INSTRUCTION & SAFETY MANUAL

SIL 2 Temperature Signal Converter, Duplicator, Adder/Subtractor Din-Rail Models D1072S, D1072D

technology for safety

Characteristics

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 provides 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).
Configurability: 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.

Technical Data

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/I.S. In 500 V; Out/Supply 500 V; Out/Out 500 V.
Input: millivolt or thermocouple type A1, A2, A3, B, E, J, K, L, Lr, N, R, S, S1, 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 thermocouple type B, R, S, S1, 2 µV thermocouple A1, A2, A3, 20 mΩ on RTD, 0.05 % on transmitting potentiometer.
Visualization: 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 nA.
Burnout: enabled or disabled. Analog output can be programmed to detect burnout condition with downscale or highscale 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.
Ref. Junction Compensation influence: ≤ ± 1 °C (thermocouple sensor).
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:
CE mark compliant, conforms to Directive:
2014/34/EU ATEX, 2014/30/EU EMC, 2014/35/EU LVD, 2011/65/EU RoHS.
Environmental conditions: ***Operating:*** temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
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 ec IIC T4 Gc
IECEx: [Ex ia Ga] IIC, [Ex ia Da] IIIC, [Ex ia Ma] I, Ex ec IIC T4 Gc
INMETRO: [Ex ia Ga] IIC, [Ex ia Da] IIIC, [Ex ia Ma] I
Uo/Voc = 10.8 V, Io/Isc = 9 mA, Po/Po = 24 mW at terminals 13-14-15-16, 9-10-11-12.
Ui/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.
Approvals:
DMT 01 ATEX E 042 X conforms to EN60079-0, EN60079-11.
IECEx BVS 07.0027X conforms to IEC60079-0, IEC60079-11.
IMQ 09 ATEX 013 X conforms to EN60079-0, EN60079-7.
IECEx IMQ 13.0011X conforms to IEC60079-0, IEC60079-7.
INMETRO DNV 13.0108 X conforms to ABNT NBR IEC60079-0, ABNT NBR IEC60079-11.
UL & C-UL E222308 conforms to UL913, UL 60079-0, UL60079-11, UL60079-15,
ANSI/ISA 12.12.01 for UL and CSA-C22.2 No.157-92, CSA-E60079-0, CSA-E60079-11, CSA-C22.2 No. 213 and CSA-E60079-15 for C-UL.
FM & FM-C No. 3024643, 3029921C, conforms to Class 3600, 3610, 3611, 3810,
ANSI/ISA 12.12.02, ANSI/ISA 60079-0, ANSI/ISA 60079-11, C22.2 No.142,
C22.2 No.157, C22.2 No.213, E60079-0, E60079-11, E60079-15.
ЕАЭС RU C-IT.HA67.B.00113/20 conforms to GOST 31610.0, GOST 31610.11, GOST 31610.15.
СЦ 16.0034 X conforms to ДСТУ 7113, ГОСТ 22782.5-78, ДСТУ IEC 60079-15.
TÜV Declaration of Compliance No. C-IS-722238330, SIL 2 according to IEC 61508:2010 Ed.2.
SIL 3 Functional Safety TÜV Certificate conforms to IEC61508:2010 Ed.2, for Management of Functional Safety.
DNV No. TAA00002BM and KR No.MIL20769-EL001 Cert. for maritime applications.
Mounting: EN/IEC60715 TH 35 DIN-Rail.
Weight: about 170 g D1072D, 140 g D1072S.
Connection: by polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
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.

Ordering information

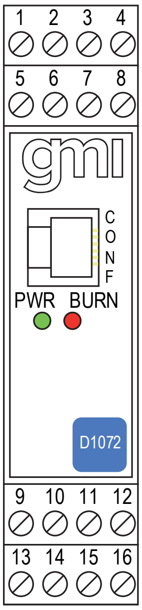
Model: D1072			
1 channel	S		
2 channels	D		
Power Bus enclosure		/B	
Reference Junction Compensator (TC input)			OPT1091

Power Bus and DIN-Rail accessories:

DIN rail anchor MCHP065
DIN rail stopper MORT016
Terminal block male MORT017
Terminal block female MORT022

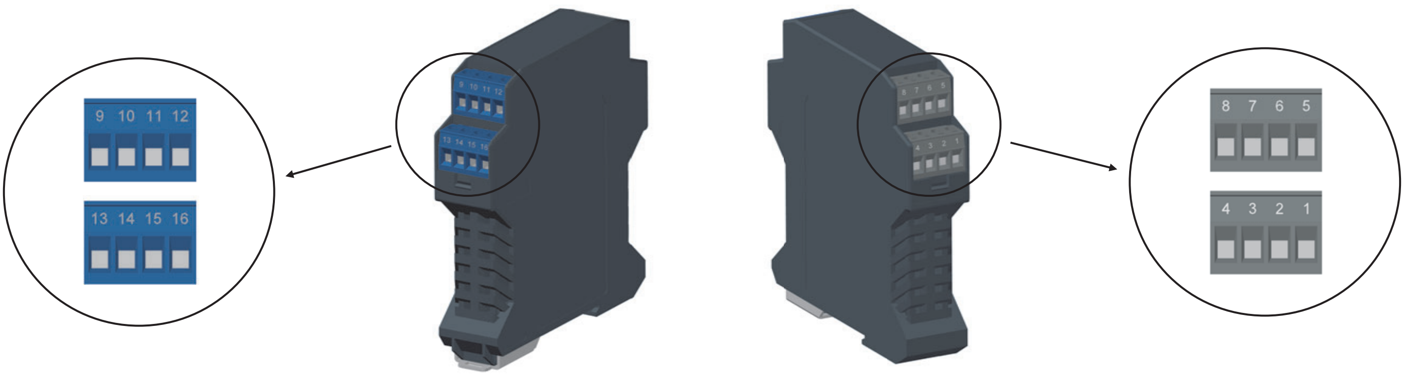
Operating parameters are programmable by the GM Pocket Portable Configurator PPC1090 or via RS-232 serial line with PPC1092 Adapter and SWC1090 Configurator software. If the parameters are provided with the purchasing order the unit will be configured accordingly, otherwise the unit will be supplied 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 61508:2010 (Route 2H)
  for analog current source output of each channel
  D1072S:Tproof = 3/10 yrs (≤10% / >10 % of total SIF)
  D1072D:Tproof = 3/10 yrs (≤10% / >10 % of total SIF)
- SC2 : Systematic Capability SIL2.
- 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	
9	Input Ch 2 for Reference Junction Compensator Option 91 or Input Ch 2 for 3-4 wire RTD or potentiometer
10	Input Ch 2 for 3-4 wire RTD
11	+ Input Ch 2 for thermocouple TC or Input Ch 2 for 4 wire RTD or Input Ch 2 for potentiometer
12	- Input Ch 2 for thermocouple TC or Input Ch 2 for 3-4 wire RTD or potentiometer
13	Input Ch 1 for Reference Junction Compensator Option 91 or Input Ch 1 for 3-4 wire RTD or potentiometer
14	Input Ch 1 for 3-4 wire RTD
15	+ Input Ch 1 for thermocouple TC or Input Ch 1 for 4 wire RTD or for potentiometer
16	- Input Ch 1 for thermocouple TC or Input Ch 1 for 3-4 wire RTD or potentiometer

SAFE AREA	
1	+ Output Ch 1 for Current Source mode or + Output Ch 1 for Voltage Source mode
2	- Output Ch 1 for Current Source mode or - Output Ch 1 for Voltage Source mode
3	+ Power Supply 12 - 24 Vdc
4	- Power Supply 12 - 24 Vdc
5	+ Output Ch 2 for Current Source mode or + Output Ch 2 for Voltage Source mode
6	- Output Ch 2 for Current Source mode or - Output Ch 2 for Voltage Source mode
7	Not used
8	Not used

Parameters 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 (Ui/Vmax, Ii/Imax, Pi/Pi) are not exceeded by the safety parameters (Uo/Voc, Io/Isc, Po/Po) 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:

