User's Manual

FVX110
Fieldbus Segment Indicator

IM 01S01C01-01EN

Yokogawa Electric Corporation

IM 01S01C01-01EN
6th Edition

FVX110
Fieldbus Segment Indicator

IM 01S01C01-01EN 6th Edition

Contents

6th Edition: Oct. 2023 (YK)

1. Introduction

Thank you for purchasing the FVX110 Fieldbus Segment Indicator.

Your FVX110 Fieldbus Segment Indicator was precisely calibrated at the factory before shipment. To ensure both safety and efficiency, please read this manual carefully before you operate the instrument.

Model	Style code
FVX110	S1

■ 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.
- Yokogawa assumes no responsibility for this product except as stated in the warranty.
- If the customer or any third party is harmed by the use of this product, Yokogawa assumes no responsibility for any such harm owing to any defects in the product which were not predictable, or for any indirect damages.
- This manual and the identification tag attached on the packing box are essential parts of the product. Please keep them in a safe place for future reference.
  When products whose suffix code or optional codes contain code "Z" and an exclusive document is attached, please read it along with this manual.
- 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.

⎓ Direct current

⏚ Functional grounding terminal

⚠ Caution
This symbol indicates that the operator must refer to an explanation in the user's manual in order to avoid the risk of injury or death of personnel or damage to the instrument.

1.1 Safe Use of This Product

This product is designed to be used by a person with specialized knowledge.
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.
- 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 2.8 (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 authorized representative for this product in the EEA (European Economic Area) is:
Yokogawa Europe B.V.
Euroweg 2, 3825 HD Amersfoort,The Netherlands

(i) Morocco conformity mark

This conformity mark indicates that the product complies with Moroccan safety and EMC requirements.

(j) Control of Pollution Caused by the Product

This is an explanation for the product based on “Control of Pollution caused by Electronic Information Products” in the People’s Republic of China. The information is valid only in China.

产品中有害物质或元素的名称及含量

型号	部件名称	有害物质					
		铅（Pb）	汞（Hg）	镉（Cd）	六价铬（Cr(VI)）	多溴联苯（PBB）	多溴二苯醚（PBDE）
FVX110 现场总线网段指示器	壳体	×	○	○	○	○	○
	基板组件	×	○	○	○	○	○
	电源连接线	×	○	○	○	○	○

○：表示该部件的所有均质材料中的有害物质的含量均在 GB/T26572 标准中所规定的限量以下。

×：表示至少该部件的某些均质材料中的有害物质的含量均在 GB/T26572 标准中所规定的限量以上。

环保使用期限：

该标识适用于 SJ /T11364 中所述，在中华人民共和国销售的电子电气产品的环保使用期限。

注）该年数为“环保使用期限”，并非产品的质量保证期。

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

This chapter provides important information on how to handle the indicator. Read this carefully before using the indicator.

FVX110 Fieldbus Segment Indicator thoroughly tested at the factory before shipment. When taking delivery of an instrument, visually check them to make sure that no damage occurred during shipment.

Also check that all indicator mounting hardware shown in figure 2.1 is included. If the indicator is ordered without the mounting bracket the indicator mounting hardware will not be included. After checking the indicator, carefully repack it in its box and keep it there until you are ready to install it.

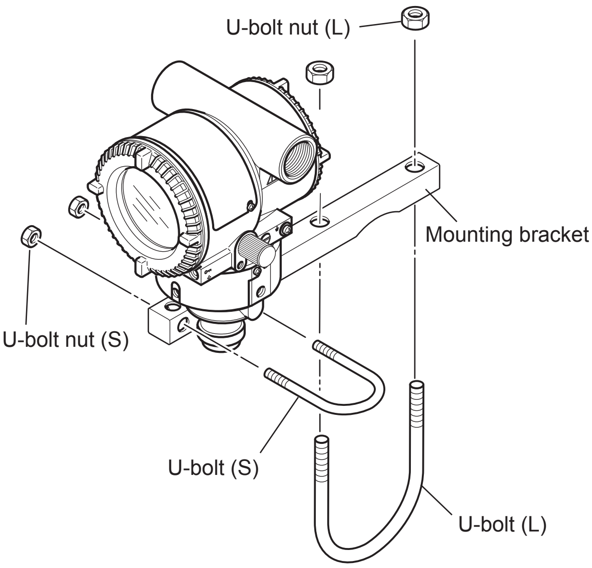

Figure 2.1 Indicator Mounting Hardware

2.1 Model and Specifications Check

The model name and specifications are written on the name plate attached to the case.

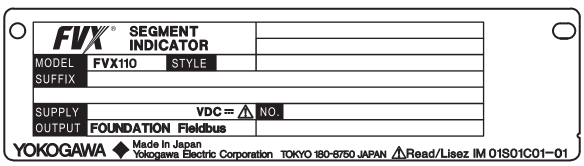

Figure 2.2 Name Plate

2.2 Unpacking

Keep the indicator in its original packaging to prevent it from being damaged during shipment. Do not unpack the indicator until it reaches the installation site.

2.3 Storage

The following precautions must be observed when storing the instrument, especially for a long period.

(a) Select a storage area which meets the following conditions:
- It is not exposed to rain or subject to water seepage/leaks.
- Vibration and shock are kept to a minimum.
- It has an ambient temperature and relative humidity within the following ranges.

Storage ambient temperature:
–30 to 80°C
Relative humidity:
0% to 100% R.H.
Preferred temperature and humidity:
approx. 25°C and 65% R.H.

(b) When storing the indicator, repack it carefully in the packaging that it was originally shipped with.

2.4 Selecting the Installation Location

The indicator is designed to withstand severe environmental conditions. However, to ensure that it will provide years of stable and accurate performance, take the following precautions when selecting the installation location.

(a) Ambient Temperature
Avoid locations subject to wide temperature variations or a significant temperature gradient. If the location is exposed to radiant heat from plant equipment, provide adequate thermal insulation and/or ventilation.

(b) Ambient Atmosphere
Do not install the indicator in a corrosive atmosphere. If this cannot be avoided, there must be adequate ventilation as well as measures to prevent the leaking of rain water and the presence of standing water in the conduits.

(c) Shock and Vibration
Although the indicator is designed to be relatively resistant to shock and vibration, an installation site should be selected where this is kept to a minimum.

(d) Installation of Explosion-protected Indicators
An explosion-protected indicators is certified for installation in a hazardous area containing specific gas types. See subsection 2.8 “Installation of an Explosion-Protected Indicators.”

2.5 Waterproofing of Cable Conduit Connections

Apply a non-hardening sealant to the threads to waterproof the indicator cable conduit connections. (See figure 5.2, 5.3 and 5.4.)

2.6 Restrictions on Use of Radio Transceivers

IMPORTANT

Although the indicator has been designed to resist high frequency electrical noise, if a radio transceiver is used near the indicator or its external wiring, the indicator may be affected by high frequency noise pickup. To test this, start out from a distance of several meters and slowly approach the indicator with the transceiver while observing the measurement loop for noise effects. Thereafter use the transceiver outside the range where the noise effects were first observed.

2.7 Insulation Resistance and Dielectric Strength Test

Since the indicator has undergone insulation resistance and dielectric strength tests at the factory before shipment, normally these tests are not required. If the need arises to conduct these tests, heed the following:

(a) Do not perform such tests more frequently than is absolutely necessary. Even test voltages that do not cause visible damage to the insulation may degrade the insulation and reduce safety margins.

(b) Never apply a voltage exceeding 500 V DC (100 V DC with an internal lightning protector) for the insulation resistance test, nor a voltage exceeding 500 V AC (100 V AC with an internal lightning protector) for the dielectric strength test.

(c) Before conducting these tests, disconnect all signal lines from the indicator terminals. The procedure for conducting these tests is as follows:

• Insulation Resistance Test

1) Short-circuit the + and – SUPPLY terminals in the terminal box.
2) Turn OFF the insulation tester. Then connect the insulation tester plus (+) lead wire to the shorted SUPPLY terminals and the minus (–) leadwire to the grounding terminal.
3) Turn ON the insulation tester power and measure the insulation resistance. The voltage should be applied as briefly as possible to verify that the insulation resistance is at least 20 MΩ.
4) After completing the test and being very careful not to touch exposed conductors disconnect the insulation tester and connect a 100 kΩ resistor between the grounding terminal and the short-circuiting SUPPLY terminals. Leave this resistor connected at least one second to discharge any static potential. Do not touch the terminals while it is discharging.

• Dielectric Strength Test

1) Short-circuit the + and – SUPPLY terminals in the terminal box.
2) Turn OFF the dielectric strength tester. Then connect the tester between the shorted SUPPLY terminals and the grounding terminal. Be sure to connect the grounding lead of the dielectric strength tester to the ground terminal.
3) Set the current limit on the dielectric strength tester to 10 mA, then turn ON the power and gradually increase the test voltage from ‘0’ to the specified voltage.
4) When the specified voltage is reached, hold it for one minute.
5) After completing this test, slowly decrease the voltage to avoid any voltage surges.

2.8 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 (e.g. IEC 60079-14) 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.

2.8.1 FM approval

a. FM Explosionproof Type

Caution for FM Explosionproof type

Note 1. FVX110 Fieldbus Segment Indicator with optional code /FF1 is applicable for use in hazardous locations:

- Applicable Standard: FM3600, FM3615, FM3810, ANSI/NEMA 250
- 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 rating: Type 4X.
- Temperature Class: T6
- Ambient Temperature: –40* to 60°C
  * –15°C when O-ring material is Fluoro-rubber.
- Supply Voltage: 32V dc max.
- Output Signal: 15 mA dc

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 indicator.
  WARNING: OPEN CIRCUIT BEFORE REMOVING COVER. FACTORY SEALED, CONDUIT SEAL NOT REQUIRED. INSTALL IN ACCORDANCE WITH THE USERS MANUAL IM 01S01C01.
- 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

FVX110 Fieldbus Segment Indicator with optional code /FS15.

- Applicable standard: FM3600, FM3610, FM3611, FM3810, ANSI/NEMA250, ISA60079-27
- FM Intrinsically Safe Approval
  [Entity Model]
  Class I, II & III, Division 1, Groups A, B, C, D, E, F & G, Temperature Class T4 Ta=60°C, Type 4X and Class I, Zone 0, AEx ia IIC, Temperature Class T4 Ta=60°C, Type 4X
  [FISCO Model]
  Class I, II & III, Division 1, Groups A, B, C, D, E, F & G, Temperature Class T4 Ta=60°C, Type 4X and Class I, Zone 0, AEx ia IIC, Temperature Class T4 Ta=60°C, Type 4X
- Nonincendive Approval
  Class I, Division 2, Groups A, B, C & D Temperature Class T4 Ta=60°C, Type 4X and Class II, Division 2, Groups F & G Temperature Class T4 Ta=60°C, Type 4X and Class I, Zone 2, Group IIC, Temperature Class T4 Ta=60°C, Type 4X and Class III, Division 1, Temperature Class T4 Ta=60°C, Type 4X
- Electrical Connection: 1/2 NPT female, M20 female

Model: FVX Series Date: June 18, 2010

10.0 Drawings

10.1Installation Diagram

10.1.1 Installation Diagram for Intrinsically Safe, Division 1 Installation

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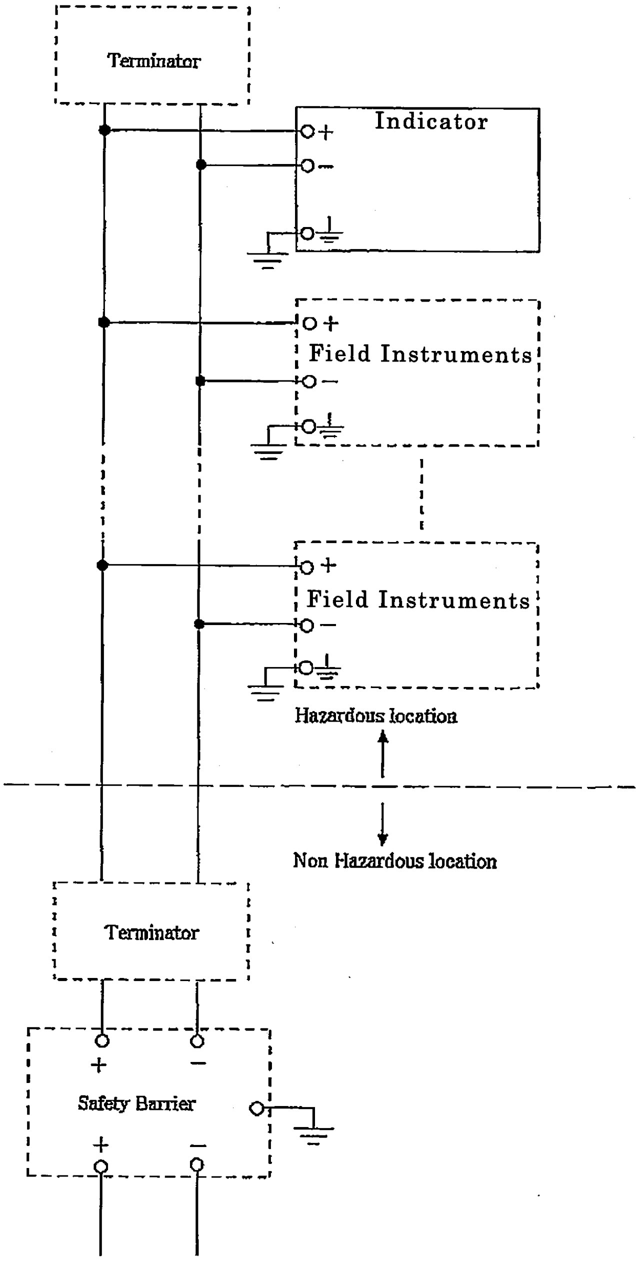


Rev.1: March 15, 2012 T. Itou

Doc. No.: IFM040-A11 P.1
Drawing: T. Itou
Approved: A. Matsunaga

Yokogawa Electric Corporation

IFM040

Model: FVX Series Date: June 18, 2010

Note: 1. Barrier must be installed in an enclosure that meets the requirements of ANSI/ISA 61010-1.
2. Control equipment connected to the Associated Apparatus must not use or generate more than 250 Vrms or Vdc.
3. Installation should be in accordance with ANSI/ISA 12.06.01 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the National Electrical Code® (ANSI/NFPA 70) Sections 504 and 505.
4. The configuration of Associated Apparatus must be FM Approved.
5. Approved under FISCO Concept.
6. Dust-tight conduit seal must be used when installed in Class II and Class III environments.
7. Associated Apparatus manufacturer's installation drawing must be followed when installing this apparatus.
8. No revision to drawing without prior FM Approvals.
9. Terminator must be FM Approved.
10. Note a warning label worded "SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY", and "INSTALL IN ACCORDANCE DOC.NO. IFM40-A11 P.1 TO 6".
⚠ 11. In the case where the enclosure of the Pressure Transmitter is made of aluminum, if it is mounted in Zone 0, it must be installed such, that even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

Electrical data:
Supply circuit
Rating 1 (Entity)
For Groups A, B, C, D, E, F and G or Group IIC
Ui: 24V
Ii: 250mA
Pi: 1.2W
Ci: 1.76nF
Li: 0μH
or
Rating 2 (FISCO)
For Groups A, B, C, D, E, F and G or Group IIC
Ui: 17.5V
Ii: 500mA
Pi: 5.5W
Ci: 1.76nF
Li: 0μH
or
Rating 3 (FISCO)
For Groups C, D, E, F and G or Group IIB
Ui: 17.5V
Ii: 500mA
Pi: 5.5W
Ci: 1.76nF
Li: 0μH

Rev.1: March 15, 2012 T. Itou

Doc. No.: IFM040-A11 P.2
Drawing: T. Itou
Approved: A. Matsunaga

Yokogawa Electric Corporation

IFM040

Model: FVX Series Date: June 18, 2010

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 5nF and 10μH 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 14Vdc to 17.5Vdc. 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 50μA 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....150Ω/km
Inductance per unit length L':0.4....1mH/km
Capacitance per unit length C': 45....200nF/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. 60m
Length of trunk cable: max. 1km in IIC and 5km in IIB
Length of splice: max = 1m
Terminators
At the end of each trunk cable an FM Approved line terminator with the following parameters is suitable:
R= 90...100Ω
C = 0 ....2.2μF

Doc. No.: IFM040-A11 P.3
Drawing: T. Itou
Approved: A. Matsunaga

Yokogawa Electric Corporation

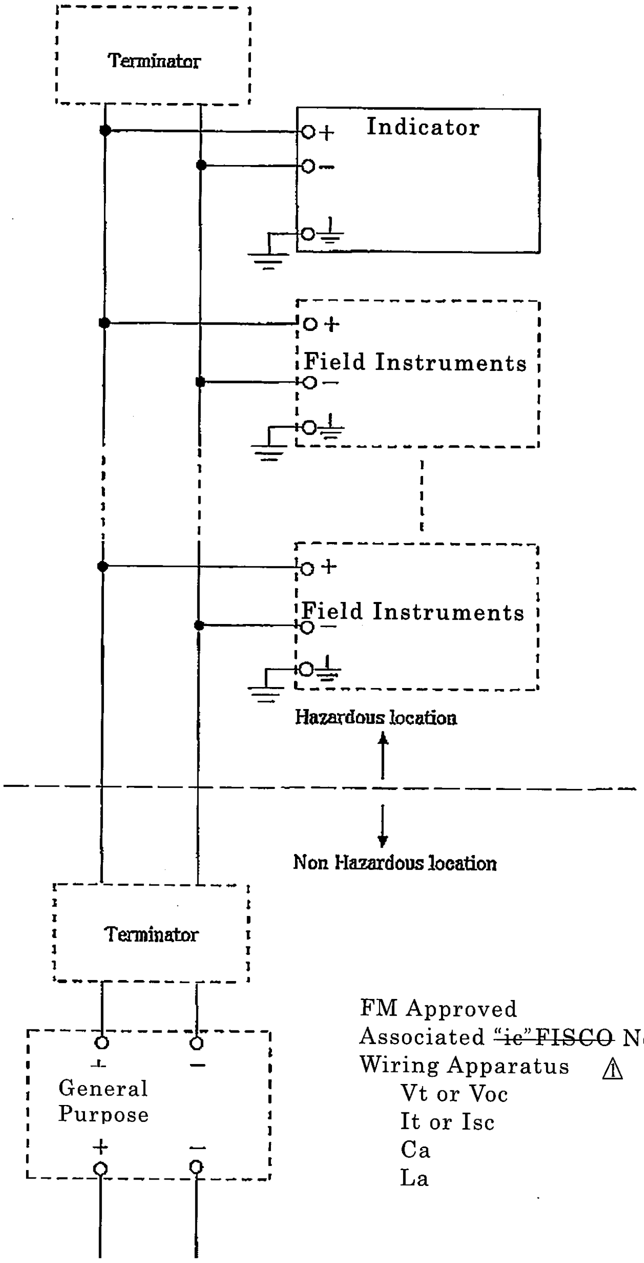
IFM040

Model: FVX Series Date: June 18, 2010

⚠ Nonincendive

10.1.2 Installation Diagram for ~~"ic" FISCO~~, Division 2 Installation

⚠



FM Approved
Associated ~~"ic" FISCO~~ Nonincendive Field
Wiring Apparatus ⚠
Vt or Voc
It or Isc
Ca
La

Rev.1: March 15, 2012 T. Itou

Doc. No.: IFM040-A11 P.4
Drawing: T. Itou
Approved: A. Matsunaga

Yokogawa Electric Corporation

IFM040

Model: FVX Series Date: June 18, 2010

⚠ Note:
1. Installation should be in accordance with the National Electrical Code ® (ANSI/NFPA 70) Article 500.
2. The configuration of Associated Nonincendive Field Wiring Apparatus must be FM Approved.
3. Approved under FNICO Concept.
4. Dust-tight conduit seal must be used when installed in Class II and Class III environments.
5. Associated Apparatus manufacturer's installation drawing must be followed when installing this apparatus.
6. No revision to drawing without prior FM Approvals.
7. Terminator must be FM Approved.
8. The nonincendive field wiring circuit concept allows interconection of nonincendive field wiring apparatus with associated nonincendive field wiring apparatus, using any of the wiring methods permitted for unclassified locations.
9. Installation requirements;
   Vmax ≧ Voc or Vt
   Imax = see note 10.
   Ca ≧ Ci + Ccable
   La ≧ Li + Lcable
10. For this current controlled circuit, the parameter (Imax) is not required and need not be aligned with parameter (Isc) of the barrier or associated nonincendive field wiring apparatus.
11. If ordinary location wiring methods are used, the indicator shall be connected to FM Approved associated non-incendive field wiring apparatus.

Electrical data:

• Supply circuit
Vmax = 32Vdc
Ci = 1.76nF
Li = 0μH

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Doc. No.: IFM040-A11 P.5
Drawing: T. Itou
Approved: A. Matsunaga

Yokogawa Electric Corporation

IFM040

Model: FVX Series Date: June 18, 2010

⚠ 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 5nF and 20uH 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 14Vdc to 17.5Vdc. 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....1mH/km

Capacitance per unit length C': 45....200nF/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. 60m
Length of trunk cable: max. 1km in IIC and 5km in IIB
Length of splice: max = 1m
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 ....2.2uF

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Drawing: T. Itou
Approved: A. Matsunaga

Yokogawa Electric Corporation

IFM040

2.8.2 CSA Certification

a. CSA Explosionproof Type

Caution for CSA explosionproof type.

Note 1. FVX110 Fieldbus Segment Indicator with optional code /CF1 is applicable for use in hazardous locations:

Certificate: 2325751

- Applicable Standard:
  C22.2 No 25
  C22.2 No 30
  C22.2 No 94
  C22.2 No 61010-1
  C22.2 No 60079-0:07
  C22.2 No 60079-1:07
  C22.2 No 60529

[For CSA C22.2]

- Explosion-proof for Class I, Groups B, C and D.
- Dustignition-proof for Class II/III, Groups E, F and G.
- Enclosure: TYPE 4X
- Temperature Code: T6

[For CSA E60079]

- Flameproof for Zone 1, Ex d IIC T6
- Enclosure: IP66 / IP67
- Ambient Temperature: –50* to 75ºC (T6)
  * –15ºC when O-ring material is Fluoro-rubber.
- Supply Voltage: 32 V dc max.
- Output Signal: 15 mA dc

Note 2. Wiring

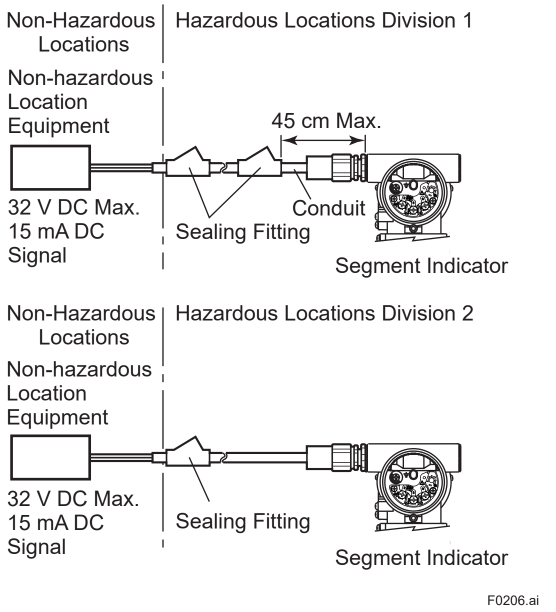
- All wiring shall comply with Canadian Electrical Code Part I and Local Electrical Codes.
- In hazardous location, wiring shall be in conduit as shown in the figure.
- WARNING:
  A SEAL SHALL BE INSTALLED WITHIN 45cm OF THE ENCLOSURE.
  UN SCELLEMENT DOIT ÊTRE INSTALLÉÀ MOINS DE 45cm DU BOîTIER.
- WARNING:
  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 ≥ 65ºC, USE THE HEAT-RESISTING CABLES ≥ 90ºC.
  QUAND LA TEMPÉRATURE AMBIANTE ≥ 65ºC, UTILISEZ DES CÂBLES RÉSISTANTES Á LA CHALEUR ≥ 90ºC.
- 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.



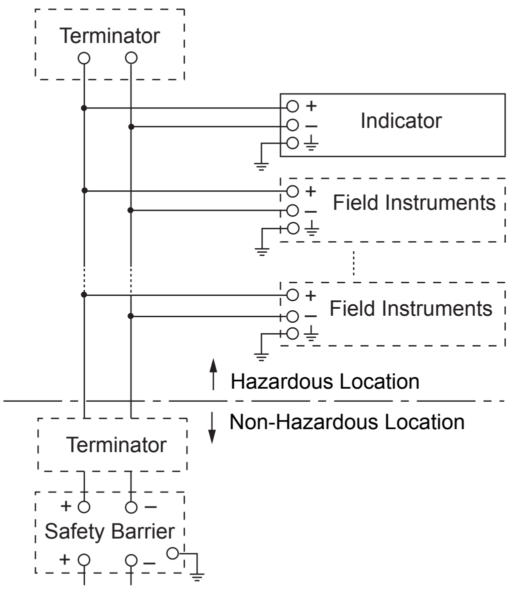
b. CSA Intrinsically safe and Nonincendive Type

FVX110 Fieldbus Segment Indicator with optional code /CS15.

- Certificate: 2422326
- Applicable standard:
  C22.2 No. 25
  CAN/CSA C22.2 No. 94
  CAN/CSA C22.2 No. 157
  C22.2 No. 213
  CAN/CSA C22.2 No. 61010-1
  CAN/CSA C22.2 No.60079-0:07
  CAN/CSA-E60079-11-02
  CAN/CSA-E60079-15:02
  CAN/CSA C22.2 No. 60529
  As a reference IEC 60079-27:2005
- Intrinsically Safe Approval
  Class I, Division 1, Groups A, B, C, & D;
  Class II, Division 1, Groups E, F & G;
  Class III Division 1; Ex ia IIB/IIC T4
  Ambient Temperature: –40* to 60°C (–40* to 140°F) Encl. Type 4X, IP66 / IP67
  * –15ºC when O-ring material is Fluoro-rubber.
- Nonincendive Approval
  Class I, Division 2, Groups A, B, C, & D;
  Class II, Division 2, Groups F & G;
  Class III Division 1; Ex nL IIC T4
  Ambient Temperature: –40* to 60°C (–40* to 140°F) Encl. Type 4X, IP66 / IP67
  * –15ºC when O-ring material is Fluoro-rubber.

● **Caution for CSA Intrinsically safe type. (Following contents refer to “DOC. No. ICS018”)**

Installation Diagram for Intrinsically safe (Division 1 Installation)



F0207.ai

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) = 500 mA
  Pi (Pmax) = 5.5 W
  Ci = 3.52 nF
  Li = 0 µH

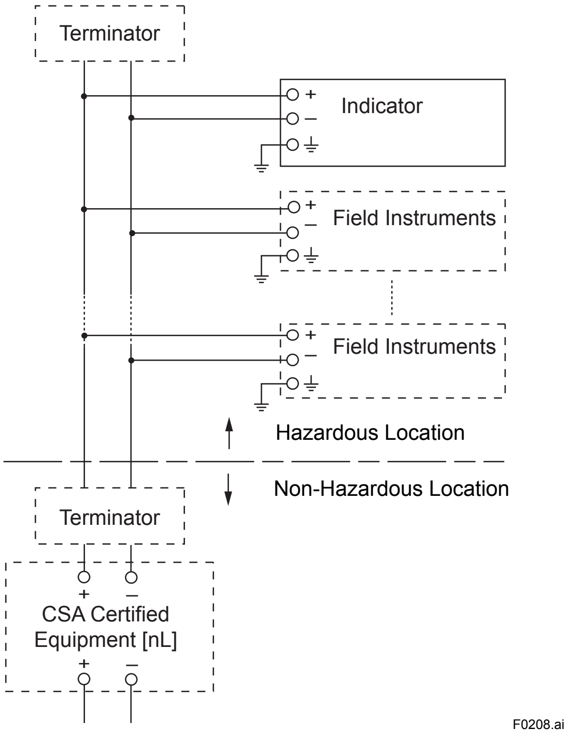
or

- Rating 3 (FISCO)
  For Groups C, D, E, F, and G or Group IIB
  Ui (vmax) = 17.5 V dc
  Ii (Imax) = 500 mA
  Pi (Pmax) = 5.5 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

2.8.3 ATEX Certification

(1) Technical Data

a. ATEX Intrinsically Safe Type

Caution for ATEX Intrinsically safe type.

Note 1. FVX110 Fieldbus Segment Indicator with optional code /KS25 for potentially explosive atmospheres:

- Applicable standards:
  EN IEC 60079-0, EN 60079-11
- Certificate number: DEKRA 11ATEX0022 X
- Specific Ex marking:
  Ex II 1 G Ex ia IIC T4 Ga
  II 2 D Ex ia IIIC T80°C Db
- Ambient temperature:
  EPL Ga −40°C ≤ Ta ≤ +60°C
  EPL Db −30°C ≤ Ta ≤ +60°C
  EPL Db * −15°C ≤ Ta ≤ +60°C
  * When FKM O-rings are used.
- Enclosure:
  EPL Ga IP66/IP67 in accordance with only EN 60529
  EPL Db IP66 in accordance with EN IEC 60079-0
- Power supply: ≤ 32V, ≤ 24 mA
- Dielectric strength:
  500 V AC, r.m.s., 1 min Terminals: Supply + Supply − to Enclosure

Note 2. Specific condition of use

When the equipment is mounted in an area where the use of Category 1 G equipment is required, it shall be installed in such a way that, even in the event of rare incidents, an ignition source due to impact and/or friction sparks is excluded.

Precaution shall be taken to minimize the risk from electrostatic discharges or propagating brush discharges on the non-metallic parts (excluding glass parts) or coated parts of the equipment.

The dielectric strength of at least 500 V of the intrinsically safe circuits of the equipment is limited only by the overvoltage protection. From the safety point of view, the intrinsically safe circuit of the equipment shall be assumed to be connected to earth.

Note 3. Installation and erection

Cable entry devices suitable for the thread form and the size of the cable entries must be used, according to the following marking on the equipment.

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

F0214.ai

When installing the equipment, the selected Type of Protection should be ticked as follows.
☑ Ex ia IIC T4 Ga
☐ Ex ia IIIC T80ºC Db
See the installation diagram.

Note 4. Use and setting-up (operation)

If the equipment 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. Maintenance and repair

WARNING

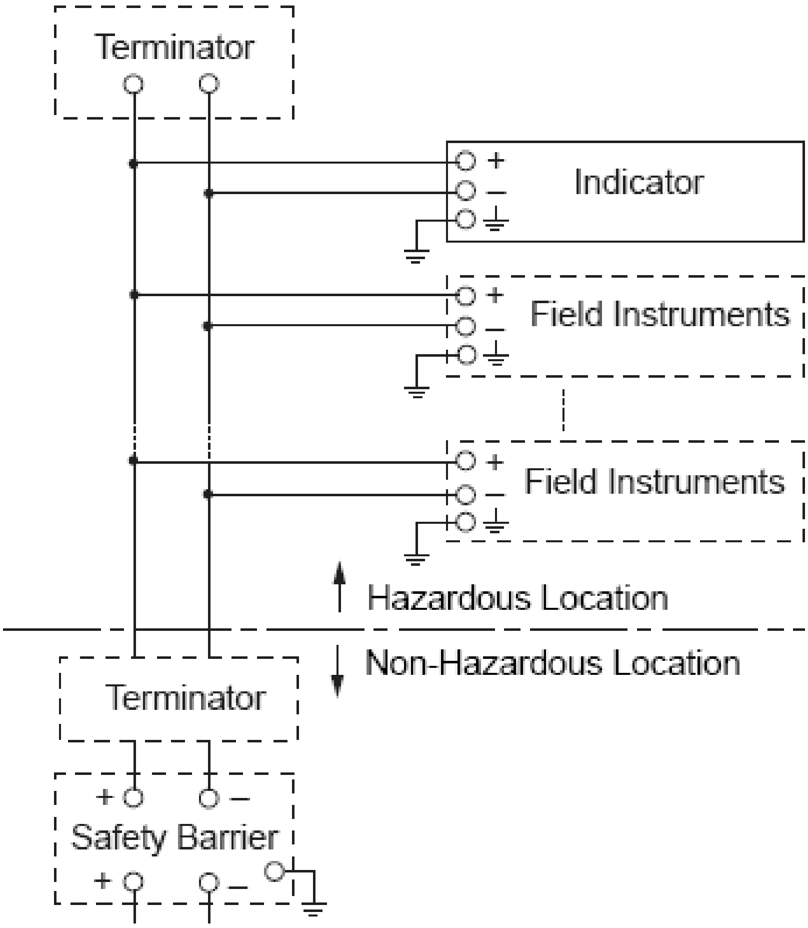
A modification of the equipment would no longer comply with the construction described in the certificate documentation.
Only personnel authorized by Yokogawa Electric Corporation can repair the equipment.

Model: FVX Series Date: July 17, 2010

11 Drawings

11.1 Installation Diagram

Intrinsically safe apparatus level of protection “ia”



Doc. No.: IKE040-A31 P.1
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

IKE040

Model: FVX Series Date: July 17, 2010

Note

[Intrinsically safe apparatus level of protection "ia"]

- 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 indicator 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 indicator may be connected to the power supply line.
- The terminator and the safety barrier shall be certified.

Electrical data:

[Intrinsically safe apparatus level of protection "ia"]

Supply circuit

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

*1: Rating 1

or

Maximum Input Voltage Ui: 17.5V
Maximum Input Current Ii: 500mA
Maximum Input Power Pi: 5.5W
Maximum Internal Capacitance Ci: 3.52nF
Maximum Internal Inductance Li: 0 μH

*2: Rating 2

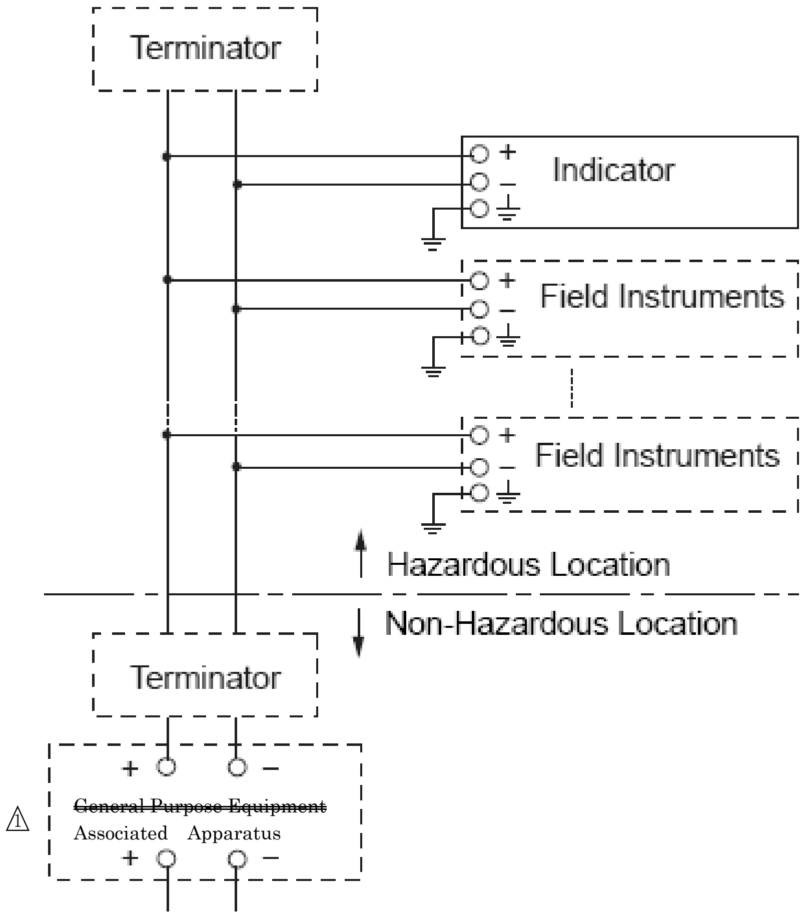
Doc. No.: IKE040-A31 P.2
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

IKE040

Model: FVX Series Date: July 17, 2010

Intrinsically safe apparatus level of protection “ic”



Rev.1: Nov. 15, 2011 T. Itou

Doc. No.: IKE040-A31 P.3
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

IKE040

Model: FVX Series Date: July 17, 2010

Note
[Intrinsically safe apparatus level of protection “ic”]

- The terminators may be built in the “ic” equipment.
- More than one indicator may be connected to the power supply line.
- The terminator and the “ic” equipment shall be certified.

