PROTOCOL ANALYZER

Bus Expert II

USER GUIDE

V1.0 August 2017

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Precautions

Users are advised to carefully review this section to avoid potential hazards to persons, this product and other products connected to it.

- *To protect the instrument and the Device under Test (DUT), grounding is required during signal acquisition.*
- *Follow the "Operating environment" recommendations from Table 2-1.*
- *Protect the Bus Expert II from static discharge.*
- *Avoid direct impacts and rough handling.*
- *The Bus Expert II is an IEC 61010-1 Level 2 instrument. The relevant pollution caution is: "Normally only non-conductive pollution occurs. But temporary conductivity caused by the occasional condensation must be kept in mind."*
- *Do not place heavy objects on the Bus Expert II.*
- *As a Class A product, the Bus Expert II may cause radio interference in a domestic environment.*
- *Do not disassemble the Bus Expert II as this will void the warranty and may affect its operation.*

1. Introduction

1.1. Preface

This User Guide presents the Zeroplus* Bus Expert II Protocol analyzer, its operation and software. The purpose of the User Guide is to help users understand and get familiar with the operations of the instruments and the software. Throughout the document, the instruments software is referred to as Bus Expert and the instrument as Bus Expert II.

Zeroplus attaches great importance to users' suggestions. Users are welcome to give us feedback by email or telephone. Thank you for purchasing the Bus Expert II.

** Zeroplus is short for Zeroplus Technology Co. Ltd*

1.2. About this document

This User Guide is organized as follows: First, the characteristics of the Bus Expert II are presented, followed by installation and setup procedures. The next section familiarizes the user with the software user interface. Section 4 then goes in-depth on the software functions.

NOTE The software functions in chapter 4 are sorted by their locations on the Bus Expert Main Menu.

NOTE Right-click menus are found under the corresponding view modes in chapters 4.43.1 and 4.43.2.

1.3. Product Introduction

The Bus Expert II is an eMMC/SD dedicated PC-based protocol analyzer. It offers uncompromised breadth in one single instrument: high sample rate, large channel count and deep memory. Two modes are available. The Logic

Analyzer mode (LA mode) captures digital signals and displays their waveform. The Protocol Analyzer mode (PA mode) captures packets and display a list of all captured packets. Each mode has its advantage. The LA mode is indicated for checking timings and glitches. The PA mode allows long captures and thus more packets to be recorded. Moreover, in PA mode you can store captured packets on your computer's storage device with the Long-time Record mode (LTR). This function streams the packets to your computer making it possible to perform long acquisitions.

1.4. Package Content

All items contained in the Bus Expert II package are listed in Table 1-1. If any of the items is missing or damaged, please contact your distributor as soon as possible.

Item	Bus Expert II	Detail
Bus Expert II instrument	1	
CD w/ driver, software and manual	1	
eMMC probes	32	
USB 3.0 cable connecting the probes to the Bus Expert II	32	A to A type; 32.5 cm
USB 3.0 cable; PC-to-Bus Expert II	1	A to B type; 1.5 m
Power cord	1	1.8 m
Power cable	1	9 V
BNC cable	1	1 m
2 years warranty card	1	

Table 1-1 Bus Expert II package content

1.5. System Requirements

1.5.1. Operating System Requirement

The Bus Expert II supports operating systems from Microsoft only. See Table 1-2 below for a list of supported operating systems. Please contact our Technical Support team if you have questions about older operating systems.

Supported OS	Versions
Windows 10	32- and 64-bit (Recommended)
Windows 8.1	32- and 64-bit
Windows 7	32- and 64-bit
Windows Vista	32- and 64-bit

Table 1-2 Supported operating systems

1.5.2. Hardware Requirements

Item	Value	Type
CPU	2 GHz	Minimum
Memory		
RAM	2 GB	Minimum
RAM	4 GB	Recommended
Hard disk	80 GB	Minimum
Interface		
	USB 3.0	Recommended support
	USB 2.0	Recommended compatibility
Display		
Display size	17”	Recommended
Display resolution	1,024 x 768	Minimum
Display card	8 Mb SDRAM	Recommended

Table 1-3 PC hardware requirements and recommendations

1.6. Product Specifications

1.6.1. Product Photos

Figure 1-1 Bus Expert II

1.6.2. Specifications

Item	Bus Expert II
Supported operating systems	See Table 1-2
Acquisition Channels	32
Interface	USB 3.0 (2.0 compatible)
Sampling Frequency	
Internal (Timing)	5MHz - 2 GHz
Memory/channel (LA mode) max	2 Gbits
Memory (PA mode) max	8 GBytes
Trigger	
Trigger Channels	8
Trigger Events	Pattern / Edge
Trigger Delay	Yes
Trigger Sequence Levels	47
Trigger Pass	1-65,535
Trigger Level	One per channel
Auxiliary Cursors	250
Protocol Triggers (HW)	eMMC5.1, SD3.0

Test signal	
Bandwidth	200 MHz (DC)
Input Signal Voltage	1.2V/1.8V/3.3V
Trigger Voltage Resolution	100mv
Software functions	
Languages	English, Chinese (Traditional), Chinese (Simplified)
Zooming & Panning	Two cursor modes
Wavefrom & UI customization	Modify the appearance of channels, menus, traces, windows etc
State List & Waveform View	Present the samples as a list of 1s and 0s or as a waveform
DSO Connection	Connect to and import signals from DSOs
Files Comparison	Compare 2 files to quickly see where and how they differ
Navigator	Instantly navigate to distant parts of the waveform
Memory View	See what the memory looks like; what is read/written to each address
Packet List	Breakdown of all packets in list form
Statistics	Table view of number of periods, periods that satisfy conditions etc
Protocol Decoders	eMMC5.1 (and older versions), SD3.0 (and older versions), Toggle
Miscellaneous	
Phase Errors	< 3 ns
Power	AC (IN): 100-240 V 50/60 Hz; DC (OUT): 9 V / 5.55 A
Dimensions	318.5 x 167.0 x 51.4 mm
Certifications	CE and FCC

Table 1-4 Bus Expert II specifications

1.6.3. Electrical Specifications

Item	Minimum	Normal	Maximum
Phase error	0.2 ns	-	3 ns
Working Voltage (DC)	-	9 V	-
Standby Current	-	-	1.9 A
Working Current	-	-	2.0 A
Standby Power	-	-	17 W
Working Power	-	-	18 W

Table 1-5 Bus Expert II electrical specifications

1.6.4. Probe Specifications

The Bus Expert II comes with 32 probes; one per channel.

They are presented in Table 1-6.

Item	eMMC/SD
Code	P200EM
Signal Type	Single-ended
Input Impedance	190 kohm ±10%
Capacitance	4.3 pF ±2 pF
DUT Bandwith (Max)	200 MHz
Transm. Rate (Max)	400 Mbit/s
Trigger Level	User-defined
Input DC V (Max)	±10 V

Table 1-6 Bus Expert II probes specifications

NOTE Voltages that exceed the Input DC level can damage the probes.

1.6.5. Port Overview

Figure 1-2 shows the ports of the Bus Expert II.

Figure 1-2 Rear view of the Bus Expert II.

Port	Number	Description
Signal Channels	32	USB connections to probes for signal acquisition.
CLK IN	1	Not currently available for Bus Expert II.
JTAG	1	Not currently available for Bus Expert II.
STACK	1	Not currently available for Bus Expert II.
TRIG. OUT	1	Connect to DSO for external triggering; see chapter 錯誤! 找不到參照來源。
USB	1	Connection to the PC; both USB 3.0 and 2.0 are supported.
CLK OUT	1	Not currently available for Bus Expert II.
DC	1	External power supply; see chapters 1.6.3 and 2.2.

Table 1-7 Bus Expert II input ports

In Figure 1-3, cables are connected to the Bus Expert II ports listed above. Some of the 32 signal channel ports are seen in the left part of the picture.

Figure 1-3 Cable connections to the Bus Expert II

2. Installation and Setup

2.1. Software Installation

Close all other programs and connect the Bus Expert II to the PC via USB. Insert the Bus Expert Software CD into the CD-ROM. If the CD does not auto play, open the setup.exe file manually. The dialog box from Figure 2-1 will be shown.

Figure 2-1 Main installation window

Choose the Application Setup as this option will install both the software and the instrument driver. The Driver Setup is for driver reinstallation.

Before the installation starts you will be asked to read the License Agreement carefully. “I accept the terms of the license agreement” must be checked to continue.

Clicking “Next” throughout the installation to install the standard version is recommended, but options for customizing the installation are also available

for users who want that. Upon completion, the user will be prompted to restart the computer; it is recommended to do so.

When Bus Expert is launched for the first time, a Find New Hardware dialog box will appear and the driver will then be installed automatically.

Once the Bus Expert and the driver installations have finished, the Bus Expert II and Bus Expert are ready for use.

2.2. Hardware Setup

First prepare the probes. Connect the USB cables with the probes.

Proceed to connect the USB cables to the instrument; see Figure 2-2.

Figure 2-2 Test cables connected to the Bus Expert II

Connect the Bus Expert II to the PC using the USB3.0 cable, then power up the instrument to ensure that it‘s working. Connect the AC power cord to the transformer and the DC cable to DC plug of the Bus Expert II. The power lamp indicated in Figure 2-3 turns on when the power is connected.

Figure 2-3 Signal cable connection and power lamp location

2.3. Connection to DUT

The Bus Expert II comes with 32 flying lead probes: The probe are active, i.e. they are not merely pieces of wire but have active components in the probe head that amplify, filter, isolate and in other ways improve the signal quality. These characteristics make the probes well-suited for high-speed signal measurements.

Each active probe provides one channel and consists of two cables: one signal cable and one ground cable that all have Dupont pods on the ends; see Figure 2-4.

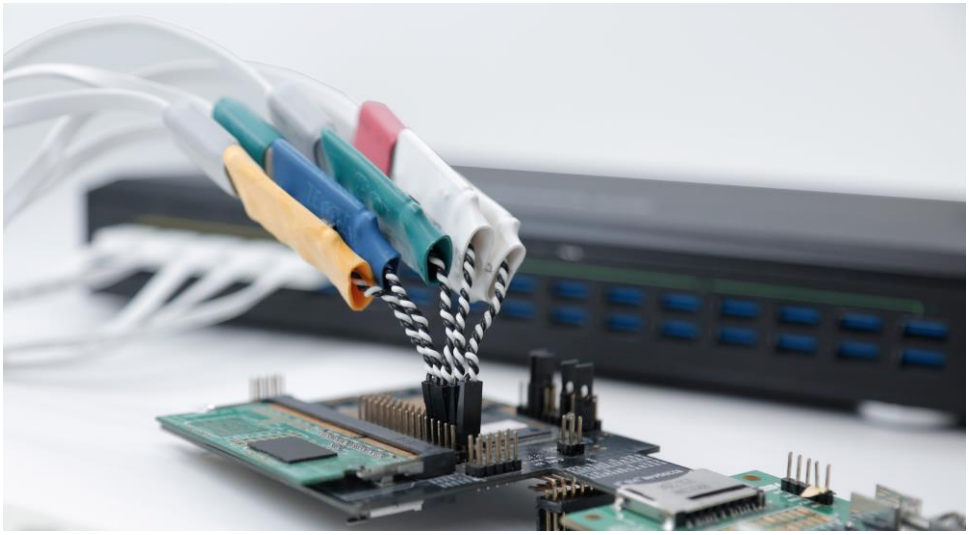

Figure 2-4 Connection to DUT

NOTE There is one ground cable per probe (to have short ground leads).

NOTE The signal cable is white and the ground cable is black.

NOTE The supplied probes are numbered and colored since this can help eliminate confusion. However, all probes are electrically identical so it is not necessary to follow the numbering.

2.4. eMMC Probe Tuning

Figure 2-5 shows a probe. Turn the tiny screw as explained in the steps below to adjust the Trigger Level.

Figure 2-5 Probe tuning screw

STEP 1 Connect the probe to the Bus Expert II.

STEP 2 Connect the Dupont connector to the clk pin of the DUT (the grounded terminal of the probe must be connected to the grounded terminal of the DUT).

STEP 3 Capture the clk signal. The aim of this exercise is to have the trace of the acquisition show as equally long periods of high and low.

STEP 4 If more than 50% of the trace is high, turn the screw on top of the probe clockwise to reduce the duty cycle and vice versa if more than 50% of the trace is low.

STEP 5 Repeat steps 3-4 until the duty cycle of the reference signal equals 50%.

NOTE Alternatively you can use a signal generator outputting a square wave with its Vpp and frequency matching the characteristics of the signals of your DUT.

2.5. Trigger In/Out

The Bus Expert II can be connected to a DSO (or another instrument) for external or internal triggering.

NOTE It is also possible to display the analog waveform of a connected DSO in Bus Expert. This is described in chapter 錯誤! 找不到參照來源。.

2.5.1. Trigger Out

When the trigger conditions have been met the Bus Expert II emits a signal that can be used to trigger another instrument. This signal can be sent on the occurrence of three different events; these are detailed in Table 4-26. The signal is sent from the BNC port.

To trigger out, the “Send output signal upon triggering” must be checked in the Trigger Options dialog box (Figure 4-29).

2.6. Operating Environment and Maintenance

Please follow the below instructions when using, cleaning or storing your Bus Expert II and probes. Please also see the Precautions chapter prior to the Introduction.

Type	Description
Cleaning	
Clean with a soft, damp cloth using a mild detergent.	
Do not spray any liquid on the Bus Expert II.	
Do not immerse the Bus Expert II in any liquid.	
Do not use harsh chemicals or cleaners containing substances such as benzene, toluene,	

xylene or acetone.

Operating environment		
Temperature (Working)	Min: 5° C	Max: 35° C
Temperature (Storage)	Min: -20° C	Max: 60° C
Rel. humidity (Working)	Min: 20%	Max: 85%
Rel. humidity (Storage)	-	Max: 90%
Altitude	-	Max: 2,000 m
Insolation	Avoid direct sunlight.	
Environment	Use in a dust free, non-conductive environment.	

Table 2-1 General advices for cleaning, operation and storage

3. User Interface

The Bus Expert user interface is shown in Figure 3-1.

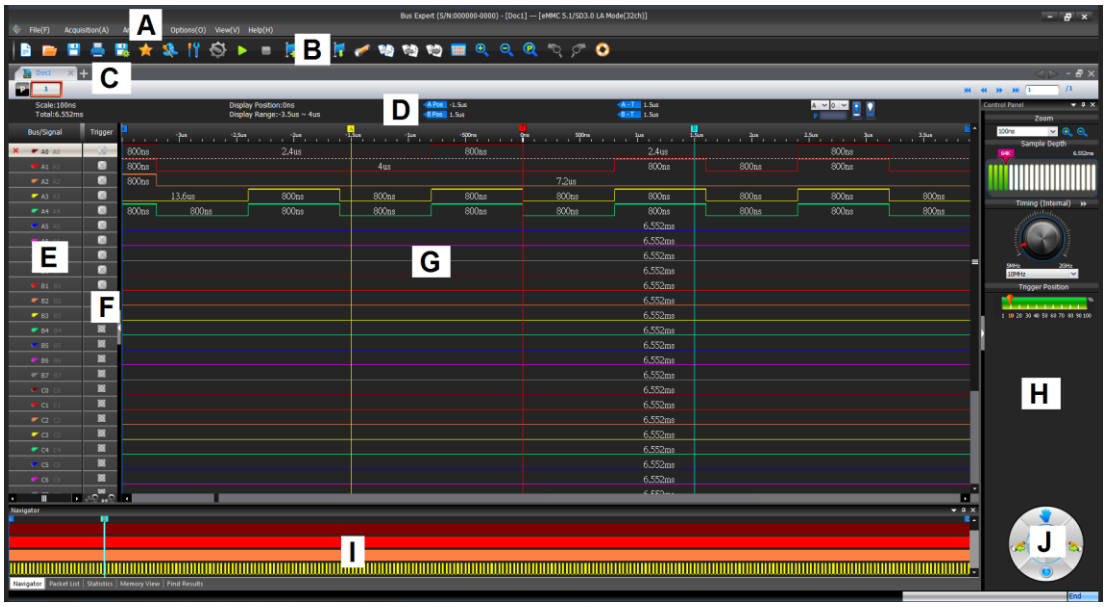

Figure 3-1 Bus Expert user interface

The Bus Expert window can be divided into sections; see Table 4-57. Note that many functions can be accessed with Hot Key combinations.

Name	Area	Description
Main Menu	A	All operations can be accessed from the Main Menu bar. The organization of chapter 4 corresponds to that of the Main Menu; see chapter 4 for details.
Quick Access Toolbar	B	The Quick Access Toolbar provides convenient access to frequently used functions; see chapter 4.11.3 for details.
File Bar	C	The File Bar consists of File Page, Memory Page and Show All. The File Page displays the new added files. File Page can be minimized, restored and closed.
Timing Bar	D	Facilitates quick reading of the samples and traces; see Table 4-57 for details.
Channel Column	E	See and edit channels; see Figure 4-59 for details.
Trigger Column	F	Set trigger conditions; Figure 4-61 for details.
Waveform Area	G	Displays the captured signals as traces or as a numeric list; see

		chapter 4.43 for details.
Control Panel	H	The Control Panel gives quick access to acquisition settings; see chapter 4.46 for details.
Secondary Display	I	Area where the Navigator, Memory View, Packet List and Statistics are shown; see chapters 4.47, 4.48, 4.49, 4.50 and 錯誤! 找不到參照來源。.
Action Wheel	J	The Action Wheel provides shortcuts to functions related to acquisition and searching; see Figure 4-68 for more details.

Table 3-1 UI description; "Area" refers to the letter codes on the figure above

NOTE The Control Panel and the Secondary Display can be repositioned or hidden. Right-click to bring up the menu from Figure 3-2.

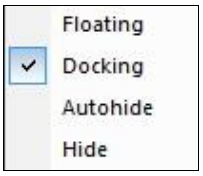

Figure 3-2 Reposition/hide sector; right-click menu

Item	Description
Floating	Move the Control Panel/Secondary Window freely; see Figure 3-3 for an example.
Docking	Fix the Control Panel/Secondary Window to its position.
Autohide	The control panel hides in the right edge, users could move the cursor to the icon of "Control Panel" to show it.
Hide	Don't show the Control Panel/Secondary Window; to have it appear enable from View menu.

Table 3-2 Reposition/hide sector; right-click menu description

Figure 3-3 shows an example where the Control Panel is "floating"; if the user un-clicks the mouse when hovering over one of the arrows the Panel will be repositioned to the corresponding transparent/blue area (in the example the user is holding the mouse over the upward arrow).

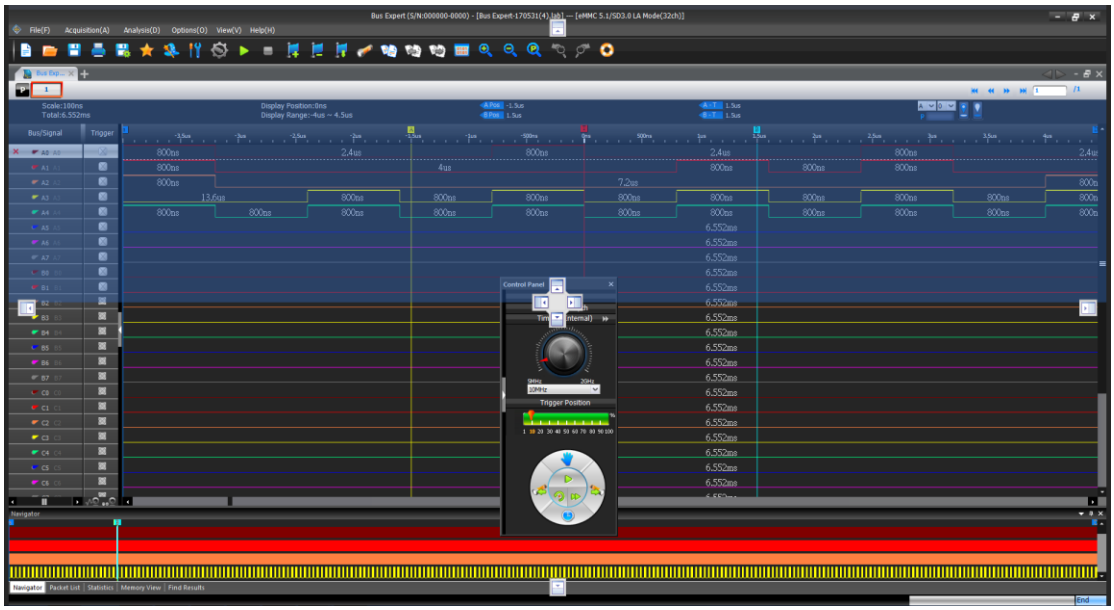

Figure 3-3 Repositioning the Control Panel example

4. Software Operations

This chapter follows the Bus Expert Main Menu organization. Each section starts off by showing the corresponding drop-down menu from the Main Menu. The functions are presented one by one in the succeeding subchapters.

NOTE Bus Expert will automatically check online for updates upon startup.

File

Press ALT + F to open this Main Menu item with the keyboard.

4.1. Menu Layout

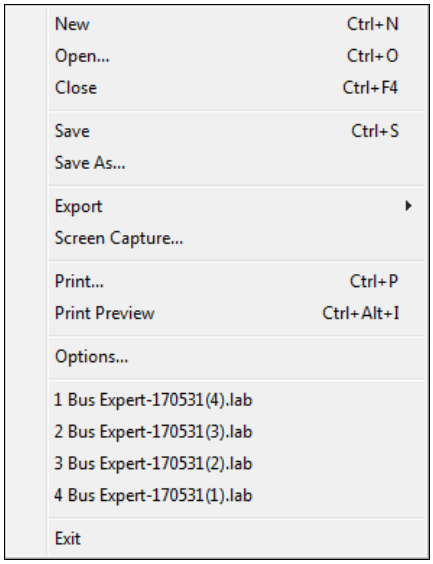

Figure 4-1 File drop-down menu

4.2. New

Create a new, empty file.

Hot Key: CTRL + N.

4.3. Open

Open an existing file. When selecting a file in the Open file dialog box, file information such as author name, creation date, project title will be shown in the lower part of the dialog box. Some of this information is user-added to the file when saving; the rest is automatically added by Bus Expert.

Hot Key: CTRL + O.

4.4. Close

Close the active file. When closing a file that has previously not been saved, Bus Expert prompts the users to save it before closing.

Hot Key: CTRL + F4.

4.5. Save

Save the active file. If the file has not been saved before, the Save As dialog box will open; see chapter 4.6.

Hot Key: CTRL + S.

4.6. Save As

Save As is useful for users who wish to save a file under a different name or type or change the destination folder. The Save As dialog box also opens when the user saves a file for the first time so that these parameters can be defined.

The Save As dialog box lets users input file information such as author name and a note. This information is used for previews in the Open file dialog box; see chapter 4.3.

NOTE Acquisitions are stored as temporary files that are instantly available to the user for most software functions. These temporary acquisition files need to be processed before they can be saved.

Since file processing slows down the software, users can choose not to process the temporary acquisition files automatically. If chosen, users who try to save a file (or initiate certain other functions) will be informed that the acquired data needs to be processed to proceed. This setting is accessed under General in the Options dialog box as “Automatically process acquired data (NB: Slower)” shown in Figure 4-7.

4.7. Export

Users can choose between three types of exports: Waveform, Packet List or Memory View. The characteristics of each type are presented below.

4.7.1. Waveform

This chapter treats the export of waveforms; please refer to chapter 4.43.1 for more details on the Waveform View itself. The Export Waveform dialog box is shown in Figure 4-2.

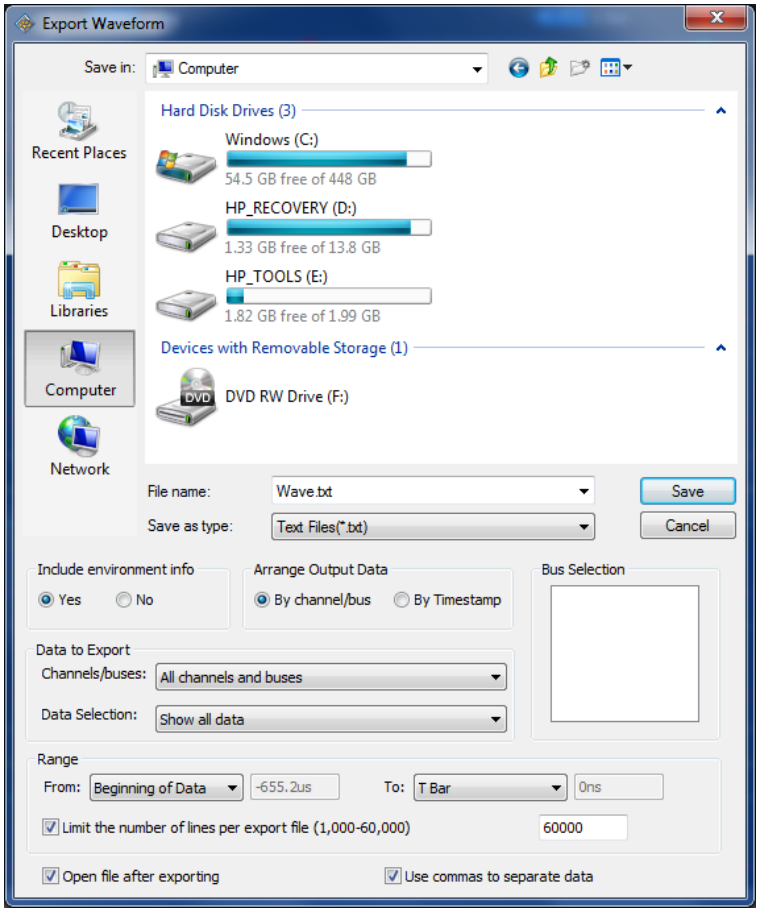

Figure 4-2 Export Waveform dialog box

Item	Description
File name	Input the file name; the default is Wave.
Save as type	Save the file as .txt or .csv; the default is .txt.
Include environment info	Include acquisition parameters etc. in the export file; checked by default.
Arrange Output Data	
By channel/bus	Each column in the export file contains data for one channel; default option.
By Timestamp	Each column in the export file contains data for one timestamp.
Data to Export	
All channels and buses	Export channel, bus and protocol decoder data.

All buses (excl. channels)	Export bus and protocol decoder data.
Buses with PD (incl. channels)	Export protocol decoder data (channel data included).
Buses with PD (excl. channels)	Export protocol decoder data (channel data not included).
Data Selection	
All Data	Export all data.
Show changes in state only	Export data for timestamp X only if at least one signal has changed state from timestamp X-1 to timestamp X.
Show changes in data only	Export data for timestamp X only if at least one data has changed state from timestamp X-1 to timestamp X (for buses only).
Bus Selection	Select buses to be included in the export file.
Range	
From, To	Select the range for the data to be exported; the measure for the range is time (with the exception of Memory Page which is measured in pages).
Limit the number of lines per export file	Limit the size of exported files; if there are data don't fit on the amount of lines selected by the user then multiple files will be created.
Open file automatically after exporting	Open the exported file once it is ready; activated by default.
Use tabs to separate data (Faster)	When selected, blank spaces in the export file are replaced by tabs; this increases the writing by up to 50%; selected by default.

Table 4-1 Export Waveform dialog box description

NOTE To export a waveform, the temporary acquisition file must be processed; see note in chapter 4.6 for details.

