# WaterMaster
Electromagnetic flowmeter

PROFIBUS RS485 Physical Layer
(FEX100-DP)

**Measurement made easy**

—
**WaterMaster**
**flowmeter**

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or by scanning this code:

| | Search for or click on |
|---|---|
| Data Sheet | DS/WM-EN |
| WaterMaster | Electromagnetic flowmeter | |
| User Guide | IM/WM |
| WaterMaster | Electromagnetic flowmeter | |
| Programming Guide | IM/WMP |
| WaterMaster | Electromagnetic flowmeter | |
| User Guide Supplement – PROFIBUS FEX100-DP Parameter Tables | IM/WMPBST-EN |
| WaterMaster | Electromagnetic flowmeter | |
| Setup Guide | IM/WM/VM |
| VeriMaster | Software tools | |

# Contents

# 1 Introduction

This publication contains information specific to the PROFIBUS®-enabled WaterMaster with RS485 physical layer (PNO registered model FEX100-DP). It must be read in conjunction with IM/WMP and IM/WMPST-EN. The PROFIBUS model name FEX100-DP is applicable to several variants of the WaterMaster flowmeter system (for example, FEV1xx, FEF1xx, FET1xx). Refer to data sheet DS/WM-EN for details of specific order codes.

## 1.1 PROFIBUS

PROFIBUS is a manufacturer-independent, open Fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standard EN 50170.

Using the PROFIBUS protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment.

Further information on PROFIBUS can be found at www.profibus.com.

### 1.1.1 PROFIBUS DP

PROFIBUS DP is designed for high-speed data exchange and is commonly used by complex or externally-powered devices. The central controller or 'master' device (for example, PLC or PC) utilizes PROFIBUS DP as a fast serial connection with distributed (slave) field devices such as PROFIBUS-enabled WaterMasters.

The master device reads the input information cyclically in a defined, recurring order from the slave(s). When configuring the bus system, the user assigns an address in the range 0 to 125 to each slave device and also defines which of the slaves are to be included in, or excluded from, the data acquisition cycle.

### 1.1.2 PROFIBUS PA

PROFIBUS-PA is designed to accommodate process automation field devices and specifies an application profile that characterizes device behavior and parameters in a standard way making integration with a controller easier.

PROFIBUS-PA supports several physical layer options including RS485 and the IEC61168-2 current-loop based bus that can power low-power devices from the bus and is ideal for intrinsic safety in hazardous areas.

## 1.2 PROFIBUS and ABB Products

WaterMaster utilizes PROFIBUS DP as this protocol is optimized for high speed and low connection costs (see www.abb.com/fieldbus and follow the PROFIBUS link).

The WaterMaster FEX100-DP variant has an RS485 physical layer so, while it benefits from the well-defined PROFIBUS PA application profile (version 3.01), it can also be connected directly to a traditional PROFIBUS-DP RS485 network.

## 1.3 PROFIBUS DP Transmission Technology

The most common transfer method of PROFIBUS-DP is RS485 – a proven technology. A twisted, shielded, 2-wire copper cable is used as the transfer medium.

The bus structure enables addition and removal of stations or step-by-step commissioning of the system without affecting other stations. Later expansion has no influence on stations already in operation.

Transmission speeds from 9.6 kbps up to 1.5 Mbps are supported. One uniform transmission speed is selected for all devices on the bus when the system is commissioned.

## 1.4 Acronyms and Abbreviations

| AI | Analog Output Function Block |
|---|---|
| AO | Analog Output Function Block |
| FB | PROFIBUS-PA Function Block |
| Input | Data passed into a Master device (for example, from a Slave device) |
| I&M | PROFIBUS Identification and Maintenance function |
| MS1 | Class 1 Master-Slave acyclic transaction |
| MS2 | Class 2 Master-Slave acyclic transaction |
| Output | Data passed out of a Master device (for example, to a Slave device) |
| PA | PROFIBUS-PA application profile |
| PB | PROFIBUS-PA Physical Block |
| PCS/DCS | Process control system / distributed control system |
| PI/PNO | PROFIBUS International / PROFIBUS User Organization (www.profibus.com) |
| TB | PROFIBUS-PA Transducer Block |
| TOT | Totalizer Function Block |

*Table 1.1 Acronyms and Abbreviations*

## 1.5 PROFIBUS Interface

| Physical layer | RS485 |
|---|---|
| Supported baud rates | 9.6 kbps to 1.5 Mbps |
| Supported DP Protocol services | DPV0, DPV1 |
| Concurrent MS2 connections | 3 |
| Device stub length | 250 mm (9.8 in.) |
| Application profile | PA version 3.01 |
| Master components available | GSD, DTM, EDD |

*Table 1.2 PROFIBUS Interface*

# 2  Installation

## 2.1  Installation Overview

All devices are connected in a bus structure ('line') as shown in Fig 2.1. Up to 32 stations (master or slaves) can be linked to create one 'segment', although it is recommended not to install more than 16 devices on a single segment.

Each end of a segment must be terminated by an active bus terminating resistor. Both bus terminators must always be powered to ensure fault-free operation, therefore it is strongly recommended that they are connected to a back-up power supply. The use of bus amplifiers (repeaters) and segment couplers can be used to extend the network.
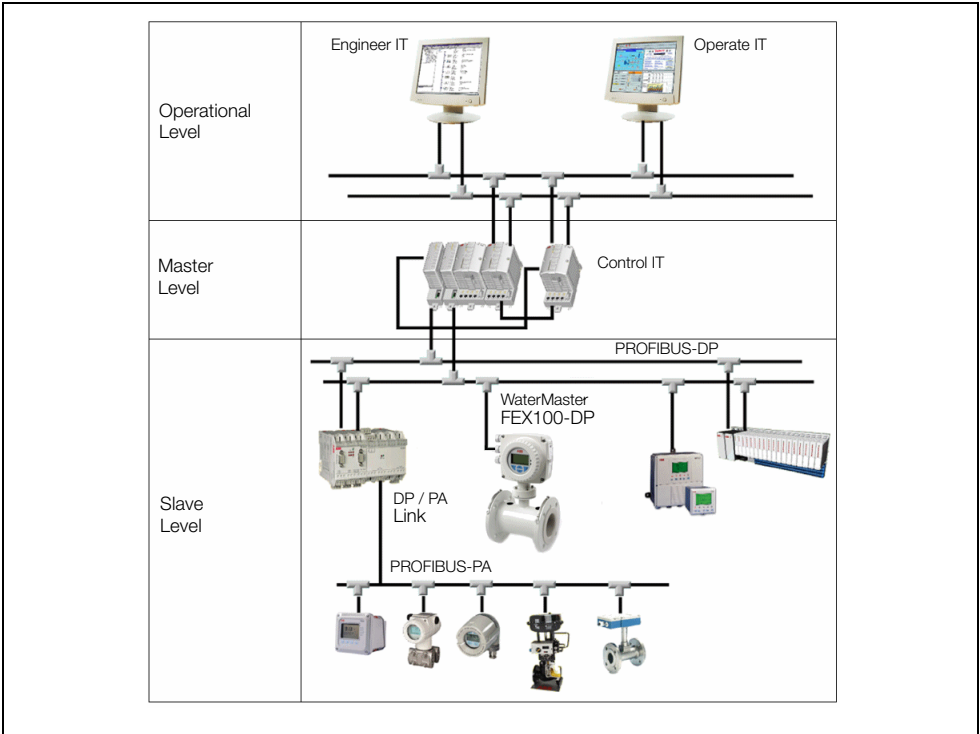


*Fig. 2.1  Typical PROFIBUS Network*

## 2.2  Cable Length

The maximum cable length of a segment is determined by the transmission speed (see Table 2.1). The cable length specified can be extended using repeaters, but it is recommended that no more than 3 repeaters are connected in series.

| Transmission Rate (bits / second) | Maximum Segment Length (m [ft.]) | Maximum Total Network Length (m [ft.]) |
|---|---|---|
| 9.6 to 93.75 kbps | 1200 (3937) | 4800 (15748) |
| 187.5 kbps | 1000 (3280) | 4000 (13123) |
| 500 kbps | 400 (1312) | 1600 (5249) |
| 1.5 Mbps | 200 (656) | 800 (2624) |
| 3 to 12 Mbps | 100 (328) | 400 (1312) |

*Table 2.1  Cable Length*

## 2.3  Cable Specification

The cable lengths in Table 2.1 refer to the following cable type:

| | |
|---|---|
| Characteristic impedance | 135 to 165 $\Omega$ |
| Capacitance per unit length | <30 pf/m |
| Loop resistance | 110 $\Omega$/km |
| Core diameter | 0.64 mm |
| Core cross section | >0.34 mm$^2$ |

*Table 2.2  Cable Specification*

Suitable PROFIBUS cable (part numbers PCA010, PCA011 and PCA012) can be obtained from ABB. Refer to Data Sheet 10/63-6.46 EN.

# 3  Network Connection

> **Caution.**
>
> When connecting a WaterMaster to a PROFIBUS-DP RS485 network:
>
> - Refer to the WaterMaster User Guide (IM/WM) before making electrical connections.
> - Refer to IM/WM for all other installation and connection details.
> - Use cable that meets PROFIBUS specifications for reliable RS485 communications.
> - Ensure RS485 signals are not reversed.
> - Ensure a PROFIBUS active terminator is fitted each end of the RS485 bus segment.
> - Route data lines clear of the source of any strong electrical and magnetic fields.

## 3.1  Network Connections

PROFIBUS network connections are made to the terminal blocks on the WaterMaster backplane PCB located below the cartridge assembly (refer to Fig 3.1). Refer to IM/WM to remove the cartridge assembly and access these terminals and to replace the cartridge before powering up the transmitter.
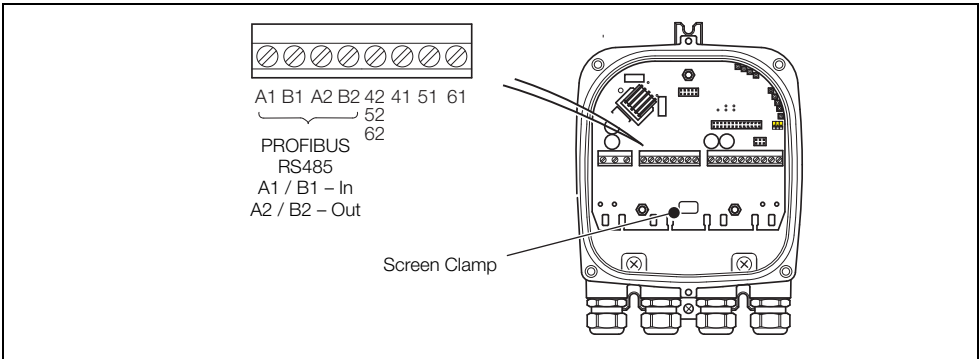


*Fig. 3.1  WaterMaster RS485 Backplane Connections to PROFIBUS Network*

| Data Signal | Cable Color | Description |
|---|---|---|
| A | Green | Negative (–) data line: connect to pin 8 on PROFIBUS DP equipment with 9-way D-type connectors. |
| B | Red | Positive (+) data line: connect to pin 3 on PROFIBUS DP equipment with 9-way D-type connectors. |
| Braided screen | N / A | Cable screen – usually connected to the D-type shell or pin 1 on PROFIBUS DP equipment with 9-way D-type connectors. |

*Table 3.1  PROFIBUS DP Data Cable Signals*

# 4 Configuration

## 4.1 Setting the PROFIBUS Station Address

The PROFIBUS Station Address for a WaterMaster can be set set locally via the keypad and menus or remotely by a master using the SET_SLAVE_ADDRESS service.

When the PROFIBUS Master sets the transmitter's Station Address, the address is stored and overwrites the address value previously held in the the instrument.

