- GENERAL

smar
FIRST IN FIELDBUS

INSTALLATION, OPERATION AND MAINTENANCE PROCEDURES MANUAL

PROFIBUS PA SERIES 303 OF FIELD DEVICES

FY303

LD303

FP303

IF303

TT303

FI303

LD293

DT303

TP303

MAR/22
GENERAL
VERSION 2

GERAL - PAME

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INTRODUCTION

The Profibus is an open and independent of field network of suppliers, whose interface between them allows a wide application in processes and manufacture. This standard meets the EN 50170 and EN 50254 recommendations, besides IEC 611158-2 in the case of PROFIBUS PA.

The PROFIBUS DP is a Profibus high-speed solution. Its development has been optimized specifically for communication between decentralized automation systems and equipment for control systems, which emphasize access to I/O-distributed devices.

PROFIBUS PA is the PROFIBUS solution for process automation. PROFIBUS PA connects automation systems and process control systems with field devices such as pressure, temperature and level transmitters. PROFIBUS PA can be used as a substitute for the analog 4 to 20 mA technology. PROFIBUS PA achieves cost savings of over 40% in planning, cabling, commissioning and maintenance and offers a significant increase in functionality and security.

There are potential advantages for using this technology, which briefly highlights the functional advantages (transmission of reliable information, treatment of status variables, security system in case of failure, equipment with autodiagnosis capabilities, rangeability, high-resolution in measurings, integration with high-speed discrete control, applications in any segments etc). Besides the economic benefits to the installations (reduction of up to 40% in some cases for conventional systems), maintenance costs (down by 25% in some cases for conventional systems) and less startup time, offers a significant increase in functionality, availability and security.

PROFIBUS PA uses only one two-wire line to power field devices and applications on intrinsically safe areas, as well as permits the maintenance and connection/disconnection of devices during operation, without effect on other stations even in potentially explosive areas. It has been developed in close cooperation with users in the Process Control Industry (NAMUR) and meets the special requirements of this application area:

• Unique application profiles for process automation and interoperability of field devices from different makers.
• Addition and removal of bus stations even in intrinsically safe areas without influence to other stations.
• Transparent communication via segment couplers between the PROFIBUS PA process automation bus and the PROFIBUS-DP industrial automation bus.
• Power supply and data transmission over the same two-wire line with basis on IEC 1158-2 technology.
• Use in potentially explosive areas with "intrinsically safe" or "not intrinsically safe" shield types.

The connection of transmitters, converters and positioners in a PROFIBUS DP network is made by a DP / PA Coupler. The shielded twisted pair cable is used in power suplly and data communication for each equipment, facilitating the installation and resulting in low hardware cost, less startup time, trouble-free maintenance, low engineering software cost and high operation confidence.

This is due to the fact that PROFIBUS PA communication protocol uses the same communication services and telegrams. In fact, PROFIBUS PA = PROFIBUS DP communication protocol + Extended Acyclic Services + IEC 1158 , also known as H1 Physical Level.

Profibus permits uniform and full integration between the automation and process control levels in plant areas. This means that the integration of all plant areas can be accomplished with one communication protocol using different variations.

On field level, the distributed periphery, such as: I/O modules, transducers, drivers, valves and operation panels work in efficient communication system in real time, the PROFIBUS DP or PA. Process data transmission is done cyclically, while alarms, parameters and diagnostics are transmitted only when necessary, in a non-cyclic way.

This manual presents PROFIBUS-PA installation details and common configuration points of Smar 303 PROFIBUS PA Series equipment.

Whenever possible, see EM 50170 for physical regulations, as well as safety practices for each area.

It is necessary to act with safety in measurements, avoiding contact with terminals and wiring, beccause the high voltage may cause electric shock. Remember that each plant and system has its safety details. To be aware of them before starting work is very important.

To minimize the risk of potential problems related to safety, follow the applicable safety standards and local hazardous locations that regulate equipment installation and operation. These standards vary from area to area and are constantly updated. It is the users´s responsibility to determine which norms should be followed in their applications and ensure that each equipment is installation in compliance with them.

An improper equipment installation or use in applications can damage the system performance and consequently the process, besides being a source of danger and accidents. Because of this, it is recommended using only qualified and trained professionals for installation, operation and maintenance.

HAZARDOUS AREAS
Damages due to inadequate equipment installations or use in wrong applications are not covered by warranty.

Get the best results from the Profibus PA Series 303 by carefully reading these instructions.

WARNING
This Manual is compatible with version 2.XX, where 2 denote software version and XX software release. The indication 2.XX means that this manual is compatible with any release of Series 303 field devices with software version 2.

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INSTALLATION

Network Wiring

Access the wiring block by removing the Electrical Connection Cover. This cover can be closed by the cover locking screw. To release the cover, rotate the locking screw clockwise. See Figure 1.1 - Housing Rotation.

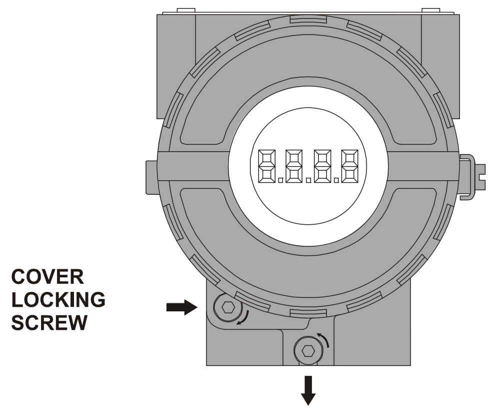


Figure 1.1 - Housing Rotation

Cable access to wiring connections is obtained by one of the two outlets. Conduit threads should be sealed by means of code-approved sealing methods. The unused outlet connection should be plugged accordingly.

The wiring block has screws on which fork or ring-type terminals can be tightened. See Figure 1.2- Wiring Block.

For convenience there are two ground terminals: one inside the cover and one external, located close to the conduit entries. For more details consult Shield and Grounded.

Avoid adjusting signal wiring close to power cables or switching equipment.

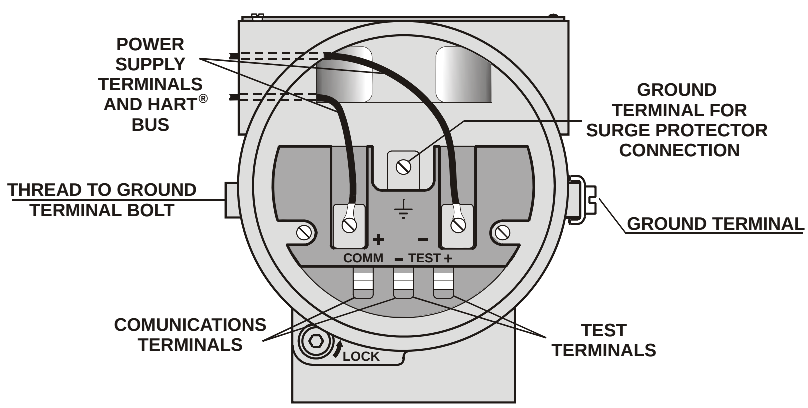


Figure 1.2- Wiring Block

NOTE
The passage of the signal wiring routes by which it has power cables or electrical switches must be avoided.

The Figure 1.3 show as a device must be connecting in a PROFIBUS network.

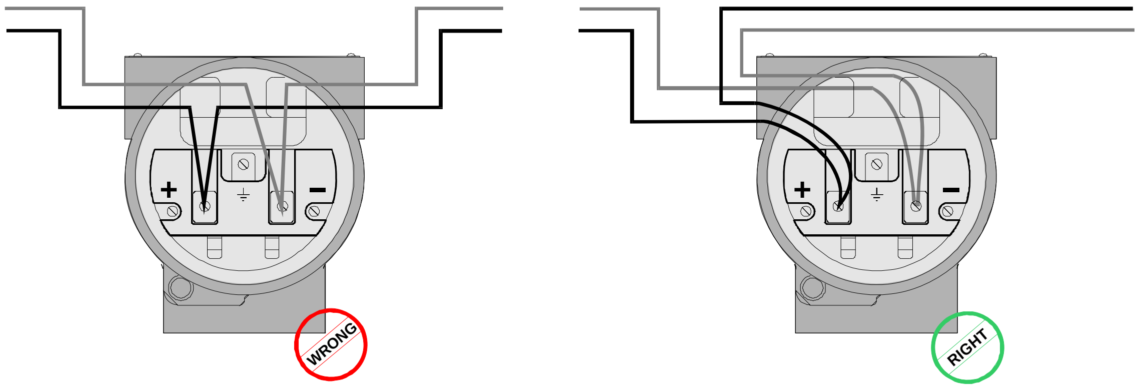


Figure 1.3 – Wiring Mode of a Device in a Profibus Network

The **Series 303** devices are protected against reverse polarity, and can withstand up to 35 Vdc without damage. When in reverse polarity the device will not operate.

Physical Signaling

The **Profibus PA Series 303** devices use the 31.25 kbit/s voltage mode wire media option for the physical signaling. All devices on the bus must use the same Manchester modulation type. All devices are connected in parallel along the same pair of wires. This devices are powered by bus, while some may be powered externally, not absorving the energy PROFIBUS PA bus.

The signal used to communicate is a 750 mV to 1000 mV AC signal covering the DC supply signal.

Physical Layer, Cabling and Installation – Profibus PA

Physical Layer

PROFIBUS PA is a bi-directional digital communications protocol that allows the interconnection of several equipments on a single network directly in the field, performing acquisition and actuation functions as well as monitoring processes and stations (HMIs) with supervisory software. It is based on the ISO/OSI standard, whose layers: Physical Layer, Communication Stack and User Application execute comprehensive management and applications of new models with basis on Function Blocks and Device Descriptions.

The Physical Layer (known as PA or H1) is defined by the IEC and ISA standards. It receives messages from the Communication Stack and converts them into physical signals among fieldbus transmissions and vice versa, by including and removing preambles and limitators in the beginning and the end of messages.

The Physical Layer is based on the IEC61158-2, with the following characteristics:

- Data transference by using Manchester coding, with 31.25 kbit/s rate;
- For a clear communication signal, each product must be powered at least with 9 volts. The H1 Physical Layer allows powering the equipment via bus, as the same pair of wires that power the equipment also provides the communication signal. There are some equipments that are powered externally;
- Maximum 1900 m/segment length without repeaters;
- By using up to 4 repeaters, the maximum length can reach 9.5 km;
- A PROFIBUS PA bus without intrinsic safety and external power on the communication wiring must support from 2 to 32 equipments in application;
- PROFIBUS PA bus should support several equipments in application with intrinsic safety and without power supply. Typical values for equipments with 10 mA quiescent current:
  - Explosion Group IIC: 9 devices;
  - Explosion Group IIB: 23 devices.

Note: It is possible to connect more equipments than specified, but this depends on their consumption, power supply and the features of the intrinsic safety barrier and the FISCO model;

- The bus nor the equipments should be disconnected while in operation;
- Topologies available in bus, tree, star or mixed.

The FISCO model has the following restrictions:

a) There is only one active element (power supply) in the field bus, located in a non-classified area;
b) The other equipments in the area are classified as passive;
c) Each field equipment must have a minimum 10 mA consumption;
d) On Ex ia and Ex ib areas the maximum bus length must be 1000 m;
e) Individual stubs should be limited to 30 m;
f) Use 2 active terminators in the main bus, one in the beginning and one in the end of the bus;
g) Use transmitters and barrier/power supplies approved by FISCO;
h) The cables (without restrictions for cabling up to 1000 m) must have the follow parameters:
   - R´: 15 to 150 Ω/km;
   - L´: 0.4 to 1 mH/km;
   - C´: 80 to 200 nF/km.
   Cable type A: 0.8 mm² (AWG18)
i) Each transmitter must be:
   - Voltage limited: Vo < Vi;
   - Current limited: Io < Ii;
   - Power limited: Po < Pi;

   Note: It is not necessary to calculate C and L to the segment.
j) The terminator must have the follow parameters:
   - R = 90 to 100 Ω;
   - C = 0 to 2.2 μF.

The FISCO concept was optimized to allow greater number of field devices according to the bus length, considering the variation in the cable characteristics (R', L', C') and terminators, to meet categories and groups of gases with a simple installation involving intrinsic safety. By this, the capacity of current per segment increased and facilitated the user´s assessment. Moreover, by purchasing certified products, the user need not worry with estimates, even for a change in operation.

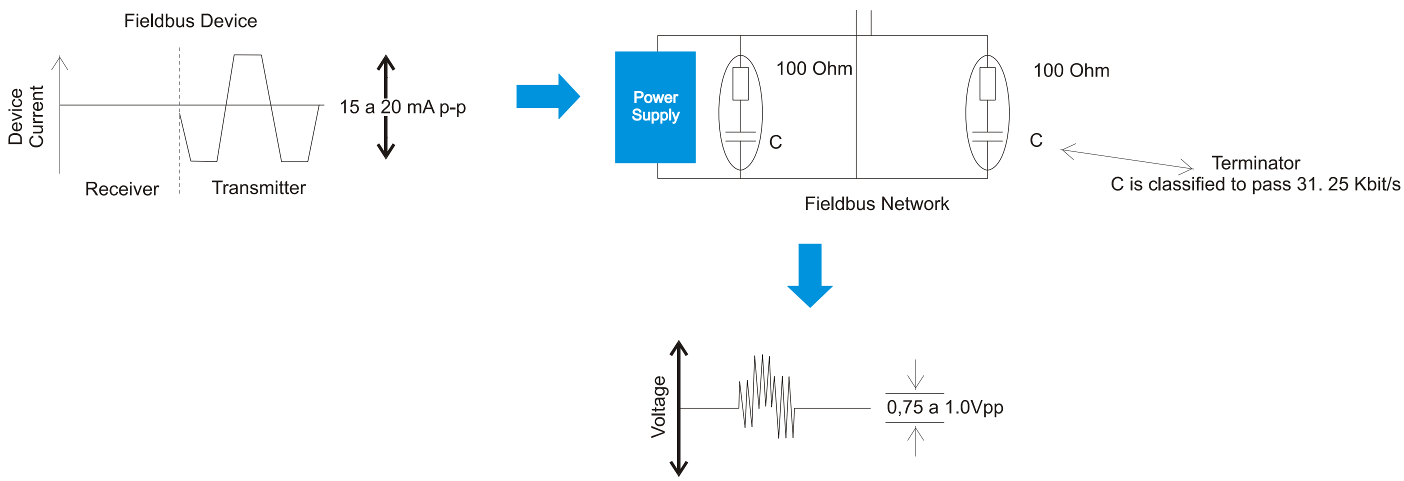


Figure 1.4 – 31.25 kbit/s Voltage Mode

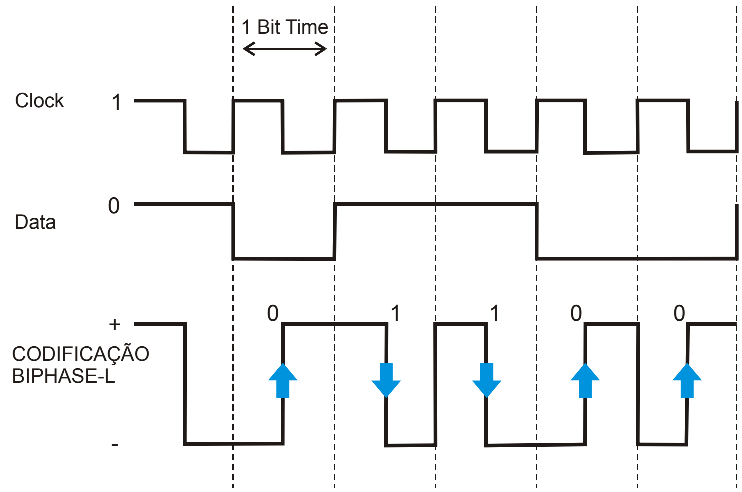


Figure 1.5 – Manchester Coding

An equipment transmission supplies 10 mA to 31.25 kbit/s in a load equal to 50 Ω, creating a peak to peak 750 mV to 1.0 V modulated signal voltage. The power supply can provide 9 to 32 VDC, but in safe applications (IS) it should meet the requirements of the intrinsic safety barriers. See Figure 1.4.

TYPES OF CABLE RECOMMENDED

The IEC 61158-2 requires the PROFIBUS PA physical medium to be a shielded twisted pair cable. The properties of field bus are determined by the conditions of the electrical properties used. Although the IEC 61158-2 do not specify technically the cable, the A type cable is highly recommended to ensure the best conditions for communication and the distances involved.

Table 1.1 presents in detail the specifications of the various cables to 25 °C. Remember that most cable manufacturers recommend operating temperature between -40 ºC to +60 ºC. The temperature in the critical points that guide and support the cable wiring same needs to be checked. The strength of the type A 22 Ω/Km cable is valid at 25 ºC. The cable resistance increases with temperature, about 0.4% per ºC.

	Type A	Type B	Type C	Type D
Cable Description	Shielded twisted pair cable	One or more Shielded twisted pair cable	Several pair cable without Shield	Several non-twisted pairs without Shield
Nominal Conductor Area	0,8 mm² (AWG 18)	0,32 mm² (AWG 22)	0,13 mm² (AWG 26)	0,25 mm² (AWG 16)
DC Resistence Maximum (loop)	44 Ω/km	112 Ω/km	264 Ω/km	40 Ω/km
Characteristic Impedance of 31.25 KHz	100Ω ± 20%	100 Ω ± 30%	**	**
Maximum Attenuation at 39 KHz	3 dB/km	5 dB/km	8 dB/km	8 dB/km
Maximum Unbalanced Capacitance	2 nF/km	2 nF/km	**	**
Distortion of the Group Delay (7.9 to 39 kHz)	1,7 µs/km	**	**	**
Area Covered by Shield	90%	**	-	-
Recommendation for Network Extension (including Spurs)	1900 m	1200 m	400 m	200 m

Table 1.1 – Several Characteristics of the Cables Used for PROFIBUS PA

CABLE TOTAL LENGTH AND RULES OF DISTRIBUTION AND INSTALLATION

The PROFIBUS PA total cable length should be totaled from the exit of the conversion DP/PA point to the farthest point of the segment, considering the derivations. Remember that spurs lower than 1 m do not enter this total.

The total length of cable is the sum of the trunk (main bus) size and all the spurs (derivations larger than 1m) but for the type A cable it is the maximum unsafe areas in 1900 m. In safe areas it is a maximum 1000 m with the type A cable and the Spurs can not exceed 30 m.

It is recommended to avoid splice in the installation and distribution. The splices are any part of the network that has impedance change, which can be caused, for example, by changing the type of cable, discontinuity of the shield, crushing or very sharp bends in the cable etc. In networks with total length greater than 400 m, the sum of the lengths of all the splices should not exceed 2% of the total length and, in lengths less than 400 m, must not exceed 8 m.

The maximum length of a PA segment when using different types of cable is limited by the following equation:

$$\left(\frac{LA}{LA\max}\right)+\left(\frac{LB}{LB\max}\right)+\left(\frac{LC}{LC\max}\right)+\left(\frac{LD}{LD\max}\right)\langle=1$$

Where:

LA : Cable A length;

LB : Cable B length;

LC : Cable C length;

LD : Cable D length;

$LA\max$: Maximum length allowed with the cable A (1900 m);

$LB\max$: Maximum length allowed with the cable B (1200 m);

$LC\max$: Maximum length allowed with the cable C (400 m);

$LD\max$: Maximum length allowed with the cable D (200 m);

To respect to Spurs, it is necessary to be attentive to the lengths them. The number of PA devices (to be considered when the repeaters) should be according to Table 1.2. In areas classified Spur the maximum is 30 m.

Total PA Device per Segment DP/PA Coupler Total PA	Equipamento Spur Length (m) with 01 Device	Spur Length (m) with 02 Device	Spur Length (m) with 03 Device	Spur Length (m) with 04 Device	Length (m) Considering the Maximum Number of Spurs
1-12	120	90	60	30	12 x 120 = 1440
13-14	90	60	30	1	14 x 90 = 1260
15-18	60	30	1	1	18 x 60 = 1080
19-24	30	1	1	1	24 x 30 = 720
25-32	1	1	1	1	1 x 32 = 32

Table 1.2 –Spur vs. PA Devices

Note: The cable capacitance limit must be considered, since the effect on the signal of a spur is less than 300 m and is similar to a capacitor. In the absence of the cable manufacturer data, a value of 0.15 nF/m can be used for Profibus cables.

$$Ct=(Ls*Cs)+Cd$$

Where:

Ct : Total capacitance in nF;

LS : Spur Length in m;

Cs: Wire Capacitance per segment in nF (default: 0.15);
Cd : PA device capacitance.

The attenuation associated with this capacitance is 0.035 dB/nF. Thus, the total attenuation is:

$$A = Ct * Ls * 0.035\, dB / nF \langle 14\, dB$$

Since 14 dB will produce the minimum signal required to detect it with integrity.

There are some rules that must be followed in terms of separation between cabling and other cables, whether regarding signs or power. Preferably use tray or metal rails, observing the distances shown on Table 1.3. Never pass the PROFIBUS PA cable along high voltage lines, because the induction is a source of noise and can affect the communication signal. Moreover, the fieldbus signal must be isolated from noise sources, such as power cables, motors and frequency inverters. It is recommended them to be placed in separate tabs and rails. The ideal is to use aluminum conduits, with internal and external electromagnetic shielding. The Foucault current are practically immune, due to the good aluminum electrical conductivity. And remember that the the cables should cross at an 90° angle.

Notice that a complete signal condition is guaranteed by appropriate grounding techniques.

	Profibus Communication Cable	**Cables with and without shield: 25 Vac and < 400 Vac and < 400Vac**	**Cables with and without shield: > 400 Vac**	**Any cable exposed to rays**
Profibus Communication Cable	--	10 cm	20 cm	50 cm
Cables with and without shield: 25 Vac e < 400 Vac	10 cm	--	10 cm	50 cm
Cables with and without shield: > 400 Vac	20 cm	10 cm	--	50 cm
Any cable exposed to rays	50 cm	50 cm	50 cm	--

Tabela 1.3 – Minimum Distance of Separation between Cabling

PROFIBUS PA NETWORK TERMINATORS

Two bus terminators must be connected to the PROFIBUS PA network, one in the output of the DP/PA Coupler and the other in the last device (usually the most distant from the Coupler), depending on the topology adopted.

If the cabling has a junction box at the end of the main stem with several spurs, the field terminator should be placed in this point, which will facilitate the maintenance when removing the equipment.

Make sure the terminator connection is correct, remembering that the lack of terminators cause communication intermittency, without impedance and with increased reflection signal.

The lack of a terminator or its connection to the wrong point also degrades the signal, as it also work as part of the wiring as an antenna. This lack can increase the signal by more than 70% and an extra terminator can decrease the signal up to 30%. The atenuation and intermittency can generate communication failures.

The PA network terminator has a 100Ω ± 2% resistor and a 1µF ± 20% capacitor in series. See Figure 1.6. To verify typical wave forms of the H1 according to the termination, see Figure 1.7.

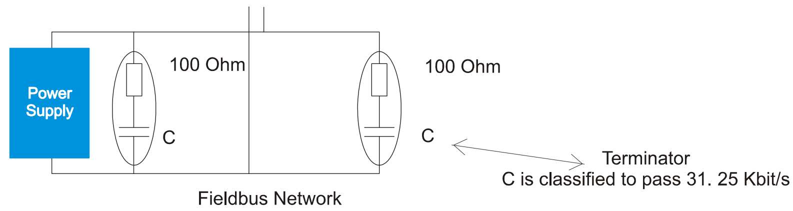


Figure 1.6 – Bus Terminator

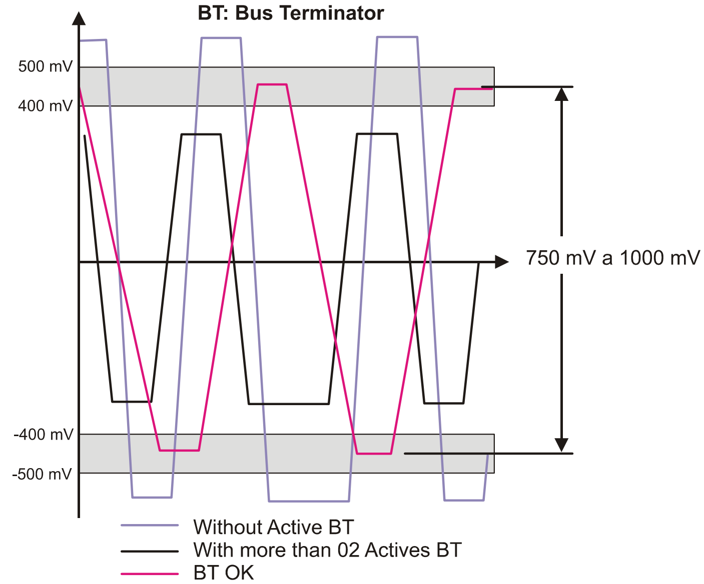


Figura 1.7 – Typical wave forms of the H1 according to the Termination

TOPOLOGIES
In terms of topology, there are the following models: Star (Figure 1.8), Bus (Figure 1.9) and Point-to-Point (Figure 1.10). In practice, normally it has a mixed topology.

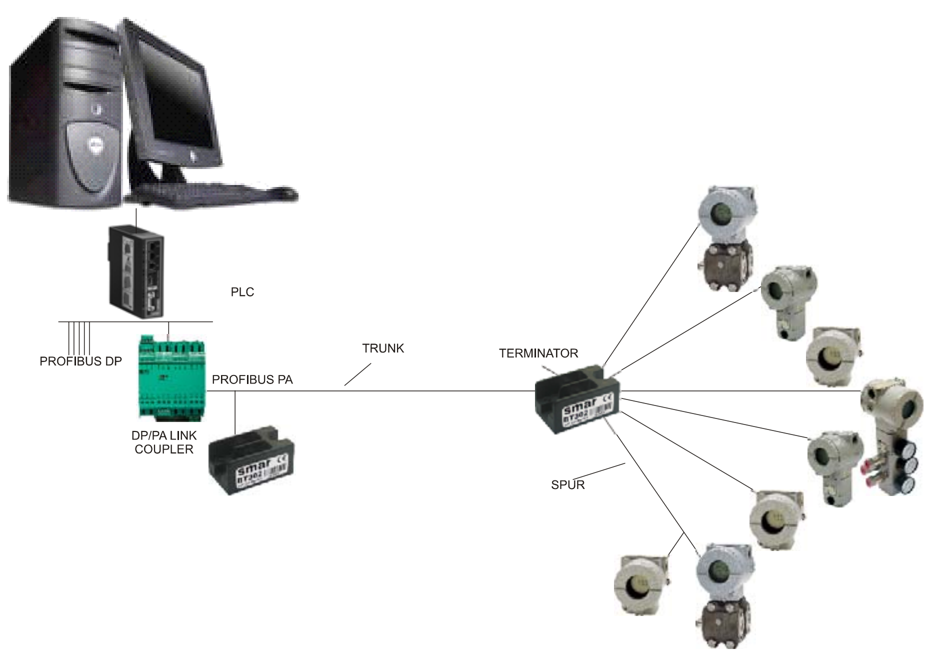


Figura 1.8 –Star Topology

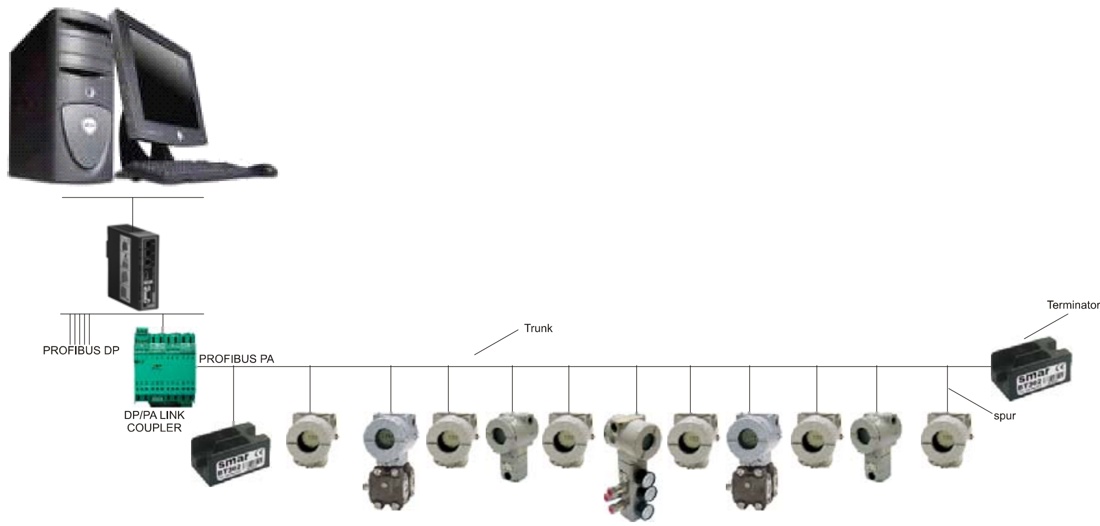


Figura 1.9 –Bus Topology

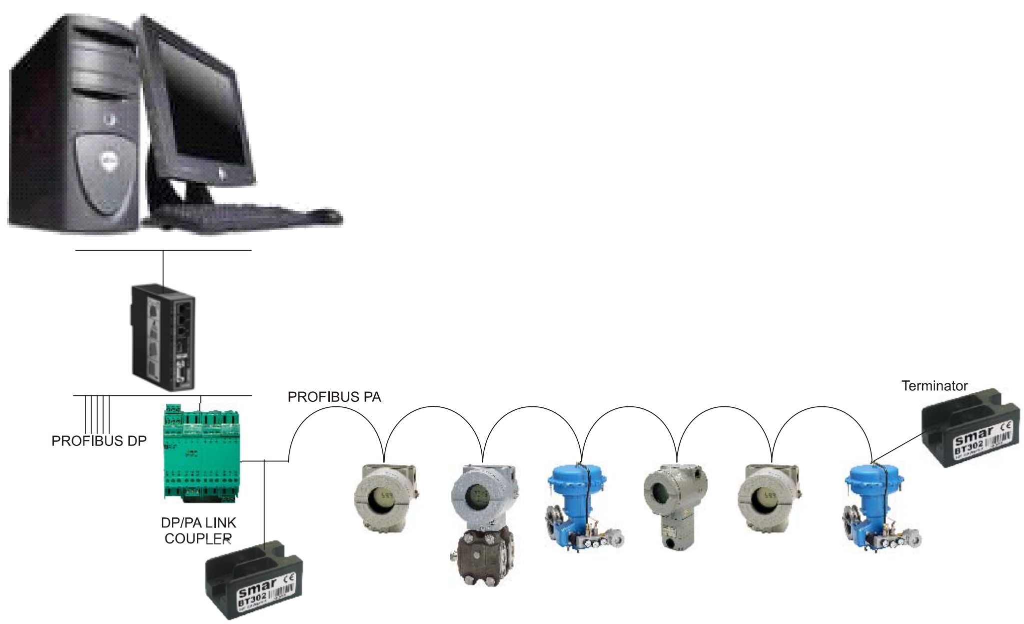


Figura 1.10 - Point-to-Point Topology

REPEATERS

The PROFIBUS PA network has up to 4 repeaters. These are used when needing to increase the quantity of devices or increase the signals levels that have been weakened by the wiring length or expanding it the up to 9500 m.

Check for terminators in the end of the segment (beginning repeater) and the repeater output.
Whenever there is a repeater is as if there was a new network with the same rules seen before.

TRANSIENT SUPPRESSOR

Whenever there is an effective distance between 50 and 100 m horizontally or vertically 10 m between two grounded points, it recommend the use of transient suppressor in the initial and final points of the distance, as shown in Figure 1.11.

NOTE
The transient suppressor protects the electric circuit against overvoltages.

