INSTRUCTION & SAFETY MANUAL

SIL 2 Temperature Signal Converter,
Duplicator, Adder/Subtractor
Din-Rail Models D1072S, D1072D
General Description:
The Single and dual channel DIN Rail Temperature Signal Converter D1072S and D1072D accepts a low level dc signal from millivolt, thermocouple or RTD temperature sensor, located in Hazardous Area, and converts, with isolation, the signal to drive a Safe Area load. Output signal can be direct or reverse.

Duplicator function provides two independent outputs for the single input.
Adder, subtractor, low/high selector functions provide two independent outputs representing input A, input B, input A plus input B, input A minus input B, low/high selector.
Function: 1 or 2 channel I.S. input from mV, thermocouples, 3-4 wires resistance thermometers, transmitting potentiometers, provides 3 port isolation (input/output/supply) and current (source mode) or voltage output signal. Duplicator, adder, subtractor, low/high selector function provided. The programmable RTD line resistance compensation allows the use of 2 wires RTDs or error compensation for 3-4 wires RTDs. Reference junction compensation can be automatic, with option 91, or fixed by software setting.

Signalling LEDs: Power supply indication (green), burnout (red).

Compatibility: Totally software configurable, no jumpers or switches, input sensor, connection mode, burnout operation, mA or V output signal, by GM Pocket Portable Configurator PPC1090, powered by the unit or configured by PC via RS-232 serial line with PPC1092 Adapter and SWC1090 Configurator software. A 16 characters tag can be inserted using SWC1090 Configurator software. To operate PPC1090 or PPC1092 refer to instruction manual.

EMC: Fully compliant with CE marking applicable requirements.

Supply: 12-24 Vdc nom (10 to 30 Vdc) reverse polarity protected, ripple within voltage limits ≤ 5 Vpp.

Current consumption @ 24 V: 70 mA for 2 channels D1072D, 45 mA for 1 channel D1072S with 20 mA output typical.

Current consumption @ 12 V: 140 mA for 2 channels D1072D, 80 mA for 1 channel D1072S with 20 mA output typical.

Power dissipation: 1.5 W for 2 channels D1072D, 1.0 W for 1 channel D1072S with 24 V supply voltage and 20 mA output typical.

Max. power consumption: at 30 V supply voltage, overload condition and PPC1090 connected, 2.1 W for 2 channels D1072D, 1.4 W for 1 channel D1072S.

Isolation (Test Voltage): I.S. In/Out 1.5 kV; I.S. In/Supply 1.5 kV; I.S. In/In 1.5 kV; I.S. In/In 500 V; Out/Supply 500 V; Out/Out 500 V.

Input: millivolt or thermocouple type A1, A2, B, E, J, K, L, R, N, S, R, T, U or 3-4 wires RTD Pt100, Pt200, Pt300 to DIN43760, Pt100 (0.3916), Ni100 Ni120 or Pt500, Pt100, Pt50, Cu100, Cu53, Cu50, Cu46 (russian standard) or 3 wires transmitting potentiometer (50 Ω to 20 KΩ).

Integration time: 500 ms.

Resolution: 5 µV on mV or thermocouple, 1 µV on thermocouple type B, R, S, S1, 2 µV on thermocouple type A1, A2, A3, 20 mΩ on RTD, 0.05 % on transmitting potentiometer.

Vissualization: 0.1 °C on temperature, 10 µV on mV, 0.1 % on potentiometer.

Input range: within rated limits of sensor (-10 to + 80 mV).

Measuring RTD current: ≤ 0.5 mA.

RTD line resistance compensation: ≤ 10 Ω.

RTD line resistance error compensation: -5 to + 20 Ω, programmable.

Thermocouple Reference Junction Compensation: automatic, by external sensor OPT1091 separately ordered, or fixed programmable from -60 to + 100 °C.

Thermocouple burnout current: ≤ 30 mA.

Burnout: enabled or disabled. Analog output can be programmed to detect burnout condition with downscale or higtscale forcing. Burnout condition signalled by red front panel LED.

Output: 0/4 to 20 mA, on max. 600 Ω load source mode, current limited at 22 mA or 0/1 to 5 V or 0/2 to 10 V signal, limited at 11 V.

Resolution: 2 µA current output or 1 mV voltage output.

Transfer characteristic: linear or reverse on mV or transmitting potentiometer, temperature linear or reverse on temperature sensors.

Response time: ≤ 50 ms (10 to 90 % step change).

Output ripple: ≤ 20 mVrms on 250 Ω load.

Performance: Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temperature.

Input: Calibration and linearity accuracy: ≤ ± 40 µV on mV or thermocouple, 200 mΩ on RTD, 0.2 % on potentiometer or ≤ 0.05 % of input value.

Temperature influence: ≤ ± 2 µV, 20 mΩ, 0.02 % or ± 0.01 % of input value for a 1 °C change.


Analog Output: Calibration accuracy: ≤ ± 0.1 % of full scale.

Linearity error: ≤ ± 0.05 % of full scale.

Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply change.

Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.

Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:

Environmental conditions:
Operating: temperature limits -20 to + 60 °C, relative humidity max 95 %.
Storage: temperature limits – 45 to + 80 °C.

Safety Description:
ATEX: II (1) G [Ex ia Ga] IIC, II (1) D [Ex ia Da] IIIC, I (M1) [Ex ia Ma] I, II 3G Ex ia IIC T4 Gc
IECEx / INMETRO: [Ex ia Ga] IIC, [Ex ia Da] IIIC, [Ex ia Ma] I, Ex nA IIC T4 Gc
associated electrical apparatus.
Uo/Vac = 10.8 V, Io/Isc = 9 mA, Po/Po = 24 mW at terminals 13-14-15-16, 9-10-11-12.
Ul/Vmax = 18 V, Ci = 6 nF, Li = 0 nH at terminals 13-14-15-16, 9-10-11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60 °C.
Appraisals:
DMT 01 ATEX E 042 X conforms to EN60079-0, EN60079-11, EN60079-26. 
IECEX BVS 07.02XTCX conforms to IEC60079-0, IEC60079-11, IEC60079-26.
IMQ 09 ATEX 013 X conforms to EN60079-0, EN60079-15.
UL A-UL E222308 conforms to UL1913, UL 60079-0, UL60079-11, UL60079-15.
FM & FMC No. 3024643, 3002921C, conforms to Class 3600, 3610, 3611, 3810,
ANSI/ISA 12.12.02, ANSI/ISA 60079-0, ANSI/ISA 60079-11, C22.2 No.142,
C.I 16.0034 X conforms to DSTD 7113, GOST 22782.5-78, DSTU IEC 60079-15.
TUV Certificate No. C-IS-236198-02, SIL 2 according to IEC 61511.
DNV No.A-13778 and KR No.ML10768-EL001 Certificates for maritime applications.
Mounting: T35 DIN Rail according to EN50022.
Weight: about 170 g D1072D, 140 g D1072S.
Connection: by polarized plug-in disconnect screw terminal blocks to accommodate terminations up to 2.5 mm².
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Characteristics

