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User Manual

Rev. 0.1, 06/2004

FREEMASTER

for Embedded Applications

MOTOROLA.COM/SEMICONDUCTORS

FreeMaster for Embedded Applications

User Manual — Rev. 0.1

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The following revision history table summarizes changes contained in this document. For your convenience, the page number designators have been linked to the appropriate location.

Revision history

Date	Description	Page Number(s)
Feb. 2002	Published as 56F800 SDK document SDK111/D	n/a
Jun. 2004	Updated for FreeMaster Application. Made as separate document.	n/a

Table of Contents

Section 1. INTRODUCTION

1.1 Overview

This User Manual describes the FreeMaster application (formerly known as PC Master) developed by Motorola/Freescale engineers to allow control of an embedded application from a graphical environment running on a PC. The application was initially created for developers of hard-real time motor control applications but many users found it very useful for their custom development.

The FreeMaster application is fully backward compatible with previous “PC Master” versions.

1.2 Supported Platforms

The PC-side FreeMaster application can be installed on any Microsoft Windows-based systems starting Windows 98. **Table 1-1** gives a brief summary of embedded-side “drivers” which implement the FreeMaster communication protocol.

Table 1-1. Supported Platforms

Device / Family	Software Package containing FreeMaster support
56F800/E	Metrowerks IDE / Processor Expert Embedded DSP Software Development Kit (SDK) 56F800_Quick_Start development tool 56F800E_Quick_Start development tool
HC08/HCS08	Stand alone implementation (Freescale Application Note AN2637)
HC12/HCS12	Stand alone implementation derived from HC08 code
MPC500	MPC500_Quick_Start development tool
MPC5500	MPC5500_Quick_Start development tool

1.3 FreeMaster Features

- Graphical environment
- Easy to understand navigation
- Simple RS232 connection
- Real-time access to embedded-side C variables
- Visualization of real-time data in Scope window
- Acquisition of fast data changes using on-target Recorder
- Built-in support for standard variable types (integer, floating point, bit fields)
- Value interpretation using custom defined text messages
- Several built-in transformations for real type variables
- Automatic C-application variable extraction from Metrowerks CodeWarrior output files (ELF/DWARF1/2, Map Files,...)
- Demo mode with password protection support
- HTML-based description or navigation pages
- ActiveX interface to enable VBScript or JScript control over embedded application
- Remote Communication Server enabling a connection to target board over a network, including the Internet

Features not available in free distribution

- Custom communication plug-in modules available for various physical media and protocol (CAN/CCP, JTAG, BDM)
- Matlab interface to the FreeMaster ActiveX object

1.4 License

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Section 2. QUESTIONS and ANSWERS

First question: why place this topic immediately after an introduction? The reason is really quite practical. While writing this User Manual, the following questions were raised. Since the answers to these questions clarified terms and topics described further in the manual, it was decided to put this topic before those that are more detailed and perhaps less easily understood.

2.1 Why do I need it?

The primary goal of developing FreeMaster software was to deliver a tool for debugging and demonstrating Motor Control algorithms and applications. The result was a tool with the versatility to be used for multipurpose algorithms and applications. Some real-world uses include:

- Real-Time debugging - FreeMaster allows users to debug applications in true real-time through its ability to watch variables. Moreover, it allows debugging at the algorithm level, which helps to shorten the development phase.
- Diagnostic tool - FreeMaster remote control capability allows it to be used as a diagnostic tool for debugging customer applications remotely across a network.
- Demonstrations - FreeMaster is an outstanding tool for demonstrating algorithm or application execution and variable outputs.
- Education - FreeMaster may be used for educational purposes. Its application control features allow students to play with the application in demonstration mode learning how to control program execution.

2.2 What does it do?

FreeMaster communicates with the target system application via serial communication to read and write application internal variables. FreeMaster provides the following visualization features for displaying variable information in a friendly format:

- Oscilloscope - provides monitoring/visualization of application variables in the same manner as a classical oscilloscope with CRT. In this case, monitoring rates are limited by the serial communication speed.
- Recorder - provides monitoring/visualization of application variables that are changing at a rate faster than the sampling rate of the oscilloscope. While the Scope periodically reads FreeMaster variable values and plots them in real-time, the Recorder is running on the target board. Variable values are sampled into a memory buffer on the board, then the sampled data is downloaded from board to FreeMaster. This mechanism allows a much shorter sampling period and enables sampling and plotting of very quick actions.

2.3 Why is it so great demonstration tool?

The embedded-side algorithm can be demonstrated in one block, or divided into several blocks, depending on which possibility better reflects the algorithm structure. Each block's input parameters may be explored to observe how they affect output parameters. Each block has a description tab for explaining algorithm details using multimedia-capable and scriptable HTML format.

2.4 What could I do with it if I follow the instructions?

Using the demo project included with the embedded-side implementation, it is easy to learn how to use FreeMaster by playing with the project's defined blocks and parameters. The demo project allows you to understand how to control the application as well. You can go into details of each item, check its properties, change parameters and determine how each can be used in your application. For a detailed explanation of the parameters, see **Section 4**.

2.5 How is it connected to a target development board?

FreeMaster requires a serial communication port on the target development hardware. Connection is made using a standard RS-232 serial cable. On one side, the cable is plugged into the PC serial port (COM1, COM2 or other) and, on the opposite side, into the target development board's serial connector.

In addition to RS232 link, the custom communication plug-in modules can be written and used by FreeMaster. As an option not included in the free distribution, the communication plug-ins are available e.g. for CAN Calibration Protocol, JTAG Real-time Data Exchange port on 56F800E, BDM interface on HCS08/12 devices etc.

2.6 What are all of these dialog boxes for?

In **Section 4**, you will see pictures with dialog boxes. These dialog boxes are used as a questionnaire, where you will enter parameters describing, for example, one algorithm block or application variable and its visualization.

2.7 How does a project relate to my application?

There can be many FreeMaster projects related to a single target-board application. For example, three specific FreeMaster projects can work with the same board application to provide three different purposes:

- to provide information used during debug process
- to provide service maintenance capabilities
- may be used for learning about your application during operator training phase

2.8 How do I set up remote control? Why would I want to?

For remote control, you need at least two computers connected via a network, one running the stand-alone mini-application called FreeMaster Remote Communication Server and the second running the standard FreeMaster application. The target development board is then connected to the computer running FreeMaster Server.

Remote control operation is valuable for performing remote debugging or diagnostics. An application may be diagnosed remotely by connecting the target development board to the remote PC and then running the FreeMaster locally with a service project for this customer's application.

2.9 What is the Watch-grid?

Watch-grid is one of the panes in FreeMaster application window. It shows selected application variables and their content in human readable format. The application variables displayed are selected separately in the block property settings of each project block.

2.10 What is the Recorder?

Recorder is created in software on the target development board and stores changes of variables in real-time. You can define the list of variables which will be recorded by the embedded-side timer periodic interrupt service routine. After the requested number of variable samples are stored within the Recorder buffer on the target board, it is downloaded from the board and displayed in FreeMaster Recorder pane as a graph. The main advantage of the Recorder is the ability to sample very fast actions.

2.11 What is the Oscilloscope?

FreeMaster Oscilloscope is similar to the classical hardware oscilloscope. It shows graphically selected variables in real-time. The variable values are read from the board application in real-time through the serial communication line. Oscilloscope GUI looks similar to the

Recorder, except that the sampling speed of variables is limited by the communication data link.

Section 3. INSTALLATION

3.1 System Requirements

The FreeMaster application can run on any computer with Microsoft Windows 98 or later operating system. Before installing, the Internet Explorer 4.0 or higher (5.5 is recommended) should be installed.

The following requirements result from those for the Internet Explorer 4.0 application:

Computer: 486DX/66 MHz or higher processor

Operating system: Microsoft Windows XP, Windows 2000, Windows NT4 with SP6, Windows 98

Required software: Internet Explorer 4.0 or higher installed. For selected features (e.g. regular expression-based parsing), Internet Explorer 5.5 or higher is required.

Hard drive space: 8 MB

Other hardware requirements: Mouse, serial RS-232 port for local control, network access for remote control

3.2 Enabling FreeMaster Connection on Target Application

To enable the FreeMaster connection to the target board application, follow the instructions provided with the embedded-side development tool. The recommended and fastest way to start using FreeMaster is by trying the sample application. Note that the sample application name may still refer the “PC Master” software, which is the previous name of the FreeMaster tool. FreeMaster is fully backward compatible with PC Master.

3.3 How to Install

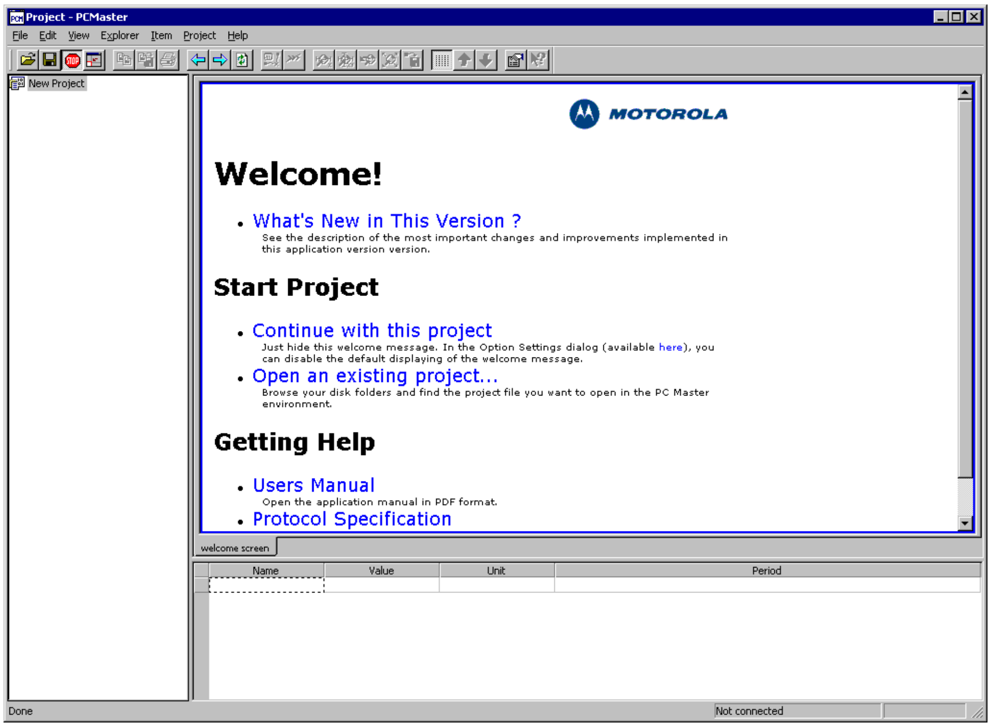
The FreeMaster application is distributed either as a part of bigger development tool (e.g. Metrowerks CodeWarrior) or as a stand-alone single-file self-extracting executable file. In the latter case, run the executable file and follow the instructions on the screen.

Section 4. FreeMaster USAGE

This chapter contains a detailed description of the user interface for the FreeMaster application.

4.1 Application Window Description

When the application is started, the main window is displayed on the screen. When there is no project loaded, the welcome page is displayed in the main pane of the window. The initial look of the main window is shown in **Figure 4-1**.



Welcome!

- What's New in This Version ?
  See the description of the most important changes and improvements implemented in this application version version.

Start Project

- Continue with this project
  Just hide this welcome message. In the Option Settings dialog (available here), you can disable the default displaying of the welcome message.
- Open an existing project...
  Browse your disk folders and find the project file you want to open in the PC Master environment.

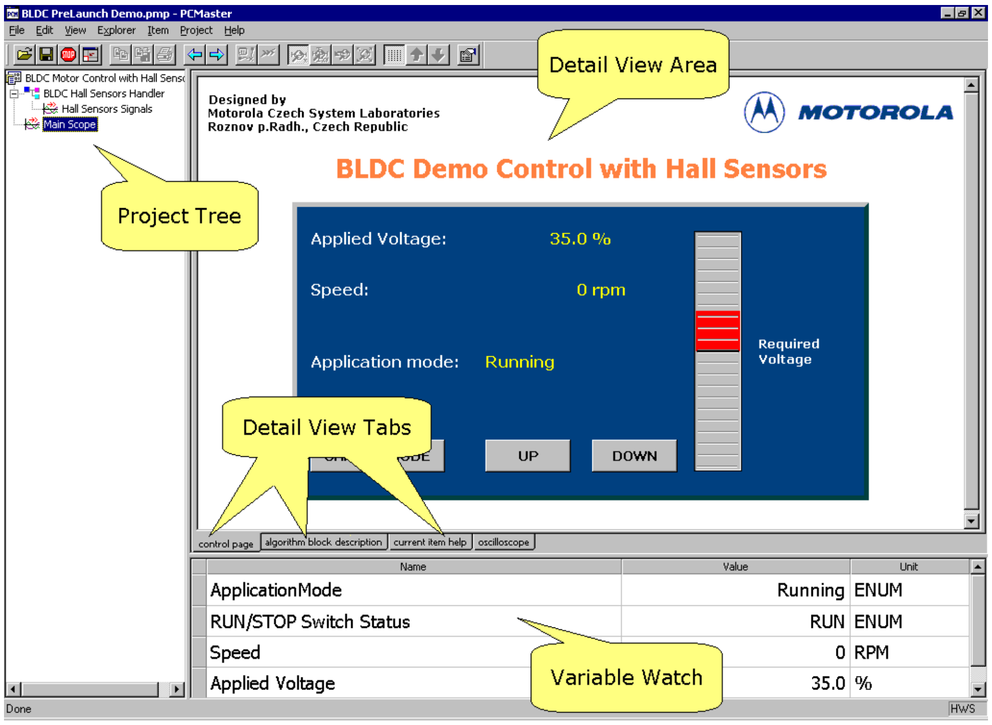
Getting Help

- Users Manual
  Open the application manual in PDF format.
- Protocol Specification

Figure 4-1. Initial Application Window

The welcome page contains links to the documentation and to the application help. There are also several other links corresponding to the standard menu commands (for example, the *Open project* command).

In the remaining part of this chapter, an application usage is demonstrated on an example of a motor control project. The FreeMaster project and the source code of the related embedded application, can be found in Motorola's Embedded Software Development Kit or in Motor Control library for MC56F800E_Quick_Start tool.



Designed by
Motorola Czech System Laboratories
Roznov p.Radh., Czech Republic

BLDC Demo Control with Hall Sensors

Applied Voltage: 35.0 %

Speed: 0 rpm

Application mode: Running

Name	Value	Unit
ApplicationMode	Running	ENUM
RUN/STOP Switch Status	RUN	ENUM
Speed	0	RPM
Applied Voltage	35.0	%

Figure 4-2. Application Window

As shown in **Figure 4-2**, the application window consists of three panes: the *Project Tree* pane, the *Detail View* pane and the *Variable Watch* pane. There is also the optional *Fast Access* pane, which can be displayed in the lower part of the *Project Tree* pane and is further described in **Section 4.5.3**.

The *Project Tree* pane contains a logical tree structure of the application being monitored/controlled. Users can add project sub-blocks, Scope, and Recorder definitions to the project block in a logical structure to form a *Project Tree*. This pane provides point and click selection of defined *Project Tree* elements.

The *Detail View* pane dynamically changes its content depending on the item selected in the *Project Tree*. Depending on the type of the item selected in the tree, this pane also provides several tabs to sub-pages of additional information associated with the item.

- *control page* = An HTML page created for controlling the target system
- *algorithm block description* = An HTML page or another document whose URL is defined in the selected *Project Tree* item's properties
- *current item help* = Another HTML document whose URL is defined in the Scope or Recorder properties.
- *oscilloscope* = A real-time graph displaying application variables as defined in the Scope properties
- *recorder* = A graph displaying recorded application variables as defined in the Recorder properties
- The *control page*, when defined, is available for all *Project Tree* items to allow the user to control the board at any time. The content of the *algorithm block description* page changes with the *Project Tree* item selected. When a Scope or Recorder is selected from the *Project Tree*, the *current item help* and *oscilloscope/recorder* chart pages are also available.

The *Variable Watch* pane contains the list of variables assigned to the watch. The pane displays the immediate variable values and also enables you to change them (if this is enabled in the variable definition).

All the information related to one application is stored in a single project file with the extension "*.pmp*". This information includes the project settings and options, the *Project Tree*, *Detail View* HTML pages, real-time chart definitions, watch interface settings, variables and commands, stimulators and more.

4.1.1 Project Tree

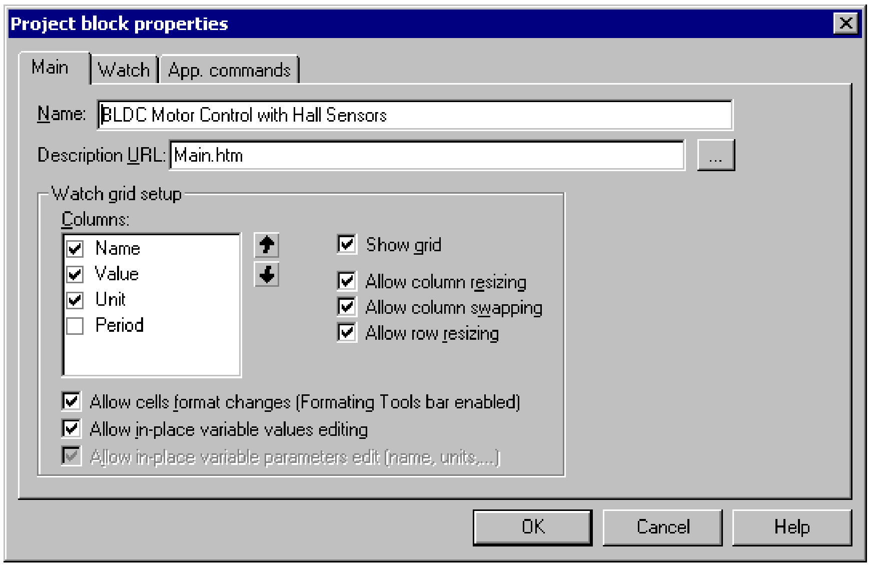
When a new project is created, the *Project Tree* window contains an empty structure with just one root project block called *"New Project"*. You can then change properties of this block or add sub-blocks, Scopes or Recorders to the structure.

Property changes and *Project Tree* additions can be done in two ways:

- Select an item in the *Project Tree* and right mouse click to use the local menu
- Select an item in the *Project Tree* and select main menu *"Item"* pull-down

4.1.1.1 Project Block and Sub-block

The *Project block* should cover an integral component of the selected algorithm. *Sub-blocks* may be added should the user care to break the algorithm into multiple blocks. Each block has its own *algorithm block description* page, (shown in **Figure 4-19**), watch variables and commands. All of these can be defined in the *Project block properties* dialog, as shown in **Figure 4-3**.



Name: BLDC Motor Control with Hall Sensors
Description URL: Main.htm

Watch grid setup
Columns:
[✓] Name
[✓] Value
[✓] Unit
[ ] Period

[✓] Show grid
[✓] Allow column resizing
[✓] Allow column swapping
[✓] Allow row resizing

[✓] Allow cells format changes (Formating Tools bar enabled)
[✓] Allow in-place variable values editing
[✓] Allow in-place variable parameters edit (name, units,...)

Figure 4-3. Project Block Properties - Main Page

The *Main* page contains the following user configuration items.

- *Name* = Name of Project block that will be displayed in the *Project Tree*
- *Description URL* = Select a description URL or .htm or .html file to be shown in the *Detail View* pane under the *algorithm block description* tab. This file may be created with any HTML editor such as MS Front Page Express or Netscape Composer.
- *Watch-Grid setup* = You can select columns to display in the Watch-Grid (Name, Value, Unit, Period); specify column order using the Up and Down arrow buttons; check the grid behavior options (column resizing/swapping, row resizing); allow format changes to grid cells with Toolbar (see **Section 4.6.2**) and edit in-place variable values by checking the next option boxes.

The *Watch* page shown in **Figure 4-4** selects which FreeMaster project variables are to be watched in the context of this project block.

