600T EN Series Pressure Transmitter

ADDENDUM for FOUNDATION™ Fieldbus

Valid for 600T_EN_FF Version 2

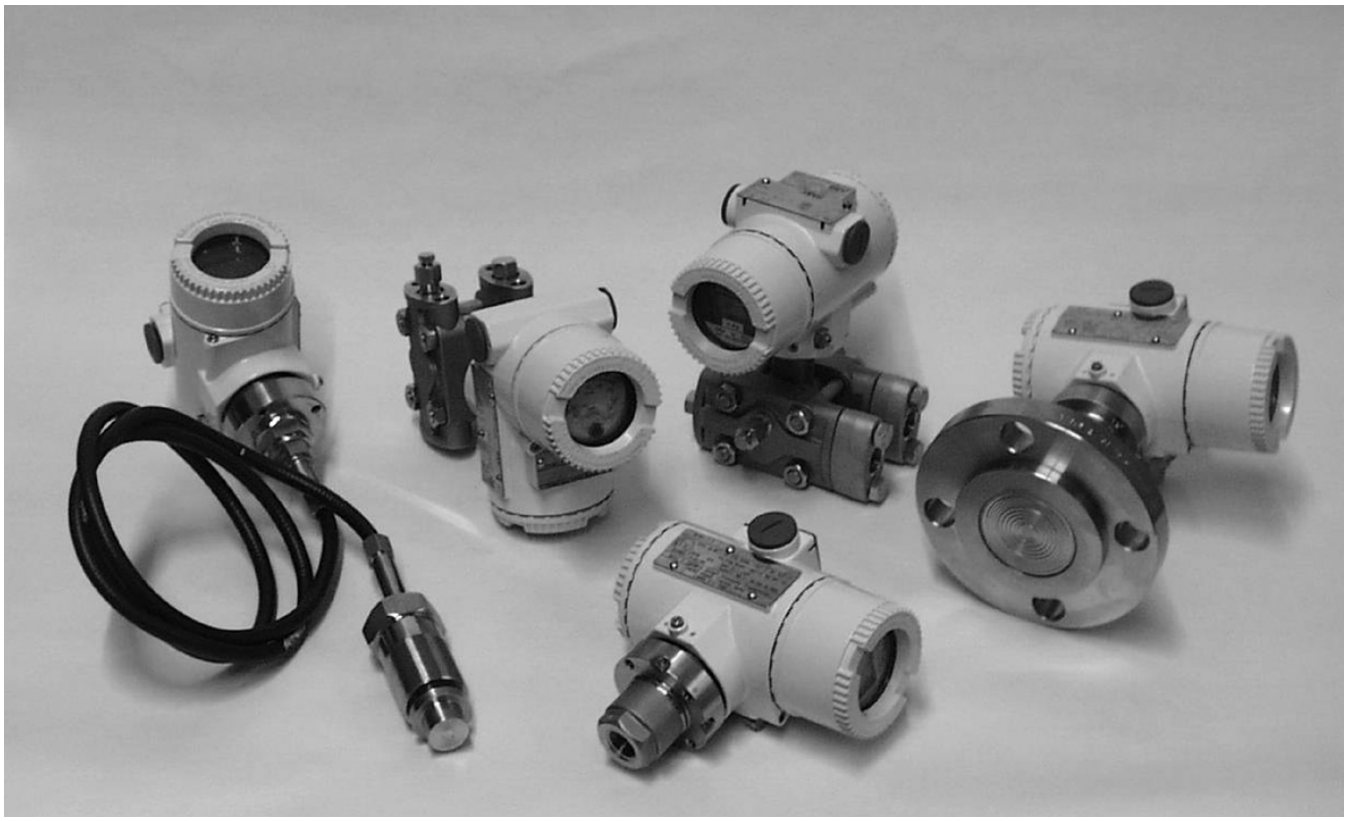


ABB Instrumentation

INDEX:

ACRONYMS

- LCD - **L**iquid **C**rystal **D**isplay
- CPU - **C**ontrol **P**rocess **U**nit
- DSP - **D**igital **S**ignal **P**rocessing
- H1 - Low Speed Fieldbus Segment
- FF - **F**oundation **F**ieldbus
- LAS - **L**ink **A**ctive **S**cheduler
- AIFB - **A**nalog **I**nput **F**unction **B**lock
- RB - **R**esource **B**lock
- TB - **T**ransducer **B**lock
- AOFB - **A**nalog **O**utput **F**unction **B**lock
- PIDFB - **P**roportional **I**ntegral **D**erivative **F**unction **B**lock
- DD - **D**evice **D**escription
- I.S. - **I**ntrinsically **S**afe

Preamble

In order to make easier the description, all the variables mentioned in this document are written with the suffix RB or TB or AIFB or PID indicating the block into where the variables are mapped.

1. – Foundation Fieldbus Definition

FOUNDATION™ Fieldbus is an all-digital, serial, two-way communication system that serves as a Local Area Network (LAN) for factory/plant instrumentation and control devices.
FOUNDATION™ Fieldbus is designed to be compatible with the officially sanctioned SP50 standards project of the ISA (The International Society for Measurement and Control) and the specifications of the IEC (International Electrotechnical Committee
A unique characteristic of FOUNDATION™ Fieldbus is interoperability that ensures its use of a fully specified, standard User Layer based on “Blocks” and Device Description technology.

Detailed information of the Foundation fieldbus is available read on the WebPage of the FIELDBUS FOUNDATION (www.fieldbus.org) and/or from the ABB WebPage (www.abb.com)

2. – Device Introduction

2.1 – General Considerations

The 600T_EN Pressure Transmitter Series include a complete line of differential, absolute and gauge pressure transmitters used also for level, flow and volume applications.
In addition, 600TEN series offers the most complete line of remote seal forms and wetted materials in the industry; different process and application matching fill fluids cover the widest process temperature range.
The series is covered by multiple agency safety approvals (including ATEX and FM) supported by intrinsically safe and explosion proof designs, for a full compliance to hazardous area requirements.

The 600T_EN FF version differs by the traditional 4-20 mA version only in the secondary electronic and in the Terminal block[1]. The transducer with its own primary electronic has to be considered the common part of all the different Transmitter versions (Hart, Profibus, and FF). This feature offers the possibility to replace on the same transmitters different electronics with the plug and play capability.

[1] Anyway the standard Terminal Block, without surge protector, can be used also for the FF application connecting the FF bus cable to the +/- terminals. **The polarity has not consistency.**

2.2 – FF version Considerations

The FF Revision 2 of the 600T_EN Series implements and is compliant to the communication Protocol FOUNDATION™ Fieldbus specification version 1.4.

The 600T_EN FF with Revision 2 (see section 8 the RB_DEV_REV) is registered as a Link Master Device.
When the 600T_EN FF is properly configured as back-up LAS, if the current LAS running in the controller fails, it enables its own LAS functionality with the task to maintain alive the fieldbus operations.
The 600T_EN FF Revision 2 includes 1 Standard Resource Block, 2 Standard Analog Input Function Blocks 1 Standard PID Function Block and 1 Custom Pressure with Calibration Transducer Block.

Here is a summary of the FF functionality implemented in the 600T_EN FF:

- **Client/Server VCR.**
  This communication type is used for the operator messages like read/write of configurations or maintenance data. This is a not scheduled message but executed when the operator requires it.
- **Publisher/subscriber VCR.**
  This communication type is used for Process Control purpose. These are the scheduled and cyclic exchange of data.
- **Report/Distribution VCR.**
  This communication type is used when the slave device has to advise the operator consoles about the occurrence of alarms (Event Notification) or for Trend report.
- **LAS Functionality.**
  With this functionality the 600T_EN FF can acts as backup master, keeping alive the Function block application whenever the Master/Controller fails.
  The LAS implemented in the device supports 1 sub-schedule, 25 sequences and 25 elements for sequence.
- **1 Standard Resource Block**
  This block identifies the transmitter and includes characteristics of the instrument connected at the fieldbus like Model, Serial Number, Manufacturer and so on. Only 1 Resource Block can be present in each device.
- **2 Standard Analog Input Function Block**
- **1 Standard Proportional Integral Derivative Function Block.**
  Inside the Function blocks (AI, PID) are contained the information/parameters relating the Process Control. Each Function Block type provides specific functionality. The combination of different Function Blocks offers the possibility to design a complete control loop.
- **1 Enhanced Pressure with Calibration Transducer Block**
  In this block are contained the information relating the 600T_EN sensor like Model, Calibration, Physical Limits or Construction, and setting about how to convert the measured Pressure to Flow, Level or Volume measurement.
- **FMS services supported:**
  - Initiate
  - Abort
  - Status
  - Identify
  - Read variable
  - Write Variable
  - Get Object Dictionary

  Only for factory use:
  - Physical Read
  - Physical Write
- **Link objects mechanism.**
  This allows the linking between the produced Values or Alarms or Trends in output from the AIFBs (Publisher) with other Input Blocks enabled to receive these information (Subscriber).
  i.e. Pressure in output from AIFB, linked as input for PIDFB.
- **Event Notification mechanism.**
  This provides to automatically send an alarm message to the Master whenever an alarm or event condition occur. This message include details about when the event occurred (date, time) and about the reason of the event or alarm (subcode).
- **Trend Objects.**
  These objects collect a defined number of sampling of a selected variable, under different conditions.

2.3 – Registration Details

DEVICE

Model:	600T_EN
Type:	Pressure Transmitter
Revision:	2.0
Tested Function Blocks:	2xAI(Standard), 1xPID(Standard), 1xRB(Standard)
Other Blocks:	1xTB(Custom)
Comm. Profile Class:	31PS, 32L
IT Campaign Number:	IT011000

PHYSICAL LAYER

Class:	111, 113

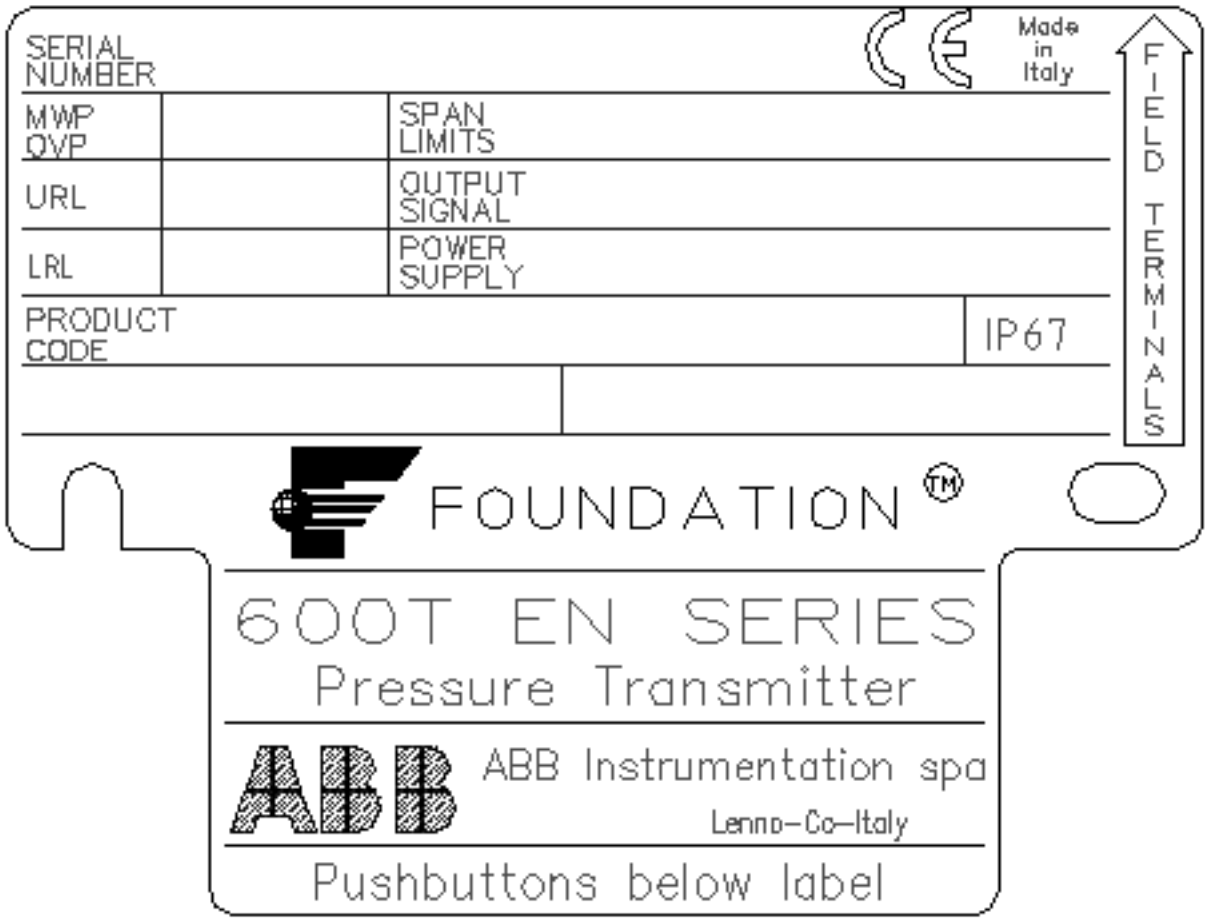
DEVICE DESCRIPTION

Manufacturer ID Num:	0x00320
Device Type:	0x0002
DD Revision:	2.0

CAPABILITY FILE

Filename:	020201.cff

FOUNDATION™ Fieldbus Type Plate



3. – Hardware Characteristics

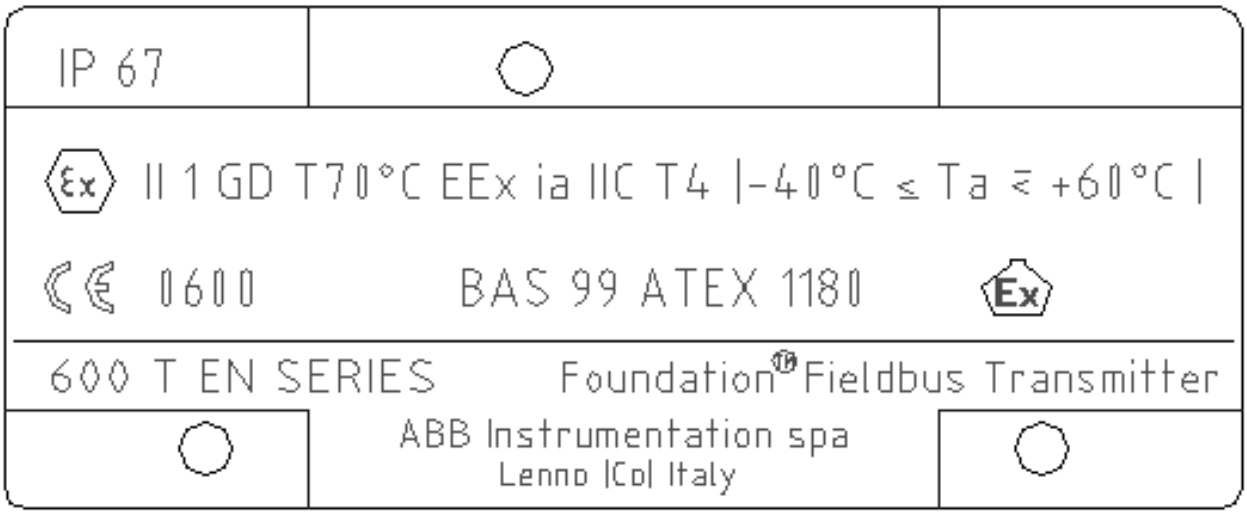
3.1 – Environmental Protection

The 600T_EN FF Pressure transmitter is an integrated electronic designed for I.S. application. In the Table A are listed the Certifications of the 600T_EN FF.

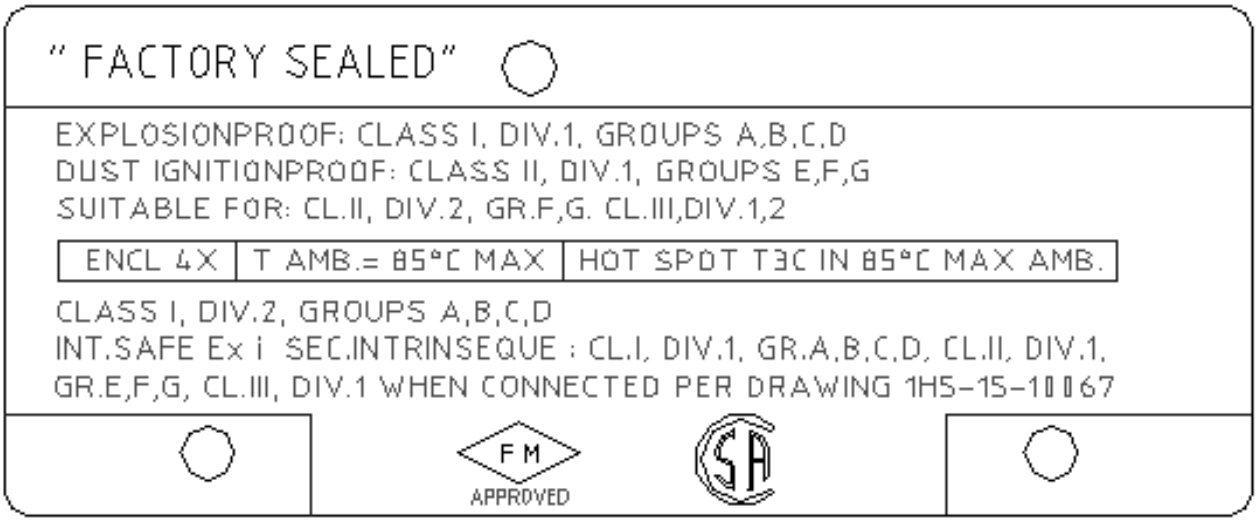
TABLE A

EUROPE	ATEX/BASEEFA	EC-Type Examination Certificate n° BAS 99ATEX 1180	II 1GD T50°C, EEx ia IIC T4 (-40°C ≤ Ta ≤ +60°C)
NORTH AMERICA	CSA & FM	Explosionproof: Class I, Div.1, Groups A, B, C, D	
		Dust Initionproof: Class II, Div.1, Groups E, F, G	
		Suitable for: Class II, Div.2, Groups F, G; Class III, Div.1, 2	
		Nonincendive: Class I Div.2, Groups A, B, C, D	
		Intrinsically safe: Class I, II, III, Div.1, Groups A, B, C, D, E, F, G	

EUROPE CERTIFICATION LABEL



NORTH AMERICA CERTIFICATION LABEL



3.2 – Fault Protection

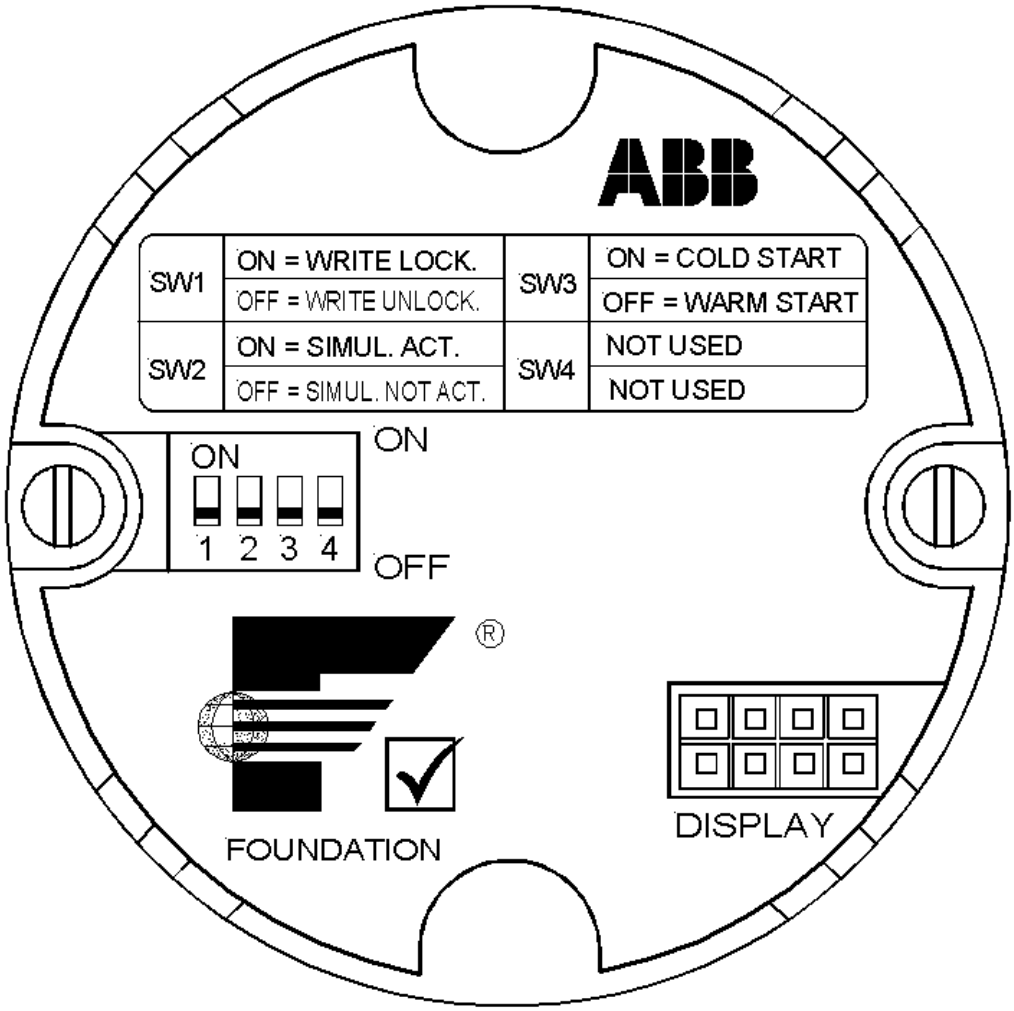
This electronic implements also an especial circuitry for the fault current protection. Whenever a fatal failure occurs and the current consumption increase over the 16 mA, this circuitry provides to disconnect the device from the bus, in order to save the good functionality of the other connected devices that otherwise would be switched off due to the missing power available.

