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M68ICS08MRUM/D

M68ICS08MR

In-Circuit Simulator

User's Manual

MOTOROLA

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Section 1. General Information

1.1 Introduction

This manual provides information about the Motorola M68ICS08MR in-circuit simulator (MRICS).

The MRICS is a stand-alone development and debugging tool . It contains all of the hardware and software needed to develop and simulate source code, and to program this series of MCU devices:

- MC68HC908MR4
- MC68HC908MR8
- MC68HC908MR32

The MRICS and it's software comprise an editor, assembler, programmer, simulator, and limited real-time input/output emulator for the MCUs. When connected to a host PC (personal computer) and target hardware (your prototype product), actual inputs and outputs of the target system may be used during code simulation.

The MRICS can interface with any IBM® Windows 95®-based computer (or later version) through connection of a single RS-232 serial port using a DB-9 serial cable.

Connection to the target system is accomplished by a ribbon cable, a Motorola M6CLB05C flex cable, or a MONO8 cable. The ribbon cable or flex cable is used when an MCU is resident on the MRICS for emulation or simulation, and the MONO8 cable is used to debug or program a target system's MCU, directly, when the MCU resides on the target hardware.

The MRICS is a low-cost development system that supports editing, assembling, in-circuit simulation, in-circuit emulation, and FLASH memory programming. Its features include:

- Editing with WinIDE
- Assembling with CASM08W
- FLASH memory programming with PROG08SW
- In-circuit and stand-alone simulation of MC68HC908MR MCUs with ICS08MRW software, providing:
  - Simulation of all instructions, memory, and peripherals
  - Simulation of pin inputs from the target system
  - Installation of conditional breakpoints, script files, and logfiles
- Limited real-time emulation and debugging with ICD08SW, including:
  - Loading code into RAM
  - Executing real-time in RAM or FLASH
  - Placing one hardware breakpoint in FLASH
  - Placing multiple breakpoints in RAM
- On-line help documentation for all software
- Software integrated into the WinIDE environment, allowing function key access to all applications
- MON08 emulation connection to the target system allowing:
  - In-circuit emulation (limited)
  - In-circuit programming
- Four modes of operation:
  - Standalone — using the MRICS as a standalone system without a target board
  - Simulation — using the MRICS as an in-circuit simulator/emulator with a target cable
  - Evaluation - using the MRICS for real-time evaluation of the MCU and to debug user developed hardware and software
  - Programming — using the MRICS as a programmer

Functions of the MRICS vary depending upon which software you choose:

- With the WinIDE, CASM08W, editor, simulator, and assembler software - the function is as a limited real-time emulator.
- With the PROG08SW software - the function is to program MCU FLASH memory. (This function is not available on the MC68HC08MR4 MCU, which does not have FLASH). Only one part may be programmed at a time. The MRICS also supports in-circuit programming of either version of the part through either MON08 cable.
- With the ICS08MRZ simulation software, the MCU provides the required input/output information that lets the host computer simulate code, performing all functions except for maintaining port values. (The internal FLASH memory on the device is downloaded with a program that generates the appropriate port values.) The ICS08MRZ software on the host computer lets the host computer become a simulator.
- With using the ICD08SZ debugging software, code can be run directly out of the MCU's internal FLASH at real-time speeds.
- The MRICS board also provides +5 Vdc power, +8.6 Vdc power for the V_{TST} voltage required to enter monitor mode, either a 4.0000-MHz or 4.9152-MHz clock signal, and host PC RS-232 level translation, when it is supplied an active DTR signal.

NOTE: *The simulation speed will be slower than this rate because the host computer is the simulator.*

1.2 MRICS Components

The MRICS system includes the product components listed in **Table 1-1**.

