Profibus Supplemental Manual

SLA5800 & SLAMf Series Digital Mass Flow Controllers & Meters

BROOKS® INSTRUMENT

Beyond Measure

Essential Instructions

Read this page before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using and maintaining Brooks Products.

- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.
- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation and maintenance of the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

ESD (Electrostatic Discharge)

⚠CAUTION

This instrument contains electronic components that are susceptible to damage by static electricity. proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.

Handling Procedure:

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

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Section 1 Introduction

Introduction

Many applications of Flow Controllers/Meters are moving to increasing use of automation. Automation comes in many forms: PLC's (Programmable Logic Controllers such as the Siemens S7 300/4000), DCS's (Distributed Control Systems, such as Emerson's Digital V), and PC based solutions (National Instrument's Labview™). Digital communications from these varied systems and the devices they measure and control are a very effective means of not only accomplishing more effective and rapid system integration, but also providing greatly improved system diagnostics and maintainability. Profibus is an open, digital communication system with a wide range of applications, particularly in the fields of factory and process automation. Brooks Instrument has several of its devices available on this universal fieldbus technology and is a member of the Profibus organization.

Section 2 Definition of Terms

Definition of Terms

Abbreviation	Description
MFC/MFM	Mass Flow Controller/Meter device
MSB	Most Significant Bit
LSB	Least Significant Bit
IOM	Installation and Operation Manual
NA	Not Applicable

Section 3 Before Starting

Background & Assumptions

This manual is a supplement to the Brooks SLA Enhanced Series installation and operation manual. It is assumed that the owner of these Profibus devices is thoroughly familiar with the theory and operation of this device. If not, it is recommended that the owner reads the installation and operation manual first before continuing with this supplement.
This manual assumes basic knowledge and understanding of Profibus (its topology and its method of logically accessing the data or parameters contained within the device). This manual is not intended to be a replacement to the Profibus specifications. It is recommended but not required for the purposes of this manual, that the user obtains a copy of the Profibus specifications (www.profibus.com).
This manual does not make any assumptions about any particular manufacturer of equipment or custom software used by the user to communicate with the Brooks device, but assumes the user has thorough understanding of such equipment and any configuration software. Application Notes and FAQ's are available at the Brooks Instrument web site (www.BrooksInstrument.com).

Numbers

Numeric values used throughout this manual will be clearly denoted as to the base numeric system it represents. All hexadecimal numbers (base 16) will be prefixed with a 0x, like 0xA4. All binary numbers (base 2) will be suffixed with a b, like 1001b. All other numbers not annotated this way will be assumed decimal (base 10).

Section 4 Quick Start

This section assumes the owner of the Digital Series device has a fully operational and trouble-free communications network with appropriate power supplies. This section also assumes that one or two master type of devices are connected to the Profibus network capable of DPV0 cyclic and DPV1 acyclic data communication. Both types of data communication modes are supported by these Brooks Profibus devices.

Supported Baud rates

Data communication can be performed at a number of baud rates: 9600, 19.2K, 45.45K, 93.75K, 187.5K, 500K, 1.5M, 3M, 6M and 12M baud. The communication electronics allows for automatic baud rate detection, thus making the need for any hardware baud rate selection methods not required.

Address selection

A Profibus slave device needs a valid address in order to get into data exchange mode with a Profibus master. The address range is 2..125 and can be configured using 2 rotary switches with an arrow indicator. The MSD (Most Significant Digit) switch supports 16 positions and is used to specify 10, 20, 30..120, the LSD (Least Significant Digit) is used to specify the 0, 1, 2.. 9. Default the address selectors will be set to the P (Programmable) position for the MSB and the 0 position for the LSB, see picture below. The P position allows for using the “Set Slave” functionality of a class 2 master device to change the default address, i.e. 126, to an address in the range of 2..125. If the rotary switches are configured into any other position than P the “Set Slave” functionality can not be used and the address will be retrieved from the rotary switch positions.

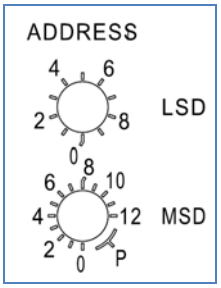

Figure 4-1 Address switches positioned at outlet side of enclosure

Table 4-1 Configuring the address switches

Scenario	Current Address	New Address	Required Action
1	P (126), P(2..125)	P (2..125)	Default the MSD rotary switch will be set to the P position and the LSD to the 0 position, the selected address will show up as 126 in the Profibus master. This is an invalid address which can not be used to get a device into Profibus data exchange mode. The P (Programmable) position allows for digitally programming the address using the DPV1 "Set Slave Address" functionality. Once this function has been used to change the address to an address in the range of 2..125, the device can be put into data exchange mode using the newly programmed address without a power cycle. Note that the rotary switch position may not be changed.
2	P (126), P (2..125)	2..125	When the rotary switches are changed from a programmable to a hard station address, the power must be cycled on the device in order to recognize the new station address. The new station address is indicated by the rotary switches.
3	2..125	2..125	When the rotary switches are changed from a hard station address to another hard station address, the power must be cycled on the device in order to recognize the new station address. The new station address is indicated by the rotary switches.
4	2..125	P (126)	When the rotary switches are changed from a hard station address to programmable, the power must be cycled on the device in order to recognize that the station address is programmable. The station will show up as 126 in the Profibus master. Scenario 1 or 2 can then be used to select a valid station address.
5	P (2..125)	P (126)	In case the saved station address needs to be reset to the default 126 value, the following procedure needs to be performed: • Verify that the MSD address switch is in the P position and the device is powered • Move any switch LSD or MSD to any new position. • If Required, turn the MSD switch back to the P position • Power cycle the device The station address will show up as 126 in the Profibus master and scenario 1 or 2 can be used to select a valid station address.

Bus and Device LEDs

The device supports a NET and MOD LED to indicate the status of network communication and the device. The NET LED will indicate the following:

Table 4-2 NET Led specification

Flash Code	Description
Off	No Network Connected
Flashing Green	Network Connected
Solid Green	Communications Established (DP and/or V1)
Flashing Red	Configuration Error
Flashing Red/Green	Parameterization Error
Solid Red	Hardware Error or Station Address set as 0,1, or 126-129.

The MOD LED will indicate the following:

Table 4-3 MOD Led specification

Flash Code	Description
Flashing Red/Green	The device is in the Self-Test mode
Solid Green	All self-tests have passed. No faults have been detected
Flashing Red	A recoverable fault has been detected or the device has been commanded into the Abort state
Solid Red	An unrecoverable fault has occurred

Power Supply and analog I/O

Power needs to be supplied via the separate 15 pin D-Sub connector. This connector also provides access to analog I/O signals, see the table below.

Table 4-4 Pin layout of 15 pin D-Sub connector

Pin No.	Function at remote connector
1.	Setpoint/RT Common
2.	Flow Output (0-5V, 1-5V, 0-10V)
3.	Alarm Output
4.	Flow Current Output (0-20mA, 4-20mA)
5.	Power Supply (13.5-27V)
6.	Not Connected
7.	Setpoint Input (0-20mA, 4-20mA)
8.	Setpoint Input (0-5V, 1-5V, 0-10V)
9.	Power Supply Common
10.	Flow Output Common
11.	Not Connected
12.	Valve Override Input
13.	AUX/RT Input (0-5V, 0-10V)
14.	Not Used
15.	Not Used

Section 5 Slave Configuration

Introduction

The purpose of the Profibus field bus system is to exchange data between the master and its slave devices. In addition to Input/Output data which are exchanged when the slave device is in data exchange mode, also parameter, configuration and diagnostic data is transferred.
Many Profibus masters need a configuration program to setup the Profibus network and configure slave devices, e.g. Siemens Step7 for the S7 controller. These programs require a device configuration file called GSD file and can be retrieved from the www.profibus.com web site.

