HI-WAVE
D-Bug12 Monitor
Target Component

Revised 07/17/2003

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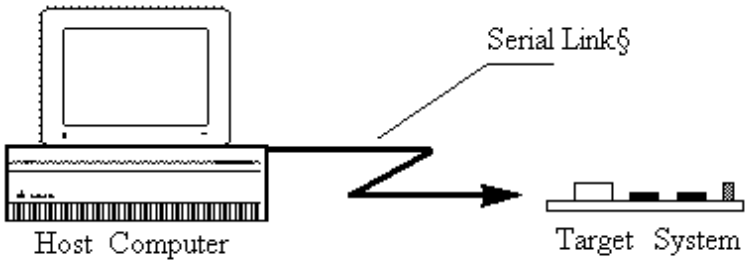
D-Bug12 Monitor Target Component

Introduction

Another advanced feature of HI-WAVE for the embedded system development world is the ability to load different Framework targets. The D-Bug12 Monitor Target Interface is introduced in this document.

The D-Bug12 Monitor target component is an interface used by HI-WAVE to communicate with the Target System **"*M68HC12B32EVB Evaluation Board*"** and **"*M68HC12A4EVB Evaluation Board*"**.



With this interface, you can download an executable program from the HI-WAVE environment to an external target system based on a Motorola MCU which will

execute it. You will also have the feedback of the real target system behavior to HI-WAVE.

HI-WAVE will fully supervise and monitor the MCU of the target system i.e. control the CPU execution. You can read and write in internal/external memory (even when the CPU is running), single-step/run/stop the CPU, set breakpoints in the code.

NOTE	Unconcerned Components: As the code is executed by an external MCU, memory statistics are not available with the D-Bug12 Monitor target component. Therefore, Profiling, Coverage analysing, watchpoints and I/O simulation will not work with the D-Bug12Monitor component.

Interfacing Your System and a Target

Hardware Connection

M68HC12B32EVB Evaluation Board or M68HC12A4EVB Evaluation Board must be connected to the COM port of the host with a standard serial communication cable connected to J3 port on M68HC12A4EVB or P1 port on M68HC12B32EVB.

The host communication port and baudrate can be configured within HI-WAVE has explained below.

Communication Configuration

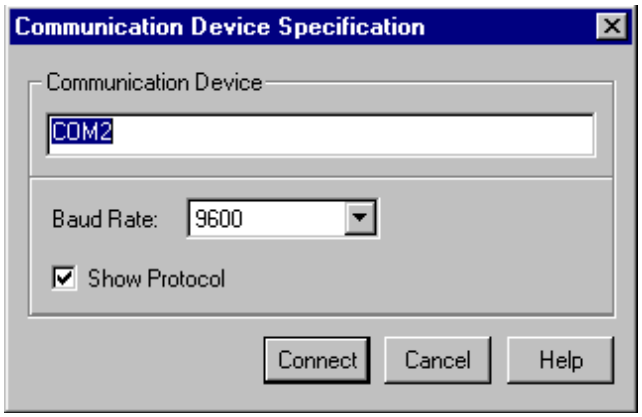
In a general way, the communication between HI-WAVE and Target System is set automatically. In case of communication setup default, the following dialog will pop up.

Make sure that the parameters on your host computer are correctly configured and that the serial communication device used is set correctly.

When using the HC12B32EVB board, check if the jumpers on the Evaluation Board are set on the right positions depends on the used EVB- or POD Mode and if the BDM cable is connected correct in POD Mode, otherwise, any communication between HI-WAVE and the target is impossible.

Communication Device

If host and target are not connected, or the connection is not via the communication device expected, a dialog box pops up in HI-WAVE as shown below.



Choose an available communication device, type it in the *Communication Device* edit box, set the Baud Rate with the drop down control and click *Connect*. This command only tries the communication device that you chose. If no connection can be established on the selected baudrate, HI-WAVE tries 57600, 38400, 28800, 19200, 9600, ... 1200. The communication device chosen is saved for a later debugging session. When clicking *Cancel,* the dialog box and the environment can be quit. The default device is COM1 and the default speed is 9600 baud.

NOTE	The communication device and the baud rate saved through this dialog override environment variables `BAUDRATE` and `COMDEV` of the `DEFAULT.ENV` file.

