User's Manual

ADMAG AE

ADMAG AE
Magnetic Flowmeter
Fieldbus Communication Type

IM 1E7F1-01E

YOKOGAWA
Yokogawa Electric Corporation

IM 1E7F1-01E
5th Edition

Contents

1. INTRODUCTION

This manual contains a description of the ADMAG AE Magnetic Flowmeter FOUNDATION Fieldbus Communication Type. The FOUNDATION Fieldbus communication type is similar to the BRAIN communication type in terms of basic performance and operation. This manual describes only those topics that are required for operation of the FOUNDATION Fieldbus communication type and that are not contained in the BRAIN communication type instruction manual. Refer to ADMAG AE Magnetic Flowmeter instruction manual IM1E7B0-02E or 1E7C1-E for topics common to the BRAIN communication and FOUNDATION Fieldbus communication types.

■ 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 instrument.
- 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.

FOUNDATION is a registered trademark of Fieldbus FOUNDATION .

■ Warranty

- The warranty shall cover the period noted on the quotation presented to the purchaser at the time of purchase. Problems occurred during the warranty period shall basically be repaired free of charge.
- In case of problems, the customer should contact the Yokogawa representative from which the 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.
- Responsible party for repair cost for the problems shall be determined by Yokogawa based on our investigation.
- 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.
  - Failure or damage due to improper handling, use or storage which is out of design conditions.
  - 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.

WARNING

- The Magnetic Flowmeter is a heavy instrument. Please give attention to prevent that persons are injured by carrying or installing. It is preferable for carrying the instrument to use a cart and be done by two or more persons.
- In wiring, please confirm voltages between the power supply and the instrumet before connecting the power cables. And also, please confirm that the cables are not powered before connecting.
- If the accumulated process fluid may be toxic or otherwise harmful, take appropriate care to avoid contact with the body, or inhalation of vapors even after dismounting the instrument from process line for maintenance.

■ Safety Precautions

- For the protection and safety of the operator and the instrument or the system including the instrument, please be sure to follow the instructions on safety described in this manual when handling this instrument. In case the instrument is handled in contradiction to these instructions, Yokogawa does not guarantee safety.
- The following safety symbol marks 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.

■ ATEX Documentation

This procedure is only applicable to the countries in European Union.

GB

All instruction manuals for ATEX Ex related products are available in English, German and French. Should you require Ex related instructions in your local language, you are to contact your nearest Yokogawa office or representative.

DK

Alle brugervejledninger for produkter relateret til ATEX Ex er tilgængelige på engelsk, tysk og fransk. Skulle De ønske yderligere oplysninger om håndtering af Ex produkter på eget sprog, kan De rette henvendelse herom til den nærmeste Yokogawa afdeling eller forhandler.

I

Tutti i manuali operativi di prodotti ATEX contrassegnati con Ex sono disponibili in inglese, tedesco e francese. Se si desidera ricevere i manuali operativi di prodotti Ex in lingua locale, mettersi in contatto con l'ufficio Yokogawa più vicino o con un rappresentante.

E

Todos los manuales de instrucciones para los productos antiexplosivos de ATEX están disponibles en inglés, alemán y francés. Si desea solicitar las instrucciones de estos artículos antiexplosivos en su idioma local, deberá ponerse en contacto con la oficina o el representante de Yokogawa más cercano.

NL

Alle handleidingen voor producten die te maken hebben met ATEX explosiebeveiliging (Ex) zijn verkrijgbaar in het Engels, Duits en Frans. Neem, indien u aanwijzingen op het gebied van explosiebeveiliging nodig hebt in uw eigen taal, contact op met de dichtstbijzijnde vestiging van Yokogawa of met een vertegenwoordiger.

SF

Kaikkien ATEX Ex -tyyppisten tuotteiden käyttöhjeet ovat saatavilla englannin-, saksan- ja ranskankielisinä. Mikäli tarvitsette Ex -tyyppisten tuotteiden ohjeita omalla paikallisella kielellännne, ottakaa yhteyttä lähimpään Yokogawa-toimistoon tai -edustajaan.

P

Todos os manuais de instruções referentes aos produtos Ex da ATEX estão disponíveis em Inglês, Alemão e Francês. Se necessitar de instruções na sua língua relacionadas com produtos Ex, deverá entrar em contacto com a delegação mais próxima ou com um representante da Yokogawa.

F

Tous les manuels d'instruction des produits ATEX Ex sont disponibles en langue anglaise, allemande et française. Si vous nécessitez des instructions relatives aux produits Ex dans votre langue, veuillez bien contacter votre représentant Yokogawa le plus proche.

D

Alle Betriebsanleitungen für ATEX Ex bezogene Produkte stehen in den Sprachen Englisch, Deutsch und Französisch zur Verfügung. Sollten Sie die Betriebsanleitungen für Ex-Produkte in Ihrer Landessprache benötigen, setzen Sie sich bitte mit Ihrem örtlichen Yokogawa-Vertreter in Verbindung.

S

Alla instruktionsböcker för ATEX Ex (explosionssäkra) produkter är tillgängliga på engelska, tyska och franska. Om Ni behöver instruktioner för dessa explosionssäkra produkter på annat språk, skall Ni kontakta närmaste Yokogawakontor eller representant.

GR

Όλα τα εγχειρίδια λειτουργίας των προϊόντων με ATEX Ex διατίθενται στα Αγγλικά, Γερμανικά και Γαλλικά. Σε περίπτωση που χρειάζεστε οδηγίες σχετικά με Ex στην τοπική γλώσσα παρακαλούμε επικοινωνήστε με το πλησιέστερο γραφείο της Yokogawa ή αντιπρόσωπο της.

2. AMPLIFIER FOR FIELDBUS COMMUNICATION

Refer to the instruction manual for detailed descriptions of the parts. This section describes the topics applicable to the Fieldbus communication type.

(1) In the Fieldbus communication type, there are no local key access function.
(2) The Fieldbus communication type has no BRAIN terminal connection pin.
(3) The Fieldbus communication type has no Instantaneous/Totalizer rate alternate display function.
(4) The Fieldbus communication type has a simulation function. A SIMULATE-ENABLE jumper switch is mounted in the ADMAG AE amplifier. Refer to Section 6.3, “Simulation Function” for details of the simulation function.
(5) ADMAG AE adjusting using AM012 calibrator must be done on off-line.

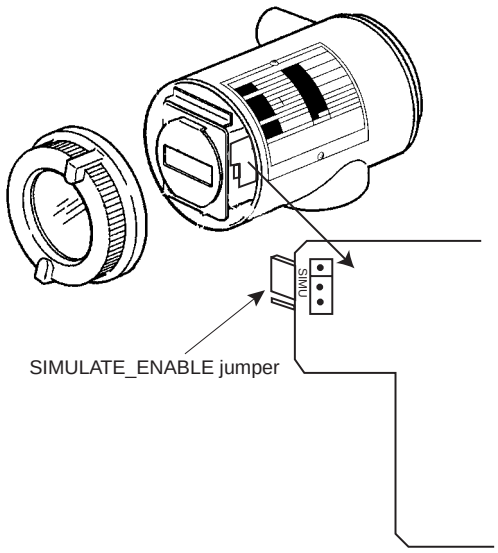

Figure 2.1 Amplifier for Fieldbus communication

3. ABOUT FIELDBUS

3.1 Outline

Fieldbus is a bi-directional digital communication protocol for field devices, which offers an advancement in implementation technologies for process control systems and is widely employed by numerous field devices.

ADMAG AE 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 function block, providing the means to implement a flexible instrumentation system.

For information on other features, engineering, design, construction work, startup and maintenance of Fieldbus, refer to “Fieldbus Technical Information” (TI 38K3A01-01E).

3.2 Internal Structure of ADMAG AE

ADMAG AE contains two Virtual Field Devices (VFD) that share the following functions.

3.2.1 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).

3.2.2 Function Block VFD

(1)Resource block

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

(2)Transducer block

- Converts sensor output to flow rate signal and transfers to AI function block.

(3)AI function block

- Conditions raw data from the Transducer block.
- Outputs flow rate signals.
- Carries out scaling extraction.

(4)PID function block(option)

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

3.3 Logical Structure of Each Block

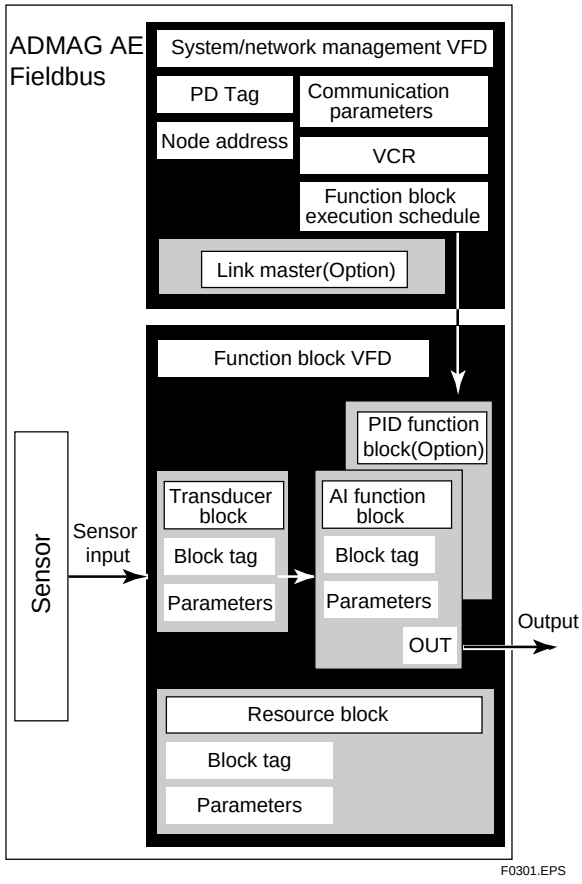

Figure 3.1 Logical Structure of Each Block

Setting of various parameters, node addresses, and PD Tags shown in Figure 3.1 is required before starting operation.

3.4 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 allow device performance to be fully exhibited.

4. 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 fieldbus devices in accordance with the procedures described in this section. The procedures assume that fieldbus devices will be set up on a bench of an instrument shop.

4.1 Connection of Devices

The following instruments 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. For ADMAG AE, power supply is required separately. ADMAG AE current consumption does not concern the dedicated power supply for Fieldbus.
- **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 ADMAG AE. Two or more ADMAG AE devices or other devices can be connected. Refer to Figure 4.1 Terminal Connection for ADMAG AE.

Integral Type Flowmeter:

Terminal Symbols	Description
P+ P–	Not used
I+ I–	Fieldbus communication signal
L/+ N/–	Power supply
⏚	Protective grounding

Remote Type Converter (AE14):

Terminal Symbols	Description
SA	A shield
A	Flow signal input
B	
SB	B shield
C	Common
EX1 EX2	Excitation current output
P+ P–	Not used
I+ I–	Fieldbus communication signal
L/+ N/–	Power supply
⏚	Protective grounding

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Figure 4.1 Terminal connection for ADMAG AE

- **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 details of the host are explained in the rest of this material.
- **Cable:**
  Used for connecting devices. Refer to “Fieldbus Technical Information” (TI 38K3A01-01E) for details of instrumentation cabling. If the total length of the cable is in a range of 2 to 3 meters for laboratory or other experimental use, the following simplified cable (a twisted pair wire with a cross section of 0.9 mm^2 or more and cycle period of within 5 cm (2 inches) may be used.) Termination processing depends on the type of device being deployed. For ADMAG AE, use an M4 screw terminal. Some hosts require a connector.

