TC-BRIDGE™

Low-Profile 8-Channel Thermocouple Positioning Device

Revision A **(02/2009)**

Warranty

General Terms

Magna Systems, L.L.C. warrants this product to be free from defects in material and workmanship for a period of one year from the date of shipment. If this product is found to be defective during the warranty period, the product will either be repaired or replaced at Magna Systems' sole option.

To Use This Warranty

To exercise this warranty, write or telephone your local Magna Systems representative or contact Magna Systems headquarters in California. Detailed contact information may be found on the Magna Systems web site, www.magnasystems.net . You will receive prompt assistance and return instructions. Send the product, shipping prepaid, to the indicated service facility. The repaired or replacement product will be returned to you with shipping prepaid. The repaired or replaced product will be warranted for the remainder of the original warranty term or ninety days whichever is longer.

Limitation of Warranty

This warranty does not apply to defects or malfunctions resulting from modification or misuse of any product or part. This warranty does not apply to fuses or other circuit protection components, to batteries, damage from battery leakage or damage resulting from improper battery installation.

Entire Warranty

This warranty is the complete warranty and stands in lieu of any or all other warranties, expressed or implied, including any implied warranty of merchantability or suitability for a particular use. Magna Systems, L.L.C. shall not be liable for any indirect, special or consequential damages.

Symbols Used in This Manual

CAUTION Indicates potential for equipment damage or injury. Refer to procedures or instructions.

CAUTION Indicates potential risk of electrical shock. Take suitable precautions.

Important Safety Information

Electrical Shock Hazard

There are no hazardous voltages present in the TC-Bridge, however the American National Standards Institute (ANSI) states that a shock hazard exists when probes or sensors are exposed to voltages greater than 42 VDC or 42 V peak AC. In some applications thermocouples may be attached to objects or surfaces between which voltages in excess of the ANSI shock hazard standard exist. Despite the electrical isolation designed into the thermocouple assemblies, conditions may exist such that hazardous voltages could be conducted by attached thermocouples and present within the TC-Bridge. In such cases, users must handle the TC-Bridge in a manner consistent with the presence of hazardous voltages.

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Care of Your New TC-Bridge

DO NOT EXPOSE YOUR TC-Bridge TO ANY OF THE FOLLOWING-

Harsh Chemicals
Don't expose your TC-Bridge to highly corrosive chemicals. Although your TC-Bridge is composed primarily of stainless steel, you can damage it by prolonged exposure to strong acids or bases.

CAUTION

Extreme Heat or Cold
Avoid temperatures outside of the operating range of -200°C to 427°C (-328°F to 800°F).

PROLONGED EXPOSURE TO EXTREME TEMPERATURES WILL DAMAGE THE TC-Bridge.

Microwaves or Intense RF Energy
Do not place your TC-Bridge in a microwave oven or expose it to direct radio frequency (RF) energy such as from a RF power transmitter. Although the TC-Bridge may tolerate such an environment, doing this may seriously damage the microwave generator or RF transmitter.

Magna Systems will bear no responsibility for damages incurred from the use of a TC-Bridge in an environment with microwave or RF energy.

Shock
Do not expose your TC-Bridge to mechanical shock in excess of a three (3) foot drop or vibration in excess of 10 g's.

Cleaning
Dirt and dust can be removed from the TC-Bridge by wiping with a damp cloth. In addition, the TC-Bridge may be cleaned with hot soapy water or steam spray. When cleaning a TC-Bridge attached to a ThermoBlade or ThermoBiscuit™ AVOID SPRAYING DIRECTLY INTO THE THERMOCOUPLE ENTRY SLOT.

Maintenance & Service
The TC-Bridge has no user serviceable parts. Please contact Magna Systems directly for any required replacement parts or service.

Getting Started

The figure below (Figure 1) shows a ThermoBlade™ with an attached TC-Bridge in its stowed configuration. The TC-Bridge has been designed with several things in mind. Its primary function is to position thermocouple wires in specific locations to help you make quick, repeatable measurements in your process lines. In addition, it has been designed for easy handling, a small storage footprint and ease of adjustment for a variety of belt / band widths.

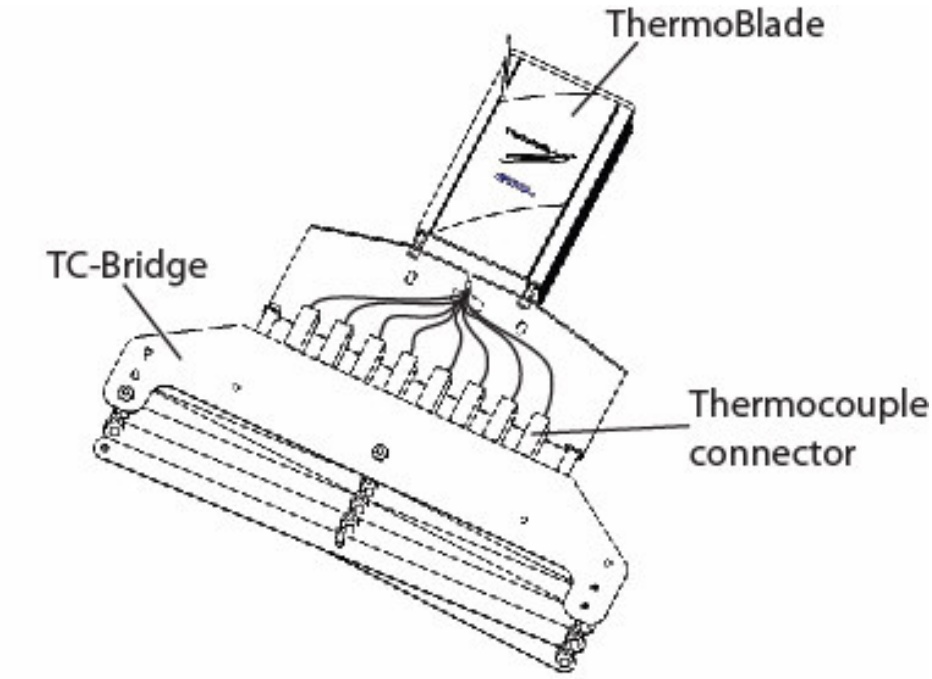

Figure 1. A ThermoBlade / TC-Bridge assembly in the stowed configuration

During routine use, the most frequently performed operations with the TC-Bridge are:

- Connecting the TC-Bridge to a ThermoBlade,
- Deploying the TC-Bridge to make a measurement, and
- Stowing the TC-Bridge until its next use.

Each of these operations is described in detail below, but first a comment about the thermocouple routing.

The thermocouples that come with the TC-Bridge were routed at the factory such that they would not tangle or get cut during deployment or stowage operations. Before re-routing the thermocouples, please refer to page 10 of this manual where re-routing / replacing the thermocouples is covered.

Connecting the TC-Bridge to a ThermoBlade-

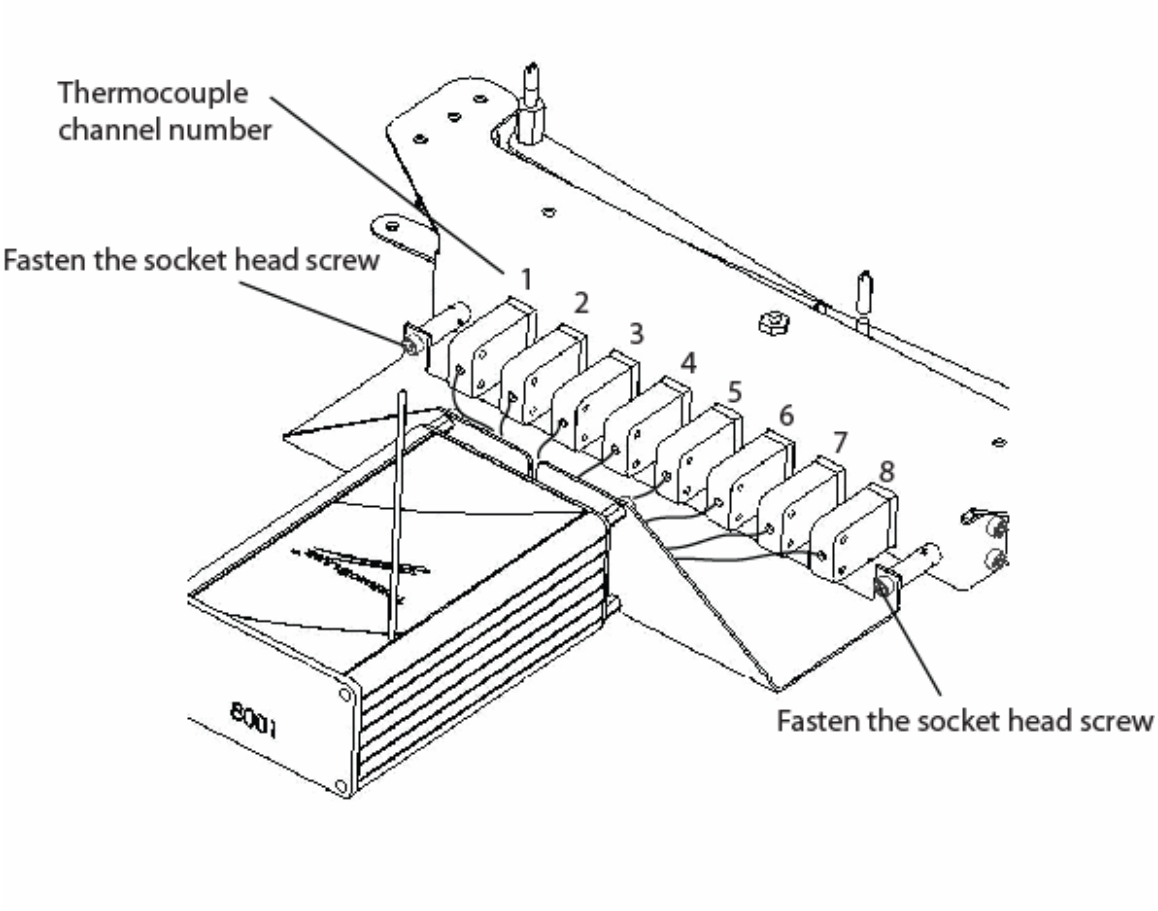

Figure 2. Connecting the TC-Bridge and ThermoBlade

1. Verify the thermocouple types on the ThermoBlade and the TC-Bridge match (e.g., T-type to T-type, K-type to K-type, etc.).
2. Position TC-Bridge in front of ThermoBlade, as shown in Figure 2. Use the two (2) 6-32 socket head cap screws to connect the TC-Bridge and ThermoBlade as shown.
3. To connect the thermocouple connectors, find and gently mate the matching channel numbers on both male and female connectors.

   NOTE: The connectors are POLARIZED, so if there is significant resistance to insertion, turn the connector over and try again.

4. You can confirm proper connection by running a real time test with DataLink. When DataLink starts it checks for thermocouple continuity and flags any broken or disconnected thermocouple channels. To confirm that the channel numbers are correct, you can simply apply heat to each channel in turn and watch the real time display to be sure that the correct channel shows increased temperature.

Once the TC-Bridge and ThermoBlade are connected you are ready to deploy the TC-Bridge.