Baudrate

set the Baud Rate with the drop down control and click *Connect*. This command only tries the communication device that you chose. The communication device chosen is

saved for a later debugging session. When clicking *Cancel,* the dialog box and the environment can be quit. The default device is COM1.

Show Protocol

If the *Show Protocol* box is checked, all the commands and responses sent and received are reported in the Command Line window.

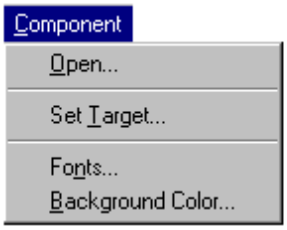
NOTE	This feature is used by support personnel from Motorola or Metrowerks.

NOTE	The communication device, the baud rate and the show protocol saved through this dialog override environment variables `BAUDRATE`, `COMDEV and SHOWPROT` of the `DEFAULT.ENV` file.

Loading the D-Bug12 Monitor Target Component

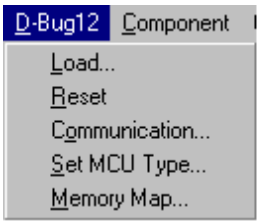
Usually the target is set in the `PROJECT.INI` file, where `Target=d-bug12`. The D-Bug12 Monitor Component detects automatically that the target is connected to your system. However, if nothing is detected, the dialog box mentioned above pops up and inform you that the target is not connected, is connected to a different port or the jumpers of the Evaluation Board are not set correctly.

If no target is set in the `PROJECT.INI` file or if a different target is set, you can load the D-Bug12 Monitor Component selecting in the main menu *Component* | *Set Target...* as shown below and choose *D-bug12* in the list of proposed targets.



D-Bug12 Monitor Target Component Menu Entries

After loading the Monitor component, the *Target* menu item is replaced by Monitor.



The different entries of the Monitor menu are explained below:

Loading an application

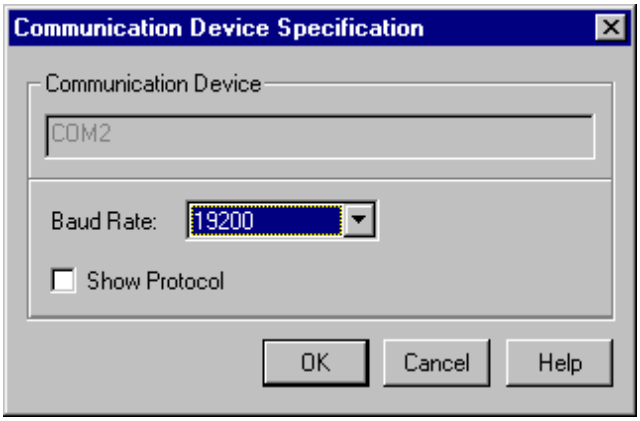
Choose *Monitor* | *Load...* to load the application to debug, i.e. a `.ABS` file.

Reset

The Command *Monitor* | *Reset* executes the reset command file `RESET.CMD` file and resets the target system processor when operating in POD Mode **only**.

Communication

Select entry *Monitor* | *Communication...* to display the dialog box shown below. Through this dialog the communication speed can be set. The Baudrate 57600..1200 baud are available. If there is no connection to the target, the entry *Communication..* of menu *Monitor* is replaced with *Connect* and it is possible to change also the Communication Device.

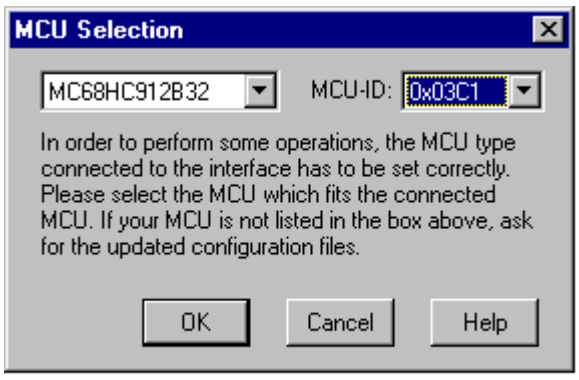


For details about *Communication Device*, *Baudrate* and *Show Protocol* please see in chapter *Communication Configuration.*

NOTE	When using the D-Bug12 Monitor with M68HC12B32EVB and loading an application onto on-chip RAM in POD mode, a transfer timing problem could occur. Sometimes the monitor is not able to handle high transfer rates and the RAM program is written incorrectly. Please reduce the baudrate to 38400 or lower rates to overcome this problem.

