



easyMC9S12 Basic User Manual For MC9S12XS Series MCU

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Owner and General Manager of LogiFind Tech CO., Ltd.



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Chapter 1 . About easyMC9S12 Basic

1.1 What is easyMC9S12 Basic

easyMC9S12 Basic development board is a multi-functional development platform based on Freescale (NXP) MC9S12 Series MCU. Especially for those who want to get started with automotive electronics, this is an excellent development platform. The hardware resources of the development board are rich and the layout is clear. It has many common modules on this board like CAN,LIN,SD card,LCD Socket,Segment LED display,Keys,Buzzer,RS232,RS485,1-Wire DS18B20 and LEDs.And we provide over 60 sample sources for these modules.It will make it easier for you to master the MC9S12 series MCUs. This part will briefly introduce the functions of easymc9s12 basic development board, so that users can quickly understand the functions of the development board.

Card Modu 卡樵ቱ ADC0 Input 模数转换输。 MM EXT Power Jack 外部电源接口 Switching Regulators 稳压器 3 18 RS485 Connecto RS485接口 (o RS485 Modul C E3 RS232 DB9(F) Connector 串口母座 1-Wire DS18B20 DS18B20插座 NC A7 A6 A5 LCD1602 Socket LCD1602插座 RS232 Module RS232模块 A4 A3 A2 0000000000 Buzzer Module 蜂鸣器模块 CAN Interface CAN接口 a0 J7 J6 H2 U0 50 M2 V0 LIN Interface LIN接口 LCD12864/TFT Socket LCD12864/TFT插座 0 CAN Module CAN模块 LIN Module LIN模块 8*LEDs 8*流水灯 4*Buttons 4*用户按键 m Reset 系统复位 m Clock 系统时钟

1.2 What's on easyMC9S12 Basic

Figure 1-1 easyMC9S12 Basic Hardware Resources



1.3 Features

The easyMC9S12 Basic development board has the following functional modules:

- •Power Circuit Supply: external DC12V input,On-board +5V regulator,On-board +3.3V regulator.
- •LED: 8 User LED Indicators.
- •Button: 4 User Push Button Switches.
- •Sound: 1 Buzzer.
- •SCI: 1 RS-232 Serial Data Physical Layer Transceiver
- •LIN Bus: Enhanced TJA1020 LIN Physical Layer Transceiver
- •CAN Bus: 1 High-Speed TJA1050 CAN Physical Layer Transceiver
- •485 Bus: 1 SP485 Module.
- •AD: 2 AD input AD00 and AD01.
- •TIM: Timer inside.
- •PWM: PWM output.
- •IIC interface.
- •SPI interface.
- •Socket for Wireless.
- •6-digit LED Display module.
- •Socket for LCD12864 Display Module.
- •Socket for LCD1602 Display Module.
- •Socket for 2.4" 240*320TFT Display module.
- •Socket for DS18B20 temperature sensor.
- •Socket for SD card.
- •BDM header for external BDM cable support.
- •MC9S12 small system.

1.4 Power Supply Requirement

Connecting the external DC12V is the only way to power the development board.

1.5 Programmer/Debugger Requirement

An external programmer/Debugger is required to download code to the MCU on the board. It supports many Programmer/Debuggers like USBDM etc.



Chapter 2 . Installing CodeWarrior

SYSTEM REQUIREMENTS		
Hardware	PC with 1 GHz Intel [®] Pentium [®] -compatible processor 512 MB of RAM (1 GB recommended) CD-ROM drive Depending on host-target connection: Parallel Port, 9-pin Serial Port, or USB Port	
Operating System	Microsoft [®] Windows [®] 2000 or Windows [®] XP	
Disk Space	2 GB total 1.7 GB on Windows system disk	

Figure 2-1 System requirement

Double click on the "CW_HC12_v5.1_SPECIAL.exe" file in the CD ROM and start to install.The installation method is very simple and will not be described here.



Chapter3 . Create a New Project

1. In your PC, click on "Start>All>Freescale CodeWarrior>

CodeWarrior development studio for S12(X) V5.1>CodeWarriorIDE" to run the CodeWarrior IDE or directly Run it with the shortcut created.

