Installation, Operation and Maintenance Manual
MDE 255 Rev. 0
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Bettis XTE3000

FF2000v4 FOUNDATION™ Fieldbus Module

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Section 1: Introduction

The FF2000v4 rev. 3 is an electronic module that allows to connect the Bettis electrical actuator XTE3000 to a FOUNDATION™ Fieldbus serial communication line. The module has its microprocessor and it is controlled by a program stored internally, it works as a pure bus interface and does not affect the actuator control integrity.

It is installed inside the actuator housing and the communication interface is powered directly from the fieldbus. The data lines are fully isolated from the actuator electronics.

Section 2: Operation and Storage

The module is designed to work and to be stored in the same environment of the actuator.

Section 3: Communication Features

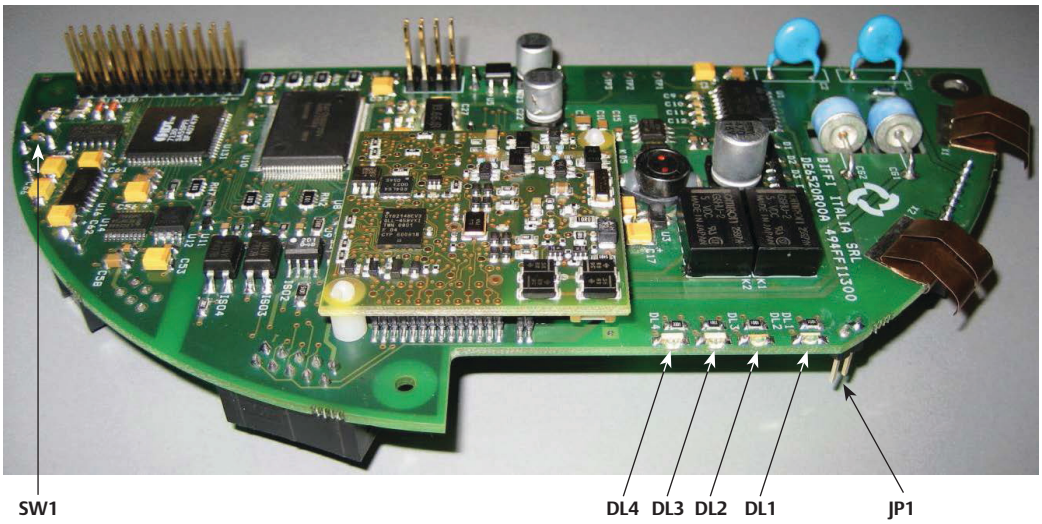
Communication protocol:	FOUNDATION™ Fieldbus
Electrical interface:	IEC 61158-2, 2 wire communication
Bus type:	H1 communication bus, Voltage Mode signalling
Data rate:	31.25 kbit/second
Transmission medium:	18 AWG shielded, twisted pair as specified in the IEC / ISA Physical Layer Standard, Clause 22.7
Topology:	Bus or tree structure
Device number:	32 devices per segment
Addressing capability:	Up to 240
Bus length:	1,900 m per segment
Electrical power:	Bus powered Max. voltage 32 V Min. voltage 9 V Rated current I_n = 19 mA Fault current I_{max} = 24 mA
Device capacitance:	< 5 nF
Device inductance:	Negligible
Temperature:	-40 °C, +85 °C
EMC protections:	Burst. EN 61000-4-4:1995 + A1:2001 + A2:2001 Electromagnetic compatibility (EMC) Part 4 - 4: Testing and measuring techniques Electrical fast transient/burst immunity test Surge. EN 61000-4-5:1995 + A1:2001 Electromagnetic compatibility (EMC) Part 4 - 5: Testing and measuring techniques - Surge immunity test
Device type:	Link Master or Basic Device
Field diagnostic:	FD_VER 1.0
Device replacement:	COMPATIBILTY_REV. 2
ITK version:	6.1.1

Section 4: FF2000v4 rev. 3 Module

The module consists in a single PCB that is installed inside the actuator housing. It is connected to the XTE3000 base card via strip connector.

The internal wiring connects the FOUNDATION™ Fieldbus data lines to the actuator terminal board.

Figure 1



4.1 On Board Indications

Four LEDs are mounted on the FF2000v4 rev. 3 to give the following indications for the field service. LEDs indicators are active only when jumper JP1 is closed. There is also the SW1 switch button that performs a reset of the FF2000v4 rev. 3 card.

DL4 (red) Base comm:	BLINK or ON: when the communication between the base card and the interface is not working properly. OFF: when the communication between the base card and the interface is working properly.
DL3 (red) Data area empty:	ON: when Data Area on interface card is not yet loaded. BLINK: when Data Area is being read from base card. OFF: when Data Area is completely loaded.
DL2 (green) FF module comm:	BLINK: The communication between the interface card and FF bus module is working properly. OFF or ON: The communication between the interface card and FF bus module is not working properly.
DL1 (green) Power:	ON: when the FF2000v4 rev. 3 is correctly powered from the main power supply. OFF: when the FF2000v4 rev. 3 is not powered from the main power supply.

Section 5: FOUNDATION™ Fieldbus Overview

FOUNDATION Fieldbus is an open networking standard which provides an open specification for both the control application and the communication on the bus.

FOUNDATION Fieldbus communication protocol is an industry proven international standard (IEC 61158-2) designed for use in the process industry and also complies with the ISA-SP50 recommendation for fieldbus devices.

The major benefits in adopting this standard include:

- Multi-drop capability with up to 32 devices per segment;
- Extended trunk length using repeaters which increase the total bus length and the number of devices in the network;
- Power and communications over the same shielded twisted pair network that allow to know the physical status of XTE3000 actuator even if it is without actuator mains power;
- Distribution of the control into the field devices reducing the amount of control equipment in the plant.

This last item is one of the advantages of FOUNDATION Fieldbus, which uses standards 'Function Blocks' and Device Descriptions to implement control strategy. Function Blocks are standardized automation functions with defined behaviour used to represent different type of functions, such as discrete input (DI), discrete output (DO), analog input (AI), analog output (AO), Proportional / Integral / Derivative (PID), etc.

Furthermore, every FOUNDATION Fieldbus device has a Resource Block and at least a Transducer Block.

Once the hardware of a FOUNDATION Fieldbus device is configured, fieldbus communication is used to configure the transducer block parameters. The desired transducer functionality is associated with a specific function block via a Channel.

The host system is used to link the function blocks together to create a control application that can be downloaded to the devices in the segment.

More information about FOUNDATION Fieldbus are in the documents:

- FOUNDATION Fieldbus – Technical Overview
- FOUNDATION Fieldbus – Wiring and installation 31.25 kbit/second, Voltage Mode, Wire Medium Application Guide

Available at the website http://www.fieldbus.org

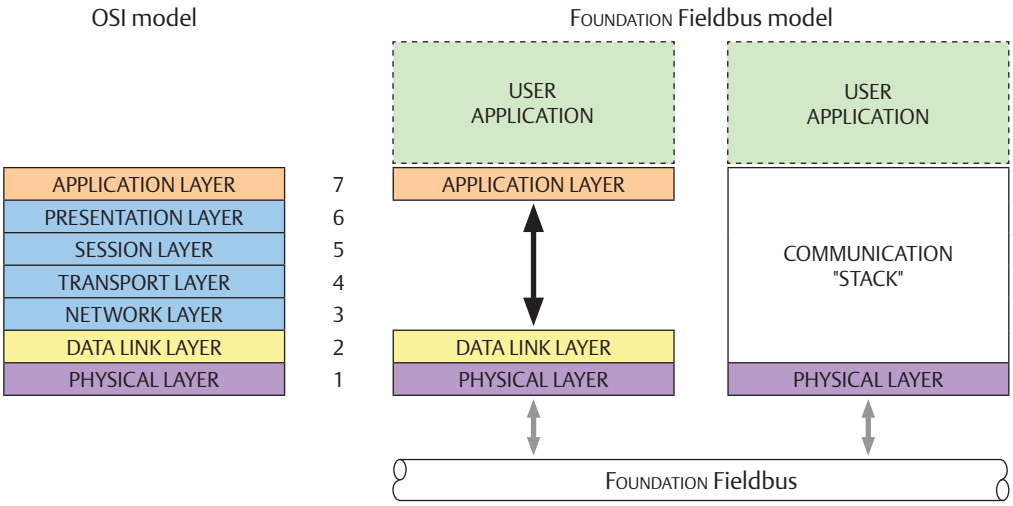
5.1 FOUNDATION™ Fieldbus Technology

FOUNDATION Fieldbus technology consists of:

- Physical Layer
- Communication “Stack”
- User Application

The Open System Interconnect (OSI) layered communication model is used to model these components as shown in Figure 2:

Figure 2



The Physical Layer and the Data Link Layer correspond respectively to OSI layer 1 and layer 2.

The Communication Stack is comprised of OSI layers 2 and 7; the fieldbus protocol does not use OSI layers 3, 4, 5, and 6.

The User Application is not defined by the OSI model. Fieldbus FOUNDATION has specified a User Application model that Bettis has applied for FF2000v4 rev. 3 interface.

5.1.1 Physical Layer

FF2000v4 rev. 3 implements the Physical layer standards H1 that FOUNDATION Fieldbus defines for field device connections. The bus communication is fixed at 31.25 kbit/second, the devices can be powered directly from the fieldbus and operate on wiring previously used for 4 - 20 mA devices.

FF2000v4 rev. 3 module is a bus powered interface: it will continue to communicate to the other devices in the segment even if the actuator is powered off.

H1 fieldbus also supports intrinsically safe (I.S.) applications: in this case, the appropriate barriers will be used.

Bettis electrical actuators XTE3000 are certified explosion proof and do not require an intrinsically safe network. To preserve hazardous area protection armored cables or conduits will be used.

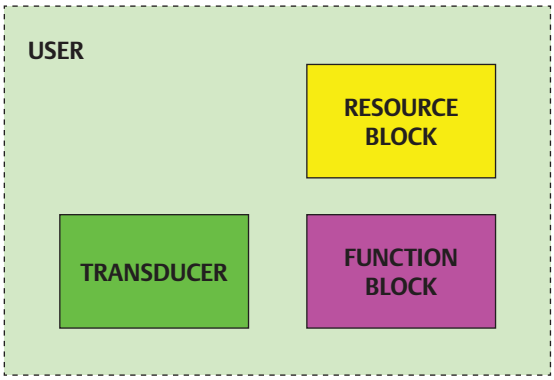
5.1.2 Communication Stack

Two types of devices are defined in the Data Link Layer specification: Basic Device and Link Master. FF2000v4 rev. 3 module acts both type, Basic Device or Link Master.

5.1.3 User Application Layer - Blocks

The Fieldbus FOUNDATION™ has defined a standard User Application based on “Blocks”. Blocks are representations of different types of application functions.

Figure 3

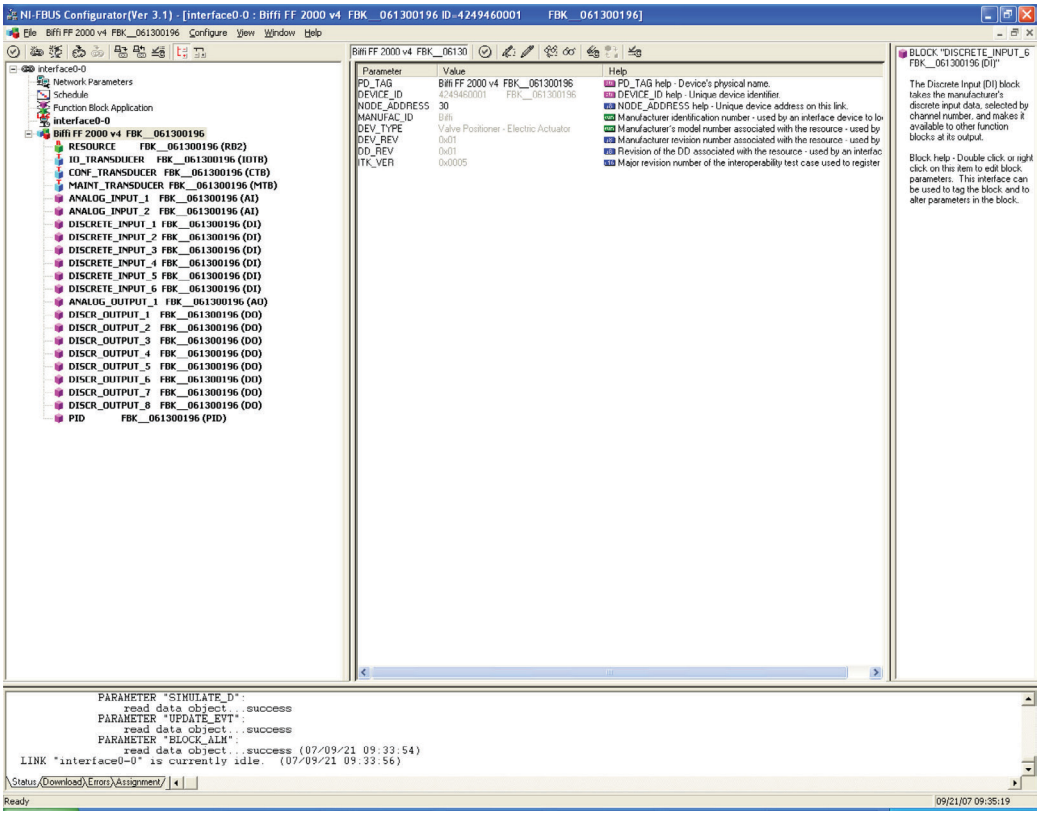


The following Function Blocks are implemented in the FF2000v4 rev. 3 module:

Discrete Output (DO)	8 blocks for commands to the actuator
Discrete Input (DI)	6 blocks for data coming from the actuator
Analog Output (AO)	1 block for set-point in inching service
Analog Input (AI)	2 blocks for analog data from the actuator
PID	1 block
Transducer Blocks	1 Input Output Transducer Block, 1 Configuration Transducer Block, 1 Maintenance Transducer Block
Resource Block	1 block

The following Figure shows the blocks contained in the FF2000v4 module as seen by NI-FBUS, National Instruments configuration tool.

Figure 4



The characteristics of fieldbus devices are described by the Device Description (DD) and the Capability File (CF) that provides an extended description of each data from the device.
From the CF file, is possible achieve information about the execution time of each function block.

The blocks in the FF2000v4 rev. 3 module have the following execution time:

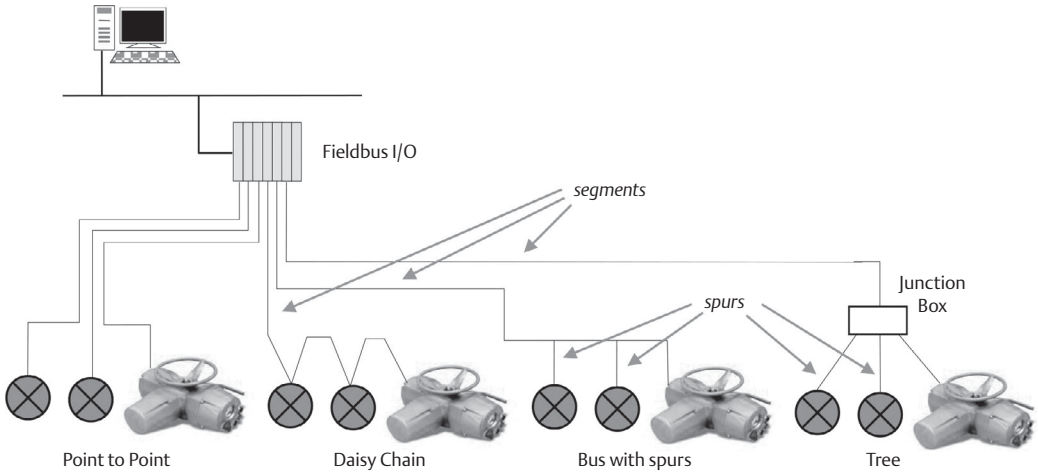
Table 1.

