



DEMO9S12PFAME

Demonstration Board for Freescale MC9S12P128 (80-Pin QFP)

User's Manual

Revision 1.0



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1 Introduction

1.1 Overview

The DEMO9S12PFAME Demonstration board has been designed for the evaluation, demonstration and the debugging of the Freescale MC9S12P128 microcontroller.

The DEMO9S12PFAME can be used as a standalone application, or via its built-in USB-to-BDM bridge, or together the Freescale Student Learning Kit (Freescale code: MCUSLK) through three external 40-pin I/O female header connectors.

1.2 Package Contents

The DEMO9S12PFAME package includes the following items:

- The DEMO9S12PFAME evaluation board;
- A USB cable;
- A LIN cable;
- The SofTec Microsystems “System Software” CD-ROM;
- The CodeWarrior Development Studio Special Edition CD-ROM;
- A Quick Start Guide sheet;
- This user’s manual.

1.3 Supported Devices

The DEMO9S12PFAME Demonstration Board supports the following devices:

- MC9S12P128.

1.4 Recommended Reading

- Freescale S12 microcontroller-specific datasheets;
- DEMO9S12PFAME Schematic.

2 Hardware Features

2.1 Demonstration Board Features

The DEMO9S12PFAME board features:

- A MC9S12P128 microcontroller (in 80-Pin QFP package, already programmed with a demo application);
- A 4 MHz crystal;
- A 12 V DC power supply input connector;
- Power input selection jumper for selecting the input voltage source:
 - 12 V DC input connector;
 - USB connector.
- A built-in USB-to-BDM circuitry which allows the host PC to communicate with the microcontroller through a standard USB interface. USB 2.0 is fully supported. When using an external in-circuit debugger (via the “BDM” connector), the USB-to-BDM circuitry must be bypassed by removing the BKGD and RESET# jumpers.
- A Reset push-button connected to the MCU Reset pin.
- A series of inputs:
 - Two push-buttons, together with jumpers to connect/disconnect them to/from the microcontroller;
 - Four DIP-switches, together with jumpers to connect/disconnect them to/from the microcontroller;
 - A potentiometer, together with a jumper to connect/disconnect it to/from the microcontroller;
 - A photocell, together with a jumper to connect/disconnect it to/from the microcontroller.
- Four high-efficiency (low-current) LEDs together with jumpers to connect/disconnect them to/from the microcontroller;
- An RS-232 channel connected to the microcontroller's SCI serial communication interface, together with a jumper to select the RS-232 or LIN functionality (see point below);
- Two LIN connectors sharing one LIN transceiver, together with jumpers for configuration;
- One CAN connector with high-speed CAN transceiver, together with jumpers for configuration.

3 Software Setup

3.1 Overview



Note: *before connecting the Demonstration Board to the PC, it is recommended that you install all of the required software first (see below), so that the appropriate USB driver will be automatically found by Windows when you connect the Demonstration Board.*

The Demonstration Board requires that both CodeWarrior Development Studio Special Edition and SofTec Microsystems Additional Components be installed in the host PC.



Note: *CodeWarrior Development Studio for HCS12(X) must be installed first.*

3.2 Host System Requirements

The Demonstration Board is controlled by CodeWarrior Development Studio. The following hardware and software are required to run the CodeWarrior user interface together with the Demonstration Board:

- A 200-MHz (or higher) PC compatible system running Windows 98, Windows 2000 or Windows XP;
- 128 MB of available system RAM plus 1 GB of available hard disk space;
- A USB port;
- CD-ROM drive for installation.

3.3 Installing CodeWarrior Development Studio

To install the CodeWarrior Development Studio Special Edition, insert the CodeWarrior CD-ROM into your computer's CD-ROM drive. A startup window will automatically appear. Follow the on-screen instructions.

3.4 Installing SofTec Microsystems Additional Components

The SofTec Microsystems “System Software” CD-ROM contains other required components to your hard drive. These components include:

- SofTec Microsystems DLL for DEMO9S12PFAME support;
- Examples;
- Demonstration Board’s user’s manual;
- Demonstration Board’s schematic;
- Additional documentation.

To install the required components, do the following:

1. Insert the SofTec Microsystems “**System Software**” CD-ROM into your computer’s CD-ROM drive. A startup window will automatically appear.
2. Choose “**Install Instrument Software**” from the main menu.
3. Click on the “**Copy SofTec Microsystems DLL to \CodeWarrior for HCS12 V4.7\Prog\gdi**” option. An Explorer window will open. Copy the “**SofTec_BDM12.dll**” file to your PC in the “**\CodeWarrior for HC12 V4.7\Prog\gdi**” folder, relative to the CodeWarrior installation path.
4. Click on the “**Copy examples for CodeWarrior for HCS12 V.4.7**” option. An Explorer window will open. Copy the “**DEMO9S12PFAME**” folder to your PC, in a location of your choice. These are the examples specific for the demonstration board, and will be used later in the step-by-step tutorial.



