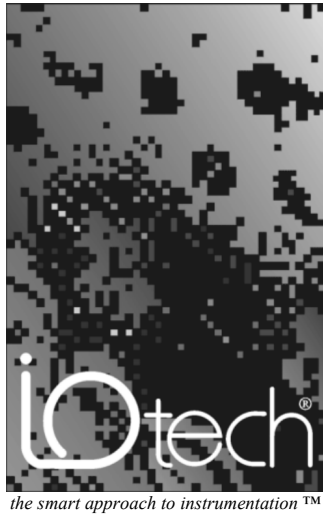


TempBook User's Manual

Thermocouple & Voltage Measurement Data Acquisition System



IOtech, Inc.

25971 Cannon Road
Cleveland, OH 44146-1833
Phone: (440) 439-4091
Fax: (440) 439-4093

E-mail (sales): sales@iotech.com

E-mail (post-sales): productsupport@iotech.com

Internet: www.iotech.com

TempBook User's Manual

Thermocouple & Voltage Measurement Data Acquisition System

p/n TempBook/66-901 Rev. 4.0

Released per EO# 1788R5

Warranty Information

Your IOtech warranty is as stated on the *product warranty card*. You may contact IOtech by phone, fax machine, or e-mail in regard to warranty-related issues.

Phone: (440) 439-4091, fax: (440) 439-4093, e-mail: sales@iotech.com

Limitation of Liability

IOtech, Inc. cannot be held liable for any damages resulting from the use or misuse of this product.

Copyright, Trademark, and Licensing Notice

All IOtech documentation, software, and hardware are copyright with all rights reserved. No part of this product may be copied, reproduced or transmitted by any mechanical, photographic, electronic, or other method without IOtech's prior written consent. IOtech product names are trademarked; other product names, as applicable, are trademarks of their respective holders. All supplied IOtech software (including miscellaneous support files, drivers, and sample programs) may only be used on one installation. You may make archival backup copies.

FCC Statement



IOtech devices emit radio frequency energy in levels compliant with Federal Communications Commission rules (Part 15) for Class A devices. If necessary, refer to the FCC booklet *How To Identify and Resolve Radio-TV Interference Problems* (stock # 004-000-00345-4) which is available from the U.S. Government Printing Office, Washington, D.C. 20402.

CE Notice



Many IOtech products carry the CE marker indicating they comply with the safety and emissions standards of the European Community. As applicable, we ship these products with a Declaration of Conformity stating which specifications and operating conditions apply.

Warnings, Cautions, Notes, and Tips



Refer all service to qualified personnel. This caution symbol warns of possible personal injury or equipment damage under noted conditions. Follow all safety standards of professional practice and the recommendations in this manual. Using this equipment in ways other than described in this manual can present serious safety hazards or cause equipment damage.



This warning symbol is used in this manual or on the equipment to warn of possible injury or death from electrical shock under noted conditions.



This ESD caution symbol urges proper handling of equipment or components sensitive to damage from electrostatic discharge. Proper handling guidelines include the use of grounded anti-static mats and wrist straps, ESD-protective bags and cartons, and related procedures.



This symbol indicates the message is important, but is not of a Warning or Caution category. These notes can be of great benefit to the user, and should be read.



In this manual, the book symbol always precedes the words "Reference Note." This type of note identifies the location of additional information that may prove helpful. References may be made to other chapters or other documentation.



Tips provide advice that may save time during a procedure, or help to clarify an issue. Tips may include additional reference.

Specifications and Calibration

Specifications are subject to change without notice. Significant changes will be addressed in an addendum or revision to the manual. As applicable, IOtech calibrates its hardware to published specifications. Periodic hardware calibration is not covered under the warranty and must be performed by qualified personnel as specified in this manual. Improper calibration procedures may void the warranty.

Quality Notice



IOtech has maintained ISO 9001 certification since 1996. Prior to shipment, we thoroughly test our products and review our documentation to assure the highest quality in all aspects. In a spirit of continuous improvement, IOtech welcomes your suggestions.

About This Manual

This manual explains the setup and operation of the TempBook data acquisition system. This manual consists of chapters and document modules. The later are like chapters, but as they are shared by other manuals and are sometimes used as “stand-alone” documents. For these reasons the document modules do not contain chapter headings, nor do they contain footers that associate them with a specific manual.

Chapter 1 - **Introduction and Quick Start** includes an overview, specifications, and a Quick Start that explains how to hook up a simple system.

Chapter 2 - **Installation, Configuration, and Calibration** discusses switches, indicators, connectors, hardware hookups, software installation, configuration, and calibration.

Document Module – **DaqView [32-Bit Support]**. DaqView is *out-of-the-box* data acquisition software that is installed during **32-Bit Product Support Installation**. Pull-down menus, toolbars, charts, and parameter fields are discussed. **The program does not apply to 16-Bit TempBook Support.**

Document Module - **DaqViewXL [32-Bit Support]**. DaqViewXL is an optional *out-of-the-box* Microsoft-based add-on for data-acquisition and spreadsheet display. **The program does not apply to 16-Bit TempBook Support.**

Document Module - **DIAdem [32-Bit Support]**. DIAdem is *out-of-the-box* data acquisition viewing and analysis program. The document module is an abbreviated manual that provides for rapid familiarization with the program. **For 16-Bit Product Support information, refer to the PostView document module.**

Document Module - **TempView [16-Bit Support]**. This document module explains the use and features of the *out-of-the-box* data acquisition software that is installed during the **16-Bit Product Support Installation**. Pull-down menus, charts, and parameter fields are discussed. **Note that this document module does not apply to 32-Bit TempBook Support.**

Document Module – **PostView [16-Bit and 32-Bit Support]**. PostView is a post-data acquisition viewing program that is installed as a part of IOtech’s 16-Bit TempBook Support. PostView allows you to view waveforms that were previously acquired by TempView. Although PostView can provide 32-Bit program support, the program is **not installed** as a part of IOtech’s 32-Bit TempBook Support. **Refer to the DIAdem document module regarding 32-Bit TempBook Support.**

Chapter’s 3 and 4 – These two chapter’s have been replaced with document modules. Your user’s manual continues at this point with chapter 5.

Chapter 5 - **Programmer’s Guide** explains how to custom-program for your application. Various concerns are discussed; e.g., a comparison of standard and enhanced APIs and language support.

Chapter 6 – **16-Bit API Programming of the TempBook With C** describes several example programs using the standard API with the C language.

Chapter 7 - **Software Calibration and Zero Compensation** describes the commands and parameters related to calibration and zero compensation. This chapter organizes and supplements related sections of the *tbkCommand Reference* chapter.

Chapter 8 - **Thermocouple Measurement** describes the commands and parameters related to thermocouple measurement. This chapter organizes and supplements related sections of the *tbkCommand Reference* chapter.

Chapter 9 - **tbkCommand Reference (16-Bit API)** describes the commands and parameters of the 16-Bit API including useful reference tables.

Chapter 10 - **Programming Models for 32-Bit API** describes the fundamental building blocks for TempBook data acquisition software. These programming blocks can then be arranged and filled with your parameters to make your system do as you please. Program excerpts illustrate the basic concepts and can often (with modifications) be used in your code.

Chapter 11 - **daqCommand Reference (32-Bit API)** describes the commands and parameters of the 32-Bit API including useful reference tables.

CAUTION



Using this equipment in ways other than described in this manual can cause personal injury or equipment damage. Before setting up and using your equipment, you should read *all* documentation that covers your system. Pay special attention to cautions and warnings formatted like this one.



Software Reference Note for Users of 16-Bit TempBook Support:

16-bit PC users can use TempView out-of-the-box software (see the TempView document module), or may choose to program their own application.

