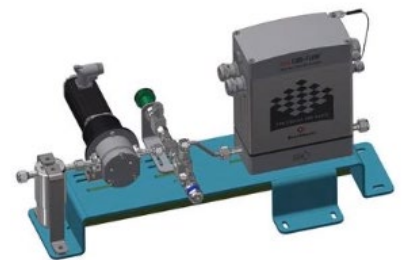
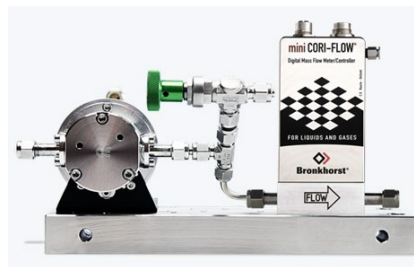


Liquid Dosing Control Manual

Dosing functions and parameter overview

9.17.150 REV C



2023-07

Introduction	3
1. Reference documents	4
2. Connect and Configure	5
2.1 Connect with the device	5
2.1.1 Via FlowDDE and FlowPlot.....	5
2.1.2 Via Bronkhorst FlowSuite	5
2.1.3 Via user specific control platform.....	5
2.2 Modify controller configuration	5
2.2.1 Disable and Enable protected mode	5
2.2.2 Change configuration from Flow Meter to Flow Controller	5
2.2.3 Change Flow Settings – Mass or Volume	6
2.2.4 Change Flow Settings – Capacity Unit	8
2.2.5 Change Flow Settings – Capacity Value	9
2.2.6 Dosing specific settings – Response Alarm / Dry Running Protection Alarm	10
2.2.7 Dosing specific settings – OUT signal to external device.....	11
2.2.8 Ratio dosing specific configuration settings.....	12
2.2.9 Batch dosing specific configuration settings	13
3. Prepare for operation	17
3.1 Fill the system	17
3.2 Flush the system	18
3.3 Verify system status	21
3.4 Zero procedure.....	22
4. Operate the Liquid Dosing Set.....	23
4.1 Start dosing	23
4.1.1 Continuous Dosing	23
4.1.2 Ratio Dosing	24
4.1.3 Batch Dosing.....	24
4.2 Pause dosing	25
4.3 Stop dosing	25
4.4 Read parameters	26
5. Optimize control settings	28
5.1 Changing Filter Settings.....	28
5.2 Actuator Control Speed.....	29
5.3 Adjust Proportional and Integral value (Kp and Ti).....	29
5.4 Correct for actuator delay	30
5.5 Setpoint Slope.....	30
5.6 Batch Dosing specific control optimization	31
5.6.1 Minimize ON/OFF Valve temperature	31
5.6.2 Tune the Batch Counter Controller.....	31
5.6.3 General guide for batch dosing optimization based on observation.....	32
6. Parameters.....	33

Introduction

This document provides a description of functions required for a successful operation of the Liquid Dosing Set (LDS). These functions are listed in detail, including applicable pre-conditions, manual actions and involved instrument parameters.

The scope for this version of the document includes:

Bronkhorst controlling instrument

- ES-FLOW series
- mini CORI-FLOW M-series
- mini CORI-FLOW MI-series
- mini CORI-FLOW ML-series
- CORI-FLOW M-series

Actuator

- Pumps
- Valves

Functions for setup and operation

- Connect and configure settings
- Prepare for Operation
- Start, pause and stop dosing

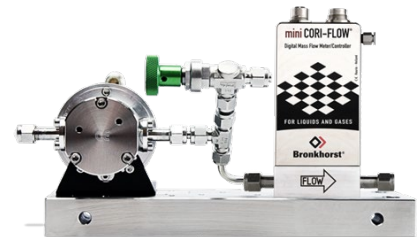


Image 1 - Example of a Liquid Dosing Set

For the ease of reading:

- Instructions are for all instruments and written for an RS232 interface using a Process Parameter (ProPar) protocol, and references are made to Dynamic Data Exchange (DDE) parameter numbers, which are unique numbers for parameter identification.
- Chapter 1 contains a table with reference documentation, including dedicated manuals for fieldbus specific communication instructions.
- Where instructions deviate for specific instruments, this will be clearly noted
- Fieldbus specific parameters will be provided
- Instructions are for all types of actuators, unless specific deviations are noted
- Instructions for (manual) operator actions are shown in blue
- Programmable interactions or system control and parameter readout are shown in red

Note

this document does not include any instructions or recommendations on the installation and connection of the Liquid Dosing Set.

1. Reference documents

The documentation listed can be downloaded from www.bronkhorst.com/downloads

Type	Document	Document number
Manual	Manual DeviceNet™ interface	9.17.026
	EtherNet/IP interface	9.17.132
	CANopen interface	9.17.131
	EtherCAT® interface	9.17.063
	FLOW-BUS interface	9.17.024
	Modbus ASCII / RTU / TCP interface	9.17.035
	PROFIBUS DP interface	9.17.025
	PROFINET interface	9.17.095
	RS232 interface	9.17.027
Manual	Instruction Manual mini CORI-FLOW ML120	9.17.097
Manual	Instruction Manual CORI-FILL	9.17.075
Manual	Installation Manual – Liquid Dosing Sets	9.17.146
E-book	How to handle low liquid flows	<i>Release October 2020</i>

2. Connect and Configure

2.1 Connect with the device

Several methods to open connection with the Bronkhorst controlling instrument

2.1.1 Via FlowDDE and FlowPlot

Refer to the instrument manual for details

2.1.2 Via Bronkhorst FlowSuite

Find out more about Bronkhorst FlowSuite on our [website](#).


2.1.3 Via user specific control platform

Refer to the manual of the used platform.
Bronkhorst offers Fieldbus specific [configuration files](#).

2.2 Modify controller configuration

2.2.1 Disable and Enable protected mode

To prevent accidental changes to the instrument settings, a Protection mode has been automatically enabled. Disabling this mode is required at several steps throughout this document. After making the required changes, it is strongly recommended to enable the protection mode again.

Parameters marked with a  symbol can only be changed after disabling the protected mode

Disable protected mode

- Write value 64 to [parameter 7 – Init Reset](#) (unlock secured parameters)

Enable protected mode

- Write value 82 to [parameter 7 – Init Reset](#) (lock secured parameters)

2.2.2 Change configuration from Flow Meter to Flow Controller

When the Bronkhorst instrument has been purchased as a controller, then the controller functions have been enabled. If an instrument was originally purchased as a flow meter and needs to be configured as a controller, then please contact your local Bronkhorst representative for support.

2.2.3 Change Flow Settings – Mass or Volume

(mini) CORI-FLOW

The Bronkhorst Coriolis based flow meters are mass flow meters. Setpoint and measurement values can be displayed in volume flow units using an internal conversion.

3 options are currently available.



Disable protected mode

- Write value 64 to parameter 7 – Init Reset (unlock secured parameters)

Option A – Mass Flow (default)

- Write value 0 to parameter 243 – Capacity Unit Type Index (set to mass flow mode)

Option B – Volume Flow with fixed density (volume flow mode)

- Write value 1 to parameter 243 – Capacity Unit Type Index (set to volume flow mode)

Set fixed fluid density value

- Write value <density> to parameter 170 – Density (density value in [kg/m³])

Option C – Actual Volume Flow using measured density (actual converted volume flow)

(This option is only available for mini CORI-FLOW ML1xx / MI1xx)

- Write value 4 to parameter 243 – Capacity Unit Type Index (set to actual volume flow mode)

Read measured fluid density value (for reference)

- Read value [kg/m³] from parameter 270 – Actual Density (density measurement)

Note on Actual Volume Flow mode

Using the instrument for measuring volume flows (e.g. l/h, ml/min) will introduce an additional inaccuracy, based on the actual density measured by the instrument.