MCU Selection

Choose *D-Bug12* | *Set MCU Type...* to open this dialog.



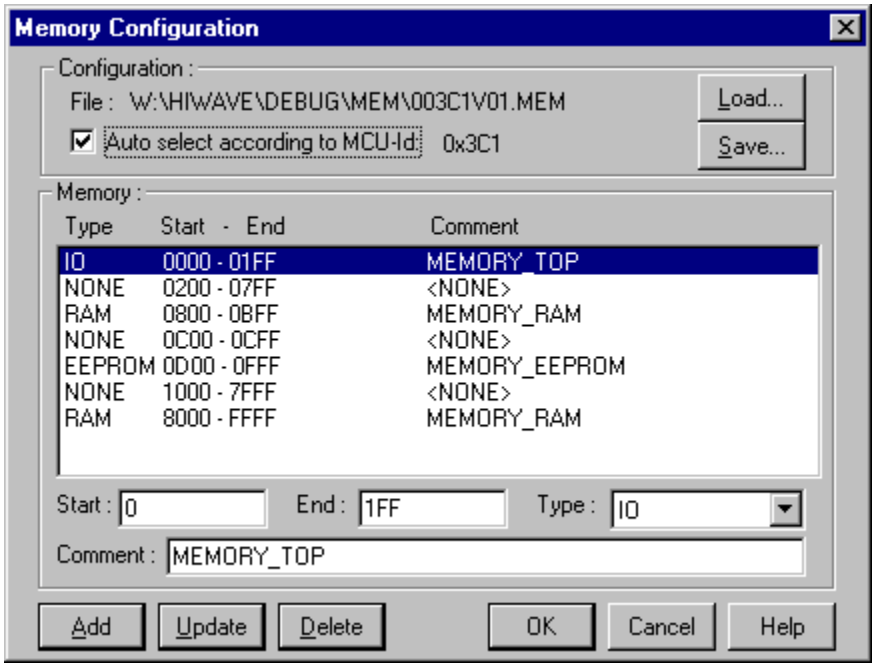
This dialog allows you to select the MCU currently used. There are two drop list Combo controls. They show the currently selected MCU name and MCU-ID.

The information will be taken from the file `MDSEMCU.INI`. If a specific MCU is not found in this file, the user is advised to update his installation.

The selection will be saved and used as default for the next session.

Memory Configuration

Choose *D-Bug12* | *Memory Map...* to open this dialog.



This dialog shows the default configuration for the configured MCU. This setup is automatically loaded if the *Auto select* box is checked. The information about the memory layout is read from the MCU specific personality file. The personality file can be decomposed in the following way:

`00nnnVvv.MEM`

where `nnn` is the hexadecimal representation of the MCUid (3 digits) and `vv` is the version number.

This file is looked up in the "`PROG\MEM`" subdirectory of your installation.

NOTE At the moment, this dialog is just used to display the default memory layout. Therefore it is not possible to modify this configuration and all buttons are disabled except "Ok", "Cancel" and "Help" buttons.

The HI-WAVE Status Bar for the Monitor

When the Monitor target component has been loaded, specific information are given in the HI-WAVE status bar. The baudrate of the serial communication, the current evaluation board Mode (EVB or POD), the CPU derivative and the HI-WAVE status (target status) are displayed from the left to the right in the status bar.

Default Target Setup

As any other target, the Monitor target component can be loaded from the *Target* menu or can be set as a default target in the `PROJECT.INI` file which should be located in the working directory.

Example of `PROJECT.INI` file.

```
[DEFAULTS]
Window0=Source      0    0   50   40
Window1=Assembly   50    0   50   40
Window2=Register   50   40   50   30
Window3=Memory     50   70   50   30
Window4=Data        0   40   50   25
Window5=Command     0   65   50   20
Window6=Module      0   85   50   15
Target=D-bug12
```

NOTE	Please see HI-WAVE Userguide for further information about the `PROJECT.INI` file.

Typically the target is set in the `PROJECT.INI` file as shown above. However, if the target is not defined, load the Monitor target component interactively when opening the *Component* menu, choosing *Set Target...* and select the *D-bug12* target component.

