



HP E1432A and HP E1433A Digitizers

System Overview



Part Number E1432-90010

Printed in U.S.A
Print Date: June 1997, First Edition

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8600 Soper Hill Road Everett, Washington 98205-1298 U.S.A.



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In This Book

This book provides an overview of a VXI measurements system which includes an HP E1432A or HP E1433A Digitizer module.

The HP E1432A 16 Channel 51.2 kSa/s Digitizer plus DSP is a C-size VXI module. “51.2 kSa/s” refers to the maximum sample rate of 51,200 samples per second, per channel. The HP E1432A can have up to 16 inputs.

The HP E1433A 8-Channel 196 kSa/s Digitizer plus DSP is a C-size VXI module. “196 kSa/s” refers to the maximum sample rate of 196,000 samples per second, per channel. The HP E1433A can have 8 inputs.

For more information see the HP E1432A User’s Guide or the HP E1433A User’s Guide.

TABLE OF CONTENTS

In This Book i-iii

1 The HP E1432A/ HP E1433A System

Introduction 1-8

System Programming Environments 1-10

Additional Equipment 1-11

HP E1432A/HP E1433A options 1-11

Break Out Boxes 1-11

Sensors and transducers 1-11

Other VXI modules in a HP E1432A/HP E1433A system 1-12

Application Software 1-12

2 Example and Scenarios

An example program 2-14

scopefft.vee 2-14

Measurement scenarios 2-20

Channel Groups 2-20

Deleting channels from a group 2-20

Turning on the Source and ADC 2-21

Turning on the Tachometer 2-23

Glossary 3-25

1

The HP E1432A/
HP E1433A System

Introduction

The HP E1432A and HP E1433A are VXI C-sized, scaleable input modules. The HP E1432A 16-Channel 51.2 kSa/s Digitizer plus DSP may have up to 16 inputs. The HP E1433A 8-Channel 196 kSa/sec Digitizer plus DSP may have up to 8 inputs. The main difference between the two models is in their frequency ranges. The HP E1433A's sample rate is 4 times that of the HP E1432A. This allows the HP E1433A to be used for acoustic and real-time 1/3 octave applications.

Unlike many instruments, the HP E1432A and HP E1433A have no hardware front panel. Instead of pressing buttons on a front panel, you communicate with the instrument using software. The Soft Front Panel (SFP) program provides an interface that is useful for checking your system, but it is not very useful for making measurements. For making measurements it is usually better to write your own program using the example programs.

The supplied example programs, such as scopefft.vee also provide examples of ways to interface with the HP E1432A/E1433A. Using these examples and the software libraries, you can write programs tailored to your own specific kinds of measurements. The HP E1432A/E1433A can be programmed from several different environments. From a PC it can be programmed using C-language, HP VEE, Microsoft® Visual Basic™, and Mathworks® Matlab™. From a unix environment it can be programmed using C-language, Microsoft Visual Basic, and Mathworks Matlab.

The power and flexibility of the HP E1432A/E1433A software and hardware allow you to create a system that will make the measurements you need.

This document provides an overview of some typical HP E1432A/E1433A systems. For detailed information about the modules and the programming commands used with them, see the HP E1432A User's Guide, the HP E1433A User's Guide and/or the help text which is supplied with the software for both modules.

