User's Manual

ADMAG AXF™

ADMAG AXF Series
FOUNDATION Fieldbus Communication Type
Magnetic Flowmeter

IM01E20F02-01E

vigilantplant.®

YOKOGAWA
Yokogawa Electric Corporation

IM01E20F02-01E
3rd Edition

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3rd Edition: June 2012

1. INTRODUCTION

This manual is for the ADMAG AXF Series Magnetic Flowmeter Remote Converter FOUNDATION fieldbus Communication Type. The FOUNDATION fieldbus communication type is based on the same ADMAG AXF technology used in the BRAIN/HART communication type, and is similar to the communication types in terms of basic performance and operation. This manual describes only those topics that are required for operation of the FOUNDATION fieldbus communication type. For information on the installation, wiring, and maintenance of AXF series magnetic flowmeter, refer to the user's manual for each model (IM 01E20D01-01E or IM 01E20C02-01E).

As far terminal connection, refer to Page 9-3 of this manual.

■ Regarding This Manual

- This manual should be passed on to the end user.
- The contents of this manual are subject to change without prior notice.
- All rights reserved. No part of this manual may be reproduced in any form without Yokogawa's written permission.
- Yokogawa makes no warranty of any kind with regard to this manual, including, but not limited to, implied warranty of merchantability and fitness for a particular purpose.
- If any question arises or errors are found, or if any information is missing from this manual, please inform the nearest Yokogawa sales office.
- The specifications covered by this manual are limited to those for the standard type under the specified model number break-down and do not cover custom-made instruments.
- Please note that changes in the specifications, construction, or component parts of the instrument may not immediately be reflected in this manual at the time of change, provided that postponement of revisions will not cause difficulty to the user from a functional or performance standpoint.
- The following safety symbols are used in this manual:

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

IMPORTANT

Indicates that operating the hardware or software in this manner may damage it or lead to system failure.

NOTE

Draws attention to information essential for understanding the operation and features.

FOUNDATION is a registered trademark of Fieldbus FOUNDATION.

FOUNDATION

1.1 Safe Use of This Product

For the safety of the operator and to protect the instrument and the system, please be sure to follow this manual's safety instructions when handling this instrument. If these instructions are not heeded, the protection provided by this instrument may be impaired. In this case, Yokogawa cannot guarantee that the instrument can be safely operated. Please pay special attention to the following points:

(a) Installation

- Installation of the magnetic flowmeter must be performed by expert engineer or skilled personnel. No operator shall be permitted to perform procedures relating to installation.

- The magnetic flowmeter is a heavy instrument. Be careful that no damage is caused to personnel through accidentally dropping it, or by exerting excessive force on the magnetic flowmeter. When moving the magnetic flowmeter, always use a trolley and have at least two people carry it.

- When the magnetic flowmeter is processing hot fluids, the instrument itself may become extremely hot. Take sufficient care not to get burnt.

- Where the fluid being processed is a toxic substance, avoid contact with the fluid and avoid inhaling any residual gas, even after the instrument has been taken off the piping line for maintenance and so forth.

- Do not apply excessive weight, for example, a person stepping on the magnetic flowmeter.

- All procedures relating to installation must comply with the electrical code of the country where it is used.

(b) Wiring

- The wiring of the magnetic flowmeter must be performed by expert engineer or skilled personnel. No operator shall be permitted to perform procedures relating to wiring.

- When connecting the wiring, check that the supply voltage is within the range of the voltage specified for this instrument before connecting the power cable. In addition, check that no voltage is applied to the power cable before connecting the wiring.

- The protective grounding must be connected securely at the terminal with the ⏚ mark to avoid danger to personnel.

(c) Operation

- When opening the cover, wait for more than 10 minutes after turning off the power. Only expert engineer or skilled personnel are permitted to open the cover.

(d) Maintenance

- Maintenance of the magnetic flowmeter should be performed by the trained personnel having safety standard knowledge. No operator shall be permitted to perform any operations relating to maintenance.

- When opening the cover, wait for more than 10 minutes after turning off the power.

- Please carry out only the maintenance procedures described in this manual. If you require further assistance, please contact the nearest Yokogawa office.

- Care should be taken to prevent the build up of dust or other materials on the display glass and the name plate. To clean these surfaces, use a soft, dry cloth.

(e) Explosion Protected Type Instrument

- Users of explosion proof instruments should refer to chapter of Explosion Protected Type Instrument in the user's manual for each model (IM 01E20D01-01E or IM 01E20C02-01E).

- The use of this instrument is restricted to those who have received appropriate training in the device.

- Take care not to create sparks when accessing the instrument or peripheral devices in a hazardous location.

(f) Modification

- Yokogawa will not be liable for malfunctions or damage resulting from any modification made to this instrument by the customer.

1.2 Warranty

- The warranty shall cover the period noted on the quotation presented to the purchaser at the time of purchase. Problems occurring during the warranty period shall basically be repaired free of charge.

- If any problems are experienced with this instrument, the customer should contact the Yokogawa representative from which this instrument was purchased or the nearest Yokogawa office.

- If a problem arises with this instrument, please inform us of the nature of the problem and the circumstances under which it developed, including the model specification and serial number. Any diagrams, data and other information you can include in your communication will also be helpful.

- The party responsible for the cost of fixing the problem shall be determined by Yokogawa following an investigation conducted by Yokogawa.

- The purchaser shall bear the responsibility for repair costs, even during the warranty period, if the malfunction is due to:

  - Improper and/or inadequate maintenance by the purchaser.
  - Malfunction or damage due to a failure to handle, use, or store the instrument in accordance with the design specifications.
  - Use of the product in question in a location not conforming to the standards specified by Yokogawa, or due to improper maintenance of the installation location.
  - Failure or damage due to modification or repair by any party except Yokogawa or an approved representative of Yokogawa.
  - Malfunction or damage from improper relocation of the product in question after delivery.
  - Reason of force majeure such as fires, earthquakes, storms/floods, thunder/lightening, or other natural disasters, or disturbances, riots, warfare, or radioactive contamination.

- Trademarks:
  ADMAG, AXF and ADMAG AXF are registered trademarks of Yokogawa Electric Corporation.
  Company names and product name used in this material are registered trademarks or trademarks of their respective owners.

1.3 Combination Remote Flowtubes

IMPORTANT

- The AXFA14 Magnetic Flowmeter Converter should be used in combination with the following remote flowtubes:
  AXF002□-P to AXF400□-P

Other flowtubes (size 500 to 2600 mm) cannot be combined with the AXFA14 converter.

CAUTION

In case of the explosion proof type, please see the manual IM 01E20D01-01E. The construction of the instrument, installation, external wiring, maintenance, and repair are strictly restricted, and non-observance or negligence of these restriction would result dangerous condition.

2. ABOUT FIELDBUS

2.1 Outline

Fieldbus is a widely used bi-directional digital communication protocol for field devices that enable the simultaneous output to many types of data to the process control system.

The AXF Series Fieldbus communication type employs the specification standardized by The Fieldbus Foundation, and provides interoperability between Yokogawa devices and those produced by other manufacturers. Fieldbus comes with software consisting of AI, DI, IT, AR and optional PID function blocks that enable the flexible implementation of systems.

For information on other features, engineering, design, construction work, startup and maintenance of Fieldbus, refer to “Fieldbus Technical Information” (TI 38K03A01-01E).

2.2 Internal Structure of AXF

The AXF contains two Virtual Field Devices (VFD) that share the following functions.

2.2.1 System/network Management VFD

- Sets node addresses and Physical Device tags (PD Tag) necessary for communication.
- Controls the execution of function blocks.
- Manages operation parameters and communication resources (Virtual Communication Relationship: VCR).

2.2.2 Function Block VFD

(1)Resource block

- Manages the status of AXF hardware.
- Automatically informs the host of any detected faults or other problems.

(2)Transducer block

- Converts the flow sensor output to the volumetric flow rate signal, and transfers to the AI function block.
- Transfers limit switch signals to DI function blocks.
- Adhesion diagnosis levels are set and monitored.

(3)AI function blocks

- Condition raw data from the transducer block, including scaling and damping (with a first-order lag), and allow input simulation.
- Outputs volumetric or mass flow rate signals.

(4)DI function blocks (two)

- Limit switches for the flow rate and adhesion alarm, warning.

(5)IT function blocks (two)

- Add two main inputs and integrate them for output.

(6)AR function block

- Switches two main inputs of different measurement ranges and combines the result with three auxiliary inputs through the selected compensation function to calculate the output.

(7)PID function block (optional)

- Performs the PID control computation based on the deviation of the measured value from the setpoint.

2.3 Logical Structure of Each Block

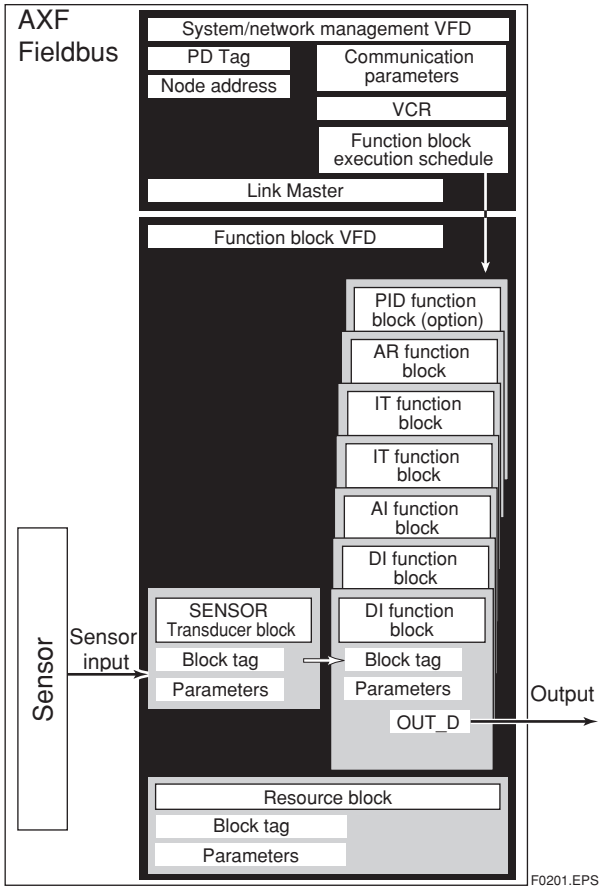

Figure 2.1 Logical Structure of Each Block

Setting of various parameters, node addresses, and PD Tags shown in Figure 2.1 is required before starting operation.

2.4 Wiring System Configuration

The number of devices that can be connected to a single bus and the cable length vary depending on system design. When constructing systems, both the basic and overall design must be carefully considered to achieve optimal performance.

3. GETTING STARTED

Fieldbus is fully dependent upon digital communication protocol and differs in operation from conventional 4 to 20 mA transmission and the BRAIN communication protocol. It is recommended that novice users use field devices in accordance with the procedures described in this section. The procedures assume that field devices will be set up on a bench or in an instrument shop.

3.1 Connection of Devices

The following are required for use with Fieldbus devices:

- **Power supply:**
  Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.
- **Terminator:**
  Fieldbus requires two terminators. Refer to the supplier for details of terminators that are attached to the host.
- **Field devices:**
  Connect Fieldbus communication type AXF (Refer to section 9.3 terminal connection). Two or more AXF devices or other devices can be connected.
- **Host:**
  Used for accessing field devices. A dedicated host (such as DCS) is used for an instrumentation line while dedicated communication tools are used for experimental purposes. For operation of the host, refer to the instruction manual for each host. No other details on the host are given in this manual.
- **Cable:**
  Used for connecting devices. Refer to “Fieldbus Technical Information” (TI 38K03A01-01E) for details of instrumentation cabling. For laboratory or other experimental use, a twisted pair cable two to three meters in length with a cross section of 0.9 mm^2 or more and a cycle period of within 5 cm (2 inches) may be used. Termination processing depends on the type of device being deployed. For AXF, use an M4 screw terminal claw. Some hosts require a connector.

Refer to Yokogawa when making arrangements to purchase the recommended equipment.

Connect the devices as shown in Figure 3.1. Connect the terminators at both ends of the trunk, with a minimum length of the spur laid for connection.

The polarity of signal and power must be maintained.

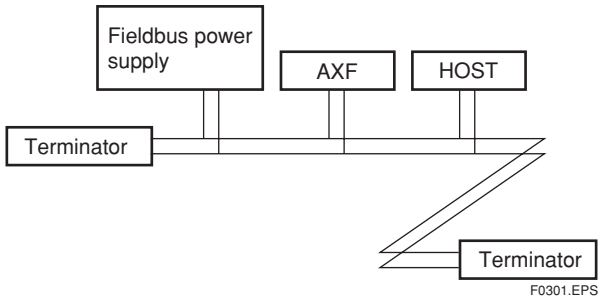

Figure 3.1 Cabling

NOTE

No CHECK terminal is used for Fieldbus communication AXF. Do not connect the field indicator and check meter.

Before using a Fieldbus configuration tool other than the existing host, confirm it does not affect the loop functionality in which all devices are already installed in operation. Disconnect the relevant control loop from the bus if necessary.

IMPORTANT

Connecting a Fieldbus configuration tool to a loop with its existing host may cause communication data scrambling resulting in a functional disorder or a system failure.

3.2 Host Setting

To activate Fieldbus, the following settings are required for the host.

IMPORTANT

Do not turn off the power immediately after setting. When the parameters are saved to the EEPROM, the redundant processing is executed for an improvement of reliability. If the power is turned off within 60 seconds after setting is made, the modified parameters are not saved and the settings may return to the original values.

Table 3.1 Operation Parameters

Symbol	Parameter	Description and Settings
V (ST)	Slot-Time	Indicates the time necessary for immediate reply of the device. Unit of time is in octets (256 μs). Set maximum specification for all devices. For AXF, set a value of 4 or greater.
V (MID)	Minimum-Inter-PDU-Delay	Minimum value of communication data intervals. Unit of time is in octets (256 μs). Set the maximum specification for all devices. For AXF, set a value of 4 or greater.
V (MRD)	Maximum-Reply-Delay	The worst case time elapsed until a reply is recorded. The unit is Slot-time; set the value so that V (MRD) ×V (ST) is the maximum value of the specification for all devices. For AXF, the setting must be a value of 12 or greater.
V (FUN)	First-Unpolled-Node	Indicate the address next to the address range used by the host. Set 0×15 or greater.
V (NUN)	Number-of-consecutive-Unpolled-Node	Unused address range.

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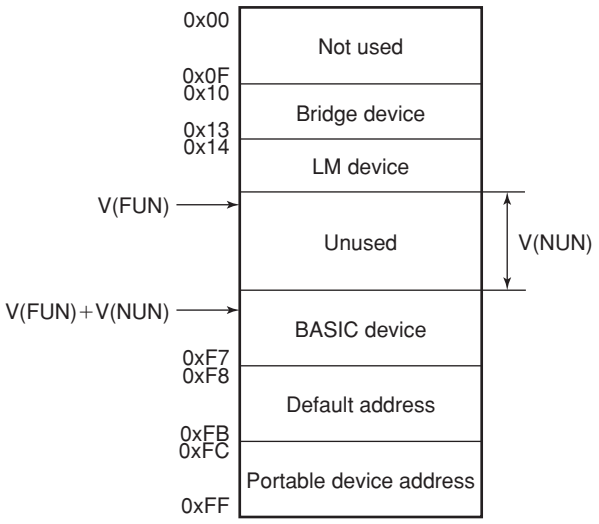

Note 1: Bridge device: A linking device which brings data from one or more H1 networks.
Note 2: LM device: with bus control function (Link Master function)
Note 3: BASIC device: without bus control function

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Figure 3.2 Available Address Range

3.3 Bus Power ON

Turn on the power of the host and the bus and also the power for the AXF. Where the AXF is equipped with an LCD indicator, first all segments are lit, then the display begins to operate.

Using the host device display function, check that the AXF is in operation on the bus.

The device information, including PD tag, Node address, and Device ID, is described on the sheet attached to the AXF. The device information is given in duplicate on this sheet.

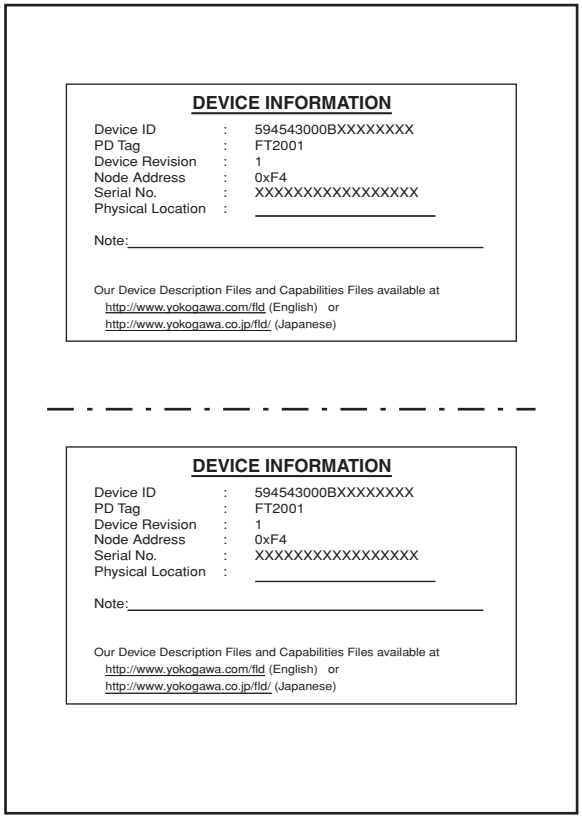

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Figure 3.3 Device Information Sheet Attached to AXF

If no AXF is detected, check the available address range. If the node address and PD tag are not specified when ordering, default value is factory set. If two or more AXFs are connected at a time with default value, only one AXF will be detected from the host as AXFs have the same initial address. Separately connect each AXF and set a different address for each.

3.4 Integration of DD

If the host supports DD (Device Description), the DD of the AXF needs to be installed. Check if host has the following directory under its default DD directory.

594543\000B
(594543 is the manufacturer number of Yokogawa Electric Corporation, and 000B is the AXF device number, respectively.)

If this directory is not found, the DD of the AXF has not been included. Create the above directory and copy the DD file (0m0n.ffo, 0m0n.sym) (m, n is a numeral) into the directory. '0m' in the file name shows the device revision, and '0n' shows the DD revision. If you do not have the DD or capabilities files, you can download them from our web site:

http://www.yokogawa.com/fld

Once the DD is installed in the directory, the name and attribute of all parameters of the AXF are displayed.

Off-line configuration is possible by using capabilities files.

AXF has two capabilities levels, "1" and "2".

Select "Capabilities level = 1" when the AXF doesn't have LC1(PID function) option.

Select "Capabilities level = 2" when the AXF has LC1(PID function) option.

The capabilities level defines the kind and the number of function blocks that can be used.
The table below shows the relation.

The capability level and function blocks that can be used

Capabilities Level	AI	DI	IT	AR	PID
1	1	2	2	1	0
2	1	2	2	1	1

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3.5 Reading the Parameters

To read AXF parameters, select the AI block of the AXF from the host screen and read the OUT parameter. The current selected signal is displayed. Check that MODE_BLOCK of the function block and resource block is set to AUTO, and change the signal input and read the parameter again. A new designated value should be displayed.

3.6 Continuous Record of Values

If the host has a function that continuously records the indications, use this function to list the indications (values). Depending on the host being used, it may be necessary to set the schedule of Publish (the function that transmits the indication on a periodic basis).

3.7 Generation of Alarm

Generation of an alarm can be attempted from AXF. Block alarm, Output limit alarm, and Update alarm are informed to the host. When generating alarm, a Link Object and a VCR Static Entry need to be set. For details of Link Object and VCR Static Entry, refer to section 4.6.1 Link object and section 4.5.1 VCR Setting.

4. CONFIGURATION

This chapter describes how to adapt the function and performance of the AXF to suit specific applications. Because multiple devices are connected to Fieldbus, it is important to carefully consider the device requirements and settings when configuring the system. The following steps must be taken.

(1)Network design
Determines the devices to be connected to Fieldbus and checks the capacity of the power supply.

(2)Network definition
Determines the tag and node addresses for all devices.

(3)Definition of combining function blocks
Determines how function blocks are combined.

(4)Setting tags and addresses
Sets the PD Tag and node addresses for each device.

(5)Communication setting
Sets the link between communication parameters and function blocks.

(6)Block setting
Sets the parameters for function blocks.

The following section describes in sequence each step of this procedure. The use of a dedicated configuration tool significantly simplifies this procedure. Refer to Appendix 6 when the AXF is used as Link Master.

4.1 Network Design

Select the devices to be connected to the Fieldbus network. The following are essential for the operation of Fieldbus.

- **Power supply**
  Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.
- **Terminator**
  Fieldbus requires two terminators. Refer to the supplier for details of terminators that are attached to the host.
- **Field devices**
  Connect the field devices necessary for instrumentation. The AXF has passed the interoperability test conducted by The Fieldbus Foundation. In order to properly start Fieldbus, it is recommended that the devices used satisfy the requirements of the above test.
- **Host**
  Used for accessing field devices. A minimum of one device with the bus control function is needed.
- **Cable**
  Used for connecting devices. Refer to “Fieldbus Technical Information” for details of instrumentation cabling. Provide a cable sufficiently long to connect all devices. For field branch cabling, use terminal boards or a connection box as required.

First, check the capacity of the power supply. The power supply capacity must be greater than the sum of the maximum current consumed by all devices to be connected to Fieldbus. The maximum current consumed for the AXF is 15 mA. The cable used for the spur must be of the minimum possible length.

4.2 Network Definition

Before connection of devices with Fieldbus, define the Fieldbus network. Allocate PD Tag and node addresses to all devices (excluding such passive devices as terminators).

The PD Tag is the same as the conventional one used for the device. Up to 32 alphanumeric characters may be used for definition. Use a hyphen as a delimiter as required.

The node address is used to specify devices for communication purposes. Because this data is too long for a PD Tag, the host uses the node address in place of the PD Tag for communication. A range of 20 to 247 (or hexadecimal 14 to F7) can be set. The device (LM device) with bus control function (Link Master function) is allocated from a smaller address number (20) side, and other devices (BASIC device) without

bus control function allocated from a larger address number (247) side respectively. Place the AXF in the range of the BASIC device. When the AXF is used as Link Master, place the AXF in the range of the LM device. Set the range of addresses to be used to the LM device. Set the following parameters.

Table 4.1 Parameters for Setting Address Range

Symbol	Parameters	Description
V (FUN)	First-Unpolled-Node	Indicates the address next to the address range used for the host or other LM device.
V (NUN)	Number-of-consecutive-Unpolled-Node	Unused address range

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The devices within the address range written as "Unused" in Figure 4.1 cannot be used on a Fieldbus. For other address ranges, the range is periodically checked to identify when a new device is mounted. Care must be taken to keep the unused device range as narrow as possible so as to lessen the load on the Fieldbus.

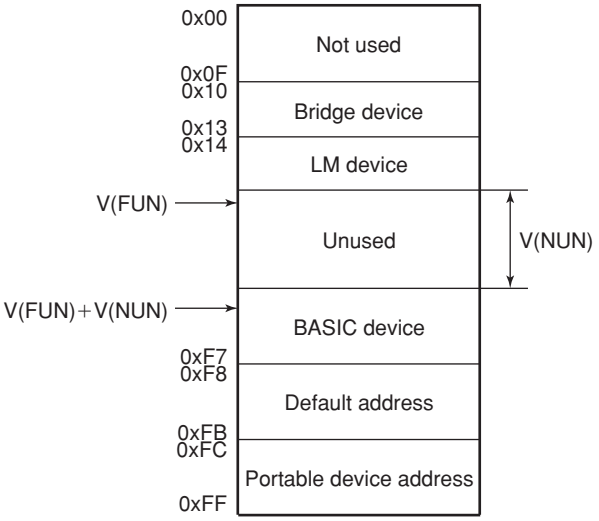

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Figure 4.1 Available Range of Node Addresses

To ensure stable operation of Fieldbus, determine the operation parameters and set them to the LM devices. While the parameters in Table 4.2 are to be set, the worst-case value of all the devices to be connected to the same Fieldbus must be used. Refer to the specification of each device for details. Table 4.2 lists AXF specification values.

Table 4.2 Operation Parameter Values of the AXF to be Set to LM Devices

Symbol	Parameters	Description and Settings
V (ST)	Slot-Time	Indicates the time necessary for immediate reply of the device. Unit of time is in octets (256 μs). Set maximum specification for all devices. For AXF, set a value of 4 or greater.
V (MID)	Minimum-Inter-PDU-Delay	Minimum value of communication data intervals. Unit of time is in octets (256 μs). Set the maximum specification for all devices. For AXF, set a value of 4 or greater.
V (MRD)	Maximum-Reply-Delay	The worst case time elapsed until a reply is recorded. The unit is Slot-time; set the value so that V (MRD) ×V (ST) is the maximum value of the specification for all devices. For AXF, the setting must be a value of 12 or greater.

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4.3 Definition of Combining Function Blocks

The input/output parameters for function blocks are combined. As required, they can be combined with the input of the control block. The setting is written to the AXF link object. See "Block setting" in Section 4.6 for the details. It is also possible to read values from the host at proper intervals instead of connecting the AXF block output to other blocks.

The combined blocks need to be executed synchronously with other blocks on the communications schedule. In this case, change the AXF schedule according to the following table. The values in the table are factory-settings.

Table 4.3 Execution Schedule of the AXF Function Blocks

Index	Parameters	Setting (Enclosed is factory-setting)
269 (SM)	MACROCYCLE_ DURATION	Cycle (MACROCYCLE) period of control or measurement. Unit is 1/32 ms. (16000 = 0.5 s)
276 (SM)	FB_START_ENTRY.1	AI1 block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32 ms. (0 = 0 s)
277 to 289 (SM)	FB_START_ENTRY.2 to FB_START_ENTRY.14	No setting

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A maximum of 30 ms is taken for execution of AI block. For scheduling of communications for combination with the next function block, the execution is so arranged as to start after a lapse of longer than 30 ms. In no case should function blocks of the AXF be executed at the same time (execution time is overlapped).

Figure 4.3 shows an example of schedule based on the loop shown in Figure 4.2.

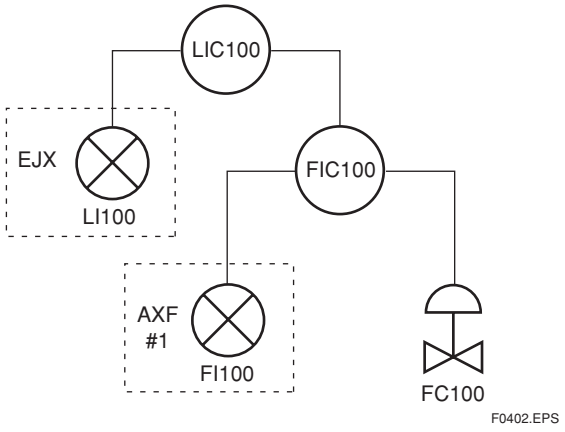

Figure 4.2 Example of Loop Connecting Function Block of the AXF with Other Instruments

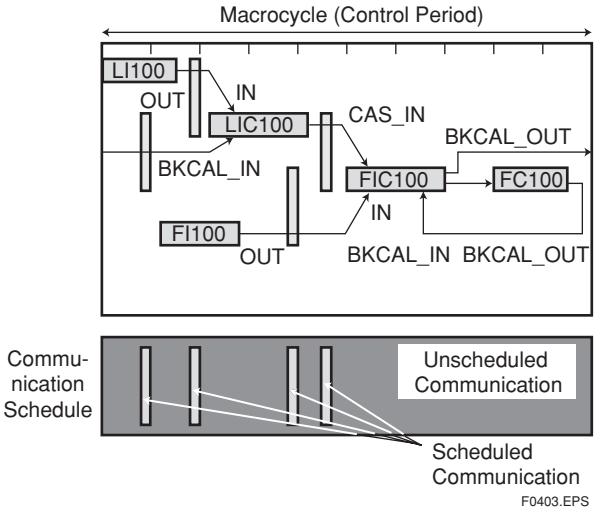

Figure 4.3 Function Block Schedule and Communication Schedule

When the control period (macrocycle) is set to more than 4 seconds, set the following intervals to be more than 1% of the control period.

- Interval between “end of block execution” and “start of sending CD from LAS”
- Interval between “end of block execution” and “start of the next block execution”

4.4 Setting of Tags and Addresses

This section describes the steps in the procedure to set PD Tags and node addresses in the AXF. There are three states of Fieldbus devices as shown in Figure 4.4, and if the state is other than the lowest SM_OPERATIONAL state, no function block is executed. AXF must be transferred to this state when an AXF tag or address is changed.

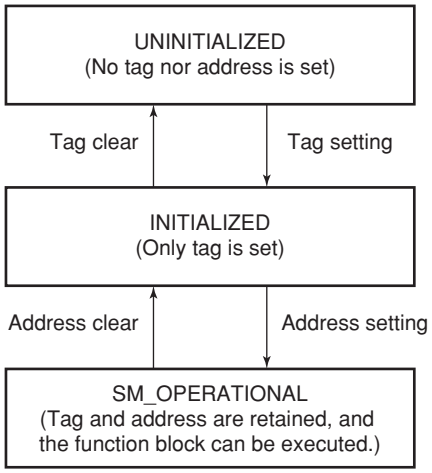

Figure 4.4 Status Transition by Setting PD Tag and Node Address

AXF has a PD Tag (FT2001) and node address (244, or hexadecimal F4) that are set upon shipment from the factory unless otherwise specified. To change only the node address, clear the address once and then set a new node address. To set the PD Tag, first clear the node address and clear the PD Tag, then set the PD Tag and node address again.

Devices whose node addresses have been cleared will have the default address (randomly chosen from a range of 248 to 251, or from hexadecimal F8 to FB). At the same time, it is necessary to specify the device ID in order to correctly specify the device. The device ID of the AXF is 594543000Bxxxxxxxx. (The xxxxxxxx at the end of the above device ID is a total of 8 alphanumeric characters.)

4.5 Communication Setting

To set the communication function, it is necessary to change the database residing in SM-VFD.

4.5.1 VCR Setting

Set VCR (Virtual Communication Relationship), which specifies the called party for communication and resources. AXF has 33 VCRs whose application can be changed, except for the first VCR, which is used for management.

AXF has VCRs of four types:

Server(QUB) VCR
: A Server responds to requests from a host. This communication needs data exchange. This type of communication is called QUB (Queued User-triggered Bidirectional) VCR.

Source (QUU) VCR
: A Source multicasts alarms or trends to other devices. This type of communication is called QUU (Queued User-triggered Unidirectional) VCR.

Publisher (BNU) VCR
: A Publisher multicasts AI block output to another function block(s). This type of communication is called BNU (Buffered Network-triggered Unidirectional) VCR.

Subscriber (BNU) VCR
: A Subscriber receives output of another function block(s) by PID block.

A Server VCR is capable to responding to requests from a Client (QUB) VCR after the Client successfully initiates connection to the Server. A Source VCR transmits data without established connection. A Sink (QUU) VCR on another device can receive it if the Sink is configured so. A Publisher VCR transmits data when LAS requests so. An explicit connection is established from Subscriber (BNU) VCR(s) so that a Subscriber knows the format of published data.

Each VCR has the parameters listed in Table 4.4. Parameters must be changed together for each VCR because modification of individual parameters may cause inconsistent operation.

Table 4.4 VCR Static Entry

Sub-index	Parameter	Description
1	FasArTypeAndRole	Indicates the type and role of communication (VCR). The following 4 types are used for AXF. 0x32: Server (Responds to requests from host.) 0x44: Source (Transmits alarm or trend.) 0x66: Publisher (Sends AI block output to other blocks.) 0x76: Subscriber (Receives output of other blocks by PID block.)
2	FasDllLocalAddr	Sets the local address to specify VCR in AXF. A range of 20 to F7 in hexadecimal.
3	FasDllConfigured RemoteAddr	Sets the node address of the called party for communication and the address (DLSAP or DLCEP) used to specify VCR in that address. For DLSAP or DLCEP, a range of 20 to F7 in hexadecimal is used. Addresses in Subindex 2 and 3 need to be set to the same contents of the VCR as the called party (local and remote are reversed).
4	FasDllSDAP	Specifies the quality of communication. Usually, one of the following types is set. 0x2B: Server 0x01: Source (Alert) 0x03: Source (Trend) 0x91: Publisher/Subscriber
5	FasDllMaxConfirm DelayOnConnect	To establish connection for communication, a maximum wait time for the called party's response is set in ms. Typical value is 60 seconds (60000).
6	FasDllMaxConfirm DelayOnData	For request of data, a maximum wait time for the called party's response is set in ms. Typical value is 60 seconds (60000).
7	FasDllMaxDlsduSize	Specifies maximum DL Service Data unit Size (DLSDU). Set 256 for Server and Trend VCR, and 64 for other VCRs.
8	FasDllResidual ActivitySupported	Specifies whether connection is monitored. Set TRUE (0xff) for Server. This parameter is not used for other communication.
9	FasDllTimelinessClass	Not used for AXF.
10	FasDllPublisherTime WindowSize	Not used for AXF.
11	FasDllPublisher SynchronizaingDlcep	Not used for AXF.

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Sub-index	Parameter	Description
12	FasDllSubsriberTime WindowSize	Not used for AXF.
13	FasDllSubscriber SynchronizationDlcep	Not used for AXF.
14	FmsVfdId	Sets VFD for AXF to be used. (0x1: System/network management VFD 0x1234: Function block VFD)
15	FmsMaxOutstanding ServiceCalling	Set 0 to Server. It is not used for other applications.
16	FmsMaxOutstanding ServiceCalled	Set 1 to Server. It is not used for other applications.
17	FmsFeatures Supported	Indicates the type of services in the application layer. In the AXF, it is automatically set according to specific applications.

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33 VCRs are factory-set as shown in the table below.

Table 4.5 VCR List

Index (SM)	VCR Number	Factory Setting
293	1	For system management (Fixed)
294	2	Server (LocalAddr = 0xF3)
295	3	Server (LocalAddr = 0xF4)
296	4	Server (LocalAddr = 0xF7)
297	5	Trend Source (LocalAddr = 0x07, Remote Address=0x111)
298	6	Publisher for AI (LocalAddr = 0x20)
299	7	Alert Source (LocalAddr = 0x07, Remote Address=0x110)
300	8	Server (LocalAddr = 0xF9)
301 to 315	9 to 33	Not used.

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4.5.2 Function Block Execution Control

According to the instructions given in Section 4.3, set the execution cycle of the function blocks and schedule of execution.

4.6 Block Setting

Set the parameter for function block VFD.

4.6.1 Link Object

A link object combines the data voluntarily sent by the function block with the VCR. The AXF has 40 link objects. A single link object specifies one combination. Each link object has the parameters listed in Table 4.6. Parameters must be changed together for each VCR because the modifications made to each parameter may cause inconsistent operation.

Table 4.6 Link Object Parameters

Sub-index	Parameters	Description
1	LocalIndex	Sets the index of function block parameters to be combined; set “0” for Trend and Alert.
2	VcrNumber	Sets the index of VCR to be combined. If set to “0”, this link object is not used.
3	RemoteIndex	Not used in AXF. Set to “0”.
4	ServiceOperation	Set one of the following. Set only one each for link object for Alert or Trend. 0: Undefined 2: Publisher 3: Subscriber 6: Alert 7: Trend
5	StaleCountLimit	Set the maximum number of consecutive stale input values which may be received before the input status is set to BAD. To avoid the unnecessary mode transition caused when the data is not correctly received by subscriber, set this parameter to “2” or more.

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Set link objects as shown in Table 4.7.

Table 4.7 Factory-Settings of Link Objects (example)

Index	Link Object #	Factory Settings
30000	1	AI.OUT → VCR#6
30001	2	Trend → VCR#5
30002	3	Alert → VCR#7
30003 to 30039	4 to 40	Not used

T0407.EPS

4.6.2 Trend Object

It is possible to set the parameter so that the function block automatically transmits Trend. AXF has seven Trend objects, six of which are used for Trend in analog mode parameters and one is used for Trend in discrete mode parameter. A single Trend object specifies the trend of one parameter.

Each Trend object has the parameters listed in Table 4.8. The first four parameters are the items to be set. Before writing to a Trend object, it is necessary to release the WRITE_LOCK parameter.

