M4C – Starter kit

User's Manual
REV. 1.0

Beta Control Ltd.
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1. Contents

2. Features M4C

MCU MC68HC908GT8CFB

- 8K bytes of on-chip FLASH memory with in-circuit programming (ISP) capabilities
- 512 bytes of on-chip RAM
- SCI, SPI
- 8-channel, 8-bit ADC
- Two 16-bit TIM channels
- Up to 36 general-purpose I/O pins with selectable pull-ups
- 44-pin plastic quad flat pack (QFP)

External 8 MHz clock generator

Low-cost development tools with integrated RS232/MON08 interface for ISP and debugging

- Compatible with Metrowerks® CodeWarior for HC08
- Compatible with P&E ICS software tools

Simple applications examples

- SCI
- 2 LEDs
- 2 push-buttons
- Temperature sensor
- IR transmitting LED
- 38kHz IR receiver

9V battery power supply

Dimensions 122x60 mm

3. Software for M4C

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. The Special Edition contains more than $2000 worth of advanced tools from the world's leading development tool vendors, and is provided at no charge to Motorola's 68HC08 microcontroller customers.

The M4C is specially designed for easy and quick starting with CodeWarior for HC08. You can easy debug and simulate your source code.

4. Configuring the M4C

This chapter explains how to configure the M4C development board for ISP and debugging from a host PC.

JP1 – Connects VTST with IRQ		
Pins	Name	Description
1 – 2	**MON**	VTST is connected with IRQ (MON08 mode)
2 – 3	SCI	VTST is disconnected from IRQ

JP2 – RS232 interface connection		
Pins	Name	Description
1 – 2	**MON**	PTA0 for MON08 communication (MON08 mode)
2 – 3	SCI	PTE0/TXD

JP3 – RS232 interface connection		
Pins	Name	Description
1 – 2	**MON**	PTA0 for MON08 communication (MON08 mode)
2 – 3	SCI	PTE1/RXD

JP4 – Oscillator Source		
Pins	Name	Description
ON	**OSC**	8MHz – External clock generator (MON08 mode)
OFF		The MCU ICG module is clock source

Assembling the M4C target board for the MON08 mode for using with a host PC:
– Set the configuration headers on the M4C to MON08 positions and install the JP4 to connect external clock generator 8MHz with the OSC1 pin.
– Connect the M4C to the host PC. Use the cable provided. Connect it to a serial COM port on the host PC. Set up baud rate *7680Bd* for communication with MCU in the MON08 mode.
– Apply power to the target. Connect the 9V battery to the holder on the board and switch-on the SP1.
– Start the Integrated Development Environment.

5. 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

6. Schematic Description

The basic component of the M4C kit is the microcontroller MC68HC908GT8 from Motorola.

The board is powered from the 9V battery. The power input is protected against reversing of polarity by diode VD3 BAT46. The input voltage is stabilized for 5V by NR1 MC78L05 circuit. Because the correct function of the kit depends on battery voltage your application can measure it at analog input PTB1/AD1. The kit operation voltage range is from 7,8V to 10V. 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. The LVI50R bit in the CONFIG1 register in the MCU selects the value of VTRIP (see MC68HC908GT16/8 datasheet).

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 PTC0.PTC3 to enter MON08. The VTST voltage should be from 7,5V to 9V and is connected by JP1. When the VTST voltage is not in defined range MCU will not enter MON08. Check the battery voltage and configuration jumpers setting. The MCU needs an external clock source for MON08 mode. For this reason kit contains the clock generator based on the 8MHz ceramic resonator. The JP4 connects the external clock generator with MCU OSC1 pin.

Other gates from DD2 74HC04 are used for very simple RS232 interface. The VD1 diode protects DD2D input against high input voltage and the internal diode implemented in DD2 protects against reversing input voltage. The diode VD5 together with R3 enables bi-directional communication through the PTA0 pin in MON08 mode. The user application can use this simple RS232 interface. There are jumpers JP2 and JP3 to select input for the RS232 interface.

Components R13 and VD4 are used for external MCU reset via DTR from the PC serial port. This feature is useful for debugging of application software.
Warning! This feature is not possible to unlock MCU FLASH in the time of programming. The MCU needs POR reset when supply voltage is bellow 0,1V. The POR is generated by turn-off the switch SP1.

The kit contains some simple peripherals like LEDs, buttons and temperature sensor.
PTC0 and PTC2 are used for LEDs driving. The LED lights when the MCU sets value 0 on appropriate PTC pin. VL1 and R10 set log.1 when MCU enters MON08 and PTC0 is input.
Resistors R14 and R2 are used for measuring the battery voltage. An analog voltage on the PTB1/AD1 pin is calculated by this formula *Uad1=((Ubat-0.35)/(R14+R2))*R2*.