3.3 – Hardware Settings

On the electronic, below the Local Display when installed, there are available 4 DIP switches, see the Figure 1, with the following functionality:

- **Write Locking:**
  SW1 in ON position enables the Write Locking condition. The attempts to change the configuration of the device are refused.
- **Simulation**
  SW 2 in ON position enables the Simulation.
- **Cold Start**
  SW 3 in ON position enables the Cold Start-up. A Cold Start-up feature is available in order to initialise all the parameters requiring a well-defined value, with the default values. This operation can be performed setting the Cold Start-up switch 3 in the ON position before to power on the device, Many variables of the AIFBs and TB are properly set with values strictly related to the connected transducer type
- **SW 4 not used.** (For future use)

Figure 1: Electronic Front View:



3.4 – Local Display

The 600T_EN FF Pressure Transmitter is available with an integral display as optionally item, see the Figure 2. This integral display offers the possibility to display the selected variable or diagnostic strings whenever failure and/or warnings are detected.
The variable to be displayed is user selectable among several variables produced in the TB as well as the Function Blocks output in Engineering Value[3], or its percentage.

The variable to be displayed is selected writing the right code in the TB_LCD_SEL. See section 8 in the Transducer Block table.
-At the start-up, during the initialisation phase, the display appears with all the segments lit on.
- At the end of the initialisation, if the result is correct and the transmitter works correctly, the variable selected in the TB_LCD_SEL is displayed together with the unit code, and it is updated every 0.5 seconds.
-When some malfunctions are detected on the display appears one of the following diagnostic string sequences:

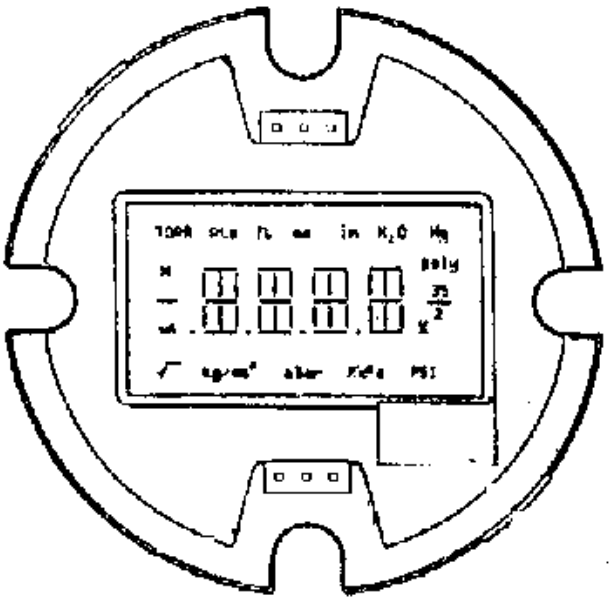
‘SNSR’ and after 0.5 seconds ‘FAIL’ when a sensor fail has been detected.
‘ELEC’ and after 0.5 seconds ‘FAIL’ when an electronic fail has been detected.
‘TEMP’ and after 0.5 seconds ‘FAIL’ when the sensor for the sensor temperature to be used as compensation variable is failed. This is a Warning indication
‘STAT’ and after 0.5 seconds ‘FAIL’ when the sensor for the static pressure to be used as compensation variable is failed. This is a Warning indication.

-Depending by some operating condition of the device there could be additional string sequences like:

‘SIM ‘ and after 0.5 seconds ‘MODE’ when the device is set in simulation mode.
‘OUT ‘ and after 0.5 seconds ‘SERY’ when the Function Block has been set in Out of Service mode.

The display acts also as feedback of the operations performed with the external push buttons, for additional display indications see the next section 3.5 Local Adjustment.

Figure 2: Integral Local Display



[3] The today’s display allows the displaying of Pressure Unit code only.

3.5 – Local Adjustment

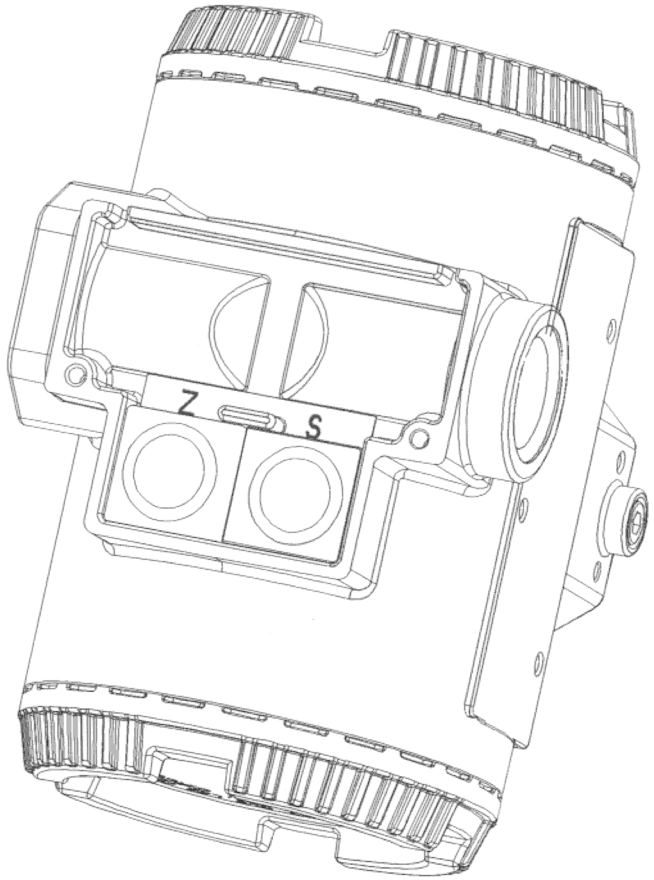
Of two external push buttons only the 'Z' is active in this version, see the Figure 3.
With this operation the TB_TRIMMED_VALUE indication is automatically adjusted to 'zero'. Whenever the user wants to set the measure produced by the transmitter to 'zero' (i.e. when the measure is different by 'zero' due to the installation position) the following sequence of operations are required when the user acts with the local push button:

When the 'Z' button is kept push for more than 1 second, when released, the 'Zero Alignment' operation is executed adjusting to 'zero' value the TB_TRIMMED_VALUE and automatically setting to 'zero' also the TB_CAL_POINT_LO as Calibration Point Low.

As consequence of the operation, the feedback appearing on the display is one of the following string sequences:
- 'ZERO' and after 1 second 'PASS' when the operation was OK.
- 'ZERO' and after 1 second 'FAIL' when the operation was not OK
- 'ZERO' and after 1 second 'PROT' when the security-locking switch 1 is in ON position (Write Protection).
- 'ZERO' and after 1 second 'DSBL' when the Local operations are disabled (see TB_KEY_ENABLE in the Transducer Block).

Note: The 'zero alignment' operation is executed only if the TB is in Out of Service

Figure 3: Push Buttons View



3. – Network Architecture

A simple FOUNDATION™ filedbus system is represented in Figure.4. The H1 segment is applicable in Ex and non Ex area. The fieldbus can be designed following 3 different topologies as shown in the Figure 5 or can be applied as a mix of the three.

Figure 4: Simple FOUNDATION™ fieldbus System

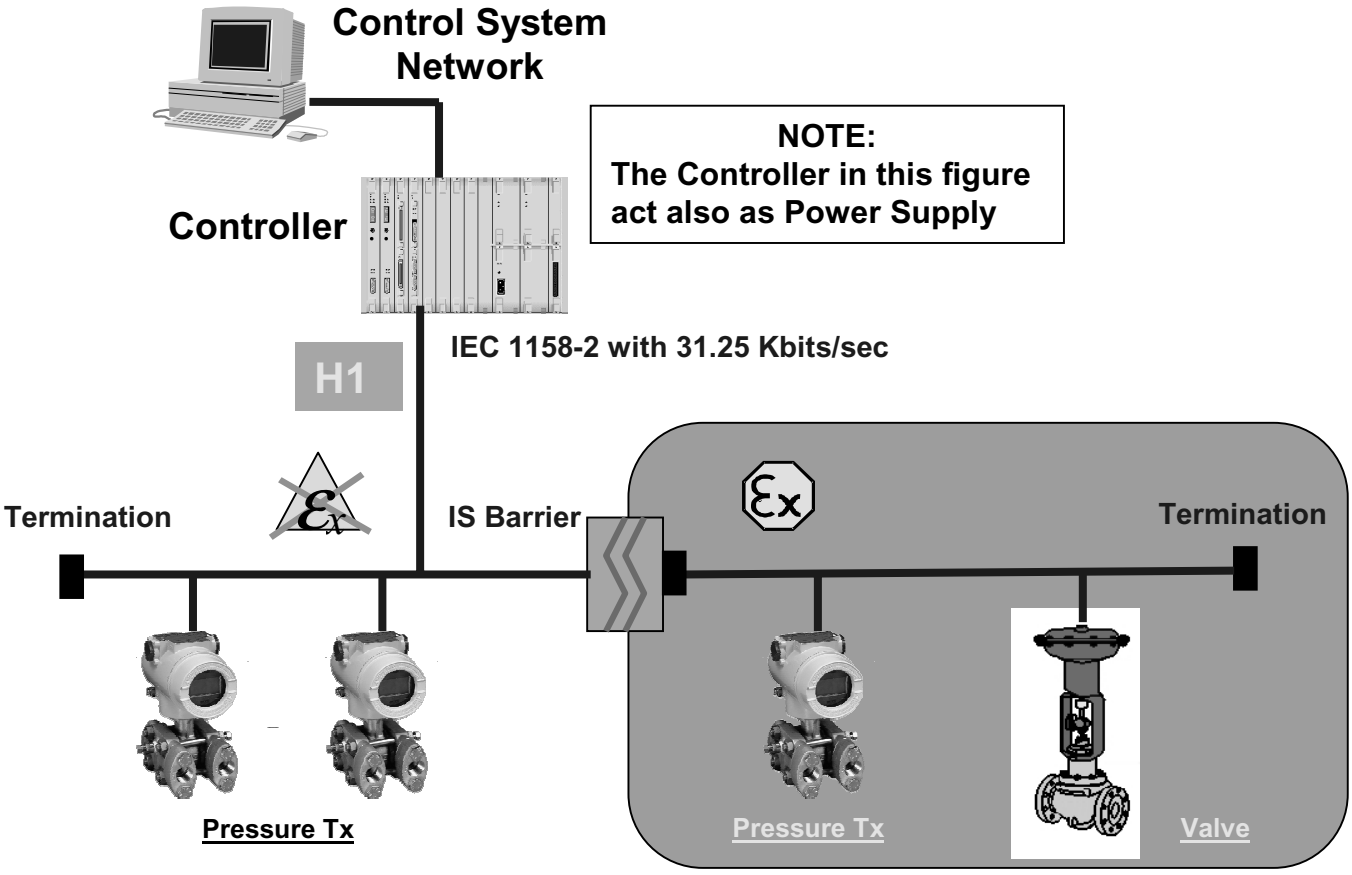
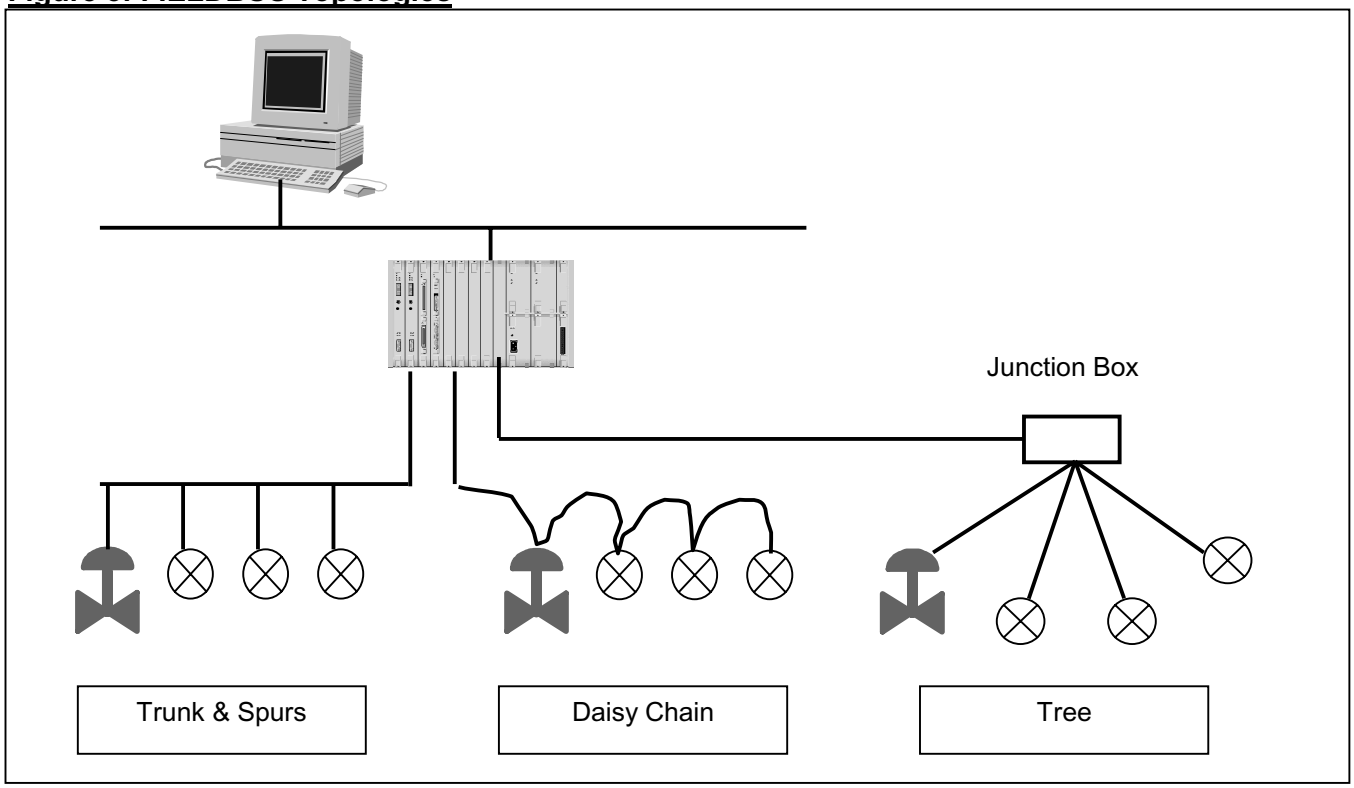


Figure 5: FIELDBUS Topologies



In the Table B below are summarised some fieldbus characteristics.

TABLE B

Parameters	Specifications	
Data Rate	31.25 Kbits/s	
Type	Voltage	
Topology	Bus/Tree	
Bus Power	Dc	
Intrinsically Safe	No	Yes
Max Number of Devices (1)	32	6
Max Cable length (2)	1900 m	
Max Spurs length (3)	120 m	

(1) The number of devices is strictly dependent by factors like the device power consumption, Type of cable used, additionally accessory devices such as repeaters and so on.
(2) The maximum length includes the bus plus all the spurs length. The cable Type 'A' (#18 AWG 0.8 mm²) twisted pairs cable allows the maximum length of 1900 m.
(3) The maximum Spur length is 120 m when only 1 device is connected. Any additional device reduces of 30 m the maximum Spur length.

The 600T_EN FF has the following power requirements:

Current consumption =10.5 mA ± 1 mA
Power Supply non Ex = 9 to 32 VDC
Power Supply Ex = 9 to 24 VDC

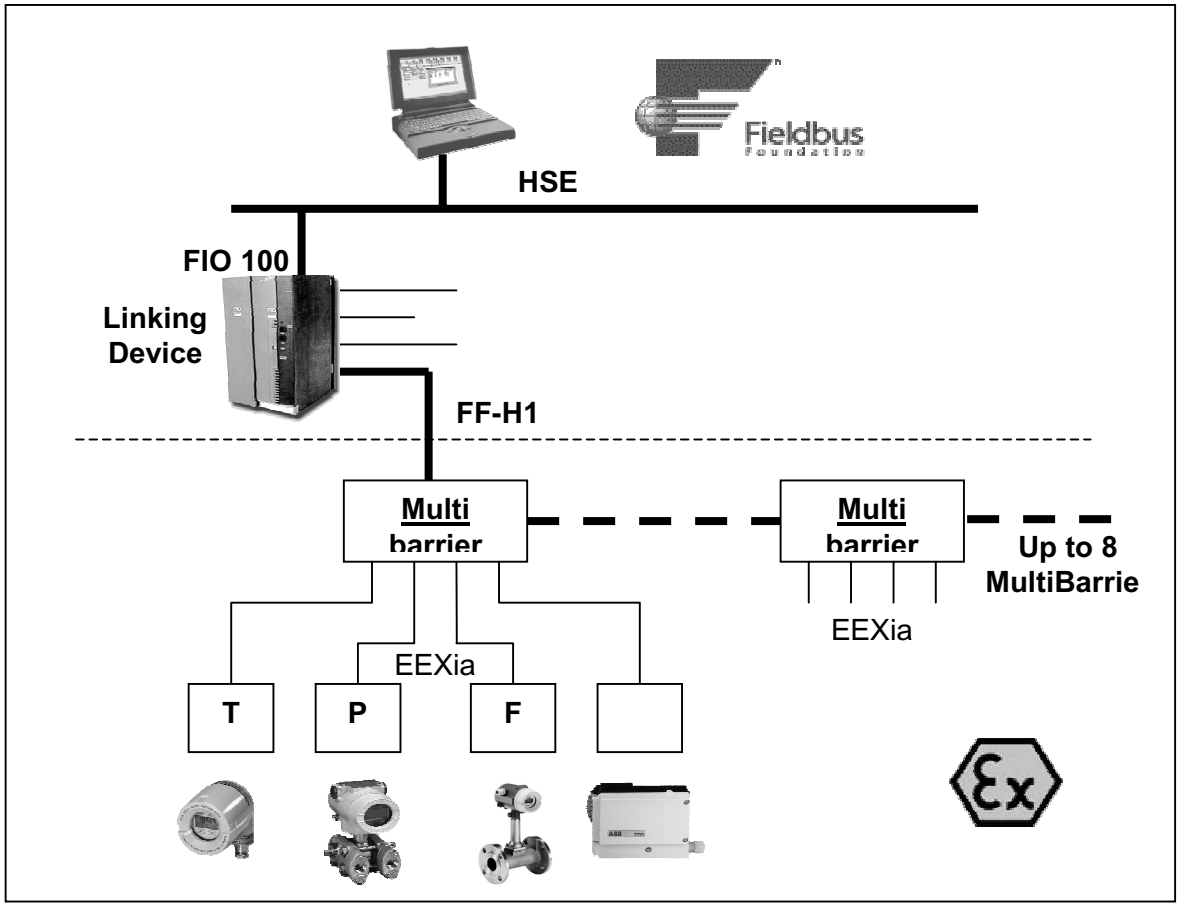
Generally for the 600T_EN FF it is possible to consider:

About 10 transmitters connected on one segment for EEx ia applications **.
Max. 32 transmitters connected on one segment for non EEx applications

**** The number of 600T_EN FF transmitters connected on one segment for EEx ia applications can be increased when used in conjunction with the ABB Multibarrier MB204.**

It is possible to connect up to 8 multibarrier MB204 on one EEx ia segment and on each multibarrier is possible to connect up to 4 transmitters. See an example of segment with Multibarrier in the Figure 6.

Figure 6: FF-H1 Segment with Multibarrier

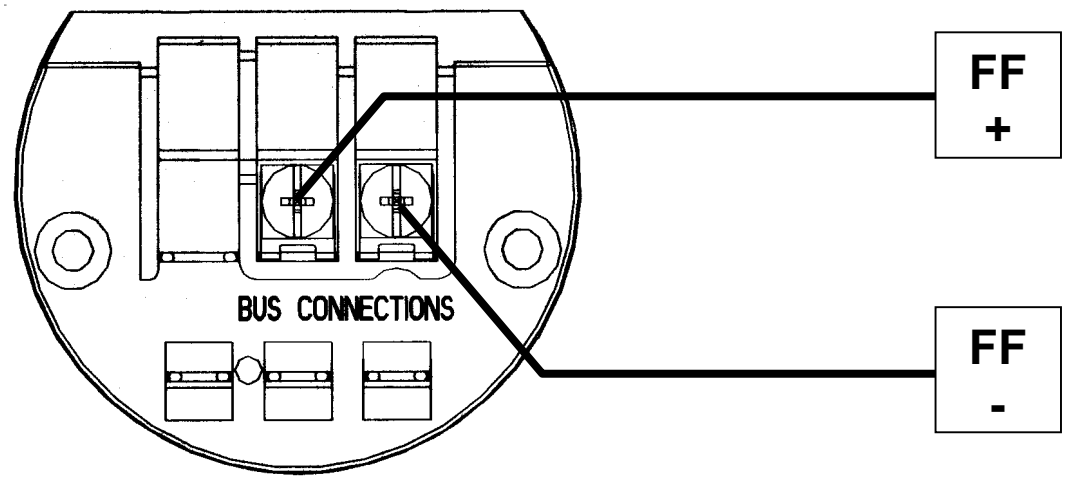


4.1 – Electrical Connections

The 600T_EN FF is a Bus Powered device with Foundation Fieldbus output. On the terminal block two screws for the BUS CONNECTION are available, see the Figure 7.

The Polarity has not consistency, so the two bus cables can be connected without take care about the polarity.

