User's Manual

DPharp Fieldbus Communication Type (EJX□□□A, EJA□□□E)

IM 01C25T02-01E

FOR THE DIGITAL WORLD

YOKOGAWA
Yokogawa Electric Corporation

IM 01C25T02-01E
17th Edition

DPharp
Fieldbus Communication Type

IM 01C25T02-01E 17th Edition

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Revision Information

1. Introduction

This manual is for the DPharp EJX/EJA Series Differential Pressure/Pressure Transmitter Fieldbus Communication Type "transmitter". The Fieldbus communication type is based on the same silicon resonant sensing technology used in the BRAIN/HART communication type, and is similar to the communication types in terms of basic performance and operation. This manual describes only those topics that are required for operation of the Fieldbus communication type. For information on the installation, wiring, and maintenance of transmitters, refer to the user's manual for each model. Also note that the contents of this manual are applicable for device revision 6 of EJX series pressure transmitters and device revision 2 of EJA series pressure transmitters. See a device information sheet attached to the instrument to check the device revision.

■ Regarding This Manual

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

WARNING

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

CAUTION

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

IMPORTANT

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

NOTE

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

■ Trademarks

- 'DPharp', 'EJX', 'EJA', 'FieldMate' and 'BRAIN TERMINAL' are registered trademarks of Yokogawa Electric Corporation. Company names and product names used in this material are registered trademarks or trademarks of their respective owners.
- In this manual, trademarks or registered trademarks are not marked with ™ or ®.

1.1 Safe Use of This Product

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

(a) Installation

- This instrument may only be installed by an engineer or technician who has an expert knowledge of this device. Operators are not allowed to carry out installation unless they meet this condition.
- With high process temperatures, care must be taken not to burn yourself by touching the instrument or its casing.
- Never loosen the process connector nuts when the instrument is installed in a process. This can lead to a sudden, explosive release of process fluids.
- When draining condensate from the pressure detector section, take appropriate precautions to prevent the inhalation of harmful vapors and the contact of toxic process fluids with the skin or eyes.
- When removing the instrument from a hazardous process, avoid contact with the fluid and the interior of the meter.
- All installation shall comply with local installation requirements and the local electrical code.

(b) Wiring

- The instrument must be installed by an engineer or technician who has an expert knowledge of this instrument. Operators are not permitted to carry out wiring unless they meet this condition.
- Before connecting the power cables, please confirm that there is no current flowing through the cables and that the power supply to the instrument is switched off.

(c) Operation

- Wait 5 min. after the power is turned off, before opening the covers.

(d) Maintenance

- Please carry out only the maintenance procedures described in this manual. If you require further assistance, please contact the nearest Yokogawa office.
- Care should be taken to prevent the build up of dust or other materials on the display glass and the name plate. To clean these surfaces, use a soft, dry cloth.

(e) Explosion Protected Type Instrument

- Users of explosion proof instruments should refer first to section 2.1 (Installation of an Explosion Protected Instrument) of this manual.
- The use of this instrument is restricted to those who have received appropriate training in the device.
- Take care not to create sparks when accessing the instrument or peripheral devices in a hazardous location.

(f) Modification

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

(g) Product Disposal

- The instrument should be disposed of in accordance with local and national legislation/ regulations.

(h) Authorized Representative in EEA

- In relation to the CE Marking, The authorised representative for this product in the EEA (European Economic Area) is: Yokogawa Europe B.V. Euroweg 2, 3825 HD Amersfoort,The Netherlands

1.2 Warranty

- The warranty shall cover the period noted on the quotation presented to the purchaser at the time of purchase. Problems occurring during the warranty period shall basically be repaired free of charge.
- If any problems are experienced with this instrument, the customer should contact the Yokogawa representative from which this instrument was purchased or the nearest Yokogawa office.
- If a problem arises with this instrument, please inform us of the nature of the problem and the circumstances under which it developed, including the model specification and serial number. Any diagrams, data and other information you can include in your communication will also be helpful.
- The party responsible for the cost of fixing the problem shall be determined by Yokogawa following an investigation conducted by Yokogawa.
- The purchaser shall bear the responsibility for repair costs, even during the warranty period, if the malfunction is due to:

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

2. Handling Cautions

2.1 Installation of an Explosion-Protected Instrument

If a customer makes a repair or modification to an intrinsically safe or explosionproof instrument and the instrument is not restored to its original condition, its intrinsically safe or explosionproof construction may be compromised and the instrument may be hazardous to operate. Please contact Yokogawa before making any repair or modification to an instrument.

CAUTION

This instrument has been tested and certified as being intrinsically safe or explosionproof. Please note that severe restrictions apply to this instrument's construction, installation, external wiring, maintenance and repair. A failure to abide by these restrictions could make the instrument a hazard to operate.

WARNING

Maintaining the safety of explosionproof equipment requires great care during mounting, wiring, and piping. Safety requirements also place restrictions on maintenance and repair. Please read the following sections very carefully.

WARNING

The range setting switch must not be used in a hazardous area.

IMPORTANT

All the blind plugs which accompany the transmitters upon shipment from the factory are certified by the applicable agency in combination with the transmitters. The plugs which are marked with the symbols "◊ Ex" on their surfaces are certified only in combination with the transmitters.

2.1.1 FM approval

a. FM Explosionproof Type

Caution for FM Explosionproof type

Note 1. The transmitters with optional code /FF1 are applicable for use in hazardous locations:

- Applicable Standard: FM3600, FM3615, FM3810, NEMA 250, ANSI/UL 61010-1, ANSI/UL 61010-2-30
- Explosionproof for Class I, Division 1, Groups B, C and D.
- Dust-ignitionproof for Class II/III, Division 1, Groups E, F and G.
- Enclosure: Type 4X
- Temperature Class: T6
- Ambient Temperature: –40 to 60°C
- Supply Voltage:
  32 V dc max. (FOUNDATION Fieldbus and PROFIBUS PA type)
- Output signal:
  15 mA (FOUNDATION Fieldbus and PROFIBUS PA type)

Note 2. Wiring

- All wiring shall comply with National Electrical Code ANSI/NFPA70 and Local Electrical Codes.
- When installed in Division 1, "FACTORY SEALED, CONDUIT SEAL NOT REQUIRED."

Note 3. Operation

- Keep the "WARNING" nameplate attached to the transmitter.
  WARNING: OPEN CIRCUIT BEFORE REMOVING COVER.
  FACTORY SEALED, CONDUIT SEAL NOT REQUIRED.
  INSTALL IN ACCORDANCE WITH THE USERS MANUAL IM 01C25.
- Take care not to generate mechanical sparking when accessing the instrument and peripheral devices in a hazardous location.

Note 4. Maintenance and Repair

- The instrument modification or parts replacement by other than authorized representative of Yokogawa Electric Corporation is prohibited and will void Factory Mutual Explosionproof Approval.

b. FM Intrinsically safe and Nonincendive Type

EJX/EJA-E Series pressure transmitters with optional code /FS15 are applicable for use in hazardous locations.

Note 1.

- Applicable Standard:
  FM 3600
  FM 3610
  FM 3611
  FM 3810
  ANSI/ISA-60079-0-2009
  ANSI/ISA-60079-11-2009
  ANSI/ISA-60079-27-2006
  ANSI/UL 121201
  ANSI/ISA-61010-1
  NEMA 250
- Rating
  Intrinsically Safe with Entity/FISCO for
  Class I, II, III Division 1,
  Groups A, B, C, D, E, F, G T4
  Class I Zone 0 AEx ia IIC T4
  Nonincendive field wiring/FNICO for
  Class I, II Division 2
  Groups A, B, C, D, F, G T4
  Class III Division 1 T4
  Class I, Zone 2 Group IIC T4
- Ambient temperature: –55 to 60°C
- Enclosure: Type 4X
- Electrical Connection:
  1/2 NPT female, M20 female

Note 2. Installation

Installation should be in accordance with Control Drawing IFM024-A12.

Note 3. Specific conditions of use

Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts.

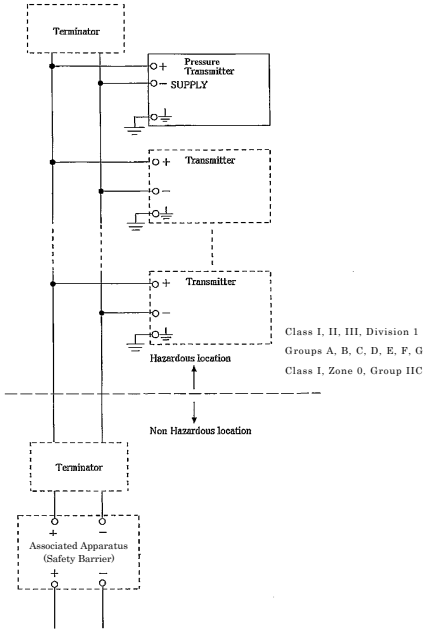
When the enclosure of the Pressure Transmitters is made of aluminum alloy, if it is mounted in Zone 0, it shall be installed such that, even in the event of rare incidents, an ignition source due to impact and/or friction sparks is excluded.

Note 4. Maintenance and Repair

Only personnel authorized by Yokogawa Electric Corporation can repair the equipment.

Model: EJX-F Series Date: January 27, 2005

Control drawing (intrinsic safety)



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Yokogawa Electric Corporation

IFM024

Model: EJX-F Series Date: January 27, 2005

Specific conditions of use:
- Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts.
- When the enclosure of the Pressure Transmitters is made of aluminum alloy, if it is mounted in Zone 0, it shall be installed such that, even in the event of rare incidents, an ignition source due to impact and/or friction sparks is excluded.

Entity parameters [Groups: A, B, C, D, E, F, G, and IIC]
Ui: 24 V
Ii: 250 mA
Pi: 1.2 W
Ci: 3.52 nF
Li: 0 µH

FISCO parameters (1) [Groups: A, B, C, D, E, F, G, and IIC]
Ui: 17.5 V
Ii: 380 mA
Pi: 5.32 W
Ci: 3.52 nF
Li: 0 µH

FISCO parameters (2) [Groups: C, D, E, F, G, and IIB]
Ui: 17.5 V
Ii: 460 mA
Pi: 5.32 W
Ci: 3.52 nF
Li: 0 µH

Notes:
1. Installation must be in accordance with the National Electric Code (NFPA70), ANSI/ISA-RP12.06.01, and relevant local codes.
2. The Associated Apparatus and the Terminators must be FM-approved.
3. The following conditions must be satisfied.
   Voc (or Uo) ≤ Ui
   Isc (or Io) ≤ Ii
   Po ≤ Pi
   Ca (or Co) ≥ Ci + Ccable
   La (or Lo) ≥ Li + Lcable
4. General Purpose Equipment connected to the Associated Apparatus must not use or generate a voltage more than Um of the Associated Apparatus.
5. The control drawing of the Associated Apparatus must be followed when installing the equipment.
6. Dust-tight conduit seals must be used when installed in Class II or Class III environments.
7. WARNING –ELECTROSTATIC CHARGE MAY CAUSE AN EXPLOSION HAZARD. AVOID ANY ACTIONS THAT CAUSE THE GENERATION OF ELECTROSTATIC CHARGE, SUCH AS RUBBING WITH A DRY CLOTH ON COATING FACE OF THE PRODUCT.
8. WARNING – SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY AND SUITABILITY FOR HAZARDOUS LOCATION

Rev.4: July 16, 2019 Doc. No.: IFM024-A12 P.2

Yokogawa Electric Corporation

IFM024

Model: EJX-F Series Date: May 9, 2006

FISCO Rules

The FISCO Concept allows the interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criterion for such interconnection is that the voltage (Ui), the current (Ii) and the power (Pi) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage (Uo, Voc or Vt), the current (Io, Isc or It) and the power (Po) which can be provided by the associated apparatus (supply unit). In addition, the maximum unprotected residual capacitance (Ci) and inductance (Li) of each apparatus (other than terminators) connected to the Fieldbus must be less than or equal to 5 nF and 10 µH respectively.
In each I.S. Fieldbus segment only one active source, normally the associated apparatus, is allowed to provide the necessary power for the Fieldbus system. The allowed voltage (Uo, Voc or Vt) of the associated apparatus used to supply the bus cable must be limited to the range of 14 V d.c. to 17.5 V d.c. All other equipment connected to the bus cable has to be passive, meaning that the apparatus is not allowed to provide energy to the system, except a leakage current of 50 µA for each connected device. Separately powered equipment needs galvanic isolation to ensure the intrinsically safe Fieldbus circuit remains passive.
The cable used to interconnect the devices needs to comply with the following parameters:
Loop resistance R': 15....150 Ω/km
Inductance per unit length L': 0.4....1 mH/km
Capacitance per unit length C': 45....200 nF/km C' = C' line/line + 0.5 C' line/screen, if both lines are floating or C' = C' line/line + C'line/screen, if the screen is connected to one line.
Length of spur cable: max. 60 m
Length of trunk cable: max. 1 km in IIC and 5 km in IIB
Length of splice: max = 1 m
Terminators
At the end of each trunk cable an FM Approved line terminator with the following parameters is suitable:
R = 90...100 Ω
C = 0 ....2.2 µF

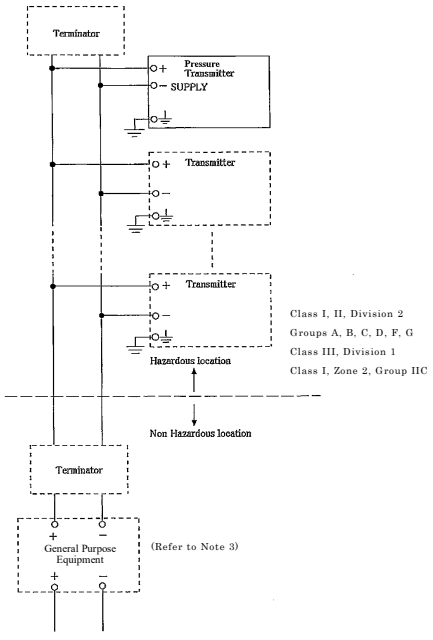
Model: EJX-F Series Date: January 27, 2005

Nonincendive field wiring parameters
Vmax: 32 V
Ci: 3.52 nF
Li: 0 µH

Notes:
1. Installation must be in accordance with the National Electric Code (NFPA70), ANSI/ISA-RP12.06.01, and relevant local codes.
2. The following conditions must be satisfied.
3. In case Nonincendive Field Wiring Concept is used for the interconnection, FM-approved Associated Nonincendive Field Wiring Apparatus, which meets the following conditions, must be used as the General Purpose Equipment. The Terminators also must be FM approved.
Voc (or Uo) ≤ Vmax
Ca (or Co) ≥ Ci + Ccable
La (or Lo) ≥ Li + Lcable
4. Dust-tight conduit seals must be used when installed in Class II or Class III environments.
5. WARNING – SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY AND SUITABILITY FOR HAZARDOUS LOCATION

Model: EJX-F Series Date: January 27, 2005

Control drawing (nonincendive)



Model: EJX-F Series Date: August 19, 2005

FNICO Rules

The FNICO Concept allows the interconnection of nonincendive field wiring apparatus to associated nonincendive field wiring apparatus not specifically examined in such combination. The criterion for such interconnection is that the voltage (Vmax), the current (Imax) and the power (Pmax), which nonincendive field wiring apparatus can receive and remain nonincendive, must be equal or greater than the voltage (Uo, Voc or Vt), the current (Io, Isc or It) and the power (Po) which can be provided by the associated nonincendive field wiring apparatus (supply unit). In addition the maximum unprotected residual capacitance (Ci) and inductance (Li) of each apparatus (other than terminators) connected to the Fieldbus must be less than or equal to 5 nF and 20 µH respectively.
In each N.I. Fieldbus segment only one active source, normally the associated nonincendive field wiring apparatus, is allowed to provide the necessary power for the Fieldbus system. The allowed voltage (Uo, Voc or Vt) of the associated nonincendive field wiring apparatus used to supply the bus cable must be limited to the range 14 V d.c. to 17.5 V d.c. All other equipment connected to the bus cable has to be passive, meaning that the apparatus is not allowed to provide energy to the system, except a leakage current of 50 µA for each connected device. Separately powered equipment needs galvanic isolation to ensure the nonincendive field wiring Fieldbus circuit remains passive.
The cable used to interconnect the devices needs to comply with the following parameters:
Loop resistance R': 15....150 Ω/km
Inductance per unit length L': 0.4....1 mH/km
Capacitance per unit length C': 45....200 nF/km C' = C' line/line + 0.5 C' line/screen, if both lines are floating or C' = C' line/line + C'line/screen, if the screen is connected to one line.
Length of spur cable: max. 60 m
Length of trunk cable: max. 1 km in IIC and 5 km in IIB
Length of splice: max = 1 m
Terminators
At the end of each trunk cable an FM Approved line terminator with the following parameters is suitable:
R = 90...100 Ω
C = 0 ....2.2 µF

2.1.2 CSA Certification

a. CSA Explosionproof Type

Caution for CSA explosionproof type.

Note 1. The transmitters with optional code /CF1 are applicable for use in hazardous locations:

Certificate: 2014354

- Applicable Standard:
  C22.2 No. 25
  C22.2 No. 30
  CAN/CSA-C22.2 No. 94
  CAN/CSA-C22.2 No. 61010-1-12
  CAN/CSA-C22.2 No. 61010-2-030-12
  CAN/CSA-C22.2 No. 60079-0:07
  CAN/CSA-C22.2 No. 60079-1:07
  CAN/CSA-C22.2 No. 60529
  ANSI/ISA-12.27.01
- Explosion-proof for Class I, Groups B, C and D.
- Dustignition-proof for Class II/III, Groups E, F and G.
- Enclosure: Type 4X, IP66/IP67
- Temperature Code: T6...T4
- Ex d IIC T6...T4
- Maximum Process Temperature:
  120°C (T4), 100°C (T5), 85°C (T6)
- Ambient Temperature:
  –50* to 75°C (T4), –50* to 80°C (T5),
  –50* to 75°C (T6)
  * –15°C when /HE is specified.
- Supply Voltage: 32 V dc max.
- Output Signal: 15 mA dc

Note 2. Wiring

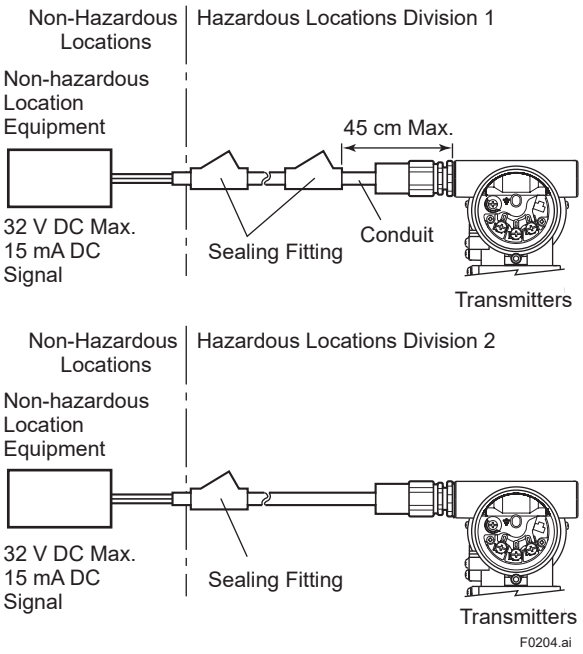
- All wiring shall comply with Canadian Electrical Code Part I and Local Electrical Codes.
- In hazardous location, wiring shall be in conduit as shown in the figure.
- WARNING:
  A SEAL SHALL BE INSTALLED WITHIN 45cm OF THE ENCLOSURE.
  UN SCELLEMENT DOIT ÊTRE INSTALLÉ À MOINS DE 45cm DU BOÎTIER.
- WARNING:
  WHEN INSTALLED IN CL.I, DIV 2, SEAL NOT REQUIRED.
  UNE FOIS INSTALLÉ DANS CL I, DIV 2, AUCUN JOINT N'EST REQUIS.

Note 3. Operation

- WARNING:
  AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING.
  APRÉS POWER-OFF, ATTENDRE 5 MINUTES AVANT D'OUVRIR.
- WARNING:
  WHEN AMBIENT TEMPERATURE ≥ 65°C, USE THE HEAT-RESISTING CABLES ≥ 90°C.
  QUAND LA TEMPÉRATURE AMBIANTE ≥ 65°C, UTILISEZ DES CÂBLES RÉSISTANTES Á LA CHALEUR ≥ 90°C.
- Take care not to generate mechanical sparking when accessing to the instrument and peripheral devices in a hazardous location.

Note 4. Maintenance and Repair

- The instrument modification or parts replacement by other than authorized representative of Yokogawa Electric Corporation and Yokogawa Corporation of America is prohibited and will void Canadian Standards Explosionproof Certification.



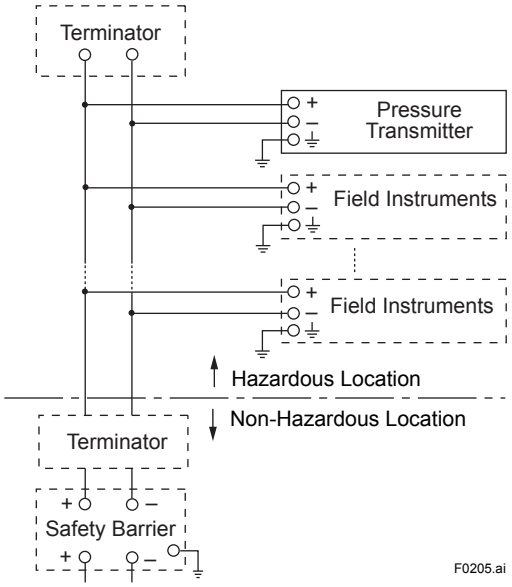
b. CSA Intrinsically safe and Nonincendive Type

The transmitters with optional code /CS15.

- Certificate: 1689689
- Applicable standard: C22.2 No.0, C22.2 No.94, C22.2 No.157, C22.2 No.213, C22.2 No.61010-1, C22.2 No.61010-2-030, CAN/CSA-C22.2 E60079-0:07, CAN/CSA-E60079-11:02, CAN/CSA-E60079-15:02, CAN/CSA-C22.2 No.60529 ANSI/ISA-12.27.01
- CSA Intrinsically Safe Approval
  Class I, Division 1, Groups A, B, C, & D; Class II, Division 1, Groups E, F & G; Class III; Ex ia IIC T4
  Ambient Temperature: –55* to 60°C
  * –15°C when /HE is specified.
  Type 4X, IP66/IP67
- CSA Nonincendive Approval
  Class I, Division 2, Groups A, B, C, & D; Class II, Division 2, Groups F & G; Class III; Ex nL IIC T4
  Ambient Temperature: –55* to 60°C
  * –15°C when /HE is specified.
  Type 4X, IP66/ IP67

- **Caution for CSA Intrinsically safe type. (Following contents refer to "DOC. No. ICS018)**

Installation Diagram for Intrinsically safe (Division 1 Installation)



Note 1. The safety barrier must be CSA certified.

Note 2. Input voltage of the safety barrier must be less than 250Vrms/Vdc.

Note 3. Installation should be in accordance with Canadian Electrical Code Part I and local Electrical Code.

Note 4. Do not alter drawing without authorization from CSA.

Electrical Data:

• Rating 1 (Entity)
For Groups A, B, C, D, E, F, and G or Group IIC
Ui (vmax) = 24 V dc
Ii (Imax) = 250 mA
Pi (Pmax) = 1.2 W
Ci = 3.52 nF
Li = 0 µH

or

• Rating 2 (FISCO)
For Groups A, B, C, D, E, F, and G or Group IIC
Ui (vmax) = 17.5 V dc
Ii (Imax) = 380 mA
Pi (Pmax) = 5.32 W
Ci = 3.52 nF
Li = 0 µH

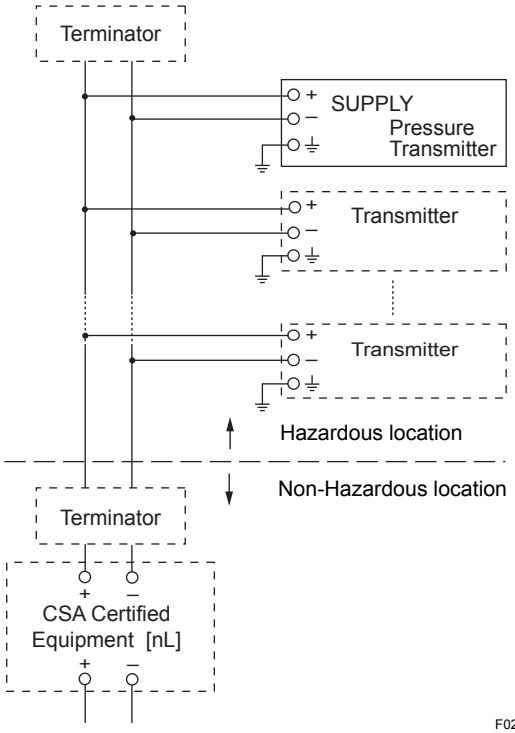
or

• Rating 3 (FISCO)
For Groups C, D, E, F, and G or Group IIB
Ui (vmax) = 17.5 V dc
Ii (Imax) = 460 mA
Pi (Pmax) = 5.32 W
Ci = 3.52 nF
Li = 0 µH

Installation requirements;
Po ≤ Pi Uo ≤ Ui Io ≤ Ii,
Co ≥ Ci + Ccable Lo ≥ Li + Lcable
Vmax ≥ Voc Imax ≥ Isc
Ca ≥ Ci + Ccable La ≥ Li + Lcable
Uo, Io, Po, Co, Lo,Voc, Isc, Ca and La are parameters of barrier.

- **Caution for CSA Non-incendive type. (Following contents refer to "DOC. No. ICS018)**

Installation Diagram for Non-incendive or Type of protection "n" (Division 2 Installation)



Note 1. Installation should be in accordance with Canadian Electrical Code Part I and local Electrical Code.

Note 2. Dust-tight conduit seal must be used when installed in class II and III environments.

Note 3. Do not alter drawing without authorization from CSA.

Electrical Data:

• Rating (including FNICO)
Ui or Vmax = 32 V
Ci = 3.52 nF
Li = 0 µH

2.1.3 ATEX Certification

(1) Technical Data

a. ATEX Intrinsically Safe Ex ia

Caution for ATEX Intrinsically safe type.

Note 1. EJX/EJA-E series pressure transmitters with optional code /KS26 for potentially explosive atmospheres:
Certification Information:

WARNING

A modification of the equipment would no longer comply with the construction described in the certificate documentation.

Certificate Number:
KEMA 04ATEX1116 X

NOTE

The symbol "X" placed after the certificate number indicates that the equipment is subject to specific conditions of use.

Applicable Standard:
EN IEC 60079-0, EN 60079-11

Note 2. Rating
Ex Marking:
II 2 G Ex ia IIC/IIB T4 Ga
II 2 D Ex ia IIIC T85°C T100°C T120°C Db
Temperature Specifications:
Ambient Temperature range and Process Temperature range for Gas:

Ambient temperature range	Process temperature range
–55 to 60°C	–55 to 120°C

Ambient Temperature range and Process Temperature range for Dust:

Maximum surface temperature	Ambient temperature range	Process temperature range	Type of O-ring
T85°C	–30 to 60°C	–30 to 80°C	NBR
	–15 to 60°C	–15 to 80°C	Fluoro-rubber (FKM)
T100°C	–30 to 60°C	–30 to 100°C	NBR
	–15 to 60°C	–15 to 100°C	Fluoro-rubber (FKM)
T120°C	–30 to 60°C	–30 to 120°C	NBR
	–15 to 60°C	–15 to 120°C	Fluoro-rubber (FKM)

Enclosure:
IP66/IP67 in accordance with only EN60529
Electrical Parameters:
Intrinsically safe ratings are as follows:
[Entity]
Ui = 24 V
Ii = 250 mA
Pi = 1.2 W
Ci = 3.52 nF
Li = 0 µH
[FISCO IIC]
Ui = 17.5 V
Ii = 380 mA
Pi = 5.32 W
Ci = 3.52 nF
Li = 0 µH
[FISCO IIB]
Ui = 17.5 V
Ii = 460 mA
Pi = 5.32 W
Ci = 3.52 nF
Li = 0 µH

Note 3. Installation:

- Refer to the control drawing IKE022-A12 P.1 and P.2. (Note 7.)
- The type of threads is indicated at the cable entry, using the following marking.

Screw Size	Marking
ISO M20 × 1.5 female	⚠M
ANSI 1/2 NPT female	⚠A or ⚠N or ⚠W

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- The selected type of the Ex marking on the name plate should be indicated. For this purpose, the tick boxes can be used as follows.
☑ Ex ia IIC/IIB T4 Ga
☐ Ex ia IIIC T85°C T100°C T120°C Db

Note 4. Operation:

- If the pressure transmitter is mounted in an area where explosive atmospheres may be present, it must be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust are avoided.

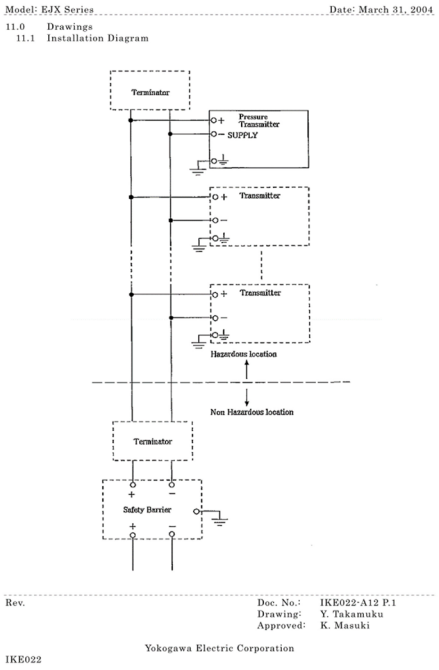
Note 5. Specific conditions of use:

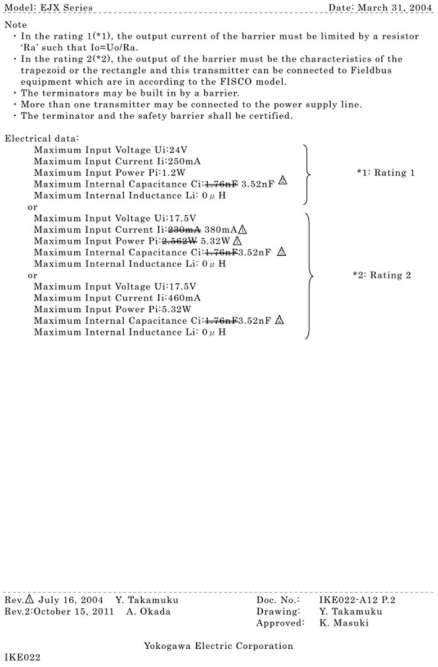
- When the enclosure of the pressure transmitter is made of aluminum alloy, if it is mounted in an area where the use of Category 1 G equipment is required, it shall be installed such that, even in the event of rareincidents, an ignition source due to impact and friction sparks is excluded.
- Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts.
- The dielectric strength of at least 500 V of the intrinsically safe circuits of the pressure transmitter is limited only by the overvoltage protection.

Note 6. Maintenance and Repair:

- Only personnel authorized by Yokogawa Electric Corporation can repair the equipment.

Note 7. Control drawing





Model: EJX Series Date: March 31, 2004

Note
- In the rating 1(*1), the output current of the barrier must be limited by a resistor 'Ra' such that Io=Uo/Ra.
- In the rating 2(*2), the output of the barrier must be the characteristics of the trapezoid or the rectangle and this transmitter can be connected to Fieldbus equipment which are in according to the FISCO model.
- The terminators may be built in by a barrier.
- More than one transmitter may be connected to the power supply line.
- The terminator and the safety barrier shall be certified.

Electrical data:

*1: Rating 1
Maximum Input Voltage Ui:24V
Maximum Input Current Ii:250mA
Maximum Input Power Pi:1.2W
Maximum Internal Capacitance Ci:~~1.76nF~~ 3.52nF △
Maximum Internal Inductance Li: 0μH

or

*2: Rating 2
Maximum Input Voltage Ui:17.5V
Maximum Input Current Ii:~~380mA~~ 380mA△
Maximum Input Power Pi:~~2.562W~~ 5.32W△
Maximum Internal Capacitance Ci:~~1.76nF~~3.52nF △
Maximum Internal Inductance Li: 0μH

or

Maximum Input Voltage Ui:17.5V
Maximum Input Current Ii:460mA
Maximum Input Power Pi:5.32W
Maximum Internal Capacitance Ci:~~1.76nF~~3.52nF △
Maximum Internal Inductance Li: 0μH

Rev.△ July 16, 2004 Y. Takamuku
Rev.2:October 15, 2011 A. Okada

Doc. No.: IKE022-A12 P.2
Drawing: Y. Takamuku
Approved: K. Masuki

Yokogawa Electric Corporation

IKE022

b. ATEX Flameproof Type

Caution for ATEX flameproof type

Note 1. The transmitters with optional code /KF22 for potentially explosive atmospheres:

- No. KEMA 07ATEX0109X
- Applicable Standard: EN IEC 60079-0, EN 60079-1, EN 60079-31
- Type of Protection and Marking Code: II 2G Ex db IIC T6...T4 Gb, II 2D Ex tb IIIC T85°C Db
- Group: II
- Category: 2G, 2D
- Enclosure: IP66 / IP67
- Temperature Class for gas-proof: T6, T5, and T4
- Ambient Temperature for gas-proof: –50 to 75°C (T6), –50 to 80°C (T5), and –50 to 75°C (T4)
- Maximum Process Temperature (Tp.) for gas-proof: 85°C (T6), 100°C (T5), and 120°C (T4)
- Maximum Surface Temperature for dust-proof: T85°C (Tamb.: –30* to 75°C, Tp.: 85°C)

* –15°C when /HE is specified.

Note 2. Electrical Data

- Supply voltage: 32 V dc max.
  Output current: 15 mA dc

Note3. For combined approval types

Once a device of multiple approval type is installed, it should not be re-installed using any other approval types. Apply a permanent mark in the check box of the selected approval type on the ertification label on the transmitter to distinguish it from unused approval types.

Note 4. Installation

- All wiring shall comply with local installation requirements.
- In order to prevent the earthing conductor from loosening, the conductor must be secured to the terminal, tightening the screw with appropriate torque. Care must be taken not to twist the conductor.
- Cable glands, adapters and/or blanking elements with a suitable IP rating shall be of Ex d IIC/Ex tb IIIC certified by ATEX and shall be installed so as to maintain the specific degree of protection (IP Code) of the equipment.

Note 5. Operation

- WARNING: AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING. WHEN THE AMBIENT TEMP.≥65°C, USE HEAT-RESISTING CABLES≥90°C.
- Take care not to generate mechanical sparking when accessing the instrument and peripheral devices in hazardous location.

Note 6. Maintenance and Repair

- Warning: When maintenance and repair are performed, confirm the following conditions and the then perform works.
  Confirm the power supply is cut off and the voltage of power supply terminal is not supplied.
- Only personnel authorized by Yokogawa Electric Corporation can repair the equipment in accordance with the relevant standards: IEC / EN 60079-19 (Equipment repair, overhaul and reclamation) and IEC / EN 60079-17 (Electrical installation inspection and maintenance); otherwise the certification will be voided.

Note 7. Special Conditions for Safe Use

WARNING

- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of the product.
- In the case where the enclosure of the Pressure Transmitter is made of aluminium, if it is mounted in an area where the use of category 2D apparatus is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust is avoided.
- The fasteners used to fasten the transmitter enclosure onto the sensor capsule is special fastener, and the property class of it is A2-50 (A4-50) or more.
- For transmitters with a membrane made of titanium, ignition hazard due to impact and friction on the membranes shall be avoided.
- Maximum Surface Temperature for dust-proof: T85°C (Tamb.: –30* to 75°C, Tp.: –30* to 85°C)
  * –15°C when /HE is specified.

c. ATEX Intrinsically Safe Ex ic

Caution for ATEX Intrinsically safe Ex ic

Note 1. The transmitters with option code /KN26 for potentially explosive atmospheres:
Applicable Standard:
EN IEC 60079-0, EN 60079-11

Note 2. Rating
Ex Marking
Ex II 3 G Ex ic IIC T4 Gc
Temperature specifications:

Ambient temperature range	Process temperature range	Type of O-ring
–30 to 60°C	–30 to 120°C	NBR
–15 to 60°C	–15 to 120°C	Fluoro-rubber (FKM)

IP Code: IP66
Overvoltage Category: I
Electrical Parameters: See control drawing IKE047-A70 (Note 7.)

Note 3. Installation
- See control drawing IKE047-A70. (Note 7.)
- The type of threads is indicated at the cable entry, using the following marking.

Screw Size	Marking
ISO M20 × 1.5 female	⚠M
ANSI 1/2 NPT female	⚠A or ⚠N or ⚠W

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Note 4. Operation
If the pressure transmitter is mounted in an area where explosive atmospheres may be present, it must be installed in such a way that the risk from electrostatic discharges.

Note 5. Specific conditions of use
See control drawing IKE047-A70 (Note 7.)

Note 6. Maintenance and Repair
Only personnel authorized by Yokogawa Electric Corporation can repair the equipment.

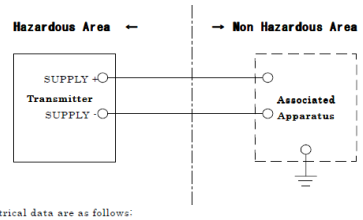
Note 7. Control drawing

Note 7. Control drawing

Model: EJX Series Date: February 28, 2013

14 Control Drawing

Following instructions shall be included in the user's manual, together with the following items:
- a list of the standards in 1, including the issue year:
- specifications in 2:
- marking information in 13.



Electrical data are as follows:
Ui = 32 V
Ci = 3.52 nF
Li = 0 μH

Specific Conditions of Use:
- Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts.
- The dielectric strength of at least 500 V a.c. r.m.s between the intrinsically safe circuits and the enclosure of the Pressure Transmitter Model EJX Series,Model EJA***E Series and Model EJA***J Series are limited only by the overvoltage protection.

WARNING:
- POTENTIAL ELECTROSTATIC CHARGING HAZARD - SEE USER'S MANUAL.

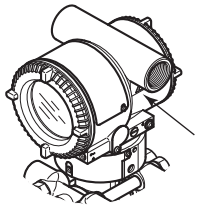
Note:
- Cable glands, adapters and/or blanking elements shall be of type "n", type "e" or type "d" and shall be installed so as to maintain the specified degree of protection (IP Code) of the equipment.

Rev. Doc. No.: IKE047-A70
Drawing: T.Itou
Approved: A.Matsunaga

(2) Electrical Connection

A mark indicating the electrical connection type is stamped near the electrical connection port. These marks are as follows.

Screw Size	Marking
ISO M20 × 1.5 female	⚠M
ANSI 1/2 NPT female	⚠N or ⚠W



Location of the mark

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(3) Installation

WARNING

- All wiring shall comply with local installation requirements and the local electrical code.
- There is no need for a conduit seal in Division 1 and Division 2 hazardous locations because this product is sealed at the factory.

(4) Operation

WARNING

- OPEN CIRCUIT BEFORE REMOVING COVER. INSTALL IN ACCORDANCE WITH THIS USER'S MANUAL
- Take care not to generate mechanical sparking when accessing the instrument and peripheral devices in a hazardous location.

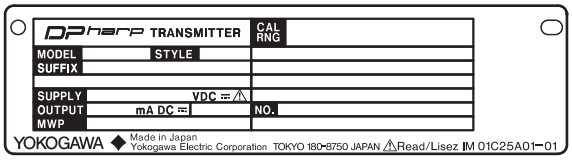
(5) Maintenance and Repair

WARNING

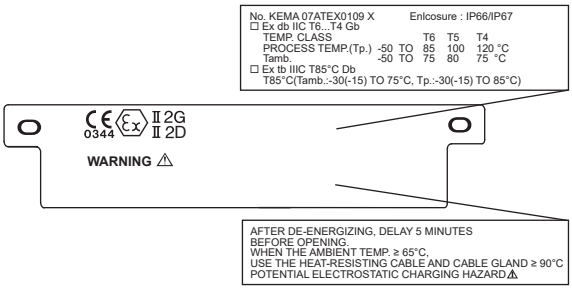
When maintenance and repair are performed, confirm the following conditions and then perform works. Confirm that the power supply is cut off and the voltage of power supply terminal is not supplied.

(6) Name Plate

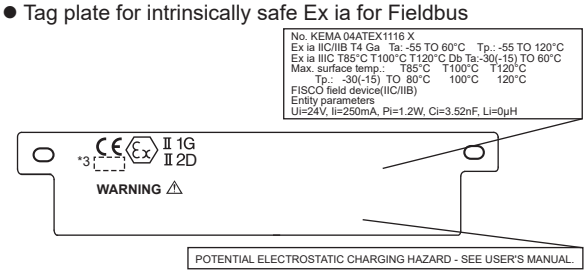
- Name plate



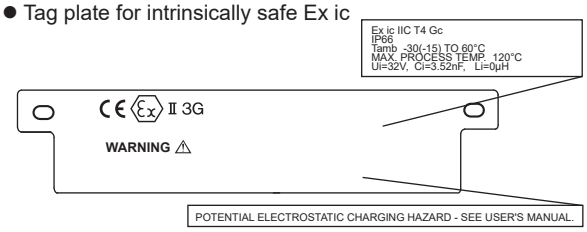
- Tag plate for flameproof type



- Tag plate for intrinsically safe Ex ia for Fieldbus



- Tag plate for intrinsically safe Ex ic



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MODEL: Specified model code.
STYLE: Style code.
SUFFIX: Specified suffix code.
SUPPLY: Supply voltage.
OUTPUT: Output signal.
MWP: Maximum working pressure.
CAL RNG: Specified calibration range.
NO.: Serial number and year of production*1.
TOKYO 180-8750 JAPAN:
The manufacturer name and the address*2.

*1: The first digit in the final three numbers of the serial number appearing after "NO." on the name plate indicates the year of production. The following is an example of a serial number for a product that was produced in 2010:

91K819857 032
The year 2010

*2: "180-8750" is the Zip code for the following address.
2-9-32 Nakacho, Musashino-shi, Tokyo Japan

*3: The identification number of Notified Body.

2.1.4 IECEx Certification

a. IECEx Flameproof Type

Caution for IECEx flameproof type.

Note 1. The transmitters with optional code /SF2 are applicable for use in hazardous locations:

- No. IECEx CSA 07.0008
- Applicable Standard: IEC60079-0:2011, IEC60079-1:2007-4
- Flameproof for Zone 1, Ex d IIC T6...T4 Gb
- Enclosure: IP66 and IP67
- Maximum Process Temperature: 120°C (T4), 100°C (T5), 85°C (T6)
- Ambient Temperature: –50* to 75°C (T4), –50* to 80°C (T5), –50* to 75°C (T6)
  * –15°C when /HE is specified.
- Supply Voltage: 32 V dc max.
- Output Signal: 15 mA dc

Note 2. Wiring

- In hazardous locations, the cable entry devices shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.
- Unused apertures shall be closed with suitable flameproof certified blanking elements.

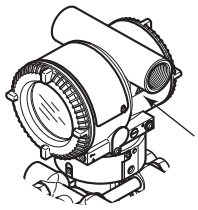
Note 3. Operation

- WARNING: AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING.
- WARNING: WHEN THE AMBIENT TEMP.≥65°C, USE HEAT-RESISTING CABLE AND CABLE GLAND ≥90°C.
- Take care not to generate mechanical sparking when accessing to the instrument and peripheral devices in a hazardous location.
- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of the product.

Note 4. Maintenance and Repair

- The instrument modification or parts replacement by other than authorized representative of Yokogawa Electric Corporation is prohibited and will void IECEx Certification.
- Electrical Connection
  A mark indicating the electrical connection type is stamped near the electrical connection port. These marks are as follows.

Screw Size	Marking
ISO M20 × 1.5 female	⚠M
ANSI 1/2 NPT female	⚠N or ⚠W



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b. IECEx Intrinsically Safe Ex ia

Caution for IECEx Intrinsically safe Ex ia.

Note 1. EJX/EJA-E Series pressure transmitters with optional code /SS26 are applicable for use in hazardous locations.

Certification Information:

WARNING

A modification of the equipment would no longer comply with the construction described in the certificate documentation.

Certificate Number:
IECEx DEK 12.0016X

NOTE

The symbol “X” placed after the certificate number indicates that the equipment is subject to specific conditions of use.

Applicable Standard:
IEC 60079-0, IEC 60079-11

Note 2. Rating

Ex Marking: Ex ia IIC/IIB T4 Ga

Temperature specifications:

Ambient Temperature range and Process Temperature range for Gas:

Ambient temperature range	Process temperature range
–55 to 60°C	–55 to 120°C

Electrical Parameters:

Intrinsically safe ratings are as follows:

[Entity]

Ui = 24 V
Ii = 250 mA
Pi = 1.2 W
Ci = 3.52 nF
Li = 0 µH

[FISCO IIC]

Ui = 17.5 V
Ii = 380 mA
Pi = 5.32 W
Ci = 3.52 nF
Li = 0 µH

[FISCO IIB]

Ui = 17.5 V
Ii = 460 mA
Pi = 5.32 W
Ci = 3.52 nF
Li = 0 µH

Note 3. Installation

- Refer to the control drawing IKE022-A12 P.1 and P.2. (Note 7.)
- The type of threads is indicated at the cable entry, using the following marking.

Screw Size	Marking
ISO M20 × 1.5 female	⚠M
ANSI 1/2 NPT female	⚠A or ⚠N or ⚠W

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- The selected type of the Ex marking on the name plate should be indicated. For this purpose, the tick boxes can be used as follows.

☑ Ex ia IIC/IIB T4 Ga
☐ Ex ic IIC T4 Gc

Note 4. Operation

- If the pressure transmitter is mounted in an area where explosive atmospheres may be present, it must be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust are avoided.

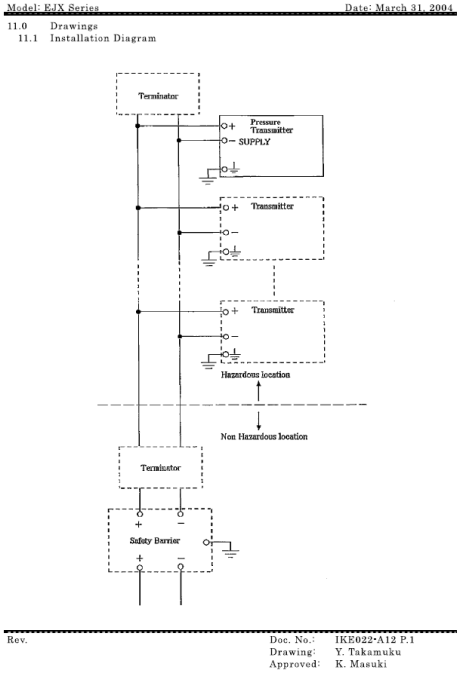
Note 5. Specific conditions of use

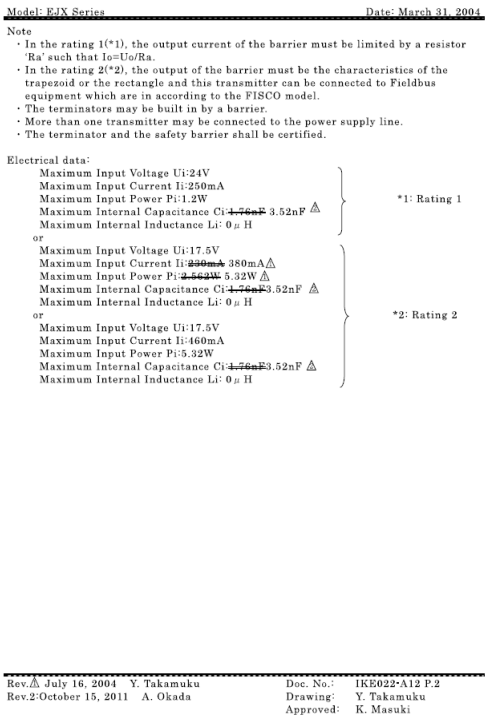
- When the pressure transmitter is made of aluminum alloy, if it is mounted in an area where the use of EPL Ga equipment is required, it shall be installed such that, even in the event of rareincidents, an ignition source due to impact and friction sparks is excluded.
- Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts.
- The dielectric strength of at least 500 V of the intrinsically safe circuits of the pressure transmitter is limited only by the overvoltage protection.

Note 6. Maintenance and Repair

- Only personnel authorized by Yokogawa Electric Corporation can repair the equipment.

Note7. Control drawing





Model: EJX Series Date: March 31, 2004

Note
- In the rating 1(*1), the output current of the barrier must be limited by a resistor 'Ra' such that Io=Uo/Ra.
- In the rating 2(*2), the output of the barrier must be the characteristics of the trapezoid or the rectangle and this transmitter can be connected to Fieldbus equipment which are in according to the FISCO model.
- The terminators may be built in by a barrier.
- More than one transmitter may be connected to the power supply line.
- The terminator and the safety barrier shall be certified.

Electrical data:

*1: Rating 1
- Maximum Input Voltage Ui:24V
- Maximum Input Current Ii:250mA
- Maximum Input Power Pi:1.2W
- Maximum Internal Capacitance Ci:~~1.76nF~~ 3.52nF △
- Maximum Internal Inductance Li: 0 μ H

or

*2: Rating 2
- Maximum Input Voltage Ui:17.5V
- Maximum Input Current Ii:~~230mA~~ 380mA△
- Maximum Input Power Pi:~~2.562W~~ 5.32W△
- Maximum Internal Capacitance Ci:~~1.76nF~~3.52nF △
- Maximum Internal Inductance Li: 0 μ H

or
- Maximum Input Voltage Ui:17.5V
- Maximum Input Current Ii:460mA
- Maximum Input Power Pi:5.32W
- Maximum Internal Capacitance Ci:~~1.76nF~~3.52nF △
- Maximum Internal Inductance Li: 0 μ H

Rev.△ July 16, 2004 Y. Takamuku
Rev.2:October 15, 2011 A. Okada

Doc. No.: IKE022-A12 P.2
Drawing: Y. Takamuku
Approved: K. Masuki

c. IECEx Intrinsically Safe Ex ic

Caution for IECEx Intrinsically safe Ex ic.

Note 1. EJX/EJA-E Series pressure transmitters with optional code /SS26 are applicable for use in hazardous locations.

Certification Information:

WARNING

A modification of the equipment would no longer comply with the construction described in the certificate documentation.

Certificate Number: IECEx DEK 13.0064X

NOTE

The symbol “X” placed after the certificate number indicates that the equipment is subject to specific conditions of use.

Applicable Standard:
IEC 60079-0, IEC 60079-11

Note 2. Ratings

Ex Marking: Ex ic IIC T4 Gc

Temperature specifications:

Ambient temperature range	Process temperature range	Type of O-ring
–30 to 60°C	–30 to 120°C	NBR
–15 to 60°C	–15 to 120°C	Fluoro-rubber (FKM)

IP Code: IP66

Overvoltage Category: I

Electrical Parameters: See control drawing IIE020-A70 (Note 7.)

Note 3. Installation

- See control drawing IIE020-A70. (Note 7.)
- The type of threads is indicated at the cable entry, using the following marking.

