Datasheet
DS-20201-01
January 2016

20 201 Temperature Transmitter

Description

The 20 201 offers a reliable solution to any temperature measurement application. With the HART protocol the 20 201 is easily configurable via a PC or handheld configuration tool. The 20 201 can be mounted easily on DIN rail. High precision electronics and advanced thermal compensation processing give excellent accuracy when reading from any of the industry standard RTD and Thermocouple sensors. In addition, the 20 201 can read any voltage source ranging from 1mV to 1V, and also possesses a software controllable current source enabling the device to read resistance values from any generic transducer.

Features

- 4-20 mA transmitter with HART communication.
- Sensor type Resistance(RTD), Thermocouple(TC), Diode, Transistor.
- Single sensor: 2, 3, or 4 wire configurations.
- Dual Sensor: Differential, Average, Maximum or Minimum.
- Voltage input for mV transducers.
- Resistance input for Ohm transducers.
- Sensor burn-out detection and alarm.
- Sensor isolation 500V minimum.
- DIN rail mounting.

The purpose of this document is assist with the setup, installation, operation and maintenance of the 20 201 as well as providing technical specifications and basic data, for further information about this product can be found at www.springres.com

Table of Contents

1 General Information

The 20 201 is designed to measure process temperature using sensors type RTD's, thermocouples, resistance or mV input, and transmit the signal via a 4-20mA current loop . The 20 201 can be mounted on DIN rail. The 20 201 meets HART Foundation physical layer requirements to be programable via standard HART configurators.

The overall accuracy of the 20 201 temperature transmitter depends on proper installation. Direct exposure to heat sources must be avoided because it will cause temperature differences in the electronic circuits making the electronic compensation ineffective. If high temperature environment is unavoidable we recommend the use of cooling necks, or installation of the transmitter as far as possible of the source or in the shade of the heat source. Ultimately the maximum surrounding temperature of 75C must be assured at any circumstance.

Special care must be taken around the terminals of the 20 201, these external elements are directly exposed to humidity, vibration or chemical exposures, under this situation we recommend the use a thin layer of general purpose electrical silicone sealant into the terminals and exposed conductors to minimize effects. Most applications of the 20 201 should not require this extra care.

Sensor cable should be as short as possible, although the 20 201 will provide error compensation algorithm for 3 or 4 wires RTD one must consider possible noise injection on the sensor cable yielding measurement error. Same can be observed with thermocouples. As a rule sensor wires must be kept as short as possible and possibly use of shielded wires with ground as close as possible to the 20 201.

For long distances from sensor to transmitter it is recommended to use for the sensors compensation cable.

2 *Mounting & Electrical*

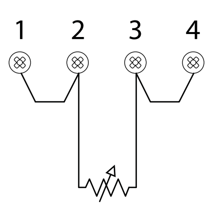
The 20 201 is mechanically designed to mount straight on DIN standard rail, on wall into panel. Proper RFI shielding the basis of installation should be connected to the ground base of the nearby installation.

The terminals connections are on top of the 20 201 serving the 4-20mA current loop and the sensor circuitry. The 20 201 can be configured by HART protocol and the loop current is electrically isolated from the sensor side.

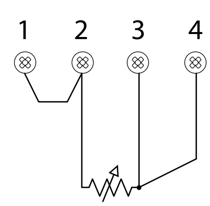
3 *Electric Wiring*

Figure 3.1 and the table below describe the electrical designators of the 20 201 terminals.