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

Connect the devices as shown in Figure 4.2. 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.

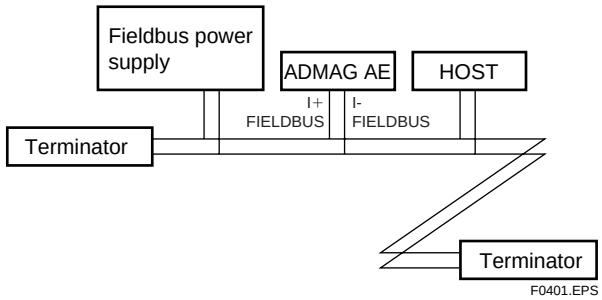

Figure 4.2 Device Connection

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 scrambles resulting in a functional disorder or a system failure.

4.2 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 the 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 4.1 Operation Parameters

Symbol	Parameter	Description and Settings
V (ST)	Slot-Time	Set 4 or greater value.
V (MID)	Minimum-Inter-PDU-Delay	Set 4 or greater value.
V (MRD)	Maximum-Reply-Delay	Set so that V (MRD) × V (ST) is 12 or greater
V (FUN)	First-Unpolled-Node	Indicate the address next to the address range used by the host. Set 0x15 or greater.
V (NUN)	Number-of-consecutive-Unpolled-Node	Unused address range. ADMAG AE address is factory-set to 0xF4. Set this address to be within the range of the BASIC device in Figure 4.3.

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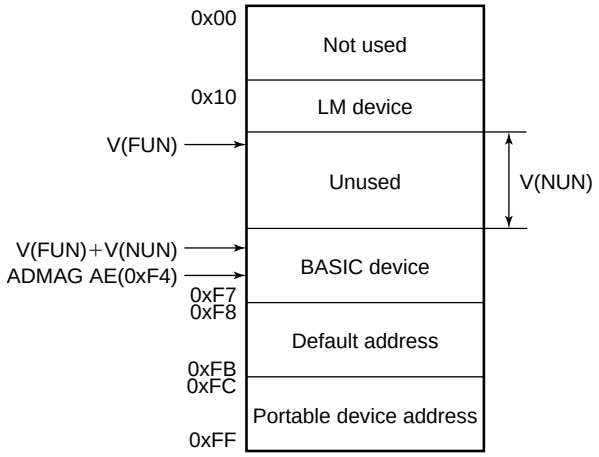

Note 1: LM device: with bus control function (Link Master function)
Note 2: BASIC device: without bus control function

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Figure 4.3 Available Address Range

4.3 Bus and ADMAG AE Power ON

Turn on the power of the host, the bus and ADMAG AE. Where the ADMAG AE is equipped with an LCD indicator(option), first all segments are lit, then the segments for a right-most digit are blinking till communication starting. If the indicator is not lit, check the voltage of the power supply for ADMAG AE.

Using the host device display function, check that the ADMAG AE is in operation on the bus. Unless otherwise specified, the following settings are in effect when shipped from the factory.

PD tag: FT1002
Node address: 244 (hexadecimal F4)
Device ID: 5945430004xxxxxxxx (xxxxxxxx = a total of 8 alphanumeric characters)

If no ADMAG AE 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 ADMAG AEs are connected at a time with default value, only one ADMAG AE will be detected from host as ADMAG AEs have the same initial address. Separately connect each ADMAG AE and set a different address for each.

4.4 Integration of DD

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

594543\0004
(594543 is the manufacturer number of Yokogawa Electric Corporation, and 0004 is the ADMAG AE device number, respectively.)

If this directory is not found, DD of ADMAG AE 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.

If you do not have the DD file, you can download it from our web site.
Visit the following web site.

http://www.yokogawa.com/fi/fieldbus/download.htm

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

Off-line configuration is possible using Capability file(CFF).

NOTE

Ensure to use the suitable file for the device. ADMAG AE has two types, /FB-with a AI function block, and /FB/LC1-with PID/LM function. If the different type CFF is used, some errors occur at downloading to the device.

4.5 Reading the Parameters

To read ADMAG AE parameters, select the AI block of the ADMAG AE from the host screen and read the OUT parameter. The current flow rate is displayed. Check that MODE_BLOCK of the function block and resource block is set to AUTO.

4.6 Continuous Record of Values

If the host has a function of continuously recording 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).

4.7 Generation of Alarm

If the host is allowed to receive alarms, generation of an alarm can be attempted from ADMAG AE. In this case, set the reception of alarms on the host side. ADMAG AE's VCR-7 is factory-set for this purpose. For practical purposes, all alarms are placed in a disabled status; for this reason, it is recommended that you first use one of these alarms on a trial basis. Set the value of link object-3 (index 30002) as "0, 299, 0, 6, 0". Refer to section 5.6.1 Link Object for details.

Since the LO_PRI parameter (index 4029) of the AI block is set to "0", try setting this value to "3". Select the Write function from the host in operation, specify an index or variable name, and write "3" to it.

The LO_LIM parameter (index 4030) of the AI block determines the limit at which the lower bound alarm for the process value is given. In usual cases, a very small value is set to this limit. Set 1 (the unit is same as XD_SCALE unit) to the limit. Since the flow rate is almost 0, a lower bound alarm is raised. Check that the alarm can be received at the host. When the alarm is confirmed, transmission of the alarm is suspended.

The above-mentioned items are a description of the simple procedure to be carried out until ADMAG AE is connected to Fieldbus. In order to take full advantage of the performance and functionality of the device, it is recommended that it be read together with Chapter 5, where describes how to use the ADMAG AE.

5. CONFIGURATION

This chapter contains information on how to adapt the function and performance of the ADMAG AE to suit specific applications. Because two or more devices are connected to Fieldbus, settings including the requirements of all devices need to be determined. Practically, 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 PD tag and node addresses for all devices.

(3)Definition of combining function blocks
Determines the method for combination between each function block.

(4)Setting tags and addresses
Sets the PD Tag and node addresses one by one 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 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 to be assigned for a host which has relatively simple functions. Refer to Appendix 5 when the ADMAG AE is used as Link Master (option).

5.1 Network Design

Select the devices to be connected to the Fieldbus network. The following instruments are necessary for 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). For ADMAG AE, separate power supply is required. Therefore, ADMAG AE current consumption does not affect the dedicated power supply for Fieldbus.
- **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. ADMAG AE 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 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. For ADMAG AE, separate power supply is required. Thus, ADMAG AE current consumption does not concern the dedicated power supply for Fieldbus. The cable must have the spur in a minimum length with terminators installed at both ends of the trunk.

5.2 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 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 16 to 247 (or hexadecimal 10 to F7) can be set. The device (LM device) with bus control function (Link Master function) is allocated from a smaller address number (16) side, and other devices (BASIC device) without bus control function allocated from a larger address number (247) side respectively. Place ADMAG AE in the range of the BASIC device. When the ADMAG AE is used as Link Master (option), place ADMAG AE in the range of LM device. Set the range of addresses to be used to the LM device. Set the following parameters.

Table 5.1 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 5.1 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 not to allow the address range to become wider, which can lead to exhaustive consumption of Fieldbus communication performance.

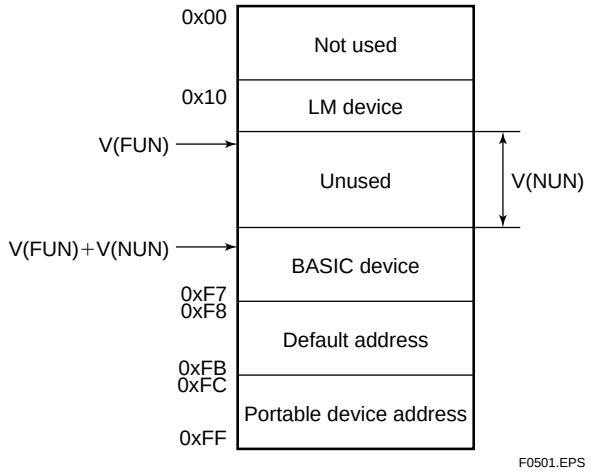

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Figure 5.1 Available Range of Node Addresses

To ensure stable operation of Fieldbus, determine the operation parameters and set them to the LM devices. While the parameters in Table 5.2 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 5.2 lists ADMAG AE specification values.

Table 5.2 Operation Parameter Values of the ADMAG AE 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 ADMAG AE, 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 ADMAG AE, 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 ADMAG AE, value of V(MRD)×V (ST) must be 12 or greater.

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5.3 Definition of Combining Function Blocks

The input/output parameters for function blocks are combined. For the ADMAG AE, AI block output parameter (OUT) and PID block (option) is subject to combination. They are combined with the input of the control block as necessary. Practically, setting is written to the ADMAG AE link object with reference to "Block setting" in Section 5.6 for details. It is also possible to read values from the host at proper intervals instead of connecting the ADMAG AE 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 ADMAG AE schedule according to the following table. Enclosed values in the table are factory-settings.

Table 5.3 Execution Schedule of the ADMAG AE 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. (32000 = 1 s)
276 (SM)	FB_START_ENTRY.1	AI block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32 ms. (0 = 0 s)
277 (SM)	FB_START_ENTRY.2	9600=0.3s for PID block (option)
278 (SM)	FB_START_ENTRY.3	Not factory-set.
279 (SM)	FB_START_ENTRY.4	Not factory-set.

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A maximum of 100 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 100 ms.

Figure 5.3 shows an example of schedule based on the loop shown in Figure 5.2.

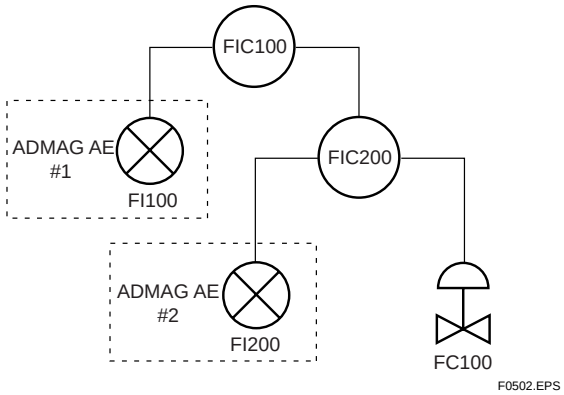

Figure 5.2 Example of Loop Connecting Function Block of Two ADMAG AE with Other Instruments

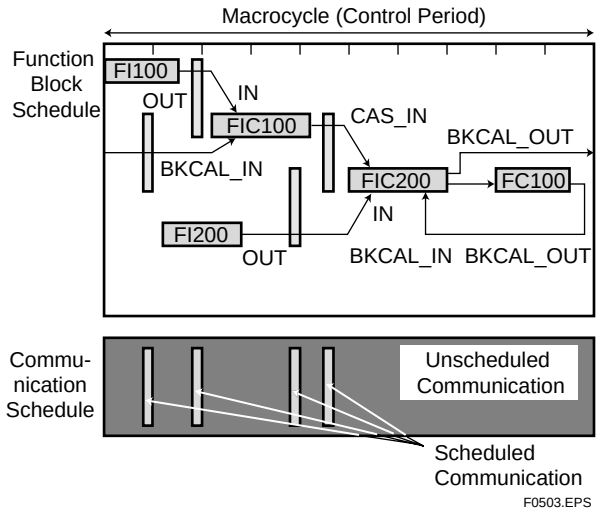

Figure 5.3 Functionn Block Schedule and Communication Schedule

When the control period (macrocycle) is set to more than 4 seconds, set the following interval 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 "starrt of the next block execution"

5.4 Setting of Tags and Addresses

This section describes the steps in the procedure to set PD Tags and node addresses in the ADMAG AE. There are three states of Fieldbus devices as shown in Figure 5.4, and if the state is other than the lowest SM_OPERATIONAL state, no function block is executed. ADMAG AE must be transferred to this state when an ADMAG AE tag or address is changed.