For the Profibus network configuration of the SLA Smart III devices the following GSD file is provided:

- BIMF5000.GSD – SLA Series

This GSD file supports the following models:

Table 5-1 Supported device models

Model Code	Description	Abbreviation used in this document
SLA**5*	Mass Flow Controller	MFC
SLA**6*	Mass Flow Meter	MFM
SLA**10	Downstream Pressure Controller	PC
SLA**20	Upstream Pressure Controller	PC
SLA**40	Remote Transducer (Combined Mass Flow Controller and Pressure Controller using a Remoter Pressure Transducer)	RT

Parameterization of the slave

During the initialisation phase of the slave device the master configures the slave with “user parameters”. This part of the initialisation phase is called the parameterization. Using the master configuration program these user parameters can be changed, giving the slave device a different configuration during initialisation.

Table 5-2 Complete DP Parameterization

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11	…	Byte-n
As defined by DP specification							As defined by DP-V1 specification			DP oper-ation	Device parameter bytes		

Bit 0 (DP parameterization enable) of Byte 10 (‘DP Operation’) of the DP Parameterization defines if parameterization over DP is enabled, or if the parameterization data is ignored to allow configuration through acyclic data transfer. The structure of the ‘DP operation’ byte is defined as follows.

Bit field							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved							DP parameter-ization enable
-							0 = disabled 1 = enabled

Bytes 11 through n (number of parameterization bytes depends on device type) contain the device parameterization data that will configure the device when DP Parameterization is enabled. The bytes are defined as follows.

Table 5-3 User parameters passed during parameterization

	byte	Attribute Name	Block	Description	Instance	Attrib ID	Size (bytes)	Default Value	
								Dec	Hex
1	0-1	Flow Data Units	Analog Flow Sensor FB	Flow Data Units: Parameterizes the Data Units for the Analog Sensor FB. Refer to the Table 8-2 Volumetric Flow Units Table (See section 5.2 of Process Control Profile) for a list of valid values. Valid for MFC, MFM, RT	FB_1	2	2	1342	0x053e
2	2-3	Pressure Data Units	Analog Pressure Sensor FB	Defines the engineering units for the Pressure Refer to Table 8-3 Pressure Units Table (See section 5.2 of Process Control Profile) for more details. Valid for PC, RT	FB_2	2	2	1342	0x053e
3	4-5	Temperature Data Units	TMF Device PB	Defines the engineering units for the temperature. Refer to Table 8-4 Temperature Units Table (See section 5.2 of Process Control Profile) for more details. Valid for MFC, MFM, RT	PB_1	2	2	1001	0x03E9
4	6	Valve Drive Safe State	Actuator FB	In case the device is commanded into safe state, the valve should be put into safe mode indicated by this setting. Refer to the Table 8-8 Valve Drive Safe State Table for more details. Valid for MFC, PC, RT	FB_6	7	1	1	0x01
5	7	Flow Control Alarm Enable		Parameterizes the flow control alarm enable. 0 = Disabled. 1 = Enabled. Valid for MFC, RT	FB_3	9	0	0	0x00
6	8	Flow Meter Alarm Enable		Parameterizes the flow meter alarm enable. 0 = Disabled. 1 = Enabled. Valid for MFC, MFM, RT	TB_1	19	1	1	0x01
7	9	Drive Valve Alarm Enable		Parameterizes the drive valve alarm enable. 0 = Disabled. 1 = Enabled. Valid for MFC, PC, RT	TB_3	2	0	0	0x00
8	10-11	Flow Controller Alarm Error Band		Allows the controller alarm error band to be preset in percentage (0..140%) Valid for MFC, RT	FB_3	10	2	1400	0x0578
9	12-13	Flow Meter Alarm Trip Point High		Allows the meter alarm trip point high to be preset in percentage (-1.0..140.0%) Valid for MFC, MFM, RT	TB_1	20	2	1400	0x0578
10	14-15	Flow Meter Alarm Trip Point Low		Allows the meter alarm trip point low to be preset in percentage (-1.0..140.0%) Valid for MFC, MFM, RT	TB_1	21	2	-10	0xFFF6
11	16-17	Drive Valve Alarm Trip Point High		Allows the drive valve alarm trip point high to be preset in percentage (0.0..140.0%) Valid for MFC, PC, RT	TB_3	3	2	1400	0x0578

12	18-19	Drive Valve Alarm Trip Point Low		Allows the drive valve alarm trip point low to be preset in percentage (0.0..140.0%) Valid for MFC, PC, RT	TB_3	4	2	0	0x0000
13	20-23	Flow Control Ramp Time		Parameterizes the flow control ramp time. Refer to the Table 8-10 Flow Control Ramp Time Table for more details. Valid for MFC, RT			4	0	0x00000000
14	24	Flow Control Mode	Controller FB	Parameterizes the flow control mode. Refer to the Table 8-11 Flow Control Mode Table for more details. Valid for MFC, RT	FB_3	8	1	0	0x00
15	25-28	Pressure Control Ramp Time		Parameterizes the pressure control ramp time. Refer to the Table 8-10 Flow Control Ramp Time Table for more details. Valid for PC, RT			4	0	0x00000000
16	29	Pressure Control Mode	Controller FB	Parameterizes the pressure control mode. Refer to the Table 8-11 Flow Control Mode Table for more details. Valid for PC, RT	FB_4	8	1	0	0x00
17	30-31	Flow Totalizer Data Units	TMF Sensor TB	Defines the engineering unit for the flow totalizer. Refer to the Table 8-5 Flow Totalizer Data Units Table for more details. Valid for MFC, MFM, RT	TB_1	16	2	1036	0x040C
18	32	Multiple Input Single Output Switch	MISO Selection	Selects the flow-0 or pressure-1 controller input. Valid for RT	PB_1	9	1	0	0x00
19	33	Pressure Control Alarm Enable		Parameterizes the pressure control alarm enable. 0 = Disabled. 1 = Enabled. Valid for PC, RT	FB_4	9	0	0	0x00
20	34	Pressure Meter Alarm Enable		Parameterizes the pressure meter alarm enable. 0 = Disabled. 1 = Enabled. Valid for PC, RT	TB_2	19	1	1	0x01
21	35-36	Pressure Controller Alarm Error Band		Allows the controller alarm error band to be preset in percentage (0.0..140.0%) Valid for PC, RT	FB_4	10	2	1400	0x0578
22	37-38	Pressure Meter Alarm Trip Point High		Allows the meter alarm trip point high to be preset in percentage (-1.0..140.0%) Valid for PC, RT	TB_2	20	2	1400	0x0578
23	39-40	Pressure Meter Alarm Trip Point Low		Allows the meter alarm trip point low to be preset in percentage (-1.0..140.0%) Valid for PC, RT	TB_2	21	2	-10	0xFFF6
24	41	Enable Legacy Modules		0-Standard 1-Legacy Enables selection of Legacy S-Series Profibus modules, refer to below tables 5-5 thru 5-7 for the module descriptions. Valid for MFC, MFM (not PC or RT). De-fault is 0 - Standard. See Note below for details.			1	0	0x00

The "DPV0 Modules" User Parameter can be used to allow selection of the older Brooks legacy S-Series product Profibus IO modules.These modules are assemblies, and are included in the SLA Enhanced Profibus im-plementation for the convenience of our customers, especially those transitioning to the SLA product line that prefer to continue to use them.