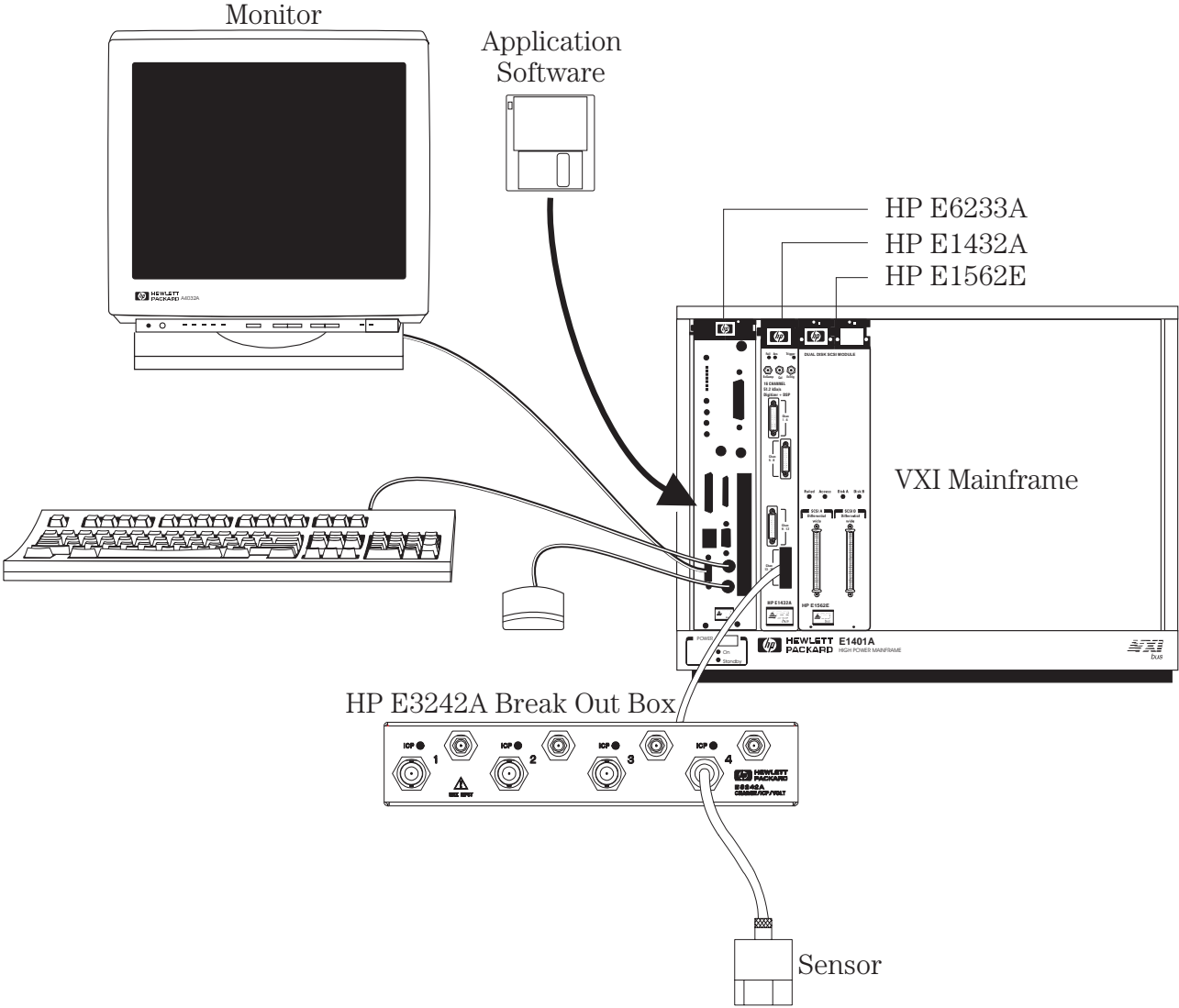


Figure 1-1: An example of an HP E1432A/HP1433A System

This illustration shows an example of a typical system. An actual system may include several mainframes or modules, and many break out boxes and sensors. This example shows an HP E6233A embedded computer, another option is to use a standalone PC with a VXILink kit.

System Programming Environments

Note: Specific models mentioned below are examples only; in many cases they may be superseded by newer models. See your HP representative for up-to-date information.

The HP E1432A and HP E1433A can be used in any of four different environments:

- ❑ A UNIX environment with an embedded controller. The embedded controller is a computer in a module which is installed in the VXI mainframe along with the HP E1432A or HP E1433A. An example is the HP E1498A. An advantage of embedded controllers is that they have direct access to the VXI backplane for high speed without added MXIbus equipment. Another advantage is that they save space by putting the computer within the mainframe.
- ❑ A UNIX environment with an external computer, connected by way of MXIbus. An example is an HP 9000 Series 700 computer equipped with an HP E1489C EISA/ISA-to-MXIbus Interface card. The card is connected by a MXI cable to a VXI extender module such as the HP 1482B, which is installed in Slot 0 of the VXI mainframe. This system has the advantage of greater flexibility than an embedded system, while still working at high speed.
- ❑ A PC environment with an embedded PC computer. An example is the HP E6233A (for Windows NT) or the HP E6232A (for Windows95). Like the UNIX embedded computers these have the advantages of high speed and space-saving. The various models use Pentium processors and support programming in Windows 95 and/or Windows NT environments.
- ❑ A PC environment with a MXI connection to an external PC. An example of a PC-to-VXI connection is the National Instruments VXI-PCI8000 Series kit. This kit consists of a board that can be installed in almost any PC, a MXI-2 cable, and a C-size module that can be installed in the mainframe. This system has the advantages of flexibility and high speed along with the ability to program in a Windows 95 or Windows NT environment.

The software for the HP E1432A and HP E1433A supports UNIX 10.2 (in the UNIX environment) and Windows 95 and Windows NT (in the PC environment). It does not support UNIX 9.x or Windows 3.1.

Additional Equipment

HP E1432A/HP E1433A options

The following options are available for the HP E1432A and HP E1433A (a single module cannot have both tachometer and source):

- Tachometer input, Option AYP. This option is useful for applications involving rotating machinery (RPM measurements) and for computed order tracking.
- Arbitrary Source output, Option 1D4. This option is useful for performing stimulus-response measurements. These can be measurements of electrical circuits or physical measurements, such as a structural modal analysis using frequency response.
- Local Bus interface, Option UGV. The local bus is used for high-speed data transfer within the mainframe. In an HP E1432A/HP E1433A system it is most often used to send raw time-domain data to the HP E1562 Throughput Disk Module to be stored at high speed. This is especially useful for destructive tests because the data can be analyzed later and reviewed as needed without repeating the test.

Break Out Boxes

A Break Out Box connects the HP E1432A or HP E1433A to a set of connectors to receive input signals.

Several types of Break Out Boxes are available, including:

- HP E1432-61600 ICP Break Out Box
- HP E1432-61602 Voltage Break Out Box
- HP E3242A Charge/ICP/Voltage Break Out Box

For more information see the HP E1432A User's Guide or the HP E1433A User's Guide.

Sensors and transducers

To bring information into the system from the outside world you can use any of a variety of microphones, transducers, and sensors. These include:

- Free field microphones
- Pressure microphones
- Sound intensity probes
- Vibration probes
- Piezo-electric accelerometers
- ICP accelerometers
- Voltage devices (such as strain gauges)

See your Hewlett-Packard representative for a catalog of these and other accessories for your HP E1432A/HP E1433A system.

Other VXI modules in a HP E1432A/HP E1433A system

Other VXI modules that may be important in an HP E1432A/HP E1433A system include:

- The HP E1562D/E/F Throughput Disk Module
- The HP E1434A Arbitrary Source Module

Refer to the documentation for these modules for more information.

