RD400 SERIES

4 to 20 mA & HART® and PROFIBUS PA

GUIDED WAVE RADAR TRANSMITTER

FOR CONTINUOUS LEVEL MEASUREMENT

- Based on Time Domain Reflectometry (TRD) principle
- Not affected by density and/or temperature variations
- Not affected by viscosity, gravity, vapour or gases over the process
- Easy to install and maintain
- Up to ±7 mm accuracy
- Excellent repeatability and resolution
- Supports DD, EDDL and FDT/DTM
- Volume calculation for irregular tanks
- Analog input functional blocks

CEPEL OCP-0007

FM APPROVED

HART COMMUNICATION PROTOCOL

PROFIBUS®

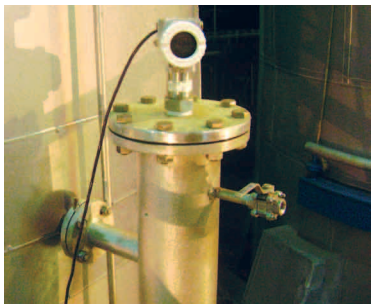
FDT

EDDL ELECTRONIC DEVICE DESCRIPTION LANGUAGE

smar

Features

- Easy to install and maintain;
- Local adjustment;
- Multifunctional rotative display;
- Sensor Threshold Level for different products;
- Supports DTM and EDDL.



HART® / 4 - 20 mA

- Zero and span local adjustment;
- HART® protocol;
- Output current with 1.6 µA resolution;
- Easy to configure by Smar CONF401 and DDCON100 for Windows.

PROFIBUS-PA

- PROFIBUS-PA protocol;
- Analog input functional block;
- 12 mA consuption;
- Integrated to Smar ProfibusView or Simatic PDM;
- Profile 3.0 improves interchangeability.

Equipment

Housing – Contain all the electronics, local adjustment, electrical connections and Liquid Crystal Display (LCD).

Isolator – Isolates the electronics from the probe, and contains the frequency generator, which emits and receives the waves that will be guided through the probe. Also allows the probe rotation, granting high tensions over it.

Probe – See figure “RD400 Probes”, page 3. The electromagnetic waves are guided through the probe - immersed into middle which level is desired.

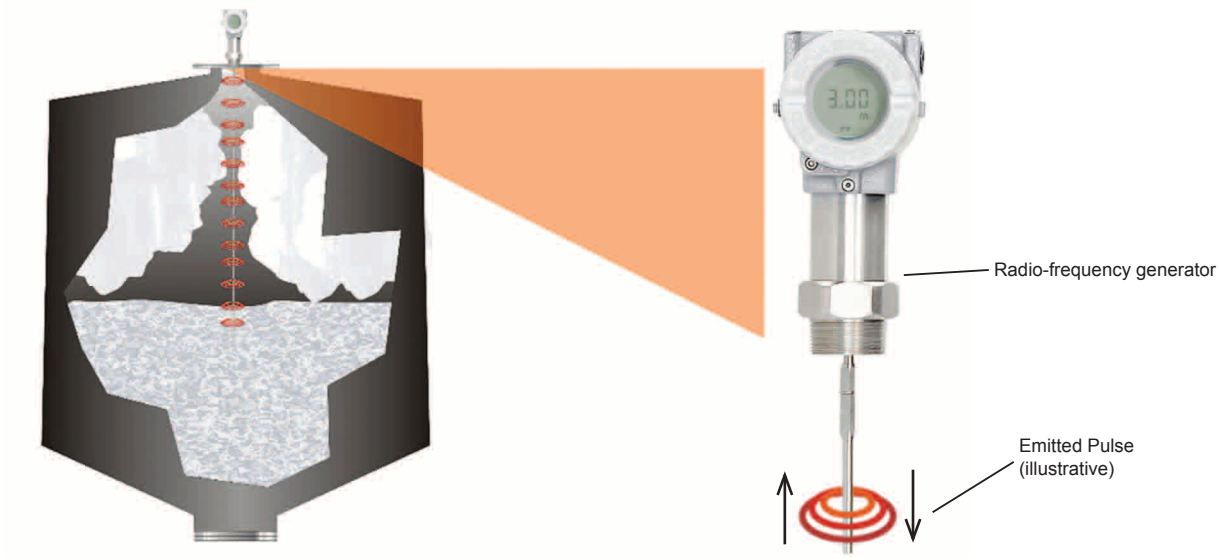
RD400 components

Smar **RD400** uses the TDR – Time Domain Reflectometry principle, usually applied on dielectric constant measurement of liquids, on fissures detection of concrete structures, concentration and humidity measurement and, among others, on direct level measurement in industrial processes.

By using a frequency generator, the equipment emits electromagnetic pulses which are guided through a probe in contact with the process.
These waves, by reaching a different environment, return through the probe because of the environment's impedance changing. This parameter has a direct relation with the dielectric constant of the process, and it will be decisive on waves reflection quality.

With a dedicated software, **RD400** calculates continuously the time between waves reflection. With waves' frequency, this software will calculate the real level desired.

The process variable, as well as monitoring and diagnostic information, are provided by digital communication protocol.The communication protocols options available are: HART® and PROFIBUS PA.



Pulses generation through Radio-frequency emitter

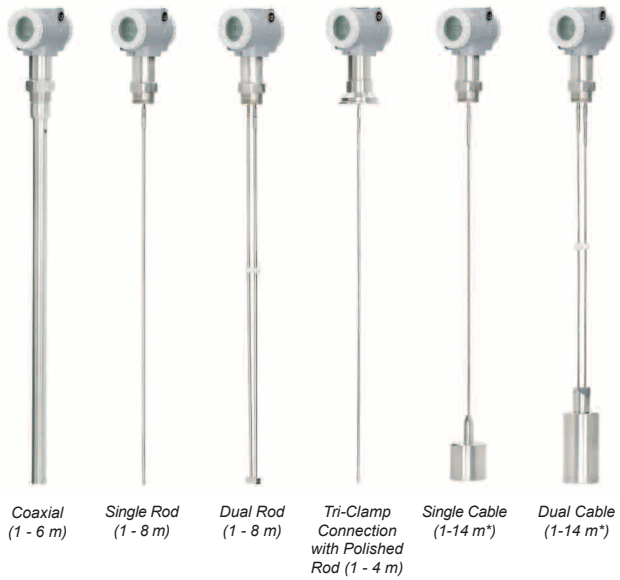
RD400 is two-wire power supplied with 4 to 20 mA/ HART® output signal. This signal is configurable by the user locally via magnetic tool and can be seen on the equipment LCD indicator, or remotely via HART® configurators.