Programmers using 16-bit API should refer to chapters 5 through 9. Chapters 6, 7, and 8 provide examples and explain how to perform common tasks with the 16-bit API detailed in chapter 9.

Software Reference Note for Users of 32-Bit TempBook Support:

32-bit PC users can use the DaqView and DaqViewXL out-of-the-box software programs (refer to the related document modules); or program their own application. Programmers using 32-bit API should refer to chapters 5, 10, and 11. Chapter 10 explains programming models for the enhanced API, detailed in chapter 11.

Note: 16-Bit and 32-bit refer to software support, not to A/D resolution.

Table of Contents

1 Introduction and Quick Start

Overview	1-1
Description	1-1
Available Accessories	1-2
Specifications	1-2
Quick Start	1-4
Signal Connection	1-4
PC Connection	1-4
Power Connection	1-5
Software Installation	1-5
Parallel Port Capabilities	1-6
TempBook Configuration Under Windows 95/98/Me/NT and 2000	1-6

2 Installation, Configuration, and Calibration

Inspection	2-1
Panel Connectors and Indicators	2-1
Termination Card and I/O Connectors	2-2
Internal Configuration	2-3
Watchdog Timer Enable/Disable (JP8).....	2-4
Time Base Selection (JP9).....	2-4
Hardware Installation	2-4
Rechargeable Battery Module (DBK30A).....	2-4
Charging the Battery Modules	2-5
Battery Module Connection	2-5
Connection Troubleshooting	2-6
Calibration of TempBook	2-7
Calibration Constants File Installation	2-7
Hardware Calibration	2-7
Differential Measurement Configurations	2-8
Floating Differential	2-8
Referenced Differential	2-8

Document Module – DaqView

[32-Bit Support]

Overview.....	DaqView_d, pg. 2
Starting DaqView.....	DaqView_d, pg. 2
A Tour of DaqView.....	DaqView_d, pg. 2
Acquisition Setup	DaqView_d, pg. 13
Data Destination	DaqView_d, pg. 15
Pull-Down Menus	DaqView_d, pg. 16
Toolbar Items	DaqView_d, pg. 19

Document Module – DaqViewXL

[32-Bit Support]

Overview.....	DaqViewXL, pg. 1
Program Requirements.....	DaqViewXL, pg. 1
Installation of DaqViewXL Software.....	DaqViewXL, pg. 2
Basic Function of DaqViewXL	DaqViewXL, pg. 2
Hints and Tips for using DaqViewXL	DaqViewXL, pg. 4

Document Module – DIAdem

[32-Bit Support]

Preface	DIAdem, pg. 2
DIAdem® Quick Start	DIAdem, pg. 3
DIAdem - the PC Workshop	DIAdem, pg. 13
DIAdem DATA: Loading and Saving Data	DIAdem, pg. 23
DIAdem VIEW: Viewing, Measuring & Editing Data	DIAdem, pg. 27

Document Module - TempView

[16-Bit Support]

Application Startup.....	TempView, pg. 1
TempView Components.....	TempView, pg. 2
Charts and the Spreadsheet's "Reading" Column.....	TempView, pg. 7
TempView Menu Items	TempView, pg. 8

Document Module – PostView

[16-Bit & 32-Bit Support] see DIAdem for 32-bit support

Introduction	PostView, pg. 2
Starting PostView	PostView, pg. 3
Toolbar	PostView, pg. 4
Channel Information Region	PostView, pg. 5
Menu Items	PostView, pg. 6
Understanding Groups, Charts, and Channels	PostView, pg. 7
Chart Setup Wizard	PostView, pg. 7
Display Configuration	PostView, pg. 9
PostView Timebase	PostView, pg. 15

3 – 4 Chapters 3 and 4 have been replaced by the preceding Document Modules.

5 Programmer's Guide

A Programmer's View of TempBook Operations	5-1
Driver Options	5-3
16-Bit API (tbk...)	5-3
32-Bit API (daq...)	5-3
Language Support	5-3

6 16-Bit API Programming of the TempBook With C

<i>Accessing TempBook from a Windows Program</i>	6-1
<i>Accessing TempBook from a C-for-Windows Program</i>	6-1
<i>High-Level Analog Input</i>	6-1
<i>Low-Level Analog Input</i>	6-2
<i>Analog Input in the Background</i>	6-2
<i>General Purpose Digital I/O Functions</i>	6-4
<i>High-Speed Digital Input</i>	6-4
<i>Counter/Timer Functions</i>	6-5
<i>High-Level Thermocouple Data Acquisition</i>	6-6
<i>Thermocouple Linearization</i>	6-7
<i>Sample Programs</i>	6-8
High-Level Analog Input	6-8
Low-Level Analog Input	6-9
Analog Input in the Background	6-10
General Purpose Digital I/O	6-11
High-Speed Digital Input	6-12
Counter Timer Functions	6-13
High-Level Thermocouple Measurement	6-14
Low-Level Thermocouple Linearization	6-15
<i>16-Bit API Command Summary, for C Language</i>	6-17

7 Software Calibration and Zero Compensation

<i>Software Calibration</i>	7-1
Initializing the Calibration Constants	7-1
Calibration Setup and Conversion	7-2
Calibration Example	7-2
<i>Zero Compensation</i>	7-3
Zero Compensation Example	7-4
Automatic Zero Compensation	7-5

8 Thermocouple Measurement

<i>Low-Level Thermocouple Data Conversion Functions</i>	8-1
<i>High-Level Thermocouple Measurement Functions</i>	8-3
Single-Channel Measurement (tbkRdTemp)	8-3
Multiple Measurements from a Single Channel (tbkRdTempN)	8-4
Multiple Channel Measurement (tbkRdTempScan)	8-4
Multiple Measurements from Multiple Channels (tbkRdTempScanN)	8-4

9 tbkCommand Reference (16-Bit API)

<i>Overview</i>	9-1
<i>Commands in Alphabetical Order</i>	9-2
<i>API Reference Tables</i>	9-32
A/D Channel Descriptions	9-32
A/D Gain Definitions	9-32
A/D Trigger Source Definitions	9-32
Pretrigger Functions Trigger Source Definitions	9-33
Thermocouple Types	9-33
API Error Codes - C Languages	9-33
API Error Codes - QuickBASIC	9-34
API Error Codes - Turbo Pascal	9-35
API Error Codes - Visual Basic	9-36

10 32-Bit API Programming Models for TempBook

Overview 10-1

Data Acquisition Environment 10-1

- Application Programming Interface (API) 10-1
- 32-Bit vs 16-Bit API 10-1
- Hardware Capabilities and Constraints 10-1
- Signal Environment 10-2

Basic Models 10-2

- Initialization and Error Handling 10-3
- Foreground Acquisition with One-Step Commands 10-4
- Temperature Acquisition Using One-Step Commands 10-6
- Counted Acquisition Using Linear Buffers 10-8
- Indefinite Acquisition, Direct-To-Disk Using Circular Buffers 10-10
- Multiple Hardware Scans, Software Triggering 10-13
- Background Acquisition 10-15
- Temperature Acquisition Using TC Conversion Functions 10-17
- Double Buffering 10-20
- Direct-To-Disk Transfers 10-22
- Transfers With Driver-Allocated Buffers 10-25