Figure 7: Terminal Block



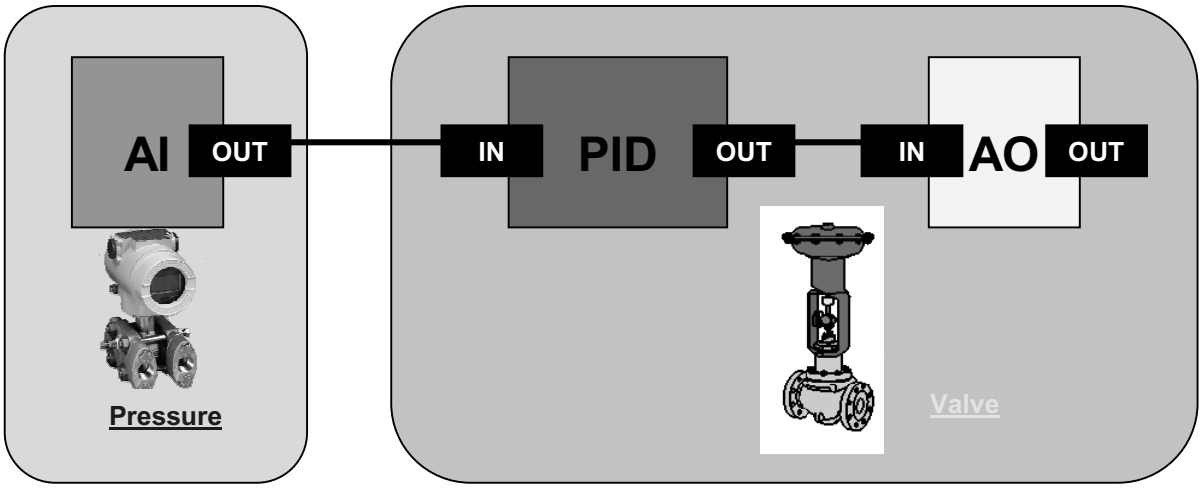
The special FF connector (gland receptacles) is also available as optional item for the 'quick connection' of the transmitter to the bus.

If necessary the ground terminal could be also connected. For details about the connections refer to the 'Fieldbus Installation & Planning Guide' document AG-165 available on the Fieldbus Foundation website (www.fieldbus.org)

5. – FOUNDATION Fieldbus Overview

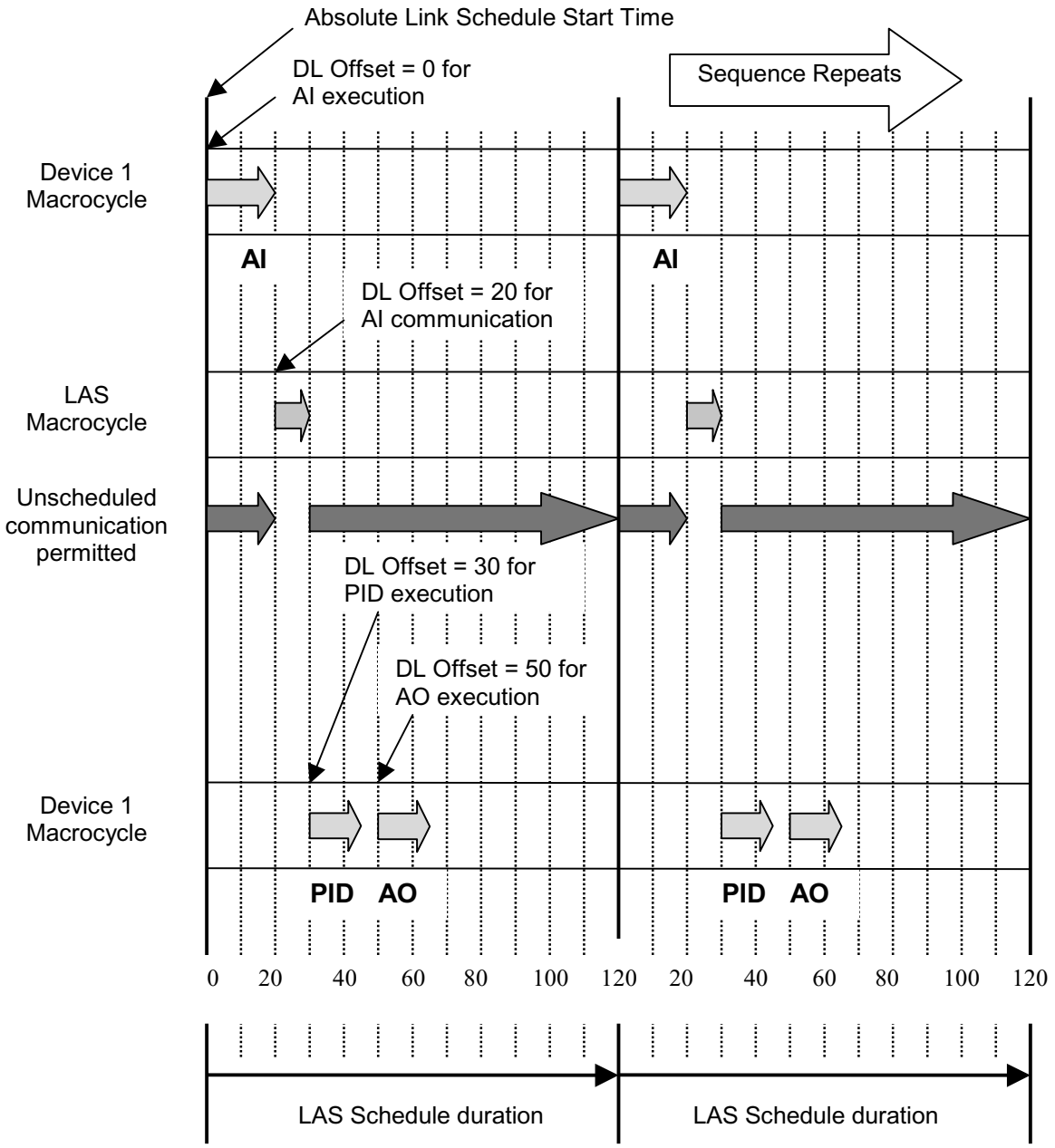
In the Figure 8, is represented how the Function Blocks inside the FF devices connected on the bus, can be linked together in order to achieve a simple control loop. After the loop has been designed, the LAS Master device located in the Controller or, as back-up, in the slave device itself, starts the scheduling of the Function Block executions and of the publisher/subscriber communications in a deterministic way.
In the example of Figure 8, the Pressure Transmitter implementing the AIFB publish the pressure value, then the PID FB implemented in the valve, subscribe this value from the bus in order to be used as input for the PIDFB. In the same way the exchange of values between the PIDFB and the AOFB occurs but without communications on the bus, because the two Blocks are inside the same device.

Figure 8: Simple Single Loop configuration example



In the Figure 9 is represented the macrocycle of the above loop. The LAS functionality inside the controller provides to handle the loop, and the macrocycle is the temporary representation of how, function blocks and communications, are scheduled. From the instant 0 to 20 the AIFB is executed, in the period from 20 to 30 the LAS provide to schedule the AIFB output. The Pressure Transmitter provides to publisch the pressure value, the PIDFB subscribes this value. Then the PIDFB is executed from the instant 30 to 40 and at the end the PIDFB output is scheduled and goes in input to the AOFB without communications because the two Function blocks reside inside the same device.
The unscheduled communications are always active unless during the period between 20-30 when the pressure value is published on the bus.

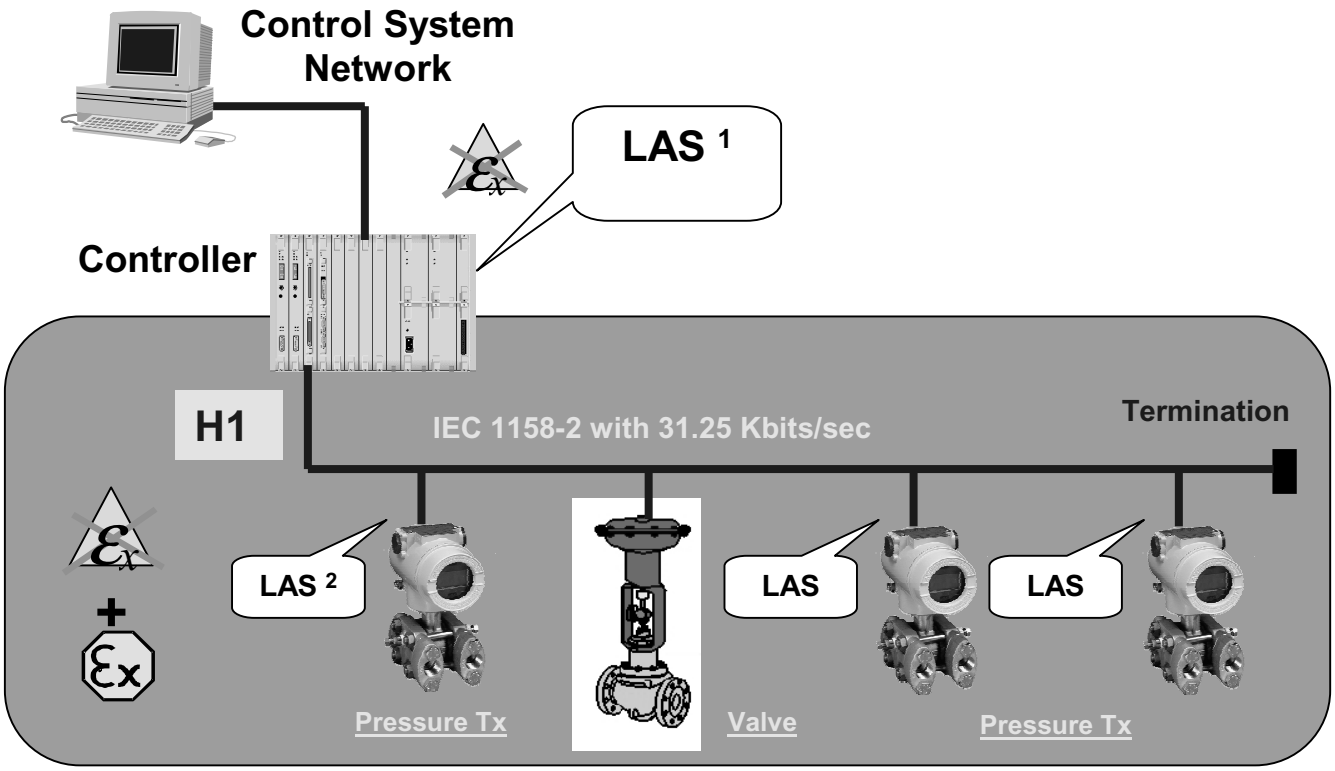
Figure 9: Macrocycle Example



The LAS functionality handling the control loops, is also available inside the 600T_EN FF revision 2. Whenever failure of the controller occurs, and the LAS[1] stops its execution, the 600T previously set as back-up LAS[2] take care of the loop maintaining alive the fieldbus executing the same macrocycle that was active before of the controller failure.

Note: When more than 1 field device is configured as back-up LAS, the one with lower Node Address has high priority for assuming the control when the Primary LAS fails.

Figure 10: Back-up LAS diagram



Further and detailed descriptions about the FOUNDATION Fieldbus concepts refers to the 'Technical Overview' document FD-043 available on the Fieldbus Foundation website (www.fieldbus.org)

6. – Initialisation

At the power up, the 600T_EN FF executes some internal self-test. Both the Hardware and the memory contents are checked before to start the normal operations.
During this phase, on the display all the segments remain lit on for few seconds until the initial testing is complete. After that, depending by the test result, on the display appears the selected variable (TB_LCD_SEL) when all is OK or the diagnostic string when some failure has been detected.

By default, the Function Blocks of the 600T_EN FF are not running, until a FB application is not downloaded into the transmitter. For this reason the selected default variable to be displayed is the TB_TRIMMED_VALUE because it is always produced independently by the creation of the FB application.
After the Function Block has been successfully downloaded into the transmitter, the FBs start to be scheduled producing in output the value to be used for the Process Control. After this condition is established, the user can select on the TB_LCD_SEL the preferred variable to be displayed.

By default the 600T_EN FF starts as PRESSURE Transmitter with the two AIFBs set and selected for measure:

- **AIFB_1 produce the Pressure Measurement** (AIFB_CHANNEL = 1)
- **AIFB_2 produce the Sensor Temperature** (AIFB_CHANNEL = 2)

The user can select different TB_PRIMARY_VALUE_TYPE in order to use the 600T_EN FF as FLOW, LEVEL or VOLUME measurement. Depending by the TB_PRIMARY_VALUE_TYPE selected, the AIFB_CHANNEL can be linked to different variables produced by the TB as input for the AIFB. See the TABLE C.

Table C:

	TYPE OF MEASURE (TB_PRIMARY_VALUE_TYPE)			
	Pressure	**Flow**	**Level**	**Volume**
Channel 1 (TB_PRIMARY_VALUE)	Pressure	Flow	Level	Volume
Channel 2 (TB_SECONDARY_VALUE_1)	Sensor Temp	Sensor Temp	Sensor temp	Sensor Temp
Channel 3 (TB_SECONDARY_VALUE_3)		Pressure	Pressure	Pressure
Channel 4 (TB_SECONDARY_VALUE_4)				Normalised Pressure
Channel 5 (TB_SECONDARY_VALUE_2)	Static Pressure	Static Pressure	Static Pressure	Static Pressure

Note: The Channel selection of the two AIFB must to be always different.

7. – Device Addressing

When the 600T_EN FF Transmitter is connected on a FF bus, the Master has to recognize it with an unique address in the world. For this reason the FF specifications define three different addressing levels that characterize the FF devices:

- The DEV_ID is the unique device identifier
- The PD_TAG is the physical name of the device
- The Node Address is the real node at which the device is connected on the bus (It is automatically set by the Master)

The most important one with the higher priority is the DEV_ID. This is a string of 32 characters and must identify in a unique way each FF device in the world.
In order to fulfil this requirement the 600T_EN FF applies the following mechanism:

- The first part of the string are the Manufacturer Code (000320) and Device Type code (0002).
- The second part of the string is the device type identification (600T_EN).
- The third part of the string is filled with the TB_SENSOR_SERIAL_NUMBER read from the transducer database. This number is written at factory configuration stage and it is assigned in a well-defined way just to be sure to have always different numbers.

Finally the DEV_ID appears of 32 characters in this way '0003200002 600T_EN xxxxxxxxxxxx', where all the 'x' represent the Serial number.
Whenever an electronics replacement after an electronics failure is necessary, appear clear that the device will be recognized on the network as before of the replacement. This is possible because the transducer, which includes the serial number, remains unchanged and the DEV_ID will be maintained the same as before of the failure.

8. – Device Configuration

The 600T_EN FF Pressure Transmitter offers a set of variables available trough the FF communication. The variables can be accessed by the Master for configuration and maintenance purposes with Read and Write operations each addressed by an Index number. The FF Profile Standard defines the relative index of each variable, but the Start Index of each block is Manufacturer Specific.

In order to allow a full visibility and support of the variables mapped inside the 600T_EN FF transmitter, it is necessary to import in the Master configuration system the DD files (.sym, and .ffo)
These files together with the Capability file (.cff) are available from the ABB Instrumentation SpA or directly from the website www.abb.com.

These registered files have the following names:

- **0202.sym as DD symbol file**
- **0202.ffo**
- **020201.cff as Capability file.**

The list of the variables available on the FF communication are reported in the following tables with the relevant block where:

IDX = Relatve Index of the Variable
PC = Allowed type of access for the variables.
Note: Some variables can be changed only if the relevant block is in Out of Service.

The RB the AIFB and the PIDFB are implemented in accordance with the Function Block Part 2 specification Document, the TB is a manufacturer specific implementation.

For details about the meaning of each single variable refer at the FF Function Block Part 2 (Ref. 1), and at the Transducer Block Application Process Part 2 (Ref. 2).

RESOURCE BLOCK

Idx	Name	N° byte	PC	Description
0	BLOCK_OBJ	62	mix.	In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on
1	ST_REV	2	R	The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value in the block is changed.
2	TAG_DESC	32	R/W	The user description of the intended application of the block
3	STRATEGY	2	R/W	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	1	R/W	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	1	R/W	Target – The selected mode from the operator.
		1	R	Actual – The mode the block is currently in.
		1	R/W	Permitted – Allowed modes that the target may take on
		1	R/W	Normal – The common mode for the Actual.
6	BLOCK_ERR	2	R	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	RS_STATE	1	R	State machine of the function block application.
8	TEST_RW	112	R/W	Read/Write test parameter – used only for conformance testing.
9	DD_RESOURCE	32	R	String identifying the tag of the resource, which contains the Device Description for this resource.
10	MANUFAC_ID	4	R	Manufacturer Identification number – used by an interface device to locate the DD file for the resource. **000320 hex for ABB**
11	DEV_TYPE	2	R	Manufacturer's model number associated with the resource – used by interface devices to locate the DD file for the resource.
12	DEV_REV	1	R	Manufacturer's revision number associated with the resource – used by interface devices to locate the DD file for the resource.
13	DD_REV	1	R	Revision of the DD associated with the resource – used by interface devices to locate the DD file for the resource.
14	GRANT_DENY	1	R/W	Grant
		1	R/W	Deny
15	HARD_TYPES	2	R	The type of Hardware available as channel numbers. For the 600T_EN this is limited to Scalar Inputs (i.e. Analog Input)
16	RESTART	1	R/W	Allows a manual restart to be initiated. Several degrees of restart are possible, they are: **1: Run** – Normal state when running **2: Restart Resource** **3: Restart with Default** – Set the parameters to INITIAL VALUES. **4: Restart Processor** – perform a warm start-up
17	FEATURES	2	R	Used to show supported resource block options
18	FEATURES_SEL	2	R/W	Used to select resource block options
19	CYCLE_TYPE	2	R	Identifies the block execution methods for this resource
20	CYCLE_SEL	2	R/W	Used to select the block execution methods for this resource. The 600T_EN supports the following: - **Scheduled**: Blocks are executed depending by the function block schedule. - **Block execution**: A block may be executed by linking to another block completion.
21	MIN_CYCLE_T	4	R	Time duration of the shorted cycle interval of which the resource is capable.
22	MEMORY_SIZE	2	R	Available configuration memory in the empty resource. To be checked before attempting a download

23	NV_CYCLE_TIME	4	R	Minimum time interval for writing copies of NV parameters to non-volatile memory. Zero means it will be never automatically copied.
24	FREE_SPACE	4	R	Percent of memory available for further configuration. Zero in a preconfigured device
25	FREE_TIME	4	R	Percent of the block processing time that is free to process additional blocks.
26	SHED_RCAS	4	R/W	Time duration at which to give up on computer writes to function block Rcas locations. Shed from Rcas shall never happen when Shed_Rcas = 0
27	SHED_ROUT	4	R/W	Time duration at which to give up on computer writes to function block Rout locations. Shed from Rout shall never happen when Shed_Rout = 0
28	FAULT_STATE	1	R	Fault State
29	SET_FSTATE	1	R/W	Set Fault State
30	CLR_FSTATE	1	R/W	Clear Fault State
31	MAX_NOTIFY	1	R	Maximum number of unconfirmed alert notify messages possible
32	LIM_NOTIFY	1	R/W	Maximum number of unconfirmed alert notify messages allowed
33	CONFIRM_TIME	4	R/W	The minimum time between retries of alert report. Retries shall not happen when Confirm_Time = 0
34	WRITE_LOCK	1	R/W	If set, no writes from anywhere are allowed except to clear Write_Lock. Block inputs will continue to be updated.
35	UPDATE_EVT			This alert is generated by any change to the static data.
		1	R/W	Unacknowledged:
		1	R	Update State:
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Static Revision: The number of the last increment generating the alert
		2	R	Relative Index: The index of the changed variable generating the alert
36	BLOCK_ALM			The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode: Cause of the alert
		1	R	Value: The value generating the alert
37	ALARM_SUM			The alert status associated to the function block
		2	R	Current
		2	R	Unacknowledged
		2	R	Unreported
		2	R/W	Disabled
38	ACK_OPTION	2	R/W	Selection of whether alarms associated the function block will be automatically acknowledged.
39	WRITE_PRI	1	R/W	Priority of the alarm generated by clearing the write_lock
40	WRITE_ALM			This alert is generated if the write_lock parameter is cleared
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		1	R	Value
41	ITK_VER	2	R	Major revision number of the Interoperability test case used in certifing this device as interoperable

ANALOG INPUT FUNCTION BLOCK

Idx	Name	N° byte	PC	Description
0	**BLOCK_OBJ**	62	mix.	In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on
1	**ST_REV**	2	R	The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value in the block is changed.
2	**TAG_DESC**	32	R/W	The user description of the intended application of the block
3	**STRATEGY**	2	R/W	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	**ALERT_KEY**	1	R/W	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	**MODE_BLK**	1	R/W	Target – The selected mode from the operator.
		1	R	Actual – The mode the block is currently in.
		1	R/W	Permitted – Allowed modes that the target may take on
		1	R/W	Normal – The common mode for the Actual.
6	**BLOCK_ERR**	2	R	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	**PV**	4	R	The process variable used in block execution, expressed in XD_SCALE unit Code
		1	R	The process variable status
8	**OUT**	4	R	The block output value calculated as a result of the block execution, expressed in OUT_SCALE unit code Only when the function block is in Manual MODE this variable can be written
		1	R	The block output status
9	**SIMULATE**	1	R/W	Simulate Transducer Status
		4	R/W	Simulate Transducer Value
		1	R	Current Transducer Status
		4	R	Current Transducer Value
		1	R/W	Simulation Enable/Disable bit

10	XD_SCALE	4	R/W	High Range	All the values are associated with the channel input value
		4	R/W	Low Range	
		2	R/W	Unit Index	
		1	R/W	Decimal point	

