ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Measurement Computing / IOtech WaveBook/516* at our website: *Click HERE*

WaveBook User's Manual

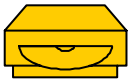
High-Speed Portable Data Acquisition Systems **User's Manual**

A Hardware Reference Manual for:

WaveBook/512A
WaveBook/516
WaveBook/516A
WaveBook/516E



Ethernet operation requires one of the following Operating Systems:



Windows NT
Windows 2000
Windows XP

IOtech, Inc.
25971 Cannon Road
Cleveland, OH 44146-1833
Phone: (440) 439-4091
Fax: (440) 439-4093
E-mail: sales@iotech.com
Internet: www.iotech.com

WaveBook User's Manual

for models: ***/512A, /516, /516A, /516E***

High-Speed Portable Data Acquisition Systems

p/n **489-0901** Rev. **5.0**

© 2003 … 2005 by IOtech, Inc.

Printed in the United States of America

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.

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 been an ISO 9001 registered firm 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.

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 Warnings and Cautions.

Note: During software installation, Adobe® PDF versions of user manuals will automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Initial navigation is as follows:

Start [on Desktop] ⇒ **Programs** ⇒ **IOtech WaveBook Software**

You can also access the PDF documents directly from the data acquisition CD by using the <**View PDFs**> button located on the opening screen.

Refer to the PDF documentation for details regarding both hardware and software.

A copy of the Adobe Acrobat Reader® is included on your CD. The Reader provides a means of reading and printing the PDF documents. Note that hardcopy versions of the manuals can be ordered from the factory.



PDF
489-0901

WaveBook_512A_516_Series Users Manual.pdf

Explains how to make signal and power connections and how to install software. The document includes an operational reference and a chapter on troubleshooting and customer support. The following PDFs are companion documents.



PDF

WaveView_WaveCal.pdf

Discusses how to install and use two "out-of-the-box" applications that are intended for use with WaveBook systems. WaveView is a data acquisition program with a "spread-sheet" style interface that makes it easy to set up your application quickly and begin acquiring data within minutes of completing hardware connections. The second program, WaveCal, is used for periodic calibration of system devices.



PDF
1086-0926
1086-0922

PostAcquisition Analysis.pdf

This PDFconsists of two documents. The first discusses *eZ-PostView*, a post data acquisition analysis program. *eZ-PostView* is included on the data acquisition CD. The second PDF pertains to *eZ-FrequencyView, eZ-TimeView, and eZ-Analyst*. These last three applications have more features than does *eZ-PostView* and are available for purchase. They can; however, be used freely during a 30-day trial period.



PDF
489-0902

WBK Options.pdf

The WBK Option Cards and Modules Manual discusses each of the WBK products available at the time of print.



PDF
1008-0901

ProgrammersManual.pdf

The programmer's manual pertains to developing custom programs using Applications Program Interface (API) commands.

Note that the install CD-ROM includes WaveBook program examples.

About WaveBook Documentation

In addition to the *WaveBook User's Manual* there are several PDF documents of importance. During software installation, Adobe® PDF versions of documents are automatically installed onto your hard drive. The default location is in the **Programs** group, accessible through the *Windows Desktop*. The documents may also be viewed directly from the data acquisition CD via the <**View PDFs**> button located on the CD's opening screen.

Unless you have hardcopy equivalents, you should refer to the PDF version documents for details regarding both hardware and software.

The *WaveBook User's Manual for WaveBook/512A, /516, /516A,* and */516E* consists of the following chapters. The chapters contain references to other documents as applicable. If you use the PDF version of this and the other documents, you can take advantage of the built in links to related material.

Chapter 1 – An Introduction to WaveBooks and Optional WBKs
Chapter 2 – System Setup and Power Options
Chapter 3 – System Examples
Chapter 4 – WaveBook Operation Reference
Chapter 5 – Software & Related Documents, An Overview
Chapter 6 – CE Compliance and Noise Considerations
Chapter 7 – Troubleshooting and Customer Support
Chapter 8 – Specifications
Chapter 9 – Fuse Replacement

Appendices

Appendix A – Using the Daq Configuration Applet
Appendix B – TCP/IP and Resource Tests

Glossary

CAUTION



Using the equipment in ways other than described in the documentation can cause personal injury or equipment damage. Pay attention to all Warnings and Cautions.



Reference Notes:
Information (not available at the time of publication), will be made available in **ReadMe** files, or in supplemental documentation.

Note: A copy of the Adobe Acrobat Reader® is included on your CD. The Reader provides a means of reading and printing the PDF documents. Note that hardcopy versions of the manuals can be ordered from the factory.



Reference Note:
This manual pertains to WaveBook/512A, WaveBook/516, WaveBook/516A, and WaveBook/516E. For information regarding earlier WaveBook models, please refer to document p/n 481-0901.

This page is intentionally blank.

Table of Contents

Chapter 1 – An Introduction to WaveBook and Optional WBKs

What Are WaveBooks? …… 1-1
How Do the WaveBook Models Compare?…… 1-2
What Are WBKs?…… 1-3
How Do WaveBooks and WBKs Interrelate? …… 1-6
How are WaveBook Systems Powered?…… 1-7
How Are Multiple WaveBooks Synchronized? …… 1-7

Chapter 2 – System Setup and Power Options

Minimum System Requirements …… 2-1
Understanding WaveBook and WBK Connectors …… 2-2
Parallel Port Connections…… 2-6
Ethernet Connections…… 2-8
System Enhancement and Expansion …… 2-21
Adding WBK Option Cards …… 2-21
Adding WBK Modules…… 2-22
The Daisy-Chain Concept …… 2-26
How Channel Numbers are Determined …… 2-26
Scan Synchronization …… 2-27
Stacking Modules …… 2-28
Connecting the System to Power ……2-29
Calculating the System Power Requirement…… 2-29
System Power, Examples …… 2-32
Power Supplies …… 2-33

Chapter 3 – System Examples

Introduction …… 3-1
Cable Review …… 3-2
Single WaveBook Systems, 4 Examples …… 3-3
Example 1: WaveBook/516E with two WBK10A Modules …… 3-3
Example 2: WaveBook/516E with a WBK17 and a WBK40 …… 3-4
Example 3: WaveBook/516A with a WBK25, WBK17, and a WBK10A …… 3-5
Example 4: WaveBook/516E with a WBK41 and 2 WBK10A Modules …… 3-6
Multiple WaveBook Systems, 2 Examples …… 3-7
Example 1: A WaveBook/516E with 3 WaveBook/516A Units …… 3-7
Example 2: Two WaveBook/516A Sub-Systems Connected via a WBK25 Module ….. 3-8

Chapter 4 – WaveBook Operation Reference

Basic Operation …… 4-2
WBK Option Cards and Modules …… 4-7
Analog-Signal & Ground Conections…… 4-12
Digital I/O Connections…… 4-13
Triggers …… 4-15
Synchronizing Multiple WaveBooks …… 4-22
Programmable Features …… 4-24

Chapter 5 – Software & Related Documents, An Overview

Accessing Software-Related PDF Documents …… 5-1
WaveView Out-of-the-Box Software …… 5-2
eZ-Analyst Series Software ……. 5-3
Calibration Software …… 5-6
Icon-Based Software **(DASYLab® and LabVIEW™) …… 5-6**
DaqX Language Drivers for Programmers …… 5-6

Chapter 6 – CE Compliance and Noise Considerations

Overview …… 6-1
CE Standards and Directives …… 6-1
Safety Conditions ……6-2
Emissions/Immunity Conditions …… 6-3
Using Shielded BNC Connectors for CE Compliance …… 6-3
CE Compliance for WaveBook System Expansion …… 6-3
Noise Considerations …… 6-4

Chapter 7 – Troubleshooting and Customer Support

Electrostatic Discharge (ESD), Handling Notice…… 7-1
Product Care …… 7-1
ReadMe Files and the Install CD-ROM …… 7-2
Driver Support…… 7-2
Ethernet Problems …… 7-2
Parallel Port Problems…… 7-5
Frequently Asked Questions …… 7-10
Customer Support …… 7-14

Chapter 8 – Specifications

Specifications – WaveBook/512A ……8-1
Specifications – WaveBook/516, /516A, /516E, and WBK10A …… 8-3

Appendices

Appendix A – Using the Daq Configuration Applet
Appendix B – TCP/IP and Resource Tests

Glossary

An Introduction to WaveBooks and Optional WBKs 1

What Are WaveBooks? …… 1-1
How Do the WaveBook Models Compare?…… 1-2
What Are WBKs?…… 1-3
How Do WaveBooks and WBKs Interrelate? …… 1-6
How Are WaveBook Systems Powered?…… 1-7
How Are Multiple WaveBooks Synchronized? …… 1-7

What Are WaveBooks?

WaveBooks are high-speed portable data acquisition devices that can be used in a variety of applications, such as testing engine strain, multi-channel acoustics, mechanical integrity, and vibration/shock/strain. WaveBook models that are discussed in this manual have the following features, with exceptions as noted:

- ***Power Options:*** Power can be supplied from an AC-to-DC adapter, battery, DBK30A rechargeable battery module, DBK34, or DBK34A uninterruptible power supply modules.
- ***Easy Connection to Notebook or Desktop PCs***.
- ***Analog Input Channels:*** BNC connectors keep input signals isolated from the chassis and commons.
- ***16 High-Speed Digital Inputs***
- ***Digital Signal Processing (DSP):*** Allows you to define a channel scan-sequence and associated gains across all channels. Also provides for real-time digital calibration on a per-sample basis.
- ***Programmable Scan Sequencing:*** A 128-location scan sequencer allows you to program the analog channel scan sequence, the associated unipolar/bipolar A/D range, and the input amplifier gain. WaveBook performs 1 MHz scanning and gain switching over both its built-in and expansion channels.
- ***Single, or Multi-Channel Triggering***
- ***Pre- and Post-Trigger Readings***
- ***Digital-Pattern Trigger:*** A trigger occurs when a Digital I/O pattern is equal to, not-equal to, greater than, or less than a user-defined 16-bit digital pattern. This is useful when trying to capture noise, vibrations or some other physical disturbance that occurs at a particular point in a digitally-sequenced process, such as a relay-logic-control system. Trigger latency of the digital pattern trigger is less than 200 ns for post-trigger acquisitions.
- ***Pulse Trigger:*** Enables triggering and the correlation of lower-speed waveforms with the occurrence of a user-defined, high-speed pulse.
- ***20 kHz Low Pass Filters:*** When a PGA option is installed, eight low pass anti-alias filters are available, one for each channel.
- ***External Clock Input:*** The external clock is useful when data collection depends on rotational speed or axial position. Note that the external clock's input can be set to a slower rate.
- ***Synchronization:*** The "A" and "E" Series WaveBooks include a *synchronizing feature* that allows multiple WaveBook/516As, WaveBook/512As, and WaveBook/516E units to operate in sync.
- **WaveBook/516E only**: Includes a 10/100BaseT Ethernet connection port, which allows for a continuous stream of data to be collected and stored in a PC.
- **WaveBook/516E only**: Includes 3 expansion ports for expanding the acquisition system via the built-in parallel port interfaces of up to three other devices. For example, a WaveBook/516A could be attached to WaveBook/516E's Expansion Port 1, a WaveBook/512A could be attached to Expansion Port 2, and a WBK40 Thermocouple Module could be attached to Expansion Port 3.

How Do the WaveBook Models Compare?



WaveBook/516A Front Panel

Note: /516 & /512A Front Panels also have this appearance.



WaveBook/516A Rear Panel

Note: The /512A Rear Panel also has this appearance. The /516 Rear Panel has a Printer Pass-Thru Port instead of two SYNC Ports.



WaveBook/516E Front Panel



WaveBook/516E Rear Panel

WaveBook Product Comparison

Analog Input	/512A	/516, /516A, /516E
A/D resolution	12-bit	16-bit
A/D speed	1 MHz	1 MHz
Sample rate	1 μs/channel	1 μs/channel
Ranges Unipolar (Note 2) Bipolar	0 to +10V, 0 to +4V, 0 to +2V (Note 2) ±10V, ±5V, ±2V, ±1V	0 to +10V, 0 to +4V, 0 to +2V (Note 2) ±10V, ±5V, ±2V, ±1V
A/D accuracy	±0.03 % FS	±0.012% FS
20-kHz low-pass filter	Yes	Yes
Analog input channels	8 DE	8 DE
Differential amplifiers	8 (1 per analog input)	8 (1 per analog input)
PGAs (Option)	1 (shared by all 8 inputs)	1 (shared by all 8 inputs)
Maximum capacity	72 Channels	72 Channels
FIFO depth	64K samples	64K samples
Total Harmonic Distortion 10Hz to 20Khz, Typical[1]	-70dB	-84dB
Signal to Noise and Distortion (SINAD)[1]	-70dB	-74dB
High-Speed Digital Inputs		
Digital I/O	16	16
External Clock / Frequency Input		
32-Bit Period Measurement	Yes	Yes
Trigger		
Single and multi-channel	Yes	Yes
Digital Pattern	Yes	Yes
Pulse	Yes	Yes
Synchronization		
	2 SYNC Ports	2 SYNC Ports (/516A & /516E Only)
Ethernet Connection		
	Via a WBK25 Interface or a connection to a WaveBook/516E	/516E – Direct connection to Ethernet /516 and /516A – via WBK25 Interface or a connection to a WaveBook/516E
Parallel Expansion Ports		
	No*	/516 and /516A – No* /516E – Yes, 3 expansion ports

[1] The THD and SINAD values apply to the -10 to +10 V range.

[2] Unipolar mode does not apply when a WBK11A, WBK12A, or WBK13A is installed.

* Three parallel expansion ports are available to the WaveBook/512A, /516, and /516A when the unit is connected to a WBK25 Ethernet Interface option.

Note: Specifications are subject to change without notice.

What Are WBKs?

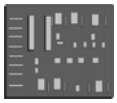
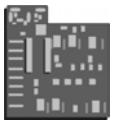
You can use optional modules and cards to enhance or expand your WaveBook system. These WaveBook options are known as WBKs.

Internally, WaveBooks have room for one signal-conditioning card. Externally, you can use one or more expansion modules.

Reference Note:
The WBK option cards and modules that follow are detailed in a companion document, the *WBK Option Cards and Modules User's Manual*, p/n 489-0902. A PDF version of the document is included on your data acquisition CD.

WBK Options

Note: The items represented in the table are not shown to the same scale.

 **WBK10A** Analog Expansion Module *8 Channels via BNC Connectors*	Each WBK10A module can be used to provide WaveBook with 8 additional differential-analog-inputs. The modules are equipped with a programmable gain instrumentation amplifier (PGA) and, like the WaveBook, each has a built-in expansion bus. Up to eight WBK10A modules can be cascaded together for a system capacity of 72 differential channels. Each module is capable of supporting a WBK11A, WBK12A, or WBK13A option card.
 **WBK11A** Simultaneous Sample & Hold Card (8 channels)	The WBK11A card can simultaneously sample 8 channels and can be installed inside a WaveBook or in a WBK10A module. The cards allow for concurrent (<150 ns) capture of multiple input channels and virtually eliminate channel-to-channel time skewing. The WBK11A option is factory install only.
 **WBK12A** Programmable Low-Pass Filter Card (8 channels) **WBK13A** Programmable Low-Pass Filter Card with SSH (8 channels)	WBK12A and WBK13A are 8-channel programmable low-pass filter cards for use with WaveBook data acquisition systems. These cards install directly into a WaveBook or WBK10A module and provide programmable low-pass filtering over all channels. Multiple WBK12A and WBK13A cards can be installed in one system for up to 72 channels. All of the cards' low-pass filters and cutoff frequencies are configured via software. WBK13A cards have the additional capability of sampling all channels at the same time. The WBK12A and WBK13A options are factory install only.
 **WBK14** Dynamic Signal Conditioning Module *8 Channels via BNC Connectors*	The WBK14 is a dynamic analog signal input module. It enables WaveBooks to interface with piezoelectric transducers that include accelerometers, microphones, and force/pressure transducers. Each WBK14 channel has a: • current source for transducer biasing • high-pass filter • programmable gain amplifier • anti-aliasing low-pass filter • simultaneous sample-and-hold (SSH) amplifiers
 **WBK15** 8-Slot 5B Signal Conditioning Module 8 channels via 5B Modules	The WBK15 module provides for a diverse range of signals available through optional 5B modules. Measurement types include: LVDT, potentiometer, isolated current loop, ±10mV to ±40V inputs, linearized RTD, thermocouple, frequency-to-voltage, and strain gage. *See latest catalog or contact your sales representative in regard to the types of 5B Modules available for your application.*



WBK16
Strain-Gage Module
8 channels via Standard Female DB9

WBK16 is an 8-channel strain-gage signal-conditioning module. Up to eight WBK16 modules (64 channels) can be accommodated by the WaveBook and scanned at 1 µs/channel. Almost all bridge configurations are supported via a bridge-completion network and software. High-gain differential-amplifier applications are also supported. Software controls bridge configuration, gain, offset, excitation voltage, polarity, filtering, and the calibration process.



WBK17
Counter-Input Module with Quadrature Encoder Support
8 channels via Removable Screw Terminal Blocks

The WBK17 is an 8-channel multi-function counter/encoder module for use with Wavebook/512A, /516, /516A, and /516E. Each of the high-speed, 32-bit counter channels can be configured for counter, period, pulse width, time between edges, or encoder modes. All channels are capable of measuring analog inputs that are digitized by the WaveBook.



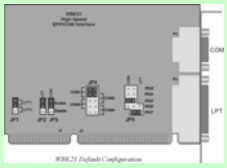
WBK18
Dynamic Signal Conditioning Module with Transducer Electronic Data Sheet support (T.E.D.S).
8 channels via BNC Connectors

WBK18 provides 8 channels of dynamic signal input for WaveBook systems. Each channel on the WBK18 has independent, software control for AC or DC coupling, ICP biasing (0 or 4 mA), and low-pass filter cut-off frequency. The 8-pole Butterworth filter on each channel is programmable from 5 Hz to 50 kHz, in a 1-2-5 progression. The filter can also be bypassed, resulting in a bandwidth of greater than 200 kHz.

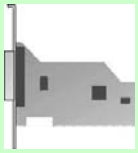
WBK20A, WBK21, and WBK23 – Three Interface options that can be used to obtain an Enhanced Parallel Port.



WBK20A
PC-Card /EPP Interface & Cable



WBK21
ISA/EPP Interface Plug-in Board



WBK23
PCI/EPP Interface Plug-In Board

WBK20A – *PCMCIA/EPP Interface Card and Cable*
For linking WaveBook to a Notebook PC. This interface provides an Enhanced Parallel Port via a PC-Card Slot.

WBK21 – ISA/EPP Interface Plug-in Board
For linking WaveBook to a desktop PC. This interface provides an Enhanced Parallel Port via an ISA Bus-slot.

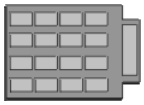
WBK23 – *PCI/EPP Interface Plug-In Board*
(For linking WaveBook to a desktop PC)
Provides an Enhanced Parallel Port from a PCI Bus-slot.

These three interfaces are shipped with separate documentation and are not detailed in this manual.



WBK25
10/100BaseT Ethernet Interface Module

The WBK25 provides high-speed Ethernet connectivity for WaveBook, DaqBook and WBK40 series products. The WBK25 contains one 10/100BaseT Ethernet port for connection to a PC, and three expansion ports that can attach to any model of WaveBook, DaqBook, WBK40 Series option, or any combination of these devices.



WBK30
WaveBook Memory Options

WBK30 is a DRAM-based memory board that installs inside a WaveBook. There are three models of WBK30 available; each significantly increases the capacity of a WaveBook's standard data buffer of 64 K samples. Capacities are as follows:

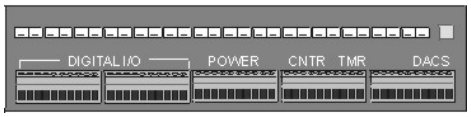
WBK30/16 — 16 MB
WBK30/64 — 64 MB
WBK30/128 — 128 MB

Note: For WaveBook/516E the WBK30 option, if selected, must be factory installed.



WBK40
Thermocouple Input Module
14 channels via Mini-T/C Connectors

The WBK40 attaches to any one of the three expansion ports on the WaveBook/516E or the WBK25, and provides 14 thermocouple input channels. The 14 built-in TC channels accept any type of thermocouple, including types J, K, S, T, E, B, R, and N. Mini-TC connections make it quick and easy to attach thermocouples. The WBK40 can be expanded in 14 channel increments using the DBK84 TC expansion module. A total of 15 DBK84s can be attached to one WBK40, for a total TC channel capacity of 224 channels.



WBK41
Multi-Function I/O Module
14 Thermocouple channels via Mini-T/C Connectors
40 Digital I/O Lines
4 Counter Inputs
2 Timer Outputs
(Optional) 4 Analog Channel Outputs

The WBK41 attaches to any one of the three expansion ports on the WaveBook/516E or WBK25 and provides 14 thermocouple inputs, 40 digital I/O lines, 4 counter inputs, and 2 timer outputs. The WBK41 can also be supplied with an internal, 4-channel, 16-bit, 100-kHz analog output option.

The built-in TC channels on the WBK41 are accessed via mini-TC connectors on the front panel. The counter/timer functions and 16 bits of digital I/O are accessed via removable front panel screw-terminal connectors. Additional digital I/O and expansion connectors are located at the rear of the WBK41.

The WBK41 can be easily expanded beyond its built-in channel capacity. A maximum WBK41 system can include up to 224 TC input channels, 272 digital I/O channels, 4 analog output channels, 4 counter input channels and 2 timer output channels.



WBK61 and WBK62

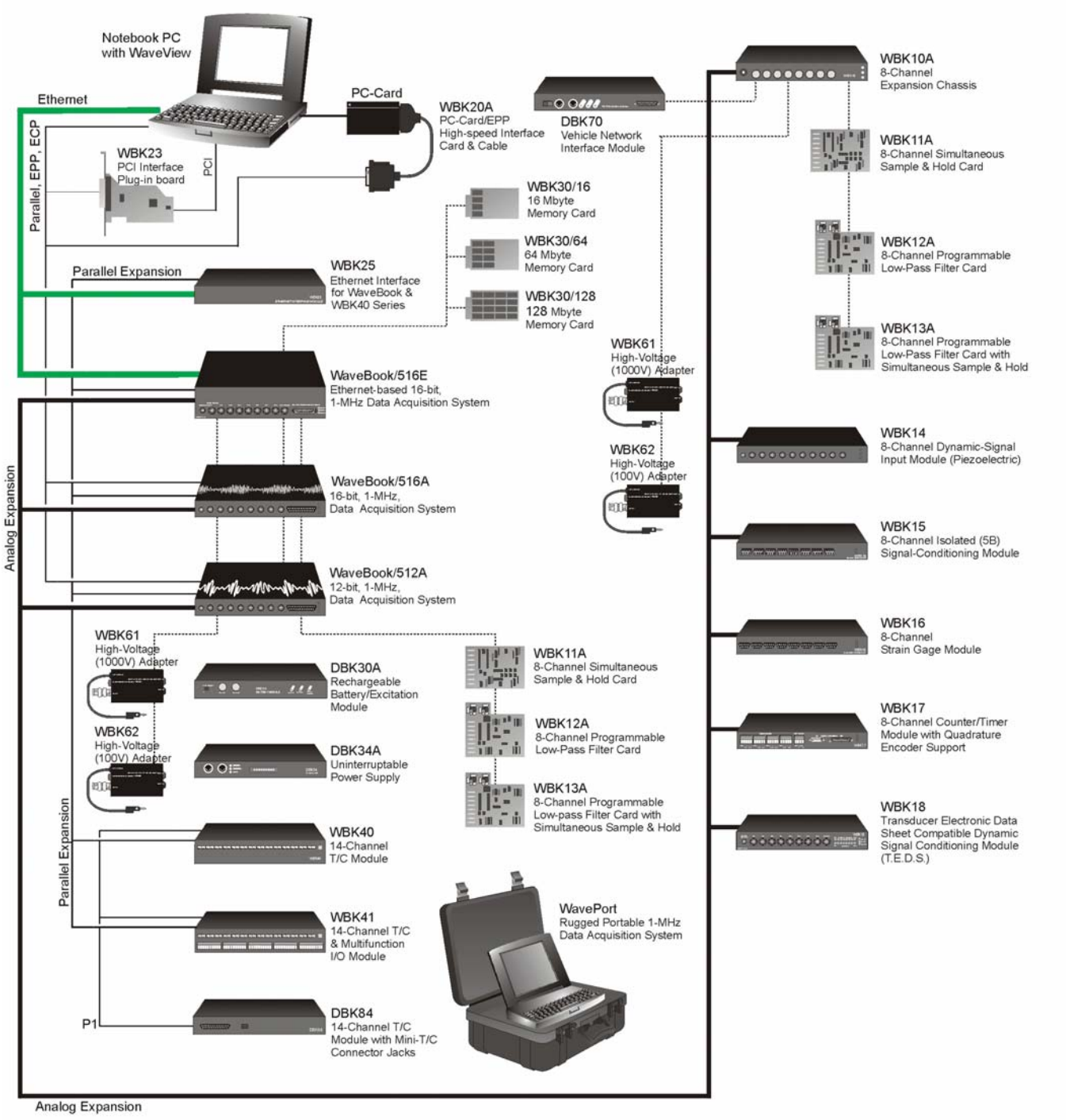
WBK61: High-Voltage Adapter with 200:1 Voltage Divider (1 channel)
WBK62: High-Voltage Adapter with 20:1 Voltage Divider (1 channel)

WBK61 and WBK62 are single-channel high-voltage adapters that can be used with the WaveBook or with a WBK10A expansion module. In addition, WBK61 and WBK62 can be used in conjunction with WBK11A, WBK12A, and WBK13A cards.

WBK61 and WBK62 include safety-style banana-jacks for the high and low inputs, and 60-inch (152 cm) cables with probe tips and alligator clips for easy input connection.

How Do WaveBooks and WBKs Interrelate?

WaveBooks and WBKs interrelate when they become part of the same data-acquisition system. The relationship can be broken down into *enhancement*, *expansion*, or both. The following illustrates the relationship of various system components. Detailed information and product specifications are provided in *WBK Option Cards and Modules Manual*, p/n 489-0902.



WaveBook System Components

How Are WaveBook Systems Powered?

Power supply input voltage to the WaveBook and to the system modules, e.g., WBK10A, WBK14, WBK15, WBK16, WBK17, WBK18, WBK40, and WBK41 must be in the range of 10 VDC to 30 VDC and can come from an appropriate AC-to-DC adapter or a battery option. The latter includes DBK power modules and batteries in the range of 10 VDC to 30 VDC.

Note: Power supply input to the WBK25 Ethernet Module must be in the range of 10 VDC to 30 VDC.

Available AC-to-DC adapters include the TR-40U, which has an input of 90-264 VAC and a output rating of 2.2 amps @ 15 VDC.

Battery options include the DBK30A, DBK34A, and other 10 to 30 VDC sources, such as car batteries. The DBK30A provides 14 VDC and when fully charged has a storage capacity of 3.4 A·hr; car batteries have much higher capacities. The basic formula for battery life is:

Runtime (hr) = Battery capacity (A·hr) / Current load (A)

System cards, e.g., WBK11A, WBK12A, and WBK13A, get power from their host WaveBook or their host WBK10A expansion module.

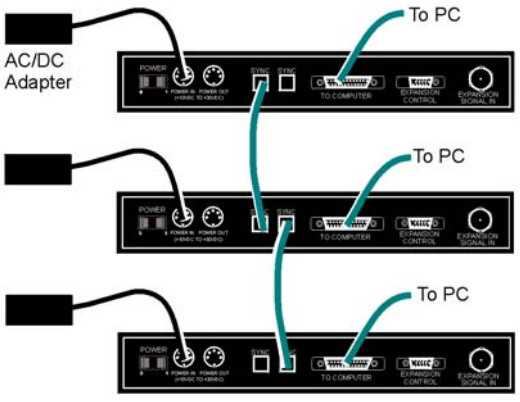
Before connecting your system to power, you need to know the power requirements of your specific system. A calculation method that incorporates the use of worktables is presented in Chapter 2.

Reference Notes:

- Chapter 2, *System Setup and Power Options*, includes examples of power connections for different WaveBook system scenarios. In these examples the included TR-40U power adapters are used.
- Chapter 3, *WaveBook Operation Reference*, includes discussion of power supplies other than the TR-40U.

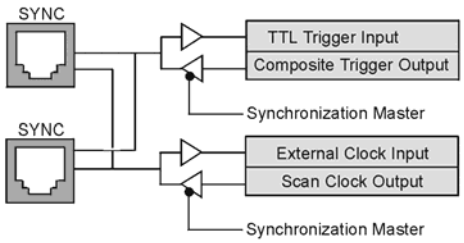
How Are Multiple WaveBooks Synchronized?

Up to four "A-series" and "E-Series" WaveBooks can be synchronized to each other via their SYNC ports. Each unit has two identical SYNC ports. Either or both SYNC ports can be used to connect to the units via SYNC cables CA-74-1 or CA-74-5 (1-foot or 5-foot cables, respectively). The units can be scan-synchronized and triggered from any other SYNC-connected unit.



Three "A-Series" WaveBooks, Synchronized

Not all trigger modes are supported in multiple WaveBook Systems.



Synchronization Concept Block Diagram

The preceding diagram shows how an “A” or “E” series WaveBook can input or output synchronization timing and trigger events on either SYNC connector.

SYNC cables are not to exceed a total combined length of 15 feet (4.57 m).

System Setup and Power Options 2

Minimum System Requirements…… 2-1
Understanding WaveBook and WBK Connectors …… 2-2
Parallel Port Connections …… 2-6
Ethernet Connections …… 2-8
System Enhancement and Expansion …… 2-21
Adding WBK Option Cards …… 2-21
Adding WBK Modules…… 2-22
The Daisy-Chain Concept …… 2-26
How Channel Numbers are Determined …… 2-26
Scan Synchronization …… 2-27
Connecting the System to Power ……2-28
Calculating the System Power Requirement…… 2-28
System Power, Examples …… 2-31
Power Supplies …… 2-32

CAUTION

An incorrect use of power can damage equipment or degrade performance. Prior to connecting your devices to power, calculate your system's power requirements.

This chapter pertains to setting up a WaveBook system. Topics include how to: connect a WaveBook to a PC, add option cards and modules, properly power a system, install software, and check connections using the Daq Configuration Applet. As stated in the above Caution, you will need to calculate system power requirements prior to powering the system.

Minimum System Requirements

The following minimum system requirements apply:



- **PC system with Pentium® Processor**
- **Windows Operating System RAM as follows***
  - 32 Mbytes of RAM for Windows 95/ 98
  - 64 Mbytes of RAM for Windows Me
  - 32 Mbytes Ram for Windows NT
  - 64 Mbytes of RAM for Windows 2000
  - 64 Mbytes of RAM for Windows XP
- **10 MB of Available Disk Space**
- **For WaveBook/512A, /516, & /516A, if connecting via a parallel port****
  EPP (Enhanced Parallel Port), or
  ECP (Extended Capabilities Port)
- **For WaveBook/516E and the WBK25 Ethernet Interface Module**:
  10/100BaseT Ethernet Port

*** Windows NT, 2000, or XP is required for Ethernet operation.**

** As an alternative to a parallel port connection to a PC, WaveBook/512A, /516, and /516A can be connected to the Ethernet via a WaveBook/516E or a WBK25 Ethernet Interface Module.

Understanding WaveBook and WBK Connectors

WaveBook/516E Front Panel



The WaveBook/516E Front Panel includes the following connectors and LED indicators.

Analog Common – banana jack receptacle

Channels 1 through 8 – BNC connectors; Channel 1 is also used for Analog Trigger

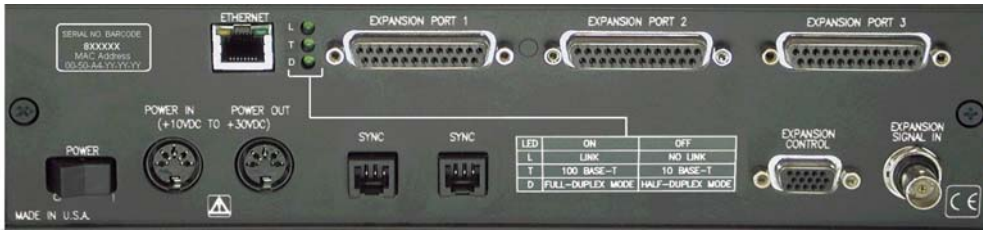
Pulse Trigger – BNC connector

Digital I/O, External Clock, TTL Trigger – DSUB25 connector

LEDs: *ACTIVE* – Lights when a sample has been converted by the A/D Converter.
READY – Lights when the WaveBook/516E's internal Ethernet module establishes communication.
POWER – Lights when power is turned on and is present.

WaveBook/516E Rear Panel

The upper row of the WaveBook/516E rear panel includes a label with a barcode for the device serial number and a MAC Address (Internet Protocol Address). The row also has an Ethernet Port, three LEDs (designated L, T, and D), and three Expansion Ports. The panel's lower row includes a Power Switch, one DIN5 Power In connector, one DIN5 Power Out connector, two SYNC (synchronization ports), an LED legend, a 15 pin Expansion Control connector, and a BNC Expansion Signal In connector. Additional detail follows. Items described below are done so from left to right, when looking at the rear panel.

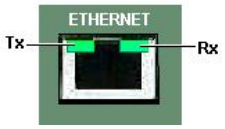


MAC Address Label: The Media Access Control (MAC) label is located in the upper left corner of the rear panel. The label shows the device serial number in barcode and base 10 formats. It also shows the Ethernet address (MAC Address) which is derived from the serial number in hexadecimal. If prompted to enter a serial number in software, use the base 10 number. Conversion to a hexadecimal number for use in addressing will be automatic.

Note: If your network administrator asks you for a MAC number or MAC Address, provide him [or her] with the hexadecimal number that is located at the bottom of the label.

ETHERNET: The 10/100BaseT Ethernet port can connect to the Ethernet port of the host PC, or to an Ethernet network. Either of two Ethernet patch cables may be used to make the connection. CA-242 is a 1.5 foot cable. CA-242-7 is a 7-foot cable. Note that the Ethernet connector has two built in LEDs that indicate traffic flow. These are discussed with the three other Ethernet-related LEDs. Note that the Ethernet cable length must be <10m in order for the system to be CE Compliant.

LEDs: There are 5 ETHERNET Status LEDS. Two rectangular LEDs (Tx and Rx) are built into the frame of the Ethernet jack. The other three LEDs, located just to the right of the jack, are round and are labeled L, T, and D.



Tx and Rx LEDs

Tx – "ON" indicates traffic is being transmitted (see figure at right).
Rx – "ON" indicates that the port is receiving traffic.
L (Link) "ON" indicates a link exists. "OFF" indicates no link.
T (BaseT) "ON" indicates 100BaseTx, "OFF" indicates 10BaseT.
D (Duplex) "ON" indicates full duplex, which allows simultaneous two-way data traffic. "OFF" indicates half-duplex, which only allows one-way data traffic at any given time.

EXPANSION PORTS [1, 2, and 3]: used to expand the system with up to three additional devices. Each Expansion Port can be used to connect the WaveBook/516E to the PARALLEL PORT connector of a WaveBook/516A, WaveBook/512A, WaveBook/516, WBK40, or WBK41.

POWER Switch: A rocker-type switch with a "0" label for Power Off, and a "1" for Power On.

POWER IN: +10 VDC to +30 VDC, through a socket type DIN5 connector on the chassis. Power is typically supplied from a TR-40U power adapter.

POWER OUT: +10 VDC to +30 VDC, through a socket type DIN5 connector on the chassis. Power can be supplied from the WaveBook/516E to another device in the system, in which case, the power cable would connect the receiving device's POWER IN DIN5 connector. **A current limit of 5 amps is not to be exceeded.**



Calculate system amp load prior to creating a system daisy-chain. Although WaveBook device connectors and CA-115 power cables have 5 amp limits, TR-40Us are limited to 2.2 amps. Tables for determining amp load are provided in an upcoming section, entitled *Calculating the System Power Requirement*.

SYNC (Qty of 2) – Two "synchronization ports" provide a means of synchronizing up to four WaveBook "A" and/or "E" units in regard to post-trigger scanning. The ports accept CA-74-1 (1 foot) and CA-74-5
(5 foot) cables. Both are 6-conductor RJ-11 cables.



Up to four units can be synchronized. The total combined length of the SYNC cables is not to exceed 15 feet (4.57 m).

EXPANSION CONTROL: The HD15 EXPANSION CONTROL connector provides a means of connecting a control output signal [from the WaveBook/516E] to the 15HD EXPANSION CONTROL IN connector of the first WBK expansion device in the system. Expansion Control signal lines can be daisy-chained, as will be seen in upcoming system examples.

EXPANSION SIGNAL IN: This BNC connector provides a way for the WaveBook/516E to receive return signals from the EXPANSION SIGNAL OUT BNC connector of the first WBK expansion device in the system. Expansion Signal lines can be daisy-chained, as will be seen in upcoming system examples.

WaveBook/512A, /516, and /516A Front Panels



The front panel for each of these three units includes the following connectors and LED indicators.

Analog Common – banana jack receptacle

Channels 1 through 8 –BNC connectors; Channel 1 is also used for Analog Trigger

Pulse Trigger – BNC connector

Digital I/O, External Clock, TTL Trigger – DSUB25 Connector

LEDs: *ACTIVE* – Lights when a sample has been converted by the A/D Converter.
READY – Lights when an appropriate parallel port protocol has been established with the unit.
POWER – Lights when power is turned on and is present.

WaveBook/512A, /516, and /516A Rear Panels [WaveBook/516A Rear Panel Shown]



Note: WaveBook/516 has no SYNC ports. In their place is a DB25S connector that serves as a printer pass-through.

POWER Switch: A rocker-type switch with a "0" label for Power Off, and a "1" for Power On.

POWER IN: +10 VDC to +30 VDC, through a socket type DIN5 connector on the chassis. Power is typically supplied from a TR-40U power adapter.

POWER OUT: +10 VDC to +30 VDC, through a socket type DIN5 connector on the chassis. Power can be supplied from the WaveBook/516E to another device in the system, in which case, the power cable would connect the receiving device's POWER IN DIN5 connector. **A current limit of 5 amps is not to be exceeded.**



Calculate system amp load prior to creating a system daisy-chain. Although WaveBook device connectors and CA-115 power cables have 5 amp limits, TR-40Us are limited to 2.2 amps. Tables for determining amp load are provided in an upcoming section, entitled *Calculating the System Power Requirement*.

SYNC (Qty of 2) – **"A" and "E" units only**. Two "synchronization ports" provide a means of synchronizing up to four WaveBook "A" and/or "E" units in regard to post-trigger scanning. The SYNC ports accept CA-74-1 and CA-74-5 cables. Both are 6-conductor, RJ-11 cables.

Note: WaveBook/516 has no SYNC ports. In their place is a DB25S connector that serves as a printer pass-through.



Up to four units can be synchronized. The total combined length of the SYNC cables is not to exceed 15 feet (4.57 m).

PARALLEL PORT: WaveBook/512A, /516, and /516A can be connected to a PC's Parallel Port or to an Ethernet. In regard to Parallel Port connection, use of an Enhanced Parallel Port (EPP) or an Extended Capabilities Port (ECP) is recommended. Three WBK options, WBK20A, WBK21, and WBK23 are available for use with PCs that do not have Enhanced Parallel Ports and are discussed on page 2-6. With exception of the WBK20A, which has its own cable, when this type of connection is desired, a 2-foot CA-35-2, or a 6-foot CA-35-6 communication cable is used to connect the WaveBook to the host PC.

In regard to Ethernet connection, the WaveBook can be connected to one of three Expansion Ports on a WaveBook/516E or to one of three Expansion Ports on a WBK25 Ethernet Module.

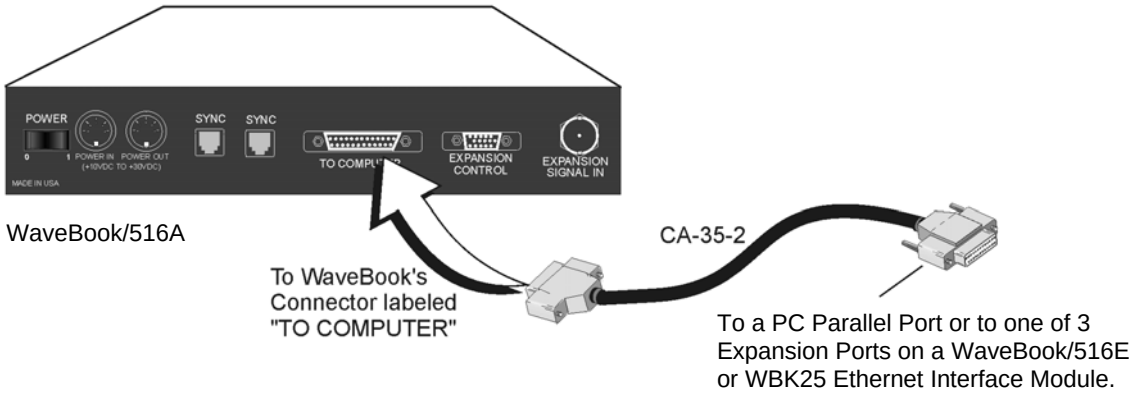
EXPANSION CONTROL: The HD15 EXPANSION CONTROL connector provides a means of connecting a control output signal [from the WaveBook/516E] to the 15HD EXPANSION CONTROL IN connector of the first WBK expansion device in the system. Expansion Control signal lines can be daisy-chained, as will be seen in upcoming system examples.

EXPANSION SIGNAL IN: This BNC connector provides a way for the WaveBook/516E to receive return signals from the EXPANSION SIGNAL OUT BNC connector of the first WBK expansion device in the system. Expansion Signal lines can be daisy-chained, as will be seen in upcoming system examples.



To ensure EPP speeds are properly handled, it is important that WaveBook systems make use of a 1284-compliant cable. Standard parallel cables will not work properly, primarily due to a lack of shielding. Note that CA-35-12 (1 foot), CA-35-2 (2-foot), and CA-35-6 (6 foot) cables are 1284-compliant.

Use of the CA-35-12 cable will result in less noise due to its shorter length.



Connecting the Communication Cable (CA-35-2) to a WaveBook/516A

Parallel Port Connections

Note: If you do not need to add a parallel port, skip this *parallel port* section.

If you need to connect a WaveBook/512A, /516, or /516A to a notebook or desktop PC that lacks a parallel port, you can use an interface device to obtain a port. To do so, your PC needs to have an available PC-Card Slot, ISA Bus Slot, or a PCI Bus Slot. You can use one of the following devices, depending on which interface is needed.

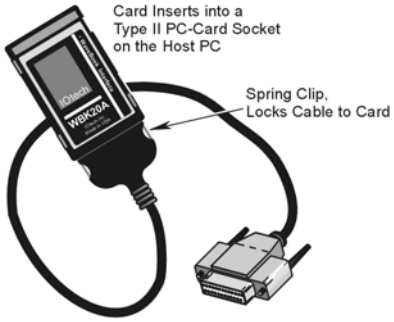
Reference Note:
You will need to use the Daq Configuration Applet to set the parallel port system devices. *Appendix A, Using the Daq Configuration Applet*, contains instructions for opening the applet and configuring devices. *Appendix B, TCP/IP and Resource Tests*, provides instructions for using the Daq Configuration Applet to test the system.

WBK20A

For Interfacing with a PC-Card Slot

If you need to connect your WaveBook/512A, /516, or /516A to a notebook PC that has no available parallel port, you can use a WBK20A. The device consists of a PCMCIA Interface Card, cable, and DB25 Connector.

Refer to separate instructions [supplied with the WBK20A] if applicable.



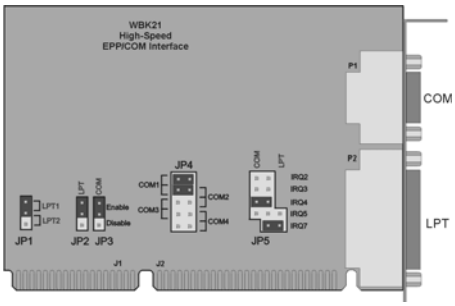
WBK20A, Plugs into a PC-Card Slot

WBK21

For Interfacing with an ISA Bus Slot.

If you need to connect your WaveBook/512A, /516, or /516A to a desktop PC that has no available parallel port, you may be able to use the WBK21 option to provide a port. The board's connector is labeled LPT. WBK21 plugs into and ISA Bus Slot.

Refer to separate instructions [supplied with the WBK21] if applicable.



WBK21, Plugs into an ISA Bus Slot

WBK23

For Interfacing with a PCI Bus Slot.

If you need to connect your WaveBook/512A, /516, or /516A to a desktop PC that has no available parallel port, you may be able to use a WBK23 to provide a port. The WBK23 plugs into a PCI Bus Slot.

Refer to separate instructions [supplied with the WBK23] if applicable.



WBK23, Plugs into a PCI Bus Slot

WBK25

For interfacing with an Ethernet jack on a PC or on a network hub.

If you are using a PC or a network with an available Ethernet jack you can obtain three parallel ports by using a WBK25 Ethernet-to-Parallel Port Interface.

The WBK25 provides high-speed Ethernet connectivity for WaveBook, DaqBook, WBK40, and WBK41 systems. Connection to the Ethernet is made via an Ethernet patch cable, which links the WBK25's 10/100BaseT Ethernet port to a PC's Ethernet jack or an Ethernet network hub.



The WBK25 Ethernet-to-Parallel Port Interface connects to the Ethernet and provides three parallel ports.

Refer to separate instructions [supplied with the WBK25] if applicable.



WBK25's three parallel ports are labeled as expansion ports 1 through 3. They are used to connect to WaveBook, DaqBook, WBK40, and WBK41 systems via parallel cables. The ports cannot be used for other parallel devices, such as printers and scanners.

Ethernet Connections

Ethernet connectivity can only be used with operating systems Windows NT, Windows 2000, Windows XP, or later.