Summary Guide of Selected 32-Bit API Functions 10-27

11 daqCommand Reference, 32-Bit

Overview 11-1

Commands in Alphabetical Order 11-2

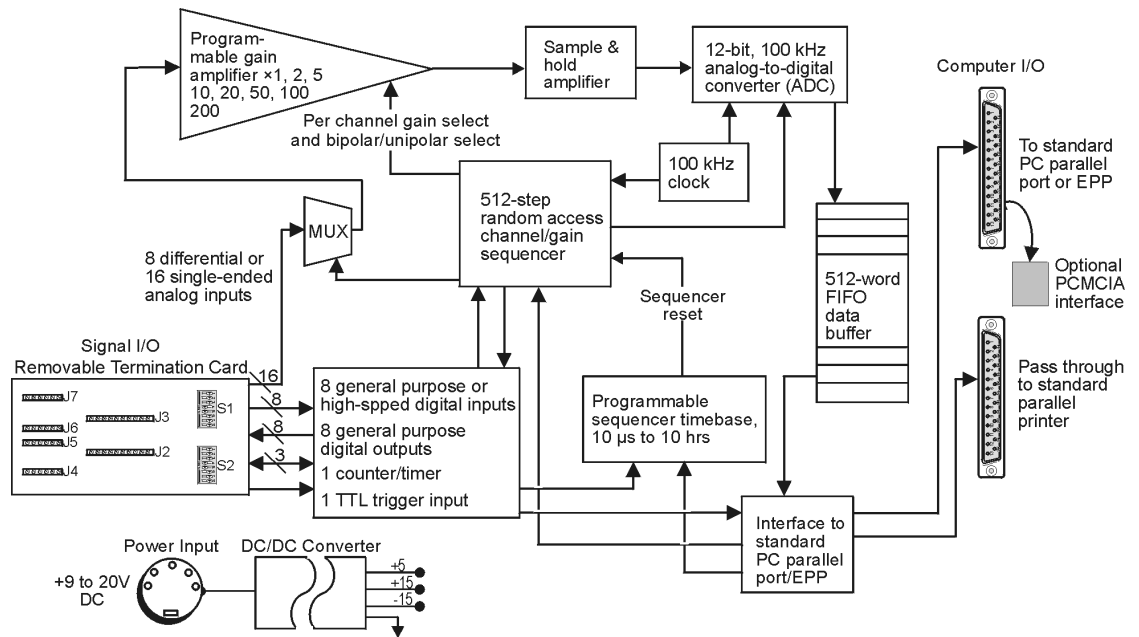
API Reference Tables 11-35

- Daq Device Property Definitions 11-36
- Event-Handling Definitions 11-36
- Hardware Information Definitions 11-36
- ADC Trigger Source Definitions 11-37
- ADC Miscellaneous Definitions 11-37
- TempBook Definitions 11-38
- General I/O Definitions 11-38
- DaqTest Command Definitions 11-38
- Calibration Input Signal Sources 11-38
- API Error Codes 11-39

Overview

This chapter describes the TempBook in general terms including specifications. A Quick Start is included in the chapter to help you get a simple system up and running in a short amount of time. Chapter 2 has more detailed instructions.

Description



TempBook/66 Block Diagram

The TempBook/66 adds voltage and thermocouple measurement capability to notebook PCs for portable test applications. The TempBook also provides an effective alternative to plug-in boards for desktop PCs. The TempBook provides 12-bit, 100 kHz data acquisition and can support up to 800 Kbyte/s data transfer to a PC via an enhanced parallel port interface or PCMCIA link. The unit can also connect to a standard parallel port and transfer readings [directly to disk] at up to 100K readings/s. As an external module with the same footprint as a typical notebook PC, the TempBook can be attached directly under a notebook PC for portability.

The TempBook has a built-in analog capability that permits it to measure 8 channels in a differential mode or 16 channels in single-ended mode. Its on-board programmable-gain instrumentation amplifier can be set to gains of $\times 1, 2, 5, 10, 20, 50, 100$ or 200 on a per channel basis. Its A/D converter scans selected channels at a constant $10 \mu\text{s}/\text{channel}$ rate, minimizing the time skew between consecutive channels. The time between the start of each scan sequence can be programmed to start immediately or at intervals of up to 10 hours. The TempBook features a hardware-based digital/TTL trigger that minimizes trigger latency to less than $10 \mu\text{s}$. The TempBook can also be triggered from a command from the PC.

The TempBook/66 can be powered by an included AC adapter, a standard 12V car battery, any +9 to 20 VDC source, or an optional rechargeable nickel-cadmium battery module (DBK30A). This makes it ideal for field and remote data acquisition applications.

TempBook related Software – What you should install from the Data Acquisition CD

For 32-Bit Support*	For 16-Bit Support*
<ul style="list-style-type: none">• 32-bit TempBook Support* is used with Windows 9x, ME, NT, and 2000 Operating Systems and installs: DaqView (32-bit) DaqViewXL (32-bit) File Converter (32-bit) DaqCal (32-bit) 32-bit drivers for VB, C, and Delphi PDF version of Programmer's Manual	<ul style="list-style-type: none">• 16-bit TempBook Support* is used with Windows 3.x Operating Systems and installs: TempView (16-bit) PostView (16-bit) TempCal (16-bit) 16-bit drivers for VB, C, PASCAL, and DOS
<ul style="list-style-type: none">• DIAdem Post Acquisition Data Analysis Program	<ul style="list-style-type: none">• Acrobat Reader
<ul style="list-style-type: none">• Acrobat Reader	

*32-bit refers to support, not to A/D resolution.

*16-bit refers to support, not to A/D resolution.

Available Accessories

Additional accessories that can be ordered for the TempBook/66 include:

- WBK20A PCMCIA interface card and cable
- DBK30A Rechargeable battery module
- WBK21 ISA Interface Card

Specifications

General

Connector: Connects to a PC via an included parallel port cable; user signals are connected via screw terminals on a removable screw-terminal card.

Thermocouple Types: J, K, S, T, E, B, R & N

Input Ranges:

Unipolar: .05, 0.1, 0.2, 0.5, 1, 2, 5, 10V

Bipolar: ± 0.025 , .05, 0.1, 0.25, 0.5, 1, 2.5, 5 V

Analog Inputs: 8 differential or 16 single-ended voltage or 8 differential thermocouple inputs

Analog-to-Digital Converter: 12-bit with no missing codes, unsigned binary output format.

Cold Junction Sensor Output: 100 mV/°C

Input Impedance: 100K/100M Ohm, Switch-selectable on a per-channel basis in parallel with switched 100 pF

Input RC Filter -3dB Frequency: 15.9 kHz switch-selectable on a per channel basis

Gain Accuracy: 0.1%

Maximum Input Voltage: ± 15 V

CMRR (Input Stage): 90 dB typ, DC to 60 Hz

Offset: Software-compensated

Offset Drift: Software-compensated

Channel Sequencer

Depth: 512 locations

Speed: 10 μ s per channel, fixed

Interval Between Scans: 10 μ s to 10 hours, software-programmable

Gains: Sequencer programmable on a per-channel basis.

Unipolar/Bipolar: Sequencer programmable on a per channel basis.