Table 4.8 Parameters for Trend Objects

Sub-index	Parameters	Description
1	Block Index	Sets the leading index of the function block that takes a trend.
2	Parameter Relative Index	Sets the index of parameters taking a trend by a value relative to the beginning of the function block. In the AXF AI block, the following three types of trends are possible. 7: PV 8: OUT 19: FIELD_VAL
3	Sample Type	Specifies how trends are taken. Choose one of the following 2 types: 1: Sampled upon execution of a function block. 2: The average value is sampled.
4	Sample Interval	Specifies sampling intervals in units of 1/32 ms. Set the integer multiple of the function block execution cycle.
5	Last Update	The last sampling time.
6 to 21	List of Status	Status part of a sampled parameter.
21 to 37	List of Samples	Data part of a sampled parameter.

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Seven trend objects are factory-set as shown Table 4.9.

Table 4.9 Trend Object are Factory-Set

Index	Parameters	Factory Settings
32000 to 32007	TREND_FLT.1 to TREND_FLT.8	No setting
32008 to 32009	TREND_DIS.1 to TREND_DIS.2	No setting

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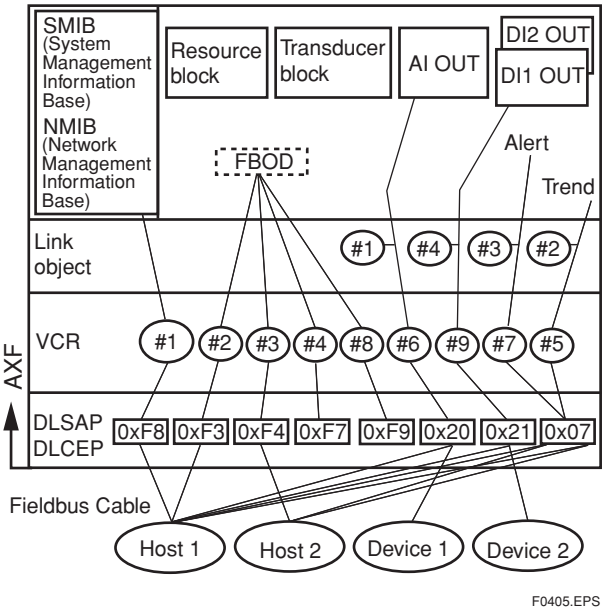

F0405.EPS

Figure 4.5 Example of Default Configuration

4.6.3 View Object

This object forms a group of parameters in a block. One advantage brought by forming groups of parameters is the reduction of load for data transactions. View Object has the parameters listed in Table 4.11 to 4.16. Purpose of View Objects is shown in Table 4.10.

Table 4.10 Purpose of Each View Object

	Description
VIEW_1	Set of dynamic parameters required by operator for plant operation. (PV, OUT, Mode etc.)
VIEW_2	Set of static parameters which need to be shown to plant operator at once. (Range etc.)
VIEW_3	Set of all the dynamic parameters.
VIEW_4	Set of static parameters for configuration or maintenance.

T0410.EPS

Table 4.11 View Object for Resource Block

(byte)

Relative Index	Parameter	VIEW_1	VIEW_2	VIEW_3	VIEW_4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	RS_STATE	1		1	
8	TEST_RW				
9	DD_RESOURCE				
10	MANUFAC_ID				4
11	DEV_TYPE				2
12	DEV_REV				1
13	DD_REV				1
14	GRANT_DENY		2		
15	HARD_TYPES				2
16	RESTART				
17	FEATURES				2
18	FEATURE_SEL		2		
19	CYCLE_TYPE				1
20	CYCLE_SEL		2		
21	MIN_CYCLE_T				4
22	MEMORY_SIZE				2
23	NV_CYCLE_T		4		
24	FREE_SPACE		4		
25	FREE_TIME	4		4	
26	SHED_RCAS		4		
27	SHED_ROUT		4		
28	FAULT_STATE	1		1	
29	SET_FSAFE				
30	CLR_FSAFE				

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(byte)

Relative Index	Parameter	VIEW_1	VIEW_2	VIEW_3	VIEW_4
31	MAX_NOTIFY				4
32	LIM_NOTIFY		1		
33	CONFIRM_TIME		4		
34	WRITE_LOCK		1		
35	UPDATE_EVT				
36	BLOCK_ALM				
37	ALARM_SUM	8		8	
38	ACK_OPTION				2
39	WRITE_PRI				1
40	WRITE_ALM				
41	ITK_VER				
42	SOFT_REV				
43	SOFT_DESC				
44	SIM_ENABLE_MSG				
45	DEVICE_STATUS_1			4	
46	DEVICE_STATUS_2			4	
47	DEVICE_STATUS_3			4	
48	DEVICE_STATUS_4			4	
49	DEVICE_STATUS_5			4	
50	DEVICE_STATUS_6			4	
51	DEVICE_STATUS_7			4	
52	DEVICE_STATUS_8			4	
53	SOFTDWN_PROTECT				1
54	SOFTDWN_FORMAT				1
55	SOFTDWN_COUNT				2
56	SOFTDWN_ACT_AREA			1	
57	SOFTDWN_MOD_REV			16	
58	SOFTDWN_ERROR			2	
	Totals	22	30	73	35

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Table 4.12 View Object for Transducer Block

(byte)

Relative Index	Parameter Mnemonic	VIEW_1	VIEW_2	VIEW_3 1st	VIEW_3 2nd	VIEW_4 1st	VIEW_4 2nd	VIEW_4 3	VIEW_4 4	VIEW_4 5	VIEW_4 6	VIEW_4 7
1	ST_REV	2	2	2	2	2	2	2	2	2	2	2
2	TAG_DESC											
3	STRATEGY					2						
4	ALERT_KEY					1						
5	MODE_BLK	4		4								
6	BLOCK_ERR	2		2								
7	UPDATE_EVT											
8	BLOCK_ALM											
9	TRANSDUCER_DIRECTORY											
10	TRANSDUCER_TYPE	2	2	2		2						
11	XD_ERROR	1		1								
12	COLLECTION_DIRECTORY											
13	PRIMARY_VALUE_TYPE		2									
14	PRIMARY_VALUE	5		5								
15	PRIMARY_VALUE_RANGE					11						
16	CAL_POINT_HI		4									
17	CAL_POINT_LO		4									
18	CAL_MIN_SPAN					4						
19	CAL_UNIT					2						
20	SENSOR_TYPE					2						
21	SENSOR_RANGE					11						
22	SENSOR_SN					32						
23	SENSOR_CAL_METHOD						1					
24	SENSOR_CAL_LOC						32					
25	SENSOR_CAL_DATE						7					
26	SENSOR_CAL_WHO						32					
27	LIN_TYPE					1						
28	SECONDARY_VALUE			5								
29	SECONDARY_VALUE_UNIT					2						
30	LANGUAGE		1									
31	DISPLAY_SELECT1		1									
32	DISPLAY_SELECT2		1									
33	DISPLAY_SELECT3		1									
34	NOMINAL_SIZE_UNIT		2									
35	NOMINAL_SIZE		4									
36	PRIMARY_VALUE_FTIME		4									
37	AUTO_ZERO_EXE		1									
38	MAGFLOW_ZERO		4									
39	LOW_MF		4									
40	HIGH_MF		4									
41	LOW_MF (EDF)		4									
42	HIGH_MF (EDF)		4									
43	SELECT_FLOW_TUBU		1									
44	MEASURE_MODE		1									
45	PRIMARY_VALUE_LOWCUT		4									
46	BI_DIRECTION		1									
47	FLOW_DIRECTION		1									

(byte)

Relative Index	Parameter Mnemonic	VIEW_1	VIEW_2	VIEW_3 1st	VIEW_3 2nd	VIEW_4 1st	VIEW_4 2nd	VIEW_4 3	VIEW_4 4	VIEW_4 5	VIEW_4 6	VIEW_4 7
48	VELOCITY_CHECK		4									
49	DENSITY_UNIT		1									
50	MASS_FLOW_DENSITY		4									
51	LIMSW_1_VALUE_D			2								
52	LIMSW_1_TARGET							1				
53	LIMSW_1_SETPOINT							4				
54	LIMSW_1_ACT_DIRECTION							1				
55	LIMSW_1_HYSTERESIS							4				
56	LIMSW_1_UNIT							1				
57	LIMSW_2_VALUE_D			2								
58	LIMSW_2_TARGET							1				
59	LIMSW_2_SETPOINT							4				
60	LIMSW_2_ACT_DIRECTION							1				
61	LIMSW_2_HYSTERESIS							4				
62	LIMSW_2_UNIT							1				
63	SWITCH_1_VALUE_D			2								
64	SWITCH_1_TARGET							1				
65	SWITCH_2_VALUE_D			2								
66	SWITCH_2_TARGET							1				
67	SIGNAL_LOCK							1				
68	DISPLAY_CYCLE							1				
69	RATE_LIMIT							4				
70	DEAD_TIME							4				
71	PULSING_FLOW							1				
72	POWER_SYNCH							1				
73	POWER_FREQUENCY							4				
74	SOFTWARE_REV_NO							8				
75	ALARM_PERFORM							4				
76	OPERATION_TIME				16							
77	ALM_RECORD1				1							
78	ALM_RECORD_TIME1				16							
79	ALM_RECORD2				1							
80	ALM_RECORD_TIME2				16							
81	ALM_RECORD3				1							
82	ALM_RECORD_TIME3				16							
83	ALM_RECORD4				1							
84	ALM_RECORD_TIME4				16							
85	ALARM_SUM			8								
86	ADHESION_CHECK							1				
87	ADHESION_LEVEL1							4				
88	ADHESION_LEVEL2							4				
89	ADHESION_LEVEL3							4				
90	ADHESION_LEVEL4							4				
91	ADH_MEASURE_VALUE			4								
	Total	16	66	41	86	72	74	71	2	2	2	2

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Table 4.13 View Object for AI Function Block

(byte)

Relative Index	Parameter	VIEW_1	VIEW_2	VIEW_3	VIEW_4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	OUT	5		5	
9	SIMULATE				
10	XD_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	IO_OPTS				2
14	STATUS_OPTS				2
15	CHANNEL				2
16	L_TYPE				1
17	LOW_CUT				4
18	PV_FTIME				4
19	FIELD_VAL	5		5	
20	UPDATE_EVT				
21	BLOCK_ALM				
22	ALARM_SUM	8		8	
23	ACK_OPTION				2
24	ALARM_HYS				4
25	HI_HI_PRI				1
26	HI_HI_LIM				4
27	HI_PRI				1
28	HI_LIM				4
29	LO_PRI				1
30	LO_LIM				4
31	LO_LO_PRI				1
32	LO_LO_LIM				4
33	HI_HI_ALM				
34	HI_ALM				
35	LO_ALM				
36	LO_LO_ALM				
	Total	31	26	31	46

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Table 4.14 View Object for DI (DI1, DI2) Function Block

(byte)

Relative Index	Parameter	VIEW_1	VIEW_2	VIEW_3	VIEW_4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV_D	2		2	
8	OUT_D	2		2	
9	SIMULATE_D				
10	XD_STATE		2		
11	OUT_STATE		2		
12	GRANT_DENY		2		
13	IO_OPTS				2
14	STATUS_OPTS				2
15	CHANNEL				2
16	PV_FTIME				4
17	FIELD_VAL_D	2		2	
18	UPDATE_EVT				
19	BLOCK_ALM				
20	ALARM_SUM	8		8	
21	ACK_OPTION				2
22	DISC_PRI				1
23	DISC_LIM				1
24	DISC_ALM				
	Total	22	8	22	19

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Table 4.15 View Object for (IT1, IT2) Function Block

(byte)

Relative Index	Parameter	VIEW_1	VIEW_2	VIEW_3	VIEW_4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	TOTAL_SP	4		4	
8	OUT	5		5	
9	OUT_RANGE		11		
10	GRANT_DENY		2		
11	STATUS_OPTS				2
12	IN_1	5		5	
13	IN_2	5		5	
14	OUT_TRIP	2		2	
15	OUT_PTRIP	2		2	
16	TIME_UNIT1		1		
17	TIME_UNIT2		1		
18	UNIT_CONV				4
19	PULSE_VAL1				4
20	PULSE_VAL2				4
21	REV_FLOW1	2		2	
22	REV_FLOW2	2		2	
23	RESET_IN	2		2	
24	STOTAL			4	
25	RTOTAL	4		4	
26	SRTOTAL			4	
27	SSP			4	
28	INTEG_TYPE				1
29	INTEG_OPTS				2
30	CLOCK_PER				4
31	PRE_TRIP				4
32	N_RESET	4		4	
33	PCT_INCL	4		4	
34	GOOD_LIM				4
35	UNCERT_LIM				4
36	OP_CMD_INT	1		1	
37	OUTAGE_LIM				4
38	RESET_CONFIRM	2		2	
39	UPDATE_EVT				
40	BLOCK_ALM				
41	ACCUM_TOTAL			4	
	Total	52	17	64	42

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Table 4.16 View Object for AR Function Block

(byte)

Relative Index	Parameter	VIEW_1	VIEW_2	VIEW_3	VIEW_4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	OUT	5		5	
9	PRE_OUT	5		5	
10	PV_SCALE		11		
11	OUT_RANGE		11		
12	GRANT_DENY		2		
13	INPUT_OPTS				2
14	IN			5	
15	IN_LO			5	
16	IN_1			5	
17	IN_2			5	
18	IN_3			5	
19	RANGE_HI				4
20	RANGE_LO				4
21	BIAS_IN_1				4
22	GAIN_IN_1				4
23	BIAS_IN_2				4
24	GAIN_IN_2				4
25	BIAS_IN_3				4
26	GAIN_IN_3				4
27	COMP_HI_LIM				4
28	COMP_LO_LIM				4
29	ARITH_TYPE				1
30	BAL_TIME				4
31	BIAS				4
32	GAIN				4
33	OUT_HI_LIM				4
34	OUT_LO_LIM				4
35	UPDATE_EVT				
36	BLOCK_ALM				
	Total	23	26	48	68

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Table 4.17 Indexes of View for Each Block

	VIEW_1	VIEW_2	VIEW_3	VIEW_4
Resourse Block	40100	40101	40102	40103
Transducer Block	40200	40201	40202	40203
AI Function Block	40400	40401	40402	40403
DI1 Function Block	40600	40601	40602	40603
DI2 Function Block	40610	40611	40612	40613
PID Function Block	40800	40801	40802	40803
IT1 Function Block	41600	41601	41602	41603
IT2 Function Block	41610	41611	41612	41613
AR Function Block	41750	41751	41752	41753

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4.6.4 Function Block Parameters

Function block parameters can be read from the host or can be set. For a list of the parameters of Resource block, Transducer block, AI block and DI block, refer to “8. PARAMETER LISTS”. For other function blocks, refer to Appendix.

5. EXPLANATION OF BASIC ITEMS

5.1 Outline

This chapter describes basic TR (Transducer block), AI, and DI function block parameter setting, displays of the integral indicator. Refer to Appendixes other function blocks and LM function.

This chapter contains information on how to adapt the function and performance of the ADMAG AXF to suit specific applications. Because two or more devices are connected to FOUNDATION Fieldbus, settings including the requirements of all devices need to be determined. Practically, the following steps must be taken.

The following section describes each step of the procedure in the order given. Using a dedicated configuration tool allows the procedure to be significantly simplified. This section describes the procedure which has relatively simple functions.

5.2 Setting and Changing Parameters for the Whole Process

IMPORTANT

Do not turn off the power immediately after setting. When the parameters are saved to the EEPROM, the redundant processing is executed for an improvement of reliability. If the power is turned off within 60 seconds after setting is made, the modified parameters are not saved and the setting may return to the original values.

Block mode

Many parameters require a change of the block mode of the function block to O/S (Out of Service) when their data is changed. To change the block mode of the function block, its MODE_BLK needs to be changed. The MODE_BLK is comprised of four sub-parameters below.

(1) Target (Target mode):
Sets the operating condition of the block.
(2) Actual (Actual mode):
Indicates the current operating condition.
(3) Permit (Permitted mode):
Indicates the operating condition that the block is allowed to take.
(4) Normal (Normal mode):
Indicates the operating condition that the block will usually take.

5.3 Transducer Block Parameters

The transducer block sets functions specific to the flow rate measurement of the ADMAG AXF. Figure5.3.1 presents the diagram of the Transducer block.

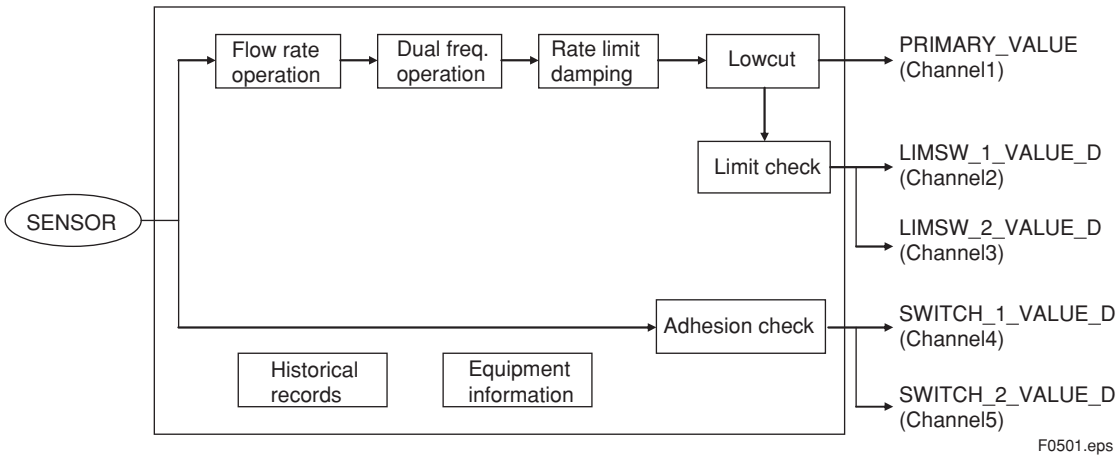

Figure 5.3.1 Diagram of the Transducer Block

For a list of the parameters of each block of the ADMAG AXF, refer to "List of parameters for each block of the ADMAG AXF" in Chapter 8. The following is a list of important parameters.

NOMINAL_SIZE:
Sets the size of the flowtube.

NOMINAL_SIZE_UNIT:
Sets the unit of the flowtube size.

LOW_MF:
Sets the meter factor of low frequency side for standard dual frequency excitation.

HIGH_MF:
Sets the meter factor of high frequency side for standard dual frequency excitation.

LOW_MF(EDF):
Sets the meter factor of low frequency side for enhanced dual frequency excitation.

HIGH_MF(EDF):
Sets the meter factor of high frequency side under enhanced dual frequency excitation.

PRIMARY_VALUE_RANGE:
Shows the range of PRIMARY_VALUE. The engineering units must match the units selected in the parameter XD_SCALE of the AI Block that reads the channel with this value.

PRIMARY_VALUE_FTIME:
Sets the time constant of damping to the flow rate calculation.

PRIMARY_VALUE_LOWCUT:
Sets low cut range for output. Setting range is 0 to 10% of PRIMARY_VALUE_RANGE. EU_100. "0%" is factory set.

Normally low cut be set by this parameter, not by LOW_CUT of AI function block.

DISPLAY_SELECT1, 2, 3:

Table 5.3.1 DISPLAY SELECT

DISPLAY_SELECT 1	DISPLAY_SELECT 2	DISPLAY_SELECT 3
The display content for the display unit's first line.	The display content for the display unit's second line.	The display content for the display unit's third line.
1:Flow Rate(%) 2:Flow Rate 3:Integrator1 Out 4:Integrator2 Out 5:Arithmetic Out The factory default setting is 2.	1:Off 2:Flow Rate(%) 3:Flow Rate 4:Flow Rate(Bar) 5:Integrator1 Out 6:Integrator2 Out 7:Arithmetic Out 8:PD Tag 9:Adhesion Check 10:Communication The factory default setting is 1.	1:Off 2:Flow Rate(%) 3:Flow Rate 4:Flow Rate(Bar) 5:Integrator1 Out 6:Integrator2 Out 7:Arithmetic Out 8:PD Tag 9:Adhesion Check 10:Communication The factory default setting is 1.

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DISPLAY_CYCLE:

Sets the cycle of LCD display. The factory default setting of the display cycle is 2: 400ms. The valid range can be selected from below;

1: 200ms
2: 400ms
3: 1s
4: 2s
5: 4s
6: 8s

If the low temperature environment makes it difficult to view the display, it is recommended that you set a longer display cycle.

PRIMARY_VALUE_TYPE:

Indicates the measuring value type used in PRIMARY_VALUE. Valid range are as follows;

100: mass flow
101: volumetric flow
102: average mass flow
103: average volumetric flow
65535: other

Factory default is 101: volumetric flow.

ALARM_PERFORM

(1) Overview

This parameter masks Alarm/Warning. By setting "0" to each bit, corresponding Alarm/Warning are cleared. When masked the corresponding bit of DEVICE_STATUS becomes OFF and no alarm is displayed on LCD, and also becomes out of scope of Primary value status, ED_ERROR setting.

(2) Bit mapping (0 :MASK, 1 :NON MASK)

bit	categorize	Alarm	defalt
0	Process Alarms	30:Sig Overflow	1
1		31: Empty Pipe	1
2		33:Adhesion Alm	0
3	Warning	80:Adhesion Wng	0
4		82:Auto Zero Wng	1
5		85:Flow Vel Over	1
6 ~ 15	Not used in AXF		0
16	AI	42:AI FB O/S Mode 110:AI Lo Lo Alm 111:AI Hi Hi Alm 130:AI Non-Schedule 141:AI Sim. Enabled 150:AI FB Man Mode	1
17	IT1	43:IT1 FB O/S Mode 131:IT1 Non-Schedule 151:IT1 FB Man Mode 120:IT1 Low Clock Per	0
18	IT2	44:IT2 FB O/S Mode 132:IT2 Non-Schedule 152:IT2 FB Man Mode 121:IT2 Low Clock Per	0
19	DI1	45:DI1 FB O/S Mode 133:DI1 Non-Schedule 142:DI1 Sim. Enabled 153:DI1 FB Man Mode	0
20	DI2	46:DI2 FB O/S Mode 134:DI2 Non-Schedule 143:DI2 Sim. Enabled 154:DI2 FB Man Mode	0
21	AR	47:AR FB O/S Mode 135:AR Non-Schedule 155:AR FB Man Mode 122:AR Range Set Err	0
22	PID	42:PID FB O/S Mode 112:PID Lo Lo Alm 113:PID Hi Hi Alm 136:PID Non-Schedule 156:PID FB Man Mode 160:PID FB Bypass Mode	0
23 ~ 31	Not used in AXF		0

T0502.eps

5.4 AI Function Block Parameters

AI Function block parameters can be read or set from the host. Figure5.4.1 presents the diagram of AI Function block.

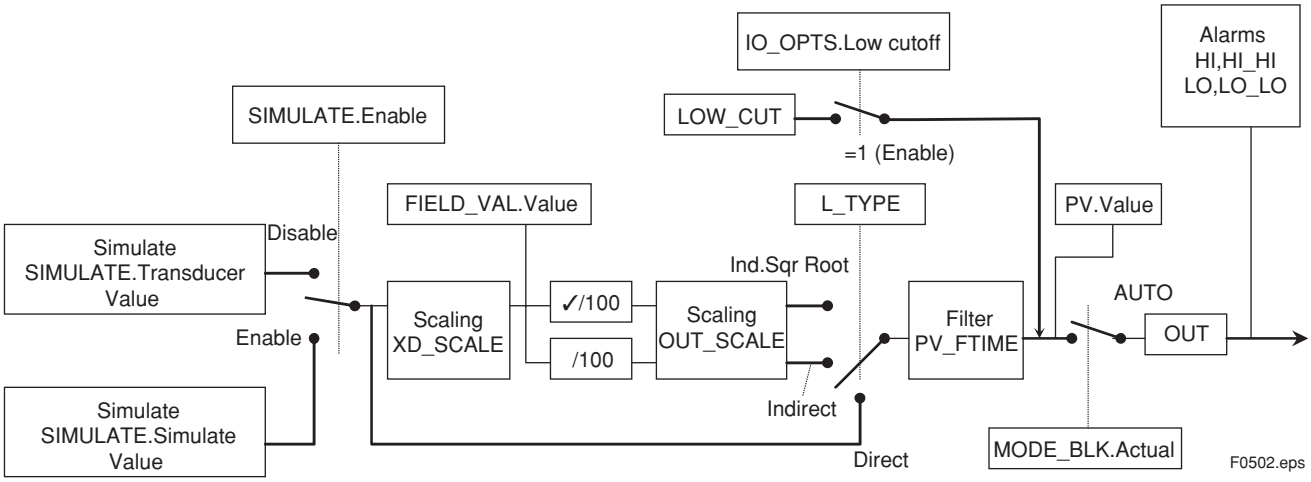

Figure 5.4.1 Diagram of AI Functional Block

For a list of the parameters of blocks held by the ADMAG AXF, refer to "List of parameters for each block of the ADMAG AXF" in Chapter 8. The following is a list of important parameters with a guide how to set them.

TAG_DESC, MODE_BLK:

Indicates the three types of function block modes; Out_Of_Service, Manual, and Auto. TAG_DESC indicates what mode of operation is desired for AI Function block. In Out_Of_Service (O/S) mode, the AI block does not operate. The Manual mode does not allow values to be updated. The Auto mode causes the measured value to be updated. Under normal circumstances, set the Auto mode to take effect. For MODE_BLK the Auto mode is the factory default.

CHANNEL:

This is the parameter of the transducer block to be input to the AI block. AI block is assigned flow rate.

OUT:

This parameter contains the current measurement value from Transducer Block or configuration adjusted engineering unit and the belonging state in AUTO MODE. OUT contains the value and status set by an operator in MAN MODE.

Quality	Sub-status	Limit	Alarm
Good(NC)	Non-specific	0:Not Limited 1:Low Limited 2:High Limited 3:Constant	Normal
	Active Block Alarm		Block Alarm is Active
	Active Advisory Alarm		Advisory Alarm is Active
	Active Critical Alarm		Critical Alarm is Active
	Unack. Block Alarm		Block Alarm is Unacknowledged
	Unack. Advisory Alarm		Advisory Alarm is Active
	Unack. Critical Alarm		Critical Alarm is Active
Uncertain	Engineering Unit Range Violation	--	Out of sensor operating range Out of range of min. span and max. span
Bad	No-specific	--	FB board EEPROM failure TB is O/S BLOCK_ERR is O/S etc.
	Device Failure	0:Not Limited 1:Low Limited 2:High Limited 3:Constant	EEPROM failure Internal communication error
	Sensor Failure		CPU board failure
	Out of Service	--	RS, AI are O/S

T0503.eps

XD_SCALE:

Scale of input from the transducer block. The maximum flow rate range on an order sheet is set. "0" (0%), "10.000"(100%), and "m/s" for the unit are factory-set unless specified in the order. Changing the unit (can be set only in flow rate) also causes the unit within the transducer block to be automatically changed.(The unit is automatically changed according to the unit selected in AI. Units which can be set by XD_SCALE are shown in Table 5.4.1.

Table 5.4.1 Unit Codes

Volume/ Mass unit	Time unit			
	d	h	min	s
L	Ml/d (1355) kL/d (1520) L/d (1354)	Ml/h (65521) kL/h (1519) L/h (1353)	Ml/min (65520) kL/min (1518) L/min (1352)	kL/s (65522) L/s (1351)
m3	m3/d (1350)	m3/ h (1349)	m3/min (1348)	m3/s (1347)
cm3	cm3/d (1514)	cm3/h (1513)	cm3/min (1512)	cm3/s (1511)
m	-	-	-	m/s (1061)
t	t/d (1329)	t/h (1328)	t/min (1327)	t/s (1326)
kg	kg/d(1325)	kg/h (1324)	kg/min (1323)	kg/s (1322)
g	g/d (1321)	g/h (1320)	g/min (1319)	g/s (1318)
CF	ft3/d (1359)	CFH (1358)	CFM (1357)	CFS (1356)
gal(US)	Mgal (US)/d (1366) kgal (US)/d (1462) gal (US)/d (1365) mgal (US)/d (1461)	Mgal (US)/h (1459) kgal (US)/h (1458) gal (US)/h (1364) mgal (US)/h (1457)	Mgal (US)/min (1455) kgal (US)/min (1454) GPM (1363) mgal (US)/min (1453)	Mgal (US)/s (1451) kgal (US)/s (1450) gal (US)/s (1362) mgal (US)/s (1449)
bbl(US Oil)	kbbl (US Oil)/d (1493) bbl (US Oil)/d (1374) mbbl (US Oil)/d (1492) µbbl (US Oil)/d (1491)	kbbl (US Oil)/h (1489) bbl (US Oil)/h (1373) mbbl (US Oil)/h (1488) µbbl (US Oil)/h (1487)	kbbl (US Oil)/min (1485) bbl (US Oil)/min (1372) mbbl (US Oil)/min (1484) µbbl (US Oil)/min (1483)	kbbl (US Oil)/s (1481) bbl (US Oil)/s (1371) mbbl (US Oil)/s (1480) µbbl (US Oil)/s (1479)
bbl(US Beer)	kbbl (US Beer)/d (65525) bbl (US Beer)/d (65529) mbbl (US Beer)/d (65533)	kbbl (US Beer)/h (65524) bbl (US Beer)/h (65528) mbbl (US Beer)/h (65532)	bbl (US Beer)/min (65527) mbbl (US Beer)/min (65531) µbbl (US Beer)/min (65535)	bbl (US Beer)/s (65526) mbbl (US Beer)/s(65530) µbbl (US Beer)/s
lb	lb (US)/d (1333)	lb (US)/h (1332)	lb (US)/min (1331)	lb (US)/s (1330)
ft	-	-	-	ft/s (1067)

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OUT_SCALE:

Set the range of output (from 0% to 100%). In the case of AXF, OUT_SCALE is always the same setting as XD_SCALE.

L_TYPE:

L_TYPE is always selected as "Direct".

(Note) "Indirect" also can be set.

PV_FTIME:

Sets the time constant of the damping function within AI block (primary delay) in seconds.

For normal magmeter's damping setting, set by PRIMARY_VALUE_FTIME of transducer block instead of setting AI function block's PV_FTIME.

5.5 DI Function Block Parameters

DI Function block parameters can be read or set from the host. Figure5.5.1 presents the diagram of DI Function block.

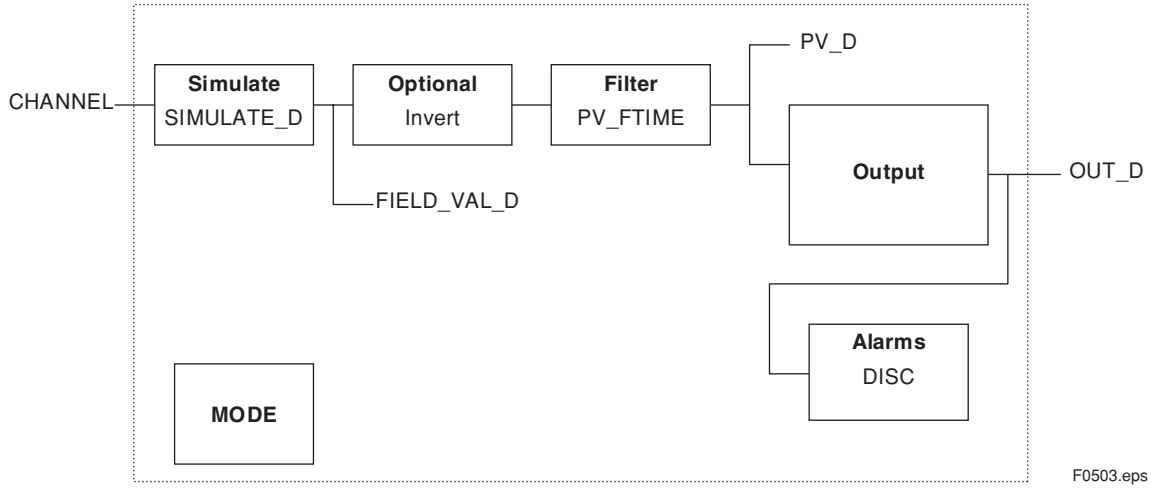

Figure 5.5.1 Diagram of DI Function Block

ADMAG AXF contains two DI function blocks, which individually transfer the "Flow switch" and "Adhesion Alarm/warning" generated by the transducer block. For a list of the parameters of blocks held by the ADMAG AXF, refer to "List of parameters for each block of the ADMAG AXF" in Chapter 8. The following is a list of important parameters with a guide to how to set them.

MODE_BLK:

Indicates the three types of function block modes; Out_Of_Service, Manual, and Auto. MODE_BLK indicates what mode of operation is desired for DI Function block. In Out_Of_Service mode, the DI block does not operate. The Manual mode does not allow values to be updated. The Auto mode permits the measured value to be updated. Under normal circumstances, set the Auto mode to take effect. The Auto mode is the factory default.

CHANNEL:

This is the parameter to specify the value of the transducer block to be input to the DI block.

Value	Content
2	LIMSW_1
3	LIMSW_2
4	SWITCH_1
5	SWITCH_2

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Each DI block is assigned to either "Flow switch" or "Adhesion Alarm/warning".

PV_FTIME:

Stipulates the delay time (in seconds) of changing the output value after a change of the value inside the DI block.

DISC_PRI:

Deternines the priority level of the discrete alarm on the block's output (OUT_D). The alarm will be transmitted upon occurrence only when the DISC_PRI is set at 3 or higher. This parameter is set to 1 before the AXF is shipped from the factory.

Table 5.5.1 Alarm Priority

Value	Description
0	Alert is not notified. Alarm parameters are not updated.
1	Alert is not notified.
3 to 7	Advisory alarms.
8 to 15	Critical alarms.

T0506.eps

DISC_LIM:

Setpoint of the discrete alarm; when the value of OUT_D agrees with the value set in DISC_LIM, the discrete alarm is generated.

5.6 Integral LCD Indicator

Employing 32*132 full dot matrix backlit LCD, various display can be obtained.

5.6.1 Flow Data Display

By the transducer block parameters setting in DISPLAY_SELECT1, 2, 3 as described in 5.3, up to three lines display can be made among the following data.

-Flow Rate(%)
-Flow Rate
-Flow Rate(Bar)
-Integrator1 Out
-Integrator2 Out
-Arithmetic Out
-PD Tag
-Adhesion Check
-Communication

The number of the data can be configured by setting DISPLAY_SELECT1, 2, 3 as follows;

	1 line display	2 line display	3 line display
Display Select1	-	-	-
Display Select2	Off	Other than "Off"	Other than "Off"
Display Select3	-	Off	Other than "Off"

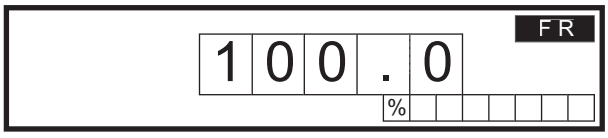
T0507.eps

The data titles are displayed together with the flow data and units.

FR : Flow Rate, Flow Rate(%)
IT1 : Integrator1 Out
IT2 : Integrator2 Out
AR : Arithmetic Out
TAG : PD Tag
ADH : Adhesion Check
COM : Communication

F0504.eps

Flow Rate (%)

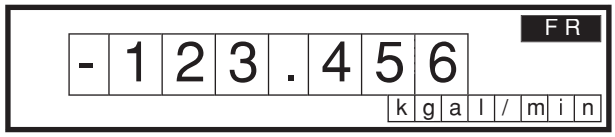


F0505.eps

Decimal point is always to the first place.

Flow Rate

Flow rate is displayed together with the units set in XD_SCALE, the maximum number of figures is six.



F0506.eps

In the case of L_TYPE is "Direct " decimal point location of the data becomes as follows.

XD_SCALE.Decimal_Point	Desimal Point Location	Example
0	0	123
1	1	123.4
2	2	123.45
3	3	123.456
Other	Auto	Refer to below

T0508.eps

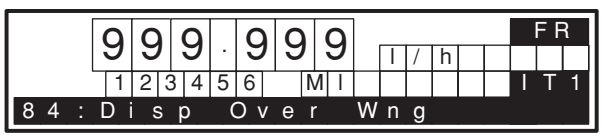
When XD_SCALE.Units_Index is set as Other decimal point location of the data becomes as follows.