Monitor Default Environment

As any HI-WAVE component, the behavior of the Monitor target component can be parameterized through the `DEFAULT.ENV` file which should be located in the working directory. The section shown below is the sample of the `DEFAULT.ENV` file concerning the Monitor target (example).

Example

```
BAUDRATE=19200
```

`BAUDRATE`

This parameter specifies the baudrate of the communication between host computer and target. The default speed is 9600 baud.

Example

```
BAUDRATE=9600
```

COMDEV

The communication port to be used on the host computer can be specified using environment variable COMDEV. `COM1` is the default communication device for PCs and `/dev/ttya` for UNIX systems. You can set a different device from the following lists:

For a PC:

Any valid communication device (COM1, COM2, etc.).

Example

```
COMDEV=COM3
```

For SUN:

Any valid communication device (`/dev/ttya`, etc.).

Example

```
comdev=/dev/ttyb
```

SLAVEDELAY

There is an environment variable SLAVEDELAY that can be set. The default value is 20 ms (milliseconds), and values up to 1000 ms are allowed. This environment variable sets the delay that the target system uses to respond to the host. If the target system does not react correctly with the given delay, the delay should be increased, e.g. set the value to 100ms.

Example

```
SLAVEDELAY=100
```

SHOWPROT

If the *Show Protocol* is used, all the commands and responses sent and received are reported in the command line window. If the environment variable is set to *ON*, *Show Protocol* is activated.

Example

```
SHOWPROT=ON
```

NOTE	This feature is used by support personnel from Motorola or Metrowerks.

MCUID

If this parameter is specified, the corresponding register file is loaded from the current working directory.

Example

```
MCUID=0x3C1
```

NOTE	The communication device, the baud rate and the show protocol saved through the communication device dialog override environment variables `BAUDRATE`, `COMDEV` and `SHOWPROT` of the `DEFAULT.ENV` file.

EEPROM_START, EEPROM_END

The default EEPROM address range set for this demo version is set for the HC912B32 MCU. However, you can force this default configuration with environment variables `EEPROM_START` and `EEPROM_END`.

Example for the HC812A4

```
EEPROM_START=0x1000
EEPROM_END=0x1FFF
```

Monitor Target Component Commands

The following commands can be entered in the `STARTUP.CMD` file or in the Command Line component.

PROTOCOL

If this command is used, all the commands and responses sent and received are reported in the command Line window.

Syntax:

PROTOCOL ON|OFF

Example

```
PROTOCOL ON
```

NOTE	This feature is used by support personnel from Motorola or Metrowerks.

BAUDRATE

With this command it is possible to change the baudrate from the command line window.

Syntax:

BAUDRATE <baudrate>

Example

```
BAUDRATE 19200
```

PT

With the command **PT** (***Pass Through***), it is possible to use any D-Bug12 commands (from the HIWAVE Command Line component window) which are terminated with 'return'. That means that e.g. the commands '`ASM`', '`MM`' will not work from the command line window (because several instructions can be executed and a '. return' terminates the command).

Syntax

PT <D-Bug12 Command>

To set a hardware breakpoint from the command line window, type:

```
PT USEHBR
```

If HIWAVE sets the next time a breakpoint (through the commands: set Breakpoint, StepOver...) a hardware breakpoint is used.

To see all available D-Bug12 commands, type `PT HELP` in the Command Line.

VER

The version command displays the version of the D-Bug12 Target Interface Component, followed by the output from the D-Bug12 'device' command.

Syntax

```
VER
```

Example:

```
....
D-Bug12 Target   5.3.2
Device: 912B32
EEPROM: $0D00 - $0FFF
Flash: $8000 - $FFFF
RAM: $0800 - $0BFF
I/O Regs: $0000
HC12 CPU         6.0
```

DEVICE

The device command is recognized and directed to the D-Bug12. No checking of the parameters is done (this is left to the D-Bug12).

Syntax:

DEVICE <parameters>

Example:

```
DEVICE  DG128 800 FFF 4000 FFFF 1000 1bFF 0
```

TERMINAL

This command enables pseudo terminal emulation. In order to simulate the terminal I/O a work space of 6 bytes is needed. The parameter WSPAdr of this command specifies the base address of this work space.

Syntax:

`TERMINAL <WSPAdr>`

Example:

```
TERMINAL 0x9FA
```

This command enables terminal emulation and the memory from 0x9FA to 0x9FF is used as work space.

