ST62GP-EMU2
HDS2 Series Emulator
User Manual

Release 1.2

December 2000

Ref: DOC-ST62GP-EMU2

USE IN LIFE SUPPORT DEVICES OR SYSTEMS MUST BE EXPRESSLY AUTHORIZED.

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2. A critical component is any component of a life support device or system whose failure to perform can reasonably be expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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1 INTRODUCTION

Thanks for choosing ST6! This manual will help you get started with the ST62GP-EMU2 emulator kit.

The ST62GP-EMU2 Emulator Kit allows you to control the execution of programs that you have written for the ST62 series of MCUs and assists you in debugging your application hardware as well as your software.

The real-time capability of the ST62GP-EMU2 allows you to run your application at full speed while still under debugger control. This allows you to test your program while running under the same conditions as the final application.

Note: If you come across any terms or abbreviations you do not understand, you can check their meaning in the Glossary on page 49.

First off, check that the ST6 MCU that you have picked for your application is in the list of devices supported by this emulator. You will be able to choose and emulate any of these 21 devices by configuring the ST6 debugger, WGDB6:

Supported Devices	**Collectively known in this document as....**
ST6200C ST6201C ST6203C ST6208C ST6209C	ST620x
ST6210C ST6215C	ST621x
ST6220C ST6225C	ST622x
ST6218C ST6228C	ST6218/28
ST6252C ST6353C ST6255C	ST625x

Supported Devices	Collectively known in this document as....
ST6230 ST6232 ST6235	ST623X
ST6260C ST6262C ST6263C ST6265C	ST626x

The ST6 HDS2 Emulator Series is a modular system. The emulator is principally made up of two boards:

- The dedication board or DBE.
- The main board.

If you look at the emulator front panel, you will see that the main board is installed in the lower slot of the enclosure while the dedication board is installed in the upper slot.

The main board is common to all ST6 HDS2 Emulators. It emulates the ST6 Program Memory and contains the breakpoint logic, trace memory and all the logic needed for real time emulation.

The dedication board applies to the set of specific devices listed in the table above. It emulates all peripherals related to these devices (RAM, EEPROM, ADC, Timers, I/Os, etc.).

With this modular architecture, once you have bought a complete emulator, you only need to change the dedication board (which is supplied with the probe boards included) to emulate other ST6 devices.

In addition to the ST WGDB6 debugger, a third-party debugger, Raisonance's WRKit Devopment Suite software package, is supported by the ST62GP emulator. This software is included in the *MCU-on-CD* CD-ROM provided with your emulator kit.

1.1 About this manual....

Detailed instructions on how to install your emulator configuration are described in *Chapter 2: Getting Started* on page 9.

How to install your software is described in *Chapter 3: Installing the Software* on page 19.

Chapter 4: Tutorial on page 23 familiarizes you with the emulator environment using an example program.

The emulator kit's hardware features are described in *Chapter 5: Emulator Features* on page 39.

1.2 Getting assistance

For more information, application notes, FAQs and software updates on all the ST microcontroller families, check out the CD-ROM or our website:

http://mcu.st.com

For assistance on all ST microcontroller subjects, or if you need help with using your emulator, refer to *Product Support* on page 53. We'll be glad to help you!

2 GETTING STARTED

2.1 Delivery checklist

The following items are packed with the ST62GP-EMU2 (refer to *Figure 1*):

- ST62GP-EMU2 box with two flat cables for connecting a probe.
- One DB324/DIP probe board for use with ST6230, ST6218 and ST6228 target devices.
- One DB324/SDIP42 probe board for use with the ST6232 target device.
- One DB448 probe board for use with ST620x, ST621x and ST622x target devices.
- One DB449 probe board for use with 5x and 6x devices, including:
  - 16-pin probe with 3 different male-male interfaces, depending on the target device.
  - 20-pin probe with 3 different male-male interfaces, depending on the target device.
  - 28-pin probe with 3 different male-male interfaces, depending on the target device.

A duplicate set of these interfaces is provided in case of damage.

Caution: *Take precautions against electrostatic discharge (ESD) before unpacking the emulator probe boards. These boards must only be handled in a static-safe area.*

- Three probe adapters—DIP16, DIP20 and DIP28—to be soldered to a footprint.
- Three SO adapters—SO16, SO20 and SO28.

Note: *If the probe boards are already assembled with SO adapters, refer to Figure 3 on page 12 for how to use the DIP connectors, if required.*

- One parallel interface cable (Ref.: DB25M/DB25M).
- One power adapter.
- One power cable.
- Two ferrites to be clipped over the flat cables (for EMC compliance).
- Analyser probes.
- A CD-ROM, containing the WGDB6 debugger software. (Not shown).
- This manual. (Not shown).

Note: *Do not use other parallel interface cables, power adapters or other accessories with the ST62GP-EMU2.*

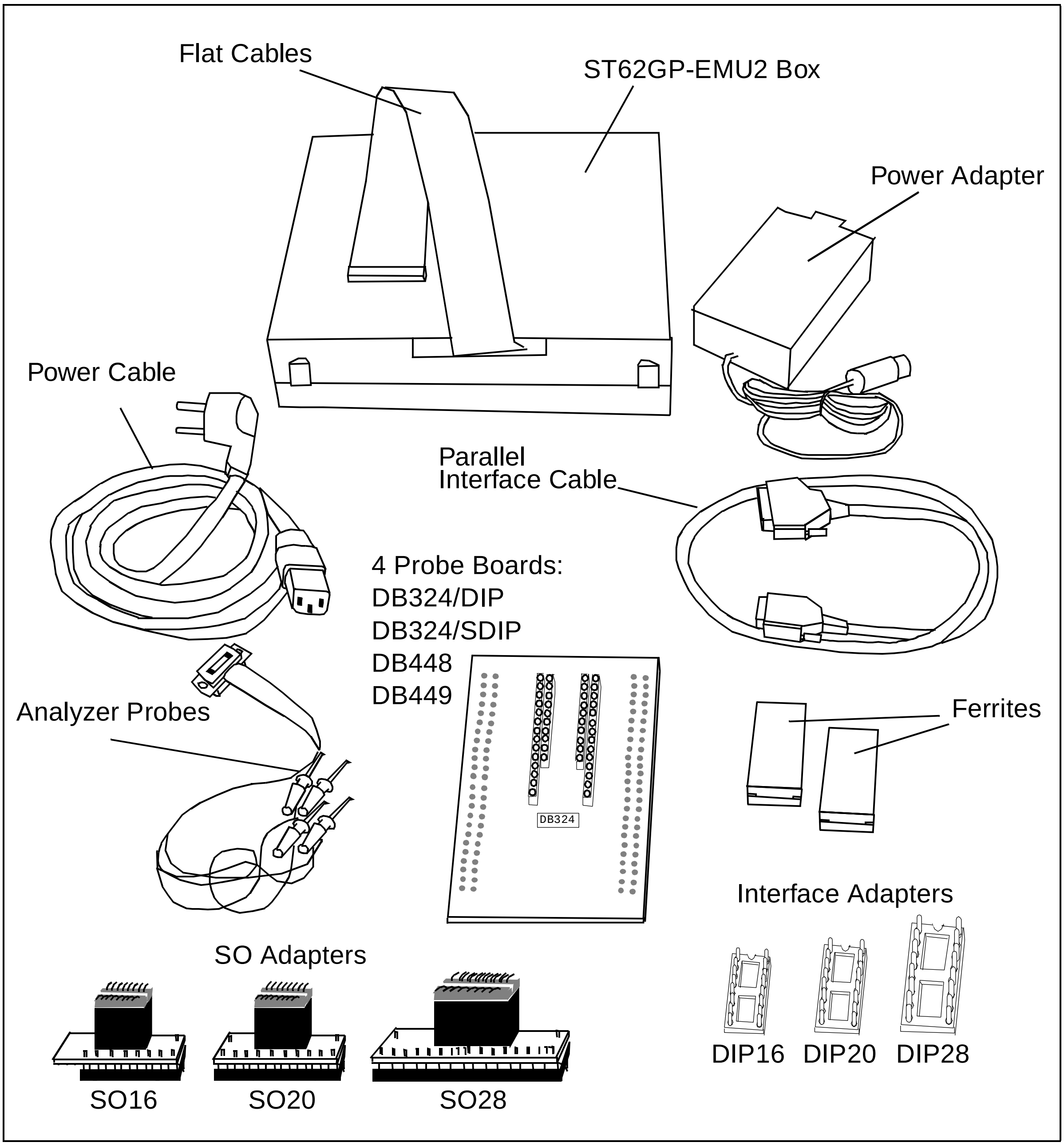


Figure 1: ST62GP-EMU2 Emulator Kit Contents

2.2 Adapters for SSOP devices

If you wish to emulate SSOP devices, you must order the following adapters:

- 16-pin SSOP adapter (Ref.: DB381).
- 28-pin SSOP adapter (Ref.: DB388).

Refer to *Product Support* on page 53 for a contact list of qualified STMicroelectronics representatives near you.

2.3 installing the hardware

To set up your emulator hardware, follow these steps:

2.3.1 Step 1: Connecting the emulator to your PC

1 Shut down and power off the PC that is to be connected to the ST62GP-EMU2.

2 Ensure that both the ST62GP-EMU2 emulator and your application board are disconnected from their power supplies.

3 Connect the parallel interface cable supplied with the ST62GP-EMU2 emulator kit to a parallel connector on your PC (LPT1 or LPT2).

4 Connect the parallel interface cable to the parallel port connector on the back panel of the ST62GP-EMU2 (See *Figure 2*).

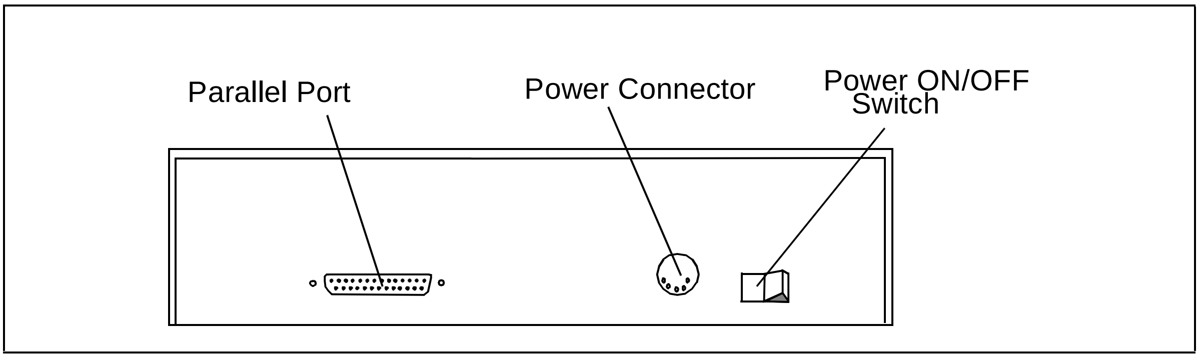


Figure 2: ST62GP-EMU2 Back Panel

2.3.2 Step 2: Putting together your emulator probe

1 Select one of the emulator probes supplied in the package and mount the footprint adapter for SO devices if necessary (refer to *Figure 3*). *Table 1* indicates which probe board and footprint should be used with your target device.

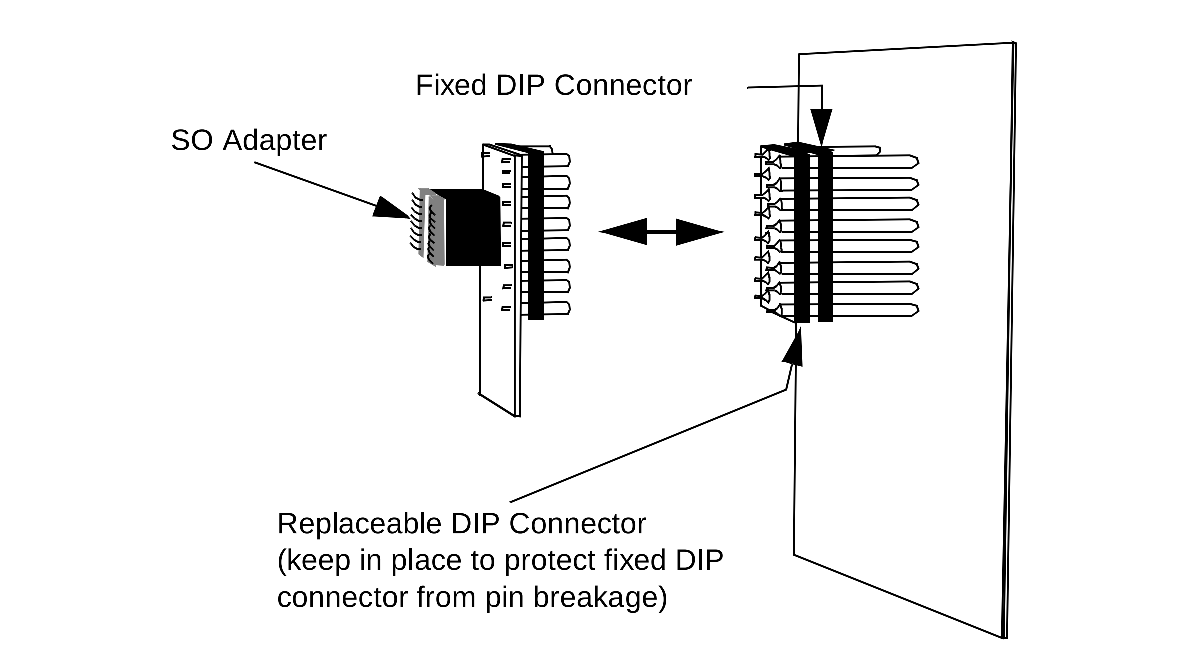

Fixed DIP Connector
SO Adapter
Replaceable DIP Connector
(keep in place to protect fixed DIP
connector from pin breakage)

Figure 3: DIP Probe Connectors with SO Adapter

Target device	Probe Board
ST6200C ST6201C ST6203C	DB448 with DIP16 footprint: interface to be added
ST6208C ST6209C ST6210C ST6220C	DB448 with DIP20 footprint: interface to be added
ST6215C ST6225C	DB448 with DIP28 footprint: interface to be added
ST6252C ST6262C	DB449 with DIP16 footprint: interface to be added

Table 1: Use of Probe Boards and Footprints

Target device	Probe Board
ST6353C ST6260C ST6263C	DB449 with DIP20 footprint: interface to be added
ST6255C ST6265C	DB449 with DIP28 footprint: interface to be added
ST6230C	DB324 with DIP28 footprint: interface to be added
ST6232C	DB324 with SDIP42 footprint
ST6235C	DB324 with QFP52 footprint: third probe must be ordered separately
ST6218	DB324 with DIP20 footprint: interface to be added
ST6228	DB324 with DIP28 footprint: interface must be added

Table 1: Use of Probe Boards and Footprints

2 Configure the probe board settings using the information in *Table 2*.

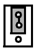
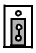
Jumper	Setting		Function	Remark
W1	1-2		Clock source is user-installed oscillator on probe board in the **OSCILLA** position.	Refer to *Clock source* on page 39 for more information.
	2-3		Clock source is a signal input on the probe board in the **OSCIN** position.	
W2	1-2		**Jumper installed:** Disable user-installed oscillator on probe board **No jumper:** Enable user-installed oscillator on probe board.	This jumper must be installed if an oscillator on the probe board is **not** used.