Application Software

In order to view and process your data, the HP E1432A/HP E1433A system has application software running on the computer. Several kinds of software are available, including:

- HP VEE
- C-language programs
- Other application software programs

2

Example and Scenarios

An example program

scopefft.vee

scopefft.vee is an HP VEE example program for the HP E1432A and HP E1433A. There are other example programs. For more information see the HP E1432A User's Guide or the HP E1433A User's Guide.

This program displays four channels with time record and FFT for each channel.

These are the functions called in the scopefft.vee program to control the instruments and display data. The same functions can be used in VXIplug&play programs or HP VEE programs. The same functions with similar names are used in host C library programs.

Functions used in scopefft.vee:

Delete any leftover channel groups, create a channel group, and turn the modules off.

```
"hpe1432_deleteAllChanGroups(instrHandle)"  
"hpe1432_createChannelGroup(instrHandle, num, channels, groupID)"  
"hpe1432_setActive(instrHandle, -1, HPE1432_CHANNEL_OFF)"
```

Create a new channel group, with the required number of active channels

```
"hpe1432_deleteAllChanGroups(instrHandle)"  
"hpe1432_createChannelGroup(instrHandle, num, channels, groupID)"
```

Set up the ADCs (the input Analog-to-Digital Converters)

```
"hpe1432_setBlocksize(instrHandle, -1, blocksize)"  
"hpe1432_setSpan(instrHandle, -1, span)"  
"hpe1432_setRange(instrHandle, -1, range)"  
"hpe1432_setDataMode(instrHandle, -1, HPE1432_BLOCK_MODE)"
```

Put all the modules in the idle state, ready for a measurement.

```
"hpe1432_initMeasure(instrHandle, -1)"
```

Read a block of data.

```
"hpe1432_readFloat64Data(instrHandle, -1, HPE1432_TIME_DATA, data, size, actualCnt,  
HPE1432_WAIT_FLAG)"
```

The scopefft.vee program is located at \HPE1432\examples\hpvee\ on a Microsoft Windows system or at /opt/e1432/vee-examples on an HP-UX system.

To run scopefft.vee, first type:

```
veetest
```

from an HP-UX environment, or click on the HP VEE icon in Windows.

To begin using HP VEE:

In HP VEE click on File, then Open. In the Open File dialog box select scopefft.vee from the list of files. Then click OK.

Note: the illustrations in this chapter were made using VEE 3.21. If you are using a later version of VEE, your screens will look slightly different.

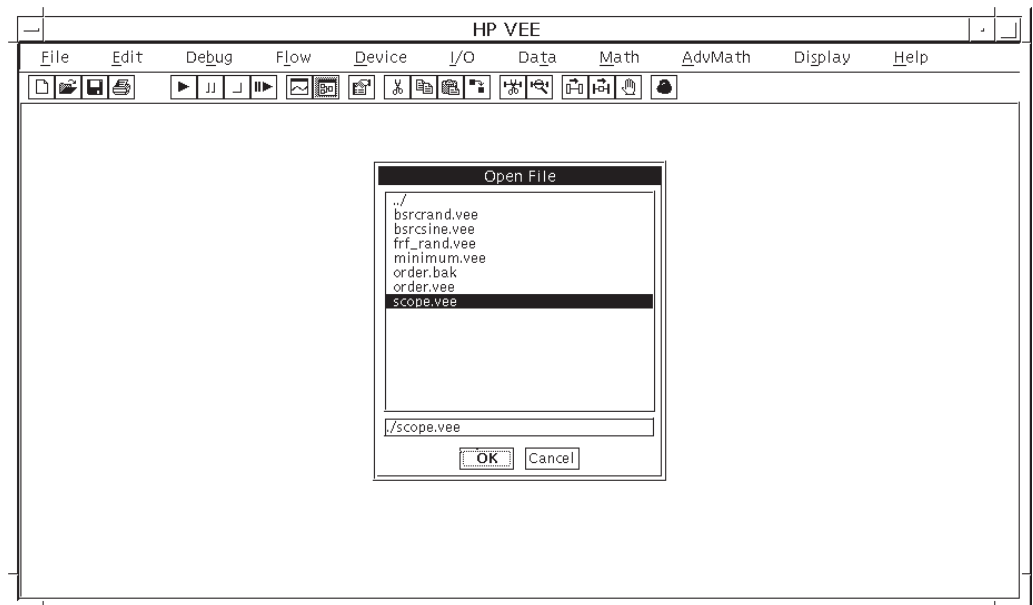


Figure 2-2: HP VEE - Open File dialog box

The program scopefft.vee starts, showing four channels, with time record and FFT for each channel.

This illustration was made using VEE 3.21. If you are using VEE 4.0 you will see a column on the left side of the screen which allows you to select a detail to view.

