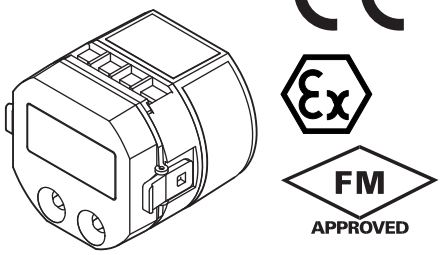
Field-mounted Two-wire Signal Conditioners
B6-UNIT SERIES

2-WIRE UNIVERSAL TEMPERATURE TRANSMITTER
(HART communication, intrinsically safe)

Functions & Features
- Universal input: mV, V, T/C, RTD, resistance and potentiometer
- High accuracy
- HART communication
- Intrinsically safe approval
- Programming via hand-held communicator or via PC
- A wide variety of T/C and RTD types
- User's temperature table can be used
- Self diagnostics
- Input-output isolated



MODEL: B6U–[1][2]

ORDERING INFORMATION

- Code number: B6U-[1][2]

Specify a code from below for each of [1] and [2].
(e.g. B6U-21)

Use Ordering Information Sheet (No. ESU-7451). Factory standard setting will be used if not otherwise specified. Specify the country in which the product is to be used with the Safety Approval code 2.

[1] SAFETY APPROVAL

0: None
1: FM intrinsically safe
2: IECEx/ATEX intrinsic safety
5: FM nonincendive
7: TIIS intrinsic safety (CE not available)

[2] LCD DISPLAY

0: Without
1: With

RELATED PRODUCTS

- Outdoor enclosure (model: 6BX-E)
- USB interface Bell202 modem (model: COP-HU)

Usable in 'non-hazardous' area only.

- Hand-held communicator
- AMS (version 6.0 or higher)
- PC configurator software (model: B6UCFG)

Downloadable at M-System's web site.

- LCD display (model: B6U-LCD) (non safety approval)

GENERAL SPECIFICATIONS

Electrical connection: M3.5 screw terminals (torque 0.8 N·m)
Materials
Transmitter housing: Flame-resistant resin (black)
Screw terminals: Nickel-plated brass
Isolation: Input to output
Burnout (T/C, RTD, Potentiometer & Resistance): Upscale, downscale or no burnout selectable (standard: upscale); Also detects wire breakdown and overrange input exceeding the electrical design limit for DC input.
Cold Junction Compensation (thermocouple input): CJC sensor incorporated
User-configurable items:
· Input sensor type
· Number of wires (RTD & resistance)
· Input range
· Inverted output
· Burnout
· Damping time (via HART only, standard: 0)
· Sensor calibration (via HART only)
· Output calibration
· Special linearization data (via HART only)
· HART communication mode

HART COMMUNICATION

Protocol: HART communication protocol
HART address range: 0 – 15 (factory set to 0)
Transmission speed: 1200 bps
Digital current: Approx. 1 mAp-p when communicating
Character format: 1 Start Bit, 8 Data Bits, 1 Odd Parity Bit, 1 Stop Bit
Distance: 1.5 km (0.9 miles)
HART communication mode: Master-Slave Mode and Burst Mode (factory set to Master-Slave)
HART network mode: Point-to-Point Mode and Multi-drop Mode; automatically set to Multi-drop Mode when the address is set to other than 0.

LCD DISPLAY (option)

Features:
· Setting and display of input signals, engineering units and the transmitter operating status, etc.
· Removable while the module is powered.
Display size: 36 × 20 mm (1.42" × 0.79")
Characters
Color: Black
Format:
• 2 rows of 5 alphanumeric characters:
Top row: 7.4 mm high;
Bottom row: 6.5 mm high,
• Status indicators and engineering units
For detail of the LCD panel indication, refer to the instruction manual.
Display range: -99999 to 99999
Decimal point: In top row
Read rate: 150 msec.
Back light: None

INPUT SPECIFICATIONS

The input type is factory-set to K thermocouple, and the input range to 0 to 100°C.
See Table 1 for the available input type, the minimum span, and the maximum range.
■ **DC mV & V**
Input resistance: ≥ 1 MΩ
■ **Thermocouple**
Input resistance: ≥ 1 MΩ
Burnout sensing: 130 nA ±10 %
■ **RTD** (2-wire, 3-wire or 4-wire)
Input resistance: ≥ 1 MΩ
Allowable leadwire resistance: Max. 20 Ω per wire
■ **Resistance** (2-wire, 3-wire or 4-wire)
Excitation: 0.2 mA ±10 %
Allowable leadwire resistance: Max. 20 Ω per wire
■ **Potentiometer**
Excitation: 0.2 mA ±10%
Allowable leadwire resistance: Max. 20 Ω per wire