Enable protected mode

- Write value 82 to parameter 7 – Init Reset (lock secured parameters)

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Unlock Secured Parameters							
1	7	0/10	Init Reset	UInt8	write	64	Unlock secured parameters
Mass Flow							
2	243	1/29	Capacity Unit Type Index	UInt8	write	0	Mass Flow
Volume Flow							
2	243	1/29	Capacity Unit Type Index	UInt8	write	1	Volume Flow (with fixed density)
3	170	33/21	Density	Float	write	<density>	Density for the fluid [kg/m ³]
Actual Volume Flow							
2	23	1/29	Capacity Unit Type Index	UInt8	write	4	Actual Volume Flow (with measured density)
3	270	116/15	Actual Density	Float	read	<density>	Measured density for the fluid [kg/m ³]
Lock Secured Parameters							
4	7	0/10	Init Reset	UInt8	write	82	Lock secured parameters

ES-FLOW

The Bronkhorst Ultrasonic based flow meters are volume flow meters. Setpoint and measurement values can be displayed in mass flow units using an internal conversion.

2 options are currently available.



Disable protected mode

- Write value 64 to [parameter 7 – Init Reset](#) (unlock secured parameters)

Option A – Volume Flow

(default)

- Write value 1 to [parameter 243 – Capacity Unit Type Index](#) (set to volume flow mode)

Option B – Mass Flow with fixed density

(converted mass flow mode)

- Write value 0 to [parameter 243 – Capacity Unit Type Index](#) (set to mass flow mode)

Set fixed fluid density value

- Write value <density> to [parameter 170 – Density](#) (density value in [kg/m³])

Enable protected mode

- Write value 82 to [parameter 7 – Init Reset](#) (lock secured parameters)

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Unlock Secured Parameters							
1	7	0/10	Init Reset	UInt8	write	64	Unlock secured parameters
Volume Flow							
2	23	1/29	Capacity Unit Type Index	UInt8	write	1	Volume Flow
Mass Flow							
2	23	1/29	Capacity Unit Type Index	UInt8	write	0	Mass Flow (with fixed density)
3	170	33/21	Density	Float	write	<density>	Density for the fluid [kg/m ³]
Lock Secured Parameters							
4	7	0/10	Init Reset	UInt8	write	82	Lock secured parameters

2.2.4 Change Flow Settings – Capacity Unit

The options for the capacity unit can be found in the table below.

Changing between mass flow or volume flow can affect the displayed capacity unit.

Capacity unit index FLOW-DDE 23	Mass-flow	(Actual) Volume Flow
0	kg / h	l / min
1	kg / min	ml / h
2	kg / s	ml / min
3	g / h	l / h
4	g / min	mm3 / s
5	g / s	cm3 / min
6	mg / h	m3 / h
7	mg / min	ul / min
8	mg / s	



Disable protected mode

- Write value 64 to parameter 7 – Init Reset (unlock secured parameters)

Change Capacity Unit Index

- Write value <index> to parameter 23 – Capacity Unit Index (capacity unit index)

Enable protected mode

- Write value 82 to parameter 7 – Init Reset (lock secured parameters)

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Unlock Secured Parameters							
1	7	0/10	Init Reset	UInt8	write	64	Unlock secured parameters
Volume Flow							
2	23	1/15	Capacity Unit Index	UInt8	write	<index>	Unit index
Lock Secured Parameters							
3	7	0/10	Init Reset	UInt8	write	82	Lock secured parameters

Alternative: Instruments in the ES-FLOW, ML- and MI-series automatically change to Mass or Volume mode when only changing the Capacity Unit.

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Unlock Secured Parameters							
1	7	0/10	Init Reset	UInt8	write	64	Unlock secured parameters
Volume Flow							
2	129	1/31	Capacity Unit	String	write	<index>	Unit
Lock Secured Parameters							
3	7	0/10	Init Reset	UInt8	write	82	Lock secured parameters

2.2.5 Change Flow Settings – Capacity Value

The instrument has a set minimum and maximum Full Scale capacity, which are the operating limits of the instrument as set by Bronkhorst according to the specification sheet. The Capacity Value can be changed between these minimum and maximum values.

Situations where changing the Capacity Value can benefit the dosing application:

- An oversized instrument is selected because of a larger sensor tube diameter (lower pressure drop). The Capacity Value can be adjusted to match the application.

Example: An instrument with a maximum flowrate of 30 kg / h is used for an application operating at a maximum of 10 kg / h, resulting in a flow measurement of 33.3%. Lowering the Capacity Value to 10 kg / h to match the application will result in a flow measurement of 100%, which can be beneficial for monitoring and logging purposes.

- The setup is used for flows in both the lower range and higher range of the instrument. Changing the capacity value to match the desired flow rate can increase the resolution of the measurement data.
- The Bronkhorst instrument sends an Analog signal to another instrument. The resolution of the analog signal improves when the Capacity Unit is in the same range as the process flow. Please note that by changing the Capacity Unit, the analog out signal can change as well, and the receiving instrument might need to be adjusted
- A Ratio control setup where the setpoint (Slave Factor) is calculated using the Capacity Value (100% point) of the instrument. Adjusting this value can help to determine the ratio control setpoint.



Disable protected mode

- Write value 64 to [parameter 7 – Init Reset](#) (unlock secured parameters)

Change Capacity Value

- Write value <flow> to [parameter 21 – Capacity](#) (Full Scale capacity value)

Use the same flow measurement unit as configured in the Capacity Unit section

Enable protected mode

- Write value 82 to [parameter 7 – Init Reset](#) (lock secured parameters)

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Unlock Secured Parameters							
1	7	0/10	Init Reset	Uint8	write	64	Unlock secured parameters
Volume Flow							
2	21	1/13	Capacity	Float	write	<capacity>	Full Scale Capacity in Capacity Unit
Lock Secured Parameters							
3	7	0/10	Init Reset	Uint8	write	82	Lock secured parameters

2.2.6 Dosing specific settings – Response Alarm / Dry Running Protection Alarm

Enable Response Alarm / Dry Running Protection Alarm

The response alarm is setup to trigger when the measured value does not reach the setpoint within a certain time. A band around the setpoint must be configured in which the measure is valid. The range in which the measure should be is setpoint + Maximum Limit and setpoint – Minimum Limit. This alarm can be useful to indicate a potential problem in the liquid flow setup.

Examples

- Liquid supply vessel is empty
- Blocked fluid lines preventing liquid to be supplied or blocking the flow downstream
- Tubing is incorrectly dimensioned

For pump systems this alarm can be used to prevent Dry Running, which can damage the pump head and reduce the lifetime.