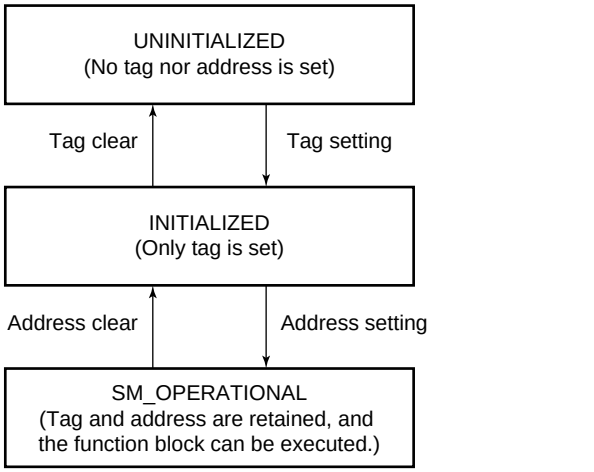

Figure 5.4 Status Transition by Setting PD Tag and Node Address

ADMAG AE has a PD Tag (FT1002) 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 address was cleared will await 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 ADMAG AE is 5945430004xxxxxxxx. (The xxxxxxxx at the end of the above device ID is a total of 8 alphanumeric characters.)

5.5 Communication Setting

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

5.5.1 VCR Setting

Set VCR (Virtual Communication Relationship), which specifies the called party for communication and resources. ADMAG AE has 16 VCRs whose application can be changed, except for the first VCR, which is used for management.

ADMAG AE 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 respond to requests from a Client (QUB) VCR after the Client initiates connection to the Server successfully. 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 5.4. Parameters must be changed together for each VCR because modification for each parameter may cause inconsistent operation.

Table 5.4 VCR Static Entry

Sub-index	Parameter	Description
1	FasArTypeAndRole	Indicates the type and role of communication (VCR). The following 4 types are used for ADMAG AE. 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 ADMAG AE. 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 secounds (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 secounds (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 ADMAG AE.
10	FasDllPublisherTime WindowSize	Not used for ADMAG AE.
11	FasDllPublisher SynchronizaingDlcep	Not used for ADMAG AE.

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Sub-index	Parameter	Description
12	FasDllSubscriberTime WindowSize	Not used for ADMAG AE.
13	FasDllSubscriber SynchronizationDlcep	Not used for ADMAG AE.
14	FmsVfdId	Sets VFD for ADMAG AE 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 ADMAG AE, it is automatically set according to specific applications.

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16 VCRs are factory-set as shown in Table 5.5.

Table 5.5 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 (LocalAddr = 0x20)
299	7	Alert Source (LocalAddr = 0x07, Remote Address=0x110)
300	8	Server (LocalAddr = 0xF9)
301	9	Not factory-set.
302	10	Not factory-set.
303	11	Not factory-set.
304	12	Not factory-set.
305	13	Not factory-set.
306	14	Not factory-set.
307	15	Not factory-set.
308	16	Not factory-set.

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5.5.2 Function Block Execution Control

According to the instructions given in Section 5.3, set the execution cycle of the function blocks and schedule of execution.

5.6 Block Setting

Set the parameter for function block VFD.

5.6.1 Link Object

Link object combines the data voluntarily sent by the function block with VCR. ADMAG AE has 11 link objects. A single link object specifies one combination. Each link object has the parameters listed in Table 5.6. Parameters must be changed together for each VCR because the modifications made to each parameter may cause inconsistent operation.

Table 5.6 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 ADMAG AE. 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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Link objects are not factory-set. Set link objects as shown in Table 5.7.

Table 5.7 Settings of Link Objects (example)

Index	Link Object #	Settings(example)
30000	1	AI. OUT→VCR#6
30001	2	Trend→VCR#5
30002	3	Alert→VCR#7
30003	4	No used
30004	5	No used
30005	6	No used
30006	7	No used
30007	8	No used
30008	9	No used
30009	10	No used
30010	11	No used

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5.6.2 Trend Object

It is possible to set the parameter so that the function block automatically transmits Trend. ADMAG AE has four Trend objects, three 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 of Resource block.

Each Trend object has the parameters listed in Table 5.8. 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 of Resource block.

Table 5.8 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 ADMAG AE 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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Five trend objects are not factory-set.

Table 5.9 Trend Objects

Index	Trend Object #	Factory Settings
32000	TREND_FLT.1	Not factory-set.
32001	TREND_FLT.2	Not factory-set.
32002	TREND_FLT.3	Not factory-set.
32003	TREND_FLT.4	Not factory-set.
32004	TREND_DIS.1	Not factory-set. (only with PID function)

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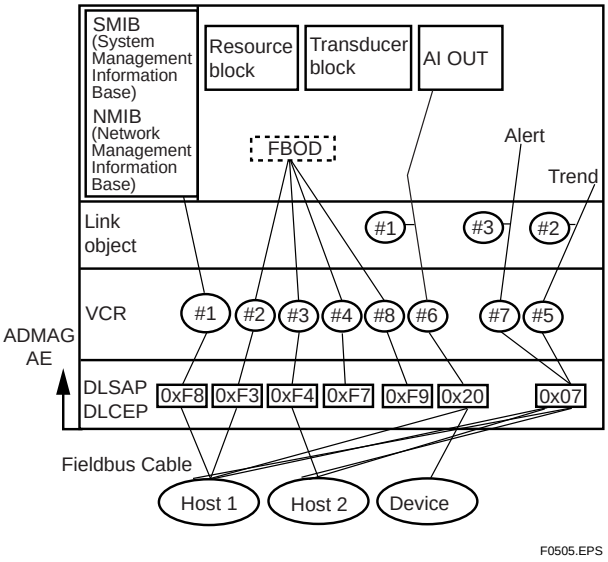

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Figure 5.5 Examle of Default Configuration

5.6.3 View Object

This is the object to form groups of parameters in a block. One of advantage brought by forming groups of parameters is the reduction of load for data transaction. ADMAG AE has four View Objects for each Resource block, Transducer block, and AI function block, and each View Object has the parameters listed in Table 5.11 to 5.14.

Table 5.10 Purpose of Each View Object

	Description
VIEW_1	Set of dynamic parameters required by operator for plant operation. (PV, SV, 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.

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Table 5.11 View Object for Resource 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	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				2
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_FSTATE				
30	CLR_FSTATE				
31	MAX_NOTIFY				1
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				2
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	
	Totals (# bytes)	22	30	54	31

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Table 5.12 View Object for Transducer 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	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				4
23	SENSOR_CAL_ METHOD				2
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	PRIMARY_VALUE_FTIME		4		
31	PRIMARY_VALUE_LOWCUT		2		
32	LINE_SIZE		4		
33	SIZE_UNIT		2		
34	LOW_MF		4		
35	HIGH_MF		4		
36	ZERO_TUNING				1
37	AUTO_ZERO				4
38	FLOW_DIRECTION		1		
39	RATE_LMT				2
40	DEAD_TIME				2
41	POWER_SYNCH				1
42	POWER_FREQ				4
43	PULSATING_FLOW				1
44	EMPTY_PIPE				1
45	MODEL				
46	DISPLAY_MODE				1
47	DISPLAY_CYCLE				1
48	ALARM_SUM	8		8	
	Totals (# bytes)	24	35	29	135

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Table 5.13 View Object for AI 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	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				
37	TOTAL			5	
38	TOTAL_UNIT				1
39	TOTAL_SCALE				4
40	TOTAL_LIM				2
41	TOTAL_LOWCUT				1
42	TOTAL_SET_VALUE				
43	REVERSE_TOTAL			5	
44	DIFF_TOTAL			5	
45	TOTAL_OPTS				1
46	VELOCITY_CHECK				
	Totals (# bytes)	31	26	46	55

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Table 5.14 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
(PID Function Block)	40800	40801	40802	40803

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5.6.4 AI Function Block Parameters

AI Function block parameters can be read or set from the host. For a list of the parameters of blocks held by the ADMAG AE, refer to "List of parameters for each block of the ADMAG AE" in Appendix 1. The following is a list of important parameters with a guide to how to set them. For PID/LM function option, refer to Appendix 4 and 5.

MODE_BLK:

Indicates the three types of function block modes; Out_Of_Service, Manual, and Auto. In Out_Of_Service 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. 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. Do not change this setting.

XD_SCALE:

Scale of input from the transducer block. "0"(0%), "10"(100%), and "m/s" for the unit are factory-set unless otherwise specified. 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 by AI.) Units which can be set by XD_SCALE are shown below.

m/s(1061), ft/s(1067), m^3/s(1347), m^3/min(1348), m^3/h(1349), m^3/d(1350), L/s(1351), L/min(1352), L/h(1353), L/d(1354), cm^3/s(1511), cm^3/min(1512), cm^3/h(1513), cm^3/d(1514), Mgal/s(1451), Mgal/min(1455), Mgal/h(1459), Mgal/d(1366), kgal/s(1450), kgal/min(1454), kgal/h(1458), kgal/d(1462), gal/s(1362), GPM(1363), gal/h(1364), gal/d(1365), mgal/s(1449), mgal/min(1453), mgal/h(1457), mgal/d(1461), kbbl/s(1481), kbbl/min(1485), kbbl/h(1489), kbbl/d(1493), bbl/s(1371), bbl/min(1372), bbl/h(1373), bbl/d(1374), mbbl/s(1480), mbbl/min(1484), mbbl/h(1488), mbbl/d(1492), ubbl/s(1479), ubbl/min(1483), ubbl/h(1487), ubbl/d(1491)

OUT_SCALE:

Sets the range of output (from 0% to 100%). Available units for OUT_SCALE are the above units for XD_SCALE and the units shown below.

%(1342), CFS(1356), CFM(1357), CFH(1358), ft^3/d(1359), t/s(1326), t/min(1327), t/h(1328), t/d(1329), kg/s(1322), kg/min(1323), kg/h(1324), kg/d(1325), g/s(1318), g/min(1319), g/h(1320), g/d(1321), lb/s(1330), lb/min(1331), lb/h(1332), lb/d(1333), STON/s(1334), STON/min(1335), STON/h(1336), STON/d(1337), LTON/s(1338), LTON/min(1339), LTON/h(1340), LTON/d(1341), MImpGal/s(1466), MImpGal/min(1470), MImpGal/h(1474), MImpGal/d(1478), kImpGal/s(1465), kImpGal/min(1469), kImpGal/h(1474), kImpGal/d(1477), ImpGal/s(1367), ImpGal/min(1368), ImpGal/h(1369), ImpGal/d(1370), mImpGal/s(1464), mImpGal/min(1468), mImpGal/h(1472), mImpGal/d(1476)

L_TYPE:

Specifies the operation function of the AI block. If set to “Direct”, the input delivered to CHANNEL is directly reflected on OUT. If set to “Indirect”, scaling by XD_SCALE and OUT_SCALE is carried out and is reflected on OUT. “Indirect SQRT” is not used for ADMAG AE.

