Starter Kit LJ12EVB

User's Manual

Rev 1.0

Brno
November 2002

Beta Control ®
real-time control and information systems

Content

Introduction

The Motorola 68HC08 is a very strong and useful product family. The excellent FLASH memory, various peripheral subsystems, large variety of packages, programming and debugging on-chip support brings designer's dreams reality.

The Beta Control's Low Cost Starter Kit represents very good entry gate to design in. Various Target Boards could be used as a stand alone board or together with the universal debugger module. Some instant on board demo peripheral components and associated tutorial programs enable users to start immediately.

This is ideal tool for any distributors seminars, for the teachers at schools, users clubs and also for anybody who is interested in application with modern microcontrollers.

Jiri Gutman
Motorola consultant

Who is Beta Control

Beta Control Ltd. is an innovation based company. Its basic strategy consists in utilizing its own know how of modern technologies in the field of electronic control and information systems. More then sixty percent of employees are focused on design and development. As the most products of Beta Controls are based on Motorola technology and products, the Beta Control became a cooperation partner in promoting Motorola 68HC08 family.

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CZ-141/2000

Features of LJ12EVB

- MCU MC68HC908LJ12CFU
    - 12K bytes of on-chip FLASH memory with in-circuit programming (ISP) capabilities
    - 512 bytes of on-chip RAM
    - LCD driver (4/3 backplanes and static with maximum 27 frontplanes liquid crystal displays)
    - SCI, SPI
    - Internal RTC (real time clock) module
    - 6-channel, 10-bit ADC
    - Two 16-bit TIM channels
    - Up to 32 general-purpose I/O pins with selectable pull-ups
    - 64-pin plastic quad flat pack (QFP)
- External 32 KHz crystal oscilator
- The miniMON interface for ISP and debugging
    - Compatible with Metrowerks® CodeWarior for HC08
    - Compatible with P&E ICS software tools
- Simple applications examples
    - SCI
    - LCD
    - 2 LEDs
    - 12+2 push-buttons
    - Temperature sensor
    - Relay output
    - Beeper
- +5V power supply
- Dimensions 122x60 mm

Software for LJ12EVB

LJ12EVB is fully compatible with MON08 debugging/programming scheme. Any MON08 compatible software can be used, e.g. CodeWarrior for HC08, P&E Micro's development environment and many more 3rd party software.

Motorola® and Metrowerks® have broken new ground in providing next-generation tools that speed time to market and improve quality. These next-generation tools are a critical part of Motorola's total system solution and include the new CodeWarrior Development Studio for 68HC08.

For easy beginning with HC08 MCUs there are also several dedicated examples, which gives the user basic experience in HC08's world.

Quick start instructions

For users experienced in installing Motorola® or other development tools, the following steps provide a quick-start installation procedure for the software. If problems occur with the quick start procedures, refer to the chapter "Troubleshooting" for instructions.

The CodeWarior SE quick start instructions are described in these files:
1. HC08QS.PDF
2. IDE_Quickstart.PDF

Note: You have to use the PEDebug interface for full chip simulation, in-circuit simulation and full chip debugging with miniMON08 debugger. You can select this target interface with the menu Component > Set Target and then selecting the P&E Target Interface. Now you have to save the debugger configuration.

ESD caution: Ordinary amounts of static electricity from clothing or the work environment, can damage or degrade electronic devices and equipment. For example, the electronic components installed on printed circuit boards are extremely sensitive to electrostatic discharge (ESD). Wear a grounding wrist strap whenever handling any printed circuit board. This strap provides a conductive path for safely discharging static electricity to ground.

Configuring the LJ12EVB

This chapter explains how to configure the LJ12EVB development board for ISP and debugging from a host PC using miniMON interface. LJ12EVB uses an external miniMON programmer/debugger (miniMON-DBG). You can build your own miniMON programmer/debugger according to free schematic from www.hc08.cz/minimon/. Here you can find useful application notes and schematic of simple miniMON programmer/debugger.