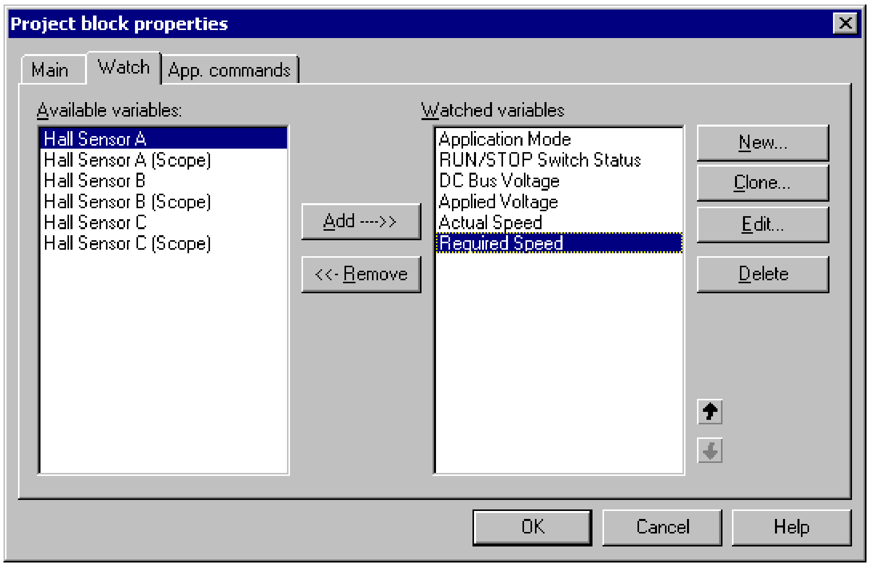


Figure 4-4. Project Block Properties - Watch Page

The variables in the *Watched variables* list are the project variables which are currently selected for watching in the Watch-Grid. The *Available variables* list contains the remaining available project variables not selected for watching with the current block item selected in the tree. You can use the following buttons:

- *Add/Remove* = Moves variables into and out of the *Watched variables* window
- *New* = Creates a new variable (see **Section 4.2**)
- *Clone* = Creates a new variable based on a copy of the selected variable
- *Edit* = Changes the selected variable properties
- *Delete* = Deletes the selected variable from the project
- *Up/Down arrows* = Sets the display order of the watched variables in the Watch-Grid

FreeMaster communicates with the board application by reading/writing variables and/or sending so called "application commands" (see **Section 4.3**). As the variable appearance in the Watch-Grid can be dependent on the block selected in the *Project Tree* pane, the availability of application commands can also be dependent on the selected block. The *App. commands* page, shown in **Figure 4-5**, sets which commands will be available in the *Fast Access* pane in the context of this project block and also enables the management of application commands.

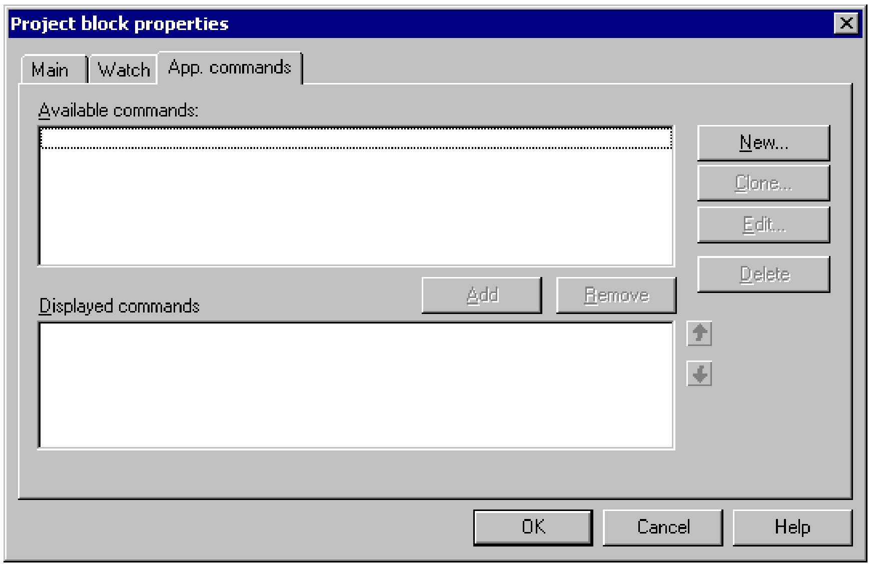


Figure 4-5. Project Block Properties - App. commands Page

The commands are listed in the *Available commands* window. Use the *Add* button to move a command into the *Displayed commands* window and to make it available in the *Fast Access* pane. Use the *Remove* button for reverse operation. You can use the following buttons:

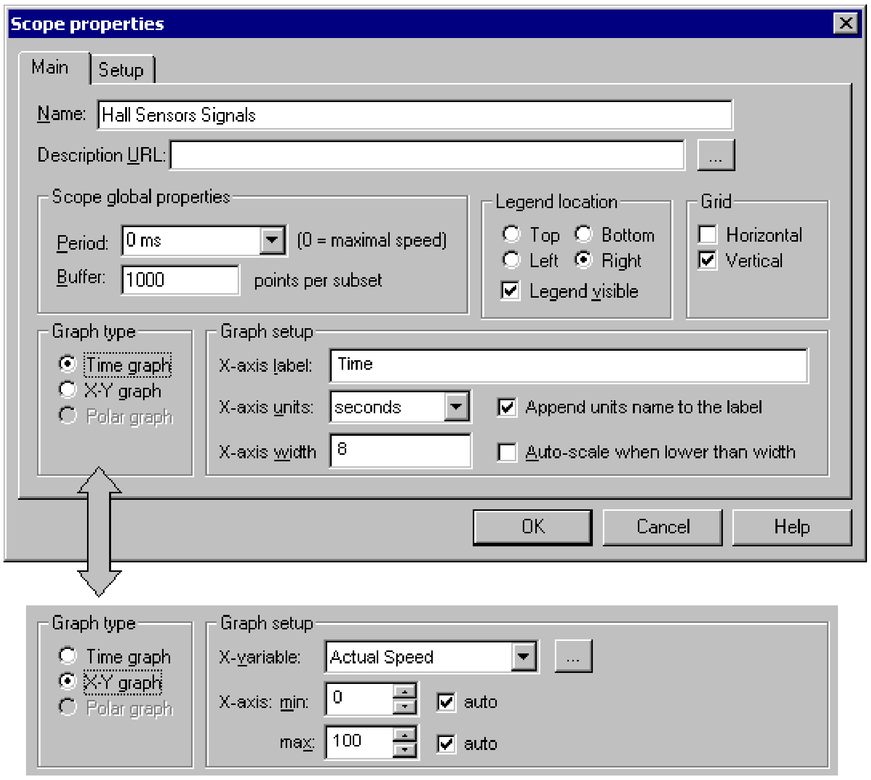
- *New* = Creates a new command (see **Section 4.3**)
- *Clone* = Creates a new command based on a copy of the selected command
- *Edit* = Changes the selected command properties
- *Delete* = Deletes the selected command
- *Up/Down arrows* = Sets the display order of commands in the *Fast Access* pane

4.1.1.2 Scope

The *Scope* item in the *Project Tree* structure defines a new real-time oscilloscope chart to be shown in the *Detail View* pane. The Scope properties window, shown in **Figure 4-6**, allows you to configure the appearance and characteristics of the scope chart.

The *Main* page contains these user configuration items:

- *Name* = The name of the Scope item that will be displayed in the *Project Tree*
- *Description URL* = Specify the URL of the document or local path to a file to be shown in the *Detail View* pane under the *current item help* tab. This file may be created with any HTML editor, such as MS Front Page Express or Netscape Composer, and should explain the chart variables and settings to the user.
- *Scope global properties* = Common properties for all scope variables
- *Period* = Oscilloscope sampling period
- *Buffer* = The number of samples in one data subset in the chart
- *Legend location* = Set the visibility and location of the chart legend


Scope properties

Main | Setup

Name: Hall Sensors Signals

Description URL:

Scope global properties
Period: 0 ms (0 = maximal speed)
Buffer: 1000 points per subset

Legend location
Top, Bottom, Left, [✓ Right]
[✓ Legend visible]

Grid
Horizontal
[✓ Vertical]

Graph type
[✓ Time graph]
X-Y graph
Polar graph

Graph setup
X-axis label: Time
X-axis units: seconds
[✓ Append units name to the label]
X-axis width 8
Auto-scale when lower than width

OK | Cancel | Help

Graph type
Time graph
[✓ X-Y graph]
Polar graph

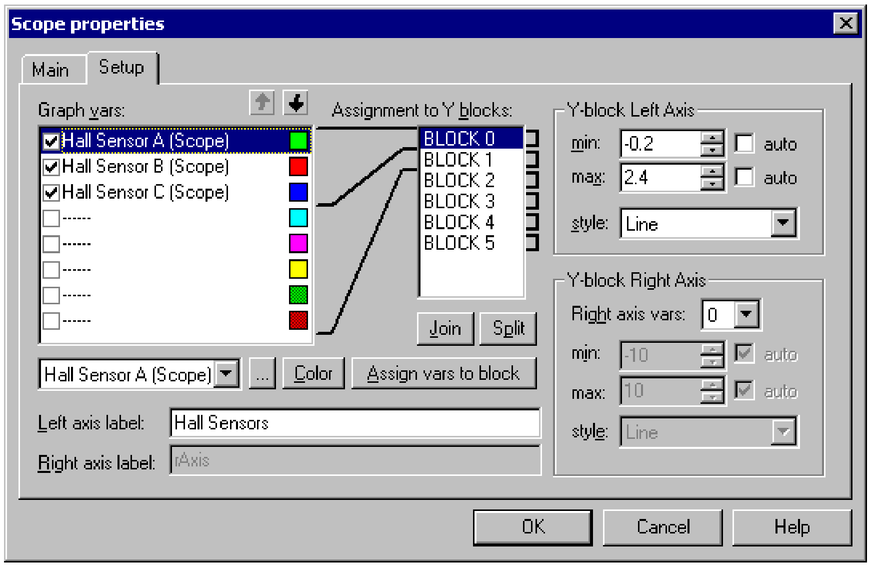
Graph setup
X-variable: Actual Speed
X-axis: min: 0 [✓ auto]
max: 100 [✓ auto]

Figure 4-6. Scope properties - Main Page

- *Grid* = Choose the horizontal and/or vertical grid lines to be displayed in the chart
- *Graph type* = Select the mode of oscilloscope operation
- *Time graph* = A variable (*values* versus *time)* will be displayed in the chart
- *X-Y graph* = Inter-variable dependencies (*value* versus *value*) will be displayed in the chart
- *Graph setup* (for *Time graph*):
- *X-axis label* = Specify the name displayed for the X axis
- *X-axis units* = Select the axis units
- *X-axis width* = Specify the range of the X axis

- *Auto-scale X axis until width is reached* = Scales the axis width after Scope start when the length of subset is shorter than the *X axis width*
- *Graph setup* (for *X-Y graph*):
- *X-variable* = Selects the variable whose values will be used for X axis values
- *X-axis min* = Sets the X axis lower limit value (checks the *auto* box to enable X axis auto-scaling)
- *X-axis max* = Sets the X axis upper limit value (checks the *auto* box to enable X axis auto-scaling)

The *Setup* page (**Figure 4-7**) is used to assign variables to be displayed on the oscilloscope chart. Up to eight *Chart vars* (seven in *X-Y* mode) may be selected for display in the chart and assigned to a maximum of five Y-blocks. Select one of eight positions and browse for a variable in the drop-down list below the list to set or change a variable at this position. Select the first (empty) item in the drop-down list to clear the selected position in the list. Each chart variable is assigned to a Y block.


Scope properties

Main | Setup

Graph vars:
- ☑ Hall Sensor A (Scope) 🟩
- ☑ Hall Sensor B (Scope) 🟥
- ☑ Hall Sensor C (Scope) 🟦
- ☐ ------
- ☐ ------
- ☐ ------
- ☐ ------
- ☐ ------

Assignment to Y blocks:
BLOCK 0
BLOCK 1
BLOCK 2
BLOCK 3
BLOCK 4
BLOCK 5

Y-block Left Axis
min: -0.2 ☐ auto
max: 2.4 ☐ auto
style: Line

Y-block Right Axis
Right axis vars: 0
min: -10 ☑ auto
max: 10 ☑ auto
style: Line

Hall Sensor A (Scope)
Left axis label: Hall Sensors
Right axis label: rAxis

Figure 4-7. Scope Properties - Set-up Page

The Y block is a graph element represented by one left Y axis and, optionally, one right Y axis also. The Y blocks can be drawn separately, or overlapped in the graph.

- *Assign vars to block* button = Assigns successive selected *Chart vars* to a Y block. Select the chart variables you want to group into one Y block and press this button. The simple assignment of three variables into single Y block is shown in **Figure 4-7**.
- In the *Y-block Left axis* frame, set the axis range by specifying the *min* and *max* axis value, or check *auto* box to enable automatic minimum and/or maximum tracking. Select a *Style* of drawing the data subsets from the drop-down list box.
- Type the *Left axis label*, which will be assigned to a selected Y-block.

The resulting oscilloscope chart is displayed in **Figure 4-8**.

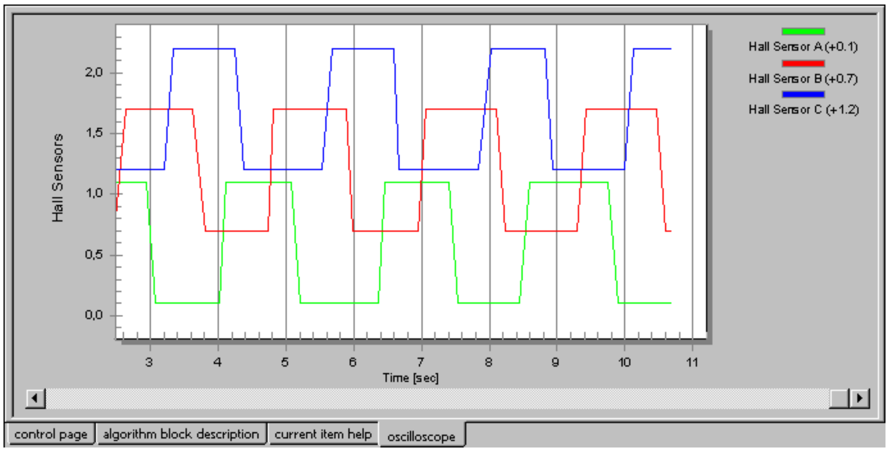
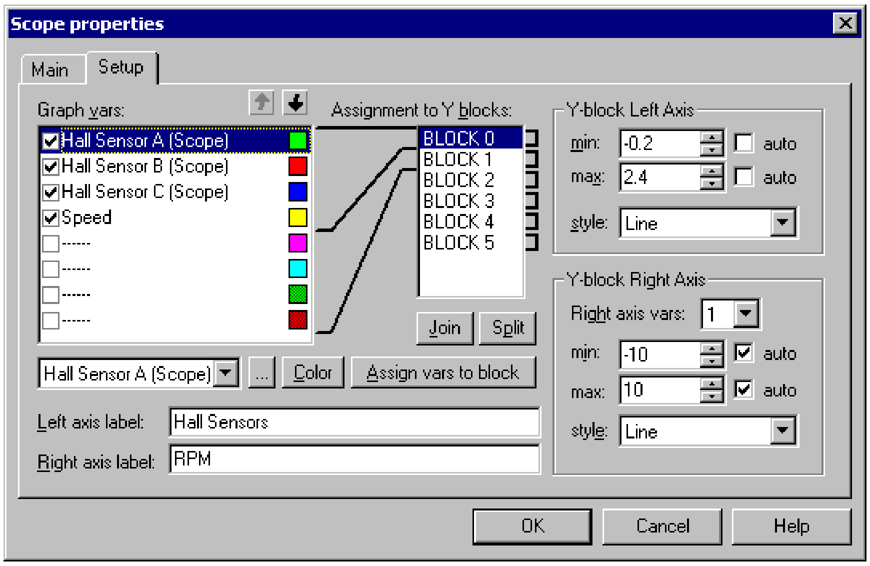


Figure 4-8. Basic Oscilloscope Chart

- To define a separate *Right axis* for the selected Y-block, select the number of *Right axis vars* that will use the right axis within the Y-block. The value of *Right axis vars* specifies the number of variables (counting from the bottom of the *Chart vars* list) that are assigned to the right axis within the Y-block.
- As with *Left axis*, specify *min*, *max, style* and *axis label* for the right axis in the selected Y block.

In **Figure 4-9**, we added the fourth variable to the Y-block and set *Right axis vars* to one. This means that the added variable (*Speed*) will be assigned to the Right axis labeled *RPM*.



Scope properties

Main | Setup

Graph vars:
- ☑ Hall Sensor A (Scope) 🟩
- ☑ Hall Sensor B (Scope) 🟥
- ☑ Hall Sensor C (Scope) 🟦
- ☑ Speed 🟨
- ☐ ------
- ☐ ------
- ☐ ------
- ☐ ------

Assignment to Y blocks: BLOCK 0, BLOCK 1, BLOCK 2, BLOCK 3, BLOCK 4, BLOCK 5

Join | Split

Hall Sensor A (Scope) | ... | Color | Assign vars to block

Left axis label: Hall Sensors

Right axis label: RPM

Y-block Left Axis
- min: -0.2 ☐ auto
- max: 2.4 ☐ auto
- style: Line

Y-block Right Axis
- Right axis vars: 1
- min: -10 ☑ auto
- max: 10 ☑ auto
- style: Line

OK | Cancel | Help

Figure 4-9. Fourth Variable Added

The resulting chart is displayed in **Figure 4-10**

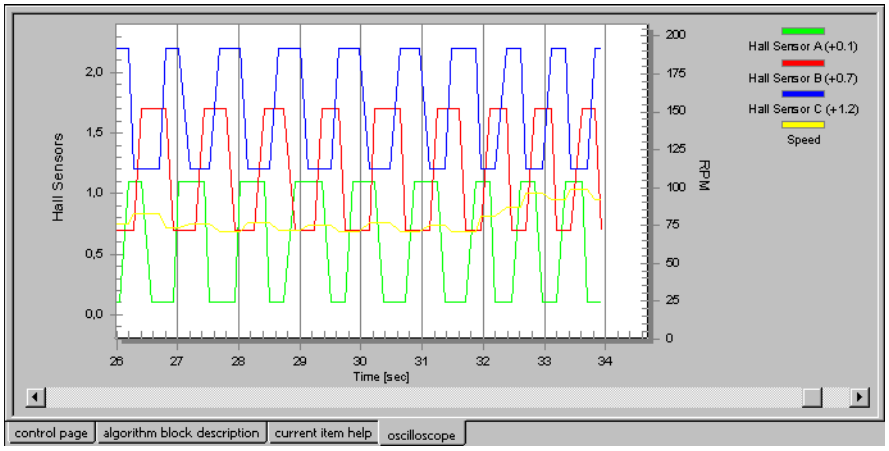
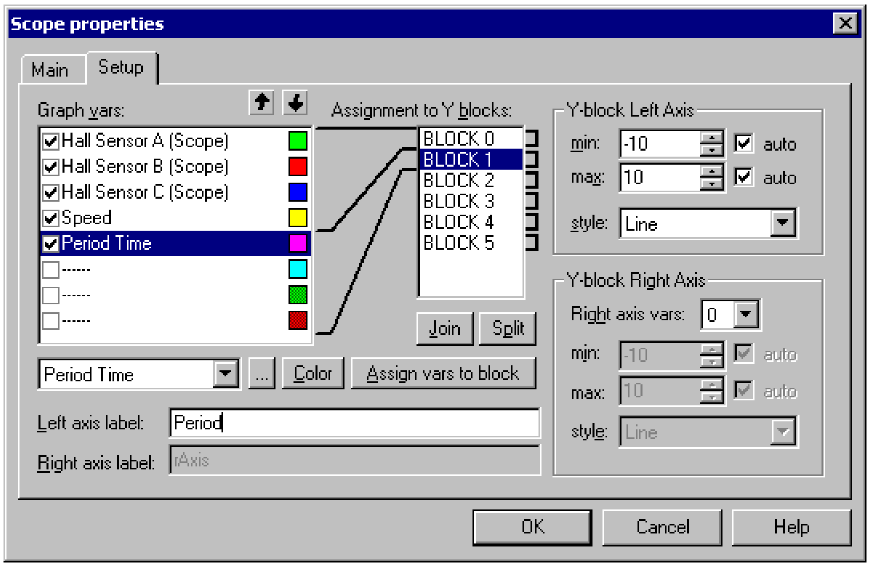


Figure 4-10. Resulting Oscilloscope Chart

Figure 4-11 shows the addition of a fifth variable, *Period Time*, put into a separate Y-block.