Screw Size	Marking
ISO M20 × 1.5 female	△M
ANSI 1/2 NPT female	△A or △N or △W

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- The selected type of the Ex marking on the name plate should be indicated. For this purpose, the tick boxes can be used as follows.
  ☐ Ex ia IIC/IIB T4 Ga
  ☑ Ex ic IIC T4 Gc

Note 4. Operation

- If the pressure transmitter is mounted in an area where explosive atmospheres may be present, it must be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust are avoided.

Note 5. Specific conditions of use

See control drawing IIE020-A70 (Note 7.)

Note 6. Maintenance and Repair

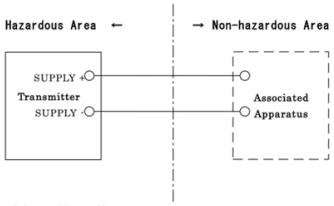
- Only personnel authorized by Yokogawa Electric Corporation can repair the equipment.

Note 7. Control drawing

Model: EJX Series Date: April 01, 2013

13 Control Drawing

Following instructions shall be included in the user's manual, together with the following items:
- a list of the standards in Section 1 of IIE020-A03, including the issue year;
- specifications in Section 2 of IIE020-A03;
- marking information in IIE020-A60.



Electrical data: Ui = 32 V
Ci = 3.52 nF
Li = 0 µH

Specific Conditions of Use:
- Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts.
- The dielectric strength of at least 500 V a.c. r.m.s. between the intrinsically safe circuits and the enclosure of the pressure transmitter is limited only by the overvoltage protection.

WARNING:
- POTENTIAL ELECTROSTATIC CHARGING HAZARD - SEE THE USER'S MANUAL

Notes:
- The pressure transmitter is allowed to be installed in "nL" systems, on condition that the output parameters of the "nL" source (associated energy-limited apparatus) are suitable to the above-mentioned input parameters of the pressure transmitter and the cable parameters.
- Cable glands, adapters and/or blanking elements shall be of Ex "n", Ex "e" or Ex "d" and shall be installed so as to maintain the specified degree of protection (IP Code) of the equipment.
- In case of multiple types of protection, the selected Ex marking on the marking plate shall be checked at the time of installation.

Rev.1: September 02, 2019 Doc. No.: IIE020-A70
Drawing: T.Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

3. About Fieldbus

3.1 Outline

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

The transmitter of Fieldbus communication type employs the specification standardized by The FieldComm Group, and provides interoperability between Yokogawa devices and those produced by other manufacturers. Fieldbus comes with software consisting of three AI function blocks that enable the flexible implementation of systems.

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

3.2 Internal Structure of DPharp

The transmitter 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 transmitter hardware.
- Automatically informs the host of any detected faults or other problems.

(2) SENSOR Transducer block

- Converts sensor output to pressure, static pressure, and capsule temperature signals, and transfers to the AI function blocks.

(3) LCD Transducer block

- Controls the display of the integral indicator.

(4) AI1 function block

- Condition raw data from the Transducer block.
- Output differential pressure, static pressure and capsule temperature signals.
- Carry out scaling, damping and square root extraction.

(5) PID function block

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

3.3 Logical Structure of Each Block

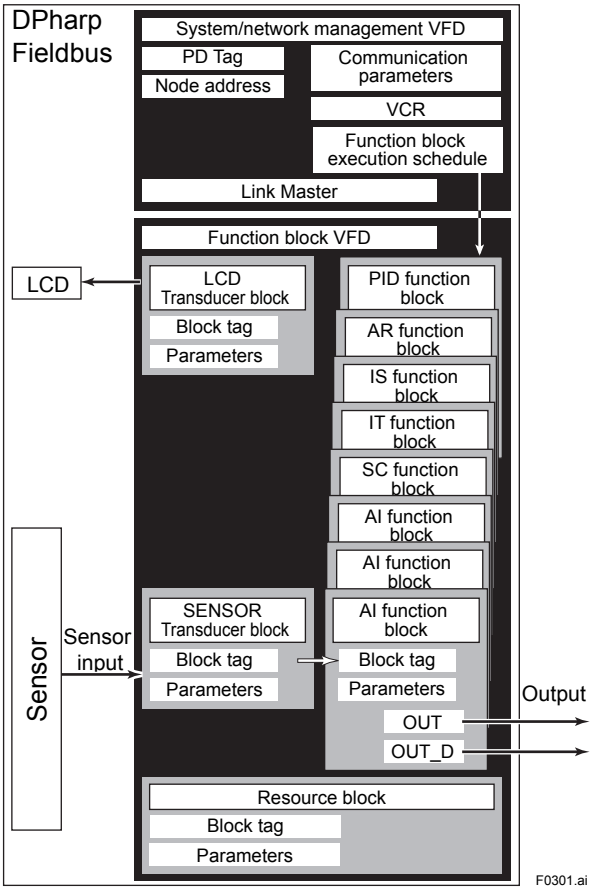


Figure 3.1 Logical Structure of Each Block

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 achieve optimal performance.

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 or HART communication protocol. It is recommended that novice users use field devices in accordance with the procedures described in this section. The procedures assume that field devices will be set up on a bench or in an instrument shop.

4.1 Connection of Devices

The following are required for use with Fieldbus devices:

- **Power supply:**

  Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.

- **Terminator:**

  Fieldbus requires two terminators. Refer to the supplier for details of terminators that are attached to the host.

- **Field devices:**

  Connect the Fieldbus communication type transmitter. Two or more transmitters or other devices can be connected.

- **Host:**

  Used for accessing field devices. A dedicated host (such as DCS) is used for an instrumentation line while dedicated communication tools are used for experimental purposes. For operation of the host, refer to the instruction manual for each host. No other details on the host are given in this manual.

- **Cable:**

  Used for connecting devices. Refer to “Fieldbus Technical Information” (TI 38K03A01-01E) for details of instrumentation cabling. For laboratory or other experimental use, a twisted pair cable two to three meters in length with a cross section of 0.9 mm^2 or more and a cycle period of within 5 cm (2 inches) may be used. Termination processing depends on the type of device being deployed. For the transmitter, use an M4 screw terminal claw. Some hosts require a connector.

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

Connect the devices as shown in Figure 4.1. Connect the terminators at both ends of the trunk, with a minimum length of the spur laid for connection.

The polarity of signal and power must be maintained.

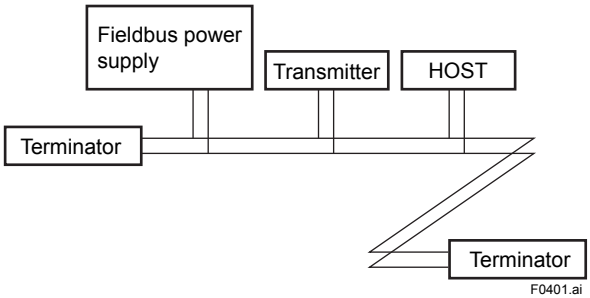


Figure 4.1 Cabling

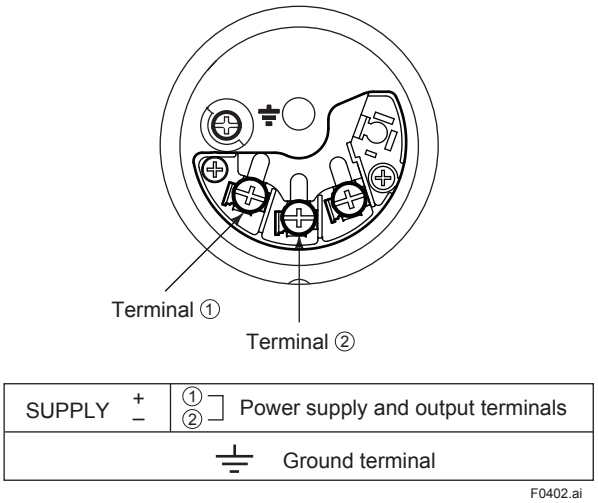


Figure 4.2 Wiring Diagram

NOTE

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

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

IMPORTANT

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

4.2 Host Setting

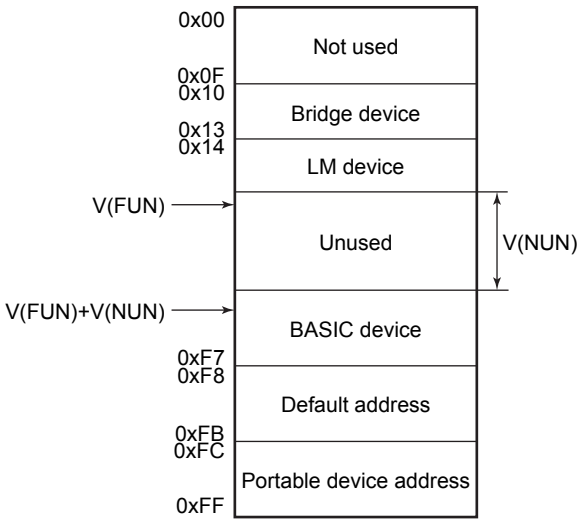
To activate Fieldbus, the following settings are required for the host.

IMPORTANT

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

Table 4.1 Operation Parameters

Symbol	Parameter	Description and Settings
V (ST)	Slot-Time	Indicates the time necessary for immediate reply of the device. Unit of time is in octets (256 µs). Set maximum specification for all devices. For the transmitter, 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 the transmitter, 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 the transmitter, the setting must be a value of 12 or greater.
V (FUN)	First-Unpolled-Node	Indicate the address next to the address range used by the host. Set 0 × 15 or greater.
V (NUN)	Number-of-consecutive-Unpolled-Node	Unused address range.



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

F0403.ai

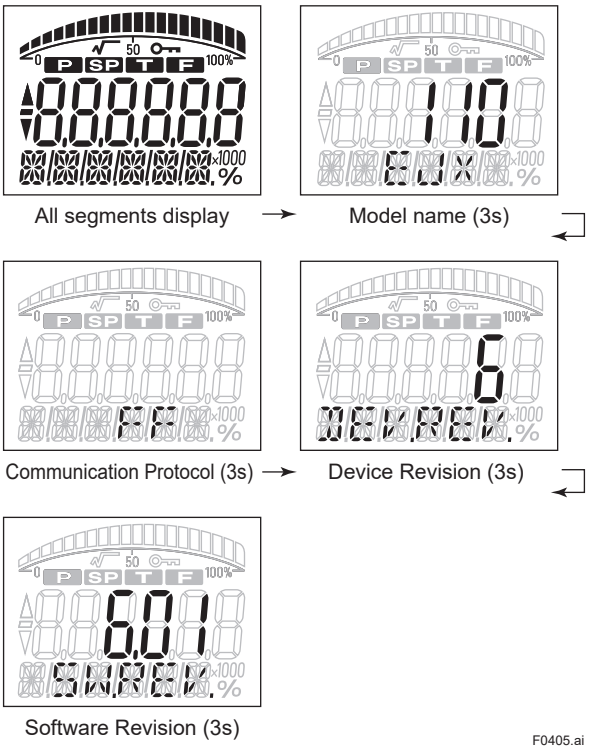
Figure 4.2 Available Address Range

4.3 Bus Power ON

4.3.1 Integral Indicator Display When Powering On

Turn on the power of the host and the bus.

For models with the integral indicator code “D”, the display shows all segments in the LCD and then changes to the displays shown below sequentially.



NOTE

LCD display can be set to all segments display only by changing the following parameter.
LCD Tranceducer Block POWER_ON_INFO
1:ON(Default)
Show all segments display, Model name, Communication Protocol, device revision and software revision when powering on.
0:OFF
Show all segments display when powering on.

4.3.2 Confirming that Transmitter is Operating Properly

Turn on the power of the host and the bus. If the indicator is not lit, check the polarity of the power supply.

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

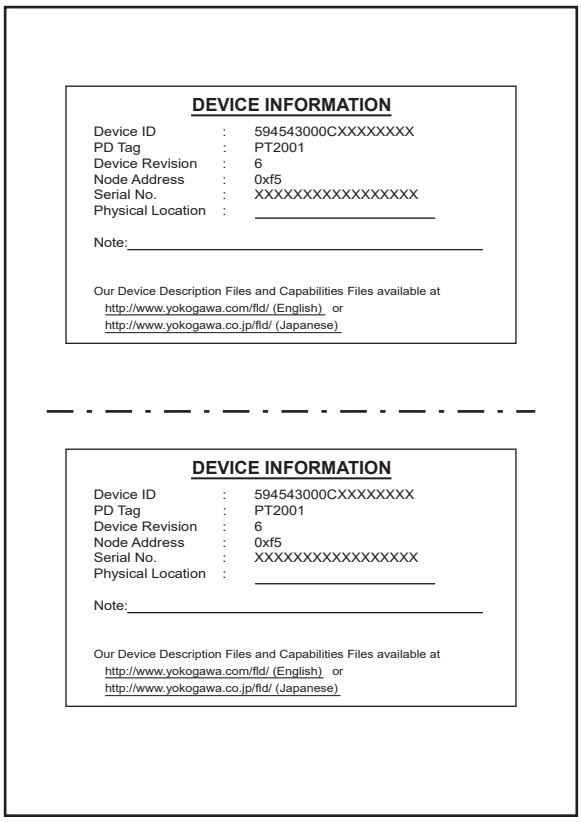


Figure 4.4 Device Information Sheet Attached to Transmitter

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

4.4 Integration of DD

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

594543\000C
(594543 is the manufacturer number of Yokogawa Electric Corporation, and 000C is the EJX device number, respectively. The device number of EJA is "0011".)

If this directory is not found, the DD of the transmitter has not been included. Create the above directory and copy the DD file (0m0n.ffo, 0m0n.sym, 0m0n.ff5, 0m0n.sy5) (m, n is a numeral) into the directory. '0m' in the file name shows the device revision, and '0n' shows the DD revision. If you do not have the DD or capabilities files, you can download them from our web site:

https://www.yokogawa.com/library/

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

Off-line configuration is possible by using capabilities files.

4.5 Set the parameters using DTM

When configure the parameters using FieldMate, use the DTM (Device Type Manager) shown in the Table 4.2.

Table 4.2 DTM

DTM	Transmitters		
Name	Model Name	Devise Type	Device Revision
EJX V5.1	EJX□□□A (Except EJX9□□A)	EJX (0x000C)	6
EJA –NEXT V1.1	EJA□□□E	EJA-NEXT (0x0011)	2

"Field Diagnostics" function (refer to IM 01R01A15-01EN) is available on EJX FF DTM Revision 3.4.0.21 or later and EJA-NEXT FF DTM Revision 3.4.0.21 or later.

The DTM corresponding to the above is included in Yokogawa Device DTM Library 4.0/Device Files R 3.05.00 or later.

4.6 Reading the Parameters

To read the transmitter parameters, select the AI1 block of the transmitter from the host screen and read the OUT parameter. The current selected signal is displayed. Check that MODE_BLOCK of the function block and resource block is set to AUTO, and change the signal input and read the parameter again. A new designated value should be displayed.

4.7 Continuous Record of Values

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

4.8 Generation of Alarm

Generation of an alarm can be attempted from the transmitter. Block alarm, Output limit alarm, and Update alarm are informed to the host. When generating alarm, a Link Object and a VCR Static Entry need to be set. For details of Link Object and VCR Static Entry, refer to section 5.6.1 Link object and section 5.5.1 VCR Setting.

5. Configuration

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

(1) Network design

Determines the devices to be connected to Fieldbus and checks the capacity of the power supply.

(2) Network definition

Determines the tag and node addresses for all devices.

(3) Definition of combining function blocks

Determines how function blocks are combined.

(4) Setting tags and addresses

Sets the PD Tag and node addresses for each device.

(5) Communication setting

Sets the link between communication parameters and function blocks.

(6) Block setting

Sets the parameters for function blocks.

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

5.1 Network Design

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

- **Power supply**

  Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.

- **Terminator**

  Fieldbus requires two terminators. Refer to the supplier for details of terminators that are attached to the host.

- **Field devices**

  Connect the field devices necessary for instrumentation. The transmitter has passed the interoperability test conducted by The Fieldbus Foundation. In order to properly start Fieldbus, it is recommended that the devices used satisfy the requirements of the above test.

- **Host**

  Used for accessing field devices. A minimum of one device with the bus control function is needed.

- **Cable**

  Used for connecting devices. Refer to “Fieldbus Technical Information” (TI 38K03A01-01E) for details of instrumentation cabling. Provide a cable sufficiently long to connect all devices. For field branch cabling, use terminal boards or a connection box as required.

First, check the capacity of the power supply. The power supply capacity must be greater than the sum of the maximum current consumed by all devices to be connected to Fieldbus. The maximum current consumed (power supply voltage 9 V to 32 V) for the transmitter is 15 mA (24 mA in Software download operation). The cable used for the spur must be of the minimum possible length.

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

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 to keep the unused device range as narrow as possible so as to lessen the load on the Fieldbus.

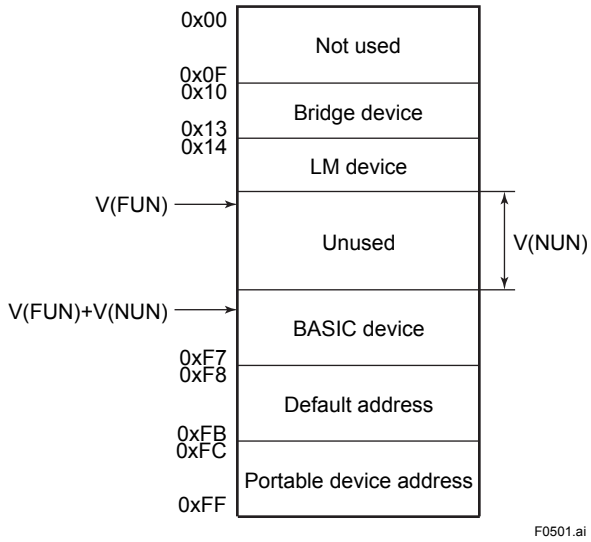


Figure 5.1 Available Range of Node Addresses

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 DPharp specification values.

Table 5.2 Operation Parameter Values of the DPharp 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 the transmitter, 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 the transmitter, 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 Slottime; set the value so that V (MRD) × V (ST) is the maximum value of the specification for all devices. For the transmitter, the setting must be a value of 12 or greater.

5.3 Definition of Combining Function Blocks

The input/output parameters for function blocks are combined. As required, they can be combined with the input of the control block. The setting is written to the transmitter link object. See “Block setting” in Section 5.6 for the details. It is also possible to read values from the host at proper intervals instead of connecting the transmitter 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 DPharp schedule according to the following table. The values in the table are factory-settings.

Table 5.3 Execution Schedule of the DPharp 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 = 1.0 s)
351 (SM)	FB_START_ENTRY.1	AI1 block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32 ms. (0 = 0 s)
352 to 381 (SM)	FB_START_ENTRY.2 to FB_START_ENTRY.31	Not used.

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

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

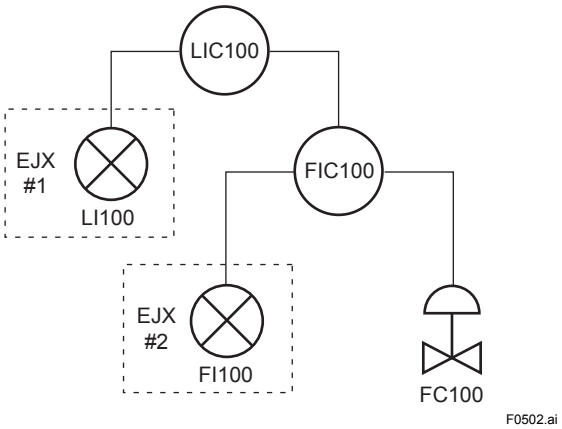


Figure 5.2 Example of Loop Connecting Function Block of Two EJX with Other Instruments

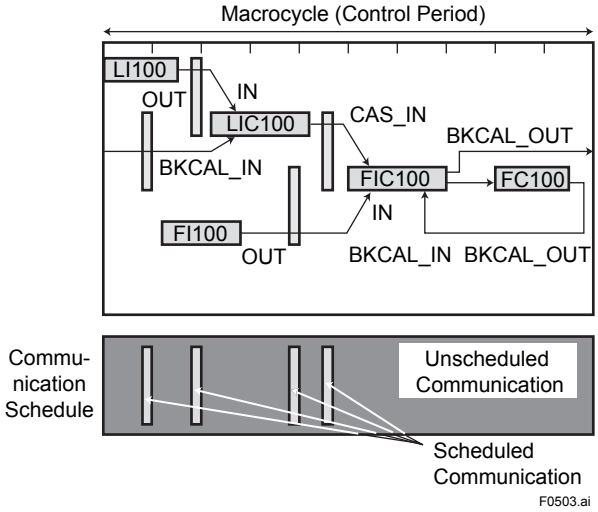


Figure 5.3 Function Block Schedule and Communication Schedule

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

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

5.4 Setting of Tags and Addresses

This section describes the steps in the procedure to set PD Tags and node addresses in the transmitter. 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. EJX must be transferred to this state when a transmitter tag or address is changed.

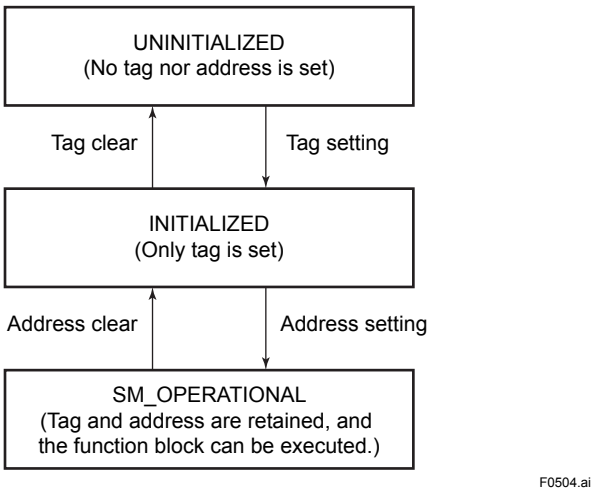


Figure 5.4 Status Transition by Setting PD Tag and Node Address

The transmitter has a PD Tag (PT2001) and node address (245, or hexadecimal F5) that are set upon shipment from the factory unless otherwise specified. To change only the node address, clear the address once and then set a new node address. To set the PD Tag, first clear the node address and clear the PD Tag, then set the PD Tag and node address again.

Devices whose node addresses have been cleared will have the default address (randomly chosen from a range of 248 to 251, or from hexadecimal F8 to FB). At the same time, it is necessary to specify the device ID in order to correctly specify the device. The device ID of the EJX is 594543000Cxxxxxxxx and that of the EJA is 5945430011xxxxxxxx. (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. The transmitter has 38 VCRs whose application can be changed, except for the first VCR, which is used for management.

The transmitter has VCRs of four types:

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

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

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

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

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

Each VCR has the parameters listed in Table 5.4. Parameters must be changed together for each VCR because modification of individual parameters 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 DPharp. 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 DPharp. A range of 20 to F7 in hexadecimal.
3	FasDllConfigured RemoteAddr	Sets the node address of the called party for communication and the address (DLSAP or DLCEP) used to specify VCR in that address. For DLSAP or DLCEP, a range of 20 to F7 in hexadecimal is used. Addresses in Subindex 2 and 3 need to be set to the same contents of the VCR as the called party (local and remote are reversed).
4	FasDllSDAP	Specifies the quality of communication. Usually, one of the following types is set. 0x2B: Server 0x01: Source (Alert) 0x03: Source (Trend) 0x91: Publisher/ Subscriber
5	FasDllMaxConfirm DelayOnConnect	To establish connection for communication, a maximum wait time for the called party's response is set in ms. Typical value is 60 seconds (60000).
6	FasDllMaxConfirm DelayOnData	For request of data, a maximum wait time for the called party's response is set in ms. Typical value is 60 seconds (60000).
7	FasDllMaxDlsduSize	Specifies maximum DL Service Data unit Size (DLSDU). Set 256 for Server and Trend VCR, and 64 for other VCRs.
8	FasDllResidual ActivitySupported	Specifies whether connection is monitored. Set TRUE (0xff) for Server. This parameter is not used for other communication.
9	FasDllTimelinessClass	Not used for DPharp.
10	FasDllPublisherTime WindowSize	Not used for DPharp.
11	FasDllPublisher SynchronizaingDlcep	Not used for DPharp.
12	FasDllSubsriberTime WindowSize	Not used for DPharp
13	FasDllSubscriber SynchronizationDlcep	Not used for DPharp.
14	FmsVfdId	Sets VFD for DPharp 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 DPharp, it is automatically set according to specific applications.

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

Table 5.5 VCR List

Index (SM)	VCR Number	Factory Setting
402	1	For system management (Fixed)
403	2	Server (LocalAddr = 0xF3)
404	3	Server (LocalAddr = 0xF4)
405	4	Server (LocalAddr = 0xF7)
406	5	Trend Source (LocalAddr = 0x07, Remote Address=0x111)
407	6	Publisher for AI1 (LocalAddr = 0x20)
408	7	Alert Source (LocalAddr = 0x07, Remote Address=0x110)
409	8	Server (LocalAddr = 0xF9)
410	9	Publisher for AI2 (LocalAddr = 0x21)
411 to 439	10 to 38	Not used.

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

A link object combines the data voluntarily sent by the function block with the VCR. 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	Parameter	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 DPharp. 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.

Set link objects as shown in Table 5.7.

Table 5.7 Factory-Settings of Link Objects (example)

Index	Link Object #	Factory Settings
30000	1	AI1.OUT → VCR#6
30001	2	Trend → VCR#5
30002	3	Alert → VCR#7
30003	4	AI2.OUT → VCR#9
30004 to 30044	5 to 45	Not used

5.6.2 Trend Object

It is possible to set the parameter so that the function block automatically transmits Trend. The transmitter has 10 Trend objects, 8 of which are used for Trend in analog mode parameters and 2 is used for Trend in discrete mode parameter. A single Trend object specifies the trend of one parameter.

Each Trend object has the parameters listed in Table 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.

Table 5.8 Parameters for Trend Objects

Sub-index	Parameter	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 DPharp 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.
22 to 37	List of Samples	Data part of a sampled parameter.

10 trend objects are factory-set as shown Table 5.9.

Table 5.9 Trend Object are Factory-Set

Index	Parameters	Factory Settings
32000 to 32007	TREND_FLT.1 to TREND_FLT.8	Not used.
32008 to 32009	TREND_DIS.1 to TREND_DIS.2	Not used.

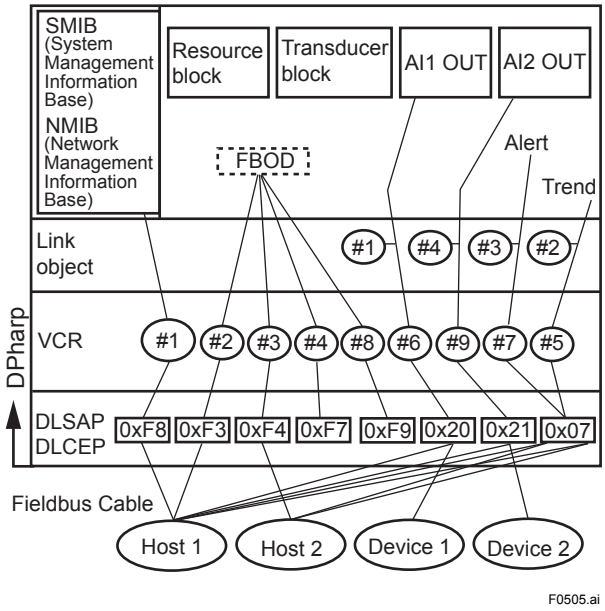


Figure 5.5 Example of Default Configuration

5.6.3 View Object

This object forms a group of parameters in a block. One advantage brought by forming groups of parameters is the reduction of load for data transactions. View Object has the parameters listed in Table 5.11 to 5.14. Purpose of View Objects is shown in Table 5.10.

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.

Table 5.11 View Object for Resource Block

Relative Index	Parameter Mnemonic	VIEW					
		1	2	3	3_2	4	4_2
1	ST_REV	2	2	2	2	2	2
2	TAG_DESC						
3	STRATEGY					2	
4	ALERT_KEY					1	
5	MODE_BLK	4		4			
6	BLOCK_ERR	2		2			
7	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			
53	SOFTDWN_ PROTECT					1	
54	SOFTDWN_FORMAT						
55	SOFTDWN_COUNT					2	
56	SOFTDWN_ACT _AREA			1			
57	SOFTDWN_MOD _REV			16			
58	SOFTDWN_ERROR			2			
59	SOFTDWN_HISTORY						
60	SOFTDWN_HIST_ INDEX						
61	COMPATIBILITY_REV			1			
62	CAPABILITY_LEV			1			
63	CAPABILITY_CONFIG			2			
64	WRITE_LOCK_LEVEL		1				
65	SI_CONTROL_CODES		1				
66	FD_VER					2	
67	FD_FAIL_ACTIVE	4			4		
68	FD_OFFSPEC _ACTIVE	4			4		
69	FD_MAINT_ACTIVE	4			4		
70	FD_CHECK_ACTIVE	4			4		
71	FD_FAIL_MAP					4	
72	FD_OFFSPEC_MAP					4	
73	FD_MAINT_MAP					4	
74	FD_CHECK_MAP					4	
75	FD_FAIL_MASK					4	
76	FD_OFFSPEC_MASK					4	
77	FD_MAINT_MASK					4	
78	FD_CHECK_MASK					4	
79	FD_FAIL_ALM						
80	FD_OFFSPEC_ALM						
81	FD_MAINT_ALM						
82	FD_CHECK_ALM						
83	FD_FAIL_PRI					1	
84	FD_OFFSPEC_PRI					1	
85	FD_MAINT_PRI					1	
86	FD_CHECK_PRI					1	
87	FD_SIMULATE				9		
88	FD_RECOMMEN_ACT	2			2		
89	FD_EXTENDED _ACTIVE_1				4		
90	FD_EXTENDED _ACTIVE_2				4		
91	FD_EXTENDED _ACTIVE_3				4		
92	FD_EXTENDED _ACTIVE_4				4		
93	FD_EXTENDED _ACTIVE_5				4		
94	FD_EXTENDED _ACTIVE_6				4		
95	FD_EXTENDED _ACTIVE_7				4		

Relative Index	Parameter Mnemonic	VIEW					
		1	2	3	3_2	4	4_2
96	FD_EXTENDED _ACTIVE_8				4		
97	FD_EXTENDED_ MAP_1						4
98	FD_EXTENDED_ MAP_2						4
99	FD_EXTENDED_ MAP_3						4
100	FD_EXTENDED_ MAP_4						4
101	FD_EXTENDED_ MAP_5						4
102	FD_EXTENDED_ MAP_6						4
103	FD_EXTENDED_ MAP_7						4
104	FD_EXTENDED_ MAP_8						4
105	PRIVATE_1						
106	PRIVATE_2						
107	PRIVATE_3						
108	PRIVATE_4						
109	PRIVATE_5						
110	PRIVATE_6						
111	PRIVATE_7						
112	PRIVATE_8						
113	PRIVATE_9						
114	PRIVATE_10						
115	PRIVATE_11						
116	DEVICE_CONDITION_ ACTIVE_1						4
117	DEVICE_CONDITION_ ACTIVE_2						4
118	DEVICE_CONDITION_ ACTIVE_3						4
119	DEVICE_CONDITION_ ACTIVE_4						4
120	DEVICE_CONDITION_ ACTIVE_5						4
121	DEVICE_CONDITION_ ACTIVE_6						4
122	DEVICE_CONDITION_ ACTIVE_7						4
123	DEVICE_CONDITION_ ACTIVE_8						4
	Totals (# bytes)	40	32	77	61	72	66

Table 5.12 View Object for SENSOR Transducer Block

Relative Index	Parameter Mnemonic	VIEW									
		1	2	3_1	3_2	3_3	4_1	4_2	4_3	4_4	4_5
1	ST_REV	2	2	2	2	2	2	2	2	2	2
2	TAG_DESC										
3	STRATEGY						2				
4	ALERT_KEY						1				
5	MODE_BLK	4		4							
6	BLOCK_ERR	2		2							
7	UPDATE_EVT										
8	BLOCK_ALM										
9	TRANSDUCER_ DIRECTORY										
10	TRANSDUCER _TYPE	2	2	2			2				
11	XD_ERROR	1		1							
12	COLLECTION_ DIRECTORY										
13	PRIMARY_ VALUE_TYPE		2								
14	PRIMARY_VALUE	5		5							
15	PRIMARY_ VALUE_RANGE						11				
16	CAL_POINT_HI		4								
17	CAL_POINT_LO		4								
18	CAL_MIN_SPAN						4				
19	CAL_UNIT						2				
20	SENSOR_TYPE						2				
21	SENSOR_ RANGE						11				
22	SENSOR_SN							32			
23	SENSOR_CAL_ METHOD							1			
24	SENSOR_ CAL_LOC							32			
25	SENSOR_CAL_ DATE							7			
26	SENSOR_CAL_ WHO							32			
27	SENSOR_ ISOLATOR_MTL						2				
28	SENSOR_FILL_ FLUID						2				
29	SECONDARY_ VALUE	5		5							
30	SECONDARY_ VALUE_UNIT		2								
31	CAL_DEVIATION _HI		4								
32	CAL_DEVIATION _LO		4								
33	EXTERNAL_ ZERO_TRIM						1				
34	PRIMARY_ VALUE_FTIME		4								
35	TERTIARY_ VALUE	5		5							
36	SP_VALUE_TYPE		2								
37	SP_VALUE_ RANGE						11				
38	CAL_SP_ POINT_HI		4								
39	CAL_SP_POINT_ LO		4								
40	CAL_SP_MIN_ SPAN						4				
41	CAL_SP_UNIT						2				

Relative Index	Parameter Mnemonic	VIEW									
		1	2	3_1	3_2	3_3	4_1	4_2	4_3	4_4	4_5
42	CAL_SP_ DEVIATION_HI		4								
43	CAL_SP_ DEVIATION_LO		4								
44	SP_VALUE_ FTIME		4								
45	ATM_PRESS		4								
46	CLEAR_CAL										
47	CAP_TEMP_VAL	5		5							
48	CAP_TEMP_ RANGE						11				
49	AMP_TEMP_VAL	5		5							
50	AMP_TEMP_ RANGE						11				
51	MODEL								16		
52	SPECIAL_ ORDER_ID								32		
53	MANUFAC_DATE								7		
54	CAP_GASKET_ MTL								1		
55	FLANGE_MTL								1		
56	D_VENT_PLUG								1		
57	FLANGE_TYPE								1		
58	REM_SEAL_ ISOL_MTL								1		
59	FLANGE_SIZE								1		
60	REM_SEAL_NUM								1		
61	REM_SEAL_ FILL_FLUID								1		
62	REM_SEAL_ TYPE								1		
63	ALARM_SUM	8		8							
64	AUTO_ RECOVERY						1				
65	MS_CODE										
66	DIAG_MODE									1	
67	DIAG_PERIOD									2	
68	DIAG_PRI									1	
69	DIAG_ERR				2						
70	DIAG_H_ALM				13						
71	DIAG_L_ALM				13						
72	DIAG_OPTION									2	
73	REF_LIM_ FDPMIN									4	
74	REF_LIM_ FSPMIN									4	
75	REF_LIM_ BLKFMAX									4	
76	COMP_FLAG									1	
77	DIAG_LIM									40	
78	DIAG_COUNT									1	
79	REFERENCE_ TIME									8	
80	REFERENCE_ FDP									5	
81	REFERENCE_ FSPL									5	
82	REFERENCE_ FSPH									5	
83	REFERENCE_ BLKF									5	
84	REFERENCE_ DPAVG									5	
85	VALUE_TIME				8						
86	VALUE_FDP				5						
87	VALUE_FSPL				5						
88	VALUE_FSPH				5						

Relative Index	Parameter Mnemonic	VIEW									
		1	2	3_1	3_2	3_3	4_1	4_2	4_3	4_4	4_5
89	VALUE_BLKF				5						
90	VALUE_DPAVG				5						
91	RATIO_FDP				5						
92	RATIO_FSPL				5						
93	RATIO_FSPH				5						
94	CRATIO_FDP				5						
95	NRATIO_FDP				5						
96	DIAG_ APPLICABLE				2						
97	FLG_TEMP_VAL				5						
98	FLG_TEMP_ RANGE										11
99	FLG_TEMP_ COEF										4
100	FLG_TEMP_PRI										1
101	FLG_TEMP_H_ LIM										4
102	FLG_TEMP_L_ LIM										4
103	FLG_TEMP_ALM				13						
104	TEST_KEY1										
105	TEST_KEY2										
106	TEST_KEY3										
107	TEST_1										
108	TEST_2										
109	TEST_3										
110	TEST_4										
111	TEST_5										
112	TEST_6								2		
113	TEST_7								2		
114	TEST_8								1		
115	TEST_9								1		
116	TEST_10								1		
117	TEST_11								2		
118	TEST_12								2		
119	TEST_13					15					
120	TEST_14					38					
121	TEST_15					30					
122	TEST_16										33
123	TEST_17										
124	TEST_18										
125	TEST_19										
126	TEST_20										
127	TEST_21										
128	TEST_22										
129	TEST_23										
130	TEST_24										
131	TEST_25										
132	TEST_26										
133	TEST_27										
134	TEST_28										
135	TEST_29										
136	TEST_30										
137	TEST_31										
	Totals (# bytes)	44	54	44	62	85	82	106	77	95	35

Table 5.13 View Object for LCD 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	DISPLAY_SEL		1		
14	INFO_SEL		1		
15	BLOCK_TAG1		32		
16	PARAMETER_SEL1		2		
17	DISPLAY_TAG1		8		
18	UNIT_SEL1		1		
19	DISPLAY_UNIT1		8		
20	EXP_MODE1		1		
21	BLOCK_TAG2		32		
22	PARAMETER_SEL2		2		
23	DISPLAY_TAG2		8		
24	UNIT_SEL2		1		
25	DISPLAY_UNIT2		8		
26	EXP_MODE2		1		
27	BLOCK_TAG3				32
28	PARAMETER_SEL3				2
29	DISPLAY_TAG3				8
30	UNIT_SEL3				1
31	DISPLAY_UNIT3				8
32	EXP_MODE3				1
33	BLOCK_TAG4				32
34	PARAMETER_SEL4				2
35	DISPLAY_TAG4				8
36	UNIT_SEL4				1
37	DISPLAY_UNIT4				8
38	EXP_MODE4				1
39	BAR_GRAPH_ SELECT		1		
40	DISPLAY_CYCLE				1
41	POWER_ON_INFO				1
42	TEST_40				1
	Totals (# bytes)	11	111	11	114

Table 5.14 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	OUT_D_SEL				2
38	OUT_D			2	
	Totals (# bytes)	31	26	33	48

Table 5.15 Indexes of View for Each Block

	VIEW 1	VIEW 2	VIEW 3	VIEW 4
Resourse Block	40100	40101	40102 to 40103	40104 to 40105
SENSOR Transducer Block	40200	40201	40202 to 40204	40205 to 40209
LCD Transducer Block	40250	40251	40252	40253
AI1 Function Block	40400	40401	40402	40403
AI2 Function Block	40410	40411	40412	40413
AI3 Function Block	40420	40421	40422	40423
PID Function Block	40800	40801	40802	40803
SC Function Block	41450	41451	41452	41453
IT Function Block	41600	41601	41602	41603
IS Function Block	41700	41701	41702	41703
AR Function Block	41750	41751	41752	41753

5.6.4 Function Block Parameters

Function block parameters can be read from the host or can be set. For a list of the parameters of blocks held by the transmitter, refer to “9. Parameter Lists”. For the function blocks other than AI block, LM function, software download function and Advanced Diagnostics, refer to Appendix 1 to 8.

6. Explanation of Basic Items

6.1 Outline

This chapter describes the SENSOR transducer block, the LCD transducer block, and the AI function block and explains basic parameter settings. Refer to Appendixes for other function blocks, LM function, software download function, and advanced diagnostics.

6.2 Setting and Changing Parameters for the Whole Process

IMPORTANT

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

Block mode

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

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

6.3 SENSOR Transducer Block

The SENSOR transducer block is in between the sensor and the AI function blocks. It calculates pressure/differential pressure, static pressure, and capsule temperature from sensor signals. Then it performs damping and range checks for the measured values of these three variables and sends signals to the AI function block.

6.3.1 Functional Block

Figure 6.1 presents the functional block of the SENSOR transducer. The calculated values of pressure/differential pressure, H-side static pressure, L-side static pressure, and capsule temperature are assigned to PRIMARY_VALUE, SECONDARY_VALUE, TERTIARY_VALUE, CAP_TEMP_VAL, AMP_TEMP_VAL, and FLG_TEMP_VAL (option code: /DG1) respectively. Measured values output to the AI function blocks are selected by the Channel parameter of those blocks.

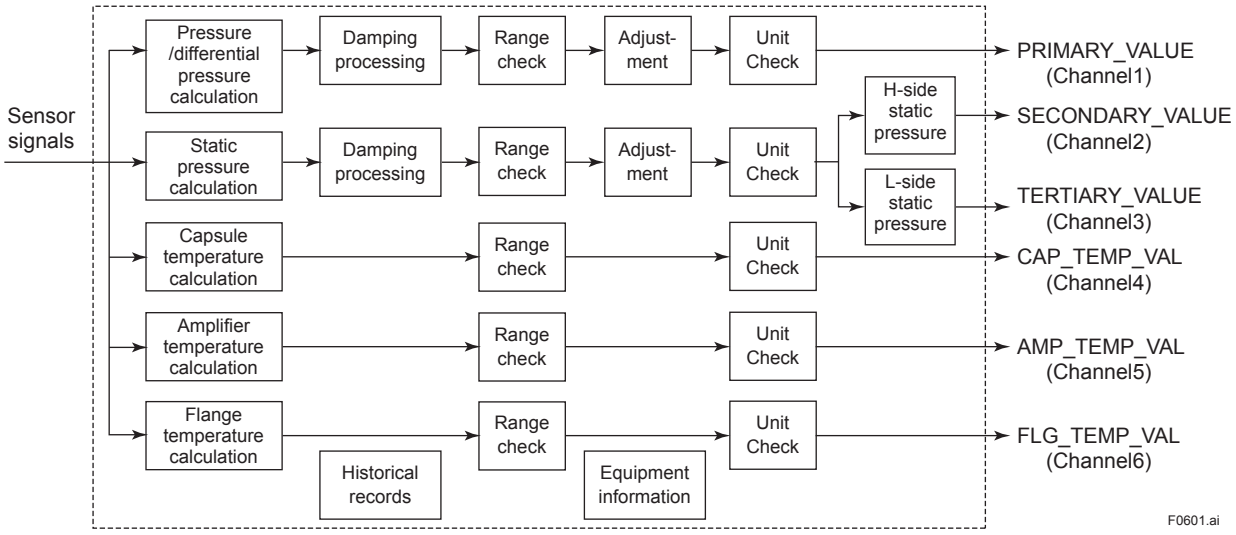


Figure 6.1 SENSOR Transducer Functional Block

6.3.2 Block Mode

The Block modes permitted for the SENSOR transducer block are Automatic (Auto) and Out of Service (O/S). The mode must be set to Auto under normal operating conditions, and to O/S when making changes to an important parameter. For parameters that can only be changed in the Auto and O/S modes, refer to the parameter list for the SENSOR Transducer block in Chapter 9.

6.3.3 Functions Relating to Pressure/ Differential Pressure

Reference to pressure/differential pressure value:

By accessing PRIMARY_VALUE, it is possible to refer to the pressure/differential pressure value and status. The update period of this value is 100 mseconds. The pressure unit is selected by XD_SCALE.unit of the AI block, in which PRIMARY_VALUE is selected. The status is normally Good-Non Specific. However, in the case of a sensor failure or out of measurement range, it turns to Bad or Uncertain. For details, refer to Table 8.9.

Setting of signal damping for pressure/ differential pressure:

When the pressure/differential pressure signal fluctuates greatly, the fluctuation can be reduced by increasing the time constant for signal damping. PRIMARY_VALUE_FTIME is the parameter for setting the signal damping for pressure/differential pressure. The unit of signal damping is second.

Determination of the range limit of pressure/ differential pressure signal:

When the pressure/differential pressure signal deviates more than 10% from the capsule measurement range shown in PRIMARY_VALUE_RANGE, set the status of PRIMARY_VALUE to Uncertain-Sensor Conversion not Accurate.

Adjustment of pressure/differential pressure signal:

EJX Series Pressure/Differential Pressure Transmitters have been accurately adjusted according to the specifications at factory setting. Minimal errors can occur due to the environment where the transmitter is installed and the mounting position. To fine-tune any errors, three zero/span adjustment functions can be used: automatic and manual zero/span adjustment by communication terminals, and zero-point adjustment by means of the external adjustment screw on the transmitter.

Automatic adjustment
The value of the pressure exerted on the point where the adjustment is to be made is assigned to parameters (CAL_POINT_LO, CAL_POINT_HI). After this assignment is set, the amount of adjustment is calculated by the transmitter and automatically updated.

Manual adjustment
From the exerted pressure and the output of the transmitter, calculate the amount of zero/span adjustment manually, and assign the calculated value to parameters (CAL_DEVIATION_LO, CAL_DEVIATION_HI).

Zero-point adjustment by the external screw.
With pressure being exerted on the point where the adjustment is to be made, zero adjustment needs to be performed. To do this, adjust the calculated value by turning the external Zero-point adjustment screw, so that it agrees with the actual input pressure (true value). The output value increases when the screw is rotated to the right. It decreases when the screw is rotated to the left. The adjustment width is small when the rotation speed is low and large when fast.

When performing zero-point adjustment by the external screw, EXTERNAL_ZERO_TRIM needs to be set to “Enable.”

Procedure for automatic adjustment

The procedure for automatic adjustment is as follows:

(1) Change the Block mode
Set MODE_BLK to O/S.

↓

(2) Enter zero% pressure
Apply the actual zero% pressure to EJX.

↓

(3) Perform zero adjustment
When the value of the applied pressure is written to CAL_POINT_LO, EJX calculates the amount of adjustment for zero adjustment. The calculated amount of adjustment is incorporated into CAL_DEVIATION_LO.

↓

(4) Input pressure for span adjustment
For span adjustment, apply the actual 100% pressure to EJX.

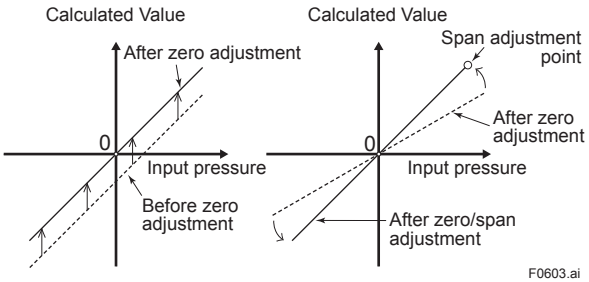
↓

(5) Performance of span adjustment
When the value of the applied pressure is written to CAL_POINT_HI, EJX calculates the amount of adjustment for span adjustment. The calculated amount of adjustment is incorporated into CAL_DEVIATION_HI.

↓

(6) Change the operation mode
Set MODE_BLK to AUTO for normal operation.

F0602.ai



F0603.ai

CAUTION

Span adjustment is a function for adjusting the gradient with respect to the point of zero adjustment. If that point is not zero, the gradient of input and output values cannot be accurately adjusted. Perform span adjustment after zero adjustment is completed.

Diagnosis of adjustment results:

When the amount of zero adjustment or span adjustment exceeds any of the following adjustment limits, “AL-50: Adjustment range error for pressure/differential pressure” is displayed.

The conditions for zero/span adjustment are as follows:

<1> The point of zero adjustment is within ±10% of the capsule range.
<2> The amount of zero adjustment is within ±10% of the capsule range.
<3> The point of span adjustment is within the capsule range.
<4> The input and output gradients after span adjustment are within ±10% of the gradient at factory setting.

6.3.4 Functions Relating to Static Pressure

The static pressure measurement function is unique to differential pressure transmitters. The pressure transmitter does not have this function.

Reference to static pressure value:

In SECONDARY_VALUE and TERTIARY_VALUE, it is possible to refer to the H-side static pressure value and the L-side static pressure value, respectively. The update period of these values is 100 msec. The pressure unit is selected by XD_SCALE.unit in the AI block, in which SECONDARY_VALUE and TERTIARY_VALUE are selected. The status is normally Good-Non Specific. However, in the case of a sensor failure or out of measurement range, it turns to Bad or Uncertain. For specifics, refer to Table 8.9.

Setting of signal damping for static pressure:

SP_VALUE_FTIME is parameter that set signal damping for static pressure signals. The unit of the signal damping is second.

Determination of the range limit of static pressure signal:

When the static pressure signal exceeds the maximum working pressure (MWP) of the capsule, set the status of PRIMARY_VALUE to Uncertain-Subnormal. Also, set the status of SECONDARY_VALUE and TERTIARY_VALUE to Uncertain-Sensor Conversion not Accurate. The status under normal conditions is Good-Non Specific.

Adjustment of static pressure signal:

The zero/span adjustment function can be used for static signals, as in the case of pressure /differential pressure signals. However, the zero-point adjustment by the external screw function is not supported for static pressure signal.

Automatic adjustment
The value of the static pressure exerted on the point where adjustment is to be made is assigned to parameters (CAL_SP_POINT_LO, CAL_SP_POINT_HI). After this assignment is set, the amount of adjustment is calculated by the transmitter and automatically updated. The procedure for adjusting the static pressure signal is the same as that of pressure/differential pressure signal.

Manual adjustment
From the exerted pressure and the output of the transmitter, calculate the amount of zero/span adjustment manually and assign the calculated value to parameters (CAL_SP_DEVIATION_LO, CAL_SP_DEVIATION_HI).

Selection of static pressure signal type:

Differential pressure transmitters measure the absolute static pressure. Based on the assumption that atmospheric pressure is constant, these transmitters can output signal equivalent to gauge pressure calculated by deducting the atmospheric pressure (fixed value) from the measured absolute pressure. The type of static pressure signal output to SECONDARY_VALUE and TERTIARY_VALUE is selected in SP_VALUE_TYPE. SP_VALUE_TYPE allows selection of gauge pressure or absolute pressure. When selecting gauge pressure, set the value of the atmospheric pressure (fixed value) to ATM_PRESS. The default value of ATM_PRESS is equal to the value of standard atmospheric pressure (101.325 kPa).

6.3.5 Functions Relating to Capsule and Amplifier Temperature

Reference to capsule and amplifier temperature value:

In CAP_TEMP_VAL and AMP_TEMP_VAL, it is possible to refer to the capsule and amplifier temperature value and status. The update period of this value is about 1 second. The temperature unit is selected by XD_SCALE.unit of the AI block, in which CAP_TEMP_VAL is selected. The status is normally Good-Non Specific. However, in the case of sensor failure or out of measurement range, it turns to Bad or Uncertain. For specifics, refer to Table 8.9.

Determination of the range limit of capsule temperature:

The range of capsule temperature is from –40 to 120°C. When the measured capsule temperature deviates from –50 to 130°C range, set the status of CAP_TEMP_VAL to Uncertain-Sensor Conversion not Accurate. The status under normal conditions is Good-Non Specific. Also, set the status of PRIMARY_VALUE, SECONDARY_VALUE and TERTIARY_VALUE TO Uncertain-Subnormal.

Determination of the range limit of amplifier temperature:

The range of amplifier temperature is from –40 to 120°C. When the measured amplifier temperature deviates from –50 to 95°C range, set the status of AMP_TEMP_VAL to Uncertain-Sensor Conversion not Accurate. The status under normal conditions is Good-Non Specific.