Technical Data
Ordering information

<table>
<thead>
<tr>
<th>Model: D1072</th>
<th>Power Bus and DIN-Rail accessories:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 channel</td>
<td>DIN rail anchor MCHP065</td>
</tr>
<tr>
<td>2 channels</td>
<td>DIN rail stopper MOR016</td>
</tr>
<tr>
<td>Power Bus enclosure /B</td>
<td>Terminal block male MOR017</td>
</tr>
<tr>
<td>Reference Junction Compensator (TC input)</td>
<td>Terminal block female MOR022</td>
</tr>
</tbody>
</table>

Operating parameters are programmable by the GM Pocket Portable Configurator PPC1090 or via RS-232 serial line with PPC1092 Adapter and SWC1090 Configurator software. If the parameters are provided with the purchasing order the unit will be configured accordingly, otherwise the unit will be supplied with default parameters.

**NOTE:** for thermocouple sensor input, the Reference Junction Compensator is required for automatic ambient temperature compensation. It has to be ordered as OPT1091, it will be supplied separately and it has to be connected to the input terminal blocks as indicated in the function diagram.

### Front Panel and Features

- **SIL 2 according to IEC 61511** (for current output)
  - D1072S: T_proof = 2/10 yrs (≤10% / >10% of total SIF) PFDavg (1 year) 3.35 E-04, SFF 76.12 %;
  - D1072D: T_proof = 2/10 yrs (≤10% / >10% of total SIF) PFDavg (1 year) 3.74 E-04, SFF 76.40 %.
- Input from Zone 0 (Zone 20), Division 1, installation in Zone 2, Division 2.
- mV, thermocouples, RTD or transmitting potentiometers Input Signal.
- Programmable RTD line resistance compensation.
- Reference Junction Compensation automatic or fixed (programmable value).
- 0/4-20 mA, 0/1-5 V, 0/2-10 V Output Signal temperature linear or reverse.
- Duplicated output for single channel input.
- Adder, Subtractor, low/high Selector.
- 16 characters tag for each channel.
- Common burnout detection available when using Power Bus enclosure.
- High Accuracy, µP controlled A/D converter.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Fully programmable operating parameters.
- ATEX, IECEx, UL & C-UL, FM & FM-C, INMETRO, EAC-EX, UKR TR n. 898, TÜV Certifications.
- TÜV Functional Safety Certification.
- Type Approval Certificate DNV and KR for maritime applications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail and plug-in terminal blocks.
- 250 Vrms (Um) max. voltage allowed to the instruments associated with the barrier.

### Terminal block connections

#### HAZARDOUS AREA

<table>
<thead>
<tr>
<th>9</th>
<th>Input Ch 2 for Reference Junction Compensator Option 91 or Input Ch 2 for 3-4 wire RTD or potentiometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Input Ch 2 for 3-4 wire RTD</td>
</tr>
<tr>
<td>11</td>
<td>+ Input Ch 2 for thermocouple TC or Input Ch 2 for 4 wire RTD or Input Ch 2 for potentiometer</td>
</tr>
<tr>
<td>12</td>
<td>- Input Ch 2 for thermocouple TC or Input Ch 2 for 3-4 wire RTD or potentiometer</td>
</tr>
<tr>
<td>13</td>
<td>Input Ch 1 for Reference Junction Compensator Option 91 or Input Ch 1 for 3-4 wire RTD or potentiometer</td>
</tr>
<tr>
<td>14</td>
<td>Input Ch 1 for 3-4 wire RTD</td>
</tr>
<tr>
<td>15</td>
<td>+ Input Ch 1 for thermocouple TC or Input Ch 1 for 4 wire RTD or for potentiometer</td>
</tr>
<tr>
<td>16</td>
<td>- Input Ch 1 for thermocouple TC or Input Ch 1 for 3-4 wire RTD or potentiometer</td>
</tr>
</tbody>
</table>

#### SAFE AREA

<table>
<thead>
<tr>
<th>1</th>
<th>+ Output Ch 1 for Current Source mode or + Output Ch 1 for Voltage Source mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>- Output Ch 1 for Current Source mode or - Output Ch 1 for Voltage Source mode</td>
</tr>
<tr>
<td>3</td>
<td>+ Power Supply 12 - 24 Vdc</td>
</tr>
<tr>
<td>4</td>
<td>- Power Supply 12 - 24 Vdc</td>
</tr>
<tr>
<td>5</td>
<td>+ Output Ch 2 for Current Source mode or + Output Ch 2 for Voltage Source mode</td>
</tr>
<tr>
<td>6</td>
<td>- Output Ch 2 for Current Source mode or - Output Ch 2 for Voltage Source mode</td>
</tr>
<tr>
<td>7</td>
<td>Not used</td>
</tr>
<tr>
<td>8</td>
<td>Not used</td>
</tr>
</tbody>
</table>
In the system safety analysis, always check the Hazardous Area/Hazardous Locations devices to conform with the related system documentation, if the device is Intrinsically Safe check its suitability for the Hazardous Area/Hazardous Locations and gas group encountered and that its maximum allowable voltage, current, power (U/V, I/mA, P/W) are not exceeded by the safety parameters (Uo/Voc, Io/Is, Po/Pi) of the D1072 Associated Apparatus connected to it. Also consider the maximum operating temperature of the field device, check that added connecting cable and field device capacitance and inductance do not exceed the limits (Co/Ca, Lo/La, Lo/Ro) given in the Associated Apparatus parameters for the effective gas group. See parameters on enclosure side and the ones indicated in the table below:

<table>
<thead>
<tr>
<th>D1072 Terminals</th>
<th>D1072 Associated Apparatus Parameters</th>
<th>Must be</th>
<th>Hazardous Area/ Hazardous Locations Device Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch1 13 - 14 - 15 - 16</td>
<td>Uo / Voc = 10.8 V</td>
<td>≤</td>
<td>Ui / Vmax</td>
</tr>
<tr>
<td>Ch2 9 - 10 - 11 - 12</td>
<td>Io / Isc = 9 mA</td>
<td>≤</td>
<td>li / lmax</td>
</tr>
<tr>
<td>Ch1 13 - 14 - 15 - 16</td>
<td>Po / Po = 24 mW</td>
<td>≤</td>
<td>Pi / Pi</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D1072 Terminals</th>
<th>D1072 Associated Apparatus Parameters</th>
<th>Must be</th>
<th>Hazardous Area/ Hazardous Locations Device Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch1 13 - 14 - 15 - 16</td>
<td>Co / Ca = 2.134 µF, Ci = 6 nF, Li = 0 nH</td>
<td>(IIC-A, B), (IIA-D), (IIC)</td>
<td>≥</td>
</tr>
<tr>
<td>Ch2 9 - 10 - 11 - 12</td>
<td>Co / Ca = 14.994 µF</td>
<td>(IIB-C), (IIC)</td>
<td>≥</td>
</tr>
<tr>
<td>Ch1 13 - 14 - 15 - 16</td>
<td>Lo / La = 468 mH, Lo / La = 1874 mH</td>
<td>(IIC-A, B), (IIB-C)</td>
<td>≥</td>
</tr>
<tr>
<td>Ch2 9 - 10 - 11 - 12</td>
<td>Co / Ca = 65.994 µF</td>
<td>(IIA-D), (IIC)</td>
<td>≥</td>
</tr>
</tbody>
</table>

When used with separate powered intrinsically safe devices, check that maximum allowable voltage (U/Vmax) of the D1072 Associated Apparatus are not exceeded by the safety parameters (Uo/Voc) of the Intrinsically Safe device, indicated in the table below:

<table>
<thead>
<tr>
<th>D1072 Terminals</th>
<th>D1072 Associated Apparatus Parameters</th>
<th>Must be</th>
<th>Hazardous Area/ Hazardous Locations Device Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch1 13 - 14 - 15 - 16</td>
<td>Ui / Vmax = 18 V</td>
<td>≥</td>
<td>Uo / Voc</td>
</tr>
<tr>
<td>Ch2 9 - 10 - 11 - 12</td>
<td>Ci = 6 nF, Li = 0 nH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For installations in which both the Ci and Li of the Intrinsically Safe apparatus exceed 1 % of the Co and Lo parameters of the Associated Apparatus (excluding the cable), then 50 % of Co and Lo parameters are applicable and shall not be exceeded (50 % of the Co and Lo become the limits which must include the cable such that Ci device + C cable ≤ 50 % of Co and Li device + L cable ≤ 50 % of Lo). If the cable parameters are unknown, the following value may be used: Capacitance 60pF per foot (180pF per meter), Inductance 0.20µH per foot (0.60µH per meter).

The Intrinsic Safety Entity Concept allows the interconnection of Intrinsically Safe devices approved with entity parameters not specifically examined in combination as a system when the above conditions are respected.

For Division 1 and Zone 0 installations, the configuration of Intrinsically Safe Equipment must be FM approved under Entity Concept (or third party approved); for Division 2 installations, the configuration of Intrinsically Safe Equipment must be FM approved under non-incendive field wiring or Entity Concept (or third party approved).

**NOTE for USA and Canada:**
IIC equal to Gas Groups A, B, C, D, E, F and G
IIB equal to Gas Groups C, D, E, F and G
IIA equal to Gas Groups D, E, F and G

For installations in which both the Ci and Li of the Intrinsically Safe apparatus exceed 1 % of the Co and Lo parameters of the Associated Apparatus (excluding the cable), then 50 % of Co and Lo parameters are applicable and shall not be exceeded (50 % of the Co and Lo become the limits which must include the cable such that Ci device + C cable ≤ 50 % of Co and Li device + L cable ≤ 50 % of Lo). If the cable parameters are unknown, the following value may be used: Capacitance 60pF per foot (180pF per meter), Inductance 0.20µH per foot (0.60µH per meter).
HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC, HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D, CLASS II, DIVISION 1, GROUPS E, F, G, CLASS III, DIVISION 1, CLASS I, ZONE 0, GROUP IIC

SAFE AREA, ZONE 2 GROUP IIC T4, NON HAZARDOUS LOCATIONS, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1072D

In 1
TC
Reference Junction Compensator Option 91

In 2
TC
Reference Junction Compensator Option 91

MODEL D1072D (Duplicator)

In 1
TC
Reference Junction Compensator Option 91

Pot.
4 wire RTD
3 wire RTD

Pot.
4 wire RTD
3 wire RTD

MODEL D1072D

In 1
Pot.
4 wire RTD
3 wire RTD

In 2
Pot.
4 wire RTD
3 wire RTD

Function Diagram

Supply 12-24 Vdc
Source I
Source V
Out 1

Out 2

Out 1-A

Out 1-B

G.M. International ISM0018-18
D1072 - SIL 2 Temperature Signal Converter, Duplicator, Adder/Subtractor
HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC, HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D, CLASS II, DIVISION 1, GROUPS E, F, G, CLASS III, DIVISION 1, CLASS I, ZONE 0, GROUP IIC

SAFE AREA, ZONE 2 GROUP IIC T4, NON HAZARDOUS LOCATIONS, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1072D (Duplicator)