Default setting for DPV0 Modules is "Standard", and enables use of the SLA Enhanced IO Modules *only (Please see Tables 5-7 through 5-7 for more detail on the below-written modules)*:

MEASURED FLOW FLOAT (READ)
VALVE OUTPUT FLOAT (READ)
TEMPERATURE FLOAT (READ)
FLOW SETPOINT FLOAT (READ)
VALVE OVERRIDE (READ)
PROCESS GAS PAGE (READ)
FLOW TOTALIZER (READ)
ZERO FLOW METER STATUS (READ)
ZERO FLOW METER (READ)
TOTALIZER COMMAND (READ)
FLOW SETPOINT FLOAT (WRITE)
VALVE OVERRIDE (WRITE)
ZERO FLOW METER (WRITE)
PROCESS GAS PAGE (WRITE)
TOTALIZER COMMAND (WRITE)
MEASURED PRESSURE FLOAT (READ)
PRESSURE SETPOINT FLOAT (READ)
PRESSURE APPLICATION PAGE (READ)
PRESSURE SETPOINT FLOAT (WRITE)
PRES APPLICATION PAGE (WRITE)

For customers that would like to use the SLA Profibus enhancements (i.e. DPV1, user parameters, etc.) but prefer to continue to use the legacy certified IO modules for DPV0, these can be selected when the User Parameter “DPV0 Modules” is set to “Legacy S-Series”. The S-Series style IO modules are actual assemblies that include both an input and output component. You must choose a single IO assembly module for the device to use when connected to the master. There are three assemblies to choose from:

Module 1: "out[Setp],in[Flow]"				
Output	**Description**	**Byte Mapping**	**Byte Size**	**Type**
Setp	Setpoint	0..3	4	Floating Point
Output	**Description**	**Byte Mapping**	**Byte Size**	**Type**
Flow	Flow	0..3	4	Floating Point

Module 2: “out[Setp,CMD],in[Flow,Tot,CMD]”				
Output	**Description**	**Byte Mapping**	**Byte Size**	**Type**
Setp	Setpoint	0..3	4	Floating Point
CMD	Command (Totalizer control & VOR)	4	1	Unsigned Byte
Input	**Description**	**Byte Mapping**	**Byte Size**	**Type**
Flow	Flow	0..3	4	Floating Point
Tot	Totalizer	4..7	4	Floating Point
CMD	Command (Read)	8	1	Unsigned Byte

Module 3: “Maximum Configuration”				
Output	**Description**	**Byte Mapping**	**Byte Size**	**Type**
Setp	Setpoint	0..3	4	Floating Point
CMD	Command (Totalizer control & VOR)	4	1	Unsigned Byte
Input	**Description**	**Byte Mapping**	**Byte Size**	**Type**
Setp	Setpoint (Read)	0..3	4	Floating Point
Flow	Flow	4..7	4	Floating Point
Temp	Temperature	8..11	4	Floating Point
Tot	Totalizer	12..15	4	Floating Point
Valv	Valve Drive Indicator	16..19	4	Unsigned Integer
CMD	Command (Read)	20	1	Unsigned Byte

SLA Enhanced and Legacy S-Series IO modules cannot be combined. Including selections from both in a single device configuration will result in configuration errors.

Configuration of the slave

Using the master configuration program the user can select inputs and outputs which define the data to be exchanged in DPV0 data exchange mode. The table below lists the input and output modules which can be selected per device model. Note that if the device model is not in line with the selected modules a configuration error will be raised by the PLC and the device will not get into data exchange mode, see Table 5-1 Supported device models.

Table 5-4 DPV0 input/output modules for device model MFC

Input Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x43,0x03,0xA9,0x06,0x01	Measured Flow Float	Analog Sensor FB	FB_1	0	The amount of flow going through the device in engineering units.	4
0x43,0x03,0x32,0x06,0x01	Valve Output Float	Actuator FB	FB_3	2	The value of the analog output signal used to drive the physical actuator.	4
0x43,0x03,0xA4,06,0x01	Temperature Float	TMF Sensor TB	TB_1	11	Temperature of the device in engineering units. Refer to the Table 8-4 Temperature Units Table (See section 5.2 of Process Control Profile) for more details.	4
0x43,0x03,0x9E,0x06,0x01	Flow Setpoint Float	Controller FB	FB_2	1	The amount of flow that device will control to in engineering units. Refer to the Table 8-2 Volumetric Flow Units Table (See section 5.2 of Process Control Profile) for more details.	4
0x43,0x00,0x32,0x05,0x01	Valve Override	Actuator FB	FB_3	6	The override of the physical actuator. Refer to the Table 8-9 Valve Override Table for more details.	1
0x43,0x01,0xA9,0x23,0x01	Process Gas Page	TMF Sensor TB	TB_1	4	The active calibration instance. Refer to the Table 8-7 Calibration or Application Instance Table for more details.	2
0x43,0x03,0xA9,0x7E,0x01	Flow Totalizer	TMF Sensor TB	TB_1	15	The total amount of flow through the device as a long integer in engineering units. Refer to the Table 8-5 Flow Totalizer Data Units Table for more details.	4
0x43,0x00,0xA9,0x1C,0x01	Zero Flow Meter Status	TMF Sensor TB	TB_1	3	Indicates the status of the zero flow meter: 1 = In progress. 0 = Idle.	1
0x43,0x00,0xA9,0x70,0x01	Zero Flow Meter	TMF Sensor TB	TB_1	2	Indicates the zero flow meter state: 1 = Zero adjust initiated. 0 = No zero adjust.	1

Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x43,0x01,0xA9,0x7C,0x01	Totalizer Command	TMF Sensor TB	TB_1	17	Totalizer command allowing to stop, run or reset the totalizer, see Table 8-6 Totalizer Command Table	1

Output Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x83,0x03,0x9E,0x06,0x01	Flow Setpoint Float	Controller FB	FB_2	1	The amount of flow the device will control to in engineering units.	4
0x83,0x00,0x32,0x05,0x01	Valve Override	Actuator FB	FB_3	6	Specifies a direct override of the physical actuator, see Table 8-9 Valve Override Table	1
0x83,0x00,0xA9,0x70,0x01	Zero Flow Meter Status	TMF Sensor TB	TB_1	2	Initiates a Zero Adjust.	1
0x83,0x01,0xA9,0x23,0x01	Process Gas Page	TMF Sensor TB	TB_1	4	Selects the active calibration instance. See Table 8-7 Calibration or Application Instance Table	2
0x83,0x01,0xA9,0x7C,0x01	Totalizer Command	TMF Sensor TB	TB_1	17	Totalizer command allowing to stop, run or reset the totalizer, see Table 8-6 Totalizer Command Table	1

Table 5-5 DPV0 input/output modules for device model MFM

Input Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x43,0x03,0xA9,0x06,0x01	Measured Flow Float	Analog Sensor FB	FB_1	0	The amount of flow going through the device in engineering units.	4
0x43,0x03,0xA4,06,0x01	Temperature Float	TMF Sensor TB	TB_1	11	Temperature of the device in engineering units. Refer to the Table 8-4 Temperature Units Table (See section 5.2 of Process Control Profile) for more details.	4
0x43,0x01,0xA9,0x23,0x01	Process Gas Page	TMF Sensor TB	TB_1	4	The active calibration instance. Refer to the Table 8-7 Calibration or Application Instance Table for more details.	2
0x43,0x03,0xA9,0x7E,0x01	Flow Totalizer	TMF Sensor TB	TB_1	15	The total amount of flow through the device as a long	4

					integer in engineering units. Refer to the Table 8-5 Flow Totalizer Data Units Table for more details.	
0x43,0x00,0xA9,0x1C,0x01	Zero Flow Meter Status	TMF Sensor TB	TB_1	3	Indicates the status of the zero flow meter: 1 = In progress. 0 = Idle.	1
0x43,0x00,0xA9,0x70,0x01	Zero Flow Meter	TMF Sensor TB	TB_1	2	Indicates the zero flow meter state: 1 = Zero adjust initiated. 0 = No zero adjust.	1

Output Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x83,0x00,0xA9,0x70,0x01	Zero Flow Meter Status	TMF Sensor TB	TB_1	2	Initiates a Zero Adjust.	1
0x83,0x01,0xA9,0x23,0x01	Process Gas Page	TMF Sensor TB	TB_1	4	Selects the active calibration instance. See Table 8-7 Calibration or Application Instance Table	2
0x83,0x01,0xA9,0x7C,0x01	Totalizer Command	TMF Sensor TB	TB_1	17	Totalizer command allowing to stop, run or reset the totalizer, see Table 8-6 Totalizer Command Table	1