Electrical data:

[Intrinsically safe apparatus level of protection “ic”]

Maximum Input Voltage Ui:32V
Maximum Internal Capacitance Ci:3.52nF
Maximum Internal Inductance Li: 0μH

Doc. No.: IKE040-A31 P.4
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation
IKE040

b. ATEX Flameproof Type

Caution for ATEX flameproof type

Note 1. FVX110 Fieldbus Segment Indicator with optional code /KF25 for potentially explosive atmospheres:

- No. KEMA 10ATEX0157 X
- Applicable Standard:
  IEC EN 60079-0
  EN 60079-1
  EN 60079-31
- Type of Protection and Marking Code:
  II 2 G Ex db IIC T6 Gb
  II 2 D Ex tb IIIC T80°C Db
- Temperature Class: T6
- Enclosure: IP66 / IP67
- Ambient Temperature for gas-proof:
  −50°C ≤ Ta ≤ +75°C
- Ambient Temperature for dust-proof:
  Maximum Surface Temperature: T80°C
  −30°C ≤ Ta ≤ +75°C
  −15°C ≤ Ta ≤ +75°C (When FKM O-rings area used.)

Note 2. Electrical Data

- Supply Voltage: 32V DC
  Output Current: 15mA

Note 3. For combined approval

When installing the equipment, the selected Type of Protection should be ticked as follows.
☑ Ex db IIC T6 Gb
☐ Ex tb IIIC T80°C Db

Note 4. Installation

- All wiring shall comply with local installation requirements.
- 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

- Keep the “WARNING” label attached to the indicator.
  WARNING: AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING. WHEN THE AMBIENT TEMP.≥65ºC, USE HEAT-RESISTING CABLES AND CABLE GLAND≥90ºC.
- Take care not to generate mechanical sparking when accessing the instrument and peripheral devices in hazardous location.

Note 6. Maintenance and Repair

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.
- 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: EN 60079-19 (Equipment repair, overhaul and reclamation) and EN 60079-17 (Electrical installation inspection and maintenance); otherwise the certification will be voided.
- A modification of the equipment would no longer comply with the construction described in the certificate documentation.

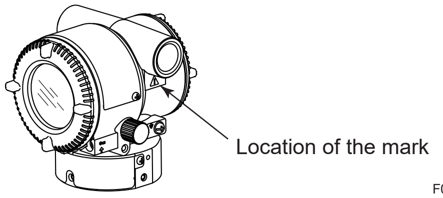
Note 7. Specific conditions of use

- Repair of the equipment is only allowed when done by the manufacturer or an authorised representative.
- The property class of special fasteners used to fasten the indicator case onto the body is at least A*-50.
- Precautions shall be taken to minimize the risk of electrostatic discharge of painted parts.

(2) Electrical Connection

Cable entry devices suitable for the thread form and the size of the cable entries must be used, according to the following marking on the equipment.

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



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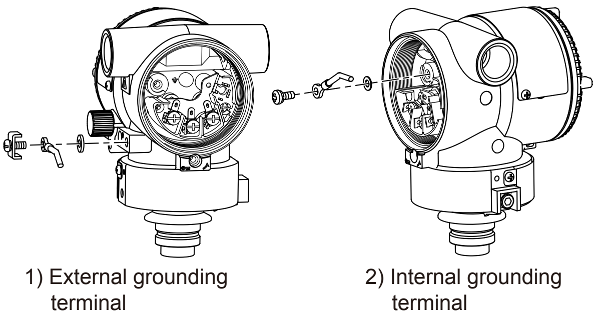
(3) Installation

⚠ 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.

The grounding terminals are located on the inside and outside of the terminal area.
Connect the cable to grounding terminal in accordance with wiring procedure 1) or 2).



F0212.ai

Wiring Procedure for Grounding Terminals

(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.

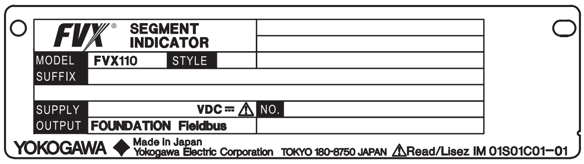
(5) Maintenance and Repair

⚠ WARNING

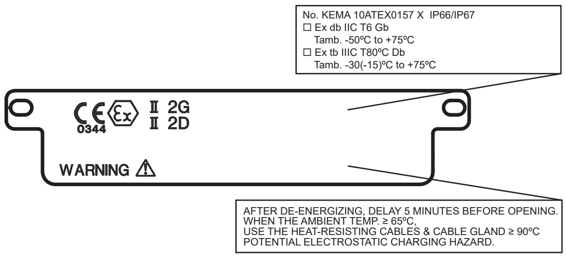
The instrument modification or part replacement by other than an authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

(6) Name Plate

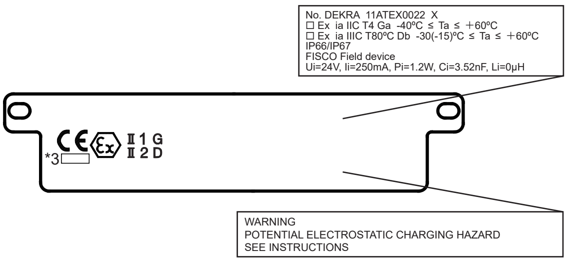
- Name plate



- Tag plate for flameproof type



- Tag plate for intrinsically safe type



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MODEL: Specified model code.
STYLE: Style code.
SUFFIX: Specified suffix code.
SUPPLY: Supply voltage.
OUTPUT: Output signal.
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.

2.8.4 IECEx Certification

a. IECEx Flameproof Type

Caution for IECEx flameproof type.

Note 1. FVX110 Fieldbus Segment Indicator with optional code /SF25 are applicable for use in hazardous locations:

- No. IECEx KEM10.0071 X
- Applicable Standard:
  IEC60079-0,
  IEC60079-1
- Type of Protection and Marking Code:
  Ex db IIC T6 Gb
- Temperature Class: T6
- Enclosure: IP66 / IP67
- Ambient Temperature for gas-proof:
  –50°C ≤ Ta ≤ +75°C
- Supply Voltage: 32V DC
- Output Current: 15mA

Note 2. Wiring

- Cable glands, adapters and/or blanking elements with a suitable IP rating shall be of Ex d IIC certified by IECEx and shall be installed so as to maintain the specific degree of protection (IP Code) of the equipment.
- Unused apertures shall be closed with suitable flameproof certified blanking elements.
- All wiring shall comply with local installation requirements.

Note 3. Operation

Keep the "WARNING" label attached to the indicator.

- WARNING:
  AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING.
- WARNING:
  WHEN AMBIENT TEMPERATURE ≥65°C, USE THE HEAT-RESISTING CABLES 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

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 60079-19 (Equipment repair, overhaul and reclamation) and IEC 60079-17 (Electrical installation inspection and maintenance); otherwise the certification will be voided.
- A modification of the equipment would no longer comply with the construction described in the certificate documentation.

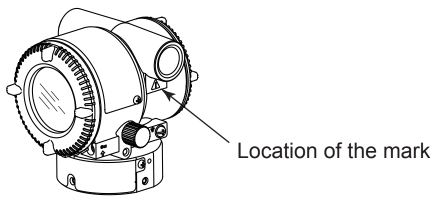
Note 5. Specific conditions of use

- Repair of the equipment is only allowed when done by the manufacturer or an authorised representative.
- The property class of special fasteners used to fasten the indicator case onto the body is at least A*-50.
- Precautions shall be taken to minimize the risk of electrostatic discharge of painted parts.

Note 6. Electrical Connection

Cable entry devices suitable for the thread form and the size of the cable entries must be used, according to the following marking on the equipment.

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



F0216.ai

b. IECEx Intrinsically Safe Type

Caution for IECEx Intrinsically safe type.

Note 1. FVX110 Fieldbus Segment Indicator with optional code /SS25 are applicable for use in hazardous locations:

- Applicable standards:
  IEC 60079-0, IEC 60079-11
- Certificate number: IECEx DEK11.0004X
- Specific Ex marking:
  Ex ia IIC T4 Ga
  Ex ic IIC T4 Gc
- Ambient temperature: −40ºC ≤ Ta ≤ +60ºC
- Enclosure: IP66/IP67 in accordance with only IEC 60529
- Power supply: ≤ 32V, ≤ 24 mA
- Dielectric strength:
  500 V AC, r.m.s., 1 min   Terminals: Supply + Supply −   to Enclosure

Note 2. Specific condition of use

When the equipment is mounted in an area where the use of EPL Ga equipment is required, it shall be installed in such a way that, even in the event of rare incidents, an ignition source due to impact and/or friction sparks is excluded.
Precaution shall be taken to minimize the risk from electrostatic discharges or propagating brush discharges on the non-metallic parts (excluding glass parts) or coated parts of the equipment.
The dielectric strength of at least 500 V of the intrinsically safe circuits of the equipment is limited only by the overvoltage protection. From the safety point of view, the intrinsically safe circuit of the equipment shall be assumed to be connected to earth.

Note 3. Installation and erection

Cable entry devices suitable for the thread form and the size of the cable entries must be used, according to the following marking on the equipment.

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

F0214.ai

When installing the equipment, the selected Type of Protection should be ticked as follows.
☑ Ex ia IIC T4 Ga
☐ Ex ic IIC T4 Gc
See the installation diagram.

Note 4. Use and setting-up (operation)

If the equipment 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. Maintenance and repair

WARNING

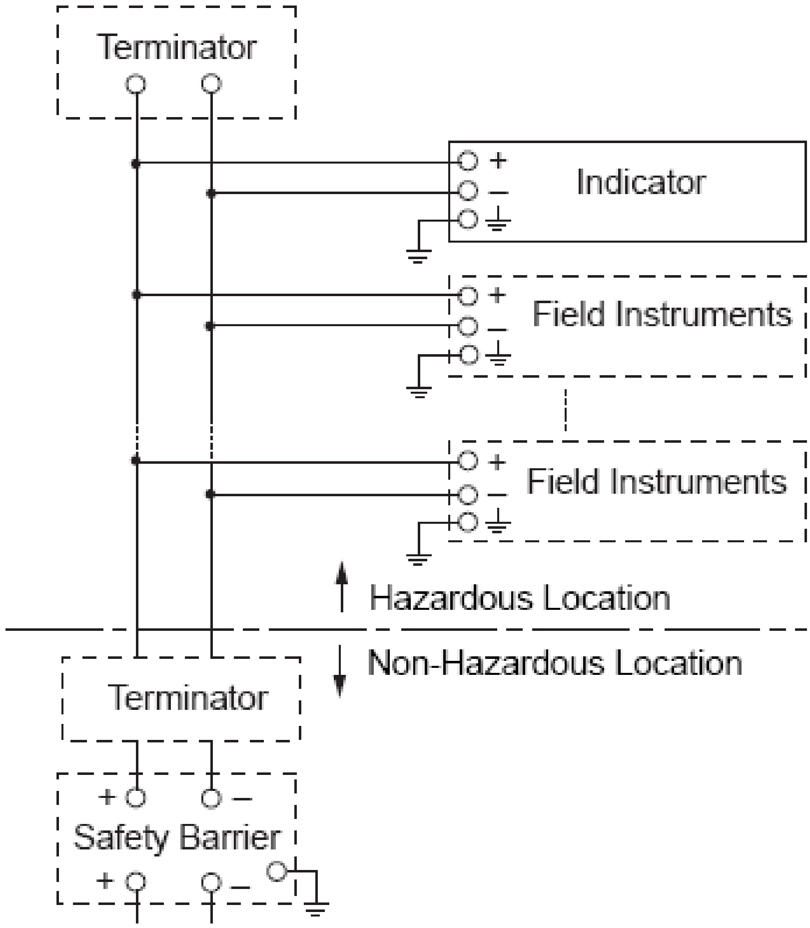
A modification of the equipment would no longer comply with the construction described in the certificate documentation.
Only personnel authorized by Yokogawa Electric Corporation can repair the equipment.

Model: FVX Series Date: July 17, 2010

11 Drawings

11.1 Installation Diagram

Intrinsically safe apparatus level of protection “ia”



Doc. No.: IKE040-A31 P.1
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

IKE040

Model: FVX Series Date: July 17, 2010

Note
[Intrinsically safe apparatus level of protection “ia”]
- 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 indicator 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 indicator may be connected to the power supply line.
- The terminator and the safety barrier shall be certified.

Electrical data:

[Intrinsically safe apparatus level of protection “ia”]

Supply circuit

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

*1: Rating 1

or

Maximum Input Voltage Ui: 17.5V
Maximum Input Current Ii: 500mA
Maximum Input Power Pi: 5.5W
Maximum Internal Capacitance Ci: 3.52nF
Maximum Internal Inductance Li: 0 μH

*2: Rating 2

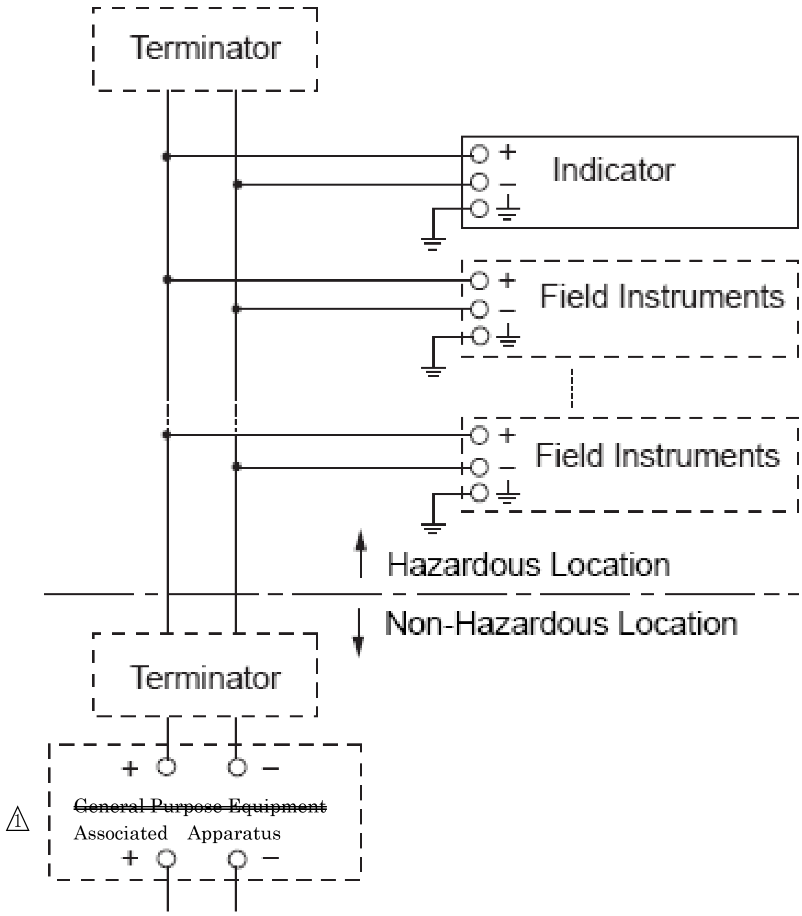
Doc. No.: IKE040-A31 P.2
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

IKE040

Model: FVX Series Date: July 17, 2010

Intrinsically safe apparatus level of protection "ic"



Rev.1: Nov. 15, 2011 T. Itou

Doc. No.: IKE040-A31 P.3
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

IKE040

Model: FVX Series Date: July 17, 2010

Note
[Intrinsically safe apparatus level of protection "ic"]

- The terminators may be built in the "ic" equipment.
- More than one indicator may be connected to the power supply line.
- The terminator and the "ic" equipment shall be certified.

Electrical data:

[Intrinsically safe apparatus level of protection "ic"]

Maximum Input Voltage Ui:32V
Maximum Internal Capacitance Ci:3.52nF
Maximum Internal Inductance Li: 0μH

Doc. No.: IKE040-A31 P.4
Drawing: T. Itou
Approved: A.Matsunaga

Yokogawa Electric Corporation

IKE040

2.9 EU RoHS Directive

Applicable standard: EN IEC 63000

2.10 Safety Requirement Standards

Applicable standard:
EN 61010-1, C22.2 No.61010-1

(1) Pollution Degree 2

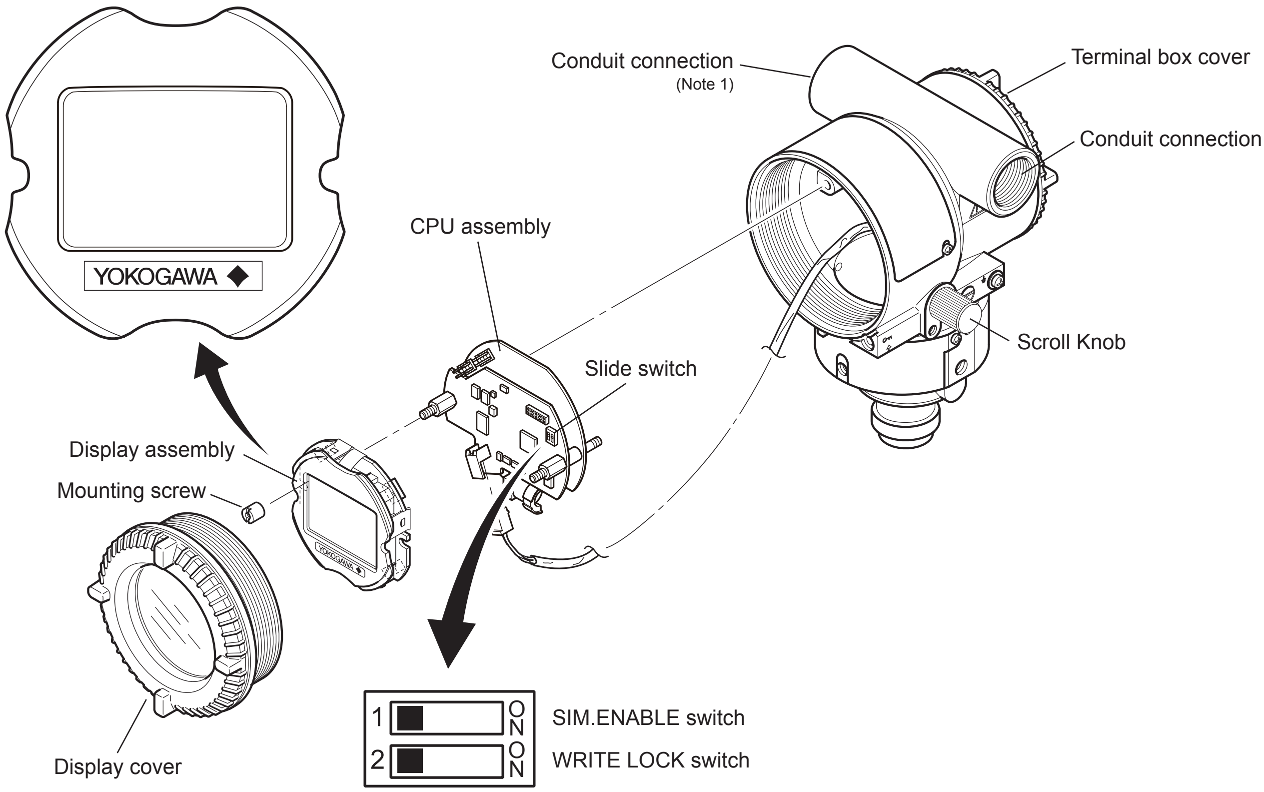
"Pollution degree" describes the degree to which a solid, liquid, or gas which deteriorates dielectric strength or surface resistivity is adhering. " 2 " applies to normal indoor atmosphere. Normally, only nonconductive pollution occurs. Occasionally, however, temporary conductivity caused by condensation must be expected.

(2) Installation Category I

"Overvoltage category (Installation category)" describes a number which defines a transient overvoltage condition. It implies the regulation for impulse withstand voltage. " I " applies to electrical equipment which is supplied from the circuit when appropriate transient overvoltage control means (interfaces) are provided.

(3) Indoor/Outdoor use

3. Component Names



SIM.ENABLE Switch		
SIM.ENABLE Switch position (Note 2)	1 ON / 2 ON	1 ON / 2 ON
SIM.ENABLE	OFF (Simulation disenable)	ON (Simulation enable)

WRITE LOCK Switch		
WRITE LOCK Switch position (Note 2)	1 ON / 2 ON	1 ON / 2 ON
WRITE LOCK	OFF (WRITE LOCK OFF)	ON (WRITE LOCK ON)

F0301.ai

(Note 1) See General Specifications sheet (GS 01S01C01-01EN) for details.
(Note 2) Set the switches as shown in the figure above to set the SIM.ENABLE and WRITE LOCK.
The SIM.ENABLE and WRITE LOCK switch is set to OFF for delivery. (For function detail, please refer to Subsection 9.3 and 9.4.)

Figure 3.1 Component Names

4. About Fieldbus

4.1 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.

FVX110 Fieldbus Segment Indicatior employs the specification standardized by The Fieldbus Foundation, and provides interoperability between Yokogawa devices and those produced by other manufacturers.

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

4.2 Internal Structure of FVX110

The FVX110 contains two virtual field devices (VFD) that share the following functions.

4.2.1 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).

4.2.2 Function Block VFD

(1) Resource block

- Manages the status of FVX110 hardware.
- Automatically informs the host of any detected faults or other problems.

(2) LCD Transducer block

- Controls the display of the integral indicator.

(3) MAO function block

- Transfers 8 analog variables of the IO subsystem to transducer block using 8 input parameters (IN_1 to IN_8).

(4) PID function block

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

(5) SC function block

- Uses the line-segment function to convert input signal values.

(6) IT function block

- Integrates input signal values.

(7) IS function block

- Same as MAO function block, this block transfer 8 analog variables (IN_1 to IN_8) to transducer block.
- Provides a function for automatic selection of one signal from multiple input signals using a specified method of selection.

(8) AR function block

- Applies gain multiplication and bias addition to the calculated result through use of multiple computing equations to perform limitation processing for output.

4.3 Logical Structure of Each Block

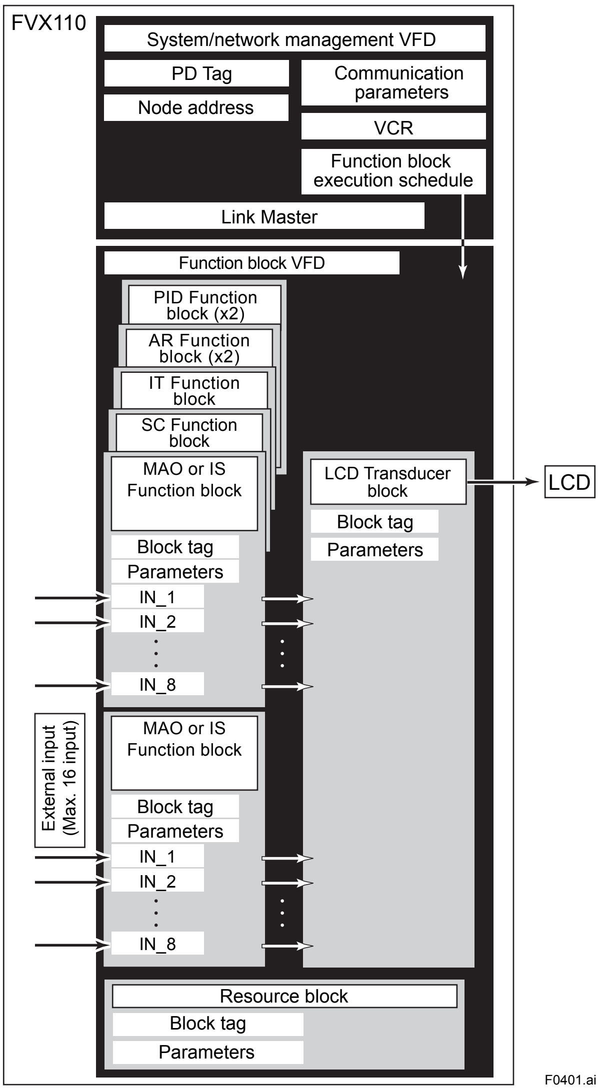


Figure 4.1 Logical Structure of Each Block

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

4.4 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.

5. Installation

5.1 Precautions

Before installing the indicator, read the cautionary notes in section 2.4, “Selecting the Installation Location.” For additional information on the ambient conditions allowed at the installation location, please find information in General Specifications sheet (GS 01S01C01-01EN).

IMPORTANT

- When welding piping during construction, take care not to allow welding currents to flow through the indicator.
- Do not step on this instrument after installation.

5.2 Mounting

■ The Indicator can be mounted on a nominal 50 mm (2-inch) pipe using the mounting bracket supplied, as shown in Figure 5.1.

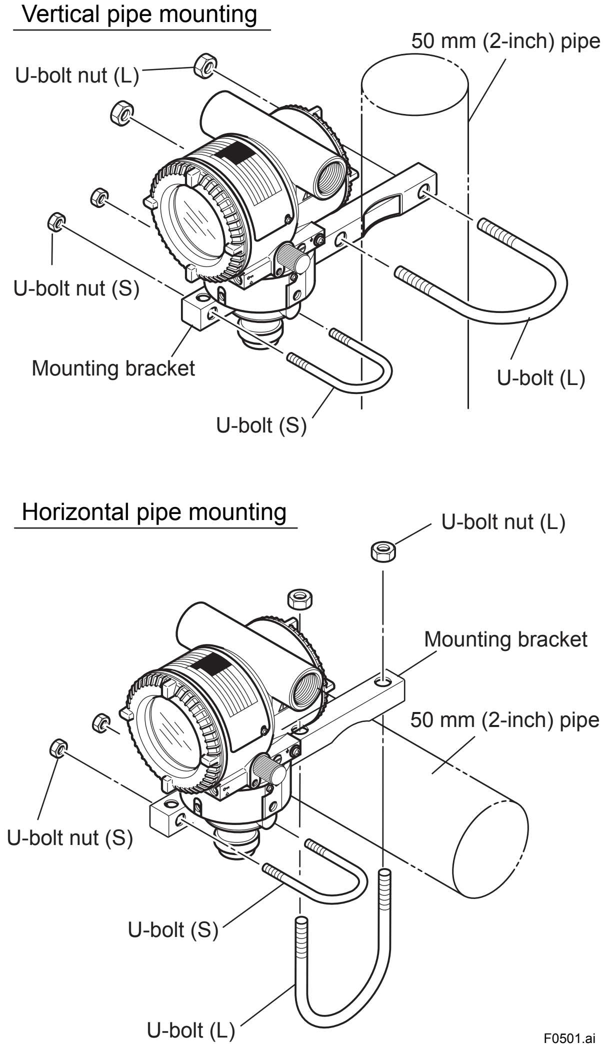


Figure 5.1 Indicator Mounting

5.3 Wiring

5.3.1 Wiring Precautions

IMPORTANT

- Lay wiring as far as possible from electrical noise sources such as large capacity transformers, motors, and power supplies.
- Remove the electrical connection dust cap before wiring.
- All threaded parts must be treated with waterproofing sealant. (A non-hardening silicone group sealant is recommended.)
- To prevent noise pickup, do not pass signal and power cables through the same ducts.
- Explosion-protected instruments must be wired in accordance with specific requirements (and, in certain countries, legal regulations) in order to preserve the effectiveness of their explosion-protected features.
- The terminal box cover is locked by an Allen head bolt (a shrouding bolt) on ATEX flameproof type indicators. When the shrouding bolt is driven clockwise using an Allen wrench, it goes in. The cover lock can then be released and the cover can be opened by hand. See subsection 10.2 “Disassembly and Reassembly” for details.
- Plug and seal an unused conduit connection.

5.3.2 Wiring Installation

(1) General-use Type and Intrinsically Safe Type

With the cable wiring, use a metallic conduit or waterproof glands.

- Apply a non-hardening sealant to the terminal box connection port and to the threads on the flexible metal conduit for waterproofing.

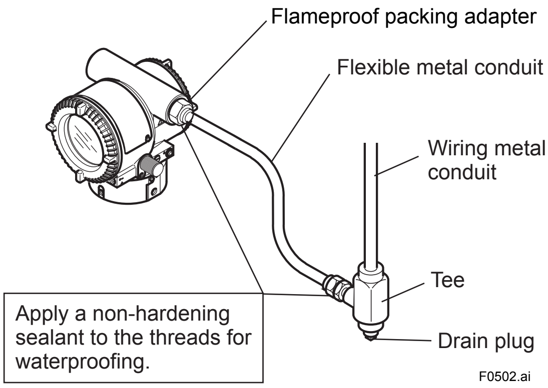


Figure 5.2 Typical Wiring Using Flexible Metal Conduit

(2) Flameproof Type

Wire cables through a flameproof packing adapter, or use a flameproof metal conduit.

■ Wiring cable through flameproof packing adapter.

- Apply a non-hardening sealant to the terminal box connection port and to the threads on the flameproof packing adapter for waterproofing.

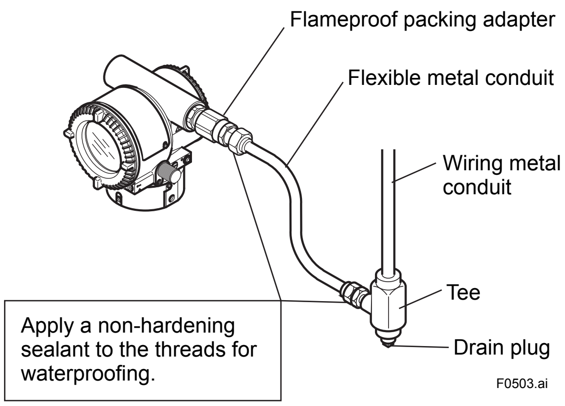


Figure 5.3 Typical Cable Wiring Using Flameproof Packing Adapter

■ Flameproof metal conduit wiring
- A seal fitting must be installed near the terminal box connection port for a sealed construction.
- Apply a non-hardening sealant to the threads of the terminal box connection port, flexible metal conduit and seal fitting for waterproofing.

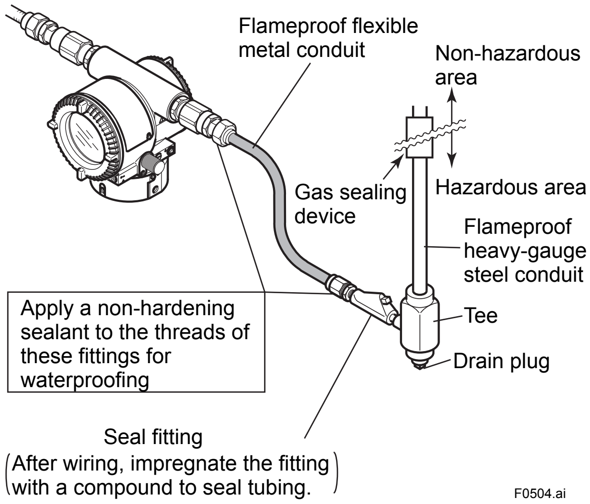


Figure 5.4 Typical Wiring Using Flameproof Metal Conduit

5.4 Grounding

Grounding is always required for the proper operation of indicator. Follow the domestic electrical requirements as regulated in each country. For a indicator with a built-in lightning protector, grounding should satisfy ground resistance of 10Ω or less.

Ground terminals are located on the inside and outside of the terminal box. Either of these terminals may be used.

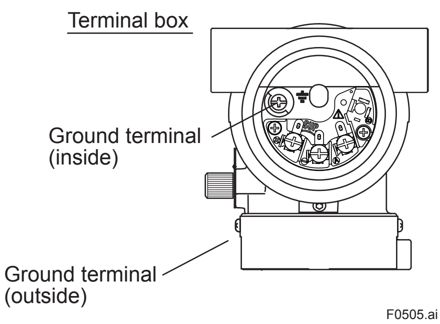


Figure 5.5 Ground Terminals

5.5 Connection of Devices

- **Power supply:**

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

- **Terminator:**

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

- **Field devices:**

  Connect Fieldbus communication type field devices. Two or more EJX, YTA, AXF 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 FVX110, 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 5.6. 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.

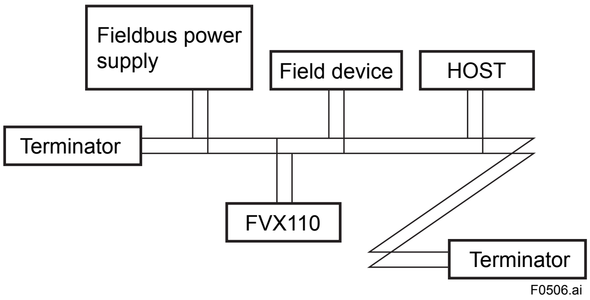


Figure 5.6 Cabling

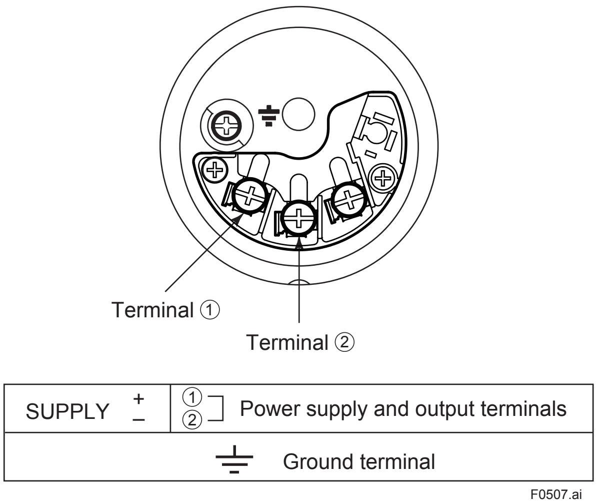


Figure 5.7 Wiring Diagram

CAUTION

Connectiong with the commercial AC power supply will damage the device. Be sure to use a dedicated power supply for Filedbus.

NOTE

No CHECK terminal is used for FVX110. Do not connect anything on CHECK terminal.

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.

5.6 Host Setting

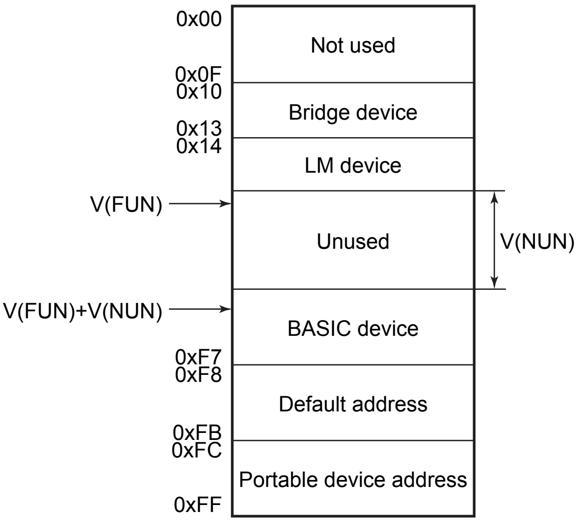
To activate Fieldbus, the following settings are required for the host.

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 5.1 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 FVX110, 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 FVX110, 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 FVX110, 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.

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Figure 5.8 Available Address Range

5.7 Bus Power ON

Turn on the power of the host and the bus. After displaying the startup screen shown in Figure 5.9, the regular screen display appears. If the indicator is not lit, check the polarity of the power supply.

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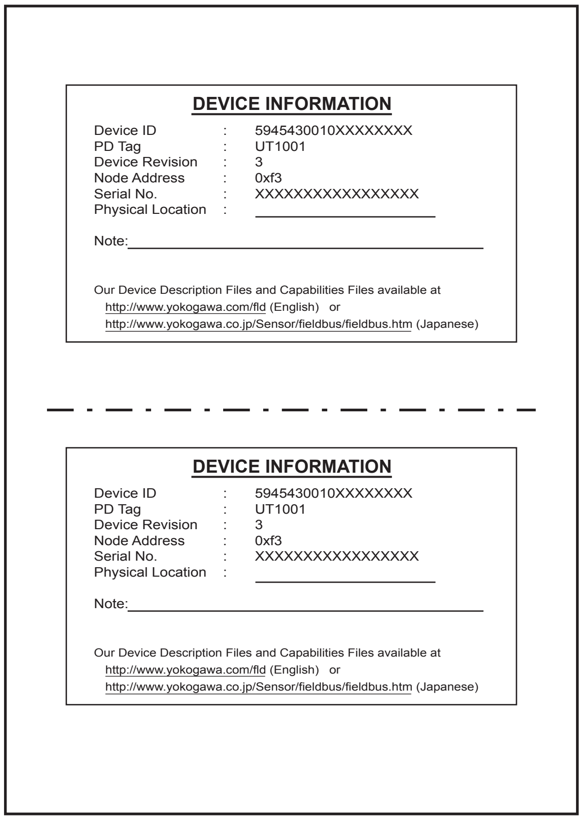
Figure 5.9

Using the host device display function, check that the FVX110 is in operation on the bus.

The device information, including PD tag, Node address, and Device ID, is described on the sheet attached to the FVX110. The device information is given in duplicate on this sheet.



