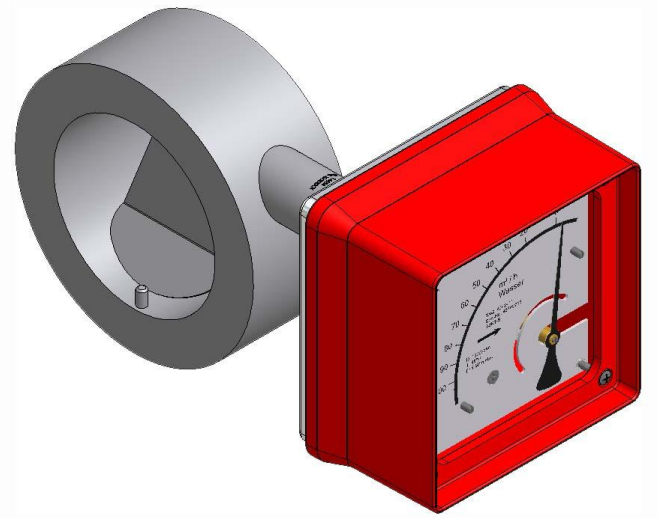
Operating manual for the electronic transmitter ES-FF with Foundation-Fieldbus interface



Supplement to the BGN/ES, BGF/ES, TSK/ES, BA/ES and DWF/ES manuals

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1 Identification

1.1 Supplier/manufacturer

Manufacturer Heinrichs Messtechnik GmbH
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Product type Transmitter to convert pointer positions into proportional electrical signals (flow, level, density)
Product name ES-FF
Revision-No. 2.0 / 27.11.2013

1.2 Product

Foundation Fieldbus-Transmitter type „ES-FF“ for converting the pointer position into a flow rate (BGN, BGF, TSK), a level indication (BA) or a density (DWF).

2 Applications

The ES-FF transmitter is used as a volume flowmeter in BGN, BGF and TSK series flowmeters, in BA level meters or in DWF density meters. It is designed for installation in a housing with a degree of protection of at least IP 20.

3 Operational Mode and System Design

3.1 Measuring principle

The position of a float or a paddle is transmitted to the pointer axle by means of a magnetic system.
The ES-FF transmitter measures the field of a magnet mounted on the pointer axle (sensor signals A, B) and generates a digitalized measured value. The scale, which is generally non-linear, is linearized in the process with a maximum of 16 interpolation points.

The earth's magnetic field and moderate homogeneous external magnetic fields are largely compensated by the applied differential measurement.

3.2 System design

The display unit prepared for integrating the ES transmitter consists of a base plate, a special bearing unit with a pointer and magnet mounted on it as well as the stud bolts for mounting the ES.

4 Input

4.1 Measured variable

Volume flow rate, alternative level or density.

5 Output

Foundation Fieldbus interface for the digital output of the measured value.

6 Characteristic Values

6.1 Supply voltage

9V...32V, terminals 9 and 10
Supply voltage influence: < 0.1% of measured value

6.2 Basic current

app. 18 mA

6.3 Baud rate

31,25 kBaud

6.4 Accuracy

< +-0.2% of URV (upper range value) in the interpolation points

6.5 Repeatability

typically < 0.1% of URV

6.6 Resolution

typically 0.05% of URV

6.7 Environmental conditions

External magnetic fields (e.g. from adjacent fittings) must be avoided.

6.7.1 Degree of protection

The ES transmitter must be installed in a housing that offers a degree of protection of at least IP 20.

6.7.2 Ambient temperature limits

-20 °C bis + 70 °C
It must be ensured that the temperature in the display unit does not exceed a value of 70°C due to environmental influences such as hot medium, sunlight or heating of the meter tube. If necessary, a pulled-forward display unit must be used when the fluid temperature is high. Please also observe the tables of the section "Medium temperature limit" of the device description of the fitting..

