Thermocouple Temperature Sensors Modular Design for Industrial Applications

MTM100C

Introduction

MTM100C Thermocouple Temperature Sensors (hereinafter referred to as thermocouple) incorporate a thermocouple element, compliant with GB/T 18404-2022, housed in a mineral-insulated (MI) sheath. The product has a slim form factor, fast thermal response, and excellent resistance to mechanical stress as well as environmental adaptability.

Measurement Principle

A closed circuit is formed by two homogeneous conductors (electrodes A and B). When the junctions are at different temperatures, an electric current is generated, creating a thermoelectric potential (Seebeck voltage) between the junctions. This potential depends on the materials of the conductors and the temperature difference between the two junctions. Thermocouples utilize this principle to measure temperature.

Technical Standards

- Standards GB/T 18404-2022　JB/T 8205-1999
- IEC 61515-2016

Applications

- Chemical industry
- Energy and power generation
- Marine and shipbuilding
- HVAC systems

Features

- Measuring range: -40°C ~+1600°C
- Sensing element: K/J/E/T/N base metal, B/S noble metal
- Compatible with transmitter modules to enhance measurement accuracy, reliability, and system integration
- Modular design allows for various specifications and compatibility with thermowells

Material Properties

Type	MIthermo couple	Temp range	Accuracy class	Tolerance class/°C	
K	K-type (NiCr – NiSi)	-40°C ~ 1200°C	1	±1.5°C or±0.4%|t|	-40°C～ 1000°C
			2	±2.5°C or±0.75%|t|	-40°C～ 1200°C
J	J-type（Fe – CuNi)	-40°C～ 750°C	1	±1.5°C or±0.4%|t|	-40°C～ 750°C
			2	±2.5°C or±0.75%|t|	-40°C～ 750°C
E	E-type (NiCr – CuNi)	-40°C～ 900°C	1	±1.5°C or±0.4%|t|	-40°C～ 800°C
			2	±2.5°C or±0.75%|t|	-40°C～ 900°C
T	T-type（CuNi – Cu)	-40°C～ 350°C	1	±0.5°C or±0.4%|t|	-40°C～ 350°C
			2	±1.0°C or±0.75%|t|	-40°C～ 350°C
N	N-type (NiCrSi – NiSiMg)	-40°C～ 1200°C	1	±0.5°C or±0.4%|t|	-40°C～ 1000°C
			2	±1.0°C or±0.75%|t|	-40°C～ 1200°C
S	S-type (PtRh10 – Pt)	-40°C～ 1600°C	1	t＜1100°C为 ±1°C t＞1100°C（1+0.3%|t-1100|)	0°C～ 1600°C
			2	±1.5°C or±0.25%|t|	0°C～ 1600°C
B	B-type (PtRh30 – PtRh6)	600°C～ 1600°C	2	±1.5°C or±0.25%|t|	600°C～ 1600°C

Thermal Response Time

Sheath diameter (mm)	Thermal response time $\tau_{0.632}$ (s)
φ6	1.7

- Test medium: water
- Test conditions: Flow velocity 1 m/s
- Reference standard: JJF 1049-2024
- Temperature step: 10 K per change

Insulation Resistance

Under ambient temperature 15℃ ~35℃ and relative humidity ⩽ 80%, the insulation resistance between the thermocouple wire and the sheath shall meet the following requirements:

Insulation resistance	Test voltage DC V
Length L ⩽ 1m, R ⩾ 1000MΩ Length L > 1m, R · L > 1000MΩ · m	Diameter ⩽ 1.5mm: 75±25 Diameter > 1.5mm: 500±50

Vibration Resistanc

Vibration	10g

Test conditions
- Frequency range: 10Hz – 1000Hz
- Acceleration: 10g
- Amplitude: 0.15mm
- Test axes: X, Y, Z
- Duration: 30 min per axis
- Reference standard: GB/T 2423.10-2019

Shock Resistance

Shock	50g

Test conditions
- Waveform: Half-sine wave
- Acceleration: 50g
- Pulse duration: 6ms
- Test directions: ±X, ±Z
- Test cycles: 3 times per direction
- Reference standard: GB/T 2423.5-2019

