#10
		5D..7D	#11
	Inwards	1D	#12
		2D	#13
		3D	#14
		5D	#15
		5D..7D	#16
	Side	1D	#17
		2D	#18
		3D	#19

Installation case	Sensor position	Safety distance (L)	Value of parameter *SelectDuctType*
		5D	#20
		5D..7D	#21
	Outwards	1D	#22
		2D	#23
		3D	#24
		5D	#25
		5D..7D	#26
	Inwards	1D	#27
		2D	#28
		3D	#29
		5D	#30
		5D..7D	#31
	Side	1D	#32
		2D	#33
		3D	#34
		5D	#35
		5D..7D	#36
	Outwards	1D	#37
		2D	#38
		3D	#39
		5D	#40
		5D..7D	#41

Installation case	Sensor position	Safety distance (L)	Value of parameter *SelectDuctType*
	Inwards	1D	#42
		2D	#43
		3D	#44
		5D	#45
		5D..7D	#46
	Side	1D	#47
		2D	#48
		3D	#49
		5D	#50
		5D..7D	#51

7.4.3 Halton Max Ultra Circular (MUC) Modbus RTU parameters

3xxxx, Input registers, Type 16-bit unsigned integer

Register	Parameter	Description	Values	Default value
30001	*FWver*	Firmware version	0 .. 65535 → 0 .. 65535 ver	Latest software version
30002	*CWorkingHoursHi*	Counter of controller working hours, high word	0 .. 65535 → 0 .. 65535 h	-
30003	*CWorkingHoursLo*	Counter of controller working hours, low word	0 .. 65535 → 0 .. 65535 h	-
30004	*AWorkingHoursHi*	Counter of actuator working hours, high word	0 .. 65535 → 0 .. 65535 h	-
30005	*AWorkingHoursLo*	Counter of actuator working hours, low word	0 .. 65535 → 0 .. 65535 h	-
30006	*AirSpeed*	Measured air speed	20 .. 1500 → 0.20 .. 15.00 m/s	-
30007	*AirFlow*	Measured airflow with selected unit	0 .. 65535 → 0 .. 65535 m^3/h or l/s	-
30009	*AirFlow*	Measured airflow with secondary unit	0 .. 65535 → 0 .. 65535 m^3/h or l/s	-
30011	*AirTemp*	Temperature inside the duct	500 .. 4000 → 5.00 .. 40.00°C	-
30012	*AuxTemp*	Temperature of auxiliary sensor	0 .. 5000 → 0.00 .. 50.00°C	-
30013	*ControlMode*	Control mode feedback	0 → Modbus 1 → Console 2 → Analog	2
30014	*DamperPosition*	Damper position feedback	0 .. 10000 → 0.00 .. 100.00%	-
30015	*DamperStatus*	Status of damper	0 → Stop	-

Register	Parameter	Description	Values	Default value
			1 → Closing 2 → Opening	
30016	*ZeroOffsetCalibrationStatus*	Status of zero offset calibration	0 → Idle 1 → Complete 2 → Failed	1
30017	*RecalDamperUSstatus*	Status of recalibration of damper and ultrasound position	0 → Idle 1 → Complete 2 → Failed	1

4xxxx, Holding registers, Type 16-bit unsigned integer

Register	Parameter	Description	Values	Default value
40001	ControlledSignal	Airflow regulation or damper manual position	0 → Airflow 1 → Damper position	0
40002	*SelectDuctType*	Installation case	0 .. 51	0
40003	*AirFlowSP*	Setpoint for airflow regulation for selected unit	0 .. 65535 → 0 .. 65535 m^3/h or l/s	-
40004	*AirFlowDB*	Airflow regulation deadband, percentage of AirFlowSP	0 .. 10000 → 0.00 .. 100.00%	200
40005	*DamperSP*	Setpoint for damper position	0 .. 10000 → 0.00 .. 100.00%	-
40023	*AI1scaleMin*	(Vmin) Analog input 1 minimum value	0 .. 65535 → 0 .. 65535 m^3/h	0
40024	*AI1scaleMax*	(Vmax) Analog input 1 maximum value	0 .. 65535 → 0 .. 65535 m^3/h	Depending on the damper size
40025	*AO1scaleMin*	(Vmin feedback) Analog output 1 minimum value	0 .. 65535 → 0 .. 65535 m^3/h	0
40026	*AO1scaleMax*	(Vmax feedback) Analog output 1 maximum value	0 .. 65535 → 0 .. 65535 m^3/h	Depending on the damper size
40030	*Kp*	K factor of PI regulator	0 .. 1000	-

Register	Parameter	Description	Values	Default value
			→ 0.0 .. 100.0	
40031	*Ki*	I factor of PI regulator	0 .. 1000 → 0.0 .. 100.0	-

0xxxx, Coils, Type Boolean

Register	Parameter	Description	Values	Default value
00001	*AI1type*	Voltage or current type of AI1	0 → Voltage 1 → Current	0
00002	*AI1rg*	Range of AI1	0 → 0-10V/0-20mA 1 → 2-10V/4-20mA	0
00003	*AO1sig*	Signal on AO1	0 → Airflow 1 → Damper position	0
00004	AO1actSP	Actual or setpoint value	0 → Actual 1 → Setpoint	0
00005	*AO1type*	Voltage or current type of AO1	0 → Voltage 1 → Current	0
00006	*AO1rg*	Range of AO1	0 → 0-10V/0-20mA 1 → 2-10V/4-20mA	0

1xxxx, Discrete inputs, Type Boolean

Register	Parameter	Description	Values	Default value
10001	*ErrCode1*	Faulty sensor connection or sensors not connected	0 → No error 1 → Error	0
10004	*ErrCode4*	Air temperature sensor A is not working	0 → No error 1 → Error	0
10005	*ErrCode5*	Air temperature sensor B is not working	0 → No error 1 → Error	0
10006	*ErrCode6*	End switch position of LAC-1.MA1 is faulty	0 → No error 1 → Error	0