Field-mounted Two-wire Signal Conditioners
B6-UNIT

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

Functions & Features
• Universal input: mV, V, T/C, RTD, resistance and potentiometer
• High accuracy
• HART communication
• Intrinsically safe and explosion-proof approval
• Optional stainless steel enclosure
• 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-B-[1][2][3][4][5]

ORDERING INFORMATION
Specify code number: B6U-B-[1][2][3][4][5]
Specify a code from below for each [1] through [5].
(e.g. B6U-B-4121).

[1] SAFETY APPROVAL
0: None
1: FM intrinsically safe
2: IECEx/ATEX intrinsic safety
3: FM explosion-proof
4: IECEx/ATEX flameproof
5: FM nonincendive
7: TIIS intrinsic safety (CE not available)

[2] LCD DISPLAY
0: Without
1: With

[3] WIRING CONDUIT
0: G 1/2
1: 1/2 NPT
2: M20 x 1.5
3: PG 13.5

[4] MOUNTING BRACKET
0: Without
1: With

[5] OPTIONS
Enclosure Materials
Blank: Diecast aluminium enclosure
/S: Stainless steel enclosure
(TIIS flameproof approval not selectable)

RELATED PRODUCTS
• USB interface Bell202 modem (model: COP-HU)
Useable 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.
• Cable gland (model: BX-E-SXY)
PACKAGE INCLUDES...

- **Cable gland**: Two provided for TIIS flameproof type
  
  Model No.: BX-E-SXY

- **Cable entries**: Elastomeric sealing rings

- **Wiring conduit size**: G 1/2

- **Material**: Chrome-plated brass (entry)

  CR (sealing ring)

- **Applicable wire size**: 8 - 12 dia.

- **Mounting bracket assembly** (option):

  Stainless steel 304

- **Applicable pipe**: 1 1/2” min.; 2” max.

- **Mounting screws**: (4)

GENERAL SPECIFICATIONS

- **Degree of protection**: NEMA 4X, IP66/IP67

- **Wiring conduit**: See ‘Ordering information.’

- **Electrical connection**: M3.5 screw terminals (torque 0.8 N·m)

- **Materials**

  - **Transmitter housing**: Flame-resistant resin (black)
  
  - **Screw terminals**: Nickel-plated brass

- **Enclosure**: Diecast aluminium standard; stainless steel casting optional (equivalent to type 316);

  silver color, epoxy resin coated

- **Isolation**: Input to output to outdoor enclosure

- **Burnout (T/C, RTD, Potentiometer & Resistance)**: Upscale, downside 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 mAmp-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

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**:

  - Indicates and sets input signal, engineering unit and transmitter status.

  - Removable while the module is powered.

- **Display size**: 36 x 20 mm (1.41” x 0.79”)

- **Characters**

  - **Color**: Black

  - **Format**: 2 rows of 5 alphanumeric characters;

    Top: 7.4 mm high

    Bottom: 6.5 mm high

    6 status characters, 1.9 mm high

- **Display range**: -99999 to 99999

- **Decimal point**: In top row

- **Read rate**: 150 msec.

- **Back light**: None

INPUT SPECIFICATIONS

The input is factory set for use with K thermocouple, 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

  - **Excitation**: 0.2 mA ±10 %

  - **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**: 3.6 - 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:** -40 to +85°C (-40 to 185°F)

**Electronics**
(See Safety Parameters for use in a hazardous location.)
-30 to +80°C (-22 to 185°F) Display (full visibility)

**Weight:**
- Unit
  - Approx. 1.3 kg (2.9 lb), aluminium
  - Approx. 4.0 kg (8.8 lb), stainless steel
  - Approx. 2.0 kg (4.4 lb), TiIS flameproof
- Mounting bracket assembly (option)
  - Approx. 0.78 kg (1.72 lb)

**PERFORMANCE**

**Accuracy:** See Table 1 and ‘Explanations of Terms.’

**Cold junction compensation error:** ±0.5°C or ±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 to outdoor enclosure)

**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:

\[
\text{Accuracy} = \text{A/D Conversion Error} + \text{D/A Conversion Error}
\]

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

\[
40 \mu V = \frac{200000 \mu V \times 100}{200} = 0.02 \% < 0.1 \%
\]