> **Warning.** The WaterMaster reboots after its PROFIBUS Station Address parameter is changed. During this period it is not visible to any PROFIBUS masters.

To change the Station Address:

1   From the *Operator* page, press ◥ (the key beneath the ▫▪ icon).

    The *Access Level* is displayed.

    **Note**. Values displayed on the *Operator* page are determined by the transmitter's configuration – refer to IM/WMP for configuration details.
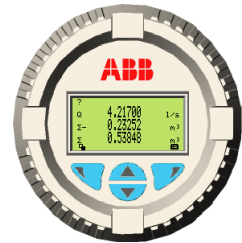
2   Use the ▲ and ▼ keys to scroll to the *Advanced* menu and press ⬜ to display the *Enter Password* page.
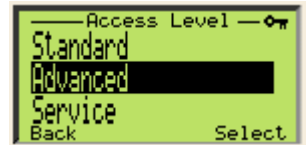
3   Use the ▲ and ▼ keys to move to and highlight the first password character.

    Press ◥ to select the character.

    Navigate to and select any additional password characters.

    Press ⬜ to accept the password and log in to the *Operator* level menus.
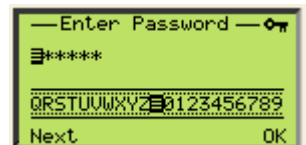
    **Note**. The factory default password for *Advanced* level access is null or no password (this can be changed in the *Device Setup* pages).

    If an invalid password is entered, the *Advanced* level menus cannot be accessed and the *Operator* page is displayed.

4   Use the ▲ and ▼ keys to move to the *Communication* page.

Press ⟊ to enter the *Communication* level.

─── Menu ─── 7
Communication

Exit                Select

5   Use the ▲ and ▼ keys to move to and highlight the *PROFIBUS* menu.

Press ⟊ to enter the *PROFIBUS* level.

── Communication ── 4
Cyclic Data Output
Service Port
Profibus
Back                Select

6   If the *Station Address* menu is not already highlighted, use the ▲ and ▼ keys to move to and highlight the *Station Address* menu.

Press ⟊ to enter the PROFIBUS / *Station Address* page.

──── Profibus ──── 1
Station Address
Ident. Select
Data Exchange State
Back                Select

7   The current *Station Address* setting (for example 70) is displayed.

To edit this value, press ⟊ to enter the *Station Address* edit page.

**Note**. To exit the page without changing the setting and return to the *Operator* page, press ⟉ 4 times.

──── Profibus ──── 1
Station Address
                      70
Back                 Edit
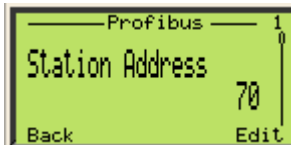
8   Use the ⟉ key to move between editable numbers and use the ▲ and ▼ keys to increment / decrement each number.

Press ⟊ to accept the new value and exit the *Station Address* edit page.

**Note**. Press ⟉ 4 times to return to the *Operator* page.

─Station Address ─123
          070
Max   126
Min   1
Next                 OK

## 4.2 Integration using GSD

PROFIBUS devices differ with respect to available functionality and parameters for each device type and manufacturer. In order to obtain 'Plug-and-Play' configuration for PROFIBUS, characteristic device communication features such as manufacturer name, device name, hardware / software versions, baud rate and the number and nature of inputs / outputs are defined in an electronic device data sheet known as a GSD (Generic Station Description) file.

A GSD file is readable ASCII text file that contains both general and device-specific specifications for communication. Each of the entries describes a feature supported by a device. By using keywords, a configuration tool reads the device identification, the adjustable parameters, the corresponding data type and the permitted limit values for the configuration of the device from the GSD. Some keywords are mandatory, for example, Vendor_Name; others are optional, for example, Sync_Mode_supported.

The GSD file for WaterMasters specifies the device-specific Ident No. 3431. It conforms to the PROFIBUS standard, providing a clear and comprehensive description of each instrument in a precisely defined format. This enables the system configuration tool to use the information automatically when configuring a PROFIBUS bus system.

The ABB GSD file (Ident No. 3431) is divided into 2 sections:

■ **General Specifications**

Identification of the device, together with hardware and software versions, baud rates supported and the possible time intervals for monitoring times.

■ **DP Slave-Related Specifications**

Information about the user parameter block for device-specific configuration and modules containing details of the input and output data that can be exchanged cyclically with a PROFIBUS master.

The WaterMaster GSD file (ABB_3431.gsd) is available for download from the ABB website at: www.abb.com/fieldbus (follow the link for PROFIBUS DP field devices).

## 4.2.1 Condensed Diagnostic Status

WaterMaster supports enabling / disabling of condensed diagnostic status (as the PROFIBUS PA version 3.01 profile specification) via the PRM_COND bit of the profile-specific Prm_Structure that can be included by the SET_PRM service, depending on the settings in the GSD file.

Values for the Prm_Structure octets sent in the SET_PRM service are defined in the WaterMaster-specific GSD file.

Condensed status / diagnostics are disabled by default, if the Prm_Structure is not sent in the SET_PRM service.

| Octet | Description |
|-------|-------------|
| 0 | Structure length – fixed to 5 |
| 1 | Structure type – fixed to 65 (profile-specific) |
| 2 | Slot number – fixed to 0 (settings in Prm_Structure apply to whole device) |
| 3 | Reserved – fixed to 0 |
| 4 | Options:<br><br>Bit0          PRM_COND:<br>                  1 = condensed status enabled<br>                  0 = condensed status disabled<br><br>Bit1 to Bit7    Reserved – fixed to 0 |

*Table 4.1 Profile-specific Prm_Structure*

## 4.2.2 Cyclic Data Exchange Modules

Modules are defined for the following functions (see Table 4.2). Their formats are in accordance with PROFIBUS PA version 3.01 Function Block specifications – see Appendix A for details of the structure of these blocks.

| Module | Data Type |
|--------|-----------|
| 1 | Empty Module (for slot not used) |
| 2 | Analog Input OUT (input) value |
| 3 | Totalizer TOTAL (input) value |
| 4 | Totalizer SET_TOT (output) and TOTAL (input) values |
| 5 | Totalizer SET_TOT (output), MODE_TOT (output) and TOTAL (input) values |
| 6 | Analog Output SP (output) value |

*Table 4.2 GSD File Module Definitions (Ident No. 3431)*

Selection of modules operates for the following slots:

| Slot | Slot Name (see Table for Slot Descriptions) | Module Options | |
|---|---|---|---|
| | | Default | Option(s) |
| 1 | AI1 Volume Flowrate (Q) | 2 | 1,2 |
| 2 | TOT1 Totalizer 1 | 3 | 1, 3, 4, 5 |
| 3 | TOT2 Totalizer 2 | 3 | 1, 3, 4, 5 |
| 4 | AI2 Internal Volume (FWD) | 2 | 1, 2 |
| 5 | AI3 Internal Volume (REV) | 2 | 1, 2 |
| 6 | AI4 Diagnostics | 2 | 1, 2 |
| 7 | AO1 Display Value | 6 | 1, 6 |

*Table 4.3  GSD file slot definitions*

| Slot Name | Description |
|---|---|
| AI1 Volume Flowrate (Q) | The meter's primary process measurement value. |
| TOT1 Totalizer 1 | PROFIBUS PA totalizer for volumetric flow.<br>Operation is determined by the MODE setting.<br>Factory set to forward flow totalization. |
| TOT2 Totalizer 2 | PROFIBUS PA totalizer for volumetric flow.<br>Operation is determined by the MODE setting.<br>Factory set to reverse flow totalization. |
| AI2 Internal Volume (FWD) | The meter's internal forward volumetric flow totalizer<br>(as shown on the local display). |
| AI3 Internal Volume (REV) | The meter's internal reverse volumetric flow totalizer<br>(as shown on the local display). |
| AI4 Diagnostics | To read system diagnostic measurements such as coil current etc.<br>The AI CHANNEL number determines the source. |
| AO1 Display Value | A process value from another instrument to be shown on the WaterMaster's local display in addition to its own process values. |

*Table 4.4  GSD File Slot Name Descriptions*

## 4.3  Configuration from the WaterMaster Display

PROFIBUS-related parameters are configured from the WaterMaster's *Communication / PROFIBUS* page.

*PROFIBUS* parameters are readable at all access levels. Write access to secure (writable) parameters is possible only at 'Advanced' access level. Refer to Section 4.1, page 9 and the WaterMaster User Guide (IM/WMP) for details of *Access Level* page parameters.

*PROFIBUS* parameters options are described in Table 4.5.

| Parameter | Description |
|---|---|
| *Station Address* | Sets the PROFIBUS *Station Address* value – see page 10. |
| *Ident Select* | Selected profile ident number.<br>Options are the specific WaterMaster ident number (3431) and supported profile specific ident numbers. |
| *Data Exchange State* | Indicates if the transmitter is in cyclic data exchange with a PROFIBUS master (read only parameter).<br>*Active*<br>*Inactive* |
| *Baud Rate* | Indicates the baud rate (in kbps) the transmitter has locked on to (read only parameter). |

*Table 4.5  PROFIBUS Parameter Descriptions*

## 4.4 Configuration using Device Type Manager (DTM) Software

The WaterMaster DTM can be used for acyclic parameter configuration and monitoring of measurement values using a suitable PC-based FDT 1.2/1.2.1 frame application tool (such as ABB AssetVision Basic) and a Class 2 PROFIBUS master (with its corresponding Communication DTM).

**Downloads and Bundles**:

■ AssetVision Basic – available as a download from the ABB website at www.abb.com/fieldbus (follow the link for Scalable Device Management Tools).

■ WaterMaster DTM – available as a download from the ABB website at www.abb.com/fieldbus (follow the link for DTM Bundle) or supplied in the ABB DTM500 Bundle – contact ABB sales for details.

An example dialog from the WaterMaster PROFIBUS FEX100-DP DTM is shown in Fig. 4.1.



*Fig. 4.1 Example Dialog – Extract from WaterMaster FEX100-DP DTM*

## 4.5 Configuration using an EDD

Similar to the use of a DTM, configuration of WaterMaster parameters and monitoring of measurement values is possible using an EDD interpreter application with the WaterMaster EDD file.

This EDD file is available for download from the ABB website at www.abb.com/fieldbus (follow link for PROFIBUS DP field devices).

# 5 PROFIBUS Block Parameters

WaterMaster parameters are arranged in blocks that are formatted in accordance with PROFIBUS-PA specifications that define 3 categories of blocks: Physical Block, Transducer Block and Function Block.

Analog Input, Totalizer and Analog Output Function Blocks are used by WaterMaster – see Appendix A for PROFIBUS PA block structure diagrams.

PROFIBUS-PA blocks described in Table 5.1 are defined for WaterMaster – Fig. 5.1, page 18 shows the relationship between WaterMaster Transducer Blocks and Function Blocks.

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**Note.**

■ TOT blocks are defined by the PROFIBUS PA specification and are not the same as the WaterMaster's own internal totalizers.

■ WaterMaster's own internal totalizers (AI2, AI3) should be used instead of PROFIBUS totalizer blocks (TOT1, TOT2) for custody transfer and fiscal metering applications.

■ The locally displayed totalizer values have a much higher resolution and range than the internal totalizer values expressed via AI blocks. This means that the lower significance digits should be the same, allowing for limitation of floating point value accuracy, but higher significance digits may be cut off on the AI totalizer value.

■ Refer to IM/WMPBST-EN for full details of PROFIBUS Block Parameters Slots 0 to 12. This manual can be downloaded from www.abb.com.