Single-Ended/Differential: Software programmable for all channels

Digital I/O

Inputs

Number: 8 fixed as inputs

Usage: General-purpose register addressable or high-speed scanned via channel sequencer

Type: TTL-compatible

High Voltage: 2.0 V min

Low Voltage: 0.8 V max

Outputs

Number: 8 fixed as outputs

Usage: General-purpose register addressable

Type: TTL-compatible

High Voltage: 3.0 V @ 2.5 mA source

Low Voltage: 0.4V @ 2.5 mA sink

Trigger Input

Type: TTL-compatible

High Voltage: 2.0 V min

Low Voltage: 0.8 V max

Counter/Timer Port

Device: 8254 (P0 only)

Number: 1 gate input, 1 clock input & 1 output

Clock: Internal 100 kHz or external up to 10 MHz

Usage: Register addressable

Type: TTL compatible

Input High Voltage: 2.0 V min

Input Low Voltage: 0.8 V max

Output High Voltage: 3.0 V @ 2.5 mA source

Output Low Voltage: 0.4 V @ 2.5 mA sink

Temperature Specifications

Thermocouple Accuracy (TempBook/66 @ 0 to 50°C)				
Type	Min (°C)	Max (°C)	Accuracy	
			(<°C)	(>°C)
J	-200	760	±0.9	±0.9
K	-200	1260	±2.4	±1.5
T	-200	400	±2.1	±1.2
E	-270	1000	±2.1	±1.3
N28	-270	400	±1.2	±1.2
N14	-	1300	-	±1.5
S	-	1780	-	±2.4
R	-	1780	-	±2.4
B	+900	1820	-	±2.7

Thermocouple Resolution (°C)		
Type	<0°C	>0°C
J	1.2	0.5
K	1.1	0.8
T	0.8	0.3
E	1.9	0.9
N28	0.9	0.9
N14	-	5.0
S	-	1.6
R	-	1.5
B	-	1.8

Quick Start

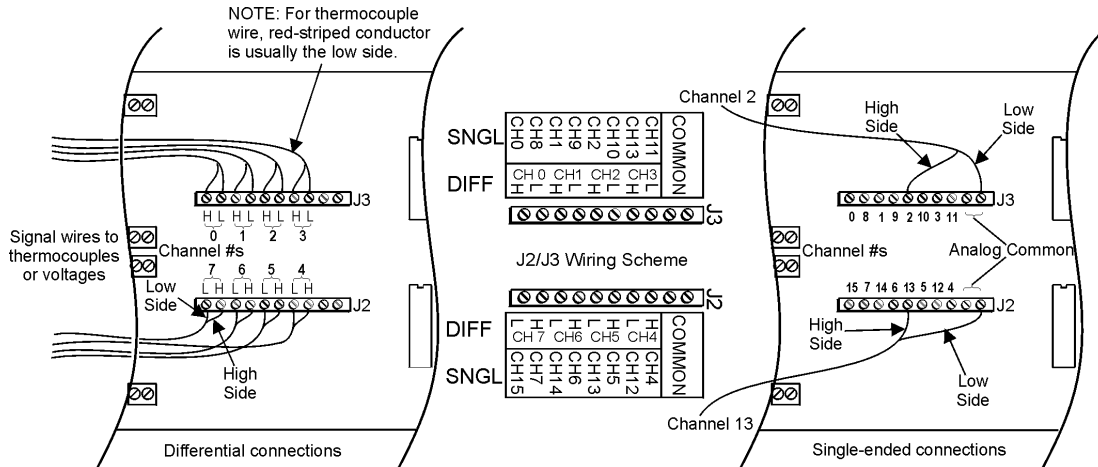
For those users who wish to get their TempBook up and running as quickly as possible, this section provides a brief explanation of the steps required.



Reference Note: Refer to [chapter 2, *Installation and Configuration*](#), if you are not already familiar with TempBook systems, or if you need information that goes beyond the scope of this Quick Start.

Signal Connection

The thermocouple and voltage input signals are fed to the TempBook through a removable termination card. To remove this card, rotate the ejector handle with your thumb or finger. Once removed, the thermocouple or voltage connections should be made as shown in the figure.



Signal Connections, Differential and Single-Ended



When connecting both low and high level signals, the low-level signals should be connected to the lowest numbered channels with connections following in ascending order of signal magnitude.

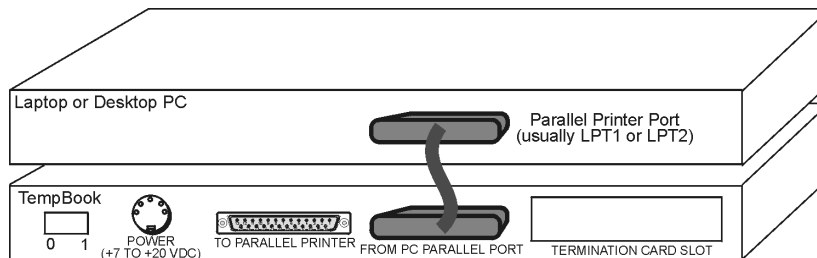
The DIP switches located on the termination card connect optional biasing resistors as well as input filters.

- For thermocouple or other differential inputs, these switches should be closed to provide the required bias current path.
- For single-ended inputs these switches can be optionally opened or closed.

For further details, refer to section [Termination Card and I/O Connectors](#) in [chapter 2](#).

PC Connection

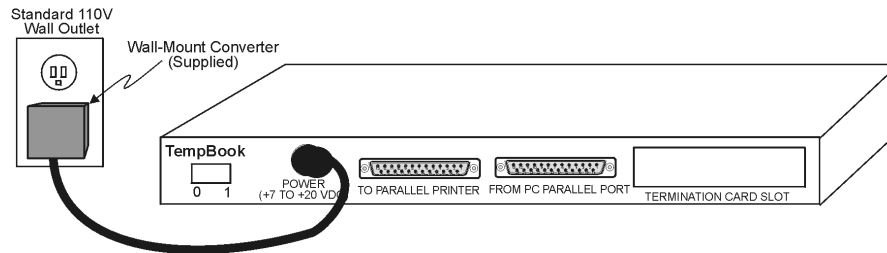
The TempBook communicates with a laptop or desktop computer through the parallel printer port. Connect the supplied cable to the computer's parallel port and the TempBook's parallel port.



PC-to-TempBook Connection

Power Connection

The TempBook is typically powered from the supplied wall-mount converter or from an optional DBK30A battery module. The wall-mount converter plugs into any standard 110 VAC wall outlet and its other end plugs into the circular DIN5 receptacle on the TempBook's rear panel. If using the battery module, please refer to the section [Rechargeable Battery Module](#) in chapter 2.

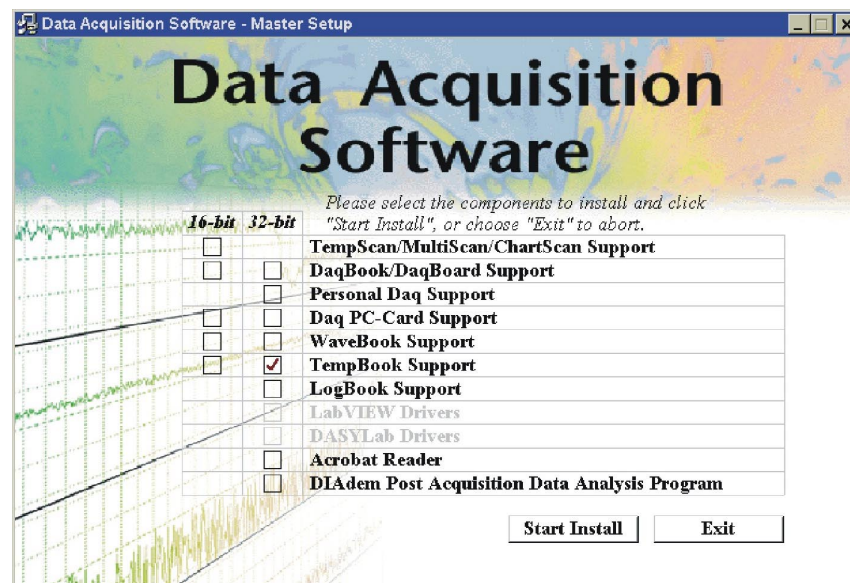


TempBook Power Connection

Software Installation

If you are using Windows 3.x, select 16-bit TempBook Support from the Data Acquisition Software Master Setup screen, otherwise select 32-bit (see following figure).