Table 2: Probe Settings

2.3.3 Step 3: Connecting the emulator to the probe

1 Remove the dedication board from the ST62GP-EMU2 enclosure as follows:

a Completely loosen the two screws on the front panel of the dedication board (see *Figure 4*).

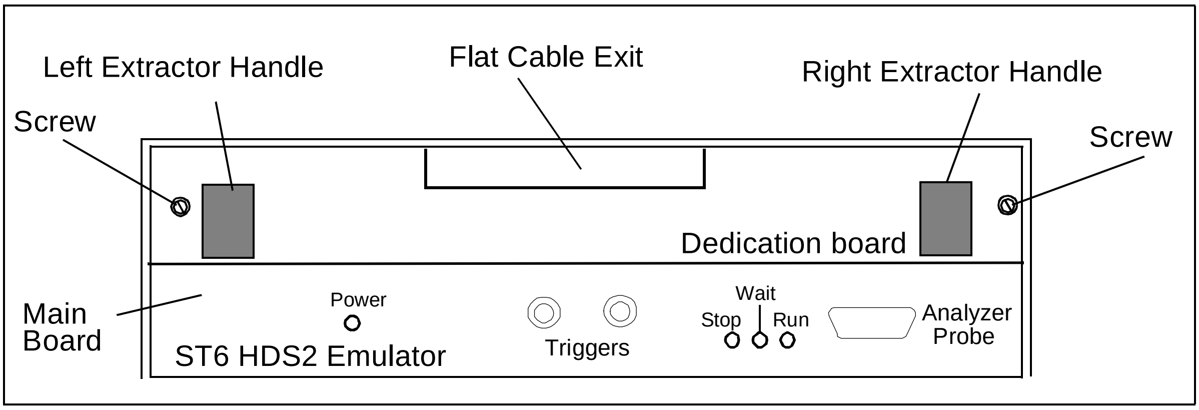


Figure 4: ST62GP-EMU2 Front Panel

b Extract the board by placing your thumbs on the two handles and pressing them firmly outwards to loosen the board (see *Figure 5*).

c Slide the board out gently and place it on a static-safe surface.

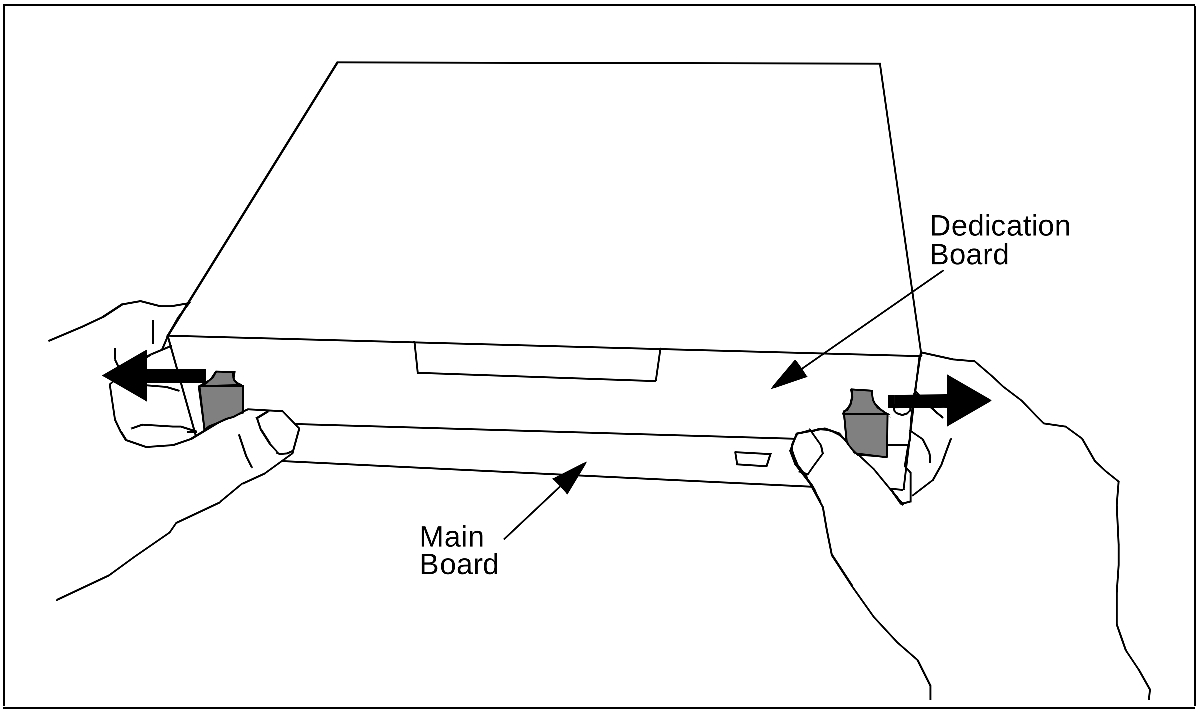


Figure 5: Using the extractor handles to loosen the dedication board

2 Connect the two flat cables between the dedication board and the emulator probe as follows (refer to *Figure 7*):

a Connect one flat cable to J1 on the probe board and J1 on the dedication board (see schema of dedication board in *Figure 6*).

b Connect the other flat cable to J2 on the probe board and J2 on the dedication board.

Note: *The cable must be kept parallel between the emulator and the probe.*

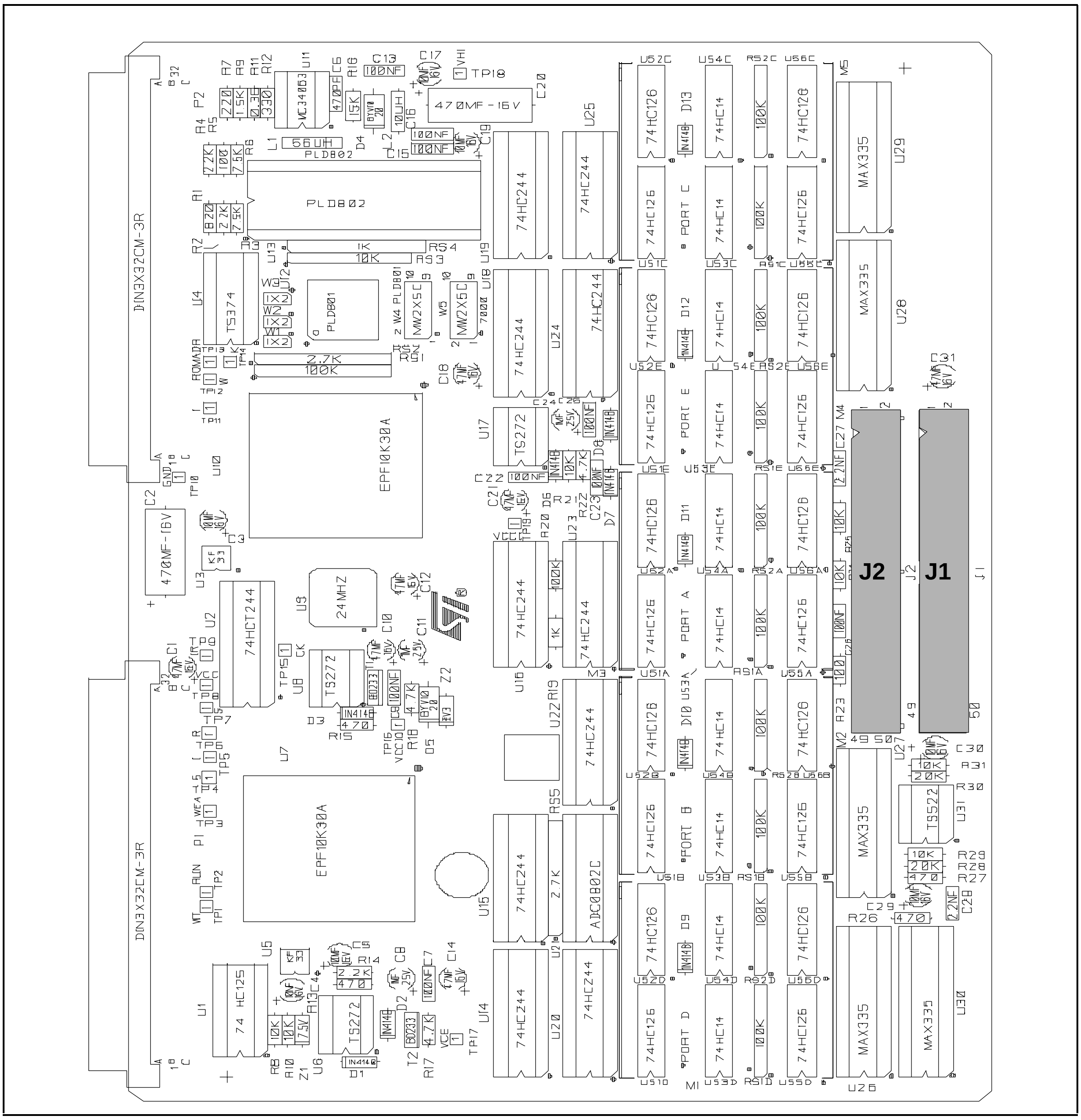


Figure 6: Schema of Dedication Board

3 Slide the dedication board gently back in its slot in the ST62GP-EMU2, pressing it firmly into place.

4 Clip the two ferrites to the flat cables, positioning them as close as possible to each end of the flat cables (see *Figure 7*).

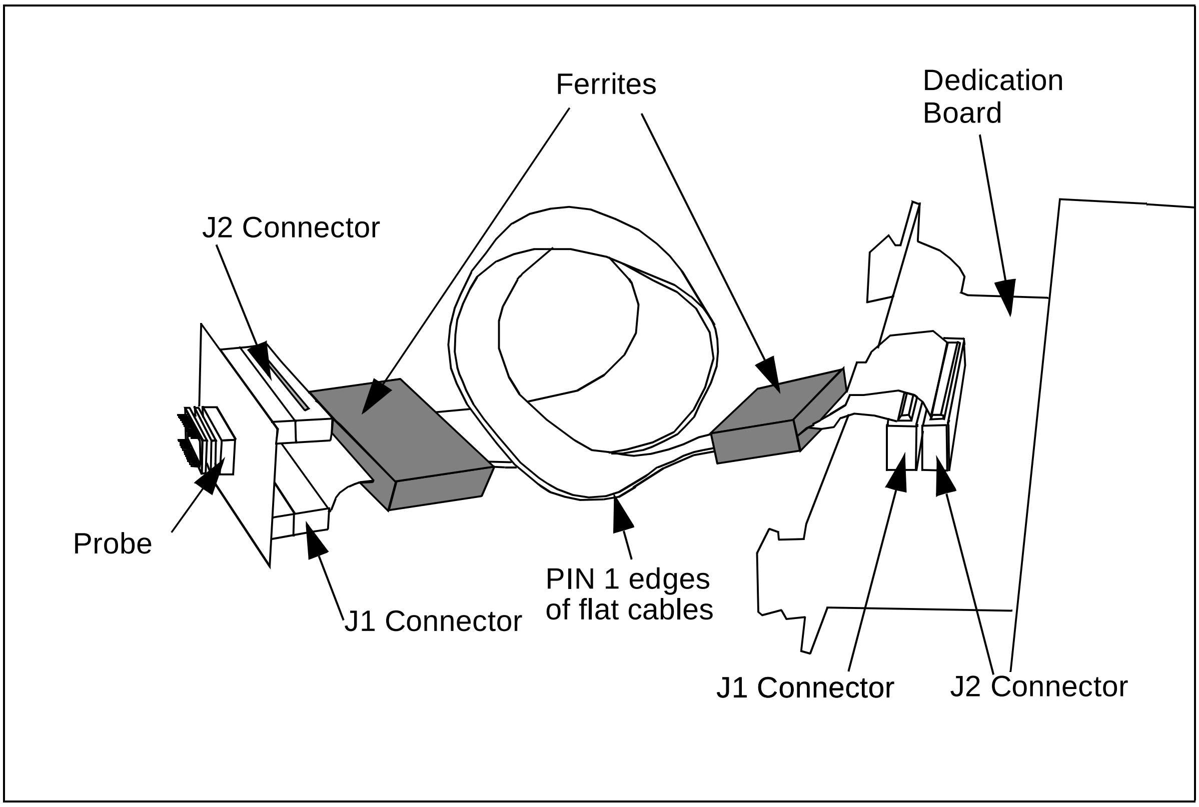


Figure 7: Installing the Flat Cables

2.3.4 Step 4: Powering up

1 Plug the power jack from the power adapter to the power connector on the ST62GP-EMU2 back panel (refer to *Figure 2* on page 11).