4.7.2. Packet List

This chapter treats the export of Packet Lists; please refer to chapter 4.49 for more details on the Packet List function itself. The Export Packet List dialog box is shown in Figure 4-3.

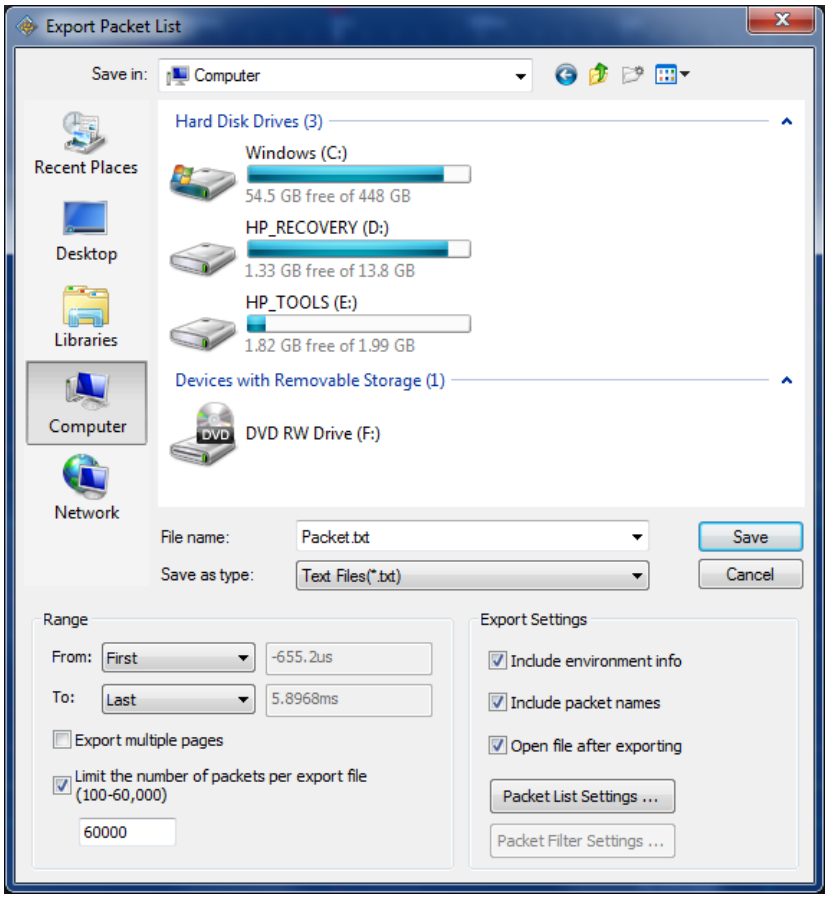

Figure 4-3 Export Packet List dialog box

Item	Description
File name	Input a file name; the default is Packet.
Save as type	Export in .csv or .txt format; the default is .txt.
Range	
From, To	Select the range for the data to be exported; the range in seconds or pages.
Export multiple pages	If the file to be exported comprises more than one Memory Page these can be exported together; unchecked by default.
Limit the number of packets per export file (100-60,000)	Set the maximum quantity of lines per export file; if the file length overshoots the limitation then several files will be created; selected by default.
Export Settings	
Include environment info	Include acquisition parameters etc. in the export file; checked by default.

Include packet names	Include packet titles in the export; unselected by default.
Open file after exporting	Open the exported file once it is ready; activated by default.
Packet List Settings	Open the Packet List Settings dialog box; see details in Figure 4-74.

Table 4-2 Export Packet List dialog box description

4.7.3. Memory View

This chapter is about exporting the Memory View; please refer to chapter 4.47 for more details on the Memory View function itself. The Export Memory View dialog box is shown in Figure 4-4.

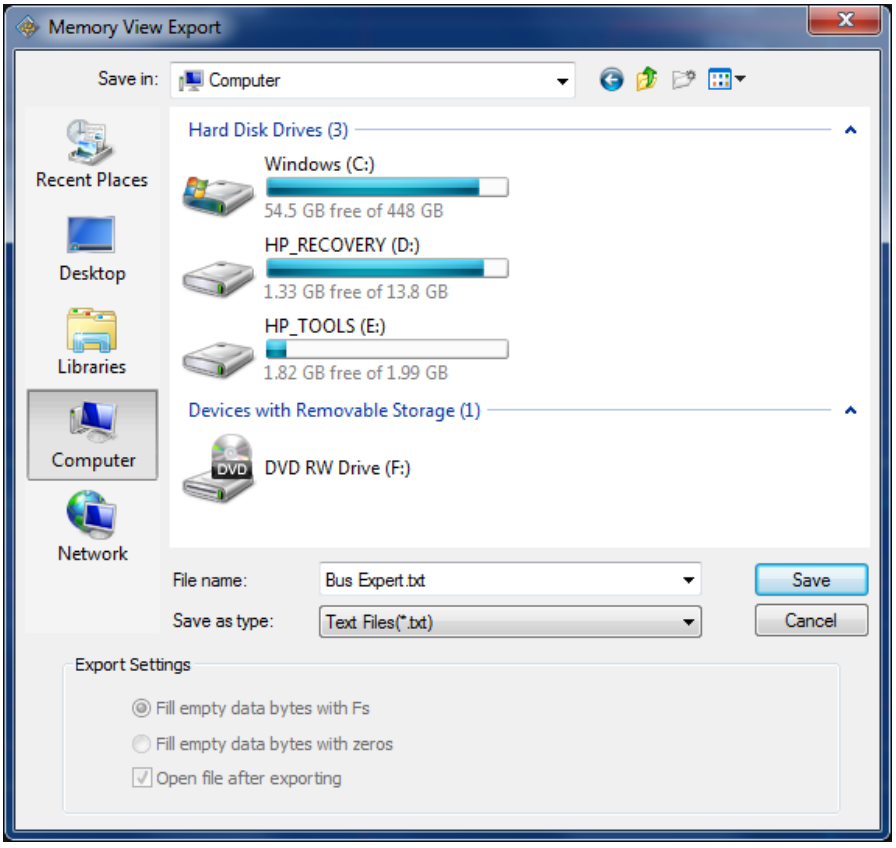

Figure 4-4 Export Memory View dialog box

Item	Description
File name	Choose a name for the file to be saved; the default is Bus Expert.
Save as type	Export in .txt, .csv or .bin format; the default is .txt.

Export Settings	Available for .bin exports.
Fill empty data bytes with Fs	Fill empty spaces with the letter F; selected by default.
Fill empty data bytes with zeros	Fill empty spaces with the number 0.
Open file after exporting	Open the exported file once it is ready; selected by default.

Table 4-3 Export Memory View dialog box description

4.8. Screen Capture

Select a part of the screen – or all of it – and store it as a file or a picture; see the dialog box in Figure 4-5. If Clipboard is selected the file will be stored in the RAM. Some level of customization is possible as described in Table 4-4.

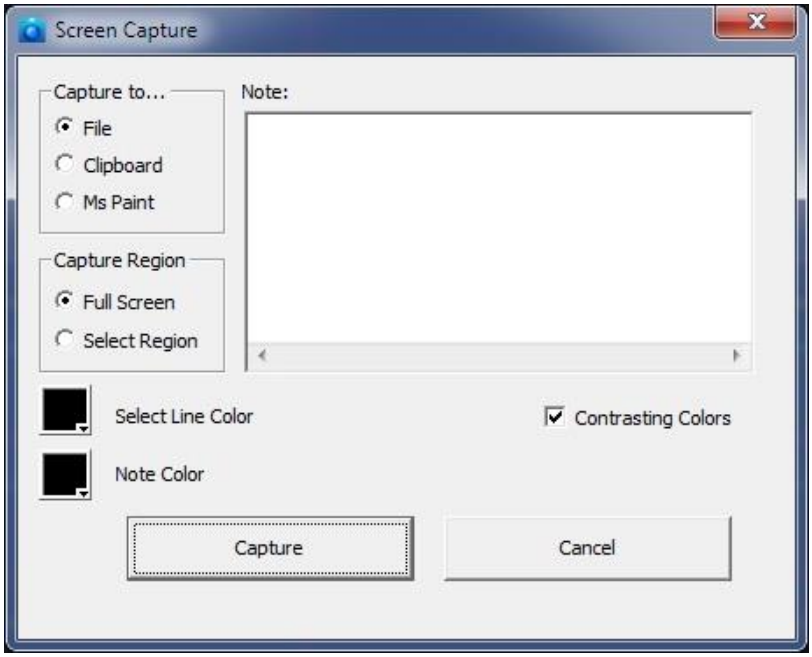

Figure 4-5 Screen capture dialog box

Item	Description
Capture to	

File	Save the captured region in .bmp or .jpeg format.
Clipboard	Copy the captured region to the clipboard for editing in other softwares.
MS Paint	Open the captured region in MS Paint.
Capture Region	
Full Screen	Capture the full screen.
Select Region	Select a part of the screen to be captured by dragging a square with the left mouse button.
Note	Users can enter text to accompany the screen capture; if the field is not empty a blank area will be added below the screen capture where the text will be displayed.
Note Color	Change the color of the Note text.
Line Color	Change the color of the Select Region frame; by default this is black.
Invert Colors	The Select Region frame color is the opposite of Line Color; selected by default.

Table 4-4 Screen capture dialog box description

4.9. Print

The print function works on the part of the waveform or state list that is viewed at the moment of printing. The Timing Bar (above the waveform) and the Channel Column with the trigger conditions is also printed. The Waveform/State List background is printed as white and an extra field containing the file name, date and page number is added to the top of the page.

The print option dialog box has a standard layout that lets the user choose what to print and also gives access to other printer properties; see Figure 4-6.

Hot Key: CTRL + P.

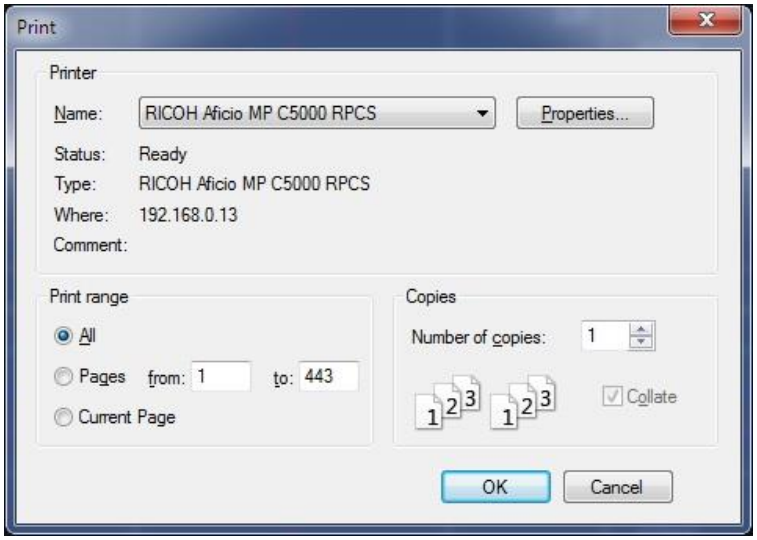

Figure 4-6 Print Setup dialog box

Item	Description
Name	Select a printer.
Properties	Open the Print Properties dialog box for more print options.
Print range	
All	Print the entire waveform or state list.
Pages	Print parts of the waveform or state list. What is currently being viewed is regarded as one page.
Current Page	Print the current view.
Copies	
Number of copies	Number of copies to be printed.
Collate	Organization of multiple copies. Ex: 2 copies of 3 pages will print 1, 2, 3, 1, 2, 3 when collate is checked (default option) and 1, 1, 2, 2, 3, 3 when unchecked.

Table 4-5 Print Setup dialog box description

4.10. Print Preview

Preview what the printed file will look like. When opening the Print Preview, a new toolbar will appear above the preview; this is used for zooming and navigation between pages. Press Esc to leave the Print Preview.

Hot Key: Press CTRL + ALT + I.

4.11. Settings

The appearance and behavior of the user interface and functions can be customized. Configurations, options and settings are gathered under this menu item.

4.11.1. General

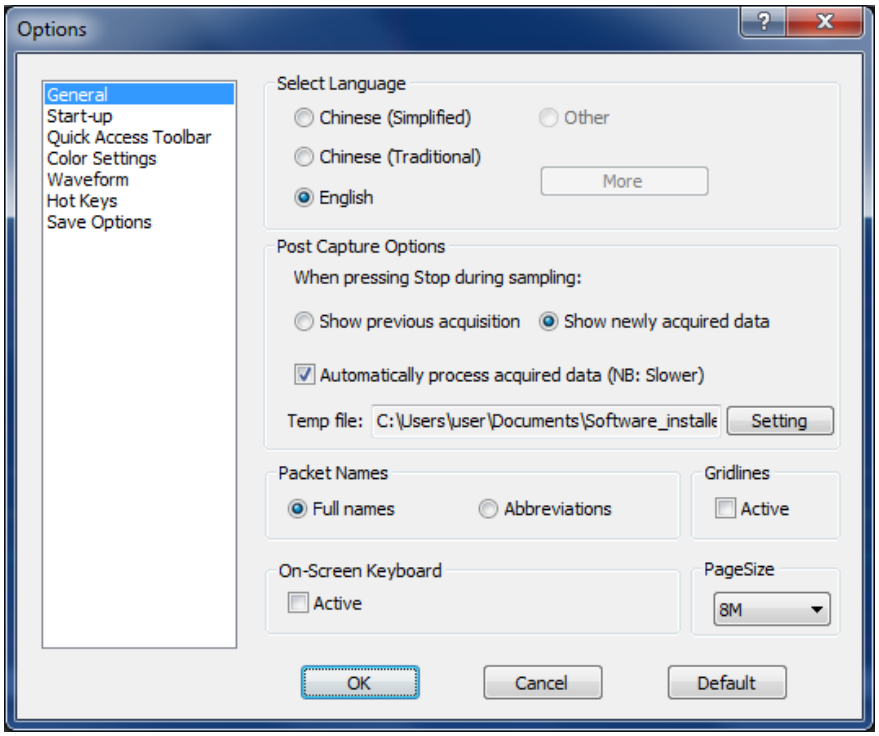

Figure 4-7 General settings dialog box

Item	Description
Select Language	Choose between English, Chinese (Simplified) and Chinese (Traditional); the one selected during installation is the default. The *More* option is used by customers who have developed a proprietary language pack.
Post Capture Options	
Show previous acquisition	This option governs the software behavior when the user presses Stop in the middle of an acquisition. If this option is selected then the previous acquisition will be displayed again.
Show newly acquired data	When pressing Stop during an acquisition, the data acquired up until the Stop moment are displayed; this is the default option.

Automatically process acquired data (NB: Slower)	Process the data upon finalizing acquisitions; if unchecked Bus Expert will prompt the user to process data when launching certain functions. See a more detailed explanation in chapter 4.6.The function is turned on by default.
Temp	Location of temporary acquisition files.
Gridlines	Show vertical gridlines in the waveform area; unchecked by default.
Packet Name	
Full names	Display the full names of packets; this is the default option.
Abbreviations	Display packet names abbreviated to a single letter: Data is shown as D etc. This option lets users see the packet type for short packets where the full name would otherwise not be shown due to space limitations (which is a combination of packet size and zoom level).
Keyboard	Open an on-screen keyboard when inputting numbers. The on-screen keyboard is operated with the mouse; by default it is not shown.
PageSize	PageSize relates to our *Memory Page* feature. To speed up the loading of waveforms, large acquisitions are divided into *pages*. The PageSize determines the size of these pages. Ex: A 16 Mb acquisition will be split into 8 pages if the PageSize is set to 2 Mb. 1½ pages are displayed at a time and the user moves between pages by means of the File Bar; see Figure 3-1 for the location of this. It is also possible to navigate between pages using the Go To function; see chapter 4.29.

Table 4-6 General settings dialog box description

4.11.2. Start-up

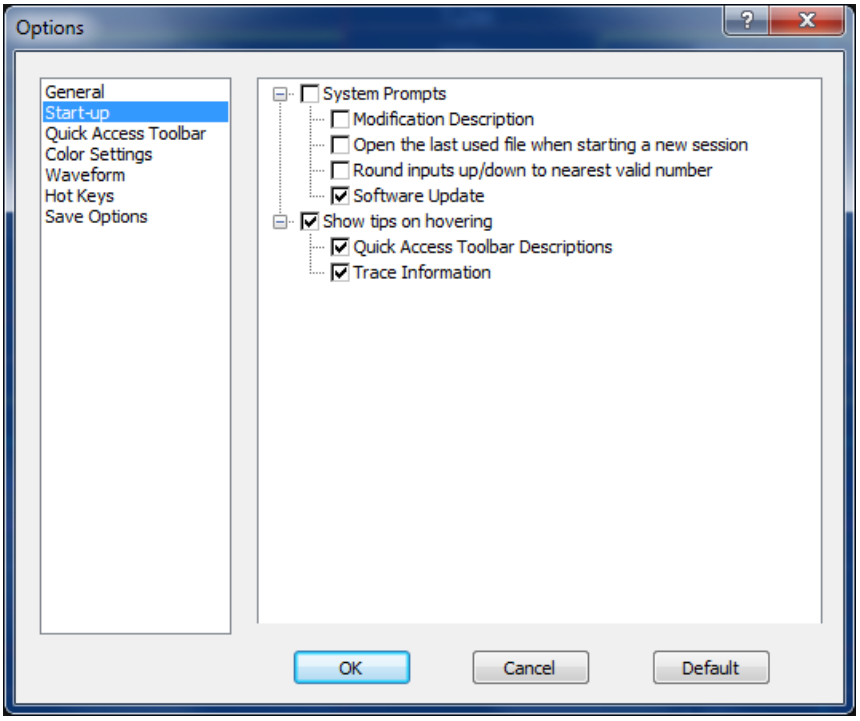

Figure 4-8 Start-up settings dialog box

Item	Description
System Prompts	
Modification Description	Show modification descriptions.
Open the last used file when starting a new session	The last saved file is opened when Bus Expert starts; selected by default.
Round inputs up/down to nearest valid number	Illegal input values are automatically rounded to the nearest valid value; selected by default.
Software upadte	Automatically search for new version at startup.
Show Tips on Hovering	
Quick Access icon names	Show function names when hovering over the Quick Access Toolbar icons; selected by default.
Trace Information	Show channel name, signal state and trace information when hovering over a trace in the waveform view; selected by default.

Table 4-7 Start-up settings dialog box description

4.11.3. Quick Access Toolbar

The Quick Access Toolbar consists of shortcut icons to commonly used functions. It is located below the Main Menu and is shown by default. Table 4-9 lists all functions that can be placed on the Quick Access Toolbar.

Users can customize the Quick Access toolbar by organizing the icons into groups. Bus Expert comes with pre-defined groups; a Standard group and one group for each of the Main Menu items. The Standard group consists of a selection of common functions; the second type provides shortcut icons to all the functions under a Main menu item. Users can modify the Quick Access Toolbar in three ways:

- By selecting the group or groups that are displayed
- By adding or removing items from the pre-defined groups
- By creating a custom group

These modifications are done from the Quick Access Toolbar dialog box shown in Figure 4-9.

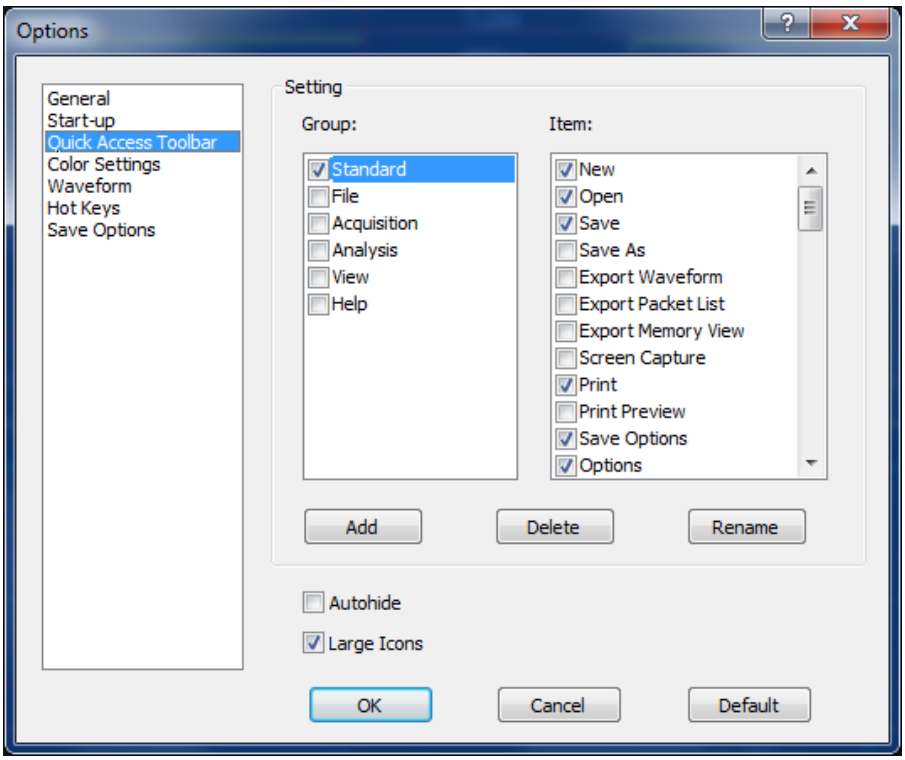

Figure 4-9 Quick Access toolbar dialog box

Item	Description
Group	Select the group or groups to be displayed as large shortcut icons below the Main Menu; the Standard group is selected by default. Groups can be added, deleted or renamed (with exception of the Standard group).
Item	Check/uncheck items to add/remove them from the selected group (in blue in the left column).
Autohide	The Quick Access toolbar is hidden whenever the mouse cursor does not hover over it; this option is unchecked by default.
Large Icons	Set the icon size to 32x32 px; the default size is 24x24 px.

Table 4-8 Quick Access Toolbar dialog box description

Table 4-9 below shows all the icons that can be placed on the Quick Access Toolbar and which function they link to.

Icon	Function	Icon	Function
	Create File		Analog Display
	Open File		Pointer
	Save File		Hand
	Save File As		Zoom Out
	Save Settings		Zoom In
	Export Waveform		Display All Waveform
	Export Packet List		Previous Zoom
	Export Memory View		Cancel Previous Zoom
	Screen Capture		Add Bar
	Print file		Delete Bar

Single Capture	Reposition Bar
Repeated Capture	Customize
Stop	Highlight Data
Sampling Setup	Don't Show Information
Find	Frequencies
Find previous	Number of Samples
Find next	Time
Add Channel/Bus	Waveform
DSO Connection	State List
Active Range	Real-time Frequencies
Noise Filter	Navigator
Files Comparison	Packet List
Previous Difference	Statistics
Next Difference	Memory View
Boolean Operation	Show on Both Screens
Arithmetic Operation	Show on Primary Screen
Go To	Show on Secondary Screen
Level Status	Image Decode
Center display on A-bar	Refresh

	Center display on B-bar		Help
	Center display on T-bar		Hot Keys Map
	About ZEROPLUS		Send Feedback
	About Bus Expert		

Table 4-9 Quick Access toolbar icons

4.11.4. Colors Settings

Users can customize the colors of bars, texts, traces and other elements of the user interface. To change the color of an element, click the corresponding color bar in the Color column of the dialog box shown in Figure 4-10 to access the color palette. Proceed to select a predefined color or define a custom color for the element.

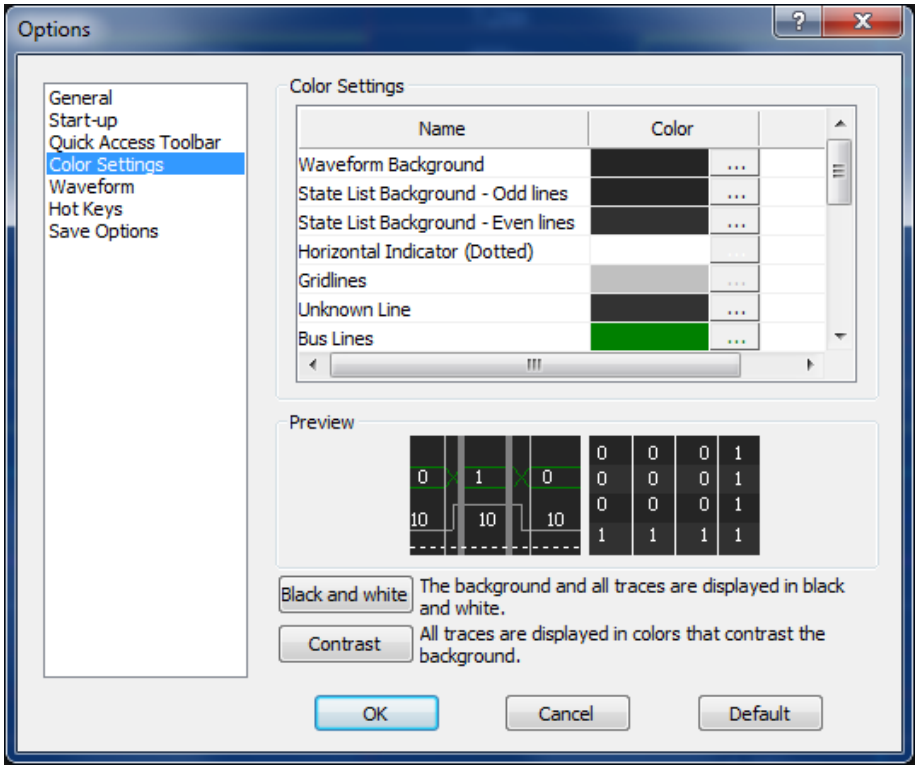

Figure 4-10 Color settings dialog box

Item	Description
Color Settings	
Name	Customizable element.
Color	Current color of the element; click it to change the color.
Preview	Preview the color selections; the left frame shows the Waveform and the right the State List.
Black and white	The background and all traces are shown in black and white.
Contrast	All traces are displayed in colors that contrast the background.

Table 4-10 Color settings dialog box description

4.11.5. Waveform

The appearance of the traces and surrounding information can be changed from the dialog box in Figure 4-11.