Probes

The **RD400** uses probes as coaxial, single flexible, dual flexible, single rigid and dual rigid, allowing larger flexibility to the user depending on the application characteristics.

- **Single Rod:** for measurement range up to 8 m in process with high dielectric constant (strong water presence, for example); installation in communicating vessel; polished food installations and with tri-clamp connection.
- **Dual Rod:** for measurement range up to 8 m in process where the dielectric constant is relatively low, as products with little water presence (example:grains constantly humid).
- **Single Cable:** for bigger ranges, up to 14 m* in process with high dielectric constant (strong water presence, for example) and turbulence situations which demand more flexibility and mechanical efforts of the probe.
- **Dual Cable:** for bigger ranges, up to 14 m*, in process where the dielectric constant is relatively low.
- **Coaxial:** for measurement range up to 6 m in liquids process with dielectric constant very low (see Table from page 7), vapour, surface with high turbulence and presence of bubbles and foam.

** Probes for measurements above 14 m (up to 30 m) are available only under consult.*



RD400 Probes

Level Measurement

Levels of solids and liquids can be measured with precision in a lot of applications and temperature conditions, tanks geometry no comma etc. The main parameter for the measurement is the dielectric constant of the product (consult our team for more informations about dielectric constants).

Volume Calculation

RD400 calculates automatically volumes of typical tanks like vertical and horizontal cylinders or spherical tanks. Other tank shapes can be calculated with a strap table with a maximum of 10 points.

Probe Types

RD400 uses coaxial, single flexible, dual flexible, single rigid (polished with tri-clamp connection or not) and dual rigid, allowing larger flexibility to the user depending on the application characteristics.

Alarms

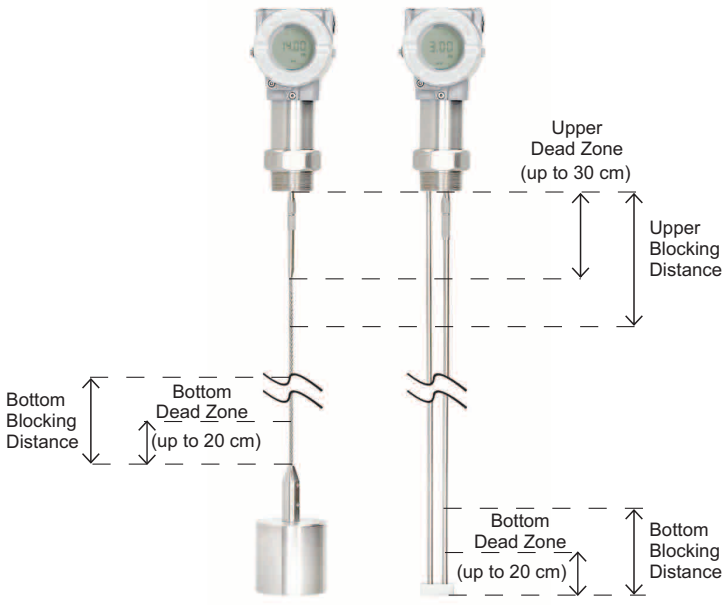
Besides the saturation alarms of output current 0 (Low) and 100% (High), the **RD400** can retains the last reads value, immediately before the equipment indicates this condition, entering in alarm mode.

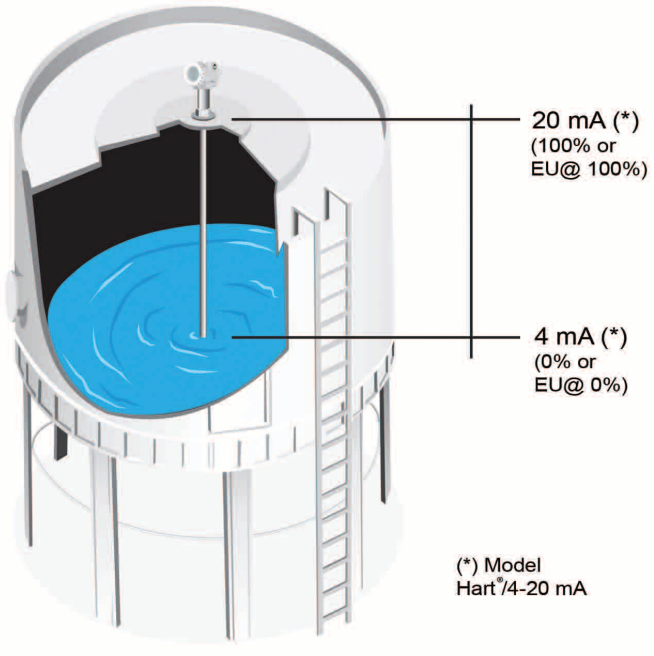
Local Adjustment

Many **RD400** parameters can be changed by using the local adjustment via magnetic tool – like range limits and tank configuration, for example.

Upper and Bottom Blocking Distances

RD400 can be configured to not consider distances at the top and at the bottom of the probe. It is very useful when internal obstacles generate noises which can interfere on the waves signal. Also, the equipment's upper (up to 50 cm) and bottom (up to 20 cm) dead zones must be considered.





The 0 and 100% points are set over the probe

RD400 measures process levels like:

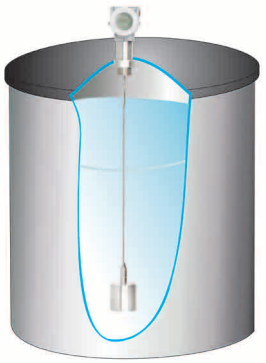
- Various powdered and granular solids;
- Semi-solids;
- Liquids based or not on water.

The measurement will basically depend on the minimum dielectric constant of the process. This measurement generally not depend on density and temperature changing, foam on the surface, agitation, viscosity, and most part of internal obstacles which usually generate false echoes to non-contact radars and ultra-sounds.

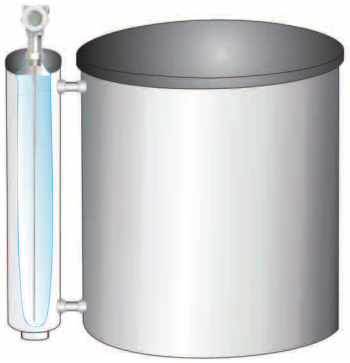
Many tanks already have sockets at their upper part, in order to install equipments or simply verify the process. RD400 can be installed at these sockets, which is an advantage, considering that the structure will not be perforated again. **RD400** installation can be done by communicating vessel or over the tank (top mounting).

In underground tanks, for example, the access to them can be unviable sometimes, so hydrostatic pressure transmitters become inapplicable. In this case, top mounting equipments are recommended.

