Model: 400B-TC, 400B-RTD, 402B-TC, and 402B-RTD

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Note: This manual is for the enhanced version of the Model 400 and 402 units. For models 400 and 402 before 3-2002 with serial numbers without the letter "N" please refer to manual part number M0035.

M3777/0602

SECTION 1 DESCRIPTION

1.1 DESCRIPTION.

This manual contains installation, operation, and calibration information for Series 400 digital indicators. These solid-state instruments digitally display a temperature of thermocouple, RTD type of sensors. All instruments feature a dual-slope A/D converter with multi-segment digital linearization, reference junction compensation, and a large 0.8" (20mm) easy-to-read 4-digit LED display.

The displays are in-line, uniplanar, 7-segment RED LEDS, easy to read through the front Plexiglas panel. A single dash (-) displayed at the left of the read-out indicates a negative polarity. Positive readings are inferred (no sign displayed). All dashes (----) across the display indicate an overload, over- range, or open thermocouple condition. Zeros to the left of the decimal point or most significant digit are suppressed. The indicator accepts NBS thermocouple types J, K, T, E, S, R, and B; or 3-wire platinum resistance temperature detectors (RTD) with α of .00385 or .00392. The instrument can be configured to display 1° resolution throughout the range in °F or °C. It can also be configured to display 0.1 resolutions in °F or °C up to 999°. It automatically switches to 1° resolution above 999.9°. R,S and B thermocouples are

fixed with 1 degree resolution. The instrument can be easily converted between degrees C or degrees F.

All units operate from 100, 120, 220, or 240VAC 50-60 Hz power source. A power connector and ground screw for shield are located at the rear of the instrument. The instrument case is made of solid die-cast aluminum, which is rugged enough to withstand the most hostile environments. It is designed to mount in a panel. The optional rack mount can accommodate up to 3 units. Bench mount option 400-W5 provides for convenient bench top use.

Multiple Input Options, Models 402, 405 and 409

Model 402 can accept five inputs of the same input type thermocouple . Buttons numbered 1-5 are located below the display. Individual input is selected by pressing the appropriate button.

The Model 405A provide 10-switchable inputs to a single indicator. The Model 405A is housed in the same rugged case design as the basic indicator. Each unit may be rack-mounted beside another 405A or indicator. Pushbuttons are in two rows of five and are numbered 1-10, 11-20, etc. Each horizontal row is interlocked to prevent simultaneous input selection. However, top and bottom rows are not interlocked and errors will occur if buttons on the top and bottom rows are pushed at

the same time. Model 405 is used for thermocouple ranges. Model 409 is used for RTD models.

SECTION 2 SPECIFICATIONS

Operating Range:

Temperature: 0 to 50°C
Relative Humidity: 10-80% RH non-condensing

Storage Range:

-40 to 65°C

Power:

115VAC ± 10%, 50-60 Hz
230VAC ± 10%, 50-60 Hz
30mA Max input current @ 115VAC

Size:

Case: 144mm W x 72mm H x 173 mm D
(5.768” x 2.84” x 6.82”)

Maximum Weight:

1.7 kg / 2.5 lb

Panel cutout:

68mm H x 138mm W
2.68” H x 5.44” W

Input Impedance:

Thermocouple: 20MΩ (exclusive of break detect current effects)
RTD: 16.9kΩ, V+ input; 16.9kΩ, I – input

Break Detection:

Upscale, ≈50 nanoamps

A/D Read Rate:

2 per second nominal, 1° reading; 1 per second nominal, 0.1° readings

Reference Junction (Thermocouple):