---

| Slot | Block | Description |
|------|-------|-------------|
| 0 | Physical Block (PB) | Standard PROFIBUS PA Physical Block parameters plus settings for profile selection, alarms and alarm history. |
| 1 | AI1 Volume Flowrate (Q) | Volumetric flow rate, that is the primary process value for the instrument. |
| 2 | TOT1 Totalizer 1 | Volume totalizer. Factory-set to accumulate in the forward flow direction, but mode can be changed to suit user requirements. |
| 3 | TOT2 Totalizer 2 | Volume totalizer. Factory-set to accumulate in the reverse flow direction, but mode can be changed to suit user requirements. |
| 4 | AI2 Internal Volume (FWD) | WaterMaster's internal forward flow volume totalizer. This is the same as the totalizer value displayed on the *Operator* page. |
| 5 | AI3 Internal Volume (REV) | WaterMaster's internal reverse flow volume totalizer. This is the same as the totalizer value displayed on the *Operator* page. |

*Table 5.1 PROFIBUS Block Parameters – Slots 0 to 12*

| Slot | Block | Description |
|------|-------|-------------|
| 6 | AI4 Diagnostic Signal | Value of certain measurements used for diagnostics purposes such as electromagnetic coil resistance. The block's channel number defines the actual measurement source. |
| 7 | AO1 Display Value | Allows the master to send a process value from another instrument to be shown on the local display in addition to the WaterMaster's own process values (for example, if the remote instrument did not have its own local display). |
| 8 | TB1 Flow | Block for signal processing of process measurements. Holds similar configuration items to the *Device Setup* menu pages. |
| 9 | TB2 Device Info | Unique information about a particular instrument such as serial numbers. Holds similar configuration items to the *Device Info* menu pages. |
| 10 | TB3 Special Function | Holds similar configuration items to the *Totalizer* and *Input / Output* menu pages. |
| 11 | TB4 Display | Holds similar configuration items to the menu pages displayed on the WaterMaster. |
| 12 | TB5 Diagnostics | Block for processing of diagnostic signal measurements. Holds similar configuration items to the *Diagnostic* menu pages. |

*Table 5.1 PROFIBUS Block Parameters – Slots 0 to 12 (Continued)*
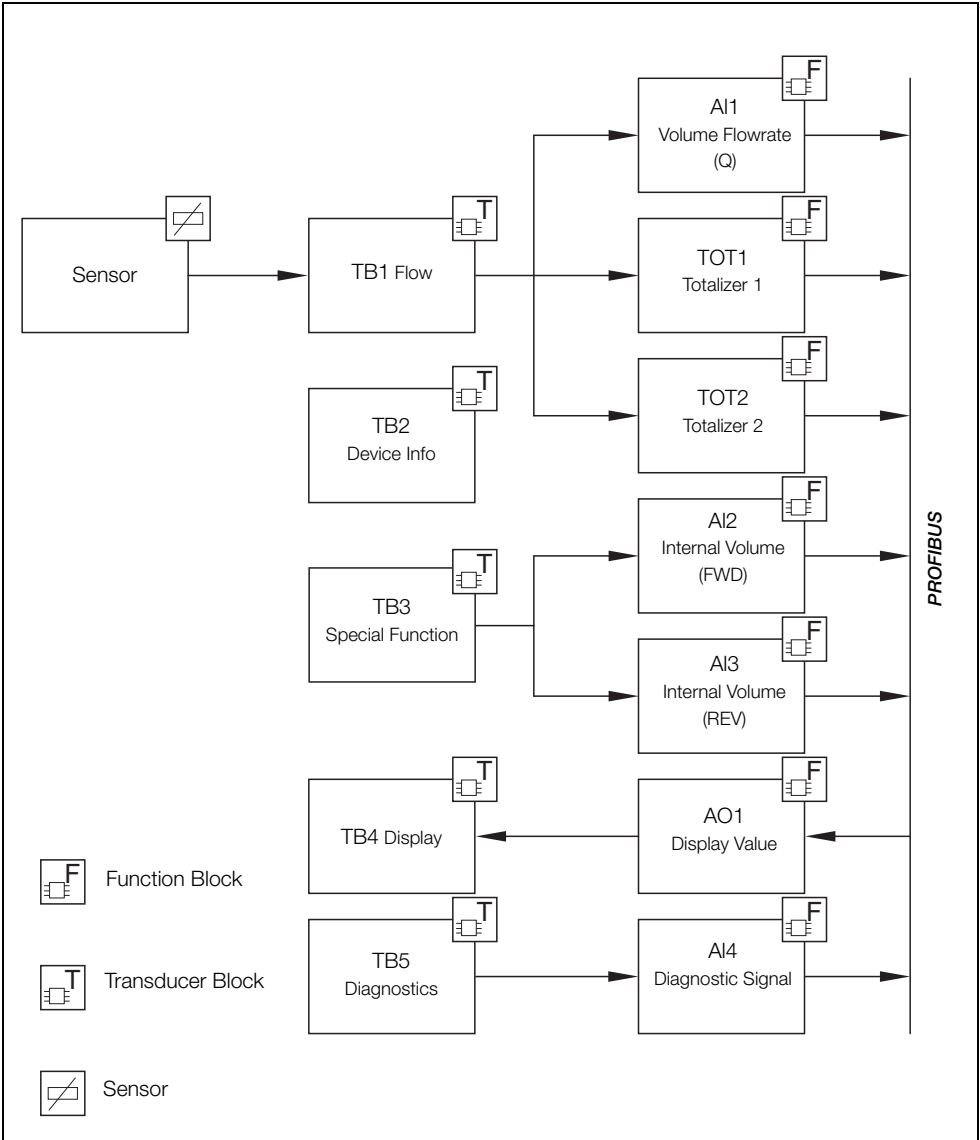
*Fig. 5.1  WaterMaster Transducer and Function Block Relationships*

| | Supported PA Ident Numbers | | | |
|---|---|---|---|---|
| | 0x3431<br>FEX100-DP | 0x9741<br>Profile-specific<br>(2AI + 1TOT) | 0x9740<br>Profile-specific<br>(1AI + 1TOT) | 0x9700<br>Profile-specific<br>(1AI ) |
| Physical Block (PB) | Slot 0 | Slot 0 | Slot 0 | Slot 0 |
| AI1 Volume Flowrate (Q) | Slot 1 | Slot 1 | Slot 1 | Slot 1 |
| TOT1 Totalizer 1 | Slot 2 | Slot 2 | Slot 2 | – |
| TOT2 Totalizer 2 | Slot 3 | – | – | – |
| AI2 Internal Volume (FWD) | Slot 4 | Slot 4 | – | – |
| AI3 Internal Volume (REV) | Slot 5 | – | – | – |
| AI4 Diagnostics | Slot 6 | – | – | – |
| AO1 Display Value | Slot 7 | – | – | – |
| TB1 Flow | Slot 8 | Slot 8 | Slot 8 | Slot 8 |
| TB2 Device Info | Slot 9 | Slot 9 | Slot 9 | Slot 9 |
| TB3 Special Function | Slot 10 | Slot 10 | Slot 10 | Slot 10 |
| TB4 Display | Slot 11 | Slot 11 | Slot 11 | Slot 11 |
| TB5 Diagnostics | Slot 12 | Slot 12 | Slot 12 | Slot 12 |

*Table 5.2  Slots used for Supported PA Ident numbers*

# 6 Error and Warning Handling

## 6.1 Device Alarms

WaterMaster has two instrument-specific alarm registers: one for current alarms, the other for alarm history (latch of alarm bits that have been set since last being cleared).

These alarms are a combination of errors and warnings (as defined in IM/WMP) and are located in the *Physical Block*. The alarm history can be cleared by writing to the *Clear Alarm History* parameter of the *Physical Block*. In addition to instrument-specific alarms, each Function Block has separate error and warning registers. For testing, it is possible to simulate device-specific error and warning alarms, although the alarm history does not show simulated alarms.
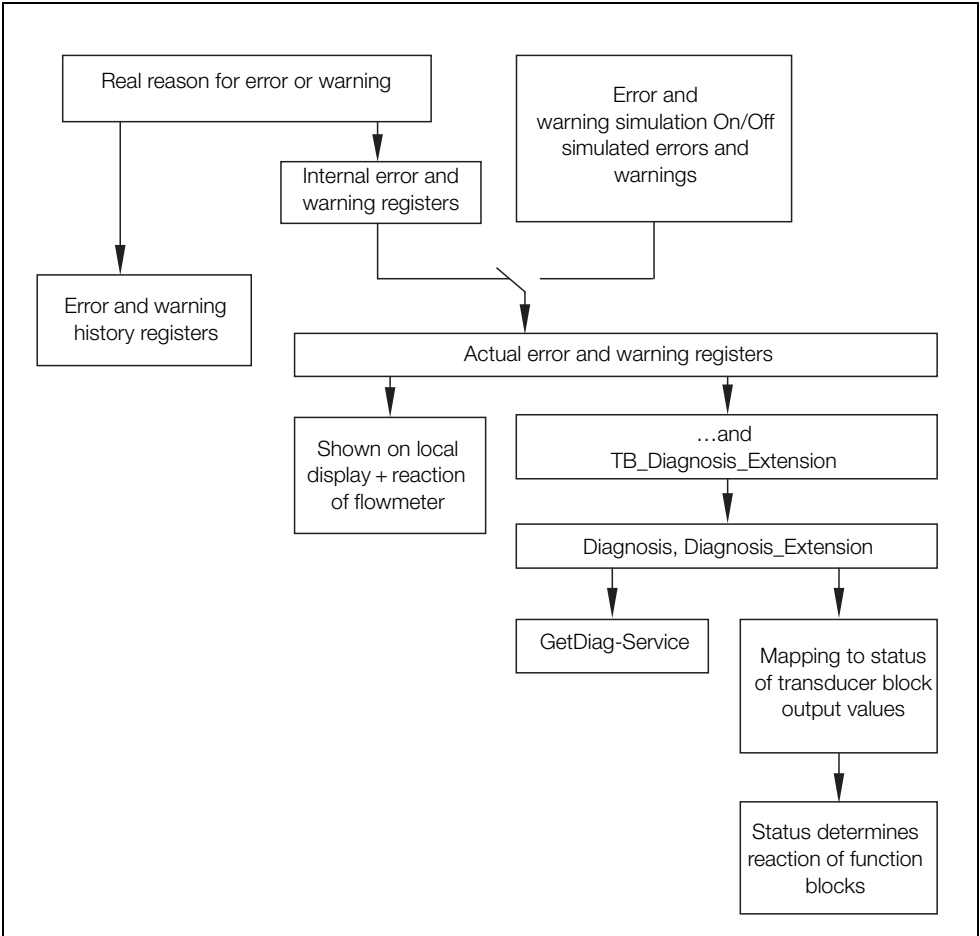


*Fig. 6.1 WaterMaster Error and Warning Activities*

## 6.2 Diagnostic Message Formats

The WaterMaster responds to diagnostics requests from the PROFIBUS master in 1 of 2 formats:

■ **Short format**

The short format is sent if there are no extended diagnostic alarms that need to be signalled (when the diagnostic response Ext_Diag bit is not set). This format is the standard PROFIBUS diagnostic response of 6 bytes without extended diagnostics information.

■ **Long format**

The long format is sent if extended diagnostic alarms need to be signalled (when the diagnostic response Ext_Diag bit is set). This format is the standard diagnostics information plus DPV1 extended diagnostics information.

## 6.3 Extended Diagnostics

The following PROFIBUS DPV1 extended diagnostic information is available, this information is always located after the standard diagnostic information (that occupies bytes 0 to 5 inclusive):

| Byte | Description |
|------|-------------|
| 6 | The length of the DPV1 status message (including this byte) |
| 7 | DPV1 status type |
| 8 | Slot number (of Physical Block) |
| 9 | Specifier. The value of Bit0 and Bit1 indicate the change condition:<br>1 = status appears<br>2 = status disappears |
| 10 to 13 | 4 octets DIAGNOSIS |
| 14 to 19 | 6 octets DIAGNOSIS_EXTENSION |

*Table 6.1 PROFIBUS Parameter Descriptions*

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**Note.** Bytes 6 to 9 inclusive are defined by the DPV1 diagnostic model specification.