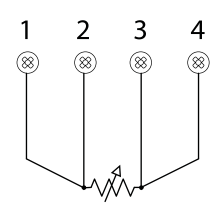
Pin #	Designator
1	Sensor Terminal
2	Sensor Terminal
3	Sensor Terminal
4	Sensor Terminal
5	24 VDC HART Comm. (non-polarized)
6	24 VDC - HART Comm. /Test Current non-polarized)
7	Test Current (non-polarized)
8	Ground



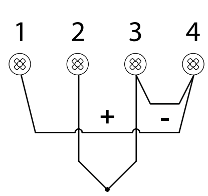
2-Wire RTD or Ohm input



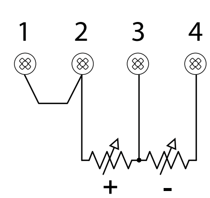
3-Wire RTD or Ohm input



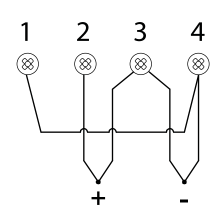
4-Wire RTD or Ohm input



Thermocouple or Millivolt input



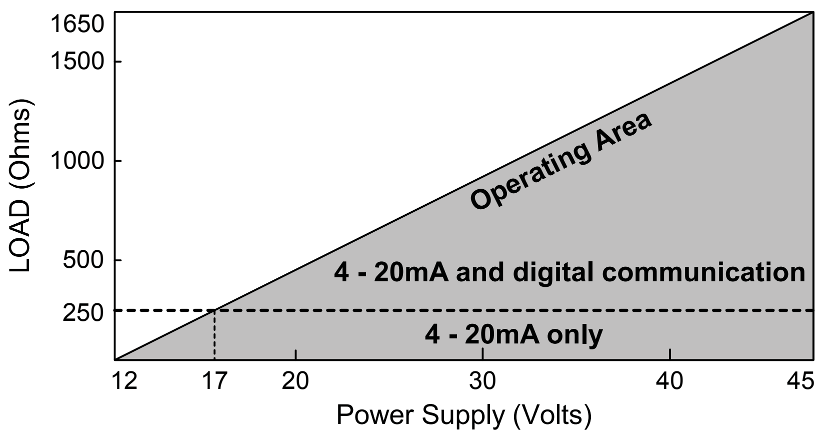
Differential, Min, Max, Average in either RTD or Ohm input



Differential, Min, Max, Average in either Thermocouple or Millivolt input

4 *Functional Specifications*

- Inputs: Figure 4.1 pins 1, 2, 3, 4
- Output Signal: Figure 4.1 pins 5, 6 4-20 mA plus HART Protocol Version 5.1
- Power Supply: 12 to 45 Vdc
- Load Limitation: See diagram



- Zero and Span Adjustment: Non interactive, via HART Communicator or factory adjusted.
- Operating Temperature: -40C ≤ Ta ≤ +75C
- Storage Temperature: -40C ≤ Ta ≤ 90C
- Loss of Input (Burnout)/Failure Alarm: output programable to 3.6 or to 21.0 mA.
- Humidity Limits: 10 to 100% RH
- Turn-on Time: about 10 seconds.
- Update Time: about 0.5 second.
- Damping: 0.5 to 32 seconds.
- Configuration: via HART Communicator.

5 Performance Specifications

Accuracy

See the tables below

Ambient Temperature Effect: for evert 10C variation:

- mV (-6...22 mV), TC (NBS: B, R, S, T): ±0.03% or 0.002 mV whichever is greater.
- mV (-10...100 mV), TC (NBS: E, J, K, N; DIN: (L, U): ±0.03% or 0.01 mV whichever is greater.
- mV (-50...500 mV): ±0.03% or 0.05 mV whichever is greater.
- Ohms (0...100 Ohms), RTD (GE: Cu10) : ±0.03%.
- Ohms (0...400 Ohms), RTD (DIN: Ni: 120; IEC: Pt50, Pt100; JIS: Pt50, Pt100): ±0.03%.
- Ohms (0...2000 Ohms), RTD (IEC: Pt500; Pt1000): ±0.03%.
- TC: Cold-junction compensation rejection 60:1 Reference: 25,0 ±0,3oC

Power Supply Effect:	±0.005% of calibrated span per volt.
Vibration Effect:	Meets SAMA PMC 31.1
Electro-Magnetic Interference:	Designed to comply with IEC 801

6 Physical Specifications

Electrical Connection:	conductors up to 2.5mm2 (12 AWG)
Mounting:	Industry standard DIN rail.