6.8 Storage temperature

-40°C bis + 70°C

6.9 Influence of ambient temperature

< +-0.5% of URV/10°K;

6.10 Electromagnetic compatibility (EMC)

EMC Directive 89/336/EEC
EN 61000-6-2:1999 Immunity industrial environment
EN 61000-6-3:2001, Emitted interference residential environment
EN 55011:1998+A1: 1999 Group 1, Class B (emitted interference)
DIN EN 61000-4-2 to DIN EN 61000-4-6, DIN EN 61000-4-8, DIN EN 61000-4-11,
DIN EN 61000-4-29, DIN 4
NAMUR guideline NE21:2008
In order to ensure electromagnetic compatibility, a shielded cable must be used
which is grounded at least at PLC side.
With conducted disturbances in the frequency range 50kHz…80kHz the failure increases up to +1% of URV.

6.11 Safety data

EC Type Examination Certificate
DMT 00 ATEX E075

Type of protection: II 2G Ex ia IIC T6

FF- communications circuit (terminals 9 and 10)
For connecting a certified FF circuit in accordance with the FISCO model,
or for connection to intrinsic safe circuits which do not comply to the FISCO model.

The maximum values satisfying safety requirements are the following:

Voltage	Ui	DC 32 V
Current	Ii	280 mA
Wattage	Pi	2 W
Effective inner inductance	Li	< 10 µH
Effective inner capacitance	Ci	< 5 nF

7 Electrical connection

7.1 Shielding

The shield has to be grounded at least at the PLC side.

7.2 Installation procedure

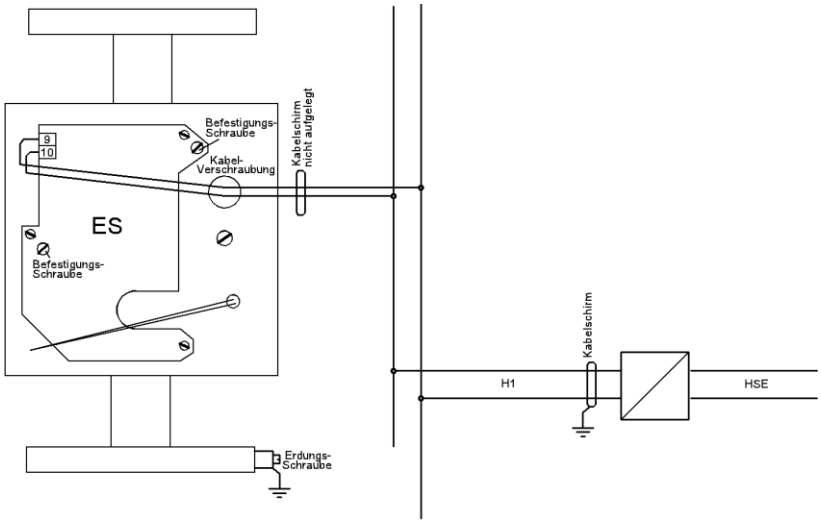
Remove the cover.

Connect the signal lines. The signal cores are connected to terminals 9 and 10. There is no need to observe polarity when making these connections. The unmarked terminals do not have an electrical function.

Reinstall the cover.

7.3 Checking the function

The measured value can be read out shortly after the supply voltage has been switched on. Due to the influence of the float magnet, the ES transmitter will only output the correct value if the pointer position is brought about by moving the float. Turning the pointer will cause deviating values, but makes possible checking of the tendency.



electrical connection of ES-FF

8 Certificates and approvals

EX: EC Type Examination Certificate DMT 00 ATEX E075

CE: The ES-FF transmitter complies with the EC Directives 94/9/EC (Explosion Protection) and 89/336/EEC (Electromagnetic Compatibility) including all changes and/or supplements published up to date (05.09.2013). Conformity with the tested prototype is confirmed by applying the CE Mark.

9 Order Information

The ES transmitter is only supplied in conjunction with a fitting or a spare part. When ordering the device as a spare part, please specify the serial number of the fitting.