2 Connect the power adapter to the mains power supply.

3 Plug the probe connector in the MCU socket of the application board.

4 Power on the PC.

5 Switch on the ST62GP-EMU2 using the power switch on the back panel (see *Figure 2*).

6 The power LED on the front panel should light up (see *Figure 4*). If not, refer to *Troubleshooting* on page 47, otherwise proceed to the next step.

7 To run the emulator, you must now install the Windows Debugger Software for ST6 (WGDB6). To do this, refer to *Installing the Software* on page 19.

8 Power on the application board.

2.4 How to power on and off

When powering on the emulator, always proceed in this order:

1 Power on the development PC.

2 Power on the ST62GP-EMU2.

3 Start WGDB6 and load your program.

4 Power on the application board.

When turning off the emulator, proceed in the reverse order.

3 WGDB6

3.1 Your system requirements

To run/install the software provided on the *MCU on CD* CD-ROM, you must have a PC running either Microsoft® Windows® 95, Windows® 98 or Windows® NT®.

3.2 Installing WGDB6 and other ST6 software tools

Your emulator comes with the *MCU on CD* CD-ROM which contains a number of ST6 software tools. To install them, follow these steps:

1 Place the *MCU on CD* CD-ROM in your CD-ROM drive. The CD-ROM's autorun feature opens up a welcome screen on your PC.

If the autorun feature does not work, use Windows® Explorer to browse to the CD-ROM's root folder, and double-click on `welcome.exe`.

2 Select ***Install Your Development Tools*** from the list of options. A new screen appears listing the different families of STMicroelectronics MCUs.

3 Use your mouse to place the cursor over the ***ST6 TOOLS*** option. Choose ***ST TOOLS*** and ***ST6 TOOLCHAIN*** from the lists that appear.

4 The install wizard is launched. Follow the instructions that appear on the screen.

You can choose the package you wish to install. To install the complete ST6 Toolchain for your emulator, select **Complete Toolchain for Emulator**. This option installs the WGDB6 debugger version for your emulator, as well as a Windows Epromer and ST6 Assembler-Linker software.

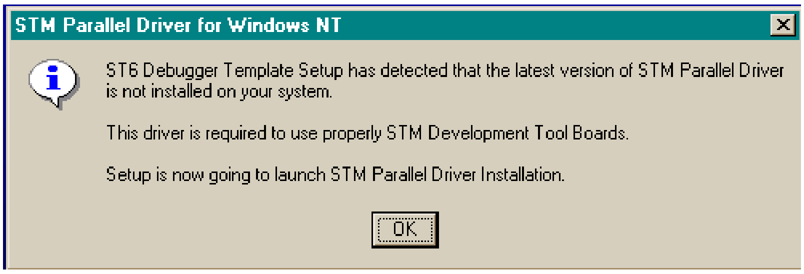
Alternatively, you can choose to perform a custom installation where you choose which of the available software applications you wish to install.

Note: *In order to configure your emulator, you must, as a minimum, install the* ***ST6 WGDB6 for*** *Emulator*
If you do not choose any options, but click ***Next>****, the ST6 Assembler-Linker will be installed by default.*

5 Follow the instructions that appear on your screen. You will be prompted to select the parallel port you wish to connect the emulator to, as well as the program folder that the software will be installed to.

6 If you are installing WGDB6 on a Windows® NT® platform, you must install the Windows® NT® parallel port driver supplied on the CD-ROM.

A window pops up if you have not already installed this driver (***parstm.sys***).



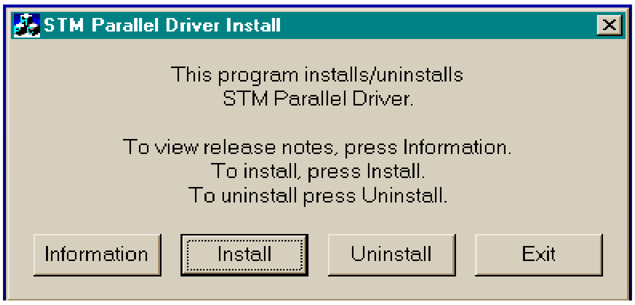
STM Parallel Driver for Windows NT

ST6 Debugger Template Setup has detected that the latest version of STM Parallel Driver is not installed on your system.

This driver is required to use properly STM Development Tool Boards.

Setup is now going to launch STM Parallel Driver Installation.

7 Click **OK**. The following window appears:

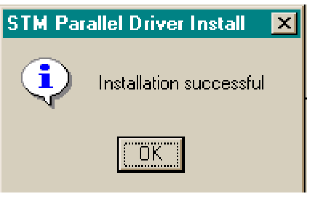


STM Parallel Driver Install

This program installs/uninstalls
STM Parallel Driver.

To view release notes, press Information.
To install, press Install.
To uninstall press Uninstall.

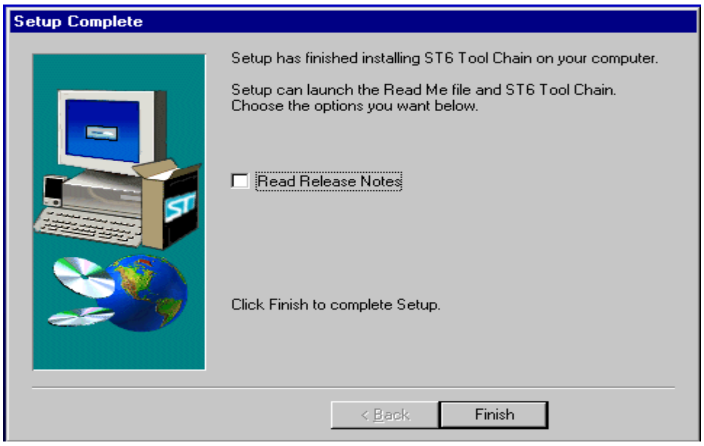
8 Click **Install**. The following window appears:



STM Parallel Driver Install

Installation successful

9 Click **OK**, the installation is now complete. The following window appears.



Setup Complete

Setup has finished installing ST6 Tool Chain on your computer.

Setup can launch the Read Me file and ST6 Tool Chain.
Choose the options you want below.

□ Read Release Notes

Click Finish to complete Setup.

10 Choose to read the **Release Notes** or start WGDB6, then click the **Finish** button.

3.3 Launching WGDB6

From Windows® 95, 98 or Windows® NT, click the **Start** button, point to **Programs** -> **ST6 Tool Chain -> Development Tools**, then choose **Wgdb6 Emulator**.

Refer to the *WGDB6 Windows Debugger for the ST6 Family User Manual* for full instructions on how to use WGDB6. This manual is available in PDF format on the *MCU on CD* CD-ROM.

4 TUTORIAL

4.1 Introduction

The goal of this tutorial is make you familiar with the emulator environment using an example program installed in the following directory:

```
D:\Program Files\Stm\ST6toolchain\soft
```

The example uses the standard timer of the ST6265 to toggle an I/O pin (PB0).

You can easily modify this example to work with other devices, because the hardware resources it uses can be found on all ST6 devices supported by the ST62GP-EMU2. To find out how to modify the program, refer to *Using the tutorial with ST62 devices other than the ST6265* on page 37.

The example program is located in the following directory:

```
D:\Program Files\Stm\ST6toolchain\soft\6x-emu2\tutorial
```

The file is called `tutorial.asm`.

4.2 Required tools

The following tools are required to do this tutorial:

- ST62GP-EMU2.
- Oscilloscope.
- 5 V power supply.

4.3 Getting prepared

Before you start the tutorial, make sure your system has been correctly set-up. To do so:

1. Install the ST62GP-EMU2 emulator as described in *installing the hardware* on page 11.
   - The tutorial example is based on a ST6265 device.
   - On the 28-pin DB449 probe board, there should be a jumper in W2 (jumper W1 is irrelevant in this case).
2. Install the software (i.e. the WGDB6 debugger) as described in *Installing the Software* on page 19.

4.4 Let’s go!

This section gives you a quick step-by-step procedure, showing how to **Run** & **Step** through the `tutorial.asm` tutorial program.

Note: *Refer to the comments in the `tutorial.asm` program for information on what each instruction does.*

In this example, since we are not using an application board, you should connect the probe to a regulated 5 V power supply

- V_{DD} (pin 11): 5 V
- V_{SS} (pin 12): 0 V

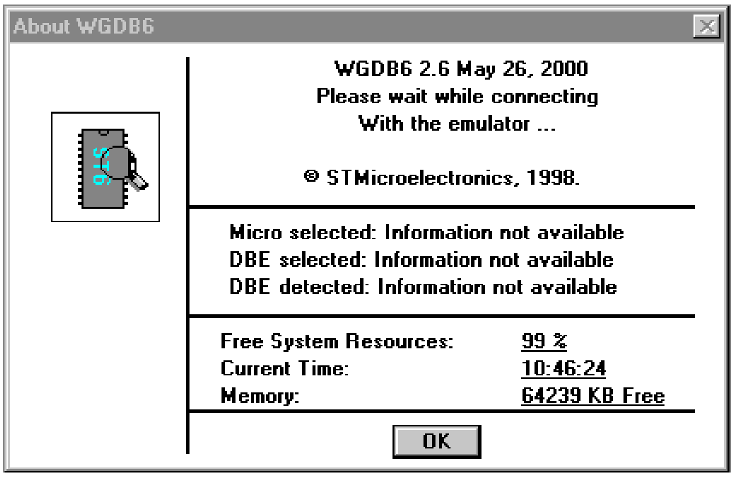
Caution: *Be careful when applying the 5 V to ensure that you don’t short circuit the emulator.*

1 Start the WGDB6 Emulator:

2 From the Windows Start menu, select ***Start -> Programs -> ST6 Tool Chain -> Development Tools -> Wgdb6 -> Emulator ST6***.

This starts the software used for emulation. The **About WGDB6** window (see *Figure 8*) pops up.

Note: *Do **not** click the “OK” button but wait for the communications link between the emulator and the PC to be synchronized.*



WGDB6 2.6 May 26, 2000
Please wait while connecting
With the emulator ...

© STMicroelectronics, 1998.

Micro selected: Information not available
DBE selected: Information not available
DBE detected: Information not available

Free System Resources: 99 %
Current Time: 10:46:24
Memory: 64239 KB Free

Figure 8: About WGDB6 window

3 After synchronization is completed, the **Control Bar** window (see *Figure 9*) pops up.

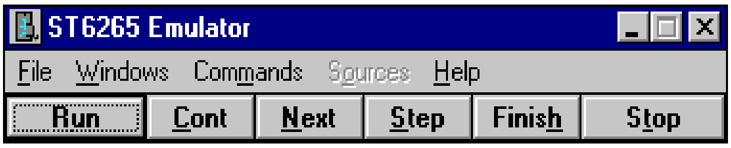
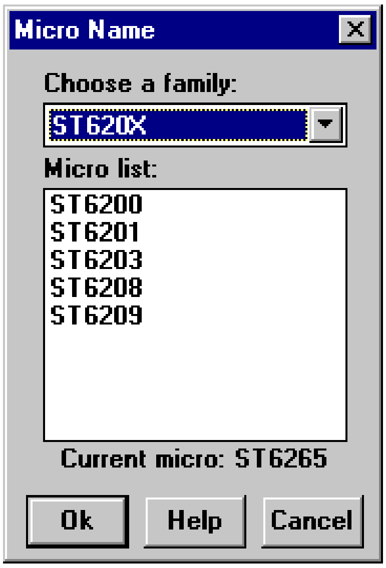


Figure 9: Control Bar window

4 Once the WGDB6 is launched you can select a DBE family by selecting **Commands-> DBE Family -> ST6xxx** from the main menu.

5 After selecting the DBE family, select **Commands -> Micro_Name...**, the **Micro Name** window is displayed (see *Figure 10*).