Internal, automatic

FUNCTIONAL SPECIFICATIONS

Input Range Table

INPUT TYPE	RANGE (0.1 degree resolution)	RANGE (1.0 degree resolution)
J Thermocouple	-99.9 to 761.8 C -99.9 to 999.9 F	-205 to 762 C -337 TO 1403 F
K Thermocouple	-99.9 to 999.9 C -99.9 to 999.9 F	-202 to 1377 C -331 to 2510 F
T Thermocouple	-99.9 to 401.4 C -99.9 to 754.6 F	-210 to 401 C -346 to 755 F
E Thermocouple	-99.9 to 999.9 C -99.9 to 999.9 F	-205 to 1002 C -338 to 1835 F
S Thermocouple	————	0 to 1769 C 32 to 3218 F
R Thermocouple	————	0 to 1769 C 32 to 3216 F
B Thermocouple	————	316 to 1829 F 601 to 3325 F
PT 100 RTD .00385	-99.9 to 862.6 C -99.9 to 999.9 F	-200 to 863 C -329 to 1585 F
PT 100 RTD .00392	-99.9 to 850.8 C -99.9 to 999.9 F	-202 to 851 C 332 to 1563 F

PERFORMANCE SPECIFICATIONS

Reference Operating Conditions (ROC):

±10% line voltage
23 ±2 °C ambient temperature
<80% RH non- condensing

Accuracy (at ROC): +/- 1 count LSD

SENSOR TYPE	ACCURACY	
	1 Degree Resolution	0.1 Degree Resolution
J, K, T, E Thermocouple	1 degree +/- .03% RDG	+/- 0.5 degree C +/- 1.0 degree F
R, S, B Thermocouple	1 degree +/- .05% RDG	_____
Pt .00385 and Pt .00392 RTD	1 degree +/- .03% RDG	+/- 0.5 degree C +/- 1.0 degree F

Multi-Input Option Accuracy:

Add ± 0.5 °C / ± 1° F to accuracy specification when Multi-Input option is used.

Noise Rejection:

NMRR: ≥ 60 db @ 50/60 Hz, ± 0.1Hz
CMRR: ≥ 120 db@ 50/60 Hz, ± 0.1Hz with 250Ω unbalance.

RTD Leading Error @ 150 μA excitation current:

40 milliohms per Ohm of equal resistance in V+ and V- leads
1 Ohm per Ohm of unbalance in V+ and V- leads
Overload Protection:
Power lead to ground: 115VDC or AC RMS
Across inputs
T/C: Up to 250VDC or VAC for 1 minute, V+ to V-
RTD: Up to 125VDC or VAC for I minute, V+ to V-
Up to 62 VDC or VAC for 1 minute, V- to I

Stability With Temperature:

Zero: 1μV/°C
Span: 0.01% rdg /°C
Thermocouple Reference Junction: 0.03° per degree, 5 - 45°C

Stability With Time:

1°/year

Repeatability:

±1 count

SECTION 3 INSTALLATION

3.1 UNPACKING / REPACKING

The Series 400 indicators are rugged, but they must be properly packed. Instruments are shipped in a custom-designed carton for shipping, but damage may occur. When you receive your instrument, look for evidence of transit damage. If damage is found, ask the carrier to prepare a Damage Inspection Report and notify our Instrument Repair Department immediately. If your instrument has arrived in good condition, you may perform the functional test described in 3.2.2 to verify proper operation.

REPACKING AND RETURNING THE INSTRUMENT

The original shipping container should be retained in case the instrument must be returned for repair or modification. When returning an instrument for any reason, advise us of the model number, serial number, your name, billing address, shipping address, phone number and a description of the problem. This information will enable our Instrument Repair Department to expedite the return of your instrument. Instruments being returned to the factory are required to be shipped freight prepaid.

Instruments being returned for warranty service must also refer to the original purchase date on packing lists and

purchase orders. Instruments without this information will be processed as a non-warranty repair at current service rates.

If the original shipping container has been discarded, pack your instrument for shipping as follows:

Select a strong cardboard box of sufficient size to allow an inch of packing material around all sides of the unit.

a. Ensure that the printed circuit boards are secured and front and rear panels are firmly in place.
b. Wrap the instrument in plastic or strong paper. Place it centrally in the shipping container, and pack poly foam, bubble pack, or rubberized hair around all six sides of the instrument.
c. Tape the carton flaps securely and label the container “FRAGILE, DELICATE INSTRUMENT”. Ship the instrument, freight prepaid (do not ship by U.S mail)

3.2 CONFIGURING THE INSTRUMENT

3.2.1 GENERAL

The instrument is configured at the factory for various power, range sensor type, and display requirements as stated on the initial order. However, the instrument can easily be reconfigured to accommodate any future changes as required by the user.