The thermistors VR1 and R6 are used for temperature measuring. An analog voltage on the PTB0/AD0 pin is calculated by this formula *Uad0=(Vcc/(VR1+R6))*R6*. The VR1 nominal values according to temperature are in the following table.

Buttons SA1 and SA2 are connected with PTA1 and PTA2. When a button is pressed a logical 0 will appear on appropriate MCU pin. When user's application uses buttons internal pull-ups must be enabled. The MCU has implemented internal KBI module and it is useful to use its properties for buttons reading. When a port pin is enabled for keyboard interrupt function, an internal pull-up device is also enabled on the pin.

7. M4C Connector X3

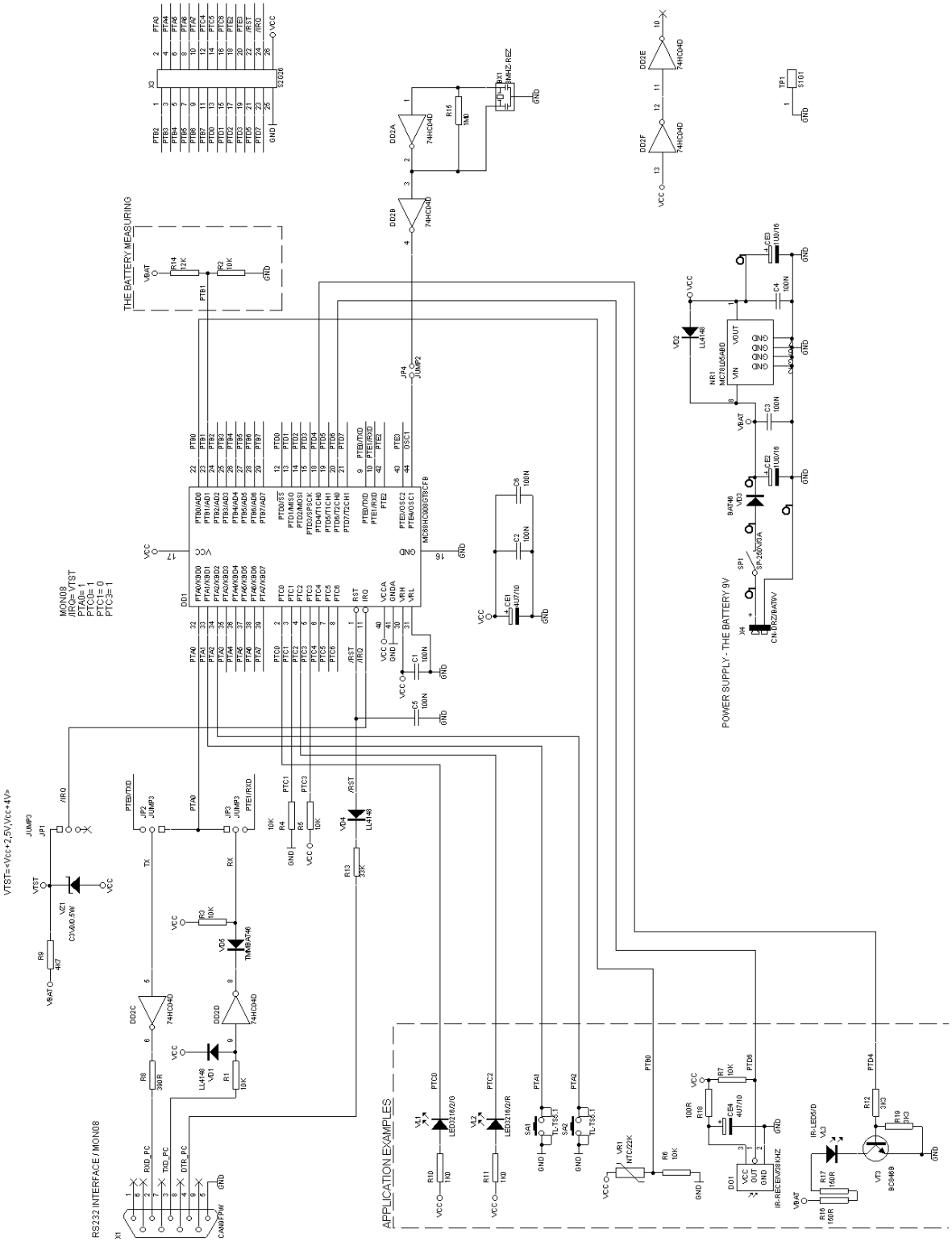
PTA3	PTA4	PTA5	PTA6	PTA7	PTC4	PTC5	PTC6	PTE2	PTE3	/RST	/IRQ	VCC
2	4	6	8	10	12	14	16	18	20	22	24	26
1	3	5	7	9	11	13	15	17	19	21	23	25
PTB2	PTB3	PTB4	PTB5	PTB6	PTB7	PTD0	PTD1	PTD2	PTD3	PTD5	PTD7	GND