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### 6.3.1 DIAGNOSIS Parameter

The DIAGNOSIS parameter is at relative index 13 of the Physical Block. The meaning of bits within the DIAGNOSIS value are defined or reserved by the application profile PROFIBUS PA version 3.01 and depend on whether extended or condensed status is enabled. Alarm status is maintained for the duration of the alarm condition, with the exception of *Warm Start* and *Cold Start* indications that reset after 10 seconds.

**Extended Status**

The PROFIBUS PA application profile defines a standard set of alarm status bits and is used when condensed diagnostic status is disabled. The instrument's diagnostic response Ext_Diag bit is set when any of these alarm bits are set.

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) |
|---|---|---|---|
| 1 | 0 | 24 | Hardware failure of the electronics |
| | 1 | 25 | Hardware failure mechanics |
| | 2 | 26 | Motor temperature too high |
| | 3 | 27 | Electronic temperature too high |
| | 4 | 28 | Memory error |
| | 5 | 29 | Failure in measurement |
| | 6 | 30 | Device not initialized (no self-calibration) |
| | 7 | 31 | Self-calibration failed |
| 2 | 0 | 32 | Zero point error (limit position) |
| | 1 | 33 | Power supply failed (electrical, pneumatic) |
| | 2 | 34 | Configuration not valid |
| | 3 | 35 | Warm Start performed |
| | 4 | 36 | Cold Start performed |
| | 5 | 37 | Maintenance required |
| | 6 | 38 | Characterization invalid |
| | 7 | 39 | Ident_Number of the running cyclic data transfer and the value of Physical Block IDENT_NUMBER_SELECTOR parameter are different. |
| 3 | 0 to 7 | 40 to 47 | Reserved by PNO, fixed to 0 |
| 4 | 0 to 6 | 48 to 54 | Reserved by PNO, fixed to 0 |
| | 7 | 55 | More diagnosis information is available in DIAGNOSIS_EXTENSION |

*Table 6.2 DIAGNOSIS Bit Descriptions (Extended)*

## Condensed Status

The PROFIBUS PA application profile defines condensed status and diagnostics to:

- ■ make diagnostic events clearer with reference to the usage in the PCS / DCS and the Maintenance Station
- ■ indicate the need of maintenance in a graduated way
- ■ add new required status information

When condensed diagnostic status is enabled, the instrument's diagnostic response Ext_Diag bit is set only when a failure alarm bit is set.

The following table shows condensed alarm bits as defined by the PROFIBUS PA application profile.

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) |
|-------|-----|---------------------|----------------------------|
| 1 | 0 to 7 | 24 to 31 | Reserved by PNO, fixed to 0 |
| 2 | 0 to 2 | 32 to 34 | Reserved by PNO, fixed to 0 |
| | 3 | 35 | *Warm Start* performed |
| | 4 | 36 | *Cold Start* performed |
| | 5 | 37 | Maintenance required |
| | 6 | 38 | Reserved by PNO, fixed to 0 |
| | 7 | 39 | Ident_Number of the running cyclic data transfer and the value of Physical Block IDENT_NUMBER_SELECTOR parameter are different |
| 3 | 0 | 40 | Device failure. Causes Ext_Diag bit to be set |
| | 1 | 41 | Maintenance demanded |
| | 2 | 42 | Device is in function check mode or in simulation or under local control (for example, maintenance) |
| | 3 | 43 | The process conditions prevent return to valid values – the value has the following quality status definitions: Uncertain, process related; Uncertain, no maintenance; Bad, process related; Bad, no maintenance |
| | 4 to 7 | 44 to 47 | Reserved by PNO, fixed to 0 |
| 4 | 0 to 6 | 48 to 54 | Reserved by PNO, fixed to 0 |
| | 7 | 55 | More diagnosis information is available in DIAGNOSIS_EXTENSION |

*Table 6.3 DIAGNOSIS Bit Descriptions (Extended)*

### 6.3.2 DIAGNOSIS_EXTENSION Parameter

The DIAGNOSIS_EXTENSION parameter is at relative index 14 of the Physical Block.

WaterMaster's map device-specific diagnostic error and warning messages into bits of the DIAGNOSIS_EXTENSION. Because the standard profile Ident Numbers do not support these device-specific alarms, they are available only when the WaterMaster-specific Ident Number (3431) is used.

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) |
|-------|-----|---------------------|----------------------------|
| 1 | 0 | 56 | Unused |
|   | 1 | 57 | Logic simulation selected on OP1 |
|   | 2 | 58 | Pulse simulation selected on OP1 |
|   | 3 | 59 | Logic simulation selected on OP1 |
|   | 4 | 60 | Pulse simulation selected on OP2 |
|   | 5 | 61 | Logic simulation selected on OP3 |
|   | 6 | 62 | Low flow alarm |
|   | 7 | 63 | High flow alarm |
| 2 | 0 | 64 | Q > 103% Qmax |
|   | 1 | 65 | Simulation mode on |
|   | 2 | 66 | Tx. simulator / calibrator mode |
|   | 3 | 67 | At Qmax, volume display overrun <1600 hours |
|   | 4 | 68 | Totalizer reset |
|   | 5 | 69 | Intermittent sensor comms |
|   | 6 | 70 | Unused |
|   | 7 | 71 | Tx. memory fault detected |
| 3 | 0 | 72 | Sensor memory not detected |
|   | 1 | 73 | Tx. measurement suspended |
|   | 2 | 74 | Empty pipe |
|   | 3 | 75 | Unused |
|   | 4 | 76 | Unused |
|   | 5 | 77 | Open circuit electrode |
|   | 6 | 78 | Short circuit electrode |
|   | 7 | 79 | Unused |

*Table 6.4  DIAGNOSIS Bit Descriptions – Extended*

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) |
|---|---|---|---|
| 4 | 0 | 80 | Installation fault / condition |
| | 1 | 81 | Open circuit coil / wiring |
| | 2 | 82 | Short circuit coil / wiring |
| | 3 | 83 | Check cable + coil resistance |
| | 4 | 84 | Transmitter hardware fault |
| | 5 | 85 | Bad flow data |
| | 6 | 86 | Accuracy warning |
| | 7 | 87 | OIML self-check limits exceeded |
| 5 | 0 | 88 | Measurement starting |
| | 1 | 89 | Unused |
| | 2 | 90 | Sensor setup not complete |
| | 3 | 91 | Incompatible sensor |
| | 4 | 92 | Tx. code memory fault |
| | 5 | 93 | Tx. data memory fault |
| | 6 | 94 | Unused |
| | 7 | 95 | Alarm simulation active |
| 6 | 0 | 96 | Non-volatile summary alarm |
| | 1 to 7 | 97 to 103 | Unused |

*Table 6.4  DIAGNOSIS Bit Descriptions – Extended  (Continued)*

## 6.4  Mapping Alarms to Transducer Block Status

Transducer Blocks deliver measurement values to their corresponding Function Blocks in a data structure (PROFIBUS data type structure 101) containing the measurement value plus a status code to indicate the quality of the measurement value.

WaterMasters have three diagnostic groups that affect the measurement value status of the associated Transducer Block channels and the Function Blocks connected to them when error or warning bits are set – these are defined in Table 6.5.

| Diagnostic Group | TB Channels Affected | FBs Affected |
|---|---|---|
| 0 | VOLUME_FLOWRATE | AI1, TOT1, TOT2 |
| 1 | VOLUME_FORWARD,VOLUME_REVERSE | AI2, AI3 |
| 2 | ELECTRODE_1_RESISTANCE ELECTRODE_2_RESISTANCE BACK_OFF_VOLTAGE COIL_AND_CABLE_RESISTANCE COIL_INDUCTANCE SENSOR_INDUCTANCE_SHIFT TRANSMITTER_AVERAGE_GAIN_SHIFT | AI4 |

*Table 6.5  Diagnostic Group TB Channels*

### 6.4.1  Extended Status Tables

The following tables define how set alarm bits affect the measurement status of the corresponding Transducer Block channels for extended status (refer to the PROFIBUS PA application profile specification for more details on these definitions).

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) | Diagnostic Group 0 | Diagnostic Group 1 | Diagnostic Group 2 |
|---|---|---|---|---|---|---|
| 1 | 0 | 56 | Unused | | | |
| | 1 | 57 | Logic simulation selected on OP1 | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| | 2 | 58 | Pulse simulation selected on OP1 | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| | 3 | 59 | Logic simulation selected on OP1 | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| | 4 | 60 | Pulse simulation selected on OP2 | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| | 5 | 61 | Logic simulation selected on OP3 | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| | 6 | 62 | Low flow alarm | GOOD(NC), low limited | GOOD(NC), low limited | GOOD(NC), low limited |
| | 7 | 63 | High flow alarm | GOOD(NC), high limited | GOOD(NC), high limited | GOOD(NC), high limited |
| 2 | 0 | 64 | Q > 103% Qmax | GOOD(NC), high limited | GOOD(NC), high limited | GOOD(NC), high limited |

*Table 6.6  Alarm Mapping for Extended Status*

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) | Diagnostic Group 0 | Diagnostic Group 1 | Diagnostic Group 2 |
|---|---|---|---|---|---|---|
| | 1 | 65 | Simulation mode on | UNCERTAIN, simulated value | UNCERTAIN, simulated value | GOOD(NC) |
| | 2 | 66 | Tx. simulator / calibrator mode | UNCERTAIN, simulated value | UNCERTAIN, simulated value | GOOD(NC) |
| | 3 | 67 | At Qmax, volume display overrun <1600 hours | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| | 4 | 68 | Totalizer reset | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| | 5 | 69 | Intermittent sensor comms | GOOD(NC), maintenance required | GOOD(NC), maintenance required | GOOD(NC), maintenance required |
| | 6 | 70 | Unused | | | |
| | 7 | 71 | Tx. memory fault detected | BAD, device failure | BAD, device failure | BAD, device failure |
| 3 | 0 | 72 | Sensor memory not detected | BAD, device failure | BAD, device failure | BAD, device failure |
| | 1 | 73 | Tx. measurement suspended | BAD, device failure | BAD, device failure | BAD, device failure |
| | 2 | 74 | Empty pipe | UNCERTAIN, non-specific | UNCERTAIN, non-specific | UNCERTAIN, non-specific |
| | 3 | 75 | Unused | | | |
| | 4 | 76 | Unused | | | |
| | 5 | 77 | Open circuit electrode | UNCERTAIN, non-specific | UNCERTAIN, non-specific | UNCERTAIN, non-specific |
| | 6 | 78 | Short circuit electrode | UNCERTAIN, non-specific | UNCERTAIN, non-specific | UNCERTAIN, non-specific |
| | 7 | 79 | Unused | | | |