Code for Pressure

1130	pascal	**1144**	grams / centimeter^2
1131	gigapascal	**1145**	Kilograms / centimeter^2
1132	Megapascal	**1146**	inches H2O (20 deg. C)
1133	Kilopascal	**1147**	inches H2O (4 deg. C)
1134	Millipascal	**1148**	inches H2O (68 deg. F)
1135	Micropascal	**1149**	mm H2O (20 deg. C)
1136	Hectopascal	**1150**	mm H2O (4 deg. C)
1137	bar	**1151**	mm H2O (68 deg. F)
1138	millibar	**1152**	feet H2O (20 deg. C)
1139	Torr (0 deg. C)	**1153**	feet H2O (4 deg. C)
1140	Atmosphere	**1154**	feet H2O (68 deg. F)
1141	Psi	**1155**	inches Hg
1142	Psia	**1156**	inches Hg (0 deg. C)
1143	Psig	**1157**	mm Hg
		1158	mm Hg 0 deg. C)

Code for Flow

1347	cubic meters per sec	**1360**	Std.Cubic feet per hour
1348	cubic meters per min	**1361**	Std.Cubic feet per day
1349	cubic meters per hour	**1362**	Gallons per sec
1350	cubic meters per day	**1363**	Gallons per min
1351	liters per sec	**1364**	Gallons per hour
1352	liters per min	**1365**	Gallons per day
1353	liters per hour	**1366**	Megagallons per day
1354	liters per day	**1367**	Imperial gallons per sec
1355	Megaliters per day	**1368**	Imperial gallons per min
1356	Cubic feet per sec	**1369**	Imperial gallons per hour
1357	Cubic feet per min	**1370**	Imperial gallons per day
1358	Cubic feet per hour	**1371**	barrel per sec
1359	Cubic feet per day	**1372**	barrel per min
		1373	barrel per hour
		1374	barrel per day

Code for Volume

1034	cubic meters	**1044**	cubic yard
1035	cubic decimeters	**1045**	cubic mile
1036	cubic centimeters	**1046**	pint
1037	cubic millimeters	**1047**	quart
1038	liters	**1048**	gallons
1039	centiliters	**1049**	imp.gallons
1040	milliliters	**1050**	bushel
1041	hectoliters	**1051**	barrel
1042	cubic inch	**1052**	barrel liq.
1043	cubic feet	**1053**	Standard cubic foot

Code for Level

1010	meters	**1016**	pm
1011	Km	**1017**	angstrom
1012	cm	**1018**	feet
1013	mm	**1019**	inches
1014	micron	**1020**	yard
1015	nm	**1021**	mile
		1022	naut.mile

11	**OUT_SCALE**	4	R/W	High Range	All the values are associated with the OUT.
		4	R/W	Low Range	All the units code specified by the FF are available for this
		2	R/W	Unit Index	Scaling. Refer to the FF specs (Ref. 2) for the complete set
		1	R/W	Decimal point	Of available unit code
12	**GRANT_DENY**	1	R/W	Grant	
		1	R/W	Deny	
13	**IO_OPTS**	2	R/W	Option which the user can select to alter Input and Output block processing Only the Low cutoff can be enabled/disabled	
14	**STATUS_OPTS**	2	R/W	Option which the user can select block processing of status. The available selections are: – **Propagate Fault Forward** – **Uncertain if Limited** – **BAD if Limited** – **Uncertain if MAN Mode**	
15	**CHANNEL**	2	R/W	The CHANNEL value is used to select the measurement value from the I/O block. Refer to the TABLE C of this Manual for understand how the CHANNEL can be selected.	
16	**L_TYPE**	1	R/W	Linearisation Type. The selectable types are: - **Direct** - **Indirect** - **Indirect Square Root**	
17	**LOW_CUT**	4	R/W	Limit used in square root processing. A value of zero percent of scale is used in block processing if the transducer falls below this limit, in % of scale. The features may be used to eliminate noise near zero for a flow sensor.	
18	**PV_FTIME**	4	R/W	Time constant of a single exponential filter for the PV, expressed in seconds. This is the time necessary for reach the 63% of the variation in input.	
19	**FIELD_VAL**	4	R	The percent of the value from the Transducer block or from the simulation value, when enabled, before the characterisation (L_TYPE) and Filtering (PV_FTIME)	
		1	R	Field Value Status	
20	**UPDATE_EVT**	This alert is generated by any change to the static data			
		1	R/W	Unacknowledged	
		1	R	Update State	
		8	R	Time Stamp: The date and time of when the alert was generated	
		2	R	Static Revision	
		2	R	Relative Index	
21	**BLOCK_ALM**	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Actve Status, if the subcode has changed			
		1	R/W	Unacknowledged	
		1	R	Alarm State	
		8	R	Time Stamp: The date and time of when the alert was generated	
		2	R	Subcode	
		1	R	Value	

22	**ALARM_SUM**			The summary alarm is used for all process alarm in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Actve Status, if the subcode has changed
		2	R	Current
		2	R	Unacknowledged
		2	R	Unreported
		2	R/W	Disabled
23	**ACK_OPTION**	2	R/W	Used to set auto acknowledgment of the alarms
24	**ALARM_HYS**	4	R/W	Amount the PV must return within the alarm limit before the alarm condition clears. Alarm Hysteresis is expressed as percent of the OUT_SCALE span.
25	**HI_HI_PRI**	1	R/W	Priority of the High High Alarm
26	**HI_HI_LIM**	4	R/W	The setting of the High High Limit producing the High High Alarm. This value is expressed in OUT_SCALE Unit Code
27	**HI_PRI**	1	R/W	Priority of the High Alarm
28	**HI_LIM**	4	R/W	The setting of the High Limit producing the High Alarm. This value is expressed in OUT_SCALE Unit Code
29	**LO_PRI**	1	R/W	Priority of the Low Alarm
30	**LO_LIM**	4	R/W	The setting of the Low Limit producing the Low Alarm. This value is expressed in OUT_SCALE Unit Code
31	**LO_LO_PRI**	1	R/W	Priority of the Low Low Alarm
32	**LO_LO_LIM**	4	R/W	The setting of the Low Low Limit producing the Low Low Alarm. This value is expressed in OUT_SCALE Unit Code
33	**HI_HI_ALM**			The HI HI Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
34	**HI_ALM**			The HI Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
35	**LO_ALM**			The LO Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
36	**LO_LO_ALM**			The LO LO Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated

PID FUNCTION BLOCK

Idx	Name	N° byte	PC	Description
0	BLOCK_OBJ	62	mix.	In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on
1	ST_REV	2	R	The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value in the block is changed.
2	TAG_DESC	32	R/W	The user description of the intended application of the block
3	STRATEGY	2	R/W	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	1	R/W	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	1	R/W	Target – The selected mode from the operator.
		1	R	Actual – The mode the block is currently in.
		1	R/W	Permitted – Allowed modes that the target may take on
		1	R/W	Normal – The common mode for the Actual.
6	BLOCK_ERR	2	R	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	PV	4	R	The process variable used in block execution, expressed in PV_SCALE Unit Code
		1	R	The process variable status
8	SP	4	R/W	The analog Set Point value of this block, expressed in PV_SCALE Unit Code
		1	R/W	The analog Set Point status of this block
9	OUT	4	R	The block output value calculated as a result of the block execution, expressed in OUT_SCALE unit code Only when the function block is in Manual MODE this variable can be written
		1	R	The block output status
10	PV_SCALE	4	R/W	High Range — All the values are associated with the PV
		4	R/W	Low Range
		2	R/W	Unit Index
		1	R/W	Decimal point
11	OUT_SCALE	4	R/W	High Range — All the values are associated with the OUT
		4	R/W	Low Range
		2	R/W	Unit Index
		1	R/W	Decimal point
12	GRANT_DENY	1	R/W	Grant
		1	R/W	Deny
13	CONTROL_OPTS	2	R/W	Option which the user may select to alter the calculation done in a control loop. The supported action I the 600T are: - Bypass enabled - SP-PV track in MAN - SP-PV track in Rout - SP-PV track in LO or IMAN - SP track retained target - Direct acting - Track enable - Track in Manual - Use PV for BKCAL_OUT - No out limits in Manual
14	STATUS_OPTS	2	R/W	Option which the user can select block processing of status. The available selections are: - Initiate Fault Sate if BAD IN - Initiate Fault Sate if BAD CAS_IN - Use Uncertain as Good - Target to Manual if BAD IN - Target AUTO if BAD CAS_IN
15	IN	4	R/W	The Primary Input Value for the block coming from another block, Expressed in PV_SCALE Unit Code
		1	R/W	The Primary Input Status

16	**PV_FTIME**	4	R/W	Time constant of a single exponential filter for the PV, expressed in seconds. This is the time necessary for reach the 63% of the variation of IN value.	
17	**BYPASS**	1	R/W	The normal control algorithm may be bypassed trough this parameter. When bypass is set, the set point value (in percent) will be directly transferred to the output.	
18	**CAS_IN**	4	R/W	Remote set point value from another block. Expressed in PV_SCALE Unit Code	
		1	R/W	Remote set point status from another block	
19	**SP_RATE_DN**	4	R/W	Ramp rate for downward SP changes. When the ramp rate is set to zero the SP is used immediately. Expressed in PV_SCALE Unit Code per seconds	
20	**SP_RATE_UP**	4	R/W	Ramp rate for upward SP changes. When the ramp rate is set to zero the SP is used immediately. Expressed in PV_SCALE Unit Code per seconds	
21	**SP_HI_LIM**	4	R/W	The Highest Set Point value allowed. Expressed in PV_SCALE Unit Code	
22	**SP_LO_LIM**	4	R/W	The Lowest Set Point value allowed. Expressed in PV_SCALE Unit Code	
23	**GAIN**	4	R/W	The proportional gain value.	
24	**RESET**	4	R/W	The integral time constant, in seconds per repeat.	
25	**BAL_TIME**	4	R/W	The specified time for the internal working value of bias to return to operator set bias. Also used to specify the time constant at which the integral term will move to obtain balance when the output is limited and the mode is AUTO, CAS, or RCAS. Expressed in seconds	
26	**RATE**	4	R/W	The derivative action time constant expressed in seconds	
27	**BKCAL_IN**	4	R/W	The analog input value from another block's BKCAL_OUT output that is used to prevent reset windup and to initialize the control loop. Expressed in OUT_SCALE Unit Code	
		1	R/W	Back Calculation Input Status	
28	**OUT_HI_LIM**	4	R/W	The max. Output value allowed. Expressed in OUT_SCALE Unit Code	
29	**OUT_LO_LIM**	4	R/W	The min. Output value allowed. Expressed in OUT_SCALE Unit Code	
30	**BKCAL_HYS**	4	R	The amount that the output must change away from its output limit before the limit status is turned off. Expressed as percent of the OUT_SCALE span	
31	**BKCAL_OUT**	4	R	The value required by an upper block's BKCAL_IN so that the upper block may prevent reset windup and provide bumpless transfer to closed control loop. Expressed in PV_SCALE Unit Code	
		1	R	Back Calculation Status	
32	**RCAS_IN**	4	R/W	Target setpoint value provided by a supervisory host. Used when mode is RCAS. Expressed in PV_SCALE Unit Code.	
		1	R/W	RCAS_IN Status	
33	**ROUT_IN**	4	R/W	Target output value provided by a supervisory host. Used when the mode is ROUT. Expressed in OUT_SCALE Unit Code	
		1	R/W	ROUT_IN Status	
34	**SHED_OPT**	1	R/W	Define actions to be taken on remote control device timeout	
35	**RCAS_OUT**	4	R	Block setpoint Value after ramping – provided by a supervisory host for back calculations and to allow action to be taken under limiting conditions or mode change. Used when mode is RCAS. Expressed in PV_SCALE Unit Code	
		1	R	RCAS_OUT Status	
36	**ROUT_OUT**	4	R	Block output Value provided to a supervisory host for a back calculation to allow action to be taken under limiting conditions or mode change. Used when mode is ROUT. Expressed in OUT_SCALE Unit Code	
		1	R	ROUT_OUT Status	
37	**TRK_SCALE**	4	R/W	High Range	All the values are associated with the external tracking value (TRK_VAL)
		4	R/W	Low Range	
		2	R/W	Unit Index	
		1	R/W	Decimal point	
38	**TRK_IN_D**	2	R/W	Discrete input used to initiate external tracking of the block output to the value specified by the TRK_VAL	

39	**TRK_VAL**	4	R/W	This input is used as tack value when external tracking is enabled by TRK_IN_D. Expressed in TRK_SCALE Unit Code.	
		1	R/W	Tracking Status	
40	**FF_VAL**	4	R/W	The Feed-Forward Control Value. Expressed in FF_SCALE Unit Code	
		1	R/W	The Feed-Forward Control Status	
41	**FF_SCALE**	4	R/W	High Range	All the values are associated with the feed forward value (FF_VAL)
		4	R/W	Low Range	
		2	R/W	Unit Index	
		1	R/W	Decimal point	
42	**FF_GAIN**	4	R/W	The gain that the feed forward input is multiplied by before it is added to the calculated control loop.	
43	**UPDATE_EVT**			This alert is generated by any change to the static data	
		1	R/W	Unacknowledged	
		1	R	Update State	
		8	R	Time Stamp: The date and time of when the alert was generated	
		2	R	Static Revision	
		2	R	Relative Index	
44	**BLOCK_ALM**			The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Actve Status, if the subcode has changed	
		1	R/W	Unacknowledged	
		1	R	Alarm State	
		8	R	Time Stamp: The date and time of when the alert was generated	
		2	R	Subcode	
		1	R	Value	
45	**ALARM_SUM**			The summary alarm is used for all process alarm in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Actve Status, if the subcode has changed	
		2	R	Current	
		2	R	Unacknowledged	
		2	R	Unreported	
		2	R/W	Disabled	
46	**ACK_OPTION**	2	R/W	Used to set auto acknowledgment of the alarms	
47	**ALARM_HYS**	4	R/W	Amount the PV must return within the alarm limit before the alarm condition clears. Alarm Hysteresis is expressed as percent of the OUT_SCALE span.	
48	**HI_HI_PRI**	1	R/W	Priority of the High High Alarm	
49	**HI_HI_LIM**	4	R/W	The setting of the High High Limit producing the High High Alarm. This value is expressed in OUT_SCALE Unit Code	
50	**HI_PRI**	1	R/W	Priority of the High Alarm	
51	**HI_LIM**	4	R/W	The setting of the High Limit producing the High Alarm. This value is expressed in OUT_SCALE Unit Code	
52	**LO_PRI**	1	R/W	Priority of the Low Alarm	
53	**LO_LIM**	4	R/W	The setting of the Low Limit producing the Low Alarm. This value is expressed in OUT_SCALE Unit Code	
54	**LO_LO_PRI**	1	R/W	Priority of the Low Low Alarm	
55	**LO_LO_LIM**	4	R/W	The setting of the Low Low Limit producing the Low Low Alarm. This value is expressed in OUT_SCALE Unit Code	
56	**DV_HI_PRI**	1	R/W	The Priority of the Deviation High alarm	
57	**DV_HI_LIM**	4	R/W	The setting of the Deviation High Limit producing the Deviation High Alarm. This value is expressed in OUT_SCALE Unit Code	
58	**DV_LO_PRI**	1	R/W	The Priority of the Deviation Low alarm	

59	**DV_LO_LIM**	4	R/W	The setting of the Deviation Low Limit producing the Deviation Low Alarm. This value is expressed in OUT_SCALE Unit Code
60	**HI_HI_ALM**			The HI HI Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
61	**HI_ALM**			The HI Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
62	**LO_ALM**			The LO Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
63	**LO_LO_ALM**			The LO LO Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
64	**DV_HI_ALM**			The Deviation HI Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated
65	**DV_LO_ALM**			The Deviation LO Alarm data
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		4	R	Value: The date and time of when the alert was generated

PRESSURE TRANSDUCER BLOCK

Idx	Name	N° byte	PC	Description
0	**BLOCK_OBJ**	62	mix.	In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on
1	**ST_REV**	2	R	The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value in the block is changed.
2	**TAG_DESC**	32	R/W	The user description of the intended application of the block
3	**STRATEGY**	2	R/W	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	**ALERT_KEY**	1	R/W	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	**MODE_BLK**	1	R/W	Target – The selected mode from the operator.
		1	R	Actual – The mode the block is currently in.
		1	R/W	Permitted – Allowed modes that the target may take on
		1	R/W	Normal – The common mode for the Actual.
6	**BLOCK_ERR**	2	R	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	**UPDATE_EVT**			This alert is generated by any change to the static data
		1	R/W	Unacknowledged
		1	R	Update State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Static Revision
		2	R	Relative Index
8	**BLOCK_ALM**			The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed
		1	R/W	Unacknowledged
		1	R	Alarm State
		8	R	Time Stamp: The date and time of when the alert was generated
		2	R	Subcode
		1	R	Value
9	**TRANSDUCER_ DIRECTORY**	4	R	Directory that specifies the number and starting indices of the transducers in the transducer block
10	**TRANSDUCER_ TYPE**	2	R	Identifies the transducer type – **For the 600T_EN FF it is 100 = Standard Pressure with calibration**
11	**XD_ERROR**	1	R	Transducer block error subcode
12	**COLLECTION_ DIRECTORY**	36	R	Directory that specifies the number, starting indices, and the DD items IDs of the data collections in each transducer within a transducer block
13	**PRIMARY_ VALUE_TYPE**	2	R/W	Type of measurement representing the primary value. The default measurement type is Differential Pressure. When writing on this parameter is performed in order to switch the device as Flow, Level or Volume measurement, the device should go in O/S mode until all the necessary TB and AIFB variables are not properly configured. **101** Volumetric Flow **109** Absolute Pressure **107** Differential Pressure **110** Level **108** Gauge Pressure **200** Volume

14	**PRIMARY_ VALUE**	4	R	This is the output value from the TB and input for the AIFB when the CHANNEL selection is = 1. It is always represented in the PRIMARY_VALUE_RANGE Unit Code	
		1	R	This is the output status from the TB	
15	**PRIMARY_ VALUE_RANGE**	4	R	High Range	All the values are associated with the Primary value (Primary_Value).
		4	R	Low Range	This parameter is read only and it is always a copy of the XD_SCALE of the AIFB having the Channel selection = 1.
		2	R	Unit Index	Whenever writing on XD_SCALE of the AIFB selected with CHANNEL = 1 are performed, the PRIMARY_VALUE_RANGE is updated in the same way.
		1	R	Decimal point	The usable units code are the same of the XD_SCALE in the Analog Input Function Block
16	**CAL_POINT_HI**	4	R/W	The Highest calibrated value	
17	**CAL_POINT_LO**	4	R/W	The lowest calibrated value	
18	**CAL_MIN_SPAN**	4	R	The minimum span to be used between the calibration points, high and low.	
19	**CAL_UNIT**	2	R/W	Calibration Unit. Only Pressure unit code are usable See in the Analog Input Function Block Table the XD_SCALE Unit Code the allowed **Code for Pressure**	
20	**SENSOR_TYPE**	2	R/W	Type of sensor. **The 600T_EN is –121 - Pressure sensor unknown**	
21	**SENSOR_RANGE**	4 4 2 1	R R R R	High Range Low Range Unit Index Decimal point	All the values represent the physical sensor limits. See in the Analog Input Function Block Table the XD_SCALE Unit Code the allowed **Code for Pressure**
22	**SENSOR_SN**	32	R	Serial Number of the sensor	
23	**SENSOR_CAL_ METHOD**	1	R/W	Calibration Method	
24	**SENS_CAL_LOC**	32	R/W	The last location of the sensor Calibration	
25	**SENS_CAL_DATE**	7	R/W	The last date on which the calibration was performed	
26	**SENS_CAL_WHO**	32	R/W	The name of the person responsible of the last sensor calibration	
27	**SENS_ISOL_MTL**	2	R	Type of materials for sensor isolator: **104** Monel 400 **125** 17-4-PH **105** Tantalum **130** Hastelloy C276 **119** AISI 316L Stainless Steel	
28	**SENSOR_FILL_ FLUID**	2	R	Type of Fill Fluid used in the sensor: **1** Silicone Oil **50** Inert Oil (Galden) **2** Inert Oil (Fluorolube)	
29	**SECONDARY_ VALUE_1**	4	R	This is the Sensor temperature value to be linked in input to the AIFB when the CHANNEL = 2 is selected. Expressed in SECONDARY_VALUE_UNIT_1	
		1	R	This is the Sensor temperature Status	
30	**SECONDARY_ VALUE_UNIT_1**	2	R/W	Sensor Temperature Unit. The allowed units are: **1000** Kelvin **1002** Fahrenheit Degree **1001** Celsius Degree **1003** Rankine Degree	
31	**SECONDARY_ VALUE_2**	4	R	This is the Static Pressure value to be linked in input to the AIFB when the CHANNEL = 5 is selected. Expressed in SECONDARY_VALUE_UNIT_2	
		1	R	This is the Static Pressure Status	
32	**SECONDARY_ VALUE_UNIT_2**	2	R/W	Static Pressure Unit. Only Pressure unit code are usable See in the Analog Input Function Block Table the XD_SCALE Unit Code the allowed **Code for Pressure**	
33	**SECONDARY_ VALUE_3**	4	R	This is the Process Pressure Value available when the PRIMARY_VALUE_TYPE is selected as Flow, Level or Volume, **see also the Figure 14.** This Pressure Value can be linked in input to the AIFB when the CHANNEL = 3 is selected. Expressed in SECONDARY_VALUE_UNIT_3	
		1	R	This is the Process Pressure Status when the PRIMARY_VALUE_TYPE is different by pressure	