D1072 Terminals		D1072 Associated Apparatus Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters
Ch1	13 - 14 - 15 - 16	Uo / Voc = 10.8 V	≤	Ui / Vmax
Ch2	9 - 10 - 11 - 12			
Ch1	13 - 14 - 15 - 16	Io / Isc = 9 mA	≤	Ii/ Imax
Ch2	9 - 10 - 11 - 12			
Ch1	13 - 14 - 15 - 16	Po / Po = 24 mW	≤	Pi / Pi
Ch2	9 - 10 - 11 - 12			

D1072 Terminals		D1072 Associated Apparatus Parameters		Must be	Hazardous Area/ Hazardous Locations Device + Cable Parameters
Ch1	13 - 14 - 15 - 16	Co / Ca = 2.134 µF	(IIC-A, B)	≥	Ci / Ci device + C cable
Ch2	9 - 10 - 11 - 12	Co / Ca = 14.994 µF	(IIB-C)		
		Co / Ca = 65.994 µF	(IIA-D)		
		Co / Ca = 58 µF	(I)		
		Co / Ca = 14.994 µF	(IIIC)		
Ch1	13 - 14 - 15 - 16	Lo / La = 468 mH	(IIC-A, B)	≥	Li / Li device + L cable
Ch2	9 - 10 - 11 - 12	Lo / La = 1874 mH	(IIB-C)		
		Lo / La = 3749 mH	(IIA-D)		
		Lo / La = 6100 mH	(I)		
		Lo / La = 1874 mH	(IIIC)		
Ch1	13 - 14 - 15 - 16	Lo / Ro = 1510 µH/Ω	(IIC-A, B)	≥	Li / Ri device and L cable / R cable
Ch2	9 - 10 - 11 - 12	Lo / Ro = 6050 µH/Ω	(IIB-C)		
		Lo / Ro = 12100 µH/Ω	(IIA-D)		
		Lo / Ro = 19850 µH/Ω	(I)		
		Lo / Ro = 6050 µH/Ω	(IIIC)		

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

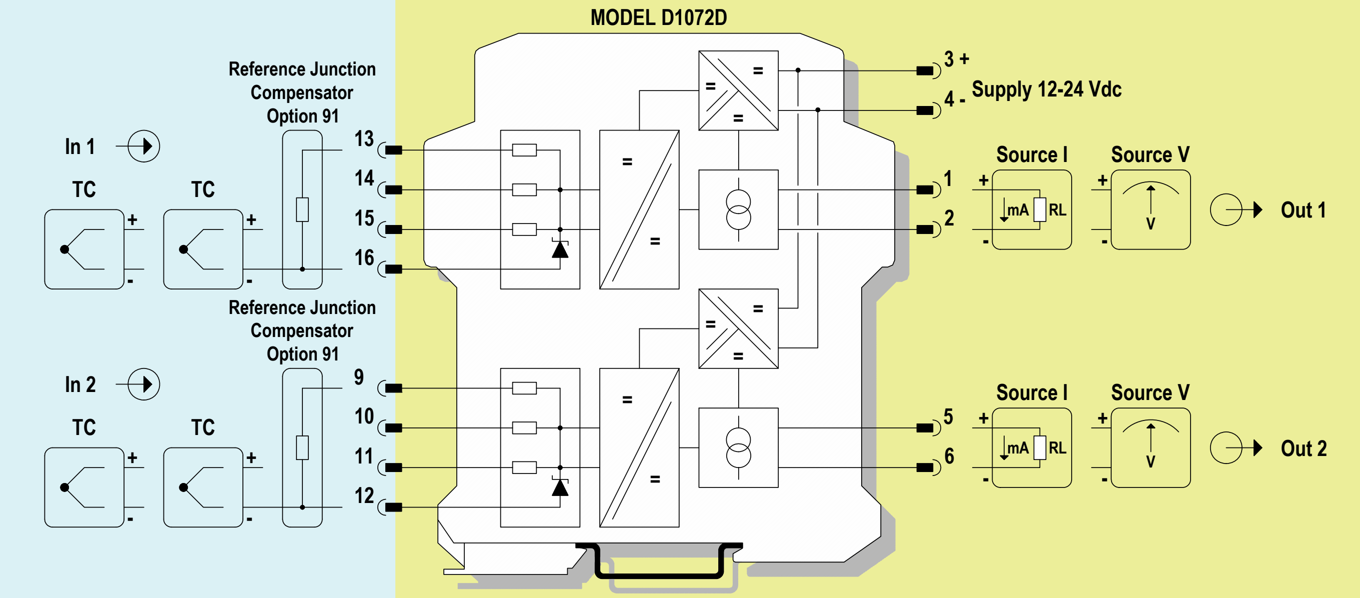
When used with separate powered intrinsically safe devices, check that maximum allowable voltage (Ui/Vmax) of the D1072 Associated Apparatus are not exceeded by the safety parameters (Uo/Voc) of the Intrinsically Safe device, indicated in the table below:

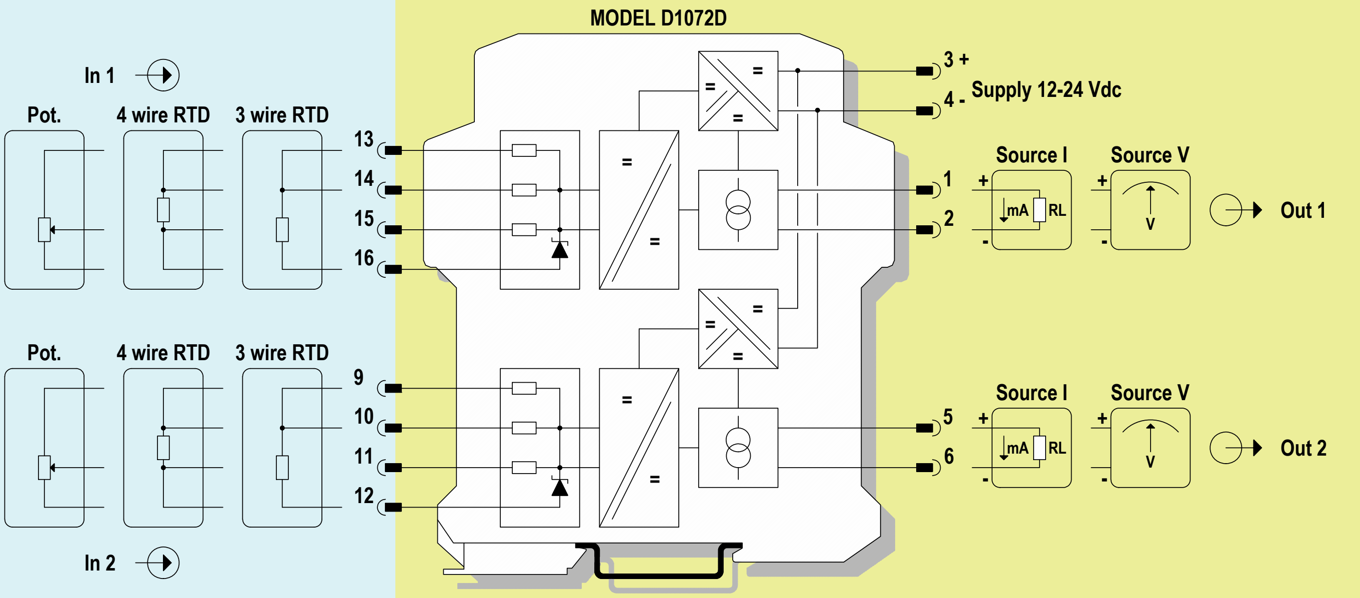
D1072 Terminals		D1072 Associated Apparatus Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters
Ch1	13 - 14 - 15 - 16	Ui / Vmax = 18 V	≥	Uo / Voc
Ch2	9 - 10 - 11 - 12			
Ch1	13 - 14 - 15 - 16	Ci = 6 nF, Li= 0 nH		
Ch2	9 - 10 - 11 - 12			