Scope properties

Main | Setup

Graph vars:
- ✓ Hall Sensor A (Scope) 🟩
- ✓ Hall Sensor B (Scope) 🟥
- ✓ Hall Sensor C (Scope) 🟦
- ✓ Speed 🟨
- ✓ Period Time 🟪
- ------
- ------
- ------

Assignment to Y blocks: BLOCK 0, BLOCK 1, BLOCK 2, BLOCK 3, BLOCK 4, BLOCK 5

Join | Split

Period Time | ... | Color | Assign vars to block

Left axis label: Period

Right axis label: rAxis

Y-block Left Axis
- min: -10 ✓ auto
- max: 10 ✓ auto
- style: Line

Y-block Right Axis
- Right axis vars: 0
- min: -10 ✓ auto
- max: 10 ✓ auto
- style: Line

OK | Cancel | Help

Figure 4-11. Fifth Variable Added in Separate Y-block

The resulting chart is displayed in **Figure 4-12**

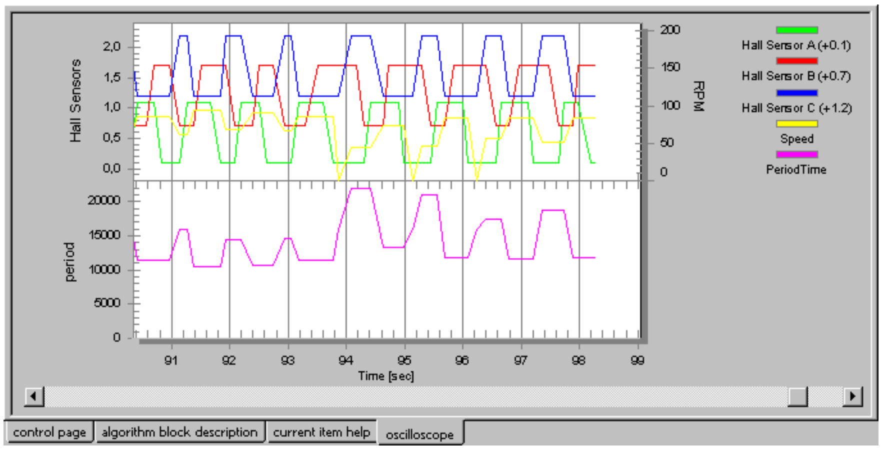
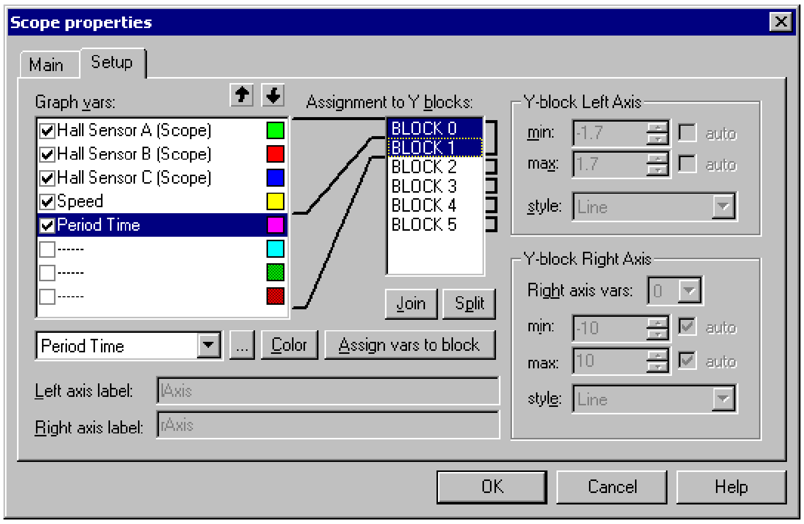


Figure 4-12. Resulting Oscilloscope Chart

- *Join* button = Several successive Y-blocks can be joined and set to be overlapped. The overlapped blocks then behave as a block with multiple left axes and, optionally, multiple right axes as well.

Figure 4-13 shows the joining of two Y-blocks defined in previous examples.



Scope properties

Main | Setup

Graph vars:
- [✓] Hall Sensor A (Scope) 🟩
- [✓] Hall Sensor B (Scope) 🟥
- [✓] Hall Sensor C (Scope) 🟦
- [✓] Speed 🟨
- [✓] Period Time 🟪
- [ ] ------
- [ ] ------
- [ ] ------

Assignment to Y blocks:
BLOCK 0
BLOCK 1
BLOCK 2
BLOCK 3
BLOCK 4
BLOCK 5

Join | Split

Period Time | ... | Color | Assign vars to block

Left axis label: lAxis

Right axis label: rAxis

Y-block Left Axis
min: -1.7 [ ] auto
max: 1.7 [ ] auto
style: Line

Y-block Right Axis
Right axis vars: 0
min: -10 [✓] auto
max: 10 [✓] auto
style: Line

OK | Cancel | Help

Figure 4-13. Two Y-blocks Joined

Figure 4-14 displays the Oscilloscope Chart that resulted when Y-blocks were set to overlap.

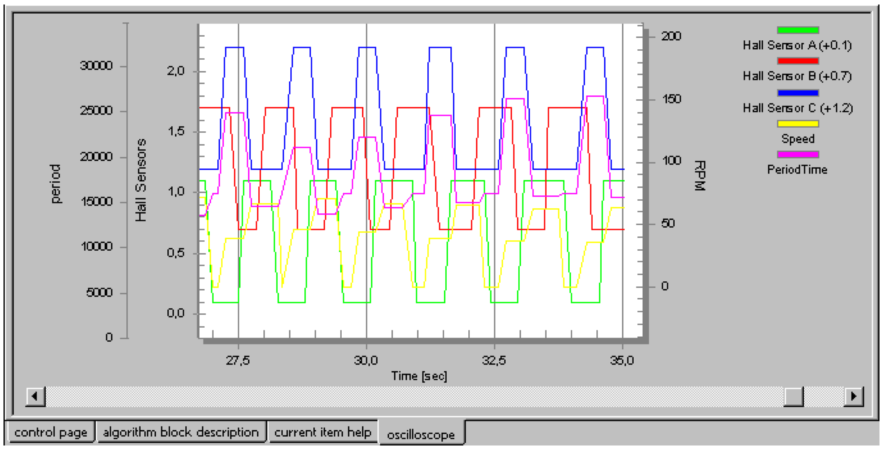
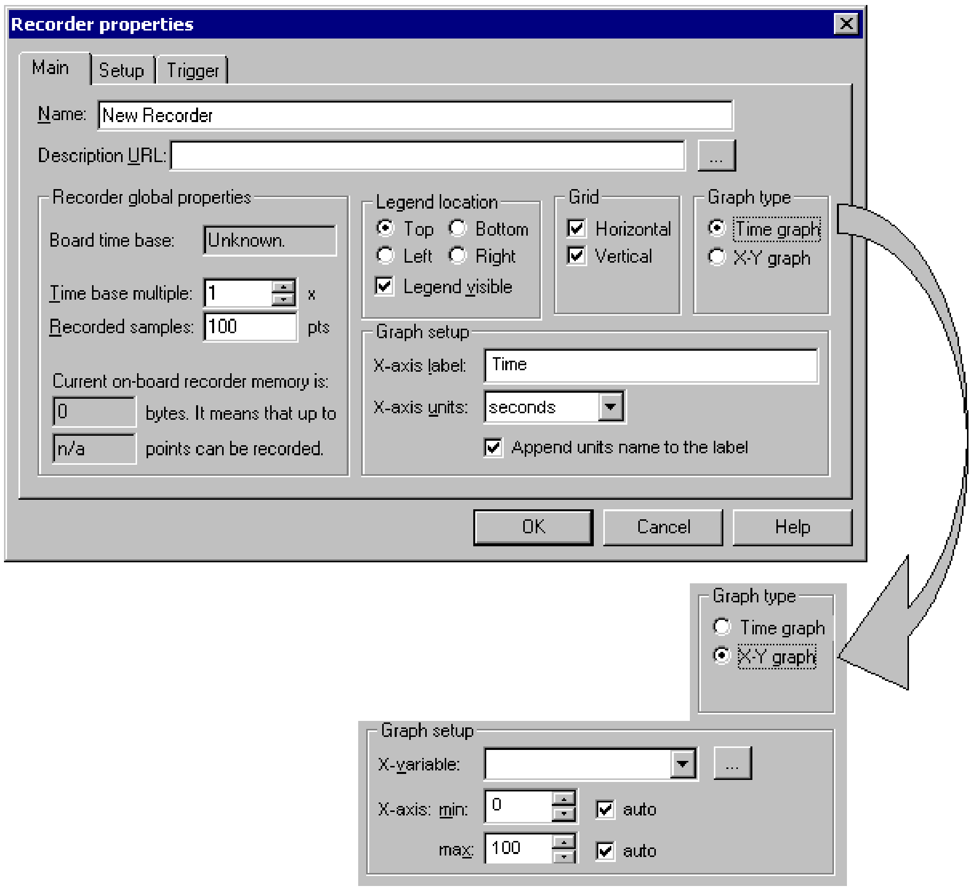


Figure 4-14. Resulting Oscilloscope Chart (Y-blocks Overlap)

4.1.1.3 Recorder

The *Recorder* item in the *Project Tree* structure defines a real-time recorder chart to be shown in the *Detail View* pane. While the Scope periodically reads variable values and plots them in real time, the Recorder is running on the target board, reads application variables, and sends them to the FreeMaster tool in a burst mode fashion. The recorder variables are continually sampled and stored into a circular buffer in the target board application. When the trigger event is detected by the target, data samples are counted until the number of *Recorder samples* is reached. At this point, data is sent to the FreeMaster application. This mechanism enables use of much shorter sampling period and enables sampling and plotting very quick actions.



Name: New Recorder
Description URL:
Recorder global properties
Board time base: Unknown.
Time base multiple: 1 x
Recorded samples: 100 pts
Current on-board recorder memory is: 0 bytes. It means that up to n/a points can be recorded.
Legend location: [✓ Top] Bottom Left Right
[✓ Legend visible]
Grid: [✓ Horizontal] [✓ Vertical]
Graph type: [✓ Time graph] X-Y graph
Graph setup
X-axis label: Time
X-axis units: seconds
[✓ Append units name to the label]

Graph type: Time graph [✓ X-Y graph]
Graph setup
X-variable:
X-axis: min: 0 [✓ auto]
max: 100 [✓ auto]

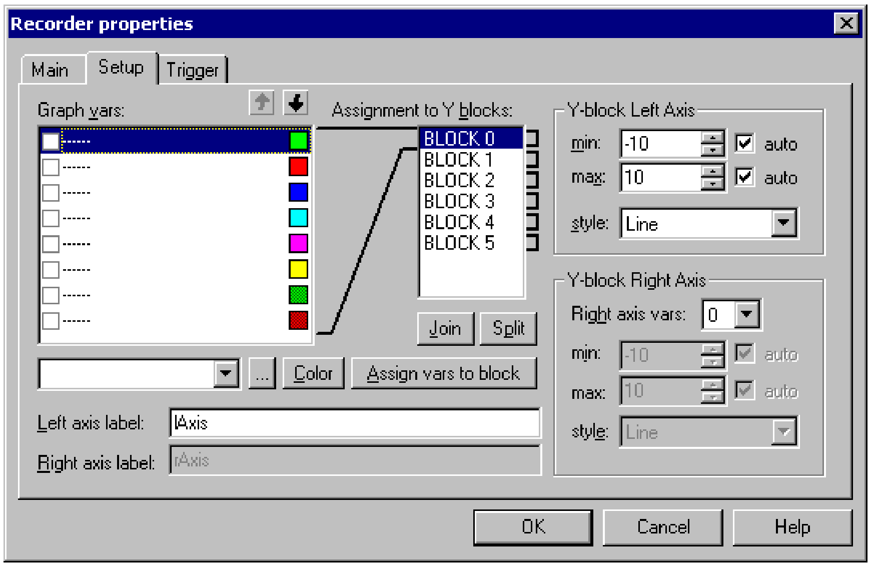
Figure 4-15. Recorder Properties - Main Page

The *Main* page contains the following user configuration items:

- *Name* = The name of the Recorder item that will be displayed in the *Project Tree*
- *Description URL* = Specify the document's URL or local path to a file to be shown in the *Detail View* pane under the *current item help* tab. This file may be created with any HTML editor, such as MS Front Page Express or Netscape Composer, and should explain the chart variables and settings to the user.
- *Recorder global properties* = Common properties for all Recorder variables
  - *Board time base* = A sampling period preset by the board application. In the SDK, the time base value can be adjusted by setting PC_MASTER_RECORDER_TIME_BASE in the *appconfig.h* file during the board application development.
  - *Time base multiple* = Sets an integer multiple of the time base to extend the sampling period used for recorder operation
  - *Recorded samples* = The number of samples buffered for one recorded subset
  - *On board recorder memory* = Displays the amount of on-board application memory allocated for recorder operation. Based on the memory size, recorded variables format, and the number of recorded variables, the maximum number of points which fit in the recorder's memory is calculated and displayed. The *Recorded samples* value set should be lower than this result.
- *Legend location* = Sets the visibility and location of the chart legend
- *Grid* = Chooses the horizontal and/or vertical grid lines to be displayed in the chart
- *Graph type* = Selects the mode of recorder operation
  - *Time graph* = A variable (*values* versus *time*) will be displayed in the chart
  - *X-Y graph* = Inter-variable dependencies (*value* versus *value*) will be displayed in the chart

- *Graph setup* (for *Time graph*):
  – *X-axis label* = Specify the name displayed for X axis
  – *X-axis units* = Selects the axis units
- *Graph setup* (for *X-Y graph*):
  – *X-variable* = Selects the variable whose values will be used for X axis values
  – *X-axis min* = Sets the lower limit value of the X axis (check the *auto* box to enable auto-scaling of the X axis)
  – *X-axis max* = Sets the upper limit value of the X axis (check the *auto* box to enable auto-scaling of the X axis)

The *Setup* page of the *Recorder properties* dialog, shown in **Figure 4-16**, looks exactly the same as the appropriate page of the *Scope properties* dialog. For more information about how to add variables to the recorder chart and how to set up the chart itself, see **Section 4.1.1.2**.



Y-block Left Axis: min: -10 [✓ auto]; max: 10 [✓ auto]; style: Line

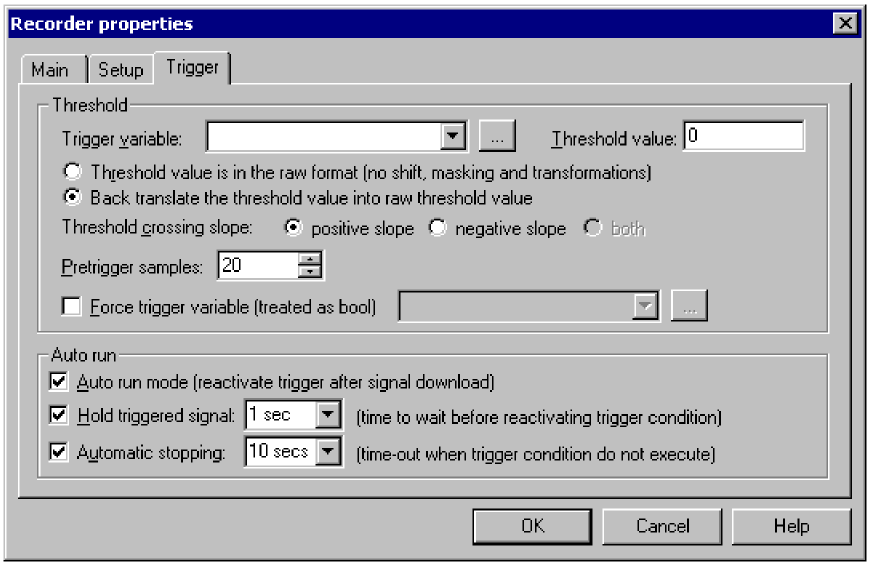
Y-block Right Axis: Right axis vars: 0; min: -10 [✓ auto]; max: 10 [✓ auto]; style: Line

Left axis label: lAxis

Right axis label: rAxis

Figure 4-16. Recorder Properties - Setup Page

The *Trigger* page, shown in **Figure 4-17**, defines the Recorder start conditions. The trigger starts the Recorder when the *Trigger variable* exceeds the specified *Threshold value* with the selected type of slope, (positive = rising edge or negative = falling edge).



Threshold
Trigger variable:
Threshold value: 0
Threshold value is in the raw format (no shift, masking and transformations)
[✓ Back translate the threshold value into raw threshold value]
Threshold crossing slope: [✓ positive slope] negative slope both
Pretrigger samples: 20
☐ Force trigger variable (treated as bool)

Auto run
☑ Auto run mode (reactivate trigger after signal download)
☑ Hold triggered signal: 1 sec (time to wait before reactivating trigger condition)
☑ Automatic stopping: 10 secs (time-out when trigger condition do not execute)

Figure 4-17. Recorder Properties - Trigger Page

- *Threshold* = Specify conditions for the trigger event
  - *Trigger variable* = Selects a variable to be tracked for the trigger event
  - *Threshold value* = The value of the variable being recorded that, when crossed, causes the trigger event. Specify a threshold value and select whether the value is in raw format (as in the board application) or whether it must be translated back into raw format (e.g., when a real-type transformation is defined for the variable and you want to apply an inverse transformation on the trigger value before it is set as threshold in the embedded application).
  - *Threshold crossing slope* = Selects the slope on which the threshold crossing is monitored
  - *Pretrigger samples* = Specify the number of samples to save and display prior to the trigger event

- *Auto run* = Specifies conditions for reactivating the trigger for repeated recording
  - *Auto run mode* = Select to enable repeated recording. After detecting the trigger event, filling the buffer and downloading the buffer data to FreeMaster, the trigger is automatically reactivated and new data is downloaded immediately after the next trigger event occurs.
  - *Hold triggered signal* = Check this box and specify how long to wait after one signal is displayed in the chart and before reactivating the trigger.
  - *Automatic stopping* = Check this box and specify the maximum time period for detecting the trigger event. If the event is not detected within the specified time, the sampling is unconditionally stopped, and actual buffer data is downloaded.

4.1.2 Detail View

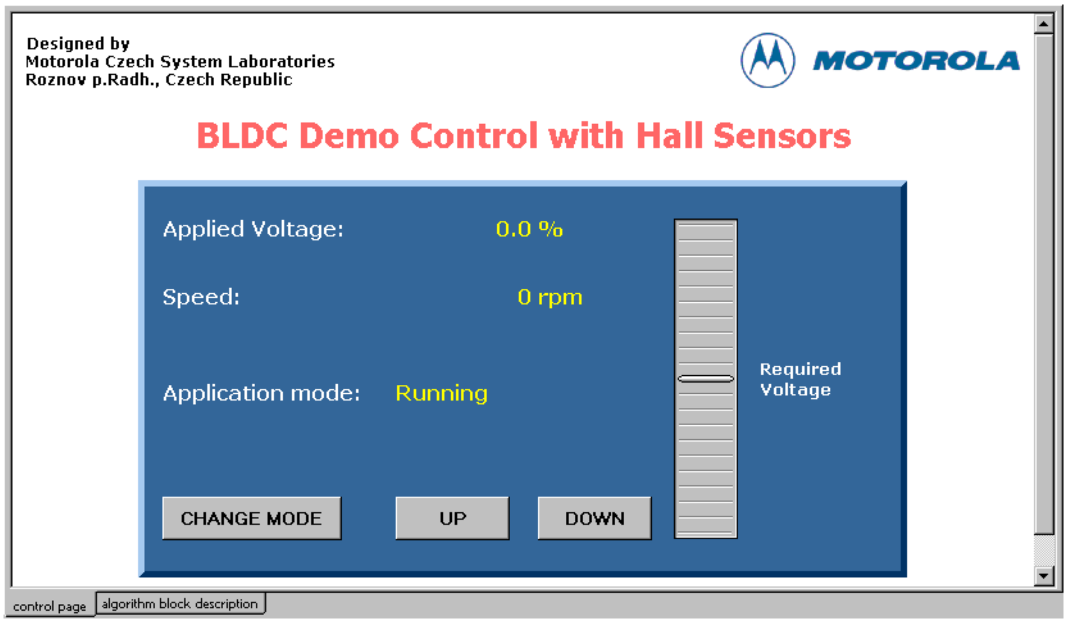
The *Detail View* is a multipage pane. Availability of various pages in the *Detail View* depends on the type of item selected in the *Project Tree*.

The *control page*, when defined in project *Options* (**Section 5.4**), is available for all *Project Tree* items to allow the user to control the board at any time. The content of the *algorithm block description* page changes with the *Project Tree* item selected. When a Scope or Recorder item is selected in the *Project Tree*, the *current item help* and *oscilloscope/recorder* chart pages are also available.