2.Choose "File > New Project" to create a new project from a stationery - the HC(S)12(X) Microcontrollers New Project wizard screen appears.



Figure 3-1

3.In the tree navigate to the family and select derivative, for example HCS12X> HCS12XS Family > MC9S12XS128.(Take MC9S12XS128 for example) As shown as the Figure 3-2 and Figure 3-3.

Tizard Bap	Select the derivative you would like to use:	Choose your default connection:
Device and Connecti	Image: HC12 Image: HC12 Image: HC512	Connections
GATE Setup	HCS12X	
Project Parameters		
dd Additional Files		
Processor Expert		
		HCS12X
		16-bit Enhanced CPU Core * C-optimized CISC architecture produces extremely compact code * Excellent 32-bit calculations and semaphore handling
	1	

Figure 3-2 HC(S) 12(X) Microcontrollers New Project Screen



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Tizard Map	Select the derivative you would like to use:	Choose your default connection:
evice and Connectio		Connections
roject Parameters	HCS12	Full Chip Simulation P&E Multilink/Cyclone Pro
dd Additional Files	+ HCS12XA Family HCS12XB Family	SofTec HCS12 Abatron BDI
rocessor Expert	HCS12XD Family HCS12XE Family HCS12XF Family HCS12XF Family	TEDML
	HCS12XS Family MC9S12XS64 MC9S12XS128 MC9S12XS256	Connect to a board through Freescale TBDML (TurboBDM Light).
	1	1

Figure 3-3 HC(S) 12(X) Microcontrollers New Project Screen

4.Select the connection by clicking on the appropriate connection, we select TBDML here.

5.Click "Next" to continue. The Project Parameters screen appears.

HC(S)12(X) Microcontro	Ilers New Project	X
Wizard Map Device and Connection XGATE Setup Project Parameters Add Additional Files Processor Expert C/C++ Options Memory model options PC-Lint	Please choose the set of languages to be supported initially. You can make multiple selections. Absolute assembly Relocatable assembly C C C++ This will set up your application with an ANSI-C compliant startup code (doing initialization of global variables).	Project_1.mcp Location: D:\Project_1 Set
	< Back	Next > Finish Cancel



6.Select the language format by checking its checkbox. As shown as Figure 3-4.

7.In the **Project name** textbox, type the name of your new project. As shown as **Figure 3-4**.

8.Click "Next" to continue. The Add Additional Files screen appears. As shown as Figure 3-5.

HC(S)12(X) Microcontro	illers New Project	
Wizard Map Device and Connection XGATE Setup Project Parameters Add Additional Files Processor Expert	Add existing files to the project Add existing fil	Add Remove
C/C++ Options Memory model options PC-Lint	AN3784_suggestion_sg.pdf Compiler_HC12-IR-PW(1).pdf Compiler_HC12-IR-PW(1).pdf.gv	Copy files to project
	Select files to be added to the new project and p To copy the added files to the project folder, sele To have the wizard generate default main.c and A Back	ress "Add" ct "Copy Files to Project" /or main.asm files, select "Create

Figure 3-5 Add Additional Files Screen

9.Select files to be added to the new project and click **Add** button. You can also ignore this step and click **"Next"** to continue. As shown as **Figure 3-5**.

10. The Processor Expert screen appears. As shown as Figure 3-6.

Wizard Map	Rapid Application Development
evice and Connection	Opuons.
GATE Setup	None
roject Parameters	C Device Initialization
dd Additional Files	C Processor Expert
rocessor Expert	
/C++ Options	
lemory model options	No device initialization code is generated. Unly generates startup code. See readme.bit in project how
C-Lint	Processor Expert can be enabled (if not done here).
	✓ Help

Figure 3-6 Processor Expert Screen



11.Click "Next" to continue. The C/C++ Options screen appears. As shown as Figure 3-7.