34	**SECONDARY_ VALUE_UNIT_3**	2	R/W	Process Pressure Unit. Only Pressure unit code are usable See in the Analog Input Function Block Table the XD_SCALE Unit Code the allowed **Code for Pressure**
35	**SECONDARY_ VALUE_4**	4	R	This is the Normalised Pressure Value. It is expressed always in percentage of the Input Scaling. **See also the Figure 14**
		1	R	This is the Normalised Pressure Status
36	**SECONDARY_ VALUE_UNIT_4**	2	R	This unit is always percentage **(%)**
37	**CHANNEL_MAP**	5	R/W	An optional parameter that aids in the correlation of channels in a device to channels as defined for a plant or process area.
38	**LIN_TYPE**	1	R/W	Manufacturer specific Linearisation Type available for converting the Pressure value in Flow, Level or Volume depending by the PRIMARY_VALUE_TYPE selection. The available types are: **0** undefined **1** linear with input **2** linear with output **3** square root **4** square root to the third power **5** square root to the fifth power **200** Table
39	**TRIMMED_ VALUE**	4	R	This is the Pressure value used as reference for the Calibration operation. **See also the section 12**.
		1	R	This the Trimmed Value Status
40	**O_RING_MTL**	2	R/W	Type of materials for the O-ring: **110** PTFE **111** Viton **112** Buna-N **139** TFE Glass Filled
41	**FLANGE_TYPE**	2	R/W	Type of Flanges: **12** Conventional **14** Remote Seal **53** Level Flange Type Flush **54** Level Flange Type Extended **55** Welded Flange **56** Level Sanitary **57** Level Food **58** No Flange, Direct Connection **59** All Welded for Remote Seal **60** Gasketed for Remote Seal
42	**FLANGE_ MATERIAL**	2	R/W	Type of material for the Flange: **100** Carbon Steel **102** AISI 316 Stainless Steel **103** Hastelloy C **104** Monel 400 **119** AISI 316L Stainless Steel **125** 17-4-PH
43	**DRAIN_VENT_ MATERIAL**	2	R/W	Type of material of the Drain Vent: **103** Hastelloy C **104** Monel 400 **119** AISI 316L Stainless Steel **251** None
44	**REMOTE_SEAL_ TYPE**	2	R	Type of remote seals: **51** Wafer **55** Off line threated **56** Chemical Tee **57** Button **58** Triclamp & Cherry Burrell **59** Alimentary **60** Union Connection **61** Aseptic **62** Off line flanged connection **63** Sanitary Flush **64** Sanitary Extended **65** Flush Flanged **66** Extended Flanged **67** Urea Service
45	**REMOTE_SEAL_ FILL_FLUID**	2	R	Type of Fill fluid for the remote seals: **1** Silicon Oil **2** Inert Oil (Fluorolube) **50** Inert Oil (Galden) **51** Glyceryn + H2O **54** Santotherm **55** Silicone Oil food **56** Neobee **57** Dowtherm **58** Ethyl benzene **59** Ethyl Alcohol **60** Propylene Glycol/Water **61** Dibutyl Penthalate **62** Siltherm 800 **63** Mercury **253** Special

46	**REMOTE_SEAL_ ISOLATOR**	2	R	Type of remote seals isolator: **104** Monel 400 **130** Hastelloy C276 **105** Tantalum **142** AISI 316L TFE Coated **119** AISI 316L Stainless Steel **155** Hastelloy C276 TFE Coated
47	**NUMBER_ REMOTE_SEAL**	1	R	Number of remote seals: **1** One Seal **2** Two Seals **251** None
48	**CALIBRATION_ TYPE**	1	R	Type of Calibration: **100** Standard **102** Special Temperature **101** Special Line Pressure **103** Special Line Pressure and Temp.
49	**PROCEDURE_ TYPE**	1	R	Type of procedure: **1** None **4** Hydrogen Preparation **2** Oxygen Cleaning **5** Special degreasing **3** Chlorine Cleaning
50	**HIGH_TEMP_LIM**	4	R	Highest allowed temperature limit. +85°C for the 600T_EN. This is expressed in SECONDARY_VALUE_UNIT_2
51	**LOW_TEMP_LIM**	4	R	Lowest allowed temperature limit. –40°C for the 600T_EN. This is expressed in SECONDARY_VALUE_UNIT_2
52	**MAX_WORK_ PRESS_UNIT**	2	R/W	Maximum working pressure Unit code. Only Pressure unit code are usable See in the Analog Input Function Block Table the XD_SCALE Unit Code the allowed **Code for Pressure**
53	**MAX_WORK_ PRESSURE**	4	R/W	Max allowed working pressure of the sensor.
54	**STATIC_PRESS_T RIM**	4	R/W	Value at which the Static Pressure has been adjusted to. Expressed in MAX_WORK_PRESS_UNIT
55	**SCALE_IN**	4 4 2 1	R/W R/W R/W R/W	High Range Low Range Unit Index Decimal point All the values represent the input scaling, **see also the Figure 14.** Only Pressure unit code are usable See in the Analog Input Function Block Table the XD_SCALE Unit Code the allowed **Code for Pressure**
56	**FLW_CUT_OFF**	4	R/W	Limit used in square root processing. A value of zero percent of scale is used in block processing if the transducer falls below this limit, in % of input scale. The features may be used to eliminate noise near zero for a flow sensor. The FLW_CUT_OFF has to be always lower than the LIN_SQR_PNT. The accepted values are between 0 – 15% of the input scale. **See also the figure 15.**
57	**LIN_SQR_PNT**	4	R/W	Limit used in square root processing. Starting from the FLW_CUT_OFF value a linear part is applied before to apply the square root function. The LIN_SQR_PNT has to be always greater than the FLW_CUT_OFF. The accepted values are between 0 – 20% of the input scale. **See also the figure 15.**
58	**TAB_ACT_NUM**	1	R	Number of X, Y points currently defined and used, of the 21 available.
59	**TAB_INDEX**	1	R/W	This parameter identify which element of the table is in the X_VALUE and Y_VALUE parameter currently
60	**TAB_MAX_NUM**	1	R	Maximum number of X, Y elements as points of the linearisation table. The 600T_EN has max.21 X, Y points available
61	**TAB_MIN_NUM**	1	R	Minimum number of X, Y elements as points of the linearisation table. The 600T_EN has minimum 2 points at least always defined
62	**TAB_OP_CODE**	1	R/W	This parameter controls the transaction of the table. The type of operations to be applied for the table handling are: - **0** – Not Initialzed - **1** – New Operation characteristic, first value (TAB_ENTRY = 1) - **2** – No Operation - **3** – Last value, end transmission, check table, swap the old curve with the new curve, update TAB_ACT_NUM

63	**TAB_STATUS**	1	R	This is the result of a plausibility check in the device after the table setting. The possible status are: - **0** not initialized - **1** Good (new table is valid) - **2** not monotonous increasing (old table is valid) - **3** not monotonous decreasing (old table is valid) - **4** not enough value transmitted (old table is valid) - **5** too many values transmitted (old table is valid) - **6** gradient of edge too high (old table is valid) - **7** Values not excepted (old table is valid)
64	**TAB_X_Y_VALUE**	168	R/W	Couple of X, Y value for the linearisation table setting up to 21 elements
65	**LCD_VAL_SEL**	1	R/W	Type of variable to be displayed on the local display: **100** Primary Value **104** FB_2 output percent **101** FB_1 output value **105** Sensor Value **102** FB_2 output value **106** Sensor Value Percent **103** FB_1 output percent **107** Trimmed value
66	**LCD_INST**	1	R	Indication about the installation of the Display on the transmitter: **100** Not Installed **101** Installed
67	**KEY_ENABLE**	1	R/W	Local operations enabled/disabled. The Push buttons can be selected as: **100** Push Buttons Enabled **101** Push Buttons Disabled
68	**MODULE_TYPE**	2	R	Type of sensor module: **107** Differential pressure **101** Absolute Pressure **100** Gauge Pressure
69	**AUTO_CONFIG**	1	R/W	Auto_config Enable / Disable. When this variable is set to TRUE, at every AIFB_CHANNEL writing/changing or at every PRIMARY_VALUE_TYPE selection, all the AIFB and TB variables are automatically set with default values consistent for the kind of selected measure/channel linked in input at the AIFB.
70	**TR_CODE**	16	R/W	Transmitter product code. The same printed on the type plate
71	**REM_SEAL_ CODE_H**	16	R/W	Remote seal side H code
72	**REM_SEAL_ CODE_L**	16	R/W	Remote seal side L code
73	**PRIV_HW_REV**	1	R	Private HW revision
74	**PRIV_SW_REV**	1	R	Private SW revision
75	**PWR_ON_CNT**	2	R	Power On Counter .This counter represents the number of power on of the device. After a defined number of power-on cycles an alert notification is sent to the Master.
76	**OVER_RNG_ CNT**	2	R/W	Over-range Counter. For diagnostic purpose each overrange occurrence is counted. This counter can be cleared by the operator writing command
77	**OVER_TEMP_ CNT**	2	R/W	Over Sensor Temp. Counter For diagnostic purpose each time the sensor temperature goes outside the HIGH_TEMP_LIMIT and/or LOW_TEMP_LIMIT the occurrence is counted. This counter can be cleared by the operator writing command
78	**OVER_STAT_ CNT**	2	R/W	Over Static Press. Counter. For diagnostic purpose each time the static pressure goes outside the MAX_WORK_PRESS the occurrence is counted. This counter can be cleared by the operator writing command
79	**TOT_WORK_ HOUR**	6	R	Total Working hours. Total amount of time that the transmitter has been in switched on
80	**PAR_WORK_ HOUR**	6	R/W	Partial Working hours. Partial amount of time the transmitter has been in switched on. This data can be cleared by the operator writing command.
81	**MANUFACTORY_ BLOCK_ERR**	2	R	Manufacturer block error. In this variable are included additional block errors bit. **See details in the section 13.4**
82	**PRIVATE_ INDEX**	32	R/W	Manufacturer Read/write command. Factory usage only for specific maintenance/setting operations

9. - Operating Modes

As defined by the FOUNDATION™ fieldbus specifications, the Resource and Function Blocks have to satisfy defined operating modes each represented by a proper bit in the MODE_BLK_PERMITTED data structure. (See section 8)

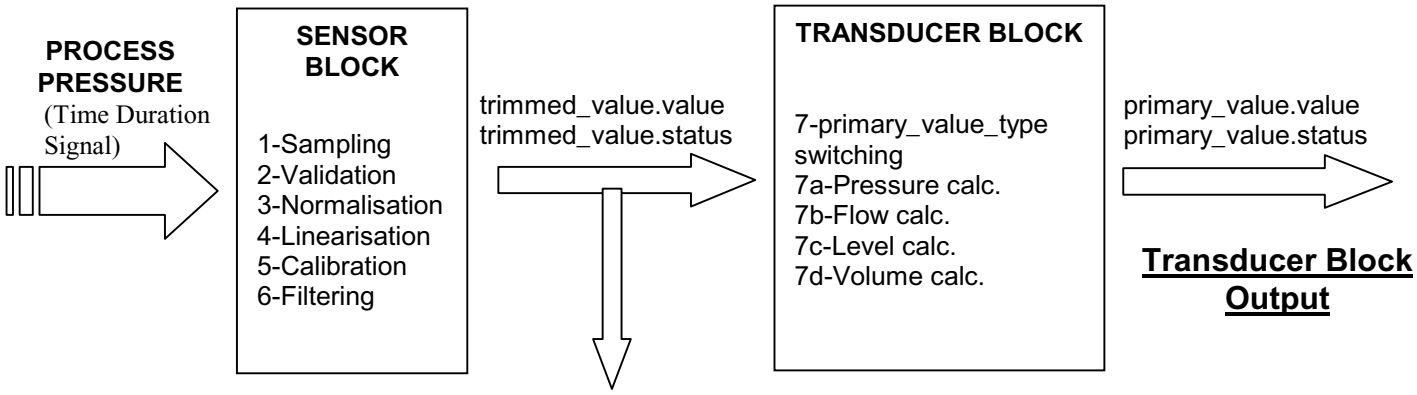
The AIFB supports	The PID FB supports	The RB supports	The TB supports
- Manual (MAN)	- Manual (MAN)	- IMAN	- AUTO
- Automatic (AUTO)	- Automatic (AUTO)	- AUTO	- O/S
- Out of Service (O/S)	- Out of Service (O/S)	- O/S	
	- IMAN (Initialisation Manual)		
	- CAS (Cascade)		
	- RCAS (Remote Cascade)		
	- ROUT (Remote Output)		
	- LO (Local Override)		

When the RB is Out of Service, all the other blocks are forced in Out of Service too.

10. – Process Flow

Depending by the selected TB_PRIMARY_VALUE_TPE the device assumes different operating modes just to produce in output from the TB one of various measurement types. The Pressure Value is the standard or default measurement, but are available also the Flow, Level and Volume measurements.
These different operating modes require the configuration of additional manufacturer specific parameters defined in the TB and then used by different algorithms in order to perform the necessary conversions.
The Figure 11 shows the main function steps executed inside the Transducer Block DSP, starting from the acquisition until the TB output producing.

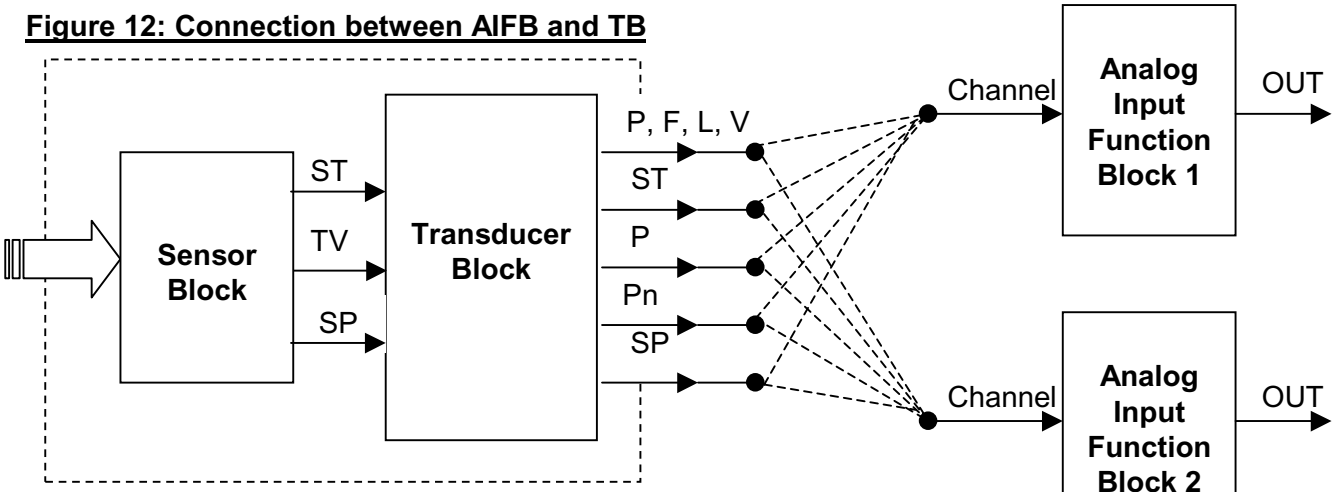
Figure 11: Transducer Block DSP



The Analog Input Function blocks receive in input one of the values produced by the Transducer Block selected through the AIFB_CHANNEL number. The default selection for the AIFB_1 is the process variable (Channel 1), the default for the AIFB_2 is the Sensor Temperature (Channel 2).
Whenever the transmitter, previous selected as Pressure type, is then selected for one of the other measure type (i.e. Flow, Level or Volume), the connected AIFB variables (i.e. Unit code, ranges and so on) have to be properly configured with consistent values for the new measure type.

The following Figure 12 shows the possible connections between the 2 AIFBs and the variables in output from the Transducer Block.

Figure 12: Connection between AIFB and TB



TV = Trimmed value (only Pressure units. See section 8)
P = Pressure
F = Flow
Pn = Normalised Pressure
V = Volume
ST = Sensor Temperature
SP = Static Pressure

Here is a more detailed representation of the operation performed by the DSP algorithm every loop and already described above.