Micro Name

Choose a family: ST620X

Micro list:
ST6200
ST6201
ST6203
ST6208
ST6209

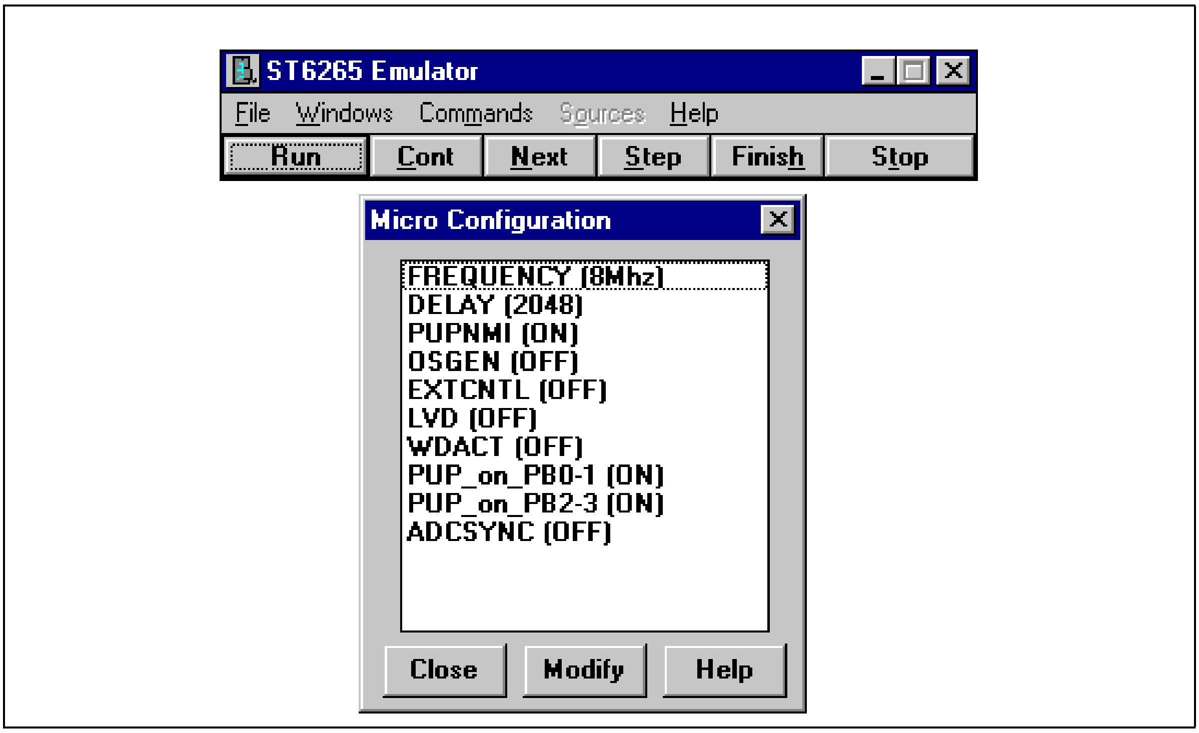
Current micro: ST6265

Figure 10: Micro Name window

6 In the **Micro Name** window choose a family from the pull down list and then choose a micro from the micro list.

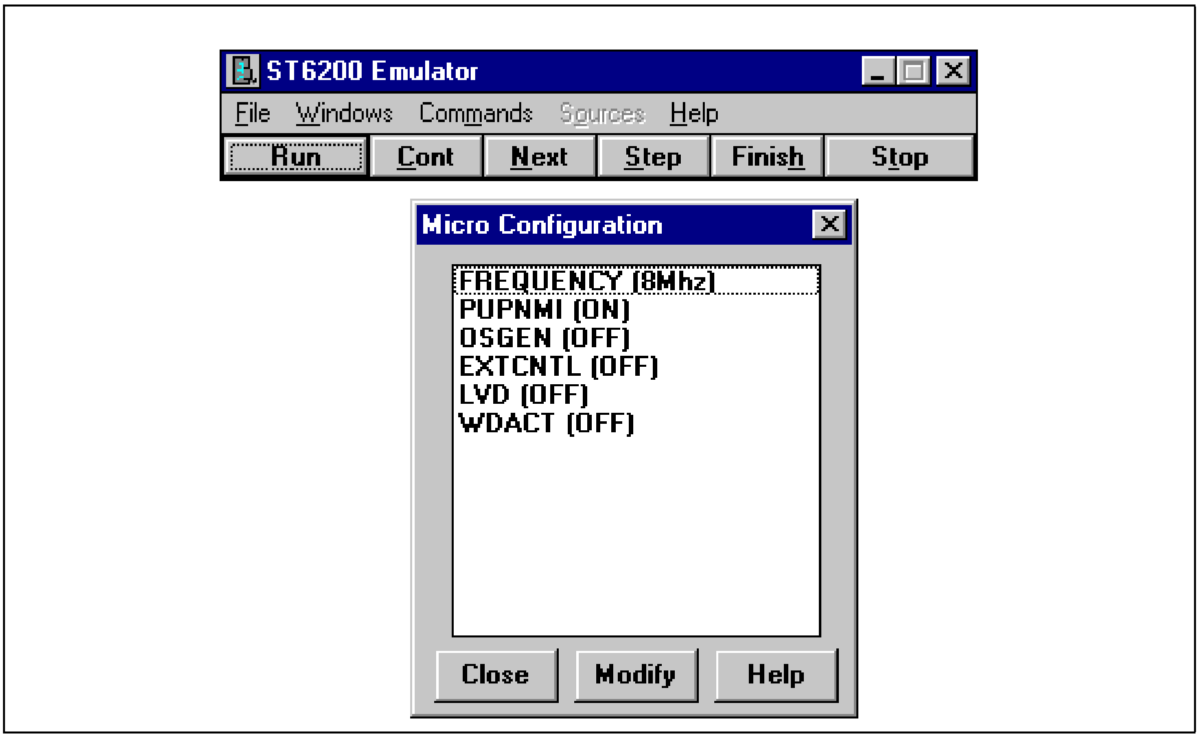
7 After you have selected the correct emulator, from the main menu, select ***Commands -> Micro_Configuration...***. Depending on the emulator selected, different configuration options are available.

For example, the ST6265 emulator has the following Micro Configuration options:


ST6265 Emulator
File Windows Commands Sources Help
Run Cont Next Step Finish Stop
Micro Configuration
Close Modify Help

FREQUENCY (8Mhz)
DELAY (2048)
PUPNMI (ON)
OSGEN (OFF)
EXTCNTL (OFF)
LVD (OFF)
WDACT (OFF)
PUP_on_PB0-1 (ON)
PUP_on_PB2-3 (ON)
ADCSYNC (OFF)

However, the ST6200 emulator has the following Micro Configuration options:

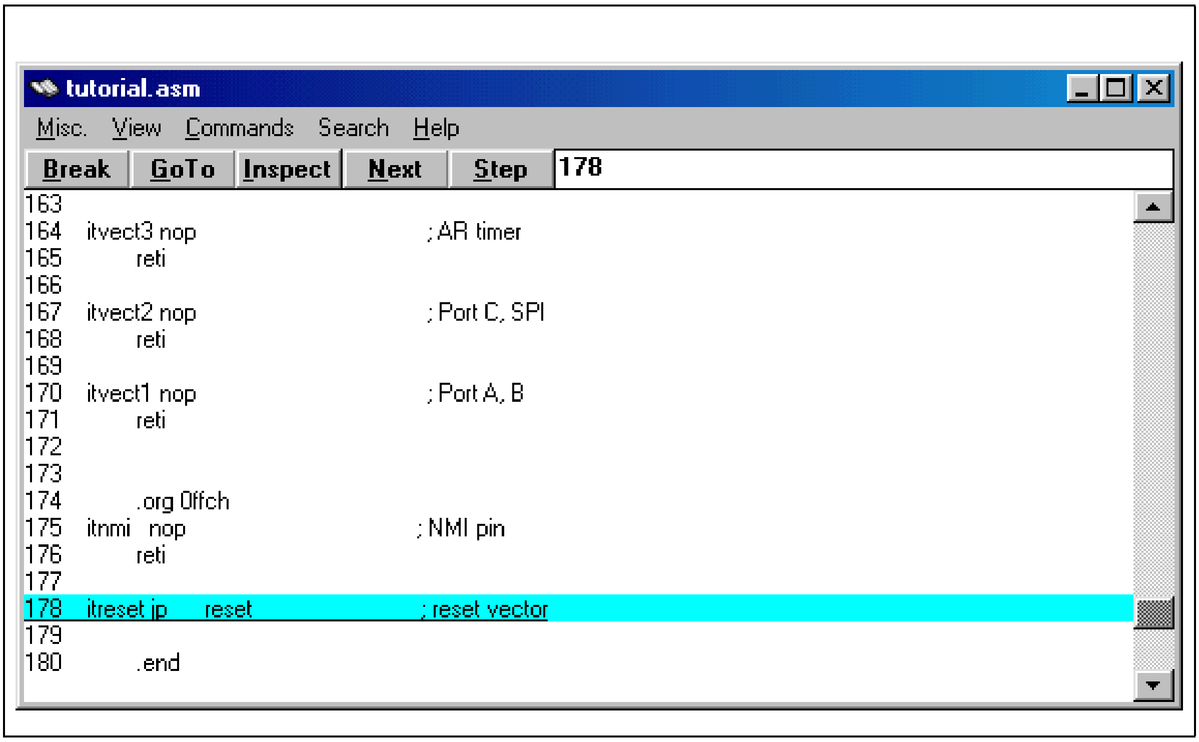

ST6200 Emulator
File Windows Commands Sources Help
Run Cont Next Step Finish Stop
Micro Configuration
Close Modify Help

FREQUENCY (8Mhz)
PUPNMI (ON)
OSGEN (OFF)
EXTCNTL (OFF)
LVD (OFF)
WDACT (OFF)

The first option, **frequency**, is the same for all emulators. The options listed below this depend on the specific emulator.

8 Open the `tutorial.hex` file by selecting ***File -> Open*** from the main menu, and then browsing to `D:\Program Files\Stm\ST6toolchain\soft\6x-emu2\tutorial` where the `tutorial.hex` file is located. Double-click on the file to open it.

9 A window titled **tutorial.asm** (see *Figure 11*) pops up and the title of the **Control Bar** changes to **ST626x Emulator tutorial.hex**.



```

itvect3 nop                 ; AR timer
        reti

itvect2 nop                 ; Port C, SPI
        reti

itvect1 nop                 ; Port A, B
        reti


        .org 0ffch
itnmi   nop                 ; NMI pin
        reti

itreset jp      reset       ; reset vector

        .end
```

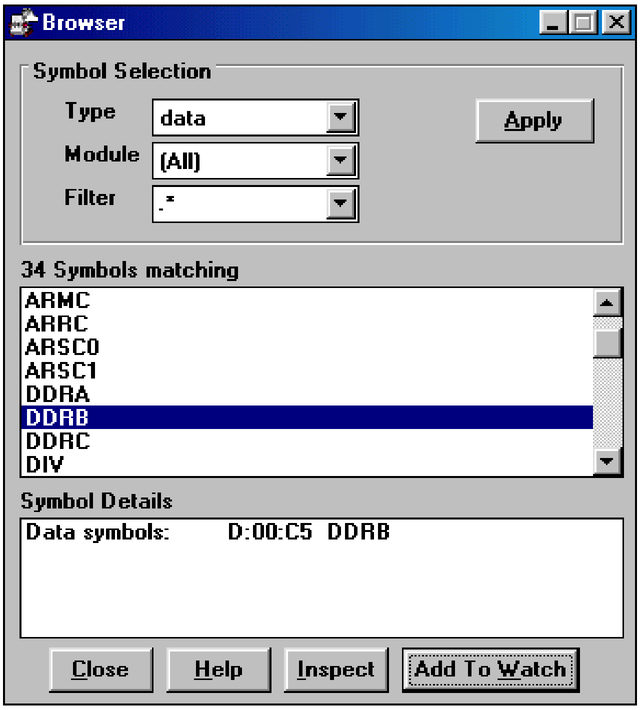
Figure 11: tutorial.asm window

There are two ways of executing the `tutorial.hex` file, one way is to **Step** through each of its instructions and the other is to **Run** through each of its instructions. Both will be described in this tutorial, beginning with stepping.

4.5 Step Mode

In this procedure, we learn how to execute programs step-by-step. Before doing this, we must setup the **Watch** window, to observe what happens when each instruction is executed.

1 In the **Control Bar**, click **Windows -> Browser**. The **Browser** window pops up (see *Figure 12*).



Type data

Module (All)

Filter *

34 Symbols matching

ARMC
ARRC
ARSC0
ARSC1
DDRA
DDRB
DDRC
DIV

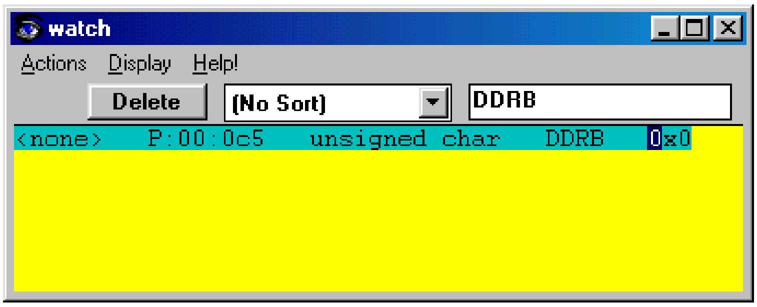
Symbol Details

Data symbols: D:00:C5 DDRB

Figure 12: Browser window

2 In the **Browser** window, click the arrow next to **Type**, select **data** and click **Apply**.

3 Scroll through the symbols to find **DDRB**, click it once to highlight it and then click **Add To Watch.** This causes the **Watch** window (see *Figure 13*) which displays the contents of **DDRB** to pop up.



DDRB

```
<none>   P:00:0c5   unsigned char   DDRB   0x0
```

Figure 13: Watch window

4 In the **Watch** window, click on **DDRB** and then **Display**, **Base**, **Hexadecimal**. This changes the DDRB register (because it is highlighted) from decimal to hexadecimal notation. Then click **Display**, **Prefs** and **Hexa** - this will make any new register that is added to the **Watch** window be displayed in hexadecimal format.

5 Make the **Watch** window smaller and move the **Watch**, **Browser**, **tutorial.asm** and **Control Bar** windows to a location on the screen where they can all be easily read.