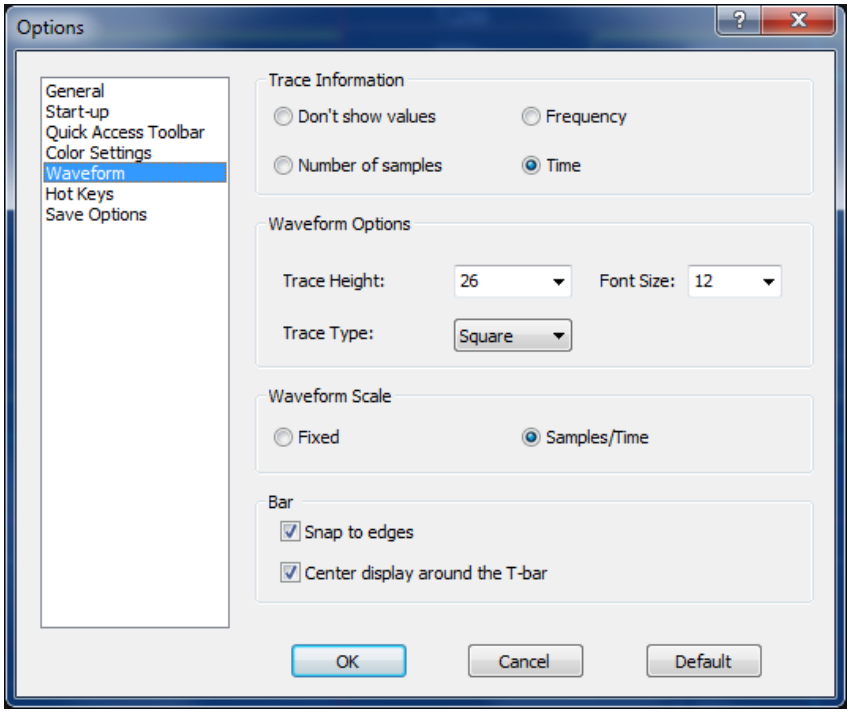

Figure 4-11 Waveform settings dialog box

Item	Description
Trace Information	
Frequency	Show frequencies between two edges. The frequency of full period

	(rising to rising edge) is displayed. See Table 4-49 for more details on the Trace Information.
Number of samples	Show number of samples between two edges.
Time	Show the time between two edges.
Don't show values	No information is shown inside the traces; this is the default option.
Waveform Settings	
Trace Height	Set the trace amplitude from 22 to 180 px; the default is 26.
Font Size	Set the font size from 6 to 60. The default is 12.
Waveform Mode	Choose between saw tooth- and square-shaped traces.
Ruler Mode	
Fixed	The center of the screen is fixed at 0 sec.
Samples/Time	Second is defined as the trigger event; this is the default option.
Bar	
Snap to edges	Bars snap automatically to the nearest trace edge when being repositioned.
Center display around the T-bar	Center the waveform area around the T-bar when the trigger condition is met.

Table 4-11 Waveform settings dialog box description

4.11.6. Hot Keys

In Bus Expert, Hot Keys are keyboard combinations that invoke a function. See Table 4-59 for a complete description of all Hot Keys. Figure 4-12 shows the dialog box used to customize the Hot Keys.

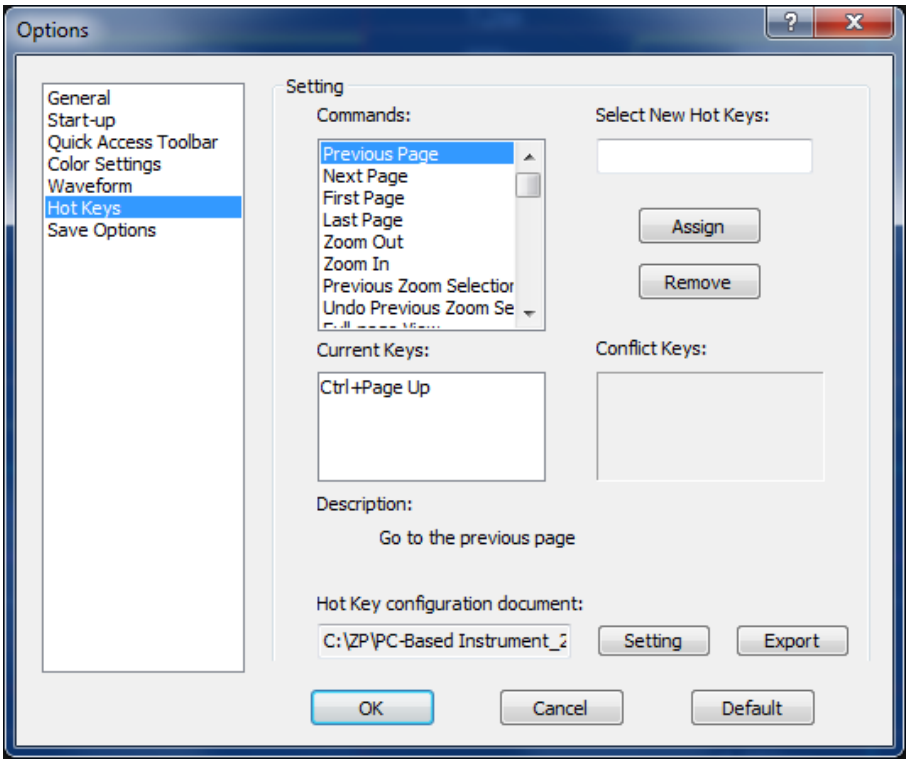

Figure 4-12 Hot Key settings dialog box

Item	Description
Commands	Select a Command (function) for which a Hot Key can be assigned.
Select New Hot Keys	Input the new Hot Keys combination (or single key) and click Assign to make the change effective.
Current Keys	Displays the current Hot Keys for the selected command.
Conflict Keys	If the new Hot Keys are already in use, the command currently using them will be shown.
Description	Displays a brief description of the selected command.
Shortcut-key Setting document	Export the Hot Keys configuration document or load a different one.

Table 4-12 Hot Key settings dialog box description

4.11.7. Save Options

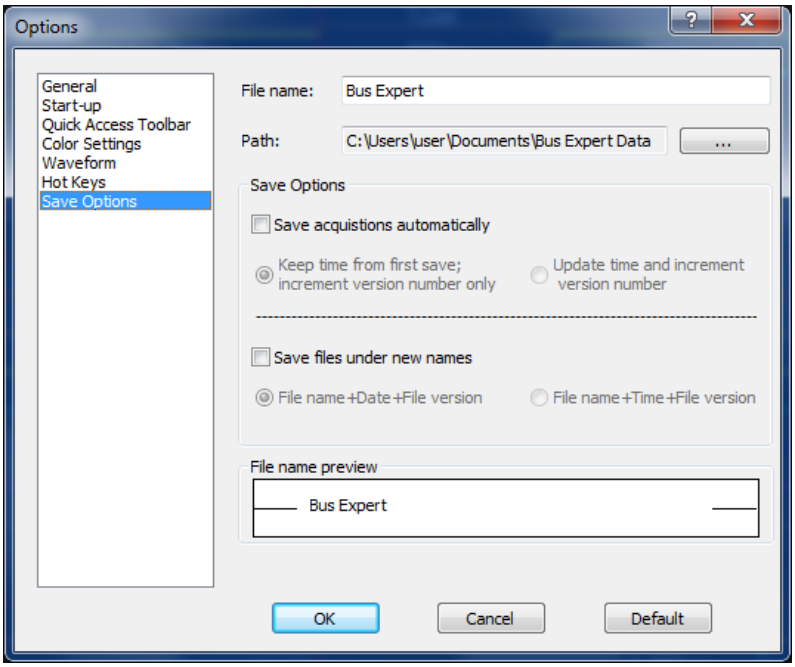

Figure 4-13 Save Options dialog box

Item	Description
File name	Choose a name for the files to be saved; the default is Bus Expert.
Path	Choose where to save files; the default is C:\Documents and settings\Administrator\ My Documents\ Bus Exoert Data (if C: is the system disk).
Save Options	
Save acquisitions automatically	Auto-save all acquisitions.
Keep time from first save; increment version number only	When saving multiple acquisitions the file names will all preserve the time of the first save and only change version number. If the first acquisition was made 3:45:12 pm and the next 3:55:47 the names will become; FileName154500 and FileNameTime154500(1). This can be useful for sorting the files.
Update time and increment version number	In the example above the file names would become; FileName154512 and FileName155547(1); this is the

	default selection.
Save files under new names	Files will overwrite each other if this option is not checked. It is therefore common to combine this option with the Save As function.
File Name + Date + File Version	Add the date [Year, Month, Day] and version number after the file name. Ex: August 25th 2015 becomes Bus Expert_20150825(1).
File Name + Time + File Version	Add the time (Hour, Minute, Second) and the version number after the file name. Ex: 13:45:02 pm becomes Bus Expert_134205(1); default selection.
File Name Preview	Preview the name of files to be saved.

Table 4-13 Save settings dialog box description

If the “Auto Add the Serial No” is not activated, “Keep time from first save; increment version number only” and “Update time and increment version number” will be disabled. In other words, any new file that is saved will overwrite the existing file.

4.12. Exit

Exit Bus Expert. The software prompts users to save unsaved files.

Hot Key: ALT + F4.

Acquisition

Press ALT + A to open this Main Menu item with the keyboard.

4.13. Menu Layout

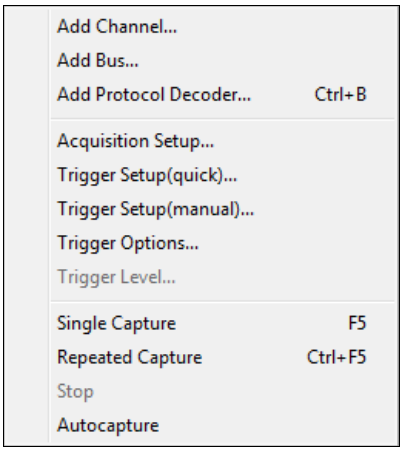

Figure 4-14 Acquisition drop-down menu

4.14. Add Channel

To add one or several channels, select the channels to be included and bring them over to the right column using the arrow. The CTRL and SHIFT keys can be used to mark several channels at the same time. Using the lower arrows channels can also be removed. To finalize the inclusion of new channels the user must choose whether he wants all other channels to be deleted or not. The select channels dialog box is shown in Figure 4-15 where four channels have been added.

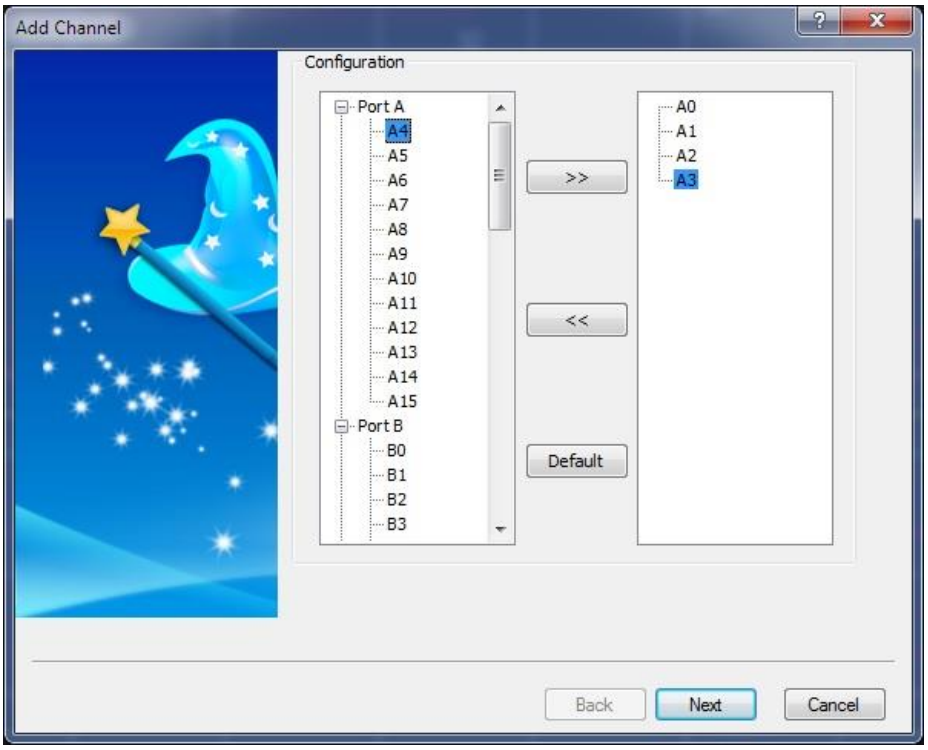

Figure 4-15 Add Channel dialog box

4.15. Add Bus

Adding a bus follows the same routine as adding a channel (chapter 4.14), but the dialog box differs slightly; see Figure 4-16. First, it links to the Advanced Settings dialog box; see Figure 4-17. Second, the right-most column indicates which is the most significant bit and which is the least. Show caution to ensure that channels are added in the correct sequence; the first channel added will become the LSB and the final addition will be the MSB.

Hot Key: CTRL + B.

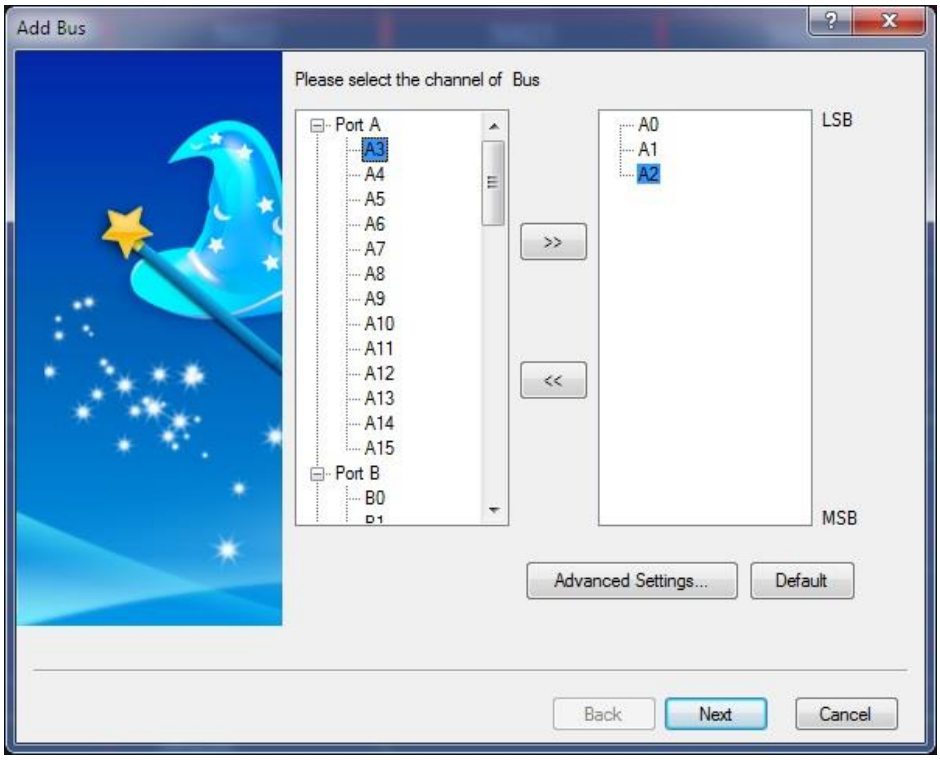

Figure 4-16 Add Bus dialog box

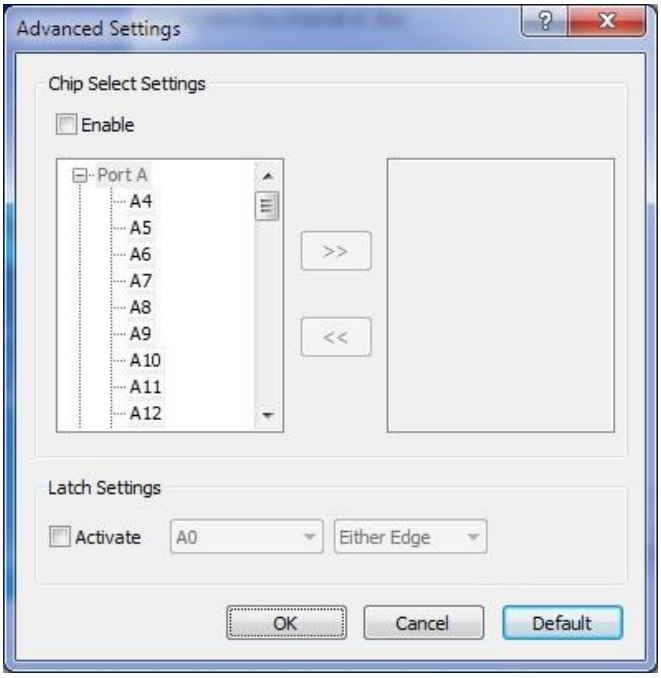

Figure 4-17 Add Bus / Advanced Settings dialog box

Item	Description
Chip Select	
(Channel	The Chip Select function emulates a real chip select. The function is similar

and Level)	to the Latch function (below) in that it decodes bus data, but it only does so when all the conditions are met.
Latch Settings	
(Channel and Event)	The Latch function is used to analyze/decode bus activity that does not use a specific protocol (referred to simply as a Bus in Bus Expert). When selecting a channel and an event (for instance A0 and Falling Edge), the bus data will be decoded and displayed at every occurrence of this event.
Packet Settings	
Packet Interval	Breaks packets wich length is greater than the value set into smaller packets.
Packet Idle(Time)	Set the Idle time of bus packets. Unchanged bus signals that meet the Idle time value are decoded as one packet instead of being individually decoded.

Table 4-14 Add Bus / Advanced Settings dialog box description

4.16. Add Protocol Decoder

Select the desired Protocol Decoder from the dialog box shown in Figure 4-18. The right part of the dialog box shows a brief description of the selected protocol decoder.

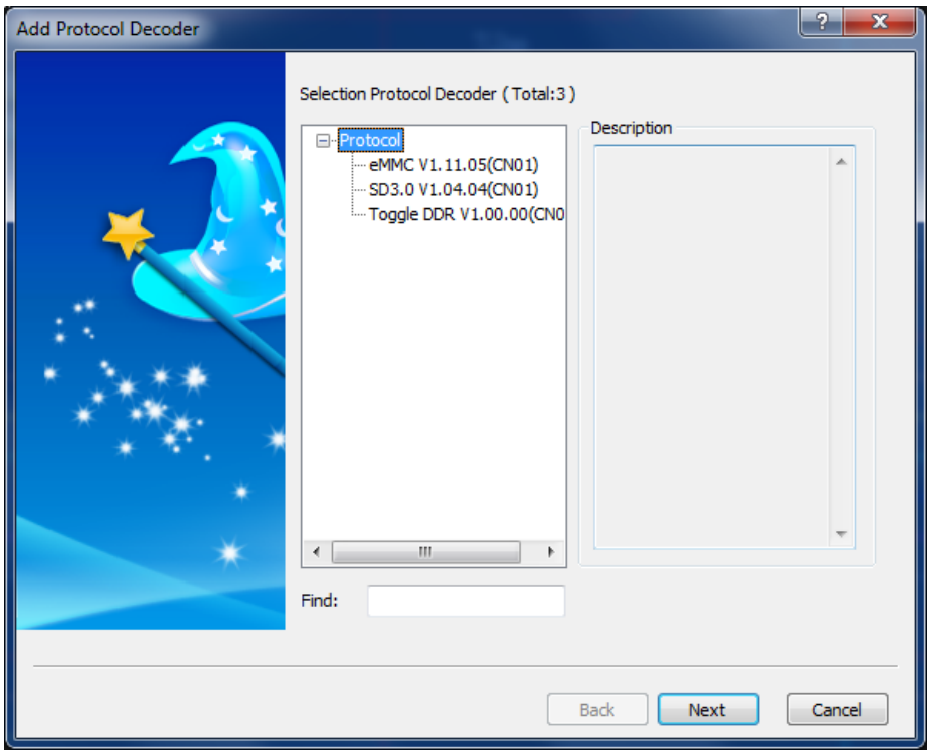

Figure 4-18 Add Protocol Decoder dialog box

Table 4-15 lists the protocol decoders available in Bus Expert.

Built-in Protocol Decoders
eMMC
SD3.0
Toggle DDR

Table 4-15 Built-in protocol decoders

4.17. Acquisition Setup

Fundamental sampling choices such as acquisition mode, memory depth and acquisition rate are selected in the Acquisition Setup dialog box; see Figure 4-19 below. This is also where users can configure a DSO connection.

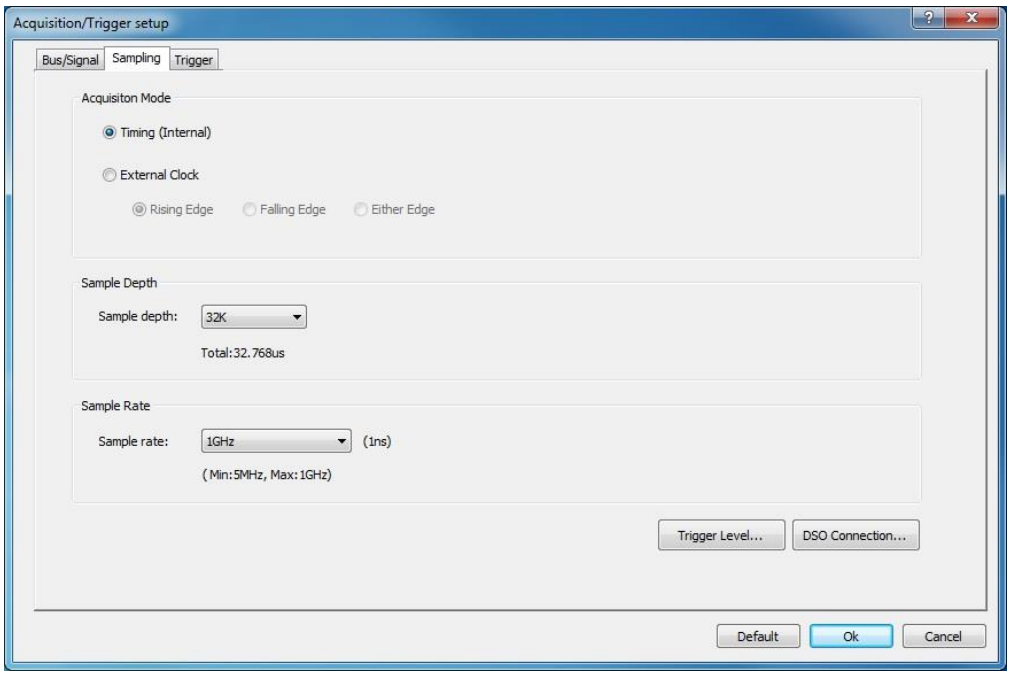

Figure 4-19 Acquisition Setup dialog box

Item	Description
Acquisition Mode	
Timing (Internal Clock)	In Timing mode (also called asynchronous acquisition) the input signals are sampled and stored at equal time intervals based on Bus Expert II's internal clock. The Timing mode sample rate goes from 5 MHz to 2 GHz.
Sample Depth	Determine the amount of data to be acquired per channel; it is set to 32 kb by default.
Sample Rate	The sample rate or acquisition frequency determines how often samples are taken. Press CTRL + U to increase the sample rate and CTRL + D to decrease it.

Table 4-16 Acquisition Setup dialog box description

4.18. Trigger Setup (quick)

Trigger Setup (quick) provides an interface for users to quickly set up an ensemble of trigger conditions; see the dialog box in Figure 4-20

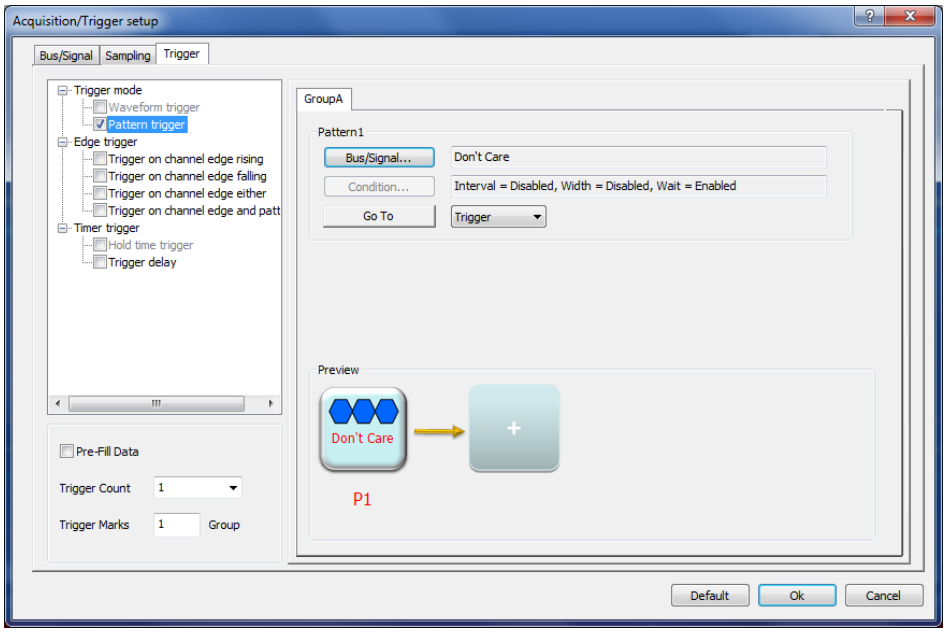

Figure 4-20 Trigger Setup (quick) dialog box

Item	Description
Trigger mode	
Pattern trigger	Create a sequence of events; see chapter 4.18.1.
Edge trigger	
Trigger on channel edge rising	Trigger when a rising edge is detected on the selected channel; see chapter 4.18.2
Trigger on channel edge falling	Trigger when a falling edge is detected on the selected channel; see chapter 4.18.3.
Trigger on channel edge either	Trigger when either a rising or falling edge is detected on the selected channel; see chapter 4.18.4
Trigger on channel edge and pattern	Trigger when either a rising edge, falling edge, or either a rising or falling edge and a bus pattern are detected on the selected channel; see chapter 4.18.5.
Timer trigger	
Trigger delay	Trigger x seconds after the event; see chapter 4.18.6.
Pre-Fill Data	The Trigger Position combined with the Sample Depth determines how many bits of

	pre-trigger data should be stored. The Pre-Fill Data determines the Bus Expert's behavior if the trigger event occurs before the pre-trigger data requirement has been fulfilled. If unchecked (default option) the BUS EXPERT II will override the Trigger Position/Sample Depth requirement and start storing data when the trigger event occurs. If checked, triggering will be postponed until the pre-trigger data requirement has been fulfilled.
Trigger Count	Trigger on the Xth event that satisfies the trigger conditions; at the default value of 1 the BUS EXPERT II will trigger on the first event.
Trigger Marks	Place a vertical bar on all samples that meet the trigger conditions. By default, only one trigger bar is shown (the T-bar), but there can be up to 256 trigger bars. These are numbered T0, T1, T2 etc. (Trigger Marks are sometimes referred to as Cursors or Auxiliary Cursors).