Disable protected mode

- Write value 64 to parameter 7 – Init Reset (unlock secured parameters)

Enable and set the Response Alarm

- Write value 2 to parameter 118 - Alarm Mode (enable response alarm)

Value 0 = alarm disabled

Value 2 = alarm on limits related to setpoint (response alarm) 100%

- Write <delay time> to parameter 182 – Alarm Delay Time (delay before alarm)

Value defined in seconds between detection and triggering an actual alarm

- Write <maximum limit> to parameter 116 – Alarm Maximum Limit (0 – 32000)
- Write <minimum limit> to parameter 117 – Alarm Minimum Limit (0 – 32000)

0 – 32000 = 0 – 100%

A limit of 5% translates to a value of 1600

Define action when alarm triggers

- Write <setpoint mode> to parameter 120 – Alarm Setpoint Mode (enable alarm action)

Value 0 = no action

Value 1 = change setpoint to 'Alarm new Setpoint'

- Write <alarm new setpoint> to parameter 121 – Alarm New Setpoint (new setpoint)

Define new setpoint after alarm trigger, value 0 – 32000

Value 0 = 0% setpoint

Value 3200 = 10% setpoint

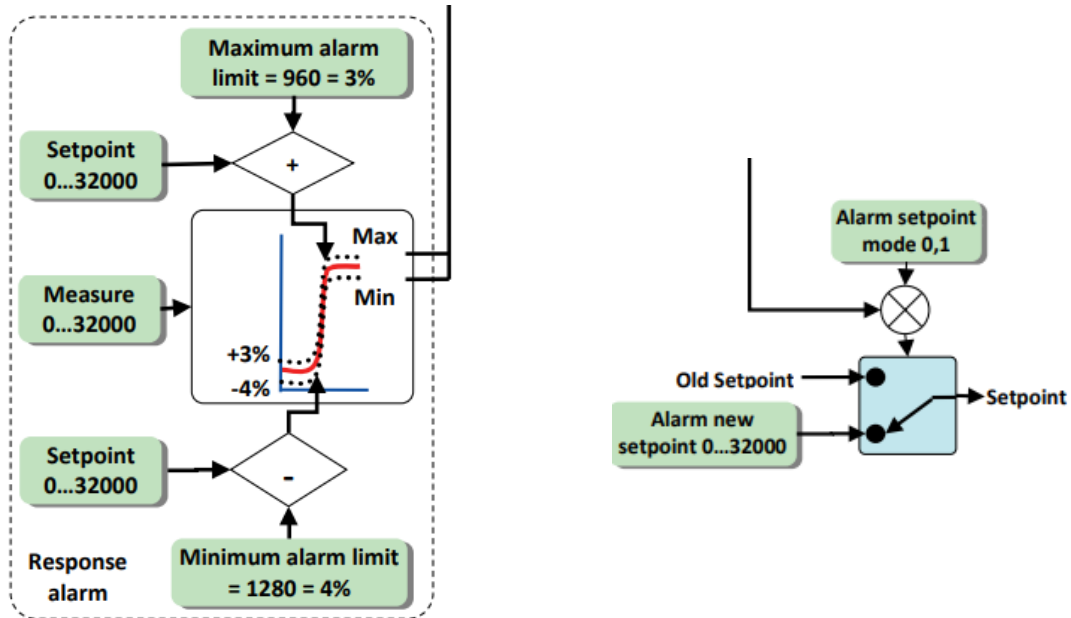
Enable protected mode

- Write value 82 to parameter 7 – Init Reset (lock secured parameters)

Reset alarm status

There are several methods to reset the alarm status. The most commonly used are the Automatic Reset – when the alarm conditions do not longer apply, and the Reset.

- Write value 2 to parameter 114 – Reset (reset alarm)



Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Unlock Secured Parameters							
1	7	0/10	Init Reset	Uint8	write	64	Unlock secured parameters
Response Alarm							
2	118	97/3	Alarm Mode	Uint8	write	2	Response Alarm
3	182	97/7	Alarm Delay	Uint8	write	_	Delay in seconds.
4	116	97/1	Alarm Maximum Limit	Uint16	write	_	Limit 0-32000 = 0-100%
5	117	97/2	Alarm Minimum Limit	Uint16	write	_	Limit 0-32000 = 0-100%
6	120	97/5	Alarm Setpoint Mode	Uint8	write	1	Setpoint change on alarm.
7	121	97/6	Alarm New Setpoint	Uint16	write	0	Setpoint 0.
Lock Secured Parameters							
8	7	0/10	Init Reset	Uint8	write	82	Lock secured parameters
Reset alarm							
9	114	115/8	Reset	Uint8	Write	2	Alarm reset

Note

At startup, only air is present in the sytem which can trigger the alarm.

2.2.7 Dosing specific settings – OUT signal to external device

Configure OUT signal to external device

Instruments within the ES-, MI- and ML-series have the option to trigger an external device, such as a indication light or sound.

To configure a physical output on the instrument, please contact your local Bronkhorst representative for support.

2.2.8 Ratio dosing specific configuration settings

Ratio or Master/Slave control loop

In a Ratio or Master/Slave control loop, the Liquid Dosing Set operates in a Slave control mode based on a measurement signal from an external flow meter, the Master signal.

The Master measurement signal is connected as an analog input signal.

Using the calculated Slave Factor, the Liquid Dosing Set doses the right amount of liquid as a function of the Master measurement signal.

Electrical connection

Refer to the electrical hook-up diagram of the instrument for Analog Operation connection instructions.

Depending on the type of actuator, the control signal is configured as 4 – 20 mA or 0 – 10 V. The Master measurement analog signal needs to be configured in the same way.

Configure instrument for Ratio Control

Change control mode

Change Control Mode

- Write value 10 to parameter 12 – Control Mode (Analog Slave Operation)

Calculate Ratio Control setting

The ratio control setting is defined as a percentage, the Slave Factor.

To determine the settings:

Master Flow Analog signal 4 – 20 mA or 0 – 10 V = 0 – 32000 = 0 – 100% of range.

- Read parameter 11 – Measure (Measure of Master 0 – 32000)

Example A Master Flow meter with a maximum capacity of 10,000 kg / h provides an input signal of 16000 = 50%, therefore a measurement of 5,000 kg / h.

Determine the Slave Factor

Example The ratio of liquid to be dosed is 1 : 1,000, for every 1,000 kg measured in the main flow, the Liquid Dosing Set will need to add 1 kg of liquid.

The Bronkhorst controller is configured for 10 kg / h (Capacity Value)

Capacity Value Master	10,000 kg / h (100%)
Capacity Value Slave	10 kg / h (100%)
Ratio	1:1,000

At 100% Master flow, a dosage of 1:1,000 for 10,000 kg = 10 kg = 100% of Slave capacity.

Slave Factor = 100

If Master meter measures 50% (5000 kg) and Slave factor is 100, then the setpoint for the dosed amount of liquid will be 50% = 5 kg / hr.

Example The ratio of liquid to be dosed is 1:25.

Capacity Value Master	1,000 kg / hr (100%)
Capacity Value Slave	200 gr / hr (100%)
Ratio	1:10,000

At 100% Master flow, a dosage of 1:10,000 for 1,000 kg = 100 **gr**

100 gr = 50% of the Slave Capacity

Slave Factor = 50

Or, by adjusting the Capacity Value (100% - point) of the instrument to 100 gr / hr, the factor changes to:

Slave Factor = 100

To start dosing

Write determined factor

- Write value <_> to parameter 139 – Slave Factor (0 – 500%)

Read instrument internal calculated setpoint
Defined as Analog Input x Slave Factor

- Read parameter 9 – Setpoint (Measure 0 – 32000)

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Control Mode							
1	12	1/4	Control Mode	Uint8	write	10	Analog Slave Operation.
Factor							
2	11	1/3	Analog Input	Sint16	read	0-32000	Measure of master
3	139	33/1	Slave Factor	Float	write	xx	0 – 500%
4	9	1/1	Setpoint	Uint16	read		Analog Input * Slave Factor

2.2.9 Batch dosing specific configuration settings

Generic dosing settings

Due to the potential complexity of batch dosing applications and the high amount of optimization possibilities this section is limited to generic settings regarding batch dosing.

