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KEITHLEY

DAS-TC/B

User's Guide



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DAS-TC/B User's Guide

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Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If  or  is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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Preface

The *DAS-TC/B User's Guide* contains information and instructions for handling and using a DAS-TC/B thermocouple/voltage measuring board. To follow the information and instructions contained in this manual, you must be familiar with data-acquisition principles, with your application, and with the Windows® 95/98/NT operating system and compatible computers. This product works best with a computer having a Pentium-series processor.

The *DAS-TC/B User's Guide* is organized as follows:

- Section 1 describes board features, software, and accessories.
- Section 2 describes operating features of a board in more detail. This section contains a block diagram and brief descriptions of the features as they relate to your options for setting up and using a board.
- Section 3 contains instructions for inspection, software installation, configuration, and board installation.
- Section 4 shows the preferred methods of making I/O (Input/Output) connections, using the available accessories and cables.
- Section 5 summarizes the features of the DriverLINX DAS-TC/B Data Logger program, how to start the program, how to access detailed information, and instructions.
- Section 6 describes calibration requirements.
- Section 7 contains information on troubleshooting and on obtaining technical support.

- Appendix A contains specifications.
- Appendix B contains pin assignments for the main I/O connector.
- Appendix C contains CE mark certification.
- The index provides hyperlinks, as well as written page numbers, to locate various subjects in the manual.

1

Overview

The DAS-TC/B is a thermocouple/voltage measuring board that accepts up to 16 inputs. You can configure input channels individually to accept inputs from thermocouples or other voltage sources. Channels configured for thermocouple inputs provide readings in degrees (Celsius or Fahrenheit), while channels configured for voltage inputs provide readings in volts.

This section describes the DAS-TC/B features, software, and accessories.

Features

DAS-TC/B features are as follows:

- The board fits an accessory slot of a computer.
- All 16 channels are differential inputs.
- Thermocouple inputs can be any mix of up to seven standard types, as follows: B, E, J, K, R, S, and T.
- Thermocouple measurements are linearized by an onboard microprocessor for readings in degrees.
- Open-thermocouple detection is selectable.
- Automatic CJC (cold-junction compensation) is performed on a per-channel-basis and is continuous.
- Calibration of the CJC and board logging parameters is automatic and continuous.
- Inputs to the DAS-TC/B enter through either a plug-in screw-terminal block (the STC-TC/B) or an external screw-terminal box (the STA-TC/B).

- CMRR (Common Mode Rejection Ratio) is greater than 100dB for gains greater than one.
- The rejection rate is configurable for 50, 60, or 400Hz.
- Analog inputs (measurement section) are electrically isolated from the PC.
- The board can perform onboard averaging.

Supporting Software

Available software allows you to take two different approaches to configuring and running your DAS-TC/B board. You can use a fully integrated data acquisition software package (TestPoint or LabVIEW) or write a custom program in Visual C/C++, Visual Basic, or Delphi using DriverLINX (included with the hardware). A summary of the pros and cons of using integrated packages or writing custom programs is provided in the Keithley Full Line Catalog. The DAS-TC/B has fully functional driver support for use under Windows 95/98/NT.

Note: DriverLINX must be installed to run any applications for the board, whether they are custom-programmed applications or integrated software packages, such as TestPoint or LabVIEW.

The characteristics of DriverLINX, TestPoint, and LabVIEW are summarized below.

DriverLINX Driver Software for Windows 95/98/NT

DriverLINX software, supplied by Keithley with the DAS-TC/B board, provides convenient interfaces to configure and set I/O bits without register-level programming.

Most importantly, however, DriverLINX supports those programmers who want to create custom applications using Visual C/C++, Visual Basic, or Delphi. DriverLINX accomplishes foreground and background

tasks to perform data acquisition. The software includes memory and data buffer management, event triggering, extensive error checking, and context sensitive online help.

More specifically, DriverLINX provides application developers a standardized interface to over 100 services for creating foreground and background tasks for the following:

- Analog input and output
- Digital input and output
- Time and frequency measurement
- Event counting
- Pulse output
- Period measurement

In addition to basic I/O support, DriverLINX also provides:

- Built-in capabilities to handle memory and data buffer management
- A selection of starting and stopping trigger events, including pre-triggering, mid-point triggering, and post-triggering protocols
- Extensive error checking
- Context-sensitive on-line help system

DriverLINX is essentially hardware independent; its portable APIs work across various operating systems. This capability eliminates unnecessary programming when changing operating system platforms.

TestPoint

TestPoint is a fully featured, integrated application package that incorporates many commonly used math, analysis, report generation, and graphics functions. TestPoint's graphical drag-and-drop interface can be used to create data acquisition applications, without programming, for IEEE-488 instruments, data acquisition boards, and RS232-485 instruments and devices.

TestPoint includes features for controlling external devices, responding to events, processing data, creating report files, and exchanging information with other Windows programs. It provides libraries for controlling most popular GPIB instruments. OCX and ActiveX controls plug directly into TestPoint, allowing additional features from third party suppliers.

LabVIEW

LabVIEW is a fully featured, graphical programming language used to create virtual instrumentation. It consists of an interactive user interface, complete with knobs, slides, switches, graphs, strip charts, and other instrument panel controls. Its data driven environment uses function blocks that are virtually wired together and pass data to each other. The function blocks, which are selected from palette menus, range from arithmetic functions to advanced acquisition, control, and analysis routines. Also included are debugging tools, help windows, execution highlighting, single stepping, probes, and breakpoints to trace and monitor the data flow execution. LabVIEW can be used to create professional applications with minimal programming.

Accessories

The following accessories are available for the DAS-TC/B:

- **STC-TC/B** — a panel containing a CJC sensor and screw terminals for all DAS-TC/B I/O connections. The STC-TC/B plugs directly into the main I/O connector of the DAS-TC/B and extends from the rear of the computer.
- **STA-TC/B** — contains a CJC sensor and screw terminals for all DAS-TC/B I/O connections. Use a C-1800 cable to connect the STA-TC/B to the DAS-TC/B.
- **C-1800** — an 18-inch ribbon cable for connecting the STA-TC/B to the DAS-TC/B. This cable is available in longer lengths that must be specified in the part number (for example, to specify three extra feet use C-1803).
- **S-1800** — a shielded version of the C-1800 cable.

2

Functional Description

This section describes the operating features of the DAS-TC/B.

The DAS-TC/B consists of two sections: the isolated input section and the control section. The isolated input section handles the measurement functions, while the control section handles data processing. Figure 2-1 is a block diagram of the two sections and their stages.

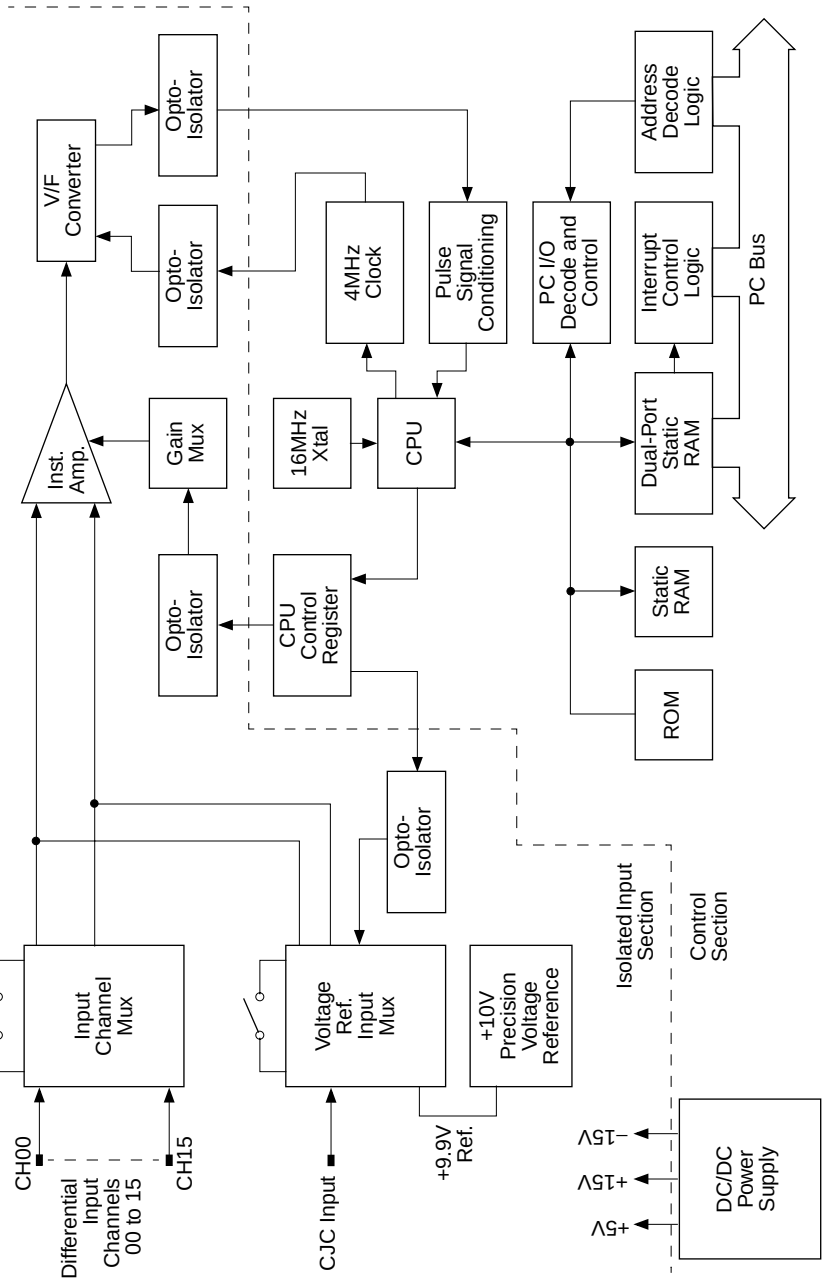


Figure 2-1. Block Diagram of DAS-TC/B

Isolated Input Section

The isolated input section consists of a 16-channel input multiplexer, a CJC sensor input, calibration inputs, a programmable gain amplifier, and a V/F (voltage-to-frequency) converter. During operation, the DAS-TC/B constantly monitors and uses the CJC input to maintain the accuracy of the board. At the same time, the board switches in a precision 9.9V input to measure gain error at a gain of 1 and to measure offset errors for all four gain ranges. The board then stores these measurements in onboard memory.

