

# **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<sup>®</sup> Windows 95<sup>®</sup>-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<br>XU2<br>XU4<br>XU3 | Target sockets for the Motorola MC68HC908MR16/32 MCUs:<br>56-pin SDIP (dual-in-line package)<br>64-pin QFP (quad flat pack)<br>Target sockets for the Motorola MC68HC(9)08MR4/8 MCUs:<br>28-pin DIP (dual-in-line package)<br>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:<br>Operating<br>Storage | 0° to 40°C<br>-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.





## User's Manual — M68ICS08MR In-Circuit Simulator

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# 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

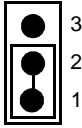
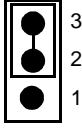
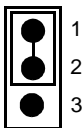
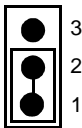
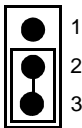
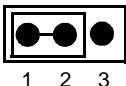
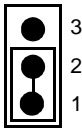
The MRICS supports four configuration options: standalone, simulation, evaluation, and programming.

- 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).

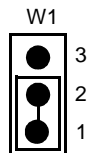
Seven jumper headers on the MRICS are used to configure the hardware options. **Table 2-1** is a quick reference to these optional settings, and subparagraphs **2.2.2.1** through **2.2.2.6** describe jumper header configuration in greater detail.

**Table 2-1. MRICS Jumper Header Description**

| Jumper Header  | Type  | Description   |
|--|---|---|
| W1<br>MR16/32<br>Target clock<br>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.<br>Jumper on pins 2 and 3 — Disconnects the MC68HC908MR16/32 clock from the target system.  |
| W2<br>Target<br>reset<br>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.<br>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<br>I/O<br>Baud rate<br>selection:<br>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.<br>Jumper on pins 2 and 3 — MR16/32 I/O baud rate is set to 9600. This position is labeled 9600.<br>This jumper header does not affect the MR4/8, which operates at 9600 baud only  |
| W4<br>Serial<br>communication<br>selection           |   | Jumper on pins 1 and 2 (factory default) — MC68HC908MR16/32 MCU is installed. This position is labeled MR32/16.<br>Jumper on pins 2 and 3 — MC68HC(9)08MR4/8 MCU is installed. This position is labeled MR8/4.  |
| W5<br>XTAL<br>clock<br>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.<br>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<br>MR4/8<br>target<br>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.<br>Jumper on pins 2 and 3 — Disconnects the MC68HC(9)08MR4/8 clock from the target system. This position is labeled O.   |
| W7<br>MRICS<br>reset<br>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.<br>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)

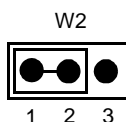
Use jumper header W1 (**Figure 2-1**) to connect the MC68HC908MR16/32 clock to the target system clock. Install a jumper on pins 1 and 2 (factory default) to drive the target system clock with the MC68HC908MR16/32 clock. Install a jumper on pins 2 and 3 to isolate the MC68HC908MR16/32 clock from the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

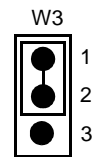


**Figure 2-2. Reset Source Selection Jumper (W2)**

### 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 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.

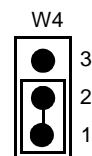
Use jumper W3 (**Figure 2-3**) to define the baud rate of the MR16/32. Install the jumper in jumper position 1-2 (labeled 9600 baud) to communicate at 9600 baud if a 4.9152-MHz clock is installed as Y1. Place the jumper in the 2-3 position (labeled 4800 baud) to communicate at 4800 baud. If Y1 is not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

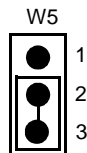
Install the jumper on jumper header W4 (**Figure 2-4**) pins 1 and 2 (factory default) when an MC68HC908MR16/32 MCU is installed. Install the jumper on pins 2 and 3 when an MC68HC(9)08MR4/8 MCU is installed.



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

### 2.2.2.5 MRICS XTAL Clock Enable Jumper (W5)

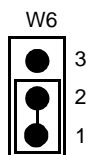
Install a jumper on jumper header W5 (**Figure 2-5**) pins 1 and 2 to disable the MRICS XTAL clock. Install a jumper on pins 2 and 3 (factory default) to enable the MRICS XTAL clock. The clock is 4.9152 MHz for the MC68HC908MR16/32 MCUs and 4.0000 MHz for the MC68HC(9)08MR4/8 MCUs.



