Space-saving Two-wire Signal Conditioners B3-UNIT

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

Functions & Features
• Universal input: mV, V, T/C, RTD, resistance, potentiometer and DC voltage
• 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: B3HU-[1]/A

ORDERING INFORMATION
• Code number: B3HU-[1]/A
  Specify a code from below for [1].
  (e.g. B3HU-0/A)
• Use Ordering Information Sheet (No. ESU-7502). 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: CENELEC intrinsic safety (ATEX)

OPTIONS
CJC Sensor
/A: External Sensor (must be specified)

RELATED PRODUCTS
• USB interface Bell202 modem (model: COP-HU)
  Usable in ‘non-hazardous’ area only.
• Hand-held communicator
  (Consult HART Communication Foundation (HCF) web
  site: www.hartcomm.org.)
  • AMS (version 6.0 or higher)
  • Simatic PDM (version 6.0 or higher)
  • PC configurator software (model: B3HUCFG)
    Downloadable at M-System’s web site.

GENERAL SPECIFICATIONS
Construction: Small-sized front terminal structure
Connection: Euro type connector terminal
(Aplicable wire size: 0.2 - 2.5 mm² (pin terminals: 0.2 - 1.5
mm²), stripped length 8 mm)
Housing material: Flame-resistant resin (gray)
Isolation: Input to output
Burnout (except DC voltage input): Upscale, downscale or
no burnout selectable (standard: upscale);
Also detects wire breakdown and overrange input
exceeding the electrical design limit for DC voltage input.
Cold junction compensation (T/C): CJC sensor (included) to
be attached to the input terminals
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.

B3HU SPECIFICATIONS
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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)
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: 3.8 – 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: -40 to +85°C (-40 to +185°F)
(See Safety Parameters for use in a hazardous location.)
Operating humidity: 0 to 95 %RH (non-condensing)
Mounting: DIN rail
Weight: 80 g (2.8 oz)

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 ground)

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

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, Div. 1, Groups A, B, C and D
Class I, Zone 0, AEx ia IIIC
T4 and T5
(Class 3610)
CENELEC: Intrinsic safety (ATEX)
  ☓ II 1G, Ex ia IIIC; T4 and T5
  (EN 60079-11)

SAFETY PARAMETERS

Operating temperature
For CENELEC (ATEX) / FM:
  T4: -40 to +80°C
  T5: -40 to +55°C

Ex-data:
  • Output circuit
    U_{i} (V_{max}): 30 V DC
    I_{i} (I_{max}): 96 mA DC
    P_{i} (P_{max}): 0.72 W
    C_{i}: 1 nF
    L_{i}: 0 mH
  • Sensor circuit
    U_{o} (V_{oc}): 6.4 V DC
    I_{o} (I_{sc}): 30 mA DC
    P_{o}: 48 mW
    C_{o} (C_{a}): 20 μF
    L_{o} (L_{a}): 10 mH
## INPUT TYPE, RANGE & ACCURACY

### DC mV & V

<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 ±10μV, whichever is greater (F.S. input ≤ 50 mV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±0.1 % or ±40μV, whichever is greater (F.S. input ≤ 200 mV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±0.1 % or ±80μV, whichever is greater (F.S. input ≤ 500 mV)</td>
</tr>
</tbody>
</table>

(For 2- or 3-wire resistance or RTD, the value is valid by the sensor calibration after the wiring is done.)

### Potentiometer

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potentiometer</td>
<td>2 %</td>
<td>Total resistance 150 to 4000Ω</td>
<td>±0.1 %</td>
</tr>
</tbody>
</table>

### Resistance

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance</td>
<td>1Ω</td>
<td>0 to 4000Ω</td>
<td>±0.1 % or ±0.1Ω, whichever is greater.*2</td>
</tr>
</tbody>
</table>

