F²MC-16L/LX FAMILY
16-BIT MICROCONTROLLER
MB903XX/4XX/5XX/6XX

EMULATOR SETUP MB2147-05
16BIT COMPACT-ICE

APPLICATION NOTE

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Revision History

Date	Issue
18.11.02	V1.0 tka
10.04.03	V1.1 tka, Emulator comparison table corrected: Third row, Maximum Operating Frequency
17.08.03	V1.2 tka, Notes for monitor-load auto programming added
06.01.2005	V1.3, hwe, chapter 5.2 'Monitoring' added

This document contains 23 pages.

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Contents

0   Introduction

The MB2147-05 emulator system is a low cost emulator system which can be used for Fujitsu 16-Bit microcontrollers of the 16L/16LX Series. This application note should give a short guideline how to install an MB2147-05 emulation system. This guide describes on the one side the hardware installation configuration and shows on the other side how to install and configure the corresponding software development environment to allow users a quick start-up.

This guide does not replace the Hardware Manual of MB2147-05. This guide is giving just a short introduction how to set-up and configure the emulator system environment. For more detailed information please check the corresponding hardware manual of MB2147-05.

Note

There may exist restrictions in supporting some microcontroller series, so please check first whether the used microcontroller evaluation chip can be supported by MB2147-05. Currently the MB2147-05 can only support evaluation chips based on 0.5μm technology:

   MB906xx, MB905xx, MB90385, MB90420, MB90425, MB90435, MB90440,
   MB90455, MB90460, MB90470, MB90495

The following series are **not** supported by this low cost emulation system:

   MB90340, MB90350, MB90390, MB90480

1 Overview

1.1 Features of MB2147-05 low cost In-Circuit Emulator

▸ Supported Series

MB906xx, MB905xx, MB90385, MB90420, MB90425, MB90435, MB90440, MB90455, MB90460, MB90470, MB90495

▸ Microcontroller operation frequency : max 25MHz

▸ Microcontroller operation voltage 1.8V – 5.5V – Voltage range (Max and Min) depends on microcontroller specification and operating frequency

▸ CPU Clock supply

▸ 1MB emulation memory

▸ Status LEDs for emulator and CPU status indication

▸ Fully Softune Workbench integrated user Interface

▸ Supports debugging on source level (assembly and C-source code)

▸ Mixed source code view to debug C-code and assembly code

▸ Display-Windows for Variables, Stack, Memory, CPU Registers, Watch window

▸ Instruction- and Data breakpoints with data mask

▸ Function Call

▸ View of Vector Table

▸ Trace buffer 64KB with trace filter

▸ Time measurements via CPU clock cycle count

▸ Use of Fujitsu standard probe cables

▸ Host Interface

  ▸ USB1.1

  ▸ RS232 max. 115k Baud

1.2 Features Compared to MB2141A/B, MB2147-01

Compared with the MB2141A/B and MB2147-01 emulator system some features are not supported by MB2147-05 or are restricted. The following table gives a short summary of the features and displays the differences between the emulation systems.

Feature	MB2147-05	MB2147-01	MB2141A	MB2141B
Supported Series	MB90385 MB90420 MB90425 MB90435 MB90440 MB90455 MB90460 MB90470 MB90495 MB905xx MB906xx	Emulation adapter MB2147-20: MB903xx except MB90385 MB90480 Emulation adapter MB2147-10: MB90385 MB904xx, except MB90480 MB905xx MB906xx	MB90385 MB904xx except MB90480 MB905xx MB906xx	MB90385 MB904xx except MB90480 MB905xx MB906xx
Maximum Operating Frequency	24MHz	25MHz	16MHz/20MHz for 90V470	16MHz/20MHz for 90V470
Host Interface	USB 1.1, RS232	USB 1.1, LAN, RS232	RS232, LAN via optional adapter	RS232, LAN via optional adapter
Instruction Breakpoints	Yes	Yes	Yes	Yes
Data Breakpoints	Yes	Yes	Yes	Yes
Sequential Breakpoints	No	3 Events, 3 Levels	8 Events, 8 Levels	8 Events, 8 Levels
External Trigger	No	Yes	Yes	Yes
External Probe	No	Yes	Yes	Yes
Trace	Yes/64K	Yes/64K	Yes/64K	Yes/64K
Coverage	No	Yes	Yes	Yes
Read-on the fly	No	Yes	Yes	Yes
Time-Measurement	Restricted to CPU cycles count	Yes	Yes	Yes
Memory Window	Yes	Yes	Yes	Yes
Stack Window	Yes	Yes	Yes	Yes
Watch Window	Yes	Yes	Yes	Yes
CPU Register Window	Yes	Yes	Yes	Yes
Source Code Mixed Mode view	Yes	Yes	Yes	Yes
Emulation memory	1MB	1MB	3MB	3MB

2 Hardware Installation

2.1 State of Delivery

The following parts are included in the shipment of MB2147-05

- MB2147-05 emulation unit
- Power supply
- RS232 cable
- USB cable
- CD-ROM with Softune Workbench Development environment
- Floppy disk with MB2147-05 Hardware Manual

The MB2147-05 is delivered with a CD-ROM containing the latest softune workbench development environment. Please take care that Softune ProPack3000013 or later must be used (Softune V30L28). Previous versions do not support MB2147-05. Additionally a floppy disk is included, which contains the hardware manual of the ICE. For any detailed hardware settings please check the hardware manual of the MB2147-05.