OUTPUT SPECIFICATIONS

Output range: 4 – 20 mA DC
Operational range: 3.8 – 21.6 mA
Load resistance vs. supply voltage:
Load Resistance (Ω) = (Supply Voltage (V) – 12 (V)) ÷ 0.024 (A) (including leadwire resistance)

INSTALLATION

Supply voltage
· 12 – 42 V DC (non-approved)
· 12 – 28 V DC (approved)
Operating temperature:
· Non-safety-approved unit: -40 to +85℃ (-40 to +185°F)
· Safety-approved unit: See Safety Parameters for use in a hazardous location.
· LCD display (full visibility): -30 to +80℃ (-22 to +176°F)
Operating humidity: 0 to 95 %RH (non-condensing)
Weight: 150 g (0.33 lb) including the LCD

PERFORMANCE

Accuracy: See Table 1 and 'Explanations of Terms.'
Cold junction compensation error: ±0.5℃ (±0.9°F)
Temp. coefficient: ±0.015 %/°C (±0.008 %/°F) of max. span at -5 to +55°C [23 to 131°F]
Start-up time: Approx. 8 sec.
Response time: ≤ 2 sec. (0 – 90 %) with damping time set to 0 and when not communicating via HART.
Supply voltage effect: ±0.003 % × [Output Span] / 1 V
Insulation resistance: ≥ 100 MΩ with 500 V DC
Dielectric strength: 1500 V AC @1 minute (input to output)
Safety integrity level: Suitable for use in a safety instrumented system up to SIL1 or SIL2 if appropriate safety instructions are observed. Consult M-System.

EXPLANATIONS OF TERMS

■ ACCURACY
This transmitter's accuracy is theoretically defined as the addition of A/D and D/A conversion errors:

Accuracy = A/D Conversion Error + D/A Conversion Error

The A/D conversion error means that measured as HART signal which is A/D converted from the analog input signal. The D/A conversion error of this transmitter is relatively very small so that it does not really affect the unit's overall performance.
The "Accuracies" given in Table 1 therefore equals the A/D conversion error.
The temperature drift (coefficient) or the cold junction compensation error is not included in the "Accuracy."

■ CALCULATION EXAMPLES OF OVERALL ACCURACY IN %
• **DC Voltage**
1) 0 – 200 mV
Absolute value accuracy (Table 1): 40 µV
40 µV ÷ 200000 µV × 100 = 0.02 % < 0.1 %
➠ Overall accuracy = ±0.1% of span
2) 0 – 4 mV
Absolute value accuracy (Table 1): 10 µV
10 µV ÷ 4000 µV × 100 = 0.25 % > 0.1%
➠ Overall accuracy = ±0.25 % of span
• **Thermocouple**

1) K thermocouple, 0 – 1000°C
Absolute value accuracy (Table 1): 0.25°C
0.1% × 1000°C = 1°C > 0.25°C
CJC error (0.5°C) added: 1 + 0.5 = 1.5°C
1.5°C ÷ 1000°C × 100 = 0.15 %
➠ Overall accuracy including CJC error = ±0.15 % of span
2) K thermocouple, 50 – 150°C
Absolute value accuracy (Table 1): 0.25°C
0.1 % × (150 – 50)°C = 0.1°C < 0.25°C
CJC error (0.5°C) added: 0.25 + 0.5 = 0.75°C
0.75°C ÷ (150 – 50)°C × 100 = 0.75 %
➠ Overall accuracy including CJC error = ±0.75 % of span

• **RTD**

1) Pt 100, -200 – 800°C
Absolute value accuracy (Table 1): 0.15°C
0.15°C ÷ (800 – -200)°C × 100 = 0.015 % < 0.1 %
➠ Overall accuracy = ±0.1 % of span
2) Pt 100, 0 – 100°C
Absolute value accuracy (Table 1): 0.15°C
0.15°C ÷ 100°C × 100 = 0.15 % > 0.1 %
➠ Overall accuracy = ±0.15 % of span

STANDARDS & APPROVALS

Refer to the manuals to comply with the standards.