Deploying the TC-Bridge -

Before discussing the details of TC-Bridge deployment, it is useful to know that the TC-Bridge has been designed to accommodate belt / band widths of 39” (99cm) and 60” (152.4cm).

Deployment of the TC-Bridge consists of three basic steps:

1. detaching the spreader mechanism from the control plate,
2. rotating and extending the spreader mechanism, and
3. re-attaching it to the control plate using the proper holes.

Referring to Figure 3 below, there are three tall standoffs in the TC-Bridge assembly. One tall standoff (A) is located at the center of TC-Bridge members. The other two tall standoffs (B&C) are located at the ends of two TC-Bridge members.

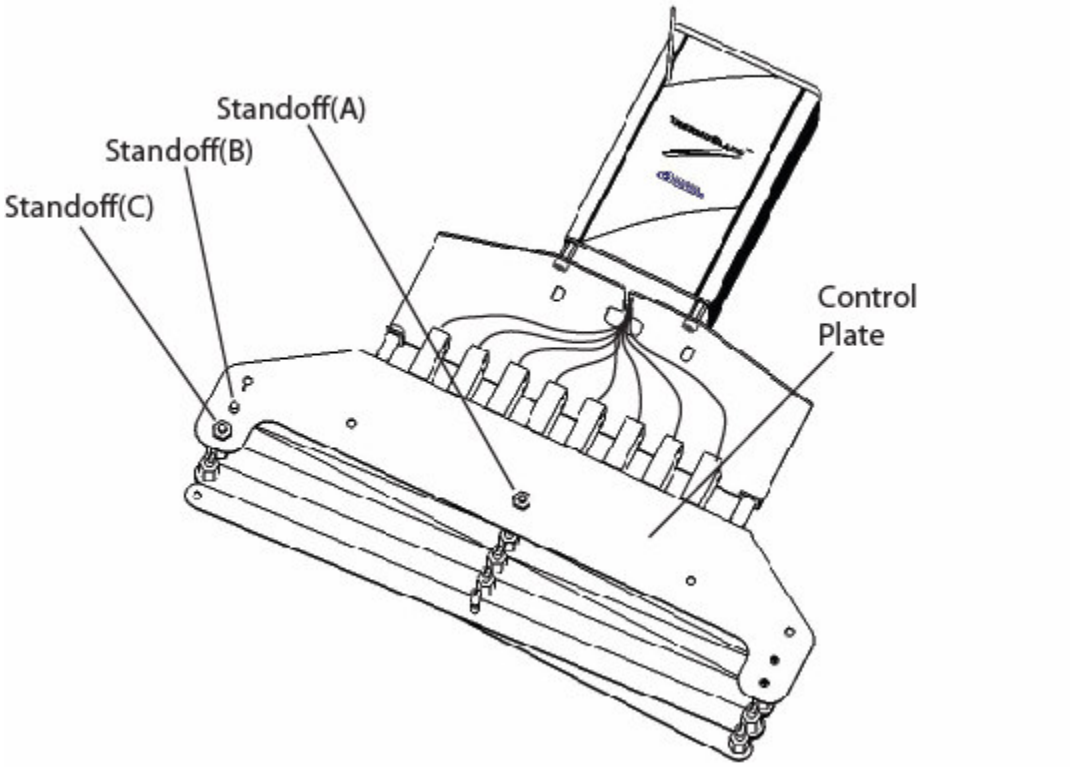

Figure 3. Standoffs on TC-Bridge

The span of the TC-Bridge is controlled by the positions of the two tall standoffs (B&C) as shown in Figures 4 and 5. There are five aligned open holes on the control plate of the TC-Bridge. By positioning standoffs B & C such that they engage two of the open holes, the TC-Bridge may be set for either a 39” (99cm) span (half-deployed) or for a 60” (152.4cm) span (fully deployed).

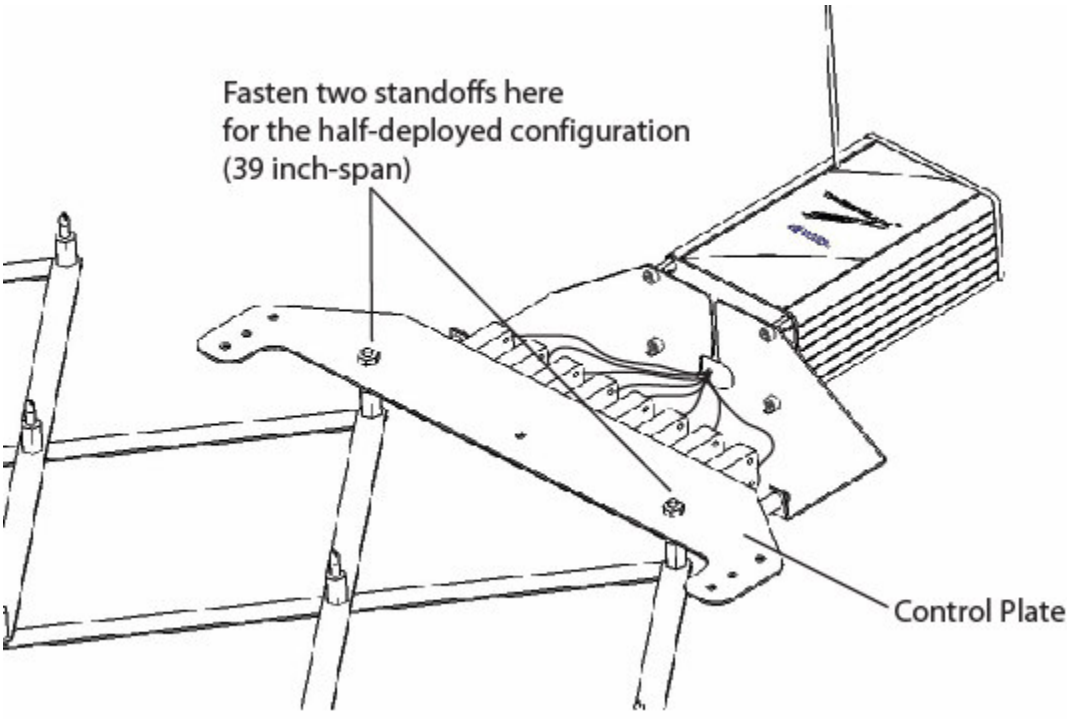

Figure 4. TC-Bridge, half-deployed (39” span)