2.2 System Set-up

The emulator system hardware is installed as shown on the following pictures. Please take care that a target system is connected via a probe cable to the emulator, otherwise debugging of any software is not possible.
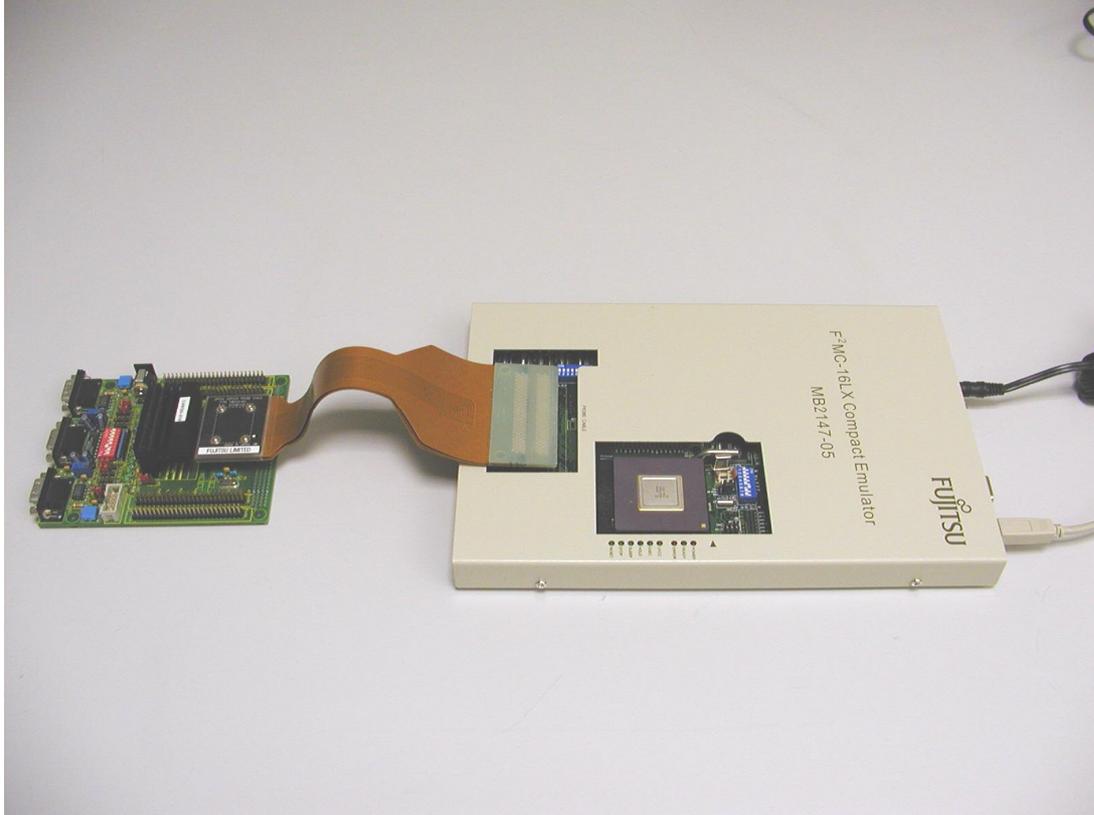
Figure2.2.1 MB2147-05 System Set-up

Figure2.2.2 MB2147-05 System Set-up

2.2 System Configuration

To work with the MB2147-05 some system configurations must be done as:

- Insertion of Evaluation chip (EVA-Chip)

- define clock supply for main clock

- define clock supply for sub-clock

- connection of C-Pin

Note: To avoid any damages to the system, all configurations must be done when the emulation and target system is switched off from any power supply.

2.2.1 Insert Evaluation Chip

The following pictures show the evaluation chip and the corresponding configuration switches and jumpers.

