Data Sheet
DS/TTF300-EN

Field mounted Temperature Transmitter TTF300

HART,
Pt100 (RTD), thermocouples,
galvanic isolation

- **Input**
  - Resistance thermometers
  - Thermocouples
  - Resistance-remote signalling unit (0 ... 5000 Ω)
  - Voltages, mV transmitter (-125 ... 1100 mV)
- **Input functionality**
  - 1 or 2 sensors (e.g. 2 x Pt100 3-L)
  - Sensor backup/redundancy
  - Sensor drift monitoring
- **Output**
  - 2-wire technique
  - 4 ... 20 mA temperature linear
  - HART signal
- **Measurement error**
  - 0,1 K
- **Specific linearization**
  - Callendar van Dusen coefficients
  - Customer specific curve / 32 tie points
- **Continuous sensor and self-monitoring**
  - Supply voltage monitoring
  - Wire break and corrosion monitoring (NE 89)
  - Extended diagnostics (NE 107)
- **Device safety in accordance with NE 53, NE 79**
- **Approvals for explosion protection**
  - intrinsically safe: ATEX EEx ia (Zone 0), FM, CSA
  - non-incendive: ATEX EEx n A
  - Dust-ignition proof: ATEX / Zone 20
  - air tight: ATEX / Zone 1, FM, CSA
- **Configuration**
  - Display with TTF300 configuration function
  - FDT/DTM
  - SMART VISION DSV401
  - EDD

HART® FIELD COMMUNICATIONS PROTOCOL

Sensor adjustment
Redundancy 2 x Pt100 3-L
Sensor drift monitoring

Contents

1 Technical data

1.1 Input

1.1.1 Resistance

RTD resistance thermometer

Pt100 in acc. with DIN IEC 60751, JIS, MIL, Ni in acc. with DIN 43760, Cu (for additional information, see the section "Measuring accuracy")

Resistance measurement

0 … 500 Ω

0 … 5000 Ω

Sensor connections

2-, 3-, 4-wire circuit

Connecting cables

2-, 3-, 4-wire max. sensor line resistance (R_W) for each wire 50 Ω in acc. with NE 89 (March 2003);

(3-wire balanced, 2-wire circuit compensation up to 100 Ω sensor total line resistance)

Measurement current

< 300 µA

Sensor short-circuit

< 5 Ω (for RTD)

Sensor wire break (temperature resistance measurement 2-, 3-, 4-wire)

Measuring range 0 ... 500 Ω	> 0.6 ... 10 kΩ
Measuring range 0 ... 5 kΩ	> 5.3 ... 10 kΩ

Corrosion detection in accordance with NAMUR NE 89

3-wire resistance reading > 50 Ω

4-wire resistance reading > 50 Ω

1.1.2 Thermocouples/Voltages

Types

B, E, J, K, L, N, R, S, T, U, C, D

(see "Measuring accuracy")

Voltages

-125 mV ... 125 mV

-125 mV ... 1100 mV

Connecting cables

Max. sensor line resistance (R_W) for each line 1.5 kΩ, total 3 kΩ

Sensor wire break monitoring in accordance with Namur NE 89

pulsed with 1 µA outside the measurement interval

Thermoelement measurement	5.3 ... 10 kΩ
Voltage measurement	5.3 ... 10 kΩ

Input resistance

> 10 MΩ

Internal reference junction

Pt100, DIN IEC 60751 Cl. B

(no jumpers necessary)

Customer specific curve, 32-tie points

Resistance measurement up to max. 5 kΩ

Voltages up to max. 1.1 V

Sensor matching

via Callendar van Dusen coefficients

via table of 32 sampling points

via single point (offset adjustment)

via two point adjustment

Input functionality

1 Sensor

2 Sensors:

mean measurement

Differential measurement: Zero point where Ia = 4 mA

Differential measurement: Zero point where Ia = 12 mA

Sensor redundancy

Sensor fault signaling

RTD sensor:	Short circuit and wire break
Linear resistance measurement:	Wire break
Thermocouple:	Wire break
Linear voltage measurement:	Wire break

1.2 Output

Transmission characteristics

temperature linear

resistance linear

voltage linear

Output signal

Configurable 4 ... 20 mA (standard)

Configurable 20 ... 4 mA

(NE43 dynamic range: 3.8 ... 20.5 mA)

Simulation mode

3.5 ... 23.6 mA

Induced current consumption

< 3.5 mA

Maximum output current

23.6 mA

Configurable error current signal

override	22 mA (20.0 … 23.6 mA)
underdrive	3.6 mA (3.5 … 4.0 mA)

Two configurable warning limits

HART-Signal/diagnostic bit information

Two configurable alarm limits

HART-Signal/diagnostic bit information

1.3 Power supply (polarity safe)

(2-wire technique; power lines = signal lines)

Supply voltage

Non ignition-proof application with or without LCD-display:

U_S = 11 ... 42 V DC

Ignition-proof applications with or without LCD-display:

U_S = 11 ... 30 V DC

Max. permissible residual ripple for supply voltage

Max. permissible ripple for supply voltage during communication in accordance with HART FSK "Physical Layer" specification, version 8.1 (08/1999) Section 8.1

Undervoltage detection

$U_{Terminal-Mu}$ < 10 V results in I_a = 3.6 mA

Max. load

R_{load} = (supply voltage: 11 V)/0.022 A

Max. load (W) depending on supply voltage (V DC)

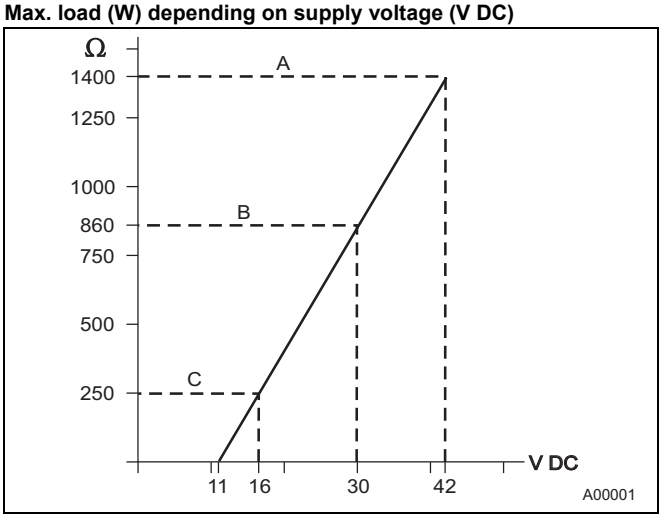

Fig. 1:

A TTF300,
B TTF300 in EEx ia design
C HART communication resistance

Max. power consumption

P = U_s x 0.022 mA

e.g., U_s = 24 V $\rightarrow$ P_{max} = 0.528 W

2 General information

Galvanic isolation (input/output)	3.5 kV AC (approx. 2.5 KV DC) 60 s
MTBF time	28 years at 60 °C ambient temperature
Input filter	50 / 60 Hz
Switch-on delay	< 10 s (I_a ≤ 3.6 mA during starting cycle)
Warm-up time	5 min.
Responce time t90	400 … 1000 ms
Output update rate[1)]	10/s with 1 sensor, 5/s with 2 sensors
Output filter	Digital filter 1st order: 0 ... 100 s

1) depending on sensor type and sensor circuit

2.1 Ambient conditions

Ambient temperature:

Standard: -40 … 85 °C / -40 … 185 °F

Optional: -50 … 85 °C / -58 … 185 °F

For use with LCD-display HMI type A:

-20 … 70 °C / -4 … 158 °F

For ignition-proof design, see prototype test certificate PTB 05 ATEX 2079 X.