Bock Type	Execution Time
Discrete Output (DO)	30 milliseconds
Discrete Input (DI)	20 milliseconds
Analog Output (AO)	30 milliseconds
Analog Input (AI)	30 milliseconds
PID	40 milliseconds
Maintenance Transducer	Not Applicable
Configuration Transducer	Not Applicable
Input_output Transducer	Not Applicable
Resource	Not Applicable

5.2 Fieldbus Topology and Wiring

General structures of H1 networks are shown in Figure 5:

Figure 5



An appropriate termination conditioning network (terminators) must be placed at the beginning and at the end of each segment. A suitable power supply has to be added in the segments where bus power devices are connected.

The following Table shows the types of cables indicated by IEC / ISA Physical Layer Standard.

Table 2.

Type	Description	Size	Max Length
Type A	Shielded, twisted pair	18 AWG	1,900 m
Type B	Multi twisted pair with shield	22 AWG	1,200 m

The total length of the H1 fieldbus is determined by several factors as the cable type, I.S. option and also the total spurs length has to be considered in the total fieldbus length.

Furthermore, it is also necessary to grant to each bus powered device the minimum requested voltage to work properly since the cable length will cause a voltage drop over the line.

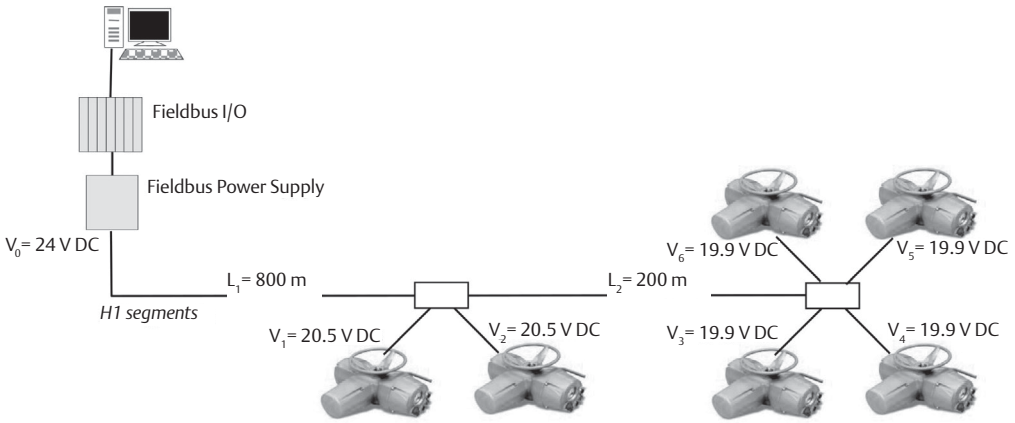
The FF2000v4 rev. 3 module is a bus powered device and it will work with the following electrical parameters:

Voltage supply: minimum 9 V DC
maximum 32 V DC

Current drain: nominal 19 mA
maximum (fault) 24 mA

The following Figure shows an H1 segment where 6 actuators are connected in a tree structure; the example highlight the voltage at each device:

Figure 6



NOTE

Each spur has been considered 3 m long.

As shown in Figure 6, the current drawn by the actuators cause a voltage drop of 5.8 V on the Section L_1 and a voltage drop of 0.9 V on the Section L_2.

5.2.1 Cable Selection

The preferred cable is specified in the IEC / ISA Physical Layer Standard, Clause 22.7.2 for conformance testing and it is referred to as "Type A" fieldbus cable.

Belden 3076F is a "Type A" fieldbus cable. The following Table shows the electrical characteristics:

Table 3.

Belden 3076F	
Description	18 AWG (7x26) Tinned Copper conductor, Polyethylene insulation, Aluminium Foil-Polyester Tape (Beldfoil) shield
Shielding	100% shield coverage
Size	18 AWG (0.78 mm^2)
Nominal Resistance	24 Ω/km @ 25 °C
Nominal Mutual Capacitance	78.7 pF/m @ 1 KHz
Nominal Impedance	100 Ω @ 31.25 KHz
Temperature rating	-40 to +105 °C

5.3 Terminators

Each segment must be properly connected to a termination conditioning network (terminators) placed at the beginning and at the end of each segment.

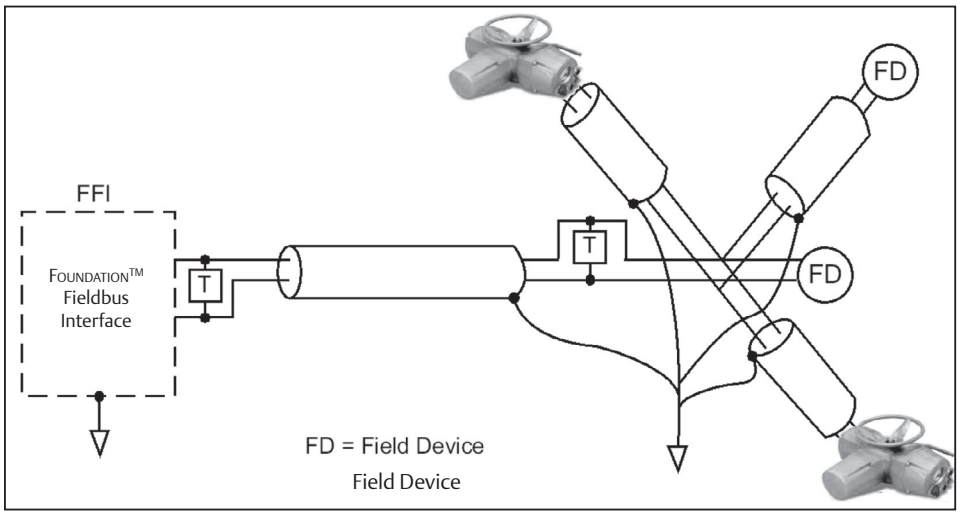
The terminators prevent distortion and signal loss and are typically purchased and installed as a pre-assembled sealed module.

The actuator is not equipped with termination facilities.

5.4 Shielding

When using a shielded cable, connect each spur's shield to the trunk shield and connect the overall shield to ground at one point. Do not connect the spur's shield in to the actuator ground as shown in Figure 7.

Figure 7



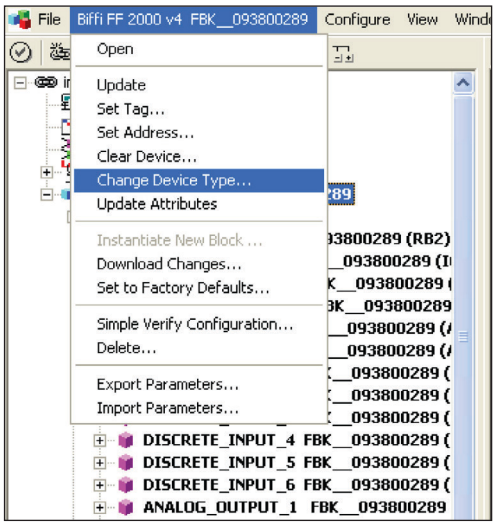
5.5 Link Master Capabilities

FF2000v4 rev. 3 has Link Master (LM) capabilities; it contains Link Active Scheduler (LAS) functionality that can control communications on H1 fieldbus Link.

The LAS schedules and controls the segment communication. There must be at least one LM on an H1 Link; one of those LM devices will be elected to serve as LAS. In a redundant system containing multiple Link Masters, one of the Link Masters will become the LAS if the active LAS fails.

The LM functionality could be enabled or disabled by the configuration utility.

Figure 8



5.6 Field Diagnostic Profile

The FF2000v4 rev. 3 interface, implements FF-912 Field Diagnostic Profile specification. It is implemented by a specific parameter group of Resource Block. The diagnostics are divided into four categories: Failure, Out of specification, Maintenance and Check Function - consistent with NAMUR NE-107. Each of these categories share 32 conditions. Each condition can be mapped or unmapped for each category by selecting the appropriate bit in FD_*_MAP parameter. If a condition is mapped, then it is indicated in the parameter FD_*_ACTIVE. If the condition in FD_*_ACTIVE parameter is not masked the corresponding bit in parameter FD_*_MASK, then the condition will be queued for transmission using the corresponding FD_*_ALM parameter associated with the priority indicated by the parameter FD_*_PRI.

The four categories of conditions are defined below.

Table 4.

Maintenance	Although the output signal is valid, the wear reserve is nearly exhausted or a function will soon be restricted due to operational conditions e.g. build-up of deposits.
Off-Specification	Off-specification means that the device is operating outside its specified range or an internal diagnostic indicates deviations from measured or set values due to internal problems in the device or process characteristics (e.g. bubble formation in flow metering or valve sticking).
Check Function	Output signal temporarily invalid (e.g. frozen) due to on-going work on the device.
Failed	Output signal invalid due to malfunction in the field device or its peripherals.

With the FD_*_ACTIVE parameters you know the result after the filtering by FD_*_MAP. Prior to filtering by FD_*_MAP, the detected conditions may be observed in the FD_Simulate.Diagnostic_Value.

The complete list and functionality of Field Diagnostic parameters implemented in FF2000v4 rev. 3 interface is reported on the Resource Block paragraph. All the parameter related to Field diagnostic are prefixed with FD_.

In the Table below are listed all the conditions handled by FF2000v4 rev. 3 with respectively manufacturer default mapping and Recommended Action.

Table 5.

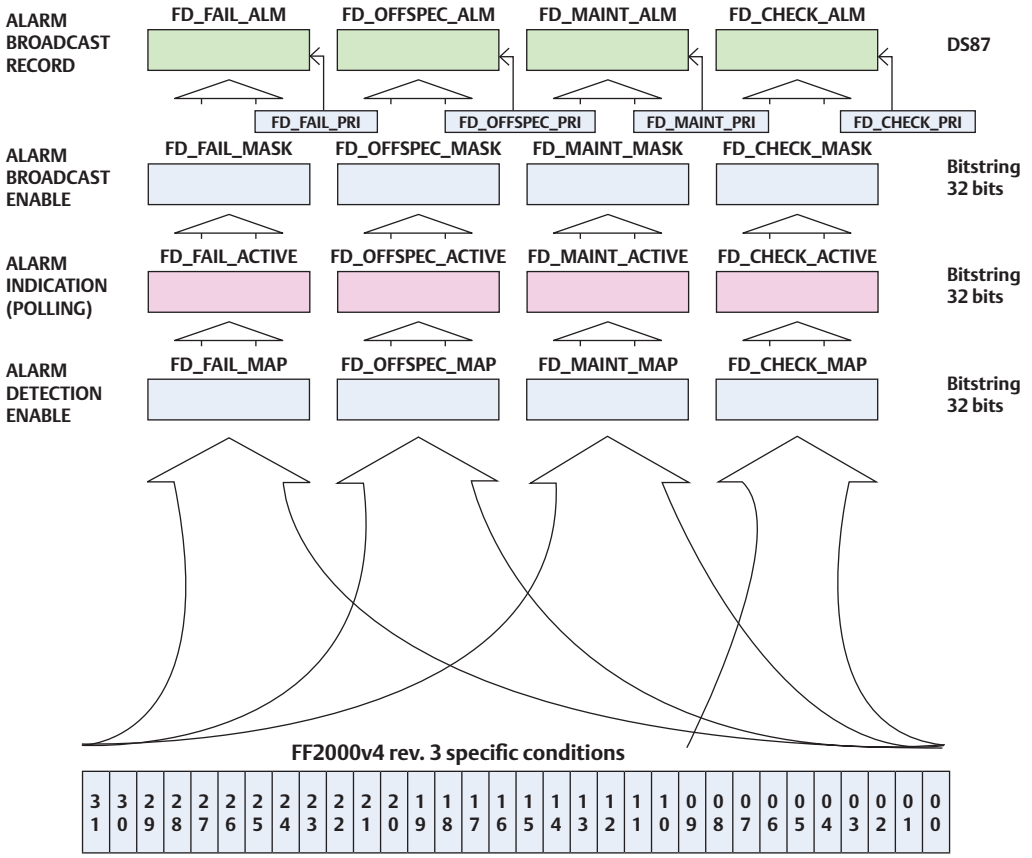
FC CONDITIONS TABLE							
BIT	CONDITION	FAILURE-F	OFF-SPECIFICATION-S	CHECK FUNCTION-C	MAINTENANCE-M	DESCRIPTION	RECOMMENDED ACTION
31	MAIN_POWER_SUPPLY	x				Indicates whether device has lost a power supply, or in case of fault of one of the phases that supply the actuator transformer, or main voltage lower than -20% or higher than +20% of the value stated in the nameplate menu.	Indicates whether device has lost a power supply, or in case of fault of one of the phases that supply the actuator transformer, or main voltage lower than -20% or higher than +20% of the value stated in the nameplate menu.
30	SPEED_SENSOR	x				Measure of motor speed not valid.	Replace speed sensor
29	POSIT_SENSOR	x				Value of the actuator position not valid.	Replace position sensor or recalibrate both stroke limits.
28	HI_HI_LO_LO_INT_TEMP	x				Temperature inside the actuator enclosure higher than 90 °C or lower than -40 °C	Ambient temperature too high or too low. Verify insulation among actuator and heat source

BIT	CONDITION	FAILURE-F	OFF-SPECIFICATION-S	CHECK FUNCTION-C	MAINTENANCE-M	DESCRIPTION	RECOMMENDED ACTION
27	HW_ERROR	x				The diagnostic program detects some malfunction in the electronics controlling the actuator.	Some circuit is damaged and does not work (Call Bettis After-sales service to solve the problem).
26	CONFIG_ERROR	x				The checksum of the EEPROM memory that contains the configuration data is wrong.	Reconfigure all parameters (See details next page).
25	BASE_COM_FAIL	x				The communication between Interface card and motherboard card is lost.	Check the main power supply, or replace the Hardware (Base card and Interface card).
24	MOT_THERMOST	x				Motor thermostat open for high temperature in the motor windings.	Wait until the motor cools down.
23	CONTACTOR	x				The test routine reports a failure of contactor (coil or auxiliary contact).	Check the contactor.
22	MID_TRAV_AL		x			The valve does not move in presence of an open or close control.	Check status of actuator and valve mechanical parts. Recalibrate both stroke limits.
21	JAMMED		x			No position change after receiving an open or close control.	Check status of actuator and valve mechanical parts.
20	HI_HI_TORQUE		x			Measured torque greater than the relevant value configured in torque setup or stroke limits routine.	Operate the actuator in opposite direction. Check the torque needed to operate the valve.
19	LOW_9V_BATTERY		x			The voltage of the lithium battery is too low (only detected if the lithium battery is present and the relevant parameter of the miscellaneous routine is set to “present”).	Change lithium battery.
18	EFS_MID_TRAVEL	x				The position is > 4% after ESD action.	Check reset time, check electrical stroke limits, check mechanical stops.
17	PST T-PST			x		Time needed to change the position of the PST TRAVEL by the spring action out of specification.	Check baseline values and parameter T-PST.
16	PST T-RET			x		Time to return to position before testing out of specification.	Check baseline values and parameter T-RET.