To insert the evaluation chip lift the lever beside the socket and insert the chip in the right position. Pin 1 of the evaluation chip is marked with a golden rectangle. Beside the socket a black arrow on the metal case of the emulator is marking Pin 1 position of the socket. The following picture shows the right position of EVA-Chip. After insertion of the chip, the lever can be removed to its horizontal position, fastening the EVA-Chip in the socket.
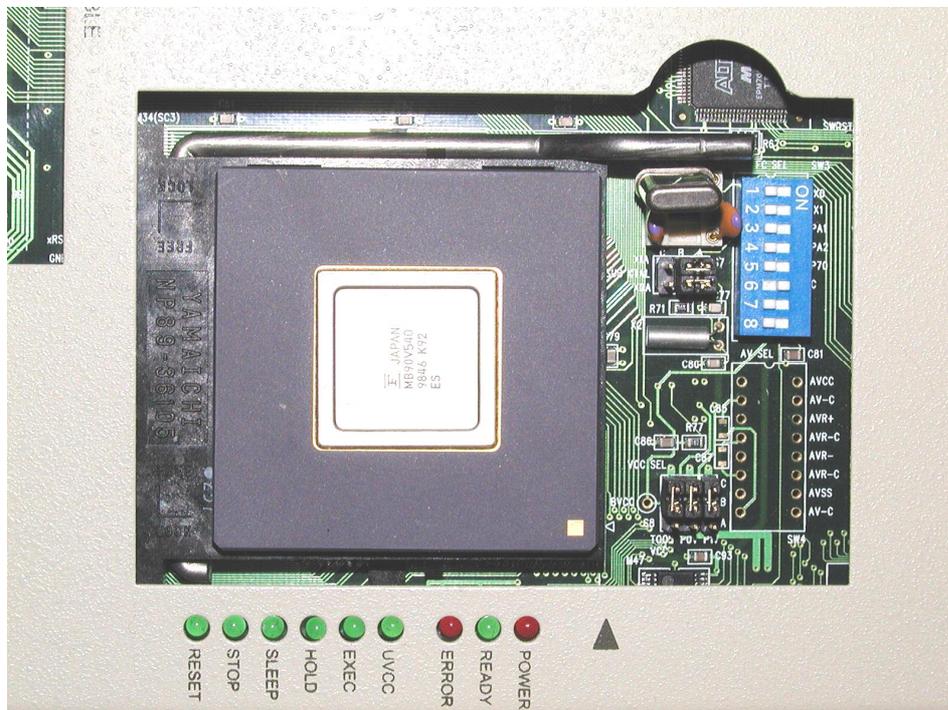
Figure2.3.1.1 Configuration Area for the Evaluation Chip

2.2.2 Supply of Clocks to the evaluation Chip

2.3.2.1 Configuration of Main Clock Supply

In case a crystal is used for the clock supply, it is highly recommended to use the crystals mounted on the emulator system. Otherwise clocks might not work correctly.

The mounting of the main crystal is done in SC4 and is shown in the next figure. For the capacitors mostly 22pF or 33pF are preferred values.
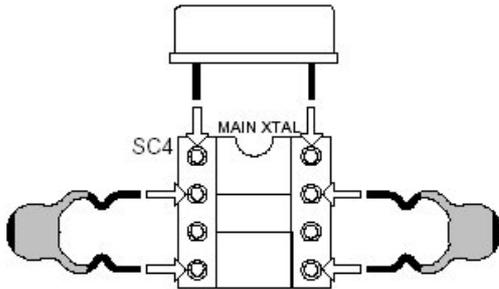
Figure 2.3.2.1.1 Crystal Mounting Example

To define the usage of the main and sub-clock pins the settings of SW3 and S7 must be checked. The following schematic show the crystal peripheral circuit.
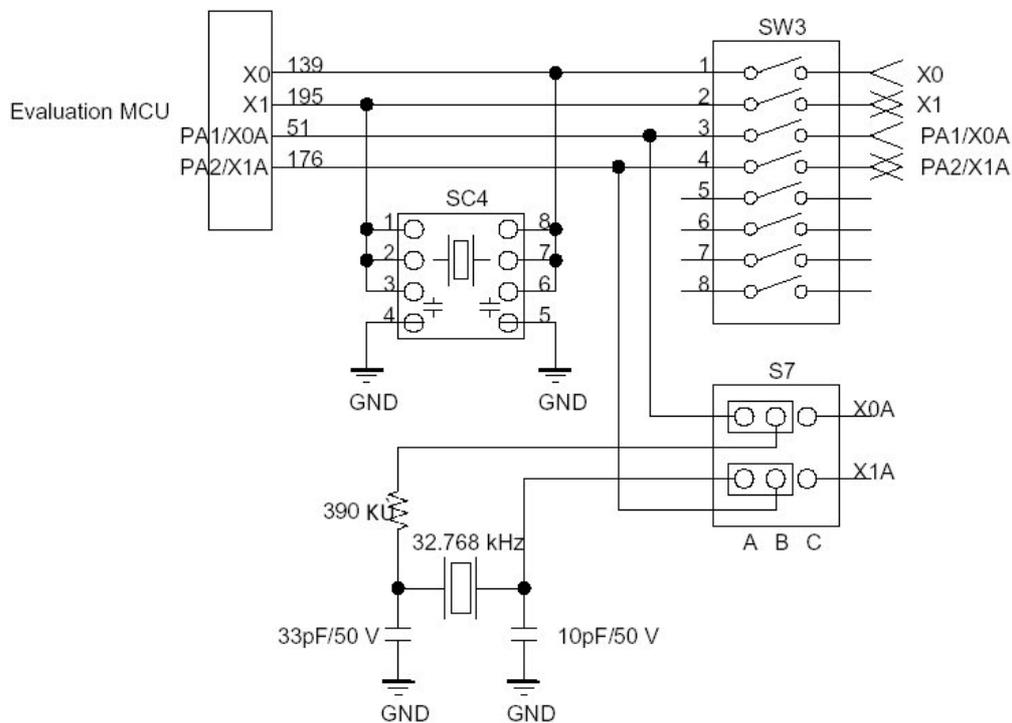
Figure 2.3.2.1.2 Crystal Peripheral Circuit