The TempBook/66 comes with a Microsoft Windows-based application (32-bit DaqView) that provides the easiest means to collect data from the TempBook. To install the software insert the installation CD into your PC's CD drive. After agreeing with the legal statement a master setup screen will appear (see following figure).



Selecting TempBook Support (32-Bit) from the Master Setup Screen

After selecting TempBook Support [and Acrobat Reader and DIAdem, if desired], click Start Install and follow the on-screen prompts.

Once the setup program has installed the software, a TempBook program group will appear within Windows. To start DaqView, click on its program icon. The main window will soon display a spreadsheet of channels in rows and channel parameters in columns.

For information regarding the use of DaqView, refer to the [DaqView document module](#).



Reference Note: Users of **32-bit TempBook Support** should refer to the [DaqView](#), [DaqViewXL](#), and [DIAdem](#) document modules for detailed information regarding these documents. Users of **16-bit TempBook Support** should refer to the [TempView](#) and [PostView](#) document modules for detailed information

Parallel Port Capabilities

The TempBook includes a test program which verifies your computer's parallel port, testing its standard and enhanced capabilities.

- Standard LPT ports on an IBM compatible computer have two modes to read data from the printer port: 4-bit and 8-bit. The 8-bit mode is somewhat faster than the 4-bit, but not all printer ports support this mode.
- Enhanced parallel ports (EPP) are parallel ports which include additional hardware that allows the TempBook to communicate with the PC at 3 to 10 times the speed possible with standard parallel ports. This greatly improves data acquisition performance.

Enhanced parallel ports require special hardware, and only certain computers are EPP capable. Most laptop computers that use the Intel 386SL or 486SL chip set (which includes the 82360 I/O Controller) are EPP capable. For those computers which have plug-in card slots, EPP adapter cards are available. You may wish to contact your computer's manufacturer for details about your machine and possible adapter cards.

TempBook Configuration Under Windows 95/98/Me/NT/ and 2000

This section describes the configuration of TempBook devices under the Windows 95/98/Me/NT and 2000 operating systems. A configuration utility is supplied via a control panel applet. The **Daq Configuration** applet allows you to add a device, remove a device, or change existing configuration settings. Daq Configuration also has a built-in test utility to test the device. The test utility provides feedback on the validity of the current configuration settings as well as providing relevant performance summaries.

Daq Configuration can be found in the Windows control panels and can be executed any time that it is desirable to add, remove or change device configuration settings. Daq Configuration may also be entered during driver installation. The following description applies to either method.

The Daq Configuration/Device Inventory screen at right will display all currently configured devices. Devices are identified by their name, and by an icon that indicates the device type. If no device is currently configured, no device will appear in this field.

The 4 buttons across the bottom of the Daq Configuration screen are used as follows:



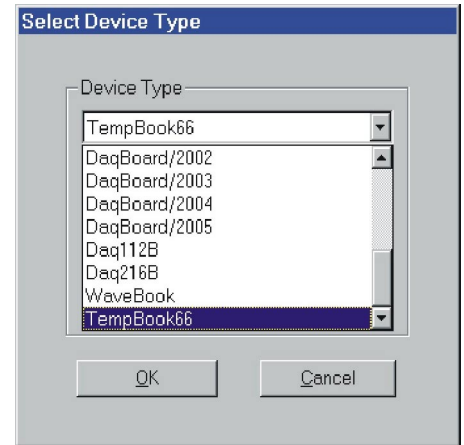
- **Properties.** Current configuration settings for a device can be changed by bringing up the corresponding properties screen. To do so, double-click the device icon or single-click the device and then select the Properties button.
- **Remove.** The Remove button is used to remove a device from the configuration. A device may be removed if it is no longer installed or if the device's configuration no longer applies.
Note: If a device is removed, applications may no longer access the device. However, the device can be re-configured at any time using the Add Device function described below.
- **Close.** The Close button may be used at any time to exit the Daq Configuration applet.

- **Add.** The **Add Device** button is used to add a device configuration whenever a new device is added to the system. Failure to perform this step will prevent applications from properly accessing the device. Selecting the **Add Device** button will display a window as shown in the figure.

Use the scroll bar to find the TempBook device type to be configured. Once found, click the device type (the type should then appear in the main edit box). Now select the OK button.

The next screen displays the properties for the TempBook device with the default configuration settings. Fields include:

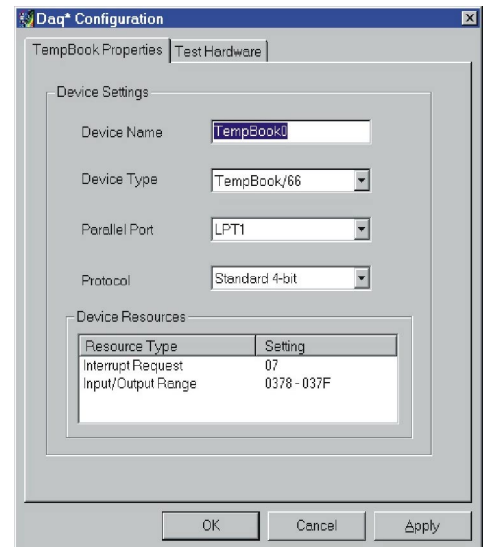
- The **Device Name** field is displayed with the default device name. However, this field can be changed to any descriptive name as desired.
- The **Device Type** field should indicate the device type which was initially selected. However, it can be changed here if necessary.
- The **Protocol** field is used to set the parallel port protocol for communicating with the TempBook. Depending on your system, not all protocols may be available.



When all fields have been changed to the desired settings, you can click:

- the **Apply** button to store the configuration.
- the **OK** button to store the configuration and exit the current property screen.
- the **Cancel** button to exit the current device configuration property screen without storing any changes.
- the **Test Hardware** tab to test the current stored configuration for the device. This selection will bring up the Test property screen.

Before testing the TempBook, make sure the device has been properly installed and powered-on. Make sure the parallel port cable is firmly in place on both the TempBook and the proper LPT port in the computer.



Testing the TempBook device may, in some cases, cause the system to hang.

If test results are not displayed in 30 seconds or if the system does not seem to be responding ...

- (1) reboot the system.
- (2) upon power-up, re-enter the Daq Configuration, and
- (3) change the configuration settings to those that work properly.

To test the current stored configuration for the device, click the **Test** button. Test results should be displayed within a few seconds. The test results have 2 components:

Resource Tests and Performance Tests.

Resource Tests

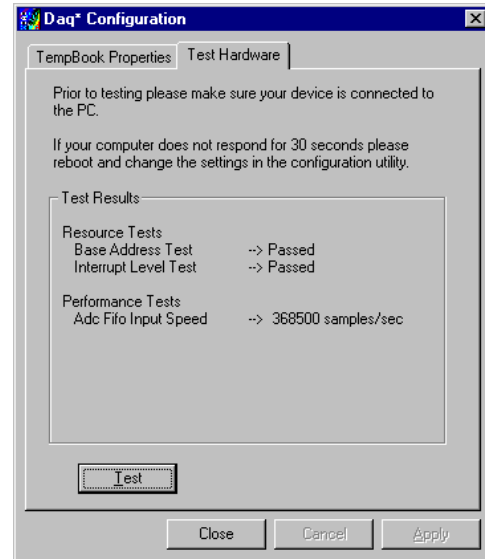
The resource tests are intended to test system capability for the current device configuration. These tests are pass/fail. Resource test failure may indicate a lack of availability of the resource or a possible resource conflict.

- **Base Address Test** - This test will test the base address for the selected parallel port. Failure of this test may indicate that the parallel port is not properly configured within the system. See relevant operating system and computer manufacturer's documentation to correct the problem.