For each process, its dielectric constant value and the type of **RD400** probe must be known to grant a better performance on the measurement.

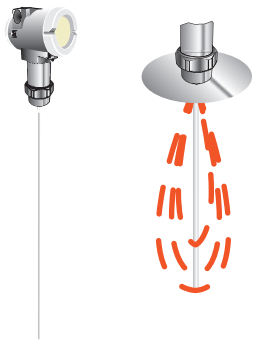


Top Mounting

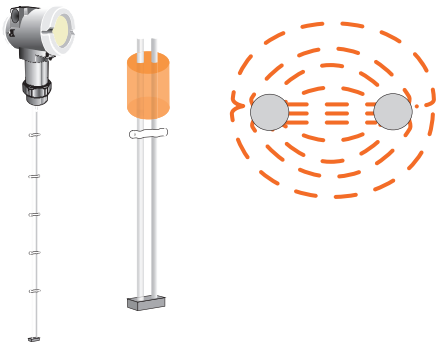


Installation in Communicating Vessel

Electromagnetic Field over each Probe



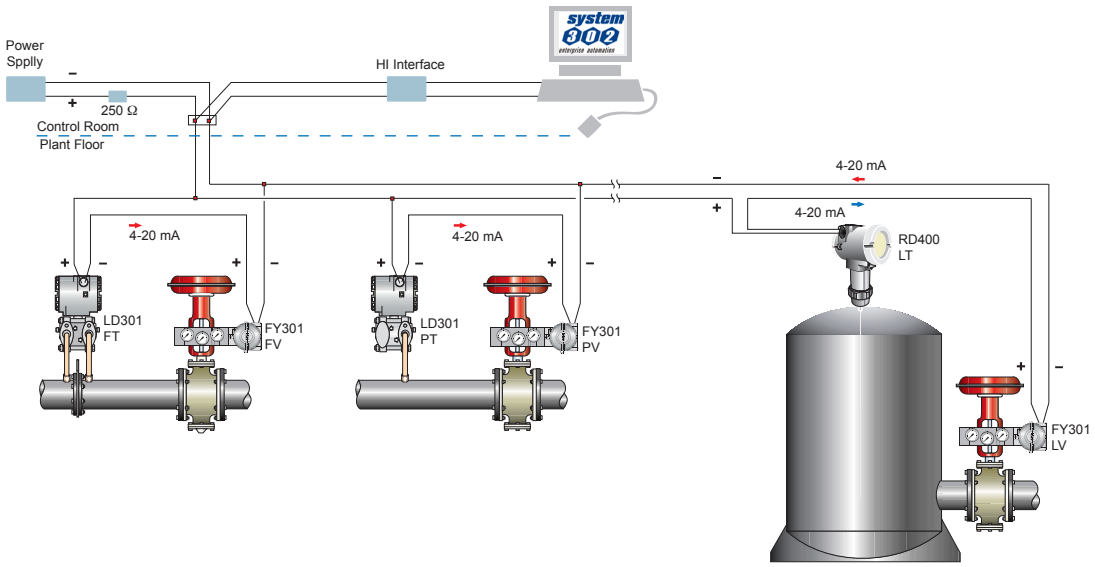
Single Probe
(with metal sheet / flange)



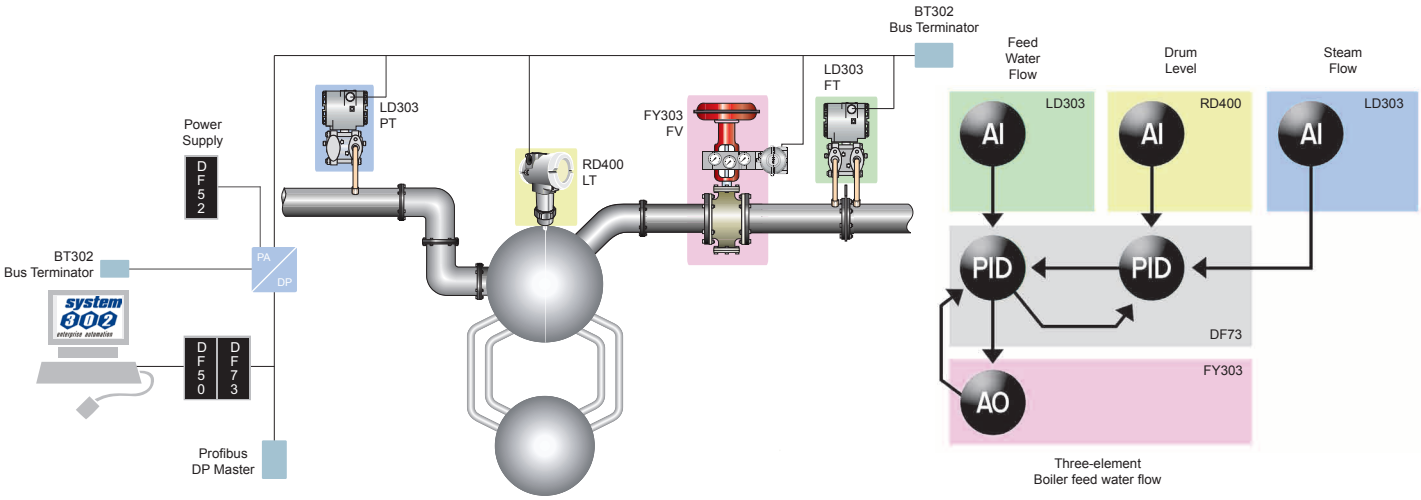
Dual Probe

Coaxial

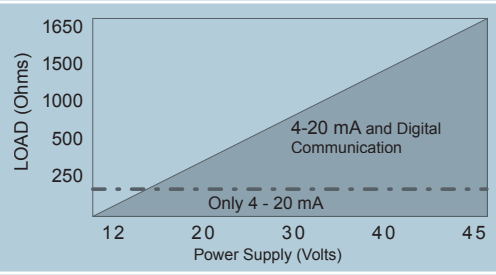
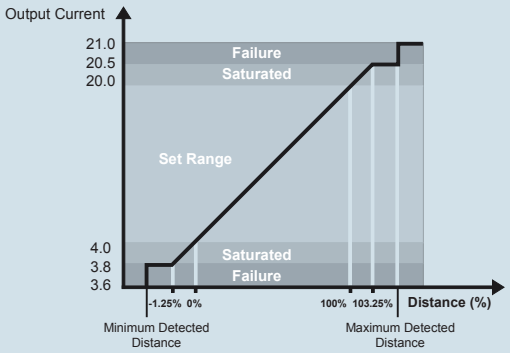
HART®