BIT	CONDITION	FAILURE-F	OFF-SPECIFICATION-S	CHECK FUNCTION-C	MAINTENANCE-M	DESCRIPTION	RECOMMENDED ACTION
15	PST OV-TR			x		Position change greater than allowable.	Check PST travel and parameter OV-TR.
14	PST_ABORTED			x		PST cycle aborted due to external condition.	Check if condition to abort has happened.
13	HI_LO_MAINS		x			Value of the main voltage out of the correct range (-15% or +10% of the value stated in the nameplate menu) or wrong frequency.	Check section of wires and values of voltage and frequency.
12	WRONG_LIMITS		x			The routine that monitors the stroke limits detects a wrong end of travel condition.	Recalibrate both stroke limits.
11	HI_TORQUE		x			Measured torque 10% lower than the relevant value configured in torque setup or stroke limits routines.	Check the torque necessary to move the valve.
10	MAX_CYCLES_CONTACT				x	Maximum number of contactor cycles reached.	Change contactor and reset operation log.
9	HI_LO_INT_TEMP		x			Temperature inside the actuator enclosure higher than 80 °C or lower than -35 °C.	Find the heat source and insulate the actuator.
8	MOTOR_CUR		x			Motor current greater or lower than limits.	Check electrical motor.
7	MAINTEN_REQ				x	Date of the next maintenance reached.	Perform maintenance and set next maintenance date.
6	MANUAL_OPER			x		The actuator is changing the position without electrical command.	Operator is changing the actuator position by handwheel.
5	ESD_ON			x		ESD command active (hardwired or from FF).	Check and remove the ESD condition (C4 pin of terminal board or FF ESD command).
4	INTERLOCK_ON			x		Interlock open or close active (hardwired or from FF).	Check the Interlock condition (B4 and B5 pin of terminal board or FF Interlock command).
3	LOC_STOP_ON			x		Local stop button pressed.	Release the Local Stop button.
2	REM_HARDWIRED_OPER			x		Local selector in remote with manual mode enabled.	Check B/HW (C8 connection on terminal board) signal.
1	LSEL_OUT_OF_REM			x		Local selector not in REMOTE position.	Switch the Local selector to REMOTE.
0	CHECK			x		Check function.	Allow ITK to verify operation of Field Diagnostics.

The Figure below explains in schematic mode the functionality of Field Diagnostic.

Figure 9



5.7 Device Replacement

The FF2000v4 rev. 3 interface, implements AN-007 Device Replacement specification.

This DEV_REV 3 is a “Like Device” of previous version DEV_REV 2. It can be used as replacement for previous FF2000v4 rev. 2 in a working plant.

The FF2000v4 rev. 3 can run the same configuration that was running in the FF2000v4 rev. 2 without reengineering the host configuration or changing the configuration of any other element of the H1 network other than the new device.

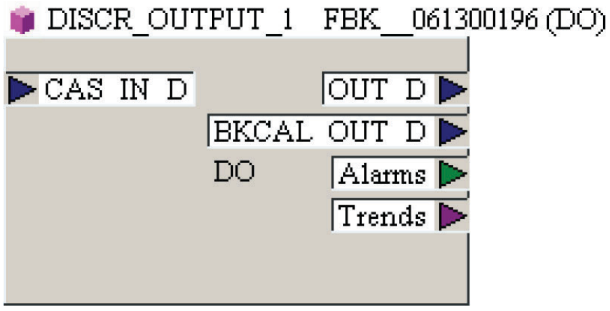
The host system is informed by the backward compatibility with older DEV_REV 2 of FF2000v4 by COMPATIBILITY_REV parameter in Resource Block. For more detail about Device replacement specification, check the FOUNDATION™ Fieldbus literature.

Section 6: Function Blocks Description

6.1 Function Block: DO

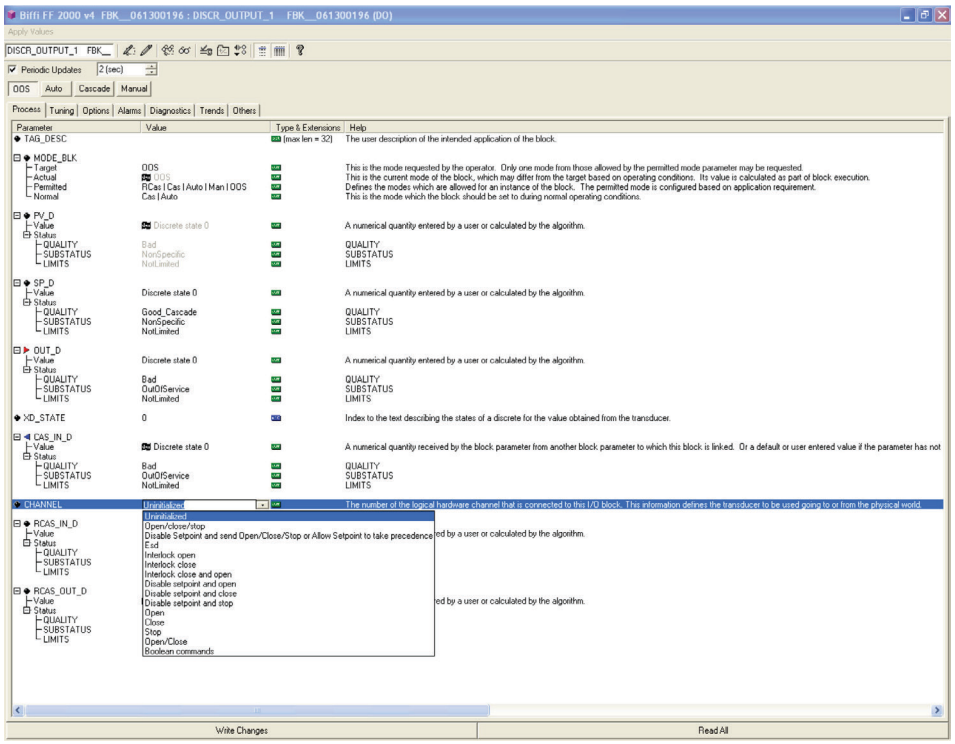
A Discrete Output block converts the value received across the fieldbus to something useful to the hardware in the device. In the FF2000v4 rev. 3, there are 8 available DO Function Blocks.

Figure 10



Each DO may be connected by means of any FOUNDATION™ Fieldbus Configuration Tool to one of the related channels defined in the paragraph 'DO Channels'.

Figure 11



6.1.1 DO Channels

Table 6.

CH	Name	Description	Value
51	Open/Close/Stop	Stop Command Close Command Open Command	0 1 2
52	Disable Setpoint and send Open/Close/Stop or Allow Setpoint to take precedence	Disable Setpoint and send a Stop Command Disable Setpoint and send a Close Command Disable Setpoint and send a Open Command Setpoint Enabled	0 1 2 3
53(*)	Esd(1) (2)	ESD (PST) Command active ESD (PST) Command inactive	1 0
54	Interlock open(2)	Interlock Open Command active Interlock Open Command inactive	1 0
55	Interlock open(2)	Interlock Close Command active Interlock Close Command inactive	1 0
56	Interlock close and open(2)	Interlock Close and Open Command active Interlock Close and Open Command inactive	1 0
57	Disable setpoint and open	Disable Setpoint and send a Open Command active Disable Setpoint and send a Open Command inactive	1 0
58	Disable setpoint and close	Disable Setpoint and send a Close Command active Disable Setpoint and send a Close Command inactive	1 0
59	Disable setpoint and stop	Disable Setpoint and send a Stop Command active Disable Setpoint and send a Stop Command inactive	1 0
60	Open	Open Command active Open Command inactive	1 0
61	Close	Close Command active Close Command inactive	1 0
62	Stop	Stop Command active Stop Command inactive	1 0
63	Open/Close	Open Command active Close Command active	1 0
64	Boolean commands	b0: Enable setpoint command b1: Open command active b2: Close command active b3: Stop command active b4: ESD command active b5: Interlock in closing command active b6: Interlock in opening command active b7: Spare	0X01 0X02 0X04 0X08 0X10 0X20 0X40 0X80

(1) In case of EFS actuator, this channel performs the PST command.

(2) Signal affected by modification of SW base version 7.00, see Section 9 for details.

6.1.2 Discrete Output Channel Interlocks

Table 7.

Channel	Purpose	Other DO Block's Available Selection														
		0	51	52	53	54	55	56	57	58	59	60	61	62	63	64
0	No Transducer Connection	O	O	O	O	O	O	O	O	O	O	O	O	O	O	0
51	Open/Close/Stop	O	X	X	O	O	O	O	X	X	X	X	X	X	X	X
52	Disable and Op/Cl/St | Enable sp	O	X	X	O	O	O	O	X	X	X	X	X	X	X	X
53	ESD	O	O	O	X	O	O	O	O	O	O	O	O	O	O	X
54	Interlock Open	O	O	O	O	X	O	O	O	O	O	O	O	O	O	X
55	Interlock Close	O	O	O	O	O	X	O	O	O	O	O	O	O	O	X
56	Interlock Close and Open	O	O	O	O	O	O	X	O	O	O	O	O	O	O	X
57	Open with sp override	O	X	X	O	O	O	O	X	✓	O	X	X	X	X	X
58	Close with sp override	O	X	X	O	O	O	O	✓	X	O	X	X	X	X	X
59	Stop with sp override	O	X	X	O	O	O	O	✓	✓	X	X	X	X	X	X
60	Open	O	X	X	O	O	O	O	X	X	X	X	✓	O	X	X
61	Close	O	X	X	O	O	O	O	X	X	X	✓	X	O	X	X
62	Stop	O	X	X	O	O	O	O	X	X	X	✓	✓	X	X	X
63	Open/Close	O	X	X	O	O	O	O	X	X	X	X	X	X	X	X
64	Boolean command	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X

✓ – required X – disallowed O – optional

Table 7 is provided to prevent illegal configuration.

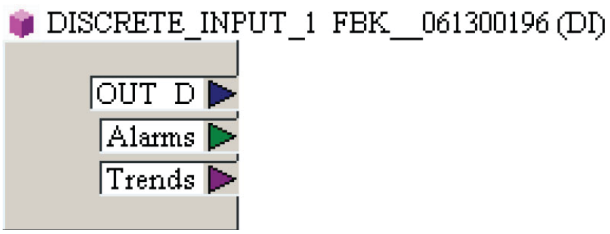
The first column lists the current channel selected in a Discrete Output Block. When the channel in the first column is selected, the row corresponds to the allowed or required selections for the other Discrete Output blocks.

The host programmer must carefully pay attention to the configuration shown in Table 7 to avoid ambiguous programming and unexpected stroke of actuator.

6.2 Function Block: DI

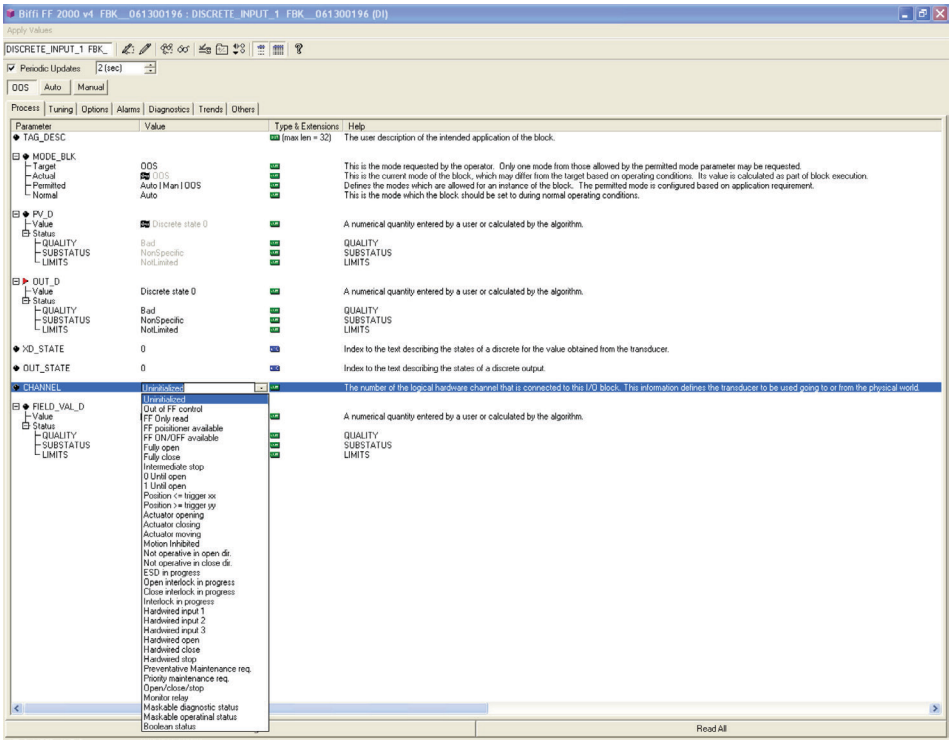
A Discrete Input block takes the manufacturer's discrete input data and makes it available to other function block for use in control; FF2000v4 rev. 3 has 6 available DI Function Blocks.

Figure 12



Each DI may be connected by means of any FOUNDATION™ Fieldbus Configuration Tool to one of the related channels defined in the paragraph 'DI Channels'.

Figure 13



6.2.1 DI Channels

Table 8.

CH	Actuator Command	Description	Meaning
1	Out of FF control	Not operational by FF interface.	**0**: Inactive **1**: Actuator not in FF control.
2	FF Only read	FF can only read data (other operator interface has the control).	**0**: FF can read data and control actuator. **1**: FF can read data, other operator interface has control.
3	FF positioner available	The actuator is ready to follow the setpoint from the bus.	**0**: Actuator unable to follow setpoint from bus. **1**: Actuator ready to follow setpoint from the bus.
4	FF ON/ OFF available	The actuator is ready to follow the Open / Close / Stop commands from the bus.	**0**: Actuator unable to execute Open / Stop / Close commands from bus. **1**: Actuator able to execute Open / Stop / Close commands from bus.
5	Fully open	Fully open position	**0**: Inactive **1**: Valve in fully open position.
6	Fully close	Fully close position	**0**: Inactive **1**: Valve in fully close position.
7	Intermediate stop	Actuator stop in an intermediate position.	**0**: Inactive **1**: Valve stopped in an intermediate position.
8	0 Until open	0 until the fully open position reached and at 1 until the fully close position reached.	**0**: Inactive **1**: 0 until fully open and 1 until fully close
9	1 Until open	1 until the fully open position reached and at 0 until the fully close position reached.	**0**: Inactive **1**: 1 until fully open and 0 until fully close
10	Position < = trigger xx	position < = xx% trigger	**0**: Inactive **1**: Valve position < = trigger 'xx' as defined at Local Operator Interface.
11	Position > = trigger yy	Valve position > = xx% trigger	**0**: Inactive **1**: Valve position > = trigger 'yy' as defined at Local Operator Interface.
12	Actuator opening	The actuator is moving in opening direction.	**0**: Actuator not opening. **1**: Actuator is moving in opening direction.
13	Actuator closing	The actuator is moving in closing direction.	**0**: Actuator not closing. **1**: Actuator is moving in closing direction.
14	Actuator moving	The actuator is moving.	**0**: Actuator not moving. **1**: Actuator moving in opening or in closing direction.
15	Motion Inhibited	The current movement is in the OFF period when the TIMER is active.	**0**: Inactive **1**: In On/Off service: set during Off period when Timer is active. In Modulating service: set during delay time before next positioning.
16	Not operative in open dir.	Open command not available due to current Interlock active or Alarms trip in Opening direction.	**0**: Open command available. **1**: Open command not available due to current Interlock active or Alarms trip in Opening direction.
17	Not operative in close dir.	Close command not available due to current Interlock active or Alarms trip in Closing direction.	**0**: Close command available. **1**: Close command not available due to current Interlock active or Alarms trip in Closing direction.
18	ESD in progress[3][2]	ESD operation in progress.	**0**: ESD not active **1**: ESD command active
19	Open interlock in progress	Open Interlock operation in progress.	**0**: Inactive **1**: Open Interlock operation in progress.
20	Close interlock in progress	Open Interlock operation in progress.	**0**: Inactive **1**: Close Interlock operation in progress.