10 Maintenance

The ES transmitter is maintenance-free. In case of a malfunction, the ES transmitter can be replaced. A malfunction has occurred, for example, when the measured value differs considerably from the expected value (e.g. difference cannot be explained with a temperature drift). If there is a legitimate doubt as to the correct operation of the device, it must be returned to the manufacturer. The device must not be repaired by the user.

10.1 Replacing the ES transmitter

If an ES transmitter is to be replaced, the new transmitter will adopt all parameters of the old transmitter by importing the archived data record through the bus. An ES transmitter supplied as a spare part is generally parameterized by the manufacturer before delivery with the characteristic curve of the device to be replaced. The order/serial number of the fitting must be specified for this purpose.

Replacement procedure

- Disconnect the device from the bus
- Remove the cover and disconnect the signal cores
- Remove the scale (a screw in the center of the scale at the level of the pointer axle)
- Remove the ES transmitter (two M4 countersunk screws)
- Mount the new ES transmitter and reconnect the signal cores
- Remount scale and cover.

11 Foundation Fieldbus Interface

The parameters required for integration of the device into the PLC are divided into functional groups.

The Resource Block contains informations about the device (eg. type of the device, manufacturer).

The Transducer Block contains sensor-specific parameters as well as the measured value (flow, level with BA, density with DWF)

The Analog Input Functionblock contains parameters forming the output value (limits, range, cutoff, damping value,…)

Additionally the ES-FF contains an Integrator Block which can be used to accumulate the flow.

The ES-FF is capable of performing a LAS functionality.

The device does not support any write protection.

A detailed description of the functions and the Foundation Fieldbus standardized parameters can be get from the literature published by the Fieldbus Foundation.

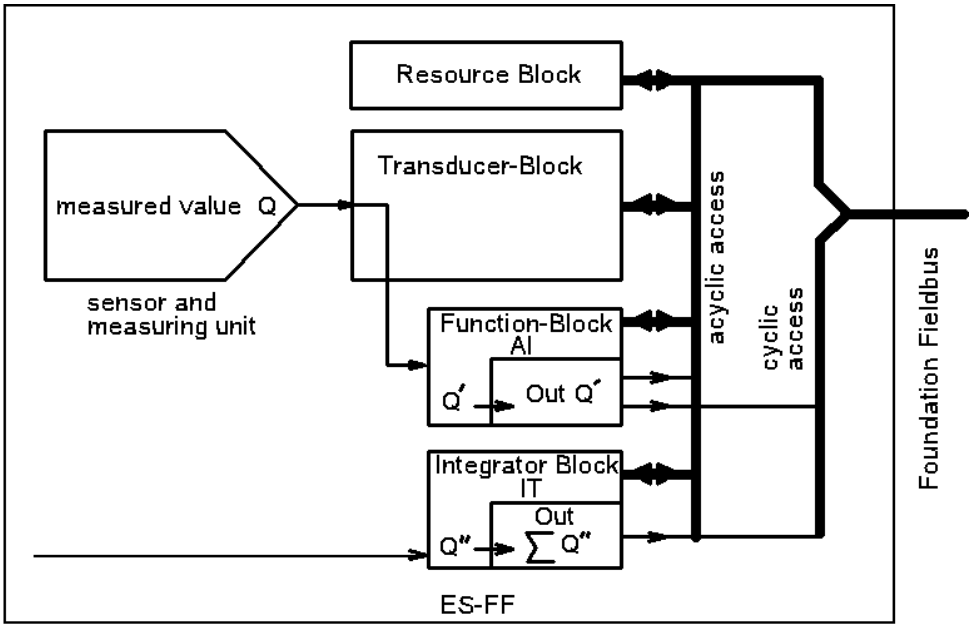


Fig 2: Block model of the ES-FF

11.1 Device description files

To declare the function of ES-FF to a PLC the device description files are needed.
These files are delivered on CD and can also be downloaded from the homepage of the Fieldbus Foundation:
http://www.fieldbus.org/index.php?option=com_mtree&task=search&Itemid=324&ffbstatus=Registered&ffbmfg=Heinrichs+Messtechnik+GmbH&ffbcategory=

- 010101.cff
- 0101.sym
- 0101.ffo

11.2 Device specific parameters of the Transducerblock

SERIAL_NUMBER : that is the commissioning number of the device
PV_UNIT: that is the unit the ES-FF was calibrated in
USL (Upper Sensor Limit): that is the upper sensor limit of the device
URV: This is the range the ES-FF was calibrated for.