To disable this feature (default) zero can be specified as work space address:

Example:

```
TERMINAL 0
```

How works the terminal emulation?

The terminal area is three words long as shown below.

terminal_area	in_flag
terminal_area+1	in_char
terminal_area+2	out_flag (hi)
terminal_area+3	out_flag (lo)
terminal_area+4	str_adr (hi)
terminal_area+5	str_adr (lo)

If the in_flag byte is not zero, this indicates that the in_char byte contains a character sent to the application by HI-WAVE. In other words: for the application in the target, this in_flag byte is an “input character received” flag.

If the out_flag word contains the value $5A5A, this indicates that the str_adr field contains the address of a string the application in the target wants to send to the HI-WAVE/terminal. HI-WAVE sets the out_flag to some other value once it has processed that string to indicate that the application may continue sending data.

To use the terminal emulation with your application, you need to link your application with “inout.o”, “terminal.o” and “termmoni.o” and use functions available in associated sources files.

For more information and example, please see the Calculator demo program and sources file and specially “termmoni.c” in the demo directory of the installation. The application **calc*.abs** is an example which uses terminal emulation and in the file termmoni.c the structures of the terminal area as they are defined above are used.

Monitor Target Startup File

The startup command file `STARTUP.CMD` is executed by HI-WAVE straight after the D-Bug12 Monitor target driver has been loaded. This file must be located in the working directory. You can use any HI-WAVE command in this file and take advantage of the wide set of commands introduced in the *HI-WAVE* manual to setup the target hardware before loading any application.

Example of a `STARTUP.CMD` file content:

```
wb 0x0035   0x00
wb 0x0012   0x11
baudrate 19200
protocol off
TERMINAL 0x9FA
```

M68EVB912B32 Evaluation Board

Introduction

The D-Bug12 Monitor supports the EVB- and the POD operating mode of the Evaluation Board.

In EVB Mode the application loaded into to the RAM area of the Evaluation Board is executed and controlled through HI-WAVE.

In POD Mode the Evaluation Board serves as a BDM interface between the user and a second M68EVB912B32 board or any other M68HC12 system. In this case the W12 connector must be used as BDM output.

Operating Modes

The D-Bug12 Monitor is on-chip (HC912B32) Flash EEPROM, located in $8000-$F67F and is automatically run when setting the board in EVB or POD mode.

You can reprogram the Flash EEPROM through the BOOTLOAD mode to install your own program in this area but if you remove/overwrite the D-Bug12 monitor, HI-WAVE will no longer monitor the board.

The EVB mode (jumper W3-0, W4-0) is used to debug applications loaded directly on your board connected to your PC serial port, monitored by D-Bug12. In POD mode (using 2 target boards), the host EVB serves as a non intrusive controller for a second target board via the BDM interface, like an SDI interface. Therefore the BDM-OUT connector of the host target should be connected to the BDM-IN connector of the target board.

Note that using factory configuration memory map on the M68HC12B32EVB board, user code/data available is 512 bytes of on-chip RAM in $800-$9FF and 768 bytes of on-chip EEPROM in $D00-$FFF.

Jumper Settings

Jumper	Operating Mode
W3-0, W4-0	EVB Mode
W3-0, W4-1	POD Mode

Memory Map

In EVB Mode the application must be loaded into the memory area 0x800..0x9FF. The memory area 0xA00..0xBFF is used by the D-Bug12 monitor program and must not be used. In POD Mode the area 0xA00..0xBFF can also be used by the application (on HC12B32 target only).

It is not possible to define user vectors because the interrupt vector jump table is located in the Flash EEPROM area.

Address	Memory
0x0000..0x01FF	on-chip registers
0x0800..0x09FF	user RAM in EVB/POD Mode
0x0A00..0x0BFF	user RAM in POD Mode/reserved for D-Bug12 in EVB Mode
0x0D00..0x0FFF	on-chip EEPROM
0x8000..0xFFFF	on-chip Flash EEPROM

How does the Communication works?

This section describes the way HI-WAVE in the host communicates with the M68HC12B32 Evaluation Board.

HIWAVE will use the commands which are provided from the D-Bug12 monitor which is installed in Flash EPROM of the M68HC12B32 Evaluation board.