XD_SCALE.EU_0,EU_100 set value	Desimal Point Location	Example
XD_SCALE value≤ -10000	0	-33333
-10000 < XD_SCALE value ≤ -1000	1	-4444.1
-1000 < XD_SCALE value ≤ -100	2	-555.12
-100 < XD_SCALE value ≤ -10	3	-66.123
-10 < XD_SCALE value < 10	3	-7.123 0.123
10 ≤ XD_SCALE value < 100	3	66.123
100 ≤ XD_SCALE value < 1000	2	555.12
1000 ≤ XD_SCALE value < 10000	1	4444.1
10000 ≤ XD_SCALE value	0	33333

T0509.eps

*XD_SCALEvalue : Max (|XD_SCALE.EU0|, |XD_SCALE.EU100|)

When the flow data exceeds the maximum number of figures six, then "84:Disp Over Wng" message is displayed.



F0507.eps

Flow Rate Unit Display on LCD

Flow Rate Unit Display is shown by the following table corresponding to the XD_SCALE Units Codes.

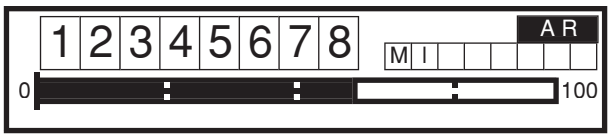
Table 5.6.1 Display Unit Codes

Units Codes	LCD Display Unit [/d]	Units Codes	LCD Display Unit [/h]	Units Codes	LCD Display Unit [/min]	Units Codes	LCD Display Unit [/s]
1355:Ml/d	Ml/d	65521:Ml/h	Ml/h	65520:Ml/min	Ml/min		
1350:m3/d	m^3/d	1349:m3/h	m^3/h	1348:m3/min	m^3/min	1347:m3/s	m^3/s
1520:kL/d	kl/d	1519:kL/h	kl/h	1518:kL/min	kl/min	65522:kL/s	kl/s
1354:L/d	l/d	1353:L/h	l/h	1352:L/min	l/min	1351:L/s	l/s
1514:cm3/d	cm^3/d	1513:cm3/h	cm^3/h	1512:cm3/min	cm^3/min	1511:cm3/s	cm^3/s
						1061:m/s	m/s
1329:t/d	t/d	1328:t/h	t/h	1327:t/min	t/min	1326:t/s	t/s
1325:kg/d	kg/d	1324:kg/h	kg/h	1323:kg/min	kg/min	1322:kg/s	kg/s
1321:g/d	g/d	1320:g/h	g/h	1319:g/min	g/min	1318:g/s	g/s
1359:ft3/d	cf/d	1358:CFH	cf/h	1357:CFM	cf/min	1356:CFS	cf/s
1366:Mgal(US)/d	Mgal/d	1459:Mgal(US)/h	Mgal/h	1455:Mgal(US)/min	Mgal/min	1451:Mgal(US)/s	Mgal/s
1462:kgal(US)/d	kgal/d	1458:kgal(US)/h	kgal/h	1454:kgal(US)/min	kgal/min	1450:kgal(US)/s	kgal/s
1365:gal(US)/d	gal/d	1364:gal(US)/h	gal/h	1363:GPM	gal/min	1362:gal(US)/s	gal/s
1461:mgal(US)/d	mgal/d	1457:mgal(US)/h	mgal/h	1453:mgal(US)/min	mgal/min	1449:mgal(US)/s	mgal/s
1493:kbbl(US Oil)/d	kbbl/d	1489:kbbl(US Oil)/h	kbbl/h	1485:kbbl(US Oil)/min	kbbl/min	1481:kbbl(US Oil)/s	kbbl/s
1374:bbl(US Oil)/d	bbl/d	1373:bbl(US Oil)/h	bbl/h	1372:bbl(US Oil)/min	bbl/min	1371:bbl(US Oil)/s	bbl/s
1492:mbbl(US Oil)/d	mbbl/d	1488:mbbl(US Oil)/h	mbbl/h	1484mbbl(US Oil)/min	mbbl/min	1480:mbbl(US Oil)/s	mbbl/s
1491:ubbl(US Oil)/d	µbbl/d	1487:ubbl(US Oil)/h	µbbl/h	1483:ubbl(US Oil)/min	µbbl/min	1479:ubbl(US Oil)/s	µbbl/s
65525:kbbl(US Beer)/d	kbbl/d	65524:kbbl(US Beer)/h	kbbl/h				
65529:bbl(US Beer)/d	bbl/d	65528:bbl(US Beer)/h	bbl/h	65527:bbl(US Beer)/min	bbl/min	65526:bbl(US Beer)/s	bbl/s
65533:mbbl(US Beer)/d	mbbl/d	65532:mbbl(US Beer)/h	mbbl/h	65531:mbbl(US Beer)/min	mbbl/min	65530:mbbl(US Beer)/s	mbbl/s
				65535:ubbl(US Beer)/min	µbbl/min	65534:ubbl(US Beer)/s	µbbl/s
1333:lb(US)/d	lb/d	1332:lb(US)/h	lb/h	1331:lb(US)/min	lb/min	1330:lb(US)/s	lb/s
						1067:ft/s	ft/s

T0510.eps

Flow Rate (Bar)

Bi Direction is set "Unidirectional"



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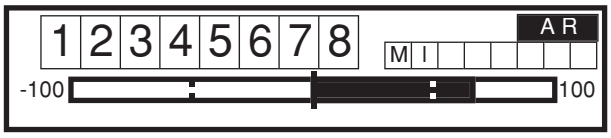
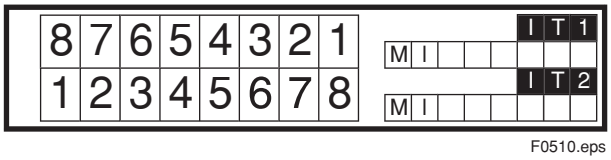
Bi Direction is set "Bidirectional"



F0509.eps

Integrator1 Out, Integrator2 Out

The maximum number of figures is eight in addition to sign (±) for Integrator Out display.



F0510.eps

The decimal point location of the data becomes as follows depending on the setting of IT block OUT_RANGE. Decimal_Point

IT1 or IT2:OUT_RANGE.Decimal_Point	Desimal Point Location	Example
0	0	12345678
1	1	1234567.8
2	2	123456.78
3	3	12345.678
4	4	1234.5678
5	5	123.45678
6	6	12.345678
7	7	1.2345678
Other	0	12345678

T0511.eps

Integrator Out Unit Display

Only when the following units are set in IT1 or IT2 :OUT_RANGE.Units_Index the unit is displayed on LCD, otherwise eight charactor space is displayed.

Table 5.6.2 Integrator Unit Display

Units Codes	LCD Display Unit	Units Codes	LCD Display Unit
65523:Ml	Ml	1091:Mg	Mg
1034:m^3	m^3	1088:kg	kg
1035:dm^3	dm^3	1089:g	g
1517:kL	kl	1090:mg	mg
1041:hL	hl	1043:CF	cf
1038:L	l	1048:gallon	gal
1040:mL	ml	1051:bbl	bbl
1036:cm^3	cm^3	1094:lb	lb
1092:t	t	1588:no units	space

T0512.eps

Arithmetic Out

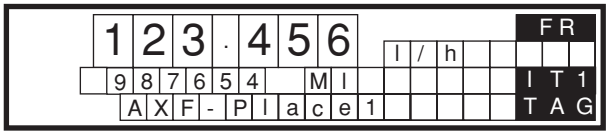
The display is given in the same manner as Integrator Out, decimal point is set by "AR:OUT_RANGE.Decimal_Point".

AR:OUT_RANGE.Decimal_Point	Desimal Point Location	Example
0	0	12345678
1	1	1234567.8
2	2	123456.78
3	3	12345.678
4	4	1234.5678
5	5	123.45678
6	6	12.345678
7	7	1.2345678
Other	0	12345678

T0513.eps

PD Tag

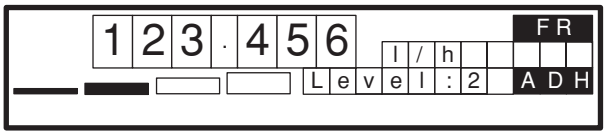
The third line shows the example of PD Tag display. Maximum number of figures is 16, on LCD the head 16 charactors out of 32 charactors of management PD Tag can be displayed.



F0511.eps

Adhesion Check

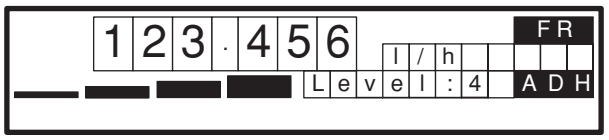
When Adhesion Check display is selected result is displayed as below showing the level number.



F0512.eps

Adhesion Check Level Judge

Level4 : Adh Measure Value > Adhesion Level4



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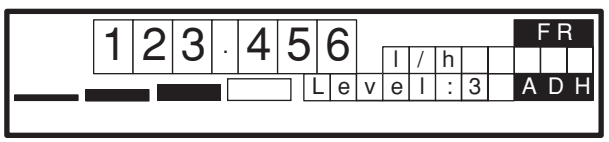
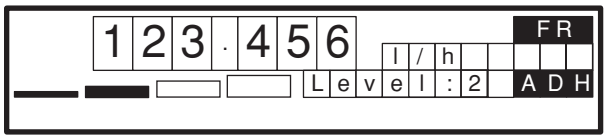
Level3 : Adhesion Level4 ≥ Adh Measure Value > Adhesion Level3



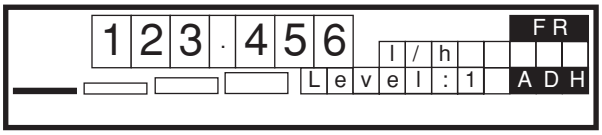
F0514.eps

Level2 : Adhesion Level3 ≥ Adh Measure Value > Adhesion Level2



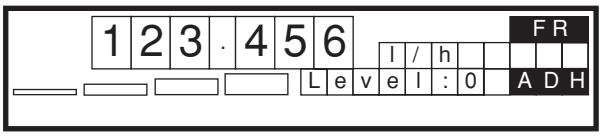
F0515.eps

Level1 : Adhesion Level2 ≥ Adh Measure Value > Adhesion Level1



F0516.eps

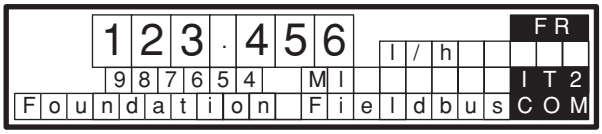
Level0 : Adhesion Level1 ≥ Adh Measure Value



F0517.eps

Communication

The third line shows the example of Communication display.



F0518.eps

5.6.2 Display Modes

ADMAG AXF has following display modes.

- Normal Display
- Alarm Display
- Warning Display
- Autozero Display

Display Renewal Time

Display renewal time for each display modes depends on Display Cycle setting;

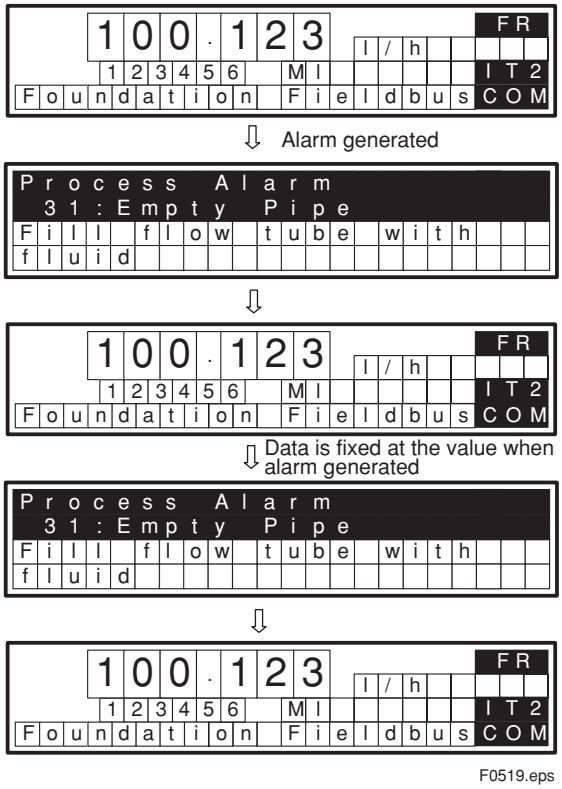
Display Mode	Display Cycle set Time		
	2s,1s,400ms,200ms	4s	8s
Normal Display	2s	4s	8s
Alarm Display	4s	4s	8s
Warning Display	4s	4s	8s
Autozero Display	30s		

T0514.eps

Normal Display

In this display mode various flow data from one to three lines are displayed as described in 5.5.1.

Alarm Display



F0519.eps

Alarm Message / Countermeasure Message

On the Integral LCD indicator following messages are displayed when alarm is generated.

Table 5.6.3 Alarm Message Display

Category	Alarm Message	Countermeasure Message	Alarm Description
System Alarms	10:uP Fault	Contact nearest office or service center	Microprocessor (CPU) failure
	11:EEPROM Fault		EEPROM failure
	12:A/D(H) Fault		A/D converter failure
	13:A/D(L) Fault		
	14:A/D(Z) Fault		
	15:Coil Open	Cut the power and check coil & EX cables	Flowtube coil is open-circuit
	16:EEPROM Dflt	Contact nearest office or service center	EEPROM default values
	100:Comm uP Fault		Communication uP failure
	101:Comm EEPROM Fault		Communication EEPROM failure
	102:IT1 Not Saved		IT1 save error
	103:IT2 Not Saved		IT2 save error
	104:Comm Error1		AXF internal communication error
	105:Comm Error2		AXF internal communication error
	106:DL Incomplete	Check software download error code	Download is not completed
	107:Download Fail		Download failure
	108:Not Ready	Schedule FB, or check LAS communication	Function block not scheduled
Process Alarms	30:Sig Overflow	Check signal cable and grounding	Input signal error
	31:Empty Pipe	Fill flow tube with fluid	Flowtube is not filled with fluid
	33:Adhesion Alm	Clean electrodes	Electrode adhesion alarm
	110:AI Lo Lo Alm	Check the flow rate and setting value	AI process alarm
	111:AI Hi Hi Alm	Check the flow rate and setting value	AI process alarm
	112:PID Lo Lo Alm	Check the setting value	PID process alarm
	113:PID Hi Hi Alm	Check the setting value	PID process alarm
O/S Mode Alarms	40:RS O/S Mode		RS. MODE_BLK.Target is O/S mode
	41:TB O/S Mode		TB. MODE_BLK.Target is O/S mode
	42:AI FB O/S Mode		AI. MODE_BLK.Target is O/S mode
	43:IT1 FB O/S Mode		IT1. MODE_BLK.Target is O/S mode
	44:IT2 FB O/S Mode		IT2. MODE_BLK.Target is O/S mode
	45:DI1 FB O/S Mode		DI1. MODE_BLK.Target is O/S mode
	46:DI2 FB O/S Mode		DI2. MODE_BLK.Target is O/S mode
	47:AR FB O/S Mode		AR. MODE_BLK.Target is O/S mode
	48:PID FB O/S Mode		PID. MODE_BLK.Target is O/S mode
Setting Alarms	50:Span > 10m/s	Check XD Scale of AI	Span flow velocity setting is 11 m/s or more
	51:Span < 0.1m/s		Span flow velocity setting is 0.05 m/s or less
	57:Dens Set Err	Check XD Scale,Density Unit,Mass Flow Density	Mass units have been selected for Base Flow Unit but density is set to zero.
	71:Meas Mod Set	Check Measure Mode of TB	Measure Mode is set to Enhanced DF without selecting an optional code HF1 or HF2.
	72:Size Set Err	Check Nominal Size,Nominal Size Unit	A value of 3000.1 mm or more is set for Nominal Size.
	73:Adh Set Err	Check Adhesion Level1 to Adhesion Level 4	The condition in Adhesion detection level, Level:1<Level:2<Level:3<Level:4 is not satisfied.
	120:IT1 Clock Per Err	Check Clock Period,Period of Execution	IT1 CLOCK_PER set value is smaller than excecution period
	121:IT2 Clock Per Err	Check Clock Period,Period of Execution	IT2 CLOCK_PER set value is smaller than excecution period
	122:AR Range Set Err	Check Range Hi and Range Lo of AR	RANGE_HI>RANGE_LO is not satisfied

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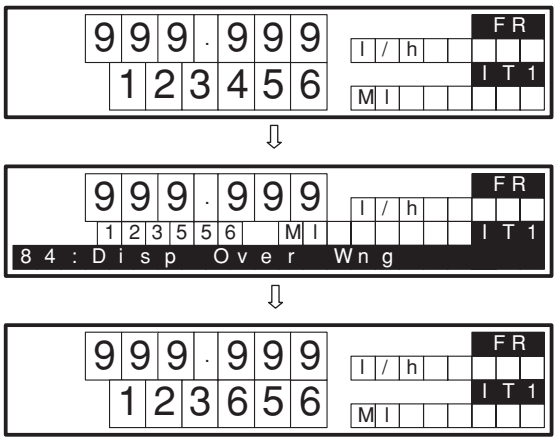
Warning Display

In each normal display one to three line display, when warning is generated, at the third line warning message is displayed. The following is the example of two line

Data display.



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Warning Message

On the Integral LCD indicator following messages are displayed when warning is generated.

Table 5.6.4 Warning Display

Category	Warning Message	Warning Description
Warning	80:Adhesion Wng	Slight adhesion to electrodes.
	82:Auto Zero Wng	Results of automatic zero adjustment are higher than the rated value.
	84:Disp Over Wng	Overflow in the display digits during instantaneous flow rate display
	85:Flow Vel Over	PRIMARY_VALUE exceeds 108% of Span
Warning in FB	130:AI Non-Schedule	AI Block not scheduled
	131:IT1 Non-Schedule	IT1 Block not scheduled
	132:IT2 Non-Schedule	IT2 Block not scheduled
	133:DI1 Non-Schedule	DI1 Block not scheduled
	134:DI2 Non-Schedule	DI2 Block not scheduled
	135:AR Non-Schedule	AR Block not scheduled
	136:PID Non-Schedule	PID Block not scheduled
	140:Sim. Jmpr On	Simulation jumper is ON
	141:AI Sim. Enabled	AI.SIMULATE is enable
	142:DI1 Sim. Enabled	DI1.SIMULATE is enable
	143:DI2 Sim. Enabled	DI2.SIMULATE is enable
	150:AI FB Man Mode	AI. MODE_BLK.Target is Manual mode
	151:IT1 FB Man Mode	IT1. MODE_BLK.Target is Manual mode
	152:IT2 FB Man Mode	IT2. MODE_BLK.Target is Manual mode
	153:DI1 FB Man Mode	DI1. MODE_BLK.Target is Manual mode
	154:DI2 FB Man Mode	DI2. MODE_BLK.Target is Manual mode
	155:AR FB Man Mode	AR. MODE_BLK.Target is Manual mode
	156:PID FB Man Mode	PID. MODE_BLK.Target is Manual mode
	160:PID FB Bypass Mode	PID is bypass mode

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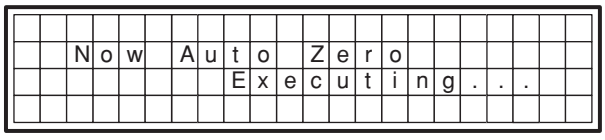
Auto Zero Display

When AUTO_ZERO_EXE is executed, the following is displayed until auto zeroing finishes.



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6. IN-PROCESS OPERATION

This chapter describes the procedure performed when changing the operation of the function block of the AXF in process.

6.1 Mode Transition

When the function block mode is changed to Out_Of_Service, the function block pauses and a block alarm is issued.

When the function block mode is changed to Manual, the function block suspends updating of output values. In this case alone, it is possible to write a value to the OUT parameter of the block for output. Note that no parameter status can be changed.

6.2 Generation of Alarm

6.2.1 Indication of Alarm

When the self-diagnostics function indicates that a device is faulty, an alarm (device alarm) is issued from the resource block. When an error (block error) is detected in each function block or an error in the process value (process alarm) is detected, an alarm is issued from each block. If an LCD indicator is installed, the error number is displayed. If two or more alarms are issued, multiple error numbers are displayed.
For details of ALARM, refer to Section 7.2.

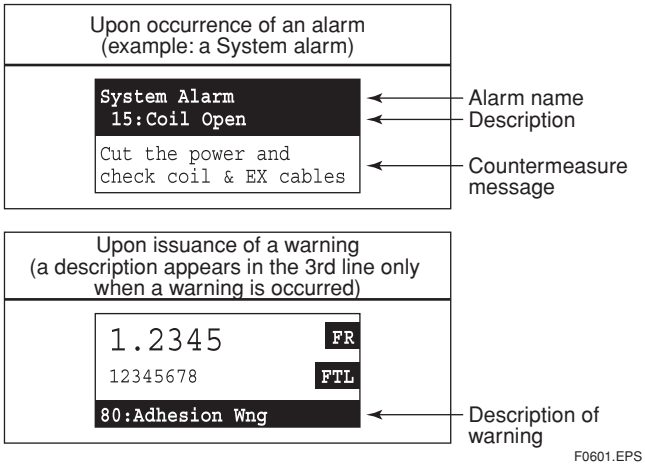

Figure 6.1 Error Identification on Indicator

6.2.2 Alarms and Events

The following alarms or events can be reported by the AXF if Link object and VCR static entry are set.

Analog Alerts (Generated when a process value exceeds threshold)
By AI Block Hi-Hi Alarm, Hi Alarm, Low Alarm, Low-Low Alarm

Discrete Alerts (Generated when an abnormal condition is detected)
By Resource Block Block Alarm, Write Alarm
By Transducer Block Block Alarm
By AI, DI, IT, AR and PID Blocks Block Alarm

Update Alerts (Generated when an important (restorable) parameter is updated)
By Resource Block Update Event
By Transducer Block Update Event
By AI, DI, IT, AR and PID Blocks Update Event

An alert has following structure:

Table 6.1 Alert Object

Subindex			Parameter Name	Explanation
Analog Alert	Discrete Alert	Update Alert		
1	1	1	Block Index	Index of block from which alert is generated
2	2	2	Alert Key	Alert Key copied from the block
3	3	3	Standard Type	Type of the alert
4	4	4	Mfr Type	Alert Name identified by manufacturer specific DD
5	5	5	Message Type	Reason of alert notification
6	6	6	Priority	Priority of the alarm
7	7	7	Time Stamp	Time when this alert is first detected
8	8		Subcode	Enumerated cause of this alert
9	9		Value	Value of referenced data
10	10		Relative Index	Relative index of referenced data
		8	Static Revision	Value of static revision (ST_REV) of the block
11	11	9	Unit Index	Unit code of referenced data

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6.3 Simulation Function

The simulation function simulates the input of a function block and lets it operate as if the data was received from the transducer block. It is possible to conduct testing for the downstream function blocks or alarm processes.

A SIMULATE_ENABLE switch is mounted in the AXF amplifier. This is to prevent the accidental operation of this function. When this is switched on, simulation is enabled. (See Figure 6.2.) To initiate the same action from a remote terminal, if REMOTE LOOP TEST SWITCH is written to the SIM_ENABLE_MSG parameter (index 1044) of the resource block, the resulting action is the same as is taken when the above switch is on. Note that this parameter value is lost when the power is turned OFF. In simulation enabled status, an alarm is generated from the resource block, and other device alarms will be masked; for this reason the simulation must be disabled immediately after using this function.

The SIMULATE parameter of AI and DI block consists of the elements listed in Table 6.2 below.

Table 6.2 Simulate Parameter (SIMULATE/SIMULATE_D)

Sub-index	Parameters	Description
1	Simulate Status	Sets the data status to be simulated.
2	Simulate Value	Sets the value of the data to be simulated.
3	Transducer Status	Displays the data status from the transducer block. It cannot be changed.
4	Transducer Value	Displays the data value from the transducer block. It cannot be changed.
5	Enable Disable	Controls the simulation function of this block. 1: Disable (standard) 2: Active

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When Simulate “Enable Disable” in Table 6.2 above is set to 2, the applicable function block uses the simulation value set in this parameter instead of the data from the transducer block. This setting can be used for propagation of the status to the trailing blocks, generation of a process alarm, and as an operation test for trailing blocks.

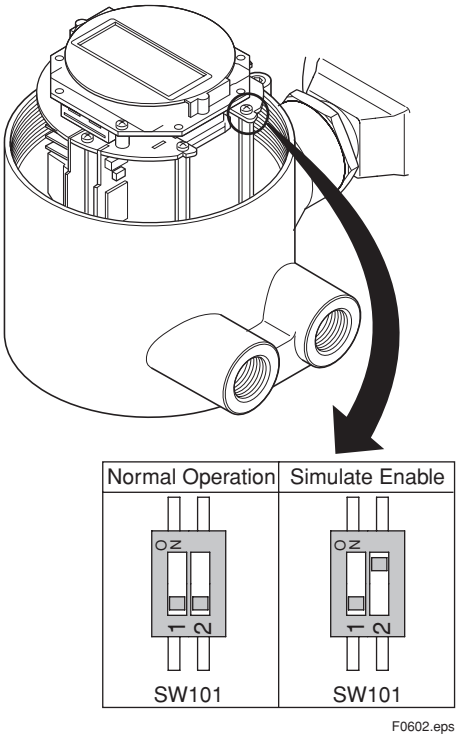

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Figure 6.2 SIMULATE_ENABLE Switch Position

IMPORTANT

- Removing and installing cover are necessary for the setting SIMULATE_ENABLE switch. Perform removing and installing cover as described in following Section of user’s manual. Refer to Section 5.4.2.1 and Section 5.4.2.3 of IM01E20D01-01E, or refer to Section 10.1.2.1 and Section 10.1.2.3 of IM01E20C02-01E.
- To preserve the safety, do not touch the electrical circuit and cable except the SIMULATE_ENABLE switch.

7. DEVICE INFORMATION

7.1 DEVICE STATUS

Device status for the AXF are indicated by using parameter DEVICE_STATUS_1 to DEVICE_STATUS_7 (index 1045 to 1052) in Resource Block.

Table 7.1 Contents of DEVICE_STATUS_1 (Index 1045)

bit	Hex	Indicator	description
0	0x00000001		Link Obj.16/32 not open
1	0x00000002		Link Obj.15/31 not open
2	0x00000004		Link Obj.14/30 not open
3	0x00000008		Link Obj.13/29 not open
4	0x00000010		Link Obj.12/28 not open
5	0x00000020		Link Obj.11/27 not open
6	0x00000040		Link Obj.10/26 not open
7	0x00000080		Link Obj.9/25 not open
8	0x00000100		Link Obj.8/24/40 not open
9	0x00000200		Link Obj.7/23/39 not open
10	0x00000400		Link Obj.6/22/38 not open
11	0x00000800		Link Obj.5/21/37 not open
12	0x00001000		Link Obj.4/20/36 not open
13	0x00002000		Link Obj.3/19/35 not open
14	0x00004000		Link Obj.2/18/34 not open
15	0x00008000		Link Obj.1/17/33 not open
16	0x00010000		
17	0x00020000		
18	0x00040000		
19	0x00080000	101:Comm EEPROM Fault	Communication EEPROM(FB) failure
20	0x00100000		
21	0x00200000		
22	0x00400000	41:RS O/S Mode	RS. MODE_BLK.Target is O/S mode
23	0x00800000	100:Sim. Jmpr On	Sim.enable Jmpr On
24	0x01000000	21:DL Incomplete	Download incomplete
25	0x02000000	22:Download Fail	Download fail
26	0x04000000		
27	0x08000000		
28	0x10000000		
29	0x20000000		
30	0x40000000		
31	0x80000000		

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Table 7.2 Contents of DEVICE_STATUS_2 (Index 1046)

bit	Hex	Indicator	description
0	0x00000001	10:uP Fault	Microprocessor (CPU) failure
1	0x00000002	11:EEPROM Fault	EEPROM failure
2	0x00000004	12:A/D (H) Fault	A/D converter failure
3	0x00000008	13:A/D (L) Fault	A/D converter failure
4	0x00000010	14:A/D (Z) Fault	A/D converter failure
5	0x00000020	15:Coil Open	Flowtube coil is open-circuit
6	0x00000040	16:EEPROM Dflt	EEPROM default values
7	0x00000080		
8	0x00000100		
9	0x00000200		
10	0x00000400		
11	0x00000800		
12	0x00001000		
13	0x00002000		
14	0x00004000		
15	0x00008000		
16	0x00010000	100:Comm uP Fault	Communication uP failure
17	0x00020000	101:Comm EEPROM Fault	Communication EEPROM failure
18	0x00040000	102:IT1 Not Saved	IT1 save error
19	0x00080000	103:IT2 Not Saved	IT2 save error
20	0x00100000	104:Comm Error1	AXF internal communication error
21	0x00200000	105:Comm Error2	AXF internal communication error
22	0x00400000	106:DL Incomplete	Download is not completed
23	0x00800000	107:Download Fail	Download failure
24	0x01000000	108:Not Ready	Function block not scheduled
25	0x02000000		
26	0x04000000		
27	0x08000000		
28	0x10000000		
29	0x20000000		
30	0x40000000		
31	0x80000000		

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Table 7.3 Contents of DEVICE_STATUS_3 (Index 1047)

bit	Hex	Indicator	description
0	0x00000001	30:Sig Overflow	Input signal error
1	0x00000002	31:Empty Pipe	Flowtube is not filled with fluid
2	0x00000004		
3	0x00000008	33:Adhesion Alm	Electrode adhesion alarm
4	0x00000010		
5	0x00000020		
6	0x00000040		
7	0x00000080		
8	0x00000100		
9	0x00000200		
10	0x00000400		
11	0x00000800		
12	0x00001000		
13	0x00002000		
14	0x00004000		
15	0x00008000		
16	0x00010000	110:AI Lo Lo Alm	AI process alarm
17	0x00020000	111:AI Hi Hi Alm	AI process alarm
18	0x00040000	112:PID Lo Lo Alm	PID process alarm
19	0x00080000	113:PID Hi Hi Alm	PID process alarm
20	0x00100000		
21	0x00200000		
22	0x00400000		
23	0x00800000		
24	0x01000000		
25	0x02000000		
26	0x04000000		
27	0x08000000		
28	0x10000000		
29	0x20000000		
30	0x40000000		
31	0x80000000		

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Table 7.4 Contents of DEVICE_STATUS_4 (Index 1048)

bit	Hex	Indicator	description
0	0x00000001	40:RS O/S Mode	RS. MODE_BLK.Target is O/S mode
1	0x00000002	41:TB O/S Mode	TB. MODE_BLK.Target is O/S mode
2	0x00000004	42:AI FB O/S Mode	AI. MODE_BLK.Target is O/S mode
3	0x00000008	43:IT1 FB O/S Mode	IT1. MODE_BLK.Target is O/S mode
4	0x00000010	44:IT2 FB O/S Mode	IT2. MODE_BLK.Target is O/S mode
5	0x00000020	45:DI1 FB O/S Mode	DI1. MODE_BLK.Target is O/S mode
6	0x00000040	46:DI2 FB O/S Mode	DI2. MODE_BLK.Target is O/S mode
7	0x00000080	47:AR FB O/S Mode	AR. MODE_BLK.Target is O/S mode
8	0x00000100	48:PID FB O/S Mode	PID. MODE_BLK.Target is O/S mode
9	0x00000200		
10	0x00000400		
11	0x00000800		
12	0x00001000		
13	0x00002000		
14	0x00004000		
15	0x00008000		
16	0x00010000		
17	0x00020000		
18	0x00040000		
19	0x00080000		
20	0x00100000		
21	0x00200000		
22	0x00400000		
23	0x00800000		
24	0x01000000		
25	0x02000000		
26	0x04000000		
27	0x08000000		
28	0x10000000		
29	0x20000000		
30	0x40000000		
31	0x80000000		

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Table 7.5 Contents of DEVICE_STATUS_5 (Index 1049)

bit	Hex	Indicator	description
0	0x00000001	50:Span > 10m/s	Span flow velocity setting is 11 m/s or more
1	0x00000002	51:Span < 0.1m/s	Span flow velocity setting is 0.05 m/s or less
2	0x00000004		
3	0x00000008	57:Dens Set Err	Mass units have been selected for Base Flow Unit but density is set to zero.
4	0x00000010	71:Meas Mod Set	Measure Mode is set to Enhanced DF without selecting an optional code HF1 or HF2.
5	0x00000020	72:Size Set Err	A value of 3000.1 mm or more is set for Nominal Size.
6	0x00000040	73:Adh Set Err	The condition in Adhesion detection level, Level:1 < Level:2 < Level:3 < Level:4 is not satisfied.
7	0x00000080		
8	0x00000100		
9	0x00000200		
10	0x00000400		
11	0x00000800		
12	0x00001000		
13	0x00002000		
14	0x00004000		
15	0x00008000		
16	0x00010000	120:IT1 Clock Per Err	IT1 CLOCK_PER set value is smaller than excecution period
17	0x00020000	121:IT2 Clock Per Err	IT2 CLOCK_PER set value is smaller than excecution period
18	0x00040000	122:AR Range Set Err	RANGE_HI>RANGE_LO is not satisfied
19	0x00080000		
20	0x00100000		
21	0x00200000		
22	0x00400000		
23	0x00800000		
24	0x01000000		
25	0x02000000		
26	0x04000000		
27	0x08000000		
28	0x10000000		
29	0x20000000		
30	0x40000000		
31	0x80000000		

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Table 7.6 Contents of DEVICE_STATUS_6 (Index 1050)

bit	Hex	Indicator	description
0	0x00000001	80:Adhesion Wng	Slight adhesion to electrodes.
1	0x00000002		
2	0x00000004	82:Auto Zero Wng	Results of automatic zero adjustment are higher than the rated value.
3	0x00000008		
4	0x00000010	85:Flow Vel Over	PRIMARY_VALUE exceeds 108% of Span
5	0x00000020		
6	0x00000040		
7	0x00000080		
8	0x00000100		
9	0x00000200		
10	0x00000400		
11	0x00000800		
12	0x00001000		
13	0x00002000		
14	0x00004000		
15	0x00008000		
16	0x00010000		
17	0x00020000		
18	0x00040000		
19	0x00080000		
20	0x00100000		
21	0x00200000		
22	0x00400000		
23	0x00800000		
24	0x01000000		
25	0x02000000		
26	0x04000000		
27	0x08000000		
28	0x10000000		
29	0x20000000		
30	0x40000000		
31	0x80000000		

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Table 7.7 Contents of DEVICE_STATUS_7 (Index 1051)

bit	Hex	Indicator	description
0	0x00000001	130:AI Non-Schedule	AI Block not scheduled
1	0x00000002	131:IT1 Non-Schedule	IT1 Block not scheduled
2	0x00000004	132:IT2 Non-Schedule	IT2 Block not scheduled
3	0x00000008	133:DI1 Non-Schedule	DI1 Block not scheduled
4	0x00000010	134:DI2 Non-Schedule	DI2 Block not scheduled
5	0x00000020	135:AR Non-Schedule	AR Block not scheduled
6	0x00000040	136:PID Non-Schedule	PID Block not scheduled
7	0x00000080	140:Sim. Jmpr On	Simulation jumper is ON
8	0x00000100	141:AI Sim. Enabled	AI.SIMULATE is enable
9	0x00000200	142:DI1 Sim. Enabled	DI1.SIMULATE is enable
10	0x00000400	143:DI2 Sim. Enabled	DI2.SIMULATE is enable
11	0x00000800	150:AI FB Man Mode	AI. MODE_BLK.Target is Manual mode
12	0x00001000	151:IT1 FB Man Mode	IT1. MODE_BLK.Target is Manual mode
13	0x00002000	152:IT2 FB Man Mode	IT2. MODE_BLK.Target is Manual mode
14	0x00004000	153:DI1 FB Man Mode	DI1. MODE_BLK.Target is Manual mode
15	0x00008000	154:DI2 FB Man Mode	DI2. MODE_BLK.Target is Manual mode
16	0x00010000	155:AR FB Man Mode	AR. MODE_BLK.Target is Manual mode
17	0x00020000	156:PID FB Man Mode	PID. MODE_BLK.Target is Manual mode
18	0x00040000		
19	0x00080000		
20	0x00100000		
21	0x00200000		
22	0x00400000	160:PID FB Bypass Mode	PID is bypass mode
23	0x00800000		
24	0x01000000		
25	0x02000000		
26	0x04000000		
27	0x08000000		
28	0x10000000		
29	0x20000000		
30	0x40000000		
31	0x80000000		

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Table 7.8 Contents of DEVICE_STATUS_8 (Index 1052)

Hexadecimal	Display through DD	Description
Not used		

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7.2 Status of each parameter in failure mode

Following tables summarize the value of AXF parameters and LCD display indicates an Alarm.