### THERMOCOUPLE

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>CONFORMANCE RANG</th>
<th>ACCURACY 1</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>CONFORMANCE RANG</th>
<th>ACCURACY 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PR)</td>
<td>20</td>
<td>0 to 1760</td>
<td>0 to 1760</td>
<td>±1.00</td>
<td>36</td>
<td>32 to 3200</td>
<td>32 to 3200</td>
<td>±1.80</td>
</tr>
<tr>
<td>K (CA)</td>
<td>20</td>
<td>-270 to +1370</td>
<td>-150 to +1370</td>
<td>±0.25</td>
<td>36</td>
<td>-454 to +2498</td>
<td>-238 to +2498</td>
<td>±0.45</td>
</tr>
<tr>
<td>E (CRC)</td>
<td>20</td>
<td>-270 to +1000</td>
<td>-170 to +1000</td>
<td>±0.20</td>
<td>36</td>
<td>-454 to +1832</td>
<td>-274 to +1832</td>
<td>±0.38</td>
</tr>
<tr>
<td>J (IC)</td>
<td>20</td>
<td>-210 to +1200</td>
<td>-180 to +1200</td>
<td>±0.25</td>
<td>36</td>
<td>+346 to +2192</td>
<td>-292 to +2192</td>
<td>±0.45</td>
</tr>
<tr>
<td>T (CC)</td>
<td>20</td>
<td>-270 to +400</td>
<td>-170 to +400</td>
<td>±0.25</td>
<td>36</td>
<td>-454 to +752</td>
<td>-274 to +752</td>
<td>±0.45</td>
</tr>
<tr>
<td>B (RH)</td>
<td>20</td>
<td>100 to 1820</td>
<td>400 to 1760</td>
<td>±0.75</td>
<td>36</td>
<td>212 to 3308</td>
<td>752 to 3200</td>
<td>±1.35</td>
</tr>
<tr>
<td>R</td>
<td>20</td>
<td>-50 to +1760</td>
<td>200 to 1760</td>
<td>±0.50</td>
<td>36</td>
<td>-58 to +3200</td>
<td>392 to 3200</td>
<td>±0.90</td>
</tr>
<tr>
<td>S</td>
<td>20</td>
<td>-50 to +1760</td>
<td>0 to 1760</td>
<td>±0.50</td>
<td>36</td>
<td>-58 to +3200</td>
<td>32 to 3200</td>
<td>±0.90</td>
</tr>
<tr>
<td>C (WRe 5-26)</td>
<td>20</td>
<td>0 to 2315</td>
<td>0 to 2315</td>
<td>±0.25</td>
<td>36</td>
<td>32 to 4199</td>
<td>32 to 4199</td>
<td>±0.45</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>-270 to +1300</td>
<td>-130 to +1300</td>
<td>±0.30</td>
<td>36</td>
<td>-454 to +2372</td>
<td>-202 to +2372</td>
<td>±0.54</td>
</tr>
<tr>
<td>U</td>
<td>20</td>
<td>-200 to +600</td>
<td>-200 to +600</td>
<td>±0.20</td>
<td>36</td>
<td>-328 to +1112</td>
<td>-328 to +1112</td>
<td>±0.36</td>
</tr>
<tr>
<td>L</td>
<td>20</td>
<td>-200 to +900</td>
<td>-200 to +900</td>
<td>±0.25</td>
<td>36</td>
<td>-328 to +1652</td>
<td>-328 to +1652</td>
<td>±0.45</td>
</tr>
<tr>
<td>P (Platinel II)</td>
<td>20</td>
<td>0 to 1395</td>
<td>0 to 1395</td>
<td>±0.25</td>
<td>36</td>
<td>32 to 2543</td>
<td>32 to 2543</td>
<td>±0.45</td>
</tr>
</tbody>
</table>

### RTD

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>ACCURACY 2</th>
<th>MIN. SPAN</th>
<th>MAXIMUM RANGE</th>
<th>ACCURACY 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt 100 (JIS ’97, IEC)</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +1562</td>
<td>±0.27</td>
</tr>
<tr>
<td>Pt 200</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +1562</td>
<td>±0.27</td>
</tr>
<tr>
<td>Pt 300</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +1562</td>
<td>±0.27</td>
</tr>
<tr>
<td>Pt 400</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +1562</td>
<td>±0.27</td>
</tr>
<tr>
<td>Pt 500</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +1562</td>
<td>±0.27</td>
</tr>
<tr>
<td>Pt 1000</td>
<td>20</td>
<td>-200 to +850</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +1562</td>
<td>±0.27</td>
</tr>
<tr>
<td>Pt 50 Ω (JIS ’81)</td>
<td>20</td>
<td>-200 to +649</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +1200</td>
<td>±0.27</td>
</tr>
<tr>
<td>JPt 100 (JIS ’89)</td>
<td>20</td>
<td>-200 to +510</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +950</td>
<td>±0.27</td>
</tr>
<tr>
<td>Ni 100</td>
<td>20</td>
<td>-80 to +260</td>
<td>±0.15</td>
<td>36</td>
<td>-112 to +500</td>
<td>±0.27</td>
</tr>
<tr>
<td>Ni 120</td>
<td>20</td>
<td>-80 to +260</td>
<td>±0.15</td>
<td>36</td>
<td>-112 to +500</td>
<td>±0.27</td>
</tr>
<tr>
<td>Ni 508.4 Ω</td>
<td>20</td>
<td>-50 to +200</td>
<td>±0.15</td>
<td>36</td>
<td>-58 to +392</td>
<td>±0.27</td>
</tr>
<tr>
<td>Ni-Fe 604</td>
<td>20</td>
<td>-200 to +200</td>
<td>±0.15</td>
<td>36</td>
<td>-328 to +392</td>
<td>±0.27</td>
</tr>
<tr>
<td>Cu10 @ 25°C</td>
<td>20</td>
<td>-50 to +250</td>
<td>±0.20</td>
<td>36</td>
<td>-58 to +482</td>
<td>±0.90</td>
</tr>
</tbody>
</table>
EXTERNAL DIMENSIONS & TERMINAL ASSIGNMENTS unit: mm (inch)

- DIN RAIL 35mm wide
- When mounting, no extra space is needed between units.

SCHEMATIC CIRCUITRY & CONNECTION DIAGRAM

- Specifications are subject to change without notice.