**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)**

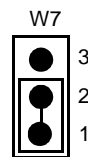
## 2.2.2.7 Board Reset Selection Jumper (W7)

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<br>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).

|                              |    | J2 |   |    |                              |
|------------------------------|----|----|---|----|------------------------------|
| MR32_PT B2                   | 1  | •  | • | 2  | MR32_PT B3                   |
| MR32_PT B5                   | 3  | •  | • | 4  | MR32_PT B6                   |
| PTC0                         | 5  | •  | • | 6  | PTC1                         |
| Ground                       | 7  | •  | • | 8  | No Connect                   |
| Ground                       | 9  | •  | • | 10 | MR32_PTA7                    |
| MR32_PTA3                    | 11 | •  | • | 12 | MR32_PTA4                    |
| TGT_PTA0                     | 13 | •  | • | 14 | Ground                       |
| TGT_CLK                      | 15 | •  | • | 16 | No Connect                   |
| $\overline{\text{TGT\_RST}}$ | 17 | •  | • | 18 | $\overline{\text{TGT\_IRQ}}$ |
| PTF3                         | 19 | •  | • | 20 | PTF2                         |
| PTF0                         | 21 | •  | • | 22 | Ground                       |
| PTE6                         | 23 | •  | • | 24 | PTE5                         |
| PTE3                         | 25 | •  | • | 26 | PTE2                         |
| Ground                       | 27 | •  | • | 28 | MR32_PWM6                    |
| MR32_PWM4                    | 29 | •  | • | 30 | MR32_PWM3                    |
| PTD6                         | 31 | •  | • | 32 | Ground                       |
| PTD2                         | 33 | •  | • | 34 | PTD3                         |
| PTD1                         | 35 | •  | • | 36 | No Connect                   |
| PTC5                         | 37 | •  | • | 38 | Ground                       |
| TGT_PTC3                     | 39 | •  | • | 40 | Ground                       |

**Figure 2-8. J2 Pin Assignments; MR16/32 Target Interface**

**J3**

|            |    |   |   |    |            |
|------------|----|---|---|----|------------|
| Ground     | 1  | • | • | 2  | MR32_PT B4 |
| MR32_PT B7 | 3  | • | • | 4  | Ground     |
| No Connect | 5  | • | • | 6  | No Connect |
| MR32_PT B0 | 7  | • | • | 8  | MR32_PT B1 |
| MR32_PTA5  | 9  | • | • | 10 | MR32_PTA6  |
| MR32_PTA1  | 11 | • | • | 12 | MR32_PTA2  |
| No Connect | 13 | • | • | 14 | No Connect |
| No Connect | 15 | • | • | 16 | No Connect |
| PTF5       | 17 | • | • | 18 | PTF4       |
| Ground     | 19 | • | • | 20 | PTF1       |
| No Connect | 21 | • | • | 22 | PTE7       |
| PTE4       | 23 | • | • | 24 | Ground     |
| PTE1       | 25 | • | • | 26 | PTE0       |
| MR32_PWM5  | 27 | • | • | 28 | No Connect |
| MR32_PWM2  | 29 | • | • | 30 | MR32_PWM1  |
| PTD4       | 31 | • | • | 32 | PTD5       |
| No Connect | 33 | • | • | 34 | No Connect |
| PTC6       | 35 | • | • | 36 | PTD0       |
| TGT_PTC4   | 37 | • | • | 38 | Ground     |
| TGT_PTC2   | 39 | • | • | 40 | Ground     |

**Figure 2-9. J3 Pin Assignments; MR16/32 Target Interface**

## 2.2.3.2 MR4/8 Target Interface Connectors (J5 and J6)

Use connectors J5 (**Figure 2-10**), J6, (**Figure 2-11**), and Motorola's M68CLB05C flex cable to connect the MRICS to the target system when emulating an MC68HC(9)08MR4/8 MCU. Connectors J5 and J6 are 40-pin shrouded headers (3M 2540-6002).