6.3.6 BLOCK_ERR

BLOCK_ERR presents the cause of an error in the block. The SENSOR transducer block checks the following causes and sets the relevant bits.

BLOCK_ERR

Bit	Error	Cause
0	other	Pressure sensor failure, Temperature sensor failure, Electronic circuit failure, Differential pressure adjusted by zero/span adjustment out of measurement range, Static pressure adjusted by zero/span adjustment out of measurement range
15	Out-of-Service	MODE_BLK.Target is O/S

6.3.7 XD_ERROR

XD_ERROR is a parameter that contains codes for the most significant errors that can occur in the SENSOR transducer block. The errors of XD_ERROR supported by transmitter and their causes are presented in the table below. When multiple errors occur and their error codes are different, the error of greater importance is stored and shown first.

XD_ERROR (order of importance)

Bit	Error	Cause
22	I/O Failure	An I/O failure has occurred.
20	Electronics Failure	An electronic component has failed.
15	Out of Service	Sensor TB is in O/S mode.
18	Calibration error	An error occurred during calibration or a calibration error has been detected.

6.4 LCD Transducer Block

6.4.1 Outline of the Functions

The LCD transducer block controls alarms and measured values that are displayed on the integral indicator. It displays not only OUT signals from the AI blocks, but also I/O signals of the Installed blocks on the integral indicator.

6.4.2 Block Mode

The Block modes permitted for the LCD transducer block are Automatic (Auto) and Out of Service (O/S). Settings can be changed in the AUTO mode for this block, except the Block tag parameter.

6.4.3 Display Contents of the Integral Indicator

The components of the integral indicator are the bar graph, the title field, the center field for numerical values, the lower text field, and auxiliary characters. The contents and meanings of these components are as follows:

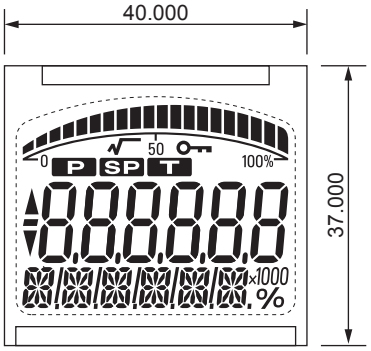
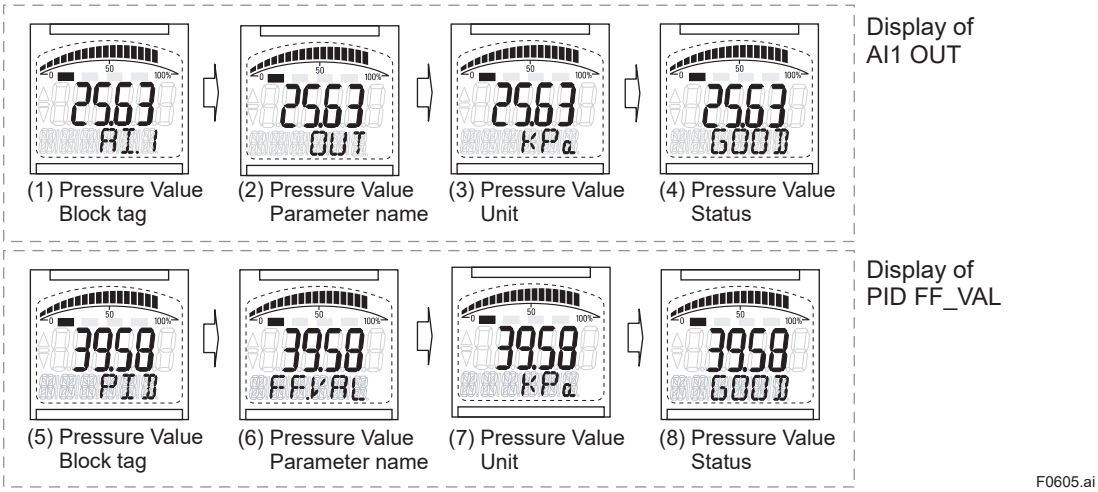


Figure 6.2 Screen Display of the integral indicator

Component name	Contents	
Bar graph	Shows the value displayed in the center field for numerical values scaled in terms of percentage.	
Center field for numerical values	Presents values of inputs and outputs. While the alarm is on, the alarm number alternates with the displayed value here.	
Lower text field	Displays tag, parameter name, unit, and signal status. While the alarm is on, the alarm contents alternate.	
Title field	Depicts the type of the value displayed on the center field for numerical value.	
	P	Flashes when pressure/ differential pressure is displayed.
	SP	Flashes when static pressure is displayed.
	T	Flashes when temperature is displayed.
Auxiliary characters	%	Flashes when the center field for numerical values displays a % value.
	√	Flashes when square root display is selected.
	Key mark	Flashes when Write Protect is selected.
	×10, ×100, ×1000	Used when the calculated value displayed in the center field for numerical values is rounded.

6.4.4 Example Displays of the Integral Indicator

Example display of AI1 OUT and PID FF_VAL, respectively



(1) Pressure Value Block tag
(2) Pressure Value Parameter name
(3) Pressure Value Unit
(4) Pressure Value Status

Display of AI1 OUT

(5) Pressure Value Block tag
(6) Pressure Value Parameter name
(7) Pressure Value Unit
(8) Pressure Value Status

Display of PID FF_VAL

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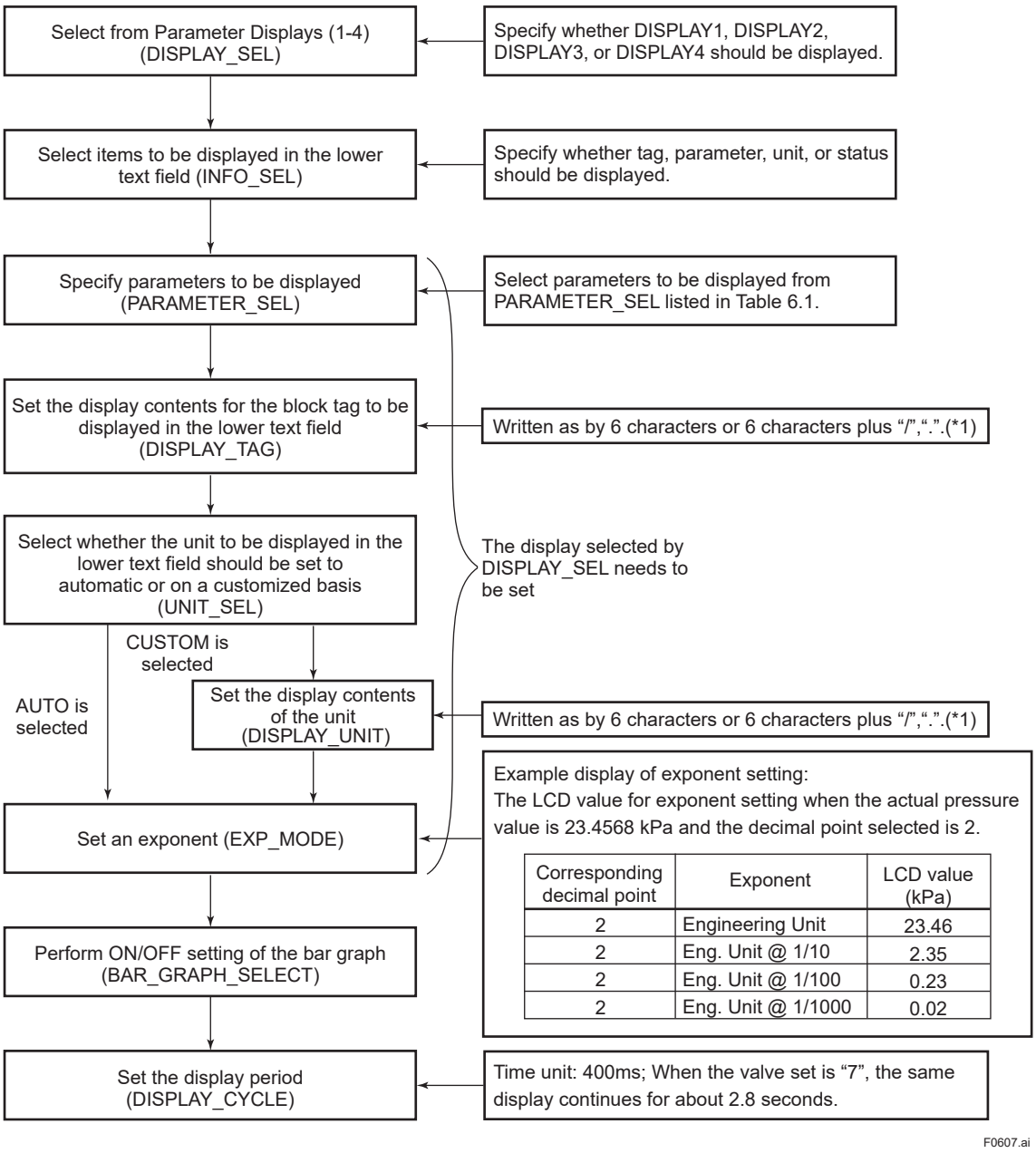
Example display during mechanical failure alarm

Alarm number and
Error Massage (Capsule error)

F0606.ai

6.4.5 Procedure to Set the Built-in Display



Corresponding decimal point	Exponent	LCD value (kPa)
2	Engineering Unit	23.46
2	Eng. Unit @ 1/10	2.35
2	Eng. Unit @ 1/100	0.23
2	Eng. Unit @ 1/1000	0.02

Figure 6.3 Procedures to Set the Built-in Display

*1: Combination of up to 6 characters of alphanumeric and the symbols of [/], [.] and [ ] (space) are available.
If the other characters are specified, space will be displayed.
The symbols of [/] and [.] cannot be specified on the head of a string.

Table 6.1 Parameters to be displayed on LCD

Block Name	Parameter	PARAMETER_SEL	Display
SENSOR TRANSDUCER	PRIMARY_VALUE	PRIMARY VALUE	PV
	SECONDARY_VALUE	SECONDARY VALUE	SP.HI
	TERTIARY_VALUE	TERTIARY VALUE	SP.LO
	CAP_TEMP_VAL	CAP TEMP VALUE	CAP.TMP
	AMP_TEMP_VAL	AMP TEMP VALUE	AMP.TMP
	FLG_TEMP_VAL*	FLG TEMP VALUE	FLG.TMP
AI1	PV	AI1 PV	PV
	OUT	AI1 OUT	OUT
	FIELD_VAL	AI1 FIELD VAL	FLD.VAL
AI2	PV	AI2 PV	PV
	OUT	AI2 OUT	OUT
	FIELD_VAL	AI2 FIELD VAL	FLD.VAL
AI3	PV	AI3 PV	PV
	OUT	AI3 OUT	OUT
	FIELD_VAL	AI3 FIELD VAL	FLD.VAL
PID	SP	PID SP	SP
	PV	PID PV	PV
	OUT	PID OUT	OUT
	IN	PID IN	IN
	CAS_IN	PID CAS IN	CAS.IN
	BKCAL_IN	PID BKCAL IN	BKC.IN
	BKCAL_OUT	PID BKCAL OUT	BKC.OUT
	RCAS_IN	PID RCAS IN	RCAS.IN
	ROUT_IN	PID ROUT IN	ROUT.IN
	RCAS_OUT	PID RCAS OUT	RCA.OUT
	ROUT_OUT	PID ROUT OUT	ROU.OUT
	FF_VAL	PID FF VAL	FF.VAL
	TRK_VAL	PID TRK VAL	TRK.VAL
AR	OUT	AR OUT	OUT
	IN	AR IN	IN
	IN.LO	AR IN LO	IN.LO
	IN1	AR IN 1	IN1
	IN2	AR IN 2	IN2
	IN3	AR IN 3	IN3
IT	OUT	IT OUT	OUT
	IN1	IT IN 1	IN1
	IN2	IT IN 2	IN2
SC	OUT_1	SC OUT 1	OUT_1
	OUT_2	SC OUT 2	OUT_2
	IN_1	SC IN 1	IN1
	IN_2	SC IN 2	IN2
IS	OUT	IS OUT	OUT
	IN_1	IS IN 1	IN1
	IN_2	IS IN 2	IN2
	IN_3	IS IN 3	IN3
	IN_4	IS IN 4	IN4
	IN_5	IS IN 5	IN5
	IN_6	IS IN 6	IN6
	IN_7	IS IN 7	IN7
	IN_8	IS IN 8	IN8

*: The flange temperature is not calculated without option code /DG1, so 0 is displayed.

6.4.6 Units That Can Be Displayed on the LCD by the Automatic Link Function

Index	Unit	Display
1000	K	Kelvin
1001	°C	degC
1002	°F	degF
1010*	m	m
1011*	km	km
1012*	cm	cm
1013*	mm	mm
1018*	ft	ft
1019*	in	in
1020*	yd	yd
1034*	m^3	m3
1035*	dm^3	dm3
1036*	cm^3	cm3
1037*	mm^3	mm3
1038*	L	L
1039*	cl	cl
1040*	ml	ml
1041*	hl	hl
1042*	in^3	in3
1043*	ft^3	ft3
1044*	yd^3	yd3
1045*	$mile^3$	mile3
1046*	pint	pint
1047*	quart	quart
1048*	gallon	gallon
1049*	ImpGal	ImpGal
1050*	bushel	bushel
1051*	bbl	bbl
1052*	bbl(liq)	bblliq
1088*	kg	kg
1089*	g	g
1090*	mg	mg
1091*	Mg	Mg
1092*	t	t
1094*	lb	lb
1097*	kg/cm^3	kg/cm3
1100*	g/cm^3	g/cm3
1101*	g/m^3	g/m3
1103*	kg/L	kg/L
1104*	g/ml	g/ml
1105*	g/L	g/L
1130	Pa	Pa
1131	GPa	GPa
1132	MPa	MPa
1133	kPa	kPa
1134	mPa	mPa
1135	µPa	uPa
1136	hPa	hPa
1137	bar	bar
1138	mbar	mbar
1139	torr	torr

*: Available for software revision (SOFT_REV) R5.05 or later.

Index	Unit	Display
1140	atm	atm
1141	psi	psi
1142	psia	psia
1143	psig	psig
1144	g/cm^2	g/cm2
1145	kg/cm^2	kg/cm2
1146	inH_2O	inH2O
1147	inH_2O (4°C)	inH2O
1148	inH_2O (68°F)	inH2O
1149	mmH_2O	mmH2O
1150	mmH_2O (4°C)	mmH2O
1151	mmH_2O (68°F)	mmH2O
1152	ftH_2O	ftH2O
1153	ftH_2O (4°C)	ftH2O
1154	ftH_2O (68°F)	ftH2O
1155	inHg	inHg
1156	inHg (0°C)	inHg
1157	mmHg	mmHg
1158	mmHg (0°C)	mmHg
1318*	g/s	g/s
1319*	g/min	g/min
1320*	g/h	g/h
1321*	g/d	g/d
1322*	kg/s	kg/s
1323*	kg/min	kg/min
1324*	kg/h	kg/h
1325*	kg/d	kg/d
1326*	t/s	t/s
1327*	t/min	t/min
1328*	t/h	t/h
1329*	t/d	t/d
1330*	lb/s	lb/s
1331*	lb/min	lb/min
1332*	lb/h	lb/h
1333*	lb/d	lb/d
1334*	STon/s	STon/s
1335*	STon/min	STon/mi
1336*	STon/h	STon/h
1337*	STon/d	STon/d
1338*	LTon/s	LTon/s
1339*	LTon/min	LTon/mi
1340*	LTon/h	LTon/h
1341*	LTon/d	LTon/d
1342	%	%
1347*	m^3/s	m3/s
1348*	m^3/min	m3/min
1349*	m^3/h	m3/h
1350*	m^3/d	m3/d
1351*	L/s	L/s
1352*	L/min	L/min
1353*	L/h	L/h
1354*	L/d	L/d
1355*	ML/d	ML/d
1356*	CFS	CFS

*: Available for software revision (SOFT_REV) R5.05 or later.

Index	Unit	Display
1357*	CFM	CFM
1358*	CFH	CFH
1359*	ft^3/d	ft3/d
1360*	SCFM	SCFM
1361*	SCFH	SCFH
1362*	gal/s	gal/s
1363*	GPM	GPM
1364*	gal/h	gal/h
1365*	gal/d	gal/d
1366*	Mgal/d	Mgal/d
1371*	bbl/s	bbl/s
1372*	bbl/min	bbl/min
1373*	bbl/h	bbl/h
1374*	bbl/d	bbl/d
1448*	µgal/s	ugal/s
1449*	mgal/s	mgal/s
1450*	kgal/s	kgal/s
1451*	Mgal/s	Mgal/s
1452*	µgal/min	ugal/mi
1453*	mgal/min	mgal/mi
1454*	kgal/min	kgal/mi
1455*	Mgal/min	Mgal/mi
1456*	µgal/h	ugal/h
1457*	mgal/h	mgal/h
1458*	kgal/h	kgal/h
1459*	Mgal/h	Mgal/h
1460*	µgal/d	ugal/d
1461*	mgal/d	mgal/d
1462*	kgal/d	kgal/d
1479*	µbbl/s	ubbl/s
1480*	mbbl/s	mbbl/s
1481*	kbbl/s	kbbl/s
1482*	Mbbl/s	Mbbl/s
1483*	µbbl/min	ubbl/mi
1484*	mbbl/min	mbbl/mi
1485*	kbbl/min	kbbl/mi
1486*	Mbbl/min	Mbbl/mi
1487*	µbbl/h	ubbl/h
1488*	mbbl/h	mbbl/h
1489*	kbbl/h	kbbl/h
1490*	Mbbl/h	Mbbl/h
1491*	µbbl/d	ubbl/d
1492*	mbbl/d	mbbl/d
1493*	kbbl/d	kbbl/d
1494*	Mbbl/d	Mbbl/d
1495*	$\mu m^3/s$	um3/s
1496*	mm^3/s	mm3/s
1497*	km^3/s	km3/s
1498*	Mm^3/s	Mm3/s
1499*	$\mu m^3/min$	um3/min
1500*	mm^3/min	mm3/min
1501*	km^3/min	km3/min
1502*	Mm^3/min	Mm3/min
1503*	$\mu m^3/h$	um3/h

*: Available for software revision (SOFT_REV) R5.05 or later.

Index	Unit	Display
1504*	mm^3/h	mm3/h
1505*	km^3/h	km3/h
1506*	Mm^3/h	Mm3/h
1507*	$\mu m^3/d$	um3/d
1508*	mm^3/d	mm3/d
1509*	km^3/d	km3/d
1510*	Mm^3/d	Mm3/d
1511*	cm^3/s	cm3/s
1512*	cm^3/min	cm3/min
1513*	cm^3/h	cm3/h
1514*	cm^3/d	cm3/d
1517*	kL	kL
1518*	kL/min	kL/min
1519*	kL/h	kL/h
1520*	kL/d	kL/d
1522*	Nm^3/s	Nm3/s
1523*	Nm^3/min	Nm3/min
1524*	Nm^3/h	Nm3/h
1525*	Nm^3/d	Nm3/d
1527*	Sm^3/s	Sm3/s
1528*	Sm^3/min	Sm3/min
1529*	Sm^3/h	Sm3/h
1530*	Sm^3/d	Sm3/d
1532*	NL/s	NL/s
1533*	NL/min	NL/min
1534*	NL/h	NL/h
1535*	NL/d	NL/d
1537*	SL/s	SL/s
1538*	SL/min	SL/min
1539*	SL/h	SL/h
1540*	SL/d	SL/d
1541	Paa	Paa
1542	Pag	Pag
1543	GPaa	GPaa
1544	GPag	GPag
1545	MPaa	MPaa
1546	MPag	MPag
1547	kPaa	kPaa
1548	kPag	kPag
1549	mPaa	mPaa
1550	mPag	mPag
1551	µPaa	uPaa
1552	µPag	uPag
1553	hPaa	hPaa
1554	hPag	hPag
1555	g/cm^2a	g/cm2a
1556	g/cm^2g	g/cm2g
1557	kg/cm^2a	kg/cm2a
1558	kg/cm^2g	kg/cm2g
1559	inH_2Oa	inH2Oa
1560	inH_2Og	inH2Og
1561	$inH_2Oa(4°C)$	inH2Oa
1562	$inH_2Og(4°C)$	inH2Og
1563	$inH_2Oa(68°F)$	inH2Oa

*: Available for software revision (SOFT_REV) R5.05 or later.

Index	Unit	Display
1564	inH_2Og(68°F)	inH2Og
1565	mmH_2Oa	mmH2Oa
1566	mmH_2Og	mmH2Og
1567	mmH_2Oa(4°C)	mmH2Oa
1568	mmH_2Og(4°C)	mmH2Og
1569	mmH_2Oa(68°F)	mmH2Oa
1570	mmH_2Og(68°F)	mmH2Og
1571	ftH_2Oa	ftH2Oa
1572	ftH_2Og	ftH2Og
1573	ftH_2Oa(4°C)	ftH2Oa
1574	ftH_2Og(4°C)	ftH2Og
1575	ftH_2Oa(68°F)	ftH2Oa
1576	ftH_2Og(68°F)	ftH2Og
1577	inHga	inHga
1578	inHgg	inHgg
1579	inHga(0°C)	inHga
1580	inHgg(0°C)	inHgg
1581	mmHga	mmHga
1582	mmHgg	mmHgg
1583	mmHga(0°C)	mmHga
1584	mmHgg(0°C)	mmHgg
1588	No unit	
1589	ml/min	ml/min
1590	Barg	Barg
1591	mBarg	mBarg
1597	Bara	Bara
1598*	MSCFD	MSCFD
1599*	MMSCFD	MMSCFD
1600*	MLB/H	MLB/H
1617*	Ml/h	Ml/h
1618*	Ml/min	Ml/min
1619*	kL/s	kL/s
1620*	kft^3/d	kft3/d
1621*	kCFH	kCFH
1622*	kCFM	kCFM
1623*	kCFS	kCFS
1624*	mft^3/d	mft3/d
1625*	mCFH	mCFH
1626*	mCFM	mCFM
1627*	mCFS	mCFS
1645*	Ml	Ml
1646*	mBara	mBara

*: Available for software revision (SOFT_REV) R5.05 or later.

6.5 AI Function Block

The AI function block is a unit of the software and executed according to the system schedule. During execution, it incorporates data from the SENSOR transducer block. After execution, it updates analog outputs and processes newly generated alarms. AI function blocks can provide a discrete output which shows the status of LO, LO_LO, HI, or HI_HI. In terms of function, there is no difference between the three AI function blocks provided in EJX.

6.5.1 Function Blocks

The AI function block, via the Channel, incorporates analog signals from the transducer block, performs scaling processing, filtering, low-cut, and alarm processing before outputting. It has the function to generate a discrete output. Figure 6.4 presents the AI function block.

6.5.2 Block Mode

The Block modes permitted for the AI function block are Automatic (Auto), Manual (Man), and Out of Service (O/S). When the Block mode of RB (Resource Block) is Out of Service (O/S), Actual is Out of Service (O/S) even if Automatic (Auto) or Manual (Man) is written to Target.

6.5.3 IO_OPTS

IO_OPTS is a parameter used to select whether options regarding input and output signals should be enabled or disabled. In the case of the AI function block, the only available option is “Low cutoff”. When enabling the low cut function for outputs, set this option.

6.5.4 STATUS_OPTS

STATUS_OPTS is a parameter to select options regarding the status of signals. The AI function block offers four options: Propagate Fault Forward, Uncertain if Limited, BAD if Limited, and Uncertain if Man mode.

Propagate Fault Forward
If the status from the sensor is Bad, Device failure or Bad, Sensor failure, propagate it to OUT without generating an alarm. The use of these sub-statuses in OUT is determined by this option. Through this option, the user may determine whether alarming (sending of an alert) will be done by the block or propagated downstream for alarming

Uncertain if Man mode
When the “Uncertain if Man” is enabled and the Actual mode is Man, the OUT signal status should be “Uncertain”.

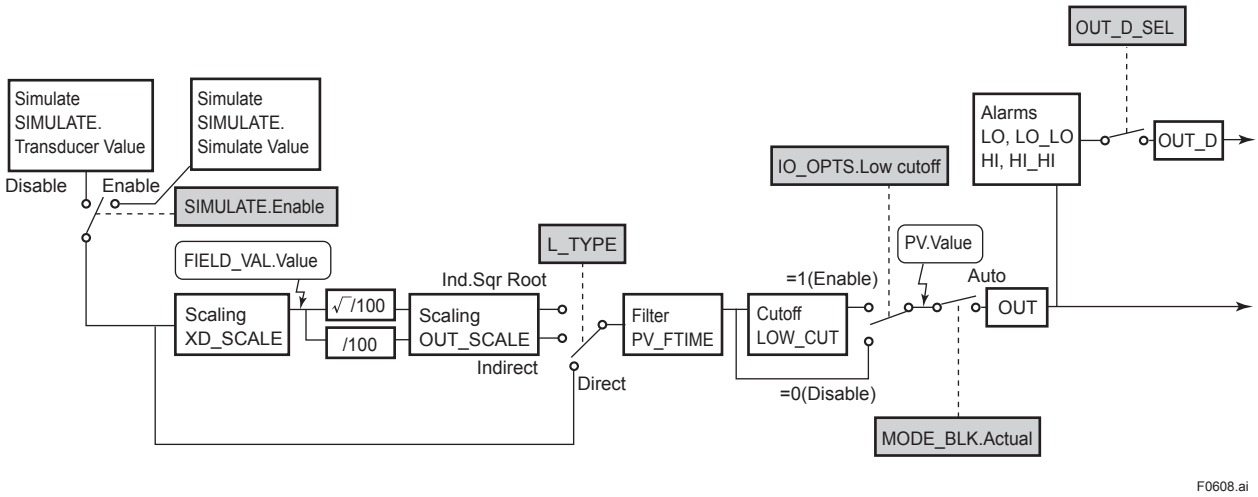


Figure 6.4 Diagram of the AI Functional Block

6.5.5 OUT_D

OUT_D.value is “1” when the alarms selected by OUT_D_SEL occur.
OUT_D.status is linked OUT.status. OUT_D.value can be written the value form 0 to 15 when block mode is O/S or MAN mode. The OUT_D_SEL options are shown below.

High High Alarm (1):
OUT_D.value will be “1” when HI_HI alarm occurs.
High Alarm (2):
OUT_D.value will be “1” when HI alarm occurs.
Low Low Alarm (4):
OUT_D.value will be “1” when LO_LO alarm occurs.
Low Alarm (8):
OUT_D.value will be “1” when LO alarm occurs.

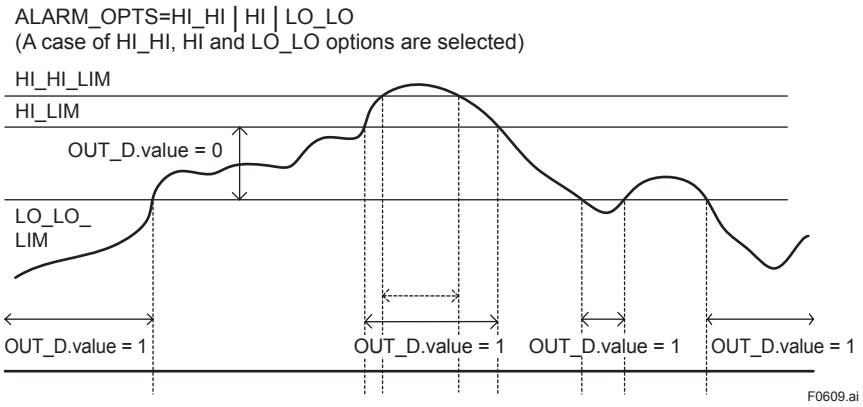


Figure 6.5 An Example of OUT_D.value

6.5.6 Basic Parameters of the AI Block.

Parameter	Outline
OUT	Shows output value and status. When the Block mode is Man and O/S, the value is held.
SIMULATE	Used for simulation. It sets the value and status arbitrarily from the transducer. Use this parameter for loop checking. Refer to 7.3 Simulation Function.
XD_SCALE	Sets the range of inputs from the transducer block that corresponds to 0% and 100% in the AI function block. Also sets the unit of the range, inputs values that correspond to 0% and 100%, and four decimal values.
OUT_SCALE	Sets the range, unit, and digit of the output scale.
CHANNEL	Selects the signal which is calculated in SENSOR Transducer Block. The relation between the signals and channels are shown below; Channel 1: PRIMARY_VALUE (pressure/differential pressure) Channel 2: SECONDARY_VALUE (H-side static pressure) Channel 3: TERTIARY_VALUE (L-side static pressure) Channel 4: CAP_TEMP_VAL (capsule temperature) Channel 5: AMP_TEMP_VAL (amplifier temperature) Channel 6: FLG_TEMP_VAL (flange temperature for Heat trace monitoring)
L_TYPE	The operation function of the AI function block can be selected from Direct, Indirect Linear, or Indirect SQRT: Direct: The Signal from the transducer block is directly output by filtering only, but without scaling or square root extraction. Indirect Linear: Values scaled according to the range settings of XD_SCALE and OUT_SCALE are output. Indirect SQRT: Values are scaled according to the range settings of XD_SCALE, square root extraction is performed for them, and then the values are scaled according to the range setting of OUT_SCALE before being output.
LOW_CUT	As for low-cut settings of the output signal (LOW_CUT), the output is made to 0 if the output goes below the low-cut setpoint. To enable the low-cut function, the “Low cutoff” option should be enabled with IO_OPTS. However, when the status returns from the low-cut state to the normal state, hysteresis is waited. When the L_TYPE setting of the output mode is direct, the hysteresis width is 1% of XD_SCALE, and otherwise, the width is 1% of OUT_SCALE.

7. In-Process Operation

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

7.1 Mode Transition

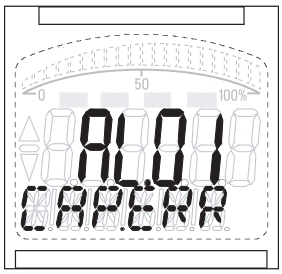
When the function block mode is changed to Out_Of_Service, the function block pauses and a block alarm is issued.

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.

7.2 Generation of Alarm

7.2.1 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.
For details of ALARM, refer to Section 8.2.



F0701.ai

Figure 7.1 Error Identification on Indicator

7.2.2 Alarms and Events

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

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

Discret Alerts (Generated when an abnormal condition is detected)
- By Resource Block Block Alarm, Write Alarm
- By Transducer Block Block Alarm
  Diagnostic Alarm (when /DG1 is specified)
- By AI, SC, IT, IS, AR and PID Blocks
  Block Alarm

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

Field Diagnostic Alerts (Generated when an abnormal condition in field device is detected)
- By Resource Block Check Alarm, Failure Alarm, Maintenance Alarm, and off specification Alarm.

An alert has following structure:

Table 7.1 Alert Object

Subindex				Parameter Name	Explanation
Analog Alert	Discrete Alert	Update Alert	Field Diagnostic Alert		
1	1	1	1	Block Index	Index of block from which alert is generated
2	2	2	2	Alert Key	Alert Key copied from the block
3	3	3	3	Standard Type	Type of the alert
4	4	4	4	Mfr Type	Alert Name identified by manufacturer specific DD
5	5	5	5	Message Type	Reason of alert notification
6	6	6	6	Priority	Priority of the alarm
7	7	7	7	Time Stamp	Time when this alert is first detected
8	8		8	Subcode	Enumerated cause of this alert
9	9		9	Value	Value of referenced data
10	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
			11	Source Block Index	Index of the block that triggered the alert

7.2.3 Standard categories for NAMUR NE-107 instrument diagnostics alarms

The following standard categories of instrument diagnostics are defined for the NAMUR NE-107.

F (Failed):
An alarm category that indicates a failure has occurred in the instrument or in its peripheral devices.

C (Check Function):
An alarm category that indicates that a detected failure is a temporary event.

S (Off Specification):
An alarm category that indicates that the detected failure was caused by the instrument being used outside of its range or because a discrepancy has occurred between the set value and measured value. The alarm was caused either by the instrument or process state.

M (Maintenance):
An alarm category for a detected failure that has a low level of urgency but is a failure that could develop into a problem causing restrictions in instrument functionality in some environments.

Alarms displayed by DEVICE_STATUS_1 to DEVICE_STATUS_8 resource block parameters in their default setting are categorized as described in “NAMUR NE-107 Alarm Categories” in the DEVICE_STATUS table in section 8.1. When an alarm occurs, a character string that corresponds to an alarm category is assigned to FD_*_ACTIVE (index 1067 to 1070) [* indicates FAIL, OFF SPEC, MAINT or CHECK]. (For example, an F category alarm is assigned to FD_FAIL_ACTIVE) Similarly, procedures for processing alarms are assigned to FD_RECOMMEN_ACT. For details on alarm displays and how to deal with them, refer to Table 7.2.

The DTM-based “Field Diagnostics” function on FieldMate R2.06 or later makes configuration or checking of alarm classified on NE-107 easier.

For the detailed usage of “Field Diagnostics” function, refer to FieldMate user’s manual: IM 01R01A15-01EN.

Table7.2 Field Diagnostic Alert

Indication of FD_*_ACTIVE	Indication of FD_RECOMMEN_ACT	Solution
Electronics failure	Repair electronics	Replace electrical parts e.g. amplifier. Or contact sales office or service center.
Sensor/Actuator failure	Repair Sensor/Actuator	Replace mechanics e.g. sensor or actuator. Or contact sales office or service center.
Potential failure	Investigate failure	Perform reconfiguration, cleaning, wiring/ connector or electrical board check. If alarm still persists, contact sales office or service center.
Backup function in operation	Repair primary side	Repair primary sensor before backup sensor fails.
Firmware update error	Retry updating firmware	Retry firmware update. Check cause of the failure if alarm persists.
Communication configuration error	Configure communication correctly	Correct configuration of communication.
Non-operating-state	Wait for a while	Wait for a while. Check cause of the failure if alarm persists.
Calibration warning	Check calibration	Investigate cause of failure and recalibrate device.
Device configuration error	Configure device correctly	Correct configuration relating to sensor or actuator.
Function restricted	Confirm the state	Check if this is right state.
Simulation mode	Confirm the state	Check if this is right state.
Manual mode	Confirm the state	Check if this is right state.
Function Block notice	Check Function Block status	Check conditions of function blocks. In order to avoid alarm from unused function blocks, configure RESOURCE2.FD_ EXTENDC_MAP_n (n: 1 to 3) parameter.
Sensor/Actuator out of range	Check specification	Check specification of sensor and actuator. Or process conditions may be temporarily non-conforming.
Out of operating limit	Check environment	Check environment specification of sensor and actuator. Or process environment may be temporarily non-conforming.
Temporal decrease of value quality	Check process or peripherals	Check process and peripherals conditions.
Deterioration estimated by Time Based Maintenance	Check deterioration	Check if maintenance is required.
Deterioration estimated by Condition Based Maintenance	Check deterioration	Check if maintenance is required.
Impulse Line Blockage Detected	Check process and impulse line condition	1.Check process and impulse line condition. 2.If there are large flow change or the change of fluid under the measured process conditions, obtain the reference value again.(Please follow the operation procedure in User Manual)
Heat Trace Warning Detected	Check the heater failure	1.Check the heater failure. 2.Check the capsule temp. and Amplifier temp. 3.Adjust Flg Temp Coef(STB.FLG_ TEMP_COEF).
Optional function configuration error	Check optional configuration	Check configuration of optional functions.
Alarm related information	Confirm information	Check the alarm related information.
Process alarm	Check process	Check process conditions.
CHECK	CHECK	Check both modes for the SENSOR and LCD transducer blocks are AUTO.

7.3 Simulation Function

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

A SIMULATE_ENABLE switch is mounted in the transmitter amplifier. This is to prevent the accidental operation of this function. When this is switched on, simulation is enabled. (See Figure 7.2.) To initiate the same action from a remote terminal, if REMOTE LOOP TEST SWITCH is written to the SIM_ENABLE_MSG parameter (index 1044) of the resource block, the resulting action is the same as is taken when the above switch is on. 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 7.3 below.

Table 7.3 SIMULATE Parameter

Subindex	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: Simulation disabled (standard) 2: Simulation started

When Simulate En/Disable in Table 7.3 above is set to 2, the applicable function block uses the simulation value set in this parameter instead of the data from the transducer block. This setting can be used for propagation of the status to the trailing blocks, generation of a process alarm, and as an operation test for trailing blocks.

The FD_SIMULATE parameter of Resource block consists of the elements listed in Table 7.4 below.

Table 7.4 FD_SIMULATE parameter

Subindex	Parameters	Description
1	Diagnostic Simulate Value	Sets the alarm bit to be simulated. When the Sub-index3: Enable is being Disable, the value of Sub-index2: Diagnostic Value is shown here.
2	Diagnostic Value	This parameter always shows the actual diagnostic status of the device instead of the simulated diagnostic alarm.
3	Simulate En/ Disable	Control the simulation function. 1: Disable simulation (default setting) 2. Enable simulation

When setting “2” to Simulate En/Disable parameter (as of Table 7.4) while the simulation function is enabled by SIMULATE_ENABLE switch or using SIM_ENABLE_MSG of Resource Block, an alarm bit set in the Diagnostic Simulate Value parameter is generated. With using this function, it is possible to confirm if a diagnostic alarm from the device is generated as intended.

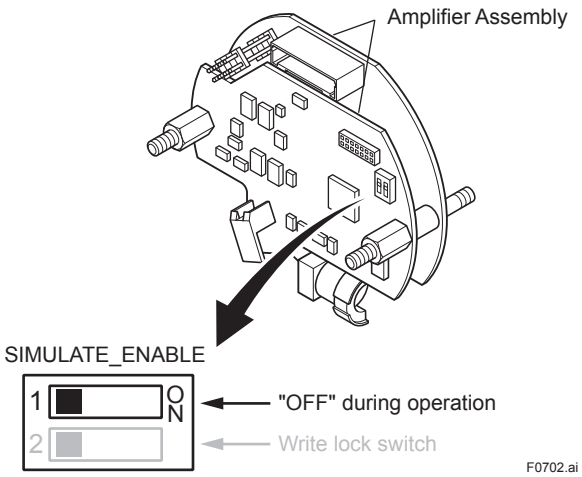


Figure 7.2 SIMULATE_ENABLE Switch Position

7.4 Write lock (Write-protect) function

The transmitter is provided with a write lock (write-protect) function to restrict write operations to blocks and prevent inadvertent writing of parameter data. To enable this function, use the write lock switch (Hard W Lock) or the WRITE_LOCK (index 1034) (Soft W Lock).
The CPU assembly of the transmitter is provided with a write lock switch (switch 2 in Figure 7.3). Setting switch 2 to On activates the write lock function, to prevent changes to block parameters of WRITE_LOCK_LEVEL (index 1064). Table 7.5 shows how WRITE_LOCK_LEVEL relates to the block targeted by write lock. In the factory default setting, WRITE_LOCK_LEVEL is “2” (preventing writing to the transducer block, resource block and function block). To enable the switch lock function, set "Hard W Lock” (bit 4) of FEATURE_SEL (index 1018) to “1” (On). (The factory default for “Hard W Lock” (bit 4) is “0” (Off).

Table 7.5 Relationship between WRITE_LOCK_ LEVEL and block targeted by write lock

WRITE_LOCK_ LEVEL (index 1064)	Block targeted by Write lock
0	All parameters for the transducer block and FEATURE_SEL and WRITE_LOCK_LEVEL parameter settings for FEATURE_SEL
1	All parameters for the transducer block and resource block
2 (Factory default)	All function block parameters in addition to WRITE_LOCK_ LEVEL “1”
3	MIB and VCR in addition to WRITE_LOCK_LEVEL “2”

When the write lock switch is disabled, set 2 (enabled) for WRITE_LOCK (index 1034) of the resource block to enable the write lock function. To enable the write lock function using the WRITE_ LOCK setting, FEATURE_SEL (index 1018) of the resource block must be returned to its factory default. (In the factory default setting, “Hard W Lock” (bit 4) is “0” (Off) and “Soft W Lock” (bit 3) is “1” (On).

Table 7.6 FEATURE_SEL, write lock switch and WRITE_LOCK parameter relationship

FEATURE_SEL (index 1018)		Write lock switch	WRITE_LOCK (index 1034)
Hard W Lock (bit4)	Soft W Lock (bit3)		
0 (OFF)	0 (OFF)	Disabled	Unavailable (“1” (Write lock disabled))
	1 (ON)		1 (Write lock disabled) (Factory default)
			2 (Write lock enabled)
1 (ON)	0 (OFF)	Enabled	Unavailable (depends on write lock switch)

* When “Hard W Lock” and “Soft W Lock” are both 1 (On), the “Hard W Lock” setting takes precedence and “Soft W Lock” is automatically set to 0 (Off).

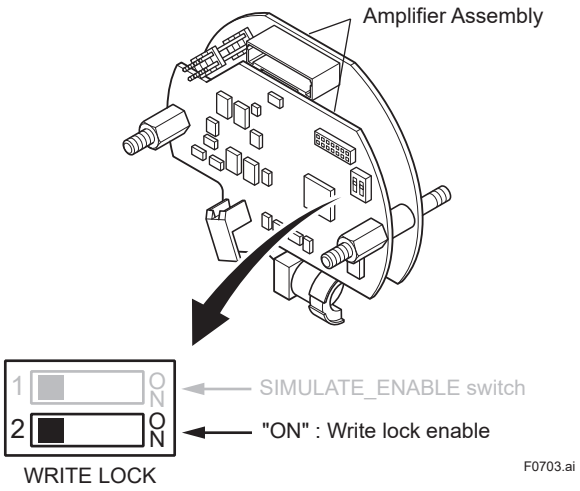


Figure 7.3 Write lock Switch

8. Device Information

8.1 DEVICE STATUS

Device status for the transmitter are indicated by using parameter DEVICE_STATUS_1 to DEVICE_STATUS_8 (index 1045 to 1052) in Resource Block.

Table 8.1 Contents of DEVICE_STATUS_1 (index 1045)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x40000000	Write Unlocked	Writing to parameters is Unlocked.	—
0x20000000	Hard Write Lock SW OFF	Hardware write lock switch is OFF.	—
0x10000000	Write Locked	Writing to parameters is locked.	—
0x08000000	Hard Write Lock SW ON	Hardware write lock switch is ON.	—
0x04000000	Abnormal Boot Process	Abnormal boot processing was detected at the starting.	F
0x02000000	SoftDL Failure	Software download has failed.	C
0x01000000	SoftDL Incomplete	Software download is incomplete.	C
0x00800000	Simulation Switch ON	Software or hardware simulation switch is ON.	—
0x00400000	RB in O/S mode (AL-40)	Resource Block is in O/S mode.	—
0x00200000	Simulation Switch OFF	Software or hardware simulation switch is OFF.	—
0x00080000	Amp EEPROM Failure (AL-02)	Amplifier EEPROM failed.	F
0x00008000	Link Obj. 1/17/33 Not Open	Link object 1, 17 or 33 is not open	C
0x00004000	Link Obj. 2/18/34 Not Open	Link object 2, 18 or 34 is not open	C
0x00002000	Link Obj. 3/19/35 Not Open	Link object 3, 19 or 35 is not open	C
0x00001000	Link Obj. 4/20/36 Not Open	Link object 4, 20 or 36 is not open	C
0x00000800	Link Obj. 5/21/37 Not Open	Link object 5, 21 or 37 is not open	C
0x00000400	Link Obj. 6/22/38 Not Open	Link object 6, 22 or 38 is not open	C
0x00000200	Link Obj. 7/23/39 Not Open	Link object 7, 23 or 39 is not open	C
0x00000100	Link Obj. 8/24/40 Not Open	Link object 8, 24 or 40 is not open	C
0x00000080	Link Obj. 9/25 Not Open	Link object 9 or 25 is not open	C
0x00000040	Link Obj. 10/26 Not Open	Link object 10 or 26 is not open	C
0x00000020	Link Obj. 11/27 Not Open	Link object 11 or 27 is not open	C
0x00000010	Link Obj. 12/28 Not Open	Link object 12 or 28 is not open	C
0x00000008	Link Obj. 13/29 Not Open	Link object 13 or 29 is not open	C
0x00000004	Link Obj. 14/30 Not Open	Link object 14 or 30 is not open	C
0x00000002	Link Obj. 15/31 Not Open	Link object 15 or 31 is not open	C
0x00000001	Link Obj. 16/32 Not Open	Link object 16 or 32 is not open	C

Table 8.2 Contents of DEVICE_STATUS_2 (index 1046)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x80000000	Pressure Sensor Failure 1 (AL-01)	Pressure sensor failed 1.	F
0x40000000	Pressure Sensor Failure 2 (AL-01)	Pressure sensor failed 2.	F
0x20000000	Pressure Sensor Failure 3 (AL-01)	Pressure sensor failed 3.	F
0x10000000	Pressure Sensor Failure 4 (AL-01)	Pressure sensor failed 4.	F
0x08000000	Capsule Temp Sensor Failure (AL-01)	Capsule temp sensor failed.	F
0x04000000	Capsule EEPROM Failure 1 (AL-01)	Capsule EEPROM failed 1.	F

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x02000000	Capsule EEPROM Failure 2 (AL-01)	Capsule EEPROM failed 2.	F
0x00800000	Amp Temp Sensor Failure (AL-02)	Amplifier Temp Sensor failed.	F
0x00400000	Amp EEPROM Failure 1 (AL-02)	Amplifier EEPROM failed 1.	F
0x00200000	Amp EEPROM Failure 2 (AL-02)	Amplifier EEPROM failed 2.	F
0x00100000	CPU Board Failure 1 (AL-02)	CPU board failed 1.	F
0x00080000	CPU Board Failure 2 (AL-02)	CPU board failed 2.	F
0x00040000	CPU Board Failure 3 (AL-02)	CPU board failed 3.	F
0x00020000	CPU Board Failure 4 (AL-02)	CPU board failed 4.	F
0x00010000	No Device ID	No Device ID.	F
0x00008000	CPU Board Failure 5 (AL-02)	CPU board failed 5.	F

Table 8.3 Contents of DEVICE_STATUS_3 (index 1047)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x80000000	Diff Pressure outside Range Limit (AL-10)	Input Pressure is outside measurement range limit of capsule	S
0x40000000	Static Pressure outside Range Limit (AL-11)	Static Pressure exceeds limit	S
0x20000000	Capsule Temp outside Range Limit (AL-12)	Capsule Temperature is out of range	S
0x10000000	Amp Temp outside Range Limit (AL-13)	Amplifier Temperature is out of range	S
0x00008000	No FB Scheduled (AL-20)	No Function Block is scheduled.	C

Table 8.4 Contents of DEVICE_STATUS_4 (index 1048)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x80000000	AI1 Hi Hi Alarm (AL-30)	Hi_Hi Alarm occurs in AI1 Function block	—
0x40000000	AI1 Lo Lo Alarm (AL-30)	Lo_Lo Alarm occurs in AI1 Function block	—
0x20000000	AI2 Hi Hi Alarm (AL-31)	Hi_Hi Alarm occurs in AI2 Function block	—
0x10000000	AI2 Lo Lo Alarm (AL-31)	Lo_Lo Alarm occurs in AI2 Function block	—
0x08000000	AI3 Hi Hi Alarm (AL-32)	Hi_Hi Alarm occurs in AI3 Function block	—
0x04000000	AI3 Lo Lo Alarm (AL-32)	Lo_Lo Alarm occurs in AI3 Function block	—
0x02000000	PID Hi Hi Alarm (AL-33)	Hi_Hi Alarm occurs in PID Function block	—
0x01000000	PID Lo Lo Alarm (AL-33)	Lo_Lo Alarm occurs in PID Function block	—
0x00008000	RB in O/S Mode (AL-40)	Resource Block is in O/S mode	—
0x00004000	Sensor TB in O/S Mode (AL-41)	Sensor Transducer Block is in O/S mode.	C
0x00002000	LCD TB in O/S Mode	LCD Transducer Block is in O/S mode.	C
0x00000800	AI1 in O/S Mode (AL-43)	AI1 block is in O/S mode	C
0x00000400	AI2 in O/S Mode (AL-44)	AI2 block is in O/S mode	C
0x00000200	AI3 in O/S Mode (AL-45)	AI3 block is in O/S mode	C
0x00000100	AI1 Not Scheduled (AL-46)	AI1 block is not scheduled	C
0x00000080	AI2 Not Scheduled (AL-47)	AI2 block is not scheduled	C
0x00000040	AI3 Not Scheduled (AL-48)	AI3 block is not scheduled	C

Table 8.5 Contents of DEVICE_STATUS_5 (index 1049)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x80000000	Diff Pressure Span Trim Error (AL-50)	Trimming range error for differential pressure span	C
0x40000000	Diff Pressure Zero Trim Error (AL-50)	Trimming range error for differential pressure zero	C
0x20000000	Static Pressure Span Trim Error (AL-51)	Trimming range error for static pressure span	C
0x10000000	Static Pressure Zero Trim Error (AL-51)	Trimming range error for static pressure zero	C

Table 8.6 Contents of DEVICE_STATUS_6 (index 1050)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x80000000	PID in O/S Mode (AL-70)	PID block is in O/S mode	C
0x40000000	PID in MAN Mode (AL-70)	PID block is in MAN mode	C
0x20000000	PID Not Scheduled (AL-70)	PID block is not Scheduled	C
0x10000000	PID in Bypass Mode	PID Block is in Bypass mode.	C
0x08000000	SC in O/S Mode (AL-71)	SC block is in O/S mode	C
0x04000000	SC in MAN Mode (AL-71)	SC block is in MAN mode	C
0x02000000	SC Not Scheduled (AL-71)	SC block is not scheduled	C
0x01000000	IT in O/S Mode (AL-72)	IT block is in O/S mode	C
0x00800000	IT in MAN Mode (AL-72)	IT block is in MAN mode	C
0x00400000	IT Not Scheduled (AL-72)	IT block is not scheduled	C
0x00100000	IS in O/S Mode (AL-73)	IS block is in O/S mode	C
0x00080000	IS in MAN Mode (AL-73)	IS block is in MAN mode	C
0x00040000	IS Not Scheduled (AL-73)	IS block is not scheduled	C
0x00020000	AR in O/S Mode (AL-74)	AR block is in O/S mode	C
0x00010000	AR in MAN Mode (AL-74)	AR block is in MAN mode	C
0x00008000	AR Not Scheduled (AL-74)	AR block is not scheduled	C
0x00000004	IT Total Backup Err (AL-78)	IT Total Backup has failed. Last IT Output Value (IT. LAST.VALUE) is not saved.	F
0x00000002	LCD Display Outside Range Limit (AL-79)	Displayed value exceeds limit	C
0x00000001	LCD Display Config Error (AL-79)	Specified settings for Display do not meet the conditions	C

Table 8.7 Contents of DEVICE_STATUS_7 (index 1051) (Applicable for option code "DG1".)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x00004000	Flg Temp High Alarm (AL-87)	Flange Temperature High Alarm occurs.	M
0x00002000	Flg Temp Low Alarm (AL-87)	Flange Temperature Low Alarm occurs.	M
0x00001000	Outside Diagnosis Range (AL-89)	Outside Diagnosis Range.	—
0x00000800	Invalid Ref fDP (AL-88)	VALUE_FDP under normal conditions is not up to the reference fluctuation level required to blockage detection.	C
0x00000400	Invalid Ref fSPl (AL-88)	VALUE_FSPL under normal conditions is not up to the reference fluctuation level required to blockage detection.	C

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x00000200	Invalid Ref fSPh (AL-88)	VALUE_FSPH under normal conditions is not up to the reference fluctuation level required to blockage detection.	C
0x00000100	Invalid Ref BlkF (AL-88)	VALUE_BLKF under normal conditions is not up to the reference fluctuation level required to blockage detection.	C
0x00000080	B Blocking (AL-89)	B Blocking (both-side blockage) is detected	M
0x00000040	High Side Blocking (AL-89)	High-pressure-side blockage is detected	M
0x00000020	Low Side Blocking (AL-89)	Low-pressure-side blockage is detected	M
0x00000010	Large Fluctuation of High Side (AL-89)	Pressure fluctuation amplitude of highpressure side is large	M
0x00000008	Large Fluctuation of Low Side (AL-89)	Pressure fluctuation amplitude of lowpressure side is large	M
0x00000004	A Blocking (AL-89)	A Blocking (single-side blockage) is detected	M

Table 8.8 Contents of DEVICE_STATUS_8 (index 1052)

Hexadecimal	Display through DD	Description	NAMUR NE-107 category
0x80000000	AI1 Simulate Active (AL-90)	AI1 Block is in simulation mode.	C
0x40000000	AI2 Simulate Active (AL-91)	AI2 Block is in simulation mode.	C
0x20000000	AI3 Simulate Active (AL-92)	AI3 Block is in simulation mode.	C
0x10000000	AI1 in MAN Mode (AL-93)	AI1 Block is in Man mode.	C
0x08000000	AI2 in MAN Mode (AL-94)	AI2 Block is in Man mode.	C
0x04000000	AI3 in MAN Mode (AL-95)	AI3 Block is in Man mode.	C

8.2 Status of Each Parameter in Failure Mode

Following tables summarize the value of EJX parameters when LCD display indicates an Alaram.