The following paragraphs describe input voltage selection, sensor type (T/C), °C/°F selection and 1°/ 0.1° resolution.

3.2.2 INSTRUMENT CHECKOUT PROCEDURE

An instrument functional checkout may be made as follows:

a- Remove the rear cover.

b- For thermocouple type input short input sensor terminals with copper wire

c- Apply power to the instrument. The display should approximate the approximate readout in the table on the following page.

INPUT TYPE	SIGNAL INPUT TERMINALS	READOUT
Thermocouple	See Note 1	room temperature
RTD	100 ohms	0°C to 32°F

Note1: For “B” thermocouple range, simulate the TC input with a millivolt calibrator. Example: a 4.833mV input should produce a display of about 1832°F(1000°C).

Note 2: For RTDs connect +V , –V and –I. Connect a resistor equal to 100 ohms between +V and –V.

3.2.3 If the sensor type needs to be changed, refer to the following instructions.

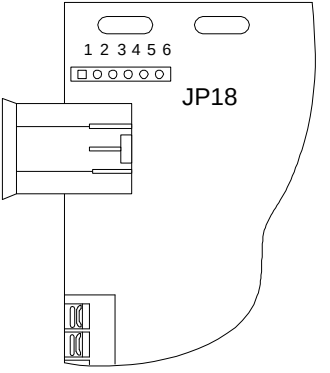
REMOVING THE ELECTRONICS FROM THE ENCLOSURE

1- Make sure to disconnect power from the unit
2- Remove the three back cover screws and remove the rear panel
3- Remove the screw located directly above the AC plug
4- Remove two screws from the front panel lens and remove lens
5- Remove two screws from the front holding the Board assembly and pull it out of the case.
6- Reinstall the assembly when finished.

Input Voltage Selection (requires removal)

Input voltage 115 or 220VAC, is selectable by cutting and adding jumpers on the main board as shown in below. Locate JP18 on the printed circuit board. Cut and make connection as shown on table depending on input voltage.

Input Voltage	JP18
120 VAC	1-2, 4-5
220 VAC	2-3, 5-6



3.2.4 Changing Sensor type

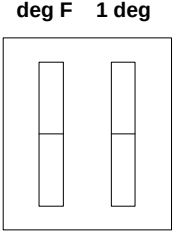
Locate the JP14, JP15, JP16 and JP17 located behind the front panel lens. Remove and reinstall jumper blocks to select the type of sensor. **The following configuration change requires removal of the front panel lens only. RTD units may be configured for RTD only.**

	JP14	JP15	JP16	JP17
J	●			●
K				
T	●			
E		●		
S	●	●		
R			●	
B	●		●	
PT1 385	●	●	●	
PT2 392				●
CAL		●	●	

Table 3.2 CONFIGURATION CHART

3.2.5 The following configuration change requires removal of the front panel lens only.

Changing form °F to °C or °C to °F and 1° to 0.1° or 0.1° to 1° resolution.
Locate switch S4 on lower left comer of the assembly behind the front lens.
Toggle the switch to the desire position as shown below. Reinstall the front lens.