HC(S)12(X) Microcontro	llers New Project	
Wizard Map Device and Connection XGATE Setup Project Parameters Add Additional Files Processor Expert C/C++ Options Memory model options PC-Lint	 Which level of startup code do you want to use? Select 'minimal startup code' for best code density. minimal startup code ANSI startup code Which memory model shall be used? Small Banked Large Custom Select the floating point format supported. Select 'None' for best code density. None float is IEEE32, double is IEEE64 	mpliant bal he
	< Back Next > Finish	Cancel

Figure 3-7 C/C++ Options Screen

12.The C/C++ options screen lets you select the level of **Startup Code** you wish to produce. Set as shown as **Figure 3-7** and click "**Next**" to continue.

13. The **Memory model options** screen appears. The Memory model options are available for derivatives from HCS12X family. As shown as **Figure 3-8**.

HC(S)12(X) Microcontrol	lers New Project	\mathbf{X}
Wizard Map Device and Connection XGATE Setup Project Parameters Add Additional Files Processor Expert C/C++ Options	Select if all non-constant data fit in the non-paged RAM or all constants and the code fit into the non-paged flash I don't know All non-constant data fit in the non-paged RAM All constants and the code fit into the non-paged flash Memory Mapping HAM FLASH External Use both ranges 0x4000-0x7FFF and 0xC000-0xFFFF for placing code and constants? Yes No	
Memory model options PC-Lint	Use MemoryBanker for: Code Data Choose this if you are not sure will non-constant data fit in the non-paged RAM or constants and the code fit into the non-paged flash < Back Next > Finish Cancel	

Figure 3-8 Memory model options Screen



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14.Click "Next" to continue. The PC-lint options screen appears. As shown as Figure 3-9.

HC(S)12(X) Microcontro	llers New Project	X
Wizard Map Device and Connection XGATE Setup Project Parameters Add Additional Files Processor Expert C/C++ Options Memory model options PC-Lint	Do you want to create a project set up for PC-lint(TM)? Yes No Lint tools can find common programming mistakes or suspicious lines in source code by analyzing it. PC-lint(TM) is a product from Gimpel Software. You need the PC-lint(TM) software from Gimpel installed in order to use the CodeWarrior plugin. This will add an additional Target to the project with the name PC-Lint. You need a professional license in order to use the PC-Lint plugin.	
	< Back Next > Finish Cancel	

Figure 3-9 PC-lint Options Screen

15.Click the **"Finish"** button. The IDE opens(As shown as **Figure 3-10**). Click "**main.c**",you add and modify the source code.

True-Time Simulator & Real-Time Debugger D:\Profiles\b13819\My Documents\project2\my_	E128_project\Full_Chip_S	imulation.ini	
He Wew Run HCS12FCS Component Memory Window Hep			
S Source		Assembly	
D:\Pholies\b13819\My Documents\project2\my_E128_project\Sources\main.c	Line: 1	main	
<pre>#include chidef.bb /* common defines and macros */ #include chodellell8.bb /* derivative information */ #program LING_INFO DERIVATIVE "mcbellell8"</pre>		<u>1880008AU00512735</u> 388002 BDA ++0 388004 DDA 0x000D 388007 DDY 0x000B 388000 BEQ ++16 _rabs = 0x38801A	
void main(void) () /* put your own code here */ DmableToverrupts;		388000 LDY 2,X+ 38800F LDY 2,X+ 38800F LDD 2,X+ 388011 CLR 1,Y+	N
<pre>for(::) { > (*) * wait forever */ /* please make sure that you never leave this function */</pre>		Register	
(8)		HC12 CPU Cycles: 41	Auto
P Procedure	🛛	D 0 A 0 B 0 IX C017 IY 0	
		IP 388000 PC 8000 PPAGE 38	
main () <coob></coob>		SP 4FD CCR SARABEVC	
🗓 Data: 1		Memory	
/ main.c	Auto Symb Global	Auto	
fibl+fib2 undefined expression (unknown identifier)			< 1 ×
🐻 Data: 2	- X	Command	X
∫ ∫ean	Auto Symb Local	STARTED ROBING Breekpoint 1m>	
			×

Figure 3-10 PC-lint Options Screen



Chapter 4: Hardware Details

4.1 Power Supply

easyMC9S12 Basic Board contains power supply that creates stable voltage **5V** and **3.3V** and current levels necessary for powering each part of the board. Power supply section contains two power regulators: L7805, which generates **5V**, and LM1117-3.3 which creates **3.3V** power supply. The board can be powered only by using external DC12V (on adapter connector Jack "+12VDC"). Upon providing the power using external power source you can turn on power supply by using switch(POWERSW). LED (PWRLED) will indicate the presence of power supply.