Performance Tests

The performance tests are intended to test various TempBook functions with the current device configuration. These tests give quantitative results for each supported functional group. The results represent maximum rates at which the various operations can be performed. These rates depend on the selected parallel port protocol and will vary according to port hardware capabilities.

- **ADC FIFO Input Speed** - This test will test the maximum rate at which data can be transferred from the TempBook's internal ADC FIFO to computer memory through the parallel port. Results are given in samples/second (sample is 2 bytes in length representing a single A/D count).



Inspection

The TempBook components were carefully inspected prior to shipment. When you receive your data acquisition system, carefully unpack all items from the shipping carton and check for any obvious signs of physical damage that may have occurred during shipment. Immediately report any damage to the shipping agent. Retain all shipping materials in case you must return the unit to the factory.

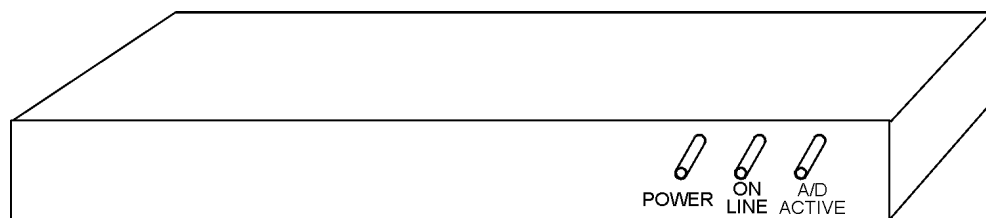
Every TempBook is shipped with the following items:

- TempBook Data Acquisition System
- User's Manual
- Installation CD
- Calibration Constants Disk
- Accessory Kit, including: CA-35-2 (2 ft parallel port cable) and an AC Adapter

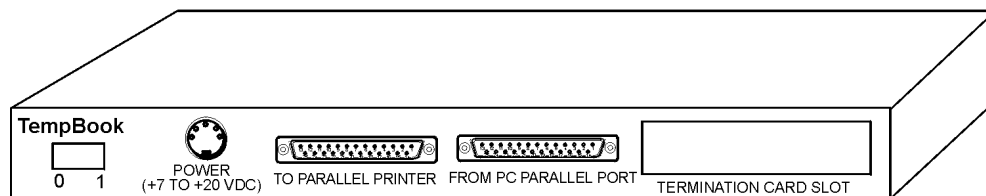
Panel Connectors and Indicators

The TempBook front panel consists of 3 status-indicator LEDs. The rear panel consists of the power switch, power input, two DB25s for parallel port connection and pass-thru, and a slot to accept the input termination card. The function of each of these components is described below.

TempBook Panel Connectors and Indicators	
POWER SWITCH	This rocker arm switch turns on the DC power to the TempBook when the "1" side of the switch is depressed.
POWER INPUT	This input connector accepts +7 VDC to +20 VDC.
TO PARALLEL PRINTER	This parallel port can connect to any standard parallel printer. This allows the user to attach both the TempBook and a parallel printer to the system simultaneously.
FROM PC PARALLEL PORT	This parallel port connects directly to the PC's parallel printer port. This allows the host system to communicate with the TempBook.
POWER	This LED is ON when power is applied to the TempBook (and the power switch is in the ON position). OFF, if power is not present.
ON-LINE	This LED is ON when the TempBook is in an Active state. OFF, when the TempBook is not enabled or in the printer pass through mode.
A/D ACTIVE	ON during an A/D scan sequence. If the sequence has a small number of steps and occurs infrequently, this indicator will only flash briefly.



Front Panel of TempBook/66

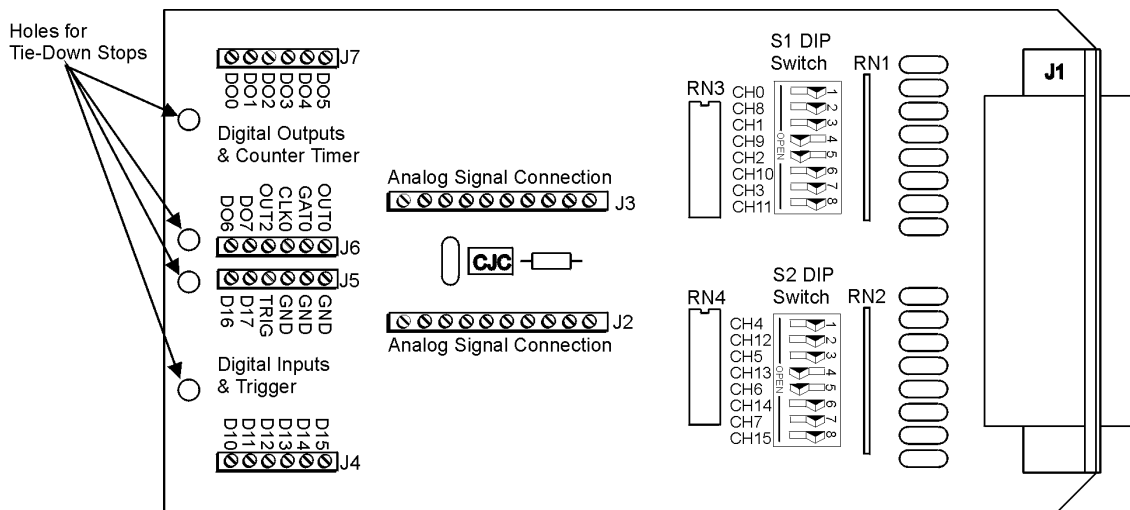


Rear Panel of TempBook/66

TempBook Front and Rear Panels

Termination Card and I/O Connectors

The TempBook/66 accepts all analog and digital I/O signals via a removable termination card (see figure). This termination card has six screw terminal strips, a CJC temperature sensor, and input R/C filters which also provide a bias current return path for the TempBook's instrumentation amplifier. The filters/bias resistors are switch-selectable on a per channel basis.

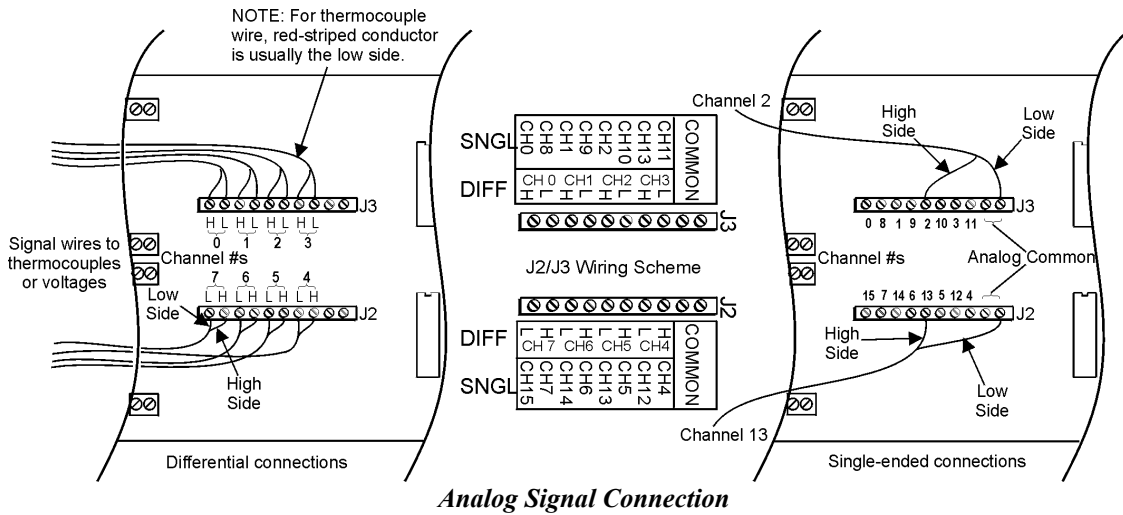


TempBook Termination Card

Terminal strips J2 and J3 provide analog input signal connection. Note that the terminals are arranged in differential pairs for easy thermocouple connection. These terminal strips also provide analog signal common connections for convenient referencing of single-ended input signals.