DEVICE INFORMATION

Device ID : 5945430010XXXXXXXX
PD Tag : UT1001
Device Revision : 3
Node Address : 0xf3
Serial No. : XXXXXXXXXXXXXXXXX
Physical Location : ____________

Note: ____________

Our Device Description Files and Capabilities Files available at
http://www.yokogawa.com/fld (English) or
http://www.yokogawa.co.jp/Sensor/fieldbus/fieldbus.htm (Japanese)

DEVICE INFORMATION

Device ID : 5945430010XXXXXXXX
PD Tag : UT1001
Device Revision : 3
Node Address : 0xf3
Serial No. : XXXXXXXXXXXXXXXXX
Physical Location : ____________

Note: ____________

Our Device Description Files and Capabilities Files available at
http://www.yokogawa.com/fld (English) or
http://www.yokogawa.co.jp/Sensor/fieldbus/fieldbus.htm (Japanese)

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Figure 5.10 Device Information Sheet Attached to FVX110

If no FVX110 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 FVX110s are connected at a time with default value, only one FVX110 will be detected from the host as FVX110 have the same initial address. Separately connect each FVX110 and set a different address for each.

5.8 Integration of DD

If the host supports DD (Device Description), the DD of the FVX110 needs to be installed. Check if host has the following directory under its default DD directory.

594543\0010

(594543 is the manufacturer number of Yokogawa Electric Corporation, and 0010 is the FVX110 device number, respectively.)

If this directory is not found, the DD of the FVX110 has not been included. Create the above directory and copy the DD file (0m0n.ffo, 0m0n.sym) (m, n is a numeral) into the directory. ‘0m’ in the file name shows the device revision, and ‘0n’ shows the DD revision. If you do not have the DD or capabilities files, you can download them from our web site:

http://www.yokogawa.com/fld

Once the DD is installed in the directory, the name and attribute of all parameters of the FVX110 are displayed.

Off-line configuration is possible by using capabilities files.

5.9 Set the Parameters Using DTM

Following Device DTM on YOKOGAWA FieldMate can be used to configure the parameters for FVX110 Fieldbus Segment Indicator

Table 5.2 YOKOGAWA device DTM for FVX110 Fieldbus Segment Indicator

Device DTM	FVX110 Fieldbus Segment Indicator		
Name	**Model Name**	**Device Type**	**Device Revision**
FVX FF DTM	FVX110	FVX (0x0010)	1

NOTE

For more information on FieldMate, refer to the User’s Manual IM 01R01A01-1E “Versatile Device Management Wizard”.

5.10 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).

5.11 Generation of Alarm

Generation of an alarm can be attempted from FVX110. 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 6.6.1 Link object and section 6.5.1 VCR Setting.

6. Configuration

This chapter describes how to adapt the function and performance of the FVX110 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 7 when the FVX110 is used as Link Master.

6.1 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 this.

- **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 FVX110 has passed the interoperability test conducted by The Fieldbus Foundation. In order to properly start Fieldbus, it is recommended that the devices used satisfy the requirements of the above test.

- **Host**

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

- **Cable**

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

First, check the capacity of the power supply. The power supply capacity must be greater than the sum of the maximum current consumed by all devices to be connected to Fieldbus. The maximum current consumed (power supply voltage 9 V to 32 V) for the FVX110 is 15 mA (24 mA in Software download operation). The cable used for the spur must be of the minimum possible length.

6.2 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 FVX110 in the range of the BASIC device. When the FVX110 is used as Link Master, place the FVX110 in the range of the LM device. Set the range of addresses to be used to the LM device. Set the following parameters.

Table 6.1 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 6.1 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.

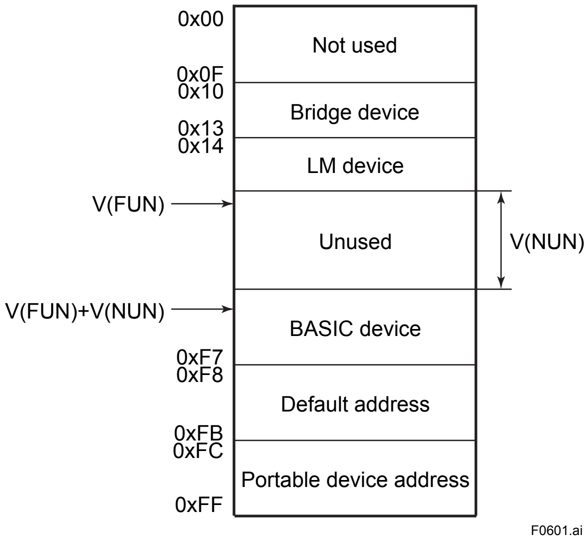

Figure 6.1 Available Range of Node Addresses

To ensure stable operation of Fieldbus, determine the operation parameters and set them to the LM devices. While the parameters in Table 6.2 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 6.2 lists FVX110 specification values.

Table 6.2 Operation Parameter Values of the FVX110 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 FVX110, 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 FVX110, 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 FVX110, the setting must be a value of 12 or, greater and V (MID) < V (MRD) × V (ST).

6.3 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 FVX110 link object. See “Block setting” in Section 6.6 for the details. It is also possible to read values from the host at proper intervals instead of connecting the FVX110 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 FVX110 schedule according to the following table. The values in the table are factory-settings.

Table 6.3 Execution Schedule of the FVX110 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)
276 (SM)	FB_START_ENTRY.1	Excution block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32 ms. (0 = 0 s)
277 to 291 (SM)	FB_START_ENTRY.2 to FB_START_ENTRY.16	Excution block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32 ms. (0 = 0 s)

A maximum of 30 ms is taken for execution of MAO function block and IS function 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 FVX110 be executed at the same time (execution time is overlapped).

Figure 6.3 shows an example of schedule based on the loop shown in Figure 6.2.

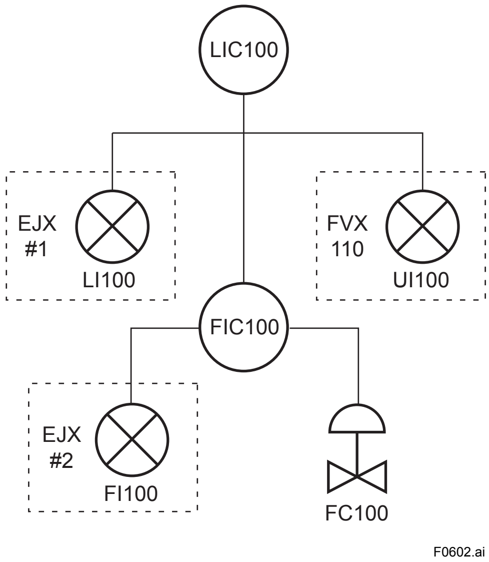

Figure 6.2 Example of Loop Connecting Function Block of FVX110 and Two EJX with Other Instruments

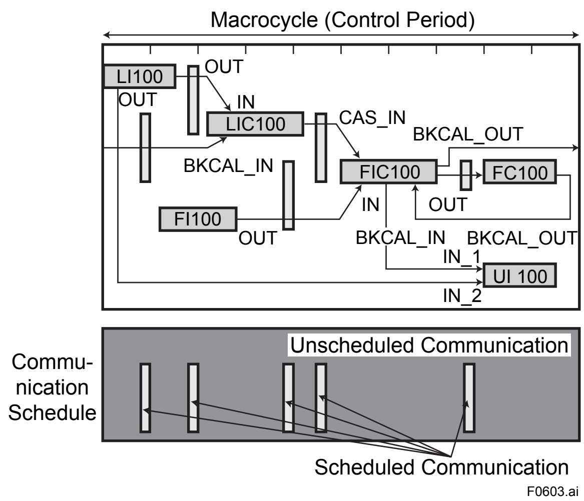

Figure 6.3 Function Block Schedule and Communication Schedule

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”

6.4 Setting of Tags and Addresses

This section describes the steps in the procedure to set PD Tags and node addresses in the FVX110. There are three states of Fieldbus devices as shown in Figure 6.4, and if the state is other than the lowest SM_OPERATIONAL state, no function block is executed. FVX110 must be transferred to this state when an FVX110 tag or address is changed.

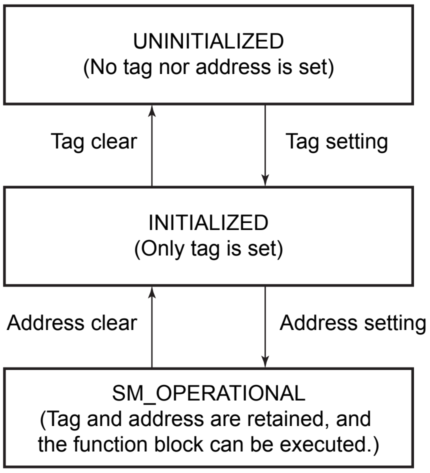

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Figure 6.4 Status Transition by Setting PD Tag and Node Address

FVX110 has a PD Tag (UT1001) 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 FVX110 is 5945430010xxxxxxxx. (The xxxxxxxx at the end of the above device ID is a total of 8 alphanumeric characters.)

6.5 Communication Setting

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

6.5.1 VCR Setting

Set VCR (Virtual Communication Relationship), which specifies the called party for communication and resources. FVX110 has 35 VCRs whose application can be changed, except for the first VCR, which is used for management.

FVX110 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 of field device 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 MAO block or 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 6.4. Parameters must be changed together for each VCR because modification of individual parameters may cause inconsistent operation.

Table 6.4 VCR Static Entry

Sub-index	Parameter	Description
1	FasArTypeAndRole	Indicates the type and role of communication (VCR). The following 4 types are used for FVX110. 0x32: Server (Responds to requests from host.) 0x44: Source (Transmits alarm or trend.) 0x66: Publisher (Sends AI block output of field device to other blocks.) 0x76: Subscriber (Receives output of other blocks by MAO block or PID block.)
2	FasDllLocalAddr	Sets the local address to specify VCR in FVX110. A range of 20 to F7 in hexadecimal.
3	FasDllConfigured RemoteAddr	Sets the node address of the called party for communication and the address (DLSAP or DLCEP) used to specify VCR in that address. For DLSAP or DLCEP, a range of 20 to F7 in hexadecimal is used. Addresses in Subindex 2 and 3 need to be set to the same contents of the VCR as the called party (local and remote are reversed).
4	FasDllSDAP	Specifies the quality of communication. Usually, one of the following types is set. 0x2B: Server 0x01: Source (Alert) 0x03: Source (Trend) 0x91: Publisher/ Subscriber
5	FasDllMaxConfirm DelayOnConnect	To establish connection for communication, a maximum wait time for the called party's response is set in ms. Typical value is 60 secounds (60000).
6	FasDllMaxConfirm DelayOnData	For request of data, a maximum wait time for the called party's response is set in ms. Typical value is 60 secounds (60000).
7	FasDllMaxDlsduSize	Specifies maximum DL Service Data unit Size (DLSDU). Set 256 for Server and Trend VCR, and 64 for other VCRs.
8	FasDllResidual ActivitySupported	Specifies whether connection is monitored. Set TRUE (0xff) for Server. This parameter is not used for other communication.
9	FasDllTimelinessClass	Not used for FVX110.
10	FasDllPublisherTime WindowSize	Not used for FVX110.
11	FasDllPublisher SynchronizaingDlcep	Not used for FVX110.
12	FasDllSubsriberTime WindowSize	Not used for FVX110.
13	FasDllSubscriber SynchronizationDlcep	Not used for FVX110.
14	FmsVfdId	Sets VFD for FVX110 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 FVX110, it is automatically set according to specific applications.

35 VCRs are factory-set as shown in the Table 6.5.

Table 6.5 VCR List

Index (SM)	VCR Number	Factory Setting
303	1	For system management (Fixed)
304	2	Server (LocalAddr = 0xF3)
305	3	Server (LocalAddr = 0xF4)
306	4	Server (LocalAddr = 0xF7)
307	5	Trend Source (LocalAddr = 0x07, Remote Address=0x111)
308	6	Publisher for PID1 (LocalAddr = 0x20)
309	7	Alert Source (LocalAddr = 0x07, Remote Address=0x110)
310	8	Server (LocalAddr = 0xF9)
311	9	Publisher for PID2 (LocalAddr = 0x21)
312 to 337	10 to 35	Not used.

6.5.2 Function Block Execution Control

According to the instructions given in Section 6.3, set the execution cycle of the function blocks and schedule of execution.

6.6 Block Setting

Set the parameter for function block VFD.

6.6.1 Link Object

A link object combines the data voluntarily sent by the function block with the VCR. The FVX110 has 40 link objects. A single link object specifies one combination. Each link object has the parameters listed in Table 6.6. Parameters must be changed together for each VCR because the modifications made to each parameter may cause inconsistent operation.

Table 6.6 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 FVX110. 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.

6.6.2 Trend Object

It is possible to set the parameter so that the function block automatically transmits Trend. FVX110 has seven Trend objects, six of which are used for Trend in analog mode parameters and one is used for Trend in discrete mode parameter. A single Trend object specifies the trend of one parameter.

Each Trend object has the parameters listed in Table 6.8. 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 6.7 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.
3	Sample Type	Specifies how trends are taken. Choose one of the following 2 types: 1: Sampled upon execution of a function block. 2: The average value is sampled.
4	Sample Interval	Specifies sampling intervals in units of 1/32 ms. Set the integer multiple of the function block execution cycle.
5	Last Update	The last sampling time.
6 to 21	List of Status	Status part of a sampled parameter.
21 to 37	List of Samples	Data part of a sampled parameter.

Seven trend objects are factory-set as shown Table 6.8.

Table 6.8 Trend Object are Factory-Set

Index	Parameters	Factory Settings
32000 to 32005	TREND_FLT.1 to TREND_FLT.5	Not used.
32006	TREND_DIS.1	Not used.

6.6.3 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 6.10 and 6.11. Purpose of View Objects is shown in Table 6.9.

Table 6.9 Purpose of Each View Object

	Description
VIEW_1	Set of dynamic parameters required by operator for plant operation. (PV, SP, 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 6.10 View Object for Resource Block

Relative Index	Parameter Mnemonic	View					
		1	2	3_1	3_2	4_1	4_2
1	ST_REV	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					1	
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		
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						
	Total (# bytes)	40	32	77	61	73	32

Table 6.11 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	NOW_DISPLAYING	1		1	
14	DISP_TARGET_FORCE	1		1	
15	NO_OF_VALID_CON	1		1	
16	VALID_CON_SUMMARY				2
17	MAO_CON_SUMMARY	2		2	
18	ISEL_CON_SUMMARY	2		2	
19	SIM_CON_SUMMARY	2		2	
20	BAR_GRAPH_SELECT				1
21	EACH_BAR_GRAPH		2		
22	MAIN_TAG_SCROLL				1
23	V_SCROLL_BAR				1
24	SCROLL_DIRECTION				1
25	DISP_PAGE_INFO				1
26	DISP_QUIET_MODE		1		
27	DISP_FORMAT_TYPE				1
28	DISPLAY_CYCLE				1
29	DISPLAY_TEST				
30	DISPLAY_CONTRAST				1
31	SQUAWK				
32	AMBIENT_TEMPERATURE	4		4	
33	MAIN_CONNECT_TYPE				1
34	IN01_CONNECTION		1		1
35	IN02_CONNECTION		1		1
36	IN03_CONNECTION		1		1
37	IN04_CONNECTION		1		1
38	IN05_CONNECTION		1		1
39	IN06_CONNECTION		1		1
40	IN07_CONNECTION		1		1
41	IN08_CONNECTION		1		1
42	IN09_CONNECTION		1		1
43	IN10_CONNECTION		1		1
44	IN11_CONNECTION		1		1
45	IN12_CONNECTION		1		1
46	IN13_CONNECTION		1		1
47	IN14_CONNECTION		1		1
48	IN15_CONNECTION		1		1
49	IN16_CONNECTION		1		1
50	IN_01	5		5	
51	IN_02	5		5	
52	IN_03	5		5	
53	IN_04	5		5	
54	IN_05	5		5	
55	IN_06	5		5	
56	IN_07	5		5	
57	IN_08	5		5	
58	IN_09	5		5	
59	IN_10	5		5	
60	IN_11	5		5	
61	IN_12	5		5	
62	IN_13	5		5	
63	IN_14	5		5	
64	IN_15	5		5	
65	IN_16	5		5	
66	IN01_MAIN_TAG				
67	IN01_SUB_TAG				
68	IN01_SCALE				
69	IN02_MAIN_TAG				
70	IN02_SUB_TAG				
71	IN02_SCALE				
72	IN03_MAIN_TAG				
73	IN03_SUB_TAG				
74	IN03_SCALE				
75	IN04_MAIN_TAG				
76	IN04_SUB_TAG				
77	IN04_SCALE				
78	IN05_MAIN_TAG				
79	IN05_SUB_TAG				
80	IN05_SCALE				
81	IN06_MAIN_TAG				
82	IN06_SUB_TAG				
83	IN06_SCALE				
84	IN07_MAIN_TAG				
85	IN07_SUB_TAG				
86	IN07_SCALE				
87	IN08_MAIN_TAG				
88	IN08_SUB_TAG				
89	IN08_SCALE				
90	IN09_MAIN_TAG				
91	IN09_SUB_TAG				
92	IN09_SCALE				
93	IN10_MAIN_TAG				
94	IN10_SUB_TAG				
95	IN10_SCALE				
96	IN11_MAIN_TAG				
97	IN11_SUB_TAG				
98	IN11_SCALE				
99	IN12_MAIN_TAG				
100	IN12_SUB_TAG				
101	IN12_SCALE				
102	IN13_MAIN_TAG				
103	IN13_SUB_TAG				
104	IN13_SCALE				
105	IN14_MAIN_TAG				
106	IN14_SUB_TAG				
107	IN14_SCALE				
108	IN15_MAIN_TAG				
109	IN15_SUB_TAG				
110	IN15_SCALE				
111	IN16_MAIN_TAG				
112	IN16_SUB_TAG				
113	IN16_SCALE				
114	MS_CODE				
115	SERIAL_NO				
116	MANUFAC_DATE				
117	TEST_KEY1				
118	TEST_KEY2				
119	TEST_KEY3				
120	TEST_1				
121	TEST_2				
122	TEST_3				
123	TEST_4				
124	TEST_5				
125	TEST_6				
	Total (# bytes)	104	23	104	34

Table 6.12 Indexes of View for Each Block

	VIEW 1	VIEW 2	VIEW 3	VIEW 4
Resourse Block	40100	40101	40102	40103
LCD Transducer Block	40250	40251	40252	40253
PID1 Function Block	40800	40801	40802	40803
PID2 Function Block	40810	40811	40812	40813
MAO1 Function Block	41000	41001	41002	41003
MAO2 Function Block	41010	41011	41012	41013
SC Function Block	41450	41451	41452	41453
IT Function Block	41600	41601	41602	41603
IS1 Function Block	41700	41701	41702	41703
IS2 Function Block	41710	41711	41712	41713
AR1 Function Block	41750	41751	41752	41753
AR2 Function Block	41760	41761	41762	41763

6.6.4 Function Block Parameters

Function block parameters can be read from the host or can be set. For a list of the parameters of blocks refer to “12. Parameter Lists”. For the function blocks, LM function and software download function, refer to Appendix 1 to 8.

7. Explanation of Basic Items

7.1 Outline

This chapter provides an outline of the LCD transducer block and describes basic parameter setup procedures. For information on function blocks as well as the LM function and software download functions, refer to Appendix 1 to 8.

7.2 Setting and Changing Parameters for the Whole Process

IMPORTANT

Do not turn off the power immediately after making a setting. When data is saved to the EEPROM, redundant processing is performed to enhance reliability. If the power is turned off within 60 seconds after making a setting, the modified parameters are not saved and may return to their original values.

Operating mode

Many parameters require a change of operating mode of the function block to O/S (Out of Service) to rewrite parameter data. To change the operating 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):
Parameter to set the operating mode of the block.

(2) Actual (Actual mode):
Parameter to indicate the current operating mode of the block.

(3) Permit (Permitted mode):
Parameter to indicate operating mode that the block is allowed to take.

(4) Normal (Normal mode):
Parameter to indicate the operating mode the block will usually take.

7.3 LCD Transducer Block

7.3.1 Function Outline

The LCD transducer block controls the indications displayed on the LCD. FVX110 displays process variables from field instruments which have received in MAO or IS function block and also simulation input.

7.3.2 Operating mode

The operating conditions permitted for the LCD transducer block are Automatic (AUTO) and Out of Service (O/S) mode. Settings can normally be changed in the O/S mode, but can also be performed in the Auto mode except for changes of the block tag parameter of the block header in the LCD transducer block.

7.3.3 Indicator names and functions

The LCD consists of three fields: the top, center and bottom fields. The top field shows the Main Tag which identifies the instrument whose values are indicated (for example PD_Tag), and other freely settable information. It also shows the page information (number of displayed page)/(total number of display pages). The middle field shows process value and measuring unit. The lower field shows the Sub Tag, a field indicating data required for identifying instruments whose values are displayed, communication status, bar graph and other information. At the center right edge, there is a scroll bar enabling visual confirmation of page numbers. The lower right corner displays an icon indicating the scroll knob turning direction and the center left edge provides an icon indicating communication status.

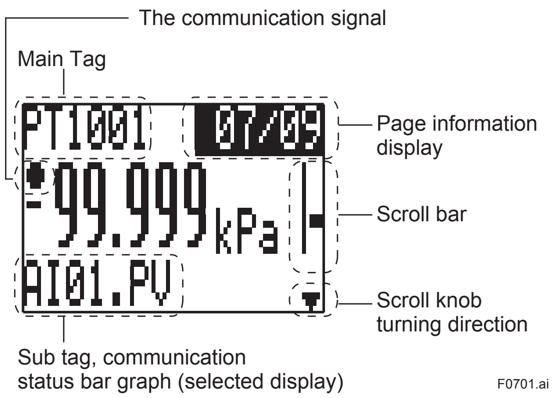


Figure 7.1 Display design

Table 7.1 Indicated values

Component name	Description	
Top field	Shows the Main Tag and page number information. Maximum of 32 characters can be set for Main Tag. But 14 characters (8 characters in case page information indicates) is limit of displaying on LCD. Main Tag scroll enables to confirm more than 14 characters.	
Center field	Indicates process value and measuring unit from field instruments including +/- sign. "Squawk" indicate incase squawk function enabled.	
Lower field	Displays the Sub Tag (a settable descriptor), communication status and bar graphs. The scaling range of the bar graph must be set elsewhere.	
Additional displays	▲ ▼	Shows scroll knob turning direction. (Single scroll mode)
	⏫ ⏬	Shows scroll knob turning direction (continuous scan mode)
	●	Flashes when communication status is normal.

7.3.4 Communication status indication

The lower field of the LCD shows communication status (Quality + SubStatus + Limit).
Table 7.2 shows characters for each status displayed on the LCD.

Table 7.2 Communication status indications

Quality	Sub-status	limit (Upper line: LCD indication, Lower line: Status Code)			
		Not limited	Low limited	High limited	Constant
Bad	Non-specific	Bad NonSpc 0x00	Bad NonSpc L 0x01	Bad NonSpc H 0x02	Bad NonSpc C 0x03
	Configuration Error	Bad ConfErr 0x04	Bad ConfErr L 0x05	Bad ConfErr H 0x06	Bad ConfErr C 0x07
	Not Connected	Bad NotCnnct 0x08	Bad NotCnnct L 0x09	Bad NotCnnct H 0x0A	Bad NotCnnct C 0x0B
	Device Failure	Bad DevFail 0x0C	Bad DevFail L 0x0D	Bad DevFail H 0x0E	Bad DevFail C 0x0F
	Sensor Failure	Bad SnsrFail 0x10	Bad SnsrFail L 0x11	Bad SnsrFail H 0x12	Bad SnsrFail C 0x13
	No Comm, with LastUsableValue	Bad NC LUV 0x14	Bad NC LUV L 0x15	Bad NC LUV H 0x16	Bad NC LUV C 0x17
	No Comm, no LUV (NoComm_withNoUsableValue)	Bad NCnoLUV 0x18	Bad NCnoLUV L 0x19	Bad NCnoLUV H 0x1A	Bad NCnoLUV C 0x1B
	Out of Service	Bad OOS 0x1C	Bad OOS L 0x1D	Bad OOS H 0x1E	Bad OOS C 0x1F
Uncertain	Non-specific	Unc NonSpc 0x40	Unc NonSpc L 0x41	Unc NonSpc H 0x42	Unc NonSpc C 0x43
	Last Usable Value	Unc LUV 0x44	Unc LUV L 0x45	Unc LUV H 0x46	Unc LUV C 0x47
	Substitute/Manual Entry (SubstitudeValue)	Unc S/M_Entr 0x48	Unc S/M_Entr L 0x49	Unc S/M_Entr H 0x4A	Unc S/M_Entr C 0x4B
	Initial Value	Unc InitVal 0x4C	Unc InitVal L 0x4D	Unc InitVal H 0x4E	Unc InitVal C 0x4F
	Sensor Conversion not Accurate	Unc SnCnv_nA 0x50	Unc SnCnv_nA L 0x51	Unc SnCnv_nA H 0x52	Unc SnCnv_nA C 0x53
	Engineering Unit Range Violation	Unc EURangeV 0x54	Unc EURangeV L 0x55	Unc EURangeV H 0x56	Unc EURangeV C 0x57
	Sub-normal	Unc SubNrml 0x58	Unc SubNrml L 0x59	Unc SubNrml H 0x5A	Unc SubNrml C 0x5B
Good(NC)	Non-specific	G(NC) NonSpc 0x80	G(NC) NonSpc L 0x81	G(NC) NonSpc H 0x82	G(NC) NonSpc C 0x83
	Active Block Alarm	G(NC) A_Blk 0x84	G(NC) A_Blk L 0x85	G(NC) A_Blk H 0x86	G(NC) A_Blk C 0x87
	Active Advisory Alarm	G(NC) A_Adv 0x88	G(NC) A_Adv L 0x89	G(NC) A_Adv H 0x8A	G(NC) A_Adv C 0x8B
	Active Critical Alarm	G(NC) A_Crit 0x8C	G(NC) A_Crit L 0x8D	G(NC) A_Crit H 0x8E	G(NC) A_Crit C 0x8F
	Unack Block Alarm	G(NC) U_Blk 0x90	G(NC) U_Blk L 0x91	G(NC) U_Blk H 0x92	G(NC) U_Blk C 0x93
	Unack Advisory Alarm	G(NC) U_Adv 0x94	G(NC) U_Adv L 0x95	G(NC) U_Adv H 0x96	G(NC) U_Adv C 0x97
	Unack Critical Alarm	G(NC) U_Crit 0x98	G(NC) U_Crit L 0x99	G(NC) U_Crit H 0x9A	G(NC) U_Crit C 0x9B
Good(C)	Non-specific	G(C) NonSpc 0xC0	G(C) NonSpc L 0xC1	G(C) NonSpc H 0xC2	G(C) NonSpc C 0xC3
	Initialization Acknowledge	G(C) InitAck 0xC4	G(C) InitAck L 0xC5	G(C) InitAck H 0xC6	G(C) InitAck C 0xC7
	Initialization Request	G(C) InitReq 0xC8	G(C) InitReq L 0xC9	G(C) InitReq H 0xCA	G(C) InitReq C 0xCB
	Not Invited	G(C) NotInv 0xCC	G(C) NotInv L 0xCD	G(C) NotInv H 0xCE	G(C) NotInv C 0xCF
	Not Selected	G(C) NotSel 0xD0	G(C) NotSel L 0xD1	G(C) NotSel H 0xD2	G(C) NotSel C 0xD3
	Local Override	G(C) LocOvr 0xD8	G(C) LocOvr L 0xD9	G(C) LocOvr H 0xDA	G(C) LocOvr C 0xDB
	Fault State Active	G(C) FSActiv 0xDC	G(C) FSActiv L 0xDD	G(C) FSActiv H 0xDE	G(C) FSActiv C 0xDF
	Initial Fault State	G(C) InitFS 0xE0	G(C) InitFS L 0xE1	G(C) InitFS H 0xE2	G(C) InitFS C 0xE3

“Invalid status” will be indicated in case of code not listed in chart above

7.3.5 Indicator settings

To use the FVX110 as a field indicator, information (Main Tag and Sub Tag) identifying field instruments, units, bar graph scaling and other parameters must be set to enable display on the FVX110.

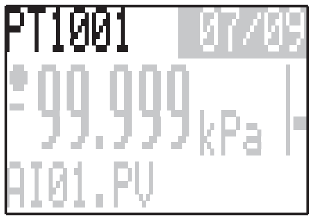
Selection of function block to receive output signals from field instruments (MAIN_CONNECT_YTPE, INxx_CONNECTION)
Select function block to receive output signals from field instruments from MAO or IS function block. Batch settings should start from the MAIN_CONNECT_TYPE parameter in the LCD transducer block. To use the MAO function block to receive all 16 inputs, select 1: All connects to MAO-FB, to use the IS function block, select 2: All connects to ISEL-FB and to use a simulation instruction for all inputs, select 3: All are in simulate. To set a separate input source, start from the INxx_CONNECTION parameter in the LCD transducer block. To use the MAO function block to receive inputs IN_01 to IN_08, set 1:from MAO-FB_1_INxx (xx: 01~08). To use the IS function block to receive the same inputs, set 2:from ISEL-FB_1_INxx (xx: 01~08). To use the MAO function block to receive inputs from IN_09 to IN_16, set 1:from MAO-FB_2_INxx (xx : 09~16). To use the IS function block to receive the same inputs, set 2:from ISEL_FB_2_INxx (xx : 09~16). Select 0:In simulate for all inputs to perform a simulation instruction.

NOTE

Selecting 0: All are in simulate or 0: In simulate will display directly input test input values for IN_xx on the display.

Valid input values (VALID_CON_SUMMARY)
Select valid IN_xx (xx: 01~16) to indicate in LCD at VALID_CON_SUMMARY. IN_xx which is not chosen at VALID_CON_SUMMARY will not indicated in LCD.
This setting is reflected to the MAO_CON_SUMMARY, ISEL_CON_SUMMARY and the SIM_CON_SUMMARY.

Main Tag settings (INxx_MAIN_TAG)
The Main Tag is a memo field for making settings used for entering the most important information to identify the indicating field instrument (for example, a PD_TAG of field instrument). Setting can be done in INxx_MAIN_TAG (xx: 01 to 16). Maximum of 32 characters can be set, but 14 characters are limit of indication on LCD. Scroll to view the digits beyond the first 14 digits. Use MAIN_TAG_SCROLL to set the scroll Main Tag.



F0702.ai

Figure 7.2 Main Tag settings

NOTE

8 characters are allowed if page information have set to enable. To set MAIN_TAG_SCROLL=1:Active, it is possible to view information exceeding the allowed number of characters through scrolling.

Indicator setting (INxx_SCALE)
Use INxx_SCALE(xx:01 to 16) to set measuring units, bar graph scaling and the number of decimal point digits of display values. Scaling is normally set to the same value as the field instrument measurement range. Set the upper limit and lower limit values in EU at 100% and EU at 0%. Scaling is not a mandatory setting, but is required to enable display of bar graphs.

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Figure 7.3 Indicator value settings

You can set the range of decimal places that are displayed after the decimal point from 0 to 4 digits. The number of decimal places is automatically adjusted so that 5 digits are displayed.
Any measuring unit in the table of section 7.3.8 can be selected. Here, (N) indicates “Normal” (normal state) and (S) indicates “Standard” (standard state) for standard mass flow rate.

NOTE

- When 5 digits are displayed, the values beyond the decimal point are rounded off.
- When the sum of displayed digits and decimal places is 5 or more digits, the number of displayed digits and decimal place digits is automatically adjusted to 5 digits regardless of decimal place setting.

Sub Tag settings (INxx_MAIN_TAG)

The Sub Tag is a memo field for making settings used for entering information (for example, AI1.OUT or AI1 PV1 and other I/O block information) that is to be displayed to identify a field instrument in addition to the information displayed by the Main Tag. Use INxx_SUB_TAG (xx: 01 to 16) for setting Sub Tags. A total of 32 characters can be displayed 14 of which appear on the screen.

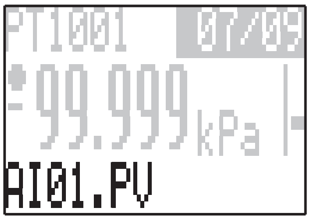

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Figure 7.4 Sub Tag settings

Bar graph setting example (BAR_GRAPH_SELECT, EACH_BAR_GRAPH)

The bar graph in the lower field on the LCD allows the user to select either (BAR_GRAPH_SELECT) to display all IN_xx (xx:01 to 16) or to display an individual selection of inputs (EACH_BAR_GRAPH). Bar graphs display upper and lower limit values according to values scaled using INxx_SCALE (xx: 01 to 16).
In a batch bar graph setting, setting BAR_GRAPH_SELECT=0: All are set to inactive will turn off all bar graph displays and setting 2: All are set to active will display bar graphs on all screens.
When bar graphs are enabled, the lower display field will alternately display Sub Tag, communication status and bar graphs in stated order according to the interval set by DISPLAY_CYCLE.

Scroll bar display setting (V_SCROLL_BAR)

Use V_SCROLL_BAR to set the scroll bar display setting. Set V_SCROLL_BAR = 0: Inactive to turn off the scroll bar display and set it to V_SCROLL_BAR = 1 Active to have it on at all times. Selecting V_SCROLL_BAR = 2: Knob link will turn on the scroll bar display only during display switching and turns off the display within a few seconds.

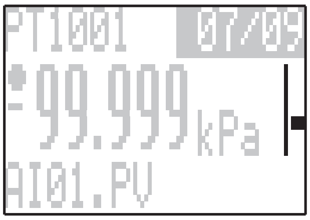

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Figure 7.5 Scroll bar settings

Changing scroll direction (SCROLL_DIRECTION)

The user can change the direction of display changes made using the scroll knob. Selecting 0: Turn page clockwise for SCROLL_DIRECTION increases page numbers (For example: 1/16 → 2/16 → ··· → 16/16 → 1/16→ ··· when the scroll knob is turned clockwise). Selecting 1:Turn page counter-clockwise increase page numbers when the scroll knob is turned counter-clockwise. 0:Turn page clockwise is the factory default setting.

Page number information settings (DISP_PAGE_INFO)

Page number information for process values indicated by the FVX110 can be displayed in a minute format. The denominator indicating the total number of pages is the total number of IN_xx (xx:01 to 16) specified using VALID_CON_SUMMARY above.

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Figure 7.6 Setting page number information

NOTE

DISP_PAGE_INFO does not display numbers of function blocks whose inputs are valid. It only displays the numbers of total inputs that are valid, which do not necessarily correspond to input signal numbers and page numbers displayed by the minute of function blocks.
Example: When IN_01, IN_03, IN_04 inputs are valid for the function block of the VALID_CON_SUMMARY, page number information is displayed as 1/3, 2/3 and 3/3.

When DISP_PAGE_INFO is 0: Knob link, page information is displayed only when switching screens and disappears after a few seconds. Page information is displayed at all times when DISP_PAGE_INFO is set to 1: Active and displays information for highlighted pages when DISP_PAGE_INFO is set to 2: Active (Reverse).

Setting screen displaying cycle (DISPLAY_CYCLE)

Select from AUTO, 0.5 sec, 1.0 sec, 2.0 sec, or 4.0 sec for screen displaying cycle. This cycle determines the displaying cycle in scan mode, displaying cycle of indication in the lower display field, scroll bar movement cycle and cycle of communication icon flashing. When set to AUTO, displaying cycle listed above are automatically set according to ambient temperature where FVX110 installed (-10 °C is the border of temperature) Displaying cycle is listed in Table 7.3.

NOTE

When the ambient temperature where FVX110 installed is very low, Please set the DISPLAY_CYCLE to AUTO or more than 2.0 sec.

NOTE

Please don't charge DISPLAY_CYCLE setting during squawk. It will be cause of stopping squawk indication.