Warning: Target board LJ12EVB is powered from +5V power supply!

Assembling the LJ12EVB target board for the MON08 mode for using with a host PC:

1. Check the miniMON-DBG configuration. Select MON08 mode and 5V-power supply output on miniMON interface.
2. Disconnect power from the target board and miniMON debugger (miniMON-DBG).
3. Connect the LJ12EVB connector X3 with the miniMON-DBG. Use the cable provided.
4. Connect miniMON-DBG to a serial COM port on the host PC. Set up baud rate for communication with MCU in the MON08 mode. Select correct Target Hardware Type: e.g. Class III – Direct serial to target w/MON08 serial port circuitry build in. *Note: The communication baud rate in the MON08 mode depends on used external clock oscillator and the state of the PTC1 pin in the time of entering the MON08 mode. Typical external oscillator frequency is 9,83MHZ or 4,915MHz. See the MC68HC908LJ12 Technical Data - Section 10. Monitor ROM (MON).*
5. Connect the power supply. The miniMON-DBG can power the target board LJ12EVB.
6. Start the programmer/debugger software.

Pinouts

LJ12EVB Connector X2

VCC	GND	PTA3	PTA4	PTA5	PTA6	PTA7	RXD-X2
2	4	6	8	10	12	14	16
1	3	5	7	9	11	13	15
VCC	GND	PTD0	PTD1	PTD2	PTD3	PTC7	TXD-X2

LJ12EVB Connector X3 (miniMON)

OSC1	/IRQ	PTA1	PTA2	PTA0
2	4	6	8	10
1	3	5	7	9
VCC	GND	/RES		PTC1

NTC/22K Parameters and Nominal Values

NTC/22 K – BC Components, Ordering code 2322 640 6322

Temperature range ....-40 °C to 125 °C
Thermal cooling time constant .... 1,2 s
Max. Power dissipation at 25 °C..............0,5 W

T is an actual temperature [K]
The resistance of the sensor at a reference temperature of 25 °C ....R_{25} = 22 k. ± 5 %
A material constant ....$B_{25,85}$ = 3 740 ± 2 %
T_0 298,15

Resistance value at temperature T:
$$R_T = R_{25} \exp \{B_{25,85} (1/T - 1/T_0)\}$$

T [°C]	0	5	10	15	20	25	30	35	40	45	50
Rt [Ω]	69348	54217	42758	34000	27248	22000	17888	14643	12063	9999	8336

LCD pinout and segments draft

BP1	BP0	FP22	FP21	FP19	FP18	FP17	FP16	FP15	FP14	FP13	FP12	FP11
1	2	3	4	5	6	7	8	9	10	11	12	13
	BP0	1F	1A	1B	2F	2A	2B	3F	3A	3B	4F	4A
BP1		1E	1G	1C	2E	2G	2C	3E	3G	3C	4E	4G
		K1	1D	K2	K3	2D	P1	K4	3D	K5	K6	4D
		X1	H1	X2	X3	H2	P2	X4	H3	X5	Y1	H4

