68HC12 Training Lab
Instructor Manual

Date: 13 September, 2000

Document Revision:1.01

BiPOM Electronics

WARRANTY:

BiPOM Electronics warrants 68HC12 Training Kit for a period of 1 year . If the Kit becomes defective during this period, BiPOM Electronics will at its option, replace or repair the Kit. This warranty is voided if the product is subjected to physical abuse or operated outside stated electrical limits. BiPOM Electronics will not be responsible for damage to any external devices connected to the Kit. BiPOM Electronics disclaims all warranties express or implied warranties of merchantability and fitness for a particular purpose. In no event shall BiPOM Electronics be liable for any indirect, special, incidental or consequential damages in connection with or arising from the use of this product. BiPOM's liability is limited to the purchase price of this product.

Introduction

The objective of the 68HC12 Training Kit is to give the students hands-on experience with micro-controllers by developing practical applications using 68HC12 Assembly language. The 68HC12 Training Kit consists of lab exercises that vary from simple to complicated. It is recommended that the lab accompany a micro-controller course during the semester.

Depending on the duration of each lab during the week, each lab in the student manual can be covered during one or two lab weeks. Based on the remaining time during the semester, the instructor is advised to have the students to work on one or more advanced projects. Some project ideas are listed in Advanced Projects section of this manual.

Preparation

The 68HC12 Training Kit consists of the following components:

- Motorola M68EVB912B32 Micro-controller Board (Training Board)
- Micro-IDE Integrated Development Environment
- 68HC12 Assembler
- (Optional) Micro C Compiler and linker for the 68HC12
- Serial Cable

The following external items are required for each Training Kit station:

- IBM Compatible Personal Computer (PC) running Windows 95/98/NT 4.0 or 2000. (M68HC12 Training Kit will not work with DOS, Windows 3.1 or lower). Minimum 16MB memory and 10 MB of available hard disk space.
  One available RS232 Serial Port.

- 5 Volts regulated power supply
  (minimum 300 mA, preferably short-circuit protected)

- Digital Voltmeter

Prepare each Training Kit station as follows:

<u>Installing the hardware</u>

1. Place the Training Board on a clean bench top (if possible on an anti-static mat) close to the PC.

2. While the 5-Volt Power Supply is off, connect the power supply outputs to the Training Board Power Supply Connector (P5) as shown in Figure 1.

   Positive supply is connected to the RED terminal block (labeled +5V) on the M68EVB912B32 board.

   Negative supply (ground) is connected to BLACK terminal block (labeled GND) on the M68EVB912B32 board.

   CAUTION: Connecting the supply leads incorrectly will permanently DAMAGE the board !