The four ranges of the programmable gain amplifier are selectable to match the thermocouple input ranges and to accommodate the voltage input range of –2.5V to 10V (using a gain of 1).

The V/F converter provides excellent noise rejection and high resolution, while generating a pulsed output whose frequency is proportional to the voltage input. The pulsed output passes first through a stage of optical isolation and then into a stage of counting, where a count of the square waves over a specified period determines a value for the corresponding voltage input. The period for each count of square waves is set by the value entered in the configuration file for Normal Mode Rejection Frequency (50, 60, or 400 samples/s); the actual period is one-half this selected value. The longer the count time, the higher the resolution and better the noise rejection.

Control Section

The control section consists of the microprocessor and its memory. The microprocessor performs all control functions and mathematical calculations, precluding the need for any computer processing. Working from the configuration file, the microprocessor sets up the board for the desired configuration. Board parameters include interrupt level and Normal Mode Rejection Frequency. Channel parameters include thermocouple type, number of samples to average, and type of engineering units. During the acquisition process, the microprocessor also handles scan order, thermocouple linearization, and calculations for CJC.

Onboard memory includes ROM, Static RAM, and Dual-Port Static RAM. ROM contains the DAS-TC/B control program, which directs the activities of the microprocessor and the thermocouple look-up tables. Static RAM serves as the CPU "scratch pad," providing temporary storage for measurement results and calibration coefficients. The dual-port RAM is the buffer for communications and data flow to/from the computer.

Operational Flow

Configuration data for the DAS-TC/B board and channels is contained in a configuration file. The configuration file is generated through DriverLINX.

During DAS-TC/B initialization, the CPU downloads configuration information from the computer hard drive to the DAS-TC/B board memory. The CPU then sets up the DAS-TC/B board and channel parameters to the specified values. Following parameter setup, the CPU performs a calibration and stores the gain and offset coefficients in board memory. Next, the board reads and stores the CJC sensor value.

When the PC initiates a channel scan, the DAS-TC/B scans the channels in the order specified by the PC. Channels designated for thermocouple input use parameter values from the configuration file. Channels designated for voltage input also use parameter values from the configuration file, unless you overwrite these values.

Channel readings proceed at less than the rate specified by the value for Normal Mode Rejection Frequency in the configuration file. The reading for each channel requires a count of the frequency output of the V/F converter. The CPU compensates for calibration errors in these readings. For channels configured as thermocouple inputs, the CPU also adjusts for CJC and converts the readings to temperature measurements. For channels configured as voltage inputs, the CPU converts the readings to volts.

To convert thermocouple readings to temperature measurements, the CPU refers to look-up tables, stored in ROM. A separate look-up table is available for each thermocouple type accommodated by the DAS-TC/B. The look-up tables optimize accuracy by using more reference points along ranges of greatest temperature-versus-voltage change than along ranges of minimal change. (Using the same number of points at fixed intervals would lead to error along ranges of greatest temperature-versus-voltage change.)

As soon as all readings and conversions are complete, the DAS-TC/B requests an interrupt and transfers all measurements to the computer.

The DAS-TC/B makes periodic measurements of the CJC and performs self-calibration as a background task.

3

Installation

Overview

This section describes the following procedures, which appear in the order they are to be performed:

- Inventorying installation resources for the board
- Installing the software used to operate your DAS-TC/B board
- Configuring the installation in software
- Unpacking and inspecting the board, setting the base address of the board, and then installing the board in your computer
- Checking the installation

If you encounter any problems with the board after installation, refer to Section 7 for troubleshooting information.

Note: Install the DriverLINX software before installing the DAS-TC/B board. Otherwise, the device drivers will be more difficult to install.

Inventorying Required Installation Resources

Before installing DriverLINX and the board, do the following:

1. Inventory your DAS-TC/B board's configuration settings.
2. Determine the resources your DAS-TC/B board requires.
3. Inventory your computer's resources already allocated to other installed devices.

4. Determine whether your computer has sufficient resources for your DAS-TC/B board.
5. Determine whether your DAS-TC/B board can use your computer's free resources.
6. If you have the needed resources, continue with the next section, "Installing the Software."

Note: *The DriverLINX Installation and Configuration Guide*, Section 1, amplifies the inventory process in checklist items 1-5. (Ignore the rest of the checklist items for now.) To display this manual from your DriverLINX DAS-TC/B CD-ROM, open the Windows Explorer, then double click on X:\Drvlinx4\Docs\Instconf.pdf, where X = the letter of the CD-ROM drive. Acrobat Reader must already be installed on the other system. If necessary, you can first install Acrobat Reader directly from the CD-ROM by double clicking X:\Acrobat\setup.exe.

Installing the Software

Installing Application Software and Drivers

Installing the TestPoint software and driver

The DriverLINX driver for TestPoint is provided as part of the TestPoint software. The driver therefore installs automatically when you install TestPoint.

You can install TestPoint application software, made by Capital Equipment Corporation (CEC), at any time—before or after installing DriverLINX and the DAS-TC/B board. For TestPoint installation instructions, consult the manual provided by CEC.

Note: Before using TestPoint with the DAS-TC/B version of DriverLINX, check with CEC to ensure that your version of TestPoint is compatible with DriverLINX.

Installing the LabVIEW Software and Driver

A DriverLINX driver for LabVIEW is provided on your DriverLINX CD-ROM. The LabVIEW driver does not install automatically when you install DriverLINX and your board. You must first install the LabVIEW application program, then install the DriverLINX driver. Access the LabVIEW driver installation routine by starting setup.exe on the DriverLINX CD-ROM, then selecting LabVIEW™ Support from the Install These DriverLINX Components screen.

Consult the manual provided by National Instruments for LabVIEW installation instructions.

Continue with the next procedure, "Installing DriverLINX Software Components and Documentation."

Installing DriverLINX Software Components and Documentation

This section discusses installation of DriverLINX drivers and interfaces, and DriverLINX and board documentation.

Note: If you plan to use LabVIEW with your board, the LabVIEW program must be installed before installing the DriverLINX support files for LabVIEW. Keithley recommends installing LabVIEW now—before performing the installation sequence below—and then installing the DriverLINX support files for LabVIEW during the same session in which you install DriverLINX.

Even if DriverLINX versions other than the DAS-TC/B Series version are already installed on your system, you must also install the DAS-TC/B Series DriverLINX version. In the process, some DriverLINX capabilities shared by all boards may be upgraded (test utilities, for example).

DriverLINX Installation Options

The component installation options provided by the DriverLINX setup program are as follows:

- **Install Drivers** — This required component installs only the files you need for configuring your hardware and running third-party data-acquisition applications that require DriverLINX.
- **Install Interfaces** — This optional component installs the files and example programs that you will need to develop custom applications for DriverLINX using C/C++, Visual Basic, and Delphi.
- **Install Documentation** — This optional component installs this manual and the electronic documentation for DriverLINX, all of which you can read, search, and print using the Adobe Acrobat Reader.
- **Install Acrobat** — This optional component installs the Adobe Acrobat Reader for the DriverLINX electronic documentation.
- **LabVIEW™ Support** — DriverLINX for the DAS-TC/B Series includes a copy of DriverLINX for LabVIEW. This optional component installs a complete set of Virtual Instruments to use Keithley hardware in National Instruments LabVIEW. Before you can install this optional component, you must first install DriverLINX drivers and LabVIEW.

DriverLINX Installation Procedure

Install the DriverLINX software components as follows:

1. Place the DriverLINX DAS-TC/B Series CD-ROM in your drive and wait a few seconds. On most systems, setup starts automatically. If not, run the setup.exe file found in the root directory of the CD-ROM.

   A DriverLINX Browser Introduction screen appears. Thereafter, the DriverLINX CD Navigator screen appears automatically after waiting a few seconds or after clicking **Next**.

Note: On the DriverLINX CD Navigator and other DriverLINX Browser screens, place the cursor over a menu item to see an explanation. A star next to a menu item means that it was selected previously.

Before continuing with this installation, Keithley suggests clicking **Read Me First** on the DriverLINX CD Navigator and reviewing the brief information that appears.

2. On the DriverLINX CD Navigator screen, click **Install DriverLINX**. An Install These DriverLINX Components screen appears.
3. Click **Install Drivers** and follow the series of on-screen instructions. When done, the Install These DriverLINX Components screen reappears.
4. If you do not plan to develop custom application software for your DAS-TC/B board, then skip to step 5. If you do plan to develop custom application software, you must install DriverLINX interfaces before writing the software. Install them now by clicking **Install Interfaces** and following the series of on-screen instructions. When done, the Install These DriverLINX Components screen reappears.
5. Click **Install Documentation** and follow the series of on-screen instructions. This step installs the manuals. When done, the Install These DriverLINX Components screen reappears.
6. If Acrobat Reader is not already installed on your system, install it now. You need Acrobat Reader to read the manuals, a section of which you must access in step 10. Click on **Install Acrobat** and follow the series of on-screen instructions. When done, the Install These DriverLINX Components screen reappears.
7. If you have already installed the LabVIEW program, then click **LabVIEW™ Support** and follow the series of on-screen instructions. When done, the Install These DriverLINX Components screen reappears.
8. Click **Exit.** Then, on the screen that appears saying "Thank you for using DriverLINX," click **Done**. The System Settings Changed dialog box appears.