The main clock supply is selected by the switches 1 and 2 of SW3. The following table show the settings, depending whether the crystal on the crystal area is used or the clock is supplied from the target system. Note: If the clock is supplied from the target system, the influence of the probe cable must be considered. If a crystal is used on the target system, it is highly recommended to use the crystal area on the emulation system.

Function	SW3 Setting	
	SW3.1	SW3.2
Clock supply by Crystal installed on emulator	OFF	OFF
Clock supply by clock supply on target system	ON	ON

Table 2.3.2.1.1 Main-Clock Switching Settings

2.3.2.2 Configuration of Sub-Clock supply

S7 is used to configure the function of the sub-clock pins. Because on some microcontrollers the sub-clock pins are used as IO ports, the Configuration for these pins is as shown in table 2.3.2.2.1. Note: If a sub-clock crystal is used, it is highly recommended to use the sub-clock mounted on the emulation system.

Function	S7 Setting	SW3 Setting	
		SW3.3	SW3.4
Sub-clock Function	A-B	OFF	OFF
Port Function	B-C	ON	ON

Table 2.3.2.2.1 Configuration of Sub-clock Switching Jumper S7

2.3.2.3 C-Pin Switching

In case the C-Pin of the EVA-Chip must be connected to an external capacitor, in order to buffer the internal core supply voltage, the following configuration must be performed.
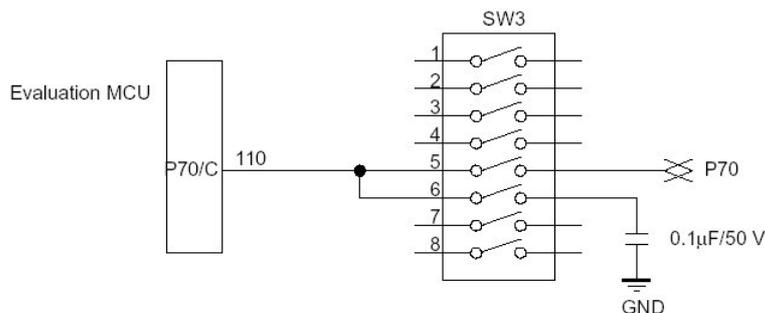
Figure 2.3.2.3.1 C-Pin Switch Peripheral Circuit

C-Pin Function	SW3 Setting	
	SW3.5	SW3.6
Provided	OFF	ON
Not Provided	ON	OFF

Table 2.3.2.3.1 Setting of SW3 for C-Pin configuration

2.3.2.4 User Data Bus Switching Configuration

When the probing target CPU pins (P00 to P07, P10 to P17) are based on a special specification e.g. for high voltage ports, the user data port bus probing circuit must be set OFF via SW1, SW2. For more details on this configuration please check the description in the hardware manual.

2.2.3 Example Configuration

The following table show an example configuration for MB90V540 and MB90V495.

SW3.1	SW3.2	SW3.3	SW3.4	SW3.5	SW3.6	SW3.7	SW3.8		S7
OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF		A-B

SW1	SW2
All switches OFF	All switches OFF

Table 2.3.3.1 Example Configuration of SW3

The following table show an example configuration for MB90V590 and MB90V595.

SW3.1	SW3.2	SW3.3	SW3.4	SW3.5	SW3.6	SW3.7	SW3.8		S7
OFF	OFF	ON	ON	OFF	ON	OFF	OFF		B-C

SW1	SW2
All switches OFF	All switches OFF

Table 2.3.3.2 Example Configuration of SW3

3 Software Installation

3.1 Installation of Softune Workbench

To work with the emulator MB2147-05 Softune Workbench V30L28 (ProPack300013) or higher must be used. Included in the shipping of the MB2147-05 is a CD-ROM containing the corresponding software package. To install the Softune Workbench start the corresponding installation set-up and follow the installation instructions.