The following commands are used:

Function	D-Bug12 D-Bug12Command
read memory	upload <startadr> <endadr>
write memory	load <adr>
read register	rd
write register	<register> <value>
read PC	rd
write PC	pc <value>
set breakpoint	br <adr>
delete breakpoint	nobr <adr>
start program	g
single step	t

Function	D-Bug12 D-Bug12Command
halt program	POD mode: stop EVB mode: see below
reset	POD mode: reset EVB mode: -

Halt Program in EVB mode

To halt the program the SCI receiver interrupt is used. Before the application is started, the 'Receiver Interrupt Enable' Flag is set. If now a character is sent to the target, a SCI0 interrupt occures and the message 'SCI0 Exception' is sent to host computer. If the target was running while a SCI0 interrupt occurred, the target is restarted after the command (which triggered the interrupt) is processed. So it is possible to read and write memory while the target is running.

User defined Vectors

Traps are not cached because the interrupt jump table is located in Flash EEPROM (0xF7C0..0xF7CF) and so it is not possible to initialize the vector table.

Hardware Breakpoints

For monitor versions equal or bigger than '`Monitor V2.0.2`' it exists a command '`USEHBR`' to switch to hardware breakpoints. It is not possible to switch back to normal breakpoints (except with a reset).

To set a normal breakpoint, the command '`BR`' is used, e.g. `BR 800` // sets a breakpoint at address `0x800`

To set a hardware breakpoint the following commands are used:

```
USEHBR // switch to hardware breakpoint
BR D00 // set hardware breakpoint at address 0xD00
       // (EEPROM area for a M68EVB912B32 board)
```

NOTE There are only two hardware breakpoints available and it is not possible to switch back to set 'Software' breakpoints. To set normal breakpoints, a reset of the board must be done.

To set a hardware breakpoint from the Command Line component window, type:

```
PT USEHBR
```

If HIWAVE sets the next time a breakpoint (through the commands: set Breakpoint, StepOver...) a hardware breakpoint is used.

For more information, please refer to the *M68EVB912B32 Evaluation Board User's Manual* or the *M68HC12A4EVB Evaluation Board User's Manual*.

M68HC12A4EVB Evaluation Board

On the A4 board, user code/data available is 512 bytes of on-chip RAM in $800-$9FF, 4KB of on-chip EEPROM in $1000-$1FFF and 16KB of pseudo-ROM (external RAM) in $4000-$7FFF. The D-Bug12 monitor is installed on the 32 KB external EPROMs above address $8000.

Please make sure that jumper settings of the board are default (D-Bug12) settings and not SDI (Background Debug Mode) settings.

For more information, please refer to the *M68HC12A4EVB Evaluation Board User's Manual*.

2

D-Bug12 Monitor Demo

Debugging with the D-Bug12 Monitor on the M68HC12B32EVB and M68HC12A4EVB Target Boards

This section gives an overview of debugging with the D-Bug12 Monitor on the M68HC12B32EVB and M68HC12A4EVB Target Boards.

The ***Asciimon*** target component is an interface used by HI-WAVE to communicate with the above boards, using the on-board **D-Bug12 Monitor** and communicating in ASCII with the monitor.

With this interface, you can download an executable program from the HI-WAVE environment to an external target system based on a Motorola MCU which will execute it. You will also have the feedback of the real target system behavior to HI-WAVE.

HI-WAVE will fully supervise and monitor the MCU of the target system i.e. control the CPU execution. You can read and write in internal/external memory (even when the CPU is running), single-step/run/stop the CPU, set breakpoints in the code.

NOTE	**Unconcerned Components** As the code is executed by an external MCU, memory statistics are not available with the D-Bug12 Monitor target component. Therefore, Profiling, Coverage analysing, watchpoints and I/O simulation are not available with the D-Bug12Monitor component.

Technical Considerations about M68HC12B32EVB and M68HC12A4EVB

Two debugging mode can be set with the M68HC12B32EVB board: EVB mode and POD mode. The HI-WAVE monitor can be handle both modes.

The D-Bug12 Monitor is on-chip (HC912B32) Flash EEPROM, located in $8000-$F67F and is automatically run when setting the board in EVB or POD mode.

You can reprogram the Flash EEPROM through the BOOTLOAD mode to install your own program in this area but if you remove/overwrite the D-Bug12 monitor, HI-WAVE will no longer monitor the board.