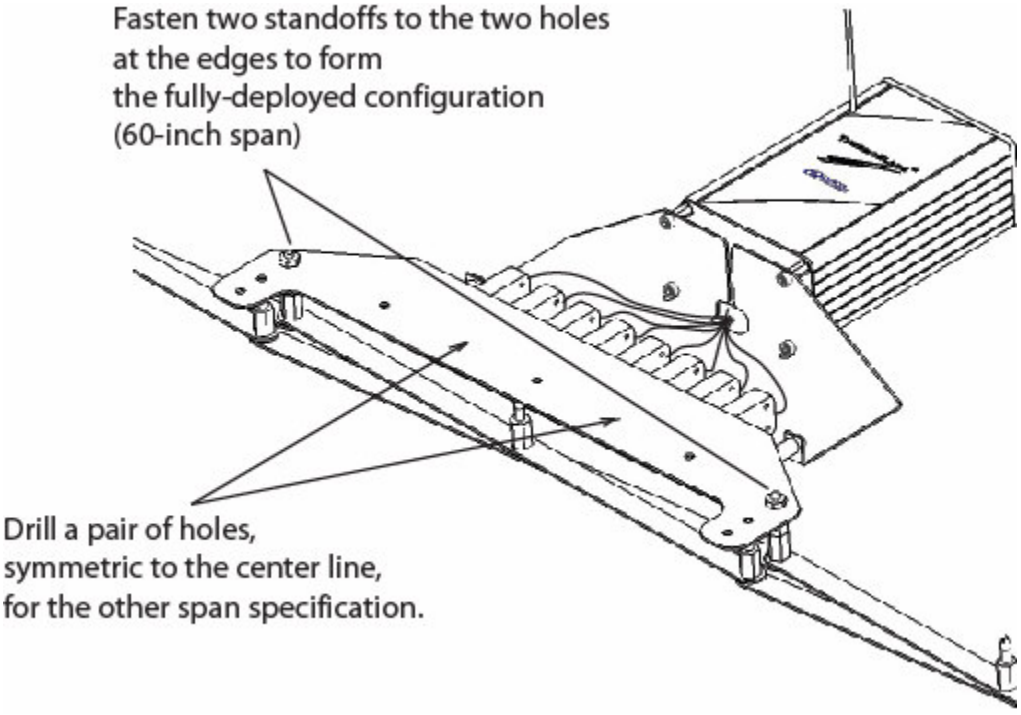

Figure 5. TC-Bridge, fully deployed (60” span)

Detailed TC-Bridge deployment procedure-

1. Referring again to Figure 3, locate and unscrew the two wing nuts from standoffs A and C.

2. Lift the control plate away from the standoffs (A&C) such that the standoffs are not engaged with the control plate any more.

CAUTION- POSSIBLE PINCH HAZARD!

Handle the TC-Bridge carefully since there may be the potential danger of pinching your fingers between TC-Bridge members.

3. Carefully rotate the TC-Bridge spreader mechanism out of the plane such that the standoffs point directly toward ThermoBlade as shown in Figure 6.

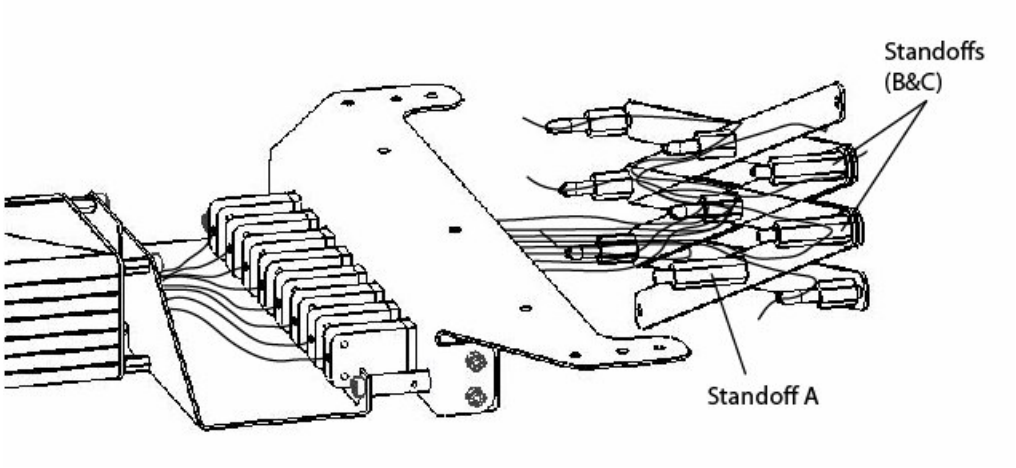

Figure 6. TC-Bridge deployment

4. Rotate the TC-Bridge spreader mechanism 90 degrees such that the standoffs (B&C) are at the bottom of the assembly.

5. Pull TC-Bridge spreader mechanism apart until the standoffs (B&C) align with the open holes on the control plate, as shown in Figure 7, for the half-deployed configuration.