|            |    | J5 |   |    |                              |
|------------|----|----|---|----|------------------------------|
| No Connect | 1  | •  | • | 2  | MR4_PTA1                     |
| MR4_PTA6   | 3  | •  | • | 4  | No Connect                   |
| MR4_PTB1   | 5  | •  | • | 6  | MR4_PTB2                     |
| No Connect | 7  | •  | • | 8  | No Connect                   |
| Ground     | 9  | •  | • | 10 | No Connect                   |
| MR4_PTA2   | 11 | •  | • | 12 | No Connect                   |
| No Connect | 13 | •  | • | 14 | Ground                       |
| MR4_PWM3   | 15 | •  | • | 16 | MR4_PWM4                     |
| MR4_PTC0   | 17 | •  | • | 18 | MR4_PTB0                     |
| MR4_PTC1   | 19 | •  | • | 20 | No Connect                   |
| No Connect | 21 | •  | • | 22 | No Connect                   |
| MR4_PTB5   | 23 | •  | • | 24 | No Connect                   |
| MR4_PTA0   | 25 | •  | • | 26 | No Connect                   |
| Ground     | 27 | •  | • | 28 | No Connect                   |
| No Connect | 29 | •  | • | 30 | No Connect                   |
| No Connect | 31 | •  | • | 32 | Ground                       |
| No Connect | 33 | •  | • | 34 | $\overline{\text{TGT\_IRQ}}$ |
| No Connect | 35 | •  | • | 36 | Ground                       |
| No Connect | 37 | •  | • | 38 | Ground                       |
| No Connect | 39 | •  | • | 40 | Ground                       |

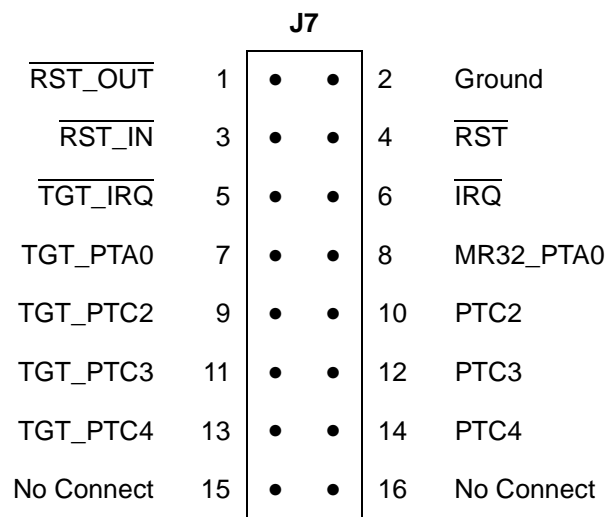
**Figure 2-10. J5 Pin Assignments; MR4/8 Target Interface**

|            |    | <b>J6</b> |   |    |                              |
|------------|----|-----------|---|----|------------------------------|
| Ground     | 1  | •         | • | 2  | MR4_PTA4                     |
| MR4_PTA5   | 3  | •         | • | 4  | Ground                       |
| MR4_PTB3   | 5  | •         | • | 6  | MR4_PTB4                     |
| No Connect | 7  | •         | • | 8  | No Connect                   |
| MR4_PTA3   | 9  | •         | • | 10 | No Connect                   |
| No Connect | 11 | •         | • | 12 | No Connect                   |
| MR4_PWM1   | 13 | •         | • | 14 | MR4_PWM2                     |
| MR4_PWM5   | 15 | •         | • | 16 | MR4_PWM6                     |
| No Connect | 17 | •         | • | 18 | No Connect                   |
| Ground     | 19 | •         | • | 20 | No Connect                   |
| No Connect | 21 | •         | • | 22 | No Connect                   |
| MR4_PTB6   | 23 | •         | • | 24 | Ground                       |
| No Connect | 25 | •         | • | 26 | No Connect                   |
| No Connect | 27 | •         | • | 28 | No Connect                   |
| No Connect | 29 | •         | • | 30 | No Connect                   |
| No Connect | 31 | •         | • | 32 | No Connect                   |
| No Connect | 33 | •         | • | 34 | MR8/4_TGT_CLK                |
| No Connect | 35 | •         | • | 36 | $\overline{\text{TGT\_RST}}$ |
| No Connect | 37 | •         | • | 38 | Ground                       |
| No Connect | 39 | •         | • | 40 | Ground                       |