Figure 13: Sensor Block

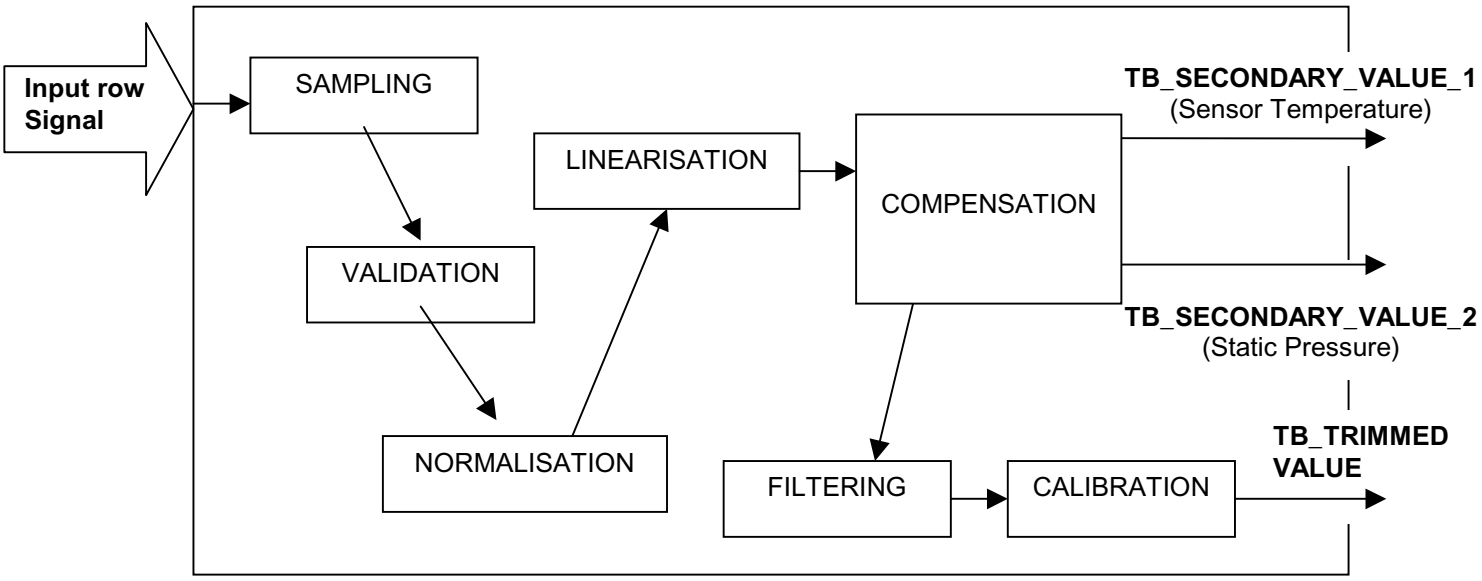


Figure 14: Custom Pressure Transducer Block

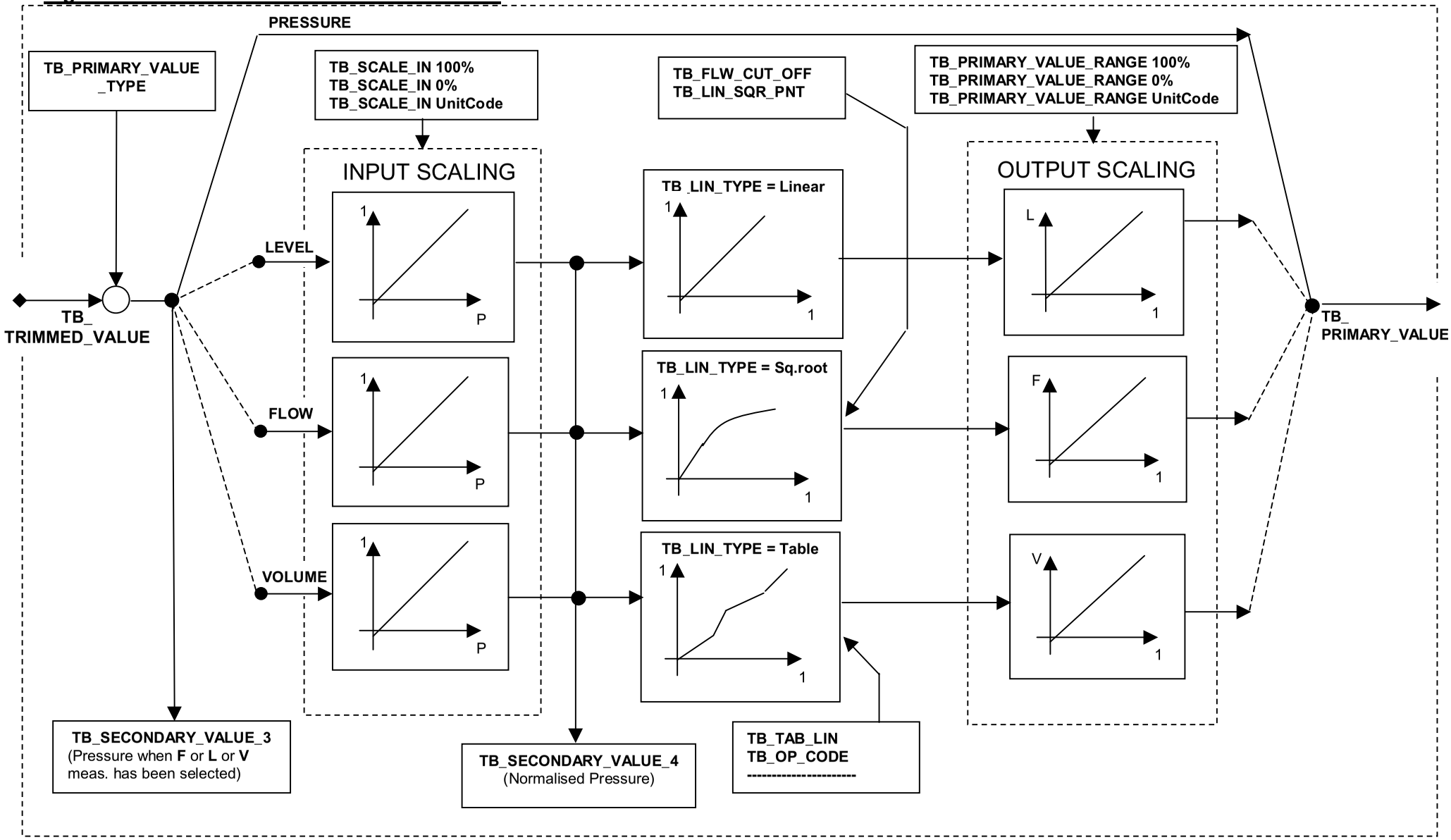
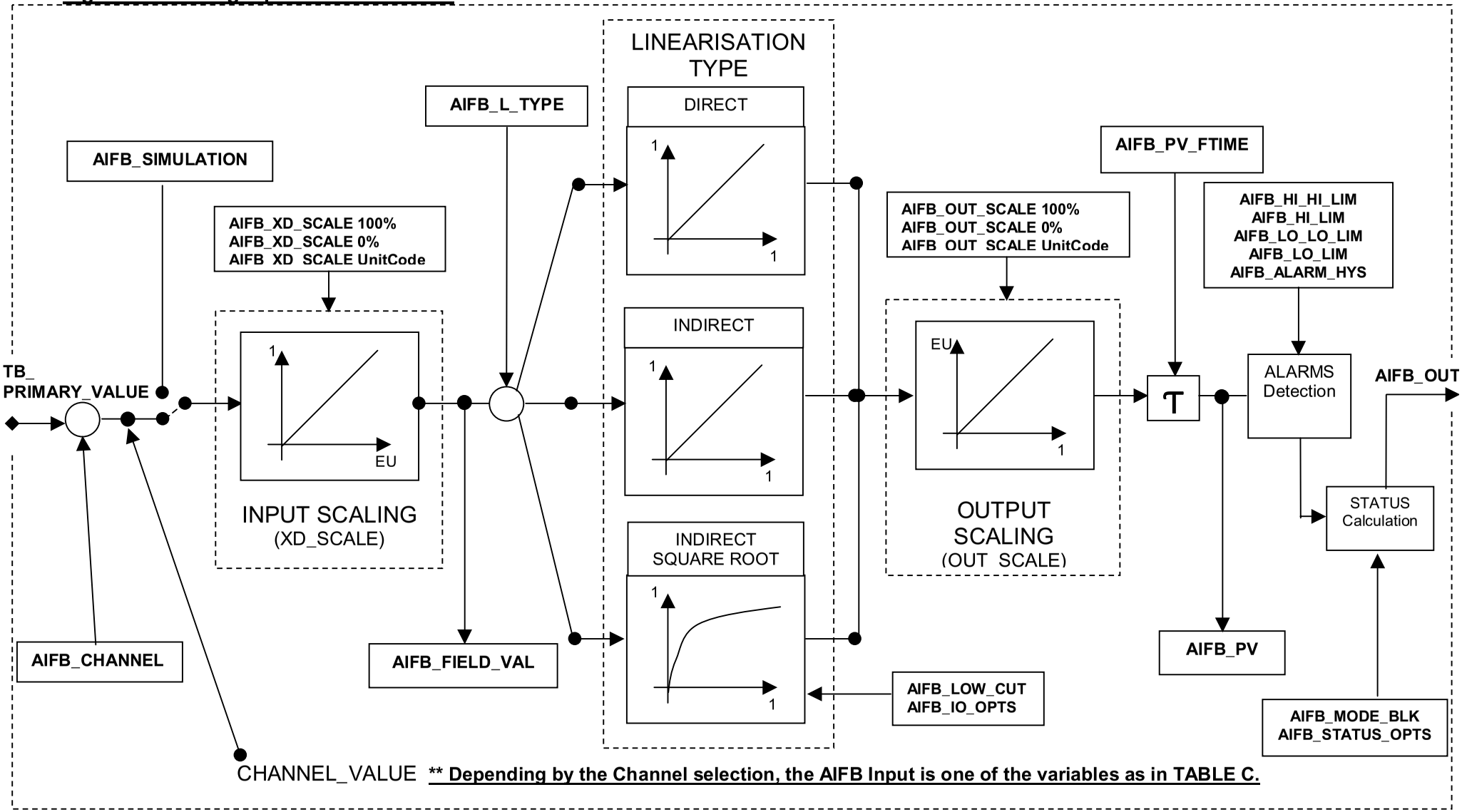


Figure 15: Analog Input Function Block

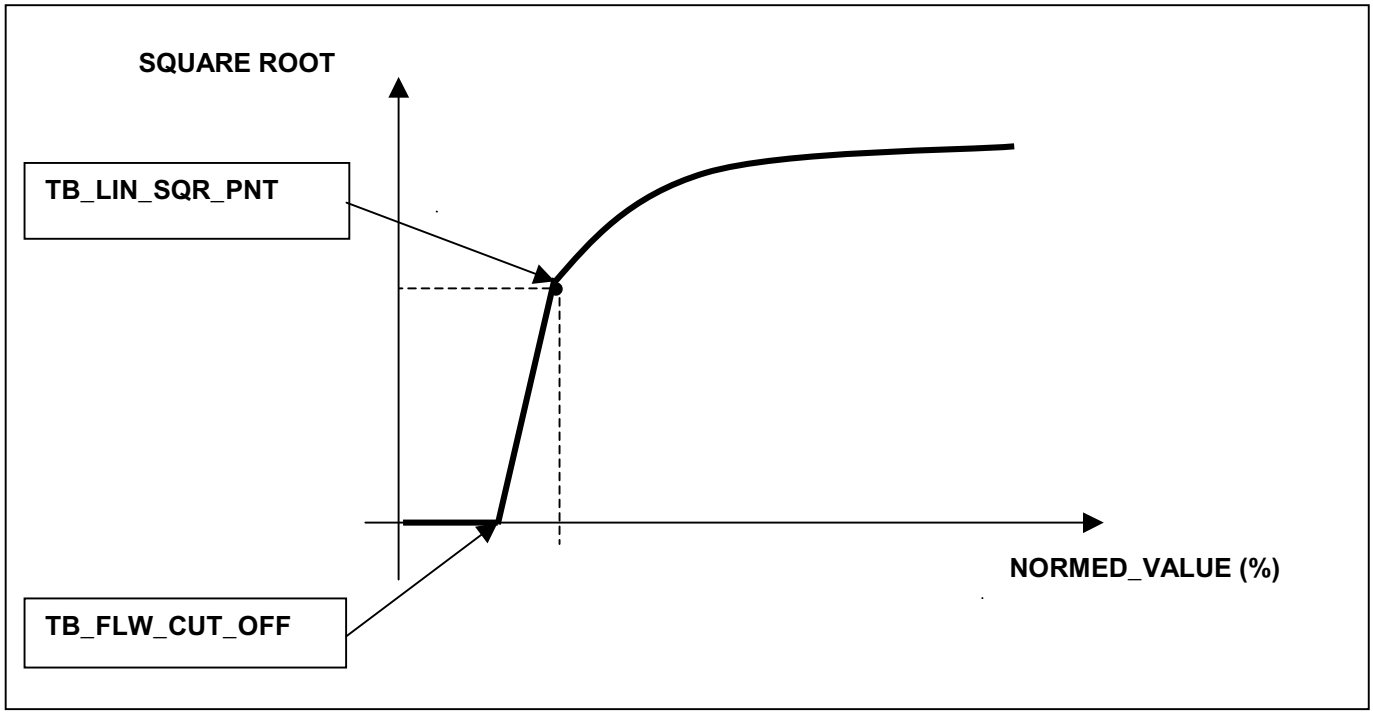


**** Depending by the Channel selection, the AIFB Input is one of the variables as in TABLE C.**

The Square Root function and relating setting is represented in the Figure 16.
- The TB_LIN_SQR_PNT can be set between 0 to 20% of the input
- The TB_FLW_CUT_OFF can be set between 0 to 15% of the input

The TB_LIN_SQR_PNT must to be always greater than the TB_FLW_CUT_OFF.

Figure 16: Square Root Function



10.1 - Transducer Block Algorithms

Referring to the Figure 14 these are the calculation internally executed:

SECONDARY_VALUE_3 = TRIMMED_VALUE (converted in TB_SCALE_IN UnitCode for monitoring only)

SECONDARY_VALUE_4 = (TRIMMED_VALUE – SCALE_IN_0%) / (SCALE_IN_100% - SCALE_IN_0%)

Depending from the TB_PRIMARY_VALUE_TYPE selection, the internal calculations proceed as follow:

Pressure:
PRIMARY_VALUE = TRIMMED_VALUE

Level:
PRIMARY_VALUE = SECONDARY_VALUE_4 * (PRIMARY_VALUE_RANGE_100% - PRIMARY_VALUE_RANGE_0%) - PRIMARY_VALUE_RANGE_0%

Flow:
PRIMARY_VALUE = sqr(SECONDARY_VALUE_4) * (PRIMARY_VALUE_RANGE_100% - PRIMARY_VALUE_RANGE_0%) - PRIMARY_VALUE_RANGE_0%

Volume:
PRIMARY_VALUE = ƒ table (SECONDARY_VALUE_4) * (PRIMARY_VALUE_RANGE_100% - PRIMARY_VALUE_RANGE_0%) - PRIMARY_VALUE_RANGE_0%

10.2 - Analog Input Function Block Algorithms

Referring to the Figure 15 these are the calculation internally executed:

FIELD_VAL = 100 * (CHANNEL_VALUE – XD_SCALE_0%) / (XD_SCALE_100% - XD_SCALE_0%)

Depending by the L_TYPE parameters selection there are applied the following signal conversions:

Direct: PV = CHANNEL_VALUE
Indirect: PV = FIELD_VAL / 100 * (OUT_SCALE_100% - OUT_SCALE_0%) + OUT_SCALE_0%

This conversion is applied when the XD_SCALE values are different from the OUT_SCALE values.

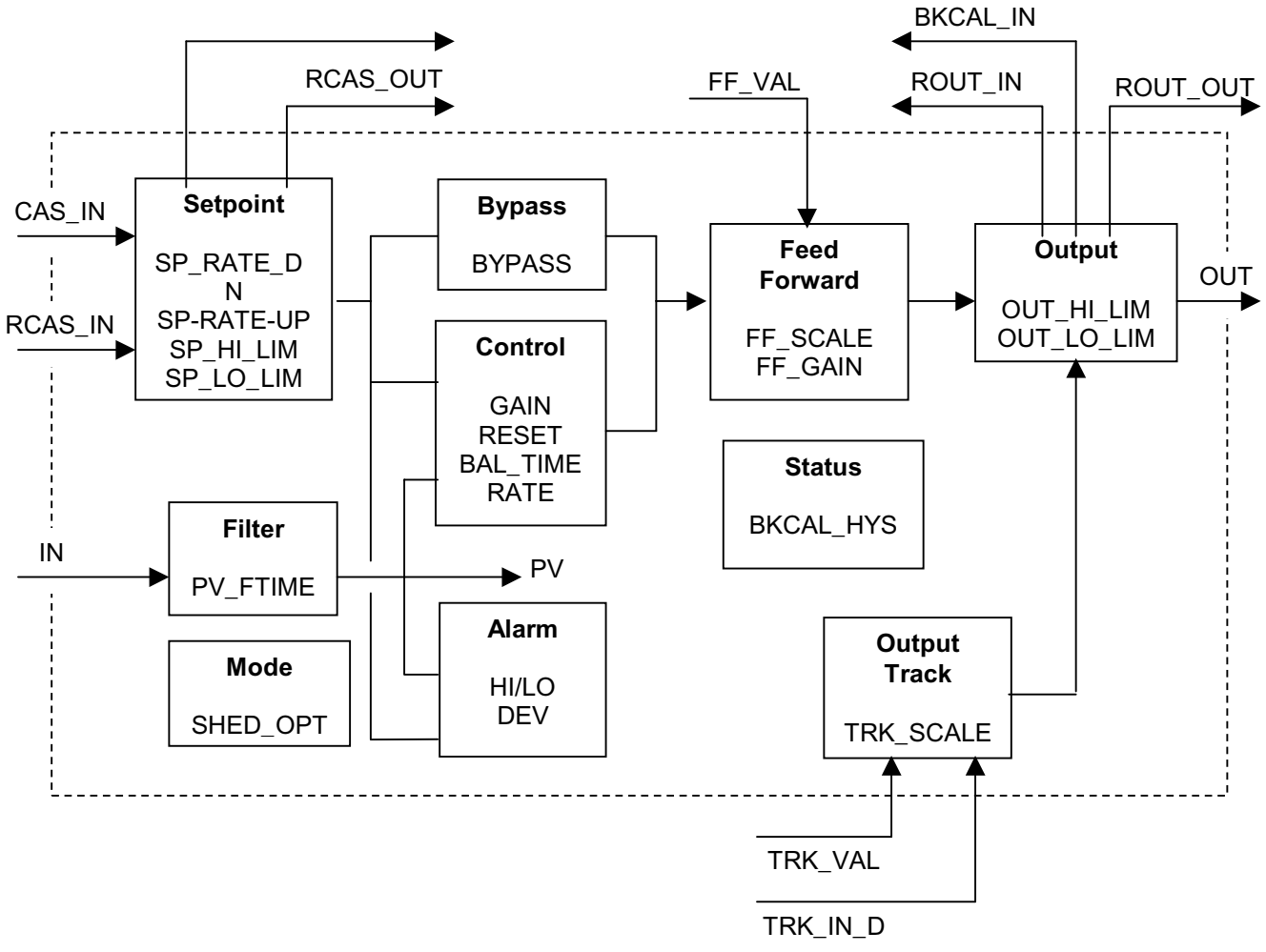
Indirect Square Root:

IF FIELD_VAL < LOW_CUT
PV = OUT_SCALE 0%
ELSE
PV = sqr (FIELD_VAL / 100) * (OUT_SCALE_100% - OUT_SCALE_0%) + OUT_SCALE_0%

10.3 – PID Function Block

The PIDFB is available inside the 600T_EN FF as additional network functionality. The PIDFB here contained is not part of the basic functionality of the Pressure Transmitters as well as the AIFB, but it has to be seen as additional functionality to be used, when required, to satisfy the process requirements.
Detail about the implemented PIDFB is represented in the Figure 17.

Figure 17: PID Function Block



The PIDFB receives in input the value produced in output from another block like Analog Input, and provides to apply the algorithm with the Proportional, Integral, Derivative contribute as previously set.
The algorithm applied is as in the following formula:

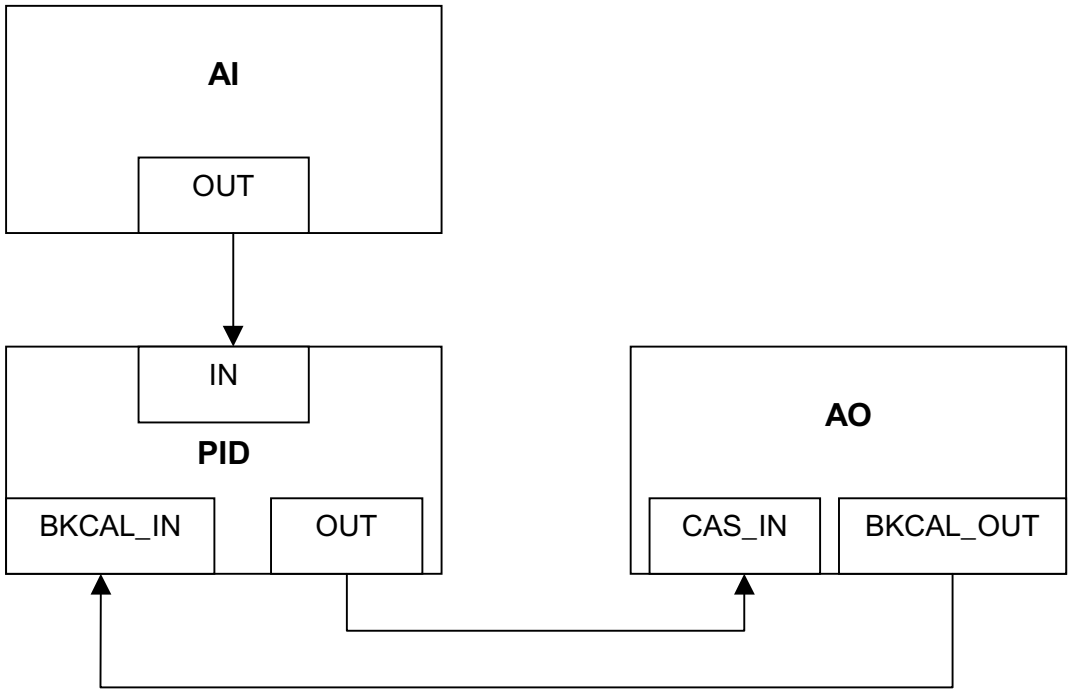
Standard Out = GAIN * e * ((1 + 1/τ_rS + 1) + (τ_dS/ α * τ_dS + 1)) + F

Where:

GAIN:	Proportional Gain Value
τ_r:	Integral action Time constant (RESET Parameter) in seconds
S:	Laplace operator
τ_d:	Derivative action time constant (RATE parameter)
α:	Fixed smoothing factor of 0.1 applied to RATE
F:	Feedforward control contribution from the feedforward input (FF_VAL parameter)
e:	Error between setpoint and process variable

In a simple single loop Feed-back Control as in Figure 18, the parameters communicated are represented by the arrows among the blocks

Figure 18: Parameters communicated for single loop



11. – Commissioning

The 600T_EN FF can be configured for measure Pressure, Flow, Level or Volume.
When the TB_AUTO_CONFIG is set to TRUE, at every AIFB_CHANNEL or PRIMARY_VALUE_TYPE selection, all the relevant variables of the TB and AIFB are automatically set with values consistent with the new selection. i.e. switching the AIFB Channel from Pressure to Temperature, all the units and range values are set to °C and temperature range values, changing the PRIMARY_VALUE_TYPE from Pressure to Flow, all the units and range values are set to cubic meter per hour and the TB_LIN_TYPE to square root. Then the user will set the wanted configuration.

11.1 - Pressure Configuraton

By default the 600T_EN FF is configured and works as Pressure Transmitter. The value produced by the sensor block (TRIMMED_VALUE), is the same in output from the Transducer Block (PRIMARY_VALUE), see the figure 12 and 14. This value is linked in input to the AIFB_1 trough the Channel selection as CHANNEL_VALUE of the formula applied in the section 10.2 AIFB algorithms.
The AIFB_1 is linked with the Primary_value (Channel = 1) and the AIFB_2 is linked with the Sensor_temperature (Channel = 2).

This is the default setting of the 600T_EN FF:
- TB_PRIMARY_VALUE_TYPE = PRESSURE
- TB_SCALE_IN_100% = Not used
- TB_SCALE_IN_05 = Not Used
- TB_SCALE_IN_UnitCode = Not Used
- TB_LIN_TYPE = Not Used
- TB_PRIMARY_VALUE_RANGE_100% = Upper Range Limit (strictly dependent by the sensor type)
- TB_PRIMARY_VALUE_RANGE_0% = Lower Range Limit (strictly dependent by the sensor type)
- TB_PRIMARY_VALUE_RANGE_UnitCode = Kpa

The TB_PRIMARY_VALUE, as output of the TB, is produced by default in Kpa

- AIFB_1_CHANNEL = 1	AIFB_2_CHANNEL = 2
- AIFB_1_XD_SCALE_100% = Upper Range Limit	AIFB_2_XD_SCALE_100% = 90.0
- AIFB_1_XD_SCALE_0% = Lower Range Limit	AIFB_2_XD_SCALE_0% = -40.0
- AIFB_1_XD_SCALE_UnitCode = Kpa	AIFB_2_XD_SCALE_UnitCode = °C
- AIFB_1_L_TYPE = Direct	AIFB_2_L_TYPE = Direct
- AIFB_1_OUT_SCALE_100% = Upper Range Limit	AIFB_2_OUT_SCALE_100% = 90.0
- AIFB_1_OUT_SCALE_0% = Lower Range Limit	AIFB_2_OUT_SCALE_0% = -40.0
- AIFB_1_OUT_SCALE_UnitCode = Kpa	AIFB_2_OUT_SCALE_UnitCode = °C

The AIFB_1_OUT, as output of the Analog Input 1 function Block, produce in output the pressure value in Kpa
The AIFB_2_OUT, as output of the Analog Input 2 function Block, produce in output the Sensor Temperature value in °C

Unless of specific requirements, the AIFB receiving in input the PRIMARY_VALUE works without additional conversions; L_TYPE = direct.

11.2 - Flow Configuraton

When the TB_PRIMARY_VALUE_TYPE is selected as FLOW, the TB_TRIMMED_VALUE goes trough the FLOW algorithm of the Transducer Block in the section 10.1. See also the Figure 14.

- TB_PRIMARY_VALUE_TYPE = FLOW

If the TB_AUTO_CONFIG is set to TRUE, automatically the 600T_EN FF became set as follows:

- TB_SCALE_IN_100% = Upper Range Limit.
- TB_SCALE_IN_05 = 0.0
- TB_SCALE_IN_UnitCode = Kpa
- TB_LIN_TYPE = Square Root
  - TB_LOW_CUT_OFF = 0%
  - TB_LIN_SQR_PNT = 0%
- TB_PRIMARY_VALUE_RANGE_100% = 100.0
- TB_PRIMARY_VALUE_RANGE_0% = 0.0
- TB_PRIMARY_VALUE_RANGE_UnitCode = Cubic Meter per hours

The TB_PRIMARY_VALUE, as output of the TB, is produced by default in Cubic meter per hours

The input scaling (SCALE_IN) always represents the input pressure range, and the output scaling (PRIMARY_VALUE_RANGE) represents the output conversion range.