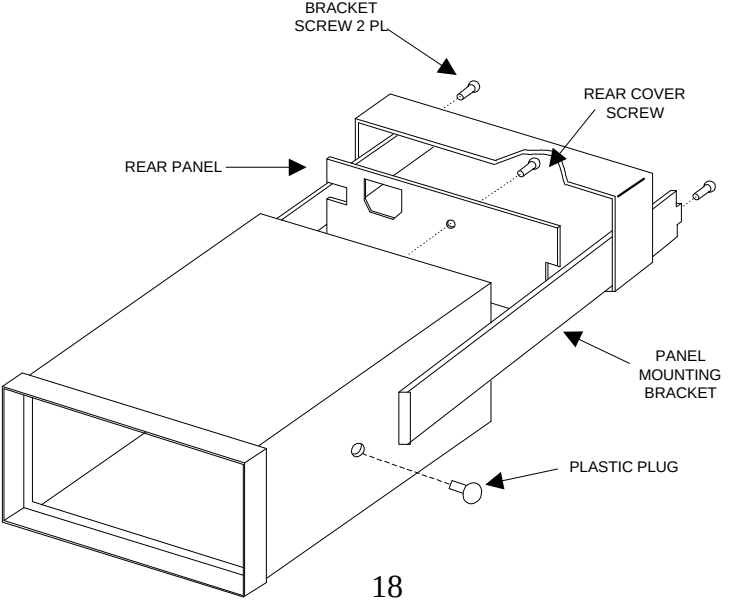


Dip Switch

3.3 INSTALLATION

Panel Mounting

Panel mounting hardware is supplied standard with the instrument. The instrument bezel butts against the front of the mounting panel; the mounting bracket fits over the instrument rear panel. The bracket screws force it against the rear of the mounting panel, locking the instrument in place. Panel cutout dimensions are 68mm x 138mm (2.68” x 5.44”).

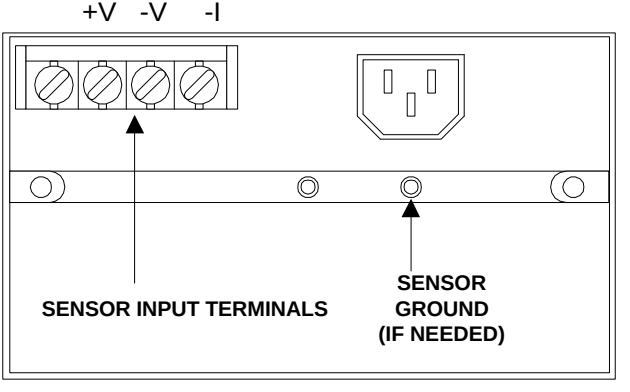


3.4 WIRING THE INSTRUMENT.

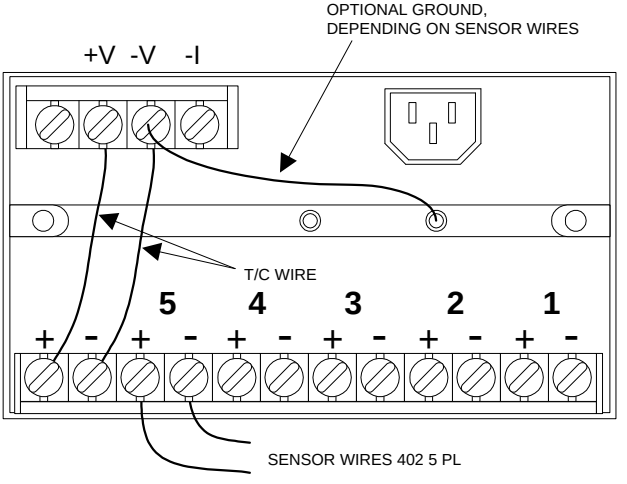
All signal input connections are made to the instrument using screw terminals. To gain access to the recessed terminal strip, the rear cover panel must be removed. The four signal input terminals are located in the upper-left corner, and are labeled +V, -V, and -I.