9. On the System Settings Changed dialog box, click **No**. The system will be rebooted and configured later under "Configuring Your Installation" on page 3-7. The screen returns to the Windows desktop.
10. Print out one section of a DriverLINX manual that you will briefly review later during system configuration. Proceed as follows:
    a. In the **Start** menu under **Programs** → **DriverLINX,** click **On-line Manuals.** A menu document appears.
    b. In the menu document, scroll until you find the major category **Configuration**.
    c. Under **Configuration**, click **Hardware References**. A list of documents appears.
    d. In the list of documents, click **Keithley DAS-TC/B**. Acrobat Reader opens and the manual entitled *Using DriverLINX with Your Hardware—Keithley DAS-TC/B* appears.
    e. Print the following section from the *Using DriverLINX with Your Hardware—Keithley DAS-TC/B* manual: "Configuring the DAS-TC/B."

Note: If your data acquisition system is not connected to a printer, you can display and print the *Using DriverLINX with Your Hardware—Keithley DAS-TC/B* manual sections from another system, directly from the CD-ROM (without installing anything). To display the manual, open the Windows Explorer, then double click on **X:\Drvlinx4\Docs\Notes\Kdastc.pdf**, where **X** = the letter of the CD-ROM drive. Acrobat Reader must already be installed on the other system. If necessary, you can first install Acrobat Reader directly from the CD-ROM by double clicking **X:\Acrobat\setup.exe.**

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11. Continue with the next section, "Configuring Your Installation."

1. Locate and briefly review the DriverLINX manual section, "Configuring the DAS-TC/B," that you printed earlier during step 10 of "Installing DriverLINX Software Components and Documentation" on page 3-3. Reviewing this section will help prepare you to input information and select options when configuring your installation.

Note: Be sure to note and follow all configuration differences between installations for Windows NT and Windows 95/98.

---

2. Reboot your computer. The DriverLINX Plug and Play Wizard appears on your screen automatically at the end of the boot cycle.

Note: If you do not run the DriverLINX Plug and Play Wizard now, it will not reappear during the current computer session, although it may appear after a subsequent reboot. If you wish to configure your board sometime later, you can start the Plug and Play Wizard manually from a batch file. In the Windows Explorer, double click **X:\Drvlinx4\Help\Kdastc.bat**, where X is the letter of the drive on which DriverLINX is installed.

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3. On the Plug and Play Wizard, click **Wizard** and follow the series of on-screen instructions that appear. The wizard will first lead you through the steps of installing your hardware—from a software viewpoint—and configuring it.

Note: If your operating system is Windows NT, use Windows NT Diagnostics to find the free resources that the Plug and Play Wizard asks you to assign. However, if your board requires an interrupt, to reliably find a free ISA interrupt you may need to 1) configure your computer as having a non-Plug and Play operating system, using BIOS setup, and then 2) individually assign the interrupt to the ISA bus.

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4. Continue with the next section, "Preparing and Installing Your Board."

Preparing and Installing Your Board

This section describes the following:

- Safely unwrapping and then inspecting your board before installing it
- Setting the base-address DIP switch of the board
- Physically installing the board in your computer

Caution: Ensure that the computer is turned off before installing or removing a board. Installing or removing a board while power is on can damage your computer, the board, or both.

Handle the board in a static-controlled workstation; wear a grounded wrist strap. Discharge static voltage differences between the wrapped board and the handling environment before removing the board from its protective wrapper. Failure to discharge static electricity before and during handling may damage semiconductor circuits on the board.

Handle the board using the mounting bracket. Do not touch the circuit traces or connector contacts when handling the board.

Unwrapping and Inspecting Your Board

Unwrap and inspect your board as follows:

1. The factory packages your board in an anti-static wrapper that must not be removed until you have discharged any static electricity from yourself by either of the following methods:
   - If you are equipped with a grounded wrist strap, discharge static electricity by holding the wrapped board.
   - If you are not equipped with a grounded wrist strap, you can discharge static electricity by holding the wrapped board in one hand while placing your other hand firmly on a metal portion of the computer chassis (your computer must be turned off, but grounded). This approach is less secure than using a grounded wrist strap.

2. Carefully unwrap your board from its anti-static wrapping material. (You can store the wrapping material for future use.)
3. Inspect the board for signs of damage. If damage is apparent, arrange to return the board to the factory (see "Technical Support").
4. Check the remaining contents of your package against the packing list, and immediately report any missing items.
5. When you are satisfied with the inspection, continue with the next procedure, "Setting the Base Address."

Note: Your DAS-TC/B is factory calibrated and requires no further adjustment prior to installation. If at a later time you decide to recalibrate the board, refer to Section 6 for instructions.

Setting the Base Address

Note: Before setting the base address switch, check the different requirements for Windows 95/98 and Windows NT. Refer to "Configuring the DAS-TC/B" in *Using DriverLINX with Your Hardware—Keithley PIO Series* manual. (You printed this information in step 10 of "Installing DriverLINX Software Components and Documentation.")

The only manually configurable component on the DAS-TC/B is the DIP switch for setting the board's base address. Figure 3-1 shows the 7-position DIP switch with factory settings. (Note that the switches set the values shown only when in the off positions).

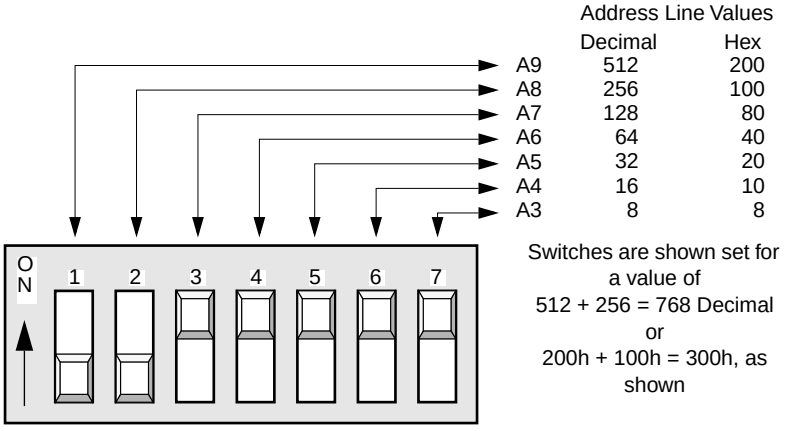


Figure 3-1. Base Address Switch

The DAS-TC/B requires a block of four non-overlapping addresses between 100h and 3FFh in the computer I/O address space. If the factory-preset base address,1 300h, was also assigned to the board when you ran the DriverLINX Plug and Play Wizard, you do not need to reset the address switch. Otherwise, reset the base address switch to conform to the base address assigned when you ran the Wizard.

When you finish setting the base address switch, continue with the next procedure, “Installing the Board.”

Installing the Board

Caution: Inserting or removing a board with the computer on can damage your board or your computer.

To install a DAS-TC/B board in your computer, perform the following steps:

1. Turn off power to the computer and all attached equipment.
2. Remove the computer chassis cover.
3. Select an available accessory slot and remove the slot door cover at the rear of the computer.

4. Make sure the base address switch is properly set (refer to "Setting the Base Address" on page 3-9).
5. Insert and secure the board.
6. Replace the computer cover.
7. Continue with the next section, "Checking Your Installation."

Checking Your Installation

The ability to start the DriverLINX DAS-TC/B Data Logger utility, which is available only after you install DriverLINX, verifies that DriverLINX and the board are installed and configured satisfactorily. Do the following:

1. Click the Windows 95/98/NT **Start** tab.
2. In the **Start** menu, click **Programs**.
3. Find the **DriverLINX** → **Test Panels** folder, you should find the **DAS-TC/B Data Logger** entry.
4. Click on the **DAS-TC/B Data Logger** entry. The initial DAS-TC/B Data Logger screen should appear if the installation is satisfactory.

Refer also to the *DriverLINX Installation and Configuration Guide* and *Using DriverLINX with Your Hardware—Keithley DAS-TC/B* manuals.

After you configure and check your installation, you can attach accessories as needed and wire the appropriate signals to the board. Refer to Section 4, "Cabling and Wiring," for instructions.

4

Cabling and Wiring

This section discusses the following to help you correctly wire your thermocouples and other signal sources to the DAS-TC/B:

- The screw terminal accessories that are needed to interface your circuits to the DAS-TC/B inputs
- The nature of the DAS-TC/B inputs and how this influences wiring
- The appropriate wiring connections for floating and grounded signals

Using Screw Terminal Accessories

Signal connections to the DAS-TC/B main I/O connector require using either an STC-TC/B or an STA-TC/B screw terminal accessory. This section describes the features of these accessories and attachment of these accessories to the board.

Features of Screw Terminal Accessories

Both the STC-TC/B and STA-TC/B screw terminal accessories provide screw terminals that mate with the pins on the main I/O connector of the DAS-TC/B. (Appendix B lists the pin assignments for the DAS-TC/B main I/O connector.) They both support all sixteen differential channels of the DAS-TC/B.

The STC-TC/B mounts on the main I/O connector. The STA-TC/B mates with the main I/O connector via a cable. Figure 4-1and Figure 4-2 show the layouts of the STC-TC/B and STA-TC/B.