Transport / storage temperature:	-40 … 85 °C / -40 … 185 °F
Climate class:	Cx (-40 … 85 °C / -40 … 185 °F, 5 … 95% relative humidity) DIN EN 60654-1
Max. permissible humidity:	100% relative humidity, condensation permitted in accordance with IEC 68-2-6
Vibration resistance*:	10 … 2000 Hz at 5 g acc. to IEC 68-2-6
Shock*:	gn = 30 in accordance with IEC 68-2-27
Earthquake resistance:	Acc. to EN1473
Salt fog:	Acc. to IEC 68-2-11
Type of protection:	IP66 and IP67; NEMA 4X, ENCL 4X

* applies to operation and transport

2.2 Electromagnetic compatibility

Emitted interference in accordance with IEC 61326 (2002) and Namur NE21 (02/2004)

2.3 Interference immunity

Interference immune in accordance with IEC 61326 (2002) and Namur NE21 (02/2004)

Pt100: Measuring range 0 ... 100 °C, span 100 K

Type of test	Testing accuracy	Influence
Burst to signal/data lines	2 kV	< 0.5%
Static discharge		
• Contact plate (indirect)	8 kV	no
• Supply terminals[1)]	6 kV	no
• Sensor terminals[1)]	4 kV	no
Radiated field 80 MHz ... 2 GHz	10 V/m	< 0.5%
Coupling 150 kHz … 80 MHz	10 V	< 0.5%
Surge		
between the lines	0.5 kV	no malfunction
Line to earth	1 kV	no malfunction

1) Air discharge (at 1 mm distance)

2.4 Measuring accuracy

Includes linearity deviation, reproducibility/hysteresis at 23 °C ± 5 K and 20 V supply voltage

Information on measuring accuracy corresponds to 3 σ (Gaussian distribution)

Input element		Measuring range limits	Minimum span	Digital measuring accuracy (24-bit A/D converter)	D/A accuracy[1] (16-bit DA)
Standard	**Sensor**				
Resistance sensors/potentiometer					
DIN IEC 60 751	RTD Pt10 (a=0,003850)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,80 °C / ± 1,44 °F	± 0,05 %
	RTD Pt50 (a=0,003850)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,16 °C / ± 0,29 °F	± 0,05 %
	RTD Pt100 (a=0,003850)[2]	**-200 ... 850 °C / -328 ... 1562 °F**	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
	RTD Pt200 (a=0,003850)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,24 °C / ± 0,43 °F	± 0,05 %
	RTD Pt500 (a=0,003850)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,16 °C / ± 0,29 °F	± 0,05 %
	RTD Pt1000 (a=0,003850)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
JIS C1604-81	RTD Pt10 (a=0,003916)	-200 ... 645 °C / -328 ... 1193 °F	10 °C / 18 °F	± 0,80 °C / ± 1,44 °F	± 0,05 %
	RTD Pt50 (a=0,003916)	-200 ... 645 °C / -328 ... 1193 °F	10 °C / 18 °F	± 0,16 °C / ± 0,29 °F	± 0,05 %
	RTD Pt100 (a=0,003916)	-200 ... 645 °C / -328 ... 1193 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
MIL-T-24388	RTD Pt10 (a=0,003920)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,80 °C / ± 1,44 °F	± 0,05 %
	RTD Pt50 (a=0,003920)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,16 °C / ± 0,29 °F	± 0,05 %
	RTD Pt100 (a=0,003920)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
	RTD Pt200 (a=0,003920)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,24 °C / ± 0,43 °F	± 0,05 %
	RTD Pt1000 (a=0,003920)	-200 ... 850 °C / -328 ... 1562 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
DIN 43760	RTD Ni50 (a=0,006180)	-60 ... 250 °C / -76 ... 482 °F	10 °C / 18 °F	± 0,16 °C / ± 0,29 °F	± 0,05 %
	RTD Ni100 (a=0,006180)	-60 ... 250 °C / -76 ... 482 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
	RTD Ni120 (a=0,006180)	-60 ... 250 °C / -76 ... 482 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
	RTD Ni1000 (a=0,006180)	-60 ... 250 °C / -76 ... 482 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
	RTD Cu10 (a=0,004270)	-50 ... 200 °C / -58 ... 392 °F	10 °C / 18 °F	± 0,80 °C / ± 1,44 °F	± 0,05 %
	RTD Cu100 (a=0,004270)	-50 ... 200 °C / -58 ... 392 °F	10 °C / 18 °F	± 0,08 °C / ± 0,14 °F	± 0,05 %
	Resistance measurement	0 ... 500 Ω	4 Ω	± 32 mΩ	± 0,05 %
	Resistance measurement	0 ... 5000 Ω	40 Ω	± 320 mΩ	± 0,05 %
Thermocouples[3]/voltages					
IEC 584	Type K (Ni10Cr-Ni5)	-270 ... 1372 °C / -454 ... 2502 °F	50 °C / 90 °F	± 0,35 °C / ± 0,63 °F	± 0,05 %
	Type J (Fe-Cu45Ni)	-210 ... 1200 °C / -346 ... 2192 °F	50 °C / 90 °F	± 0,35 °C / ± 0,63 °F	± 0,05 %
	Type N (Ni14CrSi-NiSi)	-270 ... 1300 °C / -454 ... 2372 °F	50 °C / 90 °F	± 0,35 °C / ± 0,63 °F	± 0,05 %
	Type T (Cu-Cu45Ni)	-270 ... 400 °C / -454 ... 752 °F	50 °C / 90 °F	± 0,35 °C / ± 0,63 °F	± 0,05 %
	Type E (Ni10Cr-Cu45Ni)	-270 ... 1000 °C / -454 ... 1832 °F	50 °C / 90 °F	± 0,35 °C / ± 0,63 °F	± 0,05 %
	Type R (Pt13Rh-Pt)	-50 ... 1768 °C / -58 ... 3215 °F	100 °C / 180 °F	± 0,95 °C / ± 1,71 °F	± 0,05 %
	Type S (Pt10Rh-Pt)	-50 ... 1768 °C / -58 ... 3215 °F	100 °C / 180 °F	± 0,95 °C / ± 1,71 °F	± 0,05 %
	Type B (Pt30Rh-Pt6Rh)	- 0 ... 1820 °C / +32 ... 3308 °F	100 °C / 180 °F	± 0,95 °C / ± 1,71 °F	± 0,05 %
DIN 43710	Type L (Fe-CuNi)	-200 ... 900 °C / -328 ... 1652 °F	50 °C / 90 °F	± 0,35 °C / ± 0,63 °F	± 0,05 %
	Type U (Cu-CuNi)	-200 ... 600 °C / -328 ... 1112 °F	50 °C / 90 °F	± 0,35 °C / ± 0,63 °F	± 0,05 %
ASTM E 988	Type C	- 0 ... 2315 °C / +32 ... 4200 °F	100 °C / 180 °F	± 1,35 °C / ± 2,43 °F	± 0,05 %
	Type D	- 0 ... 2315 °C / +32 ... 4200 °F	100 °C / 180 °F	± 1,35 °C / ± 2,43 °F	± 0,05 %
	Voltage measurement	-125 mV ... 125 mV	2 mV	± 12 µV	± 0,05 %
	Voltage measurement	-125 mV ... 1100 mV	20 mV	± 120 µV	± 0,05 %