In 1
Pot. 4 wire RTD 3 wire RTD

13 14 15 16

3 + 4 Supply 12-24 Vdc

Source I Source V

Out 1-A

1 2

Source I Source V

Out 1-B

5 6

Source I Source V

Out 1

5 6

Source I Source V

Out 2

In A

Reference Junction Compensator Option 91

In B

Reference Junction Compensator Option 91

In A

Adder, Subtractor, Low/High Selector
Output repeats input A, B, (A+B)/2 or A-B

In B

Adder, Subtractor, Low/High Selector
Output repeats input A, B, (A+B)/2 or A-B

Pot. 4 wire RTD 3 wire RTD

9 10 11 12

Pot. 4 wire RTD 3 wire RTD

9 10 11 12

Pot. 4 wire RTD 3 wire RTD

9 10 11 12

Pot. 4 wire RTD 3 wire RTD

9 10 11 12
HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC, HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D, CLASS II, DIVISION 1, GROUPS E, F, G, CLASS III, DIVISION 1, CLASS I, ZONE 0, GROUP IIC

SAFE AREA, ZONE 2 GROUP IIC T4, NON HAZARDOUS LOCATIONS, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1072S

- Supply 12-24 Vdc
- Source I
- Source V
- Out 1

In 1
- TC
- 3 wire RTD
- 4 wire RTD
- Pot.

Reference Junction
Compensator Option 91

Out 1

Option 91
Description:
For this application, enable 4 - 20 mA Source mode for ch.1 (see page 13 for more information).
The module is powered by connecting 12-24 Vdc power supply to Pins 3 (+ positive) and 4 (- negative). The green LED is lit in presence of supply power.
Input sensor (Thermocouple, RTD, Potentiometer) is applied from Pins 13 to 16 (see page 13 for more information about input settings).
Source output current is applied to Pins 1-2 (for ch. 1).

Safety Function and Failure behavior:
D1072S is considered to be operating in Low Demand mode, as a Type B module, having Hardware Fault Tolerance (HFT) = 0.
The failure behaviour of D1072S module (only the 4 - 20 mA current output configuration is used for safety applications) is described from the following definitions:
- Fail-Safe State: is defined as the output going Low or High, considering that the safety logic solver can convert the Low or High fail (dangerous detected) to the fail-safe state.
- Fail Safe: failure mode that causes the module (or) sub-system to go to the defined fail-safe state without a demand from the process.
- Fail Dangerous: failure mode that does not respond to a demand from the process (i.e. being unable to go to the defined fail-safe state) or deviates the output current by more than 3 % (± 0.5 mA) of full span.
- Fail High: failure mode that causes the output signal to go above the maximum output current (> 20 mA). This limit value can be programmed from the user, but in this analysis it is set to 20 mA. Assuming that the application program in the safety logic solver is configured to detect High failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.
- Fail Low: failure mode that causes the output signal to go below the minimum output current (< 4 mA). This limit value can be programmed from the user, but in this analysis it is set to 4 mA. Assuming that the application program in the safety logic solver is configured to detect Low failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.
- Fail “No Effect”: failure mode of a component that plays a part in implementing the safety function but that is neither a safe failure nor a dangerous failure. When calculating the SFF, this failure mode is not taken into account.
- Fail “Not part”: failure mode of a component which is not part of the safety function but part of the circuit diagram and is listed for completeness. When calculating the SFF this failure mode is not taken into account.

As the module is supposed to be proven-in-use device, therefore according to the requirements of IEC 61511-1 section 11.4.4, a HFT = 0 is sufficient for SIL 2 (sub-) systems including Type B components and having a SFF equal or more than 60% and less than 90%.

Failure rate table:

<table>
<thead>
<tr>
<th>Failure category</th>
<th>Failure rates (FIT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>λsu = Total Safe Undetected failures</td>
<td>0.00</td>
</tr>
<tr>
<td>λdd = Total Dangerous Detected failures</td>
<td>242.35</td>
</tr>
<tr>
<td>λtd = Total Safe Detected failures</td>
<td>76.01</td>
</tr>
<tr>
<td>λtot safe = Total Failure Rate (Safety Function) = λsu + λdd + λtd</td>
<td>318.36</td>
</tr>
<tr>
<td>λtot = Total Safe Undetected failures</td>
<td>0.00</td>
</tr>
<tr>
<td>MTBF (safety function, single channel) = (1 / λtot safe) * MTTR (8 hours)</td>
<td>358 years</td>
</tr>
<tr>
<td>MTBF (device, single channel) = (1 / λtot device) * MTTR (8 hours)</td>
<td>503.80</td>
</tr>
<tr>
<td>226 years</td>
<td></td>
</tr>
</tbody>
</table>

MTBF (device, single channel) = (1 / λtot device) * MTTR (8 hours)

Failure rates table according to IEC 61508-2010 Ed.2:

<table>
<thead>
<tr>
<th>λsu (FIT)</th>
<th>λdd (FIT)</th>
<th>λtot safe (FIT)</th>
<th>λtot (FIT)</th>
<th>SFF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.00</td>
<td>242.35</td>
<td>76.01</td>
<td>76.12</td>
</tr>
</tbody>
</table>

where DC means the diagnostic coverage (safe or dangerous) for the input sensor by the safety logic solver and internal diagnostic circuits. This type "B" system has SFF = 76.12 % ≥ 60 % and HFT = 0, which is sufficient to get SIL 2 in accordance with the requirements of IEC 61511-1 section 11.4.4 during a proven-in-use assessment.

PFDavg vs T[Proof] table (assuming Proof Test coverage of 99%), with determination of SIL supposing module contributes ≤10% of total SIF dangerous failures:

<table>
<thead>
<tr>
<th>T[Proof] = 1 year</th>
<th>T[Proof] = 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFDavg = 3.35E-04 Valid for SIL 2</td>
<td>PFDavg = 6.70E-04 Valid for SIL 2</td>
</tr>
</tbody>
</table>

PFDavg vs T[Proof] table (assuming Proof Test coverage of 99%), with determination of SIL supposing module contributes >10% of total SIF dangerous failures:

<table>
<thead>
<tr>
<th>T[Proof] = 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFDavg = 3.35E-03 Valid for SIL 2</td>
</tr>
</tbody>
</table>
Application for D1072D, with 4-20 mA Current Output

Failure rates table according to IEC 61508:2010 Ed.2:

<table>
<thead>
<tr>
<th>Failure category</th>
<th>Failure rates (FIT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \lambda_{su} )</td>
<td>0.00 FIT</td>
</tr>
<tr>
<td>( \lambda_{sd} )</td>
<td>84.66 FIT</td>
</tr>
<tr>
<td>( \lambda_{dd} )</td>
<td>274.16 FIT</td>
</tr>
<tr>
<td>( \lambda_{tot-safe} )</td>
<td>0.00 FIT</td>
</tr>
<tr>
<td>( \lambda_{tot} )</td>
<td>358.82 FIT</td>
</tr>
<tr>
<td>( \lambda_{MTBF} )</td>
<td>318 years</td>
</tr>
<tr>
<td>( \lambda_{MTBF (8 hours)} )</td>
<td>145.60 FIT</td>
</tr>
<tr>
<td>( \lambda_{MTBF (device, one channel)} )</td>
<td>752.60 FIT</td>
</tr>
<tr>
<td>( \lambda_{MTBF (device, all channels)} )</td>
<td>151 years</td>
</tr>
</tbody>
</table>

MTBF: time between failures of a safety function or device, including all secondary failures, including all secondary failures.

SFF: safety function failure rate.

DC: diagnostic coverage (safe or dangerous) for the input sensor by the safety logic solver and internal diagnostic circuits.

Failure rate table:

- \( \lambda_{su} \): Total Safe Undetected failures
- \( \lambda_{sd} \): Total Safe Detected failures
- \( \lambda_{dd} \): Total Dangerous Undetected failures
- \( \lambda_{tot-safe} \): Total Safe Failure Rate (Safety Function)
- \( \lambda_{tot} \): Total Failure Rate (Device)
- \( \lambda_{MTBF} \): Mean time between failures (MTBF)
- \( \lambda_{MTBF (device, one channel)} \): Mean time between failures of a safety function or device, including all secondary failures.
- \( \lambda_{MTBF (device, all channels)} \): Mean time between failures of a safety function or device, including all secondary failures.

Safety Function and Failure behavior:

D1072D is considered to be operating in Low Demand mode, as a Type B module, having Hardware Fault Tolerance (HFT) = 0.

The failure behaviour of D1072D module (only the 4 - 20 mA current output configuration is used for safety applications) is described from the following definitions:

- Fail-Safe State: is defined as the output going Low or High, considering that the safety logic solver can convert the Low or High fail (dangerous detected) to the fail-safe state.
- Fail Safe: failure mode that causes the module (sub)system to go to the defined fail-safe state without a demand from the process.
- Fail Dangerous: failure mode that does not respond to a demand from the process (i.e., being unable to go to the defined fail-safe state) or deviates the output current by more than 3 % (± 0.5 mA) of full span.
- Fail High: failure mode that causes the output signal to go above the maximum output current (> 20 mA). This limit value can be programmed from the user, but in this analysis it is set to 20 mA. Assuming that the application program in the safety logic solver is configured to detect High failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.
- Fail Low: failure mode that causes the output signal to go below the minimum output current (< 4 mA). This limit value can be programmed from the user, but in this analysis it is set to 4 mA. Assuming that the application program in the safety logic solver is configured to detect Low failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.
- Fail ‘No Effect’: failure mode of a component that plays a part in implementing the safety function but that is neither a safe failure nor a dangerous failure. When calculating the SFF, this failure mode is not taken into account.
- Fail ‘Not part’: failure mode of a component which is not part of the safety function but part of the circuit diagram and is listed for completeness. When calculating the SFF this failure mode is not taken into account.

As the module is supposed to be proven-in-use device, therefore according to the requirements of IEC 61511-1 section 11.4.4, a HFT = 0 is sufficient for SIL 2 (sub-) systems including Type B components and having a SFF equal or more than 60% and less than 90%.

Failure rate data: taken from Siemens Standard SN29500.

Fail High: failure mode that causes the output signal to go above the maximum output current (> 20 mA). This limit value can be programmed from the user, but in this analysis it is set to 20 mA. Assuming that the application program in the safety logic solver is configured to detect High failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.

Fail Low: failure mode that causes the output signal to go below the minimum output current (< 4 mA). This limit value can be programmed from the user, but in this analysis it is set to 4 mA. Assuming that the application program in the safety logic solver is configured to detect Low failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.

Fail “Not part”: failure mode of a component which is not part of the safety function but part of the circuit diagram and is listed for completeness. When calculating the SFF this failure mode is not taken into account.

Fail “No Effect”: failure mode of a component that plays a part in implementing the safety function but that is neither a safe failure nor a dangerous failure. When calculating the SFF, this failure mode is not taken into account.

Fail-Safe State: is defined as the output going Low or High, considering that the safety logic solver can convert the Low or High fail (dangerous detected) to the fail-safe state.

Fail Safe: failure mode that causes the module (sub)system to go to the defined fail-safe state without a demand from the process.

Fail Dangerous: failure mode that does not respond to a demand from the process (i.e., being unable to go to the defined fail-safe state) or deviates the output current by more than 3 % (± 0.5 mA) of full span.

Fail High: failure mode that causes the output signal to go above the maximum output current (> 20 mA). This limit value can be programmed from the user, but in this analysis it is set to 20 mA. Assuming that the application program in the safety logic solver is configured to detect High failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.

Fail Low: failure mode that causes the output signal to go below the minimum output current (< 4 mA). This limit value can be programmed from the user, but in this analysis it is set to 4 mA. Assuming that the application program in the safety logic solver is configured to detect Low failure and does not automatically trip on this failure, this failure has been classified as a dangerous detected (DD) failure.

Fail ‘No Effect’: failure mode of a component that plays a part in implementing the safety function but that is neither a safe failure nor a dangerous failure. When calculating the SFF, this failure mode is not taken into account.

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As the module is supposed to be proven-in-use device, therefore according to the requirements of IEC 61511-1 section 11.4.4, a HFT = 0 is sufficient for SIL 2 (sub-) systems including Type B components and having a SFF equal or more than 60% and less than 90%.

Failure rate data: taken from Siemens Standard SN29500.
Testing procedure at T-proof

The proof test shall be performed to reveal dangerous faults which are undetected by diagnostic.
This means that it is necessary to specify how dangerous undetected faults, which have been noted during the FMEDA, can be revealed during the proof test.