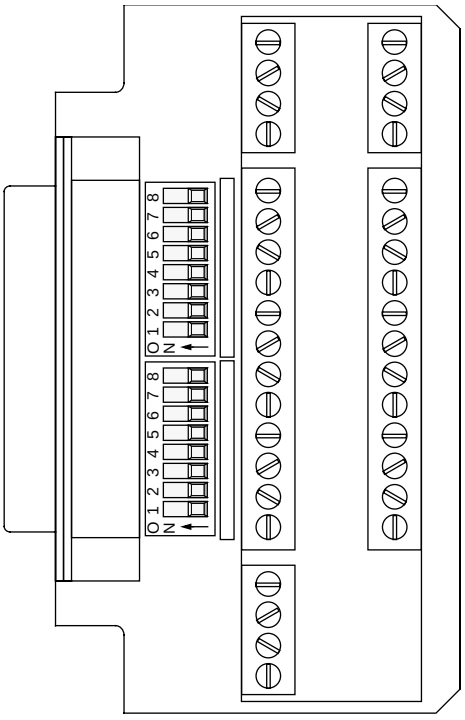


Figure 4-1. STC-TC/B Layout

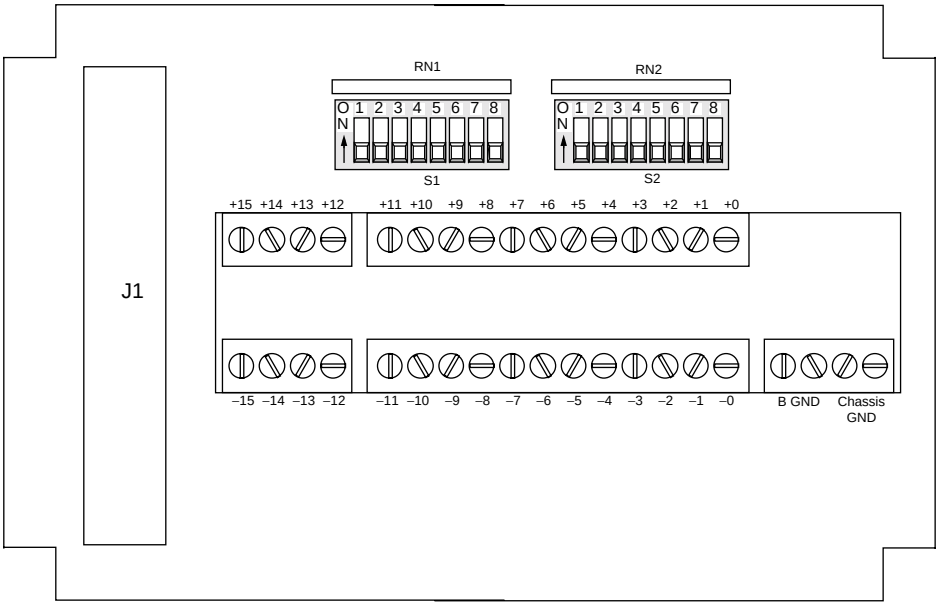


Figure 4-2. STA-TC/B Layout

Both the STC-TC/B and STA-TC/B screw terminal accessories include a CJC temperature sensor and provide an optional switch-selectable open-thermocouple detection signal for each channel. These provisions are described in the next two subsections.

Cold Junction Compensation (CJC) Temperature Sensor

Both the STC-TC/B and STA-TC/B screw terminal accessories include a CJC temperature sensor. The CJC sensor and the screw-terminal blocks of the STC-TC/B are both mounted on an isothermal bar; a metal plate that keeps the screw terminals and the CJC sensor at the same temperature. Figure 4-3 shows the schematic for the CJC temperature sensor.

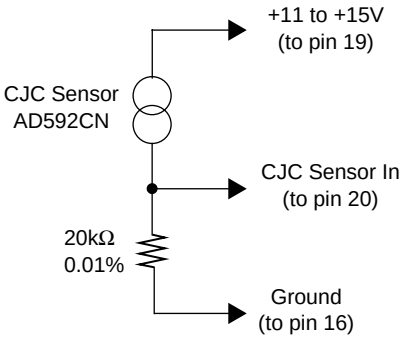


Figure 4-3. Schematic for CJC Temperature Sensor Circuit

The CJC sensor consists of an Analog Devices AD592CN integrated circuit in series with a 20kΩ, ±0.01% resistor. The output of the CJC sensor, measured across the 20kΩ resistor, is 5.964V at 25°C. This output changes at the rate of 20mV/°C. The CJC sensor requires no calibration.

The CJC is needed for accurate thermocouple temperature measurements. A temperature-dependent voltage, called the reference junction voltage (or cold junction voltage), is always generated between a thermocouple and the terminals to which the thermocouple is connected. Therefore, when you connect a thermocouple to a DAS-TC/B board via an STC-TC/B or STA-TC/B screw terminal accessory, a reference-junction voltage is generated between the thermocouple leads and the screw terminals. The reference junction voltage is defined as follows:

Reference junction voltage	=	(Voltage generated by your thermocouple at reference-junction temperature—the temperature of the screw terminals)	-	(Voltage generated by your thermocouple at 0°C, which is defined to be 0V)

This reference-junction voltage must be added to the thermocouple reading to obtain an accurate temperature value.

An appropriate cold junction compensation algorithm follows:

1. Read the CJC circuit output voltage at pins 16 and 20 of the main I/O connector of the DAS-TC/B.
2. Perform the following data manipulations in the host computer:
    a. Convert the CJC circuit voltage to the reference-junction temperature.
    b. Convert the reference-junction temperature to a reference-junction voltage, using the appropriate equation or lookup table for your thermocouple type.
    c. Add the reference-junction voltage to the thermocouple reading.
    d. Convert the corrected thermocouple reading to a temperature value, using the appropriate equation or lookup table for your thermocouple type.

Open-Thermocouple Detection Signals

The consequences of an open thermocouple circuit can be serious. For example, when using a thermocouple for automatic control of an elevated temperature, an open circuit in the thermocouple typically causes the measured temperature to appear constantly below the control set point. Consequently, the control algorithm could apply excessive, potentially damaging heat in a futile attempt to restore the measured temperature to the control set point.

However, some temperature control software includes a feature that interprets a positive out-of-range input as an open-thermocouple event, then takes protective action. Therefore, on both the STC-TC/B and STA-TC/B accessories, open-thermocouple detection signals are available to drive high-impedance (100MΩ minimum) DAS-TC/B inputs out of range during open-thermocouple events. These signals are small enough not to interfere with normal thermocouple temperature measurements. For example, the open-thermocouple detection signal to each channel on an STA-TC/B is roughly 10nA, causing only a tiny voltage drop across the thermocouple circuit—roughly 1μV across 100Ω.

Use the two 8-position DIP switches on the STC-TC/B or STA-TC/B to connect/disconnect the open-thermocouple-detection signals on a channel-by-channel basis. Connect an open-thermocouple detection signal to a channel by sliding the DIP switch for that channel to ON. Board labeling for the switches is CH0 (for Channel 0) and CH15 (for Channel 15).

Note: On channels connected to high source impedances (for signals other than thermocouple signals), you may want to disconnect the open-thermocouple detection signals to get more accurate readings.

Ground Terminals

Two types of ground terminals are included on the STC-TC/B and STA-TC/B accessories, B GND and CHASSIS GND.

- Use the B GND terminals to externally connect the grounds of grounded signal sources to the analog ground of the DAS-TC/B input amplifier. The B GND terminals lead to the analog ground. Refer to "Connecting Signals" on page 4-7 for more information about the analog ground.
- Use the CHASSIS GND terminals to connect signal-wire shields. The CHASSIS GND terminals connect to the mounting screws of the 37-pin connector, and to a protective ground plane on the bottom of the accessory. Therefore, when an STC-TC/B is mounted on an installed DAS-TC/B, the CHASSIS GND terminals are directly connected to the chassis ground of the host computer. Likewise, when an STA-TC/B is attached to a DAS-TC/B via an S-1800 shielded cable, the CHASSIS GND terminals are connected to the chassis ground of the host computer via the shield of the cable.

Note: You must use an S-1800 cable to connect the CHASSIS GND terminals of an STA-TC/B to the chassis ground of the host computer. If you use a C-1800 cable, the CHASSIS GND terminals will be ungrounded.

Connecting an STC-TC/B

Figure 4-4 shows how to attach an STC-TC/B to a DAS-TC/B.

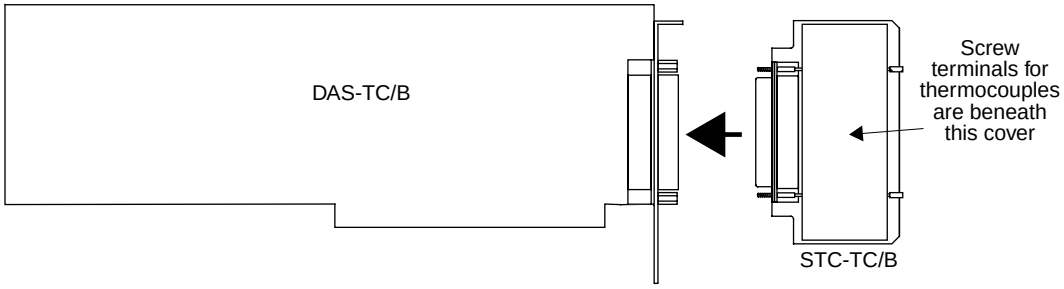


Figure 4-4. Attaching an STC-TC/B to a DAS-TC/B

Connecting an STA-TC/B

Figure 4-5 shows how to attach an STA-TC/B to a DAS-TC/B.

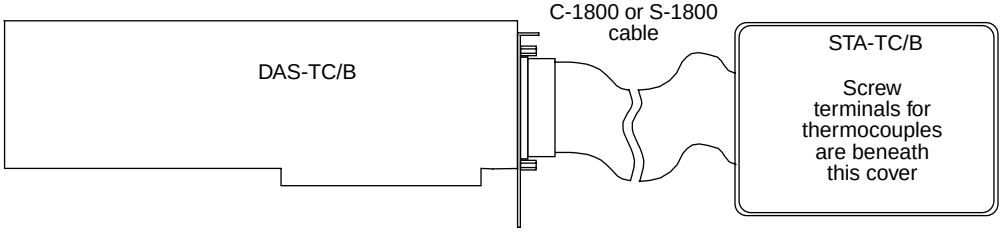


Figure 4-5. Attaching an STA-TC/B to a DAS-TC/B

Connecting Signals

Warning A short between DAS-TC/B signal inputs and AC creates a safety hazard. To avoid these shorts, secure all input connections to prevent signal wires from coming loose and shorting to high voltages.