4.1.2.1 Control Page

The *Control Page* is an HTML page created for board application control. It typically contains the scripts-enhanced form or forms which enable user-friendly control of the embedded application. The URL of the page or the path to the HTML file with a page source code can be specified in project *Options* dialog described in **Section 5.4**.

The control page for a simple motor control application is shown in **Figure 4-18**.


Designed by
Motorola Czech System Laboratories
Roznov p.Radh., Czech Republic

BLDC Demo Control with Hall Sensors

Applied Voltage: 0.0 %

Speed: 0 rpm

Application mode: Running

Figure 4-18. Example of Control Page

HTML scripting and other techniques to create active control pages are described in **Section 6.2**.

4.1.2.2 Algorithm Block Description

The *Algorithm Block Description* page in the *Detail View* pane is designated for placing an HTML page describing the selected block functionality. The URL or local path to the source file is specified in block item properties dialog, described in **Section 4.1.1.1**. This page is displayed when it is defined and when the user selects the appropriate block item or any of its child scope or recorder items.

As the standard HTML page, this page can also contain the scripts or other controls, but it is not a common practice.

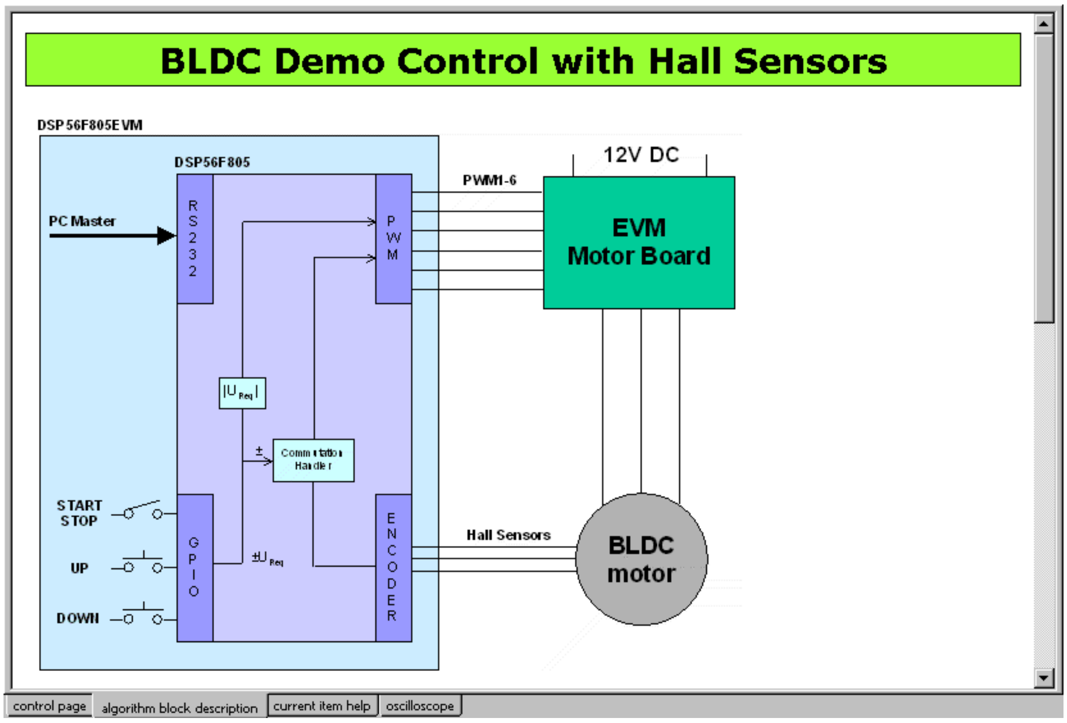


Figure 4-19. Example of an Algorithm Block Description Page

4.1.2.3 Current Item Help

The *Current item help* tab is designated for placing an HTML page describing the selected *Scope* or *Recorder.* This page should contain such information as definitions or use instructions and is specified as the Description URL (see **Figure 4-3**) for scope and recorder items. A simple example of such a page is shown in **Figure 4-20**.

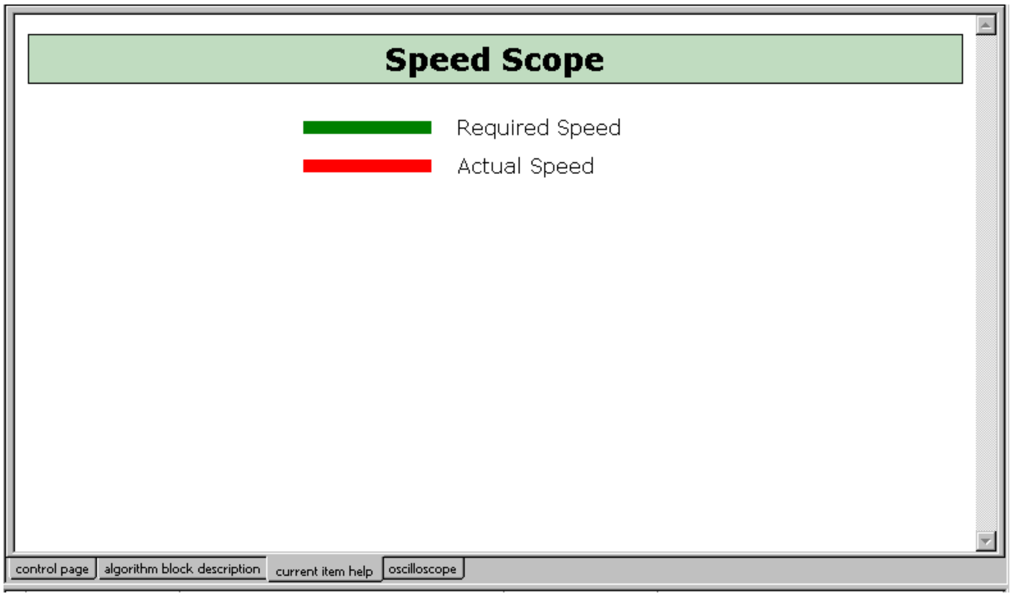


Figure 4-20. Example of Current Item Help Tab

4.1.2.4 Oscilloscope / Recorder

The *Oscilloscope page* in the *Detail View* pane contains the real-time chart representing tracked variables, as shown in **Figure 4-21**. Similarly, the *Recorder page* contains the chart created from the recorded data. Select *Scope* in the project tree to view the oscilloscope page or select *recorder* to view the recorder page.

See **Section 4.1.1.2** and **Section 4.1.1.3** for more information about setting up the oscilloscope or recorder views.

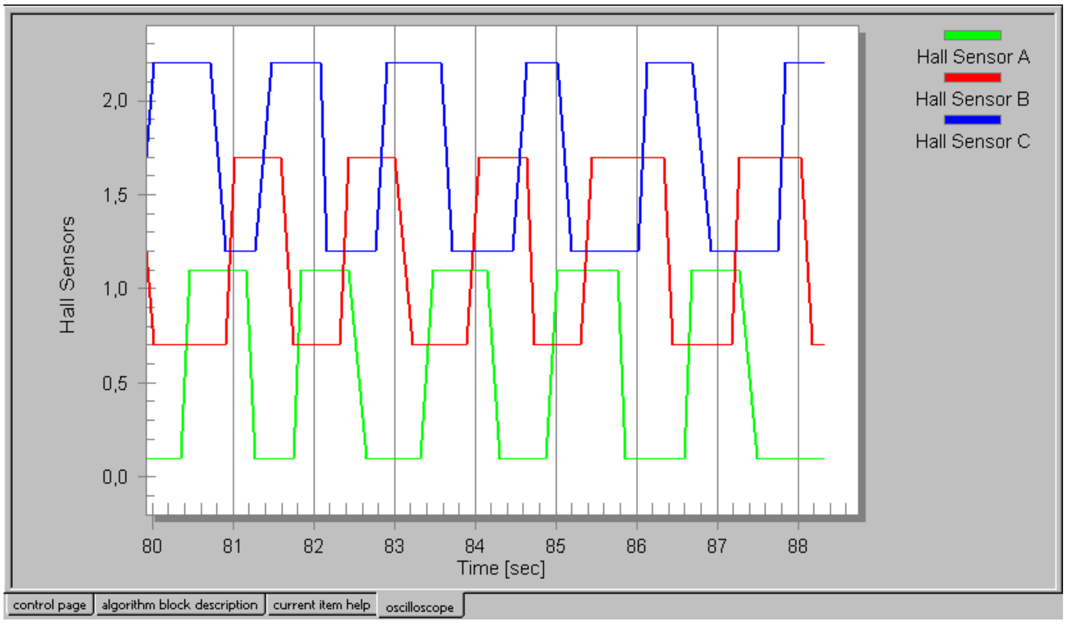


Figure 4-21. Example of Oscilloscope View

4.1.3 Watch-Grid

The *Watch-Grid* pane in the bottom of the application window contains the list of watch variables. The selection of watch variables and their graphical properties are defined separately for each project block. As a result, the *Watch-Grid* pane changes its contents each time a different project block is selected.

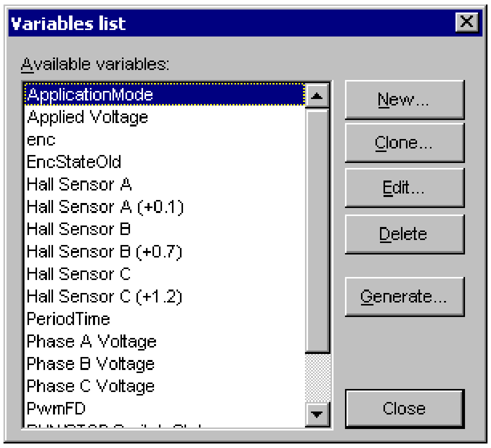
During the definition of the variable, the variable name, units, and number format are specified. Moreover, the *Watch bar* can be used to change the graphical look of the variable, including font type and size, foreground and background color, and alignment. Refer to **Section 4.6.2** for details.

Read-only variables can only be monitored. Variables with changes allowed (modifying enabled in the variable definition) can be altered from the *Watch-Grid* pane. Details about variables are found in **Section 4.2**.

4.2 Variables

FreeMaster communicates with the board application via a well-defined communication protocol. This protocol supports sending commands from the PC application to the target board application and reading or writing its variables. All commands and variables used in the FreeMaster project must be specified within the project.

The *Variables list* dialog box, shown in **Figure 4-22**, can be opened by selecting the *Variables* item from the *Project* menu. It can also be opened from other project-development points, where it could be used to manage variables (e.g. *Scope Setup*).



ApplicationMode
Applied Voltage
enc
EncStateOld
Hall Sensor A
Hall Sensor A (+0.1)
Hall Sensor B
Hall Sensor B (+0.7)
Hall Sensor C
Hall Sensor C (+1.2)
PeriodTime
Phase A Voltage
Phase B Voltage
Phase C Voltage
PwmFD

Figure 4-22. Variables list Dialog Box

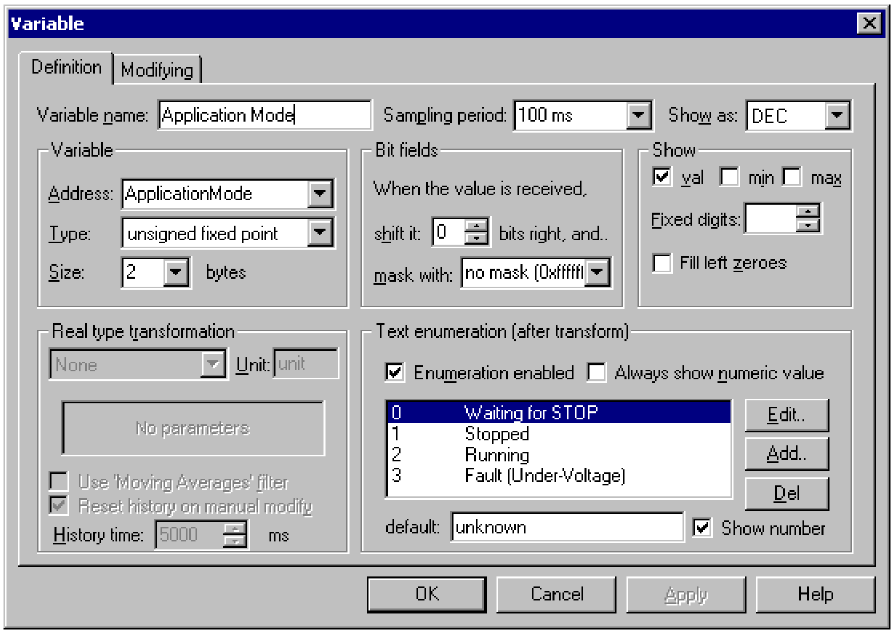
To define a new variable, use the button *New*. This will open the *Variable* dialog box, where you can set the variable properties described in **Section 4.2.1**. When you need to create a copy of an existing variable, select the original variable and press the *Clone* button.

The *Edit* button opens the same *Variable* dialog box for changing the selected variable properties. After pressing the *Delete* button, the user is asked for confirmation of deletion and the selected variable will be deleted.

Generate button opens the interface for mass creation of variable objects based on the symbols loaded from an embedded application executable file. It is described in **Section 4.2.2**; loading of symbol files is described in **Section 5.2**.

4.2.1 Variable Settings

The *Variable* definition dialog has two tabs: *Definition,* shown in **Figure 4-23**, and *Modifying*, shown in **Figure 4-24**.



Variable name: Application Mode
Sampling period: 100 ms
Show as: DEC

Variable
Address: ApplicationMode
Type: unsigned fixed point
Size: 2 bytes

Bit fields
When the value is received,
shift it: 0 bits right, and..
mask with: no mask (0xffffff

Show
[✓] val [ ] min [ ] max
Fixed digits:
[ ] Fill left zeroes

Real type transformation
None Unit: unit
No parameters
[ ] Use 'Moving Averages' filter
[✓] Reset history on manual modify
History time: 5000 ms

Text enumeration (after transform)
[✓] Enumeration enabled [ ] Always show numeric value

0	Waiting for STOP
1	Stopped
2	Running
3	Fault (Under-Voltage)

default: unknown [✓] Show number

Figure 4-23. Variable Dialog Box - Definition Tab

On the *Definition* tab*,* you specify a general variable properties.

- *Variable name* = Specify the variable name as the variable identifier in the project
- *Sampling period* = The time period of reading the variable value from the board when the variable is displayed in the variable watch
- *Shows as* = A format in which the variable value is printed in the watch window. Select the proper format from the drop-down list (`DEC`, `HEX`, `BIN`, `ASCII` or `REAL`).
- *Variable* panel = Information about the variable as it is defined in the embedded application

  - *Address* = The physical address of the variable in the target application memory. Although you can type the direct hexadecimal value, it is recommended that you select a symbol name of the application variable from the drop-down list. A symbol table can be loaded directly from the embedded application executable (if it is in standard ELF/Dwarf1 format) or from the text-based MAP file generated by the linker. See **Section 5.2** for more information about loading the symbol tables from selected files.
  - *Type* = Select the variable type as it is defined in the target application (*unsigned fixed point*, *signed fixed point*, *floating point IEEE, fractional <-1,1)*, *unsigned fractional <0,2)* or *string*)
  - *Size* = Specify the size of the variable as it is defined in target application
- *Bit fields* = The parameters for extracting the single bit or bit groups from a given variable
  - *Shift* = Specify the number of bits the received value is right-shifted before it is masked
  - *Mask* = Select or specify the mask value which is *AND*-ed with the shifted value

    Using the *Shift* and *Mask* fields, you can extract any bit field from the received variable. For example: to extract the most significant bit from the 16-bit integer value, you would specify 15-bit shifting and one-bit mask (0x1).
- *Show* = According to the value display format selected in the *Show as* field, this set of parameters controls how the variable value is actually printed
  - *val, min, max* = Check the boxes if you want the variable watch to display the immediate variable value and/or the detected peak values. The peak values can be reset by right-clicking the variable entry in the watch window and selecting the menu command *Reset MIN/MAX*.

- *Fixed digits* (for *Show as* set to `DEC`, `HEX` or `BIN`) = Prints numeric values left-padded by zeroes or spaces to a given number of digits
- *Fixed digits* (for *Show as* set to `REAL`) = Prints floating-point numeric values with a constant number of digits after the decimal point
- *Zero terminated* (for *Show as* set to string) = The string values are printed only to the first occurrence of zero character. For string values, you can also select whether to display unprintable characters as HEX numbers (or question marks) and a few other string-specific settings.

• *Real type transformation* = When the *Show as* format is set to `REAL`, you can define further post-processing numeric transformation, which is applied to the variable value.

- Transformation type

  linear: ax + b: Specify the *a* and *b* constants of the linear transformation *y = ax + b*. The '*a*' and '*b*' parameters can be specified as a numeric values or by the name of the project variables whose immediate value (last valid value) is then used as the parameter.

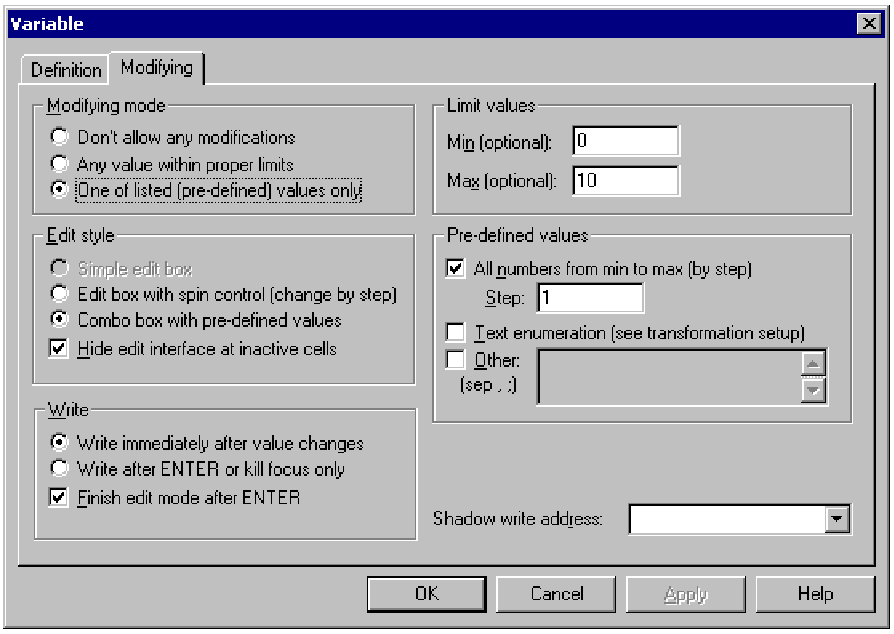
  linear two points: If it is more convenient for you to specify the linear transformation by two points, rather than by the parameters *a* and *b,* fill in the two coordinate points *(x1, y1)* and *(x2, y2)*. As the parameter values, you can again specify the numeric values or variable names.

  hyp: d/(ax+b) + c: Specify the parameters *a*, *b*, *c* and *d* of a hyperbolic transformation function.

- *Unit* = The name of unit displayed in the variable watch
- *Use "Moving Averages" filter* = When monitoring a noisy action, you might want to display the average value instead of the immediate one
- *History time* = The time interval from which the average value is computed

- *Text enumeration* = This allows you to describe the meaning of certain variable values and assign the text label to each of them, which is then displayed in the variable watch together with or instead of the numeric value. Use *Edit*, *Add* and *Del* buttons to manage the look-up table with value to text label assignment.
  - *Default* = Specify the default text label, which is displayed when no matching text is found in the look-up table.

The *Modifying page*, shown in **Figure 4-24**, contains settings and restrictions for variable value modifications.



Modifying mode
- ○ Don't allow any modifications
- ○ Any value within proper limits
- ● One of listed (pre-defined) values only

Limit values
- Min (optional): 0
- Max (optional): 10

Edit style
- ○ Simple edit box
- ○ Edit box with spin control (change by step)
- ● Combo box with pre-defined values
- ☑ Hide edit interface at inactive cells

Pre-defined values
- ☑ All numbers from min to max (by step)
- Step: 1
- ☐ Text enumeration (see transformation setup)
- ☐ Other: (sep , ;)

Write
- ● Write immediately after value changes
- ○ Write after ENTER or kill focus only
- ☑ Finish edit mode after ENTER

Shadow write address:

Figure 4-24. Variable Dialog Box - Modifying Tab

- *Modifying mode*
  - *Don't allow any modifications* = The variable is read-only; all other settings on this page are disabled
  - *Any value within proper limits* = You can specify the *Min* and/or *Max* value. The value the user enters in the watch window is then validated with the specified limits.