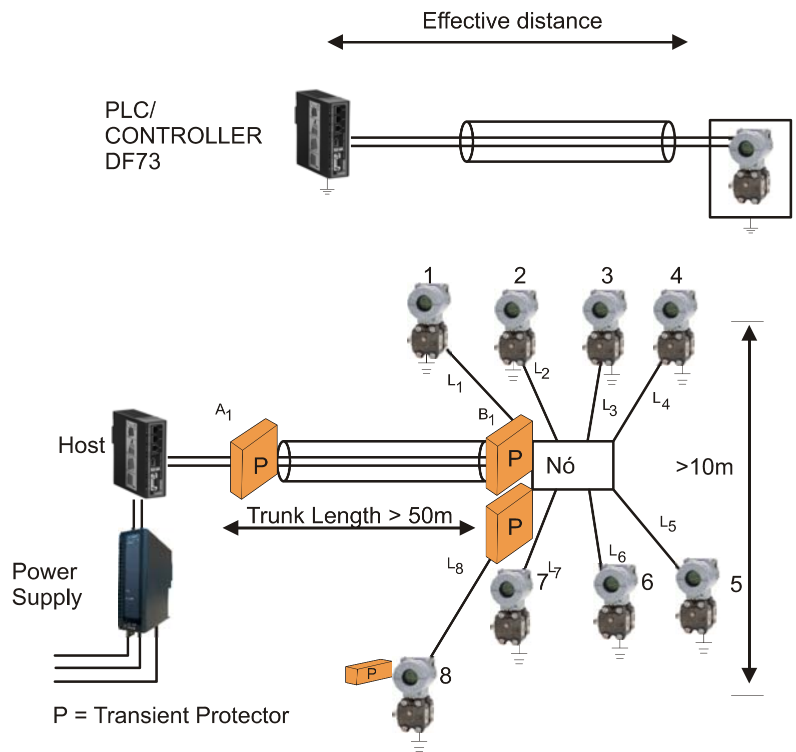


Figura 1.11 – Effective Cable Distribution Distance

Install the transient suppressor immediately after the DP/PA Coupler, before each equipment and junction box. In classified areas, use certified protectors.

POWER SUPPLY AND COMMUNICATION SIGNAL

Power consumption varies from one equipment to another, as well as from manufacturer to manufacturer. All Smar PROFIBUS PA devices have the same current consumption (12 mA). The smaller is the device consumption, the best is its performance, especially in intrinsically safe applications. The cable resistance must not be very high as to cause a voltage drop, in order to have lower power supply levels in the more distant Coupler DP/PA device. The resistance must kept low to ensure good connections and joints.

For the power supply signal, the following values are considered as acceptable in practice:

- 12 to 32 Vdc, on the DP/PA Coupler output, depending on the manufacturer;
- Rippler (mV):
  - < 25: excellent;
  - 25 < r < 50: ok;
  - 50 < r < 100: marginal;
  - > 100: not acceptable.
- Voltage Level
  - 750 a 1000 mVpp: ok;
  - > 1000mVpp: Very high. There may lack a terminator.
  - Some barriers and segment protectors (spur guard or segment protector) have high serial impedance and can result in up to 2000 mV signals and allow the adequate operation.
  - < 250 mVpp: Very low. Check if there is more than 2 active terminators, power supply, DP/PA coupler, etc.

Some equipments have polarity, others not, so it is very important to ensure the correct device polarity. All devices must be connected in parallel in the bus.

The use of coded color wires is recommended to distinguish the positive from the negative. Use data line A (negative) as green conductor and line B (positive) as red conductor.

NOTE
Avoid the inversion of data lines along the path of the Profibus network, keeping the same nomenclature for all the cabling.

DP/PA COUPLER

The DP/PA coupler is used to translate the PROFIBUS PA and PROFIBUS DP bus physical features, because it needs to convert physical environment (RS485/fiber optic) into IEC61158-2 (H1), whose communication speeds are different.

The DP/PA Coupler is also available for applications that require safety in classified areas.

The DP/PA Coupler is transparent, i.e., has no address on the bus. The field devices connected to it are addressed or accessed directly programmable controller or automation system. There are few suppliers on the market and the most common are Pepperl + Fuchs with 93.75 kbits/s and Siemens with 45.45 kbits/s on the PROFIBUS DP side. The Pepperl + Fuchs offers its high-speed models in the DP, the so-called High Speed couplers that reach 12Mbits/s, namely, SK2 and SK3, with an application that converts the GSD file slaves to the format suitable for these couplers:

http://files.pepperl-fuchs.com/selector_files/navi/productInfo/18/1830112d.zip

Table 1.4 presents details of some types of couplers. For more details and the latest versions consult the manufacturers.

	Siemens	Siemens	Siemens	Pepper+Fuchs	Pepper+Fuchs
Ordering Code	6ES7157-0AD00-0XA0	6ES7157-0AC00-0XA0	6ES7157-0AA00-0XA0 PA/Link	KFD2-BR-EX 1.PA	KFD2-B-1.PA
“Ex”	IA DE EX IIC	-	IA DE EX IIC	IA DE EX IIC	-
Operation Voltage (V)	12.5	19	(3)	12.6	22
Maximum Operation Current (mA)	100	400	(3)	110	380
Maximum Power Supply (W)	1.8		(3)	1.93	
Maximum line resistance	35	25	(3)	32.7	34.2
Maximum Cable Length (m)	1000	1900 (2)	(3)	1000 (1)	1900 (2)
Transmission/Reception DP Rate	45.45 kbits/s	45.45 kbits/s	Até 12 Mbits/s	93.75 kbits/s	93.75 kbits/s

Tabela 1.4 – DP/PA Couplers Features

NOTE
(1) Maximum cable length for Ex IIC and 1000 m. **(2)** Maximum value specified in IEC 61158-2. **(3)** Both Siemens PA couplers, 6ES7157-0AD00-0xA0 and 6ES7157-0AC00-0xA0, can be connected to the DP/PA link.

	SK1 KFD2-BR-1.PA.93	SK1 KFD2-BR-EX1.3PA.93	SK2 Power Link KLD2-PL-1.PA	SK1 Power Link KLD2-PL-EX1.PA
PA Segment – Explosion Protection	-----------------------	Intrinsically Safe according to FISCO	---------------------------	Intrinsically Safe according to FISCO
Power Supply				
Voltage	20 … 35 Vdc	20 … 35 Vdc	20 … 35 Vdc	20 … 35 Vdc
Current	790 mA up to 20 V	430 mA up to 20 V	790 mA up to 20 V	430 mA up to 20 V
	400 mA up to 35 V	190 mA up to 35 V	400 mA up to 35 V	190 mA up to 35 V
PROFIBUS DP Conection				
Baude Rate	93.75 kbits/s	93.75 kbits/s	See Gateway	See Gateway
Termination Impedance	100 Ohm, selectable	100 Ohm, selectable	See Gateway	See Gateway
PROFIBUS PA Conection				
Voltage	24 ... 26 V	12.6 ... 13.4 V	24 ... 26 Vdc	12.6 ... 13.4 V
Current	Max. 400 mA	Max. 100 mA	Max. 400 mA	Max. 100 mA
Termination Impedance	100 Ohm, integrated	100 Ohm, integrated	100 Ohm, integrated	100 Ohm, integrated
Mechanical				
DP connection terminal	2.5 mm²	2.5 mm²	See Gateway	See Gateway
PA connection terminal	2.5 mm²	2.5 mm²	2.5 mm²	2.5 mm²
Housing	For housing installation in power rail			
Dimensions (WxLxH)	80 x 115 x 107 mm	100 x 115 x 107 mm	80 x 115 x 107 mm	100 x 115 x 107 mm
Ingress Protection	IP20	IP20	IP20	IP20

	SK2 Gateway KLD2-GT-DP1PA	SK2 Gateway KLD2-GT-DP1PA	SK2 Gateway KLD2-GT-DPR.4PA
Number of channels	1/5	2/10	4/20
Power Supply			
Voltage	20 … 35 Vdc	20 … 35 Vdc	20 … 35 Vdc
Current	138 mA at 20 V	138 mA at 20 V	138 mA at 20 V
	84 mA at 35 V	84 mA at 35 V	84 mA at 35 V
PROFIBUS DP Connection			
Baude Rate	45.45 kbits/s … 12Mbits/s	45.45 kbits/s … 12 Mbits/s	45.45 kbits/s … 12 Mbits/s
Impedance Terminator	None	None	None
Mechanical			
PROFIBUS DP Connection	1 x RS485-9-pin sub-D socket	1 x RS485-9-pin sub-D socket	2 x RS485-9-pin sub-D socket
Power Link Connection	Power Rail ou 2.5 mm² terminals		
Housing	For housing installation in power rail		
Dimensions (WxLxH)	60 x 115 x 107 mm	60 x 115 x 107 mm	60 x 115 x 107 mm
Ingress Protection	IP20	IP20	IP20

Tabela 1.5 – DP/PA Couplers Features – Pepperl + Fuchs

Explosion Zone / Group	Coupler	Notes
Zone 0	(Ex ia) IIx	Devices that are installed in Zone 0 must operate in a segment with "Ex ia." type protection.
Zone 1	(Ex ia) IIx (Ex ib) IIx	Devices that are installed in Zone 1 must operate in a segment with "Ex ia" or "Ex ib" type protection. All circuits connected in this segment should be certified for "Ex ia" or "Ex ib." type protection.
Explosion Group IIC	IIC (Ex ia) IIC	If the measuring is determined in a average IIC explosion group, the devices and the segment coupler involved must be certified for IIC explosion group.
Explosion Group IIB	(Ex ia) IIC (Ex ib) IIB	For the average IIB explosion group, both devices and Coupler segments can be certified as IIB or IIC groups.
Non-Ex	Non-Ex	Devices that are not operating in a non-Ex segment should not be installed in explosion risk areas.

Tabela 1.6 - Certification Details of Coupler as the Classification of Area

DF95 AND DF97 CONTROLLERS WITH INTEGRATED DP/PA INTERFACES

The controllers with integrated interfaces are autonomous units that process information from DP and PA networks and High Speed Ethernet (HSE) gateway.

These controllers make up the Smar DFI302 control platform. They incorporate all communication interfaces in a single hardware and increase the system reliability and availability, besides accepting more compact automation architectures since they combine process control functions with direct access to the DP and PA variables via redundant Ethernet industrial networks, without needing external network couplers or interfaces.

Technical features of the DF95/DF97 PROFIBUS HSE and Gateway controllers are:

- Two ports 10/100 Mbps Ethernet;
- One RS-232 channel per controller;
- MODBUS Gateways (RTU and TCP);
- One exclusive channel for Hot Standby redundancy;
- One Profibus DP channel supporting up to 12 Mbps;
- 2 channels H1 (IEC 61158) 31.25 kbps (for DF95);
- 4 channels H1 (IEC 61158) 31.25 kbps (for DF97);
- Class-1 master for cyclic communication;
- Class-2 master for acyclic communication;
- Supports up to 125 PROFIBUS network addresses;
- 250 FF functional blocks;
- 1200 functional block for ladder;
- 2048 Profibus discreet points;
- 512 Profibus analog points;
- Up to 50 ms minimum time for Ladder execution.

Table 1.7 shows the network component technical features used with the DF95 and DF97. For more details consult the product manual.

DF95 AND DF97 NETWORK COMPONENT		DF49 / DF53	DF47-12	DF47-17
Certification		--	For details on certification, consult the product manual	For details on certification, consult the product manual
Power Supply Input	Adjustable Input Voltage	--	24 Vdc	24 Vdc
	Maximum Applicable Voltage in Safety Conditions	--	250 Vac	250 Vac
	Adjustable Input Power	--	3 W	3 W
	14 V Current Supply	--	75 mA	110 mA
Power Supply Output	Maximum Available Voltage at the Barrier Terminals for Maximum Current	--	13,8 Vdc	13,8 Vdc
	Maximum current in typical operation (considering Us = 13.8 Vdc)	--	65 mA	90 mA
	Current Limitating Resistor	--	Ri ≥ 247,5 Ω	Ri ≥ 176,22 Ω
	Maximum Output Power	--	1,2 W	1,72 W
Operation Voltage		24 a 32 Vdc ± 10%	--	--
Output Current		340 mA per channel	--	--
Attenuation in Input Filter		10dB in the input power ripple @ 60 Hz	--	--
Number of Ports for *Fieldbus*		DF49: 2 ports DF53: 4 ports	--	--
Maximum Cable Length		--	Up to 1900 m. Note: Maximum cables lengths are determined by IS requirements, and depend on both the number of devices attached and the maximum acceptable voltage drop along the cable. Use FISCO cable.	Up to 1900 m. Note: Maximum cables lengths are determined by IS requirements, and depend on both the number of devices attached and the maximum acceptable voltage drop along the cable. Use FISCO cable.
Digital Signal Transmission		--	Compatible with 31.25 kbps - Fieldbus systems.	Compatible with 31.25 kbps - Fieldbus systems.
Fuses		--	In order to guarantee the product safe, the internal fuse change must be executed only by the manufacturer.	In order to guarantee the product safe, the internal fuse change must be executed only by the manufacturer.
Terminals		--	Accommodate conductors up to 2.5 mm2 (22 AWG)	Accommodate conductors up to 2.5 mm2 (22 AWG)
Insulation		--	2500 V galvanic isolation between input, output, and power supply terminals. Tested at 1500 Vrms minimum between hazardous and safe area terminals	2500 V galvanic isolation between input, output, and power supply terminals. Tested at 1500 Vrms minimum between hazardous and safe area terminals
Internal Dissipation		--	3 W maximum at 24 V input, nominal conditions (for non intrinsically safe circuits).	3 W maximum at 24 V input, nominal conditions (for non intrinsically safe circuits).

LINK DP/PA

The PROFIBUS PA field devices can be connected to the PROFIBUS DP also by a DP/PA link. The DP/PA link is used for wide networks, in which case more than one DP/PA link can be connected to a PROFIBUS DP line, depending on the complexity of the network and the processing time needs. The DP/PA link works as a slave in the PROFIBUS DP and as a master in the PROFIBUS PA, disconnecting all network communication data. This means that the PROFIBUS DP and PROFIBUS PA can be combined without affecting the performance of the PROFIBUS DP process.

The DP/PA link can be operated in all standard PROFIBUS DP masters and the addressing capacity of the system increases considerably, but the DP/PA link keeps only one PROFIBUS DP address. The slaves connected to the DP/PA link have their addresses started as if on a new network, so it is used when the addresses are expanded.

Siemens has a DP/PA link that is similar to the IM 157. This link works on the PA side in 31.25 kbits/s and on DP side in 9.6 kbits/s to 12 Mbits/s. The link consists of an interface module with up to 5 DP/PA couplers, intrinsically safe version, or up to 2 DP/PA couplers, non-secure version. The 157 IM and each coupler should be powered by 24 Vdc. The maximum number of field devices per link is limited to 30 or 64 devices, but this depends on the type and amount of bytes exchanged cyclically.

An important point to consider is that in the GSD file the IM157 link must add the cyclic data of each device, where the starting and ending areas must be delimited as follows, in the IM157 GSD. Check if in the DP/PA GSD file the IM157 Link includes modules for Smar devices. If they are included, add them:

```
Module = "==SMAR device beginning" 0x01, 0xfc
270
EndModule
Module = “==Analog Input “0x94
271
EndModule
Module = "==Totalizer" 0x41, 0x84, 0x85
272
EndModule
Module = "==SP” 0xA4
273
EndModule
Module = "==RCAS_OUT, RCAS_IN" 0xB4
274
EndModule
Module = "==READBACK + POS_D, SP----Part1" 0x96
275
EndModule
Module = "==READBACK + POS_D, SP----Part2" 0xA4
276
EndModule
Module = "==CHECKBACK, SP -Part1" 0x92
277
EndModule
Module = "==CHECKBACK, SP -Part2" 0xA4
278
EndModule
Module = "==READBK+POS_D+CHKBK, SP--Part1" 0x99
279
EndModule
Module = "==READBK+POS_D+CHKBK, SP--Part2" 0xA4
280
EndModule
Module = "==RCAS_OUT+CHKBK, RCAS_IN-Part1" 0x97
281
EndModule
Module = "==RCAS_OUT+CHKBK, RCAS_IN-Part2" 0xA4
282
EndModule
Module = "==RB+RC_OUT+POS_D+CB, SP+RC_IN1" 0x9E
283
EndModule
Module = "==RB+RC_OUT+POS_D+CB, SP+RC_IN2" 0xA9
284
EndModule
Module = "== Empty Module” 0x00
285
EndModule
Module = "==SMAR device end” 0x01, 0xfd
286
EndModule;
```

ADDRESSING USING DP/PA COUPLERS

Figure 1.12 shows in detail the transparent addressing when couplers are used (low or high speed) on the PROFIBUS DP and PROFIBUS PA networks. The default address is 126 and only one device with 126 may be present on the bus at a time.

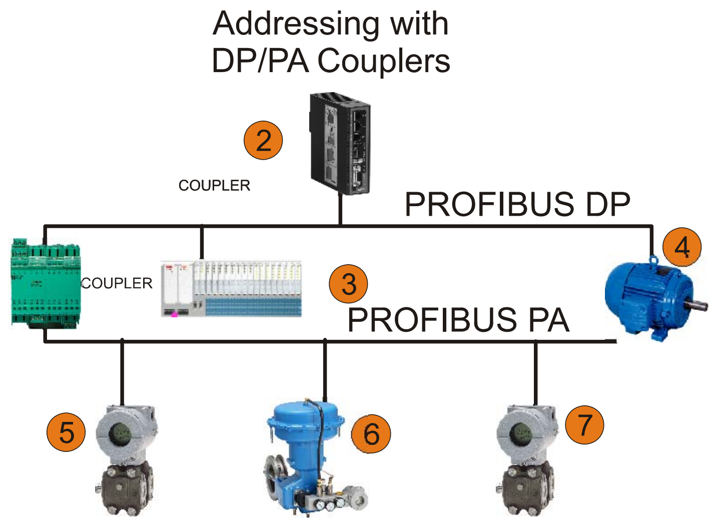


Figura 1.12 - Transparent Addressing with Use of Coupler DP/PA

The Figure 1.13 shows in detail the extended addressing when using the link DP/PA in the PROFIBUS DP and PROFIBUS PA network. It is important that the link address is different from the slave address associated with it. For example, in this figure, the 3 to 5 address is not used to address the links.

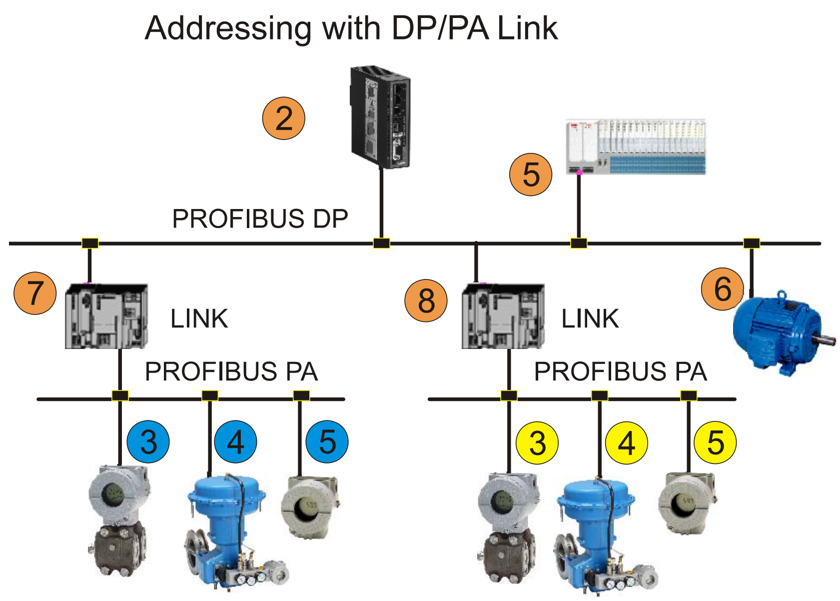


Figura 1.13 - Addressing extended link with the use of DP/ PA

SHIELD and GROUNDING

When considering the question of grounding shield on fieldbuses, one should take into account:

- Electromagnetic compatibility (EMC);
- Explosion proof;
- People protection.

According to the IEC 61158-2, to ground means being permanently connected to the ground through sufficient low impedance and conductivity to prevent any tension that may cause damage to devices or people. Transmission lines with 0 Volts must be connected to ground and be galvanically isolated from the fieldbus bus. The purpose of grounding the shield is to prevent high-frequency noises.

Preferably, the shield must be grounded in two points: at the beginning and the end of the bus, provided there is no difference in potential between these points, allowing the passage of the loop current. In practice, when there is such a difference, it is recommended the shield to be grounded in only one point, i.e., in the power supply or the intrinsic safety barrier. It must ensure the continuity of the cable shielding in more than 90% of the total cable length.

The shield should completely cover the electrical circuit through the connectors, couplers, splice and distribution boxes and junction.

Never should be used the shield as driver of the signal. It is need to check the continuity of the shield until the last segment of the device PA, analyzing the connection and completion, because this should not be grounded in the housing of devices.

In classified areas, if a potential balance between safety area and hazardous area is not possible, the shield should be connected directly to ground (Equipotential Bonding System) only on the side of the dangerous area. In the safety area, the shield should be connected through a capacitive coupling preferably a ceramic capacitor (dielectric solid), C ≤ 10nF, isolation voltage ≥ 1.5kV. See Figures 1.14 and 1.15.

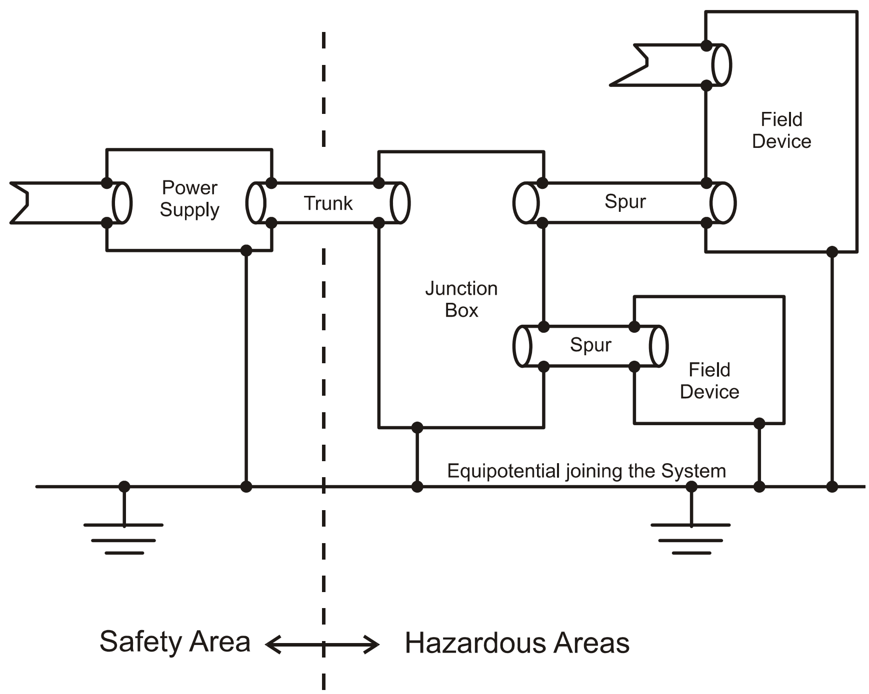


Figura 1.14 – Ideal Combination of Shield and Grounding

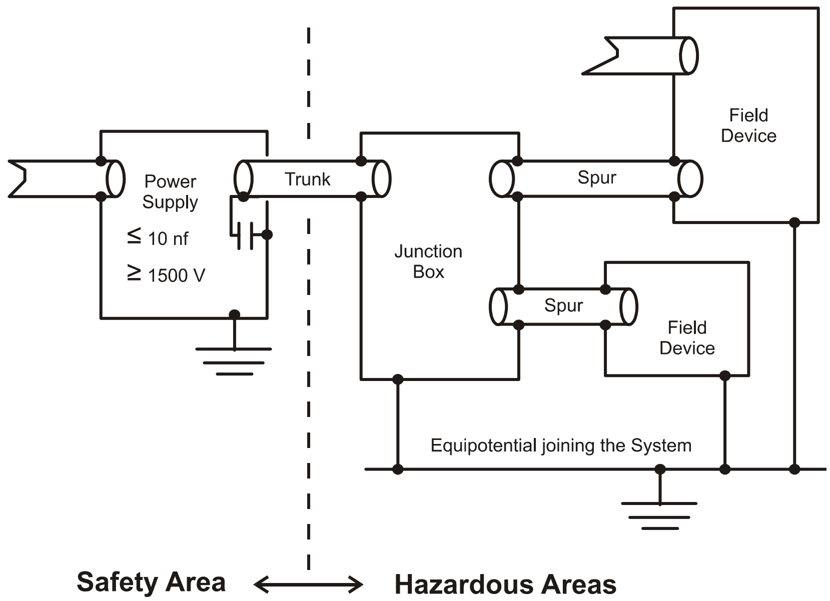


Figura 1.15 – Capacitive Grounding

The IEC 61158-2 recommends the complete isolation. This method is used mainly in the United States and in England. In this case, the shield is isolated from all groundings, except the ground point or the negative power supply of the intrinsic safety barrier side. The shield has continuity since the DP/PA Coupler output, via the junction and distribution boxes and reaches the devices. The device housings are grounded individually in the non-safety side. This method has the disadvantage of not fully protecting the high-frequency signals and depending on the topology and cable length can generate in some cases the communication intermittency. Recommended in this case is the use of metal conduits.

Another isolation way, would be to ground junction boxes and device housings in a ground equipotential line, in the non-safety side. The groundings on the non-safety and the safety sides are kept separated.

The multiple grounding condition is also common, with more effective protection against high frequency and electromagnetic noises. This method is used mainly in Germany and some European countries. In this method, the shield is grounded at the negative of power suplly or that of the intrinsic safety barrier of the safety side in addition to the junction boxes ground and the device housings, which are also grounded individually, on the non-safety side. In another complementary condition, the ground connections would be grounded together in an equipotential ground line, connecting the non-safety side to the safe side.

For more details, always consult the local safety standards. Use as a reference the IEC 60079-14 for applications in classified areas. See Figure 1.16.

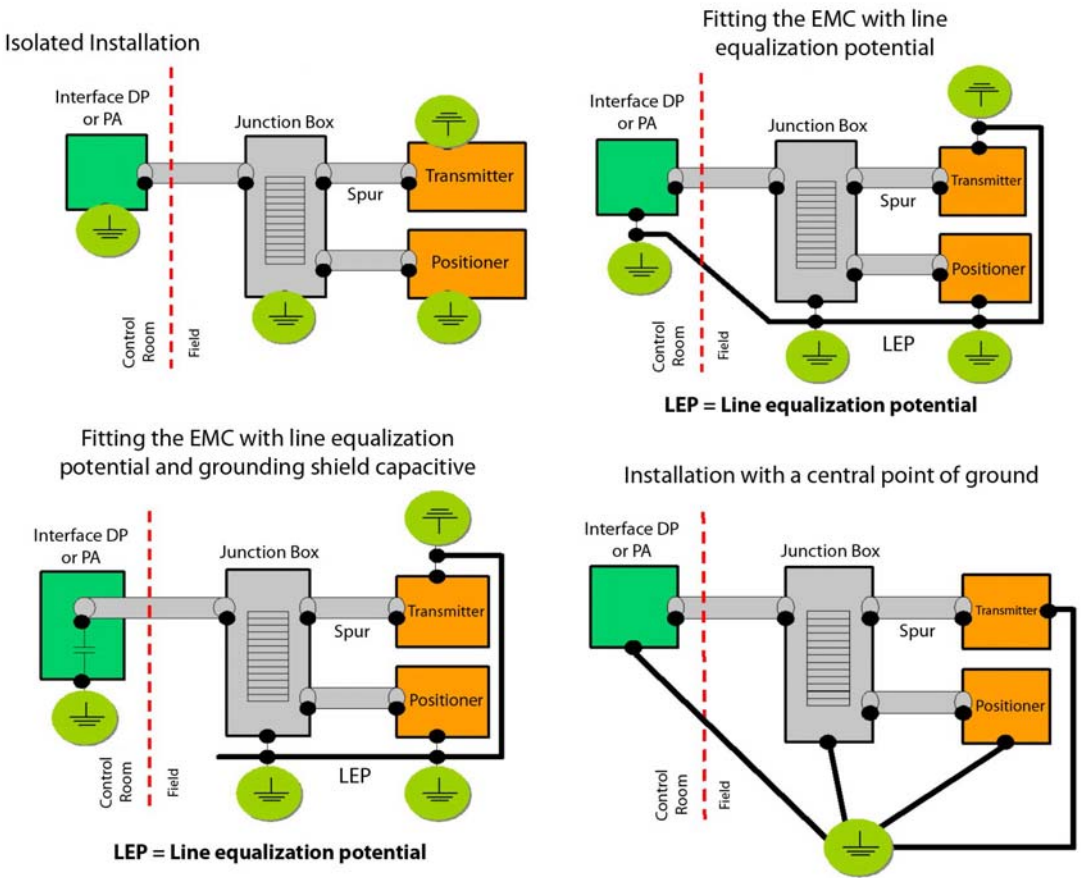


Figura 1.16 – Several Shield Grounding Types

NUMBER OF DEVICES IN A PROFIBUS PA SEGMENT

The number of devices (N) per PA segment is the purpose of quiescent consumption of each PA device, the distances involved (type A loop cable resistance: 44 Ω/km), the DP/PA Coupler and its drained current, area classification (couplers for classified area drain currents around 110 mA, 12V output voltage), besides the FDE current (usually 0 mA, depending on the manufacturer). In hazardous areas the device number must be limited by intrinsic safety barrier, according to security restrictions in the area and limits of the DP/PA coupler. See Figure 1.17.

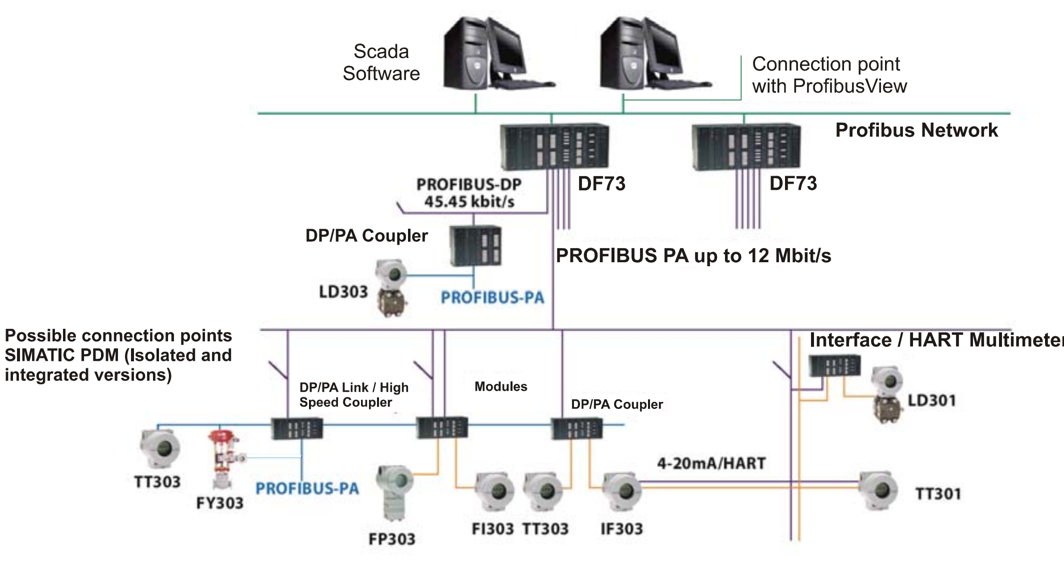


Figure 1.17 – Bus Parametrization

The total current in the segment must be less than that drained by the coupler. Smar devices consume 12 mA.

$$I_{Seg} = \sum I_{BN} + I_{FDE} + I_{FREE}$$

Where:

$$I_{Seg} \langle I_C$$

I_{Seg} : Current in the segment PA;

$\sum I_{BN}$: Sum of quiescent currents of all devices in the PA segment;

I_{FDE} : Additional current in case of failure, usually negligible;

I_{FREE} : Current off, useful in case of expansion or change of manufacturer, recommended 20 mA;

I_C : Current drained by coupler.

In addition, there must be at least 9.0 V in the terminal block of the most distant device from the DP/PA Coupler to ensure the correct power supply

$$V_{BN} = V_C - (R * L)$$

Where:

V_C : DP/PA coupler output voltage;

R : Loop Resistence (Cable type A, R = 44 Ω/km);

L : Total length of the PA bus;

V_{BN} : Voltage in the terminal block of the most distant PA device from the DP/PA Coupler.