Component Materials

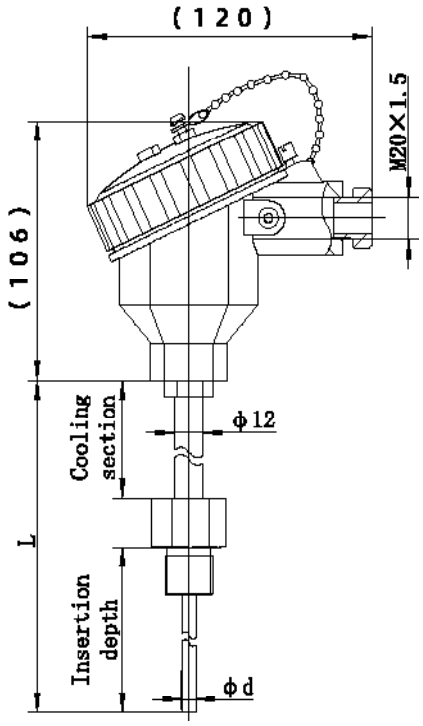
Type	Material (s)
Thermocouple sheath	304、321、316L、GH3030、GH3039、GH2520、inconel 600
Process connection	304、321、316L
Junction box	Cast aluminum
Terminal block	Ceramic
Wires	Polyimide, PTFE shielded, silicone rubber

Material Properties

Material	Features
304	• General austenitic stainless steel • Excellent corrosion resistance, formability, and low-temperature toughness • Widely used in food processing, chemical & pharmaceutical industries, building decoration, and energy equipment
321	• Titanium-stabilized austenitic stainless steel • Excellent intergranular corrosion resistance even after welding • Good weldability, suitable for all standard welding methods • Widely used in chemical industry, petrochemical applications, and pressure vessels
316L	• Low-carbon, molybdenum-containing austenitic stainless steel • Strong general corrosion resistance • Enhanced resistance to chloride, acidic, and non-oxidizing environments due to molybdenum addition (e.g., dilute phosphoric, sulfuric, acetic, and tartaric acids) • Resistant to intergranular corrosion and pitting
GH3030	• Austenitic nickel-based high-temperature alloys • Strong general corrosion resistance • Forms a dense oxide film at 800~900℃, providing high-temperature oxidation resistance far superior to stainless steel • Resistant to intergranular corrosion and pitting
GH3039	• Precipitation-hardened austenitic nickel-based high-strength alloys • Strong general corrosion resistance • Forms a dense oxide film at 900~950℃, providing high-temperature oxidation resistance far superior to stainless steel
GH2520	• Nickel-based precipitation-hardened high-temperature alloys • Strong general corrosion resistance • GH2520 is an “extreme-environment material,” suitable for applications requiring high-temperature strength, oxidation resistance, and corrosion resistance simultaneously
inconel 600	• Nickel-chromium-iron-based solid solution strengthened high-temperature alloys • Strong general corrosion resistance and high temperature oxidation resistance • Exhibit high-temperature oxidation resistance and corrosion resistance in neutral and alkaline media, suitable for use in extreme environments

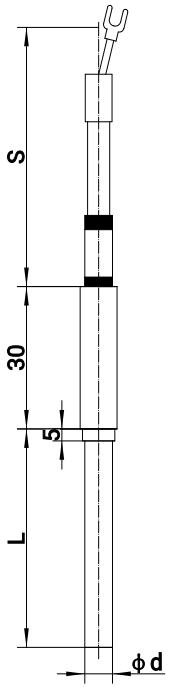
Outline Construction

Unit：mm



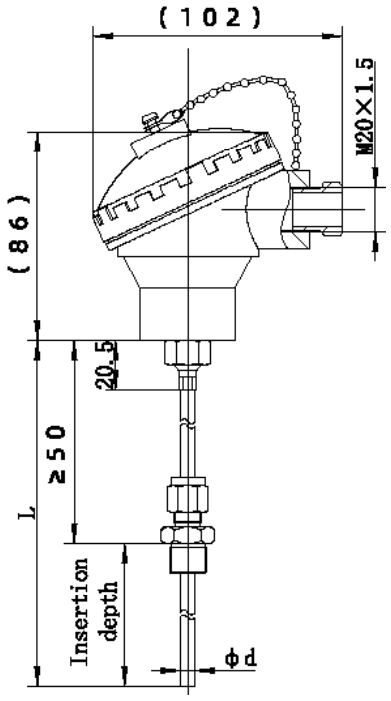
Fixed Insertion Thermocouple (Ex-proof Junction Box)

- Code: A
- Housing material: Cast aluminum
- Ex-proof mark: Ex db IIC T6 Gb
- Insertion depth: Probe length + thread length
- IP rating: IP67