Table 8.9 Action of each parameters in failure mode related Resource block and Sensor Transducer block

ALARM Display	Cause of Alarm	Resource block	SENSOR Transducer block*					
		BLOCK_ERR	BLOCK_ERR	XD_ERROR	PV.STATUS	SV.STATUS TV.STATUS	CAP_TEMP_ VAL.STATUS	AMP_TEMP_ VAL.STATUS
AL.01 CAP.ERR	Pressure Sensor problem	—	other	I/O Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure
	Capsule Temperature Sensor problem	—	other	I/O Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure
	Capsule memory problem	Lost NV Data	other	I/O Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure
AL.02 AMP.ERR	Amplifier Temperature Sensor problem	—	other	Electronics Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure
	Amplifier memory problem	Lost Static Data Device Needs Maintenance Now	other	Electronics Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure
	Amplifier problem	—	other	Electronics Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure
AL.10 PRESS	Input Pressure is outside measurement range limit of capsule	—	—	—	UNCERTAIN: Sensor Conversion not Accurate	UNCERTAIN Subnormal	—	—
AL.11 ST.PRSS	Static Pressure exceeds limit	—	—	—	UNCERTAIN Subnormal	UNCERTAIN: Sensor Conversion not Accurate	—	—
AL.12 CAP.TMP	Capsule Temperature is out of range	—	—	—	UNCERTAIN Subnormal	UNCERTAIN Subnormal	UNCERTAIN: Sensor Conversion not Accurate	—
AL.13 AMP.TMP	Amplifier Temperature is out of range	—	—	—	—	—	—	UNCERTAIN: Sensor Conversion not Accurate
AL.20 NOT.RDY	No communication is found with LAS.	—	—	—	—	—	—	—
AL.40 RS O/S	Resource Block is in O/S mode	Out of Service	—	—	BAD: Non-specific	BAD: Non-specific	BAD: Non-specific	BAD: Non-specific
AL.41 TB O/S	Sensor TB is in O/S mode	—	Out of Service	Out of Service	BAD:Out of Service	BAD:Out of Service	BAD:Out of Service	BAD:Out of Service
AL.50 P.SDEV P.ZDEV	Trimming range error for differential pressure span	—	other	Calibration error	UNCERTAIN: Engineering Unit Range Violation	—	—	—
AL.51 SP.SDEV SP.ZDEV	Trimming range error for static pressure span	—	other	Calibration error	—	UNCERTAIN: Engineering Unit Range Violation	—	—

*: For FLG_TEMP_VAL.STATUS, refer to A8.3.5.

Table 8.10 Action of each parameters in failure mode related LCD display

ALARM Display	Cause of Alarm	LCD TB	
		BLOCK_ERR	XD_ERROR
AL.79 LCD.RNG	Displayed value exceeds limit or LCD configuration error	—	—

Table 8.11 Action of each parameters in failure mode related Function block

ALARM Display	Cause of Alarm	Object block	BLOCK_ERR	OUT.STATUS
AL.30 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in AI1 Function block	AI1	—	Depends on specified High High(Lo Lo) Priority (*1)
AL.31 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in AI2 Function block	AI2	—	Depends on specified High High(Lo Lo) Priority (*1)
AL.32 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in AI3 Function block	AI3	—	Depends on specified High High(Lo Lo) Priority (*1)
AL.33 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in PID Function block	PID	—	—
AL.43 AI O/S	AI1 block is O/S mode	AI1	Out-of-Service	BAD-Out of Service
AL.44 AI O/S	AI2 block is O/S mode	AI2		
AL.45 AI O/S	AI3 block is O/S mode	AI3		
AL.46 NO.SCHD	AI1 block is not scheduled	AI1	HOLD	HOLD
AL.47 NO.SCHD	AI2 block is not scheduled	AI2		
AL.48 NO.SCHD	AI3 block is not scheduled	AI3		
AL.70 PID O/S PID.MAN NO.SCHD PID.BYP	PID block is in O/S mode, MAN mode, “not scheduled”, or Bypass mode.	PID	Depends on cause of Alarm	Depends on cause of Alarm
AL.71 SC O/S SC MAN NO.SCHD	SC block is in O/S mode, MAN mode or “not scheduled”.	SC	Depends on cause of Alarm	Depends on cause of Alarm
AL.72 IT O/S IT MAN NO.SCHD	IT block is in O/S mode, MAN mode or “not scheduled”.	IT	Depends on cause of Alarm	Depends on cause of Alarm
AL.73 IS O/S IS MAN NO.SCHD	IS block is in O/S mode, MAN mode or “not scheduled”.	IS	Depends on cause of Alarm	Depends on cause of Alarm
AL.74 AR O/S AR MAN NO.SCHD	AR block is in O/S mode, MAN mode or “not scheduled”.	AR	Depends on cause of Alarm	Depends on cause of Alarm
AL.90 AI SIM	Simulation function of AI1 block is active	AI1	Simulate Active	Specified Status
AL.91 AI SIM	Simulation function of AI2 block is active	AI2	Simulate Active	Specified Status
AL.92 AI SIM	Simulation function of AI3 block is active	AI3	Simulate Active	Specified Status
AL.93 AI MAN	AI1 block is MAN mode	AI1	—	Depends on setting condition of STATUS_OPTS. Limit Status:Constant
AL.94 AI MAN	AI2 block is MAN mode	AI2	—	Depends on setting condition of STATUS_OPTS. Limit Status:Constant
AL.95 AI MAN	AI3 block is MAN mode	AI3	—	Depends on setting condition of STATUS_OPTS. Limit Status:Constant

(*1) Priority:
0 = the associated alert will never occur.
1 = the associated alert is not sent as a notification. If the priority is above 1, then the alert must be reported.
2 = Block alarm and update event have a fixed priority of 2.
3-7 = advisory alarms (PV.STATUS = Active Advisory Alarm)
8-15 = critical alarms (PV.STATUS = Active Critical Alarm)

Table 8.12 Action of each parameters in failure mode related Advanced Diagnostic (option code: /DG1)

ALARM Display	Cause of Alarm	SENSOR Transducer block		
		DIAG_ERR		PV.STATUS SV.STATUS TV.STATUS (*1)
		Hexadecimal	Display through DD	
AL.87 FLG.HI	Flange Temperature High Alarm occurs.	0x4000	Flg Temp High Alarm	
AL.87 FLG.LO	Flange Temperature Low Alarm occurs.	0x2000	Flg Temp Low Alarm	
AL.88 INVR.DP	Reference fDP value is invalid.	0x0800	Invalid Ref fDP	
AL.88 INVR.SL	Reference fSPl value is invalid.	0x0400	Invalid Ref fSPl	
AL.88 INVR.SH	Reference fSPh value is invalid.	0x0200	Invalid Ref fSPh	
AL.88 INVR.F	Reference BlkF value is invalid.	0x0100	Invalid Ref BlkF	
AL.89 B BLK	B Blocking is detected.	0x0080	B Blocking	UNCERTAIN:Non Specific
AL.89 H BLK	High-pressure-side Blocking is detected.	0x0040	High Side Blocking	UNCERTAIN:Non Specific
AL.89 L BLK	Low-pressure-side Blocking is detected.	0x0020	Low Side Blocking	UNCERTAIN:Non Specific
AL.89 H LRG	Large Fluctuation of High Side.	0x0010	Large Fluctuation of High Side	UNCERTAIN:Non Specific
AL.89 L LRG	Large Fluctuation of Low Side.	0x0008	Large Fluctuation of Low Side	UNCERTAIN:Non Specific
AL.89 A BLK	A Blocking is detected.	0x0004	A Blocking	UNCERTAIN:Non Specific
AL.89 ILBD.OV	DPavg is outside range.	0x1000	Outside Diagonosis Range	

(*1): These settings depend on bit 15 in DIAG_OPTION.

9. Parameter Lists

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

9.1 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	Space (32 characters)	AUTO	The user description of the intended application of the block.
3	1003	STRATEGY	0	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	0	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	—	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	—	AUTO	Read/write test parameter-used only for conformance testing and simulation.
9	1009	DD_RESOURCE	Space (32 characters)	—	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	EJX:12 EJA:17	—	Manufacturer’s model number associated with the resourceused by interface devices to locate the DD file for the resource.
12	1012	DEV_REV	EJX:6 EJA:2	—	Manufacturer revision number associated with the resourceused 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	0	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. 1: Run:Run 2: Resource:Restart resource 3: Defaults:Restart with initial value specified in FF functional spec.(*1) 4: Processor: Restart processor *1: FF-891 Foundation™ Specification Function Block Application Process Part 2.
17	1017	FEATURES	Reports Fault state Soft W Lock Hard W Lock Multi_bit Alarm support	—	Used to show supported resource block options.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
18	1018	FEATURE_SEL	Report Fault state Soft W Lock	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	0x0000	AUTO	Used to select the block execution method for this resource.
21	1021	MIN_CYCLE_T	3200 (100 ms)	—	Time duration of the shortest cycle interval of which the resource is capable.
22	1022	MEMORY_SIZE	0	—	Available configuration memory in the empty resource. To be checked before attempting a download.
23	1023	NV_CYCLE_T	0	—	Interval between writing copies of nonvolatile parameters to non-volatile memory. Zero means never.
24	1024	FREE_SPACE	0	—	Percent of memory available for further configuration. DPharp 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. DPharp does not support this.
26	1026	SHED_RCAS	640000 (20 s)	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 (20 s)	AUTO	Time duration at which to give up on computer writes to function block ROut locations. Supported only with PID function.
28	1028	FAULT_STATE	1	—	Condition set by loss of communication to an output block, failure promoted to an output block or a physical contact. When fail-safe condition is set, then output function blocks will perform their FSAFE actions.
29	1029	SET_FSTATE	1	AUTO	Allows the fail-safe condition to be manually initiated by selecting Set.
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.
31	1031	MAX_NOTIFY	128	—	Maximum number of unconfirmed notify messages possible.
32	1032	LIM_NOTIFY	4	AUTO	Maximum number of alarm information which transmitter can transfer at the same time. Setting of this parameter restrict number of alarm transfer to the HOST and prevent HOST from overflow.
33	1033	CONFIRM_TIM	640000 (20 s)	AUTO	The minimum time between retries of alert reports.
34	1034	WRITE_LOCK	1(Not Locked)	AUTO	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated 1: Not Locked 2: Locked
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	—	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	1038	ACK_OPTION	0xFFFF	AUTO	Selection of whether alarms associated with the block will be automatically acknowledged.
39	1039	WRITE_PRI	0	AUTO	Priority of the alarm generated by clearing the write lock.
40	1040	WRITE_ALM	—	—	This alert is generated if the write lock parameter is cleared.
41	1041	ITK_VER	6	—	Version number of interoperability test by Fieldbus Foundation applied to the transmitter.
42	1042	SOFT_REV		—	Transmitter software revision number.
43	1043	SOFT_DESC		—	Internal use
44	1044	SIM_ENABLE_MSG	Space (32 characters)	AUTO	Software switch for simulation function.
45	1045	DEVICE_STATUS_1	0	—	Device status For details, refer to Table 8.1
46	1046	DEVICE_STATUS_2	0	—	Device status For details, refer to Table 8.2
47	1047	DEVICE_STATUS_3	0	—	Device status For details, refer to Table 8.3
48	1048	DEVICE_STATUS_4	reserve	—	Device status For details, refer to Table 8.4

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
49	1049	DEVICE_STATUS_5	reserve	—	Device status For details, refer to Table 8.5
50	1050	DEVICE_STATUS_6	reserve	—	Device status For details, refer to Table 8.6
51	1051	DEVICE_STATUS_7	reserve	—	Device status For details, refer to Table 8.7
52	1052	DEVICE_STATUS_8	reserve	—	Device status For details, refer to Table 8.8
53	1053	SOFTDWN_ PROTECT	0x01	AUTO	Defines whether to accept software downloads. 0x01: Unprotected 0x02: Protected
54	1054	SOFTDWN_FORMAT	0x01	AUTO	Selects the software download method. 0x01: Standard 0x02: YOKOGAWA Standard
55	1055	SOFTDWN_COUNT	0	—	Indicates the number of times the internal FlashROM was erased.
56	1056	SOFTDWN_ACT_ AREA	0	—	Indicates the ROM number of the currently working FlashROM. 0: FlashROM #0 working 1: FlashROM #1 working
57	1057	SOFTDWN_MOD_ REV	1, 0, 0, 0, 0, 0, 0, 0, 0	—	Indicates the software module revision.
58	1058	SOFTDWN_ERROR	0	—	Indicates the error during a software download. Refer Table A7.4.
59	1059	SOFTDWN_HISTORY		—	Not used for the transmitter.
60	1060	SOFTDWN_HIST_ INDEX	0	AUTO	Not used for the transmitter.
61	1061	COMPATIBILITY_REV	EJX: 6 EJA: 2	—	Indicates the smallest Rev value compatible with device DevRev.
62	1062	CAPABILITY_LEV	0x00	—	Indicates the capability level of instrument interior.
63	1063	CAPABILITY_CONFIG	0x0000	—	A parameter corresponding to AP_CONF or DEV_OPTIONS before the addition of parameter CAPABILITY_LEV.
64	1064	WRITE_LOCK_LEVEL	2	AUTO	Specifies blocks that activates Write Lock.
65	1065	SI_CONTROL_ CODES	1	—	A parameter for switching to make the instrument compatible with SI units.
66	1066	FD_VER	0	—	Indicates value of major version of instrument diagnostics specifications (FF-912).
67	1067	FD_FAIL_ACTIVE	0x00000000	—	A parameter that corresponds to ”Failed” in the NAMUR NE 107 category.
68	1068	FD_OFFSPEC_ ACTIVE	0x00000000	—	A parameter that corresponds to ”Off Specification” in the NAMUR NE 107 category.
69	1069	FD_MAINT_ACTIVE	0x00000000	—	A parameter that corresponds to ”Maintenance” in the NAMUR NE 107 category.
70	1070	FD_CHECK_ACTIVE	0x00000000	—	A parameter that corresponds to ”Check Function” in the NAMUR NE 107 category.
71	1071	FD_FAIL_MAP	0xFC000000	AUTO	Specifies the bit assigned to FD_FAIL_ACTIVE, a parameter for indicating ”Failed,” a 32-bit alarm listed in FD_SIMULATE. DiagnosticValue.
72	1072	FD_OFFSPEC_MAP	0x00003800	AUTO	Specifies the bit assigned to FD_OFFSPEC_ACTIVE, a parameter for indicating ”Off Specification,” a 32-bit alarm listedin FD_SIMULATE. DiagnosticValue.
73	1073	FD_MAINT_MAP	0x000003E0	AUTO	Specifies the bit assigned to FD_MAINT_ACTIVE, a parameterfor indicating ”Maintenance,” a 32-bit alarm listed in FD_SIMULATE. DiagnosticValue.
74	1074	FD_CHECK_MAP	0x01FF8008	AUTO	Specifies the bit assigned to FD_CHECK_ACTIVE, a parameter for indicating ”Check Function,” a 32-bit alarm listed in FD_SIMULATE. DiagnosticValue.
75	1075	FD_FAIL_MASK	0x00000000	AUTO	Specifies the bit that notifies the host of 32-bit ”Failed” alarms listed in FD_FAIL_ACTIVE.
76	1076	FD_OFFSPEC_MASK	0x00000000	AUTO	Specifies the bit that notifies the host of 32-bit ”Off Specification” alarms listed in FD_OFFSPEC_ACTIVE.
77	1077	FD_MAINT_MASK	0x00000000	AUTO	A parameter that specifies the bit that notifies the host of 32-bit ”Maintenance” alarms listed in FD_MAINT_ACTIVE. A parameter set by the user.
78	1078	FD_CHECK_MASK	0x00000000	AUTO	Specifies the bit that notifies the host of 32-bit ”Check Function”alarms listed in FD_CHECK_ACTIVE.
79	1079	FD_FAIL_ALM		AUTO	Indicates alarm information for alarms categorized under ”Failed.”
80	1080	FD_OFFSPEC_ALM		AUTO	Indicates alarm information for alarms categorized under ”Off Specification.”

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
81	1081	FD_MAINT_ALM		AUTO	Indicates alarm information for alarms categorized under ”Maintenance”.
82	1082	FD_CHECK_ALM		AUTO	Indicates alarm information for alarms categorized under ”Check Function”.
83	1083	FD_FAIL_PRI	0	AUTO	Indicates the FD_FAIL_ALM priority for an alarm.
84	1084	FD_OFFSPEC_PRI	0	AUTO	Indicates the FD_OFFSPEC_ALM priority for an alarm.
85	1085	FD_MAINT_PRI	0	AUTO	Indicates theFD_MAINT_ALM priority for an alarm.
86	1086	FD_CHECK_PRI	0	AUTO	Indicates the FD_CHECK_ALM priority for an alarm.
87	1087	FD_SIMULATE		AUTO	A parameter for simulating an alarm.
88	1088	FD_RECOMMEN_ ACT	0	—	Indicates procedures for handling essential alarms.
89	1089	FD_EXTENDED_ ACTIVE_1	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
90	1090	FD_EXTENDED_ ACTIVE_2	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
91	1091	FD_EXTENDED_ ACTIVE_3	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
92	1092	FD_EXTENDED_ ACTIVE_4	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
93	1093	FD_EXTENDED_ ACTIVE_5	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
94	1094	FD_EXTENDED_ ACTIVE_6	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
95	1095	FD_EXTENDED_ ACTIVE_7	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
96	1096	FD_EXTENDED_ ACTIVE_8	0x00000000	—	A parameter serving as a starting point for alarms handled by FF-912.
97	1097	FD_EXTENDED_ MAP_1	0x0708FFFF	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_1 to FD_EXTENDED_ACTIVE_1.
98	1098	FD_EXTENDED_ MAP_2	0xFEFF8000	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_2 to FD_EXTENDED_ACTIVE_2.
99	1099	FD_EXTENDED_ MAP_3	0xF0008000	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_3 to FD_EXTENDED_ACTIVE_3.
100	1100	FD_EXTENDED_ MAP_4	0xFF000000	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_4 to FD_EXTENDED_ACTIVE_4.
101	1101	FD_EXTENDED_ MAP_5	0xF0000000	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_5 to FD_EXTENDED_ACTIVE_5.
102	1102	FD_EXTENDED_ MAP_6	0x00000007	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_6 to FD_EXTENDED_ACTIVE_6.
103	1103	FD_EXTENDED_ MAP_7	0x00007FFC	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_7 to FD_EXTENDED_ACTIVE_7.
104	1104	FD_EXTENDED_ MAP_8	0x00000000	AUTO	A parameter set by the user as a mask from DEVICE_ STATUS_8 to FD_EXTENDED_ACTIVE_8.
105	1105	PRIVATE_1		—	Not used for the transmitter.
106	1106	PRIVATE_2		—	Not used for the transmitter.
107	1107	PRIVATE_3		—	Not used for the transmitter.
108	1108	PRIVATE_4		—	Not used for the transmitter.
109	1109	PRIVATE_5		—	Not used for the transmitter.
110	1110	PRIVATE_6		—	Not used for the transmitter.
111	1111	PRIVATE_7		—	Not used for the transmitter.
112	1112	PRIVATE_8		—	Not used for the transmitter.
113	1113	PRIVATE_9		—	Not used for the transmitter.
114	1114	PRIVATE_10		—	Not used for the transmitter.
115	1115	PRIVATE_11		—	Not used for the transmitter.
116	1116	DEVICE_ CONDITION_ ACTIVE_1	0x00000000	—	FD_EXTENDED_ACTIVE_1 & FD_EXTENDED_MAP_1
117	1117	DEVICE_ CONDITION_ ACTIVE_2	0x00000000	—	FD_EXTENDED_ACTIVE_2 & FD_EXTENDED_MAP_2
118	1118	DEVICE_ CONDITION_ ACTIVE_3	0x00000000	—	FD_EXTENDED_ACTIVE_3 & FD_EXTENDED_MAP_3

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
119	1119	DEVICE_ CONDITION_ ACTIVE_4	0x00000000	—	FD_EXTENDED_ACTIVE_4 & FD_EXTENDED_MAP_4
120	1120	DEVICE_ CONDITION_ ACTIVE_5	0x00000000	—	FD_EXTENDED_ACTIVE_5 & FD_EXTENDED_MAP_5
121	1121	DEVICE_ CONDITION_ ACTIVE_6	0x00000000	—	FD_EXTENDED_ACTIVE_6 & FD_EXTENDED_MAP_6
122	1122	DEVICE_ CONDITION_ ACTIVE_7	0x00000000	—	FD_EXTENDED_ACTIVE_7 & FD_EXTENDED_MAP_7
123	1123	DEVICE_ CONDITION_ ACTIVE_8	0x00000000	—	FD_EXTENDED_ACTIVE_8 & FD_EXTENDED_MAP_8

9.2 SENSOR Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2000	Block Header	TAG: “STB”	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	2001	ST_REV	—	—	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	Space (32 characters)	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	—	The actual, target, permitted, and normal modes of the block.
6	2006	BLOCK_ERR	—	—	This parameter reflects the error status associated with hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	2007	UPDATE_EVT	—	—	This alert is generated by any change to the static data.
8	2008	BLOCK_ALM	—	—	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute.
9	2009	TRANSDUCER_ DIRECTORY	—	—	A directory that specifies the number and starting indices of the transducers.
10	2010	TRANSDUCER_ TYPE	100 (Standard Pre-ssure with Calibration)	—	Identifies transducer.
11	2011	XD_ERROR	—	—	The error code in transducer. 0=No failure 18=Calibration error 20=Electronics failure 22=I/O failure
12	2012	COLLECTION_ DIRECTORY	—	—	A directory that specifies the number, starting indices, and DD Item Ids of the data collections in each transducer within a transducer block.
13	2013	PRIMARY_ VALUE_ TYPE	107: differential pressure 108: gauge pressure 109: absolute pressure	O/S	The type of measurement represented by primary value. Followings are available for the transmitter: 107=differential pressure 108=gauge pressure 109=absolute pressure
14	2014	PRIMARY_ VALUE	—	—	The measured value and status available to the function block.
15	2015	PRIMARY_ VALUE_ RANGE	Range of capsule	—	The High and Low range limit values, engineering units code and the number of digits to the right of the decimal point to be used to display the primary value.
16	2016	CAL_POINT_HI	Max range	O/S	The highest calibrated value.
17	2017	CAL_POINT_LO	0	O/S	The lowest calibrated value.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
18	2018	CAL_MIN_SPAN	Minimum span of capsule	—	The minimum calibration span value allowed.
19	2019	CAL_UNIT	kPa or as specified upon ordering	—	The engineering unit for the calibrated values.
20	2020	SENSOR_TYPE	Silicon resonant	—	The type of sensor.
21	2021	SENSOR_ RANGE	Range of capsule	—	The High and Low range limit values, engineering units code and the number of digits to the right of the decimal point for the sensor.
22	2022	SENSOR_SN	Serial No.	—	Serial number.
23	2023	SENSOR_CAL_ METHOD	103: factory trim standard calibration	O/S	The method of the last sensor calibration. 100=volumetric 101=static weight 102=dynamic weight 103=factory trim standard calibration 104=user trim standard calibration 105=factory trim special calibration 106=user trim special calibration 255=Other
24	2024	SENSOR_CAL_LOC	—	O/S	Set/indicate the location of the last sensor calibration.
25	2025	SENSOR_CAL_DATE	—	O/S	Set/indicate the date of the last sensor calibration.
26	2026	SENSOR_CAL_WHO	—	O/S	Set/indicate the name of the person responsible for the last sensor calibration.
27	2027	SENSOR_ ISOLATOR_MTL	Unkown	—	Defines the construction material of the isolating diaphragms.
28	2028	SENSOR_FILL_ FLUID	Unkown	—	Defines the type of fluid used in the sensor.
29	2029	SECONDARY_VALUE		—	Static pressure (high pressure side) value and status
30	2030	SECONDARY_ VALUE_UNIT	1133 (KPa)	—	The engineering unit of static pressure (high pressure side). This unit is linked to XD_SCALE.unit of AI blocks
31	2031	CAL_DEVIATION_HI	0	O/S	Deviation value for span adjustment.
32	2032	CAL_DEVIATION_LO	0	O/S	Deviation value for zero adjustment.
33	2033	EXTERNAL_ZERO_ TRIM	0	O/S	Permission of external zero-adjustment
34	2034	PRIMARY_VALUE_ FTIME	2	O/S	Damping time constant for primary value
35	2035	TERTIARY_VALUE		—	Value and status of static pressure at low side
36	2036	SP_VALUE_TYPE	109 (absolute pressure)	O/S	Select the type of measurement for static pressure, absolute or gauge
37	2037	SP_VALUE_RANGE	Range of capsule	—	High and low range limit values, engineering units, and decimal point place for static pressure.
38	2038	CAL_SP_ POINT_HI	Maximum range value of SP	O/S	The highest calibrated value for static pressure
39	2039	CAL_SP_ POINT_LO	0	O/S	The Lowest calibrated value for static pressure
40	2040	CAL_SP_MIN_ SPAN	Minimum span of SP	—	The minimum calibration span allowed for static pressure
41	2041	CAL_SP_UNIT	1133 (KPa)	—	The calibrated engineering unit for static pressure. This unit is linked to XD_SCALE.unit of AI blocks
42	2042	CAL_SP_ DEVIATION_HI	0	O/S	Deviation value for span adjustment of static pressure
43	2043	CAL_SP_ DEVIATION_LO	0	O/S	Deviation value for zero adjustment of static pressure
44	2044	SP_VALUE_FTIME	2	O/S	Damping time constant for static pressure
45	2045	ATM_PRESS	101.325	O/S	Atmosphere pressure value used to obtain gauge pressure value from absolute pressure.
46	2046	CLEAR_CAL	0	O/S	Reset zero and span adjustment to factory calibrated values for pressure, static pressure, and or all.
47	2047	CAP_TEMP_VAL		—	Measured capsule temperature value and status.
48	2048	CAP_TEMP_RANGE	-50.0 to 130.0°C	—	High and low range limit values, engineering units, decimal point place for capsule temperature.
49	2049	AMP_TEMP_VAL		—	Measured Amplifier temperature value and status.
50	2050	AMP_TEMP_ RANGE	-50.0 to 95.0°C	—	High and low range limit values, engineering units, decimal point place for Amplifier temperature.
51	2051	MODEL	Model code	—	The model code.
52	2052	SPECIAL_ ORDER_ ID	Special order number	—	Identification number of special order.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
53	2053	MANUFAC_DATE	0	O/S	Date of production
54	2054	CAP_GASKET_MTL	Depend on Specify	O/S	Material of capsule gasket
55	2055	FLANGE_MTL	Depend on Specify	O/S	Material of flange
56	2056	D_VENT_PLUG	Depend on Specify	O/S	Material of drain or vent plug
57	2057	FLANGE_TYPE	Depend on Specify	O/S	Flange type
58	2058	REM_SEAL_ ISOL_MTL	Depend on Specify	O/S	Material of isolating diaphragms for remote seal
59	2059	FLANGE_SIZE	Depend on Specify	O/S	Flange size
60	2060	REM_SEAL_ NUM	Depend on Specify	O/S	Number of remote seal
61	2061	REM_SEAL_ FILL_FLUID	Depend on Specify	O/S	Types of fill fluid in remote seals.
62	2062	REM_SEAL_ TYPE	Depend on Specify	O/S	Types of remote seals
63	2063	ALARM_SUM	Alarm Disable	—	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
64	2064	AUTO_RECOVERY	1 (ON)	O/S	Permission of auto recovery from sensor errors
65	2065	MS_CODE	—	—	Model suffix and codes
66	2066	DIAG_MODE	Stop (0)	—	Used for ILBD. Refer to A8.2.12.
67	2067	DIAG_PERIOD	180 (s)	—	Used for ILBD. Refer to A8.2.12.
68	2068	DIAG_PRI	1	—	Used for ILBD. Refer to A8.2.12.
69	2069	DIAG_ERR	0x0000	—	Used for ILBD. Refer to A8.2.12.
70	2070	DIAG_H_ALM		—	Used for ILBD. Refer to A8.2.12.
71	2071	DIAG_L_ALM		—	Used for ILBD. Refer to A8.2.12.
72	2072	DIAG_OPTION	0x08FC	—	Used for ILBD. Refer to A8.2.12.
73	2073	REF_LIM_FDPMIN	7E-10	—	Used for ILBD. Refer to A8.2.12.
74	2074	REF_LIM_FSPMIN	1E-10	—	Used for ILBD. Refer to A8.2.12.
75	2075	REF_LIM_BLKFMAX	0.5	—	Used for ILBD. Refer to A8.2.12.
76	2076	COMP_FLAG	0	—	Used for ILBD. Refer to A8.2.12.
77	2077	DIAG_LIM	Refer to Table A8.2	—	Used for ILBD. Refer to A8.2.12.
78	2078	DIAG_COUNT	3	—	Used for ILBD. Refer to A8.2.12.
79	2079	REFERENCE_TIME	0x00000000	—	Used for ILBD. Refer to A8.2.12.
80	2080	REFERENCE_FDP	0x00, 0	—	Used for ILBD. Refer to A8.2.12.
81	2081	REFERENCE_FSPL	0x00, 0	—	Used for ILBD. Refer to A8.2.12.
82	2082	REFERENCE_FSPH	0x00, 0	—	Used for ILBD. Refer to A8.2.12.
83	2083	REFERENCE_BLKF	0x00, 0	—	Used for ILBD. Refer to A8.2.12.
84	2084	REFERENCE_DPAVG	0x00, 0	—	Used for ILBD. Refer to A8.2.12.
85	2085	VALUE_TIME		—	Used for ILBD. Refer to A8.2.12.
86	2086	VALUE_FDP		—	Used for ILBD. Refer to A8.2.12.
87	2087	VALUE_FSPL		—	Used for ILBD. Refer to A8.2.12.
88	2088	VALUE_FSPH		—	Used for ILBD. Refer to A8.2.12.
89	2089	VALUE_BLKF		—	Used for ILBD. Refer to A8.2.12.
90	2090	VALUE_DPAVG		—	Used for ILBD. Refer to A8.2.12.
91	2091	RATIO_FDP		—	Used for ILBD. Refer to A8.2.12.
92	2092	RATIO_FSPL		—	Used for ILBD. Refer to A8.2.12.
93	2093	RATIO_FSPH		—	Used for ILBD. Refer to A8.2.12.
94	2094	CRATIO_FDP		—	Used for ILBD. Refer to A8.2.12.
95	2095	NRATIO_FDP		—	Used for ILBD. Refer to A8.2.12.
96	2096	DIAG_APPLICABLE		—	Used for ILBD. Refer to A8.2.12.
97	2097	FLG_TEMP_VAL	0	—	Used for Heat trace monitoring. Refer to A8.3.6.
98	2098	FLG_TEMP_RANGE	-50.0 to 130.0°C	—	Used for Heat trace monitoring. Refer to A8.3.6.
99	2099	FLG_TEMP_COEF	0	—	Used for Heat trace monitoring. Refer to A8.3.6.
100	2100	FLG_TEMP_PRI	1	—	Used for Heat trace monitoring. Refer to A8.3.6.
101	2101	FLG_TEMP_H_LIM	130	—	Used for Heat trace monitoring. Refer to A8.3.6.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
102	2102	FLG_TEMP_L_LIM	-50	—	Used for Heat trace monitoring. Refer to A8.3.6.
103	2103	FLG_TEMP_ALM		—	Used for Heat trace monitoring. Refer to A8.3.6.
104	2104	TEST_KEY1		—	Not used for the transmitter.
105	2105	TEST_KEY2		—	Not used for the transmitter.
106	2106	TEST_KEY3		—	Not used for the transmitter.
107 to 137	2107 to 2137	TEST_1 to TEST_31		—	Not used for the transmitter.

9.3 LCD Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2500	Block Header	TAG: “LTB”	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	2501	ST_REV	—	—	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	2502	TAG_DESC	Space (32 characters)	AUTO	The user description of the intended application of the block
3	2503	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	2504	ALERT_KEY	1	AUTO	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	2505	MODE_BLK	AUTO	—	The actual, target, permitted, and normal modes of the block.
6	2506	BLOCK_ERR	—	—	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	2507	UPDATE_EVT	—	—	This alert is generated by any change to the static data.
8	2508	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	2509	TRANSDUCER_ DIRECTORY	—	—	A directory that specifies the number and starting indices of the transducers.
10	2510	TRANSDUCER_TYPE	65535 (other)	—	Identifies transducer.
11	2511	XD_ERROR	—	—	The error code in transducer. 0=No failure 19=Configuration error
12	2512	COLLECTION_ DIRECTORY	—	—	A directory that specifies the number, starting indices, and DD Item Ids of the data collections in each transducer within a transducer block.
13	2513	DISPLAY_SEL	DISPLAY1 ON	AUTO	Selection of display1 to 4 to be shown on LCD Bit0=1:DISPLAY1 ON Bit1=1:DISPLAY2 ON Bit2=1:DISPLAY3 ON Bit3=1:DISPLAY4 ON
14	2514	INFO_SEL	UNIT ON, PARAMETER ON	AUTO	Selection of items to be displayed Bit0=1:TAG ON Bit1=1:PARAMETER ON Bit2=1:UNIT ON Bit3=1:STATUS ON
15	2515	BLOCK_TAG1	AI1	—	Block tag which includes a parameter to be displayed on display1
16	2516	PARAMETER_SEL1	AI OUT	AUTO	Selection of a parameter to be displayed on display1. Select a parameter from Table 6.1
17	2517	DISPLAY_TAG1	Space (8 characters)	AUTO	Name of block tag to be displayed on display1; up to six alphanumeric plus a slash [/] and a period [.]
18	2518	UNIT_SEL1	0 (Auto)	AUTO	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL1 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT1 will be displayed when "Custom" is selected.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
19	2519	DISPLAY_UNIT1	Space (8 characters)	AUTO	User specified unit to be displayed on display1, which will be available when "Custom" is selected at UNIT SEL1.
20	2520	EXP_MODE1	0	AUTO	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
21	2521	BLOCK_TAG2	2014 (PRIMARY_ VALUE)	—	Block tag which includes a parameter to be displayed on display2
22	2522	PARAMETER_SEL2	0 (PRIMARY_ VALUE)	AUTO	Selection of a parameter to be displayed on display2. Select a parameter from Table 6.1
23	2523	DISPLAY_TAG2	Space (8 characters)	AUTO	Name of block tag to be displayed on display2; up to six alphanumeric plus a slash [/] and a period [.]
24	2524	UNIT_SEL2	0 (Auto)	AUTO	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL2 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT2 will be displayed when "Custom" is selected.
25	2525	DISPLAY_UNIT2	Space (8 characters)	AUTO	User specified unit to be displayed on display2, which will be available when "Custom" is selected at UNIT SEL2.
26	2526	EXP_MODE2	0	AUTO	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
27	2527	BLOCK_TAG3	2029 (SECONDARY_ VALUE)	—	Block tag which includes a parameter to be displayed on display3
28	2528	PARAMETER_SEL3	1 (SECONDARY_ VALUE)	AUTO	Selection of a parameter to be displayed on display3. Select a parameter from Table 6.1
29	2529	DISPLAY_TAG3	Space (8 characters)	AUTO	Name of block tag to be displayed on display3; up to six alphanumeric plus a slash [/] and a period [.]
30	2530	UNIT_SEL3	0 (Auto)	AUTO	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL3 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT3 will be displayed when "Custom" is selected.
31	2531	DISPLAY_UNIT3	Space (8 characters)	AUTO	User specified unit to be displayed on display3, which will be available when "Custom" is selected at UNIT SEL3.
32	2532	EXP_MODE3	0	AUTO	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
33	2533	BLOCK_TAG4	2047 (CAP_ TEMP_VAL)	—	Block tag which includes a parameter to be displayed on display4
34	2034	PARAMETER_SEL4	3 (CAP_TEMP_ VAL)	AUTO	Selection of a parameter to be displayed on display4. Select a parameter from Table 6.1
35	2535	DISPLAY_TAG4	Space (8 characters)	AUTO	Name of block tag to be displayed on display4; up to six alphanumeric plus a slash [/] and a period [.]
36	2536	UNIT_SEL4	0 (Auto)	AUTO	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL4 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT4 will be displayed when "Custom" is selected.
37	2537	DISPLAY_UNIT4	Space (8 characters)	AUTO	User specified unit to be displayed on display4, which will be available when "Custom" is selected at UNIT SEL4.
38	2038	EXP_MODE4	0	AUTO	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
39	2039	BAR_GRAPH_ SELECT	1 (display)	AUTO	Selection of bar graph indicator
40	2540	DISPLAY_CYCLE	0 (2.8 s)	AUTO	Duration of display cycle. 0: 2.8 s 1-255: 400 ms x set value
41	2541	POWER_ON_INFO	1	—	Display when powering on.
42	2542	TEST 40	0	O/S	Not used for the transmitter.

9.4 AI Function Block

Relative Index	Index AI1	Index AI2	Index AI3	Parameter Name	Factory Default	Write Mode	Explanation
0	4000	4100	4200	Block Header	TAG: “AI1” or “AI2” or “AI3”	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	4001	4101	4201	ST_REV	—	—	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	4102	4202	TAG_DESC	Space (32 characters)	AUTO	The user description of the intended application of the block.
3	4003	4103	4203	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	4104	4204	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	4105	4205	MODE_BLK	AUTO	—	The actual, target, permitted, and normal modes of the block.
6	4006	4106	4206	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	4007	4107	4207	PV	—	—	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	4108	4208	OUT	—	Value = MAN	The primary analog value calculated as a result of executing the function.
9	4009	4109	4209	SIMULATE	Disable	AUTO	Allows the transducer analog input or output to the block to be manually supplied when simulate is enabled. When simulation is disabled, the simulate value and status track the actual value and status.
10	4010	4110	4210	XD_SCALE	Specified at the time of order	O/S	The high and low scale values, engineering units code, and number of digits to the right of the decimal point used with the value obtained from the transducer for a specified channel.
11	4011	4111	4211	OUT_ SCALE	Specified at the time of order	O/S	The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the OUT parameter and parameters which have the same scaling as OUT.
12	4012	4112	4212	GRANT_DENY	0	AUTO	Options for controlling access of host computers and local control panels to operating, tuning and alarm parameters of the block.
13	4013	4113	4213	IO_OPTS	0	O/S	Options which the user may select to alter input and output block processing
14	4014	4114	4214	STATUS_OPTS	0	O/S	Options which the user may select in the block processing of status
15	4015	4115	4215	CHANNEL	AI1: 1 AI2: 2 AI3: 4	O/S	The number of the logical hardware channel that is connected to this I/O block. This information defines the transducer to be used going to or from the physical world. 1:PV 2:SV 3:TV 4:CAP_TEMP_VAL 5:AMP_TEMP_VAL 6:FLG_TEMP_VAL
16	4016	4116	4216	L_TYPE	Specified at the time of order	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.

Relative Index	Index AI1	Index AI2	Index AI3	Parameter Name	Factory Default	Write Mode	Explanation
17	4017	4117	4217	LOW_CUT	Linear: 0% Square root: 10% of OUT_SCALE	AUTO	Limit used in square root processing. A value of zero percent of scale is used in block processing if the transducer value falls below this limit. This feature may be used to eliminate noise near zero for a flow sensor. The setting is in an engineering unit of OUT_SCALE.
18	4018	4118	4218	PV_FTIME	0 (s)	AUTO	Time constant of a single exponential filter for the PV, in seconds.
19	4019	4119	4219	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) or filtering (PV_FTIME).
20	4020	4120	4220	UPDATE_EVT	—	—	This alert is generated by any change to the static data.
21	4021	4121	4221	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	4122	4222	ALARM_SUM	Enable	—	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
23	4023	4123	4223	ACK_OPTION	0xFFFF	AUTO	Selection of whether alarms associated with the block will be automatically acknowledged.
24	4024	4124	4224	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	4125	4225	HI_HI_PRI	0	AUTO	Priority of the high high alarm.
26	4026	4126	4226	HI_HI_LIM	+INF	AUTO	The setting for high high alarm in engineering units.
27	4027	4127	4227	HI_PRI	0	AUTO	Priority of the high alarm.
28	4028	4128	4228	HI_LIM	+INF	AUTO	The setting for high alarm in engineering units.
29	4029	4129	4229	LO_PRI	0	AUTO	Priority of the low alarm.
30	4030	4130	4230	LO_LIM	-INF	AUTO	The setting for the low alarm in engineering units.
31	4031	4131	4231	LO_LO_PRI	0	AUTO	Priority of the low low alarm.
32	4032	4132	4232	LO_LO_LIM	-INF	AUTO	The setting of the low low alarm in engineering units.
33	4033	4133	4233	HI_HI_ALM	—	—	The status for high high alarm and its associated time stamp.
34	4034	4134	4234	HI_ALM	—	—	The status for high alarm and its associated time stamp.
35	4035	4135	4235	LO_ALM	—	—	The status of the low alarm and its associated time stamp.
36	4036	4136	4236	LO_LO_ALM	—	—	The status of the low low alarm and its associated time stamp.
37	4037	4137	4237	OUT_D_SEL	0	AUTO	Selection of alarm to output it from OUT_D
38	4038	4138	4238	OUT_D	—	Value= MAN	A discrete value and status that shows HI_HI, HI, LO_LO, LO state.

10. General Specifications

10.1 Standard Specifications

For items other than those described below, refer to each User's Manual.

Applicable Model:

All DPharp EJX/EJA series, except for EJX9□0A.

Output:

Digital communication signal based on FOUNDATION Fieldbus protocol.

Supply Voltage:

9 to 32 V DC for general use, flameproof type and Type n

9 to 24 V DC for intrinsically safe type Entity model

9 to 17.5 V DC for intrinsically safe type FISCO model

Communication Requirements:

Supply Voltage: 9 to 32 V DC

Current Draw (Stedy state): 15 mA (max)

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

Update Period:

Differential Pressure: 100 ms

Static Pressure: 100 ms

Capsule Temperature: 1 s

Amplifier Temperature: 1 s

Integral Indicator (LCD display):

5-digit Numerical Display, 6-digit Unit Display and Bar graph. The indicator is configurable to display one or up to four of the I/O signals periodically.

Functional Specifications:

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

Function Block:

Block name	Number	Execution time	Note
AI	3	30 mS	For differential pressure, static pressure and temperature
SC	1	30 mS	An Output of Signal Characterizer block is a non-linear function of the respective input. The function is determined by a table
IT	1	30 mS	Integrator block integrates a variable as a function of the time or accumulates the counts
IS	1	30 mS	Input Selector block provides selection of up to eight inputs and generate an output based on the configured action
AR	1	30 mS	Arithmetic block permits simple use of popular measurement math functions
PID	1	45 mS	Works as a field PID controller in conjunction with other function blocks.

LM Function:

LM function is supported.

LM function is disabled when shipped.

10.2 Optional Specifications

For items other than those described below, refer to each User's Manual.

Item	Description	Code
Data configuration at factory	Software damping	**CC**
Software Download Function	Based on FOUNDATION fieldbus Specification (FF-883) Download class: Class1	**EE**
Advanced diagnostics *3	Multi-sensing process monitoring • Impulse line blockage detection *1 • Heat trace monitoring *2	**DG1**

*1: The change of pressure fluctuation is monitored and then detects the impulse line blockage. See TI 01C25A31-01E for detailed technical information required for using this function.
*2: Not applicable for flange mounted differential pressure transmitters and diaphragm sealed differential pressure transmitters
*3: Applicable for EJX series. This option code must be specified with option code EE.

10.3 Optional Specifications (For Explosion Protected type)

Item	Description	Code
Factory Mutual (FM)	FM Explosionproof *1	**FF1**
	FM Intrinsically safe and Nonincendive *1	**FS15**
ATEX	ATEX Flameproof *1	**KF22**
	ATEX Intrinsically safe Ex ia *1	**KS26**
	ATEX Intrinsically safe Ex ic *1	**KN26**
Canadian Standards Association (CSA)	CSA Explosionproof *1	**CF1**
	CSA Intrinsically safe *1	**CS15**
IECEx Scheme	IECEx Flameproof *1	**SF2**
	IECEx Intrinsically safe Ex ia and Ex ic.*1	**SS26**

Contact Yokogawa representative for the codes indicated as '-'.
*1: Applicable for Electrical connection code 2, 4, 7, 9, C and D .

< Factory Setting >

Tag Number (Tag plate)		As specified in order
Software Tag (PD_TAG)		'PT2001' unless otherwise both Tag Number and Software Tag specified in order
Node Address		'0xF5' unless otherwise specified in order
Operation Functional Class		'BASIC' or as specified
Primary value *1	Output Mode (L_TYPE)	'Direct' unless otherwise specified in order
	Calibration Range (XD_SCALE) Lower/Higher Range Value	As specified in order
	Calibration Range Unit	Selected from mmH_2O, $mmH_2O(68°F)$, mmHg, Pa, hPa, kPa, MPa, mbar, bar, gf/cm^2, kgf/cm^2, inH_2O, $inH_2O(68°F)$, inHg, ftH_2O, $ftH_2O(68°F)$ or psi. (Only one unit can be specified)
	Output Scale (OUT_SCALE) Lower/Higher Range Value	'0 to 100%' unless otherwise specified.
	Software Damping *2	'2 seconds' or as specified in order
Static pressure display range		0 to Maximum Working Pressure of each model. Absolute pressure. (High or Low side is depending on the model.)

*1: Primary means differential pressure in case of differential pressure transmitters and pressure in case of pressure transmitters.
*2: To specify this item, /CC option is required.

Appendix 1. Signal Characterizer (SC) Block

The Signal Characterizer (SC) block is used to convert the values of input signals according to a line-segment function. The line-segment function is created using 21 points of the X/Y coordinates specified by the user. This function block can also be used as a transmission line for control signals and supports backward control.

Application

The Signal Characterizer block is primarily used if you wish for one of the following reasons to correct signals using the coordinates rather than a computational expression:

- The computational expression for correction in relation to input signals is complex
- The relationship between input signals and the signals after correction is only empirically known

A1.1 Schematic Diagram of Signal Characterizer Block

The following shows the schematic diagram of the Signal Characterizer block.

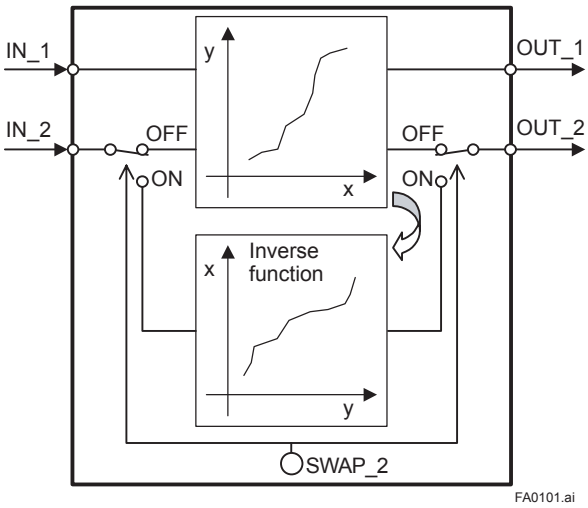


Figure A1.1 Signal Characterizer Block

Input/Output Parameters

Input	IN_1	Inputs a signal desired to be corrected using a line-segment function. (It is substituted for X of the line-segment function.)
	IN_2	Inputs a signal desired to be corrected using a line-segment function. (If SWAP_2 = off, it is substituted for X of the line-segment function.) (If SWAP_2 = on, it is substituted for Y of the line-segment function.)
Output	OUT_1	Outputs the result of the IN_1 input that has been corrected using the line-segment function. (The function block outputs the value of Y corresponding to IN_1.)
	OUT_2	Outputs the result of the IN_2 input that has been corrected using the line-segment function. The output can also be approximated using the inverse function of the specified line-segment function. (This is used for backward control.) (If SWAP_2 = off, the value of Y corresponding to X of IN_1 is output.) (If SWAP_2 = on, the value of X corresponding to Y of IN_1 is output.)
Others	CURVE_X	The points of the curve determining inputs and outputs. The x points of the curve are defined by an array of 1 to 21 points with a monotone increase. "+INFINITY" is configured for unused point(s).
	CURVE_Y	The points of the curve determining inputs and outputs. The y points of the curve are defined by an array of 1 to 21 points. If SWAP_2 = on, the elements of the curve are defined with a monotone increase or decrease. "+INFINITY" is configured for unused point(s).
	SWAP_2	Selector switch used to specify if an inverse function is used for the line-segment approximation of IN_2 to OUT_2. The setting of SWAP_2 = on (which uses the inverse function) is used for backward control.