Terminal strips J4 and J5 provide connections for the eight digital outputs and the TTL trigger input. These terminal strips also provide ground connections for referencing digital signals. Terminal strips J6 and J7 provide connections for the eight digital inputs, the pacer clock output (OUT2), and the three counter/timer (8254 P0) I/O signals.

The thermocouple or voltage connections should be made as shown in the following figure.

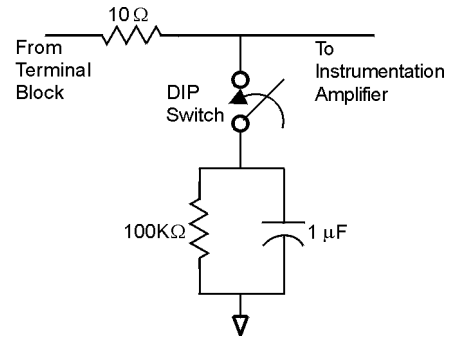


When connecting both low and high level signals, the low-level signals should be connected to the lowest numbered channels with connections following in ascending order of signal magnitude.

Each of the 16 analog input channels is configured as shown in the figure (also, refer to page 2-10 for more information on wiring differential inputs).

The series resistance and shunt capacitance form a single-pole low-pass filter with a corner frequency of 15.9 kHz. The shunt resistance provides the bias current path for the instrumentation amplifier.

When reading thermocouples, these filters should be switched in. If the filters are not used with thermocouples or any other differential input, then the user must provide a bias current return path to signal common.



Two DIP switches need to be set for each differential channel.

Internal Configuration



Reference Note:

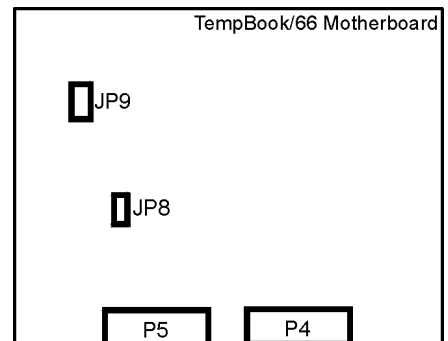
This section pertains to TempBook/66 hardware configuration. Software installation and software configuration under Windows 95/98/Me/NT and 2000 is discussed in chapter 1.

To open the unit, place the TempBook on a flat surface. Remove the screw on the top rear of the case, and slide out the top cover. Reverse this procedure to assemble the unit.

The internal configuration of a TempBook/66 consists of setting the following jumpers to reflect the desired mode of operation:

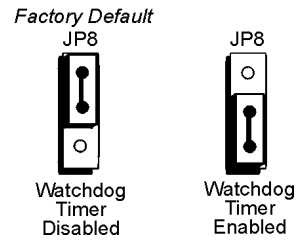
- Time Base (JP9)
- Watchdog Timer Enable (JP8)

The location of each jumper is shown in the figure.



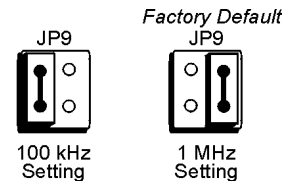
Watchdog Timer Enable/Disable (JP8)

This 3-pin header allows the elective use of the TempBook watchdog timer function. If using a printer with the TempBook, the watchdog timer should be enabled to allow the TempBook to be most reliably reset by the host computer. Note that enabling the watchdog timer might impede background measurements. If the user is not going to attach a printer, the timer is optional. The default setting is Watchdog Timer Disabled. To enable, place the shunt jumper in the enabled position as shown in the figure. To disable, place the jumper in the disabled position, as shown.



Time Base Selection (JP9)

This 2×2 header allows the user to select one of two oscillator derived frequencies to be applied to the pacer clock (8254 P1 & P2). The pacer clock sets the interval between scans in continuous trigger mode. The two frequencies are 1 MHz and 100 kHz. The most useful range of clock output frequencies [for the typical user] is provided by the default, 1 MHz setting.



DaqView only supports a setting of 1 MHz, which is the factory default.

Hardware Installation

Connect the TempBook to any PC parallel printer port (female DB25) by unplugging the printer cable and plugging the male end of the supplied cable (CA-35) into the computer and the female end into the mating connector on the TempBook. Any printer port (LPT1, LPT2, or LPT3) may be used but should be noted for use in software installation.

TempBook allows for LPT pass-through for simultaneous data acquisition and printer operation. When using a printer in the system, attach the original printer cable male DB25 into the mating connector on the TempBook.

The TempBook may be powered by the supplied AC adapter that plugs into any standard wall outlet or from an isolated 9-20 VDC source of 1-2 A.

If using the power adapter, plug it into a 120 VAC outlet, and attach the low voltage end to the jack on the TempBook. Turn ON the power switch, and the POWER LED should be on.

At power-on, the printer should behave normally and can be checked by issuing a **PRINT SCREEN** command (or any other convenient method of checking the printer). (Installation of the software will be necessary before the TempBook can perform any functions.)

Rechargeable Battery Module (DBK30A)

For portable applications where external AC or DC power is not available, the DBK30A rechargeable nickel cadmium battery module can be used with the TempBook/66. This module is housed in a rugged metal package that is the same size as the TempBook. It also comes with high-strength Velcro tabs that allow convenient mounting underneath the TempBook/66.

The DBK30A has two modes, the 14 VDC default and the 28 VDC mode. An internal slide-switch determines the mode.

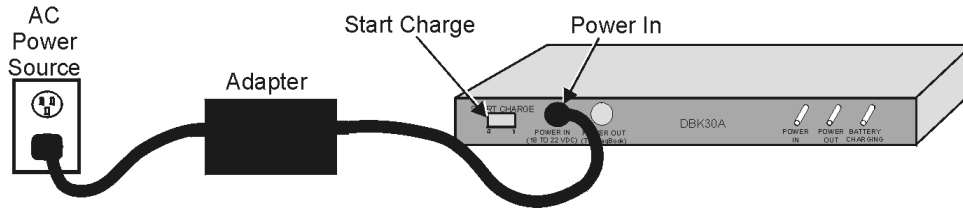


Only the 14VDC mode of the DBK30A is to be used with the TempBook/66.

The 14VDC operating mode provides 14.4 VDC at 3.4 A-Hr. This setup can power the TempBook for 3 to 6 hours depending on the application. The battery module has built-in automatic battery-charging circuits, which quickly and safely recharge the internal batteries when connected to the supplied AC adapters. The only requirement for trouble-free operation is for the user to fully charge the battery module before attempting to use it.

Charging the Battery Modules

The DBK30A package includes a charger for the intended line voltage (either 120 VAC or 230 VAC). To charge the battery module, plug the output cable from the charger into the POWER IN connector on the DBK30A, and plug the charger into an appropriate source of AC power (see figure). The charge cycle will be initiated automatically, and the batteries will be fully charged after the charging cycle terminates.