   - *One of listed values only* = Once you have specified a list of values, only those values will be accepted in the watch window to be written. The acceptable values can be specified in the *Pre-defined values* group.

     All numbers from min to max = All the numbers from "*min*" to "*max*" by "*step*" will be treated as predefined values

     Text enumeration = Treat all values from the text enumeration look-up table as predefined

     Other = Specify any other predefined values (comma or semicolon separated)

- *Edit style* = Select the look of the edit interface for a given variable, which is displayed in the appropriate cell in the watch window grid
   - *Edit box with spin control* = The variable value edit interface will be displayed in the form of an edit box with two spin arrows for incrementing and decrementing the value
   - *Combo box with pre-defined values* = The variable value edit interface will be displayed in the form of a drop-down list box. The predefined values will be available in the list.
   - *Hide edit interface at inactive cells* = The variable edit interface will be hidden when the appropriate cell in the watch grid looses a keyboard focus
- *Write* style = Specify exactly when the new variable value is actually sent to the board application.
   - *Write immediately after each value changes* = The modified variable value will be sent to the embedded application each time the user presses the spin arrow button or selects a new value in the drop-down list box.
   - *Write after ENTER or kill focus only* **=** The modified variable value will not be sent to the embedded application until the user does not press the Enter key

4.2.2 Generating Variables

The *Generate* button in the variable list dialog (**Figure 4-25**) opens the *Generate variable* dialog box shown in **Figure 4-26**.

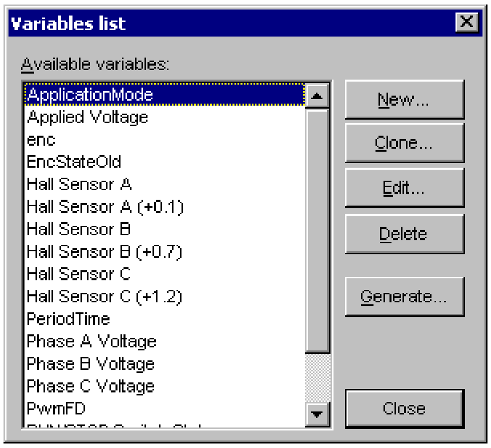


Figure 4-25. Project Variable List

In this dialog, the user can automatically generate the variable objects for the symbols loaded from an embedded application executable (ELF) or a linker MAP file (see **Section 5.2** for more information about symbol tables).

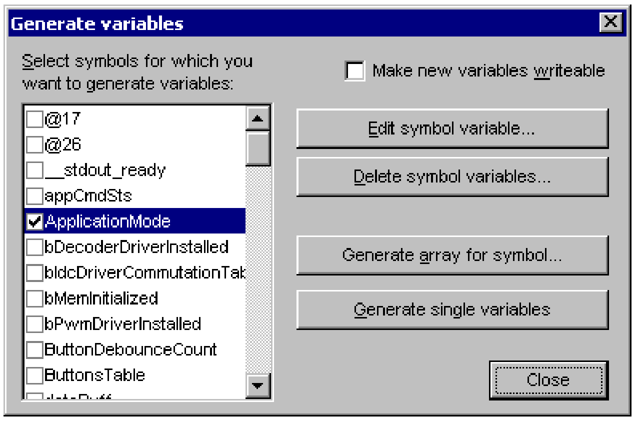


Figure 4-26. Generating Variables

The list in the dialog shows all the symbols available in the project as they were read from the current symbol file. The symbols for which the variables are already defined are marked with a check mark.

- *Edit symbol variable* = Press this button to edit a variable bound to the selected symbol, if any
- *Delete symbol variable* = Press to delete a variable bound to the selected symbol(s)
- *Generate single variables* = Generates a new variable with the same name as the symbol and with proper address, type and size settings. After creation, you can push the *Edit symbol variable* button to see and change other settings in the *Variable* dialog box
- *Generate array for symbol* = Enables you to generate a set of variables encapsulating the selected symbol and its successive locations (offsets)

4.3 Commands

The list of *Application commands* defined in the project can be opened by selecting the *Project / Commands* menu and is shown in **Figure 4-27**. You can use the buttons *New*, *Clone*, *Edit* and *Delete* to manage the list. It is very similar to variables management:

- *New* button = Creates a new application command
- *Edit* button = Edits properties of the selected application command
- *Clone* button = Creates a new command as a copy of the selected command
- *Delete* button = Deletes the selected command
- *Send* button = Opens the interface which enables the command to be sent to the embedded application

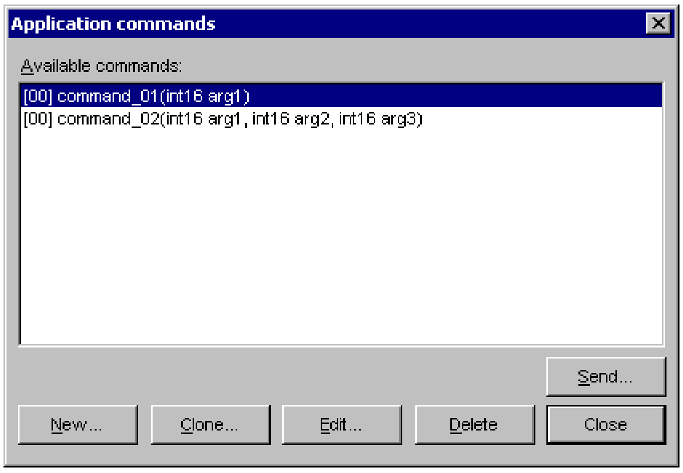
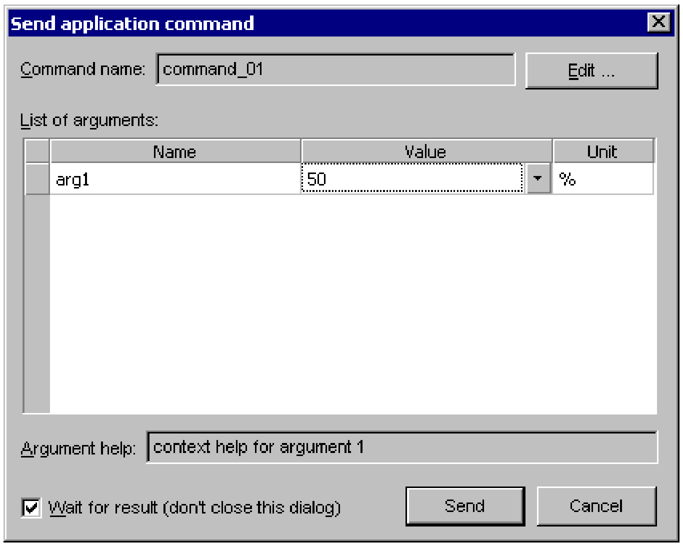

Application commands
Available commands:
[00] command_01(int16 arg1)
[00] command_02(int16 arg1, int16 arg2, int16 arg3)
Send...
New...
Clone...
Edit...
Delete
Close

Figure 4-27. Project Application Commands

In the *Send application command* dialog box which follows after pressing the *Send* button, specify the command parameters (if any) and you can send the command to the embedded application. The dialog is shown in **Figure 4-28**. For each argument, you can define the help message, which is displayed in this dialog when typing the argument value as shown in **Figure 4-29**.



Command name: command_01

List of arguments:

Name	Value	Unit
arg1	50	%

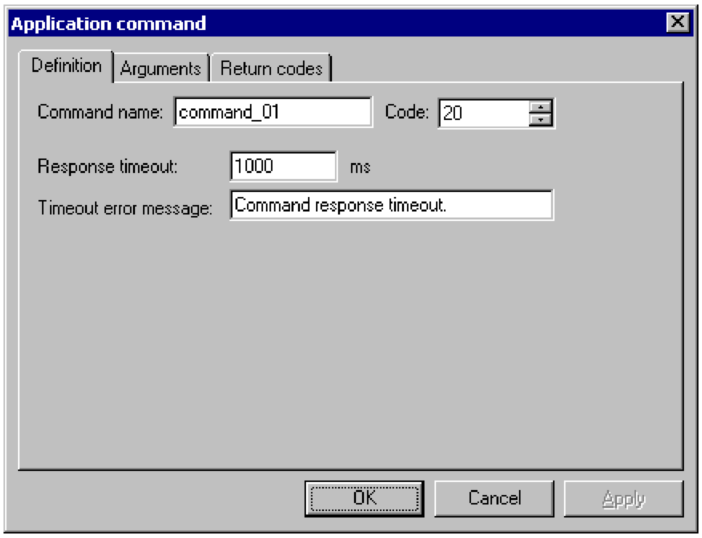
Argument help: context help for argument 1

☑ Wait for result (don't close this dialog)

Figure 4-28. Sending Application Command

If you wish to wait for data to be returned from the board (a command result) without closing the dialog, check the *Wait for result* box. Before sending the command, you can review or edit the command definition.

When defining or editing the command, the *Application command* dialog box is opened. The first of three pages of the dialog is shown in **Figure 4-29**.

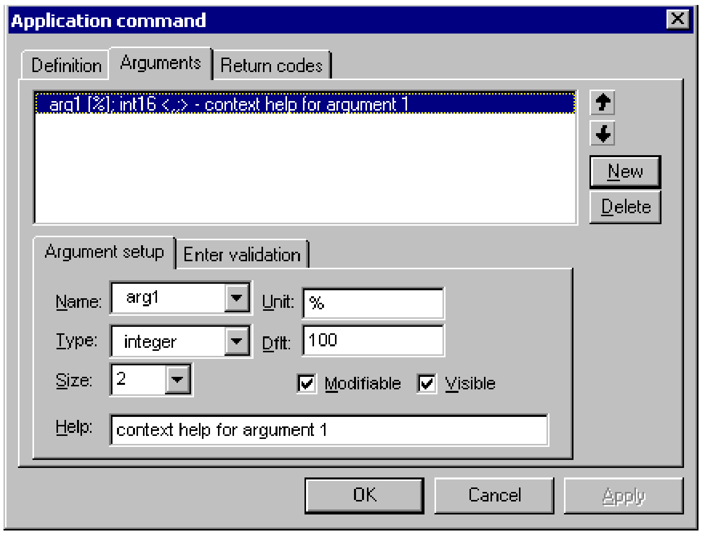


Command name: command_01
Code: 20
Response timeout: 1000 ms
Timeout error message: Command response timeout.

Figure 4-29. Application Command - Definition Tab

On the *Definition* tab, enter the *Command name* used in the project and specify the one-byte command *Code* which identifies the command in the target board application. The command codes and their purposes, as well as the command return codes and their purposes, come from the board application developer.

The *Response time-out* is the maximum time interval in milliseconds that FreeMaster waits for response from the board application. If the embedded application does not acknowledge the command and respond to it before this time-out occurs, the text entered into the *Timeout error message* field appears in alert window.



arg1 [%]: int16 <,> - context help for argument 1

Name: arg1
Unit: %
Type: integer
Dflt: 100
Size: 2
☑ Modifiable ☑ Visible
Help: context help for argument 1

Figure 4-30. Application Command - Arguments Tab, page 1

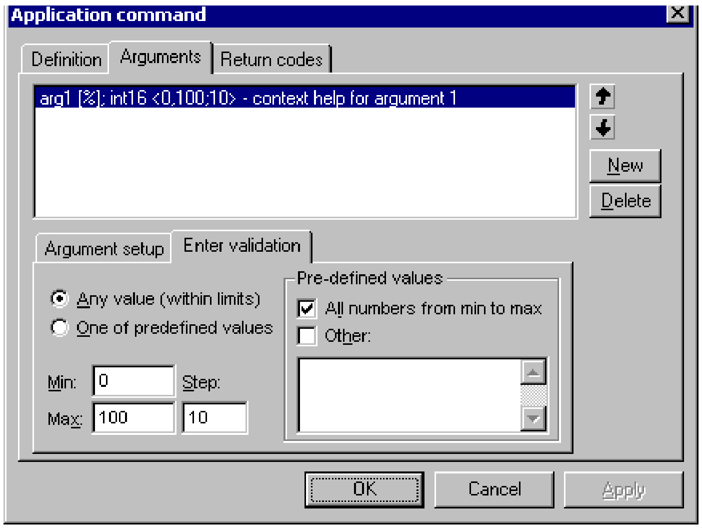
The *Arguments* tab, shown in **Figure 4-30**, is used for definition of command arguments. Commands which do not have arguments will have an empty argument list. Commands can have arguments to pass a value to the target board application together with the command code.

Use the *New* button to create a new argument, the *Delete* button to delete an argument selected in the list, and the up and down *arrows* to change the arguments' order.

On the *Argument setup* sub-page, you define the selected argument parameters:

- *Name* = Specify the argument name as it should appear in the list and in the *Send application command* dialog when the user is prompted for argument values. You can also select the existing argument name from the drop-down list box.
- *Type* = Specify the argument's numeric value (*integer* or *floating point*)
- *Size* = Specify the argument's value size in bytes
- *Unit* = Specify any text which will be displayed as argument units. This text is not sent to the target application.

- *Dflt* = Enter the default value of the argument. This value will be set in the argument list of the *Send application command* dialog. If empty, the user must type the value any time he sends the command.
- *Modifiable* = Unless this box is checked, the user is not allowed to change the default argument value in the argument list of *Send application command* dialog.
- *Visible* = If this box is not checked, the argument will not be displayed in the argument list and its default value will always be sent to the target application.
- *Help* = Write any text information which will be shown in the *Send application command* dialog when the user will be prompted for an argument value.



arg1 [%]; int16 <0,100;10> - context help for argument 1

(●) Any value (within limits)
( ) One of predefined values

Min: 0 Step: 10
Max: 100

[✓] All numbers from min to max
[ ] Other:

Figure 4-31. Application Command - Arguments Tab, page 2

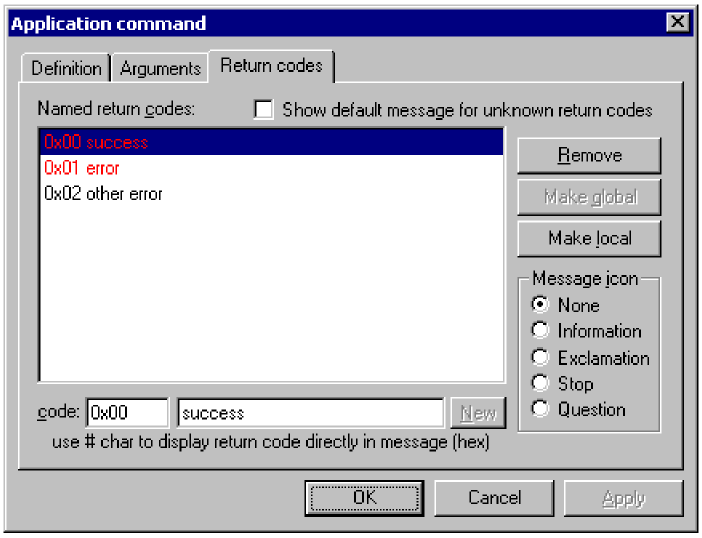
On the *Enter validation* sub-page, shown in **Figure 4-31**, you define the validation criteria for the argument value:

- Specify which values are allowed for the argument
  - *Any value* = Any numeric value is allowed as the argument value. The value must be between *Min* and *Max* limits, if these are set.

   - *One of predefined values* = Only one of the values defined in the *Pre-defined values* fields can be supplied as an argument value

- Pre-defined values
   - All numbers from *min* to *max* = When this box is checked, all numbers between *Min* and *Max* limits, incremented by *Step,* are considered to be valid for the argument value
   - *Other* = Check this box and specify the list of other values (comma separated) which are valid as argument value

The *Return codes* page, shown in **Figure 4-32**, is used for specifying the command return code messages. To create a return code, enter the return code value in hexadecimal (0x00) or decimal form in the *code* field at the lower left of the page; enter the return code message in the next field; and click the *New* button. The return code item will appear in the list. Repeat to create all desired return codes. A *Message icon* may be assigned to each return code message from the panel at the lower right of the page. It will then appear in the message dialog, together with the text of message.


Application command
Definition | Arguments | Return codes

Named return codes: [ ] Show default message for unknown return codes

0x00 success
0x01 error
0x02 other error

code: 0x00 success
use # char to display return code directly in message (hex)

Message icon: [✓ None] Information Exclamation Stop Question

Figure 4-32. Application Command - Return Codes Tab

Return codes can be local or global. Local return codes apply to a single command, while global return codes are valid for all commands of the project. To switch between local and global validity, use the *Make local* and *Make global* buttons.

Check the *Show default messages for unknown return codes* box at the top of the page to pop up a standard message box with return code when an unlisted code returns from the board application.

4.4 Importing Project Files

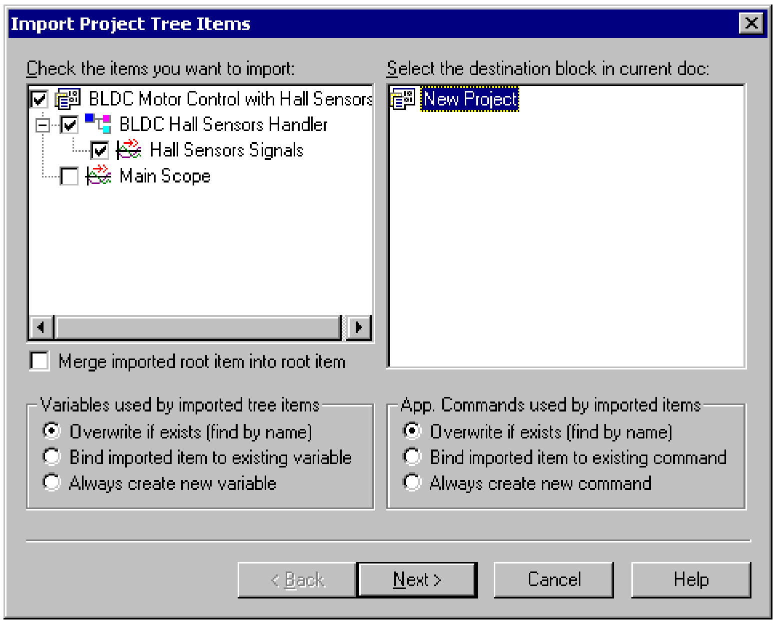
When preparing your project, you may want to reuse the variables, commands, scope and recorder definitions or watch definitions you created in previous projects. Selecting the *File / Import* menu command opens a dialog in which you can select objects defined in different projects and import them to the current project.

The first dialog of the *Import* procedure is shown in **Figure 4-33**. After specifying the name of the original project file, you select and check the project tree items you wish to have in your current project. You can also select the target block item under which you want the imported items to be created.

Together with imported tree items, all referenced objects, such as variables or application commands, are also automatically imported. Using the switch radio-buttons below the lists, you can specify how the referenced objects are created:

- *Overwrite existing* = When there is an object, such as a variable, imported with a tree item, for example, an oscilloscope, the current project is searched for an object of the same type (variable) and with the same name. If found, it is overwritten with the one imported.
- *Bind to existing* = If an object with the same name is found, it is not overwritten, but the imported tree item binds to it
- *Always create new* = All referenced objects are created, even if they already exist in the current document; in such a case, the name will be duplicated

- *Merge imported root item* = When importing the root item, it is possible to merge its variable watch definition with the watch of the root item in the current project. When this option is not checked, the root item will be imported and inserted as a standard block item.