*Table 6.6 Alarm Mapping for Extended Status (Continued)*

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) | Diagnostic Group 0 | Diagnostic Group 1 | Diagnostic Group 2 |
|-------|-----|---------------------|---------------------------|---------------------|---------------------|---------------------|
| 4 | 0 | 80 | Installation fault / condition | BAD, device failure | BAD, device failure | BAD, device failure |
| | 1 | 81 | Open circuit coil / wiring | BAD, device failure | BAD, device failure | BAD, device failure |
| | 2 | 82 | Short circuit coil / wiring | BAD, device failure | BAD, device failure | BAD, device failure |
| | 3 | 83 | Check cable and coil resistance | BAD, device failure | BAD, device failure | BAD, device failure |
| | 4 | 84 | Transmitter hardware fault | BAD, device failure | BAD, device failure | BAD, device failure |
| | 5 | 85 | Bad flow data | BAD, device failure | BAD, device failure | BAD, device failure |
| | 6 | 86 | Accuracy warning | UNCERTAIN, non-specific | UNCERTAIN, non-specific | UNCERTAIN, non-specific |
| | 7 | 87 | OIML self-check limits exceeded | GOOD(NC), maintenance required | GOOD(NC), maintenance required | GOOD(NC), maintenance required |
| 5 | 0 | 88 | Measurement starting | UNCERTAIN, non-specific | UNCERTAIN, non-specific | UNCERTAIN, non-specific |
| | 1 | 89 | Unused | | | |
| | 2 | 90 | Sensor setup not complete | UNCERTAIN, non specific | UNCERTAIN, non specific | UNCERTAIN, non specific |
| | 3 | 91 | Incompatible sensor | BAD, device failure | BAD, device failure | BAD, device failure |
| | 4 | 92 | Tx. code memory fault | BAD, device failure | BAD, device failure | BAD, device failure |
| | 5 | 93 | Tx. data memory fault | BAD, device failure | BAD, device failure | BAD, device failure |
| | 6 | 94 | Unused | | | |
| | 7 | 95 | Alarm simulation active | GOOD(NC) | GOOD(NC) | GOOD(NC) |
| 6 | 0 | 96 | Non-volatile summary alarm | BAD, device failure | BAD, device failure | BAD, device failure |
| | 1 to 7 | 97 to 103 | Unused | | | |

*Table 6.6  Alarm Mapping for Extended Status  (Continued)*

For extended status, the status value is formatted into several fields and is defined in Table 6.7:

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|
| Quality | | Quality Sub Status | | | | Limits | |

*Table 6.7  Status Value Field Formats*

| | |
|---|---|
| 0 | BAD – the value is not useful. |
| 1 | UNCERTAIN<br>– the quality of the value is less than normal, but the value may still be useful. |
| 2 | GOOD (non-cascade / NC)<br>– the quality of the value is good. Possible alarm conditions may be indicated by the sub-status. |
| 3 | GOOD (cascade / C)<br>– the value can be used in control. |

*Table 6.8  Quality*

| | |
|---|---|
| 0 | Non-specific |
| 1 | Configuration error |
| 2 | Not connected |
| 3 | Device failure |
| 4 | Sensor failure |
| 5 | No communication (last usable value) |
| 6 | No communication (no usable value) |
| 7 | Out-of-service |

*Table 6.9  Quality Sub Status for BAD*

| 0: | Non specific |
|---|---|
| 1: | Last usable value (LUV) |
| 2 | Substitute value |
| 3 | Initial value |
| 4 | Sensor conversion not accurate |
| 5 | Engineering unit violation |
| 6 | Sub normal |
| 7 | Configuration error |
| 8 | Simulated value |
| 9 | Sensor calibration |

*Table 6.10  Quality Sub Status for UNCERTAIN*

| 0 | OK |
|---|---|
| 1 | Update event |
| 2 | Active advisory alarm |
| 3 | Active critical alarm |
| 4 | Unacknowledged update event |
| 5 | Unacknowledged advisory alarm |
| 6 | Unacknowledged critical alarm |
| 7 | – |
| 8 | Initiate fail-safe |
| 9 | Maintenance required |

*Table 6.11  Quality Sub Status for GOOD (Non-cascade)*

| 0 | OK |
|---|---|
| 1 | Initialisation acknowledged |
| 2 | Initialisation request |
| 3 | Not invited |
| 4 | Reserved |
| 5 | Do not select |
| 6 | Local override |

*Table 6.12 Quality Sub Status for GOOD (Cascade)*

| 0 | OK |
|---|---|
| 1 | Low limited |
| 2 | High limited |
| 3 | Constant |

*Table 6.13 Limits*

## 6.4.2 Condensed Status Tables

Tables to 6.14 to 6.20 (page 37 )define how set alarm bits affect the measurement status of the corresponding Transducer Block channels for condensed status (refer to the PROFIBUS PA application profile specification for more details on these definitions).

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) | Diagnostic Group 0 | Diagnostic Group 1 | Diagnostic Group 2 |
|-------|-----|------|------------|------------|------------|------------|
| 1 | 0 | 56 | Unused | | | |
| | 1 | 57 | Logic simulation selected on OP1 | GOOD(G) | GOOD(G) | GOOD(G) |
| | 2 | 58 | Pulse simulation selected on OP1 | GOOD(G) | GOOD(G) | GOOD(G) |
| | 3 | 59 | Logic simulation selected on OP1 | GOOD(G) | GOOD(G) | GOOD(G) |
| | 4 | 60 | Pulse simulation selected on OP2 | GOOD(G) | GOOD(G) | GOOD(G) |
| | 5 | 61 | Logic simulation selected on OP3 | GOOD(G) | GOOD(G) | GOOD(G) |
| | 6 | 62 | Low flow alarm | GOOD critical alarm, low limit | GOOD critical alarm, low limit | GOOD critical alarm, low limit |
| | 7 | 63 | High flow alarm | GOOD-critical alarm, high limit | GOOD-critical alarm, high limit | GOOD-critical alarm, high limit |
| 2 | 0 | 64 | Q > 103% Qmax | GOOD-critical alarm, high limit | GOOD-critical alarm, high limit | GOOD-critical alarm, high limit |
| | 1 | 65 | Simulation mode on | Check(C) | Check(C) | Good(G) |
| | 2 | 66 | Tx. simulator / calibrator mode | Check(C) | Check(C) | Good(G) |
| | 3 | 67 | At Qmax, volume display overrun <1600 hours | GOOD(G) | GOOD(G) | GOOD(G) |
| | 4 | 68 | Totalizer reset | GOOD(G) | GOOD(G) | GOOD(G) |
| | 5 | 69 | Intermittent sensor comms | Maintenance(M) | Maintenance(M) | Maintenance(M) |
| | 6 | 70 | Unused | | | |
| | 7 | 71 | Tx. memory fault detected | Failure(F) | Failure(F) | Failure(F) |

*Table 6.14 Alarm Mapping for Extended Status*

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) | Diagnostic Group 0 | Diagnostic Group 1 | Diagnostic Group 2 |
|-------|-----|---------------------|---------------------------|--------------------|--------------------|--------------------|
| 3 | 0 | 72 | Sensor memory not detected | Failure(F) | Failure(F) | Failure(F) |
| | 1 | 73 | Tx. measurement suspended | Failure(F) | Failure(F) | Failure(F) |
| | 2 | 74 | Empty pipe | Out of Specification(S) | Out of Specification(S) | Out of Specification(S) |
| | 3 | 75 | Unused | | | |
| | 4 | 76 | Unused | | | |
| | 5 | 77 | Open circuit electrode | Out of Specification(S) | Out of Specification(S) | Out of Specification(S) |
| | 6 | 78 | Short circuit electrode | Out of Specification(S) | Out of Specification(S) | Out of Specification(S) |
| | 7 | 79 | Unused | | | |
| 4 | 0 | 80 | Installation fault / condition | Failure(F) | Failure(F) | Failure(F) |
| | 1 | 81 | Open circuit coil / wiring | Failure(F) | Failure(F) | Failure(F) |
| | 2 | 82 | Short circuit coil / wiring | Failure(F) | Failure(F) | Failure(F) |
| | 3 | 83 | Check cable + coil resistance | Failure(F) | Failure(F) | Failure(F) |
| | 4 | 84 | Transmitter hardware fault | Failure(F) | Failure(F) | Failure(F) |
| | 5 | 85 | Bad flow data | Failure(F) | Failure(F) | Failure(F) |
| | 6 | 86 | Accuracy warning | Out of Specification(S) | Out of Specification(S) | Out of Specification(S) |
| | 7 | 87 | OIML self-check limits exceeded | Maintenance(M) | Maintenance(M) | Maintenance(M) |

*Table 6.14 Alarm Mapping for Extended Status (Continued)*

| Octet | Bit | Unit Diag Bit (GSD) | Description (When Bit Set) | Diagnostic Group 0 | Diagnostic Group 1 | Diagnostic Group 2 |
|---|---|---|---|---|---|---|
| 5 | 0 | 88 | Measurement starting | Out of Specification(S) | Out of Specification(S) | Out of Specification(S) |
| | 1 | 89 | Unused | | | |
| | 2 | 90 | Sensor setup not complete | Out of Specification(S) | Out of Specification(S) | Out of Specification(S) |
| | 3 | 91 | Incompatible sensor | Failure(F) | Failure(F) | Failure(F) |
| | 4 | 92 | Tx. code memory fault | Failure(F) | Failure(F) | Failure(F) |
| | 5 | 93 | Tx. data memory fault | Failure(F) | Failure(F) | Failure(F) |
| | 6 | 94 | Unused | | | |
| | 7 | 95 | Alarm simulation active | Good(G) | Good(G) | Good(G) |
| 6 | 0 | 96 | Non-volatile summary alarm | Failure(F) | Failure(F) | Failure(F) |
| | 1 to 7 | 97 to 103 | Unused | | | |

*Table 6.14 Alarm Mapping for Extended Status  (Continued)*

Condensed status values are formatted into several fields defined and is defined in Table 6.15:

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| Quality | | Quality Sub-status | | | | Limits | |

*Table 6.15  Status Value Field Formats*

| NE107 Meaning | PCS / DCS usage | Coding | | | | PROFIBUS-PA meaning |
| | | Quality | Sub Status | Limits | | |
|---------------|-----------------|---------|------------|--------|------|---------------------|
| Failure(F) | Failure | 0 0 | 1 0 0 1 | X X | 0x24 to 0x27 | BAD maintenance alarm, more diagnosis available |
| Check(C) | Failure | 0 0 | 1 1 1 1 | X X | 0x3C to 0x3F | BAD function check / local override |
| Out of specification(S) | Uncertain | 0 1 | 1 1 1 0 | X X | 0x78 to 0x7B | UNCERTAIN process related, no maintenance |
| Maintenance(M) | Good | 1 0 | 1 0 0 1 1 0 1 0 | X X | 0xA4 to 0xAB | GOOD maintenance required / demanded |

*Table 6.16  Coding of the Condensed Status Restricted to NE107*

| NE107 Meaning | PCS / DCS usage | Coding | | | | PROFIBUS-PA meaning |
| | | Quality | Sub Status | Limits | | |
|---------------|-----------------|---------|------------|--------|------|---------------------|
| Good(G) | Good | 1 0 | 0 0 0 0 | 0 0 | 0x80 | GOOD ok |
| Good(G) | Good | 1 0 | 0 0 0 1 | X X | 0x84 to 0x87 | GOOD update event |
| Good(G) | Good | 1 0 | 0 0 1 0 | 0 1 | 0x89 | GOOD advisory alarm, low limit |
| Good(G) | Good | 1 0 | 0 0 1 0 | 1 0 | 0x8A | GOOD advisory alarm, high limit |
| Good(G) | Good | 1 0 | 0 0 1 1 | 0 1 | 0x8D | GOOD critical alarm, low limit |
| Good(G) | Good | 1 0 | 0 0 1 1 | 1 0 | 0x8E | GOOD critical alarm, high limit |