For more detailed information and background information, please refer to the Batch Dosing information in the applicable Instruction Manuals:

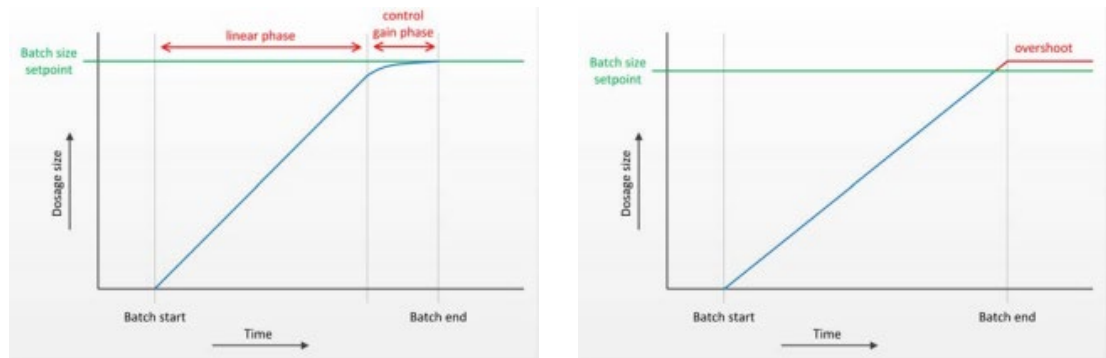
- [9.17.097](#) – Instruction Manual mini CORI-FLOW ML120, chapter 5
- [9.17.075](#) – Instruction Manual CORI-FILL

Dosing Principles (explained in more detail in referenced documents)

At the start of each batch, the flow is initiated by opening a valve (or starting a pump). The flow meter measures and totalizes the flow, continuously calculating the current batch size

(Batch size = Flow x Time. As soon as the delivered batch size reaches the configured batch size, the flow is stopped.

Depending on the importance of accuracy as opposed to dosing speed, proportional control or on/off control is advised. Proportional control using a control valve or (gear) pump is the common method if batch size accuracy is of critical importance. On/off control using a shut-off valve is typically used in situations where dosing speed is more important.



Example Proportional Control (left) and ON/OFF Control (right)

The overshoot can also occur in Proportional control mode, although it will be minimized. In both control modes the automatic self-learning function will optimize the delivered batch size until it matches the required batch size.

Estimated Dosing Time

With Proportional Control, the estimated dosing time per batch can be calculated:

$$\text{Dosing Time (seconds)} = 2 \text{ seconds} + \frac{\text{Batch Size}}{\text{Full Scale Flow Rate}}$$

With ON/OFF Control, the estimated dosing time per batch can be calculated:

$$\text{Dosing Time (seconds)} = 1 \text{ second} + \frac{\text{Batch Size}}{\text{Maximum Instrument Flow}}$$

Generic batch dosing requirements

- In order to achieve consistent batches within the specified timeframe, the liquid supply pressure needs to be constant. When the required dose cannot be achieved, it might be required to increase the supply pressure.
- Gas bubbles in the liquid can influence the batches. It is therefore strongly recommended to ensure that the system is completely filled with liquid and (if needed) to periodically bleed out any entrapped gas. Gas entering the system can be minimized by following the recommendations for a system setup in the E-book on Low Flow Handling

Configure instrument for Batch Control

Enable and configure the Counter functionality

- Write value 2 to parameter 130 – Counter Mode (mode Up to Limit – Batch)
- Write value <_> to parameter 124 – Counter Limit (Batch size)

Batch Size is defined in the Capacity Unit as configured in section 1.2.4

For optimization purposes, the measurement unit can be changed with Counter Unit using the same index values as listed in section 1.2.4

- Write value <index> to parameter 128 – Counter Unit (Measurement unit per batch)
- Write value 1 to parameter 126 – Counter Setpoint Mode (Enable new setpoint on limit)
- Write value 0 to parameter 127 – Counter New Setpoint (Setpoint 0 on batch limit)

When configuring the instrument for batch dosing, always set New setpoint on limit to 0. With any other value the media flow will not stop after reaching the configured batch size. In that case, dosing can only be stopped by disabling the counter (Counter Mode = Off) and changing the main setpoint to 0.”

- Write value <index> to parameter 157 – Reset Counter Enable (Reset counter)

The following reset methods are supported

Value 1 – Micro-Switch

Value 4 – Parameter 114 – Reset / External Input (pin 5)

Value 7 – Micro-switch / parameter 114 – Reset / External Input (pin 5)

Value 8 – Automatically

Value 16 – Analog Setpoint Input

Note on External Input (pin 5)

External input (pin5) is optional on instruments in the ES-FLOW, ML- and MI-series.

Note on Analog Setpoint Input

When the Analog Setpoint Input will be set to 0, the counter will be reset. When the setpoint will be set to a value >0, the batch counter will restart the next batch.

For connecting an external device for a Batch Reset signal, refer to the Liquid Flow Controller hook-up diagram.

Prepare a Batch counter [Batch mode]

Step	DDE	ProPar	Name	Data type	Execute	Value	Remark
1	130	104/8	Counter Mode	Uint8	write	2	Counter Mode up to limit (batch Mode)
2	124	104/3	Counter Limit	Float	write	x.xx	Batch size
3	128	104/2	Counter Unit	Uint8	write	xx	Counter Unit [for example g / kg]
4	126	104/5	Counter setpoint mode	Uint8	write	1	Enable new setpoint on batch limit
5	127	104/6	Counter New setpoint	Uint16	write	0	New setpoint when batch limit is reached
6	157	104/9	Reset Counter Enable	Uint8	write	7	Enable reset source [default 7 = all inputs]

Optimize Full Scale flow for Batch mode

The Liquid Flow Controller needs to be configured for the hourly total flow equivalent.

With a 1 gram dose in 1 second every 10 seconds, the hourly equivalent is 3600 gram.

The total amount of liquid dosed is 360 gram.

For the best performance it's advised to optimize the Full Scale Capacity according to the maximum flow rate during a batch. This will result in a minimum loss of resolution and highest possible accuracy.

For example, when execute a batch with a flow rate of 100 g/h at an Full scale capacity of 100 g/h is more accurate then at an Full Scale capacity of 1000 g/h.

To calculate the optimal Full Scale value in kg / h = $\frac{\text{Batch size [g]}}{\text{Batch duration [s]}} \times 3.6$

Changing the Full Scale value is explained in section 1.2.5 – Change the Capacity Value

When another Capacity Unit is used (section 1.2.4), then the Full Scale flow needs to be calculated accordingly.

Tune the Batch Counter Controller

The Batch Counter value is used to control the actuator to achieve the desired Batch value.

By setting Counter Controller Overrun Correction to a value between 0 and 1, the system closes the valve (or stops the pump) a fraction before reaching the batch size, minimizing overshoot.

- Write value <_> to [parameter 274 – Counter Controller Overrun Correction](#) (Overrun Correction)

Value can be defined between 0 and 1. A typical value is 0.8.

A higher value corresponds with a faster correction and less learning cycles required, but might also result in an unstable control behaviour.

A lower value corresponds with a slower correction and more learning cycles required.

The Counter Controller Gain will gradually close the valve or decrease the pump speed to ramp down the flow speed until the batch size is reached. This will result in a more accurate batch. The starting point of the ramp down is determined by the value of Counter control gain.

- Write value <_> to [parameter 275 – Counter Controller Gain](#) (Point to ramp down)

Value can be defined as listed in the below overview.

If set to 0, the Control Gain is disabled and the system operates in ON/OFF control.

Percentage delivered	Counter control gain	
0%	1	
50%	2	▲
75%	4	longer dosing time, less overshoot
80%	5	
90%	10 (default)	●
95%	20	shorter dosing time, more overshoot
98%	50	
99%	100	▼

Step	DDE	ProPar	Name	Data type	Execute	Value	Remark
1	274	104/10	Counter Controller Overrun Correction	Float	Write	0.0...1.0	Overrun correction Default = 0.8
2	275	104/11	Counter Controller Gain	Float	Write	1...100	% of Batch size [point to ramp down]

3. Prepare for operation

The main purpose of this section is to prepare the Bronkhorst Liquid Dosing Set for operation. This includes filling the controlling instrument and actuator with liquid, flushing all the air from the dosing set, and performing an instrument Auto-Zero function.