Being $V_{BN} \rangle 9.0V$. This ensures powering the latest PA device. Remember that the communication sign should have a range from 750 to 1000 mV.

Some junctions boxes or short-circuit protectors for segments, called spur guards are active and can be powered via PA (H1) bus, in which case it will be included in the total current. In addition, each spur guard output has a current limit that must be observed.

GSD FILES (DEVICE DATABASE FILES)

The Profibus requires a file known as GSD that describes the device in detail with input and output data, their formats (identifier numbers), communication rates supported, if it has an address change command, hardware and firmware version etc. This information is used by the Profibus master during the cyclic data exchange**.** BMP files are normally associated with each device. Smar device files are available at:

http://www.smar.com/files/DevicesLibrary/Smar_DeviceLibrary_Version1_11%20-20Profibus.zip

There are three types of profiles for PROFIBUS PA equipments according to the GSD file version:

- *Manufacturer Specific*: This type ensures maximum functionality, according to the manufacturer;
- *Profile Specific*: This type contains a fixed number of AI (Analog Input Block) and if the device is replaced by another from a different manufacturer, this new device will have the same basic features;
- *Profile Multi-variable*: The device will have for ID number the number 0x9760 and the GSD file will contain all the blocks specified in the profile of the device, such as AI, DO, DI, etc.

In most cases, the devices are used as the GSD according to the Manufacturer Specific type, which ensures the maximum functionality, according to the manufacturer.

Depending on the Profibus system used, GSD files can be copied in a directory and BMPs files copied in a specific one. Some systems require that, after copying, a GSD scan is activated to update the cyclic configuration tool.

CYCLIC DATA

The input and output function blocks can be configured to exchange cyclic data, as a link between two different equipment parameters. The cyclic data exchange indicates that a function block input parameter gets its output parameter value cyclically. from of a specific output parameter on another function block in other equipment.

In general, a transmitter or actuator function block does the cyclic data exchange with the master controller device (for example, DF73 or PLC). Normally the transmitter obtains data from the sensor and the controller device receives these data, calculates them and sends the information to an actuator, which receives it and works in the process according to a control strategy.

Smar Devices have the following definition for modules and blocks:

- LD303– the GDS file (smar 0895.gds) defines 2 modules for this equipment: The first for Analog Input and the second to Totalizer. This means that the LD303 has two main function blocks available, Analog Input Block and Totalizer Block, respectively. Thus, the configuration of cyclic reading when not using the totalizer should be the followingt: Analog Input (0x94) and empty module (0x00), respectively. However, if you use the totalizer, the LD303 still will require two modules: Analog Input (0x94) and Totalizer (0x41, 0x84, 10x85), respectively;

- TP303 - The GDS file (smar0904.gds) defines 2 modules for this equipment: The first for the Analog Input and the second for the Totalizer.

- TT303 - The GDS file (smar089A.gds) defines 2 modules for this equipment: 2 modules for Analog Input. The TT303 has 2 Analog Input Blocks . Normally, it uses only one AI block to measure the temperature. If it has two different sensors, the two Analog Input Blocks should be used. Consequently, there are two independent temperature measurings, one per channel.

The TT303 manual describes the configuration of the necessary parameters and shows the connection diagram for the different types of sensors (this diagram is mentioned on the document above). The only cases where the two analog input blocks should be used are the last two in this diagram. If only one sensor is configured it is necessary to configure the two modules, one for the analog input 1 (0x94) and one for the empty module (0x00), respectively. However, if the TT303 was configured for two independent measurings, two modules must be configured, one for the analog input 1 and the other for the analog input 2.

So it is very important to know that when using only one sensor, always configure two modules for the Master DP cyclic reading.

- IF303 - The GDS file (smar0896.gds) defines 6 modules for this equipment: 3 modules for Analog Input and 3 modules for the Totalizer (an AI and a TOT function block for each terminal).

- FY303 - The GDS file (smar0897.gds) defines 1 module for this equipment: 1 module for Analog Output.

- FP303 – The GDS file (smar0898.gds) defines 1 module for this equipment: 1 module for Analog Output.

- FI303 - The GDS file (smar0899.gds) defines 3 modules for this equipment: 3 modules for Analog Output.

- LD293 - The GDS file (smar0906.gds) defines 1 module for this equipment: the module for Analog Input.

- DT303 - The GDS file (smar0905.gds) defines 1 module for this equipment: the module for the Analog Input block, for firmware version less than 2.00. For versions greater than or equal to 2.00, the DT303 uses the GSD file (smar0905a.GSD) that defines 3 analog input modules for this device, in this order: concentration, density (kg/m³) and temperature.

Table 1.8 shows the function blocks available, the cyclic data order, the number of modules required and the default address for each of the Smar devices.

In the same table it is possible to see the definition of the buffer order to cyclic data reading, where this order is described in more detail.

Devices	Functional Block Availablel			Order for Exchange Cyclic Data						Number of Modules	Default Address
	AI	AO	TOT	1	2	3	4	5	6		
LD303	1	-	1	AI	TOT	-	-	-	-	2	126
TP303	1	-	1	AI	TOT	-	-	-	-	2	126
TT303	2	-	-	AI	AI	-	-	-	-	2	126
IF303	3	-	3	AI	AI	AI	TOT	TOT	TOT	6	126
FY303	-	1	-	AO	-	-	-	-	-	1	126
FP303	-	1	-	AO	-	-	-	-	-	1	126
FI303	-	3	-	AO	AO	AO	-	-	-	3	126
LD293* DT303 < 2.00	1	-	-	AI	-	-	-	-	-	1	126
DT303* > = 2.00	3			AI	AI	AI				3	126

* Firmware Version

Table 1.8 –Setting the Order for Cyclic Data Reading

FB	Parameter	Identifier Byte	Extended Format Identifier
AI	OUT	0x94	0x42,0x84,0x08,0x05
AO	SP	0xA4	0x82,0x84,0x08,0x05
	SP/READBACK/POS_D	0x96,0xA4	0xC6,0x84,0x86,0x08,0x05,0x08,0x05, 0x05,5x05
	SP/CHECK_BACK	0x92,0xA4	0xC3,0x84,0x82,0x08,0x05,0x0A
	SP/READBACK/POS_D/CHECK_BACK	0x99,0xA4	0xC7,0x84,0x89,0x08,0x05,0x08,0x05, 0x05,0x05,0x0A
	RCAS_IN/RCAS_OUT	0xB4	0xC4x84,0x84,0x08,0x05,0x08,0x05
	RCAS_IN/RCAS_OUT/CHECK_BACK	0x97,0xA4	0xC5,0x84,0x87,0x08,0x05,0x08,0x05, 0x0A
	SP/READBACK/RCAS_IN/RCAS_OUT/ POS_D/CHECK_BACK	0x9E,0xA9	0xCB,0x89,0x8E,0x08,0x05,0x08,0x05, 0x08,0x05,0x08,0x05,0x05,0x05,0x0A
TOT	TOTAL	-	0x41,0x84,0x85
	TOTAL/SETTOT	-	0xC1,0x80,0x84,0x85
	TOTAL/SETTOT/MODETOT	-	0xC1,0x81,0x84,0x84

Table 1.9 - Indentifier Numbers According to Functional Blocks and contained in GSDs files

FLOAT IEEE754 FORMAT

The float format used in PROFIBUS is defined according to the IEEE:
byte_ MSB (byte1) byte2 byte3 byte_LSB (byte4)

byte_MSB(byte1) = exp
byte2 = mantissa
byte3 = mantissa
byte_LSB(byte4) = mantissa

Example: 41 F1 01 80 => 30.1255

01000001 11110001 00000001 1000000

float = (-1)^bitsignal*[2^(exp-127)*[1+mantissa]]

Where:

bit signal is the bit msb bit of the byte_MSB(byte1),
If this bit is 0, the number is positive and if it is 1, it is negative

Bit Signal	Exp	Mantissa
0	1000001 1	1110001 00000001 100000000

In the example, the number is positive.

exp is the sum of the other bits of the byte_MSB(byte1) and of the bit msb of the byte2.

In the Example:

1*2^7+0*2^6+0*2^5+0*2^4+0*2^3+0*2^2+1*2^1+1*2^0 = 2^7+2^1+2^0 = 131 mantissa: it follows the same rule of the exp from the byte2 to the byte_LSB(byte4), until the exponential factor -23.

1*2^(-1)+1*2^(-2)+1*2^(-3)+1*2^(-7)+1*2^(-15)+1*2^(-16) = 0,882858276367

So, float = (1)*[2^(131-127)]*1,882858276367 = 30.1255

STATUS CODE

According to the V 3.0 profile, the status variables follow the table below, where:

- De 0x00 a 0x3F => Device Status: Bad;
- De 0x40 a 0x7F => Device Status: Uncertain;
- 0x80 => Device Status: Good

For more details, consult the Functional Blocks Manual.

	Quality	Sub-status	Limits
Good (NC)	The value quality is good. Possible alarm conditions can be indicated by the sub-status. The indication of the alarm is only planned for PV and not for output.	Not specified Alarm Block Active Auxiliary Alarm Active Critical Alarm Block Alarm not recognized Alarm advisory not recognized Critical alarm Alarm not recognized	**Not Limited:** The value is inside of the limits **Low Limit:** The value is below the limit. **High Limits:** The value is above the high limit. **Constants:** The low and high limits are the same, making the constant value.
Good (cascade)	The value must be used in control.	Not specified Recognized initialization Request of Initialization Non Guest Not Selected Override Local Fail Safe Active Fail Safe Started	
Uncertain	The quality of the value is smaller than the normal, but the value can still be useful.	Not specified Last Value Used Substitute Initial Value Conversion of the Sensor Non-precision Violation of the Range in Engineering Units Subnormal Out of Service	
Bad	The value is not used.	Not specified Configuration Error Not Conected Device with damages Sensor with damages Without Communication... with last value used Out of Service	

Table 1.10 – Status Code

BUS PARAMETRIZATION

The Smar Profibus DPV1 DF73 master supports baud rates up to 12 Mbits/s, where this rate should be selected according to the speed of the slowest device in the network DP.

With the PROFIBUS PA, notice the couplers types, because some have smaller speed rates:

- P+F SK1: 93.75 kbits;
- P+F SK2, Sk3: 45.45 kbits to 12 Mbits/s;
- Siemens DP/PA *coupler*: : 45.45 kbits;
- Siemens DP/PA *link* DP/PA: 9.6 kbits to 12 Mbits/s.

Coupler	Siemens	P+F (version before 2/12/98)	P+F (subsequent version to 2/12/98)
Slot Time	640	10000	4095
Max. Station Delay Time	400	1000	1000
Min. Station Delay Time	11	255	22
Setup time	95	255	150
Gap Actualization factor	1	1	1
Max. Retry Limit	3	3	3
Target Rotation Time(TTR, it should be set in all masters)	TTR calculated by the master + 20000 bit teams		

Table 1.11 –Bus Parameters for DF73

TIME CONFIGURATION CLUES INVOLVED IN PROFIBUS

The Profibus bus parameters are normally in bit times (T_{bit}). This is the unit shown typically in the GSD files and in the configuration tools, etc.

Target Token Rotation Time (TTR) it is given in bit teams and is usually calculated by the configuration tools. It is the time spent by the token to scan the whole network and return to its initial master. When there are multiple masters, this includes the total time for each master to complete its I/O cycle, to pass the token on to the next master and the token to come back to the initial master. Some factors influence TTR directly: the baud rate, the number of slaves with cyclic data exchange, the total number of I/Os during the exchange of data and the number of masters.

A parameter directly influenced by TTR is the watchdog time. This is the time spent in each slave's configuration and that will be used by the slave to detect communication fails. At each fail detected as the time expires, the slave converts to the reset state and with this no exchange of cyclic data is allowed and it should be initialized by the master. This procedure will take at least 4 bus cycles. It is common, however not recommended, to see in practice A common practice users reducing the TTR time, which causes very small watchdog time, what does with that and, in the end, of the bus time the slave always will take 4 cycles to change data again and the performance of the network is committed. See Figure 1.18.

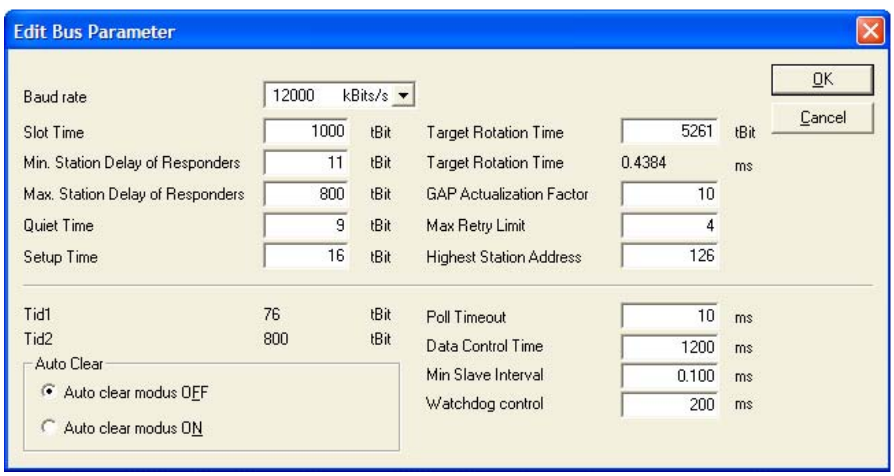


Figure 1.18 – Bus Parametrization

If a slave detects a transmission error when receiving a request from the master, it simply doesn't respond and, after waiting for a slot time, the master will send the request again. Similarly, if the master detects a failure in the slave response, it retransmits the request. The number of times the master will try to succeed in communicating with the slave depends on the baud rate, where:

- 9.6kbits/s to 1.5Mbits/s → 1;
- 3.0 Mbits/s → 2;
- 6.0 Mbits/s → 3;
- 12.0 Mbits/s → 4.

After utilizing all retries, the master marks the slave indicating a problem and performs the logout. In subsequent cycles, if the master succeeds, it executes the startup sequence again (4 cycles to exchange data).

It is common, for example, in networks where communication is not fully due to the noise level or due to bad condition of the grounding *shield* and increase the number of retries, until they fix the problem. Another situation in that it try to increase this number it is when there is more than 9 repeaters. The use of repeaters provokes traffic jams, and to solve this problem a new mechanism was designed to insert idle time between transactions through two Profibus Idle Time temporizers.

In situations with multiple masters from the same maker, using the same tools, the TTR most times is optimized by the tools themselves, in such a way to ensure the perfect network operation. In another situation, the masters are from different manufacturers and the tools don't calculate the TTR automatically. In this case, the right TTR for each master must be calculated, and the TTR for both masters added for a final figure.

Still in Figure 1.18 see the following important parameters:

- Tid1: How long the master takes to receive a response or an acknowledgement;
- Tid2: How long the master waits after sending a message and before sending the next message;
- *Quiet time*: it is the bit time the master waits in each transmission, before beginning to send data;
- *Gap Actualization Factor:* It is the number of token rotations between requests for a new master.

WATCHDOG TIME (TWD)

The Profibus configures the watchdog feature to monitor ciclically the data exchange with the slaves. This time is monitored by the slave and it is activated whenever the last cyclical communication expires. After the time watchdog elapses the outputs go to a safe state and the slave enters in the *Wait_prm* mode. This time value varies according to the user, but its minimum value is a cycle time.

For most configuration tools, this value is calculated in function of the communication rate and the previously commented times. What is recommended in practice is that this value be not too long, for the outputs to take longer to move into a safe state, a very short duration or any other safe situation even if the master fails.

Usually, when had 12 Mbits/s in PROFIBUS DP and there is PROFIBUS PA, a factor of 300 is used.

Tip: When the P+ F'S SK2 is used, use T_{WD} = 5s.

The T_{WD} should not be larger than the largest time of delay $T_{\max Delay}$ that will happen:

$$T_{\max Delay} = T_{CycleDP} + T_{Cycle\,PAChannel}$$

Where:

$T_{CycleDP}$: Profibus DP Cycle time;

$T_{Cycle\,PAChannel}$: Profibus PA Cycle time;

P+F recommend three times the Profibus PA cycle time for SK2. The PA cycle time depends on the number of equipments in the channel, as well as the amount of bytes exchanged by the slaves with the master DP in the channel:

- LΣ: Total input bytes of all the devices + total output bytes of all the devices/N;
- N: Total number of devices.

$$T_{Cycle\,PAChannel} = n*\left(0.256\,ms*L\sum+12\,ms\right)+40ms$$

For more details consult the SK2 manual.

$$T_{Cycle\,PAChannel} = \left(N*10.5\,ms\right)+\left(0.256\,ms*B\right)+10\,ms$$

When there is more than a segment, it should be considered the sum of all the cycle times by segment.

CYCLE TIME

The response time in a PROFIBUS DP system depends on the following factors:

- MaxTSDR: response time after which a station can answer;
- The communication rate selected;
- *Min_Slave_Intervall*: Time between two polling cycles in which a slave can exchange data with a slave. It depends on the ASIC used, although in the market we find 100 μs times.

T_{Cycle} : The addition of every cycle times + PLC cycle time + PROFIBUS DP transmisson time

When SK2 is used, the cycle total time can be reduced.

For example, presume there is a Siemens coupler or the P+F SK1 and 10 input devices and that the PLC has a cycle time of 100ms, then:

$$T_{Cycle} = 10 * 10\,ms + 100\,ms = 200\,ms$$

This case also includes the PROFIBUS DP transmition time.

Consider now the coupler SK2. For this coupler, the following theorem applies:

$$T_{Cycle} = T_{CycleDP} + T_{Cycle\,PAChannel}$$

Where:

$$T_{Cycle\,PAChannel} = (N_{PA} * 10.5\,ms) + (0.256\,ms * (L_E + L_A)) + 10\,ms$$

$$T_{CycleDP} = (T_{Bit} * N * 500) + (11 * T_{Bit} * (LT_{E+} LT_A))$$

Being:

N_{PA} : Total PA devices number;

N : Total PA and DP devices number;

L_E : Total number of input bytes of all the PA devices in the channel;

L_A : Total number of output bytes of all PA devices in the channel;

LT_E : Total number of input bytes of all the PA and DP devices;

LT_A : Total number of output bytes of all devices PA and DP;

T_{Bit} : Bit time (baude rate).

NOTES
- A safety value of 10% is added to the $T_{CycleDP}$.
- It is considered a single master, that is, a mono-master system. If more than one master is used, the token time and the additional times should be added. - If there is acyclic communication, the time for this access should be added.

For the Siemens DP/PA link consider:

T_{Cycle} = 10 ms x number of PA devices + 10 ms (master class-2 acyclic services) + 2.0 ms (for each group of 5 bytes of cyclic values). The Figure 1.19 presents the cycle time with the DP/PA link.

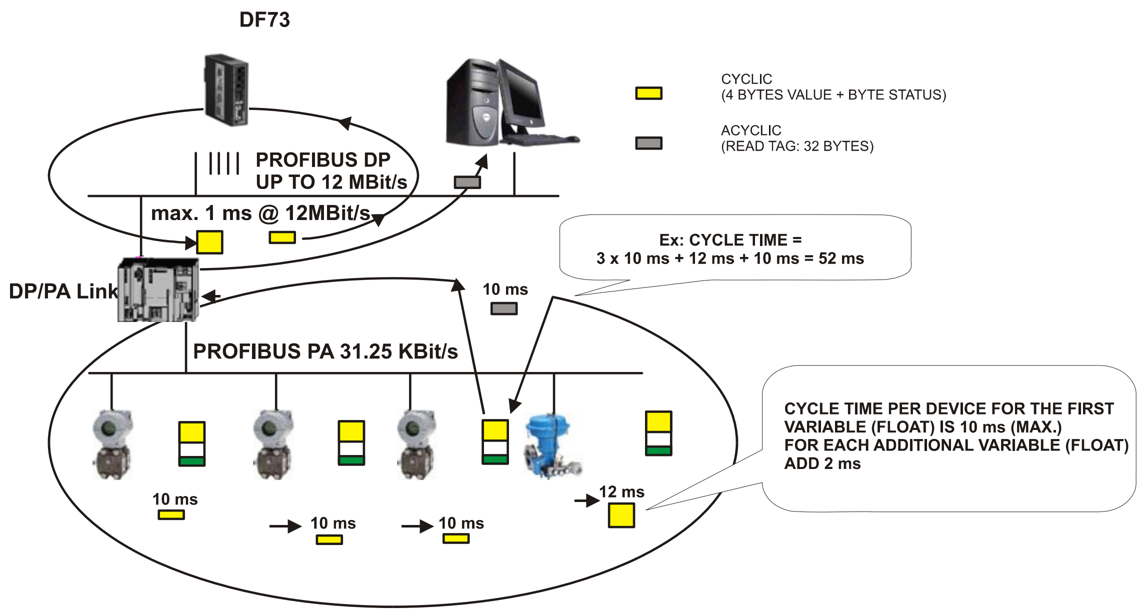


Figure 1.19 – Cycle time with link DP/PA

SLOT – DEVICES SMAR

Next, the correspondent Slot is represented for each Smar device according to the functional block. Note that the beginning of the Physical Block relative index is 116 and 16 for the other blocks.

LD303/TP303	Physical Block	Analog Input Block	Totalizer Block	Transducer Block	Display Block
Slot	1	1	2	3	4

LD293 / DT303 < V2.00	Physical Block	Analog Input Block	Transducer Block	Display Block
Slot	1	1	2	3

TT303	Physical Block	Analog Input Block 1	Analog Input Block 2	Transducer Block 1	Transducer Block 2	Display Block
Slot	1	1	2	3	4	5

DT303 >= V2.00	Physical Block	Analog Input Block 1	Analog Input Block 2	Transducer Block 1	Display Block
Slot	1	1	2	3	5

FP303 / FY303	Physical Block	Analog Output Block	Transducer Block	Display Block
Slot	1	1	2	3

IF303	Physical Block	Analog Input Block 1	Analog Input Block 2	Analog Input Block 3	Totali-zer Block 1	Totali-zer Block 2	Totali-zer Block 3	Transdu-cer Block 1	Transdu-cer Block 2	Transdu-cer Block 3	Display Block
Slot	1	1	2	3	4	5	6	7	8	9	10

FI303	Physical Block	Analog Input Block 1	Analog Input Block 2	Analog Input Block 3	Transducer Block 1	Transducer Block 2	Transducer Block 3	Display Block
Slot	1	1	2	3	4	5	6	7

CONNECTING EQUIPMENTS TO FIELDBUS

The fieldbus devices can be connected to or removed from a network fieldbus in operation. When removing a device, check that the fieldbus wires are not shortcircuited or in contact with other wires, shielding or grounding.

It cannot be mixed devices fieldbus with communication different speeds in the same network. Powered device or not for the bus can be mixed and shared in the same network.

Fieldbus devices with different communication speeds cannot be mixed in the same network. Devices powered or not by the bus can be mixed and shared in the same network.

PROCEDURE OF RECEIVING

When receiving the equipment, unwrap it and connect it the power supply and check if the configuration of your address is in agreement with the application using the procedure of local adjustment or during the initialization when your address is shown in a short time.

The user can change the physical address of fieldbus device in an operational network without disconnecting it.

NETWORK DEVICES

The address 126 is the *default* address for all the devices.

Using the Smar Profibus View or Siemens Simatic PDM, the user can change the device address and to configure it for a same generic default 126.

MINIMUM VERIFICATION BEFORE ESTABLISHING THE PROFIBUS NETWORK COMMUNICATION

- Check the network configuration;

- Check if all the GSDs files are according match the installed devices models and if the versions are compatible with same ones. If the network has the IM157 link, check if all your PA slaves are included in your GSD files. The P+F High Speed Coupler (SK2) need an adaptation on the GSD files. P+F offers in its site an applicative that makes the adaptation:

http://www.pepperl-fuchs.com/selector/navi/productInfo/18/1830112c.zip

- Check if all the slaves support the communication rate selected;

- Check the parameterization of the DP/PA coupler according to the manufacturers' manuals;

- Check if all the slaves are addressed correctly and if do not exist any duplicated address. Note that the default is 126 and only a 126 device can be in the bus at a time. If the network has the IM157 link, check the addressing and its slaves. When establishing the communication, there will be indication of failure in the DP/PA coupler and/or IM157 link if there are repeated addresses.

- Check if all the chosen module options in the GSD files are adequate and if the empty modules were attributed to the modules not used.

- Check the bytes swap condition, because in some systems it is necessary. In the Smar system the swap is not necessary See Table 1.12 below:

System	Master	Profibus Configuration Software	System Programation Software	Bytes swap
Siemens	S5...series S7...series	COM PROFIBUS HW Config HW Config	Step 5 Step 7 PCS 7	No
Allen Bradley	PLC-5 ControlLogix SLC-500 ProcessLogix	SST PROFIBUS Configuration Tool	RS Logix-5 RS Logix-5000 RS Logix-500	Yes
Scheneider	TSX Premium	Sycon Hilscher	PL7 Pro	Yes
Scheneider and Quantum	Modicon Quantum	Syscon	Concept	Yes
Klockner – Moller	PS 416	CFG-DP	S 40	Yes
ABB Free Lance	AC B00 F	Control Builder F	Control Builder F	No
Bosh	ZS 401	Win DP	Win SPS	Yes
Emerson	Delta V	Delta V Explorer	Delta V Explorer	No

Table 1.12 – Profibus Systems and Bytes Swap Condition

TROUBLESHOOTING

Basic *Troubleshooting:* The communication errors are detected automatically and indicated depending on the engineering tools. Troubleshooting is a useful way to remove the parts, one by one, until the failure is detected by elimination. It is also recommended to test the faulty device in your own work bench. Check the following parameters:

- If the polarity is correct;
- If the addresssis correct;
- If the network is secure;
- If the power supply voltage is adequate, always with a minimum 9V current during the communication, plus the course of the Manchester sign.

If there is not any communication, there is a problem with your configuration or installation.

Advanced Troubleshooting: In order to find serious problems, bus analyzers can be used to study the communication messages;

An oscilloscope (balanced/isolated - for example, operated by battery) can also be a useful tool in severe cases.

COMMUNICATION ERRORS

Installation problems, non-configuration or other main causes of communication errors:

- Loose connections
- Badly installed terminator, without endpoint.
- Very low or unstable power supply;
- Very long spurs or excessive spurs;
- Wrong grounding or no grounding;
- Water leak due to poor electric connections and cable clamp.

MINIMUM WHEN ESTABLISHING THE COMMUNICATION IN THE PROFIBUS NETWORK

- Check if all devices appear in the *Live List*;

- Check if there is some diagnostic message condition. If there is, try to identify it;

- Check if there is some visual error condition in the Master Class 1, DP/PA link, DP/PA couplers or slaves. Note that the Identifier Number selected in the slave it should be in *Manufacturer Specific* (0x01) so that it matches with the slave GSD.
Table 1.13 below display some symptoms, probable causes and recommendations that can be useful during the comissioning/startup phase and maintenance:

Symptoms	Probable Causes	Recommendations
Excessive noise or spiking in the bus or very high signal.	Humidity in the terminal block and/or connectors causing low signal isolation, low isolation or bad operation power supply and/or devices and/or terminators etc inadequate shield grounding, excessive log or spur, inadequate amount of terminators or noise source near the Profibus cabling.	Check every device connector and terminal block, and make sure that no humidity got in; detect bad contact, if the shield cables are well ended and grounded properly, the ripple level in the power supply and in the bus are within acceptable values, the terminador number and cable lengths and are within the recommended values and also the cabling is distant from noise sources. Check if the grounding is adequate. If damaged devices generate noises, disconnect one at a time and monitor the noise.
Excessive transmissions or intermittent communication.	Inadequate cabling or spur length; power supply voltage in the wrong device terminal block; bad device operation; improper terminals, inadequate shielding or grounding, the amount of devices for spur in the network etc.	Check the cabling lengths, if the power supply voltage of the devices is between 9 to 32 Vdc, if there are no noise sources close to the Profibus bus. In some situations, if damaged devices generate noises or intermitence, disconnect one at a time and monitor the status of the communication. Check the communication AC signal course (750mV to 1000mV). Check the shielding and grounding distribution. Check the number of devices in the network and per spur.
Communication fails with some devices.	Repeated address in the bus, feeding tension insufficient (<9.0 Vdc), position of the terminators, cable excess, amount of devices besides allowed in the segment, etc.	Make sure all the devices have different addresses, and note that when placing a device in the bus with address 126, place it according to the configuration, and only then include another device with address 126 in the bus. Check the cabling lengths and amount of devices, as well as their power supply and terminators positioning.
Intermittent powering of some or all the equipments.	Short circuit between the bus shielding and the terminals, defective power supply, excessive equipment or improper amount of devices.	Check the shield isolation, the amount of devices and their consumption, etc.
The Profibus PA equipment does not communicate with the Siemens DP/PA link.	When the link is activated, the addresses from 3 to 5 are stored for future use and not used.	Change the PA device address.
The measurement value is not correct; it is not the same as indicated in the equipment LCD.	Conversion errors for IEEE 754 float or scale error.	Check if the bytes swap is necessary or if in the Profibus system used exists some function for this automatic conversion. Check the scale in the equipment and/or in the DP master.
The value measured in the Siemens S7 system is always zero.	Conversion error involving data consistence.	Use the reading function with, SF14 consistence.
The value sent by the PLC in the Siemens S7 system is always zero or it was written wrong in the device output.	Conversion error involving data consistence or the status is not being reported appropriately or, still, the inadequate use of the GSD file if the modules were not concluded with Empty_Module.	When using the Siemens systems, make sure to use the writing function with SF15 consistence. Check the PLC and equipment scales and also if the status has a value suitable for the equipment. Check if the cyclical configuration is adequate.
Without communication between the DP master and PA slaves.	Error in the baud rate selection of the DP/PA coupler or link, error in their parameterization or problem in the bus.	Check the configurations below: - P+F SK1: 93.75 kbits/s; - P+F SK2: até 12 Mbits/s; - Siemens: 45.45 kbits/s; - Link Siemens: up to 12 Mbits/s; - The SK2 requires the convertion of the GSD files; - Review the cabling and terminators conditions, their lengths, spurs, sources, repeaters, etc.

Table 1.13 – Symptoms, Probable Causes and Useful Maintenance Recommendations

Installation in Hazardous Locations

WARNING
Explosions could result in death or serious injury, besides financial damage. Installation of this transmitter in explosive areas must be carried out in accordance with the local standards and the protection type adopted. Before continuing the installation make sure the certificate parameters are in accordance with the classified area where the equipment will be installed. The instrument modification or parts replacement supplied by other than authorized representative of Smar is prohibited and will void the certification. The transmitters are marked with options of the protection type. The certification is valid only when the protection type is indicated by the user. Once a particular type of protection is selected, any other type of protection can not be used. The electronic housing and the sensor installed in hazardous areas must have a minimum of 6 fully engaged threads. Lock the housing using the locking screw (Figure 1.1). The cover must be tighten with at least 8 turns to avoid the penetration of humidity or corrosive gases. The cover must be tighten until it touches the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking screw (Figure 1.1). Consult the Appendix A for further information about certification.

Explosion/Flame Proof

WARNING
The electric connection's entries must be connected or closed using the appropriate Ex-d metal cable gland and/or metal blanking plug with certified IP66 rating. As the transmitter is non-ignition capable under normal conditions, the statement "Seal not Required" could be applied for Explosion Proof Version (CSA Certification). The standard plugs provided by Smar are certified according to the standards at FM, CSA and CEPEL. If the plug needs to be replaced, a certified plug must be used. The electrical connection with NPT thread must use waterproofing sealant. A non-hardening silicone sealant is recommended. Do not remove the transmitter covers when power is ON.

Intrinsically Safe

WARNING
In hazardous zones with intrinsically safe or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed. To protect the application the transmitter must be connected to a barrier. Match the parameters between barrier and the equipment (consider the cable parameters). Associated apparatus ground bus shall be insulated from panels and mounting enclosures. Shield is optional. If used, be sure to insulate the end not grounded. Cable capacitance and inductance plus C_i and L_i must be smaller than Co and Lo of the associated Apparatus. It is not recommended to remove the transmitter cover when the power is ON.

Section 2

OPERATION

The **Series 303** device has an optional digital LCD display that works as a local operator interface. It can be used for some basic configuration and operation. However, all configuration, operation and diagnostics may also be done remotely using for example a configurator or operator console.