*Table 6.17  Coding of Limit Checks / Update Events for Quality GOOD*

| NE107 Meaning | PCS / DCS usage | Maintenance Station Usage | Coding | | | | PROFIBUS-PA meaning |
|---|---|---|---|---|---|---|---|
| | | | Quality | Sub Status | Limits | | |
| Failure(F) | Failure | Failure | 0 0 | 0 0 0 0 | 0 0 | 0x00 | BAD non-specific |
| Failure(F) | Passivated | Good | 0 0 | 1 0 0 0 | 1 1 | 0x23 | BAD passivated (diagnostic alerts inhibited) |
| Failure(F) | Failure | Maintenance alarm | 0 0 | 1 0 0 1 | X X | 0x24 to 0x27 | BAD maintenance alarm, more diagnosis available |
| Failure(F) | Failure | Good | 0 0 | 1 0 1 0 | X X | 0x28 to 0x2B | BAD process related, no maintenance |
| Check(C) | Function check | Function check | 0 0 | 1 1 1 1 | X X | 0x3C to 0x3F | BAD function check / local override, value not usable |

Table 6.18  Detailed Coding of the Condensed Status – Quality BAD

| NE107 Meaning | PCS / DCS usage | Maintenance Station Usage | Coding | | | | PROFIBUS-PA meaning |
|---|---|---|---|---|---|---|---|
| | | | Quality | Sub Status | Limits | | |
| Failure(F) | Uncertain | Maintenance alarm | 0 1 | 0 0 1 0 | 1 1 | 0x4B | UNCERTAIN substitute set |
| Failure(F) | Uncertain | Good | 0 1 | 0 0 1 1 | 1 1 | 0x4F | UNCERTAIN initial value |
| Maintenance(M) | Uncertain | Maintenance demanded | 0 1 | 1 0 1 0 | X X | 0x68 to 0x6B | UNCERTAIN maintenance demanded |
| Check(C) | Uncertain | Function check | 0 1 | 1 1 0 0 | 1 1 | 0x73 | UNCERTAIN simulated value, start |
| Check(C) | Uncertain | Good | 0 1 | 1 1 0 1 | X X | 0x74 to 0x77 | UNCERTAIN simulated value, end |
| Out of specification(S) | Uncertain | Good | 0 1 | 1 1 1 0 | X X | 0x78 to 0x7B | UNCERTAIN process related, no maintenance |

Table 6.19  Detailed Coding of the Condensed Status – Quality UNCERTAIN

| | | | Coding | | | | |
|---|---|---|---|---|---|---|---|
| **NE107 Meaning** | **PCS / DCS usage** | **Maintenance Station Usage** | **Quality** | **Sub Status** | **Limits** | | **PROFIBUS-PA meaning** |
| Good(G) | Good | Good | 1 0 | 0 0 X X | X X | 0x80 to 0x8E | GOOD |
| Good(G) | Good | Good | 1 0 | 1 0 0 0 | X X | 0xA0 to 0xA3 | GOOD initiate fail safe |
| Maintenance(M) | Good | Maintenance required | 1 0 | 1 0 0 1 | X X | 0xA4 to 0xA7 | GOOD maintenance required |
| Maintenance(M) | Good | Maintenance demanded | 1 0 | 1 0 1 0 | X X | 0xA8 to 0xAB | GOOD maintenance demanded |
| Good(G) | Good | Function check | 1 0 | 1 1 1 1 | X X | 0xBC to 0xBF | GOOD function check |

*Table 6.20  Detailed Coding of the Condensed Status – Quality GOOD*

# 7  Identification and Maintenance

PROFIBUS DPV1 specifies functionality for Identification and Maintenance services (I&M) that allow information about an instrument to be requested via bus in a standard format.

WaterMaster flowmeters support the following standard I&M functions (as the mandatory requirements of PROFIBUS PA application profile version 3.01):

- I&M0
- I&M1
- I&M2
- I&M3
- profile-specific function PA_I&M0

All of these functions are available with read-only access from parameter slot 0. I&M functions are not available for the other parameter slots.

> **Note.** Unless otherwise stated, reserved parameters have their data value set to 0x00 for numerical values or all characters set to ASCII 0x20 (space) for text values.

| Parameter | | Description |
|---|---|---|
| 0 | HEADER | Reserved. |
| 1 | MANUFACTURER_ID | PROFIBUS manufacturer code for ABB<br>(0x1A – as DEVICE_MAN_ID parameter in PB). |
| 2 | ORDER_ID | Fixed to '9AAC133129' that is the ABB catalogue ID for WaterMaster flowmeters. This can be used to create a web query for locating information about the device on the ABB website:<br>www.abb.com |
| 3 | SERIAL_NUMBER | Serial number of the device –<br>as DEVICE_SER_NUM parameter in PB. |
| 4 | HARDWARE_REVISION | Fixed to 0xFF, 0xFF (to indicate profile-specific information). |
| 5 | SOFTWARE_REVISION | Fixed to 'V', 0xFF, 0xFF, 0xFF<br>(to indicate profile-specific information). |
| 6 | REV_COUNTER | Incremental change count for any static data in any block<br>(PB, TB or FB). |

*Table 7.1  Function: I&M0*

| Parameter | | Description |
|---|---|---|
| 7 | PROFILE_ID | Fixed to 0x9700, indicating device supporting PROFIBUS PA profile. |
| 8 | PROFILE_SPECFIC_TYPE | Byte 0 – BlockObject type code for the block of slot being accessed (PB gives value 0x01). |
| | | Byte 1 – ParentClass type code for the block of slot being accessed (PB gives value 0x01 [transmitter]). |
| 9 | IM_VERSION | Fixed to 0x01, 0x01 (indicating I&M version 1.1). |
| 10 | IM_SUPPORTED | Fixed to 0x00, 0x0F (indicating I&M0 to I&M3 supported). |

*Table 7.1 Function: I&M0  (Continued)*

| Parameter | | Description |
|---|---|---|
| 0 | HEADER | Reserved. |
| 1 | TAG_FUNCTION | Same as the TAG parameter in PB. |
| 2 | TAG_FUNCTION | Filled with ASCII 0x20 (space) characters. |

*Table 7.2 Function: I&M1*

| Parameter | | Description |
|---|---|---|
| 0 | HEADER | Reserved. |
| 1 | DATE | Same as the DEVICE_INSTALL_DATE parameter in PB. |
| 2 | Reserved | Reserved. |

*Table 7.3 Function: I&M2*

| Parameter | | Description |
|---|---|---|
| 0 | HEADER | Reserved. |
| 1 | DESCRIPTOR | Same as the DESCRIPTOR parameter in PB. |

*Table 7.4  Function: I&M3*

| Parameter | | Description |
|---|---|---|
| 0 | HEADER | Reserved. |
| 1 | PA_IM_VERSION | Fixed to 0x01, 0x00 (version 1.0) |
| 2 | HARDWARE_REVISION | Same as HARDWARE_REVISION in PB. |
| 3 | SOFTWARE_REVISION | Same as SOFTWARE_REVISION in PB. |
| 4 | Reserved | Reserved. |
| 5 | PA_IM_SUPPORTED | Fixed to 0x00, 0x00 (no manufacturer-specific I&M data). |

*Table 7.5  Function: PA_I&M0*

**Note.**

■ In the event of a WaterMaster transmitter electronics fault, most problems can be fixed by replacing the cartridge with a new one. For other transmitter faults contact ABB customer support.

■ Parameter data held in the sensor (such as the internal totalizer values and sensor calibration settings) are uploaded into the new cartridge at next power-up.

■ The PROFIBUS Totalizer Block totals (TOT1.TOTAL and TOT2.TOTAL) are held only in the cartridge. These need to be re-written back into the WaterMaster via the bus after the new cartridge has been fitted.

# Appendix A  – PROFIBUS-PA Block Structure Diagrams

The following diagrams illustrate the relationship and data flow in PROFIBUS PA Function Blocks and Flow Transducer Block used in WaterMaster.
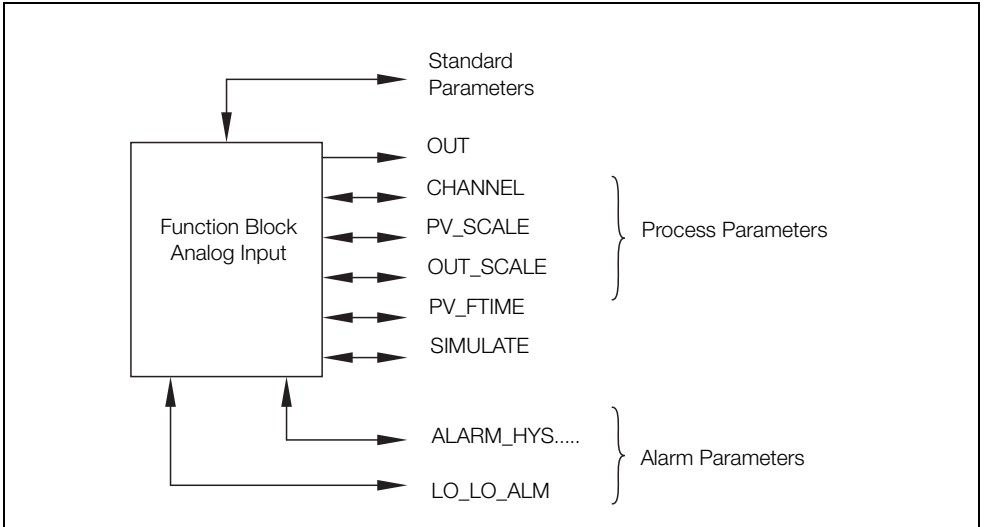
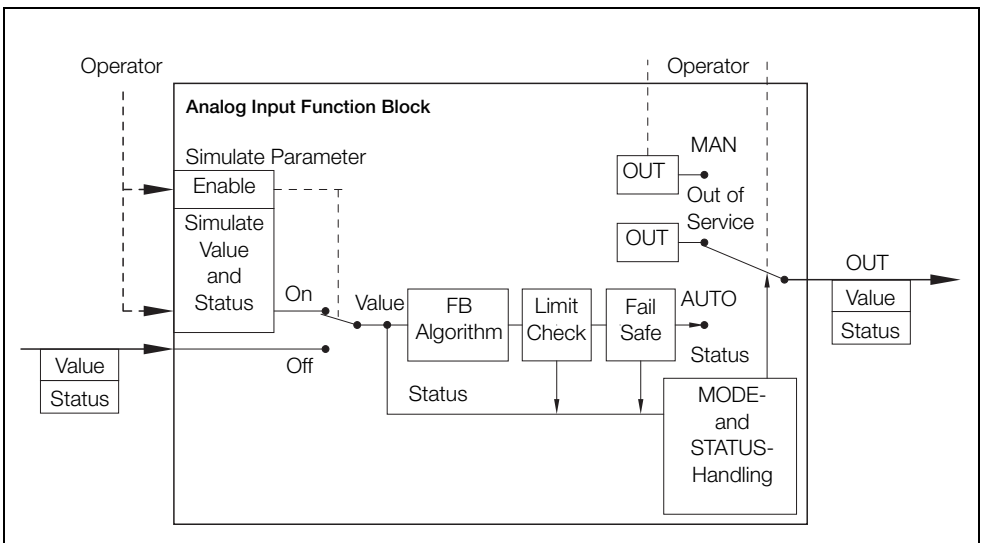## A.1  Analog Input Function Block