REMOVE THE POWER CORD BEFORE WIRING

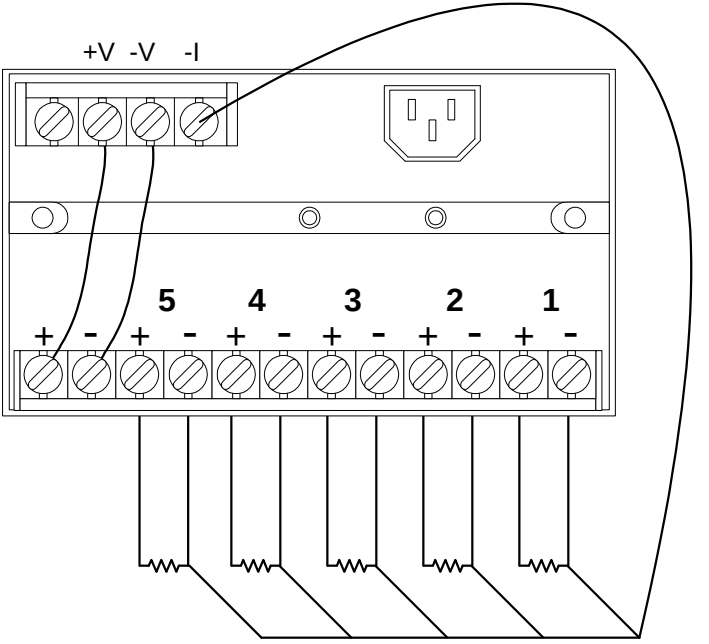
Basic Single Channel Wiring



Model 402 Switching Unit Wiring
(Thermocouples)



Model 402 Switching Unit Wiring
(3-WIRE RTDs)



Buss all current legs to main board terminal

SECTION 4 OPERATION

4.1 APPLYING POWER TO THE INSTRUMENT

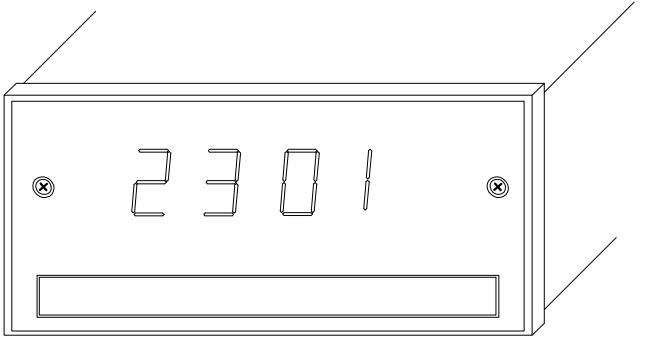
Power is applied to the instrument as long as the instrument is plugged into an active source. To remove power, unplug the power cord from the instrument or AC outlet.

To eliminate shock hazard or possible instrument damage, always remove the power cord either from the instrument or power source before calibrating or configuring the indicator.

4.2 USING BASIC UNITS MODELS 400

Models 400 indicators are single range indicators with a single input. Once the instrument is configured for the desired range, measurements can be made by connecting the appropriate sensor to the rear input terminals

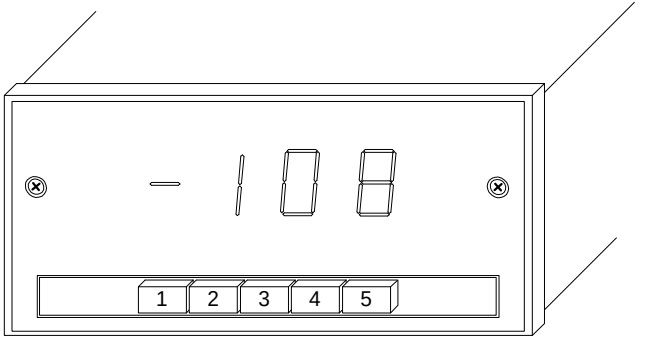
Front Panel Model 400 Basic indicator



4.3 USING THE 5 INPUT SWITCHING UNITS MODELS 402

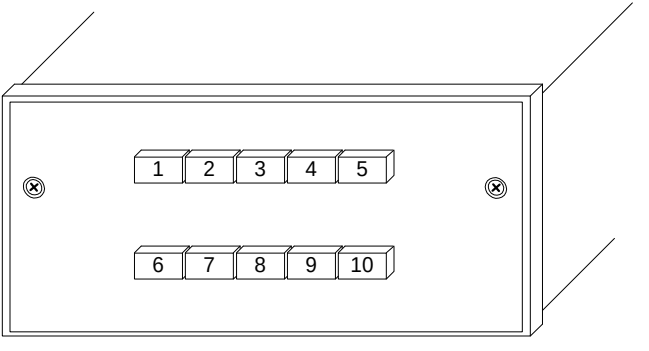
The 5 input switching units accommodate five inputs of the same range as determined by the analog program model. Inputs are selected by a row of pushbuttons directly below the display. The pushbuttons are number 1-5 Pressing a particular pushbutton selects that input point for display. The pushbuttons are interlocked so that only one pushbutton is selected at one time.

