Instruction manual

2 Channel
Ratio Controller

Doc. no.: 9.17.070A Date: 15-06-2012

ATTENTION
Please read this instruction manual carefully before installing and operating the instrument.
Not following the guidelines could result in personal injury and/or damage to the equipment.

Bronkhorst®

Disclaimer

The information in this manual has been reviewed and is believed to be wholly reliable. No responsibility, however, is assumed for inaccuracies. The material in this manual is for information purposes only, and is subject to change without notice.

Bronkhorst High-Tech B.V.
December 2011

Symbols

Important information. Discarding this information could cause injuries to people or damage to the Instrument or installation.

Helpful information. This information will facilitate the use of this instrument.

Additional info available on the internet or from your local sales representative.

Warranty

Bronkhorst products are warranted against defects in material and workmanship for a period of three years from the date of shipment provided they are used in accordance with the ordering specifications and not subjected to abuse or physical damage. Products that do not operate properly during this period may be repaired or replaced at no charge. Repairs are normally warranted for one year or the balance of the original warranty, whichever is the longer.

See also paragraph 9 of the Conditions of sales:
http://www.bronkhorst.com/files/corporate_headquarters/sales_conditions/en_general_terms_of_sales.pdf

The warranty includes all initial and latent defects, random failures, and undeterminable internal causes.

It excludes failures and damage caused by the customer, such as contamination, improper electrical hook-up, physical shock etc.

Re-conditioning of products primarily returned for warranty service that is partly or wholly judged non-warranty may be charged for.

Bronkhorst High-Tech B.V. or affiliated company prepays outgoing freight charges when any party of the service is performed under warranty, unless otherwise agreed upon beforehand, however, if the product has been returned collect to our factory or service center, these costs are added to the repair invoice. Import and/or export charges, foreign shipping methods/carriers are paid for by the customer.

Table of contents

1 SHORT FORM START-UP

Read document “9.17.063 Manual EtherCAT slave interface” for additional information.

Step 1: Setup communication (Op mode).

Both controllers automatically start up in safe state control mode 0x8C.

Step 2: Read opject “UserTag” (0x2071:07) to check which controller is the “CHANNEL_1” and which is the “CHANNEL_2”

Step 3: Write value to object “SlaveFactor” (0x2021:02) of the “CHANNEL_1”

Step 4: Write 0x8A (analog slave) to object “CO Controller Mode” (0x6423:01) of the “CHANNEL_1”

Step 5: Write 0x84 (idle) to object “CO Controller Mode” (0x6423:01) of the “CHANNEL_2”.

Now the ratio control is running.

While the ratio control is running, you can:

Change SlaveFactor (0x2021:02) of the “CHANNEL_1”

Check the flows trough both controllers by reading opject “CO Effective current value Xeff” (0x6400:01)

Stop ratio control by setting the “CO Controller Mode” (0x6423:01) of both controllers to 0x8C (safe state)