Note: To attach your signals to the DAS-TC/B, use either an STC-TC/B or an STA-TC/B accessory. Refer to the section "Using Screw Terminal Accessories" on page 4-1.

Understanding the DAS-TC/B Inputs

The input configuration of the DAS-TC/B is shown schematically in Figure 4-6.

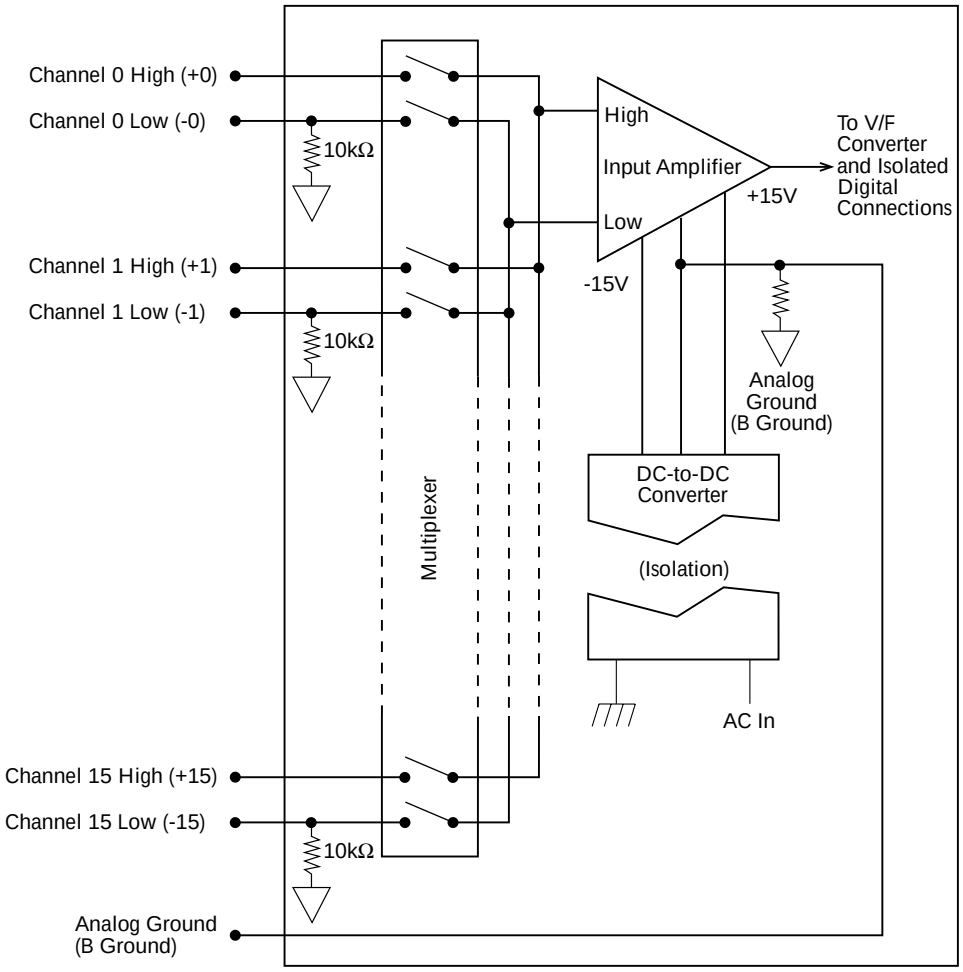


Figure 4-6. DAS-TC/B Inputs

Each DAS-TC/B board provides sixteen differential inputs. These inputs are designed especially for thermocouple signals, but are also suitable for general-purpose analog signals. Signals from all sixteen inputs are amplified by one input amplifier, an instrumentation amplifier, and are digitized by one voltage-to-frequency (V/F) converter. The multiplexer allows a time-sharing arrangement, in which inputs are scanned and connected intermittently to the input amplifier and V/F converter. The multiplexer is effectively a solid-state 16-pole, double-throw switch.

The entire input section of the DAS-TC/B is isolated to reject most unwanted signals from your measurements. Refer to “Isolated Input Section” on page 2-3 and see Figure 2-1. Additionally, the differential High and Low input terminals of the input amplifier reject all but a tiny fraction of the common mode voltage—the voltage that they “see” in common relative to the analog ground (B GND). The High and Low input terminals respond almost exclusively to the voltage difference between them. This limits response to noise, power supply voltages, and other unwanted signals that are common to the terminals within the common mode rejection ratio (CMMR) of the amplifier.

Note: The CMRR, when expressed in decibels, may be defined as shown below:

$$\text{CMRR} = 20 \log_{10} \left| \frac{\text{Common mode voltage}}{\text{Common mode error, the part of common mode voltage not rejected}} \right|$$

However, the common mode voltage must be within specified limits. If no resistance path is defined between the Low input terminal and the analog ground (B GND), amplifier bias currents attempt to flow to the analog ground across a high insulation resistance, driving the common-mode voltage close to the positive supply voltage of the amplifier. The amplifier saturates and data measurements are unusable.

Note: Bias currents are very small but finite currents drawn from the input terminals of an amplifier. The magnitude of a bias current can range from a few femtoamperes to a few microamperes, depending on amplifier design.

Therefore, a resistance path must be defined for the bias currents via a common mode connection. It must be defined either externally by the user or internally on the data acquisition board, as follows:

- Your DAS-TC/B board provides 10kΩ resistance paths internally. The 10kΩ resistors are appropriate when the source resistance of the signal is low—as with thermocouples—and the signal is isolated. These resistors are connected between the analog signal ground (B GND) and each of the sixteen Low inputs. See Figure 4-6.
- However, when the signal source is grounded, the internal 10kΩ resistor should be overridden by an external low-resistance path from the source ground to the analog signal ground (B GND). Refer to the following sections "Connecting a Grounded Thermocouple" on page 4-12 and "Connecting a Grounded Signal Source" on page 4-14.

Connecting an Ungrounded Thermocouple

In many applications, either the junction of a thermocouple is electrically isolated from the object being monitored for temperature or the object being monitored is isolated from ground. If any of your thermocouples are completely isolated, connect them as shown in Figure 4-7.

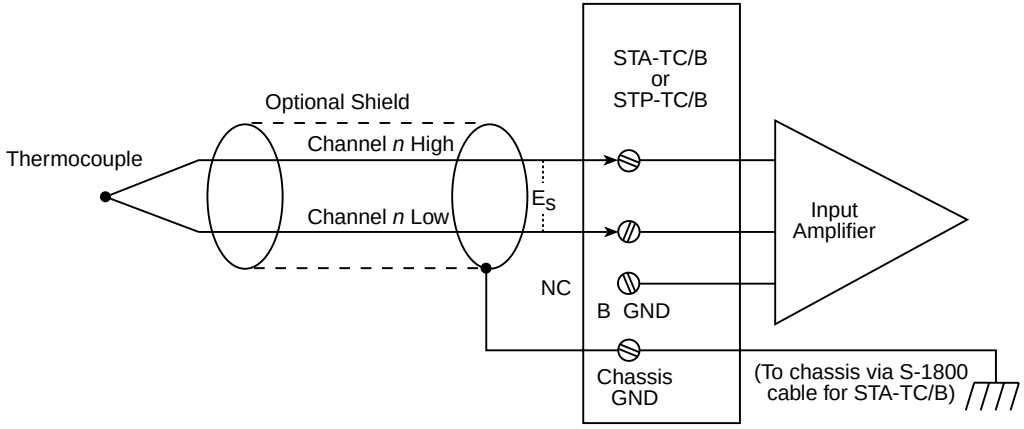


Figure 4-7. Connecting an Ungrounded Thermocouple

As discussed in "Understanding the DAS-TC/B Inputs" on page 4-8, no external connection to the B GND terminal is required; the common mode connection is provided by an internal 10kΩ resistor.

Note: If the junction of a thermocouple is connected in some way to the output of an isolated power supply, it is sometimes better to connect the object being monitored to the analog ground (B GND). The capacitance to ground in even a highly isolated power supply can be hundreds of picofarads, providing a substantial path for high frequency noise. Connecting the object being monitored to the analog ground (B GND) helps this noise to be rejected as a common mode signal, instead of flowing through the thermocouple and being accepted as part of the measured signal. Refer also to the next section, "Connecting a Grounded Thermocouple." Trial and error is sometimes required to achieve the best connection for your application.

Connecting a Grounded Thermocouple

A thermocouple junction is sometimes joined to an object that is directly or indirectly grounded, usually to optimize heat transfer and response time. In such cases, connect the ground of the object being monitored directly to the analog ground (B GND), as shown in Figure 4-8.

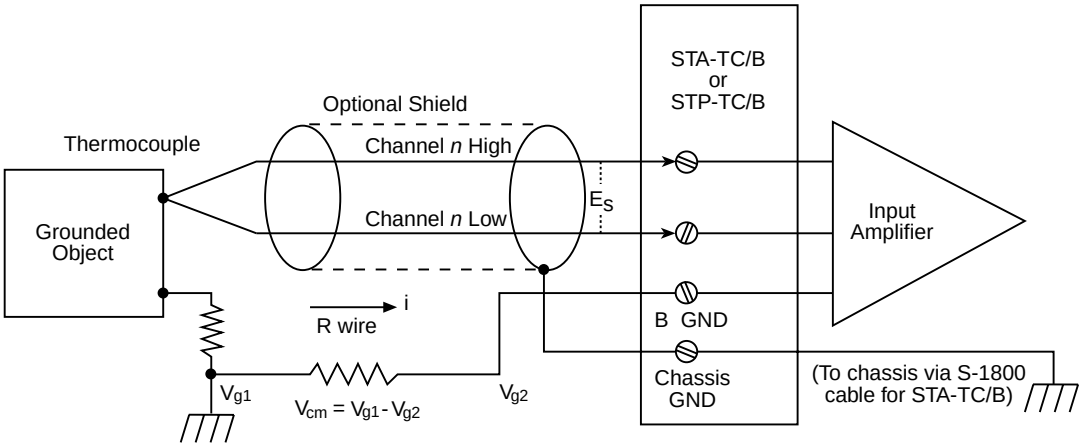


Figure 4-8. Connecting a Grounded Thermocouple

This external low-resistance common-mode connection essentially overrides the internal 10kΩ resistor of the DAS-TC/B.