Table 7.9 Alarm Summary

Category	Alarm	XD_ ERROR (Value)	BLOCK_ ERROR	Primary Value	Primary Value Status
System Alarms	10:uP Fault	200	Other	Hold	BAD:Device Failure
	11:EEPROM Fault	199	Other	Hold	BAD:Device Failure
	12:A/D (H) Fault	198	Other	Hold	BAD:Device Failure
	13:A/D (L) Fault	197	Other	Hold	BAD:Device Failure
	14:A/D (Z) Fault	196	Other	Hold	BAD:Device Failure
	15:Coil Open	195	Other	Hold	BAD:Sensor Failure
	16:EEPROM Dflt	194	Other	Hold	BAD:Device Failure
	100:Comm uP Fault	190	Other	Variable	BAD:Device Failure
	101:Comm EEPROM Fault	189	Other	Variable	BAD:Device Failure
	102:IT1 Not Saved				-
	103:IT2 Not Saved				-
	104:Comm Error1	188	Other	Variable	BAD:Device Failure
	105:Comm Error2	187	Other	Variable	BAD:Device Failure
	106:DL Incomplete				-
	107:Download Fail				-
	108:Not Ready				-
Process Alarms	30:Sig Overflow	170	Other	Hold	BAD:Sensor Failure
	31:Empty Pipe	169	Other	Hold	BAD:Sensor Failure
	33:Adhesion Alm	167	Other	Hold	BAD:Sensor Failure
	110:AI Lo Lo Alm				-
	111:AI Hi Hi Alm				-
	112:PID Lo Lo Alm				-
	113:PID Hi Hi Alm				-
O/S Mode Alarms	40:RS O/S Mode				BAD:Non-specific
	41:TB O/S Mode		Out of Service		BAD:Out of Service
	42:AI FB O/S Mode				-
	43:IT1 FB O/S Mode				-
	44:IT2 FB O/S Mode				-
	45:DI1 FB O/S Mode				-
	46:DI2 FB O/S Mode				-
	47:AR FB O/S Mode				-
	48:PID FB O/S Mode				-
Setting Alarms	50:Span > 10m/s	160	Other	Hold	BAD:Configuration Error
	51:Span < 0.1m/s	159	Other	Hold	BAD:Configuration Error
	57:Dens Set Err	157	Other	Hold	BAD:Configuration Error
	71:Meas Mod Set	156	Other	Hold	BAD:Configuration Error
	72:Size Set Err	155	Other	Hold	BAD:Configuration Error
	73:Adh Set Err	154	Other	Hold	BAD:Configuration Error
	120:IT1 Clock Per Err				-
	121:IT2 Clock Per Err				-
	122:AR Range Set Err				-

Category	Alarm	XD_ ERROR (Value)	BLOCK_ ERROR	Primary Value	Primary Value Status
Warning	80:Adhesion Wng	150	Other		Uncertain:Sensor Conversion not Accurate
	82:Auto Zero Wng	148	Other		Uncertain:Sensor Conversion not Accurate
	84:Disp Over Wng				-
	85:Flow Vel Over	147	Other		Uncertain: Engineering Unit Range Violation
	130:AI Non-Schedule				-
	131:IT1 Non-Schedule				-
	132:IT2 Non-Schedule				-
	133:DI1 Non-Schedule				-
	134:DI2 Non-Schedule				-
	135:AR Non-Schedule				-
	136:PID Non-Schedule				-
	140:Sim. Jmpr On				-
	141:AI Sim. Enabled				-
	142:DI1 Sim. Enabled				-
	143:DI2 Sim. Enabled				-
	150:AI FB Man Mode				-
	151:IT1 FB Man Mode				-
	152:IT2 FB Man Mode				-
	153:DI1 FB Man Mode				-
	154:DI2 FB Man Mode				-
	155:AR FB Man Mode				-
	156:PID FB Man Mode				-
	160:PID FB Bypass Mode				-

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8. PARAMETER LISTS

Note: The Write Mode column contains the modes in which each parameter is write enabled.
O/S: Write enabled in O/S mode.
MAN: Write enabled in Man mode and O/S mode.
AUTO: Write enabled in Auto mode, Man mode, and O/S mode.

8.1 Resource Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	1000	Block Header	TAG="RS"	O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	1001	ST_REV	0	-	The revision level of the static data associated with the resource block. The revision value is incremented each time a static parameter value in this block is changed.
2	1002	TAG_DESC	Spaces	Auto	The user description of the intended application of the block.
3	1003	STRATEGY	1	Auto	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	1004	ALERT_KEY	1	Auto	The identification number of the plant unit. This information may be used in the host for sorting alarm, etc.
5	1005	MODE_BLK	Auto	Auto	The actual, target, permitted, and normal modes of the block.
6	1006	BLOCK_ERR	0	-	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	1007	RS_STATE	-	-	State of the resource block state machine.
8	1008	TEST_RW	0	Auto	Read/write test parameter-used only for conformance testing and simulation.
9	1009	DD_RESOURCE	Spaces	-	String identifying the tag of the resource which contains the Device Description for this resource.
10	1010	MANUFAC_ID	0x594543	-	Manufacturer identification number-used by an interface device to locate the DD for the resource.
11	1011	DEV_TYPE	0x000b	-	Manufacturer's model number associated with the resource-used by interface devices to locate the DD file for the resource.
12	1012	DEV_REV		-	Manufacturer revision number associated with the resource-used by an interface device to locate the DD file for the resource.
13	1013	DD_REV	1	-	Revision of the DD associated with the resource-used by an interface device to locate the DD file for the resource.
14	1014	GRANT_DENY	0x00	Auto	Options for controlling access of host computer and local control panels to operating, tuning and alarm parameters of the block.
15	1015	HARD_TYPES		-	The types of hardware available as channel numbers. bit0: Scalar input bit1: Scalar output bit2: Discrete input bit3: Discrete output
16	1016	RESTART	1	Auto	Allows a manual restart to be initiated. Several degrees of restart are possible. They are 1:Run, 2: Restart resource, 3:Restart with initial value specified in FF functional spec. (*1), and 4: Restart processor. *1: FF-891 Foundation™ Specification Function Block Application Process Part 2.
17	1017	FEATURES	0x000a	-	Used to show supported resource block options.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
18	1018	FEATURE_SEL	0x000a	Auto	Used to select resource block options defined in FEATURES.
19	1019	CYCLE_TYPE	0x0001	-	Identifies the block execution methods available for this resource. bit0: Scheduled bit1: Event driven bit2: Manufacturer specified
20	1020	CYCLE_SEL	0x0001	Auto	Used to select the block execution method for this resource.
21	1021	MIN_CYCLE_T	3200	-	Time duration of the shortest cycle interval of which the resource is capable.
22	1022	MEMORY_SIZE	0	-	Available configuration memory in the empty resource. To be checked before attempting a download.
23	1023	NV_CYCLE_T	0	-	Interval between writing copies of nonvolatile parameters to non-volatile memory. Zero means never.
24	1024	FREE_SPACE	0	-	Percent of memory available for further configulation. AXF has zero which means a preconfigured resource.
25	1025	FREE_TIME	0	-	Percent of the block processing time that is free to process additional blocks. AXF does not support this.
26	1026	SHED_RCAS	640000(20S)	Auto	Time duration at which to give up on computer writes to function block Rcas locations. Supported only with PID function.
27	1027	SHED_ROUT	640000(20S)	Auto	Time duration at which to give up on computer writes to function block ROut locations. Supported only with PID function.
28	1028	FAULT_STATE	1	-	Condition set by loss of communication to an output block, failure promoted to an output block or a physical contact. When fail-safe condition is set, then output function blocks will perform their FSAFE actions.
29	1029	SET_FSTATE	1	-	Allows the fail-safe condition to be manually initiated by selecting Set.
30	1030	CLR_FSTATE	1	-	Writing a Clear to this parameter will clear the device fail-safe state if the field condition, if any, has cleared.
31	1031	MAX_NOTIFY	3	-	Maximum number of unconfirmed notify messages possible.
32	1032	LIM_NOTIFY	3	Auto	Maximum number of unconfirmed alert notify messages allowed.
33	1033	CONFIRM_TIME	640000(20S)	Auto	The minimum time between retries of alert reports.
34	1034	WRITE_LOCK	1(Not Locked)	Auto	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block imputs will continue to be updated.
35	1035	UPDATE_EVT	1(Acknowledged)	Auto	This alert generated by any change to the static data.
36	1036	BLOCK_ALM	1(Acknowledged)	Auto	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
37	1037	ALARM_SUM	0	-	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	1038	ACK_OPTION	0xffff	Auto	Selection of whether alarms associated with the block will be automatically acknowledged.
39	1039	WRITE_PRI	0	Auto	Priority of the alarm generated by clearing the write lock.
40	1040	WRITE_ALM	1(Acknowledged)	-	This alert is generated if the write lock parameter is cleared.
41	1041	ITK_VER		-	Version number of interoperability test by Fieldbus Foundation applied to AXF.
42	1042	SOFT_REV		-	AXF software revision number.
43	1043	SOFT_DESC		-	Yokogawa internal use.
44	1044	SIM_ENABLE_MSG	Spaces	Auto	Software switch for simulation function.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
45	1045	DEVICE_STATUS_1	0	-	Device status for details, refer to Table 7.1.
46	1046	DEVICE_STATUS_2	0	-	Device status for details, refer to Table 7.2.
47	1047	DEVICE_STATUS_3	0	-	Device status for details, refer to Table 7.3.
48	1048	DEVICE_STATUS_4	0	-	Device status for details, refer to Table 7.4.
49	1049	DEVICE_STATUS_5	0	-	Device status for details, refer to Table 7.5.
50	1050	DEVICE_STATUS_6	0	-	Device status for details, refer to Table 7.6.
51	1051	DEVICE_STATUS_7	0	-	Device status for details, refer to Table 7.7.
52	1052	DEVICE_STATUS_8	0	-	Not used in AXF.
53	1053	SOFTDWN_PROTECT	0x01	Auto	Defines whether to accept software downloads. 0x01: Unprotected 0x02: Protected
54	1054	SOFTDWN_FORMAT	0x01	Auto	Selects the software download method. 0x01: Standard
55	1055	SOFTDWN_COUNT	0x0000	Auto	Indicates the number of times the internal FlashROM was erased.
56	1056	SOFTDWN_ACT_AREA	0x00	Auto	Indicates the ROM number of the currently working FlashROM. 0: FlashROM #0 working 1: FlashROM #1 working
57	1057	SOFTDWN_MOD_REV	[0]:1,[1]-[7]:0	-	Indicates the software module revision.
58	1058	SOFTDWN_ERROR	0	-	Indicates the error during a software download.

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8.2 Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2000	BLOCK_HEADER			Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	2001	ST_REV	0		The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
2	2002	TAG_DESC	32 space characters	Auto	The user description of the intended application of the block.
3	2003	STRATEGY	1		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	2004	ALERT_KEY	1	Auto	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	2005	MODE_BLK			The actual, target, permitted, and normal modes of the block.
6	2006	BLOCK_ERR	0x0000		This parameter reflects the error status associated with hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	2007	UPDATE_EVT			This alert is generated by any change to the static data.
8	2008	BLOCK_ALM			The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute.
9	2009	TRANSDUCER_ DIRECTORY			A directory that specifies the number and starting indices of the device.
10	2010	TRANSDUCER_ TYPE	104: Standard Flow with Calibration		Identifies the device type, which is "Standard Flow with Calibration" for the AXF.
11	2011	XD_ERROR	0		Indicates the error code of the error of the highest priority from among the errors currently occurring in the transducer block. 0=No failure, 20=Electronics failure, 21=Mechanical failure, 22=I/O failure
12	2012	COLLECTION_ DIRECTORY			A directory that specifies the number, starting indices, and DD Item IDs of the data collections in each transducer with a transducer block.
13	2013	PRIMARY_VALUE_ TYPE	101:Volumetric flow	O/S	The type of measurement represented by the primary value. Followings are available for the AXF: 100: mass flow, 101: volumetric flow, 102: average mass flow, 103: average volumetric flow
14	2014	PRIMARY_VALUE	-		Indicates the flow rate.
15	2015	PRIMARY_VALUE_ RANGE			Indicates the flow range. These values are converted the value of SENSOR_RANGE by the unit of XD_SCALE and the data of LINE_SIZE.
16	2016	CAL_POINT_HI	2	O/S	The highest calibrated value. To set within the range of SENSOR_RANGE.
17	2017	CAL_POINT_LO	0	O/S	The lowest calibrated value. To set within the range of SENSOR_RANGE.
18	2018	CAL_MIN_SPAN	0.1		The minimum calibration span value allowed.
19	2019	CAL_UNIT	1061:m/s	O/S	The engineering unit for the calibrated values. Refer to Table in 5.4.1 for the units available.
20	2020	SENSOR_TYPE	102	O/S	Indicates the sensor type, which is "Electromagnetic" for the AXF.
21	2021	SENSOR_RANGE			The high and low range limit values, engineering units code and the number of digits to the right of the decimal point for the sensor.
22	2022	SENSOR_SN	Spaces		Serial number.
23	2023	SENSOR_CAL_ METHOD	101: Static weigh	O/S	The method of the last sensor calibration. 100=volumetric 101=static weigh 102=dynamic weigh 255=other
24	2024	SENSOR_CAL_LOC	Yokogawa	O/S	Sets/indicates the location of the last sensor calibration.
25	2025	SENSOR_CAL_DATE	0, 0, 0, 0, 0, 0	O/S	Sets/indicates the date of the last sensor calibration.
26	2026	SENSOR_CAL_WHO	Yokogawa	O/S	Sets/indicates the name of the person responsible for the last sensor calibration.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
27	2027	LIN_TYPE	1: linear with input	O/S	The linearization type of sensor output. AXF is "linear with input"
28	2028	SECONDARY_ VALUE			N/A. For the future use.
29	2029	SECONDARY_ VALUE_UNIT	1061: m/s	O/S	N/A. For the future use.
30	2030	LANGUAGE	1: English	Auto	This parameter is used to select the language for use on the display. Now only 1: English is available.
31	2031	DISPLAY_SELECT1	2: Flow Rate	Auto	This parameter is used in order to set the LCD display mode. 1: Flow Rate (%) 2: Flow Rate 3: Integrator1 Out 4: Integrator2 Out 5: Arithmetic Out can be selected.
32	2032	DISPLAY_SELECT2	1: Off	Auto	This parameter is used in order to set the LCD display mode. 1: Off 2: Flow Rate (%) 3: Flow Rate 4: Flow Rate (Bar) 5: Integrator1 Out 6: Integrator2 Out 7: Arithmetic Out 8: PD Tag 9: Adhesion Check 10: Communication can be selected.
33	2033	DISPLAY_SELECT3	1: Off	Auto	This parameter is used in order to set the LCD display mode. 1: Off 2: Flow Rate (%) 3: Flow Rate 4: Flow Rate (Bar) 5: Integrator1 Out 6: Integrator2 Out 7: Arithmetic Out 8: PD Tag 9: Adhesion Check 10: Communication can be selected.
34	2034	NOMINAL_SIZE_ UNIT	1013: mm	O/S	This parameter is used in order to select the unit of size (diameter) of the sensor (flowtube).
35	2035	NOMINAL_SIZE	100	O/S	This parameter is used in order to set the size (diameter) of the sensor (flowtube). If the set value exceeds the valid range, the warning "72:Size Set Err" will be displayed.
36	2036	PRIMARY_VALUE_ FTIME	3.0	O/S	Sets the time constant of damping for the flow rate calculation.
37	2037	AUTO_ZERO_EXE	1: Cancel	Auto	This parameter execute the automatic zero adjustment function: If "2:Execute" is selected, this function will be started. "Now Auto Zero Executing..." is indicated whle the Auto Zero function being carried out and after finishing the adjustment, this parameter is set to "1:Cancel". The result of the automatic zero adjustment is confirmed using MAGFLO_ZERO, and if the result exceeds the rated value, the warning"82:Auto Zero Wng" will be displayed.
38	2038	MAGFLOW_ZERO	0.00	O/S	This parameter shows the current zero point compensation value for the sensor. This parameter is used to display the results obtained from AUTO_ZERO_EXE. Specifically, the correction values displayed, and it is also possible to directly enter correction values. This parameter must not be downloaded by the operator
39	2039	LOW_MF	1.0000	O/S	This parameter is used in order to set the low-frequency meter factor.
40	2040	HIGH_MF	1.0000	O/S	This parameter is used in order to set the high-frequency meter factor.
41	2041	LOW_MF(EDF)	1.0000	O/S	This parameter is used in order to set the low-frequency meter factor as required when Enhanced DF (i.e., enhanced dual frequency excitation) is selected. If "Standard DF" has been selected for MEASURE_MODE, neither LOW_MF (EDF) nor HIGH_MF (EDF) is displayed.
42	2042	HIGH_MF(EDF)	1.0000	O/S	This parameter is used in order to set the high-frequency meter factor as required when Enhanced DF (i.e., enhanced dual frequency excitation) is selected.
43	2043	SELECT_FLOW_ TUBE	1: ADMAG AXF	O/S	Always 1:ADMAG AXF
44	2044	MEASURE_MODE	1: Standard DF	O/S	Selects measurement mode for dual frequency. Selectable 1: Standard DF 2: Enhanced DF.
45	2045	PRIMARY_VALUE_ LOWCUT	0	O/S	Set the low cut range corresponding 0 to 10% of the range.
46	2046	BI_DIRECTION	1: Unidirectional	O/S	Set the mode of the flow measurement, either unidirectional or bidirectional.
47	2047	FLOW_DIRECTION	1: Positive	O/S	Assign an arbitrary positive or negative sign to the measured PV value. 1. Positive 2: Negative

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
48	2048	VELOCITY_CHECK	10		This parameter is used in order to display the span velocity corresponding to PV_SCALE. E100.
49	2049	DENSITY_UNIT	1097: kg/m^3	O/S	This parameter selects the units for density as required when making settings using MASS_FLOW_DENSITY.
50	2050	MASS_FLOW_ DENSITY	0	O/S	Setting of the density for mass-flow rate. This parameter is necessary in situations where t, kg, klb or lb has been selected as the mass unit in PRIMARY_VALUE_RANGE. If a mass unit is selected in PRIMARY_VALUE_RANGE and a value of 0 is set for this parameter, the setting alarm "57: Density SetErr." will be displayed. In this case, ensure that density is set correctly.
51	2051	LIMSW_1_VALUE_D			Indicate the value of limit switch 1, which switches ON and OFF depending on the digital value of the target input parameter selected in LIMSW_1_TARGET and based on the threshold set in LIMSW_1_SETPOINT with the hysteresis set in LIMSW_1_HYSTERESIS. The direction of the switching action determined by the setting in LIMSW_1_ACT_DIRECTION.
52	2052	LIMSW_1_TARGET	1: PRIMARY_ VALUE	O/S	The target of limit switch 1.
53	2053	LIMSW_1_SETPOINT	-10	O/S	Sets the threshold of limitswitch 1. If the value of LIMSW_1_ACT_DIRECTION is HIGH LIMIT, limit switch 1 turns ON when LIMSW_1_TARGET has gone beyond LIMSW_1_SETPOINT. If the value of LIMSW_1_ACT_DIRECTION is LO LIMIT, limit switch 1 turns ON when LIMSW_1_TARGET has gone below LIMSW_1_SETPOINT. The unit set in LIMSW_1_UNIT applies.
54	2054	LIMSW_1_ACT_ DIRECTION	1: Low Limit	O/S	Selects the direction of the limit switch 1's actions: 1: LO LIMIT (Low-limit switch) 2: HIGH LIMIT (high-limit switch)
55	2055	LIMSW_1_ HYSTERESIS	0	O/S	Sets the hysteresis of limit switch 1 to be applied for resetting the LIMSW_1_VALUE_D to OFF after LIMSW_1_TARGET went beyond LIMSW_1_SETPOINT and LIMSW_1_VALUE_D turned ON (when used as a high-limit switch), or after LIMSW_1_TARGET went below LIMSW_1_SETPOINT and LIMSW_1_VALUE_D turned ON (when used as a low-limit switch).
56	2056	LIMSW_1_UNIT	1061: m/s		Indicate the unit set in LIMSW_1_TARGET.
57	2057	LIMSW_2_VALUE_D			Indicate the value of limit switch 2, which switches ON and OFF depending on the digital value of the target input parameter selected in LIMSW_2_TARGET and based on the threshold set in LIMSW_2_SETPOINT with the hysteresis set in LIMSW_2_HYSTERESIS. The direction of the switching action determined by the setting in LIMSW_2_ACT_DIRECTION.
58	2058	LIMSW_2_TARGET	1: PRIMARY_ VALUE	O/S	The target of limit switch 2.
59	2059	LIMSW_2_SETPOINT	10	O/S	Sets the threshold of limitswitch 2. If the value of LIMSW_2_ACT_DIRECTION is HIGH LIMIT, limit switch 2 turns ON when LIMSW_2_TARGET has gone beyond LIMSW_2_SETPOINT. If the value of LIMSW_2_ACT_DIRECTION is LO LIMIT, limit switch 2 turns ON when LIMSW_2_TARGET has gone below LIMSW_2_SETPOINT. The unit set in LIMSW_2_UNIT applies.
60	2060	LIMSW_2_ACT_ DIRECTION	2: High Limit	O/S	Selects the direction of the limit switch 2's actions: 1: LO LIMIT (Low-limit switch) 2: HIGH LIMIT (high-limit switch)
61	2061	LIMSW_2_ HYSTERESIS	0	O/S	Sets the hysteresis of limit switch 2 to be applied for resetting the LIMSW_2_VALUE_D to OFF after LIMSW_2_TARGET went beyond LIMSW_2_SETPOINT and LIMSW_2_VALUE_D turned ON (when used as a high-limit switch), or after LIMSW_2_TARGET went below LIMSW_2_SETPOINT and LIMS W_2_VALUE_D turned ON (when used as a low-limit switch).
62	2062	LIMSW_2_UNIT	1061: m/s		Indicate the unit set in LIMSW_2_TARGET.
63	2063	SWITCH_1_ VALUE_D			Indicate the value of switch 1, which switches ON and OFF depending on the digital value of the target input parameter selected in SWITCH_1_TARGET.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
64	2064	SWITCH_1_TARGET	1: Adhesion Alarm	O/S	This parameter selects the input channel used to LIMSW_1_VALUE_D. 1: Adhesion Alarm 2: Adhesion Warning
65	2065	SWITCH_2_ VALUE_D			Indicate the value of switch 2, which switches ON and OFF depending on the digital value of the target input parameter selected in SWITCH_2_TARGET.
66	2066	SWITCH_2_TARGET	2: Adhesion Warning	O/S	This parameter selects the input channel used to LIMSW_2_VALUE_D. 1: Adhesion Alarm 2: Adhesion Warning
67	2067	SIGNAL_LOCK	1: Unlock	Auto	When "2:Lock" is selected, signal lock function becomes active and output is fixed to 0%. 1: Unlock 2: Lock
68	2068	DISPLAY_CYCLE	2: 400ms	Auto	Sets the cycle for the display unit's display-response speed. Settings should be made in accordance with the measurement environment, e.g. Set the longer display cycle when using the equipment in low temperature environment. 1: 200ms 2: 400ms 3: 1s 4: 2s 5: 4s 6: 8s
69	2069	RATE_LIMIT	5	O/S	Sets the rate limit value. Valid range is 0 to 10%.
70	2070	RATE_LIMIT_ DEAD_TIME	0	O/S	Sets the dead time for late limit function, if 0 is set then the rate limit function becomes inactive. Valid range is 0 to 15 s.
71	2071	PULSING_FLOW	1: No	O/S	Set 2: Yes if flow is pulsing. Valid range is 1: No 2: Yes.
72	2072	POWER_SYNCH	2: Yes	O/S	This parameter is used to indicate whether or not the internal frequency is to be synchronized with that of power supply frequency. Valid range is 1: No 2: Yes
73	2073	POWER_ FREQUENCY	50	O/S	Sets the power frequency. Valid range is 47.00 to 63.00 Hz.
74	2074	SOFTWARE_ REV_NO			Display the software revision number. Set in ASCII code 8 characters.
75	2075	ALARM_PERFORM	0x00010033	O/S	This parameter masks Alarm/Warning. By setting "0" to each bit, corresponding Alarm/Warning are cleared. When masked the corresponding bit of DEVICE_STATUS becomes OFF and no alarm is displayed on LCD, and also becomes out of scope of Primary value status, ED_ERROR setting. Valid range is 0x00000000 to 0x007f003f
76	2076	OPERATION_TIME	0D 00: 00		This parameter displays the operation time, e.g. "1D23:45" indicates an operation time of 1 day, 23 hours and 45 minutes. Valid range is 0D 00:00 to 99999D 23:59
77	2077	ALM_RECORD1	0		Display the most-recent alarm. Valid range is 0: space, 1: 10: μ P fault, 2: 11: EEPROM Fault, 3: 12: A/D (H) Fault, 4: 13: A/D (L) Fault, 5: 14: A/D (Z) Fault, 6: 15: Coil Open, 7: 16: EEPROM Dflt, 8: 18: Power Off, 9: 19: Inst Pwr Fail, 10: 28: WDT, 11: 30: Sig Overflow, 12: 31: Empty Pipe, 13: 33: Adhesion Alm, 14: 34: Insu-Brk Alm
78	2078	ALM_RECORD_ TIME1	0D 00: 00		Display the operation time at which the alarm indicated by Alm_record1 was occurred. For example, "1D23:45" indicates that an alarm was triggered at the operation time of 1 day, 23 hours and 45 minutes. Valid range is 0D 00:00 to 99999D 23:59
79	2079	ALM_RECORD2	0		Display the second most-recent alarm. Valid range is the same as ALM_RECORD_TIME1
80	2080	ALM_RECORD_ TIME2	0D 00: 00		This parameter is used to display the operation time at which the alarm indicated by Alm_Record2 occurred.
81	2081	ALM_RECORD3	0		Display the third most-recent alarm. Valid range is Valid range is the same as ALM_RECORD_TIME1
82	2082	ALM_RECORD_ TIME3	0D 00: 00		This parameter is used to display the operation time at which the alarm indicated by Alm_Record3 occurred.
83	2083	ALM_RECORD4	0		Display the fourth most-recent alarm. Valid range is Valid range is the same as ALM_RECORD_TIME1
84	2084	ALM_RECORD_ TIME4	0D 00: 00		This parameter is used to display the operation time at which the alarm indicated by Alm_Record4 occurred.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
85	2085	ALARM_SUM			Block Alarm status is shown by this parameter. Valid range is bit 0: Discrete alm, bit7: Block alarm (only bit 0 and bit 7 are effective). Initial value is Current: 0, Unacknowledged: 0, Unreported: 0, Disable: 0X0000 (all alarms are enable).
86	2086	ADHESION_CHECK	1:No	O/S	Selects whether or not the adhesion diagnostic function will be carried out. (If the judgment value for Level 3 exceeds, a warning is displayed; and if the value for level 4 exceeds, an alarm is displayed. Valid range is 1: No, 2: Yes
87	2087	ADHESION_LEVEL1	0.10	O/S	This parameter is used in order to set the resistance value for judgment of Level 1. Valid range is 0.0 to 100.00 M Ohm
88	2088	ADHESION_LEVEL2	0.50	O/S	This parameter is used in order to set the resistance value for judgment of Level 2.Valid range is 0.0 to 100.00 M Ohm
89	2089	ADHESION_LEVEL3	1.00	O/S	This parameter is used in order to set the resistance value for judgment of Level 3.Valid range is 0.0 to 100.00 M Ohm
90	2090	ADHESION_LEVEL4	3.00	O/S	This parameter is used in order to set the resistance value for judgment of Level 4.Valid range is 0.0 to 100.00 M Ohm
91	2091	ADH_MEASURE_ VALUE	-		This parameter displays the value measured using the adhesion diagnostic function. Valid range is 0.0 to 1000.00 M Ohm

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8.3 AI Function Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	4000	Block Hedder	TAG="AI"	O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	4001	ST_REV	0	-	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
2	4002	TAG_DESC	spaces	Auto	The user description of the intended application of the block
3	4003	STRATEGY	1	Auto	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block. Valid range is 0 to 65535.
4	4004	ALERT_KEY	1	-	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc. Valid range is 1 to 255
5	4005	MODE_BLK	Auto bit	Auto	The mode parameter is a structured parameter composed of the target mode, the actual mode, the normal mode and the permitted mode. Target: Mode to set the mode of the block Actual: Indicates the current operating condition. Permit: Indicates the operating condition that the block is allowed to take. Normal: Indicates the operating condition that the block will usually take.
6	4006	BLOCK_ERR	0	-	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	4007	PV	0	-	Either the primary analog value for use in executing the function, or a process value associated with it. May also be calculated from the READBACK value of an AO block.
8	4008	OUT	0	-	The primary analog value calculated as a result of executing the function.
9	4009	SIMULATE	1: Disable	Auto	Allows the transducer analog input or output to the block to be manually supplied when simulate is enabled. When simulation is disabled, the simulate value and status track the actual value and status. 1: Disable, 2: Active
10	4010	XD_SCALE	Specified at the time of order, otherwise set below. 10.0 0.0 1061: m/s 4	O/S	The high and low scale values, engineering units code, and number of digits to the right of the decimal point used with the value obtained from the transducer for a specified channel. Refer to 5.4 AI Function Block Parameters for the units available.
11	4011	OUT_SCALE	10.0 0.0 1061: m/s 4	O/S	The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the OUT parameter and parameters which have the same scaling as OUT. Refer to 5.4 AI Function Block Parameters for the units available.
12	4012	GRANT_DENY	0x00	Auto	Options for controlling access of host computers and local control panels to operating, tuning and alarm parameters of the block.
13	4013	IO_OPTS	0x0000	O/S	Options which the user may select to alter input and output block processing. bit 10: Low cutoff
14	4014	STATUS_OPTS	0x0000	O/S	Options which the user may select in the block processing of status. bit3: Propagate Fault Forward, bit6: Uncertain if limited, bit7: Bad if limited, bit 8: Uncertain if Man mode.
15	4015	CHANNEL	1	O/S	The number of the logical hardware channel that is connected to this I/O block. This information defines the transducer to be used going to or from the physical world. 1: PV
16	4016	L_TYPE	1: Direct	Man	In the case of AXF, always set 1: Direct. (Note)
17	4017	LOW_CUT	0	Auto	Sets low cut point of output. This low cut value becomes available by setting "Low cutoff" to "IO_OPS".
18	4018	PV_FTIME	0	Auto	Time constant of a single exponential filter for the PV, in seconds.

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(Note) "Indirect" also can be set.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
19	4019	FIELD_VAL	Bad - O/S	-	Raw value of the field device in percent of the PV range, with a status reflecting the Transducer condition, before signal characterization (L_TYPE), filtering (PV_FTIME), or low cut (LOW_CUT).
20	4020	UPDATE_EVT	1 (Acknowledged)	-	This alert is generated by any change to the static data.
21	4021	BLOCK_ALM	1 (Acknowledged)	-	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
22	4022	ALARM_SUM	0	-	The current alert status, unacknowledged status, unreported states, and disabled states of the alarms associated with the function block.
23	4023	ACK_OPTION	0xffff	Auto	Selection of whether alarms associated with the block will be automatically acknowledged.
24	4024	ALARM_HYS	0.50%	Auto	Amount the PV must return within the alarm limits before the alarm condition clears. Alarm Hysteresis is expressed as a percent of the PV span. 0 to 50.
25	4025	HI_HI_PRI	0	Auto	Priority of the high high alarm. 0, 1, 3 to 15.
26	4026	HI_HI_LIM	1: INF	Auto	The setting for high high alarm in engineering units. (Note 1)
27	4027	HI_PRI	0	Auto	Priority of the high alarm. 0, 1, 3 to 15.
28	4028	HI_LIM	1: INF	Auto	The setting for high alarm in engineering units. (Note 1)
29	4029	LO_PRI	0	Auto	Priority of the low alarm. 0, 1, 3 to 15.
30	4030	LO_LIM	-1: INF	Auto	The setting for low alarm in engineering units. (Note 2)
31	4031	LO_LO_PRI	0	Auto	Priority of the low low alarm. 0, 1, 3 to 15.
32	4032	LO_LO_LIM	-1: INF	Auto	The setting for low low alarm in engineering units. (Note 2)
33	4033	HI_HI_ALM	1 (Acknowledged)	Auto	The status of high high alarm and its associated time stamp.
34	4034	HI_ALM	1 (Acknowledged)	Auto	The status of high alarm and its associated time stamp.
35	4035	LO_ALM	1 (Acknowledged)	Auto	The status of low alarm and its associated time stamp.
36	4036	LO_LO_ALM	1 (Acknowledged)	Auto	The status of low low alarm and its associated time stamp.

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Note 1: An intended set value can be written only if Min (XD_SCALE.EU100, XD_SCALE.EU_0) ≤ the intended value ≤ + INF
Note 2: An intended set value cannot be written if -INF ≦ the intended value ≦ Min (OUT_SCALE.EU0, OUT_SCALE.EU100).

8.4 DI Function Block

Relative Index	Index DI1	Index DI2	Parameter Name	Factory Default	Write Mode	Explanation
0	6000	6100	Block Header	DI1: TAG="DI1" DI2: TAG="DI2"	O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	6001	6101	ST_REV	0		The revision level of the static data of the DI block. The value of this parameter is incremented each time a static parameter value is changed. Valid range is 0 to 65535.
2	6002	6102	TAG_DESC	spaces	Auto	The user description of the intended application of the block
3	6003	6103	STRATEGY	1	Auto	Used by an upper-level system to identify grouping of the block. Not checked or processed by the block. Valid range is 0 to 65535.
4	6004	6104	ALERT_KEY	1	Auto	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	6005	6105	MODE_BLK			The actual, target, permitted and normal modes of the block.
6	6006	6106	BLOCK_ERR			Indicates the error statuses related to the block itself.
7	6007	6107	PV_D			The primary discrete value (or process value) for execution of the block's functions.
8	6008	6108	OUT_D			Indicates the value and status of block's output.
9	6009	6109	SIMULATE_D		Auto	Allows use of values manually set instead of the limit switch input from the transducer block. When Disable is set for this value, the block reflects the actual input value and status.1: Disabled, 2: Active
10	6010	6110	XD_STATE	0		Not used in AXF.
11	6011	6111	OUT_STATE	0		Not used in AXF.
12	6012	6112	GRANT_DENY		Auto	Option to control access from the host computer and local control panel to tuning and alarm parameters. Before write access to a parameter, set the GRANT bit in this parameter to have the operation right to be granted. Then after write access, check the DENY bit in this parameter. If the write access is successfully, it is not ON.
13	6013	6113	IO_OPTS	0x0000	O/S	Sets the block input/output options. The AXF supports only 0: Invert (LSB).
14	6014	6114	STATUS_OPTS	0x0000	O/S	Defines block actions depending on block status conditions. For DI blocks of the AXF, 3: Propagate fault Forward, 8: Uncertain if Man mode are supported.
15	6015	6115	CHANNEL	DI1: 2 DI2: 3	O/S	The channel number of the transducer block's logical hardware channel connected to this block. Valid range is 2: LIMSW_1, 3: LIMSW_2, 4: SWITCH_1, 5: SWITCH_2
16	6016	6116	PV_FTIME	0	Auto	Sets the time constant of damping for PV_D.
17	6017	6117	FIELD_VAL_D			The status of the limit switch signal transferred from the transducer block.
18	6018	6118	UPDATE_EVT		-	Shows the content of an update event (a change to the setpoint) upon occurrence.
19	6019	6119	BLOCK_ALM		-	Shows the contents of a block alarm upon occurrence
20	6020	6120	ALARM_SUM	0x0000		Indicates the current alarm statuses.
21	6021	6121	ACK_OPTION	0xFFFF		Selects whether alarms associated with the block will be automatically acknowledged.
22	6022	6122	DISC_PRI	0		Sets the alarm priority level.
23	6023	6123	DISC_LIM	0		Indicates the status of the input for the discrete alarm.
24	6024	6124	DISC_ALM			Indicates the status of the related to the discrete alarm.