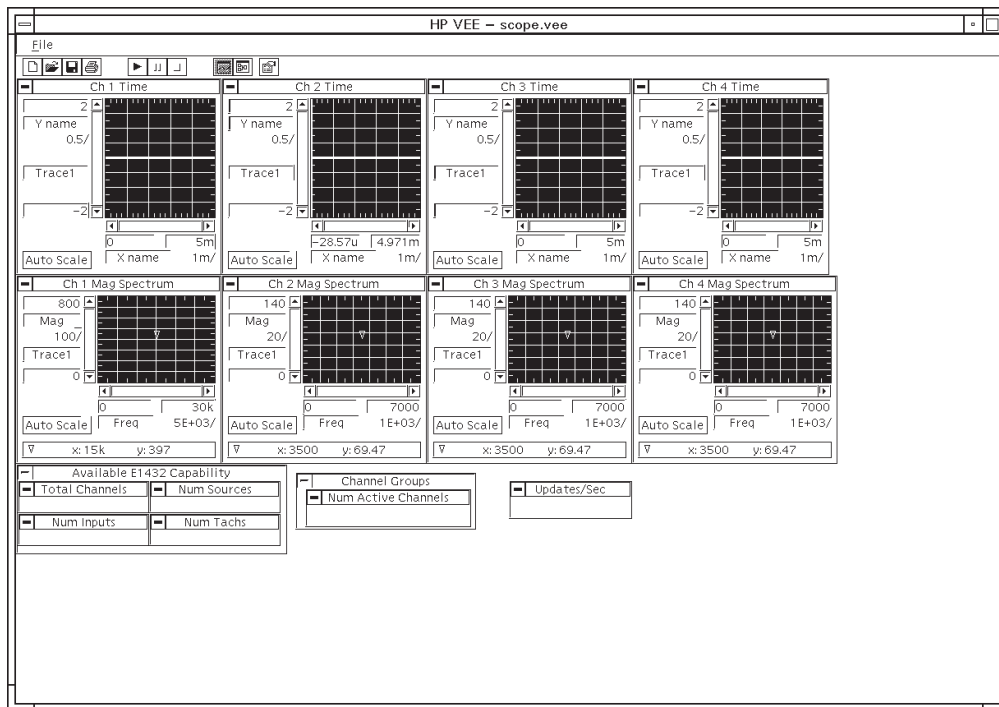


Figure 2-3: scopefft.vee - panel view

To start a measurement, click the Run button on the toolbar (triangle symbol). To pause, click on the Pause button (two vertical bars, next to the Run button). To stop the measurement, click the Stop button (square symbol).

This screen is VEE's panel view, where you can interact with the system much as you would with the front panel of a standalone instrument. You can also go to VEE's detail view screen where you can configure the system and the view panel to make your own measurements.

To look at the scopefft.vee program "behind the scenes," click on the View Detail button on the toolbar (chart symbol). To return to the original (panel) view, click on the View Panel button (sine wave symbol).

Click on the View Detail button again to look at the detail view screen.

To use and modify scopefft.vee you need to be familiar with using the HP VEE program. Refer to HP VEE documentation if necessary. In View Detail mode you can click on Help on the menu bar to get help on using HP VEE.

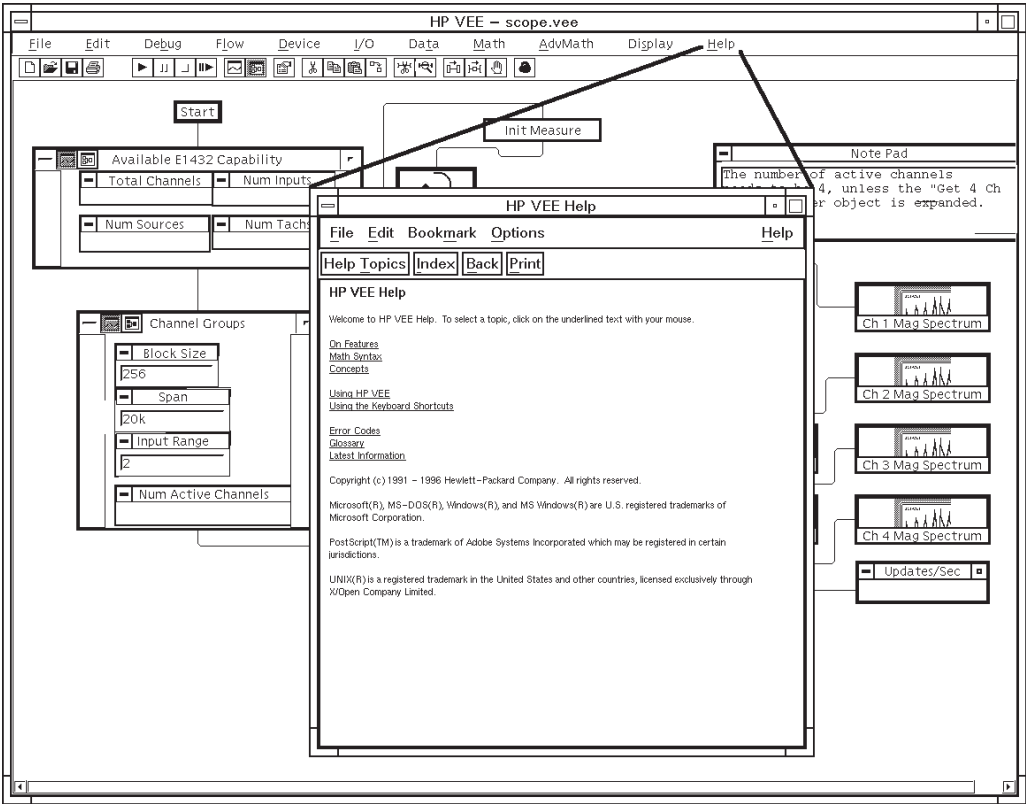


Figure 2-4: HP VEE help text

In detail view there are boxes representing parts of the scopefft.vee program. For programs that are too large to be viewed all at one time, use the scroll bars at the bottom and left side of the screen to scroll the display. You can double-click on a box to see more detail, or click on the View Detail (chart symbol) button on the top bar of the box. Some of the boxes contain a function. If you click on the function you can view the parameters associated with it.