Tip !

The goal is to completely fill the instrument and actuator with liquid. This is required for a smooth start of the control loop, and for this reason it is not necessary to completely fill the downstream process lines at this time.

By opening a drain point (if installed) directly downstream of the dosing set, the filling time can be reduced and the presence of liquid can be directly observed.

Only if the fluid, method of collecting the drained liquid and process environment allows for this tip.

3.1 Fill the system

Filling the system is the first step of removing all air to ensure a stable and smooth control loop.

1. Prepare the system to be filled

- Make sure all fluid connections have been leak tested
- Make sure the system outlet is connected to the process or a suitable waste
- Open (if applicable) process valves outside the Bronkhorst set

To ease the filling process by decreasing the system pressure drop and volume to be filled

- Open (if present) a drain point between the Bronkhorst set and the process
- Close (if present) the installed bypass downstream of the pump

Note, ensure that any liquid is safely collected at the opening.

Ensure Batch Mode is disabled

- Write value 0 to parameter 130 – Counter Mode (Batch Mode disabled)

2. Slowly operate the actuator to draw in liquid

- Write value < ___ > to parameter 206 – Flow setpoint (provide setpoint to draw liquid)

Choose 10% of the normal operation flow of the system as setpoint at this step. Increase with steps of 10% to speed up the filling process.

Filling a system can take a long time depending on tube diameters and the configured flow rate of the system. By taking larger setpoint steps, the filling time can be reduced, but when the system is sensitive to pressure spikes, then take caution and use a slow but steady flowrate.

3. Wait until liquid is present in the system

Visually check if liquid is present downstream of the Liquid Dosing Set (observed in process, visible in clear tubing if used,

or

Wait 60 seconds

or

- Monitor the Actual Density reading (mini CORI – parameter 270) for readings as expected what indicates liquid is detected

4. Stop filling

- Write value 0 to parameter 206 – Flow setpoint (setpoint 0)

5. Completion of Filling step

- Check (partially) filled system for leaks
- Close any used drain points of bypass lines

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Preparation							
1	130	104/8	Counter Mode	Uint8	write	0	Counter Mode disabled (batch mode)
Start Filling							
2	206	33/3	fSetpoint	Float	write	<value>	Flow rate in Capacity Unit.
CORI-FLOW							
3	270	116/15	Actual Density	Float	read		Check if density is range of used liquid
Stop Filling							
4	206	33/3	fSetpoint	Float	write	0.0	In Capacity Unit.

3.2 Flush the system

After the system is partially filled with liquid, the system can now be flushed to remove all air out of the liquid flow control loop.

1. Operate the actuator at 100% setpoint

When a pump is used, run at full application flow (actuator 100%)

- Write value <__> to parameter 206 – Flow setpoint (full application flow)

Choose 100% of the application flow as setpoint

When a valve is used, fully open the valve (actuator 100%)

- Write value 8 to parameter 12 – Control Mode (Actuator 100%)

2. Wait until all entrapped gas is flushed out of the system

- Visually check for bubbles downstream of the Liquid Dosing Set (observed in process, visible in clear tubing if used,

or

- Monitor the Actual Density reading (mini CORI – parameter 270) until the value is in range of used liquid and stable over a time of ~ 30 seconds

or

- Monitor the Flow Rate reading (parameter 205 – fMeasure) until the value is stable over a time of ~ 30 seconds

3. Stop the pump or close the valve

When a pump is used

- Write value 0 to parameter 206 – Flow setpoint (stop flow)

When a valve is used

- Write value 3 to parameter 12 – Control Mode (Actuator 0%)

4. Optional steps for actuator – Valve with bleed connection (i.e. Bronkhorst C2 valve)

- Ensure the bleed connection or bypass are connected to a suitable container or waste line
- Ensure that liquid downstream of the dosing set is properly collected

Start bleeding the valve

- Write value 3 to parameter 12 – Control Mode (Actuator 0%)
- Open the bleed connection
- Allow the system pressure to flush out all air bubbles (observed at bleed tube outlet or visible in clear tubing if used)

Force remaining air out of the valve by opening and closing several times

- Write value 8 to parameter 12 – Control Mode (Actuator 100%)
- Write value 3 to parameter 12 – Control Mode (Actuator 0%)
- Write value 0 to parameter 12 – Control Mode (Restore to previous)
- Repeat 2 ~ 5 times
- Write value 0 to parameter 206 – Flow setpoint (end with setpoint 0)
- Allow the system pressure to flush out all air bubbles (observed at bleed tube outlet or visible in clear tubing if used)

Wrap-up

- Close the bleed connection

5. Optional step for actuator – Pump with bypass circuit

- Ensure the bleed connection or bypass are connected to a suitable container or waste line
- Ensure that liquid downstream of the dosing set is properly collected

Start bleeding the bypass circuit

- Write value < ___ > to parameter 206 – Flow setpoint (provide setpoint to fill bypass)

Choose roughly 25% of the normal operation flow of the system as setpoint at this step.

- Slowly open the bypass valve to allow flow to pass through
- Wait 10 seconds
- Write value 0 to parameter 206 – Flow setpoint (setpoint 0)

Wrap-up

- Close the bypass valve (default state)

The system is now ready to perform the bypass adjustment
See *Installation Manual – Liquid Dosing Sets (9.17.146)* for instructions

6. Completion of Flush step

- Check for leakages with complete system being filled
- Close (if applicable) process valves outside the Bronkhorst set to avoid unexpected liquid flows

Re-Enable Batch Mode if required for operation

- Write value 2 to parameter 130 – Counter Mode (Counter mode up to limit)

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	206	33/3	fSetpoint	Float	write	<value>	Flow Setpoint
1	12	1/4	Control Mode	UInt8	write	8	Actuator 100%
2	270	116/15	Actual Density	Float	read		Check for change, which indicates fluid in instrument.
3	205	33/0	fMeasure	Float	read	<measure>	Flow Rate in Capacity Unit.
4	12	1/4	Control Mode	UInt8	write	8	Actuator 100%
5	12	1/4	Control Mode	UInt8	write	3	Actuator 0%
6	270	116/15	Actual Density	Float	read		Check for change, which indicates fluid in instrument.
7	206	33/3	fSetpoint	Float	write	<value>	Flow Setpoint for bypass circuit
8	130	104/8	Counter Mode	UInt8	write	2	Counter Mode up to limit (batch Mode)

3.3 Verify system status

The system readiness for operation can be checked by monitoring the below parameters (assuming Idle condition)

Internal temperature sensor

When the internal temperature sensor provides a stable measurement value, then this is an indication of a stable liquid supply temperature, stable ambient temperatures, and a completion of the warm-up time of the instrument.

- Read [parameter 142 – Temperature](#) (Temperature in °C)

Please note that upstream temperature changes are not detected by the instrument when there is no flow. However, the instrument itself can warm up causing a rise in temperature.

Density (Coriolis sensor)

The density measurement provides an indication of any gas trapped in the liquid (bubbles) or a change in the concentration or composition of the fluid. This measurement is affected by temperature changes.

- Read [parameter 270 – Actual Density](#) (Density in kg/m³)

Example H₂O at room temperature 1001.91943359375 kg/m³

Zero stability

Process or application specific conditions can influence the zero stability. Factors include ambient temperatures, gas dissolved in the fluid, or switching fluids.