Table 7.3 Screen displaying cycle

			Seting of DISPLAY_CYCLE					
			0: Auto		1: 0.5sec	2: 1.0sec	3: 2.0sec	4: 4.0sec
			Ambient Temperature					
			> -10 °C	≤ -10 °C				
Object	**Parameter**	**Setting**	**Time**					
Scan mode	-		0.5 sec	5 sec	0.5 sec	1 sec	2 sec	4 sec
Flashing cycle of comm. Signal	-		1 sec	10 sec	1 sec	2 sec	4 sec	8 sec
Display cycle of lower field	-		1 sec	5 sec	0.5 sec	1 sec	2 sec	4 sec
Main Tag Scrolling speed ()is scroll starting time	MAIN_TAG_SCROLL	1:Active	0.25 sec (2 sec)	5 sec (10 sec)	0.5sec (1 sec)	1 sec (2 sec)	2 sec (4 sec)	4 sec (8 sec)
Scroll bar moving speed (Display out time for 2:Knob link)	V_SCROLL_BAR	1:Active	0.5 sec	5 sec	0.5 sec	1 sec	2 sec	4 sec
		2:Knob link	4 sec	5 sec	4 sec	4 sec	4 sec	4 sec
Display cycle of Squawk	SQUAWK	1:Squawk	0.5 sec	5 sec	0.5 sec	1 sec	2 sec	4 sec
Display action after backlight off	DISP_QUIET_MODE	1:Turn page cyclic	1 sec	5 sec	0.5 sec	1 sec	2 sec	4 sec
Display out time of Page number information	DISP_PAGE_INFO	0:Knob link	4 sec	5 sec	4 sec	4 sec	4 sec	4 sec

7.3.6 Other display settings

Setting display mode after backlight off (DISP_QUIET_MODE)
This setting allows the user to set the display mode after backlight off. DISP_QUIET_MODE: 0 = Stay at last target (the display remains in the state it had before backlight off), 1: Turn page cyclic (engages scan mode after backlight off), 2: Display off (the screen is turned off after backlight off).

Squawk (SQUAWK)
This function displays a notice that identifies the communicating FVX110. Executing this function alternates the screen shown in Figure 7.7. The squawk display is automatically cancelled after about a minute, but can also be cancelled by turning the scroll knob.

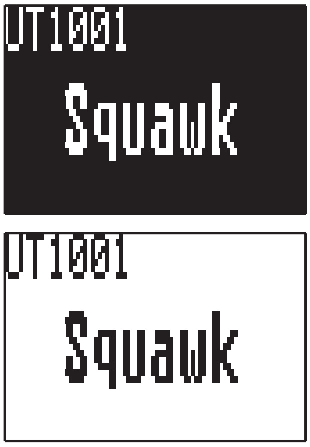

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Figure 7.7 Screen displayed during squawk operation

7.3.7 Flow chart of indicator settings

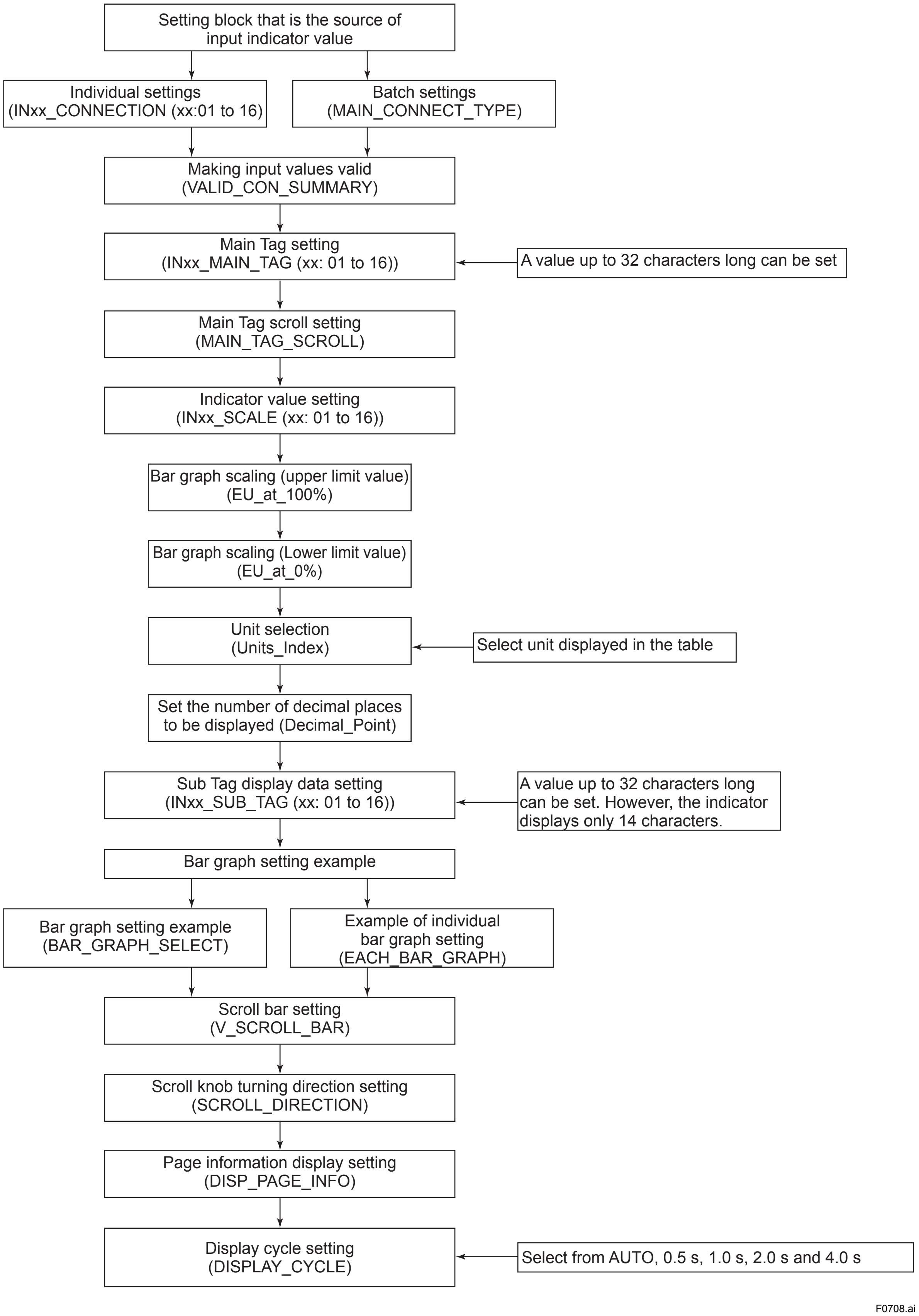


Figure 7.8 Flow chart of indicator settings

7.3.8 Units the auto link function allows you to display on the LCD

Index	Unit	Display on the LCD
1000	K	K
1001	°C	° C
1002	°F	° F
1003	°R	° R
1004	rad	r a d
1005	°	°
1006	min	'
1007	sec	"
1008	gon	g o n
1009	rev	r e v
1010	m	m
1011	km	k m
1012	cm	c m
1013	mm	m m
1014	µm	u m
1015	nm	n m
1016	pm	p m
1017	Å	Å
1018	ft	f t
1019	in	i n
1020	yd	y d
1021	mile	m i l e
1022	nautical mile	n a u t i m i l e
1023	m2	m ^{2}
1024	km2	k m ^{2}
1025	cm2	c m ^{2}
1026	dm2	d m ^{2}
1027	mm2	m m ^{2}
1028	a	a
1029	ha	h a
1030	in2	i n ^{2}
1031	ft2	f t ^{2}
1032	yd2	y d ^{2}
1033	mile2	m i l e ^{2}
1034	m3	m ^{3}

Index	Unit	Display on the LCD
1035	dm3	d m ^{3}
1036	cm3	c m ^{3}
1037	mm3	m m ^{3}
1038	L	L
1039	cl	c l
1040	ml	m l
1041	hl	h l
1042	in3	i n ^{3}
1043	ft3	f t ^{3}
1044	yd3	y d ^{3}
1045	mile2	m i l e ^{3}
1046	pint	p i n t
1047	quart	q u a r t
1048	gal	g a l
1049	Imp Gal	I m p G a l
1050	bushel	b u s h e l
1051	bbl	b b l
1052	bbl (liquid)	b b l (l i q)
1053	SCF	S C F
1054	sec	s
1055	ksec	k s
1056	msec	m s
1057	µsec	u s
1058	min	m i n
1059	h	h
1060	d	d
1061	m/s	m / s
1062	mm/s	m m / s
1063	m/h	m / h
1064	km/h	k m / h
1065	knot	k n o t
1066	in/s	i n / s
1067	ft/s	f t / s
1068	yd/s	y d / s
1069	in/min	i n / m i n

Index	Unit	Display on the LCD
1070	ft/min	ft /min
1071	yd/min	yd /min
1072	in/h	in/h
1073	ft/h	ft/h
1074	yd/h	yd/h
1075	MPH	MPH
1076	m/s2	m/s^2
1077	Hz	Hz
1078	THz	THz
1079	GHz	GHz
1080	MHz	MHz
1081	kHz	kHz
1082	1/s	1/s
1083	1/min	1/ min
1084	rev/s	rev /s
1085	RPM	RPM
1086	rad/s	rad /s
1087	1/s2	1/s^2
1088	kg	kg
1089	g	g
1090	mg	mg
1091	Mg	Mg
1092	t	t
1093	oz	oz
1094	lb	lb
1095	STon	STon
1096	Lton	LTon
1097	kg/m2	kg /m^3
1098	Mg/m2	Mg /m^3
1099	kg/m2	kg /dm^3
1100	g/cm3	g /cm^3
1101	g/m3	g/m^3
1102	t/m3	t/m^3
1103	kg/L	kg/L
1104	g/ml	g/ml
1105	g/L	g/L

Index	Unit	Display on the LCD
1106	lb/in3	lb /in^3
1107	lb/ft3	lb /ft^3
1108	lb/gal	lb /gal
1109	STon/yd3	STon /yd^3
1110	deg Twad	deg Twad
1111	Deg Baum hv	degBa um hv
1112	dg Baum lt	degBa um lt
1113	dep API	deg API
1114	SGU	SGU
1115	kg/m	kg/m
1116	mg/m	mg/m
1117	tex	tex
1118	kg•m2	kg •m^2
1119	kg•m/s	kg•m /s
1120	N	N
1121	MN	MN
1122	kN	kN
1123	mN	mN
1124	µN	uN
1125	kg•m2/s	kg• m^2/s
1126	N•m	N•m
1127	MN•m	MN•m
1128	kN•m	kN•m
1129	mN•m	mN•m
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
1140	atm	atm
1141	psi	psi

Index	Unit	Display on the LCD
1142	psia	p s i a
1143	psig	p s i g
1144	g/cm2	g / c m ^{2}
1145	k/cm2	k g / c m ^{2}
1146	inH2O	i n H 2 O
1147	inH2O (4°C)	i n H 2 O (4 C)
1148	inH2O (68°F)	i n H 2 O (6 8 F)
1149	mmH2O	m m H 2 O
1150	mmH2O (4°C)	m m H 2 O (4 C)
1151	mmH2O (68°F)	m m H 2 O (6 8 F)
1152	ftH2O	f t H 2 O
1153	ftH2O (4°C)	f t H 2 O (4 C)
1154	ftH2O (68°F)	f t H 2 O (6 8 F)
1155	inHg	i n H g
1156	inHg (0°C)	i n H g (0 C)
1157	mmHg	m m H g
1158	mmHg (0°C)	m m H g (0 C)
1159	Pa•s	P a • s
1160	m2/s	m ^{2} / s
1161	P	P
1162	cP	c P
1163	St	S t
1164	cSt	c S t
1165	N/m	N / m
1166	mN/m	m N / m
1167	J	J
1168	EJ	E J
1169	PJ	P J
1170	TJ	T J
1171	GJ	G J
1172	MJ	M J
1173	kJ	k J
1174	mJ	m J
1175	W•h	W • h
1176	TW•h	T W • h
1177	GW•h	G W • h
1178	MW•h	M W • h
1179	kW•h	k W • h
1180	cal	c a l
1181	kcal	k c a l
1182	Mcal	M c a l
1183	Btu	B t u
1184	decatherm	d e c a t h e r m
1185	ft-lb	f t - l b
1186	W	W
1187	TW	T W
1188	GW	G W
1189	MW	M W
1190	kW	k W
1191	mW	m W
1192	μW	u W
1193	nW	n W
1194	pW	p W
1195	Mcal/h	M c a l / h
1196	MJ/h	M J / h
1197	Btu/h	B t u / h
1198	hp	h p
1199	W/(m•K)	W / (m • K)
1200	W/(m2•K)	W / (m ^{2} • K)
1201	m2•K/W	m ^{2} • K / W
1202	J/K	J / K
1203	kJ/K	k J / K
1204	J/(kg•K)	J / (k g • K)
1205	kJ/(kg•K)	k J / (k g • K)
1206	J/kg	J / k g
1207	MJ/kg	M J / k g
1208	KJ/kg	k J / k g
1209	A	A
1210	kA	k A
1211	mA	m A
1212	μA	u A
1213	nA	n A

Index	Unit	Display on the LCD
1214	pA	p A
1215	C	C
1216	MC	M C
1217	kC	k C
1218	μC	u C
1219	nC	n C
1220	pC	p C
1221	A•h	A • h
1222	C/m3	C / m 3
1223	C/mm3	C / m m 3
1224	C/cm3	C / c m 3
1225	kC/m3	k C / m 3
1226	mC/m3	m C / m 3
1227	μC/m3	u C / m 3
1228	C/m2	C / m 2
1229	C/mm2	C / m m 2
1230	C/cm2	C / c m 2
1231	kC/m2	k C / m 2
1232	mC/m2	m C / m 2
1233	μC/m2	u C / m 2
1234	V/m	V / m
1235	MV/m	M V / m
1236	kV/m	k V / m
1237	V/cm	V / c m
1238	mV/m	m V / m
1239	μV/m	u V / m
1240	V	V
1241	MV	M V
1242	kV	k V
1243	mV	m V
1244	μV	u V
1245	F	F
1246	mF	m F
1247	μF	u F
1248	nF	n F
1249	pF	p F

Index	Unit	Display on the LCD
1250	F/m	F / m
1251	μF/m	u F / m
1252	nF/m	n F / m
1253	pF/m	p F / m
1254	C•m	C • m
1255	A/m2	A / m 2
1256	MA/cm2	M A / m 2
1257	A/cm2	A / c m 2
1258	KA/m2	k A / m 2
1259	A/m	A / m
1260	kA/m	k A / m
1261	A/cm	A / c m
1262	T	T
1263	mT	m T
1264	μT	u T
1265	nT	n T
1266	Wb	W b
1267	mWb	m W b
1268	Wb/m	W b / m
1269	kWb/m	k W b / m
1270	H	H
1271	mH	m H
1272	μH	u H
1273	nH	n H
1274	picoH	p i c o H
1275	H/m	H / m
1276	μH/m	u H / m
1277	nH/m	n H / m
1278	A•m2	A • m 2
1279	N•m2/A	N • m 2 / A
1280	Wb•m	W b • m
1281	Ω	o h m
1282	GΩ	G o h m
1283	MΩ	M o h m
1284	□Ω	k o h m
1285	mΩ	m o h m

Index	Unit	Display on the LCD
1286	μΩ	uohm
1287	S	S
1288	kS	kS
1289	mS	mS
1290	μS	uS
1291	Ω•m	ohm•m
1292	GΩ•m	Gohm•m
1293	MΩ•m	Mohm•m
1294	kΩ•m	kohm•m
1295	Ω•cm	ohm•cm
1296	mΩ•m	mohm•m
1297	μΩ•m	uohm•m
1298	nΩ•m	nohm•m
1299	S/m	S/m
1300	MS/m	MS/m
1301	kS/m	kS/m
1302	mS/cm	mS/cm
1303	μS/mm	uS/mm
1304	1/H	1/H
1305	sr	sr
1306	W/sr	W/sr
1307	W/(sr•m2)	W/(sr•m^2)
1308	W/m2	W/m^2
1309	lm	lm
1310	lm•s	lm•s
1311	lm•sh	lm•h
1312	lm/m2	lm/m^2
1313	lm/W	lm/W
1314	lx	lx
1315	lx•s	lx•s
1316	cd	cd
1317	cd/m2	cd/m^2
1318	g/s	g/s
1319	g/min	g/min
1320	g/h	g/h
1321	g/d	g/d

Index	Unit	Display on the LCD
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/min
1336	STon/h	STon/h
1337	STon/d	STon/d
1338	LTon/s	LTon/s
1339	LTon/min	LTon/min
1340	LTon/h	LTon/h
1341	LTon/d	LTon/d
1342	%	%
1343	%sol/wt	%sol/wt
1344	%sol/vol	%sol/vol
1345	% stmqual	%stmqual
1346	m3/min	%plato
1347	m3/s	m^3/s
1348	m3/min	m^3/min
1349	m3/h	m^3/h
1350	m3/d	m^3/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
1357	CFM	CFM

Index	Unit	Display on the LCD
1358	CFH	CFH
1359	ft3/d	ft3 /d
1360	CFM (0°C, 1atm)	CFM (S)
1361	CFH (0°C, 1atm)	CFH (S)
1362	gal/s	gal /s
1363	GPM	GPM
1364	gal/h	gal /h
1365	gal/d	gal /d
1366	Mgal/d	Mgal /d
1367	IGal/s	IGal /s
1368	IGal/min	IGal /min
1369	IGal/h	IGal /h
1370	IGal/d	IGal /d
1371	bbl/s	bbl /s
1372	bb/min	bbl /min
1373	bbl/h	bbl /h
1374	bbl/d	bbl /d
1375	kW/m2	kW /m2
1376	mW/m2	mW /m2
1377	µW/m2	uW /m2
1378	pW/m2	pW /m2
1379	Pa•s/m3	Pa•s /m3
1380	N•s/m	N•s /m
1381	Pa•s/m	Pa•s /m
1382	B	B
1383	dB	dB
1384	mol	mol
1385	kmol	kmol
1386	mmol	mmol
1387	µmol	umol
1388	kgmol	kg /mol
1389	g/mol	g /mol
1390	m3/mol	m3 /mol
1391	d3/mol	dm3 /mol
1392	cm3/mol	cm3 /mol
1393	L/mol	L /mol

Index	Unit	Display on the LCD
1394	J/mol	J /mol
1395	kJ/mol	kJ /mol
1396	J/mol k	J/ molK
1397	mol/m3	mol /m3
1398	mol/dm3	mol /dm3
1399	mol/L	mol /L
1400	mol/kg	mol /kg
1401	mmol/kg	mmol /kg
1402	Bq	Bq
1403	MBq	MBq
1404	kBq	kBq
1405	Bq/kg	Bq /kg
1406	kBq/kg	kBq /kg
1407	MBq/kg	MBq /kg
1408	Gy	Gy
1409	mGy	mGy
1410	rad	rad
1411	Sv	Sv
1412	mSv	mSv
1413	rem	rem
1414	C/kg	C/kg
1415	mC/kg	mC /kg
1416	R	R
1417	1/J•m3	1/J •m3
1418	e/V•m3	e/V •m3
1419	m3/C	m3/C
1420	V/k	V/K
1421	mV/K	mV/K
1422	pH	pH
1423	ppm	ppm
1424	ppb	ppb
1425	ppt	ppt
1426	degBrix	deg Brix
1427	degBall	deg Ball
1428	proof/vol	proof /vol
1429	proof/mass	proof /mass

Index	Unit	Display on the LCD
1430	lb/lgal	lb/ lGal
1431	kcal/s	kcal /s
1432	kcal/min	kcal /min
1433	kcal/h	kcal /h
1434	kcal/d	kcal /d
1435	Mcal/s	Mcal /s
1436	Mcal/min	Mcal /min
1437	Mcal/d	Mcal /d
1438	kJ/s	kJ/s
1439	kJ/min	kJ /min
1440	kJ/h	kJ/h
1441	kJ/d	kJ/d
1442	MJ/s	MJ/s
1443	MJ/min	MJ /min
1444	MJ/d	MJ/d
1445	Btu/s	Btu /s
1446	Btu/min	Btu /min
1447	Btu/d	Btu /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 /min
1453	mgal/min	mgal /min
1454	kgal/min	kgal /min
1455	Mgal/min	Mgal /min
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	mgl/d	mgal /d
1462	kgal/d	kgal /d
1463	μImpGal/s	uImp Gal/s
1464	mImpGal/s	mImp Gal/s
1465	kImpGal/s	kImp Gal/s

Index	Unit	Display on the LCD
1466	MImpGal/s	MImp Gal/s
1467	μlGal/min	ulGal /min
1468	mlGal/min	mlGal /min
1469	klGal/min	klGal /min
1470	MlGal/min	MlGal /min
1471	μImpGal/h	uImp Gal/h
1472	mImpGal/h	mImp Gal/h
1473	kImpGal/h	kImp Gal/h
1474	MImpGal/d	MImp Gal/h
1475	μImpGal/d	uImp Gal/d
1476	mImpGal/d	mImp Gal/d
1477	kImpGal/d	kImp Gal/d
1478	MImpGal/d	MImp Gal/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 /min
1484	mbbl/min	mbbl /min
1485	kbbl/min	kbbl /min
1486	Mbbl/min	Mbbl /min
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	μm3/s	um^3 /s
1496	mm3/s	mm^3 /s
1497	km3/s	km^3 /s
1498	M3/s	Mm^3 /s
1499	μm3/min	um^3 /min
1500	mm3/min	mm^3 /min
1501	km3/min	km^3 /min

Index	Unit	Display on the LCD
1502	Mm3/min	Mm3 /min
1503	µm3/h	um3 /h
1504	mm3/h	mm3 /h
1505	km3/h	km3 /h
1506	Mm3/h	Mm3 /h
1507	µm3/d	um3 /d
1508	mm3/d	mm3 /d
1509	km3/d	km3 /d
1510	Mm3/d	Mm3 /d
1511	cm3/s	cm3 /s
1512	cm3/min	cm3 /min
1513	cm3/h	cm3 /h
1514	cm3/d	cm3 /d
1515	kcal/kg	kcal /kg
1516	Btu/lb	Btu /lb
1517	kL	kL
1518	kL/min	kL /min
1519	kL/h	kL/h
1520	kL/d	kL/d
1521	m3 (0°C, 1atm)	m3(N)
1522	m3/s (0°C, 1atm)	m3(N) /s
1523	m3/min (0°C, 1atm)	m3(N) /min
1524	m3/h (0°C, 1atm)	m3(N) /h
1525	m3/d (0°C, 1atm)	m3(N) /d
1526	m3 (20°C, 1atm)	m3(S)
1527	m3/s (20°C, 1atm)	m3(S) /s
1528	m3/mine(20°C, 1atm)	m3(S) /min
1529	m3/h(20°C, 1atm)	m3(S) /h
1530	m3/d (20°C, 1atm)	m3(S) /d
1531	L (0°C, 1atm)	L(N)
1532	L/s (0°C, 1atm)	L(N) /s
1533	L/min (0°C, 1atm)	L(N) /min
1534	L/h (0°C, 1atm)	L(N) /h
1535	L/d (0°C, 1atm)	L(N) /d
1536	L (20°C, 1atm)	L(S)
1537	L/s (20°C, 1atm)	L(S) /s

Index	Unit	Display on the LCD
1538	L/min (20°C, 1atm)	L(S) /min
1539	L/h (20°C, 1atm)	L(S) /h
1540	L/d (20°C, 1atm)	L(S) /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/cm3a	g/ cm2a
1556	g/cm2a	g/ cm2g
1557	kg/cm2a	kg/ cm2a
1558	kg/cm2g	kg/ cm2g
1559	inH2Oa	inH2O a
1560	inH2Og	inH2O g
1561	inH2Oa (4°C)	inH2O a(4C)
1562	inH2Og (4°C)	inH2O g(4C)
1563	inH2Oa (68°F)	inH2O a(68F
1564	inH2Og (68°F)	inH2O g(68F
1565	mmH2Oa	mmH2O a
1566	mmH2Og	mmH2O g
1567	mmH2Oa (4°C)	mmH2O a(4C)
1568	mmH2Og (4°C)	mmH2O g(4C)
1569	mmH2Oa (68°F)	mmH2O a(68F
1570	mmH2Og (68°F)	mmH2O g(68F
1571	ftH2Oa	ftH2O a
1572	ftH2Og	ftH2O g
1573	ftH2Oa (4°C)	ftH2O a(4C)

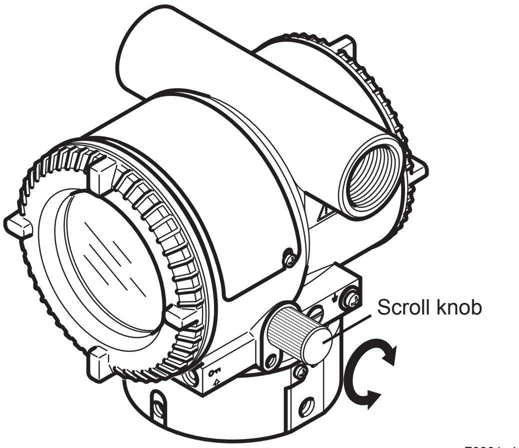
Index	Unit	Display on the LCD
1574	ftH2Og (4°C)	f t H 2 O g (4 C)
1575	ftH2Oa (68°F)	f t H 2 O a (6 8 F
1576	ftH2Og (68°F)	f t H 2 O g (6 8 F
1577	inHga	i n H g a
1578	inHgg	i n H g g
1579	inHga (0°C)	i n H g a (0 C)
1580	inHgg (0°C)	i n H g g (0 C)
1581	mmHga	m m H g a
1582	mmHgg	m m H g g
1583	mmHga (0°C)	m m H g a (0 C)
1584	mmHgg (0°C)	m m H g g (0 C)
1585	mV/pH	m V / p H
1586	µS/cm	u S / c m
1587	MΩ•cm	M o h m • c m
1588	no units	
1589	ml/min	m l / m i n
1590	Garg	B a r g
1591	mGarg	m B a r g
1592	ft/s2	f t / s ^{2}
1593	G's	G ' s
1594	microns	m i c r o n s
1595	mils	m i l s
1596	lb/in	l b / i n
1597	Bara	B a r a
1598	MSCFD	M S C F D
1599	MMSCFD	M M S C F D
1600	MLB/H	M L B / H
1601	nA/ppm	n A / p p m
1602	mS/m	m S / m
1603	µS/m	u S / m
1604	kΩ•cm	k o h m • c m
1605	%/°C	% / ° C
1606	pH/°C	p H / ° C
1607	/cm	/ c m
1608	mg/L	m g / L
1609	Mmcells/mL	M M c e l l s / m L
1610	AU	A U
1611	cnt/g	c n t / s
1612	EBC	E B C
1613	FTU	F T U
1614	OD	O D
1615	Unitless	U n i t l e s s
1616	J/g	J / g
1617	Ml/h	M l / h
1618	Ml/min	M l / m i n
1619	kL/s	k L / s
1620	kft3/d	k f t ^{3} / d
1621	kCFH	k C F H
1622	kCFM	k C F M
1623	kCFS	k C F S
1624	mft3/d	m f t ^{3} / d
1625	mCFH	m C F H
1626	mCFM	m C F M
1627	mCFS	m C F S
1628	kbbl(US Beer)/d	k b b l (U B) / d
1629	kbbl (US Beer)/h	k b b l (U B) / h
1630	kbbl (US Beer)/min	k b b l U B / m i n
1631	bbl(US Beer)/d	b b l (U B r) / d
1632	bbl (US Beer)/h	b b l (U B r) / h
1633	bbl (US Beer)/min	b b l U B / m i n
1634	bbl (US Beer)/s	b b l (U B r) / s
1635	mbbl(US Beer)/d	m b b l (U B) / d
1636	mbbl (US Beer)/h	m b b l (U B) / h
1637	mbbl (US Beer)/min	m b b l U B / m i n
1638	mbbl (US Beer)/s	m b b l (U B) / s
1639	µbbl (US Beer)/min	u b b l U B / m i n
1640	µbbl (US Beer)/s	u b b l (U B) / s
1641	klb (US)/d	k l b (U S) / d
1642	klb (US)/h	k l b (U S) / h
1643	klb (US)/min	k l b U S / m i n
1644	klb (US)/s	k l b (U S) / s
1645	Ml	M l

Index	Unit	Display on the LCD
1646	mBara	m B a r a
1647	1/32 mec	1 / 3 2 m s
1648	kgal	k g a l
1649	kImpGal	k I m p G a l
1650	WT-%	W T - %
1651	Vol-%	V o l - %
1652	lbf/in	l b f / i n
1653	Mft3/d	M f t ^{3} / d
1654	Mm3/d	M m ^{3} / d
1655	ac-in/s	a c - i n / s
1656	ac-in/m	a c - i n / m
1657	ac-in/h	a c - i n / h
1658	ac-in/d	a c - i n / d
1659	ac-ft/s	a c - f t / s
1660	ac-ft/m	a c - f t / m
1661	ac-ft/h	a c - f t / h
1662	ac-ft/d	a c - f t / d
1663	Mft3	M f t ^{3}
1664	Mbbl	M b b l
1665	ac-in	a c - i n
1666	ac-ft	a c - f t
1667	Mgal	M g a l
1668	Mm3/d	M m ^{3}
1669	Vol%	V o l %
1670	%LEL	% L E L
1671	L/m3	L / m ^{3}
1672	mg/m3	m g / m ^{3}
1673	mL/L	m L / L
1674	mL/m3	m L / m ^{3}
1675	µbar	u b a r
1676	µg/L	u g / L
1677	µg/m3	u g / m ^{3}
1678	µL/L	u L / L
1679	µL/m3	u L / m ^{3}
1680	S/cm	S / c m
1681	rH	r H

Index	Unit	Display on the LCD
1682	mils/yr	m i l s / y r
1683	mm/yr	m m / y r

8. Explanation of Basic Items (switching displays)

Turn the scroll knob on the outside of the case to switch displays. Display switching on the FVX110 is of two modes depending on the speed of turning the scroll knob. Single scroll mode, when one display is switched to another, or continuous scroll mode (scan mode) when displays are switched continuously during a set cycle. By changing the turning direction of the scroll knob, you can scroll forward or backward through the displays.



F0801.ai

Figure 8.1 Scroll knob for switching displays

NOTE

Long continuous use during high or low temperatures may reduce visibility. Should this happen, replace the indicator at the earliest opportunity.

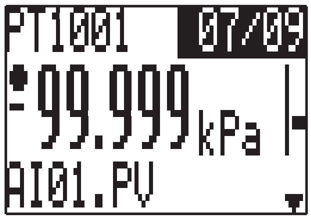
NOTE

Notes for scroll knob operation

- Do not use a spanner, wrench or other tools for turning the scroll knob as it could damage the knob. Turn the scroll knob only by hand.

8.1 Single Scroll Mode

To scroll only one display, turn the scroll knob about 90° (Single scroll mode). An arrow icon (▲ or ▼) indicating the direction the scroll knob is turned will appear in the lower right corner of the display.



F0802.ai

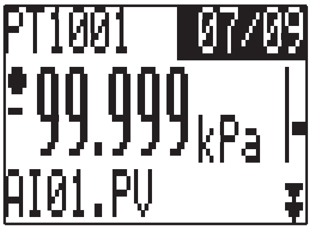
Figure 8.2 Screen display during single display switching

NOTE

Turning the scroll knob 90° is only rough description. Thus even if a 90° turn of the scroll knob fails to switch the displays, this is not a malfunction.

8.2 Continuous Scroll Mode (scan mode)

To scroll display continuosly (scan mode), turn the scroll knob about 180° or more in less than a second. Scan mode operation is automatically cancelled about 1 minute after start of operation. To stop during operation, turn the scroll knob in the opposite direction used to start continuous scroll mode. During continuos scroll mode, an arrow icon (⏫ or ⏬) indicating the direction the scroll knob is turned will appear in the lower right corner of the display.
Automatically scrolling cycle will be the setting of DISPLAY_CYCLE in LCD transducer block. (Please refer to Table 7.3)



F0803.ai

Figure 8.3 Screen display during continuous display switching

NOTE

Turning the scroll knob 180° is only rough description. Thus even if a 180° turn of the scroll knob fails to switch the displays, this is not a malfunction. If a 180° turn of the scroll knob fails to engage scan mode, try turning the knob faster.

8.3 Direction of Display Switching

The direction of display switching by turning the scroll knob can be changed by SCROLL_DIRECTION setting of the LCD transducer block. In the factory default setting, turning the scroll knob clockwise increases the page numbers. For details, refer to the instructions provided in the Section 7.3.

9. In-Process Operation

This chapter describes the procedure performed when changing the operation of the function block of the FVX110 in process.

9.1 Mode Transition

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

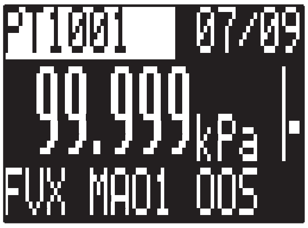
9.2 Generation of Alarm

9.2.1 Indication of Alarm

The self-diagnostics function of the FVX110 uses the display to notify the user of the following three faults.

- The Resource block is in O/S mode
- The MAO1 block is in O/S mode
- The MAO2 block is in O/S mode

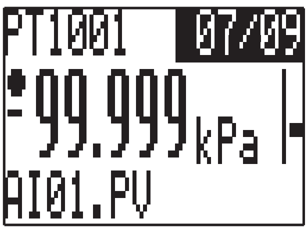
The display will then indicate FVX RB OOS, FVX MAO1 OOS, or FVX MAO2 OOS.



F0901.ai

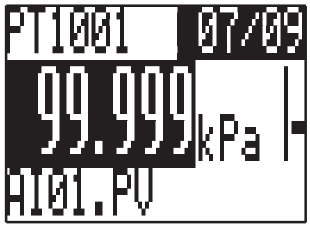
Figure 9.1 Error identification on indicator (when MAO1 block is in O/S mode)

When process value have transferred correctly from field instruments, the ● icon at the center part of the display flashes. When they are not correctly transferred, the ● icon is off and the process value will be highlighted.



F0902.ai

Figure 9.2 Example showing when process value have correctly transferred



F0903.ai

Figure 9.3 Example showing when process value have not correctly transferred

The ● icon is not displayed during simulation.

9.2.2 Alarms and Events

The following alarms or events can be reported by the FVX110 if Link object and VCR static entry are set.

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

Discret Alerts (Generated when an abnormal condition is detected)
By Resource Block Block Alarm, Write Alarm
By Transducer Block Block Alarm
By MAO, 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 MAO, 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 9.1 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	Relative index of the block that triggered the alert

9.2.3 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_3 resource block parameters in their default setting are categorized as described in “NAMUR NE-107 Alarm Categories” in the DEVICE_STATUS table in section 11.1. 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 9.2.

Table 9.2 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.
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.

9.3 Device Diagnostic Simulation Function

It is possible to conduct testing for the downstream function blocks or alarm processes.

A SIMULATE_ENABLE switch is mounted in the FVX110 amplifier. This is to prevent the accidental operation of this function. When this is switched on, simulation is enabled. (See Figure 9.4.) 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 FD_SIMULATE parameter located in the Resource Block consists of the elements shown in Table 9.3.

Table 9.3 FD_SIMALATION parameters

Subindex	Parameters	Description
1	Diagnostic Simulate Value	Sets alarm bits that perform simulation. When Sub-index3: Enable becomes disabled, Sub-index2: Diagnostic Value is displayed here.
2	Diagnostic Value	This parameter displays actual instrument diagnostics states at all times not simulation diagnostics alarms.
3	Enable	It controls the simulator function. 1: Simulation inhibited (default setting) 2: Simulation start

Turn on the simulator function either by the SIMULATE_ENABLE switch or by setting SIM_ENABLE_MSG in the Resource Block to ON when "2" is set in Enable for the Sub-index parameter in Table 9.3 to generate the alarm bits set in the Sub-index parameter Diagnostic Simulate Value. Use this function to check whether or not the field instrument can correctly generate diagnostics alarms.

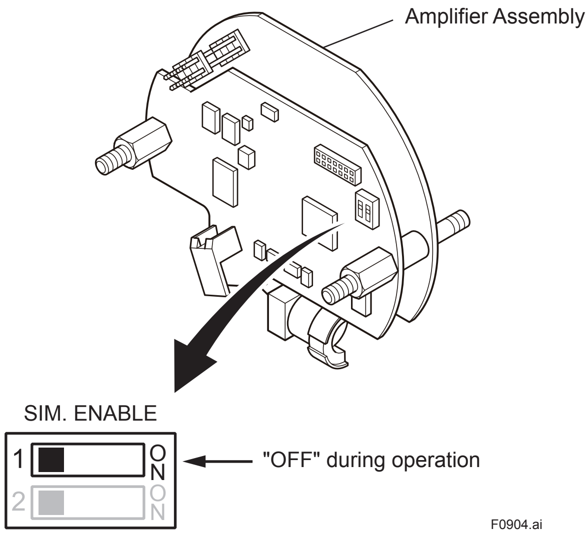


Figure 9.4 SIMULATE_ENABLE Switch

9.4 Write lock (Write-protect) function

The FVX110 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 FVX110 is provided with a write lock switch (switch 2 in Figure 9.5). Setting switch 2 to On activates the write lock function, to prevent changes to block parameters of WRITE_LOCK_LEVEL (index 1064). Table 9.4 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 LCD 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 9.4 Relationship between WRITE_LOCK_LEVEL and block targeted by write lock

WRITE_LOCK_LEVEL	Block targeted by Write lock
0	All parameters for the LCD transducer block and FEATURE_SEL and WRITE_LOCK_LEVEL parameter settings for FEATURE_SEL
1	All parameters for the LCD 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 9.5 FEATURE_SEL, write lock switch and WRITE_LOCK parameter relationship

FEATURE_SEL		Write lock switch	WRITE_LOCK
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).