PV_FTIME:

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

Alarm Priority:

Indicates the priority of the process alarm. If a value of 3 or greater is set, an alarm is transmitted. The factory default is 0. Four types of alarm can be set: HI_PRI, HI_HI_PRI, LO_PRI, and LO_LO_PRI.

Alarm Threshold:

Sets the threshold at which a process alarm is generated. The factory default setting is a value that does not generate an alarm. Four types of alarm can be set: HI_LIM, HI_HI_LIM, LO_LIM, and LO_LO_LIM.

5.6.5 Transducer Block Parameters

The transducer block sets functions specific to the flow rate measurement of the ADMAG AE. For a list of the parameters of each block of the ADMAG AE, refer to “List of parameters for each block of the ADMAG AE” in Appendix 1. The following is a list of important parameters with a guide to how to set them.

LINE_SIZE:

Sets the size of the flow tube.

SIZE_UNIT:

Sets the unit of the flow tube size.

LOW_MF:

Sets the meter factor of low frequency side.

HIGH_MF:

Sets the meter factor of high frequency side.

For integral type ADMAG AE, these above parameters are set when shipping. Please confirm with data plate. For remote type AE14 converter, please set the above parameters which are shown in the data plate on the combined flow tube.

PRIMARY_VALUE_FTIME:

Sets output time constants. Setting range is 0.1 to 200sec. “ 3sec.” is factory set.

PRIMARY_VALUE_LOWCUT:

Sets low cut range for output. Setting range is 0 to 10%. “ 0%” is factory set. The larger absolute value from EU at 100% or EU at 0% is used for the scale.

DISPLAY_MODE:

Sets the unit to be used for LCD display.

1=Out value
2=%
3=Totalized value
4=Reverse totalized value
5=Diff. totalized value

The factory default setting is 2.

DISPLAY_CYCLE:

Sets the cycle of LCD display. The display cycle is 500ms x (setting). The factory default setting is 1, but if a low temperature environment makes it difficult to view the display, it is recommended that you set a longer display cycle.

6. IN-PROCESS OPERATION

This chapter describes the procedure performed when changing the operation of the function block of the ADMAG AE 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 as AL-XX. If two or more alarms are issued, multiple error numbers are displayed in 2-second intervals. (when "1" is set to DISPLAY_CYCLE). An alarm lamp(LED) flashes during alarming.

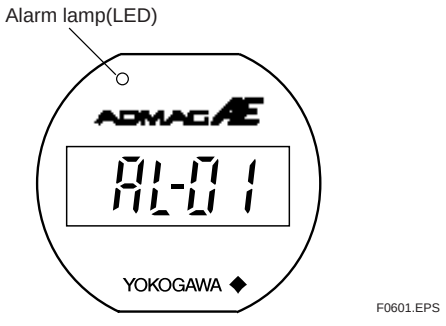

Figure 6.1 Error Identification on Indicator

Table 6.1 List of Error Messages

LCD	Content of Alarms
AL_01	Microprocessor failure.
AL_02	Amplifier or hardware failure.
AL_03	EEPROM failure.
AL_04	A/D converter(high frequency side) failure.
AL_05	A/D converter(low frequency side) failure.
AL_06	Excessive input signal.
AL_07	Flow tube coil open-circuit.
AL_20	AI block is not scheduled.
AL_21	The resource block is in O/S mode.
AL_22	The transducer block is in O/S mode.
AL_23	AI function block is in O/S mode.
AL_41	The flow rate is out of the measurement range. Measurement flow velocity exceed 108% of forward flow direction span setting.
AL_42	The flow rate is out of the measurement range. Measurement flow velocity exceed -108% of reverse flow direction span setting.
AL_43	Setting for flow velocity span exceeds 11m/s.
AL_44	Setting for flow velocity span is 0.2m/s or under.
AL_45	Totalization rate exceeds 1100pps.
AL_46	Totalization rate is 0.00005pps or less.
AL_47	Empty pipe detection. Flow tube is not filled with fluid.
AL_61	Out of the range of the indicator display.
AL_62	AI function block is in Simulate mode.
AL_63	AI function block is in Man mode.
AL_64	Zero-point adjustment is abnormal.
✻	ADMAG AE is not participating in Fieldbus network.

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✻ The segments for a right-most digit are blinking.

6.2.2 Alarms and Events

Following alarm or event can be reported by ADMAG AE as an alert.

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

Discrets Alerts (Generated when an abnormal condition is detected)
By Resource Block: Block Alarm, Write Alarm
By Transducer Block: Block Alarm
By AI Block: Block Alarm

Update Alerts (Generated when a important (restorable) parameter is updated)
By Resource Block: Update Event
By Transducer Block: Update Event
By AI Block: Update Event

An alert has following structure:

Table 6.2 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	Mft 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 jumper switch is mounted in the ADMAG AE amplifier. This is to prevent the accidental operation of this function. When jumper is shortcircuited with a pin, simulation is enabled. (See Figure 6.2.) To initiate the same action from a remote terminal, if REMOTE LOOP TEST SWITCH is written to SIM_ENABLE_MSG (index 1044) parameter 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 block consists of the elements listed in Table 6.3 below.

Table 6.3 SIMULATE Parameter

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	Simulate En/Disable	Controls the simulation function of this block. 1: Disabled (standard) 2: Active(simulation)

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When Simulate En/Disable in Table 6.3 above is set to "Active", 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.

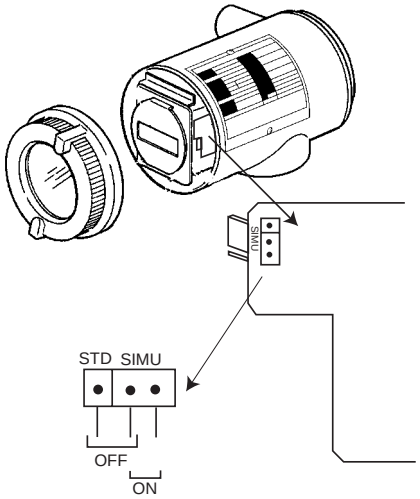

Figure 6.2 SIMULATE_ENABLE Switch Position

IMPORTANT

This display board connector is released before simulation jumper switching. Do not pull the amplifier out of the case. After jumper switching, please confirm that the display board connector is not loose.

7. DEVICE STATUS

Device status and failures of ADMAG AE are indicated by using parameter DEVICE_STATUS_1, DEVICE_STATUS_2 and DEVICE_STATUS_3 (index 1045, 1046 and 1047) in Resource Block.

Table 7.1 Contents of DEVICE_STATUS__1 (index 1045)

Hexadecimal	Display through DD	Description
0×30000000		
0×40000000		
0×20000000		
0×10000000		
0×08000000		
0×04000000		
0×02000000		
0×01000000		
0×00800000	Sim.enable Jmpr On	SIMULATE_ENABLE Switch is ON.
0×00400000	RB in O/S mode(AL.21)	Resource Block is in O/S mode.
0×00200000		
0×00100000		
0×00080000	AMP Module Failure 2(AL.03)	AMP module failure.
0×00040000		
0×00020000		
0×00010000		
0×00008000	LINK OBJ. 1/17 not open	Link object 1 is not open.
0×00004000	LINK OBJ. 2 not open	Link object 2 is not open.
0×00002000	LINK OBJ. 3 not open	Link object 3 is not open.
0×00001000	LINK OBJ. 4 not open	Link object 4 is not open.
0×00000800	LINK OBJ. 5 not open	Link object 5 is not open.
0×00000400	LINK OBJ. 6 not open	Link object 6 is not open.
0×00000200	LINK OBJ. 7 not open	Link object 7 is not open.
0×00000100	LINK OBJ. 8 not open	Link object 8 is not open.
0×00000080	LINK OBJ. 9 not open	Link object 9 is not open.
0×00000040	LINK OBJ. 10 not open	Link object 10 is not open.
0×00000020	LINK OBJ. 11 not open	Link object 11 is not open.
0×00000010	LINK OBJ. 12 not open	Not used for ADMAG AE.
0×00000008	LINK OBJ. 13 not open	Not used for ADMAG AE.
0×00000004	LINK OBJ. 14 not open	Not used for ADMAG AE.
0×00000002	LINK OBJ. 15 not open	Not used for ADMAG AE.
0×00000001	LINK OBJ. 16 not open	Not used for ADMAG AE.

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Table 7.2 Contents of DEVICE_STATUS__2 (index 1046)

Hexadecimal	Display through DD	Description
0×80000000		
0×40000000		
0×20000000		
0×10000000		
0×08000000		
0×04000000		
0×02000000		
0×01000000		
0×00800000		
0×00400000		
0×00200000		
0×00100000		
0×00080000		
0×00040000		
0×00020000		
0×00010000	Zero adjustment error(AL-64)	Zero-point adjustment is abnormal.
0×00008000	Data is out of LCD display range(AL-61)	Out of the range of the indicator display.
0×00004000	Empty pipe(AL-47)	Empty pipe detection. Flow tube is not filled with fluid.
0×00002000	Internal total rate is less than 0.00005 pps(AL-46)	Totalization rate is 0.00005pps or less.
0×00001000	Internal total rate is more than 1100 pps(AL-45)	Totalization rate exceeds 1100pps.
0×00000800	Span velocity is less than 0.2m/s (AL-44)	Setting for flow velocity span is 0.2m/s or under.
0×00000400	Span velocity is more than 11m/s (AL-43)	Setting for flow velocity span exceeds11m/s.
0×00000200	Flow velocity overflow (Reverse) (AL-42)	The flow rate is out of the measurement range. Measurement flow velocity exceed -108% of reverse flow direction span setting.
0×00000100	Flow velocity overflow (Forward) (AL-41)	The flow rate is out of the measurement range. Measurement flow velocity exceed 108% of forward flow direction span setting.
0×00000080	AMP Module Failure 3(AL-02)	Amplifier or hardware failure.
0×00000040	AMP Module Failure 2(AL-03)	EEPROM failure.
0×00000020	AMP Module Failure 1(AL-02)	Amplifier or hardware failure.
0×00000010	Coil open(AL-07)	Flow tube coil open-circuit.
0×00000008	Input signal overflow(AL-06)	Excessive input signal.
0×00000004	AD Low Failure(AL-05)	A/D converter(low frequency side) failure.
0×00000002	AD High Failure(AL-04)	A/D converter(high frequency side) failure.
0×00000001	CPU Module Failure(AL-01)	Microprocessor failure.

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Table 7.3 Contents of DEVICE_STATUS__3(index 1047)

Hexadecimal	Display through DD	Description
0×80000000		
0×40000000		
0×20000000		
0×10000000		
0×08000000	Transducer Block is in O/S mode(AL-22).	Transducer Block is in O/S mode.
0×04000000		
0×02000000		
0×01000000		
0×00800000		
0×00400000		
0×00200000		
0×00100000		
0×00080000		
0×00040000		
0×00020000		
0×00010000		
0×00008000		
0×00004000		
0×00002000		
0×00001000		
0×00000800	AI Function Block is not scheduled (AL-20).	AI Function Block is not scheduled.
0×00000400	Simulation is enabled in AI Function Block(AL-62).	AI Function Block is in Simulation mode.
0×00000200	AI Function Block is in Manual mode (AL-63).	AI Function Block is in Manual mode.
0×00000100	AI Function Block is in O/S mode (AL-23).	AI Function Block is in O/S mode.
0×00000080		
0×00000040		
0×00000020		
0×00000010		
0×00000008	PID Function Block Error 2	Not used for ADMAG AE.
0×00000004	PID Function Block Error 1	Not used for ADMAG AE.
0×00000002	PID Function Block is in BYPASS mode.	PID Function Block is in BYPASS mode.
0×00000001	PID Function Block is in O/S mode.	PID Function Block is in O/S mode.