CH	Actuator Command	Description	Meaning
21	Interlock in progress	Interlock operation in progress.	**0**: Interlock Open or Close not active. **1**: Interlock operation in progress.
22	Hardwired input 1	Digital Input #1 active and Hardwired mode not enabled.	**0**: Inactive **1**: Digital Input #1 active when Hardwired mode not enabled.
23	Hardwired input 2	Digital Input #2 active and Hardwired mode not enabled.	**0**: Inactive **1**: Digital Input #2 active when Hardwired mode not enabled.
24	Hardwired input 3	Digital Input #3 active and Hardwired mode not enabled.	**0**: Inactive **1**: Digital Input #3 active when Hardwired mode not enabled.
25	Hardwired open	Hardwired Open Command Active when Hardwired mode enabled.	**0**: Inactive **1**: Hardwired Open Command Active when Hardwired mode enabled.
26	Hardwired close	Hardwired Close Command Active when Hardwired mode enabled.	**0**: Inactive **1**: Hardwired Close Command Active when Hardwired mode enabled.
27	Hardwired stop	Hardwired Stop Command Active when Hardwired mode enabled.	**0**: Inactive **1**: Hardwired Stop Command Active when Hardwired mode enabled.
28	Preventative Maintenance req.	Condition may require maintenance intervention at the next available opportunity.	**0**: No maintenance required **1**: Warning conditions require intervention.
29	Priority maintenance req.	Condition may require maintenance intervention as soon as possible.	**0**: No maintenance required **1**: Alarm conditions require immediate intervention.
30	Open/close/stop	Indicate the status of the actuator: Fully opened, fully closed or stopped in intermediate position.	**0**: Valve stopped in an intermediate position. **1**: Valve in fully closed position. **2**: Valve in fully opened position. **3**: Valve is moving in closing direction. **4**: Valve is moving in opening direction.
31	Monitor relay	Available for remote control	**0**: Monitor relay not active **1**: Monitor relay active
32	Maskable diagnostic status	Maskable signal that indicate the status of the actuator for diagnostic and nonoperational status. It is possible to choose the condition to generate this signal by setting the parameters MASK_TOTAL_NOT_OPER, MASK_PART_NOT_OPER and MASK_DIAGNOSTIC into the Input Output TB.	**0**: No masked signal active **1**: Masked signal active
33	Maskable operational status	Maskable signal that indicate the status of the actuator in normal operation. It is possible to choose the condition to generate this signal by setting the parameters MASK_OPERATIONAL to the Input Output TB.	**0**: No masked signal active **1**: Masked signal active
34	Boolean status	This channel has a value between 0 and 255. If the host DCS uses it's Boolean Fan Out function the returned value may be decoded into 8 individual bit where each bit represents a single piece of data.	**b0:** Positioner mode **b1:** Fully open **b2:** Fully close **b3:** Position < = XX% **b4:** Position > = YY% **b5:** motion inhibited **b6:** local selector in remote **b7:** monitor relay status
35	Local selector position	Publish the position of local selector.	**0**: selector in REMOTE **1**: selector in LOCAL **2**: selector in OFF

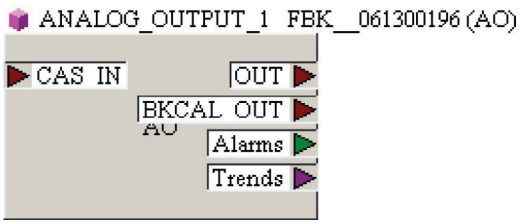
(2) Signal affected by modification of SW base version 7.00, see Section 9 for details.

(3) In case of EFS actuator, this channel shows the PST in progress.

6.3 Function Block: AO

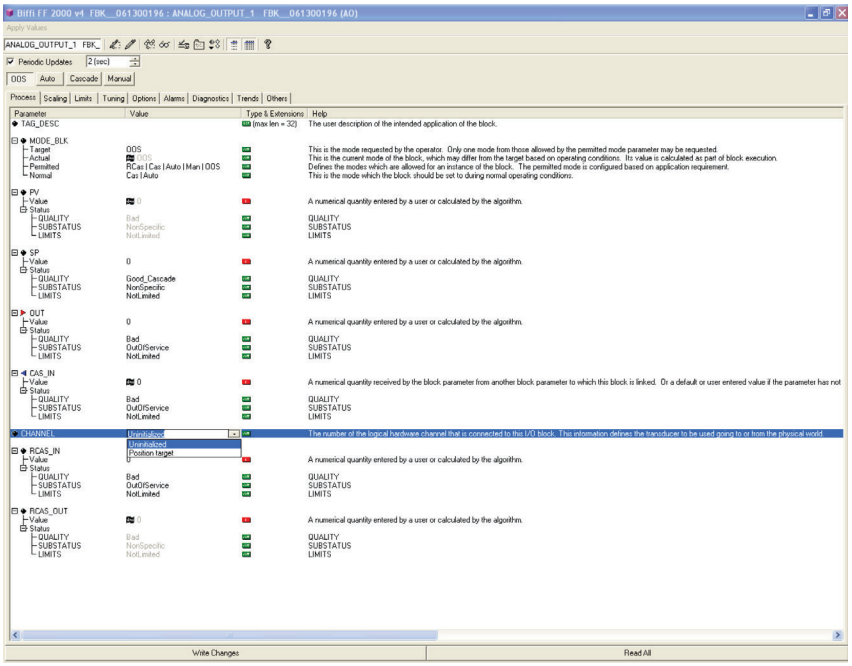
There is one AO Function Block which receives the Position Demand channel as defined in the paragraph 'AO Channels'.

Figure 14



The AO may be connected by means of any FOUNDATION™ Fieldbus Configuration Tool to the related channel "Position Target".

Figure 15



6.3.1 AO Channel

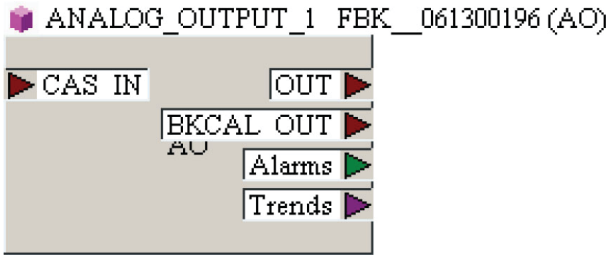
Table 9.

Name	Channel Number	Type	Value	EU	Description
Position target	91	Float	0.0 – 100.0	%	Position demand

6.4 Function Block: AI

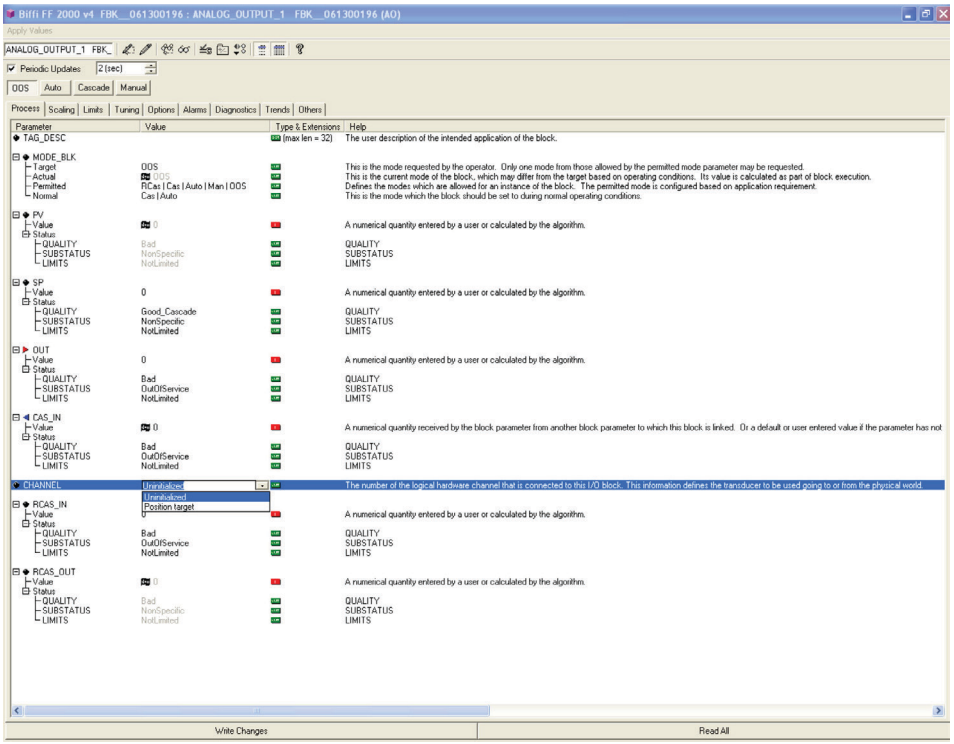
There are 2 independent AI Function Blocks:

Figure 16



Each AI may be connected by means of any FOUNDATION™ Fieldbus Configuration Tool to one of the related channels defined in the paragraph 'AI Channels'.

Figure 17



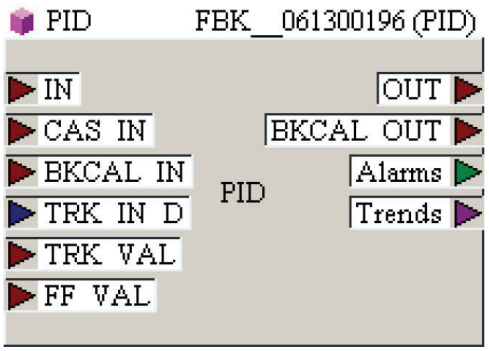
6.4.1 AI Channels

Table 10.

Name	Channel Number	Type	Value	EU	Description
Position - actual	81	Float	0.0 ÷ 100.0	%	Current actuator position
Torque - actual	82	Float	-100.0 ÷ +100.0	%	Current actuator torque

6.5 Function Block: PID

Figure 18



A standard PID function block is provided with full 3 terms control block.

The PID controller calculation (algorithm) involves three separate parameters; the proportional, the integral, and derivative values. The proportional value determines the reaction to the current error, the integral value determines the reaction based on the sum of recent errors, and the derivative value determines the reaction based on the rate at which the error has been changing. The weighted sum of these three actions is used to adjust the process via a control element such as the position of a control valve or the power supply of a heating element.

By tuning the three constants in the PID controller algorithm, the controller can provide control action designed for specific process requirements.

Detailed description of PID algorithm and setup can be found on MDE 230 “PID Function Block Technical Description”.

Section 7: Resource Block

Table 11 below lists the elements that are added to the standard FF RESOURCE Block.

Table 11.

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

Item	Element Name	Description
42	ACTUATOR_SN	Actuator Serial Number
43	ACTUATOR_SIZE	Actuator size
44	WIRING_DIAGRAM	Wiring diagram
45	ACTUATOR_TORQUE_EU	Torque EU
46	ACTUATOR_TORQUE_THRUST	Nominal Torque Thrust
47	ACTUATOR_SPEED_EU	Actuator speed EU
48	ACTUATOR_SPEED	Actuator speed
49	POWER_INFORMATIONS	Actuator power information
50	MOTOR_DATA	Motor data
51	ACTUATOR_ENCLOSURE	Actuator Enclosure
52	ACTUATOR_CERTIFICATE	Actuator certificate
53	ACTUATOR_LUBRICANT	Actuator lubricant
54	TEST_DATE	Test date
55	HW_VERSION	Base card HW revision
56	SW_VERSION	Base card SW revision
57	SW_PIC_VERSION	Base card Pic SW revision
58	ACTUATOR_TYPE	Actuator type
59	VALVE_SERIAL_NUMBER	Valve serial number
60	VALVE_TAG_NAME	Valve tag name
61	VALVE_MANUFACTURER	Valve manufacture's
62	BREAK_TO_OPEN_TRQ	Break to open torque
63	BREAK_STEAM_THRUST	Break steam thrust
64	VALVE_COUPLING_TYPE	Valve coupling type
65	FD_VER	Revision
66	FD_FAIL_ACTIVE	Fail Active
67	FD_OFFSPEC_ACTIVE	Offspec Active
68	FD_MAINT_ACTIVE	Maintenance Active
69	FD_CHECK_ACTIVE	Check Active
70	FD_FAIL_MAP	Fail Map
71	FD_OFFSPEC_MAP	Offspec Map
72	FD_MAINT_MAP	Maintenance Map
73	FD_CHECK_MAP	Check Map
74	FD_FAIL_MASK	Fail Mask
75	FD_OFFSPEC_MASK	Offspec Mask
76	FD_MAINT_MASK	Maintenance Mask
77	FD_CHECK_MASK	Check Mask
78	FD_FAIL_ALM	Diagnostic Alarm
79	FD_OFFSPEC_ALM	Offspec Alarm
80	FD_MAINT_ALM	Maintenance Alarm
81	FD_CHECK_ALM	Check Alarm
82	FD_FAIL_PRI	Fail Priority
83	FD_OFFSPEC_PRI	Offspec Priority
84	FD_MAINT_PRI	Maintenance Priority
85	FD_CHECK_PRI	Check Priority
86	FD_SIMULATE	Field Diagnostic Simulate
87	FD_RECOMMEN_ACT	Recommended Action
88	COMPATIBILITY_REV	Compatibility Revision

The explanation of the FOUNDATION™ Fieldbus specific parameters is in the FOUNDATION specific literature.

The FF2000v4 rev. 3 specific parameters are described here below:

42 ACTUATOR_SN

Type: STRING
Size: 28 octets
Handling: READ

It is the actuator serial number stored by the manufacturer in the nameplate data.

43 ACTUATOR_SIZE

Type: STRING
Size: 28 octets
Handling: READ

It is the actuator size stored by the manufacturer in the nameplate data.

44 WIRING_DIAGRAM

Type: STRING
Size: 28 octets
Handling: READ

It is the actuator wiring diagram stored by the manufacturer in the nameplate data.

45 ACTUATOR_TORQUE_EU

Type: ENUMERATED
Size: 1 octet
Handling: READ

It is the torque EU selected stored by the manufacturer in the nameplate data. It may assume the following values:

Table 12.

Enumeration	Description
0	Torque lbf
1	Torque Nm
2	Torque lb
3	Torque KNF

46 ACTUATOR_TORQUE_THRUST

Type: STRING
Size: 7 octets
Handling: READ

It is the actuator nominal torque / thrust stored by the manufacturer in the nameplate data.

47 ACTUATOR_SPEED_EU

Type: ENUMERATED
Size: 1 octet
Handling: READ

It is the actuator speed EU selected stored by the manufacturer in the nameplate data. It may assume the following values:

Table 13.

