GE Energy

Masoneilan* Products
FVP*110 (Rev B)
Maintenance Manual

FVP110 offers advanced control technology for pneumatically actuated valves.

imagination at work

Warranty

Items sold by GE Energy are warranted to be free from defects in materials and workmanship for a period one (1) year from first use or eighteen (18) months from delivery provided said items are used according to GE recommended usages. GE reserves the right to discontinue manufacture of any product or change product materials, design or specifications without notice.

Software is warranted for ninety (90) days from delivery.

This instruction manual applies to the following instruments and approved software: FVP110* II Valve Positioner and ValVue* FF software.

The FVP110 positioners are warranted for use only with interface software approved by GE Energy. Consult GE Masoneilan factory locations for approved software listing.

About this Guide

This instruction manual applies to the following instruments and approved software:

- ValVue FF software
- FVP110

In no case does this manual guarantee the merchantability of the positioner or the software or its adaptability to a specific client needs.

Please report any errors or questions about the information in this manual to your local supplier or visit www.masoneilan.com.

The information contained in this manual is subject to change without prior notice.

Should any doubt or error be found in this manual, submit inquiries to your local dealer.

Changes to specifications, structure, and components used may not lead to the revision of this manual unless such changes affect the function and performance of the instrument.

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Introduction

1

The FVP110 advanced valve positioner is fully factory-tested according to the specifications indicated upon the order.

This User's Manual consists of two parts: *Hardware* and *Functions*:

- ❑ *Hardware* gives instructions on handling, wiring set-up and maintenance of FVP110.
- ❑ *Functions* describes the software functions of FVP110.

In order for the FVP110 to be fully functional and to operate in an efficient manner, both parts in this manual must be carefully read to become familiar with the functions, operation, and handling of the FVP110.

Some of the diagrams in this instruction manual are partially omitted, described in writing, or simplified for ease of explanation. The drawings contained in the instruction manual may have a position or characters (upper/lower case) that differ slightly from the what are actually seen to an extent that does not hinder the understanding of functions or monitoring of operation.

Conventions Used in This Manual

Conventions used in this manual are as follows:

- ❑ Italics is used for emphasis on important items.
- ❑ Fields where data is entered or user-entered data is *italicized*.
- ❑ Actions performed on buttons, checkboxes, etc. appear bolded. For example: Click **Done**.

NOTE *Indicates important facts and conditions.*

CAUTION *Indicates a potentially hazardous situation, which if not avoided could result in property damage or data loss.*

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

For Safe Use of Product

For the protection and safety of the operator and the instrument or the system including the instrument, follow the instructions on safety described in this manual when handling this instrument. In case the instrument is handled in contradiction to these instructions, GE Masoneilan does not guarantee safety. GE Masoneilan will not be liable for malfunctions or damage resulting from any modification made to this instrument by the customer. Give your highest attention to the following:

Installation

- ❑ The instrument must be installed by an expert engineer or skilled personnel. The procedures described about INSTALLATION are not permitted for operators.
- ❑ Some of the operations stroke the valve. Keep clear of the valve while the positioner is pneumatically or electrically supplied, so as not to be hit by unexpected movements of the valve.
- ❑ Where ambient temperature is high, take care not to burn yourself, as the instrument surface reaches a high temperature.
- ❑ All installation shall comply with local installation requirement and local electrical codes.
- ❑ Do not supply air at a pressure exceeding the maximum rated air supply pressure. Doing so can result in a high risk of damage or cause an accident.
- ❑ To avoid injury or the process being affected when installing or replacing a positioner on a control valve, ensure that;
  - ❑ All inputs to the valve actuator and other accessories of the valve and actuator, including air supply and electrical signal, are cut off;
  - ❑ The process has been shut down or the control valve is isolated from the process by using bypass valves or the like; and
  - ❑ No pressure remains in the valve actuator.
- ❑ Auto-Manual switch must not be moved by anyone except for the authorized engineer.

Wiring

- ❑ The instrument must be installed by an expert engineer or skilled personnel. The procedures described about WIRING are not permitted for operators.
- ❑ Confirm voltages between the power supply and the instrument before connecting the power cables and that the cables are not powered before connecting.

Operation

- ❑ Wait three minutes after power is turned off, before opening the covers.

Maintenance

- ❑ Only the procedures written in maintenance descriptions are allowed for users. When further maintenance is needed, please contact nearest GE Masoneilan office.
- ❑ Prevent the build up of drift, dust or other material on the data plate. In case of its maintenance, use clean, soft and dry cloth.
- ❑ The instrument modification or parts replacement for explosion-protected type instruments by other than authorized representative of GE Masoneilan is prohibited and voids the approval.

ATEX Documentation

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

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

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

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

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

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

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

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

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

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

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

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

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Safety

2

The FVP110 advanced valve positioner is fully factory-tested upon shipment. When the FVP110 is delivered, visually check that no damage occurred during the shipment.

FVP110 Product Safety

For FVP110 positioners intended for use with industrial compressed air: Ensure that an adequate pressure relief provision is installed when the application of system supply pressure could cause peripheral equipment to malfunction. Installation must be in accordance with local and national compressed air and instrumentation codes.

General installation, maintenance or replacement

- ❑ Products must be installed in compliance with all local and national codes and standards by qualified personnel using safe site work practices. Personal Protective Equipment (PPE) must be used per safe site work practices.
- ❑ Ensure proper use of fall protection when working at heights, per safe site work practices. Use appropriate safety equipment and practices to prevent the dropping of tools or equipment during installation.

Intrinsically Safe Installation

Products certified for use in intrinsically safe installations *MUST BE:*

- ❑ Installed, put into service, used and maintained in compliance with national and local regulations and in accordance with the recommendations contained in the relevant standards concerning those environments.
- ❑ Used only in situations that comply with the certification conditions shown in this document and after verification of their compatibility with the zone of intended use and the permitted maximum ambient temperature.
- ❑ Installed, put into service and maintained by qualified and competent professionals who have undergone suitable training for instrumentation used in such areas.

WARNING *Before using these products with fluids/compressed gases other than air or for non-industrial applications, consult GE. This product is not intended for use in life support systems.*

WARNING *Do not use damaged instruments.*

WARNING *Installation in poorly ventilated confined areas, with any potential of gases other than oxygen being present, can lead to a risk of personnel asphyxiation.*

Use only genuine replacement parts which are provided by the manufacturer, to guarantee that the products comply with the essential safety requirements of the European Directives.

Changes to specifications, structure, and components used may not lead to the revision of this manual unless such changes affect the function and performance of the product.

Nameplate

The model name and configuration are indicated on the nameplate. Verify that the configuration indicated in the Figure 45 on page 78 is in compliance with the specifications written on the order sheet.

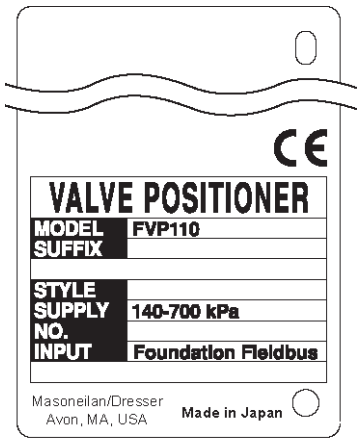


Figure 1 Nameplate

Transport

To prevent damage while in transit, leave the positioner in the original shipping container until it reaches the installation site.

Storage

When an extended storage period is expected, observe the following precautions:

- ❑ If at all possible, store the positioner in factory-shipped condition, that is, in the original shipping container.
- ❑ Choose a storage location that satisfies the following requirements:
  - ❑ A location that is not exposed to rain or water.
  - ❑ A location subject to a minimum of vibration or impact.
- ❑ The following temperature and humidity range is recommended. Ordinary temperature and humidity (25 °C, 65%) are preferable.
  - ❑ Temperature: –40 to 85 °C
  - ❑ Humidity: 5 to 100% RH (at 40 °C)
  - ❑ The performance of the positioner can be impaired if stored in an area exposed to direct rain and water. To avoid damage to the positioner, install it immediately after removal from the shipping container. Follow wiring instructions in this manual.

Choosing the Installation Location

Although the advanced valve positioner is designed to operate in a vigorous environment, to maintain stability and accuracy, the following is recommended:

Ambient Temperature	It is preferable not to expose the instrument to extreme temperatures or temperature fluctuations. If the instrument is exposed to radiation heat a thermal protection system and appropriate ventilation is recommended.
Environmental Requirements	Do not allow the positioner to be installed in a location that is exposed to corrosive atmospheric conditions. When using the positioner in a corrosive environment, ensure the location is well ventilated. Protect the unit and its wiring from exposure to rainwater.
Impact and Vibration	Install the positioner in a location that is subject to a minimum amount of impact and vibration.

Use of a Transceiver

Although the positioner is designed to resist influence from high frequency noise, use of a transceiver in the vicinity of installation can cause problems. Installing the transmitter in an area free from high frequency noise (RFI) is recommended.

Insulation Resistance Test and Withstand Voltage Test

CAUTION

Overvoltage of the test voltage is so small that it does not cause an dielectric breakdown but can deteriorate insulation and lower the safety performance; to prevent this, keep the amount of testing to a minimum.

The voltage for the insulation resistance test must be 500V DC or lower, and the voltage for the withstand voltage test must be 500V AC or lower. Failure to heed these guidelines may cause faulty operation.

Where a built-in arrester is provided (suffix code: /A), the voltage for the insulation resistance test must be 100V DC or lower, and the voltage for the withstand voltage test must be 100V AC or lower. Failure to heed these guidelines may cause faulty operation.

Follow the steps below to perform the test, the wiring of the communication line must be removed before initiating testing.

Insulation Resistance Test Procedure

1. Lay transition wiring between the + terminal and the − terminal.
2. Connect the insulation resistance meter (with the power turned OFF) between the transition wiring of Step 1 and the ground terminal. The polarity of the input terminals must be positive and that of the ground must be negative.
3. Turn the power of the insulation resistance meter ON and measure the insulation resistance. The duration of the applied voltage must be the period during which 100 MΩ or more is confirmed (or 20 MΩ if the unit is equipped with a built-in arrester).
4. Remove the insulation resistance meter, connect a 100 kΩ resistor between the transition wiring, and allow the electricity to discharge. Do not touch the terminal with your bare hands while the electricity discharges (one second).

Withstand Voltage Test Procedure

Testing between the input terminals and the grounding terminal:

1. Lay the transition wiring between the + terminal and the - terminal, and connect the withstand voltage tester (with the power turned OFF) between the transition wiring and the grounding terminal. Connect the grounding side of the withstand voltage tester to the grounding terminal.
2. After setting the current limit value of the withstand voltage tester to 10 mA, turn the power ON, and gradually increase the voltage from 0 V to the specified value.
3. Maintain the voltage at the specified value for one minute.
4. On test completion, carefully reduce voltage to avoid voltage surge.

Notes for Safety

WARNING

When air is supplied to a valve, do not touch the moving part (a stem of the valve), as it may suddenly move.

While A/M selection switch is set to manual side (M), the pressure set in the regulator for air supply is directly output to the actuator regardless of the control signal. Before changing the mode from auto to manual, confirm thoroughly that there will be no effect which may cause a danger in process or personal injury by changing the mode.

Do not change the mode by using auto/manual switch during the operation. If the mode is changed from auto to manual or manual to auto, the valve stem will move to a position which is different from the control signal (the input signal to the positioner), and thus be dangerous.

As soon as the manual operation is finished, make it sure to change the mode to auto by moving the A/M selection switch to Auto(A) side.

EMC Conformity Standards

EN61326, AS/NZSCISPR11

Installation of Explosion Protected Type Positioner

WARNING

To preserve the safety of explosion proof equipment requires great care during mounting, wiring and piping. Safety requirements also place restrictions on maintenance and repair activities. Please read the following section very carefully.

FM Certification

A) FM Intrinsically Safe Type

Cautions for FM Intrinsically safe type. (Following contents refer "Doc No. IFM017-A12 P.1, 1-1, 2, 2-1, and 2-2.")

Note 1. Model FVP110 Advanced Valve Positioner with optional code /FS15 are applicable for use in hazardous locations.

- ❑ Applicable standard: FM3600, FM3610, FM3611, FM3810, ANSI/NEMA250
- ❑ Intrinsically safe, with FISCO parameters, for use in Class I, II, III, Division 1, Groups A, B, C, D, E, F, G and Class I, Zone 0, AEx ia IIC

- ❑ Non-incendive for Class I, Division 2, Groups A, B, C, D and Class I, Zone 2, Group IIC
- ❑ Indoor/Outdoor hazardous locations, NEMA 4X Ambient Temperature: -40 to 60 °C

Note 2. Electrical Data

Rating I

For Groups A, B, C, D, E, F and G or Group IIC:

- ❑ Maximum Input Voltage Vmax: 24 V
- ❑ Maximum Input Current Imax: 250 mA
- ❑ Maximum Input Power Pmax: 1.2 W
- ❑ Maximum Internal Capacitance Ci: 1.76 nF
- ❑ Maximum Internal Inductance Li: 0 µH

or

Rating 2

For Groups A, B, C, D, E, F and G or Group IIC:

- ❑ Maximum Input Voltage Vmax: 17.5 V
- ❑ Maximum Input Current Imax: 360 mA
- ❑ Maximum Input Power Pmax: 2.52 W
- ❑ Maximum Internal Capacitance Ci: 1.76 nF
- ❑ Maximum Internal Inductance Li: 0 µH

or

Rating 3

For groups C, D, E, F and G or Group IIB:

- ❑ Maximum Input Voltage Vmax: 17.5 V
- ❑ Maximum Input Current Imax: 380 mA
- ❑ Maximum Input Power Pmax: 5.32 W
- ❑ Maximum Internal Capacitance Ci: 1.76 nF
- ❑ Maximum Internal Inductance Li: 0 µH
- ❑ In the rating 1, the output current of the barrier must be limited by a resistor *Ra* such that Io = Uo/Ra.
- ❑ In the rating 2 or 3, the output characteristics of the barrier must be the type of trapezoid which are certified as the FISCO model.

- ❑ The safety barrier may include a terminator.
- ❑ More than one field instruments may be connected to the power supply line.

Note 3. Installation

- ❑ Dust-tight conduit seal must be used when installed in Class II and Class III environments.
- ❑ Control equipment connected to the Associated Apparatus must not use or generate more than 250 Vrms or Vdc.
- ❑ Installation should be in accordance with ANSI/ISA RP12.6 “Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations” and the National Electrical Code (ANSI/NFPA 70) Sections 504 and 505.
- ❑ The configuration of Associated Apparatus must be Factory Mutual Research Approved under FISCO Concept.
- ❑ Associated Apparatus manufacturer’s installation drawing must be followed when installing this equipment.
- ❑ The FVP series are approved for Class I, Zone 0, applications. If connecting AEx[ib] associated Apparatus or AEx ib I.S. Apparatus to the FVP series the I.S. circuit is only suitable for Class I, Zone 1, or Class I, Zone 2, and is not suitable for Class I, Zone 0, or Class I, Division 1, Hazardous (Classified) Locations.

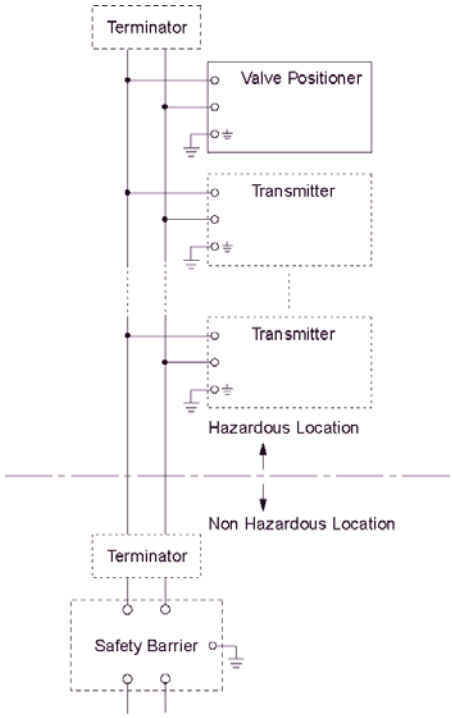


Figure 2 Installation Diagram (Intrinsically safe, Division 1 Installation)

Note 4. 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, Vt), the current (Io) 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 the terminators) connected to the fieldbus must be less than or equal to 5 nF and 10 µH respectively.

In each I.S. fieldbus segment only one active source, normally the associated apparatus, is allowed to provide the necessary power for the fieldbus system. The allowed voltage Uo of the associated apparatus used to supply the bus is limited to the range of 14 V dc. to 24 V dc. 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 to a leakage current of 50 µA for each connected device.

Supply Unit

Trapezoidal or rectangular output characteristic only

Uo = 14 to 24 V (I.S. maximum value)

Io according to spark test result or other assessment,

e.g. 133 mA for Uo = 15 V (Group IIC, rectangular characteristic)

No specification of Lo and Co in the certificate and on the label.

Cable

The cable used to interconnect the devices needs to comply with the following parameters:

loop resistance R': 15 to 150 Ω/km

inductance per unit length L': 0.4 to 1 mH/km

capacitance per unit length C': 80 to 200 nF/km

C' = C' line/line + 0.5 C' line/screen, if both lines are floating

or

C' = C' line/line + C' line/screen, if the screen is connected to one line

length of spur cable: max. 30 m (Group IIC) or 120 m (Group IIB)

length of trunk cable: max. 1 km (Group IIC) or 1.9 km (Group IIB)

Terminators

At each end of the trunk cable an approved line terminator with the following parameters is suitable:

R = 90 to 100 Ω

C = 0 to 2.2 μF

The resistor must be infallible according to IEC 60079-11. One of the two allowed terminators might already be integrated in the associated apparatus (bus supply unit).

System Evaluation

The number of passive devices like transmitters, actuators, hand held terminals connected to a single bus segment is not limited due to I.S. reasons. Furthermore, if the above rules are respected, the inductance and capacitance of the cable need not to be considered and will not impair the intrinsic safety of the installation.

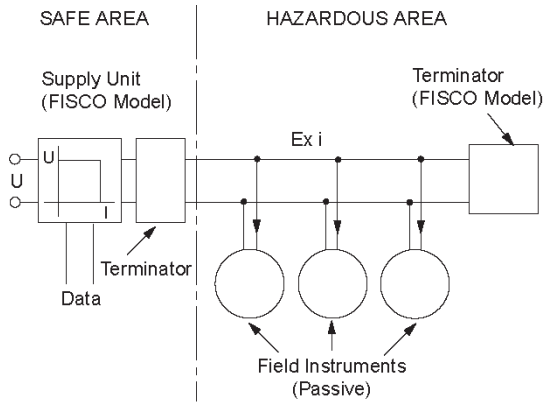


Figure 3 Passive Devices

Note 5. Maintenance and Repair

The instrument modification or parts replacement by other than authorized representative of GE Masoneilan is prohibited and will void Factory Mutual Intrinsically Safe and Non-incendive Approval.

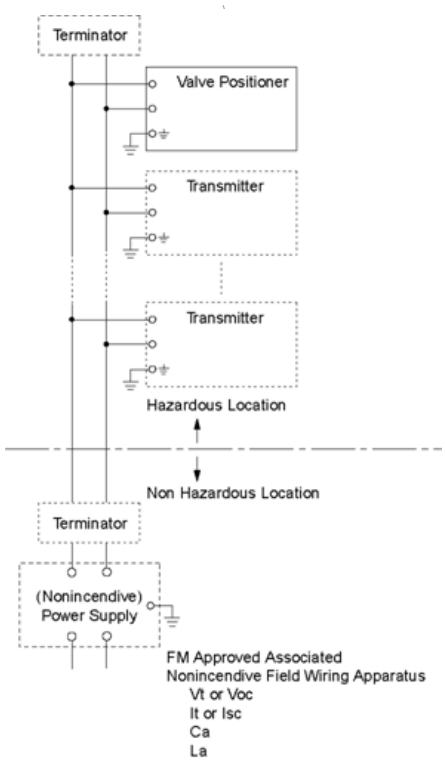


Figure 4 Installation Diagram (Nonincendive, Division 2 Installation)

*1: Dust-tight conduit seal must be used when installed in Class II and Class III environments.

*2: Installation should be in accordance with the National Electrical Code (ANSI/NFPA 70) Sections 504 and 505.

*3: The configuration of Associated Nonincendive Field Wiring Apparatus must be FM Approved.

*4: Associated Nonincendive Field Wiring Apparatus manufacturer's installation drawing must be followed when installing this equipment.

*5: No revision to drawing without prior FM Approvals.

*6: Terminator and supply unit must be FM Approved.

*7: If use ordinary wirings, the general purpose equipment must have nonincendive field wiring terminal approved by FM Approvals.

*8: The nonincendive field wiring circuit concept allows interconnection 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 or It) of the barrier or associated nonincendive field wiring apparatus.

Electrical Data:

Maximum Input Voltage Vmax: 32 V

Maximum Internal Capacitance Ci: 1.76 nF

Maximum Internal Inductance Li: 0 µH

B) FM Explosionproof Type

Caution for FM explosionproof type.

Note 1. Model FVP110 Valve Positioner with optional code /FF1 are applicable for use in hazardous locations.

- ❑ Applicable standard: FM3600, FM3615, FM3810, ANSI/NEMA250
- ❑ Explosionproof for Class I, Division 1, Groups A, B, C and D
- ❑ Dust-ignitionproof for Class II/III, Division 1, Groups E, F and G
- ❑ Enclosure Rating: NEMA 4X
- ❑ Temperature Class: T6
- ❑ Ambient Temperature: –40 to 80 °C

Note 2. Wiring

- ❑ All wiring shall comply with National Electrical Code ANSI/NEPA70 and Local Electrical Codes.
- ❑ FACTORY SEALED, CONDUIT SEAL NOT REQUIRED."

Note 3. Operation

- ❑ Note a warning label worded as follows;
  WARNING: OPEN CIRCUIT BEFORE REMOVING COVER.
- ❑ Take care not to generate mechanical spark when accessing to the instrument and peripheral devices in hazardous locations.

Note 4. Maintenance and Repair

- ❑ The instrument modification or parts replacement by other than authorized representative of GE Masoneilan is prohibited and will void the approval of Factory Mutual Research Corporation.

C) FM Nonincendive approval

Model FVP110 Advanced Valve Positioner with optional code/FN15.

❑ Applicable standard: FM3600, FM3611, FM3810

❑ Nonincendive Approval

Class I, Division 2, Groups A, B, C and D

Class II, Division 2, Groups F and G

Class III, Division 1 and

Class I, Zone 2, Group IIC in Hazardous

(Classified) Locations.

Temperature Class: T4

Ambient Temperature: –40 to 60 °C

Enclosure: NEMA Type4X

❑ Electrical Parameters:

Vmax = 32 Vdc

Ci = 1.76 nF

Li = 0 μH

❑ Caution for FM Nonincendive type. (Following contents refer to *DOC. No. NFM010-A12 p.1 and p.2*)

NFM010-A12

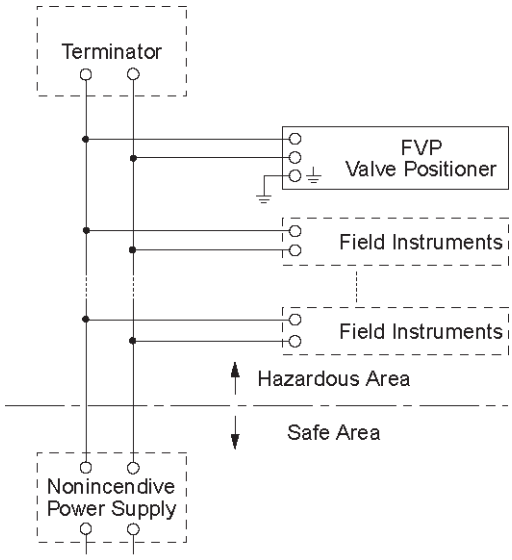


Figure 5 Installation Drawing

Note 1.

Use dust-tight conduit seal when installed in Class II and Class III environments.

Note 2.

Install in accordance with National Electrical Code (ANSI/NFPA 70) Sections 504, 505 and Local Electrical Code.

Note 3.

The configuration of Associated Apparatus must be Factory Mutual Research Approved.

Note 4.

Follow the Associated Apparatus manufacturer's installation drawing when installing.

Note 5.

No revision to drawing without prior Factory Mutual Research Approval.

Note 6.

Terminator and supply unit must be FM approved.

Note 7.

Installation requirements:

- ❑ Vmax Voc or Vt
- ❑ Ca Ci + Ccable
- ❑ La Li + Lcable

CENELEC ATEX (KEMA) Certification

Technical Data

A) CENELEC ATEX (KEMA) Intrinsically Safe Type Caution for CENELEC ATEX (KEMA) Intrinsically Safe Type.

WARNING

- ❑ Do not open the cover when energized.
- ❑ When the ambient temp.70 °C, Use the heat-resisting cable 90 °C

NOTE

Keep the safety use conditions for 1GD when used in the hazardous gas and dust area.

Note1

Model FVP110 Advanced Valve positioner with optional code /KS25 for potentially explosive atmospheres: No. KEMA 02ATEX1274X

- ❑ Applicable standard: EN50014, EN50020, EN500284, EN50281-1-1
- ❑ Certificate: KEMA 02ATEX1274X

Note 2. Ratings

[EEx ia IIC T4]

Type of Protection: EEx ia IIC T4

Group: 1G, 1D, 1GD

Maximum Surface Temperature for dust proof.: T100 °C

Ambient Temperature for 1G: -40 °C to + 60 °C

Ambient Temperature for 1GD: -40 °C to + 60 °C

Degree of Protection of the Enclosure: IP65

Electrical Data

When combined with Entity model IIC barrier

- ❑ Ui = 24.0 V, Ii = 250 mA, Pi = 1.2 W,
- ❑ Cint = 1.76 nF, Lint = 0 µH

When combined with Trapezoidal or Rectangular output characteristic FISCO model IIC barrier

Ui = 17.5 V, Ii = 360 mA, Pi = 2.52W,

Cint = 1.76 nF, Lint = 0ìH

[EEx ia IIB T4]

Type of Protection: EEx ia IIB T4

Group: 1G, 1D, 1GD

Maximum Surface Temperature for dust proof.: T100 °C

Ambient Temperature for 1G: -40 °C to + 60 °C

Ambient Temperature for 1GD: -40 °C to + 60 °C

Degree of Protection of the Enclosure: IP65

Electrical Data

When combined with Trapezoidal or Rectangular output characteristic FISCO model IIB barrier

- ❑ Ui = 17.5 V, Ii = 380 mA, Pi = 5.32 W,
- ❑ Cint = 1.76 nF, Lint = 0 µH

[For 1D]

Group: 1D

Maximum Surface Temperature for dust proof: T100 °C

Ambient Temperature for 1D: -40 °C to +80 °C

Degree of Protection of the Enclosure: IP65

Electrical Data

Un=32.0 V

Note 3. Installation

All wiring shall comply with local installation requirements (Refer to Figure 5 on page 18).

Note 4. Maintenance and Repair

The instrument modification or parts replacement by other than authorized representative of GE Masoneilan is prohibited and will void KEMA Intrinsically safe Certification.

Note 5. Special Conditions for Safe Use

In the case where the enclosure of the Valve Positioner is made of aluminum, if it is mounted in an area where the use of category 1G apparatus is required, it must be installed such, that even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

Note 6. Installation Instructions

When used in a potentially explosive atmosphere, requiring the use of apparatus of equipment category 1D, suitable certified cable entry devices or certified blanking elements with a degree of ingress protection of at least IP6X according to EN 60529 shall be used and correctly installed.

Note 7. Installation

When used in potentially explosive atmosphere for category 1D, need not use safety barrier.

FISCO Model

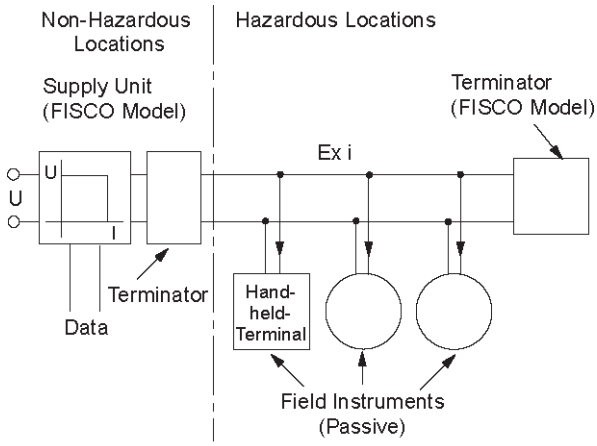


Figure 6 FISCO Model

I.S. fieldbus system complying with FISCO

The criterion for such interconnection is that the voltage (Ui), the current (Ii) and the power (Pi), which intrinsically safe apparatus can receive, must be equal or greater than the voltage (Uo), the current (Io) 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 the terminators) connected to the fieldbus line must be equal or less than 5 nF and 10 µH respectively.

Supply Unit

The supply unit must be certified by a notified body as FISCO model and following trapezoidal output characteristic is used.

Uo = 14 to 24 V (I.S. maximum value)

Io based on spark test result or other assessment,

ex. 133 mA for Uo = 15 V (Group IIC)

The maximum allowed Co and Lo are determined by the combinations as specified below.

Cable

The cable used to interconnect the devices needs to comply with the following parameters:

- ❑ Loop resistance R': 15 to 150 Ω/km
- ❑ Inductance per unit length L': 0.4 to 1 mH/km
- ❑ Capacitance per unit length C': 80 to 200 nF/km

C' = C' line/line + 0.5 C' line/screen, if both lines are floating

or

C' = C' line/line + C' line/screen, if the screen is connected to one line

length of spur cable: max. 30 m (EEx ia IIC T4) or 120 m (EEx ia IIB T4)

length of trunk cable: max. 1 km (EEx ia IIC T4) or 1.9 km (EEx ia IIB T4)

Terminators

The terminator must be certified by a notified body as FISCO model and at each end of the trunk cable an approved line terminator with the following parameters is suitable:

R = 90 to 100 Ω

C = 0 to 2.2 µF

The resistor must be infallible according to EN 50020. One of the two allowed terminators might already be integrated in the associated apparatus (bus supply unit).

Field Instruments

Descriptions and Intrinsically safe ratings of the positioner (FIELD INSTRUMENTS) are as follows:

Ambient Temperature: –40 to 60 °C

Enclosure: IP65

Electrical parameters:

- ❑ EEx ia IIC T4
- ❑ Maximum Voltage (Ui) = 17.5 V
- ❑ Maximum Current (Ii) = 360 mA
- ❑ Maximum Power (Pi) = 2.52 W
- ❑ Internal Capacitance (Ci) = 1.76 nF
- ❑ Internal Inductance (Li) = 0 µH

or

- ❑ EEx ia IIB T4
- ❑ Maximum Voltage (Ui) = 17.5 V
- ❑ Maximum Current (Ii) = 380 mA
- ❑ Maximum Power (Pi) = 5.32 W
- ❑ Internal Capacitance (Ci) = 1.76 nF
- ❑ Internal Inductance (Li) = 0 µH

Number of Devices

The number of devices (max. 32) possible on a fieldbus link depends on factors such as the power consumption of each device, the type of cable used, use of repeaters, etc.

Entity Model

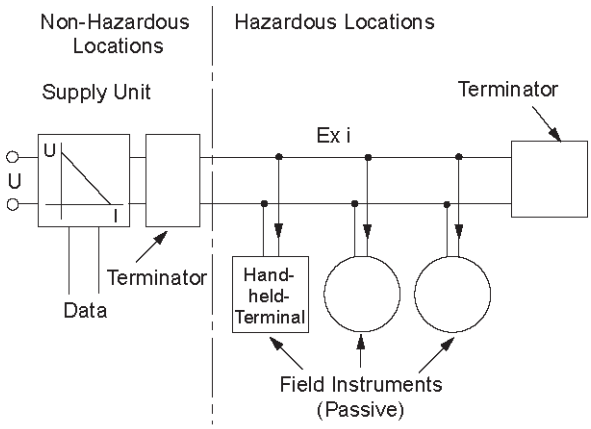


Figure 7 Entity Model

I.S. fieldbus system complying with Entity model

I.S. values Power supply-field device:

$Po \leq Pi, Uo \leq Ui, Io \leq Ii$

Calculation of max. allowed cable length:

$Ccable \leq Co - \Sigma ci - \Sigma ci$ (Terminator)

$Lcable \leq Lo - \Sigma Li$

Field Instruments

Descriptions and Intrinsically safe ratings of the positioner (FIELD INSTRUMENTS) are:

Ambient Temperature: –40 to 60 °C

Enclosure: IP65

Electrical parameters:

- ❑ EEx ia IIC T4
- ❑ Maximum Voltage (Ui) = 24.0 V
- ❑ Maximum Current (Ii) = 250 mA
- ❑ Maximum Power (Pi) = 1.2 W
- ❑ Internal Capacitance (Ci) = 1.76 nF
- ❑ Internal Inductance (Li) = 0 µH

Number of Devices

The number of devices (max. 32) possible on a fieldbus link depends on factors such as the power consumption of each device, the type of cable used, use of repeaters, etc.

B) CENELEC ATEX (KEMA) Flameproof Type

Caution for CENELEC ATEX (KEMA) flameproof type.

Note 1. Model FVP110 Valve Positioner with optional code /KF2 is applicable for potentially explosive atmospheres:

- ❑ Applicable standard: EN50014, EN50018
- ❑ Certificate: KEMA 02ATEX2159
- ❑ Type of Protection and Marking Code: EEx d IIC
- ❑ Temperature Class: T6, T5
- ❑ Ambient Temperature: T6; –40 to 75 °C T5; –40 to 80 °C

Note 2. Electrical Data

- ❑ Supply voltage: 32 V DC max.
- ❑ Output signal: 17 mA DC

Note 3. Installation Instructions

- ❑ The cable glands and blanking elements shall be certified in type of protection flameproof enclosure *d* suitable for the conditions of use and correctly installed.
- ❑ With the use of conduit entries a sealing device shall be provided either in the flameproof enclosure or immediately on the entrance thereto.

- ❑ To maintain the degree of ingress protection IP65 according to EN 60529 special care must be taken to avoid water entering the breathing and draining device when the valve positioner is mounted with the feedback shaft in the upright position.

Note 4. Operation

- ❑ Keep strictly the WARNING on the label on the positioner.

WHEN THE AMBIENT TEMP. ≥ 70° C,

USE HEAT-RESISTING CABLES .≥ 90° C.

- ❑ Take care not to generate mechanical sparking when accessing to the instrument and peripheral devices in a hazardous location.

Note 5. Maintenance and Repair

- ❑ The instrument modification or parts replacement by other than authorized representative of GE Masoneilan is prohibited and will void KEMA Flameproof Certification.

C) CENELEC ATEX Type of Protection n

Note 1. Model FVP110 Advanced Valve Positioner with optional code /KN25.

- ❑ Applicable standard: EN60079-15:2003
- ❑ Referential standard: IEC60079-0:1998, IEC60079-11:1999

WARNING

When using a power supply not having a nonincendive circuit, please pay attention not to ignite in the surrounding flammable atmosphere.
In such a case, we recommend using wiring metal conduit in order to prevent the ignition.

- ❑ Type of Protection and Marking Code: EEx nL IIC T4
- ❑ Group: II
- ❑ Category: 3G
- ❑ Ambient Temperature: –40 to 60 °C
- ❑ Enclosure: IP65

Note 2. Electrical Data

Ui = 32 Vdc

Ci = 1.76 nF

Li = 0 µH

Note 3. Installation

❑ All wiring shall comply with local installation requirements (Figure 8 on page 27).

Note 4. Maintenance and Repair

❑ The instrument modification or parts replacement by other than authorized representative of GE Masoneilan is prohibited and will void Type of Protection *n*.

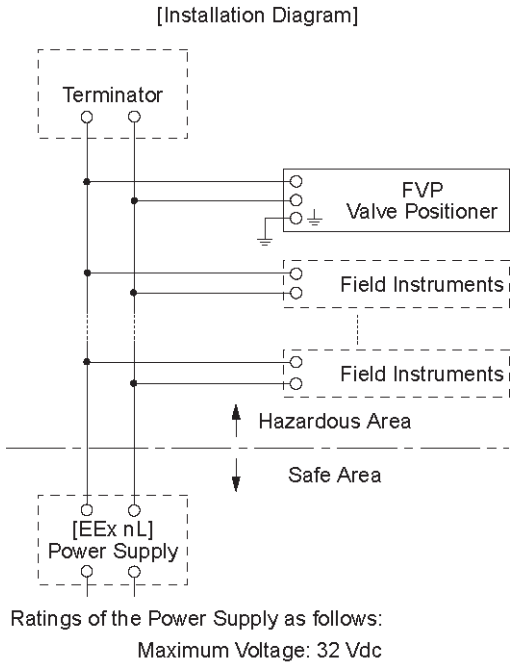


Figure 8 Installation Diagram

(2) Electrical Connection

The type of electrical connection is stamped near the electrical connection port according to the following marking.

Screw Size	Marking
ISO M20X1.5 female	⚠ M
ANSI 1/2 NPT female	⚠ A

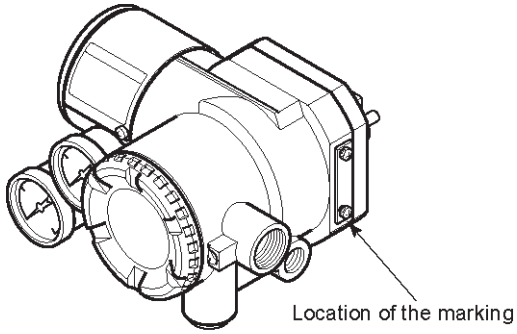


Figure 9 Type of Electrical Connection

(3) Installation

WARNING *All wiring shall comply with local installation requirement and local electrical code.*

(4) Operation

WARNING *OPEN CIRCUIT BEFORE REMOVING COVER. INSTALL IN ACCORDANCE WITH THIS USER'S MANUAL*

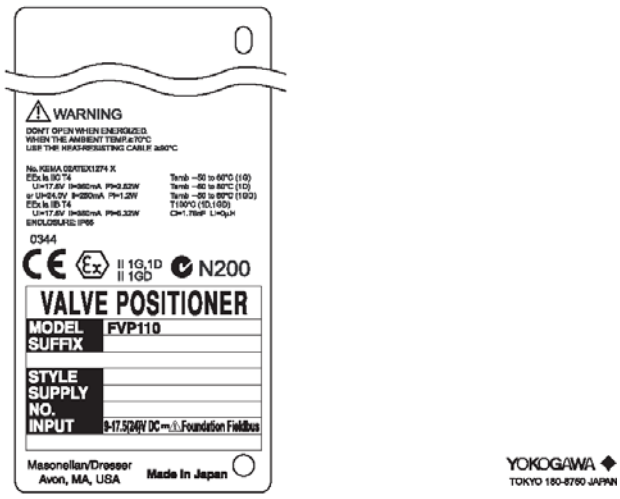
Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.

(5) Maintenance and Repair

CAUTION *The instrument modification or parts replacement by other than authorized Representative of GE Masoneilan Electric Corporation is prohibited and will void the certification.*

(6) Name Plate

● Name plate for intrinsically safe type



● Name plate for flameproof type

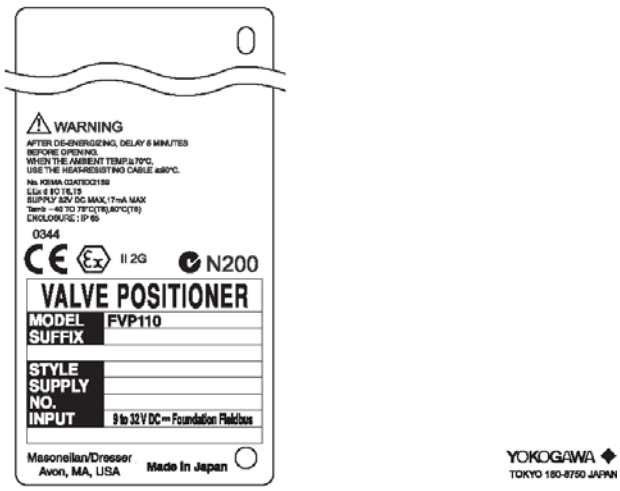


Figure 10 Nameplates

MODEL: Specified model code.

SUFFIX: Specified suffix code.

STYLE: Style code.

SUPPLY: Air supply pressure.

NO.: Serial number and year of production*1.

INPUT: Type of electrical input (FOUNDATION FIELDBUS).

*1: The third figure from the last of the serial number shows the year of production. For example, the production year of the product engraved in *NO*. column on the name plate as follows is 2001.

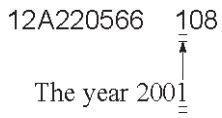


Figure 11 Production Year

*2: *180-8750* is a zip code which represents the following address: *2-9-32 Nakacho, Musashino-shi, Tokyo Japan*

CSA Certification

A) CSA Explosionproof Type

Cautions for CSA Explosionproof type.

Note 1. Model FVP110 Advanced Valve Positioner with optional code /CF1 are applicable for use in hazardous locations:

- •Applicable standard: C22.2 No. 0, No. 0.4, No. 0.5, No. 25, No. 30, No. 94, No. 1010.1
- Certificate: 1186507
- Explosionproof for Class I, Groups B, C and D; Class II, Groups E, F and G; Class III.
- Enclosure Rating: Type 4X
- Temperature Code: T6 and T5
- Ambient Temperature: –40 to 75 °C for T6, –40 to 82 °C for T5

Note 2. Wiring

- All wiring shall comply with National Electrical Code ANSI/NFPA 70 and Local Electrical Codes.
- *FACTORY SEALED, CONDUIT SEAL NOT REQUIRED*.
- When the ambient temperature is 60 °C or more, use an external cable having a maximum allowable heat resistance of at least 90 °C.

Note 3. Maintenance and Repair

- The instrument modification or parts replacement by other than authorized representative of GE Masoneilan is prohibited and will void CSA Certification.

TIIS Certification

A) TIIS Flameproof Type

The model FVP110 Valve Positioner with optional code /JF3, which has obtained certification according to technical criteria for explosion-protected construction of electric machinery and equipment (Standards Notification No. 556 from the Japanese Ministry of Labor) conforming to IEC standards, is designed for hazardous areas where inflammable gases or vapors may be present. (This allows installation in Division 1 and 2 areas)

To preserve the safety of flameproof equipment requires great care during mounting, wiring, and piping. Safety requirements also place restrictions on maintenance and repair activities. Users absolutely must read “Installation and Operating Precautions for JIS Flameproof Equipment” at the end of this manual.

When selecting cables for TIIS flameproof type positioners, use cables having a maximum allowable heat resistance of at least 70 °C.

Low Voltage Directive

Applicable standard: EN61010-1

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 non-conductive pollution occurs. Occasionally, however, temporary conductivity caused by condensation must be expected.

Installation Category I

Overvoltage category (Installation category) 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.