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9. GENERAL SPECIFICATIONS

9.1 STANDARD SPECIFICATIONS

For items other than those described below, refer to IM 01E20D01-01E, IM 01E20C02-01E.

Applicable Models:

Integral Flowmeter AXF
Remote Converter AXFA14

Output:

Digital communication signal based on FOUNDATION fieldbus protocol.

Supply Voltage:

Power supply code 1:

- AC specifications
  Rated power supply: 100 to 240 V AC, 50/60 Hz
- DC specifications
  Rated power supply: 100 to 120 V DC

Power supply code 2:

- AC specifications
  Rated power supply: 24 V AC, 50/60 Hz
- DC specifications
  Rated power supply: 24 V DC

Communication Requirements:

Supply Voltage: 9 to 32 V DC
Current Draw: 15mA (maximum)

Functional Specifications:

Functional specifications for Fieldbus communication conform to the standard specifications (H1) of FOUNDATION fieldbus.

Function Block:

Block name	Number	Excecution time	Note
AI	1	30 ms	For flow rate
DI	2	25 ms	For flow limit switches
IT	2	30 ms	Integrator block integrates variables of forward and reverse flow
AR	1	30 ms	Arithmetic block permits simple use of popular measurement math functions
PID	1	50 ms	Applicable when LC1 option is specified

T01.EPS

LM Function:

LM function is supported.

Displayed Language:

In the case of FOUNDATION fieldbus communication type, only English is provided.

STANDARD PERFORMANCE

Accuracy:

Note: The accuracy of a product before shipment is defined as totalized value at the result of calibration test in our water actual flow test facility.
Calibrated conditions in our water actual test facility are as follows:
Fluid temperature; 20 ± 10°C
Ambient temperature; 20 ± 5°C
Length of straight runs; 10 D or more on the upstream side; 5 D or more on the downstream side
Reference conditions; Similar to BS EN29104 (1993); ISO 9104 (1991)

PFA/Ceramics Lining;

Size mm (in.)	Flow Velocity *V* m/s (ft/s)	Standard Accuracy (Calibration code B)	Flow Velocity *V* m/s (ft/s)	High Grade Accuracy (Calibration code C)
2.5 (0.1) to 15 (0.5)	$V < 0.3$ (1)	±1.0 mm/s	—	
	$0.3 \leqq V \leqq 10$ (1) (33)	±0.35% of Rate		
25 (1.0) to 200 (8.0)	$V < 0.15$ (0.5)	±0.5 mm/s	$V < 0.15$ (0.5)	±0.5 mm/s
	$0.15 \leqq V \leqq 10$ (0.5) (33)	±0.35% of Rate	$0.15 \leqq V < 1$ (0.5) (3.3)	±0.18% of Rate ± 0.2mm/s
			$1 \leqq V \leqq 10$ (3.3) (33)	±0.2% of Rate
250 (10) to 400 (16)	$V < 0.15$ (0.5)	±0.5 mm/s	—	
	$0.15 \leqq V \leqq 10$ (0.5) (33)	±0.35% of Rate		

T02.EPS

Polyurethane Rubber /Natural Soft Rubber / EPDM Rubber Lining;

Size mm (in.)	Flow Velocity *V* m/s (ft/s)	Standard Accuracy (Calibration code B)
25 (1.0) to 400 (16)	$V < 0.3$ (1.0)	±1.0 mm/s
	$0.3 \leqq V \leqq 10$ (1.0) (33)	±0.35% of Rate

T03.EPS

Enhanced dual frequency excitation
(Option code HF2): Standard accuracy ±1 mm/s

Repeatability:

± 0.1% of Rate (V ≧ 1 m/s (3.3 ft/s))
± 0.05% of Rate ± 0.5 mm/s (V < 1 m/s (3.3 ft/s))

MODEL AND SUFFIX CODE

Integral Flowmeter AXF:

AXF□□□□-F□□□□□-□□□□-□□□/□

Remote Converter AXFA14:

AXFA14□-F□-□□/□

(Note1) "F" following the first dash indicates that the output is digital communication compliant with the FOUNDATION fieldbus protocol.

9.2 OPTIONAL SPECIFICATIONS

For options other than below, refer to IM 01E20D01-01E and IM 01E20C02-01E (Optional codes C1, C2, C3, EM, G11 and G13 are unable to select).

Item	Description	Code
PID Function	PID control Function	LC1
Software download function	Based on Fieldbus Foundation Specification (FF-883) Download class: Class1	EE

T04.eps

<Factory Setting>

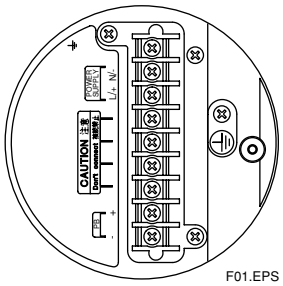
Tag Number (Name Plate and/or stainless steel tag plate)	As specified in order
Software Tag (PD_TAG)	In case of different Software Tag (PD_TAG) is required from Tag Number above in the amplifier memory, specify at Software Tag. Default (FT2001) be set for PD_TAG unless otherwise both Tag Number and Software Tag specified in order.
Node Address	'0xF4' unless otherwise specified in order
Operation Function Class	'BASIC' or as specified
Output Mode (L_TYPE)	Always 'Direct'
Calibration Range (XD_SCALE) Lower/Higher Range Value	FROWRATE SPAN of flowtube order information be set in XD_SCALE. Lower Range Value be always zero.
Calibration Range Unit	Refer to Table below.
Output Scale (OUT_SCALE) Lower/Higher Range Value	'OUT_SCALE' always be the same as 'XD_SCALE'.

T05.EPS

9.3 TERMINAL CONNECTION

Integral Flowmeter AXF

Terminal configuration



F01.EPS

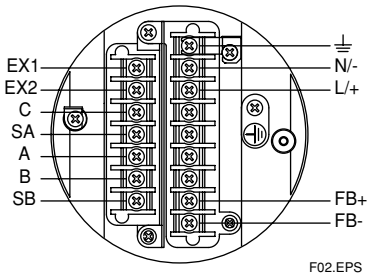
Terminal wiring

Terminal Symbols	Description
⏚	Functional grounding
N/– L/+	Power supply
FB+ FB–	Fieldbus communication signal
⊜	Protective grounding (Outside of the terminal)

T06.EPS

Remote Type Converter AXFA14

Terminal configuration



F02.EPS

Terminal wiring

Terminal Symbols	Description
EX1 EX2	Excitation current Output
C SA A B SB	Flow singal input

Terminal Symbols	Description
⏚	Functional grounding
N/– L/+	Power supply
FB+ FB–	Fieldbus communication signal
⊜	Protective grounding (Outside of the terminal)

T07.EPS

⚠ CAUTION

Do not connect to these terminals which are marked “CAUTION Don’t connect”.

10. MAINTENANCE

For maintenance items, please refer to user's manual IM 01E20D01-01E or IM 01E20C02-01E.

APPENDIX 1. APPLICATION, SETTING AND CHANGE OF BASIC PARAMETERS

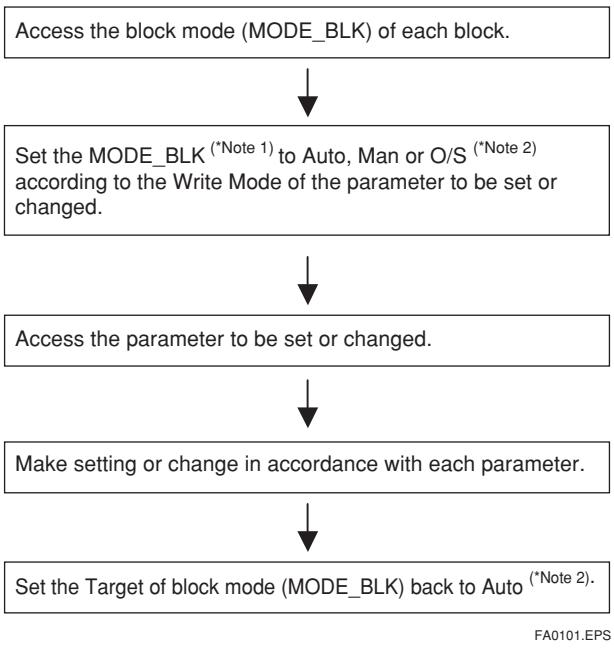
A1.1 Applications and Selection of Basic Parameters

Setting Item (applicable parameters)	Summary
Tag No.(PD_TAG)	Sets PD_Tag. Up to 32 alphanumeric characters can be set.
Calibration range setup (XD_SCALE of AI block)	Sets the range of input from the transducer block corresponding to the 0% and 100% points in operation within the AI function block. Sets the range unit, input value of the 0% point (in case of ADMAG AXFA14, 0), input value of the 100% point (correspond to flow rate span).
Output scale setup (OUT_SCALE of AI block)	Always set the same as XD_SCALE.
Simulation setup (SIMULATE of AI/DI block)	Performs simulation of the each function block. The input value and status for the calibration range can also be set. It is recommended that this parameter be used for loop checks and other purposes. Refer to “Simulation Function” in Section 6.3.
Damping time constant setup (PRIMARY_VALUE_FTIME of Transduecr block)	Sets the time constant of damping function to VOLUME_FLOW in seconds. The setting of PRIMARY_VALUE_FTIME affects not only the flow rate but also the totalization. In comparison, the setting of parameter PV_FTIME in an AI function block works as the damping time constant for the AI block’s OUT. As the damping feature of the flowmeter itself, it is advisable to use PRIMARY_VALUE_FTIME.
Output signal low cut mode setup (PRIMARY_VALUE_LOWCUT of Transducer block)	This setup is used for zeroing flow rate readings in a low flow rate area. The value of PRIMARY_VALUE_LOWCUT (the cutoff level) is set in percent of PRIMARY_VALUE_RANGE. In comparison, the setting of parameter LOW_CUT in an AI function block works as a low cutoff level setting for the AI block’s OUT. As the low cutoff feature of the flowmeter itself, it is advisable to use PRIMARY_VALUE_LOWCUT.
LCD display setup (DISPLAY_SELECT1-3, DISPLAY_CYCLE of Transducer block)	Sets the unit to be displayed on the LCD and the display speed. Adjust display speed if a low temperature environment causes a poor LCD display quality.
Zero-point adjustment (AUTO_ZERO_EXE,MAGFLO_ZERO of Transducer block)	Performs zero-point adjustment. Zero-point adjustment should be done only when the measurement fluid is filled in the flowtube and the fluid velocity is completely zero.

TA0101.EPS

A1.2 Setting and Change of Basic Parameters

This section describes the procedure taken to set and change the parameters for each block. Obtaining access to each parameter differs depending on the configuration system used. For details, refer to the instruction manual for each configuration system.



FA0101.EPS

IMPORTANT

Do not turn the power OFF immediately after parameter setting. When the parameters are saved to the EEPROM, the redundant processing is executed for the improvement of reliability. If the power is turned OFF within 60 seconds after setting of parameters, changed parameters are not saved and may return to their original values.
When the consecutive parameter setting to the multiple parameters is not executed via the acyclic data exchange, the time inverval between each parameter setting must not be within 2 seconds.
Changed parameters may not be written to the device.

Note 1: Block mode consists of the following four modes that are controlled by the universal parameter that displays the operating condition of each block.
- Target: Sets the operating condition of the block.
- Actual: Indicates the current operating condition.
- Permit: Indicates the operating condition that the block is allowed to take.
- Normal: Indicates the operating condition that the block will usually take.

Note 2: The followings are the operating conditions which the individual blocks will take.

	AI Function Block	IT Function Block	DI Function Block	AR Function Block	PID Function Block	Transducer Block	Resource Block
Automatic (Auto)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manual (Man)	Yes	Yes	Yes	Yes	Yes		
Out of Service (O/S)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

TA0102.EPS

Refer to the "List of parameters for each block of the ADMAG AXF" for details of the Write Mode for each block.

A1.3 Setting the AI Function Block

The AI function block outputs the flow rate signals.

(1)Setting the flow range

Access the XD_SCALE parameter.
Set the required unit in Unit Index of XD_SCALE. Set the upper range limit in EU at 100% of XD_SCALE. Set the lower range limit in EU at 0% of XD_SCALE.
Set the decimal point position in Decimal Point of XD_SCALE.

FA0102.EPS

Example:

To measure 0 to 100m^3/h,

Set m^3/h (1349)* in Units Index of XD_SCALE,
Set 100 in EU at 100% of XD_SCALE, and
Set 0 in EU at 0% of XD_SCALE.
Set 0 in Decimal Point of XD_SCALE.

(2)Setting the output scale

Access the OUT_SCALE parameter.
Set the required unit of output in Units Index of OUT_SCALE.
Set the output value corresponding to the upper range limit in EU at 100% of OUT_SCALE.
Set the output value corresponding to the lower range limit in EU at 0% of OUT_SCALE.
Set the decimal position in Decimal Point.

FA0103.EPS

Example:

To set the output to 0.00 to 100.00kg/h,

Set kg/h(1324)* to Units Index of OUT_SCALE,
Set 100 to EU at 100% of OUT_SCALE,
Set 0 in EU at 0% of OUT_SCALE, and
Set 2 to Decimal Point of OUT_SCALE.

* Each unit is expressed using a 4-digit numeric code. Refer to Section 5.4 AI Function Block Parameters.

(3)Setting the output mode

Access the L_TYPE parameter.

Set the output mode. (In AXF series output mode is always 1:Direct so please confirm the setting.)
1: Direct (Sensor output value)
2:Indirect (Linear output value)
3:IndirectSQRT (Square root extraction output value)

FA0104.EPS

(4)Simulation

Perform simulation of the AI function block by setting the desired value and status of the input to the block.

REMOTE LOOP TEST SWITCH is written to SIM_ENABLE_MSG(index 1044) parameter of the resource block.

↓

Access the En/Disable element of the SIMULATE parameter to enable simulation.
1: Disabled
2: Active

↓

Access the Simulate status element of SIMULATE and set the desired status code.

↓

Access the Simulate value element of SIMULATE and set the desired input value.

FA0105.EPS

If simulation is enabled, AI block uses SIMULATE Status and SIMULATE Value as the input, and if disabled, the AI block uses Transducer Status and Transducer Value as input.

Refer to Section 6.3 "Simulation Function."

A1.4 Setting the Transducer Block

To access the AXF-specific functions in the transducer block, the Device Description (DD) for AXF needs to have been installed in the configuration tool used.

(1)Setting the damping time constant

Access the PRIMARY_VALUE_FTIME parameter. Set the damping time constant (in units of seconds).

FA0106.EPS

(2)Setting the output signal Low Cut

Set the low cut of flow rate.

Access the PRIMARY_VALUE_LOWCUT parameter. Set the value subject to low cut in % of PRIMARY_VALUE_RANGE.

FA0107.EPS

(3)Setting the limit switch functions

Set up limit switches 1 and 2. Limit switch statuses can be read from a host as outputs of DI blocks.

Access the LIMSW_1_TARGET parameter and select the primary value to be monitored by limit switch 1. (In AXF series limit switch target is always 1:Primary value so please confirm the setting.)
1: PRIMARY_VALUE

↓

Access the LIMSW_1_ACT_DIRECTION parameter and select the direction of limit switch 1's actions.
1: LO LIMIT Low alarm
2: HI LIMIT High alarm

↓

Access the LIMSW_1_SETPOINT parameter and set the threshold for tuning on limit switch 1 in unit specified in the parameter LIMSW_1_UNIT. As necessary, the on/off hysteresis can be modified by changing the value of the LIMSW_1_HYSTERESIS parameter (only a positive value can be set).

FA0108.EPS

The above shows the setting procedure for limit switch 1.

As necessary, also set up limit switch 2.

(4)Setting the LCD display

Select the data to be displayed on the LCD indicator and the display refresh cycle.

Access the DISPLAY_SELECT1-3 parameter and set the item of display.
ex. DISPLAY_SELECT1
1:Flow Rate(%)
2:Flow Rate
3:Integrator1 Out
4:Integrator2 Out
5:Arithmetic Out

For detail, please refer to 5.6 "Integral LCD indicatior".

↓

Access the DISPLAY_CYCLE parameter and set display cycle. The display cycle is can be selected from 200ms to 8s. It defaults to 2(400 ms), but if the LCD display looks unclear when used in lower temperature environments, increase the value as required.

FA0109.EPS

A1.5 Setting the Integrator (IT) Function Block

The Integrator function block output the flow totalization.

(1)Setting the unit of totalization

1) Access the TIME_UNIT1 parameter in IT block and set the Time unit corresponding IN_1. (If there exists input to IN_2, set the time unit in TIME_UNIT2)
2) Access the OUT_RANGE parameter in IT block and set the Flow unit in "Units Index".

FA0110.EPS

(2)Setting the direction of the totalization

Access the INTEG_OPTS parameter in IT block and set 0 or 1 to "Bit#2" or "Bit#3".
(Example1) Foward flow totalization
Bit#2=1
Bit#3=0
(Example2) Reverse flow totalization
Bit#2=0
Bit#3=1
(Example3) Differential flow totalization
Bit#2=1
Bit#3=1

FA0111.EPS

(3)Resetting or presetting TOTAL value

Reset totalization

Access the OP_CMD_INT parameter in IT block and set Reset "1".

FA0112.EPS

Preset totalization

1) Access the MODE_BLK parameter in IT block and set O/S or Man in "Target".
2) Access the OUT parameter in IT block and set preset value in "Value".
3) Access the MODE_BLK parameter in IT block and set Auto in "Target".

FA0113.EPS

A1.6 Setting the DI Function Block

DI function blocks output limit switch signals received from the transducer block.

Two DI blocks (DI1 and DI2) in each AXF have independent parameters. Set up the parameters of each DI block you use, individually as necessary. The following shows the DI1 setting procedure as an example.

(1) Setting the channel

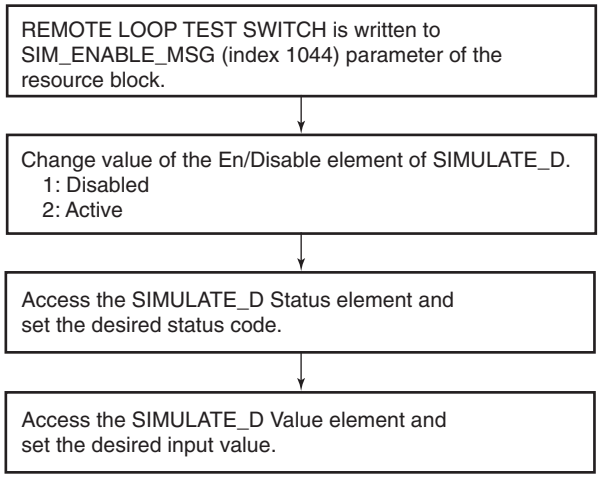
The CHANNEL parameter of the DI block, which specifies the switch number of the transducer's limit switch to be input to DI (DI1: 2, DI2: 3) for the AXF.

(2) Setting the damping time constant

Access the PV_FTIME parameter and set the damping time constant (in units of seconds).

(3) Simulation

Perform simulation of each DI function block by setting the desired value and status of the input to the block. Access the SIMULATE_D parameter and change the values of its elements as follows.



FA0114.EPS

The DI block uses SIMULATE_D Status and SIMULATE_D Value in the SIMULATE_D parameter as its input status and value when simulation is active, or uses Transducer Status and Transducer Value in SIMULATE_D as its input status and value when simulation is disabled. Refer to Section 6.3, "Simulation Function."

APPENDIX 2. INTEGRATOR (IT) BLOCK

The Integrator (IT) block adds two main inputs and integrates them for output. The block compares the integrated or accumulated value to TOTAL_SP and PRE_TRIP and generates discrete output signals OUT_TRIP or OUT_PTRIP when the limits are reached.

The output is as represented by the following equation (for counting upward and rate conversion).

OUT.Value = Integration start value + Total
Total = Total + Current Integral
Current Integral = $(x + y) \times \Delta t$
x: IN_1 value whose unit has been converted
y: IN_2 value whose unit has been converted
Δt: block execution period

A2.1 Schematic Diagram of Integrator Block

The following shows the schematic diagram of the Integrator block.

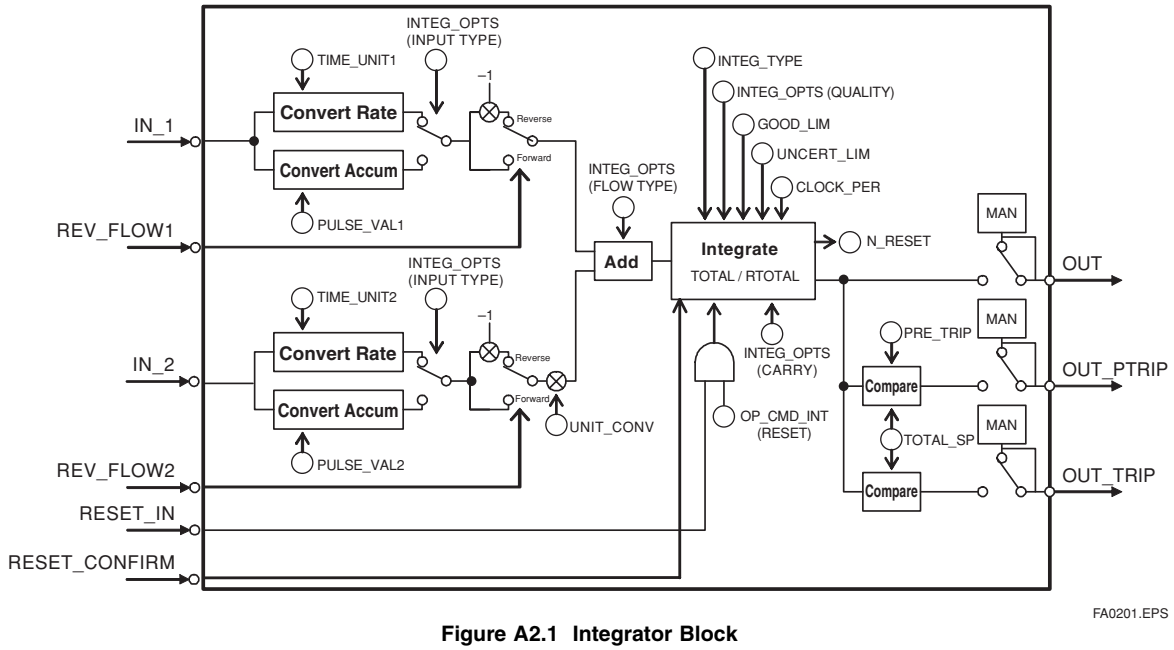


Figure A2.1 Integrator Block

IN_1: Block input 1 (value and status)

IN_2: Block input 2 (value and status)

REV_FLOW1: Indicates whether the sign of IN_1 is reversed. It is a discrete signal.

REV_FLOW2: Indicates whether the sign of IN_2 is reversed. It is a discrete signal.

RESET_IN: Resets the integrated values. It is a discrete signal.

RESET_CONFIRM: Reset confirmation input. It is a discrete signal.

OUT: Block output (value and status)

OUT_PTRIP: Set if the target value exceeds PRE_TRIP. It is a discrete signal.

OUT_TRIP: Set if the target value exceeds TOTAL_SP (or 0). It is a discrete signal.

The Integrator block is classified into the following five sections for each function:

- Input process section: Determines the input value status, converts the rate and accumulation, and determines the input flow direction.
- Adder: Adds the two inputs.
- Integrator: Integrates the result of the adder into the integrated value.
- Output process section: Determines the status and value of each output parameter.
- Reset process section: Resets the integrated values.

A2.2 Input Process Section

When executed, the Integrator block first performs input processing in the order of:

"Determining input status" → "Converting Rate or Accum" → "Determining the input flow direction"

Switching between Convert Rate and Convert Accum is made using bit 0 (for IN_1) or bit 1 (for IN_2) of INTEG_OPTS. INTEG_OPTS is one of the system parameters and should be set by the user. The values of IN_1 and IN_2 are not retained if the power is turned OFF.

A2.2.1 Determining Input Value Statuses

The following shows the correlation between the statuses of input parameters (IN_1, IN_2) and the statuses of input values used in the Integrator block.

Statuses of Input Parameters (IN_1, IN_2)	Bit 4 of INTEG_OPTS (Use Uncertain)	Bit 5* of INTEG_OPTS (Use Bad)	Status of Input Values Handled in IT Block
Good	Irrelevant	Irrelevant	Good
Bad	Irrelevant	H (=1)	Good
Bad	Irrelevant	L (=0)	Bad
Uncertain	H (=1)	Irrelevant	Good
Uncertain	L (=0)	Irrelevant	Bad

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For addition (see A2.3), if the status of an input value is "Bad," the "Good" value just before the status changed to "Bad" is used.

* Even if the Use Bad option is used, changing the internal status to "Good," the value of "Good" just before the status changed to "Bad" is used.

A2.2.2 Converting the Rate

The following describes an example of rate conversion.

In rate conversion, firstly convert the unit of two inputs to that based on seconds.

Next, convert the unit of the inputs to the same unit to be added together. The unit of IN_2 is standardized to that of IN_1. Then, calculates a weight, volume, or energy by multiplying each input value and block execution time. Because unit information is not input to the Integrator block as an input value, the user must input in advance tuned values to the TIME_UNIT1/2 and UNIT_CONV parameters.

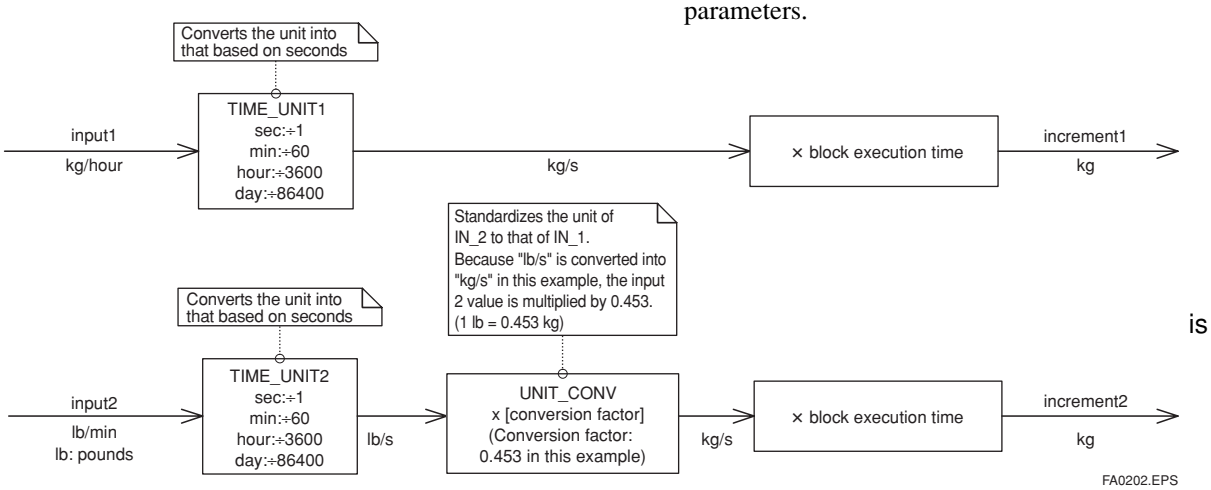

Figure A2.2 Increment Calculation with Rate Input

A2.2.3 Converting Accumulation

This following describes an example of accumulation conversion.

In accumulation conversion, the difference between the value executed previously and the value executed this time is integrated or accumulated. This conversion applies when the output of a function block used as a counter is input to the input process of the Integrator block.

In order to convert the rate of change of an input to a value with an engineering unit, the user must configure the factor of conversion to the appropriate engineering unit in the PULSE_VAL1 and PULSE_VAL2 parameters.

Moreover, the unit of IN_2 is standardized to that of IN_1 in the same way as rate conversion. Thus, the user must also set an appropriate value to UNIT_CONV.

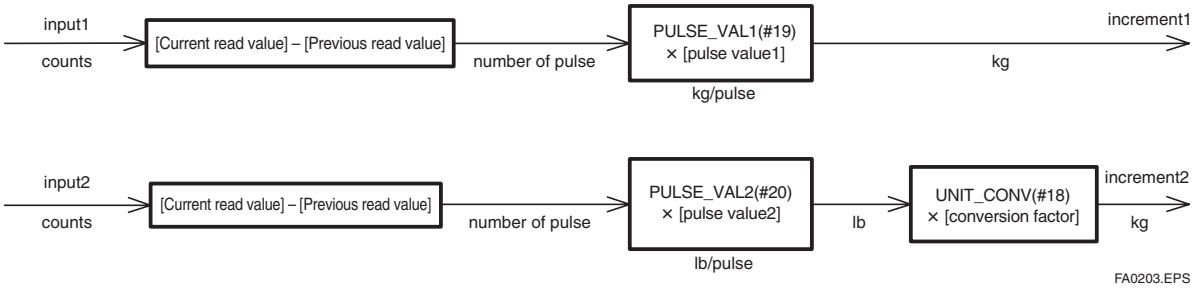

Figure A2.3 Increment Calculation with Counter Input

A2.2.4 Determining the Input Flow Direction

The Integrator block also considers the input flow direction. Information about the input flow direction is contained in REV_FLOW1 and REV_FLOW2 (0: FORWARD, 1: REVERSE).

In input processing, the sign of the value after rate and accumulation conversion is reversed if the REV_FLOW1 and REV_FLOW2 parameters are set to REVERSE. When determination of the flow direction of two input values is complete, these two inputs are passed to the adder. The settings in REV_FLOW will be retained even if the power is turned OFF.

A2.3 Adder

When input processing is complete, two arguments that have been rate and accumulate converted will be passed to the adder. The adder adds these two values according to the option.

A2.3.1 Status of Value after Addition

If one of the statuses of two arguments is "Bad" or if two of them are both "Bad," the status of the value after addition becomes "Bad." In this case, the value of "Good" just before the status changed to "Bad" is used as the addition value (see A2.1).

When the statuses of two arguments are both "Good," the status of the value after addition becomes "Good." In this case, the status of the value after addition will be used for the status applied to integration.

A2.3.2 Addition

The following three options are available for addition:

- TOTAL: Adds two argument values as is.
- FORWARD: Adds two argument values, regarding a negative value as "0."
- REVERSE: Adds two argument values, regarding a positive value as "0."

You can choose these options using bit 2 and bit 3 of INTEG_OPTS as follows:

Bit 2 of INTEG_OPTS (Flow Forward)	Bit 3 of INTEG_OPTS (Flow Reverse)	Adder Options
H	H	TOTAL
L	L	TOTAL
H	L	FORWARD
L	H	REVERSE

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The result of the adder is passed to the integrator. If only one of the inputs is connected, the value of a non-connected input will be ignored.

When bit 7 of INTEG_OPTS (Add zero if bad) has been set, if the status of a value after addition is "Bad," the value after addition (increment) becomes "0."

A2.4 Integrator

When addition is complete, its result will be passed to the integrator.

Integration consists of combinations of a reset method and counting up/down. There are the following seven integration types, which can be set using INTEG_TYPE.

1. UP_AUTO : Counts up with automatic reset when TOTAL_SP is reached
2. UP_DEM : Counts up with demand reset
3. DN_AUTO : Counts down with automatic reset when zero is reached
4. DN_DEM : Counts down with demand reset
5. PERIODIC : Counts up and is reset periodi cally according to CLOCK_PER
6. DEMAND : Counts up and is reset on demand
7. PER&DEM : Counts up and is reset periodi cally or on demand

Each type of integration is independently run as a function.

There are the following four types of integrated values:

1. Total: Integrates the result of the adder as is.
2. ATotal: Integrates the absolute value of the result of the adder.
3. RTotal: Integrates the absolute value of the result of the adder only if the status of the result is "Bad."
   This value is used for the RTOTAL value.
4. AccTotal: An extension function. The result of the adder is integrated as is and will not be reset.

The value is used for the ACCUM_TOTAL (expanded parameter) value.

The table A2.1 shows the details of INTEG_TYPE.

Table A2.1 INTEG_TYPE

Name	Integration Method	Integration Range	Reset Trigger (Reset if one of the following conditions is established)	Trip Output
UP_AUTO(1)	Counting up Starting from "0"	-INF< Total <TOTAL_SP 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• OUT reaches TOTAL_SP. • RESET_IN = 1 • OP_CMD_INT = 1	○
UP_DEM(2)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• RESET_IN = 1 • OP_CMD_INT = 1	○
DN_AUTO(3)	Counting down Starting from TOTAL_SP	0< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• OUT reaches "0." • RESET_IN = 1 • OP_CMD_INT = 1	○
DN_DEM(4)	Counting down Starting from TOTAL_SP	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• RESET_IN = 1 • OP_CMD_INT = 1	○
PERIODIC(5)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• At the period specified by CLOCK_PER • OP_CMD_INT = 1	×
DEMAND(6)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• RESET_IN = 1 • OP_CMD_INT = 1	×
PER&DEM(7)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• At the period specified by CLOCK_PER • RESET_IN = 1 • OP_CMD_INT = 1	×

Legend ○: Trip output is made. ×: No trip output is made.

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A2.5 Output Process

There are the following three output parameters:

1. OUT
2. OUT_TRIP
3. OUT_PTRIP

Parameters OUT_TRIP and OUT_PTRIP are used only when INTEG_TYPE is a value from 1 to 4.

In case of Integrator block related memory failed, the status of OUT, OUT_TRIP, OUT_PTRIP becomes “Bad-Device Failure”.

A2.5.1 Status Determination

The same criteria for determining the status of the output of the Integrator block are used in common for the above three parameters.

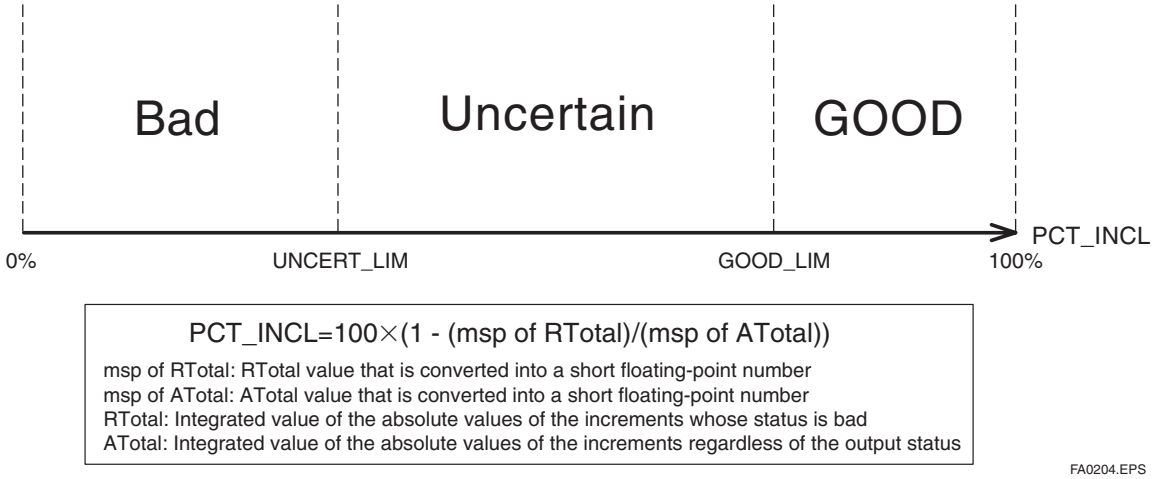


Figure A2.4 Status of OUT, OUT_TRIP, and OUT_PTRIP Outputs

OUT.Value, OUT_TRIP.Status, and OUT_PTRIP.Status are determined by the ratio of the "Good" integrated values to all integrated values, which is stored in PCT_INCL (0% to 100%). The user must set the threshold value of each status to UNCERT_LIM and GOOD_LIM.