Table 5-6 DPV0 input/output modules for device model PC

Input Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x43,0x03,0xA8,0x06,0x01	Process Variable (PV)	Analog Sensor FB	FB_2	0	The amount of pressure measured by the device in engineering units.	4
0x43,0x03,0x32,0x06,0x01	Valve Output Float	Actuator FB	FB_3	2	The value of the analog output signal used to drive the physical actuator.	4
0x43,0x03,0x9F,0x06,0x01	Setpoint	Controller FB	FB_4	1	The amount of pressure that device will control to in engineering units. Refer to the Table 8-3 Pressure Units Table (See section 5.2 of Process Control Profile) for more details.	4
0x83,0x00,0x32,0x05,0x01	Valve Override	Actuator FB	FB_3	6	The override of the physical actuator. Refer to the Table 8-9 Valve Override Table	1

					for more details.	
0x43,0x01,0xA8,0x23,0x01	Pressure Application Page	TMF Sensor TB	TB_2	4	The active calibration/ application instance. Refer to the Table 8-7 Calibration or Application Instance Table for more details.	2

Output Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x83,0x03,0x9F,0x06,0x01	Pressure Setpoint Float	Controller FB	FB_2	1	The amount of pressure the device will control to in engineering units.	4
0x83,0x00,0x32,0x05,0x01	Valve Override	Actuator FB	FB_3	6	Specifies a direct override of the physical actuator, see Table 8-9 Valve Override Table	1
0x83,0x01,0xA8,0x23,0x01	Pressure Application Page	TMF Sensor TB	TB_1	4	Selects the active calibration/application instance. See Table 8-7 Calibration or Application Instance Table	2

Table 5-7 DPV0 input/output modules for device model RT

Input Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x43,0x03,0xA9,0x06,0x01	Flow Process Variable (PV)	Analog Sensor FB	FB_1	0	The amount of flow going through the device in engineering units.	4
0x43,0x03,0xA8,0x06,0x01	Measured Pressure Float	Analog Sensor FB	FB_2	0	The amount of pressure measured by the device in engineering units.	4
0x43,0x03,0x32,0x06,0x01	Valve Output Float	Actuator FB	FB_6	2	The value of the analog output signal used to drive the physical actuator.	4
0x43,0x03,0xA4,06,0x01	Temperature Float	TMF Sensor TB	TB_1	11	Temperature of the device in engineering units. Refer to the Table 8-4 Temperature Units Table (See section 5.2 of Process Control Profile) for more details.	4
0x43,0x03,0x9E,0x06,0x01	Measured Flow Float	Controller FB	FB_3	1	The amount of flow that device will control to in engineering units. Refer to the Table 8-2 Volumetric Flow Units	4

					Table (See section 5.2 of Process Control Profile) for more details.	
0x43,0x03,0x9F,0x06,0x01	Pressure Setpoint Float	Controller FB	FB_4	1	The amount of pressure that device will control to in engineering units. Refer to the Table 8-3 Pressure Units Table (See section 5.2 of Process Control Profile) for more details.	4
0x43,0x00,0x32,0x05,0x01	Valve Override	Actuator FB	FB_6	6	The override of the physical actuator. Refer to the Table 8-9 Valve Override Table for more details.	1
0x43,0x01,0xA9,0x23,0x01	Process Gas Page	TMF Sensor TB	TB_1	4	The active calibration instance. Refer to the Table 8-7 Calibration or Application Instance Table for more details.	2
0x43,0x01,0xA8,0x23,0x01	Pressure Application Page	TMF Sensor TB	TB_2	4	The active application instance. Refer to the Table 8-7 Calibration or Application Instance Table for more details.	2
0x43,0x03,0xA9,0x7E,0x01	Flow Totalizer	TMF Sensor TB	TB_1	15	The total amount of flow through the device as a long integer in engineering units. Refer to the Table 8-5 Flow Totalizer Data Units Table for more details.	4
0x43,0x00,0xA9,0x1C,0x01	Zero Flow Meter Status	TMF Sensor TB	TB_1	3	Indicates the status of the zero flow meter: 1 = In progress. 0 = Idle.	1
0x43,0x00,0xA9,0x70,0x01	Zero Flow Meter	TMF Sensor TB	TB_1	2	Indicates the zero flow meter state: 1 = Zero adjust initiated. 0 = No zero adjust.	1

Output Data						
Configuration Byte	Attribute Name	Block	Instance	Attrib. ID	Description	Size (bytes)
0x83,0x03,0x9E,0x06,0x01	Measured Flow Float	Controller FB	FB_2	1	The amount of flow the device will control to in engineering units.	4

0x83,0x03,0x9F,0x06,0x01	Pressure Setpoint Float	Controller FB	FB_2	1	The amount of pressure the device will control to in engineering units.	4
0x83,0x00,0x32,0x05,0x01	Valve Override	Actuator FB	FB_3	6	Specifies a direct override of the physical actuator, see Table 8-9 Valve Override Table	1
0x83,0x00,0xA9,0x70,0x01	Zero Flow Meter Status	TMF Sensor TB	TB_1	2	Initiates a Zero Adjust.	1
0x83,0x01,0xA9,0x23,0x01	Process Gas Page	TMF Sensor TB	TB_1	4	Selects the active calibration instance. See Table 8-7 Calibration or Application Instance Table	2
0x83,0x01,0xA8,0x23,0x01	Pressure Application Page	TMF Sensor TB	TB_1	4	Selects the active application instance. See Table 8-7 Calibration or Application Instance Table	2
0x83,0x01,0xA9,0x7C,0x01	Totalizer Command	TMF Sensor TB	TB_1	17	Totalizer command allowing to stop, run or reset the totalizer, see Table 8-6 Totalizer Command Table	1

Device Diagnostics

The device supports 2 diagnostic bytes, below the layout of these bytes.

Byte nr	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	Pressure Meter High	Pressure Meter Low	Valve high	Valve low	Flow Controller Error band	Flow Meter High	Flow Meter Low	Pressure Controller Error band
2	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	DPV0 Pressure Application Instance	DPV0 calibration instance

Figure 5-1 Device diagnostic byte

In case of a Mass Flow Meter (MFM) and Pressure Meter (PM) the Valve high/low and the Controller Error band alarms are disabled. If the ‘Selected Calibration’ module is used in DPV0 cyclic communication, make sure that it’s set to a valid value, otherwise the ‘DPV0 calibration instance’ diagnostic indication will be raised. If the ‘Selected Application Instance’ module is used in DPV0 cyclic communication, make sure that it’s set to a valid value, otherwise the ‘DPV0 Pressure Application Instance’ diagnostic indication will be raised.

Section 6 DPV0 Cyclic Data Exchange

DPV0 Cyclic data exchange

Once the device has gone through the parameterization and DPV0 input and output modules have been selected the master will direct the slave into DPV0 cyclic data exchange mode, see 5.2 Parameterization of the slaand 5.3 Configuration of the slave. In this mode data is exchanged between master and slave on a periodic basis. The input is data which is going from slave to master and output is data which is going from master to slave.

Section 7 DPV1 Acyclic Data Communication

Device Block Model

The Profibus interface provides access to device data. The device data is grouped in blocks, where each block is comprised of a set of attributes that defines the configuration and represents the state of a logical function. An attribute provides access to specific data within a functional block.
The structure of modeling these acyclic parameters is taken from the Profibus PA standard. However the interface is not compliant to this Profibus PA standard but will follow the Profibus DP v1 specifications for acyclic parameter communication.
The following figure provides an overview of blocks, with their relationships, that can exist in a SLA Enhanced Series device.