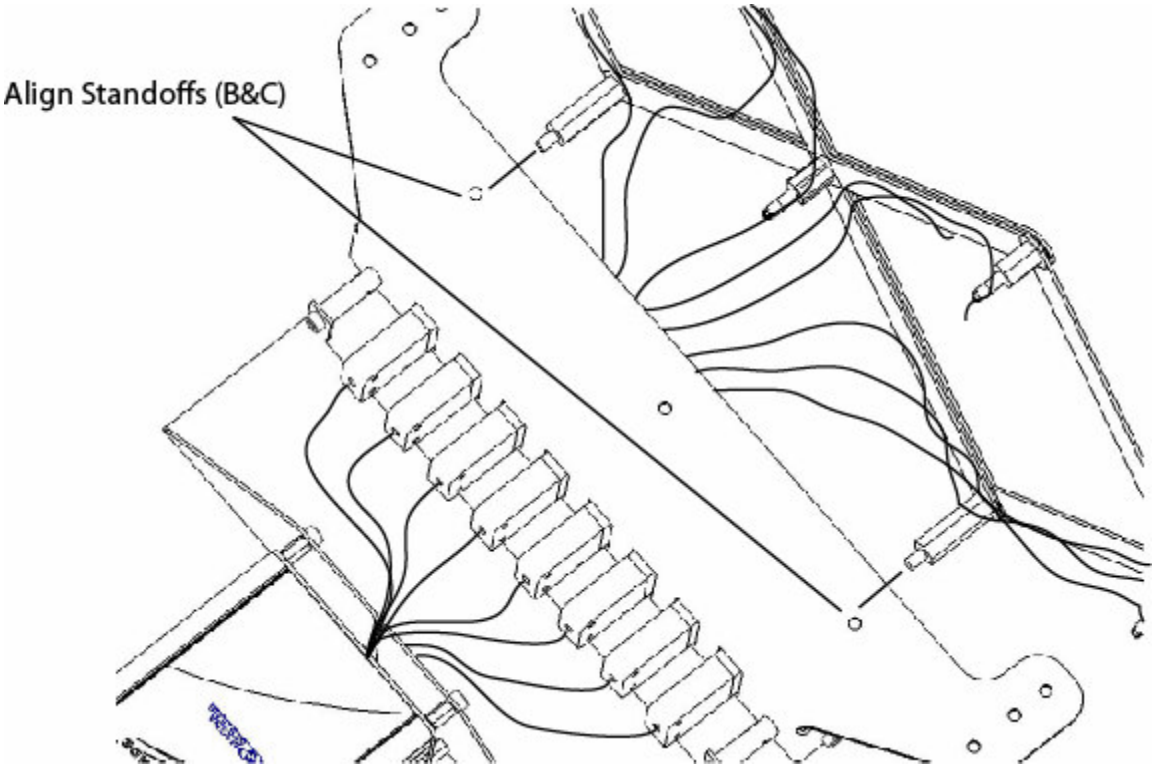

Figure 7. TC-Bridge alignment

6. Rotate the TC-Bridge spreader mechanism such that the standoffs are again pointing upward and engage the standoffs (B&C) with the holes in the control plate as indicated in Figures 4 & 7.

7. Re-attach the spreader mechanism to the control plate using the two (2) wing nuts that you removed in Step 1.

The fully-deployed configuration can be completed by following the same procedure and aligning standoffs (B&C) with the outer set of open holes near the edges of the control plate as shown in Figure 5.

Accommodating other belt / band widths-

Additional belt / band widths less than 60” may be easily accommodated by simply adding more open holes on the control plate. The additional holes should be drilled in line with the existing holes and symmetrically about the centerline of the control plate.

Belt / band widths greater than 60” may be accommodated by adding members to the spreader mechanism and adding the desired holes.

Please contact Magna Systems if you would like assistance in configuring the TC-Bridge for other belt / band widths.

Stowing the TC-Bridge-

Stowing the TC-Bridge is quick and easy. It is basically a reversal of the deployment procedure. The TC-Bridge has been designed such that routing and re-routing of the thermocouple wires during deployment and stowage is NOT REQUIRED. Once stowed, the TC-Bridge may be left connected to the ThermoBlade or disconnected depending on user preference.

Detailed TC-Bridge stowage procedure-

1. Remove the two wing nuts fastening the two tall standoffs (B&C) to the control plate of TC-Bridge.

2. Lift the control plate to release the standoffs (B&C) from the control plate.

3. Rotate the TC-Bridge spreader mechanism such that the standoffs point directly toward the control plate, as shown in Figure 7.

4. Fold the TC-Bridge spreader mechanism until all members are parallel to each other, as shown in Figure 6.

5. Rotate the spreader mechanism so that the standoffs are pointing upwards.

6. Align the standoffs (A&C) with the open holes on the control plate, as shown in Figure 3. Secure the standoffs (A&C) to the control plate using the two wing nuts from Step 1.

Thermocouple Wire Routing Procedure-

When using the TC-Bridge their may be times when you may wish to re-configure the thermocouple wire path on TC-Bridge. To do this, follow the steps listed below:

1. Always route the thermocouple wire along the longitudinal axis (long axis) of a TC-Bridge member, as shown in Figure 8. By doing this, the thermocouple wire will follow the motion of TC-Bridge members during deployment and stowage.

NOTE: If you do not follow this guideline, the thermocouple wires are much more likely to be cut or stressed during deployment or stowage.