[1] percentages refer to the configured measuring span
[2] Standard model
[3] include the internal reference junction error for digital accuracy: Pt100, DIN IEC 60751 Cl. B
[4] without reference junction error

Total accuracy = digital measuring accuracy [°C] + (D/A measuring accuracy [%] x I conf. measuring span [°C] I /100%)
(refer to the block diagram on next page)

Example 1:
Pt100 (IEC 60751), conf. measuring range 0 ... 100 °C, conf. measuring span = measurement end – measurement start = 100 °C
Digital measuring accuracy: ± 0,08 °C
D/A measuring accuracy ± 0.05% x (100 °C/100%) = ± 0,05 °C
Total accuracy: Digital accuracy + D/A accuracy; ± 0,08 °C + (± 0,05 °C) = ± 0,13 °C

Example 2:
Thermocouple type K, conf. measuring range 0 ... 1000 °C, conf. measuring span = measurement end – measurement start = 1000 °C
Digital measuring accuracy: ± 0,35 °C
D/A measuring accuracy ± 0.05% x (1000 °C/100%) = ± 0,50 °C
Total accuracy[4]: Digital accuracy + D/A accuracy; ± 0,35 °C + (± 0,50 °C) = ± 0,85 °C

Long-term drift
± 0.05 °C or ± 0.05%[1] per year, the larger value applies.

2.4.1 Block diagram

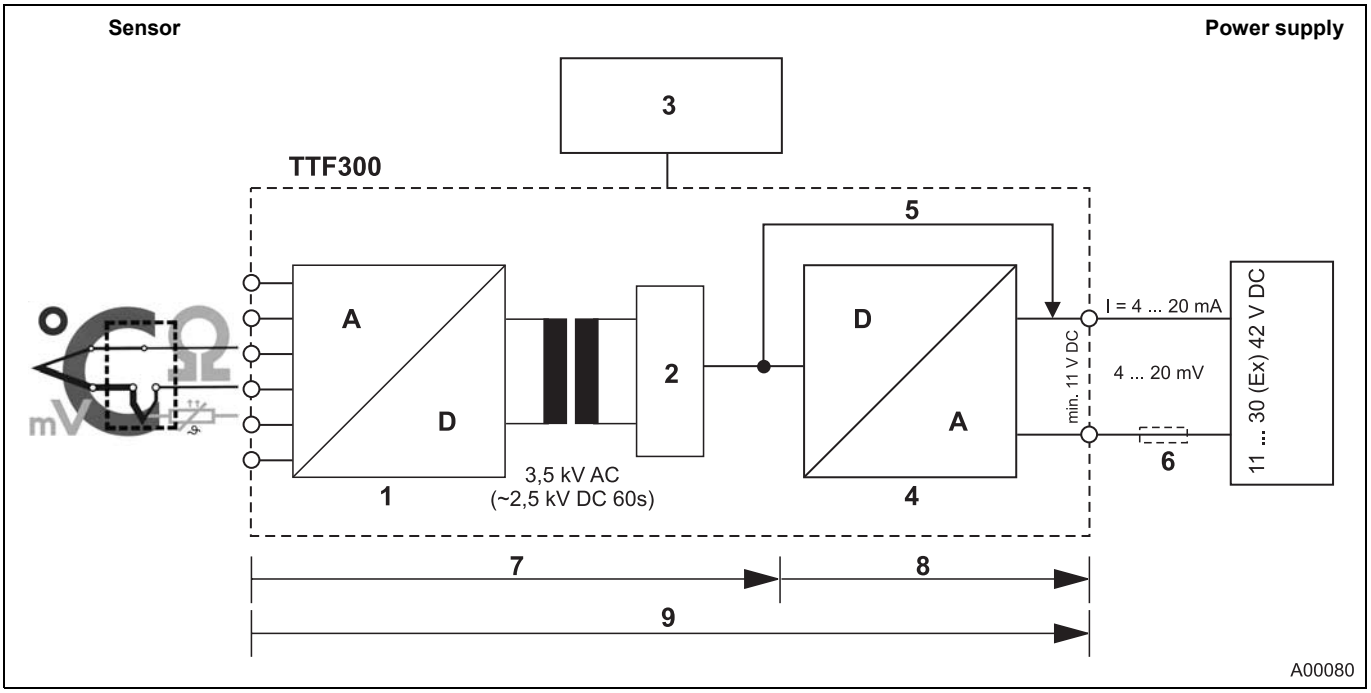

Fig. 1

1 24-bit A/D converter
2 Microcontroller
3 LCD-display with TTF300 configuration options
4 16-bit D/A converter
5 HART signal
6 Load (observe voltage drop, refer to the section "Terminal connection diagrams")
7 Digital accuracy
8 D/A accuracy
9 Overall accuracy

2.5 Operating conditions

The percentages refer to the configured measuring span.

Supply voltage influence/load influence: within the specified limits for the voltage/load the total influence is less than 0.001% per volt

Common-mode interference no influence up to 100 V Veff (50 Hz) or 50 VDC

Ambient temperature influence: based on 23 °C / 73.4 °F (ambient temperature range: -40 ... 85 °C / -40 °F ... 185 °F)

Sensor	**Ambient temperature influence For 1 °C / 1.8 °F dev. to 23 °C / 73,4 °F for digital readings**	**Ambient temperature influence[1)] For 1 °C / 1.8 °F dev. to 23 °C / 73,4 °F for D/A converter**
2-, 3-, 4-wire circuit		
RTD Pt10 IEC, JIS, MIL	± 0.04 °C / ± 0.072 °F	± 0.003 %
RTD Pt50 IEC, JIS, MIL	± 0.008 °C / ± 0.014 °F	± 0.003 %
RTD Pt100 IEC, JIS, MIL	± 0.004 °C / ± 0.007 °F	± 0.003 %
RTD Pt200 IEC, MIL	± 0.02 °C / ± 0.036 °F	± 0.003 %
RTD Pt1000 IEC, MIL	± 0.004 °C / ± 0.007 °F	± 0.003 %
RTD Ni50 DIN 43760	± 0.008 °C / ± 0.014 °F	± 0.003 %
RTD Ni100 DIN 43760	± 0.004 °C / ± 0.007 °F	± 0.003 %
RTD Ni120 DIN 43760	± 0.003 °C / ± 0.005 °F	± 0.003 %
RTD Ni1000 DIN 43760	± 0.004 °C / ± 0.007 °F	± 0.003 %
Resistance measurement 0 ... 500 Ω	± 0.002 Ω	± 0.003 %
Resistance measurement 0 ... 5000 Ω	± 0.02 Ω	± 0.003 %
Thermoelement for all defined types	± [(0.001% x (ME[mV] / MS[mV]) + (100% x (0.009 °C / MS [°C])] [1)]	± 0.003 %
Voltage measurement		
-125 ... 125 mV	± 1.5 µV	± 0.003 %
-125 ... 1100 mV	± 15 µV	± 0.003 %