6 In the **Browser** window, add the following registers to the **Watch** window in the same way that you added **DDRB**: **ORB**, **DRB**, **drbcopy**, **IOR**, **TSCR** and **TCR**. Close the **Browser** window.

Note: You can also type the names of the registers directly in the ***Watch*** *window.*

7 In the **Control Bar,** click **Commands,** then **Reset**. This resets the microcontroller and places the Program Counter at the Reset vector.

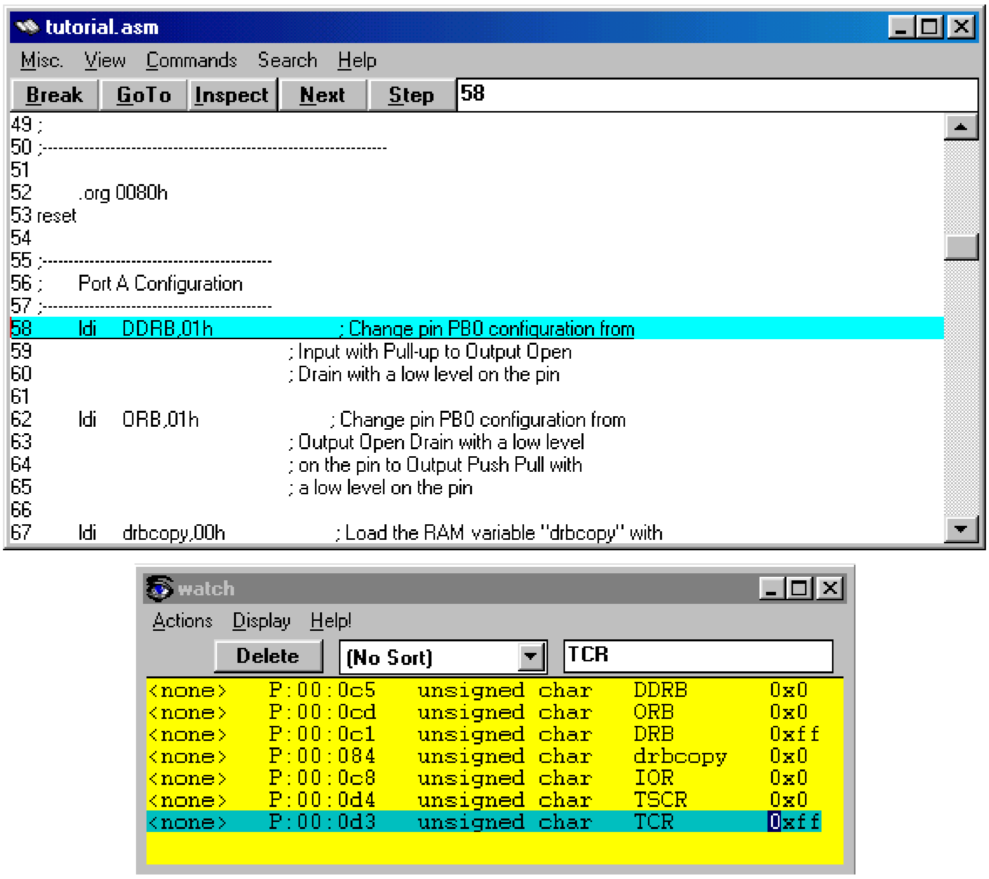
8 In the **Control Bar, click Step.** This executes only one instruction and since the instruction at the Reset vector is `jp reset`, it will jump to where the label `reset` is located. After the `jp reset` instruction is executed, the `ldi DDRB,01h` instruction will be highlighted.

Note: The highlighted instruction is the next one to be executed.

Results: The **Watch** window shows the DRB value to be FFh in hexadecimal as shown in *Figure 14*. This is due to the Port B configuration: all the Port B I/

Os are defined as input with pull-up (reset state). The pull-ups have the effect that the pins are all high (logic 1), and because they are all configured as input this means their logic state is read from the DRB.

The other variables (`drbcopy`...) are not yet initialized at this stage.



```
;
;-------------------------------------------------------------

        .org 0080h
reset

;------------------------------------------
;       Port A Configuration
;------------------------------------------
        ldi     DDRB,01h             ; Change pin PB0 configuration from
                                ; Input with Pull-up to Output Open
                                ; Drain with a low level on the pin

        ldi     ORB,01h              ; Change pin PB0 configuration from
                                ; Output Open Drain with a low level
                                ; on the pin to Output Push Pull with
                                ; a low level on the pin

        ldi     drbcopy,00h          ; Load the RAM variable "drbcopy" with
```

```
<none>   P:00:0c5   unsigned char   DDRB      0x0
<none>   P:00:0cd   unsigned char   ORB       0x0
<none>   P:00:0c1   unsigned char   DRB       0xff
<none>   P:00:084   unsigned char   drbcopy   0x0
<none>   P:00:0c8   unsigned char   IOR       0x0
<none>   P:00:0d4   unsigned char   TSCR      0x0
<none>   P:00:0d3   unsigned char   TCR       0xff
```

Figure 14: tutorial.asm and Watch windows

9 Note that in the **Watch** window, the contents of the DDRB register is 00h in hexadecimal notation. In the **Control Bar** click the **Step** button again. This loads the hexadecimal value 01h into the DDRB register.

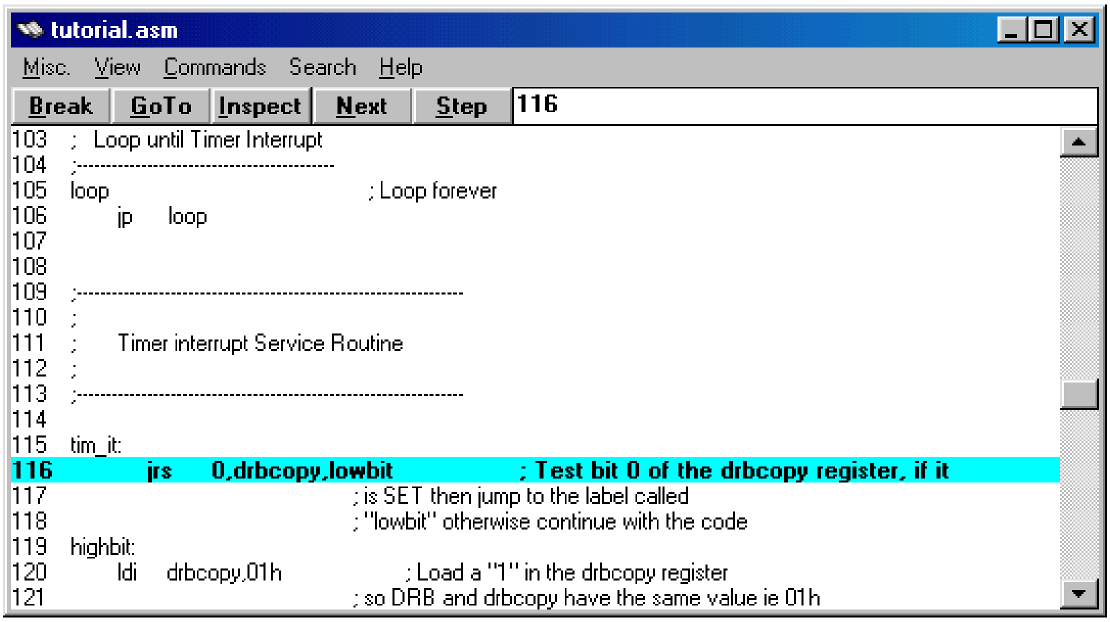
10 Click the **Step** button again. This loads the hexadecimal value 01h into the ORB register.

11 Click the **Step** button again. This loads the hexadecimal value 00h into the drbcopy register.

We could continue this Stepping process and watch each register being loaded, as the instructions are executed one-by-one, but for the purposes of this tutorial we will leave the Stepping process and continue executing the program without stepping.

12 In the **tutorial.asm** window, scroll down to the `jrs 0,drbcopy,lowbit` instruction and click it once - this highlights the instruction in blue. This instruction is in the Timer Interrupt Service Routine and will not be reached until the timer interrupts the program (which means that it counts down to zero).

13 Click the **Break** button - this causes the instruction to be displayed in bold (see *Figure 15*) which means a breakpoint has been set at this instruction.



116

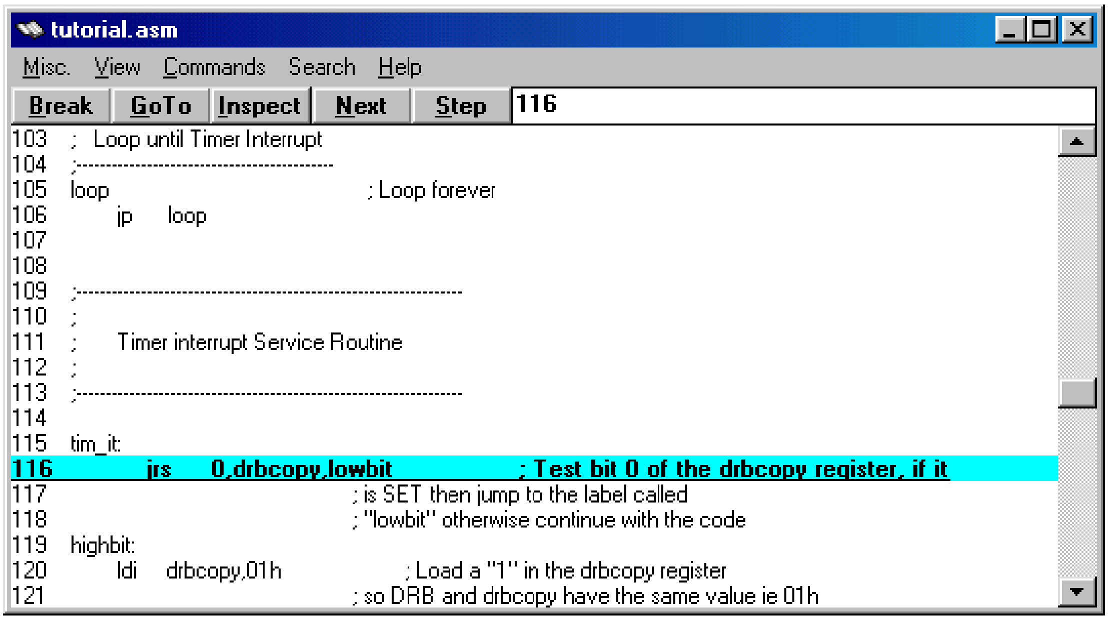
```
;  Loop until Timer Interrupt
;------------------------------------------
loop                                ; Loop forever
        jp      loop


;--------------------------------------------------------------
;
;       Timer interrupt Service Routine
;
;--------------------------------------------------------------

tim_it:
        jrs     0,drbcopy,lowbit            ; Test bit 0 of the drbcopy register, if it
                                    ; is SET then jump to the label called
                                    ; "lowbit" otherwise continue with the code
highbit:
        ldi     drbcopy,01h              ; Load a "1" in the drbcopy register
                                    ; so DRB and drbcopy have the same value ie 01h
```

Figure 15: tutorial.asm window showing set breakpoin

14 In the **Control Bar,** click the **Cont** button - this runs the program from the current Program Counter location without stopping until a breakpoint is encountered (see *Figure 16*).



```
;  Loop until Timer Interrupt
;-----------------------------------------------
loop                                    ; Loop forever
        jp      loop


;-----------------------------------------------------------------------
;
;       Timer interrupt Service Routine
;
;-----------------------------------------------------------------------

tim_it:
        jrs     0,drbcopy,lowbit        ; Test bit 0 of the drbcopy register, if it
                                        ; is SET then jump to the label called
                                        ; "lowbit" otherwise continue with the code
highbit:
        ldi     drbcopy,01h             ; Load a "1" in the drbcopy register
                                        ; so DRB and drbcopy have the same value ie 01h
```

Figure 16: Breakpoint encountered

15 After the program stops running (note that it has stopped where the breakpoint was set), click the **Step** button in the **Control Bar.** It executes the `jrs 0,drbcopy,lowbit` instruction which tests the zero bit of the drbcopy register to see if it is a “1” or a “0”. If it is a “1”, then it jumps to the label referred to as `lowbit`. In our case the zero bit is “0”, so the `jrs` instruction does not make a jump and the next instruction is highlighted (`ldi drbcopy,01h`).

16 Click the **Step** button again - this loads the hexadecimal value 01h into the drbcopy register.

Results: Look at the oscilloscope which is displaying the voltage level of pin PB0 and note that it is low (0 V).

17 Click the **Step** button again - this loads the hexadecimal value 01h into the DRB register.

Results: Look at the oscilloscope which is displaying the voltage level of pin PB0 and note that it has changed to high (5 V). The reason why it changed is because the last instruction that was executed changed PB0 from Output

Push-Pull with a “0” in its data register to Output Push-Pull with a “1” in its data register.

*Note: In the **Watch** window, the contents of the TSCR register is EFh in hexadecimal notation.*

18 In the **Control Bar** click the **Step** button. This resets the 7th bit of the TSCR register, making its value change to 6Fh.

19 In the **Control Bar** click the **Cont** button. This runs the rest of the instructions and does not stop until a breakpoint is encountered.
The **Cont** button runs the code from the current Program Counter location (the last instruction that was executed).

20 After the program stops running (note that it stops at the same breakpoint that was set before) click the **Step** button in the **Control Bar**. It executes the `jrs 0,drbcopy,lowbit` instruction which tests the zero bit of the drbcopy register to see if it is a “1” or a “0”. If it is a “1” then it will jump to the label referred to as `lowbit`, otherwise it will not jump and the next instruction will be executed, but since the zero bit of the drbcopy register is a “1” it will jump to the `lowbit` label.