PROFIBUS-PA



Functional Specifications

Power Supply	**HART®/4-20mA:** Non-Ex Instrument: 14 – 36 Vdc **Profibus PA:** Ripple (AC Signal) — Permissible Residual <100 Hz — Uss < 1V 100 Hz – 10 kHz — Uss < 10 mV
Output	**HART®/4-20mA:** Two-wire, 4-20 mA with superimposed digital communication (HART® Protocol V5.1/ Transmitter/Poll-response mode/Common 4-20 mA). Resolution: 1.6 µA Current limit: 22 mA Load: See Figure below Turn-on Time: Aprox. 10 sec. Burnout / Failure Alarm: 3.6 or 21 mA selectable Update Time: Aprox. 1 sec. **Profibus PA:** Only digital. According with to IEC 61158-2:2000 (H1): 31.25 kbit/s, bus powered.
Indication	4 1/2 -digit numerical and 5-character alphanumerical LCD indicator (optional).
Load Limitation	
Failure Alarm (Diagnostics)	**HART®/4-20mA:** In case of sensor or circuit failure, the self-diagnostics drives the output to 3.6 or 21.0 mA, according to the user's choice and NAMUR NE43 specification. Detailed diagnostic through HART® communication.  **Profibus PA:** For faults in the sensor circuit, events are generated and the status is propagated to the output function blocks according to strategy. Detailed diagnostics available in the internal parameters of the functional blocks.
Humidity Limits	0 to 100% (Relative Humidity).

Pressure Limit

Process Pressure -1 to 40 bar

Flange ANSI B 16.5		
Class	150	300
Temperature	Limit Pressure	
-29 to 38 °C	1893 kPa (18.9 bar)	4962 kPa (49.6 bar)
93 °C	1618 kPa (16.2 bar)	4275 kPa (42.8 bar)
149 °C	1481 kPa (14.8 bar)	3864 kPa (38.6 bar)

Flange DIN EN 1092-1 / DIN 2501				
Temperature	- 10 to 50 °C	50 °C	100 °C	150 °C
PN	Limit Pressure			
16	1230 kPa (12.3 bar)	1180 kPa (11.8 bar)	1020 kPa (10.2 bar)	930 kPa (9.3 bar)
40	3060 kPa (30.6 bar)	2960 kPa (29.6 bar)	2550 kPa (25.5 bar)	2310 kPa (23.1 bar)

Tri-Clamp (TC) (Bar)		
DN	Normal Pressure	
	20 °C (68 ºF)	120 °C (248 ºF)
2"	28	17
3"	**22**	**13**

Certification

Weather proof and intrinsically safe. Tests accomplished in organs certifiers such as: CEPEL and FM.

Damping Adjustment

User configurable from 0 to 32 seconds (via digital communication).

Temperature Limit

Ambient (Housing and Electronic)	-40	to	85 °C	
	-28	to	150 °C	(Viton O-Ring)
Ambient (Probe and Internal Sealing)	-57	to	121 °C	(EPDM O-Ring)
Storage	-40	to	80 °C	
Digital Display (LCD Indicator)	-20	to	85 °C	
Transport	-40	to	80 °C	

Performance Specifications

Performance	Accuracy:	Up to ± 7 mm for rigid and flexible probes (for values within the configured measurement range)
	Temperature Drift:	Negligible
	Range:	0.5 m - 14 m* (Flexible Lead) 0.5 m - 8 m (Rigid Lead) 0.3 m - 6 m (Coaxial)
	Repeatability:	± 3 mm

Minimum Dielectric Constant (ε)

Probe	ε Minimum
Dual Rigid Lead	2.4
Dual Flexible Lead	2.5
Single Rigid Lead	3.0
Single Flexible Lead	3.0
Coaxial	1.7

Minimum Distance to Obstacles	Coaxial	0 mm
	Single Probe	200 mm
	Dual Probe	100 mm
Measurement Limits (if ε > 10)**	Single Rod Dead Zone	Top: 300 mm Bottom: 30 mm
	Dual Rod Dead Zone	Top: 300 mm Bottom: 20 mm
	Single Cable Dead Zone	Top: 300 mm Bottom: Counter weight leghth + 30 mm
	Dual Cable Dead Zone	Top: 300 mm Bottom: Counter weight leghth + 20 mm
	Coaxil Dead Zone	Top: 300 mm Bottom: 26 mm

* Probes for measurements above 14 m (up to 30 m) are available only under consult.
**If ε < 10, the bottom dead zone will be 200 mm. For values of Upper Dead Zone less than 500 mm, contact our representative.

Physical Specifications

Materials	**Wetted Parts**	
	Insulator O-Ring:	Viton, EPDM
	Probe:	316 SST
	Non-Wetted Parts	
	Housing:	Aluminum or 316 SST
	Seal Ring (Cover and Neck):	Buna-N
	LCD Window:	Polycarbonate
	Ground Terminal:	316 SST
Probes	Single Flexible Lead: 1 - 14 m*	Single Rigid Lead: 1 - 8 m Dual Rigid Lead: 1 - 8 m
	Dual Flexible Lead: 1 - 14 m*	Coaxial: 1 - 6 m
Lateral Strength	Single Rigid Lead: 3 Nm, 0.1 kg to 4 m Dual Rigid Lead: 6 Nm, 0.2 kg to 4 m	Flexible Probe Angle: 0 to 90° from vertical axis
Tension Strength	Single Flexible Lead: 9 kN (Collapse Load)	

* Probes for measurements above 14 m (up to 30 m) are available only under consult.

Ordering Code

RD400 — GUIDED WAVE RADAR LEVEL TRANSMITTER

Communication Protocol

COD.	
H	HART®
P	PROFIBUS PA

Safety Option

COD.	
0	Standard – For use in measurement and control

Process Connection

COD.	
1	1 ½ NPT for Probe Type Rigid Lead and Probe Type Flexible Lead
2	1 ½ NPT Special for Probe Type Coaxial
3	2" Tri-Clamp
4	3" Tri-Clamp

COD.		Length (meters) Max
1	Single Flexible Lead	14*
2	Dual Flexible Lead	14*
3	Single Rigid Lead	8
4	Dual Rigid Lead	8
5	Coaxial	6
6	Polished Single Rigid Lead	4

Probe Material

COD.	
I	316 Stainless Steel

Probe Length (1)

0	Up to 1 m	3	Up to 4 m	6	Up to 10 m **(13)**	Z	Specific lenght
1	Up to 2 m	4	Up to 6 m	7	Up to 12 m **(13)**		
2	Up to 3 m	5	Up to 8 m **(13)**	8	Up to 14 m* **(13)**		