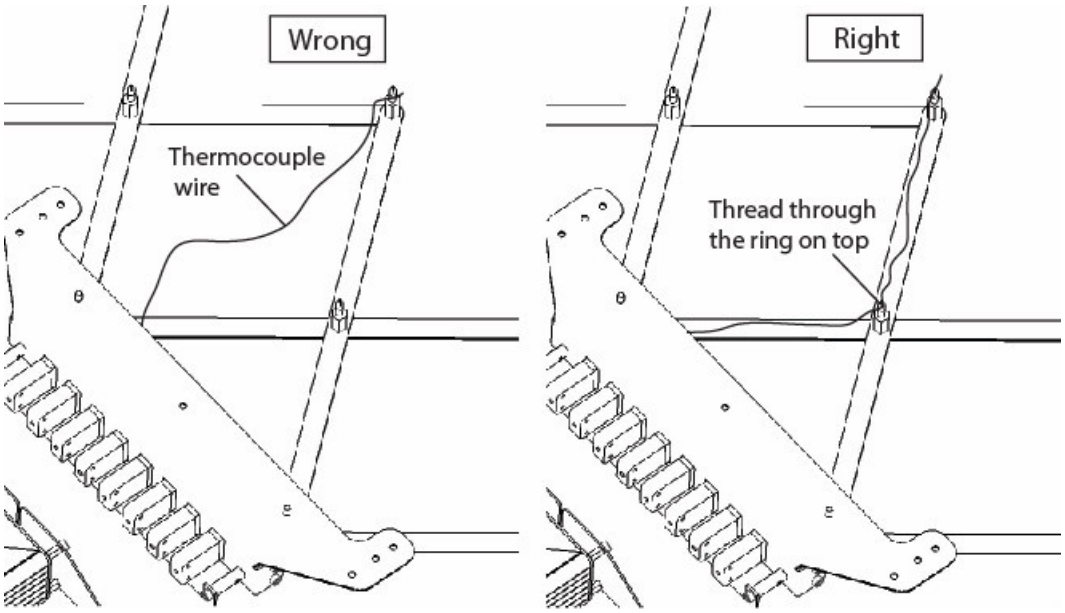

Figure 8. Thermocouple Routing

2. Thread the thermocouple wire through a ring on the top of an extension spring at a standoff, as shown in Figure 9. This will help guide thermocouple motion during the stowage or deployment.

3. When measuring air temperature, fasten the thermocouple tip between spring coils, as shown in Figure 10. This is most easily done by bending or pulling the spring to increase the gap between the coils. Once opened, press the thermocouple wire into the space between the spring coils. Release the spring to pinch the thermocouple tip in place.

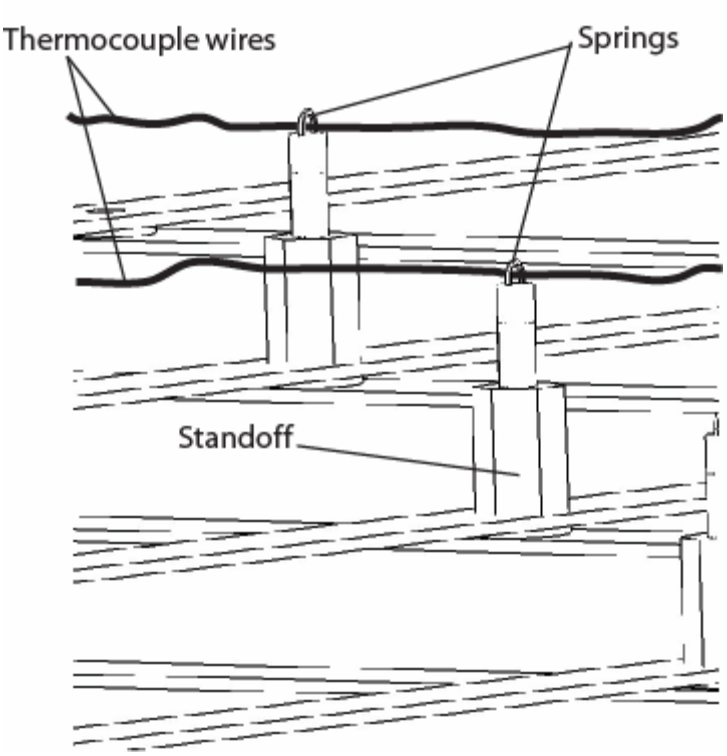

Figure 9. Thermocouple through a spring top

Figure 10. Thermocouple tip between spring coils

4. When measuring band temperature, fasten the thermocouple tip to a nut plate. Route the thermocouple tip as shown in Figure 11 and fasten the nut plate at the desired location on TC-Bridge member.

TIP: *When measuring band temperatures, remember to attach the nut plate to a TC-Bridge member that rests directly on the band. This will ensure good thermal contact between the thermocouple and the band.*