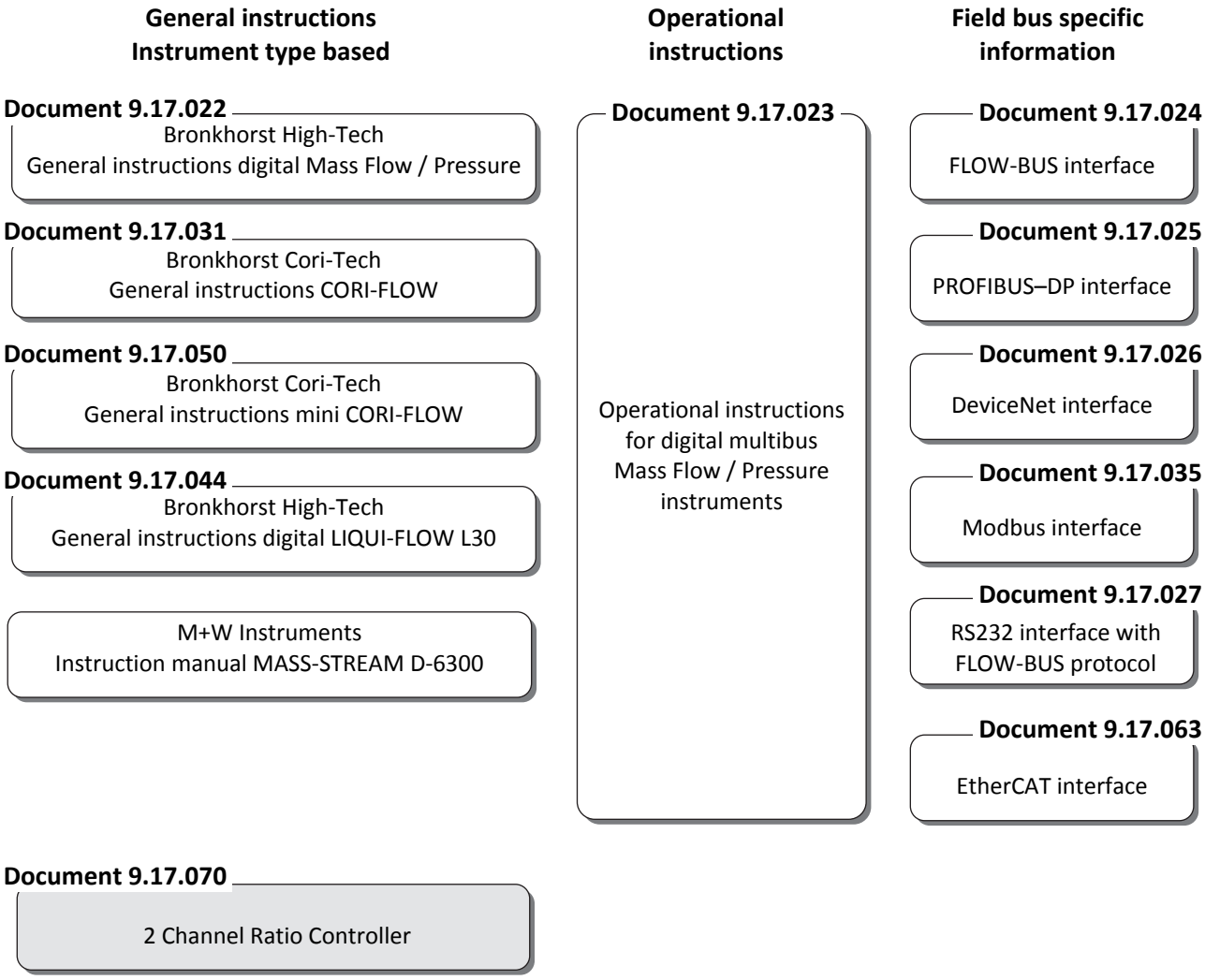
When communication is lost, both controllers return into the safe state controller mode 0x8C.
If the flow of “CHANNEL_1” result in a flow <1.5%, the valve of this channel wil be closed.

2 GENERAL INFORMATION

2.1 REFERENCES TO OTHER APPLICABLE DOCUMENTS

Manuals and guides for digital instruments are modular. General instructions give information about the functioning and installation of instruments. Operational instructions explain the use of the digital instruments features and parameters. Field bus specific information explains the installation and use of the field bus installed on the instrument.

2.2 MANUALS AND USER GUIDES:



2.3 TECHNICAL DRAWINGS:

Hook-up diagram laboratory-style Ratio Controller (document nr. 9.16.100)

2.4 SOFTWARE TOOLING:

Flowfix
FlowDDE

All these documents can be found at:
http://www.bronkhorst.com/en/downloads

3 RATIO CONTROL

The ratio control is achieved using two standard Bronkhorst EtherCAT mass-flow controllers with a special configuration. One of these controllers handles the actual ratio control and is labeled as “CHANNEL_1” the other one has no controller functionality and is labeled as “CHANNEL_2”.
At power-up, both controllers are automatically set in the safe-state controller mode in which both valves are closed. To start ratio control, the controller mode of “CHANNEL_1” should be set to 0x8A and the controler mode of “CHANNEL_2” should be set to 0x84. (See par. **Error! Reference source not found.**, Short Form Start-Up).

The relation between the ratio, the input flow and the output flows is shown in Figure 1 below:

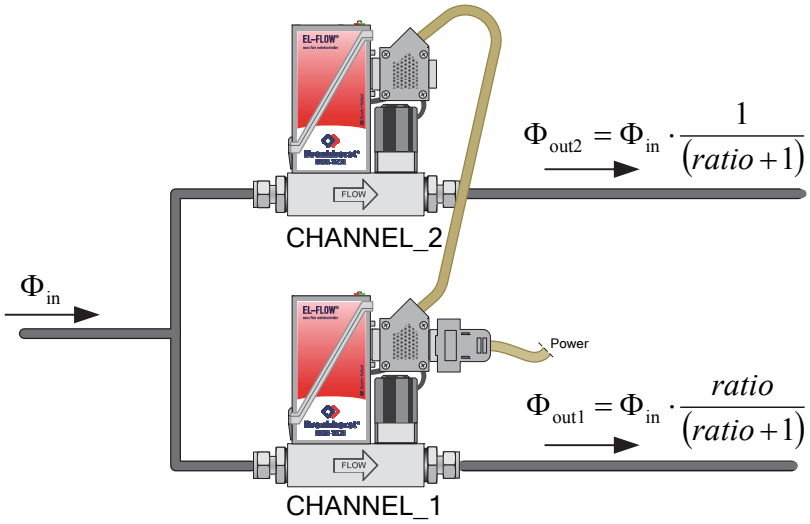


Figure 1: Ratio Control Configuration

3.1 OBJECTS INVOLVED

The next table contains the objects which are involved in the configuration of the ratio controller. An overview of all objects can be found in the manual: *“9.17.063 – manual EtherCAT slave interface”.* Detailed information of the mapped parameters: *“9.17.023 Operational instructions for digital multibus Mass Flow / Pressure instruments”*

Index	Sub Index	Description	Data Type	Access	PDO mapping
0x2021	02	*Slave Factor	Float	RW	Possible
0x2071	07	*User tag	String	RW	No
0x6400	01	CO Effective current value Xeff	Float	RO	Possible
0x6423	01	CO Controller Mode	Unsigned8	RW	Possible

*) Avialable via Generated Object Dictionary

3.2 SLAVE FACTOR (0X2021:02)

This object is mapped to the slave factor parameter. With this parameter the ratio between “CHANNEL_1” and “CHANNEL_2” can be set. The range of this parameter: 0 .. 500, unit: %

Ratio = Slave Factor/100

CHANNEL1_flow = INPUT_flow * Ratio / (Ratio + 1)
CHANNEL2_flow = INPUT_flow / (Ratio+1)

Or

CHANNEL1_flow = CHANNEL2_flow * Ratio

3.3 USER TAG (0X2071:07)

This object is mapped to the User tag parameter. This parameter can be used to label the controller. For this configuration the label indicates the function of the controller: “CHANNEL_1” or “CHANNEL_2”. Changing this label will not affect the function of the controller.

3.4 CO EFFECTIVE CURRENT VALUE XEFF (0X6400:01)

This object is mapped to the fMeasure parameter. It indicates the actual flow true the controller.

3.5 CO CONTROLLER MODE (0X6423:01)

This object is mapped to the Control Mode parameter. At power-up, reset and configuration mode this parameter is automatically set to the fail-safe mode 0x8C. To start ratio control in “Op” mode, the parameter should be set for both controllers :

Control Mode values		
	Value	
state	**“CHANNEL_1”**	**“CHANNEL_2”**
Safe state	0x8C	0x8C
Ratio control	0x8A (analog slave)	0x84 (idle)

4 EXAMPLES

4.1 EXAMPLE 1, SLAVEFACTOR = 100

Ratio = 100/100 = 1.0

CHANNEL1_flow = INPUT_flow * 1/(1+1) = INPUT_flow * 0.5
CHANNEL2_flow = INPUT_flow / (1+1) = INPUT_flow * 0.5

Or

CHANNEL1_flow = 1.0 * *CHANNEL2_flow*

Both flows are equal.

4.2 EXAMPLE 2, SLAVE FACTOR = 50

Ratio = 50/100 = 0.5

CHANNEL1_flow = INPUT_flow * 0.5/(0.5+1) = INPUT_flow * 0.333
CHANNEL2_flow = INPUT_flow / (0.5+1) = INPUT_flow * 0.667

Or

CHANNEL_1FLOW = 0.5 * CHANNEL2_flow

The flow through the “CHANNEL_2” controller is twice the flow through the “CHANNEL_1” controller.

4.3 EXAMPLE 3, SLAVEFACTOR = 300

Ratio = 300/100 = 3.0
CHANNEL1_flow = INPUT_flow * 3/(3+1) = INPUT_flow * 0.75
CHANNEL2_flow = INPUT_flow / (3+1) = INPUT_flow * 0.25

Or

CHANNEL1_flow = 3.0 * CHANNEL2_flow

The flow through the “CHANNEL_1” controller is three times the flow through the “CHANNEL_2” controller.