Weight for Flexible Leads – Weight and Material (5)

COD.	
0	Without Weight
1	2.5 Kg in 316SST
2	2.5 Kg in Plated Carbon Steel
3	5.0 Kg in 316 SST
4	5.0 Kg in Plated Carbon Steel

O-Ring Material (Wet Part)

COD.	
E	EPDM
V	Viton

Local Indicator

COD.	
0	Without Indicator
1	With Indicator

Electrical Connection

0	1/2 – 14 NPT **(10)**	A	M20 X 1.5 **(10)**
1	3/4 – 14 NPT (with 316SST adapter for ½-14NPT) **(10)**	B	PG 13.5 DIN **(12)**
2	3/4 – 14 BSP (with 316SST adapter for ½-14NPT) **(11)**		
3	1/2 – 14 BSP (with 316SST adapter for ½-14NPT) **(11)**		

Electrical Connection Plug

COD.	
I	304 SST
C	Carbon Steel (Only available for ½" NPT process connection) **(6)**

Housing Material (8) (9)

A	Aluminum (Default) (IP/Type)	I	316 SST - CF8M (ASTM - A351) (IP/Type)
B	Aluminum for Saline Atmosphere (IPW/TypeX) **(7)**	J	316 SST for Saline Atmosphere (IPW/TypeX) **(7)**
H	Copper Free Aluminum (IPW/TypeX) **(7)**		

Painting

0	Gray Munsell N 6,5 Polyester	9	Safety Blue Epoxy – Electrostatic Painting
8	Without Painting **(2)**	C	Safety Blue Polyester – Electrostatic Painting

Certification Type

COD.	
0	Wihout Certification
I	Intrinsic Safety

Certification Body

0	Without Certification Body	1	FM	5	CEPEL

Tag Plate

COD.	
0	With Tag, when specified (Default)
1	Blank
2	User's Specification

Optional Items (3)**

COD.	
ZZ	User's Specification

RD400	-	H	0	-	1	1	I	-	1	1	B	-	0	0	I	-	A	0	0	0	0	/	*

TYPICAL MODEL

* Probes for measurements above 14 m (up to 30 m) are available only under consult.
** Leave it blank if there are no optional items.

Optional Items

LCD1 Indication (4)	Y0 - LCD1: Percentage (default) Y1 - LCD1: Current – I (mA) Y2 - LCD1: Level (Eng. Unit) Y3 - LCD1: Temperature (Eng. Unit) Y4 - LCD1: Volume (Eng. Unit) Y5 - LCD1: Length (Eng. Unit)
LCD2 Indication (4)	Y0 - LCD2: Percentage (default) Y1 - LCD2: Current – I (mA) Y2 - LCD2: Level (Eng. Unit) Y3 - LCD2: Temperature (Eng. Unit) Y4 - LCD2: Volume (Eng. Unit) Y5 - LCD2: Length (Eng. Unit)

Notes:

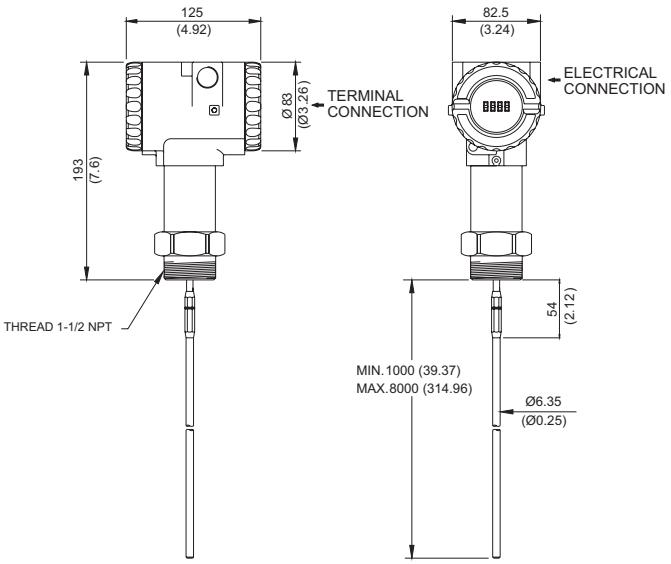
(1) It is necessary to inform the probe length in meters, respecting the limits established in the field "Probe Length (meters)" of the ordering code table, according to the chosen probe type. For example: 2 correspond to a length up to 3 meters. Order a length immediately superior to the installation and adjust the probe length at the field. For more details consult Dimensional Drawings.
(2) Not available for Aluminum Housing.
(3) See Table Items Optional Items.
(4) Only applicable with local indicator.
(5) If the probe needs to be anchored in the bottom of the tank, the RD400 can be supplied with an anchorage ring, without counter-weight.
(6) Not applicable for saline atmosphere.
(7) IPW / TypeX tested for 200 hours according to NBR 8094 / ASTM B 117 standard.
(8) IPX8 tested in 10 meters of water column for 24 hours.
(9) Ingress Protection:

Product	CEPEL	FM
RD400	IP66/68/W	Type 4X/6P IP66/68

(10) Certified for use in Explosive Atmosphere (CEPEL and FM).
(11) Options not certified for Explosive Atmosphere.
(12) Certified for use in Explosive Atmosphere (CEPEL).
(13) Not recommended with coaxial probe.

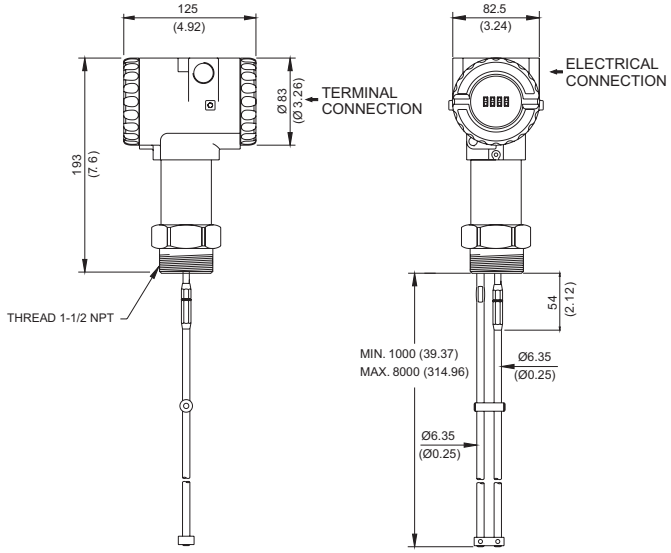
* Probes for measurements above 14 m (up to 30 m) are available only under consult

Dimensions in milimeters (inches)