Import Project Tree Items

Check the items you want to import:
- [✓] BLDC Motor Control with Hall Sensors
  - [✓] BLDC Hall Sensors Handler
    - [✓] Hall Sensors Signals
  - [ ] Main Scope

Select the destination block in current doc:
- New Project

[ ] Merge imported root item into root item

Variables used by imported tree items
- [● Overwrite if exists (find by name)]
- ○ Bind imported item to existing variable
- ○ Always create new variable

App. Commands used by imported items
- [● Overwrite if exists (find by name)]
- ○ Bind imported item to existing command
- ○ Always create new command

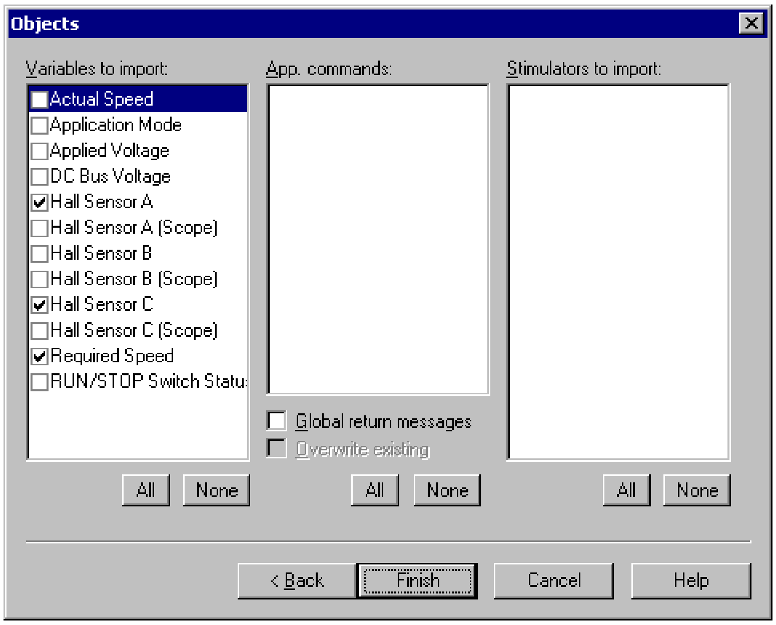
Figure 4-33. Import Project Tree Items

Pressing the *Next* button opens the second part of the *Import* procedure, where you can select additional objects to be imported. The second dialog is shown in **Figure 4-34**. The three check-box lists contain the objects found in the source project file:

- *Variables* = Put a check mark by each variable you want to import. You don't need to import variables which are referenced from the tree items selected in previous dialog from **Figure 4-33**; such variables are always unconditionally imported.
- *App. commands* = Put a check mark by each application command definitions you want to import. As with variable objects, you don't need to check commands which are referenced from the block tree items selected in previous dialog.

- *Global return messages* = If this box is checked, the application commands return codes and messages are imported from the source document.
- *Overwrite existing* = The existing return codes are overwritten with those being imported.

- *Stimulators* = Put a check mark by each variable stimulator you want to import.



Variables to import:
- ☐ Actual Speed
- ☐ Application Mode
- ☐ Applied Voltage
- ☐ DC Bus Voltage
- ✓ Hall Sensor A
- ☐ Hall Sensor A (Scope)
- ☐ Hall Sensor B
- ☐ Hall Sensor B (Scope)
- ✓ Hall Sensor C
- ☐ Hall Sensor C (Scope)
- ✓ Required Speed
- ☐ RUN/STOP Switch Statu:

☐ Global return messages
☐ Overwrite existing

Figure 4-34. Import Project Objects

4.5 Menu description

4.5.1 File Menu

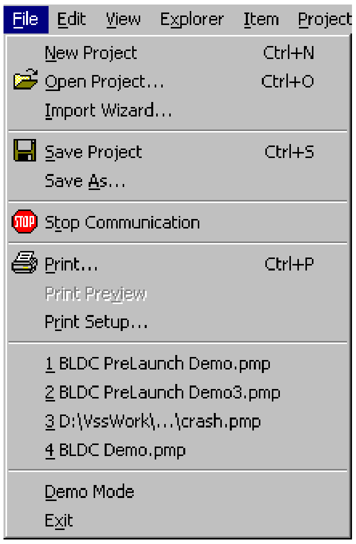


Figure 4-35. File Menu

Selecting *New Project* creates a new empty project, while *Open Project* opens an existing project file, which has the extension *.pmp*.

Import Wizard enables you to import selected objects (*Project Tree* items, variables, commands, stimulators) from an existing project (*.pmp* file) into the current project.

Save Project saves the open project into the current file, while *Save As* allows users to specify a new filename for the current project.

Stop Communication pauses the communication with the board and unlocks the communication port. When the communication is released from the paused state, the symbol file is automatically checked for changes. If a difference is found, the user can choose to reload the new version of the file.

Print prints the content of current window, when possible. Currently, printing is supported only for HTML description and control pages. *Print Setup* opens the standard *Print Setup* dialog.

The list of the most recently loaded projects: Selecting one of these items loads the specified project, just like using the *Open Project* command.

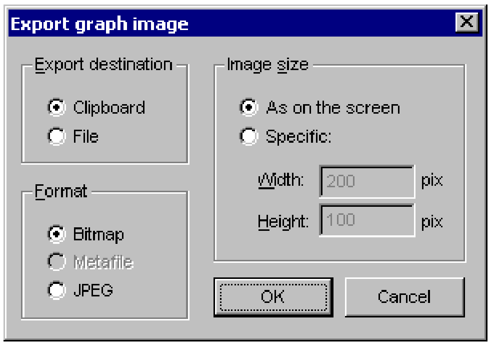
Demo Mode is a switch to enter or leave the application demonstration mode. While in *Demo Mode,* you cannot modify any important project settings.

Exit exits the application.

4.5.2 Edit Menu

Edit menu contains standard clipboard manipulation commands (*Cut*, *Copy* and *Paste*).

Copy Special is enabled when the *Oscilloscope* or *Recorder* graph is active. The command enables saving the graph image to the clipboard or to a file in a different format or size. The set-up dialog is shown in **Figure 4-36**.



Export graph image

Export destination: [✓ Clipboard] File

Format: [✓ Bitmap] Metafile JPEG

Image size: [✓ As on the screen] Specific:

Width: 200 pix

Height: 100 pix

OK Cancel

Figure 4-36. Export graph image Dialog

4.5.3 View Menu

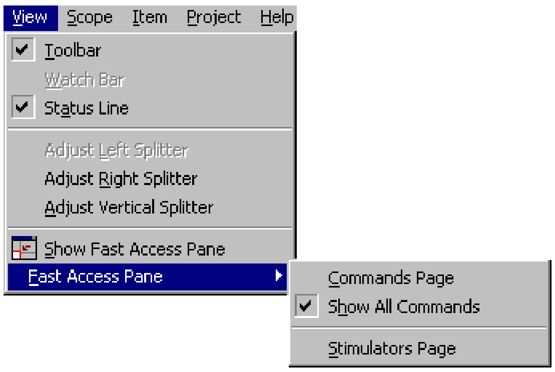


Figure 4-37. View Menu

In the *View* menu, you can select whether to show or hide the ***Toolbar***, the ***Watch Bar*** or the ***Status Line***.

Another feature of the *View* menu is the ability to adjust the size of individual panes without using a mouse. Use *Adjust Left Splitter* for changing the height of the *Fast Access* pane in the *Tree* pane. *Adjust Right Splitter* can be used for changing the height of the *Detail View* pane (HTML pages and charts). Finally, *Adjust Vertical Splitter* changes the width of the *Project Tree* pane.

Show Fast Access Pane switches the display of the *Fast Access* pane, a small helper window located at the bottom-left part of the application window. It contains two pages: the *Commands Page,* which lists currently-defined application commands and the *Stimulators Page*, which lists all stimulator objects. When the menu item *Show all project commands* is checked, FreeMaster is forced to show all application commands defined in the project. The content of the *commands* page is then independent of which block is currently selected from the *Project Tree*. Otherwise, only commands selected for displaying in the current tree context are displayed; see **Figure 4-5** and **Section 4.1.1.1** for more information.

4.5.4 Explorer Menu

The *Explorer* sub-menu is available when an HTML page (*Control* page, *Block Description* page or *Chart Variables Info*) is displayed in the *Detail View*. When a *Chart View* page is displayed in the *Detail View*, then the *Explorer* menu item is replaced by the *Scope* or *Recorder* sub-menu.

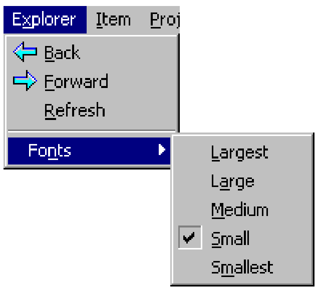


Figure 4-38. Explorer Menu

Items *Back*, *Forward* and *Refresh* represent commands for the Internet Explorer window embedded in the FreeMaster. They are used to move through previously-visited pages and to refresh the page contents.

Fonts sets the font size for the current Internet Explorer window.

4.5.5 Scope Menu

The *Stop Scrolling* and *Stop Data* commands cause the FreeMaster to stop moving (rolling) the oscilloscope chart and to enter a mode in which the chart can be zoomed and the data series can be examined with the data cursor.

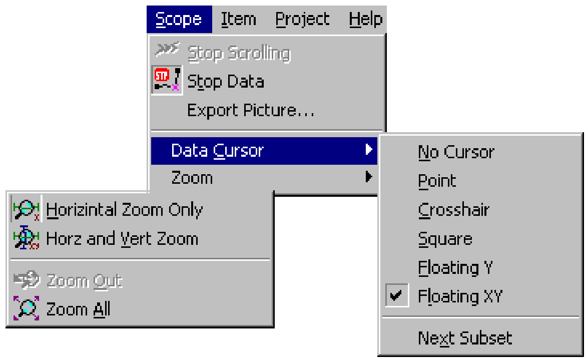


Figure 4-39. Scope Menu

The difference between these two commands is that *Stop Scrolling* stops the picture, but allows incoming data to be appended to the end of the chart, while *Stop Data* also stops the incoming data.

Export Picture opens the *Export graph* image dialog, where you can specify the picture format and export the picture to the clipboard or to a file.

Data cursor enables you to select the style of data cursor for examining the chart values. The *Next Subset* sub-item selects the next chart line to be examined.

The *Zoom* submenu consists of zooming modes and commands. The *Horizontal Zoom Only* mode allows “x-axis only” zooming; *Horz and Vert Zoom* allows free rectangle zooming.

4.5.6 Item Menu

The content of this sub-menu depends on the selected object within the FreeMaster application window. The same menu is displayed when you click the right mouse button on this object. The menu usually consists of the *Delete* item for deleting the selected object and the *Properties* item for opening an object properties dialog.

4.5.7 Project Menu

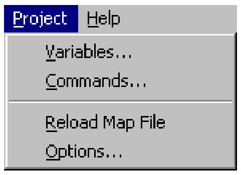


Figure 4-40. Project Menu

Variables opens the Variables list dialog box, where you can manage all project variables at once.

Commands opens the Application commands dialog box, where you can manage all project commands.

The *Reload Map File* command updates the physical addresses of board application variables from the *.map* file.

Options opens the multipage dialog box for all project option settings.

4.6 Toolbars

4.6.1 Toolbar

The *toolbar* allows quick access to some of the menu commands.

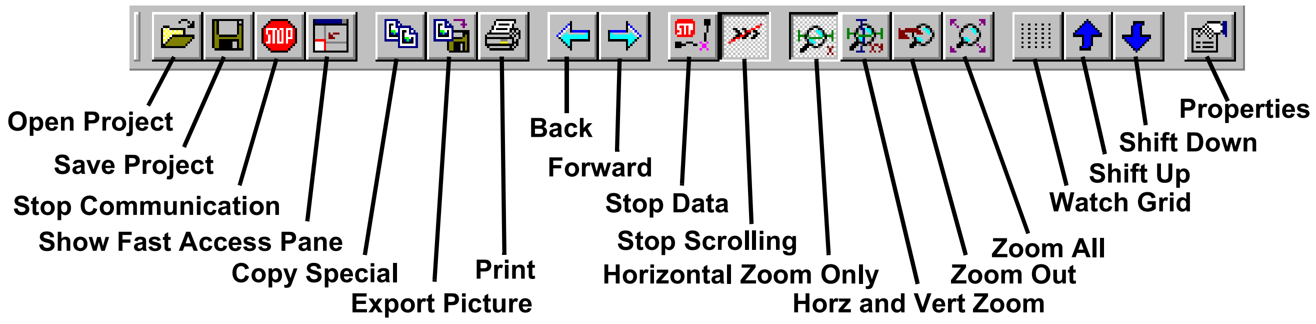


Figure 4-41. Toolbar

4.6.2 Watch Bar

The *Watch Bar* is available when the *Watch-Grid* pane has the focus and *Watch Pane* is selected from the *View* menu. It contains buttons with which you can change various graphical attributes of variables.

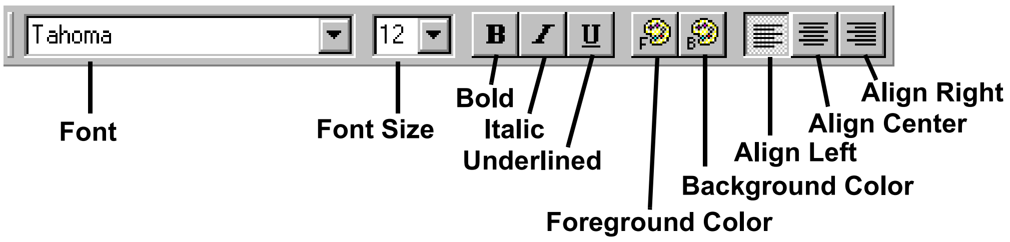


Figure 4-42. Watch Bar

Section 5. PROJECT OPTIONS

To set application and project options, use the *Options* dialog, which can be activated by selecting *Options* from the *Project* menu. The dialog consists of several pages - each dedicated to a different group of settings.

5.1 Communication

To set up the parameters related to communication between FreeMaster application and target board, select the first tab, as shown in **Figure 5-1**.

- *Communication*
  - *Direct RS232 connection* = The standard serial interface (3-wire RS232 cable) will be used to connect to the target application

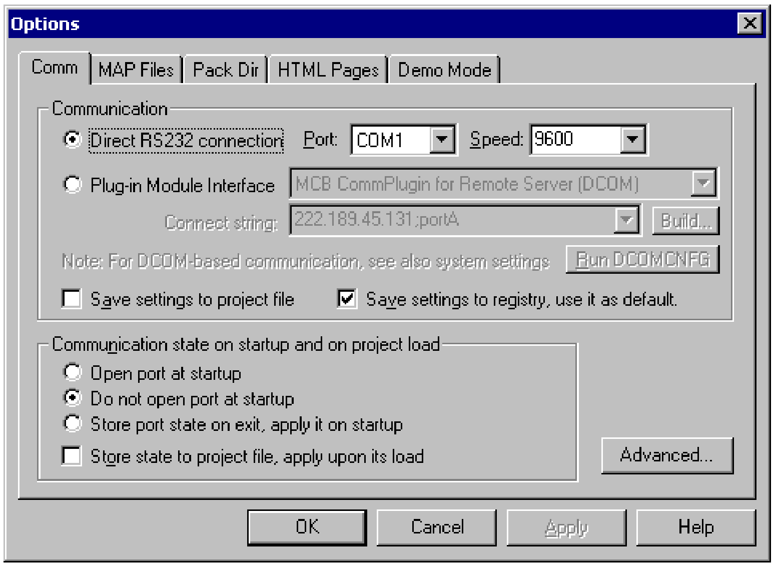
    Port = Select the serial port on which the board is accessed

    Speed = Select or specify the communication baud rate. This speed must correspond with the embedded application settings.
  - *Plug-in Module Interface* = The communication with an embedded device will be handled by a separate (custom) plug-in module. The module must conform to the Microsoft COM specification and must be registered in the system registry database. See protocol and communication library documentation for more information.

    The drop-down list contains all plug-in modules known (registered) in the local system.

Connect string = The plug-in module configuration is saved in string form, internally called a “connect string”. You can directly specify this string, or you can press the *Build* button to open the module-specific configuration dialog.

Run DCOMCNFG = If the custom communication module internally uses Microsoft DCOM technology, the DCOM should be properly set up at the system level. This button launches the DCOM system configuration utility.



Communication

[● Direct RS232 connection] Port: COM1 Speed: 9600

○ Plug-in Module Interface: MCB CommPlugin for Remote Server (DCOM)

Connect string: 222.189.45.131;portA

Note: For DCOM-based communication, see also system settings

☐ Save settings to project file ☑ Save settings to registry, use it as default.

Communication state on startup and on project load

○ Open port at startup

[● Do not open port at startup]

○ Store port state on exit, apply it on startup

☐ Store state to project file, apply upon its load

Figure 5-1. Communication Options

– *Save settings to project file* = If checked, the communication parameters will be stored within the project file during the next *Save Project* operation. When the project is next loaded, the communication settings will be restored and used instead of the defaults.

– *Save settings to registry* = If checked, the settings are stored in the local computer registry database. These settings will be used as default when the application is started next time.

NOTE: *There are two communication plug-in modules distributed within the FreeMaster installation pack. Both modules handle a communication with the FreeMaster Remote Server application. The difference between* *the two is a protocol used to connect to the server. One uses Microsoft DCOM remote procedure call interface while the other uses standard HTTP text-based protocol.*

When using the DCOM-based communication to remote server, the security issues must be considered when connecting over the network. Both sides of the communication must have the DCOM properly set up on the system level by running the DCOMCNFG utility. Also, the remote server must be properly installed on the remote side. If there are problems connecting to the remote computer, contact your local network administrator.

- *Communication state* = By selecting one of three options, you can set whether the communication port will be opened or not when the application is started.

  Open port at start-up

  Do not open port at start-up

  Store port status on exit, apply it on start-up

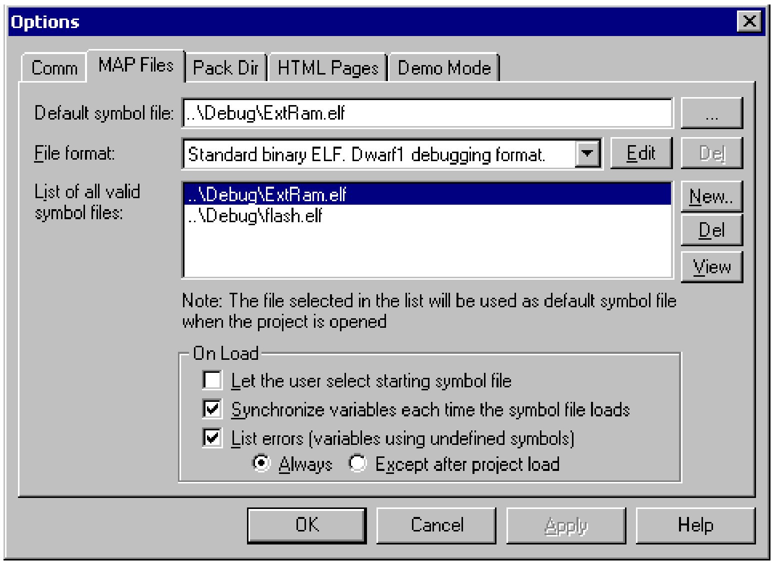
  – *Store status to project file, apply it on its load* = If checked, the state of the communication port will be saved to a project file during the next *Save Project* operation. The state will be then restored the next time the project is loaded.

5.2 Symbol Files

When defining project variables, it is often useful to specify the physical address of the target memory location as the symbol name instead of direct hexadecimal value. The symbol table can be loaded directly from the embedded application executable if it is the standard ELF or Dwarf1debugging format. For other cases, the text MAP file generated by the linker may be loaded and parsed for symbol information.

In the project, you can specify multiple files which contain the symbol table. Later, you can switch between different symbol tables from different files by selecting the menu command *Project / Select Symbol File*. For example, with the DSP embedded application tested on an EVM board, you can have two symbol files specified in the project--one for code running from RAM memory and the second for code running from Flash.

Figure 5-2 shows the *MAP File* tab in the project *Options* dialog.



Default symbol file: ..\Debug\ExtRam.elf

File format: Standard binary ELF. Dwarf1 debugging format.

List of all valid symbol files:
..\Debug\ExtRam.elf
..\Debug\flash.elf

Note: The file selected in the list will be used as default symbol file when the project is opened

On Load
- ☐ Let the user select starting symbol file
- ☑ Synchronize variables each time the symbol file loads
- ☑ List errors (variables using undefined symbols)
  - [✓ Always] Except after project load

Figure 5-2. Symbol Files Options

- *Default symbol file* = Specify the name of the symbol file, which will be loaded by default. You can press the browse button (...) to locate the file in the standard open file dialog.
- *File format* = Select the format of the file
  - *Standard binary ELF* = Choose this option for an ELF file
  - *Hiware MAP File 509* = Choose this option for HiWare Smart Linker v5.0.9
  - *Define new Regular Expression-based parser* = Choose this to define a new text file parser based on regular expression pattern matching; see **Section 5.2.1**
- *List of valid symbol files* = The list of symbol files defined in the project. Use *New* and *Del* buttons to manage the list.
- *View* = View the symbol table parsed from the selected file

NOTE: *The paths to symbol files may be specified in several forms. It can be the absolute path on the local disk, the path relative to the directory where the project file is stored or the path relative to the current "pack" directory. The latter is the most suitable for project deployment to other computers; see **Section 5.3** for more information.*

- *On Load* panel options control the actions performed with symbol files after the project is loaded:
  - *Let the user select the symbol file* = When checked, the user is prompted to select the initial symbol file when the project is loaded.
  - *Synchronize variables each time the map file loads* = When checked, the variables are automatically updated by new symbol addresses after the project is loaded
  - *List errors* = When this box is checked, all the variables using the symbols missing in the loaded symbol table are listed in a special dialog box. The user is able to edit the corrupted variables or select another symbol file.