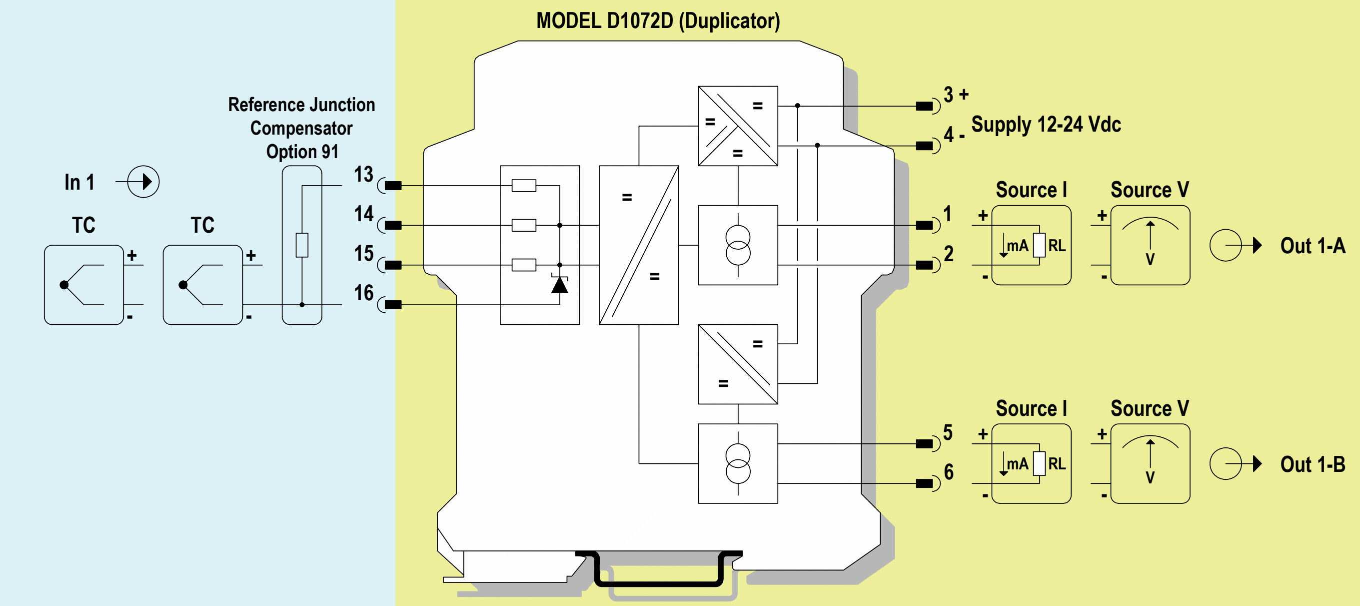
For installations in which both the Ci and Li of the Intrinsically Safe apparatus exceed 1% of the Co and Lo parameters of the Associated Apparatus (excluding the cable), then 50% of Co and Lo parameters are applicable and shall not be exceeded (50% of the Co and Lo become the limits which must include the cable such that Ci device + C cable ≤ 50 % of Co and Li device + L cable ≤ 50 % of Lo). The reduced capacitance of the external circuit (including cable) shall not be greater than 1 µF for Groups I, IIA, IIB and 600 nF for Group IIC. If the cable parameters are unknown, the following value may be used: Capacitance 200 pF per meter (60 pF per foot), Inductance 1 µH per meter (0.20 µH per foot).
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).

Function Diagram

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



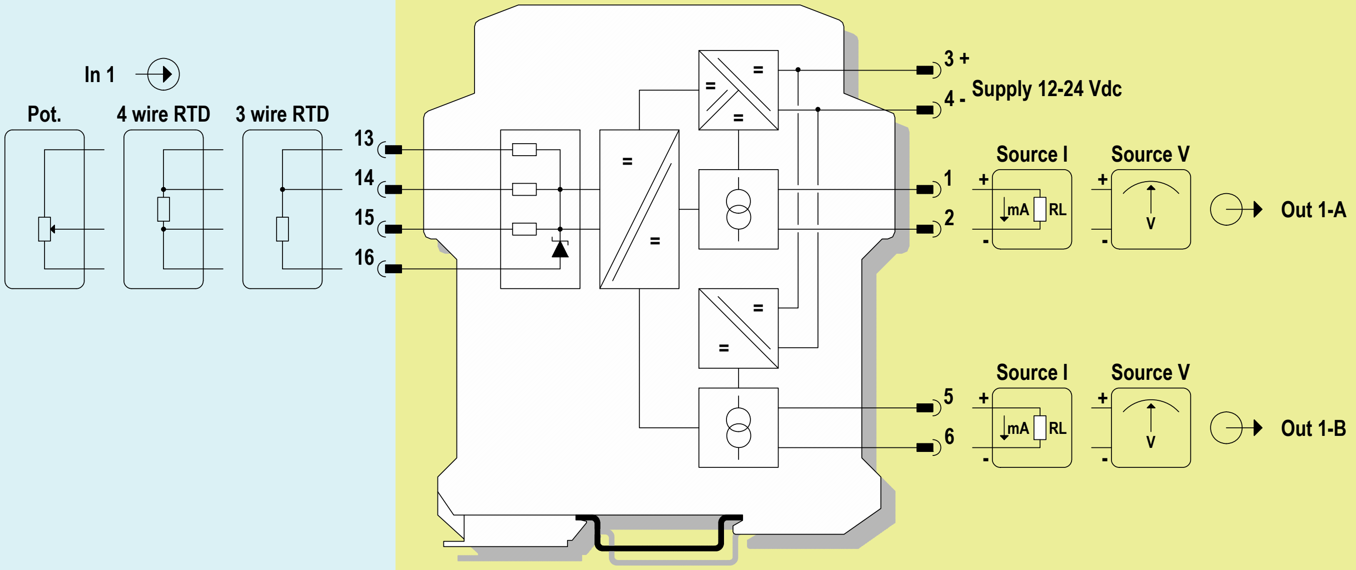




Function Diagram

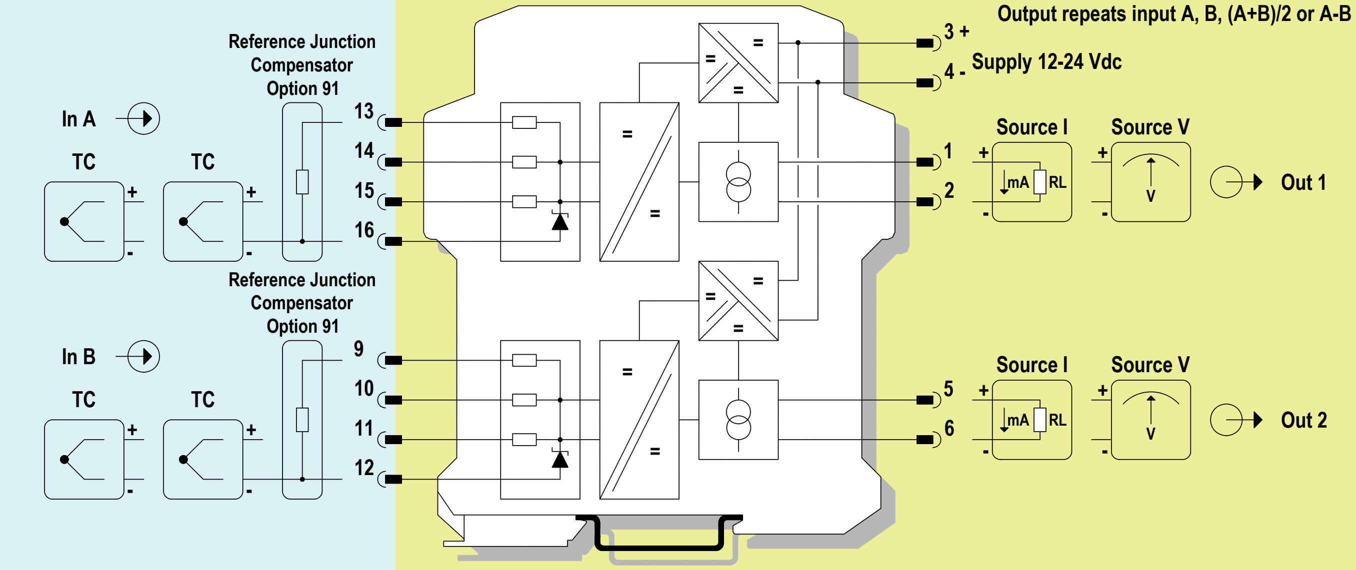
HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC, HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D, CLASS II, DIVISION 1, GROUPS E, F, G, CLASS III, DIVISION 1, CLASS I, ZONE 0, GROUP IIC	SAFE AREA, ZONE 2 GROUP IIC T4, NON HAZARDOUS LOCATIONS, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1072D (Duplicator)