The EVB mode (jumper W3-0, W4-0) is used to debug applications loaded directly on your board connected to your PC serial port, monitored by D-Bug12. In POD mode (using 2 target boards), the host EVB serves as a non intrusive controller for a second target board via the BDM interface, like an SDI interface. Therefore the BDM-OUT connector of the host target should be connected to the BDM-IN connector of the target board.

Note that using factory configuration memory map on the M68HC12B32EVB board, user code/data available is 512 bytes of on-chip RAM in $800-$9FF and 768 bytes of on-chip EEPROM in $D00-$FFF.

On the A4 board, user code/data available is 512 bytes of on-chip RAM in $800-$9FF, 4KB of on-chip EEPROM in $1000-$1FFF and 16KB of pseudo-ROM (RAM) in $4000-$7FFF. The D-Bug12 monitor is installed on the 32 KB external EPROMs above address $8000.

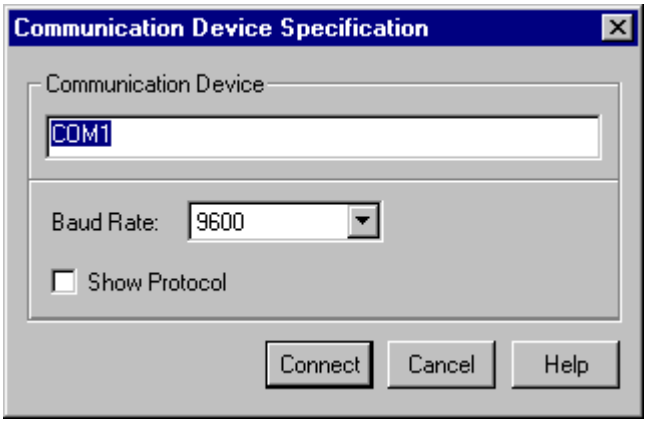
For more information, please refer to the *M68EVB912B32 Evaluation Board User's Manual* or the *M68HC12A4EVB Evaluation Board User's Manual*.

Starting with the D-Bug12 ASCII Monitor

1. First close HI-WAVE if it is running then, within the Hiware Technology Tools shell, open the project directory `C:\HICROSS\DEMO\DBG12C`.
2. Make sure that the board hardware settings are the default settings for D-Bug12 mode given by Motorola user manuals.
3. Then connect the M68HC12B32EVB "**P1"** connector or the M68HC12A4EVB "**J3"** connector to the serial communication port COM1 or COM2 of your PC, using an RS-232 cable.

4. Power supply the board with the appropriate voltage (5 Volts DC, please see Motorola specifications).
5. Reset the board pressing the appropriate "RESET" button (S1 button on both boards).
6. Run HI-WAVE. If the following "*Error*" message is displayed, it means that HI-WAVE did not found the board on your COM1 port.

7. Click *Ok*, then HI-WAVE asks you to specify the communication port in the following dialog.

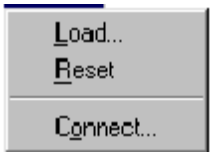


8. In the *Communication Device* edit box, type "COM2". Click the *Connect* button.

Note that HI-WAVE will select the highest possible baudrate by successive tries. However, when loading a program on M68HC12B32EVB in POD mode, you should select a baudrate not higher than **9600** for a safe data transfer.

The HI-WAVE statusbar gives the baudrate, the debugging board mode (here EVB mode) and the monitor status.

The HI-WAVE main menu contains a Monitor entry from where your can reset the monitor when selecting *Reset*, set the serial communication parameters when selecting *Connect...* or load a `.ABS` application to debug when selecting *Load...*



Fibo.abs Application

At this point, you can load example programs delivered with this demo version, like `FIBO.ABS` sample which can be executed on M68HC12B32EVB and M68HC12A4EVB boards. The program is small enough to be loaded in on-chip RAM area from $800 to $9FF (code + variables + stack).

Load and run this example as if you were running the `FIBO.ABS` application with the HI-WAVE *Simulator* described in the *HI-WAVE Simulator* previous section.

Terminal Calculator Application

A second example delivered called `CALCA4.ABS` / `CALCB32.ABS` / `CALCPOD.ABS` uses the *Terminal* component to send information type on the PC keyboard to the application running on the board. Also information are sent back from the running program to this *Terminal* window.