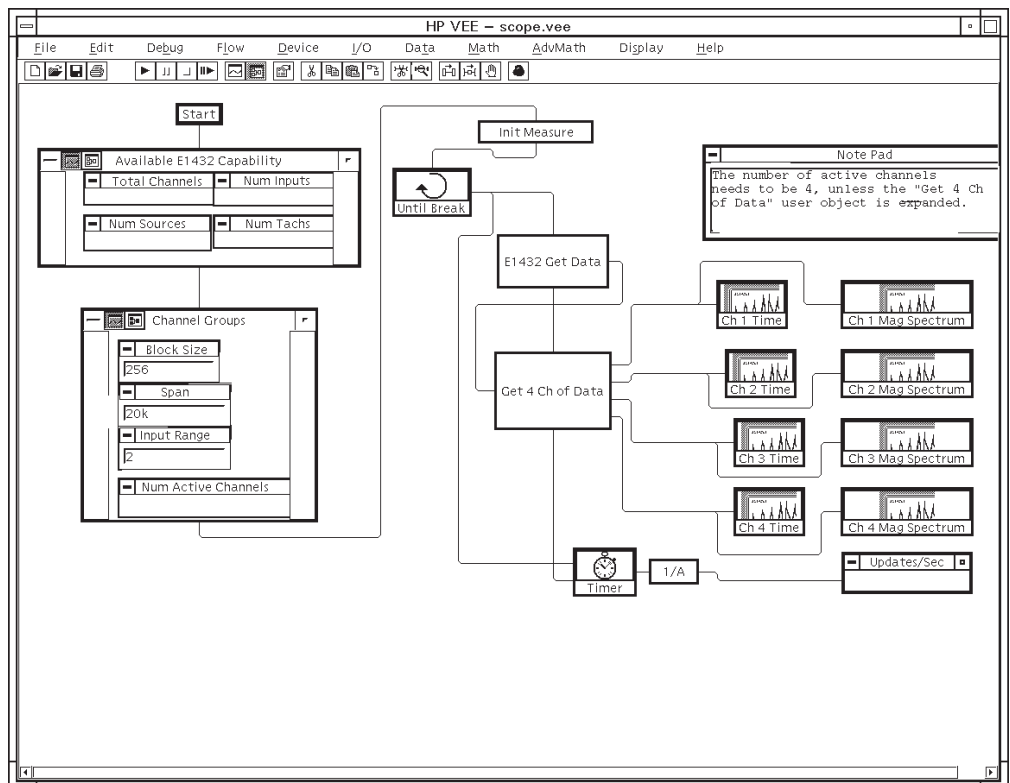


Figure 2-5: scopefft.vee - detail view

To specify a new function, click on the blank space in the box where the function is to be. A dialog box appears with a list of functions. After you select a function you can choose Panel to “hard code” constants that the function will use, or choose Parameters to allow a parameter to be input from elsewhere (from the user or another function). The input appears as a “pin” on the chart diagram. In the scopefft.vee program the user can select the blocksize, span, and range.

You can click Add To Panel in the Edit menu to make a box in the detail view visible on the panel view. This gives the user access to enter parameters or view results.

You can click on Alphanumeric in the Display menu to set up a box to specify how to display the output of a function.

Use HP VEE to look at the functions that make up the simple “scopefft.vee” program. This is an example of how the HP E1433A can be programmed using HP VEE.

Click on the Panel View button (sine wave symbol) to go to panel view. Set up your system to provide input signals to some of the input connectors of your HP E1433A. Then use the scopefft.vee interface to view the time records and FFTs of the input signals.

When you exit HP VEE, the program will ask if you want to save any changes you made to scopefft.vee. Click No, or if you wish click Cancel and then use File/Save As to save your changes with a different filename.

Measurement scenarios

Channel Groups

There are a number of functions which handle creating, deleting and other manipulations of channel groups. A channel group is one or more HP E1432A/1433A channels, either from the same or from distinct modules, grouped together under a groupID such that they can be set up easily with only one function call for the whole group.

Most functions in the HP E1432A library have as their first parameter a groupID to reference a particular grouping of modules. Most of these functions alternatively accept a chanID, in order to reference a single channel. When a function accepts both forms, there is only one parameter called ID, and this is unambiguous since groupIDs are sequential negative integers, starting with -1, and chanIDs are sequential positive integers, starting with +1.

Note that the channel numbers seen by the user start at one (for each type of input channel). However, the channel index passed to by the software to a HP E1432A/1433A module starts at zero.

Deleting channels from a group

In this example we will switch an HP E1432A from 16-channel mode to 4-channel mode. First we delete all channels from the channel group:

```
“hpe1432_deleteAllChanGroups(instrHandle)”
```

However, this is not enough. The channels are still active, we just are not receiving data from them. In order for the 4-channel mode to work properly, you must specifically turn off the other channels.

```
“hpe1432_createChannelGroup(instrHandle, num, channels, groupID)”
```

```
“hpe1432_setActive(instrHandle, -1, HPE1432_CHANNEL_OFF)”
```

Then we can create a new channel group containing only 4 channels.

```
“hpe1432_createChannelGroup(instrHandle, num, channels, groupID)”
```