„Float-movement“ function:
This function checks wether the change in the sensor signals is greater/smaller during a time period than the preset d/dt:
Parameter **SELF_TEST_MASK** (Enumeration):

- Alarm, if float movement is too small
- Alarm, if float movement is too large
- unused

The alarm is displayed by OUT-status to be „uncertain“.

The preset value is defined as a change in % based on the upper range value per measuring cycle (app. 100ms). Parameter **DELTA** (d/dt): the value by which the measured value may/must change during a measuring cycle. The change in the measured value is monitored for the duration of a selectable time window. The evaluation takes place after this time window expires:
parameter **SELF_TEST_PERIOD**.
The function is only active above a selectable flow rate (related to URV):
parameter **QREL**

This function could be used to detect

- a float blockage
- a water hammer
- compression vibrations

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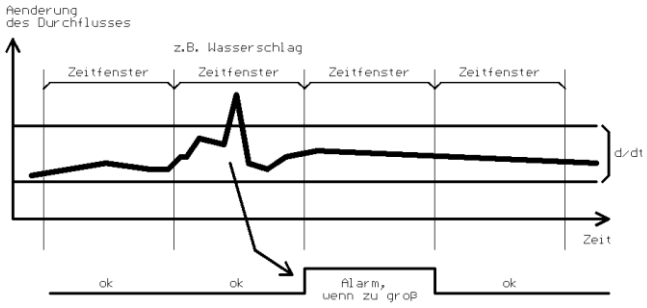
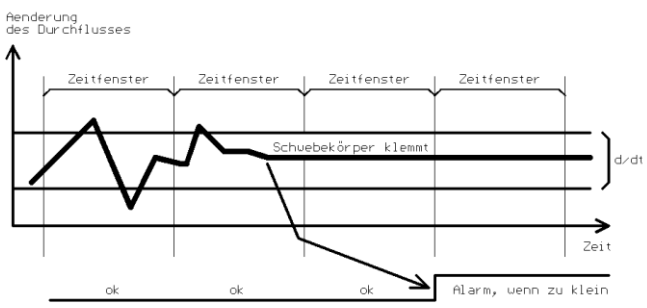




11.3 Analog Input Function Block (AI)

The following parameters have to be set to transfer the measured value from the input of the AI to the output OUT:

- **CHANNEL** must be set to „measured value“
- **L_TYPE** to „Indirect“
- **XD-SCALE** EU_100 corresponds to the upper range value printed on the scale
  EU_0 = 0
  Units Index corresponds to the unit printed on the scale

If the output of the AI is to show the same value as the output of the Transducer Block
you must set additionally **OUT-SCALE** equal to the XD-SCALE.
The unit of the OUT-value can be chosen arbitraryly. The device does not perform any conversion.

LOW CUT (low flow cutoff): The low flow cutoff is set in percent of OUT-SCALE. If the measured value falls below the cutoff it will be set zero.
To activate the low flow cut off the parameter IO_OPTS must also be set to „Low Cutoff“ .