Proof test 1 (to reveal 50 % of possible Dangerous Undetected failures)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bypass the safety PLC or take other appropriate action to avoid a false trip.</td>
</tr>
<tr>
<td>2</td>
<td>Send a command to the temperature converter to go to the full scale current output and verify that the analog current reaches that value. This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.</td>
</tr>
<tr>
<td>3</td>
<td>Send a command to the temperature converter to go to the low scale current output and verify that the analog current reaches that value. This tests for possible quiescent current related failures.</td>
</tr>
<tr>
<td>4</td>
<td>Restore the loop to full operation.</td>
</tr>
<tr>
<td>5</td>
<td>Remove the bypass from the safety-related PLC or otherwise restore normal operation.</td>
</tr>
</tbody>
</table>

Proof test 2 (to reveal 99 % of possible Dangerous Undetected failures)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bypass the safety PLC or take other appropriate action to avoid a false trip.</td>
</tr>
<tr>
<td>2</td>
<td>Perform steps 2 and 3 of Proof Test 1.</td>
</tr>
<tr>
<td>3</td>
<td>Perform a two-point calibration of the temperature converter (i.e. 4 mA and 20 mA) and verify that the output current from the module is within the specified accuracy.</td>
</tr>
<tr>
<td>4</td>
<td>Restore the loop to full operation.</td>
</tr>
<tr>
<td>5</td>
<td>Remove the bypass from the safety-related PLC or otherwise restore normal operation.</td>
</tr>
</tbody>
</table>

Warning

D1072 series are isolated Intrinsically Safe Associated Apparatus installed into standard EN50022 T35 DIN Rail located in Safe Area/ Non Hazardous Locations or Zone 2, Group IIIC, Temperature Classification T4, Class I, Division 2, Groups A, B, C, D, Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA Temperature Code T4 Hazardous Area/Hazardous Locations (according to EN/IEC60079-16, FM Class No. 3611, CSA-C22.2 No. 213-M1987, CSA-E60079-16) within the specified operating temperature limits Tamb -20 to +60 °C, and connected to equipment with a maximum limit for AC power supply UIm of 250 Vrms.

FM Approved under Entity Concept, or third party approval

Non-incendive field wiring (permitted only for US installations), or third party approval.
Operation

Input channel of D1072 accepts a signal from Hazardous Area/Hazardous Locations (thermocouple, resistance thermometer, transmitting potentiometer) and converts the signal to a 0-10 mA or 0/1-V or 0-10 V floating output to drive a load in Safe Area/Non Hazardous Locations. Presence of supply power is displayed by a green signaling LED, integrity of field sensor and connecting line can be monitored by a configurable burnout circuit which, if enabled, can drive output signal to upscale or downscale limit.

Burnout detection is also signaled by a red LED on the front panel and by an optocoupled transistor in common with power supply. Type D1072S has a single input and output channel, type D1072D has double input and output channel; type D1072D can also be programmed to interface a single input and obtain dual output channel (duplicator) or configurable output channel (outputs can repeat the corresponding inputs or be proportional to the sum or difference of the two input process variables or with low/high selector function).

Installation

D1072 series are temperature signal converter housed in a plastic enclosure suitable for installation on T35 DIN Rail according to EN50022.

D1072 unit can be mounted with any orientation over the entire ambient temperature range, see section "Installation in Cabinet" and "Installation of Electronic Equipments in Cabinet" Instruction Manual D1000 series for detailed instructions.

D1072 temperature signal converter operates at low level measuring signals, for best performance, install it far from heat sources (heat dissipating equipment) and wide temperature excursions, in example at the bottom of a cabinet with heat dissipating equipment, if any, at the top.

Electrical connection of conductors up to 2.5 mm² are accommodated by polarized plug-in removable screw terminal blocks which can be plugged in/out into a powered unit without suffering or causing any damage (for Zone 2 or Division 2 installations check the area to be nonhazardous before servicing).

The wiring cables have to be proportionate in base to the current and the length of the cable.

On the section "Function Diagram" and enclosure side a block diagram identifies all connections.

Identify the number of channels of the specific card (e.g. D1072S is a single channel model and D1072D is a dual channel model), the function and location of each connection terminal using the wiring diagram on the corresponding section, as an example:

Connect 12-24 Vdc power supply positive at terminal "3" and negative at terminal "4".

For model D1072S connect positive output of channel 1 at terminal "1" and negative output at "2".

For model D1072D in addition to channel 1 connections above, connect positive output of channel 2 at terminal "5" and negative output at "6".

For a 3 wires thermoresistance temperature input connect thermometer wire A at terminal "16", B and C interconnected wires at terminals "14" and "13" for channel 1 and at terminals "12", "10", "9" for channel 2.

Note that for a correct line resistance compensation in case of 3 wire sensor, wire A and B should have the same resistance.

Intrinsically Safe conductors must be identified and segregated from non I.S. and wired in accordance to the relevant national/international installation standards (e.g. EN/IEC60079-14 Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines), BS S345 PM, VDE 165, ANSI/ISA RP12.06.01 Installation of Intrinsically Safe System for Hazardous (Classified) Locations, National Electrical Code NEC ANSI/NFPA 70 Section 504 and 505, Canadian Electrical Code CEC), make sure that conductors are well isolated from each other and do not produce any unintentional connection.

The enclosure provides, according to EN60529, an IP20 minimum degree of mechanical protection (or similar to NEMA Standard 250 type 1) for indoor installation, outdoor installation requires an additional enclosure with higher degree of protection (i.e. IP54 to IP65 or NEMA type 12-13) consistent with the effective operating environment of the specific installation.

Units must be protected against dirt, dust, extreme mechanical (e.g. vibration, impact and shock) and thermal stress, and casual contacts.

If enclosure needs to be cleaned use only a cloth lightly moistened by a mixture of detergent in water.

Electrostatic Hazard: to avoid electrostatic hazard, the enclosure of D1072 must be cleaned only with a damp or antistatic cloth.

Any penetration of cleaning liquid must be avoided to prevent damage to the unit. Any unauthorized card modification must be avoided.