рин Overall accuracy = ±0.1% of span

2) 0 – 4 mV

Absolute value accuracy (Table 1): 10 μV

\[
10 \mu V = \frac{4000 \mu V \times 100}{4} = 0.25 \% > 0.1\%
\]

린 Overall accuracy = ±0.25% of span

### Thermocouple

1) K thermocouple, 0 – 1000°C

Absolute value accuracy (Table 1): 0.25°C

\[
0.1\% \times 1000°C = 1°C > 0.25°C
\]

rin CJC error (0.5°C) added: 1 + 0.5 = 1.5°C

\[
1.5°C = \frac{1000°C \times 100}{100} = 0.15 \%
\]

린 Overall accuracy including CJC error = ±0.15 % of span

2) K thermocouple, 50 – 150°C

Absolute value accuracy (Table 1): 0.25°C

\[
0.1\% \times (150 - 50) = 0.1°C < 0.25°C
\]

rin CJC error (0.5°C) added: 0.25 + 0.5 = 0.75°C

\[
0.75°C = \frac{(150 - 50) \times 100}{100} = 0.75 \%
\]

린 Overall accuracy including CJC error = ±0.75 % of span

### RTD

1) Pt 100, -200 – 800°C

Absolute value accuracy (Table 1): 0.15°C

\[
0.15°C = \frac{800 - (-200)}{800} = 0.015 \% < 0.1 \%
\]

린 Overall accuracy = ±0.1 % of span

2) Pt 100, 0 – 100°C

Absolute value accuracy (Table 1): 0.15°C

\[
0.15°C = \frac{100}{100} = 0.15 \%
\]

린 Overall accuracy = ±0.15 % of span

**STANDARDS & APPROVALS**

**EU conformity:**

- ATEX Directive
  - Ex ia EN 60079-11 (for ATEX intrinsic safety)
  - Ex d EN 60079-1 (for ATEX flameproof)

- 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 II, Division 1, Groups E, F and G
  - Class III, Division 1
  - Class I, Zone 0, AEx ia IIC
  - T4, T5 and T6 (Class 3600)
  - (Class 3610)
  - (ANSI/ISA 60079-0)
  - (ANSI/ISA 60079-11)
FM: Explosion-proof and Dust-ignition proof
  Class I, Division 1, Groups B, C and D
  Class II, Division 1, Groups E, F and G
  Class III, Division 1
  T6
  (Class 3600)
  (Class 3615)
FM: Nonincendive
  Class I, Division 2, Groups A, B, C, and D
  Class II, Division 2, Groups F and G
  Class III, Division 1
  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)
IECEx flameproof
  EX d IIC; T4, T5 and T6 Gb
  (IEC 60079-0)
  (IEC 60079-1)
KOSHA: flameproof (Occupational Safety and Health Act)
  Ex d IIC T6
  (Only available for Model: B6U-B-41****)
TIIS: Intrinsic safety
  Ex ia IIC T5 X
TIIS: Flameproof
  Ex d IIC T5
CENELEC: Intrinsic safety (ATEX)
  II 1G, Ex ia IIC; T4, T5, Ga
  (EN 60079-0)
  (EN 60079-11)
CENELEC: Flameproof (ATEX)
  II 2G, Ex d IIC, T4, T5 and T6, Gb
  (EN 60079-0)
  (EN 60079-1)
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 (-40 to +80°C for FM explosion-proof)
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
<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC mV &amp; V</td>
<td>4 mV</td>
<td>-50 to +1000 mV</td>
<td>±0.1 % or ±0.1 VP, whichever is greater (F.S. input 50 mV) ±0.1 % or ±0.4 VP, whichever is greater (F.S. input 200 mV) ±0.1 % or ±0.6 VP, whichever is greater (F.S. input 500 mV) ±0.1 % or ±0.8 VP, whichever is greater (F.S. input &gt;500 mV)</td>
</tr>
</tbody>
</table>