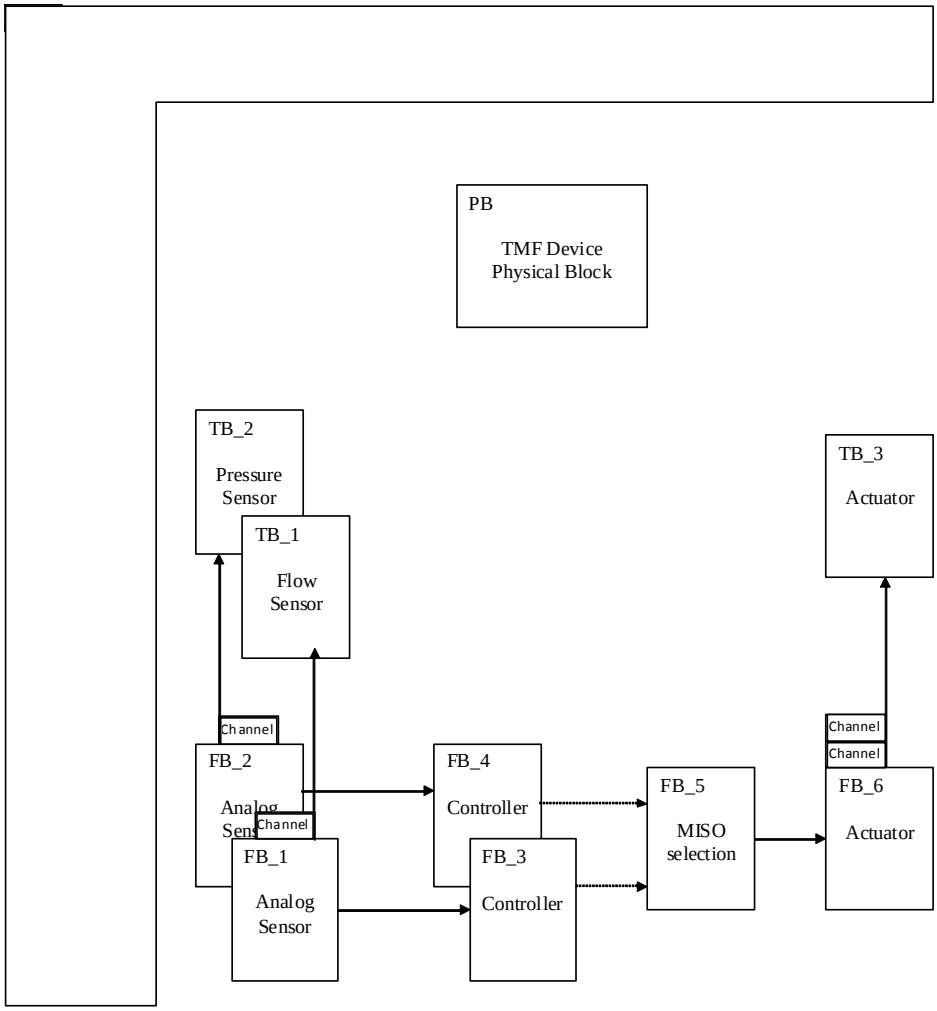

Figure 7-1 Device Block Model

Slot and Index (attribute) mapping

The figure below defines the mapping of available blocks for a Mass Flow Controller device into slots and indexes, indexes are identified by the attribute number. The mapping complies with the PA definition (refer to section 9.2 Mapping for Acyclic Data Transfer)
One slot will only contain one block. This allows for extension of blocks, without the need to shift other blocks. This will maximize flexibility for future product extensions, while maintaining compatibility (i.e. the absolute address will not change).

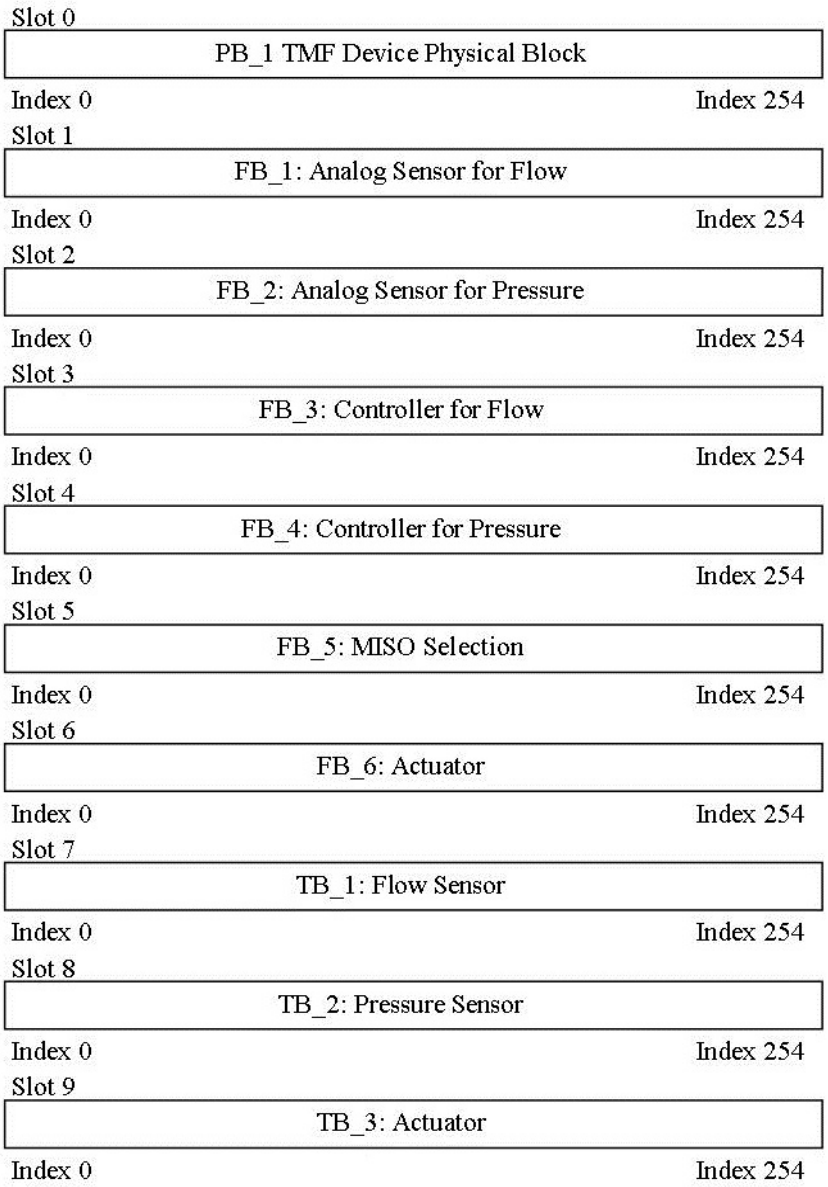

Figure 7-2 Slot and index mapping

A definition of blocks and attributes is given in the tables shown in the following paragraphs.

Table 7-1 Table legend

Table Column Heading	Description
Attribute ID	Identification of the attribute within the block

Attribute Name	Name of the attribute
Description	Description of the attribute
Object Type	Simple data type, Record (i.e. struct), or Array of simple data types
Data Type	Data format as defined in document 'Profibus DP Extensions to EN 50170, paragraph 10.5'.
Storage	Storage definition: **N**on-volatile, **D**ynamic (i.e. volatile) or **C**on**st**ant (no Static parameters are supported).
Number of Bytes	Data length in bytes
Access	**r**eadable and/or **w**ritable
DP Data Exchange	Defines if the attribute is accessible as an **I**nput or **O**utput parameter though cyclic data exchange (DP)
DP Param	Defines if the attribute can (P) or cannot (-) be set through the DP parameterization service

When the user requests an attribute from a block which is not supported by the configured device type (MFC/MFM/PC/RT) an invalid parameter response will be returned.