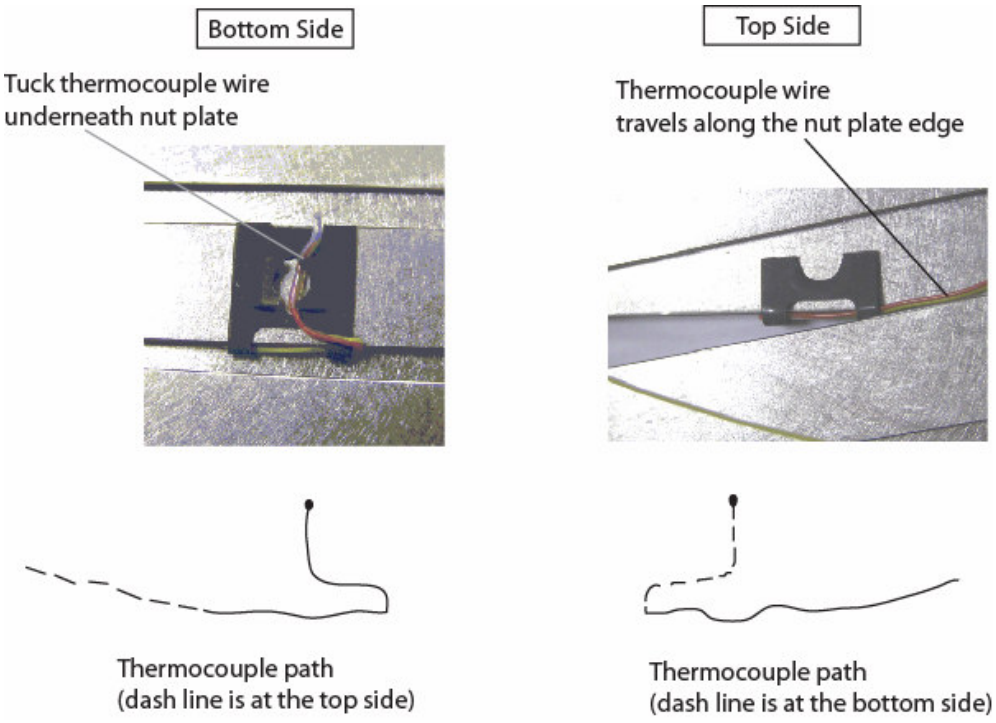

Figure 11. Thermocouple tip on a nut plate

Care of Thermocouples-

Each ThermoBlade uses a set of eight (8) permanently attached thermocouples to measure temperature. Each thermocouple is terminated with a 2-pin ceramic female connector. Thermocouples are devices comprised of two wires made from different metals that have been joined at one end. Because of the dissimilar metals, thermocouples generate a small temperature dependent voltage.

The ThermoBlade typically is shipped with 30 AWG T-type (Cu-Constantan) thermocouples which have a temperature measurement range from -270°C to 400°C (-454°F to 752°F). The use of 30 AWG diameter wire tends to provide a good compromise between ease of handling and thermal performance. Due to its single, solid wire construction thermocouple wire tends to be stiff; thicker gauge wire becomes difficult to handle while thinner wire tends to break easily. The 30 AWG wire should be handled with some care; mechanical stresses, such as pulling on the wire, should be avoided if possible.

Unless otherwise specified, the thermocouples that come with your TC-Bridge are Teflon® insulated and will withstand temperatures up to 370°C. Teflon® is a thermoplastic and will melt above ~ 370°C. Thermocouple wires can be easily cleaned by wiping with a wet cloth or paper towel. Since Teflon® is chemically inert; solvents may be used to clean only the thermocouples in cases where contaminating materials persist.

Installing the TC-Bridge on a ThermoBlade-

Usually ThermoBlade units that are equipped for TC-Bridge use will have an adapter plate already installed, but in some cases you may want to remove the adapter plate or need to install the entire TC-Bridge assembly on a unit that does not have the adapter plate attached.

NOTE: To be compatible with the TC-Bridge, your ThermoBlade unit must be equipped with female ceramic thermocouple connectors (Omega Engineering P/N SHX-?-F).

If your ThermoBlade does not have SHX-?-F connectors installed, you may install them yourself or you may send the ThermoBlade unit back to Magna Systems and we will install them for a nominal fee.

Procedure for installing the entire TC-Bridge assembly:

1. Verify the thermocouple types on the ThermoBlade and the TC-Bridge match (e.g., T-type to T-type, K-type to K-type, etc.).

2. On the end of the ThermoBlade that has the thermocouple probe exit hole, replace four flat-head screws holding the ThermoBlade end plate with four 0.375 inch long male / female hex standoffs as shown in Figure 12.

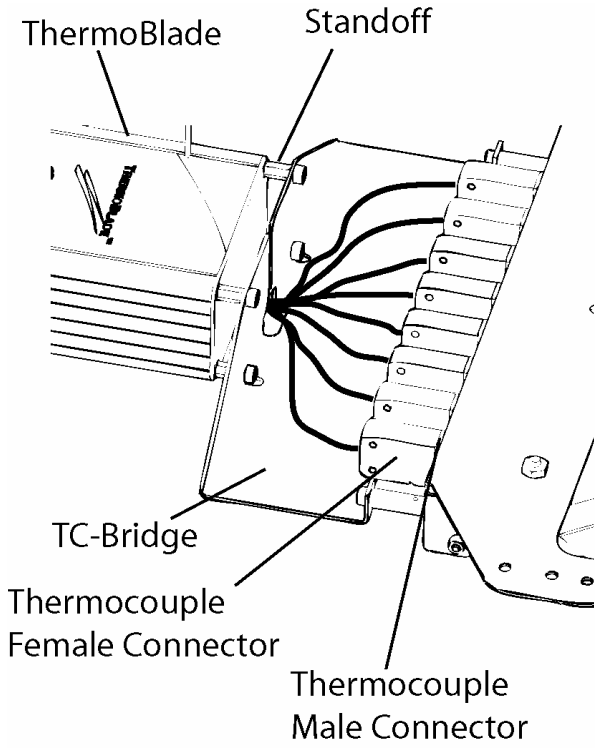

Figure 12. Connecting ThermoBlade with TC-Bridge

3. Position the thermocouple wires through the slot in the TC-Bridge Adapter Plate.

4. Align the Adapter Plate mounting holes with the four standoffs on ThermoBlade.

5. Install the four socket-head cap screws securing the TC-Bridge Adapter Plate to the ThermoBlade.

6. Connect the eight thermocouple female connectors on ThermoBlade with the eight thermocouple male connectors on TC-Bridge by matching the channel numbers on both the male and female connectors and gently mating the male and female connectors.