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8. GENERAL SPECIFICATIONS

■ Standard Specifications

For items other than those described below, refer to ADMAG AE Magnetic Flowmeter user's manual IM 1E7B0-02E or 1E7C1-E.

Applicable Model:

ADMAG AE excluding explosion proof model (except CENELEC ATEX, FM and TIIS (former JIS) ex-proof type) or 24 V DC version.

Output Signal:

Digital communication signal based on FOUNDATION Fieldbus protocol.

Conditions of Communication Line:

Supply Voltage: 9 to 32 V DC

Supply Current: 0 mA (No need power supply from bus)

Power Supply Effect:

No effect (within the supply voltage of 9 to 32 V DC)

Functional Specifications:

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

Function Block: AI block (enhanced), PID block (option) Link Master function (option)

<Setting When Shipped>

Tag Number(PD_TAG)*1	Default(FT1002)for PD_TAG, nothing for tag plate unless otherwise specified
Output Mode (L_TYPE)	'Direct' unless otherwise specified in order
Flow rate Range (XD_SCALE) Lower/Higher Range Value and Unit	'0 to 10m/s' unless otherwise specified in order
Output Range (OUT_SCALE) Lower/Higher Range Value and Unit	Same data as 'XD_SCALE' unless otherwise specified
Node Address	'0×F4(244)' unless otherwise specified

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*1: Specified Tag Number is entered in the amplifier memory and also engraved on the stainless steel plate.
-For entry in the amplifier memory,
Up to 32 letters using any of alphanumerics and symbols, - and ·.
-For engraving on the stainless steel plate,
Up to 16 letters using any of alphanumerics and symbols.

■ Standard Performance

Accuracy:

PFA, Ceramics

Size(mm)	Actual Flow Velocity(m/s)	Accuracy
2.5 to 15	less than 0.3	1.5mm/s
	0.3 or more	±0.5% of rate
25 to 400	less than 0.15	0.75mm/s
	0.15 or more	±0.5% of rate

Polyurethane rubber

Size(mm)	Actual Flow Velocity(m/s)	Accuracy
25 to 400	less than 0.3	1.5mm/s
	0.3 or more	±0.5% of rate

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■ Optional Specifications

For items other than those described below, refer to IM 1E7B0-02E or 1E7C1-E

Items	Description	Code
PID/LM function	PID control function and Link Master function (Set as Link Master device when shipped.)	/LC1

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APPENDIX 1. LIST OF PARAMETERS FOR EACH BLOCK OF THE ADMAG AE

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.

A1.1 Resource Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	1000	Block Header	TAG:"RS"	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	1001	ST_REV	–	–	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 alarms, etc.
5	1005	MODE_BLK	AUTO	AUTO	The actual, target, permitted, and normal modes of the block.
6	1006	BLOCK_ERR	–	–	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	Null	AUTO	Read/write test parameter-used only for conformance testing and simulation.
9	1009	DD_RESOURCE	Null	–	String identifying the tag of the resource which contains the Device Description for this resource.
10	1010	MANUFAC_ID	0x00594543	–	Manufacturer identification number-used by an interface device to locate the DD file for the resource.
11	1011	DEV_TYPE	4	–	Manufacturer's model number associated with the resource-used by interface devices to locate the DD file for the resource.
12	1012	DEV_REV	1	–	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	Scalar input	–	The types of hardware available as channel numbers. bit0: Scalar input bit1: Scalar output bit2: Discrete input bit3: Discrete output
16	1016	RESTART	–	–	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	Soft write lock supported Report supported	–	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	Soft write lock supported Report supported	AUTO	Used to select resource block options defined in FEATURES. bit0: Scheduled bit1: Event driven bit2: Manufacturer specified
19	1019	CYCLE_TYPE	Scheduled	–	Identifies the block execution methods available for this resource.
20	1020	CYCLE_SEL	Scheduled	AUTO	Used to select the block execution method for this resource.
21	1021	MIN_CYCLE_T	3200 (100ms)	–	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 NV parameters to non-volatile memory. Zero means never.
24	1024	FREE_SPACE	0	–	Percent of memory available for further configuration. ADMAG AE 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. ADMAG AE 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. ADMAG AE does not support this.
29	1029	SET_FSTATE	1	AUTO	Allows the fail-safe condition to be manually initiated by selecting Set. ADMAG AE does not support this.
30	1030	CLR_FSTATE	1	AUTO	Writing a Clear to this parameter will clear the device fail-safe state if the field condition, if any, has cleared. ADMAG AE does not support this.
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	Not Locked	AUTO	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated
35	1035	UPDATE_EVT	–	–	This alert is generated by any change to the static data.
36	1036	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. 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	Enable(0×0000)	–	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	1038	ACK_OPTION	0×ffff	AUTO	
39	1039	WRITE_PRI	0	AUTO	Priority of the alarm generated by clearing the write lock.
40	1040	WRITE_ALM	–	–	This alert is generated if the write lock parameter is cleared.
41	1041	ITK_VER	4	–	Version number of interoperability test by Fieldbus Foundation applied to ADMAG AE.
42	1042	SOFT_REV		–	ADMAG AE software revision number.
43	1043	SOFT_DESC		–	Yokogawa internal use.
44	1044	SIM_ENABLE_MSG	Null	AUTO	Software switch for simulation function.
45	1045	DEVICE_STATUS_1	0	–	Device status(VCR setting etc.)
46	1046	DEVICE_STATUS_2	0	_	Device status(Failure or setting error etc.)
47	1047	DEVICE_STATUS_3	0	–	Device status(Function block setting.)
48	1048	DEVICE_STATUS_4	0	–	Not used for ADMAG AE.
49	1049	DEVICE_STATUS_5	0	–	Not used for ADMAG AE.
50	1050	DEVICE_STATUS_6	0	_	Not used for ADMAG AE.
51	1051	DEVICE_STATUS_7	0	–	Not used for ADMAG AE.
52	1052	DEVICE_STATUS_8	0	–	Not used for ADMAG AE.

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A1.2 AI Function Block

Relative Index	Index AI	Parameter Name	Factory Default	Write Mode	Explanation
0	4000	Block Header	TAG: “AI”	Block Tag = 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.
4	4004	ALERT_KEY	1	AUTO	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	4005	MODE_BLK	AUTO	AUTO	The actual, target, permitted, and normal modes of the block.
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. bit 1: Block configuration error bit 3: Simulate Active bit 7: Input failure/process variable has BAD status. bit 15: Out of service
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	Value = MAN	The primary analog value calculated as a result of executing the function.
9	4009	SIMULATE	Disable(1)	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	MAN	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 5.6.4 AI Function Block Parameters for the unit available.
11	4011	OUT_SCALE	Specified at the time of order	MAN	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 5.6.4 AI Function Block Parameters for the unit available.
12	4012	GRANT_DENY	0×00	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	0×0000	O/S	Options which the user may select to alter input and output block processing. bit 10: Low cutoff
14	4014	STATUS_OPTS	0	O/S	Options which the user may select in the block processing of status. bit 3 : Propagate Failure Forward, 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.
16	4016	L_TYPE	Direct(1)	MAN	Determines if the values passed by the transducer block to the AI block may be used directly (Direct) or if the value is in different units and must be converted linearly (Indirect), or with square root (Ind Sqr Root), using the input range defined by the transducer and the associated output range. "Indirect Squre Root" is not used for ADMAG AE.

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Relative Index	Index AI	Parameter Name	Factory Default	Write Mode	Explanation
17	4017	LOW_CUT	0.01	AUTO	Sets low cut point of output. This low cut value become available by setting "Low cutoff" to "IO-OPTS".
18	4018	PV_FTIME	0sec	AUTO	Time constant of a single exponential filter for the PV, in seconds.
19	4019	FIELD_VAL	–	–	Raw value of the field device in percent of thePV 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	–	–	This alert is generated by any change to the static data.
21	4021	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. 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	Enable(0×0000)	–	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
23	4023	ACK_OPTION	0×ffff	AUTO	Selection of whether alarms associated with the block will be automatically acknowledged.
24	4024	ALARM_HYS	0.5%	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.
25	4025	HI_HI_PRI	0	AUTO	Priority of the high high alarm.
26	4026	HI_HI_LIM	+INF	AUTO	The setting for high high alarm in engineering units.
27	4027	HI_PRI	0	AUTO	Priority of the high alarm.
28	4028	HI_LIM	+INF	AUTO	The setting for high alarm in engineering units.
29	4029	LO_PRI	0	AUTO	Priority of the low alarm.
30	4030	LO_LIM	–INF	AUTO	The setting for the low alarm in engineering units.
31	4031	LO_LO_PRI	0	AUTO	Priority of the low low alarm.
32	4032	LO_LO_LIM	–INF	AUTO	The setting of the low low alarm in engineering units.
33	4033	HI_HI_ALM	0	–	The status for high high alarm and its associated time stamp.
34	4034	HI_ALM	0	–	The status for high alarm and its associated time stamp.
35	4035	LO_ALM	0	–	The status of the low alarm and its associated time stamp.
36	4036	LO_LO_ALM	0	–	The status of the low low alarm and its associated time stamp.
37	4037	TOTAL	0	Man	Indicates and presets the totalized value. 0 to 999999
38	4038	TOTAL_UNIT	PULSE/s(7)	O/S	Selects the totalized rate unit. 1=nUNIT/p, 2=μUNIT/p, 3=mUNIT/p, 4=UNIT/p, 5=kUNIT/p, 6=MUNIT/p, 7=PULSE/s
39	4039	TOTAL_SCALE	0	O/S	Sets the totalized rate. 0 to 30000
40	4040	TOTAL_LOWCUT	3%	O/S	Sets the low input signal limit for totalization. 0 to 100%
41	4041	TOTAL_SET	Disable(1)	Man	Ristricts forward direction totalization preset and reverse direction totalization reset. 1=Disable, 2=Enable
42	4042	TOTAL_SET_VALUE	0	Man	Sets the totalizer preset(reset) value. 0 to 999999
43	4043	REVERSE_TOTAL	0	Man	Indicates and resets reverse totalized value. 0 to 999999
44	4044	DIFF TOTAL	0	–	Indicates differential totalized value. 0 to 999999
45	4045	TOTAL_OPTS	Damp(2)	O/S	Sets whether instantaneous flow rate value or damped flow rate for totalization. 1=No Damping, 2=Damping
46	4046	VELOCITY_CHECK	10m/s	–	Display the velocity (m/s) at EU 100 of XD_SCALE.