- Read [parameter 8 – Measure](#) (Measure 0 – 32000)

Value 0 corresponds with 0% of the Capacity Value (Full Scale)

Value 32000 corresponds with 100% of the Capacity Value (Full Scale)

or

- Read [parameter 205 – fMeasure](#) (Measure flow)

Value is measurement value in selected Capacity Unit

Please note that small pressure changes up- or downstream can create a flow through the sensor and can therefore cause an unstable zero-stability (flow measured when no flow should be present). For calibrating an accurate zero stability it is crucial to prevent this type of flow by installing shut-off valves.

A pump does not function as a closed valve when the setpoint is 0.

In the next section, the process to execute an Auto-Zero function is described.

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	142	33/7	Temperature	Float	read	<temperature>	In degrees Celcius
2	270	116/15	Actual Density	Float	read		Measured density [kg/m3]
3	8	1/0	Measure	Uint16	read	<measure>	0-32000 = 0-100%
4	205	33/0	fMeasure	Float	read	<measure>	In Capacity Unit.

3.4 Zero procedure

Preconditions

- The system is filled with fluid
- The Liquid Flow Controller has been powered on for > 30 minutes
- The ambient conditions match the operating environment of the instrument

1. Ensure zero flow through the instrument
(**note**, a pump system does not have a shut-off function and undesired flow can occur due to upstream or downstream pressure variations)

- Write value 0 to parameter 9 – Setpoint (setpoint 0)
- Close shut-off valves upstream and downstream of the instrument



2. Execute zeroing procedure

- Write value 64 to parameter 7 – Init Reset (unlock secured parameters)
- Write value 9 to parameter 12 – Control Mode (enable calibration mode)
- Write value 0 to parameter 58 – Calibration Mode (reset calibration mode)
- Write value 9 to parameter 58 – Calibration Mode (start zeroing)

3. Complete zeroing procedure

- Wait until the Green LED changes from fast blinking to solid (approx. 30 seconds)
- Parameter 12 – Control Mode returns automatically to its initial value
- Parameter 58 – Calibration Mode changes to 0 (idle) when procedure is successful
- Parameter 58 – Calibration Mode changes to 255 when the procedure has failed
-> troubleshooting procedure

4. Finalize zeroing procedure

- Write value 82 to parameter 7 – Init Reset (lock secured parameters)
- Open shut-off valves upstream and downstream of the instrument to resume operation

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Unlock Secured Parameters							
1	7	0/10	Init Reset	UInt8	write	64	Unlock secured parameters
Factor							
2	12	1/4	Control Mode	UInt8	Write	9	Calibration Mode
3	58	115/1	Calibration Mode	UInt8	Write	0	Reset Calibration Mode
4	58	115/1	Calibration Mode	UInt8	Write	9	Auto Zero Mode
5	58	115/1	Calibration Mode	UInt8	Read	0 - 255	0 = Auto Zero Ok 255 = Auto Zero Error
Lock Secured Parameters							
6	7	0/10	Init Reset	UInt8	write	82	Lock secured parameters

4. Operate the Liquid Dosing Set

4.1 Start dosing

Check hardware

- Ensure all valves in the system are set correctly for operation

4.1.1 Continuous Dosing

Provide flow setpoint to controller

- Write value 0 to parameter 12 – Control Mode (Setpoint RS232 / BUS)

This configures the instrument to receive a setpoint via the communication interface (RS232 or Fieldbus). The Field bus will overrule any changes made via RS232.

or

- Write value <___> to parameter 206 – Flow Setpoint (Setpoint)

Value to be defined in the previously selected capacity unit (kg/h, gr/h, L/min, etc..)

or

- Write value <___> to parameter 9 – Setpoint (Setpoint)

Value based on flow percentage of Full Scale flow

Value 0 = 0%

Value 32000 = 100%

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Start Dosing							
1	12	1/4	Control Mode	UInt8	Write	0	Digital setpoint (bus)
1	206	33/3	fSetpoint	Float	write	<value>	In Capacity Unit.
1	9	1/1	Setpoint	UInt16	write	<value>	0-32000 = 0-100%

4.1.2 Ratio Dosing

Refer to section 1.2.8 on how to determine the input setting (Slave Factor)

Write determined factor

(setpoint internally calculated based on external input signal and factor)

- Write value <_> to parameter 139 – Slave Factor (0 – 100%)

Read instrument internal calculated setpoint

- Read parameter 9 – Setpoint (Measure 0 – 32000)

Step	DDE	ProPar	Name	Execute	Value	Remark
Ratio Dosing						
1	139	33/1	Slave Factor	write	0...500	0-500%
2	9	1/1	Setpoint	read		Analog Input * Slave Factor

4.1.3 Batch Dosing

Ensure Batch Mode is enabled.

- Write value 2 to parameter 130 – Counter Mode (mode Up to Limit – Batch)

Ensure no liquid flow

- Write value 0 to parameter 206 – Flow Setpoint (Setpoint)

or

- Write value 0 to parameter 9 – Setpoint (Setpoint)

Reset Batch Counter to ensure no conflict occurs

- Write value 3 to parameter 114 – Reset (Reset counter)

Define Batch size

- Write value <_> to parameter 124 – Counter Limit (Batch size)

Start liquid flow

- Write value <__> to parameter 206 – Flow Setpoint (Setpoint)

or

- Write value <__> to parameter 9 – Setpoint (Setpoint)

Liquid will start flowing until the batch size is reached.

A higher setpoint value can increase the speed of the dose.

Reset Batch Counter to start next batch

- Write value 3 to [parameter 114 – Reset](#) (Reset counter)

Step	DDE	ProPar	Name	Data type	Execute	Value	Remark
1	130	104/8	Counter Mode	Uint8	write	2	Counter up to limit [batch mode]
2	9 or 205	1/1 33/3	Setpoint Fsetpoint	Uint16 Float	write	x x.x	Flow Setpoint integer 0-32000 Flow Setpoint Real value x.xx
3	114	115/8	Reset	Uint8	write	3	Reset counter & Start batch

4.2 Pause dosing

Pause dosing

- Write value 3 to [parameter 12 – Control Mode](#) (Actuator 0%)

Resume dosing

- Write value 0 to [parameter 12 – Control Mode](#) (Restore to previous)

In case of Batch Dosing, no action is required to Pause the dosing

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Pause Dosing							
1	12	1/4	Control Mode	Uint8	Write	3	Actuator 0%
Resume Dosing							
2	12	1/4	Control Mode	Uint8	Write	0	Digital setpoint (bus)

4.3 Stop dosing

Stop controller

- Write value 0 to [parameter 206 – Flow Setpoint](#) (Setpoint)
- or
- Write value 0 to [parameter 9 – Setpoint](#) (Setpoint)

Extra step for Batch Dosing

- Write value 0 to [parameter 130 – Counter Mode](#) (Counte Mode OFF)

Check hardware

- Ensure all valves in the system are set correctly to prevent unwanted flow

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
Stop Dosing							
1	206	33/3	fSetpoint	UInt8	write	0.0	In Capacity Unit.
1	9	1/1	Setpoint	Float	write	0	0-32000 = 0-100%
2	130	104/8	Counter Mode	UInt8	write	0	Counter Mode = OFF [Batch mode = OFF]

4.4 Read parameters

Parameters to be read from the instrument for monitoring or logging purposes.