The local and remote operator interfaces also provide monitoring and actuation of variables, such as process variables and Setpoint. Using the local adjustment, the user can set and change the device address.

The LCD Display

The integral indicator is able to display each parameter belongs to function blocks, which are user-selectable. Some of them can be changed by local action, according to user configuration and properties of these parameters.

When a variable is chosen by the user, the indicator “a” indicates the parameter name defined, the value and its status when its exists. The different fields and status indicators are explained in figure 2.1.

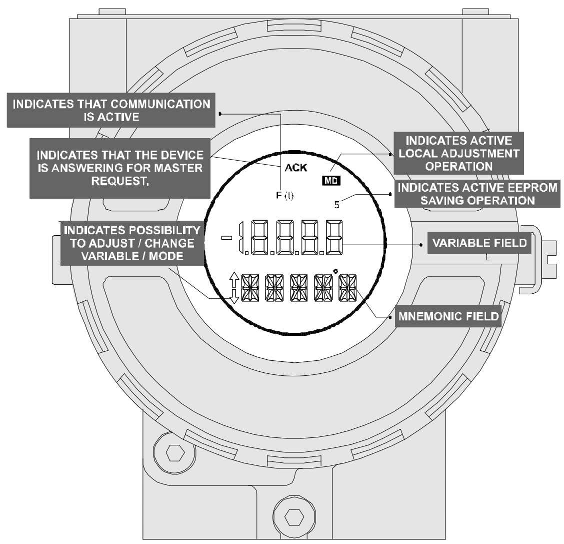


Figure 2.1 - LCD Display

During normal operation, the **Series 303** device stays in the monitoring mode. In this mode, it shows a variable indicated by user configuration. The Figure 2.2 where we have the LCD showing the "position". Whenever the displayed value exceeds "19999, it will be displayed with a two-digit mantissa and an exponent.

The display indicates values and parameters simultaneously with most status indicators.

The indicator is interrupted when the user performs action by the local adjustment.

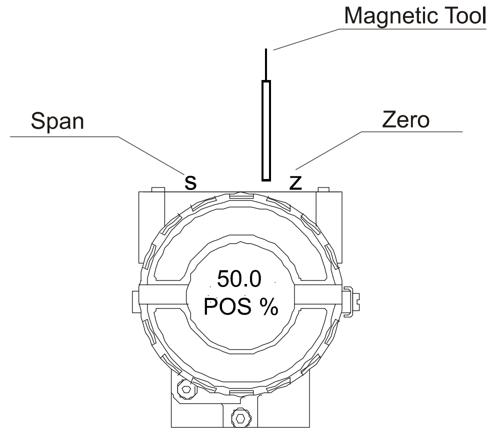


Figure 2.2 - Typical Normal Display showing Position, in this case 50.0 %

Startup with the ProfibusView

Introduction

The ProfibusView is a PROFIBUS PA parameterization field tool.

It uses the Smar Linking Device DF73 module (HSE PROFIBUS Gateway) to communicate with the plant devices and supplies functionalities such as: calibration, monitoring, online and offline parameterization and equipment diagnosis.

For more details about the DF73, consult the DFI302 Manual.

Communication

The communication between the ProfibusView and the DF73 is accomplished through a TCP/IP connection that is located in the opening of the ProfibusView. Then, the DF73 establishes an acyclic connection with the associated device and informs the ProfibusView on the communication status.

When the connection with the equipment is successful, the ProfibusView is released for the transmission of reading messages and writing parameters. However, if there is error in the connection, the DF73 will try to communicate with the equipment the number of established times in the parameter (number of retransmissions). If unsuccessful, the ProfibusView will initialize a new connection.

Through the Status Communication parameter that appears in the ProfibusView initial screen, the user can monitor the status of the transmitted messages:

GOOD: Communication is ok;

STARTING: Starting a communication;

RETRYING: Problems in the communication. After the fixed retransmissions number, the ProfibusView will initialize a new connection.

READING: Parameter reading;

WRITING: Parameter writing.

SUPPORTING TOOLS

The ProfibusView is not a stand alone tool, and therefore depends on a supporting tool to open. The tools mentioned below work as support for the ProfibusView:

System302 Studio: Tool that includes the applications that make the System302.

Profibus View Configurator: ProfibusView Configurator: ProfibusView configuration tool.

From these tools the user can configure the DF73 IP, the equipment type and address he chooses to do the parameterizaton.

LIVE LIST

The function of the Live List available in the supporting tools is to show all the current devices in the Profibus network, together with each device name and address. This is an easy way to visualize the network and also to access the ProfibusView.

IMPORTANT
Before loading the Live List, check if the DF73 IP is configured correctly.

The devices not included the line of Smar products or the equipments with the IDENT_NUMBER_SELECTOR parameter configured as "*Profile Specific Ident_Num*", should appear in the Live List with the name *Others*.

To open the ProfibusView, select the equipment to communicate with on the *Live List*. The ProfibusView provides a navigation tree to access the specific characteristics of the selected device. If the device appears as *Others* in the *Live List*, a screen of generic configuration should open (Device Settings). See Figure 2.3.

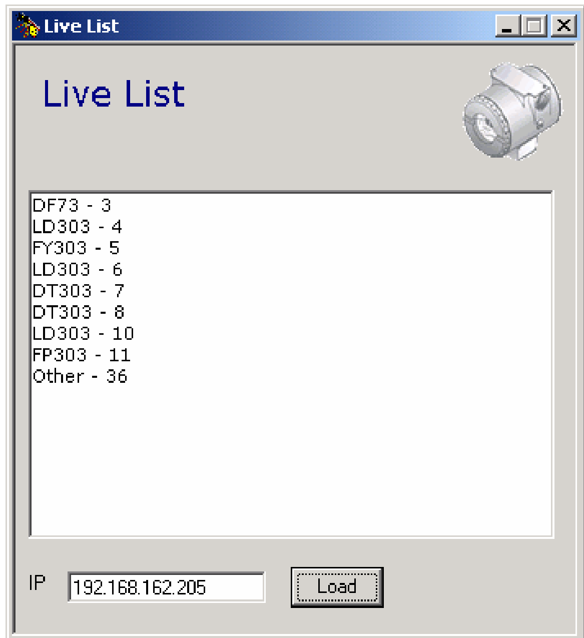


Figure 2.3 - ProfibusView Tool Live List

Manual Configuration for ProfibusView Access

Another access option to the ProfibusView offered by the supporting tools is the Manual Configuration screen. In this screen, the user has the option of configuring the DF73 IP, the equipment type and address that he wants to parameterize.

ProfibusView should provide a navigation tree that gives access to the specific characteristics of the selected device. If the selected device is *Others*, a generic configuration screen will open as Device Settings, presented on Figure 2.4.

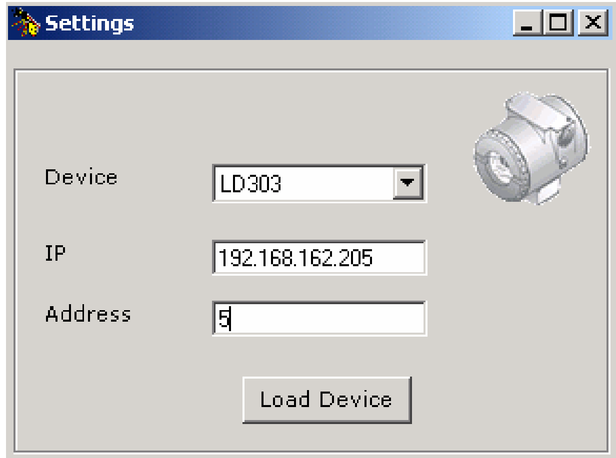


Figure 2.4 - Manual Configuration Screen of the Profibus View Configurator

After all the parameters of the screen have been filled out, the user should click on the Load Device button to open the ProfibusView. See Figure 2.5.

Figure 2.5 - Profibus View Initialization Screen

Startup with the Simatic PDM

Simatic PDM is Siemens configuration software. For more details, consult your manual.

When the devices are delivered, they have an equal factory address 126. So, before connecting several devices on the bus, it is necessary to assign different addresses for each device. The user can set the device address using the local adjustment or by Simatic PDM. Using the PDM software, the user can configure, parameterize, start up, diagnose and maintain field devices.

To configure the devices or to work with them follow these steps:

1- When creating the device, we need to set the device address. See Figure 2.6.

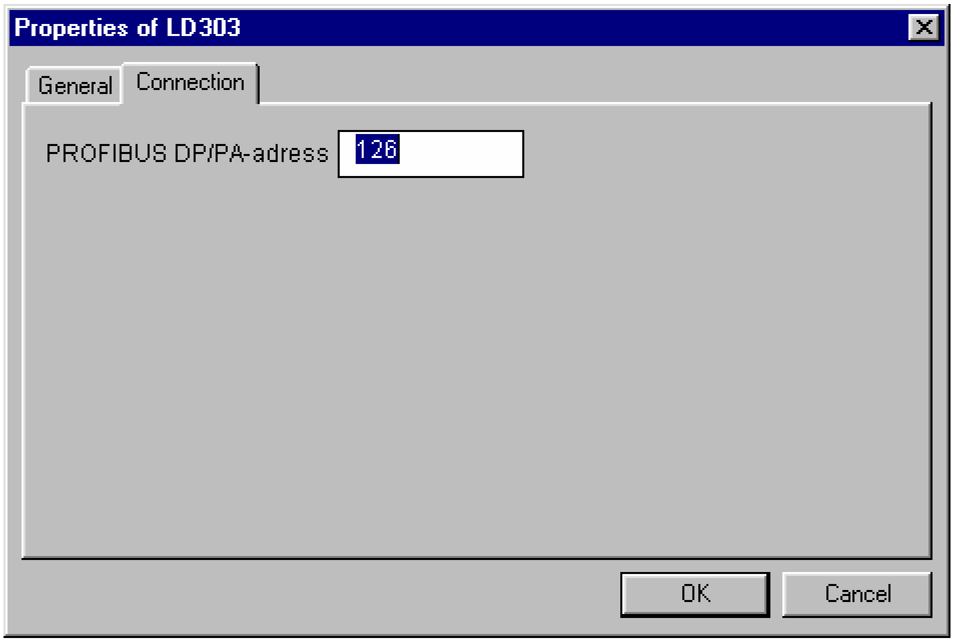


Figure 2.6 - Simatic PDM Properties

2- Whenever the user attaches the device to his network he has a window to select the devices. See Figure 2.7. The device must be chosen according to the manufacturer and the application:

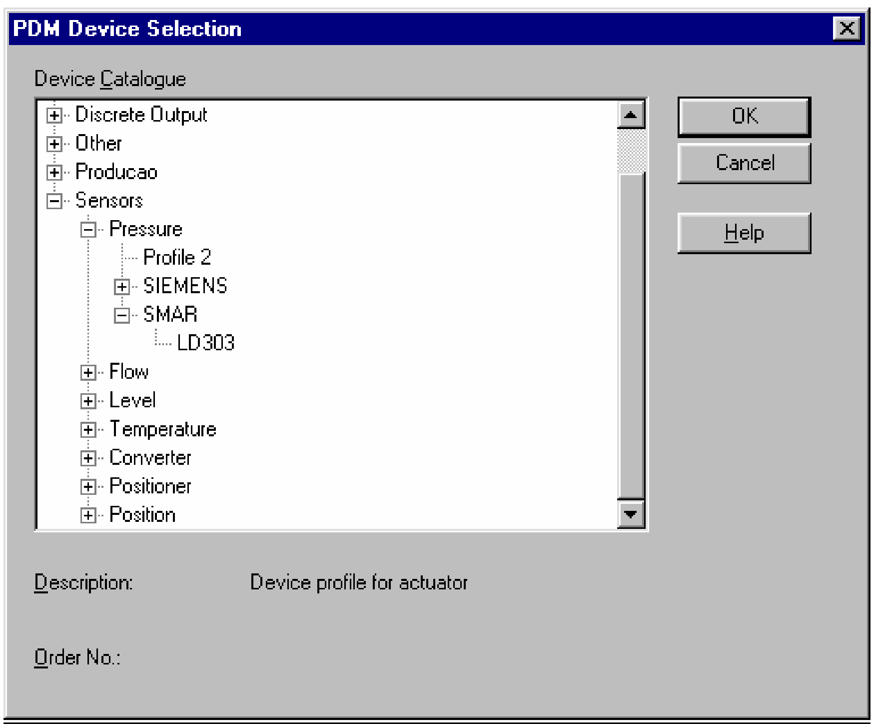


Figure 2.7 - Simatic PDM Device Selection

3- After selecting the correct device, a window with maintenance or specialist access will appear. See Figure 2.8. If the user is a maintenance engineer, he can only make changes necessary for operation and maintenance. However, if he is a specialist, he can have full access. This can be protected by a password:

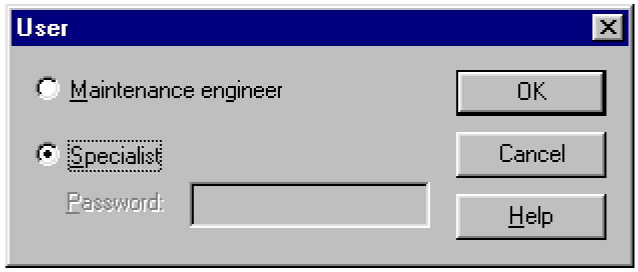


Figure 2.8 - Simatic PDM Access Rights

4- The parameter table is shown to the user and we have all preset values of the device.

5- White field can be changed by the user. See Figure 2.9.

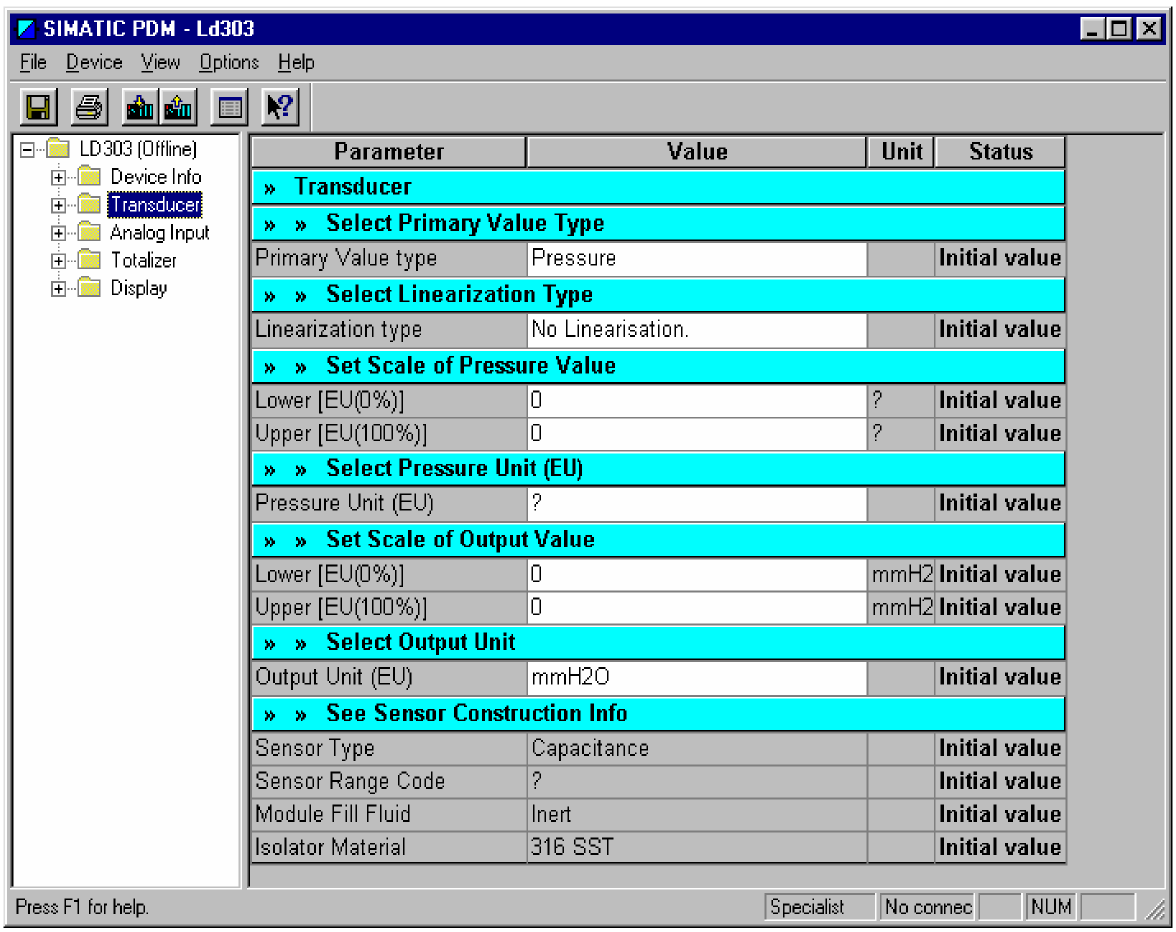


Figure 2.9 - Simatic PDM - Preset values for the device

6 - After changing, the user must save the new configuration.

7 - Using the View menu, the user can read online data from the device.

8 - When using the Device menu, the user is allowed to:
- configure all function blocks of the device;
- calibrate the device;
- save and restore some factory procedures.

9 - In order to provide online communication, set up a link between a PROFIBUS PG/PC interface and the PROFIBUS devices. For this purpose, select the *Option* menu at the main menu and then select "Set PG/PC Interface". See Figure 2.10.

10 – In order to make an offline configuration, follow the steps bellow:

- First run "*Download to PG/PC*" option to assure valid values.
- Run after the Menu Device option to configure the required parameters using the related menus.

NOTE
It is not advisable to use the "Download to Device" option. This function can misconfigure the equipment.

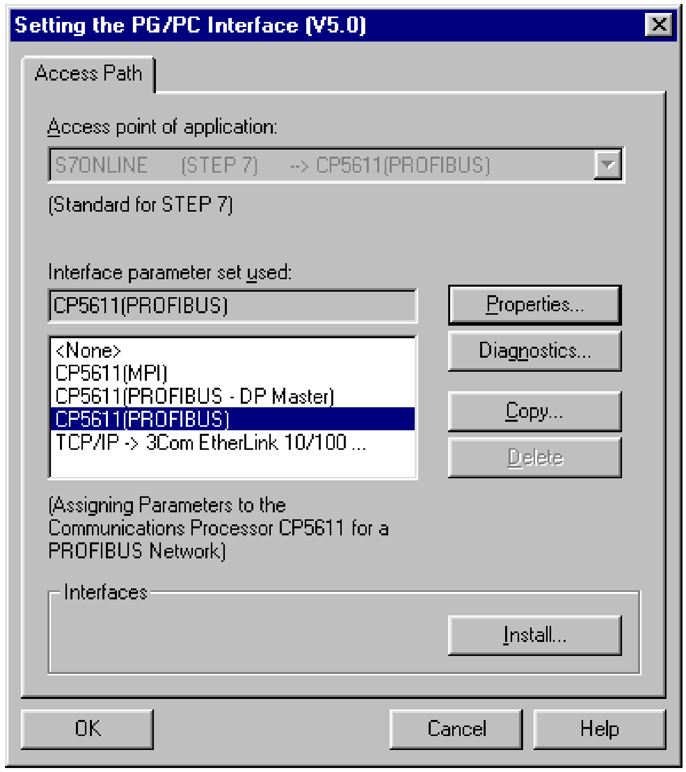


Figure 2.10 - Simatic PDM - Set PG/PC Interface

11 - Press "Install" and then select the board. See Figure 2.11.

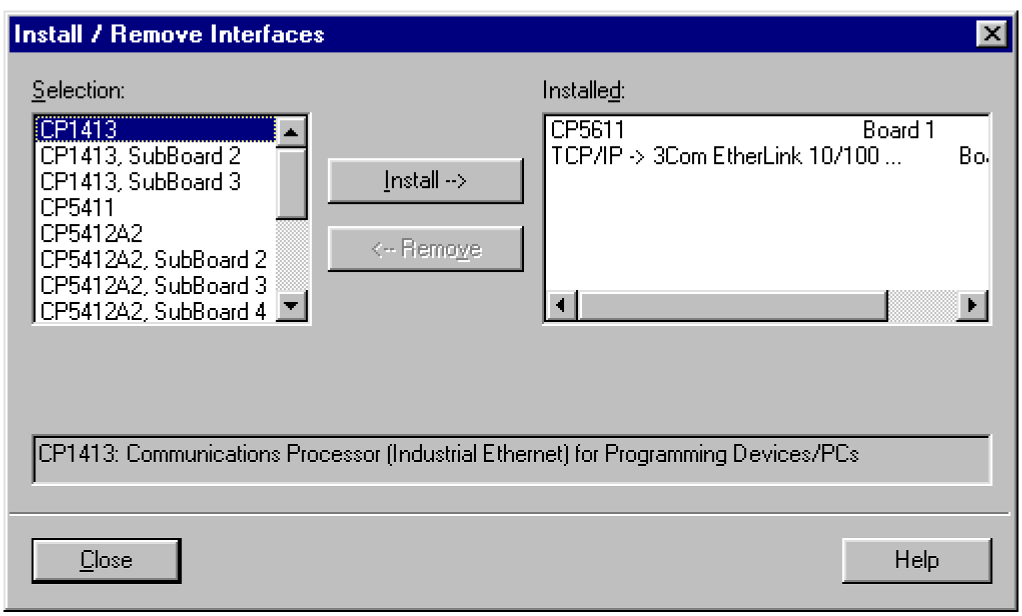


Figure 2.11 - Simatic PDM - Set PG/PC interface

12 - After installing it, the user must configure the station properties. See Figure 2.12.

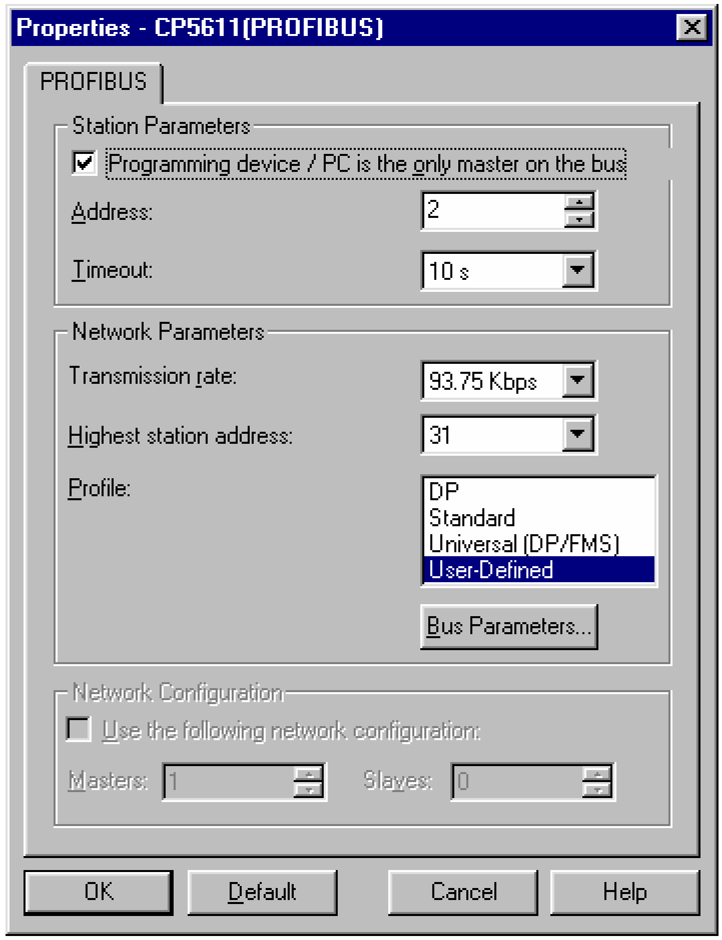


Figure 2.12 Simatic PDM - Station properties

In this step it is important to configure the bus parameters according to the following table:

	TRANSMISSION RATE:	PROFILE	BUS PARAMETERS
PROFIBUS DP/PA coupler (Siemens)	45.45 kbits/s	DP	-
PROFIBUS DP/PA coupler (Pepperl+Fuchs)	93.75 kbits/s	User Defined	Tslot: 4095 tBit
	-	-	Min Tsdr: 22 tBit
	-	-	Max Tsdr: 1000 tBit
	-	-	Tset: 150 tBit
	-	-	Tqui: 0 tBit
	-	-	Gap Factor: 10
	-	-	Retry Limit 3
	-	-	Ttr: 19968 tBit
PROFIBUS DP / PA link	e.g 187.5 kbits/s	DP	-

Table 2.1 – Bus Parameters

Startup with the Netconf – Cyclic Configuration (based on GSD file)

Profibus field devices should be inserted on the software, because they are also integral to this configuration.

The DF73 is an example to this case. Initially, open up the **Proj_DF73** window and click with the right button on the gateway already inserted, the DF73 itself. Choose the option *New Profibus* to configure the DF73 channels. On Figure 2.13 it is possible to observe the creation of the Profibus bus.

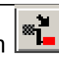
Figure 2.13 – Creating the Profibus Bus

To initialize the Netconf, select the *New Profibus* option to open the *Network Configurator* window as the configuration tool for the Profibus network, shown on Figure 2.14. Here, the user has a defined Profibus bus structure, namely, the network devices, the *baud rate* and the connection type). For more information about this tool, consult *Help*.

Figure 2.14 – Network Configurator Window

In the following example, the DF73 gateway had been previously inserted in the Syscon, and therefore it will appear in the Profibus network as the Master device. The Profibus devices that should be inserted will be called Slave devices.

IMPORTANT
- Address 1 on the Profibus network is the DF73 default address. The addresses 0, 1 and 2 should not be used because they are reserved for applications related to masters in the Profibus network; - The Slave devices that will form the Profibus network should have addresses between 3 and 126.

To insert a Slave device, click on the Insert Slave button  located on the tools bar, or through the Insert→Slave menu… Position the mouse in the line below the Master device and click with the mouse left button. See Figure 2.15.

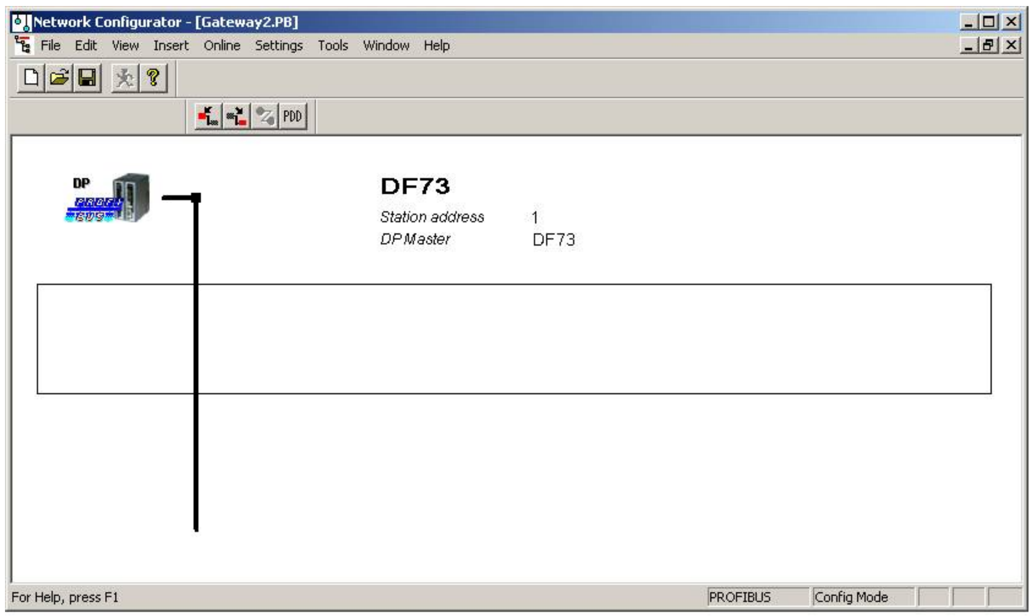


Figure 2.15 – Positioning the Slave Device on the Profibus Network

The window for inserting the Slave device will open, as shown on Figure 2.16.

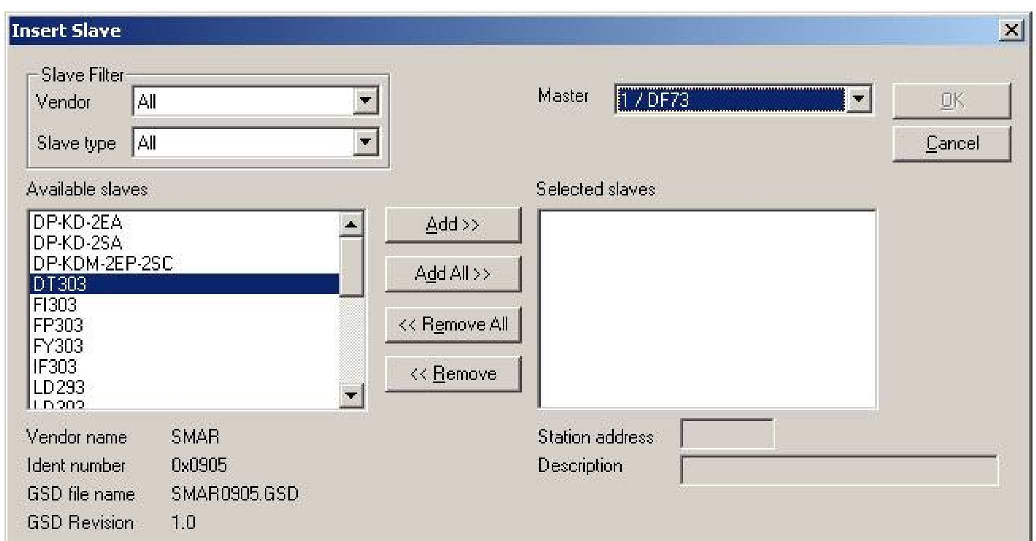


Figura 2.16 – Inserting the Slave Device

In this window, select the Slave device that will be inserted. For the proposed project, the first chosen device is the FI303. Follow the steps below to insert the Slave device:

A. Select the chosen device in the *Available Slaves* option box;
B. Press the *Add* button;
C. On the *Station address* field attribute an address to this device;
D. In the *Description* field, select a tag. If the user doesn't attribute a tag to the device, the tag *default* will be *DP Slave*.

NOTE
The addresses attributed as well as the device names should be exclusive in the Profibus network.

After carrying out these stages, the window will be as shown on Figure 2.17.

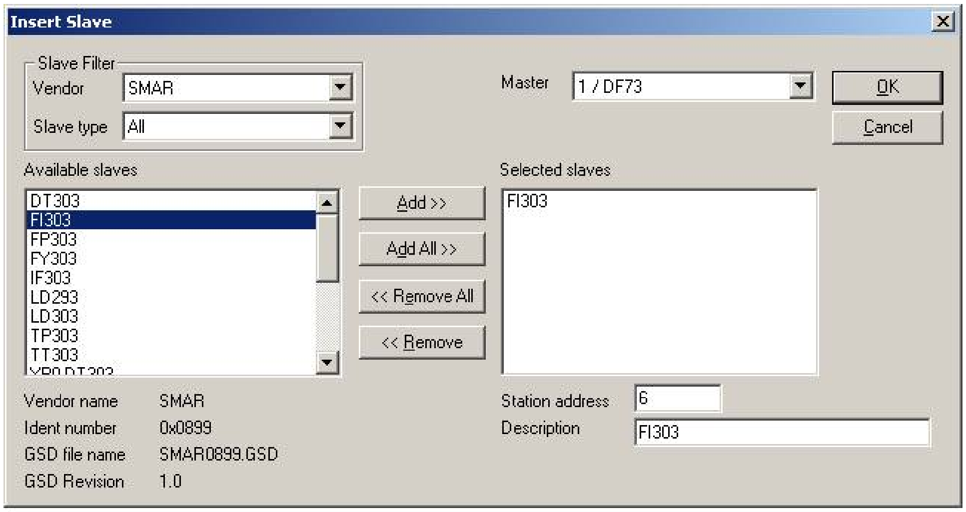


Figure 2.17 –Attributing Address and Name to the Slave Device

The LD303 and TT303 devices should also be inserted. At the end, the Profibus network will be as shown on Figure 2.18.