- AIFB_1_CHANNEL = 1	AIFB_2_CHANNEL = 2
- AIFB_1_XD_SCALE_100% = 100.0	AIFB_2_XD_SCALE_100% = 90.0
- AIFB_1_XD_SCALE_0% = 0.0	AIFB_2_XD_SCALE_0% = -40.0
- AIFB_1_XD_SCALE_UnitCode = Cubic Meter per hours	AIFB_2_XD_SCALE_UnitCode = °C
- AIFB_1_L_TYPE = Direct	AIFB_2_L_TYPE = Direct
- AIFB_1_OUT_SCALE_100% = 100.0	AIFB_2_OUT_SCALE_100% = 90.0
- AIFB_1_OUT_SCALE_0% = 0.0	AIFB_2_OUT_SCALE_0% = -40.0
- AIFB_1_OUT_SCALE_UnitCode = Cubic Meter per hours	AIFB_2_OUT_SCALE_UnitCode = °C

The AIFB_1_OUT, as output of the Analog Input 1 function Block, produce in output the flow value in Cubic Meter per hour
The AIFB_2_OUT, as output of the Analog Input 2 function Block, produce in output the Sensor Temperature value in °C

The user can start from this default and working condition, and then proceed with the real setting of the variables as the application requires.
Unless of specific requirements, the AIFB receiving in input the PRIMARY_VALUE works without additional conversions; L_TYPE = direct.

Note: See also the Table C in the section 6-Initialisation about the allowed Channel selections depending by the PRIMARY_VALUE_TYPE.

11.3 - Level Configuraton

When the TB_PRIMARY_VALUE_TYPE is selected as LEVEL, the TB_TRIMMED_VALUE goes trough the LEVEL algorithm of the Transducer Block in the section 10.1. See also the Figure 14.

- TB_PRIMARY_VALUE_TYPE = LEVEL

If the TB_AUTO_CONFIG is set to TRUE, automatically the 600T_EN FF became set as follows:

- TB_SCALE_IN_100% = Upper Range Limit.
- TB_SCALE_IN_05 = 0.0
- TB_SCALE_IN_UnitCode = Kpa
- TB_LIN_TYPE = Linear
- TB_PRIMARY_VALUE_RANGE_100% = 100.0
- TB_PRIMARY_VALUE_RANGE_0% = 0.0
- TB_PRIMARY_VALUE_RANGE_UnitCode = Meters

The TB_PRIMARY_VALUE, as output of the TB, is produced by default in meters

The input scaling (SCALE_IN) always represents the input pressure range, and the output scaling (PRIMARY_VALUE_RANGE) represents the output conversion range.

- AIFB_1_CHANNEL = 1	AIFB_2_CHANNEL = 2
- AIFB_1_XD_SCALE_100% = 100.0	AIFB_2_XD_SCALE_100% = 90.0
- AIFB_1_XD_SCALE_0% = 0.0	AIFB_2_XD_SCALE_0% = -40.0
- AIFB_1_XD_SCALE_UnitCode = Meters	AIFB_2_XD_SCALE_UnitCode = °C
- AIFB_1_L_TYPE = Direct	AIFB_2_L_TYPE = Direct
- AIFB_1_OUT_SCALE_100% = 100.0	AIFB_2_OUT_SCALE_100% = 90.0
- AIFB_1_OUT_SCALE_0% = 0.0	AIFB_2_OUT_SCALE_0% = -40.0
- AIFB_1_OUT_SCALE_UnitCode = Meters	AIFB_2_OUT_SCALE_UnitCode = °C

The AIFB_1_OUT, as output of the Analog Input 1 function Block, produce in output the Level value in Meters
The AIFB_2_OUT, as output of the Analog Input 2 function Block, produce in output the Sensor Temperature value in °C

The user can start from this default and working condition, and then proceed with the real setting of the variables as the application requires.
Unless of specific requirements, the AIFB receiving in input the PRIMARY_VALUE works without additional conversions; L_TYPE = direct.

Note: See also the Table C in the section 6-Initialisation about the allowed Channel selections depending by the PRIMARY_VALUE_TYPE.

11.4 - Volume Configuraton

When the TB_PRIMARY_VALUE_TYPE is selected as VOLUME, the TB_TRIMMED_VALUE goes trough the VOLUME algorithm of the Transducer Block in the section 10.1. See also the Figure 14.

- TB_PRIMARY_VALUE_TYPE = VOLUME

If the TB_AUTO_CONFIG is set to TRUE, automatically the 600T_EN FF became set as follows:

- TB_SCALE_IN_100% = Upper Range Limit.
- TB_SCALE_IN_05 = 0.0
- TB_SCALE_IN_UnitCode = Kpa
- TB_LIN_TYPE = Table
  - TB_TAB_X_Y_VALUE = SEE THE TABLE SETTING PROCEDURE 11.4.1.
- TB_PRIMARY_VALUE_RANGE_100% = 100.0
- TB_PRIMARY_VALUE_RANGE_0% = 0.0
- TB_PRIMARY_VALUE_RANGE_UnitCode = Cubic Meters

The TB_PRIMARY_VALUE, as output of the TB, is produced by default in Cubic Meters

The input scaling (SCALE_IN) always represents the input pressure range, and the output scaling (PRIMARY_VALUE_RANGE) represents the output conversion range.

- AIFB_1_CHANNEL = 1	AIFB_2_CHANNEL = 2
- AIFB_1_XD_SCALE_100% = 100.0	AIFB_2_XD_SCALE_100% = 90.0
- AIFB_1_XD_SCALE_0% = 0.0	AIFB_2_XD_SCALE_0% = -40.0
- AIFB_1_XD_SCALE_UnitCode = Cubic Meters	AIFB_2_XD_SCALE_UnitCode = °C
- AIFB_1_L_TYPE = Direct	AIFB_2_L_TYPE = Direct
- AIFB_1_OUT_SCALE_100% = 100.0	AIFB_2_OUT_SCALE_100% = 90.0
- AIFB_1_OUT_SCALE_0% = 0.0	AIFB_2_OUT_SCALE_0% = -40.0
- AIFB_1_OUT_SCALE_UnitCode = Cubic Meters	AIFB_2_OUT_SCALE_UnitCode = °C

The AIFB_1_OUT, as output of the Analog Input 1 function Block, produce in output the Volume value in Cubic Meters
The AIFB_2_OUT, as output of the Analog Input 2 function Block, produce in output the Sensor Temperature value in °C

The user can start from this default and working condition, and then proceed with the real setting of the variables as the application requires.
Unless of specific requirements, the AIFB receiving in input the PRIMARY_VALUE works without additional conversions; L_TYPE = direct.

Note: See also the Table C in the section 6-Initialisation about the allowed Channel selections depending by the PRIMARY_VALUE_TYPE.

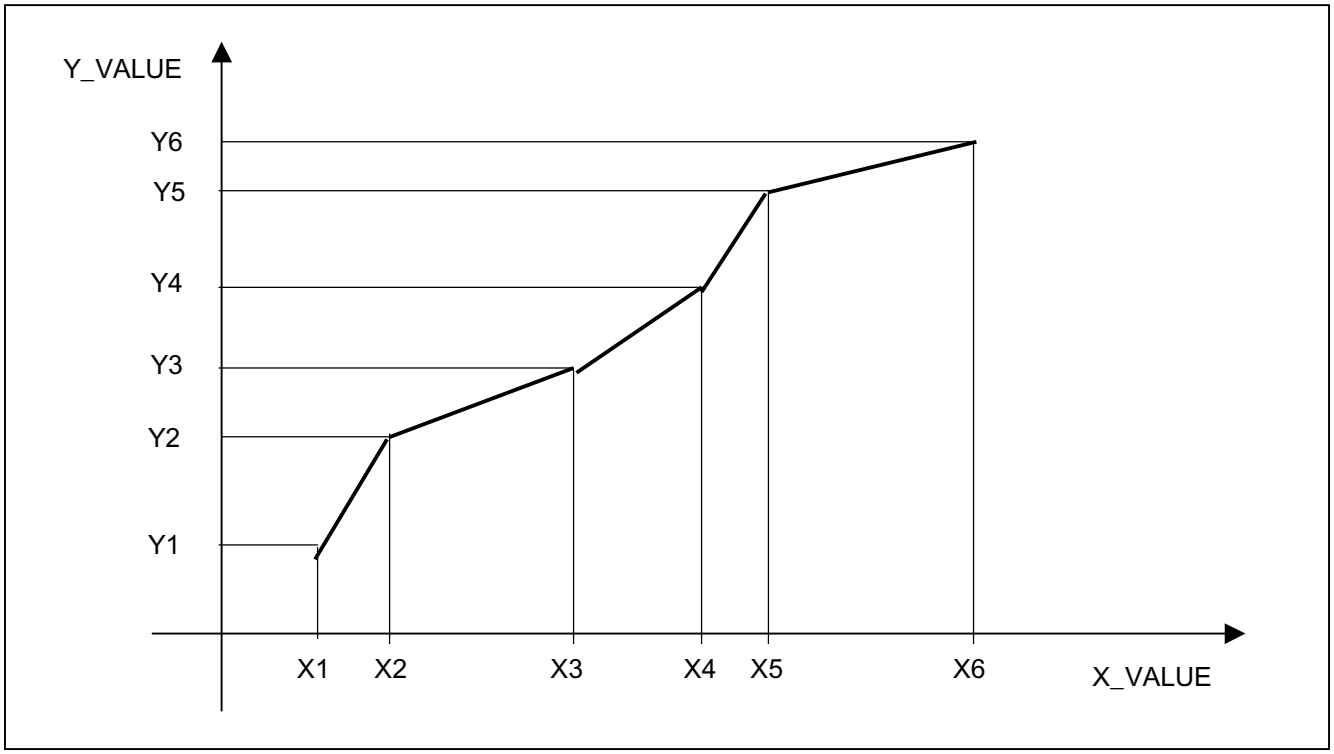
11.4.1 – LINEARISATION TABLE SETTING PROCEDURE

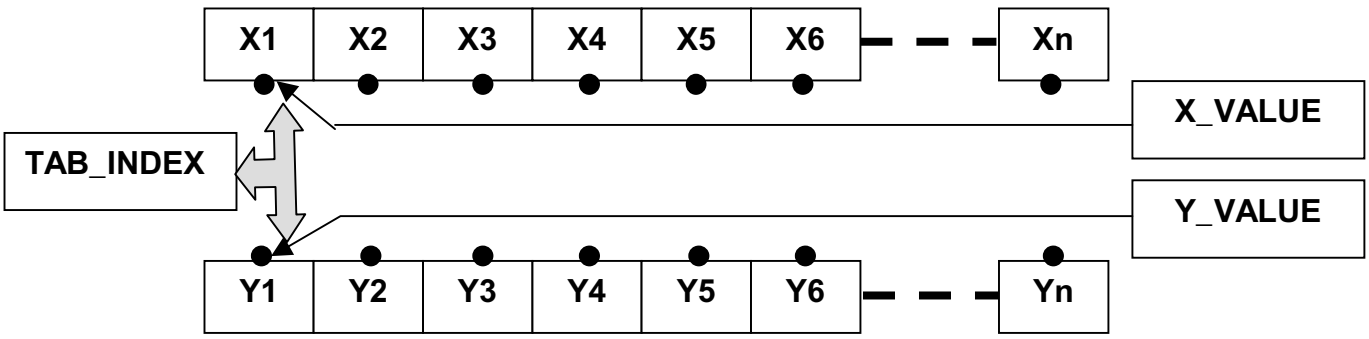
The linearisation table consist of 21 X, Y values to be set, in order to have a conversion between the input pressure value and the output volume value.

Using as example the figure 19 below, the setting procedure is done as follow:

1- The setting procedure starts writing the TAB_OP_CODE = 1. The TAB_INDEX goes to 1 as pointer to the first couple of X, Y values. See also the section 8 in the PRESSURE TRANSDUCER BLOCK TABLE.
2- Then the user can write the X1, Y1 values in the TAB_X_Y_VALUES.
3- In the TAB_INDEX the user writes 2.
4- Then the X2, Y2 values are written in the TAB_X_Y_VALUES.
5- In the TAB_INDEX the user writes 3.
6- As above until the writing of the X6 and Y6 values.
7- Then the user have to write the TAB_OP_CODE = 3. The new table is internally checked before to become valid.
8- The TAB_STATUS will reflect the result of the internal table check executed as in the point 7. See the available TAB_SATUS conditions in the section 8 (PRESSURE TRANSDUCER BLOCK TABLE)

Figure 19: Linearisation Table setting





12. – Calibration Operations

The operations provided by the transmitters and to be supported by the configuration tools are listed in the Table D below:

TABLE D

Operations	Parameters involved and modified
Zero Alignment	TB_CAL_POINT_LO
Low Trimming	TB_CAL_POINT_LO
High Trimming	TB_CAL_POINT_HI
Reset to Factory Sensor Trimming Condition	TB_CAL_POINT_LO, TB_CAL_POINT_HI, TB_CAL_UNIT
Static Pressure Trimming	TB_STATIC_PRESS_TRIM

12.1 - Zero alignment

This operation can be executed using the remote configuration tool or the local 'Z' push button. With this operation the TB_TRIMMED_VALUE indication is automatically adjusted to 'zero'. Whenever the user wants to set the measure produced by the transmitter to 'zero' (i.e. when the measure is different by 'zero' due to the installation position) the following sequence of operations are required when the remote configuration tool is used:

1. Select the desired unit for representing the measure produced by the transmitter (TB_TRIMMED_VALUE), writing the right code in the TB_CAL_UNIT.

Note: Only Pressure Unit Code is allowed

2. Read the reference value produced by the transmitter from the TB_TRIMMED_VALUE.
3. If this value is different by 'zero' the 'zero alignment' operation can be executed and it works setting automatically the TB_CAL_POINT_LO to zero and writing it into the transmitter.
4. Read again the TB_TRIMMED_VALUE and check if its value is 'zero'.

When this operation is executed using the local push button 'Z', see the section 3.5

12.2 - Low Trimming

This operation can be executed only using the remote configuration tool. With this operation the TB_TRIMMED_VALUE indication is automatically adjusted, in order to match the real value of the pressure applied in input, in the low part of the working range. The following sequence of operations is required:

1. Apply a reference pressure in input using a reference pressure generator.
2. Select the desired unit for representing the measure produced by the transmitter (TB_TRIMMED_VALUE), writing the right code in the TB_CAL_UNIT.

Note: Only Pressure Unit Code is allowed

3. Read the reference value produced by the transmitter from the TB_TRIMMED_VALUE.
4. If this value doesn't match the pressure applied in input, write the right value in the TB_CAL_POINT_LO and send it to the transmitter.
5. Read again the TB_TRIMMED_VALUE and check if its value has been adjusted for matching the applied pressure.

12.3 - High Trimming

This operation can be executed only using the remote configuration tool. With this operation the TB_TRIMMED_VALUE indication is automatically adjusted, in order to match the real value of the pressure applied in input, in the high part of the working range. The following sequence of operations is required:

1. Apply a reference pressure in input using a reference pressure generator.
2. Select the desired unit for representing the measure produced by the transmitter (TB_TRIMMED_VALUE), writing the right code in the TB_CAL_UNIT.

Note: Only Pressure Unit Code is allowed

3. Read the reference value produced by the transmitter from the TB_TRIMMED_VALUE.
4. If this value doesn't match the pressure applied in input, write the right value in the TB_CAL_POINT_LO and send it to the transmitter.
5. Read again the TB_TRIMMED_VALUE and check if its value has been adjusted for matching the applied pressure.

12.4 - Reset to Factory Sensor Trimming *(NOT AVAILABLE ON THIS VERSION)*: With this operations the all the parameters involved in the trimming operations are updated with the original values recorded during the final calibration performed in the factory.

12.5 - Static Pressure Trimming

This operation can be executed only using the remote configuration tool. With this operation the TB_SECONDARY_VALUE_2 (Static Pressure) indication is automatically adjusted, in order to match the known value of Static Pressure applied at the transducer.. The following sequence of operations is required:

1. Read the Static Pressure value from the TB_SECONDARY_VALUE_2.
2. If this value doesn't match the known Static pressure applied in input at the transducer, write the right value in the TB_STATIC_PRESS_TRIM and send it to the transmitter.
3. Read again the TB_SECONDARY_VALUE_2 and check if its value has been adjusted for matching the real Static Pressure value.

13. - Diagnostic

The FOUNDATION™ Fieldbus defines different ways to report diagnostics information. Standard and Manufacturer specific variables include and represent diagnostic Flags/Codes updated dynamically every DSP loop.
First of all it is necessary to distinguish between the flags available only when accessed from the user with a read operation, and the others which in addition, enable the Alert Notification mechanism if allowed by the ALARM_SUMMARY disabled variable. The notification provides to automatically inform the Master about the occurred event with the information defined in the Alert_Discrete data structure. These events could be then acknowledged or not depending by the operator at the Master side. These events are notified only when the error appears, there are not notifications when the error conditions disappear.

Furthermore the Alert Notification mechanism is used to notify to the Master not only error conditions, but also some process conditions.
For example whenever the OUT value of the AIFB goes outside the Advisory and/or Critical limits, the notification mechanism get starts only if enabled in the ALARM_SUMMARY disabled variable. The notification provides to inform the Master about the OUT value which enabled the event, the time and date of the occurred event (Time_Stamp), and other information defined in the Alert_Float data structure. The alarm could be then acknowledged or not depending by the operator at the Master side. Respect the errors handling, the same mechanism is enabled also when the OUT value came back inside the Advisory and/or Critical limits.

The FOUNDATION™ Fieldbus defines also others events which have to be automatically notified to the Master. Each changing of the HW and/or SW security locking condiition is notified trough an Alert_Discrete data structure, and every changing of the variable's value, which consequently requires the increment the Static Revision value, is notified with the information of the Alert_Update data structure.
Only for the notifications of Alert_Update type is not contemplated the acknowledgement form the Master.

The error flags supported by the 600T_FF are a subset of the standard errors defined in the BLOCK_ERR variable, and the additionally errors flags defined in the MANUFATORY_BLOCK_ERR. Each Block implemented in the 600T_FF includes the BLOCK_ERR bitstring variable, and each bit represents an error condition. Some of these bits can also be source of the Alert Notification mechanism. See the sections 13.3, 13.4, 13.5.

Whenever an error or alarm condition enables an Alert Notification mechanism, it can assume different state machine conditions like acknowledged, unacknowledged, reported, unreported and so on. The complete status of each supported alarm is summarised by the ALARM_SUMMARY variable. See the section 13.1.

Another information to be considered for possible diagnostic usage is the Status byte that is produced every loop together with some dynamic variables like the OUT value of the Function Blocks. It represents the Quality of the associated variable. See the section 13.6.

13.1 – Alarm Summary

The ALARM_SUMMARY data structure reflects the general status of the alarms handled in the 600T_EN FF. The bits listed below represent the alarms supported in the 600T_FF, and each of them is available with 4 information:

1. Current Alarms
2. Unacknowledged
3. Unreported
4. Disabled

Whenever the alarm is enabled in the Disabled field, and the alarm condition occurs, it is notified at the Master trough the Alert Notification state machine and the relevant bit is set in the Current Alarms field. The Unacknowledged field reflects if the alarm has been recognised at the Master side. The Unreported field reflects if the alarm was linked to a system at which each alarm event has to be reported.

Octet	Bit	Mnemonic	Description
1	0	Discrete Alarm	Supported only by the Resource Block. When the HW (Switch 1) and/or SW write locking change its status.
	1	HI_HI_Alarm	Supported by AIFB and PIDFB. Notified when the OUT value goes over the HI_HI_LIM value, and also when the OUT value came back below the HI_HI_LIM value.
	2	HI_Alarm	Supported by AIFB and PIDFB. Notified when the OUT value goes over the HI_LIM value, and also when the OUT value came back below the HI_LIM value.
	3	LO_LO_Alarm	Supported by AIFB and PIDFB. Notified when the OUT value goes below the LO_LO_LIM value, and also when the OUT value came back over the LO_LO_LIM value.
	4	LO_Alarm	Supported by AIFB and PIDFB. Notified when the OUT value goes below the LO_LIM value, and also when the OUT value came back over the LO_LIM value.
	5	DEV_HI_Alarm	Supported only by PIDFB
	6	DEV_LO_Alarm	Supported only by PIDFB
	7	Block Alarm	Supported by RB, AIFB and PIDFB. Notify every Block Error occurrence of the relating block. See 13.3 – Block Error.
2	0-7	Reserved	

Limit alarm bits will be set to 1 or 0 if the alarm reason occurs (1) or is gone (0) in the Current Alarms field.

13.2 – Alarm Priority

Foe each alarm there is the possibility to select the correspondent priority level between 0 to 15. The table below define what the different priority means.

Alarm Priority	Description
0	Alarm is Suppressed
1	Recognised by the system but not reported
2	Report to the operator, but doesn't require his attention
3 – 7	Advisory alarm of increasing priority
8 – 15	Critical alarm of increasing priority

13.3 – Block Error

This is the Standard BLOCK_ERR variable contained in each block implemented in the device. The bits handled in the 600T_EN FF are in the grey boxes of the table below, with indication of which blocks support each single indication and which error enables the Alert Notification mechanism.

