Intronics Power ®

Two-Wire, Thermocouple Temperature Transmitters

MODELS 2B52 and 2B53

FEATURES

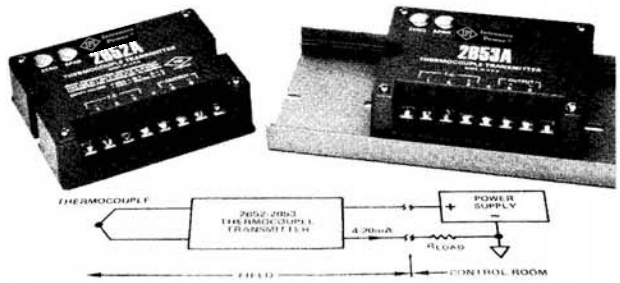
- Accept Type J, K or T Thermocouple Inputs
- Compatible with Standard 4–20mA Loops
- High Accuracy: ±0.1%
- High CMV Isolation: 600V rms; CMR = 160dB (2B52)
- High Noise Rejection and RFI Immunity
- Internal Cold Junction Compensation
- Open Thermocouple Detection
- Millivolt Signal Transmission
- Low Cost
- FM Approved (2B52)

APPLICATIONS

Thermocouple Temperature Monitoring and Control In:

- Process Control
- Factory Automation
- NEW! Energy Management

CUSTOM RANGING



GENERAL DESCRIPTION

Models 2B52 and 2B53 are high performance, low cost temperature transmitters designed to accept a thermocouple input from types J, K or T and produce a standard 4–20mA output current proportional to the measured temperature.

Two basic models are available. The 2B52 features high input to output isolation (600V rms) and high CMR (160dB @ 60Hz). The 2B53 offers a functionally equivalent design without input to output isolation. Both models were designed to operate as two-wire transmitters and are compatible with standard 4–20mA loops. The 2B52 is approved by Factory Mutual for intrinsically safe use in hazardous locations.

In addition to the standard ranges, special (or custom) ranges for the 2B52A and 2B53A are also available. To arrange for a special configuration, a "2B52-CUSTOM" or "2B53-CUSTOM" may be ordered, indicating the desired thermocouple and temperature range. Thermocouple types J, K, T, E, S, R, and B are available to those ordering the "– CUSTOM" module. (There is an additional charge for custom ranging.)

The 2B52 and 2B53 offer high noise rejection, RFI immunity and automatic cold junction compensation to assure accurate operation in noisy industrial environments over a wide ambient temperature range. Other features include open thermocouple detection, fast response time and a low bias current to minimize errors induced by thermocouple extension wires. A rugged metal enclosure, suitable for field mounting, offers environmental protection and screw terminal input and output connections. This enclosure may be either surface or standard relay track mounted.

APPLICATIONS

The 2B52 and 2B53 have been specifically designed to provide low cost, reliable and accurate thermocouple temperature measurement and transmission in a wide array of industries, including chemical, petrochemical, power generation and food processing.

These models are especially useful in process control and monitoring applications where the process sensor is located remotely from the receiver. The 2B52 and 2B53 may then be used to provide signal conditioning near the point of temperature measurement and to transmit an accurate, noise immune, high level current signal over conventional copper wires, resulting in improved performance and reduced cost.

DESIGN FEATURES AND USER BENEFITS

Low Cost: Low transmitter cost, two-wire operation and the use of inexpensive copper wire for transmission result in lower total installation cost.

High Isolation (2B52): Input to output isolation eliminates ground loop errors in installations requiring grounded sensors and permits direct transmission of signal to a receiver where common mode voltages up to 600V rms may exist.

High Noise Rejection: The 2B52 and 2B53 feature internal filtering circuitry to eliminate errors caused by RFI/EMI and line frequency pickup.

Environmental Protection: High quality electronic components, protective coating and mechanical packaging combine to provide a high degree of reliability and protection against temperature, humidity and noise interference.

Millivolt Transmission: Unique circuitry of the 2B52 and 2B53 allows both models to be used as mV signal transmitters.

Ease of Calibration: Both models can be quickly, easily and accurately calibrated in the field to operate over any input span between 5 and 100 millivolts.