General

- Read value [parameter 129 – Capacity Unit](#) (Measurement unit, index value)
- Read value [parameter 28 – Alarm Info](#) (Instrument alarm information)

Value	Type	Description
1	Error	Error flag raised
2	Warning	Warning flag raised
4	Minimum alarm	<i>Measure < Alarm minimum limit</i>
8	Maximum alarm	<i>Measure > Alarm maximum limit</i>
16	Batch counter alarm	Batch counter reached its limit
32	<ul style="list-style-type: none"> • This bit only: Power-up alarm • If combined with bit 2 or 3: Response alarm 	Alarm possibly caused by a power dip Difference between <i>Measure</i> and <i>Setpoint</i> too big
64	Master/slave alarm	Setpoint out of limits (caused by <i>Slave factor</i>)
128	Hardware alarm	Hardware error

Setpoint

- Read value [parameter 206 – Flow Setpoint](#) (Setpoint in unit)
- or
- Read value [parameter 9 – Setpoint](#) (Setpoint 0 - 32000)

Flow

- Read [parameter 205 – Flow Measure](#) (Measure in unit)
- or
- Read [parameter 8 – Measure](#) (Measure 0 – 32000)

Temperature

- Read [parameter 142 – Temperature](#) (Temperature in °C)

Actuator out

- Read [parameter 55 – Actuator Out](#) (Actuator in %)

Density (Coriolis)

- Read [parameter 270 – Actual Density](#) (Density in kg/m³)

External Master Flow (ratio dosing)

- Read [parameter 11 – Analog Input](#) (analog input of slave = measure of master)

Parameter is without flow unit and is depending on the configuration of the input signal. Commonly used is Signal 4 – 20 mA = Value 0 – 32000 = Flow 0 – 100%

Counter information (batch dosing)

- Read [parameter 122 – Counter Value](#) (Counter during dose)
- Read [parameter 128 – Counter Unit](#) (Flow measurement unit)
- Read [parameter 28 – Alarm Info](#) (Value 16, Counter Limit Batch size reached)

Read a Batch status

Step	DDE	ProPar	Name	Data type	Execute	Value	Remark
1	205	33/0	fMeasure	Float	read	<measure>	Flow Rate in Capacity Unit.
1	8	1/0	Measure	Uint16	read	<measure>	0-32000 = 0-100%
2	129	1/31	Capacity Unit	String	read	xxx	Flow rate Capacity unit [example g/h]
3	122	104/1	Counter Value	Float	write	x.xx	Actual Counter value [Batch value]
4	128	104/2	Counter Unit	Uint8	read	xxx	Counter Unit [example g/ kg]
5	28	1/20	Alarm Info [bit4]	Uint8	read	16 [1]	Counter limit [batch] finished

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	206	33/3	fSetpoint	Float	read	< setpoint>	In Capacity Unit.
1	9	1/1	Setpoint	Uint16	read	<setpoint>	0-32000 = 0-100%
2	205	33/0	fMeasure	Float	read	<measure>	In Capacity Unit.
2	8	1/0	Measure	Uint16	read	<measure>	0-32000 = 0-100%
3	142	33/7	Temperature	Float	read	<temperature>	In degrees Celcius
4	55	114/1	Actuator Output	Uint32	read	<actuator>	0-100% = 0-16777215
5	270	116/15	Actual Density	Float	read	<density>	Measured density for the fluid [kg/m3]
6	11	1/3	Analog Input	Sint16	read	<input>	0-100% = 0-32000.
7	114	115/8	Reset	Uint8	write	1	Reset counter value
8	122	104/1	Counter	Float	read	<counter>	Actual counter value

5. Optimize control settings

Instruments have been configured and optimized in the factory based on standard testing conditions. Depending on the actual process conditions such as pressure, temperature and fluid properties, an adjustment can improve the control response.

Disclaimer

Changing the control characteristics can have a negative effect on the behaviour of the Liquid Dosing Set. It is strongly advised to:

- Log or store the default control settings
- Ensure process variations are minimized or eliminated
- Make changes with small increments
- Request support from a trained Bronkhorst service engineer

Please refer to the specific Liquid Flow Controller manual for more details and instructions.

5.1 Changing Filter Settings

Controller speed can be increased by changing or disabling output and sensor filters. Disabling filters, however, not only makes the instrument faster, it also makes it more sensitive to vibrations and electrical noise.

- Write value <_> to [parameter 56 – Dynamic Display Factor](#) (change filter)

Value 1.0E-3 default response time
Value 3.00E-3 fast response time
Value 1.0 filter OFF

- Write value <_> to [parameter 57 – Static Display Factor](#) (change filter)

Value 1.0E-2 default response time
Value 2.0E-2 fast response time
Value 1.0 filter OFF

- Write value <_> to [parameter 74 – Sensor Exponential Smoothing Filter](#) (change filter)

Value 0.05 slow response time
Value 0.1 default response time
Value 0.2 increased response time
Value 1.0 filter OFF

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	56	117/1	Dynamic Display Factor	Float	Write	1	Disable filter
2	57	117/2	Static Display Factor	Float	Write	1	Disable filter
3	74	117/4	Sensor Exponential Smoothing Filter	Float	Write	1	Disable filter

5.2 Actuator Control Speed

- Write value <_> to parameter 254 – Controller Speed (Controller speed)

Default value 1

Step	DDE	ProPar	Name	Data type	Execute	Value	Remark
1	254	114/30	Controller Speed	Float	write	0...10	Actuator controller speed [default=1]

5.3 Adjust Proportional and Integral value (Kp and Ti)

Adjust Kp

- Write value <_> to parameter 167 – PID-Kp (proportional action)

Default value 10

Increase to speed up, decrease to slow down the controller

Adjust Ti

- Write value <_> to parameter 168 – PID-Ti (integral action)

Typical values

Value 0.05 for lower accuracy but increased speed

Value 0.10 for balance between accuracy and speed (default)

Value 0.15 for higher accuracy but decreased speed

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	167	114/21	PID-Kp	Float	Write	X	Default value 10 Increase to speed up, decrease to slow down the controller
2	168	114/22	PID-Ti	Float	Write	X	Typical values Value 0.05 for lower accuracy but increased speed Value 0.10 for balance between accuracy and speed (default) Value 0.15 for higher accuracy but decreased speed

Note on controller Derivative action (Td)

This setting is default not used and therefore set to value 0.

In Bronkhorst flow setups it can be useful if the volume between the sensor and valve is relatively large (e.g. when the sensor and actuator are mounted away from each other).

5.4 Correct for actuator delay

A control valve (or pump) needs a minimum electrical current (threshold) to open (or start running). Normally, when opening the valve, the current is increased gradually, until the threshold is reached and the valve opens. The time to reach the threshold (dead time) can be minimized, by specifying a starting power/current, just under the threshold. This shortens the valve response time, because the starting power is immediately applied when the valve is opened (instead of gradually).

- Write value <_> to parameter 190 – Valve Open (set opening power)

Value as required. An automated script can be performed in FlowPlot to automatically determine an optimum setpoint.

Note, in the firmware is referred to the parameter as 'Valve Open', but when a pump is used, this parameter can be considered as the threshold to enable or start the Actuator.

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	190	114/24	Valve Open	Float	Write	X	Minimum power (Amps) to stay open shut-off

5.5 Setpoint Slope

Setpoint slope can be used to smooth 'nervous' behavior of the PID controller (reduce setpoint overshoot or undershoot), but with proportional batch dosing, this might lengthen the dosing time unacceptably. The recommended value for Setpoint slope is 0.

- Write value <_> to parameter 10 – Setpoint Slope (smoothen PID behaviour)

Adjustment time when changing setpoint from 0% - 100%.

The value can be set from 0 – 30000, where value 100 will result in a time of 10 seconds.

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	10	1/2	Setpoint Slope	Uint16	Write	X	0 – 30000, where value 100 will result in a time of 10 seconds.

5.6 Batch Dosing specific control optimization

In addition to the previously listed parameters, for Batch Dosing applications the below listed optimizations can provide extra benefit to the behaviour of the Liquid Dosing Set.