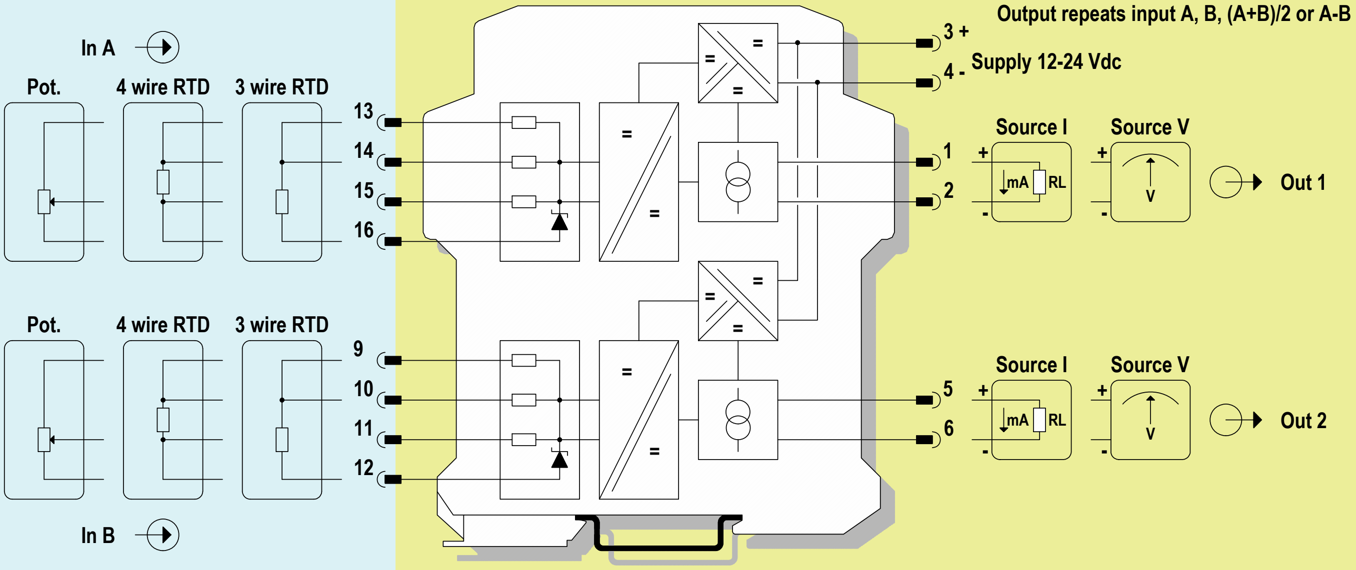
MODEL D1072D

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



MODEL D1072D

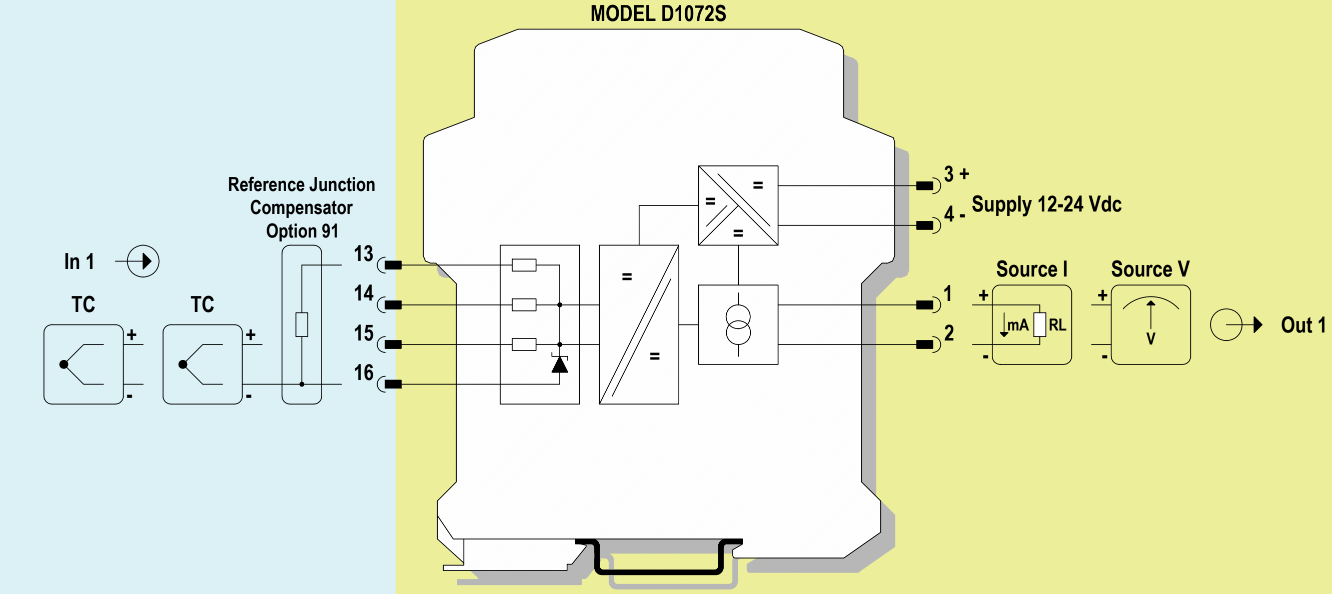
Adder, Subtractor, Low/High Selector
Output repeats input A, B, (A+B)/2 or A-B