The Integrator block determines the status of the output using the three parameters: PCT_INCL,

UNCERT_LIM, and GOOD_LIM.

- PCT_INCL≧GOOD_LIM
  ⇒Good
- UNCERT_LIM≦PCT_INCL＜GOOD_LIM
  ⇒Uncertain
- PCT_INCL＜UNCERT_LIM
  ⇒Bad

If INTEG_TYPE is 5, 6, or 7, the status of the trip output becomes "Good-NS-Constant."

A2.5.2 Determining the Output Value

The value of OUT.Value is determined as follows:

- For counting up

  OUT = integration start value (0) + Total

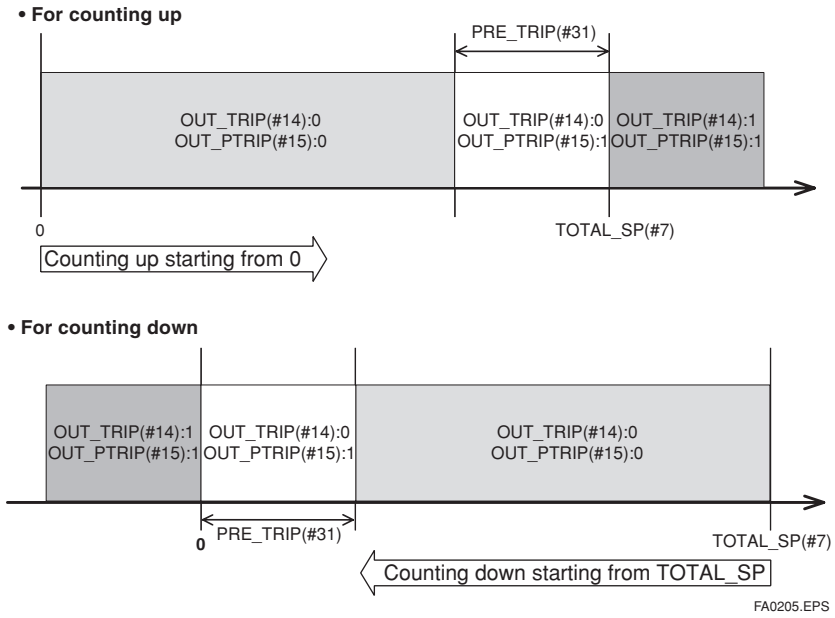
- For counting down

  OUT = integration start value (TOTAL_SP) - Total

  Total: Total of integrated values. This value is retained even if INTEG_TYPE is changed during integration (in AUTO).

If OUT is rewritten in the MAN mode, integration starts with the value rewritten in MAN mode after the mode was returned to AUTO.

The values in OUT_TRIP and OUT_PTRIP are determined according to the correlation between OUT and TOTAL_SP/PRE_TRIP.



For counting up, the OUT value is as follows:

- OUT < TOTAL_SP - PRE_TRIP
  ⇒OUT_TRIP = 0, COUT_PTRIP = 0
- TOTAL_SP - PRE_TRIP <= OUT < TOTAL_SP
  ⇒OUT_TRIP = 0, COUT_PTRIP = 1
- TOTAL_SP <= OUT
  ⇒OUT_TRIP = 1, COUT_PTRIP = 1

For counting down, the OUT value is as follows:

- PRE_TRIP < OUT
  ⇒OUT_TRIP = 0, COUT_PTRIP = 0
- 0 < OUT <= PRE_TRIP
  ⇒OUT_TRIP = 0, COUT_PTRIP = 1
- OUT <= 0
  ⇒OUT_TRIP = 1, COUT_PTRIP = 1

Note that the given conditions do not apply to the following cases:

- If INTEG_TYPE is 5, 6, or 7, OUT_TRIP and OUT_PTRIP always output "0."
- If INTEG_TYPE is 1 or 3, occurrence of AutoRESET (reset caused if the threshold is exceeded) causes OUT_TRIP to hold "1" for five seconds.

A2.5.3 Mode Handling

Mode	Action	Output
Automatic (AUTO)	Normal action	Normal output
Manual (MAN)	Integration calculation is stopped. OUT will not be updated unless you set a value to it. No reset is accepted.	You may rewrite a value in OUT. If no value is rewritten, the value just before running in AUTO is held. When the mode returns to AUTO, integration starts with the written value or the value just before running in AUTO.
Out of Service (O/S)		

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If you rewrite the value in OUT and RTOTAL while the mode is in MAN or O/S, N_RESET is incremented.

A2.6 Reset

A2.6.1 Reset Trigger

There are the following five types of reset triggers:

1. An integrated value exceeds TOTAL_SP.
2. An integrated value falls below "0."
3. RESET_IN is "H."
4. Every period specified in CLOCK_PER (for more information, see CLOCK_PER in A2.6.2)
5. OP_CMD_INT is 1.

The table A2.2 shows the correlation between INTEG_TYPE and RESET triggers.

Table A2.2 RESET Triggers

	(1)	(2)	(3)	(4)	(5)
1:UP_AUTO	○	×	○	×	○
2:UP_DEM	×	×	○	×	○
3:DN_AUTO	×	○	○	×	○
4:DN_DEMO	×	×	○	×	○
5:PERIODIC	×	×	×	○	○
6:DEMAND	×	×	○	×	○
7:PER&DEM	×	×	○	○	○

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When OP_CMD_INT has become "H" and a reset was made, OP_CMD_INT automatically returns to "L."

Even if RESET_IN becomes "H," activating a reset, RESET_IN does not automatically return to "L." The

RESET_IN setting will not be retained if the power is turned OFF.

A2.6.2 Reset Timing

All items are reset during execution of the function block. Therefore, the minimum period of a reset is the

block execution period.

● 5-second rule

If a reset is made, the next reset will not be accepted for 5 seconds after that.

Even if UP_AUTO (or DN_AUTO) is activated and TOTAL_SP (or 0) is reached within 5 seconds, the next reset will not be made for 5 seconds from the previous reset.

● CLOCK_PER

If INTEG_TYPE is PERIODIC (5) or PER&DEM (7), a reset is made at the period (sec) set to the CLOCK_PER parameter.

If the value in CLOCK_PER is smaller than the function block's execution period, bit 1 of BLOCK_ERR "Block Configuration Error" is set.

A2.6.3 Reset Process

The basic reset process sequence is as follows:

1.) Snapshot

2.) Clearing the integrated values

3.) Reset count increment

4.) Judging OUT_TRIP and OUT_PTRIP (see A2.5)

1.) Snapshot

Saves the following values in the specified parameters before clearing the integrated values. These values will be retained until the next reset is made.

STOTAL = Total

SRTOTAL = RTotal

SSP = TOTAL_SP

2.) Clearing the integrated values

The reset process clears the Total, ATotal, and RTotal values in the internal registers.

Total = 0

ATotal = 0

RTotal = 0

3.) Reset count increment

Each time a reset is made, the N_RESET parameter will be incremented.

The high limit is 999,999, and if this limit is exceeded, the count returns to "0."

4.) Judging OUT_TRIP and OUT_PTRIP (see A2.5)

OUT_TRIP and OUT_PTRIP are judged again on the basis of the cleared integrated values.

There are three options relating to a reset:

i Confirm reset (bit 8 of INTEG_OPTS)

ii Carry (bit 6 of INTEG_OPTS)

iii Generate reset event (bit 9 of INTEG_OPTS)

i Confirm reset (bit 8 of INTEG_OPTS)

If this option is enabled, the next reset is rejected until "1" is set to RESET_CONFIRM.

ii Carry (bit 6 of INTEG_OPTS)

If this option is enabled while INTEG_TYPE is UP_AUTO or DN_AUTO, the value exceeding the threshold at a reset will be carried into the next integration.

If INTEG_TYPE is any setting other than UP_AUTO or DN_AUTO, this option is irrelevant.

iii Generate reset event (bit 9 of INTEG_OPTS)

If this option is enabled, an alert event is generated if a reset occurs.

A2.7 List of Integrator Block Parameters

Index	Parameter Name	Initial Value	Write Mode	View 1	View 2	View 3	View 4	Definition
0	BLOCK_HEADER	IT1:TAG="TT1" IT2:TAG="TT2"	Block Tag =o/s					Information relating to this function block, such as block tag, DD revision, execution time
1	ST_REV	0	—	2	2	2	2	The revision level of the set parameters associated with the Integrator block
2	TAG_DESC	Spaces						Stores comments describing tag information.
3	STRATEGY	1					2	The strategy field is used by a high-level system to identify the function block.
4	ALERT_KEY	1					1	Key information used to identify the location at which an alert occurred
5	MODE_BLK			4		4		Integrator block mode. O/S, MAN, and AUTO are supported.
6	BLOCK_ERR	0	—	2		2		Indicates the active error conditions associated with the function block in bit strings.
7	TOTAL_SP	1000000.0	Auto	4		4		The setpoint of an integrated value or a start value for counting down
8	OUT		MAN	5		5		The block output
9	OUT_RANGE	1000000.0 0.0 m3(1034) 0			11			Set scaling for output display. This does not affect operation of the function block. It is used for making memos.
10	GRANT_DENY	0			2			The parameter for checking if various operations have been executed
11	STATUS_OPTS	0	OS				2	Allows you to select a status-related option. The Integrator block uses "Uncertain if Man mode" only.
12	IN_1	0.0	Auto	5		5		Inputs flow (Rate, Accum) signals from the AI block or PI block.
13	IN_2	0.0	Auto	5		5		
14	OUT_TRIP	0		2		2		An output parameter informing the user that the integrated value has exceeded the setpoint
15	OUT_PTRIP	0		2		2		An output parameter informing the user that the integrated value is reaching the setpoint
16	TIME_UNIT1	sec(1)	MAN		1			Set the time unit of the rate (kg/s, lb/min, kg/h ... etc.) of the corresponding IN.
17	TIME_UNIT2	sec(1)	MAN		1			
18	UNIT_CONV	1.0	Auto				4	Specify the unit conversion factor for standardizing the unit of IN_2 into that of IN_1.
19	PULSE_VAL1	1.0	MAN				4	Set the factor for converting the number of pulses for the corresponding IN into an appropriate engineering unit.
20	PULSE_VAL2	1.0	MAN				4	
21	REV_FLOW1	0	Auto	2		2		Selector switch used to specify the fluid flow direction (forward/reverse) with respect to the corresponding IN
22	REV_FLOW2	0	Auto	2		2		
23	RESET_IN	0	Auto	2		2		The parameter that receives a reset request from an external block to reset the integrated values
24	STOTAL	0.0				4		Indicates the snapshot of OUT just before a reset.
25	RTOTAL	0.0	MAN	4		4		Indicates the integrated value of the absolute values of the increments if the input status is "Bad."
26	SRTOTAL	0.0				4		Indicates the snapshot of RTOTAL just before a reset.
27	SSP	0.0				4		Indicates the snapshot of TOTAL_SP just before a reset.
28	INTEG_TYPE	UP_AUTO (1)	Auto				1	Integration Type Setting Value / Name / Description 1 / UP_AUTO / Counts up and is automatically reset when TOTAL_SP is reached. 2 / UP_DEM / Counts up and is reset as demanded. 3 / DN_AUTO / Counts down and is automatically reset when "0" is reached. 4 / DN_DEM / Counts down and is reset as demanded. 5 / PERIODIC / Counts up and is reset at periods specified in CLOCK_PER. 6 / DEMAND / Counts up and is reset as demanded. 7 / PER&DEM / Reset periodically or as demanded.
29	INTEG_OPTS	0×0004	Auto				2	Specifies an integration optional function. bit / Option Name / Description 0 / Input 1 accumulate / Selects Rate or Accum input of IN_1. 1 / Input 2 accumulate / Selects Rate or Accum input of IN_2. 2 / Flow forward / Integrates forward flow (interprets reverse flow as zero).* 3 / Flow reverse / Integrates reverse flow (interprets forward flow as zero).* 4 / Use uncertain / Uses an input value of IN_1 or IN_2 whose status is "Uncertain" regarding it as a value of "Good." 5 / Use bad / Uses an input value of IN_1 or IN_2 whose status is "Bad" regarding it as a value of "Good." 6 / Carry / Carries over an excess exceeding the threshold at reset to the next integration. (Note that this does not apply to UP_AUTO or DN_AUTO.) 7 / Add zero if bad / Interprets an increment as zero if the status of the increment is "Bad." 8 / Confirm reset / After a reset, rejects the next reset until "Confirm" is set to RESET_CONFIRM. 9 / Generate reset event / Generates an alert event at reset. 10~15 / Reserved / * If both forward and reverse flows are enabled or disabled, both forward and reverse flows are integrated.

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Index	Parameter Name	Initial Value	Write Mode	View				Definition
				1	2	3	4	
30	CLOCK_PER	86400.0[sec]	Auto				4	Specify the period at which a periodic reset is made.
31	PRE_TRIP	100000.0	Auto				4	Set an allowance applied before an integrated value exceeds the setpoint.
32	N_RESET	0.0		4		4		Indicates the number of resets in the range of 0 to 999999.
33	PCT_INCL	0.0[%]		4		4		The ratio of "the integrated values of the absolute values of the increments whose status is Good" to the "integrated values of the absolute values of the increments irrelevant to the status" (Equation)
34	GOOD_LIM	0.0[%]	Auto				4	The threshold value of the ratio of "the integrated values of the increments whose status is Good" to all integrated values in which the status of OUT is "Good"
35	UNCERT_LIM	0.0[%]	Auto				4	The threshold value of the ratio of "the integrated values of the increments whose status is Good" to all the integrated values in which the status of OUT is "Uncertain"
36	OP_CMD_INT	0	Auto	1		1		Operator command that resets integrated values
37	OUTAGE_LIM	0.0	Auto				4	Maximum time for which values can be retained in the event of power failure. It does not effect the block operation.
38	RESET_CONFIRM	0	Auto	2		2		Reset confirmation input, which is enabled when the Confirm reset option of INTEG_OPTS is chosen
39	UPDATE_EVT	1 1 0 0 0						Indicates event information if an update event occurs.
40	BLOCK_ALM	1 1 0 0 0						Indicates alarm information if a block alarm occurs.
41	ACCUM_TOTAL	0.0	Auto			4		Accumulated integrated values (no extension parameter is reset)

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APPENDIX 3. ARITHMETIC (AR) BLOCK

The Arithmetic (AR) block switches two main inputs of different measurement ranges seamlessly and combines the result with three auxiliary inputs through the selected compensation function (10 types) to calculate the output.

A3.1 Schematic Diagram of Arithmetic Block

The diagram below shows the Arithmetic block schematic.

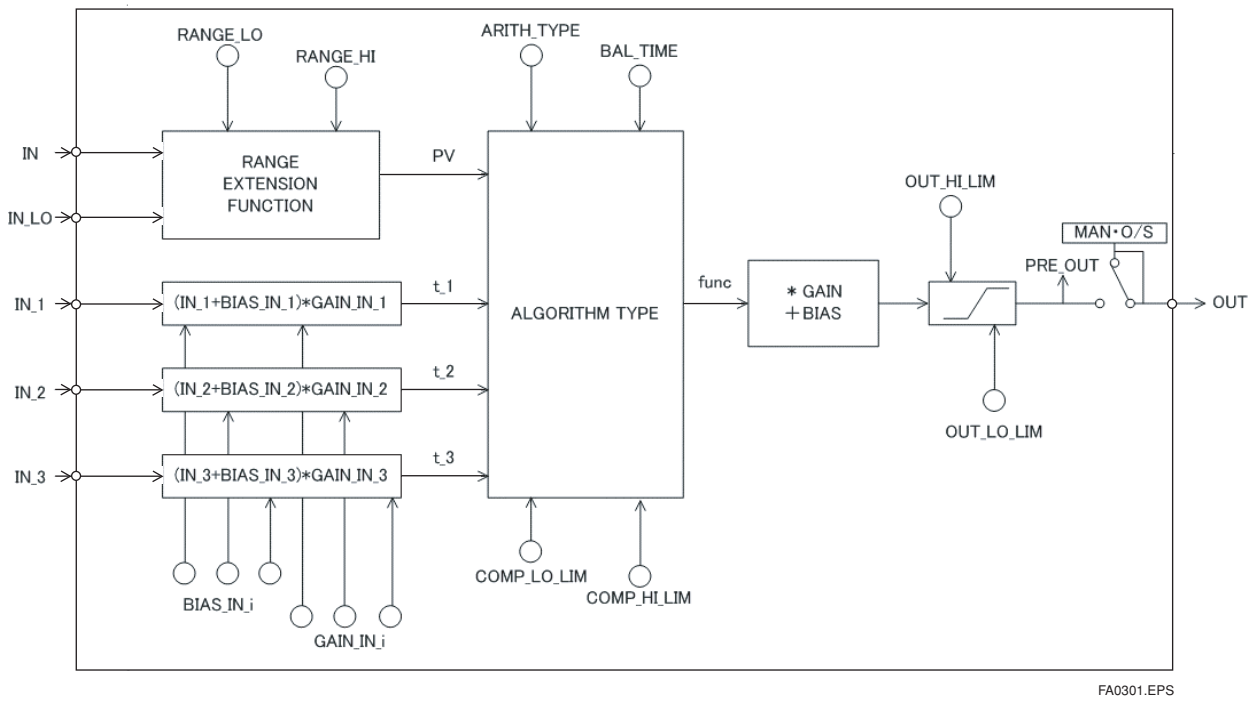

Figure A3.1 AR Block

The Arithmetic block is divided into three sections:

· Input section: Makes a go/no-go decision on the use of an input value, switches the range, and determines the PV status.

· Computation section: Makes calculations through ARITH_TYPE.

· Output section: Applies gain multiplication and bias addition to the calculated result to perform limitation processing for output.

* The range extension function compensates the IN and IN_LO input values when two devices with different ranges are connected, to make smooth input switching.

A3.2 Input Section

There are five inputs: IN and IN_LO main inputs and IN_1, IN_2, and IN_3 auxiliary inputs.

IN and IN_LO are intended to connect devices with different measurement ranges and allow the use of switching a measurement range by selecting the measuring device. However, because there are slight differences between IN and IN_LO values even when the same item is measured, instantaneous switching causes abrupt changes in the output.

To prevent this phenomenon, the Arithmetic block uses a function known as range extension to compensate the IN and IN_LO values between RANGE_HI and RANGE_LO. This enables the input to be switched smoothly. The result of the range extension function is substituted into PV to be used for calculations.

A3.2.1 Main Inputs

The range extension function determines the PV value in the following order:

1. If IN ≧ RANGE_HI → PV = IN
2. If IN ≦ RANGE_LO → PV = IN_LO
3. If RANGE_HI > IN > RANGE_LO → PV = g × IN + (1- g) × IN_LO

g = (IN - RANGE_LO) / (RANGE_HI - RANGE_LO)

RANGE_HI and RANGE_LO are threshold values for switching two main inputs seamlessly.

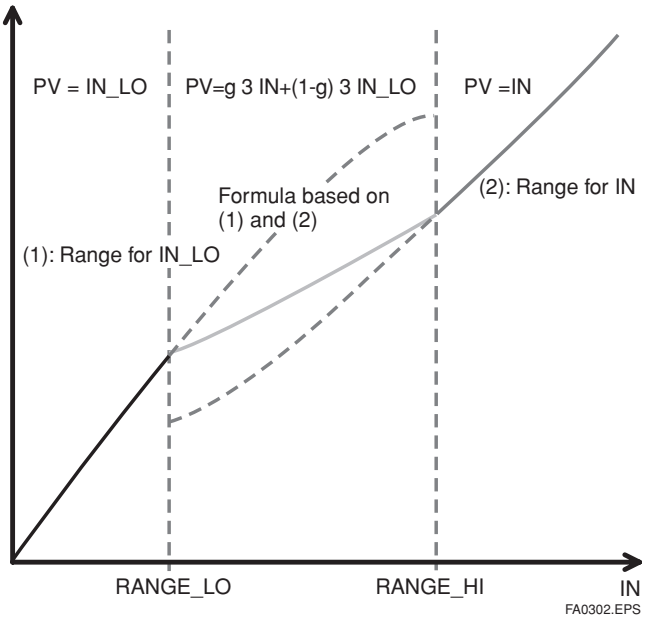

Figure A3.2 Range Extension Function and PV

PV is a parameter with status information, and PV status is determined by the value of "g."

If "g" < 0.5 → The status of IN_LO is used.

If "g" ≧ 0.5 → The status of IN is used.

Determination of the status is made with a hysteresis of 10% provided for 0.5.

If RANGE_LO > RANGE_HI, the statuses of PV and OUT are "Bad. Configuration Error." Then "Configuration Error" is output to BLOCK_ERR.

If there is only one main input, the input is incorporated into the computation section as is, not taking into account RANGE_HI and RANGE_LO.

Example:

Assuming that

RANGE_LO	20
RANGE_HI	300

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the following are established:

IN = 310, IN_LO = 20 → PV = 310

IN = 230, IN_LO = 20 → g = (230 - 20) / (300 - 20) = 0.75

PV = 0.75 × 230 + (1 - 0.75) × 20 = 177.5

IN = 90, IN_LO = 20 → g = (90 - 20) / (300 - 20) = 0.25

PV = 0.25 × 230 + (1 + 0.25) × 20 = 37.5

IN = 19, IN_LO = 10 → PV = 10

A3.2.2 Auxiliary Inputs

There are bias and gain parameters for the IN_1, IN_2, and IN_3 auxiliary inputs. The following shows the equation using them.

$$t\_i = (IN\_i + BIAS\_IN\_i) \times GAIN\_IN\_i$$

The bias parameter is used for calculating absolute temperature or absolute pressure, while the gain parameter is used for normalization of square root extraction.

A3.2.3 INPUT_OPTS

INPUT_OPTS has an option that handles an input with "uncertain" or "bad" status as a "good" status input.

Bit	Function
0	Handles IN as a "good" status input if its status is "uncertain."
1	Handles IN_LO as a "good" status input if its status is "uncertain."
2	Handles IN_1 as a "good" status input if its status is "uncertain."
3	Handles IN_1 as a "good" status input if its status is "bad."
4	Handles IN_2 as a "good" status input if its status is "uncertain."
5	Handles IN_2 as a "good" status input if its status is "bad."
6	Handles IN_3 as a "good" status input if its status is "uncertain."
7	Handles IN_3 as a "good" status input if its status is "bad."
8 to 15	Reserved

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There are options called "IN Use uncertain" and "IN_LO Use uncertain" for the IN and IN_LO inputs. When these options are valid, IN and IN_LO are internally interpreted as "good" IN and IN_LO even if their statuses are "uncertain." (There is no option for "bad" status.)

For the IN_1, IN_2, and IN_3 auxiliary inputs, there are options known as "IN_i Use uncertain" and "IN_i Use bad." If these options are valid, an IN_i with "uncertain" or "bad" status is internally interpreted as a "good" IN_i.

* The exception is that if the input status is "Bad. Not Connected," INPUT_OPTS does not apply and the input is considered "bad" as is.

A3.2.4 Relationship between the Main Inputs and PV

The value and PV status are determined by the statuses of two main inputs, INPUT_OPTS, and RANGE_LO and RANGE_HI.

· If the statuses of two main inputs are both "good" or anything other than "good"
  See A4.2.1, Main Inputs.

· If only one of two main inputs has "good" status after application of INPUT_OPTS, the PV value is determined as follows:

  · If the status of IN is "good" and that of "IN_LO" is anything other than "good"

    IN > RANGE_LO → PV = IN

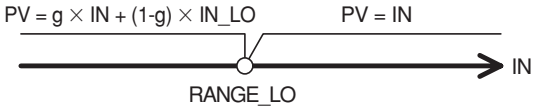
    IN ≦ RANGE_LO → See A3.2.1.

  · If the status of IN is anything other than "good" and that of "IN_LO" is "good"

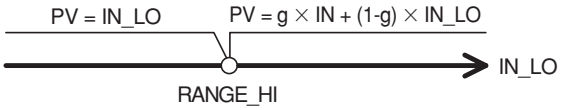
    IN_LO < RANGE_HI → PV = IN_LO

    IN_LO ≧ RANGE_H → See A3.2.1.

If the status of IN is "good" and that of "IN_LO" is anything other than "good"



If the status of IN is anything other than "good" and that of "IN_LO" is "good"



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A3.3 Computation Section

A3.3.1 Computing Equations

This subsection shows computing equations used in the computation section:

1) Flow compensation (linear)

func = PV × f

f = (t_1 / t_2)

2) Flow compensation (square root)

func = PV × f

f = sqrt(t_1 / t_2 / t_3)

3) Flow compensation (approximate expression)

func = PV × f

f = sqrt(t_1 × t_2 × t_3 × t_3)

4) Quantity of heat calculation

func = PV × f

f = (t_1 - t_2)

5) Multiplication and division

func = PV × f

f = ((t_1 / t_2) + t_3)

6) Average calculation

func = (PV + t_1 + t_2 + t_3) / N

where N: number of inputs

7) Summation

func = PV + t_1 + t_2 + t_3

8) Polynomial computation

func = PV + t_1^2 + t_2^3 + t_3^4

9) HTG-level compensation

func = (PV - t_1) / (PV - t_2)

10) Polynomial computation

func = PV + t_1 × PV^2 + t_2 × PV^3 + t_3 × PV^4

* Precaution for computation

Division by "0": If a value is divided by "0," the calculation result is interpreted as 10^{37} and, depending with core, a plus sign is added to it.

Negative square root: The square root of an absolute value is extracted and a minus sign is added to it.

A3.3.2 Compensated Values

In computing equations 1) to 5) in A3.3.1, the value "f" is restricted by the COMP_HI_LIM or COMP_LO_LIM parameter. In this case, the value "f" is treated as follows:

If "f" > COMP_HI_LIM,

f = COMP_HI_LIM

If "f" < COMP_LO_LIM,

f = COMP_LO_LIM

A3.3.3 Average Calculation

In computing equation 6) in A3.3.1, the average of input value is calculated. Here, it is necessary to obtain the number of inputs, N. For this, determination is made to see if the sub-status of each input is "Not Connected." Note that the main inputs may be accepted if IN or IN_LO is not in "Not Connected" sub-status. In this case, the number of inputs that are not in "Not Connected" sub-status is regarded as "N."

A3.4 Output Section

After executing the computing equation, the block applies a gain to the calculated result and then adds a bias to it.

It then substitutes the result into PRE_OUT and if the mode is in AUTO, the value of PRE_OUT is taken as OUT.

PRE_OUT = func × gain + bias

where func: result of computing equation execution

OUT = PRE_OUT (when the mode is in AUTO)

Next, the block performs limitation processing (OUT_HI_LIM, OUT_LOW_LIM). This processing is described as follows with respect to the value of PRE_OUT.

If PRE_OUT > OUT_HI_LIM:

PRE_OUT = OUT_HI_LIM

The "high limited" processing is applied to the status of PRE_OUT.

If PRE_OUT < OUT_LO_LIM:

PRE_OUT = OUT_LO_LIM

The "low limited" processing is applied to the status of PRE_OUT.

A3.4.1 Mode Handling

Mode	Output
Auto	OUT = PRE_OUT
MAN	For OUT, the OUT value in the Auto mode just before change to MAN or O/S is retained.
O/S	

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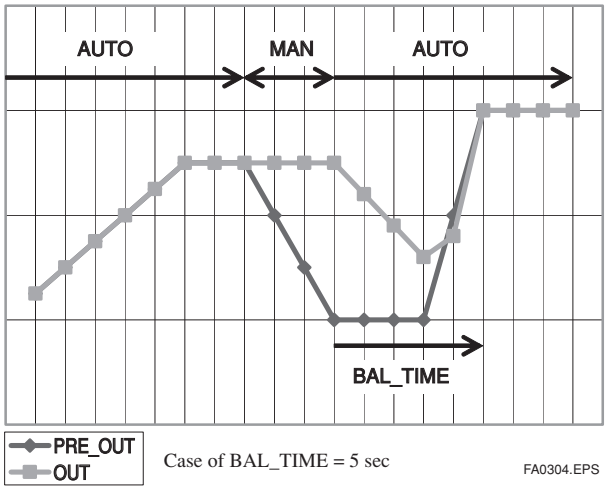
In the Manual mode (including O/S), the value of OUT in the Auto mode just before a change to the Manual mode is held or the value written to OUT is output.

If the mode is switched from Manual to Auto, the value of OUT that is linearly changed with respect to the value of PRE_OUT for time set by BAL_TIME is output. The PRE_OUT always indicates the results of calculation. After elapse of BAL_TIME, OUT = PRE_OUT is established. Note that if the value of BAL_TIME is changed during linear change of the OUT value, it is not reflected. The value of BAL_TIME will be reflected only after the mode is changed the next time.



Case of BAL_TIME = 5 sec

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The value of OUT is represented by the following equation.

$$y_n = y_{n-1} + (x_n - y_{n-1}) / (\alpha - n)$$

$$\alpha = (T / tc) + 1$$

*: The value of T/tc truncates digits to the right of the decimal point.

where y: OUT

x: PRE_OUT

tc: period of execution

T: BAL_TIME

n: period

A3.4.2 Status Handling

The setting of INPUT_OPTS is applied to the input status. When INPUT_OPTS is applied, there are cases where the PV status becomes “good” even if the status of main inputs is “uncertain” or the status of auxiliary inputs is “uncertain” or “bad.”

The PV status is classified by the following:

· If the statuses of two main inputs are both “good” or anything other than “good”:

See A3.2.1, Main Inputs.

· If only one of the statuses of two main inputs is “good”:

· If the status of IN is “good” and that of “IN_LO” is anything other than “good”

IN > RANGE_LO → The status of IN applies.

IN ≦ RANGE_LO → See A3.2.1, Main Inputs

· If the status of IN is anything other than “good” and that of “IN_LO” is “good”

IN_LO < RANGE_H → The status of IN_LO applies.

IN_LO ≧ RANGE_HI → See A3.2.1, Main Inputs

The exception is that if RANGE_LO > RANGE_HI, the PV status is made “Bad. Configuration Error.”

The input status irrelevant to the computing equation selected by ARITH_TYPE will be ignored and does not affect other statuses. The statuses of outputs (OUT.Status and PRE_OUT.Status) are interpreted as the status of the worst input among the statuses of PV and auxiliary inputs (IN_1, IN_2, and IN_3) to which INPUT_OPTS has been applied.

Example:

		Case 1	Case 2	Case 3
PV		Good		
IN_1		Uncertain		
IN_2		Bad		
IN_3		Bad		
INPUT_OPTS	IN_1	Handled as a “good” input if its status is “uncertain.”	No option	
	IN_2	Handled as a “good” input if its status is “bad.”		No option
	IN_3	No option		
ARITH_TYPE		1) Flow compensation (linear) in A3.3.1, “Computing Equations”		
OUT.Status		Good	Uncertain	Bad

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A3.5 List of the Arithmetic Block Parameters

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View 1	View 2	View 3	View 4	Description / Remarks
0	BLOCK_HEADER	O/S		TAG="AR"					Information relating to this function block, such as block tag, DD revision, and execution time
1	ST_REV			0	2	2	2	2	Indicates the revision level of the set parameters associated with the Arithmetic block. If a setting is modified, this revision is updated. It is used to check for parameter changes, etc.
2	TAG_DESC			Null					A universal parameter that stores comments describing tag information
3	STRATEGY			1				2	A universal parameter intended for use by a high-level system to identify function blocks
4	ALERT_KEY		1-255	1				1	Key information used to identify the location at which an alert has occurred. Generally, this parameter is used by a high-level system to identify specific areas in a plant that are under the control of specific operators, to separate necessary alerts only. This is one of the universal parameters.
5	MODE_BLK			AUTO	4		4		A universal parameter representing the operation status of the Arithmetic block. It consists of the Actual, Target, Permit, and Normal modes.
6	BLOCK_ERR			0	2		2		Indicates the error status relating to the Arithmetic block. The bit used by this function block is as follows: Bit 1: Block Configuration Error Bit 15: O/S mode
7	PV			0	5		5		The result of a range extension function is substituted into this. When viewed from the computing equation, PV is the main input.
8	OUT	MAN		0	5		5		Block output
9	PRE_OUT			0	5		5		Always indicates the calculation result. The value is substituted into OUT in Auto mode.
10	PV_SCALE	O/S				11			Indicates PV scaling (for making a memo).
11	OUT_RANGE					11			Output scaling for the host (for making a memo)
12	GRANT_DENY			0		2			The parameter used to check if various operations have been executed. The bits in the GRANT parameter corresponding to various operations are set before any of them are executed. After the operations are complete, the DENY parameter is checked to find out if any bit corresponding to the relevant operation has been set. If no bit has been set, it is evident that the operations have been executed successfully.
13	INPUT_OPTS			0				2	Determines whether an input is used as a "good" input when the input status is "bad" or "uncertain." Bit 0: Handles IN as "good" input if its status is "uncertain." Bit 1: Handles IN_LO as "good" input if its status is "uncertain." Bit 2: Handles IN_1 as "good" input if its status is "uncertain." Bit 3: Handles IN_1 as "good" input if its status is "bad." Bit 4: Handles IN_2 as "good" input if its status is "uncertain." Bit 5: Handles IN_2 as "good" input if its status is "bad." Bit 6: Handles IN_3 as "good" input if its status is "uncertain." Bit 7: Handles IN_3 as "good" input if its status is "bad." Bit 8 to 15: Reserved
14	IN			0			5		Input block
15	IN_LO			0			5		Input for a low-range transmitter. This is used for the range extension function.
16	IN_1			0			5		Auxiliary input 1
17	IN_2			0			5		Auxiliary input 2
18	IN_3			0			5		Auxiliary input 3
19	RANGE_HI			0				4	High limit for switching to a high-range transmitter by the range extension function.
20	RANGE_LO			0				4	Low limit for switching to a low-range transmitter by the range extension function.
21	BIAS_IN_1			0				4	IN_1 bias
22	GAIN_IN_1			0				4	IN_1 gain
23	BIAS_IN_2			0				4	IN_2 bias
24	GAIN_IN_2			0				4	IN_2 gain
25	BIAS_IN_3			0				4	IN_3 bias
26	GAIN_IN_3			0				4	IN_3 gain
27	COMP_HI_LIM			+INF				4	High limit of compensation factor f
28	COMP_LO_LIM			-INF				4	Low limit of compensation factor f

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<table>
<tr><th rowspan="2">Relative Index</th><th rowspan="2">Parameter</th><th rowspan="2">Write Mode</th><th rowspan="2">Valid Range</th><th rowspan="2">Initial Value</th><th colspan="4">View</th><th rowspan="2">Description / Remarks</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>29</td><td>ARITH_TYPE</td><td></td><td>1 to 10</td><td>0x01</td><td></td><td></td><td></td><td>1</td><td>Computation algorithm identification no.
<table>
<tr><th>Value</th><th>Selection Name</th><th>Description</th></tr>
<tr><td>1</td><td>Flow compensation, linear</td><td>Flow compensation (linear)</td></tr>
<tr><td>2</td><td>Flow compensation, square root</td><td>Flow compensation (square root)</td></tr>
<tr><td>3</td><td>Flow compensation, approximate</td><td>Flow compensation (approximate expression)</td></tr>
<tr><td>4</td><td>BTU flow (*)</td><td>Quantity of heat calculation</td></tr>
<tr><td>5</td><td>Traditional Multiply Divide</td><td>Multiplication and division</td></tr>
<tr><td>6</td><td>Average</td><td>Average calculation</td></tr>
<tr><td>7</td><td>Traditional summer</td><td>Summation</td></tr>
<tr><td>8</td><td>Fourth order Polynomial, Type 1</td><td>4th-order (auxiliary input) polynomial computation</td></tr>
<tr><td>9</td><td>HTG level compensation (*)</td><td>HTG-level compensation</td></tr>
<tr><td>10</td><td>Fourth order Polynomial, Type 2</td><td>4th-order (main input) polynomial computation</td></tr>
</table>
* BTU stands for British thermal unit.
HTG stands for hydrostatic tank gauging.</td></tr>
<tr><td>30</td><td>BAL_TIME</td><td></td><td>More than 0</td><td>0</td><td></td><td></td><td></td><td>4</td><td>Time taken to return to the set value</td></tr>
<tr><td>31</td><td>BIAS</td><td></td><td></td><td>0</td><td></td><td></td><td></td><td>4</td><td>Bias value used to calculate the output</td></tr>
<tr><td>32</td><td>GAIN</td><td></td><td></td><td>1</td><td></td><td></td><td></td><td>4</td><td>Gain value used to calculate the output</td></tr>
<tr><td>33</td><td>OUT_HI_LIM</td><td></td><td></td><td>+INF</td><td></td><td></td><td></td><td>4</td><td>Maximum output value</td></tr>
<tr><td>34</td><td>OUT_LO_LIM</td><td></td><td></td><td>-INF</td><td></td><td></td><td></td><td>4</td><td>Minimum output value</td></tr>
<tr><td>35</td><td>UPDATE_EVT</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Indicates event information if an update event (setting change) occurs.</td></tr>
<tr><td>36</td><td>BLOCK_ALM</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Indicates alarm information if a block alarm occurs.</td></tr>
</table>

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APPENDIX 4. LINK MASTER FUNCTIONS

A4.1 Link Active Scheduler

A link active scheduler (LAS) is a deterministic, centralized bus scheduler that can control communications on an H1 fieldbus segment. There is only one LAS on an H1 fieldbus segment.