Note: *to install the Additional Components on Windows 2000 or Windows XP, you must log in as Administrator.*

4 Hardware Setup

4.1 First Connection

The Demonstration Board connects to a host PC through a USB port. Connection steps are listed below in the recommended flow order:

1. Install all the required system software as described in the previous section.
2. Make sure the “POWER SEL” jumper is in the “USB” position.
3. Insert one end of the USB cable into a free USB port.
4. Insert the other end of the USB cable into the USB connector on the Demonstration Board.
5. The first time the Demonstration Board is connected to the PC, Windows recognizes the instrument and starts the “**Found New Hardware Wizard**” procedure, asking you to specify the driver to use for the instrument. On Windows XP (SP2) the following dialog box will appear.



6. Select the “**No, not this time**” option and click the “**Next >**” button. The following dialog box will appear.



Click the “Next >” button.

- Depending on your Windows settings, the following warning may appear.



Note: *this warning is related to the fact that the USB driver used by the Demonstration Board is not digitally signed by Microsoft, and Windows considers it to be potentially malfunctioning or dangerous for the system. However, you can safely ignore the warning, since every kind of compatibility/security test has been carried out by SofTec Microsystems.*

Click the “Continue Anyway” button.

- Windows will install the driver files to your system. At the end of the installation, the following dialog box will appear.



Click the **“Finish”** button to exit from the **“Found New Hardware Wizard”** procedure.

9. The Demonstration Board’s USB driver is now installed on your system.

4.2 Power Supply

The Demonstration Board can be powered in three ways:

- 12 V DC input connector;
- USB connector;
- I/O header connector.

The **“POWER SEL”** jumper allows you to power the board through either the 12 V DC input connector or the USB connector.

When using the I/O header connector, its pin 1 is connected to the VDD line of the carrier board through the **“VAUX ENA”** jumper.

5 Operating Modes

5.1 Overview

The Demonstration Board can work in two modes: “standalone” mode and “host” mode.

5.2 Standalone Mode

In standalone mode, no PC connection is required. The microcontroller is factory programmed with a sample application.

To run the built-in example:

1. Ensure that the light sensor “ENA” jumper is inserted.
2. Ensure that all of the “LED ENA” jumpers are inserted.
3. Ensure that the two push-button “ENA” jumpers are inserted.
4. Ensure that the “RS-232/LIN SEL” jumper selects the “RS-232” position.
5. Ensure that the “POWER SEL” jumper selects the “UNREG” position.
6. Power on the Demonstration Board through the 12 V DC plug-in power supply.
7. The green “POWER” LED on the board should turn on.
8. Press the “PP0” push-button. Rotate the potentiometer. Its value will be shown on the LEDs.
9. Press the “PP1” push-button. The output of the light sensor will be displayed on the LEDs.
10. The value of the potentiometer or the light sensor is also sent to the RS-232 port (baud rate = 9600, data bits = 8, parity = N, stop bits = 1).

5.3 Host Mode

In host mode the program execution is controlled by the host PC through the “USB” connector. You can use the PC to debug the application by, for example, executing the program step by step and watching how the microcontroller registers vary, using the provided CodeWarrior Development Studio.



Note: *all MCUs in the S12 family contain a single-wire background debug interface which supports in-circuit programming of on-chip non-volatile memory. This system does not interfere with normal application resources. It does not use any user memory or locations in the memory map. The Background Debug Module (BDM) uses a single-wire communication interface (via the BKGD line) to allow non-intrusive access to target system memory and registers.*

To work in host mode (using the built-in USB to BDM interface):

- Make sure that both the “RESET#” and “BKGD” jumpers are inserted.
- Make sure that the “POWER SEL” jumper is in the “USB” position.
- Connect the host PC to the board through the provided USB cable.

6 Application Tutorial

6.1 Overview

This section will provide a step-by-step guide on how to launch your first project and get started with the CodeWarrior for HCS12(X) user interface.

6.2 Step-by-Step Tutorial






The sample application is the same as the one described in the “*Standalone Mode*” section above.