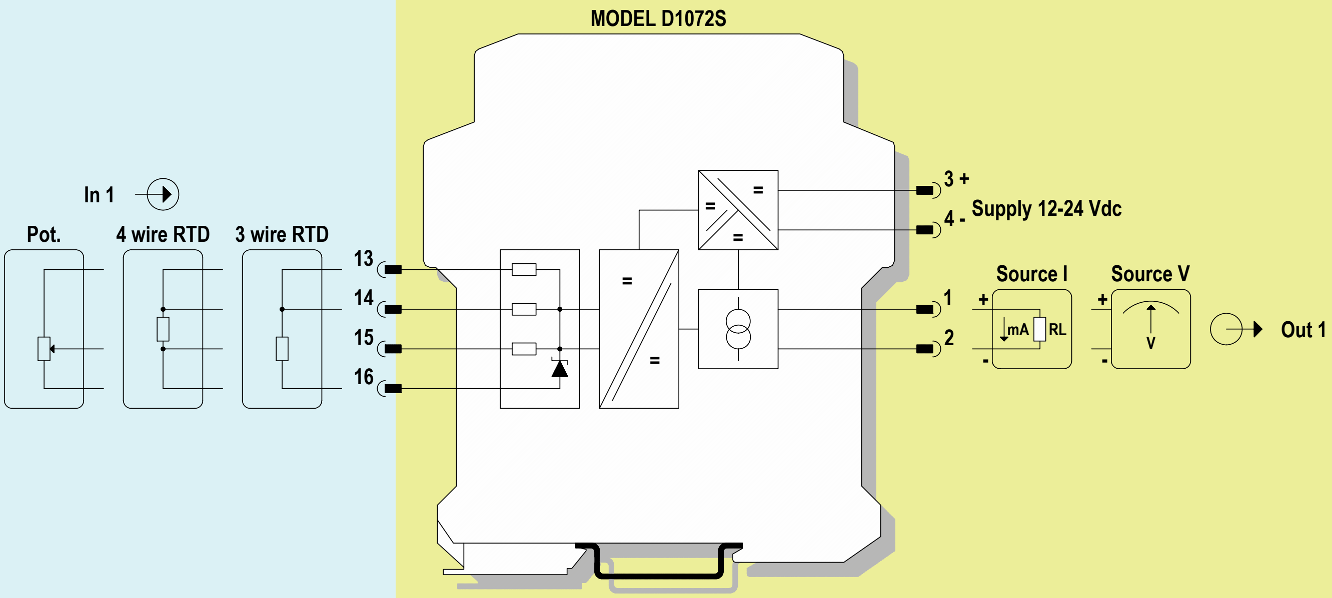


Function Diagram

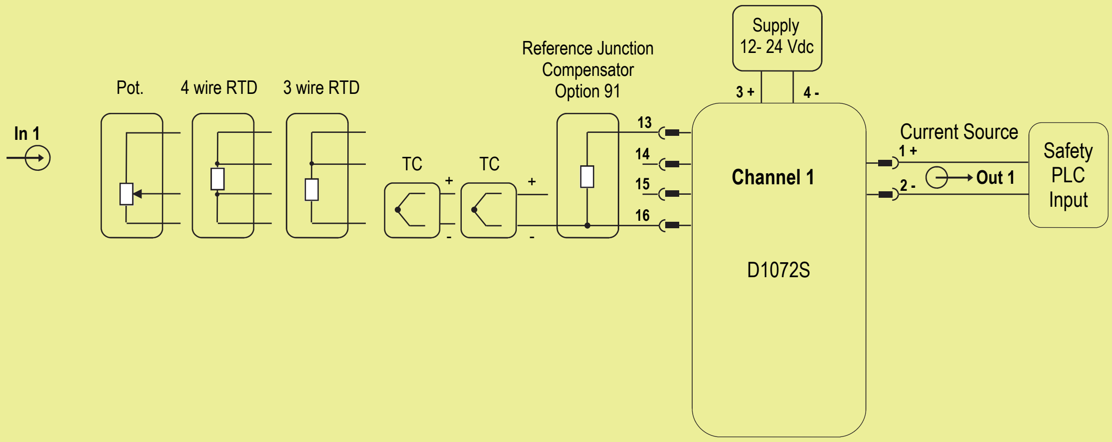
HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC, HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D, CLASS II, DIVISION 1, GROUPS E, F, G, CLASS III, DIVISION 1, CLASS I, ZONE 0, GROUP IIC

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





Application for D1072S , with 4-20 mA Current Output



Description:

For this application, enable 4 - 20 mA Source mode for ch.1 (see pages 11, 12 and 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 pages 11, 12 and 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 source output configuration is used for safety applications) is described from the following definitions :

- □ Fail-Safe State: is defined as the output going to 0 mA due to module shutdown.
- □ 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 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 > 20 mA, but in this analysis it has been set to 20 mA. Assuming that the application program in the Safety logic solver is configured to detect High 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 < 4 mA, but in this analysis it has been set to 4 mA. Assuming that the application program in the Safety logic solver is configured to detect Low failure, this failure has been classified as a dangerous detected (DD) failure.
- □ Fail Dangerous Detected: it's a dangerous failure which has been detected from module internal diagnostic so that output signal is forced below the minimum output current < 4 mA (as Fail Low) or above the maximum output current > 20mA (as Fail High).
- □ 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 has been evaluated in accordance with Route 2H (proven-in-use) of the IEC 61508:2010, Diagnostic Coverage DC ≥ 60% is required for Type B elements.
Being HFT = 0, in Low Demand mode the maximum achievable functional safety level is SIL 2.
Failure rate data: taken from Siemens Standard SN29500.

Failure rate table:

Failure category	Failure rates (FIT)
λ_{dd} = Total Dangerous Detected failures	162.32
λ_{du} = Total Dangerous Undetected failures	61.57
λ_{sd} = Total Safe Detected failures	0.00
λ_{su} = Total Safe Undetected failures	76.76
$\lambda_{tot\ safe}$ = Total Failure Rate (Safety Function) = λ_{dd} + λ_{du} + λ_{sd} + λ_{su}	**300.65**
MTBF (safety function, single channel) = (1 / $\lambda_{tot\ safe}$) + MTTR (8 hours)	**380 years**
$\lambda_{no\ effect}$ = "No Effect" failures	173.75
$\lambda_{not\ part}$ = "Not Part" failures	32.60
$\lambda_{tot\ device}$ = Total Failure Rate (Device) = $\lambda_{tot\ safe}$ + $\lambda_{no\ effect}$ + $\lambda_{not\ part}$	**507.00**
MTBF (device) = (1 / $\lambda_{tot\ device}$) + MTTR (8 hours)	**225 years**

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

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	DC	SFF
0.00 FIT	76.76 FIT	162.32 FIT	61.57 FIT	72.50%	79.52%

where DC means the diagnostic coverage for the input sensor by module internal diagnostic circuits and by Safety logic solver. This type "B" system, operating in Low Demand mode with HFT = 0, has got DC = 72.50 % ≥ 60 % as required by Route 2H evaluation (proven-in-use) of the IEC 61508:2010.

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

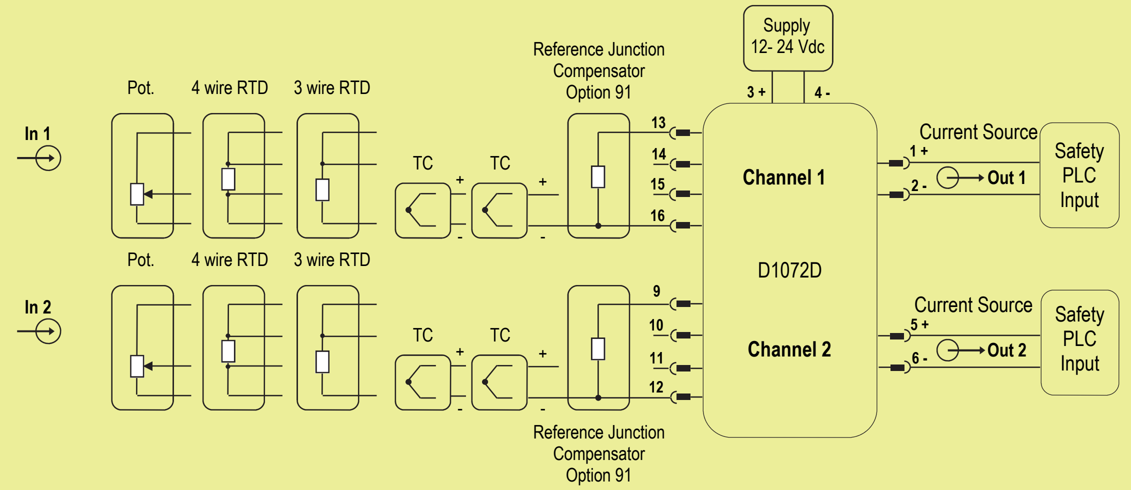
T[Proof] = 1 year	T[Proof] = 3 years
PFDavg = 2.71E-04 Valid for **SIL 2**	PFDavg = 8.14E-04 Valid for **SIL 2**

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

T[Proof] = 10 years
PFDavg = 2.71E-03 Valid for **SIL 2**

SC 2: Systematic capability SIL 2.

Application for D1072D , with 4-20 mA Current Output



Description:

For this application, enable 4 - 20 mA Source mode for ch.1 and ch. 2 (see pages 11, 12 and 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 (for ch. 1) and from Pins 9 to 12 (for ch. 2) (see pages 11, 12 and 13 for more information about input settings). Source output current is applied to Pins 1-2 (for ch. 1) and to Pins 5-6 (for ch.2).

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 source output configuration is used for safety applications) is described from the following definitions:

- □ Fail-Safe State: is defined as the channel output going to 0 mA due to module shutdown.
- □ 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 or deviates the channel output current by more than 3 % (± 0.5 mA) of full span.
- □ Fail High: failure mode that causes the channel output signal to go above the maximum output current (> 20 mA). This limit value can be programmed from the user > 20 mA, but in this analysis it has been set to 20 mA. Assuming that the application program in the Safety logic solver is configured to detect High failure, this failure has been classified as a dangerous detected (DD) failure.
- □ Fail Low: failure mode that causes the channel output signal to go below the minimum output current (< 4 mA). This limit value can be programmed from the user < 4 mA, but in this analysis it has been set to 4 mA. Assuming that the application program in the Safety logic solver is configured to detect Low failure, this failure has been classified as a dangerous detected (DD) failure.
- □ Fail Dangerous Detected: it's a dangerous failure which has been detected from module internal diagnostic so that channel output signal is forced below the minimum output current < 4 mA (as Fail Low) or above the maximum output current > 20mA (as Fail High).
- □ 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 has been evaluated in accordance with Route 2H (proven-in-use) of the IEC 61508:2010, Diagnostic Coverage DC ≥ 60% is required for Type B elements.
Being HFT = 0, in Low Demand mode the maximum achievable functional safety level is SIL 2.
Failure rate data: taken from Siemens Standard SN29500.