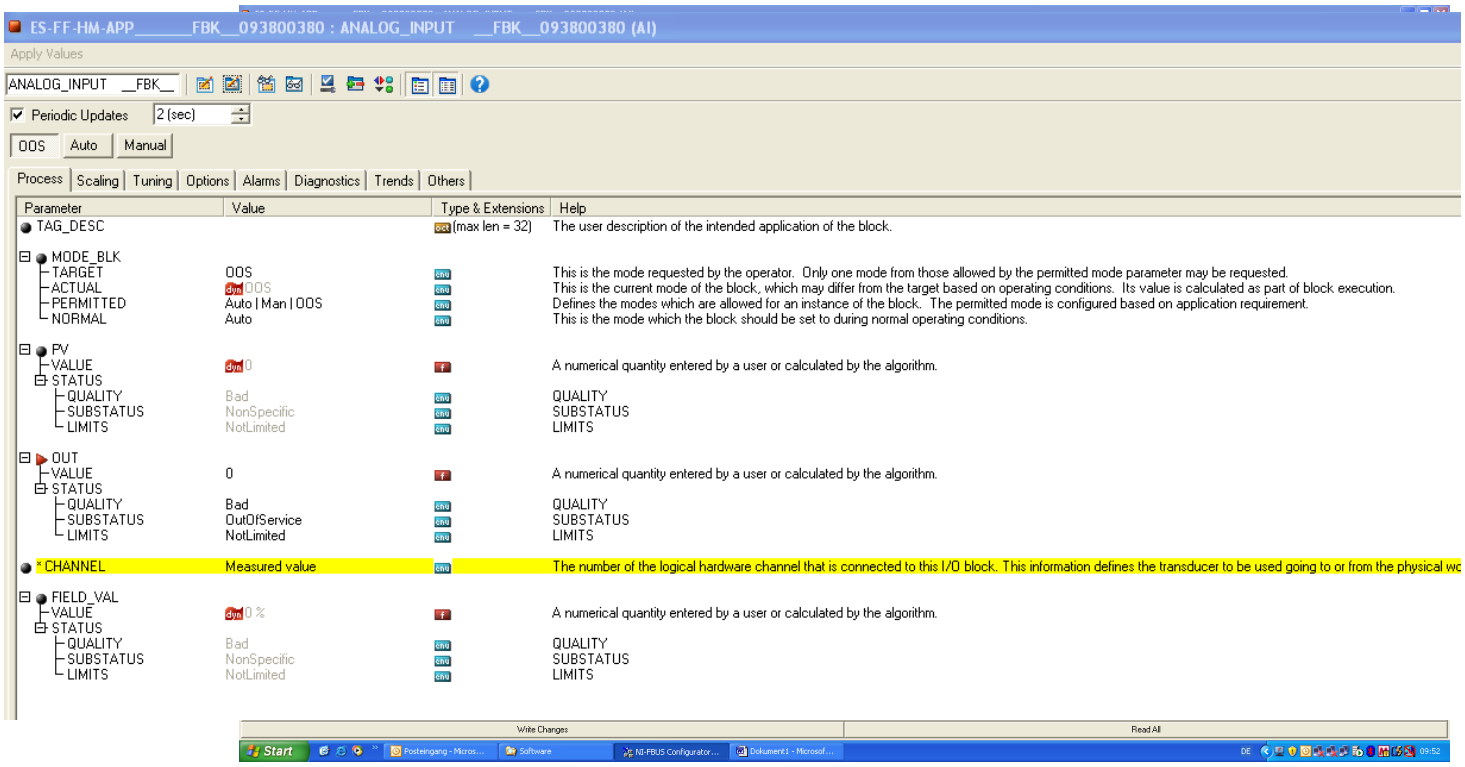
PV_FTIME (Damping):
The damping is used for smoothing the measured value.