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Part Names

3

Appearance and Part Names

Single Acting Type

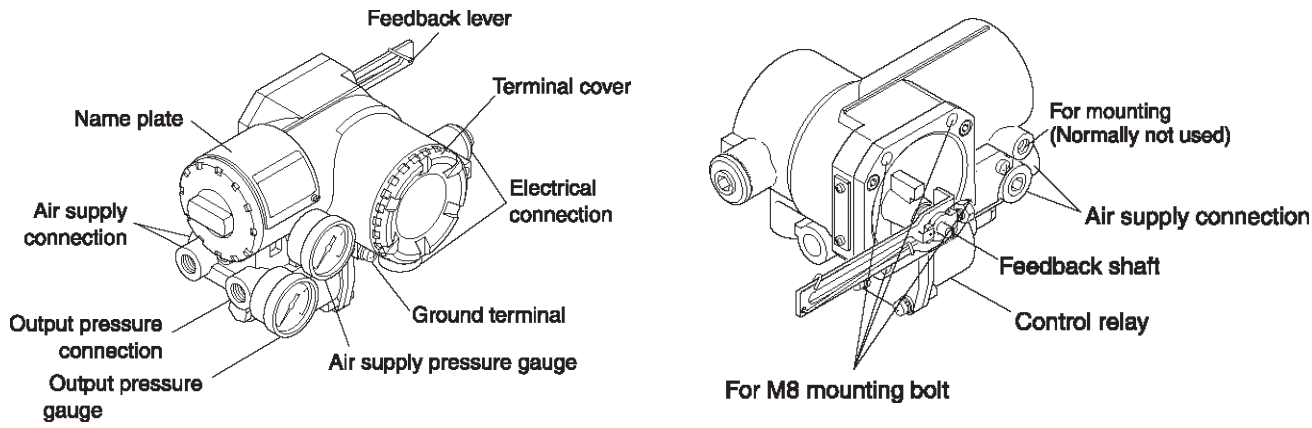


Figure 12 Single Acting Parts

Double Acting Type

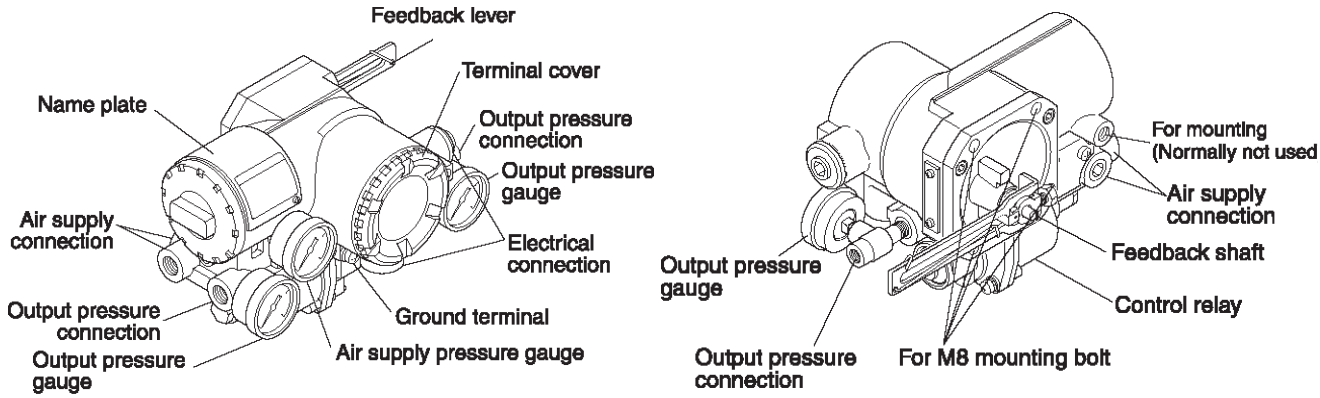


Figure 13 Double Acting Parts

Block Diagram

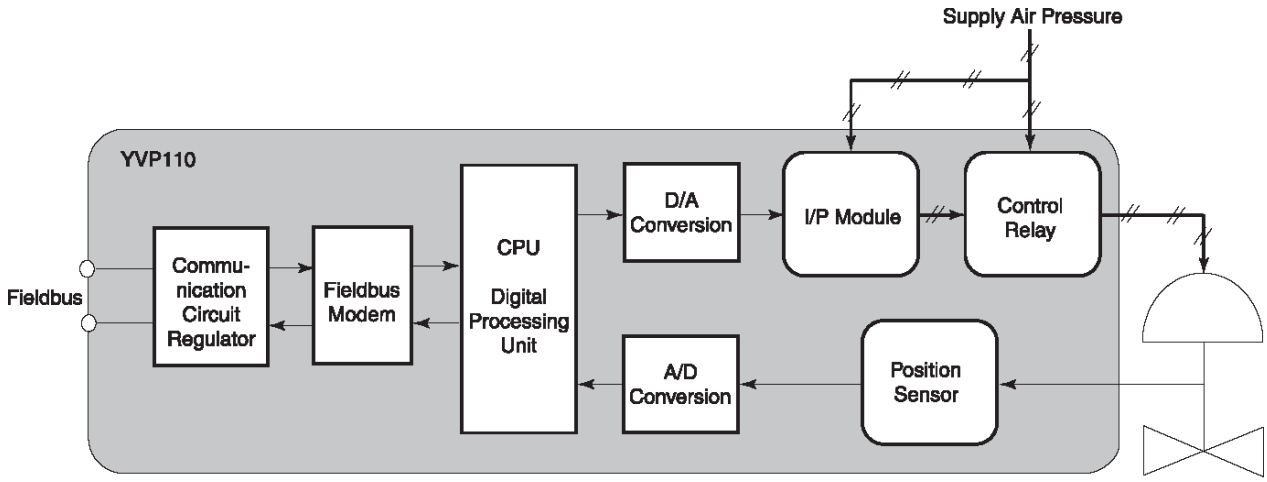


Figure 14 Block Diagram

Installing the FVP110 on the Actuator

4

General

For installation of a FVP110, see “Choosing the Installation Location” on page 9. For the ambient, environmental conditions required for installation, see “Standard Specifications” on page 73.

WARNING

To avoid injury or the process being affected when installing or replacing a positioner on a control valve, ensure that:

- ❑ *All inputs to the valve actuator and other accessories of the valve and actuator, including the air supply and electric signal, are cut off.*
- ❑ *The process has been shut down or the control valve is isolated from the process by using bypass valves or the like.*
- ❑ *No pressure remains in the valve actuator.*

General Installation Procedures: FVP110 to the Actuator

An FVP110 can be installed on a valve actuator with a mounting bracket. Prepare the bracket and clamp necessary to install the valve. In general, the installation method is determined by the combination of the control valve and positioner, as well as by the valve manufacturer who performs the adjustment. For details, consult the control valve manufacturer.

Required Tools: To install an FVP110 prepare a nominal:

- ❑ 13-mm open end or box end wrench for M8 bolts used to fix the mounting bracket to the positioner.
- ❑ 10-mm open end or box end wrench for M6 bolt used to fix the feedback lever to the shaft.

Installing FVP110 on a Linear-motion Control Valve

This section gives the general installation procedure when assembling an FVP110 with a linear-motion control valve (e.g., a globe valve) combined with a diaphragm actuator or cylinder actuator (Figure 15). The most suitable procedure may differ depending on the shapes of the bracket and valve actuator, and the structure of the mounting position.

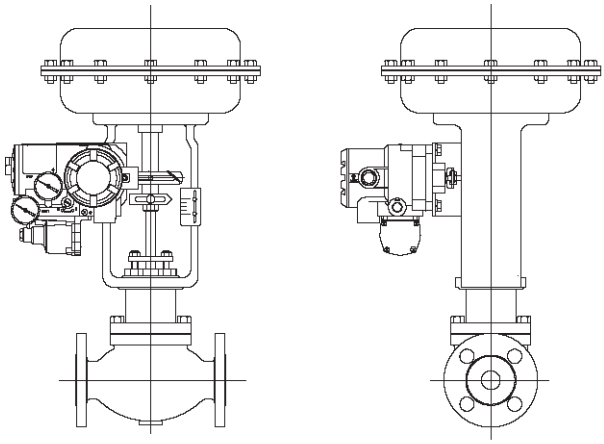


Figure 15 FVP Installed on Linear-motion Valve/Actuator

1. Attach the bracket to FVP110 using the four M8 bolts supplied (See “Part Names” on page 33).
2. Choose the appropriate feed back lever. The FVP110 with option code /LV1 comes with two different feedback levers, (1) and (2), and the one with option code /LV2 comes with lever (3) (Figure 16). Check the specifications of the levers (Table 1) and choose the lever most suitable lever by valve.

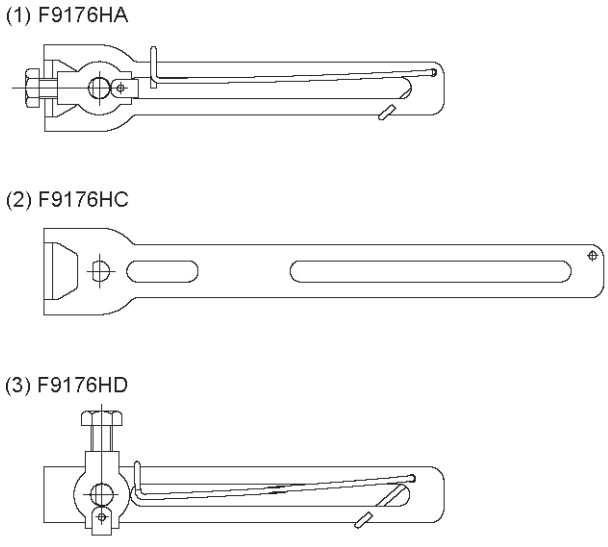


Figure 16 Feedback Levers

Table 1 Specifications of Levers

Lever Model	Stroke (X)	Pin-to-Shaft Distance (L)	Allowable Range of Rotation Angle of Feedback Shaft (θ)
F9176HA	10 to 60 mm	25 to 75 mm	±10 to 25 °
F9176HC	30 to 100 mm	75 to 115 mm	
F9176HD	5 to 20 mm	14 to 25 mm	

3. Ensure that the rotation angle (Figure 17) of the FVP110's feedback shaft does not exceed the allowable range (10 to 25°). The range of the rotation angle must be within this specification to guarantee that the specified accuracy is obtainable by linearity correction (see the description for travel calibration in "Carrying out Tuning" on page 61)

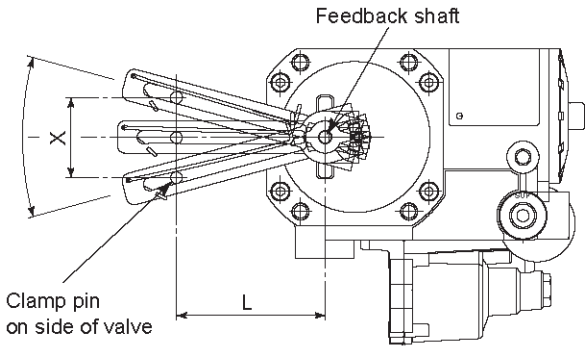


Figure 17 Stroke of Lever

4. Attach the lever:

   ❑ For /LV1, the hardware for attaching the lever to the feedback shaft and the spring for fixing the clamp pin are attached to the F9176HA, the smaller feedback lever for generally used mid-capacity actuators.

   ❑ For /LV2, when using the F9176HC, the feedback lever for high-capacity actuators, detach and use the hardware and spring from the F9176HA (Figure 18) by:

   a. Detaching spring <4>.

   b. Detaching clip <1> and removing the hardware <2> and <3>.

   c. Attaching <1> to <4> to the F9176HC feedback lever for high-capacity actuators in the reverse order.

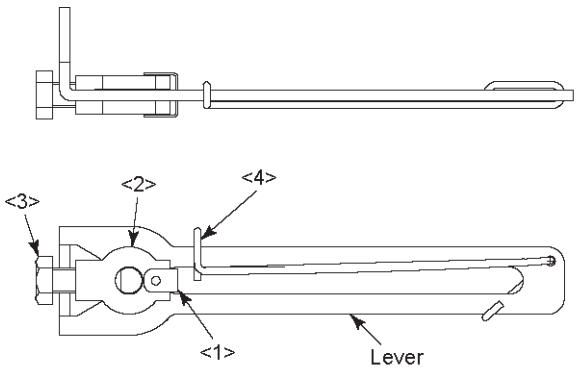


Figure 18 Disassembling a Lever Assembly

5. Attach the FVP110 to the actuator with the bracket using the specified bolts.

   The linkage between the FVP110 positioner and control valve's stem via the clamp and lever and the adjustment of this linkage is a decisive factor for determining the characteristics of the control valve combined with the FVP110 positioner.

6. Insert the FVP110's feedback shaft into the small hole on the stopper side of the lever (Figure 19).

CAUTION

Attaching the lever in the wrong orientation causes the feedback shaft to rotate at an angle exceeding its mechanical limits of ±55 °, resulting in the FVP110 being seriously damaged.

A stopper is attached to the feedback shaft to prevent an over-rotation of the shaft (Figure 19).

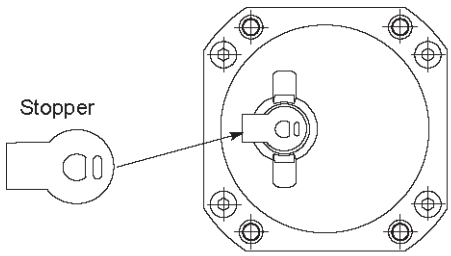


Figure 19 Stopper

7. Install the lever, ensuring you install it on the stopper and fix the lock screw (Figure 20).

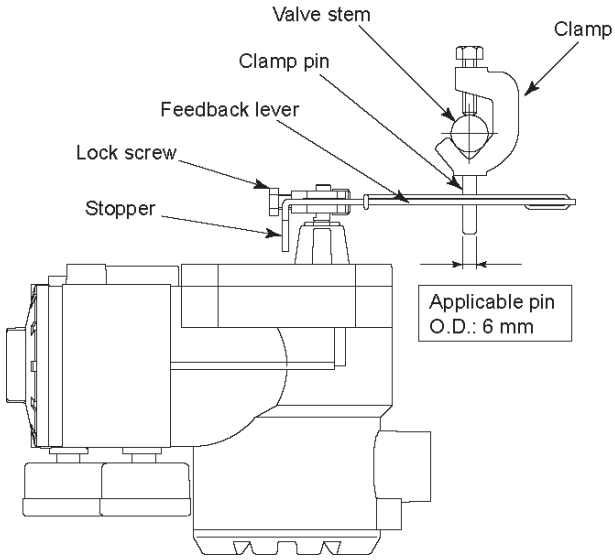


Figure 20 Attaching Lever and Clamp

8. Attach the clamp to the stem (Figure 21). You must set the clamp of the FVP110 in a position that allows the feedback lever to be at an angle within ±15 ° from the horizontal level when the valve stem is at the 50% position. Installing the FVP110 at a carefully determined position, where the feedback lever is at the horizontal level when the valve stem is at the 50% position, makes the consequent installation work easier.

CAUTION

The FVP110 must be installed in a position meeting the specification above to guarantee that the specified accuracy is obtainable by linearity correction (see "Travel Calibration" on page 129).

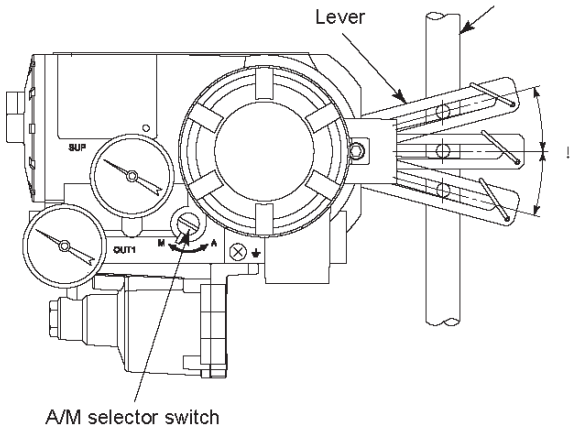


Figure 21 Checking Position at Which Clamp Should Be Fixed

When using the Single Acting Type, you can adjust the position of the feedback lever while air is being supplied to the actuator. See "Position Adjustment of Feedback Lever" on page 251.

Installing FVP110 on Rotary-motion Control Valve

This section gives the general installation procedure when assembling a FVP110 with a rotary-motion control valve (Figure 22) combined with a diaphragm actuator or cylinder actuator. The most suitable procedure may differ depending on the bracket shapes and valve actuator, and the structure of the actuator.

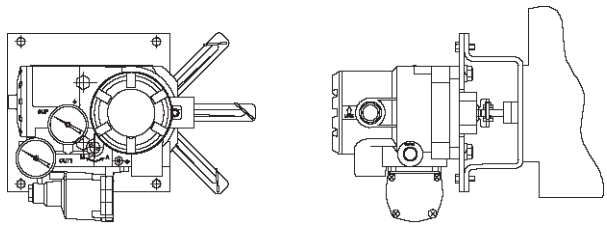


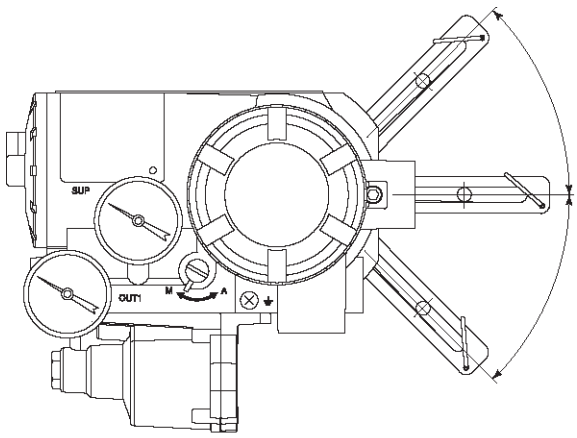
Figure 22 FVP Installed on Rotary-motion Valve/Actuator

CAUTION

When combining an FVP110 with a rotary-motion actuator, ensure that the rotation of the feedback shaft by the position feedback meets the following specifications (Figure 23):

- ❑ Range of rotation angle of shaft: Within ±45° from horizontal level
- ❑ Minimum span: 20°
- ❑ Maximum span: 90°
- ❑ Mechanically allowable rotation angle: ±55°

If any one or more of the specifications above are not met, the specified accuracy is not guaranteed, resulting in the FVP110 positioner being damaged. An advance check is essential.



Range of rotation angle of shaft :	Within	45 degrees
Mechanically allowable rotation angle :	Within	55 degrees

Figure 23 Allowable Range of Rotation Angle of Feedback Shaft

1. Attach the bracket to the FVP110 using the four M8 bolts provided (See “Part Names” on page 33). The installation method is determined by the combination of the control valve and positioner, as well as by the valve manufacturer who performs the adjustment. For details, consult the control valve manufacturer.
2. Attach the feedback lever by:
   a. Ensuring that the stopper located on the side of the FVP110 to prevent an over-rotation of the shaft (Figure 24) is attached to the feedback shaft.

CAUTION

Attaching the lever in the wrong orientation causes the feedback shaft to rotate at an angle exceeding its mechanical limits of ±55°, resulting in the FVP110 being seriously damaged.

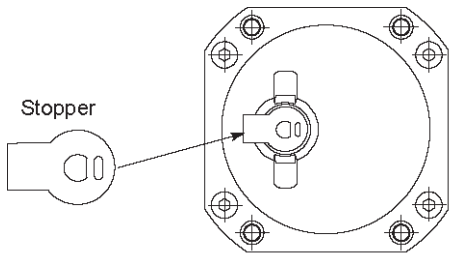


Figure 24 Stopper

3. Instal the lever, ensuring you install it on the stopper and fix the lock screw.
4. Attach the FVP110 to actuator with the bracket by (Figure 25):
   a. Carefully positioning the bracket to the actuator so that the center of the rotation axis of the valve plug and the FVP110 positioner's feedback shaft are aligned

both horizontally and vertically. Misalignment of these rotation axes decreases the level of accuracy.

b. Inserting the pin attached to the valve spindle, into the long hole of the FVP110 positioner feedback shaft.

c. Attaching the bracket to the actuator with the specified bolts.

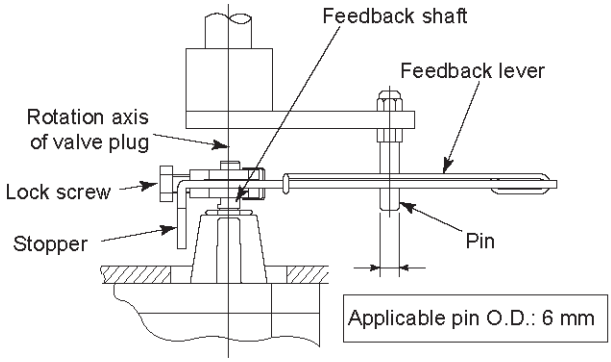


Figure 25 Inserting Pin into Hole of Feedback Lever (In case of using F9176HA)

A/M Switching

To perform manual operation of the valve using the A/M (automatic/manual) mode switching mechanism of the FVP110, there needs to be a pressure regulator for the air supply. To perform manual operation:

WARNING

Prior to changing the A/M selector switch position, make sure that doing so neither causes an injury nor affects the process.

Changing the A/M selector switch position from M (manual) to A (automatic) or vice versa during operation causes the valve stem to temporarily move to a position different from the position determined by the level of the input signal to the positioner. If a pressure applied is larger than the allowable range of pressure gauge, the pressure gauge may be damaged.

1. Turn the A/M selector switch clockwise to *M* (Figure 26).

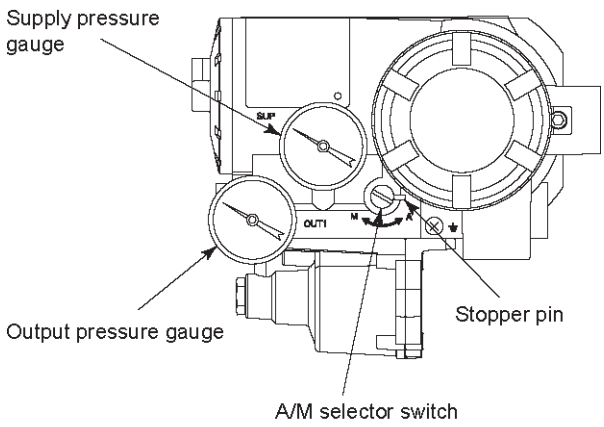


Figure 26 A/M Selector Switch

2. Vary the pneumatic pressure output to the valve actuator by changing the regulator output pressure by more than 70 kPa (approximately), regardless of the input signal of the FVP110. For an FVP110 equipped with pressure gauges, you can read the output pressure to the actuator.

   When using the Double Acting Type, the pneumatic pressure can only be varied from *OUT1* to the valve actuator. The pressure is always 0% from *OUT2* to the valve actuator. The valve position is not always in accord with the regulator pressure.

3. Turn the A/M selector switch counterclockwise until the stopper pin touches the side of the FVP110's casing to ensure the switch position changes to *A*.

Camflex Rotary Valve Mounting

This section describes the procedure for mounting the FVP on rotary control valves, using GE Masoneilan rotary valves as an example. Refer to Figure 27 on page 44 and Figure 28 on page 45 for details.

Tools Required

- ❑ 5/32 and 3/16" Hex Wrench with tee handle
- ❑ 3 mm, 4 mm, and 5mm Hex Wrench
- ❑ 7/16" Combination Wrench

The mounting bracket for the Camflex* has four sides, two square and two rectangular. One square side has a large hole in the center with four smaller holes above, below, left and right of the center hole; this side mounts to the actuator.

The other square side has a large hole that is a little bit off center and two rows of two smaller holes above and below the large hole; this side mounts to the FVP.

To install:

1. Place the mounting bracket by turning the bracket so that side that mounts to the FVP (with the off-center hole) has more space to the right of the hole when facing the actuator.
2. Mount the FVP mounting bracket to the valve actuator using two (2) 5/16 - 18 UNC flat-head cap screws. Unless otherwise specified the FVP is mounted with the actuator/valve in the normal upright position with the lettering on actuator right side up (Figure 27).

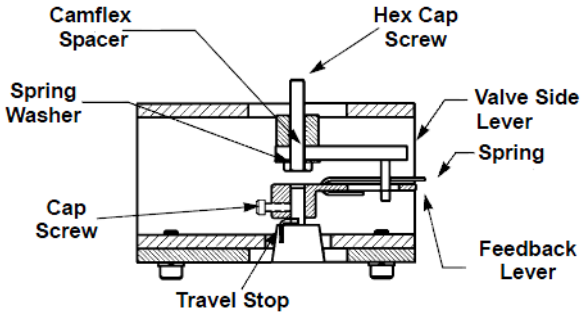


Figure 27 Camflex Mounting

3. Bolt the valve side lever to the valve position take-off shaft using a 1/4 - 28 UNF cap screw, spacer and washer. The spacer goes between the take off shaft and lever, and the washer under the head of the cap screw. On:
   - ❑ Camflex and Varimax valves, orient the valve side lever 90° from the valve position indicator and securely tighten the cap screw.
   - ❑ Ball and butterfly valve actuators, orient the valve side lever so that it is midway between the two bracket mounting holes (45° from horizontal) and tighten the cap screw. Alternatively, for all rotary mountings, the actuator can be pressurized to mid-stroke and the valve side lever secured in a horizontal position.
4. Clamp the feedback lever to the shaft. A travel stop is attached to the feedback shaft to prevent an over-rotation of the shaft. When installing the FVP feedback lever, make sure that you install it on the travel stop.The flat side on the FVP shaft must always face the pneumatic block with the lever facing the cover. When using a standard lever, the orientation of the lever to the FVP is set by the clamping screw's location relative to flat on shaft. Leave approximately 1/16" space between the FVP housing and the back of the feedback lever.

There is a label on the back of the FVP, located to the right of the travel stop that states:

±55° Max.

CAUTION

This device may be damaged if the feedback shaft exceeds its allowable limit. When mounting the FVP110 on a rotary valve, ensure that the rotation of the feedback shaft is correct by checking that:

- ❑ *Range of rotation angle of shaft: within ±45° from horizontal level*
- ❑ *Minimum span: 20°*
- ❑ *Maximum span: 90°*
- ❑ *Mechanically allowable rotation angle: ±55°*

5. Loosely assemble the FVP to the mounting bracket using only the two top 1/4 - 20 UNC socket-head cap screws.
6. Pull the FVP away from the actuator to allow the pin on the valve side lever to be inserted into the slot in the FVP lever under the anti-backlash spring (Figure 28).
7. Assemble the two bottom bolts and securely tighten all four bolts.

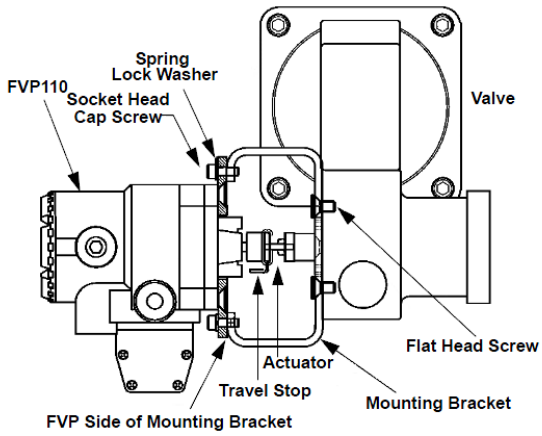


Figure 28 FVP110 Mounted on a Camflex Valve (Side View)

87/88 Reciprocating Valve Mounting

This section describes the procedure for mounting the FVP on reciprocating control valves and uses the GE Masoneilan 87/88 Multi-Spring actuator as an example. See Figure 30 on page 47 for an example of an FVP on a reciprocating valve.

Tools Required

- ❑ 7/16" Combination Wrench (2 required)
- ❑ 3/8" Combination Wrench
- ❑ 1/2" Combination Wrench
- ❑ 4 mm Hex Wrench
- ❑ 3/16" Hex Wrench

1. Mount the FVP mounting bracket to the actuator using two (2) 5/16 - 18 UNC cap screws. Unless otherwise specified mount the FVP with the actuator is in the normal upright position. The slotted opening of the mounting bracket is on the left when facing the actuator.
2. Clamp the FVP lever (Figure 29) to the FVP shaft.

   The flat side on the FVP shaft must always face the pneumatic block with the lever orientated towards the cover.

   When using a standard lever, the orientation of the lever to the FVP is set by clamping screw location relative to flat on shaft. Leave approximately 1/16" space between the FVP housing and back of lever.
3. Attach the right hand threaded rod end to the FVP lever using a 1/4 - 20 x 1?h cap screw. The lever hole position to be used is dependent upon the specific valve stroke. Refer to Table 2 for lever hole positions.

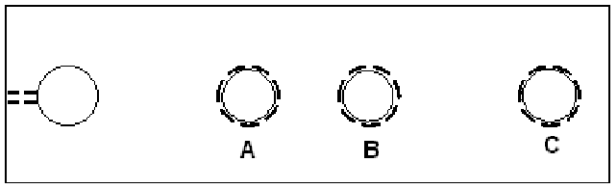


Figure 29 Lever for 87/88 Multi-Spring Actuator

Table 2 Lever Hole Locations for 87/88 Multi-Spring Actuator

Valve Stroke mm (inches)	Lever Hole
20.3 (0.8)	A
25.4 (1.0)	A
38.1 (1.5)	B
50.8 (2.0)	C
63.5 (2.5)	C

4. Mount the FVP to the mounting bracket using four 1/4 - 20 UNC socket-head cap screws. The set of mounting holes to be used is dependent upon the specific valve stroke.

Figure 30 FVP Mounted on Reciprocating Valve

5. Screw the take-off rod to the actuator stem connector.
6. Ensure that the travel pointer is correctly positioned.
7. Bolt the left hand threaded rod end to the take-off rod with 1/4- 20 UNC nut.
8. Connect turnbuckle and lock nuts to each rod end. Turnbuckle length is a function of actuator size. Verify proper length according to Table 3.
9. Position valve at mid-stroke by supplying air to the actuator or using a manual handwheel if applicable.

10. Adjust the turnbuckle such that the FVP lever is horizontal. The lever should be at an angle within + 15° from the horizontal level when the valve stem is at the 50% position.
11. Tighten the turnbuckle lock nuts.

Table 3 Turnbuckle Length

Actuator Size	Turnbuckle Length
#6	1.25”
#10	1.25”
#16	2.90"
#23	5.25”

NOTE

When assembling an FVP110 on a reciprocating valve ensure that the rotation angle of the feedback shaft does not exceed the allowable range of 10 to 25°.

Mounting the FVP110 with NAMUR Kits

The kit comes complete for mounting to various two valves. The socket head screws vary depending on the valve.

Tools required:

- ❑ M4 hex key
- ❑ M5 hex key
- ❑ M7 hex key

Refer to Figure 31 for this procedure.

To mount using this kit:

1. Attach the mounting bracket (#5) to the valve actuator using four (4) M8 x 1.25 x 25 flat-head cap screws (# 7).

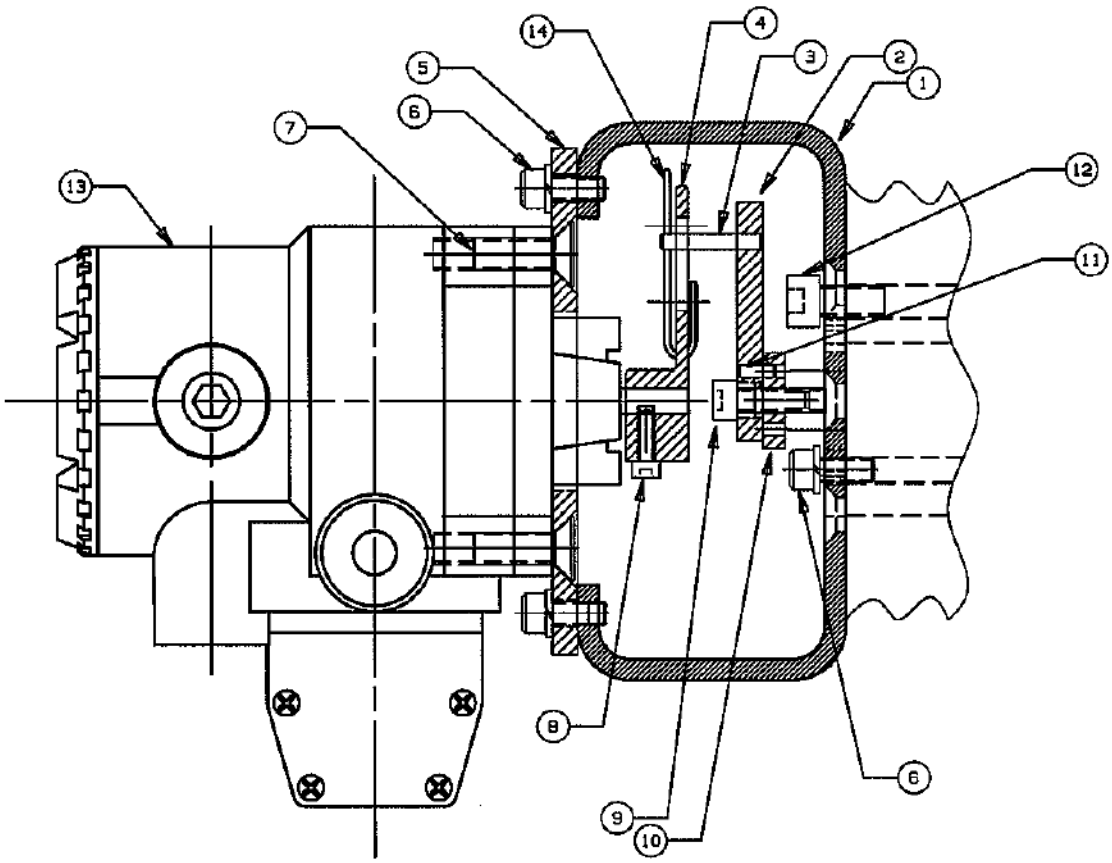


Figure 31 Namur Mounting Kit

2. Place the indicator disk with metal insert over the valve actuator shaft and secure using an M6 x 1.0 x 22 socket-head screw (#9).

3. Place the FVP Rotary Mounting Bracket (#1) into place sliding it through the anti-backlash spring (#14) into the dowel pin (3#) at the end of the plate into the hex head screw installed in step 2.
4. Secure the plate to the bracket using four (4) M6 x 1.0 x16 socket head cap screws (#6) and either:

   ❑ Four (4) M8 x 1.25 x16 socket head cap screws (#12).

   or

   ❑ Four (4) M5 x 0.8 x16 socket head cap screws (#12).

Wiring and Piping

5

General

This section describes the air piping and electric wiring connections.

WARNING

Cut off all inputs to the valve actuator and other accessories of the valve and actuator, including the air supply and electric signal before making or modifying the piping and wiring connections.

The process must be shut down or the control valve isolated from the process by using bypass valves or the like when making or modifying the piping and wiring connections.

Always cap the unused wiring ports with blind plugs.

In general, all topics must be completed in the order given:

1. “Piping” on page 52
2. “Wiring” on page 54
3. “Grounding” on page 57

Piping

Air Supply

For stable operation of the FVP110 over a long term, a clean and dry supply of air needs to be maintained. Be careful about the following:

- ❑ To prevent moisture, oil, and dust from being led into the FVP110 through pipes, give careful consideration to the choice of the air supply system and supply air suction point as well as installation of the air supply header and air supply piping.
- ❑ The desired supply air must:
  - ❑ Be dry air whose dew point is at least 10 °C lower than that of the ambient temperature.
  - ❑ Be free from solid particles as a result of being passed through a 5-µm or finer filter.
  - ❑ Not contain oil at a concentration higher than 1 ppm in weight or volume.
  - ❑ Not be contaminated by a corrosive, explosive, flammable, or toxic gas.
  - ❑ Comply with ANSI/ISA-57.3 1975 (R1981) or ISA-S7.3-1975 (R1981).
- ❑ The FVP110 requires an air supply of 140 to 400 kPa. Within this range, regulate the air supply pressure at a level within ±10% of the air supply pressure specified for the actuator, and at 10% of the actuator's spring range or higher.

WARNING

Do not supply air at a pressure exceeding the maximum rated air supply pressure of the actuator or the FVP110 (400 kPa). Doing so can result in a high risk of damage to the equipment or lead to an accident.

Pneumatic Piping

To obtain the maximum air processing flow rate of the FVP110, the inner diameter of the piping tube must be at least 6 mm. When the FVP110 is combined with a high-capacity actuator and a minimum response speed is required, use a tube whose inner diameter is 6 mm or larger. A power failure results in the fail-safe action; OUT1=0% and OUT2=100%.

CAUTION

Do not use an unnecessarily long tube or piping as it decreases the air flow rate, leading to a decrease in response speed.

To connect pneumatic piping:

1. Connect the air supply pipe to the SUP port of the FVP110, and the output pressure pipe to the OUT1 port.

CAUTION

The FVP110 has two air supply ports (SUP): one at the rear and the other on the side. When delivered, the rear SUP port (OUT2) is capped with a blind plug. To use the rear SUP port, remove the blind plug and cap the side SUP port with it. Be very careful that no foreign matter or dust caught in the sealing tape is allowed to enter inside the pipe.

Figure 32 shows the pneumatic piping ports. The port specification is chosen when ordering the FVP110.

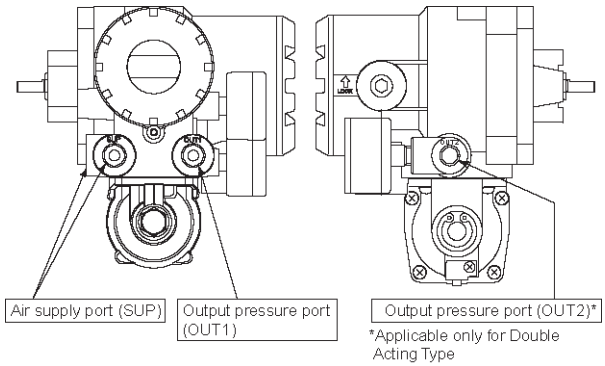


Figure 32 Pneumatic Piping Port

2. Install the Double Acting type by:
   a. Connecting the output pressure pipe to the OUT2 port, ensure that the OUT2 Pressure Gauge plug does not get turned around.
   b. Adjusting the pressure balance of the control relay as required (see “Tuning the Pressure Balance of Control Relay” on page 71).
3. Check that there is no leakage from the joints.
4. Perform sufficient flushing of the piping tubes and fittings to ensure that no foreign matter such as metal refuse can enter the piping.

Wiring

CAUTION

For flameproof equipment, wiring materials and wiring work for this equipment including peripherals are strictly restricted. Read "Installation and Operating Precautions for JIS Flameproof Equipment" prior to the work.

Recommended Cables

For wiring for a FVP110:

- ❑ Use a cable for H1 fieldbus segments specified by the Fieldbus FOUNDATION™. A shielded cable is recommended. For the details of cables required for H1 fieldbus segments, see *Fieldbus Technical Information* (TI 38K3A01-01).
- ❑ Choose cables suitable for the respective ambient temperature ranges, especially when they are to be laid in a hot or cold place.
- ❑ Laying cables in or through a place where the atmosphere may include a toxic gas or liquid, or oil or solvent requires wires and cables made of sufficient durability.
- ❑ Prevent the cables from being affected by noise induced from a high-capacity transformer or power supply to a motor.
- ❑ Make the cables and connection adapters watertight and prevent the cables from being damaged by using a cable conduit and duct.

General-use Type and Intrinsically Safe Type

1. Remove the terminal box cover and dust proofing plug (Figure 33). Be sure to securely seal the unused wiring port with a blind plug.

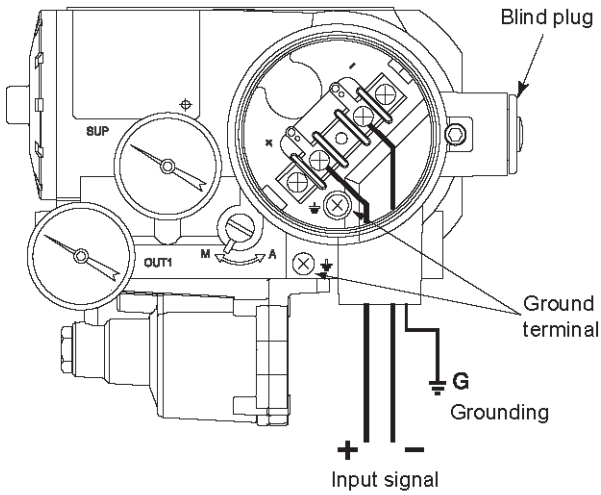


Figure 33 Wiring

2. Make cable wiring using metallic conduit or waterproof glands (Figure 34).
3. Apply a non-hardening sealant to the terminal box connection port and to the threads on the flexible metal conduit for waterproofing.

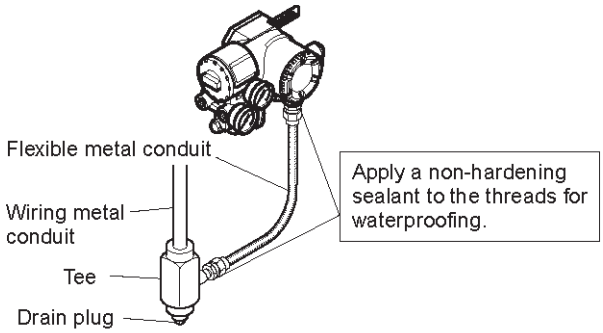


Figure 34 Typical Wiring Using Flexible Metal Conduit

Flameproof Type (JIS)

1. Remove the terminal box cover and dust proofing plug (Figure 33). Be sure to securely seal the unused wiring port with a blind plug.

NOTE

Wire cables through a flameproof packing adapter, or using a flameproof metal conduit by (Figure 35):

- ❑ Installing only flameproof packing adapters approved by GE Masoneilan.
- ❑ Applying a nonhardening sealant to the terminal box connection port and to the threads on the flameproof packing adapter for waterproofing.

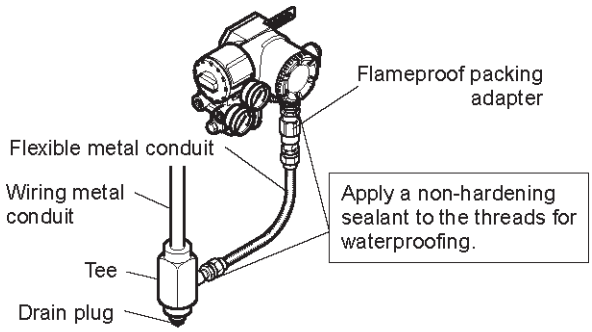


Figure 35 Typical Cable Wiring Using Flameproof Packing Adapter

2. Measure the cable outer diameter in two directions to within 1 mm.
3. Calculate the average of the two diameters, and use packing with an internal diameter nearest to this value (Table 4).

Table 4 Flameproof Packings and Applicable Cable Outer Diameters

Optional Code	Wiring Port Thread Diameter	Applicable Cable OD (mm)	Identifying Mark
F1	G 1/2	8 to 10 10.1 to 12	16 8-10 16 10-12

4. Mount the flameproof packing adapter body to conduit connection (Figure 36) by:
   a. Screwing the flameproof packing adapter into the terminal box until the O-ring touches the wiring port (at least 6 full turns), and firmly tightening the lock nut.
   b. Inserting the cable through the union cover, the union coupling, the clamp nut, the clamp ring, the gland, the washer, the rubber packing, and the packing box, in that order.
   c. Inserting the end of the cable into the terminal box.
   d. Tightening the union cover to grip the cable. When tightening the union cover, tighten approximately one turn past the point where the cable no longer moves up and down.

CAUTION

Proper tightening is important. If it is too tight, a circuit break in the cable can occur; if not tight enough, the flameproof effectiveness is compromised.

   e. Fastening the cable by tightening the clamp nut.
   f. Tightening the lock nut on the union cover.
   g. Connecting the cable wires to each terminal.

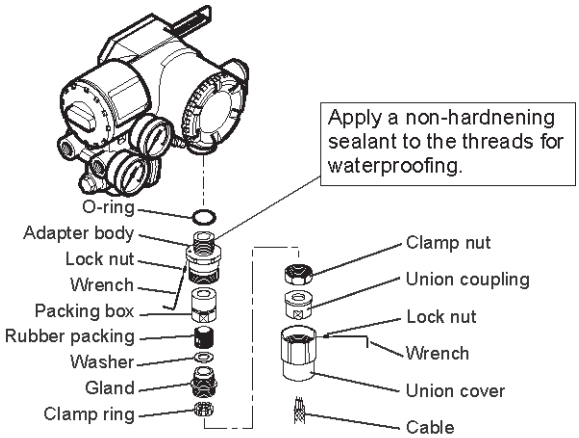


Figure 36 Installing Flameproof Packing Adapter

5. Install a seal fitting near the terminal box connection port for a sealed construction (Figure 37).
6. Apply a non-hardening sealant to the threads of the terminal box connection port, flexible metal conduit and seal fitting for waterproofing.

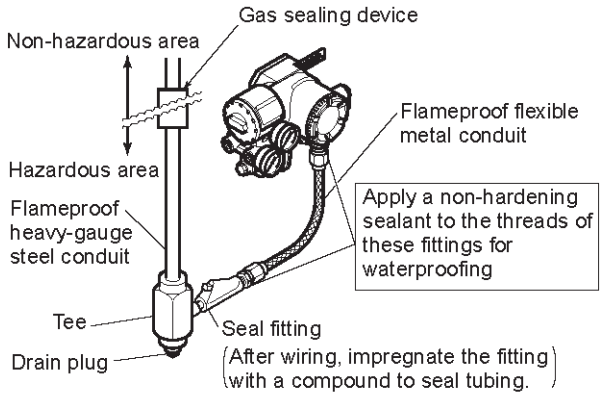


Figure 37 Typical Wiring Using Flameproof Metal Conduit

Grounding

Grounding is always required for the proper operation of transmitters. Follow the domestic electrical requirements as regulated in each country.

Ground terminals are located on the inside and outside of the terminal box. Either of these terminals may be used. See Figure 33 on page 54.

WARNING *For JIS flameproof type and intrinsically safe type, grounding should satisfy Class D requirements (grounding resistance, 100 or less).*

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Setup

6

WARNING

During the setup, especially when autotuning is being executed, the valve stem may move suddenly. Before starting the setup, confirm that the process has been shut down or the control valve is isolated from the process. During the setup, keep away from the movable parts to avoid injury.

General

After mechanically attaching the FVP110 to an actuator and finishing the wiring and piping, connect the FVP110 to a fieldbus and make settings, such as carrying out auto tuning and setting the tight-shut option, using a parameter setting tool or the like.

For the operation of a parameter setting tool, read the manual of each tool. Also, read “About Fieldbus” on page 85 through “Actions of the FVP110 During Operation” on page 109 and “Transducer Block” on page 123 to become familiar with the configuration of the fieldbus instrument and the function of the transducer block before starting adjustment.

Check that the piping and wiring connections are all correct, and then supply the specified input voltage and air pressure. For the connection to the fieldbus, see “Wiring and Piping” on page 51 and “Configuration” on page 89.

Parameter settings for the actuator and valve are made in the FVP110 positioner transducer block parameters. For details of each parameter, refer to the parameters list in “Function Block Parameters” on page 183.

Follow the procedure below.

1. “Set Basic Parameters” on page 60.
2. “Carrying out Tuning” on page 61.
3. “Check Valve Actions” on page 63.
4. “Set Transducer Block Parameters” on page 64.

Set Basic Parameters

Set the target mode's in the parameters MODE_BLK of the transducer block and AO function block to O/S (Out of Service). When either one or both of the transducer block and AO function block are in the O/S mode, the transducer block's parameters that determine the valve actions are write-locked.

1. Select the acting direction of valve by setting the value, 1 or 2 in the parameter ACT_FAIL_ACTION corresponding to the acting direction of the valve. This setting determines the relationship between the pneumatic input signal and 0-100% of the valve position, where the 0% position means complete closure.
   - ❑ *1* = air to open
   - ❑ *2* = air to close

The 0-100% of the transducer block's output can be logically reversed by setting IO_OPTS in the AO block to true.

Independently of the above setting, the FVP110 always acts identically on power off and air supply cut-off. When a power failure or serious hardware damage is detected, the FVP110 cuts the current signal being fed to the I/P module to zero, moving the valve to the safe side. The action of the FVP110 on occurrence of a communication error can be predefined by AO block's parameters; see "Fault State" on page 135.