Turning on the Source and ADC

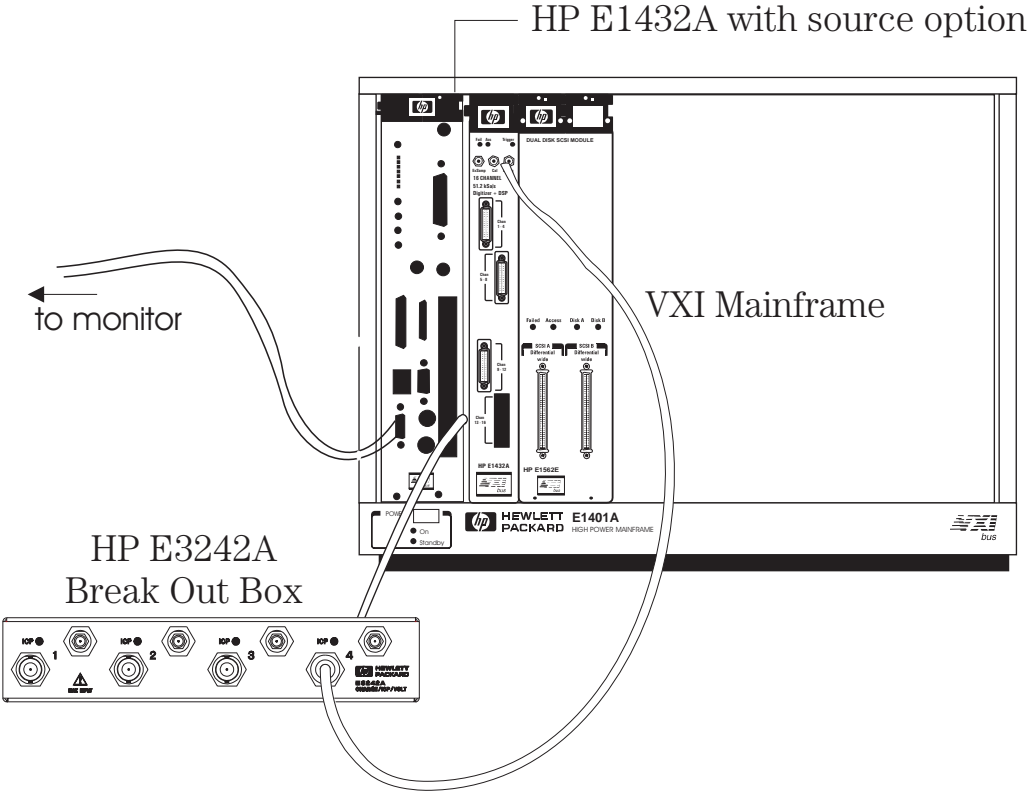


Figure 2-6: HP E1432A with source option

In this example we will turn on the optional source in a HP E1432A or HP E1433A and turn on the ADC (Analog-to-Digital Converter). The following functions will be used in this process. (An example can be found in the program bsrscine.vee).

Functions for setting up the source:

Delete any leftover channel groups, create a new channel group, and turn the modules off.

```
"hpe1432_deleteAllChanGroups(instrHandle)"  
"hpe1432_createChannelGroup(instrHandle, num, channels, groupID)"  
"hpe1432_setActive(instrHandle, -1, HPE1432_CHANNEL_OFF)"
```

Set up the ADCs (the input Analog-to-Digital Converters)

```
"hpe1432_setBlocksize(instrHandle, -1, blocksize)"  
"hpe1432_setSpan(instrHandle, -1, span)"  
"hpe1432_setRange(instrHandle, -1, range)"  
"hpe1432_setDataMode(instrHandle, -1, HPE1432_BLOCK_MODE)"
```

Set up the source and create a channel group.

```
"hpe1432_setSourceMode(instrHandle, group, HPE1432_SOURCE_MODE_BSINE)"  
"hpe1432_setRange(instrHandle, group, range)"  
"hpe1432_setDutyCycle(instrHandle, group, duty)"  
"hpe1432_setRampRate(instrHandle, group, rate)"  
"hpe1432_setSineFreq(instrHandle, group, sineFreq)"  
"hpe1432_setTriggerChannel(instrHandle, group, HPE1432_CHANNEL_ON)"  
"hpe1432_setAutoTrigger(instrHandle, group, HPE1432_MANUAL_TRIGGER)"  
"hpe1432_setActive(instrHandle, group, HPE1432_CHANNEL_ON)"
```

Put all the modules in the idle state, ready for a measurement.

```
"hpe1432_initMeasure(instrHandle, -1)"
```

Read a block of data.

```
"hpe1432_readFloat64Data(instrHandle, -1, HPE1432_TIME_DATA, data, size, actualCnt,  
HPE1432_WAIT_FLAG)"
```

Note that the source takes time to ramp up to its full output, so the first output of the ADC will have no data. At first, it may appear that the system isn't working, but the output will appear when the source ramps up.

Using HP VEE, you can give the program parameters such as ramp rate or sine frequency by filling in boxes in the VEE detail view. If you are programming in C language you can assign values to the parameters.

Turning on the Tachometer

In this example we will turn on the optional tachometer in an HP E1432A or HP E1433A and monitor it on one or more of the other input channels.

The following functions will be used in this process. (An example can be found in the program tachmon.c).