3. Turn on the 5-Volt Power Supply.

4. If the PC is running, shutdown Windows and turn off the PC.

5. Connect the 9-pin serial connector (P1) on the M68EVB912B32 board to the PC's serial port using the supplied serial cable as shown in Figure 1.
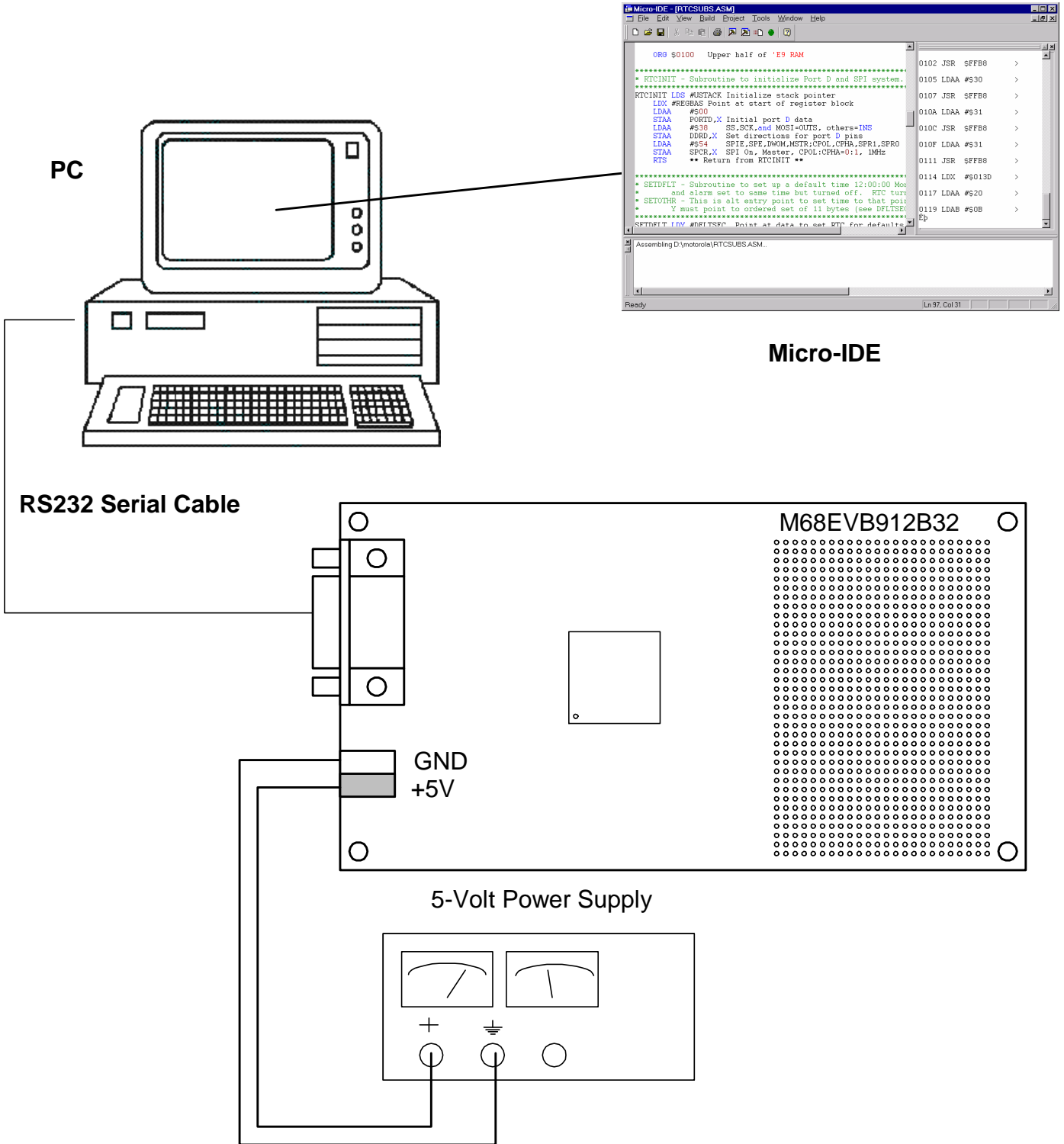
6. Turn on the PC and start Windows.

PC

Micro-IDE

RS232 Serial Cable

M68EVB912B32

GND
+5V

5-Volt Power Supply

Figure 1

Installing the Software

1. Install the 68HC12 Development System software on the PC following the instructions on the 68HC12 Development System envelope. You will be prompted for the Serial number for Micro-IDE during installation; this number is printed on the 68HC12 Development System envelope for each Training Kit.

   For Micro-IDE, you can specify either the default installation location of c:\bipom\devtools\microide or any other location.

   For the DK12 disks, use the default location of **c:\mc** during installation; this is the location that Micro-IDE expects to find the 68HC12 tools.

2. After installation, start Micro-IDE by selecting Start, Programs and Micro-IDE. Select the Micro-IDE option under Micro-IDE folder. This will start Micro-IDE.

Configuring communications

1. Select the correct COM port and communications parameters. From the Micro-IDE menu, select Tools and Options.

2. Under Build tab, check mark Build With box. Select

   ASM12 Assembler for 68HC12

   as the toolkit. Select **Motorola M68EVB912B32 Serial Loader** as the loader (next to Download with checkbox).