Table 1-1. M68ICS08MR Product Components

Part Number	Description
ICS08MR	MRICS software development package
ICS08MRZ	MRICS simulator
ICD08SZ	MRICS debugger
MC68HC908MR32	MCU
MC68HC908MR8	MCU
M68CLB05C	Flex target cable
KRISTA 22-122	Serial cable
FRIWO 11.8999-P5	Power supply
01-RE91008WI	MON08 cable
M68DIP28S01C	28-pin SOIC adapter

1.2.1 M68ICS08MR Connector Components

Table 1-2. Hardware Components

Components	Description
XU1 XU2 XU4 XU3	Target sockets for the Motorola MC68HC908MR16/32 MCUs: 56-pin SDIP (dual-in-line package) 64-pin QFP (quad flat pack) Target sockets for the Motorola MC68HC(9)08MR4/8 MCUs: 28-pin DIP (dual-in-line package) 32-pin QFP (quad flat pack)
J2, J3	Two 2-row × 20-pin, 0.1-inch spacing connectors connect the MRICS to a target system using the M68CLB05C flex cable. Connectors J2 and J3 are used when emulating MC68HC908MR16/32 MCUs.
J4	+5 Vdc input voltage (V_{DD})
J5, J6	Two 2-row × 20-pin, 0.1-inch spacing connectors connect the MRICS to a target system using the M68CLB05C flex cable. Connectors J5 and J6 are used when emulating MC68HC(9)08MR4/8 MCUs.
J1	One 60-pin, 0.3-inch spacing connector connect the MRICS to the target system using a ribbon cable. Connector J1 is used when emulating a MC68HC908MR16/32 MCU.
J7, J8	Two 2-row × 8-pin, 0.1-inch spacing connectors connect MON08 debug circuit to your remote target. Use connector J7 when emulating MC68HC908MR32/16 MCUs. Use connector J8 when emulating MC68HC(9)08MR4/8 MCUs.
J9, J10	Two 3-pin, 0.1-inch spacing connectors connect the MRICS clock circuit to your remote target. Connector J9 routes the 4.9152 MHz clock for the MC68HC908MR16/32 MCUs. Connector J10 routes the 4.000 MHz clock for the MC68HC(9)08MR4/8 MCUs.
J11	One 2-row × 14-pin, 0.3-inch spacing dual in-line package (28-pin DIP) socket connects the MRICS to the target system, using a ribbon cable, when emulating an MC68HC(9)08MR4/8 MCU.
J12	RS-232 connector interface to the host serial connector.

1.2.2 MRICS Interface Software

Windows-optimized software components, **Table 1-3**, are referred to, collectively, as " MRICS software" (part number ICS08MRZ). It is a product of *P&E Microcomputer Systems, Inc.*, and is included in the MRICS kit.

Table 1-3. Software Components

Components	Description
WINIDE.EXE	Integrated development environment (IDE) software interface for editing and performing software or in-circuit simulation
CASM08Z.EXE	CASM08Z command-line cross-assembler
ICS08MRZ.EXE	In-circuit/stand-alone simulator software for MC68HC908MR MCUs
PROG08SZ.EXE	FLASH memory programming software
ICD08SZ.EXE	In-circuit debugging software for limited, real-time emulation

1.3 Hardware and Software Requirements

The MRICS software requires an IBM-compatible host computer with this minimum hardware and software configuration:

- Windows 95 or later version operating system
- Approximately 2 Mbytes of available random-access memory (RAM) and 5 Mbytes of free disk space
- A serial port for communications between the MRICS and the host computer

1.4 Specifications

Table 1-4. M68ICS08MR Board Specifications

Characteristic	Specification
Temperature: Operating Storage	 0° to 40°C –40° to +85°C
Relative humidity	0 to 95%, non-condensing
Power requirement	+5 Vdc, from included ac/dc adapter
Size	5" 8 "

1.5 About This Manual

The procedural instructions in this manual assume that the user is familiar with the Windows interface and selection procedures.

1.6 Customer Support

To obtain information about technical support or ordering parts, call the Motorola help desk at 800-521-6274.