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A1.3 Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2000	Block Header	TAG: “TB”	Block Tag = O/S	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	(spaces)	AUTO	The user description of the intended application of the block
3	2003	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	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	AUTO	AUTO	The actual, target, permitted, and normal modes of the block.
6	2006	BLOCK_ERR	0	–	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	1,2010	–	A directory that specifies the number and starting indices of the device.
10	2010	TRANSDUCER_ TYPE	Standard Flow with Calibration(104)	–	Identifies device. ADMAG AE is Standard Flow with Calibration.
11	2011	XD_ERROR	0	–	The sub-code of error with the first priority is displayed. 0=No failure, 17=General error, 18=Calibration error, 19=Configuration error, 20=Electronics failure, 21=Mechanical failure 22=I/O failure
12	2012	COLLECTION_ DIRECTORY	2,2013, 0×80020354 2028, 0×80020382	–	A directory that specifies the number, starting indices, and DD Item IDs of the data collections in each transducer within a transducer block.
13	2013	PRIMARY_ VALUE_TYPE	Volumetric flow(101)	O/S	The type of measurement represented by primary value. Followings are available for ADMAG AE: 101=volumetric flow 103=average volumetric flow
14	2014	PRIMARY_ VALUE	–	–	Indicates flow rate.
15	2015	PRIMARY_ VALUE_RANGE	10 -10 m/s(1061)	–	Indicates flow range. These values are converted the values 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	0.3	–	The minimum calibration span value allowed. Indicates the value converted 0.3m/s by the unit of CAL_UNIT and the data of LINE_SIZE.
19	2019	CAL_UNIT	m/s(1061)	O/S	The engineering unit for the calibrated values. The units for XD_SCALE are available.
20	2020	SENSOR_TYPE	Electromagnetic(112)	O/S	The type of sensor. ADMAG AE is Electromagnetic.
21	2021	SENSOR_RANGE	10 -10 m/s(1061)	–	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.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
22	2022	SENSOR_SN	–	–	ADMAG AE does not use this.
23	2023	SENSOR_CAL_ METHOD	Volumetric(100)	O/S	The method of the last sensor calibration. 100=volumetric 101=static weigh
24	2024	SENSOR_CAL_ LOC	– location	O/S	Sets/indicates the location of the last sensor calibration.
25	2025	SENSOR_CAL_ DATE	– date	O/S	Sets/indicates the date of the last sensor calibration.
26	2026	SENSOR_CAL_ WHO	– name	O/S	Sets/indicates the name of the person responsible for the last sensor calibration.
27	2027	LIN_TYPE	linear with input(1)	–	The linearization type of sensor output. ADMAG AE is "linear with input".
28	2028	SECONDARY_ VALUE	0	O/S	Totalizer value.
29	2029	SECONDARY_ VALUE_UNIT	m(1010)	O/S	Totalizer value unit. The unit is linked to the unit of XD_SCALE.
30	2030	PRIMARY_ VALUE_FTIME	3sec	AUTO	Sets the time constant of output. 0.1 to 200sec.
31	2031	PRIMARY_ VALUE_LOWCUT	0	O/S	Sets low cut range for output. 0 to 10%.
32	2032	LINE_SIZE	Sets the size of flow tube	O/S	Nominal size of flow tube.
33	2033	SIZE_UNIT	mm(1013)	O/S	Nominal size unit of flow tube. 1013=mm, 1019=inch
34	2034	LOW_MF	Sets the calibration value	O/S	Meter factor of low frequency side.
35	2035	HIGH_MF	Sets the calibration value	O/S	Meter factor of high frequency side.
36	2036	ZERO_TUNING	Enable(2)	O/S	Sets the operation of Auto zero adjustment. 1=Disable, 2=Enable, 3=Now executing(Auto zero is in progress)
37	2037	AUTO_ZERO	0.00	O/S	Executes Auto zero adjustment.
38	2038	FLOW_DIRECTION	Forward(2)	O/S	Sets the flow direction. 1=Reverse, 2=Forward
39	2039	RATE_LIMIT	5%	O/S	Sets the level to reduce output fluctuation. 0 to 10%
40	2040	DEAD_TIME	0sec	O/S	Sets the dead time to reduce output fluctuation. When "0" is set, RATE_LIMIT is not available. 0 to 15sec
41	2041	POWER_SYNCH	Synch(2)	O/S	Selects whether the internal frequency is to be synchronized with the power supply or not. 1=No synch, 2= Synch
42	2042	POWER_FREQ	50.00Hz	O/S	Displays and sets the power frequency.
43	2043	PULSATING_FLOW	No(1)	O/S	Counteraction of pulsating flow. 1=No, 2=Yes
44	2044	EMPTY_PIPE	Alarm(2)	O/S	Selects whether empty pipe detection is to be used as an alarm or not. 1=No alarm, 2=Alarm
45	2045	MODEL	AE100	O/S	Displays the device model name.
46	2046	DISPLAY_MODE	%(2)	AUTO	Sets the LCD display mode. 1 = OUT Value 2 = % 3 = Totalized Value 4 = Reverse Totalized Value 5 = Diff. Totalized Value
47	2047	DISPLAY_CYCLE	1	AUTO	Sets the renewal cycle of LCD display. 1 to 10.
48	2048	ALARM_SUM	Disabled(0×ffff)	–	Indicates the status of the alarm of the block.

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APPENDIX 2. APPLICATION, SETTING AND CHANGE OF BASIC PARAMETERS

A2.1 Applications and Selection of Basic Parameters

Setting Item (applicable parameters)	Summary
Tag No.	Sets PD Tag and each block tag. Up to 32 alphanumeric characters can be set for both tags. Refer to “Tag and address” in Section 5.4.
Calibration range setup (XD_SCALE)	Sets the range of input from the transducer block corresponding to the 0% and 100% points in operation within the AI1 function block. The calibrated range (0% and 100%) is the factory default setting. Sets the range unit, input value of the 0% point (in case of ADMAG AE, 0), input value of the 100% point (correspond to flow rate span), and the 4 data at the decimal point.
Output scale setup (OUT_SCALE)	Sets the scale of output corresponding to the 0% and 100% points in operation within the AI function block. It is possible to set a unit and scale that differs from the measurement range. Sets the range unit, input value of the 0% point (lower bound of output scale), input value of the 100% point (upper bound of output scale), and the 4 data at the decimal point.
Output mode setup (L_TYPE)	Selects the operation function of the AI function block. It may be chosen from among Direct, Indirect, and IndirectSQRT. Direct: The output of the transducer block is directly output only via filtering without scaling and square root extraction. (XD_SCALE) Indirect: Output processed by proportion at the AI function block. (OUT_SCALE) IndirectSQRT: Output processed by square root extraction at the AI function block. IndirectSQRT is not used for ADMAG AE. *The scale and unit of LCD indicator depend on this setting.
Simulation setup (SIMULATE)	Performs simulation of the AI 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)	Sets the time constant of damping function in seconds. The setting of PRIMARY_VALUE_FTIME affects not only flow rate but internal totalization. The totalization is not affected by setting "No Damping" to TOTAL_OPTS of AI function block. PV_FTIME of AI function block is a parameter for damping the value of AI OUT. It is recommended to use PRIMARY_VALUE_FTIME for flowmeter's damping function.
Output signal low cut mode setup (PRIMARY_VALUE_LOWCUT)	Sets the low cut value in percent against the larger absolute value between EU at 100% and EU at 0%. The hysteresis is 0.5% when the low cut functions and also is released. LOW_CUT of AI function block is a parameter for low cut of AI OUT. It has 1% hysteresis when the low cut is released. Do not make LOW_CUT functioned when flow measuring in reverse direction, or the output is zero at any flow rate because the flow rate is always regarded as under zero. It is recommended to use PRIMARY_VALUE_LOWCUT for flowmeter's low cut function.
LCD display setup (DISPLAY_MODE, DISPLAY_CYCLE)	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 (ZERO_TUNING, AUTO_ZERO)	Performs zero-point adjustment. Zero-point adjustment should be done only when the fluid is filled in the flow tube and the fluid velocity is completely zero.

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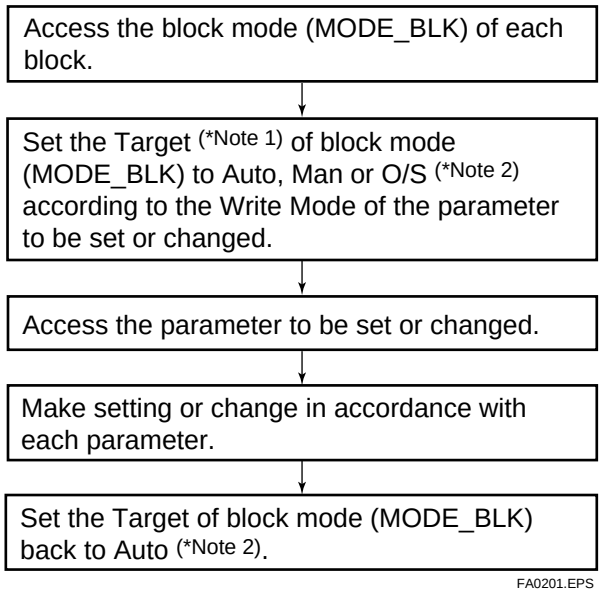
A2.2 Setting and Change of Basic Parameters

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.



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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.

Note 1: Block mode consists of the following four modes that are controlled by the universal parameter that displays the running 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	Transducer Block	Resource Block
Automatic (Auto)	Yes	Yes	Yes
Manual (Man)	Yes		
Out of Service (O/S)	Yes	Yes	Yes

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Refer to the “List of parameters for each block of the ADMAG AE” for details of the Write Mode for each block.

A2.3 Setting the AI Function Block

The AI function block outputs the flow rate signals.

(1)Setting the calibration range

Access the XD_SCALE parameter.
Set the necessary unit to Units Index on XD_SCALE.
Set the higher range value to EU at 100% on XD_SCALE.
Set the lower range value to EU at 0% on XD_SCALE.
Set the decimal position to Decimal Point.

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Example:
To measure 0 to 100m^3/h,
Set m^3/h (1349)* to Units Index on XD_SCALE,
Set 100 to EU at 100% on XD_SCALE, and
Set 0 to EU at 0% on XD_SCALE.

(2)Setting the output scale

Access the OUT_SCALE parameter.
Set the necessary unit of output to Units Index on OUT_SCALE.
Set an output value corresponding to the higher range value to EU at 100% on OUT_SCALE.
Set an output value corresponding to the lower range value to EU at 0% on OUT_SCALE.
Set the decimal position to Decimal Point.

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Example:
To set the output to 0.00 to 100.00kg/h,
Set kg/h(1324)* to Units Index on OUT_SCALE,
Set 100 to EU at 100% on OUT_SCALE,
Set 0 to EU at 0% on OUT_SCALE,
and Set 2 to Decimal Point on OUT_SCALE.

* Each unit is expressed using a 4-digit numeric code. Refer to Section 5.6.4 AI Function Block Parameters.

Restrictions imposed when the device is equipped with a built-in indicator.

When the output mode (L_TYPE) is set as Indirect or IndirectSQRT, the range determined by the output scale corresponds to the scale and unit of the indicator. Set the lower and higher value of the range (numeric string excluding decimal point if the decimal point is included) in a range of –30000 to 30000. Down to the third decimal position can be set. (When the output mode (L_TYPE) is set as Direct, unit determined at XD_SCALE is displayed.)

(3)Setting the output mode

Access the L_TYPE parameter.
Set the output mode.
1: Direct (Sensor output value)
2: Indirect (Linear output value)
3: IndirectSQRT (Square root extraction output value)*

* Indirect SQRT is not used for ADMAG AE.

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(4)Totalization function

When setting PULSE/s to totalozation unit (TOTAL_UNIT), the larger value between the absolute values of EU at 100% or EU at 0% is used for totalizing.
example : EU at 100%=1m/s, EU at 0%=-2m/s
"2m/s" is used for totalizing.

(5)Simulation

By optionally setting the input value to the calibration range and status, perform simulation of the AI function block.

Access the Simulate En/Disable parameter.
Set whether Simulation is enabled or disabled.
Disabled(1) = disabled
Active(2) = enabled

↓

Access the Simulate Status parameter.
Set the status code.

↓

Access the Simulate Value parameter.
Set an optional input value.

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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.