### Potentiometer
2. Or ±0.1% of span, whichever is greater.

### Resistance
10Ω

<table>
<thead>
<tr>
<th>THERMOCOUPLE</th>
<th>MIN-SPAN</th>
<th>MAXIMUM RANGE</th>
<th>ACCURACY</th>
<th>CONFORMANCE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PR)</td>
<td>20</td>
<td>0 to 1760</td>
<td>±1.00</td>
<td>36</td>
</tr>
<tr>
<td>K (CA)</td>
<td>20</td>
<td>-270 to +1370</td>
<td>±0.25</td>
<td>36</td>
</tr>
<tr>
<td>E (CRC)</td>
<td>20</td>
<td>-270 to +1000</td>
<td>±0.20</td>
<td>36</td>
</tr>
<tr>
<td>J (IC)</td>
<td>20</td>
<td>-210 to +1200</td>
<td>±0.25</td>
<td>36</td>
</tr>
<tr>
<td>T (CC)</td>
<td>20</td>
<td>-270 to +400</td>
<td>±0.25</td>
<td>36</td>
</tr>
<tr>
<td>B (RH)</td>
<td>20</td>
<td>100 to 1820</td>
<td>±0.75</td>
<td>36</td>
</tr>
<tr>
<td>R</td>
<td>20</td>
<td>-50 to +1760</td>
<td>±0.50</td>
<td>36</td>
</tr>
<tr>
<td>S</td>
<td>20</td>
<td>-50 to +1760</td>
<td>±0.50</td>
<td>36</td>
</tr>
<tr>
<td>C (WRe 5-26)</td>
<td>20</td>
<td>0 to 2315</td>
<td>±0.25</td>
<td>36</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>-270 to +1300</td>
<td>±0.30</td>
<td>36</td>
</tr>
<tr>
<td>U</td>
<td>20</td>
<td>-200 to +600</td>
<td>±0.20</td>
<td>36</td>
</tr>
<tr>
<td>L</td>
<td>20</td>
<td>-200 to +900</td>
<td>±0.25</td>
<td>36</td>
</tr>
<tr>
<td>P (Platinel II)</td>
<td>20</td>
<td>0 to 1395</td>
<td>±0.25</td>
<td>36</td>
</tr>
</tbody>
</table>

### RTD

<table>
<thead>
<tr>
<th>MODEL</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt 100 (JIS '97, IEC)</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
</tr>
<tr>
<td>Pt 200</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
</tr>
<tr>
<td>Pt 300</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
</tr>
<tr>
<td>Pt 400</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
</tr>
<tr>
<td>Pt 500</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
</tr>
<tr>
<td>Pt 1000</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
</tr>
<tr>
<td>Pt 50 Ω (JIS '81)</td>
<td>20</td>
<td>-200 to +649</td>
<td>±0.15</td>
</tr>
<tr>
<td>JPt 100 (JIS '89)</td>
<td>20</td>
<td>-200 to +510</td>
<td>±0.15</td>
</tr>
<tr>
<td>Ni 100</td>
<td>20</td>
<td>-80 to +260</td>
<td>±0.15</td>
</tr>
<tr>
<td>Ni 120</td>
<td>20</td>
<td>-80 to +260</td>
<td>±0.15</td>
</tr>
<tr>
<td>Ni 508.4 Ω</td>
<td>20</td>
<td>-50 to +200</td>
<td>±0.15</td>
</tr>
<tr>
<td>Ni-Fe 604</td>
<td>20</td>
<td>-200 to +200</td>
<td>±0.15</td>
</tr>
<tr>
<td>Cu 10 @25°C</td>
<td>20</td>
<td>-50 to +250</td>
<td>±0.50</td>
</tr>
</tbody>
</table>

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 unit: mm (inch)**

Two sets of cable gland are attached with TIIS flameproof option.

4–M8, 12 deep
92 (3.62)
110 (4.33)
70 (2.76)

92 (3.62) dia.

78 (3.07) max.

78 (3.07) max.

174 (6.85)

110 (4.33)

114 (4.49)

2–G 1/2 or 1/2NPT or M20x1.5 or PG13.5

19 (0.75)

19 (0.75)

110 (4.33) dia.
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.

Optional Be sure to earth the unit’s enclosure to meet the intrinsically safe or explosion-proof (flameproof) requirements.

| 1. | Close across the terminals 1 & 2 for a resistance or RTD input. |
| 2. | Limited to 250 – 1100Ω for HART communication. |

Specifications are subject to change without notice.