2. Select the actuator type by setting the value, 1 or 2, for the parameter VALVE_TYPE for the actuator type:
   - ❑ 1 = linear-motion actuator
   - ❑ 2 = rotary-motion actuator

Choosing the linear-motion type automatically corrects a linearity error that is inherently caused between the linearly acting actuator and the rotating displacement sensor inside the FVP110 actuator.

Carrying out Tuning

WARNING

This function strokes the valve over its full range. Do not execute while valve is controlling the process. Keep away from the movable parts to avoid injury.

You now carry out auto tuning (and manual tuning, if necessary). The auto tuning program automatically:

- ❑ Adjusts the zero-point and span.
- ❑ Adjusts the parameter settings for controlling the valve.

Auto Tuning in FVP110 sets the 0% point at the position where the valve is fully closed and 100% point at the position where the valve stem stops against the mechanical stopper (fully open). If it is necessary to adjust the zero point and span precisely to the rated stroke of the valve, carry out travel calibration (“Travel Calibration” on page 63).

CAUTION

For the first time after installing the FVP110 on the actuator or anytime after detaching the FVP110 and installing it again on the actuator, be sure to perform step 1, or 2 and 3 to carry out all adjustments. Otherwise, the adjustments cannot be carried out correctly. From the next and any time thereafter, perform only step 2 or 3 independently.

After detaching the FVP110 from the valve actuator and then reinstalling it to the actuator, be sure to perform step 2.

To carry out auto tuning, write a value to the parameter AUTO_TUNE_EXEC:

1. To sequentially adjust the zero-point and span, and then control parameter settings for the first time after installing the FVP110 on a valve actuator, write: 4 (= travel calibration at stop point and control parameter tuning).
2. To leave the control parameter settings unchanged and only perform zero-point and span adjustments such as after detaching the FVP110 from the valve actuator and restoring it, write: 2 (= travel calibration at stop point).
3. To leave zero-point and span settings unchanged and only adjust control parameter settings, such as after the hysteresis of the valve actions has greatly changed, write:
   - ❑ The time needed to complete the adjustments, which varies with the actuator size and the hysteresis of the actions, is roughly 4 minutes for a mid-capacity (capacity of around 3 liters) actuator.
   - ❑ If you want to abort auto tuning for some reason such as when you have started it while leaving the air supply shut off, write: 5 (= cancel execution).

The tuning result are written to AUTO_TUNE_RESULT. The value of AUTO_TUNE_RESULT is 255 and appears as *In operation* while auto tuning is running, and changes to *1* which appears as *Succeeded* when auto tuning has finished successfully. 2 indicates cancelled. In the event of a warning or error, a value other than those above appears. For details, see the specifications for the transducer block.

The values of the hysteresis of valve actions and the air supply pressure measured during auto tuning are stored in parameters of the FVP110. transducer block. The pressure data such as air supply pressure data are available only for a FVP110 with an optional pressure sensor.

CAUTION

Ensure that the pressure of the air supply to the FVP110 positioner is regulated within the specified range. If it differs from the pressure during actual operation, or if it is unstable, optimum tuning results may not be obtained.

The following parameters are tuned by carrying out auto tuning: (For details, see “Description of Control Parameters” on page 259):

- ❑ SERVO_GAIN (static loop gain of internal valve control loop)
- ❑ SERVO_RESET (integral time)
- ❑ SERVO_RATE (derivative time)
- ❑ SERVO_RATE_GAIN (derivative gain)
- ❑ SERVO_DEADBAND (dead band of integral action)
- ❑ SERVO_OFFSET (offset of integral action)
- ❑ BOOST_ON_THRESHOLD (threshold to switch on the boost action)
- ❑ BOOST_OFF_THRESHOLD (threshold to switch off the boost action)
- ❑ BOOST_VALUE
- ❑ SERVO_I_SLEEP_LMT (timer setting for integral action)
- ❑ SERVO_P_ALPHA (multiplication coefficient for the square of proportional factor)
- ❑ INTERNAL_GAIN (total gain of I/P module, control relay and the valve)
- ❑ X_BST_ON_THRESHOLD * (the addition value to threshold for switching on boost action for exhaust.)
- ❑ X_BST_OFF_THRESHOLD * (the addition value to threshold for switching off boost action for exhaust)
- ❑ X_BOOST_VALUE * (the addition boost value for exhaust)

*Applicable only for Double Acting Type

Normally, control parameters need not be readjusted after auto tuning. If there is a problem, see “Troubleshooting” on page 175. To carry out fine adjustments of the zero-point and span settings, perform the travel calibration.

Travel Calibration

If the full stroke of the valve is too large for the maximum required flow rate, you can change the span of the travel by carrying out a travel calibration:

1. Vary the value of FINAL_VALUE.value to move the stem and adjust the stem to the desired point for the 100% position.
2. Write 3 to TRAVEL_CALIB_EXEC. This changes the span while leaving the zero point unchanged.

TRAVEL_CALIB_EXEC:

- ❑ 1 = off
- ❑ 2 = 0%-point calibration (no change to span)
- ❑ 3 = span calibration (no change to 0% point)
- ❑ 4 = 50%- point calibration (no change to either span or 0% point)

NOTE

Only when the target mode's in both the AO and transducer blocks are O/S, can FINAL_VALUE.value be written.

The result of the travel calibration is written to TRAVEL_CALIB_RESULT.

Check Valve Actions

After carrying out auto tuning, check step responses by changing the value of the transducer block's final valve position setpoint, FINAL_VALUE.value. Also, check whether the valve acts correctly over the 0-100% position range.

NOTE

Only when the target mode is in MODE_BLK parameters in both the AO and transducer blocks are O/S, can FINAL_VALUE.value be written.

It is not usually necessary to readjust the control parameters after auto tuning. However, when using the Double Acting Type, or if the expected response characteristics cannot be obtained using auto tuning, either conduct manual tuning, as in “Manual Tuning Guideline” on page 253 or refer to “Troubleshooting AutoTuning” on page 181.

Set Transducer Block Parameters

Set the following parameters as necessary. For the settings made as default when shipped, see the parameter lists in "Function Block Parameters" on page 183.

1. Write the Position-to-flow Rate Characteristic Type.

The parameter POSITION_CHAR_TYPE defines the characteristics between the valve position and flow rate, and is set to linear by default. Write the appropriate value:

- ❑ 1 = linear
- ❑ 2 = equal percent (50:1)
- ❑ 3 = equal percent (30:1)
- ❑ 4 = quick open (reversal of equal % - 50:1)
- ❑ 5 = Camflex Percentage
- ❑ 255 = user-defined

255 allows you to define the desired characteristics by 10 line segments for evenly divided input levels. The coordinates (0,0) and (100,100) are fixed; set the values corresponding to OUT (Output of AO block) = 10%, 20%, 30%..., 80%, 90%.A set value must be greater than the preceding set value; the output must increase as the input increases (Figure 38).

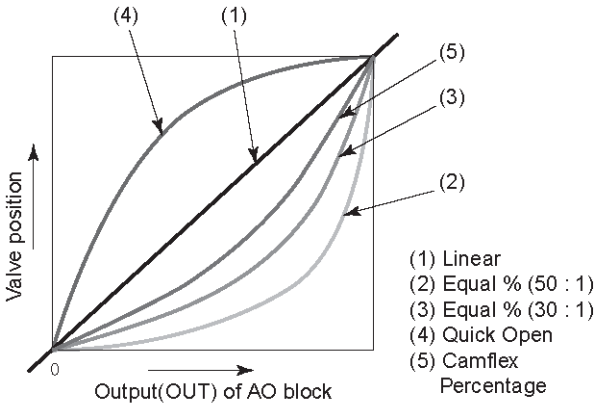

Figure 38 Position-to-flow Rate Characteristic Type

2. Set Final-value Limits.

Eu_100 and Eu_0 in the parameter FINAL_VALUE_RANGE define the upper and lower limits of FINAL_VALUE.value of the transducer block.

NOTE

Even if the range of FINAL_VALUE.value is limited by FINAL_VALUE_RANGE, the actual valve position is set to outside the FINAL_VALUE_RANGE setting when the tight-shut or full-open action described below is activated.

3. Set the Tight-shut and Full-open Actions values.

The tight-shut action is an action to decrease the output pressure to a level much lower than the 0% pressure level, or to increase it much higher than the 0% pressure level for an air-to-close valve, when FINAL_VALUE.value is less than FINAL_VALUE_CUTOFF_LO in order to ensure that the valve is tightly shut off. Conversely, the full-open action is an action to increase the output pressure to a level much higher than the 100% pressure level, or decrease it much lower than the 100% pressure level for an air-to-close valve, when FINAL_VALUE.value is larger than FINAL_VALUE_CUTOFF_HI in order to ensure that the valve is fully open.

A hysteresis of 1% is applied to the thresholds, FINAL_VALUE_CUTOFF_LO and FINAL_VALUE_CUTOFF_HI.

4. Set the Thresholds for Limit Switches by:

   a. Writing the threshold for the upper limit switch to LIMSW_HI_LIM, and the threshold for the lower limit switch to LIMSW_LO_LIM.

   b. Make a DI block read the on/off statuses of a limit switch by setting CHANNEL to:

      - *2*, for reading the on/off status of the upper limit switch.
      - *3*, for reading the on/off status of the lower limit switch.

Just like hardware limit switches for a valve, on/off status signals can be generated when the valve position read-back signal FINAL_POSITION_VALUE.value reaches specified levels. These on/off statuses can be transferred to a DI function block.

A hysteresis of 1% is applied to the thresholds, LIMSW_HI_LIM and LIMSW_LO_LIM.

5. Write the Thresholds for Operation Result Integration Alarms by:

The FVP110 has a function to integrate the following operation result quantities individually:

- TOTAL_CYCLE_COUNT (incremented by 1 at each change in the direction of the action)
- TOTAL_TRAVEL (in % where full stroke = 100%)
- TOTAL_OPEN_TIME (in hours)
- TOTAL_CLOSE_TIME (in hours)
- TOTAL_NEAR_CLOSE_TIM (total at nearly closed time in hours)
- SERVO_WARN_COUNT (Total number of times of Servo output drift warning)

   a. Setting values for the six items above.

   b. Setting limit values for the five items below.

When these values exceed the respective thresholds below, corresponding alarms are output. Set the thresholds as necessary.

- ❑ CYCLE_COUNT_LIM
- ❑ TRAVEL_LIM
- ❑ OPEN_TIME_LIM
- ❑ CLOSE_TIME_LIM
- ❑ NEAR_CLOSE_TIME_LIM

6. Set NEAR_CLOSE_THRESHOLD to define the threshold of the valve position for counting NEAR_CLOSE_TIME, as necessary. For other alarms and self-diagnostic functions, see “Online Diagnostics” on page 129.

Maintenance

7

General

The modular structure of the FVP110 increases the ease of maintenance work. This section describes cleaning and part replacement procedures.

The FVP110 is a precision instrument; read the following carefully when carrying out maintenance. For calibrations, see “Setup” on page 59

WARNING

Precautions for CENELEC, and JIS flameproof type instruments:

- *Flameproof type instruments must be, as a rule, removed to a non-hazardous area for maintenance and be disassembled and reassembled to the original state. For details, see “Installation and Operating Precautions for JIS Flameproof Equipment” on page 265.*
- *On flameproof type instruments the terminal cover is locked by an Allen head bolt (shrouding bolt). When a shrouding bolt (Figure 39) is driven clockwise by an Allen wrench, it goes in and cover lock is released, and the cover can be opened. When a cover is closed it must be locked by a shrouding bolt. Tighten the shrouding bolt to a torque of 0.7 N·m.*

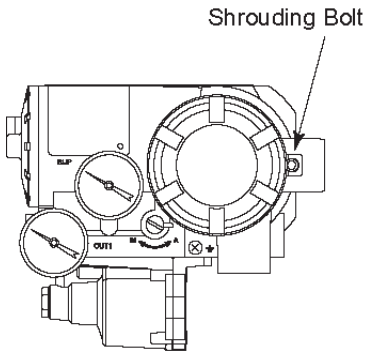

Figure 39 Shrouding Bolts

Periodic Inspections

To maintain problem-free plant operation, periodic inspections are required. At each periodic inspection, ensure that:

- ❑ No external damage is seen.
- ❑ No leakage from the FVP110 or the piping around it is detected.
- ❑ No build up in the drain, or dust or oil adhering to the air supply line has occurred.

Cleaning the Fixed Nozzle

The FVP110 fixed nozzle is attached to the control relay's surface that engages the FVP110's main structure (Figure 40). To clean the fixed nozzle:

1. Detach the control relay from the FVP110 main structure as in "Replacing the Control Relay Assembly" on page 69.
2. Thread a wire with a 0.25 mm diameter through the nozzle to clean it.
3. Replace the nozzle and O-ring at the original position and re-attach the control relay.

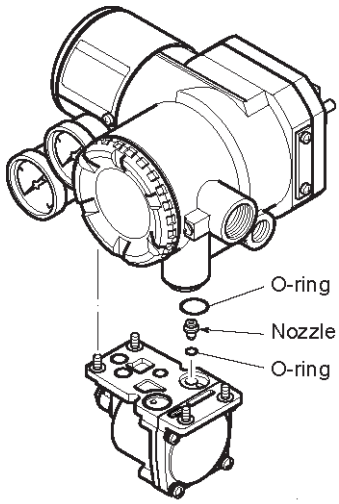

Figure 40 Cleaning the Nozzle

CAUTION

All the O-rings used for the sealing of pneumatic signal circuits are made of silicon rubber. The sealing capability is degraded if general silicon grease is applied. When applying grease to a sealing part, use a type of grease compatible with silicon rubber, such as fluoride grease and grease for silicon rubber.

Part Replacement

Replacing the Control Relay Assembly

1. Decrease the air supply pressure to zero.
2. Using a Philips screwdriver, unscrew the four mounting screws on the bottom face.
3. Pull the relay assembly downwards to detach it.
4. Remove the mounting screws and washers from the old assembly and use them to mount the new assembly in place by tightening them from below.
5. When using the Double Acting Type, adjust the pressure balance of the control relay as required (see “Tuning the Pressure Balance of Control Relay” on page 71).
6. Carry out tuning and check the valve’s actions (see “Carrying out Tuning” on page 61 and “Check Valve Actions” on page 63).

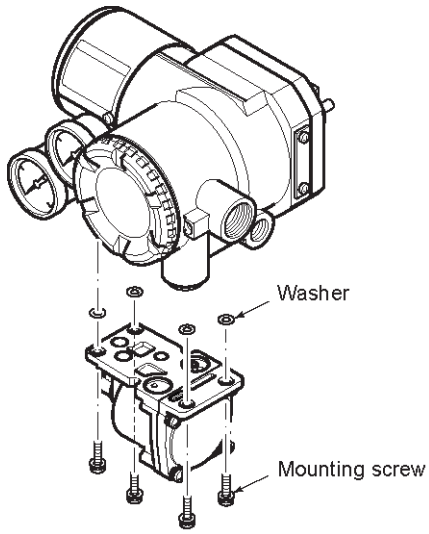

Figure 41 Replacing the Control Relay Assembly

NOTE

For the Double Acting Type, the recommended replacement cycle for the control relay is either when the actual repeat cycle exceeds 500,000 times, or after the control relay has been in use for 6 years.

Replacing the Screen Filters

When the screen filters installed deep in the air supply port and output pneumatic signal port become clogged, replace them with new filters using a tool with pointed tips such as a set of tweezers (Figure 42).

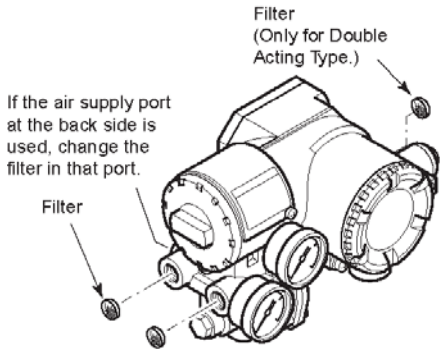

Figure 42 Replacing the Screen Filters

Replacing the Internal Air Filter

To replace the air filter at the opening to the internal pneumatic circuits (Figure 43).

1. Decrease the air supply pressure to zero.
2. Remove the relay assembly (see “Replacing the Control Relay Assembly” on page 69).
3. Remove the pneumatic circuit holding plate and gasket. There are two gaskets for Double Acting Type.
4. Remove the air filter and O-ring.
5. Set the new filter in place.
6. Perform steps 3, then 2 to restore the FVP110.

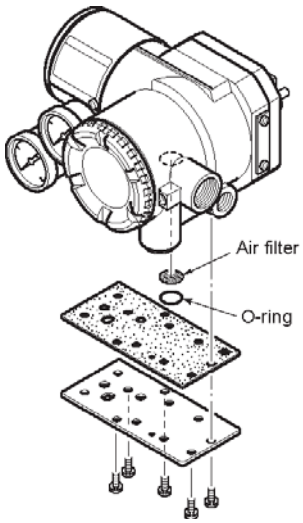

Figure 43 Replacing the Internal Air Filter

Tuning the Pressure Balance of Control Relay

For a double-acting cylinder actuator, adjust the pressure balance of the control relay, if necessary.

The optimal point of pressure balance differs slightly depending on the packing and load characteristics of the cylinders, but in general, approximately 50 to 90% of the supply air pressure is appropriate.

The pressure balance of the FVP110 is set to approx. 75% at the time of shipment.

To reduce the hunting phenomenon and air consumption adjust the balance pressure. However, if the pneumatic piping is connected to the valve actuator, the pressure of a cylinder on one side becomes higher, and the balance cannot be maintained.

To increase the balance pressure:

- ❑ Turn the screw for adjusting the balance pressure (Figure 44) counterclockwise. To decrease the balance pressure, turn the screw clockwise. *Do not* loosen the screw beside the adjustment screw.

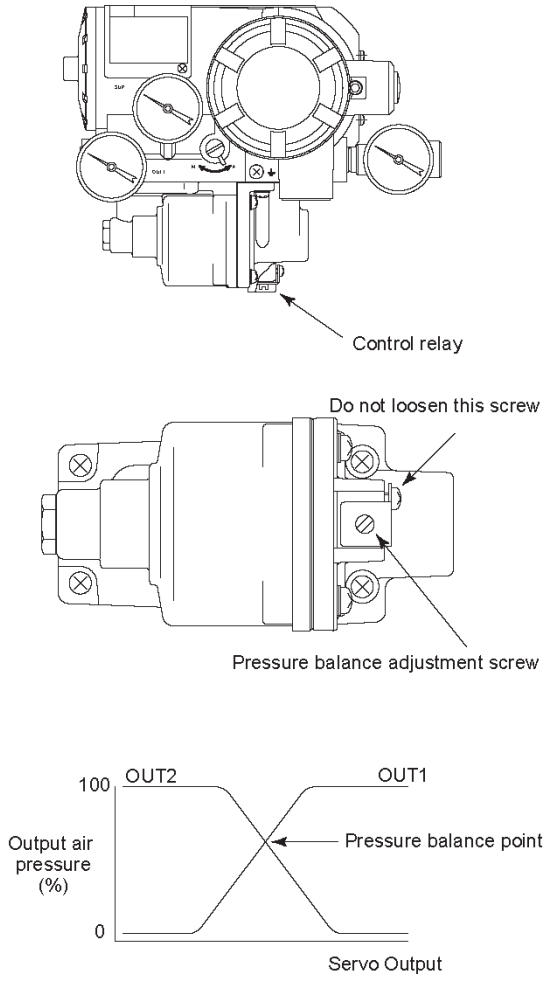

Figure 44 Tuning the Pressure Balance of Control Relay

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Standard Specifications

8

Standard Specifications

Applicable Control Valve:

Linear or Rotary Motion Control Valve (Diaphragm Actuator and Cylinder)

Functions:

Function Blocks:

- ❑ AO: One Analog Output
- ❑ DI: Two Discrete Inputs
- ❑ OS: One Splitter Block
- ❑ PID: One PID Control Function (Optional)

Link Master Function
Pressure Sensor (Optional)
Flow Characterization Feature:

- ❑ Linear
- ❑ Equal Percentage (50: 1)
- ❑ Equal Percentage (30: 1)
- ❑ Quick Opening
- ❑ Camflex Percentage
- ❑ Customer Characterization (10 segments)

Auto Tuning Function
Valve Position Detecting Function
Continuous Diagnostics Function:

- ❑ Total Travel
- ❑ Number of Cycles
- ❑ Time Open/Time Close/Time Near Close

Housing Materials:

Case: Aluminum die-cast
Paint: Polyurethane resin-baked finish
Color: Grey

Communication:

Digital: FOUNDATION fieldbus

Supply Voltage:

9 to 32V DC for general use and flameproof type
9 to 24V DC for intrinsically safe type Entity model
9 to 17.5V DC for intrinsically safe type FISCO model

Conditions of Communication Line:

Supply Voltage: 9 to 32V DC
Supply Current: 17 mA (max)

Output Signals and Pressure Gauge Scale:

No gauge is standard. Pressure gauge can be selected as option. The supply pressure unit on the name plate for non-gauge model is Pa.

Table 5 Diaphragm, Single Acting Cylinder

Calibration Unit	Supply Air Pressure	Pressure Gauge Scale	
		Supply Air	Output Signal
kPa	140 to 400	400	400
kgf/cm^2	1.4 to 4	4	4
bar	1.4 to 4	4	4
psi	20 to 60	60	60

Table 6 Diaphragm, Double Acting Cylinder

Calibration Unit	Supply Air Pressure	Pressure Gauge Scale	
		Supply Air	Output Signal
Pa	200 to 700 kPa	1 kPa	1 MPa
kgf/cm^2	2 to 7	10	10
bar	2 to 7	10	10
psi	30 to 105	150	150

Pressure Gauge Case:

Stainless steel JIS SUS 304

Normal Operating Conditions:

Air Supply pressure:

- ❑ Single Acting Actuator: 20 to 60 psi (140 to 400 kPa)
- ❑ Double Acting Actuator: 30 to 100 psi (200 to 700 kPa)

Vibration Limit: 4 mm at 5 to 15 Hz; 2G at 15 to 2000 Hz
Shock limit: 10G

Manual Operation:

Available using Auto/Manual (A/M) transfer switch

Zero Adjustment Range:

–15 to 85% of span

Span Adjustment Range:

Within 300% of span

Valve-stem Travel Range:

- ❑ Linear Motion: 10 to 100 mm (0.4 to 4.0"), (Rotation Range: ±10 to ±25°)
- ❑ Rotary Motion: 20 to 90°

Air Consumption and Output Capacity:

Table 7 Diaphragm, Single Acting Cylinder

Parameter	Value
Maximum Air Consumption	0.20 SCFM (0.32 Nm3/h) at 140 kPa
Maximum Output Capacity	4.1 SCFM (6.6 Nm3/h) at 140 kPa

Table 8 Diaphragm, Double Acting Cylinder

Parameter	Value
Maximum Air Consumption	0.62 SCFM (1.0 Nm3/h) at 400 kPa
Maximum Output Capacity	8.5 SCFM (13.7 Nm3/h) at 400 kPa

Ambient Temperature Limits:

- ❑ Single Acting Actuator: –40 to 85 °C (–40 to 185 °F)
- ❑ Double Acting Actuator: –40 to 60 °C (–40 to 140 °F) for standard, –10 to 85 °C (14 to 185 °F) for high temperature use with option code /HT

Ambient Humidity Limits:

5 to 95% RH at 40 °C (104 °F)

EMC Conformity Standards: CE N200

EN61326, AS/NZS CISPR11

Degrees of Protection:

IP65, NEMA4X

Connections:

- ❑ Air Connection: 1/4 NPT female
- ❑ Electrical Connection: 1/2 NPT, M20
- ❑ Pressure Gauge Connection:

Table 9 Pressure Gauge Connection

Connections Codes	Value
6	Rc 1/8 female
3	1/8 NPT female

Mounting:

- ❑ Front of Actuator with bracket.
- ❑ Direct Connection for rotary valve.

Weight:

- ❑ Single Acting Actuator: 2.4 kg (5.3 lb)
- ❑ Double Acting Actuator: 2.8 kg (6.2 lb)

Performance Specifications

Linearity:

- ❑ Single Acting Actuator: ±0.5% of Span (including linkages)
- ❑ Double Acting Actuator: ±1.0% of Span (including linkages)

Hysteresis:

- ❑ Single Acting Actuator: 0.3% of Span
- ❑ Double Acting Actuator: 0.5% of Span

Ambient Temperature Effect:

±0.08% of Span/ °C

Position Effect:

±0.3% of Span/90°

Vibration Effect:

±2% of Span at 2G (15 to 2000 Hz)

Model and Suffix Codes

Model	Suffix Codes	Description
FVP110	· ·	Valve positioner
Input Signal	**-F** · · · · · · · · · · · · · · · · · · ·	Digital communication (FOUNDATION Fieldbus protocol)
Applicable Control Valve	**1** · · · · · · · · · · · · · · · · · · ·	Single Acting Actuator
	2 · · · · · · · · · · · · · · · · · · ·	Double Acting Actuator
————	**A**· · · · · · · · · · · · · · · · · ·	Always A
Connections	**3** · · · · · · · · · · · · · · · · · ·	Electrical Connection: 1/2 NPT, Pneumatic Connection: 1/4 NPT
	6 · · · · · · · · · · · · · · · · · ·	Electrical Connection: M20, Pneumatic Connection: Rc 1/4
————	**N** · · · · · · · · · · · · · · · · · ·	Always N
Optional Codes	/□ · · · · · · · · · · · · · · · · · · ·	Optional Specifications

T0706.EPS

Figure 45 Model and Suffix Codes

Optional Specifications

Table 10 Optional Specifications

Item		Description	Code
Lightning protection		Power supply 9 to 32V DC Allowable current Max. 6000 A(1 x 40 s), repeating 1000 A(1 x 40 s), 100 times	**A**
Painting	Coating change	Epoxy resin coating	**X1**
PID function		PID control function	**LC1**
Output monitor		Built-in output pressure sensor *3 and signature function *4	**BP**
High temperature use *5		Ambient temperature limits: –10 to 85 C(14 to 185 F)	**HT**
Software download function *6		Based on Foundation Fieldbus Specification (FF-883) Download class: Class1	**EE**

*1: Applicable for Connections code 1, 5 and 6.
*2: Applicable for Connections code 3.
*3: For double acting actuator, OUT1 connection is available.
*4: Applicable for single acting actuator.
*5: Applicable for double acting actuator.
*6: Not applicable for Option code FS15 and KS25.

Optional Specifications For Explosion Protected Types

Table 11 Optional Specifications For Explosion Protected Types

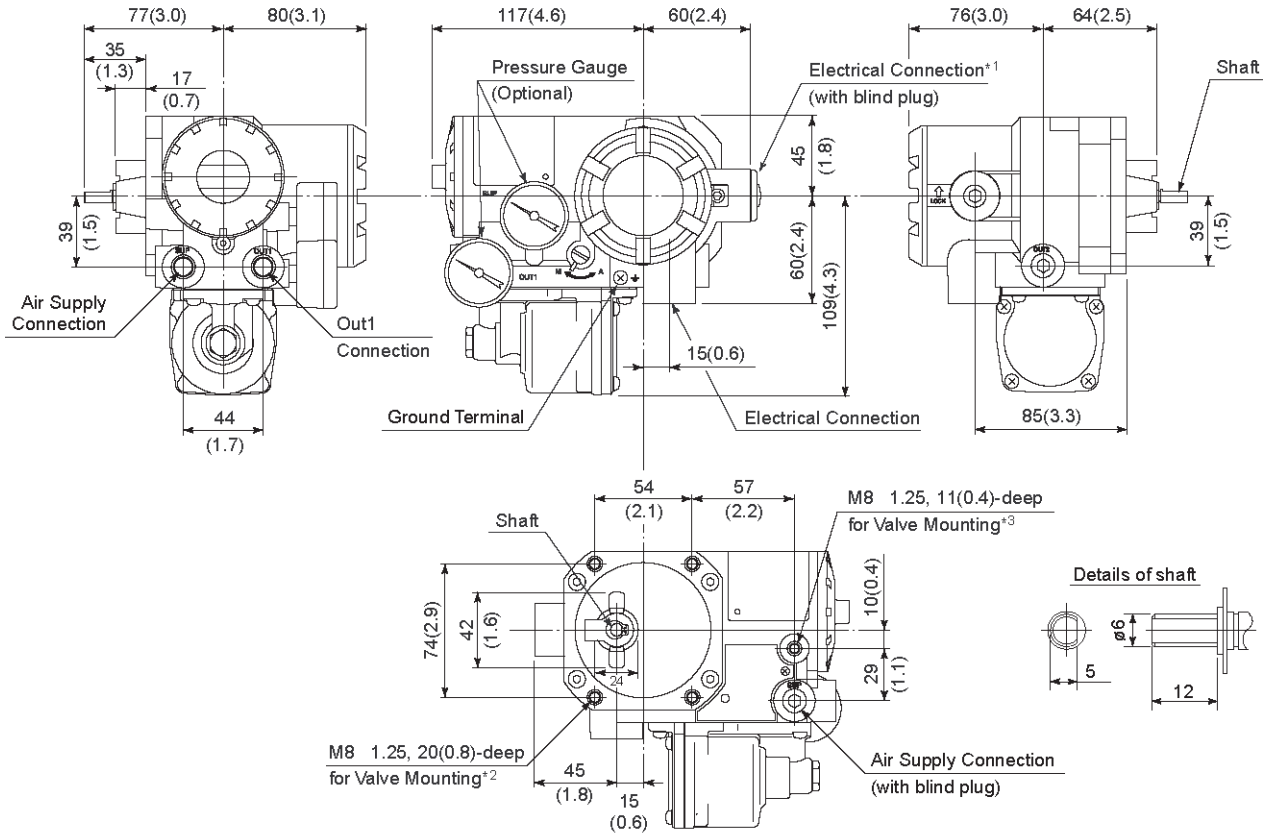
Description	Code
CSA Explosionproof Approval*1 ❑ Applicable standard: C22.2 No. 0, No. 0.4, No. 0.5, No. 25, No. 30, No. 94, No. 1010.1 ❑ Certificate: 1186507 ❑ Explosionproof for Class I, Division 1, Class B, C & D; Class II, Groups E, F & ❑ G., Class III. ❑ Enclosure Type: NEMA4X Temp. Class: T5/T6 ❑ Amb.Temp.: –40 to 82 °C(–40 to 180 °F) for T5, –40 to 75 °C (–40 to 167 °F) for T6.	**CF1**
FM Explosionproof Approval*1 ❑ Applicable standard: FM3600, FM3615, FM3810, ANSI/NEMA250 ❑ Explosion proof for Class 1, Division 1, Groups A, B, C and D; ❑ Dust-ignition proof for Class II/III, Division 1, Groups E, F and G ❑ Enclosure Type: NEMA 4X Temp. Class: T6 ❑ Amb. Temp.: –40 to 80 °C (–40 to 176 °F)	**FF1**
FM Intrinsically Safe, Nonincendive Approval*1 ❑ Applicable standard: FM3600, FM3610, FM3611, FM3810, ANSI/NEMA250 ❑ IS/ I, II, III/1/ABCDEFG/T4 Ta=60 °C; Type 4X ❑ I/0/AEx ia/IIC/T4 Ta=60 °C; Type 4X, NI/I/2/ABCD/T4 Ta=60 °C; Type 4X, I/2/IIC/T4 ❑ Ta=60 °C; Type 4X, S/II/2/FG/T4 ❑ Ta=60 °C; Type 4X, S/III/2/T4 Ta=60 °C; Type 4X Entity Parameters: ❑ Groups A, B, C, D, E, F, and G and Group IIC Vmax=24 V, Imax=250 mA, ❑ Pi=1.2 W, Ci=1.76 nF, Li=0 mH FISCO Parameters: ❑ Groups A, B, C, D, E, F, and G and Group IIC Vmax=17.5 V, Imax=360 mA, ❑ Pi=2.52 W, Ci=1.76 nF, Li=0 mH ❑ Groups C, D, E, F, and G and Group IIB Vmax=17.5 V, Imax=380 mA, ❑ Pi=5.32 W, Ci=1.76 nF, Li=0 mH Nonincendive Field Wiring Parameters: ❑ Groups A, B, C, D, E, F, and G and Group IIC: Vmax=32 V, Ci=1.76 nF, Li=0 mH	**FS15**
FM Nonincendive Approval for /EE Software download *5 ❑ Applicable standard: FM3600, FM3611, FM3810 ❑ Class I, Division 2, Group A, B, C, & D ❑ Class II, Division 2, Group F & G and Class III, Division 1 ❑ Class I, Zone 2, Group IIC in Hazardous (Classified) locations ❑ Enclosure: “NEMA4X”, Temp. Cl.: T4, Amb. Temp. –40 to 60 °C (–40 to 140 °F) Vmax.=32V, Ci=3.52 nF, Li=0 H	**FN15**

Table 11 Optional Specifications For Explosion Protected Types (Continued)

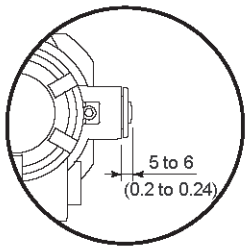
Description	Code
CENELEC ATEX (KEMA) Flameproof Approval*2 ❑ Applicable standard: EN50014, EN50018 ❑ Certificate: KEMA 02ATEX2159 ❑ II 2G EEx d IIC T6 and T5 Amb. Temp.: –40 to 75 °C (–40 to 167 °F) for T6, –40 to 80 °C (–40 to 176 °F) for T5	**KF2**
CENELEC ATEX (KEMA) Intrinsically Safe Approval*2 ❑ Applicable standard: EN50014, EN50020, EN500284, EN50281-1-1 ❑ Certificate: KEMA 02ATEX1274X ❑ 1G/1GD EEx ia IIC T4: Ui=17.5 V, Ii=360 mA, Pi=2.52 W, Ci=1.76 nF, Li=0 H (FISCO model) Ui=24.0 V, Ii=250 mA, Pi=1.2 W, Ci=1.76 nF, Li=0 H (Entity model) ❑ 1G/1GD EEx ia IIB T4: Ui=17.5 V, Ii=380 mA, Pi=5.32 W, Ci=1.76 nF, Li=0 H (FISCO model) ❑ 1D Um=32.0 V: Tamb(1G): –40 to 60 °C (–40 to 140 °F), Tamb(1D): –40 to 80 °C (–40 to 176 °F), Tamb(1GD): –40 to 60 °C (–40 to 140 °F), T100 °C (1D, 1GD) Enclosure: IP65	**KS25**
CENELEC ATEX Type n declaration*2 *5 ❑ Applicable standard: EN60079-15 ❑ EEx nL IIC T4 Amb. Temp. : –40 to 60 °C (–40 to 140 °F), Enclosure: IP65 ❑ Ui=32 V, Ci=1.76 nF, Li=0 H	**KN25**
TIIS Flameproof Approval*3 ❑ Certificate: TC15453, TC15452 for option code /BP ❑ Ex d IIC T6 Amb. Temp.: –20 to 60 °C	**JF3**
*1: Applicable for Connections code 3. *2: Applicable for Connections code 3 and 6. *3: Applicable for Connections code 1, 3 and 6. *4: If cable wiring is to be used to a TIIS flameproof type transmitter, do not fail to add the GE Masoneilan assured flameproof packing adapter. *5: Applicable for Option code EE.	

Dimensions

Unit: mm(approx. inch)

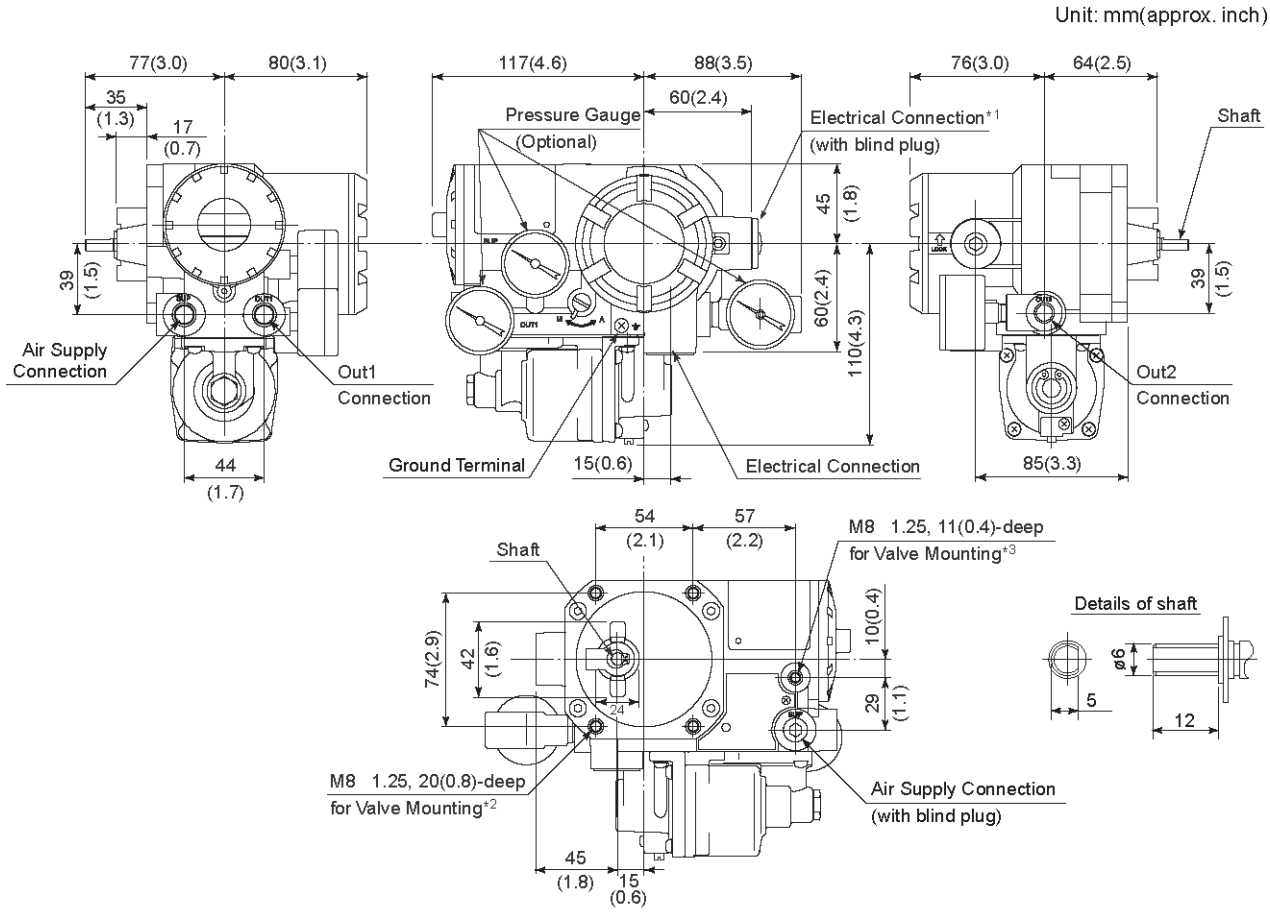


*1: Blind plug for Connection code 1, 5, and 6

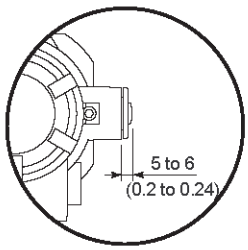


*2: Attached with 4 mounting bolts (M8, 25 mm) and spring washers (applicable 3 to 6 mm thick brackets).
*3: Available when unable to mount securely with the 4 bolts in *2.

Figure 46 Single Acting Actuator Dimensions



*1: Blind plug for Connection code 1, 5, and 6



*2: Attached with 4 mounting bolts (M8, 25 mm) and spring washers (applicable 3 to 6 mm thick brackets).
*3: Available when unable to mount securely with the 4 bolts in *2.

Figure 47 Double Acting Actuator Dimensions

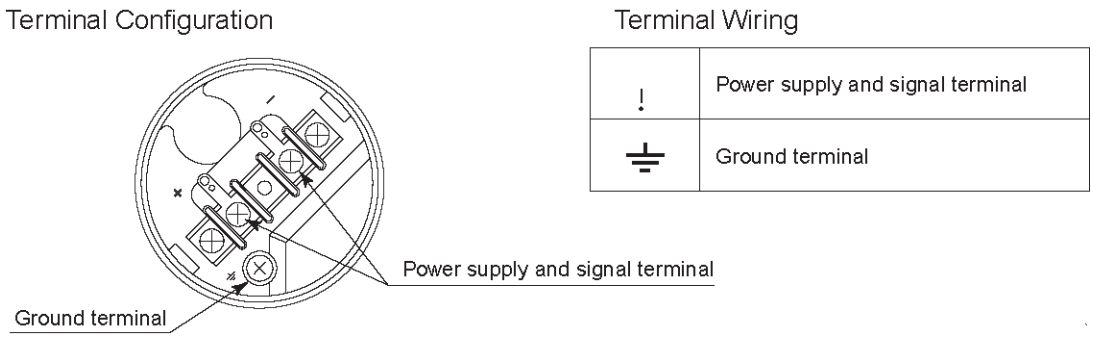


Figure 48 Terminal Configuration

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About Fieldbus

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Outline

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

FVP110 employs the specification standardized by The Fieldbus Foundation, and provides interoperability between GE Masoneilan devices and those produced by other manufacturers.

Fieldbus comes with software consisting of AO function block, two DI function blocks and optional PID function block, providing the means to implement a flexible instrumentation system.

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

Internal Structure of FVP110

The FVP110 contains two virtual field devices (VFD) that share the following functions.

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).
Function Block VFD	❑ Resource block - Manages the information common to each FB VFD in FVP110. ❑ Transducer block - Located between Hardware I/O (actuator, sensor) and AO/DI function blocks; passes the control signal from AO function block to I/P module to control the valve position. ❑ AO function block - Accepts a:

- ❑ Control signal from an upstream block and pass the signal to Transducer block.
- ❑ Valve position signal from Transducer block and feedbacks it to an upstream block.

❑ DI function block - Receives the discrete signal from Transducer block and outputs them.

❑ PID function block (optional) - Offers PID control function.

Logical Structure of Each Block

Setting of various parameters, node addresses, and PD Tags shown in Figure 49 is required before starting operation.

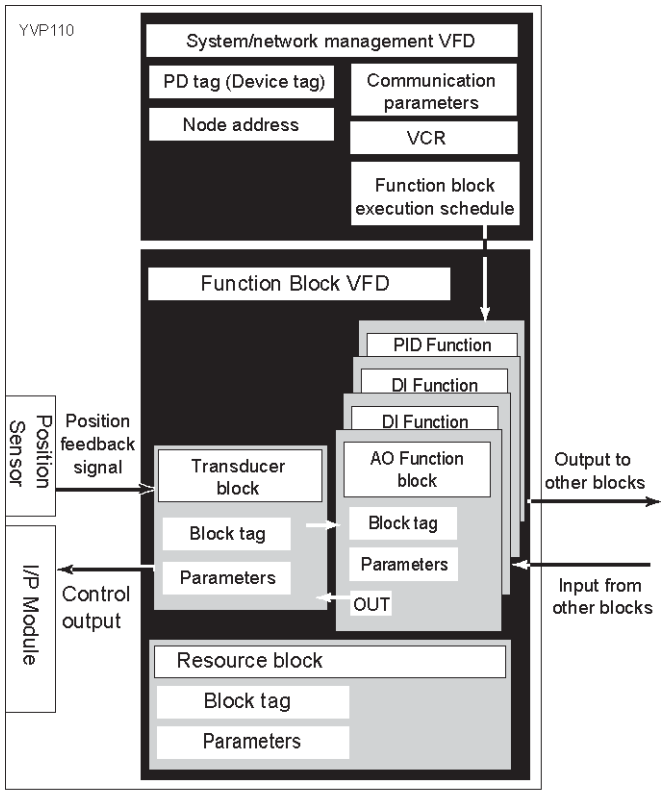

Figure 49 Logical Structure of Each Block

System Configuration

The following instruments are required for use with Fieldbus devices:

Power supply	Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.
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. FVP110 has passed the interoperability test conducted by The Fieldbus Foundation. In order to properly start Fieldbus, use the devices to satisfy the requirements of the above test.
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.
Cable	Used for connecting devices. Refer to *Fieldbus Technical Information* (TI 38K3A01-01E) for details of instrumentation cabling. Provide a cable sufficiently long to connect all devices. For field branch cabling, use terminal boards or a connection box, as required. If the total length of the cable is in a range of 2 to 3 meters for laboratory or other experimental use, use a twisted pair wire with a cross section of 0.9 mm^2 or more (AWG #18) and cycle period of within 5 cm (2"). Termination processing depends on the type of device being deployed. For FVP110, use an M4 screw terminal claw. Some hosts require a connector.

Refer to GE Masoneilan when making arrangements to purchase the recommended equipment.

The number of devices that can be connected to a single bus and the cable length vary depending on system design.

When constructing systems, both the basic and overall design must be carefully considered to allow device performance to be fully exhibited.

Connection of Devices

Connect the devices as shown in Figure 50.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.

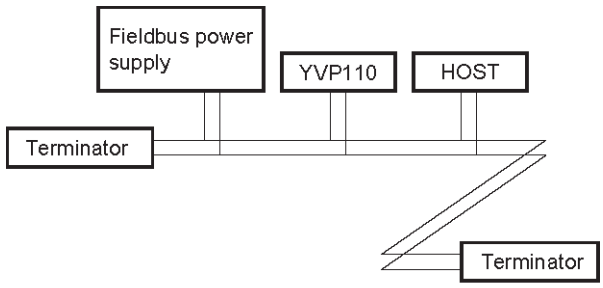

Figure 50 Cabling

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. Disconnect the relevant control loop from the bus if necessary.