21 Click the **Step** button again, this loads the hexadecimal value 00h into the drbcopy register.

Results: Look at the oscilloscope which is displaying the voltage level of pin PB0 and note that it is high (5 V). The voltage level of PB0 is 5 V because PB0 is configured as Output Push-Pull with a “1” in its data register (DRB).

22 Click the **Step** button again - this loads the hexadecimal value 00h into the DRB register.

Results: Look at the oscilloscope which is displaying the voltage level of pin PB0 and note that it has changed to low (0 V). The reason why it changed is because the last instruction that was executed changed PB0 from Output Push-Pull with a “1” in its data register to Output Push-Pull with a “0” in its data register.

*Note: In the **Watch** window that the contents of the TSCR register is EF in hexadecimal notation.*

23 In the **Control Bar** click the **Step** button. This resets the 7th bit of the TSCR register, making its value change to 6Fh.

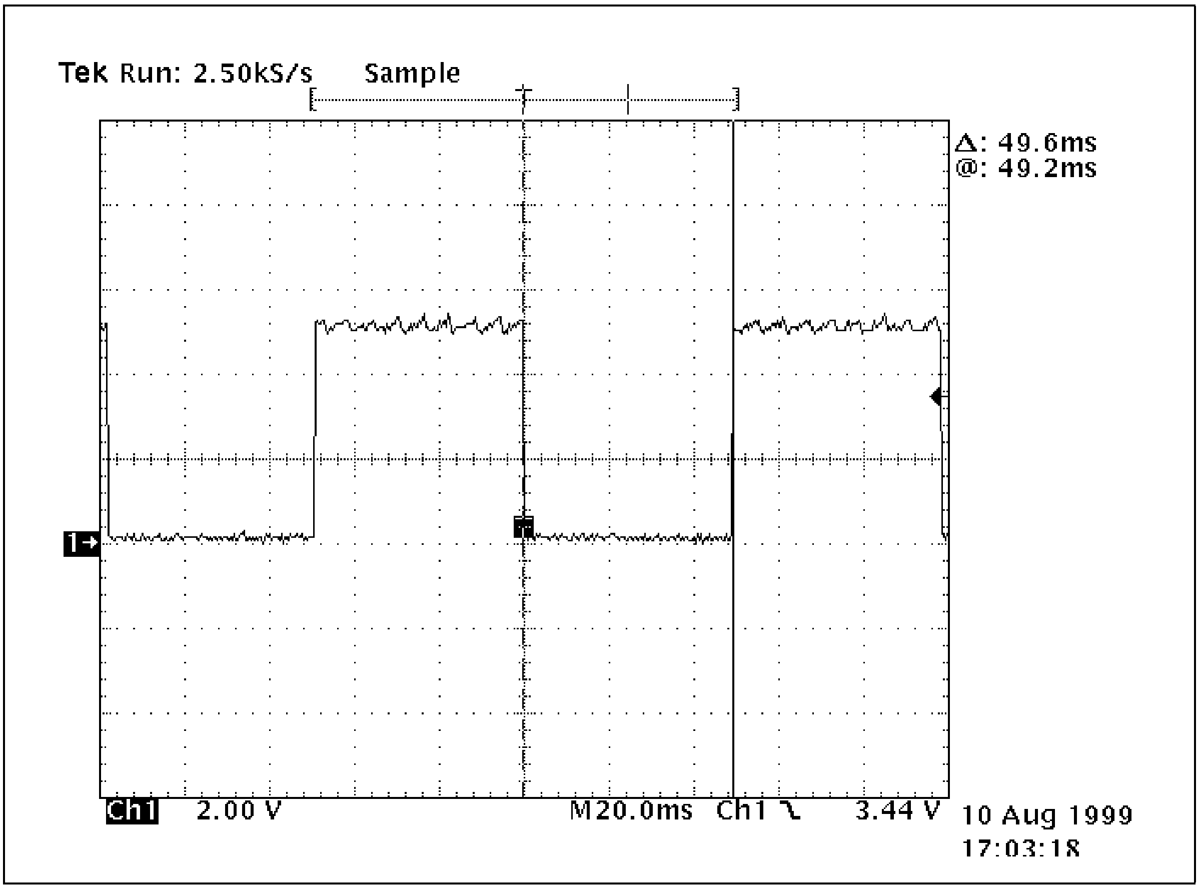
If we carry on clicking the **Cont** button and stepping through the code we can see that PB0 changes from a logic “0” (low - 0 V) to a logic “1” (high - 5 V) and vice-versa. But, instead of doing that we will stop “Stepping” through the code and “Run” through it instead.

4.6 Run Mode

1 In the **tutorial.asm** window, scroll up to the `jrs 0,drbcopy,lowbit` instruction and click it once. This highlights the instruction in blue. This instruction is in the Timer Interrupt Service Routine. Click the **Break** button - this turns the instruction back into normal lettering as opposed to bold lettering which means the breakpoint has been removed from this instruction.

2 In the **Control Bar** click the **Run** button and watch the oscilloscope which is displaying the voltage level of pin PB0. You will see it change from low to high and high to low continuously. This is a 10.17 Hz PWM signal with 50% Duty Cycle. You may have to adjust the oscilloscope to the right setting to see the 10.17 Hz PWM signal. This PWM will not stop until you click the **Stop** button in the **Control Bar**.

Note: *The **Run** button runs the code from the reset vector whereas the **Cont** button runs the code from the current Program Counter location (the last instruction that was executed).*



4.7 Conclusion

Now that you have finished this tutorial, you can start stepping and running your own code in exactly the same way as we have done with the `tutorial.asm` program.

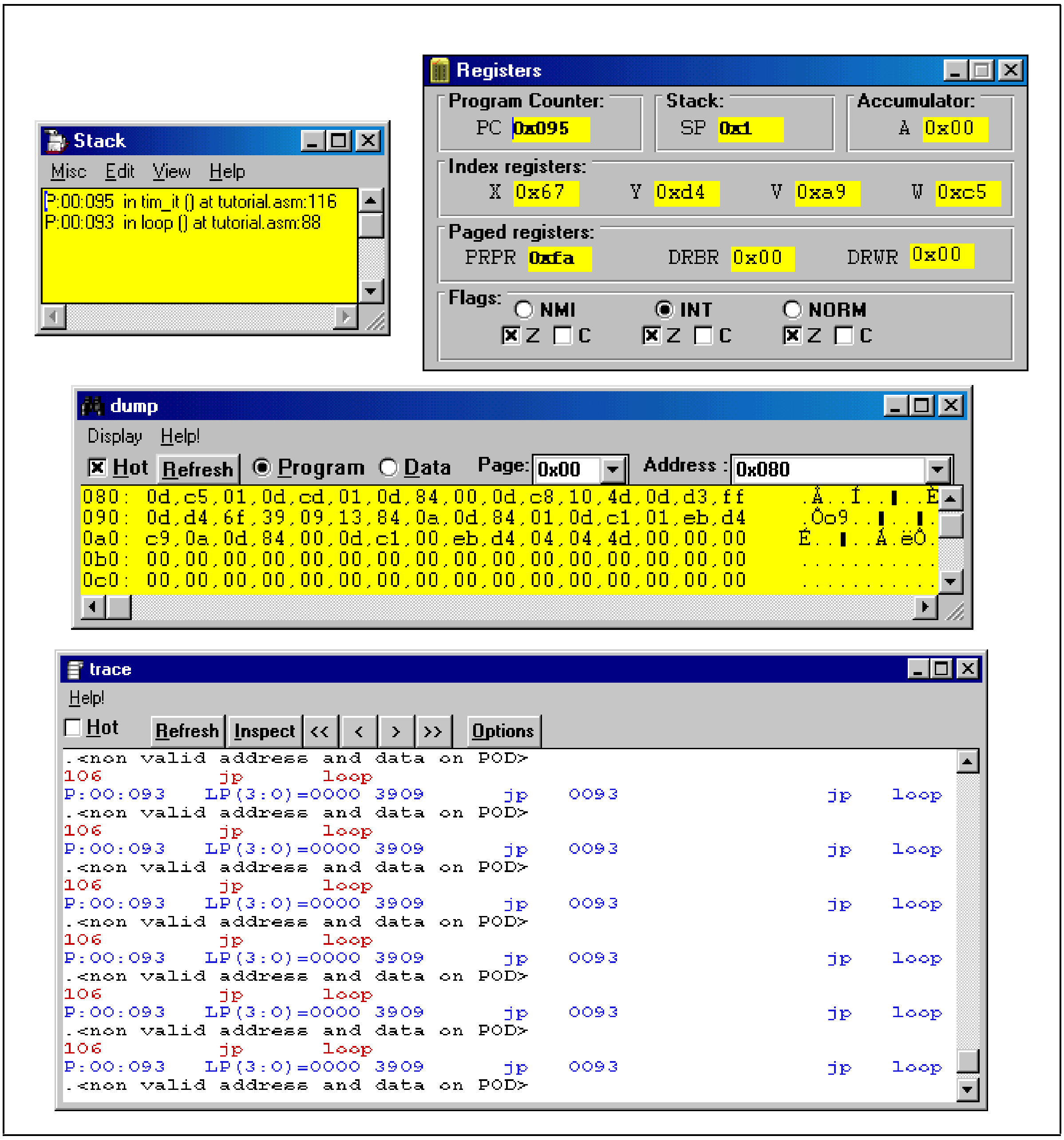
You can customize your debug session by launching other windows from the **Windows** menu on the **Control Bar** such as:

- The **Stack** window for displaying the stack status.
- The **Register** window for inspecting the core registers (accumulator, index registers etc.).
- The **Dump** window for inspecting any location in your memory (data and program space).
- The **Trace** window for a log of all the instructions executed.

These windows are shown in *Figure 17*. You can find the files for this advanced debug session in :

```
D:\Program Files\Stm\ST6toolchain\soft\6x-
emu2\tutorial\wsd_file.
```

If you have any questions please contact your local STMicroelectronics Microcontroller support person (refer to *Product Support* on page 53).



```
P:00:095  in tim_it () at tutorial.asm:116
P:00:093  in loop () at tutorial.asm:88
```

Program Counter: PC 0x095 Stack: SP 0x1 Accumulator: A 0x00

Index registers: X 0x67 Y 0xd4 V 0xa9 W 0xc5

Paged registers: PRPR 0xfa DRBR 0x00 DRWR 0x00

Flags: ○ NMI ☒ Z □ C ● INT ☒ Z □ C ○ NORM ☒ Z □ C

☒ Hot ● Program ○ Data Page: 0x00 Address : 0x080

```
080:  0d,c5,01,0d,cd,01,0d,84,00,0d,c8,10,4d,0d,d3,ff      .Å..Í..▌..È
090:  0d,d4,6f,39,09,13,84,0a,0d,84,01,0d,c1,01,eb,d4      .Ôo9..▌..▌.
0a0:  c9,0a,0d,84,00,0d,c1,00,eb,d4,04,04,4d,00,00,00     É..▌..Á.ëÔ.
0b0:  00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00      ...........
0c0:  00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00      ...........
```

□ Hot

```
.<non valid address and data on POD>
106          jp        loop
P:00:093   LP(3:0)=0000 3909      jp    0093                   jp    loop
.<non valid address and data on POD>
106          jp        loop
P:00:093   LP(3:0)=0000 3909      jp    0093                   jp    loop
.<non valid address and data on POD>
106          jp        loop
P:00:093   LP(3:0)=0000 3909      jp    0093                   jp    loop
.<non valid address and data on POD>
106          jp        loop
P:00:093   LP(3:0)=0000 3909      jp    0093                   jp    loop
.<non valid address and data on POD>
106          jp        loop
P:00:093   LP(3:0)=0000 3909      jp    0093                   jp    loop
.<non valid address and data on POD>
106          jp        loop
P:00:093   LP(3:0)=0000 3909      jp    0093                   jp    loop
.<non valid address and data on POD>
```

Figure 17: Stack, Registers and Dump windows

4.8 Using the tutorial with ST62 devices other than the ST6265

You can easily modify the tutorial program to target a device other than the ST6265. You need only take into account the interrupt channel to which the timer is connected. Any other I/O port can be used for outputting signals.

To do so, proceed as follows:

1 In the `tutorial.asm` file find the following line of code and modify the device version to reflect the new target device:

```
.vers “ST6265”                    ; Optional
```

2 In the `tutorial.asm` file find the following line of code and modify the `romsize` parameter as appropriate:

```
.romsize 4                        ; Optional
```

3 Change the hardware register definition file (`*.INI`) to that associated with the device you want to target. These files can be found in the following directory:

```
D:\Program Files\Stm\ST6toolchain\soft\6x-emu2\inc_file.
```

4 If necessary, refer to the device datasheet in order to remap the microcontroller device vector.

5 Refer to the device data sheet in order to check the ST6 memory mapping, modify the `tutorial.asm` file as appropriate (`.org` and `block` instructions).

6 Select the appropriate device name in the debugger.

5 EMULATOR FEATURES

5.1 Clock source

The clock source can be configured by software on the dedication board and using jumpers W1 and W2 on the probe board. The clock source can also be configured from an oscillator on the:

- Probe board, or
- TTL signal input to the OSCIN pin of the probe.