[1)] percentages refer to the configured measuring span
ME - Measuring end, MS - Measuring span

Example 1
Pt100 configured measuring range 0 ... 100 °C, (measuring span 100 °C), ambient temperature 33 °C
Dev. from standard temperature: 33 ... 23 °C (reference) = 10 °C
Affect of ambient temperature on digital measurement: 10 °C x ± 0.004 °C / °C = ± 0.04 °C
Affect of ambient temperature on D/A converter: 10 °C x (± 0.003 % / °C) x (100 °C / 100 %) = ± 0.03 °C

Example 2
TC type K, conf. measuring range 0 ... 1000 °C, (measuring span 1000 °C), ambient temperature 33 °C
Measuring start 0 °C corresponds to 0.0 mV; measuring end = 1000 °C corresponds to 41.6 mV; measuring span = 1000 °C or 41.6 mV
Dev. from standard temperature: 33 ... 23 °C (reference) = 10 °C
Affect of ambient temperature on digital measurement: 10 °C x [(± 0.001% x 41.6 mV / 41.6 mV) + (100% x ± 0.009 °C / 1000°C)] x (1000°C / 100%)] / °C = ± 0.19 °C
Affect of ambient temperature on D/A converter: 10 °C x [± 0.003 % x 1000 °C / 100 %] / °C = ± 0.3 °C

Worst case total error analysis
Max. possible total error = SQR [(digital accuracy)^2 + (D/A accuracy) + (digital value temp. influence) + (D/A temp. influence)]
Example 1: Pt100, 0 ... 100°C at 33 °C ambient temperature = $\sqrt{(0.08\,°C)^2 + (0.05\,°C)^2 + (0.04\,°C)^2 + (0.03\,°C)^2} = 0.10\,°C$
Example 2: Thermoelement type K, 0 ... 1000 °C at 33 °C ambient temperature = $\sqrt{(0.35\,°C)^2 + (0.50\,°C)^2 + (0.19\,°C)^2 + (0.3\,°C)^2} = 0.70\,°C$
(without reference junction error)

3 Mechanical design

Dimensions: Refer to dimensioned drawings

Weight: 1.25 kg

- Housing: Aluminum die cast, chromized inside/outside, 70 µm epoxide-coated (aluminum with 12 % silicon, magnesium content < 0.3 %, copper-free < 0.05 %)
- Color: gray RAL9002
- Types of protection:
  IP66 and IP67; NEMA 4X, ENCL 4X

Installation conditions:

- Installation position: No limitations

Electrical connection:

- Thread (selectable) 2 x M20 x 1.5 / 2 x ½" NPT / 2 x 3/4" NPT (via reducing piece)
- with cable fitting 2 x M20 1.5:

  Polyamide/gray:

  Non ignition-proof design, nonincendive max. cable outer diameter 5 ... 9 mm, temp. range acc. to data for cable fittings (manufactured by Hummel, model 1.209.2000.51)

  Polyamide/blue:

  EEx ia design, intrinsically safe max. cable outer diameter 5 ... 9 mm, temp. range acc. to data for cable fittings (manufactured by Lapp, model 5401 7600)

  Metal cable fitting:

  dust-ignition proof, hermetically sealed, explosion-proof

  max. cable outer diameter 6 ... 7.5 mm, temp. range -20 … 90 °C / -4 … 194 °F

- Ground screw external 6 mm^2 M5 internal 2 x 2.5 mm^2 M4
- Terminals for lines up to 2.5 mm^2 and hand-held terminal interface

Lightning protection:

- **model NGV220-NO**
  Non ignition-proof lightning protection for M20 x 1.5 cable fitting (see data sheet 10/63-6.15)
- **model NGV220-Ex**
  Intrinsically safe lightning protection for M20 x 1.5 cable fitting (see data sheet 10/63-6.15)

4 Communication

HART protocol version 5

The system is registered with the HART Communication Foundation.

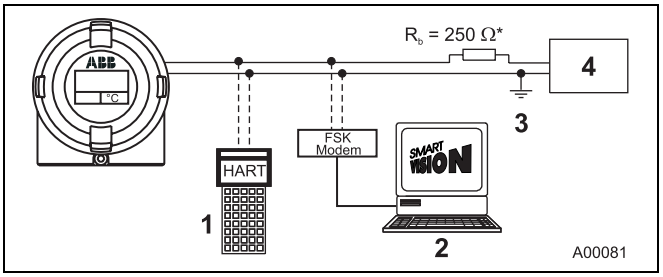

Fig. 2

* if necessary

1	DHH691 (691HT), STT04, HC275, FC375	3	Ground connection (optional)
2	FDT/DTM technology	4	Power supply (process interface)

Operating modes

- Point-to-point communication mode: standard (general address 0)
- Multidrop mode (addressing 1 ... 15)
- Burst mode

Configuration options and tools

Driver-independent:

- HMI indicator type A with configuration function

Driver-dependent:

- Device management/asset management tools
- FDT/DTM technology
- DSV401 (SMART VISION) via TTX300-DTM driver
- EDD

Configuration parameters

Measurement type

- Sensor type, connection type
- Fault signaling
- Measuring range
- General information, e.g., TAG number
- Damping
- Warning and alarm limits
- Signal simulation of output
- See "Order form configuration"

Write protection

- Software write protection via HART/indicator

Diagnostic information (NE107)

Standard

- Sensor error (wire break or short circuit)
- Device error
- Over/under alarm limits
- Over/under measuring range
- Simulation activated

Extended mode

- Redundancy/sensor backup active (in case sensor fails) with configurable analog alarm pulse signaling (see the operating instructions)
- Drift monitoring with configurable alarm pulse signaling (see the operating instructions)
- Sensor/sensor line corrosion
- Supply voltage undershoot
- Drag indicator for sensor 1, sensor 2 and ambient temperature
- Ambient temperature overshoot (> 85 °C)
- Ambient temperature undershoot (< 40°C)
- Operating hours counter

5 Explosion-protection relevant information

5.1 TTF300-E1… (intrinsically safe)

Approved for use in zone 0.

Designation:

- II 1G EEx ia IIC T6 (Zone 0)
- II 2 (1) G EEx [ia] ib IIC T6 (zone 1 [0])
- II 2 G (1D) Ex [iaD] ib IIC T6 (zone 1 [20])

Note
The Ex or ignition-proof designation is provided on the name plate.