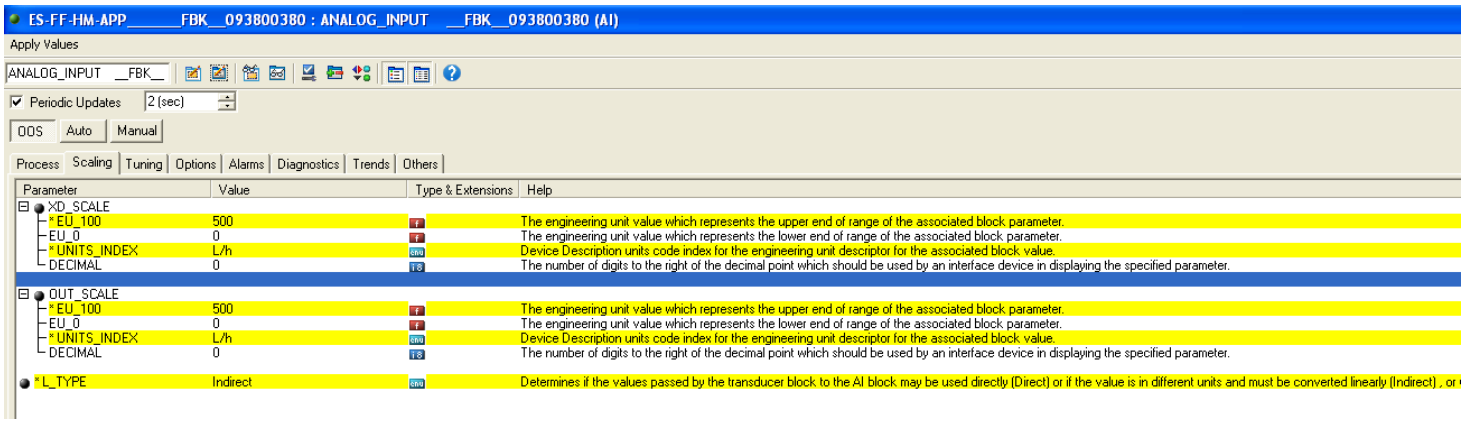
11.3.1 Execution time of AI-Block

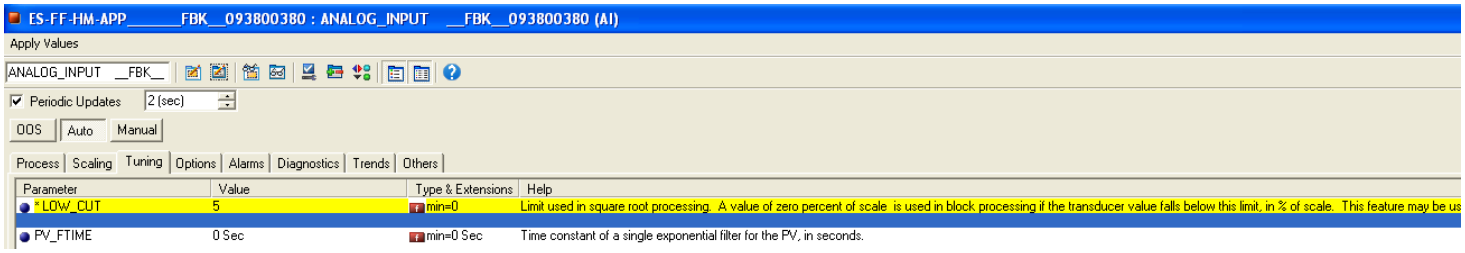
The execution time of AI-Block is 30ms.