FP10	FP9	FP8	FP7	FP6	FP5	FP4	FP3	FP2	FP1		BP3	BP2
14	15	16	17	18	19	20	21	22	23	24	25	26
4B	5F	5A	6F	6A	7F	7A	Y2	8F	8A			
4C	5G	5B	6G	6B	7G	7B		8G	8B			
K7	5E	5C	6E	6C	7E	7C		8E	8C			BP2
X6	5D	H5	6D	P3	7D	H6		8D	H7		BP3	
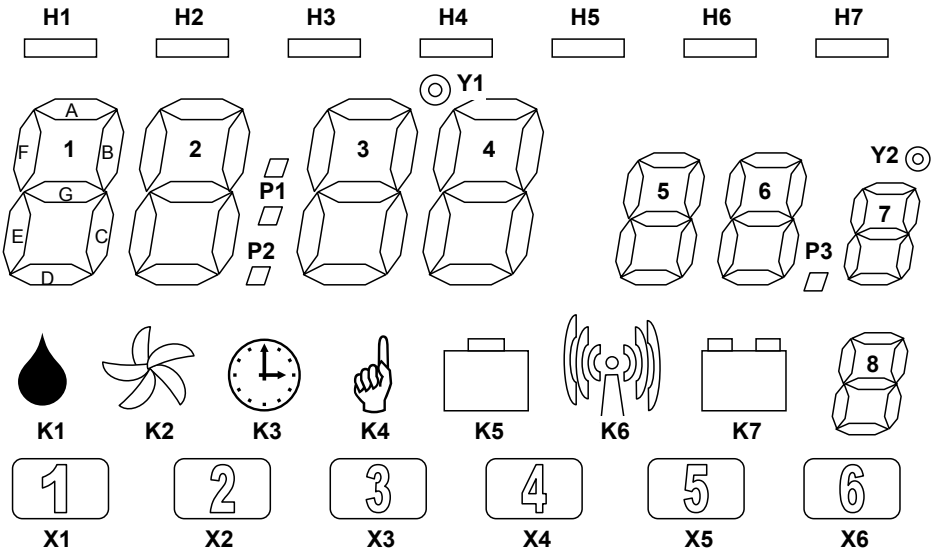
Schematic description

The basic component of the LJ12EVB target board is the microcontroller MC68HC908LJ12 from Motorola®.

The board is powered from the 5V stabilized power supply. The power input is protected against reversing of polarity and over voltage transil NT1 TRANS/6V8. The power supply can be connected from round connector X5, terminal X6 and miniMON connector X3. Because MCU has integrated the real time clock module (RTC) there is a X7 connector for 3V battery backup. In your applications you can also use the MCU low power modes WAIT or STOP. These modes decrease the MCU current consumption and you can increase the battery life. To avoid problems whenever the voltage is below operating level the MCU contains low voltage inhibit module. This module monitors the voltage on the VDD pin and forces a reset when the voltage is below LVI trip falling voltage, VTRIP. Bits LVISEL0 and LVISEL1 in the CONFIG2 register select the value of VTRIP (see MC68HC908LJ12 datasheet). Setup 3V operating mode (LVISEL1=0, LVISEL=1) because MCU is powered through VD2=TMMBAT46. When 5V operating mode is selected the LVI reset can occur.

The MON08 mode is a special MCU mode for debugging and FLASH programming. The MCU uses high voltage VTST on the IRQ pin and defined logic levels on PTA1, PTA2 and PTC1 to enter MON08. The VTST voltage should be from 7,5V to 9V and is connected by miniMON connector X3. When the VTST voltage is not in defined range MCU will not enter MON08 mode. The MCU needs an external clock source when in the MON08 mode. This condition is accomplished with OSC1 signal on miniMON X7 connector. While LJ12EVB contains the clock generator based on the 32,7 KHz crystal in MON08 mode MCU disables this crystal oscillator and uses external clock source. Some pins uses to enter MON08 mode are shared with simple applications on target board. PTA0 is used for communication in MON08 mode simultaneously with VL3 LED driving. You can see LED blinking when the MCU communicates with a host computer. Similar applications are connected to pins PTA1 and PTA2. Pin PTC1 is not connected to user's application when MCU is in user mode this pin is reserved for LCD driving. The MCU needs POR reset when supply voltage is bellow 0,1V to unlock MCU FLASH in the time of programming. The POR is generated by turn-off the switch SA15.

There is the RS232 interface (DD1 MAX202 and X4) on target board. The user application can use the RS232 interface to communicate with the host PC. There are jumpers JP4 and JP5 to select application for the communication interface. Because the MCU has implemented the Infrared communication module (IRSCI) user can disconnect RS232 interface and switch RXD/TXD pins to connector X2, prepared for external applications.

The LJ12EVB target board contains some simple peripherals like LEDs, LCD, buttons, relay output and temperature sensor.