Direct Lead Thermocouple

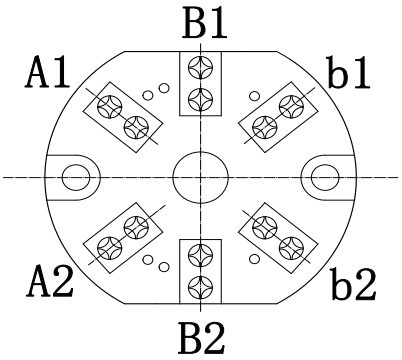
- Code: D
- IP rating: IP67
- Lead wire material: PTFE shielded or others



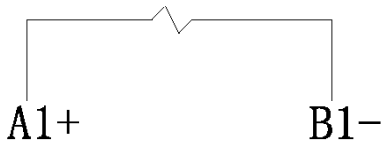
Plain Stem Thermocouple (Waterproof Junction Box)

- Code: B
- Housing material: Cast aluminum
- Insertion depth: Probe length + thread length
- IP rating: IP65

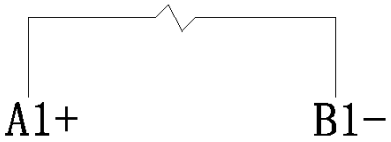
Ceramic Terminal Block Wiring

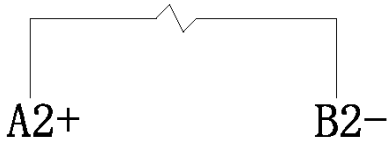


Ceramic Terminal Block



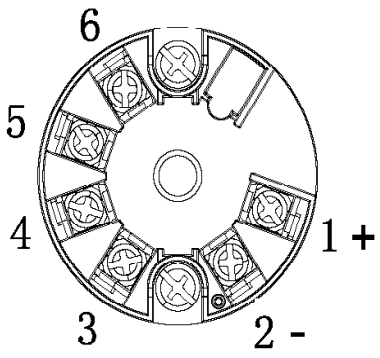
Simplex Thermocouple Wiring



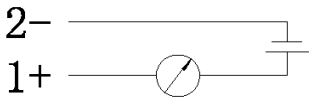


Duplex Thermocouple Wiring

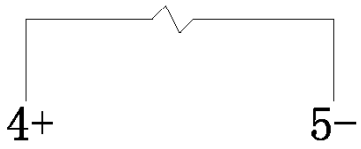
Transmitter Module Wiring



Transmitter Module Wiring

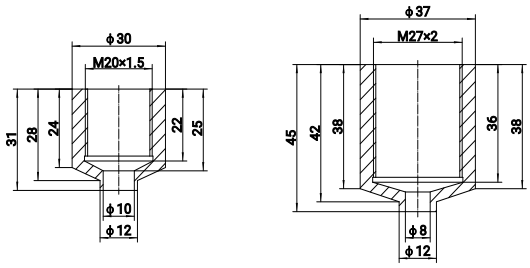


Transmitter Module Power Wiring

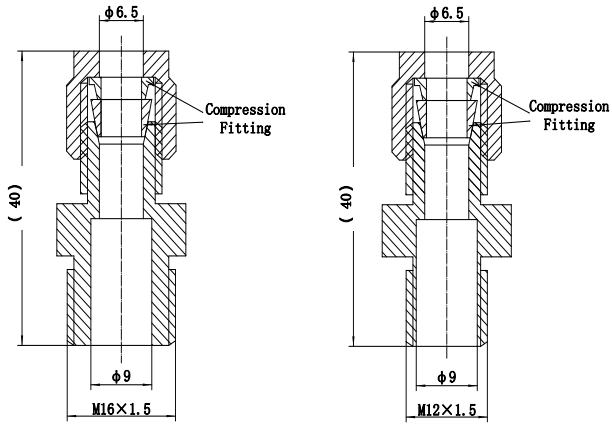


Thermocouple Transmitter Module Wiring

Mounting Accessories



Standard Welding Base



Compression Fitting Bolt

Order Guide

MTM100C-A	Industrial thermocouple (Insertion type, with cooling section, mounted via fixed threaded connection)

Code	Thermocouple type
K	K-type thermocouple (NiCr – NiSi)
J	J-type thermocouple (Fe – CuNi)
E	E-type thermocouple (NiCr – CuNi)
T	T-typeThermocouple (CuNi – Cu)
N	N-type thermocouple (NiCrSi – NiSi)
S	S-type thermocouple (PtRh10 – Pt)
B	B-type thermocouple (PtRh30 – PtRh6)