General Information

Section 2. Preparation and Installation

2.1 Introduction

This section provides information and instruction for configuring, installing, and readying the MRICS for use.

2.2 Hardware Preparation

These paragraphs explain:

- Limitations of the MRICS
- Configuration of the MRICS
- Installation of the MRICS
- Connection of the MRICS to a target system

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 the printed circuit board 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.*

2.2.1 MRICS Limitations

This section describes system limitations of the MRICS.

2.2.1.1 Bus Frequency

The MRICS communicates using the MON08 features. On the MR16/32 only, this forces the communication rate to $f_{bus}/256$. The bus frequencies are limited by standard baud rates allowed by the host software, or 9600 (and possibly 4800) baud for the MR16/32, and 9600 baud for the MR4/8.

2.2.1.2 MR16/32 Port A0

On the MR16/32, port A0 is used for communications, so it is unavailable for emulation.

2.2.1.3 MR4/8 Port B0 and Port B1

On the MR4/8, ports B0 and B1 are used for communications, so they are unavailable for emulation.

2.2.1.4 Low Voltage Interrupt (LVI)

The LVI is disabled by default in monitor mode. It is enabled by a dummy write to LVISR.

2.2.1.5 Internal Clock Generator (ICG)

The ICG is bypassed in monitor mode, so it is not available for use.

2.2.2 Configuring MRICS Jumper Headers

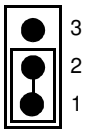
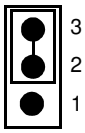
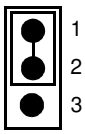
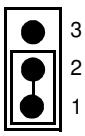
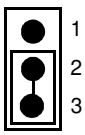
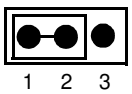
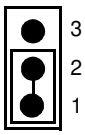
The MRICS supports four configuration options: standalone, simulation, evaluation, and programming.

- Standalone — ICS08MRZ.exe running on the host computer (the MRICS is not connected.) Emulation of the M68HC(9)08MR MCU CPU, registers, and I/O ports are done within the host computer environment.
- Simulation — Host computer connected to the MRICS via the RS-232 cable and ICS08MRZ.exe running on the host computer. This provides access to the M68HC(9)08MR MCU CPU, internal registers, and I/O ports.
- Evaluation — Host computer connected to the MRICS and the MRICS connected to the target system via the flex cable. This method provides limited real-time evaluation of the MCU and debugging user developed hardware and software.

- Programming — Host computer connected to the MRICS, and the MRICS connected to the target system via the MON08 cable. Use the PROG08SZ.exe to program the MCU FLASH module. In the programming mode there is limited evaluation (port A0 on the MR32 and port B0 and port B1 on the MR4/8 are used for communications, so they are unavailable for emulation).

Seven jumper headers on the MRICS are used to configure the hardware options. **Table 2-1** is a quick reference to these optional settings, and subparagraphs **2.2.2.1** through **2.2.2.6** describe jumper header configuration in greater detail.