EU conformity:
ATEX Directive
Ex ia EN 60079-11
EMC Directive
EMI EN 61000-6-4
EMS EN 61000-6-2
RoHS Directive
EN 50581

Safety approval:
FM: Intrinsically safe
Class I, Division 1, Groups A, B, C and D
Class I, Zone 0, AEx ia IIC
T4, T5 and T6
(Class 3600)
(Class 3610)
(ANSI/ISA 60079-0)
(ANSI/ISA 60079-11)
FM: Nonincendive
Class I, Division 2, Groups A, B, C, and D
Class I, Zone 2, Group IIC
T4, T5 and T6
(Class 3600)
(Class 3611)
IECEx intrinsic safety
Ex ia IIC T4, T5 and T6 Ga
(IEC 60079-0)
(IEC 60079-11)
TIIS: Intrinsic safety
Ex ia IIC T5 X
ATEX Intrinsic safety
Ⓔx II 1G, Ex ia IIC, T4 , T5 and T6 Ga
(EN 60079-0)
(EN 60079-11)
Functional safety
(IEC 61508-1)
(IEC 61508-2)
(IEC 61511-1)

SAFETY PARAMETERS

Operating temperature

For IECEx, ATEX and FM:
T4: -40 to +80°C
T5: -40 to +65°C
T6: -40 to +50°C

For TIIS:
T5: -20 to +60°C

Ex-data:
• Output circuit
Ui (Vmax): 30 V
Ii (Imax): 96 mA
Pi (Pmax): 720 mW
Ci: 0 µF (TIIS Intrinsic Safety: 'Negligible value')
Li: 0 mH (TIIS Intrinsic Safety: 'Negligible value')
• Sensor circuit
Uo (Voc): 6.4 V (TIIS Intrinsic Safety: 6.0 V)
Io (Isc): 30 mA
Po: 48 mW
Co (Ca): 20 µF
Lo (La): 10 mH

INPUT TYPE, RANGE & ACCURACY

■ **INPUT TYPE, RANGE & ACCURACY** **Table 1**

INPUT TYPE	MIN. SPAN	MAXIMUM RANGE	ACCURACY
DC mV & V	4 mV	-50 to +1000 mV	±0.1 % or ±10μV, whichever is greater (F.S. input 50 mV) ±0.1 % or ±40μV, whichever is greater (F.S. input 200 mV) ±0.1 % or ±60μV, whichever is greater (F.S. input 500 mV) ±0.1 % or ±80μV, whichever is greater (F.S. input >500 mV)
Potentiometer	2%	Total resistance 80 to 4000Ω	±0.1 %
Resistance	10Ω	0 to 4000Ω	±0.1 % or ±0.1Ω, whichever is greater.*2