Note: *A crystal or ceramic resonator on the application board must not be used as a clock source for the emulator.*

5.2 Dedication board oscillator

The dedication board oscillator is selectable with the software. Possible selections are:

- 500kHz
- 1MHz
- 2MHz
- 3MHz
- 4MHz
- 5MHz
- 6MHz
- 7MHz
- 8MHz

5.3 Probe board oscillator

The probe board has locations for soldering a crystal or a ceramic resonator which can be used as the clock source of the emulated MCU. To select this,

1. Select **EXTERNAL** in the menu **Command -> Micro_Configuration -> Frequency**.
2. Remove the jumper between pins 1-2 of W2 on the probe board.
3. Install a jumper between pins 1-2 of W1 on the probe board.

Note: *When you install an oscillator on the probe board, you may have to change the capacitors (refer to Changing the oscillator on the probe board on page 40).*

5.4 External signal input on OSCIN pin

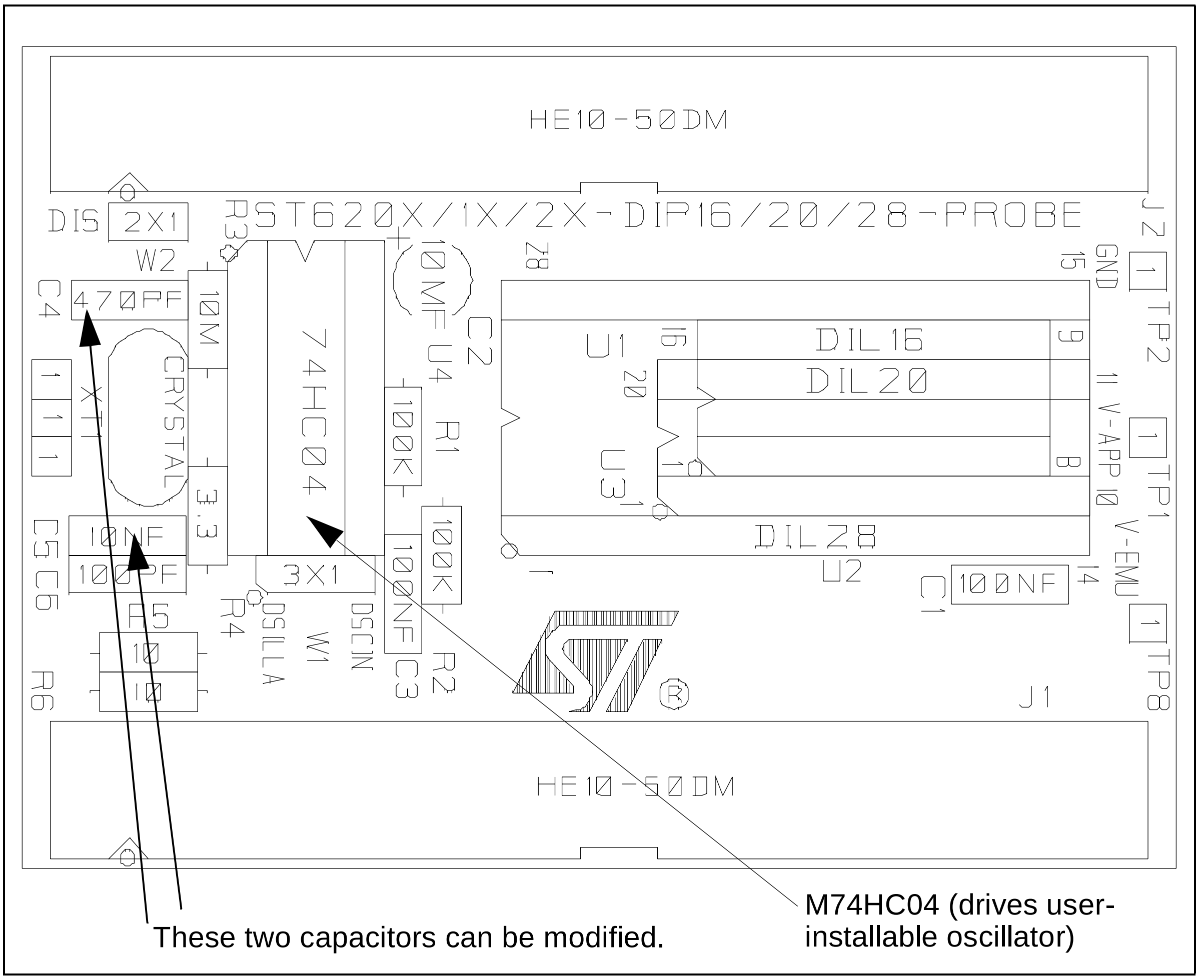
To select this,

1. Select **EXTERNAL** in the menu **Command -> Micro_Configuration -> Frequency**.
2. Install a jumper between pins 2-3 of W1 and pins 1-2 of W2 on the probe board.

5.5 Changing the oscillator on the probe board

If you install a crystal or a ceramic resonator on the probe board, you must change the value of the C4 and C5 capacitors (C3 and C4 capacitors in the case of a DB324 probe board) accordingly (see *Figure 18*).

The capacitors installed (470 pF, 1000 pF) have been tested with crystals in the range 1 to 4 MHz; however, the results you obtain will depend on the characteristics of the crystal you use.

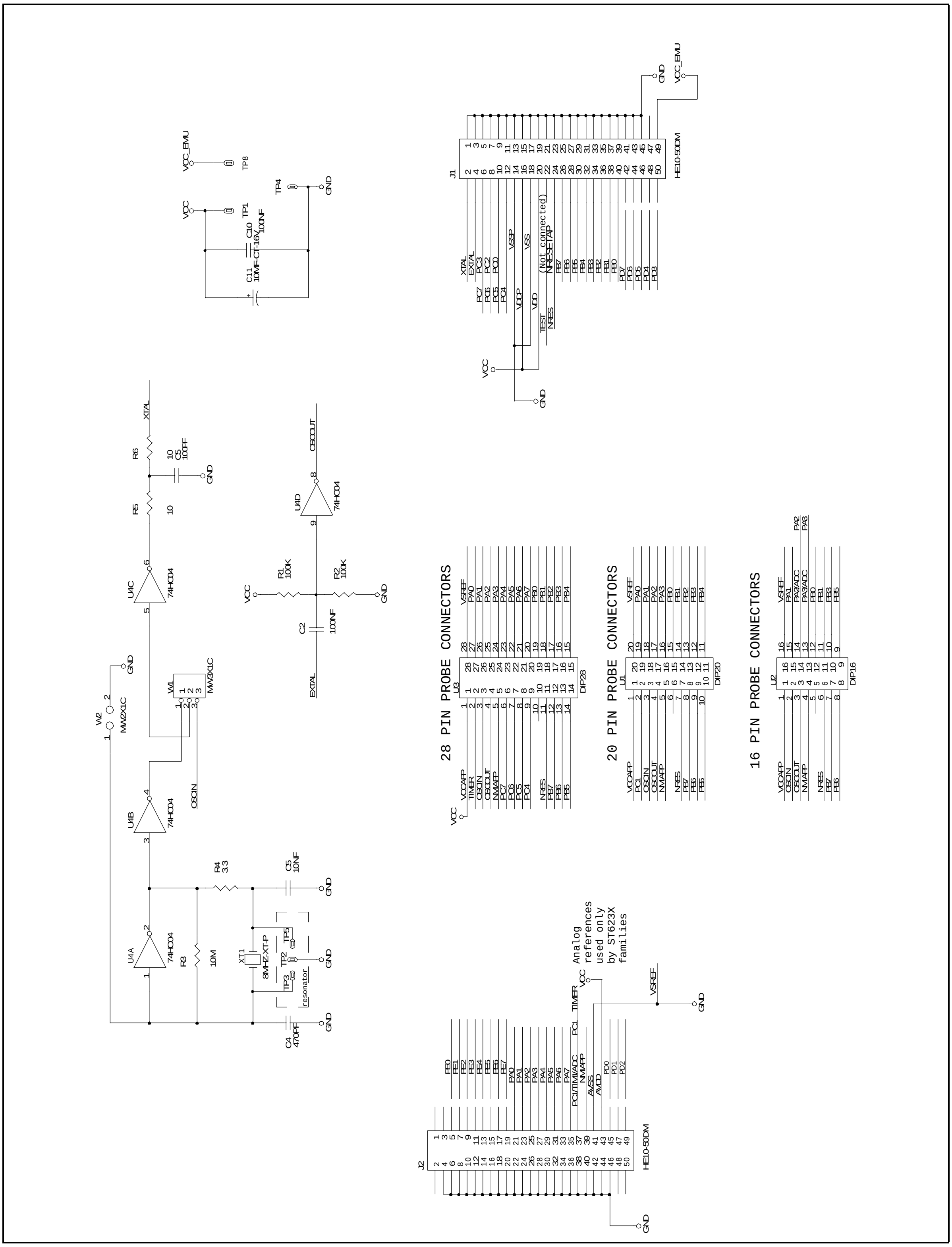


These two capacitors can be modified.

M74HC04 (drives user-installable oscillator)

Figure 18: Probe board layout

You can find these components in the following schematic:



5.6 Emulator electrical characteristics

5.6.1 Voltage measurement on V_{DD}/V_{SS} probe pins when disconnected from application board

If you measure the voltage on the power pins of the probe when disconnected from the target application, it will be much lower than the operating voltage of 5 V. This is normal, because the V_{DD} pin of the probe is used as a reference voltage by the emulator. It aligns itself to the application voltage level when the probe is plugged into the application board and the application board is powered-on.

5.6.2 Power consumption of probe

The M74HC04 on the probe board (see *Figure 18* on page 40 for its position) is intended for driving a user-installable oscillator. This M74HC04 is always under power. To obtain 0 A power consumption on the probe board, remove the M74HC04 if you do not need it to drive an oscillator.

5.7 Status LEDs

Three LEDs on the front panel of the ST62GP-EMU2 show the user the state of the emulated ST62 device as follow:

Stop	Wait	Run	Meaning
		On	ST62 device is in Run mode (core at full speed)
	On	On	ST62 device is in Wait mode
On	On	On	ST62 device is in Stop mode

5.8 Step mode advantages of the ST62GP-EMU2

The ST626P-EMU2 emulator, when run with the WGDB6 debugger in step mode, has the following characteristics:

- A/D End of Conversion flag when debugging in step mode

  The A/D converter clock is always present and the A/D conversion is performed at full speed, even when stepping through the program. This will result in the EOC flag appearing to be set immediately when the conversion is started.

- SPI communication when debugging in step mode

The SPI data register operates at full speed even in Step mode. For example, if you load the Data register in Step mode, the value will be output immediately on the pin.

5.9 Using the trigger outputs

Two connectors for trigger output signals are available on the front panel of the ST62GP-EMU2.

You can generate these signals using the Hardware Events/Trigger Menu in the WGDB6 Debugger. Output OUT1 and OUT2 can be programmed in two ways:

- **Synchronization mode** (see *Figure 19*) allows you to configure two synchronization pulses (Trig1 and Trig2) for triggering external hardware. The events can be defined by addresses or address ranges.

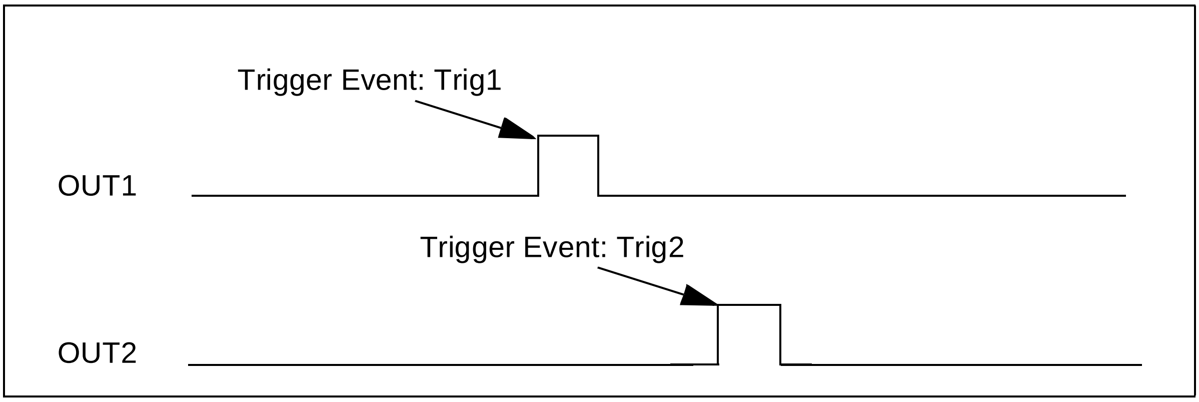


Figure 19: Synchronization Mode

- **Timing measurement mode** (see *Figure 20*) allows you to measure the time elapsed during a subroutine for example, using an oscilloscope connected to OUT1. In this case, output OUT2 is SET on a user-defined address (Trig1), and RESET on another one (Trig2).

OUT1 is the ST6 clock signal (f_{INT}) gated by OUT2.