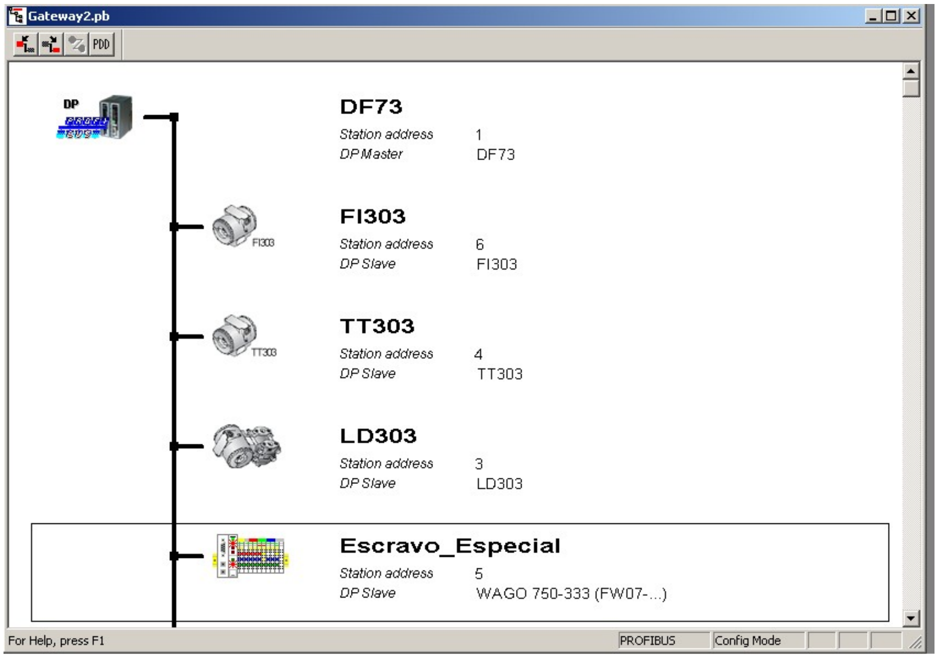


Figure 2.18 – Creating a Profibus Network

IMPORTANT
The proposed application does not need the WAGO equipment. It was already inserted as a special feature.

INSERTING SLAVE DEVICES IN THE "AVAILABLE SLAVES" LIST

If some device should be included in the Profibus network but it is not in the device list available when the Profibus network is being created, contact the device manufacturer for obtaining the GSD file and the BMP file, if existent.

The GSD files contain the description of each device available by Profibus device makers. These files define the specific functionalities of the Profibus devices in the network and their objects. The files with the device description form the device database.

CONFIGURING THE PROFIBUS DEVICES

After creating the Profibus network, click on the LD303 device with the right button of the mouse. In the open popup, choose the option *Slave Configuration* to configure the Slave device parameters.

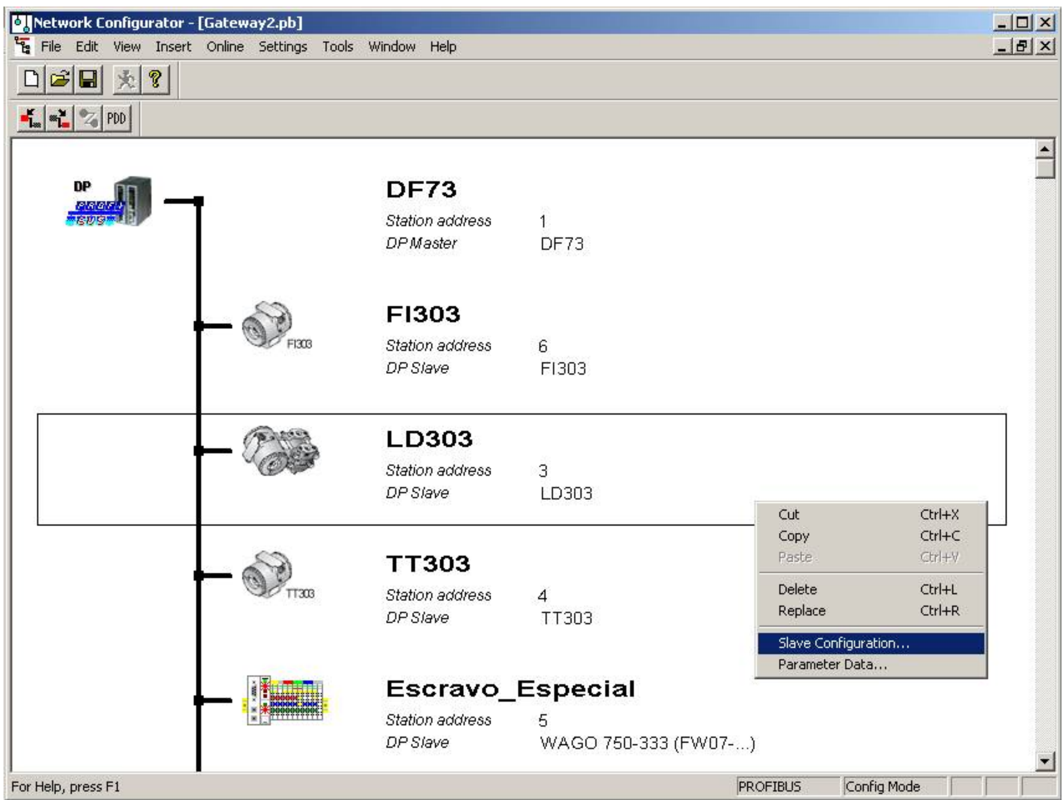


Figure 2.19 – Configuring the Profibus Slaves

Next, the window for the Slave devices configuration will be available. See Figure 2.20.

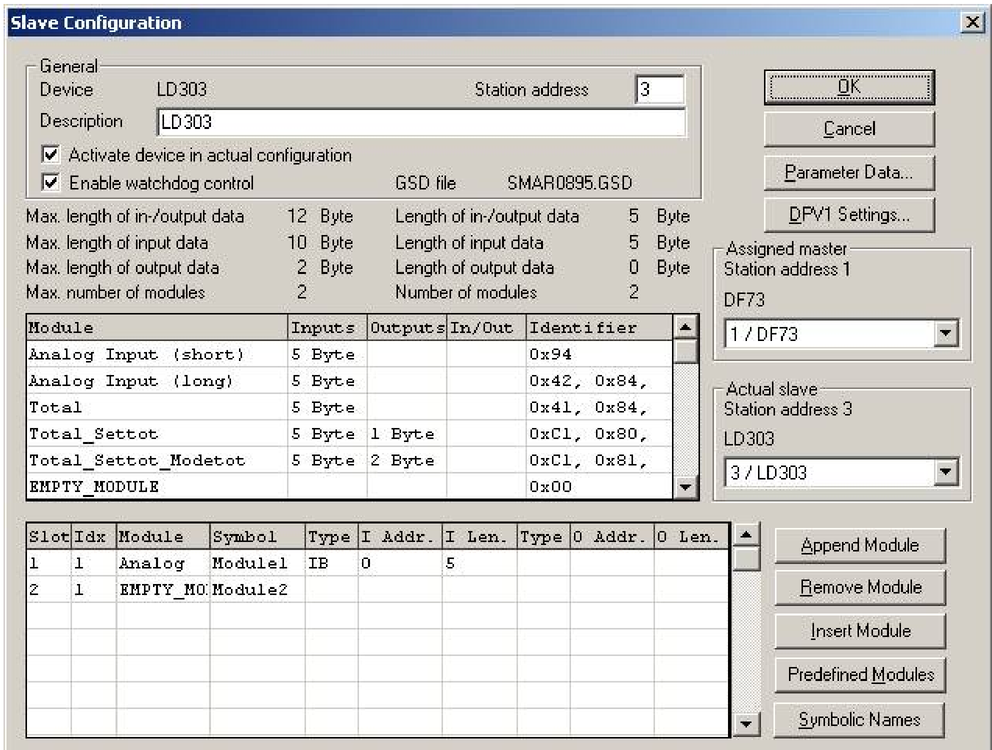


Figure 2.20 –Configuring the Profibus Slaves

After the device is added, the mapping should be made. This procedure consists of arranging the values, bytes and data that the devices will read/write on the master memory.

For LD303 there are two available modules. For the application, select the option *Analog Input* (*shorts*), then click on the button *Append Module*. Select the option *EMPTY_MODULE,* and again click on *Append Module*. After having chosen the two options, click *OK*. For TT303 2 modules are available, so the user should make the same choices for the LD303. For the FI303 there are 3 modules, so the user should first choose *SP* and then *EMPTY_MODULE* twice.

Note: The Special_Slave device should be configured according to Figure 2.21.

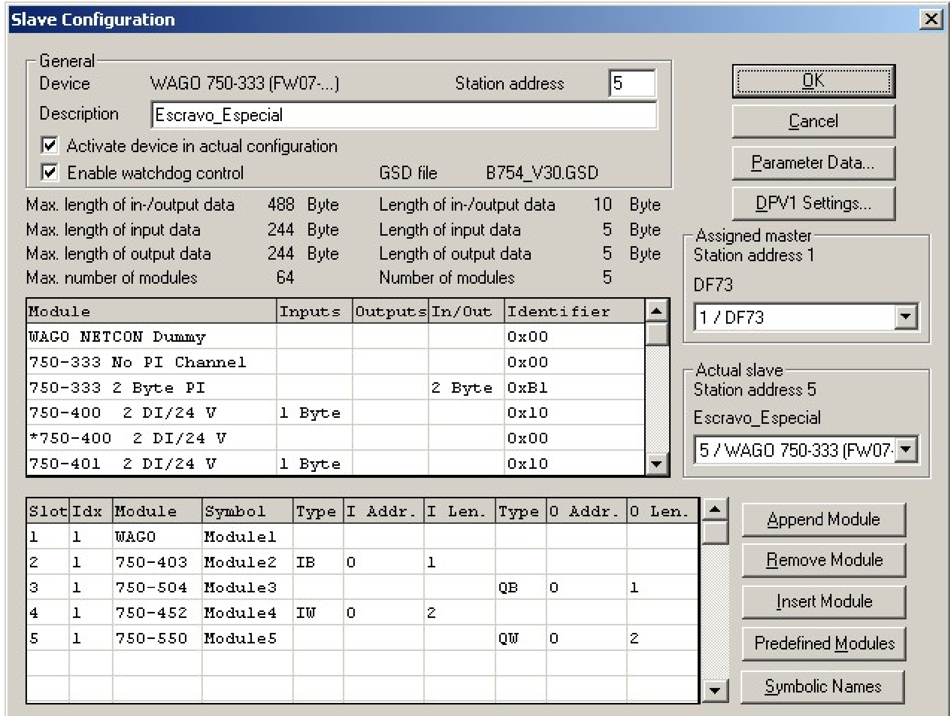


Figure 2.21 – Configuring Special_Slave Device

Observe that it was necessary to add a module for the coupler and a module regarding each used card.

ATENTION
Pay attention to the order and numbering of the input and output cards for this type of device.

IMPORTANT
The modules with (*) have a special use. They should only be used when there one of the modules is removed. However, an empty module (similar to DF0) should be inserted in the place of removal.

After selecting the Profibus device inputs and outputs, the communication rate for the Profibus network should be configured. T it, click on the Master device and then select *Settings→Bus Parameter* in the tools bar. The following dialogue box will be opened (Figure 2.22).

Figure 2.22 – Choosing the Profibus Network Baud Rate

In the *Baud Rate* list select the wanted rate and then click *OK*.

NOTE
The Profibus network *baud rate* should be configured according to the device DP with the smallest *baud rate*. For example, if in the same network there is a DP device of maximum 1500 kbits/s rate of and a 93,75kbits/s rate *coupler* DP/PA, the Profibus network baud rate to be configured should be the same as the DP/PA *coupler*.

After configuring the *baud rate,* inform which master will be used in the network.

Select the master configuration device and then *Settings→Device Assignment* in the tool bar. In the open popup window, select the *CIF TCP/IP Driver* option and click *OK*. Then, enter with the master IP to be used. See Figure 2.23.

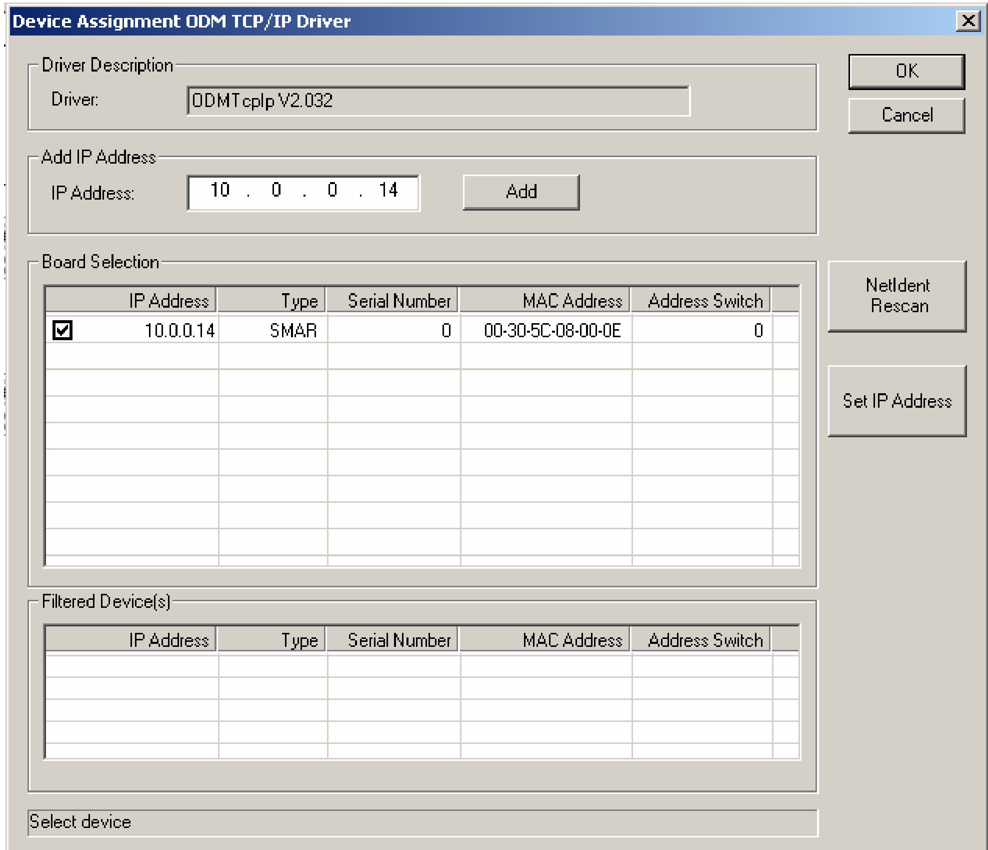


Figure 2.23 – Accomplishing the Master Device Assignment

CONFIGURATION

The way to configure function blocks on the **Series 303** devices is using tools like the ProfibusView, Simatic PDM, FieldCare, Pactware etc. These systems use the device physical address, which is configurable through local adjustment and the configuration tool. Before connecting a new device to the network and this device is not activated it is necessary to configure it with an address still not in use.

NOTE
The local adjustment can be used for some operations and configuration tasks. See in the **Local Adjustment Methodology** section how to use the local adjustment.

Configuration Using the Simatic PDM

For more details about Functional Blocks configuration, consult the Functional Block Instruction Manual.

Display Transducer

The Figure 3.1 represents the screen of the *display* Transducer Block.

The device was created is LD303

Here, you can see all blocks instantiaded.

As you can see the Transducer and Display are treated as special type of Function Blocks, called Transducer Block.

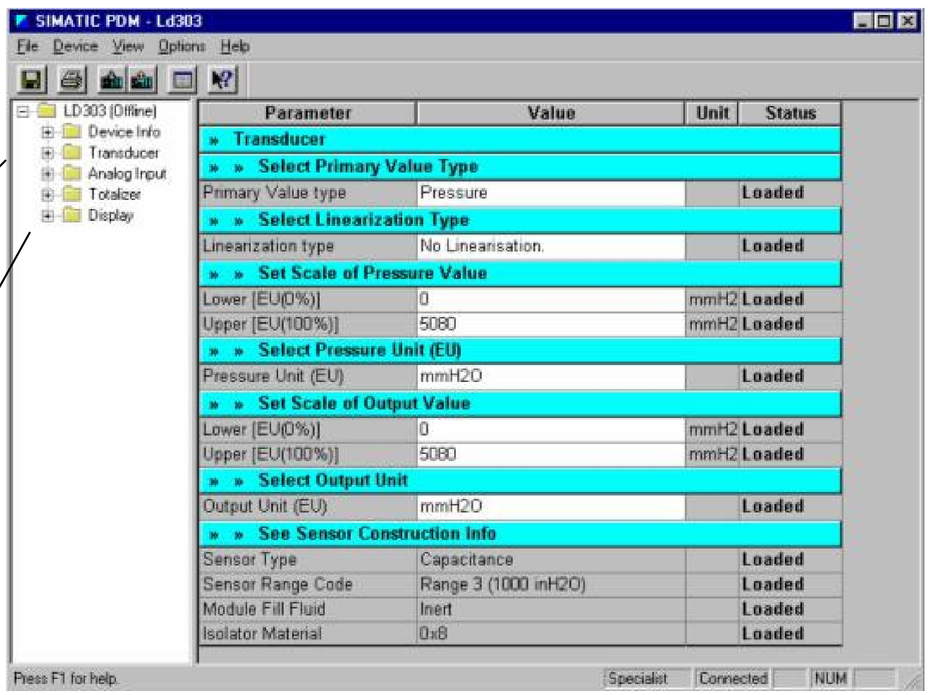


Figure 3.1 - Function and Transducer Blocks

The **Series 303** device can be supplied with one LCD indicator. There are six groups of parameters, which may be pre-configured by the user in order to able, a possible configuration by means of the local adjustment. In the monitoring mode (not executing actions by the local adjustment), the display can show up to 2 variables.

The Display Transducer Block can be configured by any configuration tool:

The display transducer works as a common function block. It means that this block can be configured by the configuration tool, which chooses values according to customer's needs. The LCD display can be used for monitoring, to work on Function Block parameters or on parameter calibration and tuning. See Figure 3.2.

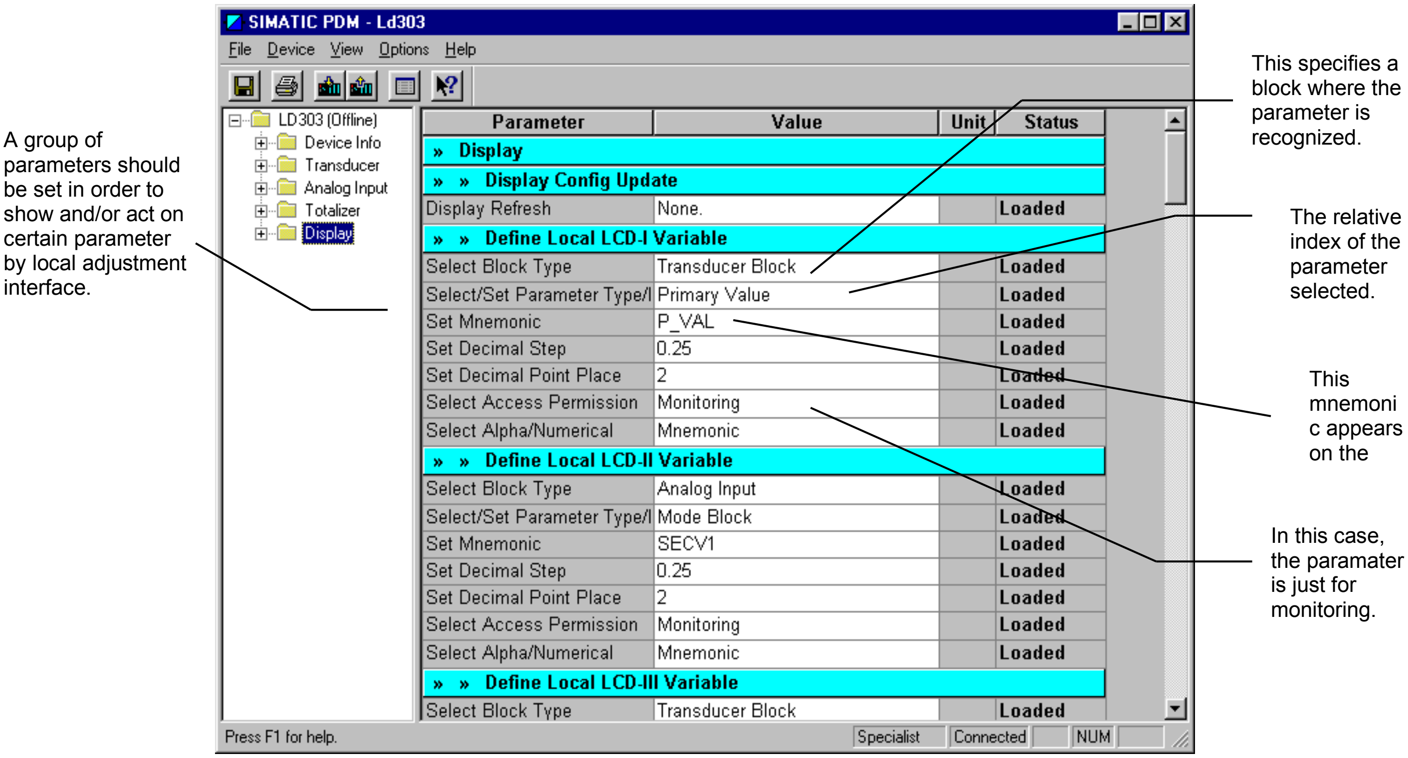


Figure 3.2 - Transducer Display - Configuration

Local Programming Tree

The programming tree is a menu system allowing the configuration of the most important items. The menu itself can be configured through the display transducer block through configuration tool or local adjustment, as it will be seen further on.

Each field device leaves the factory with a default configuration.

There is different default configuration for each type of field device, but normally it includes Tag and Output Transducer Block as monitoring parameter and calibration parameters as seen in the table below.

PARAMETER	FUNCTION	CLASS
TAG	MONITORING	READ
PRIMARY VALUE	MONITORING	READ
LOWER	CALIBRATION	READ/WRITE
UPPER	CALIBRATION	READ/WRITE

Table 3.1 - Example of Display Configuration

Display Configuration using Simatic PDM

Initial Configuration

For not being a *stand alone* tool, ProfibusView needs a supporting tool to be operated. The tools mentioned below serve as support for it:

System302 Studio – Tool that integrates all the applications that compose System302;
Profibus View Configurator – ProfibusView configuration tool.

With these tools, the user can configure the initial parameters, such as the IP on the DF73 module, the type and the field address required for the parameterization using the ProfibusView, as shown on Figure 3.3.

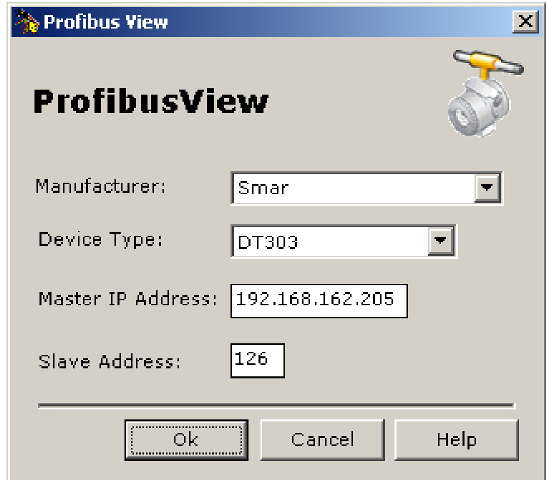


Figure 3.3 – ProfibusView Initialization Screen

The parameters having been configured, the initial screen of ProfibusView will be opened. See Figure 3.4.

Figure 3.4 – ProfibusView Configuration Initial Screen

Display Block Configuration

The display parameters selection stands for a Function Block configuration. The user should determine and configure each selected parameter for the configurations described in Figure 3.5.

The user can choose up to six parameters to be shown in the LCD display. These parameters can be used for monitoring or for local field devices work, using the Smar magnetic tool. The seventh parameter is used to access the physical address of the device. The user can change this address according to the application.

Next learn how to access and to configure the Display Block using the ProfibusView. In the main menu, select "*Equipment On-line Configuration - Display*". See Table 3.1 to obtain more information on Display Block configuration.

Configure each parameter to be showed in the display (LCD).

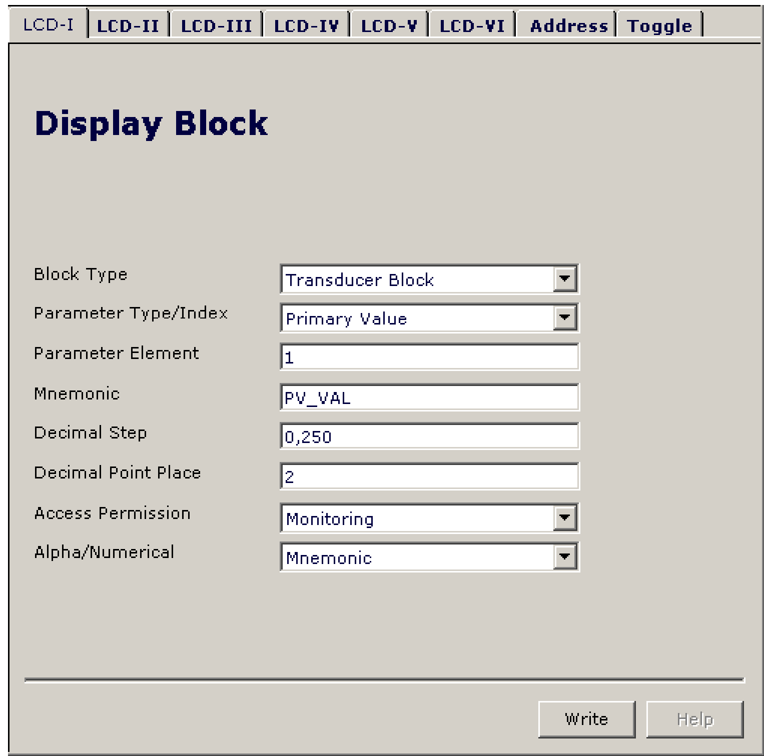


Figure 3.5 – Display Block Configuration Screen

Block Type	The Function Block where the parameter is located. The user can choose: Transducer Block, Analog Input Block, Totalizer Block, Physical Block or None.
Parameter Type/Index	This index is related to the parameter to be activated or visualized (0, 1, 2…). For each block there are some pré-defined indexes. Consult the Function Block Manual to know the indexes wanted and then enter the chosen index.
Parameter Element	*It is the element when you have a data structure.*
Mnemonic	This is the index related to the parameter to be activated or visualized (0, 1, 2…). For each block there are some pre-defined indexes. Consult the Function Block Manual to know the chosen indexes and then enter the wanted index.
Decimal Step	It is the increment and the decrement in decimal units when the parameter is a float or a float state valuet, or an integer, when the parameter is made by integer units.
Decimal Point Place	This is the number of digits after the decimal point (decimal digits from 0 to 3).
Access Permission	Permission to read and/or write. This parameter allows the user to read, in the case of the "*Monitoring*" option, and to write when the "*Action*" option is selected, then the indicator will show the increment and decrement arrows.
Alpha Numerical	These parameters include two options: *value* and *mnemonic*. In the *value* option it is possible to show both data in the alphanumeric and numeric fields; so, if the value is larger than 10.000, it will be shown in the alphanumeric field. In the mnemonic option, the display can show the value in the numeric field and the mnemonic in the alphanumeric field.

Table 3.2 – Parameters Configured for the Display Block

To visualize a given tag, choose the relative index equal to “tag", as shown on Figure 3.6. To configure other parameters select “LCD-II" to “LCD-VI” on the screen.

The 'Write' shuld be selected to perform the update of the tree local programming. After this step all selected parameters are showed on an LCD display.

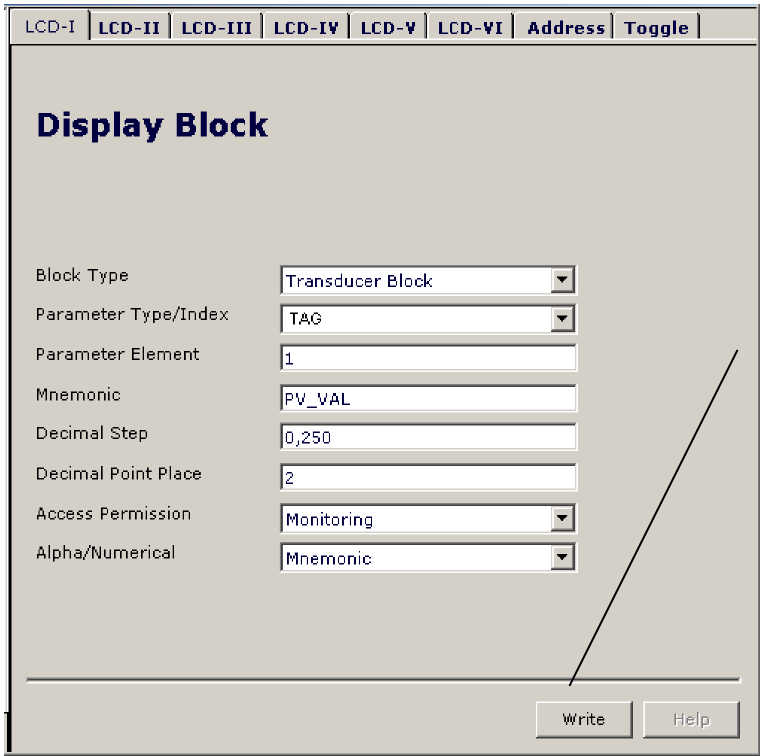


Figure 3.6 - Display Block Configuration Screen

When the user executes the local adjustment using the magnetic tool for normal monitoring operation and the parameter equalizes "*Access Permission*" and "*monitoring*", this will be seen on the LCD when the magnetic tool is removed. See Figure 3.7.

Selecting 'None' this parameter will not be showed on the LCD.

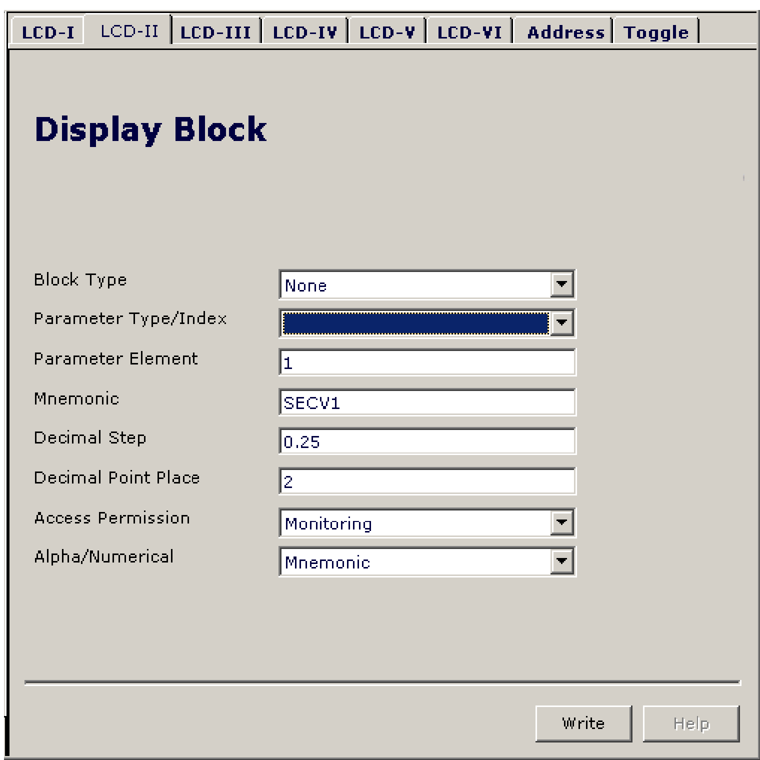


Figure 3.7 - Display Block Configuration Screen

The user can select the "*Mode Block*" parameter in the LCD. In this case, it is necessary to select an index similar to the "*Mode Block*" presented in Figure 3.8.

With this option the Mode Block parameter is showed on the display.