According to EN61010, D1072 series must be connected to SELV or SELV-E supplies.

Start-up

Before powering the unit check that all wires are properly connected, particularly supply conductors and their polarity, input and output wires, also check that Intrinsically Safe conductors and cable trays are segregated (no direct contacts with other non I.S. conductors) and identified either by color coding, preferably blue, or by marking. Check conductors for exposed wires that could touch each other causing dangerous unwanted shorts. Turn on power, the “power on” green led must be lit, output on each channel must be in accordance with the corresponding input signal value and input/output chosen transfer function. If possible change the sensor condition and check the corresponding Safe Area output.

PPC1090 Operation

The Pocket Portable Configurator type PPC1090 is suitable to configure the "smart" barrier of D1000 series. The PPC1090 unit is not ATEX, UL or FM approved and is only to be used in Safe Area/Non Hazardous Locations and prior to installation of the isolator and prior to connection of any I.S. wiring. Do not use PPC1090 configurator in Hazardous Area/Hazardous Locations.

The PPC1090 configurator is powered by the unit (no battery power) when the telephone jack is plugged into the barrier (RU1 2 poles connector type with 1:1 connection).

It has a 5 digit display, 4 leds and 4 push buttons with a menu driven configuration software and can be used in Safe Area/Non Hazardous Locations without any certification because it plugs into the non intrinsically safe portion of circuit.

PPC1090 Configuration

The configuration procedure follows a unit specific menu.

The display shows the actual menu item, the led shows the channel configured and the push button actuates as “Enter”, “Select”, “Down” and “Up” key.

The “Enter” key is pressed to confirm the menu item, the “Select” key is pressed to scroll the menu item, the “Down” and “Up” keys are pressed to decrement or increment the numeric value of menu item. The “Up” key is also pressed to decrement the menu level. When the PPC1090 is plugged into the unit, the display shows the barrier model (first level menu).

Then press the “Enter” key to the second level menu and the “Select” key to scroll the menu voice. When the selected menu item is displayed press the “Enter” key to confirm the choice. Follow this procedure for every voice of the menu. When a numeric menu item is to be changed, press the “Select” key to highlight the character and then the “Up” and “Down” keys to select the number, confirm the modification with the “Enter” key. To return to a higher level menu press the “Up” key.

Menu item description D1072S or D1072D

1) D1072 or D1072D [1 Level Menu]
   Displays Model D1072S single channel type or D1072D dual channel type. Press “Enter” key to second level menu.

2) CF/CF 1 or CF 2 [2 Level Menu]
   Displays the parameters configuration menu. Press “Enter” key to configure the functional parameters, press the “Select” key to the next menu level item or “Up” key to return to first level.

3) In/In 1 or In 2 [2 Level Menu]
   Displays the input variable monitoring. Press “Enter” to display the current input value reading, press the “Select” key to the next menu level item or “Up” key to return to first level.

4) Out/Out 1 or Out 2 [2 Level Menu]
   Displays the analog output variable monitoring. Press “Enter” to display the current output value reading, press the “Select” key to the next menu level item or “Up” key to return to first level.
CJ Set  fixed ambient temperature compensation, value is setted by CJ Ref menu item (do not require option 91 thermoresistance sensor)

CJ Aut  automatic compensation of ambient temperature (via option 91 thermoresistance sensor)

Compensation types; press "Select" key to change the type and then the "Enter" key to confirm the choice. The input compensation types are:

4-20  4 to 20 mA current output (for SIL applications)
1-5   1 to 5 V voltage output
2-10  2 to 10 V voltage output

The output types are:

0-20  0 to 20 mA current output
0-5   0 to 5 V voltage output
0-10  0 to 10 V voltage output

Displays the reference junction compensation type configuration for thermoresistance sensor. Press "Enter" to set the reference connection type, press the "Select" key to change the reference connection type, press "Select" key to change the reference connection and then the "Enter" key to confirm the choice. If you pressed "Enter", you can choose between 2 different sensor types: 3 wire connection type thermoresistance sensor.

Displays the thermoresistance compensation value configuration for thermoresistance sensor. Press "Enter" to set the thermoresistance compensation value, press the "Select" key to change the compensation value, press the "Enter" key to confirm the choice. The thermoresistance compensation types are:

Pt 100  Thermoresistance Pt 100 (russian standard), -200 to +650°C range
M 50   Thermoresistance M 50 (russian standard), -200 to +650°C range
Ni 120  Thermoresistance Ni 120 (russian standard), -75 to +300°C range
CU 36  Thermoresistance Copper 36 (russian standard), -50 to +160°C range
CU 46  Thermoresistance Copper 46 (russian standard), -50 to +180°C range

Displays the input sensor type configuration. Press "Enter" to set the input sensor, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter", you can choose between 26 different sensors; press "Select" key to change the sensor. The input sensors are:

Pt 200  Thermoresistance Pt 200 (russian standard), -200 to +650°C range
Pt 300  Thermoresistance Pt 300 (russian standard), -200 to +1000°C range
Pt 1000 Thermoresistance Pt 1000 (russian standard), -200 to +650°C range

Displays the input sensor connection type configuration for thermoresistance sensor. Press "Enter" to set the input connection type, press the "Select" key to change the input connection type, press "Select" key to change the input connection and then the "Enter" key to confirm the choice. If you pressed "Enter", you can choose between 2 different connection types: 3 wire connection type thermoresistance sensor.

Displays the reference sensor type configuration for thermoresistance sensor. Press "Enter" to set the reference sensor type, press the "Select" key to change the reference sensor type, press the "Enter" key to confirm the choice. If you pressed "Enter", you can choose between 2 different sensor types: 3 wire connection type thermoresistance sensor.

Displays the 3 wire connection type thermoresistance sensor.

Displays the 4 wire connection type thermoresistance sensor.
Each channel has independent configurations.