P.O. Box 280; Norwood, Massachusetts 02062 U.S.A.
Tel: 617/329-4700 **Twx: 710/394-6577**

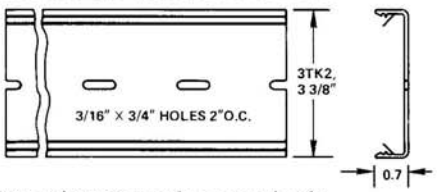
1400 PROVIDENCE HIGHWAY • BUILDING 2 NORWOOD, MASSACHUSETTS 02062-5015
PHONE: 781-551-5500 FAX: 781-551-5555

SPECIFICATIONS (typical @ +25°C and V_S = +24V dc unless otherwise noted)

Model	2B52A	2B53A
INPUT SPECIFICATIONS		
Thermocouple Types	J, K, T	*
Input Span Range	5mV min, 100mV max	*
Input Impedance	5MΩ	*
Input Bias Current[1]	85nA	30nA
Zero and Span Adj. Range	±5% of Span	*
Open Input Detection	Upscale	*
OUTPUT SPECIFICATIONS		
Output Span	4–20mA	*
Minimum Output Current	3.3mA, typ	2mA, typ
Maximum Output Current	42mA, typ	28mA, typ
Load Resistance Range Equation	R_L max = (+V_S −12V)/20mA	*
@ +24V Supply	0 to 600Ω max	*
Output Protection[2]	+60V	*
ACCURACY		*
Total Output Error[3]	±0.1%	
Stability vs. Ambient Temperature		*
Zero, for Ambient 0 to +85°C[4]	±0.03°C/°C	*
−30°C to 0°C[4]	±0.06°C/°C	*
Span, for Ambient −30°C to +85°C	±0.005%/°C	*
Warm-up Time to Rated Performance	5 min	3 min
ISOLATION		
CMV, Input to Output, Continuous	600V rms	NA
Common Mode Rejection, @ 60Hz	160dB	NA
Normal Mode Rejection, @ 60Hz	60dB	NA
RESPONSE TIME		
to 90% of Span	0.3 sec	0.1 sec
INTRINSICALLY SAFE OPERATION		
Use in Class I, Division 1, Groups A,B,C, and D Hazardous Locations	FM Approved	NA
POWER SUPPLY		
Voltage, Operating Range	+12V to +60V dc	*
Supply Change Effect, % of Span		
on Zero	0.005%/V	*
on Span	0.001%/V	*
ENVIRONMENTAL		
Temperature Range, Rated Performance	−30°C to +85°C	*
Storage Temperature Range	−55°C to +125°C	*
Relative Humidity, Noncondensing[5]	0 to 90%	*
RFI Effect (5W @ 470MHz @ 3 ft.)		
Error, % of Span	±0.5%	*
PHYSICAL		
Case Size	4" × 3.25" × 1.25"	*
Weight	8.5 oz. (240g)	8 oz. (227g)

NOTES
[1] Includes thermocouple burnout detection current.
[2] Protected for reverse polarity and for any combination of input and output pins.
[3] Accuracy is specified as a percent of output span (16mA). Accuracy spec includes combined effects of transmitter repeatability, hysteresis and linearity. Does not include sensor error.
[4] Includes combined effects of cold junction compensation and amplifier offset drift.
[5] Per MIL-STD-202E method 103.
*Specifications same as 2B52A.
Specifications subject to change without notice.

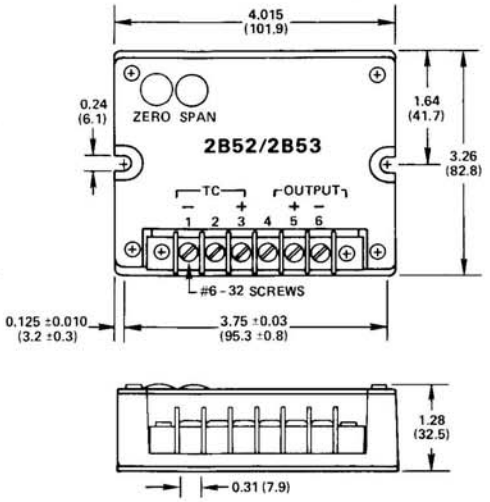
STANDARD RELAY TRACK MOUNTING



Both 2B52 and 2B53 may be conveniently mounted in a standard relay mounting channel (3.25" wide) such as Reed Devices Inc. (RDI) model 3TK2-6 or equivalent.