3.2 Installation of Communication Interface Drivers

3.2.1 RS 232 communication

If the communication to the ICE is going via RS232 no special drivers have to be installed. Just connect the RS232 interface of the ICE to the RS232 interface of the PC using the serial cable supplied with the ICE.

3.2.2 USB communication

If the communication to the ICE is going via the USB interface a special USB driver must be installed. To install the USB drivers perform the following steps:

- Switch on the PC

- switch on the ICE

- connect the ICE to the PC

As soon as the ICE is connected to the PC the new hardware will be recognized automatically and the standard windows dialog will appear to install the corresponding drivers. The USB drivers can be found in the Softune/Drivers directory on the CD-ROM delivered with the compact ICE or will be available separately as a zip file in case the Microcontroller CD-ROM V3.4 (available Q1/2003) is used. Use this USB driver if you are ask for special USB drivers to be installed for the ICE.

4 Set-up Debug Configuration

4.1 Configure Debug Set-up

When the Softune Workbench and the communication drivers have been installed the debugger set-up file must be configured first before starting the debugger. For this purpose the following steps must be performed.

- Open your Softune Workbench project using the <File>, <Open Workspace> menu.
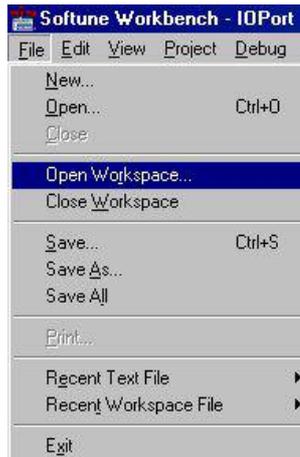
- The upcoming dialog allows you to specify the project / workspace file. Select the corresponding project file. Either select the .prj or .wsp file. If the project has been developed with a previous Softune Workbench version, the file type will be converted: select file type .prj for older Softune workbench projects or .wsp for projects developed with newer Softune Workbench versions supporting workspaces.

- If a .prj file is selected, the project file will be converted automatically by Softune Workbench into a .wsp file.
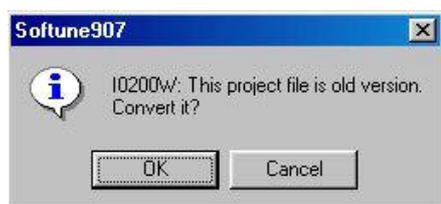
- After the conversion the project browser window shows the open project with the corresponding project files