Integration of DD

If the host supports DD (Device Description), install the DD of the FVP110. Check if the host has the following directory under its default DD directory:

594543/0001

594543/0007 (/EE) (594543 is the manufacturer number of GE Masoneilan, and 0001 or 0007 is the FVP110 device number, respectively.)

If this directory is not found, the DD of FVP110 has not been included:

1. Create the above directory.
2. Copy the DD file (0m0n.ffo,0m0n.sym) (m, n is a numeral) into the directory. The name and attribute of all parameters of the FVP110 appear.

Off-line configuration is done using the capability file (CFF). If you do not have the DD or capability file for the FVP110, download it from *www.masoneilan.com/fld/FIELDBUS/.*

CAUTION

For offline configuration, use the CFF which matches the specification of the instrument for configuration. For FVP110, there are two types of CFF file; one for standard type instruments and the other for the instruments with /LC1 option in which PID function block is available. Using unmatched CFF will cause an error on downloads, etc.

Configuration

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This section contains information on how to adapt the function and performance of the FVP110 to suit specific applications. Because two or more devices are connected to Fieldbus, settings including the requirements of all devices need to be determined. Practically, the following steps must be taken:

1. Network design - Determines the devices to be connected to Fieldbus and checks the capacity of the power supply.
2. Network definition - Determines the tag and node addresses for all devices.
3. Definition of combining function blocks - Determines the method for combination between each function block.
4. Setting tags and addresses - Sets the PD Tag and node addresses one-by-one for each device.
5. Communication setting - Sets the link between communication parameters and function blocks.
6. Block setting - Sets the parameters for function blocks.

“Network Design” on page 90 describes each step of the procedure in the order given. Using a dedicated configuration tool allows the procedure to be significantly simplified. This section describes the procedure to be assigned for a host which has relatively simple functions. For operation of the host, refer to the instruction manual for each host. No details of the host are explained in the rest of this material.

CAUTION

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

If the power is turned off within 40 seconds after setting is made, the modified parameters are not saved and settings return to original values.

Network Design

1. Select the devices to be connected to the Fieldbus network. Refer to “System Configuration” on page 87 for selection of the devices.
2. 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 FVP110 is 17 mA.
3. Ensure the cable has a spur in a minimum length with terminators installed at both ends of the trunk.

Network Definition

Define the Fieldbus network before connection of devices with Fieldbus. To do this:

1. 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). Use a hyphen as a delimiter, as required.
2. Define the node address for devices. This is used to specify devices for communication purposes. Because data is too long for a PD Tag, the host uses the node address in place of the PD Tag for communication.

   A range of 20 to 247 (or hexadecimal 0x14 to 0xF7) can be set. Generally, 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, is allocated from a larger address number (247) side, respectively (Table 12).

Table 12 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 51 cannot be used on a Fieldbus. For other address ranges, the range is periodically checked to identify when a new device is mounted. The address range *cannot* become wider, which can lead to exhaustive consumption of Fieldbus communication performance.

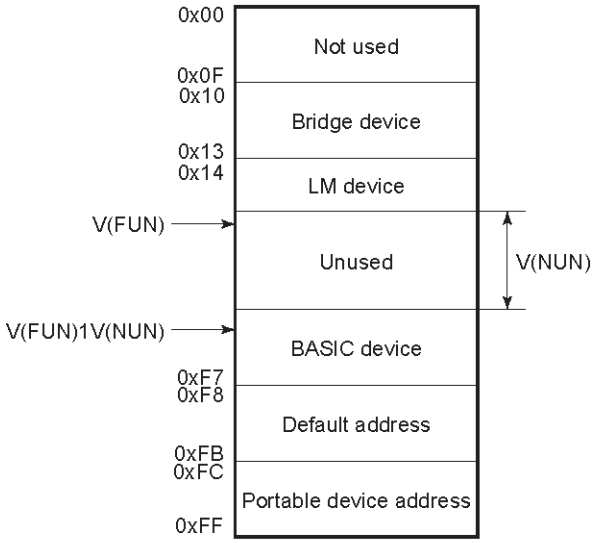

Figure 51 Available Range of Node Addresses

3. Ensure stable operation of Fieldbus by determining the operation parameters and setting them to the LM devices. The parameters in Table 13 must be set to the worst case value for all the devices connected to the same Fieldbus. Refer to the specification of each device for details. Table 13 lists FVP110 specification values.

Table 13 Operation Parameter Values of the FVP110 to be Set to LM Devices

Symbol	Parameters	Description
V (ST)	Slot-Time	Indicates the time necessary for immediate reply of the device. Unit of time is in octets (256 s). Set maximum specification for all devices. For FVP, set a value of 4 or greater.
V (MID)	Minimum-Inter-PDUDelay	Minimum value of communication data intervals. Unit of time is in octets (256 s). Set the maximum specification for all devices. For FVP, 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) 3V (ST) is the maximum value of the specification for all devices. For FVP, the setting must be a value of 12 or greater.

Definition of Combining Function Blocks

The input/output parameters for function blocks are combined. Practically, the setting is written to the FVP110 link object. See “Block Setting” on page 96 for details.

For the FVP110, in order to minimize the delay in data transfer between Transducer block and AO function block, transducer blocks are designed to execute in conjunction with the execution of AO function block. Therefore, in order to activate Transducer block, it is necessary that AO function block is always defined in the schedule.

Execute the combined blocks synchronously with other blocks on the communications schedule. In this case, change the FVP110 schedule according to Table 14. FVP110 schedule is set as shown in Table 14; change it as necessary.

Table 14 Execution Schedule of the FVP110 Function Blocks

Index	Parameters	Setting (Enclosed is factory-setting)
269 (SM)	MACROCYCLE_ DURATION	Cycle (MACROCYCLE) period of control or measurement. Unit is 1/32 ms. (32000 = 1 s)
276 (SM)	FB_START_ENTRY.1	AO block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32 ms. (32000 = 1 s)
278 (SM)	FB_START_ENTRY.2	-
	. . .	
289 (SM)	FB_START_ENTRY.14	-

Maximum execution times are:

- ❑ 95 ms for AO block
- ❑ 40 ms for each DI block
- ❑ 95 ms for an OS block
- ❑ 120 ms fora PID block.

For scheduling of communications for combination with the next function block, the execution is arranged to start after a lapse of longer than the times above mentioned. Two FVP110 function blocks *cannot* execute at the same time (execution time is overlapped).

Figure 53 shows an example of schedule based on the loop shown in Figure 52.

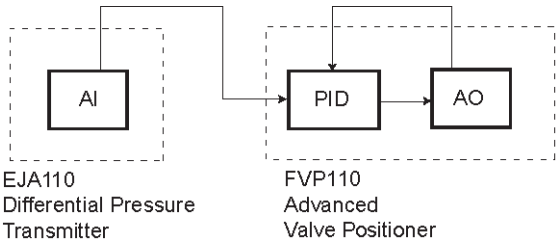

Figure 52 Example of Loop Connecting Function Block of FVP110 with Other Instruments

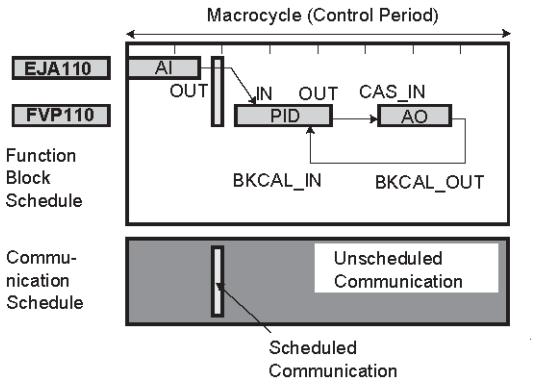

Figure 53 Function Block Schedule and Communication Schedule

For the case where the control period (macrocycle) is set to four seconds or longer, set the following interval larger than 1% of the macrocycle:

- The interval between *the end of block execution* and *the start of releasing CD from LAS*.
- The interval between *the end of a block execution* and *the start of the next block execution*.

Setting of Tags and Addresses

To set PD Tags and node addresses in the FVP110:

1. Connect the FVP110 with other network devices and turn on the power of the host and the bus.

   There are three states of Fieldbus devices (Figure 54), and if the state is other than the lowest SM_OPERATIONAL state, no function block is executed.

2. Transfer the FVP110 to the operational state when a tag or address is changed.

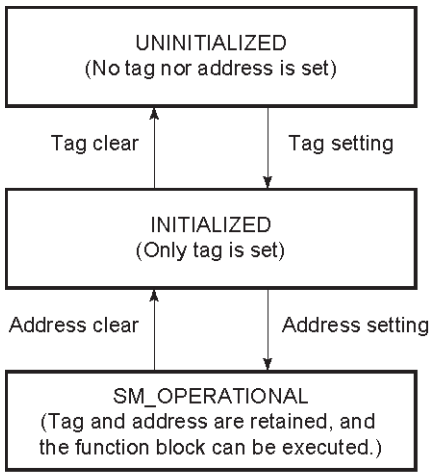

Figure 54 Status Transition by Setting PD Tag and Node Address

FVP110 has a PD Tag (CV1001) and node address (247, or hexadecimal 0xF7) that are set upon shipment from the factory, unless otherwise specified. If two FVP110s are connected at a time, one FVP110 keeps the shipment address, while the other has a default address (See Figure 52).

3. To:

   ❑ Change only the node address, clear the address once and then set a new node address.

   ❑ Set the PD Tag, first clear the node address and clear the PD Tag, then set the PD Tag and node address again.

   Devices whose node address was cleared await the default address (randomly chosen from a range of 248 to 251, or from hexadecimal 0xF8 to 0xFB).

4. Specify the device ID in order to correctly specify the device. The device ID of the FVP110 is *4456440001xxxxxxxx* or *4456440007xxxxxxxx*. The *xxxxxxxx* at the end of the device ID is a total of 8 alphanumeric characters.

Communication Setting

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

VCR Setting

Set VCR (Virtual Communication Relationship), which specifies the called party for communication and resources. FVP110 has 29 VCRs whose application can be changed, except for the first VCR, which is used for management. Change parameters together for each VCR, as modification for each parameter can cause inconsistent operation.

FVP110 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. A Server VCR is capable to respond to requests from a Client (QUB) VCR after the Client initiates connection to the Server successfully.
Source (QUU) VCR	A Source multicasts alarms or trends to other devices. This type of communication is called QUU (Queued User-triggered Unidirectional) VCR. A Source VCR transmits data without established connection. A Sink (QUU) VCR on another device can receive if the Sink is so configured.
Publisher (BNU) VCR	A Publisher multicasts AI block output to another function block(s). This type of communication is called BNU (Buffered Network-triggered Unidirectional) VCR. A Publisher VCR transmits data when LAS so requests.
Subscriber (BNU) VCR	A Subscriber receives the data from another function block(s). This type of communication is called BNU (Buffered Network-triggered Unidirectional) VCR. An explicit connection is established from Subscriber (BNU) VCR(s) so that a Subscriber knows the format of published data.

Function Block Execution Control

Use the instructions given in “Definition of Combining Function Blocks” on page 92 to set the execution cycle of the function blocks and schedule of execution.

Block Setting

Set the parameter for the VFD function block.

Link Object

Link object combines the data voluntarily sent by the function block with VCR. FVP110 has 25 non-factory set link objects. A single link object specifies one combination. Each link object has the parameters listed in Table 15. Change parameters together for each VCR, as modifications made to each parameter can cause inconsistent operation.

Table 15 Execution Schedule of the FVP110 Function Blocks

Sub-index	Parameters	Description
1	LocalIndex	Sets the index of function block parameters to be combined; set *0* for Trend and Alert.
2	VcrNumber	Sets the index of VCR to be combined. If set to *0*, this link object is not used.
3	RemoteIndex	Sets the index of remote object associated with this link object.
4	ServiceOperation	Set one of the following. Set only one each for link object for Alert or Trend. *0*: Undefined *1*: Local *2*: Publisher *6*: Alert *7*: Trend
5	StaleCountLimit	Set the maximum number of consecutive stale input values before the input status is set to BAD. Setting *2* or larger avoids unnecessary mode transfer caused when subscriber failed to receive data correctly.

Trend Object

You can set the parameter so that the function block automatically transmits Trend. FVP110 has seven non-factory set Trend objects, five for analog data, and two for discrete data. A single Trend object specifies the trend of one parameter.

Each Trend object has the parameters listed in Table 16. The first four are settable.

Table 16 Execution Schedule of the FVP110 Function Blocks

Sub-index	Parameters	Description
1	Block Index	Sets the leading index of the function block that takes a trend.
2	Parameter Relative Index	Sets the index of parameters taking a trend by a value relative to the beginning of the function block.
3	Sample Type	Specifies how trends are taken. Choose one: *1*: Sampled on function block execution. *2*: The average value is sampled.
4	Sample Interval	Specifies sampling intervals in units of 1/32 ms. Sets 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.

View Object

This is the object to form groups of parameters in a block. One of advantages brought by forming groups of parameters is the reduction of load for data transaction. FVP110 has 12 View objects for Transducer block and four View objects for each Resource, AO and DI1 and DI2 function block, and each View object has the parameters listed in Table 17 to Table 22.

Table 17 View Object for Transducer Block

Relative index	Parameters	VIEW 1	VIEW 2	VIEW 3 1st	VIEW 3 2nd	VIEW 4 1st	VIEW 4 2nd	VIEW 4 3rd	VIEW 4 4th	VIEW 4 5th	VIEW 4 6th	VIEW 4 7th	VIEW 4 8th
1	ST_REV	2	2	2	2	2	2	2	2	2	2	2	2
2	TAG_DESC												
3	STRATEGY					2							
4	ALERT_KEY					1							
5	MODE_BLK	4		4									
6	BLOCK_ERR	2		2									
7	UPDATE_EVT												
8	BLOCK_ALM												
9	TRANSDUCER_DIRECTORY												
10	TRANSDUCER_TYPE	2	2	2		2							
11	XD_ERROR	1		1									
12	CORRECTION_DIRCTORY												
13	FINAL_VALUE	5		5									
14	FINAL_VALUE_RANGE		11										
15	FINAL_VALUE_CUTOFF_HI					4							
16	FINAL_VALUE_CUTOFF_LO					4							
17	FINAL_POSITION_VALUE	5		5									
18	SERVO_GAIN					4							
19	SERVO_RESET					4							
20	SERVO_RATE					4							
21	ACT_FAIL_ACTION					1							
22	ACT_MAN_ID					4							
23	ACT_MODEL_NUM					32							
24	ACT_SN					32							
25	VALVE_MAN_ID						4						
26	VALVE_MODEL_NUM						32						
27	VALVE_SN						32						
28	VALVE_TYPE						1						
29	XD_CAL_LOC							32					
30	XD_CAL_DATE							7					
31	XD_CAL_WHO							32					
32	ALARM_SUM	8		8									
33	POSITION_CHAR_TYPE		1										
34	POSITION_CHAR												
35	LIMSW_HI_LIM		4										
36	LIMSW_LO_LIM		4										
37	ELECT_TEMP	4		4									
38	TEMPERATURE_UNIT		2										
39	SUPPLY_PRESSURE		4										
40	SPRING_RANGE		11										
41	OUT_PRESSURE	4		4									
42	SERVO_OUTPUT_SIGNAL	4		4									
43	SERVO_RATE_GAIN						4						
44	SERVO_DEADBAND						4						
45	SERVO_OFFSET						4						
46	BOOST_ON_THRESHOLD							8					

Table 11 View Object for Transducer Block (continued)

Relative index	Parameters	VIEW 1	VIEW 2	VIEW 3 1st	VIEW 3 2nd	VIEW 4 1st	VIEW 4 2nd	VIEW 4 3rd	VIEW 4 4th	VIEW 4 5th	VIEW 4 6th	VIEW 4 7th	VIEW 4 8th
47	BOOST_OFF_THRESHOLD							8					
48	BOOST_VALUE							8					
49	SERVO_I_SLEEP_LMT						4						
50	SERVO_P_ALPHA						4						
51	INTERNAL_GAIN						4						
52	MEAS_GAIN								4				
53	VALVE_TC								4				
54	VALVE_HYS								4				
55	VALVE_SLIP_WIDTH								4				
56	MEAS_PRESS_AIR								4				
57	MEAS_PRESS_SUPPLY								4				
58	MEAS_SPRING_RANGE								8				
59	CONTROL_DIR								1				
60	THETA_HI		4										
61	THETA_LO		4										
62	THETA_P		4										
63	TRAVEL_CALIB_EXEC			1									
64	TRAVEL_CALIB_RESULT		1										
65	OPEN_STOP_ADJ		4										
66	AUTO_TUNE_EXEC			1									
67	AUTO_TUNE_RESULT		1										
68	AUTO_TUNE_STATE			1									
69	SERVO_RET_TO_DEFAULT			1									
70	ADVAL_FW			2									
71	ADVAL_BW			2									
72	ADVAL_PRESS			2									
73	ADVAL_T			2									
74	TOTAL_CYCLE_COUNT			4									
75	CYCLE_DEADBAND								4				
76	CYCLE_COUNT_LIM								4				
77	TOTAL_TRAVEL			4									
78	TRAVEL_DEADBAND								4				
79	TRAVEL_LIM								4				
80	TOTAL_OPEN_TIME			4									
81	TOTAL_CLOSE_TIME			4									
82	OPEN_CLOSE_THRESHOLD								4				
83	OPEN_TIME_LIM								4				
84	CLOSE_TIME_LIM								4				
85	TOTAL_NEAR_CLOSE_TIM			4									
86	NEAR_CLOSE_THRESHOLD								4				
87	NEAR_CLOSE_TIME_LIM								4				
88	DEVIATION_LIM									4			
89	DEVIATION_TIME_TH									8			
90	RELEASE_FAILSAFE			1									
91	MODEL								32				
92	DEV_OPTIONS									2			

Table 11 View Object for Transducer Block (continued)

Relative index	Parameters	VIEW 1	VIEW 2	VIEW 3 1st	VIEW 3 2nd	VIEW 4 1st	VIEW 4 2nd	VIEW 4 3rd	VIEW 4 4th	VIEW 4 5th	VIEW 4 6th	VIEW 4 7th	VIEW 4 8th
93	PRESS_SENS_INSTALLED									1			
94	ACTUATOR_TYPE									1			
95	RELAY_TYPE									1			
96	SIGN_MEAS_EXEC			1									
97	SIGN_MEAS_RESULT									1			
98	SIGN_MEAS_STATE			1									
99	SIGN_MEAS_COUNTER			2									
100	SIGN_DATA_SAVE				1								
101	SIGN_UPLOAD_DATABASE									1			
102	SIGN_UPLOAD_POINTER									2			
103	SIGN_DATA_X												
104	SIGN_DATA_Y												
105	SIGN_MEAS_DATE			7									
106	SIGN_HEADER_DATA				28								
107	STD_ACT_SIGN_SET									12			
108	EXT_ACT_SIGN_SET									24			
109	STEP_RESP_SET									16			
110	POSITIONER_SIGN_SET									20			
111	SERVO_WARN_HI_LIM											4	
112	SERVO_WARN_LO_LIM											4	
113	SERVO_TIME_TH											4	
114	SERVO_WARN_COUNT				4								
115	X_BST_ON_THRESHOLD												8
116	X_BST_OFF_THRESHOLD												8
117	X_BOOST_VALUE												8
118 to 165	TEST_1 to TEST_47 *1			14	69						87	76	
	Total (in bytes)	41	59	99	104	96	95	97	103	95	89	90	26

*1: These parameters are not usually used.

“TEST_48 (Relative index 165)” applies to option code EE.

Table 18 View Object for AO Function Block

Relative index	Parameters	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	SIMULATE				
11	PV_SCALE		11		
12	XD_SCALE		11		
13	GRANT_DENY		2		
14	IO_OPTS				2
15	STATUS_OPTS				2
16	READBACK	5		5	
17	CAS_IN	5		5	
18	SP_RATE_DN				4
19	SP_RATE_UP				4
20	SP_HI_LIM		4		
21	SP_LO_LIM		4		
22	CHANNEL				2
23	FSAFE_TIME				4
24	FSAFE_VAL				4
25	BKCAL_OUT			5	
26	RCAS_IN			5	
27	SHED_OPT				1
28	RCAS_OUT			5	
29	UPDATE_EVT				
30	BLOCK_ALM				
	Total (in bytes)	33	34	48	28

Table 19 View Object for DI1, DI2 Function Block

Relative index	Parameters	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV_D	2		2	
8	OUT_D	2		2	
9	SIMULATE_D				
10	XD_STATE		2		
11	OUT_STATE		2		
12	GRANT_DENY		2		
13	IO_OPTS				2
14	STATUS_OPTS				2
15	CHANNEL				2
16	PV_FTIME				4
17	FIELD_VAL_D	2		2	
18	UPDATE_EVT				
19	BLOCK_ALM				
20	ALARM_SUM	8		8	
21	ACK_OPTION				2
22	DISC_PRI				1
23	DISC_LIM				1
24	DISC_ALM				
	Total (in bytes)	22	8	22	19

Table 20 View Object for OS Function Block

Relative index	Parameters	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	SP	5		5	
8	OUT_1	5		5	
9	OUT_2	5		5	
10	OUT_1_RANGE		11		
11	OUT_2_RANGE		11		
12	GRANT_DENY		2		
13	STATUS_OPTS				2
14	CAS_IN	5		5	
15	BKCAL_OUT			5	
16	IN_ARRAY				16
17	OUT_ARRAY				16
18	LOCKVAL				1
19	BKCAL_IN_1			5	
20	BKCAL_IN_2			5	
21	BAL_TIME				4
22	HYSTVAL				4
23	UPDATE_EVT				
24	BLOCK_ALM				
	Total (in bytes)	28	26	43	48

Table 21 View Object for PID Function Block

Relative index	Parameters	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				

Relative index	Parameters	VIEW 1	VIEW 2	VIEW 3	VIEW 4
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				
	Total (in bytes)	43	43	83	104

Table 22 View Object for Resource Block

Relative index	Parameters	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	RS_STATE	1		1	
8	TEST_RW				
9	DD_RESOURCE				
10	MANUFAC_ID				4
11	DEV_TYPE				2
12	DEV_REV				1
13	DD_REV				1
14	GRANT_DENY		2		
15	HARD_TYPES				2
16	RESTART				
17	FEATURES				2
18	FEATURE_SEL		2		
19	CYCLE_TYPE				2
20	CYCLE_SEL		2		
21	MIN_CYCLE_T				4
22	MEMORY_SIZE				2
23	NV_CYCLE_T		4		
24	FREE_SPACE		4		
25	FREE_TIME	4		4	
26	SHED_RCAS		4		
27	SHED_ROUT		4		
28	FAULT_STATE	1		1	
29	SET_FSTATE				
30	CLR_FSTATE				
31	MAX_NOTIFY				1
32	LIM_NOTIFY		1		
33	CONFIRM_TIME		4		
34	WRITE_LOCK		1		
35	UPDATE_EVT				
36	BLOCK_ALM				
37	ALARM_SUM	8		8	
38	ACK_OPTION				2
39	WRITE_PRI				1
40	WRITE_ALM				
41	ITK_VER				2
42	SOFT_REV				
43	SOFT_DESC				
44	SIM_ENABLE_MSG				

Relative index	Parameters	VIEW 1	VIEW 2	VIEW 3	VIEW 4
45	DEVICE_STATUS_1			4	2
46	DEVICE_STATUS_2			4	
47	DEVICE_STATUS_3			4	2
48	DEVICE_STATUS_4			4	1
49	DEVICE_STATUS_5			4	
50	DEVICE_STATUS_6			4	
51	DEVICE_STATUS_7			4	
52	DEVICE_STATUS_8			4	
	Total (in bytes)	22	30	54	31

Table 23 Indexes of View for Each Block

	VIEW_1	VIEW_2	VIEW_3	VIEW_4
Resourse Block	40100	40101	40102	40103
Transducer Block	40200	40201	40202 through 40203	40204 through 40210
AO Function Block	40500	40501	40502	40503
DI1 Function Block	40600	40601	40602	40603
DI2 Function Block	40610	40611	40612	40613
OS Function Block	41400	41401	41402	41403
PID Function Block	40800	40801	40802	40803

Table 24 View Object for IS (SIGSEL) Block

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	OUT	5		5	
8	OUT_RANGE		11		
9	GRANT_DENY		2		
10	STATUS_OPTS				2
11	IN_1	5		5	
12	IN_2	5		5	
	Subtotals	23	15	23	7

Index	Parameter Mnemonic	VIEW _1	VIEW _2	VIEW _3	VIEW _4
13	IN_3	5		5	
14	IN_4	5		5	
15	DISABLE_1	2		2	
16	DISABLE_2	2		2	
17	DISABLE_3	2		2	
18	DISABLE_4	2		2	
19	SELECT_TYPE				1
20	MIN_GOOD				1
21	SELECTED	2		2	
22	OP_SELECT	2		2	
23	UPDATE_EVT				
24	BLOCK_ALM				
	From left column	23	15	23	7
	Totals	45	15	45	9

Table 25 AR Block Arithmetic Block Access

Index	Parameter Mnemonic	VIEW _1	VIEW _2	VIEW _3	VIEW _4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	OUT	5		5	
9	PRE_OUT	5		5	
10	PV_SCALE		11		
11	OUT_RANGE		11		
12	GRANT_DENY		2		
13	INPUT_OPTS				2
14	IN			5	
15	IN_LO			5	
16	IN_1			5	
17	IN_2			5	
18	IN_3			5	
	Subtotals	23	26	48	7

Index	Parameter Mnemonic	VIEW _1	VIEW _2	VIEW _3	VIEW _4
19	RANGE_HI				4
20	RANGE_LO				4
21	BIAS_IN_1				4
22	GAIN_IN_1				4
23	BIAS_IN_2				4
24	GAIN_IN_2				4
25	BIAS_IN_3				4
26	GAIN_IN_3				4
27	COMP_HI_LIM				4
28	COMP_LO_LIM				4
29	ARITH_TYPE				1
30	BAL_TIME				4
31	BIAS				4
32	GAIN				4
33	OUT_HI_LIM				4
34	OUT_LO_LIM				4
35	UPDATE_EVT				
36	BLOCK_ALM				
	From left column	23	26	48	7
	Totals	23	26	48	68

Function Block Parameters

Function block parameters are read from the host or can be set. For a list and details of the parameters of blocks held by the FVP110, refer to the section for each function block and the list of parameters in the latter part of this manual.

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Actions of the FVP110 During Operation

11

Block Modes

All function blocks have modes. All blocks have their mode, expressed by the MODE_BLK parameter. It is a structure of four components:

Target — This is the mode into which an operator wants to bring this block and is writable.

Actual — This mode shows the actual mode of the block and is read-only. When necessary conditions are satisfied, this mode becomes same as target. There is a chance that actual mode says different from target by some reason.

Permitted — This mode shows which mode is allowed in the function block.

Normal — This mode is a memo to record mode what an operator expects in normal conditions.

Table 26 shows the modes supported by each FVP110 function block. Modes marked with *( )* cannot be specified as *target*.

Table 26 Block Modes

Function Block	Modes
Resource	Auto, O/S
Transducer	Auto, O/S
AO	RCas, Cas, Auto, Man, (LO), (IMan), O/S
DI	Auto, Man, O/S
OS	Auto, Cas, (IMan), O/S
AR	Auto, Man, and O/S
IS	Auto, Man, and O/S
PID and PID2	ROut, RCas, Cas, Auto, Man, (LO), (IMan), O/S

The following are outlines of each mode:

O/S mode	Out of Service mode, in which the block does not run, and its output and setpoint maintain their previous values.
IMan mode	Initialization Manual mode. Only the AO and PID blocks in the FVP110 support this mode. When one of these blocks detects a loss of a correct path to the downstream block (such as when the downstream block is in the O/S, Man, Auto or LO mode), it enters IMan mode. For example, when the data status of BKCAL_IN in a PID block is *bad* or *good*: *not invited*, the PID block enters IMan mode.
LO mode	Local Override mode. If the PID block enters LO mode, the block output follows the tracking value (TRK_VAL). In AO block, the block enters LO mode when the block detects the fault status. In this case, the block holds the output or outputs the pre-configured value (FSTATE_VALUE) according to the setting of options.
Man mode	Manual mode. If the data status of a function block's input is bad or its target mode is Man, the block enters Man mode. In Man mode, the function block does not update its OUT value. If the target is also Man, it allows you to write a desired value to it.
Auto mode	In Auto mode, the function block performs the specified calculations based on the setpoint and outputs the result, independently without interlocking with another function block. You can write the setpoint of a function block in this mode if the target is Auto. If the target mode of a function block is Auto, or if both of the following conditions are met for a function bock, the block enters Auto mode: ❑ The target mode is Cas or RCas. ❑ There is an error in communication with the upstream function block.
Cas mode	Cascade mode. In Cas mode, the function block performs the specified calculations based on the setpoint input from a different function block via the cascade input parameter and outputs the result.
ROut mode	Remote Output mode. In ROut mode, the output of the function block is set to the value of the remote output parameter that is written by a host computer or others. To prevent a sudden change in output, the block's calculations are initialized when a change in mode occurs.

RCas mode

Remote Cascade mode. In RCas mode, the function block performs the specified calculations based on the setpoint that is input from host computer or others via the remote cascade parameter, and outputs the result.

Table 27 shows examples of block mode combinations in a FVP110. When a block changes mode or the data status of a signal changes for some reason, the other blocks connected to that block identify the change by detecting the change in status of an input signal, and change their modes, too. For example, when the data status of BKCAL_IN in a PID block changes to bad, the PID block automatically changes mode to IMan to initialize the control of its downstream block.

Table 27 Examples of Block Mode Combinations and Operation Statuses

Operation Statuses	AI	PID	AO	TB
Transducer Initial setup, valve setup (when carrying out auto tuning, travel calibration, etc.)	-	-	O/S	O/S
Modification of parameter settings in transducer block (modification of control parameter settings, etc.)	-	-	O/S	O/S
Constant valve position control	-	-	Auto	Auto
PID single-loop control	Auto	Auto	Cas	Auto
PID cascade-loop control	Auto	Primary PID: Auto Secondary PID: Cas	Cas	Auto

The respective modes that each block enters on occurrence of a communication error and at a restart, and the handling of signals in each mode can be defined in the block's option parameters such as IO_OPTS and STATUS_OPTS. For details, see the detailed descriptions of each function block.

Alarm Generation

When the FVP110 detects an abnormality in the device using the self-diagnostic function, a device alarm is issued from the resource or transducer block. An abnormality in a function block or in a process value is issued from the corresponding block as a block error or process alarm.

A FVP110 can report the following alarms and events.

Analog alerts — A type of alarm generated when a process value or a deviation value exceeds a specified limit in the following blocks: PID block : HI, HI_HI, LO, LO_LO, DV_HI, DV_LO

Discrete alerts — A type of alarm generated when an abnormal status is detected:

- ❑ Resource block - a discrete alert is generated as a block alarm or write-error alarm.
- ❑ DI block - a discrete alert is generated as a block alarm or DISC alarm.
- ❑ Transducer, AO and PID block, a discrete alert is only generated as a block alarm.

Update alerts — Generated when a change is made to the settings of certain parameters.

Table 28 shows the elements composing an alert object.

Table 28 Alert Objects

Subindex			Parameter Name	Description
Analog Alert	Discrete Alert	Update Alert		
1	1	1	Block Index	Leading Index to the block where the alert occurs
2	2	2	Alert Key	Copy of ALERT_KEY
3	3	3	Standard Type	Type of the alert that occurred
4	4	4	Mfr Type	The name of the alert defined in the device description (DD) file written by the device manufacturer.
5	5	5	Message Type	Cause of the alert
6	6	6	Priority	Priority level of the alert
7	7	7	Time Stamp	Time when the alert occurred first
8	8		Subcode	Subcode that indicates the cause of the alert

Table 28 Alert Objects (Continued)

Subindex			Parameter Name	Description
Analog Alert	Discrete Alert	Update Alert		
9	9		Value	Value of the related data
10	10		Relative Index	Relative Index to the related data
		8	Static Revision	Value of ST_REV in the block
11	11	9	Unit Index	Unit code of the related data

Simulation Function

The FVP110 has a function to simulate input signals to its internal function blocks to make the blocks to carry out the specified actions to allow for testing applications in the host computer or alarm handling processes. Each function block has a parameter to switch on/off the simulation function. To prevent this parameter setting from being modified during plant operation by mistake, a hardware switch labeled SIM.ENABLE is provided on the FVP110's amplifier assembly (Figure 55).

To engage this function:

- ❑ Slide the switch position to *ON*.

or

- ❑ Remotely write *REMOTE LOOP TEST SWITCH* to *SIM_ENABLE_MSG*. However, the value of SIM_ENABLE_MSG is lost when the power to the FVP110 is turned off.

When the simulation can be carried out, alarms generated from the resource blocks mask the other device alarms. Hence, simulation must be disabled immediately after it has finished.

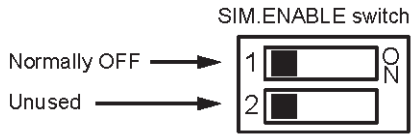

Figure 55 SIM.ENABLE Switch

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Resource Block

12

General

The resource block stores device hardware information related to all function blocks in the same device, such as the memory size, and controls the device hardware and internal function blocks. *Regardless of the execution schedule of the function blocks, the resource block runs at a certain interval.*

Alarm Processing

The resource block generates a block alarm in the following cases:

- ❑ An error represented by a bit in BLOCK_ERROR (Table 29) has occurred (identified as a Block alarm).
- ❑ A static parameter has been written (identified as an update event).
- ❑ The value of a write-locked parameter has been modified (identified as Write alarm).

Table 29 BLOCK_ERROR in Resource Block

Bit	Name of Error Represented	Cause
3	Simulate Active	SIMULATE is active.
5	Device Fail Safe Set	Fail safe function is set.
10	Lost Static Data	
11	Lost NV Data	
13	Device Needs Maintenance Now	Needs servicing urgently.
15	Out-of-Service	The target mode is O/S.

Device Status

When a fault occurs, the corresponding bits in the parameters DEVICE_STATUS_1 to _3 of the resource block are set on. Table 30 to Table 32 show the codes and indications corresponding to the individual bits in DEVICE_STATUS_ 1 to _3 as well as the meanings represented.

Table 30 DEVICE_STATUS_1

Hexadecimal Indication	Indication when Device Description is Installed	Meaning
0x80000000		
0x40000000		
0x20000000		
0x10000000		
0x08000000		
0x04000000		
0x02000000	Download fail	Download fail
0x01000000	Download incomplete	Download incomplete
0x00800000	Sim.enable Jmpr On	
0x00400000	RB is in O/S mode	
0x00200000		
0x00100000		
0x00080000	EEPROM Failure	
0x00040000		
0x00020000		
0x00010000		
0x00008000	Link Obj.1/17 not open	The VCR*1 to which link object 1 or 17 is specified to be linked is not open.
0x00004000	Link Obj.2/18 not open	The VCR*1 to which link object 2 or 18 is specified to be linked is not open.
0x00002000	Link Obj.3/19 not open	The VCR*1 to which link object 3 or 19 is specified to be linked is not open.

Table 30 DEVICE_STATUS_1 (Continued)

Hexadecimal Indication	Indication when Device Description is Installed	Meaning
0x00001000	Link Obj.4/20 not open	The VCR*1 to which link object 4 or 20 is specified to be linked is not open.
0x00000800	Link Obj.5/21 not open	The VCR*1 to which link object 5 or 21 is specified to be linked is not open.
0x00000400	Link Obj.6/22 not open	The VCR*1 to which link object 6 or 22 is specified to be linked is not open.
0x00000200	Link Obj.7/23 not open	The VCR*1 to which link object 7 or 23 is specified to be linked is not open
0x00000100	Link Obj.8/24 not open	The VCR*1 to which link object 8 or 24 is specified to be linked is not open.
0x00000080	Link Obj.9/25 not open	The VCR*1 to which link object 9 or 25 is specified to be linked is not open.
0x00000040	Link Obj.10 not open	The VCR*1 to which link object 10 is specified to be linked is not open.
0x00000020	Link Obj.11 not open	The VCR*1 to which link object 11 is specified to be linked is not open.
0x00000010	Link Obj.12 not open	The VCR*1 to which link object 12 is specified to be linked is not open.
0x00000008	Link Obj.13 not open	The VCR*1 to which link object 13 is specified to be linked is not open.
0x00000004	Link Obj.14 not open	The VCR*1 to which link object 14 is specified to be linked is not open.
0x00000002	Link Obj.15 not open	The VCR*1 to which link object 15 is specified to be linked is not open.
0x00000001	Link Obj.16 not open	The VCR*1 to which link object 16 is specified to be linked is not open.

*1: VCR: Virtual Communications Relationship

Table 31 DEVICE_STATUS_2

Hexadecimal Indication	Indication when Device Description is Installed	Meaning
0x80000000		
0x40000000		
0x20000000		
0x10000000		
0x08000000		
0x04000000		
0x02000000	TB TRAVEL_ CALIB_RESULT not Succeeded	Travel Calibration has not been succeeded.
0x01000000	TB AUTO_ TUNE_RESULT not Succeeded	Auto tuning has not been succeeded.
0x00800000		
0x00400000		
0x00200000	OS BLOCK_ERR not Zero	Block Error has occurred in the OS block.
0x00100000	PID BLOCK_ERR not Zero	Block Error has occurred in the PID block.
0x00080000	DI2 BLOCK_ERR not Zero	Block Error has occurred in the DI2 block.
0x00040000	DI1 BLOCK_ERR not Zero	Block Error has occurred in the DI1 block.
0x00020000	AO BLOCK_ERR not Zero	Block Error has occurred in the AO block.
0x00010000	TB XD_ERROR not Zero	XD Error has occurred in the Transducer block.
0x00008000	TB in Signature executing	Signature is proceeding.
0x00004000		
0x00002000		
0x00001000	PID in Bypass active	Bypass is activated in PID block.
0x00000800	DI2 in Simulate active	SIMULATE is activated in DI2 block.
0x00000400	DI1 in Simulate active	SIMULATE is activated in DI1 block.
0x00000200	AO in Simulate active	SIMULATE is activated in AO block.
0x00000100	TB in Auto tuning	Auto tuning is proceeding.

Table 31 DEVICE_STATUS_2 (Continued)

Hexadecimal Indication	Indication when Device Description is Installed	Meaning
0x00000080		
0x00000040		
0x00000020	OS in O/S mode	OS block is in O/S mode.
0x00000010	PID in O/S mode	PID block is in O/S mode.
0x00000008	DI2 in O/S mode	DI2 block is in O/S mode.
0x00000004	DI1 in O/S mode	DI1 block is in O/S mode.
0x00000002	AO in O/S mode	AO block is in O/S mode.
0x00000001	TB in O/S mode	TB block is in O/S mode.

Table 32 DEVICE_STATUS_3

Hexadecimal Indication	Indication when Device Description is Installed	Meaning
0x80000000		
0x40000000		
0x20000000		
0x10000000		
0x08000000		
0x04000000		
0x02000000		
0x01000000		
0x00800000		
0x00400000		
0x00200000		
0x00100000		
0x00080000		
0x00040000		
0x00020000		
0x00010000		

Table 32 DEVICE_STATUS_3 (Continued)

Hexadecimal Indication	Indication when Device Description is Installed	Meaning
0x00008000	Servo output drift warning	Shows the contents of the XD_ERROR in the transducer block. Refer to Table 36 on page 130 for details.
0x00004000	A/D Converter failure	
0x00002000	Position sensor failure	
0x00001000	Deviation error	
0x00000800	Severe servo output drift	
0x00000400	Pressure sensor failure	
0x00000200	Temperature sensor failure	
0x00000100	Deviation warning	
0x00000080	Position sensor out of range	
0x00000040	Pressure sensor out of range	
0x00000020	Temperature sensor out of range	
0x00000010	Total near close limit exceed	
0x00000008	Total close limit exceed	
0x00000004	Total open limit exceed	
0x00000002	Travel limit exceed	
0x00000001	Cycle count limit exceed	

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Transducer Block

13

General

The transducer block works as an interface between the hardware I/O (actuator, sensor) and internal function blocks. Most functions of the FVP110 as a valve positioner are packed in the transducer block. Major functions of the transducer blocks include:

- ❑ Transmission and reception of setpoint and readback signals for valve position
- ❑ Setpoint high/low limiters
- ❑ Auto tuning
- ❑ Valve tight-shut and full-open actions
- ❑ Valve position-to-flow rate characteristics conversion
- ❑ Travel calibration
- ❑ Diagnostics of valve and positioner
- ❑ Valve position limit switches
- ❑ Pressure and temperature measurement (pressure measurement requires the optional sensor)
- ❑ Fail safe

The FVP110 transducer block is connected to an AO function block and two DI blocks via its channels as shown in Table 33 and Figure 56.

Table 33 Correspondence between Channels and I/O Signals

Channel	Signal	Description
1	Analog input/output	Setpoint and readback signals
2	Discrete output	High limit switch status
3	Discrete output	Low limit switch status

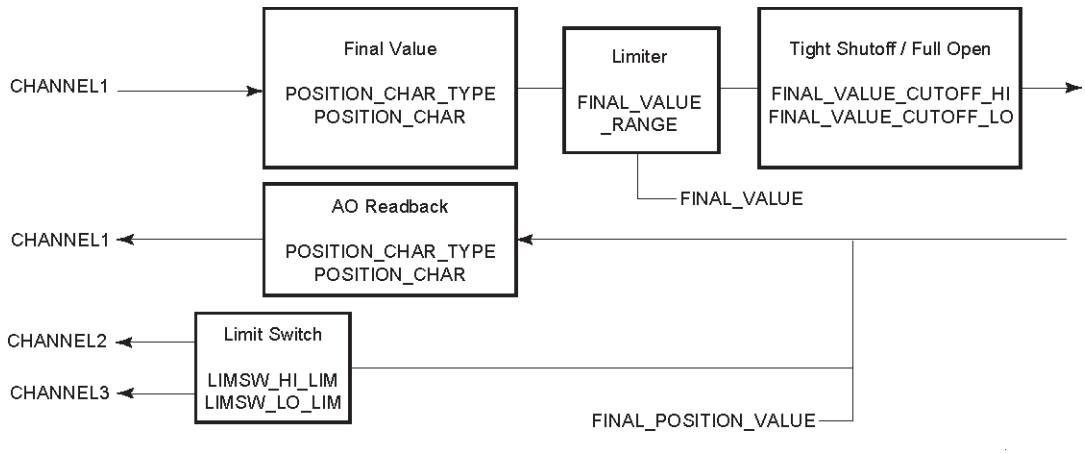

Figure 56 Function Diagram of Transducer Block

Position-to-flow Rate Characteristic Conversion

The parameter POSITION_CHAR_TYPE defines the characteristics between the valve position and flow rate, and is set to one the following:

- ❑ 1 = linear
- ❑ 2 = equal percent (50:1)
- ❑ 3 = equal percent (30:1)
- ❑ 4 = quick open (reversal of equal percent 50:1)
- ❑ 5 = Camflex Percentage
- ❑ 255 = user-defined

Writing the value 255 allows you to define the desired characteristics by 10 line segments for evenly divided input levels. The coordinates (0,0) and (100,100) are fixed; set the values corresponding to OUT (Output of AO block) = 10%, 20%, 30%..., 80%, 90%. A set value must be greater than the preceding set value; the output must increase as the input increases.

This flow rate conversion is applied to the signal in the backward path as well.

FINAL_VALUE and Range

The parameter FINAL_VALUE contains the valve position setpoint for valve control, and its value is always a percent value where 0% is the shut-off position as is the case for the input signal. High and low limits for the value of FINAL_VALUE.value can be set in FINAL_VALUE_RANGE.

Tight-shut and Full-open Actions

The tight-shut action decreases the output pressure to a level much lower than the 0% pressure level for an air-to-open valve (or increases it to a level much higher than the 0% pressure level for an air-to-close valve) when FINAL_VALUE.value is less than FINAL_VALUE_CUTOFF_LO in order to ensure that the valve is tightly shut off. After the tight-shut action is activated, when FINAL_VALUE.value becomes greater than FINAL_VALUE_CUTOFF_LO by 1% or more, the tightshut action turns off.

Conversely, the full-open action increases the output pressure to a level much higher than the 100% pressure level for an air-to-open valve (or decreases it to a level much lower than the 100% pressure level for an air-to-close valve) when FINAL_VALUE.value is larger than FINAL_VALUE_CUTOFF_HI in order to ensure that the valve is fully open. After the full-open action is activated, when FINAL_VALUE.value becomes less than FINAL_VALUE_CUTOFF_HI by 1% or more, the fullopen action turns off.

Although the actual output signal level is changed to a level outside the range during the period when the tight-shut or full-open action is on, the value of FINAL_VALUE.value remains as computed and is not affected by these actions.

Backward Path

The following describes the signal input from the device hardware to the transducer block, which is then passed to other function blocks.

FINAL_POSITION_VALUE

The parameter FINAL_POSITION_VALUE contains a percentage value of the valve position sent from the position sensor where 0% is the shut-off position as is the case for FINAL_VALUE.value. When one or more of the following conditions become true, the data status of FINAL_POSITION_VALUE becomes Bad, which is sent to the connected AO block and upstream function blocks:

- ❑ Bad - Out of service: The block is in the O/S mode.
- ❑ Bad - Sensor failure: The position sensor has failed.
- ❑ Bad - Device failure: The A/D converter has failed.
- ❑ Bad - Non specific: The deviation exceeds the limit.