Assign channel numbers and create a channel group.

```
CHECK(e1432_assign_channel_numbers(1, &laddr, &hw));  
CHECK(e1432_get_hwconfig(1, &laddr, &hwconfig));  
group = e1432_create_channel_group(hw, nchan, chan_list);
```

Set up so all input channels monitor the tach channel.

```
CHECK(e1432_set_input_high(hw, group, E1432_INPUT_HIGH_CALIN));  
CHECK(e1432_set_calin(hw, group, E1432_CALIN_CALOUT));
```

Set up the first tach channel

```
CHECK(e1432_set_input_high(hw, E1432_TACH_CHAN(1), E1432_INPUT_HIGH_CALOUT));  
CHECK(e1432_set_blocksize(hw, group, BLOCKSIZE));
```

Start measurement

```
CHECK(e1432_init_measure(hw, group));
```

The above example uses the first tach channel. Use E1432_TACH_CHAN(2) to monitor the second tach channel

You can pick just one input channel to monitor the tach channel by using an input channel ID instead of a group ID in the next two calls. The input channel should be in the same HP E1432A module as the tach channel; otherwise the input channel will not get the voltage scaling correct, because it won't know that the signal comes from a tach board.

Glossary

A16 registers

Address space using 16 address lines. The VXI definition gives each VXI module 64 bytes of A16 registers.

A24 registers

Address space using 24 address lines. VXI modules can configure how much A24 address space they use.

arbitrary source

A signal source capable of producing an arbitrary waveform according to the way it is programmed.

arbitration bus

See DTB arbitration bus.

ASCII

American Standard Code for Information Interchange, a standard format for data or commands.

backplane

A set of lines that connects all the modules in a VXI system.

baseband

A band in the frequency spectrum that begins at zero. In contrast a zoomed band is centered on a specified center frequency.

block mode

A mode of data-collecting used in instruments such as the HP E1431A. The instrument stops taking data as soon as a block of data has been collected. Overlap block mode in the HP E1432A and HP 1433A can be configured to act exactly like block mode.

block size

The number of sample points in a block of data.

breakout box

Another name for the 8-channel input connector.

C-Library (interface library)

A library of functions, written in C language, which can be used to operate the HP E1432A and HP E143A.

C-size

One of several possible sizes for VXI modules. The HP E1432A and HP E1433A are C-size modules.

channel-dependent commands

Commands that are channel-dependent change a parameter for each channel independently.

COLA

Constant Output Level Amplifier.

continuous mode

A mode of data-collecting used in the HP E1432A, the HP E1433A, and in other instruments such as the HP E1431A. The instrument collects data continuously and stops only if the FIFO overflows.

D32, D16, and D08 (EO)

The VXI Bus provides 32 data lines. Modules can use all 32 lines, or 16 lines, or 8 lines. For example, "D16 access" refers to data read across 16 lines.

daisy-chain

A set of instruments or modules connected together in a line. Data and instructions enter each one before being buffered and passed out to the next module in line.

decimation filter

A digital filter that simultaneously decreases the bandwidth of the signal and decreases the sample rate. The digital filter provides alias protection and increases frequency resolution. For more information, see *Spectrum & Network Measurements* available through your Hewlett-Packard Sales Office.

delta sigma

A method for converting an analog input to digital data. It involves using a difference of two voltages (delta) and a summation of signals (sigma) to improve accuracy.

digitizer

An instrument which converts analog signals into digital data suitable for digital signal processing.

DRAM

Dynamic Random Access Memory.

DSP

Digital Signal Processing.

DTB arbitration bus

The HP E1432A does not use the arbitration bus. The arbitration bus is part of the VXI specification and is used by some modules to request bus control.

ECL

Emitter-Collector Logic, a standard for electrical signals.

Engineering Unit (EU)

A scale factor used to convert the output of a transducer (in volts) into another unit (for example: g's).

FFT

Fast Fourier Transform.

FIFO

First-In First-Out. A buffer and controller used to transmit data. The FIFO in the HP E1432A/HP E1433A input is implemented using DRAM.

freerun counter

A counter in which the bits always increment. When the freerun counter reaches all ones it resets to all zeros and continues counting.

F_s

Sample Frequency or sample rate.

group ID

Any number of channels may be declared and uniquely identified by a groupID. A channel can be a member of more than one group.

holdoff time

A circuit that detects a trigger signal will not respond to another trigger until the holdoff time has passed. This prevents a ringing signal from being detected as multiple triggers.

HP VEE

A Hewlett-Packard program for graphical programming.

IACK

Interrupt ACKnowledge.

ICP

Integrated-Circuit Piezo-electric transducer.

IRQ

Interrupt ReQuest.

kSa/s

Kilo-Samples per second.

LED

Light Emitting Diode.

Local Bus

A high-speed port that Hewlett-Packard has defined as a standard byte-wide ECL protocol which can transfer measurement data at up to 2.62 Msamples per second from left to right on the VXI backplane.

logical address

The VXI logical address identifies where each module is located in the memory map of the VXI system.

message-based VXI device

Message-based devices communicate with the VXI Bus using high-level ASCII commands. Programming is easier and more sophisticated, but communication is slower than with register-based devices. Message-based devices can also be programmed at the register level. The HP E1432A and HP E1433A are register-based VXI devices.

module-dependent commands

Commands that are module-dependent change a parameter for all channels of the module; even when only one channel has been specified in the channel list.

MXI bus

A bus standard which can be used to connected multiple VXI mainframes.

overlap block mode

A mode of data-collecting in used in the HP E1432A and HP E1433A. It is similar to block mode except that it allows additional arms and triggers to occur before an already-acquired block is sent to the host.

pipeline mode

A Local Bus mode in which data is sent through a module and on to the next one.

Plug&Play

See VXIplug&play

RAM

Random Access Memory.

register-based VXI device

Register-based devices communicate with the VXI Bus by way of registers. They must be programmed with low-level binary commands but they can communicate faster than message-based devices. The HP E1432A and HP E1433A are register-based VXI devices.

registers

Memory locations in the hardware of a VXI module which can be used to program the module at a low level.