An AXF supports the following LAS functions.

- PN transmission: Identifies a fieldbus device newly connected to the same fieldbus segment. PN is short for Probe Node.
- PT transmission: Passes a token governing the right to transmit, to a fieldbus device on the same segment. PT is short for Pass Token.
- CD transmission: Carry out a scheduled transmission to a fieldbus device on the same segment. CD is short for Compel Data.
- Time synchronization: Periodically transmits the time data to all fieldbus devices on the segment and returns the time data in response to a request from a device.
- Live list equalization: Sends the live list data to link masters on the same segment.
- LAS transfer: Transfers the right to be the LAS on the segment to another link master.

A4.2 Link Master

A link master (LM) is any device containing a link active scheduler. There must be at least one LM on a segment. When the LAS on a segment has failed, another LM on the same segment starts working as the LAS.

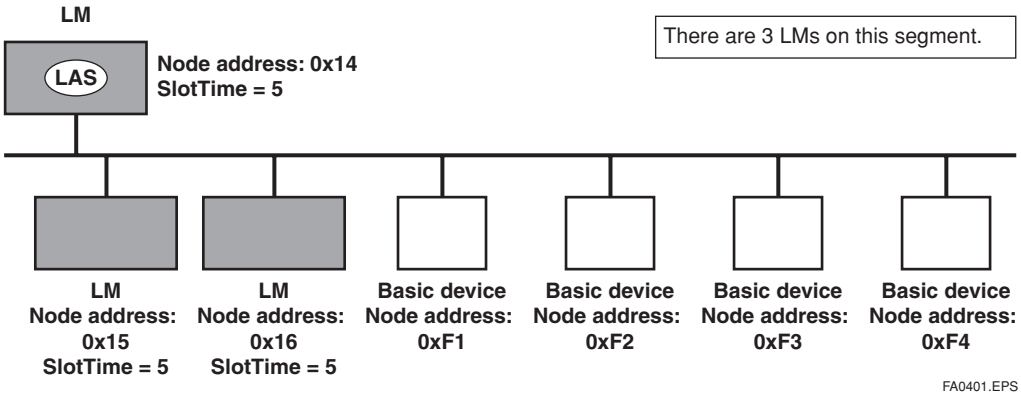

Figure A4.1 Example of Fieldbus configuration-3 LMs on Same Segment

A4.3 Transfer of LAS

There are two procedures for an LM to become the LAS:

- If the LM whose value of [V(ST)×V(TN)] is the smallest on a segment, with the exception of the current LAS, judges that there is no LAS on the segment, in such a case as when the segment has started up or when the current LAS has failed, the LM declares itself as the LAS, then becomes the LAS. (With this procedure, an LM backs up the LAS as shown in the following figure.)
- The LM whose value of [V(ST)×V(TN)] is the smallest on a segment, with the exception of the current LAS, requests the LAS on the same segment to transfer the right of being the LAS, then becomes the LAS.

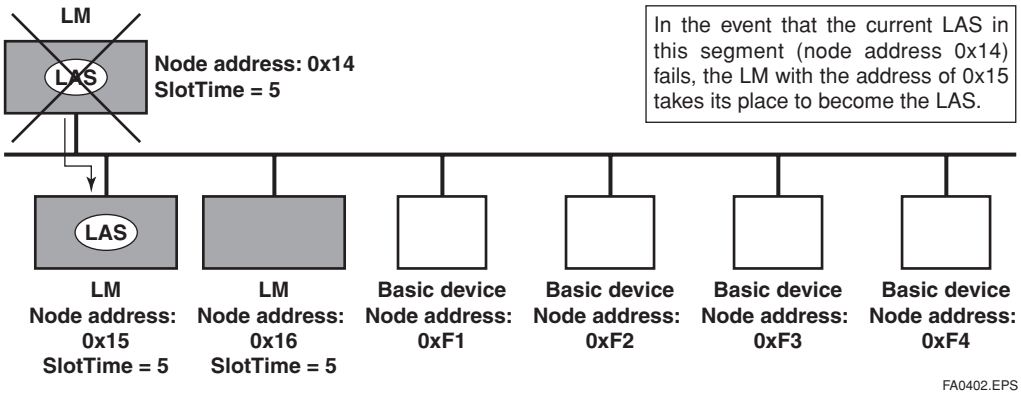

Figure A4.2 Backup of LAS

To set up an AXF as a device that is capable of backing up the LAS, follow the procedure below.

NOTE: When changing the settings in an AXF, add the AXF to the segment in which an LAS is running. After making changes to the settings, do not turn off the power to the AXF for at least 30 seconds.

(1) Set the node address of the AXF. In general, use an address from 0x10 to [V(FUN) - 1].

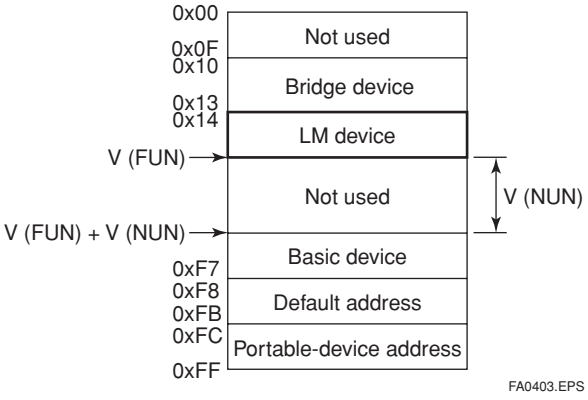

Figure A4.3 Node Address Ranges

(2) In the LAS settings of the AXF, set the values of V(ST), V(MRD), and V(MID) to the same as the respective lowest capability values in all the devices within the segment. An example is shown below.

DlmeBasicInfo (AXF Index 361 (SM))

Sub-index	Element	AXF	Device 1	Device 2	Device 3	Description
1	SlotTime	4	8	10	20	Capability value for V(ST)
3	MaxResponse Delay	3	6	3	5	Capability value for V(MRD)
6	MinInterPdu Delay	4	8	12	10	Capability value for V(MID)

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In this case, set SlotTime, MaxResponseTime, and MinInterPduDelay as follows:

ConfiguredLinkSettingsRecord (AXF Index 369 (SM))

Subindex	Element	Setting (Default)	Description
1	SlotTime	20(4095)	V (ST)
3	MaxResponseDelay	6(5)	V (MRD)
6	MinInterPduDelay	12(12)	V (MID)

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(3) In the LAS settings of the AXF, set the values of V(FUN) and V(NUN) so that they include the node addresses of all nodes within the same segment. (See also Figure 3.)

ConfiguredLinkSettingsRecord (AXF Index 369 (SM))

Subindex	Element	Default Value	Description
4	FirstUnpolledNodeId	0x25	V (FUN)
7	NumConsecUnpolledNodeId	0xBA	V (NUN)

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A4.4 LM Functions

No.	Function	Description
1	LM initialization	When a fieldbus segment starts, the LM with the smallest [V(ST) × V(TN)] value within the segment becomes the LAS. At all times, each LM is checking whether or not a carrier is on the segment.
2	Startup of other nodes (PN and Node Activation SPDU transmissions)	Transmits a PN (Probe Node) message, and Node Activation SPDU message to devices which return a new PR (Probe Response) message.
3	PT transmission (including final bit monitoring)	Passes a PT (Pass Token) message to devices included in the live list sequentially, and monitors the RT (Return Token) and final bit returned in reply to the PT.
4	CD transmission	Transmits a CD (Compel Data) message at the scheduled times.
5	Time synchronization	Supports periodic TD (Time Distribution) transmissions and transmissions of a reply to a CT (Compel Time).
6	Domain download server	Sets the schedule data. The schedule data can be equalized only when the Domain Download command is carried out from outside the LM in question. (The version of the schedule is usually monitored, but no action takes place, even when it changes.)
7	Live list equalization	Transmits SPDU messages to LMs to equalize live lists.
8	LAS transfer	Transfers the right of being the LAS to another LM.
9	Reading/writing of NMIB for LM	See Section A4.5.
10	Round Trip Delay Reply (RR) Reply to DLPDU	Not yet supported in the current version.
11	Long address	Not yet supported in the current version.

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A4.5 LM Parameters

A4.5.1 LM Parameter List

The tables below show LM parameters.

Meanings of **Access** column entries: RW = read/write possible; R = read only

Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
362	DLME_LINK_MASTER_CAPABILITIES_VARIABLE		0x04	RW	
363	DLME_LINK_MASTER_INFO_RECORD	0		RW	
		1 MaxSchedulingOverhead	0		
		2 DefMinTokenDelegTime	100		
		3 DefTokenHoldTime	300		
		4 TargetTokenRotTime	4096		
		5 LinkMaintTokHoldTime	400		
		6 TimeDistributionPeriod	5000		
		7 MaximumInactivityToClaimLasDelay	2		
		8 LasDatabaseStatusSpduDistributionPeriod	6000		
364	PRIMARY_LINK_MASTER_FLAG_VARIABLE		0	RW	LAS: True = 0xFF; non-LAS: False = 0x00
365	LIVE_LIST_STATUS_ARRAY_VARIABLE		0	R	
366	MAX_TOKEN_HOLD_TIME_ARRAY	0		RW	
		1 Element1	0		
		2 Element2	0		
		3 Element3	0		
		4 Element4	0		
		5 Element5	0		
		6 Element6	0		
		7 Element7	0		
		8 Element8	0		
367	BOOT_OPERAT_FUNCTIONAL_CLASS		Specified at the time of order	RW	0x01 (basic device); 0x02 (LM)
368	CURRENT_LINK_SETTING_RECORD	0		R	Settings for LAS
		1 SlotTime	0		
		2 PerDlpduPhlOverhead	0		
		3 MaxResponseDelay	0		
		4 FirstUnpolledNodeId	0		
		5 ThisLink	0		
		6 MinInterPduDelay	0		
		7 NumConseeUnpolledNodeId	0		
		8 PreambleExtension	0		
		9 PostTransGapExtension	0		
		10 MaxInterChanSignalSkew	0		
		11 TimeSyncClass	0		
369	CONFIGURED_LINK_SETTING_RECORD	0		RW	
		1 SlotTime	4095		
		2 PerDlpduPhlOverhead	4		
		3 MaxResponseDelay	5		
		4 FirstUnpolledNodeId	37		
		5 ThisLink	0		
		6 MinInterPduDelay	12		
		7 NumConseeUnpolledNodeId	186		
		8 PreambleExtension	2		
		9 PostTransGapExtension	1		
		10 MaxInterChanSignalSkew	0		
		11 TimeSyncClass	4		

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Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
370	PLME_BASIC_ CHARACTERISTICS	0		R	
		1 ChannelStatisticsSupported	0x00		
		2 MediumAndDataRatesSupported	0x4900000000000000		
		3 IecVersion	1 (0x1)		
		4 NumOfChannels	1 (0x1)		
		5 PowerMode	0 (0x0)		
371	CHANNEL_STATES	0		R	
		1 channel-1	0 (0x0)		
		2 channel-2	128 (0x80)		
		3 channel-3	128 (0x80)		
		4 channel-4	128 (0x80)		
		5 channel-5	128 (0x80)		
		6 channel-6	128 (0x80)		
		7 channel-7	128 (0x80)		
		8 channel-8	128 (0x80)		
372	PLME_BASIC_INFO	0		R	
		1 InterfaceMode	0 (0x0)		
		2 LoopBackMode	0 (0x0)		
		3 XmitEnabled	1 (0x1)		
		4 RcvEnabled	1 (0x1)		
		5 PreferredReceiveChannel	1 (0x1)		
		6 MediaTypeSelected	73 (0x49)		
		7 ReceiveSelect	1 (0x1)		
373	LINK_SCHEDULE_ACTIVATION_VARIABLE		0 (0x0)	RW	
374	LINK_SCHEDULE_LIST_ CHARACTERISTICS_ RECORD	0		R	
		1 NumOfSchedules	0		
		2 NumOfSubSchedulesPerSchedule	1		
		3 ActiveScheduleVersion	0		
		4 ActiveSheduleOdIndex	0		
		5 ActiveScheduleStartingTime	0		
375	DLME_SCHEDULE_ DESCRIPTOR.1	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
376	DLME_SCHEDULE_ DESCRIPTOR.2	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
377	DOMAIN.1				Read/write impossible. Get-OD possible.
378	DOMAIN.2				Read/write impossible. Get-OD possible.

TA0405-2.EPS

A4.5.2 Descriptions for LM Parameters

The following describes LM parameters of an AXF transmitter.

NOTE: Do not turn off the power to the AXF for 60 seconds after making a change to its parameter settings.

(1)DlmeLinkMasterCapabilitiesVariable

Bit Position	Meaning	Description	Value
B3: 0x04	LAS Schedule in Non-volatile Memory	Whether the LAS schedule can (= 1) or cannot (= 0) be saved to the non-volatile memory	1
B2: 0x02	Last Values Record Supported	Whether to support (= 1) or not to support (= 0) LastValuesRecord.	0
B1: 0x01	Link Master Statistics Record Supported	Whether to support (= 1) or not to support (= 0) DlmeLinkMasterStatisticsRecord.	0

TA0406.EPS

(2)DlmeLinkMasterInfoRecord

Sub-index	Element	Size [bytes]	Descrip-tion
1	MaxSchedulingOverhead	1	V(MSO)
2	DefMinTokenDelegTime	2	V(DMDT)
3	DefTokenHoldTime	2	V(DTHT)
4	TargetTokenRotTime	2	V(TTRT)
5	LinkMaintTokHoldTime	2	V(LTHT)
6	TimeDistributionPeriod	4	V(TDP)
7	MaximumInactivityToClaimLasDelay	2	V(MICD)
8	LasDatabaseStatusSpduDistributionPeriod	2	V(LDDP)

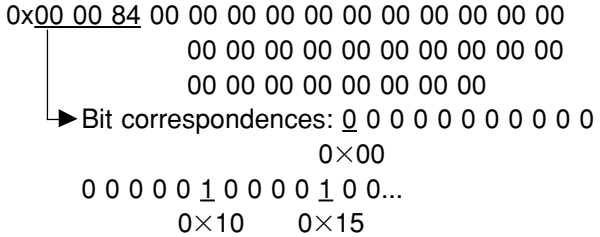
TA0407.EPS

(3)PrimaryLinkMasterFlagVariable

Explicitly declares the LAS. Writing “true” (0xFF) to this parameter in a device causes that device to attempt to become the LAS. However, a request of writing “true” to this parameter in a device is rejected if the value of the same parameter in any other device that has a smaller node address within the same segment is true.

(4)LiveListStatusArrayVariable

A 32-byte variable, in which each bit represents the status of whether a device on the same segment is live or not. The leading bit corresponds to the device address 0x00, and final bit to 0xFF. The value of LiveListStatusArrayVariable in the case where devices having the addresses 0x10 and 0x15 in the fieldbus segment is shown below.



(5)MaxTokenHoldTimeArray

An 8(64 byte array variable, in which each set of 2 bytes represents the delegation time (set as an octet time) assigned to a device. The delegation time denotes a time period that is given to a device by means of a PT message sent from the LAS within each token circulation cycle.

The leading 2 bytes correspond to the device address 0x00, and the final 2 bytes to the device address 0xFF. Specify the subindex to access this parameter.

(6)BootOperatFunctionalClass

Writing 1 to this parameter in a device and restarting the device causes the device to start as a basic device. On the contrary, writing 2 to this parameter and restarting the device causes the device to start as an LM.

(7)CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord

CurrentLinkSettingRecord indicates the bus parameter settings currently used. ConfiguredLinkSettingsRecord indicates the bus parameter settings to be used when the device becomes the LAS. Thus, when a device is the LAS, its CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord have the same values.

Sub-index	Element	Size [bytes]	Descrip-tion
1	SlotTime	2	V(ST)
2	PerDlpduPhlOverhead	1	V(PhLO)
3	MaxResponseDelay	1	V(MRD)
4	FirstUnpolledNodeId	1	V(FUN)
5	ThisLink	2	V(TL)
6	MinInterPduDelay	1	V(MID)
7	NumConsecUnpolledNodeId	1	V(NUN)
8	PreambleExtension	1	V(PhPE)
9	PostTransGapExtension	1	V(PhGE)
10	MaxInterChanSignalSkew	1	V(PhIS)
11	TimeSyncClass	1	V(TSC)

TA0408.EPS

(8)DlmeBasicInfo

Sub-index	Element	Size [bytes]	Description
1	SlotTime	2	Indicates the capability value for V(ST) of the device.
2	PerDlpduPhlOverhead	1	V(PhLO)
3	MaxResponseDelay	1	Indicates the capability value for V(MRD) of the device.
4	ThisNode	1	V(TN), node address
5	ThisLink	2	V(TL), link-id
6	MinInterPduDelay	1	Indicates the capability value for V(MID) of the device.
7	TimeSyncClass	1	Indicates the capability value for V(TSC) of the device.
8	PreambleExtension	1	V(PhPE)
9	PostTransGapExtension	1	V(PhGE)
10	MaxInterChanSignalSkew	1	V(PhIS)

TA0409.EPS

(9)PlmeBasicCharacteristics

Sub-index	Element	Size [bytes]	Value	Description
1	Channel Statistics Supported	1	0	Statistics data are not supported.
2	Medium AndData Rates Supported	8	0x4900000000000000	Wire medium, voltage mode, and 31.25 kbps are supported.
3	IceVersion	2	0x0403	IEC 4.3 is supported.
4	NumOf Channels	1	1	
5	Power Mode	1	0	0: Bus-powered; 1: Self-powered

TA0410.EPS

(10)ChannelStates

Sub-index	Element	Size [bytes]	Value	Description
1	Channel 1	1	0x00	In Use, No Bad since last read, No Silent since last read, No Jabber since last read, Tx Good, Rx Good
2	Channel 2	1	0x80	Unused
3	Channel 3	1	0x80	Unused
4	Channel 4	1	0x80	Unused
5	Channel 5	1	0x80	Unused
6	Channel 6	1	0x80	Unused
7	Channel 7	1	0x80	Unused
8	Channel 8	1	0x80	Unused

TA0411.EPS

(11)PlmeBasicInfo

Sub-index	Element	Size [bytes]	Value	Description
1	InterfaceMode	1	0	0: Half duplex; 1: Full duplex
2	LoopBackMode	1	0	0: Disabled; 1: MAU; 2: MDS
3	XmitEnabled	1	0x01	Channel 1 is enabled.
4	RcvEnebled	1	0x01	Channel 1 is enabled.
5	PreferredReceive Channel	1	0x01	Channel 1 is used for reception.
6	MediaType Selected	1	0x49	Wire medium, voltage mode, and 31.25 kbps are selected.
7	ReceiveSelect	1	0x01	Channel 1 is used for reception.

TA0412.EPS

(12)LinkScheduleActivationVariable

Writing the version number of an LAS schedule, which has already been downloaded to the domain, to this parameter causes the corresponding schedule to be executed. On the other hand, writing 0 to this parameter stops execution of the active schedule.

(13)LinkScheduleListCharacteristicsRecord

Sub-index	Element	Size [bytes]	Description
1	NumOf Schedules	1	Indicates the total number of LAS schedules that have been downloaded to the domain.
2	NumOfSub SchedulesPer Schedule	1	Indicates the maximum number of sub-schedules an LAS schedule can contain. (This is fixed to 1 in the Yokogawa communication stacks.)
3	ActiveSchedule Version	2	Indicates the version number of the schedule currently executed.
4	ActiveSchedule OdIndex	2	Indicates the index number of the domain that stores the schedule currently executed.
5	ActiveSchedule StaringTime	6	Indicates the time when the current schedule began being executed.

TA0413.EPS

(14)DlmeScheduleDescriptor

This parameter exists for the same number as the total number of domains, and each describes the LAS schedule downloaded to the corresponding domain. For the domain to which a schedule has not yet been downloaded, the values in this parameter are all zeros.

Sub-index	Element	Size [bytes]	Description
1	Version	2	Indicates the version number of the LAS schedule downloaded to the corresponding domain.
2	Macrocycle Duration	4	Indicates the macro cycle of the LAS schedule downloaded to the corresponding domain.
3	TimeResolution	2	Indicates the time resolution that is required to execute the LAS schedule downloaded to the corresponding domain.

TA0414.EPS

(15)Domain

Read/write: impossible; get-OD: possible

Carrying out the GenericDomainDownload command from a host writes an LAS schedule to Domain.

CAUTION

When downloading a LAS schedule to AXF, maximum allowable linkages between devices are 18.

A4.6 FAQs

Q1. When the LAS stops, an AXF does not back it up by becoming the LAS. Why?

A1-1. Is that AXF running as an LM? Check that the value of BootOperatFunctionalClass (index 367) is 2 (indicating that it is an LM).

A1-2. Check the values of V(ST) and V(TN) in all LMs on the segment and confirm that the following condition is met:

AXF		Other LMs
V(ST)×V(TN)	<	V(ST)×V(TN)

Q2. How can I make an AXF become the LAS?

A2-1. Check that the version numbers of the active schedules in the current LAS and the AXF are the same by reading:

LinkScheduleListCharacteristicsRecord (index 374 for an AXF)

- ActiveScheduleVersion (subindex 3)

A2-2. Make the AXF declare itself as and become the LAS by writing:

- 0x00 (false) to PrimaryLinkMasterFlagVariable in the current LAS; and
- 0xFF (true) to PrimaryLinkMasterFlagVariable (index 364) in the AXF.

Q3. On a segment where an AXF works as the LAS, another device cannot be connected. How come?

A3-1. Check the following bus parameters that indicate the bus parameter as being the LAS for the AXF and the capabilities of being the LAS for the device that cannot be connected:

- V(ST), V(MID), V(MRD) of AXF: ConfiguredLinkSettingsRecord (index 369)
- V(ST), V(MID), V(MRD) of problematic device: DlmeBasicInfo

Then, confirm that the following conditions are met:

AXF		Problematic Device
V(ST)	>	V(ST)
V(MID)	>	V(MID)
V(MRD)	>	V(MRD)

A3-2. Check the node address of the problematic device is not included in the V(FUN)+V(NUN) of the AXF.

APPENDIX 5. PID BLOCK

A PID block performs the PID control computation based on the deviation of the measured value (PV) from the setpoint (SV), and is generally used for constant-setpoint and cascaded-setpoint control.

A5.1 Function Diagram

The figure below depicts the function diagram of a PID block.

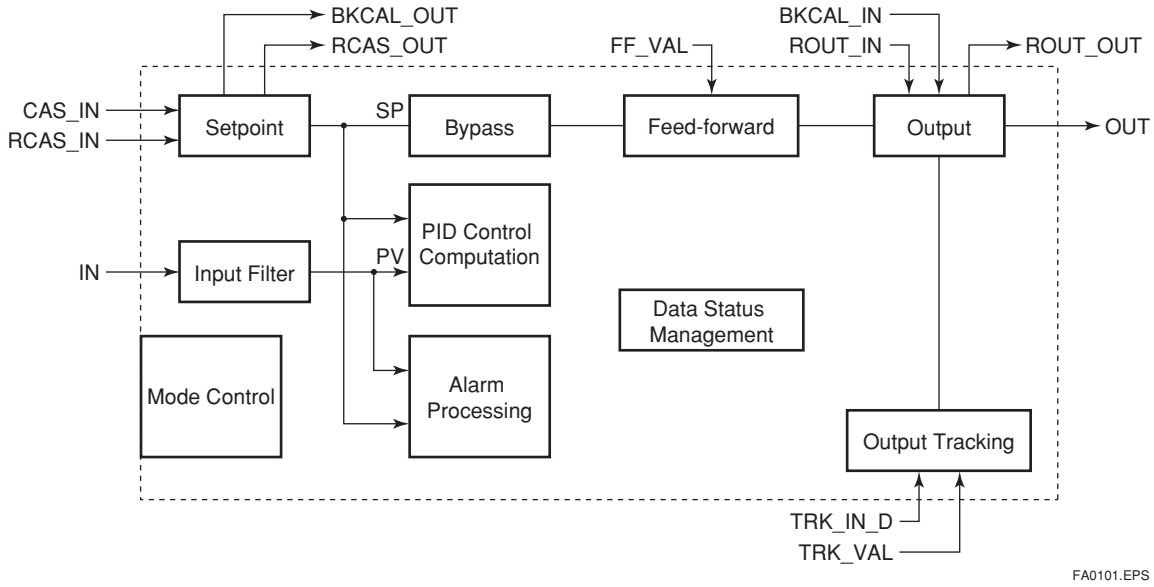


Figure A5.1 PID Block

A5.2 Functions of PID Block

The table below shows the functions provided in a PID block.

Function	Description
PID control computation	Computes the control output in accordance with the PID control algorithm.
Control output	Converts the change in control output ΔMV to the manipulated value MV that is to be actually output.
Switching of direction of control action	Switches over the direction of control action between direct and reverse, i.e., the direction of changes in the control output depending on the changes in the deviation.
Control action bypass	When the bypass is on, the value of the SP is scaled to the range of the OUT and output as the OUT.
Feed-forward	Adds the value of the FF_VAL (input to the PID block) to the output from the PID computation.
Measured-value tracking	Equalizes the setpoint SP to the measured value PV.
Setpoint limiters	Limit the value of setpoint SP within the preset upper and lower levels as well as limit the rate of change when the PID block is in Auto mode.
External-output tracking	Performs the scaling of the value of TRK_VAL to the range of the OUT and outputs it as the OUT.
Mode change	Changes the block mode between 8 modes: O/S, IMan, LO, Man, Auto, Cas, RCas, ROut.
Bumpless transfer	Prevents a sudden change in the control output OUT at changes in block mode and at switching of the connection from the control output OUT to the cascaded secondary function block.
Initialization and manual fallback	Changes the block mode to IMan and suspends the control action when the specified condition is met.
Manual fallback	Changes the block mode to Man and aborts the control action.
Auto fallback	Changes the block mode to Auto when it is Cas, and continues the control action with the setpoint set by the operator.
Mode shedding upon computer failure	Changes the block mode in accordance with the SHED_OPT setting upon a computer failure.
Alarm processing	Generates block alarms and process alarms, and performs event updates.

TA0101.EPS

A5.3 Parameters of PID Block

NOTE: In the table below, the Write column shows the modes in which the respective parameters can be written. A blank in the Write column indicates that the corresponding parameter can be written in all modes of the PID block. A dash (-) indicates that the corresponding parameter cannot be written in any mode.

Index	Parameter Name	Default (factory setting)	Write	Valid Range	Description
0	Block Header	TAG: "PID"	Block Tag = O/S		Same as that for an AI block.
1	ST_REV		—		Same as that for an AI block.
2	TAG_DESC	Null			Same as that for an AI block.
3	STRATEGY	1			Same as that for an AI block.
4	ALERT_KEY	1		1 to 255	Same as that for an AI block.
5	MODE_BLK				
6	BLOCK_ERR		—		Same as that for an AI block.
7	PV		—		Measured value; the non-dimensional value that is converted from the input (IN) value based on the PV_SCALE values and filtered.
8	SP	0	AUTO	PV_SCALE ±10%	Setpoint
9	OUT		MAN		Output
10	PV_SCALE	100 0 1133 1	O/S		Upper and lower scale limit values used for scaling of the input (IN) value.
11	OUT_SCALE	100 0 1342 1	O/S		Upper and lower scale limit values used for scaling of the control output (OUT) value to the values in the engineering unit.
12	GRANT_DENY	0	AUTO		Same as that for an AI block.
13	CONTROL_OPTS	0	O/S		Setting for control action. See Section A5.13 for details.
14	STATUS_OPTS	0	O/S		See Section A5.15 for details.
15	IN	0			Controlled-value input
16	PV_FTIME	2	AUTO	Non-negative	Time constant (in seconds) of the first-order lag filter applied to IN
17	BYPASS	1 (off)	MAN	1, 2	Whether to bypass the control computation. 1 (off): Do not bypass. 2 (on): Bypass.
18	CAS_IN	0			Cascade setpoint
19	SP_RATE_DN	+INF		Positive	Rate-of-decrease limit for setpoint (SP)
20	SP_RATE_UP	-INF		Positive	Rate-of-increase limit for setpoint (SP)
21	SP_HI_LIM	100		PV_SCALE ±10%	Upper limit for setpoint (SP)
22	SP_LO_LIM	0		PV_SCALE ±10%	Lower limit for setpoint (SP)
23	GAIN	1			Proportional gain (= 100 / proportional band)
24	RESET	10			Integration time (seconds)
25	BAL_TIME	0		Positive	Unused
26	RATE	0		Positive	Derivative time (seconds)
27	BKCAL_IN	0			Read-back of control output
28	OUT_HI_LIM	100		OUT_SCALE ±10%	Upper limit for control output (OUT)
29	OUT_LO_LIM	0		OUT_SCALE ±10%	Lower limit for control output (OUT)
30	BKCAL_HYS	0.5 (%)		0 to 50%	Hysteresis for release from a limit for OUT.status
31	BKCAL_OUT	0	—		Read-back value to be sent to the BKCAL_IN in the upper block
32	RCAS_IN	0			Remote setpoint set from a computer, etc.
33	ROUT_IN	0			Remote control output value set from a computer, etc.

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Index	Parameter Name	Default (factory setting)	Write	Valid Range	Description
34	SHED_OPT	0			Action to be performed in the event of mode shedding. SHED_OPT defines the changes to be made to MODE.BLK.target and MODE.BLK.actual when the value of RCAS_IN.status or ROUT_IN.status becomes Bad if .MODE_BLK.actual = RCas or ROut. See Section A5.17.1 for details.
35	RCAS_OUT	0	—		Remote setpoint sent to a computer, etc.
36	ROUT_OUT	0	—		Remote control output value
37	TRK_SCALE	100 0 1342 1	MAN		Upper and lower scale limits used to convert the output tracking value (TRK_VAL) to non-dimensional.
38	TRK_IN_D	0			Switch for output tracking. See Section A5.12 for details.
39	TRK_VAL	0			Output tracking value (TRK_VAL) When MODE_BLK.actual = LO, the value scaled from the TRK_VAL value is set in OUT.
40	FF_VAL	0			Feedforward input value. The FF_VAL value is scaled to a value with the same scale as for OUT, multiplied by the FF_GAIN value, and then added to the output of the PID computation.
41	FF_SCALE	100 0 1342 1	MAN		Scale limits used for converting the FF_VAL value to a non-dimensional value.
42	FF_GAIN	0	MAN		Gain for FF_VAL
43	UPDATE_EVT		—		Same as that for an AI block.
44	BLOCK_ALM		—		Same as that for an AI block.
45	ALARM_SUM	Enable			Same as that for an AI block.
46	ACK_OPTION	0xFFFF			Same as that for an AI block.
47	ALARM_HYS	0.5%		0 to 50%	Hysteresis for alarm detection and resetting to prevent each alarm from occurring and recovering repeatedly within a short time.
48	HI_HI_PRI	0		0 to 15	Priority order of HI_HI_ALM alarm
49	HI_HI_LIM	+INF		PV_SCALE	Setting for HI_HI_ALM alarm
50	HI_PRI	0		0 to 15	Priority order of HI_ALM alarm
51	HI_LIM	+INF		PV_SCALE	Setting for HI_ALM alarm
52	LO_PRI	0		0 to 15	Priority order of LO_ALM alarm
53	LO_LIM	-INF		PV_SCALE	Setting for LO_ALM alarm
54	LO_LO_PRI	0		0 to 15	Priority order of LO_LO_ALM alarm
55	LO_LO_LIM	-INF		PV_SCALE	Setting for LO_LO_ALM alarm
56	DV_HI_PRI	0		0 to 15	Priority order of DV_HI_ALM alarm
57	DV_HI_LIM	+INF			Setting for DV_HI_ALM alarm
58	DV_LO_PRI	0		0 to 15	Priority order of DV_LO_ALM alarm
59	DV_LO_LIM	-INF			Setting for DV_LO_ALM alarm
60	HI_HI_ALM	—	—		Alarm that is generated when the PV value has exceeded the HI_HI_LIM value and whose priority order* is defined in HI_HI_PRI. * Priority order: Only one alarm is generated at a time. When two or more alarms occur at the same time, the alarm having the highest priority order is generated. When the PV value has decreased below [HI_HI_LIM - ALM_HYS], HI_HI_ALM is reset.
61	HI_ALM	—	—		As above
62	LO_ALM	—	—		As above Reset when the PV value has increased above [LO_LIM + ALM_HYS].
63	LO_LO_ALM	—	—		As above
64	DV_HI_ALM	—	—		Alarm that is generated when the value of [PV - SP] has exceeded the DV_HI_LIM value. Other features are the same as HI_HI_ALM.
65	DV_LO_ALM	—	—		Alarm that is generated when the value of [PV - SP] has decreased below the DV_LO_LIM value. Other features are the same as LO_LO_ALM.

TA0102-2.EPS

A5.4 PID Computation Details

A5.4.1 PV-proportional and -derivative Type PID (I-PD) Control Algorithm

For PID control, the PID block employs the PV-proportional and PV-derivative type PID control algorithm (referred to as the I-PD control algorithm) in Auto and RCas mode. The I-PD control algorithm ensures control stability against sudden changes in the setpoint, such as when the user enters a new setpoint value. At the same time, the I-PD algorithm ensures excellent controllability by performing proportional, integral, and derivative control actions in response to changes of characteristics in the controlled process, changes in load, and occurrences of disturbances.

In Cas mode, PV derivative type PID control algorithm (referred to as the PI-D control algorithm) is employed in order to obtain better performance against the changes in the setpoint. The algorithm is automatically switched by the block according to the mode. A basic form of each algorithm is expressed in the equation below.

I-PD Control Algorithm (in Auto / RCas mode)

$$\Delta MVn = K\left\{\Delta PVn + \frac{\Delta T}{Ti}(PVn - SPn) + \frac{Td}{\Delta T}\Delta(\Delta PVn)\right\}$$

PI-D Control Algorithm (in Cas mode)

$$\Delta MVn = K\left\{\Delta(PVn - SPn) + \frac{\Delta T}{Ti}(PVn - SPn) + \frac{Td}{\Delta T}\Delta(\Delta PVn)\right\}$$

Where,

- ΔMVn = change in control output
- ΔPVn = change in measured (controlled) value = PVn - PVn-1
- ΔT = control period = period_of_execution in Block Header
- K = proportional gain = GAIN (= 100/ proportional band)
- Ti = integral time = RESET
- Td = derivative time = RATE

The subscripts, n and n-1, represent the time of sampling such that PVn and PVn-1 denote the PV value sampled most recently and the PV value sampled at the preceding control period, respectively.

A5.4.2 PID Control Parameters

The table below shows the PID control parameters.

Parameter	Description	Valid Range
GAIN	Proportional gain	0.05 to 20
RESET	Integral time	0.1 to 10,000 (seconds)
RATE	Derivative time	0 to infinity (seconds)

TA0103.EPS

A5.5 Control Output

The final control output value, OUT, is computed based on the change in control output ΔMVn, which is calculated at each control period in accordance with the aforementioned algorithm. The PID block in an EJX performs the velocity type output action for the control output.