7 Hardware Configuration

The temperature transmitter 20 201 is composed of a modern 16 bit microprocessor, RAM for volatile data, EEPROM for parameters, FlashRAM for firmware, HART interface, isolated 16 bits multi channel A/D converter. The configuration capability of the 20 201 is flexible enabling solution for several types of sensors such as thermocouples, RTD, mV, table look-up, ambient temperature compensation, sensor diagnosis, and options within the HART specifications for temperature devices.

The hardware configuration for the 20 201 can be divided into 2 blocks, the current loop connecting to the power supply and control room equipments; and the sensor side connecting to a variety of temperature sensors available in the market.

7.1 Current Loop Terminals

The 20 201 has 2 input terminals connected to internal the 4/20mA current sink and HART protocol modulator, allowing a single instrument per signal line, or up to 15 instruments per signal line in a multidrop line, physical connection are illustrated by Fig. 7.1.1 and 7.1.2 respectively.

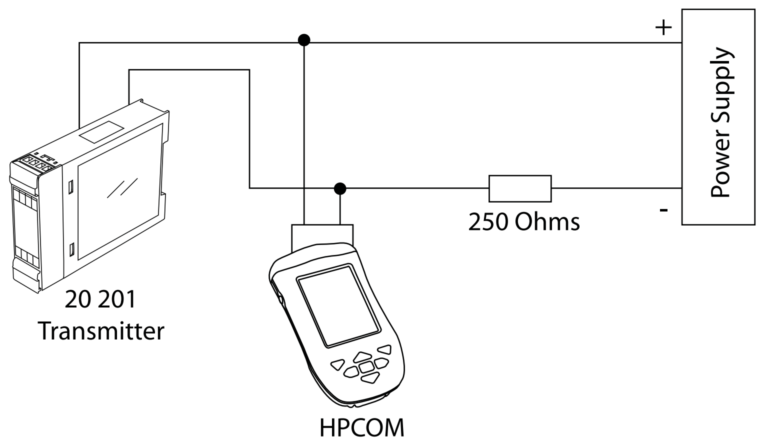


Fig. 7.1.1 – Wiring Diagram of 20 201 connected to (optional) HART Configurator.

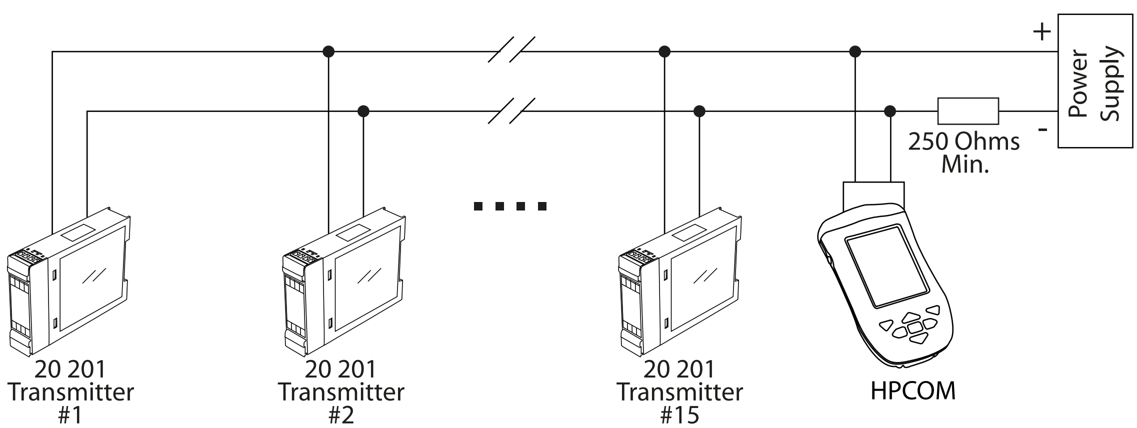
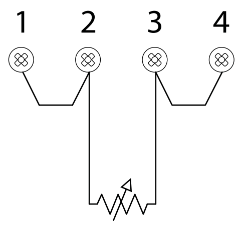