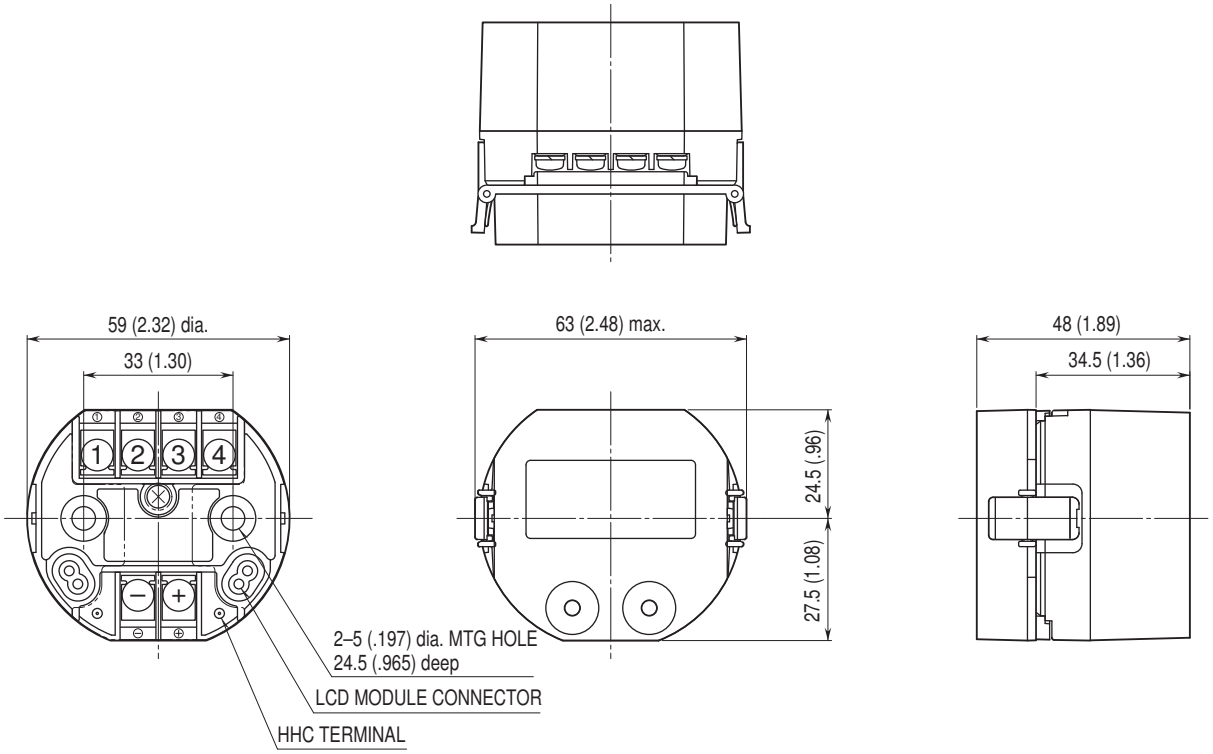
THERMOCOUPLE	°C				°F			
	MIN. SPAN	MAXIMUM RANGE	CONFORMANCE RANGE	ACCURACY *1	MIN. SPAN	MAXIMUM RANGE	CONFORMANCE RANGE	ACCURACY *1
(PR)	20	0 to 1760	0 to 1760	±1.00	36	32 to 3200	32 to 3200	±1.80
K (CA)	20	-270 to +1370	-150 to +1370	±0.25	36	-454 to +2498	-238 to +2498	±0.45
E (CRC)	20	-270 to +1000	-170 to +1000	±0.20	36	-454 to +1832	-274 to +1832	±0.36
J (IC)	20	-210 to +1200	-180 to +1200	±0.25	36	-346 to +2192	-292 to +2192	±0.45
T (CC)	20	-270 to +400	-170 to +400	±0.25	36	-454 to +752	-274 to +752	±0.45
B (RH)	20	100 to 1820	400 to 1760	±0.75	36	212 to 3308	752 to 3200	±1.35
R	20	-50 to +1760	200 to 1760	±0.50	36	-58 to +3200	392 to 3200	±0.90
S	20	-50 to +1760	0 to 1760	±0.50	36	-58 to +3200	32 to 3200	±0.90
C (WRe 5-26)	20	0 to 2315	0 to 2315	±0.25	36	32 to 4199	32 to 4199	±0.45
N	20	-270 to +1300	-130 to +1300	±0.30	36	-454 to +2372	-202 to +2372	±0.54
U	20	-200 to +600	-200 to +600	±0.20	36	-328 to +1112	-328 to +1112	±0.36
L	20	-200 to +900	-200 to +900	±0.25	36	-328 to +1652	-328 to +1652	±0.45
P (Platinel II)	20	0 to 1395	0 to 1395	±0.25	36	32 to 2543	32 to 2543	±0.45

RTD	°C			°F		
	MIN. SPAN	MAXIMUM RANGE	ACCURACY *2	MIN. SPAN	MAXIMUM RANGE	ACCURACY *2
Pt 100 (JIS '97, IEC)	20	-200 to +850	±0.15	36	-328 to +1562	±0.27
Pt 200	20	-200 to +850	±0.15	36	-328 to +1562	±0.27
Pt 300	20	-200 to +850	±0.15	36	-328 to +1562	±0.27
Pt 400	20	-200 to +850	±0.15	36	-328 to +1562	±0.27
Pt 500	20	-200 to +850	±0.15	36	-328 to +1562	±0.27
Pt 1000	20	-200 to +850	±0.15	36	-328 to +1562	±0.27
Pt 50 Ω (JIS '81)	20	-200 to +649	±0.15	36	-328 to +1200	±0.27
JPt 100 (JIS '89)	20	-200 to +510	±0.15	36	-328 to +950	±0.27
Ni 100	20	-80 to +260	±0.15	36	-112 to +500	±0.27
Ni 120	20	-80 to +260	±0.15	36	-112 to +500	±0.27
Ni 508.4 Ω	20	-50 to +200	±0.15	36	-58 to +392	±0.27
Ni-Fe 604	20	-200 to +200	±0.15	36	-328 to +392	±0.27
Cu 10 @25°C	20	-50 to +250	±0.50	36	-58 to +482	±0.90

*1. [Accuracy or ±0.1 % of span, whichever is greater] + Cold Junction Compensation Error

*2. Or ±0.1% of span, whichever is greater.
(For 2- or 3-wire resistance or RTD, the value is valid by the sensor calibration after the wiring is done.)