Figure 4-1

4.2 Eight LEDs

LED (Light-Emitting Diode) is a highly efficient electronic light source. When connecting LEDs, it is necessary to place a current limiting resistor in series so that LEDs are provided with the current value specified by the manufacturer. The current varies from 0.2mA to 20mA, depending on the type of the LED and the manufacturer. **easyMC9S12 Basic** board uses low-current LEDs with typical current consumption of 0.2mA or 0.3mA, depending of VCC voltage selection. Board contains 8 LEDs which can be used for visual indication of the logic state on PORT pins. An active LED indicates that a logic low (0) is present on the pin.In this application, the 8 LEDs are connected to **PB**.





4.3 Piezo Buzzer

Piezoelectricity is the charge which accumulates in certain solid materials in response to mechanical pressure,but also providing the charge to the **piezo** electric material causes it to physically deform. One of the most widely used applications of piezoelectricity is the production of sound generators, called piezo buzzers. **Piezo buzzer** is an electric component that comes in different shapes and sizes, which can be used to create sound waves when provided with analog electrical signal. **easyMC9S12 Basic** comes with **piezo buzzer** which can be connected to IO **PP1** or **PK5** of microcontroller via connector (**J2**). **Buzzer** is driven by a NPN transistor **Q7** (**L7**). Microcontrollers can create sound by generating a PWM(Pulse Width Modulated) signal – a square wave signal, which is nothing more than a sequence of logic zeros and ones. Frequency of the square signal determines the pitch of the generated sound, and duty cycle of the signal can be used to increase or decrease the volume in the range from 0% to 100% of the duty cycle. You can generate PWM signal using hardware capture-compare module, which is usually available in most microcontrollers, or by writing a custom software which emulates the desired signal waveform.





4.4 ADC Input

Digital signals have two discrete states, which are decoded as high and low, and interpreted as logic 1 and logic 0. Analog signals, on the other hand, are continuous, and can have any value within defined range. A/D converters are specialized circuits which can convert analog signals (voltages) into a digital representation, usually in form of an integer number. The value of this number is linearly dependent on the input voltage value. Most microcontrollers nowadays internally have A/D converters connected to one or more input pins. Some of the most important parameters of A/D converters are conversion time and resolution. Conversion time determines how fast can an analog voltage be represented in form of a digital number. This is an important parameter if you need fast data acquisition. The other parameter is resolution. Resolution represents the number of discrete steps that supported voltage range can be divided into. It determines the sensitivity of the A/D converter. Resolution is represented in maximum number of bits that resulting number occupies. Most



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microcontrollers have 10-bit resolution, meaning that maximum value of conversion can be represented with 10 bits, which converted to integer is 2^10=1024. This means that supported voltage range, for example from 0-3.3V, can be divided into 1024 discrete steps of about 3.222mV. **easyMC9S12 Basic** provides two interfaces in form of potentiometer for simulating analog input voltages. In the application, the two ADC inputs (potentiometer **ADC00** and **ADC01**) are respectively connected to **PAD00** and **PAD01**.



Figure 4-4

4.5 Four Keys

The logic state of all microcontroller digital inputs may be changed using push keys. In this application, four keys are respectively connected to IO **PH0~PH3**. When no key is not pressed, due to the pull-up resistor **R15-R18**, the level detected by the MCU is high, and when the key is pressed, the level detected by the MCU is low.



Figure 4-5

4.6 RS485 Bus

RS-485 is a standard defining the electrical characteristics of drivers and receivers for use in serial communications systems. Electrical signaling is balanced and multipoint systems are supported. Digital communications networks implementing the standard can be used effectively over long distances and in electrically noisy environments. Multiple receivers may be connected to such a network in a linear, multi-drop configuration. These characteristics make such networks useful in industrial environments and similar applications.