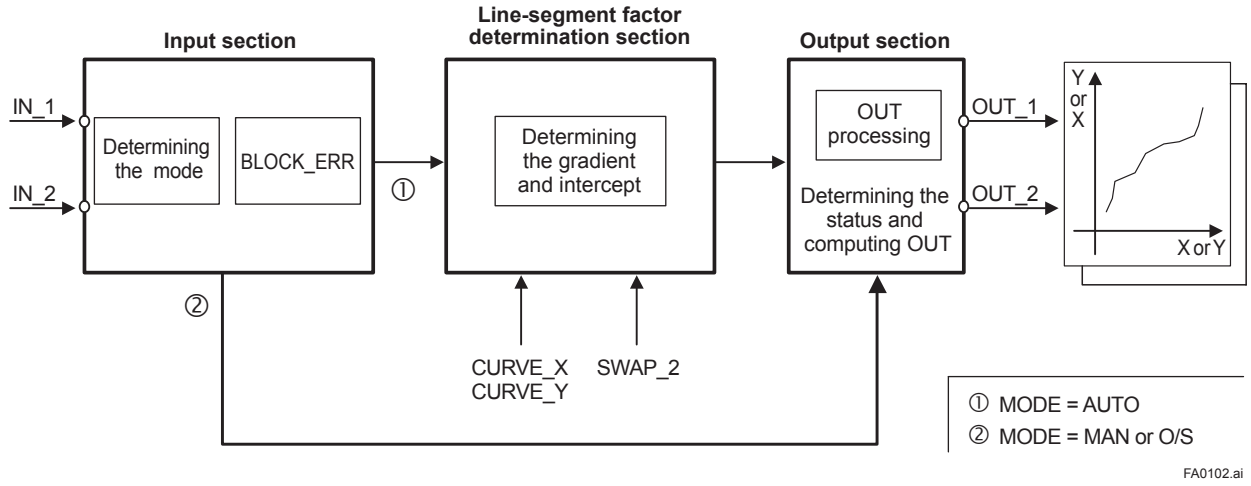


Figure A1.2 Overview of the Signal Characterizer Block

The following describes the Signal Characterizer block, dividing its functions into three sections:

- Input section: Determines the mode and judges BLOCK_ERR.
- Line-segment factor determination section: Determines the gradient and intercept for OUT_1 and OUT_2 based on CURVE_X, CURVE_Y, and SWAP_2 at shift ①.
- Output section: Multiplies the input values in IN_1 and IN_2 by the gradient and adds the intercept to them before outputting the results. Alternatively, it outputs a limit value.

A1.2 Input Section

The input section determines the mode and judges BLOCK_ERR.

A1.2.1 Determining the Mode

The following describes operations of the Signal Characterizer block.

Supported Mode	Rules
O/S (Out of Service)	• System-stopped status • Configuration change
Man	• If you do not want to output the value and the status from IN, you can manually transmit the value to OUT.
Auto	• Automatic system operation status

A1.2.2 Judging BLOCK_ERR

BLOCK_ERR indicates the cause of an error in the function block. If the cause of an error indicated by BLOCK_ERR occurs, the following configuration error is generated.

Name	Description
Block Configuration Error	1) "–INFINITY" has been configured for CURVE_X and CURVE_Y. 2) "+INFINITY" has been configured for X1 of CURVE_X. 3) "+INFINITY" has been configured for Y1 of CURVE_Y. 4) A value of the array of CURVE_X does not increase in a monotone manner. 5) A configuration error when SWAP_2 is on • A value of the array of CURVE_Y does not increase or decrease in a monotone manner. 6) The value of SWAP_2 is any value other than 1 or 2.

The mode changes to O/S if a block configuration error occurs.

A1.3 Line-segment Factor Determination Section

When the mode is AUTO and no bit in BLOCK_ERR is set, the "gradient" and "intercept" of a line passing through two points that are considered line-segment approximation values are determined.

A1.3.1 Conditions for Configuring Valid Coefficients (CURVE_X, CURVE_Y)

No write error is generated with respect to the settings in CURVE_X and CURVE_Y. However, a configuration error occurs in the following cases:

1. "+INFINITY" has been configured for X1 or Y1.
2. "–INFINITY" has been configured for each X or Y.
3. The values of CURVE_X are not increasing in a monotone manner (X1 < X2 < ... < X20 < X21). (If SWAP_2 is off, it is acceptable if the values of CURVE_Y do not increase or decrease in a monotone manner.)
4. The values of CURVE_Y are not increasing or decreasing in a monotone manner when SWAP_2 is on.

If a configuration error occurs, the Block Configuration Error bit in BLOCK_ERR is set, causing the mode to change to O/S.

Example of the case where SWAP_2 is off:

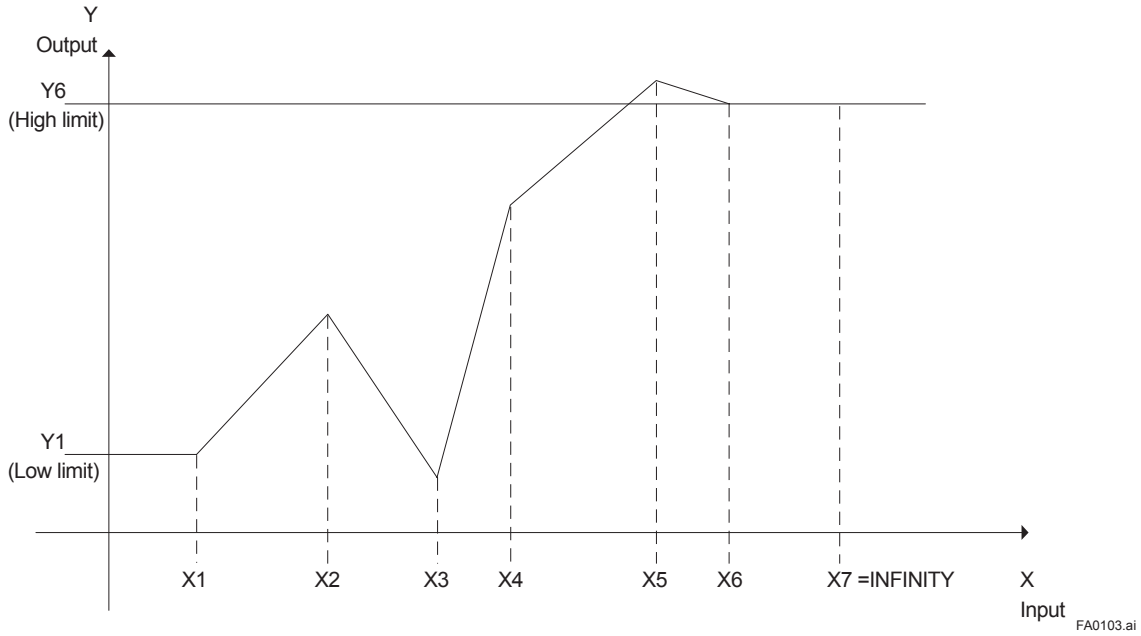


Figure A1.3 Example of Curve (SWAP_2 = off)

The range of CURVE_X: X1 to X6 (X7 and above are invalid because "+INFINITY" has been configured for X7*1.)

The X1 to X6 values always increase in a monotone manner (X1 < X2 < X3 < X4 < X5 < X6).

If an input value is smaller than X1, it is set to Y1.

If an input value is larger than X6, it is set to Y6.

The range of CURVE_Y: Y1 to Y6

It is acceptable if the Y1 to Y6 values do not increase in a monotone manner.

However, if the setting of SWAP_2 is changed from off to on, the values of CURVE_Y must increase or decrease in a monotone manner. Thus, if a value of CURVE_Y does not increase or decrease in a monotone manner in this setting, the mode changes to O/S, causing the Block Configuration Error bit in BLOCK_ERR to be set.

*1: For any points of the curve that are not used, configure "+INFINITY" for all of them.

Example of the case where SWAP_2 is on (monotone increase):

The input range of IN_1 is always in CURVE_X. The following shows the input/output graph of the IN_1 values.

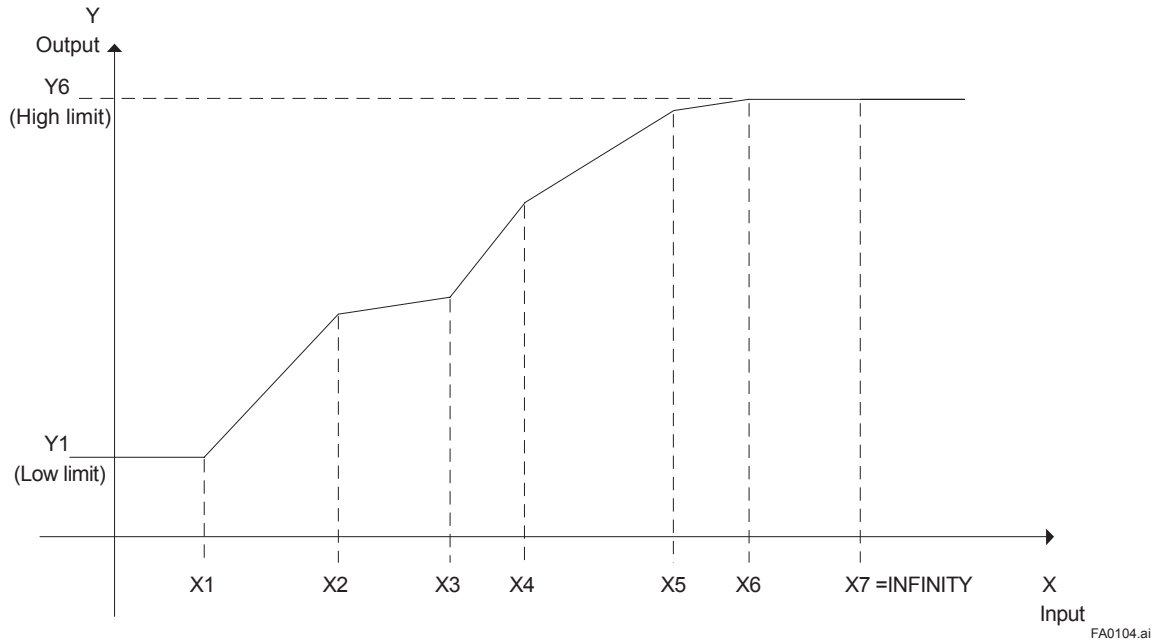


Figure A1.4 Example of Curve for IN_1 (SWAP_2 = on)

The input range of IN_2 is always in CURVE_Y. The following shows the input/output graph of the IN_2 values.

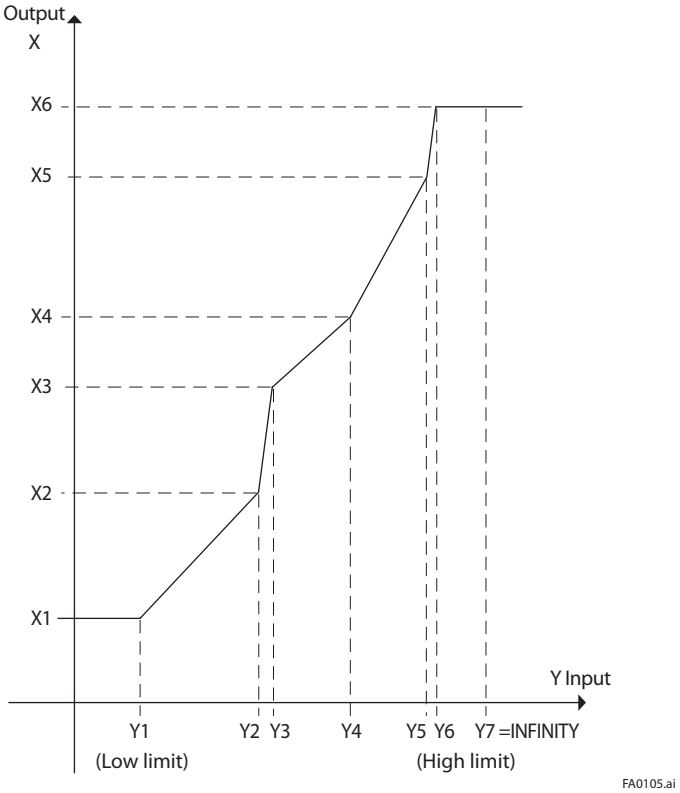


Figure A1.5 Example of Curve for IN_2 (SWAP_2 = on)

When SWAP_2 is on, the array elements of CURVE_Y must be configured for a monotone increase or decrease. (Y1 < Y2 < Y3 < Y4 < Y5 < Y6 or Y6 < Y5 < Y4 < Y3 < Y2 < Y1)

A1.4 List of Signal Characterizer Block Parameters

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View				Description / Remarks
					1	2	3	4	
0	BLOCK_ HEADER	Block Tag=O/S		TAG: "SC"					Information relating to this function block, such as block tag, DD revision, and execution time
1	ST_REV	- - - - -			2	2	2	2	The revision level of the set parameters associated with the Signal Characterizer block
2	TAG_DESC			Space (32 characters)					Stores comments describing tag information.
3	STRATEGY			1				2	The strategy field can be used by the high-level system to identify function blocks.
4	ALERT_KEY		1-255	1				1	Key information used to identify the location at which an alert has occurred
5	MODE_BLK				4		4		Mode of the Signal Characterizer block. O/S, Man, and Auto are supported.
6	BLOCK_ERR				2		2		Indicates the error status of the Signal Characterizer block in bit strings.
7	OUT_1	MAN			5		5		Outputs the result of the value of IN_1 corrected using a line-segment function.
8	OUT_2	MAN			5		5		Outputs the result of the value of IN_2 corrected using a line-segment function. It is also possible to approximate the result using the inverse function of the specified line-segment function. (This is used for backward control.)
9	X_RANGE					11			The engineering unit of variables corresponding to the x-axis for display
10	Y_RANGE					11			The engineering unit of variables corresponding to the y-axis for display
11	GRANT_DENY					2			The parameter used to check if various operations have been executed. The bits in the GRANT parameter corresponding to various operations are set before being executed. After the operations are complete, the DENY parameter is checked for the setting of any bit relating to the corresponding operation. If no bit is set, it is evident that the operations have been executed successfully.
12	IN_1				5		5		Input a signal to be corrected using a line-segment function.
13	IN_2				5		5		Input a signal to be corrected using a line-segment function.
14	SWAP_2		0:Initialized 1:No swap 2:Swap					1	Selector switch used to apply the inverse function to line-segment approximation of IN_2 to OUT_2
15	CURVE_X								Curve input points that determine inputs and outputs. The "x" points of the curve are defined by an array of 1 to 21 points with a monotone increase.
16	CURVE_Y								Curve input points that determine inputs and outputs. The "y" points of the curve are defined by an array of 1 to 21 points. If SWAP_2 is on, the elements of the curve must be defined with a monotone increase or decrease.
17	UPDATE_EVT								Indicates event information if an update event occurs.
18	BLOCK_ALM								Indicates alarm information if a block alarm occurs.

A1.5 Application Example

A1.5.1 Input Compensation

The following is an application example of pH compensation made by performing feedback control.

The pH is a value representing the degree of acidity or alkalinity and ranges from 0 to 14. pH 7 indicates neutral, a value smaller than 7 represents acidity, and a value larger than 7 denotes alkalinity. It is very difficult to control pH with a quickly changing reaction rate at a point near 7.

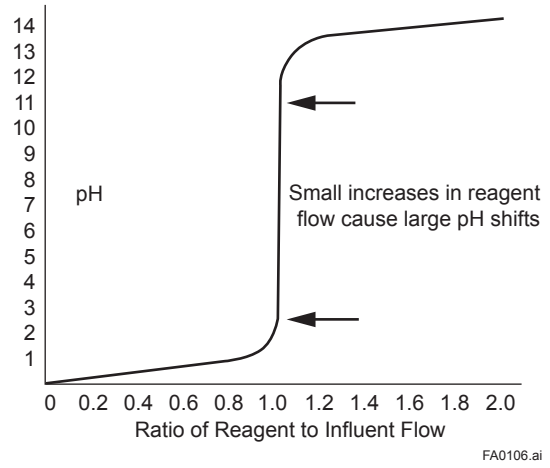


Figure A1.6 pH and Reagent Flow

To control this pH, the input is regulated using line-segment approximation, gain, and input compensation.

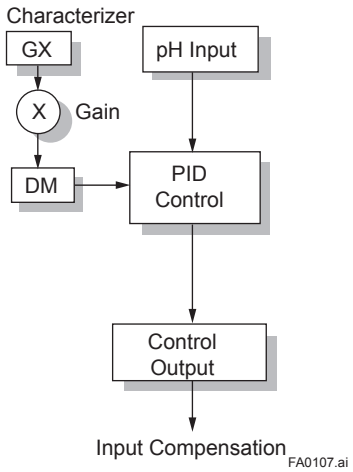


Figure A1.7 Input Compensation

The following shows the approximation-value graph of GX Output that is approximation-value output and GX Input that is pH input. pH with a quickly changing reaction rate can be controlled at a point near neutral 7 according to the following graph.

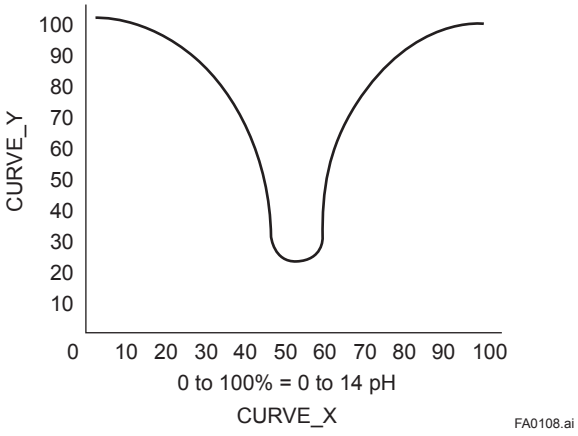


Figure A1.8 Approximation Curve

A1.5.2 Calorie Flow Compensation

AI_1: Inlet temperature, AI_2: Outlet temperature, AI_3: Flow rate
SC: Corrects the inlet and outlet temperatures.
AR: Calculates a calorie flow rate on the basis of the difference between the corrected inlet and outlet temperatures.

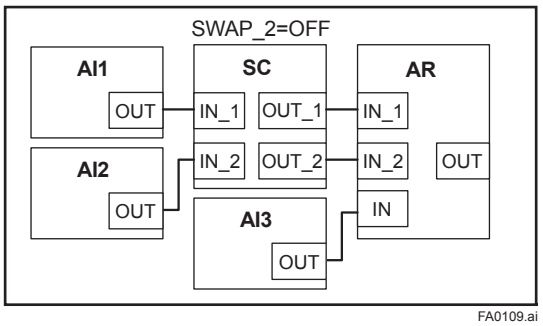


Figure A1.9 Calorie Flow Rate Compensation (SWAP_2 = Off)

A1.5.3 Backward Control

SC: The controlled variable output from PID is converted into an information quantity that can be interpreted by AO, and backward information from AO is converted into an information quantity that can be interpreted by PID before being transmitted to the PID.

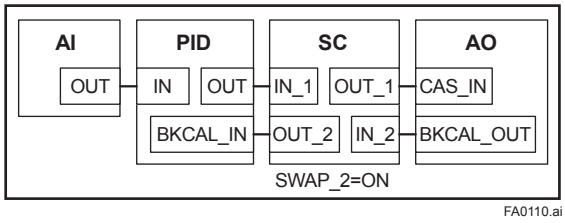


Figure A1.10 Backward Control (SWAP_2 = On)

To enable backward control (which inverts the X and Y axes), the line-segment function must be set so that the elements of the curve increase in a monotone manner.(As shown in Figure A1.11) If they do not increase in a monotone manner, the mode changes to O/S, disabling calculation.

No.	CURVE_X	CURVE_Y
1	5	5
2	10	10
3	15	11
4	20	20
5	25	25
6	30	26
7	35	30
8	40	40
9	45	45
10	50	50
11	51	51
12	52	54
13	53	59
14	54	66
15	55	75
16	65	80
17	75	81
18	80	85
19	85	86
20	90	90
21	95	95

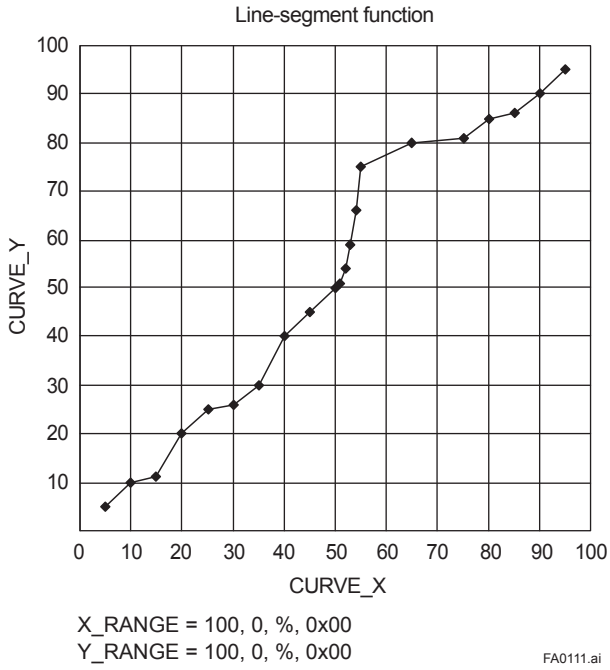


Figure A1.11 Setting Example of a Line-segment Function

Appendix 2. Integrator (IT) Block

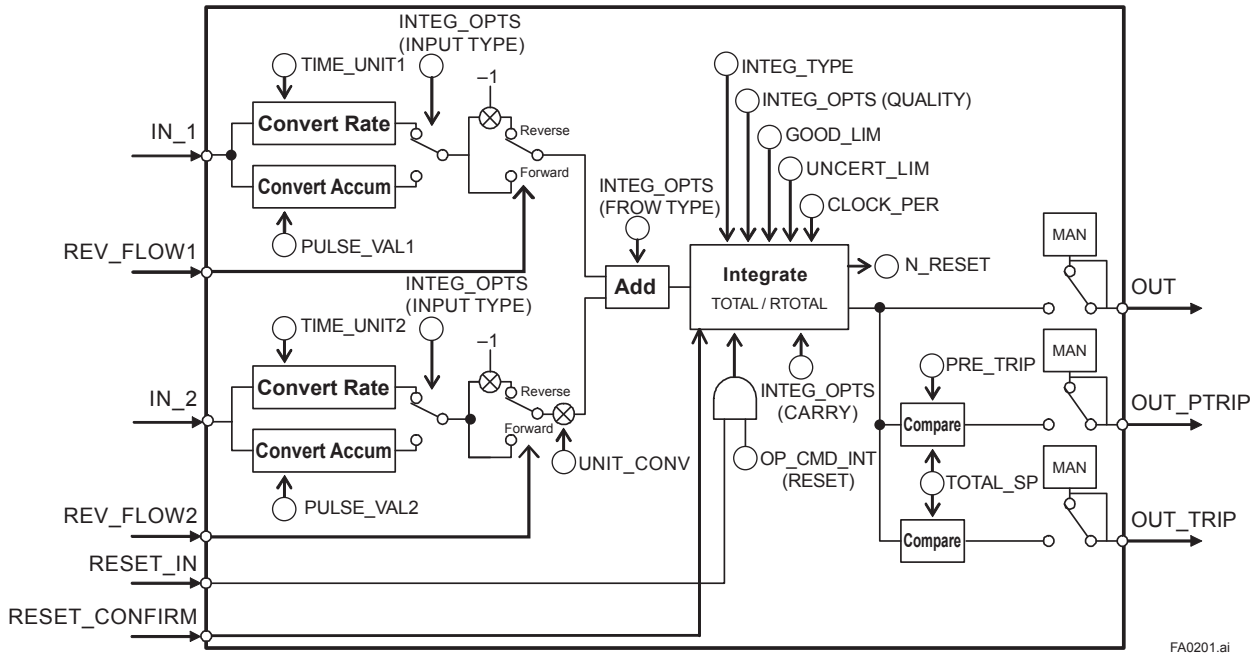
The Integrator (IT) block adds two main inputs and integrates them for output. The block compares the integrated or accumulated value to TOTAL_SP and PRE_TRIP and generates discrete output signals OUT_TRIP or OUT_PTRIP when the limits are reached.

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

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

A2.1 Schematic Diagram of Integrator Block

The following shows the schematic diagram of the Integrator block.



IN_1: Block input 1 (value and status)
IN_2: Block input 2 (value and status)
REV_FLOW1: Indicates whether the sign of IN_1 is reversed. It is a discrete signal.
REV_FLOW2: Indicates whether the sign of IN_2 is reversed. It is a discrete signal.
RESET_IN: Resets the integrated values. It is a discrete signal.
RESET_CONFIRM: Reset confirmation input. It is a discrete signal.
OUT: Block output (value and status)
OUT_PTRIP: Set if the target value exceeds PRE_TRIP. It is a discrete signal.
OUT_TRIP: Set if the target value exceeds TOTAL_SP (or 0). It is a discrete signal.
The Integrator block is classified into the following five sections for each function:

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

Figure A2.1 Integrator Block

A2.2 Input Process Section

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

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

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

A2.2.1 Determining Input Value Statuses

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

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

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

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

A2.2.2 Converting the Rate

The following describes an example of rate conversion.

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

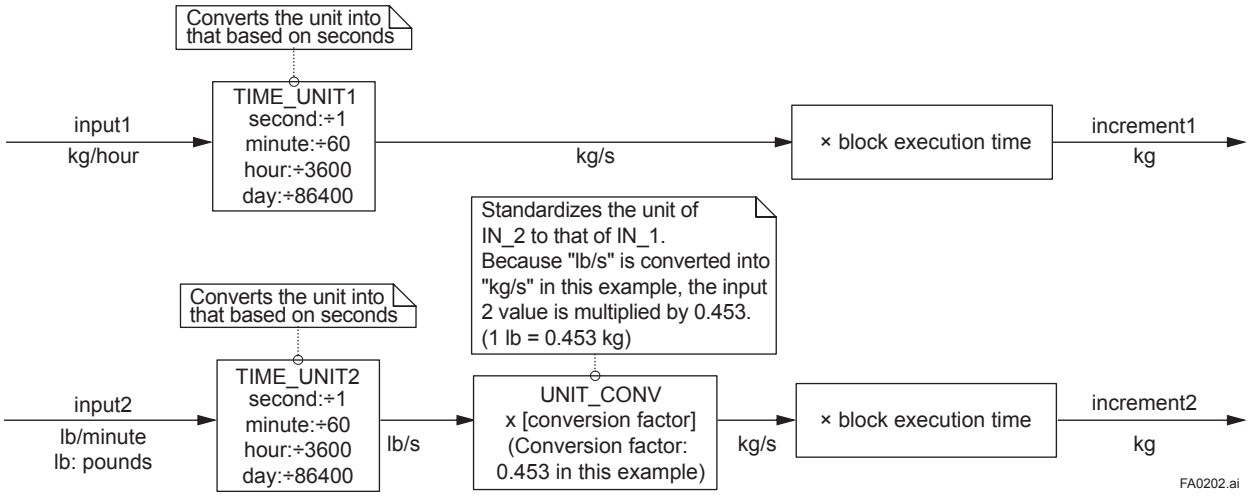


Figure A2.2 Increment Calculation with Rate Input

A2.2.3 Converting Accumulation

This following describes an example of accumulation conversion.

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

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

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

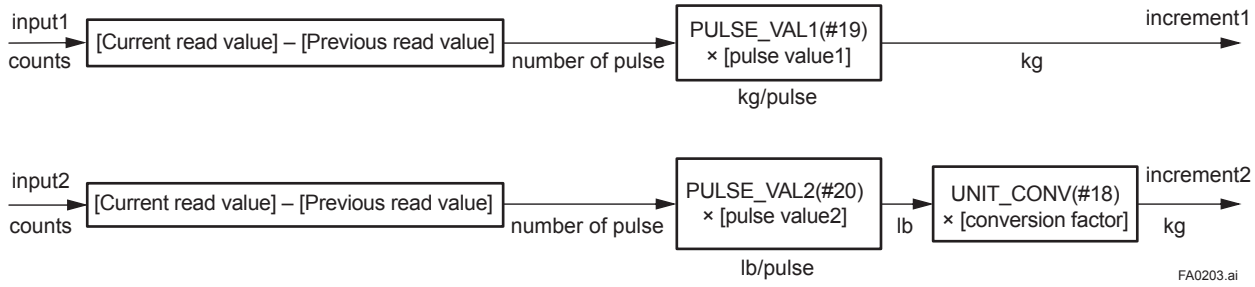


Figure A2.3 Increment Calculation with Counter Input

A2.2.4 Determining the Input Flow Direction

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

In input processing, the sign of the value after rate and accumulation conversion is reversed if the REV_ FLOW1 and REV_FLOW2 parameters are set to REVERSE. When determination of the flow direction of two input values is complete, these two inputs are passed to the adder. The settings in REV_FLOW will be retained even if the power is turned OFF.

A2.3 Adder

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

A2.3.1 Status of Value after Addition

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

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

A2.3.2 Addition

The following three options are available for addition:

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

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

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

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

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

A2.4 Integrator

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

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

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

Each type of integration is independently run as a function.

There are the following four types of integrated values:

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

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

The table A2.1 shows the details of INTEG_TYPE.

Table A2.1 INTEG_TYPE

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

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

A2.5 Output Process

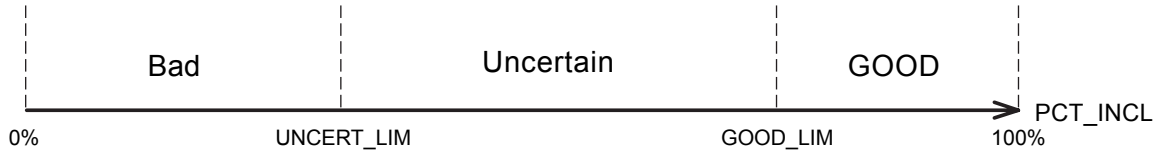
There are the following three output parameters:

1. OUT
2. OUT_TRIP
3. OUT_PTRIP

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

A2.5.1 Status Determination

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



PCT_INCL=100×(1 - (msp of RTotal)/(msp of ATotal))

msp of RTotal: RTotal value that is converted into a short floating-point number
msp of ATotal: ATotal value that is converted into a short floating-point number
RTotal: Integrated value of the absolute values of the increments whose status is bad
ATotal: Integrated value of the absolute values of the increments regardless of the output status

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

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

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

UNCERT_LIM, and GOOD_LIM.

- PCT_INCL ≥ GOOD_LIM
  ⇨ Good
- UNCERT_LIM ≤ PCT_INCL < GOOD_LIM
  ⇨ Uncertain
- PCT_INCL < UNCERT_LIM
  ⇨ Bad

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

A2.5.2 Determining the Output Value

The value of OUT.Value is determined as follows:

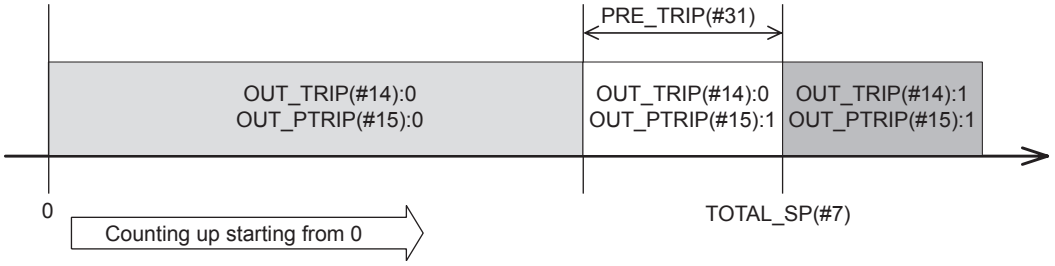
- For counting up
  OUT = integration start value (0) + Total
- For counting down
  OUT = integration start value (TOTAL_SP) _ Total

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

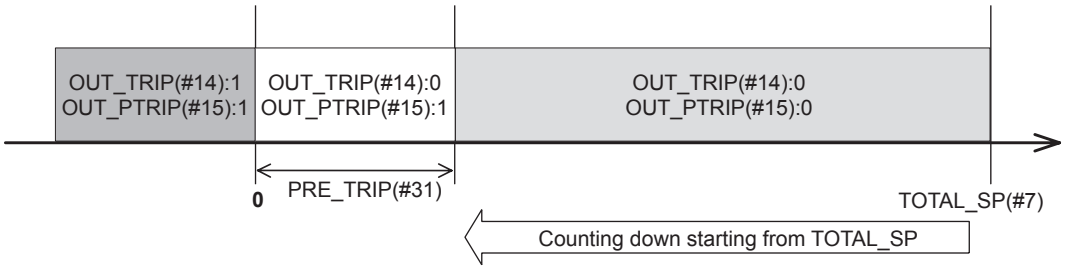
If OUT is rewritten in the MAN mode, integration starts with the value rewritten in MAN mode after the mode was returned to AUTO.

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

• For counting up



• For counting down



FA0205.ai

For counting up, the OUT value is as follows:

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

For counting down, the OUT value is as follows:

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

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

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

A2.5.3 Mode Handling

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

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

A2.6 Reset

A2.6.1 Reset Trigger

There are the following five types of reset triggers:

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

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

Table A2.2 RESET Triggers

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

When OP_CMD_INT has become "H" and a reset was made, OP_CMD_INT automatically returns to "L."
Even if RESET_IN becomes "H," activating a reset, RESET_IN does not automatically return to "L."
The RESET_IN setting will not be retained if the power is turned OFF.

A2.6.2 Reset Timing

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

- **5-second rule**

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

- **CLOCK_PER**

If INTEG_TYPE is PERIODIC (5) or PER&DEM (7), a reset is made at the period (sec) set to the CLOCK_PER parameter.
If the value in CLOCK_PER is smaller than the function block's execution period, bit 1 of BLOCK_ERR "Block Configuration Error" is set.

A2.6.3 Reset Process

The basic reset process sequence is as follows:

1.) Snapshot

2.) Clearing the integrated values

3.) Reset count increment

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

1.) Snapshot

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

STOTAL = Total
SRTOTAL = RTotal
SSP = TOTAL_SP

2.) Clearing the integrated values

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

Total = 0
ATotal = 0
RTotal = 0

3.) Reset count increment

Each time a reset is made, the N_RESET parameter will be incremented.
The high limit is 999,999, and if this limit is exceeded, the count returns to "0."

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

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

There are two options relating to a reset:

i Confirm reset (bit 8 of INTEG_OPTS)
ii Carry (bit 6 of INTEG_OPTS)

i Confirm reset (bit 8 of INTEG_OPTS)
If this option is enabled, the next reset is rejected until "1" is set to RESET_CONFIRM.

ii Carry (bit 6 of INTEG_OPTS)
If this option is enabled while INTEG_TYPE is UP_AUTO or DN_AUTO, the value exceeding the threshold at a reset will be carried into the next integration.
If INTEG_TYPE is any setting other than UP_AUTO or DN_AUTO, this option is irrelevant.

A2.7 List of Integrator Block Parameters

Index	Parameter Name	Initial Value	Write Mode	View				Definition
				1	2	3	4	
0	BLOCK_ HEADER	TAG:“IT”	Block Tag=O/S					Information relating to this function block, such as block tag, DD revision, execution time
1	ST_REV	0	---	2	2	2	2	The revision level of the set parameters associated with the Integrator block
2	TAG_DESC	Space (32 characters)						Stores comments describing tag information.
3	STRATEGY	1					2	The strategy field is used by a high-level system to identify the function block.
4	ALERT_KEY	1					1	Key information used to identify the location at which an alert occurred
5	MODE_BLK			4		4		Integrator block mode. O/S, MAN, and AUTO are supported.
6	BLOCK_ERR		---	2		2		Indicates the active error conditions associated with the function block in bit strings.
7	TOTAL_SP	1000000.0		4		4		The setpoint of an integrated value or a start value for counting down
8	OUT		MAN	5		5		The block output
9	OUT_RANGE	1000000.0 0.0 m3 (1034) 0			11			Set scaling for output display. This does not affect operation of the function block. It is used for making memos.
10	GRANT_DENY	0			2			The parameter for checking if various operations have been executed
11	STATUS_ OPTS	0	O/S				2	Allows you to select a status-related option. The Integrator block uses "Uncertain if Man mode" only.
12	IN_1	0.0		5		5		Inputs flow (Rate, Accum) signals from the AI block or PI block.
13	IN_2	0.0		5		5		
14	OUT_TRIP	0		2		2		An output parameter informing the user that the integrated value has exceeded the setpoint
15	OUT_PTRIP	0		2		2		An output parameter informing the user that the integrated value is reaching the setpoint
16	TIME_UNIT1	second (1)	MAN		1			Set the time unit of the rate (kg/s, lb/min, kg/h ... etc.) of the corresponding IN.
17	TIME_UNIT2	second (1)	MAN		1			
18	UNIT_CONV	1.0					4	Specify the unit conversion factor for standardizing the unit of IN_2 into that of IN_1.
19	PULSE_VAL1	1.0	MAN				4	Set the factor for converting the number of pulses for the corresponding IN into an appropriate engineering unit.
20	PULSE_VAL2	1.0	MAN				4	
21	REV_FLOW1	0		2		2		Selector switch used to specify the fluid flow direction (forward/reverse) with respect to the corresponding IN
22	REV_FLOW2	0		2		2		
23	RESET_IN	0		2		2		The parameter that receives a reset request from an external block to reset the integrated values
24	STOTAL	0.0				4		Indicates the snapshot of OUT just before a reset.
25	RTOTAL	0.0	MAN	4		4		Indicates the integrated value of the absolute values of the increments if the input status is "Bad."
26	SRTOTAL	0.0				4		Indicates the snapshot of RTOTAL just before a reset.
27	SSP	0.0				4		Indicates the snapshot of TOTAL_SP just before a reset.

<table>
<tr><th rowspan="2">Index</th><th rowspan="2">Parameter Name</th><th rowspan="2">Initial Value</th><th rowspan="2">Write Mode</th><th colspan="4">View</th><th rowspan="2">Definition</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>28</td><td>INTEG_TYPE</td><td>UP_
AUTO(1)</td><td></td><td></td><td></td><td></td><td>1</td><td>Integration Type Setting
<table>
<tr><th>Value</th><th>Name</th><th>Description</th></tr>
<tr><td>1</td><td>UP_AUTO</td><td>Counts up and is automatically reset when TOTAL_SP is reached.</td></tr>
<tr><td>2</td><td>UP_DEM</td><td>Counts up and is reset as demanded.</td></tr>
<tr><td>3</td><td>DN_AUTO</td><td>Counts down and is automatically reset when "0" is reached.</td></tr>
<tr><td>4</td><td>DN_DEM</td><td>Counts down and is reset as demanded.</td></tr>
<tr><td>5</td><td>PERIODIC</td><td>Counts up and is reset at periods specified in CLOCK_PER.</td></tr>
<tr><td>6</td><td>DEMAND</td><td>Counts up and is reset as demanded.</td></tr>
<tr><td>7</td><td>PER&DEM</td><td>Reset periodically or as demanded.</td></tr>
</table></td></tr>
<tr><td>29</td><td>INTEG_OPTS</td><td>0×0004</td><td></td><td></td><td></td><td></td><td>2</td><td>Specifies an integration optional function.
<table>
<tr><th>bit</th><th>Option Name</th><th>Description</th></tr>
<tr><td>0</td><td>Input 1 accumulate</td><td>Selects Rate or Accum input of IN_1.</td></tr>
<tr><td>1</td><td>Input 2 accumulate</td><td>Selects Rate or Accum input of IN_2.</td></tr>
<tr><td>2</td><td>Flow forward</td><td>Integrates forward flow (interprets reverse flow as zero).*</td></tr>
<tr><td>3</td><td>Flow reverse</td><td>Integrates reverse flow (interprets forward flow as zero).*</td></tr>
<tr><td>4</td><td>Use uncertain</td><td>Uses an input value of IN_1 or IN_2 whose status is "Uncertain" regarding it as a value of "Good."</td></tr>
<tr><td>5</td><td>Use bad</td><td>Uses an input value of IN_1 or IN_2 whose status is "Bad" regarding it as a value of "Good."</td></tr>
<tr><td>6</td><td>Carry</td><td>Carries over an excess exceeding the threshold at reset to the next integration. (Note that this does not apply to UP_AUTO or DN_AUTO.)</td></tr>
<tr><td>7</td><td>Add zero if bad</td><td>Interprets an increment as zero if the status of the increment is "Bad."</td></tr>
<tr><td>8</td><td>Confirm reset</td><td>After a reset, rejects the next reset until "Confirm" is set to RESET_CONFIRM.</td></tr>
<tr><td>9 to 15</td><td>Reserved</td><td></td></tr>
</table>
* If both forward and reverse flows are enabled or disabled, both forward and reverse flows are integrated.</td></tr>
<tr><td>30</td><td>CLOCK_PER</td><td>86400.0
[s]</td><td></td><td></td><td></td><td></td><td>4</td><td>Specify the period at which a periodic reset is made.</td></tr>
<tr><td>31</td><td>PRE_TRIP</td><td>100000.0</td><td></td><td></td><td></td><td></td><td>4</td><td>Set an allowance applied before an integrated value exceeds the setpoint.</td></tr>
<tr><td>32</td><td>N_RESET</td><td>0.0</td><td></td><td>4</td><td></td><td>4</td><td></td><td>Indicates the number of resets in the range of 0 to 999999.</td></tr>
<tr><td>33</td><td>PCT_INCL</td><td>0.0[%]</td><td></td><td>4</td><td></td><td>4</td><td></td><td>The ratio of "the integrated values of the absolute values of the increments whose status is Good" to the "integrated values of the absolute values of the increments irrelevant to the status" (Equation).</td></tr>
<tr><td>34</td><td>GOOD_LIM</td><td>0.0[%]</td><td></td><td></td><td></td><td></td><td>4</td><td>The threshold value of the ratio of "the integrated values of the increments whose status is Good" to all integrated values in which the status of OUT is "Good".</td></tr>
<tr><td>35</td><td>UNCERT_LIM</td><td>0.0[%]</td><td></td><td></td><td></td><td></td><td>4</td><td>The threshold value of the ratio of "the integrated values of the increments whose status is Good" to all the integrated values in which the status of OUT is "Uncertain".</td></tr>
<tr><td>36</td><td>OP_CMD_INT</td><td>0</td><td></td><td>1</td><td></td><td>1</td><td></td><td>Operator command that resets integrated values.</td></tr>
<tr><td>37</td><td>OUTAGE_LIM</td><td>0.0</td><td></td><td></td><td></td><td></td><td>4</td><td>Maximum time for which values can be retained in the event of power failure.
It does not effect the block operation.</td></tr>
<tr><td>38</td><td>RESET_
CONFIRM</td><td>0</td><td></td><td>2</td><td></td><td>2</td><td></td><td>Reset confirmation input, which is enabled when the Confirm reset option of INTEG_OPTS is chosen</td></tr>
<tr><td>39</td><td>UPDATE_EVT</td><td>---</td><td></td><td></td><td></td><td></td><td></td><td>Indicates event information if an update event occurs.</td></tr>
<tr><td>40</td><td>BLOCK_ALM</td><td>---</td><td></td><td></td><td></td><td></td><td></td><td>Indicates alarm information if a block alarm occurs.</td></tr>
<tr><td>41</td><td>ACCUM_
TOTAL</td><td>0.0</td><td></td><td></td><td></td><td>4</td><td></td><td>Accumulated integrated values (no extension parameter is reset)</td></tr>
</table>

Appendix 3. Input Selector (IS) Block

The function of the Input Selector (IS) block is to automatically select one signal from multiple input signals using a specified selection method.

The IS block is used for selective control in which one measured quantity is selected from multiple measured quantities to be transmitted to the controller as a controlled variable. This feature is primarily used for temperature control systems.

A3.1 Input Selector Function Block Schematic

The following shows the Input Selector function block schematic.

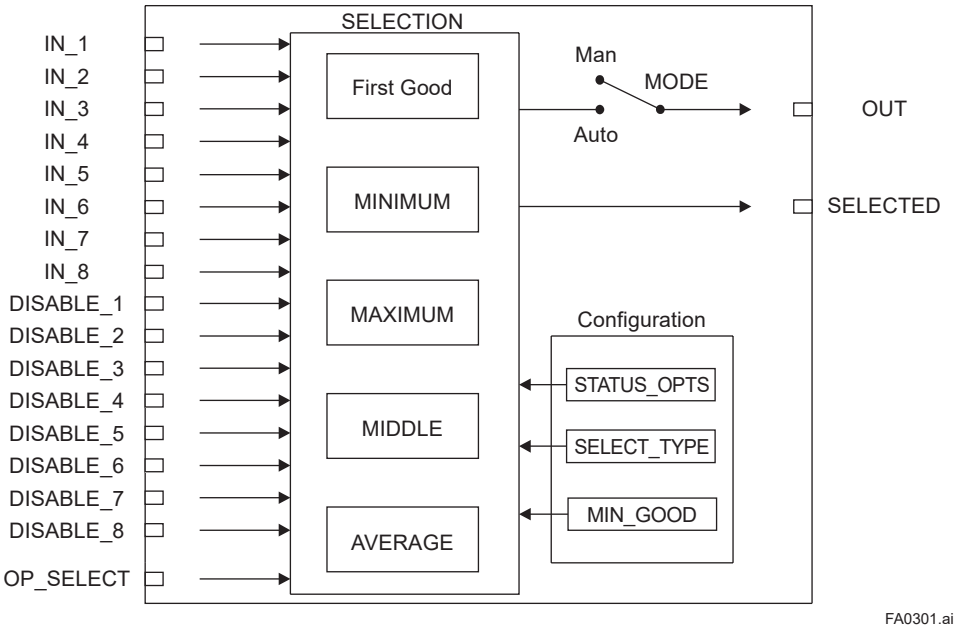


Figure A3.1 IS Block

Input Parameters (Input Terms)

IN_1 : Block input 1
IN_2 : Block input 2
IN_3 : Block input 3
IN_4 : Block input 4
IN_5 : Block input 5
IN_6 : Block input 6
IN_7 : Block input 7
IN_8 : Block input 8
DISABLE_1 : Selector switch 1 to disable input 1 from being selected
DISABLE_2 : Selector switch 2 to disable input 2 from being selected
DISABLE_3 : Selector switch 3 to disable input 3 from being selected
DISABLE_4 : Selector switch 4 to disable input 4 from being selected
DISABLE_5 : Selector switch 5 to disable input 5 from being selected
DISABLE_6 : Selector switch 6 to disable input 6 from being selected
DISABLE_7 : Selector switch 7 to disable input 7 from being selected
DISABLE_8 : Selector switch 8 to disable input 8 from being selected
OP_SELECT : A parameter which can be set by an operator to forcibly employ the input of the selected number

Output Parameters (Computation or Selection Results)

OUT : Block output
SELECTED : Indicates the input number selected using the alternatives.

Other Parameters

OUT_RANGE : Sets the OUT range.
STATUS_OPTS : Option used to specify the handling of various statuses.
SELECT_TYPE : Determines the input selection algorithm.
MIN_GOOD : Parameter specifying the minimum required number of inputs with “good” status. If the number of inputs that are “good” is less than the value of MIN_GOOD, input selection is canceled.

Mode

O/S : Allows configuration change, but disables input value output.
Man : Allows internal processing, but the output value may vary depending on the definition of usage conditions.
Auto : Outputs the input value.

The Input Selector (IS) block offers a maximum of eight input alternatives and generates the output according to the configured action. This block generally receives inputs from the Analog Input (AI) function block. The function of the IS block is to select a maximum, minimum, middle, average, “first good,” or “latched good” signal. The block combines parameter configuration (DISABLE_n) and option (“first good”) to give priority to alternative(s) or to function as a rotary position switch. When used as a rotary position switch, the block can receive operator inputs or switch information from connected inputs.

The IS block supports the concept of middle selection. This function outputs the average of two middle signals if even multiple valid signals are configured or a middle signal if odd multiple valid signals are configured. Application of the block is to supply a selected control signal in the forward path.

The SELECTED parameter is the 2nd output indicating which input has been selected using the algorithm.

A3.2 Input Section

A3.2.1 Mode Handling

The Input Selector block's operations are determined by the mode (parameter name: MODE_BLK). The following describes operations in each mode.

Supported Mode	Role
O/S (Out of Service)	· System-stopped status. · Allows you to make changes to configuration.
Man	· If you do not want to output the value and status from IN or if the value or status thus output is not preferable, you can manually transmit the value to OUT.
Auto	· Automatic system operation status.

Valid Input

When the following conditions are satisfied, the value of IN_n becomes valid.

1) The QUALITY in each status of IN_n is either Good (NC), Good (C), or Uncertain*1, 3.
2) The values of DISABLE_n corresponding to each IN_n are OFF and the QUALITY in the status of which is either Good (NC), Good (C), or Uncertain*1, 2.
3) The number of inputs that are "good" is greater than the value of MIN_GOOD*4.

Note:

*1: Uncertain is applicable when "Use Uncertain as Good" is selected in the STATUS_OPTS parameter.

*2: If the status of DISABLE_n is Bad or Uncertain, its quality is lower so that the status of IN_n is also defined as lower quality. When DISABLE_n is ON, the value of IN_n becomes invalid. For the priority of DISABLE_n is higher than that of IN_n.

Status in SELECT_TYPE except OP_SELECT

QUALITY of DISABLE / IN Status	IN
Good (NC)	Valid
Good (C)	Valid
Uncertain*1	Valid
Uncertain	Invalid
Bad	Invalid

Condition: The number of inputs that are "good" is greater than the value of MIN_GOOD.

*3: Priority of IN_n when the same value is input.

Priority 1:Highest 8:Lowest	Input
1	IN_1
2	IN_2
3	IN_3
4	IN_4
5	IN_5
6	IN_6
7	IN_7
8	IN_8

*4: Refer to A3.2.2 for the details of MIN_GOOD.

A3.2.2 MIN_GOOD Handling

If there is no selectable input or if the number of selectable inputs is less than the value of MIN_GOOD, SELECTED becomes “0.”

A case where the number of valid INs is less than the value of MIN_GOOD:

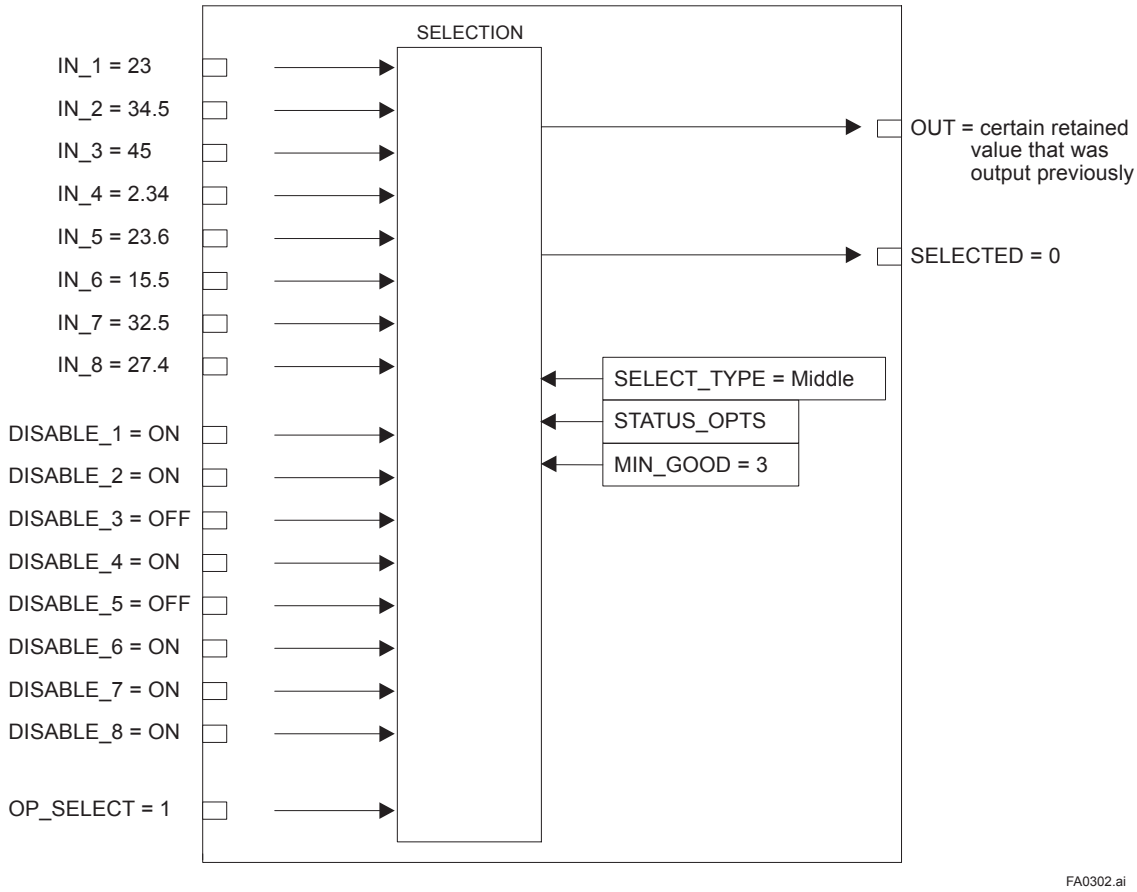


Figure A3.2 Example (1)

This example restricts the valid inputs using DISABLE_n, and the inputs are enabled only at DISABLE_3 and DISABLE_5. Because the effective number of MIN_GOOD is 3, the input specified by OP_SELECT will not be output.