A5.5.1 Velocity Type Output Action

The PID block determines the value of the new control output OUT by adding the change in control output calculated in the current control period, ΔMVn, to the current read-back value of the MV, MV_{RB} (BKCAL_IN). This action can be expressed as:

ΔMVn' = ΔMVn ∗ (OUT_SCALE. EU100 − OUT_SCALE. EU_0) / (PV_SCALE. EU_100 − PV_SCALE. EU_0)

(Direct Acting is False in CONTROL_OPTS)
OUT = BKCAL_IN − ΔMVn'
(Direct Acting is True in CONTROL_OPTS)
OUT = BKCAL_IN + ΔMVn'

A5.6 Direction of Control Action

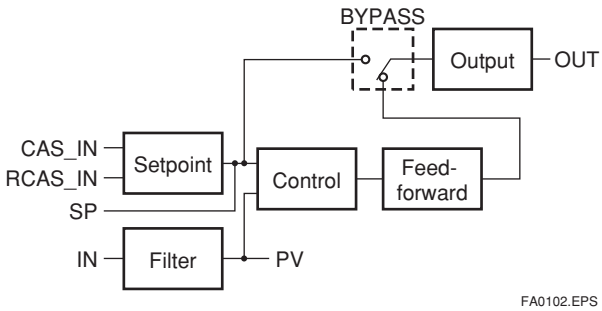
The direction of the control action is determined by the Direct Acting setting in CONTROL_OPTS.

Value of Direct Acting	Resulting Action
True	The output increases when the input PV is greater than the setpoint SP.
False	The output decreases when the input PV is greater than the setpoint SP.

TA0104.EPS

A5.7 Control Action Bypass

The PID control computation can be bypassed so as to set the SP value in the control output OUT as shown below. Setting BYPASS to "On" bypasses the PID control computation.



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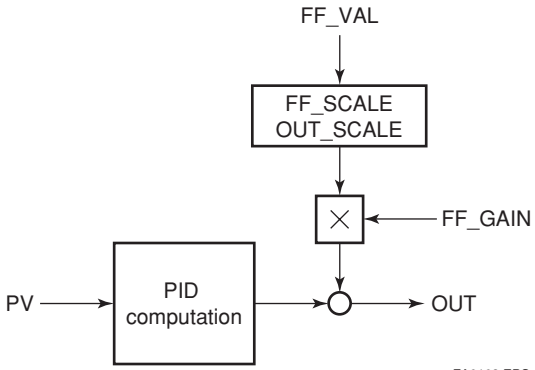
A5.8 Feed-forward

Feed-forward is an action to add a compensation output signal FF_VAL to the output of the PID control computation, and is typically used for feed-forward control. The figure below illustrates the action.



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A5.9 Block Modes

The block mode is set in the parameter MODE-BLK.

MODE_BLK	Target	Stipulates the target mode to which the PID block transfers.
	Actual	Indicates the current mode of the PID block.
	Permitted	Stipulates all the modes that the PID block can enter. The PID block is prohibited to enter any mode other than those set in this element.
	Normal	Stipulates the mode in which the PID block normally resides.

TA0105.EPS

There are eight modes for a PID block as shown below.

Block Mode	Description
ROut	Remote output mode, in which the PID block outputs the value set in ROUT_IN.
RCas	Remote cascade mode, in which the PID block carries out the PID control computation based on the setpoint (SP) set via the remote cascade connection, such as from a computer, and outputs the computed result.
Cas	Cascade mode, in which the PID block carries out the PID control computation based on the setpoint (SP) set from another fieldbus function block, and outputs the computed result.
Auto	The PID block carries out automatic control and outputs the result computed by the PID control computation.
Man	Manual mode, in which the PID block outputs the value set by the user manually.
LO	The PID block outputs the value set in TRK_VAL.

TA0106-1.EPS

Block Mode	Description
IMan	Initialization and manual mode, in which the control action is suspended. The PID block enters this mode when the specified condition is met (see Section A5.14).
O/S	Out of service mode, in which neither the control computation nor action is carried out, and the output is kept at the value that was output before the PID block entered into O/S mode.

TA0106-2.EPS

A5.9.1 Mode Transitions

Transition Destination Mode	Condition	NOT Conditions
O/S	1. If O/S is set in **MODE_BLK.target** (or if O/S is set in **target** inside the resource block)	
IMan	2. If the specified condition is met (see Section A5.14)	**NOT** if condition 1 is met
LO	3. If Track Enable is specified in **CONTROL_OPTS** and the value of **TRK_IN_D** is true	**NOT** if either or both of conditions 1 and 2 are met
Man	4. If Man is set in **MODE_BLK.target** or if **IN.status** (input status) is Bad	**NOT** if any one or more of conditions 1 to 3 are met
Auto*	5. If Auto is set in **MODE_BLK.target** **- AND -** if **IN.status** (input status) is not Bad	**NOT** if any one or more of conditions 1 to 3 are met
Cas*, **	6. If Cas is set in **MODE_BLK.target** **- AND -** if neither **IN.status** (input status) nor **CAS_IN.status** is Bad.	**NOT** if any one or more of conditions 1 to 3 are met
RCas*, **	7. If RCas is set in **MODE_BLK.target** **- AND -** if neither **IN.status** (input status) nor **RCAS_IN.status** is Bad.	**NOT** if any one or more of conditions 1 to 3 are met.
ROut*, **	8. If ROut is set in **MODE_BLK.target** **- AND -** if **ROUT_IN.status** (input status) is not Bad	**NOT** if any one or more of conditions 1 to 3 are met.
In accordance with the **SHED_OPT** setting	9. If **RCAS_IN.status** or **ROUT_IN.status** is Bad (indicating a computer failure; see Section A5.17.1 for details)	

TA0107.EPS

* To activate mode transitions to Auto, Cas, RCas, and ROut, the respective target modes must be set beforehand to MODE_BLK.permitted.

** A transition to Cas, RCas, or ROut requires that initialization of the cascade connection has been completed.

A5.10 Bumpless Transfer

Prevents a sudden change in the control output OUT at changes in block mode (MODE_BLK) and at switching of the connection from the control output OUT to the cascaded secondary function block. The action to perform a bumpless transfer differs depending on the MODE_BLK values.

A5.11 Setpoint Limiters

Active setpoint limiters that limit the changes in the SP value, differ depending on the block mode as follows.

A5.11.1 When PID Block Is in Auto Mode

When the value of MODE_BLK is Auto, the four types of limiters are in force: high limit, low limit, rate-of-increase limit, and rate-of-decrease limit.

Setpoint High/Low Limits

- A value larger than the value of SP_HI_LIM cannot be set for SP.
- A value smaller than the value of SP_LO_LIM cannot be set for SP.

Setpoint Rate Limits

The setpoint rate limits are used to restrict the magnitude of changes in the SP value so as to change the SP value gradually towards a new setpoint.

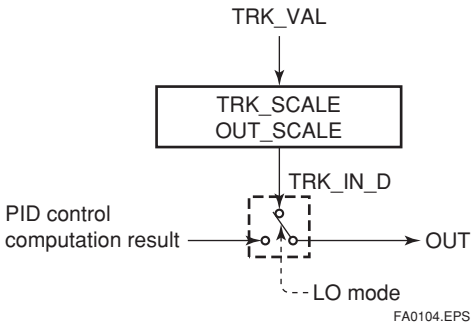
- An increase of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_UP.
- A decrease of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_DOWN.

A5.11.2 When PID Block Is in Cas or RCas Mode

By selecting Obey SP Limits if Cas or RCas in CONTROL_OPTS (see Section A5.13), the setpoint high/low limits can be put into force also when the value of MODE_BLK is Cas or RCas.

A5.12 External-output Tracking

External tracking is an action of outputting the value of the remote output TRK_VAL set from outside the PID block, as illustrated in the figure below. External tracking is performed when the block mode is LO.



To change the block mode to LO:

(1) Select Track Enable in CONTROL_OPTS.
(2) Set TRK_IN_D to true.
However, to change the block mode from Man to LO, Track in Manual must also be specified in CONTROL_OPTS.

A5.13 Measured-value Tracking

Measured-value tracking, also referred to as SP-PV tracking, is an action to equalize the setpoint SP to the measured value PV when the block mode (MODE_BLK.actual) is Man in order to prevent a sudden change in control output from being caused by a mode change to Auto.

While a cascade primary control block is performing the automatic or cascade control (in the Auto or Cas mode), when the mode of its secondary control block is changed from Cas to Auto, the cascade connection is opened and the control action of the primary block stops. The SP of the secondary controller can be equalized to its cascade input signal CAS_IN also in this case.

The settings for measured-value tracking are made in the parameter CONTROL_OPTS, as shown in the table below.

Options in CONTROL_OPTS	Description
Bypass Enable	This parameter allows BYPASS to be set.
SP-PV Track in Man	Equalizes SP to PV when **MODE_BLK.target** is set to Man.
SP-PV Track in ROut	Equalizes SP to PV when **MODE_BLK.target** is set to ROut.
SP-PV Track in LO or IMan	Equalizes SP to PV when actual is set to LO or IMAN.
SP-PV Track retained Target	Equalizes SP to RCAS_IN when **MODE_BLK.target** is set to RCas, and to CAS_IN when **MODE_BLK.target** is set to Cas when the actual mode of the block is IMan, LO, Man or ROut.
Direct Acting	Set the PID block to a direct acting controller.
Track Enable	This enables the external tracking function. The value in TRK_VAL will replace the value of OUT if TRK_IN_D becomes true and the target mode is not Man.
Track in Manual	This enables TRK_VAL to replace the value of OUT when the target mode is Man and TRK_IN_D is true. The actual mode will then be LO.
Use PV for BKCAL_OUT	Sets the value of PV in BKCAL_OUT and RCAS_OUT, instead of the value of SP.
Obey SP limits if Cas or RCas	Puts the setpoint high/low limits in force in the Cas or RCas mode.
No OUT limits in Manual	Disables the high/low limits for OUT in the Man mode.

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A5.14 Initialization and Manual Fallback (IMan)

Initialization and manual fallback denotes a set of actions in which a PID block changes mode to IMan (initialization and manual) and suspends the control action. Initialization and manual fallback takes place automatically as a means of abnormality handling when the following condition is met:

- The quality component of BKCAL_IN.status is Bad.
  - OR -
- The quality component of BKCAL_IN.status is Good (c)
  - AND -
  The sub-status component of BKCAL_IN.status is FSA, LO, NI, or IR.

The user cannot manually change the mode to IMan. A mode transition to IMan occurs only when the condition above is met.

A5.15 Manual Fallback

Manual fallback denotes an action in which a PID block changes mode to Man and suspends the control action. Manual fallback takes place automatically as a means of abnormality handling when the following condition is met:

- IN.status is Bad except when the control action bypass is on.

To enable the manual fallback action to take place when the above condition is met, Target to Manual if BAD IN must be specified beforehand in STATUS_OPTS.

The table below shows the options in STATUS_OPTS.

Options in STATUS_OPTS	Description
IFS if BAD IN	Sets the sub-status component of **OUT.status** to IFS if **IN.status** is Bad except when PID control bypass is on.
IFS if BAD CAS IN	Sets the sub-status component of **OUT.status** to IFS if **CAS_IN.status** is Bad.
Use Uncertain as Good	Does not regard **IN** as being in Bad status when **IN.status** is Uncertain (to prevent mode transitions from being affected when it is Uncertain).
Target to Manual if BAD IN	Automatically changes the value of **MODE_BLK.target** to MAN when **IN** falls into Bad status.
Target to next permitted mode if BAD CAS IN	Automatically changes the value of **MODE_BLK.target** to Auto (or to Man if Auto is not set in Permitted) when **CAS_IN** falls into Bad status.

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A5.16 Auto Fallback

Auto fallback denotes an action in which a PID block changes mode from Cas to Auto and continues automatic PID control with the user-set setpoint. Auto fallback takes place automatically when the following condition is met:

- IN.status (data status of IN) is Bad except when the control action bypass is on.

To enable the manual fallback action to take place when the above condition is met:

- Target to next permitted mode if BAD CAS IN must be previously specified in STATUS_OPTS.

  - AND -

- Auto must be previously set in MODE_BLK.permitted.

A5.17 Mode Shedding upon Computer Failure

When the data status of RCAS_IN or ROUT_IN, which is the setting received from a computer as the setpoint SP, falls to Bad while the PID block is running in the RCas or ROut mode, the mode shedding occurs in accordance with the settings in SHED_OPT. If the RCAS_IN data is not renewed within the time specified by SHED_RCAS in resource block, the data status of RCAS_IN falls to Bad.

A5.17.1 SHED_OPT

The SHED_OPT setting stipulates the specifications of mode shedding as shown below. Only one can be set.

Available Setting for SHED_OPT	Actions upon Computer Failure
Normal shed, normal return	Sets **MODE_BLK.actual** to Cas*1, and leaves **MODE_BLK.target** unchanged.
Normal shed, no return	Sets both **MODE_BLK.actual** and **MODE_BLK.target** to Cas*1.
Shed to Auto, normal return	Sets **MODE_BLK.actual** to Auto*2, and leaves **MODE_BLK.target** unchanged.
Shed to Auto, no return	Sets both **MODE_BLK.actual** and **MODE_BLK.target** to Auto*2.
Shed to Manual, normal return	Sets **MODE_BLK.actual** to Man, and leaves **MODE_BLK.target** unchanged.
Shed to Manual, no return	Sets both **MODE_BLK.actual** and **MODE_BLK.target** to Man.
Shed to retained target, normal return	If Cas is in **MODE_BLK.target**, sets **MODE_BLK.actual** to Cas*1, and leaves **MODE_BLK.target** unchanged. If Cas is not set in **MODE_BLK.target**, sets **MODE_BLK.actual** to Auto*2, and leaves **MODE_BLK.target** unchanged.
Shed to retained target, no return	If Cas is set in **MODE_BLK.target**, sets both **MODE_BLK.actual** and **MODE_BLK.target** to Cas*1. If Cas is not set in **MODE_BLK.target**, sets **MODE_BLK.actual** to Auto*2, and **MODE_BLK.target** to Cas.

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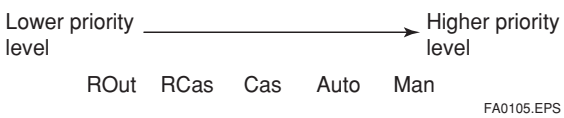
*1 The modes to which a PID block can transfer are limited to those set in MODE_BLK.permitted, and the priority levels of modes are as shown below. In fact, if Normal shed, normal return is set for SHED_OPT, detection of a computer failure causes MODE_BLK.actual to change to Cas, Auto, or MAN, whichever is set in MODE_BLK. permitted and has the lowest priority level.



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*2 Only when Auto is set as permitted mode.

NOTE: If a control block is connected as a cascade primary block of the PID block in question, a mode transition of the PID block to Cas occurs in the following sequence due to initialization of the cascade connection: RCas or ROut → Auto → Cas.

A5.18 Alarms

There are two kinds of alarms generated by a PID block: block and process alarms.

A5.18.1 Block Alarm (BLOCK_ALM)

The block alarm BLOCK_ALM is generated upon occurrence of either of the following errors (values set in BLOCK_ERR) and notifies the content of BLOCK_ERR.

Value of BLOCK_ERR	Condition
Local Override	**MODE_BLK** actual of PID block is LO.
Input Failure	**IN.status** of the PID block is either of the following: • Bad-Device Failure • Bad-Sensor Failure
Out of Service	**MODE_BLK.target** of the PID block is O/S.

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A5.18.2 Process Alarms

There are six types of process alarms. Only one process alarm can be generated at the same time, and the process alarm having the highest priority level from among those occurring at the same time is generated. The priority level is set for each process alarm type.

Process Alarm	Cause of Occurrence	Parameter Containing Priority Level Setting
HI_HI_ALM	Occurs when the PV increases above the HI_HI_LIM value.	HI_HI_PRI
HI_ALM	Occurs when the PV increases above HI_LIM value.	HI_PRI
LO_ALM	Occurs when the PV decreases below the LO_LIM value.	LO_PRI
LO_LO_ALM	Occurs when the PV decreases below the LO_LO_LIM value.	LO_LO_LIM
DV_HI_ALM	Occurs when the value of [PV - SP] increases above the DV_HI_LIM value.	DV_HI_PRI
DV_LO_ALM	Occurs when the value of [PV - SP] decreases below the DV_LO_LIM value.	DV_LO_PRI

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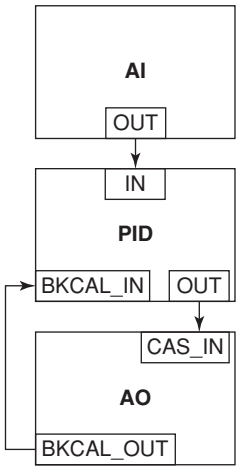
A5.19 Example of Block Connections



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When configuring a simple PID control loop by combining an AXF with a fieldbus valve positioner that contains an AO block, follow the procedure below to make the settings of the corresponding fieldbus function blocks:

1. Connect the AI block and PID block of the EJX, and the AO block of the valve positioner as shown above.
2. Set MODE_BLK.target of the PID block to O/S, and then set GAIN, RESET, and RATE to appropriate values.
3. Check that the value of MODE_BLK.actual of the AI block is Auto.
4. Set MODE_BLK.target of the AO block to CAS|AUTO (meaning "Cas and Auto").
5. Check that the value of BKCAL_IN.status of the PID block is not Bad.
6. Check that the value of IN.status of the PID block is not Bad.
7. Check that Auto is set in MODE_BLK.permitted of the PID block.
8. Set MODE_BLK.target of the PID block to Auto.

When finishing all steps in order, the PID block and AO block exchange the respective information and initialize the cascade connection. Consequently, the value of MODE_BLK.actual of the PID block changes to Auto and automatic PID control starts.

A5.20 View Object for PID Function Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	SP	5		5	
9	OUT	5		5	
10	PV_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	CONTROL_OPTS				2
14	STATUS_OPTS				2
15	IN			5	
16	PV_FTIME				4
17	BYPASS		1		
18	CAS_IN	5		5	
19	SP_RATE_DN				4
20	SP_RATE_UP				4
21	SP_HI_LIM		4		
22	SP_LO_LIM		4		
23	GAIN				4
24	RESET				4
25	BAL_TIME				4
26	RATE				4
27	BKCAL_IN			5	
28	OUT_HI_LIM		4		
29	OUT_LO_LIM		4		
30	BKCAL_HYS				4
31	BKCAL_OUT			5	
32	RCAS_IN			5	
33	ROUT_IN			5	
	Subtotals	28	43	53	41

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Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
34	SHED_OPT				1
35	RCAS_OUT			5	
36	ROUT_OUT			5	
37	TRK_SCALE				11
38	TRK_IN_D	2		2	
39	TRK_VAL	5		5	
40	FF_VAL			5	
41	FF_SCALE				11
42	FF_GAIN				4
43	UPDATE_EVT				
44	BLOCK_ALM				
45	ALARM_SUM	8		8	
46	ACK_OPTION				2
47	ALARM_HYS				4
48	HI_HI_PRI				1
49	HI_HI_LIM				4
50	HI_PRI				1
51	HI_LIM				4
52	LO_PRI				1
53	LO_LIM				4
54	LO_LO_PRI				1
55	LO_LO_LIM				4
56	DV_HI_PRI				1
57	DV_HI_LIM				4
58	DV_LO_PRI				1
59	DV_LO_LIM				4
60	HI_HI_ALM				
61	HI_ALM				
62	LO_ALM				
63	LO_LO_ALM				
64	DV_HI_ALM				
65	DV_LO_ALM				
	Subtotals	15	0	30	63
	Totals	43	43	83	104

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APPENDIX 6. SOFTWARE DOWNLOAD

A6.1 Benefits of Software Download

This function enables you to download software to field devices via a FOUNDATION Fieldbus to update their software. Typical uses are to add new features such as function blocks and diagnostics to existing devices, and to optimize existing field devices for your plant.

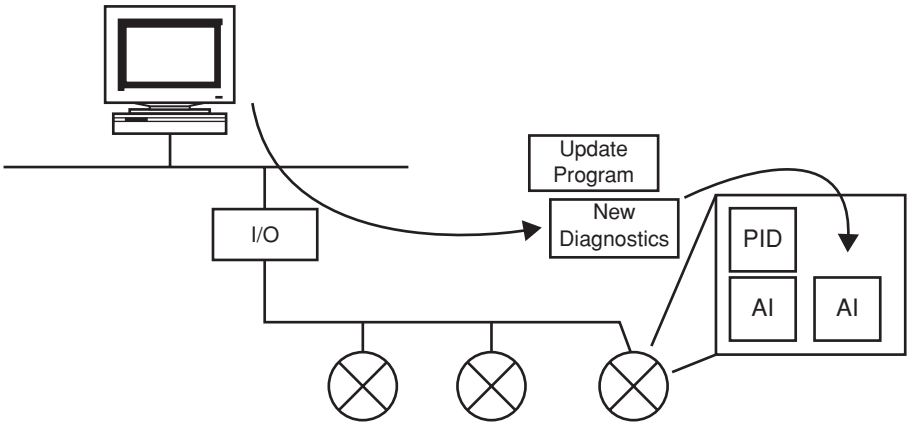

Figure A6.1 Concept of Software Downloading

A6.2 Specifications

Steady-state current: Max. 15 mA

Current Draw (Steady-state): 15mA (max)

Current Draw (Software Download state): 24mA (max)

Current during FlashROM blanking time:
Max. 24 mA additional to steady-state current

Based on Fieldbus Foundation Specification Download class: Class 1

NOTE

Class 1 devices can continue the specified measurement and/or control actions even while software is being downloaded to them. Upon completion of a download, however, the devices will be reset internally to make the new, downloaded software take effect, and this will halt fieldbus communication and function block executions for about one minute.

A6.3 Preparations for Software Downloading

For software downloading, you need to prepare the following:

- Software download tool
- Software for downloading file for each of the target field devices

For the software download tool, use only a program developped for that purpose. For details, see the software's User's Manual. For information about updates of software binary files for field devices and how to obtain them, visit the following web site.

http://www.yokogawa.com/fld/fld-top-en.htm

CAUTION

Do not hook up the software download tool to a fieldbus segment while the plant is in operation, as it may temporarily disturb the communication. Always connect the tool before starting operation.

NOTE

The download tool can not execute downloading during other system connects to the system/ network management VFD of the device.

A6.4 Software Download Sequence

The flowchart below outlines the software download procedure. Although the time taken for the entire procedure varies depending on the size of the field bus device's software, it generally take about 20 minutes where there is a one-to-one connection between a fieldbus device and download tool, and longer when multiple field devices are connected to the fieldbus.

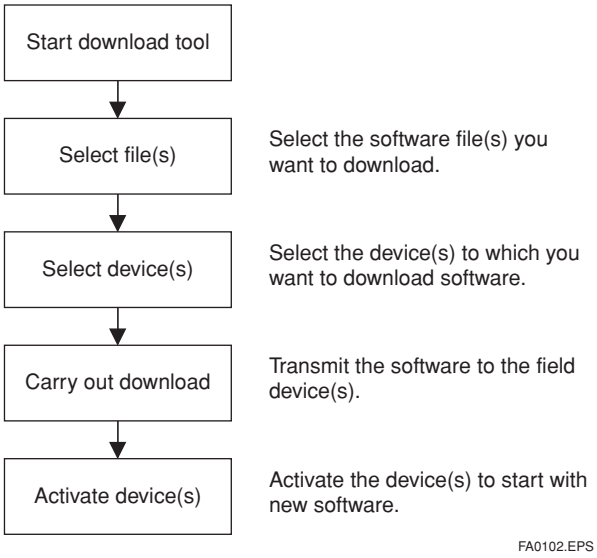

Figure A6.2 Flow of Software Download Procedure

CAUTION

Carrying out a software download leaves the PD tag, node address, and transducer block calibration parameters that are retained in the nonvolatile memory inside the target device, but may reset other parameters to the defaults (except a minor update that does not change the number of parameters). Hence, where necessary, save the parameters using an engineering tool, parameter setting utility, or the like before carrying out a software download, and then reconfigure the field device(s) after the download. For details, see Section A6.6.

CAUTION

The current dissipation of the target field device increases transitorily immediately after a download due to erasing of the FlashROM's contents. Use a fieldbus power supply which has sufficient capacity to cover such increases in feed current.

CAUTION

Upon completion of the activation, the target fieldbus device performs resetting internally, which temporarily halts fieldbus communication and function block executions. Be especially careful about a valve positioner; the output air pressure will fall to the minimum level (i.e., zero).

CAUTION

Do not turn off the power to a field device or disconnect the download tool during a download or activation. The device may fail as a result.

NOTE

Be careful about the noise on the fieldbus link. If the fieldbus is noisy, the downloading may take a very long time or fail.

A6.5 Download Files

Download files have the following filenames (with the filename extension of ".ffd"). Take care to choose the correct download file for the target field device:

"594543" + device family + "_" + device type + "_" + domain name + "_" + software name + "_" + software revision + ".ffd"

For example, the name of the download file for the AXF may have the following name:

594543000B_000B_AXF_ORIGINAL_R101.ffd

Refer to A6.10(3) DOMAIN_HEADER about each keyword of the file name.

The device type is “000B” for the AXF .

The software name is “ORIGINAL” or “UPDATE.” The former indicates an original file and the latter an update file. Whenever performing a download to update the device revision, obtain the original file. In general, an addition to the parameters or blocks requires a device revision update.

A6.6 Steps after Activating a Field Device

When the communication with a field device has recovered after activating the device, check using the download tool that the software revision of the field device has been updated accordingly. The value of SOFT_REV of the resource block indicates the software revision.

The PD tag, node address, and transducer block calibration parameters that are retained in the nonvolatile memory inside the target device will remain unchanged after a software download. However, after a software update which causes an addition to the block parameters or blocks, or to the system/network management VFD parameters, some parameters may be reset to the defaults, thus requiring parameter setup and engineering again. For details, see the table below.

Also note that a change in the number of parameters or blocks requires the DD and capabilities files corresponding to the new software revision.

Table 1. Actions after Software Update

Contents of Software Update	Action
Does not change the number of parameters.	Re-setup of parameters not needed.
Adds a block parameter.	Setup of the added parameter needed.
Adds a block.	Reengineering and setup of the added block’s parameters needed.
Changes the number of system/network management VFD parameters.	Reengineering needed.

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A6.7 Troubleshooting

For information on the download tool's error messages, see also the software's User's Manual.

Table A6.2 Problems after Software Update

Symptom	Cause	Remedy
An error occurs before starting a download, disabling the download.	The selected download file is not for the selected field device.	Check SOFTDWN_ERROR in the resource block and obtain the correct file.
An error occurs after starting a download, disabling the download.	You attempted to update the device revision by downloading a file which is not an original file.	Check SOFTDWN_ERROR in the resource block and obtain the original file.
	The selected field device does not support software downloading.	Check whether the option code /EE is included in the model and suffix codes of the device.
	The voltage on the fieldbus segment falls below the specified limit (9 volts).	Check the capacity of the field bus power supply used and the voltage at the terminal.
	There was an error in a checksum or the number of transmission bytes.	Check SOFTDWN_ERROR in the resource block and obtain the correct file.
	The download tool does not allow download with same software revision.	Check the setting of the download tool.
The download takes far longer than expected or fails frequently.	The fieldbus segment is noisy.	Check the noise level on the fieldbus segment.
An error occurs after activation.	Transient error caused by the internal resetting of the field device	Check whether communication with the field device has recovered after a while.
The new software does not work after the activation.	The file of the current revision was downloaded.	Obtain the correct file.
	Failure of the memory in field device, etc.	Check SOFTDWN_ERROR in the resource block, and re-try downloading. If fails, place a service call.

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A6.8 Resource Block's Parameters Relating to Software Download

Table A6.3 Additional Parameters of Resource Block

Relative Index	Index	Parameter Name	Default (Factory Set)	Write Mode	Description
53	1053	SOFTDWN_PROTECT	0x01		Defines whether to accept software downloads. 0x01: Unprotected 0x02: Protected
54	1054	SOFTDWN_FORMAT	0x01		Selects the software download method. 0x01: Standard
55	1055	SOFTDWN_COUNT	0	—	Indicates the number of times the internal FlashROM was erased.
56	1056	SOFTDWN_ACT_AREA	0	—	Indicates the ROM number of the currently working FlashROM. 0: FlashROM #0 working 1: FlashROM #1 working
57	1057	SOFTDWN_MOD_REV	1, 0, 0, 0, 0, 0, 0, 0, 0	—	Indicates the software module revision.
58	1058	SOFTDWN_ERROR	0	—	Indicates an error during a software download. See Table A6.4.

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Table A6.4 Download Error Codes

Error Code	Detail
0	No error
32768	Unsupported header version
32769	Abnormal header size
32770	Abnormal manufacturer ID
32771	Abnormal device family
32772	Abnormal device revision
32773	Abnormal vendor specification version
32774	Abnormal number of modules
32775	Abnormal number of bytes in module 1
32776	Abnormal number of bytes in module 2
32777	Device error in module 1
32778	Checksum error in module 1
32779	Checksum error in file
32780	Unused
32781	Write-prohibited area in FlashROM
32782	Verification error during FlashROM writing
32783	Polling error during FlashROM erasing
32784	Polling time-out during FlashROM erasing
32785	Polling error during FlashROM writing
32786	Polling time-out during FlashROM writing
32787	FlashROM driver undefined number error
32788	File endcode error
32789	File type error (UPDATE, ORIGINAL)
32790	FlashROM driver undefined number error
32791	On-start state error (other than DWNLD_NOT_READY)
32792	Start segment error in module 1
32793	Binary file error
32794	Binary file error
32795	Device error in module 2
32796	Detection of EEPROM state other than backup after activation
32797	Checksum error in module 2
32798	Not in DWNLD_READY state when receiving GenericDomainInitiate
32799	Not in DWNLD_OK state when receiving GenericDomainTerminate
32800	Not in DOWNLOADING state when receiving GenericDomainSegment
32801	Firmware error
36863	Unused

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A6.9 System/Network Management VFD Parameters Relating to Software Download

Table A6.5 System/Network Management VFD Parameters

Write Mode: R/W = read/write; R = read only

Index (SM)	Parameter Name	Sub Index	Sub-parameter Name	Default (Factory Set)	Write Mode	Remarks
400	DWNLD_PROPERTY	0			R	
		1	Download Class	1		
		2	Write Rsp Returned For ACTIVATE	1		
		3	Write Rsp Returned For PREPARE	1		
		4	Reserved	0		
		5	ReadyForDwnld Delay Secs	300		
		6	Activation Delay Secs	60		
410	DOMAIN_DESCRIPTOR	0			R/W	Read/write-permitted only for sub-index 1
		1	Command	3		
		2	State	1		
		3	Error Code	0		
		4	Download Domain Index	440		
		5	Download Domain Header Index	420		
		6	Activated Domain Header Index	430		
		7	Domain Name	(Device name)		
420	DOMAIN_HEADER.1	0				
		1	Header Version Number	0		
		2	Header Size	0		
		3	Manufacturer ID			
		4	Device Family			
		5	Device Type			
		6	Device Revision	0		
		7	DD Revision	0		
		8	Software Revision			
		9	Software Name			
		10	Domain Name			
430	DOMAIN_HEADER.2	0				
		1	Header Version Number	1		
		2	Header Size	44		
		3	Manufacturer ID	0x594543		
		4	Device Family	(DEV_TYPE of RB)		
		5	Device Type	(DEV_TYPE of RB)		
		6	Device Revision	(DEV_REV of RB)		
		7	DD Revision	(DD_REV of RB)		
		8	Software Revision	(SOFT_REV of RB)		
		9	Software Name	ORIGINAL		
		10	Domain Name	(Device name)		
440	DOMAIN					Read/write: prohibited Get-OD: permitted

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A6.10 Comments on System/Network Management VFD Parameters Relating to Software Download

IMPORTANT

Do not turn off the power to a field device immediately after changing parameter settings. Data writing actions to the EEPROM are dual redandant to ensure reliability. If the power is turned off within 60 seconds after setup, the parameters may revert to the previous settings.

(1) DWNLD_PROPERTY

Sub Index	Element	Size (Bytes)	Description
1	Download Class	1	Indicates the download class. 1: Class 1
2	Write Rsp Returned For ACTIVATE	1	Indicates whether a write response is returned to the ACTIVATE command. 1: Write Response Returned
3	Write Rsp Returned For PREPARE	1	Indicates whether a write response is returned to the PREPARE command. 1: Write Response Returned
4	Reserved	1	(Reserved)
5	ReadyForDwnld Delay Secs	2	Indicates the maximum delay after receipt of the PREPARE_FOR_DWNLD command to proceed to transition from DWNLD_NOT_READY to DWNLD_READY.
6	Activation Delay Secs	2	Indicates the maximum delay after receipt of the ACTIVATE command to proceed to transition from DWNLD_OK to DWNLD_NOT_READY.

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(2) DOMAIN_DESCRIPTOR

Sub Index	Element	Size (Bytes)	Description
1	Command	1	Reads/writes software download commands. 1: PREPARE_FOR_DWNLD (instruction of download preparation) 2: ACTIVATE (activation instruction) 3: CANCEL_DWNLD (instruction of download cancellation)
2	State	1	Indicates the current download status. 1: DWNLD_NOT_READY (download not ready) 2: DWNLD_PREPARING (download under preparation) 3: DWNLD_READY (ready for download) 4: DWNLD_OK (download complete) 5: DOWNLOADING (download underway) 6: CHECKSUM_FAIL (not used in this product) 7: FMS_DOWNLOAD_FAIL (failure during download) 8: DWNLD_INCOMPLETE (download error detected at restart) 9: VCR_FAIL (not used in this product) 10: OTHER (download error other than 6 and 7 detected)
3	Error Code	2	Indicates the error during a download and activation. 0: success, configuration retained (download successfully completed) 32768 - 65535: Download error (See Table 4 for error codes.)
4	Download Domain Index	4	Indicates the index number of the domain for software downloading.
5	Download Domain Header Index	4	Indicates the index number of the domain header to which the download is performing.
6	Activated Domain Header Index	4	Indicates the index numbers of the domain header currently running.
7	Domain Name	8	Indicates the domain name. With this product, Domain Name indicates the field device name.

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(3) DOMAIN_HEADER

Sub Index	Element	Size (Bytes)	Description
1	Header Version Number	2	Indicates the version number of the header.
2	Header Size	2	Indicates the header size.
3	Manufacturer ID	6	Indicates the value of resource block's MANUFAC_ID (manufacturer ID) as character string data.
4	Device Family	4	Indicates the device family. With this product, Device Family indicates the value of resource block's DEV_TYPE as character string data.
5	Device Type	4	Indicates the value of resource block's DEV_TYPE as character string data.
6	Device Revision	1	Indicates the value of resource block's DEV_REV.
7	DD Revision	1	Indicates the value of resource block's DD_REV.
8	Software Revision	8	Indicates the value of resource block's SOFT_REV.
9	Software Name	8	Indicates the attribute of the binary file. With this product, Software Name indicates either of the following: "ORIGINAL" followed by one space: Original file "UPDATE" followed by two spaces: Update file
10	Domain Name	8	Indicates the domain name. With this product, Domain Name indicates the field device name.

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REVISION RECORD

Title: ADMAG AXF Series FOUNDATION Fieldbus Communication Type Magnetic Flowmeter
Manual No.: IM 01E20F02-01E

Edition	Date	Page	Revised Item
1st	June 2006	–	New publication
2nd	May 2007	1-2	(d) Added the warning note of "Maintenance".
		(1-4)	Deleted the ATEX documentation.
		(2-1 to 2-9)	Deleted the chapter of "2.HANDLING CAUTIONS".
			Changed the chapter number of other chapter.
		6-2	6.3 Changed the Figure 6.2.
			Added the important note for SIMULATE_ENABLE Switch setting.
		7-3	Added the table 7.8.
		8-3	Corrected the explanation of relative index 52.
		9-2	Deleted the optional codes of explosion proof.
		10-1 to 10-3	10.1 Deleted the Section "Components Replacement".
3rd	Feb. 2012	1-3	1.2 Added the item "Trademarks".
		3-3	3.3 Changed the website address of Figure 3.3.
		5-3	Added the item "ALARM_PERFORM".
		6-2	6.3 Corrected the Figure 6.2.
		8-9	8.3 Corrected the explanation of relative index 14.
		9-1	9.1 Deleted the item "Lightning Protector".
			9.2 Changed the definition of accuracy.
		9-2	9.2 Corrected the node address.

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