Overview



WaveBook/516E

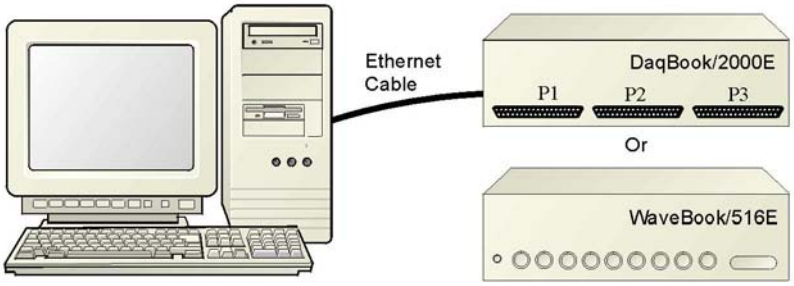


WBK25

You can connect a WaveBook/516E directly to an Ethernet port on a PC or network hub, via the unit's built-in 10/100BaseT Ethernet interface. An Ethernet patch cable CA-242 (1.5 foot) or CA-242-7 (7 foot) cable is used to make the connection. Note that either a straight-through or a cross-over cable may be used. The circuitry automatically adjusts for the cable type to ensure proper connection.

Two methods of connecting a WaveBook/512A, /516, or /516A to the Ethernet are available. These are (1) connect the unit to a WaveBook/516E, or (2) connect the unit to a WBK25 Ethernet Interface Module. In both scenarios the DB25 Parallel Port of the WaveBook/512A, /516, or /516A device connects to one of three Expansion Ports located on the WaveBook/2000E [or on the WBK25]. The connection would be made with a CA-35-2 (2-foot) or a CA-35-12 (1-foot) cable.

Note: For the most part, the following Ethernet instructions apply to both WaveBook and DaqBook Ethernet applications, with exceptions as noted. For illustrations or screen shots representing a DaqBook/2000E, note that WaveBook/516E also applies, unless implied otherwise.



Connecting a DaqBook/2000E to the Ethernet
The WaveBook/516E connects in the same manner.

The DaqBook/2000E and WaveBook/516E connect directly to an Ethernet port on a PC or network hub via the their built-in 10/100BaseT Ethernet interface. An Ethernet patch cable CA-242 (1.5 foot) or CA-242-7 (7 foot) cable is used to make the connection.

CAUTION



Turn off power to the system devices and externally connected equipment before connecting cables. Electric shock or damage to equipment can result even under low-voltage conditions.



Take ESD precautions (packaging, proper handling, grounded wrist strap, etc.)



Reference Note: Adobe PDF versions of user manuals will automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. You can also access documents directly from the data acquisition CD via the <View PDFs> button located on the CD's opening screen.

Minimum System Requirements

PC system with Pentium® Processor
Windows Operating System
RAM, as follows:
- 32 Mbytes of RAM for Windows NT
- 64 Mbytes of RAM for Windows 2000
- 64 Mbytes of RAM for Windows XP



Contact the factory or your service representative in regard to Ethernet connectivity if your operating system is other than Windows NT, Windows 2000, or Windows XP.

Step 1 – Install the Software

1. *For DaqBook applications*: Remove previous version Daq drivers, if present.
   For WaveBook applications: Remove previous version WaveBook drivers, if present.
   These drivers can be removed through Microsoft's *Add/Remove Programs* feature.
2. Place the Data Acquisition CD into the CD-ROM drive. Wait for PC to auto-run the CD. This may take a few moments, depending on your PC. If the CD does not auto-run, use the Desktop's *Start/Run/Browse* feature to locate and run **Setup.exe** [from the applicable CD-ROM drive].
3. After the intro-screen appears, follow the screen prompts.

STEP 2 – Determine the type of Network Connection

To properly connect and configure a DaqBook/2000E or a WaveBook/516E, you must determine the type of network that the device will become part of. This is because the type of network used has a direct bearing on the IP address of the device.

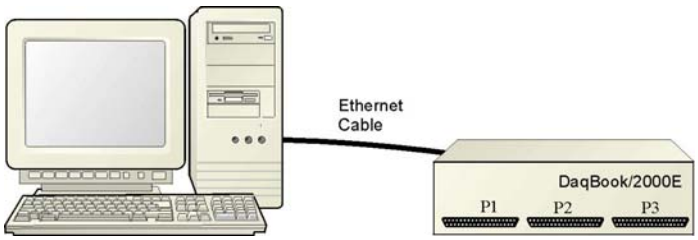
Briefly, the four network types are as follows:

- **Dedicated Network - with a direct cable connection from the PC to the device**
- **Dedicated Network - making use of a network hub or switch**
- **LAN with a DHCP server**
  (Local Area Network with a Dynamic Host Configuration Protocol)
- **LAN without a DHCP server**
  (Local Area Network with no Dynamic Host Configuration Protocol)

Brief descriptions and illustrations follow.

Dedicated Network - with a direct cable connection from the PC to the device

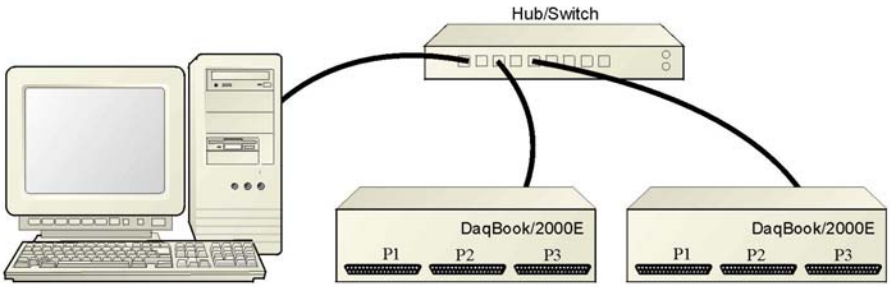
In this scenario a DaqBook/2000E or a WaveBook/516E is connected directly to an Ethernet jack on a host computer.



Dedicated Network using a Direct Cable Connection

Dedicated Network - making use of a network hub or switch

In this scenario the DaqBook/2000E or WaveBook/516E connects to the Ethernet through a network hub or switch. At least one computer is also connected to the hub.



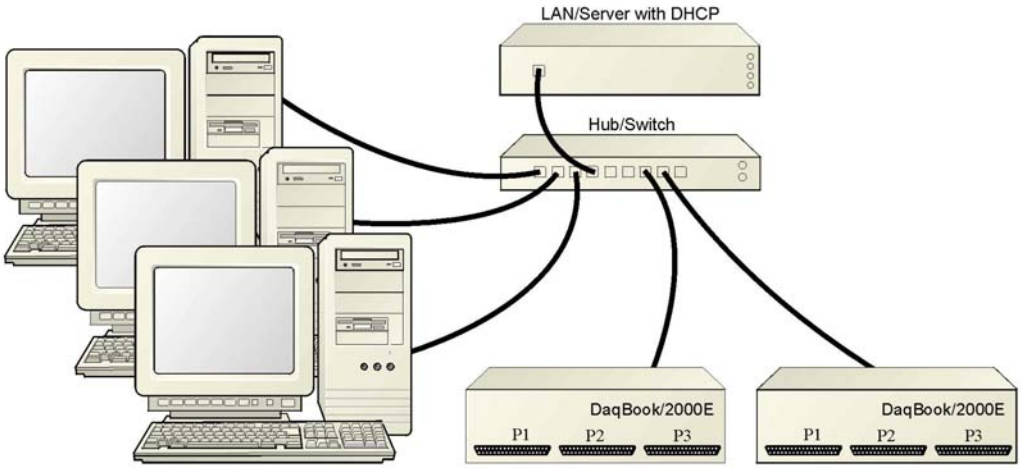
Dedicated Network using a Hub/Switch



Some network devices such as a *wireless access point* may act as a DHCP server. If this is the case, follow the instructions for the LAN with a DHCP server. For detailed information consult the documentation that is specific to your network device.

LAN with a DHCP Server (Local Area Network with a Dynamic Host Configuration Protocol server)

Many corporations use the LAN/Server with DHCP arrangement for their networks. In this type of setup several computers are typically connected to a network that makes use of a DHCP server. In addition, a DaqBook/2000E or WaveBook/516E is connected to the network hub/switch.



LAN with a DHCP Server

Notes:

- Using a DaqBook/2000E or WaveBook/516E on a typical LAN may affect the speed of the network and internet data transfer. Because of this we recommend adding a network card to the computer and using one of the two dedicated network configurations.
- Contact your network administrator before connecting a DaqBook/2000E or a WaveBook/516E to a corporate network.

LAN with no DHCP Server

(Local Area Network with no Dynamic Host Configuration Protocol server)

This scenario looks the same as that shown in the previous illustration, except there is no Dynamic Host Configuration Protocol (DHCP). In this type of setup, one or more computers are connected to a network; and each computer has a static IP address.

STEP 3 – Connect the System Components



Reference Note:
For examples of WaveBook system connections, including cable use, refer to the *System Enhancement and Expansion* section of this chapter. The section begins on page 2-21.

What you will need to connect a DaqBook/2000E or a WaveBook/516E to the Ethernet:

- An available connection to the Ethernet. The connection can be either
  - an Ethernet jack on a computer or
  - an Ethernet jack on a hub that is connected to the Ethernet.
- An Ethernet patch cable, e.g., a CA-242 (1.5 foot cable) or a CA-242-7 (7-foot cable).

1. Connect the Ethernet cable to the Ethernet jack on the DaqBook/2000E or WaveBook/516E.
2. Connect the other end of the Ethernet cable to the Ethernet jack on the host computer or network hub.

STEP 4 – Power-up the System Components



When powering up a WaveBook system it is important that the WaveBook/516E (or WBK25) is powered last, and that the most remote system components are powered first. Other power-up sequences will result in software's failure to recognize all components.*

- **First, power-on the WBK expansion modules.**
- **Second, power-on WaveBooks or WBK modules that are connected to the expansion ports of the WaveBook/516E or WBK25.**
- **Finally, power-on the WaveBook/516E and/or WBK25 devices.**

*** An exception to this power-up scheme is to power-on the entire system at once.**



Reference Notes:
- The section *System Enhancement and Expansion* (which begins on page 2-21) contains several examples, which include power connections.
- The section entitled, *Connecting the System to Power* (page 2-28) should be reviewed prior to powering up a system.

What you will need:

A power supply with a range of +10 VDC to +30 VDC.
The power supply needs to have a male DIN5 connector.

Note: The switching-mode power supply that is commonly used with these systems has an input range of 100 VAC to 240 VAC at 50 Hz to 60 Hz. The power supply's output [to the device] is typically 15 VDC @ 2.7 amps via a DIN5 connector.

Note: Various AC adapter models support power grids of USA, Europe, Japan, and Asia.

Reference Note: It is possible to use a VDC power source other than the commonly used switching-mode power supply, often referred to as an adapter. However, be sure to consult the power-related sections of this chapter, which begin on page 2-28 before doing so.

How to make the connection:

1. Using the unit's power switch, turn the DaqBook/2000E or WaveBook/516E "OFF. The switch will be in the "0" position and the power LED will be unlit.
2. Connect the DIN5 end of the adapter's cable to the power in connector on the DaqBook/2000E or WaveBook/516E.
3. Connect the adapter's plug to a standard AC outlet.
4. If your adapter has a power switch, position it to "ON."
5. Turn ON the DaqBook/2000E or the WaveBook/516E by placing the power switch to the "1" position. The power led will light up.

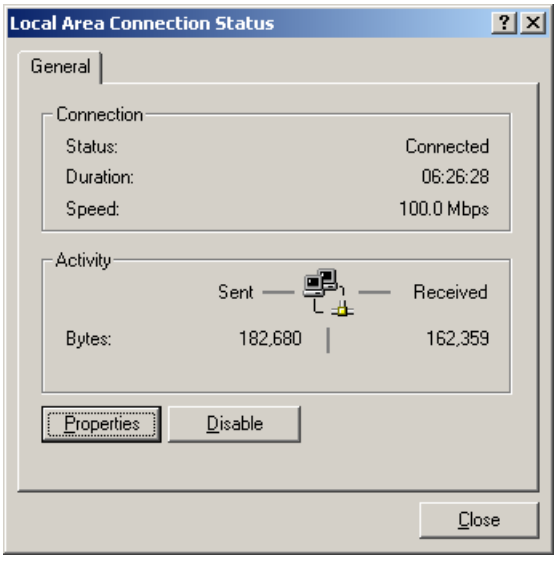
Reference Note:
Refer to the power-related sections of this manual before powering up a system. The sections begin on page 2-28.

STEP 5 - Configure the Computer's Network Settings [Applies to "dedicated networks" only]

If using a LAN (Local Area Network), which has a DHCP server, skip this section and continue with *STEP 7 - Configure and Test the System using the Daq*Configuration Applet* (page 2-18).

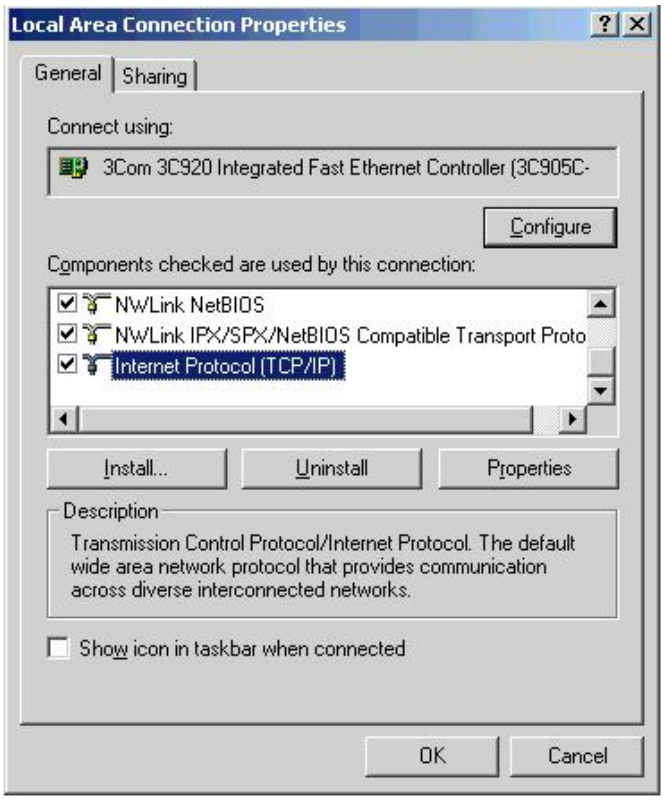
If using a LAN (Local Area Network), which has no DHCP server, skip this section and continue with *STEP 6 - Configure Device Network Settings using DaqIPConfig* (page 2-17).

1. Open the Control Panel by navigating from the Windows Desktop as follows:
   Start Menu ⇒ Settings ⇒ Control Panel.
2. Double-click the "Network and Dial-up Connections" icon.
3. Double-click the "Network Connection" icon for the network that the DaqBook/2000E or the WaveBook/516E is connected to.



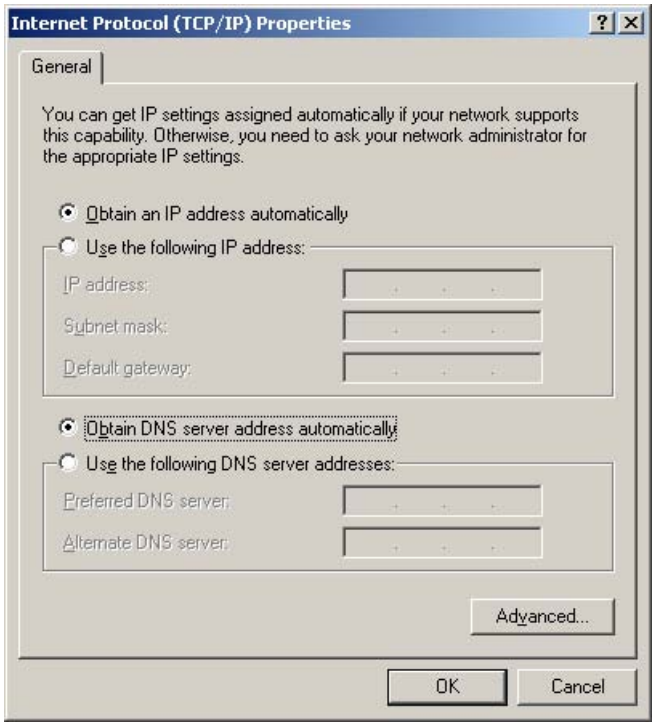
Local Area Connection Status

4. In the "Local Area Connection Status" box (previous figure), click on the <**Properties**> button. The "Local Area Connection Properties" box will appear (following figure).



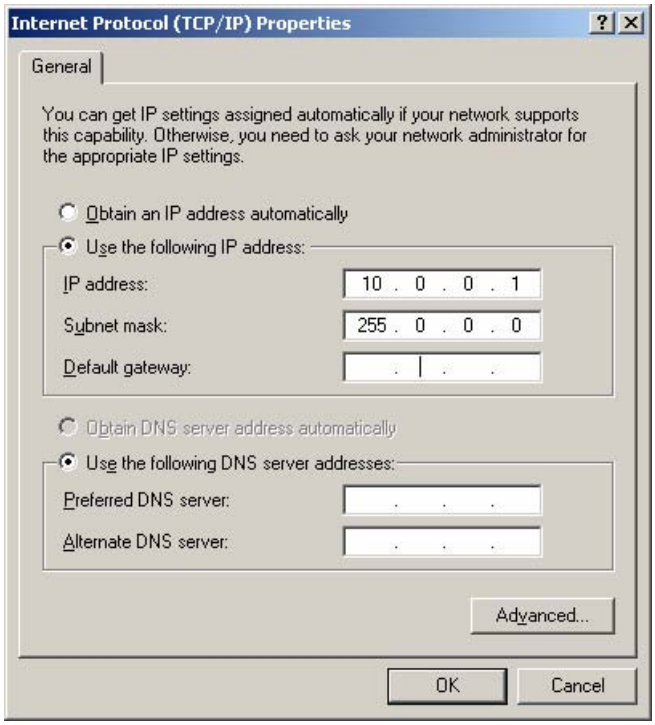
Local Area Connection Properties

5. Double-click the “Internet Protocol (TCP/IP)” component (previous figure). The “Internet Protocol (TCP/IP) Properties” box will appear (following figure).



Internet Protocol (TCP/IP) Properties

Configure the Computer's TCP/IP settings as follows.



Internet Protocol (TCP/IP) Properties

6. Select the "Use the following IP Address" radio button.
7. Set the IP address field to 10.0.0.x where x is some number from 1 to 255.

Make sure that each computer on the dedicated network has a unique IP address.

8. Set the Subnet mask to 255.0.0.0. Note that the remaining fields can be left unchanged.

STEP 6 - Configure Device Network Settings using DaqIPConfig

Applies only to a LAN (Local Area Network), which has a no DHCP server.

If using a LAN (Local Area Network), which has a DHCP server, skip this section and continue with *STEP 7 - Configure and Test the System using the Daq*Configuration Applet* (page 2-18).

The *DaqIPConfig* applet, designed for 32-bit Windows /NT/2000/XP systems. *DaqIPConfig* allows you to change the IP address of a device to match the address of a host computer. The applet is located in the program group for the associated device and can be accessed from the Windows Desktop via the start menu.

1. Locate the DaqIPConfig Applet.

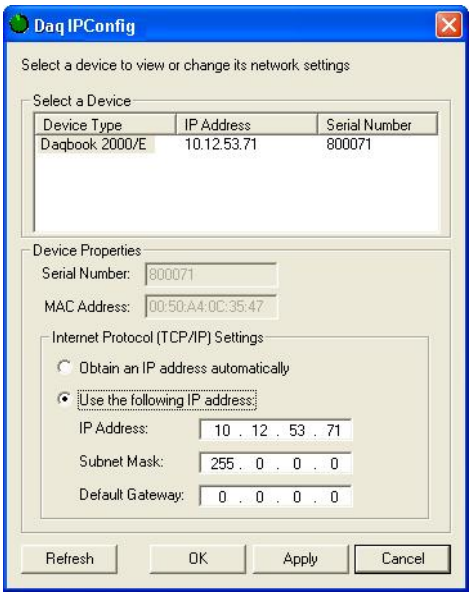
Locate the DaqIPConfig applet by navigating from the Windows' Desktop as follows:

DaqBook Users: **Start Menu ⇒ Programs ⇒ IOtech DaqX Software ⇒ DaqIPConfig**

WaveBook Users: **Start Menu ⇒ Programs ⇒ IOtech WaveBook Software ⇒ DaqIPConfig**

2. Open the DaqIPConfig Applet.

Click on the DaqIPConfig selection to open the applet.



DaqIPConfig

3. Select the device that is to have the address change.

Note: In the above figure there is only one device to select, i.e., DaqBook/2000E.

4. Set the internet protocol (TCP/IP) settings to be compatible with host computer.

(a) Select the radio button labeled "Use the following IP address."

(b) Enter the new internet protocol settings. If needed, consult your network administrator for acceptable numbers.

(c) Click the <OK> button.

5. Reboot the device.

The new IP address will not take affect until the device has been powered-off, then powered back on.

6. Repeat steps 3, 4, and 5 for other devices in the system.

After configuring the network settings for all devices, proceed to Step 7.

STEP 7 - Configure and test the System using the Daq* Configuration Applet

The *Daq* Configuration* applet, designed for 32-bit Windows NT/2000/XP systems, is located in the Windows *Control Panel*. It allows you to add or remove a device and change configuration settings. The included test utility provides feedback on the validity of current configuration settings, as well as performance summaries.

1. Open the Daq Configuration Applet.*

a. Open the Control Panel by navigating from the Windows' Desktop as follows:
Start Menu ⇒ Settings ⇒ Control Panel

b. From the Control Panel, double-click the ***Daq* Configuration*** icon.

2. Add the first-level device to the list of installed devices.

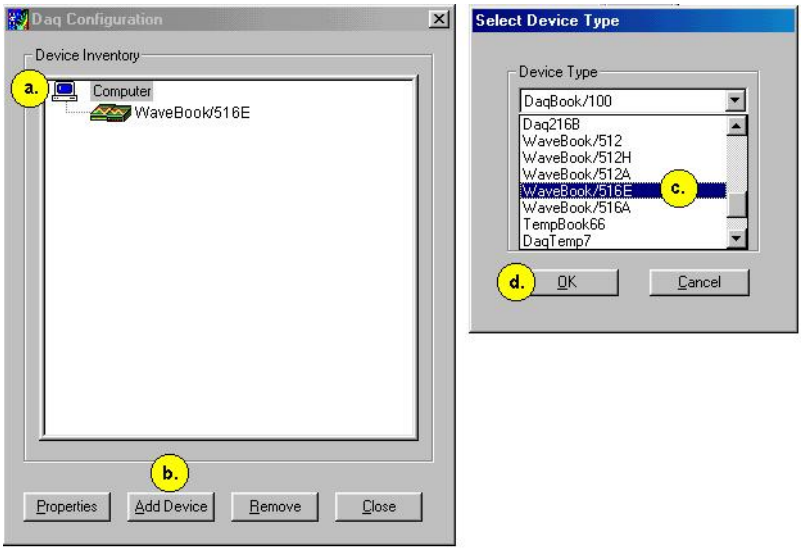
The first-level device is the device that will be connected directly to the Ethernet, via a host computer's Ethernet jack or a jack on a network hub. The DaqBook/2000E and WaveBook/516E are each examples of first-level devices.

a. Select the Computer image in the Device Inventory configuration tree (following figure).

b. Click the <**Add Device**> button. The "Select Device Type" box will appear.

c. Select the DaqBook2000E or the WaveBook516E from the list of devices, as applicable.

d. Click the <**OK**> button. The "Properties" box will appear for the selected device.



Using Daq* Configuration Device Inventory & Select Device Type to Add a Device

Note: Although the above figure indicates that a WaveBook/516E was selected as the first level device, we could similarly have a DaqBook/2000E as the first-level device.

3. *Set the properties of the first-level device.*

In this step you will set the device properties according to one of the following two methods, depending on whether you have a "Dedicated Network" or a "LAN with DHCP Server Network."

Users of Dedicated Networks follow these 2 steps.

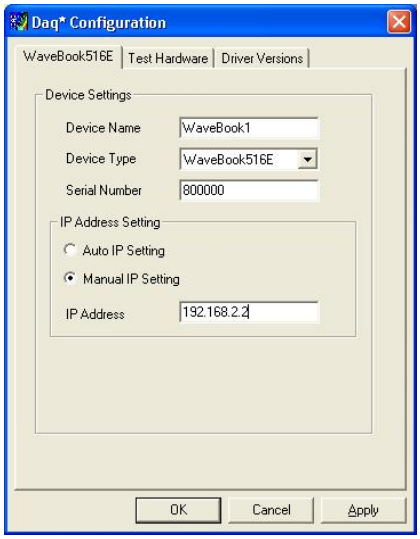
a. Enter the **Serial Number** of the first-level device (DaqBook/2000E, or WaveBook/516E). In the following screen shots the Serial Number is 800000.

b. Select the "**Auto IP Setting**" radio button. Note that the IP Address of the DaqBook/2000E, or the WaveBook/516E will automatically be calculated and displayed in the IP Address field as indicated in the following left-hand figure.

c. Click the <**OK**> button.



For DEDICATED Networks



For LAN with DHCP Server Networks

Daq* Configuration, Properties Dialog Boxes

Note: The above images are based on WaveBook/516E. We could similarly have DaqBook/2000E selected.

Users of LAN with DHCP Server Networks follow these 3 steps.

The *DaqIPConfig* applet provides the Serial Number and the IP Address of the device. Users of LAN with DHCP Server Networks will need to enter both numbers in the *Daq* Configuration, Properties* dialog boxes (previous right-hand figure). Page 2-17 includes instructions for accessing *DaqIPConfig*.

If needed, refer to the upper right-hand figure in regard to radio-button and data entry locations.

a. Enter the base 10 version of the **Serial Number** of the DaqBook/2000E or WaveBook/516E, as applicable.

b. Select the "**Manual IP Setting**" radio button.

c. In the **IP Address** field, enter the IP address.

d. Click the <**OK**> button.



Partial View of DaqIP Config
Showing IP Addresses & Serial Numbers

Provide your network administrator with the information on the device's MAC label. Also, find out from the administrator if the IP Address will be changing. If so, see if you can obtain a permanent IP Address dedicated specifically to your device.

4. Test the system connections.

a. Make sure the device has been properly installed and is powered-on.

b. Make sure all cables are properly and securely connected.

c. Click the "**Test Hardware**" tab.

d. Click the <**TCP/IP Test**> button. This tests the Transmission Control Protocol / Internet Protocol.
The TCP/IP test results have two components: *Pinging Device and TCP Connection*. *Appendix B, TCP/IP and Resource Tests*, includes a brief explanation of each.

e. Upon completion of the TCP/IP test, click the <**Resource Test**> button.
The Resource Test consists of two components: *Resource Tests* and *Performance Tests*. *Appendix B, TCP/IP and Resource Tests*, includes a brief explanation of each.



When testing a WaveBook or DaqBook device, if the unit does not respond within 30 seconds perform the following steps:

1) reboot the system
2) upon power-up, re-open the *Daq* Configuration* applet
3) select another configuration setting
4) reinitiate the test

This completes the procedure for connecting a DaqBook/2000E or WaveBook/516E to the Ethernet. At this point you should refer to other sections of the manual, e.g., pinouts, information on system expansion, and data acquisition.



Reference Notes:
Depending on your application and system setup, related information can be found in the following sources:

- The *DBK Options Manual* (p/n 457-0905).
- The *WBK Options Manual* (p/n 489-0902).
- The *Programmer's Manual*, (p/n 1008-0901).

Note: You can access PDF documents directly from the opening screen of the data acquisition CD via the <**View PDFs**> button.

Adding WBK Option Cards

Detailed information regarding WBK option cards is included in the *WBK Option Cards and Modules User's Manual* (p/n 489-0902). For WaveBook/516E, selected WBK card options must be installed at the factory. For other WaveBook models, the WBK30 card option can be installed by the user; however, other option cards must be factory-installed.



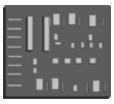
Important Notice! WaveBook/516E Users

WBK option cards for WaveBook/516E are installed at the factory per customer order. Users are not to remove or install cards for these products as the cards are not "plug-and-play" for these devices and erroneous signal values could result. If you desire to remove or add a card to WaveBook/516E contact the factory or your service representative.



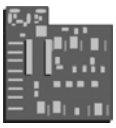
Important Notice! WaveBook/516, /516A, /512A, and WBK10A Users

With exception of the WBK30 option, WBK option cards for WaveBook/516, /516A, /512A, and WBK10A are installed at the factory per customer order. Users are not to remove or install cards for these products [other than WBK30 series cards] as the cards are not "plug-and-play" for these devices and erroneous signal values could result. If you desire to remove or add a card to these products, contact the factory or your service representative.



WBK11A

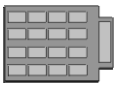
8-Channel Simultaneous Sample & Hold Card. Note that configurations are controlled by software. There are no hardware settings.



WBK12A and WBK13A

WBK12A: Programmable Low-Pass Filter Cards (8 channels each)
WBK13A: Programmable Low-Pass Filter Card with SSH (8 channels each)

Note that configurations are controlled by software. There are no hardware settings.



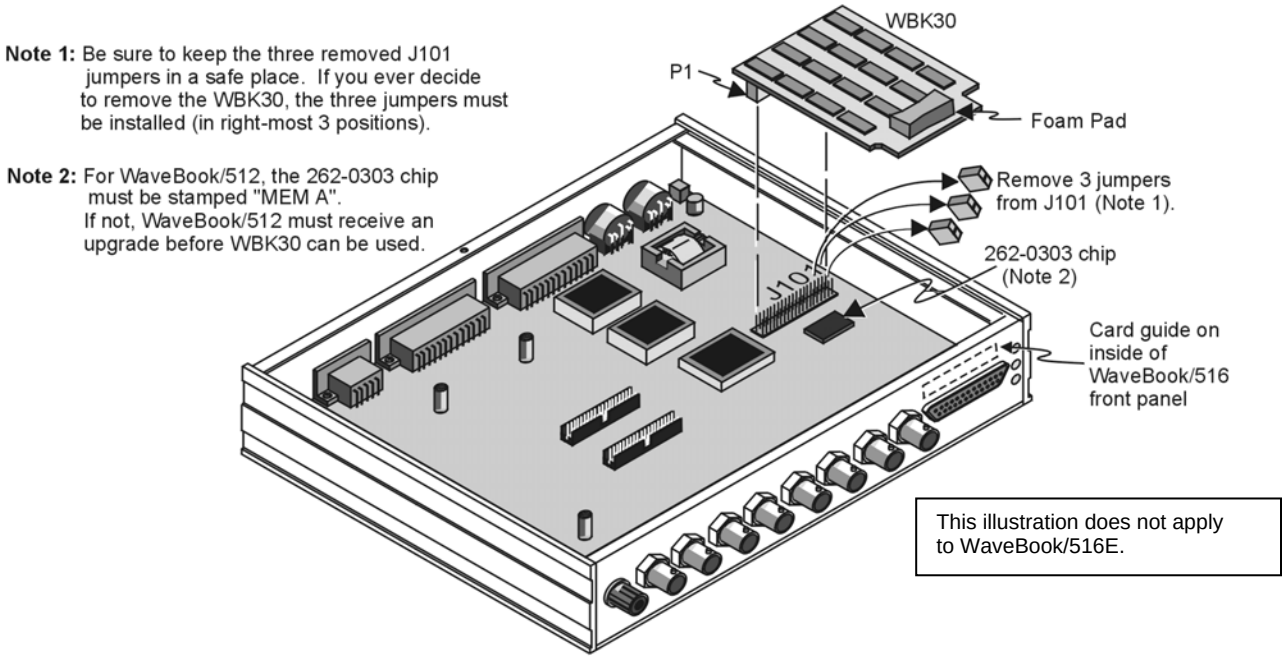
WBK30

WBK30 is a DRAM-based memory board option that can be installed inside a WaveBook. There are three models of WBK30 available; each significantly increases the capacity of a WaveBook's standard data buffer of 64 K samples. Capacities are as follows:

WBK30/16 — 16 MB
WBK30/64 — 64 MB
WBK30/128 — 128 MB

The WBK Option Cards and Modules section of Chapter 3 shows the WBK30 installation location.

Note: For WaveBook/516E the WBK30 option, if selected, must be factory installed.



WBK30 Location

Reference Note:
Refer to the *WBK Option Cards and Modules User's Manual* (p/n 489-0902) for WBK30 installation details. A PDF version of the document is included on the data acquisition CD.

Important Notice to WaveBook/516E Users!

WBK option cards for WaveBook/516E are installed at the factory per customer order. Users are not to remove or install cards for WaveBook/516E. If you desire to remove or add a card to a WaveBook/516E, contact the factory or your service representative.

Adding WBK Modules

Option Modules

Several WBK option modules are currently available for use with WaveBook systems. This section is concerned with how the modules are connected and powered.

Reference Note:
WBK module functions and specifications are discussed in the *WBK Option Cards and Modules User's Manual*, p/n 489-0902. A PDF version of the document is included on your data acquisition CD.



WBK10A
8-Channel Analog Expansion Module



WBK14
8-Channel Dynamic Signal Conditioning Module



WBK15
8-Channel 5B Signal Conditioning Module



WBK16
8-Channel Strain-Gage Module



WBK17
8-Channel Counter-Input Module with Quadrature Encoder Support. This module can only be used with WaveBook/512A, /516, 516A, and /516E.



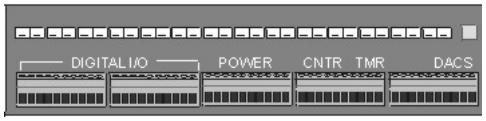
WBK18
8-Channel, Dynamic Signal Conditioning Module with Transducer Electronic Data Sheet support (T.E.D.S).



WBK25
10/100BaseT Ethernet Interface Module, includes three Expansion Ports that can attach to any model of WaveBook, DaqBook, WBK40 Series option, or any combination of these devices.



WBK40
14-Channel Thermocouple Input Module with Mini-T/C Connectors.



WBK41
Multi-Function I/O Module with: 14 thermocouple channels, 40 Digital I/O Lines, 4 Counter Inputs, 2 Timer Outputs, and an option for 4 Analog Channel Outputs.

Modules Currently Available for WaveBook System Expansion

Examples of various setups follow shortly.

Power requirements can vary greatly from one WaveBook system to another, and will need to be calculated on a system by system basis, before power is applied to the system. This chapter includes instructions for calculating power requirements.

Before discussing how to calculate power, we will look at the use of connectors and the types of cables used.

Connectors and Cables

To attach a module, connections must be made for power, expansion control, and expansion signals. The relevant connectors [located on the WBK Modules] are as follows:

- **POWER IN** – DIN5, connects to a 10 to 30 VDC source. When in a power *daisy-chain*, POWER IN connects to the previous WaveBook or WBK module's POWER OUT.
- **POWER OUT** – DIN5, can be connected to the next module's POWER IN, providing the 5 amp current limit will not be exceeded. It may be necessary to use a supplemental power supply. Power requirements and discussed in the following pages.
- **EXPANSION CONTROL OUT** – HD15, connects to the next module's EXPANSION CONTROL IN.
- **EXPANSION SIGNAL IN** – BNC, connects to the next module's EXPANSION SIGNAL OUT.
- **Additional Connectors on WBK25 Ethernet Module Only**:
  - **ETHERNET** – Connects to a PC's 10/100BaseT Ethernet port, or to a 10/100BaseT Ethernet network.
  - **EXPANSION PORT** (1, 2, & 3) – DB25, provides a means of connecting up to three WaveBook or WBK40 Series devices.



Prior to connecting your devices to power, calculate your system's power requirements as discussed in upcoming section of this chapter. Note that examples of system setups follow shortly.

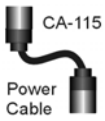


CE Compliance

If your WaveBook system needs to be CE Compliant refer to the *Declaration of Conformity* for each system component. Also, refer to Chapter 6, *CE Compliance and Noise Considerations*.

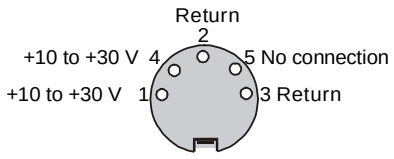
Associated Cables

CA-35-12 (1 foot), CA-35-2 (2 foot), and CA-35-6 (6 foot) DB25 Male to DB25 Female Parallel Cables. These cables are used to connect the parallel port of one device to that of another. They are typically used to connect a WaveBook's "TO COMPUTER" port (PARALLEL PORT) to the EPP connector of the host PC.



CA-115 Power Cables. CA-115 cables are 6 inches long and have two 5-pin male DIN connectors. CA-115s are frequently used to link WaveBook's POWER OUT connector to a WBK expansion module's POWER IN connector. CA-115 cables are also used to link an expansion module's POWER OUT connector to the next daisy-chained module's POWER IN connector.

CA-115 cables and the device DIN5 connectors (see following figure) are limited to 5 amps at 15 VDC.



DIN 5 Power Pinout*

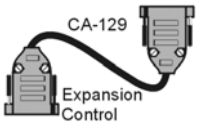
Power is supplied to WaveBook modules via a DIN5 type connector located on the rear panel of the device.

*The DIN5 pinout [to the left] is based on an external view of a WaveBook rear panel.

Note: An optional **CA-116** power cable is available. The CA-116 permits the system to be plugged into a vehicle cigarette lighter, allowing use of the vehicle's battery as a power supply for the WaveBook device.



Calculate system amp load prior to creating a system daisy-chain. Although WaveBook device connectors and CA-115 and CA-116 power cables have 5 amp limits, TR-40Us are limited to 2.2 amps. Tables for determining amp load are provided in the following section, *Calculating the System Power Requirement.*



CA-129 Expansion Control Cables. Control messages are carried by CA-129 expansion-control cables with HD-15, plug and socket connectors. The first expansion unit's control input is driven from the main unit's control output. Control inputs of additional WBK modules are driven from the preceding unit's control output.



CA-150 Expansion Signal Cables. Expansion signals are carried by a CA-150-1 male BNC to male BNC coaxial cable. Each WBK module drives a common analog bus that carries the signals to WaveBook's Analog-to-Digital Converter (ADC). Each WBK module has EXPANSION SIGNAL IN and EXPANSION SIGNAL OUT connectors for daisy-chaining multiple units.

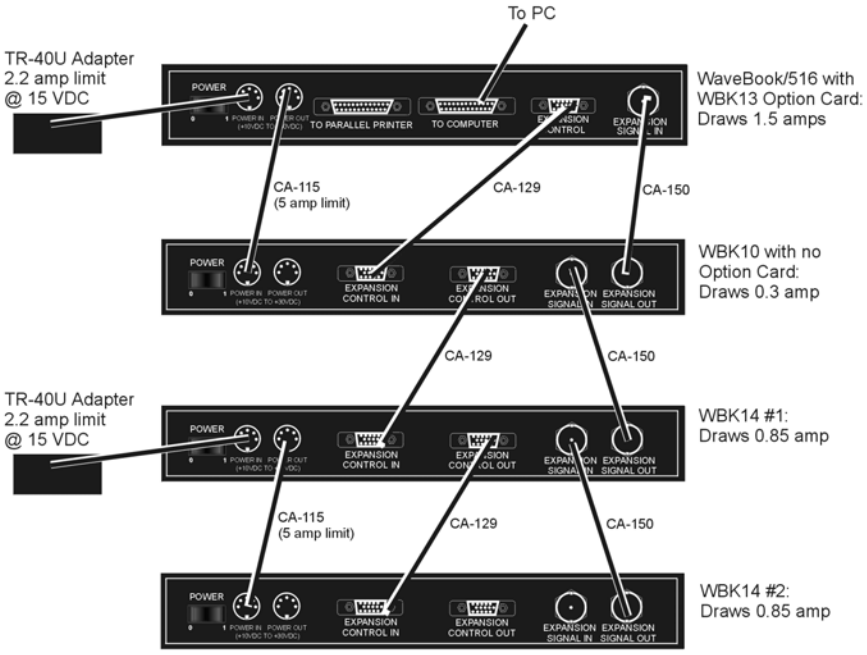
CA-177 Strain Gage Cables. CA-177 is an optional set of eight strain-gage cables intended for use with the eight channels of WBK16. Discussions of the CA-177 strain-gage cable and bridge applications are contained in the WBK16 document module.

CA-217 Digital Expansion Cables. These 8-inch cables are used for connecting one or more WBK17s to a WaveBook/512A, /516, /516A, or /516E. The CA-217 cable has a DB25M connector for Digital Expansion Out and a HD26M connector for Digital Expansion In. (See the following page, second figure).

CA-242 and CA-242-7 Ethernet Patch Cables. CA-242 is a 1.5 foot cable that can be used to connect a WaveBook/516E to an Ethernet port on a PC or network. CA-242-7 is a 7-foot cable that can be used for the same purpose.

CA-74-1 and CA-74-5 SYNC Cables. 1-foot and 5-foot cables [respectively] used to synchronize up to four "A" and/or "E" Series devices. The total combined SYNC cable length is not to exceed 15 feet (4.57 m).

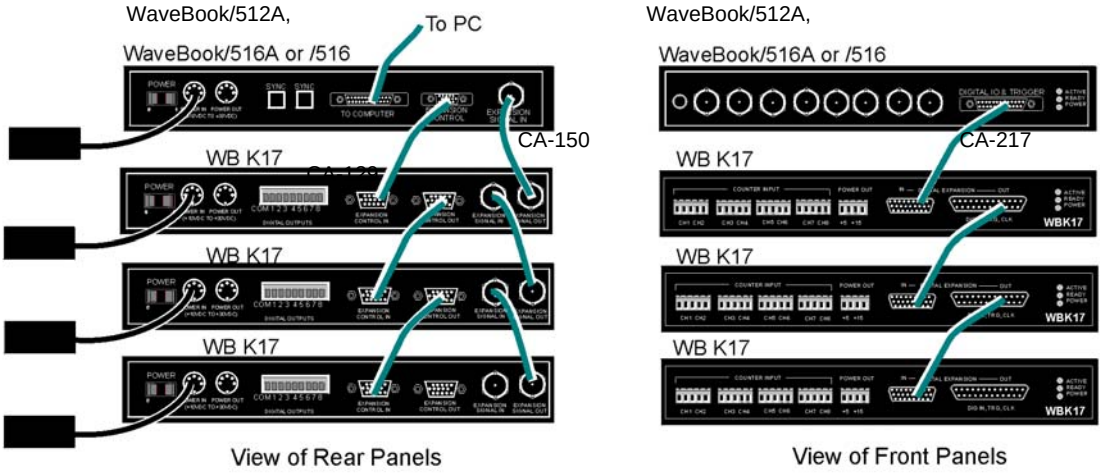
The Daisy-Chain Concept



WaveBook System drawing 4.5 amps.
Although this system is under the 5 amp current limit of the power connectors [and of the CA-115 Power Cable] the 4.5 amps exceeds TR-40U 2.2 amp limit. For this reason the WBK14 modules are receiving power from an additional TR-40U.

Reference Note:
For information regarding calculating system power requirements, refer to the upcoming section entitled, *Connecting the System to Power*.

Reference Note:
Refer to Chapter 3 for additional system examples.



Example of a WaveBook Daisy-Chain with three WBK17 Modules

How Channel Numbers are Determined

The analog input channel numbers are determined by the order of connection among the WaveBook and attached WBK modules.

- Channel 0 is the WaveBook's 8-bit digital I/O port.
- Channels 1 through 8 are the WaveBook's main channels.
- Channels 9 through 16 are located on the first expansion unit connected directly to the WaveBook.
- Additional channel numbers are added consecutively (in groups of 8) with each added WBK module (see table at right).

Unit*	Channel #
WaveBook	0 (dig I/O)
WaveBook	1-8
1st WBK	9-16
2nd WBK	17-24
3rd WBK	25-32
4th WBK	33-40
5th WBK	41-48
6th WBK	49-56
7th WBK	57-64
8th WBK	65-72

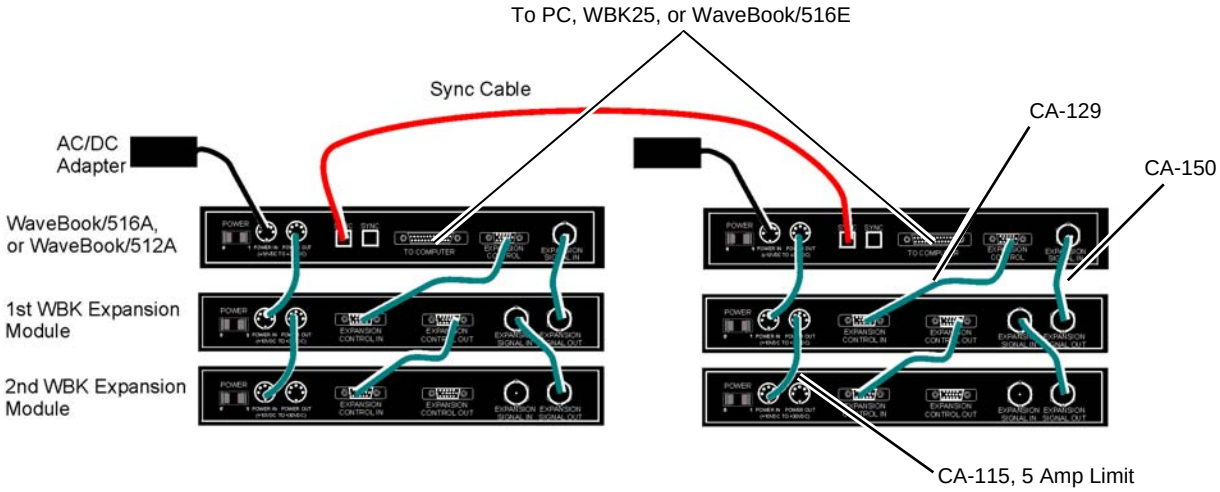
* WBK in the "Unit" column refers to a module such as a WBK10A, WBK14, WBK15, WBK16, WBK17, WBK18. Note that as this document goes to print the channel numbering method has not been determined for the WBK40 and WBK41 modules.

Scan Synchronization

Up to four “A” and/or “E” Series WaveBooks can be *scan-synchronized* and *triggered* from any other WaveBook (A or E Series) that is connected via a SYNC cable. Note that the two SYNC connectors [on each WaveBook] are identical. Either one, or both, can be used to connect to other WaveBooks.

Note that chapter 3 includes additional system examples that make use of scan-synchronization.

Up to four units can be synchronized. The total combined length of the SYNC cables is not to exceed 15 feet (4.57 m).