Pins PTB4 and PTB5 are used for LEDs driving. The LED lights when the MCU sets value 0 on appropriate PTB pin. These pins are shared for buttons SA13 and SA14. To avoid conflict between output and button input it is recommended to initialize pins for input and if LED should light clear respective PTB bit and then set this pin for output. Buttons SA1 – SA12 are circuit to multiplex

connection. The application software must clear one of driving pin PTC4 – PTC6 and than read input on PTD4 – PTD7. PTD4 to PTD7 are shared with keyboard interrupt module (KBI) so you can use it in your application. There are two configuration bits PCEH and PCEL in the CONFIG2 register. Clear the PCEH bit to configure PTC4 – PTC7 as standard I/O pins.
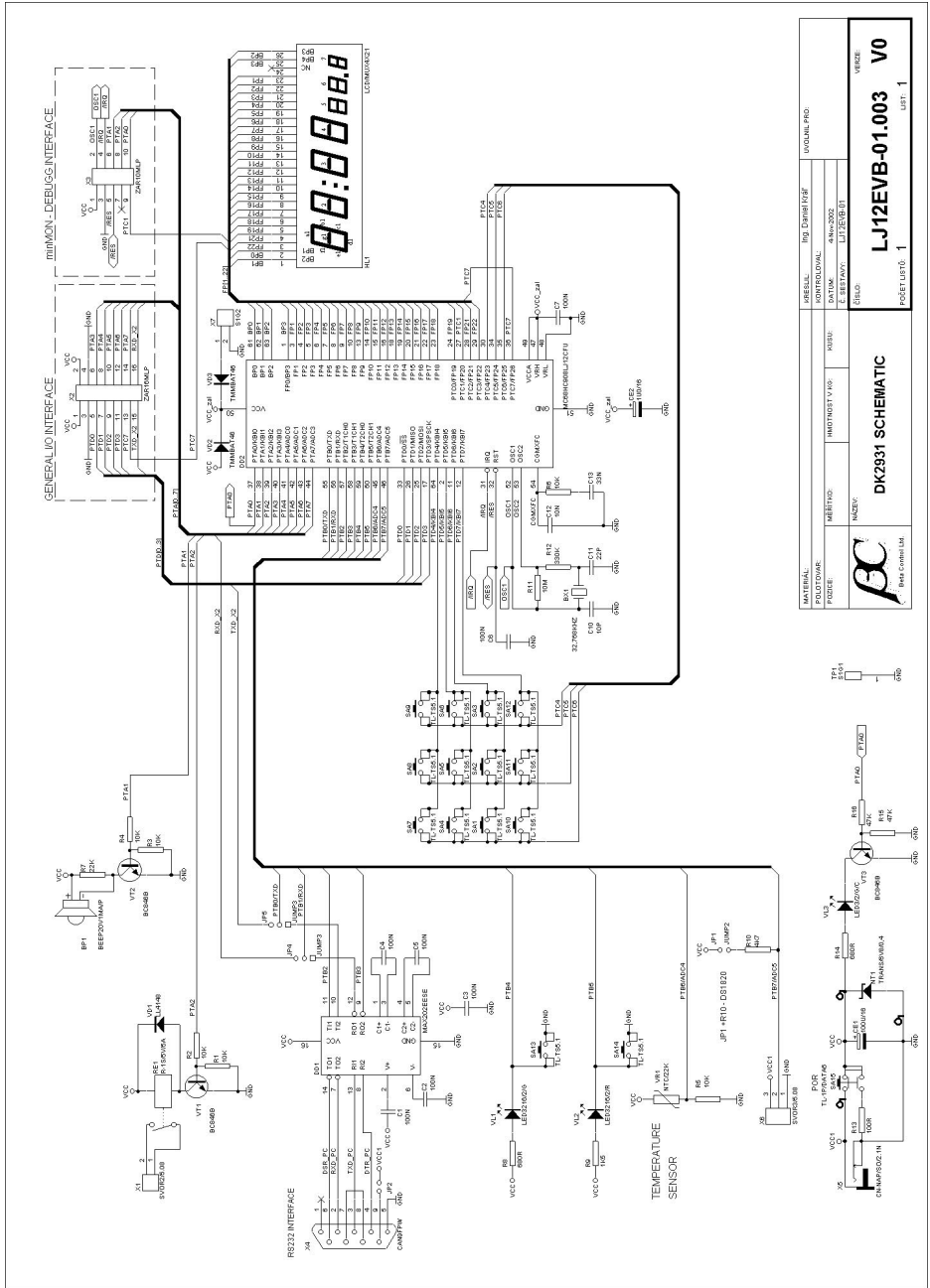
On the HC908LJ12 board is also the LCD connected to the HC908LJ12 LCD driver module. Configure LCD driver for ¼ duty cycle. In this mode BP0 – BP3 are used for the LCD backplane driving. Pins FP1 – FP22 are used for the LCD frontplane driving. Set the PCEL bit in the CONFIG2 to configure PTC0 – PTC3 as LCD frontplane drivers FP19 – FP22. See table with the LCD pinout and segments draft