A2.4 Setting the Transducer Block

To access function specifics of the ADMAG AE of the transducer block, the DD (Device Description) for ADMAG AE needs to have been installed in the configuration tool used. For integration of DD, refer to “Integration of DD” in Section 4.4.

(1)Setting the damping time constant

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

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(2)Setting the output signal Low Cut

Set the low cut value.

Access the PRIMARY_VALUE_LOWCUT parameter. Set the value subject to low cut.

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(3)Setting the LCD display

Access the DISPLAY_MODE parameter and set the item of display.
1: Flow rate in engineering unit
2: % display (Default)
3: Totalized value(Forward direction)
4: Totalized value(Reverse direction)
5: Differential totalized value

↓

Access the DISPLAY_CYCLE parameter and set display cycle.
The display cycle is 500 ms × (setting).
It defaults to 1, but if the LCD display looks unclear when used in lower temperature environments, increase the value as required.

FA0208.EPS

The units displayed on LCD are as below;

m^3/min, m^3/h, L/min, L/h, GPM, gal/h, %, kg/min, kg/h, t/min, t/h, lb/min, lb/h, CFM, CFH

APPENDIX 3. OPERATION OF EACH PARAMETER IN FAILURE MODE

- **Following table summarizes the value of ADMAG AE parameters when LCD display indicates an Alarm. (1)**

ALARM Display	Content	Resource Block	Transducer Block	Function Block
AL_01	Microprocessor Failure	–	BLOCK_ERR=Input Failure/BAD status	BLOCK_ERR=Input Failure/BAD status
			XD_ERROR= Electronics Failure	
			PV. STATUS=BAD: Device Failure	PV. STATUS=BAD: Device Failure
			SV. STATUS=BAD: Device Failure	OUT. STATUS=BAD: Device Failure
AL_02	Amplifer or Hardware Failure	–	BLOCK_ERR=Input Failure/BAD status	BLOCK_ERR=Input Failure/BAD status
			XD_ERROR= Electronics Failure	
			PV. STATUS=BAD: Device Failure	PV. STATUS=BAD: Device Failure
			SV. STATUS=BAD: Device Failure	OUT. STATUS=BAD: Device Failure
AL_03	EEPROM Failure	BLOCK_ERR=Lost Static Data or Lost NV Data	–	–
			–	
			PV. STATUS=BAD: Non Specific	PV. STATUS=BAD: Non Specific
			SV. STATUS=BAD: Non Specific	OUT. STATUS=BAD: Non Specific
AL_04	A/D Converter (high frequency side) Failure		BLOCK_ERR=Input Failure/BAD status	BLOCK_ERR=Input Failure/BAD status
			XD_ERROR= Electronics Failure	
			PV. STATUS=BAD: Device Failure	PV. STATUS=BAD: Device Failure
			SV. STATUS=BAD: Device Failure	OUT. STATUS=BAD: Device Failure
AL_05	A/D Converter (low frequency side) Failure		BLOCK_ERR=Input Failure/BAD status	BLOCK_ERR=Input Failure/BAD status
			XD_ERROR= Electronics Failure	
			PV. STATUS=BAD: Device Failure	PV. STATUS=BAD: Device Failure
			SV. STATUS=BAD: Device Failure	OUT. STATUS=BAD: Device Failure
AL_06	Excessive Input Signal		BLOCK_ERR= Maintenance needed	BLOCK_ERR=Input Failure/BAD status
			XD_ERROR= Mechanical Failure	
			PV. STATUS=BAD: Sensor Failure	PV. STATUS=BAD: Sensor Failure
			SV. STATUS=BAD: Sensor Failure	OUT. STATUS=BAD: Sensor Failure
AL_07	Flow Tube Coil Open		BLOCK_ERR=Input Failure/BAD status	BLOCK_ERR=Input Failure/BAD status
			XD_ERROR= Mechanical Failure	
			PV. STATUS=BAD: Sensor Failure	PV. STATUS=BAD: Sensor Failure
			SV. STATUS=BAD: Sensor Failure	OUT. STATUS=BAD: Sensor Failure
AL_20	AI Funciton Block is not scheduled	–	–	–
				PV. STATUS=HOLD
				OUT. STATUS=HOLD
AL_21	Resource Funciton Block is in O/S mode	BLOCK_ERR=Out of Service	–	BLOCK_ERR=Out of Service
			PV. STATUS=BAD: Non Specific	PV. STATUS=HOLD
			SV. STATUS=BAD: Non Specific	OUT. STATUS=BAD: Out of Service
AL_22	Transducer Funciton Block is in O/S mode	–	BLOCK_ERR=Out of Service	–
			PV. STATUS=BAD: Out of Service	PV. STATUS=BAD: Non Specific
			SV. STATUS=BAD: Out of Service	OUT. STATUS=BAD: Non Specific

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- **Following table summarizes the value of ADMAG AE parameters when LCD display indicates an Alarm. (2)**

ALARM Display	Cause of Alarm	Resorce Block	Transducer Block	Function Block
AL_23	AI Function Block is in O/S mode	–	–	BLOCK_ERR=Out of Service
				PV. STATUS=HOLD
				OUT. STATUS=BAD: Out of Service
AL_41	The flow rate is out of the measurement range. Measurement flow velocity exceed 108% of forward flow direction span setting.	–	PV. STATUS= UNCERTAIN: Sensor Conversion not Accurate	PV. STATUS= UNCERTAIN: Non Specific
			SV. STATUS= UNCERTAIN: Sensor Conversion not Accurate	OUT. STATUS= UNCERTAIN: Non Specific
AL_42	The flow rate is out of the measurement range. Measurement flow velocity exceeds -108% of reverse flow direction span setting.	–	PV. STATUS= UNCERTAIN: Sensor Conversion not Accurate	PV. STATUS= UNCERTAIN: Non Specific
			SV. STATUS= UNCERTAIN: Sensor Conversion not accurate	OUT. STATUS= UNCERTAIN: Non Specific
AL_ 43	Setting for flow velocity span is 11m/s or over.	–	PV. STATUS= UNCERTAIN: Engineering unit range Violation	PV. STATUS= UNCERTAIN: Non Specific
			SV. STATUS= UNCERTAIN: Engineering unit range Violation	OUT. STATUS= UNCERTAIN: Non Specific
AL_ 44	Setting for flow velocity span is 0.2m/s or under.		PV. STATUS= UNCERTAIN: Engineering unit range Violation	PV. STATUS= UNCERTAIN: Non Specific
			SV. STATUS= UNCERTAIN: Engineering unit range Violation	OUT. STATUS= UNCERTAIN: Non Specific
AL_ 45	Totalizer rate exceeds 1100pps.		PV. STATUS= UNCERTAIN: Engineering unit range Violation	PV. STATUS= UNCERTAIN: Non Specific
			SV. STATUS= UNCERTAIN: Engineering unit range Violation	OUT. STATUS= UNCERTAIN: Non Specific
AL_ 46	Totalizer rate is 0.00005pps or less.		PV. STATUS= UNCERTAIN: Engineering unit range Violation	PV. STATUS= UNCERTAIN: Non Specific
			SV. STATUS= UNCERTAIN: Engineering unit range Violation	OUT. STATUS= UNCERTAIN: Non Specific
AL_ 47	Empty pipe detection. Flow tube is not filled with fluid.		BLOCK_ERR=Input Failure/BAD Status	PV. STATUS= BAD: Non Specific
			XD_ERROR= General Error	
			PV. STATUS=BAD: Engineering Configulation Error	OUT. STATUS= BAD: Non Specific
			SV. STATUS=BAD: Engineering Configulation Error	
AL_61	Out of the range of the indicator display.	–	–	–
AL_62	AI Function Block is in simulate mode.	BLOCK_ERR= Simulate Active	–	BLOCK_ERR= Simulate Active
AL_63	AI Function Block is in Manual mode	–	–	OUT. STATUS=HOLD (When "if Man Mode" is not set.) or=Uncertain Substitute (When OUT is changed)
AL_64	Zero Adjust value is out of normal range.	–	BLOCK_ERR=Input Failure/BAD Status	PV. STATUS= BAD: Non Specific
			XD_ERROR= Configuration Error	
			PV. STATUS=BAD: Configuration Error	
			SV. STATUS=BAD: Configuration Error	OUT. STATUS= BAD: Non Specific

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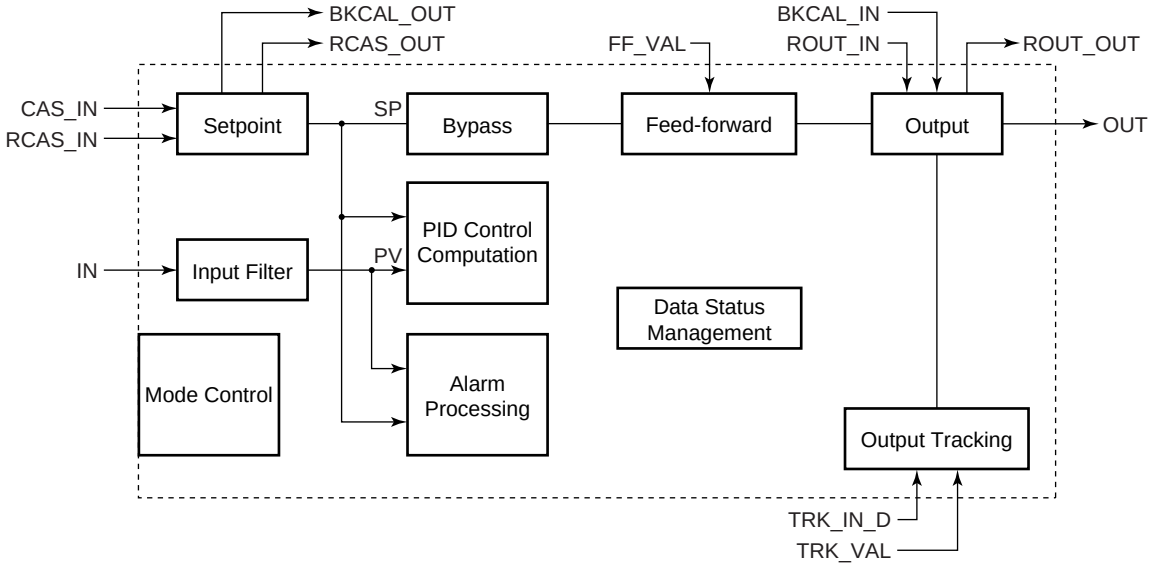
APPENDIX 4. PID Block

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.

A4.1 Function Diagram

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



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A4.2 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.

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A4.3 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	(blank)			Same as that for an AI block.
3	STRATEGY	0			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	MAN		Upper and lower scale limit values used for scaling of the input (IN) value.
11	OUT_SCALE	100 0 1342 1	MAN		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 A4.13 for details.
14	STATUS_OPTS	0	O/S		See Section A4.15 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 A4.17.1 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 A4.12 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	0×ffff			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.

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A4.4 PID Computation Details

A4.4.1 PV-proportional and -derivative Type PID (I-PD) Control Algorithm

For PID control, the PID block in an ADMAG AE 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 accoridng 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.

A4.4.2 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)

TA0403.EPS

A4.5 Control Output

The final control output value, MV, 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 ADMAG AE performs the velocity type output action for the control output.

A4.5.1 Velocity Type Output Action

The PID block determines the value of the new control output MVn 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.EU100-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'

A4.6 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.