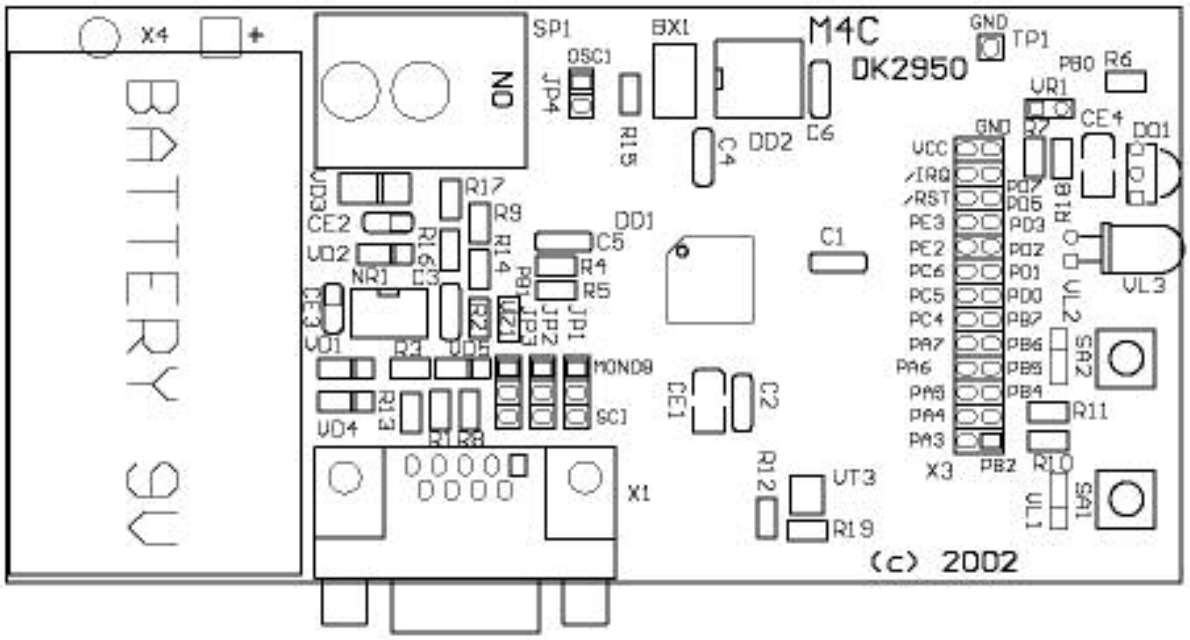
8. NTC/22K – Parameters and Nominal Values

NTC/22 K – BC Components, Ordering code 2322 640 6322
Temperature range .....-40 °C až 125 V
Thermal cooling time constant ..... 1,2 s
Max. Power dissipation at 25 °C.....0,5 W
Resistance value at temperature T..... $R_T = R_{25} \exp \{B_{25,85} (1/T - 1/T_0)\}$
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
T = actual temperature [K]

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

9. M4C –Schematic diagram and Board Layout





10. Troubleshooting the M4C

Troubleshooting M4C reset

The problem is the connection of serial cable from PC without active terminal program. In this case the MCU is resetting via DTR and user's application will not run. This feature is useful for debugging of application software in MON08 mode. Run terminal program or disconnect serial cable from the M4C to reset the MCU. Warning! This feature is not possible to unlock MCU FLASH at the time of programming. The MCU needs POR reset when supply voltage is bellow 0,1V. The POR is generated by turn-off the SP1 switch.

Troubleshooting MON08 mode

- The external clock oscillator is based on the 8MHz crystal resonator. Set up baud rate 7680Bd for communication with MCU in the MON08 mode.
- The M4C 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.
- Do not use *908_gt8_highspeed.08p* algorithm when using the PROG08SZ programming software.

Troubleshooting HC908 Security

The MC68HC908 MCUs contain a security feature based on information that the user programs into the part. Security bytes are specified in addresses $FFF6 - $FFFD (addresses of the interrupt vectors). The PROG08SZ software from PEMICRO continually records any changes to these security bytes and stores them in the file SECURITY.INI.

The information in this file is also shared by the ICS08 in-circuit simulator and the ICD08SW in-circuit debugger software. This allows the user to reset the device and still have access to the monitor mode. The ICS08 software automatically attempts to access the part by trying the default (nothing written) and up to the last 10 sequences of bytes that have been written to the part.

If after trying each of the sequence of bytes stored in the SECURITY.INI file, the ICS08 software is unable to access the part, a security dialog box is displayed. This dialog allows the user to enter the security bytes manually or to read the information from the S19 file from which the MCU was last programmed.

When you are not able to enter correct security bytes, choose "Ignore security" to enter PROG08SZ into the MON08 mode. In this case you can not read or verify MCU FLASH but you can erase it. After erasing you can enter into MON08 mode again with security bytes for blank device (FF-FF-FF-FF-FF-FF-FF-FF).