The thermistor VR1 and R5 are used for temperature measuring. An analog voltage on the PTB6/ADC4 pin is calculated by this formula Uad0=(Vcc/(VR1+R5))*R5. The VR1 nominal values according to temperature are in the following table. The pin PTB7/ADC5 is wired in the connector X6. The user's application can use this pin as general purpose I/O pin or analog input ADC5. For applications with digital thermometer DS1820 or compatible type set the jumper JP1.

The PTA2 pin drives the relay. To switch-on relay set PTA2 to high. The pin PTA1 drives the beeper. The beeper sounds when the PTA1 generates square wave signal of the acoustic frequency.

Not used MCU pins are wired in the connector X2 for a special user's applications.
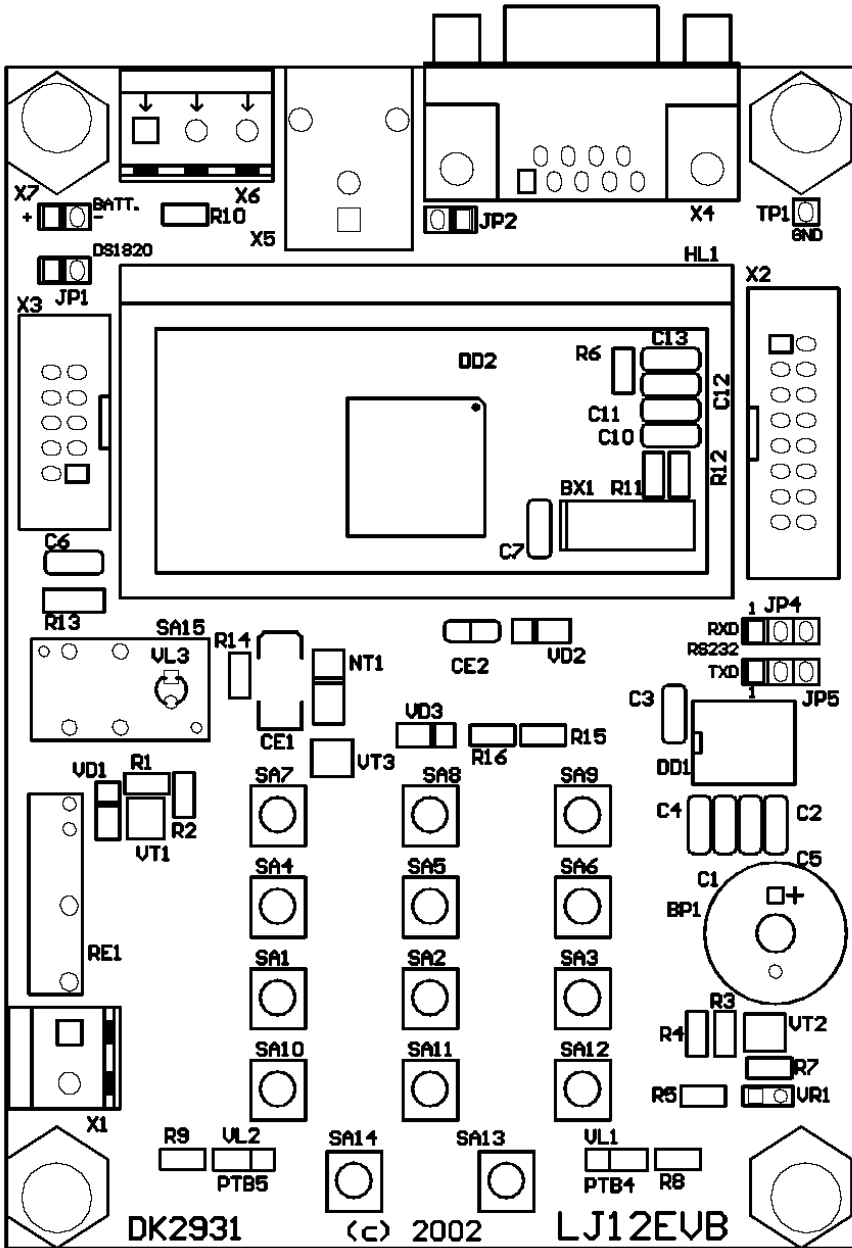
LJ12EVB schematic diagram