Fig. 7.1.2 – Wiring Diagram of 20 201 in Multidrop line (or any other HART instrument)

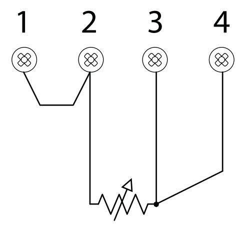
7.2 Sensor Side Terminals

The 20 201 has 4 analog inputs connected to an internal 16 bits A/D converter designed to enable usage of multiple sensor types such as Voltage, Resistance and Current, these inputs are electrical isolated from the loop terminals eliminating ground loop problems between the loop supply and the external sensor connected to the terminals. (Software configuration techniques for each mode will be addressed later on.)

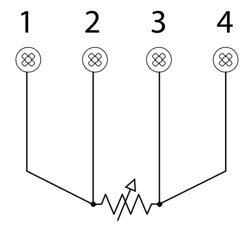
Figure 7.2.1 show connection diagrams for each sensor type.



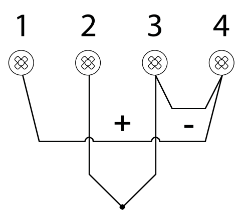
2-Wire RTD or
Ohm input



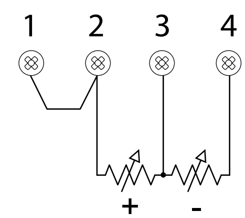
3-Wire RTD or
Ohm input



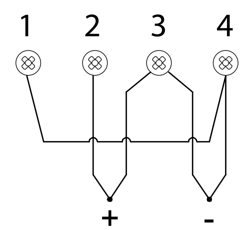
4-Wire RTD or
Ohm input



Thermocouple or
Millivolt input



Differential, Min, Max,
Average in either RTD
or Ohm input



Differential, Min, Max,
Average in either
Thermocouple or
Millivolt input

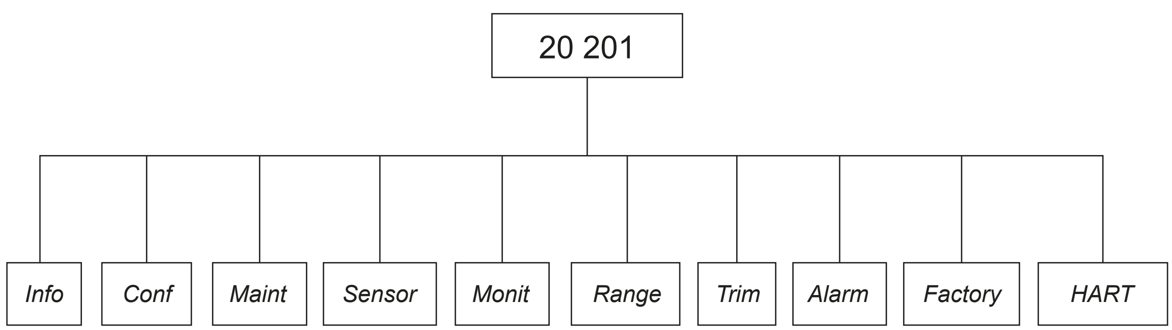
8 *Software Configuration*

The 20 201 Temperature Transmitter allows over 32 different types of sensor configuration, each sensor has its own characterization method plus ambient temperature compensation. This device must also provide functional compatibility with the HART specification for temperature class, and some more proprietary configuration functions. (Although our focus is about our Transmitter 20 201 as a temperature device, it can also be configured for measurement of other transducers such as pressure, position, level, etc)

All these features demand a configuration tool able to retrieve all information from the EEPROM of the 20 201, modify and send it back without causing process disruption. For this important task we suggest the use Springfield HART communicators such as HART Pocket Configurator (HPC), or HART Tablet Configurator (HTC), or our HART LapTop Configurator (HLC).