Failure rate table:

Failure category	Failure rates (FIT)
λ_{dd} = Total Dangerous Detected failures	180.43
λ_{du} = Total Dangerous Undetected failures	62.77
λ_{sd} = Total Safe Detected failures	0.00
λ_{su} = Total Safe Undetected failures	82.10
$\lambda_{tot\ safe}$ = Total Failure Rate (Safety Function) = $\lambda_{dd} + \lambda_{du} + \lambda_{sd} + \lambda_{su}$	**325.30**
MTBF (safety function, one channel) = (1 / $\lambda_{tot\ safe}$) + MTTR (8 hours)	**351 years**
$\lambda_{no\ effect}$ = "No Effect" failures	247.90
$\lambda_{not\ part}$ = "Not Part" failures	185.40
$\lambda_{tot\ device}$ = Total Failure Rate (Device) = $\lambda_{tot\ safe} + \lambda_{no\ effect} + \lambda_{not\ part}$	**758.60**
MTBF (device) = (1 / $\lambda_{tot\ device}$) + MTTR (8 hours)	**150 years**

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

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	DC	SFF
0.00 FIT	82.10 FIT	180.43 FIT	62.77 FIT	74.19%	80.70%

where DC means the diagnostic coverage for the input sensor by module internal diagnostic circuits and by Safety logic solver. This type "B" system, operating in Low Demand mode with HFT = 0, has got DC = 74.19 % ≥ 60 % as required by Route 2H evaluation (proven-in-use) of the IEC 61508:2010.

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

T[Proof] = 1 year	T[Proof] = 3 years
PFDavg = 2.77E-04 Valid for **SIL 2**	PFDavg = 8.31E-04 Valid for **SIL 2**

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

T[Proof] = 10 years
PFDavg = 2.77E-03 Valid for **SIL 2**

SC 2: Systematic capability SIL 2.

Testing procedure at T-proof

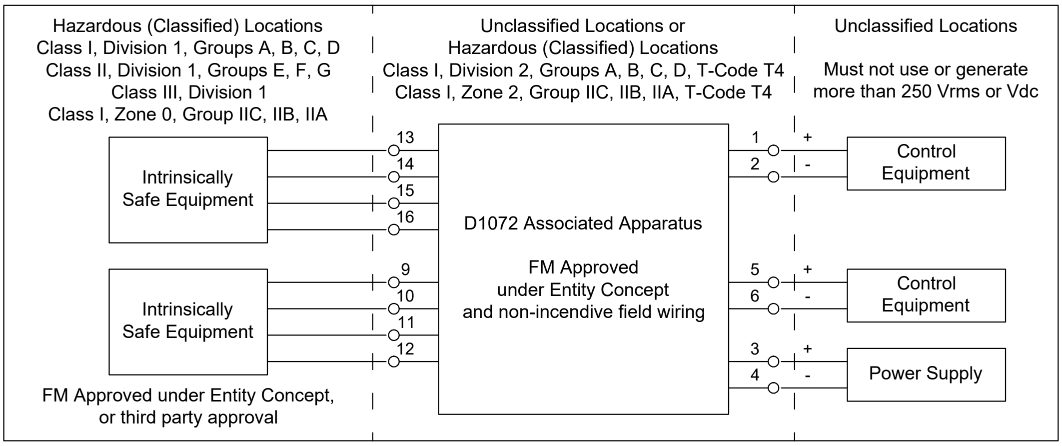
The proof test shall be performed to reveal dangerous faults which are undetected by diagnostic.
This means that it is necessary to specify how dangerous undetected faults, which have been noted during the FMEDA, can be revealed during the proof test.

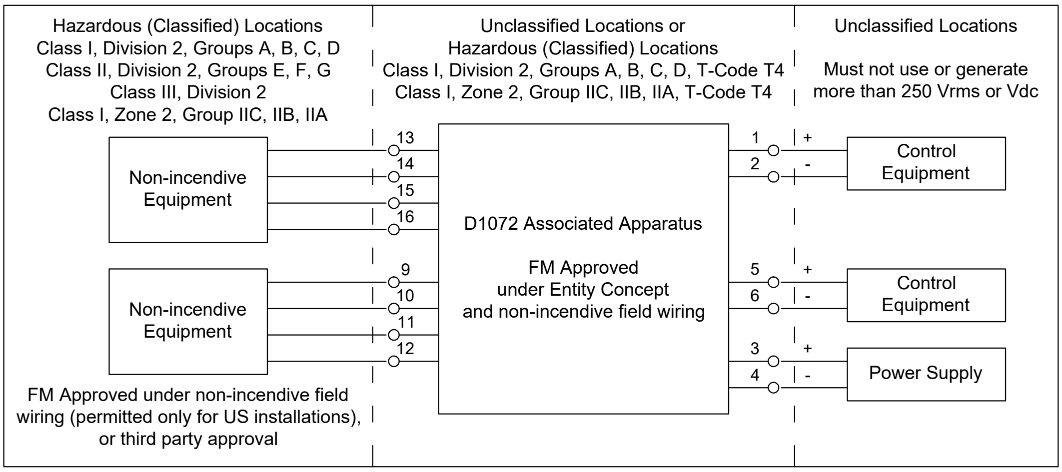
Proof test 1 (to reveal 50 % of possible Dangerous Undetected failures)	
Steps	**Action**
1	Bypass the Safety PLC or take other appropriate action to avoid a false trip.
2	Connect a mV signal generator (in order to give an equivalent thermocouple signal) to the input terminals (‘15’-‘16’ for single channel; ‘15’-‘16’ or ‘11’-‘12’ for channel 1 or channel 2 of double channel) of the temperature converter.
3	For each channel, force an input signal value to go module current output to full scale value and verify that the analog current reaches that value. This tests is for voltage compliance problems, such as low supply voltage or increased wiring resistance, and for other possible failures.
4	For each channel, force an input signal value to go module current output to low scale value and verify that the analog current reaches that value. This tests is for possible quiescent current related failures.
5	Restore the loop to full operation.
6	Remove the bypass from the Safety-related PLC or restore normal operation.

Proof test 2 (to reveal 99 % of possible Dangerous Undetected failures)	
Steps	**Action**
1	Bypass the Safety PLC or take other appropriate action to avoid a false trip.
2	Perform steps 2, 3 and 4 of **Proof Test 1**.
3	For each channel, force some input signal values, verifying that the module output current related values are within the specified accuracy (3 % (± 0.5 mA) of full span) as defined in the Safety Function.
4	Restore the loop to full operation.
5	Remove the bypass from the Safety-related PLC or restore normal operation.

Warning

D1072 series are isolated Intrinsically Safe Associated Apparatus installed into standard EN/IEC60715 TH 35 DIN-Rail located in Safe Area/ Non Hazardous Locations or Zone 2, Group IIC, 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 Um of 250 Vrms.





Non-incendive field wiring is not recognized by the Canadian Electrical Code, installation is permitted in the US only.
For installation of the unit in a Class I, Division 2 or Class I, Zone 2 location, the wiring between the control equipment and the D1072 associated apparatus shall be accomplished via conduit connections or another acceptable Division 2, Zone 2 wiring method according to the NEC and the CEC.
Not to be connected to control equipment that uses or generates more than 250 Vrms or Vdc with respect to earth ground.
D1072 series must be installed, operated and maintained only by qualified personnel, in accordance to the relevant national/international installation standards (e.g. IEC/EN60079-14 Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines), BS 5345 Pt4, 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) following the established installation rules, particular care shall be given to segregation and clear identification of I.S. conductors from non I.S. ones.
De-energize power source (turn off power supply voltage) before plug or unplug the terminal blocks when installed in Hazardous Area/Hazardous Locations or unless area is known to be nonhazardous.
Warning: substitution of components may impair Intrinsic Safety and suitability for Division 2, Zone 2.
Explosion Hazard: to prevent ignition of flammable or combustible atmospheres, disconnect power before servicing or unless area is known to be nonhazardous.
Failure to properly installation or use of the equipment may risk to damage the unit or severe personal injury.
The unit cannot be repaired by the end user and must be returned to the manufacturer or his authorized representative.
Any unauthorized modification must be avoided.