EC prototype test certificate: Refer to PTB 05 ATEX2017 X.

Temperature table

Temperature class	Permissible ambient temperature range	
	Device category 1 use	Device category 2 use
T6	-50 … 44 °C	-50 … 56 °C
T5	-50 … 56 °C	-50 … 71 °C
T4	-50 … 84 °C	-50 … 85 °C

Safety-relevant data

Intrinsically safe EEx ia IIC explosion protection

	Supply circuit	Measurement current circuit / passive transducer (RTD)	Measurement current circuit / active transducer (RTD)	Display interface
Max. voltage	U_i = 30 V	U_o = 6,5 V	U_o = 1,2 V	U_o = 6,2 V
Short-circuit current	I_i = 130 mA	I_o = 25 mA	I_o = 50 mA	I_o = 65,2 mA
Max. power	P_i = 0,8 W	P_o = 38 mW	P_o = 60 mW	P_o = 101 mW
Internal inductance	L_i = 0,5 mH	L_i = 0 mH	L_i = 0 mH	L_i = 0 mH
Internal capacitance	C_i = 5 nF	C_i = 49 nF	C_i = 49 nF	C_i = 0 nF
Maximum permissible external inductance		L_o= 5 mH	L_o = 5 mH	L_o= 5 mH
Maximum permissible external capacitance		C_o= 1,55 µF	C_o= 1,05 µF	C_o= 1,4 µF

5.2 TTF300-E2… (nonincendive)

Approved for use in zone 2/22.

Designation:

- II 3 G EEx n A II T6
- II 3 D IP 65 T 135 °C

Note
The Ex or ignition-proof designation is provided on the name plate.

ABB statement of conformity in accordance with ATEX directive.

Temperature table

Temperature class	Permissible ambient temperature range
T6	-50 °C … 56°C
T5	-50 C … 71°C
T4	-50 C … 85 C

CSA and FM

Intrinsically Safe

FM	Class I, Div. 1 + 2, Groups A, B, C, D T6 Class II, Groups E, F, G; Class III Class I, Zone 0, AEx ia IIC T6 Product variant: TTF300-L1 Control drawing: 214832
CSA	Class I, Div. 1 + 2, Groups A, B, C, D Class II, Groups E, F, G; Class III Product variant: TTF300-R1 Control drawing: 214825

Non-incendive

FM	Class I, Div. 2, Groups A, B, C, D (Class II, Groups E, F, G; Class III Product variant: TTF300-L2 Control drawing: 214830 (IS & non-incendive) Control drawing: 214828 (non-incendive)
CSA	Class I, Div. 2, Groups A,B,C,D (Class II, Groups E, F, G; Class III Product variant: TTF300-R2 Control drawing: 214827 (IS & non-incendive) Control drawing: 214895 (non-incendive)

Dust-explosion protection:

TTF300-D1..... Dust-explosion protection

Dust / Zone 20:

Designation: "Ex mark" II 1 D IP 65 T 135°C

EC prototype test certificate BVS 06 ATEX E 029

TTF300-D2..... Dust-explosion protection + Intrinsic safety

Dust / Zone 20 + Gas / Zone 0:

Designation: "Ex mark" II 1 D IP 65 135°C
"Ex mark" II 1G EEx ia IIC T6

EC prototype test certificate BVS 06 ATEX E 029

EC prototype test certificate PTB 05 ATEX 2017 X

Flameproof

TTF300-E3….flameproof

Zone 1:

Designation: "Ex mark" II 2G EEx d IIC T6

EC prototype test certificate PTB 99 ATEX 1144

TTF300-E4….flameproof + intrinsic safety

Zone 1:

Designation: "Ex mark" II 2G EEx d IIC T6
"Ex mark" II 1G EEx ia IIC T6

EC prototype test certificate PTB 99 ATEX 1144

EC prototype test certificate PTB 05 ATEX 2017 X

Explosion-proof

TTF300-L3..... FM explosion-proof

XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed

Control drawing: TTF300-L3

TTF300-R4..... CSA explosion-proof

XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed

Control drawing: TTF300-R3

6 Approvals

6.1 TTF300

CE mark

The TTF300 meets all requirements for the CE mark in accordance with IEC 61326 (2002).

Namur

The TTF300 complies with NAMUR NE 21 (02/2004).

Ignition protection

The TTF300 meets requirements for ATEX, FM and CSA. For additional information, refer to the section "Explosion-protection relevant information").

SIL: Functional safety (optional)

acc. to IEC 61508.

Device with certificate of conformity for use in safety-relevant applications, including SIL Level 2. For additional information, refer to the safety manual for the TTH300/TTF300.

7 LCD-display

Dual function: LCD-display with TTF300 configuration options

7.1 Features of LCD-display

•Transmitter-controlled graphic (alphanumeric) LCD-display

- **Character height, mode-dependent**
- Sign, 4 digits, 2 decimal places
- Bar graph display
- Rotatable in 30° increments
- Display options:
  - Sensor 1 process data
  - Sensor 2 process data
  - Sensor 1 electrical (Ω / mV)
  - Sensor 2 electrical (Ω / mV)
  - Electronics/ambient temperature
  - Output/current
  - Output %
- Display diagnostic information related to transmitter and sensor status

7.1.1 Technical data of LCD-display

Temperature range: -20 … 70 °C
(-50 … -20 °C or 70 … 85 °C no function)
Humidity: 0 … 100 %, condensation permitted
Dimensions: see the section Dimensioned drawings

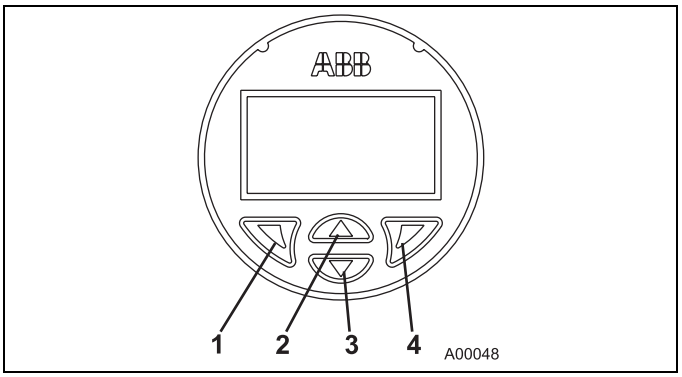

Fig. 5

1 Exit/Cancel
2 Scroll back
3 Scroll forward
4 Select

7.2 Configuration function of LCD-display

- Configurable TTF300 transmitter parameters per display:
  All parameters
  (sensor/type circuit, measuring range, error current signal, etc.)
  except: table-based sensor and freestyle characteristics, Callendar van Dusen coefficients, warning and alarm limits, drift parameters, NE107 "Maintenance required" alarm pulse signal
- Software write protection for TTF300 configuration

7.3 LCD-display HMI ignition-proof type A (intrinsically safe)

Approved for use in zone 0.

Designation:

- II 1G EEx ia IIC T6

Note
The Ex or ignition-proof designation is provided on the name plate.