Limit Switches

Limit switches monitor whether the valve position has reached a specified high or low limit position and sends the high limit switch status to channel 2 and the low limit switch status to channel 3. The thresholds (settings) for the high and low limit switches are set in LIMSW_HI_LIM and LIMSW_LO_LIM. The switch statuses sent to channels 2 and 3 mean:

- ❑ 0 = off (inactive)
- ❑ 1 = on (active)

Hysteresis of 1% is applied for both High and Low limit switch. While the limit switch of high side stays ON, it turns to OFF again only when the value of FINAL_POSITION_VALUE becomes smaller by 1% or less than the value of LIMSW_HI_LIM. Also, while limit switch of the low side stays ON, it turns to OFF again only when the value of FINAL_POSITION_VALUE becomes greater by 1% or more than the value of LIMSW_LO_LIM.

Auto Tuning

WARNING

This function strokes the valve over its full range. Do not execute while valve is controlling the process. Keep away from the movable parts to avoid injury.

Auto tuning checks the valve responses and automatically tunes control parameter settings. The actions performed are chosen as shown in Table 34. To carry out auto tuning, see “Carrying out Tuning” on page 61. Before carrying out auto tuning, change the modes of the AO function block and transducer block to O/S.

Table 34 Types of Auto Tuning

Value	Comment	Description
1	Off	—
2	Travel calibration tuning at stop point	Travel calibration at the tight-shut and full-open positions
3	Control parameter tuning	Tuning of control parameters
4	Travel calibration at stop point and Control parameter tuning	Sequential execution of travel calibration and control parameter tuning
5	Cancel execution	Cancellation of auto tuning execution
6	Travel calibration at stop point without time out (for very large valve)	Zero-point and span calibration at the tight-shut and full-open positions without time out

Table 34 Types of Auto Tuning (Continued)

Value	Comment	Description
7	Travel calibration with step by step (for very large valve)	Step-by-step travel calibration at the tight-shut and full-open positions
255	Self-check only	Execution of self-diagnostics only (without parameter tuning)

NOTE

Auto Tuning sets the 0% point at the position where the valve is fully closed and 100% point at the position where the valve stem stops against the mechanical stopper (fully open). If it is necessary to adjust the zero point and span precisely to the rated stroke of the valve, carry out travel calibration.

The result of auto tuning, which is written to AUTO_TUNE_RESULT, may be an error or warning. Any error invalidates the tuning and does not update the parameter settings.

Table 35 AUTO_TUNE_RESULT & TRAVEL_CALIB_RESULT

Value	Comment	Error /Warning (*2)	Description
1	Succeeded	—	Auto tuning/Travel calibration has succeeded.
2	Cancelled	—	Auto tuning has been canceled.
21	Exhaust air pressure warning	W	The measured exhaust pressure exceeds ±60 kPa.
22	Small supply air pressure warning	W	The measured supply air pressure is less than 100 kPa.
23	Large supply air pressure warning	W	The measured supply air pressure is greater than 800 kPa.
40	Offset drift warning	W	The offset falls outside the normal operation range.
42	Large Response speed warning	W	Waiting time for measuring time > 40 seconds.
43	Large hysteresis warning	W	Hysteresis > 30%
44	Large slip width warning	W	Slip width > 5%
60	Small angle span warning	W	Rotation-angle span < 15°.
61	Large angle span warning	W	VALVE_TYPE is linear and the rotation-angle span exceeds 55°; or VALVE_TYPE is rotary and the rotation-angle span exceeds 95°.

Table 35 AUTO_TUNE_RESULT & TRAVEL_CALIB_RESULT (Continued)

Value	Comment	Error /Warning (*2)	Description
62	50% angle warning	W	VALVE_TYPE is linear and the rotation angle at the 50% position exceeds ±20°.
100	Small angle span error	W	Rotation-angle span < 5°.
101	Large angle span error	E	VALVE_TYPE is linear and the rotation-angle span exceeds 60°; or VALVE_TYPE is rotary and the rotation-angle span exceeds 100°.
102	50% angle error	E	VALVE_TYPE is linear and the rotation angle at the 50% position exceeds ±25°.
103	Linear adjust error	E	FINAL_VALUE.value falls outside 50 ±10% at 50% position.
120	Offset measurement failed error	E	Offset measurement has failed.
121	Gain measurement failed error	E	Gain measurement has failed.
122	Response speed measurement failed error	E	Response speed measurement has failed.
123	Hysteresis measurement failed error	E	Hysteresis measurement has failed.
255	In operation	—	Auto tuning is being executed.

(*1) Number 103 is not shown for AUTO_TUNE_RESULT. Number 1 through 44 and 120 through 123 are not shown for TRAVEL_CALIB_RESULT.

(*2) E stands for *Error*, and W stands for *Warning*.

Travel Calibration

WARNING

This function strokes the valve over its full range. Do not execute while valve is controlling the process. Keep away from the movable parts to avoid injury.

To calibrate the travel of the valve stem, i.e., the stroke of the valve:

1. Set the valve stem to the desired position by changing the value of FINAL_VALUE.value.
2. Set the AO block and the transducer block to O/S mode.
3. Write the value from the following choices:
   - ❑ 1 = off
   - ❑ 2 = 0% point calibration. Calibrates only the 0% point and shifts the 100% point by the delta in the 0% point, while leaving the span unchanged.
   - ❑ 3 = span calibration. Calibrates only the 100% point while leaving the 0% point unchanged.
   - ❑ 4 = 50% point calibration. Calibrates at the 50% point while leaving the 0% point and 100% point unchanged.

The 50%-point calibration (in other words, linearity calibration) is intended to minimize the linearity error at the 50% point. Also, if the feedback lever slightly deviates from a horizontal level due to careless FVP110 positioner installation, an error caused by this shift is corrected by the 50%-point calibration. Carrying out auto tuning of Index 2 or 4 clears the 50% calibration result. Carry out the 50%-point calibration after other tuning has finished.

The result of Travel calibration, which is written to TRAVEL_ CALIB_RESULT as shown in Table 35 on page 127, may be an error or warning. An error invalidates the tuning and does not update the parameter settings.

Online Diagnostics

The FVP110 features functions to diagnose the FVP110 itself and valve actions while online. The following describes the self-diagnostics function related to the transducer block.

XD_ERROR

The transducer block performs self-diagnostics and writes the results to the parameter XD_ERROR. Table 36 shows the meanings of these results in XD_ERROR.

When the content of XD_ERROR or BLOCK_ERR becomes a nonzero value, an alarm is output to the parameter BLOCK_ALM.

Table 36 XD_ERROR

Value	Comment	Description
100	Cycle count limit exceed	TOTAL_CYCLE_COUNT has reached CYCLE_COUNT_LIM.
101	Travel limit exceed	TOTAL_TRAVEL has reached TRAVEL_LIM.
102	Total open limit exceed	TOTAL_OPEN_TIME has reached OPEN_TIME_LIM.
103	Total close limit exceed	TOTAL_CLOSE_TIME has reached CLOSE_TIME_LIM.
104	Total near close limit exceed	TOTAL_NEAR_CLOSE_TIM has reached NEAR_CLOSE_TIME_LIM.
110	Temperature out of range	The measured temperature is out of range.
111	Pressure sensor out of range	The measured pressure is out of range.
112	Position sensor out of range	The measured valve position is out of range.
113	Deviation warning	The deviation between the setpoint and measured valve position has exceeded DEVIATION_LIM continuously for the period specified by DEVIATION_TIME_TH [1].
114	Servo output drift warning	SERVO_OUTPUT_SIGNAL has reached SERVO_WARN_LO_LIM or SERVO_WARN_HI_LIM and has continued in excess of SERVO_TIME_TH. This is not applicable for tight-shut or full-open actions, or when the period specified by SERVO_TIME_TH is less than 0.
120	Temperature sensor failure	Temperature sensor failed
121	Pressure sensor failure	Pressure sensor failed,
122	Severe servo output drift	SERVO_OUTPUT_SIGNAL has reached 10% or 90%, and has continued in excess of SERVO_TIME_TH. This is not applicable for tight-shut or fullopen actions, or when the period specified by SERVO_TIME_TH is less than 0.
123	Deviation error	The deviation between the setpoint and measured valve position has exceeded DEVIATION_LIM continuously for the period specified by DEVIATION_TIME_TH [2].
124	Position sensor failure	Position sensor failed
125	A/D converter failure	A/D converter failed

Fail-safe Action

If the *A/D converter failure*, *position sensor failure*, or *deviation error* event occurs in the XD_ERROR, the transducer block activates the specified fail-safe action by cutting the current signal to the I/P module to zero. In addition, in the event of *position sensor failure* or *deviation error*, the fail-safe action is not deactivated even when the cause of the failure/error is cleared. Writing *Clear non-latch* to the parameter RELEASE_FAILSAFE deactivates the fail-safe action. The fail-safe action activated in the event of *A/D converter failure* is deactivated automatically when the cause of the failure is cleared.

Operation Result Integration

The FVP110 has a function to integrate the following operation result quantities individually. To reset an integrated quantity, write *0* to the corresponding parameter.

TOTAL_CYCLE_ COUNT	Incremented by 1 at each change in the direction of the valve action, indicating the total number of times of changes in direction of valve actions.
TOTAL_TRAVEL	Total travel distance of the stem position, shown as a percentage of the valve position span.
TOTAL_OPEN_TIME and TOTAL_CLOSE_ TIME	TOTAL_CLOSE_TIME contains the integrated time periods (in hours) when the valve position is equal to or less than the thresholds previously set in OPEN_CLOSE_THRESHOLD. TOTAL_OPEN_TIME is the integrated time periods (in hours) other than TOTAL_CLOSE_TIME.
TOTAL_NEAR_ CLOSE_TIM	Total time period (in hours) when the valve position is within the threshold set in NEAR_CLOSE_THRESHOLD.
SERVO_WARN_ COUNT	Total number of times the servo output drift warning occurred. Indicates the total number of times a drift warning occurred regarding the output current to the I/P module.

Recording of Revisions

When you make a change to the setting of a static parameter, the change is counted-up in the parameter ST_REV and an update event is generated.

Control Parameters

The following FVP110 control parameters are set up by auto tuning (See “Description of Control Parameters” on page 259):

SERVO_GAIN	SERVO_RESET	SERVO_RATE
SERVO_RATE_GAIN	SERVO_DEADBAND	SERVO_OFFSET
BOOST_ON_ THRESHOLD	BOOST_OFF_ THRESHOLD	BOOST_VALUE
SERVO_I_SLEEP_LMT	SERVO_P_ALPHA	INTERNAL_GAIN
X_BOOST_ON_ THRESHOLD *	X_BOOST_OFF_ THRESHOLD *	X_BOOST_VALUE *

* Applicable only for Double Acting Type

Temperature and Pressure Measurement

The FVP110 measures the surface temperature of the amplifier and sets it in the transducer block parameter ELECT_TEMP. The unit of temperature is defined by TEMPERATURE_UNIT and is selected from:

- ❑ 1101 = °C
- ❑ 1102 = °F

A FVP110 with an optional pressure sensor can measure the output air pressure to the valve actuator and sets it in the parameter OUTPUT_PRESSURE. The unit of pressure is defined by Unit Code in SPRING_RANGE and is selected from:

- ❑ 1133 = kPa
- ❑ 1137 = bar
- ❑ 1141 = psi
- ❑ 1145 = kgf/cm^2

AO Function Block

14

General

The AO function block receives the control signal from the transducer block and outputs it to the actuator. The major functions of the AO function block include (Figure 57):

- ❑ Scaling
- ❑ Setpoint limiters - for both the value and rate of change
- ❑ Simulation
- ❑ Valve position feedback
- ❑ Actions upon abnormality of upstream block
- ❑ Signal inversion

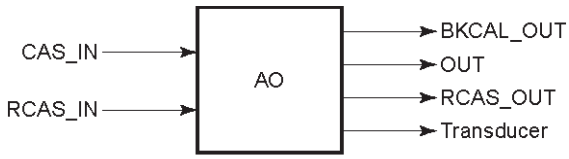

Figure 57 Inputs/Outputs of AO Function Block

The AO function block performs bi-directional signal handling (Figure 58): transfer of the valve control signal to the transducer block (forward path) and feedback of the valve position signal from the transducer block to the upstream block (backward path).

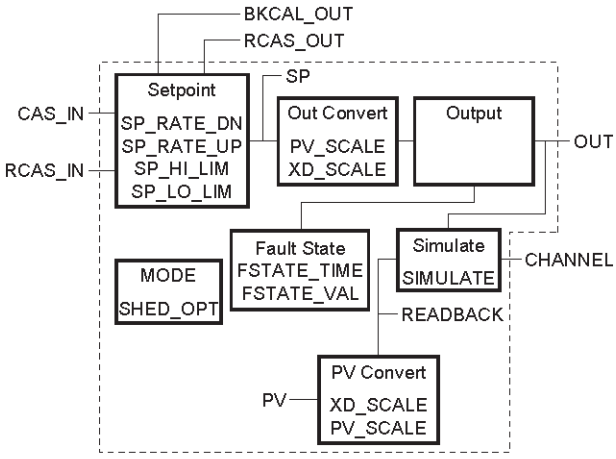

Figure 58 Function Diagram of AO Function Block

Modes

The target mode for the AO function block can be set from five block modes: RCas, Cas, Auto, Man, and O/S. Regardless of the target mode, the AO block automatically enters the IMan or LO mode when a specified condition is met (such as when another function block enters a specific status) depending on the parameter settings.

Forward Path

The following describes the signal input from the upstream block to the AO block and then passed to the transducer block. The upstream block is typically the PID controller block, and the control signal from the PID block is input as the source of computing the setpoint SP for the AO block.

The path for computing the SP differs depending on the mode: In Cas mode, CAS_IN is used for SP. In RCas mode, RCAS_IN is used for SP. If the value of CAS_IN or RCAS_IN, whichever is used, is greater than SP_HI_LIM (high limit) or less than SP_LO_LIM (low limit), the internal SP is set to the respective limits. Also, if the rate of change in the value of CAS_IN or RCAS_IN, whichever is used, is greater than SP_RATE_UP (rate-of increase limit) in the increasing direction, or than SP_RATE_DN (rate-of-decrease limit) in the decreasing direction, the change in internal SP is limited by the corresponding rate-of-change limit setting.

In RCas, Cas or Auto mode, the SP value is used for the AO block's output OUT, whose value is then passed to the transducer block via channel 1.

Fault State

As for Fieldbus-enabled positioners including the FVP110, not only a power failure but also other errors (such as a communication error) can cause the fail-safe action. For example, when the status of the CAS_IN input of the AO block from its upstream block indicates a specific status, such as a communication error, the case is regarded as an abnormality and fault state actions including a mode change are enacted.

When any of the following status exists for the moment of time specified in FSTATE_TIME, the block goes to the fault state and the mode changes to LO mode:

- ❑ Target mode is Cas, and the status of CAS_IN is *Bad: No Comm*
- ❑ Target mode is Cas, and the status of CAS_IN is *Good: IFS*
- ❑ Target mode is RCas, and the status of RCAS_IN is *Good: IFS*

In LO mode, the block holds the output (OUT) or outputs FSTATE_VAL, according to the setting of IO_OPTS. The factory setting is to hold the output.

Backward Path

The backward path functions as:

1. The valve position signal from the transducer block is written to the AO block parameter READBACK.
2. Is scaled based on XD_SCALE and PV_SCALE for conversion to the process variable PV.
3. The value of PV is fed back to the PID block or an upper-level system as the valve position signal via the parameter BKCAL_OUT and RCAS_OUT.

If SIMULATE is set to *Enable*, the value of SIMULATE.Simulate_Value is always set in READBACK.

SIMULATE contains the following data:

Simulate Status	Status to be set in simulation mode.
Simulate Value	Value to be set in simulation mode.
Transducer Status	Status of input from transducer.
Transducer Value	Value of input from transducer.
Enable/Disable	Whether to enable *2* or disable *1* simulation.

IO_OPTS and STATUS_OPTS

These parameters stipulate options about the block's signal processing and mode transitions. The settings of these options are made by setting or resetting the respective bits: on = true, off = false. Table 37 shows the options available in AO block IO_OPTS.

Table 37 IO_OPTS of AO Block

Bit	Meaning	Description
1	SP tracks PV if Man	Equalizes SP to PV when target is MAN mode.
3	SP tracks PV if LO	Equalizes SP to PV in LO mode.
4	SP tracks RCas or Cas if LO or Man (SP track retained target)	In LO mode, Equalizes SP to RCAS_IN if target mode is RCas and to CAS_IN if target mode is Cas.
5	Increase to close	Inverts the signal while it goes from SP through OUT.
6	Faultstate Type (Faultstate to value)	Uses a FSTATE_VALUE in LO mode.
7	Faultstate Type (Use Faultstate value on restart)	Uses a value preset for fault state also at a restart.
8	Target to Man	Sets the target mode to Man upon activation of the fault state.
9	PV for BKCAL_OUT	Sets the value of PV in BKCAL_OUT and RCAS_OUT.

Only the Propagate Fault Backward option is available in AO block STATUS_OPTS.

Table 38 STATUS_OPTS of AO Block

Bit	Meaning	Description
4	Propagate Fault Backward	Stipulates the handling of the value, data status and related alarm of BKCAL_OUT and RCAS_OUT to be performed. If this option is true, then: ❑ Set the quality and sub-status components of the status of BKCAL_OUT to Bad and sensor failure, respectively. ❑ Do nothing for the BKCAL_OUT value. If this option is false, then: ❑ Set the quality and sub-status components of the status of BKCAL_OUT to Bad and non specific, respectively. ❑ Generates a block alarm.

Mode Shedding on Computer Failure

When the data status of RCAS_IN falls to Bad while the block is running in RCas (remote cascade) mode, mode shedding occurs in accordance with the setting in SHED_OPT. Table 39 shows the available selections for the AO block SHED_OPT setting.

Table 39 SHED_OPT of AO Block

Bit	Available Setting for SHED_OPT	Actions upon Computer Failure
1	Normal shed, normal return	Sets MODE_BLK.actual to Cas(*1), and leaves MODE_BLK.target unchanged.
2	Normal shed, no return	Sets both MODE_BLK.actual and MODE_BLK.target to Cas(*1).
3	Shed to Auto, normal return	Sets MODE_BLK.actual to Auto(*2), and leaves MODE_BLK.target unchanged.
4	Shed to Auto, no return	Sets both MODE_BLK.actual and MODE_BLK.target to Auto(*2).
5	Shed to Manual, normal return	Sets MODE_BLK.actual to Man, and leaves MODE_BLK.target unchanged.
6	Shed to Manual, no return	Sets both MODE_BLK.actual and MODE_BLK.target to Man.
7	Shed to retained target, normal return	If Cas is set in MODE_BLK.target, ❑ sets MODE_BLK.actual to Cas 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.
8	Shed to retained target, No return	If Cas is set in MODE_BLK.target, sets: ❑ MODE_BLK.actual to Cas, and ❑ MODE_BLK.target to Cas, too. 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 the AO block can transfer are limited to those set in MODE_BLK.permitted, and the priority levels of modes (Figure 59). In fact, if Normal shed, normal return is set for SHED_OPT, the 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.

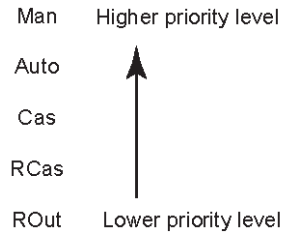

Figure 59 Mode Priority Levels

(*2) Only when Auto is set as permitted mode.

NOTE

If a control block is connected as a cascade primary block of the AO block, a mode transition of the AO block to Cas occurs in the following sequence due to initialization of the cascade connection: RCas —> Auto —> Cas.

Initialization at Start

To prevent a sudden change in output when the AO block carries out the specified actions for the first time after the power is turned on, it:

1. Equalizes SP to PV if the Faultstate Type option (bit no. 7) in IO_OPTS is false.
2. Equalizes OUT to READBACK.

If the Faultstate Type option (bit no. 7) in IO_OPTS is true, it restores FSTATE_VAL in SP.

Alarm Processing

When a condition shown inTable 40 is met, the AO block changes the bit statuses of BLOCK_ERROR accordingly and generates a block alarm.

Table 40 BLOCK_ERROR in AO Block

Bit	Name of Error Represented	Condition
3	Simulate Active	SIMULATE is active.
4	Local Override	Fault state is on, and Propagate Fault Backward is false.
7	Input Failure / process variable has BAD status	Propagate Fault Backward in STATUS_OPTS is false, and the sub-status component of the status of READBACK is sensor failure or device failure.
15	Out-of-Service	The target mode is O/S.

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DI Function Block

15

General

An FVP110 contains two DI function blocks, which individually transfer the valve-position high and low limit switch signals generated by the transducer block (Figure 60).

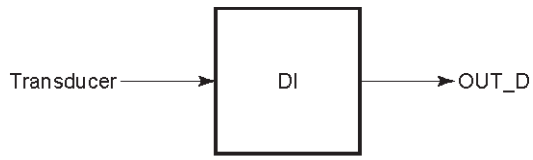

Figure 60 Inputs/Outputs of DI Function Block

The major functions of a DI function block include (Figure 61):

- ❑ Signal inversion (I/O processing option)
- ❑ Simulation
- ❑ Filtering (time delay)
- ❑ Alarm generation

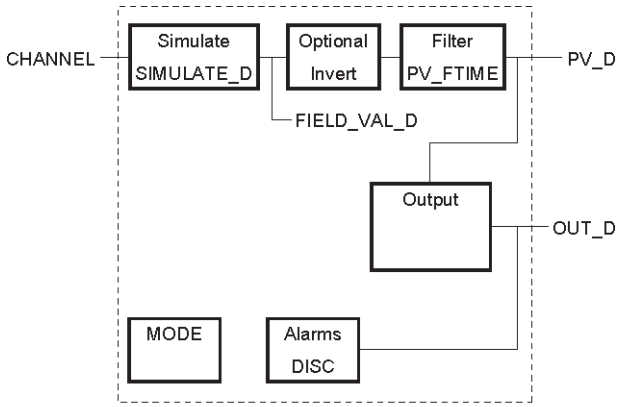

Figure 61 Function Diagram of DI Function Block

Modes

The target mode for a DI function block can be set from three block modes: O/S, Auto, and Man.

PV Value (PV_D)

A limit switch signal is transferred from the transducer block via a channel. Normally, the Transducer Value and Transducer Status values in SIMULATE_D are copied to FIELD_VAL_D, indicating the on/off status of the corresponding limit switch. If SIMULATE_D is set to *Enable*, the Simulate Value and Simulate Status values in SIMULATE_D are copied to FIELD_VAL_D.

SIMULATE_D contains the following data:

Simulate Status	Status to be set in simulation mode
Simulate Value	Value to be set in simulation mode
Transducer Status	Status of input from transducer
Transducer Value	Value of input from transducer
Enable/Disable	Whether to enable *2* or disable *1* simulation

The value of FIELD_VAL_D is copied to the process value PV_D. At this time, if the Invert option (bit 0) is specified as true, the on/off status is inverted (Table 41).

Table 41 FIELD_VAL_D

Value of FIELD_VAL_D	Value of PV_D	
	Invert = False	Invert = True
0	0 (off)	1
≥1	1 (on)	0

Filtering

Transfer of a change in the value of FIELD_VAL_D to the value of PV_D can be delayed for a desired time period set in the parameter PV_FTIME (in seconds).

Output

The value of the output OUT_D is generated based on the value of PV_D.

IO_OPTS and STATUS_OPTS

These parameters stipulate options about block's signal processing and mode transitions.

The settings of these options are made by setting or resetting the respective bits: on = true, off = false. Table 42 shows the options available in the DI block IO_OPTS.

Table 42 IO_OPTS of DI Block

Bit	Meaning	Description
0	Invert	Inverts the on/off status.

Table 43 shows the options available in the AO block STATUS_OPTS.

Table 43 IO_OPTS of DI Block

Bit	Meaning	Description
3	Propagate Fault Forward	Stipulates the handling of the value and data status of OUT_D when the quality component of the data status of SIMULATE_D falls to Bad and the substatus component falls to device failure or sensor failure. If this option is true, then it: ❑ Does not generate a block alarm. ❑ Sets the status and value of SIMULATE_D in OUT_D. If this option is false, then it: ❑ Generates the *input failure* block alarm. ❑ Set the quality and sub-status components of the status of OUT_D to Bad and non specific, respectively.
8	Uncertain if Man mode	Sets the status of OUT_D to uncertain when in Man mode.

Alarm Processing

Block Alarms

When a condition shown in Table 44 is met in a DI block, the block changes the bit statuses of BLOCK_ERROR accordingly and generates a block alarm.

Table 44 BLOCK_ERROR in DI Block

Bit	Meaning	Description
3	Simulate Active	SIMULATE_D is active.
7	Input Failure / process variable has BAD status	Propagate Fault Backward in STATUS_OPTS is false, and the sub-status component of the status of READBACK is sensor failure or device failure.
15	Out of Service	The target mode is O/S.

Discrete Alarm

The parameter DISC_ALM is a discrete alarm of the parameter OUT_D.

When the value of OUT_D agrees with the value of DISC_LIM, the alarm state of DISC_ALM is set to active and an alert is generated.

OS Function Block

16

General

The OS (output splitter) function block splits a single control signal into two parts for coordinating the actions of two or more valves, such as for split-range control or sequencing control of a large and a small valve (Figure 62).

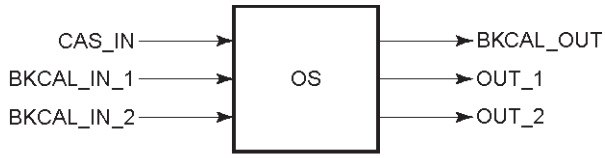

Figure 62 Inputs/Outputs of OS Function Block

The OS block receives a control signal and converts it into two signals in accordance with the predefined relationships. The major functions of the OS block include (Figure 63):

- ❑ Conversion of the setpoint (SP) value into two output values (OUT_1 and OUT_2) in accordance with the user-specified characteristics (set in IN_ARRAY and OUT_ARRAY)
- ❑ Generation of the output value to be fed back to the upstream block (BKCAL_OUT).

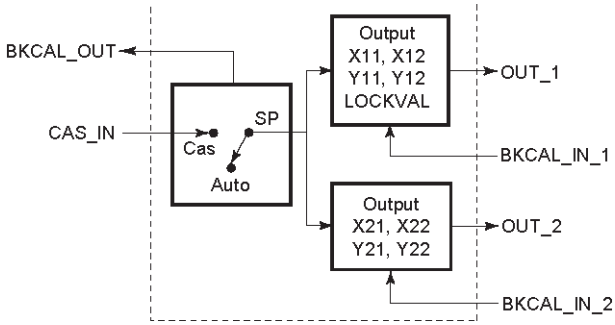

Figure 63 Function Diagram of OS Function Block

Modes

The target mode for the OS function block can be set from three block modes: Cas, Auto, and O/S. Regardless of the target mode, the OS block automatically enters the IMan mode when a specified condition is met.

Output Processing

The values of OUT_1 and OUT_2 with respect to the value of SP, which is the value of the input from the upstream block (CAS_IN) in the Cas mode or the local setpoint value in the Auto mode, are determined as shown in Figure 64.

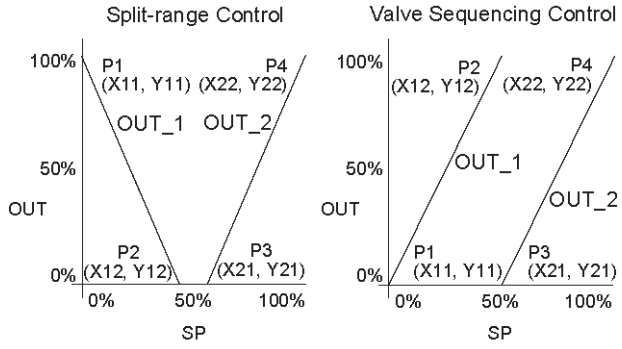

Figure 64 Examples of Valve Operation Characteristics

These characteristics are determined by the array element values in parameters:

- ❑ IN_ARRAY and OUT_ARRAY
- ❑ IN_ARRAY: [X11, X12, X21, X22]
- ❑ OUT_ARRAY: [Y11, Y12, Y21, Y22]

Coordinates P1 (X11, Y11) and P2 (X12, Y12) define the start and stop points of the characteristics for OUT_1, and P3 (X21, Y21) and P4 (X22, Y22) define those for OUT_2. These two operation characteristics may overlap each other, or start from the same point and have different slopes; however, all the following conditions must be met at all times. Settings of IN_ARRAY that do not meet one or more of these conditions cause a BLOCK_ERR, disabling the block from exiting the O/S mode.

X21 . X11
X12 > X11
X22 > X21

In areas outside the endpoints (i.e., start and stop points) of each operation characteristic, the output is retained at the Y value at the nearer end point. For OUT_1, however, depending on the setting of LOCKVAL, it is possible to:

Set the value of OUT_1 to Y11 in the areas outside the endpoints if SP is greater than X12 and if LOCKVAL is false.

When this action is enabled, the value set in HYSTVAL serves as hysteresis, which affects the output as follows (Figure 65):

When SP has increased beyond X12, OUT_1 is set to Y11.

Then, after SP has decreased below X12 minus HYSTVAL, OUT_1 returns to follow the set characteristic.

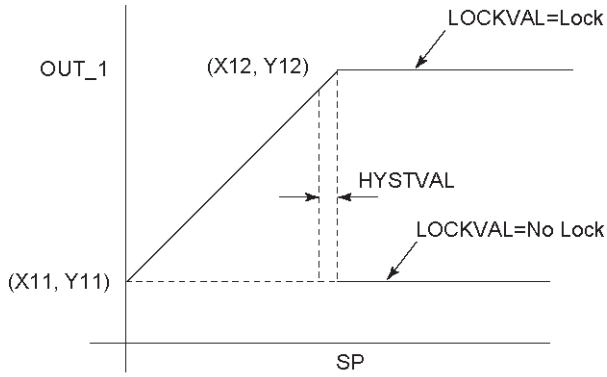

Figure 65 LOCKVAL and HYSTVAL

When both downstream blocks of the OS block are ready for cascade connection, the OS block connects the block on the side of OUT_1 first. For bumpless mode change on the side of OUT_2, the balancing time for connection can be set in BAL_TIME. When either downstream block alone is ready for cascade connection, the OS block connects it and enters the Cas mode. When neither downstream block is ready for cascade connection, the OS block mode is set to IMan.

Backward Path (BKCAL_OUT)

The value of SP or a value calculated from the value of either BKCAL_IN_1 or BKCAL_IN_2, depending on the handshake status with the downstream blocks, is output through BKCAL_OUT. In normal operating conditions (i.e., BLK_MODE.actual is Cas or Auto), BKCAL_OUT is set to the value of SP.

STATUS_OPTS

This parameter stipulates options about the block's signal processing and mode transitions. Table 45 shows the options available in the OS block STATUS_OPTS.

Table 45 STATUS_OPTS of PID Block

Bit	Options in CONTROL_OPTS	Description
1	IFS if BAD CAS_IN	If this option is True, then: Set the sub-status components of OUT_1.status and OUT_2.status to Initial Fault State (IFS) if CAS_IN.status is Bad.
4	Propagate Fault Backward	If this option is True, then: Set the status of BKCAL_OUT to device failure if the quality and substatus components of both BKCAL_IN_1 and BKCAL_IN_2 are Bad-Sensor Failure and Device Failure, respectively. If this option is False, then: Set the status of BKCAL_OUT to device failure if the quality and substatus components of either or both BKCAL_IN_1 and BKCAL_IN_2 are Bad-Sensor Failure and Device Failure, respectively.

Alarm Processing

When the condition shown in Table 46 is met in the OS block, the OS block changes the bit statuses of BLOCK_ERR accordingly and generates a block alarm (BLOCK_ALM).

Table 46 STATUS_OPTS of PID Block

Bit	Options in CONTROL_OPTS	Description
1	Block Configuration Error	The settings of IN_ARRAY and OUT_ARRAY satisfy one or more of the following conditions: X21 < X11 X12 . X11 X22 . X21
15	Out of Service	The target mode (MODE_BLK.target) is OS.

IS (SIGSEL) Function Block

17

General

The signal selector block provides selection of up to four inputs and generates an output based on the configured action (Figure 66). This block normally receives its inputs from AI blocks. The block performs maximum, minimum, middle, average and *first good* signal selection.

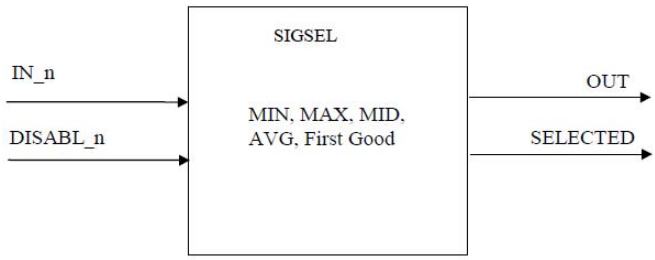

Figure 66 Inputs/Outputs of IS (SIGSEL) Function Block

With a combination of parameter configuration options the block can function as a rotary position switch, or a validated priority selection based on the use of the first good parameter and the disable_n parameter (Figure 67). As a switch, the block can receive switching information from either the connected inputs or from an operator input. The block also supports the concept of a middle selection. Although the normal configuration for this feature would be with three signals, the block should generate an average of the middle two if four signals are configured or the average of two if three are configured and a bad status is passed to one of the inputs. Logic is provided for handling uncertain and bad signals in conjunction with configured actions. The intended application of this block is to provide control signal selection in the forward path only, therefore, no back calculation support is provided. SELECTED is a second output that indicates which input has been selected by the algorithm.

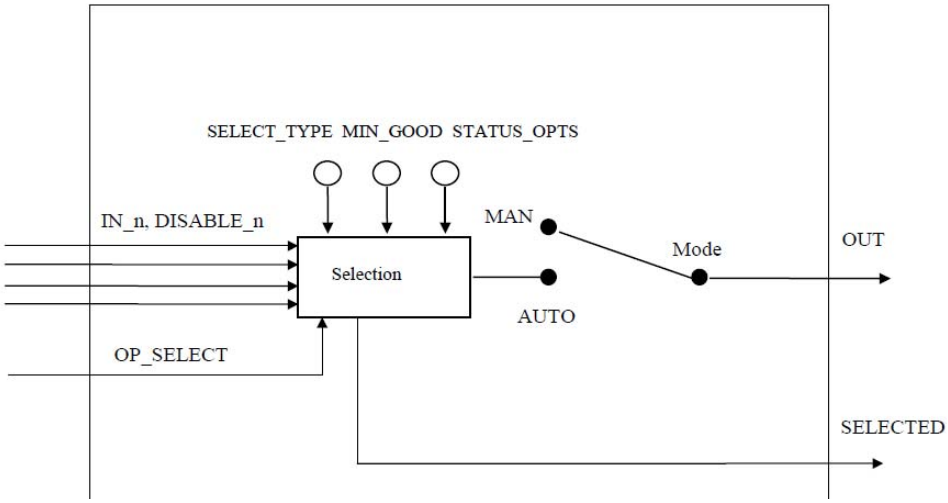

Figure 67 Function Diagram of SIGSEL Function Block

Function Supported

This block is intended to be used in a forward path only and is not intended to receive signals from the output of a controller. There is no back calculation support or propagation of control status values. The processing of the block is as follows.

Input Processing

If DISABLE_n is true then don't process (ignore) the respective input IN_n.

Process the Use Uncertain as Good status options. Discard (ignore) inputs whose status is bad.

If there are no inputs left, or fewer than MIN_GOOD inputs, then set the value of SELECTED to zero. Do not do selection processing.

Selection Processing

If OP_SELECT is non-zero, the OP_SELECT value shall determine the selected input, regardless of the SELECT_TYPE selection. Set SELECTED to the number of the input used.

If SELECT_TYPE is First Good, transfer the value of the first remaining input to the output of the block. Set SELECTED to the number of the input used.

If SELECT_TYPE is Minimum, sort the remaining inputs by value. Transfer the lowest value to the output of the block. Set SELECTED to the number of the input with the lowest value.

If SELECT_TYPE is Maximum, sort the remaining inputs by value. Transfer the highest value to the output of the block. Set SELECTED to the number of the input with the highest value.

If SELECT_TYPE is Middle, sort the remaining inputs by value. If there are 3 or 4 values, discard the highest and lowest value. If two values are left, compute their average. Transfer the value to the output of the block. Set SELECTED to zero if an average was used, else set SELECTED to the number of the input with the middle value.

If SELECT_TYPE is Average compute the average of the remaining inputs and transfer the value to the output of the block. Set

SELECTED to the number of inputs used in the average.

Limit Processing

The computations to determine high and low limit conditions for the output can be complex. They should be done to the best of the designer's ability. The limits of OUT should be able to tell a PID to stop integrating if the measurement cannot move.

Supported Modes

O/S, Man, and Auto.

Alarm Types

Standard block alarm.

Mode Handling

Standard.

Status Handling

If there are no inputs used, or fewer than MIN_GOOD inputs, then the status of OUT shall be set to Bad Non-specific.

The SELECTED output shall have Good(NC) status, unless the block is out of service.

Status options for Use Uncertain as Good and Uncertain if Manual shall be supported.

Initialization

Standard.

Power Failure Recovery

Standard.

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AR (Arithmetic) Function Block

18

General

The AR (Arithmetic) block (Figure 68) contains math functions that are selected by name.

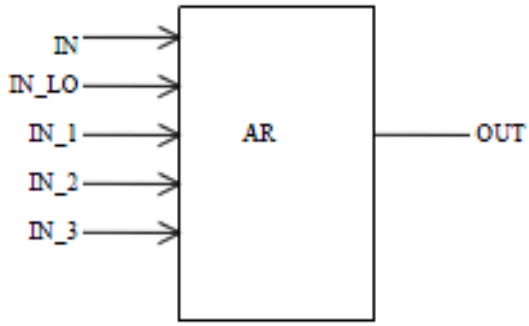


Figure 68 Inputs/Outputs of AR Function Block

The block has five inputs. The first two are dedicated to a range extension function that results in a PV, with status reflecting the input in use.

The remaining three inputs are combined with the PV in a selection of four term math functions that have been found useful in a variety of measurements. The inputs used to form the PV should come from devices with the desired engineering units, so that the PV enters the equation with the right units. Each of the additional inputs has a bias and gain constant. The bias can be used to correct for absolute temperature or pressure. The gain can be used to normalize terms within a square root function. The output also has gain and bias constants for any further adjustment required.

The AR block is intended for use in calculating measurements from combinations of signals from sensors. It is not intended to be used in a control path, so it does not support control status propagation or back calculation. It has no process alarms.

The major functions of the block are shown in Figure 69.

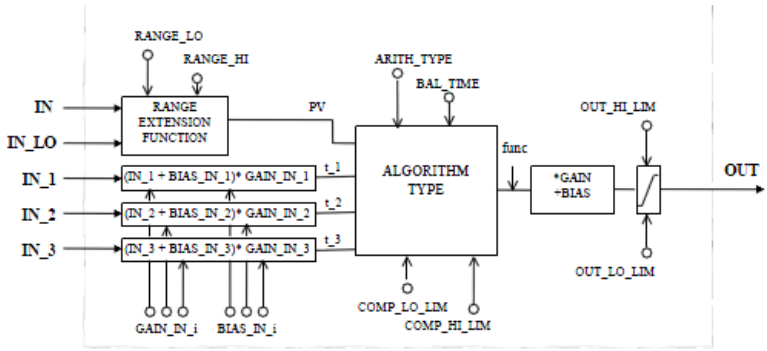


Figure 69 Function Diagram of AR Function Block

The range extension function has a graduated transfer, controlled by two constants referenced to IN. An internal value, g, is zero for IN less than RANGE_LO. It is one when IN is greater than RANGE_HI. It is interpolated from zero to one over the range of RANGE_LO to RANGE_HI. The equation for PV follows:

PV = g * IN + (1-g) * IN_LO

If the status of IN_LO is unusable and IN is usable and greater than RANGE_LO, then set *g* to one. If the status of IN is unusable, and IN_LO is usable and less than RANGE_HI, then g should be set to zero. In each case the PV should have a status of Good until the condition no longer applies. Otherwise, the status of IN_LO is used for the PV if g is less than 0.5, while IN is used for g greater than or equal to 0.5. An optional internal hysteresis can be used to calculate the status switching point.

Six constants are used for the three auxiliary inputs. Each has a BIAS_IN_i and a GAIN_IN_i. The output has a BIAS and a GAIN static constant. For the inputs, the bias is added and the gain is applied to the sum. The result is an internal value called t_i in the function equations. The equation for each auxiliary input is the following:

t_i = (IN_i + BIAS_IN_i) * GAIN_IN_i

The flow compensation functions have limits on the amount of compensation applied to the PV, to assure graceful degradation if an auxiliary input is unstable. The internal limited value is f.

Functions Supported

The following function types are supported:

Flow compensation, linear

Used for density compensation of volume flow.

func = f * PV

Flow compensation, square root

Usually, IN_1 is pressure, IN_2 temperature, and IN_3 is the compressibility factor Z.

func = f * PV

f = sqrt (t_1 / t_2 / t_3) [limited]

Flow compensation, approximate

Both IN_2 and IN_3 would be connected to the same temperature.

func = f * PV

f = sqrt (t_1 * t_2 * t_3 * t_3) [limited]

BTU flow

Where IN_1 is inlet temperature, and IN_2 the outlet temperature

func = f * PV

f = (t_1 - t_2) [limited]

Traditional Multiply Divide

func = f * PV

f = (t_1 / t_2) + t_3 [limited]

Average

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

f = number of inputs used in computation (unusable inputs are not used).

Traditional Summer

func = PV + t_1 + t_2 + t_3

Fourth order polynomial

All inputs except IN_LO (not used) are linked together.

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

S*imple HTG compensated level*

Where PV is the tank base pressure, IN_1 is the top pressure, IN_2 is the density correction pressure, and GAIN is the height of the density tap.

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

After the value of func is calculated, it is multiplied by GAIN, and then BIAS is added to the result. Finally, high and low output limits are applied, and the result is the term PRE_OUT. If the mode is Auto, PRE_OUT becomes OUT.

Difficulties with the function, such as division by zero and roots of negative numbers, should be handled gracefully, without disturbing the status of OUT, or the mode. Division by zero produces a large number of the proper sign. Infinity cannot be used, as it has a special meaning for unused limits. Roots of negative numbers produce the root of the absolute value, with a negative sign. The output has absolute high and low limits.

Supported Modes

O/S, Man, and Auto.

Alarm Types

Standard block alarm.

Mode Handling

The algorithm never changes the mode, even when inputs go bad.

If the mode is changed to Man, an internal value is set to the difference between OUT and the output of the selected function. When the mode is changed to Auto, the difference value exponentially decays to zero with a time constant of BAL_TIME.

The output of the calculation function appears in PRE_OUT.

Status Handling

The INPUT_OPTS bit string controls use of auxiliary inputs with less than good status. The status of unused inputs are ignored.

The status of the output is that of the worst of the inputs used in the calculation after applying INPUT_OPTS.

Initialization

Standard.

Power Failure Recovery

Standard.

PID Function Block

19

General

The PID function block receives an input signal (Figure 70), performs PID control computation, and outputs the control signal, like a single-loop controller.

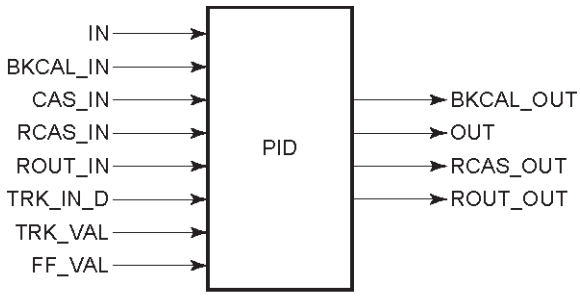


Figure 70 Inputs/Outputs of PID Function Block

In practice, it performs PID computation based on the deviation between the setpoint set in the actual mode and the PV, and generates a value of its output OUT so as to decrease the deviation. The PID block works with other function blocks such as the AI and AO blocks connected to it. The major functions of the PID block include (Figure 71):

- ❑ Filtering
- ❑ Setpoint limiters - both for the value and rate of change
- ❑ Scaling of process variable (PV), setpoint (SP), and output (OUT)
- ❑ PID control computation
- ❑ Control action bypass
- ❑ Feed-forward
- ❑ External-output tracking
- ❑ Measured-value tracking
- ❑ Output limiters
- ❑ Mode shedding upon computer failure
- ❑ Alarm generation

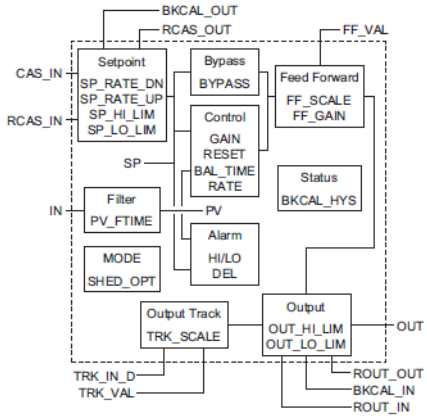


Figure 71 Function Diagram of PID Function Block

Modes

The target mode for the PID function block can be set from five block modes: ROut, RCas, Cas, Auto, Man, and O/S. Regardless of the target mode, the PID block automatically enters the IMan or LO mode when a specified condition is met (such as when another function block enters a specific status), depending on the parameter settings.

Input Processing

The input signal to IN is filtered through a lag filter whose time constant is set in PV_FTIME, and then set as the process variable (PV).