Code	Number of sensors
1	Simplex
2	Duplex (for sheath ϕ5mm and above)

Range	Measuring range
[X°C～Y°C]	X and Y represent the lower and upper temperature limits, respectively (°C)

Code	Tolerance class
A	1
B	2

Code	Sheath outer diameter (mm)
03	ϕ3
05	ϕ5
06	ϕ6
08	ϕ8
Y	Other diameters (specify)

Code	Sheath material (other materials available on request)
G	321
L	316L
GH1	GH3030
GH2	GH2520
GH3	GH3039
GH4	inconel 600

- Number -	Insertion length (mm) (incl. thread length)

Code	Cooling section length (mm)
N	None (-50°C ~100°C)
S	50 (-50°C～ 100°C)
M	100 (-200°C～ 150°C)
L	150 (-200°C～ 1600°C)

Code	Mounting type
1	Fixed thread
2	Fixed flange
3	Fixed clamp

MTM100C-A	K	1	[0°C ~100°C]	A	03	G	-Number -	L	1	The complete spec.

Code	Process connection material
A	304
L	316L
Y	Other materials (specify)

Code	Process connection	
C24	Fixed thread, M10 x 1, length: 8mm	
C23	Fixed thread, M12 x 1.5, length: 12mm	
C40	Fixed thread, M14 x 1.5, length: 12mm	
C30	Fixed thread, M16 x 1.5, length: 12mm	
C1	Fixed thread, M20 x 1.5, length: 14mm	
H1	Fixed thread, M27 x 2, length: 16mm	
C3	Fixed thread, G1/2, length: 14mm	
C30	Fixed thread, G1/4, length: 12mm	
C16	Fixed thread, G3/8, length: 12mm	
C6	Fixed thread, NPT1/4, length: 10mm	
C10	Fixed thread, NPT1/2, length: 14mm	
F1	DN10	Flanged connection: specify flange standard, PN (nominal pressure), and RF (sealing face)
F2	DN20	
F3	DN25	
F4	DN32	
F5	DN40	
F6	DN50	
G1	ϕ25.4 (Fixed clamp)	
G2	ϕ50.5 (Fixed clamp)	
Y	Other process connections (specify)	

Code	Sealing gasket
T	Copper
S	PTFE
N	None

Code	Junction box
FB	Explosion-proof junction box
FS	Waterproof junction box

Code	Electrical connection of junction box (female)
C1	M20×1.5
C10	NPT1/2
C3	G1/2

Code	Additional fittings
LT	Threaded thermowell
HT	Welded thermowell
FT	Flanged thermowell
HJ	Welded base
N	None

Code	Temperature transmitter module
B1	4~20mA
B2	4~20mA + Hart + isolated
N	None

Continued A	C24	T	FB	C1	LT	B1	The complete spec.

Order Guide

MTM100C-B	Industrial thermocouple (Plain stem type, adjustable insertion depth)

Code	Thermocouple type
K	K-type thermocouple (NiCr – NiSi)
J	J-type thermocouple (Fe – CuNi)
E	E-type thermocouple (NiCr – CuNi)
T	T-typeThermocouple (CuNi – Cu)
N	N-type thermocouple (NiCrSi – NiSi)
S	S-type thermocouple (PtRh10 – Pt)
B	B-type thermocouple (PtRh30 – PtRh6)

Code	Number of sensors
1	Simplex
2	Duplex (for sheath ϕ5mm and above)

Range	Measuring range
[X°C～Y°C]	X and Y represent the lower and upper temperature limits, respectively (°C)

Code	Tolerance class
A	1
B	2

Code	Sheath outer diameter (mm)
03	ϕ3
05	ϕ5
06	ϕ6
08	ϕ8
Y	Other diameters (specify)

Code	Sheath material (other materials available on request)
G	321
L	316L
GH1	GH3030
GH2	GH2520
GH3	GH3039
GH4	inconel 600

- Number -	Overall length (mm)

代号	Mounting type
1	Adjustable compression fitting thread
2	Adjustable compression fitting flange
N	None

MTM100C- B	K	1	[0°C ~100°C]	A	03	G	- Number -	1	The complete spec.