The **RS-485** module enables the development system to communicate to external devices whose operation is in compliance with the **RS-485** standard. The connection between this module and one of these devices is established via a screw connector (**CON1**). In order to turn on this module,the **RE/DE** pin on **RS485** chip is already connected to **PM7**,and at the same time, it is necessary to enable the connection on the "**RS485**" position on the "**JP1**" jumper.

4.7 SCI

The MC9S12 series MCUs have the serial communication interface (SCI) module. And the SCI allows asynchronous serial communications with peripheral devices and other MCUs.

easyMC9S12 Basic equips a RS232 module for the communication between the board and the PC using SCI. In order to turn on this module, it is necessary to enable the connection on the "RS232" position on the "JP1" jumper.

4.8 LIN Bus

LIN (local interconnect network) is a kind of low-cost serial communication network, which is used to realize the distributed electronic system control in automobile. LIN aims to provide auxiliary functions for the existing vehicle network (like CAN bus), so LIN bus is an auxiliary bus network.

In the communication between intelligent sensor and brake device, LIN bus can greatly reduce the cost more than CAN bus. **easyMC9S12 Basic** equips a LIN Bus module using a TJA1020 chip.

The connection between this module and one of these devices is established

via a screw connector (**CON3**). In order to turn on this module, it is necessary to enable the connection on the "**LIN**" position on the "**JP1**" jumper.

4.9 1-WIRE DS18B20 Circuit Module

DS18B20 is a digital temperature sensor that uses 1-wire® interface for it's operation. It is capable of measuring temperatures within the range of -55 to 128°C, and provides ±0.5°C accuracy for temperatures within the range of -10 to 85°C. It requires 3V to 5.5V power supply for stable operation. It takes maximum of 750ms for the **DS18B20** to calculate temperature with 9-bit resolution. 1-wire® serial communication enables data to be transferred over a single communication line, while the process itself is under the control of the master microcontroller. The advantage of such communication is that only one microcontroller pin is used. Multiple sensors can be connected on the same line. All slave devices by default have a unique ID code, which enables the master device to easily identify all devices sharing the same interface. **easyMC9S12 Basic** provides a separate socket for the DS18B20. Communication line with the microcontroller is connected to the IO "**PJ1**".

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Figure 4-9

4.10 CAN Bus

Freescale's scalable controller area network definition is based on the MSCAN12 definition. The module is a communication controller implementing the CAN 2.0A/B protocol as defined in the Bosch specification dated September 1991. Though not exclusively intended for automotive applications, CAN protocol is designed to meet the specific requirements of a vehicle serial data bus: real-time processing, reliable operation in the EMI environment of a vehicle, cost-effectiveness, and required bandwidth.MSCAN uses an advanced buffer arrangement resulting in predictable real-time behavior and simplified application software.easyMC9S12 Basic equips a TJA1020 chip and use CAN0 (PM0/RXCAN0 and PM1/TXCAN0) to drive it.

4.11 6-Digit SEGLED Display

One seven segment digit consist of 7+1 LEDs which are arranged in a specific formation which can be used to represent digits from 0 to 9 and even some letters. One additional LED is used for marking the decimal dot, in case you want to write

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a decimal point in the desired segment. The **easyMC9S12 Basic** contains six of these digits put together to form 6-digit segled display. Driving such a display is done using multiplexing techniques. Data lines are shared between segments, and therefore the same segment LEDs in each digit are connected in parallel. Each digit has it's unique digit select line, which is used to enable the digit to which the data is currently being sent. By multiplexing data through all six segments fast enough, you create an illusion that all six segments are in operation simultaneously. This is possible because human eye has a slower reaction time than the mention changes. This way you can represent numbers in decimal or hexadecimal form. Eight data lines that are common for all the digits are connected to **PP0-PP7** via **JP2**, and digit select lines are connected to **PK0-PK5** directly.

4.12 LCD 2x16 characters (Socket)

Liquid Crystal Displays or LCDs are cheap and popular way of representing information to the end user of some electronic device. Character LCDs can be used to represent standard and custom characters in the predefined number of fields. The **easyMC9S12 Basic** provides the connector and the necessary interface for supporting 2x16 character LCDs. This type of display has two rows consisted of 16 character fields. Each field is a 7x5 pixel matrix. This Board equips an universal socket "**LCD1602**" allowing you to install 16x2 LCD very easily.