Octet	Bit	Mnemonic	Blocks Supporting	Alert Notification Enabling	Description
1	0	Other	TB	YES	The error is one listed in the XD_ERROR Table. See 13.5
	1	Block Configuration error	AI, PID, TB	YES Only the TB occurrence enable the Notification	The **TB** is not properly configured for the measurement and production of Flow, Level or Volume indications. The **AIFB** or **PIDFB** have not parameters requiring a value different by 0 (Initial Value), properly set.
	2	Link Configuration error	NOT Supported		
	3	Simulate active	RB	NO	The Transmitter has been switched in Simulation Mode
	4	Local Override	PID	NO	The actual mode is LO
	5	Device Fault State Set	NOT Supported		
	6	Device needs maintenance soon	???		
	7	Input Failure/process variable has BAD status	AIFB	YES	The Process Variable linked in input at the **AIFB** has the Status byte set at one of these condiitions: BAD-Sensor Failure BAD-Device Failure And the variable AIFB_STATUS_OPTS is set to Propagate_Fault_Forward.
2	0	Output Failure	NOT Supported		
	1	Memory failure	NOT Supported		
	2	Lost Static Data	RB	NO	The FB application configuration data have been lost. I.e. Link Objects, FB start List, Macrocycle, LAS data and so on.
	3	Lost NV Data	NOT Supported		
	4	Read-back check failed	NOT Supported		
	5	Device needs maintenance now	???		
	6	Power up	TB	YES After 1500 Power-on cycles	The transmitter has just been powered on. Each occurrence is counted by a dedicated counter TB_POWER_ON_CNT
	7	Out-of-Service	TB, RB, AIFB, PIDFB	YES for all the blocks	The Actual Mode of the relevant block has been switched in Out Of Service by the operator

Block error bits will be set to 1 or 0 if the error occurs (1) or is gone (0).

13.4 – Manufacturer Block Error

This is an additional TB_MANUFACTORY_BLOCK_ERR variable mapped in the Transducer Block including more detailed indication respect the above standard Block error variable. All these error flags enable the Alert Notification mechanism

Octet	Bit	Mnemonic	Blocks Supporting	Alert Notification Enabling	Description
1	0	Checksum Error	TB	YES	A memory checksum error has been detected during the start-up checking.
	1	Electronic Error	TB	YES	The sensor signal is no more updated correctly due to electronics failure
	2	Mechanical Error	TB	YES	The sensor signal reflects wrong condition due to probably mechanical failure
	3	Configuration Error	TB	YES	When, in particular situations, changing of variable's values leave the device in a not correct configuration
	4	Overpressure Plus	TB	YES	An Overrange of pressure on the side + has been detected. Each occurrence is counted by a dedicated counter TB_OVER_RNG_CNT
	5	Overpressure Minus	TB	YES	An Overrange of pressure on the side - has been detected. Each occurrence is counted by a dedicated counter TB_OVER_RNG_CNT
	6	Over Temperature Plus	TB	YES	A Sensor Temperature Out of the operational limits High has been detected. Each occurrence is counted by a dedicated counter TB_OVER_TMP_CNT
	7	Over Temperature Minus	TB	YES	A Sensor Temperature Out of the operational limits Low has been detected. Each occurrence is counted by a dedicated counter TB_OVER_TMP_CNT
2	0	Over Static	TB	YES	A Static Pressure Out of the acceptable Working limit has been detected. Each occurrence is counted by a dedicated counter TB_OVER_STAT_CNT
	1	OOS	TB	YES	The Transducer Block has been switched in Out Of Service Mode.
	2	Power Up	TB	YES After 1500 Power-on cycles	The transmitter has just been powered on. Each occurrence is counted by a dedicated counter TB_POWER_ON_CNT
	3	Temperature Sensor Failed	TB	YES	The circuitry for the sampling of the Temperature of the Sensor is failed/broken
	4	Static Pressure Sensor Failed	TB	YES	The circuitry for the sampling of the Static Pressure is failed/broken
	5-7	Not Used			

Manufactory Block error bits will be set to 1 or 0 if the error occurs (1) or is gone (0).

13.5 – XD_Error

The XD_Error bits are relating to the Transducer Block diagnostic. Many of the below error codes are the same defined in the TB_MANUFACTORY_BLOCK_ERR. The reason of this duplication is due to the fact that the XD_Error can not reflect simultaneous error conditions, each code represents only the latest occurrence. The TB_MANUFACTORY_BLOCK_ERR in this case offer the possibility to get information about all the simultaneous error conditions represented each by a dedicated flag. The indications handled in the 600T_EN FF are the following in the grey boxes:

Value	Mnemonic	Description
16	Unspecified Error	An error has occurred that was not identified
17	General Error	An error has occurred that could not be classified as one of the errors below
18	Calibration Error	An error occurred during the calibration of the device or a calibration error has been detected during operation of the device
19	Configuration Error	An error occurred during the configuration of the device or a configuration error has been detected during operation of the device
20	Electronics Failure	An electronic component has failed
21	Mechanical Failure	A mechanical component has failed
22	I/O Failure	An I/O failure has occurred
23	Data Integrity Error	Indicated that data stored within the system may no longer be valid due to NVM checksum failure, Data verify after write failure, etc.
24	Software Error	The Software has detected an error. This could be caused by an improper interrupt service routine, an arithmetic overflow, a watchdog timer, etc.
25	Algorithm Error	The algorithm used in the transducer block produced an error. This could be due to an overflow, data reasonableness failure, etc.
26	Over Pressure Plus	An Overrange of pressure on the side + has been detected. Each occurrence is counted by a dedicated counter TB_OVER_RNG_CNT
27	Over Pressure Minus	An Overrange of pressure on the side - has been detected. Each occurrence is counted by a dedicated counter TB_OVER_RNG_CNT
28	Over Temperature Plus	A Sensor Temperature Out of the operational limits High has been detected. Each occurrence is counted by a dedicated counter TB_OVER_TMP_CNT
29	Over Temperature Minus	A Sensor Temperature Out of the operational limits Low has been detected. Each occurrence is counted by a dedicated counter TB_OVER_TMP_CNT
30	Over Static	A Static Pressure Out of the acceptable working limit has been detected. Each occurrence is counted by a dedicated counter TB_OVER_STAT_CNT
31	Temperature Sensor Failed	The circuitry for the sampling of the Temperature of the Sensor is failed/broken
32	Static Pressure Sensor Failed	The circuitry for the sampling of the Static Pressure is failed/broken

13.6 - Status Supported

The FOUNDATION™ Fieldbus defines different dynamic variables having the status byte to be produced together with the value. The status byte gives a detailed information about the Quality of the associated variable's value. The following table lists the different status conditions available/generated for the output dynamic variables coming out from the AIFB, PIDFB and TB blocks[2] implemented in the 600T_EN FF Transmitter. For each status condition is available a brief explanation about the meaning and an indication about into which block it is generated.

Status byte conditions supported in the Variables **"AIFB_OUT, PID_OUT, TB_PRIMARY_VALUE"**

		Quality		**Substatus**				**Limits**			**Function Block supporting**
Dec	Hex	Gr	Gr	QS	QS	QS	QS	Qu	Qu		
		2^7	**2^6**	**2^5**	**2^4**	**2^3**	**2^2**	**2^1**	**2^0**		
0	00	0	0							**= bad**	**TB, AI, PID**
64	40	0	1							**= uncertain**	**TB, AI**
128	80	1	0							**= good (Not Cascade)**	**TB, AI, PID**
192	C0	1	1							**= good (Cascade)**	**PID**

Details for BAD

0	00	0	0	0	0	0	0			**= non-specific**	**AI, PID**
4	04	0	0	0	0	0	1			**= configuration error**	**AI, TB**
8	08	0	0	0	0	1	0			**= not connected**	**PID**
12	0C	0	0	0	0	1	1			**= device failure**	**TB, AI**
16	10	0	0	0	1	0	0			**= sensor failure**	**TB, AI**
20	14	0	0	0	1	0	1			**= no communication with LUV**	**PID**
24	18	0	0	0	1	1	0			**= no communication no LUV**	**AI, PID**
28	1C	0	0	0	1	1	1			**= out of service**	**TB, AI, PID**

Configuration error detail:
When the TB_PRIMARY_VALUE_TYPE is selected for Flow and Volume measurement, some specific parameters of the Transducer block have to be well configured by the customer. If the configuration is not well done so the measure can not be produced (i.e. negative value in input at the Square Root operation), this status is set.
When the XD_SCALE is set different to the OUT_SCALE and the L_TYPE is not set to indirect, this status is set.
Not Connected detail:
Set if this input is not referenced by a link object within the resource.
Device failure detail:
When malfunction in the device is detected this status is produced.
Sensor failure detail:
When malfunction of the sensor is detected this status is produced.
No communication with last usable value detail:
Set if this value had been set by communication, which has now failed.
No communication, with no usable value detail:
Set if there has never been any communication with this value since it was last Out of Service.
Out of Service detail:
This status is produced when the device is in Out Of Service mode.

[2] Other variables like the Trimmed Value and the different SECONDARY_VALUE_x mapped in the TB, and several variables of the PIDFB are produced with their own status byte.

Details for UNCERTAIN

68	44	0	1	0	0	0	1			**= Last Usable Value**	**TB**
72	48	0	1	0	0	1	0			**= substitute set**	**AI**
76	4C	0	1	0	0	1	1			**= Initial Value**	**TB**
80	50	0	1	0	1	0	0			**= sensor conversion not accurate**	**TB, AI**
84	54	0	1	0	1	0	1			**= engineering unit range violation**	**TB**

Last Usable Value detail:
Whatever was writing this value has stopped doing so. (This happens when an input is disconnected by a configurer).
Substitute Set detail:
Set when the value is written when the block is not Out of Service.
Initial Value detail:
Set when the value of an input parameter is written when the block is Out of Service.
Sensor Conversion not Accurate detail:
This status is produced when the auxiliary values for compensation are not more usable (compensation sensors failed). The OUT will be always produced but with the last valid compensation. This gives an indication of degraded performances of the device
Engineering unit range violation detail:
This status is produced when the value is outside the operating range selected for this variable.

Details for GOOD (non-cascade)

128	80	1	0	0	0	0	0			**= ok**	**TB, AI, PID**
132	84	1	0	0	0	0	1			**= active block alarm**	**TB, AI, PID**
136	88	1	0	0	0	1	0			**= active advisory alarm**	**AI, PID**
140	8C	1	0	0	0	1	1			**= active critical alarm**	**AI, PID**
144	90	1	0	0	1	0	0			**= unacknowledged block alarm**	**AI, PID**
148	94	1	0	0	1	0	1			**= unacknowledged advisory alarm**	**AI, PID**
152	98	1	0	0	1	1	0			**= unacknowledged critical alarm**	**AI, PID**

Active Block alarm detail:
Set when the value is Good and the block has an Active Block alarm.
Active advisory alarm detail:
Set when the value is Good and the block has an Active alarm with priority less than 8.
Active critical alarm detail:
Set when the value is Good and the block has an Active alarm with priority greater than or equal to 8.
Unacknowledged Block alarm detail:
Set when the value is Good and the block has an unacknowledged Block alarm.
Unacknowledged advisory alarm detail:
Set when the value is Good and the block has an unacknowledged alarm with priority less than 8.
Unacknowledged critical alarm detail:
Set when the value is Good and the block has an unacknowledged alarm with priority greater than or equal to 8.

Details for GOOD (cascade)

192	C0	1	1	0	0	0	0			**= ok**	**PID**
196	C4	1	1	0	0	0	1			**= initialisation acknowledge**	**PID**
200	C8	1	1	0	0	1	0			**= initialisation request**	**PID**
204	CC	1	1	0	0	1	1			**= not invited**	**PID**
224	E0	1	1	1	0	0	0			**= initiate fault state**	**PID**

Initialisation Acknowledge detail:
The value is an initialised value from a source (cascade input, remote-cascade in, and remote-output in parameters).
Initialisation Request detail:
The value is an initialised value for a source (back calculation input parameters), because the lower loop is broken or the mode is wrong.

Not Invited detail:
The value is from a block which does not have a target mode that would use this input. This covers all cases other than Fault State Active, Local Override, and Not Selected. The target mode can be the next permitted mode of higher priority in case of shedding a supervisory computer.
Initiate Fault State detail:
The value is from a block that want its downstream output blocks (e.g. AO) to go to Fault State. This is determined by a block option to initiate Fault State is the status of the primary input and/or cascade input goes Bad. See the status option table in Part 2 and 3.

Details for bits 'LIMITS'

+0	+00							0	0	**= ok**
+1	+01							0	1	**= low limited**
+2	+02							1	0	**= high limited**
+3	+03							1	1	**= constant**

If more than one condition is present, only the one with higher priority is reported. The priority level is in the following order:
- BAD
- GOOD (Cascade)
- UNCERTAIN
- GOOD (Not Cascade)

Into any single quality group the priority level is relating to the value. (i.e. BAD - Out of Service is the higher priority and GOOD – OK is the lower priority)

13.7 – Asset Features

The 600T_EN FF implements same additional information respects what defined by the standard to be used for Asset Features purposes. These information offer to the user an increased monitoring capability of the process conditions, an historical view for analysis and a better evaluation for the device status.

Here is a list of these Asset Features information:

1. Some Counters of events provide information about the number of occurred conditions outside the operational limits of the device. Each event is also notified to the Master with Time Stamp information (date and time):
- Event /Counter for Sensor Temperature out of operational limits condition - TB_OVER_TEMP_CNT.
- Event /Counter for Static Pressure out of operational limits condition - TB_OVER_STAT_CNT.
- Event/Counter for over range or over load condition - TB_OVER_RNG_CNT.

Each Event Counter can be independently reset.

2. The following information is to be used for maintenance purposes:
   Number of device Power On counter. Each Power On is also notified to the Master with Time Stamp information- TB_PWR_ON_CNT.
- Total Working Time counter (not allowed to be reset by the user) - TB_TOT_WORK_HOUR.
- Partial Working Time counter (allowed to be reset by the user) - TB_PAR_WORK_HOUR.

3. These functions already described in the section 12 are to be considered as specific functionality of the 600T_EN FF for performances improvement.
- Static Pressure value Trimming - TB_STAT_PRESS_TRIM
- Reset to the Factory Sensor trimming conditions.

14. – Device Specification Data

The delivery of the 600T_EN FF devices includes the DD file (*.sym, *.ffo files) and the Capability file (.CFF file).

The following table is a summary of the most important information of the 600T_EN FF specification data

Manufacturer	ABB Instrumentation SpA
Device Model	600T_EN FF
Device Type	Link Master Device
Measured Variable	**Direct:** Differential, Gauge, Absolute Pressure. **Derived:** Flow, Level and Volume
Output Signal	Physical layer compliant to the standard IEC 1158-2
Communication speed	31.25 Kbit/second
Electrical Signal	Manchester Code II
Power supply	Bus Powered: 9 – 32 Volts limited to 24 Volts for IS
Interface	FOUNDATION™ Fieldbus H1 Compliant with specification V 1.4
Blocks implemented	2 Standard Analog Input, 1 Standard PID, 1 Standard Resource, 1 Enhanced Pressure with Calibration Transducer Blocks
FB Execution period	25mS for the AIFBs 70mS for the PIDFB
LAS functionality	1 sub-schedule, 25 sequences, 25 elements for sequence
Number of link objects	25
Number of VCRs	24
Current consumption	10.5 mA max
Fault Current limiting	15 – 16 mA
FF Registration	IT011000
IS Certificate	See section 3.1 – Environmental protection
Max. Temperature	-40 / +85 °C
Remote Configuration tools	Via tools using DD & CFF Files

15. - Reference -

1- Function Block Application Process – Part 2. n° FF-891- Revision 1.4 dated June 29, 1999
2- Transducer Block Application Process PART 2 n° FF-903 Revision PS 3.0 dated April 21,1998
3- Function Block Application Process – Part 1. n° FF-890- Revision 1.4 dated June 29, 1999

APPENDIX A

CONFIGURATION DATA SHEET

CUSTOMER INFORMATION	
CUSTOMER	_____
P.O Number	_____
PRODUCT CODE	_____

GENERAL DEVICE INFORMATION	
TYPE OF MEASURE ① (TB_PRIMARY_VALUE_TYPE)	***Pressure*** *(default)* *Flow* *Level* *Volume*
TAG (PD_TAG)	*(32 chars.max)* |__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|__|

DEVICE INFORMATION WHEN THE TYPE OF MEASURE = PRESSURE

UNIT CODE (AIFB_1_OUT_SCALE_unit_index) (AIFB_1_XD_SCALE_unit_index)	*Inches H2O (20 deg.C)*	*Inches Hg (0 deg.C)*	*feet H2O (20 deg.C)*
	mm H2O (20 deg.C)	*mm Hg (0 deg.C)*	*pounds / in^2*
	Bar	*millibar*	*grams / cm^2*
	Kilograms/cm^2	*Pascal*	***Kilopascal*** *(default)*
	Torr (0 deg.C)	*Atmosphere*	*Megapascal*
	Inches H2O (4 deg.C)	*Mm H2O (4 deg.C)*	*Other Unit* .....
HIGH RANGE ② (AIFB_1_OUT_SCALE_high_range) (AIFB_1_XD_SCALE_high_range)	_____	**CRITICAL LIMIT HIGH** ② (AIFB_1_HI_HI_LIM)	_____
LOW RANGE ② (AIFB_1_OUT_SCALE_low_range) (AIFB_1_XD_SCALE_low_range)	_____	**ADVISORY LIMIT HIGH** ② (AIFB_1_HI_LIM)	_____
HISTERESYS ② (AIFB_1_ALARM_HYS)	_____	**ADVISORY LIMIT LOW** ② (AIFB_1_LO_LIM)	_____
DAMPING TIME (Sec.) (AIFB_1_PV_FTIME)	*(32 sec.max)* _____	**CRITICAL LIMIT LOW** ② (AIFB_1_LO_LO_LIM)	_____

① If the MEASURE_TYPE selected is PRESSURE **only the SHEET 1** has to be filled.
If the MEASURE_TYPE selected is different by PRESSURE fill only the CUSTOMER INFORMATION and the GENERAL DEVICE INFORMATION of SHEET 1 and the SHEET 2.

DEVICE INFORMATION WHEN THE TYPE OF MEASURE = FLOW or LEVEL or VOLUME

LINEARTISATION TYPE (TB_LIN_TYPE)	*Linear* *Square Root* *$x^{3}/_{2}$* *$x^{5}/_{2}$* *Table*		
INPUT PRESSURE HIGH RANGE ③ (TB_SCALE_IN_high_range)	_____	**INPUT PRESSURE LOW RANGE** ③ (TB_SCALE_IN_low_range)	_____
OUTPUT CONVERSION HIGH RANGE ④ (AIFB_1_OUT_SCALE_high_range) (AIFB_1_XD_SCALE_high_range)	_____	**OUTPUT CONVERSION LOW RANGE** ④ (AIFB_1_OUT_SCALE_low_range) (AIFB_1_XD_SCALE_low_range)	_____
INPUT PRESSURE UNIT CODE (TB_SCALE_IN_unit_index)	*Inches H2O (20 deg.C)* *feet H2O (20 deg.C)* *mm Hg (0 deg.C)* *Bar* *grams / cm^2* *Pascal* *Torr (0 deg.C)* *Megapascal* *mm H2O (4 deg.C)*	*inches Hg (0 deg.C)* *mm H2O (20 deg.C)* *pounds / in^2* *millibar* *Kilograms/cm^2* ***Kilopascal** (default)* *Atmosphere* *inches H2O (4 deg.C)* *Other Unit*……	
OUTPUT CONVERSION UNIT CODE (AIFB_1_OUT_SCALE_unit_index) (AIFB_1_XD_SCALE_unit_index)	**FLOW** *cubic feet per minute* *gallons per minute* *liters per minute* *imperial gallons per min* ***cubic meter per hour** (default)* *gallons per second* *liters per second* *cubic feet per second* *cubic meters per sec.* *percent* *cubic feet per hour* *cubic meters per min.* *gallons per hour* *gallond per day* *Other Unit* ……	**LEVEL** *feet* ***meters** (default)* *inches* *centimeters* *millimeters* *Other Unit* ……	**VOLUME** ⑤ *gallons* *liter* *imperial gallons* ***cubic meters** (default)* *cubic feet* *hectoliters* *Other Unit* ……
CRITICAL LIMIT HIGH ④ (AIFB_1_HI_HI_LIM)	_____	**ADVISORY LIMIT LOW** ④ (AIFB_1_LO_LIM)	_____
ADVISORY LIMIT HIGH ④ (AIFB_1_HI_LIM)	_____	**CRITICAL LIMIT LOW** ④ (AIFB_1_LO_LO_LIM)	_____
HISTERESYS ④ (AIFB_1_ALARM_HYS)	_____	**DAMPING TIME (Sec.)** (AIFB_1_PV_FTIME)	*(32 sec.max)* _____

② These variables must be represented with unit code as selected in the field **UNIT CODE.**
③ These variables must be represented with unit code as selected in the field **INPUT PRESSURE UNIT CODE.**
④ These variables must be represented with unit code as selected in the field **OUTPUT CONVERSION UNIT CODE.**
⑤ For the complete configuration of the 600T used as Volume measurement it is necessary to set the Linearisation Table (up to 21 X, Y points)

APPENDIX B

600T_EN FF Electronic Replacement

The following Steps have to be followed for the FF electronic replacement:

1- Remove the cover with the glass
2- Remove the 2 screws of the electronic.
3- Extract the electronics from the housing, (be carefully with the sensor Flat cable connected to the unit), and disconnect the flat cable.
4- Remove the LCD meter, (be carefully with the plastic clips)
5- Take the new unit and put the switch 3 (cold Start-up) in ON position. Do not connect, for the moment, the LCD meter !!!!
6- Connect the sensor flat cable to the new unit and insert it into the housing (be carefully with the two in-housing jack connectors)
7- Power on the transmitter and keep it powered-on for few seconds (about 10).
8- Power-Off the transmitter again, and put the switch 3 in OFF position.
9- Insert the LCD meter, (be carefully with the 8 pins connector). May be it is easier to remove the electronic again from the Housing for the connection of the LCD meter.
10-Fix the electronics with the two screws and mount the glass cover again.

The operation is now completed and the device should work with default configuration. The Target Mode for the RB, AIFB, PID and TB is Out Of Service. The user has to set the AUTO Mode for the RB first, and then for the other blocks.

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