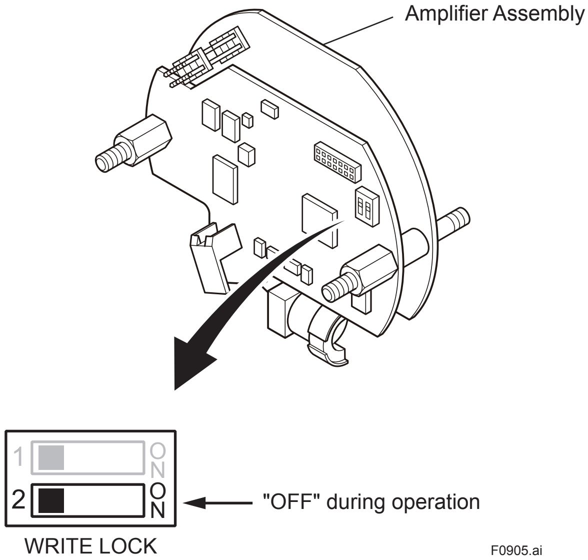


Figure 9.5 WRITE_LOCK Switch

10. Maintenance

10.1 Overview

Maintenance of the indicator is easy due to its modular construction. This chapter describes the procedures for the disassembly and reassembly procedures required for component replacement.

Indicators are precision instruments. Please carefully and thoroughly read the following sections for information on how to properly handle them while performing maintenance.

IMPORTANT

- As a rule, maintenance of this indicator should be done in a shop that has all the necessary tools.
- The CPU assembly contains sensitive parts that can be damaged by static electricity. Take precautions such as using a grounded wrist strap when handling electronic parts or touching the board circuit patterns. Also be sure to place the removed CPU assembly into a bag with an antistatic coating.

10.2 Disassembly and Reassembly

This section describes procedures for disassembly and reassembly for maintenance and component replacement.

Always turn OFF power and shut off and release pressures before disassembly. Use proper tools for all operations. Table 10.1 shows the tools required.

Table 10.1 Tools for Disassembly and Reassembly

Tool	Quantity	Remarks
Phillips screwdriver	1	JIS B4633, No. 2
Slotted screwdriver	1	
Allen wrenches	3	JIS B4648 One each, nominal 3, 4 and 2.5 mm Allen wrenches
Socket driver	1	Width across flats, 5.5 mm
Tweezers	1	

CAUTION

- Flameproof type indicators must be, as a rule, removed to a non-hazardous area for maintenance and be disassembled and reassembled to the original state.
- On the flameproof type indicators the two covers are locked, each by an Allen head bolt (shrouding bolt). When a shrouding bolt is driven clockwise by an Allen wrench, it is going in and cover lock is released, and then the cover can be opened.
  When a cover is closed it should be locked by a shrouding bolt without fail. Tighten the shrouding bolt to a torque of 0.7 N·m.

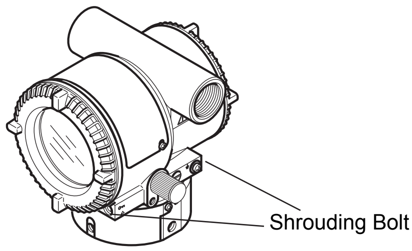


Figure 10.1 Shrouding Bolts

10.2.1 Replacing the display

CAUTION

Cautions for Flameproof Type Indicators
Users are prohibited by law from modifying the construction of a flameproof type indicator. This would invalidate the agency approval for the use of the indicator in a rated area.
It follows that the user is prohibited from using a flameproof type indicator with its display removed, or from adding an display to a indicator. If such modification is absolutely required, contact Yokogawa.

This subsection describes the procedure for replacing an display. (See figure 10.2)

NOTE

Long continuous use during high or low temperatures may reduce visibility. Should this happen, replace the indicator at the earliest opportunity.

NOTE

If two display actions below showed up, it may be failure of Display
- Display repeat turning on and off
- Abnormal indication such as blackout

If these two actions occurred, please replace display with procedure written in this user's manual or contact Yokogawa.

■ **Removing the Display assembly**

1) Remove the Display cover.
2) While supporting the Display assembly with one hand, loosen its two Mounting screws.
3) Dismount the Display assembly from the CPU assembly.
   When doing this, carefully pull the Display assembly straight forward so as not to damage the connector pins between it and the CPU assembly.

■ **Attaching the Display assembly**

1) Align both the Display assembly and CPU assembly connectors and engage them.
2) Insert and tighten the two Mounting screws.
3) Replace the Display cover.

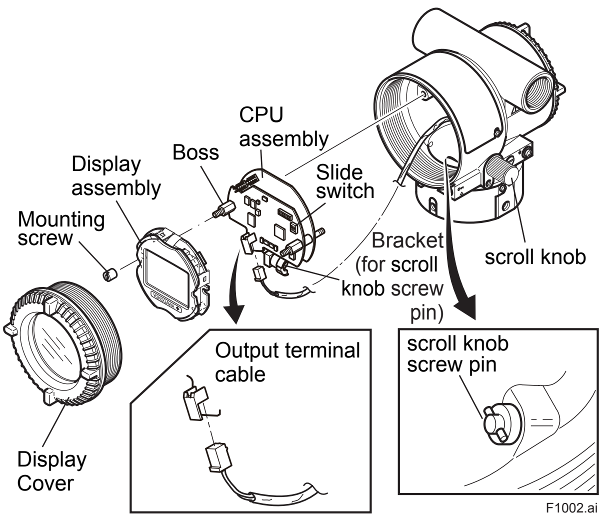


Figure 10.2 Removing and Display Assembly and CPU Assembly

10.2.2 Replacing the CPU Board Assembly

This subsection describes the procedure for replacing the CPU assembly. (See figure 10.2)

■ **Removing the CPU Assembly**

1) Remove the Display cover.
2) Turn the Scroll knob screw to the position (where the screw head slot is horizontal) as shown in figure 10.2.
3) Disconnect the Output terminal cable (cable with brown connector at the end). When doing this, lightly press the side of the CPU assembly connector and pull the cable connector to disengage.
4) Use a socket driver (width across flats, 5.5mm) to loosen the two bosses.
5) Carefully pull the CPU assembly straight forward to remove it.

NOTE

Be careful not to apply excessive force to the CPU assembly when removing it.

■ **Mounting the CPU Assembly**

1) Connect the output terminal cable (with brown connector).

NOTE

Make certain that the cables do not get pinched between the case and the edge of the CPU assembly.

2) Align and engage the scroll knob screw pin with the groove on the bracket on the CPU assembly. Then insert the CPU board assembly straight onto the post in the case.
3) Tighten the two bosses.

NOTE

Confirm that the scroll knob screw pin is placed properly in the groove on the bracket prior to tightening the two bosses. If it is not, the display scroll mechanism will be damaged.

4) Replace the Display cover.

11. Device Information

11.1 DEVICE STATUS

Device status for the FVX110 are indicated by using parameter DEVICE_STATUS_1 to DEVICE_STATUS_3 (index 1045 to 1047) in Resource Block.

Table 11.1 Contents of DEVICE_STATUS_1 (index 1045)

Hexadecimal	Diplay through DD	Description	NAMUR NE-107 category
0x10000000	Write Locked	Write lock is ON	-
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	Resource Block is in O/S mode	C
0x00080000	Amp EEPROM Failure	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 11.2 Contents of DEVICE_STATUS_2 (index 1046)

Hexadecimal	Diplay through DD	Description	NAMUR NE-107 category
0x80000000	LTB in O/S Mode	LCD Transducer Block is in O/S mode	C
0x40000000	LCD Failure	LCD has been failing	F
0x20000000	Amp Temp Out of Range	Amplifier temperature is out specification range	S
0x00008000	MAO1 in O/S Mode	MAO1 Block is in O/S mode	C
0x00004000	MAO1 in Man Mode	MAO1 Block is in Man mode	C
0x00002000	MAO1 Not Scheduled	MAO1 Block is not scheduled	C
0x00000800	MAO2 in O/S Mode	MAO2 Block is in O/S mode	C
0x00000400	MAO2 in Man Mode	MAO2 Block is in Man mode	C
0x00000200	MAO2 Not Scheduled	MAO2 Block is not scheduled	C
0x00000080	IS1 in O/S Mode	IS1 Block is in O/S mode	C
0x00000040	IS1 in Man Mode	IS1 Block is in Man mode	C
0x00000020	IS1 Not Scheduled	IS1 Block is not scheduled	C
0x00000008	IS2 in O/S Mode	IS2 Block is in O/S mode	C
0x00000004	IS2 in Man Mode	IS2 Block is in Man mode	C
0x00000002	IS2 Not Scheduled	IS2 Block is not scheduled	C

Table 11.3 Contents of DEVICE_STATUS_3 (index 1047)

Hexadecimal	Diplay through DD	Description	NAMUR NE-107 category
0x80000000	PID1 in O/S Mode	PID1 Block is in O/S mode	C
0x40000000	PID1 in Man Mode	PID1 Block is in Man mode	C
0x20000000	PID1 Not Scheduled	PID1 Block is not scheduled	C
0x10000000	PID1 in Bypass Mode	PID1 Block is in Bypass mode	C
0x08000000	PID2 in O/S Mode	PID2 Block is in O/S mode	C
0x04000000	PID2 in Man Mode	PID2 Block is in Man mode	C
0x02000000	PID2 Not Scheduled	PID2 Block is not scheduled	C
0x01000000	PID2 in Bypass Mode	PID2 Block is in Bypass mode	C
0x00080000	SC in O/S Mode	SC Block is in O/S mode	C
0x00040000	SC in Man Mode	SC Block is in Man mode	C
0x00020000	SC Not Scheduled	SC Block is not scheduled	C
0x00008000	IT in O/S Mode	IT Block is in O/S mode	C
0x00004000	IT in Man Mode	IT Block is in Man mode	C
0x00002000	IT Not Scheduled	IT Block is not scheduled	C
0x00001000	IT Total Backup Err	IT Total Backup has failed. Last IT Output.Value(IT.LAST. VALUE) is not saved	F
0x00000800	IT Conf. Err	IT Clock Period(IT.CLOCK_PER) is smaller than IT Period of Execution(EXECUTION_PERIOD)	C
0x00000080	AR1 in O/S Mode	AR1 Block is in O/S mode	C
0x00000040	AR1 in Man Mode	AR1 Block is in Man mode	C
0x00000020	AR1 Not Scheduled	AR1 Block is not scheduled	C
0x00000010	AR1 Range Conf. Err	AR1 Range High(AR1.RANGE_HI) is smaller than AR1 Range Lo(AR1.RANGE_LO)	C
0x00000008	AR2 in O/S Mode	AR2 Block is in O/S mode	C
0x00000004	AR2 in Man Mode	AR2 Block is in Man mode	C
0x00000002	AR2 Not Scheduled	AR2 Block is not scheduled	C
0x00000001	AR2 Range Conf. Err	AR2 Range High(AR2.RANGE_HI) is smaller than AR2 Range Lo(AR2.RANGE_LO)	C

11.2 Status of Each Parameter in Failure Mode

Following tables summarize the value of FVX110 parameters when LCD display indicates an Alarm.

Table 11.4 Action of each parameters in failure mode

Alarm Display	Cause of Alarm	Object Block	BLOCK_ERR
FVX RB OOS	RESOURCE block is in O/S mode	RB	Out-of-Service
FVX MAO1 OOS	MAO1 block is in O/S mode	MAO1	Out-of-Service
FVX MAO2 OOS	MAO2 block is in O/S mode	MAO2	Out-of-Service

12. 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.

12.1 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	Null	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	AUTO	The actual, target, permitted, and normal modes of the block.
6	1006	BLOCK_ERR	—	—	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	1007	RS_STATE	—	—	State of the resource block state machine.
8	1008	TEST_RW	Null	AUTO	Read/write test parameter-used only for conformance testing and simulation.
9	1009	DD_RESOURCE	Null	—	String identifying the tag of the resource which contains the Device Description for this resource.
10	1010	MANUFAC_ID	0x00594543	—	Manufacturer identification number-used by an interface device to locate the DD file for the resource.
11	1011	DEV_TYPE	16	—	Manufacturer’s model number associated with the resourceused by interface devices to locate the DD file for the resource.
12	1012	DEV_REV	1	—	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. They are 1: Run, 2: Restart resource, 3: Restart with initial value specified in FF functional spec. (*1), and 4: Restart processor. *1: FF-891 Foundation™ Specification Function Block Application Process Part 2.
17	1017	FEATURES	Reports Fault state Soft W Lock Hard W Lock Multi_bit Alarm support	—	Used to show supported resource block options.
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

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
19	1019	CYCLE_TYPE	Scheduled	—	Identifies the block execution methods available for this resource.
20	1020	CYCLE_SEL	Scheduled	AUTO	Used to select the block execution method for this resource.
21	1021	MIN_CYCLE_T	3200 (100ms)	—	Time duration of the shortest cycle interval of which the resource is capable.
22	1022	MEMORY_SIZE	0	—	Available configuration memory in the empty resource. To be checked before attempting a download.
23	1023	NV_CYCLE_T	0	—	Interval between writing copies of nonvolatile parameters to non-volatile memory. Zero means never.
24	1024	FREE_SPACE	0	—	Percent of memory available for further configuration. FVX110 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. FVX110 does not support this.
26	1026	SHED_RCAS	640000 (20S)	AUTO	Time duration at which to give up on computer writes to function block RCas locations. Supported only with PID function.
27	1027	SHED_ROUT	640000 (20S)	AUTO	Time duration at which to give up on computer writes to function block ROut locations. Supported only with PID function.
28	1028	FAULT_STATE	1	—	Condition set by loss of communication to an output block, failure promoted to an output block or a physical contact. When fail-safe condition is set, then output function blocks will perform their FSAFE actions.
29	1029	SET_FSTATE	1	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	4	—	Maximum number of unconfirmed notify messages possible.
32	1032	LIM_NOTIFY	4	AUTO	Maximum number of alarm information which FVX110 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	64000 (20S)	AUTO	The minimum time between retries of alert reports.
34	1034	WRITE_LOCK	Not locked	AUTO	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated
35	1035	UPDATE_EVT	—	—	This alert is generated by any change to the static data.
36	1036	BLOCK_ALM	—	—	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
37	1037	ALARM_SUM	Enable	—	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	5	—	Version number of interoperability test by Fieldbus Foundation applied to FVX110.
42	1042	SOFT_REV		—	FVX110 software revision number.
43	1043	SOFT_DESC		—	Yokogawa internal use.
44	1044	SIM_ENABLE_MSG	Null	AUTO	Software switch for simulation function.
45	1045	DEVICE_STATUS_1	0	—	Device status For details, refer to Table 11.1
46	1046	DEVICE_STATUS_2	0	—	Device status For details, refer to Table 11.2
47	1047	DEVICE_STATUS_3	0	—	Device status For details, refer to Table 11.3
48	1048	DEVICE_STATUS_4	reserve	—	FVX110 does not support this.
49	1049	DEVICE_STATUS_5	reserve	—	FVX110 does not support this.
50	1050	DEVICE_STATUS_6	reserve	—	FVX110 does not support this.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
51	1051	DEVICE_STATUS_7	reserve	—	FVX110 does not support this.
52	1052	DEVICE_STATUS_8	reserve	—	FVX110 does not support this.
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 A8.4.
59	1059	SOFTDWN_HISTORY		—	Not used by the FVX110.
60	1060	SOFTDWN_HIST_INDEX	0	AUTO	Not used by the FVX110.
61	1061	COMPATIBILITY_REV	1	—	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	0	—	A parameter that corresponds to ”Failed” in the NAMUR NE-107 category.
68	1068	FD_OFFSPEC_ACTIVE	0	—	A parameter that corresponds to ”Off Specification” in the NAMUR NE-107 category.
69	1069	FD_MAINT_ACTIVE	0	—	A parameter that corresponds to ”Maintenance” in the NAMUR NE-107 category.
70	1070	FD_CHECK_ACTIVE	0	—	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 listed in FD_SIMULATE. DiagnosticValue.
73	1073	FD_MAINT_MAP	0x000003E0	AUTO	Specifies the bit assigned to FD_MAINT_ACTIVE, a parameter for 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	0xFFFFFFFF	AUTO	Specifies the bit that notifies the host of 32-bit ”Failed” alarms listed in FD_FAIL_ACTIVE.
76	1076	FD_OFFSPEC_MASK	0xFFFFFFFF	AUTO	Specifies the bit that notifies the host of 32-bit ”Off Specification” alarms listed in FD_OFFSPEC_ACTIVE.
77	1077	FD_MAINT_MASK	0xFFFFFFFF	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	0xFFFFFFFF	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.”
81	1081	FD_MAINT_ALM		AUTO	Indicates alarm information for alarms categorized under ”Maintenance”.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
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	0	—	A parameter serving as a starting point for alarms handled by FF-912.
90	1090	FD_EXTENDED_ACTIVE_2	0	—	A parameter serving as a starting point for alarms handled by FF-912.
91	1091	FD_EXTENDED_ACTIVE_3	0	—	A parameter serving as a starting point for alarms handled by FF-912.
92	1092	FD_EXTENDED_ACTIVE_4	0	—	Not used by the FVX110.
93	1093	FD_EXTENDED_ACTIVE_5	0	—	Not used by the FVX110.
94	1094	FD_EXTENDED_ACTIVE_6	0	—	Not used by the FVX110.
95	1095	FD_EXTENDED_ACTIVE_7	0	—	Not used by the FVX110.
96	1096	FD_EXTENDED_ACTIVE_8	0	—	Not used by the FVX110.
97	1097	FD_EXTENDED_MAP_1	0x0748FFFF (Soft Rev 1.02 or earlier) 0x0708FFFF (Soft Rev 1.04 or later)	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	0x60000000	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	0x00001811	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		AUTO	Not used by the FVX110.
101	1101	FD_EXTENDED_MAP_5		AUTO	Not used by the FVX110.
102	1102	FD_EXTENDED_MAP_6		AUTO	Not used by the FVX110.
103	1103	FD_EXTENDED_MAP_7		AUTO	Not used by the FVX110.
104	1104	FD_EXTENDED_MAP_8		AUTO	Not used by the FVX110.
105	1105	PRIVATE_1		—	Not used by the FVX110.
106	1106	PRIVATE_2		—	Not used by the FVX110.
107	1107	PRIVATE_3		—	Not used by the FVX110.
108	1108	PRIVATE_4		—	Not used by the FVX110.
109	1109	PRIVATE_5		—	Not used by the FVX110.
110	1110	PRIVATE_6		—	Not used by the FVX110.
111	1111	PRIVATE_7		—	Not used by the FVX110.
112	1112	PRIVATE_8		—	Not used by the FVX110.
113	1113	PRIVATE_9		—	Not used by the FVX110.
114	1114	PRIVATE_10		—	Not used by the FVX110.
115	1115	PRIVATE_11		—	Not used by the FVX110.

12.2 LCD Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2000	Block Header	TAG : "LTB"	"Block Tag =O/S"	Information on this block such as Block Tag, DD Revision, Execution Time, etc.
1	2001	ST_REV	-	AUTO	Describes the revision level of parameters for setting the transducer block. The revision is updated when set values are changed. This parameter is used to check for parameter changes.
2	2002	TAG_DESC	Null	AUTO	A universal parameter intended for storing comments describing tag data.
3	2003	STRATEGY	1	AUTO	A universal parameter used by the high-level system to identify function blocks.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
4	2004	ALERT_KEY	1	AUTO	Key information used to identify the location at which an alert 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 distinguish necessary alarms only. This is a universal parameter.
5	2005	MODE_BLK	AUTO	AUTO	A universal parameter that represents block operating condition. It comprises the Actual, Target, Permit and Normal modes.
6	2006	BLOCK_ERR	-	AUTO	Indicates error status of the PID block. The FVX110 transducer block handles the following factors. Bit 0 = An XD_ERROR has occurred Bit 15 = Target mode is O/S
7	2007	UPDATE_EVT	-	AUTO	Indicates event information if an event update occurs.
8	2008	BLOCK_ALM	-	AUTO	Indicates error information if an error occurs in a block.
9	2009	TRANSDUCER_DIRECTORY	-	AUTO	Parameter for storing indexes of FVX110 transducers.
10	2010	TRANSDUCER_TYPE	65535	AUTO	Indicates FVX110 types. Indicates 65535 (other) for the FVX110.
11	2011	XD_ERROR	0	AUTO	Stores the most serious errors that occur in the transducer block. 0 = No error 50 = Reset performed 100 = LCD error
12	2012	COLLECTION_DIRECTORY		AUTO	Stores the DD item ID for the first index of important parameters in the LCD transducer block.
13	2013	NOW_DISPLAYING	0	AUTO	Indicates the number that the input currently displayed on the LCD occupies among valid inputs of information.
14	2014	DISP_TARGET_FORCE	0	AUTO	A parameter for identifying information of valid inputs that you want to view 0: Scroll knob is active 1: No.01 in valid connection 2: No.02 in valid connection 3: No.03 in valid connection 4: No.04 in valid connection 5: No.05 in valid connection 6: No.06 in valid connection 7: No.07 in valid connection 8: No.08 in valid connection 9: No.09 in valid connection 10: No.10 in valid connection 11: No.11 in valid connection 12: No.12 in valid connection 13: No.13 in valid connection 14: No.14 in valid connection 15: No.15 in valid connection 16: No.16 in valid connection
15	2015	NO_OF_VALID_CON	0 (Soft Rev 1.02 or earlier) 1 (Soft Rev 1.04 or later)	AUTO	Indicates how many of the 16 inputs are valid. (Corresponds to the denominator when DISP_PAGE_INFO is displayed.)
16	2016	VALID_CON_SUMMARY	0xFFFF (Soft Rev 1.02 or earlier) 0x0001 (Soft Rev 1.04 or later)	AUTO	Sets which of the 16 inputs are valid inputs.
17	2017	MAO_CON_SUMMARY	0x0000	AUTO	Indicates which of the 16 inputs gets MAO block values.
18	2018	ISEL_CON_SUMMARY	0x0000 (Soft Rev 1.02 or earlier) 0x0001 (Soft Rev 1.04 or later)	AUTO	Indicates which of the 16 inputs gets IS block values.
19	2019	SIM_CON_SUMMARY	0xFFFF (Soft Rev 1.02 or earlier) 0xFFFE (Soft Rev 1.04 or later)	AUTO	Indicates which of the 16 inputs gets Simulation state values.
20	2020	BAR_GRAPH_SELECT	0	AUTO	Use to specify whether bar graphs should be displayed in the lower field of the LCD. (16 input batch setting)
21	2021	EACH_BAR_GRAPH	0x0000	AUTO	Use to specify whether bar graphs should be displayed in the lower field of the LCD. (Each input batch setting)

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
22	2022	MAIN_TAG_SCROLL	1	AUTO	Use to set the character scroll function for MAIN_TAG information. 0 = scroll function Off 1 = scroll function On
23	2023	V_SCROLL_BAR	2	AUTO	Use to turn the vertical scroll bar on and off. 0 = Scroll bar display function Off 1 = Scroll bar display function On 2 = On only during display switch
24	2024	SCROLL_DIRECTION	0	AUTO	A parameter for changing scroll knob turning direction, page number turning direction and turning direction of the vertical scroll bar. 0 = Clockwise turn of scroll knob à Increases page numbers 0 = Counterclockwise turn of scroll knob à Increases page numbers
25	2025	DISP_PAGE_INFO	2	AUTO	Parameter for turning on or off current page numbers displayed as an xx/yy fraction in the top right corner of the LCD screen. 0 = On during highlighting when display screens are switched 1 = Always On 2 = Always On during highlighting
26	2026	DISP_QUIET_MODE	0	AUTO	Use to specify LCD operation after switching screens. 0 = Displays last output screen 1 = Switches screens at specified intervals to display all screens 2 = LCD display Off
27	2027	DISP_FORMAT_TYPE	0	AUTO	Not currently used.
28	2028	DISPLAY_CYCLE	0	AUTO	Use to set interval when screens are switched. 0 = Auto (automatically set depending on ambient temperature) 1 = 0.5 sec 2 = 1.0 sec 3 = 2.0 sec 4 = 4.0 sec
29	2029	DISPLAY_TEST	0	AUTO	Parameter to turn LCD test mode on and off.
30	2030	DISPLAY_CONTRAST	32 (0x20)	AUTO	Parameter for setting relative brightness (contrast) between the LCD when it is on and when it is off.
31	2031	SQUAWK	0	AUTO	Turns Squawk on and off.
32	2032	AMBIENT_TEMPERATURE	0	-	Indicates amplifier temperature.
33	2033	MAIN_CONNECT_TYPE	0 (Soft Rev 1.02 or earlier) 2 (Soft Rev 1.04 or later)	AUTO	Use to set the connection (MAO or ISEL function block) for 16 inputs at one time. 0 = All 16 inputs are input to simulation 1 = All 16 inputs are connected to MAO-FB 2 = All 16 inputs are connected to ISEL-FB
34	2034	IN01_CONNECTION	0 (Soft Rev 1.02 or earlier) 2 (Soft Rev 1.04 or later)	AUTO	Use to specify what values of IN01 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN01 2 = Connected to ISEL-FB_1 IN01
35	2035	IN02_CONNECTION	0	AUTO	Use to specify what values of IN02 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN02 2 = Connected to ISEL-FB_1 IN02
36	2036	IN03_CONNECTION	0	AUTO	Use to specify what values of IN03 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN03 2 = Connected to ISEL-FB_1 IN03
37	2037	IN04_CONNECTION	0	AUTO	Use to specify what values of IN04 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN04 2 = Connected to ISEL-FB_1 IN04
38	2038	IN05_CONNECTION	0	AUTO	Use to specify what values of IN05 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN05 2 = Connected to ISEL-FB_1 IN05

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
39	2039	IN06_CONNECTION	0	AUTO	Use to specify what values of IN06 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN06 2 = Connected to ISEL-FB_1 IN06
40	2040	IN07_CONNECTION	0	AUTO	Use to specify what values of IN07 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN07 2 = Connected to ISEL-FB_1 IN07
41	2041	IN08_CONNECTION	0	AUTO	Use to specify what values of IN08 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_1 IN08 2 = Connected to ISEL-FB_1 IN08
42	2042	IN09_CONNECTION	0	AUTO	Use to specify what values of IN09 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN01 2 = Connected to ISEL-FB_2 IN01
43	2043	IN10_CONNECTION	0	AUTO	Use to specify what values of IN10 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN02 2 = Connected to ISEL-FB_2 IN02
44	2044	IN11_CONNECTION	0	AUTO	Use to specify what values of IN11 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN03 2 = Connected to ISEL-FB_2 IN03
45	2045	IN12_CONNECTION	0	AUTO	Use to specify what values of IN12 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN04 2 = Connected to ISEL-FB_2 IN04
46	2046	IN13_CONNECTION	0	AUTO	Use to specify what values of IN13 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN05 2 = Connected to ISEL-FB_2 IN05
47	2047	IN14_CONNECTION	0	AUTO	Use to specify what values of IN14 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN06 2 = Connected to ISEL-FB_2 IN06
48	2048	IN15_CONNECTION	0	AUTO	Use to specify what values of IN15 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN07 2 = Connected to ISEL-FB_2 IN07
49	2049	IN16_CONNECTION	0	AUTO	Use to specify what values of IN16 are connected to. 0 = Simulation dISELplay 1 = Connected to MAO-FB_2 IN08 2 = Connected to ISEL-FB_2 IN08
50	2050	IN_01	- (Soft Rev 1.04 or later)	AUTO	Indicates process information for input 1.
51	2051	IN_02	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 2.
52	2052	IN_03	Status: 0xC0 Value: 0.0	AUTO	Indicates process information for input 3.
53	2053	IN_04	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 4.
54	2054	IN_05	Status: 0xC0 Value: 0.0	AUTO	Indicates process information for input 5.
55	2055	IN_06	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 6.
56	2056	IN_07	Status: 0xC0 Value: 0.0	AUTO	Indicates process information for input 7.
57	2057	IN_08	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 8.
58	2058	IN_09	Status: 0xC0 Value: 0.0	AUTO	Indicates process information for input 9.
59	2059	IN_10	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 10.
60	2060	IN_11	Status: 0xC0 Value: 0.0	AUTO	Indicates process information for input 11.
61	2061	IN_12	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 12.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
62	2062	IN_13	Status: 0xC0 Value: 0.0	AUTO	Indicates process information for input 13.
63	2063	IN_14	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 14.
64	2064	IN_15	Status: 0xC0 Value: 0.0	AUTO	Indicates process information for input 15.
65	2065	IN_16	Status: 0xC0 Value: 99999.0	AUTO	Indicates process information for input 16.
66	2066	IN01_MAIN_TAG	PD_Tag01	AUTO	Use to set the Main Tag for input 1. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
67	2067	IN01_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 1. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
68	2068	IN01_SCALE	100.0 0.0 1588 (Soft Rev 1.04 or later) 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 1.
69	2069	IN02_MAIN_TAG	ABCDEFGHIJKLMN OPQRSTUVWXYZ abcdef	AUTO	Use to set the Main Tag for input 2. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
70	2070	IN02_SUB_TAG	abcdefghijiklmnopqr stuvwxyzABCDEF	AUTO	Use the Sub Tag for input 2. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
71	2071	IN02_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 2.
72	2072	IN03_MAIN_TAG	PD_Tag03	AUTO	Use to set the Main Tag for input 3. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
73	2073	IN03_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 3. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
74	2074	IN03_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 3.
75	2075	IN04_MAIN_TAG	PD_Tag04	AUTO	Use to set the Main Tag for input 4. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
76	2076	IN04_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 4. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
77	2077	IN04_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 4.
78	2078	IN05_MAIN_TAG	PD_Tag05	AUTO	Use to set the Main Tag for input 5. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
79	2079	IN05_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 5. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
80	2080	IN05_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 5.
81	2081	IN06_MAIN_TAG	PD_Tag06	AUTO	Use to set the Main Tag for input 6. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
82	2082	IN06_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 6. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
83	2083	IN06_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 6.
84	2084	IN07_MAIN_TAG	PD_Tag07	AUTO	Use to set the Main Tag for input 7. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
85	2085	IN07_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 7. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
86	2086	IN07_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 7.
87	2087	IN08_MAIN_TAG	PD_Tag08	AUTO	Use to set the Main Tag for input 8. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
88	2088	IN08_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 8. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
89	2089	IN08_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 8.
90	2090	IN09_MAIN_TAG	PD_Tag09	AUTO	Use to set the Main Tag for input 9. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
91	2091	IN09_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 9. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
92	2092	IN09_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 9.
93	2093	IN10_MAIN_TAG	PD_Tag10	AUTO	Use to set the Main Tag for input 10. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
94	2094	IN10_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 10. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
95	2095	IN10_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 10 .

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
96	2096	IN11_MAIN_TAG	PD_Tag11	AUTO	Use to set the Main Tag for input 11. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
97	2097	IN11_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 11. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
98	2098	IN11_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 11.
99	2099	IN12_MAIN_TAG	PD_Tag12	AUTO	Use to set the Main Tag for input 12. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
100	2100	IN12_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 12. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
101	2101	IN12_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 12.
102	2102	IN13_MAIN_TAG	PD_Tag13	AUTO	Use to set the Main Tag for input 13. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
103	2103	IN13_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 13. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
104	2104	IN13_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 13.
105	2105	IN14_MAIN_TAG	PD_Tag14	AUTO	Use to set the Main Tag for input 14. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
106	2106	IN14_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 14. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
107	2107	IN14_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 14.
108	2108	IN15_MAIN_TAG	PD_Tag15	AUTO	Use to set the Main Tag for input 15. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.
109	2109	IN15_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 15. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
110	2110	IN15_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 15.
111	2111	IN16_MAIN_TAG	PD_Tag16	AUTO	Use to set the Main Tag for input 16. Use as a memo field and set the information you most want to display in order to indentify instruments. See PD_TAG connected devices and other information for setup examples.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
112	2112	IN16_SUB_TAG	BLK01.OUT	AUTO	Use the Sub Tag for input 16. Use as a memo field and set the information to be displayed after MAIN_TAG information in order to indentify instruments. See block names, parameter names and other information for setup examples.
113	2113	IN16_SCALE	100.0 0.0 1000 2	AUTO	Sets scaling, units and number of decimal places for displaying bar graphs of input 16.
114	2114	MS_CODE	Null	AUTO	Records and displays instrument MS codes.
115	2115	SERIAL_NO	Null	AUTO	Records and displays instrument serial numbers.
116	2116	MANUFAC_DATE	Null	AUTO	Records and displays manufacture dates for instruments.
117	2117	TEST_KEY1	0, 0	AUTO	Not used by the FVX110.
118	2118	TEST_KEY2	0.0, 0.0, 0.0, 0.0	AUTO	Not used by the FVX110.
119	2119	TEST_KEY3		AUTO	Not used by the FVX110.
120	2120	TEST_1		—	Not used by the FVX110.
121	2121	TEST_2		—	Not used by the FVX110.
122	2122	TEST_3		—	Not used by the FVX110.
123	2123	TEST_4		—	Not used by the FVX110.
124	2124	TEST_5		—	Not used by the FVX110.
125	2125	TEST_6		—	Not used by the FVX110.

13. General Specifications

Please refer to the following General Specifications sheet for the specifications, model, suffix and option codes, and external dimensions of each product.
The General Specifications can be downloaded from the website of Yokogawa.
Website address: https://www.yokogawa.com/solutions/products-platforms/field-instruments/

■ General Specifications List

Model	Document Title	Document No.
FVX110	Fieldbus Segment Indicator	GS 01S01C01-01EN

If you cannot find it on our website, please contact YOKOGAWA office.

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.

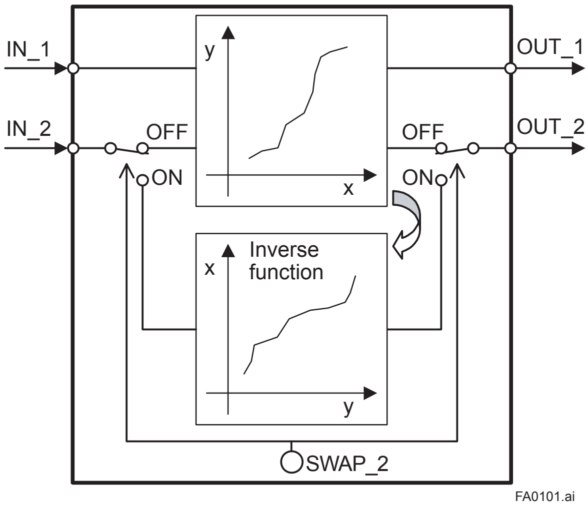


Figure A1.1 Signal Characterizer Block

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.