Connector pinout explained

1-GND 2-5V 3-Vo,LCD contrast level from potentiometer **1602-VOL** 4-RS,Register Select Signal

5-E, Display Enable

6-R/W, Determines whether display is in Read or Write mode. It's always connected to GND, leaving the display in Write mode all the time.

7~14-Data Port, Display is supported in 8-bit data mode.

- 15-LED+,Connection with 5V
- 16-LED-,Connection with GND

Figure 4-12-1

IMPORTANT:

Make sure to Place the LCD1602 in the right direction.

Make sure to turn off the power supply before placing LCD onto the board. Otherwise your display can be permanently damaged.

Figure 4-12-2

4.13 GLCD 128x64 Socket)

Graphical Liquid Crystal Displays, or GLCDs are used to display monochromatic graphical content, such as text, images, humanmachine interfaces and other content. **easyMC9S12 Basic** provides the connector and necessary interface for supporting GLCD with resolution of 128x64 pixels and proper PINOUTs. It is compatible with the most popular LCD12864 in the market with KS108 or ST7920 display controller. The example we provide is only for LCD12864 with ST7920 display controller. **The board** equips an universal socket "LCD12864&TFT" allowing you to install 128*64 Graphical LCD very easily.

Figure 4-13-1

IMPORTANT:

Make sure to Place the LCD12864 in the right direction.

Make sure to turn off the power supply before placing LCD onto the board. Otherwise your display can be permanently damaged.

Figure 4-13-2

4.14 2.4" 240*320 TFT (Socket)

easyMC9S12 Basic provides the connector and necessary interface for supporting the 2.4" 240*320 TFT display module by **LogiFind**. The TFT display module share the socket "**LCD12864&TFT**" with LCD12864 display module,but the TFT display module only uses 18pin,not 20pin.See the following figure for the installing method of the TFT.

< <u>単片机系统(MCU System)</u> ·	GND 1 VCC 3 VC 3 NC 3 NC 3 NC 3 RS 4 RN 5 PJ0 8 RN 5 RN 5 RN 6 B1 8 B2 1 PA0 9 PA1 9 PA2 1 PA3 1 PA4 1	CD12864/2.4TFT
	羅法利技 飛思卡尔	
	easyMC9S12 Basic DS18B20 Temp Sensor Current Room Temp: 25.5 °C	
	http://www.logifind.com	

Figure 4-14-1

Figure 4-14-2

4.15 IOC Interface

easyMC9S12 Basic brings out several special pins PT0,PT1 and PT7 for Tim experiments.

4.16 PT2272 Wireless Module(Socket)

easyMC9S12 Basic equips a socket "Wireless" for common PT2272 Remote Control Decoder module.

Figure 4-16-2

4.17 SD Card

Secure Digital (SD) is a non-volatile memory card format developed for use in portable devices. It comes in different packages and memory capacities. It is mostly used for storing large amounts of data. **easyMC9S12 Basic** features the SD card slot. It uses standard SPI user interface with minimum additional electronics, mainly used for stabilizing communication lines which can be significantly distorted at high transfer rates. Special ferrite is also provided to compensate the voltage and current glitch that can occur when pushing-in and pushing-out SD card into the socket. In order to access SD card, you must enable SPI communication lines via connecting the SD card Module to the SPI pins of microcontroller.

Figure 4-17

4.18 System Reset

easyMC9S12 Basic uses low level trigger reset.

Figure 4-18

4.19 Small System Circuit

DA1 is an indicator LED for system running indicating, which is controlled by IO **PK4**. Debugging and programming interface BDM port is equped. **Y1** is a 16MHz crystal for system clock.

Figure 4-23

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LogiFind Tech CO.,LTD

Address:Room 606,B# of Nanguo Building,NO.16,Zhuxi South Road,Nanning,Guangxi,P.R.China

Mobile:(0086)15978193886/TEL: (0086)0771-5677749

Skype:love100mhz

E-MAIL: love100mhz@hotmail.com

Website:www.LogiFind.com

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