Setpoint (SP) Limiters

The path for computing the SP differs depending on the mode. In Cas mode, CAS_IN is used for SP. In RCas mode, RCAS_IN is used for SP. If the value of CAS_IN or RCAS_IN, whichever is used, is greater than SP_HI_LIM (high limit) or less than SP_LO_LIM (low limit), the internal SP is set to the respective limits. When the target mode is Auto or Man, and when SP-PV tracking is not specified at the same time, the rate of change in the setpoint is also limited (by the values of SP_RATE_UP and SP_RATE_DN).

PID Computation

For PID control, the block employs the PV-proportional and PV-derivative type PID control algorithm (referred to as the I-PD control algorithm) for Auto and RCas mode. This algorithm measures control stability against sudden changes in the setpoint, such as when you enter a new setpoint value. At the same time, the IPD 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.

For Cas mode, PV-derivative type PID control algorithm (referred to as the PI-D control algorithm) is employed in order to obtain better performance against the changes in the setpoint.

The algorithm is automatically changed by the block according to the mode. A basic form of each algorithm is expressed in the equation below.

In Auto / RCas mode

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

In Cas mode

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

Where:

ΔMV_n = change in control output

ΔPV_n = change in measured (controlled) value

= PV_n - PV_{n-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 sampling time and thus PV_n and PV_{n-1} denote the PV value sampled most recently and the PV value sampled at the preceding control period respectively.

Table 47 shows the PID control parameters.

Table 47 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

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 performs the velocity type output action for the control output by determining the value of the new control output (OUT) by adding the change in control output calculated in the current control period, ΔMV_n, to the current read-back value of the MV(OUT), MVRB (BKCAL_IN). This action can be expressed as:

OUT = BKCAL_IN - $\Delta MV_{n'}$

$\Delta MV_{n'}$ = ΔMV_n which is scaled by PV_SCALE and OUT_SCALE

Direction of Control Action

The direction of the control action is determined by the Direct Acting setting in CONTROL_OPTS (Table 48).

Table 48 PID Control Parameters

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.

Control Action Bypass

The PID control computation can be bypassed to set the SP value in the control output OUT (Figure 72). Setting BYPASS to *ON* bypasses the PID control computation.

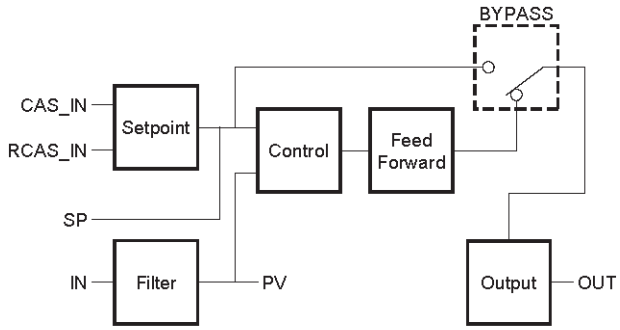


Figure 72 Control Action Bypass

Feed-forward

Feed-forward adds a compensation input signal FF_VAL to the output of the PID control computation and is typically used for feed-forward control. In practice, the value of the change in FF_VAL is scaled to the range of the OUT, multiplied by the value of FF_GAIN, and then added to the PID control computation result, as illustrated by Figure 73.

When the status of FF_VAL is Bad, the value of LUV (Last usable value) is used instead of FF_VAL. If LUV contains no value, the feed-forward action is not carried out.

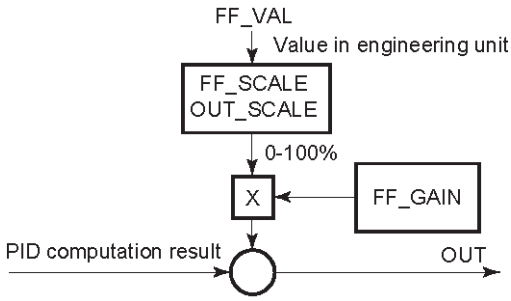


Figure 73 Feed-forward

External-output Tracking (LO)

External-output tracking outputs the value of the remote output TRK_VAL set from outside the PID block (Figure 74). External tracking is performed when the block mode is LO.

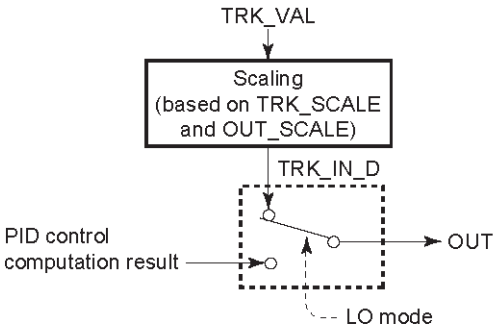


Figure 74 External-value Tracking

To change the block mode to LO:

1. Set Track Enable in CONTROL_OPTS (see “CONTROL_OPTS” on page 163) to true.
2. Set TRK_IN_D to true.

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

Measured-value Tracking

Measured-value tracking, also referred to as SP-PV tracking, is the action of equalizing 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 automatic control in Auto or Cas mode, when the mode of its secondary control block is changed from Cas to Auto, the cascade connection is opened and the control action of the primary block stops. The SP of the primary controller can also be equalized to its cascade input signal CAS_IN in this case.

The settings for measured-value tracking are made in the parameter CONTROL_OPTS (Table 49).

CONTROL_OPTS

CONTROL_OPTS is a parameter that stipulates control options (Table 49).

Table 49 CONTROL_OPTS of PID Block

Bit	Options in CONTROL_OPTS	Description
0	Bypass Enable	Switch for activating the control action bypass
1	SP-PV Track in Man	Equalizes SP to PV when MODE_BLK.target is set to Man.
2	SP-PV Track in Rout	Equalizes SP to PV when MODE_BLK.target is set to ROut.
3	SP-PV Track in LO or IMan	Equalizes SP to PV when MODE_BLK.actual is set to LO or IMan.
4	SP Track retained Target	Equalizes SP to RCAS_IN or CAS_IN when MODE_BLK.target is either in IMan, LO, Man or ROut and MODE_BLK.actual is set to RCas or Cas.
5	Direct Acting	Set the PID block to be a direct acting controller.
7	Track Enable	While this option is set, if the value of TRK_IN_D becomes *1*, the mode transfers to LO.
8	Track in Manual	Set this option when the mode should be transferred to LO even when MODE_BLK.target is set to Man. This option is invalid when Track Enable option is not set.
9	Use PV for BKCAL_OUT	Sets the value of PV in BKCAL_OUT and RCAS_OUT, instead of the value of SP.

Table 49 CONTROL_OPTS of PID Block (Continued)

Bit	Options in CONTROL_OPTS	Description
12	Obey SP limits if Cas or RCas	Puts the setpoint high/low limits in force in the Cas or RCas mode.
13	No OUT limits in Manual	Disables the high/low limits for OUT in the Man mode.

Initialization and Manual Fallback (IMan)

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

- ❑ The quality component of BKCAL_IN.status (data status of BKCAL_IN) 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.

Manual Fallback

Manual fallback denotes an abnormality handling action in which a PID block changes mode to Man (manual) and suspends the control action.

The manual fallback action is enabled to take place if the Target to Manual if BAD IN option in STATUS_OPTS is set as true, and it takes place when the following condition is met:

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

STATUS_OPTS

Table 50 shows the options in STATUS_OPTS.

Table 50 STATUS_OPTS of PID Block

Bit	Options in CONTROL_OPTS	Description
0	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.
1	IFS if BAD CAS IN	Sets the sub-status component of OUT.status to IFS if CAS_IN.status is Bad.
2	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).
5	Target to Manual if BAD IN	Automatically changes the value of MODE_BLK.target to Man when IN falls to Bad status.
9	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 to Bad status.

Auto Fallback

Auto fallback is when a PID block changes mode from Cas to Auto and continues automatic PID control with the user-set setpoint. To enable the auto fallback action to take place:

- ❑ The Target to next permitted mode if BAD CAS IN option must be preset to true in STATUS_OPTS.

AND

- ❑ Auto must be preset in MODE_BLK.permitted.

If the above settings are made, auto fallback takes place automatically when the following condition is met:

- ❑ CAS_IN.status (data status of cascade setpoint) is Bad except when the control action bypass is on.

Mode Shedding on Computer Failure

Mode shedding occurs in accordance with the SHED_OPT setting when:

- ❑ (1) the data status of RCAS_IN, which is the setting received from a computer as the setpoint SP, falls to Bad while the PID block is running in the RCas (remote cascade) mode,

or

- ❑ (2) the data status of ROUT_IN, which is the setting received from a computer as the remote output signal, falls to Bad while the PID block is running in the ROut (remote output) mode

Table 51 STATUS_OPTS of PID Block

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 set 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: ❑ MODE_BLK.actual to Cas, and ❑ MODE_BLK.target to Cas(*1), too. 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 the PID block can transfer are limited to those set in MODE_BLK.permitted, and the priority levels of modes (Figure 75). 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.

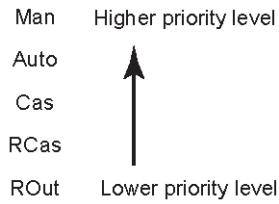


Figure 75 Priority Levels

(*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.

Alarms

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

Block Alarm (BLOCK_ALM)

The block alarm BLOCK_ALM is generated on occurrence of the errors in Table 52 (values set in BLOCK_ERR) and notifies the content of BLOCK_ERR.

Table 52 Block Alarm (BLOCK_ALM)

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

Process Alarms

There are six types of process alarms (Table 53). Only one process alarm can be generated at a time, and the process alarm having the highest priority level from among those occurring at the same time is generated. The priority level is set for each process alarm type.

Table 53 Process Alarms

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

Diagnostics

20

General

Fieldbus has the capability of gaining a wealth of information from the field via field devices. For a control valve, you can determine the status of valves, which have been difficult to identify without traveling to the field and physically examining them, to some extent from a distant control room through the information transmitted from the valve positioner. The FVP110 features diagnostics as shown below.

- ❑ Set the measurement conditions for the signature(s) you want to measure (“Signatures and Relevant Parameters” on page 172).
- ❑ Set SIGN_MEAS_EXEC to select the signature(s) for measurement and perform measurements.
- ❑ After the measurement is finished, set SIGN_UPLOAD_DATABASE to select the data to upload, and upload the values of SIGN_DATA_X and SIGN_DATA_Y.

For self-diagnostics, see “Online Diagnostics” on page 129. For valve parameter measurement, see “Carrying out Tuning” on page 61 and “Parameters of Transducer Block” on page 188.

Integration Functions

The transducer block has the parameters containing an integrated operation result quantity (Table 54).

Table 54 FVP110's Parameters Containing Integrated Operation Result Quantity

Item	Parameter (upper: integrated value; lower: threshold)	Description
Total number of times of changes in direction of valve actions	TOTAL_CYCLE_COUNT CYCLE_COUNT_LIM	Incremented by 1 at each change in the direction of the valve action. The dead band can be set in CYCLE_DEADBAND.
Total travel (%)	TOTAL_TRAVEL TRAVEL_LIM	Total travel distance of the stem position, regardless of the direction of the travel, represented as a percentage of the valve position span (full stroke). The dead band can be set in CYCLE_DEADBAND.
Total close time (hours)	TOTAL_CLOSE_TIME CLOSE_TIME_LIM	Integrated time periods when the valve position is equal to or less than the threshold set in OPEN_CLOSE_THRESHOLD.
Total open time (hours)	TOTAL_OPEN_TIME OPEN_TIME_LIM	Integrated time periods when the valve position is larger than the threshold set in OPEN_CLOSE_THRESHOLD.
Total near close time (hours)	TOTAL_NEAR_CLOSE_TIM NEAR_CLOSE_TIME _LIM	Integrated time periods when the valve position is between a shutoff and the threshold set in NEAR_CLOSE_THRESHOLD. Useful to predict deterioration of valve body.
Total number of times of servo output drift warning.	SERVO_WARN_COUNT	Indicates the total number of times a drift warning occurred regarding the output current to the I/P module.

Each integrated value is associated with a parameter specifying a threshold. Setting the desired value for a threshold raises a block alarm when that value is reached. The total travel is useful for various purposes, such as for anticipating possible degradation of the valve and determining appropriate timing for maintenance. To reset these integrated values, write *0* to the respective parameters. Use caution as the previous value cannot be restored after being reset.

Signature Measurement Functions

Acquisition of detailed data is essential to ensure that changes in valve's characteristics are captured and on-target maintenance is performed. The signature functions measure the input-to-position characteristics of the valve, and the input-to-position characteristics and step response of the positioner while off-line. As for a valve's input-to-position characteristics, a function of performing in-detail measurement is provided to enable capture of miniscule changes.

Nevertheless, since a vast amount of measured data cannot be stored in the limited memory of the positioner and most of the data is lost in the event of a power failure, upload measured data from a host as necessary.

Further, the data uploaded must be processed for analysis. These requirements make it difficult to use a general-purpose tool or application for these tasks.

ValVueFF (R2.20 or later) FVP management software, an FVP-specific tool is designed to perform these tasks with ease and offers dedicated functions. ValVueFF facilitates executions of signature measurement, uploads of measured data, display of measured data in a graph, and comparisons of measured data with previously measured data.

This User's Manual outlines the contents of each type of signature and explains the signature-pertaining parameters in the transducer block. For instructions on performing signature measurement, see the User's Manual for ValVueFF (EW1000-FF), which explains its functions and operation procedures.

Signature Measurement Procedure

The fundamental procedure for measuring signatures is as follows.

1. Set the measurement conditions for the signature(s) for measurement ("Signatures and Relevant Parameters" on page 172).
2. Set the value of MODE_BLK target in both the transducer and AO blocks to O/S.
3. Set SIGN_MEAS_EXEC to select the signature(s) for measurement and carry out the measurement. SIGN_MEAS_EXEC:

   1 Off
   2 Measure All (executing 3, 4, 6, 7)
   3 Measure Standard Actuator Signature
   4 Measure Extended Actuator Signature
   5 Measure High Resolution Actuator Signature
   6 Measure Step Response Test
   7 Measure Positioner Signature
   255 Cancel Execution

4. Set SIGN_UPLOAD_DATABASE to select the data to upload, and upload the values of SIGN_DATA_X and SIGN_DATA_Y. SIGN_UPLOAD_DATABASE:

1 Current: Standard Actuator Signature

2 Current: Extended/High Resolution Actuator Signature

3 Current: Step Response Test

4 Current: Positioner Signature

5 Factory: Standard Actuator Signature (result stored in non-volatile memory)

6 Record: Standard Actuator Signature (result stored in non-volatile memory)

NOTE

If the number of the measured data is 20 or more, specify in SIGN_UPLOAD_POINTER the leading position of the data for upload. For example, setting 21 in SIGN_UPLOAD_POINTER uploads the twenty-first through fortieth data. Refer to the value of SIGN_MEAS_COUNTER, which indicates the number of data actually measured.

Signatures and Relevant Parameters

The following describes each signature and the relevant parameters.

Standard Signature *1

The standard signature is the fundamental input-to-position valve characteristic, measured at 10% through 90% of the full stroke in 10% intervals over a round trip. The following is settable in STD_ACT_SIGN_SET:

- ❑ Recommended Scan Time [seconds]
- ❑ Scan Time [seconds]
- ❑ Deviation Margin [%]

Performing measurements sets the pressure data in SIGN_DATA_X and the position data (%) in SIGN_DATA_Y.

To save the signature to FVP110 non-volatile memory:

- ❑ Select 2 (Save as a Factory data) or 3 (Save as record data) in SIGN_DATA_SAVE and save. The standard signature previously saved is overwritten.

Save the signature data taken at the installation as a *Factory data* and that of the latest measurement as a *Record data*.

Extended Actuator Signature *1

The extended actuator signature is the valve input-to-position characteristics, measured at arbitrary positions within the full stroke of the valve. As for the positions of measuring, 50 points can be specified for each valve direction, totaling 100 points. The following is settable in EXT_ACT_SIGN_SET:

Lower Setpoint [%] (point to start the measurement)

Upper Setpoint [%] (point to finish the measurement)

Recommended Scan Time [seconds]

Scan Time [seconds]

Deviation Margin [%]

Sampling Rate [milliseconds] (not used in this function)

Performing measurements sets the pressure data in SIGN_DATA_X and the position data (%) in SIGN_DATA_Y.

High Resolution Actuator Signature *1

The high-resolution actuator signature is the valve input-to-position characteristics, measured with high resolution while sampling data at the specified time rate. Up to 100 data values can be stored in the FVP100 memory. After this limit is reached during measurement, the stored data is overwritten from the leading data in order. Using ValVueFF, you can continue measurement while uploading the measured data. The following is settable for EXT_ACT_SIGN_SET:

Lower Setpoint [%] (point to start the measurement)

Upper Setpoint [%] (point to finish the measurement)

Recommended Scan Time [seconds] (not used in this function)

Scan Time [seconds]

Deviation Margin [%]

Sampling Rate [milliseconds]

The sampling rate can be set within the range of 200 through 1000 milliseconds. The total number of measured samples is obtained by the following formula:
Scan time / sampling rate 1000 [points]

Performing measurements sets the pressure data in SIGN_DATA_X and the position data (%) in SIGN_DATA_Y.

Step Response Test

The step response test measures time-series changes in the valve position in response to a sudden change (step) in the positioner setpoint from the preset initial setpoint to the destination setpoint. The following is settable for STEP_RESP_SET:

Initial Setpoint [%]

Destination Setpoint [%]

Sampling Rate [milliseconds]

Number of Samples [points]

The sampling rate can be set within the range of 20 through 1000 milliseconds (corresponding to the measurement period of 0.4 through 600 seconds). The number of samples can be set to up to 600.

Performing measurements sets the positioner setpoints in SIGN_DATA_X and the position data (%) in SIGN_DATA_Y.

Positioner Signature

The positioner signature is the setpoint input-to-position characteristics of the positioner, measured at points in equal intervals within a specified range over a round trip.

The positioner signature reflects the positioner Cv characteristics, cutoff level, and limits, allowing the positioner setting conditions to be ascertained. The following is settable for the POSITIONER_SIGN_SET:

Lower Setpoint [%]

Upper Setpoint [%]

Intervals [points]

Recommended Wait Time [seconds] (read-only)

Wait Time [seconds]

Performing measurements sets the setpoint in SIGN_DATA_X and the position data (%) in SIGN_DATA_Y.

For the intervals, set the number of points of measurement in the increasing direction within the range of 4 through 20. The total number of points of measurement in a round trip results in: *Intervals 2 + 1.*

For the wait time, set the retention time at each point of measurement. For example, provided the lower setpoint is set to 0, the upper setpoint to 100, and the intervals to 10, the points of measurement are 0, 10, 20, …90, 100, 90, 80, …10, and 0, totaling 21 points.

*1: Applicable for Single Acting type with Code /BP.

Troubleshooting

21

What to Do First

When a problem occurs, check the following first.

Mounting of FVP110 positioner:

- ❑ Is the linkage to the valve actuator correctly set up?
- ❑ Is the feedback lever correctly attached?
- ❑ Is the span of rotation angle of the position sensor against the valve stroke more than the minimum requirement?
- ❑ Has auto tuning been performed after installation?

Air Piping:

- ❑ Are the air pipes correctly connected? Is there no leak of air?
- ❑ Is the air supply pressure high enough to drive the valve?
- ❑ Is the A/M selector on the positioner set to A (automatic)?

Wiring:

- ❑ Is the FVP110 positioner correctly connected to the fieldbus?
- ❑ Are the conductors incorrectly connected, in other words, is the plus side connected to minus, and vice-versa?
- ❑ Has the power to the fieldbus been turned on? Is the terminal-to-terminal voltage equal to or greater than 9 V?
- ❑ Is the terminator correctly installed?
- ❑ Is a host system connected to the fieldbus?

Troubleshooting Communications

Table 55 Troubleshooting Communications

Problem	Presumed Cause	Remedy	See Section
Communication with the FVP110 cannot be performed.	Wiring is incorrect.	Correct wiring.	❑ "Wiring" on page 54 ❑ "System Configuration" on page 87
	The power is off or the power supply voltage is less than 9 V.	Supply proper voltage.	❑ "Wiring" on page 54 ❑ "Standard Specifications" on page 73
	The address detection range is not correctly set.	Correct address detection range.	"Setting of Tags and Addresses" on page 94
Communication with the FVP110 is frequently cut off.	The fieldbus is experiencing a large amount of noise.	Using an oscilloscope or the like, check the waveform on the fieldbus.	—
The FVP110 can be detected, but neither function blocks nor transducer block can be seen.	The node address of the FVP110 is left as the default (0xF8-0xFB).	Change it to an operable address. See the descriptions for address settings.	"Setting of Tags and Addresses" on page 94

Troubleshooting Function Block Parameters

Table 56 Troubleshooting Function Block Parameters

Problem	Presumed Cause	Remedy	See Section
A value cannot be written to a parameter in the FVP110.	You have attempted to write a value outside the valid range.	Check the setting range of parameters.	"Function Block Parameters" on page 183
	The target mode does not allow write access.	Change the target mode. See the parameter lists.	"Function Block Parameters" on page 183

Table 56 Troubleshooting Function Block Parameters (Continued)

Problem	Presumed Cause	Remedy	See Section
The actual mode of a function block cannot be equalized to the target mode.	O/S is set for the target mode of the resource block.	Change the target mode of the resource block to Auto.	❑ "Function Block Parameters" on page 183 ❑ "Block Modes" on page 109
	The I/O of the function block in question is not connected to another function block.	Using a configuration tool, set the virtual communication relationship (VCR) and link object.	"Configuration" on page 89
	Schedules that define when function blocks execute are not set correctly.	Set the schedules using a configuration tool.	"Configuration" on page 89
	The transducer block is in O/S mode.	Change the target mode of the transducer block to Auto.	❑ "Function Block Parameters" on page 183 ❑ "Block Modes" on page 109
A block's dynamic parameters do not update.	The block in question is in O/S mode.	Change the target mode as necessary.	❑ "Function Block Parameters" on page 183 ❑ "Block Modes" on page 109
	O/S is set for the target mode of the resource block.	Change the target mode of the resource block to Auto.	❑ "Function Block Parameters" on page 183 ❑ "Block Modes" on page 109

Troubleshooting Valve Control

Table 57 Troubleshooting Valve Control

Problem	Presumed Cause	Remedy	See Section
A change in setpoint causes no action of the valve.	Air piping is incorrect.	Correct piping.	"Piping" on page 52
	The instrument is in FAILSAFE state.	Write *Clear non-latch* to RELEASE_FAILSAFE parameter.	"Fail-safe Action" on page 131
	Air supply is not being fed.	Supply proper air pressure.	"Piping" on page 52
	The valve has failed.	Apply a pneumatic pressure directly to the valve actuator and check whether there is valve action.	"A/M Switching" on page 42
	The I/P module or control relay has failed, or there is breakage in the cable between the I/P module and control relay.	If the output pressure does not increase even though the SERVO_OUTPUT_SIGNAL value is at maximum, contact the nearest service station or representative office.	—
The valve's full stroke is insufficient for the setpoint input.	The air supply pressure is not high enough to drive the valve actuator.	Check the air supply pressure rating for the valve actuator and supply air at the correct pressure, and write 4 or 2 to AUTO_TUNE_EXEC to redo Autotuning.	❑ "Piping" on page 52 ❑ "Carrying out Tuning" on page 61
	The range of the setpoint is limited by software.	Check the values of SP_HI_LIM and SP_LO_LIM in the AO block and FINAL_VALUE_RANGE in the transducer block.	❑ "Forward Path" on page 134 ❑ "Function Block Parameters" on page 183

Table 57 Troubleshooting Valve Control (Continued)

Problem	Presumed Cause	Remedy	See Section
The deviation between the setpoint and readback signal remains.	The tight-shut or full-open action is active.	Check the values of FINAL_VALUE_CUTOFF_HI and FINAL_VALUE_CUTOFF_LO.	❑ "Tight-shut and Full-open Actions" on page 125 ❑ "Function Block Parameters" on page 183
	The travel calibration has not been performed correctly.	Write 2 to AUTO_TUNE_EXEC to perform 0 &100% point adjustment.	"Carrying out Tuning" on page 61
The valve oscillates cyclically (limit cycle).	The friction of grand packing is large.	1) Write 4 or 3 to AUTO_TUNE_EXEC to redo auto tuning. 2) Use the actuator of proper size.	"Carrying out Tuning" on page 61
	The dead band of integral action is too little.	Write 4 or 3 to AUTO_TUNE_EXEC to redo auto tuning. Or, increase the SERVO_DEADBAND setting until the valve stops oscillating.	❑ "Carrying out Tuning" on page 61 ❑ "Control Parameters" on page 132 ❑ "Function Block Parameters" on page 183 ❑ "Manual Tuning Guideline" on page 253
	There's air leak from the pipe of output pressure, or feedback lever is not correctly attached.	Check the piping and attachment of the lever, and write 4 or 3 to AUTO_TUNE_EXEC to redo autotuning.	❑ "Installing the FVP110 on the Actuator" on page 35 ❑ "Carrying out Tuning" on page 61

Table 57 Troubleshooting Valve Control (Continued)

Problem	Presumed Cause	Remedy	See Section
Valve responses are too slow.	If only the responses that require air suction are slow, it means that the regulator's maximum capacity is large enough.	Replace the regulator.	—
	The I/P module's nozzle has become blocked from dirt contained in the air supply or the like.	Check whether or not error 114 or 122 occurs in XD_ERROR in steady states. If it does occur, contact the nearest service station or representative office.	"XD_ERROR" on page 129
	The control relay's nozzle has become blocked from dirt contained in the air supply or the like.	Check whether or not error 114 or 122 occurs in XD_ERROR in steady states.	"XD_ERROR" on page 129
	The control gain is insufficient.	Write 4 or 3 to AUTO_TUNE_EXEC to redo auto tuning. Or, increase the SERVO_GAIN setting.	❑ "Carrying out Tuning" on page 61 ❑ "Control Parameters" on page 132 ❑ "Function Block Parameters" on page 183 ❑ "Manual Tuning Guideline" on page 253
	There's air leak from the pipe of output pressure, or feedback lever is not correctly attached.	Check the piping and attachment of the lever, and write 4 or 3 to AUTO_TUNE_EXEC to redo autotuning.	❑ "Installing the FVP110 on the Actuator" on page 35 ❑ "Carrying out Tuning" on page 615.3
	The pressure balance deviation is too large.	Adjust the pressure balance of control relay.	"Tuning the Pressure Balance of Control Relay" on page 71

Troubleshooting AutoTuning

Table 58 Troubleshooting AutoTuning

Problem	Presumed Cause	Remedy	See Section
Auto tuning requests are rejected.	Either or both of the A/O block and transducer block are not in O/S mode.	Change the target modes of the AO and transducer block to O/S.	"Function Block Parameters" on page 183
When auto tuning has finished, AUTO_TUNE_RESULT changes value to an index from 21 to 23.	There is something wrong with the air supply pressure or spring range.	Check whether the measured pressure reading nearly equals the actual pressure. See the descriptions for auto tuning.	❑ "Carrying out Tuning" on page 61 ❑ "Auto Tuning" on page 126
When auto tuning has finished, AUTO_TUNE_RESULT changes value to index 40 or 120.	There is something wrong with the operation point of the I/P module. SERVO_OFFSET could not be measured.	If there is nothing wrong with the air supply pressure and piping, contact the nearest service station or representative office.	—
When auto tuning has finished, AUTO_TUNE_RESULT changes value to an index from 42 to 44, or from 120 to 123.	The measured time delay constant, hysteresis, and/or slip width of the valve is excessively large.	Check whether they meet the characteristics specified for the valve. See the descriptions for auto tuning.	❑ "Carrying out Tuning" on page 61 ❑ "Auto Tuning" on page 126
When auto tuning has finished, AUTO_TUNE_RESULT changes value to an index from 60 to 62, or from 100 to 103.	The span of rotation angle is incorrect or the 50% position deviation from the horizontal level is too large.	Correct the installation and try auto tuning again.	❑ "Installing the FVP110 on the Actuator" on page 35 ❑ "Carrying out Tuning" on page 61
When auto tuning has finished, AUTO_TUNE_RESULT changes value to an index from 60 to 62, or from 120 to 123.	The valve hysteresis is large.	Carry out manual tuning.	"Manual Tuning Guideline" on page 253

Troubleshooting Position, Pressure, and Temperature Sensors

Table 59 Troubleshooting Position, Pressure, and Temperature Sensors

Problem	Presumed Cause	Remedy	See Section
The position sensor signal remains unchanged.	The feedback lever is not properly attached.	See the descriptions for positioner installation.	“Installing the FVP110 on the Actuator” on page 35
	The position sensor has failed or there is breakage in the cable between the sensor and amplifier.	If ADVAL_BW does not change value when the shaft rotates, it may be necessary to replace the position sensor. Contact our nearest representative or service station.	—
The position sensor signal is unstable, or XD_ERROR indicates error 124.	The position sensor has failed or there is breakage in the cable between the sensor and amplifier.	It may be necessary to replace the position sensor. Contact the nearest representative or service station.	—
The pressure sensor signal is unstable, or XD_ERROR indicates error 121.	The pressure sensor has failed.	It may be necessary to replace the amplifier. Contact the nearest representative or service station.	—
The temperature sensor signal is unstable, or XD_ERROR indicates error 120.	The temperature sensor has failed.	It may be necessary to replace the amplifier. Contact the nearest representative or service station.	—

Function Block Parameters

A

Throughout the following tables, the *Write* column shows the modes in which the respective parameters can be written. The legends of the entries are as follows:

- ❑ O/S: Can be written when the corresponding block is in O/S mode.
- ❑ Man: Can be written when the corresponding block is in Man mode.
- ❑ Auto: Can be written when the corresponding block is in Auto, Man, or O/S mode.
- ❑ —: Can be written in no mode of the corresponding block.
- ❑ Blank: Can be written in all modes of the corresponding block.

Parameters of Resource Block

Table 60 Resource Block Parameters

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
0	1000	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	1001	ST_REV	0	—	Incremented when a change is made to the parameter settings for the resource block to indicate the revision level of the settings, and used to see whether or not there is a change in parameter settings.
2	1002	TAG_DESC	Null		Universal parameter storing the description of the tag
3	1003	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks
4	1004	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upper-level system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	1005	MODE_BLK	O/S	Auto	Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.
6	1006	BLOCK_ERR	—	—	Universal parameter indicating the hardware and software error statuses related to the block itself
7	1007	RS_STATE	—	—	Indicates the statuses of resource in the FVP110.
8	1008	TEST_RW	Null		Parameter used to test read and write access to the FVP110
9	1009	DD_ RESOURCE	Null	—	Name of the device description (DD) containing the information of this resource block
10	1010	MANUFAC_ ID	0x00594543	—	Manufacturer ID; 5850435 (= 0x594543) is assigned to Yokogawa Electric Corporation.
11	1011	DEV_TYPE	—	—	ID number of device; 1 or 7 (/EE) is assigned to the FVP110.
12	1012	DEV_REV	—	—	Revision number of the FVP110

Table 60 Resource Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
13	1013	DD_REV	1	—	Revision number of the device description (DD) applied to this FVP110
14	1014	GRANT_ DENY	0		Option to control access from the host computer and local control panel to tuning and alarm parameter
15	1015	HARD_ TYPES	Scalar input, Scalar output	—	Bit string indicating the hardware types: ❑ Bit 0: Scalar input ❑ Bit 1: Scalar output ❑ Bit 2: Discrete input ❑ Bit 3: Discrete output
16	1016	RESTART	—		Restart the FVP110 in the selected way: 1: Running 2: Restart Resource 3: Restart with the default settings defined in FF specifications.*1 4: Restart CPU
17	1017	FEATURES	—	—	Shows supportable optional features of the block.
18	1018	FEATURE_ SEL		—	Parameter used to select the optional features of the resource block
19	1019	CYCLE_ TYPE	Scheduled	—	Bit string indicating cycle types executable for the resources Bit 0: Scheduled; to be scheduled Bit 1: Event driven; to be driven by an event Bit 2: Manufacturer specified; executable by a manufacturer-specified unique function
20	1020	CYCLE_SEL	Scheduled		Bit string used to select the cycle type
21	1021	MIN_CYCLE_ T	3200 (100ms)	—	Minimum execution cycle
22	1022	MEMORY_ SIZE	0	—	Memory size allowed for use of function block configurations in the device; checked before a download, but not supported by the FVP110.

Table 60 Resource Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
23	1023	NV_CYCLE_T	0	—	Cycle of saving the settings of non-volatile attribute parameters to the EEPROM. 0 is set with the FVP110, and saving is not cyclically done.
24	1024	FREE_SPACE	0	—	Shows the free space memory for configurations as a percent value. FVP110 shows zero which means the pre-configured resource.
25	1025	FREE_TIME	0	—	Shows the free time that can be used for computations by resources but not supported by the FVP110.
26	1026	SHED_RCAS	640000		Communication time-out setting for communications with the device from which the remote cascade setpoint is sent.
27	1027	SHED_ROUT	640000		Communication time-out setting for communications with the device from which the remote output setting is sent; not used in the FVP110, however.
28	1028	FAULT_STATE	1	—	Indicates the fault-state.
29	1029	SET_FSTATE	1		Sets the fault-state.
30	1030	CLR_FSTATE	1		Clears the fault-state.
31	1031	MAX_NOTIFY	3	—	Maximum number of alerts retained in the device (FVP110).
32	1032	LIM_NOTIFY	3		Maximum number of alerts to be held by the device (YVP110); used by the user to restrict the number of alert notifications to the host to prevent overflow of alert receptions in the host.
33	1033	CONFIRM_TIM	20000 (ms)		Defines the time to wait for confirmation for an alert.
34	1034	WRITE_LOCK	Unlocked		Prohibits write access from outside the device to the settings.
35	1035	UPDATE_EVT	—	—	Shows the contents of an update event upon occurrence.
36	1036	BLOCK_ALM	—	—	Shows the contents of an alarm event upon occurrence.

Table 60 Resource Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
37	1037	ALARM_SUM	Enable		Shows the alarm summary for all blocks within the device (FVP110).
38	1038	ACK_ OPTION	0XFFFF		Defines the acknowledgment action of each alarm type. By setting a bit to 1, the corresponding alarm will behave as acknowledged immediately when it occurs without receipt of acknowledgment from the host.
39	1039	WRITE_PRI	0		Defines the priority level of WRITE_ALM as well as allows for notification to be disabled and makes acknowledgment unnecessary for WRITE_ALM.
40	1040	WRITE_ALM	—	—	Alarm generated when WRITE_LOCK is set to unlocked
41	1041	ITK_VER	4	—	Version number of the inter-operability test kit
42	1042	SOFT_REV	—	—	Revision number of software
43	1043	SOFT_DSC	—	—	Revision number of software for development purpose.
44	1044	SIM_ENABLE _MSG	Null	—	Used to determine whether to enable the simulation function to run. To enable, set “REMOTE LOOP TEST SWITCH”.
45	1045	DEVICE_STA TUS_1	0	—	Shows device statuses - mainly link object setting statuses.
46	1046	DEVICE_STA TUS_2	0	—	Shows device statuses - mainly individual for each block status.
47	1047	DEVICE_STA TUS_3	0	—	Shows device statuses - mainly the contents of XD_ERROR in each block.
48	1048	DEVICE_STA TUS_4	0	—	Not used in the FVP110.
49	1049	DEVICE_STA TUS_5	0	—	Not used in the FVP110.
50	1050	DEVICE_STA TUS_6	0	—	Not used in the FVP110.

Table 60 Resource Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
51	1051	DEVICE_STATUS_7	0	—	Not used in the FVP110.
52	1052	DEVICE_STATUS_8	0	—	Not used in the FVP110.

*1: FF-891 “Foundation TM Specification Function Block Application Process Part 2”

Parameters of Transducer Block

Parameters marked with (*1) are automatically set and changed by autotuning.
Parameters marked with (*2) are automatically set and changed by Travel calibration.

Table 61 Transducer Block Parameters

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
0	2000	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	2001	ST_REV	0	—	Incremented when a change is made to the parameter settings for the resource block to indicate the revision level of the settings, and used to see whether or not there is a change in parameter settings.
2	2002	TAG_DESC	Spaces		Universal parameter storing the description of the tag
3	2003	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks
4	2004	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upper level system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	2005	MODE_BLK	O/S		Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
6	2006	BLOCK_ERR	—	—	Indicates the error statuses related to the block itself.
7	2007	UPDATE_ EVT	—	—	Shows the contents of an update event upon occurrence.
8	2008	BLOCK_ALM	—	—	Universal parameter indicating the hardware and software error statuses related to the block itself.
9	2009	TRANSDUCE R _DIRECTOR Y	1, 10	—	Index to the text describing the transducer contained in the FVP110 positioner.
10	2010	TRANSDUCE R_TYPE	106	—	Transducer type.
11	2011	XD_ERROR	0	—	Stores the error prioritized at the highest level from among the errors that are currently occurring in the transducer block.
12	2012	CORRECTIO N _DIRCTORY	1, 13	—	Stores the number of data collection and the index number to be started with.
13	2013	FINAL_ VALUE	—	O/S	Stores the valve control level and status written by the AO block.
14	2014	FINAL_ VALUE _RANGE	-10%, 110%	O/S	Defines the upper and lower range limits of FINAL_VALUE, and the unit code and decimal point position for value indication of INAL_VALUE.
15	2015	FINAL_ VALUE _CUTOFF_HI	110%	O/S	If the value of FINAL_VALUE is greater than the value set in this parameter, the FVP110 moves the valve to the full-open position.
16	2016	FINAL_ VALUE _CUTOFF_ LO	-10%	O/S	If the value of FINAL_VALUE is less than the value set in this parameter, the FVP110 moves the valve to the shut-off position.
17	2017	FINAL_ POSITION _VALUE	—	—	Stores the position data read by the valve position sensor.

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
18	2018	SERVO_ GAIN (*1)	120	O/S	Static control loop gain set by auto tuning [0.5 to 1300]
19	2019	SERVO_ RESET (*1)	15 sec	O/S	Integral time set by auto tuning.
20	2020	SERVO_ RATE (*1)	0. 22 sec	O/S	Derivative time set by auto tuning.
21	2021	ACT_FAIL_ ACTION	1	O/S	Specifies the actuator action direction (in case of losing of air supply pressure): 1 = Air to Open 2 = Air to Close
22	2022	ACT_MAN_ID	0	—	ID of actuator manufacturer
23	2023	ACT_MODEL _NUM	Null	—	Model number of actuator
24	2024	ACT_SN	0	—	Serial number of actuator
25	2025	VALVE_MAN _ID	0	—	ID of valve manufacturer
26	2026	VALVE_ MODEL _NUM	Null	—	Model number of valve
27	2027	VALVE_SN	0		Serial number of valve
28	2028	VALVE_TYPE	1	O/S	Valve type: 1 = linear-motion valve 2 = rotary-motion valve
29	2029	XD_CAL_ LOC	Null		Shows and is used to record the location where the positioner was calibrated.
30	2030	XD_CAL_ DATE	01/01/00		Shows and is used to record the date when the positioner was calibrated.
31	2031	XD_CAL_ WHO	Null		Shows and is used to record the person who calibrated the positioner.
32	2032	ALARM_ SUM			Shows the alarm summary (current alarm statuses, acknowledged/unacknowledged states, masking states) for the transducer block.

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
33	2033	POSITION_ CHAR _TYPE	1	O/S	Defines the valve position-to-flow characteristics: 1 = linear 2 = equal % (50:1) 3 = equal % (30:1) 4 = quick open (inverse of 50:1 equal %) 5 = Camflex Percentage 255 = user-defined 10-segment function
34	2034	POSITION_ CHAR	10,20,30,40,50,60, 70,80,90	O/S	Defines the coordinates of the segment function when 255 is set for POSITION_CHAR_TYPE. [0 to 100, only simple decreasing can be allowed]
35	2035	LIMSW_HI_ LIM	+110%		Setting of high limit switch
36	2036	LIMSW_LO_ LIM	-10%		Setting of low limit switch
37	2037	ELECT_ TEMP	–	—	Indicates the temperature on amplifier board
38	2038	TEMPERATURE _UNIT	1101(°C)	O/S	Defines the unit of temperature indication above: 1101 = °C 1102 = °F
39	2039	SUPPLY _PRESSURE	140 kPa	O/S	Air supply pressure (irrespective of control)
40	2040	SPRING_ RANGE	20 kPa, 100 kPa	O/S	Defines the pressure range and unit for valve operation (with no direct effect on control). The unit defined here also applies to OUT_PRESSURE. 1133 = kPa 1137 = bar 1141 = psi 1145 = kgf/cm^2
41	2041	OUT_ PRESSURE	–	—	Output pressure to valve actuator

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
42	2042	SERVO_ OUTPUT _SIGNAL	–	—	Output current (%) to I/P module
43	2043	SERVO_ RATE _GAIN (*1)	5	O/S	Derivative gain; a control parameter set by auto tuning [2 to 20]
44	2044	SERVO _DEADBAND (*1)	0.5%	O/S	Derivative action dead band; a control parameter set by auto tuning [0 to 50%]
45	2045	SERVO_OFF SET (*1)	55% of MV	O/S	Derivative action offset; a control parameter set by auto tuning [0 to 100 % of MV]
46	2046	BOOST_ON _ THRESHOLD (*1)	1.9, 2.9%	O/S	Threshold for switching on boost action; a control parameter set by auto tuning[0, 0.1 to 10%]
47	2047	BOOST_OFF _ THRESHOLD (*1)	1.0, 1.0%	O/S	Threshold for switching off boost action; a control parameter set by auto tuning [0.1 to 10%]
48	2048	BOOST_ VALUE (*1)	8, 10% of MV	O/S	Boost value; a control parameter set by auto tuning [0 to 50 % of MV]
49	2049	SERVO_I_ SLEEP _LMT (*1)	0 sec	O/S	Integral-action sleep timer setting; a control parameter set by auto tuning [0 to10 sec]
50	2050	SERVO_P_ ALPHA (*1)	%	O/S	Multiplication coefficient for the square of proportional factor; a control parameter set by auto tuning [0 to 100%]
51	2051	INTERNAL_ GAIN (*1)(*2)	5 rad./mA	O/S	Gain for internal computation ; a control parameter set by auto tuning [0.5 to 50 rad./ mA]
52	2052	MEAS_GAIN	0 rad./mA	—	Measurement gain of I/P module, control relay and valve; a parameter set by auto tuning
53	2053	VALVE_TC	0 sec	—	Proportional factor of response speed of valve; a parameter set by auto tuning

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
54	2054	VALVE_HYS	0 %	—	Hysteresis of valve actions (%); a parameter set by auto tuning
55	2055	VALVE_SLIP _WIDTH	0 %	—	Slip width of valve actions (%); a parameter set by auto tuning
56	2056	MEAS_ PRESS_AIR	0 kPa	—	Air pressure (%); a parameter set by auto tuning (Valid when an optional pressure sensor is specified.)
57	2057	MEAS_ PRESS _SUPPLY	0 kPa	—	Air supply pressure (%); a parameter set by auto tuning (Valid when an optional pressure sensor is specified.)
58	2058	MEAS_ SPRING _RANGE	0 kPa	—	Spring range of valve; a parameter set by auto tuning (Valid when an optional pressure sensor is specified.)
59	2059	CONTROL_ DIR	2	—	Defines the acting direction of the feedback loop: 1 = direct 2 = reverse
60	2060	THETA_HI(*1) (*2)	+ 0.2 rad.	—	Upper angle signal limit of position sensor (in radians)
61	2061	THETA_LO (*1)(*2)	-0.2 rad.	—	Upper angle signal limit of position sensor (in radians)
62	2062	THETA_P(*1) (*2)	0 rad.	—	Angle signal equal to 50 % from position sensor (in radians)
63	2063	TRAVEL_ CALIB _EXEC	1	O/S	Switch for starting a travel calibration.
64	2064	TRAVEL_ CALIB _RESULT	1	—	Indicates the result of a travel calibration.
65	2065	OPEN_STOP _ADJ	–	—	Not used for FVP110.
66	2066	AUTO_TUNE _EXEC	1	O/S	Switch for starting auto tuning.

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
67	2067	AUTO_TUNE _RESULT	1	—	Indicates the result of auto tuning.
68	2068	AUTO_TUNE _STATE	0	—	Indicates auto tuning sequence number.
69	2069	SERVO_RET _TO _DFLT	1	O/S	Writing 2 to this parameter resets all control parameters to the defaults: 1 = off 2 = set (to the defaults)
70	2070	ADVAL_FW	–	—	Digital value of valve control signal, setpoint equivalent to A/D value of valve position signal.
71	2071	ADVAL_BW	–	—	A/D value of valve position signal
72	2072	ADVAL_ PRESS	–	—	A/D value of pressure from sensor
73	2073	ADVAL_T	–	—	A/D value of temperature from sensor
74	2074	TOTAL_ CYCLE _COUNT	0	O/S	Total number of cycles. To reset the count, write 0.
75	2075	CYCLE _DEADBAND	0.25%	—	Dead band of cycle counting
76	2076	CYCLE_ COUNT _LIM	2^32-1		High-limit alarm setting for TOTAL_CYCLE_COUNT. When TOTAL_CYCLE_COUNT has reached this setting, a block alarm is generated.
77	2077	TOTAL_ TRAVEL	0	O/S	Total amount of travel. To reset the count, write 0.
78	2078	TRAVEL _DEADBAND	0.25%		Dead band of travel integration
79	2079	TRAVEL_ LIM	2^32-1		High-limit alarm setting for TOTAL_TRAVEL. When TOTAL_TRAVEL has reached this setting, a block alarm is generated.
80	2080	TOTAL_ OPEN _TIME	0 hour		Total time other than counted for TOTAL_CLOSE_TIME. To reset the count, write 0.