1. Ensure that the Demonstration Board is connected to the PC (via the USB cable) and that the board is powered on.
2. Make sure that all of the Demonstration Board jumpers are set to their factory position (see chapter “7.1 Jumpers” for details).
3. Start CodeWarrior by selecting it in the Windows Start menu.
4. From the CodeWarrior main menu, choose “**File > Open**” and choose the “**DEMO9S12PFAME\C\Demo\Demo.mcp**” file. This is the board example you copied from the SofTec Microsystems “**System Software**” CD-ROM.
5. Click “**Open**”. The *Project* window will open.
6. The C code of this example is contained in the “**main.c**” file. Double click on it to open it.
7. From the main menu, choose “**Project > Debug**”. This will compile the source code, generate an executable file and download it to the demo board.
8. A new debugger environment will open. From the main menu, choose “**Run > Start/Continue**”. The program will be executed in real-time.
9. From the main menu, choose “**Run > Halt**”. The program execution will stop. The next instruction to be executed is highlighted in the *Source* window.
10. From the main menu, choose “**Run > Single Step**”. The instruction highlighted in the *Source* window will be executed, and the program execution will be stopped immediately after.
11. From the main menu, choose “**Run > Start/Continue**”. The application will restart from where it was previously stopped.

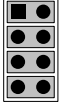
Congratulations! You have successfully completed this tutorial! You can continue to experiment with the CodeWarrior user interface and discover by yourself its potentialities. For an in-depth guide of all of the user interface features, select “**Help > CodeWarrior Help**” from CodeWarrior Development Studio's main menu.

7 Summary of Jumper and Connector Settings

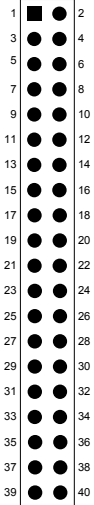
7.1 Jumpers

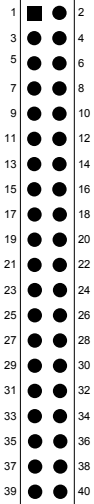
Name	Reference	Description/Pinout
J104		VAUX ENABLE Installed: Power the demonstration board through the VDD line of the carrier board (connects the pin 1 of the J101 connector to the VDD line of the demonstration board) (default) Not Installed: The demonstration board is not powered by the carrier board.
J202	1  RESET# BKGD	BDM ENABLE All installed: The USB to BDM interface is enabled (default) Not Installed: The USB to BDM interface is disabled
J304		LIN ENABLE Installed: The microcontroller's PA7 line is routed to the LIN transceiver (default) Not Installed: The LIN transceiver is not connected to the microcontroller
J305	1  2 3 4 5 6	RS-232/LIN SELECTION 1-3, 2-4 ("RS-232"): The RS-232 transceiver is connected to the microcontroller's SCI peripheral (default) 3-5, 4-6 ("LIN"): The LIN transceiver is connected to the microcontroller's SCI peripheral
J401		VDD CAN ENABLE Installed: Powers the CAN transceiver with the VDD voltage (default) Not Installed: CAN transceiver not powered

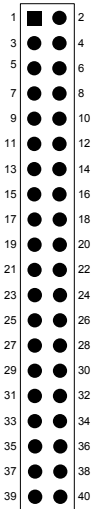
Name	Reference	Description/Pinout
J402		CAN ENABLE All Installed: The CAN transceiver is connected to the microcontroller (default) Not Installed: The CAN transceiver is not connected to the microcontroller
J502		POWER SELECTION 1-2 ("UNREG"): The power supply is taken from the power supply connector (J501) 2-3 ("USB"): The power supply is taken from the USB connector (default)
J503		PUSH-BUTTON "PP0" ENABLE Installed: The "PP0" push-button is connected to the microcontroller's PP0 line (default) Not Installed: The "PP0" push-button is not connected to the microcontroller
J504		PUSH-BUTTON "PP1" ENABLE Installed: The "PP1" push-button is connected to the microcontroller's PP1 line (default) Not Installed: The "PP1" push-button is not connected to the microcontroller
J505		POTENTIOMETER ENABLE Installed: The "PAD00" potentiometer is connected to the microcontroller's PAD00 line (default) Not Installed: The "PAD00" potentiometer is not connected to the microcontroller
J506		PHOTO RESISTOR ENABLE Installed: The photoresistor network is connected to the microcontroller's PAD01 analog input (default) Not Installed: The photoresistor network is not connected to the microcontroller
J507		DIP-SWITCH ENABLE Installed: The DIP-switches are connected to PB[3..0] ports of the microcontroller (default) Not Installed: The DIP-switches are not connected to the microcontroller