Identification & Maintenance Function (I&M0)

The I&M0 table is required as per DPV1 Profibus specification and contains data needed for identification and maintenance of the device

Block existence: MFC, MFM, PC, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Header	Manufacturer Specific	Simple	Octet String (bitwise)	N	10	r	-	-
1	Manufacturers ID	Manufacturers identification number (10 = 0x000A = Brooks Instrument)	Simple	Unsigned16	N	2	r	-	-
2	Order ID	Manufacturers order number	Simple	Visible String	N	20	r	-	-
3	Serial Number	Serial number of the device assigned by the manufacturer.	Simple	Visible String	N	16	r	-	-
4	Hardware Revision	Revision level of the hardware in the device.	Simple	Visible String	N	2	r	-	-
5	Software Revision	Revision level of the firmware in the device.	Simple	Visible String	N	4	r	-	-
6	Revision Counter	A changed value of the REV_COUNTER parameter of a given module marks a change of hardware or of its parameters	Simple	Unsigned16	N	2	r	-	-
7	Profile ID	A module following a special profile may offer extended information (PROFILE_ SPECIFIC_TYPE) about its function and/or sub devices, e.g. HART (fixed to 0xF600)	Simple	Unsigned16	N	2	r	-	-
8	Profile Specific Type	In case a module follows a special profile this parameter offers information about the usage of its channels and/or sub devices (0x0000) (PA specific)	Simple	Unsigned16	N	2	r	-	-
9	IM Version	This parameter indicates the implemented version V1.1 of the I&M functions (0x01 and 0x01)	Simple	Unsigned8	N	2	r	-	-

10	IM Supported	This parameter indicates the availability of I&M records (0x0000)	Simple	Unsigned16	N	2	r	-	-

Reading the I&M0 table can be done by using the DPV1 write and read functionality sequentially. First you should perform a write to Slot 0 and Index 255, length is 4 bytes, of the following data 08, 00, FD, E8 in hex. This will set the subindex of the I&M0 record (i.e. 65000) and each sequential read to Slot 0 and Index 255 will return the I&M0 table. After a DPV1 abort and initiate the DPV1 write cycle needs to be performed again before retrieving the I&M0 table.

TMF Device Physical Block (Slot 0; PB_1)

The TMF (Thermal Mass Flow) Device Physical Block provides access to general device parameters which are not included in I&M0

Block existence: MFC, MFM, PC, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Software Revision Digital Interface	Revision level of the firmware in the digital interface	Simple	Visible String	N	8	r	-	-
1	Hardware Revision Digital Interface	Revision level of the hardware in the digital interface.	Simple	Unsigned16	N	2	r	-	-
2	Temperature Data Units	Defines the engineering unit of temperature Refer to the Table 8-4 Temperature Units Table (See section 5.2 of Process Control Profile)	Simple	Unsigned16	N	2	r/w	-	P
5	Device Type	Defines the device type valid values: MFC=0 PC=1 RT=2 MFM=3	Simple	Unsigned8	N	1	r	-	-
6	RT/Auxiliary Analog Selection	The selection of the RT/Auxiliary analog as a coded integer: 0 = 5 volts. 1 = 10 volts.	Simple	Unsigned8	N	1	r/w[1]	-	-
7	Analog Output Mode Selection	The selection of the flow analog as a coded integer: 0 = 5 volts. 1 = 10 volts. 2 = 4 to 20 mA. 3 = 0 to 20 mA. 4 = 1 to 5 volts.	Simple	Unsigned8	N	1	r/w	-	-
8	Analog Input Mode Selection	The selection of the setpoint analog as a coded integer: 0 = 5 volts. 1 = 10 volts. 2 = 4 to 20 mA.	Simple	Unsigned8	N	1	-	-	-

[1] If the flow control mode is set to analog mode, then the auxiliary analog selection can not be written.

		3 = 0 to 20 mA. 4 = 1 to 5 volts.							
9	Control Type Select (Used by RT Devices only)	0 = Flow 1 = Pressure							

TMF Sensor Transducer Block (Slot 7; TB_1)

The TMF (Thermal Mass Flow) Sensor TB provides access to device parameters for the purpose of configuring of a Thermal Mass Flow Sensor of the device.

Block existence: MFC, MFM, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Normalized Flow	The measured flow signal, normalized to a number from 0 to 100. Note: Attribute 0	Simple	Floating-Point	D	4	r	-	-
1	Target Mode	Mode of operation of this Function Block Note Attribute 0	simple	Unsigned8	D	1	r/w	-	-
2	Sensor Zero Adjust	Initiates a Zero Adjust. Note: Attribute 2	Simple	Unsigned8	D	1	r/w	IO	P
3	Sensor Zero Status	Indicates the status of a Zero Adjust action. Note Attribute 3	Simple	Unsigned8	D	1	r	I	-
4	Selected Calibration	Selects the active sensor calibration, see Table 8-7 Calibration or Application Instance Table	Simple	Unsigned16	N	2	r/w	IO	P
5	Selected Calibration Data Units	Defines the engineering unit of the full scale attributes of the active flow sensor calibration. Refer to the Table 8-2 Volumetric Flow Units Table (See section 5.2 of Process Control Profile)	Simple	Unsigned16	N	2	r	-	-
6	Selected Calibration Full-scale	This full-scale value applies to the factory calibration polynomial of the active flow sensor calibration.	Simple	Floating-Point	N	4	r	-	-
7	Selected Calibration Reference Pressure	The absolute pressure reference condition for the active flow sensor calilbration, specified in kPa	Simple	Floating-Point	N	4	r	-	-
8	Selected Calibration Reference Temperature	The temperature reference condition for the active flow sensor calilbration	Simple	Floating-Point	N	4	r	-	-
9	Selected Calibration Gas Name	Name of the process gas of the active flow sensor calibration.	Simple	Visible-String	N	64	r	-	-

11	Temperature	Temperature specified in the data unit selected by attribute 2 of the Device Physical Block	Simple	Floating-Point	N	4	r	I	-
15	Flow Totalizer	The amount of flow through the device as a long integer in engineering units referred to by the Flow Totalizer Data Units.	Simple	Floating Point	D	4	r/w	I	
16	Flow Totalizer Data Units	The flow totalizer data units as a coded integer. Refer to the Table 8-5 Flow Totalizer Data Units Table for more details.	Simple	Unsigned16	D	2	r/w	-	P
17	Flow Totalizer Command	Command to stop, run and reset the Flow Totalizer	Simple	Unsigned8	D	1	r/w	IO	-
19	Meter Alarm Enable	Configuration of the meter alarm enable. 0 = Disabled. 1 = Enabled.	Simple	Unsigned	N	1	r/w	-	P
20	Meter Alarm Trip Point High	Allows the flow/pressure meter alarm trip point high to be configured in percentage (0..140%) The value is an integer representation of the percentage times 10. (e.g. 140% is read/written as 1400)	Simple	Unsigned16	N	2	r/w	-	P
21	Meter Alarm Trip Point Low	Allows the flow/pressure meter alarm trip point low to be configured in percentage (0..140%) The value is an integer representation of the percentage times 10. (e.g. 140% is read/written as 1400)	Simple	Unsigned16	N	2	r/w	-	P

Note: Attribute 0

The normalized flow is a measure for the amount of gas flowing through the device, where 0 means no flow, and 100 means a flow of 100% of the full scale as identified by attribute 'Selected Calibration Custom Full Scale'.

Note: Attribute 1

The target mode indicates the mode of operation of the Controller Function Block. The supported modes are described in the following table.

Code	Target Mode	Description
8 (0x08)	Automatic (default)	Attributes 'Selected Calibration' and 'Sensor Zero Adjust' can only be written through cyclic data exchange. No write access is allowed through acyclic data exchange.
16 (0x10)	Manual	Attributes 'Selected Calibration' and 'Sensor Zero Adjust' are independent of the cyclic data exchange and can only be written through acyclic data exchange.

Note: Attribute 2

Using the 'Sensor Zero Adjust' attribute, a flow sensor zero action can be initiated by setting the value to 1, see table.

Value	Zero Adjust Command Code	Description
0	Normal Operation	The device will continue normal operation and will not perform a zero adjust cycle.
1	Zero	Initiates a zero adjust cycle.

Use attribute 'Sensor Zero Status' to observe the status of a zero adjustment.
Note that the storage for this attribute defined as dynamic. The device will reset the value to 0 after the user sets it.

Note: Attribute 3

Attribute 'Sensor Zero Status' will report the status of a zero adjustment, see table.

Value	Zero Adjust Command Code	Description
0	Idle	The device is not performing a zero adjust cycle.
1	Executing	The device is zeroing the sensor and has not yet finished the zero adjustment.

Pressure Transducer Block (Slot 8; TB_2)

The Pressure Sensor TB provides access to device parameters for the purpose of configuring of a Pressure Sensor of the device.