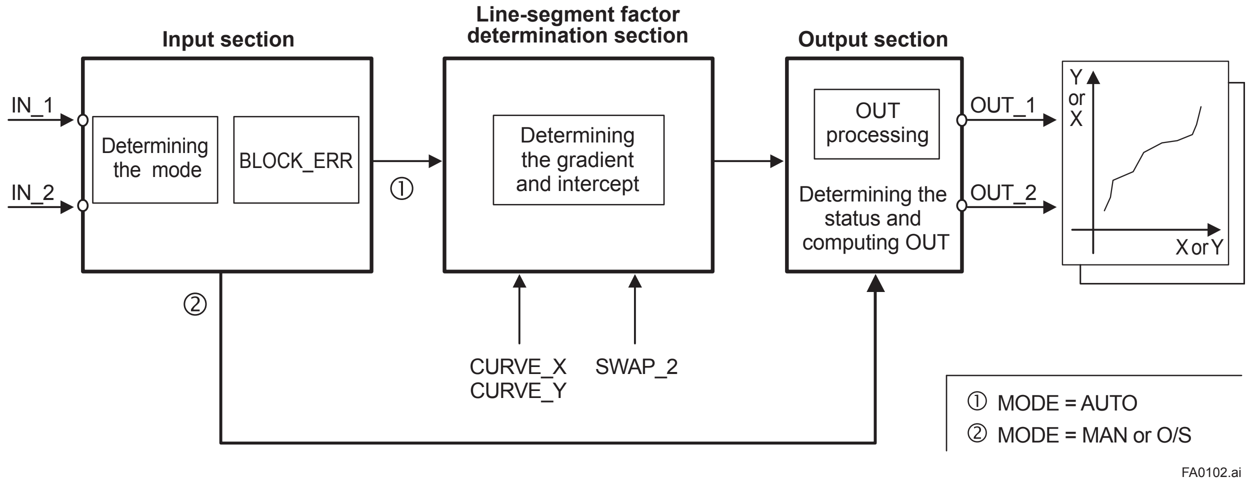


Figure A1.2 Overview of the Signal Characterizer Block

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:

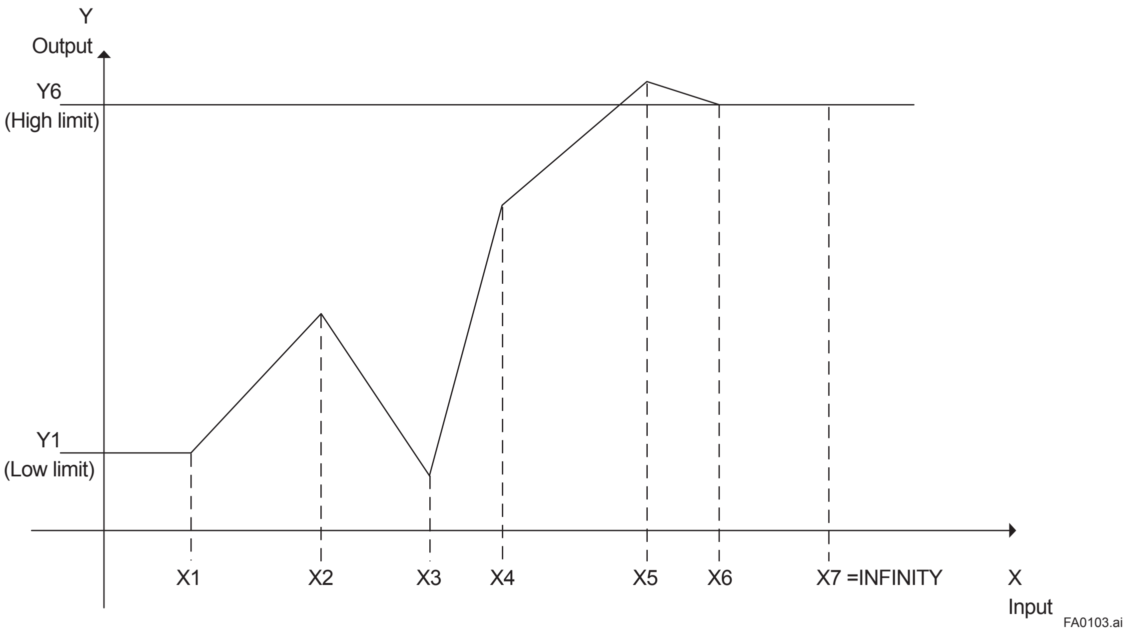


Figure A1.3 Example of Curve (SWAP_2 = off)

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.

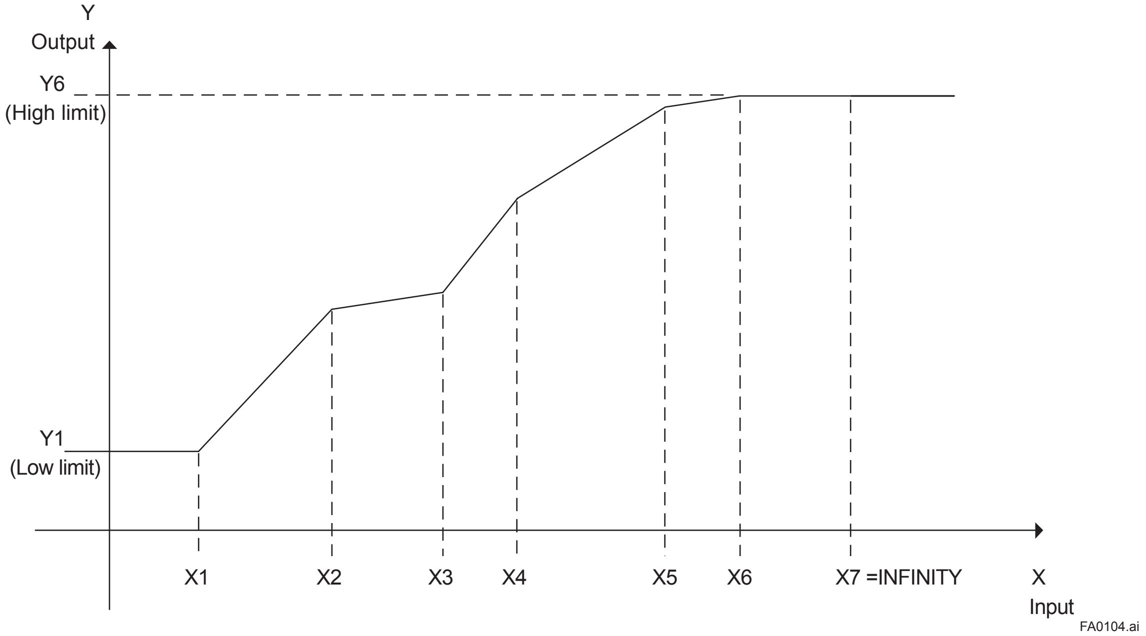


Figure A1.4 Example of Curve for IN_1 (SWAP_2 = on)

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

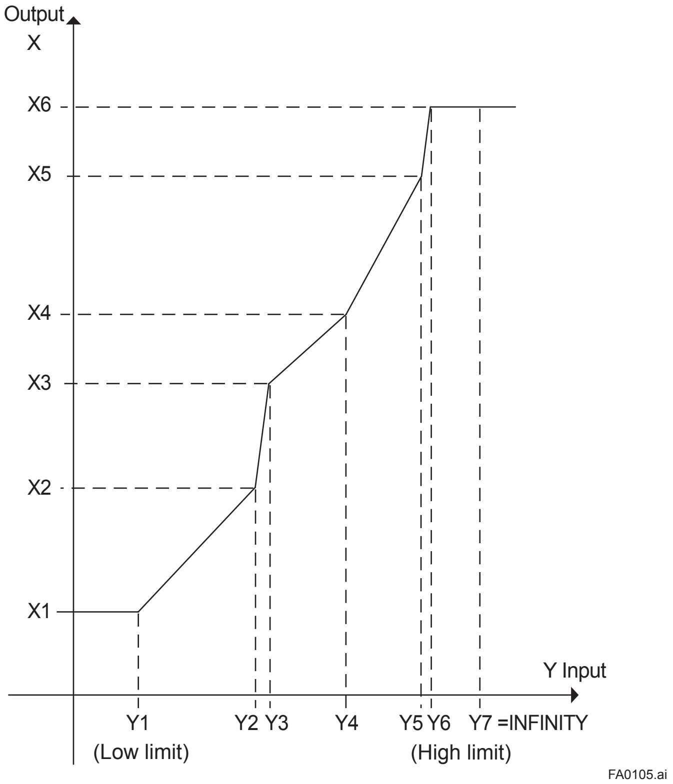


Figure A1.5 Example of Curve for IN_2 (SWAP_2 = on)

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			Null					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		100 0 1342 1			11			The engineering unit of variables corresponding to the X-axis for display
10	Y_RANGE		100 0 1342 1			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.

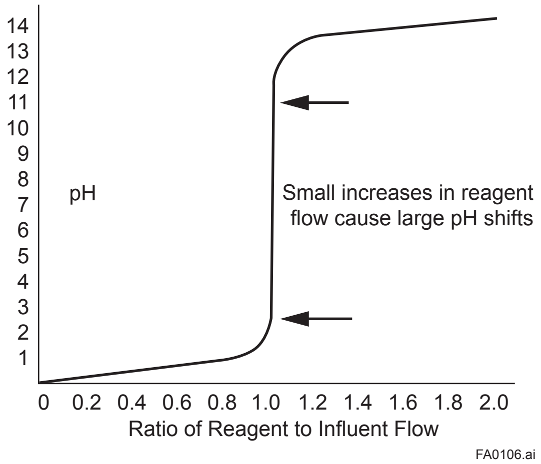


Figure A1.6 pH and Reagent Flow

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

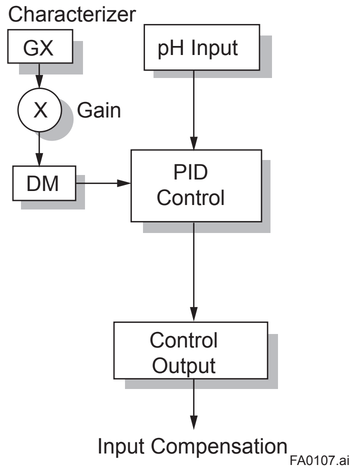


Figure A1.7 Input Compensation

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.

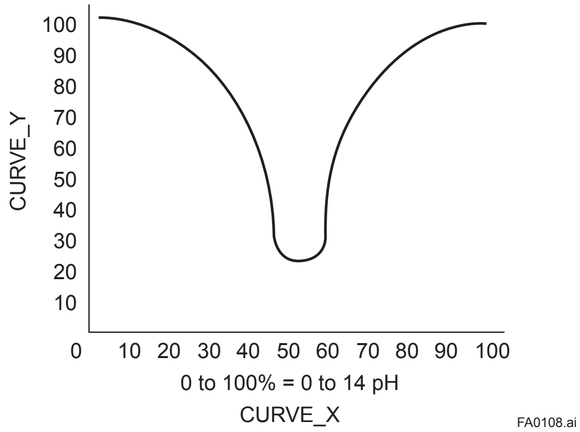


Figure A1.8 Approximation Curve

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.

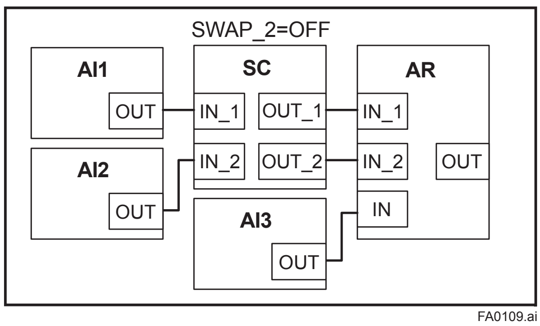


Figure A1.9 Calorie Flow Rate Compensation (SWAP_2 = Off)

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.

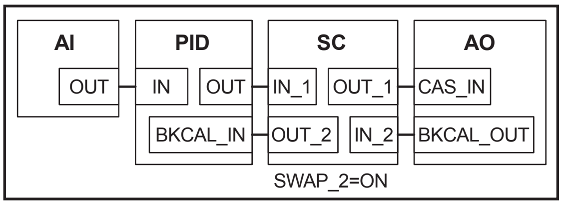
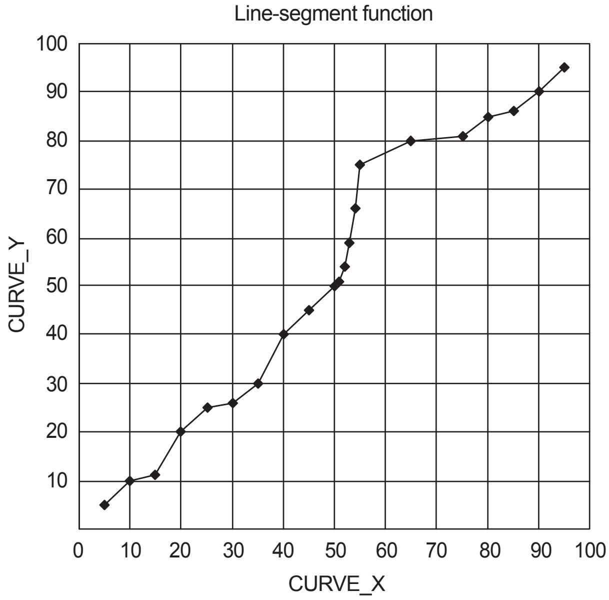


Figure A1.10 Backward Control (SWAP_2 = On)

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



X_RANGE = 100, 0, %, 0x00
Y_RANGE = 100, 0, %, 0x00

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

Appendix 2. Integrator (IT) Block

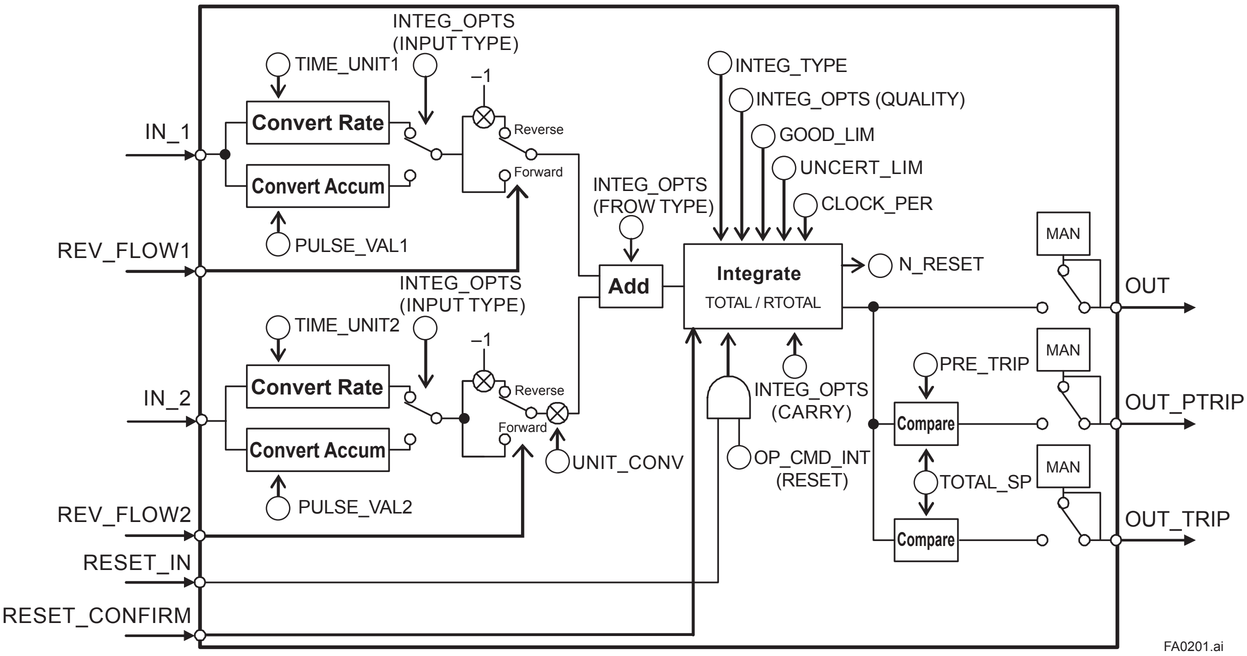
The Integrator (IT) block adds two main inputs and integrates them for output. The block compares the integrated or accumulated value to TOTAL_SP and PRE_TRIP and generates discrete output signals OUT_TRIP or OUT_PTRIP when the limits are reached.

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.

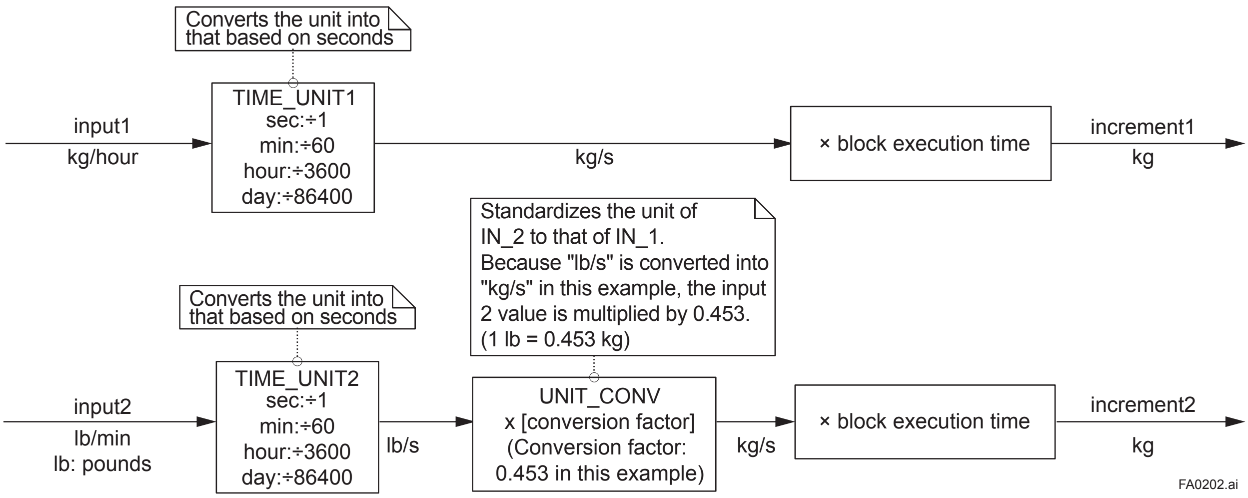


Figure A2.2 Increment Calculation with Rate Input

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.

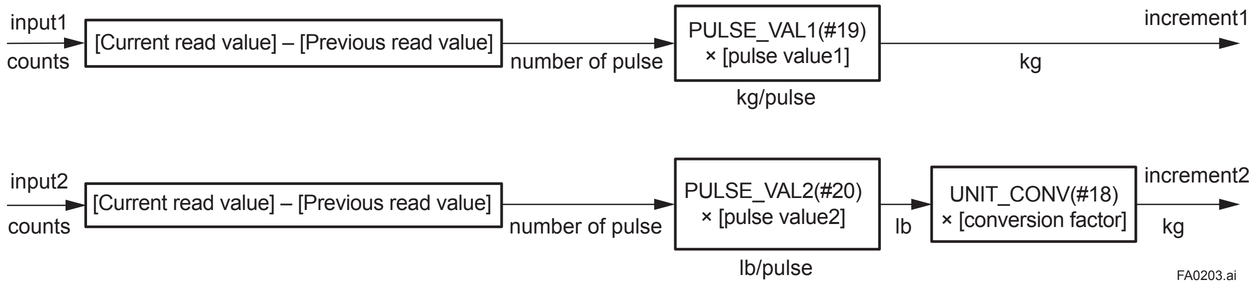


Figure A2.3 Increment Calculation with Counter Input

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.

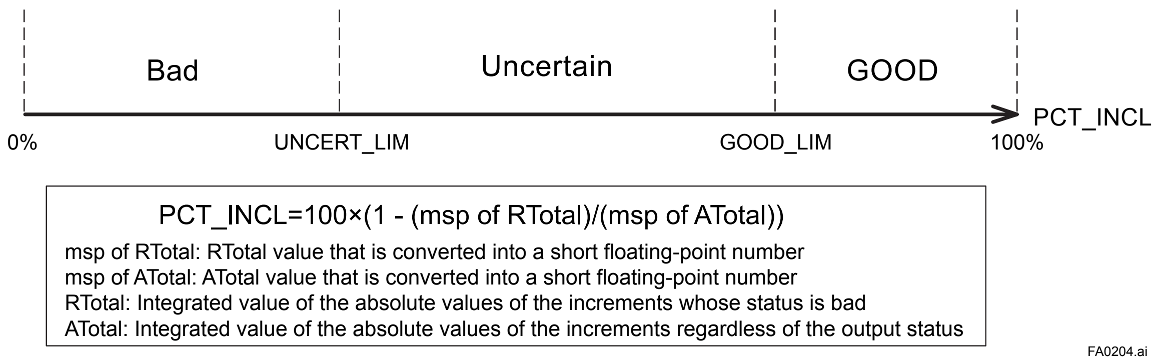


Figure A2.4 Status of OUT, OUT_TRIP, and OUT_PTRIP Outputs

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:

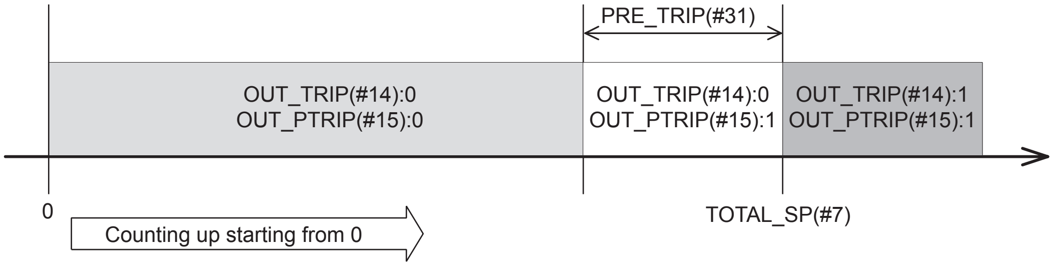
- For counting up
  OUT = integration start value (0) + Total
- For counting down
  OUT = integration start value (TOTAL_SP) _ Total

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

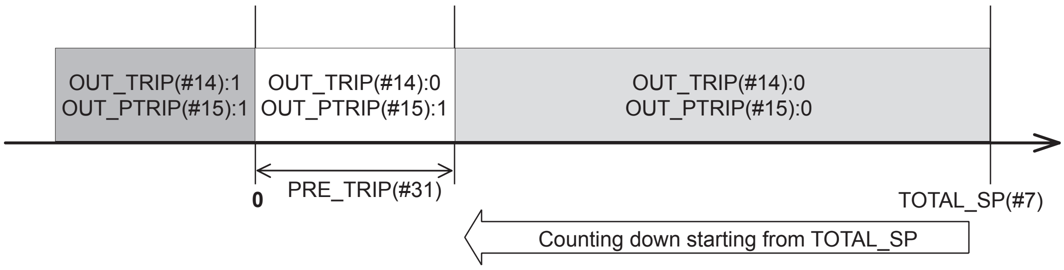
If OUT is rewritten in the MAN mode, integration starts with the value rewritten in MAN mode after the mode was returned to AUTO.

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



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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 three options relating to a reset:

i Confirm reset (bit 8 of INTEG_OPTS)
ii Carry (bit 6 of INTEG_OPTS)
iii Generate reset event (bit 9 of INTEG_OPTS)

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

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

iii Generate reset event (bit 9 of INTEG_OPTS)
If this option is enabled, an alert event is generated if a reset occurs.

A2.7 List of Integrator Block Parameters

Index	Parameter Name	Initial Value	Write Mode	View				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	Null						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 PID 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	sec(1)	MAN		1			Set the time unit of the rate (kg/s, lb/min, kg/h ... etc.) of the corresponding IN.
17	TIME_UNIT2	sec(1)	MAN		1			
18	UNIT_CONV	1.0					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."

<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>26</td><td>SRTOTAL</td><td>0.0</td><td></td><td></td><td></td><td>4</td><td></td><td>Indicates the snapshot of RTOTAL just before a reset.</td></tr>
<tr><td>27</td><td>SSP</td><td>0.0</td><td></td><td></td><td></td><td>4</td><td></td><td>Indicates the snapshot of TOTAL_SP just before a reset.</td></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</td><td>Generate reset event</td><td>Generates an alert event at reset.</td></tr>
<tr><td>10 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>2.7[sec]</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>
</table>

Index	Parameter Name	Initial Value	Write Mode	View 1	View 2	View 3	View 4	Definition
39	UPDATE_EVT							Indicates event information if an update event occurs.
40	BLOCK_ALM							Indicates alarm information if a block alarm occurs.
41	ACCUM_ TOTAL	0.0				4		Accumulated integrated values (no extension parameter is reset)

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.

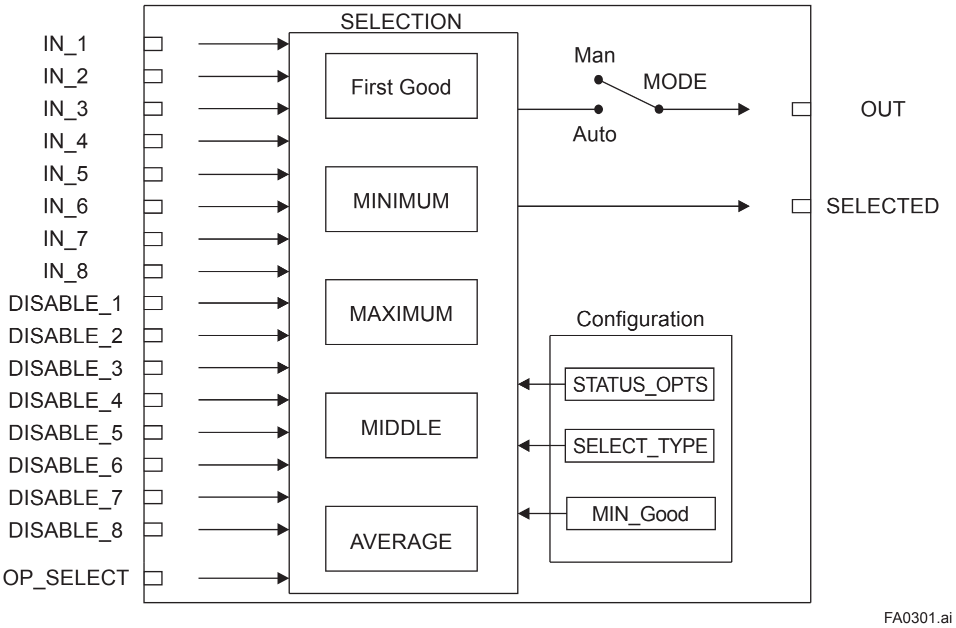


Figure A3.1 IS Block

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:

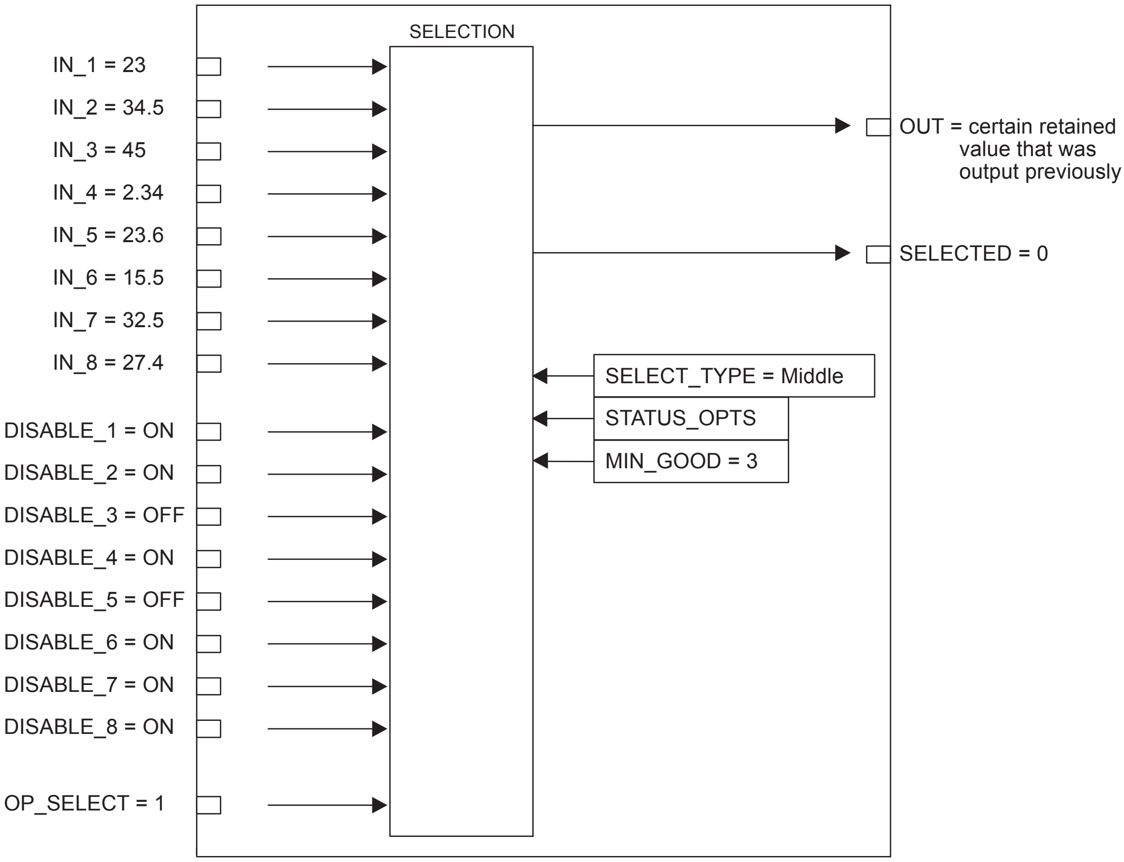


Figure A3.2 Example (1)

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.

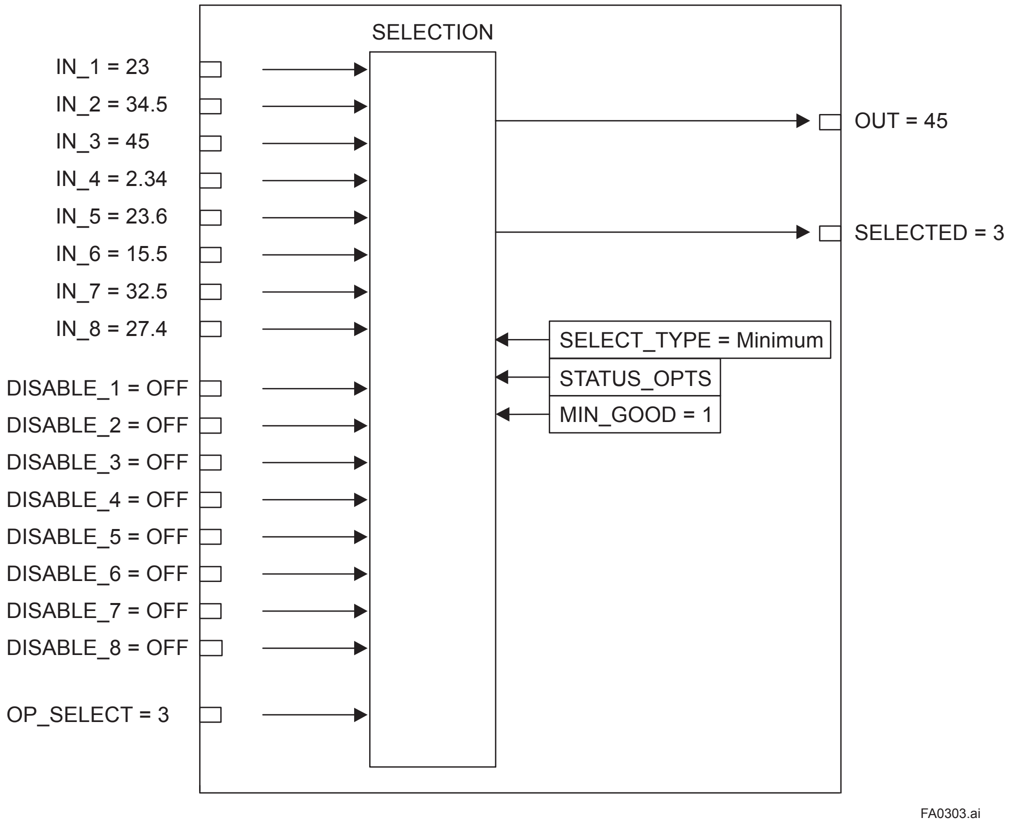


Figure A3.3 Example (2)

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.

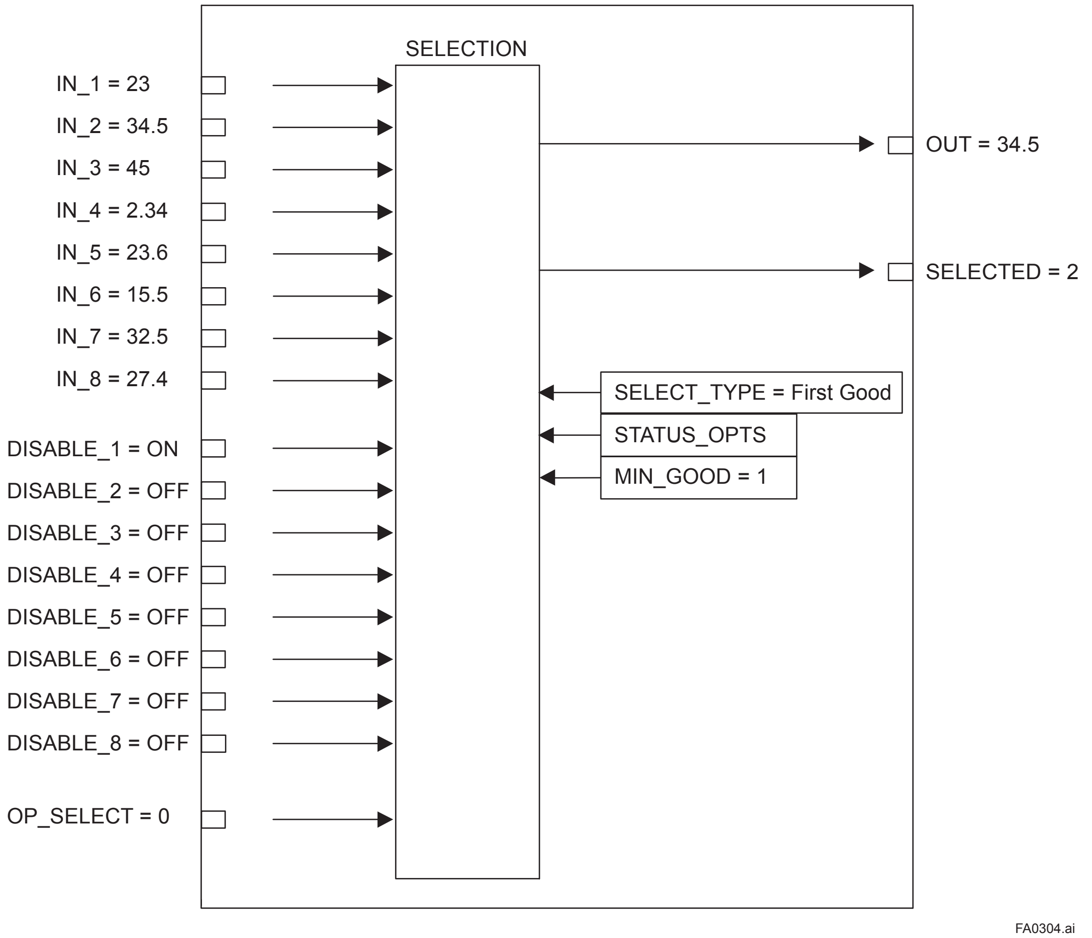


Figure A3.4 Example (3)

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.

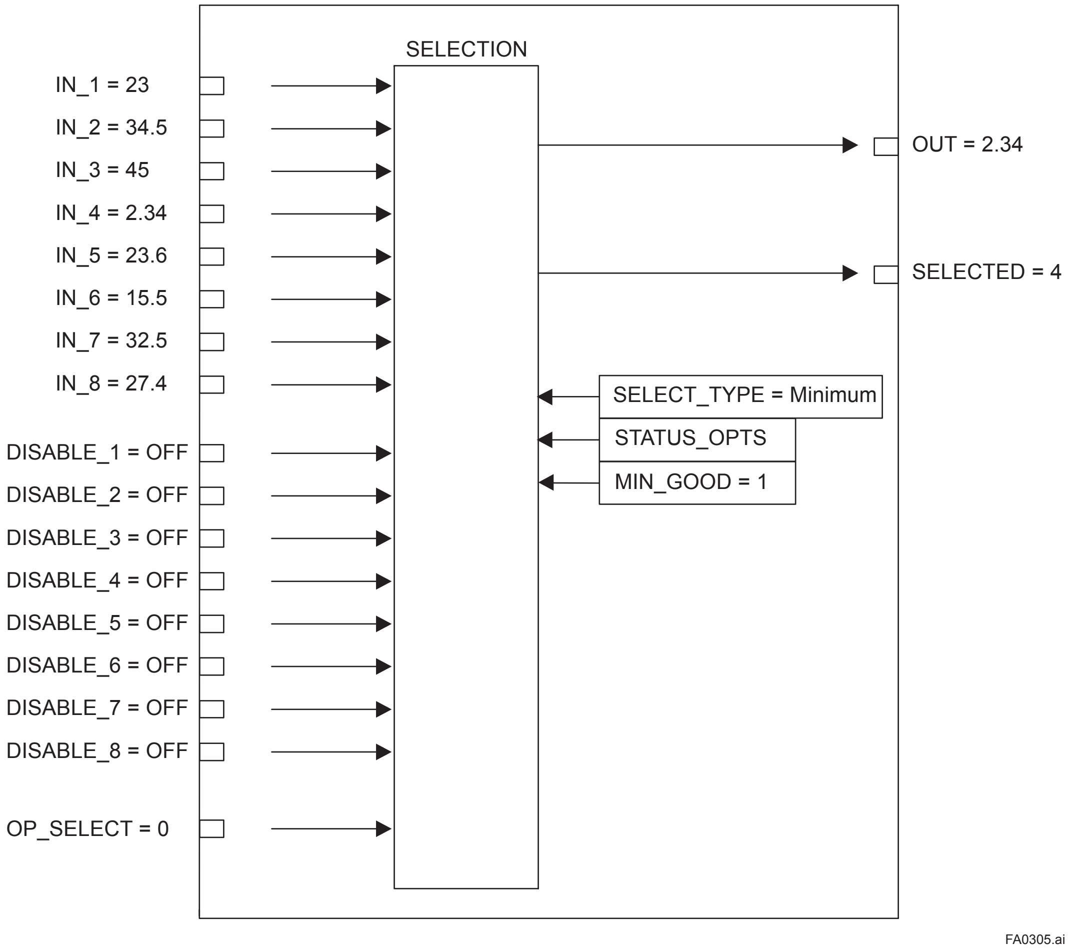


Figure A3.5 Example (4)

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.