EC prototype test certificate: PTB 05 ATEX 2079 X

Temperature table

Temperature class	Permissible ambient temperature range	
	Device category 1 use	Device category 2 use
T6	-40 … 44 °C	-40 … 56 °C
T5	-40 … 56 °C	-40 … 71 °C
T4	-40 … 60 °C	-40 … 85 °C

For the ambient temperature range from -50 °C to -20°C, additional mechanical protection is required.

Safety-relevant data

Intrinsically safe EEx ia IIC explosion protection

	Supply circuit
Max. voltage	U_i = 9 V
Short-circuit current	I_i = 65.2 mA
Max. power	P_i = 101 W
Internal inductance	L_i = 0 mH
Internal capacitance	C_i = 0 nF

8 Terminal connection diagrams

RTD resistance sensors

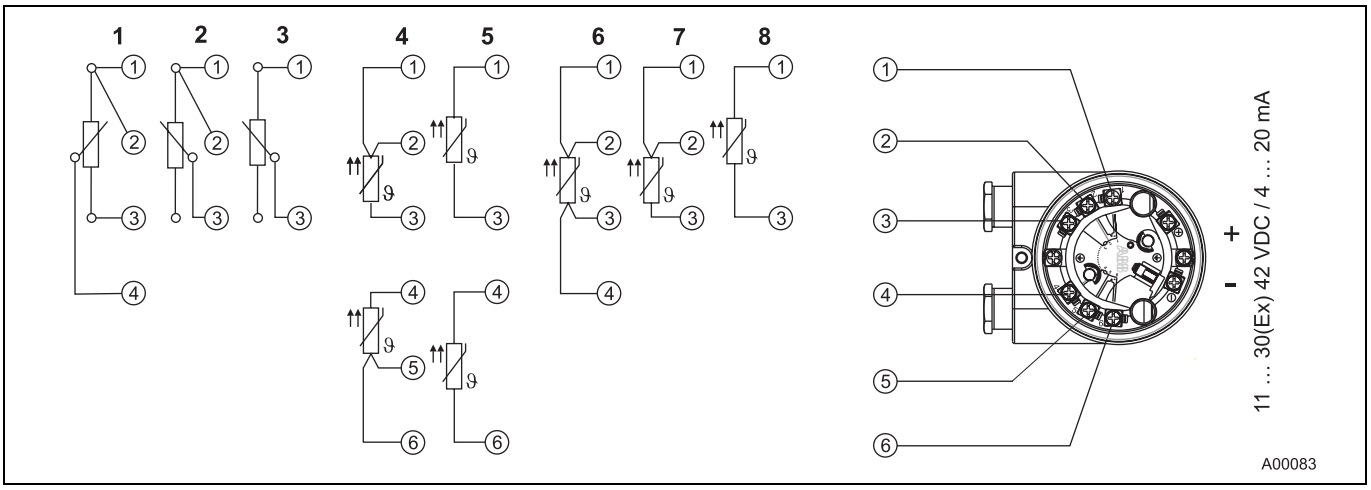

Fig. 3

Potentiometer: 0 … 500 Ω or 0 … 5000 Ω

1 Potentiometer, 4-wire circuit
2 Potentiometer, 3-wire circuit
3 Potentiometer, 2-wire circuit

4 2 x RTD, 3-wire circuit (sensor backup/redundancy, sensor drift monitoring, average value or differential temperature measurement)
5 2 x RTD, 2-wire circuit (sensor backup/redundancy, sensor drift monitoring, average value or differential temperature measurement)

6 RTD, 4-wire circuit
7 RTD, 3-wire circuit
8 RTD, 2-wire circuit

Thermocouples/Voltages

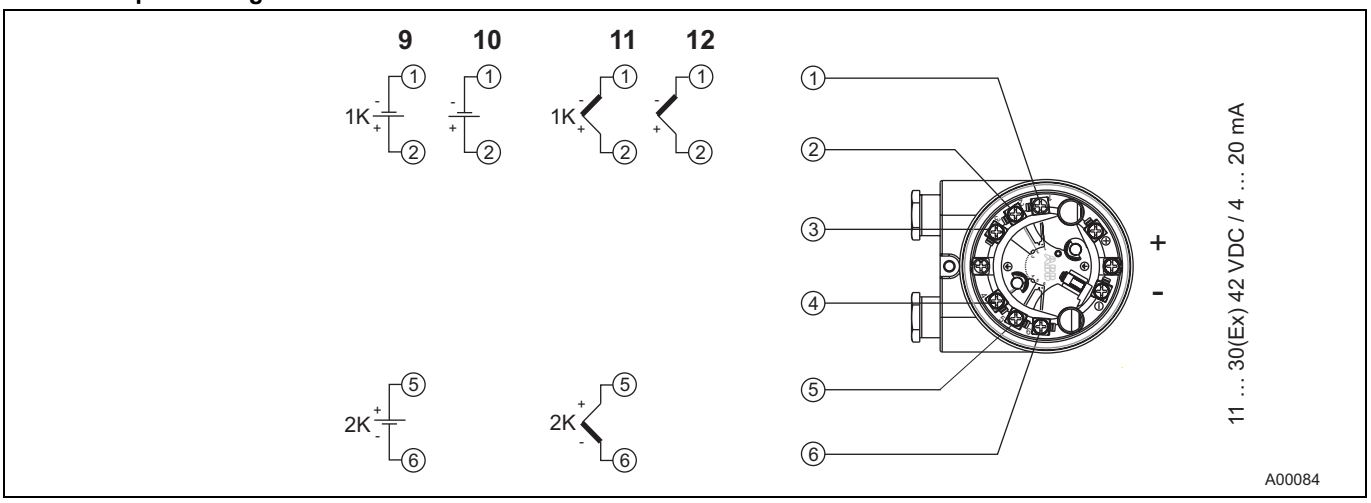

Fig. 4

9 2 x voltage measurement (sensor backup/redundancy, sensor drift monitoring, average value or differential temperature measurement)
10 Voltage measurement
11 2 x thermocouple (sensor backup/redundancy, sensor drift monitoring, average value or differential temperature measurement)
12 Thermocouple