Connecting the Charger

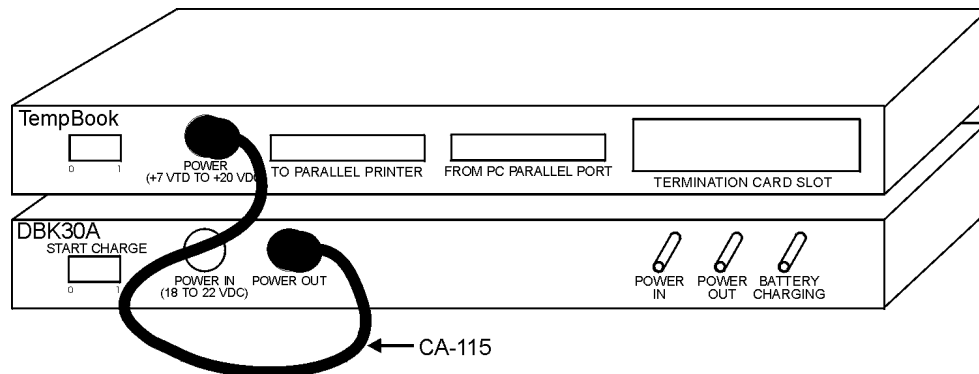
To initiate another charge cycle, depress the START CHARGE momentary rocker-arm switch. Subsequent charge cycles applied to a fully charged DBK30A will have no ill effect because the DBK30A will sense the fully-charged status of the batteries and revert to the trickle-charge state within a few minutes.

Three LED status indicators on the DBK30A provide information on the charge process or external load as noted in the table.

Power In	Illuminated when the charger is connected to a source of AC power and to the battery module.
Battery Charging	Illuminated steadily while battery is in the high current (2-amp) charge mode. Flashing briefly, one or two flashes at a time, when the internal batteries are fully charged.
Power Out	Illuminated steadily when an external TempBook product is connected and drawing current from the battery modules.

Battery Module Connection

The DBK30A package includes a short connecting cable (CA-115) to connect to the TempBook. This cable connects the Power Out connector on the DBK30A to the Power In connector on the TempBook (see figure).



Connecting the TempBook to the Battery Module

The run time available from a DBK30A operating a TempBook will depend on what the TempBook is doing. This time can be as little as 3 hours or as much as 6 hours.

CAUTION



The DBK30A must periodically be fully discharged or the cells may develop "lazy chemistry" that may limit storage capacity. (This "memory" is characteristic for nickel-cadmium batteries.) To manually discharge a battery pack, connect a TempBook, and leave it turned on until the indicator lights go dark.

Connection Troubleshooting

If communications cannot be established with the TempBook or if trying to connect causes the system to hang or crash, then you should:

- Check that TempBook's power LED is ON. If not ON, verify power connection between the TempBook and the power source.
- Make sure the LPT cable is firmly attached to the computer's proper LPT port and to the TempBook port labeled "TO COMPUTER".
- Check that the desired LPT port has the proper resource configurations. The base address and IRQ level must be properly configured and recognized by the operating system. The parallel port must be capable of generating interrupts for proper operation. (This information may be obtained in the Device Manager in the Control Panel of the operating system). More information on this subject can be found in the `readme.txt` file in the current software release.
- Check the BIOS settings for the LPT port. If ECP, change to normal or bi-directional.
- Make sure the BIOS LPT protocol settings are compatible with the settings selected for the LPT port with the Control Panel applet.
- Make sure the Daq Configuration Applet has been run and the proper LPT port and protocol have been selected for the device. The Daq Configuration applet can be found in the Control Panel of the operating system. The Test Hardware function in the control panel applet can be used to confirm proper communication with the device.

Calibration of TempBook

The TempBook/66 is factory calibrated for gain and offset. After calibration, gain and offset errors, and software correction constants are calculated.

Calibration Constants File Installation

Each TempBook is shipped with a calibration constants file. The file is named serial_no.cal where serial_no is the serial number of the TempBook for which the constants were generated.

The default calibration constants filename is tempbook.cal. Use Windows Explorer to copy serial_no.cal from the disk to the following directory.

C:\PROGRAM FILES\DAQX\APPLICATIONS\TEMPBOOK.CAL

Within DaqView, the user must go to Window/Preferences. Specify “Use Cal File” and browse to pick the **TEMPBOOK.CAL** file.

Next one should enable “Perform zero-offset adjustment” by checking the check box.



Reference Note:

Refer to the [DaqView](#) document module for more information.

Hardware Calibration

Since the TempBook is factory calibrated, user recalibration is not recommended. One exception to this recommendation is the calibration of the TempBook's internal 5V reference. This 5V reference is used to level-shift the amplified analog input signal for unipolar measurements. Reference-voltage drift is not compensated for with zero compensation; and therefore, periodic recalibration can improve unipolar measurement accuracy.

The following characteristics can be calibrated through potentiometer adjustments on the TempBook main board:

- 5V Reference Voltage
- Instrumentation Amplifier Offset
- Level Shift Amplifier Offset
- ADC Offset
- ADC Span

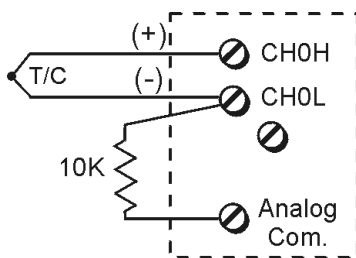
The TempBook includes a simple calibration program that can be used to perform these adjustments. If the user is only performing the reference voltage adjustment, then only a 4-1/2 digit DMM is required. If the user is performing the full TempBook calibration, then an adjustable voltage calibrator is also required.

A Microsoft Windows program, DAQCAL.EXE, is provided to perform calibration of the TempBook. To use this program, install the TempBook Windows support and launch the DAQCAL program; follow the on-screen instructions.

Differential Measurement Configurations

Floating Differential

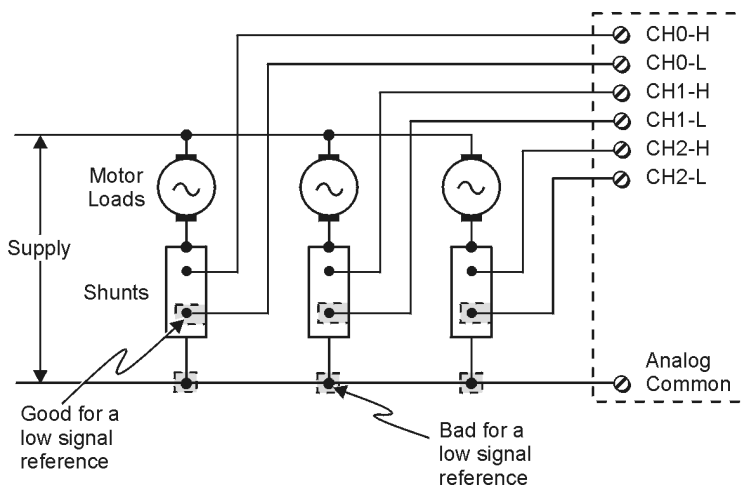
Floating differential measurements are generally made when low-level signals must be measured in the presence of relatively high levels of common mode noise. The most common example would be a non-grounded thermocouple. When the signal source has no direct connection to the system analog common, one must be provided. The easiest way to do this on the TempBook is to use the built-in biasing resistors by closing the corresponding input channel DIP switches (S1 and S2) on the termination card. Discussion of the card begins on [page 2-2](#). As an alternative, a resistor can be connected between one of the two signal lines (usually the lower in potential) and common. A resistor of 10 K Ω to 100 K Ω is satisfactory (less noise with the lower values).



Floating Differential Configuration

Referenced Differential

Referenced differential measurement is used when measuring several voltages. However, the voltages cannot share the same common node as a group of single-ended measurements might. An example is to measure several currents via shunts that happen to share a common supply terminal along a bus. The weakness in a single-ended hookup is that current flow through the common bus can introduce substantial errors that can be indistinguishable from the real values measured. The need for the system common to be connected to the common supply terminal is shown in the figure.



Referenced Differential Configuration