Enumeration	Description
0	Speed seconds/90°
1	Speed RPM
2	Speed mm/second
3	Speed in/second

48 ACTUATOR_SPEED

Type: STRING
Size: 7 octets
Handling: READ

It is the actuator speed stored by the manufacturer in the nameplate data.

49 POWER_INFORMATIONS

Type: RECORD
Size: 4 octets
Handling: READ

This data collects the parameters related to the nominal power supply.

Table 14.

Sub Index	Element Name	Description	Type	Meaning
1	POWER_TYPE	Main supply power type	ENUMERATED(1)	0 = Unknown 1 = AC 3 PH 2 = AC 1 PH 3 = DC
2	VOLTAGE	Main supply voltage	UNSIGNED16	Volt
3	FREQUENCY	Main supply frequency	ENUMERATED(1)	0 = Unknown 1 = 50 Hz 2 = 60 Hz

50 MOTOR_DATA

Type: RECORD
Size: 50 octets
Handling: READ

It is the motor data stored by the manufacturer in the nameplate data and composed of the following elements.

Table 15.

Sub Index	Element Name	Description	Type	Meaning
1	MOTOR_TYPE	Motor type	ENUMERATED(1)	0 = Unknown 1 = AC 3 PH 2 = AC 1 PH 3 = DC
2	MOTOR_RATING	Motor rating	UNSIGNED16	Watt
3	MOTOR_DUTY	Motor duty	ENUMERATED(1)	0 = Unknown 1 = S2 / 15 min. 2 = S4 / 25% / 60 str/h 3 = S4 / 25% / 200 str/h 4 = S4 / 25% / 600 str/h 5 = S4 / 25% / 1,200 str/h 6 = S4 / 25% / 3,600 str/h 7 = S9
4	MOTOR_CURRENT_IN	Motor current In	UNSIGNED16	Ampere
5	MOTOR_CURRENT_IS	Motor current Is	UNSIGNED16	Ampere
6	MOTOT_CURRENT_ICC	Motor current Icc	UNSIGNED16	Ampere
7	MOTOR_POLES	Motor poles	ENUMERATED(1)	0 = Unknown 1 = 2 poles 2 = 4 poles 3 = 6 poles 4 = 8 poles 5 = 10 poles 6 = 12 poles 7 = 14 poles 8 = 16 poles 9 = 18 poles 10 = 20 poles 11 = 22 poles 12 = 24 poles 13 = 26 poles 14 = 28 poles 15 = 30 poles 16 = 32 poles
8	MOTOR_GEAR_RATIO	Motor gear ratio	UNSIGNED16	pure number
9	MOTOR_CODE	Motor code	STRING (28)	

51 ACTUATOR_ENCLOSURE

Type: STRING
Size: 28 octets
Handling: READ

It is the actuator enclosure stored by the manufacturer in the nameplate data.

52 ACTUATOR_CERTIFICATE

Type: STRING
Size: 28 octets
Handling: READ

It is the actuator certificate stored by the manufacturer in the nameplate data.

53 ACTUATOR_LUBRICANT

Type: STRING
Size: 28 octets
Handling: READ

It is the actuator lubricant stored by the manufacturer in the nameplate data.

54 TEST_DATE

Type: DATE_AND_TIME
Size: 28 octets
Handling: READ

It is the date of the actuator factory commissioning stored by the manufacturer in the nameplate data.

55 HW_VERSION

Type: STRING
Size: 4 octets
Handling: READ

It is the actuator hardware revision stored by the manufacturer in the nameplate data.

56 SW_VERSION

Type: STRING
Size: 4 octets
Handling: READ

It is the actuator software revision stored by the manufacturer in the nameplate data.

57 SW_PIC_VERSION

Type: STRING
Size: 4 octets
Handling: READ

It is the actuator software pic revision stored by the manufacturer in the nameplate data.

58 ACTUATOR_TYPE

Type: ENUMERATED
Size: 1 octet
Handling: READ

It is the actuator type where the FF2000v4 rev. 3 module is plugged.

Table 16.

Enumeration	Description
0	Unknown
1	XTE3000
2	F01

59 VALVE_SERIAL_NUMBER

Type: STRING
Size: 28 octets
Handling: READ and WRITE

It is the valve serial number. This data may be modified by the user.

60 VALVE_TAG_NAME

Type: STRING
Size: 28 octets
Handling: READ and WRITE

It is the valve TAG name. This data may be modified by the user.

61 VALVE_MANUFACTURER

Type: STRING
Size: 28 octets
Handling: READ and WRITE

It is the valve manufacturer name. This data may be modified by the user.

62 BREAK_TO _OPEN_TRQ

Type: STRING
Size: 28 octets
Handling: READ and WRITE

It is the valve break to open torque. This data may be modified by the user.

63 BREAK_STEAM_THRUST

Type: STRING
Size: 28 octets
Handling: READ and WRITE

It is the valve break steam thrust. This data may be modified by the user.

64 VALVE_COUPLING_TYPE

Type: STRING
Size: 28 octets
Handling: READ and WRITE

It is the valve coupling type. This data may be modified by the user.

65 FD_VER

Type: Unsigned16
Size: 2 octets
Handling: READ

A parameter equal to the value of the major version of the Field Diagnostics specification that this device was designed to.

66 FD_FAIL_ACTIVE

Type: Bit String
Size: 4 octets
Handling: READ

This parameter reflects the error conditions that are being detected as active as selected for this category. It is a bit string, so that multiple conditions may be shown.

67 FD_OFFSPEC_ACTIVE

Type: Bit String
Size: 4 octets
Handling: READ

This parameter reflects the error conditions that are being detected as active as selected for this category. It is a bit string, so that multiple conditions may be shown.

68 FD_MAINT_ACTIVE

Type: Bit String
Size: 4 octets
Handling: READ

This parameter reflects the error conditions that are being detected as active as selected for this category. It is a bit string, so that multiple conditions may be shown.

69 FD_CHECK_ACTIVE

Type: Bit String
Size: 4 octets
Handling: READ

This parameter reflects the error conditions that are being detected as active as selected for this category. It is a bit string, so that multiple conditions may be shown.

70 FD_FAIL_MAP

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter maps conditions to be detected as active for this alarm category. Thus, the same condition may be active in all, some, or none of the 4 alarm categories.

71 FD_OFFSPEC_MAP

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter maps conditions to be detected as active for this alarm category. Thus, the same condition may be active in all, some, or none of the 4 alarm categories.

72 FD_MAINT_MAP

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter maps conditions to be detected as active for this alarm category. Thus, the same condition may be active in all, some, or none of the 4 alarm categories.

73 FD_CHECK_MAP

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter maps conditions to be detected as active for this alarm category. Thus, the same condition may be active in all, some, or none of the 4 alarm categories.

74 FD_FAIL_MASK

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter allows the user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask i.e. inhibit the broadcast of a condition, and a bit equal to '0' will unmask i.e. allow broadcast of a condition.

75 FD_OFFSPEC_MASK

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter allows the user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask i.e. inhibit the broadcast of a condition, and a bit equal to '0' will unmask i.e. allow broadcast of a condition.

76 FD_MAINT_MASK

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter allows the user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask i.e. inhibit the broadcast of a condition, and a bit equal to '0' will unmask i.e. allow broadcast of a condition.

77 FD_CHECK_MASK

Type: Bit String
Size: 4 octets
Handling: READ and WRITE

This parameter allows the user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask i.e. inhibit the broadcast of a condition, and a bit equal to '0' will unmask i.e. allow broadcast of a condition.

78 FD_FAIL_ALM

Type: DS-87
Size: 15 octets
Handling: READ and WRITE

This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.

79 FD_OFFSPEC_ALM

Type: DS-87
Size: 15 octets
Handling: READ and WRITE

This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.

80 FD_MAINT_ALM

Type: DS-87
Size: 15 octets
Handling: READ and WRITE

This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.

81 FD_CHECK_ALM

Type: DS-87
Size: 15 octets
Handling: READ and WRITE

This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.

82 FD_FAIL_PRI

Type: Unsigned8
Size: 1 octet
Handling: READ and WRITE

This parameter allows the user to specify the priority of this alarm category.

83 FD_OFFSPEC_PRI

Type: Unsigned8
Size: 1 octet
Handling: READ and WRITE

This parameter allows the user to specify the priority of this alarm category.

84 FD_MAINT_PRI

Type: Unsigned8
Size: 1 octet
Handling: READ and WRITE

This parameter allows the user to specify the priority of this alarm category.

85 FD_CHECK_PRI

Type: Unsigned8
Size: 1 octet
Handling: READ and WRITE

This parameter allows the user to specify the priority of this alarm category.

86 FD_SIMULATE

Type: DS-89
Size: 9 octets
Handling: READ and WRITE

This parameter allows the conditions to be manually supplied when simulation is enabled. When simulation is disabled both the diagnostic simulate value and the diagnostic value track the actual conditions. The simulate jumper is required for simulation to be enabled and while simulation is enabled the recommended action will show that simulation is active.

87 FD_RECOMMEN_ACT

Type: Unsigned16
Size: 2 octets
Handling: READ

This parameter is a device enumerated summarization of the most severe condition or conditions detected. The DD help should describe by enumerated action, what should be done to alleviate the condition or conditions. 0 is defined as Not Initialized, 1 is defined as No Action Required, all others can be viewed in FD CONDITIONS TABLE.

88 FD_RECOMMEN_ACT

Type: Unsigned8
Size: 1 octet
Handling: READ

This parameter is optionally used when replacing field devices. The correct usage of this parameter presumes the COMPATIBILITY_REV value of the replacing device should be equal or lower than the DEV_REV value of the replaced device. The compatibility is determined in regards to older DD revision(s).

7.1 Transducer Blocks

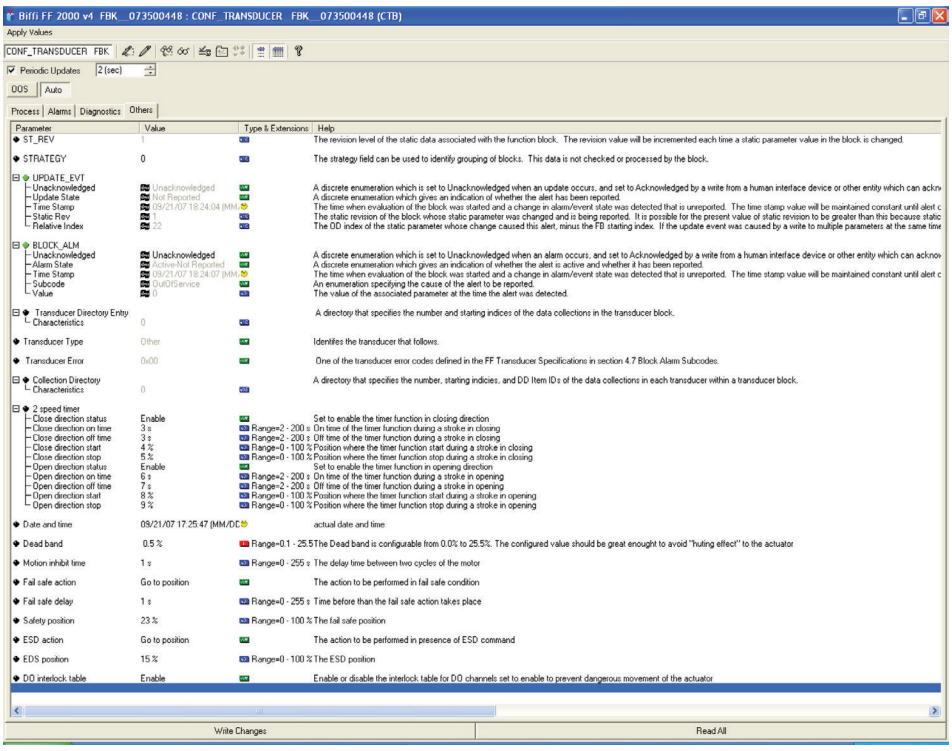
The Transducer Block defines the connection among the Function Blocks and the physical input and output functions of the actuator. The data in the Transducer Block are transmitted to the network when the actuator receives a Pass Token.

To organize in a clear defined way the large number of events, the FF2000v4 rev. 3 uses three (3) Transducer Blocks:

- Input Output Transducer (IO_TB) contains the discrete events that are process related.
- Maintenance Transducer (MAINT_TB) contains the analog events that are process related.
- Configuration Transducer (CONF_TB) contains all parameters about actuator Maintenance and Configuration.

Each parameter in the Transducer Blocks is fully described and the relevant data are shown by a Configuration Tool: Figure 19 shows Transducer Block content as seen by NI-FBUS, National Instruments Configuration Tool:

Figure 19



7.1.1 Input Output Transducer Block

See Table 17 for the list of elements that are currently in the Input Output TB.

Table 17.

Item	Element Name	Description
1	ST_REV	FF specific parameter
2	TAG_DESC	FF specific parameter
3	STRATEGY	FF specific parameter
4	ALERT_KEY	FF specific parameter
5	MODE_BLK	FF specific parameter
6	BLOCK_ERR	FF specific parameter
7	UPDATE_EVT	FF specific parameter
8	BLOCK_ALM	FF specific parameter
9	TRANSDUCER_DIRECTORY	FF specific parameter
10	TRANSDUCR_TYPE	FF specific parameter
11	XD_ERROR	FF specific parameter
12	COLLECTION_DIRECTORY	FF specific parameter
13	TOTAL_NOT_OPER_STATUS	Describe the totally nonoperational status of actuator.
14	PART_NOT_OPER_STATUS	Describe the partially nonoperational status of actuator.
15	OPERATIONAL_STATUS	Describe operational status of actuator.
16	DIAGNOSTIC_DATA	Describe the diagnostic of actuator.
17	MASK_TOTAL_NOT_OPER	Set the bits (conditions) that you wish use to generate the value of MSK_DIAG_STATUS channel. You must also check MASK PART_OPER_STAT and MASK DIAGNOSTIC.
18	MASK_PART_NOT_OPER	Set the bits (conditions) that you wish use to generate the value of MSK_DIAG_STATUS channel. You must also check MASK TOT_INOPER_STAT andnMASK DIAGNOSTIC.
19	MASK_OPERATIONAL	Set the bits (conditions) that you wish use to generate the value of MSK_OPER_STATUS channel.
20	MASK_DIAGNOSTIC	Set the bits (conditions) that you wish use to generate the value of MSK_DIAG_STATUS channel. You must also check MASK TOT_INOPER_STAT and MASK PART_OPER_STAT.
21	TORQUE	Current torque
22	POSITION	Current Position
23	COMMANDS_READ	Current discrete commands active
24	SETPOINT_READ	Current setpoint request

The explanation of the FOUNDATION™ Fieldbus specific parameters is in the FOUNDATION specific literature.

The FF2000v4 rev. 3 specific parameters are described here below:

13 TOTAL_NOT_OPER_STATUS

Type: BIT_ENUMERATED
Size: 2 octets
Handling: READ

When this parameter is set, the actuator is not available for control neither from Fieldbus FOUNDATION™ interface nor for electrical operations due to one or more of the following conditions. Only manual operation by handwheel should be possible.

Table 18.