Table 2-1. MRICS Jumper Header Description

Jumper Header	Type	Description
W1 MR16/32 Target clock selection		Jumper on pins 1 and 2 (factory default) — Connects the MC68HC908MR16/32 clock to the target system via connectors J1 and J2. This position is labeled I. Jumper on pins 2 and 3 — Disconnects the MC68HC908MR16/32 clock from the target system.
W2 Target reset selection		Jumper on pins 1 and 2 — The MC68HC908MR MCU $\overline{\text{RESET}}$ signal initiates resets to the target system. This position is labeled I. Jumper on pins 2 and 3 (factory default) — The target-system $\overline{\text{RESET}}$ signal initiates resets to the MRICS on-board MC68HC908MR MCU. This position is labeled O.
W3 I/O Baud rate selection: MR16/32 only		Jumper on pins 1 and 2 (factory default) — MR16/32 I/O baud rate is set to 4800. This position is labeled 4800. Jumper on pins 2 and 3 — MR16/32 I/O baud rate is set to 9600. This position is labeled 9600. This jumper header does not affect the MR4/8, which operates at 9600 baud only
W4 Serial communication selection		Jumper on pins 1 and 2 (factory default) — MC68HC908MR16/32 MCU is installed. This position is labeled MR32/16. Jumper on pins 2 and 3 — MC68HC(9)08MR4/8 MCU is installed. This position is labeled MR8/4.
W5 XTAL clock enable		Jumper on pins 1 and 2 — MRICS XTAL clocks are disabled. Jumper header W5 has a cut-trace short between pins 1 and 2 so no jumper is required unless the cut-trace short is removed. This position is labeled O. Jumper on pins 2 and 3 (factory default) — MRICS XTAL clocks are enabled: 4.9152 MHz for the MC68HC908MR16/32 MCUs and 4.000 MHz for the MC68HC(9)08MR4/8 MCUs. This position is labeled I.
W6 MR4/8 target clock		Jumper on pins 1 and 2 (factory default) — Connects the MC68HC(9)08MR4/8 clock to the target system via connectors J6 and J11. This position is labeled I. Jumper on pins 2 and 3 — Disconnects the MC68HC(9)08MR4/8 clock from the target system. This position is labeled O.
W7 MRICS reset clock		Jumper on pins 1 and 2 (factory default) — Reset clock set at 4.9152 MHz. Use this setting when using the MC68HC908MR16/32 MCUs. This position is labeled MR32/16. Jumper on pins 2 and 3 — Reset clock set at 4.0000 MHz. Use this setting when using the MC68HC(9)08MR4/8 MCUs. This position is labeled MR8/4.

2.2.2.1 MR16/32 Clock Source Selection Jumper (W1)

Use jumper header W1 (**Figure 2-1**) to connect the MC68HC908MR16/32 clock to the target system clock. Install a jumper on pins 1 and 2 (factory default) to drive the target system clock with the MC68HC908MR16/32 clock. Install a jumper on pins 2 and 3 to isolate the MC68HC908MR16/32 clock from the target system.

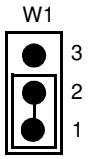


Figure 2-1. MR16/32 Clock Source Selection Jumper (W1)

2.2.2.2 Reset Source Selection Jumper (W2)

Use jumper header W2 **(Figure 2-2)** to select the target system or the MCU as the source for a system reset. Install a jumpert on jumper header pins 1 and 2 (factory default) to drive the MCU $\overline{\text{RESET}}$ signal to the target system. Install a jumper on jumper header pins 2 and 3 to reset the MCU whenever the target-system initiates a reset.

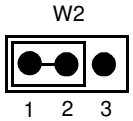


Figure 2-2. Reset Source Selection Jumper (W2)

2.2.2.3 I/O Baud Rate Selection Jumper (W3) — MR16/32 Only

There are two sockets for clocks on the MRICS board, XY1 and XY2. Socket XY1 is wired to drive the MR16/32 IC sockets and target connectors, and the the clock is available for output on J10. Using the 4.9152-MHz clock as Y1 times the MR16/32 to communicate at 4800 or 9600 baud.

Use jumper W3 (**Figure 2-3**) to define the baud rate of the MR16/32. Install the jumper in jumper position 1-2 (labeled 9600 baud) to communicate at 9600 baud if a 4.9152-MHz clock is installed as Y1. Place the jumper in the 2-3 position (labeled 4800 baud) to communicate at 4800 baud. If Y1 is not 4.9152 MHz, the baud rate will be scaled proportionally.

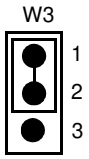


Figure 2-3. MR16/32 I/O Baud Rate Selection Jumper (W3)

2.2.2.4 Serial Communication Selection Jumper (W4)

Install the jumper on jumper header W4 (**Figure 2-4**) pins 1 and 2 (factory default) when an MC68HC908MR16/32 MCU is installed. Install the jumper on pins 2 and 3 when an MC68HC(9)08MR4/8 MCU is installed.