5.2.1 Regular Expression-based MAP File Parser

When your compiler or linker does not support ELF output format and the MAP file cannot be parsed by the built-in HiWare 5.0.9 parser, you must describe the internal MAP file structure by using the regular expression pattern.

It would be out of the scope of this document to describe the theory of regular expression pattern matching, but a simple example might help to understand the strength of this technology. In the example, we will define the parser of *xMap* files generated by Metrowerks Compiler and Linker for the Motorola DSP56800 processor family.

The example of the *xMap* line, which describes the global symbol `length` might look like the following:

```
00002320 00000001 .bss    Flength(bsp.lib pcmasterdrv.o  )
00002321 00000001 .bss    Fpos(bsp.lib pcmasterdrv.o  )
```

First, we must describe the line format by the regular expression pattern. The following pattern

```
[0-9a-fA-F]+\s+[0-9a-fA-F]+\s+\S+\s+F\w+
```

could be read as follows:

- first, there are one or more hexadecimal digits: `[0-9a-fA-F]+`
- followed by one or more spaces (or another white characters): `\s+`
- followed again by one or more hexadecimal digits: `[0-9a-fA-F]+`
- followed again by one or more white characters: `\s+`
- followed by a set of any non-white characters: `\S+`
- followed by one or more white characters again: `\s+`
- followed by the character F
- followed by one or more alphanumeric (word) characters: `\w+`

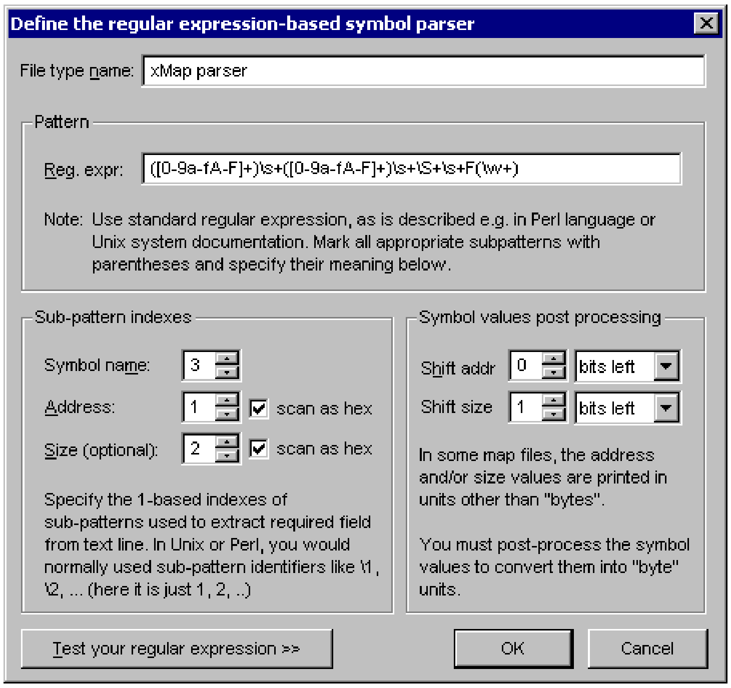
To identify the sub-patterns which describe the symbol parameters, we put them in the round parentheses:

```
([0-9a-fA-F]+)\s+([0-9a-fA-F]+)\s+\S+\s+F(\w+)
```

Now we must identify the sub-pattern indexes for individual symbol values:

- The first sub-pattern corresponds with the symbol address (index 1)
- The next sub-pattern corresponds with the symbol size (index 2)
- The next sub-pattern corresponds with the symbol name (index 3)

Supply all the parameters prepared above in the regular expression dialog as shown in **Figure 5-3**.



Define the regular expression-based symbol parser

File type name: xMap parser

Pattern

Reg. expr: ([0-9a-fA-F]+)\s+([0-9a-fA-F]+)\s+\S+\s+F(\w+)

Note: Use standard regular expression, as is described e.g. in Perl language or Unix system documentation. Mark all appropriate subpatterns with parentheses and specify their meaning below.

Sub-pattern indexes

Symbol name: 3

Address: 1 [✓] scan as hex

Size (optional): 2 [✓] scan as hex

Specify the 1-based indexes of sub-patterns used to extract required field from text line. In Unix or Perl, you would normally used sub-pattern identifiers like \1 , \2, ... (here it is just 1, 2, ..)

Symbol values post processing

Shift addr 0 bits left

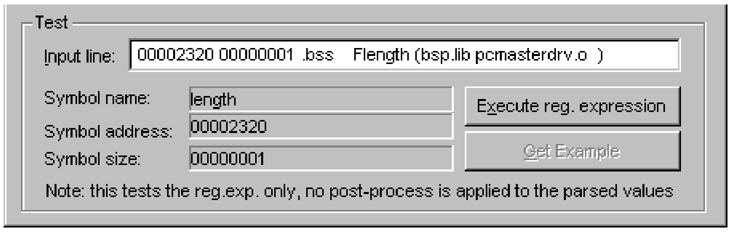
Shift size 1 bits left

In some map files, the address and/or size values are printed in units other than "bytes".

You must post-process the symbol values to convert them into "byte" units.

Figure 5-3. Regular Expression-based xMap File Parser

By pressing *Test your regular* expression button, the dialog vertically expands and the test panel is displayed as shown in **Figure 5-4**. Cut and paste a single line from the *xMap* file to *Input line* field and press the button *Execute reg. expression*:



Test

Input line: 00002320 00000001 .bss Flength (bsp.lib pcmasterdrv.o)

Symbol name: length

Symbol address: 00002320

Symbol size: 00000001

Note: this tests the reg.exp. only, no post-process is applied to the parsed values

Figure 5-4. Testing Your Regular Expression

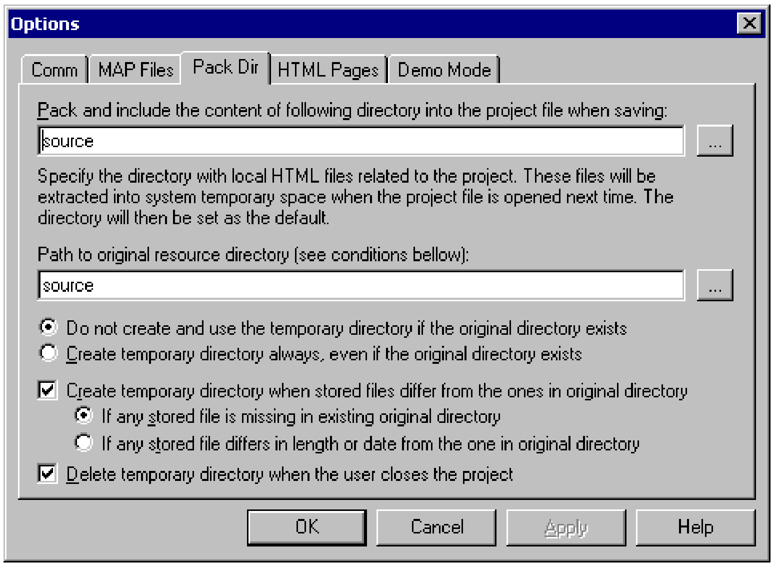
The Symbol name, Symbol address and Symbol size output fields should be displayed as shown in figure **Figure 5-4**. If you have errors, please be sure that you have Internet Explorer 5.5 or higher installed on your machine for the regular expression functionality.

To finish our example, you must set a one bit *shifting* of the “*size*” value in the *Symbol post-processing* parameters. This is because the symbol size is printed in word units (16-bit) in the *xMap* file, but we need this value in bytes.

NOTE: *All created regular-expression parsers will automatically be saved to the project file and to the local computer registry database for future use.*

5.3 Packing Resource Files into Project File

The project often uses data from many different files. For example, each HTML page displayed for a project tree item or each image used on such a page is stored in a separate file. This may cause problems when you want to deploy or distribute a project to different computers. Using the *Pack* options shown in **Figure 5-3**, you can choose to pack the resource files into the project file when it is saved.



Pack and include the content of following directory into the project file when saving:
source

Specify the directory with local HTML files related to the project. These files will be extracted into system temporary space when the project file is opened next time. The directory will then be set as the default.

Path to original resource directory (see conditions bellow):
source

[✓ Do not create and use the temporary directory if the original directory exists]
Create temporary directory always, even if the original directory exists

[✓] Create temporary directory when stored files differ from the ones in original directory
[✓ If any stored file is missing in existing original directory]
If any stored file differs in length or date from the one in original directory

[✓] Delete temporary directory when the user closes the project

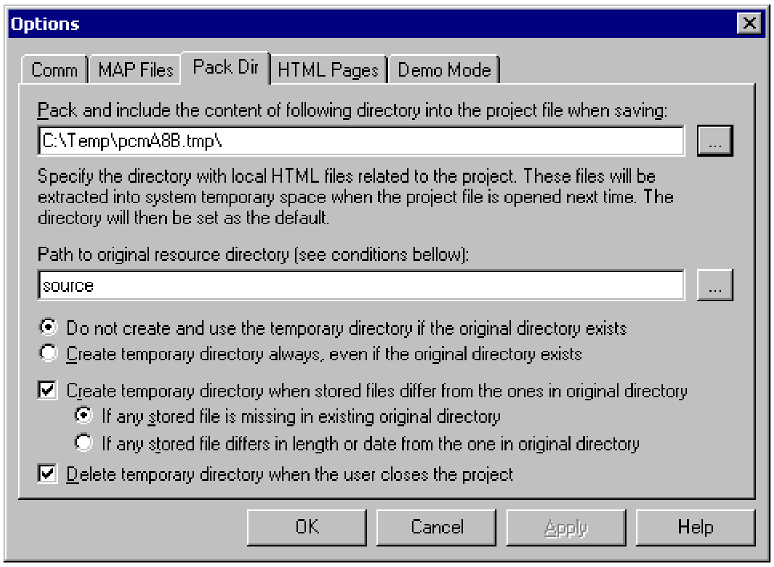
Figure 5-5. Pack Directory Options

To pack resource files into the project file, put all these files into one directory or a directory structure and specify the path to that directory in both fields of the *Pack Dir* page. By pressing the browse button (...), you can find and select the directory in the standard *open directory* dialog.

The path to the directory can be specified by a path relative to the directory where the project file is saved.

When the project with the packed files is loaded next time by the application, the *original* path, entered in the second entry of the *Pack Dir* page, is checked. If it is missing, or if one of the files in it differs from the files originally packed in the project, a temporary directory is created in the system temporary space and the packed files are extracted into that directory. The temporary directory is then set as a default for the rest of resource files. It is thus very important to specify the FreeMaster paths to HTML files or to the symbol file relative to the directory specified in *Pack Dir* dialog.

The *Pack Dir* page displays the path to the temporary directory if it is currently in use, but still remembers the path to the original resource directory.



Pack and include the content of following directory into the project file when saving: C:\Temp\pcmA8B.tmp\

Specify the directory with local HTML files related to the project. These files will be extracted into system temporary space when the project file is opened next time. The directory will then be set as the default.

Path to original resource directory (see conditions bellow): source

● Do not create and use the temporary directory if the original directory exists
○ Create temporary directory always, even if the original directory exists

☑ Create temporary directory when stored files differ from the ones in original directory
   ● If any stored file is missing in existing original directory
   ○ If any stored file differs in length or date from the one in original directory
☑ Delete temporary directory when the user closes the project

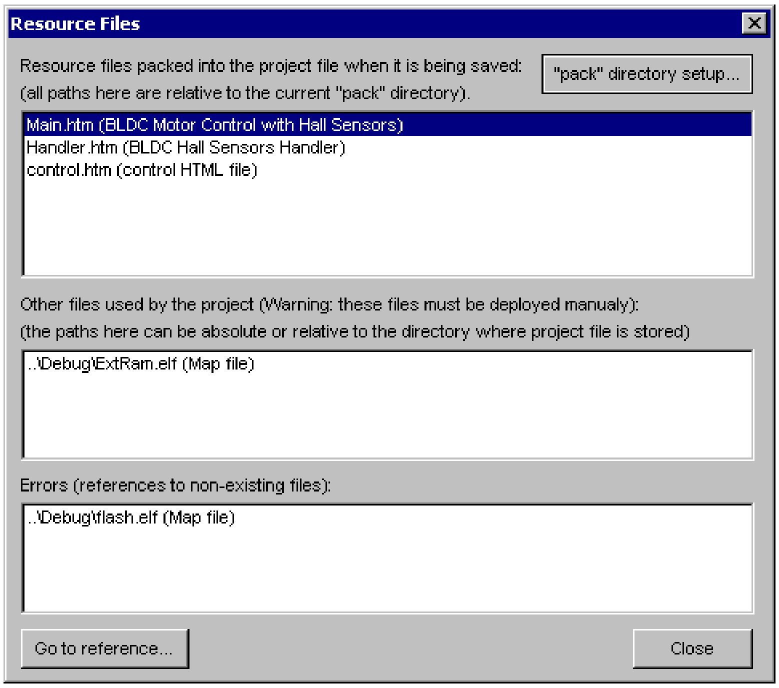
Figure 5-6. Pack Directory Options, Example 2

Using the other Pack Directory options shown in **Figure 5-6**, you can set the conditions under which the temporary directory is created.

5.3.1 Resource Files Manager

Before deploying a complex project which uses many external resources or symbol files, it is worth verifying that all file paths are correct and in the proper relative format. The path relative format must in turn be properly evaluated when the files are extracted to a temporary directory on different hosts.

The Resource Files Manager can be activated in the menu *Project / Resource Files*. The typical look of the window is shown in **Figure 5-7**



Resource files packed into the project file when it is being saved:
(all paths here are relative to the current "pack" directory).

Main.htm (BLDC Motor Control with Hall Sensors)
Handler.htm (BLDC Hall Sensors Handler)
control.htm (control HTML file)

Other files used by the project (Warning: these files must be deployed manualy):
(the paths here can be absolute or relative to the directory where project file is stored)

..\Debug\ExtRam.elf (Map file)

Errors (references to non-existing files):

..\Debug\flash.elf (Map file)

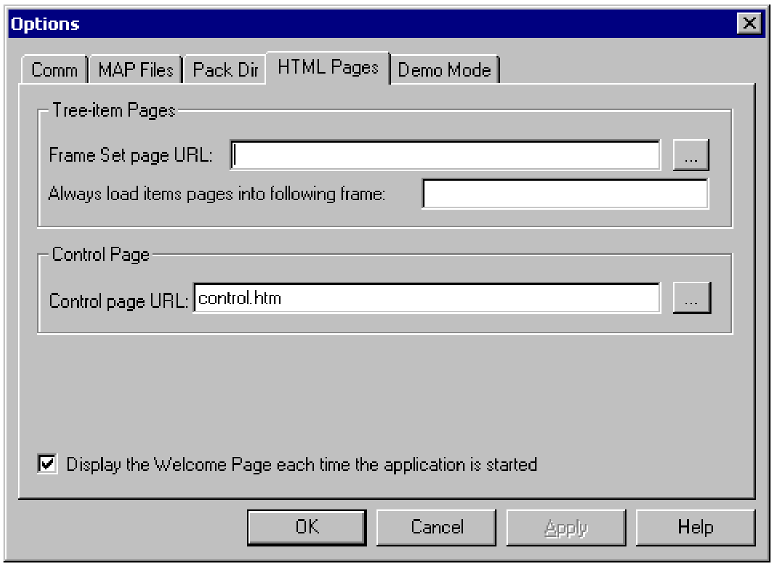
Figure 5-7. Resource Files Manager

The dialog displays all external files directly referenced by the project. Note that there can also be other files (e.g., images) referenced indirectly from the HTML pages. You should verify whether the files lie in the pack directory and whether the HTML pages point to them using a relative path.

  - The first list in the dialog contains the files located in the current pack directory. These files will be properly stored in the project file when it is saved. On other hosts, the files will be extracted in a temporary space if needed.
  - The second list in dialog contains the files which are successfully used by the project, but are located outside the pack directory. Their file names are specified either by absolute path or by a path relative to the directory where project is stored. However, the files will not automatically be stored in the project file and you will have to deploy them manually.
  - The third list contains references to nonexisting files.
- *"Pack" directory setup* = Pressing this button opens the project *Options* dialog, where you can redefine the pack directory location and other settings.
- *Go to reference* = Opens the dialog in which the selected file is referenced. This can be either a *Properties* dialog for a project tree item or a project *Options* dialog for shared HTML or symbol files.

5.4 HTML Pages

The project uses HTML pages to display the description and controls related to the selected item in the project tree. The path or URL of the pages are specified in the property dialog for each tree item. On the *HTML Pages* options tab, shown in **Figure 5-8**, you can specify the paths to common HTML files, displayed in the application main window.



Tree-item Pages
Frame Set page URL:
Always load items pages into following frame:

Control Page
Control page URL: control.htm

☑ Display the Welcome Page each time the application is started

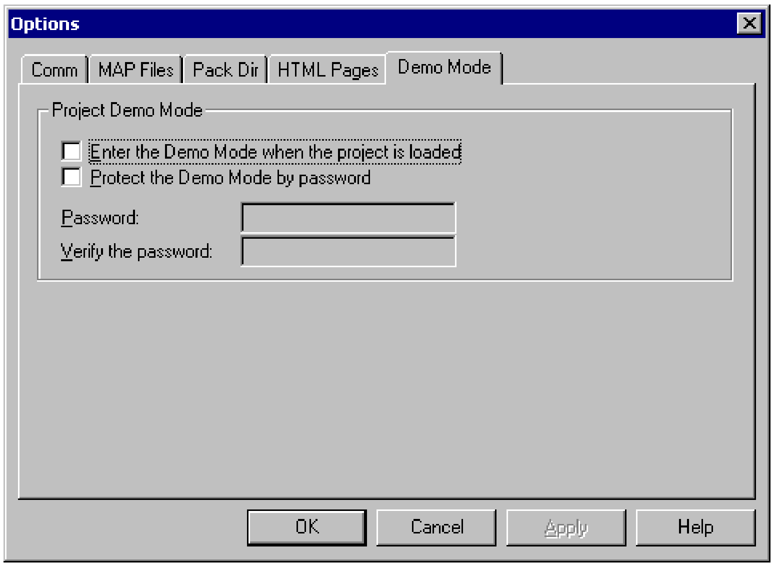
Figure 5-8. HTML Pages Options

Specify the *Frame Set page URL* if you want to divide the pages displayed for project tree items into the frames. The page specified in this field must contain the `<FRAMSET>` declaration, with one frame dedicated as a target for the description pages. The name of the target frame must be specified exactly.

The HTML code can contain frames, controls and scripts (i.e., Visual Basic Script) which can be used to access the attached target board through defined variables and commands. A special HTML page dedicated to the control task can be defined and can be displayed in the separated tab in the detail view of the application main window.

5.5 Demo Mode

An important part of the FreeMaster’s capabilities is the demonstration and description of the target board application. It is essential that the demonstration project, once prepared, is not accidentally modified. To prevent modification, the project’s author can lock the project against changes by switching it into the *Demo Mode*. See **Figure 5-9** for details of the *Demo Mode* tab.



Project Demo Mode

- [ ] Enter the Demo Mode when the project is loaded
- [ ] Protect the Demo Mode by password

Password:

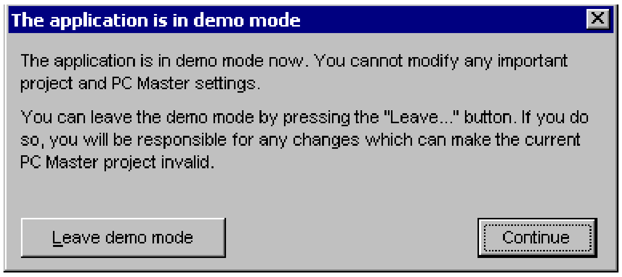
Verify the password:

Figure 5-9. Demo Mode Options

When the *Enter the Demo Mode...* box is checked, the demo mode is activated automatically after the project is loaded. The Demo Mode can be started manually by selecting *Demo Mode* from the *File* menu. Exit from Demo Mode can be protected by a password.

In the Demo Mode, the user cannot change the *Project Tree* item properties, cannot add or remove the tree items, and cannot change any project options, except those on the communication page.

When the user asks to leave the Demo Mode, the warning message shown in **Figure 5-10** appears, and the user is prompted for the password if the Demo Mode is password-protected.



The application is in demo mode now. You cannot modify any important project and PC Master settings.