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
81	2081	TOTAL_ CLOSE _TIME	0 hour		Total time where valve position is equal to or less than OPEN_CLOSE_THRESHOLD. To reset the count, write 0.
82	2082	OPEN_ CLOSE _ THRESHOLD	0.25%	—	Threshold value for TOTAL_OPEN_TIME and TOTAL_CLOSE_TIME.
83	2083	OPEN_TIME_ LIM	2^32-1 hours		High-limit alarm setting for TOTAL_OPEN_TIME. When TOTAL_OPEN_TIME has reached this setting, a block alarm is generated.
84	2084	CLOSE_TIME _LIM	2^32-1 hours		High-limit alarm setting for TOTAL_CLOSE_TIME. When TOTAL_CLOSE_TIME has reached this setting, a block alarm is generated.
85	2085	TOTAL_ NEAR _CLOSE_TIM	0	O/S	Total time period when the valve position is equal to or less than the value set in NEAR_CLOSE_THRESHOLD (judged as when the valve is nearly closed). To reset the count, write 0.
86	2086	NEAR_ CLOSE _ THRESHOLD	3.0 %		Threshold for judging that the valve is nearly closed
87	2087	NEAR_ CLOSE _TIME_LIM	2^32-1 hours		High-limit alarm setting for TOTAL_NEAR_CLOSE_TIM. When TOTAL_NEAR_CLOSE_TIM has reached this setting, a block alarm is generated.
88	2088	DEVIATION_ LIM	110%		Deviation high limit (%)
89	2089	DEVIATION_ TIME _TH	10, -1 (off)		If the time period when the deviation is continuously equal to or greater than DEVIATION_LIM has reached the time set for the first value in this parameter, a block alarm is generated. If it has reached the time set for the second value, the instrument transfers to fault state. Negative value means *off*.

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
90	2090	RELEASE _FAILSAFE	As specified upon ordering	O/S	Used to release the block from the fail-safe state. When the value of this parameter is 3, writing 1 will release the block from the fail-safe state. 1 = clear, non-latch (normal state) 2 = active, latched (during fail-safe state) 3 = clear, latched (cause has been cleared but failsafe action is still on).
91	2091	MODEL	As specified upon ordering	—	Model code
92	2092	DEV_ OPTIONS	0x000D (or 0X0001 if PID option is specified)	—	Indicates whether any software options are provided.
93	2093	PRESS_ SENS _INSTALLED	1	—	Indicates whether a pressure sensor is equipped: 1 = equipped 2 = not equipped
94	2094	ACTUATOR_ TYPE	As specified upon ordering	—	Actuator type 1 = single acting 2 = double acting
95	2095	RELAY_TYPE	1		Control relay type: 1 = direct acting
96	2096	SIGN_MEAS_ EXEC	1	O/S	Carries outs signature measurement. 1 = off
97	2097	SIGN_MEAS _RESULT	1	—	Indicates the signature measurement status and result. 1 = succeeded
98	2098	SIGN_MEAS_ STATE	0	—	Indicates the progress of signature measurement.
99	2099	SIGN_MEAS _COUNTER	0	—	Indicates the number of measured data sets. The count is reset to zero when the power is turned off or measurement of a new signature is performed.

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
100	2100	SIGN_DATA_SAVE	1		Saves the measurements of the standard actuator signature to non-volatile memory as record data. 1 = off
101	2101	SIGN_UPLOAD_DATABASE	1		Parameter used to specify the measured data to be uploaded. Set this parameter, and the related parameters will be read.
102	2102	SIGN_UPLOAD_POINTER	0		Pointer that indicates the leading position of the data to be uploaded from SIGN_DATA_X or SIGN_DATA_Y, and used when there are 20 or more data values measured.
103	2103	SIGN_DATA_X	0	—	Parameter used to upload the measured signature data (input data).
104	2104	SIGN_DATA_Y	0	—	Parameter used to upload the measured signature data (output data).
105	2105	SIGN_MEAS_DATE	01/01/00 00:00:00.000	—	Parameter used to upload the date and time of signature measurement
106	2106	SIGN_HEADER_DATA	+inf	—	Parameter used to upload the ambient temperature and settings at signature measurement
107	2107	STD_ACT_SIGN_SET	180, 180, 50		Settings of the standard actuator signature
108	2108	EXT_ACT_SIGN_SET	0, 100, 180, 180, 50, 200		Settings of the extended actuator signature and high resolution actuator signature
109	2109	STEP_RESP_SET	45, 55, 100, 600		Settings of step levels for step response test
110	2110	POSITIONER_SIGN_SET	0, 100, 10, 30, 30		Settings of the positioner signature
111	2111	SERVO_WARN_HI_LIM	80 % of MV		High-limit alarm setting for Servo Output Drift warning
112	2112	SERVO_WARN_LO_LIM	20 % of MV		Low-limit alarm setting for Servo Output Drift warning

Table 61 Transducer Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
113	2113	SERVO_ TIME_TH	10 sec		High-limit alarm setting for total time of Servo Output Drift warning.
114	2114	SERVO_ WARN_ COUNT	0	O/S	Total number of times of Servo Output Drift warning. To reset the count, write 0.
115	2115	X_BST_ON_ THRESHOLD	0, 0 %	O/S	The addition value to threshold for switching on boost action; a control parameter for exhaust [-10 to 10%] Applicable for Double Acting Type
116	2116	X_BST_OFF_ THRESHOLD	0, 0 %	O/S	The addition value to threshold for switching off boost action; a control parameter for exhaust [-10 to 10%] Applicable for Double Acting Type
117	2117	X_BOOST_ VALUE	0, 0 % of MV	O/S	The addition Boost value; a control parameter for exhaust [-50 to 50%] Applicable for Double Acting Type

Parameters of AO Block

Table 62 AO Block Parameters

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
0	5000	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	5001	ST_REV	0	—	Incremented when a change is made to the parameter settings for the AO block to indicate the revision level of the settings, and used to see whether there is a change in parameter settings.
2	5002	TAG_DESC	Spaces		Universal parameter storing the description of the tag
3	5003	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks

Table 62 AO Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
4	5004	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upper level system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	5005	MODE_BLK	O/S		Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.
6	5006	BLOCK_ERR	—	—	Indicates the error statuses related to the block itself.
7	5007	PV	—	—	Indicates the primary analog value (or the corresponding process value) used to execute the specified actions, and the status of that value.
8	5008	SP	0	Auto	Indicates the setpoint for the block.
9	5009	OUT	0	Man	Indicates the output value and its status.
10	5010	SIMULATE	disable		Used to simulate the output from the transducer block; allows the user to set the value and status input from the specified channel.
11	5011	PV_SCALE	0-100%	O/S	High and low scale values when displaying the PV parameter and the parameters which have the same scaling as PV.
12	5012	XD_SCALE	0-100%	O/S	High and low scale values used with the value obtained from or sent to the transducer block for a specified channel.
13	5013	GRANT_ DENY	0		Option to control access from the host computer and local control panel to tuning and alarm parameters
14	5014	IO_OPTS	0 x 000A	O/S	Settings for the I/O processing of the block.
15	5015	STATUS_ OPTS	0 x 0000	O/S	Defines block actions depending on block status conditions.
16	5016	READBACK	–	—	Readback signal of valve position from transducer block.
17	5017	CAS_IN	–		Cascade input

Table 62 AO Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
18	5018	SP_RATE_ DN	+INF		Rate-of-decrease limit for SP effective in AUTO, CAS, and RCAS modes. If this parameter is 0, no limit is applied to the rate of decrease.
19	5019	SP_RATE_ UP	+INF		Rate-of-increase limit for SP effective in AUTO, CAS, and RCAS modes. If this parameter is 0, no limit is applied to the rate of increase.
20	5020	SP_HI_LIM	100		Upper limit for setpoint (SP)
21	5021	SP_LO_LIM	0		Lower limit for setpoint (SP)
22	5022	CHANNEL	1	O/S	Defines the channel number of the hardware channel connected to the transducer block. Always set to 1 for the AO block in a FVP110.
23	5023	FSTATE_ TIME	0 second		Defines the time from when the fault state of the RCAS_IN or CAS_IN is detected to when the output should be set to the level preset in FSTATE_VAL (this action takes place only if Fault State to value is set as true in I/O_OPTS).
24	5024	FSTATE_VAL	0		Preset output level for fault state. See above.
25	5025	BKCAL_OUT	–	—	Value to be input to BKCAL_IN of the downstream block; used by the downstream block to prevent reset windup and perform bumpless transfer to closed-loop control.
26	5026	RCAS_IN	–		Remote cascade setpoint set by the host computer, etc.
27	5027	SHED_OPT	1		Defines the mode shedding action to be taken upon occurrence of time-out of communication in a mode using the remote setpoint.
28	5028	RCAS_OUT	–	—	Remote setpoint sent to a host computer, etc.

Table 62 AO Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
29	5029	UPDATE_ EVT	–	—	Shows the contents of an update event upon occurrence.
30	5030	BLOCK_ALM	–	—	Shows the contents of a block alarm upon occurrence.

Parameters of DI Block

Table 63 DI Block Parameters

Relative Index	Index		Parameter Name	Default (factory setting)	Write	Description
	DI1	DI2				
0	6000	6100	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	6001	6101	ST_REV	0	—	Incremented when a change is made to the parameter settings for the AO block to indicate the revision level of the settings, and used to see whether there is a change in parameter settings.
2	6002	6102	TAG_DESC	Spaces		Universal parameter storing the description of the tag
3	6003	6103	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks
4	6004	6104	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upper level system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	6005	6105	MODE_BLK	O/S		Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.
6	6006	6106	BLOCK_ERR	—	—	Indicates the error statuses related to the block itself.
7	6007	6107	PV_D	—	—	Indicates the primary discrete value (or the corresponding process value) used to execute the specified actions, and the status of that value.

Table 63 DI Block Parameters (Continued)

Relative Index	Index		Parameter Name	Default (factory setting)	Write	Description
	DI1	DI2				
8	6008	6108	OUT_D	—	Man	Indicates the output value and its status.
9	6009	6109	SIMULATE_D	disable	—	Used to determine whether to use the limit switch signal input from the transducer block or use the user-set value. When this parameter is set to disable, the block uses the actual input value and status.
10	6010	6110	XD_STATE	0		Index to the text describing the states of the discrete value obtained from the transducer, but not supported by FVP110
11	60011	6111	OUT_STATE	0		Index to the text describing the states of a discrete output, but not supported by FVP110.
12	6012	6112	GRANT_ DENY	0		Used to check whether various user operations can be put into effective. Before operations, in the GRANT parameter component, set the bits (to 1) corresponding to the intended operations. After the operations, check the DENY parameter component. If the corresponding bits are not set (to 1) in DENY, it proves that the corresponding operation has been put into effective.
13	6013	6113	IO_OPTS	0	O/S	Settings for the I/O processing of the block.
14	6014	6114	STATUS_ OPTS	0	O/S	Defines block actions depending on block status conditions.
15	6015	6115	CHANNEL	2 or 3	O/S	Defines the channel number of the hardware channel connected to the transducer block. Always set 2 for the DI1 block and 3 for DI2 in a FVP110.
16	6016	6116	PV_FTIME	–	—	Time constant of filter for PV_D.
17	6017	6117	FIELD_VAL_ D	–		Status of limit switch signal obtained from the transducer block
18	6018	6118	UPDATE_EV T	–	–	Shows the contents of an update event upon occurrence.
19	6019	6119	BLOCK_ALM	–	–	Shows the contents of a block alarm upon occurrence.
20	6020	6120	ALARM_SUM	enable		Shows the alarm summary (current alarm statuses, acknowledged/unacknowledged states, masking states) for the DI block.

Table 63 DI Block Parameters (Continued)

Relative Index	Index		Parameter Name	Default (factory setting)	Write	Description
	DI1	DI2				
21	6021	6121	ACK_OPTIO N	0XFFFF		Defines the priority of WRITE_ALM as well as allows for notification to be disabled and makes acknowledgement unnecessary for WRITE_ALM .
22	6022	6122	DISC_PRI	0	–	Priority order of discrete alarm.
23	6023	6123	DISC_LIM	1		Input status of generating a discrete alarm.
24	6024	6124	DISC_ALM	–		Status of discrete alarm.

Parameters of OS Block

Table 64 OS Block Parameters

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
0	14000	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	14001	ST_REV	0	—	Incremented when a change is made to the parameter settings for the AO block to indicate the revision level of the settings, and used to see whether there is a change in parameter settings.
2	14002	TAG_DESC	Spaces		Universal parameter storing the description of the tag
3	14003	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks
4	14004	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upper level system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	14005	MODE_BLK	O/S		Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.

Table 64 OS Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
6	14006	BLOCK_ERR	—	—	Indicates the error statuses related to the block itself.
7	14007	SP		Auto	Indicates the setpoint for the block.
8	14008	OUT_1		O/S	Indicates the value and status of output 1.
9	14009	OUT_2		O/S	Indicates the value and status of output 2.
10	14010	OUT_1_RANGE	0-100%		Defines the range of OUT_1 (output 1).
11	14011	OUT_2_RANGE	0-100%		Defines the range of OUT_2 (output 2).
12	14012	GRANT_DENY	0		Option to control access from the host computer and local control panel to tuning and alarm parameters.
13	14013	STATUS_OPTS	0	O/S	Defines block actions depending on block status conditions.
14	14014	CAS_IN			Cascade input.
15	14015	BKCAL_OUT			Value returned to BLCAL_IN of the upstream block; used by the upstream block to prevent reset windup and perform bumpless transfer to closed-loop control.
16	14016	IN_ARRAY	(0, 0, 0, 0)	O/S	Settings used to convert SP to OUT_1.
17	14017	OUT_ARRAY	(0, 0, 0, 0)	O/S	Settings used to convert SP to OUT_2.
18	14018	LOCKVAL	2		Defines the value of OUT_1 outside the set endpoints of operation characteristic. 2 = Lock
19	14019	BKCAL_IN_1			Read-back value of OUT_1 returned from the downstream block.
20	14020	BKCAL_IN_2			Read-back value of OUT_2 returned from the downstream block.
21	14021	BAL_TIME	0		Defines the balancing time. After the cascade connection to one downstream block has already been established, the cascade connection to the other downstream block will be established over the time period defined by this parameter.
22	14022	HYSTVAL	0		Defines the hysteresis for LOCKVAL. When it is set to ‘No Lock.’

Table 64 OS Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
23	14023	UPDATE_EVT			Shows the contents of an update event upon occurrence.
24	14024	BLOCK_ALM			Shows the contents of a block alarm upon occurrence.

Parameters of PID and PID2 Blocks (Optional)

Table 65 lists the PID parameters for PID1. PID2 uses the same parameters but with a starting *Index* of *8100*.

Table 65 PID Block Parameters

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
0	8000	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	8001	ST_REV	0	—	Incremented when a change is made to the parameter settings for the PID block to indicate the revision level of the settings, and used to see whether there is a change in parameter settings.
2	8002	TAG_DESC	Spaces		Universal parameter storing the description of the tag.
3	8003	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks.
4	8004	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upperlevel system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	8005	MODE_BLK	O/S		Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.
6	8006	BLOCK_ERR	—	—	Indicates the error statuses related to the block itself.

Table 65 PID Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
7	8007	PV	—	—	Indicates the primary analog value (or the corresponding process value) used to execute the specified actions, and the status of that value.
8	8008	SP	—	Auto	Setpoint of the block.
9	8009	OUT	—	Man	Value and status of output.
10	8010	PV_SCALE	0-100%	O/S	Upper and lower scale limit values used for scaling of the input (IN) value.
11	8011	OUT_SCALE	0-100%	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	GRANT_DENY	0		Option to control access from the host computer and local control panel to tuning and alarm parameters.
13	8013	CONTROL_OPTS	0x0000	O/S	Defines block actions depending on block status conditions.
14	8014	STATUS_OPTS	0x0000	O/S	Defines options for control actions of block.
15	8015	IN	0		Controlled-value input.
16	8016	PV_FTIME	0		Time constant (in seconds) of the first-order lag filter applied to IN
17	8017	BYPASS	1	Man	Determines whether to bypass control computation. 1 = off; do not bypass. 2 = on; bypass.
18	8018	CAS_IN	0		Cascade setpoint.
19	8019	SP_RATE_DN	+INF		Rate-of-decrease limit for setpoint (SP)
20	8020	SP_RATE_UP	+INF		Rate-of-increase limit for setpoint (SP)
21	8021	SP_HI_LIM	100		Upper limit for setpoint (SP)
22	8022	SP_LO_LIM	0		Lower limit for setpoint (SP)
23	8023	GAIN	1		Proportional gain (= 100 / proportional band).

Table 65 PID Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
24	8024	RESET	10	—	Integration time (seconds).
25	8025	BAL_TIME	0		Unused.
26	8026	RATE	0		Derivative time (seconds)
27	8027	BKCAL_IN	0		Readback of control output
28	8028	OUT_HI_LIM	100		Upper limit for control output (OUT)
29	8029	OUT_LO_LIM	0		Lower limit for control output (OUT)
30	8030	BKCAL_HYS	0		Hysteresis for release from a limit for OUT.status.
31	8031	BKCAL_OUT	—	–	Read-back value to be sent to the BKCAL_IN of the downstream block.
32	8032	RCAS_IN	0		Remote setpoint set from the host computer.
33	8033	ROUT_IN	—		Remote control output value set from a computer, etc.
34	8034	SHED_OPT	1		Defines the mode shedding actions, namely, the changes to be made to MODE.BLK.target and MODE.BLK.actual when (1) the value of RCAS_IN.status becomes Bad if MODE_BLK.actual = RCAS, or when (2) the value of ROUT_IN.status becomes Bad if MODE_BLK.actual = ROUT.
35	8035	RCAS_OUT	—	–	Remote setpoint sent to a host computer, etc.
36	8036	ROUT_OUT	—	–	Remote control output value.
37	8037	TRK_SCALE	0-100%	Man	Upper and lower scale limits used to convert the output tracking value (TRK_VAL) to non-dimensional.
38	8038	TRK_IN_D			Switch for output tracking.
39	8039	TRK_VAL			Output tracking value. When MODE_BLK.actual = LO, the value scaled from the TRK_VAL value is set in OUT.
40	8040	FF_VAL			Feed-forward 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.

Table 65 PID Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
41	8041	FF_SCALE	0-100%	Man	Scale limits used for converting the FF_VAL value to a non-dimensional value.
42	8042	FF_GAIN	0	Man	Gain for FF_VAL.
43	8043	UPDATE_EVT	—	–	Shows the contents of an update event upon occurrence.
44	8044	BLOCK_ALM	—	–	Shows the contents of a block alarm upon occurrence.
45	8045	ALARM_SUM	Enable		Shows the alarm summary (current alarm statuses, acknowledged/unacknowledged states, masking states)
46	8046	ACK_OPTION	0XFFFF		Selects whether or not the alarms related to the DI block are automatically self-acknowledged.
47	8047	ALARM_HYS	0.5%		Hysteresis for alarm detection and resetting to prevent each alarm from occurring and recovering repeatedly within a short time.
48	8048	HI_HI_PRI	0		Priority order of HI_HI_ALM alarm.
49	8049	HI_HI_LIM	+INF		Setting for HI_HI_ALM alarm.
50	8050	HI_PRI	0		Priority order of HI_ALM alarm.
51	8051	HI_LIM	+INF		Setting for HI_ALM alarm.
52	8052	LO_LO_PRI	0		Priority order of LO_ALM alarm.
53	8053	LO_LO_LIM	+INF		Setting for LO_ALM alarm.
54	8054	LO_PRI	0		Priority order of LO_LO_ALM alarm.
55	8055	LO_LIM	+INF		Setting for LO_LO_ALM alarm
56	8056	DV_HI_PRI	0		Priority order of DV_HI_ALM alarm.
57	8057	DV_HI_LIM	+INF		Setting for DV_HI_ALM alarm.
58	8058	DV_LO_PRI	0		Priority order of DV_LO_ALM alarm.
59	8059	DV_LO_LIM	+INF		Setting for DV_LO_ALM alarm.

Table 65 PID Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
60	8060	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	HI_ALM	—	–	As above.
62	8062	LO_LO_ALM	—	–	As above. Reset when the PV value has increased above [LO_LIM + ALM_HYS].
63	8063	LO_ALM	—	—	As above.
64	8064	DV_HI_ALM	—	—	An 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	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.

Parameters of IS (SIGSEL) Block

Table 66 IS Block Parameters

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
0	17000	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	17001	ST_REV	0	—	Incremented when a change is made to the parameter settings for the IS block to indicate the revision level of the settings, and used to see whether there is a change in parameter settings.

Table 66 IS Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
2	17002	TAG_DESC	Spaces		Universal parameter storing the description of the tag
3	17003	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks
4	17004	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upper level system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	17005	MODE_BLK	O/S		Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.
6	17006	BLOCK_ERR	—	—	Indicates the error statuses related to the block itself.
7	17007	OUT	0	Man	Indicates the output value and its status.
8	17008	OUT_RANGE			This is the display scaling for the output. It has no effect on the block. It is used by many blocks.
9	17009	GRANT_ DENY	0		Option to control access from the host computer and local control panel to tuning and alarm parameters
10	17010	STATUS_ OPTS	0 x 0000	O/S	Defines block actions depending on block status conditions.
11	17011	IN_1			Numbered input required by this block.
12	17012	IN_2			Numbered input required by this block.
13	17013	IN_3			Numbered input required by this block.
14	17014	IN_4			Numbered input required by this block.
15	17015	DISABLE_1	—		0= Use; 1=Disable
16	17016	DISABLE_2	—		0= Use; 1=Disable
17	17017	DISABLE_3	—		0= Use; 1=Disable
18	17018	DISABLE_4	—		0= Use; 1=Disable

Table 66 IS Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
19	17019	SELECT_TYPE	0		Determines the selector action: 1: First good 2: Minimum 3: Maximum 4: Middle 5: Average
20	17020	MIN_GOOD			If the number of inputs which are good is less than the value of MIN_GOOD then set the out status to bad. 0 to 4
21	17021	SELECTED		—	An integer indicating which input has been selected. 0 to 4
22	17022	OP_SELECTED			An operator settable parameter to force a given input to be used. 0 to 4
23	17023	UPDATE_EVT		Read only	An alert for any change in the static data. This alert can notify interface devices that keep track of changes that one or more changes have occurred. The relative parameter index and its associated block index is included in the alert, along with the new value of ST_REV
24	17024	BLOCK_ALM	—	—	Shows the contents of an alarm event upon occurrence.

Parameters of AR (Arithmetic) Block

Table 67 AR (Arithmetic) Block Parameters

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
0	17500	Block Header		Block Tag =O/S	Information about this block, including the block tag, DD revision, execution time
1	17501	ST_REV	0	—	Incremented when a change is made to the parameter settings for the IS block to indicate the revision level of the settings, and used to see whether there is a change in parameter settings.
2	17502	TAG_DESC	Spaces		Universal parameter storing the description of the tag
3	17503	STRATEGY	1		Universal parameter used by an upper-level system to classify the function blocks
4	17504	ALERT_KEY	1		Universal parameter used as a key to identify the point from which an alert is issued; normally used by an upper level system to select alerts to provide to a particular operator who covers a specific area of the plant.
5	17505	MODE_BLK	O/S		Universal parameter that indicates the block operation conditions and is composed of actual mode, target mode, permitted modes, and normal mode.
6	17506	BLOCK_ERR	—	—	Indicates the error statuses related to the block itself.
7	17507	PV			Either the primary value for use in executing the function, or a process value associated with it.
8	17508	OUT	0	Man	Indicates the output value and its status.
9	17509	PRE_OUT			Displays what would be the OUT value and status if the mode was Auto or lower.
10	17510	PV_SCALE		O/S	The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the PV parameter and parameters which have the same scaling as PV. 0-100%

Table 67 AR (Arithmetic) Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
11	17511	OUT_RANGE			This is the display scaling for the output. It has no effect on the block. It is used by many blocks.
12	17512	GRANT_ DENY	0		Option to control access from the host computer and local control panel to tuning and alarm parameters
13	17513	INPUT_OPTS	0		Option bit string for handling the status of the auxiliary inputs.
14	17514	IN			The primary input value of the block, required for blocks that filter the input to get the PV.
15	17515	IN_LO			Input for the low range transmitter, in a range extension application.
16	17516	IN_1			Numbered input required by this block.
17	17517	IN_2			Numbered input required by this block.
18	17518	IN_3			Numbered input required by this block.
19	17519	RANGE_HI	0		Constant value above which the range extension has switched to the high range transmitter.
20	17520	RANGE_LO	0		Constant value below which the range extension has switched to the low range transmitter.
21	17521	BIAS_IN_1	0		The constant to be added to IN_1.
22	17522	GAIN_IN_1	0		The constant to be multiplied times (IN_1 + bias).
23	17523	BIAS_IN_2	0		The constant to be added to IN_2.
24	17524	GAIN_IN_2.	0		The constant to be multiplied times (IN_2 + bias).
25	17525	BIAS_IN_3	0		The constant to be added to IN_3.
26	17526	GAIN_IN_3	0		The constant to be multiplied times (IN_3 + bias).
27	17527	COMP_HI_LI M	0		The high limit imposed on the PV compensation term.
28	17528	COMP_LO_LI M	0		The low limit imposed on the PV compensation term.

Table 67 AR (Arithmetic) Block Parameters (Continued)

Relative Index	Index	Parameter Name	Default (factory setting)	Write	Description
29	17529	ARITH_TYPE	0		The identification number of the arithmetic algorithm. 1 to 9.
30	17530	BAL_TIME	0		This specifies the time for the internal working value of bias or ratio to return to the operator set bias or ratio, in seconds.
31	17531	BIAS			The bias value used in computing the function block output, expressed in engineering units. OUT_SCALE +/- 10%.
32	17532	GAIN	0		Dimensionless value used by the block algorithm in calculating the block output.
33	17533	OUT_HI_LIM	100%		Limits the maximum output value. OUT_SCALE +/- 10%.
34	17534	OUT_LO_LIM	0%		Limits the minimum output value. OUT_SCALE +/- 10%.
35	17535	UPDATE_EVT		Read only	An alert for any change in the static data. This alert can notify interface devices that keep track of changes that one or more changes have occurred. The relative parameter index and its associated block index is included in the alert, along with the new value of ST_REV
36	17536	BLOCK_ALM	—	—	Shows the contents of an alarm event upon occurrence.

IO_OPTS - Availability of Options for Each Block

Table 68 IO_OPTS - Availability of Options for Each Block

Bit	Contents	DI	AO
0	Invert	X	
1	SP tracks PV if Man		X
2	Reserved		
3	SP tracks PV if LO		X
4	SP tracks RCas or Cas if LO or Man		X
5	Increase to close		X
6	Faultstate Type		X
7	Faultstate Type		X
8	Target to Man		X
9	PV for BKCal_Out		X
10	Reserved		

STATUS_OPTS - Availability of Options for Each Block

Table 69 STATUS_OPTS - Availability of Options for Each Block

Bit	Contents	DI	IS (SIGSEL)	AO	OS	PID/PID2
0	IFS if BAD IN					X
1	IFS if BAD CAS_IN				X	X
2	Use Uncertain as Good		X			X
3	Propagate Fault Forward	X				
4	Propagate Fault Backward			X	X	
5	Target to Manual if BAD IN					X
6	Uncertain if Limited					
7	BAD if Limited					

Table 69 STATUS_OPTS - Availability of Options for Each Block (Continued)

Bit	Contents	DI	IS (SIGSEL)	AO	OS	PID/PID2
8	Uncertain if Man mode	X	X			
9	Target to next permitted mode if Bad CAS_IN					X

CONTROL_OPTS - Availability of Options for Each Block

Table 70 CONTROL_OPTS - Availability of Options for Each Block

Bit	Contents	PID/PID2
0	Bypass Enable	X
1	SP-PV Track in Man	X
2	SP-PV Track in ROut	X
3	SP-PV Track in LO or IMan	X
4	SP Track retained target	X
5	Direct Acting	X
6	Reserved	
7	Track Enable	X
8	Track in Manual	X
9	Use PV for BKCAL_OUT	X
10	Act on IR	
11	Use BKCAL_OUT with IN_1	
12	Obey SP limits if Cas or RCas	X
13	No OUT limits in Manual	X
14	Reserved	
15	Reserved	

Link Master Functions

B

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.

FVP 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.

Link Master

A link master (LM) is any device containing a link active scheduler (Figure 76). 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.

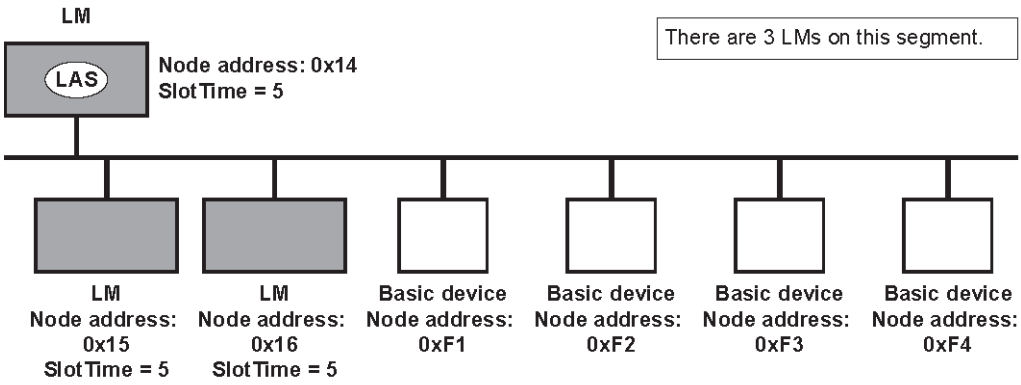


Figure 76 Example of Fieldbus Configuration-3 LMs on Same Segment

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, such as when the segment has started up or when the current LAS has failed, the LM declares itself as the LAS. With this procedure, an LM backs up the LAS as shown in Figure 77.
- 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.

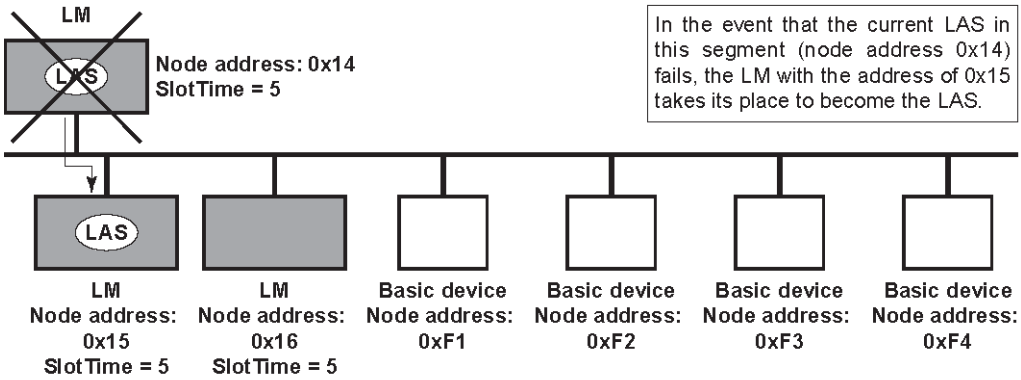


Figure 77 Backup of LAS

To set up a FVP as a device that is capable of backing up the LAS:

CAUTION

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

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

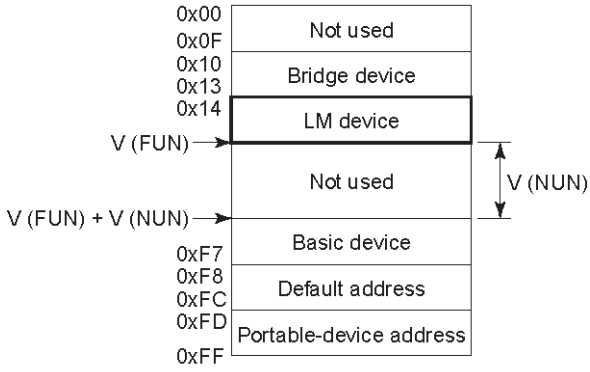


Figure 78 Node Address Ranges

2. Set the FVP LAS settings for 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 in Figure 79.

DlmeBasicInfo (YVP Index 361 (SM))

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

Figure 79 DlmeBasicInfo (YVP Index 361 (SM)) Example

In this case, set SlotTime, MaxResponseTime, and MinInterPduDelay as follows (Figure 80).

ConfiguredLinkSettingsRecord (YVP Index 369 (SM))

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

Figure 80 ConfiguredLinkSettingsRecord (YVP Index 369 (SM)) Example

3. Set the FVP LAS settings for the values of V(FUN) and V(NUN) so that they include the node addresses of all nodes within the same segment (Figure 81).

ConfiguredLinkSettingsRecord (YVP Index 369 (SM))

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

Figure 81 ConfiguredLinkSettingsRecord (YVP Index 369 (SM)) Example

LM Functions

Table 71 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).

Table 71 LM Functions (Continued)

No.	Function	Description
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 “LM Parameters” on page 221.
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.

LM Parameters

LM Parameter List

The tables in this section show LM parameters of a FVP positioner.

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

Table 72 LM Parameter Part List

Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
362	DLME_LINK_MASTER_CAPABILITIES_VARIABLE		0x04	RW	
363	DLME_LINK_MASTER_INFO_RECORD	0		RW	
		1 MaxSchedulingOverhead	0		
		2 DefMinTokenDelegTime	100		
		3 DefTokenHoldTime	300		
		4 TargetTokenRotTime	4096		
		5 LinkMaintTokHoldTime	400		
		6 TimeDistributionPeriod	5000		
		7 MaximumInactivityToClaimLasDelay	8		
		8 LasDatabaseStatusSpduDistributionPeriod	6000		
364	PRIMARY_LINK_MASTER_FLAG_VARIABLE		–	RW	LAS: True = 0xFF; non-LAS: False = 0x00
365	LIVE_LIST_STATUS_ARRAY_VARIABLE		–	R	
366	MAX_TOKEN_HOLD_TIME_ARRAY	0	0x0000×16, 0x012c×16	RW	
		1 Element1	0x012c×5, 0x0000×27		
		2 Element2	0x0000×32		
		3 Element3	0x0000×32		
		4 Element4	0x0000×32		
		5 Element5	0x0000×32		
		6 Element6	0x0000×31 ox012c		
		7 Element7	0x012c×32		
		8 Element8	0x02		
367	BOOT_OPERAT_FUNCTIONAL_CLASS		As specified upon ordering	RW	0x01 (basic device); 0x02 (LM)
368	CURRENT_LINK_SETTING_RECORD	0		R	Settings for LAS
		1 SlotTime			
		2 PerDlpduPhlOverhead			
		3 MaxResponseDelay			
		4 FirstUnpolledNodeId			
		5 ThisLink			
		6 MinInterPduDelay			
		7 NumConseeUnpolledNodeId			
		8 PreambleExtension			
		9 PostTransGapExtension			
		10 MaxInterChanSignalSkew			
		11 TimeSyncClass			
369	CONFIGURED_LINK_SETTING_RECORD	0		RW	
		1 SlotTime	4095		
		2 PerDlpduPhlOverhead	4		
		3 MaxResponseDelay	5		
		4 FirstUnpolledNodeId	37		
		5 ThisLink	0		
		6 MinInterPduDelay	12		
		7 NumConseeUnpolledNodeId	186		
		8 PreambleExtension	2		
		9 PostTransGapExtension	1		
		10 MaxInterChanSignalSkew	0		
		11 TimeSyncClass	4		

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

Descriptions for LM Parameters

The following describes LM parameters of a FVP.

CAUTION

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

Table 73 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

Table 74 DlmeLinkMasterInfoRecord

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

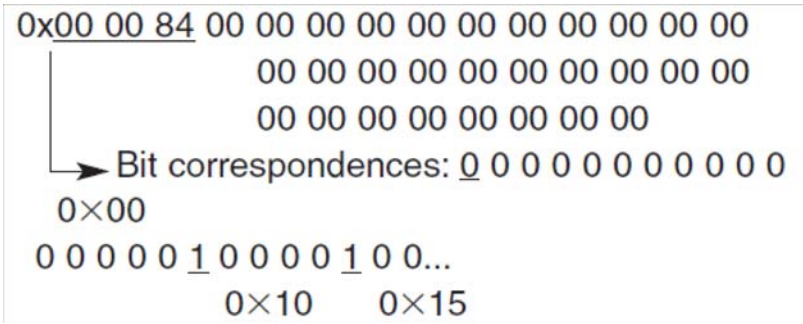
PrimaryLinkMasterFlagVariable

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.

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.



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.

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.

CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord

CurrentLinkSettingRecord indicates the bus parameter settings currently used. ConfiguredLinkSettingsRecord indicates the bus parameter settings for use when the device becomes the LAS. When a device is the LAS, its CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord have the same values.

Table 75 CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord

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)

Table 76 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)

Table 77 PlmeBasicCharacteristics

Sub-index	Element	Size [bytes]	Value	Description
1	Channel Statistics Supported	1	0	Statistics data are not supported.
2	Medium AndData Rates Supported	8	0x49 00 00 00 00 00 00 00	Wire medium, voltage mode, and 31.25 kbps are supported.
3	IceVersion	2	0x0403	IEC 4.3 is supported.
4	NumOf Channels	1	1	
5	Power Mode	1	0	0: Bus-powered; 1: Self-powered

Table 78 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

Table 79 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.

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.

Table 80 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.

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.

Table 81 DlmeScheduleDescriptor

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.

Domain

Read/write: impossible; get-OD: possible Carrying out the GenericDomainDownload command from a host writes an LAS schedule to Domain.

FAQs

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

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

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

FVP		Other LMs
V(ST) X V(TN)	<	V(ST) V(TN)

Q2. How can I make a FVP become the LAS?

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

LinkScheduleListCharacteristicsRecord (index 374 for a FVP)

- ActiveScheduleVersion (subindex 3)

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

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

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

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

Then, confirm that the following conditions are met:

FVP		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 FVP.

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DD Methods and DD Menu

C

Overview

Fieldbus technology has enabled a broad range of functions to be covered by a field device alone. Conversely, it has resulted in increased parameters to support these increased functions. To alleviate intricate operations due to the multiplied parameters and to provide easier-to-use user interfaces, fieldbus technology offers a menu facility and interactive guidance facility called methods, to be incorporated in device descriptions (DDs). With a field device whose DD contains a pre-embedded menu and methods, you can easily and intuitively access desired parameters and perform a series of setup operations.

A DD menu and DD methods are features embedded in a DD file for a field device, therefore, software supporting them needs to be used on the host computer for fieldbus system configuration. Make an inquiry to the software supplier about whether and how the software you use supports DD menus and DD methods. This User's Manual describes only the DD menu and DD methods of the FVP110.

DD Methods

DD methods guide you in setting parameter procedures properly. Simply following instructions given by DD methods accomplishes the intended parameter setting without accessing a wrong parameter or failing to follow the correct setting procedure. In principle, accessing the individual parameters can also make the settings that can be made using DD methods.

As for the FVP110, there are twelve DD methods for the transducer block, two for the AO block, and one for the OS block. The following describes these methods for each block model.

Transducer Block

Setup Wizard

This method guides you through each step of the most common setup procedure that always needs to be performed after installing the FVP110 on a valve. For the details of the setup and pertaining parameters, see “Setup” on page 59.

Setup procedure:

4. AO/TB block mode check
5. ACT_FAIL_ACTION setting
6. VALVE_TYPE setting
7. Stop position search and automatic tuning
8. Travel calibration
    - ❑ 0% calibration
    - ❑ Span calibration
    - ❑ 50% calibration
9. Operational parameter setting
10. …

Auto Tuning Wizard

This method guides you through each step to search for the valve’s mechanical stop positions and carry out auto tuning of control parameters. For details, see “Carrying out Tuning” on page 61.

Auto tuning procedure

1. AO/TB block mode check
2. Auto tuning execution: AUTO_TUNE_EXEC

Search Stop Points

This method guides you through each step to search for the valve's mechanical stop positions (both on the closed and open sides) by maximizing and minimizing the output pressure to the positioner.

Setup procedure

1. AO/TB block mode check
2. Auto tuning execution: AUTO_TUNE_EXEC

- ❑ Standard
- ❑ Step by step
- ❑ Without timeout
- ❑ Exit

Control Parameter Tuning

This method helps perform control-parameter-specific tuning, from among the parameters that can be tuned by the auto tuning function. It does not contain a help utility for a stop point search (searching for the valve's mechanical stop positions).

1. AO/TB block mode check
2. Execution of control parameter tuning: AUTO_TUNE_EXEC

Travel Calibration

This method guides you through each step to carry out travel calibration. See the respective descriptions in "Carrying out Tuning" on page 61.

Travel calibration procedure:

1. AO/Transducer block mode check
2. Execute travel calibration
   a. 0% calibration: Adjustment of FINAL_VALUE (by moving the valve position to the desired 0% position)
   b. Execute 0% calibration: TRAVEL_CALIB_EXEC
   c. Span calibration: Adjustment of FINAL_VALUE (by moving the valve position to the desired 100% position)
   d. Execute span calibration: TRAVEL_CALIB_EXEC
   e. 50% calibration: Adjustment of FINAL_VALUE (by moving the valve position to the desired 50% position)
   f. Execute 50% calibration: TRAVEL_CALIB_EXEC
   g. Exit

Operational Parameter Configuration

This method guides you through the setting of individual operational parameters excluding the selection of position to-flow rate characteristic type.

Operational parameter configuration procedure:

1. AO/Transducer block mode check
2. Operational parameter configuration
   a. Position Limit setting: FINAL_VALUE_CUTOFF_LO
      - ❑ FINAL_VALUE_CUTOFF_HI
      - ❑ FINAL_VALUE_RANGE
   b. Limit Switch setting:
      - ❑ LIM_SW_LO_LIM
      - ❑ LIM_SW_HI_LIM
   c. Fault Control:
      - ❑ DEVIATION_LIM
      - ❑ DEVIATION_TIME_TH(1)
      - ❑ DEVIATION_TIME_TH(2)
   d. Others:
      - ❑ NEAR_CLOSE_THRESHOLD
   e. Exit

Release Fail Safe

This is a method for releasing the device latched by the fail-safe actions, restoring it to the normal state.

Procedure of releasing fail safe:

1. Check whether the device is in the latched state.
2. Write *Clear-latched* to parameter RELEASE_FAIL_SAFE if the device is in the latched state, to release it from the latched state.

Instant Trouble Shooting

This is a help utility which provides troubleshooting instructions such as indicating the points and parameters to be checked for troubleshooting. This method does not contain a utility to change parameter settings. For troubleshooting of device statuses, see “Troubleshooting” on page 175.

Instant troubleshooting procedure:

1. Commanded to check DEVICE_STATUS in the resource block
2. Check XD_ERROR and the remedy will be displayed if an error has been detected
3. Check RELEASE_FAIL_SAFE
4. Commanded to check the mechanical linkage, piping, and installation conditions
5. Commanded to check the correct operation of the device hardware

Self Check Execution

The self-check measures the valve’s characteristics in the same fashion as in auto tuning, and makes no changes to parameter settings.

Self Check Execution procedure:

1. AO/TB block mode check
2. Self check execution: AUTO_TUNE_EXEC

Signature Execution

This method guides you through each step to perform signature measurement (see “Diagnostics” on page 169). Signature measurement entails off-line diagnostics functions to measure characteristics of the valve and positioner. Comparing the current signature data with the previously measured data gives clues to identify the deterioration status and a possible need of maintenance.

Signature execution procedure:

1. AO/TB block mode check
2. Signature measurement execution:
   a. Measure all:
      - ❑ Setting all signature measurement conditions
      - ❑ Executing signature measurement (SIGN_MEAS_EXEC)
      - ❑ Uploading data (see “Upload Signature Data” on page 236).
   b. Measure actuator signature: Setting STD_ACT_SIGN_SET:
      - ❑ Executing signature measurement (SIGN_MEAS_EXEC)
      - ❑ Uploading data (see “Upload Signature Data” on page 236).

c. Measure extended actuator signature: Setting EXT_ACT_SIGN_SET:
   - ❑ Executing signature measurement (SIGN_MEAS_EXEC)
   - ❑ Uploading data (see “Upload Signature Data” on page 236).

d. Step response test: Setting STEP_RESP_SET:
   - ❑ Executing step response test (SIGN_MEAS_EXEC)
   - ❑ Uploading data (see “Upload Signature Data” on page 236).

e. Measure positioner signature: Setting POSITIONER_SIGN_SET
   - ❑ Executing signature measurement (SIGN_MEAS_EXEC)
   - ❑ Uploading data (see “Upload Signature Data” on page 236).

f. Exit

Upload Signature Data

This method guides you through uploading the signature data that has been measured and stored in the positioner, from selecting the database you want to upload, to adjusting the data pointer to the leading position of the desired data and uploading it.

Signature data uploading procedure:

1. Select action from menu.
2. Upload data: Uploading data from SIGN_DATA_X and SIGN_DATA_Y
3. Select upload database (meaning, *select the database to be uploaded*)
4. Change data pointer
5. Exit

Upload Signature Header Data

This method guides you through uploading the header data of a signature measurement that has already been performed.

The header data contains the measurement condition settings, the ambient temperature at the measurement, the date of the measurement, and so on. You can select a database to access the desired header data.

Signature header data uploading procedure:

1. Selection of action from menu.
2. Upload header data: Select upload database (meaning, *select the database to be uploaded*)
3. Exit

AO Block

Simulation Enable

This is a method for causing the AO block to activate the simulation status. When a block is in the simulation status, you can apply simulated inputs to the block to let the block function with that input, and check the actions of the function block application and alarm processing. Since the simulation function is disabled to run normally in consideration of the nature of its functionality, when using this method, the simulation function needs to be rendered active by doing either of the following:

- ❑ Write *REMOTE LOOP TEST SWITCH" to SIM_ENABLE_MSG* in the resource block.
- ❑ Turn on the SIM.ENABLE hardware switch on the YPV110's amplifier assembly (see "Simulation Function" on page 113).