OUTLINE DIMENSIONS (MAX)

Dimensions shown in inches and (mm).



ORDERING INFORMATION

Example: **MODEL 2B52A - 1 - J - 03**

Select Model
2B52A (Isolated)
2B53A (Nonisolated)

Select Housing
1 — Standard Enclosure

Select Thermocouple Type
J, K or T

Select Temperature Range
01 through 06

Range in °C(°F)	TC Type	No.
−100 to +300 (−148 to +572)	J, K, T	01
0 to +200 (+32 to +392)	T	02
0 to +500 (+32 to +932)	J	03
0 to +600 (+32 to +1112)	K	04
0 to +750 (+32 to +1382)	J	05
0 to +1000 (+32 to +1832)	K	06

CUSTOM RANGING

ORDERING EXAMPLE:	2B52-CUSTOM
THERMOCOUPLE TYPE:	T
TEMPERATURE RANGE:	−50°C to +150°C

NOTE
When ordering a "−CUSTOM" range, it is necessary to consult the appropriate thermocouple table to determine a temperature span that provides at least 5mV.

Custom ranges can be ordered for thermocouple types J, K, T, E, R, S, and B.

FUNCTIONAL DESCRIPTION

The block diagram of the Model 2B52 is shown in Figure 1. The thermocouple signal is applied to the screw terminals in the isolated input stage of the transmitter. Internal cold junction compensation is based upon sensing temperature at the transmitter input terminals, thus eliminating errors due to any temperature gradients between terminals and internal circuitry.

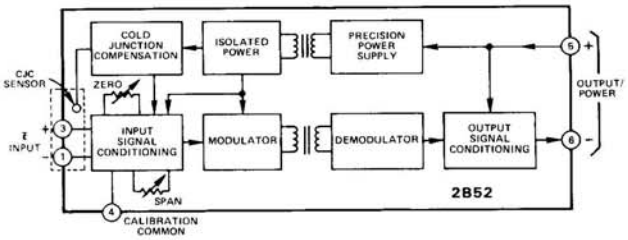


Figure 1. Model 2B52 Functional Block Diagram

The input section also contains an input protection and filtering network and a low-drift amplifier whose gain and offset are set by internal potentiometers. A calibration common terminal is provided to allow operation with a millivolt source between terminals 3 and 4 and bypassed cold junction compensation circuitry. Transformer coupling is used to achieve stable, reliable galvanic isolation between input and output.

The current loop section of the transmitter contains a power supply, demodulator, amplifier and output current generator.

The 2B52 provides a two-wire output with the same wiring used for power and output. The load resistance is connected in series with a dc power supply, and the current drawn from the supply is the 4-20mA output signal which is proportional to the measured temperature.

The maximum series load resistance is a function of the supply voltage and is given by: $R_{L\ max} = (+V_S - 12V)/20mA$ (Figure 2). A wide range of power supply voltages may be used, and regulation is not necessary for accurate operation.

The Model 2B53 offers the same functional terminal characteristics as the 2B52 but does not include isolation circuitry.

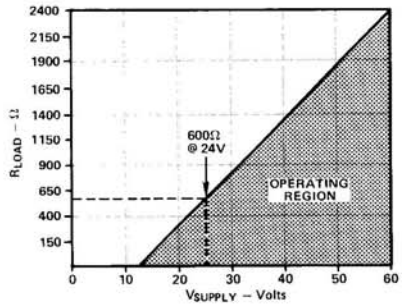


Figure 2. R_{LOAD} vs V_{SUPPLY}

OPERATING INSTRUCTIONS

The connections shown in Figure 3 are common for both the 2B52 and 2B53. Only terminals 1(–Thermocouple Input), 3(+Thermocouple Input), 5(+Output/+V_S), and 6(–Output) are used for operation as a thermocouple transmitter. For millivolt transmission operation see Figure 5.

Note: The cold junction temperature sensor is mounted beneath terminal 2, and therefore no user connection is to be made at this terminal.