The software configuration for the 20 201 can be divided into 2 blocks, the current loop configuration to interface with HART protocol for temperature class; and the sensor configuration to interface with variety of temperature sensors available in the market.

Figure 8.1 below show the configuration folders of the 20 201 internal functions followed by a brief explanation of each folder, further information is available within our HART Configuration tools.



- **Info -** Information folder: Tag, Descriptor, Message, Date and Unique ID.
- **Conf -** Configuration folder: Sensor Type, Burn out, .
- **Maint -** Maintenance folder: Loop tests, reset, counters, password, ordering codes.
- **Sensor -** Sensor folder: sensor type, connection mode.
- **Monit -** Monitor function: data logger for dynamic variables within the 20 201.
- **Range -** Range folder: Lower Range Value (LRL), Upper Range Value (URL), Unit, Damping.
- **Trim -** Trim function: for calibration of the 4-20mA output and linearity.
- **Alarm -** Alarm folder: for configuring up to 3 alarm function and value.
- **Factory -** Factory folder: Proprietary information and factory calibration.
- **HART -** HART folder: for set-up instrument address and network operating mode.

9 Sensor selection:

At the sensor folder the 20 201 inputs can be configured to handle many temperature sensor types and best connection methods. There are supports for resistance sensors (RTD), voltage sensors (thermocouples), resistance transducers or mV transducers. These sensors can also be configured as single, differential, average, maximum and minimum. The available software configurations, ranges and accuracies are listed below in tables 9.1, 9.2 and 9.3.

The 20 201 has built-in ambient temperature sensor very close to the sensor terminals, this reading can be configured for Cold Junction compensation, accuracy to +/-2C.

		2, 3 OR 4 WIRES				DIFFERENTIAL			
SENSOR	TYPE	RANGE °C	RANGE °F	MINIMUM SPAN °C	°C DIGITAL ACCURACY	RANGE °C	RANGE °F	MINIMUM SPAN °C	°C DIGITAL ACCURACY
RTD	Cu10 GE	-2 to 250	-4…482F	50	±1.0	-270 to 270	-486 to 486	50	±2.0
	Ni120 DIN	-50 to 270	-58 to 518	5	±0.1	-320 to 320	-576 to 576	5	±0.5
	Pt50 IEC	-200 to 850	-328 to 1562	10	±0.2	-1050 to 1050	-1890 to 1890	10	±1.0
	Pt100 IEC	-200 to 850	-328 to 1562	10	±0.2	-1050 to 1050	-1890 to 1890	10	±1.0
	Pt500 IEC	-200 to 450	-328 to 842	10	±0.2	NA	NA	NA	NA
	Pt50 JIS	-200 to 600	-328 to 1112	10	±0.25	-800 to 800	-1440 to 1440	10	±1.0
	Pt100 JIS	-200 to 600	-328 to 1112	10	±0.25	-800 to 800	-1440 to 1440	10	±1.5
	Pt1000 IEC	-200 to 300	-328 to 572	10	±0.25	-500 to 500	-868 to 500	10	±1.5
THERMO COUPLE	B NBS	+100 to 1800	212 to 3272	50	±0.5**	-1700 to 1700	-3060 to 3060	60	±1.0**
	E NBS	-100 to 1000	-148 to 1832	20	±0.2	-1100 to 1100	-1980 to 1980	20	±1.0
	J NBS	-150 to 750	-238 to 1382	30	±0.3	-900 to 900	-1620 to 1620	30	±0.6
	K NBS	-200 to 1350	-328 to 2462	60	±0.6	-1550 to 1550	-2790 to 2790	60	±1.2
	N NBS	-100 to 1300	-148 to 2372	50	±0.5	-1400 to 1400	-2520 to 2520	50	±1.0
	R NBS	0 to 1750	32 to 3182	40	±0.4	-1750 to 1750	-3150 to 3150	40	±2.0
	S NBS	0 to 1750	32 to 3182	40	±0.4	-1750 to 1750	-3150 to 3150	40	±2.0
	T NBS	-200 to 400	-328 to 752	15	±0.15	-600 to 600	-1080 to 1080	15	±0.8
	L DIN	-200 to 900	-328 to 1652	35	±0.35	-1100 to 1100	-1980 to 1980	35	±0.7
	U DIN	-200 to 600	-328 to 1112	50	±0.5	-800 to 800	-1440 to 1440	50	±2.5
	K DIN-IEC	-200 to 1350	-328 to 2462	60	±0.6	-1550 to 1550	-2758 to 2822	60	±1.2
	S DIN-IEC	0 to 1750	32 to 3182	40	±0.4	-1750 to 1750	-3118 to 3182	40	±2.0