Block existence: MFC, MFM, PC, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Normalized Pressure	The measured pressure signal, normalized to a number from 0 to 100. Note: Attribute 0	Simple	Floating-Point	D	4	r	-	-
1	Target Mode	Mode of operation of this Function Block Note Attribute 1	simple	Unsigned8	D	1	r/w	-	-
4	Selected Calibration	Selects the active sensor calibration, see Table 8-7 Calibration or Application Instance Table	Simple	Unsigned16	N	2	r/w	IO	P
5	Selected Calibration Data Units	Defines the engineering unit of the full scale attribute of the pressure sensor Refer to the Table 8-3 Pressure Units Table (See	Simple	Unsigned16	N	2	r	-	-

		section 5.2 of Process Control Profile)							
6	Selected Calibration Full-scale	The full-scale value applies of the pressure sensor	Simple	Floating-Point	D	4	r	-	-
18	Pressure Sensor Type	Defines the sensor pressure type. Refer to the Table 8-12 Pressure Sensor Type Table	Simple	Unsigned8	N	1	r	-	-
19	Meter Alarm Enable	Configuration of the meter alarm enable. 0 = Disabled. 1 = Enabled.	Simple	Unsigned	N	1	r/w	-	P
20	Meter Alarm Trip Point High	Allows the flow/pressure meter alarm trip point high to be configured in percentage (0..140%) The value is an integer representation of the percentage times 10. (e.g. 140% is read/written as 1400)	Simple	Unsigned16	N	2	r/w	-	P
21	Meter Alarm Trip Point Low	Allows the flow/pressure meter alarm trip point low to be configured in percentage (0..140%) The value is an integer representation of the percentage times 10. (e.g. 140% is read/written as 1400)	Simple	Unsigned16	N	2	r/w	-	P

Note: Attribute 0

The normalized value is a measure for the pressure measured by the device, where 0 means 0% and 100 means 100% of the full scale as identified by attribute 'Selected Calibration Custom Full Scale'.

Note: Attribute 1

The target mode indicates the mode of operation of the Controller Function Block. The supported modes are described in the following table.

Code	Target Mode	Description
8 (0x08)	Automatic (default)	Attribute 'Selected Calibration' can only be written through cyclic data exchange. No write access is allowed through acyclic data exchange.
16 (0x10)	Manual	Attributes 'Selected Calibration' is independent of the cyclic data exchange and can only be written through acyclic data exchange.

Analog Sensor Function Block (Slot 1; FB_1)(Slot 2; FB_2)

Block existence: MFC, MFM, PC, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Process Variable (PV)	The amount of flow/pressure measured by the	Simple	Floating-Point	D	4	r	I	-

		device. This value is corrected, converted and calibrated to report the actual value in the engineering units configured by attribute 'Data Units'.							
1	PV Channel[2]	Reference to the Sensor Transducer Block that provides the measurement value to this function block Fixed to 0x0700 for Flow Sensor (Slot 1; FB_1) Fixed to 0x0800 for Pressure Sensor (Slot 2; FB_2)	Simple	Unsigned16	N	2	r	-	-
2	Data Units	Defines the Engineering Units context of attributes 'Process Variable'. Refer to the Volumetric Flow Units Table or PressureUnitsTable Pressure Units Table	Simple	Unsigned16	N	2	r/w	-	P

Controller Function Block (Slot 3; FB_3) (Not supported by MFM)(Slot 4; FB_4)

Block existence: MFC, PC, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Target Mode	Mode of operation of this Function Block Note: Attribute 0	simple	Unsigned8	D	1	r/w	-	-
1	Setpoint	The amount of flow/pressure the device will control to. This value is represented in the engineering units defined by attribute 'Data Units'.	Simple	Floating-Point	D	4	r(/w)[3]	IO	-
2	Setpoint Data Units	Flow control setpoint data units. Refer to the Volumetric Flow Units Table or PressureUnitsTable	Simple	Unsigned16	N	2	r	-	-
3	Control Value	The normalized output value (0..100) of the controller (unit-less)	Simple	Floating-Point	D	4	r	I	-
4	Selected Controller PID Proportional Gain	Configuration of the PID controller	Simple	Floating-Point	N	4	r/w	-	-

[2] Reference is a slot (MSB) and attribute (LSB) combination

[3] Setpoint is only writable through acyclic data transfer when the Target Mode is set to manual.

		proportional gain[4]							
5	Selected Controller PID Integral Gain	Configuration of the PID controller integral gain	Simple	Floating-Point	N	4	-	-	-
6	Selected Controller PID Derivative Gain 1	Configuration of the PID controller derivative gain 1	Simple	Floating-Point	N	4	-	-	-
7	Selected Controller PID Derivative Gain 2	Configuration of the PID controller derivative gain 2	Simple	Floating-Point	N	4	-	-	-
8	Flow Control Mode	Mode of operation for flow control. Refer to Table 8-11 Flow Control Mode Table for more details.	Simple	Unsigned8	D	1	-	-	P
9	Controller Alarm Enable	Configuration of the controller alarm enable. 0 = Disabled. 1 = Enabled.	Simple	Unsigned8	N	1	-	-	P
10	Controller Alarm Error Band	Allows the controller alarm error band to be configured in percentage (0..140%) The value is an integer representation of the percentage times 10. (e.g. 140% is read/written as 1400)	Simple	Unsigned16	N	2	-	-	P

Note: Attribute 0

The target mode indicates the mode of operation of the Controller Function Block. The supported modes are described in the following table.

Code	Target Mode	Description
8 (0x08)	Automatic (default)	Attribute 'Setpoint' can only be written through cyclic data exchange. No write access is allowed through acyclic data exchange.
16 (0x10)	Manual	Attributes 'Setpoint' is independent of the cyclic data exchange and can only be written through acyclic data exchange.

Note: Attribute 4-7

The device utilizes a PID compensator in the control loop as a means of optimizing and tuning control. The 'Selected controller PID Gain' parameters are used as multipliers in the control compensation calculation.

Actuator Function Block (Slot 6; FB_6) (Not supported by MFM)

Block existence: MFC, PC, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Target Mode	Mode of operation of this Function Block	simple	Unsigned8	D	1	r/w	-	-

[4] Be aware that changing any PID Gain settings might affect operation of the device

		Note Attribute 0							
1	Drive Channel[5]	Reference to the 'Drive' attribute in the Actuator Transducer Block. Fixed to 0x0900	Simple	Unsigned16	C	2	r	-	-
2	Drive Value	The value of the analog output signal used to drive the physical actuator. In case of normally closed valve type same as Control Value, in case of normally opened valve type inverted to Control Value.	Simple	Floating-Point	D	4	r	I	-
3	Drive Valve Data Units	Defines the engineering unit for attribute 'Drive'. Note: the engineering unit [Percent] (1342) and can not be altered.	Simple	Unsigned16	C	2	r	-	-
4	Control Value	The normalized input value to the actuator (unit-less). (See Control Value of the Controller)	Simple	Floating-Point	D	4	r	-	-
5	Override Channel[6]	Reference to the 'Override' attribute in the Actuator Transducer Block. Fixed to 0x0501	Simple	Unsigned16	C	2	r	-	-
6	Override	Specifies a direct override of the physical actuator, see Table 8-9 Valve Override Table	Simple	Unsigned8	D	1	r(/w)[7]	IO	-
7	Drive Valve Safe State	In case the device is commanded into the safe state the valve should be put into safe mode indicated by the Safe State, see Table 8-8 Valve Drive Safe State Table	Simple	Unsigned8	D	1	r/w	-	P

Note: Attribute 0

The target mode indicates the mode of operation of the Actuator Function Block. The supported modes are described in the following table.

Code	Target Mode	Description
8 (0x08)	Automatic (default)	Attribute 'Override' can only be written through cyclic data exchange. No write access is allowed through acyclic data exchange.
16 (0x10)	Manual	Attributes 'Override' is independent of the cyclic data exchange and can only be written through acyclic data exchange.

[5] Reference is a slot (MSB) and attribute (LSB) combination
[6] Reference is a slot (MSB) and attribute (LSB) combination
[7] Attribute 'Override' is only writable through acyclic data transfer when the Target Mode is set to manual.