A3.3 Selection

The following processing is performed after completing input processing. If the number of valid inputs is less than the value of MIN_GOOD, no input selection is made.

A3.3.1 OP_SELECT Handling

When a value other than “0” (that is, 1 to 8) is selected for OP_SELECT:

The IS block selects the input of the number specified by OP_SELECT regardless of the setting of SELECT_TYPE, propagates the value of that input to OUT, and transmits the input number to SELECTED.

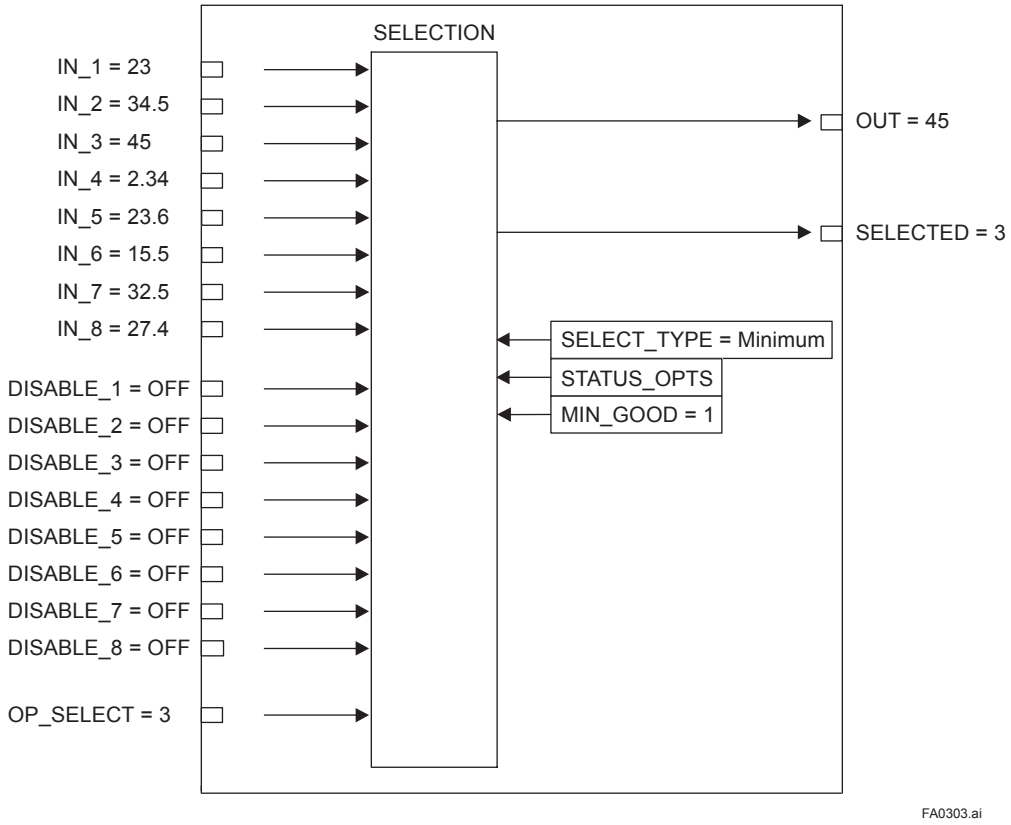


Figure A3.3 Example (2)

In the above example, SELECT_TYPE is set to Minimum. However, because OP_SELECT specifies the value and number of IN_3, the value and number of this specified IN are transmitted to OUT and SELECTED.

* Note: Even if the IN specified by OP_SELECT is an invalid input (the corresponding DISABLE parameter is ON or the IN’s status is “bad”), the value and status of that IN are transmitted to OUT.

A3.3.2 SELECTION Handling

If the value of OP_SELECT is “0,” input selection using SELECT_TYPE is enabled.

When SELECT TYPE is “first good”

The IS block selects the input with the smallest input number among valid inputs and transmits the value of that input to OUT. The number of the selected input is transmitted to SELECTED.

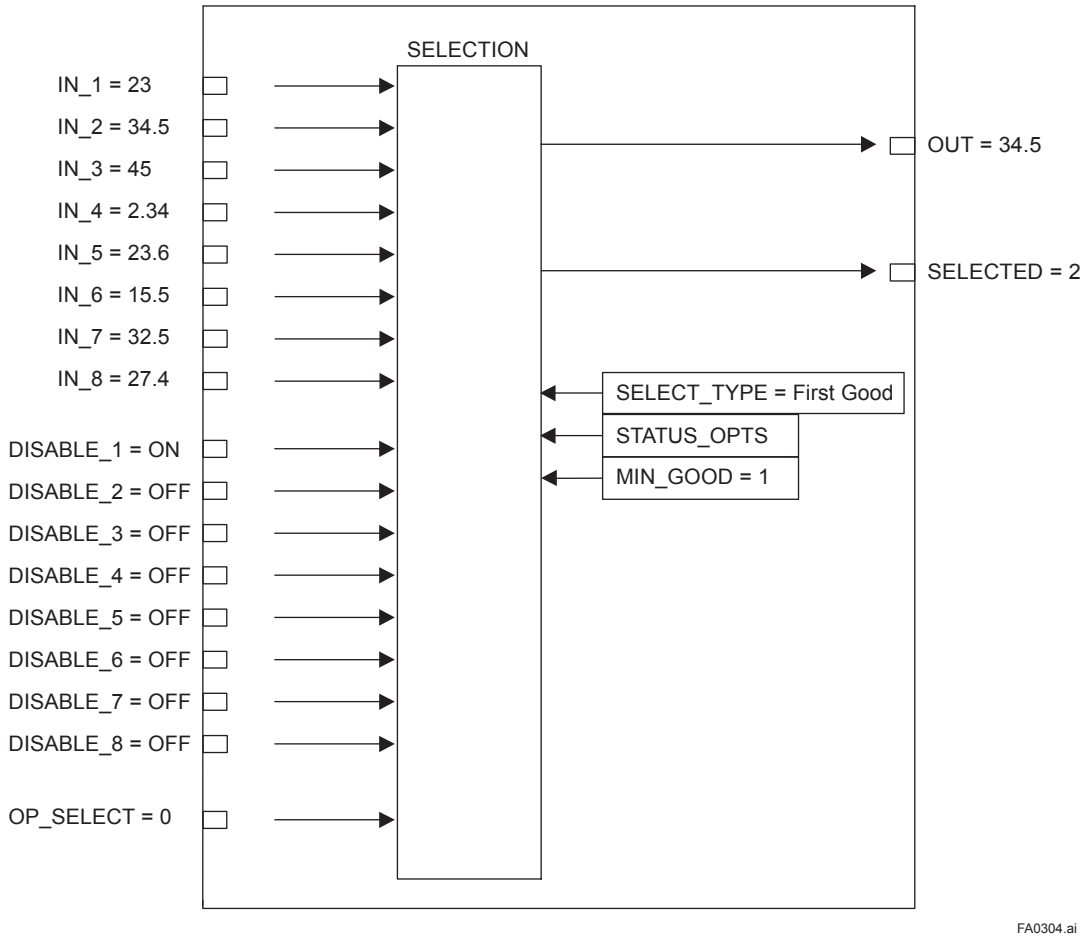


Figure A3.4 Example (3)

Because DISABLE_1 is ON, IN_1 is disabled, and IN_2 is selected for output. If DISABLE_1 is turned OFF, the output changes from IN_2 to IN_1. That is, the valid IN with the smaller input number is always selected for output.

When SELECT TYPE is “Minimum”

The IS block selects the input with the minimum value among valid inputs and transmits the value of that input to OUT. The number of the selected input is transmitted to SELECTED.

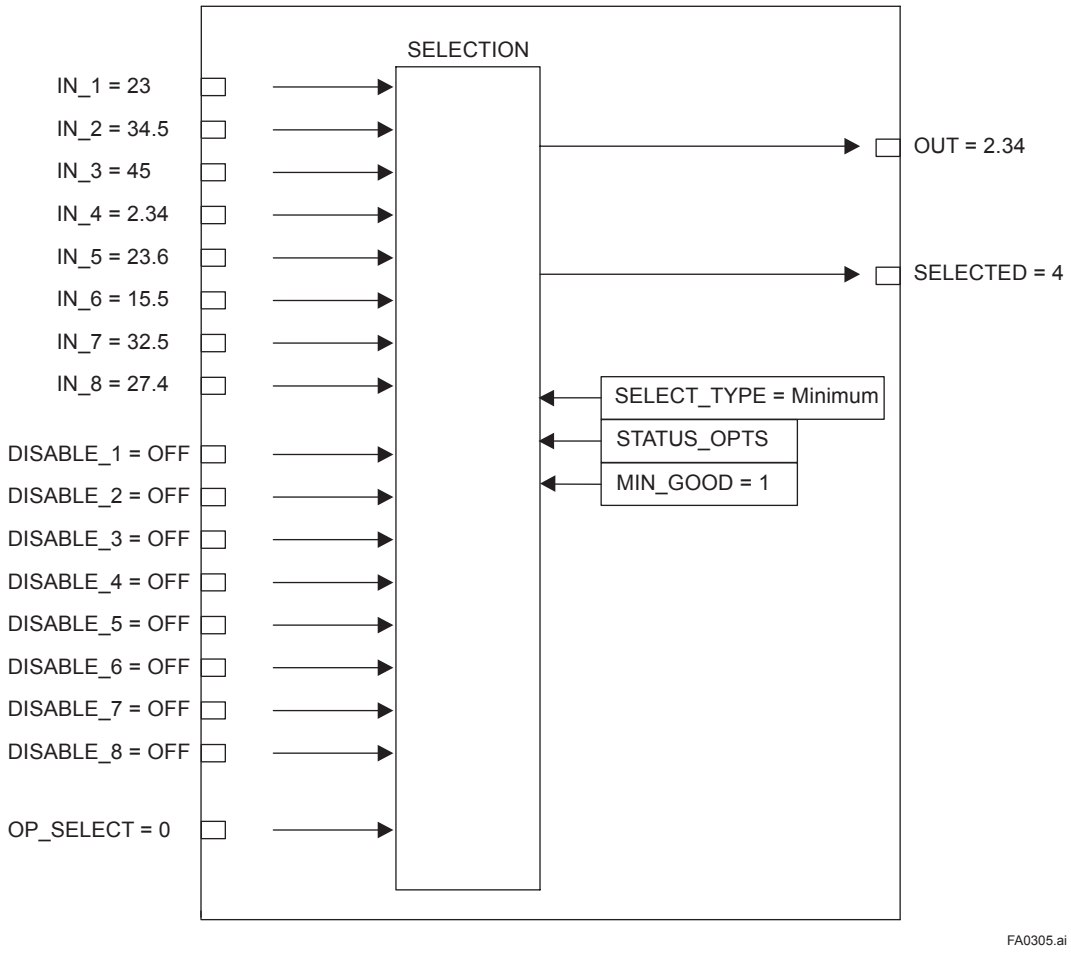


Figure A3.5 Example (4)

When SELECT TYPE is “Maximum”

The IS block selects the input with the maximum value among valid inputs and transmits the value of that input to OUT. The number of the selected input is transmitted to SELECTED.

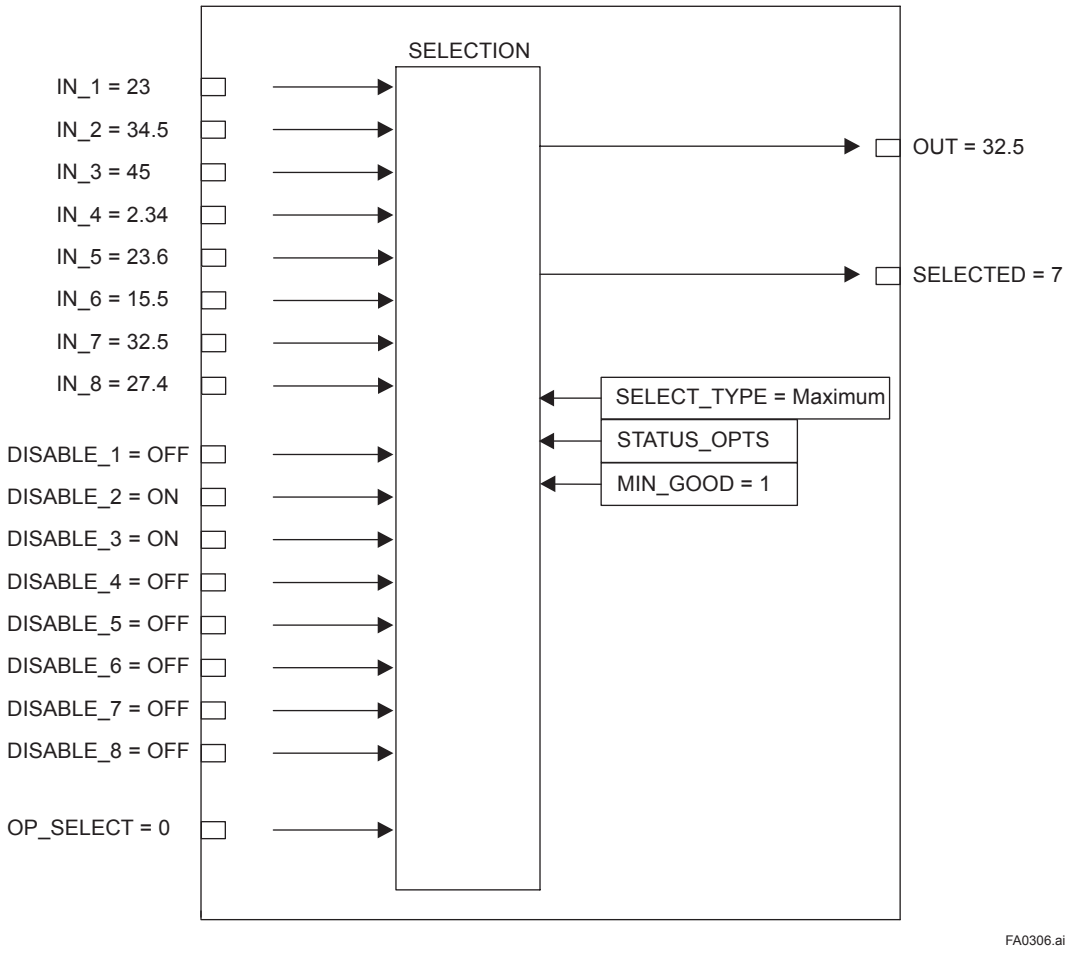


Figure A3.6 Example (5)

Because DISABLE_2 and DISABLE_3 are ON, IN_2 and IN_3 are disabled, and the IN with the maximum value among the remaining IN_n is selected for output. In the above example, since IN_7 has the maximum value among the remaining valid INs, it is output.

When SELECT TYPE is “Middle”

If there is more than one valid input and the number of such input is an odd number, the value of the middle input will be transmitted to OUT. If there is an even number of valid inputs, the average of the middle two inputs is transmitted to OUT. If the average is used for OUT, the block transmits “0” to SELECTED, while it transmits the number of the input used for the middle for other cases. If the number of valid inputs is 1, it is irrelevant to selection by “Middle” selector action. The following shows an example of selection by “Middle” selector action.

If there is an even number of valid inputs:

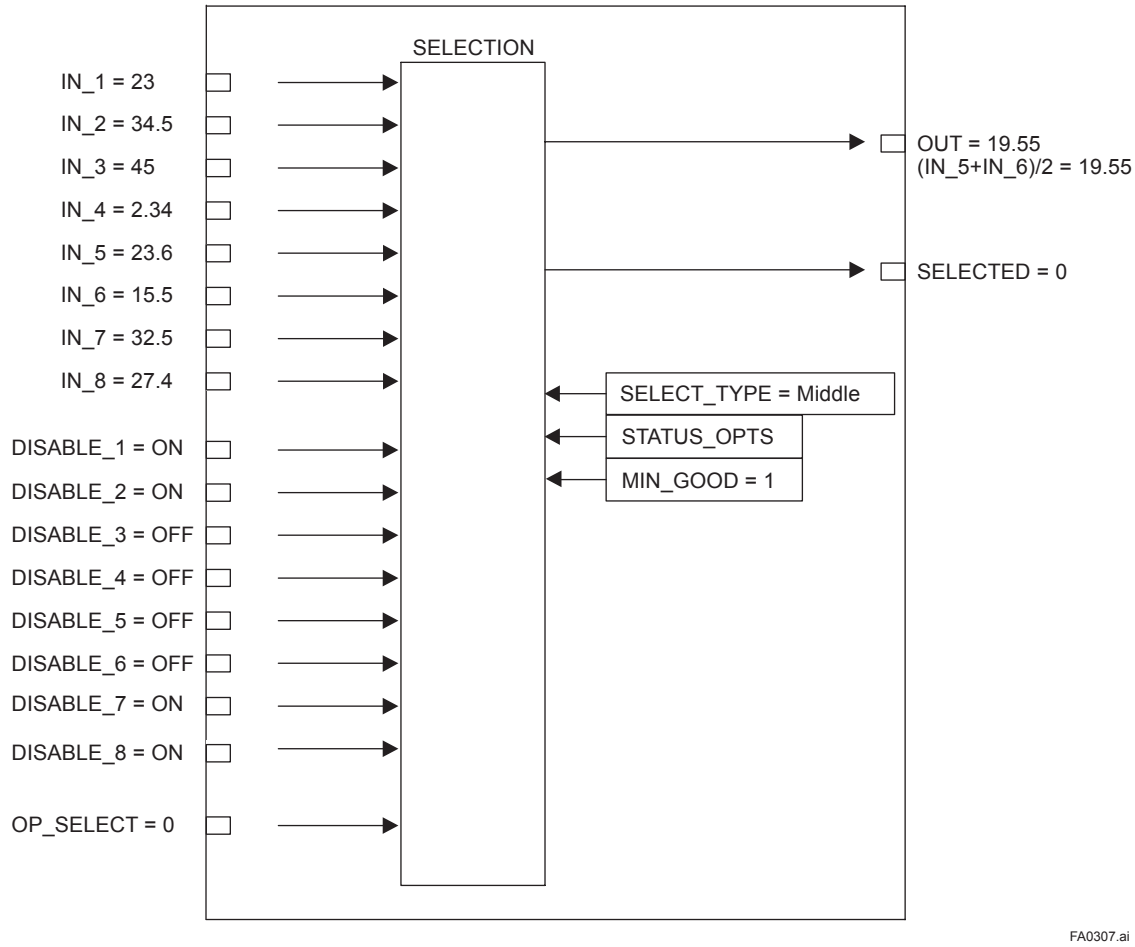


Figure A3.7 Example (6)

Because DISABLE_1, DISABLE_2, DISABLE_7, and DISABLE_8 are ON, the corresponding IN_1, IN_2, IN_7, and IN_8 are disabled and the remaining four INs are enabled. Furthermore, because IN_3 has the maximum value and IN_4 has the minimum value among the valid INs, they are not selected and the average of IN_5 and IN_6 inputs is output. When the average is selected for OUT, SELECTED is set to “0.”

If there is an odd number of valid inputs:

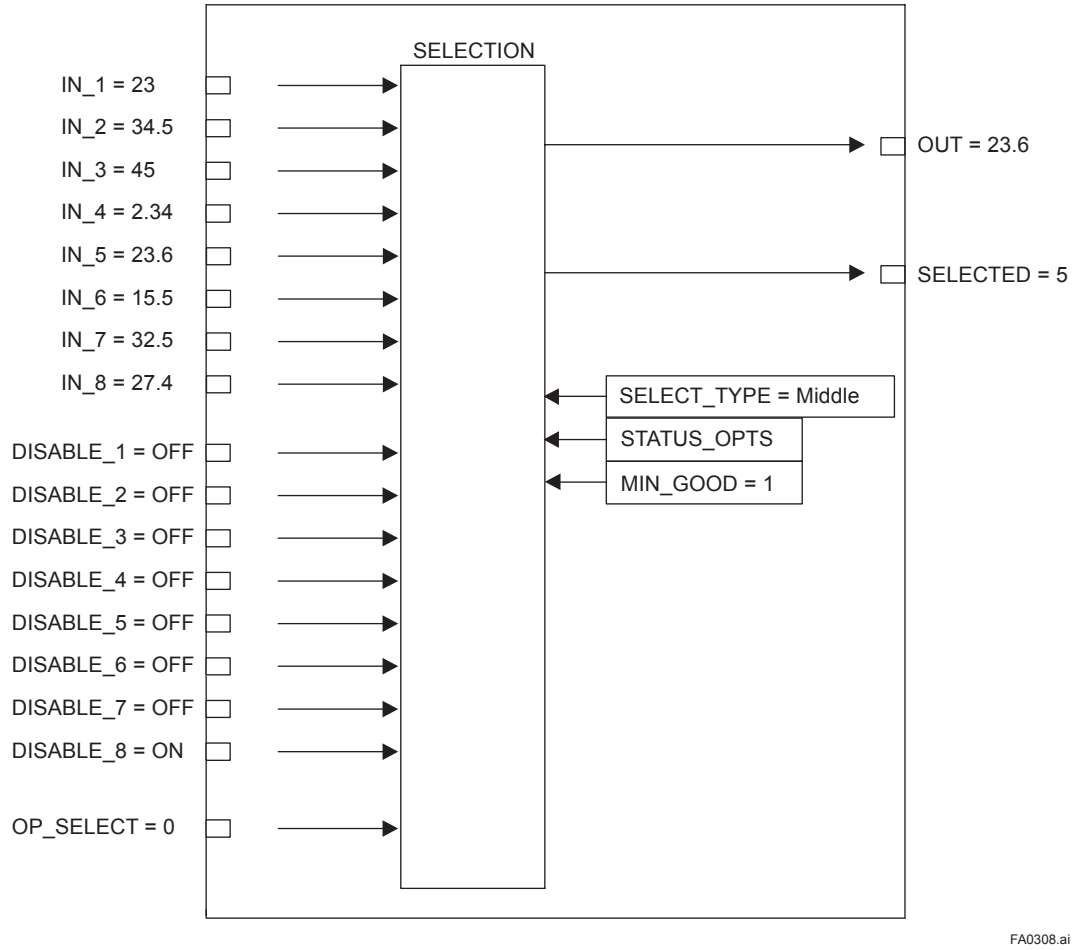


Figure A3.8 Example (7)

If the number of valid INs is an odd multiple, the IN with the middle value will be output. In the above example, the IN_5 input having the middle value is output.

When SELECT TYPE is “Average”

The block calculates the average of the valid inputs and transmits it to OUT. The number of inputs used to calculate its value is indicated in SELECTED.

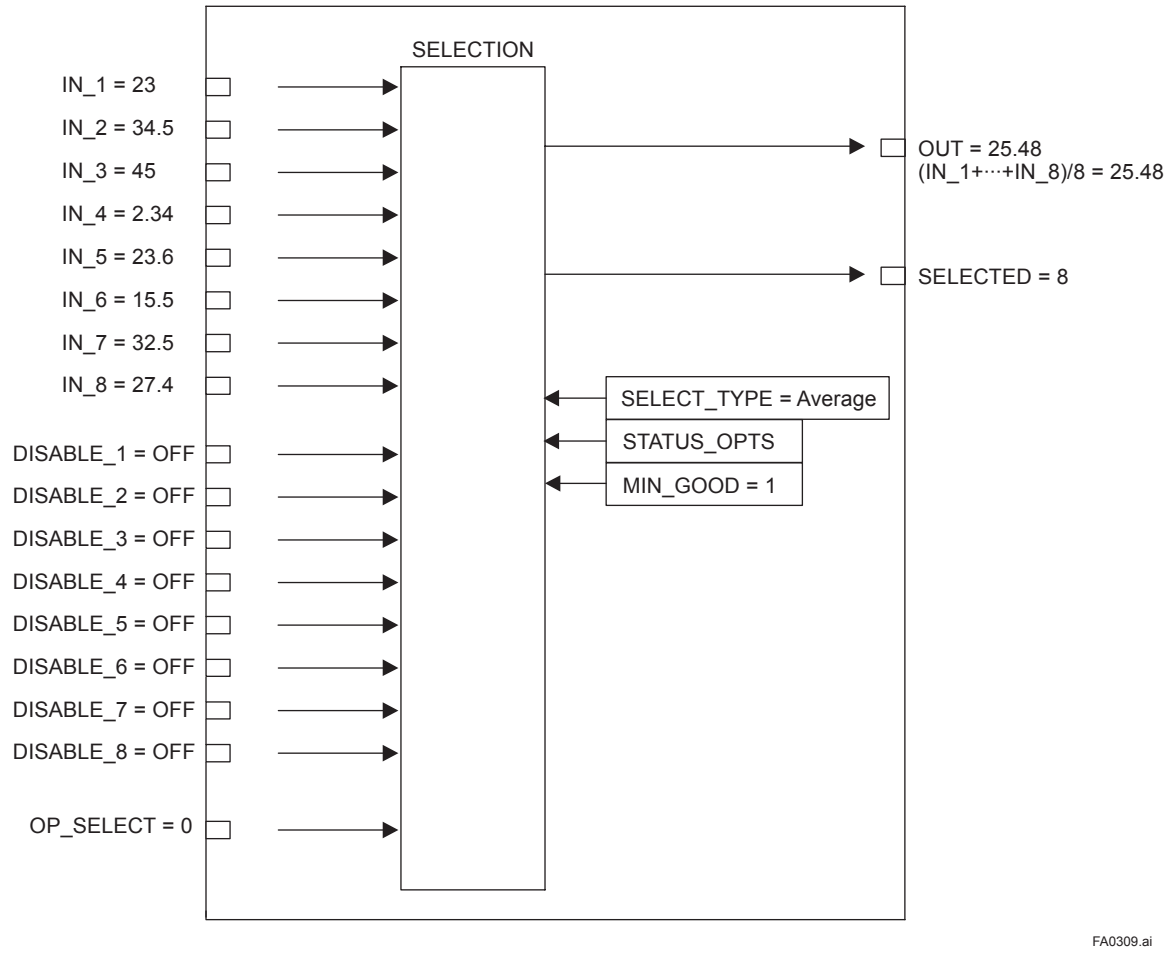


Figure A3.9 Example (8)

When SELECT TYPE is “Latched Good”

The valid input with the smaller input number is selected as an output and is held until it becomes invalid. When it becomes invalid, the next valid input will be selected as an output regardless of the magnitude of the value. Even if an input with the input number smaller than that of the currently selected input recovers, the current selection is held.

Assuming that IN_2 is the valid input with the smallest input number, the order of input selection is IN_2 → IN_3 → ...→ IN_8 → IN_1 → ....

If the power is turned OFF and then ON with SELECT TYPE set to “Latched Good,” input selection starts with the IN that was selected before the power was turned OFF.

A3.4 Output Processing

A3.4.1 Handling of SELECTED

For the value output to SELECTED when OP_SELECT has been selected (that is, not “0”), the number specified by OP_SELECT will be stored as is.

However, “0” is stored in the SELECTED in the following cases:

1. If there is no valid input;
2. If the value of MIN_GOOD is greater than the number of valid inputs;
3. If the input status is “bad” or “uncertain” when the value of OP_SELECT is anything other than “0” (with the exception of the case where the “Uncertain as good” bit in STATUS_OPTS is set.);
4. If the value of OP_SELECT is greater than 8, which is the maximum number of inputs;
5. If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is zero.

As long as there is one valid input, even an invalid input can be selected for OP_SELECT.

If the number of valid inputs is greater than the value of MIN_GOOD, the number of the input (including an invalid input) specified by OP_SELECT will be stored in SELECTED. Therefore, even if an invalid input is selected, SELECTED does not become zero.

If no input is selected for OP_SELECT, the output of SELECTED will depend on SELECT_TYPE.

The Table A3.1 shows the value of SELECTED according to the number of valid inputs and SELECT_TYPE.

Table A3.1 Value of SELECTED According to Inputs

<table>
<tr><th rowspan="2">Valid Inputs</th><th colspan="4">Value of SELECTED</th></tr>
<tr><th>SELECT_TYPE = First Good</th><th>SELECT_TYPE = MINIMUM, MAXIMUM, or Latched Good</th><th>SELECT_TYPE = MIDDLE</th><th>SELECT_TYPE = AVERAGE</th></tr>
<tr><td>None</td><td>0 (zero)</td><td>0 (zero)</td><td>0 (zero)</td><td>0 (zero)</td></tr>
<tr><td>1</td><td rowspan="3"># of IN with a smaller value</td><td rowspan="3"># of selected IN</td><td># of selected IN</td><td>1</td></tr>
<tr><td>Multiple INs (Even # of INs)</td><td>0 (the average is taken)</td><td rowspan="2"># of valid INs (the average is taken)</td></tr>
<tr><td>Multiple INs (Odd # of INs)</td><td># of IN with the middle value</td></tr>
</table>

Table A3.2 Value of SELECTED According to the Mode

O/S	MAN	AUTO
0	0	0 to 8

A3.4.2 OUT Processing

OUT is an output parameter used to send the value selected in the IS block to another function block.

The following describes OUT processing.

Table A3.3 Block Mode and Value

MODE		Value
O/S		· The previous value is output. (At startup, the initial value is used). · Writable (the operator may change the value.)
Man		
Auto	Value specified by MIN_GOOD > the number of valid inputs	· The previous value is output. · Not writable
	If there is no valid input	
	If the input status is “bad” or “uncertain” when the value of OP_SELECT is anything other than “0” (with the exception of the case where the “Uncertain as good” bit in STATUS_OPTS is set)	
	If the value of OP_SELECT is greater than 8, which is the maximum number of inputs	· Zero · Not writable
	If OP_SELECT is enabled	· The value of the selected input is output. · Not writable
	If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is “0”	· The previous value is output. · Not writable
	If SELECT_TYPE is “First Good”	· The value of a valid input with the smallest input number is output. · Not writable
	If SELECT_TYPE is “MINIMUM”	· The minimum value among the values of the valid inputs is output. · Not writable
	If SELECT_TYPE is “MAXIMUM”	· The maximum value among the values of the valid inputs is output. · Not writable
	If SELECT_TYPE is “MIDDLE” (There is an even multiple number of valid inputs.)	· Because two inputs are positioned in the middle of the values of even multiple valid inputs, the average of the values of these two inputs is output. · Not writable
	If SELECT_TYPE is “MIDDLE” (There is an odd multiple number of valid inputs.)	· The value of the input positioned in the middle of the values of odd multiple valid inputs is output. · Not writable
	If SELECT_TYPE is “AVERAGE”	· The value obtained by dividing the added value of the values of valid inputs by the number of these inputs is output. · Not writable
	If SELECT_TYPE is “Latched Good”	· The value of a valid input with the smallest input number is output. · Not writable

Table A3.4 Condition and Mode

Condition (Listed in priority sequence)	Mode
If the Actual is in O/S	O/S
If the “Uncertain if Man mode” bit in STATUS_OPTS is set and the Actual is in Man	Man
If the “Uncertain if Man mode” bit in STATUS_OPTS is not set and the Actual is in Man	Man
Values specified by MIN_GOOD > the number of valid inputs	AUTO
If there is no valid input	AUTO
If the input status is “bad” or “uncertain” when the value of OP_SELECT is anything other than “0” (with the exception of the case where the “Uncertain as good” bit in STATUS_OPTS is set)	AUTO
If the value of OP_SELECT is greater than 8, which is the maximum number of inputs	AUTO
If OP_SELECT has selected IN whose status is “bad” or “uncertain”	AUTO
If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is “0”	AUTO

A3.4.3 STATUS_OPTS

Bit	Description
Use Uncertain as Good	Causes all inputs (OP_SELECT, IN_n, and DISABLE_n) the status of which is “uncertain,” to be handled as “good” (NC) status inputs and the others to be handled as ”bad” status inputs.
Uncertain if Man mode	When the mode is Man, the status of OUT is interpreted as “uncertain.” (This does not apply to SELECTED.)

A3.5 List of Input Selector Block Parameters

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View				Description / Remarks
					1	2	3	4	
0	BLOCK_ HEADER	Block Tag=O/S		TAG: “IS”					Information relating to this function block, such as block tag, DD revision, and execution time.
1	ST_REV		-----	-----	2	2	2	2	Indicates the revision level of the set parameters associated with the IS block. If a setting is modified, this revision is updated. It is used to check for parameter changes, etc.
2	TAG_DESC			Space (32 characters)					A universal parameter that stores comments describing tag information.
3	STRATEGY			1				2	A universal parameter intended for use by the high-level system to identify function blocks.
4	ALERT_KEY		1-255	1				1	Key information used to identify the location where an alert has occurred. Generally, this parameter is used by the high-level system to identify specific areas in a plant that are under the control of specific operators, to distinguish necessary alarms only. This is one of the universal parameters.
5	MODE_BLK				4		4		A universal parameter representing the operation status of the IS block. It consists of the Actual, Target, Permitted, and Normal modes.
6	BLOCK_ ERR		-----	-----	2		2		Indicates the error status relating to the Input Selector function block. The bit used by this function block is as follows: Bit 15: O/S mode.
7	OUT	MAN		0	5		5		Block output.
8	OUT_ RANGE					11			Set the range of OUT.
9	GRANT_ DENY			0		2			The parameter used to check if various operations have been executed. The bits in the GRANT parameter corresponding to various operations are set before any of them are executed. After the operations are complete, the DENY parameter is checked to find out if any bit corresponding to the relevant operation has been set. If no bit is set, it is evident that the operations have been executed successfully.
10	STATUS_ OPTS	O/S	“Use Uncertain as good” and “Uncertain if Manual” only	0				2	A user-selectable option available for status handling in the block.
11	IN_1			0	5		5		Input 1
12	IN_2			0	5		5		Input 2
13	IN_3			0	5		5		Input 3
14	IN_4			0	5		5		Input 4
15	DISABLE_1		0, 1	0	2		2		Selector switch to disable input 1 from being selected.
16	DISABLE_2		0, 1	0	2		2		Selector switch to disable input 2 from being selected.
17	DISABLE_3		0, 1	0	2		2		Selector switch to disable input 3 from being selected.
18	DISABLE_4		0, 1	0	2		2		Selector switch to disable input 4 from being selected.
19	SELECT_ TYPE		1-6	0				1	Specifies the input selection algorithm.

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View				Description / Remarks
					1	2	3	4	
20	MIN_GOOD		0-8	0				1	Parameter specifying the minimum required number of inputs with “good” status If the number of inputs with “good” status is less than the value of MIN_GOOD, input selection is canceled.
21	SELECTED		0-8	0	2		2		Indicates the number of the selected input. However, it indicates the number of inputs used to calculate the average if SELECT_TYPE = Average. If no input is selectable or if there are multiple inputs, it becomes “0” (none).
22	OP_ SELECT		0-8	0	2		2		A parameter to forcibly employ the input of a selected number (Operator-settable).
23	UPDATE_ EVT		-----	-----					Indicates event information if an update event (setting change) occurs.
24	BLOCK_ ALM		-----	-----					Indicates alarm information if a block alarm occurs.
25	IN_5			0	5		5		Input 5
26	IN_6			0	5		5		Input 6
27	IN_7			0	5		5		Input 7
28	IN_8			0	5		5		Input 8
29	DISABLE_5		0, 1	0	2		2		Selector switch to disable input 5 from being selected.
30	DISABLE_6		0, 1	0	2		2		Selector switch to disable input 6 from being selected.
31	DISABLE_7		0, 1	0	2		2		Selector switch to disable input 7 from being selected.
32	DISABLE_8		0, 1	0	2		2		Selector switch to disable input 8 from being selected.

A3.6 Application Example

The following describes the temperature control system of a fixed bed-type reactor. In this case, there are instances where the point showing the maximum temperature changes due to catalytic deterioration, raw material flow, etc. Therefore, a large number of measurement points are provided, and the maximum value obtained among these measurement points is input to the controller to control reactor temperature.

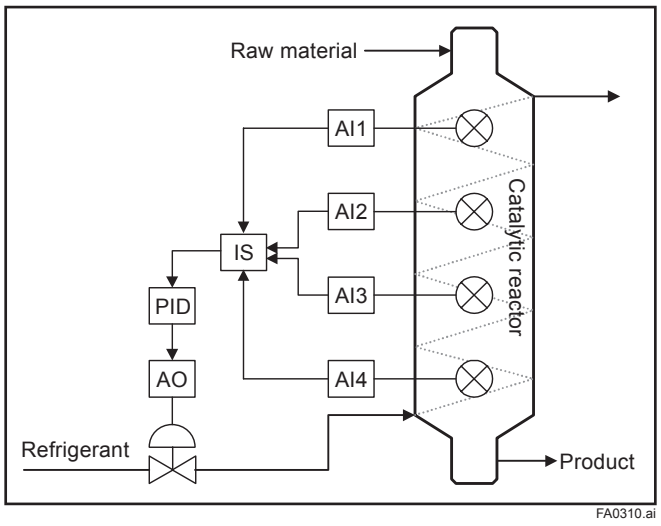


Figure A3.10 Temperature Control System of a Fixed Bed-type Reactor

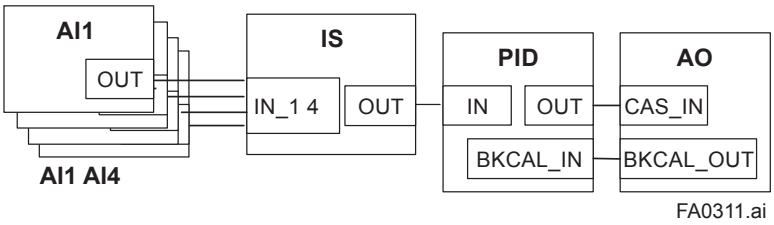


Figure A3.11 Example of Scheduling

AI1: Temperature 1, AI2: Temperature 2, AI3: Temperature 3, AI4: Temperature 4
IS: SELECT_TYPE = MAX

Basic operations and work sequence:

1. The IS block obtains values and status information from AI.
2. The block selects the AI information using the alternatives.
3. The block displays and outputs the information selected by SELECTED.

Appendix 4. Arithmetic (AR) Block

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

A4.1 Arithmetic Function Block Schematic

The diagram below shows the Arithmetic block schematic.

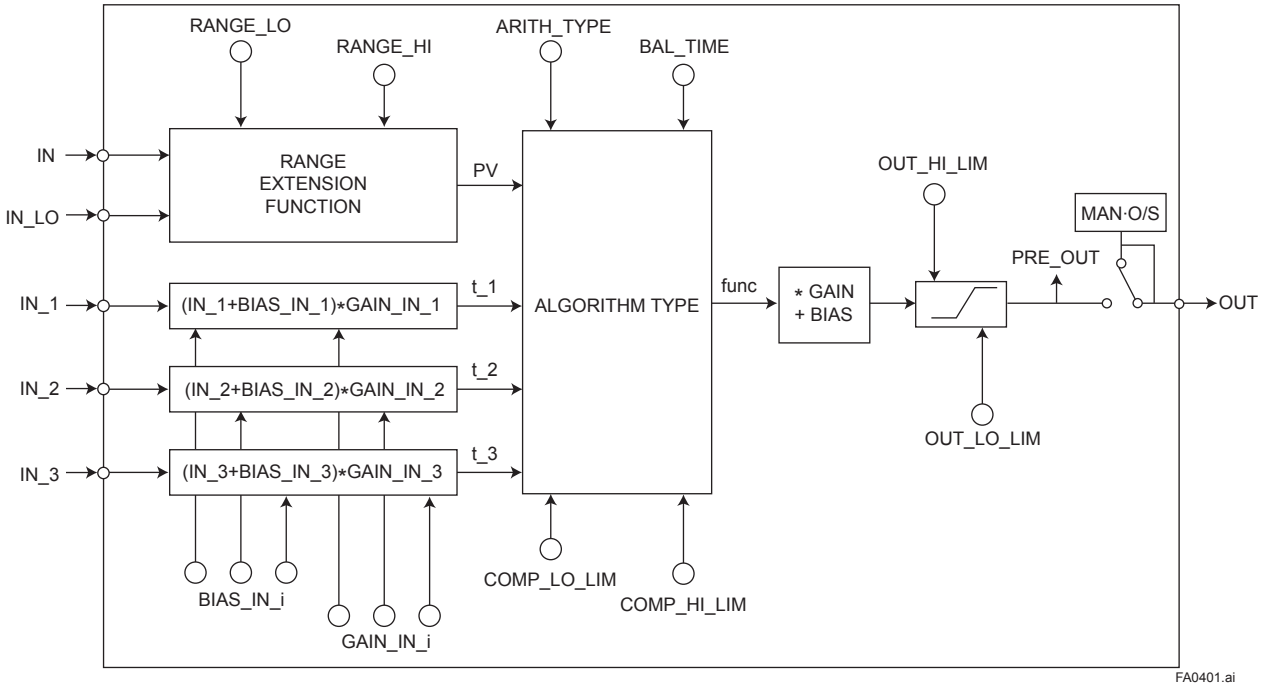


Figure A4.1 AR Block

The Arithmetic block is divided into three sections:

- Input section: Makes a go/no-go decision on the use of an input value, switches the range, and determines the PV status.
- Computation section: Makes calculations through ARITH_TYPE.
- Output section: Applies gain multiplication and bias addition to the calculated result to perform limitation processing for output.

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

A4.2 Input Section

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

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

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

A4.2.1 Main Inputs

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

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

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

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

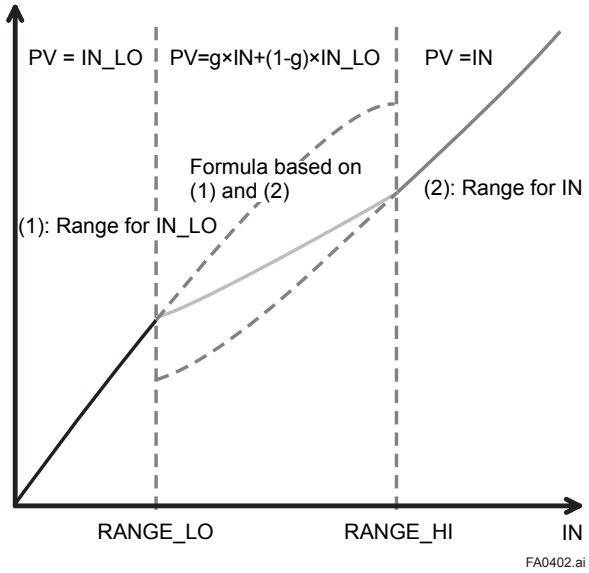


Figure A4.2 Range Extension Function and PV

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

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

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

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

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

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

Example:

Assuming that

RANGE_LO	20
RANGE_HI	300

the following are established:

IN = 310, IN_LO = 20
→ PV = 310

IN = 230, IN_LO = 20
→ g = (230 - 20) / (300 - 20) = 0.75
PV = 0.75 × 230 + (1 - 0.75) × 20 = 177.5

IN = 90, IN_LO = 20
→ g = (90 - 20) / (300 - 20) = 0.25
PV = 0.25 × 230 + (1 + 0.25) × 20 = 37.5

IN = 19, IN_LO = 10
→ PV = 10

A4.2.2 Auxiliary Inputs

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

$$t_i = (IN_i + BIAS_IN_i) \times GAIN_IN_i$$

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

A4.2.3 INPUT_OPTS

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

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

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

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

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

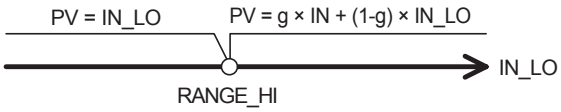
A4.2.4 Relationship between the Main Inputs and PV

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

- If the statuses of two main inputs are both “good” or anything other than “good”
  See A4.2.1, Main Inputs.
- If only one of two main inputs has “good” status after application of INPUT_OPTS, the PV value is determined as follows:
  - If the status of IN is “good” and that of “IN_LO” is anything other than “good”
    IN > RANGE_LO → PV = IN
    IN ≤ RANGE_LO → See A4.2.1.
  - If the status of IN is anything other than “good” and that of “IN_LO” is “good”
    IN_LO < RANGE_HI → PV = IN_LO
    IN_LO ≥ RANGE_H → See A4.2.1.

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

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



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A4.3 Computation Section

A4.3.1 Computing Equations

This subsection shows computing equations used in the computation section:

1) Flow compensation (linear)
   func = PV × f
   f = (t_1 / t_2)

2) Flow compensation (square root)
   func = PV × f
   f = sqrt(t_1 / t_2 / t_3)

3) Flow compensation (approximate expression)
   func = PV × f
   f = sqrt(t_1 × t_2 × t_3 × t_3)

4) Quantity of heat calculation
   func = PV × f
   f = (t_1 - t_2)

5) Multiplication and division
   func = PV × f
   f = ((t_1 / t_2) + t_3)

6) Average calculation
   func = (PV + t_1 + t_2 + t_3) / N
   where N: number of inputs

7) Summation
   func = PV + t_1 + t_2 + t_3

8) Polynomial computation
   func = PV + t_1^2 + t_2^3 + t_3^4

9) HTG-level compensation
   func = (PV - t_1) / (PV - t_2)

10) Polynomial computation
    func = PV + GAIN_IN_1 × PV^2 + GAIN_IN_2 × PV^3 + GAIN_IN_3 × PV^4

* Precaution for computation
Division by "0": If a value is divided by "0," the calculation result is interpreted as 10^{37} and, depending with core, a plus sign is added to it.
Negative square root: The square root of an absolute value is extracted and a minus sign is added to it.

A4.3.2 Compensated Values

In computing equations 1) to 5) in A4.3.1, the value "f" is restricted by the COMP_HI_LIM or COMP_LO_LIM parameter. In this case, the value "f" is treated as follows:

If "f" > COMP_HI_LIM, f = COMP_HI_LIM

If "f" < COMP_LO_LIM, f = COMP_LO_LIM

A4.3.3 Average Calculation

In computing equation 6) in A4.3.1, the average of input value is calculated. Here, it is necessary to obtain the number of inputs, N. For this, determination is made to see if the sub-status of each input is "Not Connected." Note that the main inputs may be accepted if IN or IN_LO is not in "Not Connected" sub-status. In this case, the number of inputs that are not in "Not Connected" sub-status is regarded as "N."

A4.4 Output Section

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

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

PRE_OUT = func × gain + bias
where func: result of computing equation execution
OUT = PRE_OUT (when the mode is in AUTO)

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

If PRE_OUT > OUT_HI_LIM:
PRE_OUT = OUT_HI_LIM
The "high limited" processing is applied to the status of PRE_OUT.

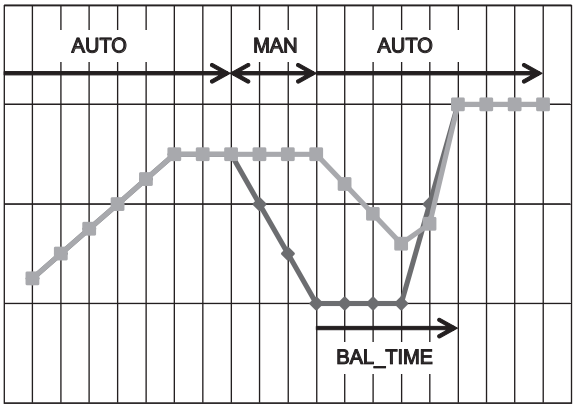
If PRE_OUT < OUT_LO_LIM:
PRE_OUT = OUT_LO_LIM
The "low limited" processing is applied to the status of PRE_OUT.

A4.4.1 Mode Handling

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

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

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



Case of BAL_TIME = 5 seconds

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The value of OUT is represented by the following equation.

$$yn = yn - 1 + (xn - yn - 1) / (\alpha - n)$$
$$\alpha = (T / tc) + 1$$

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

where y: OUT

x: PRE_OUT
tc: period of execution
T: BAL_TIME
n: period

A4.4.2 Status Handling

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

The PV status is classified by the following:

- If the statuses of two main inputs are both “good” or anything other than “good”: See A4.2.1, Main Inputs.
- If only one of the statuses of two main inputs is “good”:
  - If the status of IN is “good” and that of “IN_LO” is anything other than “good”
    IN > RANGE_LO
    → The status of IN applies.
    IN ≤ RANGE_LO
    → See A4.2.1, Main Inputs
  - If the status of IN is anything other than “good” and that of “IN_LO” is “good”
    IN_LO < RANGE_H
    → The status of IN_LO applies.
    IN_LO ≥ RANGE_HI
    → See A4.2.1, Main Inputs

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

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

Example:

		Case 1	Case 2	Case 3
PV		Good		
IN_1		Unceriain		
IN_2		Bad		
IN_3		Bad		
INPUT_OPTS	**IN_1**	Handled as a “good” input if its status is “uncertain.”	No option	
	IN_2	Handled as a “good” input if its status is “bad.”		No option
	IN_3	No option		
ARITH_TYPE		1) Flow compensation (linear) in A4.3.1, “Computing Equations”		
OUT.Status		Good	Uncertain	Bad

A4.5 List of the Arithmetic Block Parameters

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View 1	View 2	View 3	View 4	Description / Remarks
0	BLOCK_ HEADER	O/S		TAG="AR"					Information relating to this function block, such as block tag, DD revision, and execution time.
1	ST_REV			0	2	2	2	2	Indicates the revision level of the set parameters associated with the Arithmetic block. If a setting is modified, this revision is updated. It is used to check for parameter changes, etc.
2	TAG_DESC			Space (32 characters)					A universal parameter that stores comments describing tag information.
3	STRATEGY			1				2	A universal parameter intended for use by a high-level system to identify function blocks.
4	ALERT_KEY		1-255	1				1	Key information used to identify the location at which an alert has occurred. Generally, this parameter is used by a high-level system to identify specific areas in a plant that are under the control of specific operators, to separate necessary alerts only. This is one of the universal parameters.
5	MODE_BLK			AUTO	4		4		A universal parameter representing the operation status of the Arithmetic block. It consists of the Actual, Target, Permitted, and Normal modes.
6	BLOCK_ ERR			0	2		2		Indicates the error status relating to the Arithmetic block. The bit used by this function block is as follows: Bit 1: Block Configuration Error Bit 15: O/S mode
7	PV			0	5		5		The result of a range extension function is substituted into this. When viewed from the computing equation, PV is the main input.
8	OUT	MAN		0	5		5		Block output.
9	PRE_OUT			0	5		5		Always indicates the calculation result. The value is substituted into OUT in Auto mode.
10	PV_SCALE	O/S				11			Indicates PV scaling (for making a memo).
11	OUT_ RANGE					11			Output scaling for the host (for making a memo).
12	GRANT_ DENY			0		2			The parameter used to check if various operations have been executed. The bits in the GRANT parameter corresponding to various operations are set before any of them are executed. After the operations are complete, the DENY parameter is checked to find out if any bit corresponding to the relevant operation has been set. If no bit has been set, it is evident that the operations have been executed successfully.
13	INPUT_ OPTS			0				2	Determines whether an input is used as a "good" input when the input status is "bad" or "uncertain."
14	IN			0			5		Input block.
15	IN_LO			0			5		Input for a low-range transmitter. This is used for the range extension function.
16	IN_1			0			5		Auxiliary input 1
17	IN_2			0			5		Auxiliary input 2
18	IN_3			0			5		Auxiliary input 3
19	RANGE_HI			0				4	High limit for switching to a high-range transmitter by the range extension function.
20	RANGE_LO			0				4	Low limit for switching to a low-range transmitter by the range extension function.