3. Under Terminal tab, make sure COM Port is selected as the port that you connected to the Training Board. For example, if the board is connected to COM1, select COM1 under Terminal tab. Make sure that the Terminal options are set as follows:

   Baud Rate: 9600
   Data Bits: 8
   Stop Bits: 1
   Parity: None
   Echo: Off

4. Under Loader tab, make sure COM Port is selected as the port that you connected M68EVB912B32 board. For example, if M68EVB912B32 is connected to COM1, select COM1 under Loader tab. Make sure that the Loader options are set as follows:

   Baud Rate: 9600
   Data Bits: 8
   Stop Bits: 1
   Parity: None
   Echo: Off

5. Check communications to the Training board. Start the Terminal program by selecting Terminal under View menu. A blank terminal screen will appear on the right side of the Micro-IDE window. (You can resize the terminal screen by selecting the left edge of the terminal window with the left mouse button and dragging to the right.)

6. Select Tools, Terminal and Connect. This will establish communications to the Training board.

7. Press the RESET button on the Training Board. The following message should appear on the terminal screen.

    D-Bug12 v2.0.2
    Copyright 1996 - 1997 Motorola Semiconductor
    For Commands type "Help"

    >

    Depending on the version of your M68EVB912B32 board, this message may be slightly different. This message indicates that you have established communications with the board.

8. Click the left mouse button once in the Terminal window to set the input focus to that window. Press <ENTER> once. Another '>' prompt will be displayed. This means you are now ready to enter commands.

Downloading programs

Check if you can assemble and download programs to the board by following the steps below:

1. Create a simple project using Micro-IDE. This project will contain a simple 68HC912 Assembly program.

   From the Micro-IDE menu, select Project and New Project. Enter **test** as the project name and type **c:\test** for the Location. Select

   ASM12 Assembler for 68HC12

2. Now create a simple Assembly file and add to the test project. To do this, select File and New. Select ASM File and type the name **test.asm**. Location should already be **c:\test**; if not, enter the correct Location as **c:\test**.

   Click OK. This will create the empty assembly file test.asm.

   Type the following simple 68HC12 Assembly program:

   ```
   ORG $0800

   LDAA #1
   RTS
   ```

   This program loads the accumulator A with the value of 1 and returns. The origin directive (ORG) tells the assembler that the start address of program in memory is hexadecimal 0800. Address 0800 is mapped to RAM on the Training board.

   Important Note: Enter a tab or spaces to the left of each assembly instruction; otherwise the assembler will give Unknown Instruction errors.

3. Assemble the file by selecting Build and Build test.asm. This will assemble the test.asm source file and create the test.hex file to be downloaded to the board. Test.hex is in Motorola S Record format. Details of the hex format can be found in the M68EVB912B32 Evaluation Board User's Manual.

   If test.asm is assembled without errors, the following message appears in the Output window of Micro-IDE:

   Assembling c:\test\test.asm…
   First pass… Second pass… 0 error(s).

4. Download the test.hex file to the Training board by selecting Build and Download test.hex.

You should see a progress indicator during download. When the download is finished, you should see the message

>

on the Terminal screen. This means that the board has received the program successfully. Since our test program starts at address 0800 (because of the ORG $0800 directive), it will automatically be loaded to 0800.

At the > prompt, execute the simple test program by typing

call 0800

This commands instructs the D-Bug12 to pass control to the subroutine at address 0800; this is actually the program that we just created and downloaded to address 0800.

C programming

Creating C language projects is very similar to Assembly language except that in C programs, the physical starting address of the program is not specified in the C program. This is done in the C startup libraries. If the Micro C compiler has been installed under **c:\mc**, the libraries are in **c:\mc\lib12**.

Edit the library file **6812rlp.asm** and change the origin statement (ORG) at the beginning of the file. For example, to load C programs starting at address $0D00, the origin statement should be:

ORG $0D00   Place code in memory here

Advanced Project Ideas

- Connecting a printer to the 68HC912

- Using the 68HC912 as a frequency counter

- Using the 68HC912 as a temperature controller

- Connecting the 68HC912 to a Liquid Crystal Display (LCD)

- Using the 68HC912 EEPROM and the Analog-To-Digital Converter as a multi-channel data logger.

- Using Fuzzy Logic instructions of the 68HC912.