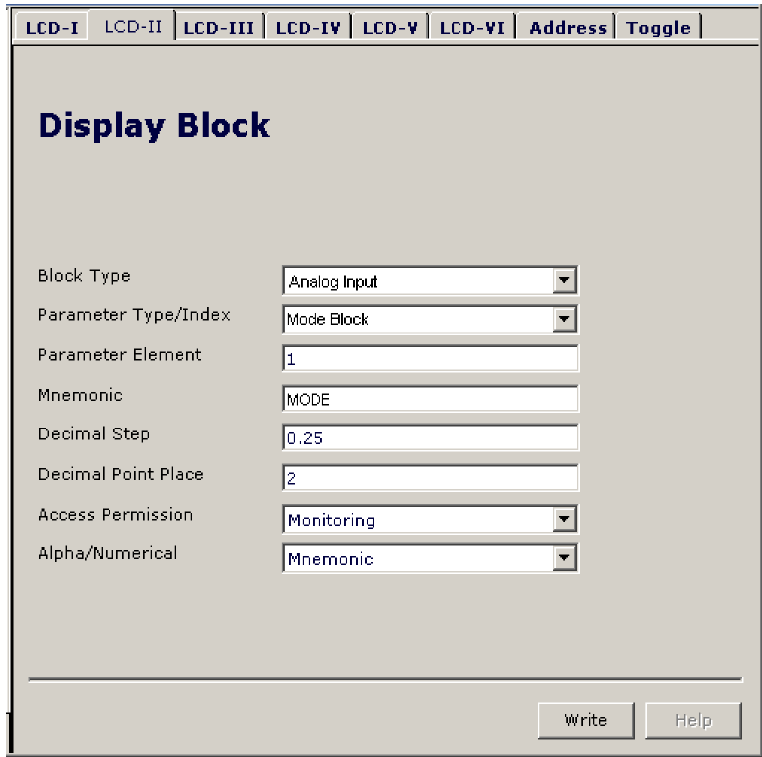


Figure 3.8 - Display Block Configuration Screen

The screen "*Address*" allows the user "enable/incapacitate" the access to change the physical address of the device (See Figure 3.9).

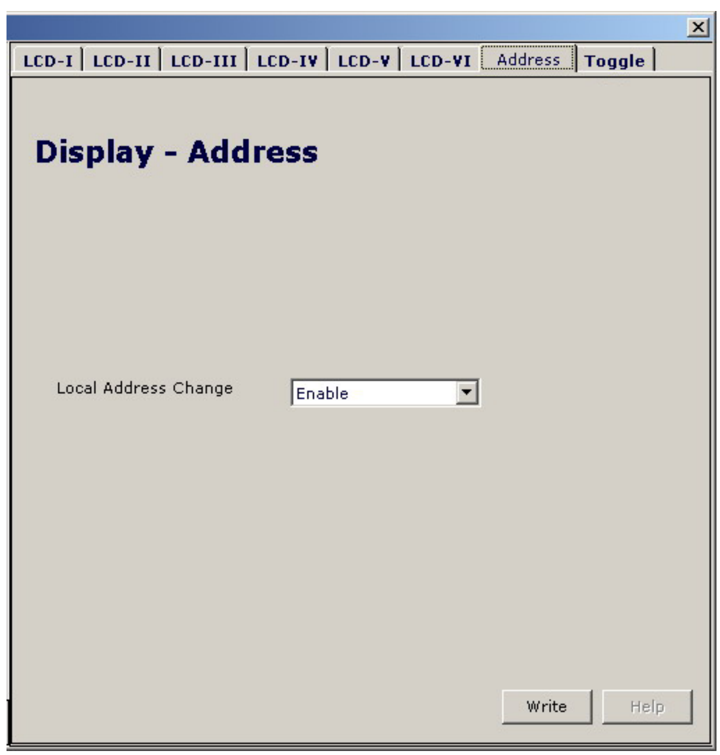


Figure 3.9 - Display Block Configuration Screen – Address

The screen "*Toggle*" is responsible for configuring the variables shown by the *display*. In the interface LCD can be shown at the same time up to 6 parameters, switching among the parameter configured in the LCD-I to the I LCD-VI. If the user doesn't want to show more than a parameter, it is enough to configure the parameter *Toggle* appropriately, as in the Figure 3.10.

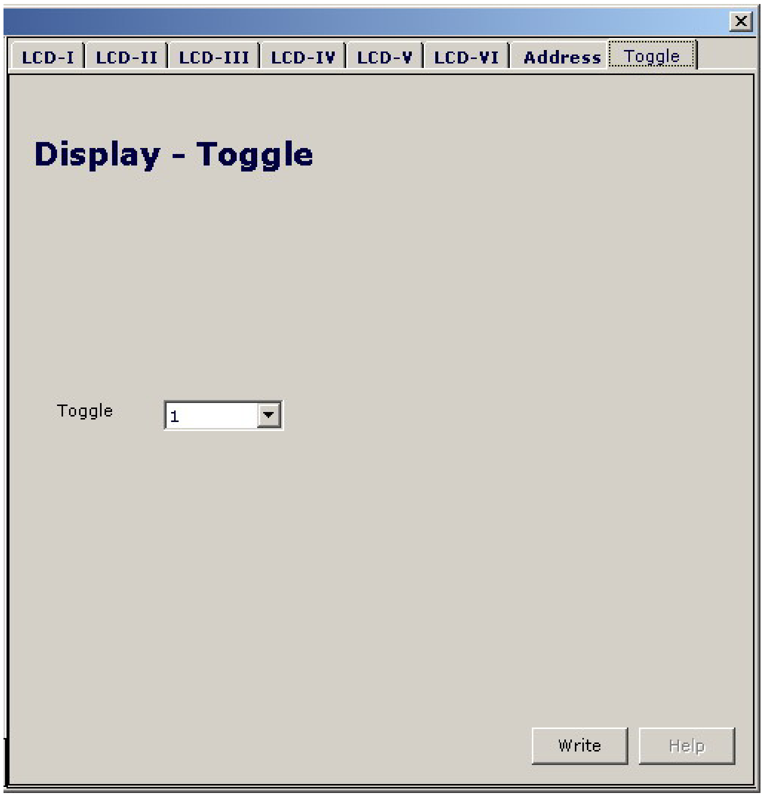


Figure 3.10 - Display Block Configuration Screen – Toggle

Display Configuration using Simatic PDM

The selection of *display* parameters should be seen as Function Block configuration.

When opening Simatic PDM, the user it should select in the initial screen the tool "*Device*". After, the option "*online configuration*" should be selected and in your submenu clicks in the option "*Display*" so that this can be configured. To determine and to configure Display Block parameters the user it should consult the Table 3.2.

In the sequence the configuration becomes similar to the ProfibusView configuration.

Local Adjustment Programming

The device should have the digital indicator for this function.

The device has two holes in the upper part of the housing to activate the magnetic switches, located under the identification plate, with the magnetic tool. See Figure 3.11.

Figure 3.11 - Local Adjustment Switches

This magnetic key enables the adjustment and the monitoring of the parameters configured for the local adjustment.

The labeled jumper "*LOC. ADJ*". (W1) in the top of the main electronic board should be in the position ON and the device should contain a digital indicator for this function to be enabled.

Local Adjustment Methodology

Enter the local adjustment by inserting the magnetic tool in the **ZERO** hole. Wait until the **"MD"** flag appears on the LCD. Then insert the magnetic tool twice in the **SPAN** hole The message **"LOC ADJ"** will appear. Next, insert the magnetic tool in the **ZERO** hole. Leaving the tool in the **ZERO** hole, browse through the items in the menu. The **ZERO** hole is used for browsing. By moving the tool to the **SPAN** hole, the parameter can be set on another value.

NOTE
SUMMARY:
Zero (z) Browses
Span (s) Selects / Actions.

To browse the available parameter options, move the tool to the **ZERO** hole to go to the specific menu option. See Figure 3.12. Then make a selection by moving the tool to **SPAN** when the choice is displayed. If the options are on/off, or enumerated, the option will appear in the value field. The mnemonic of each parameter will be displayed on the alphanumeric field. This is for viewing only, as changes are not to be made on the tag configured for the block. If the Functional Block tag is longer than five characters, it will circulate to the left.

If the magnetic tool is kept in the **SPAN** hole, the action will be continuous when the parameter is numeric. By temporarily removing the tool from the **SPAN** hole and then reinserting it, the working speed is reduced.

When the user inserts in and removes the magnetic tool from the **SPAN** hole, the increment or decrement will be done in steps.

Remove the tool when the desired value is reached.

When incrementing a variable beyond the value desired, move the tool to **ZERO** and wait until the decrement option of the same variable appears. By moving the tool to **SPAN**, it is reduced to the desired value. For "undershoot", the opposite applies.

To exit from any menu, remove the tool from any hole for a break, and an escape sequence will return to normal display.

The arrows inside each mnemonic indicate that the user can change the value by writing if the parameter has reading and writing access.

Whenever the user decrements the value of a parameter, he is given an option to “increment this value” when the magnetic tool is inserted into the **ZERO** hole.
Then the user enters the local adjustment, the last parameter used before is shown.

To monitor a parameter in normal operation, the user just needs to browse at the desired parameter and remove the magnetic tool. Then this parameter will be shown continuously on the LCD.

NOTE
Every action should be done critically because no confirmation is required to change the parameter value. After writing the value, it is automatically stored in the E2PROM memory.

Almost all Function block parameters can be configured by local adjustment. The user should select them from the following classes:

- Integer
- Float
- Status + Float
- Mode
- Tag (read-only)

All of them can be set or monitored by using the magnetic tool.

The default values for the local adjustment are trim parameters, transducer block output or input and Tag identifying the block.

Configuration Using the Local Adjustment

The device has six options of parameters to be configured into the Local Adjustment tree. These parameters can be configured using a configurator tool or even using the local adjustment, if the device software is higher than or equal to V1_10. When the device is delivered from the factory, it has a default local adjustment configuration tree and if the user desires to modify it he must enter a local adjustment and rotate over the tree. See Figure 3.14 as an example of the LD303. The way to configure this interface is the same for all Smar Profibus PA.

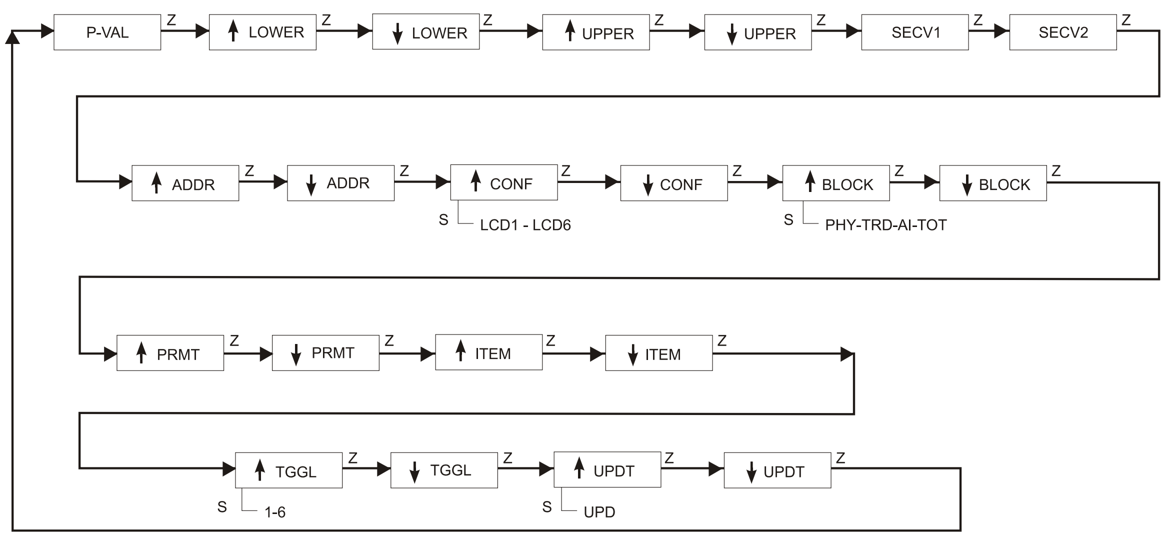


Figure 3.12 - Generic Parameter Browsing

After the "ADDR" option, we have the "CONF" option, where it is possible to select the LCD to configure. We have 6 options: LCD1 up to LCD6. Using the magnet tool the user can set this parameter.

The next option is "BLOCK", where the user must select the function block where is the parameter to be configured in the local adjustment.

The option "PRMT" is the correspondent relative index for the desired parameter in the chosen block. The user must use the Function Block manual or the specific Device manual to enter this value.

The "ITEM" option must be configured when we have data structures like DS-36 or array, which means that the user must configure the element in this structure, for example, if we want to show the element "EU at 100%" of the "Out_Scale" parameter for the Analog Block on the display, where we have the following:

E	ELEMENT NAME
1	EU at 100%
2	EU at 0%
3	Unit Index
4	Unit Index

Table 3.3 – Table of Elements

Then it is necessary to set "1" on the "ITEM" option.

The "TGGL" (Toggle) option is useful when the user wants to show a maximum 6 configured parameters switching on the LCD. If the TGGL is equal to 2, for example, the display will show the first two configured LCD parameters, and that they are valid ones. If for example, the second parameter is not valid, the user just will see the first one.

If the TGGL is equal to 3 for example, the display will show the first 3 configured parameters, e.g, the first, the second and the third configured LCD parameters and those they are valid ones. If for example, the second parameter is not valid, the user just will see the first and the third ones.

After choosing the configuration for the local adjustment, to finalize it is necessary to set "UPDT" using the "UPD" option. This will finalize the local adjustment to set the Display Block on the monitoring mode. It is necessary updating each LCD configuration made, by activating the "UPDT" option.

The mnemonics are default for some parameters (LCD1, LCD2, LCD3, LCD4, LCD5, LCD6) and some of them are predefined as follows:

Analog Input Block:

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
MODE_BLK	6	--	MODE
OUT	10	--	OUT
PV_SCALE	11	1	EU100
PV_SCALE	11	2	EU0
OUT_SCALE	12	1	EU100
OUT_SCALE	12	2	EU0
OUT_SCALE	12	3	UNIT
CHANNEL	14	--	CHNNL
PV_FTIME	16	--	FTIME
FSAFE_TYPE	17	--	FSTY
FSAFE_VALUE	18	--	FSV

Analog Output Block:

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
MODE_BLK	6	--	MODE
SP	9	--	SP
PV_SCALE	11	1	EU100
PV_SCALE	11	2	EU0
PV_SCALE	11	3	UNIT
READBACK	12	--	RBCK

RCAS_IN	14	--	RCASI
FSAFE_TIME	23	--	FST
FSAFE_TYPE	24	--	FSTY
FSAFE_VALUE	25	--	FSV
RCAS_OUT	27	--	RCASO
OUT	37	--	OUT
OUT_SCALE	38	1	EU100
OUT_SCALE	38	2	EU0
OUT_SCALE	38	3	UNIT

Totalizer Block:

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
MODE_BLK	6	--	MODE
TOTAL	10	--	TOTAL
SET_TOT	13	--	PRTOT
UNIT_TOT	11	--	UNIT
CHANNEL	12	--	CHNNL
MODE_TOT	14	--	MTOT

Transducer Block (LD303, LD293):

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
SENSOR_VALUE	8	--	SNSRV
CAL_POINT_HI	11	--	UPPER
CAL_POINT_LO	12	--	LOWER
SENSOR_UNIT	14	--	UNIT
TRIMMED_VALUE	15	--	TRIMV
PRIMARY_VALUE	18	--	PVAL
PRIMARY_VALUE_UNIT	19		UNIT
PRIMARY_VALUE_TYPE	20	--	PVTY
TEMPERATURE	27	--	TEMP
SECONDARY_VALUE_1	29	--	SEC1
SECONDARY_VALUE_UNIT_ 1	30	--	UNITf
SECONDARY_VALUE_2	31	--	SEC2
LIN_TYPE	33	--	LIN
SCALE_IN	34	1	EU100
SCALE_IN	34	2	EU0
SCALE_OUT	35	1	EU100
SCALE_OUT	35	2	EU0

Transducer Block (TP303):

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
SENSOR_VALUE	8	--	SNSRV
CAL_POINT_HI	11	--	UPPER
CAL_POINT_LO	12	--	LOWER
TRIMMED_VALUE	17	--	TRIMV
PRIMARY_VALUE	18	--	PVAL
PRIMARY_VALUE_UNIT	19	--	UNIT
SECONDARY_VALUE_1	21	--	SEC1
SECONDARY_VALUE_2	23	--	SEC2
SCALE_IN	25	1	EU100
SCALE_IN	25	2	EU0
SCALE_OUT	26	1	EU100
SCALE_OUT	26	2	EU0
SECONDARY_VALUE	29	--	TEMP

Transducer Block (TT303):

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
PRIMARY_VALUE	8	--	PVAL 1,2
PRIMARY_VALUE_UNIT	9	--	UNIT
SECONDARY_VALUE_1	10	--	SEC1
SECONDARY_VALUE_2	11	--	SEC2
SENSOR_MEAS_TYPE	12	--	MEAST
LIN_TYPE	14	--	SNSRT
SENSOR_CONNECTION	36	--	SNSRC
PRIMARY_VALUE_RANGE	62	1	EU100
PRIMARY_VALUE_RANGE	62	2	EU0
CAL_POINT_HI	63	--	UPPER
CAL_POINT_LO	64	--	LOWER
CAL_UNIT	66	--	UNIT
SECONDARY_VALUE	69	--	TEMP

Transducer Block (LD303):

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
SENSOR_VALUE	8	--	SNSRV
CAL_POINT_HI	11	--	UPPER
CAL_POINT_LO	12	--	LOWER
TRIMMED_VALUE	17	--	TRIMV
PRIMARY_VALUE	18	--	PVAL 1, 2, 3
PRIMARY_VALUE_UNIT	19		UNIT
SECONDARY_VALUE_1	21	--	SEC1
SECONDARY_VALUE_2	23	--	SEC2
SCALE_IN	25	1	EU100
SCALE_IN	25	2	EU0
SCALE_OUT	26	1	EU100
SCALE_OUT	26	2	EU0
LIN_TYPE	30	--	LIN

Transducer Block (FI303):

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
FINAL_VALUE	8	--	OUT 1,2,3
CAL_POINT_HI	10	--	UPPER
CAL_POINT_LO	11	--	LOWER
FEEDBACK_VALUE	16	--	F_BCK
LIN_TYPE	25	--	LIN
FEEDBACK_CAL	26	--	FEED
ACTUATOR_ACTION	39	--	ACT
SP_RATE_INC	40	--	R_INC
SP_RATE_DEC	41	--	R_DEC

Transducer Block (FP303):

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
FINAL_VALUE	8	--	F_VAL
CAL_POINT_HI	10	--	UPPER
CAL_POINT_LO	11	--	LOWER
CAL_UNIT	13	--	UNIT
ACTUATOR_ACTION	15	--	ACT
FEEDBACK_VALUE	25	--	F_BCK
RATE_DEC	26	--	R_DEC

RATE_INC	27	--	R_INC
LIN_TYPE	28	--	LIN
SECONDARY_VALUE	36	--	TEMP
SENSOR_PRESSURE	46	--	OUT
FEEDBACK_CAL	49	--	FEED

Transducer Block (FY303):

Parameter Name	Parameter(Relative Index)	Item(element)	Mnemonic
LIN_TYPE	25	--	LIN
SELF_CALIB_CMD	33	--	SETUP
SERVO_GAIN_1	35	--	Kp
SERVO_RESET_1	37	--	Tr
TRAVEL_RATE_DEC	49	--	R_DEC
TRAVEL_RATE_INC	50	--	R_INC
POSITIONG_VALUE	57	--	F_VAL
FEEDBACK_VALUE	58	--	F_BCK
VALVE_TYPE	61	--	VTYPE
ACTUATOR_ACTION	63	--	ACT
AIR_TO	70	--	AIR_T
CAL_POINT_HI	71	--	UPPER
CAL_POINT_LO	72	--	LOWER
SECONDARY_VALUE	78	--	TEMP
FEEDBACK_CAL	75	--	FEED

Transducer Block (DT303):

Parameter Name	Parameter (Relative Index)	Item (element)	Mnemonic
CAL_POINT_HI	11	--	UPPER
CAL_POINT_LO	12	--	LOWER
PRIMARY_VALUE	18	2	PVAL
PRIMARY_VALUE_TYPE	20	--	PTYPE
SECONDARY_VALUE	31	2	TEMP
SECONDARY_VALUE_UNIT	32	--	TEMP
MEASURED_TYPE	90	--	MEAST
AUTO_CAL_POINT_LO	95	--	LOWER
AUTO_CAL_POINT_HI	96	--	UPPER
MOUNTING_POSITION	137	--	MOUNT

NOTES
1) It is not necessary to a set a value. **2)** When the user wants to configure the Mode_Blk, it is necessary to set the "PRMT" parameter on 6, because it shows the actual mode and the action is done in the target mode. **3)** It is not possible to configure the SIMULATE and BATCH parameters using the local adjustment.

Selecting Manufacturer Specific or Profile Specific through Local Adjustment

The user must configure the following parameters using the local adjustment procedure:

CONF: Select a **LCD1**;
BLOCK: Select **PHY**;
PRMT: Select **24** - relative to the IDENT_NUMBER_SELECTOR parameter;
ITEM: Value must be **2**;
Enter in **UPDATE**;
The display will show **LCD1=0**, or other value. Change this value to **1 (Manufacturer Specific)** or **0 (Profile Specific).**

After the procedure described above, to exit LCD1 mode:
CONF: Select a **LCD1**
BLOCK: Select **TRD**;
PRMT: Select **18**;
ITEM: Value must be **2**;
Enter in **UPDATE**.

Example of Device Configurations using the Local Adjustment

1) FY303

Please, in the next steps it will be necessary to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual.

a) Transducer Block Configuration:

a.1) Valve Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **61** (VALVE_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the **VALVE_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the **"UPDT"** option and insert the magnet tool into the Span hole to update the local adjustment tree.
Enter the local adjustment and browse the **VTYPE** option, and then set the valve type according to:

0 = linear moving valve, sliding valve
1 = rotary moving valve, part-turn
2 = rotary moving valve, multi-turn

a.2) Servo Gain:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **35** (SERVO_GAIN_1), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the SERVO_GAIN_1is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **Kp** option, and then set the desired servo gain value.

a.3) Servo Reset:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **37**(SERVO_RESET_1), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.

ITEM: the **SERVO_RESET_1**is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the **"UPDT"** option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **Tr** option, and then set the desired servo gain value.

a.4) Actuator Action:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **63** (ACTUATOR_ACTION), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the **ACTUATOR_ACTION** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **ACT** option, and then set the Fail-Safe position for power- loss according to:

0 = not initialized
1 = opening (100%)
2 = closing (0%)
3 = none / remains in actual position

a.5) Air to Open and Air to Close:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **70** (AIR_TO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the **AIR_TO** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **AIR_T** option, and then set the value according to:
0 = Open
1 = Close

a.6) Self-Calibration:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **33** (SELF_CALIB_CMD), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the **SELF_CALIB_CMD** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and then browse up to **SETUP** option. To start the self calibration procedure, please, write a value equal to **2**. At the end of the self calibration procedure, this value goes to zero and during the procedure the LCD will indicate the procedure percentage.

To abort the procedure, just write a value equal to **zero**.

a.7) Lower and Upper Position Calibration:

To configure this calibration option the user must configure 3 parameters of the Transducer Block. They are:

- CAL_POINT_LO (relative index equal to 72)
- CAL_POINT_HI (relative index equal to 71)
- FEEDBACK_CAL (relative index equal to 75)

Then, using the local adjustment configuration procedure, configure the CAL_POINT_LO parameter as following:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **72** (CAL_POINT_LO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_POINT_LO** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Repeat this procedure to the **CAL_POINT_HI** and **FEEDBACK_CAL**.

Then to make the position calibration, please, see the topic "Programming Using The Local Adjustment" in the FY303 Operation & Maintenance Instructions Manual
a.8) Linearization Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **25** (LIN_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the **LIN_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **LIN** option, and then set desired linearization according to:

0 = linear
1 = user defined table
50 = EP 1:33
51 = EQ 1:33
52 = EP 1:50
53 = EQ 1:50
55 = EQ 1:25

b) Analog Output Block Configuration:

b.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;

PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- AUTO
- RCAS
- MAN
- LO
- OS

b.2) Fail Safe Type:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **24** (FSAFE_TYPE), according to the Function Blocks Instruction Manual.
ITEM: the **FSAFE_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.
Enter into the local adjustment and browse up to the **FSTY** option, and then set the value according to the following options:

0 = Use FSAFE_VALUE
1 = Use Last Usable Value
2 = Goes to ACTUATOR_ACTION position

b.3) Fail Safe Value:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **25** (FSAFE_VALUE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_VALUE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **FSV** option, and then set the value according to the desired fail safe position.

b.4) PV Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **11** (PV_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

b.5) Out Scale:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **38** (OUT_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **OUT_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range
3 - Unit: that must be according to the Unit Codes Table in this manual.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 or **UNIT** option, if the ITEM is equal to 3 and then, set the value according to the desired scaling.

2) FP303

Note that in the next steps it will be necessary to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FP303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual.

a) Configuration of Transducer Block:

a.1) Actuator Action:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **15** (ACTUATOR_ACTION), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FP303 Operation & Maintenance Instructions Manual.
ITEM: the **ACTUATOR_ACTION** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **ACT** option, and then set the Fail-Safe position for power- loss according to:

0 = not initialized
1 = opening (100%)
2 = closing (0%)
3 = none / remains in actual position

a.2) Lower and Upper Pressure Calibration:

To configure this option of calibration the user must configure 3 parameters of the Transducer Block. They are:

- **CAL_POINT_LO (relative index equal to 11)**
- **CAL_POINT_HI (relative index equal to 10)**
- **FEEDBACK_CAL (relative index equal to 49)**
- **CAL_UNIT (relative index equal to 13)**

First of all, the user should configure the desired unit of calibration:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;

PRMT: set the value **13** (CAL_UNIT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FP303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_UNIT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Then just browse up to the **"UNIT"** option and select the unit according to the the FP303 Operation & Maintenance Instructions Manual.

Then, using the local adjustment configuration procedure, configure the CAL_POINT_LO parameter as following:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **11** (CAL_POINT_LO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FP303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_POINT_LO** is a simple parameter and it does not have elements, thus no specific value is needed.
After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.
Repeat this procedure to the **CAL_POINT_HI** and **FEEDBACK_CAL**.
Then to make the pressure calibration, please, see the topic "Programming Using the Local Adjustment" in the FP303 Operation & Maintenance Instructions Manual

a.3) Linearization Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **28** (LIN_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FY303 Operation & Maintenance Instructions Manual.
ITEM: the **LIN_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **LIN** option, and then set desired linearization according to:

0 = linear
1 = user defined table

b) Analog Output Block Configuration:

b.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **RCAS**
- **MAN**
- **LO**
- **OS**

b.2) Fail Safe Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **24** (FSAFE_TYPE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_TYPE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSTY** option, and then set the value according to the following options:
0 = Use FSAFE_VALUE
1 = Use Last Usable Value
2 = Goes to ACTUATOR_ACTION position

b.3) Fail Safe Value:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **25** (FSAFE_VALUE), according to the Function Blocks Instruction Manual.
ITEM: the **FSAFE_VALUE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **FSV** option, and then set the value according to the desired fail safe position.

b.4) PV Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **11** (PV_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

b.5) Out Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **38** (OUT_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **OUT_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range
3 - Unit: that must be according to the Unit Codes Table in this manual.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 or **UNIT** option, if the ITEM is equal to 3 and then, set the value according to the desired scaling.

3) FI303

The next steps it will need to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FI303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual.

a) Configuration of Transducer Block:

a.1) Actuator Action:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: **TRD1, or the desired transducer (TRD1, TRD2, TRD3)**;
PRMT: set the value **39** (ACTUATOR_ACTION), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FI303 Operation & Maintenance Instructions Manual.
ITEM: the **ACTUATOR_ACTION** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **ACT** option, and then set the Fail-Safe position for power - loss according to:

0 = not initialized
1 = opening (100%)
2 = closing (0%)
3 = none / remains in actual position

a.2) Lower and Upper Current Calibration:

To configure this calibration option the user must configure 3 parameters of the Transducer Block. They are:

- **CAL_POINT_LO (relative index equal to 11)**
- **CAL_POINT_HI (relative index equal to 10)**
- **FEEDBACK_CAL (relative index equal to 26)**

Using the local adjustment configuration procedure, configure the CAL_POINT_LO parameter as follow:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1, or the desired transducer (TRD1, TRD2, TRD3)**;
PRMT: set the value **11** (CAL_POINT_LO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FI303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_POINT_LO** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Repeat this procedure to the **CAL_POINT_HI** and **FEEDBACK_CAL**. Then to make the current calibration, please, see the topic "Programming Using the Local Adjustment" in the FI303 Operation & Maintenance Instructions Manual

a.3) Linearization Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **25** (LIN_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the FI303 Operation & Maintenance Instructions Manual.
ITEM: the **LIN_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **LIN** option, and then set desired linearization according to:
0 = None
1 = user defined table
255 = No Linearization

b) Configuration of Analog Output Block:

b.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO1 or AO2 or AO3**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **RCAS**
- **MAN**
- **LO**

b.2) Fail Safe Type:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO1 or AO2 or AO3**;
PRMT: set the value **24** (FSAFE_TYPE), according to the Function Blocks Instruction Manual.
ITEM: the **FSAFE_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **FSTY** option, and then set the value according to the following options:

0 = Use FSAFE_VALUE
1 = Use Last Usable Value
2 = Goes to ACTUATOR_ACTION position

b.3) Fail Safe Value:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO1 or AO2 or AO3**;
PRMT: set the value **25** (FSAFE_VALUE), according to the Function Blocks Instruction Manual.

ITEM: the **FSAFE_VALUE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **FSV** option, and then set the value according to the desired fail safe position.

b.4) PV Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO1 or AO2 or AO3**;
PRMT: set the value **11** (PV_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

b.5) Out Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AO**;
PRMT: set the value **38** (OUT_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **OUT_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range
3 - Unit: that must be according to the Unit Codes Table in this manual.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 or **UNIT** option, if the ITEM is equal to 3 and then, set the value according to the desired scaling.

4) LD303 and LD293

The next steps will need to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual. For LD293, do not consider the Totalizer Block and square root capability.

a) Configuration of Transducer Block:

a.1) Primary Value Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: **TRD**;
PRMT: set the value **20** (PRIMARY_VALUE_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.

ITEM: the **PRIMARY_VALUE_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **PVTY** option, and then set the Primary Value Type according to the application:

0 = Pressure
1 = Flow

a.2) LinearizationType:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: **TRD**;
PRMT: set the value **33** (LIN_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.
ITEM: the **LIN_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **LIN** option, and then set the Lin Type according to the application:

0 = No linearization
1 = User defined table
10 = Square Root
255 = None

NOTE
1- When the user wants to totalize, please select Primary Value Type to Flow and Lin Type equal to Square Root and then set the Low Flow Cut Off and (relative index = 36) Flow Lin Sqrt Point(relative index = 37).

a.3) Scale In:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **34** (SCALE_IN), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.
ITEM: the **SCALE_IN** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired unit.