RTD/thermocouples configuration

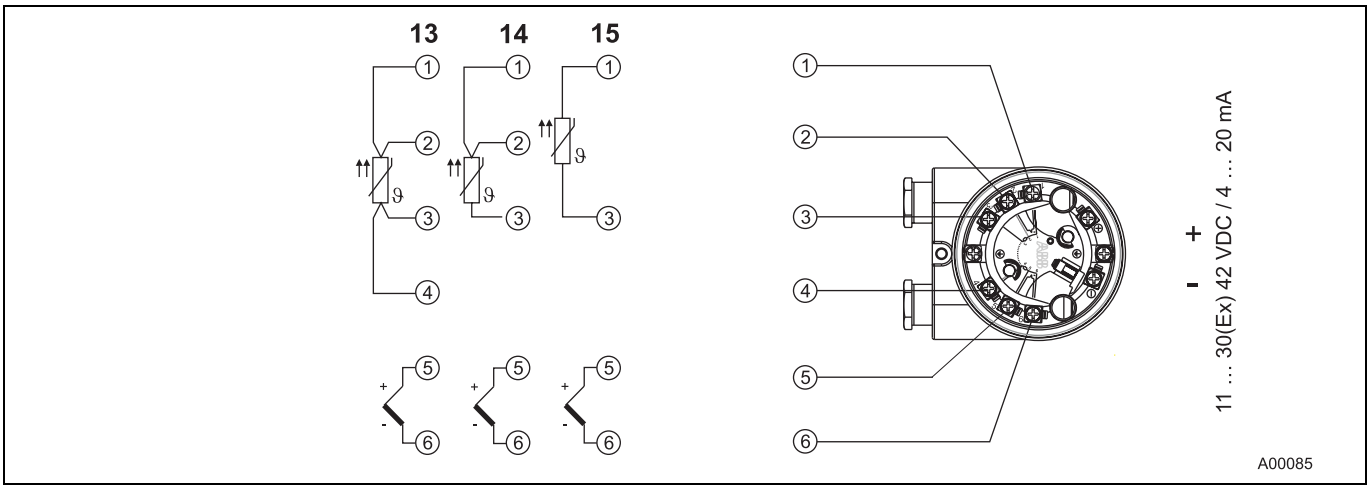

Fig. 5

13 1 x RTD, 4-wire circuit and thermocouple (sensor backup/redundancy, sensor drift monitoring, average value or differential temperature measurement)

14 1 x RTD, 3-wire circuit and thermocouple (sensor backup/redundancy, sensor drift monitoring, average value or differential temperature measurement)

15 1 x RTD, 2-wire circuit and thermocouple (sensor backup/redundancy, sensor drift monitoring, average value or differential temperature measurement)

9 Dimensioned drawing

9.1 TTF300

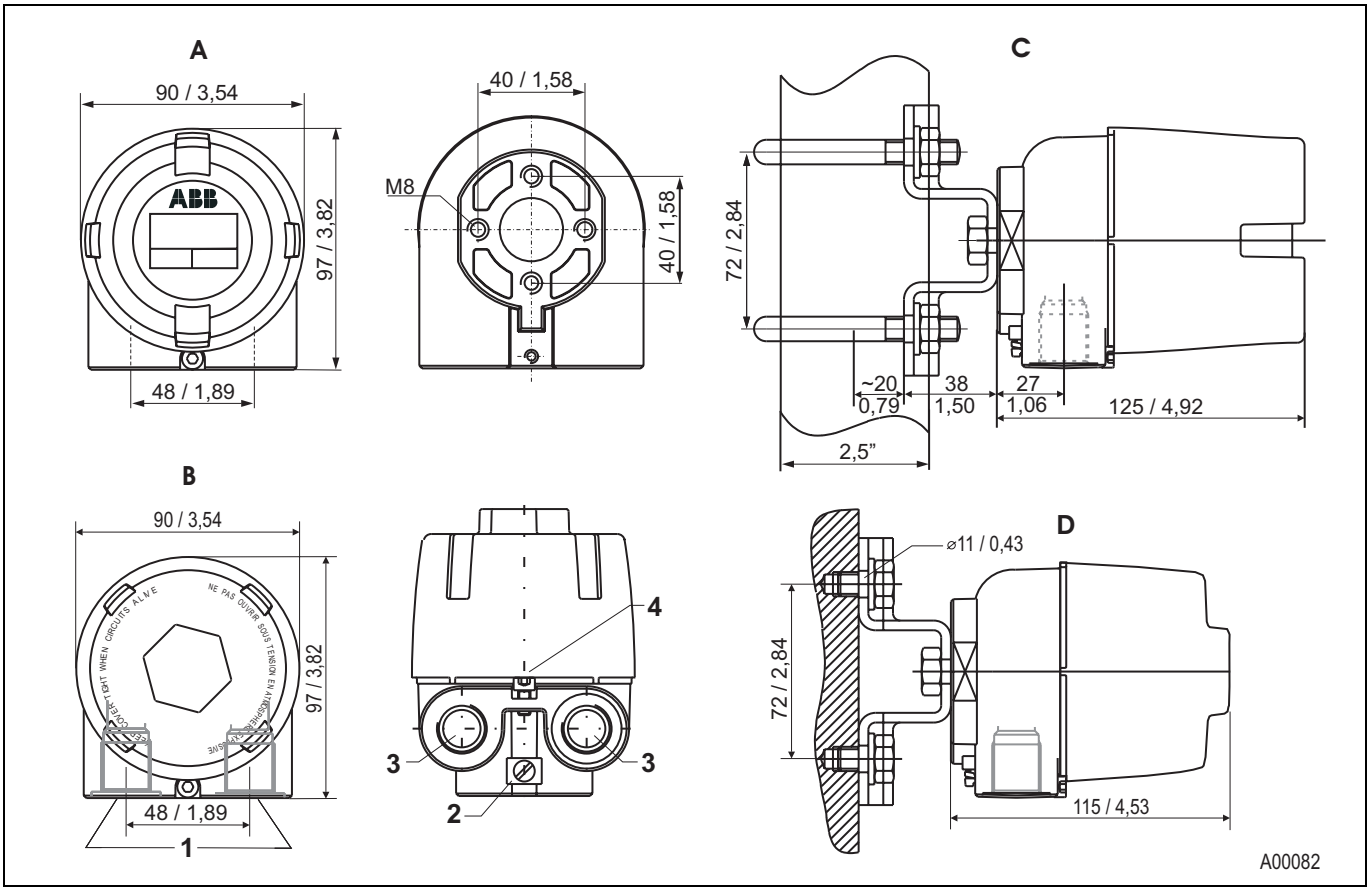

Fig. 6: Housing and mounting type with dimensions in mm/inches

A AGLFD housing
B AGLF housing
C Pipe installation
D Wall mount, 4-hole wall attachment, ∅ 11 mm / 0.43 inch, quadratically arranged, at distance of 72 mm / 2.84 inches