Value	Element Name	Description
0x8000	Extremely High or Low internal temperature	Temperature inside the actuator enclosure is greater than 90 °C or lower than –40 °C.
0x4000	Configuration error	The checksum of the EEPOM memory that contains the configuration data is wrong.
0x2000	Extremely High or Low main supply	Main voltage is ±20% exceeding the value stated in nameplate menu or the frequency is wrong.
0x1000	Lost phase	Only for 3-phase main supply: The alarm is generated in case of fault of the phase that does not supply the actuator transformer.
0x0800	Power supply failure	Power supply failure
0x0400	Speed sensor failure	Measure of motor speed not valid.
0x0200	Position sensor failure	The value of the actuator position is not valid.
0x0100	Hardware failure	The diagnostic program detects some malfunction in the electronic that control the actuator.
0x0080	Alarm extended 1	Future use
0x0040	Alarm extended 2	Future use
0x0020	Alarm extended 3	Future use
0x0010	Alarm extended 4	Future use

14 PART_NOT_OPER_STATUS

Type: BIT_ENUMERATED
Size: 4 octets
Handling: READ

The actuator may execute a subset of electric operation due to temporary condition or other Operator Interfaces may have been activated.

Table 19.

Value	Element Name	Description
0x80000000	Manual operation	Manual operation in progress by handwheel.
0x40000000	NAK motherboard	Failure in communication between the base card and the bus card.
0x20000000	Local selector in LOCAL	Local selector on LOCAL position: local commands enabled.
0x10000000	Local selector in OFF	Local selector on OFF position: neither local nor remote commands enabled.
0x08000000	Remote hardwired active	Local selector on REMOTE position and Hardwired commands enabled.
0x04000000	Local stop active	Local STOP has been activated while remote commands were in progress.
0x02000000	ESD active	ESD operation in progress.
0x01000000	Interlock open active	Open Interlock operation in progress.
0x00800000	Interlock close active	Close Interlock operation in progress.

Value	Element Name	Description
0x00400000	Extremely high torque in opening	Measured torque greater than the relevant value configured in torque setup or stroke limits routine.
0x00200000	Extremely high torque in closing	Measured torque grater than the relevant value configured in torque set-up or stroke limits routine.
0x00100000	Jammed valve in opening	No position change after receiving an Open control
0x00080000	Jammed valve in closing	No position change after receiving a Close control.
0x00040000	Motor thermostat alarm	Motor thermostat open for high temperature in the motor windings.
0x00020000	Mid-travel alarm OP	The valve does not move in presence of an open control.
0x00010000	Mid travel alarm CL	The valve does not move in presence of a close control.
0x00008000	K1 contactor failure	The test routine reports a failure of K1 (coil or auxiliary contact).
0x00004000	K2 contactor failure	The test routine reports a failure of K2 (coil or auxiliary contact).
0x00002000	Alarm extended 5	EFS mid-travel alarm (available only in EFS actuator)
0x00001000	Alarm extended 6	Future use
0x00000800	Alarm extended 7	Future use
0x00000400	Alarm extended 8	Future use

15 OPERATIONAL_STATUS

Type: BIT_ENUMERATED
Size: 4 octets
Handling: READ

The actuator is fully operational from the fieldbus interface. Details about the current status are available in the following elements:

Table 20.

Value	Element Name	Description
0x80000000	Positioner active	The actuator is ready to follow the setpoint from the bus.
0x40000000	Opened	Valve in fully open position.
0x20000000	Closed	Valve in fully close position.
0x10000000	Position < = XX%	Valve position less than or equal to a predefined trigger 'xx'.
0x08000000	Position > = YY%	Valve position greater than or equal to a predefined trigger 'yy'.
0x04000000	Valve in opening	Actuator is moving in open direction.
0x02000000	Valve in closing	Actuator is moving in closing direction.
0x01000000	Motion inhibited	In On/Off service: Set during the Off period when Timer function is active. In Modulating service: Set during the delay time before next positioning.
0x00800000	Open Available	Open travelling available
0x00400000	Close Available	Close travelling available
0x00200000	Selector in Remote	Local selector on REMOTE position: commands from bus enabled
0x00100000	Monitor relay ON	Monitor Relay Status: actuator available for the remote control
0x00080000	HW open command active	Physical status of the Digital Input #1: Hardwired Open Command
0x00040000	HW close command active	Physical status of the Digital Input #2: Hardwired Close Command
0x00020000	HW stop command active	Physical status of the Digital Input #3: Hardwired Stop Command
0x00010000	HW enabled	Physical status of the Digital Input #4: Hardwired Enabled
0x00008000	Configuration mode	Configuration mode active
0x00004000	Low alc. battery	Low alkaline battery

16 DIAGNOSTIC_DATA

Type: BIT_ENUMERATED
Size: 2 octets
Handling: READ

The diagnostic information collects the following elements:

Table 21.

Value	Element Name	Description
0x8000	High or Low main supply	Main voltage out of the correct range (-15% or +10% of the value stated in the nameplate menu) or wrong frequency.
0x4000	Wrong stroke limits	The routine that monitors the stroke limits detect a wrong end of travel condition.
0x2000	High torque in Opening	Measured torque 10% lower than the relevant value configured in torque setup or stroke limit routine.
0x1000	High torque in Closing	Measured torque 10% lower than the relevant value configured in torque setup or stroke limit routine.
0x0800	Max. contactor cycles	Maximum number of contactor cycles reached.
0x0400	High or Low internal temperature	Temperature inside the actuator enclosure higher than 90 °C or lower than –35 °C.
0x0200	Motor current	Motor current greater or lower than limits.
0x0100	Maintenance request	Date of the next programmed maintenance reached.
0x0080	Warning extended 1	T-PST value failed
0x0040	Warning extended 2	T-RET value failed
0x0020	Warning extended 3	OV-TR value failed
0x0010	Warning extended 4	PST cycle aborted

17 MASK_TOTAL_NOT_OPER

Type: BIT_ENUMERATED
Size: 2 octets
Handling: READ and STATIC WRITE
Default value: 0x0000

This parameter is a mask to create the value of DI channel 32 “Maskable diagnostic status”. Set the bit of TOTAL_NOT_OPER_STATUS that you want to affect the result of channel 32.

18 MASK_PART_NOT_OPER

Type: BIT_ENUMERATED
Size: 4 octets
Handling: READ and STATIC WRITE
Default value: 0x00000000

This parameter is a mask to create the value of DI channel 32 “Maskable diagnostic status”. Set the bit of PART_NOT_OPER_STATUS that you want to affect the result of channel 32.

19 MASK_OPERATIONAL

Type: BIT_ENUMERATED
Size: 4 octets
Handling: READ and STATIC WRITE
Default value: 0x00000000

This parameter is a mask to create the value of DI channel 33 “Maskable operational status”. Set the bit of OPERATIONAL_STATUS that you want to affect the result of channel 33.

20 MASK_DIAGNOSTIC

Type: BIT_ENUMERATED
Size: 2 octets
Handling: READ and STATIC WRITE
Default value: 0x0000

This parameter is a mask to create the value of DI channel 32 “Maskable diagnostic status”. Set the bit of DIAGNOSTIC_DATA that you want to affect the result of channel 32.

21 TORQUE

Type: FLOAT and STATUS
Size: 5 octets
Handling: READ

It is the current torque.

22 POSTION

Type: FLOAT and STATUS
Size: 5 octets
Handling: READ

It is the current position of the valve.

23 COMMANDS_READ

Type: BIT_ENUMERATED
Size: 2 octets
Handling: READ

The list of the current command active to the actuator.

Table 22.

Value	Element Name	Description
0x8000	Enable setpoint	The setpoint is active with precedence.
0x4000	Open	Open command
0x2000	Close	Close command
0x1000	Stop	Stop command
0x0800	ESD command	ESD command
0x0400	Close interlock	Close interlock command
0x0200	Open interlock	Open interlock command
0x0080	clear recent data log	Clear recent data log command
0x0040	Set torque reference	Set torque reference command

24 SETPOINT_READ

Type: FLOAT and STATUS
Size: 5 octets
Handling: READ

It is the current setpoint applied to the valve.

7.1.2 Configuration Transducer Block

See Table 23 for the list of elements that are currently in the Configuration TB.

Table 23.

Item	Element Name	Description
1	ST_REV	FF specific parameter
2	TAG_DESC	FF specific parameter
3	STRATEGY	FF specific parameter
4	ALERT_KEY	FF specific parameter
5	MODE_BLK	FF specific parameter
6	BLOCK_ERR	FF specific parameter
7	UPDATE_EVT	FF specific parameter
8	BLOCK_ALM	FF specific parameter
9	TRANSDUCER_DIRECTORY	FF specific parameter
10	TRANSDUCR_TYPE	FF specific parameter
11	XD_ERROR	FF specific parameter
12	COLLECTION_DIRECTORY	FF specific parameter
13	TWO_SPEED_TIMER	2 speed timer configuration parameters
14	ACT_DATE_AND_TIME	Actual date and time
15	DEAD_BAND	Dead band
16	POS_MOT_IN_TIMER	Delay timer after positioning
17	SAFETY_BEHAVIOUR	Safety behaviour in case of loss communication with the fieldbus interface.
18	DELAY_SAFE_OPERATION	Delay before the safe action.
19	SAFETY_POSITION	Safety position
20	ESD_ACTION	ESD action
21	ESD_POSITION	ESD position
22	DO_INTERLOCK_TABLE	Enable and disable the interlock table.

The explanation of the FOUNDATION™ Fieldbus specific parameters is in the FOUNDATION specific literature.

The FF2000v4 rev. 3 specific parameters are described here below:

13 TWO_SPEED_TIMER

Type: RECORD
Size: 10 octets
Handling: READ and STATIC WRITE

This data collects the parameters related to the Timer function.

Table 24.

Sub Index	Element Name	Description	Type	Val. min	Val. max	Meaning
1	CLOSE_DIR_STATUS	Set to enable the Timer function in closing direction.	ENUMERATED(1)	0	1	0: Off 1: On
2	CLOSE_ON_TIME	Position where the Timer function start during a stroke in closing.	UNSIGNED8	2	200	seconds
3	CLOSE_OFF_TIME	Position where the Timer function stop during a stroke in closing.	UNSIGNED8	2	200	seconds
4	CLOSE_START_PO	Position where the Timer function start during a stroke in closing.	UNSIGNED8	0	100	%
5	CLOSE_STOP_POS	Position where the Timer function stop during a stroke in closing.	UNSIGNED8	0	100	%
6	OPEN_DIR_STATUS	Set to enable the Timer function in opening direction.	ENUMERATED(1)	0	1	0: Off 1: On
7	OPEN_ON_TIME	Position where the Timer function stop during a stroke in opening.	UNSIGNED8	2	200	seconds
8	OPEN_OFF_TIME	On time of the Timer function during a stroke in opening.	UNSIGNED8	2	200	seconds
9	OPEN_START_POS	Position where the Timer function start during a stroke in opening.	UNSIGNED8	0	100	%
10	OPEN_STOP_POS	Position where the Timer function stop during a stroke in opening.	UNSIGNED8	0	100	%

14 ACT_DATE_AND_TIME

Type: DATE_AND_TIME
Size: 7 octets
Handling: READ AND STATIC WRITE

This parameter allows to set in the actuator the current date and time. This is useful to have a common time reference to associate the diagnostic events stored in the Alarm and Warning log.

15 DEAD_BAND

Type: FLOAT
Size: 4 octets
Handling: READ and STATIC WRITE
Range: 0.1 – 25.5
Unit: %

The Dead band is configurable from 0.1% to 25.5%. The configured value should be great enough to avoid “hunting” effect of the actuator.

16 POS_MOT_IN_TIMER

Type: UNSIGNED8
Size: 1 octet
Handling: READ and STATIC WRITE
Range: 0 – 255
Unit: second

Motion inhibit time: it allows to adjust the length of the delay time between two cycles of the motor. It can be configured from 0 to 255 seconds and allows to set the maximum number of start per hour of the electrical motor.

17 SAFETY_BEHAVIOUR

Type: ENUMERATED
Size: 1 octet
Handling: READ and STATIC WRITE

This parameter defined the action to run in case of loss of communication with the fieldbus interface card or if an output FB is set to OOS or has been removed from the FB schedule. The possible actions are the following:

Table 25.

Enumeration	Description
0	Off: function disabled
1	Close
2	Open
3	Stayput
4	Go to position

18 DELAY_SAFE_OPERATION

Type: UNSIGNED8
Size: 1 octet
Handling: READ and STATIC WRITE
Range: 0 – 255
Unit: second

This parameter is configured from 0 to 255 seconds and defines the delay before run the safety behaviour programmed in SAFETY_BEHAVIOUR.

19 SAFETY_POSITION

Type: FLOAT
Size: 4 octets
Handling: READ and STATIC WRITE
Range: 0.0 – 100.0
Unit: %

It is the position to drive the actuator when the SAFETY_BEHAVIOUR is programmed to 'Go to position' (= 4).

20 ESD_ACTION

Type: ENUMERATED
Size: 1 octet
Handling: READ and STATIC WRITE

This parameter defined the action to run in case of an ESD command. The possible actions are the following:

Table 26.

Enumeration	Description
0	Off: function disabled
1	Close
2	Open
3	Stayput
4	Go to position

21 ESD_POSITION

Type: FLOAT
Size: 4 octets
Handling: READ and STATIC WRITE
Range: 0.0 – 100.0
Unit: %

It is the position to drive the actuator when the ESD_ACTION is programmed to 'Go to position' (= 4).

22 DO_INTERLOCK_TABLE

Type: ENUMERATED
Size: 1 octet
Handling: READ and STATIC WRITE
Default value: 0

This parameter is a legacy from previous version of this interface.

The changing of this parameter does not have effect. In this version. The DO Interlock table must be carefully checked by host programmer to avoid unexpected stroke of actuator.

The possible actions are the following:

Table 27.

Enumeration	Description
0	Disabled
1	Enabled

7.1.3 Maintenance Transducer Block

See Table 28 for the list of elements that are currently in the Maintenance TB.

Table 28.

Item	Element Name	Description
1	ST_REV	FF specific parameter
2	TAG_DESC	FF specific parameter
3	STRATEGY	FF specific parameter
4	ALERT_KEY	FF specific parameter
5	MODE_BLK	FF specific parameter
6	BLOCK_ERR	FF specific parameter
7	UPDATE_EVT	FF specific parameter
8	BLOCK_ALM	FF specific parameter
9	TRANSDUCER_DIRECTORY	FF specific parameter
10	TRANSDUCR_TYPE	FF specific parameter
11	XD_ERROR	FF specific parameter
12	COLLECTION_DIRECTORY	FF specific parameter
13	ALARM_1	Last alarm occurred
14	ALARM_2	Last -1 alarm occurred
15	ALARM_3	Last -2 alarm occurred
16	ALARM_4	Last -3 alarm occurred
17	ALARM_5	Last -4 alarm occurred
18	WARNING_1	Last warning occurred
19	WARNING_2	Last -1 warning occurred
20	WARNING_3	Last -2 warning occurred
21	WARNING_4	Last -3 warning occurred
22	WARNING_5	Last -4 warning occurred
23	REF_CL_TRQ_CURVE_CONDITIONS	Reference close torque curve
24	REF_CL_TRQ_CURVE_DATA	The curve samples
25	REF_OP_TRQ_CURVE_CONDITIONS	Reference open torque curve
26	REF_OP_TRQ_CURVE_DATA	The curve samples
27	LAST_CL_TRQ_CURVE_CONDITIONS	Last close torque curve
28	LAST_CL_TRQ_CURVE_DATA	The curve samples
29	LAST_OP_TRQ_CURVE_CONDITIONS	Last open torque curve
30	LAST_OP_TRQ_CURVE_DATA	The curve samples
31	TORQUE_PROFILE	The torque profile data
32	OPERATION_LOG	Actuator Log data
33	MAINTENANCE_DATE	Maintenance information data
34	MOTOR_TEMPERATURE	Actual motor temperature
35	SET_TORQUE_REFERENCE	Set torque reference in torque profile
36	CLEAR_RECENT_DATA_LOG	Reset the counters related to the recent data in actuator LOG
37	SET_SIGNATURE	Set the last torque curve as signature

The explanation of the FOUNDATION™ Fieldbus specific parameters is in the FOUNDATION specific literature.