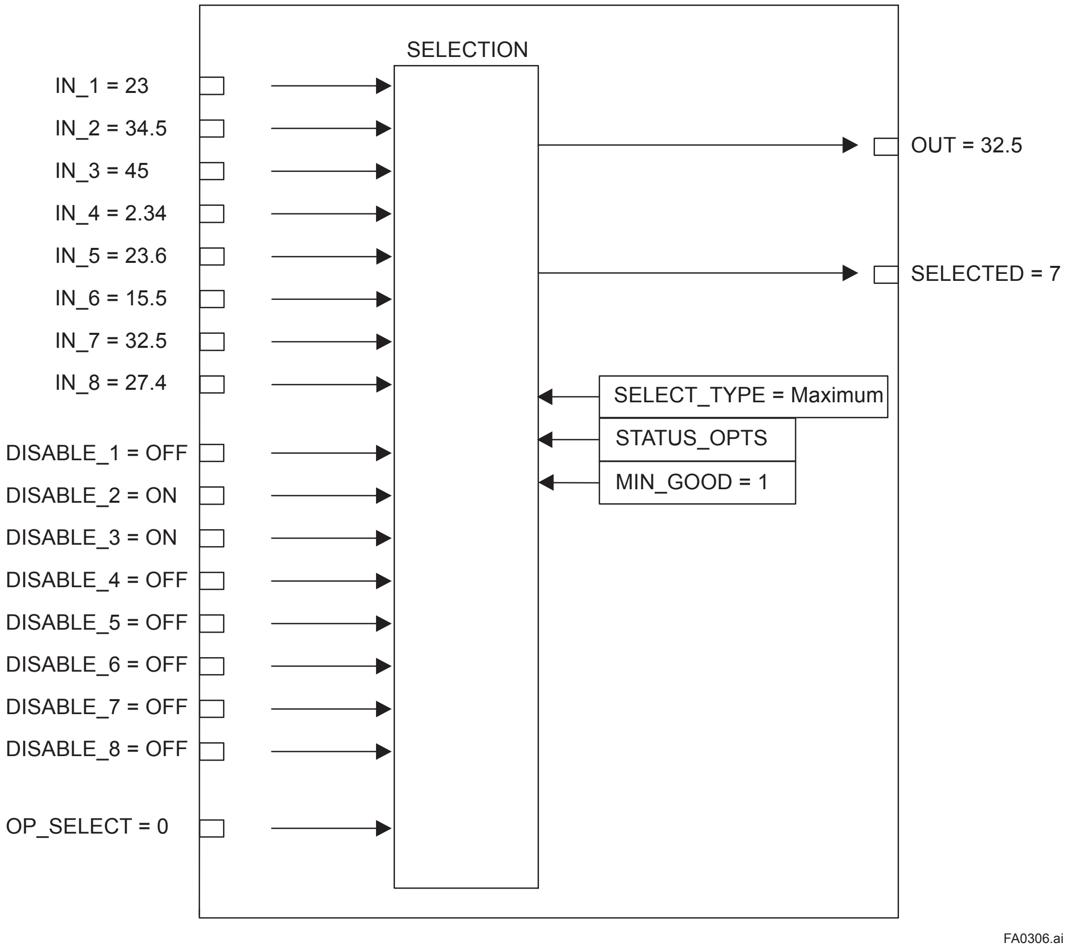


Figure A3.6 Example (5)

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:

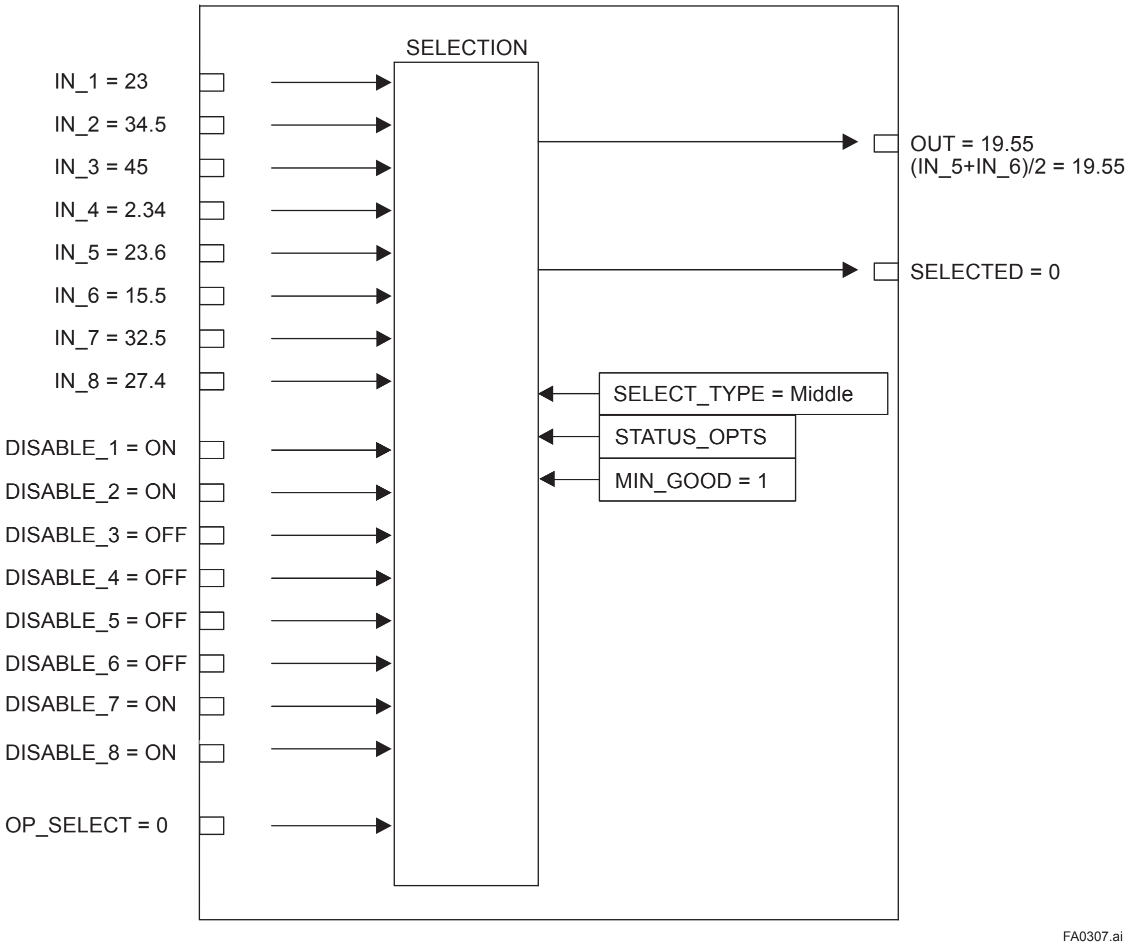


Figure A3.7 Example (6)

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:

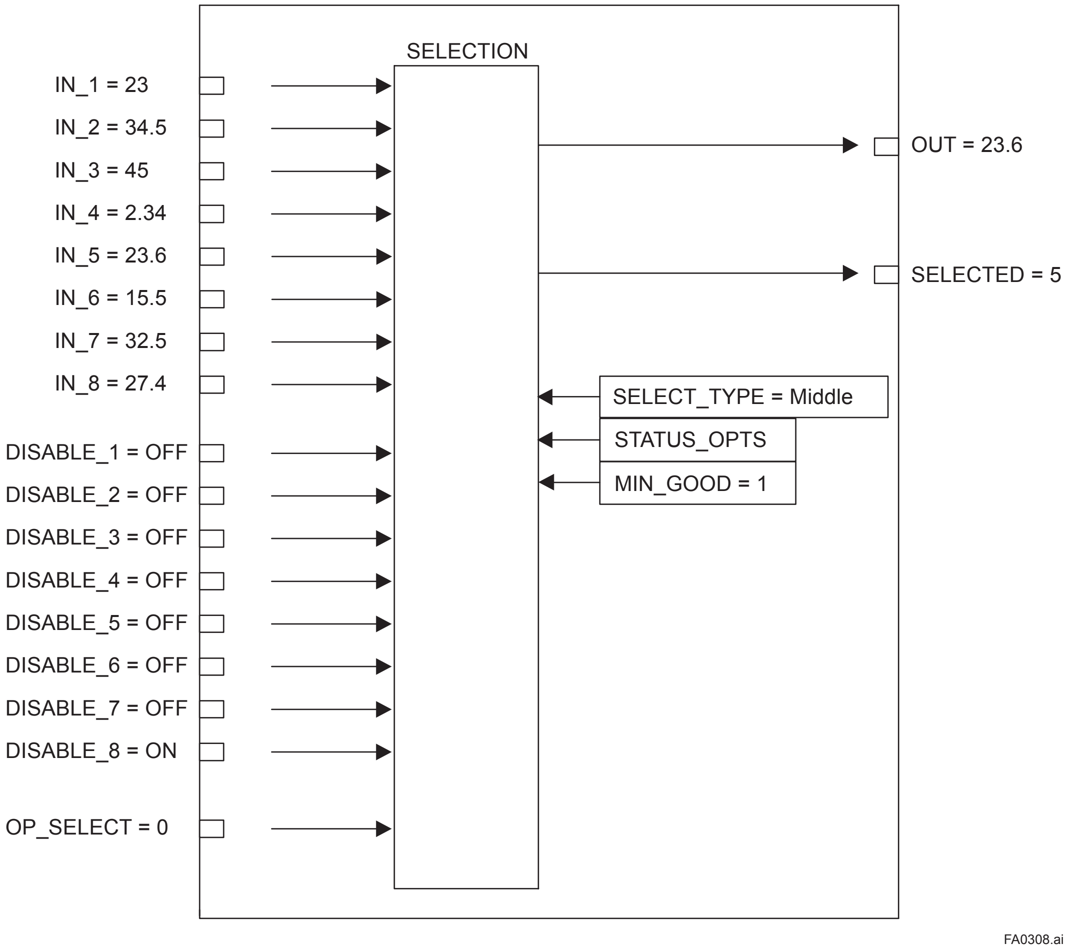


Figure A3.8 Example (7)

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.

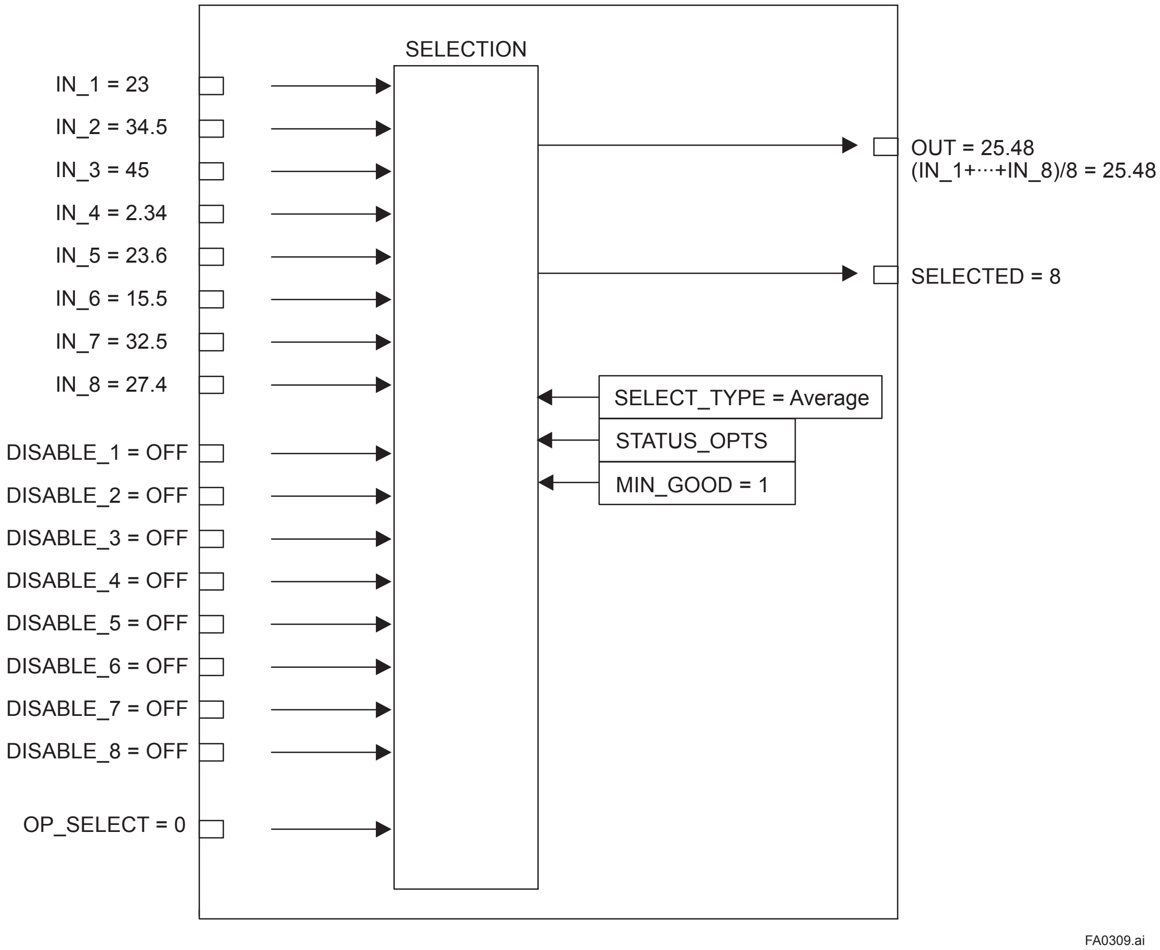


Figure A3.9   Example (8)

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

<table>
<tr><th colspan="2">MODE</th><th>Value</th></tr>
<tr><td colspan="2">O/S</td><td rowspan="2">• The previous value is output. (At startup, the initial value is used).
• Writable (the operator may change the value.)</td></tr>
<tr><td colspan="2">Man</td></tr>
<tr><td rowspan="13">Auto</td><td>Value specified by MIN_Good > the number of valid inputs</td><td rowspan="3">• The previous value is output.
• Not writable</td></tr>
<tr><td>If there is no valid input</td></tr>
<tr><td>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)</td></tr>
<tr><td>If the value of OP_SELECT is greater than 8, which is the maximum number of inputs</td><td>• Zero
• Not writable</td></tr>
<tr><td>If OP_SELECT is enabled</td><td>• The value of the selected input is output.
• Not writable</td></tr>
<tr><td>If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is “0”</td><td>• The previous value is output.
• Not writable</td></tr>
<tr><td>If SELECT_TYPE is “First Good”</td><td>• The value of a valid input with the smallest input number is output.
• Not writable</td></tr>
<tr><td>If SELECT_TYPE is “MINIMUM”</td><td>• The minimum value among the values of the valid inputs is output.
• Not writable</td></tr>
<tr><td>If SELECT_TYPE is “MAXIMUM”</td><td>• The maximum value among the values of the valid inputs is output.
• Not writable</td></tr>
<tr><td>If SELECT_TYPE is “MIDDLE”
(There is an even multiple number of valid inputs.)</td><td>• 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</td></tr>
<tr><td>If SELECT_TYPE is “MIDDLE”
(There is an odd multiple number of valid inputs.)</td><td>• The value of the input positioned in the middle of the values of odd multiple valid inputs is output.
• Not writable</td></tr>
<tr><td>If SELECT_TYPE is “AVERAGE”</td><td>• The value obtained by dividing the added value of the values of valid inputs by the number of these inputs is output.
• Not writable</td></tr>
<tr><td>If SELECT_TYPE is “Latched Good”</td><td>• The value of a valid input with the smallest input number is output.
• Not writable</td></tr>
</table>

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	Aute
If there is no valid input	Aute
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)	Aute
If the value of OP_SELECT is greater than 8, which is the maximum number of inputs	Aute
If OP_SELECT has selected IN whose status is “bad” or “uncertain” (See the item “Transition of Sub-status in the Case Where OP_SELECT is Selected.”)	Aute
If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is “0”	Aute

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	Index IS1	Index IS2	Parameter	Write Mode	Valid Range	Initial Value	View				Description / Remarks
							1	2	3	4	
0	17000	17100	BLOCK_ HEADER	Block Tag=O/S		TAG: “IS”					Information relating to this function block, such as block tag, DD revision, and execution time.
1	17001	17101	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	17002	17102	TAG_DESC			Null					A universal parameter that stores comments describing tag information.
3	17003	17103	STRATEGY			1				2	A universal parameter intended for use by the high-level system to identify function blocks.
4	17004	17104	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	17005	17105	MODE_BLK				4		4		A universal parameter representing the operation status of the IS block. It consists of the Actual, Target, Permit, and Normal modes.
6	17006	17106	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	17007	17107	OUT	MAN		0	5		5		Block output.
8	17008	17108	OUT_ RANGE		100 0 1342 1			11			Set the range of OUT.
9	17009	17109	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	17010	17110	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	17011	17111	IN_1			0	5		5		Input 1
12	17012	17112	IN_2			0	5		5		Input 2
13	17013	17113	IN_3			0	5		5		Input 3

Relative Index	Index IS1	Index IS2	Parameter	Write Mode	Valid Range	Initial Value	View				Description / Remarks
							1	2	3	4	
14	17014	17114	IN_4			0	5		5		Input 4
15	17015	17115	DISABLE_1		0, 1	0	2		2		Selector switch to disable input 1 from being selected.
16	17016	17116	DISABLE_2		0, 1	0	2		2		Selector switch to disable input 2 from being selected.
17	17017	17117	DISABLE_3		0, 1	0	2		2		Selector switch to disable input 3 from being selected.
18	17018	17118	DISABLE_4		0, 1	0	2		2		Selector switch to disable input 4 from being selected.
19	17019	17119	SELECT_ TYPE		1-6	0				1	Specifies the input selection algorithm.
20	17020	17120	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	17021	17121	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	17022	17122	OP_ SELECT		0-8	0	2		2		A parameter to forcibly employ the input of a selected number (Operator-settable).
23	17023	17123	UPDATE_ EVT		-	-					Indicates event information if an update event (setting change) occurs.
24	17024	17124	BLOCK_ ALM		-	-					Indicates alarm information if a block alarm occurs.
25	17025	17125	IN_5			0	5		5		Input 5
26	17026	17126	IN_6			0	5		5		Input 6
27	17027	17127	IN_7			0	5		5		Input 7
28	17028	17128	IN_8			0	5		5		Input 8
29	17029	17129	DISABLE_5		0, 1	0	2		2		Selector switch to disable input 5 from being selected.
30	17030	17130	DISABLE_6		0, 1	0	2		2		Selector switch to disable input 6 from being selected.
31	17031	17131	DISABLE_7		0, 1	0	2		2		Selector switch to disable input 7 from being selected.
32	17032	17132	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.

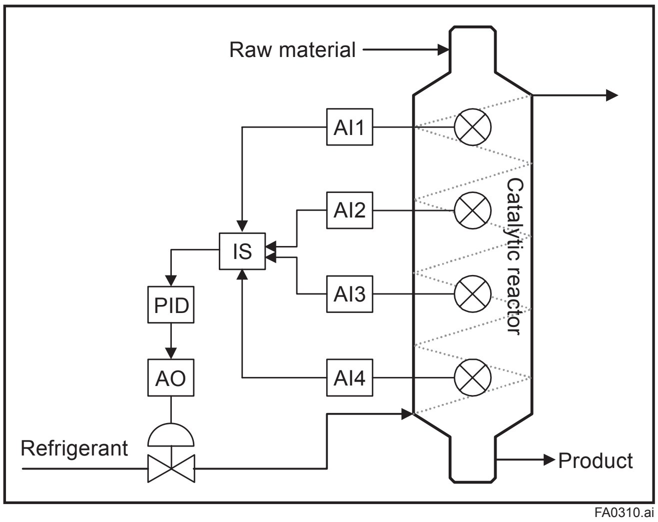


Figure A3.10 Temperature Control System of a Fixed Bed-type Reactor

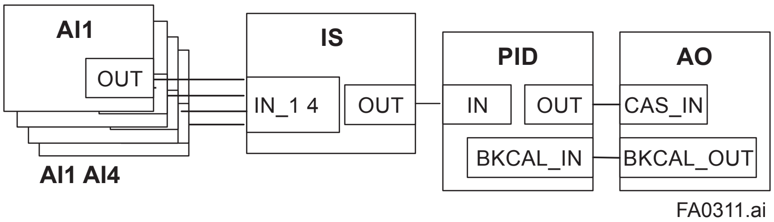


Figure A3.11 Example of Scheduling

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.

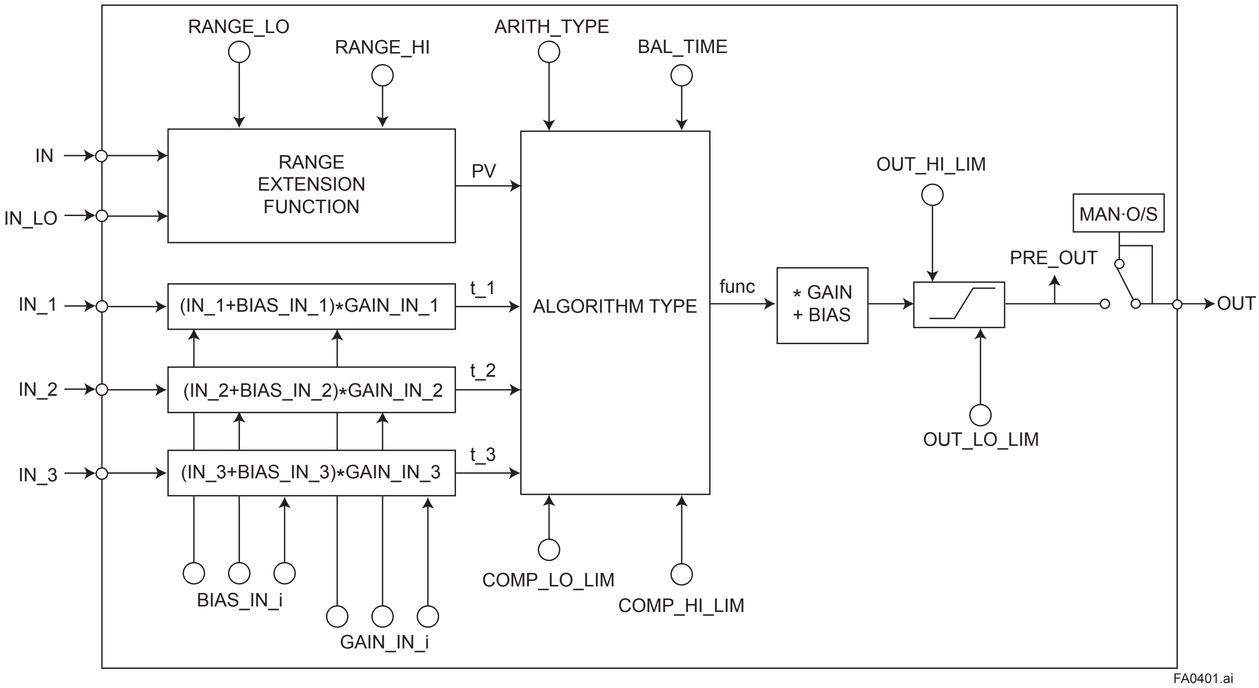


Figure A4.1 AR Block

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.

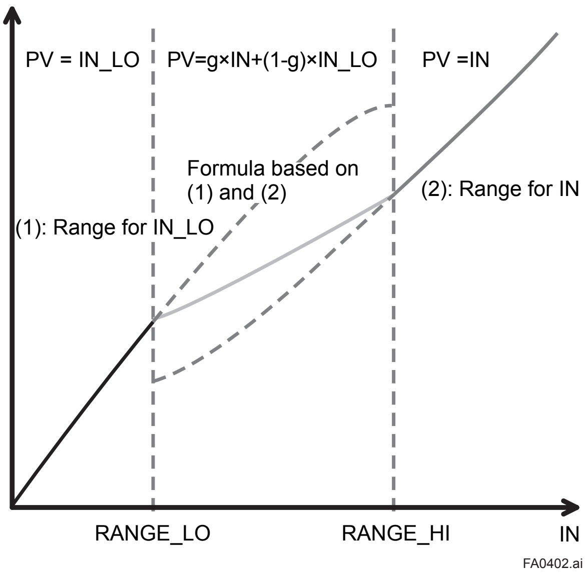


Figure A4.2 Range Extension Function and PV

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) × 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.

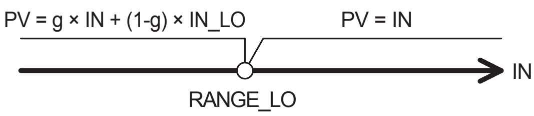
A4.2.4 Relationship between the Main Inputs and PV

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

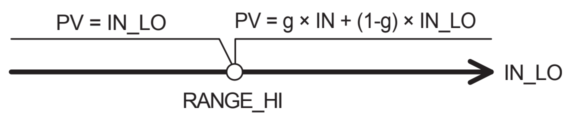
- If the statuses of two main inputs are both “good” or anything other than “good”
  See A4.2.1, Main Inputs.

- 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.

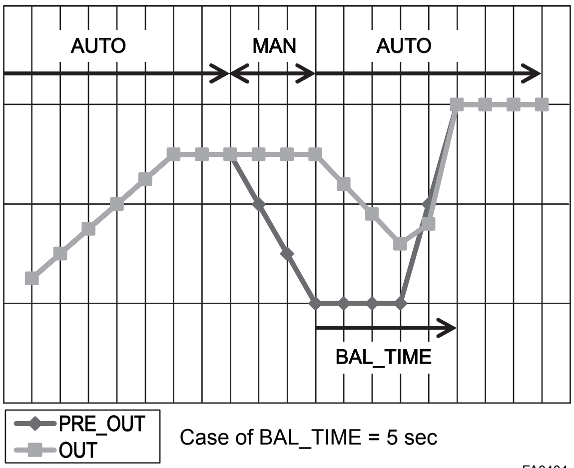
If PRE_OUT < OUT_LO_LIM:
PRE_OUT = OUT_LO_LIM
The “low limited” processing is applied to the status of PRE_OUT.

A4.4.1 Mode Handling

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

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.



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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:

<table>
<tr><th colspan="2"></th><th>Case 1</th><th>Case 2</th><th>Case 3</th></tr>
<tr><td colspan="2">PV</td><td colspan="3">Good</td></tr>
<tr><td colspan="2">IN_1</td><td colspan="3">Unceriain</td></tr>
<tr><td colspan="2">IN_2</td><td colspan="3">Bad</td></tr>
<tr><td colspan="2">IN_3</td><td colspan="3">Bad</td></tr>
<tr><td rowspan="3">INPUT_ OPTS</td><td>IN_1</td><td>Handled as a “good” input if its status is “uncertain.”</td><td colspan="2">No option</td></tr>
<tr><td>IN_2</td><td colspan="2">Handled as a “good” input if its status is “bad.”</td><td>No option</td></tr>
<tr><td>IN_3</td><td colspan="3">No option</td></tr>
<tr><td colspan="2">ARITH_TYPE</td><td colspan="3">1) Flow compensation (linear) in A4.3.1, “Computing Equations”</td></tr>
<tr><td colspan="2">OUT.Status</td><td>Good</td><td>Uncertain</td><td>Bad</td></tr>
</table>

A4.5 List of the Arithmetic Block Parameters

Relative Index	Index AR1	Index AR2	Parameter	Write Mode	Valid Range	Initial Value	View				Description / Remarks
							1	2	3	4	
0	17500	17600	BLOCK_ HEADER	O/S		TAG="AR"					Information relating to this function block, such as block tag, DD revision, and execution time.
1	17501	17601	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	17502	17602	TAG_DESC			Null					A universal parameter that stores comments describing tag information.
3	17503	17603	STRATEGY			1				2	A universal parameter intended for use by a high-level system to identify function blocks.
4	17504	17604	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	17505	17605	MODE_BLK			AUTO	4		4		A universal parameter representing the operation status of the Arithmetic block. It consists of the Actual, Target, Permit, and Normal modes.
6	17506	17606	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	17507	17607	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	17508	17608	OUT	MAN		0	5		5		Block output.
9	17509	17609	PRE_OUT			0	5		5		Always indicates the calculation result. The value is substituted into OUT in Auto mode.
10	17510	17610	PV_SCALE	O/S	100 0 1342 1			11			Indicates PV scaling (for making a memo).
11	17511	17611	OUT_ RANGE		100 0 1342 1			11			Output scaling for the host (for making a memo).
12	17512	17612	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.

Relative Index	Index AR1	Index AR2	Parameter	Write Mode	Valid Range	Initial Value	View 1	View 2	View 3	View 4	Description / Remarks
13	17513	17613	INPUT_ OPTS			0				2	Determines whether an input is used as a “good” input when the input status is "bad" or “uncertain.” 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
14	17514	17614	IN			0			5		Input block.
15	17515	17615	IN_LO			0			5		Input for a low-range indicator. This is used for the RANGE EXTENSION FUNCTION.
16	17516	17616	IN_1			0			5		Auxiliary input 1
17	17517	17617	IN_2			0			5		Auxiliary input 2
18	17518	17618	IN_3			0			5		Auxiliary input 3
19	17519	17619	RANGE_HI			0				4	High limit for switching to a high-range indicator by the RANGE EXTENSION FUNCTION.
20	17520	17620	RANGE_LO			0				4	Low limit for switching to a low-range indicator by the RANGE EXTENSION FUNCTION.
21	17521	17621	BIAS_IN_1			0				4	IN_1 bias
22	17522	17622	GAIN_IN_1			0				4	IN_1 gain
23	17523	17623	BIAS_IN_2			0				4	IN_2 bias
24	17524	17624	GAIN_IN_2			0				4	IN_2 gain
25	17525	17625	BIAS_IN_3			0				4	IN_3 bias
26	17526	17626	GAIN_IN_3			0				4	IN_3 gain
27	17527	17627	COMP_HI_ LIM			+INF				4	High limit of compensation factor f.
28	17528	17628	COMP_LO_ LIM			-INF				4	Low limit of compensation factor f.

<table>
<tr><th rowspan="2">Relative Index</th><th rowspan="2">Index AR1</th><th rowspan="2">Index AR2</th><th rowspan="2">Parameter</th><th rowspan="2">Write Mode</th><th rowspan="2">Valid Range</th><th rowspan="2">Initial Value</th><th colspan="4">View</th><th rowspan="2">Description / Remarks</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>29</td><td>17529</td><td>17629</td><td>ARITH_ TYPE</td><td>1 to 10</td><td></td><td>0x01</td><td></td><td></td><td></td><td>1</td><td>Computation algorithm identification no.
<table>
<tr><th>Value</th><th>Selection Name</th><th>Description</th></tr>
<tr><td>1</td><td>Flow compensation, linear</td><td>Flow compensation (linear)</td></tr>
<tr><td>2</td><td>Flow compensation, square root</td><td>Flow compensation (square root)</td></tr>
<tr><td>3</td><td>Flow compensation, approximate</td><td>Flow compensation (approximate expression)</td></tr>
<tr><td>4</td><td>BTU flow (*)</td><td>Quantity of heat calculation</td></tr>
<tr><td>5</td><td>Traditional Multiply Divide</td><td>Multiplication and division</td></tr>
<tr><td>6</td><td>Average</td><td>Average calculation</td></tr>
<tr><td>7</td><td>Traditional summer</td><td>Summation</td></tr>
<tr><td>8</td><td>Fourth order Polynomial, Type 1</td><td>4th-order (auxiliary input) polynomial computation</td></tr>
<tr><td>9</td><td>HTG level compensation (*)</td><td>HTG-level compensation</td></tr>
<tr><td>10</td><td>Fourth order Polynomial, Type 2</td><td>4th-order (main input) polynomial computation</td></tr>
</table>
* BTU stands for British thermal unit.
HTG stands for hydrostatic tank gauging.</td></tr>
<tr><td>30</td><td>17530</td><td>17630</td><td>BAL_TIME</td><td>More than 0</td><td></td><td>0</td><td></td><td></td><td></td><td>4</td><td>Time taken to return to the set value.</td></tr>
<tr><td>31</td><td>17531</td><td>17631</td><td>BIAS</td><td></td><td></td><td>0</td><td></td><td></td><td></td><td>4</td><td>Bias value used to calculate the output.</td></tr>
<tr><td>32</td><td>17532</td><td>17632</td><td>GAIN</td><td></td><td></td><td>1</td><td></td><td></td><td></td><td>4</td><td>Gain value used to calculate the output.</td></tr>
<tr><td>33</td><td>17533</td><td>17633</td><td>OUT_HI_ LIM</td><td></td><td></td><td>+INF</td><td></td><td></td><td></td><td>4</td><td>Maximum output value.</td></tr>
<tr><td>34</td><td>17534</td><td>17634</td><td>OUT_LO_ LIM</td><td></td><td></td><td>-INF</td><td></td><td></td><td></td><td>4</td><td>Minimum output value.</td></tr>
<tr><td>35</td><td>17535</td><td>17635</td><td>UPDATE_ EVT</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Indicates event information if an update event (setting change) occurs.</td></tr>
<tr><td>36</td><td>17536</td><td>17636</td><td>BLOCK_ ALM</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Indicates alarm information if a block alarm occurs.</td></tr>
</table>

Appendix 5. PID Block

A PID block performs the PID control computation based on the deviation of the measured value (PV) from the setpoint (SP), 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.

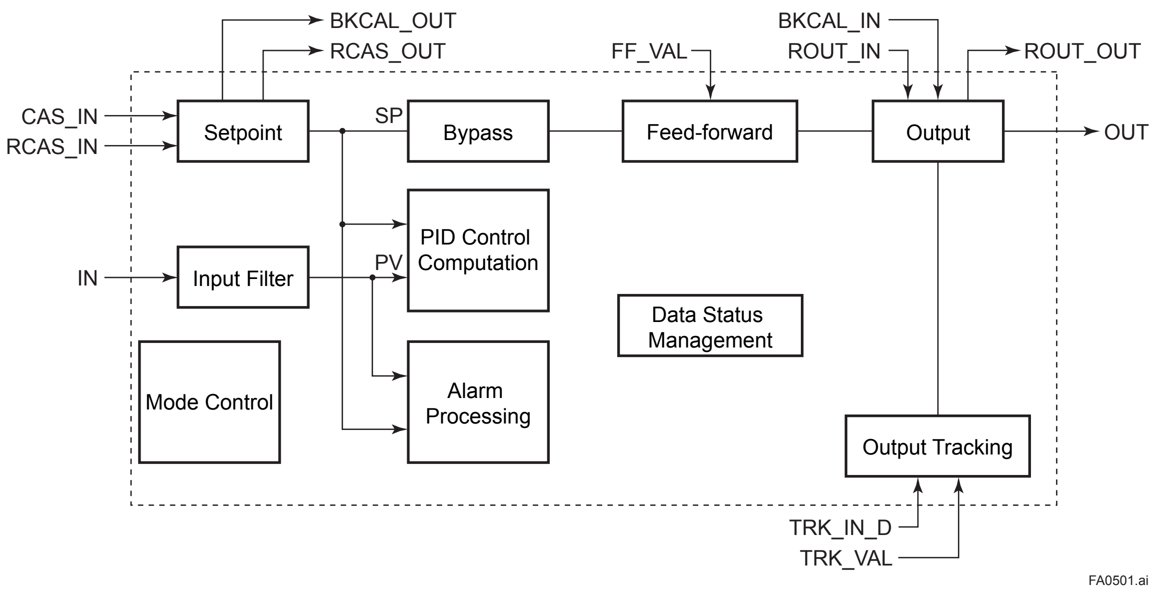


Figure A5.1 PID Block

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	Index PID1	Index PID2	Parameter Name	Default (factory setting)	Write	Valid Range	Description
0	8000	8100	Block Header	TAG: “PID”	Block Tag = O/S		Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	8001	8101	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	8002	8102	TAG_DESC	Null			The user description of the intended application of the block.
3	8003	8103	STRATEGY	1			The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	8004	8104	ALERT_KEY	1		1 to 255	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	8005	8105	MODE_BLK				A universal parameter that represents block operating condition. It comprises the Actual, Target, Permit and Normal modes.
6	8006	8106	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	8007	8107	PV		—		Measured value; the non-dimensional value that is converted from the input (IN) value based on the PV_SCALE values and filtered.
8	8008	8108	SP	0	AUTO	PV_SCALE ±10%	Setpoint
9	8009	8109	OUT		MAN		Output
10	8010	8110	PV_SCALE	100 0 1342 1	O/S		Upper and lower scale limit values used for scaling of the input (IN) value.
11	8011	8111	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	8012	8112	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	8013	8113	CONTROL_ OPTS	0	O/S		Setting for control action. See Section A5.13 for details.
14	8014	8114	STATUS_OPTS	0	O/S		See Section A5.15 for details.
15	8015	8115	IN	0			Controlled-value input.
16	8016	8116	PV_FTIME	2	AUTO	Non-negative	Time constant (in seconds) of the first-order lag filter applied to IN.
17	8017	8117	BYPASS	1 (off)	MAN	1, 2	Whether to bypass the control computation. 1 (off): Do not bypass. 2 (on): Bypass.
18	8018	8118	CAS_IN	0			Cascade setpoint
19	8019	8119	SP_RATE_DN	+INF		Positive	Rate-of-decrease limit for setpoint (SP).
20	8020	8120	SP_RATE_UP	-INF		Positive	Rate-of-increase limit for setpoint (SP).
21	8021	8121	SP_HI_LIM	100		PV_SCALE ±10%	Upper limit for setpoint (SP).