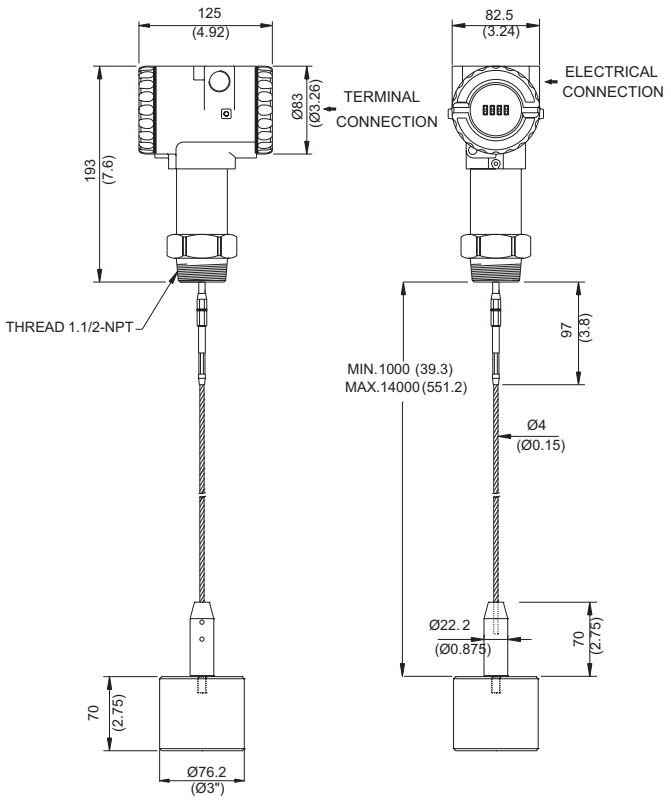
SINGLE RIGID LEAD

Dimensions in milimeters (inches)



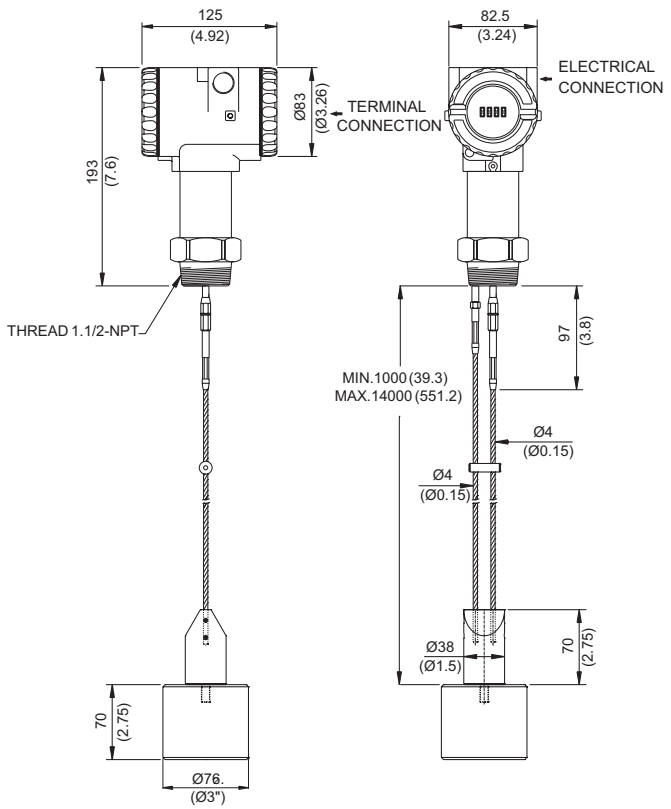
DUAL RIGID LEAD

Dimensions in milimeters (inches)



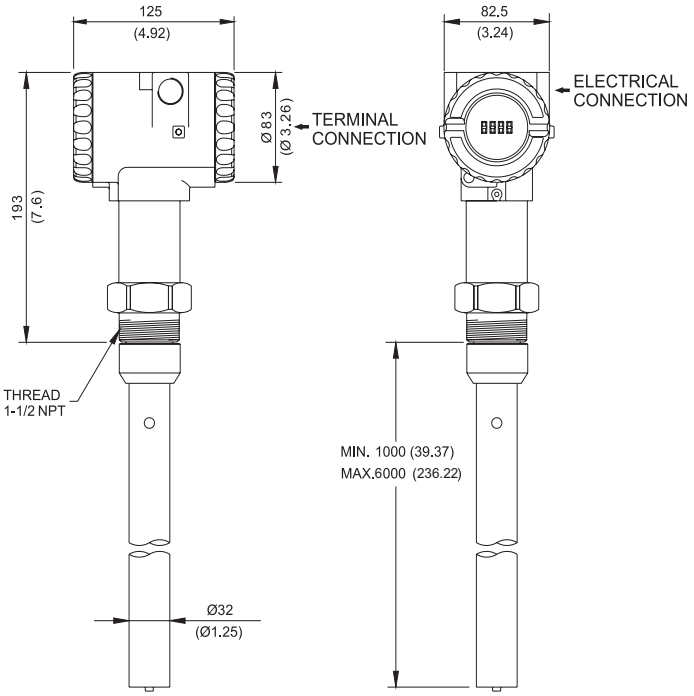
SINGLE FLEXIBLE CABLE

Dimensions in milimeters (inches)



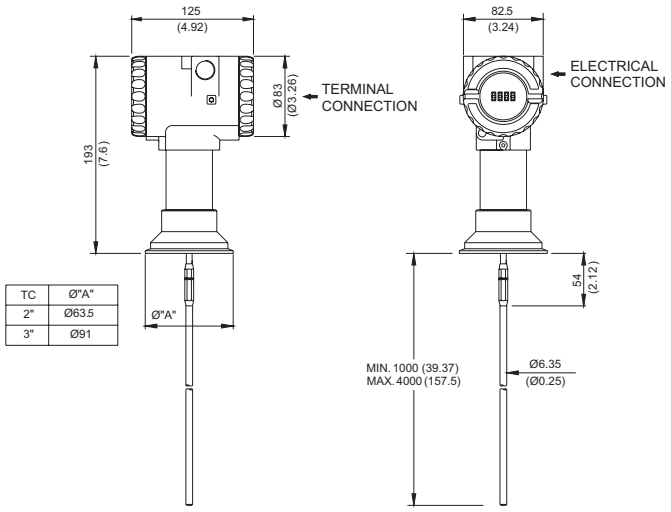
DUAL FLEXIBLE CABLE

Dimensions in milimeters (inches)