The FF2000v4 rev. 3 specific parameters are described here below:

13 ALARM_1

14 ALARM_2

15 ALARM_3

16 ALARM_4

17 ALARM_5

Type: RECORD
Size: 8 octets
Handling: READ

Table 29.

Sub Index	Element Name	Description	Type
1	DATE_TIME	Date and time of the alarm	DATE_AND_TIME
2	ALARM_CODE	Error code of the alarm	UNSIGNED8

This set of parameters is a structure that stores the last five alarms which occurred in the actuator together with the date and the time of the faults. The Alarm_1 is the newest and the Alarm_5 is the oldest.

This structure allows reporting to the fieldbus interface the alarms happened while the fieldbus was not active.

Table 30.

	Element Name	Description
ALARM_ 1	DATE	Date of the alarm in position #1
	TIME	Time of the alarm in position #1
	ERROR CODE	Error code of the alarm in position #1
ALARM_ 2	DATE	Date of the alarm in position #2
	TIME	Time of the alarm in position #2
	ERROR CODE	Error code of the alarm in position #2
ALARM_ 3	DATE	Date of the alarm in position #3
	TIME	Time of the alarm in position #3
	ERROR CODE	Error code of the alarm in position #3
ALARM_ 4	DATE	Date of the alarm in position #4
	TIME	Time of the alarm in position #4
	ERROR CODE	Error code of the alarm in position #4
ALARM _5	DATE	Date of the alarm in position #5
	TIME	Time of the alarm in position #5
	ERROR CODE	Error code of the alarm in position #5

The alarm codes have the following meanings:

Table 31.

Error Code	Element Name	Description
0	No error	
1	Configuration	The checksum of the EEPROM memory that contains the configuration data is wrong.
2	Motor thermostat	Motor thermostat open for high temperature in the motor winding.
3	Internal temperature	Temperature inside the actuator enclosure higher than 90 °C or lower than –40 °C.
4	Low battery	The voltage of the alkaline battery is too low (Only detected if the alkaline battery is present and the relevant parameter of the miscellaneous routine is set to 'Present').
5	High torque in closing	Measured torque greater than the relevant value configured in torque setup or stroke limit routine.
6	High torque in opening	Measured torque greater than the relevant value configured in torque setup or stroke limit routine.
7	Jammed in closing	No position change after receiving a Close control .
8	Jammed in opening	No position change after receiving an Open control .
9	Position sensor	Value of the actuator position is not valid.
10	Speed sensor	Measure of motor speed is not valid.
11	Main supply	Main voltage lower than –20% or higher than +20% of the value stated in the nameplate menu or wrong frequency.
12	Lost phase	Only with 3-phase main supply: the alarm is generated in case of fault of one of the phases that supply the actuator.
13	K1 contactor	The test routine reports a failure of the contactor marked K1.
14	K2 contactor	The test routine reports a failure of the contactor marked K2.
15	Mid travel alarm in closing	The actuator stops to move in presence of a Close control .
16	Mid travel alarm in opening	The actuator stops to move in presence of a Close control .
17	Hardware 1	The diagnostic program detects some malfunction in the electronics controlling the actuator.
18	Request signal	The 4 - 20 mA signal of position request is not present (Only detected if the positioner function is present).
19	Direction	Direction test (solo F01)
20	Hardware 2	HW 2 = configuration of Ain/Aout card
21	Hardware 3	HW 3 = 4 - 20 mA non comunica (esce anche nel caso di morsettiera vecchia 8 rele / 4 - 20 mA non comunicante)
22	Hardware 4	HW 4 = configuration of terminal board
23	Hardware 5	HW5 = no communication terminal board
24	Hardware 6	HW6 = wrong configuration XTE / F01
25	Hardware 7	HW7 = wrong configuration of bus card type
26	Hardware 8	HW8 = no communication between base and bus card (only protocol I24)

18 WARNING_1

19 WARNING_2

20 WARNING_3

21 WARNING_4

22 WARNING_5

Type: RECORD
Size: 8 octets
Handling: READ

Table 32.

Sub Index	Element Name	Description	Type
1	DATE_TIME	Date and time of the warning	DATE_AND_TIME
2	WARNING_CODE	Error code of the warning	UNSIGNED8

This set of parameters is a structure that stores the five last warnings happened in the actuator together with the date and the time of the faults; The Warning_1 is the newest and the Warning_5 is the oldest.

This structure allows to report to the fieldbus interface the warning happened while the fieldbus was not active.

Table 33.

	Element Name	Description
WARNING_LOG_1	DATE	Date of the warning in position #1
	TIME	Time of the warning in position #1
	ERROR CODE	Error code of the warning in position #1
WARNING_LOG_2	DATE	Date of the warning in position #2
	TIME	Time of the warning in position #2
	ERROR CODE	Error code of the warning in position #2
WARNING_LOG_3	DATE	Date of the warning in position #3
	TIME	Time of the warning in position #3
	ERROR CODE	Error code of the warning in position #3
WARNING_LOG_4	DATE	Date of the warning in position #4
	TIME	Time of the warning in position #4
	ERROR CODE	Error code of the warning in position #4
WARNING_LOG_5	DATE	Date of the warning in position #5
	TIME	Time of the warning in position #5
	ERROR CODE	Error code of the warning in position #5

The warning codes have the following meanings:

Table 34.

Error Code	Element Name	Description
0	No error	
1	High torque in opening near max.	Measured torque 10% lower than the relevant value configured in torque setup or stroke limit routine.
2	High torque in closing near max.	Measured torque 10% lower than the relevant value configured in torque setup or stroke limit routine.
3	Internal temperature near limits	Temperature inside the actuator enclosure higher than 90 °C or lower than –35 °C.
4	Main voltage near limits	Main voltage out of the correct range (-15% or +10% of the value stated in the nameplate menu) or wrong frequency.
5	Maximum contactor cycles	Maximum number of contactor cycles reached.
6	Maintenance request	Date of the next programmed maintenance reached.
7	Motor current	Motor current greater or lower than limits.
8	Wrong stroke limits	The routine that monitors the stroke limits detect a wrong end of travel condition.
9	Bus error	The communication over the fieldbus is no longer active.

23 REF_CL_TRQ_CURVE_CONDITIONS

Type: RECORD
Size: 14 octets
Handling: READ

This parameter collects all the condition (date, time, temperature, voltage and duration) of the reference torque curve in closing.

Table 35.

Sub Index	Element Name	Description	Type
1	DATE_TIME	Date and time of valve stroke	DATE_AND_TIME
2	ELETTR_TEMP	Temperature inside the electronics compartment during the valve stroke	SIGNED8
3	TERM_TEMP	Temperature inside the terminal board compartment during the valve stroke	SIGNED8
4	MOTOR_TEMP	Temperature of the electrical motor during the valve stroke	SIGNED8
5	MAIN_VOLTAGE	Main voltage supply during the valve stroke	UNSIGNED16
6	CL_TRAVEL_TIME	Duration of movement	UNSIGNED16

24 REF_CL_TRQ_CURVE_DATA

Type: ARRAY of UNSIGNED8
Size: 101 octets
Handling: READ

This parameter collects all the samples of torque during the reference closing valve stroke (torque VS position 1% step).

25 REF_OP_TRQ_CURVE_CONDITIONS

Type: RECORD
Size: 14 octets
Handling: READ

This parameter collects all the condition (date, time, temperature, voltage and duration) of the reference torque curve in opening.

26 REF_OP_TRQ_CURVE_DATA

Type: ARRAY of UNSIGNED8
Size: 101 octets
Handling: READ

This parameter collects all the samples of torque during the reference opening valve stroke (torque VS position 1% step).

27 LAST_CL_TRQ_CURVE_CONDITIONS

Type: RECORD
Size: 14 octets
Handling: READ

This parameter collects all the condition (date, time, temperature, voltage and duration) of the reference torque curve in closing.

28 LAST_CL_TRQ_CURVE_DATA

Type: ARRAY of UNSIGNED8
Size: 101 octets
Handling: READ

This parameter collects all the samples of torque during the reference closing valve stroke (torque VS position 1% step).

29 LAST_OP_TRQ_CURVE_CONDITIONS

Type: RECORD
Size: 14 octets
Handling: READ

This parameter collects all the condition (date, time, temperature, voltage and duration) of the reference torque curve in opening.

30 LAST_OP_TRQ_CURVE_DATA

Type: ARRAY of UNSIGNED8
Size: 101 octets
Handling: READ

This parameter collects all the samples of torque during the reference opening valve stroke (torque VS position 1% step).

31 TORQUE_PROFILE

Type: RECORD
Size: 40 octets
Handling: READ

The torque profile collects information about the actuator working condition in comparison with a previously memorized reference profile. It gives important indication of the changes in the process condition.

Table 36.

Sub Index	Element Name	Description	Type
1	CLOSING_BREAKOUT	Breakout torque in closing of the last full stroke	UNSIGNED8
2	CLOSING_BREAKOUT_REF	Breakout reference torque in closing	UNSIGNED8
3	CLOSING_PEAK_RUN	Peak torque in closing of the last full stroke	UNSIGNED8
4	CLOSING_PEAK_RUN_REF	Peak reference torque in closing	UNSIGNED8
5	CLOSING_ENDING	Ending torque in closing of the last full stroke	UNSIGNED8
6	CLOSING_ENDING_REF	Ending reference torque in closing	UNSIGNED8
7	DATE_LAST_CLOSING	Date of the last torque profile in closing	UNSIGNED8
8	DATE_REF_CLOSING	Date of the last set of the torque profile reference in closing	UNSIGNED8
9	OPENING_BREAKOUT	Breakout torque in opening of the last full stroke	UNSIGNED8
10	OPENING_BREAKOUT_REF	Peak torque in opening of the last full stroke	UNSIGNED8
11	OPENING_PEAK_RUN	Ending torque in opening of the last full stroke	UNSIGNED8
12	OPENING_PEAK_RUN_REF	Breakout reference torque in opening	UNSIGNED8
13	OPENING_ENDING	Peak reference torque in opening	DATE_AND_TIME
14	OPENING_ENDING_REF	Ending reference torque in opening	DATE_AND_TIME
15	DATE_LAST_OPENING	Date of the last torque profile in opening	DATE_AND_TIME
16	DATE_REF_OPENING	Date of the last set of the torque profile reference in opening	DATE_AND_TIME

32 OPERATION_LOG

Type: RECORD
Size: 58 octets
Handling: READ

The operation log collects a set of different counters and routines that provide information to assist in the maintenance program. The data are grouped into two families: general and recent data; the general data log collects data since the actuator test date in the factory; the recent data log collects data since the last operation of CLEAR_DATA_LOG.

Table 37.

Sub Index	Element Name	Description	Type
1	OPENING_TIME	Duration of the last stroke in opening	DURATION(6)
2	CLOSING_TIME	Duration of the last stroke in closing	DURATION(6)
3	GEN_CONTACTOR_CYCLE	Total contactor cycle	UNSIGNED32
4	GEN_MOTOR_RUN_TIME	Total motor run time	UNSIGNED32
5	GEN_NO_POW_TIME	Total time without electrical power	UNSIGNED32
6	GEN_UTILIZATION_RATE	Utilization rate	UNSIGNED16
7	GEN_ELETT_TEMP_MIN	Minimum electronic card temperature	SIGNED8
8	GEN_ELETT_TEMP_MAX	Maximum electronic card temperature	SIGNED8
9	GEN_TERM_TEMP_MIN	Minimum terminal board temperature	SIGNED8
10	GEN_TERM_TEMP_MAX	Maximum terminal board temperature	SIGNED8
11	GEN_MOTOR_TEMP_MAX	Maximum motor temperature	SIGNED8
12	GEN_TERMOSTAT_ALARMS	Thermostat alarms	UNSIGNED16
13	GEN_TORQUE_ALARMS,	Torque alarms	UNSIGNED16
14	REC_CONTACTOR_CYCLE	Recent contactor cycle	UNSIGNED32
15	REC_MOTOR_RUN_TIME	Recent motor run time	UNSIGNED32
16	REC_NO_POW_TIME	Recent time without electrical power	UNSIGNED32
17	REC_UTILIZATION_RATE	Recent Utilization rate	UNSIGNED16
18	REC_ELETT_TEMP_MIN	Minimum electronic card temperature	SIGNED8
19	REC_ELETT_TEMP_MAX	Maximum electronic card temperature	SIGNED8
20	REC_TERM_TEMP_MIN	Minimum terminal board temperature	SIGNED8
21	REC_TERM_TEMP_MAX	Maximum terminal board temperature	SIGNED8
22	REC_MOTOR_TEMP_MAX	Maximum motor temperature	SIGNED8
23	REC_TERMOSTAT_ALARMS	Thermostat alarms	UNSIGNED16
24	REC_TORQUE_ALARMS	Torque alarms	UNSIGNED16

33 MAINTENANCE_DATE

Type: RECORD
Size: 28 octets
Handling: READ and WRITE

The maintenance date information collects the dates of some maintenance operations executed on the actuator.

Table 38.

Sub Index	Element Name	Description	Type
1	LAST_DATE	Date of the last maintenance operation in the field	DATE_AND_TIME
2	NEXT_DATE	Programmed date of the next maintenance operation	DATE_AND_TIME
3	START_UP_DATE	Date of the startup of the actuator in the plant during the commissioning	DATE_AND_TIME
4	RECENT_LOG_DATE	Date of the last 'Clear recent data log' operation (ONLY READ)	DATE_AND_TIME

34 MOTOR_TEMPERATURE

Type: SIGNED8
Size: 1 octet
Handling: READ

It is the current temperature of the motor. The motor temperature sensor is mounted upon order.

35 SET_TORQUE_REFERENCE

Type: BOOLEAN
Size: 1 octet
Handling: WRITE
Default value: FALSE

The setting of this parameter allows to transfer the last torque profiles in the reference profile registers of TORQUE_PROFILE. The old reference data are lost and the new ones are used as new reference torque profile.

36 CLEAR_RECENT_DATA_LOG

Type: BOOLEAN
Size: 1 octet
Handling: WRITE
Default value: FALSE

The setting of this parameter allows to clear the counters related to the recent data in the ACTUATOR_LOG.

The current date is memorized and can be viewed in MAINTENANCE_INFORMATION.

37 SET_SIGNATURE

Type: ENUMERATED
Size: 1 octet
Handling: WRITE
Default value: 0

The setting of this parameter allows transferring the last torque curve in the reference curve. The old reference data are lost, and the new ones are used as new reference torque curve.

The possible actions are the following:

Table 39.

Enumeration	Description
0	Uninitialized
1	Set close signature
2	Set open signature

Section 8: Configuration via Local Operator Interface of FF2000v4 rev. 3

The FOUNDATION™ Fieldbus interface FF2000v4 rev. 3 is an additional module that allows to connect the XTE3000 actuator to a FOUNDATION Fieldbus H1 segment.