Synchronizing two WaveBook Systems, each having two Expansion Modules

Reference Notes:

- Chapter 3, System Examples includes various system setups that make use of the synchronization feature.
- The *Triggers* section of Chapter 4, *WaveBook Operation Reference*, contains a subsection regarding synchronization.

Calculating the System Power Requirement

CAUTION

An incorrect use of power can damage equipment or degrade performance. Prior to connecting your devices to power, calculate your system's power requirements.

CAUTION

Do not daisy-chain the power connections of more than three WBK10A modules. Daisy-chaining a power connection to a fourth module will exceed the power connector's 5 amp current limit.

It is important to supply your system with adequate, reliable power. For this reason, you need to know your system's power requirement. Computing power use is also important when using batteries to power modules, as you will need to know a safe runtime before recharging is required.

The following statements relate to system power. They should be reviewed before proceeding.

- **Higher voltages draw fewer Amps for the same power. Remember: Watts = voltage x current (W = V*I).**
- **The TR-40U power adapter provides power that is sufficient for the WaveBooks and WaveBook modules. You do not need to make power requirement calculations unless you intend daisy-chaining units, or you have a critical battery runtime.**
- **Do not overload your power supplies. TR-40U power adapters are limited to 2.2 amps. However, you can use more than one TR-40U, as indicated in one of the upcoming daisy-chain examples.**
- **Current drawn from other sources, such as car batteries, can be estimated from the following *WaveBook Product Current Requirements* table.**

Use the current requirements and worksheet tables to calculate your system's total power requirement. Take the appropriate amperage values from the first table to fill in the second table; then perform the indicated multiplication and addition operations to calculate the amperage for all units in your system.

WaveBook Product Current Requirements (in Amps)					
Products and Product Combinations	**DBK30A 14 VDC**	**DBK30A 28 VDC**	**DBK34A 12 VDC**	**DBK34A 24 VDC**	**TR-40U 15 VDC**
WaveBook/516 (alone) WaveBook/516A (alone) WaveBook/512A (alone)	1.00	0.50	1.20	0.60	1.00
WaveBook/516E (alone)	1.80	1.0	2.2	1.1	1.7
WBK10A (alone)	0.35	0.17	0.42	0.20	0.35
WBK11A	0.27	0.10	0.32	0.16	0.22
WBK12A	0.47	0.23	0.56	0.27	0.45
WBK13A	0.57	0.28	0.68	0.33	0.50
WBK14 Note 5	0.90	0.50	1.08	0.53	0.85
WBK15 without 5B modules	0.13	0.08	0.16	0.09	0.12
WBK15 (typical) Note 1	0.24	0.13	0.29	0.15	0.23
WBK15 (max) Note 2	0.75	0.36	0.90	0.44	0.75
WBK16 (no excitation)	1.08	0.52	1.30	0.61	1.00
WBK16 (full excitation)	1.80	0.87	2.10	1.00	1.67
WBK16/SSH	1.20	.60	1.44	0.70	1.20
WBK17 (alone)	0.52	0.31	0.62	0.36	0.52
WBK17 with 1 encoder Note 3	0.56	0.33	0.67	0.38	0.56
WBK17 with 2 encoders Note 3	0.61	0.35	0.73	0.41	0.61
WBK17 with 3 encoders Note 3	0.65	0.38	0.78	0.44	0.65
WBK17 with 4 encoders Note 3	0.70	0.40	0.84	0.47	0.70
WBK18	1.40	0.75	1.60	0.80	1.30
WBK25	0.71	0.40	0.83	0.42	0.67
WBK30	0.01	0.005	0.01	0.006	0.01
WBK40 (alone) & w/o DBK46	0.50	0.30	0.58	0.29	0.46
WBK40 (max) Note 4	1.64	0.90	1.92	0.96	1.53
WBK41 (alone) & w/o DBK46	0.50	0.30	0.58	0.29	0.46
WBK41 (max) Note 4	1.64	0.90	1.92	0.96	1.53

Note 1: Typical with 8 voltage modules.

Note 2: Maximum load with 8 strain-gage modules. You may need to consult power specifications for individual 5B modules and for any excitation currents required.

Note 3: Assumes 0.500 W per encoder.

Note 4: Assumes 8 DBK84 modules attached to P1 and no DBK46 installed.

Note 5: Assumes no transducer current is supplied.

Worksheet for Power Requirements					
Product	**Qty**	×	**Amps**	=	**Totals**
WaveBook/512A		×		=	
WaveBook/516 /516A		×		=	
WaveBook/516E					
WBK10A		×		=	
WBK11A		×		=	
WBK12A		×		=	
WBK13A		×		=	
WBK14		×		=	
WBK15		×		=	
WBK16		×		=	
WBK17		×		=	
WBK18		×		=	
WBK25		×		=	
WBK30		×		=	
WBK40		×		=	
WBK41		×		=	
				Maximum Amps	

It is important to supply your system with adequate, reliable power. For this reason, you need to know your system's power requirement. Knowing the power requirement is also important when using batteries to power modules, as you should know a safe *runtime*, i.e., how long you can run the system before recharging is required.

Input voltage to the WaveBooks and to the system modules (WBK10A, WBK14, WBK15, WBK16, WBK17, WBK18, WBK25, WBK40, and WBK41) must be in the range of 10 to 30 VDC and can come from an AC-to-DC adapter or from another source, such as a battery. System cards such as theWBK11A, WBK12A, or WBK13A get power from their host WaveBook or the WBK10A expansion module.

Available AC-to-DC adapters include the TR-40U, which has an input of 90-264 VAC and an output of 2.2 amps @ 15 VDC.

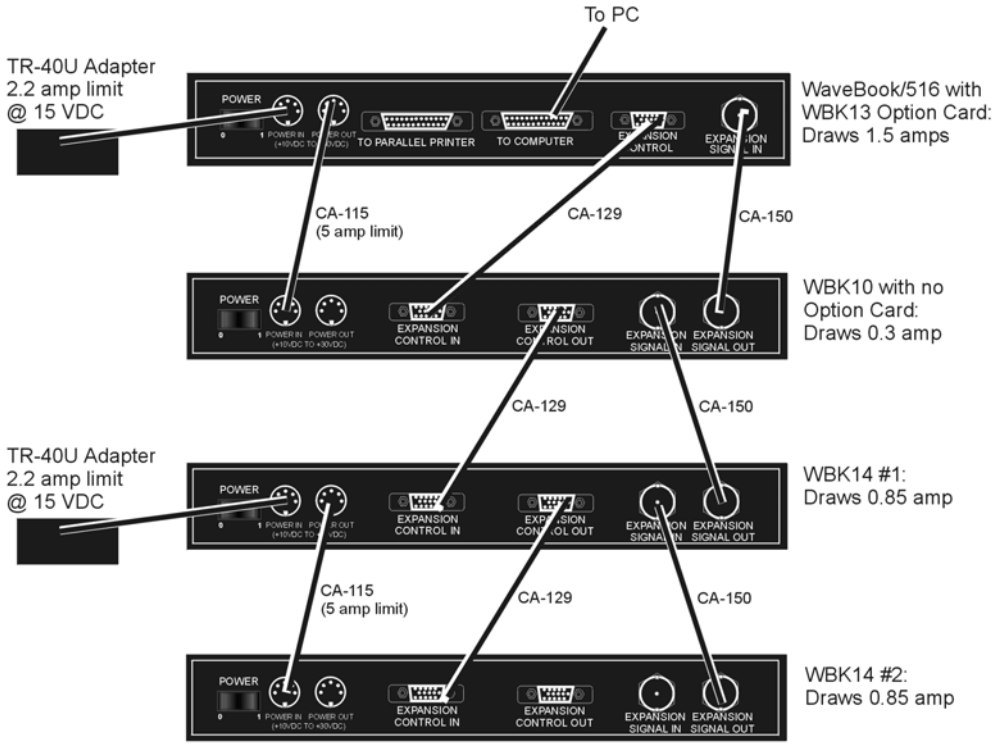
Battery options include the DBK30A, DBK34A, and other 10 to 30 VDC sources, such as car batteries. The DBK30A provides 14 VDC and when fully-charged has a storage capacity of 3.4 A·hr; car batteries have much higher capacities. The basic formula for battery life is:

Runtime (hr) = Battery capacity (A·hr) / Current load (A)

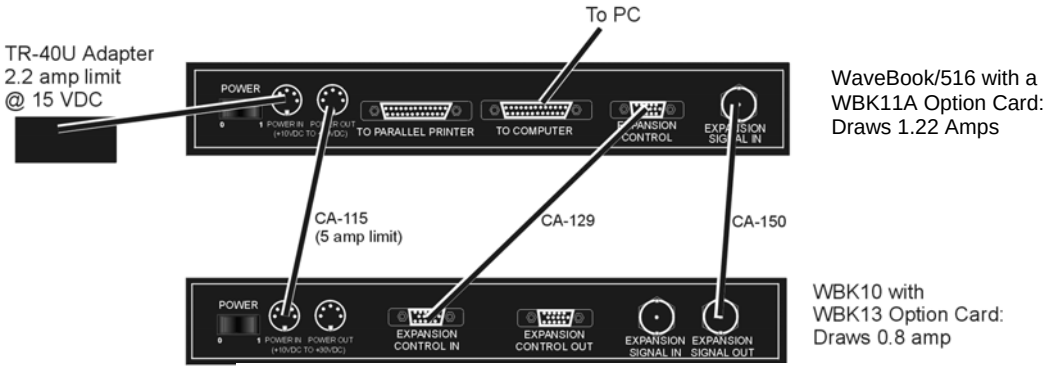


Battery life and performance depend on various factors including battery type, condition, charge level, and ambient temperature. Be sure you consider these factors, especially when runtime is a critical.

System Power, Examples



WaveBook System drawing 4.5 amps.
Although this system is under the 5 amp current limit of the power connectors [and of the CA-115 Power Cable] the 4.5 amps exceeds TR-40U 2.2 amp limit. For this reason the WBK14 modules are receiving power from an additional TR-40U.



WaveBook System Drawing 2.02 Amps

Reference Note:
Although the preceding two examples make use of one or more TR-40U power adapters, other power sources can be used. These options are discussed in the following section, *Power Supplies.*

Power Supplies

The power supplies that can be used with WaveBook setups are listed in the following table.

WaveBook Product Power Supplies		
Item	**Name/Description**	**Capacity**
TR-40U	AC Power Adapter (shipped with WaveBooks & WBK Modules)	90-264 VAC input; 2.2 A @ 15 VDC
DBK30A	Rechargeable Battery/Excitation Module (optional)	12-14 VDC, or 24-28 VDC 3.4 A-hr @ 14 VDC
DBK34A	UPS (uninterruptible Power Supply)/Battery Module (optional)	12 VDC, or 24 VDC 5.0 A-hr @ 12 VDC
Other	10 to 30 VCD source, such as a vehicle battery via a CA-116 cable.	Depends on source

DBK30A - Rechargeable Battery Module



DBK30A Front Panel

DBK30A contains two rechargeable nickel-cadmium batteries for use with WaveBook, expansion WBK modules, and transducers. DBK30A shares the same base dimensions as other WaveBook products, allowing for convenient stacking. Note that stacking can be easily accomplished with the included splice plates.

The power adapter (included) converts AC power to 24 VDC for charging DBK30A's two battery packs. Automatic charging circuits recharge the internal batteries quickly and safely. The charged battery runtime depends on the current load and mode of operation.

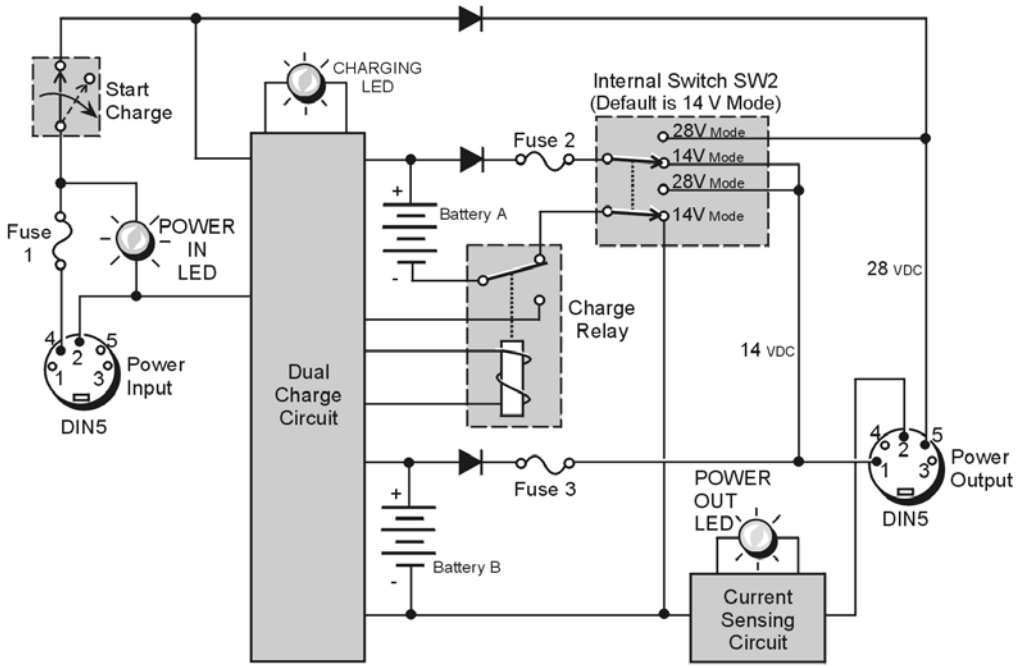
An internal slide switch (SW2) determines the unit's mode. The two modes are:

- 14 VDC Mode (default)
- 28 VDC Mode



You should check the power requirements of each component in your system, and then verify that the power source can provide sufficient power to meet your runtime requirements.

Fully charge DBK30A's batteries before use.



DBK30A Block Diagram

14 VDC Mode (*default*)

This mode provides 14 VDC for 3.4 A-hr. The typical battery runtime is from 3 to 6 hours depending on the load. Unless 28 VDC is required, the 14 VDC mode should be used in WaveBook and WBK applications,

Unless you need 28 V, leave the unit in the 14 VDC mode. Use of the 28 VDC mode results in a lower runtime, as only one battery pack can be used for 14 VDC. When in the 14 VDC mode, both packs are used in parallel, resulting in a longer runtime for the same application.

28 VDC Mode

The 28 VDC mode actually provides *both* 14 VDC *and* 28 VDC. Loop currents for two-wire, 4-20 mA transmitters (1.7 A-hr) require 28 VDC. The battery run-time ranges from 1 to 6 hours, depending on system configuration. In this mode, 14 VDC is used for unregulated bridge excitation (for bridge-configured sensors, such as load cells), and power to WBK expansion products.

Unless you need 28 V, leave the unit in the 14 VDC mode. Use of the 28 VDC mode results in a lower runtime, as only one battery pack can be used for 14 VDC. When in the 14 VDC mode, both packs are used in parallel, resulting in a longer runtime for the same application.

Hardware Setup

Configuration

The only configuration option is the choice of modes (14 VDC, or 28 VDC). If you do not need 28 V, leave SW2 in the default position.

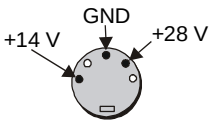
If you are using a pre-owned DBK30A, or are unsure of the mode selected, use the following steps to check SW2's position. Note that new units are always shipped with SW2 selected to the 14 VDC mode.

Internal switch SW2 is located on the printed circuit board, near the front center of the unit. To change or verify the mode:

1. Remove DBK30A's cover by removing one screw and sliding the cover forward until it separates from the module.
2. Look near the front center of the circuit board and locate slide switch SW2.
3. Check SW2's selection. The silkscreen indicates the 14 and 28 VDC positions.
4. Change the selection, if required. If you do not need 28 V, SW2 should be in the default position (14 VDC).
5. Replace the top cover, and secure with screw.

Power

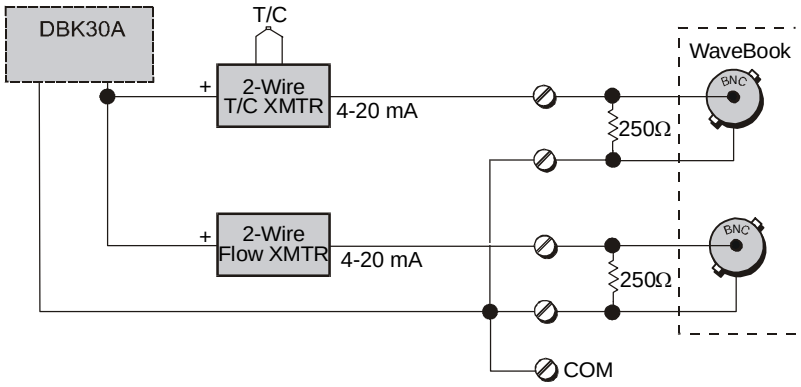
Connection. The figure shows the pinout for the POWER OUT DIN5 connector. The 28 V pin is only active in the 28 VDC mode; however, the 14 V pin is active regardless of the mode selected.



DIN5 Power Out

The CA-115 cable connects to DBK30A's POWER OUT connector and WaveBook's POWER IN connector. The cable can be used to daisy-chain a DBK30A unit to a WBK expansion module.

28 VDC Mode. The primary purpose of the 28 VDC mode is to provide power for external loop transmitters. The hookup is simple, as shown below.



Connecting Loop Transmitters

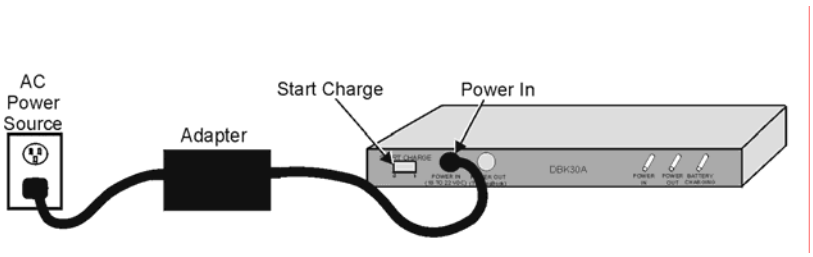
Another use of the 28 VDC mode is to provide excitation for bridge-type sensors, such as load cells (strain gages) and other devices that may be attached to 5B modules inside a WBK15.



Excitation voltage from DBK30A is not regulated by the unit, and must therefore be regulated externally. For most load cells, excitation voltage should be regulated to 10 V.

Charging. To charge the DBK30A batteries:

1. Connect the adapter to DBK30A's POWER IN connector.
2. Plug the adapter into the AC power receptacle.
   Note that the charge cycle will begin automatically whenever AC power is applied after an interruption. The charge cycle will automatically end when the batteries are fully charged.



Charging DBK30A's Batteries

3. To manually initiate a charge cycle, press the START CHARGE momentary rocker-arm switch. Note that subsequent charge cycles applied to a fully-charged DBK30A will have no ill effect. The module will sense the fully-charged status and revert to the trickle-charge state within a few minutes.

Three LEDs on the DBK30A provide status information on the charging process or the external load.

LED Indicators & Descriptions	
POWER IN	Indicates the charger is connected to a source of AC power and to the battery module.
BATTERY CHARGING	Steady Light - Indicates the battery is in the high-current (2 A) charge mode. Flashing - One or two flashes at a time indicates the batteries are fully charged.
POWER OUT	Indicates power is flowing out to an external device, such as a WaveBook product.

CAUTION

Periodically, fully discharge the DBK30A to inhibit "lazy chemistry" (memory) in the nickel-cadmium cells. To manually discharge a battery pack, connect a WaveBook to the pack and leave it powered-on until the indicator lights go out.

Use While Charging. Both operating modes are capable of powering the WaveBook products while being charged; however, the charging current is reduced, and charging time is increased. If AC power is interrupted, a new charge cycle will begin automatically when AC power returns.

CAUTION

Even with the AC adapter, the batteries will eventually discharge under a WaveBook operating load. Charging DOES NOT BEGIN AUTOMATICALLY (except on power-up). You must manually initiate the next charge cycle. Do not expect a WaveBook powered by a DBK30A to operate as an uninterruptible power supply.

Stacking Modules

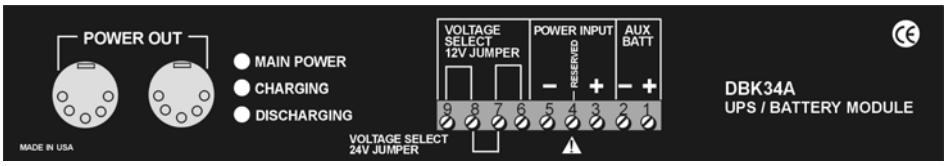
Stacking can be accomplished with splice plates, as discussed earlier in the chapter.

DBK30A Battery Module - Specifications

Name/Function: Rechargeable Battery Module
Battery Type: Nickel-cadmium
Number of Battery Packs: 2
Battery Pack Configuration: 12 series-connected sub-C cells
Output Voltage: 14.4 V or 28.8 V (depending on the selected mode)
Output Fuses: 2 A
Battery Amp-Hours: 3.4 A-hr (1.7 A-hr/pack)
Charge Termination: Peak detection
Charge Time: 2 hours
Charging Voltage from Supplied AC Adapter: 22 to 26 VDC @ 2 A
AC Adapter Input: 95 to 265 VAC @ 47 to 63 Hz
Size: 221 mm × 285 mm × 35 mm (11" × 8-1/2" × 1-3/8")
Weight: 2.4 kg (6 lb)

DBK34A Vehicle UPS/Battery Module

DBK34A is similar to DBK34 in appearance and operation; but there are differences. Before proceeding with this section, verify that your device is a DBK34A. If your device does not have the "A" suffix, use the preceding section regarding the DBK34 Vehicle UPS Module instead of this section.



DBK34A Front Panel

The DBK34A can power a data acquisition system in portable or in-vehicle UPS applications (both 12 V and 24 V systems). Power storage capacity is 5 A-hr @ 12 VDC or 2.5 A-hr @ 24 VDC.

For reliable data acquisition in a vehicle, the DBK34A provides clean and consistent operating power:

- Prior to engine/generator start
- During engine start-up (battery sag due to the high-current demand of starter motor and solenoid)
- After engine turn off.
- Before and after connection to the vehicle

The DBK34A contains two sealed-lead rechargeable batteries (Gel-Packs), associated charging circuits and current indicators. Typically, these batteries can last more than 500 full cycles and up to 10 years standby lifetime at room temperature. Recharging is fast, and extreme temperature performance is good. The DBK34A can be used with the LogBook, DaqBook, WaveBook, and related DBKs and WBKs. The unit's rugged metal package has a compatible 8×11" footprint for convenient stacking with Velcro tabs and optional splice plates and handles for carrying.

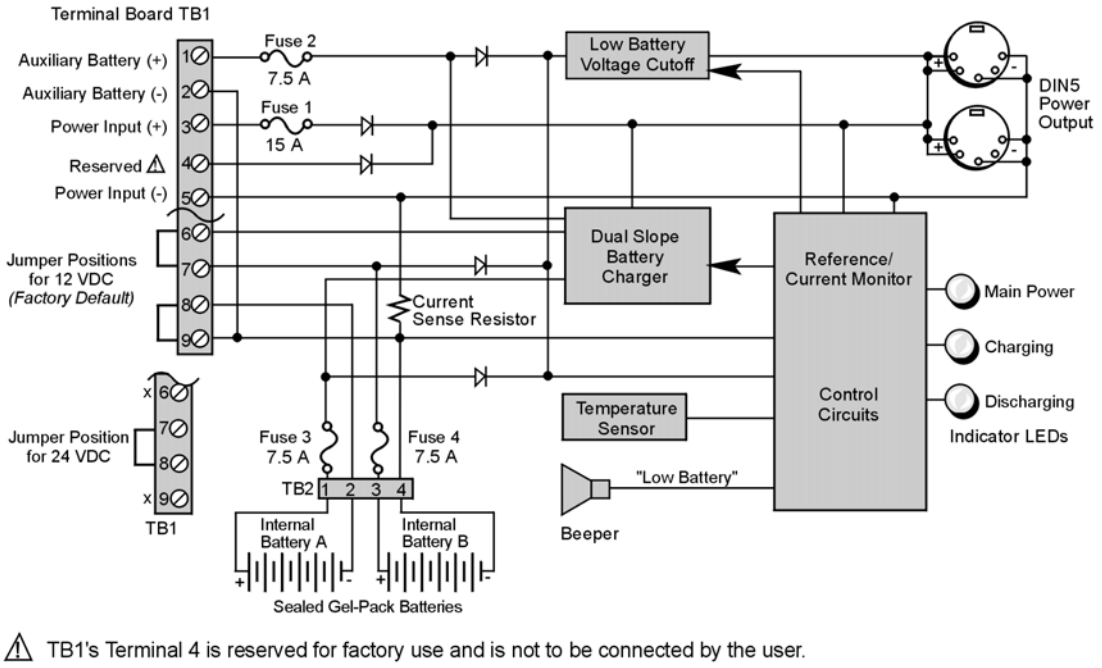
Main and auxiliary power input comes from 12 or 24 VDC via a terminal block on the unit's front panel (12 or 24 V modes are set by front-panel jumpers). Automatic, temperature-compensated charging circuits recharge the internal batteries quickly and safely. For trouble-free operation, you must fully charge the batteries before use. The charged battery runtime will depend on the load and mode of operation.

During use of the internal batteries, the Charging LED blinks and a beeper sounds when battery life is almost exhausted. Within a few minutes, internal cutoff circuits disconnect the load from the batteries to prevent the possibility of deep-cycle damage.

Note: Current protection is provided by four fuses. Two 7.5A fuses for the unit's internal batteries, one 7.5 A fuse for an auxiliary (external) battery, and a 15 A fuse for the power input.

You can use a CA-172 cable to connect a vehicle battery (via a cigarette lighter) to the DBK34A terminal board. The cable is six feet long, contains a cigarette lighter adapter at one end, and stripped leads (for terminal connection) at the other.

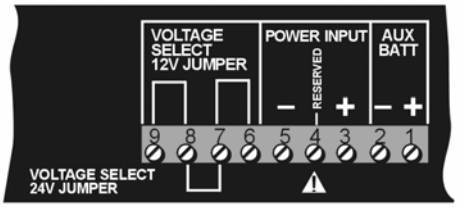
For trouble-free operation, fully charge the batteries before use. Charged battery runtime depends on the load and on the mode of operation.



DBK34A Block Diagram

Hardware Setup

Configuration for 12 Volt (Default) or 24 Volt Operation



DBK34A's Screw Terminal Board, TB1

DBK34A's screw terminal numbers read from right to left (9,8,7…3,2,1) when viewed from the front panel (see figure).

For 12 Volt Operation:

1. Remove jumper from terminals 8 and 7, if present.
2. Use a jumper to short terminals 9 and 8
3. Use a jumper to short terminals 7 and 6

For 24 Volt Operation:

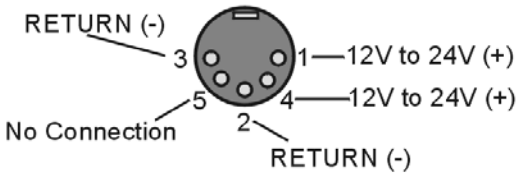
1. Remove jumpers from terminals 9 and 8, if present
2. Remove jumpers from terminals 7 and 6, if present.
3. Use a jumper to short terminals 8 and 7.

Power

Power In (12 or 24 VDC only).

- Connect MAIN POWER INPUT (+) positive to Terminal 3 of TB1.
- Connect MAIN POWER INPUT (-) negative to Terminal 5 of TB1.
- TB1's Terminal 4 is reserved for factory use and is not to be connected by the user.
- The use of an optional auxiliary battery will extend run-time. For use with DBK34A, auxiliary batteries must be of lead-acid chemistry, in the 2 to 3 A-Hr range, and of the same voltage as that set by the Voltage Select Jumpers. Auxiliary batteries charge and discharge in the same manner as the internal batteries. If an auxiliary battery is to be used, connect AUX BATT (+) *positive* to Terminal 1 (of TB1), and connect AUX BATT (-) *negative* to Terminal 2 (of TB1).

Power Out. The pinout at the right applies to the two POWER OUT DIN5 connectors. The DBK34A package includes a short connecting cable to connect to the powered device. This cable connects the POWER OUT connector on the DBK34A and to the POWER IN connector on the WaveBook, LogBook, DaqBook, or WBK/DBK module.



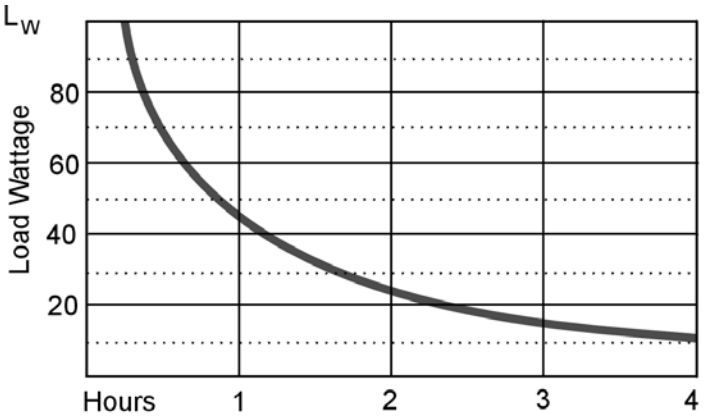
DIN5 Power Output Connector *(2 per DBK34A)*

Indicators. Three front-panel LED indicators provide power and charging status information.

LED Indicators & Descriptions	
MAIN POWER	Lights when the DBK34A power input is connected to a source of at least 12.25 VDC
CHARGING	Lights when the internal batteries are being fast-charged at a rate of 0.1 amp/cell or greater.
DISCHARGING	Lights when internal batteries (or auxiliary batteries) are discharging at a rate of 0.25A or greater.

Runtime. Approximate runtime under various loads can be computed from the storage capacity (5 A-hr in 12 V mode; 2.5 A-hr in 24 V mode) and the load (main unit and other DBKs).

The following Load Wattage vs. Hours graph is for a typical new battery that is fully charged.



DBK34 and DBK34A Load/Life Graph

Graph indicates approximate battery life under the indicated Load Wattage @ 25°C (77°F).

The following equation can be used to estimate the life of a fully charged battery for a given Load Wattage (L_W).

$$\text{Hours} \cong \frac{56 - L_W/3.33}{L_W}$$

Charging: In general, lead-acid batteries [and related Gel-Packs] require charging at 120% of drain energy (e.g., the 5 A-hr DBK34A requires a charge equal to or greater than 6 A-hr). Charging times vary; but 4 to 5 hours at 14 V is typical for a completely discharged battery; after which, charging may continue indefinitely.

Note that 16 to 18 VDC at the power input is required for optimal charging.

CAUTION

Voltage applied to a DBK34A must not exceed 30 VDC.

Environmental Concerns

CAUTION

DBK34A Gel-Pack batteries contain toxic materials (Pb and H_2SO_4). At the end of the battery life cycle (typically after 5 to 10 years of use), the Gel-Packs must be recycled or properly disposed of.

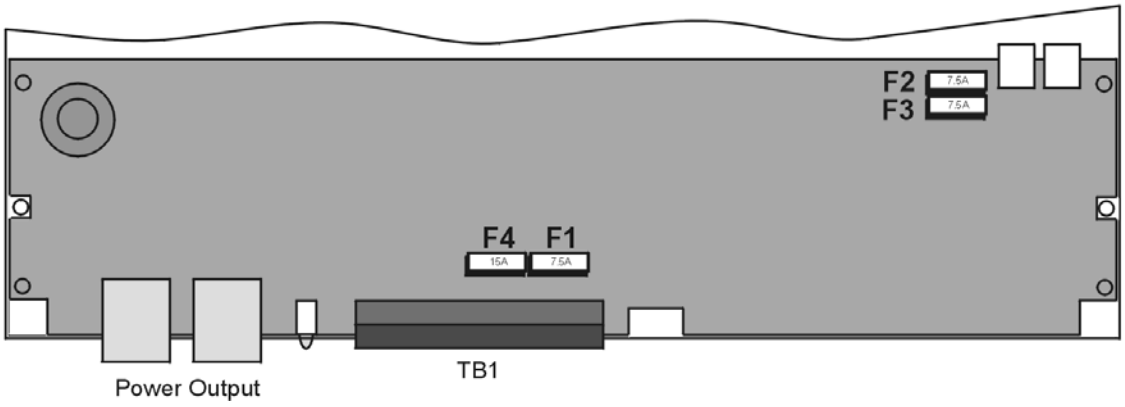
Fuse Replacement



DBK34A contains four MINI ATO fuses that can be replaced by the user. Note that you should always check your unit for blown fuses prior to sending it back to the factory for repair. This could save you time and money.

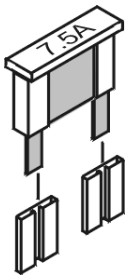
The following table indicates the probable reason that a particular fuse may have blown, and includes part numbers and fuse rating.

Fuse	Rating	Probable Cause of Blowing Fuse	Replacement Fuse
F1	7.5 A	Auxiliary Battery overload.	7.5A MINI ATO, LITTLEFUSE# 297-07.5
F2	7.5 A	Output overload.	7.5A MINI ATO, LITTLEFUSE# 297-07.5
F3	7.5 A	Output overload.	7.5A MINI ATO, LITTLEFUSE# 297-07.5
F4	15 A	Input overload.	15A MINI ATO, LITTLEFUSE# 297-015



DBK34A, Fuse Location Reference

To replace a fuse:



1. Disconnect the DBK34A from loads and from supply power.
2. Remove the DBK34A's cover plate. This requires the removal of 4 screws (2 per side).
3. Examine the fuses (F1 through F4) to see which, if any, have blown. Note that you can usually see the blown element through the fuse's transparent casing.
4. Replace the blown fuse with the appropriate replacement fuse (see preceding table). Note that the fuse value is present on top of the fuse; also, the fuses are color coded as an aid to identification.
5. Replace the DBK34A cover and secure with screws (removed in step 2).

DBK34A UPS / Battery Module - Specifications

Name/Function: Vehicle UPS Module
Battery Type: Sealed-lead rechargeable
Number of Battery Packs: 2
Battery Pack Configuration: 6 series-connected D cells
Output Voltage: 12 V or 24 V (depending on jumpers)
Output Fuses: 8 A on each internal battery (2)

Battery Capacity (Amp-Hours):
5 A-hr in 12 V mode (parallel)
2.5 A-hr in 24 V mode (series)
Operating Temperature: -20°F to 122°F (-29°C to 50°C)
Size: 8½ × 11 × 1¾ in. (216 × 279 × 44 mm)
Weight: 7.2 lb (3.27 kg)


Notes

System Examples 3

Introduction …… 3-1

Cable Review …… 3-2

Single WaveBook Systems, 4 Examples …… 3-3

Example 1: WaveBook/516E with two WBK10A Modules …… 3-3
Example 2: WaveBook/516E with a WBK17 and a WBK40 …… 3-4
Example 3: WaveBook/516A with a WBK25, WBK17, and a WBK10A …… 3-5
Example 4: WaveBook/516E with a WBK41 and 2 WBK10A Modules …… 3-6

Multiple WaveBook Systems, 2 Examples …… 3-7

Example 1: A WaveBook/516E with 3 WaveBook/516A Units …… 3-7
Example 2: Two WaveBook/516A Sub-Systems Connected via a WBK25 Module ….. 3-8

Introduction

This chapter provides examples of various single WaveBook and multiple WaveBook systems, and includes a review of the cables that are used for making various system connections.



Prior to connecting your devices to power, calculate your system's power requirements as discussed in chapter 2.

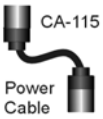


CE Compliance

If your WaveBook system needs to be CE Compliant refer to the *Declaration of Conformity* for each system component. Also, refer to Chapter 6, *CE Compliance and Noise Considerations*.

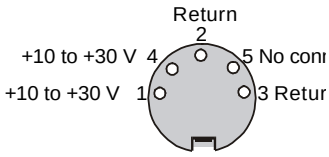
Cable Review

CA-35-12 (1 foot) and CA-35-2 (2 foot) DB25 Male to DB25 Female Parallel Cables. Either of these two cables can be used to connect the parallel port of one device to that of another. The cables are typically used to connect a WaveBook's TO COMPUTER (PARALLEL PORT) to the EPP connector of the host PC.



CA-115 Power Cables. CA-115 cables are 6 inches long and have two 5-pin male DIN connectors. CA-115s are frequently used to link WaveBook's POWER OUT connector to a WBK expansion module's POWER IN connector. CA-115 cables are also used to link an expansion module's POWER OUT connector to the next daisy-chained module's POWER IN connector.

CA-115 cables and the device DIN5 connectors (see following figure) are limited to 5 amps at 15 VDC.



DIN 5 Power Pinout*

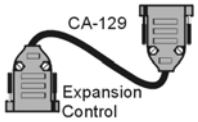
Power is supplied to WaveBook modules via a DIN5 type connector located on the rear panel of the device.

*The DIN5 pinout [to the left] is based on an external view of a WaveBook rear panel.

Note: An optional **CA-116** power cable is available. The CA-116 permits the system to be plugged into a vehicle cigarette lighter, allowing use of the vehicle's battery as a power supply for the WaveBook device.



Calculate system amp load prior to creating a system daisy-chain. Although WaveBook device connectors and CA-115 and CA-116 power cables have 5 amp limits, TR-40Us are limited to 2.2 amps. Tables for determining amp load are provided in the *Calculating the System Power Requirement* section of Chapter 2.



CA-129 Expansion Control Cables. Control messages are carried by CA-129 expansion-control cables with HD-15, plug and socket connectors. The first expansion unit's control input is driven from the main unit's control output. Control inputs of additional WBK modules are driven from the preceding unit's control output.



CA-150 Expansion Signal Cables. Expansion signals are carried by a CA-150-1 male BNC to male BNC coaxial cable. Each WBK module drives a common parallel analog bus that carries the signals to WaveBook's Analog-to-Digital Converter (ADC). Each WBK module has EXPANSION SIGNAL IN and EXPANSION SIGNAL OUT connectors for daisy-chaining multiple units.

CA-177 Strain Gage Cables. CA-177 is an optional set of eight strain-gage cables intended for use with the eight channels of WBK16. Discussions of the CA-177 strain-gage cable and bridge applications are contained in the WBK16 document module.

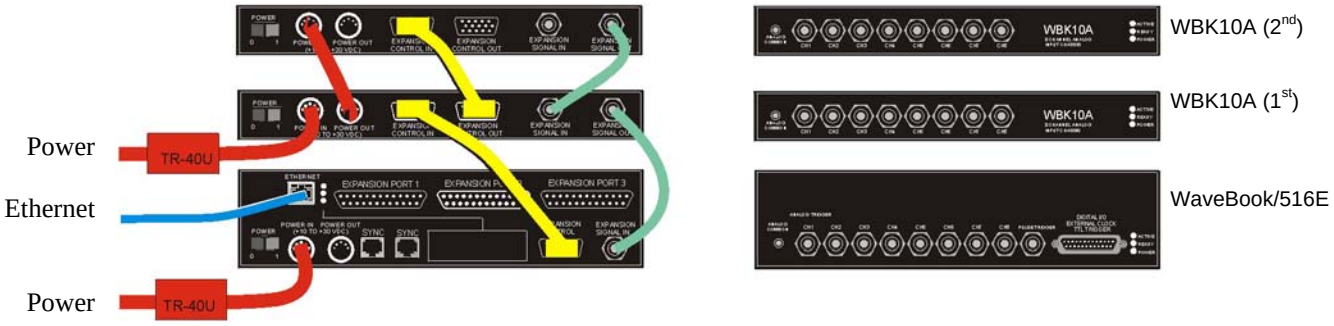
CA-217 Digital Expansion Cables. These 8-inch cables are used for connecting one or more WBK17s to a WaveBook/512A, /516, /516A, or /516E. The CA-217 cable has a DB25M connector for Digital Expansion Out and a HD26M connector for Digital Expansion In.

CA-242 and CA-242-7 Ethernet Patch Cables. CA-242 is a 1.5 foot cable that can be used to connect a WaveBook/516E to an Ethernet port on a PC or network. CA-242-7 is a 7-foot cable that can be used for the same purpose.

CA-74-1 and CA-74-5 SYNC Cables. 1-foot and 5-foot cables, respectively, that are used to synchronize multiple devices. WaveBook synchronization applies only to "A" and "E" Series devices.

Single WaveBook Systems, 4 Examples

Example 1: WaveBook/516E System with two WBK10A Modules



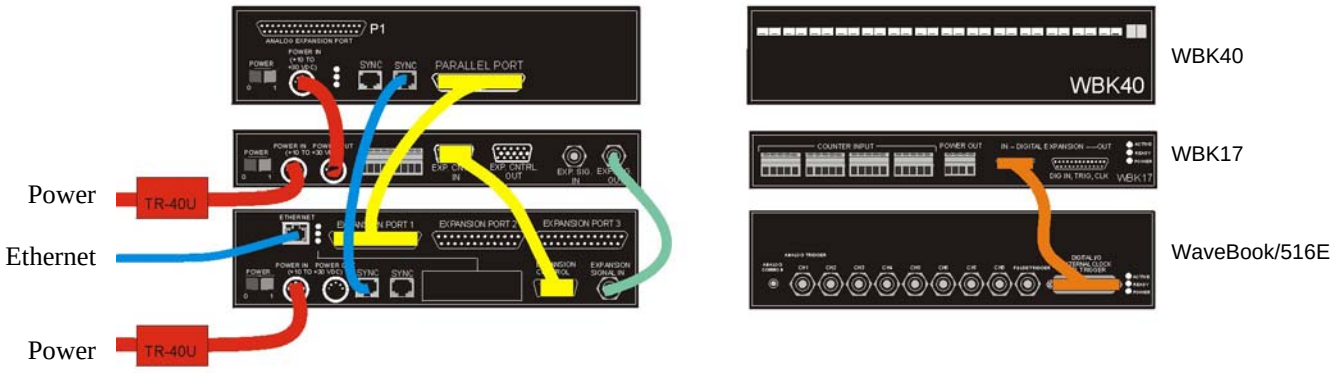
Device Interface Side ***Channel Input Side***

WaveBook/516E System
with 2 WBK10A Modules

Lines and Cables Used in Example 1, excluding channel input connections.

1. **Power Supply** - To the WaveBook/516E POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
2. **Power Supply** - To the first WBK10A's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
3. **Power Supply** – From the first WBK10A's POWER OUT DIN 5 connector, +10 VDC to +30 VDC, to the second WBK10A's POWER IN DIN 5 connector via a CA-115 Power Cable.
4. **Ethernet** – From the WaveBook/516E ETHERNET jack to a 10/100BaseT Ethernet Network or to the ETHERNET jack on a PC. Applicable Ethernet patch cables (1.5-foot or 7-foot) are CA-242 and CA-242-7, respectively.
5. **Expansion Control** – From WaveBook/516E EXPANSION CONTROL to the first WBK10A's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
6. **Expansion Control** – From the first WBK10A's EXPANSION CONTROL OUT to the second WBK10A's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
7. **Expansion Signal** – From the second WBK10A's EXPANSION SIGNAL OUT to the first WBK10A's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
8. **Expansion Signal** – From the first WBK10A's EXPANSION SIGNAL OUT to the WaveBook/516E's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.

Example 2: WaveBook/516E System with a WBK17 and a WBK40



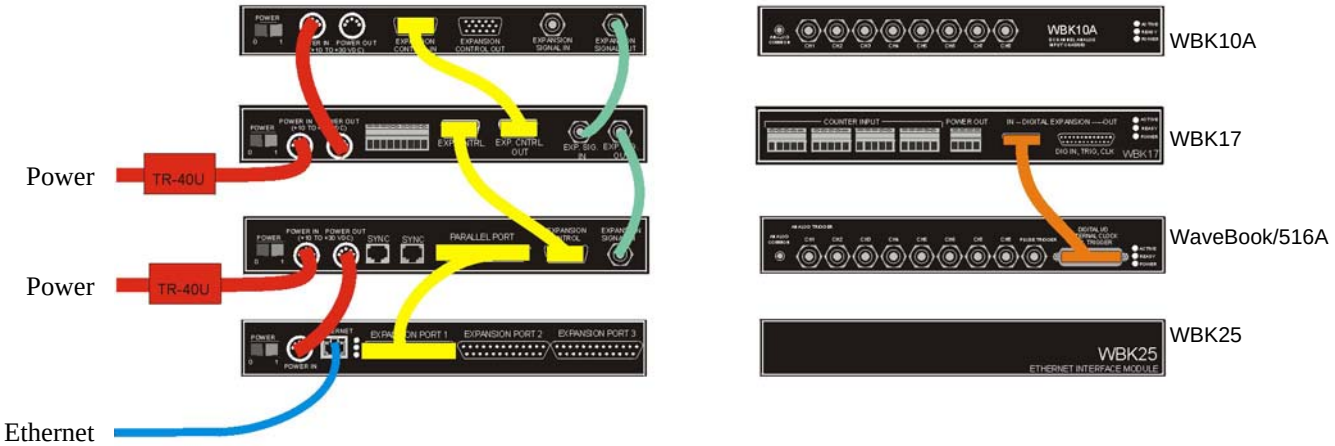
Device Interface Side ***Channel Input Side***

WaveBook/516E System
with a WBK17 and a WBK40

Lines and Cables Used in Example, excluding channel input connections.

1. **Power Supply** - To the WaveBook/516E POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
2. **Power Supply** - To the WBK17's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
3. **Power Supply** – From the WBK17's POWER OUT DIN 5 connector, +10 VDC to +30 VDC, to the WBK40's POWER IN DIN 5 connector via a CA-115 Power Cable.
4. **Ethernet** – From the WaveBook/516E ETHERNET jack to a 10/100BaseT Ethernet Network or to the ETHERNET jack on a PC. Applicable Ethernet patch cables (1.5-foot or 7-foot) are CA-242 and CA-242-7, respectively.
5. **Synchronization** – From a WaveBook/516E SYNC jack to a WBK40 SYNC jack. The connection is made via a CA-74-1 cable.
6. **Expansion** – From WaveBook/516E EXPANSION PORT 1 to the WBK40's PARALLEL PORT connector. The connection is made via a 25-pin CA-35-12 cable.
7. **Expansion Control** – From WaveBook/516E EXPANSION CONTROL to the WBK17's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
8. **Expansion Signal** – From the WBK17's EXPANSION SIGNAL OUT to the WaveBook/516E's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
9. **Digital Expansion** – This connection is made on the channel input side of the units. The cable runs from the WaveBook/516E's DIGITAL I/O / EXTERNAL CLOCK / TTL TRIGGER connector to the WBK17's IN-DIGITAL EXPANSION connector (HD26 type). The connection is made via a CA-217 Digital Expansion Cable.