Name	Reference	Description/Pinout
J508		<p>LED ENABLE</p> <p>Installed: The LEDs are connected to PA[3..0] ports of the microcontroller (default)</p> <p>Not Installed: The LEDs are not connected to the microcontroller</p>

7.2 Connectors

Name	Reference	Description/Pinout
J101		<p>40-Pin I/O Female Header Connector 1</p> <ol style="list-style-type: none"> 1. VDD (5.0 V) 2. PE1 3. GND 4. RESET# 5. PS1 6. BKGD 7. PS0 8. PP7 9. PP0 10. PAD07 11. PP1 12. PAD06 13. PT0 14. PAD05 15. PT1 16. PAD04 17. PM4 18. PAD03 19. PM2 20. PAD02 21. PM5 22. PAD01 23. PM3 24. PAD00 25. PA7 26. PJ6 27. PA6 28. PJ7 29. PA5 30. PP2 31. PA4 32. PP3 33. PA3 34. PP4 35. PA2 36. PP5 37. PA1 38. PS2 39. PA0 40. PS3

Name	Reference	Description/Pinout
J102		40-Pin I/O Female Header Connector 2 <ol style="list-style-type: none"> 1. PB0 2. PM0 3. PB1 4. PM1 5. PB2 6. PT2 7. PB3 8. PT3 9. PB4 10. N.C. 11. PB5 12. N.C. 13. PB6 14. N.C. 15. PB7 16. N.C. 17. PT4 18. N.C. 19. PT5 20. N.C. 21. PT6 22. N.C. 23. PT7 24. PAD08 25. PE7 26. PAD09 27. PE6 28. N.C. 29. PE5 30. N.C. 31. PE4 32. N.C. 33. PE3 34. N.C. 35. PE2 36. N.C. 37. GND 38. N.C. 39. PE0 40. N.C.

Name	Reference	Description/Pinout
J103		40-Pin I/O Female Header Connector 3 1. N.C. 2. GND 3. N.C. 4. GND 5. N.C. 6. GND 7. N.C. 8. GND 9. N.C. 10. GND 11. N.C. 12. GND 13. N.C. 14. GND 15. N.C. 16. GND 17. N.C. 18. GND 19. N.C. 20. GND 21. N.C. 22. GND 23. N.C. 24. GND 25. N.C. 26. GND 27. N.C. 28. GND 29. PJ0 30. GND 31. PJ1 32. GND 33. PJ2 34. GND 35. GND 36. GND 37. GND 38. GND 39. GND 40. GND

Name	Reference	Description/Pinout
J105		BDM Connector (Not Populated) <ol style="list-style-type: none"> BKGD GND N.C. RESET N.C. VDD
J201		USB Connector <ol style="list-style-type: none"> 5 V DC USB Bus Power Supply Line USB D- USB D+ GND
J301		RS-232 Connector <ol style="list-style-type: none"> Connected to pins 4 and 6 TX RX Connected to pins 1 and 6 GND Connected to pins 1 and 4 Connected to transceiver for testing purposes Connected to transceiver for testing purposes N.C.
J302, J303		LIN Connectors <ol style="list-style-type: none"> GND GND 12 V – LIN Bus Power Supply LIN – LIN Signal
J403		CAN Connector <ol style="list-style-type: none"> CANH CANL GND N.C.
J501		12 V DC Power Supply Input Connector <ol style="list-style-type: none"> 12 V DC Ground

8 Troubleshooting

8.1 USB Driver Problems

If you connected the Demonstration Board to the PC before installing the SofTec Microsystems Additional Components, the Demonstration Board's USB driver may not have been correctly installed on your system. Unplugging and replugging the USB cable is of no use, since Windows has marked the device as "disabled". As a consequence, the PC cannot communicate with the Demonstration Board.

To restore the USB driver (provided the SofTec Microsystems Additional Components have been installed), perform the following steps under Windows XP:

1. Connect the Demonstration Board to the PC.
2. Open the Control Panel (**Start > Settings > Control Panel**).
3. Open the "**System**" options.
4. Select the "**Hardware**" tab.
5. Click the "**Device Manager**" button.
6. The "**uDART In-Circuit Debugger**" device will be shown with an exclamation mark next to it. Double click on this device.
7. In the "**General**" tab, click the "**Reinstall Driver**" button. Follow the on-screen instructions.

8.2 Communication Problems between the PC and the Demo Board

1. Make sure that both the "BKGD" and "RESET#" jumpers are inserted.
2. Make sure that the "POWER SEL" jumper selects the appropriate power source (typically "USB" when the board is connected to the PC).