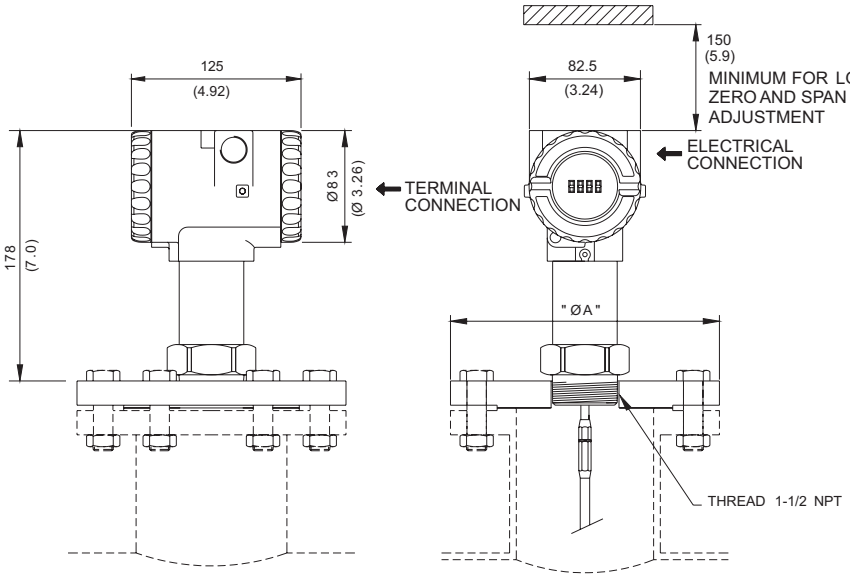
COAXIAL

Dimensions in milimeters (inches)



POLISHED SINGLE RIGID LEAD
TRI CLAMP CONNECTION

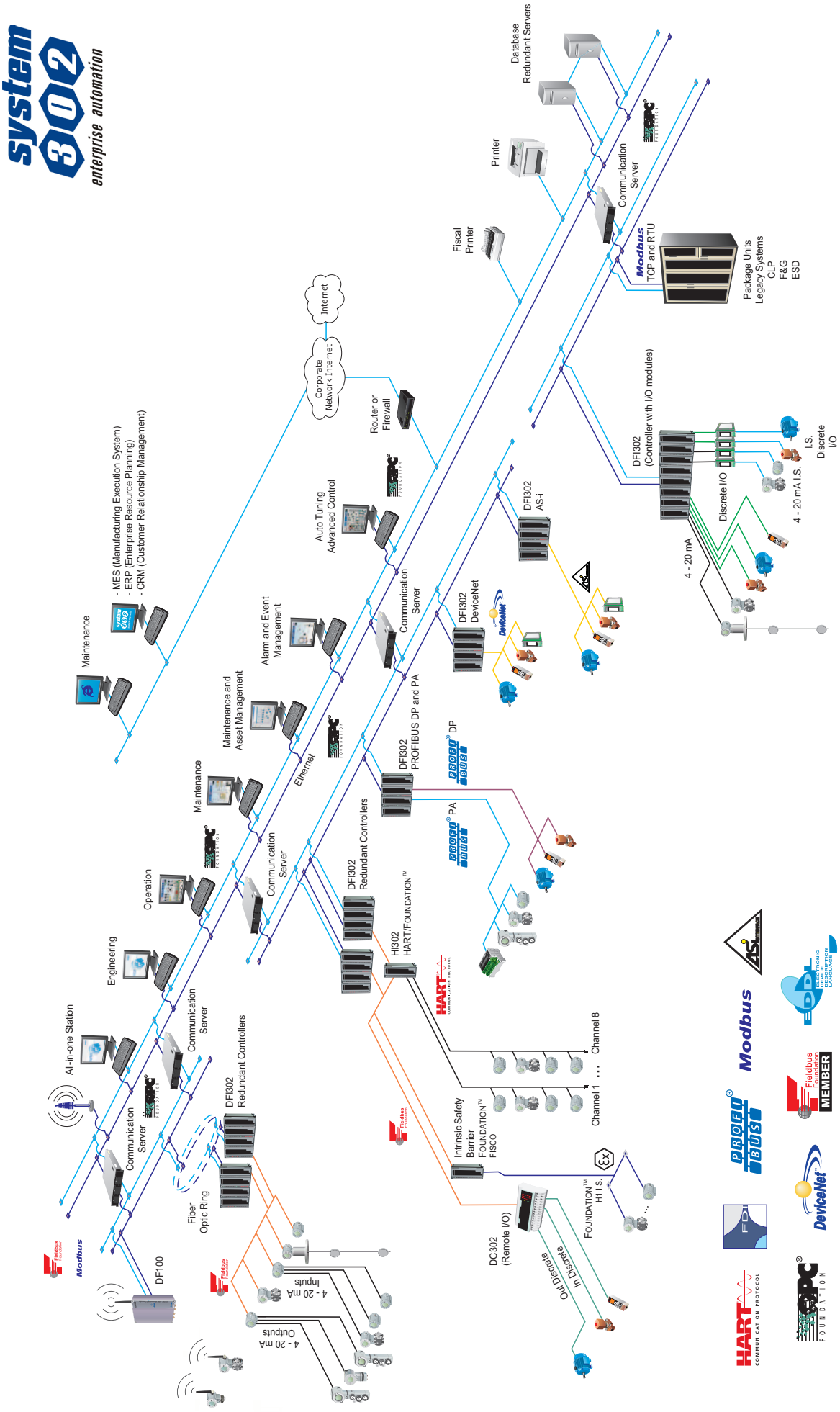
Dimensions in milimeters (inches)



ANSI-B 16.5			
DN	CLASS	"ØA"	"ØA"
2"	150 lb.	152.4	(6)
2"	300 lb.	165.1	(6.5)
3"	150 lb.	190.5	(7.5)
3"	300 lb.	209.5	(8.25)
4"	150 lb.	228.6	(9)
4"	300 lb.	254	(10)
6"	150 lb.	279.4	(11)
6"	300 lb.	318	(12.5)

DIN 2501/2528			
DN	CLASS	"ØA"	"ØA"
50	PN 10/40	165	(6.5)
80	PN 10/40	200	(7.8)
100	PN 10/16	220	(8.6)
100	PN 25/40	235	(9.25)
150	PN 16	285	(11.2)