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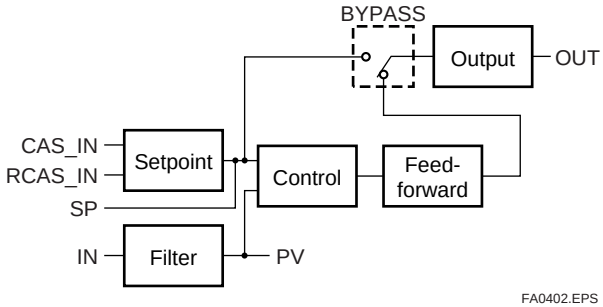
A4.7 Control Action Bypass

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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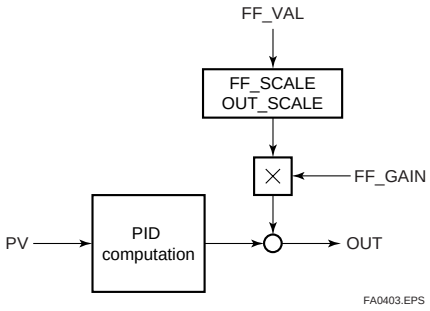
A4.8 Feed-forward

Feed-forward is an action to add a compensation input 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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A4.9 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.

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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.
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 A4.14).
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.

TA0406.EPS

A4.9.1 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 A4.14)	**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 A4.17.1 for details)	

TA0407.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.

A4.10 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.

A4.11 Setpoint Limiters

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

A4.11.1 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.

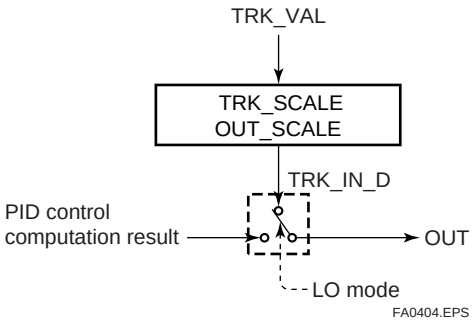
- An increase of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_UP.
- A decrease of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_DOWN.

A4.11.2 When PID Block Is in CAS or RCAS Mode

By selecting Obey SP Limits if Cas or RCas in CONTROL_OPTS (see Section A4.13), the setpoint high/low limits can be put into force also when the value of MODE_BLK is Cas or RCas.

A4.12 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.

A4.13 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 primary 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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A4.14 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.

A4.15 Manual Fallback

Manual fallback denotes an action in which a PID block changes mode to MAN (manual) 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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A4.16 Auto Fallback

Auto fallback denotes an action in which a PID block changes mode from Cas (cascade) to Auto (automatic) 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.

A4.17 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 (remote cascade) or ROut (remote output) 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.

A4.17.1 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.

TA0410.EPS

*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.

*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.

A4.18 Alarms

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

A4.18.1 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 the 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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A4.18.2 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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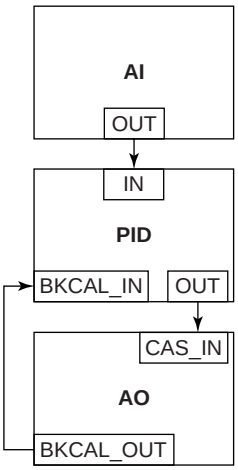
A4.19 Example of Block Connections



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When configuring a simple PID control loop by combining an ADMAG AE transmitter 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 ADMAG AE, 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.

A4.19.1 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

TA0413-2.EPS

APPENDIX 5. LINK MASTER FUNCTIONS

A5.1 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 ADMAG AE 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.

A5.2 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.

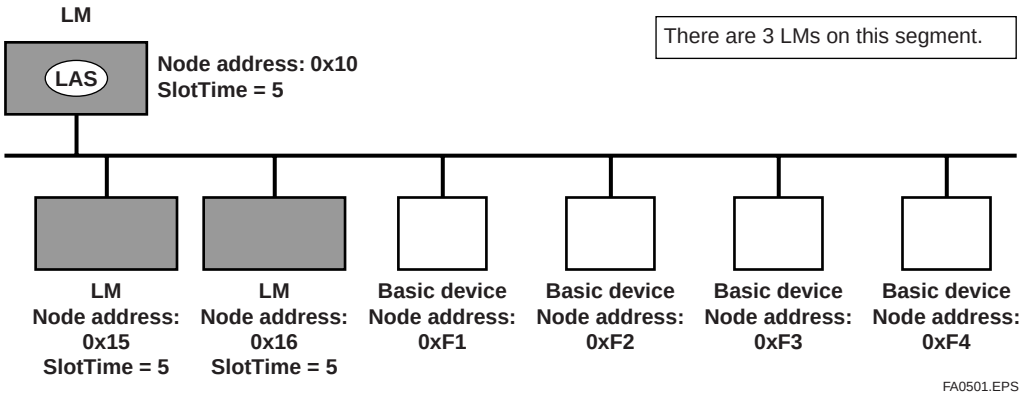

Figure 1. Example of Fieldbus configuration-3 LMs on Same Segment

A5.3 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.

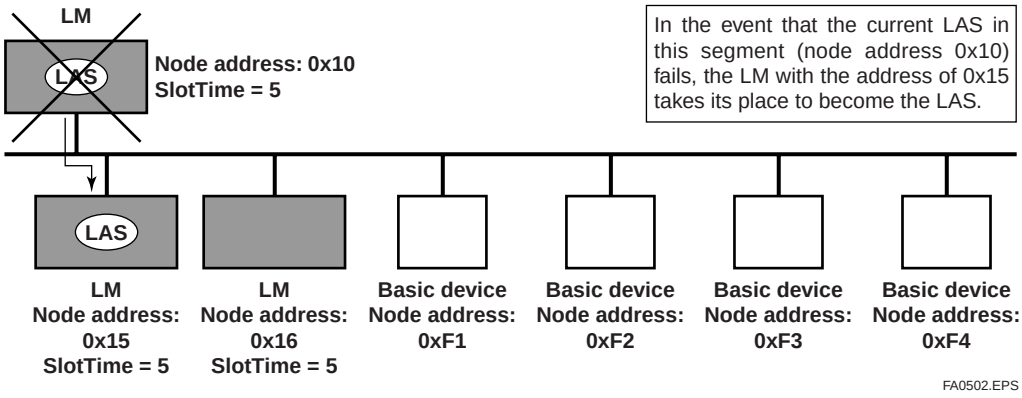

Figure 2. Backup of LAS

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

NOTE: When changing the settings in an ADMAG AE, add the ADMAG AE to the segment in which an LAS is running. After making changes to the settings, do not turn off the power to the ADMAG AE for at least 60 seconds.

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

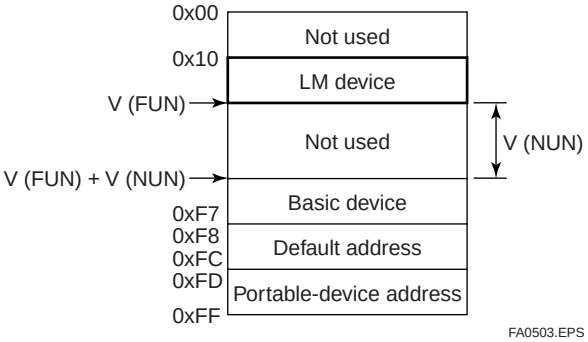

Figure 3. Node Address Ranges

(2) In the LAS settings of the ADMAG AE, 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 (ADMAG AE Index 361 (SM))

Sub-index	Element	AE	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 (ADMAG AE 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 ADMAG AE, 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 (ADMAG AE Index 369 (SM))

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

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A5.4 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 A5.5.
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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A5.5 LM Parameters

A5.5.1 LM Parameter List

The tables below show LM parameters of an ADMAG AE.

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	8		
		8 LasDatabaseStatusSpduDistributionPeriod	6000		
364	PRIMARY_LINK_MASTER_FLAG_VARIABLE		–	RW	LAS: True = 0xFF; non-LAS: False = 0x00
365	LIVE_LIST_STATUS_ARRAY_VARIABLE		–	R	
366	MAX_TOKEN_HOLD_TIME_ARRAY	0	0x0000×16, 0x012c×16	RW	
		1 Element1	0x012c×5, 0x0000×27		
		2 Element2	0x0000×32		
		3 Element3	0x0000×32		
		4 Element4	0x0000×32		
		5 Element5	0x0000×32		
		6 Element6	0x0000×31 ox012c		
		7 Element7	0x012c×32		
		8 Element8	0x02		
367	BOOT_OPERAT_FUNCTIONAL_CLASS		0x01	RW	0x01 (basic device); 0x02 (LM)
368	CURRENT_LINK_SETTING_RECORD	0		R	Settings for LAS
		1 SlotTime			
		2 PerDlpduPhlOverhead			
		3 MaxResponseDelay			
		4 FirstUnpolledNodeId			
		5 ThisLink			
		6 MinInterPduDelay			
		7 NumConseeUnpolledNodeId			
		8 PreambleExtension			
		9 PostTransGapExtension			
		10 MaxInterChanSignalSkew			
		11 TimeSyncClass			
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			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.

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A5.5.2 Descriptions for LM Parameters

The following describes LM parameters of an ADMAG AE transmitter.

NOTE: Do not turn off the power to the ADMAG AE for 40 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

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(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)

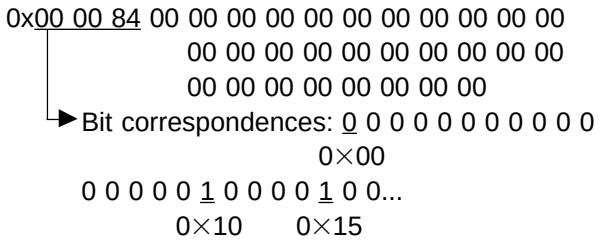
TA0507.EPS

(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)

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(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)

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(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	1	0: Bus-powered; 1: Self-powered

TA0510.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

TA0511.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.

TA0512.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.

TA0513.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.

TA0514.EPS

(15) Domain

Read/write: impossible; get-OD: possible

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

A5.6 FAQs

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

A1-1. Is that ADMAG AE 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:

ADMAG AE		Other LMs
V(ST)×V(TN)	<	V(ST)×V(TN)

Q2. How can I make an ADMAG AE become the LAS?

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

LinkScheduleListCharacteristicsRecord (index 374 for an ADMAG AE)

- ActiveScheduleVersion (subindex 3)

A2-2. Make the ADMAG AE 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 ADMAG AE.

Q3. On a segment where an ADMAG AE 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 ADMAG AE and the capabilities of being the LAS for the device that cannot be connected:

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

Then, confirm that the following conditions are met:

ADMAG AE		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 ADMAG AE.

Q4. The segments for a right-most digit on LCD of ADMAG AE are blinking.

Followings are possible causes; No LAS existing on the network or no communication being established between ADMAG AE and LAS.

A4-1. Check that LAS is correctly connected to the network.
If ADMAG AE is used as LAS (option), follow the procedures shown in A5.3(1), (2), and (3).)

A4-2. Check that LAS parameters are set so as to meet the ADMAG AE's requirement.
(See also 5.2 Network Configuration.)

LAS		ADMAG AE	
V(ST)	>	V(ST)	(4 or greater)
V(MID)	>	V(MID)	(4 or greater)
V(MRD)	>	V(MRD)	(12 or greater)

A4-3. Check that the node address of ADMAG AE is correctly set.
(See also 5.2 Network Configuration.)
Not in the range between V(FUN) and V(FUN)+V(NUN) of LAS.
Not in the default address (F8 to FB)