Example 3: WaveBook/516A System with a WBK25, WBK17, and a WBK10A

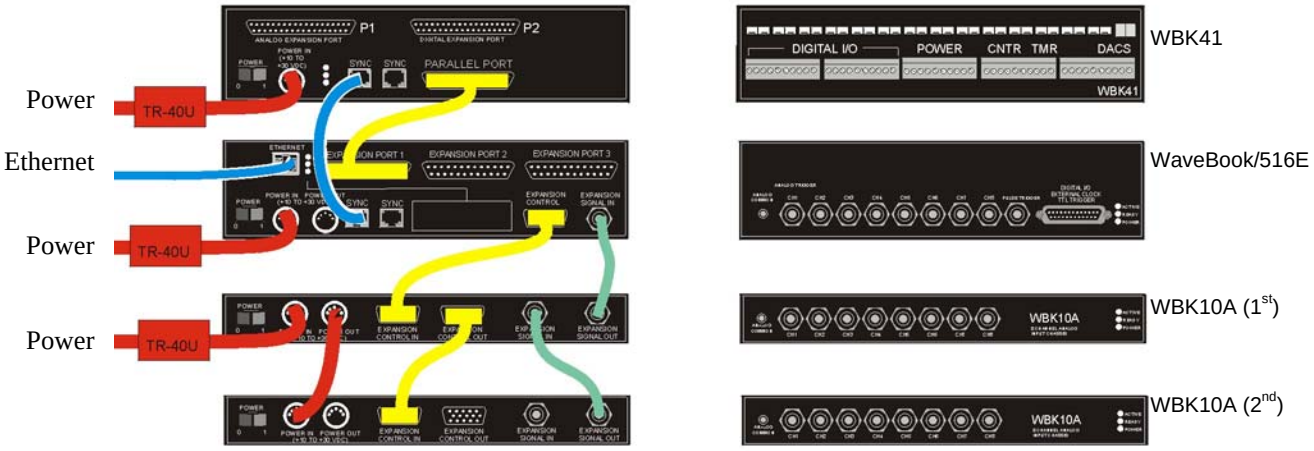


WaveBook/516A System
with a WBK25, WBK17, and a WBK10A

Lines and Cables Used in Example 3, excluding channel input connections.

1. **Power Supply** - To the WaveBook/516A POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
2. **Power Supply** – From the WaveBook/516A's POWER OUT DIN 5 connector to the WBK25's POWER IN DIN 5 connector via a CA-115 Power Cable.
3. **Power Supply** - To the WBK17's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
4. **Power Supply** – From the WBK17's POWER OUT DIN 5 connector, +10 VDC to +30 VDC, to the WBK10A's POWER IN DIN 5 connector via a CA-115 Power Cable.
5. **Ethernet** – From the WBK25's ETHERNET jack to a 10/100BaseT Ethernet Network or to the ETHERNET jack on a PC. Applicable Ethernet patch cables (1.5-foot or 7-foot) are CA-242 and CA-242-7, respectively.
6. **Expansion** – From the WBK25's EXPANSION PORT 1 to the WaveBook/516A's PARALLEL PORT connector. The connection is made via a 25-pin CA-35-12 cable.
7. **Expansion Control** – From WaveBook/516A's EXPANSION CONTROL to the WBK17's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
8. **Expansion Control** – From the WBK17's EXPANSION CONTROL OUT to the WBK10A's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
9. **Expansion Signal** – From the WBK10A's EXPANSION SIGNAL OUT to the WBK17's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
10. **Expansion Signal** – From the WBK17's EXPANSION SIGNAL OUT to the WaveBook/516A's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
11. **Digital Expansion** – This connection is made on the channel input side of the units. The cable runs from the WaveBook/516A's DIGITAL I/O / EXTERNAL CLOCK / TTL TRIGGER connector to the WBK17's IN-DIGITAL EXPANSION connector (HD26 type). The connection is made via a CA-217 Digital Expansion Cable.

Example 4: WaveBook/516E with a WBK41 and 2 WBK10A Modules



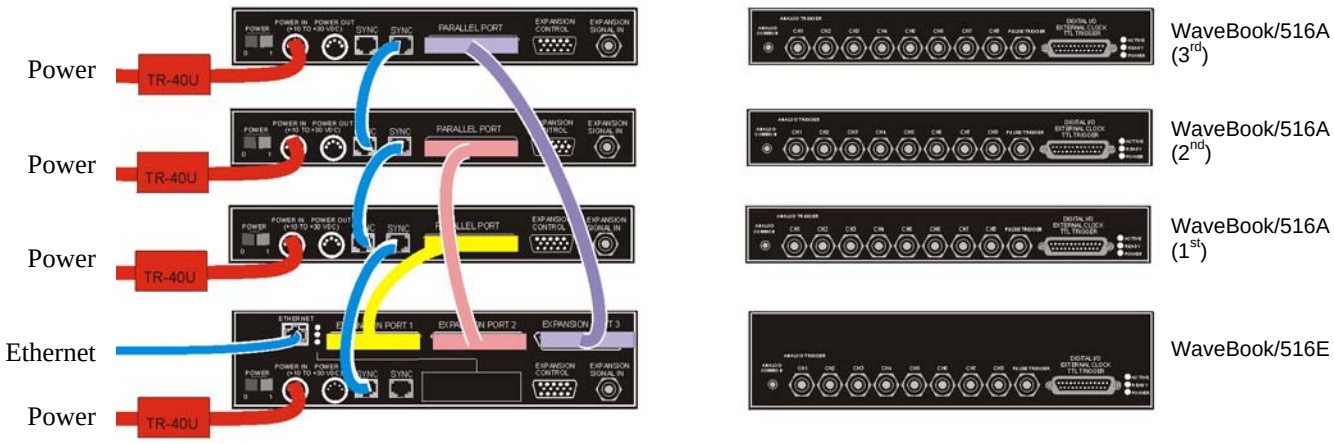
WaveBook/516E with a WBK41 and 2 WBK10A Modules

Lines and Cables Used in Example 4, excluding channel input connections.

1. **Power Supply** - To the WaveBook/516E POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
2. **Power Supply** - To the WBK41 POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
3. **Power Supply** – To the first WBK10A POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
4. **Power Supply** – From the first WBK10A's POWER OUT DIN 5 connector, +10 VDC to +30 VDC, to the second WBK10A's POWER IN DIN 5 connector via a CA-115 Power Cable.
5. **Ethernet** – From the WaveBook/516E's ETHERNET jack to a 10/100BaseT Ethernet Network or to the ETHERNET jack on a PC. Applicable Ethernet patch cables (1.5-foot or 7-foot) are CA-242 and CA-242-7, respectively.
6. **Synchronization** – From a WaveBook/516E SYNC jack to a WBK41 SYNC jack. The connection is made via a CA-74-1 cable.
7. **Expansion** – From WaveBook/516E's EXPANSION PORT 1 to the WBK41's PARALLEL PORT. The connection is made via a CA-35-12 cable.
8. **Expansion Control** – From WaveBook/516E's EXPANSION CONTROL to the first WBK10A's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
9. **Expansion Control** – From the first WBK10A's EXPANSION CONTROL OUT to the second WBK10A's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
10. **Expansion Signal** – From the second WBK10A's EXPANSION SIGNAL OUT to the first WBK10A's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
11. **Expansion Signal** – From the first WBK10A's EXPANSION SIGNAL OUT to the WaveBook/516E's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.

Multiple WaveBook Systems, 2 Examples

Example 1: A WaveBook/516E with 3 WaveBook/516A Units



Device Interface Side ***Channel Input Side***

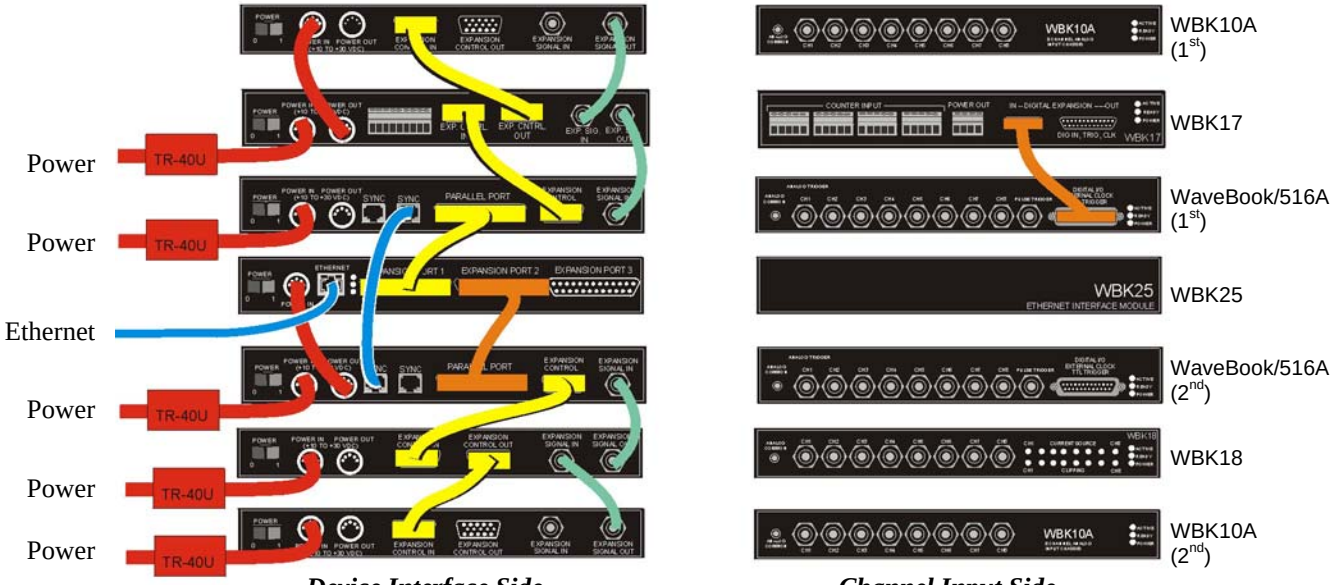
A WaveBook/516E with 3 WaveBook/516A Units

Lines and Cables Used in Example 5, excluding channel input connections.

1. **Power Supply** - To the WaveBook/516E POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
2. **Power Supply** – To each WaveBook/516A's POWER IN DIN 5 connector, +10 VDC to +30 VDC. Each unit uses its own dedicated TR-40U power adapter.
3. **Ethernet** – From the WaveBook/516E's ETHERNET jack to a 10/100BaseT Ethernet Network or to the ETHERNET jack on a PC. Applicable Ethernet patch cables (1.5-foot or 7-foot) are CA-242 and CA-242-7, respectively.
4. **Synchronization** – From a WaveBook/516E SYNC jack to a SYNC jack on the first WaveBook/516A. The connection is made via a CA-74-1 cable.
5. **Synchronization** – From the first WaveBook/516A's remaining SYNC jack to a SYNC jack on the second WaveBook/516A. The connection is made via a CA-74-1 cable.
6. **Syncronization** – From the second WaveBook/516A's remaining SYNC jack to a SYNC jack on the third WaveBook/516A. The connection is made via a CA-74-1 cable.
7. **Expansion 1** – From the WaveBook/516E's EXPANSION PORT 1 to the first WaveBook/516A's PARALLEL PORT connector. The connection is made via a 25-pin CA-35-12 cable.
8. **Expansion 2** – From the WaveBook/516E's EXPANSION PORT 2 to the second WaveBook/516A's PARALLEL PORT connector. The connection is made via a 25-pin CA-35-12 cable.
9. **Expansion 3** – From the WaveBook/516E's EXPANSION PORT 3 to the third WaveBook/516A's PARALLEL PORT connector. The connection is made via a 25-pin CA-35-12 cable.

Example 2: Two WaveBook/516A Sub-Systems Connected via a WBK25 Ethernet Interface Module

This system example consists of two WaveBook/516A Systems, one located beneath a WBK25 Ethernet Module and the other system above it. For this reason there are two lists of lines and cables used, i.e., a list for each sub-system.



Device Interface Side ***Channel Input Side***

Two WaveBook/516A Sub-Systems Connected via a WBK25 Ethernet Interface Module

Lines and Cables Used in Example 2, excluding channel input connections.

1st WaveBook/516A Sub-System -- Includes the WBK25 Ethernet Module and the 3 components above it.

1. **Power Supply** - To the first WaveBook/516A's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
2. **Power Supply** – To the WBK17's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
3. **Power Supply** – From the WBK17's POWER OUT DIN 5 connector to the first WBK10A's POWER IN DIN 5 connector via a CA-115 power cable.
4. **Expansion Control** – From the first WaveBook/516A's EXPANSION CONTROL to the WBK17's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
5. **Expansion Control** – From the WBK17's EXPANSION CONTROL OUT to the first WBK10A's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
6. **Expansion Signal** – From the first WBK10A's EXPANSION SIGNAL OUT to the WBK17's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
7. **Expansion Signal** – From the WBK17's EXPANSION SIGNAL OUT to the first WaveBook/516A's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
8. **Expansion** – From the first WaveBook/516A's PARALLEL PORT to the WBK25 Ethernet Interface Module's EXPANSION PORT 1. The connection is made via a 25-pin CA-35-12 cable.
9. **Synchronization** – From the first WaveBook/516A's SYNC jack to a SYNC jack on the second WaveBook/516A. The connection is made via a CA-74-1 cable.
10. **Ethernet** – From the WBK25's ETHERNET jack to a 10/100BaseT Ethernet Network or to the ETHERNET jack on a PC. Applicable Ethernet patch cables (1.5-foot or 7-foot) are CA-242 and CA-242-7, respectively.
11. **Digital Expansion** – This connection is made on the channel input side of the units. The cable runs from the first WaveBook/516A's DIGITAL I/O / EXTERNAL CLOCK / TTL TRIGGER connector to the WBK17's IN-DIGITAL EXPANSION connector (HD26 type). The connection is made via a CA-217 Digital Expansion Cable.

Example 2 (continued):

2nd WaveBook/516A Sub-System -- Includes the WBK25 Ethernet Module and the 3 components beneath it.

1. **Power Supply** - To the second WaveBook/516A's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
2. **Power Supply** – From the second WaveBook/516A's POWER OUT DIN 5 connector to the WBK25's POWER IN DIN 5 connector via a CA-115 power cable.
3. **Power Supply** – To the WBK18's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
4. **Power Supply** – To the second WBK10A's POWER IN DIN 5 connector, +10 VDC to +30 VDC, typically from a TR-40U power adapter.
5. **Expansion** – From the second WaveBook/516A's PARALLEL PORT to the WBK25 Ethernet Interface Module's EXPANSION PORT 2. The connection is made via a 25-pin CA-35-12 cable.
6. **Expansion Control** – From the second WaveBook/516A's EXPANSION CONTROL to the WBK18's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
7. **Expansion Control** – From the WBK18's EXPANSION CONTROL OUT to the second WBK10A's EXPANSION CONTROL IN. Connection is via a 15-pin CA-129 cable.
8. **Expansion Signal** – From the second WBK10A's EXPANSION SIGNAL OUT to the WBK18's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.
9. **Expansion Signal** – From the WBK18's EXPANSION SIGNAL OUT to the second WaveBook/516A's EXPANSION SIGNAL IN. Connection is via a BNC coaxial CA-150 cable.

Note: Ethernet and Synchronization aspects for *Multiple WaveBooks*, example 2, are dealt with in the list of lines and connections for the first WaveBook/516A Sub-System.


Notes

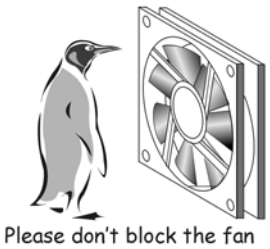
WaveBook Operation Reference 4

Basic Operation …… 4-2
WBK Option Cards and Modules …… 4-7
Analog-Signal & Ground Connections…… 4-12
Digital I/O Connections…… 4-13
Triggers …… 4-15
Digital Trigger and Single-Channel Trigger ……4-15
Multi-Channel Trigger …… 4-16
Trigger Latency and Jitter …… 4-19
Pulse Trigger …… 4-20
Digital-Pattern Trigger …… 4-21
External Clock and Counter-Timer …… 4-21
Synchronizing Multiple WaveBooks …… 4-23
Programmable Features …… 4-25
Selecting a Channel's Range …… 4-25
Selecting a Channels Units …… 4-26
mx + b, an Example …… 4-26



Reference Note:
Refer to the *WBK Option Cards and Modules User's Manual* (p/n 489-0902) for detailed information regarding the following WBK options. A PDF version of the document is included on the data acquisition CD.

WBK	Description	Hardware Type
WBK10A	8-Channel Expansion Chassis	Expansion Module
WBK11A	8-Channel SSH Card	Signal Conditioning Card
WBK12A	8-Channel Programmable Low-Pass Filter Card	Signal Conditioning Card
WBK13A	8-Channel Programmable Low-Pass Filter Card with SSH	Signal Conditioning Card
WBK14	8-Channel Dynamic Signal Input Module (piezoelectric)	Expansion Module
WBK15	8-Channel Isolated (5B) Signal Conditioning Module	Expansion Module
WBK16	8-Channel Strain Gage Module	Expansion Module
WBK17	8-Channel Counter-Input Module with Quadrature Encoder Support	Expansion Module
WBK18	8-Channel Dynamic Signal Conditioning Module with Transducer Electronic Data Sheet support (T.E.D.S.)	Expansion Module
WBK20A	PCMCIA/EPP Interface Card – provides a Parallel Port	Interface Card
WBK21	ISA/EPP Interface Plug-In Board – provides a Parallel Port	Interface Plug-In Board
WBK23	PCI/EPP Interface Plug-In Board – provides a Parallel Port	Interface Plug-In Board
WBK25	10/100BaseT Interface Module (includes 3 Expansion Ports)	Interface/Expansion Module
WBK30	Memory Expansion Cards; 16 MB, 64 MB, or 128 MB (WBK30/16, WBK30/64, WBK30/128)	Memory Expansion Cards
WBK40	14-Channel Thermocouple Input Module	Expansion Module
WBK41	Multi-Function I/O Module (14-Channel T/C, 40-Channel Digital I/O, 4 Counter Inputs, 2 Timer Outputs, Optional 4 Analog Output Channels)	Expansion Module
WBK61	1000V High Voltage Adapter with Probe	High Voltage Adapter
WBK62	100V High Voltage Adapter with Probe	High Voltage Adapter



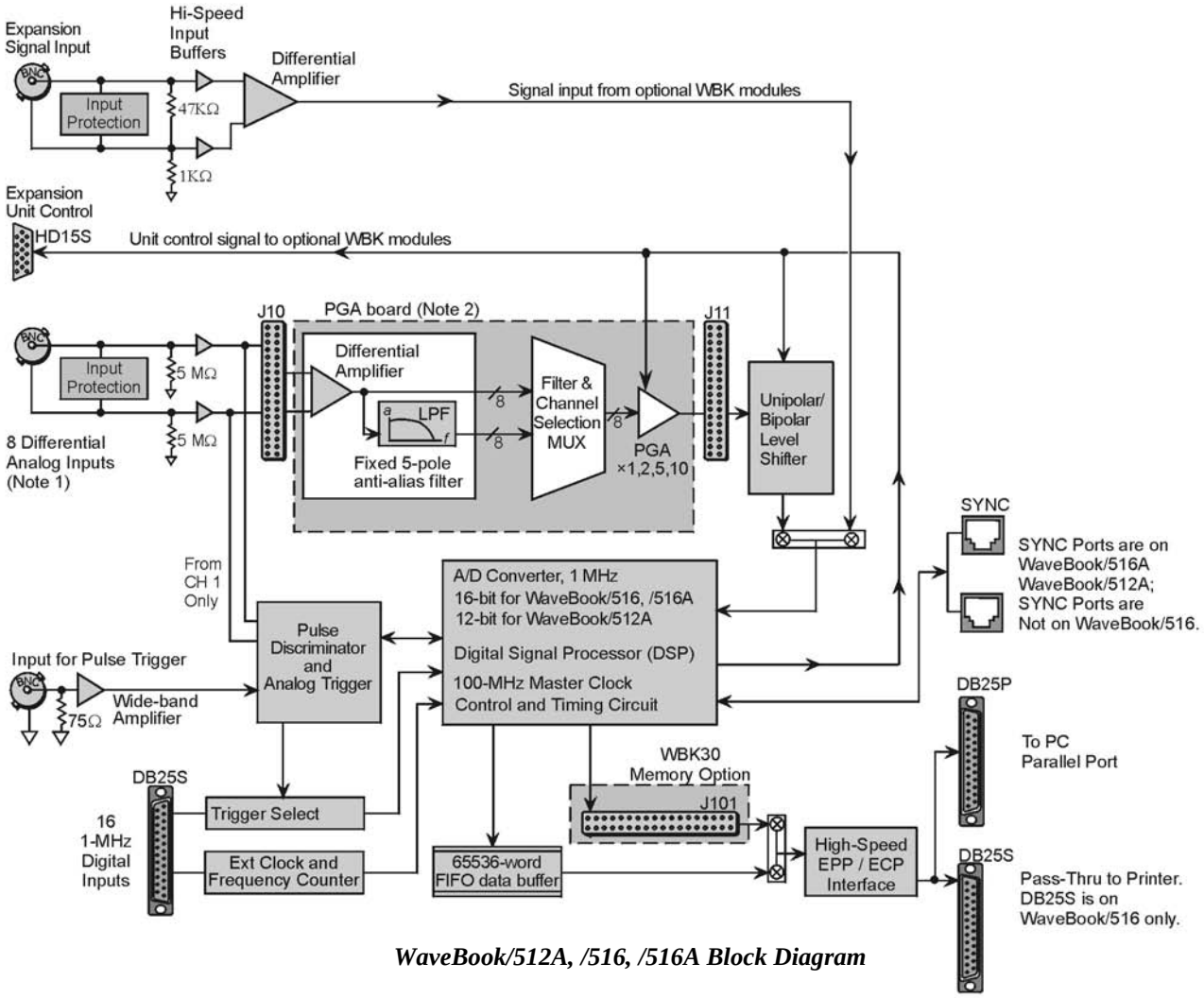
WaveBook Fan

The internal components of WaveBook/512A, /516, /516A, and /516E are air-cooled. Cooling to ambient occurs as long as the surrounding environment is cooler than the unit. When the unit becomes too warm for ambient cooling, a temperature sensor signals the fan to run.

Fan speed varies according to the WaveBook's internal temperature. In cooler temperatures the fan operates at lower speeds, thus reducing audible noise.

To allow for sufficient cooling, it is important to keep the fan and vents free of obstruction.

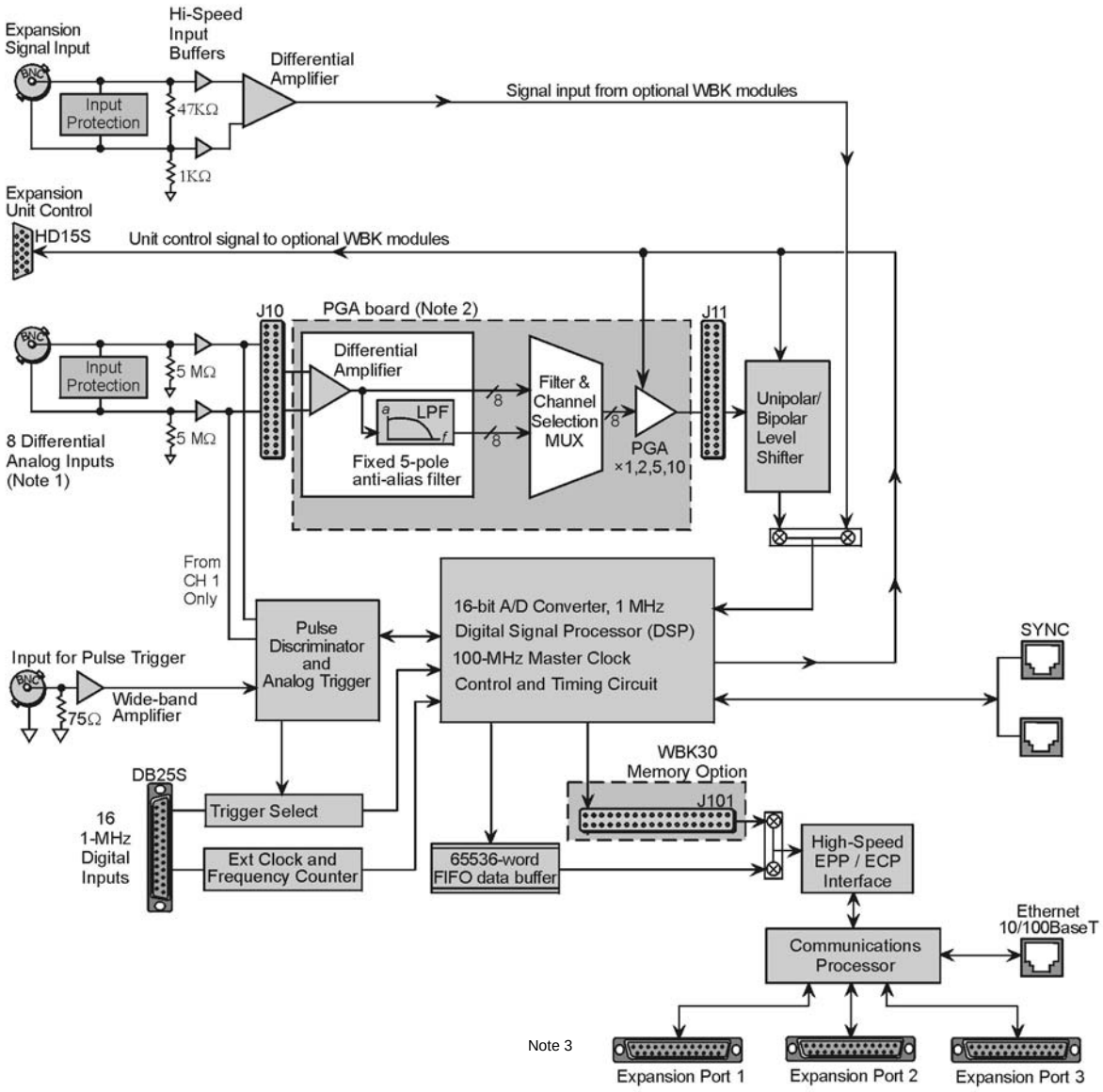
Note: The partial blocking of vents by fastener panels, when the units are stacked, does not jeopardize unit cooling.



WaveBook/512A, /516, /516A Block Diagram

Note 1: Each channel has input protection and connects to J10 via its own BNC connector. Channel 1 is the only channel that connects to the Pulse Discriminator and Analog Trigger.

Note 2: An optional WBK11A, WBK12A, or a WBK13A card can be used in place of the PGA board. However, these options are only to be installed [or removed] at the factory, as they are not “Plug-and-play” for WaveBook/512A, WaveBook/516, and WaveBook/516A.



WaveBook/516E Block Diagram

Note 1: Each channel has input protection and connects to J10 via its own BNC connector. Channel 1 is the only channel that connects to the Pulse Discriminator and Analog Trigger.

Note 2: An optional WBK11A, WBK12A, or WBK13A card can be used in place of the PGA board. However, these boards are only to be installed at the factory as they are not "Plug-and-play" for WaveBook/516E.

Note 3: Expansion Ports 1, 2, and 3 are typically used to connect up to three of the following devices: WaveBook/512A, WaveBook/516A, WBK40, WBK41. Any combination of these devices can be connected.

Buffering, Amplifying, and Filtering Differential Signals

WaveBooks have **8 pairs of differential signals,** one pair per BNC connector. Each pair of signals is buffered and applied to a differential amplifier. The output of each differential amplifier can be applied to a 5 pole, low pass filter. The filter and channel-selection multiplexer then switches the non-filtered and filtered signals to a programmable gain amplifier (PGA). The amplified signal is level-shifted to locate the desired range (within the A/D converter's fixed input range). Two offset settings are available, *unipolar* and *bipolar*. **Unipolar offset** is used for sampling signals that are *always* positive. **Bipolar offset** is used for signals that may be positive or negative. For example, when set for *unipolar* at a gain of ×5, the input span is 2 volts and the amplified signal is offset so that input voltages from 0 to +2 volts can be digitized. When set for *bipolar* operation, the offset is adjusted so that input voltages from -1.0 to +1.0 volts can be digitized.

Digitizing Signals via the A/D Converter

For the WaveBook/516, /516A, and /516E, the signal is switched over to the **A/D converter** and digitized to 16 bits in 1 μs. For WaveBook/512A, the signal is digitized to 12-bits in 1 μs. The A/D converter's input can be switched to the expansion signal input, allowing the device to read one of 64 possible expansion channels supplied by up to eight expansion modules [WBK10A, WBK14, WBK15, WBK16, WBK17, WBK18]. The *digital signal processor* (DSP) processes the digitized value and corrects the value for gain and offset errors. The DSP places the corrected result into the FIFO data buffer that holds the samples until the PC reads the data. If the sample is used for triggering, the DSP determines if a valid trigger event has occurred.

Using a Sample for Triggering

Low-Latency Analog or TTL-level Triggering

WaveBook includes **low-latency analog** or **TTL-level triggering**. The low-latency analog trigger detector examines the WaveBook input channel 1 to determine if a trigger has occurred. The selected low-latency trigger is presented to the control and timing circuit that starts the acquisition after the trigger. The TTL trigger is taken directly from the digital I/O port. A detailed discussion of triggering begins on page 4-15.

Sync Ports

The “A” and “E” Series WaveBooks each contain two SYNC ports. With respect to each other, the units can be *scan-synchronized* and *triggered* by connecting one of the two WaveBook SYNC ports to a SYNC port on a second “A” or “E” Series WaveBook or to a SYNC port of a WBK40 or WBK41 module.

Additional information on synchronization begins on page 4-23.

Control, Timing, and Signal Processing

The Control-and-Timing Circuit and the Digital Signal Processor (DSP)

The Control-and-Timing Circuit and the Digital Signal Processor (DSP) work together. At each sample time, the DSP: (a) reads from the scan sequence table, and (b) accordingly programs the Control-and-Timing Circuit for the next sample. The Control-and-Timing Circuit waits precisely until the start of the next sample, then selects:

- **the input channel**
- **PGA gain**
- **level-shifter offset**
- **A/D input source**

The control-and-timing circuit conveys this information to any attached expansion units and precisely controls the A/D conversion timing.

The EEPROM

The EEPROM holds the calibration information needed for *real-time* sample correction.

Reading from and Writing to the Digital I/O Port

The digital I/O port is read and written by the Digital Signal Processor to transfer bytes of digital data. It may be used as a simple 8-bit input port or as a 32-address byte-wide I/O port.

The high-speed EPP/ECP interface circuit connects the WaveBook and any attached printer to the PC via standard DB-25 connectors. When the WaveBook is active, the interface holds the printer in a stable state; and when the WaveBook is inactive, the interface connects the PC to the printer.

WaveBooks and the Ethernet, General Information



The following information applies to:

- **WaveBook/516E, when connected to the Ethernet**
- **WaveBook/516A, when interfaced to the Ethernet via a WBK25 module or interfaced to the Ethernet via a WaveBook/516E.**
- **WaveBook/512A, when interfaced to the Ethernet via a WBK25 module or interfaced to the Ethernet via a WaveBook/516E. However, WaveBook/512A is 12-bit instead of 16-bit.**
- **WaveBook/516, when interfaced to the Ethernet via a WBK25 module or interfaced to the Ethernet via a WaveBook/516E. However, WaveBook/516 has no synchronization feature.**

WaveBooks can transfer acquired data to the PC via a 10/100BaseT Ethernet connection. The Ethernet connection allows for a continuous stream of data to be collected and stored. The WaveBooks can be expanded up to 72 channels using 8-channel WBK expansion options. The WaveBook/516E also has 3 built-in parallel expansion ports, permitting connection of up to three additional WaveBook/516A, WaveBook/512A, WBK40, and/or WBK41 units.

Note: When a WaveBook/516, /516A, or 512A is interfaced to the Ethernet via a WBK25 module, three parallel expansion ports are made available via the module.

Each of up to four WaveBooks, i.e., the base unit plus 3 units connected to its [or the WBK25's] expansion ports, can acquire data at 1 MHz, with all acquired data flowing through the Ethernet port and back to the PC. A sync signal between all "A" and "E" WaveBook devices ensures that the multi-device system will synchronously acquire data.



One WaveBook/516E can transfer data back to the PC via Ethernet at the full rate of 1 MSample/sec. When multiple WaveBooks are attached to one Ethernet port, either through a WaveBook/516E or through a WBK25, the Ethernet may not support the full sample bandwidth. In this situation, the use of a WBK30 option may be required. To obtain information regarding the latest improvements in Ethernet-based transfer rates contact the factory.

In total, up to 288 channels of high-speed input can be measured via one Ethernet link. Beyond that, additional channels are possible using an Ethernet expansion hub, allowing multiple WaveBook units to be attached to one PC.

The optional WBK40 and WBK41 expansion modules can be connected to the parallel expansion ports of the WaveBook/516E, or to the identical expansion ports of the WBK25. Since the WBK40 has its own 200-kHz A/D converter, it does not consume bandwidth from the WaveBook's 1-MHz A/D. The SYNC connection insures that both A/Ds measure synchronously.

There are two advantages of seamlessly supporting multiple WaveBooks in one system. *First*, is the ability to expand beyond the 72 channel capacity of a single WaveBook. *Second*, if the per-channel sampling rate of a single WaveBook system is inadequate, then additional WaveBooks can provide more bandwidth per channel. For example, a 16 channel, single-WaveBook/516E system with one WBK option provides a maximum bandwidth of 62.5 kHz/channel, i.e., 1M divided by 16. Instead, a sampling rate of 125 kHz/channel could have been achieved by using one WaveBook/516E connected to one slave WaveBook/516A. This new "per-channel" sampling rate was calculated as follows:
1 MHz divided by 8 equals 125 kHz/channel.

The most common and highest-performance Ethernet connection for WaveBook/516E and for WBK25 is achieved via a dedicated, point-to-point Ethernet link between the PC and the unit's Ethernet port. Data transfer rates in this configuration will accommodate continuous, 1 Mreading/s transfers from the WaveBook to the PC.

With an enterprise-wide Ethernet network connection, any number of WaveBooks can be connected to the network. Enterprise-wide Ethernet networks are typically shared amongst a large number of devices. In such a scenario, the data transfer rates from the WaveBook are dependent on other network traffic at the time of data transfer.



If you need to have continuous, 1 Mreading/s transfers from the WaveBook, you should avoid connecting WaveBooks to an *enterprise-wide Ethernet network*. However, to improve the data transfer performance of WaveBooks that are connected to such a network, a WBK30 memory option should be installed. Contact the factory for additional information.

Up to three WaveBook/516A or WaveBook/512A units can be attached to the three Expansion Ports of a WaveBook/516E or WBK25. This application is useful when the channel requirements exceed the 72 channel capability of one WaveBook. It is also useful when the per-channel bandwidth exceeds that which could be accomplished by a lone WaveBook, or if multiple time bases are required.

Note: In multiple WaveBook applications, the system can appear to the user as one large, synchronous system. However, a system composed of many WaveBooks can be configured as several independent systems, and with each system having its own triggering and sampling rates.

The parallel expansion ports on a WaveBook/516E can also be used to attach WBK40 thermocouple modules and/or WBK41 Multi-Function modules. The units are detailed in the *WBK Options User's Manual* (p/n 489-0902). A PDF version of the document is included on the data acquisition CD. Note that the SYNC signal on an "A" or "E" Series WaveBook can connect to a SYNC port theWBK40 or WBK41, ensuring that both A/Ds will operate in synch.

A large WaveBook system can be configured with one Ethernet link to a PC, and could consist of, for example either of the following two scenarios. In each case the WaveBook was expanded to its maximum 72 channel capacity, for a total system capacity of 288 high-speed channels.

288 Channel System, *Example 1*	**216 Channel System, *Example 2***
WaveBook/516E ("Master" Unit) Connected to Ethernet **WaveBook/516A** (Expansion Port 1, "Slave" Unit)* **WaveBook/516A** (Expansion Port 2, "Slave" Unit)* **WaveBook/516A** (Expansion Port 3, "Slave" Unit)* *Expansion Ports are on the WaveBook/516E.	**WBK25 Ethernet Interface Module** Connected to Ethernet **WaveBook/516A** (Expansion Port 1, "Master" Unit)** **WaveBook/516A** (Expansion Port 2, "Slave" Unit)** **WaveBook/516A** (Expansion Port 3, "Slave" Unit)** **Expansion Ports are on the WBK25 Interface Module. Any one of the 3 WaveBooks can be designated as the Master Unit, and the other two as Slave Units.



Synchronizing Multiple WaveBooks

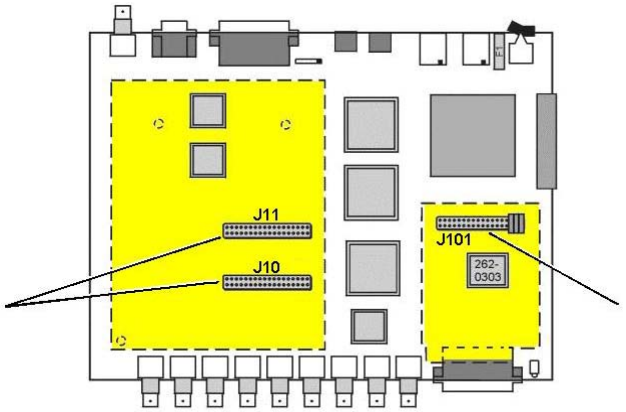
WaveBook software establishes one of the system's WaveBooks as a "master" unit and the others as "slaves" units. Master WaveBooks can run at the full 1-MHz aggregate sampling rate. Slave WaveBooks must have 1 µs of unassigned sampling time in the scan group. Note that some trigger modes are not supported in multi-WaveBook systems.

Additional information regarding synchronization is provided on page 4-23.

WBK Option Cards and Modules

WaveBook operation can be enhanced by the use of various WBK option cards and modules. A brief synopsis of each option follows, while more detailed information is provided in the WBK Options User's Manual (p/n 489-0902). A PDF version of the document is located on the data acquisition CD. The location of WBK card options [internal to WaveBook] are illustrated in the following figure. The board layout includes header locations that the cards plug in to.

A Standard PGA Board, WBK11A, WBK12A, or WBK13A option card connects to J11 and J10 headers on the WaveBook's circuit board. (See Notes 1 and 2)



The WBK30 memory option connects to J101. (See Notes 1 and 2)

Locations of WBK Option Card Connection Headers

You can use various modules and option cards to expand your WaveBook system. These WaveBook options are known as WBKs. Internally, WaveBook has room for one signal-conditioning card. Externally, you can use one or more expansion modules.

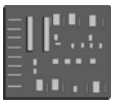
For WaveBook/516E, selected WBK card options must be installed at the factory. For other WaveBook models, the WBK30 card option can be installed by the user; however, other option cards must be factory-installed.

Note 1: **WaveBook/516E Users**

WBK option cards for WaveBook/516E are installed at the factory per customer order. Users are not to remove or install cards for these products as the cards are not "plug-and-play" for these devices and erroneous signal values could result. If you desire to remove or add a card to WaveBook/516E contact the factory or your service representative.

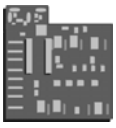
Note 2: **WaveBook/516, /516A, /512A, and WBK10A Users**

With exception of the WBK30 option, WBK option cards for WaveBook/516, /516A, /512A, and WBK10A are installed at the factory per customer order. Users are not to remove or install cards for these products [other than WBK30 series cards] as the cards are not "plug-and-play" for these devices and erroneous signal values could result. If you desire to remove or add a card to these products (other than WBK30) contact the factory or your service representative.



WBK11A

8-Channel Simultaneous Sample & Hold Card. Note that configurations are controlled by software. There are no hardware settings.



WBK12A and WBK13A

WBK12A: Programmable Low-Pass Filter Cards (8 channels each)
WBK13A: Programmable Low-Pass Filter Card with SSH (8 channels each)

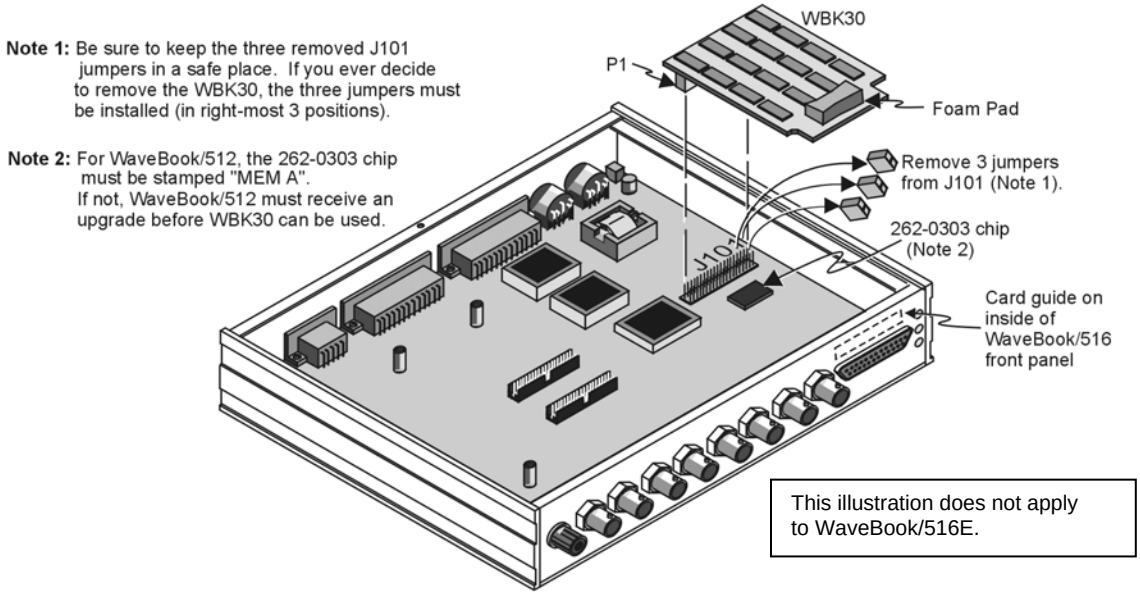
Note that configurations are controlled by software. There are no hardware settings.

WBK30

WBK30 is a DRAM-based memory board option that can be installed inside a WaveBook. There are three models of WBK30 available; each significantly increases the capacity of a WaveBook's standard data buffer of 64 K samples. Capacities are as follows:

WBK30/16 -16 MB, WBK30/64 - 64 MB, WBK30/128 - 128 MB

Note: For WaveBook/516E the WBK30 option, if selected, must be factory installed.



WBK30 Installation

Reference Note:
Refer to the *WBK Options User's Manual* (p/n 489-0902) for WBK30 installation details. A PDF version of the document is included on the data acquisition CD.

Important Notice! WaveBook/516E Users

WBK option cards for WaveBook/516E are installed at the factory per customer order. Users are not to remove or install cards for these products as the cards are not "plug-and-play" for these devices and erroneous signal values could result. If you desire to remove or add a card to WaveBook/516E contact the factory or your service representative.

Reference Note:
The WBK option cards and modules that follow are detailed later in the *WBK Options User's Manual*, p/n 489-0902. A PDF version of the document is included on the data acquisition CD.

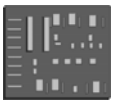
Each of the following options are detailed in product-dedicated document modules. Note that the items represented in the table are not necessarily shown to the same scale.



WBK10A
Analog Expansion Module
8 Channels via BNC Connectors

Each WBK10A module can be used to provide WaveBook with 8 additional differential-analog-inputs. The modules are equipped with a programmable gain instrumentation amplifier (PGA) and, like the WaveBook, each has a built-in expansion bus.

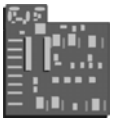
Up to eight WBK10A modules can be cascaded together for a system capacity of 72 differential channels. Each module is capable of supporting a WBK11A, WBK12A, or a WBK13A option card.



WBK11A
Simultaneous Sample & Hold Card (8 channels)

The WBK11A card can simultaneously sample 8 channels and can be installed inside a WaveBook or in a WBK10A module. The cards allow for concurrent (<150 ns) capture of multiple input channels and virtually eliminate channel-to-channel time skewing.

Note: Use of this card requires factory installation.



WBK12A
Programmable Low-Pass Filter Card
(8 channels)

WBK13A
Programmable Low-Pass Filter Card with SSH
(8 channels)

The WBK12A and WBK13A are 8-channel programmable low-pass filter cards for use with WaveBook data acquisition systems. These cards install directly into a WaveBook or WBK10A module and provide programmable low-pass filtering over all channels. Multiple WBK12A and WBK13A cards can be installed in one system for up to 72 channels. All of the cards' low-pass filters and cutoff frequencies are configured via software.

WBK13A cards have the additional capability of sampling all channels at the same time.

Note: Use of these cards requires factory installation.



WBK14
Dynamic Signal Conditioning Module
8 Channels via BNC Connectors

The WBK14 is a dynamic analog signal input module. It enables WaveBooks to interface with piezoelectric transducers that include accelerometers, microphones, and force/pressure transducers.
Each WBK14 channel has a:

- current source for transducer biasing
- high-pass filter
- programmable gain amplifier
- anti-aliasing low-pass filter
- simultaneous sample-and-hold (SSH) amplifiers



WBK15
8-Slot 5B Signal Conditioning Module
8 channels via 5B Modules

The WBK15 module provides for a diverse range of signals available through optional 5B modules. Measurement types include: LVDT, potentiometer, isolated current loop, ±10mV to ±40V inputs, linearized RTD, thermocouple, frequency-to-voltage, and strain gage.

See latest catalog or contact your sales representative in regard to the types of 5B Modules available for your application.



WBK16
Strain-Gage Module
8 channels via Standard Female DB9

WBK16 is an 8-channel strain-gage signal-conditioning module. Up to eight WBK16 modules (64 channels) can be accommodated by the WaveBook and scanned at 1 µs/channel. Almost all bridge configurations are supported via a bridge-completion network and software. High-gain differential-amplifier applications are also supported. Software controls bridge configuration, gain, offset, excitation voltage, polarity, filtering, and the calibration process.