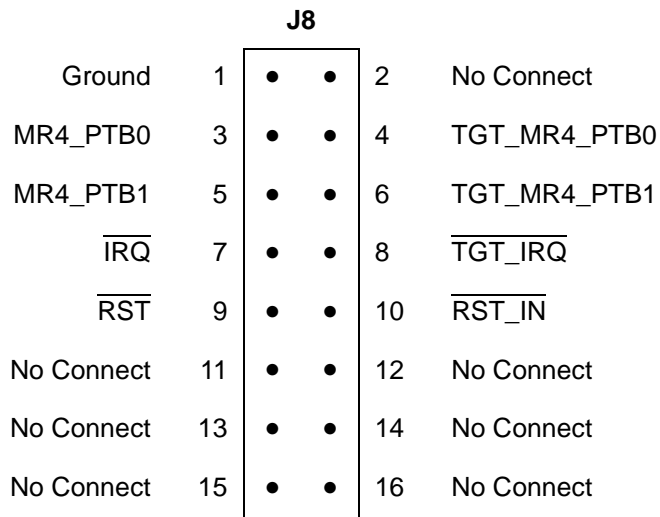
**Figure 2-11. J6 Pin Assignments; MR4/8 Target Interface**

## 2.2.3.3 MON08 Connectors (J7 and J8)

Use connectors J7 (**Figure 2-12**), J8 (**Figure 2-13**), and the provided MON08 cable to connect the MRICS board to the target system. Use connector J7 when emulating an MC68HC908MR16/32 MCU and J8 when emulating an MC68HC(9)08MR4/8 MCU. Refer to **Section 4. Using the MON08 Interface** for detailed information for using the MON08 interface.



**Figure 2-12. J7 Pin Assignments; MR16/32 MON08 Cable Connectors**



**Figure 2-13. J8 Pin Assignments; MR4/8 MON08 Cable Connectors**

**2.2.3.4 MR16/32 Target Connector (J1)**

Use connector J1 (**Figure 2-14**) and the provided 60-pin ribbon cable to connect the MRICS to the target system when emulating an MC68HC908MR16/32 MCU. shows the interface connector.

| J1         |    |   |   |    |                             |
|------------|----|---|---|----|-----------------------------|
| MR32_PTA2  | 1  | ● | ● | 2  | MR32_PTA1                   |
| MR32_PTA3  | 3  | ● | ● | 4  | MR32_PTA0                   |
| MR32_PTA4  | 5  | ● | ● | 6  | Ground                      |
| MR32_PTA5  | 7  | ● | ● | 8  | No Connect                  |
| MR32_PTA6  | 9  | ● | ● | 10 | TGT_CLK                     |
| MR32_PTA7  | 11 | ● | ● | 12 | No Connect                  |
| MR32_PTB0  | 13 | ● | ● | 14 | No Connect                  |
| MR32_PTB1  | 15 | ● | ● | 16 | $\overline{\text{TGT-RST}}$ |
| MR32_PTB2  | 17 | ● | ● | 18 | $\overline{\text{TGT-IRQ}}$ |
| MR32_PTB3  | 19 | ● | ● | 20 | PTF5                        |
| MR32_PTB4  | 21 | ● | ● | 22 | PTF4                        |
| MR32_PTB5  | 23 | ● | ● | 24 | Ground                      |
| MR32_PTB6  | 25 | ● | ● | 26 | No Connect                  |
| MR32_PTB7  | 27 | ● | ● | 28 | PTE7                        |
| No Connect | 29 | ● | ● | 30 | PTE6                        |
| No Connect | 31 | ● | ● | 32 | PTE5                        |
| Ground     | 33 | ● | ● | 34 | PTE4                        |
| No Connect | 35 | ● | ● | 36 | PTE3                        |
| PTC2       | 37 | ● | ● | 38 | No Connect                  |
| PTC3       | 39 | ● | ● | 40 | MR32_PWM6                   |
| PTC4       | 41 | ● | ● | 42 | MR32_PWM5                   |
| PTC5       | 43 | ● | ● | 44 | Ground                      |
| PTC6       | 45 | ● | ● | 46 | MR32_PWM4                   |
| PTD0       | 47 | ● | ● | 48 | MR32_PWM3                   |
| PTD1       | 49 | ● | ● | 50 | MR32_PWM2                   |
| PTD2       | 51 | ● | ● | 52 | MR32_PWM1                   |
| PTD3       | 53 | ● | ● | 54 | PTD6                        |
| PTD4       | 55 | ● | ● | 56 | PTD5                        |
| Ground     | 57 | ● | ● | 58 | Ground                      |
| Ground     | 59 | ● | ● | 60 | Ground                      |