Table 4-17 Trigger Setup (quick) dialog box description

4.18.1. Pattern Trigger

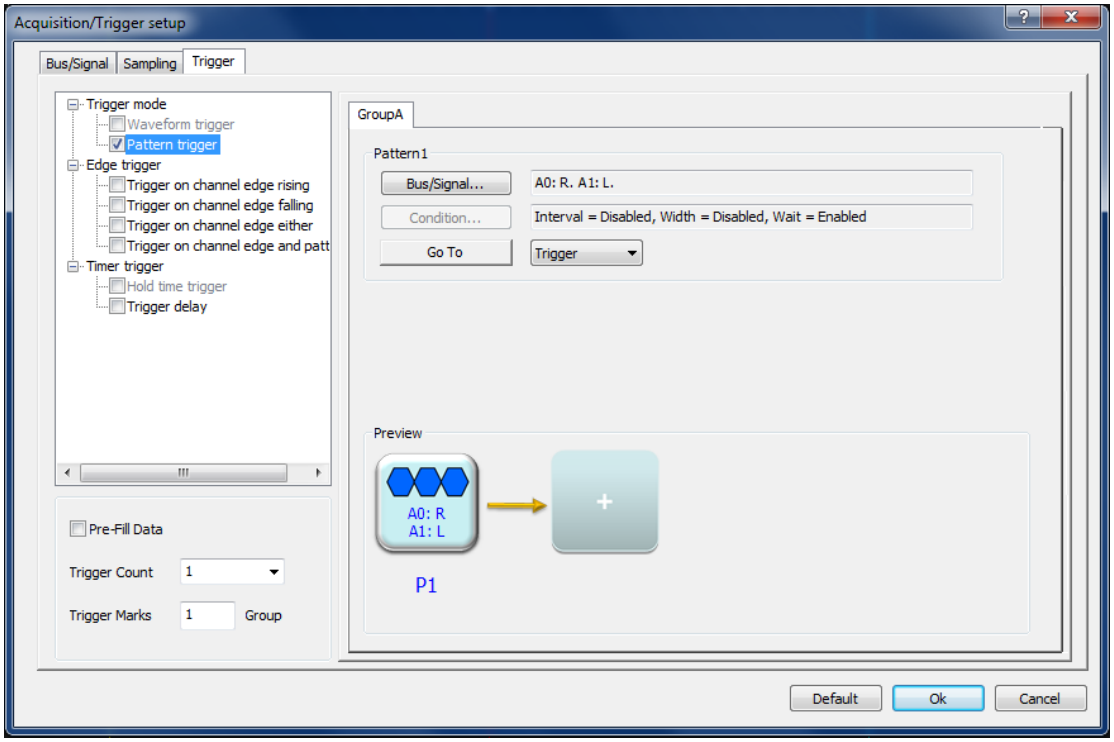

Figure 4-21 Trigger Setup (quick) Pattern trigger dialog box

Item	Description
Bus/Signal	Set the trigger value and trigger condition of the buses and channels respectively, see chapter 4.18.1.1
Go To	Go to the next level or trigger on the current level.
Preview	Clickable diagram summary of the trigger sequence. Clicking on the rightmost rectangle shaped button with the symbol '+' in the middle adds a new level to the trigger sequence.

Table 4-18 Trigger Setup (quick) Patter trigger dialog box description

4.18.1.1. Bus Signal

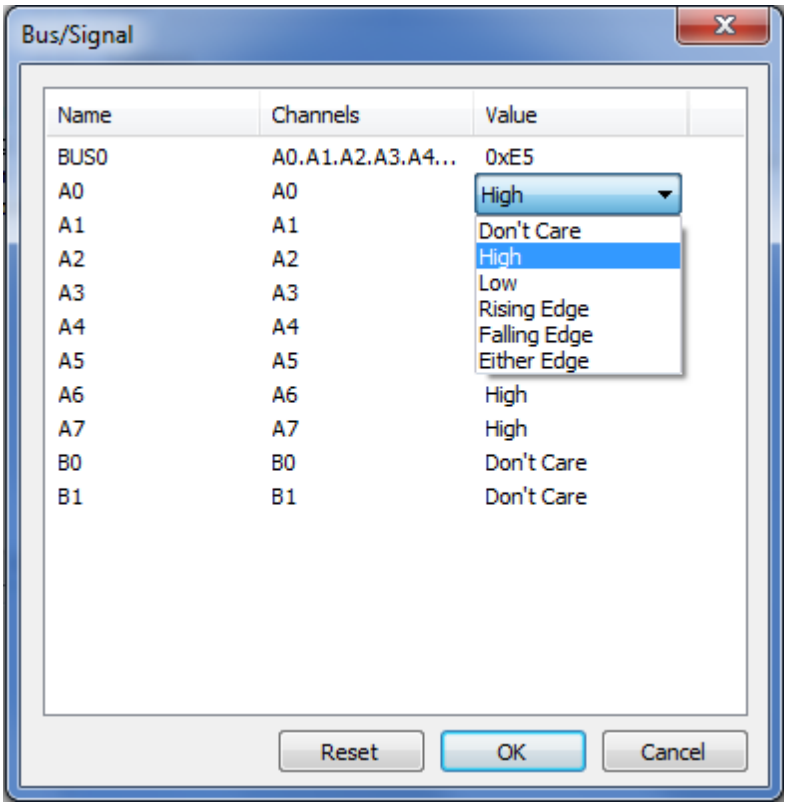

Figure 4-22 Bus/Signal dialog box

Item	Description
Name	Name of the channel in the Bus Expert software.
Channels	Physical reference of the channel.
Value	Value or event on which the Bus Expert II triggers.

Table 4-19 Bus/Signal dialog box description

4.18.2. Trigger on channel edge rising

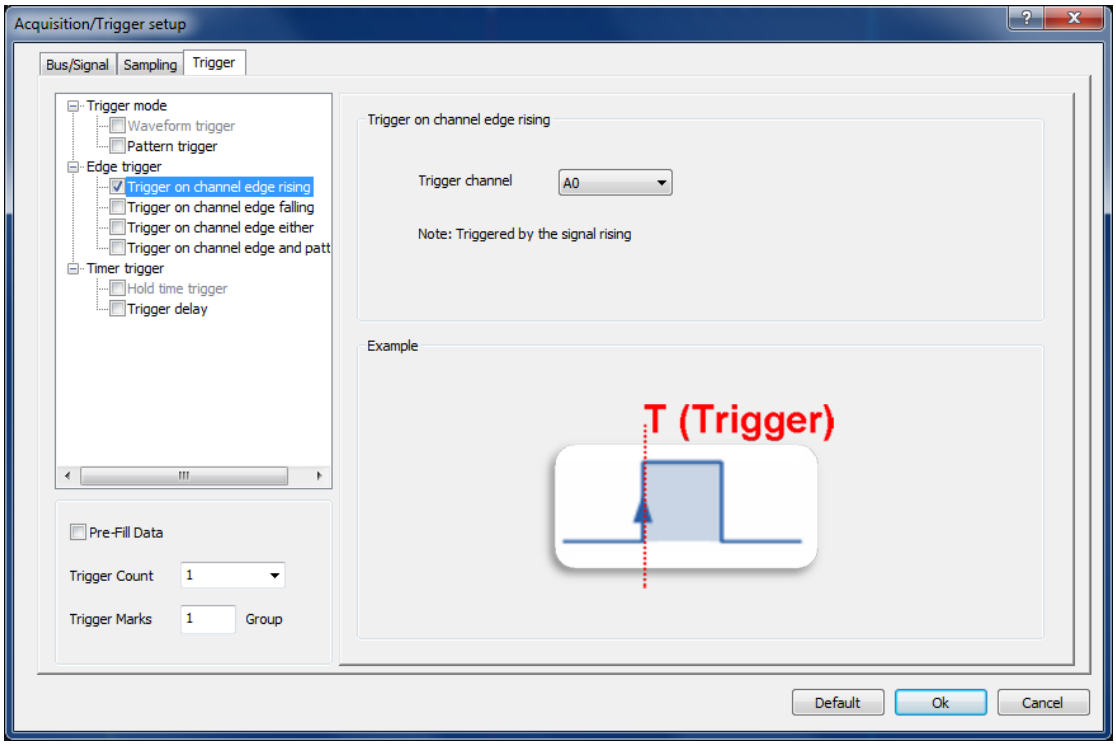

Figure 4-23 Trigger Setup (quick) Trigger on channel edge rising dialog box

Item	Description
Trigger channel	The Bus Expert II triggers when a rising edge is detected on the selected channel.

Table 4-20 Trigger Setup (quick) Trigger on channel edge rising dialog box description

4.18.3. Trigger on channel edge falling

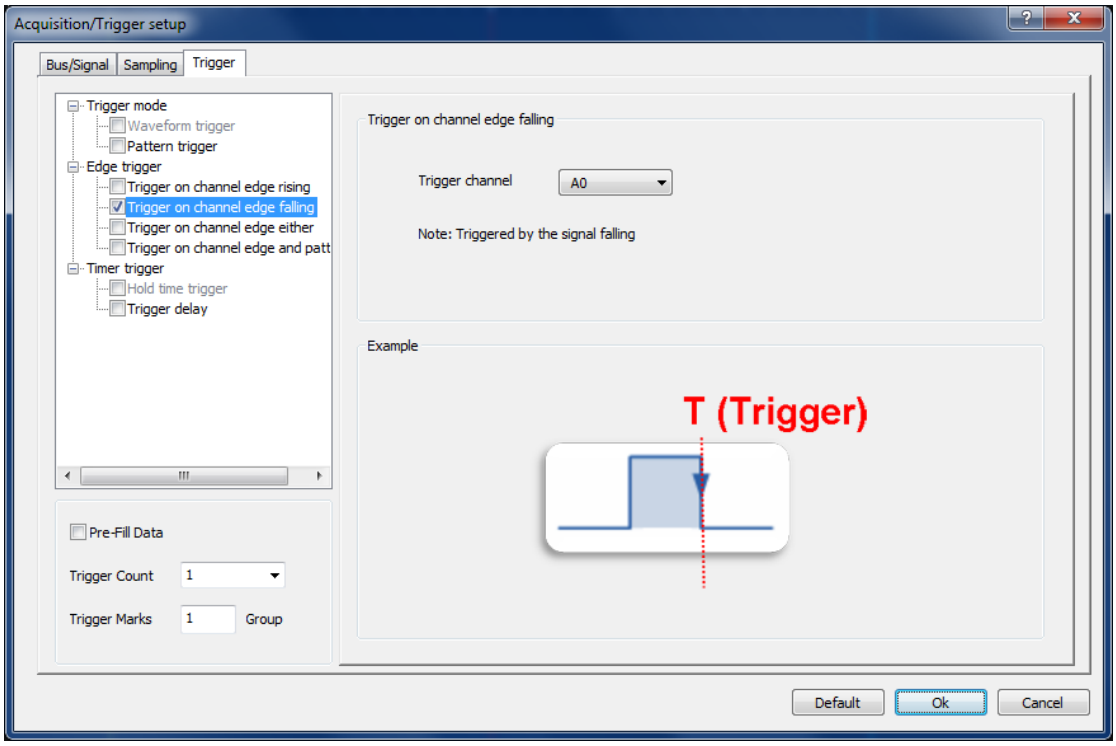

Figure 4-24 Trigger Setup (quick) Trigger on channel edge falling dialog box

Item	Description
Trigger channel	The Bus Expert II triggers when a falling edge is detected on the selected channel.

Table 4-21 Trigger Setup (quick) Trigger on channel edge falling dialog box description

4.18.4. Trigger on channel edge either

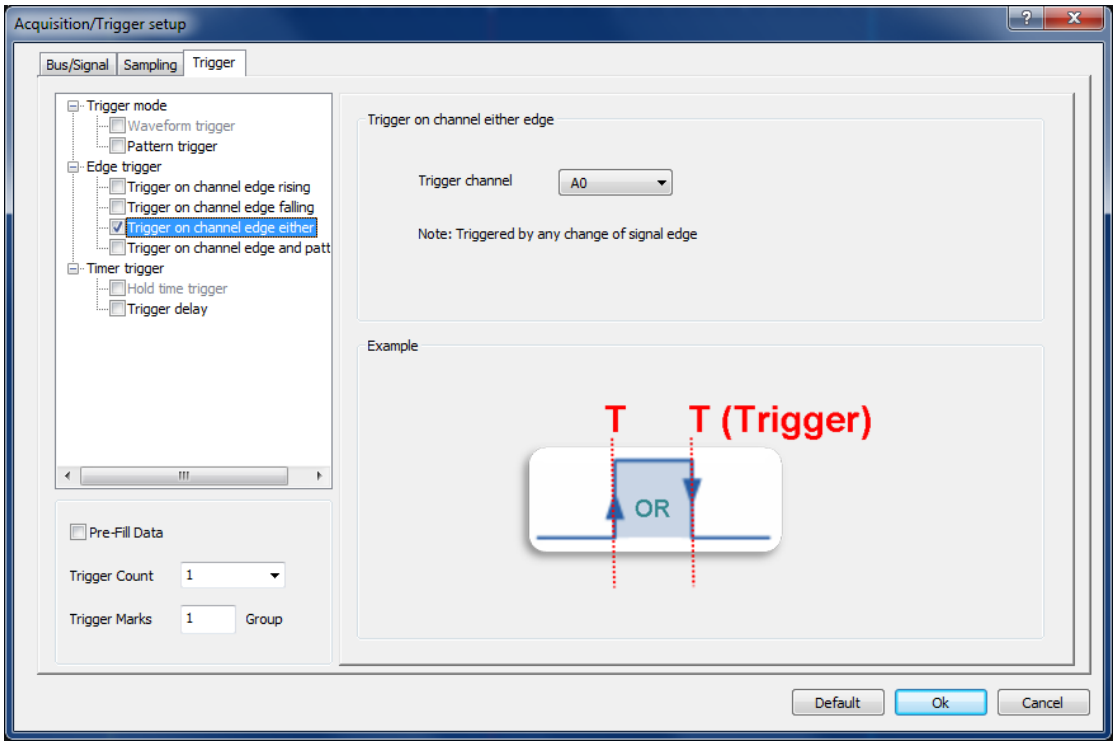

Figure 4-25 Trigger Setup (quick) Trigger on channel edge either dialog box

Item	Description
Trigger channel	The Bus Expert II triggers when either a rising edge or a falling edge is detected on the selected channel.

Table 4-22 Trigger Setup (quick) Trigger on channel edge either dialog box description

4.18.5. Trigger on channel edge and pattern

When using this function the Bus Expert II triggers when both a certain bus value and the desired channel event occur at the same time.

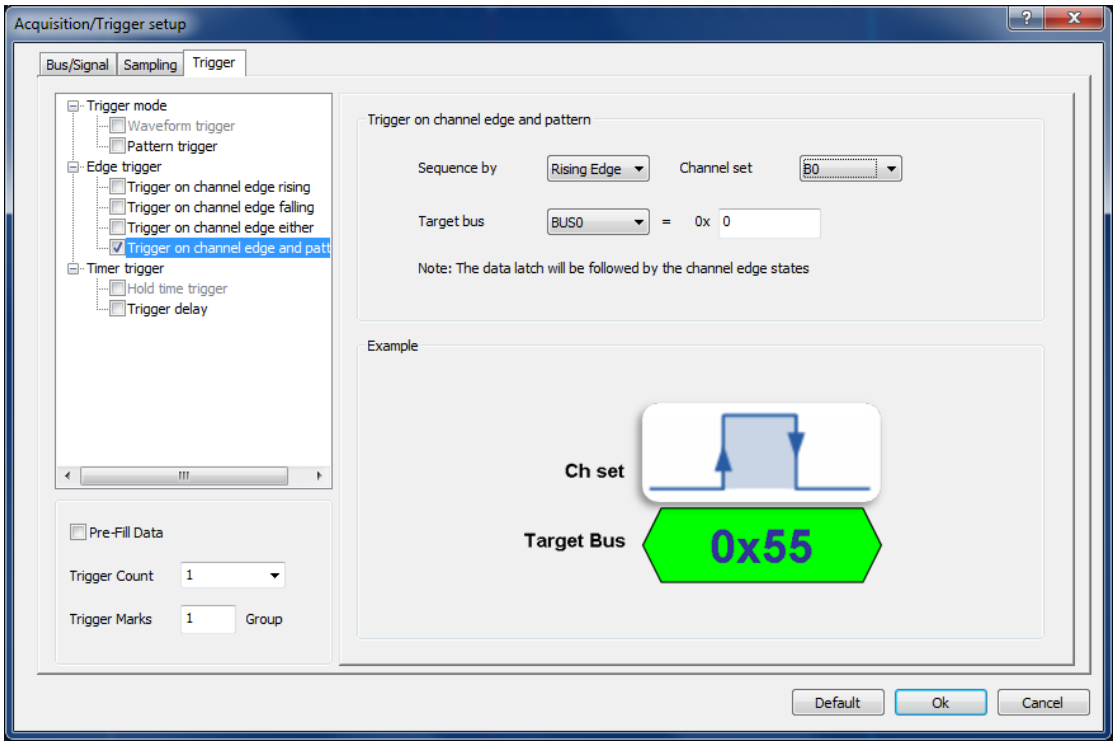

Figure 4-26 Trigger Setup (quick) Trigger on channel edge and pattern dialog box

Item	Description
Sequence by	Set the trigger to Rising, Falling, or either Falling or Rising.
Channel Set	Select the channel on which the trigger applies.
Target bus	Select the bus and enter the bus value on which to trigger.

Table 4-23 Trigger Setup (quick) Trigger on channel edge and pattern dialog box description

4.18.6. Trigger delay

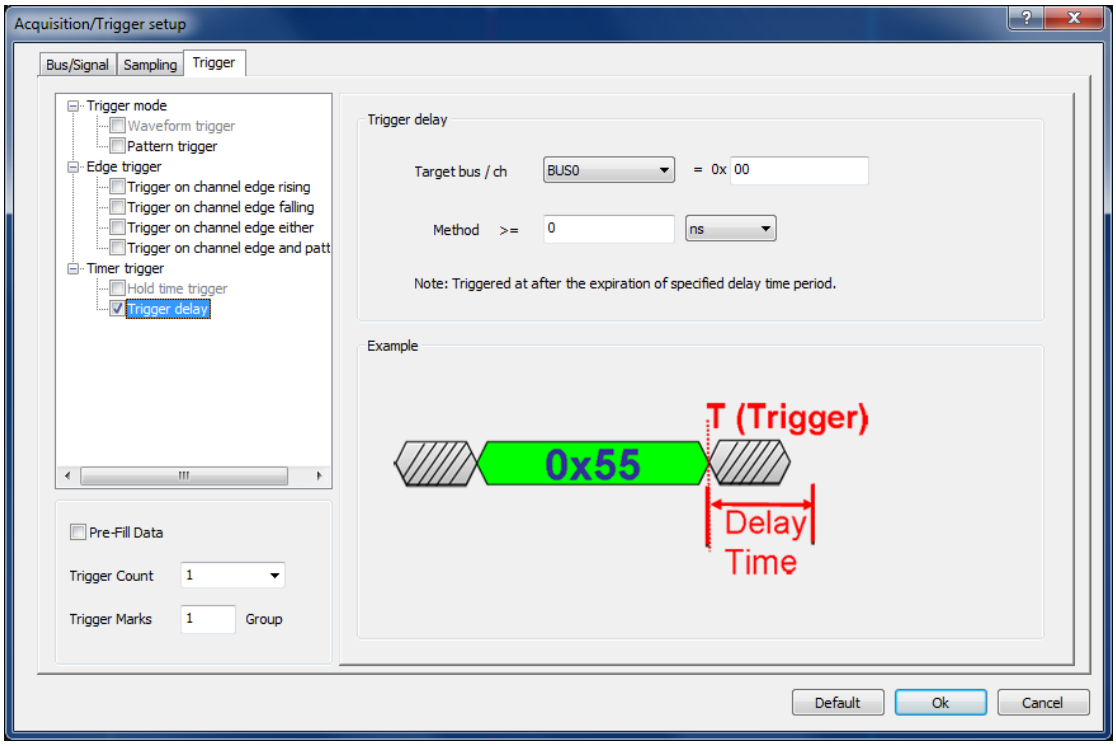

Figure 4-27 Trigger Setup (quick) Trigger delay dialog box

Item	Description
Target bus / ch	Select the bus or the channel on which you want to trigger and enter a trigger value or choose a trigger event respectively.
Method	Enter a delay in seconds after which the Bus Expert II must triggers.

Table 4-24 Trigger Setup (quick) Trigger delay dialog box description

4.19. Trigger Setup (manual)

Trigger Setup (manual) is used to define a set of trigger conditions. The BUS EXPERT II will trigger on the first event that satisfies all the conditions; see the dialog box in Figure 4-28.

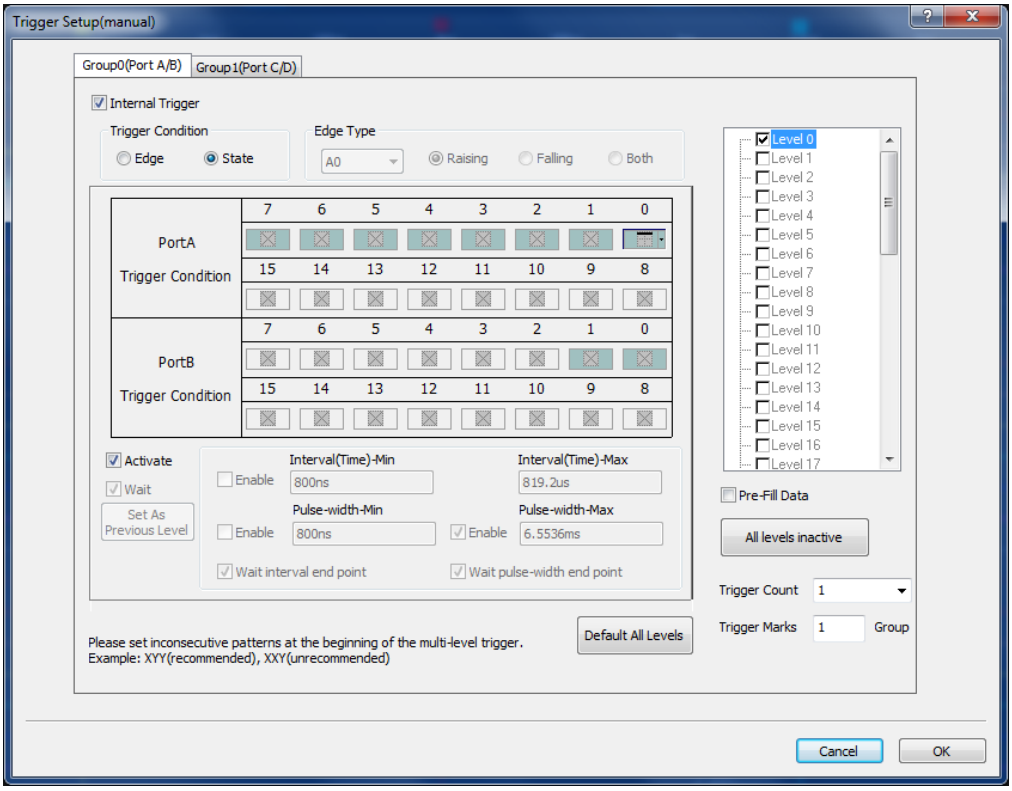

Figure 4-28 Trigger Setup (manual) dialog box

Item	Description
Trigger Mode	
Internal Trigger	Fulfillment of a condition set makes the BUS EXPERT II emit a trigger signal.
Trigger Condition	5 trigger conditions are available: High Level (1), Low Level (0), Rising Edge (transition from low to high), Falling Edge (transition from high to low) and Either Edge (Rising or Falling Edge).
Activate	Enable the trigger setup; this is done on a level-to-level basis
Wait	Wait is used for multilevel triggering with High/Low conditions. Ex: You want to set up a Rising (R), Rising, High (H) trigger where the High event satisfies a certain pulse-width (PW). When an RRH event is found, the BUS EXPERT II will check if the High satisfies the PW condition. If that is not the case, the BUS EXPERT II will either keep looking for an H that satisfies the condition and trigger when it finds it (Wait is enabled), or it will restart the search and look for a new RRH pattern that satisfies the PW condition (Wait is

	disabled; default option).
Set As Previous Level	Copy the trigger conditions from the previous level.
Default	Reset the level to default.
Trigger condition	When State is selected only High and Low can be set as trigger conditions. When Edge is selected you can set the trigger to Rising, Falling or Both.

Pulse-widths and Intervals

Enable Interval (Time)	Interval triggering can be activated when there are at least 2 levels.
Interval (Time) – Min	When Interval is enabled, for the condition set to be satisfied there needs to be a certain distance in time from trigger level X to trigger level X-1; the default min and max values are 180 and 8,192 clocks.
Enable Pulse-width	Pulse-width conditions can be set for High/Low trigger conditions.
Pulse-width – Min	Set the length of periods – be it High or Low- as a trigger condition.
Wait till Interval Max to trigger	When an Interval condition is set and this option is enabled, the BUS EXPERT II will not trigger immediately (i.e. when the H/L event being looked for changes state) upon finding an event that satisfies the Interval condition, but wait until the Interval Max number of samples is reached and then trigger. The Interval Max is counted from the beginning of the H/L event in question.
Wait till Pulse-width Max to trigger	When a pulse-width condition is set and this option is enabled, the BUS EXPERT II will not trigger immediately (i.e. when the H/L event being looked for changes state) upon finding an event that satisfies the pulse-width condition, but wait until the Pulse-width Max number of samples is reached and then trigger. The Pulse-width Max is counted from the beginning of the H/L event in question.

Trigger Levels

Trigger Level	There are 47 Trigger Levels. When the conditions of Level 1 are satisfied the BUS EXPERT II looks for an event that satisfies the conditions of Level 2. When an event satisfying the last active trigger level is found the BUS EXPERT II triggers. Note that Level X

	must be activated before Level X-1 can be activated.
Pre-Fill Data	See Table 4-17
All Levels Inactive	Disable all trigger levels.
Default All Levels	Set all trigger levels to default.
Trigger Count	See Table 4-17
Trigger Mark	See Table 4-17
Navigation	
Back	Go to the Acquisition Setup dialog box.
Next	Go to the Trigger Properties dialog box.
Cancel	Leave the dialog box without saving the setting.
OK	Leave the dialog box and save the settings.

Table 4-25 Trigger Setup dialog box description

NOTE If both Internal and External Trigger are checked, whichever of the events that occurs first will trigger the BUS EXPERT II.

4.20. Trigger Options

Adjust trigger properties such as Trigger Position and Trigger Delay.

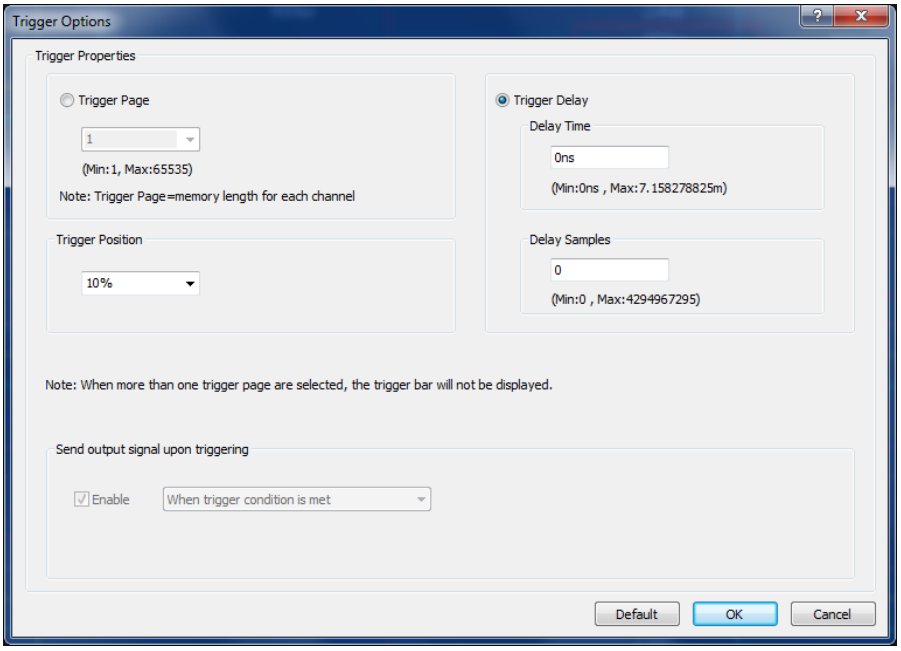

Figure 4-29 Trigger Options dialog box

Item	Description
Trigger Properties	
Trigger Page	Trigger a certain number of pages after the trigger conditions have been met. See Table 4-6 for a description of the PageSize setting.
Trigger Delay	Trigger a certain time or a certain amount of clock cycles after the trigger conditions have been met. The range goes from 0 ns to 687.19 seconds; the default is zero.
Trigger Position	
	The trigger position determines which samples are stored. At the default 10%, 10% of the available memory is allocated to pre-trigger data and 90% to post-trigger data.
Send output signal upon triggering (Trigger Out)	
	Synchronize the acquisition with another instrument. It facilitates the integration of the BUS EXPERT II into an automated test platform. See chapter 2.5.1; Trigger Out can be sent on the occurrence of 3 different events:
When trigger condition is met	Send the Trigger Out signal when the BUS EXPERT II triggers.
When clicking Capture	Send the Trigger Out signal when the user clicks Capture.
When clicking Stop	Send the Trigger Out signal when the user clicks Stop.