5.6.1 Minimize ON/OFF Valve temperature

When working with fluids with a low boiling/evaporation point, it can be useful to limit the power dissipation by a shut-off valve, in order to minimize the temperature rise caused by valve actuation. A shut-off valve needs a stronger signal to open it than to keep it open (hold signal). Once it is open, the signal can safely be set to a lower point, reducing powerdissipation by the valve coil (thereby minimizing temperature rise).

- Write value <_> to parameter 231 – Valve Maximum (set minimum power for opening)

Value depending on the specifics of the actuator.

- Write value <_> to parameter 190 – Valve Open (minimum power to keep open)

Value depending on the specifics of the actuator.

Step	DDE	ProPar	Name	Data Type	Execute	Value	Remark
1	231	114/25	Valve Maximum	Float	Write	X	Minimum power (Amps) to open shut-off
1	190	114/24	Valve Open	Float	Write	X	Minimum power (Amps) to stay open shut-off

5.6.2 Tune the Batch Counter Controller

The Batch Counter Controller parameters, Overrun Correction and Counter Control Gain as defined in section 1.2.9 can be further optimized when required.

5.6.3 General guide for batch dosing optimization based on observation

Based on the [summary table](#) as listed in the Instruction Manual mini CORI-FLOW ML120, 9.17.097, paragraph 5.4.

For functioning links to specific parameters, please use the link to the Instruction Manual.

Problem	Possible cause	Action
Batch size overshoot not reduced after more than 3 batches	Dosing time too short	<ul style="list-style-type: none"> Decrease inlet pressure Decrease maximum capacity*
	Counter control gain too high	Decrease counter control gain *
Dosing time too long	Flow rate too low	<ul style="list-style-type: none"> Increase inlet pressure Increase maximum capacity*
	Counter control gain too low	Increase counter control gain *
	Controller too slow	Optimize PID controller *
	Pump speed adjustment too slow	Increase controller speed (when using a pump, controller speed values up to 10 can be used)
New batch cannot be started	New batch trigger(s) not defined	Enable new batch trigger(s) (see Batch settings)
Flow continues after configured batch size is reached	<i>New setpoint on limit > 0%</i>	Set <i>New setpoint on limit</i> to 0% (see Batch settings)
Counter value still changes after limit is reached	Measuring signal disturbed by electrical noise	Increase minimum capacity (see Disabling filters)
	Zero point drifted	Adjust zero point (see Zeroing)
	Gas inclusion in tubing	Flush instrument and tubing at relatively high flow rate before starting batch control
	Leakage	Check system for leaks
	<i>New setpoint on limit > 0%</i>	Set <i>New setpoint on limit</i> to 0% (see Batch settings)
Flow signal too slow	Output filters enabled	Disable filters (see Disabling filters)
<ul style="list-style-type: none"> Delivered batch size inaccurate and/or unstable Delivered batch size does not match counter limit 	Vibrations in instrument surroundings	<ul style="list-style-type: none"> Avoid mounting in close proximity of mechanical vibrations Follow mounting instructions
	Zero point drifted	Adjust zero point (see Zeroing)
	Gas inclusion in liquid	Install degasser
	Inlet pressure unstable	Eliminate pressure fluctuations, e.g. by installing a pressure regulator
	Filter settings not optimized	Disable filters (see Disabling filters)
	Proportional dosing too fast	Decrease counter control gain (see Proportional control settings)*
	Controller settings not optimized	Set overrun correction to 0.8 (see Overrun correction)
Flow signal > 130%	Inlet pressure too high	Decrease inlet pressure
	Liquid tubing resistance too low	Restrict flow e.g. with needle valve or by using tubing with smaller diameter
	Full scale capacity too low	Rescale controllable flow range (see Proportional control settings)*
	Controller settings not optimized	Decrease PID-Kp value (see Proportional control settings)*

6. Parameters

DDE	ProPar	Name	Data Type	Range	Remark
7	0/10	Init Reset	UInt8	64 or 82	Lock secured parameters
8	1/0	Measure	UInt16	0...32000	0-32000 = 0-100%
9	1/1	Setpoint	UInt16	0...32000	0-32000 = 0-100%
205	33/0	fMeasure	Float		In Capacity Unit.
206	33/3	fSetpoint	Float		In Capacity Unit.
11	1/3	Analog Input	Sint16	-32767...32767	0-100% = 0-32000.
12	1/4	Control Mode	UInt8	0...255	Digital setpoint (bus)
139	33/1	Slave Factor	Float	0...500	0 – 500%
21	1/13	Capacity	Float	Cap Min...Cap Max	Capacity in Capacity Unit
23	1/15	Capacity Unit Index	UInt8	0...255	Unit index (See table in 1.2.4)
129	1/31	Capacity Unit	String		Flow rate Capacity unit [example g/h]
28	1/20	Alarm Info	UInt8	0...255	Counter limit [batch] finished
270	116/15	Actual Density	Float		Measured density for the fluid [kg/m ³]
55	114/1	Actuator Output	UInt32	0...16777215	0-100% = 0-16777215
56	117/1	Dynamic Display Factor	Float	0.0...1.0	Disables filter
57	117/2	Static Display Factor	Float	0.0...1.0	Disables filter
58	115/1	Calibration Mode	UInt8	0...255	0 = Auto Zero Ok 255 = Auto Zero Error
74	117/4	Sensor Exponential Smoothing Filter	Float	0.0...1.0	Disables filter
114	115/8	Reset	UInt8	0...255	Reset counter value
116	97/1	Alarm Maximum Limit	UInt16	0...32000	Limit 0-32000 = 0-100%
117	97/2	Alarm Minimum Limit	UInt16	0...32000	Limit 0-32000 = 0-100%
118	97/3	Alarm Mode	UInt8	0...3	Response Alarm
120	97/5	Alarm Setpoint Mode	UInt8	0...1	Setpoint change on alarm.
121	97/6	Alarm New Setpoint	UInt16	0...32000	Setpoint to activate on alarm.
182	97/7	Alarm Delay	UInt8	0...255	Delay in seconds.
122	104/1	Counter Value	Float	0.0...9999999.99	Actual Counter value [Batch value]
124	104/3	Counter Limit	Float	0.0...9999999.99	Batch size
126	104/5	Counter setpoint mode	UInt8	0...1	Enable new setpoint on batch limit
127	104/6	Counter New setpoint	UInt16	0...32000	New setpoint when batch limit is reached
123	104/2	Counter Unit	UInt8	0...255	Counter Unit [for example g / kg] as index
128	104/7	Counter Unit Name	String		Counter Unit String [example g/ kg]
130	104/8	Counter Mode	UInt8	0..2	Counter Mode
274	104/10	Counter Controller Overrun Correction	Float	0...1	Overrun correction

275	104/11	Counter Controller Gain	Float	1...100	% of Batch size [point to ramp down]
142	33/7	Temperature	Float		In degrees Celcius
157	104/9	Reset Counter Enable	Uint8	0...15	Enable reset source
254	114/30	Controller Speed	Float	0...10	Actuator controller speed [default=1]
167	114/21	PID-Kp	Float		Default value 10 Increase to speed up, decrease to slow down the controller
168	114/22	PID-Ti	Float		Typical values Value 0.05 for lower accuracy but increased speed Value 0.10 for balance between accuracy and speed (default) Value 0.15 for higher accuracy but decreased speed
190	114/24	Valve Open	Float	0...0.3 or 0...15	In amps or volts depending on valve mode (0.3A or 15V max).
231	114/25	Valve Maximum	Float	0...0.3 or 0...15	In amps or volts depending on valve mode (0.3A or 15V max).

End