Code	Process connection material
A	304
L	316L
Y	Other materials (specify)

Code	Process connection
C24	Adjustable thread, M10 × 1, length: 8mm
C23	Adjustable thread, M12 × 1.5, length: 12mm
C40	Adjustable thread, M14 × 1.5, length: 12mm
C30	Adjustable thread, M16 × 1.5, length: 12mm
C1	Adjustable thread, M20 × 1.5, length: 14mm
H1	Adjustable thread, M27 × 2, length: 16mm
C3	Adjustable thread, G1/2, length: 14mm
C30	Adjustable thread, G1/4, length: 12mm
C16	Adjustable thread, G3/8, length: 12mm
C6	Adjustable thread, NPT1/4, length: 10mm
C10	Adjustable thread, NPT1/2, length: 14mm
F1	DN10
F2	DN20
F3	DN25
F4	DN32
F5	DN40
F6	DN50
	Flanged connection: specify flange standard, PN (nominal pressure), and RF (sealing face)
Y	Other process connections (specify)

Code	Sealing gasket
T	Copper
S	PTFE
N	None

Code	Junction box
FB	Explosion-proof junction box
FS	Waterproof junction box

Code	Electrical connection of junction box (screw terminal)
C1	M20×1.5
C10	NPT1/2
C3	G1/2

Code	Additional fittings
HJ	Welded base
N	None

Code	Temperature transmitter module
B1	4~20mA
B2	4~20mA + Hart + isolated
N	None

Continued A	C24	T	FB	C1	HJ	B	The complete spec.

Order Guide

MTM100C-D	Industrial thermocouple (Direct lead type)

Code	Thermocouple type
K	K-type thermocouple (NiCr – NiSi)
J	J-type thermocouple (Fe – CuNi)
E	E-type thermocouple (NiCr – CuNi)
T	T-typeThermocouple (CuNi – Cu)
N	N-type thermocouple (NiCrSi – NiSi)
S	S-type thermocouple (PtRh10 – Pt)
B	B-type thermocouple (PtRh30 – PtRh6)

Code	Number of sensors
1	Simplex
2	Duplex (for sheath ϕ5mm and above)

Range	Measuring range
[X°C～Y°C]	X and Y represent the lower and upper temperature limits, respectively (°C)

Code	Tolerance class
A	1
B	2

Code	Sheath outer diameter (mm)
03	ϕ3
05	ϕ5
06	ϕ6
08	ϕ8
Y	Other diameters (specify)

Code	Sheath material (other materials available on request)
G	321
L	316L
GH1	GH3030
GH2	GH2520
GH3	GH3039
GH4	inconel 600

-Number -	Length (mm) (excluding cold junction and thread)

Code	Process connection
C1	Fixed thread, M20 x 1.5, length: 14mm
H1	Fixed thread, M27 x 2, length: 16mm
C30	Fixed thread, G1/4, length: 12mm
C16	Fixed thread, G3/8, length: 12mm
C6	Fixed thread, NPT1/4, length: 10mm
C10	Fixed thread, NPT1/2, length: 14mm
N	None
Y	Other process connections (specify)

MTM100C- D	K	1	[0°C ~100°C]	A	03	G	-Number -	C1	The complete spec.

Code	Process connection material
A	304
L	316L
Y	Other materials (specify)

Code	Sealing gasket
T	Copper
S	PTFE
N	None

Code	Lead wire material
P	Polyimide (-60°C ~+300°C , high temperature resistance, radiation resistant)
T	PTFE shielded (-60°C ~+250°C , shielded, corrosion resistant, flame retardant)
G	Silicone rubber (-40°C ~+200°C , high temperature resistance, not wear resistant, not waterproof)
Y	Other materials (specify)

- Number -	Cable length (mm)

Code	Cable protection
TH	Spring
BW	Bellows
Y	Other protection types (specify)

Continued	A	T	P	100	TH	The complete spec.

Order Guide

1、 1.For long-term operating temperatures between 300 ℃ and 800 ℃ , a type K thermocouple is recommended.
2、 2.For long-term operating temperatures above approximately 1200 ℃ , a type S thermocouple is recommended.
3、 3.The insertion depth of the thermowell shall be selected based on the pipe diameter and installation configuration. For optimal accuracy, the probe tip should be positioned near the center of the medium.
4、 4.Minimum insertion depth verifiable by third-party metrology institute is ⩾ 8d (d = probe diameter).
5、 5.If installation conditions on site do not allow the required insertion depth, thermal insulation shall be applied to the pipe surface to improve measurement accuracy.