Table 4-26 Trigger Options dialog box description

4.21. Single Capture

Capture samples one time using the current Acquisition Settings and Trigger Conditions.

Hot Key: F5.

4.22. Repeated Capture

Repeated Capture is used to restart acquisition periodically until a Stop Condition is met. The Stop Condition can either be a function of number of triggers (trigger X times then stop) or of time (trigger periodically for X seconds then stop) ; see Figure 4-30.

Hot Key: CTRL + F5.

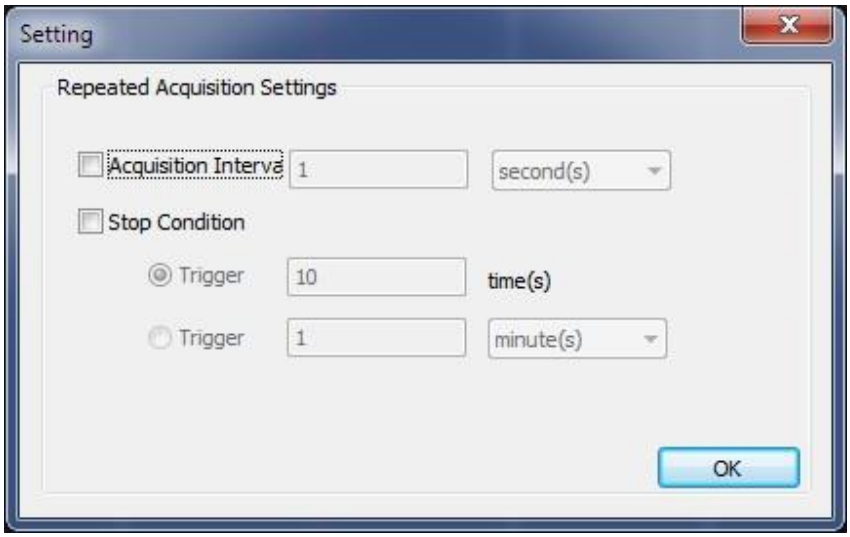

Figure 4-30 Repeated Capture dialog box

Item	Description
Acquisition Interval	Choose how often acquisition should restart. The available intervals are: 1-2,592,000 seconds, 1-43,200 minutes, 1-720 hours or 1-30 days; it is 1 second by default.
Stop Condition	
(Number of times)	Choose the number of times the acquisition should be restarted. BUS EXPERT II will then restart acquisitions until the limit is reached. 1-65,536 times is available; 10 times is the default option.
(Time)	Choose how long (in time) the acquisitions should be restarted. BUS EXPERT II will then restart acquisitions until the limit is reached. The available time limits are: 1-2,592,000 seconds, 1-43,200 minutes, 1-720 hours and 1-30 days.

Table 4-27 Repeated Capture dialog box description

4.23. Stop

Stop an ongoing acquisition. The user can chose between two different software behaviors when pressing Stop:

- Show the previous (complete) acquisition
- Show the newly acquired data

Switch between the two alternatives in the General Settings; see Figure 4-7.

4.24. Autocapture

The Autocapture is similar to the Single Capture (chapter 4.21), but the optimal sample rate is auto detected by the software.

Analysis

Press ALT + D to open this Main Menu item with the keyboard.

4.25. Menu Layout

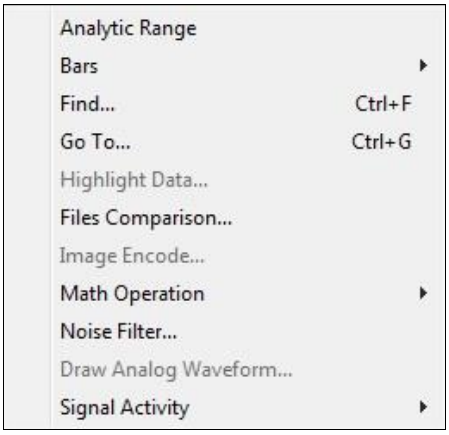

Figure 4-31 Analysis drop-down menu

4.26. Active Range

Adjust the analysis range by adjusting the position of the so-called Ds and Dp bars. The Ds-bar marks the beginning of the active range and the Dp-bar marks the end. The Active Range is used to reduce the size of acquisitions by hiding parts of the acquired data. This can be useful for navigation, reducing file sizes etc. These bars are locked whenever the user has not entered the Active Range.

NOTE Adjusting the Active Range will hide – not delete – data.

4.27. Bars

The Bus Expert Waveform / State List areas come with 5 standard bars (these are sometimes referred to as Cursors). The bars delimit the analysis range and facilitate navigation and observation. The five standard bars are described in Table 4-28.

Bar	Description
Ds bar	Demarks the beginning of the buffer data area; use the Active Range function to adjust its position.
Dp bar	Demarks the end of the buffer data area; use the Active Range function to adjust its position.
T-bar	The T-bar marks the trigger event. Press T to center the waveform view on the T-bar.
A-bar	Default bar intended for navigation and measurement that the user can move freely. Press A to center the waveform view on the A-bar.
B-bar	Default bar intended for navigation and measurement that the user can move freely. Press B to center the waveform view on the B-bar.

Table 4-28 Description of the five standard bars

4.27.1. Add

Users can insert up to 250 additional bars. When adding a bar the user can select color and where it should be positioned (in time). The bars will

automatically be named A0-A9, B0-B9 etc. User comments can be added to the bars after addition; see Figure 4-62.

Note that there is a second way to add bars: In pointer mode (see 4.42.1), move the cursor to the very left part of the waveform. The pointer will convert to a plus symbol and when left-clicking a bar will be added.

4.27.2. Reposition

Move a bar; the bar's new position will depend on how the user enters the reposition dialog box:

- If the user accesses the function from the Main Menu, the chosen bar will be placed at the center of the waveform area.
- If the user accesses the reposition dialog box by right-clicking in the waveform area, the chosen bar will be moved to where the user clicked.

NOTE The T-bar cannot be moved and the Ds- and Dp-bars can only be moved using the Active Range function; see chapter 4.26.

NOTE Users can also center the waveform on a bar by means of keyboard shortcuts. This is not the same as repositioning the bar. To center the display on the T-bar press T and correspondingly for the A- and B-bars. To focus on user defined bars use the number keys. To focus on for example the D1-bar, press 1 four time.

4.27.3. Delete

Any bar that is not a standard bar can be deleted.

4.28. Find

Post acquisition, Find is used to look up events that satisfy a user-defined condition. The user can search for basic trigger events on a particular channel or a certain value on a bus. If a protocol decoder is associated to a bus, the user can search for a value that follows the protocol format.

Hot Key: CTRL + F.

Press CTRL + → to move to the next event that satisfies the Find conditions and CTRL + ← move to the previous event.

NOTE To search through all memory pages it is necessary to process the acquired data; see the note in chapter 4.6.

A single condition set could for example be: Channel A0 = High AND Channel A1 = Rising. See the Find Single Condition Set dialog box in Figure 4-32. Note that it is not possible to look for two simultaneous edges.

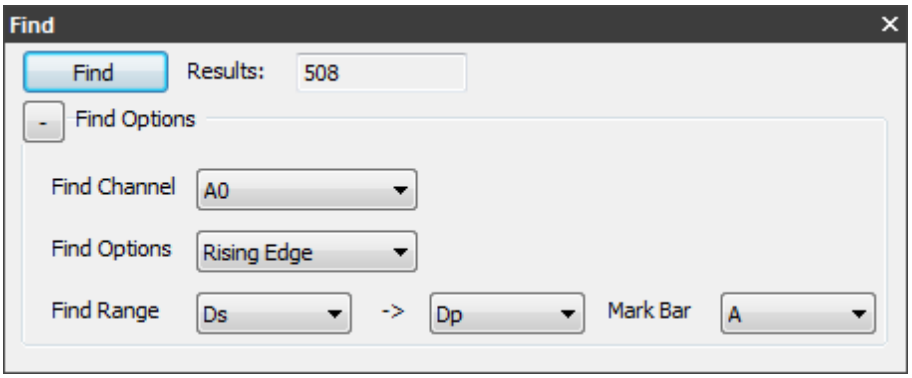

Figure 4-32 Find Single Condition Set dialog box

Item	Description
Find Channel)	Select a channel or a bus to search in.
Find Options	Look for rising/falling edges, bus values or protocol packets.
Find Range	Set the data range within which Bus Expert will look for the condition set. Any bar can be used as a starting point; by default the range encompasses the entire acquisition (alternative All).
Mark Bar	Choose to place the A bar or the B bar where the first occurence is found.

Table 4-29 Find dialog box description

4.29. Go To

The Go To function is used to find and navigate to a bar or a Memory Page; see the dialog box in Figure 4-33.

Hot Key: CTRL + G.

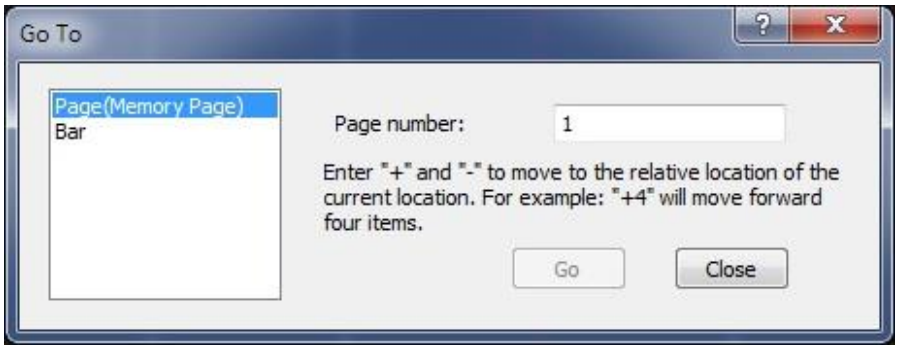

Figure 4-33 Go To dialog box

To go to a bar, select one from the drop-down menu. The waveform area will center on the selected bar. If there are several bars of type A (A0, A1, A2 etc) then click next to move from one bar to the next. The A-bar is the default choice.

It is also possible to go to a page (read about Bus Expert's pagination in Table 4-6). Input a page number and click Go To to move to the page. In Figure 4-34 the user has used the Go To dialog box to move to page 3 as indicated by the red frame on the page bar in the upper left corner.

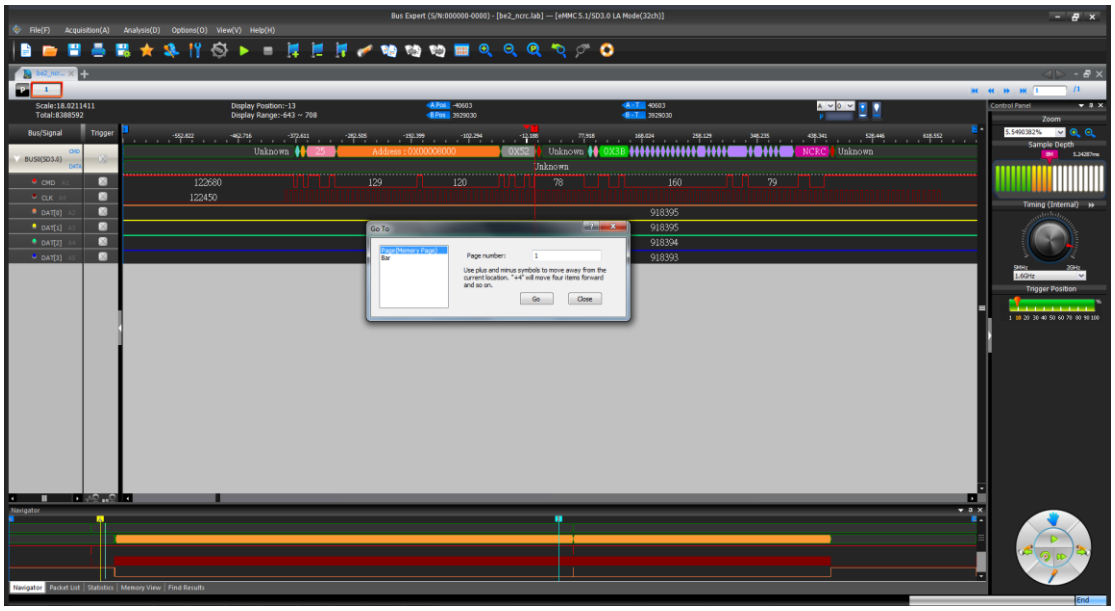

Figure 4-34 Go To example; the File bar shows that page 3 is shown

4.30. Highlight Data

Highlight Data colors data that satisfies a user-defined condition to make them stand out. See the dialog box in Figure 4-35.

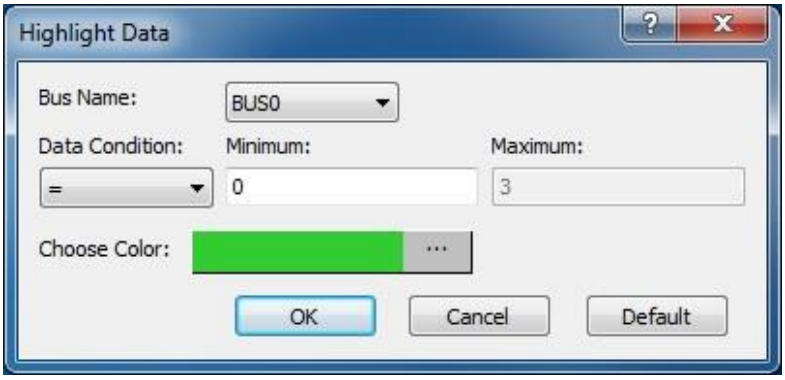

Figure 4-35 Highlight Data dialog box

Item	Description
Bus Name	Select which bus the function should focus on.
Condition	Select a condition among =, *!=*, *In Range* and *Not In Range*; = is the default.

Value / Minimum	Input the value that is to be met.
Maximum	Input the maximum value (used for *Range*/*Not in range* only).
Choose Color	Data that meet the condition are highlighted with the selected color.

Table 4-30 Highlight Data dialog box description

Figure 4-36 shows what how the Highlight Data function works. In the example, the conditions established in Figure 4-35 are used: The data belongs to BUS0 and are equal to zero. This are highlighted with an orange color. Had the function not been used, these data would have had the same white background color as the neighboring 0X1 data.

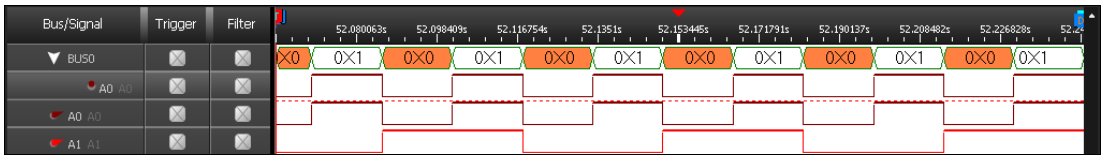

Figure 4-36 Highlight Data example; packets with Data Min = 0 are orange

4.31. Files Comparison

Files Comparison examines how and where two files differ from each other. The number of differences between the two files is listed channel by channel in the dialog box, and new, curly traces in the waveform area evidence where the two signals differ; see an example in Figure 4-38.

Figure 4-37 shows the Files Comparison dialog box and the result of a data comparison of two files in table format; the two files display a large number of differences.

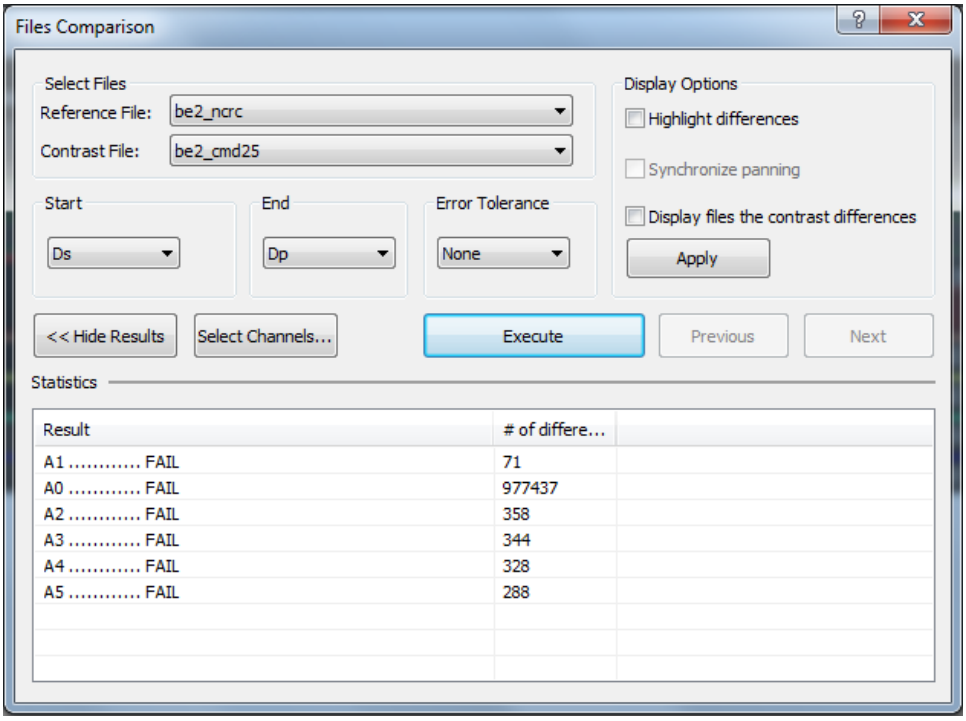

Figure 4-37 Files Comparison dialog box

Item	Description
Select Files	
Reference File	Select a file. Note that only open files can be chosen. Only open files are available.
Contrast File	Select the file that is to be compared to the Reference File. When contrasting with None, the Reference File settings will be used to make an acquisition.
Settings	
Start	Select where to start the Files Comparison, using the reference file as base.
End	Select where to end the Files Comparison, using the reference file as base.
Error Tolerance	Define how many sample points that may differ between the two files before Bus Expert regards the two files as unequal; 0-10 samples can be chosen (the default is 0).
Display Options	
Show files horizontally	Display the two files horizontally; unchecked by default.

Synchronize navigation	Synchronize panning across the two files. This option is unchecked by default and only available if "Show files horizontally" is checked.
Highlight differences	Mark the different waveforms with red wavy lines, the default is not selected.
Apply	Make changes effective.
Hide/Unhide Results	Hide/Unhide the Results area.
Select Channels	Select the channels to be contrasted. At least one must be chosen; by default all are selected.
Execute	Perform the Files Comparison. Note that this function needs to pre-process a temporary file; see note in chapter 4.6.
Statistics	
Results	Display the status of channels contrast, PASS means the data in the channel is identical for the two files and FAIL means the data is different.
# of differences	The column shows the number of differences between the two files for each channel.
Navigation	
Previous	Go to the previous difference between the two files.
Next	Go to the next difference between the two files.

Table 4-31 Files Comparison dialog box description

The reference file and the contrast file are displayed horizontally in the waveform area. New, orange, wavy traces ~~~~~ (one for each channel) in the lower window show where the two files differ. The orange waves marking the differences can be discerned in the lower waveform area in Figure 4-38.

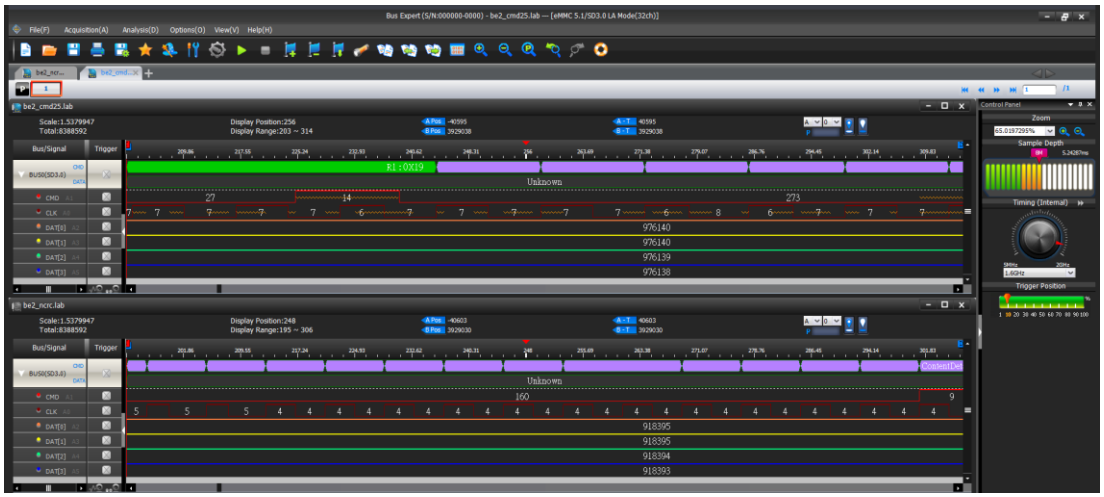

Figure 4-38 Files Comparison ex; differences marked in the upper window

4.32. Math Operations

Create a new trace by performing a mathematical operation on two existing signals.

4.32.1. Arithmetic Operation

Using the Arithmetic operation function users can create a new signal through one the following arithmetic operations: Add, Subtract, Multiply or Divide.

Bus Expert only accepts the creation of one arithmetic trace at a time.

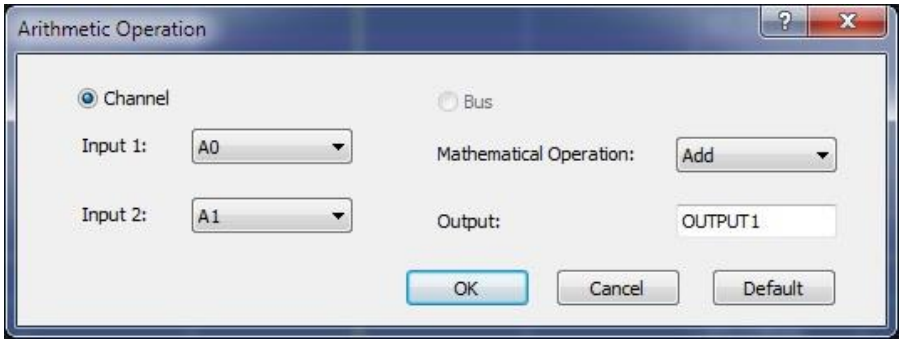

Figure 4-39 Arithmetic operation dialog box

Item	Description
Channel/Bus	Choose to perform the operation on signals or buses (at least two buses

	must exist for this option to open).
Input 1	Select a signal.
Input 2	Select a signal to be joined with the first one using the arithmetic operator.
Operation	The available arithmetic operations are: Add, Subtract, Multiply and Divide.
Output Name	Input a name for the resulting trace.

Table 4-32 Arithmetic operation dialog box description

Figure 4-40 shows the resulting trace from an ADD operation on signals A0 and A1.

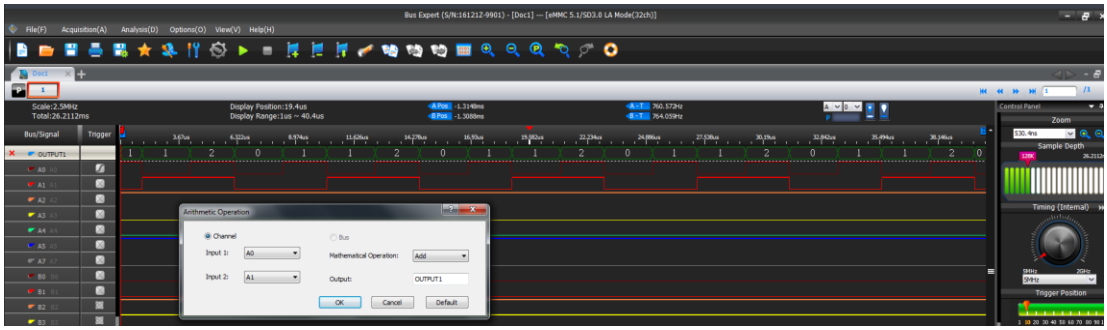

Figure 4-40 Arithmetic operation example; ADD A0 and A1

4.32.2. Boolean Operation

With the Boolean operation, users can create a new signal using one of the Boolean operators; see Figure 4-41.

Note that an Arithmetic operation can also be performed on buses, granted that at least two buses have been created. However, Bus Expert only accepts the creation of one Boolean trace at a time.

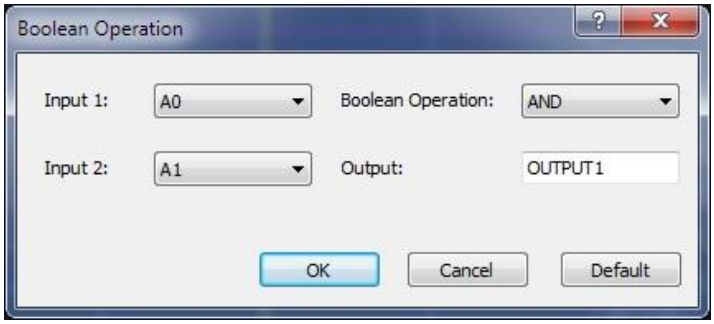

Figure 4-41 Boolean Operation dialog box

Item	Description
Input 1	Select a signal.
Input 2	Select as second signal to be XX to the first one.
Boolean Operator	The available Boolean operators are: AND, OR, NAND, NOR, XOR, XNOR and NOT. NOT takes only one argument and inverts it.
Output Name	Input a name for the resulting trace.

Table 4-33 Boolean Operation dialog box description

Figure 4-42 shows a trace created from signals A0 and A1 using the Boolean operator AND.

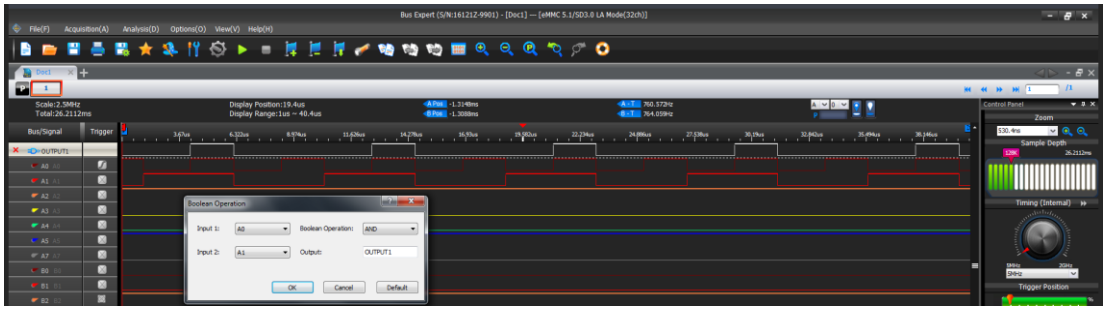

Figure 4-42 Boolean waveform example: A0 AND A1

4.33. Noise Filter

The Noise Filter is used to filter out short-lasting pulses or dips in signals that the user considers to be noise; see the dialog box in Figure 4-43.