### INPUT SECTION:

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Input sensor type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC A</td>
<td>thermocouple to ST90, GOST R.585.2001 range from –10 to +2500 °C</td>
<td></td>
</tr>
<tr>
<td>TC A2</td>
<td>thermocouple to ST90, GOST R.585.2001 range from –10 to +1800 °C</td>
<td></td>
</tr>
<tr>
<td>TC A3</td>
<td>thermocouple to ST90, GOST R.585.2001 range from –10 to +1800 °C</td>
<td></td>
</tr>
<tr>
<td>TC B</td>
<td>thermocouple to ST90, NBS125, GOST R.585.2001 range from –50 to +1800 °C</td>
<td></td>
</tr>
<tr>
<td>TC C</td>
<td>thermocouple to ST90, NBS125, GOST R.585.2001 range from –250 to +1000 °C</td>
<td></td>
</tr>
<tr>
<td>TC D</td>
<td>thermocouple to ST90, NBS125, GOST R.585.2001 range from –20 to +750 °C</td>
<td></td>
</tr>
<tr>
<td>TC E</td>
<td>thermocouple to ST90, NBS125, GOST R.585.2001 range from –250 to +1350 °C</td>
<td></td>
</tr>
<tr>
<td>TC L</td>
<td>thermocouple to SIPT68, DIN43710 range from –200 to +800 °C</td>
<td></td>
</tr>
<tr>
<td>TC Lr</td>
<td>thermocouple to ST90, GOST R.585.2001 range from –200 to +800 °C</td>
<td></td>
</tr>
<tr>
<td>TC N</td>
<td>thermocouple to ST90, NBS121, GOST R.585.2001 range from –250 to +1300 °C</td>
<td></td>
</tr>
<tr>
<td>TC R</td>
<td>thermocouple to ST90, NBS125, GOST R.585.2001 range from –50 to +1750 °C</td>
<td></td>
</tr>
<tr>
<td>TC S</td>
<td>thermocouple to ST90, NBS125, GOST R.585.2001 range from –50 to +1750 °C</td>
<td></td>
</tr>
<tr>
<td>TC S1</td>
<td>thermocouple type S1 to SIPT68, russian range from –50 to +1600 °C</td>
<td></td>
</tr>
<tr>
<td>TC T</td>
<td>thermocouple to ST90, NBS125, GOST R.585.2001 range from –250 to +400 °C</td>
<td></td>
</tr>
<tr>
<td>TC U</td>
<td>thermocouple to SIPT68, DIN43710 range from –200 to +400 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 100</td>
<td>thermistor resistance to SIPT68, IEC751 range from –200 to +650 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 200</td>
<td>thermistor resistance to SIPT68, IEC751 range from –150 to +400 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 300</td>
<td>thermistor resistance to SIPT68, IEC751 range from –150 to +250 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 500</td>
<td>thermistor resistance to SIPT68, ANSI range from –200 to +625 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 600</td>
<td>thermistor resistance to SIPT68, ANSI range from –200 to +75 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 700</td>
<td>thermistor resistance to SIPT68, russian range from –200 to +650 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 800</td>
<td>thermistor resistance to SIPT68, russian range from –200 to +650 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 900</td>
<td>thermistor resistance to SIPT68, DIN43760 range from –50 to +75 °C</td>
<td></td>
</tr>
<tr>
<td>Ni 100</td>
<td>thermistor resistance to SIPT68, DIN43760 range from –50 to +180 °C</td>
<td></td>
</tr>
<tr>
<td>Ni 200</td>
<td>thermistor resistance to SIPT68, DIN43760 range from –50 to +300 °C</td>
<td></td>
</tr>
<tr>
<td>Cu 100</td>
<td>thermistor resistance to SIPT68, russian range from –50 to +200 °C</td>
<td></td>
</tr>
<tr>
<td>Cu 50</td>
<td>thermistor resistance to SIPT68, russian range from –50 to +180 °C</td>
<td></td>
</tr>
<tr>
<td>Cu 60</td>
<td>thermistor resistance to SIPT68, russian range from –50 to +200 °C</td>
<td></td>
</tr>
<tr>
<td>Cu 46</td>
<td>thermistor resistance to SIPT68, russian range from –200 to +650 °C</td>
<td></td>
</tr>
<tr>
<td>Pt 3</td>
<td>3 wires transmitting potentiometer, 50 Ω to 20 KΩ, range from 0 to 100%</td>
<td></td>
</tr>
<tr>
<td>Pt 12</td>
<td>millivolt signal range from –20 to +85 mV</td>
<td></td>
</tr>
</tbody>
</table>

### OUTPUT SECTION:

<table>
<thead>
<tr>
<th>Output</th>
<th>Output analog output type</th>
</tr>
</thead>
<tbody>
<tr>
<td>V 1</td>
<td>0-20 mA current output range from 4 to 20 mA (for SIL applications)</td>
</tr>
<tr>
<td>V 2</td>
<td>0-20 mA current output range from 0 to 20 mA</td>
</tr>
<tr>
<td>V 3</td>
<td>1-5 V voltage output range from 1 to 5 V</td>
</tr>
<tr>
<td>V 4</td>
<td>0-5 V voltage output range from 0 to 5 V</td>
</tr>
<tr>
<td>V 5</td>
<td>2-10 V voltage output range from 2 to 10 V</td>
</tr>
<tr>
<td>V 6</td>
<td>0-10 V voltage output range from 0 to 10 V</td>
</tr>
</tbody>
</table>

### Function:

<table>
<thead>
<tr>
<th>Function</th>
<th>Output analog output type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch. A</td>
<td>analog output represents input of first channel</td>
</tr>
<tr>
<td>Ch. B</td>
<td>analog output represents input of second channel</td>
</tr>
<tr>
<td>Add</td>
<td>analog output represents the sum of the two input channels: (A+B)/2</td>
</tr>
<tr>
<td>Sub</td>
<td>analog output represents the difference of the two input channels: A-B</td>
</tr>
<tr>
<td>Low Ch.</td>
<td>analog output represents the lower of the two input channels</td>
</tr>
</tbody>
</table>

### Cold Junction:

<table>
<thead>
<tr>
<th>Value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>–60 Ω</td>
<td>–100 °C</td>
</tr>
</tbody>
</table>

### RDT line resist:

<table>
<thead>
<tr>
<th>Value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>−5 Ω</td>
<td>+20 Ω</td>
</tr>
</tbody>
</table>

### INPUT TAG SECTION:

1. first channel tag
2. second channel tag

Each channel has independent configurations.