Operation

Input channel of D1072 accepts a signal from Hazardous Area/Hazardous Locations (thermocouple, resistance thermometer, transmitting potentiometer) and converts the signal to a 0/4-20 mA or 0/1-5 V or 0/2-10 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 EN/IEC60715 TH 35 DIN-Rail.
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 thermocouple temperature input, connect thermocouple positive extension wire at terminal “15”, negative and shield (if any) at terminal “16” for channel 1, and at terminal “11” and “12” for channel 2.
Make sure that compensating wires have the correct metal and thermal e.m.f. and are connected to the appropriate thermocouple terminal, note that a wrong compensating cable type or a swapped connection is not immediately apparent but introduces a misleading measurement error that appears as a temperature drift.
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 5345 Pt4, 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 EN/IEC 60529, an IP20 minimum degree of protection. The equipment shall only be used in an area of at least pollution degree 2, as defined in EN/IEC 60664-1. For hazardous location, the unit shall be installed in an enclosure that provides a minimum ingress protection of IP54 in accordance with EN/IEC 60079-0, that must have a door or cover accessible only by the use of a tool. 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 PELV 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 (RJ12 6 poles connector type with 1:1 connection).
It has a 5 digit display, 4 leds and four 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.

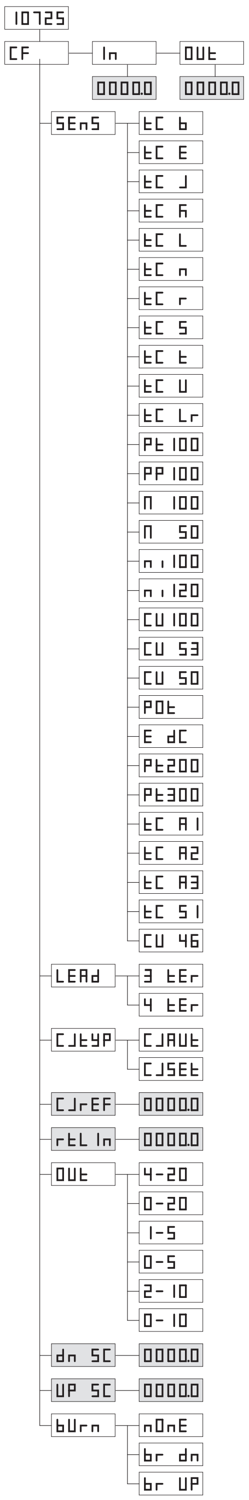
PPC1090 Configuration

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.

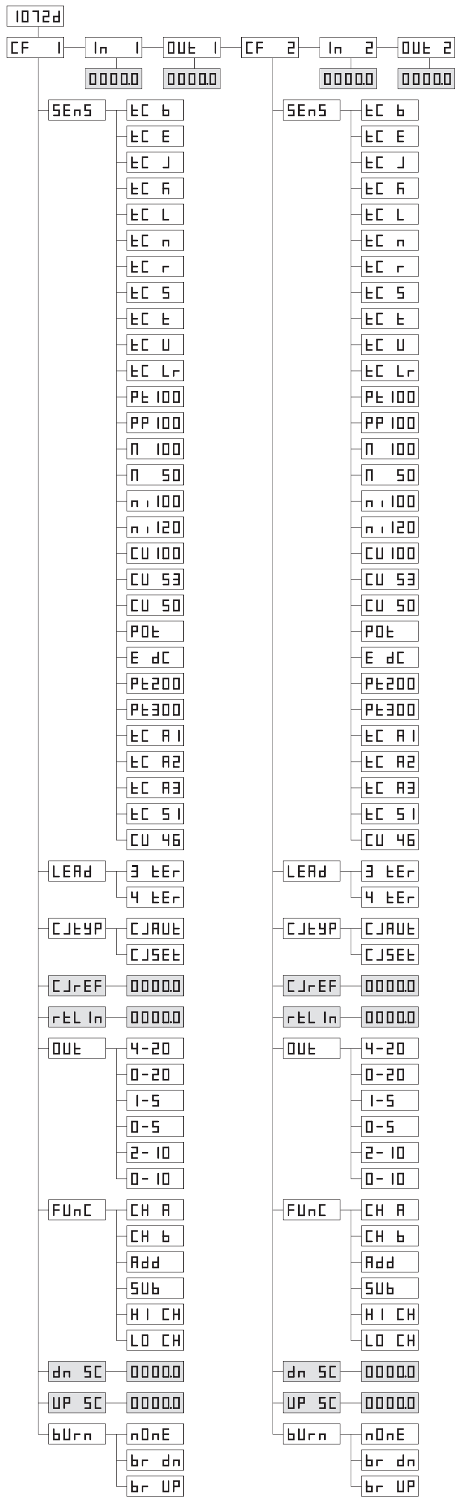
Menu item description D1072S or D1072D

1) **D1072S 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.

D1072S Menu



D1072D Menu



5) **Sens** [3 Level Menu]
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" key, you can choose between 26 different sensors; press "Select" key to change the input sensor and then the "Enter" key to confirm the choice. The input sensors are:

Tc B Thermocouple type B, -10 to +1800°C range
Tc E Thermocouple type E, -250 to +1000°C range
Tc J Thermocouple type J, -200 to +750°C range
Tc K Thermocouple type K, -250 to +1350°C range
Tc L Thermocouple type L, -200 to +800°C range
Tc N Thermocouple type N, -200 to +1300°C range
Tc R Thermocouple type R, -50 to +1750°C range
Tc S Thermocouple type S, -50 to +1750°C range
Tc T Thermocouple type T, -250 to +400°C range
Tc U Thermocouple type U, -200 to +400°C range
Tc LR Thermocouple type LR (russian standard), -200 to +800°C range
Pt 100 Thermoresistance Pt 100 Ω with 0.385 coefficient, -200 to +850°C range
PP 100 Thermoresistance Pt 100 Ω with 0.392 coefficient, -200 to +625°C range
M 100 Thermoresistance Pt 100 Ω with 0.391 coefficient (russian standard), -200 to +650°C range
M 50 Thermoresistance Pt 50 Ω with 0.391 coefficient (russian standard), -200 to +650°C range
Ni 100 Thermoresistance Ni 100 Ω, -50 to +180°C range
Ni 120 Thermoresistance Ni 120 Ω, (russian standard), -75 to +300°C range
CU 100 Thermoresistance Copper 100 Ω (russian standard), -50 to +200°C range
CU 53 Thermoresistance Copper 53 Ω (russian standard), -50 to +180°C range
CU 50 Thermoresistance Copper 50 Ω (russian standard), -50 to +200°C range
Pot Potentiometer, 0 to 100% range
E dc mV dc input from externally powered transmitter, -20 to +85mV range
Pt 200 Thermoresistance Pt 200 Ω with 0.385 coefficient, -160 to +400°C range
Pt 300 Thermoresistance Pt 300 Ω with 0.385 coefficient, -160 to +250°C range
Tc A1 Thermocouple type A1 (russian standard), -10 to +2500°C range
Tc A2 Thermocouple type A2 (russian standard), -10 to +1800°C range
Tc A3 Thermocouple type A3 (russian standard), -10 to +1800°C range
Tc S1 Thermocouple type S (russian standard), -50 to +1600°C range
CU 46 Thermoresistance Copper 46 Ω (russian standard), -200 to +650°C range

6) **Lead** [3 Level Menu]
Displays the input sensor connection type configuration for thermoresistance sensor. Press "Enter" to set the input connection type, press the "Select" key to the next menu level item or "Up" key to return to second level.
If you pressed "Enter" key, you can choose between 2 different sensor connection type; press "Select" key to change the input connection and then the "Enter" key to confirm the choice. The input connection types are:

3 ter 3 wire connection type thermoresistance
4 ter 4 wire connection type thermoresistance

7) **CJ Typ** [3 Level Menu]
Displays the reference junction compensation type configuration for thermocouple sensor. Press "Enter" to set the input compensation type, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can choose between 2 different sensor compensation types; press "Select" key to change the type and then the "Enter" key to confirm the choice. The input compensation types are:

CJ Aut automatic compensation of ambient temperature (via option 91 thermoresistance sensor)
CJ Set fixed ambient temperature compensation, value is setted by CJ Ref menu item (do not require option 91 thermoresistance sensor)

8) **CJ Ref** [3 Level Menu]
Displays the ambient temperature compensation value configuration for thermocouple sensor. Press "Enter" to set the value, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can set the compensation value; press the "Select" key to highlight the character you want to change and then the "Up" and "Down" keys to select the number; confirm the modification with the "Enter" key. The value is settable from –60 to +100 °C.