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

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View 1	View 2	View 3	View 4	Description / Remarks
21	BIAS_IN_1			0				4	IN_1 bias
22	GAIN_IN_1			0				4	IN_1 gain
23	BIAS_IN_2			0				4	IN_2 bias
24	GAIN_IN_2			0				4	IN_2 gain
25	BIAS_IN_3			0				4	IN_3 bias
26	GAIN_IN_3			0				4	IN_3 gain
27	COMP_HI_LIM			+INF				4	High limit of compensation factor f.
28	COMP_LO_LIM			-INF				4	Low limit of compensation factor f.
29	ARITH_TYPE	1 to 10		0x01				1	Computation algorithm identification no.
30	BAL_TIME	More than 0		0				4	Time taken to return to the set value.
31	BIAS			0				4	Bias value used to calculate the output.
32	GAIN			1				4	Gain value used to calculate the output.
33	OUT_HI_LIM			+INF				4	Maximum output value.
34	OUT_LO_LIM			-INF				4	Minimum output value.
35	UPDATE_EVT								Indicates event information if an update event (setting change) occurs.
36	BLOCK_ALM								Indicates alarm information if a block alarm occurs.

Value	Selection Name	Description
1	Flow compensation, linear	Flow compensation (linear)
2	Flow compensation, square root	Flow compensation (square root)
3	Flow compensation, approximate	Flow compensation (approximate expression)
4	BTU flow (*)	Quantity of heat calculation
5	Traditional Multiply Divide	Multiplication and division
6	Average	Average calculation
7	Traditional summer	Summation
8	Fourth order Polynomial, Type 1	4th-order (auxiliary input) polynomial computation
9	HTG level compensation (*)	HTG-level compensation
10	Fourth order Polynomial, Type 2	4th-order (main input) polynomial computation

* BTU stands for British thermal unit.
HTG stands for hydrostatic tank gauging.

Appendix 5. PID Block

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

A5.1 Function Diagram

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

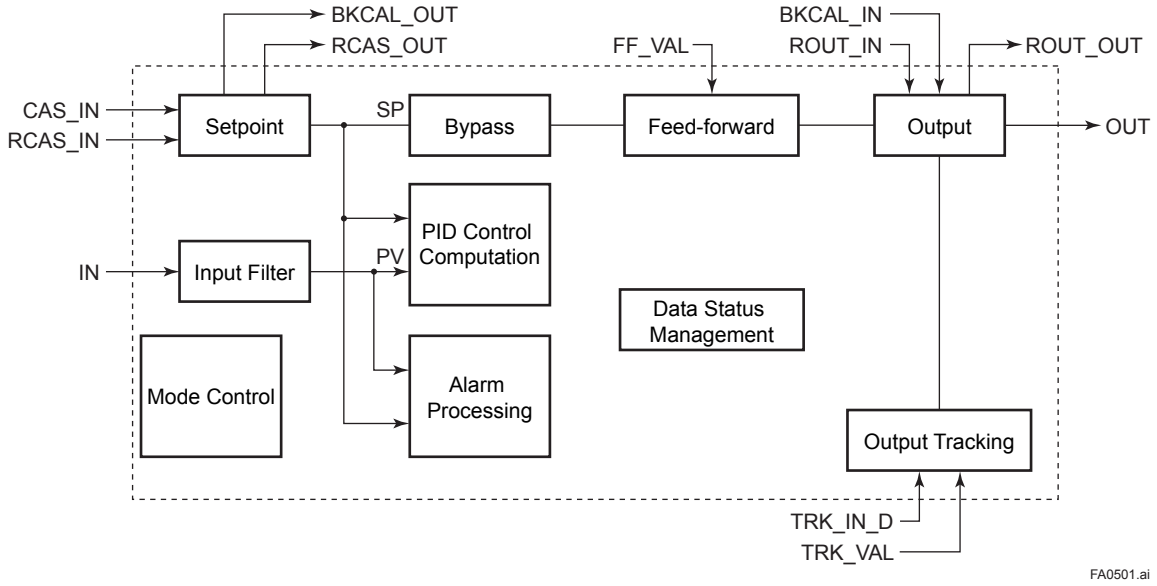


Figure A5.1 PID Block

A5.2 Functions of PID Block

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

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

A5.3 Parameters of PID Block

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

Index	Parameter Name	Default (factory setting)	Write	Valid Range	Description
0	Block Header	TAG: "PID"	Block Tag = O/S		Same as that for an AI block.
1	ST_REV		—		Same as that for an AI block.
2	TAG_DESC	Space (32 characters)			Same as that for an AI block.
3	STRATEGY	1			Same as that for an AI block.
4	ALERT_KEY	1		1 to 255	Same as that for an AI block.
5	MODE_BLK				
6	BLOCK_ERR		—		Same as that for an AI block.
7	PV		—		Measured value; the non-dimensional value that is converted from the input (IN) value based on the PV_SCALE values and filtered.
8	SP	0	AUTO	PV_SCALE ±10%	Setpoint
9	OUT		MAN		Output
10	PV_SCALE	100 0 1342(%) 1	O/S		Upper and lower scale limit values used for scaling of the input (IN) value.
11	OUT_SCALE	100 0 1342(%) 1	O/S		Upper and lower scale limit values used for scaling of the control output (OUT) value to the values in the engineering unit.
12	GRANT_DENY	0	AUTO		Same as that for an AI block.
13	CONTROL_ OPTS	0	O/S		Setting for control action. See Section A5.13 for details.
14	STATUS_OPTS	0	O/S		See Section A5.15 for details.
15	IN	0			Controlled-value input.
16	PV_FTIME	0	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.
34	SHED_OPT	0			Action to be performed in the event of mode shedding. SHED_OPT defines the changes to be made to MODE. BLK.target and MODE.BLK.actual when the value of RCAS_IN.status or ROUT_IN.status becomes Bad if MODE_BLK.actual = RCas or ROut. See Section A5.17.1 for details.

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

A5.4 PID Computation Details

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

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

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

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

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

PI-D Control Algorithm (in Cas mode)

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

Where,

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

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

A5.4.2 PID Control Parameters

The table below shows the PID control parameters.

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

A5.5 Control Output

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

A5.5.1 Velocity Type Output Action

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

This action can be expressed as:

ΔMVn' = ΔMVn * (OUT_SCALE. EU100 – OUT_SCALE. EU_0) / (PV_SCALE. EU_100 – PV_SCALE. EU_0)

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

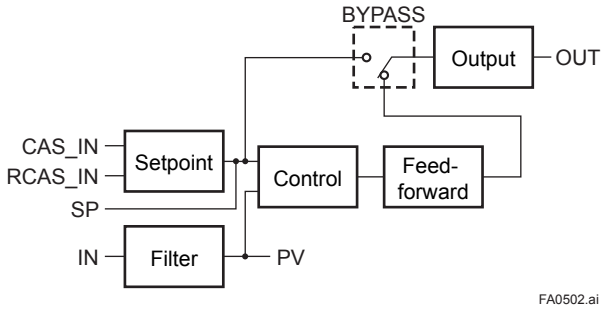
A5.6 Direction of Control Action

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

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

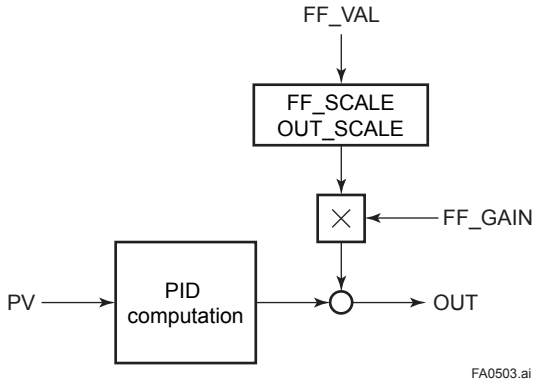
A5.7 Control Action Bypass

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



A5.8 Feed-forward

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



A5.9 Block Modes

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

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

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 A5.14).
O/S	Out of service mode, in which neither the control computation nor action is carried out, and the output is kept at the value that was output before the PID block entered into O/S mode.

A5.9.1 Mode Transitions

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

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

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

A5.10 Bumpless Transfer

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

A5.11 Setpoint Limiters

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

A5.11.1 When PID Block Is in Auto Mode

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

Setpoint High/Low Limits

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

Setpoint Rate Limits

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

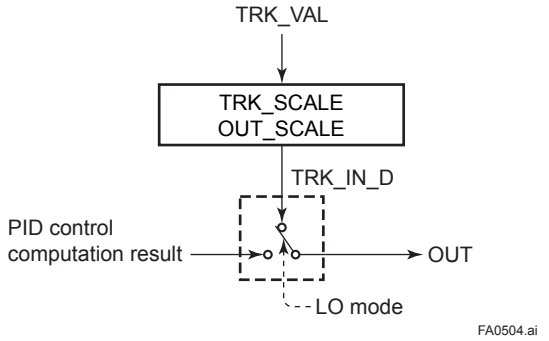
- An increase of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_UP.
- A decrease of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_DOWN.

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

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

A5.12 External-output Tracking

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



To change the block mode to LO:

(1) Select Track Enable in CONTROL_OPTS.
(2) Set TRK_IN_D to true.

However, to change the block mode from Man to LO, Track in Manual must also be specified in CONTROL_OPTS.

A5.13 Measured-value Tracking

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

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

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

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

A5.14 Initialization and Manual Fallback (IMan)

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

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

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

A5.15 Manual Fallback

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

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

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

The table below shows the options in STATUS_OPTS.

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

A5.16 Auto Fallback

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

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

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

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

A5.17 Mode Shedding upon Computer Failure

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

A5.17.1 SHED_OPT

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

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

*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.

FA0505.ai

*2 Only when Auto is set as permitted mode.

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

A5.18 Alarms

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

A5.18.1 Block Alarm (BLOCK_ALM)

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

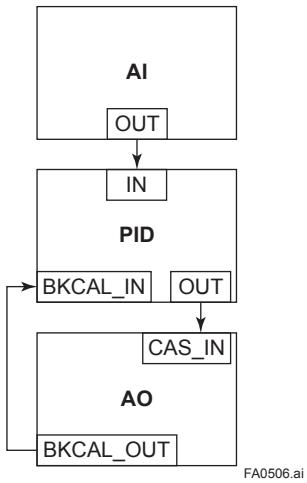
Value of BLOCK_ERR	Condition
Local Override	**MODE_BLK** actual of PID block is LO.
Sensor Failure	The status of PV is Bad. (The status of IN is Bad, or the status of IN is Uncertain and "Use Uncertain as Good" is false in STATUS_OPTS.)
Out of Service	**MODE_BLK.target** of the PID block is O/S.

A5.18.2 Process Alarms

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

Process Alarm	Cause of Occurrence	Parameter Containing Priority Level Setting
HI_HI_ALM	Occurs when the PV increases above the HI_HI_LIM value.	HI_HI_PRI
HI_ALM	Occurs when the PV increases above HI_LIM value.	HI_PRI
LO_ALM	Occurs when the PV decreases below the LO_LIM value.	LO_PRI
LO_LO_ ALM	Occurs when the PV decreases below the LO_LO_LIM value.	LO_LO_PRI
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

A5.19 Example of Block Connections



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

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

A5.20 View Object for PID Function Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	SP	5		5	
9	OUT	5		5	
10	PV_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	CONTROL_OPTS				2
14	STATUS_OPTS				2
15	IN			5	
16	PV_FTIME				4
17	BYPASS		1		
18	CAS_IN	5		5	
19	SP_RATE_DN				4
20	SP_RATE_UP				4
21	SP_HI_LIM		4		
22	SP_LO_LIM		4		
23	GAIN				4
24	RESET				4
25	BAL_TIME				4
26	RATE				4
27	BKCAL_IN			5	
28	OUT_HI_LIM		4		
29	OUT_LO_LIM		4		
30	BKCAL_HYS				4
31	BKCAL_OUT			5	
32	RCAS_IN			5	
33	ROUT_IN			5	
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				
	Totals	43	43	83	104

Appendix 6. Link Master Functions

A6.1 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.

The transmitter 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.

A6.2 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.

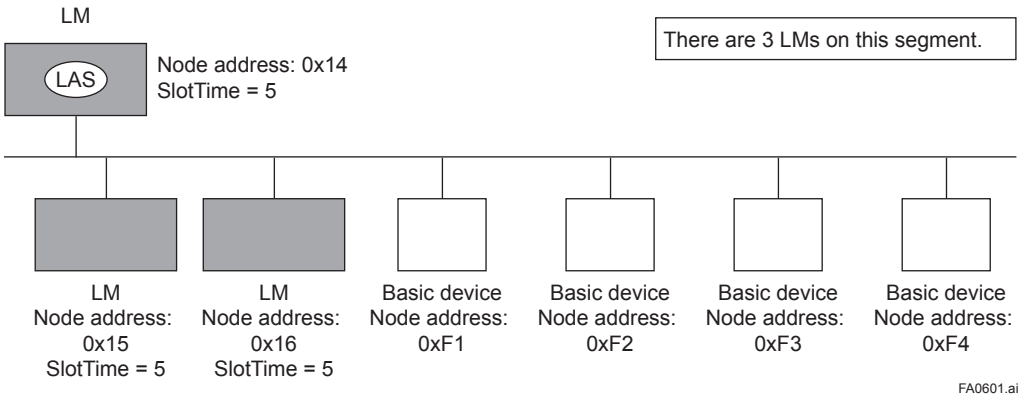


Figure A6.1 Example of Fieldbus configuration-3 LMs on Same Segment

A6.3 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.

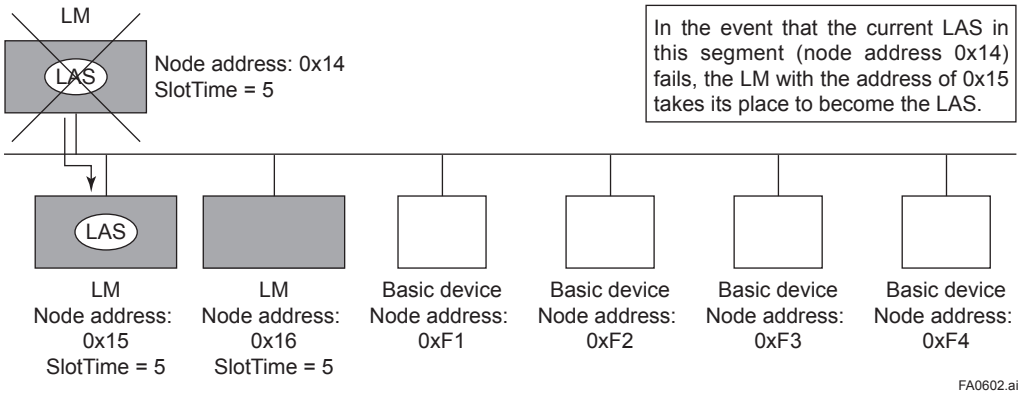


Figure A6.2 Backup of LAS

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

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

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

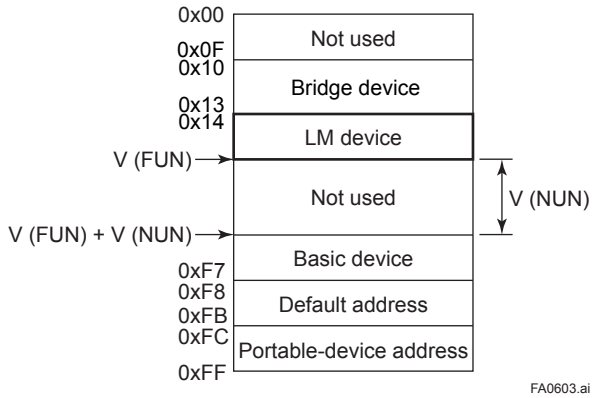


Figure A6.3 Node Address Ranges

(2) In the LAS settings of the transmitter, 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 (Index 282 (SM))

Subindex	Element	EJX	Device 1	Device 2	Device 3	Description
1	SlotTime	4	8	10	20	Capability value for V(ST)
3	MaxResponseDelay	3	6	3	5	Capability value for V(MRD)
6	MinInterPduDelay	4	8	12	10	Capability value for V(MID)

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

ConfiguredLinkSettingsRecord (Index 293 (SM))

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

(3) In the LAS settings of the transmitter, 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 (Index 293 (SM))

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

A6.4 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 A6.5.
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.

A6.5 LM Parameters

A6.5.1 LM Parameter List

The tables below show LM parameters.

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

Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
283	PLME_BASIC_ CHARACTERISTICS	0		R	
		1 ChannelStatisticsSupported	0x00		
		2 MediumAndDataRatesSupported	0x4900000000000000		
		3 IecVersion	1 (0x1)		
		4 NumOfChannels	1 (0x1)		
		5 PowerMode	0 (0x0)		
284	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)		
285	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)		
286	DLME_LINK_MASTER_CAPABILITIES_VARIABLE		0x04	RW	
287	DLME_LINK_ MASTER_INFO_ RECORD	0		RW	
		1 MaxSchedulingOverhead	0		
		2 DefMinTokenDelegTime	100		
		3 DefTokenHoldTime	300		
		4 TargetTokenRotTime	4096		
		5 LinkMaintTokHoldTime	400		
		6 TimeDistributionPeriod	5000		
		7 MaximumInactivityToClaimLasDelay	2		
		8 LasDatabaseStatusSpduDistributionPeriod	6000		
288	PRIMARY_LINK_MASTER_FLAG_VARIABLE		0	RW	LAS: True = 0xFF; non-LAS: False = 0x00
289	LIVE_LIST_STATUS_ARRAY_VARIABLE		0	R	
290	MAX_TOKEN_ HOLD_TIME_ ARRAY	0		RW	
		1 Element1	0x0000(x16), 0x012C(x16)		
		2 Element2	0x012C(x5), 0x0000(x27)		
		3 Element3	0x0000(x32)		
		4 Element4	0x0000(x32)		
		5 Element5	0x0000(x32)		
		6 Element6	0x0000(x32)		
		7 Element7	0x0000(x31), 0x012C(x1)		
		8 Element8	0x012C(x32)		
291	BOOT_OPERAT_FUNCTIONAL_CLASS		Specified at the time of order	RW	0x01 (basic device); 0x02 (LM)

Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
292	CURRENT_LINK_ SETTING_RECORD	0		R	Settings for LAS
		1 SlotTime	0		
		2 PerDlpduPhlOverhead	0		
		3 MaxResponseDelay	0		
		4 FirstUnpolledNodeId	0		
		5 ThisLink	0		
		6 MinInterPduDelay	0		
		7 NumConseeUnpolledNodeId	0		
		8 PreambleExtension	0		
		9 PostTransGapExtension	0		
		10 MaxInterChanSignalSkew	0		
		11 TimeSyncClass	0		
293	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		
294	LINK_SCHEDULE_ACTIVATION_VARIABLE		0 (0x0)	RW	
295	LINK_ SCHEDULE_LIST_ CHARACTERISTICS_ RECORD	0		R	
		1 NumOfSchedules	2		
		2 NumOfSubSchedulesPerSchedule	5		
		3 ActiveScheduleVersion	0		
		4 ActiveSheduleOdIndex	0		
		5 ActiveScheduleStartingTime	0		
296	DLME_SCHEDULE_ DESCRIPTOR.1	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
297	DLME_SCHEDULE_ DESCRIPTOR.2	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
298	DOMAIN.1				Read/write impossible. Get-OD possible.
299	DOMAIN.2				Read/write impossible. Get-OD possible.

A6.5.2 Descriptions for LM Parameters

The following describes LM parameters of the transmitter.

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

(1) DlmeLinkMasterCapabilitiesVariable

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

(2) DlmeLinkMasterInfoRecord

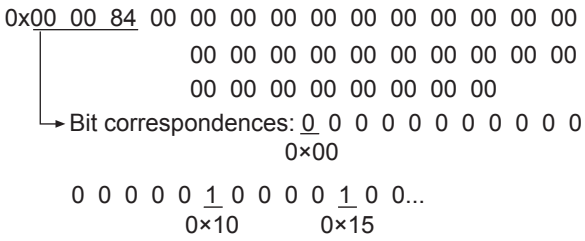
Sub-index	Element	Size [bytes]	Descrip-tion
1	MaxSchedulingOverhead	1	V(MSO)
2	DefMinTokenDelegTime	2	V(DMDT)
3	DefTokenHoldTime	2	V(DTHT)
4	TargetTokenRotTime	2	V(TTRT)
5	LinkMaintTokHoldTime	2	V(LTHT)
6	TimeDistributionPeriod	4	V(TDP)
7	MaximumInactivityToClaimLasDelay	2	V(MICD)
8	LasDatabaseStatusSpduDistributionPeriod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

(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]	Description
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)

(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)

(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	0x49 00 00 00 00 00 00 00	Wire medium, voltage mode, and 31.25 kbps are supported.
3	IceVersion	2	1	IEC Physical Layer Entity Version
4	NumOf Channels	1	1	
5	Power Mode	1	0	0: Bus-powered; 1: Self-powered

(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

(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.

(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.
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.

(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.

(15) Domain

Read/write: impossible; get-OD: possible

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

CAUTION

When downloading a LAS schedule to transmitter, maximum allowable linkages between devices are 48.

A6.6 FAQs

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

A1-1. Is that transmitter running as an LM? Check that the value of BootOperatFunctionalClass (index 291) 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:

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

Q2. How can I make the transmitter become the LAS?

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

LinkScheduleListCharacteristicsRecord (index 295 for the transmitter)

- ActiveScheduleVersion (subindex 3)

A2-2. Make the transmitter declare itself as and become the LAS by writing:
- 0x00 (false) to PrimaryLinkMasterFlagVariable in the current LAS; and
- 0xFF (true) to PrimaryLinkMasterFlagVariable (index 288) in the transmitter.

Q3. On a segment where the transmitter 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 transmitter and the capabilities of being the LAS for the device that cannot be connected:
- V(ST), V(MID), V(MRD) of the transmitter: ConfiguredLinkSettingsRecord (index 293)
- V(ST), V(MID), V(MRD) of problematic device: DlmeBasicInfo

Then, confirm that the following conditions are met:

Transmitter		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 transmitter.

Q4. "AL.20" is kept shown on LCD.

The LAS does not exist or is not identified in the fieldbus network, or the transmitter is not able to establish communication with the LAS.

A4-1. Check that the LAS is connected on the network. When using the transmitter as the LAS, follow the steps described in section A6.3.

A4-2. Adjust the parameters of the LAS to that of the transmitter. Refer to section 5.2 for details.

LAS		Transmitter
V(ST)	>	V(ST) 4 or above
V(MID)	>	V(MID) 4 or above
V(MRD)	>	V(MRD) 12 or above

A4-3. Check that the correct Node Address is used for the transmitter. Refer to section 5.2 for details.
Confirm that the Node Address of transmitter should be out of the parameters of the LAS of V (FUN) ~ V (FUN)+V (NUN)
Confirm that the Node Address is not within the default address (0xF8 to 0xFB).

Appendix 7. Software Download

A7.1 Benefits of Software Download

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

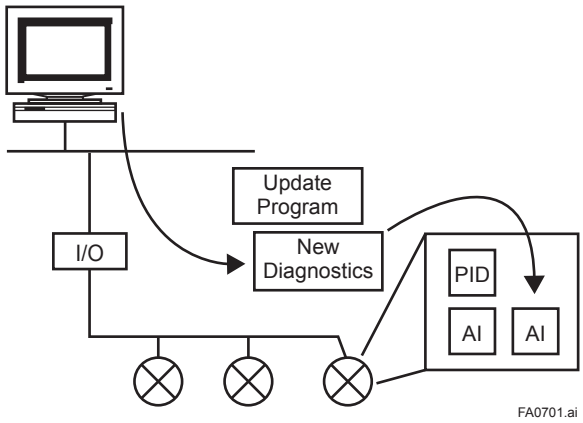


Figure A7.1 Concept of Software Downloading

A7.2 Specifications

Steady-state current: Max. 15 mA

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

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

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

Based on Fieldbus Foundation Specification
Download class: Class 1

NOTE

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

A7.3 Preparations for Software Downloading

For software downloading, you need to prepare the following:

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

For the software download tool, use only a program developped for that purpose. For details, see the software's User's Manual.

CAUTION

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

NOTE

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

A7.4 Software Download Sequence

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

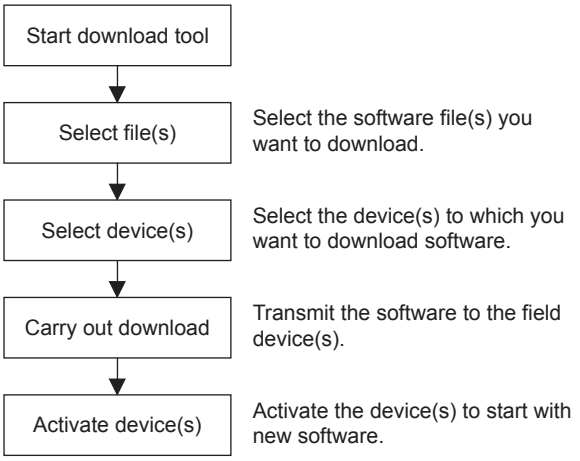


Figure A7.2 Flow of Software Download Procedure

CAUTION

Carrying out a software download leaves the PD tag, node address, and transducer block calibration parameters that are retained in the nonvolatile memory inside the target device, but may reset other parameters to the defaults (except a minor update that does not change the number of parameters). Hence, where necessary, save the parameters using an engineering tool, parameter setting utility, or the like before carrying out a software download, and then reconfigure the field device(s) after the download. For details, see Section A7.6.

CAUTION

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

CAUTION

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

CAUTION

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

NOTE

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

A7.5 Download Files

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

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

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

594543000C_000C_EJX_ORIGINAL_R101.ffd

Refer to A7.11(3) DOMAIN_HEADER about each keyword of the file name.

The device type is "000C" for an EJX transmitter, and is "0011" for an EJA transmitter.

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

A7.6 Steps after Activating a Field Device

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

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

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

Table A7.1 Actions after Software Update

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

A7.7 Troubleshooting

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

Table A7.2 Problems after Software Update

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

A7.8 Resource Block's Parameters Relating to Software Download

Table A7.3 Additional Parameters of Resource Block

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

Table A7.4 Download Error Codes

Error Code	Description
0	No error
32768	Unsupported header version (not 1)
32769	Abnormal header size (not 44)
32770	Abnormal manufacturer ID (not 0x594543)
32771	Device family error (not RB.DEV_TYPE)
32772	Device revision error (less than RB.DEV_REV)
32773	File revision error (not 3)
32774	File type error (not 0 or 1)
32775	Abnormal number of modules (9 and over)
32776	Abnormal number of EEPROM data tuning (11 and over)
32777	Abnormal module size of program (less than 13 bytes or 655373 bytes and over)
32778	Abnormal data size of EEPROM (under 13 bytes or (A area size + 13byte) and over)
32779	Module type error (except 0 and 1)
32780	Module address error (less than 32768 (0x8000) or 786432 (0xC0000)and over)
32781	Module CRC error
32782	Abnormal block size (Block size of downloaded EEPRPM data is under the existing block size)
32783	Block ID error (There is no existing Block in downloaded EEPROM data)
32784	Abnormal module ID which tunes EEPROM data (except 1 and 2)
32785	Abnormal EEPROM block ID which tunes EEPROM data
32786	Offset error from the beginning of the block which tunes EEPROM data
32787	Abnormal data size which tunes EEPPROM data
32788	EEPROM data tuning type error (except 1 to 3)
32789	File CRC error
32790	File endcode error (first 1 byte of endcode is not 0x00)
32791	Verification error during external SerialFlashROM writing
32792	Access error of external SerialFlashROM
32793	Timeout of the external SerialFlashROM access
32794	Generic initiate download sequence error
32795	Generic download segment error
32796	Generic terminate download sequence.error
32797	State error during activation (except DWNLD_NOT_READY, DWNLD_READY, and DWNLD_OK)
32798	Succeeded process error during activation (FlashROM failure, EEPRPM failure)

A7.9 System/Network Management VFD Parameters Relating to Software Download

Table A7.5 System/Network Management VFD Parameters

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

Index (SM)	Parameter Name	Sub Index	Sub-parameter Name	Default (Factory Set)	Write Mode	Remarks
310	DWNLD_ PROPERTY	0			R	
		1	Download Class	1		
		2	Write Rsp Returned For ACTIVATE	1		
		3	Write Rsp Returned For PREPARE	1		
		4	Reserved	0		
		5	ReadyForDwnld Delay Secs	300		
		6	Activation Delay Secs	60		
313	DOMAIN_ DESCRIPTOR	0			R/W	Read/write-permitted only for sub-index 1
		1	Command	3		
		2	State	1		
		3	Error Code	0		
		4	Download Domain Index	316		
		5	Download Domain Header Index	314		
		6	Activated Domain Header Index	315		
		7	Domain Name	(Device name)		
314	DOWNLOAD_ DOMAIN_ HEADER	0			R	
		1	Header Version Number	0		
		2	Header Size	0		
		3	Manufacturer ID			
		4	Device Family			
		5	Device Type			
		6	Device Revision	0		
		7	DD Revision	0		
		8	Software Revision			
		9	Software Name			
		10	Domain Name			
315	ACTIVATED_ DOMAIN_ HEADER	0			R	
		1	Header Version Number	1		
		2	Header Size	44		
		3	Manufacturer ID	0x594543		
		4	Device Family	(DEV_TYPE of RB)		
		5	Device Type	(DEV_TYPE of RB)		
		6	Device Revision	(DEV_REV of RB)		
		7	DD Revision	(DD_REV of RB)		
		8	Software Revision	(SOFT_REV of RB)		
		9	Software Name	ORIGINAL		
		10	Domain Name	(Device name)		
316	DOMAIN					Read/write: prohibited Get-OD: permitted

A7.10 Comments on System/Network Management VFD Parameters Relating to Software Download

IMPORTANT

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

(1) DWNLD_PROPERTY

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

(2) DOMAIN_DESCRIPTOR

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

(3) DOMAIN_HEADER

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

Appendix 8. Advanced Diagnostics

A8.1 Multi-sensing Process Monitoring

Multi-sensing process monitoring function (option code: /DG1) provides the advanced diagnostics to detect the abnormal conditions in process environment such as an impulse line etc. by using the EJX multi-sensing technology and its unique algorithm. There are following two functions.

■ Impulse Line Blockage Detection (ILBD)

The fluctuation change of differential pressure and static pressure is monitored by a silicone resonant sensor and detects a potential blockage condition. The differential pressure transmitter provides also a result of which pressure-side was plugged.

■ Heat Trace Monitoring

The flange temperature is calculated by two temperature sensors built in the EJX. The temperature change enables to detect the heat trace breakage or the abnormal temperature due to the failure.

A8.2 Impulse Line Blockage Detection (ILBD)

ILBD is carried out by using statistical analysis derived from the measured values of process fluctuations that exist in a fluid. An alarm on the EJX LCD display or an analog alert is generated if certain blockage level is reached. EJX provides the following results as blockage detection.

(1) A Blocking and B Blocking
These are blockage detections derived from the fluctuation value change of differential pressure/pressure. With a differential pressure transmitter, each result indicates that both or single side is plugged.

(2) Low Side Blocking
It is a low-pressur-side blockage detection derived from the change of VALUE_BLKF* or low-pressure-side fluctuation value.

(3) High Side Blocking
It is a high-pressure-side blockage detection derived from the change of VALUE_BLKF* or low-pressure-side fluctuation.

*: VALUE_BLKF indicates blockage degree characterized by a comparison of the high- and low-pressure-side fluctuation values. For the details, refer to A8.2.1.

IMPORTANT

- The pressure fluctuation amplitude in fluids must be sufficiently large for blockages to be detected.
- If the pressure fluctuation amplitude is too low for a reference value to be obtained, blockages detection operation cannot be performed with an alarm that the reference value is invalid.
- The pressure fluctuation amplitude may change due to other causes unrelated with a blockage according to process condition. In above case, a false alarm of an impulse line blockage may be generated. Before taking action in response to a blockage alarm, you need to consider the plant operating conditions.

■ Notes for Pressure or Level measurement

With pressure or level measurement, the pressure fluctuation amplitude may reduce especially for the following cases.

● Pressure Measurement

- A pressure transmitter is used and the pressure drops to nearly the low-cut value.
- Even though the pressure is constant, the flow decreases after a reference value is obtained.
- A source of pressure fluctuation (pump, compressor, blower, etc.) is shut down. As a result, the pressure fluctuation amplitude decreases.

● Level Measurement

- A transmitter is used to measure tank level and the flow of fluid into or out of the tank comes to a stop.
- The agitator in the tank is shut down.
- A source of pressure variation (a compressor, etc.) that controls the internal pressure of a sealed (closed) tank is shut down.

Before taking action in response to a blockage alarm, you need to consider the plant operating conditions.

■ Functional block diagram

The figure below shows the functional block diagram of ILBD, which is performed in the SENSOR Transducer block.

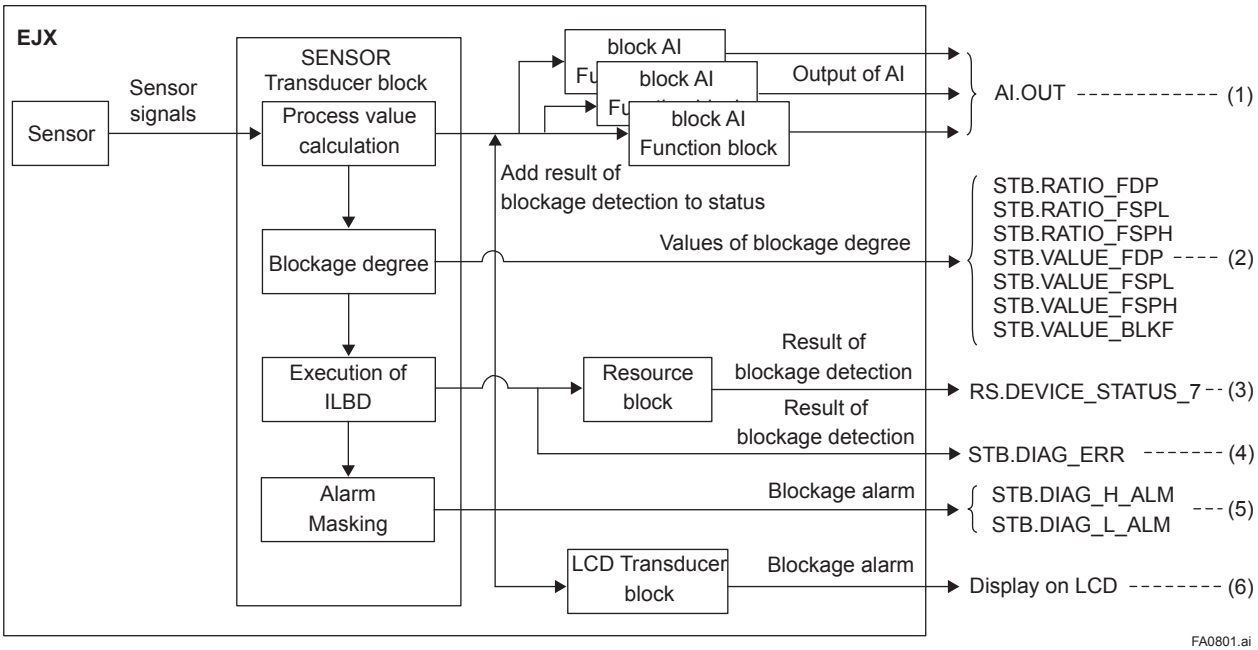


Figure A8.1 Functional Block Diagram of ILBD

The following outputs are given for the ILBD results.

Table A8.1 List of Outputs for ILBD

#	OUTPUT		Remarks
	Parameter name	Block	
(1)	OUT	AI function block	The result of blockage detection can be set to “UNCERTAIN: Non Specific” if DIAG_OPTION has been set to indicate the alarm status.
(2)	RATIO_FDP	SENSOR Transuducer Block	Parameters based on the fluctuation value and blockage degree [**COMP_FLG**: Non-Compensation] $\mathbf{RATIO_FDP} = \sqrt{\frac{\mathbf{VALUE_FDP}}{\mathbf{REFERENCE_FDP}}}$ [**COMP_FLG**: Compensation] $\mathbf{RATIO_FDP} = \sqrt{\frac{\mathbf{VALUE_FDP}}{\mathbf{REFERENCE_FDP}}} \times \left\lvert\frac{\mathbf{REFERENCE_DPAVG}}{\mathbf{VALUE_DPAVG}}\right\rvert$
	RATIO_FSPL		$\mathbf{RATIO_FSPL} = \sqrt{\frac{\mathbf{VALUE_FSPL}}{\mathbf{REFERENCE_FSPL}}}$
	RATIO_FSPH		$\mathbf{RATIO_FSPH} = \sqrt{\frac{\mathbf{VALUE_FSPH}}{\mathbf{REFERENCE_FSPH}}}$
	VALUE_BLKF		Blockage degree characterized in comparison of high-pressure side and low-pressure side pressure fluctuation value
	VALUE_FDP		Average value of the sum of squares of differential pressure fluctuations
	VALUE_FSPL		Average value of the sum of squares of low-pressure side static pressure fluctuation
	VALUE_FSPH		Average value of the sum of squares of high-pressure side static pressure fluctuation
(3)	DEVICE_STATUS_7	Resource block	When an impulse line blockage is detected, the result of the blockage detection (alarm status) is indicated.
(4)	DIAG_ERR	SENSOR Transducer block	When an impulse line blockage is detected, the results of the blockage detection (alarm status) are indicated.
(5)	DIAG_H_ALM	SENSOR Transducer block	When an impulse line blockage is detected, an alert is generated by divided into high- and low-pressure sides.
	DIAG_L_ALM		
(6)	Display on LCD		When impulse line blockage is detected, an alarm status is displayed on LCD.

FA0802.ai

A8.2.1 Blockage Detection

■ DIAG_LIM

When the parameter based on pressure fluctuation exceeds the preset value, EJX diagnoses an impulse line as blockage and gives an alarm. The threshold values are set to DIAG_LIM [1] to [8] in the SENSOR Transducer block.

TableA8.2 shows the default values at the factory setting, which are different according to the model.

NOTE

- When ILBD is performed for the first time, use the default value. If the pressure fluctuation amplitude is low or a false alarm is often generated after ILBD is performed, change the values of DIAG_LIM according to the procedure described in A8.2.10.
- Use Device description (DD) file for parameter setting.

DIAG_LIM

#	Parameter	Threshold value
[1]	fdpmax	Threshold to detect “A Blocking” by using **RATIO_FDP**
[2]	fdpmin	Threshold to detect “B Blocking” by using **RATIO_FDP**
[3]	fsplmax	Threshold to detect “Large Fluctuation of Low Side” by using **RATIO_FSPL**
[4]	fsplmin	Threshold to detect “Low Side Blocking” by using **RATIO_FSPL**
[5]	fsphmax	Threshold to detect “Large Fluctuation of High Side” by using **RATIO_FSPH**
[6]	fsphmin	Threshold to detect “High Side Blocking” by using **RATIO_FSPH**
[7]	blkfmax	Threshold to detect “High Side Blocking” by using **VALUE_BLKF**
[8]	blkfmin	Threshold to detect “Low Side Blocking” by using **VALUE_BLKF**
[9]	dpavgmax	Threshold to detect “Outside Diagosis Range” by using **VALUE_DPAVG** and to detect “Invalid Ref xx” by using **REFERENCE_DPAVG**.
[10]	dpavgmin	Threshold to detect “Outside Diagosis Range” by using **VALUE_DPAVG** and to detect “Invalid Ref xx” by using **REFERENCE_DPAVG**.

Table A8.2 Default Values of DIAG_LIM

INDEX	Parameter	Differential pressure transmitter			Flange mounted differential pressure transmitter	Diaphragm sealed differential pressure/ pressure transmitter	Absolute pressure transmitter	Gauge pressure transmitter	Gauge/ Absolute pressure transmitter
		EJX110A EJX115A	EJX120A	EJX130A EJX135A	EJX210A	EJX118A[Note 1] EJX438A	EJX310A	EJX430A EJX440A	EJX510A EJX530A
[1]	fDPmax	3	3	3	10000	10000	10000	10000	10000
[2]	fDPmin	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
[3]	fSPlmax	5	10000	5	10000	10000	10000	10000	10000
[4]	fSPlmin	0.5	0	0.5	0	0	0	0	0
[5]	fSPhmax	5	10000	5	10000	10000	10000	10000	10000
[6]	fSPhmin	0.5	0	0.5	0	0	0	0	0
[7]	blkfmax	0.6	10	0.6	10	10	10	10	10
[8]	blkfmin	-0.6	-10	-0.6	-10	-10	-10	-10	-10
[9]	dpavgmax Note2	1	1	1	1	1	1	1	1
[10]	dpavgmin Note2	0.05	0.2	0.05	-1	-1	0.05	0.05	0.05

Note 1: The default values are set for level measurement. If EJX118A is applied to the flow measurement, set the same value to DIAG_LIM [1] to [10] as those of EJX110A.
Note 2: It indicates the threshold value for ILBD over range (refer to A8.2.5.3).

■ A/B Blocking Detection

"A Blocking" and "B Blocking" indicates the result estimated from blockage degree based on the difference of the high- and low-pressure-side fluctuation values. RATIO_FDP, SQRT (VALUE_FDP / REFERENCE_FDP) is used to detect A/B Blocking.
REFERENCE_FDP is the average value of the sum of squares of differential pressure fluctuations under normal condition. As the value of RATIO_FDP exceeds the value of DIAG_LIM [1], EJX gives basically an alarm of "A Blocking". On the other hand, if this value is below the value of DIAG_LIM [2], EJX gives an alarm of "B Blocking. As a high- or low-pressure-side blockage progresses, VALUE_FDP increases. Therefore, "A Blocking" with a differential pressure transmitter indicates that a single-side impulse line is plugged for a differential pressure transmitter.
As the both-side blockages progress simultaneously, VALUE_FDP decreases. Therefore, "B Blocking" with a differential pressure transmitter indicates that bothside impulse lines are plugged.

NOTE

A single-side impulse line blockage may generate "B blocking" under the condition where the fluctuation amplitude is much different between high- and low-pressure sides.

With a transmitter to measure pressure or tank level, "B Blocking" only is detected.

■ H/L Side Blocking Detection

EJX differential pressure transmitter enables to detect both-, a high-, or low-pressure-side blockage. The blockage degree characterized by a comparison of high-pressure side and low-pressure-side fluctuation values, VALUE_BLKF, is used to detect it. The value changes within a range of –1 to +1. As VALUE_BLKF approaches +1, the high-pressure-side blockage progresses. On the other hand, if it approaches -1, the low-pressure-side blockage progresses.

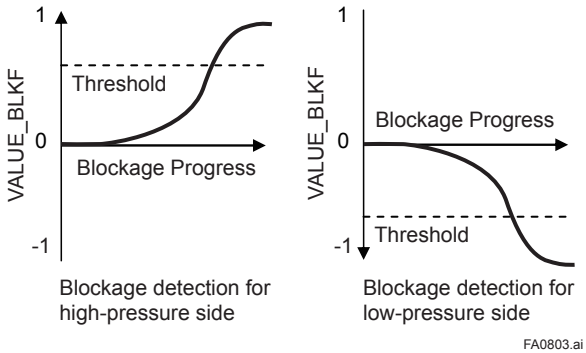


Figure A8.2 Relation between Blockage Progress and VALUE_BLKF

The each threshold value to detect the high- or low-pressure-side blockage is set to DIAG_LIM [7] or [8].

■ Low Side Blocking Detection

VALUE_BLKF is preferentially used to "Low Side Blocking" detection. If VALUE_BLKF cannot be used, RATIO_FSPL, SQRT (VALUE_FSPL / REFERENCE_FSPL) is used to "Low Side Blocking" detection. REFERENCE_FSPL is the average value of the sum of squares of low-pressure-side static pressure fluctuations under normal condition. As the value of RATIO_FSPL is below the value of DIAG_LIM [4], EJX gives an alarm of "Low Side Blocking". On the other hand, if this value exceeds the value of DIAG_LIM [3], EJX gives an alarm of "Large Fluctuation of Low Side".

■ High Side Blocking Detection

VALUE_BLKF is preferentially used to "High Side Blocking" detection. If VALUE_BLKF cannot be used, RATIO_FSPH, SQRT (VALUE_FSPH / REFERENCE_FSPH) is used to "High Side Blocking" detection. REFERENCE_FSPH is the average value of the sum of squares of high-pressure-side static pressure fluctuations under normal condition.

As the value of RATIO_FSPH is below the value of DIAG_LIM [6], EJX gives an alarm of "High Side Blocking". On the other hand, if this value exceeds the value of DIAG_LIM [5], EJX gives an alarm of "Large Fluctuation of High Side".

■ Large Fluctuation Detection

When a pump or compressor starts, the large fluctuation is generated as process condition changes rapidly. This phenomenon affects process fluctuation measurement, so correct blockage detection is not performed.

If “Large fluctuation of Low Side” or “Large fluctuation of High Side” is detected, consider whether a blockage result is correct.

The threshold values to detect large fluctuation are set to DIAG_LIM [3] and [5].

Since these values are enough to detect large fluctuation, it is not almost necessary to change them.

A8.2.2 Combination of Reference Result and Blockage Detection

An EJX differential pressure transmitter can detect four modes of impulse line blockage: both-sides, high-pressure side, low-pressure side, and/or single-side when all the reference values are properly measured. However, the detectable alarm mode combination is limited when some of the reference values are invalid. The relation between the detectable blockage modes and reference value results are shown in the below figure.

NOTE

- REFERENCE_FDP must be larger than the specified level shown in Table A8.3 (refer A8.2.6). No blockage can be detected when VALUE_FDP is not large enough.
- The plausibility of blockage detection needs to be confirmed by blockage simulation test. The simulation test can be performed by the appropriate manifold operation (refer to A8.2.8).

[Differential pressure transmitter]

Fluctuation Parameters		Simulation Test	Available Blockage Detection
REFERENCE_FDP REFERENCE_FSPL REFERENCE_FSPH REFERENCE_BLKF	OK OK OK OK	• Test for low-pressure side • Test for high-pressure side • Test for both-pressure sides	• B Blocking detection (by using RATIO_FDP) • Low side blockage detection (by using RATIO_FSPL) • High side blockage detection (by using RATIO_FSPH) • High/Low side blockage detection (by using VALUE_BLKF)
REFERENCE_FDP REFERENCE_FSPL REFERENCE_FSPH REFERENCE_BLKF	OK OK OK NG	• Test for low-pressure side • Test for high-pressure side • Test for both-pressure sides	• A/B Blocking detection (by using RATIO_FDP) • Low Side Blocking detection (by using RATIO_FSPL) • High Side Blocking detection (by using RATIO_FSPH)
REFERENCE_FDP REFERENCE_FSPL REFERENCE_FSPH REFERENCE_BLKF	OK NG OK NG	• Test for high-pressure side	• A Blocking detection (by using RATIO_FDP) • High Side Blocking detection (by using RATIO_FSPH)
REFERENCE_FDP REFERENCE_FSPL REFERENCE_FSPH REFERENCE_BLKF	OK NG NG NG	• Test for both-pressure sides	• B Blocking detection (by using RATIO_FDP)

[Transmitter for gauge/absolute pressure and level measurement]

Fluctuation Parameters		Simulation Test	Available Blockage Detection
REFERENCE_FDP	OK	• Test for high-pressure side	• B Blocking detection (by using RATIO_FDP)

A8.2.3 Operating Parameters

■ DIAG_MODE

DIAG_MODE gives the directive for the ILBD operation. There are following three modes.

DIAG MODE

Code	Mode	Function
0	Stop	The blockage detection operation is stopped.
1	Calculation	The blockage detection operation is performed. Alarms are generated along with the result.
2	Reference	Reference values for the blockage detection are obtained and updated to the latest. After sampling reference values, this mode changes to "Calculation".

When the blockage detection operation is performed, set “Calculation” to DIAG_MODE.
“Stop” must be set when you change a threshold value or set an alarm.
“Reference” is set in order to obtain the reference fluctuation values under the normal configuration.

■ DIAG_PERIOD

The values such as RATIO_FDP and BLKF are averaged based on several hundreds of pressure fluctuation values in constant time. DIAG_PERIOD defines the sampling time. The default value at the shipment is set to 180 seconds.

For the information on how to change the sampling period, refer to A8.2.10.

■ DIAG_COUNT

When the value as RATIO_FDP or BLKF exceeds the threshold value for several times in a row, it is estimated that the impulse line is plugged. DIAG_COUNT defines the number of times to estimate blockage detection.

If DIAG_COUNT is set to three times, an alarm is not generated at part ‘A’ in Figure A8.3. The reason is that only the first and second values exceeded consecutively the threshold.

When the value exceeds consecutively the threshold value three times, an alarm is generated (see part ‘B’ in Figure A8.3).

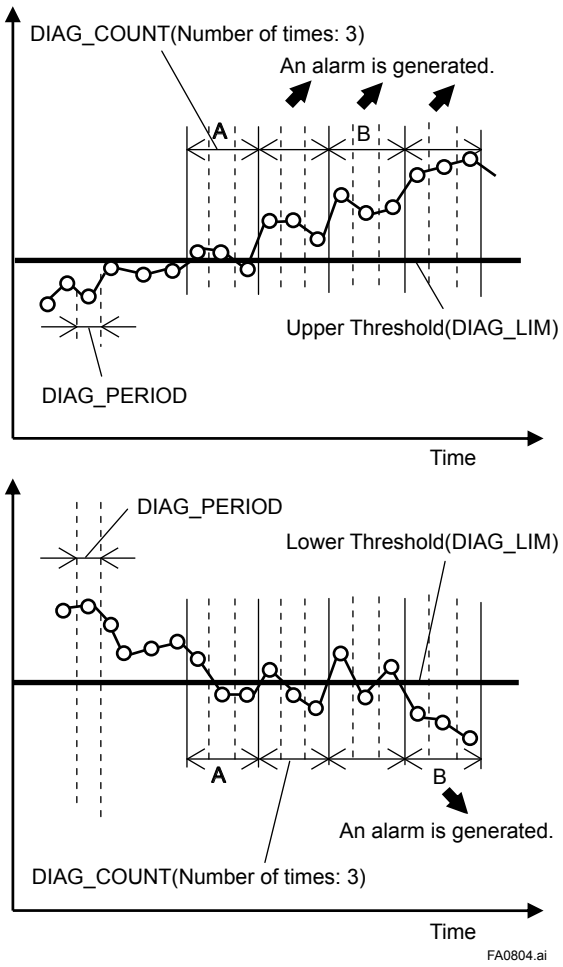


Figure A8.3 Relationship of DIAG_COUNT and Alarm

The number of detection to give an alarm is set for each blockage detection function. The default value at the shipment is set to three times.