   NOTE: The connectors are POLARIZED, so if there is significant resistance to insertion, turn the connector over and try again.

7. You can confirm proper connection by running a real time test with DataLink. When DataLink starts it checks for thermocouple continuity and flags any broken or disconnected thermocouple channels. To confirm that the channel numbers are correct, you can simply apply heat to each channel in turn and watch the real time display to be sure that the correct channel shows increased temperature.

So far we've shown a number of details about the TC-Bridge and how to set it up. In the next section we talk about how to use the TC-Bridge and ThermoBlade to easily make accurate, repeatable measurements that will allow you to optimize your baking or freezing process.

Using the ThermoBlade and TC-Bridge-

First some words of caution:

CAUTION- POSSIBLE BURN HAZARD!

After exposure to elevated temperatures the ThermoBlade and TC-Bridge will be **HOT**! To avoid burns, be sure to wear protective clothing (e.g., “hot mitts”) before touching a hot ThermoBlade and / or TC-Bridge.

CAUTION- POSSIBLE ELECTRICAL SHOCK HAZARD!

DESPITE THE ELECTRICAL ISOLATION PROVIDED BY DESIGN, IF THE THERMOCOUPLES ARE ATTACHED TO OBJECTS WHICH HAVE HIGH VOLTAGES PRESENT, THE TC-Bridge MAY PRESENT A SHOCK HAZARD. HANDLE THE TC-Bridge IN A MANNER CONSISTENT WITH THE PRESENCE OF A SHOCK HAZARD.

We assume that you have already installed a version of DataLink™ on the computer that you are going to use and that you have installed a GateWay on that computer as well.

We will walk through the process of making a real-time temperature measurement using the ThermoBlade with TC-Bridge.

CAUTION- INCORRECT BATTERY INSTALLATION MAY DAMAGE ThermoBlade!

Power the ThermoBlade

The ThermoBlade is powered by inserting two (2) AA-style batteries into the battery compartment. Batteries should be installed as indicated on the end of the ThermoBlade electronics board. Please see the ThermoBlade manual for further information.

ThermoBlade Battery Installation Procedure-

1. Locate the end plate with the unit serial number and remove the four pan head screws that secure the end plate to the main ThermoBlade body.

2. Separate the end plate from the ThermoBlade so that the battery area is clearly visible.

3. Inspect the battery compartment area and note the battery orientations indicated.

NOTE: BATTERIES ARE INSTALLED IN OPPOSITE ORIENTATIONS

4. Slide both batteries into the pocket in the correct orientation. Do not puncture the insulation material protection.

5. Replace the end plate and making sure the battery contact aligns with two batteries. Carefully position any excess wire above the PCB assembly.

6. Push the end plate in place such that the screw holes and mounting holes properly align and the insulation fits into the recess in the mating ThermoBlade insulation and seals the unit.

7. Once oriented, hold the end plate in position and re-secure it to the ThermoBlade using the four (4) screws that were previously removed.

Once the batteries are installed, the ThermoBlade is ready to take measurements using the GateWay™ Network Access Point and your DataLink™ software.

Start DataLink

TIP: *You can make network initialization easier if you connect the thermocouples before starting to test. During network initialization, DataLink checks for open thermocouples, so having the thermocouples on the TC-Bridge connected to the ThermoBlade speeds the initialization process.*

Use the test set-up wizard to configure the test you wish to run. Once configuration is complete DataLink will initialize the wireless network and prepare the modules for the start of your test. Once data acquisition has started, you may wish to confirm that the channels are connected correctly by locally heating the individual thermocouples. This will also confirm that DataLink is properly displaying data in real-time.

Into The Oven (or Freezer) We Go!

Now that the batteries have been installed and DataLink is recording data, the ThermoBlade / TC-Bridge assembly is ready for the oven (or freezer). The key question at this point is-

How long can the TC-Bridge stay in the oven or freezer?

Because the TC-Bridge has been designed to have a broad operating temperature range, the exposure duration is limited by the ThermoBlade.

CAUTION- PROLONGED EXPOSURE TO ELEVATED TEMPERATURES MAY DAMAGE ThermoBlade

In Table 1 we give the ThermoBlade high temperature exposure duration (time limit). The second column presents the maximum exposure time for a ThermoBlade before damage is likely to occur. It is assumed that the ThermoBlade is initially at room temperature (22°C or ~ 72°F).

Temperature °F (°C)	Maximum exposure time
375 °F (191 °C)	25 minutes
425 °F (218 °C)	20 minutes
475 °F (246 °C)	15 minutes

Table 1: High temperature exposure time limit versus environmental temperature

Technical Specifications

Thermocouple Inputs-

Number of Channels: 8

Thermocouple Types: T-type standard (E, J, K, R & S available by special order)

Cold Junction Compensation: Automatic, software based

Thermocouple Input: Integral thermocouples or ThermoAdapter inputs

T-type Thermocouple Temperature Range: -270ºC to +400ºC

T-type Thermocouple Characteristics:	Accuracy*	Resolution
	± 0.5ºC	0.1 ºC

*Errors are for the TC-Bridge only and do not include the thermocouple error

General Specifications-

Operating Environment: -200ºC to 427ºC (-328ºF to 800ºF)
5% to 95% Relative Humidity (non-condensing)

Vibration: 10 g (rms 20 Hz to 2000 Hz)

Shock: 3 foot drop

Power: Two AA style batteries

Storage Temperature Range: -40 to 120 ºC

Weight: TC-Bridge only: ~ 681 gm (1.5 lbs.)

TC-Bridge with ThermoBlade: ~ 1271 gm (2.8 lbs.)

Members: Stainless Steel 304

Dimensions: (in inches)