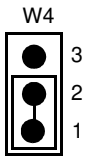


Figure 2-4. MCU Emulation Selection Jumper (W4)

2.2.2.5 MRICS XTAL Clock Enable Jumper (W5)

Install a jumper on jumper header W5 (**Figure 2-5**) pins 1 and 2 to disable the MRICS XTAL clock. Install a jumper on pins 2 and 3 (factory default) to enable the MRICS XTAL clock. The clock is 4.9152 MHz for the MC68HC908MR16/32 MCUs and 4.0000 MHz for the MC68HC(9)08MR4/8 MCUs.

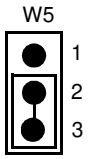


Figure 2-5. MRICS XTAL Clock Enable Jumper (W5)

2.2.2.6 MR4/8 Clock Source Selection Jumper (W6)

Use jumper header W6 (**Figure 2-6**) to connect the MC68HC(9)08MR4/8 clock to the target system clock. Install a jumper on pins 1 and 2 (factory default) to drive the target system clock with the MC68HC(9)08MR4/8 clock. Install a jumper on pins 2 and 3 to isolate the MC68HC(9)08MR4/8 clock from the target system.

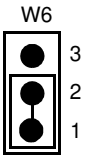


Figure 2-6. MR4/8 Clock Source Selection Jumper (W6)

2.2.2.7 Board Reset Selection Jumper (W7)

When the power to the MCU is turned on, there is a delay of a few hundred milliseconds during which the $\overline{\text{ICS\_RST}}$ signal is held low (set by U11).

When $\overline{\text{ICS\_RST}}$ goes high, the binary ripple counter (U10) begins counting clock cycles. After 1024 clock cycles are counted, the DELAY_RESET and DELAY_RESET_1 signals toggle and the counter stops counting. The delayed reset signals are used to turn on communications to the MCU and to hold several MCU pins in appropriate states to force monitor mode on power up.

Use jumper W7 (**Figure 2-7**) to set the ripple counter reset rate. Install the jumper on jumper header pins 1 and 2 (factory default) to select the MR16/32 clock, which causes Y1 to drive the counter at the factory installed rate of 4.9152 MHz. Use this setting when using the MC68HC908MR16/32 MCUs.

Install the jumper on jumper header pins 2 and 3 to select the MR4/8 clock. This sets Y2 to drive the counter at the factory installed rate of 4.0000 MHz. Use this setting when using the MC68HC(9)08MR4/8 MCUs.

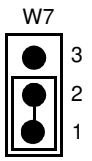


Figure 2-7. Board Reset Selection Jumper (W7)

2.2.3 Target Interface Connection Options

There are three ways to connect the MRICS simulator board to your target system:

- Flex cable — low-noise target interface connection
- Ribbon cable — low-cost target interface connection
- MON08 cable — target interface connection with MCU FLASH programming and limited emulation

Below is a quick reference for defining the cable/connector setup to use with the appropriate MCU version. Refer to **2.2.3.1 MR16/32 Target Interface Connectors (J2 and J3)** through **2.2.3.5 MR4/8 DIP Target Connector (J11)**.

Table 2-2. Cable/Connector Options for MCUs

MCU	Flex Cable M68CLB05C	Ribbon Cable	MON08 Cable
MC68HC08MR4	J5 and J6	J11	J8
MC68HC908MR8	J5 and J6	J11	J8
MC68HC908MR16	J2 and J3	J1	J7
MC68HC908MR32	J2 and J3	J1	J7

2.2.3.1 MR16/32 Target Interface Connectors (J2 and J3)

Use connectors J2 (**Figure 2-8**), J3 (**Figure 2-9**), and Motorola's M68CLB05C flex cable, when emulating an MC68HC908MR16/32 MCU, to connect the MRICS to the target system. Connectors J2 and J3 are 40-pin shrouded headers (3M 2540-6002).