Index	Index PID1	Index PID2	Parameter Name	Default (factory setting)	Write	Valid Range	Description
22	8022	8122	SP_LO_LIM	0		PV_SCALE ±10%	Lower limit for setpoint (SP).
23	8023	8123	GAIN	1			Proportional gain (= 100 / proportional band).
24	8024	8124	RESET	10			Integration time (seconds).
25	8025	8125	BAL_TIME	0		Positive	Unused
26	8026	8126	RATE	0		Positive	Derivative time (seconds).
27	8027	8127	BKCAL_IN	0			Read-back of control output.
28	8028	8128	OUT_HI_LIM	100		OUT_SCALE ±10%	Upper limit for control output (OUT).
29	8029	8129	OUT_LO_LIM	0		OUT_SCALE ±10%	Lower limit for control output (OUT).
30	8030	8130	BKCAL_HYS	0.5 (%)		0 to 50%	Hysteresis for release from a limit for OUT.status.
31	8031	8131	BKCAL_OUT	0	—		Read-back value to be sent to the BKCAL_IN in the upper block.
32	8032	8132	RCAS_IN	0			Remote setpoint set from a computer, etc.
33	8033	8133	ROUT_IN	0			Remote control output value set from a computer, etc.
34	8034	8134	SHED_OPT	0			Action to be performed in the event of mode shedding. SHED_OPT defines the changes to be made to MODE.BLK.target and MODE.BLK.actual when the value of RCAS_IN.status or ROUT_IN.status becomes Bad if MODE_BLK.actual = RCas or ROut. See Section A5.17.1 for details.
35	8035	8135	RCAS_OUT	0	—		Remote setpoint sent to a computer, etc.
36	8036	8136	ROUT_OUT	0	—		Remote control output value.
37	8037	8137	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	8038	8138	TRK_IN_D	0			Switch for output tracking. See Section A5.12 for details.
39	8039	8139	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	8040	8140	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	8041	8141	FF_SCALE	100 0 1342 1	MAN		Scale limits used for converting the FF_VAL value to a non-dimensional value.
42	8042	8142	FF_GAIN	0	MAN		Gain for FF_VAL.
43	8043	8143	UPDATE_EVT		—		This alert is generated by any change to the static data.
44	8044	8144	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.

Index	Index PID1	Index PID2	Parameter Name	Default (factory setting)	Write	Valid Range	Description
45	8045	8145	ALARM_SUM	Enable			The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
46	8046	8146	ACK_OPTION	0xFFFF			Selection of whether alarms associated with the block will be automatically acknowledged.
47	8047	8147	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	8048	8148	HI_HI_PRI	0		0 to 15	Priority order of HI_HI_ALM alarm.
49	8049	8149	HI_HI_LIM	+INF		PV_SCALE	Setting for HI_HI_ALM alarm.
50	8050	8150	HI_PRI	0		0 to 15	Priority order of HI_ALM alarm.
51	8051	8151	HI_LIM	+INF		PV_SCALE	Setting for HI_ALM alarm.
52	8052	8152	LO_PRI	0		0 to 15	Priority order of LO_ALM alarm.
53	8053	8153	LO_LIM	-INF		PV_SCALE	Setting for LO_ALM alarm.
54	8054	8154	LO_LO_PRI	0		0 to 15	Priority order of LO_LO_ALM alarm.
55	8055	8155	LO_LO_LIM	-INF		PV_SCALE	Setting for LO_LO_ALM alarm.
56	8056	8156	DV_HI_PRI	0		0 to 15	Priority order of DV_HI_ALM alarm.
57	8057	8157	DV_HI_LIM	+INF			Setting for DV_HI_ALM alarm.
58	8058	8158	DV_LO_PRI	0		0 to 15	Priority order of DV_LO_ALM alarm.
59	8059	8159	DV_LO_LIM	-INF			Setting for DV_LO_ALM alarm.
60	8060	8160	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	8061	8161	HI_ALM	—	—		As above
62	8062	8162	LO_ALM	—	—		As above Reset when the PV value has increased above [LO_LIM + ALM_HYS].
63	8063	8163	LO_LO_ALM	—	—		As above
64	8064	8164	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	8065	8165	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

The I-PD control algorithm, which is expressed in the basic equation below, 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.

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

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 FVX110 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'

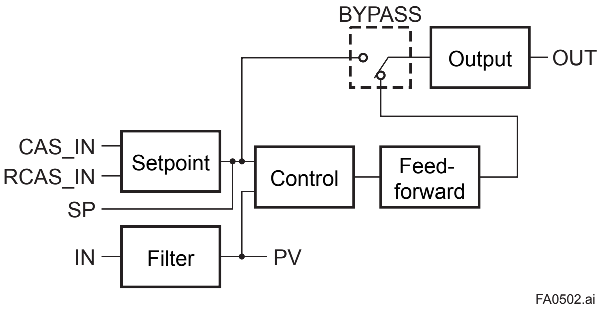
A5.6 Direction of Control Action

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.

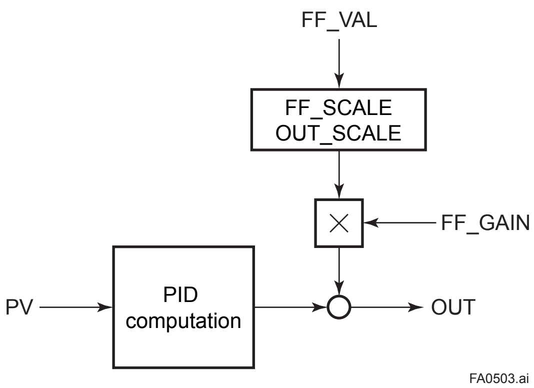
A5.7 Control Action Bypass

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.

Transition Destination Mode	Condition	NOT Conditions
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.

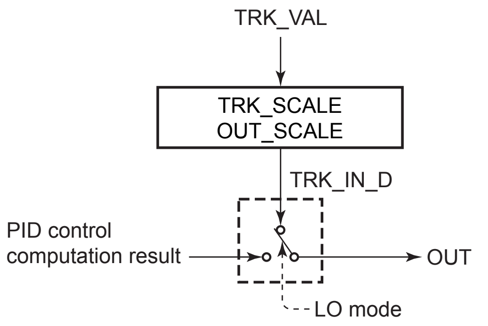
- An increase of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_UP.
- A decrease of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_DOWN.

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.



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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.

Lower priority level → Higher priority level

ROut RCas Cas Auto Man

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*2 Only when Auto is set as permitted mode.

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

A5.18 Alarms

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

A5.18.1 Block Alarm (BLOCK_ALM)

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

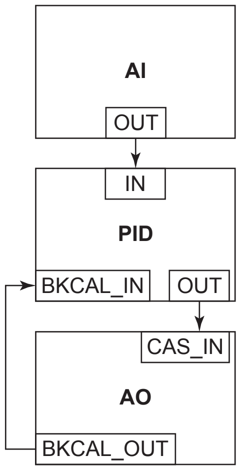
Value of BLOCK_ERR	Condition
Local Override	**MODE_BLK** actual of PID block is LO.
Input Failure	**IN.status** of the PID block is either of the following: • Bad-Device Failure • Bad-Sensor Failure
Out of Service	**MODE_BLK.target** of the PID block is O/S.

A5.18.2 Process Alarms

There are six types of process alarms. Priority level can be set to process alarms. The priority level is set for each process alarm type.

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

A5.19 Example of Block Connections



FA0506.ai

When configuring a simple PID control loop by combining an field device 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 field device, 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

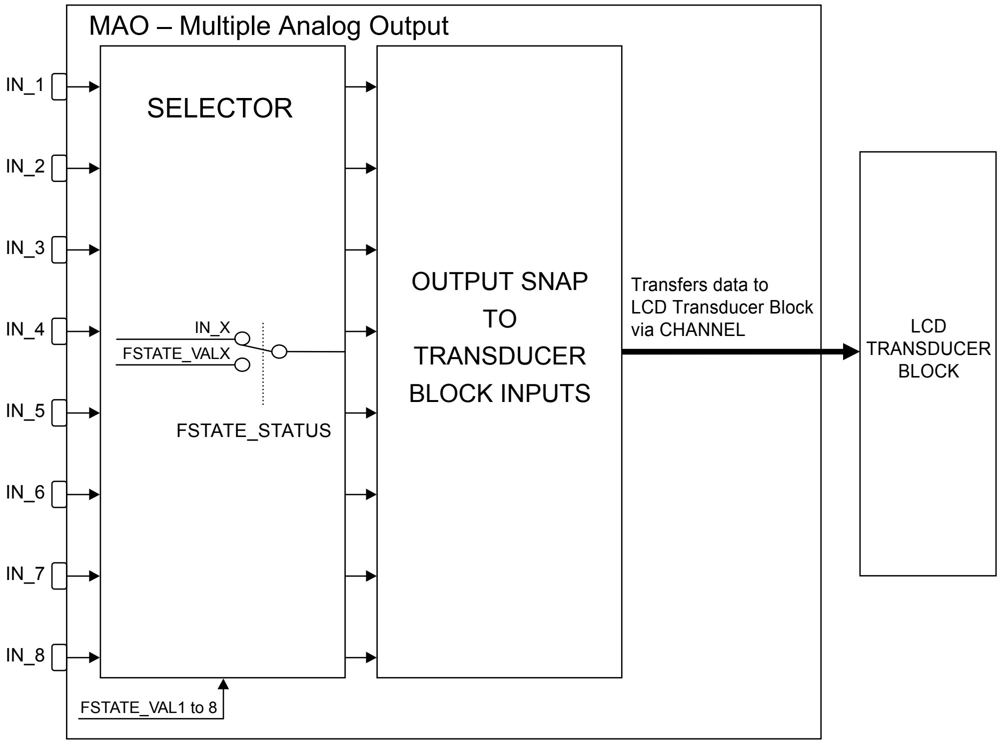
Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	SP	5		5	
9	OUT	5		5	
10	PV_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	CONTROL_OPTS				2
14	STATUS_OPTS				2
15	IN			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. Multiple Analog Output (MAO) Block

The MAO function block passes multiple input signal data.

The FVX uses it as a means to pass data to LCD Transducer Block.

A6.1 Function Block Diagram



FA0601.ai

Input parameter (input)

IN_1	Input 1 (status, value)
IN_2	Input 2 (status, value)
IN_3	Input 3 (status, value)
IN_4	Input 4 (status, value)
IN_5	Input 5 (status, value)
IN_6	Input 6 (status, value)
IN_7	Input 7 (status, value)
IN_8	Input 8 (status, value)

Other parameters

FSTATE_VAL1	Value transferred as input 1 to LCD Transducer Block during fault state status (optional setting)
FSTATE_VAL2	Value transferred as input 2 to LCD Transducer Block during fault state status (optional setting)
FSTATE_VAL3	Value transferred as input 3 to LCD Transducer Block during fault state status (optional setting)
FSTATE_VAL4	Value transferred as input 4 to LCD Transducer Block during fault state status (optional setting)
FSTATE_VAL5	Value transferred as input 5 to LCD Transducer Block during fault state status (optional setting)
FSTATE_VAL6	Value transferred as input 6 to LCD Transducer Block during fault state status (optional setting)
FSTATE_VAL7	Value transferred as input 7 to LCD Transducer Block during fault state status (optional setting)
FSTATE_VAL8	Value transferred as input 8 to LCD Transducer Block during fault state status (optional setting)
FSTATE_STATUS	List of inputs that have transitioned to a fault state
CHANNEL	A means for theoretically accessing LCD Transducer Block (cannot be set on the FVX110)

The MAO function block of the FVX110 can pass 8 inputs (IN_1 – IN_8) to LCD Transducer Block via CHANNEL.
However, if an input is in a fault state status, the previous value or a user set value (FSTATE_VAL1 – FSTATE_VAL8) is passed depending on what options (MO_OPTS) have been set.

A6.2 Block Mode

The block mode is defined by the MODE_BLK parameter.

MODE_BLK	Target	Defines the destination of a mode transition.
	Actual	Indicates the current block mode. This varies with input data status and target data.
	Permitted	Defines restrictions on the destination of a mode transition. Transitions to modes not defined here cannot be made.
	Normal	It defines regular modes.

The MAO function block can take the following three modes (MODE_BLK Actual).

Support Mode	Role
O/S	Performs configuration changes when the system is shut down.
LO	Enabled inputs enter the fault state status and the previous value or a user set value (FSTATE_VAL1 – FSTATE_VAL8) is transferred to LCD Transducer Block.
Auto	The block is in automatic operation mode.

The destination of the mode transition can be specified by MODE_BLK target, but the destination of a transition cannot be set to LO mode.
The MAO function block automatically transitions to LO mode when the FAULT_STATE parameter located in the Resource Block parameter is 2: Active.

A6.3 Fault State

Blocks and inputs in the MAO function block that are not in the normal state transition to the fault state status. Use the FSTATE_STATUS parameter to confirm inputs in the fault state status.

A6.3.1 Transition to Fault State

If the input status stays in the Bad status for longer than the time set using FSTATE_TIME, the input transitions to the fault state status. When the MAO function block is in LO mode, all inputs transferred to LCD Transducer Block transition to the fault state status.

A6.3.2 Clearing a Fault State

Run the MAO function block in Auto mode to change the status of inputs to something other than Bad to clear fault state status.

A6.3.3 Fault State Operation

Operation in fault state status is defined by MO_OPTS.

MO_OPTS		Definition
bit	Name	
0	Fault state to value 1	Operation when input 1 is in the fault state
1	Fault state to value 2	Operation when input 2 is in the fault state
2	Fault state to value 3	Operation when input 3 is in the fault state
3	Fault state to value 4	Operation when input 4 is in the fault state
4	Fault state to value 5	Operation when input 5 is in the fault state
5	Fault state to value 6	Operation when input 6 is in the fault state
6	Fault state to value 7	Operation when input 7 is in the fault state
7	Fault state to value 8	Operation when input 8 is in the fault state
8	Use fault state value on restart 1	Operation when input 1 is in the fault state at restart
9	Use fault state value on restart 2	Operation when input 2 is in the fault state at restart
10	Use fault state value on restart 3	Operation when input 3 is in the fault state at restart
11	Use fault state value on restart 4	Operation when input 4 is in the fault state at restart
12	Use fault state value on restart 5	Operation when input 5 is in the fault state at restart
13	Use fault state value on restart 6	Operation when input 6 is in the fault state at restart
14	Use fault state value on restart 7	Operation when input 7 is in the fault state at restart
15	Use fault state value on restart 8	Operation when input 8 is in the fault state at restart

Use Fault state to value 1 – Fault state to value 8 to set fault state operation either to transfer the value prior to fault state status to LCD Transducer Block (0: freeze) or to transfer FSTATE_VAL 1 – FSTATE_VAL 8 to LCD Transducer Block (1: present).

When the Use fault state value on restart 1 – Use fault state value on restart 8 bit is on, values set by FSTATE_VAL 1 – FSTATE_VAL 8 are used as default values at restart. (When this bit is not on, the value stored in IN_1 – IN_8 prior to restart is used as the default value after restart.)

The status of inputs in fault state status transitions from “Bad – No comm with LUV – Const” or “Bad – No comm, no LUV – Const.” (Refer to Appendix 6.4)

A6.4 Status Transitions

Note that inputs IN_1 – IN_8 status are not transferred to LCD Transducer Block as is when the following settings are made.

Setting	Status transition (high-level system priority)
When MAO function block is in O/S mode	Bad – Out of Service – No Limit
When fault state to value x = 0 (freeze) (x: 1 to 8)	Bad – No comm, with LUV – Const
When fault state to value x = 1 (present) (x: 1 to 8)	Bad – No comm, no LUV – Const
When no output is connected to IN_1 – IN_8	Bad – Not Connected – No Limit
The MAO function block CHANNEL is 0	Bad – Configuration Error – <received limit (*)> (*) received limit: Same as IN_1 – IN_8 status
Something other than the above	Same as IN_1 – IN_8 status

A6.5 Parameter list display

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View				Description/Remarks
					1	2	3	4	
0	BLOCK_HEADER	Block Tag =O/S							Displays Block Tag, DD Revision, Execution Time and other MAO function block information.
1	ST_REV		--------	--------	2	2	2	2	Describes the revision level of parameters for setting the MAO function block. The revision is updated when set values are changed. This parameter is used to check for parameter changes.
2	TAG_DESC			Null					A universal parameter intended for storing comments describing tag data.
3	STRATEGY			0				2	The strategy field is a universal parameter used by a high-level system to identify function blocks.
4	ALERT_KEY		1-255	0				1	Key information used to identify the location at which an alert occurred. Generally, this is a universal parameter used by a high-level system to identify specific areas in a plant that are under the control of specific operators to distinguish necessary alarms only.
5	MODE_BLK				4		4		A universal parameter that represents block operating condition. It comprises the Actual, Target, Permit and Normal modes.
6	BLOCK_ERR		--------	--------	2		2		Indicates error status of the MAO function block. The following bits are used by the MAO function block. bit1: Block Configuration Error bit 4: LO mode bit 15: O/S mode
7	CHANNEL	O/S		1				2	A means for theoretically accessing LCD Transducer Block. It cannot be used on the FVX110.
8	IN_1			0	5		5		This is an input (input 1) for the MAO function block.
9	IN_2			0	5		5		This is an input (input 2) for the MAO function block.

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View				Description/Remarks
					1	2	3	4	
10	IN_3			0	5		5		This is an input (input 3) for the MAO function block.
11	IN_4			0	5		5		This is an input (input 4) for the MAO function block.
12	IN_5			0	5		5		This is an input (input 5) for the MAO function block.
13	IN_6			0	5		5		This is an input (input 6) for the MAO function block.
14	IN_7			0	5		5		This is an input (input 7) for the MAO function block.
15	IN_8			0	5		5		This is an input (input 8) for the MAO function block.
16	MO_OPTS			0				2	This is an optional parameter for specifying output operations for the MAO function block. It is mainly used for specifying values to be transferred to LCD Transducer Block in fault state status.
17	FSTATE_TIME		Positive	0				4	An input that has become Bad and stays in that state longer than the time set by FSTATE_TIME transitions to the fault state status.
18	FSTATE_VAL1			0				4	A value transferred as input 1 to LCD Transducer Block during fault state condition (optional setting)
19	FSTATE_VAL2			0				4	A value transferred as input 2 to LCD Transducer Block during fault state condition (optional setting)
20	FSTATE_VAL3			0				4	A value transferred as input 3 to LCD Transducer Block during fault state condition (optional setting)
21	FSTATE_VAL4			0				4	A value transferred as input 4 to LCD Transducer Block during fault state condition (optional setting)
22	FSTATE_VAL5			0				4	A value transferred as input 5 to LCD Transducer Block during fault state condition (optional setting)
23	FSTATE_VAL6			0				4	A value transferred as input 6 to LCD Transducer Block during fault state condition (optional setting)
24	FSTATE_VAL7			0				4	A value transferred as input 7 to LCD Transducer Block during fault state condition (optional setting)
25	FSTATE_VAL8			0				4	A value transferred as input 8 to LCD Transducer Block during fault state condition (optional setting)
26	FSTATE_STATUS			0	2		2		List of inputs that have transitioned to fault state status
27	UPDATE_EVT								Indicates event information when an event update (a change in set values) occurs.
28	BLOCK_ALM								Indicates alarm information when a block alarm occurs.

Appendix 7. Link Master Functions

A7.1 Link Active Scheduler

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

An FVX110 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.

A7.2 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.

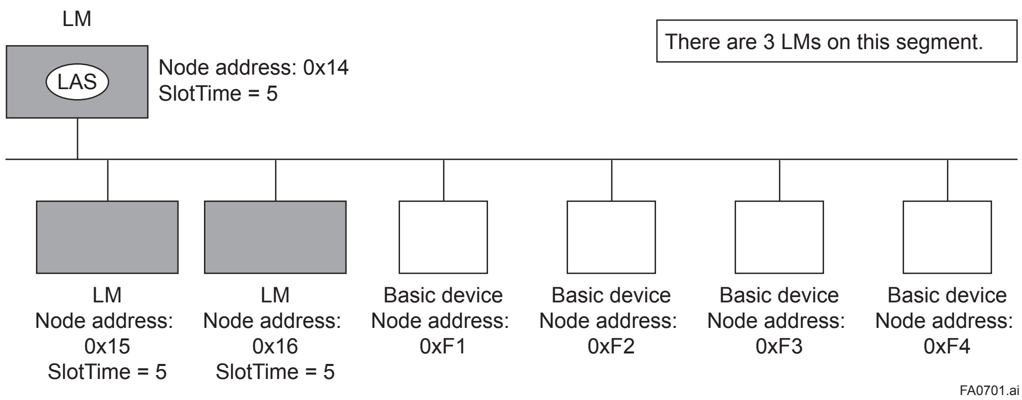


Figure A7.1 Example of Fieldbus configuration-3 LMs on Same Segment

A7.3 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.

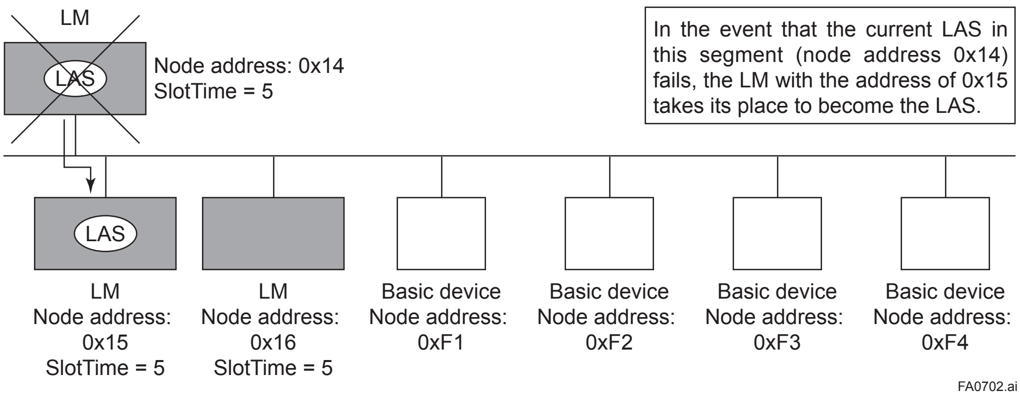


Figure A7.2 Backup of LAS

To set up an FVX110 as a device that is capable of backing up the LAS, follow the procedure below.

NOTE: When changing the settings in an FVX110, add the FVX110 to the segment in which an LAS is running. After making changes to the settings, do not turn off the power to the FVX110 for at least 30 seconds.

(1) Set the node address of the FVX110. In general, use an address from 0x10 to [V(FUN) - 1].

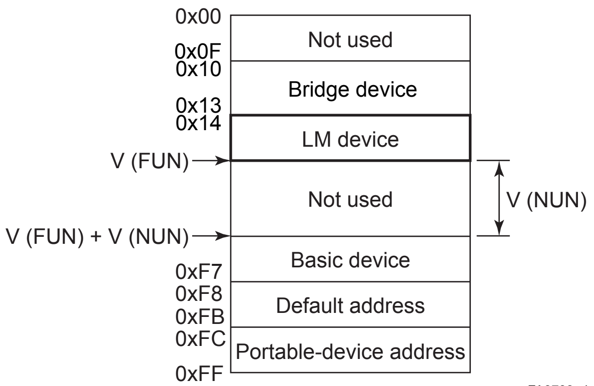


Figure A7.3 Node Address Ranges

(2) In the LAS settings of the FVX110, 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 (FVX110 Index 374 (SM))

Subindex	Element	FVX110	Device 1	Device 2	Device 3	Description
1	SlotTime	4	8	10	$\boxed{20}$	Capability value for V(ST)
3	MaxResponseDelay	3	$\boxed{6}$	3	5	Capability value for V(MRD)
6	MinInterPduDelay	4	8	$\boxed{12}$	10	Capability value for V(MID)

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

ConfiguredLinkSettingsRecord (FVX110 Index 385 (SM))

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

(3) In the LAS settings of the FVX110, 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 A7.3.)

ConfiguredLinkSettingsRecord (FVX110 Index 385 (SM))

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

A7.4 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 A7.5.
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.

A7.5 LM Parameters

A7.5.1 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
378	DLME_LINK_MASTER_CAPABILITIES_VARIABLE		0x04	RW	
379	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		
380	PRIMARY_LINK_MASTER_FLAG_VARIABLE		0	RW	LAS: True = 0xFF; non-LAS: False = 0x00
381	LIVE_LIST_STATUS_ARRAY_VARIABLE		0	R	
382	MAX_TOKEN_ HOLD_TIME_ ARRAY	0		RW	
		1 Element1	0x0000 (×16) 0x012c (×16)		
		2 Element2	0x012c (×5) 0x0000 (×27)		
		3 Element3	0x0000 (×32)		
		4 Element4	0x0000 (×32)		
		5 Element5	0x0000 (×32)		
		6 Element6	0x0000 (×32)		
		7 Element7	0x0000 (×31) 0x012c (×1)		
		8 Element8	0x012c (×32)		
383	BOOT_OPERAT_FUNCTIONAL_CLASS		Specified at the time of order	RW	0x01 (basic device); 0x02 (LM)
384	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		
385	CONFIGURED_ LINK_SETTING_ RECORD	0		RW	
		1 SlotTime	12 (0xc)		
		2 PerDlpduPhlOverhead	4 (0x4)		
		3 MaxResponseDelay	5 (0x5)		
		4 FirstUnpolledNodeId	37 (0x25)		
		5 ThisLink	0 (0x0)		
		6 MinInterPduDelay	12 (0xc)		
		7 NumConseeUnpolledNodeId	186 (0xba)		
		8 PreambleExtension	2 (0x2)		
		9 PostTransGapExtension	1 (0x1)		
		10 MaxInterChanSignalSkew	0 (0x0)		
		11 TimeSyncClass	4 (0x4)		

Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
375	PLME_BASIC_ CHARACTERISTICS	0		R	
		1 ChannelStatisticsSupported	0x00		
		2 MediumAndDataRatesSupported	0x4900000000000000		
		3 IecVersion	1 (0x1)		
		4 NumOfChannels	1 (0x1)		
		5 PowerMode	0 (0x0)		
376	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)		
377	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)		
386	LINK_SCHEDULE_ACTIVATION_VARIABLE		0 (0x0)	RW	
387	LINK_ SCHEDULE_LIST_ CHARACTERISTICS_ RECORD	0		R	
		1 NumOfSchedules	2 (0x2)		
		2 NumOfSubSchedulesPerSchedule	5 (0x5)		
		3 ActiveScheduleVersion	0		
		4 ActiveSheduleOdIndex	0		
		5 ActiveScheduleStartingTime	0		
388	DLME_SCHEDULE_ DESCRIPTOR.1	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
389	DLME_SCHEDULE_ DESCRIPTOR.2	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
390	DOMAIN.1				Read/write impossible. Get-OD possible.
391	DOMAIN.2				Read/write impossible. Get-OD possible.

A7.5.2 Descriptions for LM Parameters

The following describes LM parameters of an FVX110.

NOTE: Do not turn off the power to the FVX110 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.

```
0x00 00 84 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00
  └► Bit correspondences: 0 0 0 0 0 0 0 0 0 0 0
                          0×00
      0 0 0 0 0 1 0 0 0 0 1 0 0...
                0×10      0×15
```

(5) MaxTokenHoldTimeArray

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

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

(6) BootOperatFunctionalClass

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

(7) CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord

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

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

(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	IecVersion	2	1	Version of IEC physical Layer Entity
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. (This is fixed to 1 in the Yokogawa communication stacks.)
3	ActiveSchedule Version	2	Indicates the version number of the schedule currently executed.
4	ActiveSchedule OdIndex	2	Indicates the index number of the domain that stores the schedule currently executed.
5	ActiveSchedule StaringTime	6	Indicates the time when the current schedule began being executed.

(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 FVX110, maximum allowable linkages between devices are 25.

A7.6 FAQs

Q1. When the LAS stops, an FVX110 does not back it up by becoming the LAS. Why?

A1-1. Is that FVX110 running as an LM? Check that the value of BootOperatFunctionalClass (index 383) 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:

FVX110		Other LMs
V(ST)×V(TN)	<	V(ST)×V(TN)

Q2. How can I make an FVX110 become the LAS?

A2-1. Check that the version numbers of the active schedules in the current LAS and the FVX110 are the same by reading:

LinkScheduleListCharacteristicsRecord (index 387 for an FVX110)

- ActiveScheduleVersion (subindex 3)

A2-2. Make the FVX110 declare itself as and become the LAS by writing:
- 0x00 (false) to PrimaryLinkMasterFlagVariable in the current LAS; and
- 0xFF (true) to PrimaryLinkMasterFlagVariable (index 380) in the FVX110.

Q3. On a segment where an FVX110 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 FVX110 and the capabilities of being the LAS for the device that cannot be connected:

- V(ST), V(MID), V(MRD) of FVX110: ConfiguredLinkSettingsRecord (index 385)
- V(ST), V(MID), V(MRD) of problematic device: DlmeBasicInfo

Then, confirm that the following conditions are met:

FVX110		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 FVX110.

Appendix 8. Software Download

A8.1 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.

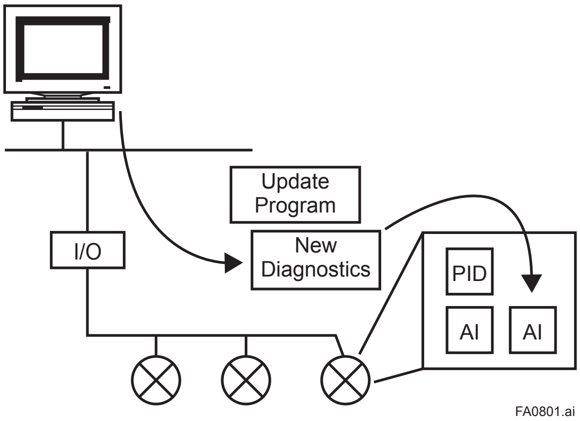


Figure A8.1 Concept of Software Downloading

A8.2 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.

A8.3 Preparations for Software Downloading

For software downloading, you need to prepare the following:

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

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

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

CAUTION

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

NOTE

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

A8.4 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.

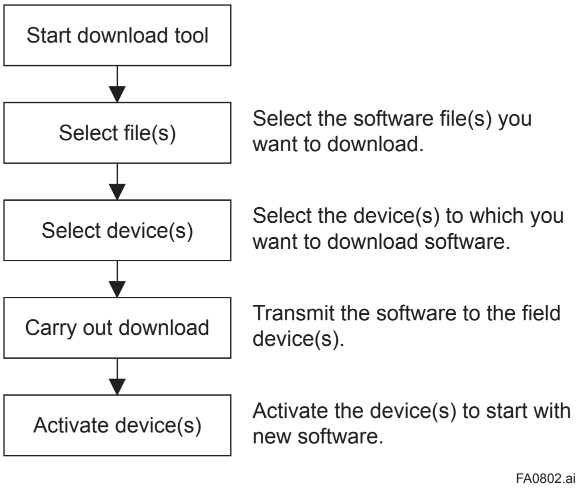


Figure A8.2 Flow of Software Download Procedure

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 A8.6.

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.

A8.5 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 FVX110 may have the following name:

5945430010_0010_FVX110_ORIGINAL_R101.ffd

Refer to A8.10(3) DOMAIN_HEADER about each keyword of the file name.

The device type is "0010" for an FVX110.

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.

A8.6 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 A8.1.

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 A8.1 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.

A8.7 Troubleshooting

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

Table A8.2 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.

A8.8 Resource Block's Parameters Relating to Software Download

Table A8.3 Additional Parameters of Resource Block

Relative Index	Index	Parameter Name	Default (Factory Set)	Write Mode	Description
53	1053	SOFTDWN_PROTECT	0x01		Defines whether to accept software downloads. 0x01: Unprotected 0x02: Protected
54	1054	SOFTDWN_FORMAT	0x01		Selects the software download method. 0x01: Standard
55	1055	SOFTDWN_COUNT	0	—	Indicates the number of times the internal FlashROM was erased.
56	1056	SOFTDWN_ACT_AREA	0	—	Indicates the ROM number of the currently working FlashROM. 0: FlashROM #0 working 1: FlashROM #1 working
57	1057	SOFTDWN_MOD_REV	1, 0, 0, 0, 0, 0, 0, 0, 0	—	Indicates the software module revision.
58	1058	SOFTDWN_ERROR	0	—	Indicates an error during a software download. See Table 8.4.

Table A8.4 Download Error Codes

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

A8.9 System/Network Management VFD Parameters Relating to Software Download

Table A8.5 System/Network Management VFD Parameters

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

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

A8.10 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 8.4 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.

Revision Information

- Title : FVX110 Fieldbus Segment Indicator
- Manual No. : IM 01S01C01-01EN

Edition	Date	Page	Revised Item
1st	Nov. 2010	—	New publication.
2nd	July 2011	— 2-3 to 2-14 13-3	Add Intrinsically safe and Nonincendive approval type. Add applicable standard and certificate number for each approval. Add code for Intrinsically safe and Nonincendive approval type of the chart. Revise the specification of Intrinsically safe and Nonincendive approval type.
3rd	Mar. 2016	— 1-1 1-2 2-10 to 2-13 2-13 to 2-14 2-15 5-4 12-4 to 12-8 13-2 13-3, 13-4	Change the drawing of the terminal. 1. Add description for marking in the manual. 1.1 Add (g) and (h). 2.8.3 Update applicable standards and notes for ATEX. 2.8.4 Update applicable standards and notes for IECEx. Add 2.9. 5.5 Replace terminal drawing. 12.2 Change factory default setting of some parameters. (Soft Rev 1.04) 13.2 Remove 304SST from nameplate and tag plate material. 13.4 Update descriptions for ATEX and IECEx.
4th	Aug. 2017	1-1 1-2 1-3 2-3 2-4 2-10 2-10 to 2-12 2-14, 2-15 2-16 2-17 12-4 13-2 13-3 to 13-4 13-5	1. Add an item to “About This Manual.” 1.1 Add notes for the users. 1.1 Add information of Chinese RoHS. 2.8.1 a. Update notes. 2.8.1 b. Show control drawing as it is. 2.8.2 a. Update notes. 2.8.2 b. Update information. 2.8.3 b. Update Note 1 and (6) Nameplate. 2.8.4 a. Update Note 1. Add 2.9 “EU RoHS Directive.” 12.1 Revise factory default of Index 98 and 99. 13.2 Revise housing material descriptions. 13.4 Update descriptions. 13.6 Add *1.
5th	July 2021	1-2 1-4 2-10 2-11 2-12 2-18 2-19 2-19 2-20 2-21 2-26 13-1	1.1 Add (i). Delete ATEX Documentation. 2.8.2 a. Update applicable standard and distance of seal. (50→45 cm) 2.8.2 b. Update applicable standard. 2.8.3 a. Update all the description. 2.8.3 b. Update Note 1, 2, 3, 6 and 7. (2) Change the description. (6) Update tag plates. 2.8.4 a. Update all the description. 2.8.4 b. Update all the description. 2.9 Change EU RoHS Directive. 13. Delete the description for general specifications and add the General Specifications list.
6th	Oct. 2023	2-3 A5-5	2.8 Update Caution for Restrictions. A5.4.1 Correct PID Control Algorithm Equation.