WBK17
Counter-Input Module with
Quadrature Encoder Support
8 channels via Removable Screw Terminal Blocks

The WBK17 is an 8-channel multi-function counter/encoder module. Each of the high-speed, 32-bit counter channels can be configured for counter, period, pulse width, time between edges, or encoder modes. All channels are capable of measuring analog inputs that are digitized by the WaveBook.



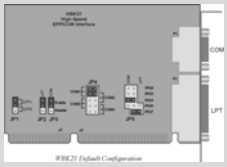
WBK18
Dynamic Signal Conditioning Module with Transducer Electronic Data Sheet support (T.E.D.S).
8 channels via BNC Connectors

WBK18 provides 8 channels of dynamic signal input for WaveBook systems. Each channel on the WBK18 has independent, software control for AC or DC coupling, ICP biasing (0 or 4 mA), and low-pass filter cut-off frequency. The 8-pole Butterworth filter on each channel is programmable from 5 Hz to 50 kHz, in a 1-2-5 progression. The filter can also be bypassed, resulting in a bandwidth of greater than 200 kHz.

WBK20A, WBK21, and WBK23 – Three Interface options that can be used to obtain an Enhanced Parallel Port.



WBK20A
PC-Card /EPP Interface & Cable



WBK21
ISA/EPP Interface Plug-in Board

WBK20A – *PCMCIA/EPP Interface Card and Cable*
For linking WaveBook to a Notebook PC. This interface provides an Enhanced Parallel Port via a PC-Card Slot.

WBK21 – ISA/EPP Interface Plug-in Board
For linking WaveBook to a desktop PC. This interface provides an Enhanced Parallel Port via an ISA Bus-slot.



WBK23
PCI/EPP Interface Plug-In Board

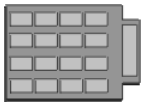
WBK23 – *PCI/EPP Interface Plug-In Board*
(For linking WaveBook to a desktop PC)
Provides an Enhanced Parallel Port from a PCI Bus-slot.

These three interfaces are shipped with separate documentation and are not detailed in this manual.



WBK25
10/100BaseT Ethernet Interface Module

The WBK25 provides high-speed Ethernet connectivity for WaveBook, DaqBook and WBK40 series products. The WBK25 contains one 10/100BaseT Ethernet port for connection to a PC, and three expansion ports that can attach to a WaveBook, DaqBook, WBK40 Series option, or any combination of these devices.



WBK30
WaveBook Memory Options

WBK30 is a DRAM-based memory board that installs inside a WaveBook. There are three models of WBK30 available; each significantly increases the capacity of WaveBook's standard data buffer of 64 K samples. Capacities are as follows:

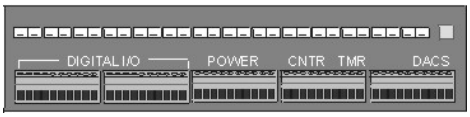
WBK30/16 - 16 MB
WBK30/64 - 64 MB
WBK30/128 - 128 MB

Note: **If a WBK30 option is selected for WaveBook/516E, it must be installed at the factory.**



WBK40
Thermocouple Input Module
14 channels via Mini-T/C Connectors

The WBK40 attaches to any of the three parallel expansion ports on the WaveBook/516E or the WBK25, and provides 14 thermocouple input channels. The 14 built-in TC channels accept any type of thermocouple, including types J, K, S, T, E, B, R, and N. Mini-TC connections make it quick and easy to attach thermocouples. The WBK40 can be expanded in 14 channel increments using the DBK84 TC expansion module. A total of 15 DBK84s can be attached to one WBK40, for a total TC channel capacity of 224 channels.



WBK41

Multi-Function I/O Module

14 Thermocouple channels via Mini-T/C Connectors
40 Digital I/O Lines
4 Counter Inputs
2 Timer Outputs
(Optional) 4 Analog Channel Outputs

The WBK4 attaches to the parallel expansion port on the WaveBook/516E or WBK25 and provides 14 thermocouple inputs, 40 digital I/O lines, 4 counter inputs, and 2 timer outputs. The WBK41 can also be supplied with an internal, 4-channel, 16-bit, 100-kHz analog output option.

The built-in TC channels on the WBK41 are accessed via mini-TC connectors on the front panel. The counter/timer functions and 16 bits of digital I/O are accessed via removable front panel screw-terminal connectors. Additional digital I/O and expansion connectors are located at the rear of the WBK41.

The WBK41 can be easily expanded beyond its built-in channel capacity. A maximum WBK41 system can include up to 224 TC input channels, 272 digital I/O channels, 4 analog output channels, 4 counter input channels and 2 timer output channels.

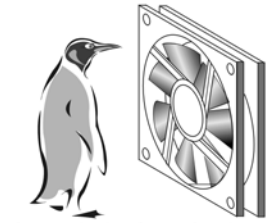


WBK61 and WBK62

WBK61: High-Voltage Adapter with 200:1 Voltage Divider (1 channel)
WBK62: High-Voltage Adapter with 20:1 Voltage Divider (1 channel)

WBK61 and WBK62 are single-channel high-voltage adapters that can be used with the WaveBook or WBK10A expansion modules. In addition, WBK61 and WBK62 can be used in conjunction with WBK11A, WBK12A, and WBK13A option cards.

WBK61 and WBK62 include safety-style banana-jacks for the high and low inputs, and 60-inch (152 cm) cables with probe tips and alligator clips for easy input connection.



WaveBook Fan

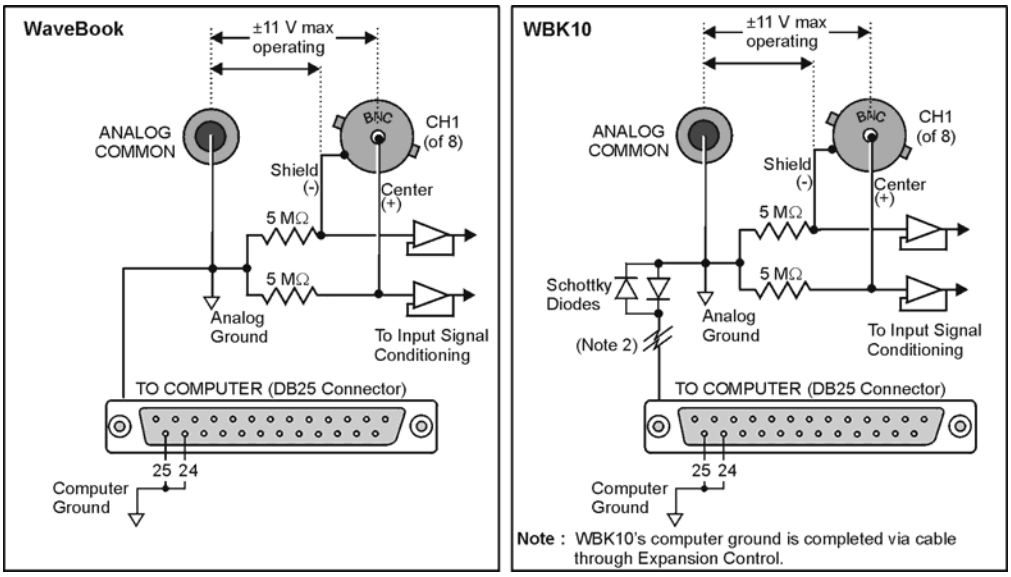
The internal components of WaveBook/512A, /516, /516A, and /516E are air-cooled. Cooling to ambient occurs as long as the surrounding environment is cooler than the unit. When the unit becomes too warm for ambient cooling, a temperature sensor signals the fan to run.

Fan speed varies according to the WaveBook's internal temperature. In cooler temperatures the fan operates at lower speeds, thus reducing audible noise.

To allow for sufficient cooling, it is important to keep the fan and vents free of obstruction.

Note: The partial blocking of vents by fastener panels, when the units are stacked, does not jeopardize unit cooling.

Analog Signal & Ground Connections



Channel Analog Input, BNC Signal Connections

For each of the eight channel analog inputs, the BNC center (+) and shield (-) are internally connected to WaveBook's binding post labeled, ANALOG COMMON. The center (+) and shield (-) each connect to ANALOG COMMON through a 5 MΩ resistor, resulting in a 10 MΩ differential input resistance (see figures). WaveBook's ANALOG COMMON connects to the computer power supply ground through the TO COMPUTER DB25 connector and cable.

- If the host computer is a desktop PC, then the computer ground will likely connect to the AC power line ground.
- If the host computer is a notebook PC, then the computer ground could be:
  (a) *floating*, for example, when operating on batteries, or
  (b) *connected to a vehicle ground*, for example, when using an automotive cigarette lighter adapter in conjunction with the vehicle's battery.

Note that a pair of Schottky diodes is used in the WBK10A to clamp the ANALOG COMMON to within 0.3V of computer ground (see figure).

WaveBook and WBK10A both have isolated power supplies. Power input common is isolated from ANALOG COMMON by $>10^9$ Ω in parallel with 0.1µF.



For WaveBook/512A, /516, /516A, /516E, or WBK10A to correctly measure analog signals, each signal must be within ±11 volts of ANALOG COMMON. The following notes provide guidelines on how to achieve this.

Like WaveBooks, notebook computers are rarely connected to AC power line ground. This is true even when these devices are plugged into AC adapters.

Floating Grounds: If the computer is battery operated *and* the signal source is floating (such as an ungrounded sensor), then the internal 5 MΩ resistors *may* provide enough of a return path to ANALOG COMMON. If either the computer or the analog signal source is committed to AC power line ground, then you will require a direct connection between the signal source and ANALOG COMMON.

When in doubt, connect the signal source common to ANALOG COMMON.

A *single-ended* signal source needs to have its common connected to ANALOG COMMON. When connecting several signal source commons to ANALOG COMMON, it is important that there is no voltage potential [between these signal source commons]. Otherwise, ground currents will circulate, leading to measurement errors.

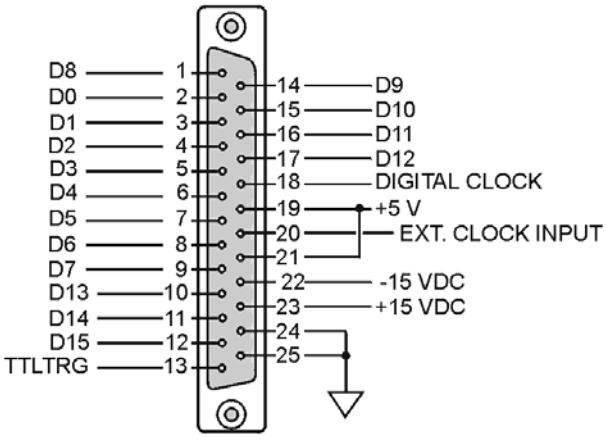
If there is a *fixed voltage potential* between multiple signal source commons, then *only one of these signal source commons* needs connected to ANALOG COMMON. This is true *as long as* the common mode voltage of any input does not exceed ±11 volts.

16-Bit Mode

For 16-bit mode, the following signals are present on the WaveBook's DB25F high-speed digital I/O connector. Note that 8-bit mode is covered in the following section.

- **16 High-Speed Digital I/O Lines (D0 through D15)**
- **TTL Trigger Input (TTLTRG)**
- **+15 V (pin 23), -15 V (pin 22), 50 mA max. (each)**
- **two +5 V (pin 19 and pin 21), 250 mA max. (total)**
- **External Clock Input (pin 20)**
- **Digital Clock (pin 18), only used for WBK17 applications**
- **two Digital Grounds (pins 24 and 25)**

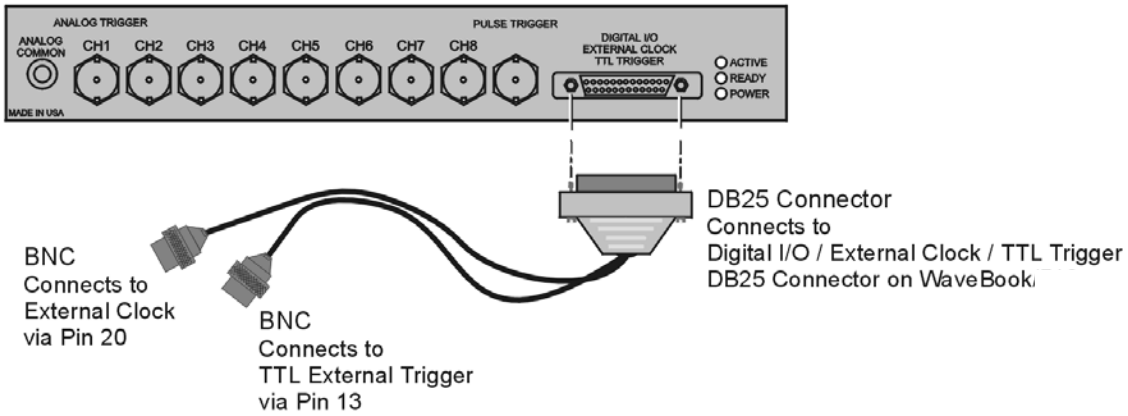
To sample just 16 digital input signals, connect them directly to the digital I/O data lines. D15 is the most significant bit, and D0 is the least.



Digital I/O Connections, 16-Bit Mode	
D0 through D15	High Speed Digital I/O data lines
TTLTRG	TTL trigger input
External Clock Input	16 bit mode, read/write strobe, Pin 20
+5 VDC	250 mA maximum
+15,-15 VDC	50 mA maximum (each)
Digital Clock	Pin 18, only used for WBK17 applications
Digital Grounds	Pins 24 and25

DB25 Pinout, 16-Bit Mode

The following figure depicts the WaveBook's Front Panel. The DB25 connector and cable for External Clock and TTL External Trigger are represented.

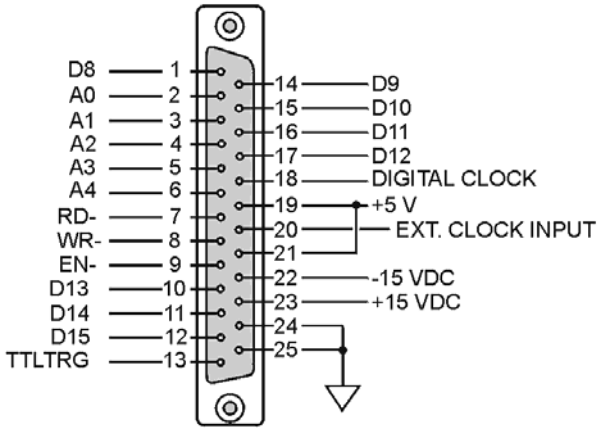


WaveBook with Optional Clock and External Trigger Cable (CA-178)

8-Bit Mode

The following pinout can be used for a WaveBook/512A, /516, /516A, or /516E providing that the unit is in the 8-bit mode, instead of in the 16-bit mode as discussed in the preceding section. When in 8-bit mode, the DB25 connections are as follows:

- **8 Digital I/O Lines (D8 – D15)**
- **5 Address Lines (A0 –A4)**
- **Active-low Digital I/O Enable output (EN-)**
- **Active-low Digital I/O Write Strobe (WR-)**
- **Active-low Digital I/O Read Strobe (RD-)**
- **TTL Trigger Input (TTLTRG)**
- **+15 V (pin 23), -15 V (pin 22), 50 mA max. (each)**
- **two +5 V power (pins 19 and 21), 250 mA max. (total)**
- **two Digital Grounds (pins 24, and 25)**
- **Digital Clock (pin 18), only used for WBK17 applications**
- **External Clock Input (pin 20)**



DB25 Pinout for 8-Bit Mode

DB25 Pinout, 8-Bit Mode	
D8 through D15	Digital I/O data lines
A0 through A4	Digital I/O address lines
EN-	Active-low digital I/O enable
RD-	Active-low read strobe
WR-	Active-low write strobe
TTLTRG	TTL trigger input
+5 VDC	250 mA maximum
+15,-15 VDC	50 mA maximum (each)
Digital Grounds	Pins 24, and 25
Digital Clock	Pin 18, only used for WBK17 applications
External Clock Input	Pin 20

To sample just 8 digital input signals, make connections directly to the digital I/O data lines. D15 is the most significant bit, and D8 is the least. The address lines, the read and write strobes, and enable signal can be left disconnected.

Triggers

External signals can be used to start or synchronize the data acquisition process.
The following trigger sources are supported:

- ***Software Trigger.*** This trigger event is generated by a **software command from the PC without waiting for an external event**. This feature may be used to begin a data acquisition immediately or to force an acquisition to occur if the expected trigger did not occur.
- ***Digital Trigger.*** Digital (or TTL-level) triggering (either rising- or falling-edge input) is performed by **digital logic connected to the digital expansion connector**.
- ***Single-Channel Trigger.*** Single-Channel (or Channel 1 Analog) triggering (rising or falling signal level) is performed by **comparator-based analog hardware connected directly to analog input channel 1**.
- ***Multi-Channel Trigger.*** Here, the trigger event is **a combination of measured channel values**. WaveBook's Digital Signal Processor (DSP) performs multi-channel triggering. The DSP samples the specified channels; if programmable conditions are met, a trigger is generated. Multi-channel triggering examines digitized data, and the trigger latencies are much greater.
- ***Digital-Pattern Trigger:*** This expanded digital-trigger capability allows data collection to start **when a user-defined 16-bit digital pattern is matched on the digital I/O connector**. This feature is useful when trying to capture noise, vibrations or some other physical disturbance; such as those that can occur in a programmed logic controller's digitally sequenced process.
- ***Pulse Trigger:*** The pulse trigger is **a high-bandwidth input that enables triggering and the correlation of lower-speed waveforms with the occurrence of a high-speed pulse**. With pulse trigger, the user defines pulse amplitude between ±5 V and pulse width from 100 ns to 800 ms.

More detailed information regarding triggers follows.

Digital Trigger & Single-Channel Trigger

The input of the digital (TTL) trigger and the output of the single-channel signal-comparator are each connected directly to hardware circuits to provide low-latency triggering. WaveBook can respond to a TTL or analog trigger with a jitter (or uncertainty in latency) of no more than 100 nanoseconds (ns).

- If **not** collecting pre-trigger data, WaveBook responds to the trigger with a latency of less than 200 ns for TTL and 300 ns for analog.
- If collecting pre-trigger data, then triggers are not acted upon until the end of the current pre-trigger scan. This increases the trigger latency and jitter, but preserves the specified scan rates.

When using the single-channel trigger, the Channel 1 analog input signal is compared with a programmable voltage level to generate an internal TTL signal that is *true* if the analog input is greater than the programmable voltage level (*false* if less).

When the digital trigger is used, then the TTL trigger signal from the digital I/O connector is used directly. The resulting TTL signal is examined under program control for either a false-to-true (rising edge) or true-to-false (falling edge) transition which, when it occurs, is the trigger event.

If the system is ready for a trigger, then the trigger event will be acted upon. If the system is not ready (due to incomplete configuration or because it is still finishing the previous trigger's action), the trigger will be ignored. No indication of an ignored trigger is given.

The low-latency analog trigger compares the analog signal with a programmable voltage source. The effective range of this voltage source depends on whether or not the WBK11A SSH option is installed.

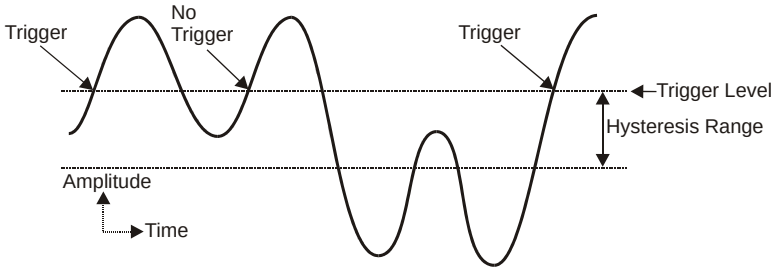
- Without SSH, the trigger threshold is settable from -5.0 to +9.996 volts with 12-bit (WaveBook/512A) resolution, regardless of any channel's gain settings. This gives better than 1% resolution at even the smallest input ranges (such as 0-1 or ±0.5 volts).
- With SSH, the single-channel (Channel 1 analog) signal is first amplified by the SSH programmable gain amplifier before being compared with the programmable voltage. This allows precise trigger-level adjustment, even at high gain.

Analog-Trigger Comparator, Ranges and Resolutions
For WaveBook/512A, /516, /516A, and /516E

SSH Input Range	Trigger Threshold Range	Resolution (mV)
0-10 or ±5	-5.0 to 9.996	0.299
0-5 or ±2.5	-2.5 to 4.998	0.114
0-2 or ±1	-1.0 to 1.999	0.0458
0-1 or ±0.5	-0.5 to 0.9996	0.0229
0-0.5 or ±0.25	-0.25 to 0.4998	0.0114
0-0.2 or ±0.1	-0.10 to 0.1999	0.00458
0-0.1 or ±0.05	-0.05 to 0.09996	0.00229

Hysteresis

The analog trigger circuit has hysteresis that **reduces the occurrence of re-triggering due to input noise**. The hysteresis level without SSH is 25 mV; the hysteresis with SSH is 1/600 of the comparator range. The next figure shows the hysteresis effect for a rising-edge trigger.



Hysteresis Effect on a Rising-Edge Trigger

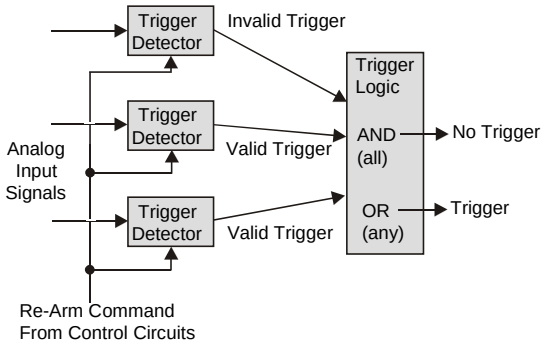
A trigger will occur when the analog input rises above the trigger level—but only after the input level has been below the hysteresis range. If the level momentarily drops just below the trigger level (perhaps due to noise) and then rises above it again, no extra triggers will be generated—the signal did not drop below the hysteresis range. After the level drops below hysteresis, it can then again produce a trigger by rising above the trigger level.

Multi-Channel Trigger

When the small hardware-limited latencies of the digital (TTL) and single-channel (Channel 1 analog) triggers are not required, the DSP chip may be used to examine the samples from one or more channels and to decide if they constitute a pre-defined trigger condition.

The DSP can sample up to 72 input channels and examine each one to determine if it meets programmed levels for a valid trigger. This multi-channel triggering is a two-step process:

1. The DSP examines each of its specified input signals to determine trigger validity.
2. After all of the channels have been examined, the DSP logically combines the individual triggers to generate the actual trigger. The DSP may be programmed to generate a trigger if *any* individual trigger is valid (OR) or if *all* triggers are valid (AND). See figure.



Multi-Channel Trigger Detection

Trigger validity in a multi-channel environment is determined by the logical relationship among three elements (*slope*, *duration*, and *initialization)* as discussed in the next section.

Multi-Channel Trigger Types

The first step in multi-channel triggering is to examine the input signals. To determine trigger validity, WaveBook can examine each input signal in 1 of 8 ways.

Note: Each trigger type is a combination of three elements: *slope*, *duration*, and *initialization*.

Trigger Type	Slope	Duration	Initialization
Above-level	Rising	Instantaneous	Level
Below-level	Falling	Instantaneous	Level
Above-level-with-latch	Rising	Latched	Level
Below-level-with-latch	Falling	Latched	Level
Rising-edge	Rising	Instantaneous	Edge
Falling-edge	Falling	Instantaneous	Edge
Rising-edge-with-latch	Rising	Latched	Edge
Falling-edge-with-latch	Falling	Latched	Edge

Slope (above/rising or below/falling) sets whether the trigger is valid when the signal is:

- Above the trigger level (**rising**)
- Below the trigger level (**falling**).

Duration (instantaneous or latched) specifies the action to take if the signal level becomes invalid after it has been valid:

- **Instantaneous** triggers become invalid as soon as the signal does; they are used to trigger on the *coincidence of signals*, when two or more signals are *simultaneously valid.*
- **Latched** triggers remain valid until the acquisition is complete; they are used to trigger on the *occurrence of signals*, when two or more signals *have already become valid.*

The trigger duration only makes a difference in multi-channel "AND" triggering. In multi-channel "OR" triggering, WaveBook will be triggered as soon as any channel becomes valid; what happens when a channel becomes invalid does not matter. In contrast, "AND" triggering waits for all of the triggers to be valid; and so, latching can be important for rapidly changing signals.

Initialization (level or edge) specifies the sequence necessary for a signal to be a valid trigger:

- **Level** triggers become valid as soon as they reach or exceed the trigger level, even if they are already past the trigger level when the acquisition is started.
- **Edge** triggers first wait until the signal level is invalid. Then they wait for the signal to reach the trigger level before becoming valid. Thus, level triggers look for a signal level, whenever it occurs; and edge triggers look for a *rising* or *falling* transition that reaches the trigger level.

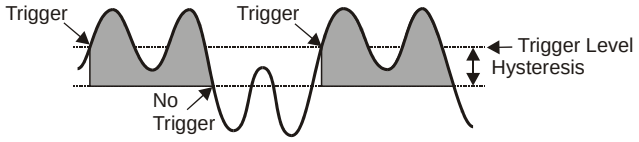
Examination of the input signals compares two specified signal levels: (a) The *trigger level* determines when the input channel is a valid trigger, and (b) the *hysteresis* is the amount by which the channel must differ from the trigger level for the channel to become invalid.

Above-Level Trigger

Rising slope

Instantaneous duration

Level initialization



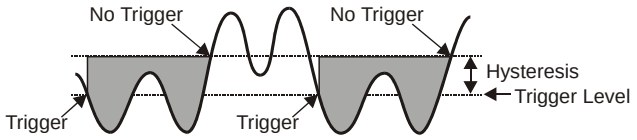
This trigger is valid whenever the signal level is above the trigger level and stays valid until the signal level goes below the hysteresis range. In the figure, the channel trigger is valid during the 2 shaded intervals. Whether this condition triggers WaveBook or not, depends on the type of multi-channel triggering ("AND" or "OR") and on the state of other trigger channels. With "OR" multi-channel triggering, WaveBook will trigger when the signal first rises above the trigger level—if ready for a new trigger, WaveBook will also trigger the second time the signal rises above the trigger level. With "AND" multi-level triggering, WaveBook will not trigger until every specified trigger channel is valid. If all other trigger channels are valid, WaveBook will trigger when the signal reaches the shaded region; but if some channels are not valid, this channel will have no effect.

Below-Level Trigger

Falling slope

Instantaneous duration

Level initialization



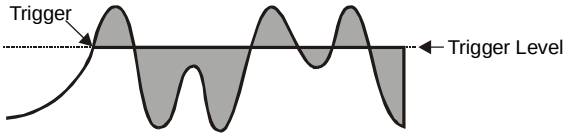
This trigger is valid whenever the signal level is below the trigger level and stays valid until the signal level goes above the hysteresis range (the reverse of above-level triggering). As with all multi-channel trigger types, WaveBook's actual trigger depends on the combination of this trigger with the other channels' trigger states.

Above-Level-With-Latch Trigger

Rising slope

Latched duration

Level initialization



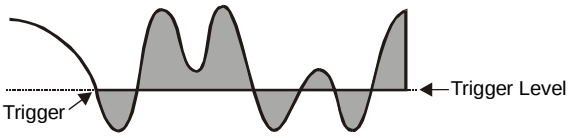
In this trigger type, the channel becomes valid when the signal level rises above the trigger level and stays valid until the acquisition is complete and WaveBook is re-armed.

Below-Level-With-Latch Trigger

Falling slope

Latched duration

Level initialization



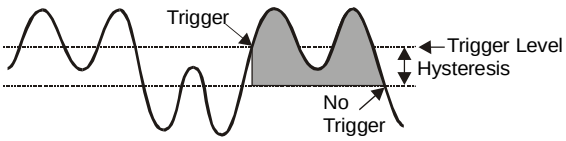
The channel becomes valid when the signal level rises above the trigger level and stays valid until the acquisition is complete and WaveBook is re-armed (the reverse of above-level-with-latch triggering). Latched triggers are often used in multi-channel "AND" triggering, where WaveBook will not trigger until all trigger channels are valid. After a latched trigger becomes valid, it stays valid (waiting for the other triggers to become valid) until WaveBook is triggered and the acquisition completes. If the trigger is non-latched instead of latched, the channel may not stay valid and WaveBook will not trigger until the channel becomes valid again and all channels simultaneously reach their trigger levels. In other words, *latched triggering is used to trigger after something has occurred, but non-latched triggering is used only during the* ***simultaneous occurrence*** *of desired signal levels.* It is possible to combine different trigger types in a single multi-channel trigger. For example, WaveBook could trigger when channel 3 is below 0.9 volts after channel 2 has gone above -1.3 volts (by configuring channel 3 for below-level triggering and channel 2 for above-level-with-latch triggering).

Rising-Edge Trigger

Rising slope

Instantaneous duration

Edge initialization



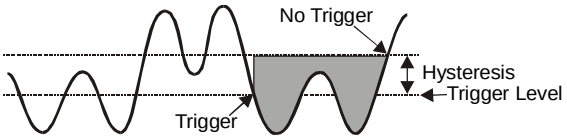
This trigger becomes valid after the signal level has been below the hysteresis range and then goes above the trigger level. This trigger becomes invalid when the signal level goes below the hysteresis range. Unlike above-level triggering, the channel cannot become valid until the signal level first goes below the hysteresis range. This prevents the false triggering that would occur if the signal were above the trigger level at the start of the acquisition.

Falling-Edge Trigger

Falling slope

Instantaneous duration

Edge initialization



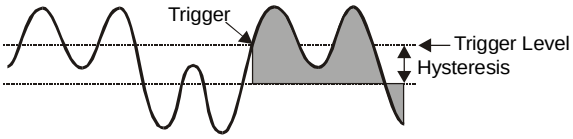
This trigger is the reverse of the rising-edge trigger: the trigger becomes valid after the signal level has been above the hysteresis range and then goes below the trigger level. This trigger becomes invalid whenever the signal level goes above the hysteresis range. This prevents the false triggering that would occur with below-level triggering if the signal was below the trigger level at the start of the acquisition.

Rising-Edge-With-Latch Trigger

Rising slope

Latched duration

Edge initialization



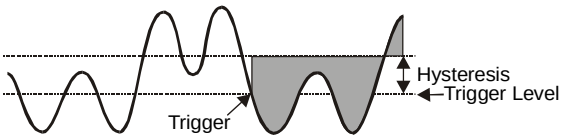
This trigger becomes valid like a rising-edge trigger: when the signal level goes above the trigger level after first being below the trigger range. However, the rising-edge-*with-latch* trigger does not become invalid, regardless of the signal level, until the acquisition is complete. Rising-edge-with-latch is used to trigger after the channel has reached the trigger level, rather than just while the channel is above the trigger level.

Falling-Edge-With-Latch Trigger

Falling slope

Latched duration

Edge initialization



This trigger is the reverse of the rising-edge-with-latch trigger: the trigger becomes valid after the signal level has been above the hysteresis range and then goes below the trigger level. The trigger remains valid until the acquisition is complete.

Trigger Latency & Jitter

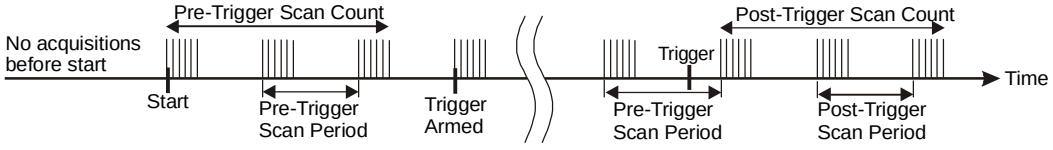
Trigger latency and jitter depend on the trigger source and the acquisition mode:

- Trigger **latency is the duration** between the valid trigger and the start of the acquisition.
- Trigger **jitter is the variation of the latency**, how much time the latency can vary from trigger to trigger.

As discussed, WaveBook has post-trigger and pre/post-trigger acquisition modes. Post-trigger modes (N-shot, N-shot with re-arm, and infinite-post-trigger) collect scans only after the trigger has occurred. They are different from the pre/post-trigger mode that collects scans both before and after the trigger. This difference affects the trigger latency and jitter.

In a post-trigger mode, WaveBook is not scanning while waiting for the trigger. Thus, it is free to respond to the trigger as soon as it occurs. This minimizes the trigger latency and jitter.

In the pre/post-trigger mode, pre-trigger data is being collected while WaveBook waits for the trigger, and WaveBook will not respond to a trigger, until after the current scan is complete. The pre-trigger scan period separates the first scan after the trigger from the last scan before the trigger. All the scans (up through the one immediately following the trigger) are collected at the pre-trigger rate; and all subsequent scans are collected at the post-trigger rate. This preserves the integrity of the acquisition timebase as shown in the figure below:



Pre/Post-Trigger Acquisition

The time needed to complete the final pre-trigger scan is part of the trigger latency; and so, in the pre/post-trigger mode, the trigger latency may be greatly increased.

Not only do the trigger latency and jitter depend on the pre- vs post-trigger type of acquisition, they also depend on the trigger source: Software, digital (TTL), single-channel (Channel 1 analog), or multi-channel. The following table gives the trigger latency and jitter for each of the different trigger sources and acquisition modes:

Acquisition Type	Trigger Source	Max. Trigger Latency	Trigger Jitter	Notes
Pre-Trigger	Software	100 µs + T	100 µs + T	a, c
	Digital (TTL)	200 ns + T	50 ns + T	c
	Single-Channel	300 ns + T	50 ns + T	c
	Multi-Channel	2 * T - NS µs	T	c, d
	Digital Pattern	300 ns + T	50 ns + T	
	Pulse	300 ns + T	50 ns + T	
Post-Trigger (N-Shot, N-Shot with re-arm, or infinite-post-trigger)	Software	100 µs	100 µs	a
	Digital (TTL)	200 ns	50 ns	
	Single-Channel	300 ns	50 ns	
	Multi-Channel	2 * NC + 3 µs	NC +2 µs	b
	Digital Pattern	300 ns	50 ns	
	Pulse	300 ns	50 ns	

Notes: a) Software trigger latency and jitter depend greatly on the host computer's speed, operating system, and printer-port protocol. Most systems should take much less than 100 µs.

b) NC is the number of channel samples used for multi-channel triggering, from 1 to 72, as specified by the trigger configuration.

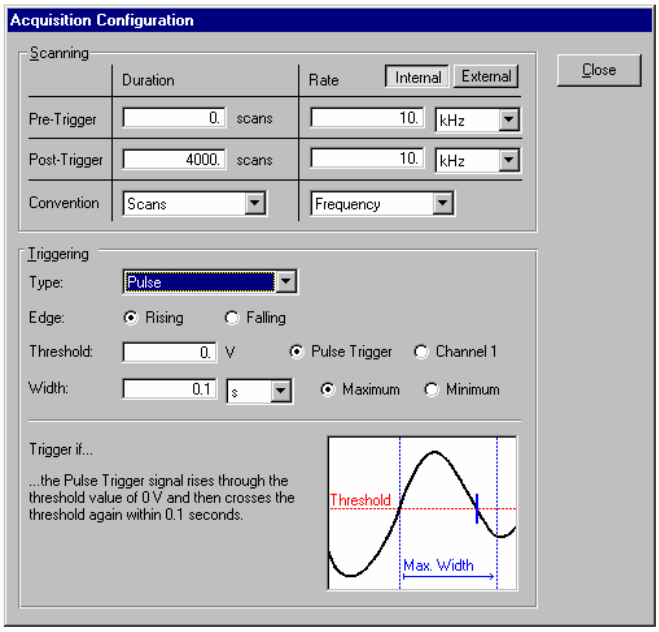
c) T is the pre-trigger scan period.

d) NS is the number of samples in a scan including, if present, the first "dummy" sample, from 1 to 128.

Pulse Trigger

In addition to the standard “single-channel” *trigger-on-level* functions, the WaveBook system supports **pulse trigger**. The connection is made via BNC connector located next to the Channel 8 BNC. With pulse trigger, you can define both the amplitude and the duration of the pulse that will be used to trigger the acquisition. Pulse trigger can be used to detect spurious transients that can be missed by simple level triggers.

Pulse Trigger allows the use of a high-bandwidth input for triggering, and the correlation of lower-speed waveforms with the occurrence of a high-speed pulse. You can set a pulse amplitude between ±5 V and a pulse width in the range of 100 ns and 800 ms.



Pulse Trigger Selected

This option allows you to trigger on analog level “pulses” on either the Channel 1 input or the Pulse Trigger input. This trigger type is similar to the Channel 1 Analog trigger but places an additional time-based condition on the signal. Depending on whether the pulse width is set as a minimum or a maximum, the signal either must or must not cross the threshold again within the given amount of time.

The red horizontal line (Threshold) and blue vertical lines (defining maximum width) will vary according to the parameter settings. You can specify either one or two thresholds for the level and width settings. The number of labels matches the number of thresholds and the placement follows the polarity.

- For **positive polarity**, the text is "**Rise Above... Stay Below**."
- For **negative polarity**, the text is "**Fall Below and Stay Above**."

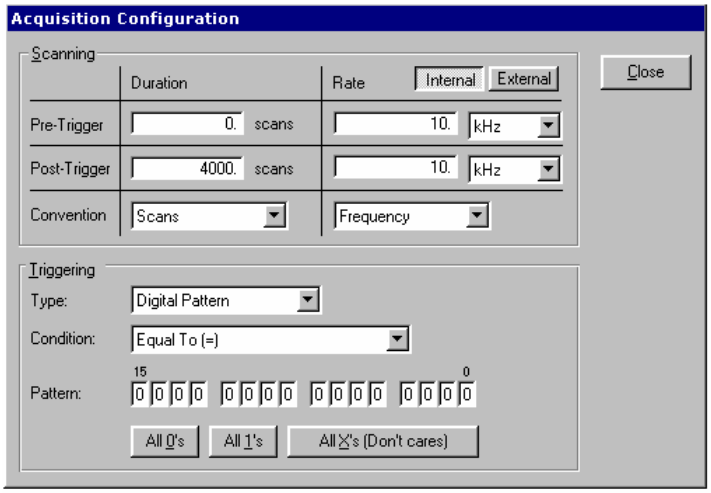
Note: When used as a *maximum*, the pulse width setting can capture signal pulses. As a *minimum*, it is useful for ignoring pulses.

Digital-Pattern Trigger

This type of trigger is useful when trying to capture noise, vibrations or some other physical disturbance that occurs at a particular point in a digitally-sequenced process, such as a relay-logic-control system. When "Digital Pattern" is selected as the Triggering *Type*, the 16-bit pattern extension appears (as indicated in the following figure). The *Condition* box allows the following choices:

Equal To (=) / Not Equal To (< >) – These options treat each digital line as a separate input to be compared to logical 1 or 0. Selecting "Equal To" triggers only on the exact pattern of 1's and 0's selected., while "Not Equal" triggers on all others. You can also set any of the inputs to "don't care" (X), which excludes it from the comparison.

Greater Than (>) / Less Than (<) – These options interpret the digital inputs as a single 16-bit value and allow a threshold trigger.



Acquisition Configuration Dialog Box, with Digital Pattern Extensions

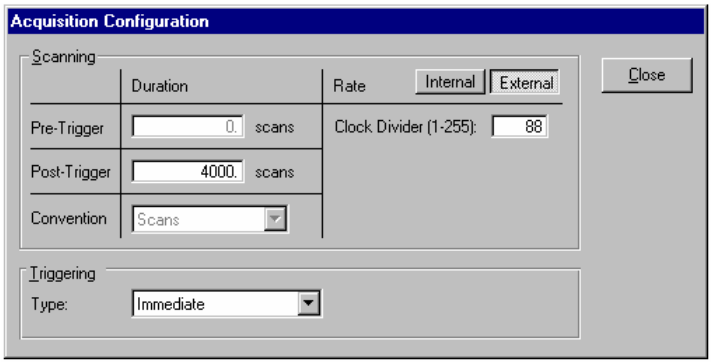
External Clock and Counter-Timer

Note: The *Internal* and *External* buttons located in the *rate* section of the screen (previous and following figures) are used to select Internal Clock or External Clock, respectively.

The external clock is useful when data collection depends on rotational speed or axial position. By synchronizing the system with an external event for correlation of data, you can collect event-dependent data instead of time-dependent data.

Make sure to adhere to the minimum slew rate requirement of 20 v/µs.

WaveBook can receive an ***external clock*** input through pin 20 of the DB25 connector labeled DIGITAL I/O, EXTERNAL CLOCK, TTL TRIGGER. This enables data scanning to be correlated with an *external pulse train*. To enable the ***external clock,*** select "External" for the Scanning Rate in the *Acquisition Configuration Dialog Box* (see following screen shot). When the external clock is enabled, the WaveBook ***begins a scan only after a rising edge on the TTL level occurs***. Optionally, the external clock may be divided [by a factor of 1 to 255]. This "pre-scaling" allows the user to select a reduced scan rate.



Note: The Clock Divider can be set to a value from 1 to 255.

Acquisition Configuration Dialog Box with External Clock Enabled

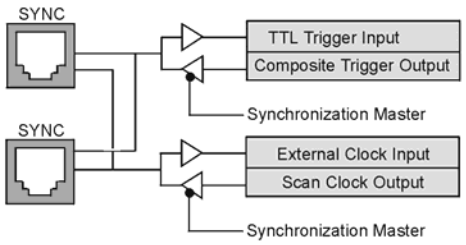
WaveBooks have a 32-bit ***internal counter*** that calculates and reports the external clock's period. The counter can be read with each scan of the analog data. This is often beneficial in later analysis, when there is a need to correlate physical phenomena with speed.

The counter channel actually consists of two independent channels (CtrLo and CtrHi). These can be turned "On" in the *Channel Configuration Spreadsheet*. When enabled, the low (CtrLo), then high (CtrHi) words of the counter will be configured in each scan. Note that the spreadsheet's ***Units*** column can be used to view a predefined period in units of seconds, ms, or µsec.

WaveView can be configured to read *only the low word* of the counter data (CtrLo:"On," CtrHi: "Off"). This decreases the minimum scan period by 1 usec. This *LoCtr only option* can be used *only* when the external clock frequency is greater than 305 Hz (20,000,000 MHz / 65536]. Note that WaveView does not enforce this.

Synchronizing Multiple WaveBooks

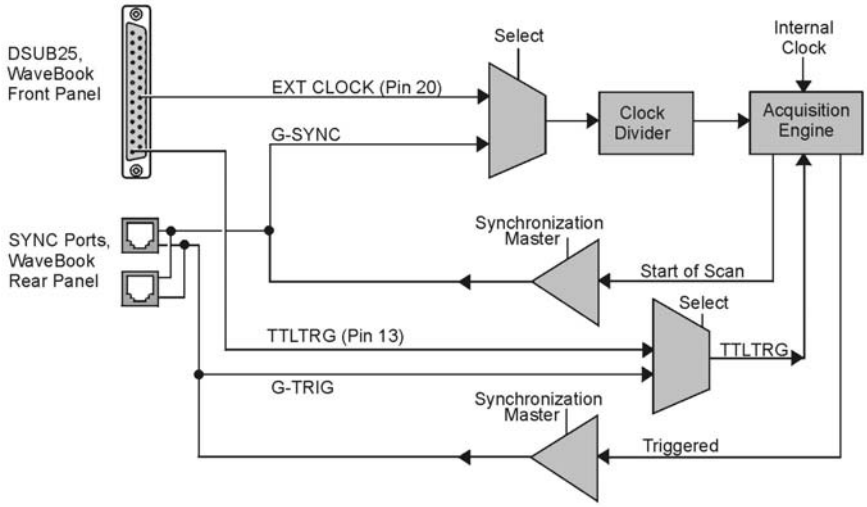
The "A" and "E" Series WaveBooks can be synchronized to other WaveBooks [of those series] or to WBK40 or WBK41 modules via the SYNC ports on those devices. Each unit has two identical SYNC ports located on the rear panel. Either, or both SYNC ports can be used to connect to the other devices via SYNC cables, CA-74-1 or CA-74-5 (1-foot or 5-foot cables, respectively). A WaveBook can be scan-synchronized and triggered from any other "A" or "E" Series WaveBook that is connected to it via a SYNC cable.



The above diagram shows how an "A" or "E" Series WaveBook can input or output synchronization timing and trigger events on either SYNC connector. A more detailed block diagram follows.

Reference Note: The SYNC features are programmable via software. For detailed information see the *Using Multiple Devices* and the **`daqAdcSetClockSource`** sections of the *Programmer's Manual* (p/n 1008-0901). A PDF version of the document is included on the data acquisition CD.

PDF NOTE: During software installation, Adobe® PDF versions of user manuals automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Refer to the PDF documentation for details regarding both hardware and software.



Synchronization Model for "A" and "E" Series WaveBooks

The synchronization model, above, illustrates the SYNC function that is available with WaveBook/512A, WaveBook/516A, and WaveBook/516E.

The following apply:

- One of three clocks can be used to drive the WaveBook's acquisition scan rate. These are:
  - the internal clock
  - an external clock connected via pin 20 of the front panel DSUB25 connector
  - the global sync (G-SYNC) input from the SYNC ports on the WaveBook's rear panel
- Both the SYNC connector input and the external clock input can be divided down.
- When an "A-series" WaveBook is in the Master Mode, both the trigger condition and the scan timing are output on the SYNC port. The global trigger (G-TRIG) is selected instead of the TTLTRIG input from the front panel DSUB25.

Whether the WaveBook is using its **internal scan clock**, or **external clock input** [from the front panel DB25], it can be programmed to output the clock on the SYNC connector. In either case, the WaveBook is behaving like a ***synchronization master***. Other WaveBooks that are connected to the *master* via a SYNC port should be programmed as ***synchronization slaves***.

When a WaveBook is programmed as a *synchronization slave*, it will derive its scan period from the SYNC port. If the *slave WaveBook* must be triggered at the same time as the *master WaveBook*, **then the slave unit should use TTL Trigger as its trigger source**.

Note: Not all trigger modes are supported for multiple WaveBook systems.