After activating the Noise Filter, users select one or more channels to be filtered and move them to the right column using the right-pointing arrows. To select two or more channels at the same time, use the CTRL and SHIFT keys.

Once a channel is in the right column, the user can choose just how short pulses/dips in the signal of that channel have to be to be filtered out. Lengths are measured in sample points or time.

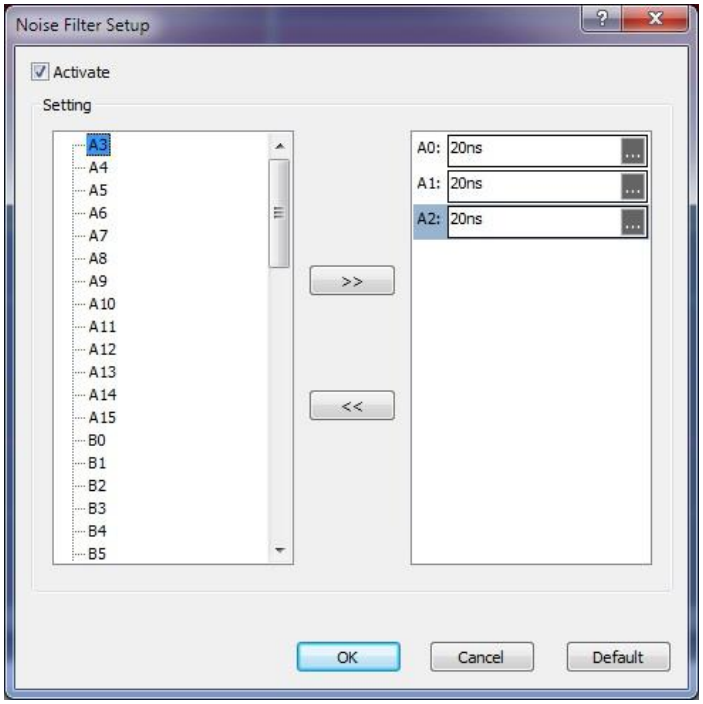

Figure 4-43 Noise Filter dialog box

4.34. Draw Analog Waveform

The Draw Analog Waveform function is used to plot traces based on the value of bus data. It is especially useful for data that can be conveniently displayed visually, such as an ADC output represented by a sine wave. The function is available for simple buses (no packets); see the setup dialog box in Figure 4-44.

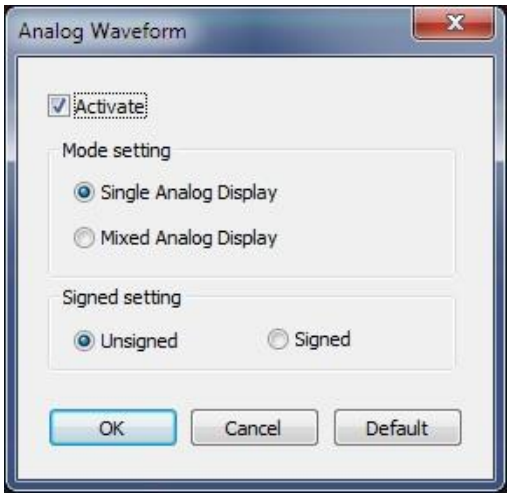

Figure 4-44 Draw Analog Waveform dialog box

Item	Description
Mode Setting	
Single Analog Display	Draw the analog waveform on a dedicated channel; default option.
Mixed Analog Display	Show the drawing on top of the traces its based on.
Signed Setting	
Unsigned	Binary data are read as unsigned; default option.
Signed	Binary data are read as signed.

Table 4-34 Draw Analog Waveform dialog box description

Figure 4-45 shows a simple example output based on four signals changing state on regular intervals (signals A0 in dark red to A4 in green are used in the example).

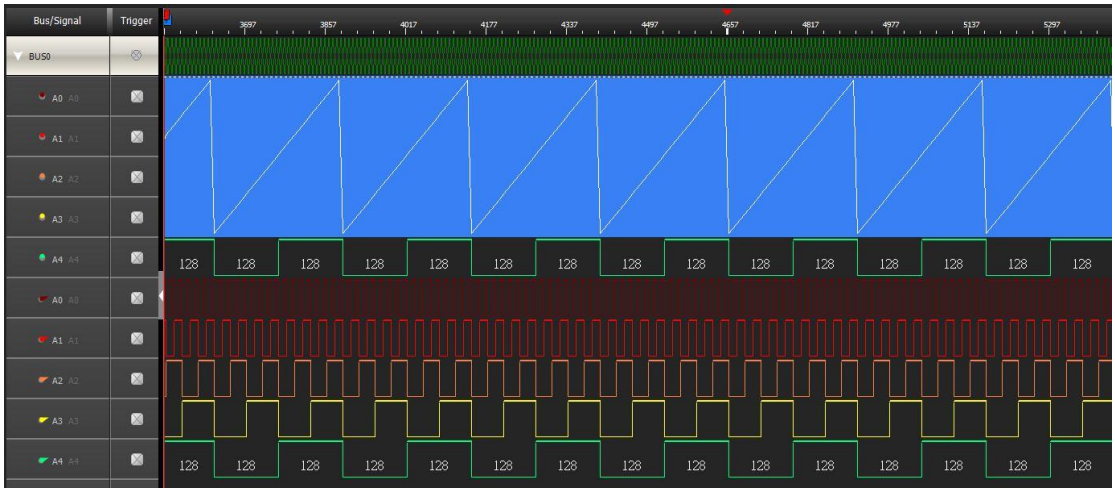

Figure 4-45 Draw Analog Waveform example

Options

Press ALT + O to open this Main Menu item with the keyboard.

The Bus Expert has two modes of capture. LA mode in which samples points are recorded and waveforms drawn from these sample points to recreate an image of the signals, and PA mode in which only packets are logged. The PA mode is subdivided into an eMMC PA mode and a SD PA mode for capturing and decoding both protocols. Finally, in PA mode you can configure the Bus Expert II to either stores packets in its internal memory or stream them over USB3.0 to the computer's storage device. This latter function is called Long-time Record (LTR) and is available for both eMMC and SD PA modes.

For a presentation of the LA mode, see chapter 4.36.

For a presentation of the PA mode, see chapter 4.39.

For a presentation of the PA mode LTR, see chapter 4.40.

4.35. Menu Layout

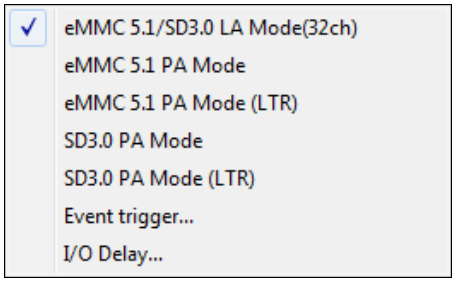

Figure 4-46 Options drop-down menu

4.36. eMMC5.1/SD3.0 LA Mode (32ch)

The Bus Expert II can decode both eMMC and SD protocols (up to their version 5.1 and 3.0 respectively). See Figure 4-47 for the eMMC display setup dialog box and Figure 4-48 for the SD display setup dialog box. These settings can be changed both before and after acquisitions.

NOTE It is also possible to trigger on eMMC events; see chapter 4.37.

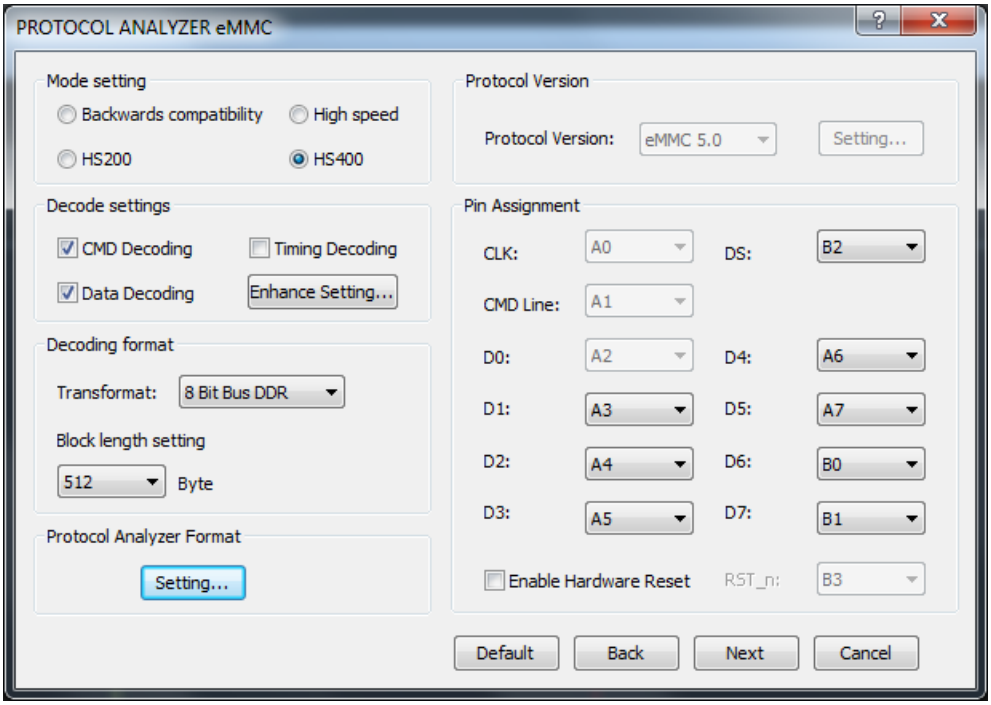

Figure 4-47 eMMC decoder dialog box

Item	Description
Mode Setting	Change the data display method.
Decode Settings	Select which data are decoded and displayed.
Decoding format	Select the way data are transmitted over the bus (x bits SDR/DDR, number of bytes per transmission).
Settings	Change colors and numeric base/encoding for numbers.
Protocol Version	Select eMMC version.
Pin Assignment	Select which signal is connected to which channel.

Table 4-35 eMMC dialog box

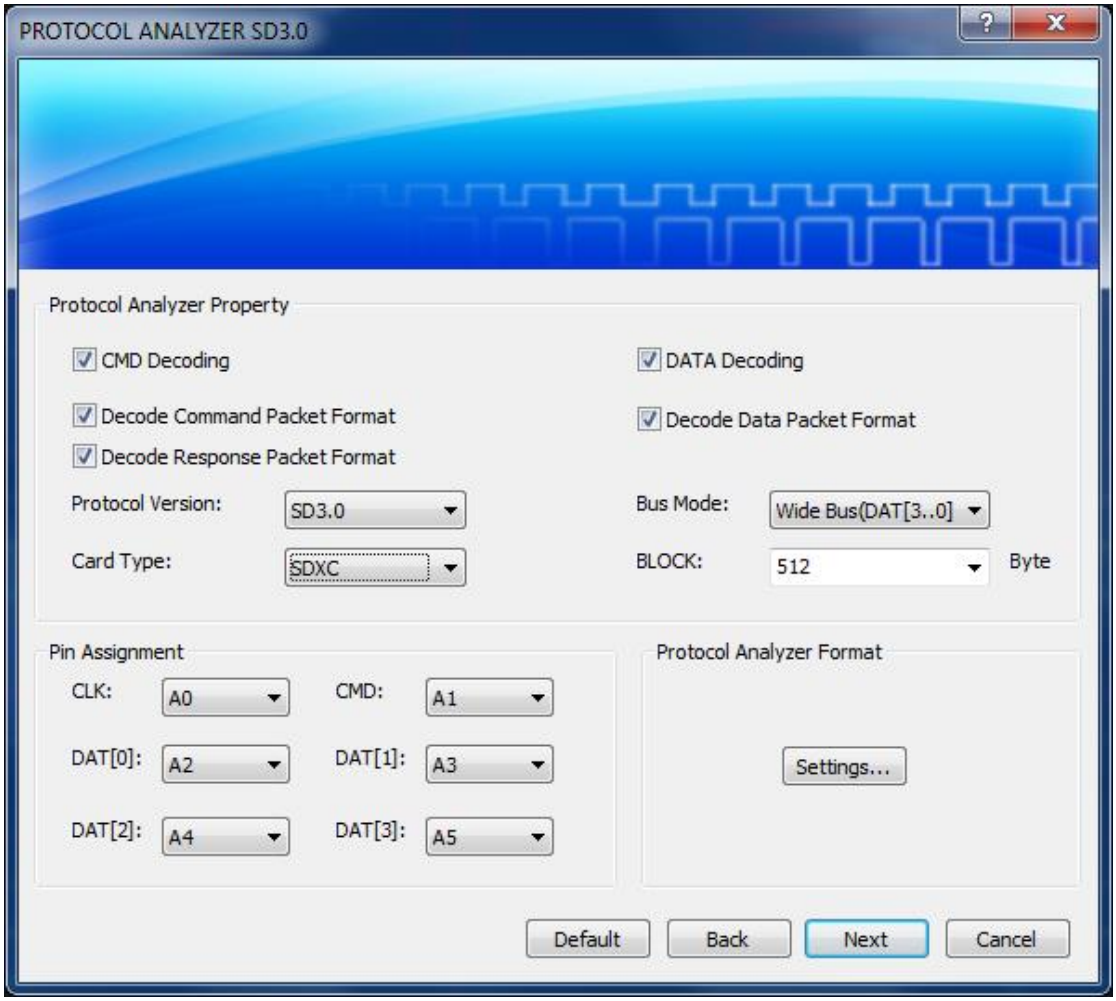

Figure 4-48 SD decoder dialog box

CMD Decoding	Tick the box to decode SD commands.
Decode Command Packet Format	Tick the box to decode Host commands.
Decode Response Packet Format	Tick the box to decode Device commands.
Protocol Version	Choose which SD protocol version you want to analyze (SD1.1/SDIO, SD2.0, SD3.0).
Card Type	Choose the specific type of your SD card (SDSC, SDHC, SDXC).
Pin Assignment	Assign each pin to the channel to which it is connected.
Data Decoding	Tick the box to decode the data read from or written to the device.
Bus Mode	Select the width of the data bus.
Protocol Analyzer Format	Change the color each protocol field is displayed in as well as numeric base/encoding for numbers.

4.37. eMMC Event Trigger

The eMMC Event Trigger is a protocol trigger; see the eMMC Event Trigger dialog box in Figure 4-49. The eMMC Event Trigger offers two kinds of triggering. On the left side of the window there are the command trigger settings. You need to check the box CMD Sequence Trigger first to enable the command trigger. Then, in the drop down menus choose the commands on which you wish to trigger. You can set up a trigger sequence comprised of up to three commands. For example if you select the commands 12, 13 and 25 in this order, the Bus Expert II will trigger only when the command 12 is followed by the command 13 which is in turn followed by the command 25. On the right of the window there are a few CRC error triggers, a Busy trigger and two drop-down menus that allows to set the bus width and block length of the eMMC/SD bus.

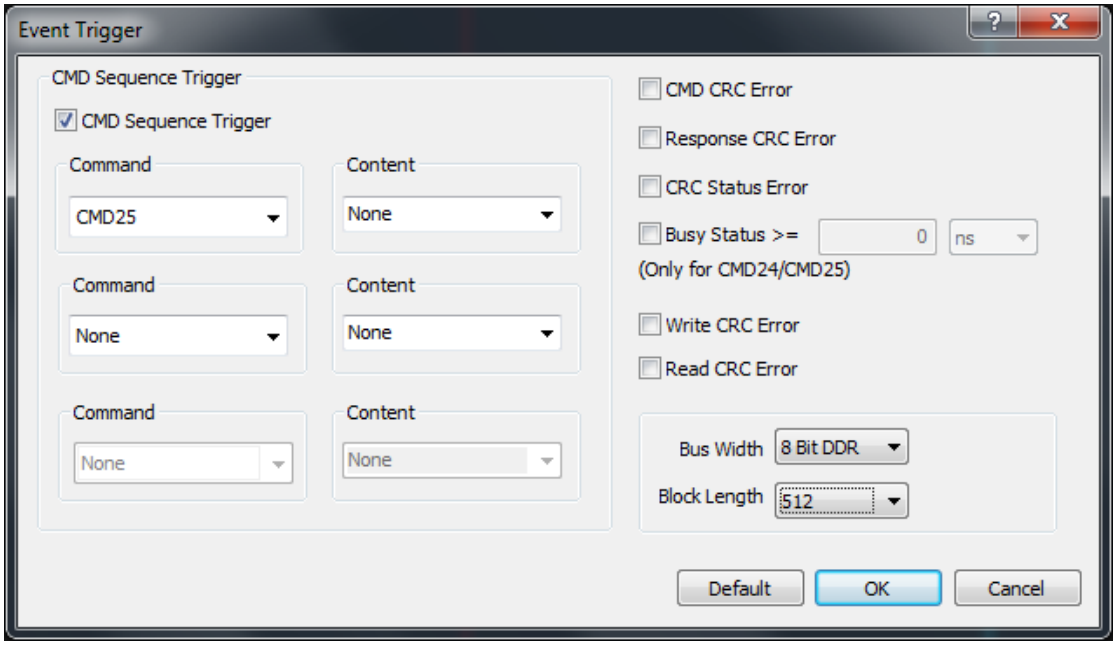

Figure 4-49 eMMC Event Trigger dialog box

4.38. I/O Delay

The I/O Delay function lets users correct clock skew.

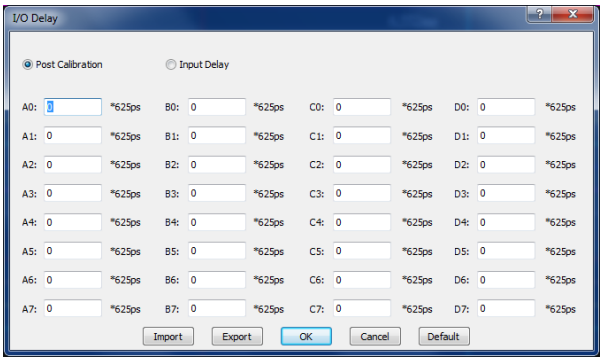

Figure 4-50 I/O Delay dialog box

Item	Description
Post Calibration	This option is used to adjust clock skew post-acquisition.
Input Delay	This option is used to adjust clock skew pre-acquisition.
A0-D7	Insert the desired delay per channel.
Import	Import a timing information .cb file.
Export	Export a timing information .cb file.

Figure 4-51 I/O Delay dialog box description

4.39. eMMC 5.1 PA mode & SD3.0 PA mode

This Chapter presents the Protocol Analyzer (PA) mode for eMMC5.1 and SD3.0 protocols. In this mode only packets are captured, not waveforms. It allows for long acquisitions with little sample depth, or acquisitions longer than what is possible in LA mode.

4.39.1. Entering PA mode

When switching to PA mode the window from Figure 4-52 appears.

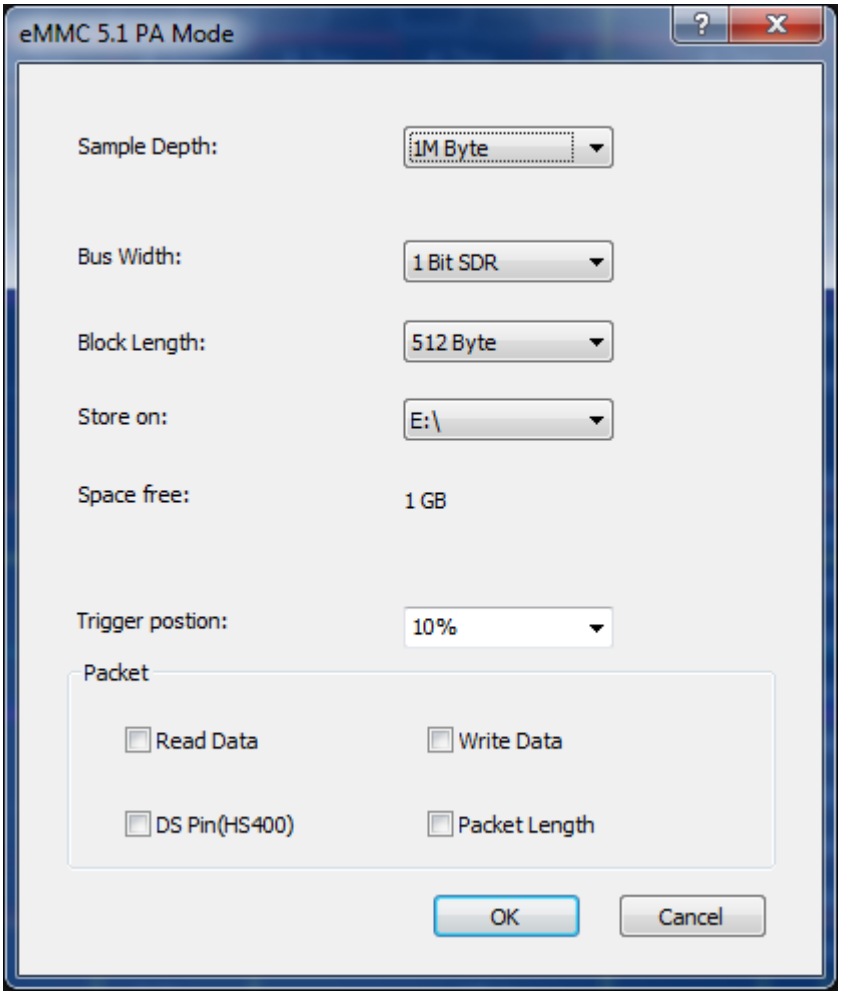

Figure 4-52 PA mode settings dialog box

Item	Description
Sample Depth	The sample depth determines how much

	data are captured by the Bus Expert II.
Bus Width	Data bus width. Supports SDR and DDR mode.
Block Length	Number of bytes read or written at once.
Store on	Select where to store files.
Space free	Indicates remaining space on your storage device.
Trigger position	See Table 4-26.
Packet	
Read Data	When ticked, data transmitted during a Read are captured.
Write Data	When ticked, data transmitted during a Write are captured.
DS Pin(HS400)	Enable DS probe. Necessary for HS400 mode.
Packet Length	Calculate and display the duration of each packet.

Table 4-36 Entering PA mode dialog box description

4.39.2. PA mode interface

The PA mode features a different yet familiar interface.

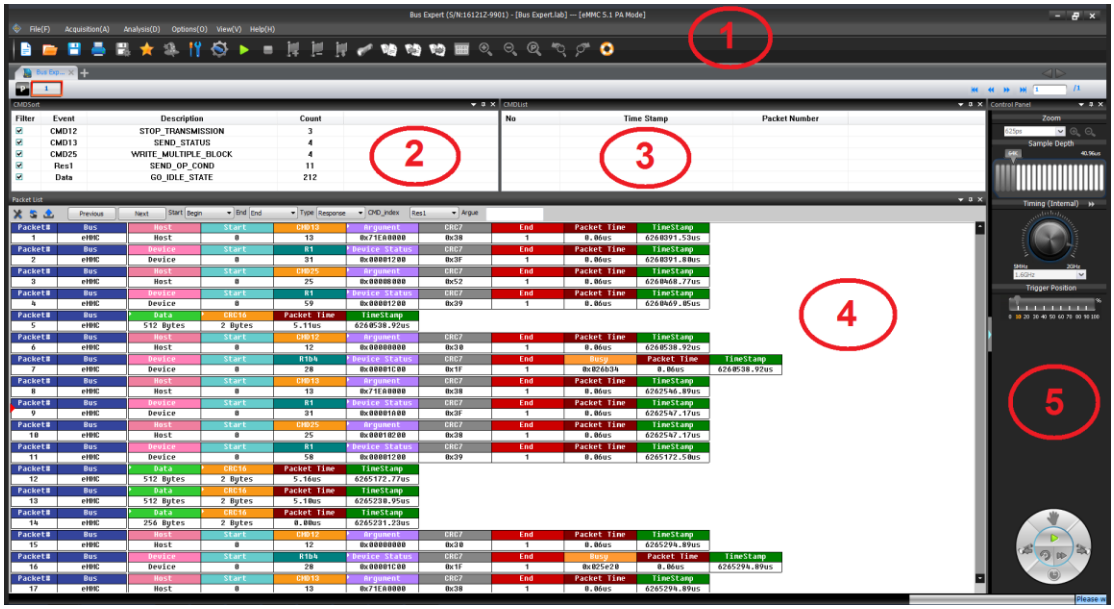

Figure 4-53 PA mode interface

Item	Description
1 Menu bar and Toolbar	Menus and shortcuts.
2 CMDSort	Summary of all commands present in the record log.
3 CMDList	Lists each occurence of the command selected in CMDSort (panel 2 on Figure 4-53).
4 Packet List	See chapter 4.7.2.
5 Control Panel	See chapter 4.46. All but Single Capture buttons are disabled.

Table 4-37 PA mode interface description

4.39.3. PA mode menu bar

In PA mode functions relevant to the LA mode only are disabled.

Below is a list of the menus and remaining opened functions in PA mode.

Item
File
New
Open
Close
Save
Save as
Export
Screen Capture
Options
Recent files
Exit
Acquisition
Acquisition Setup
Single Capture
Options
eMMC5.1/SD3.0 LA Mode (32ch)
eMMC 5.1 PA Mode

eMMC 5.1 PA Mode (LTR)
eMMC Event Trigger
I/O Delay

Table 4-38 PA modeMenu bar description

4.39.4. PA mode Packet List

Although similar to the packet list in LA mode, the packet list in PA mode features some exclusive functions. Table 4-39 lists the functions not present in LA mode.

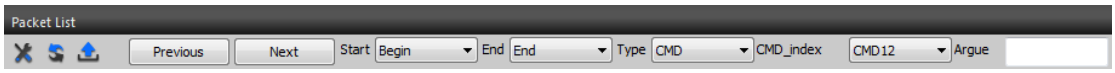

Figure 4-54 Packet List function bar

Item	Description
Start	
End	
Type (Six type of blocks are searchable in the packet list. Commands, repsonses, data, busy flag, errors (CRC) and error flags).	
CMD	Search for a particular command in the packet list.
Response	Search for a particular response in the packet list.
Data	Search for a particular data value in the packet list
Busy	Search for a busy flag greater than a certain duration in microseconds.
Errors	Search for CRC errors (Invalid CRC result or negative CRC status).
ErrorFlag	Search for eMMC/SD error bits. A list of all error bits can be found in eMMC/SD specifications.
Type: CMD	
CMD_index	Select command number.
Argue	Enter command argument value.