`CALCB32.ABS` and `CALCPOD.ABS` are for the M68HC12B32EVB board respectively for EVB and POD modes. The programs are bigger than the `FIBO.ABS`

application and are therefore loaded on on-chip EEPROM, as specified in the `.PRM` file in $D00-$FFF:

```
SECTIONS
  MY_RAM = READ_WRITE 0x800 TO 0x813;
  MY_ROM = READ_ONLY  0xD00 TO 0xFFF;
PLACEMENT
  DEFAULT_ROM  INTO  MY_ROM;
  DEFAULT_RAM  INTO  MY_RAM;
END
```

NOTE	The default EEPROM address range set for this demo version is set for the HC912B32 MCU. However, you can force this default configuration with environment variables `EEPROM_START` and `EEPROM_END` as explained in section **Programming the HC912B32 On-chip EEPROM**. (e.g. for the HC812A4: `EEPROM_START=0x1000`, `EEPROM_END=0x1FFF`.

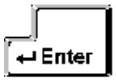
Therefore it takes more time to download them. However, they are resident and you can switch off the board without loosing them.

`CALCA4.ABS` is the same program adaptation for the M68HC12A4EVB board. Variables and stack are in the same area but the code now is installed in pseudo-ROM located in $4000-$7FFF:

```
SECTIONS
  MY_RAM = READ_WRITE 0x800 TO 0x813;
  MY_ROM = READ_ONLY  0x4000 TO 0x42FF;
PLACEMENT
  DEFAULT_ROM  INTO  MY_ROM;
  DEFAULT_RAM  INTO  MY_RAM;
END
```

Running the Calculator

1. Reset the board pressing the appropriate “RESET” button (S1 button on both boards).
2. In the main menu, choose *Component* | *Open... Terminal* to open the Terminal component.

3. In the main menu, choose *Monitor* | *Load...* `CALCA4.ABS` / `CALCB32.ABS` / `CALCPOD.ABS` (two HC12 boards required as explained above) to load the Calculator application on the appropriate board.
4. Click  to start the execution of the application.
5. In the *Terminal* window, "CALCULATOR" is displayed.
6. You can type now on your PC keyboard basic operations like "`34 * 5`" or "`12 + 23`", etc. Operators available: `+`, `-`, `/`, `*`.
7. Type 

or  to execute the operation.

NOTE	The terminal memory space interface between the **Terminal** component and the Calculator programs is set with the command "**`TERMINAL 0x9FA`**" in the **`STARTUP.CMD`** file of the **`C:\HICROSS\DEMO\DBG12C`** directory. This exchange area is therefore in on-chip RAM. Also the stack pointer is set in **`main`** function in **`calc.c`** with the instruction "**`asm LDS #0x9F9`**".

Hardware Breakpoints on M68HC12B32EVB

For D-Bug12 versions equal or bigger than *Monitor V2.0.2* you can use the command **`USEHBR`** to switch to hardware breakpoints **when loading a program in the Flash EEPROM of the HC12B32EVB** (software breakpoints are then no longer available, D-Bug12 is overwritten). Then it is not possible to switch back to normal breakpoints without resetting the board.

To set a normal breakpoint, the command '`BR`' is used, e.g. `BR 800` // sets a breakpoint at address 0x800

To set a hardware breakpoint the following commands are used:

```
USEHBR // switches to hardware breakpoints
BR D00 // sets a hardware breakpoint at address 0xD00
       // (EEPROM area for a M68EVB912B32 board)
```

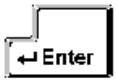
NOTE	There are only two hardware breakpoints available and it is not possible to switch back to set 'Software' breakpoints. To set normal breakpoints, a reset of the board must be done.

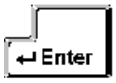
You can use the HI-WAVE "PT" (PT for *Pass Through*) command to run D-Bug12 commands within HI-WAVE. Only single line D-Bug12 commands can be used as parameter of PT. (e.g. 'ASM', 'MM' are not handled).

Syntax

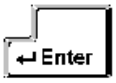
```
PT <D-Bug12 Command>
```

Therefore to set a hardware breakpoint, open the *Command Line* component and type, for example:

PT USEHBR 

then BR D00 

For example, to see all available D-Bug12 commands, type:

PT HELP 

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