- To set-up the debugger configuration use the <Project>, <Setup Project> menu and select the Debug tab in the upcoming dialog. Select for category "Setup". Now a Debug set-up name can be entered e.g. MB2147-05 USB. With the <Add> button the debug set-up wizard will be started to do some special configuration settings.
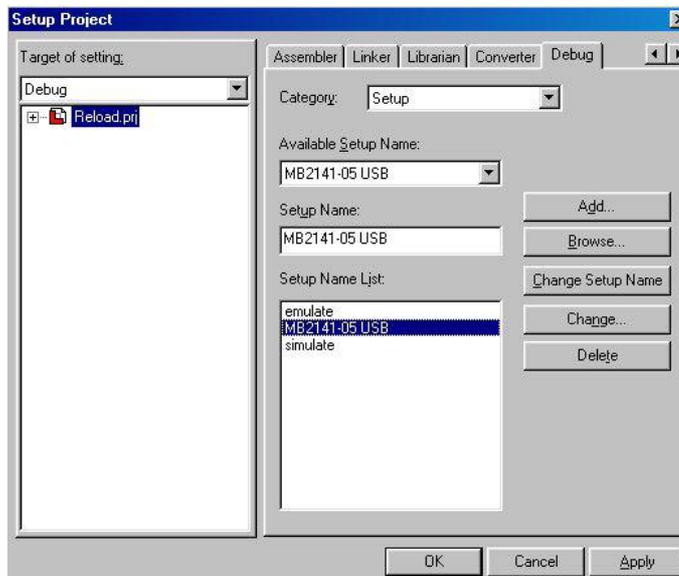
Alternately you can use the right mouse button on the Debug item in the browser window.
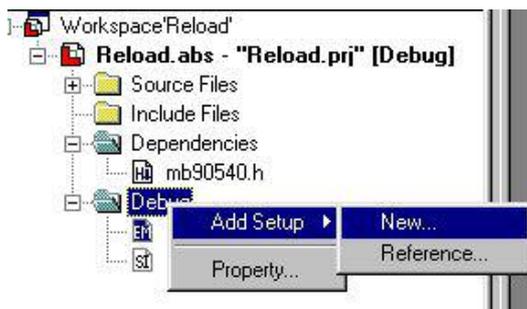
- Follow now the instructions of the wizard in the following set-up menus
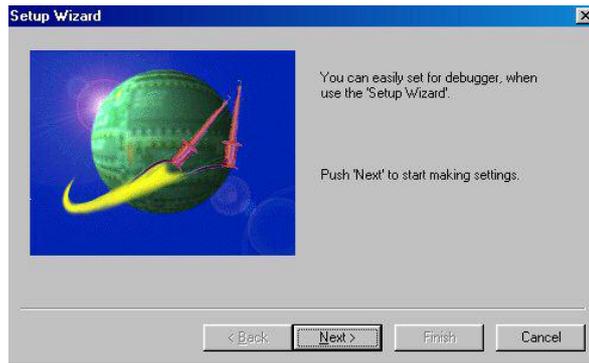
Set-up Wizard start dialog
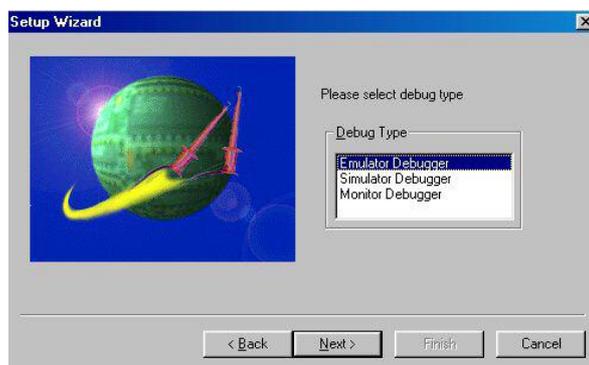
Select Debugger type
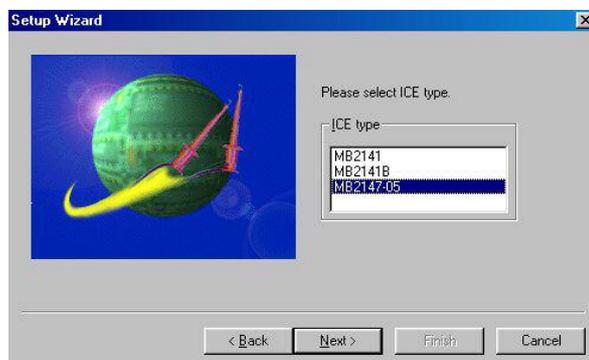
Select Emulator System
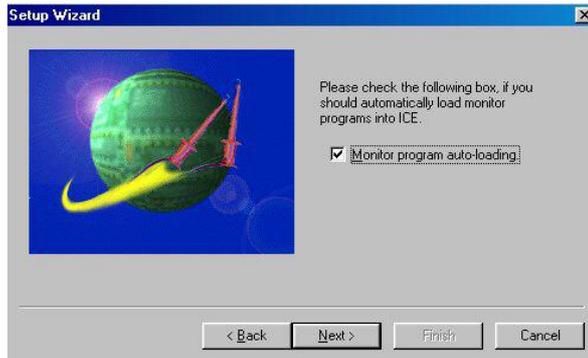
Select automatic emulator firmware download.

Note

It is highly recommended to remove this selection for security reasons afterwards, as soon as the emulator firmware has been programmed.
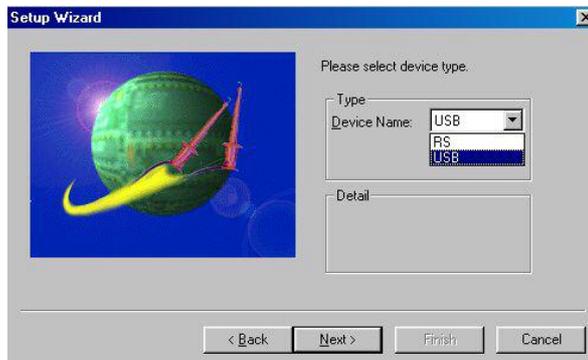
Select communication interface
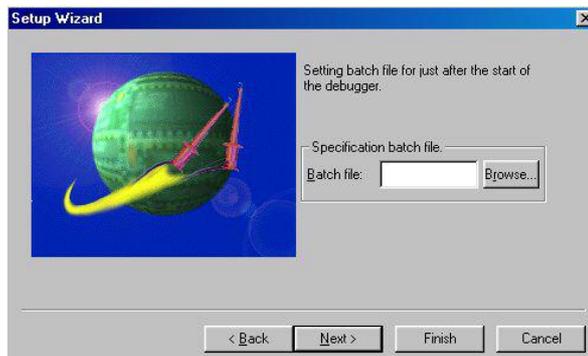
Select optional batch file to be started after debugger start