Note: Connect the analog ground (B GND) to the ground of the grounded object. Do not connect analog ground (B GND) to the Low input connection at the board. Connecting the analog ground (B GND) to the Low input at the board—or allowing the internal 10kΩ resistor to make such a connection by default—causes any noise current between the grounded object and the analog ground to flow across the Low signal lead, resulting in a noise voltage across the lead. The input amplifier accepts this noise voltage as part of the Low input signal, instead of rejecting the noise voltage as a common-mode signal.

Note: Although input isolation minimizes the flow of noise current, it cannot eliminate it entirely. Even isolated devices couple to ground through finite capacitance. Consider coupling of a 5 volt, 8MHz ISA-bus signal to the analog ground of the DAS-TC/B through a capacitance of only 1pF. This coupling can cause roughly a 200µA noise current to flow in the connection between the analog ground and the ground of the object to which the thermocouple is connected. If this current flows through the negative lead of your thermocouple, instead of through a separate wire as in Figure 4-8, a noise-voltage is generated in the lead. If you are using a 24 AWG Type K (Chromel-Alumel) thermocouple with 10-foot leads, a 200µA noise current generates roughly a 1mV noise voltage across the Alumel lead (resistance = ~ 0.44Ω/ft). Any of this noise that is rectified in the input circuit, or that otherwise ends up as unwanted pulses at the output of the voltage-to-frequency converter, results in a temperature error.

Connecting Other Signal Sources

The connection principles are similar for signals other than thermocouple signals, as discussed below.

Connecting a Floating Signal Source

If any of your signal sources are completely isolated, connect them as shown in Figure 4-9.

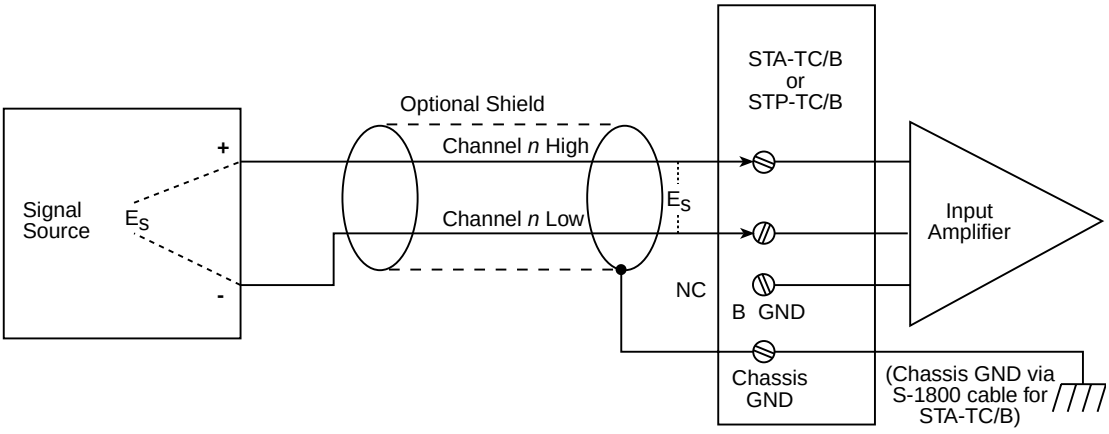


Figure 4-9. Connecting a Floating Signal Source, Method 1

As discussed in "Understanding the DAS-TC/B Inputs" on page 4-8, the common mode connection is provided by the internal 10kΩ resistor.

Alternatively, a floating signal source can be connected as in Figure 4-10.

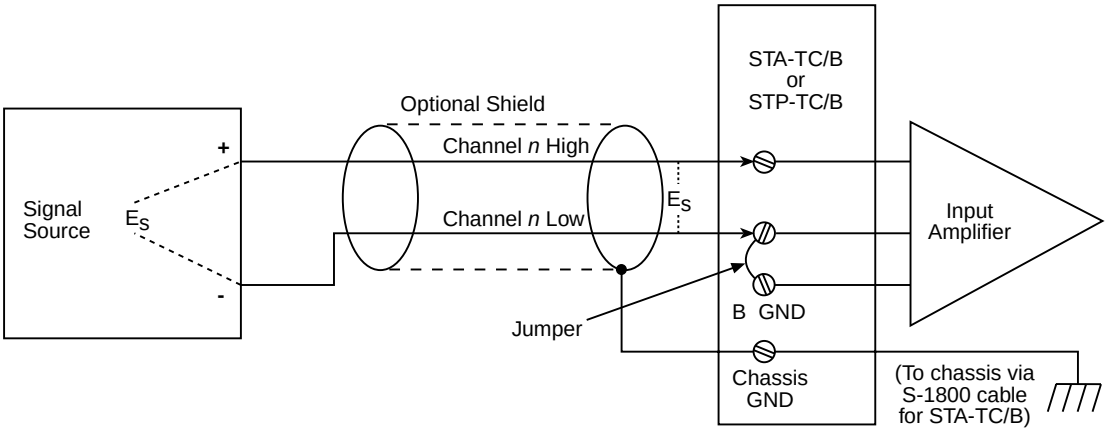


Figure 4-10. Connecting a Floating Signal Source, Method 2

However, this approach is usually less desirable. Jumpering the analog ground (B GND) to the Low input effectively changes the differential input into a single-ended input. If noise picked up electrostatically by the positive and negative leads is similar—and therefore much of the noise is essentially a common mode component, this unbalanced configuration inhibits the ability of the input amplifier to reject the noise.

Connecting a Grounded Signal Source

If any of your signal sources are coupled to ground, connect them as shown in Figure 4-11.

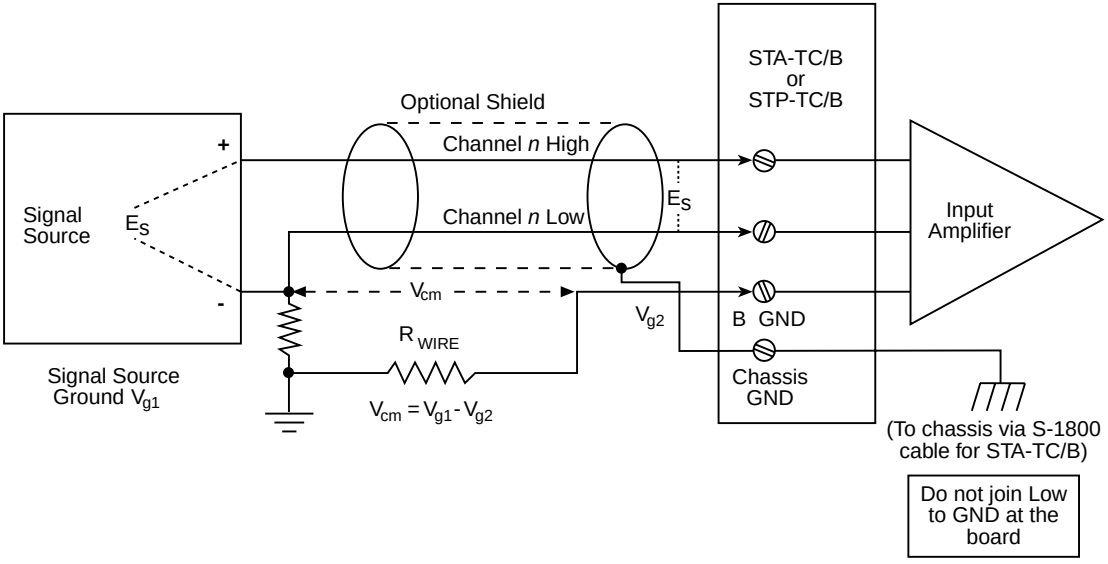


Figure 4-11. Connecting a Grounded Signal Source

A common mode connection should be made directly between the ground of the signal source and the analog ground (B GND). This low-resistance external connection essentially overrides the internal 10kΩ resistor of the DAS-TC/B.

Note: Connect the analog ground (B GND) to the ground of the grounded object. Do not connect the analog ground (B GND) to the Low input connection at the board. Connecting the analog ground (B GND) to the Low input at the board—or allowing the internal 10kΩ resistor to make such a connection by default—causes any noise current between the grounded object and the analog ground to flow across the Low signal lead, resulting in a noise voltage across the lead. The input amplifier then accepts this noise voltage as part of the Low input signal, instead of rejecting the noise voltage as a common-mode signal.

Refer also to the note in “Connecting a Grounded Thermocouple” on page 4-12.

5

The DAS-TC/B Data Logger

The DAS-TC/B Data Logger is a DriverLINX utility for viewing and recording measurements from the DAS-TC/B board. It is installed automatically when you install DriverLINX.

Use it initially to check out the combined DAS-TC/B and DriverLINX installations (refer to "Checking Your Installation" on page 3-11.) Then use it to acquire data for plotting or analysis by another package, such as Microsoft Excel.

Features of the DAS-TC/B Data Logger

You can do the following with the DAS-TC/B Data Logger:

- Configure the DAS-TC/B input channels. Specify the signal characteristics, measurement settings, and sampling order for each channel to be sampled.
- Specify the interval at which samples are logged.
- Start a data logging session.
- Preview the current sample values.
- Manually stop a data logging session.
- Import and use an acquired data log in Microsoft Excel and Microsoft Word.

For detailed information about Data Logger features, refer to the Help screens that are available after starting the program.