Terminal 4 (CAL COM) is used only as a millivolt input signal common.

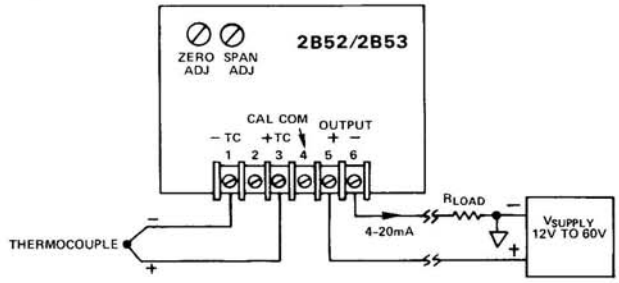


Figure 3. Model 2B52/2B53 Basic Application

INTRINSICALLY SAFE OPERATION

The 2B52 is approved by Factory Mutual for intrinsically safe use in Class I, Division 1, Groups A, B, C, and D Hazardous Locations when connected per Drawing 03-0884000, which is indicated in Figure 4. The 2B52 is approved with the MTL 188+ safety barrier as a system.

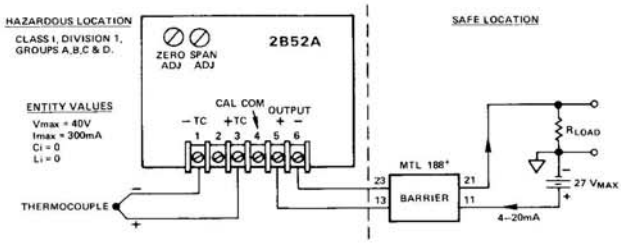


Figure 4. 2B52 Intrinsically Safe Installation System Block Diagram

Factory Mutual has defined the entity concept examination for intrinsically safe devices which allows an entity approved device to be used with an entity approved barrier without specifically examining each combination. The only requirements are that the two devices have compatible values for open circuit voltage, short circuit current, allowable capacitance and allowable inductance. The 2B52 is approved under the entity concept and can be used with any entity approved barrier that has a worst case open circuit voltage less than 40V and a worst case short circuit current less than 300mA. There is no restriction with respect to unprotected internal capacitance and unprotected internal inductance since these values are zero for the 2B52. The voltage drop across the barrier must be considered when choosing the load resistance. The entity approval provides the user with the flexibility to choose a barrier that best satisfies his requirement.

Warning - substitution of components may impair intrinsic safety.

CALIBRATION

Factory Calibration: Models 2B52 and 2B53 may be factory or user calibrated. If factory calibration is desired, the thermocouple type and zero and span temperatures (in °C) must be specified. When specified temperature ranges are ordered, both

span and zero calibration resistors are factory installed. Values indicated in Table I are for reference purposes only. Table I shows available factory ranges. Refer to Ordering Information Guide for range ordering codes.

Type	Range in °C	Total Span (in Millivolts)	Coarse Trim (Ω) 2B52 Zero	2B52 Span	2B53 Zero	2B53 Span
T	-100 to +300	18.238	102k	1.4k	90.9k	1.27k
	0 to +200	9.286	69.8k	715	66.5k	649Ω
J	0 to +500	27.388	90.9k	2.15k	84.5k	1.96k
	-100 to +300	20.957	140k	1.62k	133k	1.47k
	0 to +750	42.283	200k	3.32k	180k	3.09k
K	-100 to +300	15.76	100k	1.21k	75k	1.1k
	0 to +600	24.902	169k	1.96k	140k	1.78k
	0 to +1000	41.269	237k	3.24k	200k	3.01k

Table I. Thermocouple Range Chart

Field Calibration: Figure 5 shows the connection scheme for calibration of the 2B52 and 2B53. A precision voltage source is required.