1 Electrical connections
2 Equipotential bonding screw M5
3 Thread M20 x 1.5 or ½"NPT
4 Lock screw

10 Ordering information

Field mounted Temperature Transmitter				Variant digit No.	1 - 7	8	9	10	11	Code			
TTF300				Catalog No.	**TTF300-**								
Explosion Protection													
TTF300	Without explosion protection					Y	0						
Type of protection: intrinsically safe ATEX													
TTF300	ATEX	Zone 0:	II 1 G EEx ia IIC T6			E	1						
		Zone 1 (0):	II 2 (1) G EEx [ia] ib IIC T6										
		Zone 1 (20):	II 2 G (1D) Ex [iaD] ib IIC T6										
Type of protection: non sparking (nA) ATEX													
TTF300	ATEX	Zone 2 / Zone 22:	II 3 G EEx nA II T6 and II 3 D IP 65 T135°C			E	2						
Type of protection: intrinsically safe FM & CSA													
TTF300	FM	IS, Class I, Div. 1+2, Groups A, B, C, D, Class II, E, F, G, Class III Class I, Zone 0, AEx ia IIC T6				L	1						
	FM	nonincendive, Class I, Div. 2, Groups A, B, C, D, Class II, E, F, G, Class III				L	2						
TTF300	CSA	IS, Class I, Div. 1+2, Groups A, B, C, D, Class II, E, F, G, Class III				R	1						
	CSA	nonincendive, Class I, Div. 2, Groups A, B, C, D, Class II, E, F, G, Class III				R	2						
Type of protection: Dust explosion proof													
TTF300	ATEX	Zone 20:	II 1 D IP 65 T135°C			D	1						
TTF300	ATEX	Zone 0 / Zone 20:	II 1 G EEx ia IIC T6 and II 1 D IP 65 T135°C			D	2						
Type of protection: Flameproof													
TTF300	ATEX	Zone 1:	II 2 G EEx d IIC T6			E	3						
TTF300	ATEX	Zone 1 / Zone 0:	II 2 G EEx d IIC T6 and II 1 G EEx ia IIC T6			E	4						
Type of protection: Explosion Proof													
TTF300	FM	XP, NI, DIP, Class I, II, III, Div. 1+2, Groups A-G, factory sealed				L	3						
TTF300	CSA	XP, NI, DIP, Class I, II, III, Div. 1+2, Groups A-G, factory sealed				R	3						
Housing / Display													
Single-compartment housing (AGLF) / Without display			(Aluminium)					A					
Single-compartment housing (AGSF) / Without display			(Stainless steel)					B					
Single-compartment housing (AGLFD) / With LCD-display HMI type A			(Aluminium)					C					
Single-compartment housing (AGSFD) / With LCD-display HMI type A			(Stainless steel)					D					
Cable entry													
Thread 2 x M20 x 1.5							1)		1				
Thread 2 x 1/2 in NPT									2				
Thread 2 x 3/4 in NPT (via 1/2 in > 3/4 in adapter)							2)		3				
Cable screw connection 2 x M20 x 1.5							2)		4				

1) Not available with Explosion Protection code L1, L2, L3, R1, R2, R3
2) Not available with Explosion Protection code L3, R3

Additional ordering information

TTF300			Code			
Configuration						
Customer specific configuration with report, except user curve (e. g. TAG Number)			BF			
Customer specific configuration with report, including user curve			BG			
Certificates						
SIL2 - Declaration of conformity			CS			
Calibration Certificate						
With 5-point works calibration certificate			EM			
Mounting bracket						
Wall monting / 2 in pipe mounting bracket	(Stainless steel)		K2			
Extended Ambient Temperature range	-50 ... 85 °C	3)	SE			
Name plate						
Stainless steel plate with TAG no.			T1			
Customer specific model acc. to NL no.	(please specify)		Z9			

Accessories					
		Catalog No.			
NGV220-NO	Surge / Lightning protection for M20 x 1.5 cable glands, non-Ex version	see data sheet 10/63-6.15 EN			
NGV220-EX	Surge / Lightning protection for M20 x 1.5 cable glands, Ex version	see data sheet 10/63-6.15 EN			

3) Not available with Explosion Protection code E3, E4, D1, D2, L1, L2, L3, R1, R2, R3

11 Order form configuration

Information on customer-specific configuration of temperature transmitter TTF300.

Configuration		**Selection**
Number of sensors		☐ 1 sensor ☐ 2 sensors
Measurement type (for 2-sensor selection only)		☐ Redundancy/sensor backup ☐ Sensor drift monitoring .....°C / K Sensor drift differential ....s time limit for drift overshoot ☐ Differential measurement: Zero point where Ia = 4 mA ☐ Differential measurement: Zero point where Ia = 12 mA ☐Mean
DIN IEC 60 751 JIS C1604-81 MIL-T-24388 DIN 43760 Cu	RTD	☐ Pt10 ☐ Pt50 ☐ Pt100 (standard) ☐ Pt200 ☐ Pt500 ☐ Pt1000 ☐ Pt10 ☐ Pt50 ☐ Pt100 ☐ Pt10 ☐ Pt50 ☐ Pt100 ☐ Pt200 ☐ Pt1000 ☐ Ni50 ☐ Ni100 ☐ Ni120 ☐ Ni1000 ☐ Cu10 ☐ Cu100
	Linear Resistance measurement	☐ 0 … 500 Ω ☐ 0 … 5000 Ω
IEC 584 DIN 43710 ASTME 988	Thermocouple	☐ Type K ☐Type J ☐Type N ☐Type R ☐Type S ☐Type T ☐Type E ☐Type B ☐Type L ☐Type U ☐Type C ☐Type D
	Linear voltage measurement	☐ -125 mV … 125 mV ☐ -125 mV … 1100 mV
Sensor circuit (for RTD + resistance measurement only)		☐2-wire ☐ **3-wire** (standard) ☐4-wire 2-wire circuit: Compensation of sensor-wire resistance max. 100 Ω ☐ Sensor 1: ..... Ω ☐ Sensor 1: ..... Ω
Reference junction (for thermocouples only)		☐ Internal (for standard thermocouple, except type B) ☐ no (TC type B) ☐ External/temp.:.....°C
Measuring range		☐Measurement start: ..... (Standard: **0**) ☐Measurement end: ..... (Standard: **100**)
Unit		☐ **Celsius** (standard) ☐Fahrenheit ☐Rankine ☐Kelvin
Failure signalisation		☐ **Overrange/22 mA** (standard) ☐Underrange/3.6 mA
Damping (T_{63})		☐ **Off** (standard) ☐Seconds (1 sec. … 100 sec.)
Sensor number		☐ Sensor 1..... ☐ Sensor 2.....
Resistor value at 0°C / R_o Callendar van Dusen coefficient A Callendar van Dusen coefficient B Callendar van Dusen coefficient C (optional for RTD/Pt sensors only)		Sensor 1: R_o: ..... A: ..... B: ..... C: ..... Sensor 2: R_o: ..... A: ..... B: ..... C: .....
User characteristics based on linearization table		☐ based on attached table of variate pairs
TAG number		☐ ... . (max. 8 characters)
Software write protection		☐ **Off** (standard) ☐ On
"Maintenance required" alarm pulse or continuous signaling (NE107)		☐ **Off** (standard) pulse width .....s (0.5 .... .59.5 s increment 0.5 s) ☐ continuous signal

ABB has Sales & Customer Support
expertise in over 100 countries worldwide.

www.abb.com/temperature

The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

Printed in the Fed. Rep. of Germany (04.2007)

3KXT221001R1001

DS/TTF300-EN Rev. A

ABB Limited
Salterbeck Trading Estate
Workington, Cumbria
CA14 5DS
UK
Tel: +44 (0)1946 830 611
Fax: +44 (0)1946 832 661

ABB Inc.
125 E. County Line Road
Warminster, PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

ABB Automation Products GmbH
Borsigstr. 2
63755 Alzenau
Germany
Tel: +49 551 905-534
Fax: +49 551 905-555
CCC-support.deapr@de.abb.com