If you want to view and/or print the Help screens independently of your DriverLINX installation, you can view them directly from the CD-ROM that came with your DAS-T/C board, as follows:

1. From Windows Explorer, double click on **X:\DrvLINX4\Help\Kdastc.hlp**, where X is the letter of the drive on which DriverLINX is installed.The following window appears: Help Topics: Keithley DAS-TC/B DriverLINX Data Logger Utility.
2. From the menu, select **DAS-TC/B Data Logger**.

Starting the DAS-TC/B Data Logger

To start the Data Logger, do the following:

1. Click the Windows 95/98/NT **Start** button.
2. In the **Start** menu, click **Programs.**
3. Find the **DriverLINX** → **Test Panels** entry, then the **DAS-TC/B Data Logger** entry.
4. Click on the **DAS-TC/B Data Logger** entry. The initial DAS-TC/B Data Logger screen should appear.

Using the DAS-TC/B Data Logger

For detailed information about using the Data Logger, refer to the Help screens that are available after starting the program.

6

Calibration

DAS-TC/B calibration requires setting the voltage across two of the board's test points, which are shown in Figure 6-1. The process requires a 5½ digit DVM (Digital Voltmeter) or a DMM (Digital Multimeter), such as a Keithley Instruments 196 DMM.

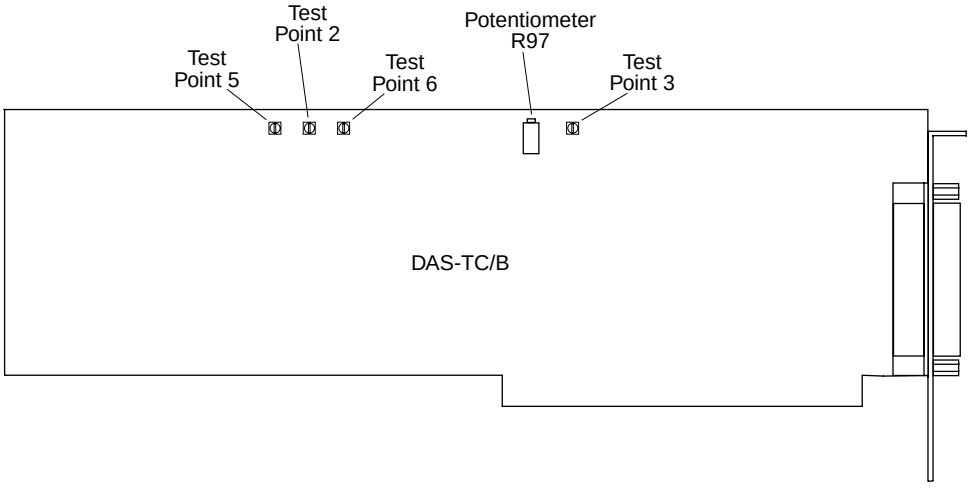


Figure 6-1. Test Points

Perform the DAS-TC/B calibration process as follows:

1. Referring to the diagram, connect the positive (+) lead of the meter to TP3 (Test Point 3), the 9.9V reference.
2. Connect the negative (–) lead of the meter to TP2, the BGND point.
3. Adjust Potentiometer R97 for a meter reading of 9.9000 ±0.0001V.

7

Troubleshooting

If your DAS-TC/B is not operating properly, use the information in this section to isolate the problem. If the problem appears serious enough to warrant technical support, refer to “Technical Support” on page 7-5 for information on how to contact an applications engineer.

Problem Isolation

Table 7-1 lists general symptoms and corresponding solutions for problems that might occur with a DAS-TC/B.

Table 7-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Intermittent operation	The most common cause of this problem is that the I/O bus speed is in excess of 8MHz.	Reduce I/O bus speed to a maximum of 8MHz (to change the I/O bus speed, run BIOS setup). See your computer documentation for instructions on running BIOS setup.
	Vibrations or loose connections exist.	Cushion source of vibration and tighten connections.
	The board is overheating.	Check environmental and ambient temperature. See the documentation for your computer.
System lockup	A timing error occurred.	Press **[Ctrl] + [Break]**.

Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Board does not respond	DriverLINX is not installed correctly or the combined DriverLINX/board installation is not properly configured.	Reinstall and/or reconfigure DriverLINX if necessary. Refer to "Installing DriverLINX Software Components and Documentation" on page 3-3 and to "Configuring the PIO Series" in the manual *Using DriverLINX With Your Hardware—Keithley DAS-TC/B*.
	Base address is incorrect or not consistent with what the program is addressing.	Check the setting of the base-address switch on the board against the setting shown in the configuration file. If the base address is set correctly, make sure no other computer device is using any of the I/O locations beginning at the specified base address. If necessary, reconfigure the base address.
	The interrupt level is incorrect or not consistent with what the program is addressing.	Make sure no other device is using the interrupt level specified in your program. If necessary, reset the interrupt level.
	The board configuration is incorrect.	Check the remaining settings in the configuration file.
	The board is incorrectly aligned in the accessory slot.	Check the board seating.
	The board is damaged.	Contact Keithley for technical support; see page 7-5.

Table 7-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Data appears to be invalid	The most common cause of this problem is that the I/O bus speed is in excess of 12MHz.	Reduce I/O bus speed to a maximum of 12MHz (to change the I/O bus speed, run BIOS setup). See the documentation for your computer for instructions on running BIOS setup.
	An open connection exists.	Check wiring to screw terminal.
	Another system resource is using the specified base address.	Reconfigure the base address of the DAS-TC/B board. Check the I/O address assignments of other system resources and reconfigure, if necessary.

If your board is not operating properly after using the information in Table 7-1, continue with the next two subsections to further isolate the problem.

Testing the Board and Host Computer

To isolate the problem to the DAS-TC/B board or to the host computer, use the following steps:

Caution: Removing a board with the power on can cause damage to your board and/or computer.

---

1. Turn power to the host computer off and remove power connections to the computer.
2. While keeping connections to accessory board intact, unplug the accessory connector or cable from the DAS-TC/B board.
3. Remove the DAS-TC/B board from the computer and visually check for damage. If a board is obviously damaged, refer to “Technical Support” on page 7-5 for information on returning the board.

4. With the DAS-TC/B board out of the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.

At this point, if you have another DAS-TC/B board that you know is functional, you can test the slot and I/O connections using the instructions in the next section. If you do not have another board, refer to the instructions on page 7-1 before calling Keithley for technical support.

Testing the Accessory Slot and I/O Connections

When you are sure that the computer is operating properly, test the computer accessory slot and I/O connections using another DAS-TC/B board that you know is functional. To test the computer accessory slot and the I/O connections, follow these steps:

1. Remove computer power again and install a DAS-TC/B board that you know is functional. Do not make any I/O connections.
2. Turn computer power on and check operation with the functional board in place. This test checks the computer accessory slot. If you were using more than one DAS-TC/B board when the problem occurred, use the functional board to also test the other slot.
3. If the accessory slots are functional, use the functional board to check the I/O connections. Reconnect and check the operation of the I/O connections one at a time.
4. If operation fails for an I/O connection, check the individual inputs one at a time for shorts and opens.
5. If operation remains normal to this point, the problem is in the DAS-TC/B board originally in the computer. If you were using more than one board, try each board one at a time in the computer to determine which is faulty.
6. If you cannot isolate the problem, refer to the next section for instructions on obtaining assistance.

Technical Support

Before returning any equipment for repair, telephone for Keithley technical support at:

1-888-KEITHLEY
Monday through Friday, 8:00 a.m. to 5:00 p.m. Eastern Time

An applications engineer will help you diagnose and resolve your board problem over the telephone. To save time, please make sure you have the following information available before you call:

DAS-TC/B Board Configuration	Model	_____
	Serial #	_____
	Revision code	_____
	Base address setting	_____
	Interrupt level setting	_____
	Number of channels	_____
Computer	Manufacturer	_____
	CPU type	_____
	Clock speed (MHz)	_____
	MB of RAM	_____
	Video system	_____
	BIOS type	_____
Operating System	Windows version	_____
Software package	Name	_____
	Serial #	_____
	Version	_____
	Invoice/Order #	_____
Compiler (if applicable)	Language	_____
	Manufacturer	_____
	Version	_____
Accessories	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____
	Type	_____

If a telephone resolution is not possible, a customer service representative will issue you a Return Material Authorization (RMA) number and ask you to return the equipment. Please reference the RMA number in any documentation regarding the equipment and on the outside of the shipping container.

When returning equipment for repair, please include the following information:

- Your name, address, and telephone number.
- The invoice or order number and date of equipment purchase.
- A description of the problem or its symptoms.
- The RMA number on the **outside** of the package.

ATTN: RMA #_____
Repair Department
28775 Aurora Road
Cleveland, Ohio 44139

Telephone 1-888-KEITHLEY
FAX (440) 248-6168

Notes: If you are submitting your equipment for repair under warranty, you must include the invoice number and date of purchase.

To enable Keithley to respond as quickly as possible, you must include the RMA number on the outside of the package.

A

Specifications

DAS-TC/B specifications are listed in the following tables:

Table A-1. Analog Input Specifications

Feature	Value
Inputs	16 differential inputs plus a CJC
Thermocouple types	B, E, J, K, R, S, and T
Voltage gains	1, 125, 166.7, and 400
Overvoltage protection	±30V maximum for powered ±20V maximum for unpowered
Isolation to PC	500VDC minimum
Input impedance	100MΩ minimum
CJC error	±0.8˚C maximum (at 25˚C) ±1.2˚C maximum (at 0 to 70˚C)
Common mode rejection ratio Voltage range of gain = 1 All other ranges	 72dB minimum (DC to 60Hz) 100dB minimum (DC to 60Hz)
Normal mode rejection ration	55dB typical (at 50/60Hz)
Open thermocouple reading Integer data format Real (floating point) data format	 +1,176,256,512 (˚C or ˚F) +10,000.00 (˚C or ˚F)

Table A-2. Conversion Rate Specifications

Rejection Rate	Conversion Speed (ms/chan)[1]	
	Temperature	Volts
50	47	43
60	40	36
400	10	6

[1] The speed values are for integer-output format. For floating-point format, add 1ms to each value.