FRONT PANEL, 5 INPUT UNIT (MODEL 402 SHOWN)



4.5 USING THE EXTERNAL SWITCHING UINTS (MODELS 405/409) AND SWITCH ERROR BOARD (OPTION 001A)

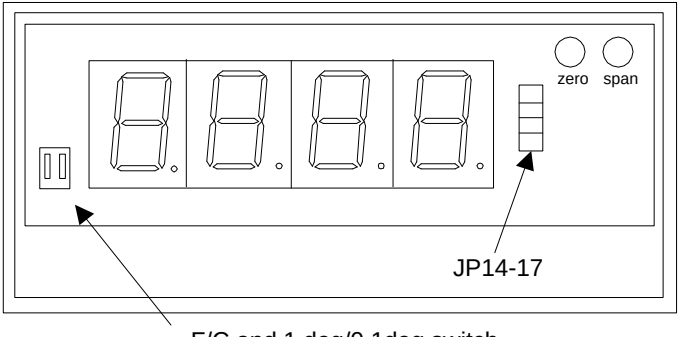
The External Switching Units provide 10 switchable inputs to a single indicator. Inputs are selected by two rows of front panel pushbuttons labeled 1-10. For special numbering contact factory. Pressing a particular pushbutton selects that input point for display. Each row of pushbuttons is interlocked so that only one pushbutton within that row is selected at once time.



SECTION 5 CALIBRATION

Calibrating your indicator once a year is recommended to assure specified accuracy. Be sure to calibrate your indicator whenever you change between thermocouple and RTD type sensors.

Locate JP14 – JP17 behind the front lens as shown below. Remove the jumper blocks (from JP14-JP17) and install across JP15 and JP16 to enter the CAL mode. Refer to the table on page 16. Remember the original jumper block configuration before removing.



PROCEDURE: Thermocouple Input

Equipment Required:

A Precision DC voltage source with a resolution to 1μV; accuracy ±0.01%(±2μV)

Interconnecting copper wire from the DC source to the unit

Trimmer adjusting tool (blade type)

Make sure the AC power to the unit is turned OFF

1- Observing contact polarity, connect the voltage source to the Thermocouple inputs as show in the wiring diagram on page 20.
   Turn power ON.
   Locate the Zero and Span control pot on the display board.
2- Adjust the voltage source output to 0.00mV.
3- Adjust the ZERO control for a display reading of 0.0(±0.1).
   (Note: display readings take up to 3 seconds to respond to change in control setting.)
4- Adjust the voltage source output to 39.000mV.
5- Adjust the SPAN control for a display reading of 560.0(±0.1) (Note: display reading take up 3 second to respond to changes in condition setting.)

6- Turn OFF the AC power. Reinstall the jumper blocks to the desired thermocouple type and install the front panel lens. This completes calibration for thermocouple input.

PROCEDURE: RTD Input For RTD 3- wire Input

Equipment Required:

A precision resistance decade box with a resolution of 0.01Ω and an accuracy of ±0.02%

Interconnecting copper wire from the resistance source to the unit

Trimmer adjusting tool (blade type)

1- Connect a decade resistance box to the RTD input (+V, -V and I) **3 wires** as shown in the wiring diagram on page 20. (Be sure the power is OFF when making connection.)
2- Adjust the decade box to 0.00Ω.
3- Adjust the ZERO control for a display reading of 0.0(±0.1).
   (Note: display readings take up to 3 seconds to respond to change in control setting.)
4- Adjust the decade box to 265.00Ω.

5- Adjust the SPAN control for a display reading of 543.8 (±0.1). (Note: display readings take up 3 seconds to show changes in control setting.)
6- Turn OFF the AC power. Set the jumper blocks to the desired RTD range (PT1=α. 00385 PT2=α. 00392), install the front panel lens. This completes calibration for RTD input.