Actuator Transducer Block (Slot 9; TB_3) (Not supported by MFM)

Block existence: MFC, PC, RT									
Attribute ID	Attribute name	Description	Object type	Data type	Storage	Number of Bytes	Access	DP Data Exchange	DP Param
0	Drive	The value of the analog output signal used to drive the physical actuator in percent	Simple	Floating-Point	D	4	r	-	-
1	Override	Specifies a direct override of the physical actuator. See Table 8-9 Valve Override Table	Simple	Unsigned8	-	1	r	-	-
2	Drive Valve Alarm Enable	Configuration of the drive valve alarm enable. 0 = Disabled. 1 = Enabled.	Simple	Unsigned8	N	1	r/w	-	P
3	Drive Valve Alarm Trip Point High	Allows the drive valve alarm trip point high to be configured in percentage (0..140%) The value is an integer representation of the percentage times 10. (e.g. 140% is read/written as 1400)	Simple	Unsigned16	N	2	r/w	-	P
4	Drive Valve Alarm Trip Point Low	Allows the drive valve alarm trip point low to be configured in percentage (0..140%) The value is an integer representation of the percentage times 10. (e.g. 140% is read/written as 1400)	Simple	Unsigned16	N	2	r/w	-	P

8 Appendices

Appendix A Data type definitions

The following table lists Profibus data types used throughout this manual. The column C/C++ Encoding is given as a comparative common example reference.

Table 8-1 Profibus Data Type Definitions

Data Type	Size (bytes)	Description	Range	C/C++ Keyword
Signed8	1	An 8-bit signed integer value	-128 to 127	char
Unsigned8	1	An 8-bit unsigned integer value	0 to 255	unsigned char
Signed16	2	A 16-bit signed integer value	-32768 to 32767	short int

Unsigned16	2	A 16-bit unsigned integer value	0 to 65535	unsigned short int
Signed32	4	A 32-bit signed integer value	-2147483648 to 2147483647	int
Unsigned32	4	A 32-bit unsigned integer	0 to 4294967296	unsigned int
Floating-Point	4	An IEEE-754 single precision floating point number	-3.8E38 to 3.8E38	float

Appendix B Data units

Table 8-2 Volumetric Flow Units Table (See section 5.2 of Process Control Profile)

Value		Description	Symbol
Dec	**Hex**		
1318	0x0526	Gram per second	g/s
1319	0x0527	Gram per minute	g/min
1320	0x0528	Gram per hour	g/h
1321	0x0529	Gram per day	g/d
1322	0x052a	Kilogram per second	kg/s
1323	0x052b	Kilogram per minute	kg/min
1324	0x052c	Kilogram per hour	kg/h
1325	0x052d	Kilogram per day	kg/d
1330	0x0532	Pound per second	lb/s
1331	0x0533	Pound per minute	lb/min
1332	0x0534	Pound per hour	lb/h
1333	0x0535	Pound per day	lb/d
1342	0x053e	Percent	%
1347	0x0543	Cubic meter per second	m^3/s
1348	0x0544	Cubic meter per minute	m^3/min
1349	0x0545	Cubic meter per hour	m^3/h
1350	0x0546	Cubic meter per day	m^3/d
1351	0x0547	Liter per second	l/s
1352	0x0548	Liter per minute	l/min
1353	0x0549	Liter per hour	l/h
1354	0x054a	Liter per day	l/d
1356	0x054c	Cubic foot per second	ft^3/s
1357	0x054d	Cubic foot per minute	ft^3/min
1358	0x054e	Cubic foot per hour	ft^3/h
1359	0x054f	Cubic foot per day	ft^3/d
1511	0x05e7	Cubic centimeter per second	cm^3/s
1512	0x05e8	Cubic centimeter per minute	cm^3/min
1513	0x05e9	Cubic centimeter per hour	cm^3/h
1514	0x05ea	Cubic centimeter per day	cm^3/d
1577	0x0629	Milliliter per second	ml/s
1563	0x061b	Milliliter per minute	ml/min
1578	0x062a	Milliliter per hour	ml/h

1579	0x062b	Milliliter per day	ml/d
1606	0x0646	Ounce per second	oz/s
1607	0x0647	Ounce per minute	oz/min
1608	0x0648	Ounce per hour	oz/h
1609	0x0649	Ounce per day	oz/d

Table 8-3 Pressure Units Table (See section 5.2 of Process Control Profile)

Value		Description	Symbol
Dec	Hex		
1130	0x046a	Pascal	Pa
1133	0x046d	Kilopascal	kPa
1137	0x0471	Bar	bar
1138	0x0472	Millibar	mbar
1139	0x0473	Torr	torr
1140	0x0474	Atmosphere	atm
1141	0x0475	Pounds/square inch	psi
1144	0x0478	Gram-force per square centimeter	gf/cm^2
1145	0x0479	Kilogram-force per square centimeter	kgf/cm^2
1146	0x047a	Inch of water	inH_2O
1152	0x0480	Foot of water	ftH_2O
1155	0x0483	Inch of mercury	inHg
1157	0x0485	Millimeter of mercury	mmHg
1342	0x053e	Percent	%

Table 8-4 Temperature Units Table (See section 5.2 of Process Control Profile)

Value		Description	Symbol
Dec	Hex		
1000	0x03e8	Kelvin	K
1001	0x03e9	Degrees Celsius	^oC
1002	0x03ea	Degrees Fahrenheit	^oF

Table 8-5 Flow Totalizer Data Units Table

Value		Description	Symbol
Dec	Hex		
1034	0x040A	Cubic meters	m^3
1036	0x040C	Cubic centimeters	cm^3
1038	0x040E	Liters	L
1040	0x0410	Milliliters	ml
1042	0x0412	Cubic inch	in^3
1043	0x0413	Cubic foot	ft^3
1088	0x0440	Kilogram	kg
1089	0x0441	Gram	g
1093	0x0445	Ounce	oz
1094	0x0446	Pound	lb

Table 8-6 Totalizer Command Table

Value		Description
Dec	Hex	
0	0x00	Stop Totalizer
1	0x01	Run Totalizer
2	0x02	Reset Totalizer

Table 8-7 Calibration or Application Instance Table

Value		Description
Dec	Hex	
1	0x01	Calibration/Application instance 1
2	0x02	Calibration/Application instance 2
3	0x03	Calibration/Application instance 3
4	0x04	Calibration/Application instance 4
5	0x05	Calibration/Application instance 5
6	0x06	Calibration/Application instance 6

Table 8-8 Valve Drive Safe State Table

Value		Description
Dec	Hex	
0	0x00	Normal
1	0x01	Closed
2	0x02	Open
3	0x03	Hold

Table 8-9 Valve Override Table

Value		Description
Dec	Hex	
0	0x00	Normal
1	0x01	Off
2	0x02	Purge
4	0x04	Safe State

Table 8-10 Flow Control Ramp Time Table

Value		Description
Dec	Hex	
0	0x0000	Fast
5000	0x1388	5 seconds
8000	0x1F40	8 seconds
12500	0x30D4	12.5 seconds
25000	0x61A8	25 seconds
50000	0xC350	50 seconds

Table 8-11 Flow Control Mode Table

Value		Description
Dec	Hex	
0	0x00	Digital
1	0x01	Off
2	0x02	Purge
128	0x80	Analog

Table 8-12 Pressure Sensor Type Table

Value		Description
Dec	**Hex**	
0	0x00	Gauge
1	0x01	Absolute

Profibus Safe State

When the device looses Profibus communications, it can enter a safe state. This safe state can be configured through the ‘valve drive safe state’ in the User Parameters.

The safe state can be set to normal, hold, close, or open. The normal safe state action will not perform any action and can be used if the device is controlled using the analog setpoint source without Profibus communication. The hold safe state action will hold the setpoint at the current setting. The close safe state action will set the setpoint to zero. The open safe state action will set the setpoint to the configured high range.

LIMITED WARRANTY

Visit www.BrooksInstrument.com for the terms and conditions of our limited warranty.

SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required. For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons. Please contact your nearest sales representative for more details.

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

X-DPT-Profibus-SLA5800-SLAMf-Series-RevB-MFC-PC-RT-eng/541B191AAG/2022-04

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