Simulation enabling procedure:

1. Check that the simulation switch is ON (active).
2. Check the AO block mode.
3. Change the value of SIMULATE.status to *Enable*.
4. Set the simulated input value in SIMULATE.value.

Simulation Disable

This is a method for disabling the simulation function of the AO block.

Simulation disabling procedure:

1. Confirm whether the simulation function can be disabled.
2. Change the value of SIMULATE.status to *Disable*.
3. The method displays a message announcing that block alarms will not be reset until both the hardware switch and software switch in the resource block for enabling execution of the simulation function are turned off.

OS Block

X-Y Scaling

This is a method for setting the scales of the X- and Y-axes for defining the conversion characteristics for OUT_1 and OUT_2 (values of IN_ARRAY and OUT_ARRAY), by setting the coordinates of four endpoints: P1 as the start point of OUT_1, P2 as the end point of OUT_1, P3 as the start point of OUT_2, and P4 as the end point of OUT_2. (See “Output Processing” on page 146).

X-Y scaling procedure:

1. Set coordinates of P1 through P4:
    - ❑ P1: IN_ARRAY, OUT_ARRAY
    - ❑ P2: IN_ARRAY, OUT_ARRAY
    - ❑ P3: IN_ARRAY, OUT_ARRAY
    - ❑ P4: IN_ARRAY, OUT_ARRAY
2. Set LOCK_VAL.

Software Download

D

Benefits of Software Download

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

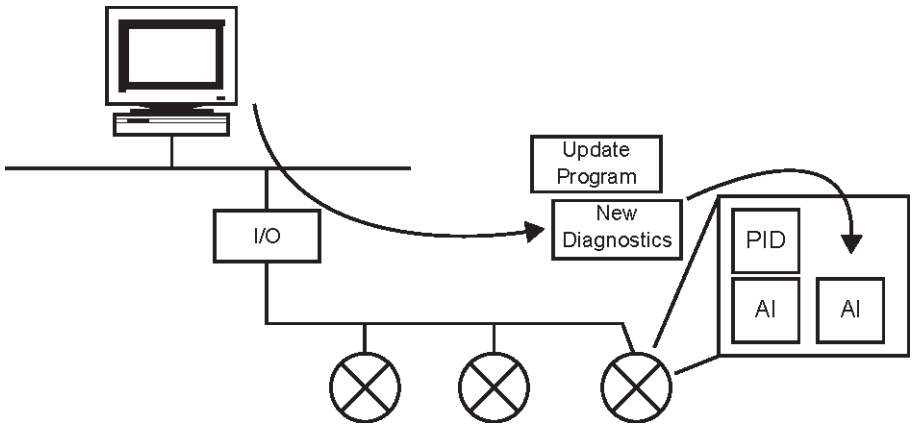


Figure 82 Concept of Software Downloading

Specifications

Steady-state current: Max. 17 mA

Current Draw (Steady-state): 17mA (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. On completion of a download, however, the devices are reset internally to make the new, downloaded software take effect, and this halts fieldbus communication and function block executions for about one minute.

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 developed for that purpose. For details, see the software's User's Manual.

CAUTION

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

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

Software Download Sequence

Figure 83 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.

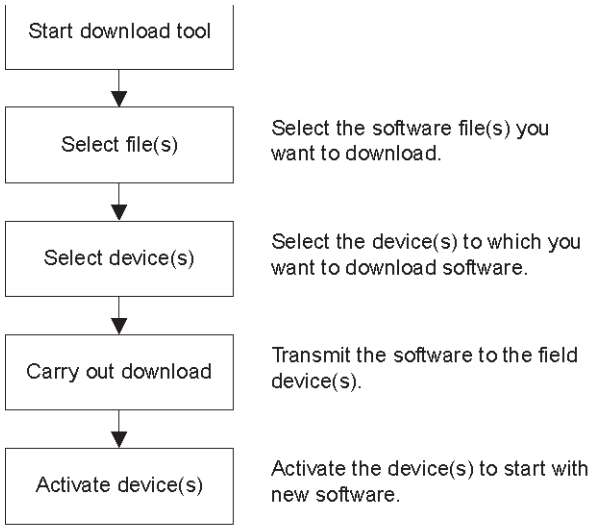


Figure 83 Flow of Software Download Procedure

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 "Steps after Activating a Field Device" on page 243.

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.

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

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.

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

Download Files

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

445644 + device family + _ + device type + _ + domain name + _ + software name + _ + software revision + *.ffd*

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

445644C_0007_FVP_ORIGINAL_R101.ffd

Refer to “Comments on System/Network Management VFD Parameters Relating to Software Download” on page 248 DOMAIN_HEADER about each keyword of the file name.

The device type is *0007* for an FVP transmitter .

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

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 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, requiring parameter setup and engineering again. For details, see Table 82.

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 82 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.

Troubleshooting

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

Table 83 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.

Resource Block's Parameters Relating to Software Download

Table 84 Resource Block's Parameters Relating to Software Download

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 4.

Table 85 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

Software Download System/Network Management VFD Parameters

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

Table 86 System/Network Management VFD Parameters

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

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

CAUTION

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

Table 87 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.

Table 88 DOMAIN_DESCRIPTOR

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

Table 89 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.

Position Adjustment of Feedback Lever

E

For Single Acting Type, you can adjust the feedback lever position while air is being supplied to the actuator.

WARNING

This procedure requires supplying air to the actuator. Piping must be carried out following the instructions shown in "Wiring and Piping".

1. Using a flat-head screwdriver, turn the FVP110 A/M selector switch clockwise to change the selector position to *M* (manual). Be sure to turn the switch until it stops.

WARNING

Changing the A/M selector switch position to M (manual) causes air at the pressure setting of the pressure regulator for air supply to be supplied to the valve actuator regardless of the input signal. Therefore, prior to switching to manual mode, make sure that doing so neither causes an injury nor affect the process.

2. Supply air to the valve actuator. This causes the valve stem to move; be extremely careful about safety. Adjust the pressure regulator to set the stroke of the stem to 50%.

WARNING

Do not supply air at a pressure exceeding the maximum rated air supply pressure of the actuator or the FVP110 (400 kPa). Doing so can result in a high risk of damage to the equipment or lead to an accident.

3. Check that the feedback lever is around the horizontal level (Figure 84). If its incline deviates from the horizontal level by 15° or more, shut off the air supply for safety. Then, after confirming that the air has been completely exhausted out of the actuator, readjust the clamp position.
4. Shut off the air supply and turn the A/M selector switch counterclockwise until it stops, to change the selector position to A (automatic).

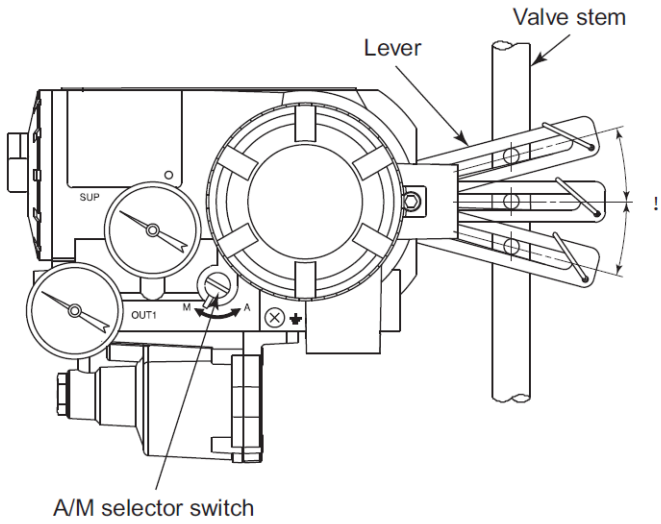


Figure 84 Checking Position at Which Clamp Should Be Fixed

Manual Tuning Guideline

F

General

The FVP110 can improve controllability by properly performing the manual tuning of control parameters for each valve and actuator.

Figure 85 shows the whole tuning procedure.

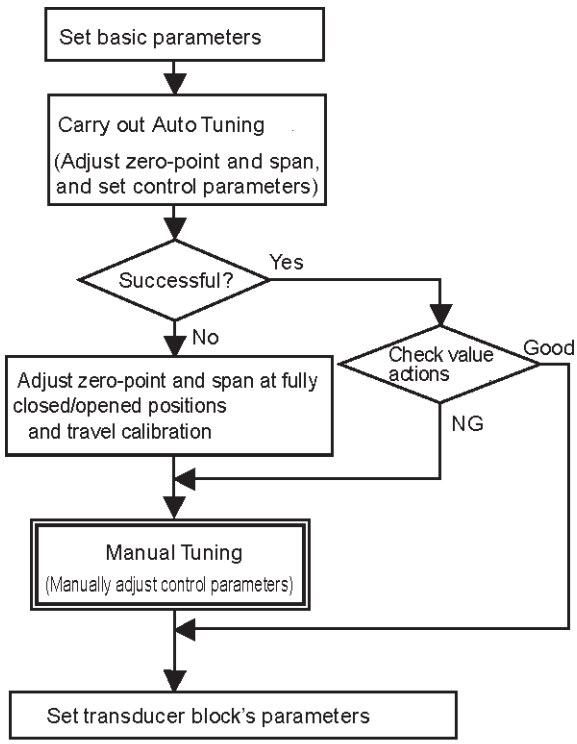


Figure 85 Manual Tuning Flowchart

If you cannot obtain expected response characteristics by Auto Tuning:

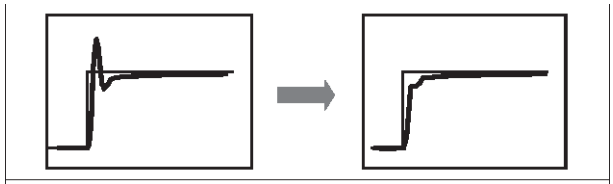
1. Change the modes of the AO function block and transducer block to O/S.
2. Verify the 10% step response and compare your response waveform with the three types of response waveforms shown in “Control Parameter Tuning Procedure” on page 254.
3. Adjust parameters by referring to the procedure of a waveform that has characteristics similar to those of your waveform.

If Auto Tuning fails:

1. Adjust the zero-point and the span.
2. Set the parameters by referring to the default settings (factory settings) or tuning examples in “Examples of Tuning Control Parameters” on page 258.
3. Verify the 10% step response and adjust the parameters according to the procedure described in “Control Parameter Tuning Procedure” on page 254. For detail about the control parameters, see “Description of Control Parameters” on page 259.

Control Parameter Tuning Procedure

Fast Response



[Characteristics]
Since both the rise and tracking of the target value are fast, a V-shaped overshoot occurs. You can obtain a better response by maintaining the response speed and reducing overshoot.
This waveform is typically observed in small capacity actuators.

Figure 86 Fast Response

Modifying overshoot

- ❑ Increase the value for SERVO_RATE to reduce an excessively rapid response. Verify the 10% step response and increment the value by 0.2.
- ❑ If a significant improvement effect cannot be obtained by only incrementing the value for SERVO_RATE in small steps of approximately 5% or less, input the value in small steps in BOOST_ON_THRESHOLD [2] and decrement the value for BOOST_VALUE [1] by 2 to decrease the boost.
- ❑ The same boost value is set on both the air delivery and exhaust sides using Auto Tuning. If the overshoot on the exhaust side is larger than that on the air delivery side for a double-acting model, input a negative value in X_BOOST_VALUE[1][2],

without changing the value of 0 in X_BST_ON_THRESHOLD[1][2] and X_BST_OFF_THRESHOLD[1][2]. First, try to input a negative value of half that of BOOST_VALUE [1] [2], and if necessary, increment or decrement the value by 1.

- ❑ If necessary, increment or decrement the value for SERVO_GAIN by 30.

Improving the Stabilization Time

1. Decrease the value for SERVO_RESET to improve the capability of tracking the target value.
2. Verify the 10% step response and decrement the value by 3.

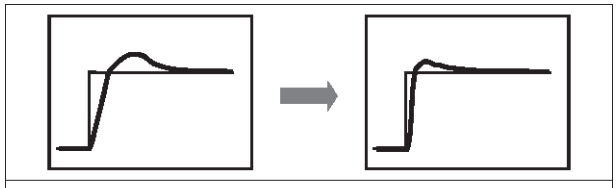
Improving the Response Time

- ❑ If you input a value in a small step of 5% or less and response is slow, increment the value for SERVO_GAIN by 30.
- ❑ If necessary, increment or decrement the value for BOOST_VALUE [1] [2] and X_BOOST_VALUE [1] [2] by 1, respectively.

Checking Hunting Operation

Input a value in a large step of approx. 80% to ensure the hunting operation does not occur. If the hunting operation does occur, decrease the value for SERVO_GAIN to 2/3 or 1/2 of the originally entered value. (5) After tuning the control parameters, re-check each parameter if necessary.

Moderate Response



[Characteristics]
The curve stabilizes slowly after an overshoot. If gain is increased, the overall response can be improved.
This waveform is typically observed in middle and large capacity actuators.

Figure 87 Moderate Response

Improving the stabilization time

1. Decrease the value for SERVO_RESET to improve the capability of tracking the target value.
2. Verify the 10% step response and decrement the value by 3.

Modifying overshoot

- ❑ Increment the value for SERVO_GAIN. Verify the 10% step response and increment the value by 1.5 times.
- ❑ If you input a value in a small step of approx. 5% or less, and you cannot obtain a significant improvement effect compared to the 10% step, increment the value for SERVO_RATE by 0.2 to reduce an excessively rapid response.
- ❑ The same boost value is set on both the air delivery and exhaust sides using Auto Tuning. If the overshoot on the exhaust side is larger than that on the air delivery side for a double-acting model, input a negative value in X_BOOST_VALUE [1] [2], without changing the value of 0 in X_BST_ON_THRESHOLD [1] [2] and X_BST_OFF_THRESHOLD [1] [2]. First, try to input a negative value of half that of BOOST_VALUE [1][2], and if necessary, increment or decrement the value by 1.

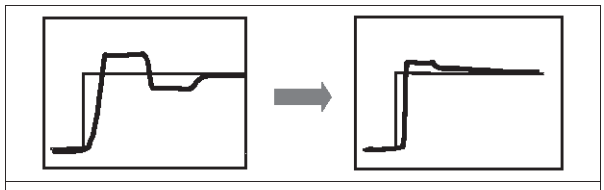
Improving the Response Time

- ❑ If you input a value in a small step of 5% or less and the response is slow, increment or decrement the value for BOOST_VALUE [1] [2] and X_BOOST_VALUE [1][2] by 1, respectively.
- ❑ If necessary, increment the value for SERVO_GAIN by 30.

Checking Hunting Operation

Input a value in a large step of approx. 80% to ensure the hunting operation does not occur. If the hunting operation does occur, decrease the value for SERVO_GAIN to 2/3 or 1/2 of the originally entered value.

Moderate Response with a Flat Overshoot



[Characteristics]
Response is slow and a flat-headed overshoot occurs.
Auto Tuning may fail, or hunting or limit cycle may occur after Auto Tuning.
This waveform is typically observed if the friction of a valve or actuator is large.

Figure 88 Moderate Response with a Flat overshoot

Occurrence of a Limit Cycle

If you increase the value for SERVO_RESET, response slows down and a limit cycle can be prevented by:

- ❑ . Verifying a large step response of 30% or more and incrementing the value by 5.

- ❑ If necessary, decrease the value for SERVO_GAIN to 2/3 or 1/2 of the originally entered value.
- ❑ If necessary, set the SERVO_DEADBAND. Set a value in approximately the range of a limit cycle (recommended upper limit is 2%).
- ❑ If the limit cycle is not eliminated, check the piping and feedback lever installation by referring to Section 18.4.

Modifying Overshoot

- ❑ Increase the value for SERVO_RATE to reduce an excessively rapid response. Verify the 10% step response and increment the value by 0.2.
- ❑ If necessary, increment the value for SERVO_RESET by 5.
- ❑ The same boost value is set on both the air delivery and exhaust sides by Auto Tuning. If the overshoot on the exhaust side is larger than that on the air delivery side for a double-acting model, input a negative value in X_BOOST_VALUE [1] [2], without changing the value of 0 in X_BST_ON_THRESHOLD [1] [2] and X_BST_OFF_THRESHOLD [1] [2]. First, try to input a negative value of half that of BOOST_VALUE [1] [2], and if necessary, increment or decrement the value by 1.

Improving the Stabilization Time and Slow Overshoot

Decrease the value for SERVO_RESET to improve the capability of tracking the target value. However, if the value is too small, the hunting operation or limit cycle may occur. Verify the 10% step response and decrement the value by 2 to 3.

Improving the Response Time

- ❑ Increment or decrement the value for BOOST_VALUE [1] [2] and X_BOOST_VALUE [1] [2] by 2, respectively.
- ❑ If necessary, increment the value for SERVO_GAIN by 30.

Checking Hunting Operation

Input a value in a large step of approx. 80% to ensure the hunting operation does not occur. If the hunting operation does occur,:

1. Decrease the value for SERVO_GAIN to 2/3 or 1/2 of the originally entered value.
2. Increase the value for SERVO_RESET by approx. 1.5 times.

After tuning the control parameters, re-check each parameter if necessary.

Examples of Tuning Control Parameters

Table 90 shows examples of tuning parameters for double-acting actuators.

[1] Valtek25sq.in. double-acting actuator, stroke = 0.75 in, capacity = approx. 300 cc, supply pressure = 400 kPa, hysteresis = 150N

[2] Valtek25sq.in. double-acting actuator, stroke = 0.75 in, capacity = approx. 300 cc, supply pressure = 400 kPa, hysteresis = 380N

[3] Valtek50sq.in. double-acting actuator, stroke = 2.5 in, capacity = approx. 2000 cc, supply pressure = 400 kPa, hysteresis = 300N

[4] Valtek50sq.in. double-acting actuator, stroke = 2.5 in, capacity = approx. 2000 cc, supply pressure = 400 kPa, hysteresis = 1200N

Table 90 Examples of Tuning Control Parameters

Parameter Name (Figures in parentheses represent default values (factory settings))	Valtek25sq.in. Stroke = 0.75 in.		Valtek50sq.in. Stroke = 2.5 in.	
	Hysteresis = 150N	Hysteresis = 380N	Hysteresis = 300N	Hysteresis = 1200N
SERVO_GAIN (120)	140	120	350	300
SERVO_RESET (15)	8	15	9	24
SERVO_RATE (0.22)	0.6	0.6	0.6	0.5
SERVO_RATE_GAIN (5.0)	5.0	5.0	5.0	5.0
SERVO_DEADBAND (0.0)	0.0	0.0	0.0	0.0
SERVO_OFFSET (55.0)	(55.0) Default	(55.0) Default	(55.0) Default	(55.0) Default
BOOST_ON_THRESHOLD[1][2] (1.9, 2.9)	0.9, 1.9	0.9, 1.9	0.9, 5.1	0.9, 1.9
BOOST_OFF_THRESHOLD[1][2] (1.0, 1.0)	0.5, 0.5	0.5, 0.5	0.5, 0.5	0.5, 0.5
BOOST_VALUE[1][2] (8.0, 10.0)	8.0, 10.0	8.0, 10.0	6.0, 10.0	6.0, 8.0
SERVO_I_SLEEP_LMT (0.0)	1.4	1.4	1.8	1.7
SERVO_P_ALPHA (0.0)	0.0	0.0	0.0	0.0
INTERNAL_GAIN (5.0)	6.8	6.8	14.1	14.1
X_BST_ON_THRESHOLD[1][2] (0.0, 0.0)	0.0, 0.0	0.0, 0.0	0.0, 0.0	0.0, 0.0
X_BST_OFF_THRESHOLD[1][2](0.0, 0.0)	0.0, 0.0	0.0, 0.0	0.0, 0.0	0.0, 0.0
X_BOOST_VALUE[1][2] (0.0, 0.0)	-5.0, -5.0	-1.0, -3.0	-3.0, -6.0	-3.0, -4.0

The above adjusted values are only for reference. Adjust parameters depending on the individual valve, actuator, and operating conditions. X_BST_ON_THRESHOLD, X_BST_OFF_THRESHOLD, and X_BOOST_VALUE are parameters that are only valid for double-acting models.

Description of Control Parameters

The FVP110's basic method of controlling the valve position is PI-D control. This control is characterized by the fact that a rapid output change is prevented by the derivative term of D being added to the feedback.

In addition, FVP110 has a boost function that serves as an output acceleration function after an input change, because it compensates the nonlinearity caused by the structure of a valve or FVP.

When you set these parameters, change the mode of the transducer block and AO function block to O/S.

SERVO_GAIN

Tuning range: 0.1 to 1300 (Default: 120)

Set the loop gain of PI-D control.

The proportional gain of PI-D control increases in proportion to (SERVO_GAIN / INTERNAL_GAIN).

If you increase the value for SERVO_GAIN, tracking capability tends to increase, whereas control stability tends to decrease.

SERVO_RESET

Tuning range: 0, 2 to 50 sec (Default: 15 sec)

Set the integral time of PI-D control.

The pace of change in integral volume quickens in reverse proportion to the integral time and the volume changes repeatedly until the deviation disappears.

If you set a:

- ❑ Smaller value for the integral time, the deviation disappears more quickly, whereas fast accumulation of integral components may cause an overshoot.
- ❑ Larger value for the integral time, you can reduce the accumulation of excessive integral components when the deviation is large, but it takes longer for the deviation to disappear.
- ❑ 0, this function is invalid.

SERVO_RATE

Tuning range: 0, 0.05 to 1.0 sec (Default: 0.22 sec)

Set the derivative time of PI-D control.

The derivative term relates to the feedback and prevents a rapid output change, and the preventive effect increases in proportion to the derivative time.

If a rapid response causes an overshoot, set a larger value for the derivative time to prevent a rapid change and reduce overshoot. However, if the effect of this change is excessive, tracking capability during step response decreases. If 0 is set, this function is invalid.

SERVO_RATE_GAIN

Tuning range: 2 to 20 (Default: 5)

Set the gain in the derivative term of PI-D control.

As with SERVO_RATE, this parameter relates to the derivative term of control, and the preventive effect increases in proportion to an increase in the gain in the derivative term.

SERVO_DEADBAND

Tuning range: 0 to 50% (Default: 0%)

Setting this parameter stops an integral operation in the vicinity of the Set point.

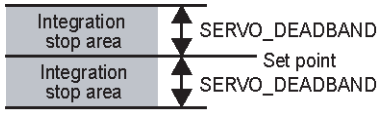


Figure 89 Servo Deadband

If you set the parameter SERVO_DEADBAND when, for example, the friction of a valve is large, a limit cycle can be prevented. However, the value of the steady-state deviation could be as large as that of SERVO_DEADBAND.

SERVO_OFFSET

Tuning range: 0 to 100% of MV (Default: 55%)

Set the initial value for the electric current that is output from the CPU to the I/P module after the power is turned on. The value simultaneously serves as the base point for an integration operation.

The unit of this parameter is % of the current output to the I/P module.

The value is usually determined by Auto Tuning, so you do not need to change the value.

If you manually set a value, input a value of SERVO_OUTPUT_SIGNAL when the valve position settles in the vicinity of 50%.

BOOST_ON_THRESHOLD [1], [2]

Tuning range: 0, 0.1 to 10% (Default: 1.9, 2.9%)

BOOST_OFF_THRESHOLD [1], [2]

Tuning range: 0.1 to 10% (Default: 1.0, 1.0%)

BOOST_VALUE [1], [2]

Tuning range: 0 to 50% of MV (Default: 8, 10% of MV)

Set the boost function that serves as a function for accelerating air delivery and exhaust. Tracking capability for response after an input change increases.

When the set point is changed, if the difference between the old set point and the new set point is greater than the BOOST_ON_THRESHOLD, the BOOST_VALUE is added to the current output to the I/P module, and the added value is removed when the deviation enters the range of BOOST_OFF_THRESHOLD.

However, each parameter has two values, [1] and [2], where [1] is for a small step and [2] for a large step. Therefore, set each parameter so that the relation [2] . [1] is established.

If the difference between the old set point and the new set point is greater than BOOST_ON_THRESHOLD[1] and less than [2], BOOST_VALUE[1] functions, and the added value is removed when the deviation enters the range of BOOST_OFF_THRESHOLD[1].

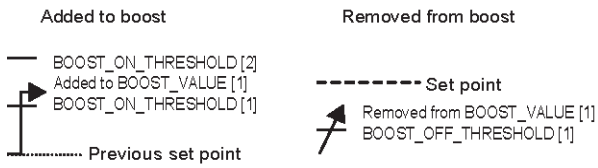


Figure 90 Boost Threshold 1

If the difference between the old set point and the new set point is greater than BOOST_ON_THRESHOLD[2],

BOOST_VALUE[2] functions independently from BOOST_VALUE[1], and the added value is removed when the deviation enters the range of BOOST_OFF_THRESHOLD[2].

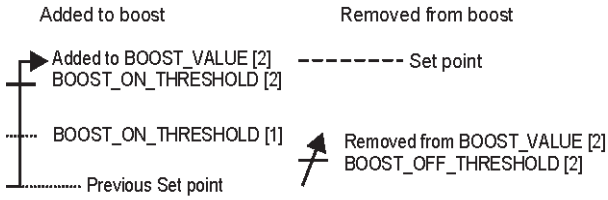


Figure 91 Boost Threshold 1

The boost function of single-acting actuators works only for the air supply side; however, that of double-acting actuators also works for the exhaust side of OUT1 (for the air delivery side of OUT2).

If you want to individually set parameters for the exhaust side of OUT1 of double-acting actuators, set the following parameters.

X_BST_ON_THRESHOLD [1], [2] Tuning range: -10 to 10% (Default: 0, 0%)

X_BST_OFF_THRESHOLD [1], [2] Tuning range: -10 to 10% (Default: 0, 0%)

X_BOOST_VALUE [1], [2] Tuning range: -50 to 50% of MV (Default: 0, 0% of MV)

If you want the boost function of double-acting actuators on the exhaust side of OUT1 to be asymmetric from the air delivery side, set these parameters. If you set values for these parameters, input differences for change in relation to the values of BOOST_ON_THRESHOLD, BOOST_OFF_THRESHOLD, and BOOST_VALUE.

For example, if you want to stop the boost function only on the exhaust side, input a negative value of the absolute value of BOOST_VALUE[1] in X_BOOST_VALUE[1], and input the value in X_BOOST_VALUE[2] in the same way to negate the effect. At this time, you do not need to change the values of X_BST_ON_THRESHOLD and X_BST_OFF_THRESHOLD.

Theses parameters are valid only for double-acting actuators.

SERVO_I_SLEEP_LMT Tuning range: 0 to 10 sec (Default: 0 sec)

If the deviation changes, the integration operation is stopped for the time of SERVO_I_SLEEP_LMT to reduce excessive integral components.

If the hysteresis of a valve is large, the valve may not react for a while after an input change, and a delay in response may occur. This delay in response is accompanied by a large deviation, and the accumulation of excessive integral components can cause an overshoot. This parameter is effective in cases such as this.

If the deviation from the set point value exceeds the SERVO_DEADBAND, this function starts. If 0 is set to SERVO_DEADBAND, this function is invalid.

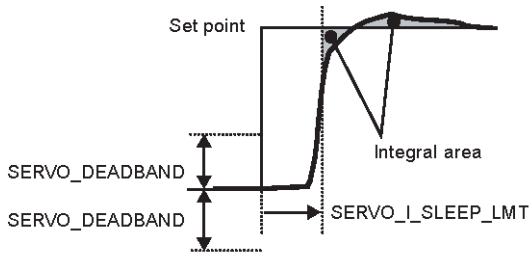


Figure 92 SERVO_I_SLEEP_LMT and SERVO_DEADBAND

SERVO_P_ALPHA

Tuning range: 0 to 100% (Default: 0%)

Setting this parameter adds more values to the proportional term for a large step compared to a small step. Use this parameter when a large value cannot be set to the proportional gain because of the large hysteresis of a value, and the response speed for a large step is insufficient.

A usual operation in the proportional term covers the deviation only; however, unless 0 is set for this parameter, a value calculated based on the following equation is added, in addition to the deviation. If 0 is set, this function is invalid.

(Value added to the proportional term) = deviation |deviation| / SERVO_P_ALPHA

You can obtain a quadratic curve in which the proportional term doubles when the deviation equals the SERVO_P_ALPHA, and the added value is in reverse proportion to an increase in the value of SERVO_P_ALPHA.

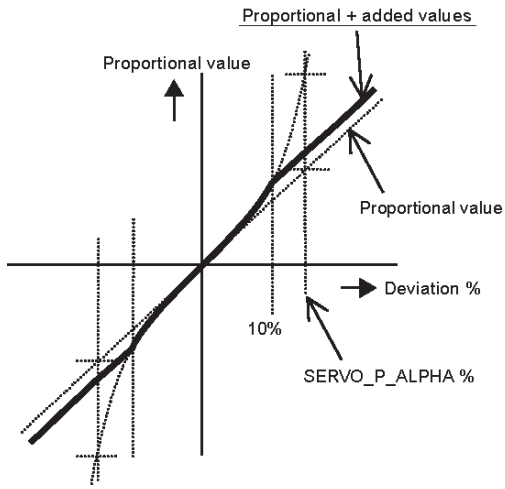


Figure 93 SERVO_P_ALPHA Operation

However, as long as the deviation is more than 10%, the added value is fixed to a value calculated when the deviation is 10%

INTERNAL_GAIN

Tuning range: 0.5 to 50 rad/mA (Default: 5 rad/mA)

INTERNAL_GAIN is the total gain of the I/P module, the control relay, the valve, the actuator, and the feedback lever.

INTERNAL_GAIN is part of the loop gain of PI-D control.

This value is usually determined by Auto Tuning, so you do not need to change the value.

Installation and Operating Precautions for JIS Flameproof Equipment

G

Apparatus Certified Under Technical Criteria (IEC-compatible Standards)

General

The following describes precautions on electrical apparatus of flameproof construction (hereinafter referred to as flameproof apparatus) in explosion-protected apparatus.

Following the Labour Safety and Health Laws of Japan, flameproof apparatus is subjected to type tests to meet either the technical criteria for explosion proof electrical machinery and equipment (standards notification no.556 from the Japanese Ministry of Labour) (hereinafter referred to as technical criteria), in conformity with the IEC Standards, or the *Recommended Practice for Explosion-Protected Electrical Installations in General Industries*, published in 1979. These certified apparatus can be used in hazardous locations where explosive or inflammable gases or vapors may be present.

Certified apparatus includes a certification label and an equipment nameplate with the specifications necessary for explosion requirements as well as precautions on explosion protection.

Confirm these precautionary items and use them to meet specification requirements.

For electrical wiring and maintenance servicing, please refer to *Internal Wiring Rules* in the Electrical Installation Technical Standards as well as *USER'S GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry*, published in 1994.

To meet flameproof requirements, equipment that can be termed *flameproof* must:

(1) Be certified by a Japanese public authority in accordance with the Labour Safety and Health Laws of Japan and have a certification label in an appropriate location on its case, and

(2) Be used in compliance with the specifications marked on its certification label, equipment nameplate and precautionary information furnished.

Electrical Apparatus of Flameproof Type of Explosion- Protected Construction

Electrical apparatus which is of flameproof construction is subjected to a type test and certified by the Japanese Ministry of Labour aiming at preventing explosion caused by electrical apparatus in a factory or any location where inflammable gases or vapors may be present. The flameproof construction is of completely enclosed type and its enclosure shall endure explosive pressures in cases where explosive gases or vapors entering the enclosure cause explosion. In addition, the enclosure construction shall be such that flame caused by explosion does not ignite gases or vapors outside the enclosure.

In this manual, the word *flameproof* is applied to the flameproof equipment combined with the types of protection *e, o, i, and d* as well as flameproof equipment.

Terminology

	The permissible sizes of gaps between joint surfaces, the path length of a joint surface and the number of joint threads are determined by such factors as the enclosure's internal volume, joint and mating surface construction, and the explosion classification of the specified gases and vapors.
Enclosure	An outer shell of an electrical apparatus, which encloses live parts and thus is needed to configure explosion-protected construction.
Shroud	A component part designed so that the fastening of joint surfaces cannot be loosened unless a special tool is used.
Enclosure internal volume	This is indicated by:— the total internal volume of the flameproof enclosure minus the volume of the internal components essential to equipment functions.
Path length of joint surface	On a joint surface, the length of the shortest path through which flame flows from the inside to outside of the flameproof enclosure. This definition cannot be applied to threaded joints.
Gaps between joint surfaces	The physical distance between two mating surfaces, or differences in diameters if the mating surfaces are cylindrical.

Installation of Flameproof Apparatus

Installation Area

Flameproof apparatus may be installed, in accordance with applicable gases, in a hazardous area in Zone 1 or 2, where the specified gases are present. Those apparatus shall not be installed in a hazardous area in Zone 0.

Hazardous areas are classified in zones based upon the frequency of the appearance and the duration of an explosive gas atmosphere as follows:

Zone 0: An area in which an explosive gas atmosphere is present continuously or is present for long periods.

Zone 1: An area in which an explosive gas atmosphere is likely to occur in normal operation.

Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and if it does occur it will exist for a short period only.

Environmental Conditions

The standard environmental condition for the installation of flameproof apparatus is limited to an ambient temperature range from –20 °C to +40 °C (for products certified under Technical Criteria). However, some field-mounted instruments may be certified at an ambient temperature up to +60 °C as indicated on the instrument nameplates. If the flameproof apparatus are exposed to direct sunshine or radiant heat from plant facilities, appropriate thermal protection measures shall be taken.

External Wiring for Flameproof Apparatus

Flameproof apparatus require cable wiring or flameproof metal conduits for their electrical connections. For cable wiring, cable glands (cable entry devices for flameproof type) to wiring connections shall be attached. For metal conduits, attach sealing fittings as close to wiring connections as possible and completely seal the apparatus. All non-live metal parts such as the enclosure shall be securely grounded. For details, see the *USER'S GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry*, published in 1994.

Cable Wiring

- ❑ For cable wiring, cable glands (cable entry devices for flameproof type) specified or supplied with the apparatus shall be directly attached to the wiring connections to complete sealing of the apparatus.
- ❑ Screws that connect cable glands to the apparatus are those for G-type parallel pipe threads (JIS B 0202) with no sealing property. To protect the apparatus from

corrosive gases or moisture, apply nonhardening sealant such as liquid gaskets to those threads for waterproofing.

- ❑ Specific cables shall be used as recommended by the “USER’S GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry,” published in 1994.
- ❑ In necessary, appropriate protective pipes (conduit or flexible pipes), ducts or trays shall be used for preventing the cable run (outside the cable glands) from damage.
- ❑ To prevent explosive atmosphere from being propagated form Zone 1 or 2 hazardous location to any different location or non-hazardous location through the protective pipe or duct, apply sealing of the protective pipes in the vicinity of individual boundaries, or fill the ducts with sand appropriately.
- ❑ When branch connections of cables, or cable connections with insulated cables inside the conduit pipes are made, a flameproof or increased-safety connection box shall be used.
  In this case, flameproof or increased-safety cable glands meeting the type of connection box must be used for cable connections to the box.

Flameproof Metal Conduit Wiring

- ❑ For the flameproof metal conduit wiring or insulated wires shall be used as recommended by the USER’S GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry, published in 1994.
- ❑ For conduit pipes, heavy-gauge steel conduits conforming to JIS C 8305 Standard shall be used.
- ❑ Flameproof sealing fittings shall be used in the vicinity of the wiring connections, and those fittings shall be filled with sealing compounds to complete sealing of the apparatus.
  In addition, to prevent explosive gases, moisture, or flame caused by explosion form being propagated through the conduit, always provide sealing fittings to complete sealing of the conduit in the following locations:
  (a) In the boundaries between the hazardous and non-hazardous locations.
  (b) In the boundaries where there is a different classification of hazardous location.
- ❑ For the connections of the apparatus with a conduit pipe or its associated accessories, G-type parallel pipe threads (JIS B 0202) shall be used to provide a minimum of five thread engagement to complete tightness. In addition, since these parallel threads do not have sealing property, nonhardening sealant such as liquid gaskets shall thus be applied to those threads for ensuring waterproofness.
- ❑ If metal conduits need flexibility, use flameproof flexible fittings.

Maintenance of Flameproof Apparatus

To maintain the flameproof apparatus, do the following.

Maintenance servicing with the power on

Flameproof apparatus shall not be maintenance-serviced with its power turned on. However, in cases where maintenance servicing is to be conducted with the power turned on, with the equipment cover removed, always use a gas detector to check that there is no explosive gas in that location. If it cannot be checked whether an explosive gas is present or not, maintenance servicing shall be limited to the following two items:

- Visual inspection - Visually inspect the flameproof apparatus, metal conduits, and cables for damage or corrosion, and other mechanical and structural defects.
- Zero and span adjustments - These adjustments should be made only to the extent that they can be conducted from the outside without opening the equipment cover. In doing this, great care must be taken not to cause mechanical sparks with tools.

Repair	If the flameproof apparatus requires repair, turn off the power and transport it to a safety (non-hazardous) location. Observe the following points before attempting to repair the apparatus. ❑ Make only such electrical and mechanical repairs as will restore the apparatus to its original condition. For the flameproof apparatus, the gaps and path lengths of joints and mating surfaces, and mechanical strength of enclosures are critical factors in explosion protection. Exercise great care not to damage the joints or shock the enclosure. ❑ If any damage occurs in threads, joints or mating surfaces, inspection windows, connections between the transmitter and terminal box, shrouds or clamps, or external wiring connections which are essential in flameproofness, contact GE Masoneilan. Do not attempt to re-process threaded connections or refinish joints or mating surfaces. ❑ Unless otherwise specified, the electrical circuitry and internal mechanisms may be repaired by component replacement, as this will not directly affect the requirements for flame-proof apparatus (however, bear in mind that the apparatus must always be restored to its original condition). If you attempt to repair the flameproof apparatus, company-specified components shall be used. ❑ Before starting to service the apparatus, be sure to check all parts necessary for retaining the requirements for flameproof apparatus. For this, check that all screws, bolts, nuts, and threaded connections have properly been tightened.
Prohibition of specification changes and modifications	Do not attempt to change specifications or make modifications involving addition of or changes in external wiring connections.

Selection of Cable Entry Devices for Flameproof Type

The cable glands (cable entry devices for flameproof type) conforming to IEC Standards are certified in combination with the flameproof apparatus. So, GE Masoneilan-specified cable entry devices for flameproof type shall be used to meet this demand.

References:

(1) Type Certificate Guide for Explosion-Protected Construction Electrical Machinery and Equipment (relating to Technical Standards Conforming to International Standards), issued by the Technical Institution of Industrial Safety, Japan

(2) USER'S GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry (1994), issued by the Japanese Ministry of Labour, the Research Institute of Industrial Safety, Japan.

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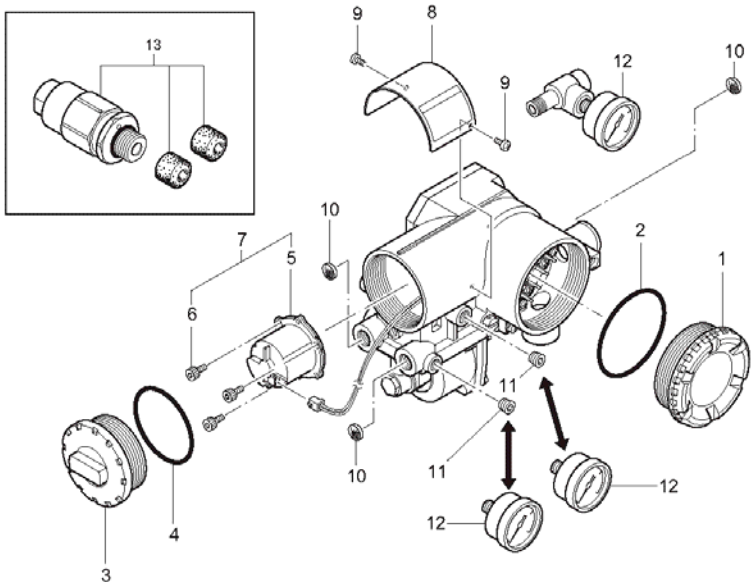
Customer Maintenance Parts List

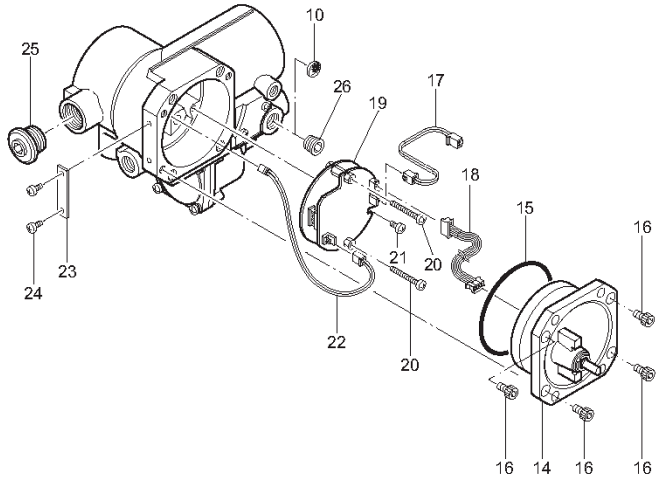
H

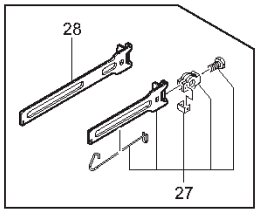


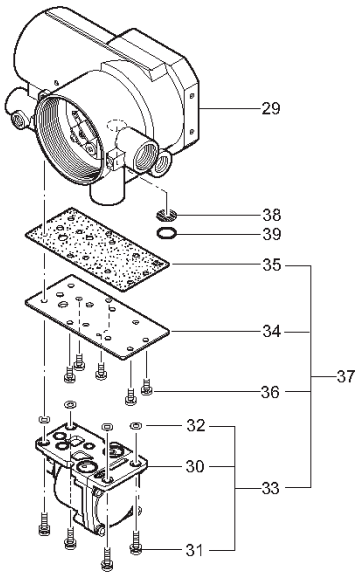
Item	Part No.	Qty	Description
1	F9341RA	1	Cover
2	F9341JP	1	O-Ring
3	—	1	I/P Cover
4	G9303AG	1	O-Ring
5	—	1	I/P Module
6	Y9408ZU	3	Bolt Hex. Socket
7	—	1	I/P Module Assembly
8	—	1	Name Plate
9	F9300AG	2	Screw
10	U0103FP	3	Screen (Single Acting Actuator)
		4	Screen (Double Acting Actuator)
11	Below	2	Plug
	G9612EJ		For Connection code 1, 5, and 6
	G9612EL		For Connection code 3
12	See Table 1	2	Pressure Gauge (Single Acting Actuator)
		3	Pressure Gauge (Double Acting Actuator)
13	G9601AM	1	Cable Gland Assy for JIS Flameproof Type (Option code /G11)

Table 1. Pressure Gauge Part Number (Item 12).

Applicable Actuator code	Connection code	Option code			
		/GP	/GM	/GB	/GE
1	1, 5, and 6	G9615ED	G9615AR	G9615EF	—
(Single Acting Actuator)	3	—	—	—	G9615EE
2	1, 5, and 6	G9615EG	G9615AS	G9615EH	—
(Double Acting Actuator)	3	—	—	—	G9615EJ







Item	Part No.	Qty	Description
14	—	1	Position Sensor Assembly
15	—	1	O-Ring
16	—	4	Bolt Hex. Socket
17	—	1	Connector Assembly
18	—	1	Connector Assembly
19	—	1	Amplifier Assembly
20	—	2	Screw Machine
21	—	1	Screw Machine
22	F9177WA	1	Connector Assembly
23	F9165DF	1	Tag Plate
24	F9300AG	2	Screw
25	Below	1	Plug
	G9330DP		G 1/2
	G9612EB		1/2 NPT
	F9340NW		Pg13.5
	F9340NX		M20
26	Below	1	Plug
	G9612EK		R 1/4
	G9612EM		1/4 NPT
27	Below	1	Lever Assembly
	F9176HA		For Option code /LV1
	F9176HD		For Option code /LV2
28	F9176HC	1	Lever for Option code /LV1
29	—	1	Case Assembly
30	—	1	Control Relay Assembly
31	Y9414JY	4	Screw
32	F9176GZ	4	Washer
33	Below	1	Control Relay Assembly with Screws
	F9177MJ		For Single Acting Actuator
	F9177ML		For Single Acting Actuator and Option code /X1
	F9177PS		For Double Acting Actuator
	F9177PU		For Double Acting Actuator and Option code /X1
	F9177PW		For Double Acting Actuator and Option code /HT
	F9177PY		For Double Acting Actuator and Option code /X1/HT
34	Below	1	Plate
	F9176GD		For Single Acting Actuator
	F9176HG		For Double Acting Actuator
35	Below		Gasket
	F9176GE	1	For Single Acting Actuator
	F9176HH	2	For Double Acting Actuator
36	G9307MQ	5	Screw M4×8
37	Below	1	Control Relay Assembly
	F9177ME		For Single Acting Actuator
	F9177MG		For Single Acting Actuator and Option code /X1
	F9177PJ		For Double Acting Actuator
	F9177PL		For Double Acting Actuator and Option code /X1
	F9177PN		For Double Acting Actuator and Option code /HT
	F9177PQ		For Double Acting Actuator and Option code /X1/HT
38	F9176GC	1	Filter
39	F9176JZ	1	O-Ring

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