Type: Response	
CMD_index	Select command response number.
Type: Data	
Data (hex)	Value of the data to search in the data fields of the packet list (in hexadecimal).
Type: Busy	
Range	Choose whether the duration must be less than, greater than, equal to a certain value, or within a certain range.
Time (μs)	Enter the duration condition (in microseconds).
Type: Errors	
CRC	Search for CRC errors.
CRCStatus	Search for CRC status tokens.
Type: ErrorFlag	
APP_CMD	
EXCEPTION_EVENT	
SWITCH_ERROR	
Ready_for_DATA	
CURRENT_STATE	
ERASE_RESET	
WP_ERASE_SKIP	
CID_CSD_OVERWRITE	Error flags are defined in eMMC/SD specifications. The description of these errors is out of scope of this manual. Refer to the eMMC/SD specifications for a detailed description of each error.
Device_Error	
CC_ERROR	
DEVICE_ECC_FAILED	
ILLEGAL_COMMAND	
COM_CRC_ERROR	
LOCK_UNLOCK_FAILED	
DEVICE_IS_LOCKED	
WP_VIOLATION	
ERASE_PARAM	
ERASE_SEQ_ERROR	
BLOCK_LEN_ERROR	

ADDRESS_MISALIGN
ADDRESS_OUT_OF_RANGE

Table 4-39 Packet List function bar description

4.40. eMMC5.1 PA mode (LTR) & SD3.0 PA mode (LTR)

The PA mode Long-time Record (PA mode LTR) lets the user stream data directly to the computer over USB3.0, thus allowing much longer acquisitions than during normal operations when samples are stored in the BUS EXPERT II's internal memory. The maximum record length per acquisition depends on the available memory on your computer. It works both for eMMC5.1 and SD3.0 protocols.

4.40.1. Entering PA mode LTR

When entering PA mode LTR the window from Figure 4-55 appears.

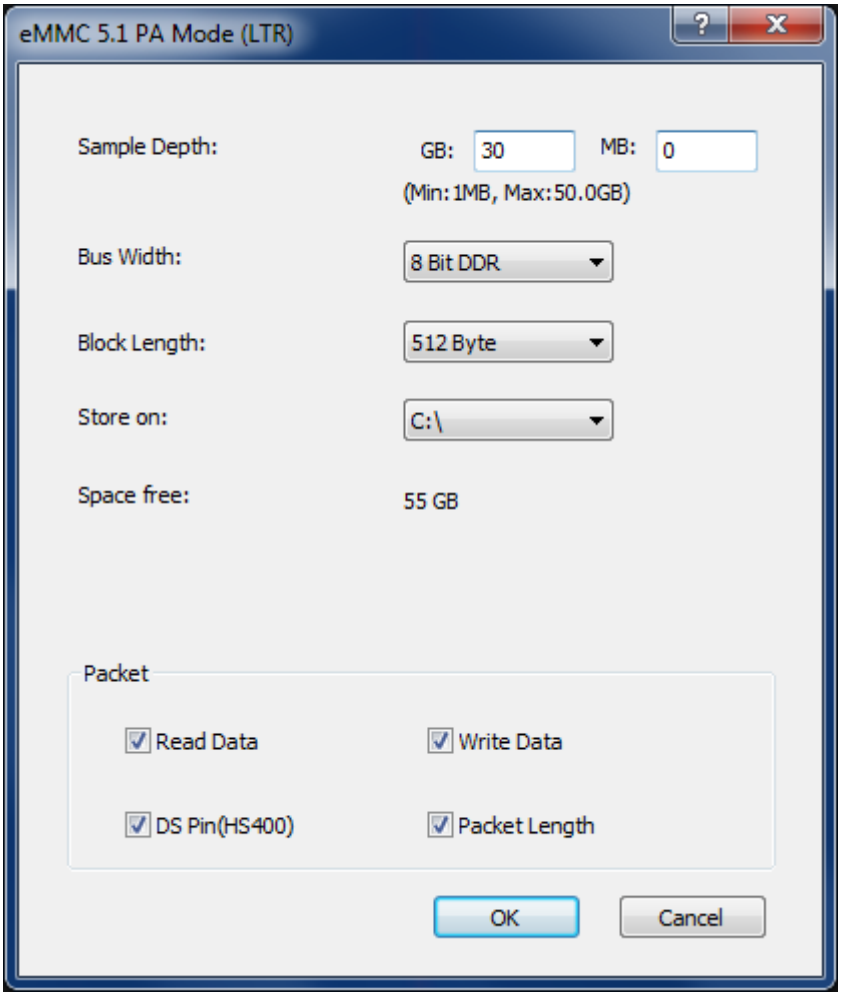

Figure 4-55 PA mode LTR settings dialog box

Item	Description
Sample Depth	Space to reserve for the acquisition on the computer's hard drive.
Bus Width	Width of the data bus. Supports SDR and DDR mode.
Block Length	Number of bytes read or written at once.
Store on	Select where to record files.
Space free	Remaining space on the selected storage device.
Packet	
Read Data	When ticked, data transmitted during a Read are captured.
Write Data	When ticked, data transmitted during a

	Write are captured.
DS Pin(HS400)	Enable DS probe. Necessary for HS400 mode.
Packet Length	Measure and display the duration of each packet.

Table 4-40 PA mode LTR dialog box description

The rest of the functions are identical to the PA mode. Anything that applies for the PA mode also applies for the PA mode LTR. See chapter 4.39 for a presentation of the PA mode and its functions.

View

Press ALT + V to open this Main Menu item with the keyboard.

4.41. Menu Layout

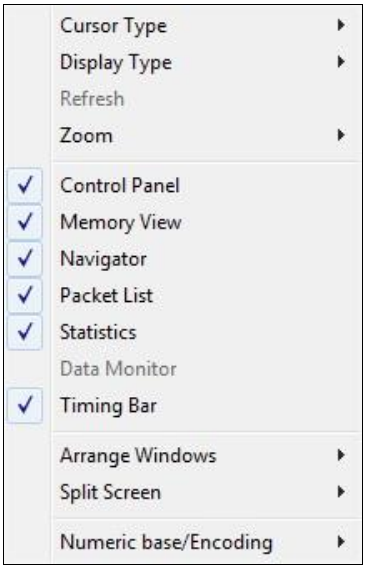

Figure 4-56 View drop-down menu

4.42. Cursor Type

The user can choose between two cursor types. Note that for both types, left/right movement in the waveform is achieved with the mouse wheel.

Hot Key: SPACE (the cursor mode changes temporarily when the user presses and holds the SPACE bar).

4.42.1. Pointer

In Pointer mode, the left mouse button is used for zooming; click and drag squares with the pointer to zoom in.

- To zoom in; form squares by dragging downwards/leftwards. The area covered by the square will be amplified to occupy the entire waveform area. In other words, form small squares to zoom in quickly.
- Zooming out is achieved by doing the opposite of zooming in; drag squares upwards/rightwards. The larger the square, the faster the zoom-out.
- To move a bar, left click on the bar name and drag sideways.

4.42.2. Hand

In Hand mode, the left mouse button is used for panning; click and hold the left mouse button to move left and write in the waveform area.

To move a bar, left click on the bar name and drag sideways.

4.43. Display Type

The menus that appear when right-clicking in the interface are found in these subchapters.

4.43.1. Waveform

In Waveform view, the state of each channel is shown as a trace that changes between high and low depending on the state of the signal. This is the default view mode.

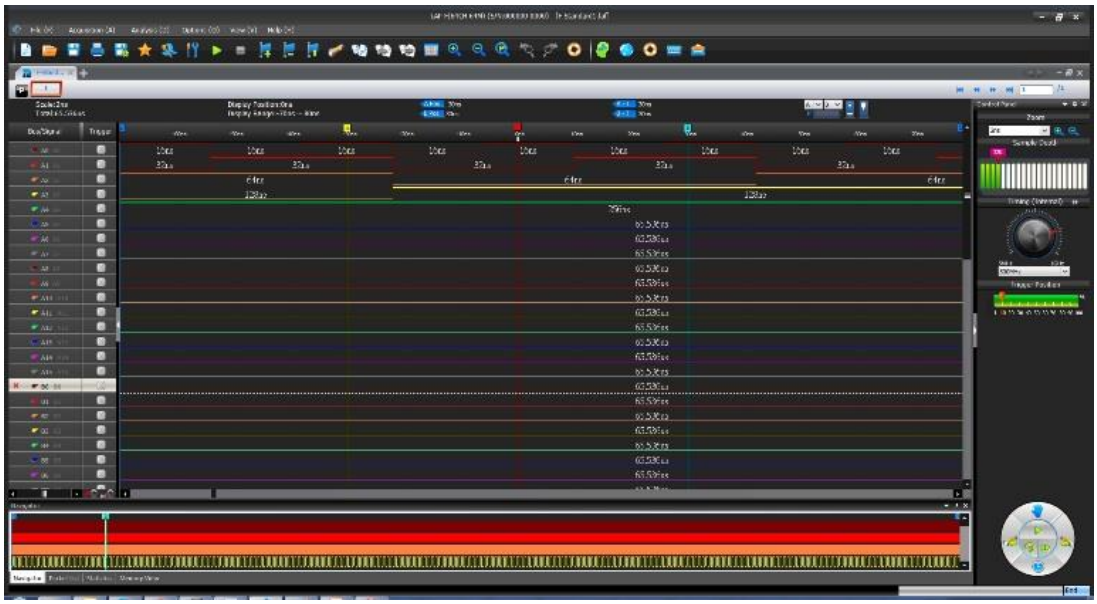

Figure 4-57 Waveform view

Figure 4-58 is shown when the user right-clicks in the trace area in Waveform View.

Figure 4-58 Waveform area; right-click menu

Item	Description
Trace Format	Change the appearance of traces, bus outlines and analog waveforms by altering their color and width. In Figure 4-63, trace A1 (in red) has been given triple weight. Notice that when right-clicking in the waveform a dotted horizontal line appear and a channel is highlighted in the channel column. This points to which trace will be modified.
Add Bar	Add a bar; see chapter 4.27.1.

Reposition

A-bar	Reposition the A-bar to the cursor location. Hot Key: SHIFT + A.
B-bar	Reposition the B-bar to the cursor location. Hot Key: SHIFT + B.
Ds-bar	Reposition the Ds-bar to the cursor location (available when Active Range is enabled).
Dp-bar	Reposition the Dp-bar to the cursor location (available when Active Range is enabled).
More Bars	Reposition other bars to the cursor location, including new added bars.
Trace Type	
Square	Display traces with vertical edges; this is the default option.
Saw tooth	Display traces with gradually ascending/descending edges.
Packet Name	Display abbreviated (initials) or full packet name.
Find Pulse-width	Find the pulse-width of a signal.

Table 4-41 Waveform area; right-click menu description

Figure 4-59 is shown when the user right-clicks in the Channel Column in Waveform View.

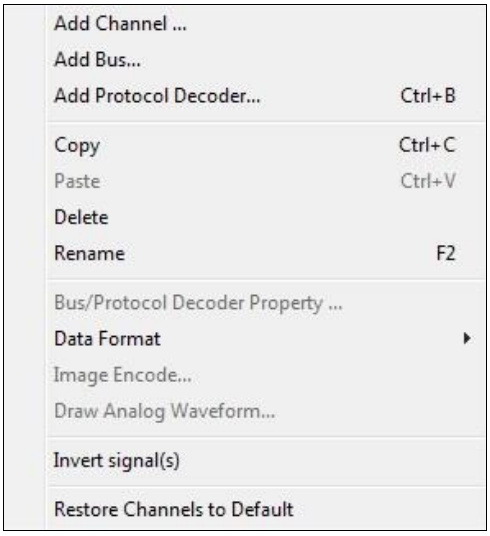

Figure 4-59 Channel/Bus column; right-click menu

Item	Description
Add Element	
Add Channel	Add a channel; see chapter 4.14.
Add Bus	Add a bus; see chapter 4.15.

Add Protocol Decoder	Add a protocol decoder; see chapter 4.16.
Clipboard / Format	
Copy	Copy the selected channel or bus. Left-click with the mouse can be combined with pressing and holding SHIFT to select several channels or with CTRL to select a range of channels. Hot Key: CTRL + C.
Paste	Paste the copied channel(s) or bus(es). Hot Key: CTRL + V.
Delete	Delete the selected channel(s) or bus(es). Hot Key: DELETE.
Rename	Rename the selected channel or bus. This option is not available when multiple channels or buses are selected. Hot Key: F2.
Functions	
Bus/Protocol Decoder Properties	Access the bus or protocol decoder properties; see chapter 4.15 and 4.16. This item is only available when right-clicking on a bus and which menu is opened depends on whether a protocol decoder is assigned or not to the bus.
Numeric Base / Encoding	Change the data format; see chapter 4.55.
Draw Analog Waveform	Draw an analog waveform to indicate the change of state; see chapter 4.34.
Invert	For traces, display high levels as low and vice versa. Inverted traces are drawn with dotted lines and a horizontal, blue bar is shown above the channel name. All channels can be inverted independently. See Figure 4-60.
Restore Channels to Default	Restore all Bus/Channels settings to default.

Table 4-42 Channel column; right-click menu description

NOTE Move the cursor to the bottom line of channel, the cursor will turn into an icon showing a two-sided arrow cut horizontally by a bar. Click and hold the left key and drag to adjust the height of trace.

Figure 4-60 shows an inverted signal. Note that the trace has become dotted and that a blue bar appears above the channel name (A3).

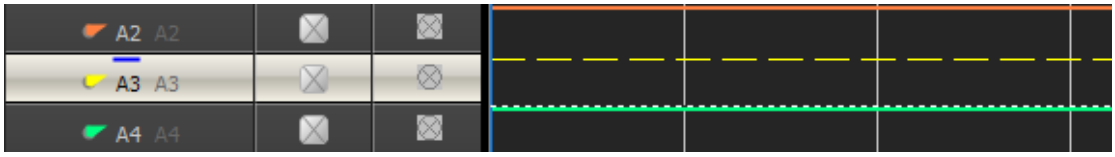

Figure 4-60 Signal inversion example; signal A3 is inverted

When right-clicking in the trigger column, the menu from Figure 4-61 is shown. The menu is used to set the channel's trigger condition as an alternative to clicking through the trigger box for the right condition.

Figure 4-61 Trigger colum; right-click menu

Item	Description
Indifferent	No trigger condition.
High	Trigger on a high level, i.e. the state of the signal is 1.
Low	Trigger on a low level, i.e. the state of the signal is 0.
Rising Edge	Trigger on a change of state of the signal from 0 to 1 (low to high).
Falling Edge	Trigger on a change of state of the signal from 1 to 0 (high to low).
Either Edge	Trigger on a change of state of the signal; either from 0 to 1 (low to high) or from 1 to 0 (high to low).
Default	Reset the trigger conditions of all channels.

Table 4-43 Trigger column; right-click menu description

When right-clicking in the trigger column, the menu from Figure 4-62 is shown.

Figure 4-62 Bar; right-click menu

Item	Description
Set As Trigger Condition	Set the trigger condition of each channel to equal the state (or edge) of the channel where the selected bar is located.
Delete Bar	Delete the selected bar.
Delete All Added Bars	Delete all added bars.
Edit Bar Comments	For user-added bars: Add a comment after the bar name. Ex: Add START to bar A2 to display the name as A2 (START). Comments can be maximum 10 characters long.

Table 4-44 Bar; right-click menu description

NOTE The T-bar has no right–click menu.

NOTE The A-bar, B-bar, Ds-bar and Dp-bar cannot hold comments or be deleted.

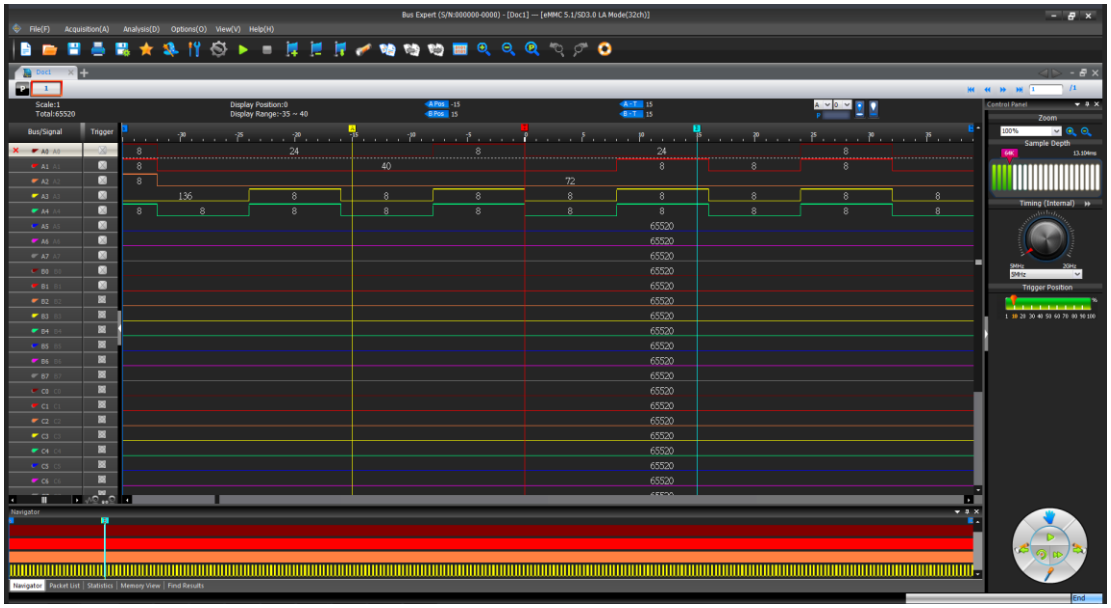

Figure 4-63 Example of trace formatting)

4.43.2. State List

State List is a numeric view of the samples. As an alternative to the waveform traces, the State List shows all samples as digits. If the logic state of a signal is low then “0” is shown and if it is high then “1” is shown. Unknown states are shown as “U”. Each column shows the samples of one channel and the leftmost column shows the sampling time. The State List view is shown in Figure 4-64.

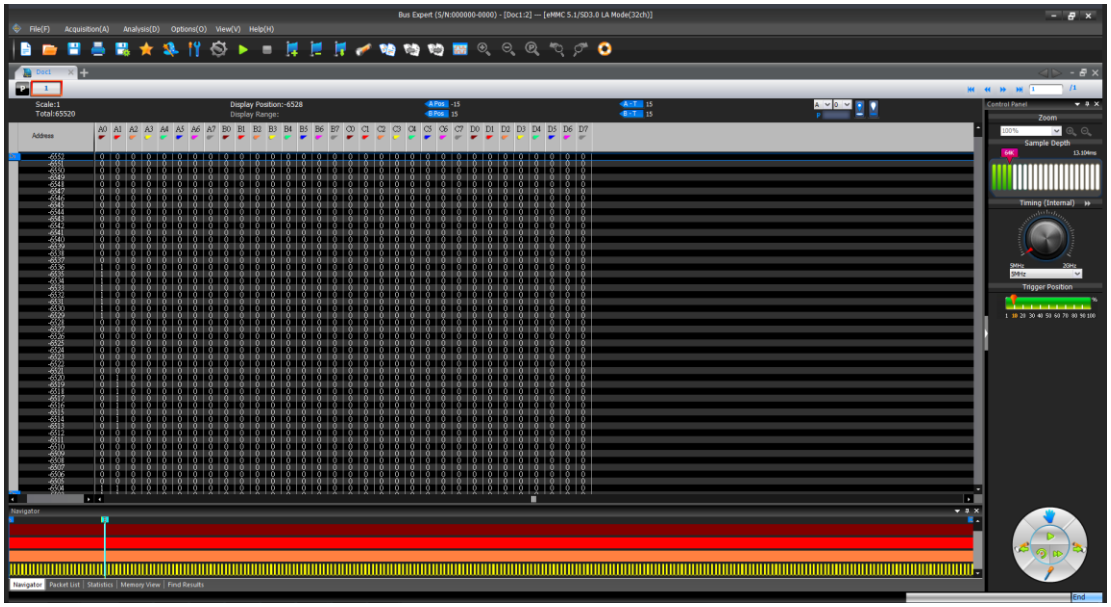

Figure 4-64 State List view

Note that there are three main presentations of the samples in the State List. One option is to show all samples. Alternatively, the user can select to display only those samples that include at least one change of state or in data. Table 4-45 shows an example of how this works: Samples #1, #2 and #3 are shown if the user views all samples. If the user chooses to show changes in state only then Sample #2 will be hidden, as all channel states are identical to those of sample #1. The purpose of showing samples with changes in state only is to facilitate observation by reducing the quantity of displayed data. Likewise, the user can choose to only show samples where there has been a change in the data; see an example of this in Figure 4-66.

NOTE No view mode will delete samples, only hide them.

Timestamp		ch. A1	ch. A2	ch. A3	ch. A4
0 ns	(sample #1)	1	1	1	1
5 ns	(sample #2)	1	1	1	1
10 ns	(sample #3)	1	0	1	1

Table 4-45 State List example; change of channel state

These presentation modes can be selected from by right-clicking in the State List number area; see Figure 4-65.

Figure 4-65 State List view; right-click menu in the number area

Item	Description
Add Bar	Add a new bar to mark a sample in the list. The bar is added to the line where the cursor is placed. Contrary to the waveform bars, bars in the State List are horizontal since each line represents a time stamp.
Reposition	
A-bar and B-bar	Reposition the A- or B-bar to the cursor position.

Ds- and Dp-bar	Reposition the Ds- or Dp-bar to the cursor position. This option is only available if “Active Range” has been activated.
More Bars	Reposition another bar to the cursor position.
Data Display	
All Data	All samples are shown; this is the default display mode.
Show changes in state only	Hide samples with timestamp X if no signal has changed state from timestamp X-1 to timestamp X.
Show changes in data only	Hide samples with timestamp X if no data has changed from timestamp X-1 to timestamp X (for buses only); see Figure 4-66.

Table 4-46 State List view; right-click menu in the number area

Figure 4-66 shows an example of the “Show changes in data only” function; had the function not been active there would have been tens of thousands of lines (one per sample) instead of twenty-something.

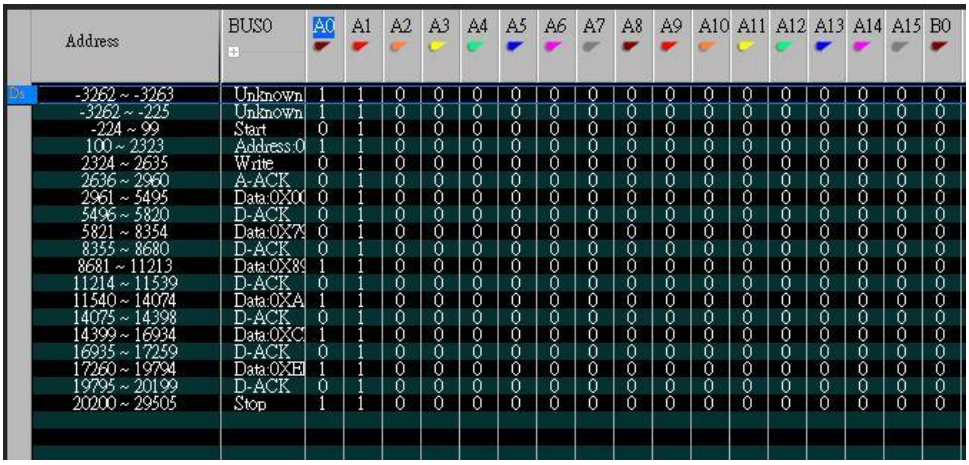

Figure 4-66 Show changes in data only example

In State List view, the menu from Figure 4-67 is shown when right-clicking in the channel row above the number area.

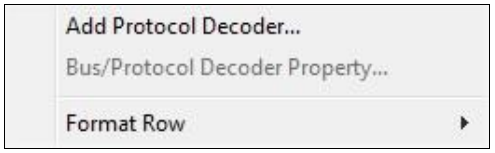

Figure 4-67 Channel/Bus (State List view); right-click menu

Item	Description
Add Protocol Decoder	Add a protocol decoder; see chapter 4.16.
Protocol Decoder Properties	Set the protocol decoder properties; see chapter 4.16. This menu item is only available when clicking on a bus.
Format Row	Change the channel order or resize the column widths.

Table 4-47 Channel/Bus (State List view); right-click menu description

4.44. Refresh

After the “Active Range” is activated, users can click it to refresh the selected data.

4.45. Zoom

Zooming can also be achieved using the mouse while holding CTRL; see chapter 4.42. Note also that all zoom functions are unavailable in the State List view.

4.45.1. In

Zoom in the waveform.

Hot Key: Z.

4.45.2. Out

Zoom out the waveform.

Hot Key: SHIFT + Z.

4.45.3. Fit to Screen

Show all data between Ds and Dp in the waveform view area.

Hot Key: CTRL + ALT + P.

4.45.4. Previous

Cancel the last zoom. In other words; go back to the previous zoom level.

Hot Key: CTRL + Z.

4.45.5. Cancel Previous

Undo the previous zoom command.

Hot Key: CTRL + Y.

4.46. Control Panel

The Control Panel provides direct access to important acquisition and triggering settings and thereby helps to speed up the user's interaction with Bus Expert. An example could be when the user wishes to redo a capture with a higher sample rate. The Control Panel is located in the rightmost part of the window estate.

See Figure 3-2 for the Control Panel right-click menu.

Item	Description
Zoom	Adjust the waveform zoom level; see chapter 4.45.
Memory depth	Select the memory depth per channel; see Table 4-16.
Sampling Mode	Adjust the sample rate by selecting a value from the pull down menu, inputting a value by hand or by dragging the pointer of knob. Click the grey, double arrows to switch between external and internal acquisition mode; see Table 4-16 for explanations of these.
Trigger Position	The trigger position determines which samples are stored. At 10%, 10% of the available memory is allocated to pre-trigger data and 90% to post-trigger data.
Action Wheel	See Figure 4-68 and Table 4-49.

Table 4-48 Control Panel description

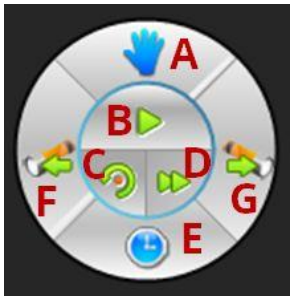

Figure 4-68 Action Wheel

#	Item	Description
A	Cursor type	Switch between cursor types Hand and Pointer; see chapter 4.42.
B	Single Capture	Capture once; see chapter 4.21.
C	Autocapture	BUS EXPERT II selects the optimal sample rate and samples; see chapter 4.24.
D	Repeated Capture	Capture on regular intervals; see chapter 4.22.
E	Trace information	Show information inside the traces (between two edges); see the available information types in Table 4-11. Note that there needs to be sufficient space between the edges for information to be shown. See Figure 4-69 as an example of times being displayed.
F	Previous	Center the display around the previous event that satisfies the Condition Set of the Find function.
G	Next	Center the display on the next event that satisfies the Condition Set of the Find function.

Table 4-49 Action Wheel description

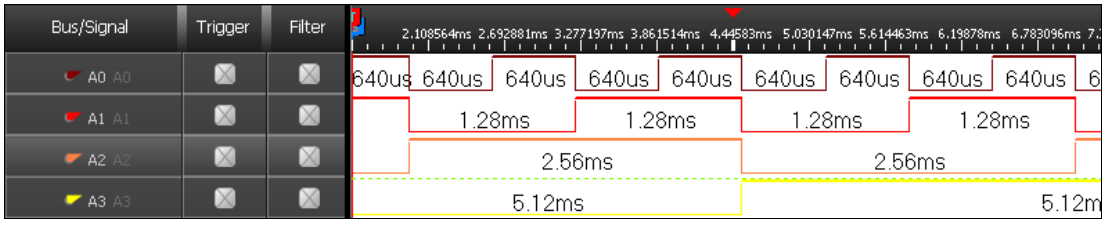

Figure 4-69 Time between two edges is displayed inside the traces

4.47. Memory View

Memory View lets users see what the memory looks like after the signals have been transmitted. By decomposing the packets into basic elements, the relationship between data and addresses in a protocol is clarified. The Memory View window is located in the Secondary Display Area.