NOTE
The unit for the Scale In is selected using the Secondary Value Unit 1(relative index = 30) (see Unit Codes for LD303).

a.4) Secondary Value Unit 1:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **30** (SECONDARY_VALUE_UNIT_1), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.
ITEM: the **SECONDARY_VALUE_UNIT_1** is a simple parameter and it is not necessary to set an element.
After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **UNIT** option then set the value according to the desired unit.

a.5) Sensor Unit:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **14** (SENSOR_UNIT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.
ITEM: the **SENSOR_UNIT** is a simple parameter and it is not necessary to set an element.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **UNIT** option then set the value according to the desired unit.

a.6) Scale Out:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **35** (SCALE_OUT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.
ITEM: the **SCALE_OUT** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

NOTE
The unit for the output is select using the Primary Value Unit (see Unit Codes for LD303).

a.7) Primary Value Unit:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;

PRMT: set the value **19** (PRIMARY_VALUE_UNIT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.
ITEM: the PRIMARY_VALUE_UNIT is a simple parameter and it is not necessary to set the an element.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter the local adjustment and browse up to the **UNIT** option then set the value according to the desired unit:

We have the following units for SENSOR_UNIT, SECONDARY_VALUE_UNIT_1, SECONDARY_VALUE_UNIT_2 and PRIMARY_VALUE_UNIT (when LIN_TYPE is not sqr root):

UNIT	VALUE
InH_2O to 68°F	1148
ftH_2O to 68°F	1154
mmHg to 0°C	1158
bar	1137
g/cm^2	1144
Pa	1130
torr	1139
MPa	1132
mmH_2O to 4°C	1150
InHg to 0°C	1156
mmH_2O to 68°F	1151
psi	1141
mbar	1138
k/cm^2	1145
kPa	1133
atm	1140
inH_2O to 4°C	1147

Table 3.4 – Units Table

When LIN_TYPE is sqr root, the units code for PRIMARY_VALUE_UNIT are:

Units	Value	Units	Value
m^3/s	1347	m^3/min	1348
m^3/h	1349	m^3/d	1350
L/s	1351	L/min	1352
L/h	1353	CFS	1356
CFM	1357	CFH	1358
CFD	1359	gal/s	1362
GPM	1363	gal/h	1364
gal/d	1365	bbl/s	1371
bbl/min	1372	bbl/h	1373
bbl/d	1374	g/s	1318
g/min	1319	g/h	1320
Kg/s	1322	Kg/min	1323
Kg/h	1324	Kg/d	1325

Units	Value	Units	Value
t/min	1327	t/h	1328
t/d	1329	lb/s	1330
lb/min	1331	lb/h	1332
lb/d	1333		

NOTE
The output unit is selected using the Primary Value Unit (see Unit Codes for LD303).

a.8) Lower and Upper Pressure Calibration:

To configure this option of calibration the user must configure 3 parameters of the Transducer Block. They are:

- **CAL_POINT_LO (relative index equal to 12)**
- **CAL_POINT_HI (relative index equal to 11)**
- **SENSOR_UNIT (relative index equal to 14)**

Using the local adjustment configuration procedure, configure the CAL_POINT_LO parameter as following:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **12** (CAL_POINT_LO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the LD303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_POINT_LO** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

Repeat this procedure to the **CAL_POINT_HI** and **SENSOR_UNIT**.

Then to make the pressure calibration, please, see the topic "Programming Using the Local Adjustment" in the LD303 Operation & Maintenance Instructions Manual and use the Engineering Unit Codes table (Table3.4, page 3-19) to select the desired unit for the calibration.

b) Analog Input Block Configuration:

b.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **MAN**
- **OS**

b.2) Fail Safe Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;

BLOCK: select **AI**;
PRMT: set the value **17** (FSAFE_TYPE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_TYPE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSTY** option, and then set the value according to the following options:
0 = Use FSAFE_VALUE
1 = Use Last Usable Value
2 = Use Wrong Value
b.3) Fail Safe Value:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **18** (FSAFE_VALUE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_VALUE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSV** option, and then set the value according to the desired fail safe position.

b.4) PV Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **11** (PV_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

b.5) Out Scale:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **12** (OUT_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range
3 - Unit: that must be according to the Unit Codes Table in this manual.

Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 or **UNIT** option, if the ITEM is equal to 3 and then, set the value according to the desired scaling.

b.6) Channel:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **14** (CHANNEL), according to the Function Blocks Instruction Manual.

ITEM: the **CHANNEL** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **CHNNL** option, and then set the value according to the following value:

0 = Disconnected
274 = Primary Value (PV)
285 = Secondary Value 1
287 = Secondary Value 2

c) Totalizer Block Configuration:

c.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **OS**

c.2) Channel:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **12** (CHANNEL), according to the Function Blocks Instruction Manual.
ITEM: the **CHANNEL** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **CHNNL** option, and then set the value according to the following value:

0 = Disconnected
274 = Primary Value (PV)

c.3) Set Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **13** (SET_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **SET_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **PRTOT** option, and then set the value according to the following value:

0 = Totalize
1 = Reset
2 = Preset

c.4) Mode Tot:
The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **14** (MODE_TOT), according to the Function Blocks Instruction Manual.

ITEM: the **MODE_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MTOT** option, and then set the value according to the following value:

0 = Balanced
1 = Positive only
2 = Negative only
3 = Hold

c.5) Unit Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **11** (UNIT_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **UNIT_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **UNIT** option, and then set the value according to the engineering unit codes for totalization.

5) TT303

Please, in the next steps it will be necessary to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual.

a) Transducer Block Configuration:

a.1) Sensor Meas Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: **TRD**;
PRMT: set the value 1**2** (SENSOR_MEAS_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual.
ITEM: the **SENSOR_MEAS_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MEAST** option, and then set the Primary Value Type according to the application:

128 = Difference
220 = Backup
230 = Process Temperature

a.2) Sensor Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: **TRD1 or TRD2**;

PRMT: set the value **14** (LIN_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual.

ITEM: the **LIN_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **SNSRT** option, and then set the Sensor Type according to the application, using the value of LIN_TYPE parameter in the TT303 Operation & Maintenance Instructions Manual.

a.3) Sensor Connection:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: **TRD1 or TRD2**;
PRMT: set the value **36** (SENSOR_CONNECTION), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual.
ITEM: the **SENSOR_CONNECTION** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **SNSRC** option, and then set the Sensor Connection according to the values:

0 = 2 wires
1 = 3 wires
2 = 4 wires
3 = 2 dual wires

a.4) Primary Value Range:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2**;
PRMT: set the value **62** (PRIMARY_VALUE_RANGE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual.
ITEM: the **PRIMARY_VALUE_RANGE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

NOTE
The unit for the output is selected using the Primary Value Unit (see Unit Codes for TT303, in the TT303 Operation & Maintenance Instructions Manual).

a.5) Primary Value Unit:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2**;

PRMT: set the value **9** (PRIMARY_VALUE_UNIT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual.
ITEM: the PRIMARY_VALUE_UNIT is a simple parameter and it is not necessary to set an element.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.
Enter the local adjustment and browse up to the **UNIT** option then set the value according to the desired value.

NOTE
See Unit Codes for TT303 in the TT303 Operation & Maintenance Instructions Manual.

a.6) Cal Unit:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2**;
PRMT: set the value **66** (CAL_UNIT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_UNIT** is a simple parameter and it is not necessary to set an element.
After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **UNIT** option then set the value according to the desired value.

NOTE
See Unit Codes for TT303 in the TT303 Operation & Maintenance Instructions Manual.

a.7) Lower and Upper Temperature Calibration:

To configure this option of calibration the user must configure 3 parameters of the Transducer Block. They are:

- **CAL_POINT_LO (relative index equal to 64)**
- **CAL_POINT_HI (relative index equal to 63)**
- **CAL_UNIT (relative index equal to 66)**

Using the local adjustment configuration procedure, configure the CAL_POINT_LO parameter as following:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2**;
PRMT: set the value **64**(CAL_POINT_LO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TT303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_POINT_LO** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Repeat this procedure to the **CAL_POINT_HI** and **SENSOR_UNIT**.

Then to make the temperature calibration, please, see the topic "Programming Using The Local Adjustment" in the TT303 Operation & Maintenance Instructions Manual.

NOTE
See Unit Codes for TT303 in the TT303 Operation & Maintenance Instructions Manual.

b) Configuration of Analog Input Block:

b.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI1 or AI2**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **MAN**
- **OS**

b.2) Fail Safe Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI1 or AI2**;
PRMT: set the value **17** (FSAFE_TYPE), according to the Function Blocks Instruction Manual.
ITEM: the **FSAFE_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSTY** option, and then set the value according to the following options:

0 = Use FSAFE_VALUE
1 = Use Last Usable Value
2 = Use Wrong Value

b.3) Fail Safe Value:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI1 or AI2**;
PRMT: set the value **18** (FSAFE_VALUE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_VALUE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSV** option, and then set the value according to the desired fail safe position.

b.4) PV Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI1 or AI2**;
PRMT: set the value **11** (PV_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

b.5) Out Scale:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI1 or AI2**;
PRMT: set the value **12** (OUT_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range
3 - Unit: that must be according to the Unit Codes Table in this manual
After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 or **UNIT** option, if the ITEM is equal to 3 and then, set the value according to the desired scaling.

b.6) Channel:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI1 or AI2**;
PRMT: set the value **14** (CHANNEL), according to the Function Blocks Instruction Manual.
ITEM: the **CHANNEL** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **CHNNL** option, and then set the value according to the following value:

0 = Disconnected
264 = Primary Value (PV)
266 = Secondary Value 1
267 = Secondary Value 2

6) IF303

The next steps will need to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the IF303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual.

a) Transducer Block Configuration:

a.1) LinearizationType:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: **TRD1 or TRD2 or TRD3**;
PRMT: set the value **30** (LIN_TYPE), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the IF303 Operation & Maintenance Instructions Manual.
ITEM: the **LIN_TYPE** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **LIN** option, and then set the Lin Type according to the application:
0 = No linearization
10 = Square Root
255 = None

NOTE
When the user wants to totalizer, please select Lin Type equal to Square Root and then set the Low Flow Cut Off (relative index = 31) and Flow Lin Sqrt Point (relative index = 32).

a.2) Scale In:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2 or TRD3**;
PRMT: set the value **25** (SCALE_IN), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the IF303 Operation & Maintenance Instructions Manual.
ITEM: the **SCALE_IN** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

NOTE
The unit for the Scale In is always mA.

a.3) Scale Out:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2 or TRD3**;
PRMT: set the value **26** (SCALE_OUT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the IF303 Operation & Maintenance Instructions Manual..
ITEM: the **SCALE_OUT** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

NOTE
The unit for the output is selected using the Primary Value Unit. When measuring current, this unit is always mA. When totalizing, the user can select the unit according to the unit code table.

a.4) Primary Value Unit:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2 or TRD3**;
PRMT: set the value **19** (PRIMARY_VALUE_UNIT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the IF303 Operation & Maintenance Instructions Manual..
ITEM: the PRIMARY_VALUE_UNIT is a simple parameter and it is not necessary to set an element.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **UNIT** option then set the value according to the desired value.

NOTE
The unit for the output is selected using the Primary Value Unit. When measuring current, this unit is always mA. When totalizing, the user can select the unit according to the unit code table.

a.5) Lower and Upper Current Calibration:

To configure this option of calibration the user must configure 3 parameters of the Transducer Block. They are:

- **CAL_POINT_LO (relative index equal to 12)**
- **CAL_POINT_HI (relative index equal to 11)**

Using the local adjustment configuration procedure, configure the CAL_POINT_LO parameter as following:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD1 or TRD2 or TRD3**;
PRMT: set the value **12** (CAL_POINT_LO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the IF303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_POINT_LO** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Repeat this procedure to the **CAL_POINT_HI**. The calibration unit is always mA. Then to make the pressure calibration, please, see the topic "Programming Using the Local Adjustment" in the IF303 Operation & Maintenance Instructions Manual.

b) Analog Input Block Configuration:

b.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI3 or AI2 or AI3**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **MAN**
- **OS**

b.2) Fail Safe Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI3 or AI2 or AI3**;
PRMT: set the value **17** (FSAFE_TYPE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_TYPE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSTY** option, and then set the value according to the following options:

0 = Use FSAFE_VALUE
1 = Use Last Usable Value
2 = Use Wrong Value

b.3) Fail Safe Value:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI3 or AI2 or AI3**;
PRMT: set the value **18** (FSAFE_VALUE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_VALUE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSV** option, and then set the value according to the desired fail safe position.

b.4) PV Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI3 or AI2 or AI3**;
PRMT: set the value **11** (PV_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

b.5) Out Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI3 or AI2 or AI3**;
PRMT: set the value **12** (OUT_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range
3 - Unit: that must be according to the Unit Codes Table in this manual.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 or **UNIT** option, if the ITEM is equal to 3 and then, set the value according to the desired scaling.

b.6) Channel:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI1 or AI2 or AI3**;
PRMT: set the value **14** (CHANNEL), according to the Function Blocks Instruction Manual.

ITEM: the **CHANNEL** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **CHNNL** option, and then set the value according to the following value:

0 = Disconnected
274 = Primary Value (PV)
277 = Secondary Value 1
279 = Secondary Value 2

c) Configuration of Totalizer Block:

c.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT1 or TOT2 or TOT3**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **OS**

c.2) Channel:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT1 or TOT2 or TOT3**;
PRMT: set the value **12** (CHANNEL), according to the Function Blocks Instruction Manual.
ITEM: the **CHANNEL** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **CHNNL** option, and then set the value according to the following value:

0 = Disconnected
274 = Primary Value (PV)

c.3) Set Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT1 or TOT2 or TOT3**;
PRMT: set the value **13** (SET_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **SET_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **PRTOT** option, and then set the value according to the following value:

0 = Totalize
1 = Reset
2 = Preset

c.4) Mode Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT1 or TOT2 or TOT3**;
PRMT: set the value **14** (MODE_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **MTOT** option, and then set the value according to the following value:
0 = Balanced
1 = Positive only
2 = Negative only
3 = Hold

c.5) Unit Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT1 or TOT2 or TOT3**;
PRMT: set the value **11** (UNIT_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **UNIT_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **UNIT** option, and then set the value according to the engineering unit codes for totalization (please, see the unit table codes in this manual).

7) TP303

Please, in the next steps it will be necessary to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TP303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual.

a) Configuration of Transducer Block:

a.1) Scale In:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **25** (SCALE_IN), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TP303 Operation & Maintenance Instructions Manual..
ITEM: the **SCALE_IN** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.
Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

NOTE
The unit for the Scale In is always percentage (%).

a.2) Scale Out:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **26** (SCALE_OUT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TP303 Operation & Maintenance Instructions Manual.
ITEM: the **SCALE_OUT** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

NOTE
The unit for the output is select using the Primary Value Unit (see Unit Codes for TP303).

a.3) Primary Value Unit:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **19** (PRIMARY_VALUE_UNIT), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TP303 Operation & Maintenance Instructions Manual.
ITEM: the PRIMARY_VALUE_UNIT is a simple parameter and it is not necessary to set an element.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **UNIT** option then set the value according to the desired value.

a.4) Lower and Upper Position Calibration:

To configure this option of calibration the user must configure 3 parameters of the Transducer Block. They are:
- **CAL_POINT_LO (relative index equal to 12)**
- **CAL_POINT_HI (relative index equal to 11)**

Using the local adjustment configuration procedure, configure the CAL_POINT_LO parameter as following:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **12** (CAL_POINT_LO), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the TP303 Operation & Maintenance Instructions Manual.
ITEM: the **CAL_POINT_LO** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Repeat this procedure to the **CAL_POINT_HI**. The for position calibration is always %. Then to make the pressure calibration, please, see the topic "Programming Using the Local Adjustment" in the TP303 Operation & Maintenance Instructions.

b) Analog Input Block Configuration:

b.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **MAN**
- **OS**

b.2) Fail Safe Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **17** (FSAFE_TYPE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_TYPE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **FSTY** option, and then set the value according to the following options:

0 = Use FSAFE_VALUE
1 = Use Last Usable Value
2 = Use Wrong Value

b.3) Fail Safe Value:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **18** (FSAFE_VALUE), according to the Function Blocks Instruction Manual.
ITEM: the FSAFE_VALUE is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **FSV** option, and then set the value according to the desired fail safe position.

b.4) PV Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **11** (PV_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Enter into the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 and then set the value according to the desired scaling.

b.5) Out Scale:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **12** (OUT_SCALE), according to the Function Blocks Instruction Manual.
ITEM: the **PV_SCALE** is a structure parameter and it is necessary to set the element according to:

1 - EU100: upper range
2 - EU0: lower range
3 - Unit: that must be according to the Unit Codes Table in this manual.
After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **EU100** option, if the ITEM is equal to 1 or **EU0** option, if the ITEM is equal to 2 or **UNIT** option, if the ITEM is equal to 3 and then, set the value according to the desired scaling.

b.6) Channel:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **AI**;
PRMT: set the value **14** (CHANNEL), according to the Function Blocks Instruction Manual.
ITEM: the **CHANNEL** is a simple parameter and it does not have elements, then it is not necessary to set an s pecific value.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **CHNNL** option, and then set the value according to the following value:

0 = Disconnected
274 = Primary Value (PV)
277 = Secondary Value 1
279 = Secondary Value 2

c) Configuration of Totalizer Block:

c.1) Mode Block:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **6** (MODE_BLOCK), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_BLOCK** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **MODE** option, and then set the value according to the following options:

- **AUTO**
- **OS**

c.2) Channel:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **12** (CHANNEL), according to the Function Blocks Instruction Manual.

ITEM: the **CHANNEL** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **CHNNL** option, and then set the value according to the following value:

0 = Disconnected
274 = Primary Value (PV)

c.3) Set Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **13** (SET_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **SET_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter into the local adjustment and browse up to the **PRTOT** option, and then set the value according to the following value:

0 = Totalize
1 = Reset
2 = Preset

c.4) Mode Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **14** (MODE_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **MODE_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **MTOT** option, and then set the value according to the following value:

0 = Balanced
1 = Positive only
2 = Negative only
3 = Hold

c.5) Unit Tot:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TOT**;
PRMT: set the value **11** (UNIT_TOT), according to the Function Blocks Instruction Manual.
ITEM: the **UNIT_TOT** is a simple parameter and it does not have elements, thus no specific value is needed.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree. Enter the local adjustment and browse up to the **UNIT** option, and then set the value according to the engineering unit codes for totalization (please, see the unit table codes in this manual).

8) DT303

Please, in the next steps it will be necessary to use the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual and the Function Blocks Instruction Manual.

a) Transducer Block Configuration:

a.1) Calibration of Lower and Upper Density/Concentration:

To configure this calibration option the user should configure 2 parameters of the Transducer Block. They are:

- **CAL_POINT_LO (relative index equal to 12);**

- **CAL_POINT_HI (relative index equal to 11);**

The user must configure the **CAL_POINT_LO** parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **25** (SCALE_IN), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: Calibration of the Inferior Value is a simple parameter and it is not necessary to configure the element.

After these settings, just browse the **"UPDT"** option and insert the magnet tool into the Span hole to update the local adjustment tree.

The user must configure the **CAL_POINT_HI** parameters using the following local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value 11 (CAL_POINT_HI – Upper Value Calibration), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: Calibration of the Inferior Value is a simple parameter and it is not necessary to configure the element.

a.2) Primary Value Unit:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **18** (PRIMARY_VALUE - Primary Value Unit), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **PRIMARY_VALUE** is a simple parameter and it is not necessary to set an element.

1 = Status;
2 = Value.

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

a.3) Primary Value Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;

BLOCK: select **TRD**;
PRMT: set the value **20** (PRIMARY_VALUE_TYPE - Primary Value Unit), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **PRIMARY_VALUE_TYPE -** Configure the Type of Transdutor according to the application:
0 = Pressure;
129 = Density / Concentration

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

a.4) Secondary Unit Value:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **31** (SECONDARY_VALUE - Secondary Unit Value), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **SECONDARY_VALUE –** Secondary Unit Value is a necessary parameter to configure the element:

1 = Status
2 = Value

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

a.5) Secondary Variable Unit:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **32** (SECONDARY_VALUE_UNIT –Secondary Variable Unit), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **SECONDARY_VALUE_UNIT –** Secondary Variable Unit is a necessary parameter to configure the element:

1000 = Temperature in Kelvin
1001 = Temperature in Celsius degrees
1002 = Temperature in Farenheit degrees

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

a.6) Measured Type:

The user must configure the following parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **90** (MEASURED_TYPE – Measured Type), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **MEASURED_TYPE –** Configure the Measured Type according to the units of the Table 3.6:

UNIT	VALUE
Density (g/cm3)	0
Density (Kg/m3)	1
Relative Density to 20°C	2
Relative Density to 4°C	3
Baumé Degree	4
Brix Degree	5
Plato Degree	6
INPM Degree	7
GL Degree	8
Percentage of Solids	9
Density (lb/ft3)	10

Table 3.6 – Units Table

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

a.7) Self-calibration Air and Water:

To configure this calibration option the user it should configure 3 parameters of the Transducer Block. They are:

- **AUTO_CAL_POINT_LO (Air - relative index equal to 95);**
- **AUTO_CAL_POINT_HI (Water - relative index equal to 96);**
- **MEASURED_TYPE (relative index equal to 90).**

NOTE
The output unit is selected using the measurement type (See Codes of the Unit for DT303).

The user must configure the **MEASURED_TYPE** and **AUTO_CAL_POINT_LO** parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **90** (MEASURED_TYPE – Measured Type) for density (Kg/m^3) equal to 1
PRMT: set the value **95** (AUTO_CAL_POINT_LO – Self-calibration of Lower Value), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **AUTO_CAL_POINT_LO –** Calibration of the Lower Value is a simple parameter and it is not necessary to configure the element.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

The user must configure the **MEASURED_TYPE** and **AUTO_CAL_POINT_HI** parameters using the local adjustment procedure:

CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **90** (MEASURED_TYPE – Measured Type) for Brix degree value equal to 5
PRMT: set the value **96** (AUTO_CAL_POINT_HI – Self-calibration of Upper Value), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **AUTO_CAL_POINT_HI –** Calibration of the Upper Value is a simple parameter and it is not necessary to configure the element.

After these settings, just browse the “UPDT” option and insert the magnet tool into the Span hole to update the local adjustment tree.

a.8) Mouting Position:

The user must configure the following parameters using the local adjustment procedure:
CONF: just select a LCD, for example **LCD2**;
BLOCK: select **TRD**;
PRMT: set the value **137** (MOUNTING_POSITION – Mouting Position), according to the Transducer Block Standard Parameter Descriptions, Transducer Block Specific Parameter Descriptions and Transducer Block Parameter Attribute Table in the DT303 Operation & Maintenance Instructions Manual.
ITEM: the **MOUNTING_POSITION –** Configure the Mounting Position according to the sensor position:

0 =Right
1 = Reverse

After these settings, just browse the "UPDT" option and insert the magnet tool into the Span hole to update the local adjustment tree.

Transducer Block

The transducer block insulates the function block from the specific I/O hardware, such as sensors, actuators. The transducer block controls the access to I/O through a manufacturer specific implementation.

By accessing the hardware, the transducer block can get data from I/O or passing control data to it. The connection between Transducer Block and Function block is called channel. These blocks can exchange data through its interface.

Normally, transducer blocks perform functions, such as linearization, characterization, temperature compensation, and data control and exchange to the hardware. For more details, see the specific manual for each Smar device.

How to Configure a Transducer Block

Each time you select a field device on the configuration tool, automatically you can see the transducer block as it appears on screen.

The transducer block has an algorithm, a set of contained parameters and a channel connecting it to a function block.

The algorithm describes the behavior of the transducer as a data transfer function between the I/O hardware and other function block. There are several parameters in the Function Block. They can be divided into Standard and Manufacturer Specific.

The standard parameters are available for such class of instruments as pressure, temperature actuator devices, etc., whatever the manufacturer. Oppositely, the manufacturer specific ones are defined only by their manufacturer. Common manufacturer specific parameters are calibration settings, materials information, linearization curve, etc.

When you perform a standard routine as a calibration, you are guided step by step by a method. The method is generally defined as guideline to help the user to make common tasks. The configuration tool, for example the Simatic PDM, identifies each method associated to the parameters and enables the interface to it.

Channels

The channel number is the one who references a value that is sent through internal transducer to the Function Block (FB)

The Analog Input, Analog Output and Totalizer function blocks are connected to the transducer block through the CHANNEL.

The CHANNEL is an unsigned 16 parameter and its value is represented by a pointer on the related transducer block and its parameter. It consists of 2 elements

- There are one TransducerID (First Byte) as the first transducer, two for the second, etc. depending on the directory order).
- The Relative Index of the used Transducer Block parameter (Second Byte).

Optionally, the channel may be disconnected having its value set on zero (0x00).

Channel of Input function blocks

Typically, a transmitter device transducer block has three parameters that can be connected to the input function block (AI and TOT): Primary Value (PV), Secondary Value 1 (SV1) and Secondary Value 2 (SV2).

The function blocks connected to the transducer may be connected with each one of these outputs. Although it depends on the device and the FB, there are some rules described below:

- Each channel (Transducer ID and Relative Index) can be connected only once on the device.
- The Totalizer block can be configured only with the PV parameter.
- The Relative index of the transducer output parameters (PV, SV1, SV2) changes for each device type.

Channel of Output function blocks

The Transducer of an Actuator device has only one reference parameter, and the Relative Index of the related Function block channel parameter shall be 0 (zero).

The AO block has two channel one to connect the AO to the transducer (AO → TRD), OUT_CHANNEL, where the AO block sends the calculate value to the transducer. The other is utilized to connect the TRD to the AO (TRD → AO), IN_CHANNEL, where the transducer sends the actual position to the readback parameter of the analog output block. But Smar devices do not need 2 channels, and then it is recommended both channels to be used with the same value.

Example Using the Channel

Configuring the channel of the LD303:

Considering the LD303 that has one transducer and 2 function blocks: 1 AI and 1 TOT. The possible channels of this FBs could be:
There is only one transducer block then the first byte is 1.

The TOT block must be configured with the PV parameter. Then the second byte of the channel needs to be PV. (in the LD303 device the transducer PV has the relative index 18(0x12)) .

As each channel can be connected only once to the device, for the AI block the second byte of the channel may be SV1 or SV2 (Relative index of SV1 = 29 (0x1D), Relative index of SV1 = 31(0x1F)).

The channel of the AI and TOT block would be:
AI.Channel = 0x011D (if the transducer output was SV1, or 0x011F if the output was SV2)
TOT.Channel = 0x0112 (PV output).

Configuring the channel of the FI303:

Considering the FI303 that has 3 transducers and 3 AO function blocks. The possible channels for these FBs could be:
There are 3 transducers then the first byte can be 1 (for the first transducer), 2 (for the second), 3 (for the third).
The second byte to the actuator device is always zero (0).

The channel of the AO blocks would be:
AO1.Channel = 0x0100 (first AO configured with the first transducer)
AO2.Channel = 0x0200 (second AO configured with the second transducer)
AO3.Channel = 0x0300 (Third AO configured with the third transducer)

Calibration

This is a specific method to make the calibration operation. It is necessary to match the source of reference applied to or connected to the device with the required value.
Some parameters should be used to configure this process: CAL_POINT_HI, CAL_POINT_LO, CAL_MIN_SPAN, SENSOR_HI_LIM, SENSOR_LO_LIM and SENSOR_UNIT. Those parameters define the highest and lowest calibrated values for each device, the minimum allowable span value for calibration (if necessary) and the engineering unit selected for calibration purposes.

When we have final control devices, like positioners, Profibus-PA to current or pressure converters, the generated value has to make the correction during the calibration process. This parameter is called FEEDBACK_CAL.

In general, the calibration process can be seen at the Figure 3.13.

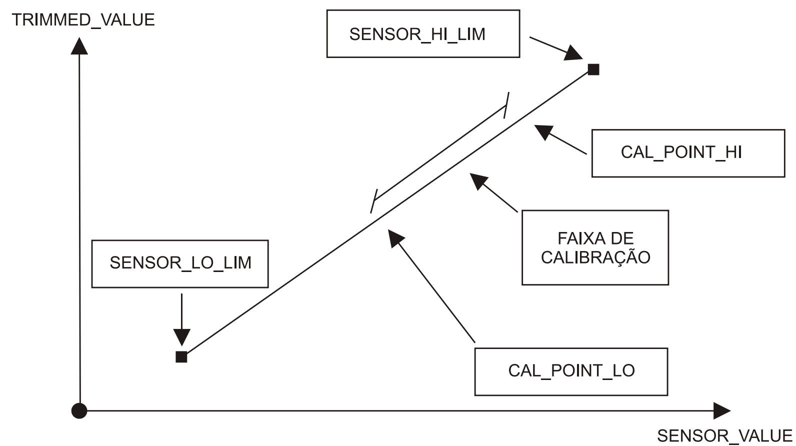


Figure 3.13 - Sensor Calibration

Diagnostics

Since the transducer block is intimately attached to the I/O hardware, it has access to a lot of information about hardware status, sensor connections, control circuit by feedback action, non-volatile burned memory, Automatic Zero Failed, etc.

Another status from Transducer block configuration as Excess Correction, Under Span Minimum Allowed, Applied Process out of Range, Calibration Failed, etc, can be received after certain operations.

Cyclic Data

Function block outputs and inputs may be set to cyclic data exchange, like a “link” between two parameters in different devices. The cyclic data exchange indicates that an input parameter of one function block obtains its value from specific output parameters of another function block in other device cyclically.

In general, a transmitter or actuator function block do cyclic data exchange with the controller device (for instance, a PLC). Typically, the transmitter gets the data from the sensor and the controller device receives this data, makes some calculation and sends information to the actuator that gets the data and takes some actions in the process.

To transfer the data for a function block, the communication channel must be known, that provides the transfer of parameter data (and other types of data) between applications.

We have the following definition of modules and blocks for each Smar device:

- **LD303**: The GSD file (smar0895.gsd) define 2 modules for this device: The first one for the Analog Input and secondly for the Totalizer.

It means that the LD303 has two main Function Blocks available, the Analog Input Block and the Totalizer Block, in this order. So the configuration of the cyclic reading when you are NOT using the Totalizer should be the following: Analog Input (0x94) and empty module (0x00) respectively.

However, if you are using the Totalizer, the LD303 still needs two modules. So the configuration of cyclic reading when you are using the Totalizer block for flow integration should be the following: Analog Input (0x94) and Totalizer (0x41 0x84 0x85) respectively.

Look at the table 3-3, ***Definition of the Buffer Order for Cyclic Data Reading,*** where this order is described in detail.

- **TP303:** The GSD file (smar0904.gsd) defines 2 modules for this device: 1 for Analog Input and 1 for Totalizer.

- **TT303:** The GSD file (smar089A.gsd) defines 2 modules for this device: They are two (2) modules for Analog Input Block.

It means that the TT303 has two (2) Analog Input blocks. Usually, it is necessary to use only one AI block for temperature measuring. In the case of two (2) different sensors, the two (2) Analog Input blocks should be used. Consequently, you will have two independent temperature measurements, one per channel.

The specific document for TT303 describes the configuration of necessary parameters and shows the connection diagram for different type of sensors. Take a look at this diagram in the document mentioned above and identify your case. The only cases where two (2) Analog Input blocks should be used are the last two ones in this diagram.

If you configured only one sensor, it is necessary to configure two modules, one for the Analog Input 1 (0x94) and other module empty (0x00) respectively.

However, if you configured the TT303 for two independent measurements, you will configure two modules, one for the Analog Input 1 and another for the Analog Input 2.

So it is very important to know that even if you are using only one sensor, you always need to configure two modules for cyclic reading by the Master DP.

Look at the table 3.3 where this order is described in detail.

- **IF303:** The GSD file (smar0896.gsd) define 6 modules for this device: 3 modules for Analog Input and 3 for Totalizer (One AI and one TOT function block for each terminal).

- **FY303:** The GSD file (smar0897 .gsd) define 1module for this device: 1 module for Analog Output.

- **FP303:** The GSD file (smar0898 .gsd) define 1module for this device: 1 module for Analog Output.

- **FI303:** The GSD file (smar0899.gsd) define 3 modules for this device: 3 modules for Analog Output (One AI block for each terminal).

- **LD293:** The GSD file (smar0906.gsd) define 1 module for this device; the module for analog Input block.

- **DT303**: The GSD file (smar0905.gsd) define 1 module for this device; the module for analog Input block.

- **DT303 (firmaware version ≥ 2.00)**: The GSD file (smar0905a.gsd) define 3 modules for this device: 3 modules for Analog Input (AI1: Concentration; AI2: Density (kg/cm³); AI3: Temperature).

The next table shows the available function blocks, the order in cyclic data, the number of necessary modules and the default address for each Smar device.