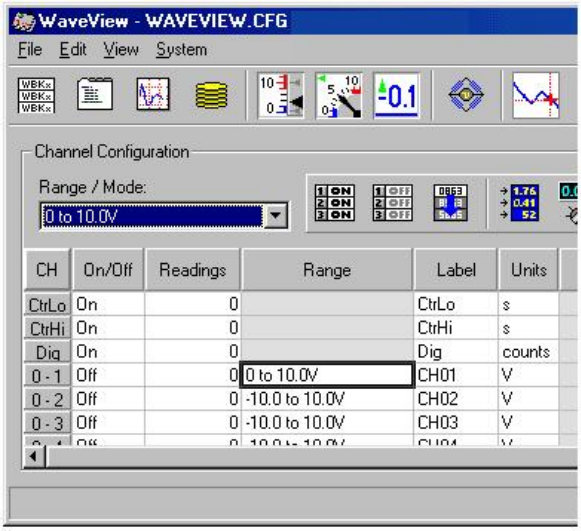
SYNC Notes:

- **When a WaveBook is programmed as a *synchronization slave*, the TTL trigger source is automatically derived from the SYNC port.**
- **When a WaveBook is programmed as a *synchronization master*, it will output its trigger condition on the SYNC port.**
- **When synchronizing two or more "A-series" WaveBooks, the slave WaveBooks should have at least 0.1 µs of *dead time* in the scan period. By "dead time," we mean a duration in which no channels are sampled. This accommodates fundamental differences in the WaveBooks' clocks.**
- **All WaveBooks that are connected via SYNC cables can be *scan-synchronized* to within 0.1µs of each other.**
- **Not all trigger modes are supported for multiple WaveBook systems.**
- **A maximum of 4 units can be synchronized; scan-synchronous (post trigger).**
- **SYNC cables are not to exceed a total combined length of 15 feet (4.57 m).**

Programmable Features

Channels can be configured through your own custom programs or through the included *out-of-the-box* WaveView software. WaveView includes a Channel Configuration screen (following figure) that allows you to turn channels ON or OFF, select channel ranges, change channel labels, and select engineering units.

Reference Note:
The *WaveView* document module contains more detailed information. Individuals who write their own programs should refer to the **readme.txt** file [on the install CD-ROM] in regard to the location of API reference material, including program examples.



Configuring Channels from WaveView's Main Window

Selecting a Channel's Range

You can use WaveView to select a channel's range in one of two ways.

(1) Click in a channel's *Range* cell; then select the desired range from the "Select Range" pull-down list.

(2) Continue to double-click in the applicable channel's *Range* cell to cycle through the available ranges. Stop double-clicking when the desired range is indicated.

Selecting a Channel's Units

You can use WaveView to select a channel's units in one of two ways.

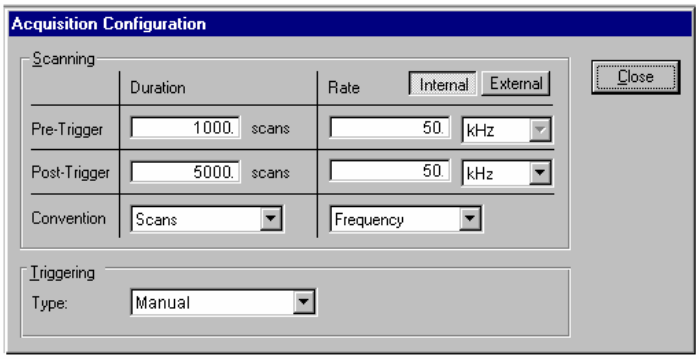
(1) Click in a channel's *Units* cell; then select the desired units from the "Select Units" pull-down list.

(2) Double-click in a channel's *Units* cell to cycle through the units. Note that after the mX+b dialog box appears you must click "OK" to continue cycling.

Note: You can use the **mX+b** equation to adjust a channel's scale and offset. You can enter user-defined units from the mX+b dialog box. An example of using **mx + b** is provided below, and on the following page.

After completing channel configuration, you can select the *Acquisition Configuration* option from WaveView's *View* menu or tool bar. The figure to the right represents the *Acquisition Configuration* dialog box. The parameters shown are a result of the values entered below the figure.

Clicking the Close button sets the acquisition parameters as the active parameters.



Acquisition Configuration Dialog Box

Triggering
Type: Manual

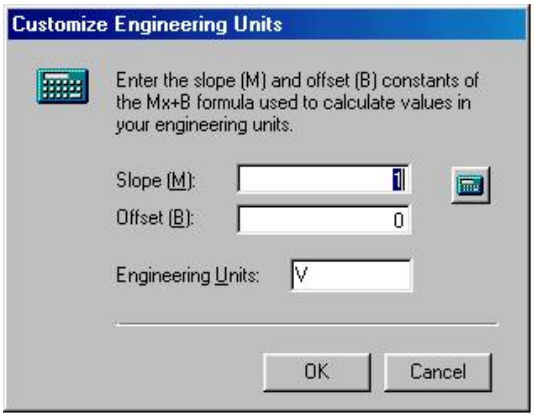
Scanning Duration
Convention: *Scans*
Pre-Trigger: 1000 scans
Post-Trigger: 5000 scans

Scanning Rate
Clock: *Internal*
Convention: *Frequency*
Pre-Trigger: 50 kHz
Post-Trigger: 50 kHz

mX +b, an Example

From the *Customize Engineering Units* dialog box (see figure at right), you can enter values for *m* and *b* components of the equation that will be applied to the data. There is also an entry field that allows you to enter a label for the new units that may result from the **mX+b** calculation.

An example of mX + b equation use follows.



Engineering Units Conversion Using mx + b

Most of our data acquisition products allow the user to convert a raw signal input (for example, one that is in volts) to a value that is in engineering units (for example, pressure in psi). The products accomplish this by allowing the user to enter *scale* and *offset* numbers for each input channel, using the software associated with the product. Then the software uses these numbers to convert the raw signals into engineering units using the following "**mx + b**" equation:

Engineering Units = m(Raw Signal) + b **(1)**

The user must, however, determine the proper values of *scale* (**m**) and *offset* (**b**) for the application in question. To do the calculation, the user needs to identify two known values: (1) the raw signal values, and (2) the engineering units that correspond to the raw signal values. After this, the scale and offset parameters can be calculated by solving two equations for the two unknowns. This method is made clear by the following example.

Example

An engineer has a pressure transducer that produces a voltage output of 10.5 volts when the measured pressure is 3200 psi. The same transducer produces an output of 0.5 volt when the pressure is 0 psi. Knowing these facts, m and b are calculated as follows.

A - Write a pair of equations, representing the two *known* points:

3200 = m(10.5) + b **(2)**

0 = m(0.5) + b **(3)**

B - Solve for m by first subtracting each element in equation (3) from equation (2):

3200 - 0 = m(10.5 – 0.5) + (b - b) **(4)**

Simplifying gives you: **3200 = m(10)** **(5)**

This means: **m = 320** **(6)**

C - Substitute the value for m into equation (3) to determine the value for b:

0 = 320 (0.5) + b **(7)**

So: **b = - 160** **(8)**

Now it is possible to rewrite the general equation (1) using the specific values for m and b that we just determined:

Engineering Units = 320(Raw Signal) - 160 **(9)**

The user can then enter the values of m and b into the appropriate location using the facilities provided by compatible data acquisition software, for example: WaveView, DaqView, Personal DaqView, LogView, and TempView. The software uses equation (9) to calculate signal values in engineering units from that point on.


Notes

Software and Related Documents, an Overview 5

This chapter includes a brief summary of software that can be used for WaveBook system applications, including calibration software. Topics include:

Accessing Software-Related PDF Documents …… 5-1
WaveView *Out-of-the-Box* Software ***…… 5-2***
eZ-Analyst Series Software …… 5-3
Calibration Software …… 5-6
Icon-Based Software (DASYLab® and LabVIEW™) ***…… 5-6***
DaqX Language Drivers for Programmers ***…… 5-6***

Accessing Software-Related PDF Documents

During software installation, Adobe® PDF versions of user manuals will automatically install onto your hard drive as a part of product support. The default location is in the **Programs** group, which can be accessed from the *Windows Desktop*. Initial navigation is as follows:

Start [Desktop "Start" pull-down menu]
⇒ **Programs**
⇒ **IOtech WaveBook Software**

You can also access the PDF documents directly from the data acquisition CD by using the <**View PDFs**> button located on the opening screen.

A copy of the Adobe Acrobat Reader® is included on your CD. The Reader provides a means of reading and printing the PDF documents. Note that hardcopy versions of the manuals can be ordered from the factory.

Software-Related PDFs Applicable to WaveBook



PDF

WaveView_WaveCal.pdf

Discusses how to install and use two "out-of-the-box" applications that are intended for use with WaveBook systems. WaveView is a data acquisition program with a "spread-sheet" style interface that makes it easy to set up your application quickly and begin acquiring data within minutes of completing hardware connections. The second program, WaveCal, is used for periodic calibration of system devices.



PDF
1086-0926
1086-0922

PostAcquisition Analysis.pdf

This PDFconsists of two documents. The first discusses *eZ-PostView*, a post data acquisition analysis program. *eZ-PostView* is included on the data acquisition CD. The second PDF pertains to *eZ-FrequencyView, eZ-TimeView, and eZ-Analyst*. These last three applications have more features than does *eZ-PostView* and are available for purchase. They can; however, be used freely during a 30-day trial period.



PDF
1008-0901

ProgrammersManual.pdf

The programmer's manual pertains to developing custom programs using Applications Program Interface (API) commands.

Note that the install CD-ROM includes WaveBook program examples.

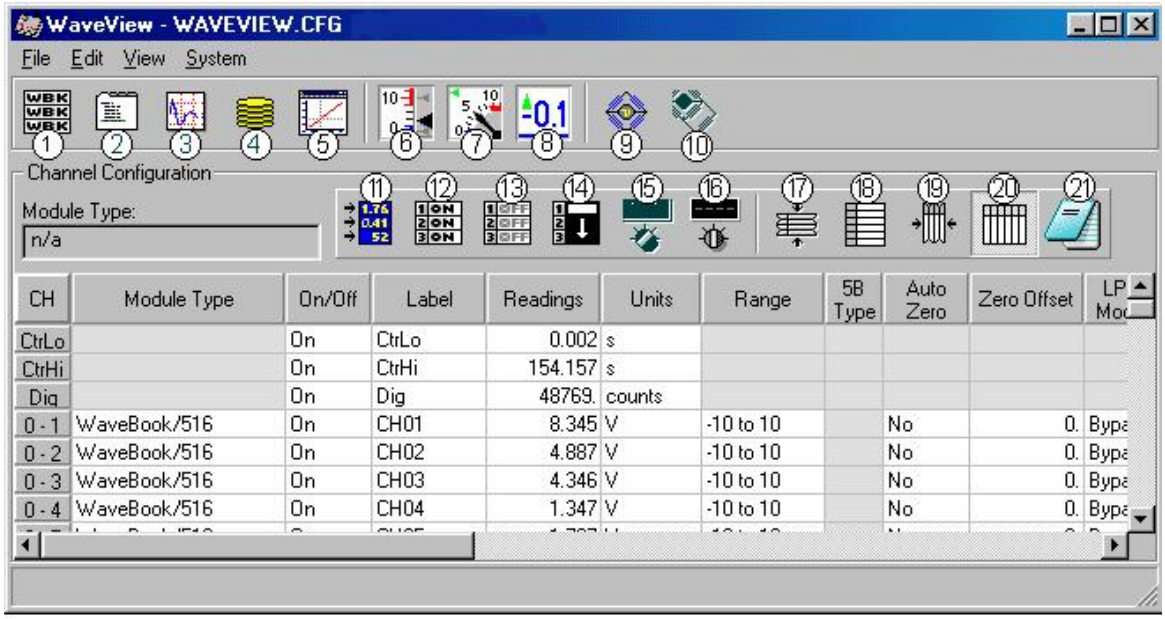
WaveView *Out-of-the-Box* Software

WaveView is a graphical Windows-based program for use in WaveBook applications. This program allows users to acquire data for immediate viewing or for storage to the PC's hard disk. WaveView's "spread-sheet" style interface makes it easy to set up your application quickly and begin acquiring data within minutes of completing hardware connections. No programming knowledge is required.

From *WaveView* you can:

- Set up all analog or digital input parameters.
- Acquire and save data to disk.
- View the acquisition in real-time.
- Send data to other Windows applications, such as spreadsheets and databases.
- Launch an independent, post acquisition data analysis program, such as eZ-PostView to view and analyze data that was previously acquired with WaveView.

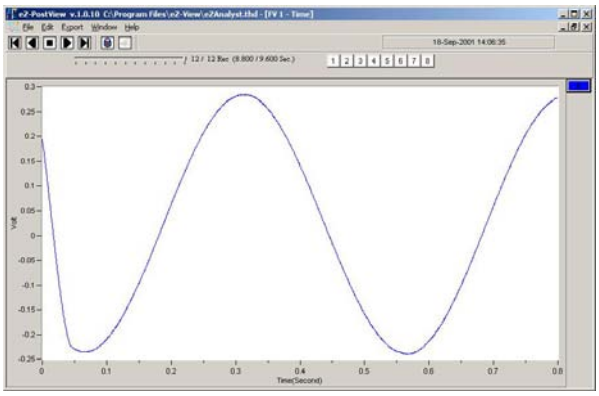
WaveView is detailed in the *WaveView_WaveCal.PDF*.



WaveView Configuration Main Window

WaveView Configuration Main Window, Button Identification			
#	**Item**	**#**	**Item**
1	Module Configuration	12	Make All Channels Active
2	Acquisition Configuration	13	Make All Channels Inactive
3	Scope Window	14	Fill Down
4	Direct to Disk Window	15	Auto Zero Active Channels
5	View File Data	16	Clear All Zero Offsets
6	Bar Graph Meters	17	Hide Inactive Channel Rows
7	Analog Meters	18	Show All Rows
8	Digital Meters	19	Customize Column Layout
9	WBK16 Sensor Calibration	20	Show All Columns
10	WBK16 Shunt Mode	21	Copy Visible Cells to Notepad
11	Enable [Disable] Spreadsheet Readings Column		

eZ-Analyst Series Software

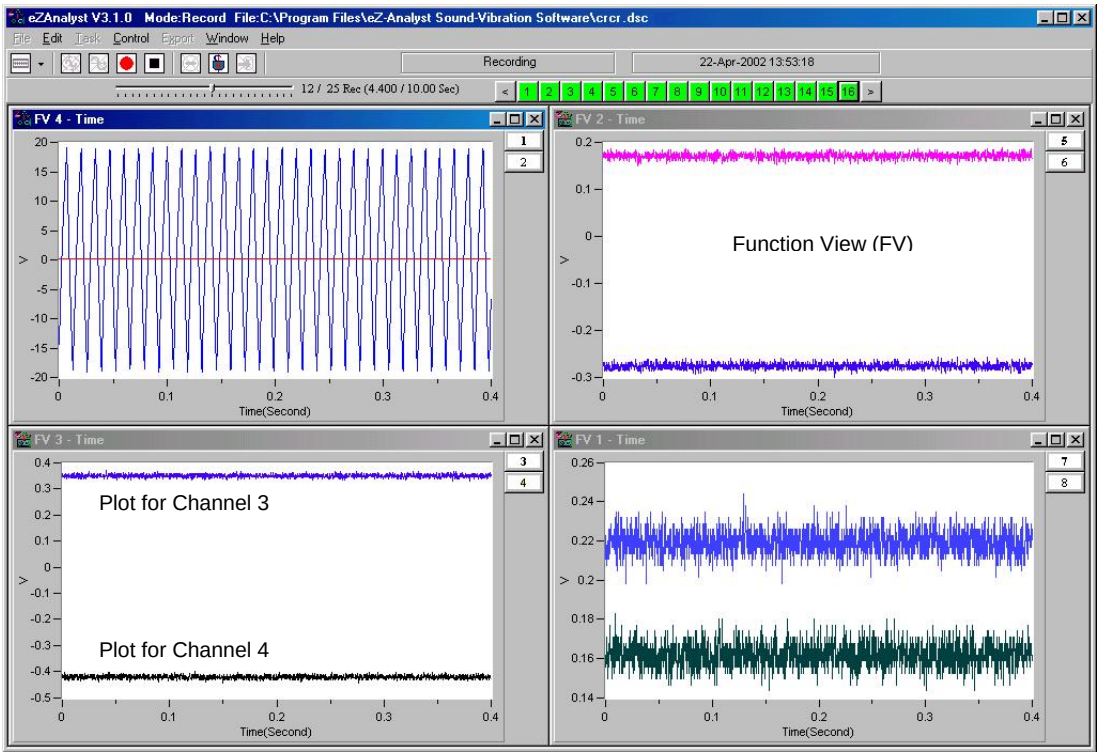


A Screen Capture from eZ-PostView

eZ-PostView, ***eZ-TimeView***, and ***eZ-FrequencyView*** are part of the *eZ-Analyst* "series" software. Each is a **post-acquisition** analysis application that was derived from the more powerful ***eZ-Analyst*** program.

The "view" applications are integrated with the primary data acquisition software, e.g., *WaveView*. The *eZ-PostView* application provides easy-to-use post-acquisition analysis capability, and is included free of charge as a part of product support. The other two *view* programs (*eZ-TimeView* and *eZ-FrequencyView*) have additional features and are available for purchase. These more versatile "view" applications are initially accessed via an authorization-code. Note that the code is only required to "unlock" the application for its first run and is not required for subsequent startups.

The following table (page 5-4) compares the "view" applications to the *eZ-Analyst* program, from which they were derived. At present, the *eZ-Analyst* program is only compatible with WaveBook and ZonicBook devices.



Recording while in eZ-Analyst's Measurement Mode

Comparing the "View" Applications to eZ-Analyst

eZ-Analyst Series Comparison Matrix				
Feature	**Post-Acquisition Viewing Package**			**eZ-Analyst**
	eZ-PostView	**eZ-TimeView**	**eZ-FrequencyView**	
File Input Format Support for: *DaqView, WaveView, Personal DaqView, ChartView*, UFF-58B.	Yes	Yes	Yes	Yes
File Export to: ME'Scope and SMS Modal, Microsoft Excel, Binary Universal File, and ASCII text files.	-----	Yes	Yes	Yes
Display Windows, number of	8	8	8	8
Channel Traces per Display Window	16	16	16	16
Automatic Data Scaling	Yes	Yes	Yes	Yes
Simulated Data Playback	-----	Yes	Yes	Yes
Configurable Data Display for channels and trace colors	Yes	Yes	Yes	Yes
Multiple Tiling of display windows	Yes	Yes	Yes	Yes
Cursor Support - for both Single Cursor and Band Cursor	-----	Yes	Yes	Yes
Data Strip Chart Display	-----	Yes	Yes	Yes
Peak-to-Peak Calculations	-----	Yes	Yes	Yes
Peak Searching, minimum and maximum	-----	Yes	Yes	Yes
Mean Calculations	-----	Yes	Yes	Yes
RMS Calculations	-----	Yes	Yes	Yes
Zooming [of the data display]	-----	Yes	Yes	Yes
Windowed Time Display Function	-----	Yes	Yes	Yes
Cross Channel Support	-----	-----	FFT, FRF, Cross, Coherence, Transfer Function	FFT, FRF, Cross, Coherence, Transfer Function
Transfer Function Display Types	-----	-----	Note 1	Note 1
Complex Function Display Types	-----	-----	Note 2	Note 2
Scale Types	-----	RMS, Peak, Peak-to-Peak	RMS, Peak, Peak-to-Peak	RMS, Peak, Peak-to-Peak
Function Display Types	-----	Time, Strip Chart	Note 3	Note 3
Octave Types	-----	-----	1/3, Full	1/3, Full
Octave Weighting	-----	-----	Linear, A, B, C	Linear, A, B, C
Waterfall Plots	-----	-----	Yes	Yes
Integration/Differentiation (Single/Double)	-----	-----	Yes	Yes
Response Channel FFT Windows	-----	-----	Note 4	Note 4
Reference Channel FFT Windows	-----	-----	Rectangular, Cosine Taper	Rectangular, Cosine Taper
Low-Pass DC Noise Filtering	-----	-----	Yes	Yes
Spectral Strip Chart Display Synchronization	-----	-----	Yes	Yes
Octave Strip Chart Display Synchronization	-----	-----	Yes	Yes
Record and Save Data to Disk	-----	-----	-----	Yes
"Real Time" Data Display	-----	-----	-----	Yes

Notes:

1) ***eZ-Analyst*** and ***eZ-FrequencyView*** - each offers the following **Transfer Function Display Types**: Inertance, Mobility, Compliance, Apparent Mass, Impedance, and Dynamic Stiffness.

2) ***eZ-Analyst*** and ***eZ-FrequencyView*** - each offers the following **Complex Function Display Types**: Magnitude, Phase, Real, Imaginary, Nyquist, Magnitude and Phase, and Real and Imaginary.

3) ***eZ-Analyst*** and ***eZ-FrequencyView*** - each offers the following **Function Display Types:** Spectrum, Auto-Spectrum, PSD (Power Spectral Function), Strip Chart.

4) ***eZ-Analyst*** and ***eZ-FrequencyView*** – each offers the following **Response Channel FFT Windows**: Hanning, Flat Top, Exponential, and Blackman-Harris.

The eZ-Analyst Series "view" programs make use of *eZ-Analyst's* Playback Mode and, therefore, do not require the presence of physical hardware. In fact, when *eZ-Analyst* is in Playback Mode, it is functioning in the exact manner as *eZ-FrequencyView*. In other words, when in PlayBack Mode, *eZ-Analyst* is strictly a post-acquisition display and analysis program.

Raw time-domain data, that has been recorded-to-disk, can be played back for analysis repeatedly. For example, a raw signal could be played back several times, each time using a different filtering algorithm to manipulate the original signal. Once the desired results have been achieved the new data can be exported in a new format and to a different file. The original file can remain unchanged, and kept for future analysis.

The "view" programs make use of a Play Task Bar.

Note: WaveBook user's who want to have post-data analysis *view capabilities* accessible from *WaveView's* <View Data> button will need to install one of the "view" applications, i.e., *eZ-PostView, eZ-TimeView*, or *eZ-FrequencyView*. The latter two applications are available for purchase. The *eZ-PostView* application is free.

eZ-FrequencyView

When you are using eZ-FrequencyView, you are essentially running eZ-Analyst in its Playback Mode. The table on page 5-4 indicates the applicable features. You can not record data from eZ-FrequencyView.

eZ-FrequencyView is supported by the primary data acquisition programs, for example, DaqView, LogView, and WaveView. It can be accessed through the primary application's View Data button, or accessed independently from your program files directory (where you installed your software).

The first time you run eZ-FrequencyView, you will need to enter an authorization code. The code is supplied when the package is purchased.

eZ-TimeView

When you are using *eZ-TimeView*, you are essentially running *eZ-Analyst* in its Playback Mode, minus several analysis features that are available in *eZ-FrequencyView* and *eZ-Analyst*. For example, when using *eZ-TimeView* there are no Transfer Function Display Types, Complex Function Display Types, or FFT Windows available. However, the application does provide calculation options pertaining to peak-to-peak, mean, RMS, and does allow for data zooming. Refer to the table on page 5-4 for a complete list of the applicable features. Note that you can not record data from *eZ-TimeView*.

eZ-TimeView is supported by the primary data acquisition programs, for example, DaqView, LogView, and WaveView. It can be accessed through the primary application's View Data button, or accessed independently from your program files directory (where you installed your software).

The first time you run *eZ-TimeView*, you will need to enter an authorization code. The code is supplied when the package is purchased.

eZ-PostView

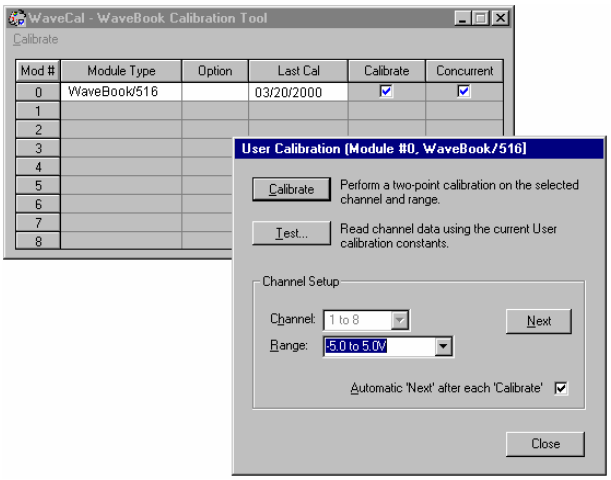
eZ-PostView provides simple "time-domain" viewing. From this application you can display up to 8 time-domain function windows and display up to 16 channel traces per window. Data is automatically scaled to optimize its fit in the window. Window, channel trace, and cursor colors can be customized.

eZ-PostView is a free "view" program. The application has no Transfer Function Display Types, Complex Function Display Types, or FFT Windows available. Refer to the table on page 5-4 for a complete list of the applicable features. Note that you can not record data from eZ-PostView.

eZ-PostView is supported by the primary data acquisition programs, for example, DaqView, LogView, and WaveView. It can be accessed through the primary application's View Data button, or accessed independently from your program files directory (where you installed your software).

You do not need to enter an authorization code to run eZ-PostView.

Calibration Software



WaveCal's WaveBook Calibration Tool and User Calibration Box

WaveBooks are calibrated at the factory, prior to shipment. However, the units must be periodically re-calibrated. WaveCal (a WaveBook calibration application) is included as a part of WaveBook product support. The application is discussed in the *WaveView_WaveCal* document, which is included as a part of the product support [PDF] documentation package.

Icon-Based Software (DASYLab® and LabVIEW™)

Most WaveBook users do not need to go beyond WaveView and the post acquisition data analysis program to satisfy their application needs. However, for individuals who want to customize their applications, "icon-based" programs such as DASY*Lab*® and LabVIEW™ offer a great degree of flexibility.

The installation CD includes language drivers for DASY*Lab*® and LabVIEW™. The CD also includes program examples for each. The CD does not, however, include user documentation dedicated to these software packages.

Individuals using either of these programs should refer to their DASY*Lab*® or LabVIEW™ user manuals, as applicable. You can obtain additional information from your sales representative.

DaqX, Language Drivers for Programmers

No programming knowledge is required for using WaveBook in conjunction with the included *Out-of-the-Box* software package; However, a set of language drivers is included on the install CD-ROM for individuals who want to develop their own custom applications using:

- **C/C++**
- **Visual Basic**

The CD includes program examples and a *Programmer's Manual* (p/n 1008-0901) in PDF format.

The Programmer's Manual automatically installs during software installation for WaveBook Support, and will be located in the directory you chose to install the WaveBook Support programs. The **Programs** file group is the default location. Note that you will need to use Adobe® Acrobat Reader, to view or print the manual. We have included a copy of the reader on the CD.

CE Compliance and Noise Considerations 6

Overview ……6-1
CE Standards and Directives …… 6-1
Safety Conditions ……6-2
Emissions/Immunity Conditions ……6-3
Using Shielded BNC Connectors for CE Compliance …… 6-3
CE Compliance for WaveBook System Expansion …… 6-3
Noise Considerations …… 6-4

Overview



CE compliant products bear the "CE" mark and include a *Declaration of Conformity* stating the particular specifications and conditions that apply. The test records and supporting documentation that validate the compliance are kept on file at the factory.

The European Union established CE standards in 1985. The standards include specifications for safety, EMI emissions, and immunity from electromagnetic interference. Products that are intended for placement in the European Union must meet or exceed the standards and bear the "CE" mark.

Although not required in the USA, meeting or exceeding the CE standards is considered good engineering practice, since doing so enhances safety while reducing noise and ESD problems.

In contracted and in-house testing most acquisition products met the required specifications. In many cases products that were not originally in compliance were redesigned accordingly. In noted instances alternate product versions, shield plates, edge guards, special connectors, or add-on kits are required to meet CE compliance.

CE Standards and Directives

The electromagnetic compatibility (EMC) directives specify two basic requirements:

1. The device must not interfere with radio or telecommunications.
2. The device must be immune from electromagnetic interference from RF transmitters, etc.

The standards are published in the *Official Journal of European Union* under direction of CENELEC (European Committee for Electrotechnical Standardization). The specific standards relevant to data acquisition equipment are listed on the product's *Declaration of Conformity*.

The safety standard that applies to data acquisition products is EN 61010-1 : 1993 (*Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements*). Environmental conditions include the following:

- indoor use
- altitude up to 2000 m
- temperature 5°C to 40°C (41°F to 104°F)
- maximum relative humidity 80% for temperatures up to 31°C (87.8°F) decreasing linearly to 50% relative humidity at 40°C (104°F)
- mains supply voltage fluctuations not to exceed ±10% of the nominal voltage
- other supply voltage fluctuations as stated by the manufacturer
- transient overvoltage according to installation categories (overvoltage categories) I, II and III For mains supply, the minimum and normal category is II
- pollution degree I or II in accordance with IEC 664

For clarification, terms used in some Declarations of Conformity include:

- **pollution degree**: any addition of foreign matter, solid, liquid or gaseous (ionized gases) that may produce a reduction of dielectric strength or surface resistivity. **Pollution Degree I** has no influence on safety and implies: the equipment is at operating temperature with non-condensing humidity conditions; no conductive particles are permitted in the atmosphere; warm-up time is sufficient to avert any condensation or frost; no hazardous voltages are applied until completion of the warm-up period. **Pollution Degree II** implies the expectation of occasional condensation.
- **overvoltage (installation) category**: classification with limits for transient overvoltage, dependent on the nominal line voltage to earth. **Category I** implies signals without high transient values. **Category II** applies to typical mains power lines with some transients.

Safety Conditions

Users must comply with all relevant safety conditions as stated in the user's manual and in the pertinent *Declarations of Conformity*. Both the documentation and the associated hardware make use of the following Warning and Caution symbols. If you see any of these symbols on a product or in a document, carefully read the related information and be alert to the possibility of personal injury and/or equipment damage.



This WARNING symbol is used in documentation and/or on hardware to warn of possible injury or death from electrical shock under noted conditions.



This WARNING/CAUTION symbol is used to warn of possible personal injury or equipment damage under noted conditions.



This CAUTION symbol warns of possible equipment damage due to electrostatic discharge. The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage. You should always handle components carefully, and you should never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate ESD-controlled area. Such guidelines include the use of properly grounded mats and wrist straps, ESD bags and cartons, and related procedures.



Unless otherwise stated our data acquisition products contain no user-serviceable parts. Only qualified personnel are to provide service to the devices.

The specific safety conditions for CE compliance vary by product; but general safety conditions include the following bulleted items:

- The operator must observe all safety cautions and operating conditions specified in the documentation for all hardware used.
- The host computer and all connected equipment must be CE compliant.
- All power must be off to the device and externally connected equipment before internal access to the device is permitted.
- Isolation voltage ratings: do not exceed documented voltage limits for power and signal inputs. All wire insulation and terminal blocks in the system must be rated for the isolation voltage in use. Voltages above 30 Vrms or ±60 VDC must not be applied if any condensation has formed on the device.
- Current and power use must not exceed specifications. Do not defeat fuses or other over-current protection.

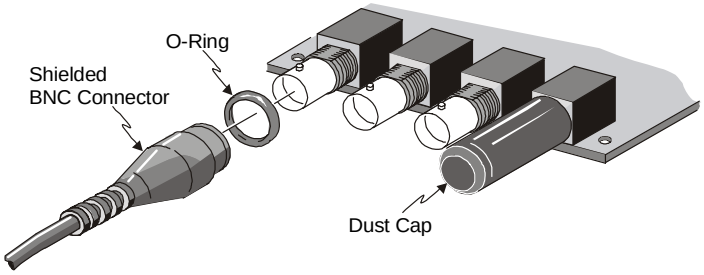
Emissions/Immunity Conditions

The specific immunity conditions for CE compliance vary by product; but general immunity conditions include:

- Cables must be shielded, braid-type with metal-shelled connectors. Input terminal connections are to be made with shielded wire. The shield should be connected to the chassis ground with the hardware provided.
- The host computer must be properly grounded.
- In low-level analog applications some inaccuracy is to be expected when I/O leads are exposed to RF fields or transients over 3 or 10 V/m as noted on the Declaration of Conformity.

Using Shielded BNC Connectors for CE Compliance

Certain *Declarations of Conformity* identify specific cables and connectors that must be used to meet CE requirements. CE compliant BNC-equipped cards and modules have BNC connectors that are insulated from high voltage sources, including electrostatic discharges (ESD). Such voltages could enter the circuitry through the exposed conductive surface of a connector, possibly resulting in damage to components.



Shielded BNC Connector (with O-Ring) and PVC Dust Cap

To meet CE requirements, PVC dust caps (p/n CN-96) must cover all unused BNC connectors. When dust caps are not in place, special coaxial cables (with insulated end-connectors and rubber O-rings) must be used. Note that part number 418-0800 includes two cables (with shielded BNC connectors at each end), and four insulating O-rings.

Properly installed connectors and dust caps ensure the metallic surfaces of the connectors are not exposed to undesirable electrical charges.

CE Compliance for WaveBook System Expansion

WaveBooks are CE Compliant at the time they leave the factory. They will remain in compliance providing that the conditions stated on the *WaveBook Declaration of Conformity* (p/n 489-0740) continue to be met.

Prior to making any efforts to expand the system refer to the *Declaration of Conformity* for each intended system component. Connecting a *non-CE Compliant* module or card to your system will make the system non-compliant. In certain scenarios the use of special shielded cables may be required.

A few general rules of thumb regarding the expansion of CE compliant WaveBook systems are:

- Use short cables, e.g. CA-35-12, CA-202.
- When possible use shielded cables.
- When assembling or disassembling components, take ESD precautions, including the use of grounded wrist straps.
- Ensure that the host computer is CE Compliant.
- Ensure that expansion devices are CE Compliant; and review the most recent *Declaration of Conformity* for each device.
- Ensure all system components are properly grounded.

Noise Considerations

Controlling electrical noise is imperative because it can present problems even with the best measurement equipment. Most laboratory and industrial environments suffer from multiple sources of electrical noise. For example, AC power lines, heavy equipment (particularly if turned on and off frequently), local radio stations, and electronic equipment can create noise in a multitude of frequency ranges.

Local radio stations are a source of high frequency noise, while computers and other electronic equipment can create noise in all frequency ranges. Creating a completely noise-free environment for test and measurement is seldom practical. Fortunately, simple techniques such as using shielded/twisted pair wires, filtering, and differential voltage measurement are available for controlling the noise in our measurements. Some techniques prevent noise from entering the system; other techniques remove noise from the signal.

While many techniques for controlling noise in signals provide a means of removing the noise that is already present, the preferred solution is to prevent the occurrence of noise in the signal in the first place.

The following practices, some of which are required for CE compliance, should be employed to minimize noise.

- **Make a solid earth ground connection**. *Required for CE Compliance*. Ensure that the chassis of the primary data acquisition device, e.g., WaveBook/516E is connected to earth ground. This practice: (a) keeps radiated emissions low by keeping the chassis electrically quiet, (b) keeps potential common-mode voltages low, (c) improves user safety, and (d) provides a safe path for Electrostatic Discharge energy back to earth ground.

- **Use short Ethernet cables**. The use of short Ethernet cables will reduce noise. The shorter the cable the better.

- **Use shielded cables**. Loose wires are effective antennae for radio frequency pickup and can form loops for inductive pickup. The use of properly connected shields will greatly reduce such noise.

- **Minimize ambient EMI**. The lower the ambient EMI, the better. Sources of electromagnetic interference include solenoids, motors, computer equipment, high power distribution wiring, etc.

- **Distance cables**. Power supply switch transients can vary in strength and frequency. Ethernet cables can radiate digital switching noise. For these reasons route the power supply and Ethernet cables such that they are as far as possible from analog lines. By analog lines we mean both the analog channel input lines on the front panel and the analog expansion (WBK expansion) on the rear panel of the device.

- **Use ferrite inductive collars**. *Required for CE Compliance*. A clamp-on ferrite collar is to be secured on both ends of the Ethernet cable and on the DIN5 end of the power supply cable [and/or near the DC power source]. The collars on the Ethernet cable will reduce digital switching noise. The ferrite inductive collars will not reduce the integrity of the Ethernet channel if the system is making use of shielded Ethernet cables, IOtech part number CA-242. A properly placed ferrite collar(s) on the power cable will reduce power supply switch transients.



This partial view of the host PC shows the Ethernet cable with a ferrite collar. The PC's connection to the ground-line is also visible.



This partial view of a data acquisition device shows its connection to the ground-line. It also shows two ferrite collars, the foremost of which is clamped to the power cable. The background collar is clamped onto the Ethernet cable.

Troubleshooting and Customer Support 7

Electrostatic Discharge (ESD), Handling Notice…… 7-1
Product Care …… 7-1
ReadMe Files and the Install CD-ROM ……7-2
Driver Support……7-2
Troubleshooting Tables ….. 7-3
Frequently Asked Questions …… 7-18
Customer Support …… 7-22

Electrostatic Discharge (ESD), Handling Notice



The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage. You should always handle components carefully, and you should never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate ESD-controlled area. Such guidelines include the use of properly grounded mats and wrist straps, ESD bags and cartons, and related procedures.

Product Care

WaveBooks and WBK options are essentially maintenance free and require a minimal amount of care. They should be treated much like other high-tech equipment. In general:

- Keep them clear of harsh chemicals and abrasive elements.
- Avoid exposing the products to extreme heat, for example, avoid setting up a WaveBook system near a boiler or furnace.
- Avoid extreme shock and vibration.
- Avoid subjecting the units to liquids and extremely fine air particulate, such as silica dust.
- Never touch circuit boards without proper ESD (Electrostatic Discharge) measures in place.

A “common-sense” approach to handling WaveBook products will go a long way in protecting them from inadvertent damage.

Note that you can use lint-free rags and Isopropyl Alcohol (Rubbing Alcohol) to clean the outer plate surfaces of WaveBook and WBK modules.



ReadMe Files and the Install CD-ROM

The Install CD-ROM includes ReadMe Files. These files often contain late-breaking information that may not appear in the user documentation. During installation you should review the ReadMe files when prompted to by the program.

The Install CD-ROM includes:

- WaveBook Windows NT/2000/XP driver
- WaveBook Windows 95/98/Me driver
- **DaqX.DLL** (32-bit API) for WaveBook
- Microsoft C/C++ API support
- Microsoft VB API support
- Daq Configuration Control Panel Applet
- User documentation in Adobe® PDF format

Upon installation, the user needs to run the *Daq Configuration* Control Panel applet. The applet is used to configure WaveBook for an appropriate LPT port. This must be performed in order for the application to access WaveBook through the Windows driver.

Driver Support

The daqX API can be used with WaveBook, DaqBook, DaqBoard, Daq PC Card and TempBook product lines. All daqX functions share the **daq** prefix.

The API support examples can be found in the installed directory **\LANGS\WAVEBOOK**.

Troubleshooting Tables

This section of the chapter pertains to WaveBook systems. Tables are used to identify potential problems, probable causes, and possible solutions. If you are using the pdf version of the document, you can click on the appropriate link below to quickly access the table associated with your system's problem.

	Symptom	Pg.
1	No communication with the PC.	7-4
2	IRQ test fails.	7-5
3	ECP and / or EPP protocol problem.	7-5
4	"Simulated Device" is the only device.	7-6
5	FIFO or Buffer Over-Run Error.	7-6
6	WBK modules and expansion channels are not recognized.	7-6
7	Channel readings are wrong.	7-7
8	WBK15 channel readings are wrong.	7-8
9	WaveView Scope stops.	7-8
10	"Insufficient Memory"	7-9
11	Scan rate – the maximum rate cannot be reached.	7-9
12	External acquisition pacer does not work.	7-9
13	WBK16 channels won't calibrate.	7-10
14	Ethernet problems.	7-11
15	Parallel port problems.	7-14

1. WaveBook does not communicate with the PC.	
Possible Causes	**Details and Possible Solutions**
There is a problem with WaveBook's power.	If the WaveBook system and the host PC fail to communicate with each other, verify that: (1) the WaveBook is powered on, and that (2) the power supply is not overloaded. Although the WBK expansion modules do not get power from the host WaveBook, when the power adapter is "daisy-chained" from the WaveBook to the expansion modules the power adapter may not have enough power for the entire system. This can cause power deprivation within the WaveBook, which hinders communication with the PC. Check the power requirements of each component to ensure that the use of the system's existing AC adapters is sufficient. If not, use additional AC adapters, for example, one for each component; or at least to create smaller power daisy-chains that do not exceed the adapter's limits. Chapter 2 includes information regarding *system setup and power options*. Chapter 3 includes several additional *examples of system setups*.
Faulty parallel port cable or connection.	Check that the parallel port cable is not loose, damaged, connected to the wrong PC port, or is not compatible with the system [standard parallel port cables are not compatible, as explained later]. Check both ends of the parallel port cable to verify proper connection. If the cable appears fine and the connections are good check to see that the cable was supplied from the factory. If not, it may be incompatible and should be replaced with a factory issued cable (CA-35-12, 12 inch cable; CA-35-2, 2-foot cable; or CA-35-6, 6-foot cable). These three cables are 1284-compliant. Standard parallel cables will not work properly, primarily due to a lack of shielding. For related information refer to table 15, *Parallel Port Problems.*
The LPT port is not correctly configured.	The LPT Port may not be properly configured in CMOS for the selected protocol. Selecting a communications protocol [such as such as EPP or ECP] in the *Daq Configuration* utility, generally requires that this mode also be set in the PC BIOS settings. This must be done in both the CMOS Setup of the PC BIOS as well as in the Windows device manager. In Windows NT, this need only be done in CMOS and the system will adjust to the change. Refer to your computer's specific user's manual for instructions on changing the parallel port mode. For related information refer to table 15, *Parallel Port Problems.*
Faulty Ethernet cable or connection	For WaveBook/516E and WBK25 applications - The Ethernet cable may be loose, damaged, or not connected. Check the Ethernet line and its connections at the WaveBook/516E [or WBK25] and at the PC Ethernet jack, or Ethernet Network hub, as applicable. For related information refer to table 14, *Ethernet Problems.*
The selected protocol is not compatible.	In regard to parallel ports – The selected protocol, e.g., 8-bit, ECP, EPP, might be incompatible between the PC and the WaveBook. This is possible because parallel ports vary somewhat from one manufacturer to another. While some protocols may work with WaveBooks on certain PCs, those same protocols may not work on others. If the EPP mode will not work, it is likely due to a subtle incompatibility between the particular PC and the IOtech drivers. In these cases, a more generic protocol such as Standard 8-bit or 4-bit protocol must be used. Standard 4-bit protocols are likely to work, even when others do not. For related information concerning parallel ports see table 3, *ECP and / or EPP protocol problem* and table 15, *Parallel Port Problems.* In regard to Ethernet Connections - For WaveBook/516E and WBK25 applications - Run the *Daq Configuration* applet from the Windows Control Panel. Make sure the device is configured to the appropriate Ethernet port with the appropriate protocol. Run the device test and if it fails try other protocols for the device. Note: Before re-running the test be sure to click on the `<Apply>` button to apply the settings. For related information concerning Ethernet connections refer to table 14, *Ethernet Problems.*

(continued)

Table 1, No communication with the PC, (continued)	
Possible Causes	**Details and Possible Solutions**
Another application is communicating with WaveBook.	WaveBooks are limited to communicating via one software application at a time. Thus, if an application such as *LabVIEW*, *DASYLab* or a custom API currently has communication established with the WaveBook, *WaveView* will not be able to communicate with the device. In the case of DASYLab, simply having a worksheet open that references a particular unit, will not allow any other application [such as *WaveView*] to open communications with that unit. In custom API programs communications to multiple units may be established, e.g., WaveBooks on multiple parallel ports. In such cases, only the current program may establish communications with these devices.
A WBK30 has been removed.	If a WBK30 memory option has been removed and the three associated bypass jumpers have not been installed inside the WaveBook (on header J101), communications to the PC will not occur. WaveBook/516E users will need to contact the factory in regard to WBK30 issues. Users of other WaveBook models should refer to the *WBK30* section of the *WBK Options User's Manual* (p/n 489-0902).

2. IRQ test fails.	The IRQ test did not pass in the *Daq Configuration* Utility.
Possible Causes	**Details and Possible Solutions**
There is a shared interrupt.	WaveBook drivers do not allow sharing of interrupts; thus the IRQ test failure was likely caused by the interrupt [which is assigned to the LPT port] being assigned elsewhere. In the case of parallel port communications, ensure that the parallel port has exclusive assignment of the interrupt used.
Windows/2000's Device Manager is not set to use interrupts.	Windows/2000 allows the user to select whether or not to use assigned interrupts for a particular device. The IRQ test failure could be due to the Device Manager being set not to use interrupts. Make sure that the Device Manager is selected to the "Use any assigned interrupt" option.

3. ECP and / or EPP protocol problem.	WaveBook is not working with ECP or EPP protocols.
Possible Causes	**Details and Possible Solutions**
The driver is not supportive of ECP protocol.	The driver version may not support the ECP protocol. Review the *read.me* file for your current installation to ensure that ECP compatibility is featured. Note that the latest drivers can be downloaded from the IOtech website, free of charge.
The EPP type is not compatible with WaveBook.	Although the WaveBook may have EPP capability, because the EPP protocol is a diversely interpreted it is possible that the PC's EPP type and version is not compatible with that of the WaveBook. Note that ECP is a more highly defined protocol; and for this reason ECP should be used in cases where EPP does not appear to be compatible
The WaveBook is not ECP compatible.	If the WaveBook was manufactured prior to June of 2000 it is likely to be incompatible with the ECP protocol. This incompatibility issue can be resolved via an upgrade. Contact the factory for additional information.
	Also refer to table 15, *Parallel Port Problems.*

4. "Simulated Device" is the only device.

Possible Causes	Details and Possible Solutions
There is no device handle for the WaveBook in the Daq Configuration applet.	When the simulated device is the only device that can be selected in WaveView, the problem is most likely that there is no device handle for the WaveBook. Device handles are created in the *Daq Configuration* control panel applet by the user. The applet can be accessed from the Windows desktop by navigating from the Start menu as follows: **Start ⇒ Settings ⇒ Control Panel ⇒ Daq Configuration** Any WaveBook devices that are currently configured in this utility will appear in the list of available devices in WaveView. Refer to Appendix A, *Using the Daq Configuration Applet* for details on how to create a device handle.