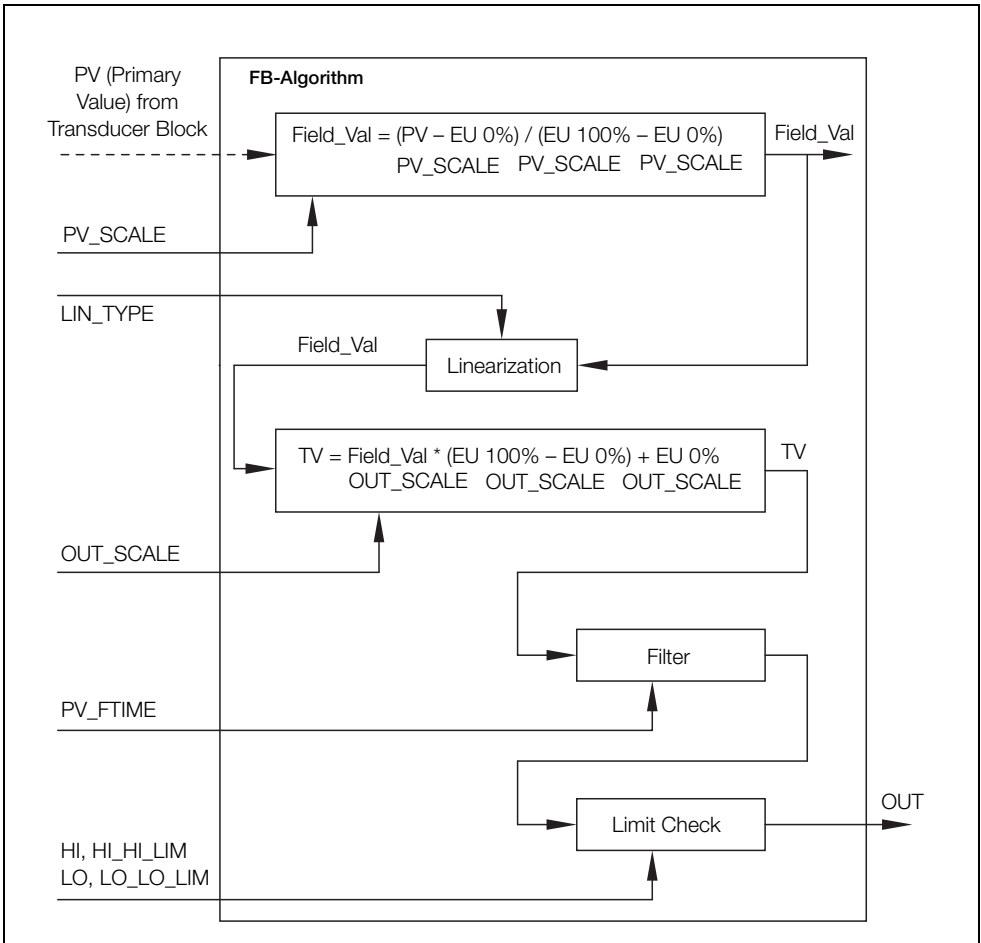*Fig. A.1  AI Block Summary*



*Fig. A.2  AI Block Structure*

*Fig. A.3  AI Block Algorithm*

## A.2  Totalizer Function Block
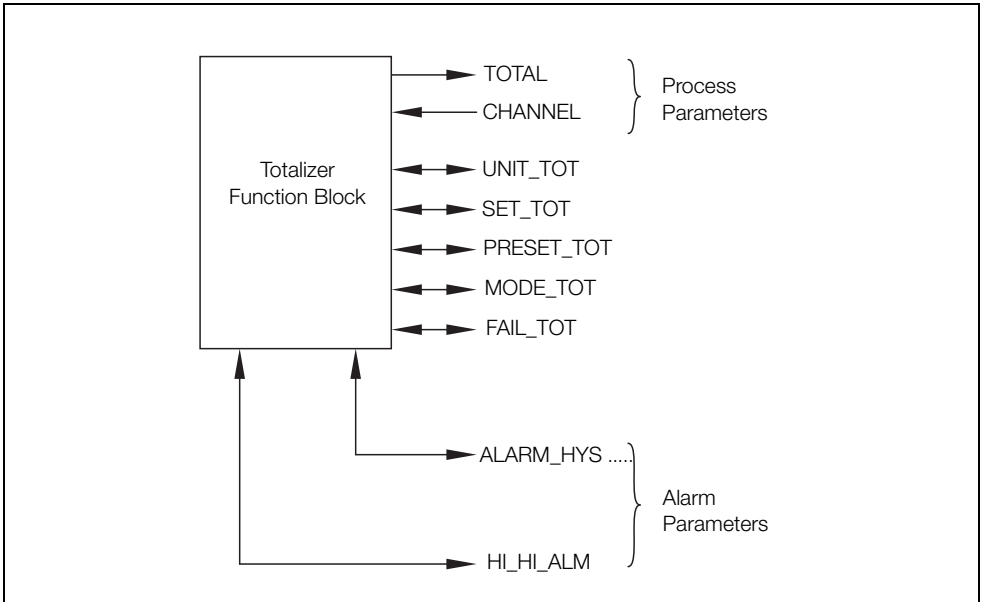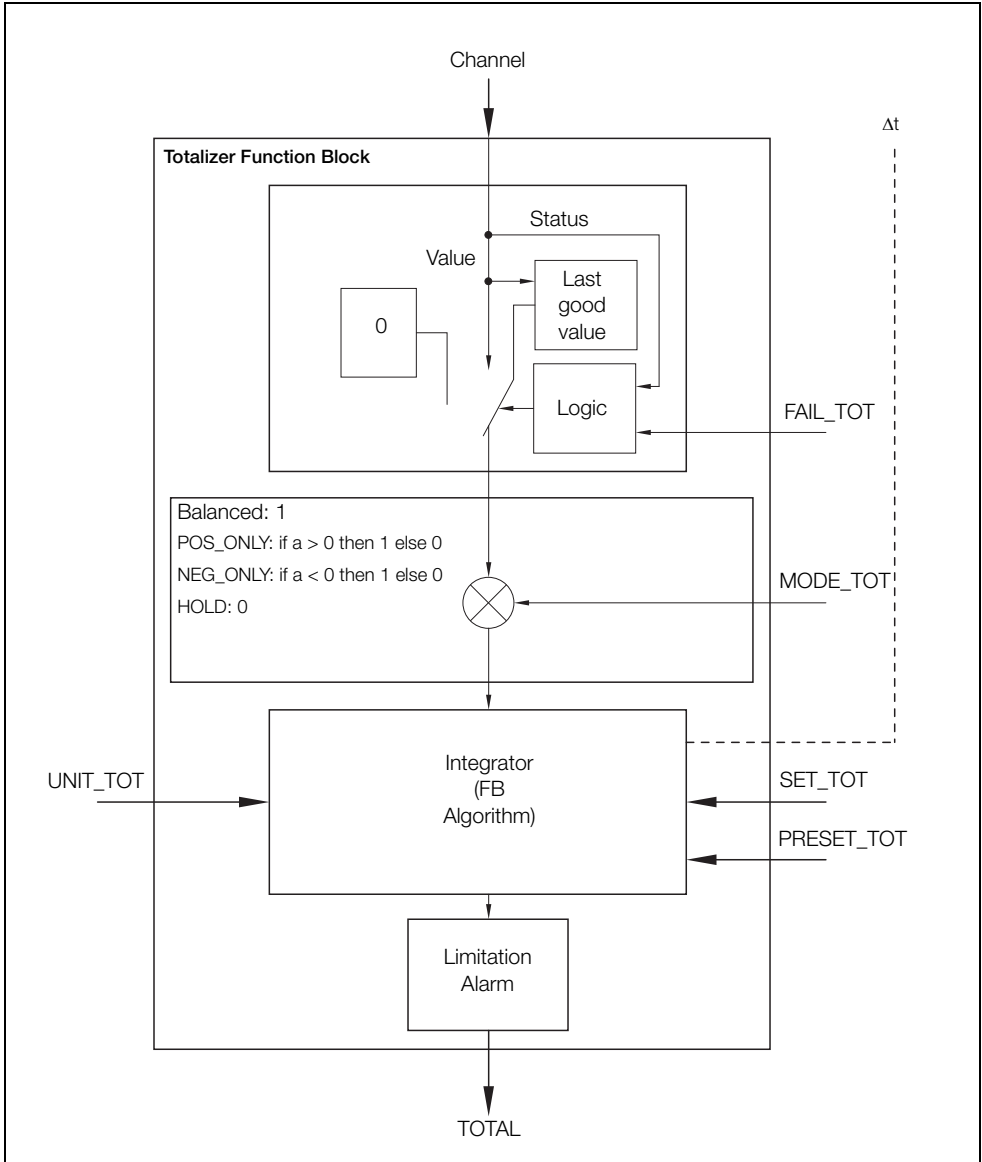


*Fig. A.4  TOT Block Summary*

*Fig. A.5  TOT Block Structure*

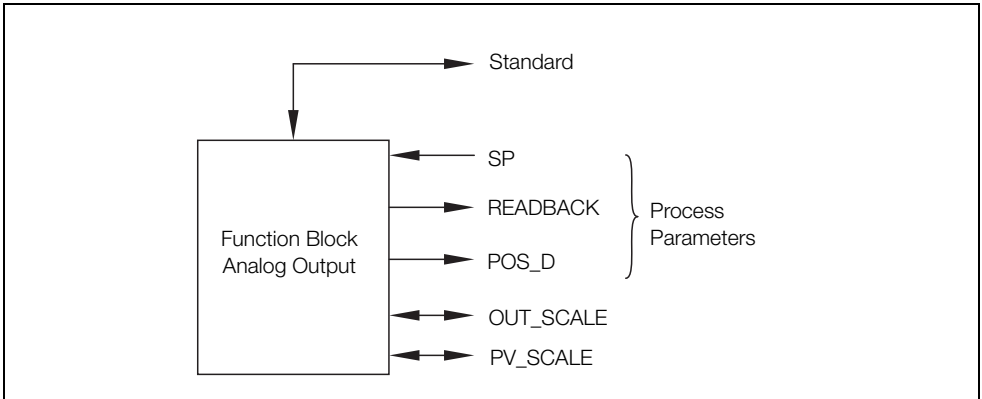## A.3 Analog Output Function Block
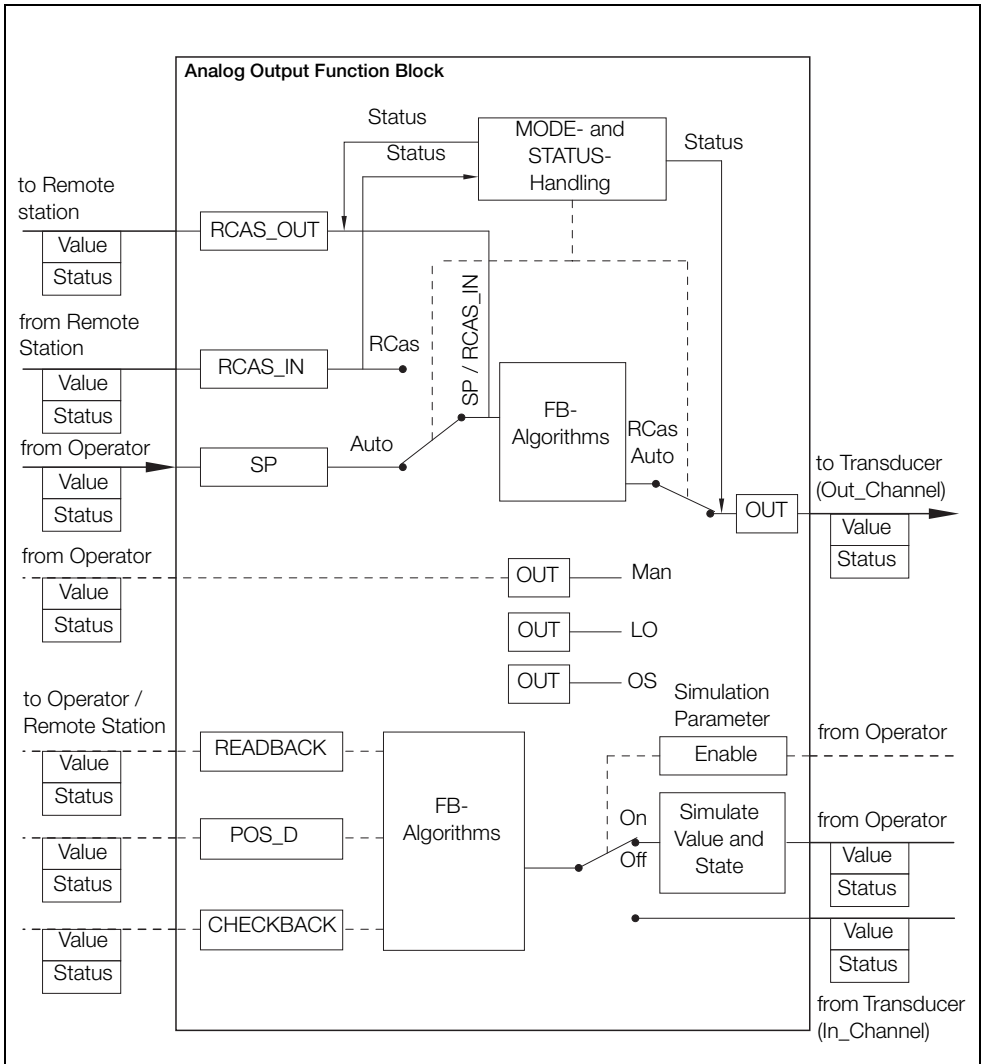