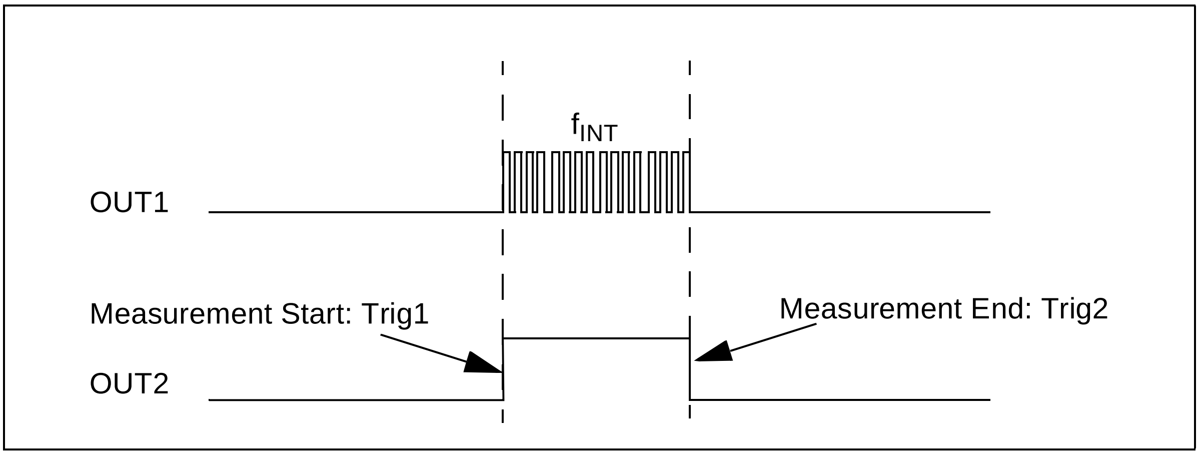


Figure 20: Timing Measurement Mode

5.10 Using the analyzer probe

The ST62GP-EMU2 has an input connector for up to 4 external signals which can be used to capture signals from your application hardware to be used as logical conditions for conditional breakpoints.

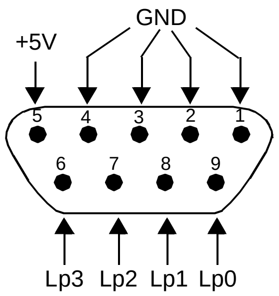
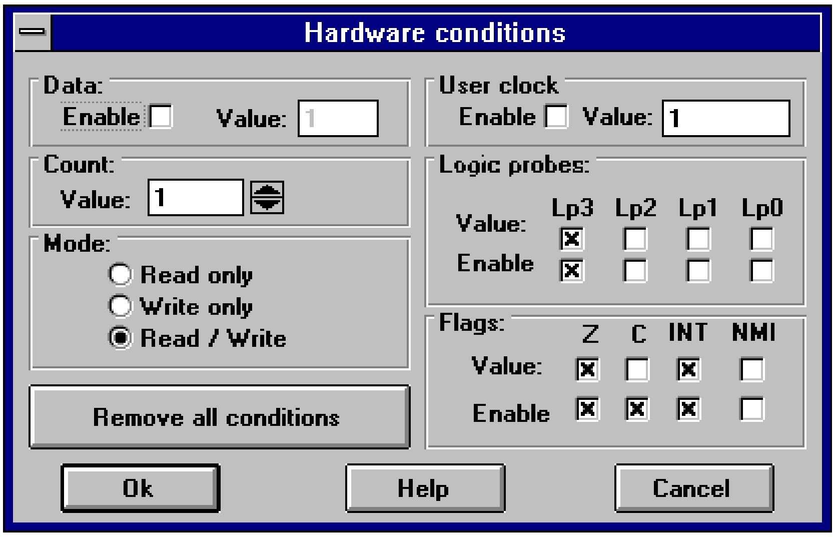


Figure 21: Analyzer Probe Connector Pin Assignment

By connecting the analyzer probe to various test points on your application board, you can set up breakpoints that will be triggered depending on the state of your application hardware, plus any other software conditions you may have configured for the breakpoint.

1 In the **WGDB6 Main Window**, click **Hardware Events**, then **Memory Breakpoints**.
The **Memory Breakpoints** window opens.

2 Click the **Conditions** button. The **Hardware Conditions** window opens as shown in *Figure 22*.



Data: Enable □ Value: 1

User clock Enable □ Value: 1

Count: Value: 1

Mode: ○ Read only ○ Write only ● Read / Write

Logic probes:

	Lp3	Lp2	Lp1	Lp0
Value:	☒	□	□	□
Enable	☒	□	□	□

Flags:

	Z	C	INT	NMI
Value:	☒	□	☒	□
Enable	☒	☒	☒	□

Figure 22: Hardware conditions window

3 In the **Logic probe** box, click the **Enable** button beneath the logic probes whose values you want to consider.

4 While still in the **Logic probe** box, click the **Value** buttons to set the logic probe values on which you want to break.

Click **OK**.
These signals must be connected on the Lp (Logic Probe) pins of the Analyzer probe connector on the front panel of the ST62GP-EMU2. The inputs are CMOS compatible at 5 V. For more information on breakpoints, refer to the WGDB6 manual or to the WGDB6 on-line help.

5.11 Emulator functional limitations and discrepancies

5.11.1 ST6 device options

On most ST6 devices, you can select device options which are described in the datasheet option list and option byte sections (refer to the ST6 Databook or CD-ROM).

The ST62GP-EMU2’s functional limitations as regards device options are listed below.

5.11.2 Oscillator Safeguard Enable (OSGEN) option

When this option is selected the OSG and LFAO frequencies are fixed as follows:

V_{DD}	OSG	LFAO
2.4 V to 3.6 V	2 Mhz	200 khz
3.6 V to 4.5 V	4 Mhz	400 khz
4.5 V to 6 V	8 Mhz	800 khz

Note: *The OSG and LFAO frequencies of the ST62GP-EMU2 are fixed relative to V_{DD}. However, on real devices the OSG and LFAO frequencies may vary depending on both V_{DD} and the device temperature.*

5.11.3 Optional external RC network (OSCIL)

Not supported by the emulator.

Note: *The restrictions above should not prevent you from fully debugging your software, although you will not be able to test these features using the emulator.*

5.11.4 Electrical characteristics of A/D converter input pins

The emulator ADC input pins have an input capacitance AC_{IN} of 120 pF on the emulator, compared to 5 pF on the ST6 device. This has the effect that, when you switch A/D channels using the emulator, the first conversion may be wrong. This conversion error will not occur when the ST6 target device is installed in the final application.

5.11.5 Other known problems

5.11.5.1 WAIT and STOP mode

In the WGDB6 debugger, if an **Inspect** window is used in real time mode (i.e. red background color) while your program is in STOP or WAIT mode (assuming your program contains these instructions), this causes the emulator to exit these modes. This means that real-time use of the Inspect window causes the clock to be reactivated, and the normal running of your program may be disrupted (especially if the STOP or WAIT mode was to facilitate the collection of data).

APPENDIX A: TROUBLESHOOTING

A.1 Identifying the Problem

IF.....		.... THEN
1	The power status LED on the ST62GP-EMU2 front panel is off.	Check the power cable connections. Check the power switch on the ST62GP-EMU2 back panel.
2	The Run status LED does not switch on when you start your program.	Check the title bar of the **WGDB6 main** window, you may be in WGDB6 Simulator instead of WGDB6 Emulator.
3	WGDB6 crashes.	Remove the wgdb6win.ini from the C:\Windows directory and the filename.wsd file from the working directory. If this does not solve the problem, save any work files, delete the directory `c:\Program Files\Stm\St6toolchain\soft` and re-install WGDB6.
4	Error message: -hds2 -lpt1 timeout during synchronization	Check that the ST62GP-EMU2 is connected to LPT1 and check if the power supply is on.
5	Error message: Check if the emulator is switched on and if the parallel cable is well connected.	This message is also displayed when there is a configuration mismatch. Configure the parallel port of your PC, referring to *Changing the Parallel Port Setup on Your PC* on page 48. If the problem persists, save any work files, delete the directory `c:\Program Files\Stm\St6toolchain\soft` and re-install WGDB6.
6	Error message: No message received from the emulator.	Check that the ST62GP-EMU2 is powered on, and that the emulator boards are fully inserted in their slots.
7	Error message: This action is forbidden while the emulator is running.	Close WGDB6 and restart Windows.
8	Error message: Error FS_TargetReadonly.	This message can occur if WGDB6 is installed over an existing version. To correct this problem, save any work files, then delete the directory `c:\Program Files\Stm\St6toolchain\soft` before reinstalling WGDB6.

A.2 Changing the Parallel Port Setup on Your PC

If you see this message displayed while you are installing WGDB6,

“Check if the emulator is switched on and if the parallel cable is well connected.”

this may mean that the setup of the LPT1 or LPT2 port on your PC is not compatible with the ST62GP-EMU2. This is a problem with some Windows 95/98 PCs but usually not with Windows NT PCs.

To setup the port correctly:

1 Shutdown and restart your PC in order to enter the BIOS Setup.

2 Follow the messages displayed on the screen and when prompted, press the key required to enter the BIOS Setup (usually a Function key or ESC key).

3 Select the parallel port settings menu.

4 Change the mode of the LPT port used for the Emulator to ECP, EPP, Bidirectional or Centronics mode (**not** SPP, Standard, Unidirectional or Printer Mode).

5 Save your changes and exit the setup.

APPENDIX B: GLOSSARY

ADC

Analog-to-digital converter.

Dedication board

A dedication board is one of the two boards installed in the enclosure of the ST62GP-EMU2. It is the part of the emulator that is specific to a set of ST6 devices. It emulates the RAM, EEPROM, oscillator, timers, watchdog, ADC, SPI and I/Os. It is connected to the probe board by two flat cables. The ST6 HDS2 emulator is available in specific versions that support a group of ST6 devices. Each version of the ST6 HDS2 has a specific dedication board and set of probe boards.

DIL or DIP

Dual In Line, also known as Dual In Line Package. These two abbreviations designate a type of device package with two rows of pins for thru-hole mounting.

ECP

Extended capabilities port.

EPP

Enhanced parallel port.

Footprint

Designates the dimensions of the location of a component on a printed circuit board or in a socket. It depends on the number of pins, their size, type and positioning. The footprint of each ST6 device is specified in the datasheet in the section titled *Package Mechanical Data.* (see the *ST6 MCU Family Databook* or *MCU-on-CD* CD-ROM).

gdb

GNU debugger.

GNU

Acronym for Not UNIX. Name of a project developed by the Free Software Foundation.

Mainframe

Emulator enclosure with only the main board installed.

Main board

The main board is the board installed in the bottom slot of the ST62GP-EMU2. It emulates the ST6 program memory, and contains the breakpoint logic, trace memory and all the logic needed for realtime emulation.

LP

Logic probe.

Probe board

A probe board is a small printed circuit board with a connector to allow you to insert it in the MCU socket of the target board. It is connected to the dedication board by two flat cables.

RC Network

Resistor-capacitor network.

SMD

Surface Mounted Device. Designates a device with pins that are designed to be glued to the surface of a printed circuit board. Contrast with thru-hole devices which have pins that are designed to be inserted in holes on a printed circuit board and soldered.

SO

Small outline. Designates a type of device package with two rows of pins for SMD or socket mounting.

SPI

Serial Peripheral Interface.

SSOP

Shrink Small Outline Package. Designates a type of device package like SO but smaller. Emulating these devices requires a special adapter that can be ordered from STMicroelectronics.

Starter Kit

A printed circuit board for microcontroller evaluation and programming. It has the ability to program one DIP EPROM or OTP part at a time. Different starter kits are available for programming different ST6 devices.

ST6 HDS2 Series

The ST6 HDS2 Series is a generic name covering several emulator versions each of which have a specific dedication board to support a set of ST6 devices.

ST62GP-EMU2

The ST62GP EMU2 is the order code of this specific ST6 HDS2 emulator version with a dedication board for the ST620x, ST621x, ST622x, ST623x, ST625x, ST626x and ST6218/28 device families.

Target Board

Designates your application board. It should include a socket for inserting the ST6 device or the emulator probe.

WGDB6

Windows GNU Debugger for ST6. This is a software tool running under Windows. It is the main user interface when operating the ST6-HDS2 emulator, and is part of the ST6 software development tool chain (editor, assembler, linker and debugger). WGDB6 is supplied on the CD-ROM with the ST6-HDS2 emulator and must be installed on your development PC.

PRODUCT SUPPORT

If you experience any problems with this product or if you need spare parts or repair, contact the distributor or ST sales office where you purchased the product:

Getting prepared before you call

Collect the following information about the product before contacting ST or your distributor:

1 Name of the company where you purchased the emulator kit.

2 Date of purchase.

3 Order Code: Refer to the side of your emulator kit box. The order code will depend on the region for which it was ordered (i.e. the UK, Continental Europe or the USA).

4 Serial Number: The serial number is located on the rear panel of the emulator box.

5 Target Device: The sales type of the ST6 microcontroller you are using in your development.

Contact List

Note: *For **American and Canadian customers** seeking technical support the US/Canada is split in 3 territories. According to your area, contact the following sales office and ask to be transferred to an 8-bit microcontroller Field Applications Engineer (FAE).*

Canada and East Coast

STMicroelectronics
Lexington Corporate Center
10 Maguire Road, Building 1, 3rd floor
Lexington, MA 02421
Phone: 781-402-2650

Mid West

STMicroelectronics
1300 East Woodfield Road, Suite 410
Schaumburg, IL 60173
Phone: 847-517-1890

West coast

STMicroelectronics, Inc.
30101 Agoura Court
Suite 118
Agoura Hills, CA 91301
Phone: 818-865-6850

Europe

France (33-1) 47407575
Germany (49-89) 460060
U.K. (44-1628) 890800

Asia/Pacific Region

Japan (81-3) 3280-4120
Hong-Kong (852) 2861 5700
Sydney (61-2) 9580 3811
Taipei (886-2) 2378-8088

Software updates

You can get software updates from the ST Internet web site http://mcu.st.com. For information on firmware and hardware revisions, call your distributor or ST using the contact list given above.

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