You can leave the demo mode by pressing the "Leave..." button. If you do so, you will be responsible for any changes which can make the current PC Master project invalid.

Figure 5-10. Exit Demo Mode Confirmation Dialog

Section 6. HTML and SCRIPTING

All HTML pages used in FreeMaster are rendered using the standard Microsoft Internet Explorer component.

The advantage of using the HTML and Internet Explorer component is that it fully supports scripting languages and enables scripts to embed and access third-party ActiveX controls. The FreeMaster application itself implements an (non-visual) ActiveX component to let script-based code to access and control the target board application.

The following text is recommended only for HTML page creators experienced with scripting and interfacing of the ActiveX controls.

6.1 Special HTML Hyperlinks

When creating HTML pages which are to be displayed in the FreeMaster environment, the author can use special hyperlinks to let users navigate in the project tree or to invoke selected application commands (see **Section 4.3**).

Application command invocation hyperlinks include:

- *HREF=pcmaster:cmd:cmdname(arguments)* sends an application command *cmdname*. Command argument values can be specified in round brackets. An argument with a defined default value may be omitted.
- *HREF=pcmaster:cmdw:cmdname(arguments)* sends an application command *cmdname* and waits until the target application processes it
- *HREF=pcmaster:cmddlg:cmdname(arguments)* displays “Send Application Command” dialog for the application command *cmdname*. Any specified argument values are filled into appropriate fields in the dialog.

- *HREF=pcmaster:selitem:itemname:tabname* selects a project tree item named *itemname* and displays detail view and watch view contents exactly as if the user had selected the item manually. It then selects the specified tab in detail view.

  Valid *tabname* identifiers are:

  – *ctl,ctltab,control,controltab* = Control Page tab

  – *blk,blktab,blkinfo,blkinfotab* = Algorithm Block Description tab

  – *info,infotab,iteminfo,iteminfotab* = Current Item Help tab

  – *scope,osc,oscilloscope,osctab,scopetab* = Oscilloscope tab

  – *recorder,rec,rectab,recordertab* = Recorder tab

6.2 FreeMaster ActiveX Object

The FreeMaster object is registered in the system registry during each start of the FreeMaster application. Its class ID (CLSID) is

`{48A185F1-FFDB-11D3-80E3-00C04F176153}`

The registry name is "`MCB.PCM.1`"; version independent name is "`MCB.PCM`".

FreeMaster functions can be called from any HTML code via the FreeMaster ActiveX control. Insert the FreeMaster ActiveX control into your HTML code by the Class ID number (see the example below) and set the dimensions (height and width) to zero to make the object invisible.

```
<object name="PCMaster" width="0" height="0"
classid="clsid:48A185F1-FFDB-11D3-80E3-00C04F176153">
```

The FreeMaster ActiveX control provides the following functions:

- *SendCommand* sends FreeMaster-defined command
- *SendCommandDlg* opens command dialog and send a FreeMaster-defined command
- *ReadVariable* reads value from a FreeMaster-defined variable

- *WriteVariable* writes value to a FreeMaster-defined variable
- *ReadMemory, ReadMemoryHex* reads a block of memory from a specified location
- *GetCurrentRecorderData* retrieves data currently displayed in the recorder chart
- *GetCurrentRecorderSerie* retrieves one data series from the currently-displayed recorder chart
- *StartCurrentRecorder* starts the currently-displayed recorder
- *StopCurrentRecorder* stops the currently-displayed recorder
- *GetCurrentRecorderState* retrieves the current recorder status code and text

One callback event is implemented:

- *OnRecorderDone*, called when the currently-selected recorder finishes downloading new recorder data

6.3 FreeMaster ActiveX Object Methods

6.3.1 SendCommand

```
SendCommand (bsCmd, bWait, bsRetMsg)
```

6.3.1.1 Description

This function sends a FreeMaster-defined application command to the target application.

6.3.1.2 Arguments:

bsCmd [in]	String value with the command name and arguments to be sent. The command must be defined in the currently-open FreeMaster project
bWait [in]	Boolean value which selects whether to wait for the result of the command; select *True* (non-zero) to wait, *False* (zero) not to wait
bsRetMsg [out, optional]	String value returned after the command invocation. When an error occurs, this value contains an error message; otherwise, it contains a message defined in the FreeMaster project as command return value

6.3.1.3 Return Value:

Boolean Value	*“True*” is returned if the command has been sent without errors. “*False”* is returned if the command could not be found in FreeMaster project or if there was a communication error.

6.3.2 SendCommandDlg

```
SendCommandDlg (bsCmd, bsRetMsg)
```

6.3.2.1 Description

This function invokes the FreeMaster *Send Application Command* dialog.

6.3.2.2 Arguments:

bsCmd [in]	String value with the command name and arguments which should be displayed in the dialog. The command must be defined in the currently-open FreeMaster project
bsRetMsg [out, optional]	Text returned after the command invocation. When an error occurs, this value contains an error message

6.3.2.3 Return Value:

Boolean value	*"True"* is returned if the command has been sent without errors. "*False"* is returned if the command could not be found in FreeMaster project.

6.3.3 ReadVariable

```
ReadVariable (bsVar, vValue, tValue, bsRetMsg)
```

6.3.3.1 Description

This function reads value from a FreeMaster-defined variable.

6.3.3.2 Arguments:

bsVar [in]	String value with the name of the variable to be read. The variable must be defined in the FreeMaster project which is currently opened.
vValue [out, optional]	Returns numeric representation of the variable *bsVar*
tValue [out, optional]	Returns string value which represents the variable format and units necessary for displaying the variable value
bsRetMsg [out, optional]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.3.3 Return Value:

Boolean value	*"True"* is returned if the variable has been read without errors. "*False"* is returned if the specified variable was not found in FreeMaster project or if a communication error occurred.

6.3.4 WriteVariable

```
WriteVariable (bsVar, vValue, bsRetMsg)
```

6.3.4.1 Description

This function writes a value to a FreeMaster variable.

6.3.4.2 Arguments:

bsVar [in]	A string value with the name of the variable to be written. The variable must be defined in the currently-open FreeMaster project
vValue [in]	Value to write to the variable
bsRetMsg [out, optional]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.4.3 Return Value:

Boolean value	*"True*" is returned if the variable has been written without errors. "*False"* is returned if the specified variable was not found in FreeMaster project, if the value passed was invalid, or if a communication error occurred.

6.3.5 ReadMemory

```
ReadMemory (vAddr, vSize, arrData, bsRetMsg)
ReadMemory_t (vAddr, vSize, arrData, bsRetMsg)
ReadMemoryHex (vAddr, vSize, bsRet, bsRetMsg)
```

6.3.5.1 Description

These functions read a block of memory from the target application. They differ in how the data is returned to the caller.

- *ReadMemory* returns data in the safearray of variants, which can be used in both scripting languages like VBScript and in compiled languages like Visual Basic.
- *ReadMemory_t* returns data in the safearray of type “unsigned 1 byte integer”, which can be used in compiled languages like Visual Basic. Using typed arrays is faster than using arrays of variants.
- *ReadMemoryHex* returns data in the string value. Each byte is represented in hexadecimal form by two characters.

6.3.5.2 Arguments:

vAddr [in]	The address of the memory block to be read. This can be either an absolute numeric address, a symbol name valid in the current FreeMaster project, or a symbol name plus offset value
vSize [in]	The size of memory block to be read
arrData [out, optional]	The return array of the values
bsRetMsg [out, optinal]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.5.3 Return Value:

Boolean value	*“True”* is returned if the memory block has been read without errors. “*False”* is returned if the specified address was invalid or if a communication error occurred.

6.3.6 WriteMemory

```
WriteMemory (vAddr, vSize, arrData, bsRetMsg])
```

6.3.6.1 Description

This function writes a block of bytes to the target application's memory.

6.3.6.2 Arguments:

vAddr [in]	The address of the memory area to be written. This can be either an absolute numeric address, a symbol name valid in the current FreeMaster project, or a symbol name plus offset value
vSize [in]	The size of memory block to be written
arrData [in]	Safe array of bytes to be written. It must contain at least vSize elements.
bsRetMsg [out, optinal]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.6.3 Return Value:

Boolean value	*"True"* is returned if the memory block has been read without errors. "*False"* is returned if the specified address was invalid or if a communication error occurred.

6.3.7 ReadXxxArray

To access array of 1,2, or 4-byte signed integers:

```
ReadIntArray (vAddr, vSize, vElemSize, arrData,
     bsRetMsg)
ReadIntArray_t (vAddr, vSize, vElemSize, arrData,
     bsRetMsg)
```

To access array of 1,2, or 4-byte unsigned integers:

```
ReadUIntArray (vAddr, vSize, vElemSize, arrData,
     bsRetMsg)
ReadUIntArray_v (vAddr, vSize, vElemSize, arrData,
     bsRetMsg)
ReadUIntArray_t (vAddr, vSize, vElemSize, arrData,
     bsRetMsg)
```

To access array of 4-byte floating point numbers:

```
ReadFloatArray (vAddr, vSize, arrData, bsRetMsg)
ReadFloatArray_t (vAddr, vSize, arrData, bsRetMsg)
```

To access array of 8-byte floating point numbers:

```
ReadDoubleArray (vAddr, vSize, arrData, bsRetMsg)
ReadDoubleArray_t (vAddr, vSize, arrData, bsRetMsg)
```

6.3.7.1 Description

These functions read a block of memory from the target application and translate return it to the caller in the form of integer or floating point numbers. For each call, there are one or two optional functions which can be used in different scripting environments:

- *ReadXxxArray* returns data as a safearray of variants, which can be used in both scripting languages like VBScript and in compiled languages like Visual Basic. As VBScript engine does not handle variants encapsulating 2 and 4-byte unsigned integer types, this method converts such a values to floating point format before returning.

- *ReadXxxArray*_v is the same as *ReadXxxArray* except it does not perform the VBScript translation for 2 and 4-byte unsigned integer types.
- *ReadXxxArray_t* returns data in the safearray of strictly typed values, which can be used in compiled languages like Visual Basic. Using typed arrays is significantly faster than using arrays of variants.

6.3.7.2 Arguments:

vAddr [in]	The address of the memory block to be read. This can be either an absolute numeric address, a symbol name valid in the current FreeMaster project, or a symbol name plus offset value
vSize [in]	The number of elements to be read from the array
vElemSize [in]	The size of an array element in bytes. The total number of bytes read from the target can be calculated as vSize * vElemSize.
arrData [out, optional]	The return array of the values
bsRetMsg [out, optinal]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.7.3 Return Value:

Boolean value	*"True"* is returned if the memory block has been read without errors. "*False"* is returned if the specified address was invalid or if a communication error occurred.

6.3.8 WriteXxxArray

To access array of 1,2, or 4-byte signed integers:

```
WriteIntArray (vAddr, vSize, vElemSize, arrData,
     bsRetMsg)
```

To access array of 1,2, or 4-byte unsigned integers:

```
WriteUIntArray (vAddr, vSize, vElemSize, arrData,
     bsRetMsg)
```

To access array of 4-byte floating point numbers:

```
WriteFloatArray (vAddr, vSize, arrData, bsRetMsg)
```

To access array of 8-byte floating point numbers:

```
WriteDoubleArray (vAddr, vSize, arrData, bsRetMsg)
```

6.3.8.1 Description

These functions translate an array of numbers passed by the caller into a block of bytes suitable for the target CPU and write it into the target memory.

6.3.8.2 Arguments:

vAddr [in]	The address of the memory block to be written. This can be either an absolute numeric address, a symbol name valid in the current FreeMaster project, or a symbol name plus offset value
vSize [in]	The number of elements to be written to the target memory.
vElemSize [in]	The size of an array element in bytes. The total number of bytes to be written to the target can be calculated as vSize * vElemSize.

arrData [in]	The array of the values to be written
bsRetMsg [out, optinal]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.8.3 *Return Value:*

Boolean value	*"True"* is returned if the memory block has been Write without errors. "*False"* is returned if the specified address was invalid or if a communication error occurred.

6.3.9 GetCurrentRecorderData

```
GetCurrentRecorderData (arrData, arrSerieNames,
     timeBaseSec, bsRetMsg)
GetCurrentRecorderData_t (arrData, arrSerieNames,
     timeBaseSec, bsRetMsg)
```

6.3.9.1 Description

These functions retrieve data currently displayed in the recorder chart. They differ in how the data is returned to the caller.

- *GetCurrentRecorderData* returns data in the safearray of variants, which can be used in both scripting languages like VBScript and in compiled languages like Visual Basic
- *GetCurrentRecorderData_t* returns data in the safearray of type "double floating point", which can be used in compiled languages like Visual Basic. Using typed arrays is faster than using arrays of variants.

6.3.9.2 Arguments:

arrData **[out, optinal]**	Return, two-dimensional array of values; the first dimension is series index, the second dimension is value index
arrSerieNames **[out, optional]**	Return array with names of series on appropriate indexes
timeBaseSec **[out, optional]**	Returned time between individual recorded samples in seconds; this value can be 0 if the target does not supply such a value.
bsRetMsg **[out, optional]**	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.9.3 Return Value:

Boolean value	*"True"* is returned if the data has been retrieved successfully from the recorder item. "*False"* is returned if there is no valid data in the recorder or there is no currently-active recorder.

6.3.10 GetCurrentRecorderSeries

```
GetCurrentRecorderSeries (bsSerieName, arrData,
     timeBaseSec, bsRetMsg)
GetCurrentRecorderSeries_t (bsSerieName, arrData,
     timeBaseSec, bsRetMsg)
```

6.3.10.1 Description

These functions retrieve one data series from the currently-displayed recorder chart. They differ in how the data is returned to the caller.

- *GetCurrentRecorderSeries* returns data in the safearray of variants, which can be used in both scripting languages like VBScript and in compiled languages like Visual Basic.
- *GetCurrentRecorderSeries_t* - returns data in the safearray of type "double floating point", which can be used in compiled languages like Visual Basic. Using typed arrays is faster than using arrays of variants.

6.3.10.2 Arguments:

bsSerieName [in]	String with the name of the series whose data is to be retrieved
arrData [out, optional]	Return array of the values
timeBaseSec [out, optional]	Returned time between individual recorded samples in seconds; this value can be 0 if the target does not supply such a value.
bsRetMsg [out, optional]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.10.3 Return Value:

Boolean value	*"True"* is returned if the data has been retrieved successfully from the recorder item. "*False*" is returned if there is no valid data in the recorder or if there is no recorder currently active.

6.3.11 StartCurrentRecorder

```
StartCurrentRecorder (bsRetMsg)
```

6.3.11.1 Description

This function starts the recorder which is currently-displayed in the FreeMaster window.

6.3.11.2 Argument:

bsRetMsg [out, optional]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.11.3 Return value:

Boolean value	“*True*” is returned if the recorder has been started successfully. “*False*” is returned if there is no recorder currently active.

6.3.12 StopCurrentRecorder

```
StopCurrentRecorder (bsRetMsg)
```

6.3.12.1 Description

This function manually stops the Recorder which is currently-displayed in the FreeMaster window.

Argument:

bsRetMsg [out, optional]	When an error occurs, this value contains an error message; otherwise, it is empty

6.3.12.2 Return Value:

Boolean value	*"True"* is returned if the recorder has been successfully stopped. "*False"* is returned if there is no recorder currently active.

6.3.13 GetCurrentRecorderState

```
GetCurrentRecorderState (nState, bsRetMsg)
```

6.3.13.1 Description

This function retrieves current recorder status code and assigned status text.

6.3.13.2 Arguments:

nState [out, optional]	Return numeric value identifying current recorder state. Valid states codes are:
	0=idle;
	1=starting;
	2=running;
	3=downloading results;
	4=holding received signal;
	5=error;
	6=manually stopping;
	7=not initialized

bsRetMsg [out, optional]	When an error occurs, this value contains an error message; otherwise, it contains text description of current recorder state

6.3.13.3 Return Value:

Boolean value	*"True"* is returned if the recorder state has been read successfully. "*False"* is returned if there is no recorder currently active.

6.3.14 RunStimulators

```
RunStimulators (bsStimNames)
```

6.3.14.1 Description

This function starts one or more FreeMaster variable stimulators.

6.3.14.2 Arguments:

bsStimNames [in]	A semicolon-delimited list of stimulators to be started.

6.3.14.3 Return Value:

Integer Value	Number of stimulators actually started. This number may be equal or less than the number of semicolon-delimited stimulator names passed in bsStimNames parameter. The return count does not include stimulators not found by name and stimulators which were already running.

6.3.15 StopStimulators

```
StopStimulators (bsStimNames)
```

6.3.15.1 Description

This function halts one or more FreeMaster variable stimulators.

6.3.15.2 Arguments:

bsStimNames [in]	A semicolon-delimited list of stimulators to be halted.

6.3.15.3 Return Value:

Integer Value	Number of stimulators actually stopped. This number may be equal or less than the number of semicolon-delimited stimulator names passed in bsStimNames parameter. The return count does not include stimulators not found by name and stimulators which were not running.

6.4 FreeMaster ActiveX Properties

Starting version 1.2.20, the FreeMaster also supports scripting languages which do not implement by-reference passing of the function parameters (e.g. JScript). The “output” parameters in all ActiveX methods are now declared as “optional” and do not need to be specified by the caller at the time the FreeMaster method is called. After the call is made, all output values can be fetched using ActiveX properties as described in the **Table 6-1** below.

For each property in the FreeMaster ActiveX interface, there is also a “GetLast...” function available and implements the same functionality as when reading the property value itself. Such functions can be used in scripting environment where accessing ActiveX object properties is not possible or convenient.

Table 6-1 FreeMaster ActiveX Object Properties

Property Name	Description
LastResult	The return value of the last ActiveX function called
LastRetMsg	The error message returned by the last ActiveX function called (the value of bsRetMsg output parameter)
LastVariable_vValue	The value of the “vValue” output parameter returned by the last ReadVariable method called
LastVariable_tValue	The value of the “tValue” output parameter returned by the last ReadVariable method called
LastMemory_hexstr	The value of the “bsRet” output parameter returned by the last ReadMemoryHex method called
LastMemory_data	The array of values returned in “arrData” output parameter by the last call to one of the ReadMemory or ReadXxxArray methods.
LastRecorder_data	The array of values returned in “arrData” output parameter by the last call to GetCurrentRecorderData or GetCurrentRecorderSeries methods.
LastRecorder_serieNames	The array of values returned in “arrSerieNames” output parameter by the last call to GetCurrentRecorderData method.

Table 6-1 FreeMaster ActiveX Object Properties

Property Name	Description
LastRecorder_timeBaseSec	The value of the “timeBaseSec” output parameter returned by the last call to GetCurrentRecorderData method.
LastRecorder_state	The value of the “nState” output parameter returned by the last call to GetCurrentRecorderState method.

6.5 FreeMaster ActiveX Object Events

6.5.1 OnRecorderDone

```
OnRecorderDone()
```

6.5.1.1 Description

This event is called when the active recorder finishes downloading of a new data.

6.6 Examples

FreeMaster ActiveX control functions can be used within HTML script code, JScript, or VBScript. The following example demonstrates the use in VBScript. JScript users should also refer to **Section 6.4**.

```
<script language="VBScript">

Function GetSpeed()

  succ = pcm.ReadVariable("Speed", vValue, tValue, bsRetMsg)

  If succ then
    idSpeed.InnerText = tValue

    If vValue > 100 then
      pcm.SendCommand("SlowDown()", 1)
    End If
  Else
    idError.InnerText = bsRetMsg
  End If

End Function

</script>

<object classid="clsid:48A185F1-FFDB-11D3-80E3-00C04F176153"
height="0" width="0" id="pcm" name="pcm">

<input TYPE=button VALUE="Get Speed" onClick="GetSpeed()">
```

Appendix A. References

1. DSP56800 Family Manual; Motorola (DSP56800FM/D)
2. DSP56F801/803/805/807 16-Bit Digital Signal Processor User’s Manual; Motorola (DSP56F801-7UM/D)
3. DSP56800E 16-bit DSP Core Reference Manual; Motorola (DSP56800ERM/D)
4. 56F8300 Hybrid Controller Peripheral User Manual; Motorola (MC56F8300UM/D)
5. MPC500 Family RCPU Reference Manual; Motorola (RCPURM/AD)
6. MPC555 / MPC556 USER’S MANUAL; Motorola (MPC555UM/D)
7. DSP56800_Quick_Start User’s Manual; Motorola
8. DSP56800E_Quick_Start User’s Manual; Motorola
9. MPC500_Quick_Start User’s Manual; Motorola
10. MPC5500_Quick_Start User’s Manual; Motorola

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