RPM

Revolutions Per Minute.

ROM

Read-Only Memory

SCA

Signal Conditioning Assembly. An example is the 4-channel input assemblies used in the HP E1432A (also called Vibrato).

sample rate

The rate at which the measurement data is sampled. For the HP E1432A, the sample rate is 2.56 times the frequency span. Sample rate is abbreviated "Fs" (for "sample Frequency").

settling

When settling, the digital filter waits a designated number samples before outputting any data.

SFP

see Soft Front Panel

shared memory

Memory locations in both a VXI module and in a host or controller which are shared and can be used to transmit data between the host and module.

slot 0 commander

The module which occupies the left-most slot in a VXI mainframe. It supplies important signals for the rest of the system.

SMB

Sub-Miniature "B"; a type of connector.

Soft Front Panel (SFP)

A VXIplug&play program which provides an easy-to-use interface for the HP E1432A. It can be used in Microsoft Windows 95 or Windows NT.

SRAM

Static Random Access Memory.

summer

A circuit that outputs the sum of two input signals.

sync/trigger line

A TTL line on the VXI back plane, used for synchronization or triggering signals.

SYSRESET*

SYSTEM RESET line, part of the VXI Bus.

system module

The module with the lowest VXI logical address. It needs to be set to output the synchronization pulse for a multiple module group. All system sync pulses come from the system module.

tachometer

The tachometer produces a signal which is proportional to the rotation of a device. It can be programmed to produce one or more signals per revolution.

target

The 'target' of a library function is either a channel, a group, or (rarely) a module, depending on the nature of the call. When the same library function may be called with either a channel or a group identifier, its 'target' is shown by a parameter named ID.

TTL

Transistor-Transistor Logic, a standard for electrical signals.

TTLTRG

TTL TRiGger lines, part of the VXI Bus.

VEE

See HP VEE

VME Bus

An industry-standard bus on the VXI backplane for module control, setup and measurement data transfers. For measurement data transfers, the Local Bus offers higher transfer rates.

VXI

VME Extensions for Instrumentation, a standard specification for instrument systems.

VXIplug&play

A set of standards which provides VXI users with a level of standardization across different vendors beyond what the VXI standard specifications spell out.

zoom

In instruments that support zoom you can select a frequency span around a specified center frequency so you can focus on a specific frequency band.

INDEX

!

1D4 (option) 1-11

A

accelerometer 1-11
accessories 1-11
ADC (Analog-to-Digital Converter) 2-21
application software 1-12
arbitrary source 1-11
arbitrary source module 1-12
assistance (rear of manual) 1-i
AYF (option) 1-11

B

break out box 1-11
bsrcsine.vee 2-21

C

C-language programs 1-12, 2-22
chanID 2-20
channel groups 2-20
charge break out box 1-11

D

detail, view 2-16

E

environments 1-10
example programs
 bsrcsine.vee 2-21
 scopefft.vee 2-14
 tachmon.c 2-23

F

flexibility 1-8
functions 2-14, 2-20, 2-22 - 2-23

G

glossary (rear of manual) 3-25
groupID 2-20
groups,channel 2-20

H

help
 HP VEE 2-17
HP E1432A
 compared with HP E1433A 1-8
HP E1434A Arbitrary Source Module
 1-12
HP E1562D/E/F Throughput Disk
Module 1-12
HP VEE 1-12, 2-16, 2-22
 help 2-17

I

ICP accelerometer 1-11
ICP break out box 1-11

L

local bus 1-11

M

measurement scenarios 2-20
microphone 1-11
MXIbus 1-10

N

National Instruments VXI-PCI8000 1-10

P

panel, view 2-16
PC computer 1-10
phone assistance (rear of manual) 1-i
piezo-electric accelerometer 1-11
probe 1-11
programming environments 1-10

R

rotating machinery 1-11
RPM measurements 1-11

S

scenarios 2-14, 2-20
scopefft.vee 2-14
sensor 1-11

HP E1432A and HP E1433A System Overview

Index

service assistance (rear of manual) 1-i

SFP 1-8

Soft Front Panel 1-8

software, application 1-12

sound intensity probe 1-11

source 1-11, 2-21 - 2-22

strain gauge 1-11

T

tachmon.c 2-23

tachometer 1-11, 2-23

telephone assistance (rear of manual)

1-i

throughput disk module 1-12

transducer 1-11

U

UNIX 1-10 - 1-11

User's Guide 1-8, 1-11, 2-14

V

VEE 1-12, 2-16, 2-22

vibration probe 1-11

Vibrato

SEE 4-channel input

view detail (HP VEE) 2-16

view panel (HP VEE) 2-16

voltage break out box 1-11

VXI-PCI8000 1-10

W

Windows 3.1 1-11

Windows 95 1-10

Windows NT 1-10

Need Assistance?

If you need assistance, contact your nearest Hewlett-Packard Service Office listed in the HP Catalog, or contact your nearest regional office listed at the back of this book. If you are contacting Hewlett-Packard about a problem with your HP E1432A 16 Channel 51.2 kSa/sec Digitizer plus DSP or HP E1433A 8-Channel 196 kSa/sec Digitizer plus DSP, please provide the following information:

- Model number: HP E1432A or HP E1433A
- Software version:
- Serial number:
- Options:
- Date the problem was first encountered:
- Circumstances in which the problem was encountered:
- Can you reproduce the problem?
- What effect does this problem have on you?