*Fig. A.6  AO Block Summary*

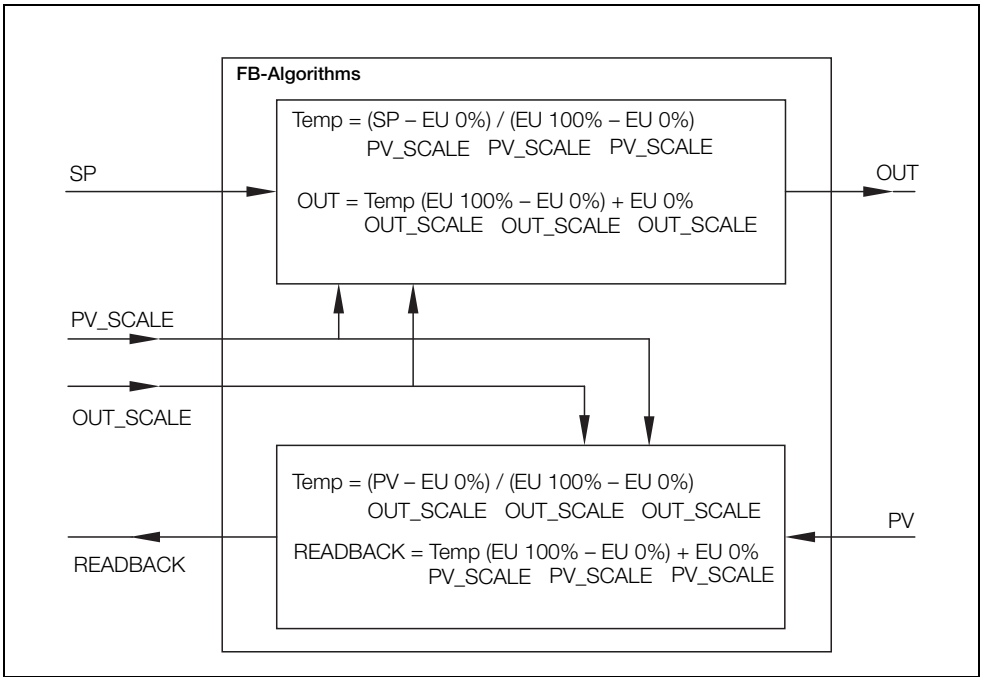*Fig. A.7  AO Block Structure*

*Fig. A.8  AO Block Algorithm*

## A.4  Flow Transducer Block

The Flow Transducer Block describes the basic set of parameters for flow devices.
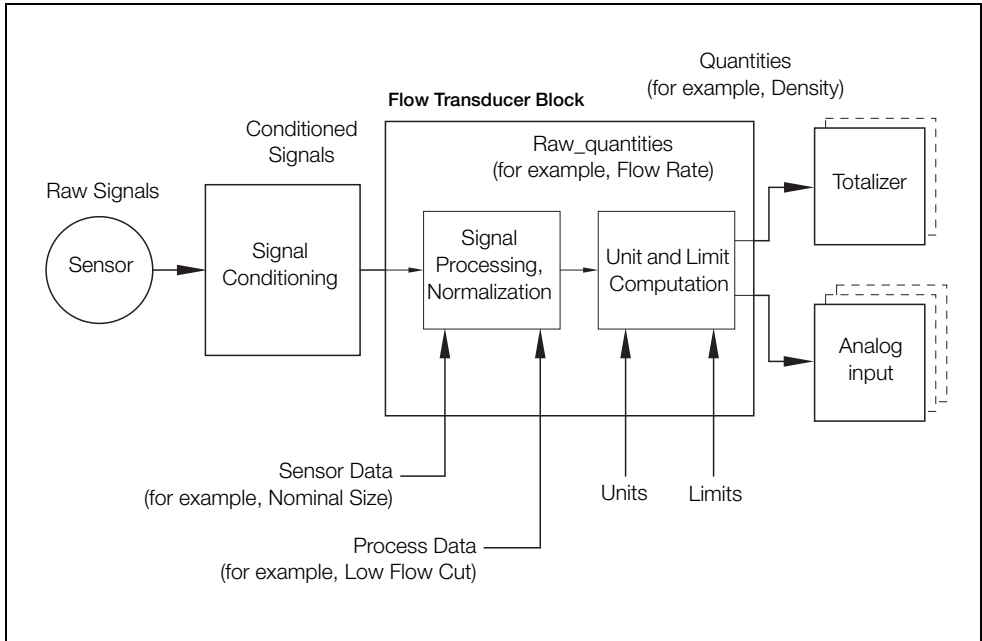


*Fig. A.9  TB Flow Functional Diagram*

# Appendix B – PROFIBUS Data Structures

The following PROFIBUS and WaterMaster specific data structures are used in the WaterMaster blocks.

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Reserved | Unsigned8 | 1 |
| 2 | Block_Object | Unsigned8 | 1 |
| 3 | Parent_Class | Unsigned8 | 1 |
| 4 | Class | Unsigned8 | 1 |
| 5 | DD_Reference | Unsigned32 | 4 |
| 6 | DD_Revision | Unsigned16 | 2 |
| 7 | Profile | OctetString | 2 |
| 8 | Profile_Revision | Unsigned8 | 1 |
| 9 | Execution_Time | Unsigned16 | 2 |
| 10 | Number_of_Parameters | Unsigned16 | 2 |
| 11 | Address_of_View_1 | Unsigned16 | 2 |
| 12 | Number_of_Views | Unsigned8 | 1 |

*Table B.1 DS-32 Block Structure*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Value | Float | 4 |
| 2 | Status | Unsigned8 | 1 |

*Table B.2 101 (Value and Status Float Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | EU_at_100% | Float | 4 |
| 2 | EU_at 0% | Float | 4 |
| 3 | Units_Index | Unsigned16 | 2 |
| 4 | Decimal_Point | Unsigned8 | 1 |

*Table B.3 DS-36 (Scaling Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Actual | Unsigned8 | 1 |
| 2 | Permitted | Unsigned8 | 1 |
| 3 | Normal | Unsigned8 | 1 |

*Table B.4 DS-37 (Mode Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Unacknowledged | Unsigned8 | 1 |
| 2 | Alarm_State | Unsigned8 | 1 |
| 3 | Time_Stamp | TimeValue | 8 |
| 4 | Subcode | Unsigned16 | 1 |
| 5 | Value | Float | 4 |

*Table B.5  DS-39 (Alarm Float Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Current | OctetString | 2 |
| 2 | Unacknowledged | OctetString | 2 |
| 3 | Unreported | OctetString | 2 |
| 4 | Disabled | OctetString | 2 |

*Table B.6  DS-42 (Alarm Summary Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Simulate_Status | Unsigned8 | 1 |
| 2 | Simulate_Value | Float | 4 |
| 3 | Simulate_Enabled | Unsigned8 | 1 |

*Table B.7  DS-50 (Simulation Float Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Batch_ID | Unsigned32 | 4 |
| 2 | Rup | Unsigned16 | 2 |
| 3 | Operation | Unsigned16 | 2 |
| 4 | Phase | Unsigned16 | 2 |

*Table B.8  DS-67 (Batch Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Supported | OctetString | 4 |
| 2 | Enabled | OctetString | 4 |

*Table B.9  DS-68 (Feature Structure)*

| E | Element Name | Data Type | Size |
|---|---|---|---|
| 1 | Alarm_Counter | Unsigned16 | 2 |
| 2 | Alarm_Time_Counter_Msec | Unsigned32 | 4 |
| 3 | Alarm_Time_Counter_Day | Unsigned16 | 2 |
| 4 | Time_Stamp_Last_Alarm_Msec | Unsigned32 | 4 |
| 5 | Time_Stamp_Last_Alarm_Day | Unsigned16 | 2 |

*Table B.10  WaterMaster Diagnosis Information Structure*

# Appendix C – FEX100-DP PROFIBUS Datasheet

| Item | Detail |
|---|---|
| PROFIBUS device name | FEX100-DP |
| Applicable standards | IEC61158 (Type 3)<br>IEC61784 (CPF3/1) |
| Protocols supported | PROFIBUS-DP (DPV0)<br>PROFIBUS-DP extensions (DPV1) |
| Application profile | Process Control Devices version 3.01 (PROFIBUS-PA) |
| Profile ident support | Standard:              9700, 9740, 9741<br>Device specific:      3431 (4xAI, 2xTOT, 1xAO) |
| PROFIBUS unit type | PROFIBUS DPV1 Slave |
| PROFIBUS media type | RS485 (EIA-485), galvanically isolated |
| PROFIBUS bus connection | Wiring terminals A1/B1 (in) and A2/B2 (out) |
| Bus address range | 1 to 126 via local display interface<br>1 to 125 via Set_Slave_Addr service |
| Baud rates supported | 9.6 kbps<br>19.2 kbps<br>45.45 kbps<br>93.75 kbps<br>187.5 kbps<br>500 kbps<br>1.5 Mbps |
| Master Class 1 – Slave cyclic services (MS0) | Set_Prm<br>Chk_Cfg<br>Set_Slave_Addr<br>Data_Exchange<br>Get_Diag<br>Global-Control (SYNC / UNSYNC, FREEZE / UNFREEZE, CLEAR)<br>Get_Cfg<br>Rd_Inp<br>Rd_Outp |
| Master Class 1 – Slave acyclic services (MS1) | MS1_Read<br>MS1_Write |

*Table C.1  PROFIBUS Datasheet*

| Item | Detail |
|------|--------|
| Master Class 2 – Slave acyclic services (MS2) | 3 concurrent MS2 connections<br>MS2_Initiate<br>MS2_Read<br>MS2_Write<br>MS2_Abort<br>MS2_DataTransport<br>MS2_Idle |
| Device-specific GSD file | ABB_3431.gsd |
| Configuration support | EDD, DTM, local display interface |

*Table C.1  PROFIBUS Datasheet  (Continued)*

# Appendix D  – Declaration of PROFIBUS Conformance

FEX100-DP is the PNO registered model name for PROFIBUS-enabled WaterMaster flowmeters (RS485 physical layer) approved by  an  independent  authorized certification laboratory for connection and use in PROFIBUS networks.

Certification of PROFIBUS specification conformance covers the following areas:

n    RS485 bus interface electrical characteristics.

n    DPV0 and DPV1 protocol services.

n    Process Control Devices Profile version 3.01 (also known as the PA Profile).

n    FEX100-DP device specific GSD file.

A copy of the conformance certificate is available for download from the WaterMaster product pages of the ABB website www.abb.com.

## Acknowledgments

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