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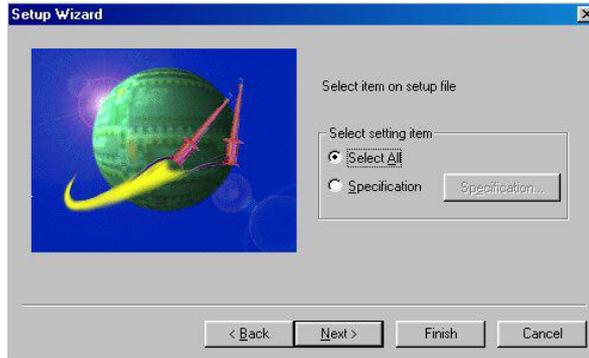
Specify e.g. special windows settings
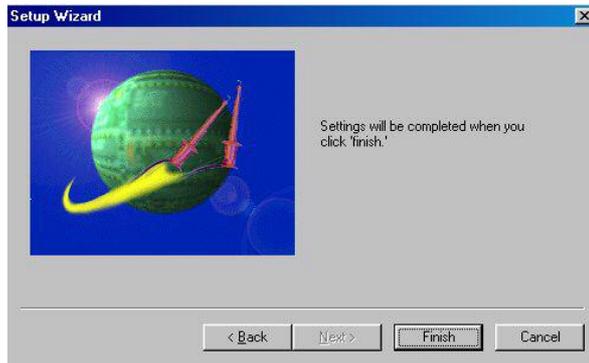
Finish wizard Set-up

After the set-up wizard is finished, the debugger can be started with its configured settings. In the browser window the default debugger is marked with a blue colour. The debugger is started via double-click on the item in the browser window or via the <Debug>, <Start debug> menu.
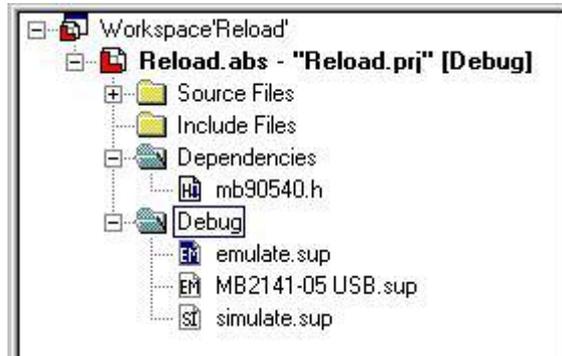
To change the debug set-up just use the right mouse button on the corresponding debug item in the browser menu. This will open a drop down menu to modify/delete the debug set-up.
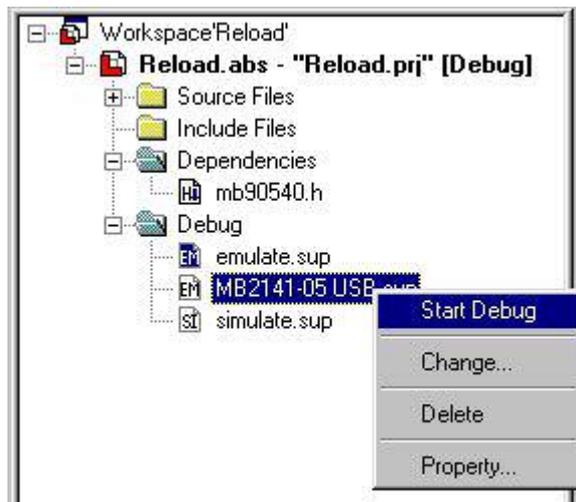
When the debugger is started the first time, the firmware will be downloaded automatically. This will be indicated by the following information box.

A load debug file notification will be displayed afterwards and the debug source window is opened, ready to set breakpoints, open watch-, register, memory- window, …