9) **Rt Lin** [3 Level Menu]
Displays the thermoresistance compensation value configuration for thermoresistance sensor. Press "Enter" to set the value, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can set the compensation value; press the "Select" key to highlight the character you want to change and then the "Up" and "Down" keys to select the number; confirm the modification with the "Enter" key. The value is settable from –5 to +20 Ω

10) **Out** [3 Level Menu]
Displays the analog output type configuration. Press "Enter" to set the analog output type and range, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can choose between 6 different output types; press "Select" key to change the output type and range and then the "Enter" key to confirm the choice. The output 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
0-20	0 to 20 mA current output	0-5	0 to 5 V voltage output	0-10	0 to 10 V voltage output

11) **Func** [3 Level Menu]
Displays the analog output function type configuration. Press "Enter" to set the analog output function type, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can choose between 6 different output function types; press "Select" key to change the output type and then the "Enter" key to confirm the choice. The output function types are:
CH A output follows the first channel input
CH B output follows the second channel input
Add output follows the sum of the two input channels (A+B/2)
Sub output follows the difference of the two input channels
HI CH output follows the higher of the two input channels
LO CH output follows the lower of the two input channels

12) **Dn Sc** [3 Level Menu]
Displays the input low scale configuration. Press "Enter" to set the low scale input value, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can set the low input value; press the "Select" key to highlight the character you want to change and then the "Up" and "Down" keys to select the number; confirm the modification with the "Enter" key. The value is settable over the entire range of the sensor as specified.

13) **Up Sc** [3 Level Menu]
Displays the input high scale configuration. Press "Enter" to set the high scale input value, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can set the high input value; press the "Select" key to highlight the character you want to change and then the "Up" and "Down" keys to select the number; confirm the modification with the "Enter" key. The value is settable over the entire range of the sensor as specified.

14) **Burn** [3 Level Menu]
Displays the burnout configuration. Press "Enter" to set the burnout condition, press the "Select" key to the next menu level item or "Up" key to return to second level. If you pressed "Enter" key, you can choose between 3 different burnout conditions; press "Select" key to change the burnout and then the "Enter" key to confirm the choice.
The condition types are:
none no burnout detection, the analog output follows the input value
br dn when in burnout condition, the analog output is forced at mA or V burnout lower value
br up when in burnout condition, the analog output is forced at mA or V burnout higher value

PPC1092, SWC1090 Configuration

INPUT SECTION:

Sensor: input sensor type
- ☐ TC A1 thermocouple to STI90, GOST R8.585 2001 range from –10 to +2500 °C
- ☐ TC A2 thermocouple to STI90, GOST R8.585 2001 range from –10 to +1800 °C
- ☐ TC A3 thermocouple to STI90, GOST R8.585 2001 range from –10 to +1800 °C
- ☐ TC B thermocouple to STI90, NBS125, GOST R8.585 2001 range from +50 to +1800 °C
- ☐ TC E thermocouple to STI90, NBS125, GOST R8.585 2001 range from –250 to +1000 °C
- ☐ TC J thermocouple to STI90, NBS125, GOST R8.585 2001 range from –200 to +750 °C
- ☐ TC K thermocouple to STI90, NBS125, GOST R8.585 2001 range from –250 to +1350 °C
- ☐ TC L thermocouple to SIPT68, DIN43710 range from –200 to +800 °C
- ☐ TC Lr thermocouple to STI90, GOST R8.585 2001 range from –200 to +800 °C
- ☐ TC N thermocouple to STI90, NBS121, GOST R8.585 2001 range from –250 to +1300 °C
- ☐ TC R thermocouple to STI90, NBS125, GOST R8.585 2001 range from –50 to +1750 °C
- ☐ TC S thermocouple to STI90, NBS125, GOST R8.585 2001 range from –50 to +1750 °C
- ☐ TC S1 thermocouple type S1 to SIPT68, russian range from –50 to +1600 °C
- ☐ TC T thermocouple to STI90, NBS125, GOST R8.585 2001 range from –250 to +400 °C
- ☐ TC U thermocouple to SIPT68, DIN43710 range from –200 to +400 °C
- ☐ Pt 100 thermoresistance α=385 to SIPT68, IEC751 range from –200 to +850°C
- ☐ Pt 200 thermoresistance α=385 to SIPT68, IEC751 range from –150 to +400°C
- ☐ Pt 300 thermoresistance α=385 to SIPT68, IEC751 range from –150 to +250°C
- ☐ Pp 100 thermoresistance α=392 to SIPT68, ANSI range from –200 to +625 °C
- ☐ Pi 500 thermoresistance α=391 to SIPT68, russian range from –200 to +75 °C
- ☐ Pi 100 thermoresistance α=391 to SIPT68, russian range from –200 to +650 °C
- ☐ Pi 50 thermoresistance α=391 to SIPT68, russian range from –200 to +650 °C
- ☐ Ni 100 thermoresistance to SIPT68, DIN43760 range from –50 to +180 °C
- ☐ Ni 120 thermoresistance α=672 to SIPT68, russian range from –75 to +300 °C
- ☐ Cu 100 thermoresistance to SIPT68, russian range from –50 to +200 °C
- ☐ Cu 53 thermoresistance to SIPT68, russian range from –50 to +180 °C
- ☐ Cu 50 thermoresistance to SIPT68, russian range from –50 to +200 °C
- ☐ Cu 46 thermoresistance to SIPT68, russian range from –200 to +650 °C
- ☐ Pot 3 wires transmitting potentiometer, 50 Ω to 20 KΩ, range from 0 to 100%
- ☐ E DC millivolt signal range from –20 to +85 mV

Lead: input sensor connection type (thermoresistance only)
- ☐ 3 wire 3 wires connection type
- ☐ 4 wire 4 wires connection type

Downscale: input value of measuring range corresponding to defined low output value.
Upscale: input value of measuring range corresponding to defined high output value.
Cold Junction: reference junction compensation type (thermocouple only)
- ☐ Automatic ambient temperature compensation automatic by OPT1091 sensor
- ☐ Fixed programmable temperature compensation at fixed temperature

CJ Reference: temperature compensation value (Cold Junction type Fixed only), range from –60 to +100 °C.
RTD line resist: line resistance error compensation value (thermoresistance only), range from –5 to +20 Ω.

INPUT TAG SECTION:
1: first channel tag
2: second channel tag

Each channel has independent configurations.

OUTPUT SECTION:

Output: analog output type
- ☐ 4-20 mA current output range from 4 to 20 mA (for SIL applications)
- ☐ 0-20 mA current output range from 0 to 20 mA
- ☐ 1-5 V voltage output range from 1 to 5 V
- ☐ 0-5 V voltage output range from 0 to 5 V
- ☐ 2-10 V voltage output range from 2 to 10 V
- ☐ 0-10 V voltage output range from 0 to 10 V

Burnout: analog output burnout state
- ☐ None burnout function is disabled; analog output represents the input measure as configured
- ☐ Downscale analog output is forced at mA Burnout or V Burnout lower value
- ☐ Upscale analog output is forced at mA Burnout or V Burnout higher value

Function: analog output function
- ☐ Ch. A analog output represents input of first channel
- ☐ Ch. B analog output represents input of second channel
- ☐ Add analog output represents the sum of the two input channels: (A+B)/2
- ☐ Sub analog output represents the difference of the two input channels: A-B
- ☐ High Ch analog output represents the higher of the two input channels
- ☐ Low Ch analog output represents the lower of the two input channels

Output Limits: current or voltage analog output normal working range limits or burnout detection range limits:
mA working: current analog output range in normal working condition.
mA Burnout: current analog output lower and higher value for burnout signalation.
V working: voltage analog output range in normal working condition.
V Burnout: voltage analog output lower and higher value for burnout signalation.

Each channel has independent configurations.