If fluctuating around the threshold value, an alarm may be often generated. In this case, change the threshold value (DIAG_LIM) or the sampling time (DIAG_PERIOD) to enhance the accuracy of the blockage detection. Refer to A8.2.10.

A8.2.4 Operating Procedure

The basic flow of the ILBD operation is as follows.

1) Initial setting
2) Condition check
3) Start up
4) Perform the ILBD algorithm

If an alarm is often generated or the process condition changed in the ILBD operation, you need to do tuning, to change the alarm setting, or to reset the reference values.

Fill out the information to the checklist, at the process shown in below figure.

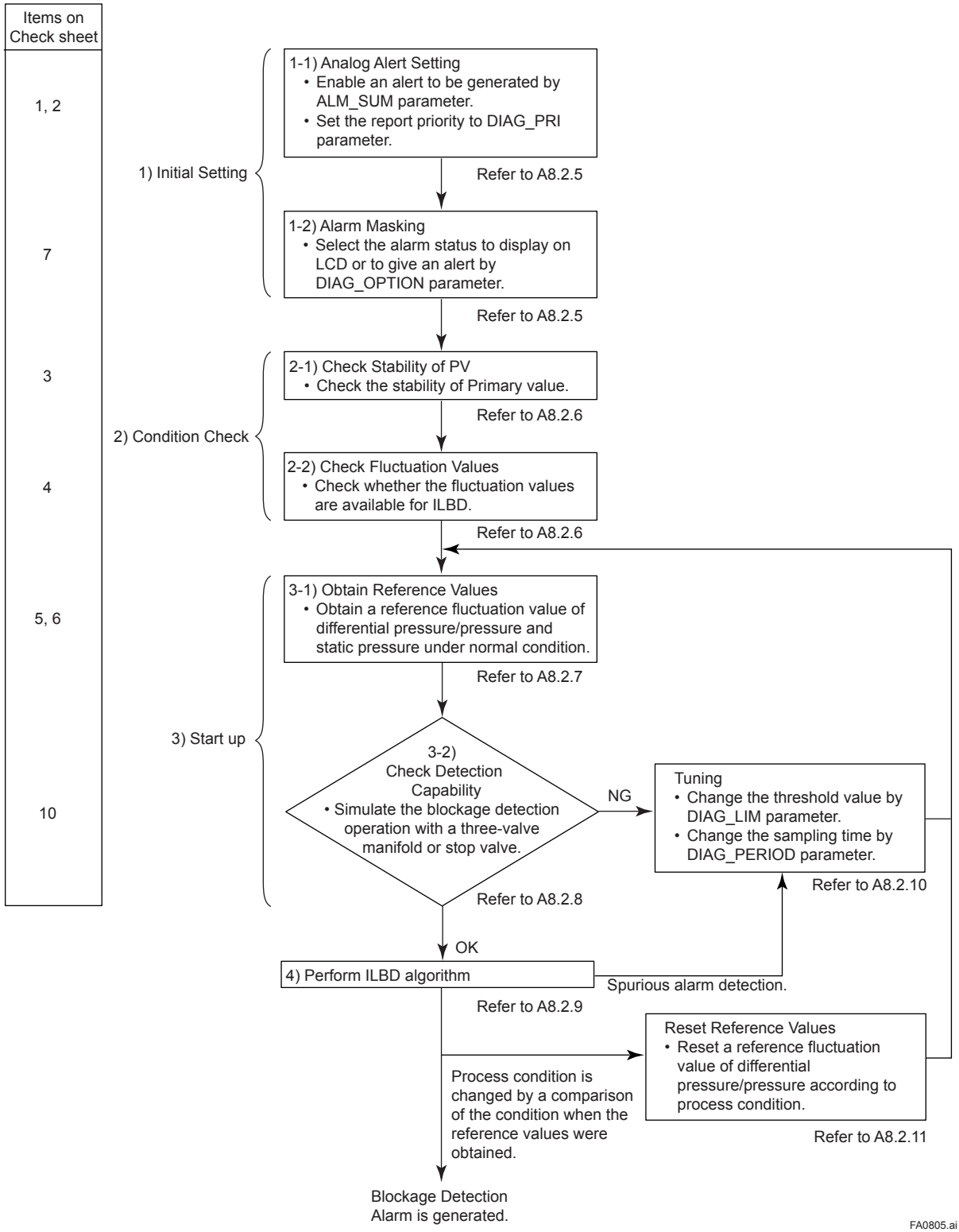


Figure A8.4 Flow Chart of ILBD Operation

A8.2.5 Alarm and Alert Setting

The abnormal results, as the blockage detection and high/low flange temperature (heat trace monitoring) are given by an analog alert or the LCD display of alarm status. The analog alert or the LCD display of alarm status is set according to the flow shown in below figure.

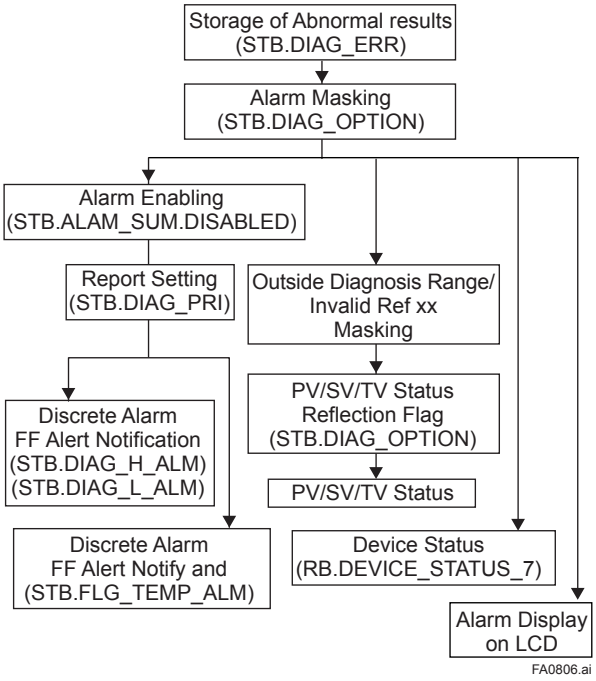


Figure A8.5 Alarm and Alert Setting

A8.2.5.1 Alert Setting

● Link to DIAG_H_ALM and DIAG_L_ALM

DIAG_H_ALM and DIAG_L_ALM enable to indicate the alarm status separately divided into the high- and low-pressure-side alert. The factory setting is not enabled to display them.

Enable to display the alarm status to DIAG_H_ALM and DIAG_L_ALM according to the following procedure.

1) Set "Stop" to DIAG_MODE.
2) Uncheck the checkbox of "Diag Alm Disabled" or "Fail Alm Disabled", which is corresponding to bit 8, in ALARM_SUM.

NOTE

In DevRev5, bit8 of "ALARM_SUM" is commonly used by "Diag Alm Disabled" and "Fail Alm Disabled". If "Diag Alm Disabled" is not displayed on DD/DTM display and "Fail Alm Disabled" is shown, clear the selection of "Fail Alm Disabled".

Note: Set to "Calculation" after setting the parameters.

● Report Setting

DIAG_PRI in SENSOR Transducer block defines the priority to transfer the analog alert to the host. The alert is generated according to the priority when interfering in other alerts.

DIAG_PRI

Bit	Description
0	An alert is not generated.
1	An alert does not be reported to the host.
2	Disabled
3-7	ADVISORY
8-15	CRITICAL

The default value at the factory setting is set to 1.

Set the priority according to the following procedure.

1) Set "Stop" to DIAG_MODE.
2) Enter the value to DIAG_PRI in the number of 3 to 15.

Note: The setting of the highest priority is 15.
Set to "Calculation" after setting the parameters.

A8.2.5.2 Alarm Display on LCD

If the ILBD algorithm detects the abnormality, the content of the detected result is displayed with "AL.88" or "AL.89" on the LCD. "AL.88" indicates that condition is not applicable for the abnormality detection and "AL.89" indicates the abnormality is detected.

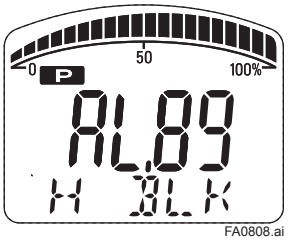


Figure A8.6 Display Example of High Side Blocking

The alarm display on LCD regarding ILBD is described in Table 8.12 of the section 8.

A8.2.5.3 Alarm Status

When the algorithm of ILBD and Heat trace monitoring detect the abnormality, the result is stored in DIAG_ERR. The alarm status based on the detected abnormality is displayed to DIAG_ERR in the SENSOR Transducer block.

DIAG_ERR

Bit	Alarm status	DIAG_H_ ALM	DIAG_L_ ALM	FLG_ TEMP_ALM
0	Not used.			
1	Not used.			
2	A Blocking	✓	✓	
3	Large Fluctuation of Low Side		✓	
4	Large Fluctuation of High Side	✓		
5	Low Side Blocking		✓	
6	High Side Blocking	✓		
7	B Blocking	✓	✓	
8	Invalid Ref BlkF	✓	✓	
9	Invalid Ref fSPh	✓		
10	Invalid Ref fSPl		✓	
11	Invalid Ref fDP	✓	✓	
12	Outside Diagnosis Range	✓	✓	
13	Flg Temp Low Alarm			✓
14	Flg Temp High Alarm			✓
15	Reflect Blockage to PV/SV/TV status			

Note: The bit 13 and 14 are used for Heat trace monitorig function.

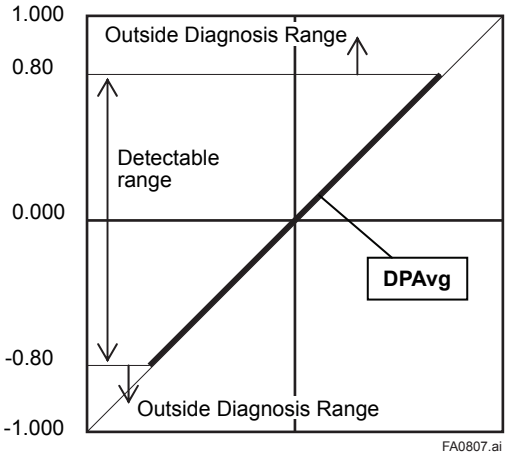
● Outside Diagnosis Range

1) dpavgmax
   The dpavgmax, DIAG_LIM [9], is the upper limit of the diagnostic capability range. The limit value can be changed when DIAG_MODE is “Stop”.
   VALUE_DPAVG indicates the ratio of the average of differential pressure to the maximum span regarded as 1. When VALUE_DPAVG exceeds this limit, “Outside Diagnosis Range” is generated so that the blockage detection becomes impossible.
2) dpavgmin
   The dpavgmin, DIAG_LIM [10], is the lower limit of the diagnostic capability range. The limit value can be changed when DIAG_MODE is “Stop”.
   When VALUE_DPAVG is below this limit, “Outside Diagnosis Range” is generated so that the blockage detection becomes impossible.

<Example>

When the level range that can be measured by the transmitter with 100 kPa span is -80 to 80 kPa, the limits are set as follows.

- dpavgmax: 0.80
- dpavgmin: -0.80



● Invalid Ref BlkF, fSPh, fSPl, or fDP

This alarm indicates that the reference value under normal condition is invalid. If REFERENCE_BLKF is invalid, the blockage detection excluding VALUE_BLKF is carried out. If blockage detection function based on VALUE_BLKF is required, obtain the reference value again.

Also when REFERENCE_DPAVG is below DIAG_LIM [10] or exceeds DIAG_LIM [9], all reference value becomes invalid so that “Invalid Ref fDP”, “Invalid Ref fSPl”, “Invalid Ref fSPh”, and “Invalid Ref BlkF” are generated.

A8.2.5.4 Alarm Masking

● DIAG_OPTION

The alarms linked to an analog alert and LCD display are selected by DIAG_OPTION in the SENSOR Transducer block. The BIT of DIAG_ OPTION is corresponding to that of DIAG_ERR.

To link the alarm to an analog alert and LCD display, follow the procedure below.

1) Set "Stop" to DIAG_MODE.
2) Check each checkbox of the alarm, which is selectable from bit 2 to bit 14.

Note: The bit 13 and 14 are used for Heat trace monitoring function.
Set to “Calculation” after setting the parameters.

A8.2.5.5 Reflect Blockage to PV/SV/TV Status

"Reflect Blockage to PV/SV/TV Status" corresponding to bit 15 in DIAG_OPTION is used to link the alarm to the OUT signal status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE.

When the ILBD algorithm detects the abnormality, each signal status becomes "UNCERTAIN: Non Specific".

The alarm is linked to the signal status of PV, SV and TV, according to the following procedure.

1) Set "Stop" to DIAG_MODE.
2) Check the checkbox of "Availability for the Status" of DIAG_OPTION.

Note:Set to "Calculation" after setting the parameters.

NOTE

The alarms of "Invalid Ref xx", "Outside Diagnosis Range" do not link to the signal status of PV, SV, and TV.

A8.2.6 Condition Check

After the EJX differential pressure/pressure transmitter was installed, it is necessary to confirm that the Primary Value (PV) is stable under the normal operating condition and that fluctuation amplitude under the normal operating condition is large enough to detect the blockage.

A8.2.6.1 Stability of Primary Value

1) Observe the value change of PRIMARY_VALUE under the normal operating condition for 10 minutes.
2) Confirm the value change is less than 10%.

If the value change is more than 10%, the error influences pressure fluctuation value so that the blockage detection becomes Unreliable. You need to consider the plant operating conditions.

A8.2.6.2 Fluctuation Value

NOTE

The blockage detection may not be carried out correctly when pressure fluctuation amplitude especially with the pressure and level measurement, is small.

Confirm that each value of VALUE_FDP, VALUE_FSPL, VALUE_FSPH, and VALUE_BLKF is more than the value specified in the below table.

Table A8.3 Requiremnents to apply ILBD

	Condition
VALUE_FDP	7×10^{-10} or more
VALUE_FSPL	1×10^{-10} or more
VALUE_FSPH	1×10^{-10} or more
VALUE_BLKF	-0.5 to 0.5

- **VALUE_FDP is not enough**

No blockage can be detected if VALUE_FDP is not larger than the specified value.

- **Only VALUE_FDP is enough**

"A Blocking" or "B Blocking" can be detected if VALUE_FSPL and VALUE_FSPH are not larger than specified values.

- **VALUE_FDP and VALUE_FSPL are enough**

"High Side Blocking" and "Large Fluctuation of High Side" can not be detected if VALUE_FSPH is not larger than specified value.

- **VALUE_FDP and VALUE_FSPH are enough**

"Low Side Blocking" and "Large Fluctuation of Low Side" can not be detected if VALUE_FSPL is not larger than specified value.

- **VALUE_FDP, VALUE_FSPL and VALUE_FSPH are enough**

All alarm modes can be detected even if VALUE_BLKF is not within the specified values.

A8.2.7 Obtain Reference Values

The pressure fluctuation values are reduced when the impulse line is plugged. Therefore, the reference value is required to determine the degree of reduction

IMPORTANT

- If the impulse line is about to be plugged at the time when a reference value is obtained, blockages cannot be detected accurately. The impulse lines on both the high-pressure and low-pressure sides need to be cleaned before a reference value is obtained.
- All air bubbles need to be adequately purged before a reference value is obtained.
- Reference values must be obtained under operating condition.
- Do not obtain the reference values when the BLOCK_MODE of SENSOR Transducer is O/S. If carried out, an alarm of "Invalid Ref xx" is generated. Some hosts may have a function to automatically change the mode to O/S when changing the setting. In such case, disable that function.

■ Start of Sampling

The sampling of reference value is carried out for 180 seconds, which is the default value set to DIAG_PERIOD.

1) Confirm that the sampling period (DIAG_PERIOD) is set to 180 seconds.
2) Set “Reference” to DIAG_MODE. The sampling starts soon after the setting.

IMPORTANT

- For the each parameter, the one value is given. If “Reference” is set to DIAG_MODE again, the value is updated and overwritten.
- If the power supply is shut down during the sampling, DIAG_MODE becomes “Stop”. Set “Reference” to DIAG_MODE in order to carry out the sampling again.

■ End of Sampling

After about 180 seconds, the sampling automatically finishes. The “Reference” setting of DIAG_MODE changes automatically to “Calculation” and the termination time is recorded to REFERENCE_TIME.

1) Confirm that the setting of DIAG_MODE changes to “Calculation”.
2) Check the termination time recorded into REFERENCE_TIME.

■ Reference Values

Confirm the latest values are obtained into the following parameters.

- REFERENCE_FDP
- REFERENCE_FSPL
- REFERENCE_FSPH
- REFERENCE_BLKF
- REFERENCE_DPAVG

■ Invalid Ref BlkF, fSPh, fSPl, or fDP

When the enough reference fluctuation value is not obtained, an alarm of Invalid Reference value for each parameter is generated and also the part of ILBD function related to the Invalid Ref BlkF, fSPh, fSPl, or fDP is not carried out.

Confirm the alarm of Invalid Ref BlkF, fSPh, fSPl, or fDP is not displayed in DIAG_ERR.

If an alarm of Invalid Reference value is generated, consider the process condition or obtain the reference fluctuation values again.

NOTE

Even if an alarm of Invalid Ref BlkF, fSPh, fSPl, or fDP is generated, “Calculation” in DIAG_MODE is kept.

A8.2.8 Capability Test of Blockage Detection Operation

Before performing the ILBD operation, check the capability of the blockage detection operation. The simulation test is performed by closing motion of a three-valve manifold or stop valve. When simulated blockage occurs, confirm that an alarm is generated.

NOTE

The fluctuation amplitude of atmospheric pressure is nearly zero with pressure or level measurement. In such case, simulate the blockage detection by closing the valve where the fluctuation existed.

■ Simulation of High-pressure-side Blockage

1) Close the high-pressure-side valve.
2) Confirm the value of PRIMARY_VALUE is stable. If unstable, open valve a little.

3) Set “Calculation” to DIAG_MODE so as to start blockage detection operation.
4) Check that an alarm of “High Side Blocking” is generated after the time that consists of DIAG_PERIOD and DIAG_COUNT passed.
5) Check also the operation of the analog alert if an analog alert is set.
6) Open the valve completely and check that there are no alarms.

■ Simulation of Low-pressure-side Blockage

1) Close the low-pressure-side valve.
2) Confirm the value of PRIMARY_VALUE is stable. If unstable, open valve a little.
3) Set “Calculation” to DIAG_MODE so as to start blockage detection operation.
4) Check that an alarm of “Low Side Blocking” is generated after the time that consists of DIAG_PERIOD and DIAG_COUNT passed.
5) Check also the operation of the analog alert if an analog alert is set.
6) Open the valve completely and check that there are no alarms.

■ Simulation of Both-pressure-side Blockage

1) Close the both-pressure-side valves.
2) Confirm the value of PRIMARY_VALUE is stable. If unstable, open valve a little.
3) Set “Calculation” to DIAG_MODE so as to start blockage detection operation.
4) Check that an alarm of “B Blocking” is generated after the time that consists of DIAG_PERIOD and DIAG_COUNT passed.
5) Check also the operation of the analog alert if an analog alert is set.
6) Open the valves completely and check that there are no alarms.

A8.2.9 Start ILBD Operation

If process condition and capability to detect a blockage are confirmed, the ILBD operation can be started according to the following procedure.

1) Check the value of sampling period (DIAG_PERIOD).
2) Check the number of times that detect the blockage consecutively in order to give an alarm (DIAG_COUNT). The default value at the shipment is set to 3 times.
3) Set “Calculation” status to DIAG_MODE. If the reference value has not yet been obtained, set “Reference” to DIAG_MODE. After obtained the reference values, the ILBD starts automatically. At the same time, DIAG_MODE changes automatically from “Reference” to “Calculation”.

A8.2.10 Tuning

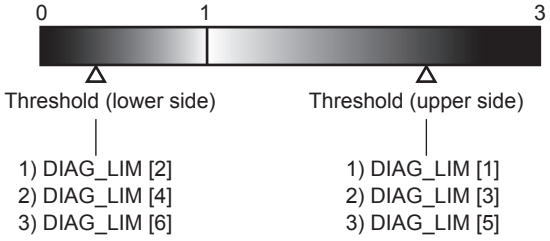
When the pressure fluctuation amplitude in fluids is not sufficiently large or an alarm is often generated according to the process condition, tune up by changing the threshold for the blockage detection (DIAG_LIM) or the sampling period (DIAG_PERIOD) to enhance the accuracy of the blockage detection.

The ILBD operation must be stopped to tune up. Set “Stop” to DIAG_MODE.

A8.2.10.1 Threshold Value

The figure below shows the image of tuning effect with a monochrome bar.

(a) The tuning image of the threshold values for
1) RATIO_FDP Sqrt (VALUE_FDP/REFERENCE_FDP),
2) RATIO_FSPL Sqrt (VALUE_FSPL/REFERENCE_FSPL),
3) RATIO_FSPH Sqrt (VALUE_FSPH/REFERENCE_FSPH)



(b) The tuning image of the threshold values for
4) Sqrt (VALUE_BLKF/REFERENCE_BLKF)

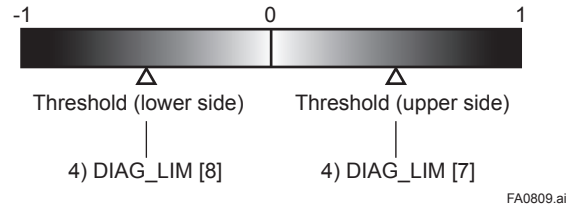


Figure A8.7 Tuning Image of Threshold Value

● **Move the threshold toward the white.**

- It becomes increasingly likely to give an alarm due to the disturbance from environment change.
- If flow/differential pressure is below DIAG_LIM [10] or exceeds DIAG_LIM [9], pressure fluctuation is likely too small or too large to detect the blockage.

● **Move the threshold toward the black.**

- It enables to be insusceptible to disturbance such as environment change and to detect the blockage easier.
- It becomes giving an alarm of the blockage after the blockage has been progressed.

The default values at the factory setting are the values of DIAG_LIM [1] to [8] shown in Table A8. 2.

Change the threshold value to solve your problem according to the above image

(1) Set “Stop” to DIAG_MODE.
(2) Change the unsuitable value of DIAG_LIM corresponding to the each blockage detection.

Note:Set to “Calculation” after setting the parameters.

DIAG_LIM

#	Parameter	Threshold value
[1]	fdpmax	Threshold to detect “A Blocking” by using **RATIO_FDP**
[2]	fdpmin	Threshold to detect “B Blocking” by using **RATIO_FDP**
[3]	fsplmax	Threshold to detect “Large Fluctuation of Low Side” by using **RATIO_FSPL**
[4]	fsplmin	Threshold to detect “Low Side Blocking” by using **RATIO_FSPL**
[5]	fsphmax	Threshold to detect “Large Fluctuation of High Side” by using **RATIO_FSPH**
[6]	fsphmin	Threshold to detect “High Side Blocking” by using **RATIO_FSPH**
[7]	blkfmax	Threshold to detect “High Side Blocking” by using **VALUE_BLKF**
[8]	blkfmin	Threshold to detect “Low Side Blocking” by using **VALUE_BLKF**

A8.2.10.2 Sampling Period

If fluctuating around the threshold value, an alarm may be often generated. When the above phenomenon happens, the sampling time (DIAG_PERIOD) can be changed as as to enhance the accuracy of the blockage detection.

The longer the sampling time, better the expected accuracy.

(1) Set “Stop” to DIAG_MODE.
(2) Enter the value to DIAG_PERIOD within the range of 20 to 65535 (seconds).

Note: Set to “Calculation” after setting the parameters.

Also, the accuracy can be improved by increasing the number of DIAG_COUNT.

A8.2.10.3 ILBD Range Setting

When the VALUE_DPAVG is less than the value of the DIAG_LIM [10] or exceeds the value of DIAG_LIM [9] shown in Table A8. 2, EJX gives an alarm of “Outside Diagnosis Range”.

If flow/differential pressure is less than the default threshold value of DIAG_LIM [10], pressure fluctuation is not large enough to detect the blockage. To prevent the fault blockage detection, the threshold value should be changed to larger value.

(1) Set “Stop” to DIAG_MODE.
(2) Enter the value to DIAG_LIM [10].

Note: Set to “Calculation” after setting the parameters.

A8.2.10.4 COMP_FLG

When “Compensation” is selected in COMP_FLG, RATIO_FDP is compensated by following formula and used as treatable monitoring value, CRATIO_FDP.

$$\text{CRATIO_FDP} = \sqrt{\frac{\text{VALUE_FDP}}{\text{REFERENCE_FDP}}} \times \left| \frac{\text{REFERENCE_DPAVG}}{\text{VALUE_DPAVG}} \right|$$

On the other hand, if the compensation is not necessary, “Non-compensation” is selected in COMP_FLG and RATIO_FDP is used as NRATIO_FDP.

$$\text{NRATIO_FDP} = \sqrt{\frac{\text{VALUE_FDP}}{\text{REFERENCE_FDP}}}$$

A8.2.11 Reset of Reference Value

When there are large flow change or the change of fluid under the measured process conditions, obtain the reference value again.

If flow change by a comparison of the reference value is ±25% or more, you need to obtain the reference value again.

A8.2.12 ILBD Parameter Lists

All the ILBD parameters belong to the SENSOR Transducer block.

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.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
66	2066	DIAG_MODE	Stop (0)	AUTO	Select the function mode for the ILBD. Stop (0): The blockage detection is stopped. Calculation (1): The blockage detection is carried out. The alarms are generated along with the detected result. Reference (2): The reference values are obtained and the update values are overwritten. After setting, this mode changes automatically to Calculation (1)
67	2067	DIAG_PERIOD	180 (s)	AUTO	Set the data acquisition period for ILBD within the range of 20 to 65535 (s). Writable only when DIAG_MODE is Stop(0). If the process fluctuation values are unsteady, change this value to the longer to enhance the accuracy of the blockage detection.
68	2068	DIAG_PRI	1	AUTO	Set alert (DIAG_H_ALM and DIAG_L_ALM) priority for ILBD. Writable only when DIAG_MODE is Stop(0).
69	2069	DIAG_ERR	0x0000	—	The following ILBD results are shown. • A Blocking (bit 2) • Large Fluctuation of Low Side (bit 3) • Large Fluctuation of High Side (bit 4) • Low Side Blocking (bit 5) • High Side Blocking (bit 6) • B Blocking (bit 7) • Invalid Ref BlkF (bit 8) • Invalid Ref fSPh (bit 9) • Invalid Ref fSPl (bit 10) • Invalid Ref fDP (bit 11) • Outside Diagnosis Range (bit 12) • Flg Temp Low Alarm (bit 13) • Flg Temp High Alarm (bit 14) Bit 15 is used to link the alarm to status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE.
70	2070	DIAG_H_ALM		—	Alerts for high-pressure side are indicated. • A Blocking • B Blocking • Large Fluctuation of High Side • High Side Blocking • Invalid Reference value (BlkF, fSPh, or fDP) • Outside Diagnosis Range
71	2071	DIAG_L_ALM		—	Alerts for low-pressure side blockage are indicated due to the following factors. • A Blocking • B Blocking • Large Fluctuation of Low Side • Low Side Blocking • Invalid Reference value (BlkF, fSPl, or fDP) • Outside Diagnosis Range
72	2072	DIAG_OPTION	0x08FC	AUTO	The alarm status linked to an analog alert and LCD display is selected by DIAG_OPTION in the SENSOR Transducer block. The alarm selected in DIAG_OPTION is corresponding to bit of DIAG_ERR. BIT 15 is used to link the alarm to the status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE. If set to 1, the signal status becomes “UNCERTAIN: Non Specific” when the ILBD algorithm detects the abnormality. Writable only when DIAG_MODE is Stop(0).

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
73	2073	REF_LIM_FDPMIN	7.0E-10	AUTO	Lower limit to judge whether **REFERENCE_FDP** is available for ILBD operation. Writable only when Diag Mode is Stop(0).
74	2074	REF_LIM_FSPMIN	1.0E-10	AUTO	Lower limit to judge whether **REFERENCE_FSPL** and REFERENCE_FSPH are available for ILBD operation. Writable only when Diag Mode is Stop(0).
75	2075	REF_LIM_BLKFMAX	0.5	AUTO	Upper limit to judge whether **REFERENCE_BLKF** is available for ILBD operation. Writable only when Diag Mode is Stop(0).
76	2076	COMP_FLAG	0 (Compensation)	AUTO	Whether RATIO_FDP is referred by CRATIO_FDP or NRATIO_FDP is selected. • Compensation(0) • Non-Compensation(1)
77	2077	DIAG_LIM	Refer to Table A8.2	AUTO	Set the ten threshold values for ILBD. [1] Upper limit to detect “A Blocking” [2] Lower limit to detect “B Blocking” [3] Upper limit to detect “Large Fluctuation of Low Side” [4] Lower limit to detect “Low Side Blocking” [5] Upper limit to detect “Large Fluctuation of High Side” [6] Lower limit to detect “High Side Blocking” [7] Upper limit to detect “High Side Blocking” by using VALUE_BLKF [8] Lower limit to detect “Low Side Blocking” by using VALUE_BLKF [9] Upper limit to detect “Outside Diagnosis Range” [10] Lower limit to detect “Outside Diagnosis Range” Writable only when DIAG_MODE is Stop(0).
78	2078	DIAG_COUNT	3	AUTO	When the statistical value such as VALUE_FDP and VALUE_BLKF exceeds consecutively the threshold by number of times preset to this parameter, it is estimated that the impulse line is plugged. Writable only when DIAG_MODE is Stop(0). If the process fluctuation values are unsteady, increase this numbers to enhance the accuracy of the blockage detection.
79	2079	REFERENCE_TIME	0x00000000	AUTO	The date and time when the reference values were obtained are automatically recorded when DIAG_MODE is set to Reference (2).
80	2080	REFERENCE_FDP	0x00, 0	AUTO	The reference value of VALUE_FDP obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
81	2081	REFERENCE_FSPL	0x00, 0	AUTO	The reference value of VALUE_FSPL obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
82	2082	REFERENCE_FSPH	0x00, 0	AUTO	The reference value of VALUE_FSPH obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
83	2083	REFERENCE_BLKF	0x00, 0	AUTO	VALUE_BLKF obtained under normal condition.
84	2084	REFERENCE_DPAVG	0x00, 0	AUTO	The average value of differential pressure obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
85	2085	VALUE_TIME		—	The date and time when the statistical values such as VALUE_FDP and VALUE_BLKF were calculated are recorded.
86	2086	VALUE_FDP		—	Average value of the sum of squares of differential pressure/ pressure fluctuations.
87	2087	VALUE_FSPL		—	Average value of the sum of squares of low-pressure side static pressure fluctuations.
88	2088	VALUE_FSPH		—	The average value of the sum of squares of low-pressure side static pressure fluctuations.
89	2089	VALUE_BLKF		—	Blockage degree characterized in comparison of high-pressure side and low-pressure side pressure fluctuation values.
90	2090	VALUE_DPAVG		—	Ratio of the average of differential pressure/pressure to the maximum span of an EJX
91	2091	RATIO_FDP		—	CRATIO_FDP or NRATIO_FDP is used by COMP_FLG setting. VALUE_FDP decreases and this parameter is used to determine whether single or both side is plugged.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
92	2092	RATIO_FSPL		—	SQRT (VALUE_FSPL/REFERENCE_FSPL). VALUE_FSPL decreases and this parameter is used to determine whether low-pressure-side is plugged.
93	2093	RATIO_FSPH		—	SQRT (VALUE_FSPH/REFERENCE_FSPH). VALUE_FSPH decreases and this parameter is used to determine whether high-pressure-side is plugged.
94	2094	CRATIO_FDP		—	RATIO_FDP is compensated by following formula and used as treatable monitoring value when the flow change is too large or small. CRATIO_FDP = Sqrt (VALUE_FDP/REFERENCE_FDP) X|REFERENCE_DPAVG / DPAVG)| When Compensation is selected in COMP_FLG, CRATIO_FDP is used as monitoring value.
95	2095	NRATIO_FDP		—	When Non-compensation is selected in COMP_FLG, NRATIO_ FDP is used as monitoring value NRATIO_FDP = Sqrt (VALUE_ FDP/REFERENCE_FDP)
96	2096	DIAG_APPLICABLE		—	After the reference value is obtained, the applicable blockage detection is displayed on this parameter.

A8.2.13 Checklist

Fill out the below checklist according to the operation flow of the ILBD in order to keep the important information for the blockage detection.

Checklist (1/5)

No.	Items	Parameters	Result	Example
1	Enable Analog Alert to Be Generated • Uncheck the checkbox of “Diag Alm Disable” in ALARM_SUM.	ALARM_SUM (Index: 2063) “Diag Alm Disable”		✓
2	Priority Setting of Analog Alert • Enter a value of more than 3 to DIAG_PRI. (3 is recommended.)	DIAG_PRI (Index: 2068)		3
3	Stability of PRIMARY_VALUE (differential pressure/pressure) under normal condition • Check that the status of PRIMARY_VALUE is “GOOD”. • Check the maximum and minimum values of PRIMARY_VALUE.	Status		Good
		PRIMARY_VALUE (Index: 2014)	Max.: Min.:	Max.: 12.3 kPa Min.: 12.1 kPa
4	VALUE_FDP under normal condition • Check that the value of VALUE_FDP is more than 7×10^{-10}.	VALUE_FDP (Index: 2086)		✓
5	Start to obtain Reference values • Set Reference to DIAG_MODE.	DIAG_MODE (Index: 2066)		✓
6	End of Reference Value Sampling • Check that DIAG_MODE is “Calcuration”, after the time set to DIAG_PERIOD passed.	DIAG_MODE (Index: 2066)		✓
7	Alarm setting • Record the status of Checkbox in DIAG_OPTION.	DIAG_OPTION (Index: 2072)		
		A Blocking	☐	☑
		Large Fluctuation of Low Side	☐	☑
		Large Fluctuation of High Side	☐	☑
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☑
		B Blocking	☐	☑
		Invalid Ref BlkF	☐	☑
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☑
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐

Checklist (2/5)

No.	Items	Parameters	Result	Example
8	Alarm status • Check the alarm status shown in DIAG_ERR. • Check that the alarm status of “Outside Diagnosis Range” is not shown in DIAG_ERR.	DIAG_ERR (Index: 2069)		
		A Blocking	☐	☐
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☐
		High Side Blocking	☐	☐
		B Blocking	☐	☐
		Invalid Ref BlkF	☐	☑
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
9	ILBD parameters • Record the values of parameters for ILBD operation. • Check the status of parameters for ILBD operation. *: Record the value after checked that the status of each parameter is “GOOD”.	DIAG_PERIOD (Index: 2067)		180
		DIAG_LIM (Index: 2077)		
		DIAG_LIM [1]		3.000000
		DIAG_LIM [2]		0.300000
		DIAG_LIM [3]		5.000000
		DIAG_LIM [4]		0.500000
		DIAG_LIM [5]		5.000000
		DIAG_LIM [6]		0.500000
		DIAG_LIM [7]		0.600000
		DIAG_LIM [8]		-0.600000
		DIAG_LIM [9]		1.000000
		DIAG_LIM [10]		0.050000
		DIAG_COUNT (Index: 2078)		3
		REFERENCE_TIME (Index: 2079)		16:22:55.876 01/31/2008
		REFERENCE_FDP* (Index: 2080)		7.43245e-9
		REFERENCE_FSPL* (Index: 2081)		7.25765e-9
		REFERENCE_FSPH* (Index: 2082)		7.18374e-9
		REFERENCE_DPAVG* (Index: 2084)		5.364248
		VALUE_TIME (Index: 2085)		16:22:55.876 01/31/2008
		VALUE_FDP (Index: 2086) *		7.48562e-9
		VALUE_FSPL (Index: 2087) *		7.23277e-9
		VALUE_FSPH (Index: 2088) *		7.14085e-9
		VALUE_BLKF (Index: 2089) *		-0.287259
		VALUE_DPAVG (Index: 2090) *		0.055957

Checklist (3/5)

Go to the following step according to the result of "Invalid Ref xx" shown in the DIAG_ERR of 8th check item.

DIAG_ERR (Index: F2086)				Check item
Invalid Ref fSPh	Invalid Ref fSPl	Invalid Ref fdP		
☐	☐	☐	→	10-a
☑	☑	☐	→	10-b

☑: The alarm is generated.
☐: The alarm is not generated.

No.	Items	Parameters	Result	Example
10-a	Simulation of Blockage detection operation • High Side Blocking: 10-a-1 • Low Side Blocking: 10-a-2 • Both Side Blocking: 10-a-3			
10-a-1	High Side Blocking • Close the high-pressure side valve completely.			
	• Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2086)*		7.48562e-9
		VALUE_FSPL (Index: 2087) *		7.23277e-9
		VALUE_FSPH (Index: 2088) *		7.14085e-9
		VALUE_BLKF (Index: 2089)		-0.287259
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “A Blocking” and “High Side Blocking” are set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2072)		
		A Blocking	☐	☑
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☐
		High Side Blocking	☐	☑
		B Blocking	☐	☐
		Invalid Ref BlkF	☐	☐
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “High Side Blocking” is generated. • Check that the alarm of “Low Side Blocking” is not generated.	DIAG_ERR (Index: 2069)		
		High Side Blocking	☐	☑
		Low Side Blocking	☐	☐

Checklist (4/5)

No.	Items	Parameters	Result	Example
10-a-2	Low Side Blocking • Close the low-pressure side valve completely.			
	• Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2086) *		7.48562e-9
		VALUE_FSPL (Index: 2087) *		7.23277e-9
		VALUE_FSPH (Index: 2088)		7.14085e-9
		VALUE_BLKF (Index: 2089) *		-0.287259
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “A Blocking” and “Low Side Blocking” are set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2072)		
		A Blocking	☐	☑
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☐
		B Blocking	☐	☐
		Invalid Ref BlkF	☐	☐
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “Low Side Blocking” is generated. • Check that the alarm of “High Side Blocking” is not generated.	DIAG_ERR (Index: 2069)		
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☐
10-a-3	Both Side Blocking • Close the both-pressure side valves completely.			
	• Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2086)		7.48562e-9
		VALUE_FSPL (Index: 2087)		7.23277e-9
		VALUE_FSPH (Index: 2088)		7.14085e-9
		VALUE_BLKF (Index: 2089)		-0.287259
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “High Side Blocking” , “Low Side Blocking” and “B Blocking” are set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2072)		
		A Blocking	☐	☐
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☑
		B Blocking	☐	☑
		Invalid Ref BlkF	☐	☐
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “B Blocking” is generated.	DIAG_ERR (Index: 2069)		
		B Blocking	☐	☑

Checklist (5/5)

No.	Items	Parameters	Result	Example
10-b	Simulation of Blockage detection operation • Close completely the valve for the side where the alarm of Invalid Reference Value is not generated.			
	For the case that the high-pressure side valve is closed; • Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2086)		7.48562e-9
		VALUE_FSPH (Index: 2088)		7.14085e-9
	For the case that the low-pressure side valve is closed; • Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2086)		7.48562e-9
		VALUE_FSPL (Index: 2087)		7.23277e-9
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “B Blocking” is set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2072)		
		A Blocking	☐	☐
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☐
		High Side Blocking	☐	☐
		B Blocking	☐	☑
		Invalid Ref BlkF	☐	☑
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☑
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “B Blocking” is generated.	DIAG_ERR (Index: 2069)		
		B Blocking	☐	☑

A8.3 Heat Trace Monitoring

The EJX with Heat trace monitoring function calculates the flange temperature by using the two temperature sensors built in the EJX. An analog alert is generated if the temperature reached to the preset level.

The flange temperature is based on the following parameters and calculation formula.

[Parameters]

Parameter name	Explanation
CAP_TEMP_VAL (CT)	Measured capsule temperature value
AMP_TEMP_VAL (AT)	Measured amplifier temperature value
FLG_TEMP_VAL (FT)	Flange temperature value (Calculated value)
FLG_TEMP_COEF (Cf)	Coefficient to calculate flange temperature
FLG_TEMP_H_LIM	Threshold to generate Flg Temp High Alarm
FLG_TEMP_L_LIM	Threshold to generate Flg Temp Low Alarm

[Calculation formula]

$$FLG_TEMP_VAL(FT) = CT + C_f \times (CT - AT)$$

The FLG_TEMP_VAL (FT) is assigned to Process Value (PV) in the AI function block. If the flange temperature exceeds the value preset to the HI_LIM, LO_LIM, HI_HI_LIM, or LO_LO_LIM in the AI function block, an analog alert is generated.

NOTE

The flange temperature is calculated by the calculation formula assumed that the capsule part of EJX is heated up or kept warm by an electrical heater or steam. In the case of an atmosphere temperature or less, the difference of temperature of approximately 3 to 4°C may occur because the amplifier temperature becomes higher than the capsule temperature.

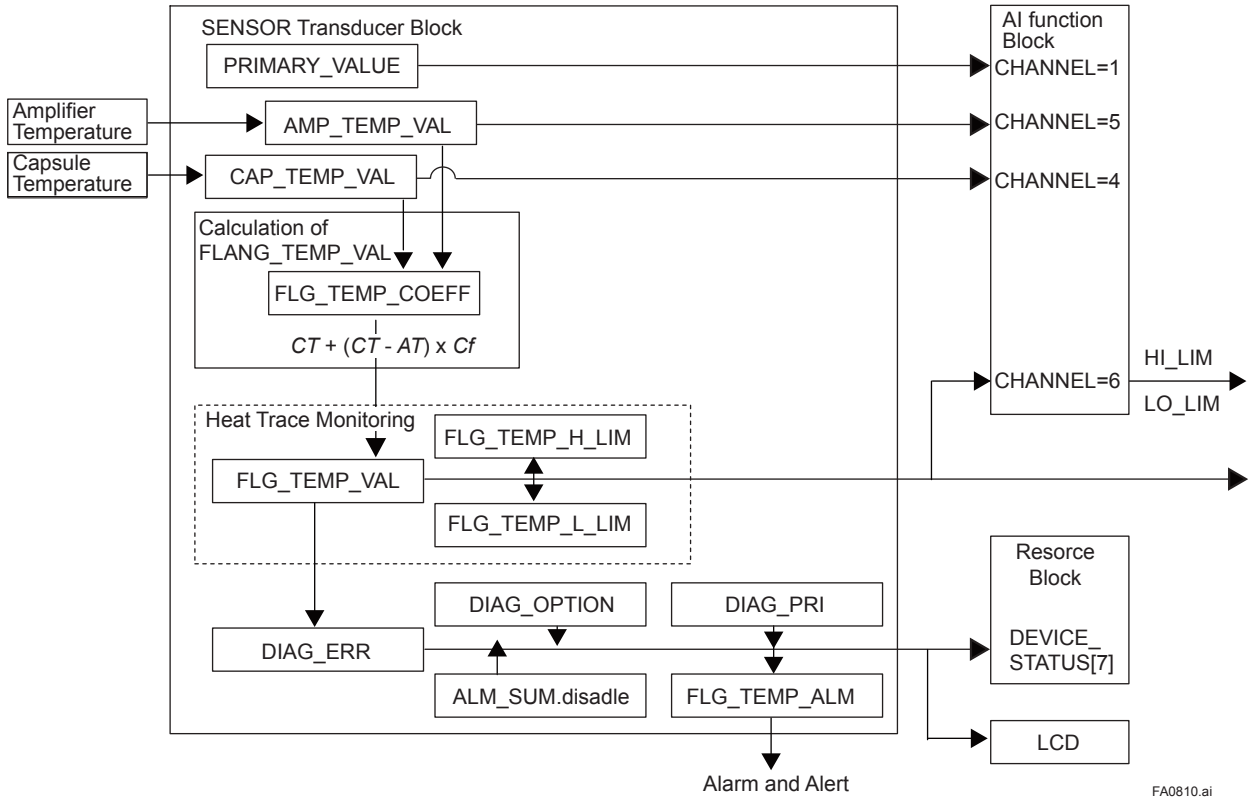


Figure A8.8 Functional Block Diagram of Heat Trace Monitoring

A8.3.1 FLG_TEMP_COEF Setting

The value calculated according to the following procedure is set to the FLG_TEMP_COEFF.

- To enhance the calculation accuracy of the flange temperature, measure the actual flange temperature by using the temperature sensor etc.
- Calculate the ratio of the capsule temperature to the capsule temperature minus the amplifier temperature from the two temperature values measured by EJX.
- Derive the FLG_TEMP_COEF from the measured flange temperature and the ratio of the capsule temperature to the amplifier temperature in accordance with the following calculation formula.

$$FLG_TEMP_COEFF(C_f) = \frac{(Actual\ measured\ value\ of\ Flange\ temperature) - CT}{CT - AT}$$

A8.3.2 Alert and Alarm Setting

The abnormal results of flange temperature (heat trace monitoring) are given by an alert or the LCD display of alarm status.

The flange temperature changes when the heat trace breaks or the abnormal temperature is detected due to the failure.

The abnormal results are stored in the bit 13 and 14 of DIAG_ERR in the SENSOR Transducer Block when the flange temperature is out of the range between the limits preset to the following parameters.

- FLG_TEMP_H_LIM
- FLG_TEMP_L_LIM

Generating an alarm or alert is set by DIAG_ OPTION.
Refer to A8.2.5 for the detail.

A8.3.3 Assignment of FLG_TEMP_VAL to Process Value (PV) in AI Function block

The EJX has four AI function blocks which of each has one channel. If set 6 to the channel of AI function block, the FLG_TEMP_VAL is assigned to Process Value (PV) in AI function block. The unit of the flange temperature follows the setting of XD_ SCALE in the assigned AI function block.

To Assign CAP_TEMP_VAL or AMP_TEMP_VAL to Process Value (PV) in AI function block, set 4 or 5 to the channel of AI function block.

A8.3.4 Analog Alert

Since Flange temperature is assigned to an AI Function Block, an analog alert can be generated by OUT_D in AI Block.

For the detail of the analog alert setting, refer to 6.6.5.

A8.3.5 Out of Temperature Measurement Range

If the measurement value of the capsule temperature or the amplifier temperature is out of the measurement range, the OUT signal status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE becomes “Uncertain-Subnormal" and the status of CAP_TEMP_VAL, AMP_TEMP_VAL, and FLG_TEMP_VAL become “Uncertain-Sensor Conversion not Accurate”.

The measurement range of the capsule temperature and the amplifier temperature is as follows.

- Amplifier temperature: -40 to 85°C
- Capsule temperature: -40 to 120°C

The out of range is detected by the margin of 10°C added with the measurement range.

A8.3.6 Status Error

There are three statuses of “GOOD”, “UNCERTAIN”, and “BAD” for the status of FLG_ TEMP_VAL.

The factor that becomes GOOD/UNCERTAIN/BAD is as follows.

Good: Normal status
Uncertain: Capsule or Amplifier temperature is out of range
Bad:
- Capsule or Amplifier temperature sensor failure
- Capsule or Amplifier EEPROM failure
- Resource block or SENSOR Transducer block is in O/S mode

A8.3.7 Parameter Lists for Heat Trace Monitoring Function

All the parameters for Heat Trace Monitoring function belong to the SENSOR Transducer block.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
47	2047	CAP_TEMP_VAL		—	Measured capsule temperature value and status.
48	2048	CAP_TEMP_RANGE	-50.0 to 130.0°C	—	High and low range limit values, engineering units, decimal point place for capsule temperature.
49	2049	AMP_TEMP_VAL		—	Measured Amplifier temperature value and status.
50	2050	AMP_TEMP_RANGE	-50.0 to 95.0°C	—	High and low range limit values, engineering units, decimal point place for Amplifier temperature.
97	2097	FLG_TEMP_VAL	(Note)	—	Calculated flange temperature valueand status.
98	2098	FLG_TEMP_RANGE	-50.0 to 130.0°C	—	High and low range limit values, engineering units, decimal point place for flange temperature.
99	2099	FLG_TEMP_COEFF	0	AUTO	Coefficient to calculate flange temperature.
100	2100	FLG_TEMP_PRI	1	AUTO	Priority of the flange temperature alarm. (Not used)
101	2101	FLG_TEMP_H_LIM	130	AUTO	Threshold to generate Flg Temp High Alarm.
102	2102	FLG_TEMP_L_LIM	-50	AUTO	Threshold to generate Flg Temp Low Alarm.
103	2103	FLG_TEMP_ALM		—	Status of flange temperature alarm.

Note: The factory default of FLG_TEMP_COEF is 0 so the factory default of FLG_TEMP_VAL indicates the same value as that of CAP_TEMP_VAL.

Revision Information

- Title : Model EJX Series
  Fieldbus Communication Type
- Manual No. : IM 01C25T02-01E

Edition	Date	Page	Revised Item	
1st	Aug. 2004	—	New publication.	
14th	June 2014	2-3	2.1.1	• Revise electrical data of FM intrinsically safe type.
		4-1	4.1	• Change terminal drawing.
		6-9 to 6-11	6.4.6	• Update unit table.
		A6-8	A6.6	• Revise index numbers.
15th	Oct. 2014	2-9	2.1.3	• Revise description in “Note3 Installation.”
		2-12	2.1.4	• Add EPL code. Revise applicable standard. Add note for electro static charge. Add electrical connection.
16th	July 2015	2-11	2.1.3 (6)	• Replace nameplate.
		2-12 to 2-14	2.1.4	• Add b and c.
		10-2	10.3	• Add SS26.
		A8-8	A8.2.5.1	• Add Note for bit8.
		A8-11	A8.2.7	• Add note in “IMPORTANT”.
17th	Apr. 2020	—		Update of device revision(EJX:6, EJA:2)
		1-1	1.	Update device revision.
		2-1	2.1.1 a.	Update Note. 1.
		2-2 to 2-3	2.1.1 b.	Update all the descriptions.
		2-4	2.1.2 a.	Update Note 1 and 2.
		2-5	2.1.2 b.	Update standard and ambient temperature.
		2-6 to 2-10	2.1.3	Update all the descriptions for ATEX approvals.
		2-11 to 2-14	2.1.4	Update all the descriptions for IEC Ex approvals.
		4-3	4.3.1	Update the figures.
		4-4	4.4	Change URL for DD downloading site.
			4.5	Update device revision.
		5-3 to 5-7	5.3 to 5.6	Update descriptions (VCR, Index, number of object, etc.)
		6-5	6.3.6 and 6.3.7	Modify descriptions for errors.
		6-13	6.5.6	Modify descriptions for LOW_CUT.
		7-1	7.2.2	Correct descriptions for alerts.
		7-4	7.3	Add descriptions including Table 7.4.
		8-5 to 8-6	8.2	Correct information in Table 8.9, 8.10 and 8.11.
		9-1 to 9-11	9	Correct factory default and write mode.
		A6-3 to 6-9	A6.3 A6.5 and A6.6	Correct index No.
		A7-4	A7.8	Modify A7.4.
		A7-5	A7.9	Correct index and default.