Table 9.1: Sensor configuration, ranges and accuracies for temperature sensors.

SENSOR	RANGE OHM	MINIMU M SPAN mV	DIGITAL * ACCURACY %
Special	0 to 2000	20	±0.02% or ±0.20 Ohm
OHM	0 to 100	1	±0.02% or ±0.01 Ohm
	0 to 400	4	±0.02% or ±0.04Ohm
	0 to 2000	20	±0.02% or ±0.20 Ohm
OHM DIF	-100 to 100	1	±0.08% or ±0.04 Ohm
	-400 to 400	4	±0.1% or ±0.2 Ohm

Table 9.2: Sensor configuration, ranges and accuracies for resistive sensors.

SENSOR	RANGE OHM	MINIMU M SPAN mV	DIGITAL * ACCURACY %
Special	-50 to 500	10.00	±0.02% or ±50 µV
mV	-6 to 22	0.40	±0.02% or ±2 µV
	-10 to 100	2.00	±0.02% or ±10 µV
	-50 to 500	10.00	±0.02% or ±50 µV
mV DIF	-28 to 28	0.40	±0.1% or ±10 µV
	-110 to 110	4	±0.1% or ±10 µV

Table 9.3: Sensor configuration, ranges and accuracies for voltage sensors.

Van Dusen:	Special temperature calculation
Types:	RTD given parameters RO, A, B, C

10 Mechanical Dimensions

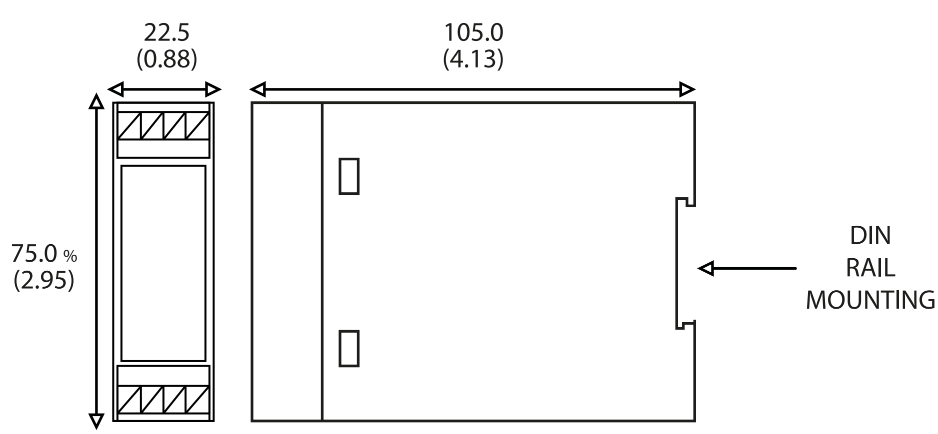


Fig. 10.1 – Mechanical Dimensions

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