The module can be used with either the base version or the optional modules AOC, APTM / APTM1, PSM / PSM1 of XTE3000.

The FF2000v4 rev. 3 does not need any configuration from the Local Operator Interface to communicate over the fieldbus; it is connected to the XTE3000 base card via an internal data highway: all the changes on the actuator parameters operated from the Local Operator Interface are reported to the fieldbus interface and all the changes performed on the Transducer Bocks over the fieldbus are reported on the base card as well.

Just a restricted number of parameters are available only at the Local Operator Interface and they are not accessible from the fieldbus.

Here below are described the facilities available by the VIEW and SETUP menu of XTE3000.

8.1 Bus Control

8.1.1 DIN 1 - DIN 2

By this routine, it is possible to choose the position triggers associated to the DI channels #10 and 11:

Table 40.

Item	Name	Comments
10	Position less than or equal to trigger	Valve position < = predefined trigger 'xx'
11	Position greater than or equal to trigger	Valve position > = predefined trigger 'yy'

- DIN 1: 'xx' position trigger
- DIN 2: 'yy' position trigger

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the set-up mode". When the message of display is "SET-UP MODE OK?" press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES if the position trigger in DIN 1 is correct, or press NO to change, then press YES.
- Repeat the previous step for DIN 2.

View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the view mode". When the message of display is "VIEW MODE OK?" press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES to scroll the list of BUS CONTROL parameters.

8.1.2 Simulation

By this routine, it is possible to choose or open the Simulation Switch (hardware).

This functionality is very useful in starting up the plant. If you set SIMULATE to ON, AI and DI block uses Simulate Value and Simulated Status as Channel value instead of Transducer Value and Transducer Status. Do not forget to set OFF the Simulation Switch when the test has finished.

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES to confirm the DIN 1 current setting.
- Press YES to confirm the DIN 2 current setting,
- Press NO to switch the selection from OFF to ON and from ON to OFF, then press YES to confirm.

View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES to scroll the list of BUS CONTROL parameters.

8.1.3 Date Syncro

By this routine, it is possible to enable the synchronization of date and time from bus.

This functionality is very useful to setup the date and time into all the actuator of a segment. If this parameter is “ENABLE,” the FF2000v4 rev. 3 picks the date and time published into the bus and synchronize the RTC of actuator.

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES to confirm the DIN 1 current setting.
- Press YES to confirm the DIN 2 current setting,
- Press YES to confirm the SIMULATION current setting,
- Press NO to switch the selection from DISABLE to ENABLE and from ENABLE to DISABLE, then press YES to confirm.

View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES to scroll the list of BUS CONTROL parameters.

8.1.4 Blank Node

By this routine, it is possible to clear all the static data into the FF2000v4 rev. 3 card and return to factory default.

This functionality is very useful to clear all the static data inside the FF 200 v4 card. If this routine is performed all the data bus and the bus communication will be lost. This routine will be successful only if the bus is powered. After this routine, it is recommended to perform a RESET NODE routine.

⚠ CAUTION

This routine causes the lost of node configuration and address. This routine must be performed only by skilled people.

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES to confirm the DIN 1 current setting.
- Press YES to confirm the DIN 2 current setting,
- Press YES to confirm the SIMULATION current setting,
- Press YES to confirm the DATE SYNCRO current setting,
- Press YES to run the BLANK NODE function,
- Press YES to confirm.

8.1.5 Reset Node

By this routine, it is possible to send a hardware reset to FF2000v4 rev. 3 card causing the reboot of the FF2000v4 rev. 3 card without clear static data.

This functionality is very useful to reset FF 2000 v4 card. If this routine is performed the bus communication will be lost.

⚠ CAUTION

This routine causes the temporary lost of bus communication. This routine must be performed only by skilled people.

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS routine.
- Press YES to confirm the DIN 1 current setting.
- Press YES to confirm the DIN 2 current setting.
- Press YES to confirm the SIMULATION current setting.
- Press YES to confirm the DATE SYNCRO current setting.
- Press NO to skip the BLANK NODE function.
- Press YES to run the RESET NODE function.
- Press YES to confirm.

8.2 Positioner Function

The function is available only on the inching and continuous modulating actuators. When the AO Channel is properly configured by a Network Configurator Tool the value 0% of position request, received from bus, corresponds to close request and the value 100% corresponds to open request. The XTE3000 compares the present position % of the actuator with the position request % received from the bus, and if the difference is greater than the dead band, the actuator is driven to reach the new requested position.

The following options can be configured via either bus or local operator interface:

- Dead band: configurable from 0.0% to 25.5% of the full stroke. It represents the maximum acceptable position error which is the difference between position request and current position. The configured value should be great enough to avoid “hunting” effect of the actuator.
- Motion inhibit time: it allows to adjust the length of the delay time between two cycles of the motor. It can be configured from 0 to 255 seconds and allows setting the maximum number of start per hour of electrical motor.

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select POSITIONER.
- Press YES if the configured value of the Dead Band is correct (from 0 to 25.5), or press NO to change, then press YES.
- Press YES if the configured value of the Motion Inhibit Time is correct (from 0 to 255 seconds), or press NO to change, then press YES.

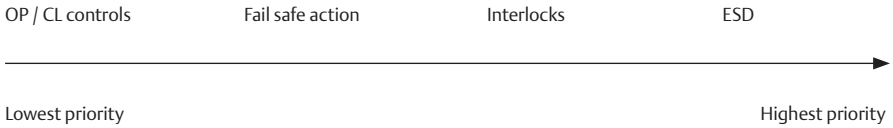
View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select the routine (POSITIONER).
- Press YES to scroll the list of parameters.

8.3 Fail Safe Function

This function is available only if requested on order. It allows to configure the action of the actuator in case of loss communication with the fieldbus interface card or if an output FB is set to OOS or has been removed from the FB schedule. The action takes place only if the local selector is in REMOTE and if bus is operating. When the communication restores, also the actuator restores at its normal functioning. The fail safe function can be configured via either bus or the local operator interface.

The hardwired controls ESD and INTERLOCKS override the Fail Safe action according to the following diagram (the hardwired controls INTERLOCKS are available only if optional modules APTM / APTM1 or PSM / PSM1 are present.



The following options can be configured:

- Fail safe action: open, close, stayput, go to position %, no action (OFF)
- Length of the delay time before than the fail safe action takes place (length = 10 seconds + configured value)

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select FAIL SAFE.
- Press YES if the configured ACTION is correct (open, close, stayput, go to position xx%, off), or press NO to change, then press YES.
- Press YES if the configured value of the DELAY is correct (from 0 to 255 seconds), or press NO to change, then press YES.

View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select the routine (FAIL SAFE).
- Press YES to scroll the list of parameters.

8.4 Viewing Transmission Information

The following procedure allows seeing the most significant info relevant to the bus data transmission:

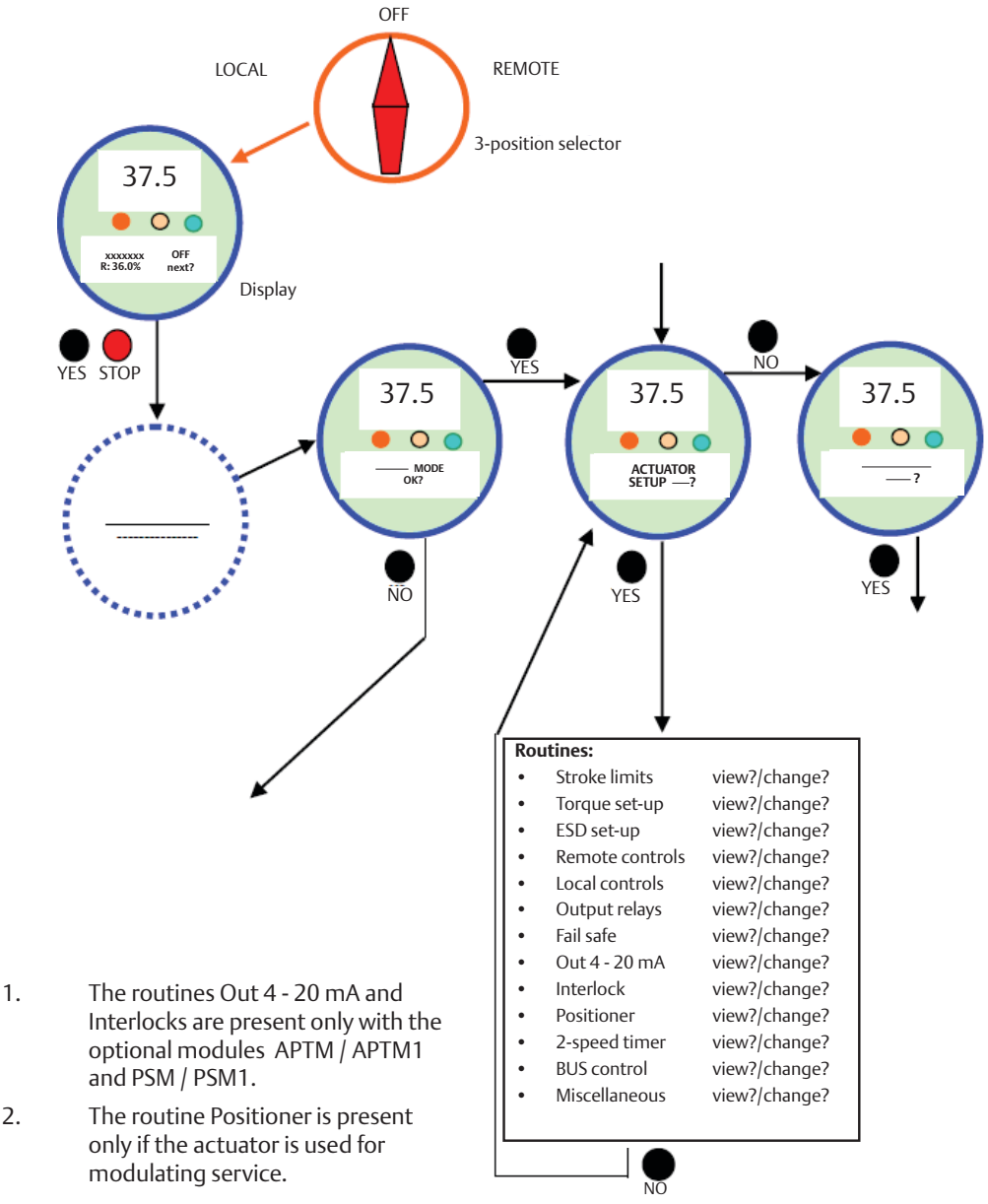
- Move the local selector to OFF or REMOTE and then press YES until the display shows NODE REPORT. Press NO to exit or press YES to scroll the list of transmission information.

8.5 Bus Signal Failure Indication

In case of loss of bus signal, a warning is generated. It is signaled by the flashing of the relevant ALARM / WARNING LED and by indication on the local 2 lines / 16 character display.

The Figure below shows the list of routines available in the XTE3000 view or setup menu.

Figure 20



1. The routines Out 4 - 20 mA and Interlocks are present only with the optional modules APTM / APTM1 and PSM / PSM1.
2. The routine Positioner is present only if the actuator is used for modulating service.

NOTE

On order, the XTE3000 can be configured to inhibit “bus signal failure” indication.

Section 9: Addendum for Base Card FW 7.00

This addendum explains some functionality introduced with base card Firmware version 7.00.
The revision of base card can be checked with parameter 56 “SW_VERSION” of Resource Block.
If revision of base card is less than 7.00, this addendum is not relevant.

9.1 Multiple Functionality of ESD Command and Status

The ESD command and status issued with channel 53 and 18 can assume the meaning of PST signal, based on type of actuator and setting of “ESD INPUT MODE” parameter.

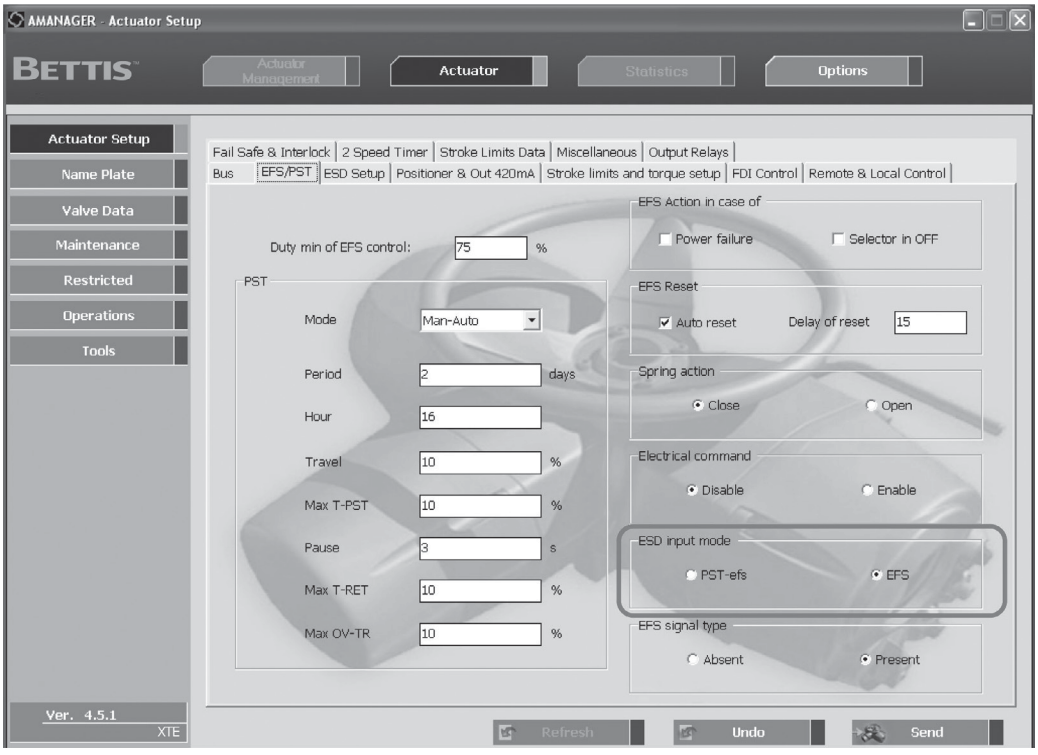
Table 41 below lists explicit its functionality.

Table 41.

ACTUATOR MODEL	ESD INPUT MODE PARAMETER	ESD COMMAND (CH 53) FUNCTIONALITY	ESD STATUS (CH 18) FUNCTIONALITY
XTE	PST-efs	Electrical ESD	ESD IN PROGRESS
XTE	EFS	Electrical ESD	ESD IN PROGRESS
EFS	PST-efs	PST	PST IN PROGRESS
EFS	EFS	Spring ESD	ESD IN PROGRESS

The ESD input mode parameter can be set on “Actuator Setup” menu of local control or AManager software (see Figure below).

Figure 21



9.2 Multiple Functionality of Interlock Command

In case on XTE actuator, the Interlock command issued with channels 54, 55, and 56, can assume the meaning of PST signal, based on type of actuator and setting of “interlock mode” parameter.

Table 42 below lists explicit its functionality.

Table 42.

ACTUATOR	INTERLOCK MODE	INTERLOCK COMMAND (CH 54, 55, 56) FUNCTIONALITY
XTE	STANDARD	INTERLOCK
XTE	ADVANCED	PST
EFS	STANDARD	INTERLOCK
EFS	ADVANCED	INTERLOCK

The “interlock mode” parameter is available on restricted menu, accessible with manufacturer login access.

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