EXTERNAL DIMENSIONS & TERMINAL ASSIGNMENTS unit: mm (inch)

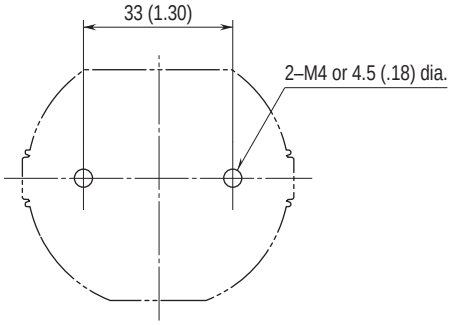


Without LCD Display
(Terminal Assignments)

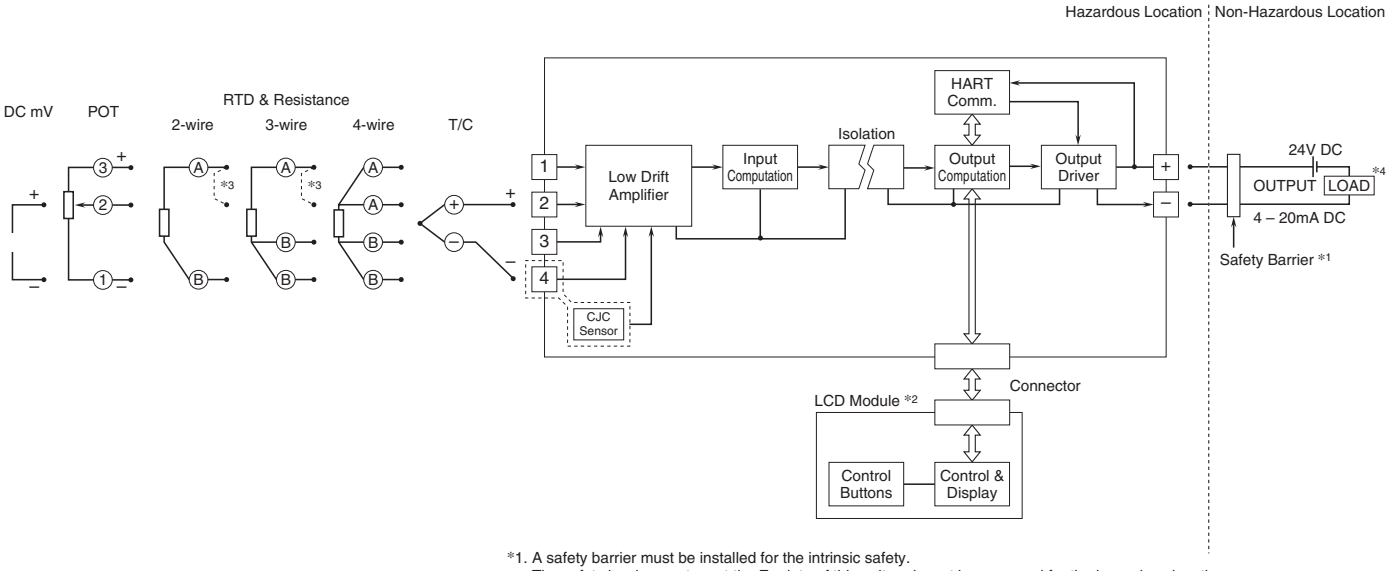
With LCD Display

Leave enough space at both sides of the module to reach the side levers when installing/removing the LCD module.

MOUNTING REQUIREMENTS unit: mm (inch)



SCHEMATIC CIRCUITRY & CONNECTION DIAGRAM



*1. A safety barrier must be installed for the intrinsic safety.
The safety barrier must meet the Ex-data of this unit and must be approved for the hazardous location.
*2. Optional
*3. Close across the terminals 1 & 2 for a resistance or RTD input.
*4. Limited to 250 – 1100Ω for HART communication.

⚠ Specifications are subject to change without notice.