Devices	Function Blocks Available for each device			Cyclic data order						Number of Necessary Modules	Default Adress (Temporary)
	AI	AO	TOT	1	2	3	4	5	6		
LD303	1	-	1	AI	TOT	-	-	-	-	2	126
TP303	1	-	1	AI	TOT	-	-	-	-	2	126
TT303	2	-	-	AI	AI	-	-	-	-	2	126
IF303	3	-	3	AI	AI	AI	TOT	TOT	TOT	6	126
FY303	-	1	-	AO	-	-	-	-	-	1	126
FP303	-	1	-	AO	-	-	-	-	-	1	126
FI303	-	3	-	AO	AO	AO	-	-	-	3	126
LD293	1	-	-	AI	-	-	-	-	-	1	126
DT303	1	-	-	AI	-	-	-	-	-	1	126
DT303 >= 2.00	3			AI	AI	AI				3	126

Table 3.7 - Definition of the Buffer Order for Cyclic Data Reading

NOTE
Always check the device address in case of having communication problems. As you can see in this document, the local adjustment can be used for this task. Note that even if you are NOT using all cyclic data related to each device according to the table above, you always need to configure the correct number of modules for cyclic reading. If necessary, set the unused empty modules. For example, the LD303 has two (2) modules, so if you just need the Analog Input cyclic data, you MUST configure two (2) modules, the first one for the Analog Input (0x94) and the second empty one (0x00) respectively, as the table above defines.

How to integrate PROFIBUS PA Smar devices into Simatic Step 7

All GSD files and Bit map files for each Smar device are provided by Smar at the device delivery. The GSD file contains information about the device and PROFIBUS DP/PA communication network.

First of all, copy the files in the work directory of Step 7. Copy the gsd file on the GSD directory and the bit map files on the Nsbmp directory.

Then, using the "install new GSD" option, in the HW-Config menu, and, finally, the "Catalog updating"option.

Get the H-W Config in the relevant project and then drag & drop the device directly on the DP master system. Pay attention to the baud rate of the PROFIBUS DP.

Using the mouse, click twice in the Smar device and you will get the cyclic options that you must configure according to your application. For example, if you have a FP303 or FY303 and your PID block generates an output and reads an input, choose RCAS_IN and RCAS_OUT). If your device has more than one block, for example, the FI303 where we have 3 Analog Output Blocks, just choose the cyclic configuration and drag & drop on the module/DP ID area in Step 7 as many times as necessary or configure empty modules. In this step, configure the input and the output addresses with the same value, but these values must be different for the modules. Pay attention to setting a good status (for example, 0xc4) when the PID output is linked to Analog Output input.

Configuration of PA Devices using COM PROFIBUS with the DP/PA Link IM157

The DP/PA link works in conjunction with the DP/PA couplers to provide the PROFIBUS DP gateway to the PA physical layer. The DP/PA couplers (up to 5) are plugged into the DP/PA Link backplane and a PA segment may be dropped from each coupler. The DP/PA Link appears to the DP master as just another DP slave that supports baud rates of up to 12 Mbits/s. The DP/PA Link (IM 157) is placed in the COM PROFIBUS configuration in exactly the same way as any other DP slave.

When the “Parameterize” button is activated, it means that the DP/PA Link has parameters that can be set by the user. One parameter indicates whether or not the user is willing to have the DP/PA Link online if the configuration does not match the PA devices on the PA bus. The other parameter is used to set the overall total length of diagnostic information that it is allowed to send to the DP master. The default of 160 bytes can be left unchanged.

The configuration of the PA devices is the next step. The DP/PA Link module appears to the DP master and to COM PROFIBUS as a “modular slave”, e.g., a device which takes plug-in modules. Each of the PA devices on any segment (up to 5) looks like a plug-in module to COM PROFIBUS as well as the DP master. The slot numbers in COM PROFIBUS correspond to the addresses assigned to the PA devices with address 3, being the lowest address which can be specified for a PA device when using the DP/PA Link module. Thus, slot 0 corresponds to PA address 3, slot 1 corresponds to PA address 4, etc. Also note that the addresses taken by the PA devices are totally separate from the DP device addresses on the DP bus. Any PA addresses that are not being used must be configured as “inactive PA address”.

As long as only “simple” PA devices are being used, i.e., those that have only 5 bytes of input data (a 32-bit Floating Point number [4 bytes] and 1 byte of status), the correspondence between the PA address and the COM PROFIBUS slot number is straightforward just add 3 to the slot number to get the PA device address.

For Complex PA devices, those that have more than one function block returning inputs to the master, the beginning and end of each device must be specified and any blocks wanted as inputs must be specified. If any input blocks are to be "skipped", each one must be specified as a "free space".

Section 4

MAINTENANCE

General

SMAR Series 303 devices are extensively tested and inspected before delivery to the end user. Nevertheless, during their design and development, consideration was given to the possibility of repairs being made by the end user, if necessary.

In general, it is recommended that end users do not try to repair printed circuit boards. Spare circuit boards may be ordered from **SMAR** whenever necessary. Refer to the item "Returning Materials" at the end of this Section.

TROUBLESHOOTING	
SYMPTOM	**PROBABLE SOURCE OF PROBLEM**
NO COMMUNICATION	***Device Connections*** _ Check wiring polarity and continuity. _ Check for shorts or ground loops. _ Check if the power supply connector is connected. _ Check if the shield is not used as a conductor. It should be grounded at only one end. - Check the coupler/link connections.
	Power Supply _ Check power supply output. The voltage must be between 9 - 32 VDC at the Series 303 device terminals.
	Network Connection _ Check that the topology is correct and all devices are connected in parallel. _ Check that two bus terminators are OK and correctly positioned. _ Check that the bus terminators are according to the specifications. _ Check length of trunk and spurs. _ Check the connections of the coupler are correct and correctly positioned. - Check the *baud rate*; - Check low isolation;
	Network Configuration _ Make sure the Device Tag is configured if system configuration is desired. _ Make sure that device address, master connection, and the address.
	Electronic Circuit Failure _ Check the main board for defect by replacing it with a spare one.

Table 4.1 - Diagnostic of the Field Devices

If the problem is not presented in the Table 4.01 follow the note below:

NOTE
The Factory Init should be tried as a last option to recover the equipment control when the equipment presents some problem related to the function blocks or the communication. **This operation must only be carried out by authorized technical personnel and with the process offline, since the equipment will be configured with standard and factory data.** This procedure resets all the configurations run on the equipment, after which a partial download should be performed. With exception to the equipment physical address and the GSD identifier number selector parameter. After doing this, all configurations must be remade according to their application. Two magnetic tools should be used to this effect, On the equipment, withdraw the nut that fixes the identification tag on the top of the housing, so that access is gained to the "S" and "Z" holes. The operations to follow are: 1) Switch off the equipment, insert the magnetic tools and keep them in the holes (the magnetic end in the holes); 2) Power up the equipment; 3) As soon as Factory Init is shown on the display, take off the tools and wait for the "5" symbol on the right upper corner of the display to unlit, thus indicating the end of the operation. This procedure makes effective the entire factory configuration and will eliminate eventual problems with the function blocks or with the equipment communication. Note that this procedure must be performed by authorized personal only and with the process switched off, since the equipment will be configured with standard and factory data.

Returning SMAR Products and/or Materials

Should it become necessary to return the transmitter and/or configurator to **SMAR**, simply contact our office, informing the defective instrument serial number, and return it to our factory.

If it becomes necessary to return the transmitter and/or configurator to Smar, simply contact our office, informing the defective instrument's serial number, and return it to our factory. In order to speed up analysis and solution of the problem, the defective item should be returned with the Service Request Form properly filled with a description of the failure observed and with as much details as possible. Other information concerning to the instrument operation, such as service and process conditions, is also helpful.

Instruments returned or to be revised outside the guarantee term should be accompanied by a purchase order or a quote request.

UNITS CODES

Value	Unit	Description	Equivalence
1000	K	Kelvin	SI
1001	°C	degree Celsius	ΔT = 1°C is equal to ΔT = 1K
1002	°F	degree Fahrenheit	
1003	°R	degree Rankine	
1004	r	radian	1 r = 1 m/m = 1
1005	°	degree	1 ° = (π/180)rad
1006	'	minute	1 ‘ = (1°/60)
1007	"	second	1 ” = (1‘/60)
1008	gon	gon (or grade)	1 gon = (π/200)rad
1009	rev	revolution	
1010	m	meter	SI
1011	km	kilometer	
1012	cm	centimeter	
1013	mm	millimeter	
1014	μm	micrometer	
1015	nm	nanometer	
1016	pm	picometer	
1017	Å	angstrom	1 Å = 10^{-10}m
1018	ft	feet	
1019	in	inch	
1020	yd	yard	
1021	mile	mile	
1022	nautical mile	nautical mile	1 nautical mile = 1852 meters
1023	m^2	square meter	
1024	km^2	square kilometer	
1025	cm^2	square centimeter	
1026	dm^2	square decimeter	
1027	mm^2	square millimeter	
1028	a	are	1 a = 10^2 m^2
1029	ha	hectare	1 ha = 10^4 m^2
1030	in^2	square inch	
1031	ft^2	square feet	
1032	yd^2	square yard	
1033	$mile^2$	square mile	
1034	m^3	cubic meter	
1035	dm^3	cubic decimeter	
1036	cm^3	cubic centimeter	
1037	mm^3	cubic millimeter	
1038	L	liter	1 L = 10^{-3} m^3
1039	cl	centiliter	
1040	ml	milliliter	
1041	hl	hectoliter	
1042	in^3	cubic inch	
1043	ft^3	cubic feet	
1044	yd^3	cubic yard	
1045	$mile^3$	cubic mile	
1046	pint	pint	

Value	Unit	Description	Equivalence
1047	quart	quart	
1048	gallon	US gallon	
1049	ImpGal	Imperial gallon	
1050	bushel	bushel	
1051	bbl	barrel	1 bbl = 42 US gallons
1052	bbl (liq)	barrel liquid	1 liquid bbl = 31.5 US gallons
1053	SCF	standard cubic foot	
1054	s	second	SI
1055	ks	kilosecond	
1056	ms	millisecond	
1057	μs	microsecond	
1058	min	minute	1 min = 60 s
1059	h	hour	1 h = 60 min
1060	d	day	1 d = 24 h
1061	m/s	meter per second	
1062	mm/s	millimeter per second	
1063	m/h	meter per hour	
1064	km/h	kilometer per hour	
1065	knot	knot	1 knot = 1.852 km/h
1066	in/s	inch per second	
1067	ft/s	feet per second	
1068	yd/s	yard per second	
1069	in/min	inch per minute	
1070	ft/min	feet per minute	
1071	yd/min	yard per minute	
1072	in/h	inch per hour	
1073	ft/h	feet per hour	
1074	yd/h	yard per hour	
1075	MPH	miles per hour	
1076	m/s^2	meter per second per second	
1077	Hz	hertz	1 Hz = 1 s^{-1}
1078	THz	terahertz	
1079	GHz	gigahertz	
1080	MHz	megahertz	
1081	kHz	kilohertz	
1082	1/s	per second	
1083	1/min	per minute	
1084	rev/s	revolutions per second	
1085	RPM	revolutions per minute	
1086	r/s	radian per second	
1087	$1/s^2$	per second per second	
1088	kg	kilogram	SI
1089	g	gram	
1090	mg	milligram	
1091	Mg	megagram	
1092	t	metric ton	1 t = 10^3kg
1093	oz	ounce	
1094	lb	pound (mass)	
1095	STon	short ton	1 short ton = 2000 pounds
1096	LTon	long ton	1 long ton = 2240 pounds
1097	kg/m^3	kilograms per cubic meter	

Value	Unit	Description	Equivalence
1098	Mg/m^3	megagrams per cubic meter	
1099	kg/dm^3	kilograms per decimeter	
1100	g/cm^3	grams per cubic centimeter	
1101	g/m^3	grams per cubic meter	
1102	t/m^3	metric tons per cubic meter	
1103	kg/L	kilograms per liter	
1104	g/ml	grams per milliliter	
1105	g/L	grams per liter	
1106	lb/in^3	pounds per cubic inch	
1107	lb/ft^3	pounds per cubic foot	
1108	lb/gal	pounds per US gallon	
1109	$STon/yd^3$	short tons per cubic yard	1 STon = 2000 pounds
1110	degTwad	degrees Twaddell	
1111	degBaum hv	degrees Baume heavy	
1112	degBaum lt	degrees Baume light	
1113	degAPI	degrees API	
1114	SGU	specific gravity units	
1115	kg/m	kilograms per meter	
1116	mg/m	milligrams per meter	
1117	tex	tex	1 tex = 10^{-6}kg/m = 1 g/km
1118	$kg\text{-}m^2$	kilogram square meter	
1119	kg-m/s	kilogram meter per second	
1120	N	newton	1 N = 1 $kg\text{-}m/s^2$
1121	MN	meganewton	
1122	kN	kilonewton	
1123	mN	millinewton	
1124	µN	micronewton	
1125	$kg\text{-}m^2/s$	kilogram square meter per second	
1126	N-m	newton meter	
1127	MN-m	meganewton meter	
1128	kN-m	kilonewton meter	
1129	mN-m	millinewton meter	
1130	Pa	pascal	1 Pa = 1 N/m^2
1131	GPa	gigapascal	
1132	MPa	megapascal	
1133	kPa	kilopascal	
1134	mPa	millipascal	
1135	µPa	micropascal	
1136	hPa	hectopascal	
1137	bar	bar	1 bar = 100 kPa
1138	mbar	millibar	1 mbar = 1 hPa
1139	torr	torr	
1140	atm	atmospheres	
1141	psi	pounds per square inch	unreferenced or differential pressure
1142	psia	ponds per square inch absolute	referenced to a vacuum
1143	psig	pounds per square inch guage	referenced to atmosphere
1144	g/cm^2	gram per square centimeter	
1145	kg/cm^2	kilogram per square centimeter	
1146	inH2O	inches of water	
1147	inH2O (4°C)	inches of water at 4°C	
1148	inH2O (68°F)	inches of water at 68°F	

Value	Unit	Description	Equivalence
1149	mmH2O	millimeters of water	
1150	mmH2O (4°C)	millimeters of water at 4°C	
1151	mmH2O (68°F)	millimeters of water at 68°F	
1152	ftH2O	feet of water	
1153	ftH2O (4°C)	feet of water at 4°C	
1154	ftH2O (68°F)	feet of water at 68°F	
1155	inHg	inches of mercury	
1156	inHg (0°C)	inches of mercury at 0°C	
1157	mmHg	millimeters of mercury	
1158	mmHg (0°C)	millimeters of mercury at 0°C	
1159	Pa-s	Pascal second	
1160	m^2/s	square meter per second	
1161	P	poise	
1162	cP	centipoise	1 cP = 1 mPa-s
1163	St	stokes	
1164	cSt	centistokes	1 cSt = 1 mm^2/s
1165	N/m	newton per meter	
1166	mN/m	millinewton per meter	
1167	J	joule	1 J = 1 N-m
1168	EJ	exajoules	
1169	PJ	petajoules	
1170	TJ	terajoules	
1171	GJ	gigajoules	
1172	MJ	megajoules	
1173	kJ	kilojoules	
1174	mJ	millijoules	
1175	WH	watt hour	1 W-h = 3.6 kJ
1176	TWH	terawatt hour	
1177	GWH	gigawatt hour	
1178	MWH	megawatt hour	
1179	KWH	kilowatt hour	
1180	cal	calorie	1 cal = 4.184 J
1181	kcal	kilocalorie	
1182	Mcal	megacalorie	
1183	Btu	British thermal unit	1 Btu = 0.2519958 kcal
1184	decatherm	decatherm	
1185	ft-lb	foot-pound	
1186	W	watt	1 W = 1 J/s
1187	TW	terawatt	
1188	GW	gigawatt	
1189	MW	megawatt	
1190	KW	kilowatt	
1191	mW	milliwatt	
1192	μW	microwatt	
1193	nW	nanowatt	
1194	pW	picowatt	
1195	Mcal/h	megacalorie per hour	
1196	MJ/h	megajoule per hour	
1197	Btu/h	British thermal unit per hour	
1198	hp	horsepower	
1199	W/(m-K)	watt per meter kelvin	

Value	Unit	Description	Equivalence
1200	$W/(m^2\text{-}K)$	watt per square meter kelvin	
1201	$m^2\text{-}K/W$	square meter kelvin per watt	
1202	J/K	joule per kelvin	
1203	kJ/K	kilojoule per kelvin	
1204	J/(kg-K)	joule per kilogram kelvin	
1205	kJ/(kg-K)	kilojoule per kilogram kelvin	
1206	J/kg	joule per kilogram	
1207	MJ/kg	megajoule per kilogram	
1208	kJ/kg	kilojoule per kilogram	
1209	A	ampere	SI
1210	kA	kiloampere	
1211	mA	milliampere	
1212	μA	microampere	
1213	nA	nanoampere	
1214	pA	picoampere	
1215	C	coulomb	1 C = 1 A-s
1216	MC	megacoulomb	
1217	kC	kilocoulomb	
1218	μC	microcoulomb	
1219	nC	nanocoulomb	
1220	pC	picocoulomb	
1221	A-h	ampere hour	1 A-h = 3.6 kC
1222	C/m^3	coulomb per cubic meter	
1223	C/mm^3	coulomb per cubic millimeter	
1224	C/cm^3	coulomb per cubic centimeter	
1225	kC/m^3	kilocoulomb per cubic meter	
1226	mC/m^3	millicoulomb per cubic meter	
1227	$\mu C/m^3$	microcoulomb per cubic meter	
1228	C/m^2	coulomb per square meter	
1229	C/mm^2	coulomb per square millimeter	
1230	C/cm^2	coulomb per square centimeter	
1231	kC/m^2	kilocoulomb per square meter	
1232	mC/m^2	millicoulomb per square meter	
1233	$\mu C/m^2$	microcoulomb per square meter	
1234	V/m	volt per meter	
1235	MV/m	megavolt per meter	
1236	kV/m	kilovolt per meter	
1237	V/cm	volt per centimeter	
1238	mV/m	millivolt per meter	
1239	μV/m	microvolt per meter	
1240	V	volt	1 V = 1 W/A
1241	MV	megavolt	
1242	KV	kilovolt	
1243	mV	millivolt	
1244	μV	microvolt	
1245	F	farad	1 F = 1 C/V
1246	mF	millifarad	
1247	μF	microfarad	
1248	nF	nanofarad	
1249	pF	picofarad	
1250	F/m	farad per meter	

Value	Unit	Description	Equivalence
1251	μF/m	microfarad per meter	
1252	nF/m	nanofarad per meter	
1253	pF/m	picofarad per meter	
1254	C-m	coulomb meter	
1255	A/m^2	ampere per square meter	
1256	MA/m^2	megampere per square meter	
1257	A/cm^2	ampere per square centimeter	
1258	kA/m^2	kiloampere per square meter	
1259	A/m	ampere per meter	
1260	kA/m	kiloampere per meter	
1261	A/cm	ampere per centimeter	
1262	T	tesla	1 T = 1 Wb/m^2
1263	mT	millitesla	
1264	μT	microtesla	
1265	nT	nanotesla	
1266	Wb	weber	1 Wb = 1 V-s
1267	mWb	milliweber	
1268	Wb/m	weber per meter	
1269	kWb/m	kiloweber per meter	
1270	H	henry	1 H = 1 Wb/A
1271	mH	millihenry	
1272	μH	microhenry	
1273	nH	nanohenry	
1274	pH	picohenry	
1275	H/m	henry per meter	
1276	μH/m	microhenry per meter	
1277	nH/m	nanohenry per meter	
1278	A-m^2	ampere square meter	
1279	N-m^2/A	newton square meter per ampere	
1280	Wb-m	weber meter	
1281	Ohm	Ohm	1 Ω = 1 V/A
1282	GOhm	gigaOhm	
1283	MOhm	megaOhm	
1284	kOhm	kiloOhm	
1285	mOhm	milliOhm	
1286	μOhm	microOhm	
1287	S	siemens	1 S = 1 Ω^{-1}
1288	kS	kilosiemens	
1289	mS	millisiemens	
1290	μS	microsiemens	
1291	Ohm-m	Ohm meter	
1292	GOhm-m	gigaOhm meter	
1293	MOhm-m	megaOhm meter	
1294	kOhm-m	kiloOhm meter	
1295	Ohm-cm	Ohm centimeter	
1296	mOhm-m	milliOhm meter	
1297	μOhm-m	microOhm meter	
1298	nOhm-m	nanoOhm meter	
1299	S/m	siemens per meter	
1300	MS/m	megasiemens per meter	
1301	kS/m	kilosiemens per meter	

Value	Unit	Description	Equivalence
1302	mS/cm	millisiemens per centimeter	
1303	µS/mm	micorsiemens per millimeter	
1304	1/H	per henry	
1305	sr	steradian	1 sr = 1 m^2/m^2 = 1
1306	W/sr	watt per steradian	
1307	W/(sr-m^2)	watt per steradian square meter	
1308	W/(m^2)	watt per square meter	
1309	lm	lumen	1 lm = 1 cd-sr
1310	lm-s	lumen second	
1311	lm-h	lumen hour	1 lm-h = 3600 lm-s
1312	lm/m^2	lumen per square meter	
1313	lm/W	lumen per watt	
1314	lx	lux	1 lx = 1 lm/m^2
1315	lx-s	lux second	
1316	cd	candela	SI
1317	cd/m^2	candela per square meter	
1318	g/s	gram per second	
1319	g/min	gram per minute	
1320	g/h	gram per hour	
1321	g/d	gram per day	
1322	kg/s	kilogram per second	
1323	kg/min	kilogram per minute	
1324	kg/h	kilogram per hour	
1325	kg/d	kilogram per day	
1326	t/s	metric ton per second	1 t = 10^3 kg
1327	t/min	metric ton per minute	
1328	t/h	metric ton per hour	
1329	t/d	metric ton per day	
1330	lb/s	pound per second	
1331	lb/min	pound per minute	
1332	lb/h	pound per hour	
1333	lb/d	pound per day	
1334	STon/s	short ton per second	1 STon = 2000 pounds
1335	STon/min	short ton per minute	
1336	STon/h	short ton per hour	
1337	STon/d	short ton per day	
1338	LTon/s	long ton per second	1 LTon = 2240 pounds
1339	LTon/min	long ton per minute	
1340	LTon/h	long ton per hour	
1341	LTon/d	long ton per day	
1342	%	percent	
1343	% sol/wt	percent solids per weight	
1344	% sol/vol	percent solids per volume	
1345	% stm qual	percent steam quality	
1346	% plato	percent plato	
1347	m^3/s	cubic meter per second	
1348	m^3/min	cubic meter per minute	
1349	m^3/h	cubic meter per hour	
1350	m^3/d	cubic meter per day	
1351	L/s	liter per second	
1352	L/min	liter per minute	

Value	Unit	Description	Equivalence
1353	L/h	liter per hour	
1354	L/d	liter per day	
1355	ML/d	megaliter per day	
1356	CFS	cubic feet per second	
1357	CFM	cubic feet per minute	
1358	CFH	cubic feet per hour	
1359	ft^3/d	cubic feet per day	
1360	SCFM	standard cubic feet per minute	
1361	SCFH	standard cubic feet per hour	
1362	gal/s	US gallon per second	
1363	GPM	US gallon per minute	
1364	gal/h	US gallon per hour	
1365	gal/d	US gallon per day	
1366	Mgal/d	mega US gallon per day	
1367	ImpGal/s	Imperial gallon per second	
1368	ImpGal/min	Imperial gallon per minute	
1369	ImpGal/h	Imperial gallon per hour	
1370	ImpGal/d	Imperial gallon per day	
1371	bbl/s	barrel per second	1 bbl = 42 US gallons
1372	bbl/min	barrel per minute	
1373	bbl/h	barrel per hour	
1374	bbl/d	barrel per day	
1375	W/m^2	watt per square meter	
1376	mW/m^2	milliwatt per square meter	
1377	$\mu W/m^2$	microwatt per square meter	
1378	pW/m^2	picowatt per square meter	
1379	$Pa\text{-}s/m^3$	pascal second per cubic meter	
1380	N-s/m	newton second per meter	
1381	Pa-s/m	pascal second per meter	
1382	B	bel	
1383	dB	decibel	1 dB = 10^{-1}B
1384	mol	mole	SI
1385	kmol	kilomole	
1386	mmol	millimole	
1387	μmol	micromole	
1388	kg/mol	kilogram per mole	
1389	g/mol	gram per mole	
1390	m^3/mol	cubic meter per mole	
1391	dm^3/mol	cubic decimeter per mole	
1392	cm^3/mol	cubic centimeter per mole	
1393	L/mol	liters per mole	
1394	J/mol	joule per mole	
1395	kJ/mol	kilojoule per mole	
1396	J/(mol-K)	joule per mole kelvin	
1397	mol/m^3	mole per cubic meter	
1398	mol/dm^3	mole per cubic decimeter	
1399	mol/L	mole per liter	
1400	mol/kg	mole per kilogram	
1401	mmol/kg	millimole per kilogram	
1402	Bq	becquerel	1 Bq = $1\text{-}s^{-1}$
1403	MBq	megabecquerel	

Value	Unit	Description	Equivalence
1404	kBq	kilobequerel	
1405	Bq/kg	becquerel per kilogram	
1406	kBq/kg	kilobecquerel per kilogram	
1407	MBq/kg	megabecquerel per kilogram	
1408	Gy	gray	1 Gy = 1 J/kg
1409	mGy	milligray	
1410	rad	rad	1 rad = 10^{-2} Gy
1411	Sv	sievert	1 Sv = 1 J/kg
1412	mSv	millisievert	
1413	rem	rem	1 rem = 10^{-2} Sv
1414	C/kg	coulomb per kilogram	
1415	mC/kg	millicoulomb per kilogram	
1416	R	röntgen	1 R = 2.58 x 10^{-4} C/kg
1417	1/J-m^3		
1418	e/V-m^3		
1419	m^3/C	cubic meter per coulomb	
1420	V/K	volt per kelvin	
1421	mV/K	millivolt per kelvin	
1422	pH	pH	
1423	ppm	parts per million	
1424	ppb	parts per billion	
1425	ppt	parts per thousand	
1426	degBrix	degrees Brix	
1427	degBall	degrees Balling	
1428	proof/vol	proof per volume	
1429	proof/mass	proof per mass	
1430	lb/ImpGal	pound per Imperial gallon	
1431	kcal/s	kilocalorie per second	
1432	kcal/min	kilocalorie per minute	
1433	kcal/h	kilocalorie per hour	
1434	kcal/d	kilocalorie per day	
1435	Mcal/s	megacalorie per second	
1436	Mcal/min	megacalorie per minute	
1437	Mcal/d	megacalorie per day	
1438	kJ/s	kilojoules per second	
1439	kJ/min	kilojoules per minute	
1440	kJ/h	kilojoules per hour	
1441	kJ/d	kilojoules per day	
1442	MJ/s	megajoules per second	
1443	MJ/min	megajoules per minute	
1444	MJ/d	megajoules per day	
1445	Btu/s	British thermal units per seoncd	
1446	Btu/min	British thermal units per minute	
1447	Btu/day	British thermal units per day	
1448	μgal/s	micro US gallon per second	
1449	mgal/s	milli US gallon per second	
1450	kgal/s	kilo US gallon per second	
1451	Mgal/s	mega US gallon per second	
1452	μgal/min	micro US gallon per minute	
1453	mgal/min	milli US gallon per second	
1454	kgal/min	kilo US gallon per minute	

Value	Unit	Description	Equivalence
1455	Mgal/min	mega US gallon per minute	
1456	µgal/h	micro US gallon per hour	
1457	mgal/h	milli US gallon per hour	
1458	kgal/h	kilo US gallon per hour	
1459	Mgal/h	mega US gallon per hour	
1460	µgal/d	micro US gallon per day	
1461	mgal/d	milli US gallon per day	
1462	kgal/d	kilo US gallon per day	
1463	µImpGal/s	micro imperial gallon per second	
1464	mImpGal/s	milli imerial gallon per second	
1465	kImpGal/s	kilo imperial gallon per second	
1466	MImpGal/s	mega imperial gallon per second	
1467	µImpGal/min	micro imperial gallon per minute	
1468	mImpGal/min	milli imerial gallon per minute	
1469	kImpGal/min	kilo imperial gallon per minute	
1470	MImpGal/min	mega imperial gallon per minute	
1471	µImpGal/h	micro imperial gallon per hour	
1472	mImpGal/h	milli imerial gallon per hour	
1473	kImpGal/h	kilo imperial gallon per hour	
1474	MImpGal/h	mega imperial gallon per hour	
1475	µImpGal/d	micro imperial gallon per day	
1476	mImpGal/d	milli imerial gallon per day	
1477	kImpGal/d	kilo imperial gallon per day	
1478	MImpGal/d	mega imperial gallon per day	
1479	µbbl/s	microbarrel per second	
1480	mbbl/s	millibarrel per second	
1481	kbbl/s	kilobarrel per second	
1482	Mbbl/s	megabarrel per second	
1483	µbbl/min	microbarrel per minute	
1484	mbbl/min	millibarrel per minute	
1485	kbbl/min	kilobarrel per minute	
1486	Mbbl/min	megabarrel per minute	
1487	µbbl/h	microbarrel per hour	
1488	mbbl/h	millibarrel per hour	
1489	kbbl/h	kilobarrel per hour	
1490	Mbbl/h	megabarrel per hour	
1491	µbbl/d	microbarrel per day	
1492	mbbl/d	millibarrel per day	
1493	kbbl/d	kilobarrel per day	
1494	Mbbl/d	megabarrel per day	
1495	$\mu m^3/s$	cubic micrometer per second	
1496	mm^3/s	cubic millimeter per second	
1497	km^3/s	cubic kilometer per second	
1498	Mm^3/s	cubic megameter per second	
1499	$\mu m^3/min$	cubic micrometer per minute	
1500	mm^3/min	cubic millimeter per minute	
1501	km^3/min	cubic kilometer per minute	
1502	Mm^3/min	cubic megameter per minute	
1503	$\mu m^3/h$	cubic micrometer per hour	
1504	mm^3/h	cubic millimeter per hour	
1505	km^3/h	cubic kilometer per hour	

Value	Unit	Description	Equivalence
1506	Mm^3/h	cubic megameter per hour	
1507	$\mu m^3/d$	cubic micrometer per day	
1508	mm^3/d	cubic millimeter per day	
1509	km^3/d	cubic kilometer per day	
1510	Mm^3/d	cubic megameter per day	
1511	cm^3/s	cubic centimeter per second	
1512	cm^3/min	cubic centimeter per minute	
1513	cm^3/h	cubic centimeter per hour	
1514	cm^3/d	cubic centimeter per day	
1515	kcal/kg	kilocalorie per kilogram	
1516	Btu/lb	British thermal unit per pound	
1517	kL	kiloliter	
1518	kL/min	kiloliter per mnute	
1519	kL/h	kiloliter per hour	
1520	kL/d	kiloliter per day	
1521	vendor-specific 1521		
1522	vendor-specific 1522		
1523	vendor-specific 1523		
1524	vendor-specific 1524		
1525	vendor-specific 1525		
1526	vendor-specific 1526		
1527	vendor-specific 1527		
1528	vendor-specific 1528		
1529	vendor-specific 1529		
1530	vendor-specific 1530		
1531	vendor-specific 1531		
1532	vendor-specific 1532		
1533	vendor-specific 1533		
1534	vendor-specific 1534		
1535	vendor-specific 1535		
1536	vendor-specific 1536		
1537	vendor-specific 1537		
1538	vendor-specific 1538		
1539	vendor-specific 1539		
1540	vendor-specific 1540		
1541	vendor-specific 1541		
1542	vendor-specific 1542		
1543	vendor-specific 1543		
1544	vendor-specific 1544		
1545	vendor-specific 1545		
1546	vendor-specific 1546		
1547	vendor-specific 1547		
1548	vendor-specific 1548		
1549	vendor-specific 1549		
1550	vendor-specific1550		
1551	S/cm	Siemens per centimeter	
1552	µS/cm	Micro Siemens per centimeter	
1553	mS/m	Milli Siemens per meter	
1554	µS/m	Micro Siemens per meter	
1555	MOHM*cm	Mega Ohm times centimeter	
1556	KOHM*cm	Kilo Ohm times centimeter	

Value	Unit	Description	Equivalence
1557	Gew%		
1558	mg/l	Milli gramm per liter	
1559	μg/l	Micro gramm per Liter	
1560	%Sät		
1561	vpm		
1562	%vol	Volume percent	
1563	ml/min	Milli liter per minute	
1564	mg/dm^3	Milli gramm per cubic deci meter	
1565	mg/l	Milli gramm per Liter	
1566	mg/m^3	Milli gramm per cubic meter	
1567	Reserved		
...	...		
1994	Reserved		
1995	Textual unit definition		
1996	Not used		
1997	None		
1998	unknown		
1999	special		

Table 5.1 - Unit Codes