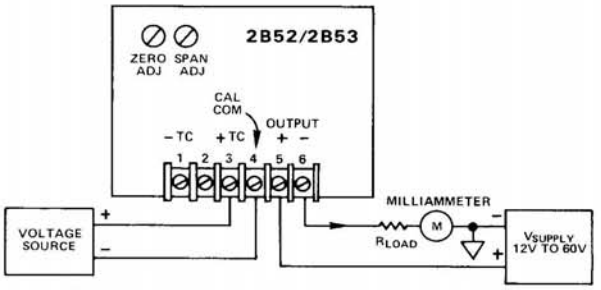


Figure 5. Calibration/Millivolt Input Connections

The Following Procedure is Recommended:

1. Make connections as shown in Figure 5. Use a precision millivolt source.
2. With a precision DVM referenced to CAL COM, measure the CJC voltage from -TC to CAL COM points. This should be approximately -10mV to -11mV for types K and T, -14mV for type J. With respect to ambient temperature and referring to standard millivolt/temperature tables, determine the appropriate millivolt output for the thermocouple type being used. This number will be sign inverted and added to the measured CJC voltage. These combined voltages must be algebraically added to the millivolt span of the thermocouple being simulated.
3. Determine zero and span points for expected measurement range for the thermocouple being used from standard millivolt/temperature tables.
4. Add the CJC voltage (from step 2) to the zero and span millivolt values.
   Example:
   Zero and span millivolt values = 0mV to +25mV
   Measured CJC voltage = -10mV
   Output at ambient temperature = 1.5mV (invert sign)
   corrected zero and span values -11.5mV to +13.5mV
5. Set millivolt source for minimum input signal (determined in step 4) and adjust zero potentiometer, if necessary, to obtain an output reading of 4 ±0.016mA.
6. Set millivolt source for maximum input signal (determined in step 4) and adjust span potentiometer, if necessary, to obtain an output reading of 20 ±0.016mA.
7. Repeat steps 5 and 6 until both readings are constant, since zero and span are slightly interactive.

MILLIVOLT SIGNALS TRANSMISSION

In some applications, conversion of direct millivolt signals may be desired. The connection scheme shown in Figure 5 may be utilized for this purpose.

The magnitude of the desired input millivolt span may require the internal Coarse Zero and Span resistors to be changed. Table II shows a table of possible input span ranges and the appropriate coarse span resistor values to be installed. The coarse zero resistor is determined by trimming (via a resistance decade), during the following set-up procedure:

1. With external supply Power OFF, open cover to expose circuit board. Set zero and span pots to mid-range.
2. Remove zero and span coarse trim resistors. Observe Figure 6a (2B52) or 6b (2B53) for locations.
3. Refer to Table II for correct coarse span resistor value for maximum millivolt input desired and install 1% tolerance, 100ppm, metal film resistor in the correct location.
4. Connect a resistance decade box across the coarse zero trim location; set to 50kΩ initially.
5. Be sure jumper is installed in the J2 position.
6. Turn Power ON.
7. Connect calibration millivolt source as shown in Figure 5.
8. Determine minimum and maximum millivolt input desired. (Disregard CJC voltage).
9. Set millivolt source for the minimum input signal and adjust decade box to obtain approximately 4mA at output.
10. Adjust Zero pot (fine adjust) to obtain 4 ±0.016mA at output.
11. Set millivolt source for the maximum input signal and adjust the Span pot for 20 ±0.016mA at output.
12. Repeat Steps 9 through 11 until both readings are constant.
13. With Power OFF, disconnect decade box and install closest 1% metal film type value in the zero trim location. Replace unit cover.
14. Repeat Trim Procedure and adjust Fine Zero and Span pots to obtain desired accuracy.

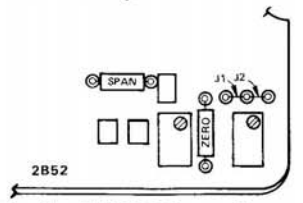


Figure 6a. Model 2B52 Coarse Zero and Span Resistor Locations

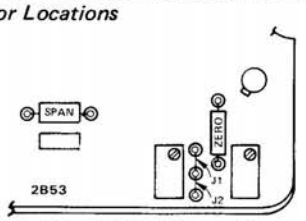


Figure 6b. Model 2B53 Coarse Zero and Span Resistor Locations

Max Input Span (mV)	Coarse Span Resistor (Ω) 2B52A	2B53A
5	374	348
10	768	698
15	1.15k	1.05k
20	1.54k	1.4k
40	3.16k	2.87k
50	4.02k	3.65k
100	8.66k	7.78k

Table II. Millivolt Input/Coarse Span Resistor Values