FLANGE MOUNTING


system 302
enterprise automation
Database Redundant Servers
Printer
Communication Server
Modbus TCP and RTU
Package Units Legacy Systems CLP F&G ESD
Fiscal Printer
Internet
Corporate Network Internet
Router or Firewall
DFI302 (Controller with I/O modules)
Discrete I/O
I.S. Discrete I/O
4 - 20 mA I.S.
4 - 20 mA
DFI302 AS-i
DFI302 DeviceNet
Auto Tuning Advanced Control
Communication Server
Alarm and Event Management
Maintenance and Asset Management
Maintenance
- MES (Manufacturing Execution System)
- ERP (Enterprise Resource Planning)
- CRM (Customer Relationship Management)
Ethernet
DFI302 PROFIBUS DP and PA
DP
PA
DFI302 Redundant Controllers
HI302 HART/FOUNDATION™
Operation
Engineering
Communication Server
All-in-one Station
Communication Server
DFI302 Redundant Controllers
Fiber Optic Ring
DF100
Modbus
4 - 20 mA Inputs
4 - 20 mA Outputs
Intrinsic Safety Barrier FOUNDATION™ FISCO
Channel 1 ... Channel 8
DC302 (Remote I/O)
FOUNDATION™ H1 I.S.
Out Distance
In Distance
Modbus
DeviceNet
Fieldbus MEMBER
HART COMMUNICATION PROTOCOL
FDT

Main Smar Products

Pressure

4-20 mA LD290
HART LD291
LD292
PROFIBUS LD293

Pressure Transmitter "In Line"

HART LD1.0

Gauge Economic Capacitive Pressure Transmitter

Pressure and Level

4-20 mA LD290
HART LD291
LD292
PROFIBUS LD293

Flanged Transmitter

4-20 mA LD290
HART LD291
LD292
PROFIBUS LD293

Pressure Transmitter with Extended Probe

Pressure, Level and Flow

HART LD301
LD302
PROFIBUS LD303

Pressure Transmitter

HART LD400

Pressure Transmitter with High Performance

WirelessHART LD400

WirelessHART Pressure Transmitter

Level

RD400
HART
PROFIBUS

Guided Wave Level Transmitter

Density/Concentration

HART DT301
DT302
PROFIBUS DT303

Intelligent Density / Concentration Transmitter

Position

HART FY301
FY302
PROFIBUS FY303

Valve Positioner

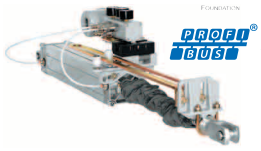
HART FY400

Valve Positioner with Auto Tuning

Position

HART FY400
HART FY301
FY302
PROFIBUS FY303

Valve Positioner with Remote Sensor



HART ACP400
HART ACP301
ACP302
PROFIBUS ACP303

Pneumatic Linear Cylindric Actuador

HART ACP400
HART ACP301
ACP302
PROFIBUS ACP303

Pneumatic Rotary Cylindric Actuador

4-20 mA TP290
HART TP301
TP302
PROFIBUS TP303

Position Transmitter

Temperature

HART TT301
TT302
PROFIBUS TT303

Temperature Transmitter

PROFIBUS TT383

Eight Input Temperature Transmitter

HART TT400 HART® SIS

Smart Temperature Transmitter

WirelessHART TT400

WirelessHART Temperature Transmitter

HART TT411

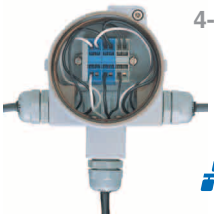
Panel Mounting Temperature Transmitter

HART TT421

Head Mouting Temperature Transmitter

Junction Box

JM1



4-20 mA

3 Ways Junction Box

JM400

4-20 mA

4 Ways Junction Box

Didactic Products

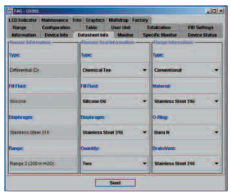
PD3

Didactic Plant

Didactical Kits

Configurators

CONF401



HART® Configurator Interface

DDCON 100

HART® Configurator Interface

HART® Configurator

Interfaces

HI311/HI321

HART-USB Interface for PC

PBI-PLUS

Advanced PROFIBUS PA Interface

Converters

FP302
FP303

FOUNDATION™ / PROFIBUS PA to Pneumatic Signal Converter

IF302
IF303

Triple Channel Current to FOUNDATION™ / PROFIBUS PA Converters

FI302
FI303

Triple Channel FOUNDATION™ / PROFIBUS PA to Current Converters

FRI302
FRI303

FOUNDATION™ / PROFIBUS PA Relay and Digital Input

HI302

HART® / Fieldbus Interface

HCC301

HART® / Current Converter

Controllers

DFI302

Interface Universal Fieldbus

LC700

Programmable Logical Controller

CD600Plus

Digital Controller

Controllers - Remote Input and Output

WirelessHART DF100

HSE Controller and
WirelessHART Gateway

DC303

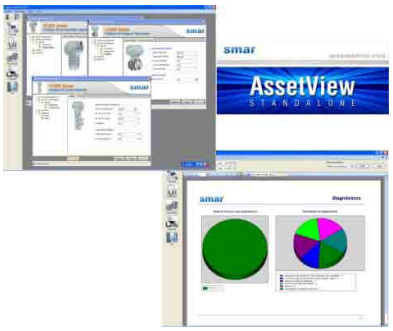
DC302

FOUNDATION™ fieldbus / PROFIBUS PA
Remote Input and Output

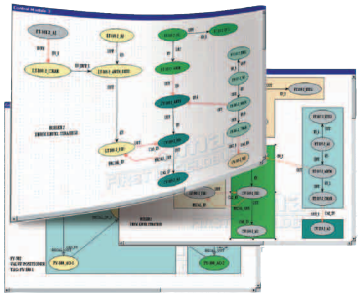
SYSTEM302

ProcessView
Supervision / Operation System

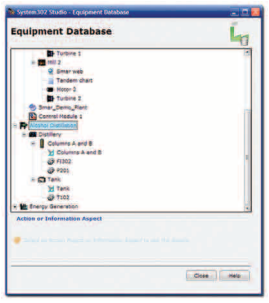
SimulationView
Control Strategy Simulator



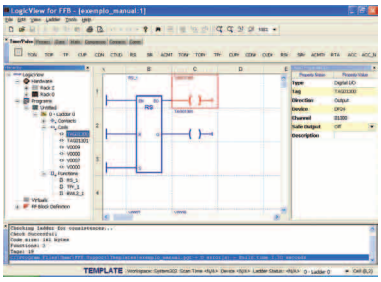
AssetView STANDALONE
Asset Management System



Syscon
Control Strategy and
Industrial Network Configurator



Process Equipment Database
Plant Information Management



LogicView for FFB
IEC61131 Programming Tool

HART COMMUNICATION PROTOCOL · FOUNDATION · PROFI BUS · DeviceNet · AS-i

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Up-to-date address information is available on our website.

web: www.smar.com/contactus.asp

TT400WHCP