5. FIFO or Buffer Over-Run Error.

Possible Causes	Details and Possible Solutions
The scan rate exceeds the parallel port's throughput capability.	If a FIFO or a Buffer-Over-Run Error exists, it is likely that the configured scan rate is too high for the parallel port to handle. FIFO over-runs generally occur when the acquisition speed of data-samples per second exceeds the throughput capabilities of the parallel port interface. Once a device handle is created in the *Daq Configuration* utility [in the Windows Control Panel] the hardware may be tested for communications and data transfer speeds. The test reports the data transfer speed in samples per second and is done with full control of system resources. This establishes the best performance. However, in real applications other system resource requirements may prevent the full rate [as reported by the test] from actually being achieved. Generally, the data transfer rate can be guaranteed to be at least half of the reported speed.

6. WBK modules and expansion channels are not recognized.

Possible Causes	Details and Possible Solutions
The expansion control cable or connection is bad.	Make sure that each expansion control cable (p/n CA-129) is connected to the proper port of the WaveBook and associated WBK Module. The cable coming from the WaveBook must be connected to the port labeled "Expansion Control." The expansion control cable is connected to the "Expansion Control In" port of the WBK Modules. Each WBK Module is equipped with an "Expansion Control Out" port for "daisy-chain" connection to other WBK Modules. Chapter 2, *System Setup and Power Options*, includes examples of system connections.
The expansion signal cable or connection is bad.	Make sure that each expansion signal connection cable (p/n CA-150) is properly connected to expansion signal BNC ports. If the cable is defective, not present, or poorly connected, the host WaveBook won't be able to identify the associated WBK Module's voltage signature. Chapter 2, *System Setup and Power Options*, includes examples of system connections.
There is insufficient power to one or more system components.	Proper operation is unlikely if any component of the WaveBook system is not adequately powered. Check the power requirements for each attached WBK module and make sure that adequate power is provided for each. Pay special attention to scenarios in which one AC adapter is shared between multiple units. Chapter 2, *System Setup and Power Options*, includes power requirement tables.

7. Channel readings are wrong.	
Possible Causes	**Details and Possible Solutions**
The channel is turned off.	The On/Off column in WaveView's Channel Configuration screen must be selected to "On" for the applicable module.
There are no input signals connected.	Verify that the channel inputs actually have input signals connected to them. Inputs that are not actually connected to a signal may behave erratically and result in erroneous readings. Unused channels should be turned off or at least shorted to analog common to prevent their values from floating.
The Simulated Instrument mode is selected.	Channel readings will not be true if WaveView is in the "Simulated Instrument" mode. When in this mode the readings displayed are, as the mode's name implies, simulated and there is no correlation to the signal lines connected to the hardware. If this is the case, simply select the desired WaveBook from the "Select Device" option in WaveView's *System* pull-down menu.
The scaling via y = mx + b needs adjusted.	Readings can be off due to improper scaling such as volts to millivolts, incorrectly configured TC or 5B module types or user defined mX+b equations. In the case of voltage readings (V), ensure that the units being displayed are not being displayed in mV. The "Units" section of the WaveView document includes an example of how the y = mx + b equation is used for scaling.
The chart's limits need adjusted.	Make sure that the amplitude of the signal being measured falls within the current min./max. scale settings of the chart's Y axis. The upper and lower limits can be changed after the acquisition is stopped. Simply type the new scale limits over the current ones. The *Collect and View Data* section of the WaveView document provides additional information.
The wrong channel is assigned to the chart.	Erroneous readings can be due to the wrong channel having been assigned to the chart. Make sure that the intended channel was selected. In WaveView, the channel is selected from a list box in the upper right-hand corner of the chart. The channels will appear in the list based on their "Label" from the main Channel Configuration spread sheet.
An option card was installed or removed by the user. These are: *WBK11A* *WBK12A* *WBK13A* *WBK30*	If an option card (WBK11A, WBK12A, or WBK13A) was removed or installed outside of the factory, acquired data will likely be erroneous. If this is the case, contact the factory or your service representative. WaveBook/516E Users: WBK option cards, including the WBK30 memory card, are installed in WaveBook/516E at the factory per customer order. Users are not to remove or install these cards as the cards are not "plug-and-play" with respect to WaveBook/516E. Erroneous signal values can result. If you desire to remove or add a card to WaveBook/516E contact the factory or your service representative. WaveBook/516, /516A, /512A, and WBK10A Users: With exception of the WBK30 option, WBK option cards for WaveBook/516, /516A, /512A, and WBK10A are installed at the factory per customer order. Users are not to remove or install cards [other than WBK30 series cards] as the cards are not "plug-and-play" for these devices and erroneous signal values could result. If you desire to remove or add a card to these products, contact the factory or your service representative. WBK30 Note: If a WBK30 memory option has been removed and the three associated bypass jumpers have not been installed inside the WaveBook (on header J101), communications to the PC will not occur. WaveBook/516E users will need to contact the factory in regard to WBK30 issues. Users of other WaveBook models should refer to the *WBK30* section of the *WBK Options User's Manual* (p/n 489-0902).
WBK15 Channel Issues	In regard to WBK15, in addition to this table refer to table 8, *WBK15 channel readings are wrong*.

8. WBK15 channel readings are wrong.

Possible Causes	Details and Possible Solutions
>	**Note**: The preceding table also applies to WBK15.
The wrong 5B type has been selected.	Check that the correct 5B Module type is selected in WaveView. Selection is made by clicking on the applicable WBK15 channel's Range / Mode cell in WaveView's Channel Configuration screen. This brings up a pull down list from which you can select the proper 5B module, for example, a 5B30-06 or a 5B47-B-11 The WBK15 section of the *WBK Options Manual* includes software setup information pertaining to 5B modules. A PDF version of the document is included on the data acquisition CD.
The wrong scaling is in effect.	WaveView automatically selects the scale related values m and b (in the y = mx + b equation) according to the type of 5B module; however, a user can easily change these values to customize the engineering units. Refer to the technical information for the specific 5B Module to ensure that the proper correlation exists between the input sensor's units and 5B module's output scale. In regard to customizing the scale via WaveView, refer to the WBK15 Software Setup section in the *WBK Options Manual.*
There is insufficient power to the 5B module.	5B Modules require +5VDC power and some minimum amount of available current, which is typically supplied by the WBK15. In cases where strain gage modules are used, ensure that no overloading of the excitation output is occurring through bridge circuits.
The thermocouple leads are reversed.	If readings appear to be negative when they should be positive, verify that the thermocouple leads are not reversed.
The load cell excitation source is overloaded or not connected properly.	Some 5B Module types, for instance strain gage conditioners, provide an excitation source for the connected sensor. Check the specifications for the module and make sure that the excitation source is properly connected and not over-loaded.

9. WaveView Scope stops.

Possible Causes	Details and Possible Solutions
Auto-Rearm is disabled.	If the WaveView Scope acquires and displays data but then stops running, it is most likely due to the Auto-rearm feature being disabled. If you desire to view data continuously click the auto-rearm button in the scope window, or select auto-rearm in the Scope window's Acquire pull-down menu. Refer to the section, *WaveView Scope Window*, in the *WaveView & WaveCal* document for additional information.

10. "Insufficient Memory"

Possible Causes	Details and Possible Solutions
The PC's memory is low.	An "Insufficient Memory" message should appear when the host PC doesn't have enough free memory for the acquisition. The only solution is to use a PC that has sufficient free space to hold the amount of data that the scan will produce. Note that each reading will occupy one 16-bit memory location.
The buffer size is set too low in WaveView.	An "Insufficient Memory" message can result from the Acquisition Buffer Size having been set too low in WaveView. To view or change the buffer size, open WaveView's System pull-down menu, then select "Options." A System Options dialog box will appear. In the bottom panel you can check a box to indicate that you want to "Set a maximum acquisition buffer size (MB)." You can enter the desired value for the buffer size, for example 32 MB. WaveView will report the total amount of memory currently installed in your PC. If errors pertaining to available memory occur, try increasing the buffer size. Additional information is included in the *System Options* section of the WaveView document.

11. Scan rate – The maximum rate cannot be reached.

Possible Causes	Details and Possible Solutions
The SSH function is in effect.	Use of the SSH (Simultaneous Sample and Hold) function adds the equivalent of one more channel to the scan, essentially reducing the scan rate. This channel addition is inherent to the use of the SSH function.
The Multiple Ch Analog trigger is in effect.	Use of "Multiple Ch Analog" as the trigger type adds the equivalent of one more channel *for each channel* in the trigger scheme. This reduces the maximum available scan rate. For more information, refer to "Trigger Types" in the Acquisition Configuration section of the WaveView document.

12. External acquisition pacer does not work.

Possible Causes	Details and Possible Solutions
The external clock is not enabled.	Before the external pacer clock feature can be used it must be enabled in WaveView. To enable the external pacer clock: (1) Open the Acquisition Configuration window, (2) In the area labeled "Rate," click the <External> button. A Clock Divider field will appear. (3) *Optional* - In the divider field enter a divisor that is to be applied to the external clock signal. This is an 8-bit divisor with valid values from 1 to 255. For additional information refer to "External Clock and Counter-Timer" in the Acquisition Configuration section of the WaveView document.
The clock signal line is not connected.	The external pacer clock, if enabled, still won't work if it has no input signal. A signal line must be connected to the WaveBook port labeled DIGITAL I/O, EXTERNAL CLOCK, TTL TRIGGR. A "Clock and External Trigger Cable" p/n CA-178 can be used for this purpose. The cable connects to the WaveBook via a DB25 connector and includes a line with a BNC connector to connect to the external clock signal. Note that the clock signal goes through pin 20. The Digital I/O section of chapter 4 includes an illustration of the cable, as well as pinouts of WaveBook's DIGITAL I/O, EXTERNAL CLOCK, TTL TRIGGR connector.
The clock source is not TTL compatible.	The clock source must produce a square-wave signal between 0 and 5 volts to be TTL compatible. If your clock signal does not meet these requirements switch to a clock source that does.
The clock source exceeds 1MHz or exceeds the maximum scan rate.	The external clock source must not exceed 1MHz or the maximum available scan rate. The maximum scan rate is determined by channel count, channel type (SSH) and multi-channel trigger configurations.

13. WBK16 channels won't calibrate.	
Possible Causes	**Details and Possible Solutions**
Resistors are positioned wrong and/or poorly soldered.	If the bridge completion resistors (BCRs) and/or shunt calibration resistors were improperly positioned or poorly soldered, the WBK16 will not calibrate properly. Check the BCR and shunt arrangements for the applicable bridge configuration. Also verify that the BCRs and shunt resistors are properly soldered. Test the solder joints by measuring the resistors through the header pins, which they are soldered to. If they don't measure within the allowed tolerance the associated resistors should be unsoldered, the old solder removed, and then the resistors should be properly re-soldered. The WBK16's hardware setup section, in the WBK Options Manual, includes illustrations of various bridge configurations. A PDF version of the document is included on the data acquisition CD.
Calibration parameters are invalid.	If invalid calibration parameters are entered into the WBK16's calibration program, the channels will not calibrate correctly. See note. If using shunt cal, make sure that the resistor values used are actually simulating the expected amount of bridge deflection. Verify that units are used consistently in all pertinent entry fields. For example, if you enter the maximum applied load as units of micro-strain, then enter the shunt units in units of micro-strain too. For additional information see the "Using the Sensor Calibration Program" section of the WBK Options Users Manual and the Wave Cal section of the WaveView and WaveCal document. PDF versions of the documents are included on the data acquisition CD. **Note**: WaveView's System pull-down file includes an "Options" selection. If selected, a dialog box will appear with a Calibration panel. This panel contains 2 radio buttons. The first selects the Factory Calibration Table, the second selects a User Calibration Table. Factory Calibration Table (*default*), the software uses the factory generated calibration constants of each system component to achieve calibration of the system. This is useful if the system calibration changes often. User Calibration Table, the WaveCal program lets you perform a calibration of the complete signal path from input to A/D stage. The cal constants are stored in the Calibration Table on the WaveBook main board. *Recalibration is required when any part of the signal path changes.* This method is useful when the configuration remains stable and you want slightly better accuracy.
Active Bridge Elements, or Load Cell are not adequately powered.	Ensure that bridge circuits [including load cells] are adequately powered. Refer to theWBK16 section of the WBK Options Manual for additional information.

14.	**Ethernet Problems** WaveBook/516E and /or WBK25 experience Ethernet related problems.
Possible Causes	**Details and Possible Solutions**
Ethernet	Your system could be setup correctly; however, the Ethernet itself could be experiencing problems. Check with your Network Administrator.
Device configuration is wrong	Ensure that your system is properly configured in the *Daq Configuration Applet* [located in the Windows' Control Panel]. If the device [WaveBook/516E or WBK25] is not configured correctly it will not be accessible from an application. Refer to the *Ethernet Connections* section of chapter 2 for additional information.
MAC number is wrong.	Check the addressing entries where the MAC (Media Access Control) number is used to ensure that the number is correct. The MAC number is clearly visible on the casing of the WaveBook/516E and the WBK25. Refer to the *Ethernet Connections* section of chapter 2 for additional material regarding the use of serial numbers and IP Addressing.
Faulty Ethernet cable or connection	The Ethernet cable may be loose, damaged, or not connected. Check the Ethernet line and its connections at the WaveBook/516E [or WBK25] and at the PC Ethernet jack, or Ethernet Network hub, as applicable. Refer to the following section, *Troubleshooting the Device Ethernet Connection Using the "Ping" Method*.
Ethernet port and/or protocol is configured wrong.	Make sure the device is configured to the appropriate Ethernet port with the appropriate protocol. Run the *Daq Configuration* applet from the Windows Control Panel. Run the device test and if it fails try other protocols for the device. Note: Before re-running the test be sure to click on the **`<Apply>`** button to apply the settings.

Troubleshooting the Device Ethernet Connection using the "Ping" Method

1. Find the IP Address of the WaveBook/516E or WBK25.

a. Open the Control Panel by navigating as follows from the Windows Desktop:
Start Menu ⇒ Settings ⇒ Control Panel

b. Double-click the Daq Configuration icon.

c. Select the device in the device tree.

d. Click the Properties button.

e. Make note of the IP Address displayed in the IP Address field.

2. Test the connection with the ping command.

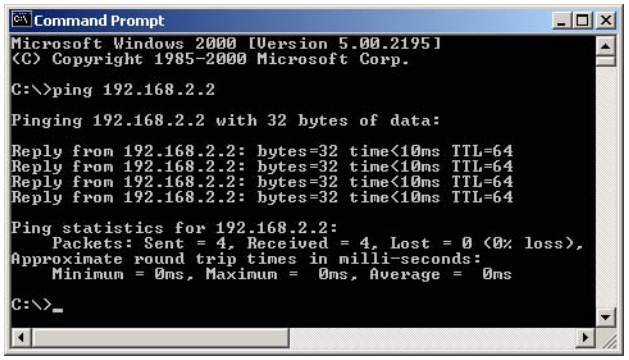
a. Open the Command Prompt by navigating as follows from the Windows Desktop.
Start Menu ⇒ Programs ⇒ Accessories ⇒ Command Prompt.

b. Run '**`ping x.x.x.x`**' where x.x.x.x is the IP Address of the WaveBook/516E, or the WBK25.

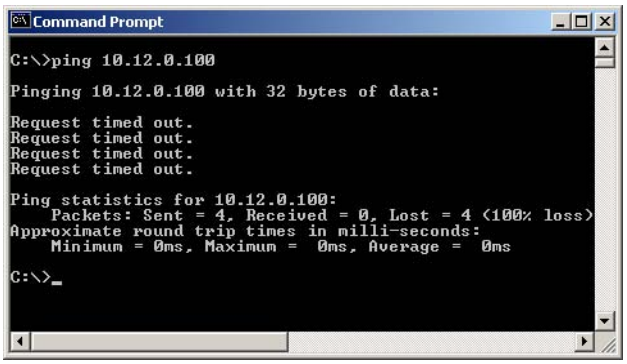
If the ping command <u>does not time out</u>, the computer and device are communicating.

c. Verify that your computer is running Windows NT/2000/XP.

d. Verify the name of the device that your software is trying to open matches the device name that is configured in the Daq Configuration Applet.



Did Not Time Out



Timed Out

Command Prompt, Ping Examples

If the ping command timed out and you are on a <u>Dedicated Network</u>, check the following:

1. Verify that the 6-digit serial number of the WaveBook/516E or WBK25, such as 800000, is entered correctly in the Serial Number field of the Device Properties page.
2. Verify that the "Auto IP Setting" radio button is selected on the Device Properties page.
3. Verify the IP settings of the computer using the **`ipconfig` command** (discussed shortly). The IP address should be 10.x.x.x with a subnet mask of 255.0.0.0.
4. Verify that there is no DHCP server on the network (see the following "if" statement.)

If the ping command timed out and you are on a <u>LAN with a DHCP Server</u>, check the following:

1. Verify that the Manual IP Setting radio button is selected on the device properties page.
2. Verify the IP Address of the WaveBook/516E or WBK25 with your system administrator and that it is entered correctly in the IP Address field of the device properties page.
3. Have your network administrator verify that your computer is configured properly to use the DHCP server. Your computer should be configured to automatically get an IP address from the DHCP server or configured with a static IP address that is compatible with other computers and devices on the network.
4. Verify the IP settings of the computer using the **`ipconfig`** command (see below).

Using the `ipconfig` Command to find the computer's TCP/IP Settings

You can use the ipconfig command to find the computer's TCP/IP Settings. This is done as follows:

1. Open the Command Prompt by navigating as follows from the Windows Desktop.
   Start Menu ⇒ Programs ⇒ Accessories ⇒ Command Prompt.
2. Run '**`ipconfig /all`**' at the command prompt.
3. Make note of the IP address, subnet mask and DHCP enabled setting.

How to check for the existence of a DHCP Server

1. Open the Control Panel by navigating from the Windows Desktop as follows:
   Start Menu ⇒ Settings ⇒ Control Panel.
2. Double-click Network and Dial-up Connections icon.
3. Double-click the Network Connection icon for the network that the WaveBook/516E [or WBK25] is connected to.
4. In the Local Area Connection Status box, click on the <Properties> button.
   The Local Area Connection Properties box will appear.
5. Double-click the "Internet Protocol (TCP/IP)" component.
   The Internet Protocol (TCP/IP) Properties box will appear.
6. Verify that the "Obtain an IP address automatically" radio button is selected.
7. Get the computer IP configuration settings using the **`ipconfig`** command.
8. Verify the DHCP Enabled value in the **`ipconfig`** output is set to "yes."
9. Check the output of the **`ipconfig`** command for **`Lease Obtained`** and **`Lease Expired`** lines. The presence of these lines indicates that there is a DHCP server on the network. If this is the case, notify your network administrator and follow the instructions in your network device documentation. The instructions should have a heading to the effect of: **Configuring a Device on a LAN with a DHCP Server**.

15. Parallel Port Problems

Possible Causes	Details and Possible Solutions
Faulty parallel port cable or connection.	Check that the parallel port cable is not loose, damaged, connected to the wrong PC port, or is not compatible with the system (standard parallel port cables are not compatible). Check both ends of the parallel port cable to verify proper connection. If the cable appears fine and the connections are good check to see that the cable was supplied from the factory. If not, it may be incompatible and should be replaced with a factory issued cable (CA-35-12, 12 inch cable; CA-35-2, 2-foot cable; or CA-35-6, 6-foot cable). These three cables are 1284-compliant. Standard parallel cables will not work properly, primarily due to a lack of shielding.
The LPT port is not correctly configured.	The LPT Port may not be properly configured in CMOS for the selected protocol. Selecting a communications protocol in the *Daq Configuration* utility, such as EPP or ECP generally requires that this mode also be set in the PC BIOS settings. This must be done in both the CMOS Setup of the PC BIOS as well as in the Windows device manager. In Windows NT, this need only be done in CMOS and the system will adjust to the change. Refer to your host computer's documentation for instructions on changing the parallel port mode.
The selected protocol is not compatible.	If the selected protocol, e.g., 8-bit, ECP, EPP, is not compatible between the PC and the WaveBook it may be due to the fact that parallel ports vary between different PC manufacturers. While some protocols may work with WaveBooks on certain PCs, those same protocols may not work with others. If the EPP mode will not work, it is likely due to a subtle incompatibility between the particular PC and the IOtech drivers. In these cases, a more generic protocol such as Standard 8-bit or 4-bit protocol must be used. Standard 4-bit protocols are likely to work, even when others do not. Also see Table 3, "ECP and/or EPP protocol problem."

Notes

Make sure the parallel port is operable and capable of generating interrupts. The parallel port, to which the WaveBook is to be connected, must be properly configured in order for the device to operate correctly.

Each device must be configured using the *Daq Configuration* Applet [located in the Windows Control Panel]. If a device is not configured correctly it will not be accessible from an application.

If communications cannot be established with the WaveBook or, if trying to connect causes the system to hang or crash, try the following:

- Verify that the MODULE POWER switch is set to ON and that the MODULES ON indicator is lit.
- Check to make sure that the Notebook PC communication cable is properly connected to the WaveBook's DB25 connector labeled "TO COMPUTER PARALLEL PORT."
- Check that the desired LPT port is properly configured and the base address and interrupt are recognized by the operating system.
- Check the BIOS settings for the LPT port. Make sure that the BIOS LPT protocol settings are compatible with the settings selected for the LPT port. "Compatibility mode" is recommended.
- Run the *Daq Configuration* applet from the Windows Control Panel. Make sure the device is configured to the appropriate LPT port with the appropriate protocol. Run the device test and if it fails try other protocols for the device. Be sure to click on **<Apply>** to apply the settings, before re-running the test.
- ***Windows NT/2000***: Make sure that the driver has been loaded. The installation will configure the operating system to automatically load the driver at boot-up. However, if there is a problem communicating with the device, the driver can be loaded manually by using the following start sequence from a DOS shell: **NET START WAVEBK**. To unload the driver manually, use the following sequence: **NET STOP WAVEBK**.

Parallel Port Setup (general)

If WaveBook fails to communicate or has problems transferring data there may be a problem with the way the parallel port is configured. If this appears to be the case take the following steps:

1. Ensure that any hardware settings on the parallel port are configured properly. If unsure of proper configuration, refer to the parallel port manufacturer's documentation. If this fails to solve the problem, proceed to the next step until the problem is resolved.
2. Click the Windows desktop *Start* button; select the *Settings* menu item; then, select the *Control Panel* menu item.
3. Double-click the *System* icon.
4. Click the *Device Manager* tab.
5. If the small box to the far left of the "Ports (COM & LPT)" entry contains a "+", click once on the "+" to show all your communication and line printer ports.
6. In the Configuration utility, click once to highlight the line containing the LPT port you chose to use with WaveBook.
7. Click the *Properties* button.
8. The *Device Status* section should contain the message “This device is working properly.” If the message is not present, either the wrong I/O address is selected, or the hardware is missing or broken.
9. Click the *Resources* tab.
10. The *Resource Settings* section should contain entries for “Input/Output Range” and “Interrupt Request” with “Settings” from the table below that correspond to the LPT port chosen for WaveBook.

    Note: A “Direct Memory Access” entry may also exist for EPP or ECP printer ports.

Printer Port	Input/Output Range	Interrupt Request
LPT1	**0378-037B (or 037F)**	**7**
LPT2	**0278-027B (or 027F)**	**5**
LPT3	**03BC-03BF**	**7 (shares with LPT1)**

    If the settings do not correspond to those in the previous table, or if there is no "Interrupt Request" entry, complete steps 10a through 10b before moving on to step 11.

    a. Click on the check mark in the small box to the left of "Use automatic settings."
    b. Click on the now active drop-down combo-box to the right of "Setting based on."
    c. Click on different "Basic configuration" choices (use the up-down slide bar to the right, if needed) until the resource settings match those of your printer port in the table above.

11. The "Conflicting device list" section should contain the message "No conflicts." If this is not the case,, and a DMA conflict is described, repeat Steps 10a - 10c *but change only the DMA setting*.
12. If one or more conflicts are described in the "Conflicting device list" section, you must find the conflicting device(s) and change the conflicting resource(s) by following these steps:

    a. Take note of all conflicts, then click the *OK* button.
    b. If a window appears titled "Creating a Forced Configuration", click *Yes* to continue.
    c. Open the conflicting device type by clicking on the "+" in the small box to its left, if necessary.
    d. The conflicting device's icon should be marked with an exclamation point in a yellow circle. Click once on the device to highlight it; then click the *Properties* button.
    e. Click the *Resources* tab.
    f. Perform Steps 10a - 10c to resolve the resource conflict.
    g. Repeat Step 11 for each additional existing resource conflict.

Table 16, Parallel Port Problems (continued)

Parallel Port Setup (general) *– continued*

13. If one or more resource conflicts remain, the conflicting device(s) must either be removed or kept absolutely dormant for proper operation. Click the *OK* button to close the device properties window and return to the "System Properties" window. If a window appears titled "Creating a Forced Configuration", click the *Yes* button to continue. To remove a device, perform the following steps:

    a. If necessary, open the device type by clicking on the "+" in the small box to its left.
    b. Click once on the device to highlight it, then click the <Remove> button.
    c. Click the <OK> button to confirm the device's removal.

14. Click the <Close> button to close the "System Properties" window. Close the "Control Panel" window and any other tasks running; then shut down Windows.

15. If any hardware was removed in Step 13 or if any hardware reconfigured in Step 12 requires manual reconfiguring, power off the computer and remove or reconfigure the hardware before rebooting. Otherwise, simply reboot the computer.

16. Run the Configuration utility and test WaveBook's communication. If problems persist and no resource conflicts exist, perform the following steps:

    a. Check for loose cable connections and verify the MODULE POWER indicator is ON.
    b. Verify that the computer's printer port and data cable work with a printer or other device.
    c. Verify there are no installed devices that Windows does not recognize but whose resources might conflict with the WaveBook.
    d. Verify that WaveBook works on another PC (from a different manufacture if possible).

(continued)

Table 16, Parallel Port Problems (continued)

Parallel Port Troubleshooting Tips

Windows9x Users

After completing the test hardware function within the DaqConfig control panel applet. It is possible that a connection may not be made. Before doing anything else, try the following:

Recheck your parallel port cable and the power supply so you are certain that the connection is tight and power is applied

Try all of the communication protocols listed in the DaqConfig icon because it is possible that the parallel port has a communication protocol other than standard or normal mode.

If you still have not established communication, then go to control panel, system, device manager, ports, LPT1 and verify that the following things are true:

Under the general and driver sections, make sure that the parallel port is a standard parallel port with a driver installed and that no resource conflicts are present. If no driver is installed or resource conflicts are present, then you need to resolve these issues with your computer supplier or your information services department.

Under the resource section, make sure that the parallel port has an interrupt level assigned. If it doesn't you will need to add one by un-checking the use default settings box, selecting configuration one so the same base address is maintained but an interrupt level is added, and then double clicking on the interrupt level so you can add the interrupt level. Generally, 7 is reserved for parallel ports but you should pick one where no conflict exists. Reboot the computer and everything should work If you find that the parallel port is configured as an ECP parallel port, then you will need to access the bios and change the parallel port to a standard or normal mode. You can generally access the bios by pushing F2 or escape during the initial boot up of the computer. If so, you will see a computer message "Push F2 to enter setup". Change the parallel port mode from ECP to standard or normal. Reboot the computer and everything should work.

WindowsNT Users

After completing the test hardware function within the DaqConfig control panel applet. It is possible that a connection may not be made. Before doing anything else, try the following:

Recheck your parallel port cable and the power supply so you are certain that the connection is tight and power is applied

Try all of the communication protocols listed in the DaqConfig icon because it is possible that the parallel port has a communication protocol other than standard or normal mode

If you still have not established communication, verify that the parallel port drivers are installed by going to control panel, devices, hardware profiles, parallel port. If the drivers are not installed, then you need to resolve this issue with your computer manufacturer. Verify that your parallel port interrupt has an interrupt level assigned to it by looking at the parallel port resources in DaqConfig applet.

If it is necessary to add an interrupt level or to change to parallel port communication protocol, that must be done in the BIOS, which can generally be accessed during computer boot up. You should see the message "Push F2 to enter setup". If the parallel port is configured for ECP or EPP, change it to standard or normal and everything should be fine.

WaveView Issues

- Acquisition parameters can not be changed during an active acquisition.
- International settings are supported, but some text boxes may not completely show the comma when it is used as the decimal place holder.
- The *Scope Mode's* print resolution is determined by the host computer's video driver. Some graphics drivers may require adjustment of the resolution and/or color palette for proper print operation. For some printers, better output is attained by changing the printer's dithering setting to "None".
- Scope scale changes do not become effective until the focus changes. This is best accomplished by hitting **<Enter>**.
- Text boxes for the filter settings may not display the proper setting if the number entered must be rounded to the nearest filter setting. This is a problem only with the number displayed and does not affect the actual filter setting that is passed down to the driver.
- Conversion to Snap Master format from the menu option is not supported. Snap Master format conversion does work properly when done as part of a direct-to-disk acquisition.

Frequently Asked Questions

(1) Topic: Environmental Factors

Question: What Environments are WaveBook Systems Intended for?

Answer: WaveBook Systems are designed to operate within 0° to 50°C (32° to 122°F) and with a relative humidity of up to 95%RH, non-condensing. The products can be stored at temperatures within the range of -20° to +70°C (-40° to 158°F). WaveBook systems should always be protected from snow, rain, extreme dust, and harsh sun.

(2) Topic: 32-Bit API Support, DaqX

Question: I am writing my own application that interfaces to the WaveBook. Is the 32-bit enhanced mode support available?

Answer: Yes, the current version of the DaqX software supports 32 bit enhanced mode programming.

Question: What is DaqX software?

Answer: DaqX software is low-level software support for application development. DaqX is installed during the installation of the WaveView application. DaqX supports Visual C++ and Visual Basic programming environments.

Question: Where can I get the latest version of WaveView/DaqX software?

Answer: You can download the latest versions from our website. This service is free.

(3) Topic: WBK14 - Dynamic Signal Conditioning Module

Question: Why can't I use the external clock feature on the WBK14 to control my acquisition speed?

Answer: The external clock on the WBK14 is used to dynamically move the corner frequency of the filter, not pace the A/D in the WaveBook. This feature is often required in vibration applications where the filter is moved as the device under test is vibrated (or excited) at varying frequencies. Unlike the WaveBook/516 that has a special input for clocking the A-to-D, the WaveBook/512 has no provisions to do so.

Question: Is there anything special I should know about WBK14's power-up state?

Answer: At power-up the current output of the WBK14 is open circuited. It is only after being programmed that the current source is engaged.

Question: In regard to attenuation, what is the filter roll-off for the WBK14 filter?

Answer: The WBK14's Butterworth filter is down 3 dB at the corner frequency. Beyond that point, the signal attenuates at 48 dB per octave or 160 dB per decade. This is a substantial amount of attenuation for most applications.

(4) Topic: WBK20 - PCMCIA/EPP Interface Card

Question: How do I configure the WBK20?

Answer: Insert the WBK20 into the PCMCIA slot. Windows should recognize it and display a window *'New Hardware Found'* followed by a window *'Building driver data base'*.

Select the option *'Select driver from disk provided by hardware manufacturer'*. *'Install from disk'* is the next window. Provide a path to the floppy drive after you have inserted the disk that came with the WBK20. It contains a file 'IOTWBK20.INF'. Select OK.

In the next window, select 'IOtech Inc' in the left box and 'IOtech WBK20: 1 Parallel Port' in the right box. Select OK. At this time, it may ask for your Windows CD or certain diskettes. Then you will be prompted to restart the computer.

The WBK20 will show up in Control Panel/System/Device Manager/ Ports (COM and LPT) as 'IOtech WBK20: 1 Parallel Port LPT#'. Double clicking on this will show you the resources (IRQ and I/O range).

(5) Topic: ECP and EPP

Question: My computer uses ECP. Is ECP the same as EPP?

Answer: No; ECP (Enhanced Capabilities Port) is a different protocol than EPP (Enhanced Parallel Port). If the WaveBook fails to communicate in ECP mode, make certain that the WaveBook hardware is actually capable of ECP communications. This can be done as follows:

1. Locate the LPT port communications chip on the main board, near the connector that the parallel cable connects to. The chip is relatively large and is stamped “262-0301,” or “262-0301, rev B.” A 262-0301 rev. B" chip supports ECP, the earlier rev does not. Contact the factory in regard to upgrading. Note that most units purchased before July 2000 do not have ECP support.
2. Verify the parallel port hardware is in ECP mode. For ports built into the computer’s motherboard, the port is usually configured using the computer’s BIOS setup utility (accessible during computer start up). See your computer's specific documentation regarding accessing the BIOS setup utility and configuring peripherals.
3. Verify the parallel port is configured [in the Windows Control Panel] as an "ECP parallel port" and not "Parallel port."

(6) Topic: Sampling Rates

Question: Does the WaveBook really collect data at 1 MHz and what should I expect on my PC?

Answer: Yes, the WaveBook samples at 1 MHz. But your computer may not. The PC’s performance is a function of the hardware configuration, operating system, background task, and other factors. The PC could very well be a bottleneck in regard to sampling.

Question: What transfer speeds can I expect from a standard 8-bit parallel port?

Answer: A typical computer will achieve 80K to 90K samples/sec [through-put to the PC].

Question: I realize that the WBK20A and WBK21 are interface options. Will they improve my speeds?

Answer: In the majority of cases, by far, both products result in higher through-put [than you would see with the use of the standard 8 bit port. The exact amount varies with PC configuration. **When using the WBK21**, ISA plug-in board, 1 MHz through put is more the rule than the exception. Because this boards sits directly on the bus, most computers can handle the data rate. **The WBK20A** (PCMCIA card) plugs into the PC-card slot on the side of the notebook PC. Up until early 1997, all notebooks with these slots were PCMCIA type. In these older computers, 1 MHz was often seen, but 750-800 kHz was typical. In early 1997 notebooks started shipping with a PC card bus instead of the PCMCIA card slot. This change was almost completely transparent to PC users since the PCMCIA card plugs in and the PC Card bus is backward compatible with PCMCIA cards. However, one important change occurred. The WBK20A appears to operate slower in the new PC Card slot. With this change, 1 MHz transfer rates using the WBK20A in a PC Card slot are almost non-existent, instead, 300K to 500K samples/sec is typical.

Question: I'm using the WBK20A but because of my PC architecture, the system is still slower than I require. What else can I do?

Answer: One option is to install a WBK30 memory card. This increases the FIFO buffer inside the WaveBook. While this option does not increase transfer speeds, it does extend the length of time an acquisition can run before a buffer over flow occurs. The exact duration is a function of sampling rates and transfer speeds. For example, assume you are using a WaveBook/512 in packed mode with the WBK30/128. This option holds 128 Mbytes (64 Msamples) of data. Furthermore, let us say you are digitizing at 1 MHz and transferring data at 400 Ksample/sec via a WBK20A. In this case, you could expect to acquire data for about 1 minutes and 51 seconds. In that amount of time, you would have collected about 148.7 Msamples. This is over a quarter gigabyte of data.

(7) Topic: Calibration

Question: Should I calibrate my WaveBook system when I receive it?

Answer: No, because each WaveBook-related product is factory-calibrated to its rated accuracy before it leaves the factory.

Question: When is calibration required?

Answer: Depending on your operating guidelines, your equipment will require periodic calibration to ensure the original accuracy is maintained. We recommend that you have your WaveBook system calibrated at least once a year. In addition, calibration is required whenever a change is made to the signal path, for example, adding a WBK11 to the system.

(8) Topic: Computers for Data Acquisition

Question: What type of computer do you recommend for use with data acquisition devices such as WaveBook?

Answer: When selecting a computer for use as a data acquisition system look for one with an Ethernet port, fast parallel port, disk drives with high rotation speeds and low access times. If you are using a notebook PC, it should have a PCMCIA or PC Card slot.

Your operating system should be Windows NT, 2000, XP or later.

Customer Support

If you want to Expand or Enhance Your WaveBook System . . .

You can visit our internet site at **http//:www.iotech.com** to find the latest accessories and WBK options that are available for your WaveBook system, or call our sales department at (440) 439-4091.

If you need to Report Problems or Request Product Support

Note: Please do not return any equipment to the factory unless it has an RMA number (Return Merchandise Authorization number). RMA numbers are issued by the factory.

To report problems or request support, call the manufacturer's Applications department. Contact information follows shortly. When you contact us, please have the following information available, as applicable:

- Hardware model numbers and software version numbers.
- Operating system, type of computer, and device information in the Windows control panel, such as interrupts and address settings for our hardware and others.
- Results of tests, such as the Daq Configuration control panel.
- Hardware setup and software configuration.
- Information on input signals, including voltage ranges, signal impedance ranges, noise content, and common mode voltages.
- The name of a contact person from your company who can discuss the problems encountered.
- Instructions for return shipping.
- All troubleshooting notes and comments on tests performed, and all problem-related conditions.

Note: Before calling for assistance, take a few minutes to read all parts of the manual that may be relevant to the problem. Also, please review the troubleshooting material.

You can reach IOtech by one of the following means:

Phone: **(440) 439-4091**

Fax: **(440) 439-4093**

E-mail (Product Information/Sales): **sales@iotech.com**

E-mail (Technical Support): **productsupport@iotech.com**

Internet: **http//:www.iotech.com**

Mail: **IOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146-1833**

All equipment returned to the manufacturer must have an RMA (Return Material Authorization) number. You can obtain an RMA number by calling the Customer Service or Applications departments. When returning the equipment, use the original shipping container (or equivalent) to prevent damage. Put the RMA number on your shipping label to ensure that your shipment will be handled properly. After receiving your equipment, we will fax a confirmation form that summarizes the charges (if applicable) and expected return date.

Specifications 8

Specifications - WaveBook/512A

General

Warm-up: 30 minutes to rated specifications
Environment
Operating: 0° to 50°C, 0 to 95% RH, non-condensing
Storage: -20° to 70°C
Power Consumption: 1.4A max @ 15 VDC
Input Power Range: 10 to 30 VDC
Input Power Fuse F201: 4A MINI ATO, see ch. 9
Vibration: MIL STD 810E
Dimensions: 285 mm W x 220 mm D x 45 mm H (11” x 8.5” x 1.75”)
Weight: 1.5 kg (3.3 lbs)

Analog Inputs (18° to 28°C)

Channels: 8 differential, expandable up to 72 differential
Connector: BNC
Resolution: 12 bit
Ranges: Unipolar/bipolar operation is software selectable via sequencer
Unipolar: 0 to +10V, 0 to +4V, 0 to +2V
Note: No unipolar mode is available when a WBK11A, WBK12A, or WBK13A is installed.
Bipolar: ±10, ±5V, ±2V, ±1V
Maximum Overvoltage: ±35 VDC
Input Bandwidth: DC to 500 kHz
Input Impedance
Single-Ended: 5M Ohm in parallel with 30 pF
Differential: 10M Ohm in parallel with 30 pF
Accuracy: ±1V to ±10V: ±0.03% of reading; 0.012% of range
Input Noise: <1 LSB (RMS)
Total Harmonic Distortion: -70 dB typ
Signal to Noise and Distortion: -70 dB typ
CMRR: 70 dB typ; 60 dB min; DC to 20 kHz

Anti-Alias Filter

Type: 5-pole Butterworth; 20 kHz low pass software enabled
Note: No unipolar mode is available when a WBK11A, WBK12A, or WBK13A is installed.

PGA Filter

Filter Type: 20KHz low pass, Butterworth, 5-pole filter

Triggering

Channel 1 Analog & Pulse Trigger
Input Signal Range: -10 to +10V
Bandwidth: 1 MHz
Latency: 300 ns
Multi-Channel Analog Trigger (up to 72 channels):
Range: Selectable per channel to input range
Latency: 2 µs/channel, plus 4 µs maximum
TTL Trigger
Input Signal Range: 0 to 5V
Input Characteristics: TTL-compatible with 10K Ohm pull-up resistor
Latency: 300 ns
Software Trigger
Latency: 100 µs typical
Pulse Trigger Input
Input Signal Range: ±5V
Input Characteristics: 75 Ohm
Input Protection: ±10V maximum
Minimum Pulse Width: 100 ns
Maximum Pulse Width: 0.8 sec
Latency: 300 ns

Note: Specifications are subject to change without notice.

External Clock

Connector: Available on DB25 digital input
Input Signal Range: 5V TTL compatible
Input Characteristics: 50K Ohms pull up (to +5V) in parallel with 50 pF
Input Protection: Zener clamped -0.7 to +5V
Delay: 200 ns
Signal Slew Rate Requirement: 20V/µs minimum
Rate: Up to 1 MHz
Divisor Ratio: Divide by 1 through 255, selectable

External Sync Ports

Number of External Sync Ports: 2, on rear panel
Maximum Number of Units to be Synchronized: 4 units, scan-synchronous (post trigger)
Maximum Length of Sync Cables: 15 feet (4.57 m), total for all cables

Sequencer

Operation: Programmable for channel, gain, and for unipolar/bipolar range in random order
Depth: 128 location
Channel-to-Channel Rate: 1 µs to 1.1 µs/channel, all channels equal
Maximum Repeat Rate: 1 MHz
Minimum Repeat Rate: 100 seconds per scan
Expansion Channel Sample Rate: Same as on-board channels, 1 to 1.1 µs, fixed

High-Speed Digital Inputs/General-Purpose Outputs

Connector: DB25 Female
Configuration: 16 TTL-compatible pins, selectable for input or output
Input Characteristics: TTL-compatible
Output Characteristics: ALS TTL output in series with 33 Ohms
Output Updates: Outputs may be changed via program control
Input/Output Protection: Diode clamped to ground and +5V

Period Counter

Operation: Internal counter calculates and reports the external clock's period; counter can be read with each scan
Clock Counter Accuracy: <0.02% error
Clock Counter Range: 0.01 Hz to 100 kHz

WBK11A Functions

Input Voltage Ranges: Software programmable prior to a scan sequence
Aperture Uncertainty (SSH): 75ps max
Voltage Droop (SSH): 0.01mV/ms typ

WBK12A, WBK13A Functions

Input Voltage Ranges: Software programmable prior to a scan sequence
Low Pass Filter Type: Software selectable, 8-Pole elliptic or linear phase
Anti-Aliasing Filters: Single-pole pre and post filters, automatically set depending on filter frequency selected
Low-Pass Filter Frequency Cutoff Range: 100KHz, 75KHz, 60KHz…400Hz, bypass (fc=300KHz/N where N=3 to 750)
Filter Grouping: 4 Channels each in two programmable banks
Aperture Uncertainty (SSH): 75ps max
Voltage Droop (SSH): 0.01mV/ms typ

Note: Specifications are subject to change without notice.

Specifications - WaveBook/516, /516A, /516E, and WBK10A

Analog Specifications

For either a stand alone WaveBook, or for a WBK10A with a WaveBook

Channel Capacity:

WaveBook/516E: 8 built-in voltage channels, expandable up to 72 channels via WBK options. In addition, WaveBook/516E can accommodate up to 3 WaveBook/516A, /512A, or WBK40 options, in any combination. Each added on WaveBook can be expanded up to 72 channels. The maximum WBK41 capacity is 224 T/C channels, 4 analog output channels, 272 digital I/O channels, and 6 counter/timer channels.

WaveBook/516 and /516A: 8 differential, expandable up to 72 differential

BNC Input Connectors: Center conductor is Channel Hi, outer conductor is Channel Low

Input Voltage Ranges (DC Specifications)

	Standard Unit			With WBK11A (Note 3)			With WBK12A/13A (Note 3)			
Voltage Range	**Accuracy (Note 2) One Year, 18-28°C**		**Input Noise LSB rms DC-500KHz (typical)**	**Accuracy (Note 2) One Year, 18-28°C**		**Input Noise LSB rms DC-500KHz (typical)**	**Accuracy (Note 2) One Year, 18-28°C**		**Input Noise LSB rms (typical)**	
	± % reading	**± % range**		**± % reading**	**± % range**		**± % reading**	**± % range**	**1KHz Filter**	**Filter Bypass**
0 to +10V	.012%	.008%	2	.012%	.008%	2	.012%	.008%	2.2	2.2
0 to +5V (10A) 0 to +4V (516)	.012%	.009%	2	.012%	.009%	2	.012%	.009%	2.2	2.2
0 to +2V	.012%	.012%	3	.012%	.012%	3	.012%	.012%	2.2	3
0 to +1V (10A only)	.012%	.018%	3	.012%	.018%	3	.012%	.018%	2.2	3
0 to +.5V				.018%	.033%	6	.018%	.033%	2.2	6
0 to +.2V				.018%	.08%	8	.018%	.08%	2.2	12
0 to +.1V				.018%	.16%	15	.018%	.16%	2.2	20
-10 to +10V	.012%	.008%	2	.012%	.008%	2	.012%	.008%	2.2	2.2
-5 to +5V	.012%	.008%	2	.012%	.008%	2	.012%	.008%	2.2	2.2
-2 to +2V	.012%	.009%	2	.012%	.009%	2	.012%	.009%	2.2	3
-1 to +1V	.018%	.012%	3	.018%	.012%	3	.018%	.012%	2.2	3.3
-.5 to +.5V (10A only)	.018%	.018%	5	.018%	.018%	6	.018%	.018%	2.2	6
-.2 to +.2V				.018%	.033%	8	.018%	.033%	2.2	12
-.1 to +.1V				.018%	.08%	15	.018%	.08%	2.2	20
-.05 to +.05V (10A only)				.018%	.16%	26	.018%	.16%	4	40

Notes: 1. Specifications assume differential input scan, unfiltered.
2. Accuracy specification is exclusive of noise.
3. Unipolar ranges are not available for WaveBook/516, /516A, or /516E when a WBK11A, WBK12A, or WBK13A option is installed. Unipolar ranges are available with WBK10A and any option.

System Performance: one year, 18-28°C unless otherwise noted

Differential Nonlinearity: ±2 LSB max

Total Harmonic Distortion (10Hz-20KHz): -84dB typical

Signal to Noise and Distortion (SINAD, 10Hz-20KHz): -74dB typical

Temperature Coefficient of Accuracy (0-18 and 28-50°C):

With PGA and WBK11A: ± (.002% + 0.6 LSB)/°C typical, -10 to +10V range

With WBK12A/13A: ± (.002% + 1 LSB)/°C typical, -10 to +10V range

Input Resistance: 5MΩ (single ended); 10MΩ (differential), in parallel with 30pF

Bias Current: <400 nA (0 to 35°C)

Common Mode Rejection: >70dB minimum; >80dB typical; DC-20KHz

Input Bandwidth: DC to 500KHz

Hostile Channel-to-channel Crosstalk (5Vrms input signal, DC-100KHz): -88dB typical

Over-Voltage Protection: ±35 V relative to analog common

Note: Specifications are subject to change without notice.