LJ12EVB Board Layout

Troubleshooting

Troubleshooting MCU power on reset (POR)

The MCU needs POR reset when supply voltage is bellow 0,1V. The POR can be generated automatically from the miniMON debugger/programmer or manually by turn-off the SA15 switch on the target board. It depends on the used programmer/debugger. It is not sufficient disconnect only MCU VDD power to generate POR. The MCU can be powered from the input pins e.g. the external oscillator.

The MCU on LJ12EVB is self-resetting

The MCU contains low voltage inhibit module. This module monitors the voltage on the VDD pin and forces a reset when the voltage is below LVI trip falling voltage, VTRIP. Bits LVISEL0 and LVISEL1 in the CONFIG2 register select the value of VTRIP (see MC68HC908LJ12 datasheet). Setup 3V operating mode (LVISEL1=0, LVISEL=1) because MCU is powered through VD2=TMMBAT46. When 5V operating mode is selected the LVI reset can occur.

Troubleshooting MON08 mode

- Set up correct baud rate for communication with MCU in the MON08 mode according to used external clock oscillator and the state of the PTC1 pin in the time of entering the MON08 mode.
- The LJ12EVB emulation of the on-board MCU is limited. Port A bit 0 (PTA0) is used for host-to-MCU communication. The port bit is not available for connection to the target system. Setting DDRA bit 0 to 1 will stop communication with the simulation or debugger software and will require the system reset to regain communication with the MCU.
- Check state of pins PTA0 – PTA2 and PTC1 in the time of active reset. The external miniMON programmer/debugger have to control their state.
  See miniMON description on www.hc08.cz/minimon/.

Troubleshooting HC908 Security

The HC908 MCU family contains a security mechanism for the code readout prevention based on information that the user programs into the part. The FLASH memory content is secured by eight-byte password, which must be sent to the MCU in time of monitor mode entering. The password secures the FLASH memory only, other functions are accessible regardless the password is correct or not.

The password resides in top of the FLASH (0xFFF6 – 0xFFFD), where interrupt vector table is as well. It can be said, that the password is made automatically, when the program is compiled and the interrupt vector table is generated. It also means, that different versions of the same software usually have different passwords.

When the user does not need to use the FLASH (e.g. in-circuit simulation), the password is not mandatory. The correct password enables to the user the access to the FLASH and FLASH control, like readout its contents, erasing, programming or program running (instruction and data fetching). The only feature not locked out by wrong password is MASS-ERASE of whole FLASH.

This is also the only way, how to regain access to the FLASH in case of unknown password. After erasing you can enter into MON08 mode again with security bytes for blank device (FF-FF-FF-FF-FF-FF-FF-FF).

Note: New versions of manual, technical documentation and application notes you can find on www.hc08.cz.