[2] The rates shown are for updates of a single channel to the on-board data buffer. Using the DriverLINX driver, the maximum interupt rate to transfer this data is 2.1Hz (i.e., 475mS intervals), which limits the effective data rate to application programs.

Table A-3. Temperature/Voltage Specifications

Feature	Value
Degrees	Celsius or Fahrenheit
Temperature/voltage data format Integer: Real:	 32-bit signed 32-bit IEEE-754 standard (floating point)
Accuracy and resolution (at 25˚C)	All ranges guaranteed monotonic

Table A-4. Voltage Input Specifications

Gain	Range	Accuracy (Worst case)	Voltage Resolution at		
			50Hz	60Hz	400Hz
1	–2.5V to 10V	±0.01% reading ±0.75mV	312.5µV	375µV	2.5mV
125	–20mV to 80mV	±0.02% reading ±8µV	2.5µV	3.0µV	20µV
166.7	–15mV to 60mV	±0.02% reading ±8µV	1.88µV	2.25µV	15.0µV
400	–6.25mV to 25mV	±0.02% reading ±3µV	0.781µV	0.938µV	6.25µV

Table A-5. Thermocouple Input Specifications

Type	Range	Accuracy (Worst case)	Temperature Resolution at		
			50Hz	60Hz	400Hz
B	400 to 799˚C 800 to 1700˚C	±3.0˚C ±1.7˚C	0.2˚C 0.1˚C	0.2˚C 0.1˚C	01.5˚C 0.8˚C
E	–200 to –50˚C –49 to 1000˚C	±1.1˚C ±0.6˚C	0.1˚C 0.05˚C	0.1˚C 0.05˚C	0.8˚C 0.4˚C
J	–200 to –1˚C 0 to 750˚C	±1.0˚C ±0.5˚C	0.1˚C 0.04˚C	0.1˚C 0.05˚C	0.7˚C 0.3˚C
K	–200 to –1˚C 0 to 900˚C 901 to 1250˚C	±1.4˚C ±0.7˚C ±0.9˚C	0.1˚C 0.05˚C 0.06˚C	0.2˚C 0.06˚C 0.07˚C	1.0˚C 0.4˚C 0.5˚C
R	0 to 299˚C 300 to 1768˚C	±2.3˚C ±1.5˚C	0.1˚C 0.08˚C	0.2˚C 0.1˚C	1.0˚C 0.6˚C
S	0 to 299˚C 300 to 1450˚C	±2.3˚C ±1.7˚C	0.1˚C 0.09˚C	0.2˚C 0.1˚C	0.1˚C 0.7˚C
T	–200 to –120˚C –119 to 400˚C	±0.9˚C ±0.5˚C	0.05˚C 0.03˚C	0.06˚C 0.04˚C	0.4˚C 0.2˚C

Table A-6. Noise Specifications

Feature	Factor[1]
Voltage Inputs	
@ gain = 1	0.75 × resolution rms
@ gain = 125	1.0 × resolution rms
@ gain = 166.7	1.5 × resolution rms
@ gain = 400	4.0 × resolution rms
Thermocouple Inputs	
Types B, R, S, or T	4.0 × resolution rms
Type E	1.0 × resolution rms
Types J or K	1.5 × resolution rms

[1] The offset error at all gains is canceled through periodic self-calibration that the DAS-TC/B microprocessor performs as a background task.

Table A-7. Maximum Gain Error Temperature Coefficients

Feature	Temperature Coefficient
Voltage Inputs	
@ gain = 1	±7ppm/°C
@ gain = 125	±10ppm/°C
@ gain = 166.7	±12ppm/°C
@ gain = 400	±17ppm/°C
Thermocouple Inputs	
Types B, R, S, or T	±17ppm/°C
Type E	±10ppm/°C
Types J or K	±12ppm/°C

Table A-8. Environmental and Physical Requirements

Feature	Specification
Temperature Ranges	
Operating	0 to 50°C
Storage	–20 to 70°C
Humidity	0 to 95% noncondensing
Dimensions	13.3 × 4.25 × 0.75 inches (33.8 × 10.8 × 1.9 cm)

Table A-9. Power Requirements

Feature	Specification
+5V Supply	550mA typical, 700mA maximum
+12V Supply	35mA typical, 50mA maximum
–12V Supply	Not used

Table A-10. Board Requirements

Feature	Specification
PC I/O base address interface	100h to 3FFh DIP-switch-selectable
Interrupt levels	• DAS-TC version A: 2, 3, 4, 5, and 7 • DAS-TC/B: 3, 5, 7, 10, 11, 12, and 15

B

Connector Pin Assignments

The following diagram shows the pin assignments of the DAS-TC/B main I/O connector and the I/O connectors of the STA-TC/B and STC-TC/B.

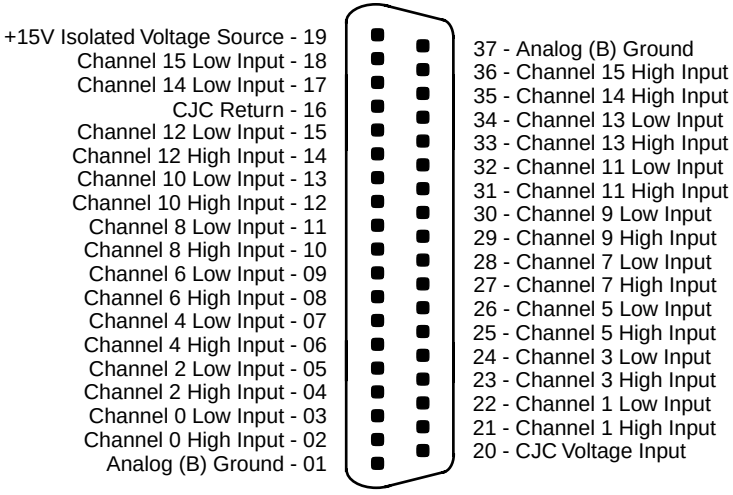


Figure B-1. Pin Assignments for DAS-TC/B Main I/O Connector

C

CE Information for the DAS-TC/B

Note: Products that contain the CE mark are certified to meet European EMC directive 89/336 EEC. If this directive is not of importance to your application, please disregard the information in this appendix.

Keithley certifies that this product has been tested and found to be in compliance with the EMC directive and relevant harmonized standards. This appendix describes the limitation of certification, the declaration of conformity, and the cabling instructions required for the CE configuration.

Limitation of Certification

This certification applies only to the operation of the product (with specified cables and accessories) in the stated configuration and under the stated operational and environmental specifications. Any modification, misuse, or improper or inadequate maintenance of the product by the user voids this certification.

Any deviation from the specific configuration may cause emissions or susceptibility not within the allowed limits required by the stated directive. It is the user's responsibility to demonstrate and maintain compliance with the directive and standards.

Please read the next section for the specific testing configuration for this product. Consult the Keithley Instruments GMBH office (European importer) or Technical Support for further information regarding the exact configuration details and testing.

Declaration of Conformity

Application of Council Directive(s)	89/336/EEC
Standard(s) to which Conformity is Declared	EN50081-1, EN50082-1
Manufacturer's Name	Keithley
Importer's Name	Keithley Instruments GMBH
Importer's Address	Landsberger Str.65 D-82110 Germering, Munich
Type of Equipment	Data Acquisition Plug-in Boards
Model Numbers	DAS-TC/B and S-1800 with either an STC-TC/B or STA-TC/B
Year of Manufacture	1996

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Place: Taunton, MA USA



(Signature)

Date: 01 January 1996

Mark Urban
(Name)

Quality Assurance Manager
(Position)

Cabling Instructions for the CE Configuration

As shown in Figure C-1, the STC-TC/B plugs directly into the I/O connector of the DAS-TC/B board.

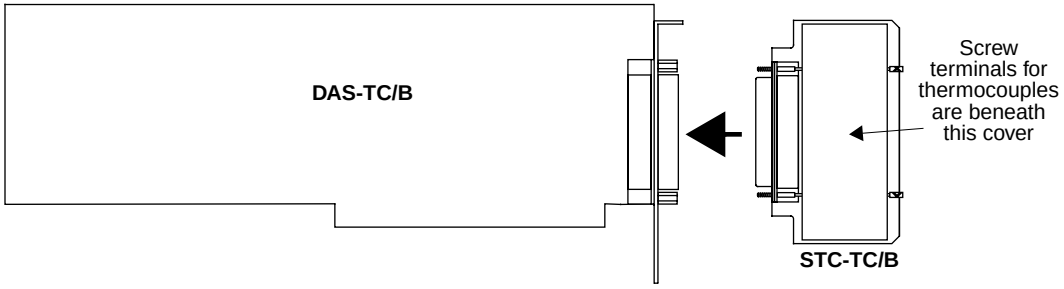


Figure C-1. Connecting a DAS-TC/B Board to an STC-TC/B

The STA-TC/B connects to the main I/O connector of the DAS-TC/B through the S-1800 cable, as shown in Figure C-2.

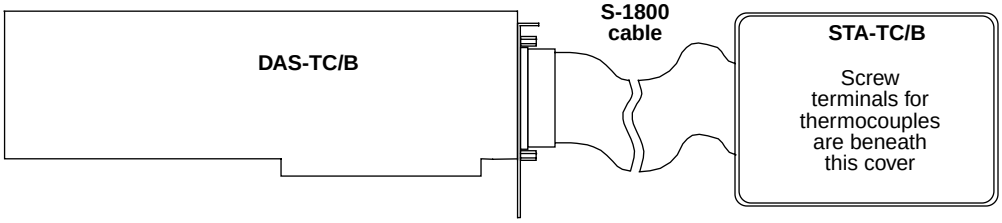


Figure C-2. Connecting a DAS-TC/B Board to an STA-TC/B

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Specifications are subject to change without notice.

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