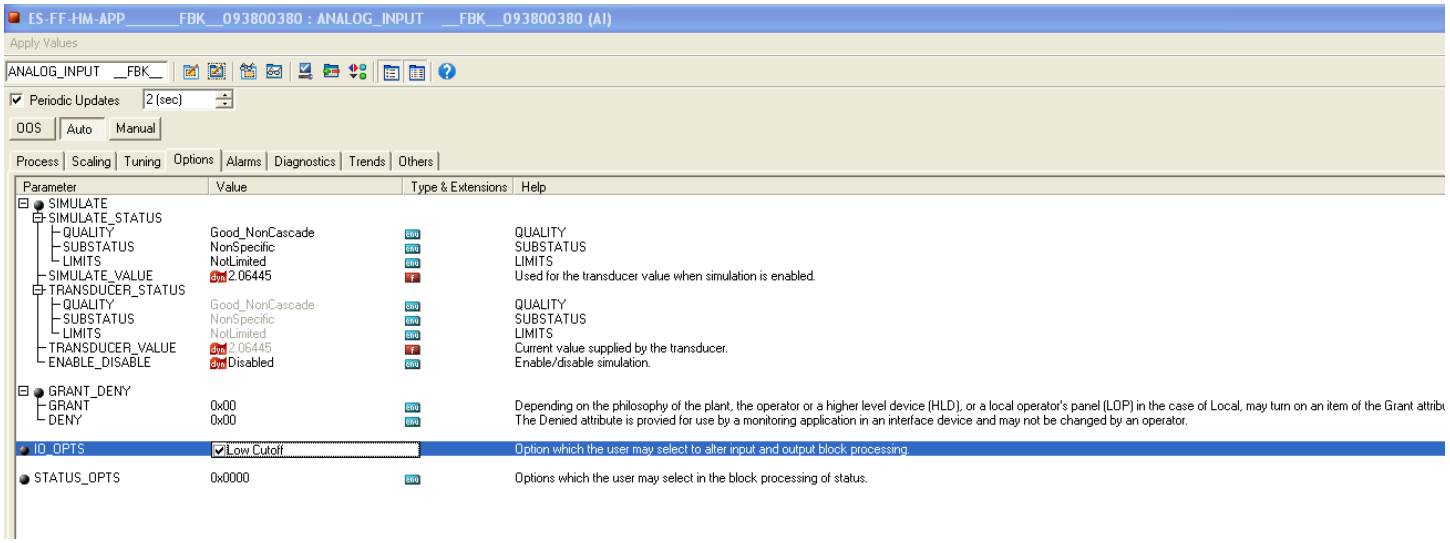
11.4 Example of a configuration

In the following there are shown some screenshots of an application example (AI parameters).
They were derived using the National Instruments FBUS-configurator:






ES-FF-HM-APP_____FBK__093800380 : ANALOG_INPUT __FBK__093800380 (AI)
Apply Values
ANALOG_INPUT __FBK__
Periodic Updates 2 (sec)
OOS Auto Manual
Process Scaling Tuning Options Alarms Diagnostics Trends Others
Parameter Value Type & Extensions Help
* LOW_CUT 5 min=0 Limit used in square root processing. A value of zero percent of scale is used in block processing if the transducer value falls below this limit, in % of scale. This feature may be us
PV_FTIME 0 Sec min=0 Sec Time constant of a single exponential filter for the PV, in seconds.


ES-FF-HM-APP_____FBK__093800380 : ANALOG_INPUT __FBK__093800380 (AI)
Apply Values
ANALOG_INPUT __FBK__
Periodic Updates 2 (sec)
OOS Auto Manual
Process Scaling Tuning Options Alarms Diagnostics Trends Others
Parameter Value Type & Extensions Help
SIMULATE
SIMULATE_STATUS
QUALITY Good_NonCascade QUALITY
SUBSTATUS NonSpecific SUBSTATUS
LIMITS NotLimited LIMITS
SIMULATE_VALUE 2.06445 Used for the transducer value when simulation is enabled.
TRANSDUCER_STATUS
QUALITY Good_NonCascade QUALITY
SUBSTATUS NonSpecific SUBSTATUS
LIMITS NotLimited LIMITS
TRANSDUCER_VALUE 2.06445 Current value supplied by the transducer.
ENABLE_DISABLE Disabled Enable/disable simulation.
GRANT_DENY
GRANT 0x00 Depending on the philosophy of the plant, the operator or a higher level device (HLD), or a local operator's panel (LOP) in the case of Local, may turn on an item of the Grant attribu
DENY 0x00 The Denied attribute is provied for use by a monitoring application in an interface device and may not be changed by an operator.
IO_OPTS Low Cutoff Option which the user may select to alter input and output block processing.
STATUS_OPTS 0x0000 Options which the user may select in the block processing of status.