PGA Filter

Filter Type: 20KHz low pass, Butterworth, 5-pole filter

WBK11A Functions

Input Voltage Ranges: Software programmable prior to a scan sequence
Aperture Uncertainty (SSH): 75ps max
Voltage Droop (SSH): 0.01mV/ms typ

WBK12A, WBK13A Functions

Input Voltage Ranges: Software programmable prior to a scan sequence
Low Pass Filter Type: Software selectable, 8-Pole elliptic or linear phase
Anti-Aliasing Filters: Single-pole pre and post filters, automatically set depending on filter frequency selected
Low-Pass Filter Frequency Cutoff Range: 100KHz, 75KHz, 60KHz…400Hz, bypass (fc=300KHz/N where N=3 to 750
Filter Grouping: 4 Channels each in two programmable banks
Aperture Uncertainty (SSH): 75ps max
Voltage Droop (SSH): 0.01mV/ms typ

Triggering

Channel 1 Analog Trigger

Input Signal Range: -10 to +10V
Input Characteristics and Protection: Same as channel inputs
Latency: 300ns

Multi-Channel Analog Trigger (up to 72 channels):

Range: Selectable per channel to input range
Latency: 2us/channel, plus 4us maximum

TTL Trigger:

Input Signal Range: 0-5V
Input Characteristics: TTL-compatible with 10K ohm pull-up resistor
Input Protection: Zener clamped –0.7 to +5V
Latency: 300ns

Software Trigger

Latency: 100us typical

Pulse Trigger

Input Signal Range: 0-5V
Input Characteristics: 75 ohms
Input Protection: ±10V maximum
Minimum Pulse Width: 100ns
Latency: 300ns

External Clock

Connector: Available on DB25 digital input
Input Signal Range: 5V TTL compatible
Input Characteristics: 50K ohms pull up (to +5V) in parallel with 50pF
Input Protection: Zener clamped –0.7 to +5V
Delay: **200ns**
Signal Slew Rate Requirement: 20V/us minimum
Rate: Up to 1MHz
Divisor ratio: Divide by 1 through 255, selectable
Clock Counter Accuracy: <0.02% error
Clock Counter Range: 0.01Hz to 100KHz

External Sync Ports

Number of External Sync Ports: 2, on rear panel

Maximum Number of Units to be Synchronized: 4 units, scan-synchronous (post trigger)

Maximum Length of Sync Cables: 15 feet (4.57 m), total for all cables

Sequencer

Operation: Programmable for channel, gain, and for unipolar/bipolar range in random order

Depth: 128 location

Channel-to-Channel Rate: 1.0 to 1.1us/channel, all channels equal

Maximum Repeat Rate: 1MHz

Minimum Repeat Rate: 100 seconds per scan

Expansion Channel Sample Rate: Same as on-board channels

High-Speed Digital Inputs/General-Purpose Outputs

Connector: DB25 Female

Configuration: 16 TTL-compatible pins, selectable for input or output

Input Characteristics: TTL-compatible

Output Characteristics: ALS TTL output in series with 33 ohms

Output Updates: Outputs may be changed via program control

Input/Output Protection: Diode clamped to ground and +5V

Period Counter

Operation: Internal counter calculates and reports the external clock's period; counter can be read with each scan

Clock Counter Accuracy: <0.02% error

Clock Counter Range: 0.01 Hz to 100 kHz

General Specifications

Warm-up: 30 minutes to rated specifications

Environment:

- **Operating**: 0-50°C, 0-95% RH (non-condensing)
- **Storage**: -20 to 70°C

Power Consumption:

- **/516E**: 1.8A max @ 15 VDC
- **/516, /516A & /512A**: 1.4A max @ 15VDC

Input Power Range: 10 VDC to 30 VDC

Input Power Fuse F201: 4A MINI ATO; See chapter 9 for fuse replacement instructions.

Vibration: MIL STD 810E, Category 1 and 10

PC Communication:

- **/516E**: 10/100BaseT Ethernet
- **/516, /516A & /512A**: Enhanced Parallel Port (EPP)

Channel Capacity:

- **/516E**: 8 built-in voltage channels, expandable up to 72 channels via WBK options. In addition, WaveBook/516E can accommodate up to 3 WaveBook/516A, /512A, or WBK40 options, in any combination. Each added on WaveBook can be expanded up to 72 channels. The maximum WBK41 capacity is 224 T/C channels, 4 analog output channels, 272 digital I/O channels, and 6 counter/timer channels.
- **/516, /516A & /512A**: 8 built-in voltage channels, expandable up to 72 channels via WBK options

Dimensions:

- **/516E**: 285 mm wide x 220 mm deep x 70 mm high (11 x 8.5 x 2.70 inches)
- **/516, /516A & /512A**: 285 mm wide x 220 deep x 45 mm high (11 x 8.5 x 1.75 inches)

Weight:

- **/516E**: 1.9 kg (4.2 lbs)
- **/516, /516A & /512A**: 1.5 kg (3.3 lbs)


Notes

Fuse Replacement – for WaveBooks 9

General Information …… 9-1

WaveBook/516A, /512A, and /516 …… 9-2

WaveBook/516E …… 9-3

CAUTION



Turn OFF the power to, and UNPLUG the WaveBook and all connected equipment. Remove all signal I/O lines from the unit. Electric shock or damage to equipment can result even under low-voltage conditions.



Take ESD precautions, to include using a grounded wrist strap.

Use care to avoid touching board surfaces and onboard components. Ensure boards do not come into contact with foreign elements such as oils, water, and industrial particulate.



You should only replace a fuse if your device shows no sign of damage. If your device appears damaged such as evidenced by a "smoked" component, contact the factory as soon as possible.

If the replacement fuse blows, contact the factory as this indicates a problem may exist with your WaveBook.

General Information

Each WaveBook has one user-replaceable fuse designated as F201.

F201 Input Power Fuse. **4.0 A, MINI ATO**.
This 4-amp fuse is located near the rear panel's 5DIN POWER IN connector.
If this fuse has blown the WaveBook will not power up.

Factory Part Number: **FU-8-4**
Littelfuse Part Number: **297-004**, Littelfuse Body Color Code: **Pink**

Observe the previous Caution and Note prior to beginning any of the fuse-replacement procedures in this chapter.

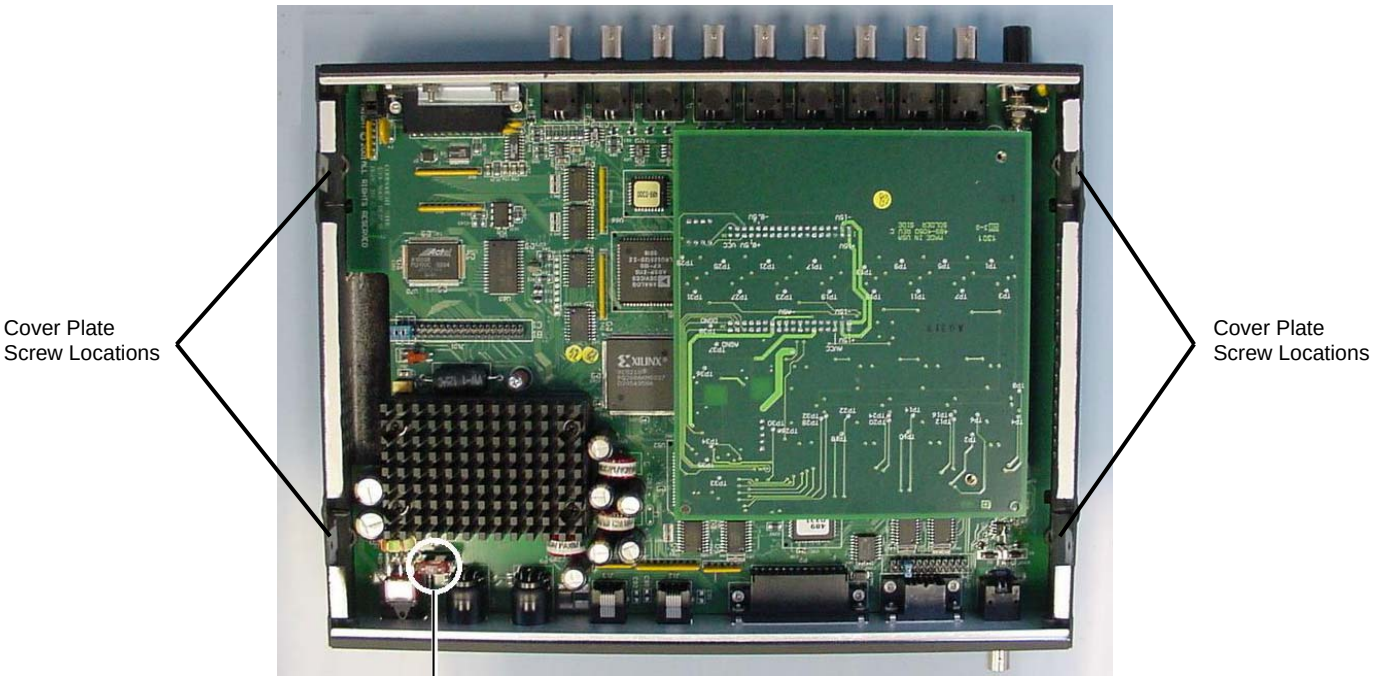
You will need the following:

- Phillips Screwdriver
- 3AG Fuse Puller, or needle-nose pliers*
- 3/16-inch hex-nut driver
- Grounding wrist strap and associated anti-static pad
- Replacement fuse F201
- wrench with 9/16 inch deep-well socket (for WaveBook/516E only)

* Needle-nose pliers can be used to pull MINI ATO fuses; but should not be used to insert fuses.

Observe the Cautions and the important note on page 9-1 prior to beginning this fuse replacement procedure.

1. If you have not already done so, turn OFF the power to, and UNPLUG the WaveBook and all connected equipment. Remove all signal I/O lines from the unit.
2. Using a Phillips screwdriver, remove the four Cover Plate Screws from the left and right sides of the unit. The following figure points out the screw locations.
3. Remove the Cover Plate [not shown].

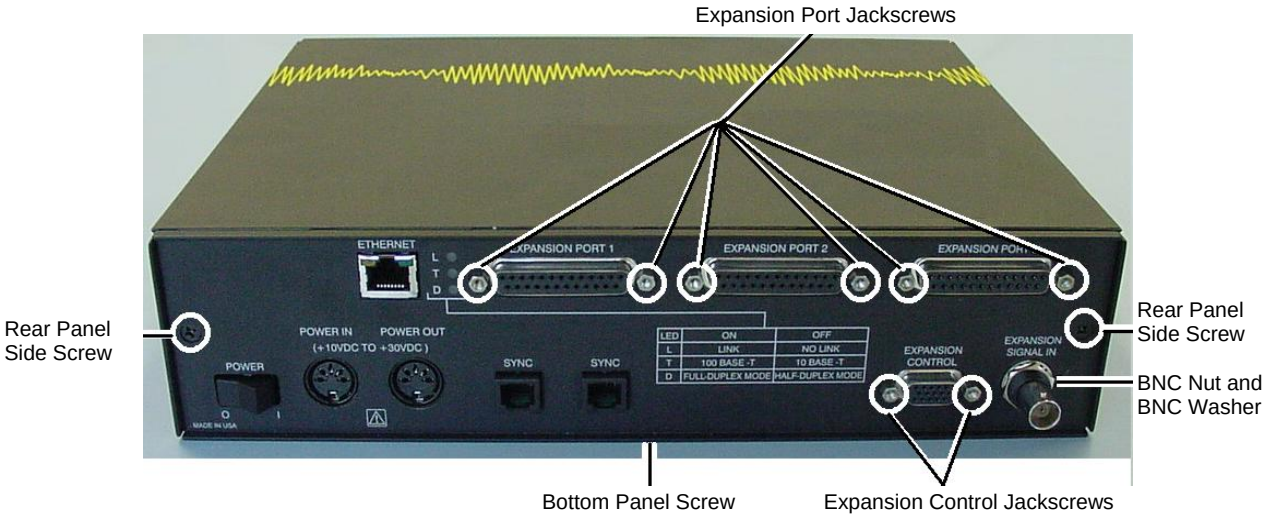


F201 Fuse Location in WaveBook/516A, /512A, /516

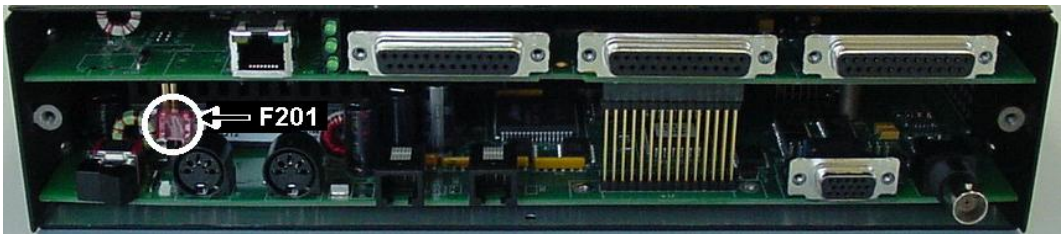
4. Locate the F201 fuse. It is located near the rear panel edge, close to the DIN5 POWER IN connector.
5. While wearing a grounded wrist strap, remove and replace the bad fuse. Ensure that the new fuse is fully seated.
6. Replace the Cover Plate and secure it to the chassis with the 4 screws that were removed in step 2.
7. Return the WaveBook to normal service. Should any problems be noted, consult the factory.

Observe the Cautions and the important note on page 9-1 prior to beginning this fuse replacement procedure.

1. If you have not already done so, turn OFF the power to, and UNPLUG the WaveBook/516E and all connected equipment. Remove all signal I/O lines from the unit.
2. Using a Phillips screwdriver, remove the two Rear Panel Side Screws and the Bottom Panel Screw from the WaveBook/516E. The following figure shows screw locations.
3. Using a 3/16 inch nut-driver, remove the six # 4-40 hex Jackscrews from the EXPANSION PORT connectors.
4. Using a 3/16 inch nut-driver, remove the two # 4-40 hex Jackscrews from the EXPANSION CONTROL connector.
5. Using a wrench with a 9/16" deep-well socket, remove the BNC Nut from the EXPANSION SIGNAL IN BNC connector.
6. Remove the BNC Washer from the base of the EXPANSION SIGNAL IN BNC connector.



7. Remove the Rear Panel from the main chassis (see following figure).



WaveBook/516E, Rear Panel Removed

8. Locate fuse F201. It is located near the rear panel edge, close to the DIN5 POWER IN connector.

9. While wearing a grounded wrist strap, remove and replace the bad F201 fuse. Ensure that the new fuse is fully seated.
10. Position the Rear Panel onto the WaveBook/516E chassis.
11. Thread the two #4-40 hex Jackscrews back into the EXPANSION CONTROL connector. Tighten snug.
12. Thread the six #4-40 hex Jackscrews back into the EXPANSION PORT connectors. Tighten snug.
13. Thread the two Rear Panel Side Screws and the Bottom Panel Screw and tighten snug.
14. Place the BNC Washer at the base of the EXPANSION SIGNAL IN BNC connector.
15. Place the BNC Nut over the EXPANSION SIGNAL IN BNC connector and thread by hand. Using the wrench and 9/16" deep-well socket, tighten the BNC Nut snug.
16. Return the WaveBook/516E to normal service. Should any problems be noted, consult the factory.

Appendix A – Using the Daq Configuration Applet A

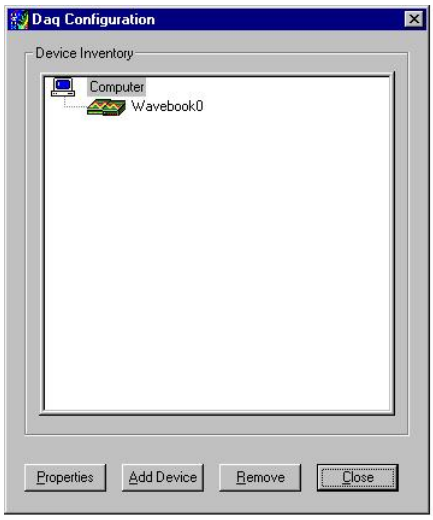
The *Daq Configuration* applet, designed for 32-bit Windows systems, is located in the Windows *Control Panel*. It allows you to add or remove a device and change configuration settings. The included test utility provides feedback on the validity of current configuration settings, as well as performance summaries.

To open the Daq Configuration Applet, navigate from the Windows Desktop as follows: **Start Menu ⇒ Settings ⇒ Control Panel;** then, from the Control Panel, double-click the ***Daq Configuration*** icon.

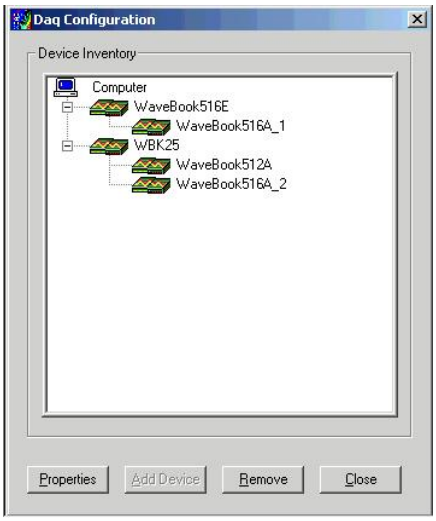
Device Inventory Dialog Box

After double-clicking on the *Daq Configuration* icon in the Windows *Control Panel*, the *Device Inventory* dialog box will open. The box displays all currently configured devices. Displayed devices show their name and an associated device icon, which identifies the device type.

Note: If no devices are configured, no devices will appear in the Device Inventory field.



A Parallel Port Connected System



An Ethernet Connected System

Daq Configuration - Device Inventory Dialog Boxes

The four buttons across the bottom of the dialog box are used as follows:

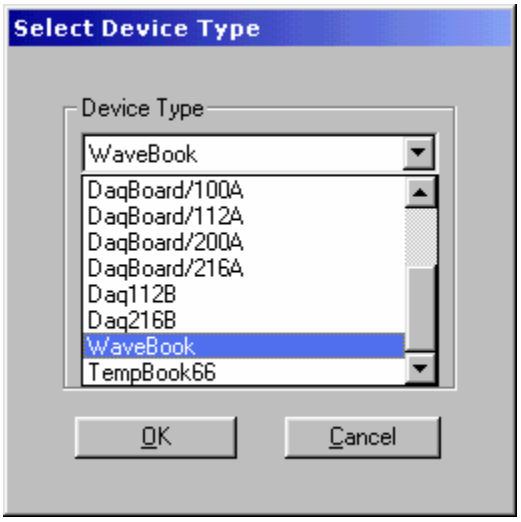
- ***Properties*:** Current configuration settings for a device can be changed by first bringing up the corresponding *Properties* dialog box. Open the *Properties* dialog box by double-clicking on the device icon or selecting the device and then clicking on the *Properties* button.
- ***Add Device*:** 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. Clicking on the *Add Device* button will open the *Select Device Type* dialog box.
- ***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 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 above.
- ***Close*:** The *Close* button may be used at any time to exit the *Daq Configuration* applet.

The "Select Device Type" Dialog Box

This dialog box opens when the *Add Device* button of the *Device Inventory* dialog box is selected.

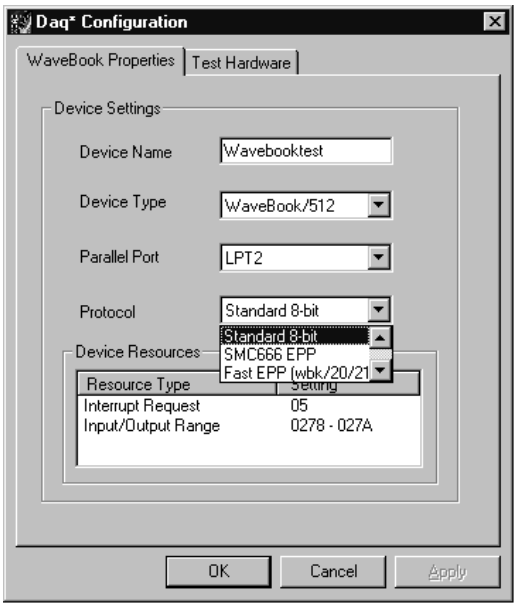
The device type you select for configuring will appear in the main edit box. Clicking on the OK button will then open the Properties Dialog Box.



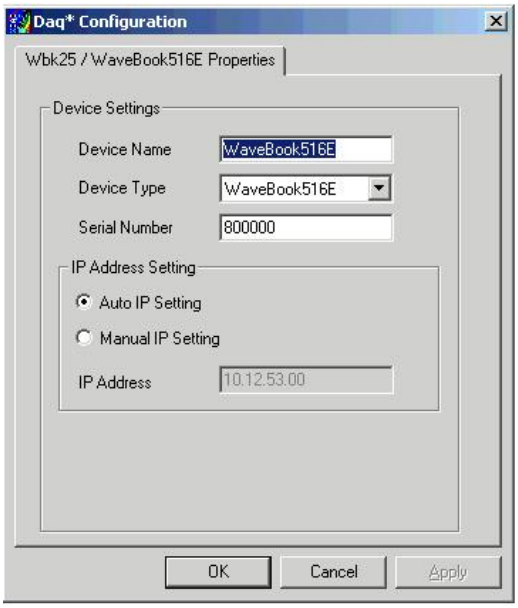
Daq Configuration - Select Device Type Dialog Box

Properties Dialog Box

This dialog box opens when the *Properties* button of the *Device Inventory* dialog box is selected, or when the *OK* button of the *Select Device Type* dialog box is selected. It displays the properties for the WaveBook device with the default configuration settings. The appearance of the Properties Dialog Box can vary, depending on whether the WaveBook device connection is via parallel port or Ethernet, as indicated in the following two figures. In addition, the box will have a third appearance for WaveBook devices that are connected to an Expansion Port of a WaveBook/516E or WBK25 Ethernet Interface Module. A discussion of the third Properties Box appearance is discussed shortly.



Configuring for Parallel Port



Configuring for Ethernet*

Daq Configuration - Properties Dialog Boxes

***Note**: The tab will not show WBK25 and WaveBook/516E at the same time.

For Parallel Port Connected WaveBooks

- ***Device Name*:** The *Device Name* field is displayed with the default device name. As shown, this field can be changed to any descriptive name as desired. This device name is the name to be used with the **daqOpen** function to open the device. This name will also be displayed in the device lists for opening the device in the WaveView and WaveCal applications.
- ***Device Type*:** The *Device Type* field indicates the device type that was initially selected. However, it can be changed here if necessary.
- ***Parallel Port*:** The *Parallel Port* field is used to set the parallel port for communicating with the WaveBook.
- ***Protocol*:** The *Protocol* field is used to set the parallel port protocol for communicating with the WaveBook. Depending on your system, not all protocols may be available. (See following Note).



In regard to Protocol – If you are using a WBK20A or WBK21, you must select "Fast EPP (wbk/20/21)" to achieve the best performance.

- ***Device Resources*:** The *Device Resources* field lists settings for various resources, among them Interrupt Request, Input/Output Range, and Direct Memory Access.
- ***OK:*** Click on the *OK* button to store the configuration and exit the current dialog box.
- ***Cancel:*** Click on the *Cancel* button to exit the current dialog box without storing any changes.
- ***Apply:*** Click on the *Apply* button to store the configuration. Or you can click the *Test Hardware* tab.
- ***Test Hardware:*** Click on the *Test Hardware* tab to test the current stored configuration for the device. This selection will open the *Test Hardware* dialog box.

For Ethernet Connected WaveBooks

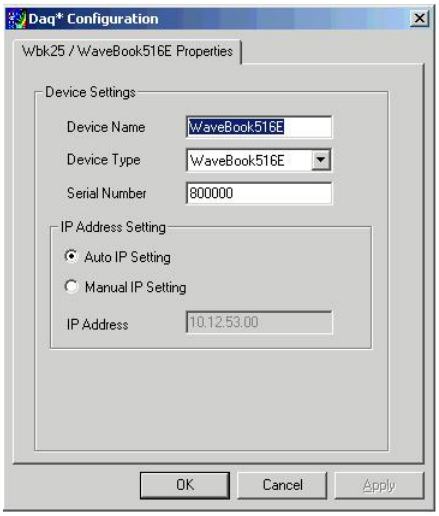
The tab label of the Properties Dialog Box, as well as the box itself, will appear different, depending on whether the device is a "first level" or a "second level" device. WaveBook/516E and WBK25 Ethernet Interface Modules are first level devices. By "first level" device we mean a device that connects directly to the Ethernet via a PC jack or network hub. The associated Properties Box [for the first level devices] includes a Serial Number field and an IP Address Setting panel.

A WaveBook that cannot connect directly to the Ethernet, but instead is an expansion device for a first level unit, has a Property Dialog Box with a much simpler appearance. An Expansion Port pull-down menu will reside in place of the Serial Number field. In this secondary Properties Box there is no IP Address Setting panel. This is because the secondary devices make use of the same address as the first level device to which they are connected.



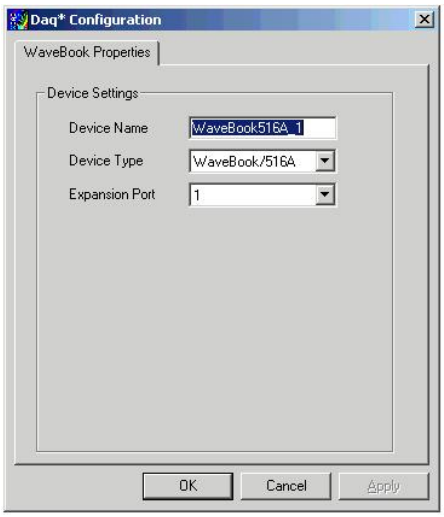
Reference Notes:

Refer to Appendix B in regard to TCP/IP and Resource Tests.



Configuring for Ethernet
First Level Ethernet Device

A **first level** device, i.e., a WaveBook/516E or a WBK25 Ethernet Module connects directly to a PC Ethernet jack, or to an Ethernet network hub



Configuring for Ethernet
Second Level Ethernet Device

A **second level** device such as a WaveBook/516A, WaveBook/516, WaveBook/512A is a device that is connected to one of 3 Expansion Ports of a first level device. Second level devices do not have a *direct* connection to the Ethernet.

- ***Device Name*:** The *Device Name* field is displayed with the default device name. The field can be changed to any descriptive name. This device name is the name to be used with the **daqOpen** function to open the device. This name will also be displayed in the device lists for opening the device in the WaveView and WaveCal applications.
- ***Device Type*:** The *Device Type* field indicates the device type that was initially selected. However, it can be changed here if necessary. In relation to Ethernet connections, the device type can be a first level device that connects directly to the Ethernet via PC or Ethernet hub. The WaveBook/516E and the WBK25 Ethernet Interface Module are examples of first level devices. The device type can also be a secondary device, such as a WaveBook/516, WaveBook/516A, or WaveBook/512A. To be connected to the Ethernet, these secondary devices must be connected to one of three Expansion Ports of a WaveBook/516E or a WBK25 Ethernet Interface Module.
- ***Expansion Port*** [second level devices only]: Used to set the Expansion Port (1, 2, or 3) of the first level device, to which the second level device is physically connected to. It is essential that the port selected here agrees with the physical connection.
- ***Serial Number*:** [for WaveBook/516E and WBK25 only]. The serial number field pertains to first level Ethernet devices, i.e., WaveBook/516E or WBK25 Ethernet Interface Module. The device serial number is used in the Auto IP Address Setting process.
- ***IP Address Setting Panel*:** [for WaveBook/516E and WBK25 only]. From this panel the user can select one of two radio buttons. The first is **Auto IP Setting**. If selected, the software will automatically derive the Internet Protocol Address. To do so, the serial number of the device must be entered in the Serial Number field. The resulting IP address will appear in the IP Address text box.

  The second radio button is labeled **Manual IP Setting**. This feature can be used when the IP address is already known. When the "manual" radio button is selected the desired address can be entered into the text field.
- ***OK:*** Click on the *OK* button to store the configuration and exit the current dialog box.
- ***Cancel:*** Click on the *Cancel* button to exit the current dialog box without storing any changes.
- ***Apply:*** Click on the *Apply* button to store the configuration. Or you can click the *Test Hardware* tab.

Quick Guide to Using the Daq Configuration Applet

To Open the Daq Configuration Applet:

a. Open the Control Panel by navigating from the Windows Desktop as follows:
Start Menu ⇒ Settings ⇒ Control Panel

b. Double-click the Daq Configuration icon.

To Add a WaveBook/516E to the list of installed devices:

a. Select the Computer in the device tree.

b. Click the <**Add Device**> button.

c. Select the WaveBook/516E or WBK25 from the list of devices, as applicable.

d. Click the <**OK**> button.

To add an expansion device, such as a WaveBook, WBK40, or WBK41 to the list of installed devices:

Note: The expansion device is connected to one of the three expansion ports of a WaveBook/516E or WBK25.

a. Select the WaveBook/516E or WBK25 in the device tree.

b. Click the <**Add Device**> button.

c. Select the appropriate WaveBook [or other expansion device] from the list of devices.

d. Click the <**OK**> button.

To add a WaveBook, which is connected directly to a parallel port:

a. Select Computer in the device tree.

b. Click the <**Add Device**> button.

c. Select the appropriate WaveBook [or other expansion device] from the list of devices.

d. Click the <**OK**> button.

Note: The following pertain to WaveBook configuration. Before starting, be aware that the devices will have default names, for example, WaveBook0. If desired, you can change the device name.

To set the properties of a WaveBook/516E or WBK25, which is connected to a dedicated network:

a. Enter the serial number of the WaveBook/516E or WBK25.

b. Select the Auto IP Setting Radio button. The IP address of the WaveBook/516E or WBK25 will automatically be calculated and displayed in the IP Address field.

To set the properties of a WaveBook/516E or WBK25 on a LAN with DHCP server.

a. Enter the base 10 version of the serial number of the WaveBook/516E or WBK25, as applicable. The number is located on the MAC label. For WaveBook/516E, the label is located on the left edge of the rear panel. For WBK25, the label is located on the left edge of the front panel.

b. Get the IP address of the device from your network administrator. The network administrator will need the unit powered-on and connected to the network. The administrator will also need the MAC address label's hexadecimal number (the label's bottom number) for the WaveBook/516E or WBK25.

c. Select the "Manual IP Setting" radio button.

d. In the IP Address field, enter the IP address obtained from your network administrator.

To set the properties of a WaveBook, which is connected to an expansion port of a WaveBook/516E or a WBK25 Ethernet Interface Module.

Simply select the expansion port number of the WaveBook/516E or WBK25 that the WaveBook is connected to.

To set the properties of a WaveBook, which is connected directly to a parallel port.

Simply select the parallel port and the protocol of the port that the WaveBook is connected to.

To test the WaveBook connection.

a. Click the "Test Hardware" tab.

b. Click the <**Resource Test**> button.

c. For WaveBook/516E you can also perform a TCP/IP test (see Appendix B).

Appendix B – TCP/IP and Resource Tests B

Before you run a test

Before testing the system, make sure the device has been properly installed and powered-on. Make sure all cables are properly and securely connected.

When testing a WaveBook or DaqBook device, if the unit does not respond within 30 seconds perform the following steps:

1) **reboot the system**
2) **upon power-up, re-open the *Daq* Configuration* applet**
3) **select another configuration setting**
4) **reinitiate the test**

How to run the TCP/IP Test (The TCP/IP test is for Ethernet devices only)

The TCP/IP (Transmission Control Protocol/Internet Protocol) test is for Ethernet devices only. The test is accessed and initiated as follows.

a. Open the Control Panel by navigating from the Windows Desktop as follows:
Start Menu ⇒ Settings ⇒ Control Panel

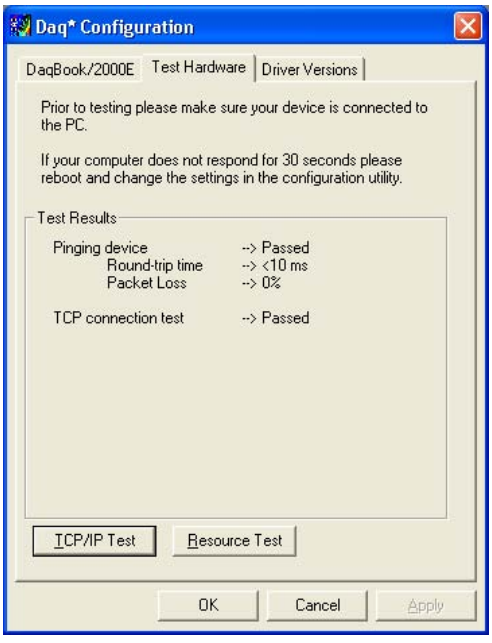
b. From the Control Panel, double-click the ***Daq* Configuration*** icon.

c. Select the device that you want to test from the Device Inventory configuration tree.

d. Click the <**Properties**> button. The Properties dialog box will open.

e. Click the "**Test Hardware**" tab.

f. Click the <**TCP/IP Test**> button.



Results of a TCP/IP Test for a DaqBook/2000E

What does the TCP/IP test tell me?

The TCP/IP test provides test results for "Pinging Device" and "TCP Connection Test."

Pinging Device. The Pinging Device test is an ICMP (Internet Control Message Protocol) ping test. In addition to indicating either "Passed" or "Failed," the test displays;

(a) The round-trip time of the ping, for example, <10 ms.
(b) Packet Loss expressed as a percent of data lost.

A long ping round trip time, for example, >50 ms and/or any packet loss indicates a slow network that is not optimized.

If the Pinging Device Test *fails* a <**Details**> button will appear just above the <**Resource Test**> button. If this is the case, click the <**Details**> button to obtain possible causes and possible solutions.

TCP (Transmission Control Protocol) Connection Test. The result of the TCP test will be either *passed* or *failed*. If the TCP test *failed* a <**Details**> button will appear just above the <**Resource Test**> button. If this is the case, click the <**Details**> button to obtain possible causes and possible solutions.

How to run the Resource Tests

For Ethernet devices, such as a WaveBook/516E or DaqBook/2000E you can run the Resource Test after a successful completion of the TCP/IP test with a simple click of the <**Resource Test**> button. For non-Ethernet devices complete the following steps.

a. Open the Control Panel by navigating from the Windows Desktop as follows:
Start Menu ⇒ Settings ⇒ Control Panel

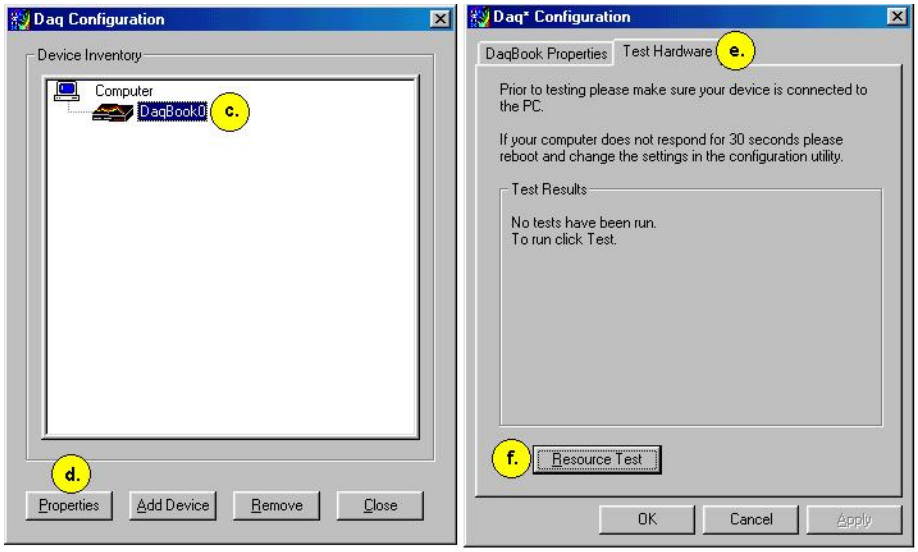
b. From the Control Panel, double-click the ***Daq* Configuration*** icon.

c. Select the device that you want to test from the Device Inventory configuration tree (see following figure, item "c").

d. Click the <**Properties**> button. The Properties dialog box will open.

e. Click the "**Test Hardware**" tab.

f. Click the <**Resource Test**> button.



Preparing to Run a Resource Test

What does the Resource Test tell me?

The Resource Test includes two categories of test, *Resource Tests* and *Performance Tests*.

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

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

Interrupt Level Test – Tests the ability of a parallel port to generate interrupts. Failure of this test may indicate that the parallel port may be currently unable to generate the necessary hardware interrupt, while other parallel port devices may work OK in this mode. Some parallel port devices (such as printers) do not require interrupts to work properly. See relevant operating system and computer manufacturer's documentation to correct the problem.

Performance Tests. These types of tests are intended to check various device functions, using the current device configuration. Performance tests provide quantitative results for each supported functional group.

Test results represent maximum rates the various operations can be performed. The rates depend on the selected parallel port protocol, and vary according to port hardware capabilities.

The ADC FIFO Input Speed part of the test results in a display of the maximum rate at which data can be transferred from the tested device's internal ADC FIFO to computer memory through the parallel port. Results are given in samples/second, where a sample (2 bytes in length) represents a single A/D value.

If the device has a WBK30 card installed, a WBK30 FIFO Test can be run.

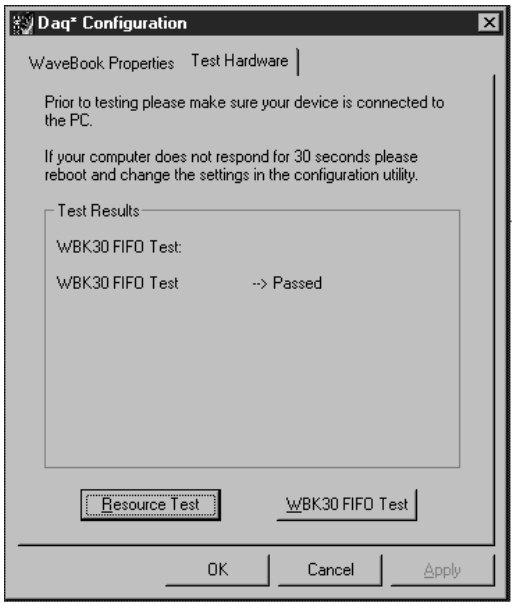
WBK30 FIFO Test. This *performance test* checks the data-storing capabilities of the optional, WBK30 memory card.

Note that the figure to the right represents results from a previous test. Initially the screen shows no test results.

When the test is completed successfully, the *Daq* Configuration Test Dialog Box* indicates a passed condition. For example, in the above figure:

WBK30 FIFO Test → Passed.

"Passed" messages indicate that you can exit the test program and run your application.



Daq* Configuration - Test Hardware Dialog Box

Reference Notes:

- If you experience difficulties, please consult additional user documentation, as applicable, before calling technical support. User documentation is included on your data acquisition CD, and is installed automatically as a part of product support, when your software is installed. The default location is the Programs Group. The documentation includes API information and a great deal of material regarding specific DBK cards and modules.
- Documents can be read directly from the data acquisition CD via the <**View PDFs**> button located on the CD's opening screen.


Notes

Glossary

Acquisition — A collection of scans acquired at a specified rate as controlled by the sequencer.

Analog — A signal of varying voltage or current that communicates data.

Analog-to-Digital Converter (ADC) — A circuit or device that converts analog values into digital values, such as binary bits, for use in digital computer processing.

API — Application Program Interface. The interface program within the data acquisition system's driver that includes function calls specific to the acquisition hardware and can be used with user-written programs. Several languages are supported.

Bipolar — A range of analog signals with positive and negative values (e.g., -5 to +5 V); see *unipolar*.

Buffer — *Buffer* refers to a circuit or device that allows a signal to pass through it, while providing isolation, or another function, without altering the signal. *Buffer* usually refers to:

(a) A device or circuit that allows for the temporary storage of data during data transfers. Such storage can compensate for differences in data flow rates. In a FIFO (First In - First Out) buffer, the data that is stored first is also the first data to leave the buffer.

(b) A follower stage used to drive a number of gates without overloading the preceding stage.

(c) An amplifier which accepts high source impedance input and results in low source impedance output (effectively, an impedance buffer).

Buffer Amplifier — An amplifier used primarily to match two different impedance points, and isolate one stage from a succeeding stage in order to prevent an undesirable interaction between the two stages. (Also see, *Buffer*).

Channel — In reference to data acquisition, *channel* simply refers to a single *input*, or *output* entity.

In a broader sense, an *input channel* is a signal path between the transducer at the point of measurement and the data acquisition system. A channel can go through various stages (buffers, multiplexers, or signal conditioning amplifiers and filters). Input channels are periodically sampled for readings.

An *output channel* from a device can be digital or analog. Outputs can vary in a programmed way in response to an input channel signal.

Common mode — Common mode pertains to signals that are identical in amplitude and duration; also can be used in reference to signal components.

Common mode voltage — Common mode voltage refers to a voltage magnitude (referenced to a common point) that is shared by 2 or more signals. Example: referenced to common, Signal 1 is +5 VDC and Signal 2 is +6 VDC. The common mode voltage for the two signals is +5.5 VDC [(5 + 6)/2].

Crosstalk — An undesired transfer of signals between systems or system components. Crosstalk causes signal interference, more commonly referred to as *noise*.

Detection Signal — In relation to WBK17, a detection signal is one of 8 outputs of the pattern detection module. Each input channel has an associated detection signal (Detect 1 for Channel 1, Detect 2 for Channel 2, etc.) A channel's detection signal will go active high when that channel's counter value meets the setpoint criteria programmed into the pattern detection module. Detection signals can be scanned along with any other channel in the scan group.

Digital A digital signal is one of discrete value, in contrast to a varying signal. Combinations of binary digits (0s and 1s) represent digital data.

Digital-to-Analog Converter (DAC) A circuit or device that converts digital values (binary bits), into analog signals.

DIP switch A DIP switch is a group of miniature switches in a small *Dual In-line Package* (DIP). Typically, users set these switches to configure their particular application.

Differential mode The differential mode measures a voltage between 2 signal lines for a single channel. (Also see *single-ended mode*).

Differential mode voltage Differential mode voltage refers to a voltage difference between two signals that are referenced to a common point. Example: Signal 1 is +5 VDC referenced to common. Signal 2 is +6 VDC referenced to common.

If the +5 VDC signal is used as the reference, the differential mode voltage is +1 VDC (+ 6 VDC - +5 VDC = +1 VDC).

If the +6 VDC signal is used as the reference, the differential mode voltage is -1 VDC (+ 5 VDC - +6 VDC = -1 VDC).

Encoder Mode The *encoder mode* allows the WBK17 to make use of data from optical incremental quadrature encoders. When in the *encoder mode*, the WBK17 accepts either *differential* or *single-ended* inputs and provides power for up to four encoders. When reading phase A, phase B, and index Z signals, the WBK17 provides positioning, direction, and velocity data.

ESD Electrostatic discharge (ESD) is the transfer of an electrostatic charge between bodies having different electrostatic potentials. This transfer occurs during direct contact of the bodies, or when induced by an electrostatic field. ESD energy can damage an integrated circuit (IC); so safe handling is required.

Excitation Some transducers [e.g. strain gages, thermistors, and resistance temperature detectors (RTDs)] require a known voltage or current. Typically, the variation of this signal through the transducer corresponds to the condition measured.

Gain The degree to which an input signal is amplified (or attenuated) to allow greater accuracy and resolution; can be expressed as ×n or ±dB.

Gating In relation to the WBK17, any counter can be gated by the mapped channel. When the mapped channel is high, the counter will be allowed to count, when the mapped channel is low, the counter will not count but hold its value.

Isolation The arrangement or operation of a circuit so that signals from another circuit or device do not affect the *isolated* circuit.

In reference to data acquisition, *isolation* usually refers to a separation of the direct link between the signal source and the analog-to-digital converter (ADC). Isolation is necessary when measuring high common-mode voltage.

Linearization Some transducers produce a voltage in linear proportion to the condition measured. Other transducers (e.g., thermocouples) have a nonlinear response. To convert nonlinear signals into accurate readings requires software to calibrate several points in the range used and then interpolate values between these points.

Mapped Channel In relation to the WBK17, a mapped channel is one of 16 signals that can get multiplexed into a channel's counter module. The mapped channel can participate with the channel's input signal by gating the counter, clearing the counter, etc. The 16 possible choices for the mapped channel are the 8 input signals (post debounce) and the 8 detection signals.

Multiplexer (MUX) A device that collects signals from several inputs and outputs them on a single channel.

Sample (reading) The value of a signal on a channel at an instant in time. When triggered, the ADC reads the channel and converts the sampled value into a 12- or 16-bit value.

Scan The channels that are selected for sampling.

Sequencer A programmable device that manages channels and channel-specific settings.

Simultaneous Sample-and-Hold An operation that gathers samples from multiple channels at the same instant and holds these values until all are sequentially converted to digital values.

Single-ended mode The single-ended mode measures a voltage between a signal line and a common reference that may be shared with other channels. (Also see *differential mode*).

Start of Scan In relation to the WBK17, "start of scan" is a signal that is internal to the WBK17. It signals the start of a scan group and therefore pulses once every scan period. It can be used to clear the counters and latch the counter value into the acquisition stream.

Terminal Count In relation to theWBK17, this signal is generated by the counter value. There are only two possible values for the terminal count: 65,535 (for a 16-bit counter) and 4,294,967,295 (for a 32-bit counter.) The terminal count can be used to stop the counter from rolling over to zero.

Ticksize In relation to theWBK17, the ticksize is a fundamental unit of time and has four possible settings: 20ns, 200ns, 2000ns, 20000ns. For measurements that require a timebase reference like period or pulsewidth, the ticksize is the basic unit of time. The count value returned in the scan is the number of ticks that make up the time measurement.

Trigger An event to start a scan or mark an instant during an acquisition. The event can be defined in various ways; e.g., a TTL signal, a specified voltage level in a monitored channel, a button manually or mechanically engaged, a software command, etc. Some applications may use pre- and post-triggers to gather data around an instant or based on signal counts.

TTL Transistor-Transistor Logic (TTL) is a circuit in which a multiple-emitter transistor has replaced the multiple diode cluster (of the diode-transistor logic circuit); typically used to communicate logic signals at 5 V.

Unipolar A range of analog signals that is always zero or positive (e.g., 0 to 10 V). Evaluating a signal in the right range (unipolar or bipolar) allows greater resolution by using the full-range of the corresponding digital value. See *bipolar*.

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP