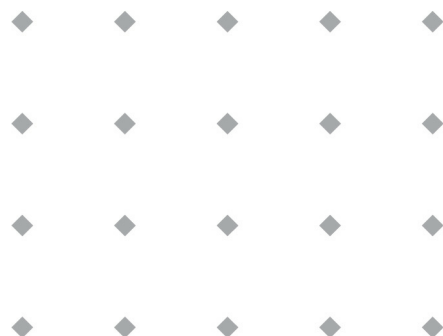




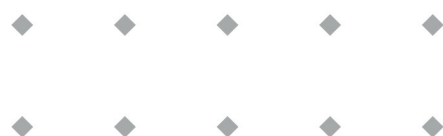
HART® Field Device Specification for Digital Bronkhorst® Instruments

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ATTENTION

**Please read this document carefully before installing and operating the equipment it concerns.
Not following the guidelines could result in personal injury and/or damage to the equipment.**



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Symbols in this document



Important information. Disregarding this information could increase the risk of damage to equipment, or the risk of personal injuries.



Helpful information.



Additional information available on the internet or from your Bronkhorst representative.

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1 Introduction

1.1 Scope

The Bronkhorst® Flow Devices , version 1.0 complies with HART® Protocol Revision 7.6. This document specifies all device specific features and documents HART® Protocol implementation details.

The functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in HART® capable Host Applications.

1.2 Purpose

This specification is designed to complement other documentation by providing a complete, unambiguous description of this Field Device from a HART® Communication perspective.

1.3 Who should use this document?

This specification is designed to be a technical reference for HART® capable Host Application Developers, System Integrators and knowledgeable End Users. It also provides functional specifications used during Field Device development, maintenance and testing. This document assumes the reader is familiar with HART® Protocol requirements and terminology.

2 Device identification

Manufacturer Name	Bronkhorst High-Tech B.V.
Manufacturer ID Code	214 (0xD6 Hex)
Model Name	Mass Flow Controller
Device Type Code	72 (0x48 Hex)
Device Revision	1
HART Protocol Revision	7.6
Number of Device Variables	6
Physical Layers Supported	FSK
Physical Device Category	Transmitter, Non-DC-isolated BUS Device

3 Product overview

Bronkhorst offers an extensive product range of thermal, Coriolis and ultrasonic flow meters and controllers for low flow rates of gases and liquids. Our flow instruments are used for a variety of applications in laboratory, machinery, industrial and hazardous areas. By sharing our knowledge and closely cooperating with OEM customers in the field we develop customer specific low flow solutions, e.g. of multifunctional, pretested modules or skids for gas, liquid or vapor flow control.



For more information please visit our website: **www.bronkhorst.com**

4 Product interfaces

4.1 Process interface

4.1.1 Sensor input channels

The [primary variable](#) is the measured value of the sensor. The sensor is housed inside the device and has no external connections. The measured value can be read through various (optional) digital communication channels (i.e. RS232/ RS485, DeviceNet™, PROFINET, EtherCAT®) and via the analog output channel on the main connector of the device.



For more information please refer to the applicable manuals and hookup-diagrams.

4.2 Host interface

4.2.1 Analog input 1: Flow

The two-wire 4 to 20 mA current loop is connected on two terminals marked M3 and M4. This is the only analog output from this device, representing the process flow linearized and scaled according to the configured range of the instrument. This output corresponds to the [primary variable](#).

Detection of Device malfunction is not supported.



For more information please refer to the applicable manuals and hookup-diagrams.

	Direction	Values (% of range)	Values (mA or V)
Linear over-range	Down	0.0 % ± 0.1 %	3.99 to 4.00 mA
	Up	+100 % ± 0.1 %	19.98 to 20.02 mA
Device malfunction indication	Down: less than	Not supported	
	Up: greater than	Not supported	
Maximum current		115 %	23 mA
Multi-drop Current draw			4.0 mA
Lift-off voltage			13.5 V

4.3 Local interfaces, jumpers and switches

4.3.1 Local controls and displays

This device has no external local controls or displays.

4.3.2 Internal jumpers and switches

A multifunctional push button is located inside the instrument, near the connection terminals.



Refer to the specific instrument manual for more information.

5 Device variables

5.1 Device variable 0 - Flow rate

The flow rate is derived from the flow sensor signal inside the device. The flow rate is read in actual units and ranges from zero to the selected capacity.

Device variable			
Number	0	Name	Flow rate
Classification	72	Unit Codes	see Tables - Mass flow units see Tables - Volumetric flow units

5.2 Device variable 1 - Temperature

This variable represents the temperature of the sensor as measured by the device.

Device variable			
Number	1	Name	Temperature
Classification	64	Unit Codes	see Tables - Temperature units

5.3 Device variable 2 - Density

This variable represents the density of the fluid inside the device. It is calculated using several sensor parameters.

Device variable			
Number	2	Name	Density
Classification	73	Unit Codes	see Tables - Mass per volume units

5.4 Device variable 3 - Setpoint

The setpoint is the desired flow rate. The setpoint can be read and written in actual units. The value ranges from zero to the selected capacity.

Device variable			
Number	3	Name	Setpoint
Classification	72	Unit Codes	see Tables - Mass flow units see Tables - Volumetric flow units

5.5 Device variable 4 - Alarm info

This parameter provides information about the event type(s) that activated an alarm situation. Up to 8 different event types can be specified. The value is a bit-wise summation of the specified event types; convert the value to binary to see which types are specified.

Device variable			
Number	4	Name	Alarm info
Classification	none	Unit Codes	see Tables - Alarm types

6 Dynamic variables

The available dynamic variables have a fixed mapping to the device variables:

Dynamic variable	Device variable number	Name
Primary variable (PV)	0 / 246	Flow rate
Secondary variable (SV)	1 / 247	Temperature
Tertiary variable (TV)	2 / 248	Density
Quaternary variable (QV)	3 / 249	Flow setpoint

7 Status information

7.1 Field device status

The Field Device Status byte communicates the following status information to the host system:

Bit	Description	Specification
7		
6		
5		
4		
3		
2		
1		
0	Primary Variable out of limits - indicates if the primary variable is within or beyond its operating limits	0: PV within limits 1: PV outside of limits

8 Common practice commands

8.1 Supported common practice commands

Command no.	Function	Description
33	Read device variables	Read the selected device variables
43	Set PV zero	Starts the autozero procedure for the primary variable (see instrument manual)
44	Write PV units	Select the unit for the primary variable
53	Write device variable units	
79	Write device variable value	Only applicable to device variable <i>Setpoint</i>

8.2 Burst Mode

This device does not support Burst Mode.

8.3 Catch Device variable

This device does not support the Catch Device variable.

9 Device specific commands

9.1 Reset counter

Reset counter		
Command number	128	
Number of command data bytes	0	
Number of response data bytes	0	
Response codes	0	No command specific errors

9.2 Reset alarm

This command is used to reset a flow related alarm.

Reset alarm		
Command number	129	
Number of command data bytes	0	
Number of response data bytes	0	
Response codes	0	No command specific errors

10 Tables

10.1 Mass flow units

Unit code	Symbol	Description
70	g/s	grams per second
71	g/min	grams per minute
72	g/h	grams per hour
73	kg/s	kilograms per second
74	kg/min	kilograms per minute
75	kg/h	kilograms per hour

10.2 Volumetric flow units

Unit code	Symbol	Description
15	cf/min	cubic feet per minute
17	l/min	liters per minute
19	m ³ /h	cubic meters per hour
24	l/s	liters per second
26	cf/s	cubic feet per second
28	m ³ /s	cubic meters per second
121	m ³ n/h	normal cubic meters per hour
122	ln/h	normal liters per hour
123	scf/min	standard cubic feet per minute
130	cf/h	cubic feet per hour
131	m ³ /min	cubic meters per minute
138	l/h	liters per hour
175	ln/h	normal liters per hour
176	ln/s	normal liters per second
178	ls/h	standard liters per hour
179	ls/min	standard liters per minute
180	ls/s	standard liters per second
182	m ³ n/min	normal cubic meters per minute
183	m ³ n/s	normal cubic meters per second
185	cfs/h	standard cubic feet per hour
186	cfs/s	standard cubic feet per second
188	m ³ s/h	standard cubic meters per hour
189	m ³ s/min	standard cubic meters per minute
190	m ³ s/s	standard cubic meters per second

10.3 Temperature units

Unit code	Symbol	Description
32	°C	degrees Celsius

10.4 Mass per volume units

Unit code	Symbol	Description
92	kg/m ³	kilograms per cubic meter

10.5 Alarm types

Bit	Value	Description
0	1	Error
1	2	Warning
2	4	Minimum alarm
3	8	Maximum alarm
4	16	Counter limit reached
5	32	This bit only: Power-up alarm If combined with bit 2 or 3: Response alarm
6	64	Master/slave alarm
7	128	Hardware alarm