Concretely, the Memory View window consist of tables that show which data have been read from- and written to which address in the memory. Write data are written in red; Read in blue; see an example of read data in Figure 3-1.

Two view modes can be accessed by right-clicking: Compact (default) and Full. The Compact Mode saves space as the information is presented in a matrix form; addresses are found by adding the column number/letter to the end of the row name, and the data located at that address is read directly from the intersection of the row/column.

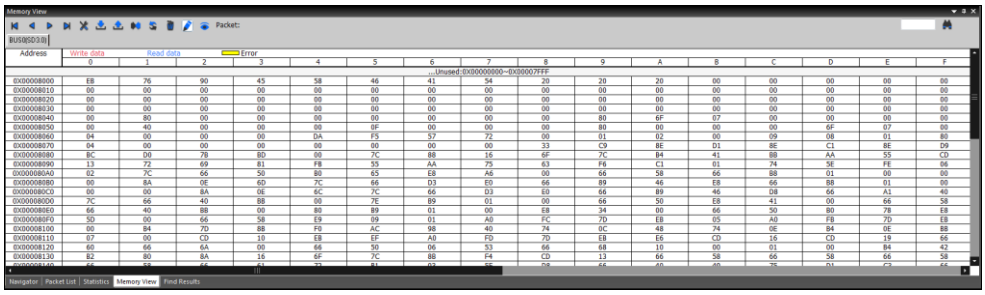

Figure 4-70 Memory View window

Item	Description
	Navigation buttons: Move between packets. The packet in focus will be in the middle of the waveform view area and marked by the reaction bar (A-bar by default). The packet data will be displayed in the Memory View window.
	Options; See Table 4-51.
	Import/Export/Merge: Users can import, export or merge .txt and .csv file for display in the Memory View or another software.
	Refresh.
	Reset: Delete the data in the Memory View window.

	Write Operation: The last written data will be shown in the cells as red text on white background. If there is incongruence between read and written data to the same address then errors will be shown on yellow background.
	Read Operation: The last read data will be shown in the cells as blue text on white background. If there is incongruence between read and written data to the same address then errors will be shown on yellow background.
Packet	Show the number of the packet where the reaction bar is located.
	Find: Input an address to look it up and highlight it with a blue frame.

Table 4-50 Memory view description

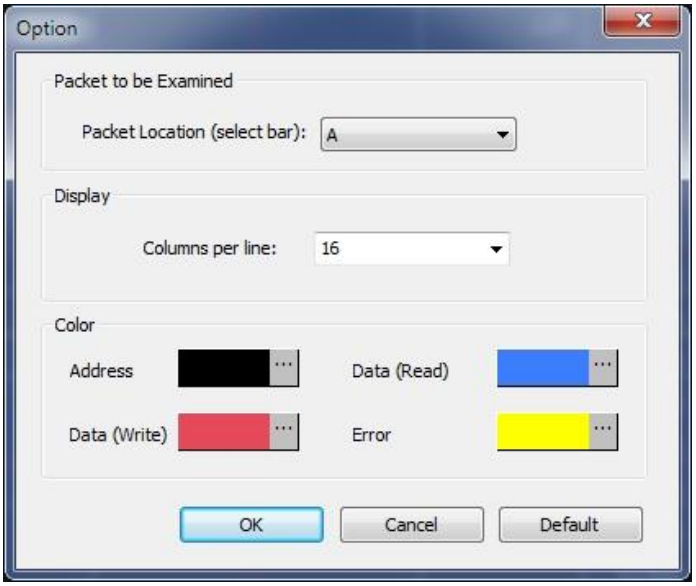

Figure 4-71 Memory View options dialog box

Item	Description
Packet Location	The Memory View will analyze the packet that is located under the selected bar; the A-bar is selected by default. Note that the Ds, Dp and T-bars cannot be chosen.
Columns per line	Choose how many cells to display per line. 4-100 is the permitted range; 16 is default.

Color	Change the color settings.

Table 4-51 Memory View options dialog box description

4.48. Navigator

The Navigator is a condensed form of the main waveform that is always zoomed to fit the entire capture of the pages in focus (see PageSize in Table 4-6). It facilitates waveform navigation by providing an overview of the entire acquisition and a tool for quick movement between distant parts of the acquisition. The Navigator is synchronized with the main waveform so users can shift the waveform focus from one part of the acquisition to another simply by clicking in the Navigator.

A light blue frame (in the left part of Figure 4-72) in the Navigator indicates which part of the waveform that is in focus; this frame naturally changes size when zooming as it is inverse proportional to the zoom rate. Four signals are shown at a time; scroll up or down to focus on other channels.

The Navigator is show by default under the waveform area in the Secondary Display area; see Figure 4-72.

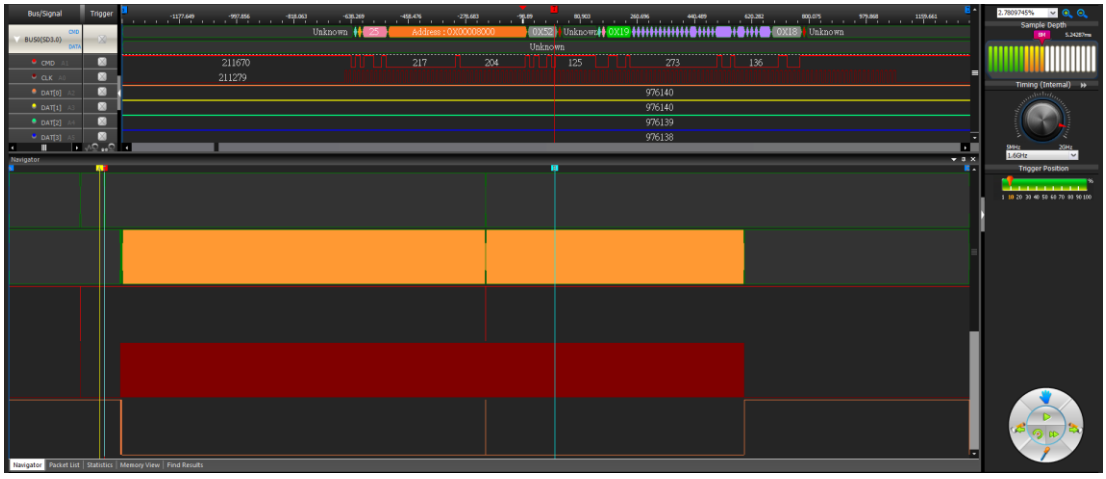

Figure 4-72 Navigator window example showing the eMMC protocol

4.49. Packet List

The Packet List shows all the acquired packets in their decomposed form. By presenting the packets in list form, the Packet List facilitates observation and analysis of all packets and their relation. Only packets under a protocol decoder can be displayed. The Packet List is located in the Secondary Display area; see Figure 4-73.

If packet in the Packet List is double-clicked, the waveform display focuses shifts focus to the location of that packet.

Figure 4-73 Packet List window example showing an SPI protocol

Item	Description
Menu Bar	
	Settings; Open the Packet List Settings dialog box; see Figure 4-74.
	Refresh the content.
	Export: Export the packet list; see chapter 4.7.1.
	Find particular packet.
	it would go to the 6th packet, it would be displayed at the top of packet list. it would be displayed the first packet of String at the top. For strings.
	Go to the previous or next packet that satisfies the Find condition.
Display Area	
Packet#	The packet number is given by Bus Expert and unrelated to the packet content.
Name	The packet name.

Time Stamp	The packet start point.
Data	The data in the packet.
Length	The length between the start point and the end point.

Table 4-52 Packet List Items description

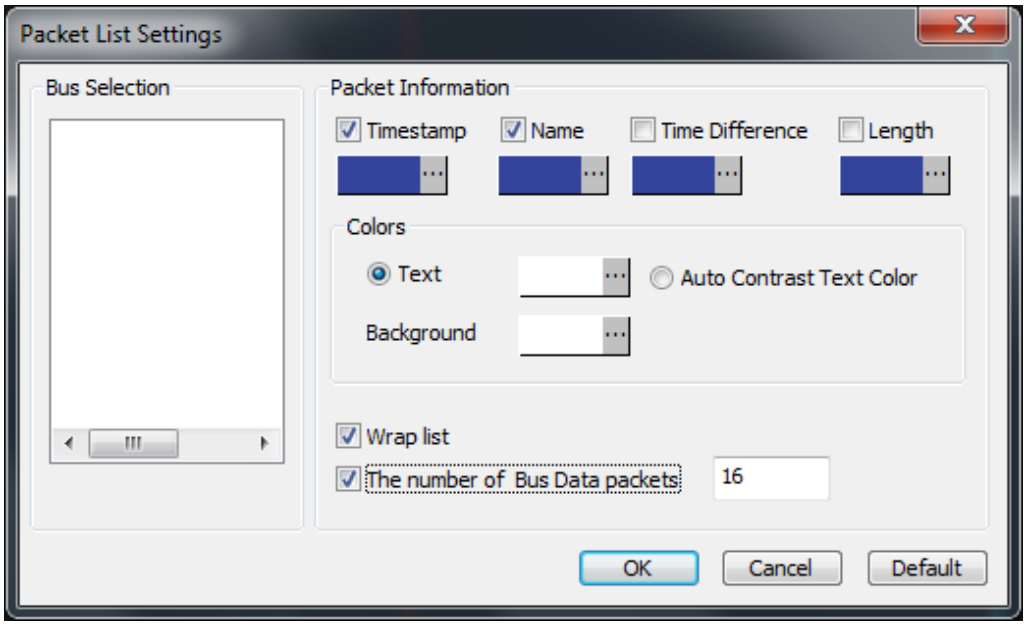

Figure 4-74 Packet List Settings

Item	Description
Bus Selection	Select the buses to be displayed; all are selected by default.
Packet Information	
Packet #	Select the items to be displayed and their colors.
Name	Include the names of the packets.
Timestamp	Packet timing; the first being defined as zero.
Time Difference	Time difference from packet X to packet X-1.
Colors	
Text	Change the text color; by default it's white.
Auto Contrast Text Color	Automatically select text colors that contrast their background colors.
Background	Change the Packet List background color.

Wrap list	If a packet contains too much data for all to be shown on one line, it is shown over two or more lines; selected by default.
Bytes of data per line	When Wrap List is enabled, select how much data to be shown per line (between 1 and 64); applies to Data only.

Table 4-53 Packet List Settings description

Figure 4-75 shows the menu that is shown when right-clicking in the Packet List.

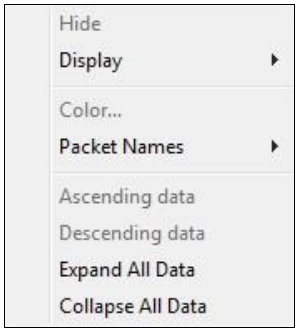

Figure 4-75 Packet List Right-click menu

Item	Description
Hide	Hide the current selection of packets.
Display	Display the hidden packets.
Color	Change the packet color.

Table 4-54 Packet List Right-click menu description

4.50. Statistics

Statistics Window is under the waveform view area after activated; it displays the quantity of positive and negative periods in a specific time range.

The Statistics window facilitates counting of signal transitions for each channel. Specifically, *Full-*, *Positive-* and *Negative periods* are all counted. *Conditional*

counters are also shown; these count all periods that are shorter or longer than a set of user defined conditions. Finally, it is also possible to adjust the data range, i.e. to only count activity within a certain range of the total acquisition.

The Statistics window is shown in Figure 4-76; it is open by default and located in the Secondary Display area.

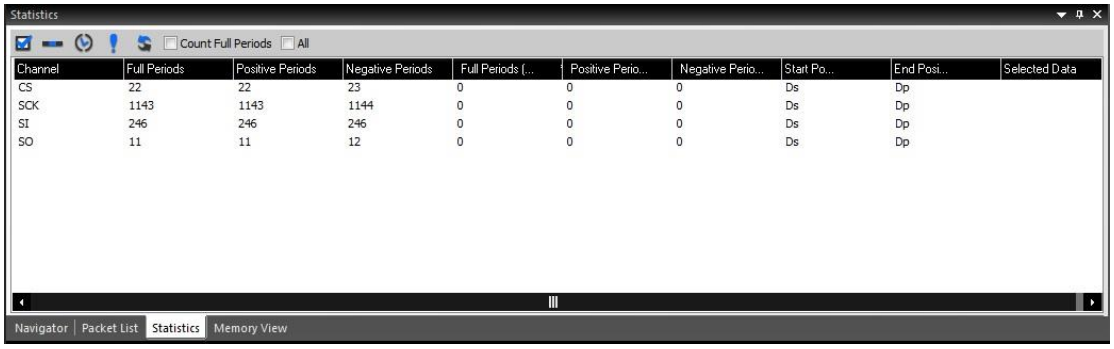

Figure 4-76 Statistics window

Item	Description
	Channel Selection; see the dialog box in Figure 4-77.
	Customize; decide which counters to show; except Probe (name) all parameters are selected by default; see the dialog box in Figure 4-78.
	Filter; only count periods that fit the filter conditions. This function is not activated by default; see the dialog box in Figure 4-79.
	Highlight signals; mark channels that don't fit the filter conditions in red; see the dialog box in Figure 4-80.
	Refresh; re-run the counters if there has been any change to the acquisition or the settings.
Count full periods only	Periods that don't have both a rising and a falling edge will not be counted.
All	Consider all the acquired data. This function requires the processing of temporary files; see chapter 4.6.

Table 4-55 Statistics window description

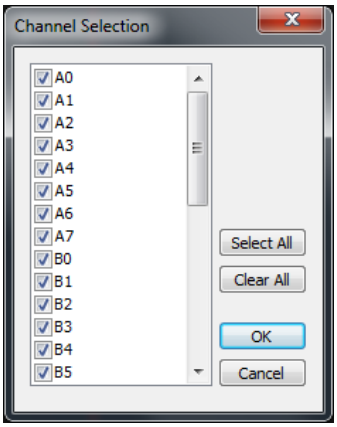

Figure 4-77 Statistics / Channel selection dialog box

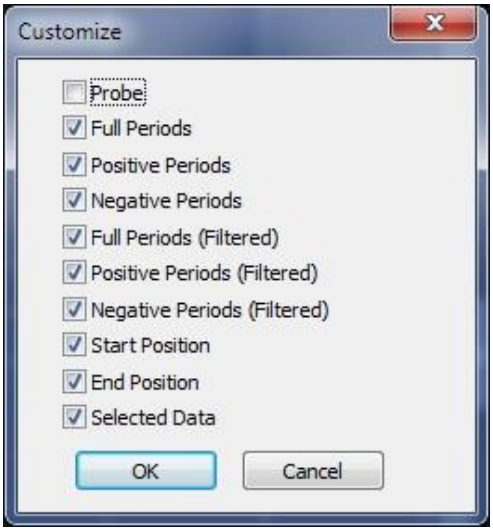

Figure 4-78 Statistics / Customize dialog box

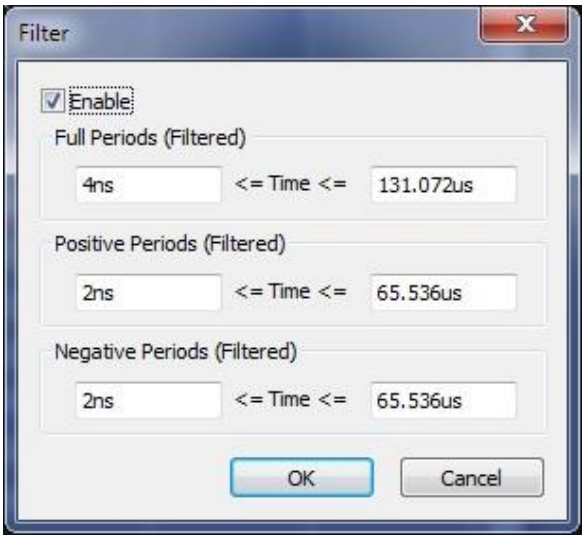

Figure 4-79 Statistics / Filter dialog box

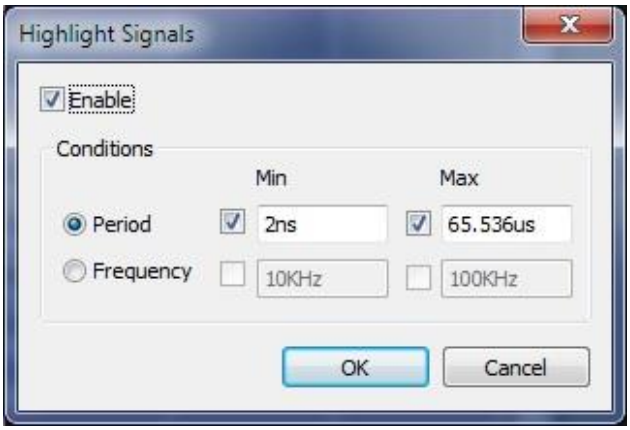

Figure 4-80 Statistics / Highlight signals dialog box

4.51. Find Results

The Find Results window lists all occurrences found in the document of the user-defined condition entered in the Find dialog box. Clicking on any of the results in the list will reposition the cursor in the waveform area at the location of the item. It is located in the Secondary Display area; see Figure 4-81.

Figure 4-81 Find Results window

Item	Description
Find	Opens the Find dialog box.
Find Pulse-width	Opens the Find Pulse-width dialog box.

Table 4-56 Find Results window description

4.52. Timing Bar

Figure 4-82 Timing Bar

Item	Description
Scale	The scale is the inverse of the zoom level.
Total	Total acquisition time.
Waveform Center	Location of the current center of the waveform.
Display Range	Timing information for the part of the waveform currently in view.
A Pos	The position of the A-bar; click to select another bar.
B Pos	The position of the B-bar; click to select another bar.
A - T	Time difference between the A and T-bars; click to select a different range.
B - T	Time difference between the B and T-bars; click to select a different range.
A 0	Select a bar.
P	Memory Page on which the bar is located.
	Go to the selected bar.
	Reposition the selected bar to the current center of the waveform area.

Table 4-57 Timing Bar description

4.53. Arrange Windows

The windows showing the files (as waveforms or as lists of states) can be moved around freely.

4.53.1. Horizontal

Display the open files above each other.

4.53.2. Vertical

Display the open files next to each other.

4.53.3. Reset Window Locations

Reset all windows to their default positions.

4.54. Split Screen

If more than one screen is connected to the computer Bus Expert is running on, users can choose to show Bus Expert on either one of the screens or on both.

4.54.1. Show on All

Show Bus Expert on both detected screens. The waveform area is amplified to show a larger part of the traces.

4.54.2. Show on Primary

Show Bus Expert on what is defined as the primary screen.

4.54.3. Show on Secondary

Show Bus Expert on what is defined as the secondary screen.

4.55. Numeric Base / Encoding

Users can choose among seven types of number systems and encodings for the displayed bus data; see Table 4-58. Hexadecimal is the default format.

Numeric base / Encoding	Description
Binary	Data are shown using the binary number system.
Decimal	Data are shown using the decimal number system.
Decimal (Signed)	Data are shown using the signed decimal number system; one bit (the first on the left) is used to specify the sign.
Hexadecimal	Data are shown using the hexadecimal number system.
ASCII	Data are encoded as ASCII characters; this only works for buses that comprise at least seven signals.
Gray Code	Data are encoded as Gray code.
Complement	Data are encoded as complements.

Table 4-58 Available data formats

Help

Press ALT + H to open this Main Menu item with the keyboard.

4.56. Menu Layout

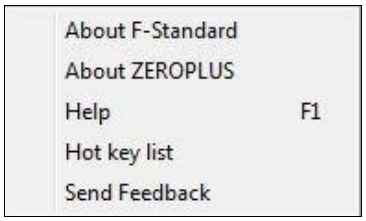

Figure 4-83 Help drop-down menu

4.57. About Bus Expert

The About Bus Expert window shows the software version, modification history, the instrument model, serial number and so on; see Figure 4-84. This window is almost identical to the information window shown the first time the Bus Expert is started.

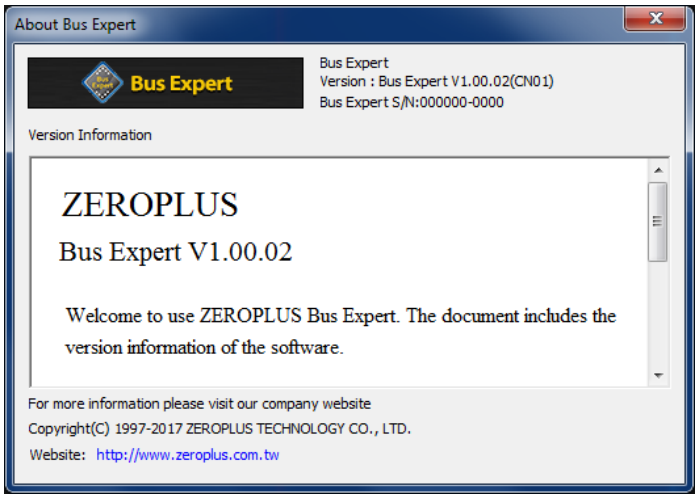

Figure 4-84 About Bus Expert information window

4.58. About Zeroplus

The About Zeroplus item on the menu takes the user to the Zeroplus website; this is opened in a new tab in the default web browser.

4.59. Help

Click the Help item to open the Help file. The Help file contains descriptions of the installation procedure and of menus and functions, answers to FAQs etc. It is contains a Search function to facilitate lookups.

Hot Key: F1.

4.60. Hot Keys

The Hot Keys item displays a list of all Hot Keys combinations. Hot Keys are keyboard combinations that the user can press to execute an action or a function without having to open a menu or use the mouse. Some Hot Keys require only a single keystroke.

Users can customize the Hot Keys in the Settings menu; see chapter 4.11.6 for descriptions of the dialog box fields.

Key combination	Description
CTRL＋N	Create a new file.
CTRL＋O	Open an existing file.
CTRL＋F4	Close the active file.
CTRL＋S	Save the active file.
CTRL＋ ↑	Open the previous file that shares the same path and name.
CTRL＋ ↓	Open the next file that shares the same path and name.
CTRL＋P	Print the active file.
CTRL＋Alt＋I	Print preview.
F5	Start acquisition.
CTRL＋F5	Open the Repeated Capture dialog box.

CTRL＋U	Increase the sample rate.
CTRL＋D	Decrease the sample rate.
CTRL＋F	Open the Find dialog box.
CTRL＋←	Go to the previous sample that meets the Find conditions.
CTRL＋→	Go to the next find sample that meets the Find conditions.
CTRL＋B	Open the Add Channel/Bus dialog box.
CTRL＋G	Open the Go To dialog box
Space	Switch cursor type.
Z	Zoom out.
SHIFT＋Z	Zoom in.
CTRL＋Alt＋P	Zoom to fit screen.
CTRL＋Z	Return to the previous zoom level.
CTRL＋Y	Cancel the last zoom.
F1	Open the Help file.
A	Center the waveform area around the A-bar.
B	Center the waveform area around the B-bar.
T	Center the waveform area around the T-bar.
SHIFT＋A	Move the A-bar to the center of the current view.
SHIFT＋B	Move the B-bar to the center of the current view.
SHIFT＋T	Center the waveform area around the T-bar.
CTRL＋Mouse Wheel	Zoom in/out.
←	Move the active bar to the left.
→	Move the active bar to the right.
↑	Move upwards in the channel list/waveform area.
↓	Move downwards in the channel list/waveform area.
CTRL＋Page Up	Go to the previous memory page.
CTRL＋Page Down	Go to the next memory page.
CTRL＋Home	Go to the first memory page.
CTRL＋End	Go to the last memory page.
Page Up	Move one waveform window to the right.
Page Down	Move one waveform window to the left.
Home	Go to the front end of the visible area.
End	Go to the tail end of the visible area.
CTRL＋C	Copy the selected item(s) in the channel area.

CTRL＋V	Paste the copied item(s) in the channel area.
Delete	Delete the selected item.
F2	Rename the selected item.
CTRL＋A	Select all channels.
Number Key	Center the waveform around the selected bar (for Added bars).
SHIFT＋Number Key	Move the corresponding bar to the center of the current view (for Added bars).
Esc	Cancel
Alt＋Letter with a baseline	Perform the menu command (or command of other baseline).
Mouse Wheel	Move left/right in the waveform.
Alt＋F4	Close Bus Expert.
Alt＋Space	Open the shortcut menu of the active window
CTRL＋Tab	Switch between open files
Alt＋Esc	Switch in the order of projects opened

Table 4-59 Hot Key descriptions

4.61. Send Feedback

The Send Feedback form can be used to contact our Technical Support if the user runs into a problem. Users are requested to provide contact information and a description of the problem. Attachments can also be uploaded; see Figure 4-85.

The benefit of using the Send Feedback form to contact the Technical Support is that data and information is automatically added to the communication: file information, instrument model, acquisitions settings, system parameters etc. This information makes it easier for the support team to get to the root of the problem and therefore improves response times.

Users who prefer to contact our Technical Support team by means of regular email should use the following address: service_2@zeroplus.com.tw

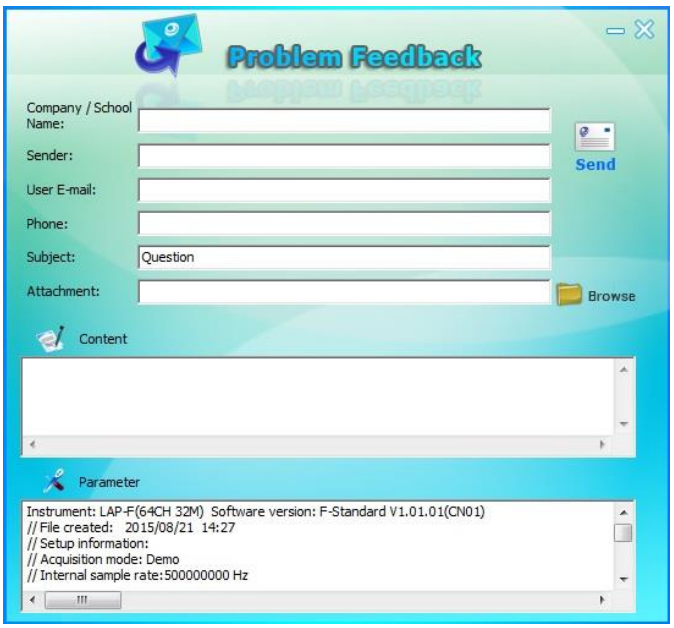

Figure 4-85 Send Feedback dialog box

Item	Description
Contact Information	
Company / School Name	Name of the senders company / institution
Sender	Name of the sender
User Email	Sender's email address
Phone	Sender's phone number
Subject	Sender's brief description of the issue.
Attachment	Relevant files, graphs etc can be attached to the form.
Content	Elaborate a written description of the issue.
Parameters	Bus Expert automatically adds information about the instrument type, acquisition settings etc. to the file to facilitate problem solving.

Table 4-60 Send Feedback dialog box description

5. Contact Us

Sales Department	
Email	service_1@zeroplus.com.tw
Phone	+886-2-6620-2225 extension #221 or #311

Table 5-1 Sales department contact info

Technical Support	
Email	service_2@zeroplus.com.tw
Phone	+886-2-6620-2225 extension #374

Table 5-2 Technical support contact info