Now first remove the selection "Monitor-load auto-program" in the emulator setup, before you start further debugging (described on page 18).
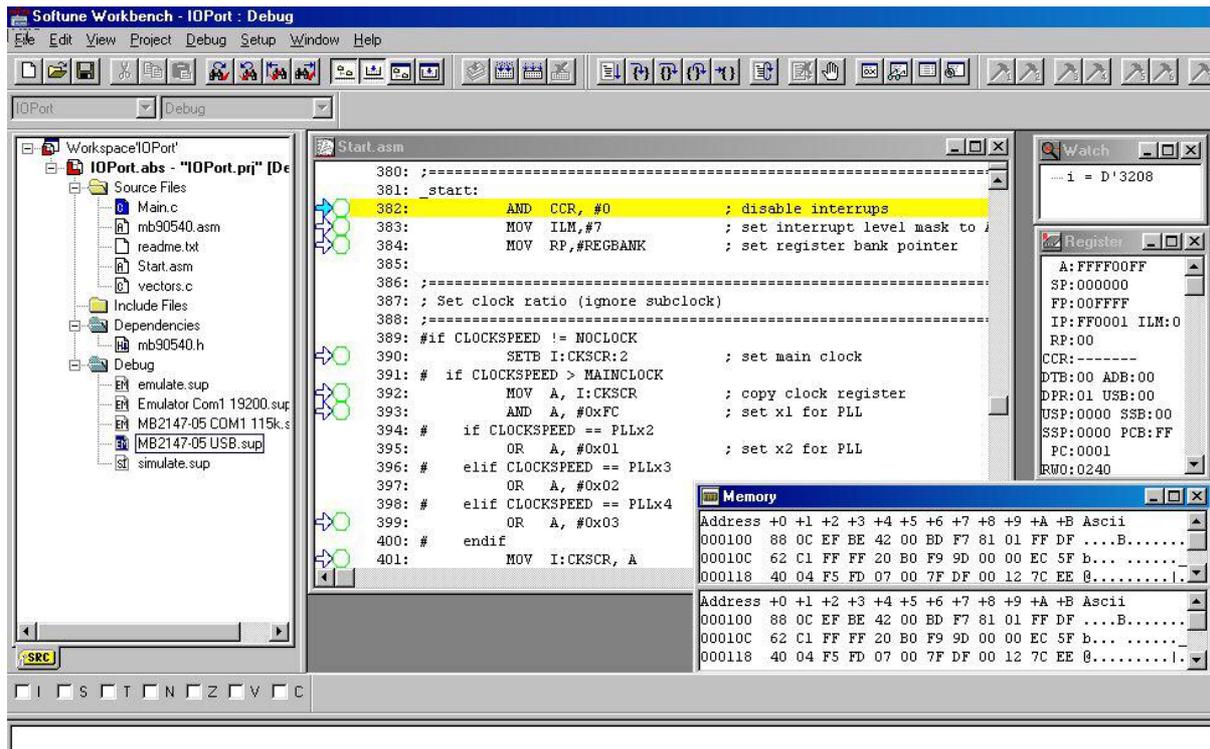
The available debug items/commands can now be executed via the corresponding icons in the main menu line, the <Debug> or <View> menu.

5 Appendix

5.1 Trouble Shooting

The debugger starts with a message as: Communication error …

Please check that the target is connected to the emulator system and the emulator and target system is powered-on.

Check that in the emulator set-up (chapter 4.1) the topic "Select automatic emulator firmware download" is selected.

Check the DIP-switch and jumper settings for the crystal area (chapter 2.2.2).

If working via USB please ensure that the USB drivers provided on the Softune Workbench CD-ROM has been installed correctly. Alternately a RS232 communication could be used first to prove that the other hardware settings of the emulator system have been done correctly.

5.2 Monitoring

Unfortunately the Low-Cost Emulator MB2147-05 does not support 'online'-monitoring of variables, memory, registers, etc. The watch-window will only be updated while the emulator is stopped e.g. by a breakpoint.

As a workaround 'monitoring' can be emulated as follows:

1. Within your application use a timer function with IRQ handler (e.g. ReloadTimer).
   In the IRQ handler just reset the IRQ flag.

2. Set a breakpoint into the Timer IRQ handler.

```
15: void main(void)
16: {
17:
18: /* One timer is needed to emulate monitoring using the Compact ICE MB2147-05.   */
19: /* Set a breakpoint witin the interrupt handler.                                 */
20:
21:     TMRLR0 = 0xFF00;      /* The reload value defines the monitor refresh time   */
22:     TMCSR0 = 0x81B;       /* Enable Timer, enable interrupt                      */
23:
24:     InitIrqLevels();      /* Interrupt table and levels are defined in vector.c  */
25:
26:     __set_il(7);          /* Set ILM to 7 in order to allow all interrupts levels */
27:     __EI();               /* Enable all interrupts at all                        */
28:
29: /* Place your code here                                                          */
30:
31:   while (1)
32:   {
33:     i=i+1;
34:   }
35: }
36:
37: /* This timer interrupt handler is needed to emulate monitoring.    */
38: /* using the Compact ICE MB2147-05. Set a breakpoint here.          */
39:
40: __interrupt void ReloadTimer0(void)
41: {
42:     TMCSR0_UF = 0;        /* reset underflow interrupt request flag */
43: }
44:
```

3. Use the following procedure file e.g.: 'monitor.prc' executed after load target file

filename: MONITOR.PRC

```
# emulation of monitoring function:

WHILE 1
GO
ENDW
```

This procedure starts debugger and re-starts debugger after break by a while loop.

Optional the procedure file can be assigned to a tools button using the following dialog:

View, Customize bar, settings

In this case the procedure file can be started by a click to a customized button.

Restrictions of the 'monitoring' workaround described above:

- Timer with IRQ is needed.
- No Real-Time monitoring.
- Timer IRQ handler and break/restart of debugger influence the timing and performance of the application.