**Figure 2-14. J1 Pin Assignments; MR16/32 Target Connector**



### 2.2.3.5 MR4/8 DIP Target Connector (J11)

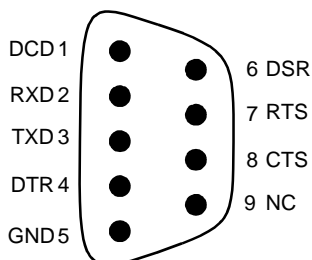
Use connector J11 (**Figure 2-15**) and the provided 28-pin ribbon cable to connect the MRICS to the target system when emulating an MC68HC(9)08MR4/8 MCU.

|                              |    | J11 |   |    |            |
|------------------------------|----|-----|---|----|------------|
| No Connect                   | 1  | •   | • | 28 | MR4_PTA3   |
| $\overline{\text{TGT\_RST}}$ | 2  | •   | • | 27 | MR4_PTA2   |
| No Connect                   | 3  | •   | • | 26 | MR4_PTA1   |
| Ground                       | 4  | •   | • | 25 | MR4_PTA0   |
| No Connect                   | 5  | •   | • | 24 | MR4_PTB6   |
| MR8/4_TGT_CLK                | 6  | •   | • | 23 | MR4_PTB5   |
| No Connect                   | 7  | •   | • | 22 | Ground     |
| $\overline{\text{TGT\_IRQ}}$ | 8  | •   | • | 21 | No Connect |
| MR4_PWM1                     | 9  | •   | • | 20 | MR4_PTB4   |
| MR4_PWM2                     | 10 | •   | • | 19 | MR4_PTB3   |
| MR4_PWM3                     | 11 | •   | • | 18 | MR4_PTB2   |
| MR4_PWM4                     | 12 | •   | • | 17 | MR4_PTB1   |
| MR4_PWM5                     | 13 | •   | • | 16 | MR4_PTB0   |
| MR4_PWM6                     | 14 | •   | • | 15 | MR4_PTC0   |

**Figure 2-15. J11 Pin Assignments; MR4/8 DIP Target Connector**

## 2.2.4 Host Computer (PC) — MRICS Serial Interconnection (J12)

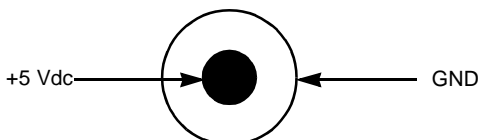
Communication with the MRICS requires an RS-232C compatible host computer connected to the MRICS I/O port J12 (**Figure 2-16**) . This cable assembly is supplied with your MRICS kit and is a DE9-male-to-female, 6-ft (2-m) long serial cable. Connect one end of this cable to your host PC and the other end to connector J12 on the MRICS board.



**Figure 2-16. J12 Pin Assignments; RS232 Connector**

## 2.2.5 J4 Pin Assingments; +5Vdc Power Connector

Connect +5-Vdc power directly to the MRICS via connector J4 (**Figure 2-17**) using the provided power supply.



**Figure 2-17. J4 Pin Assignment; +5Vdc Power Connector**

## 2.3 Connecting the MRICS

The following steps provide instructions for connecting the MRICS to the host PC and power connection.

**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.*

a. Configure the jumpers W-1 through W-7, on the MRICS, for your application.

b. Install an MCU into the appropriate socket, for your application, onto the MRICS board.

- 56-pin SDIP MC68HC908MR16/32 to XU1
- 28-pin DIP MC68HC(9)08MR4/8 to XU4
- 64-pin QFP MC68HC908MR16/32 to XU2
- 32-pin QFP MC68HC(9)08MR4/8 to XU3

*Note: Observe the pin 1 orientation with the silkscreened dot. The top (label side) of the MCU package must be visible when looking at the component side of the board.*

c. Plug the serial cable into J12 on the MRICS .

d. Plug the serial cable into the COM port on the host PC.

**NOTE:** *Steps e. through g. should not be completed until all connections to the target are completed (**Paragraph 2.4**).*

e. Connect the power cable to J4 on the MRICS board.

f. Plug the power cable into an ac power outlet, using one of the country-specific adapters.

g. The MRICS power LED lights.

## 2.4 Connecting the MRICS to a Target System

Connect the MRICS to the target system using one of these methods:

- Emulating using a flex cable

When emulating an MC68HC908MR16/32 MCU, connect the 80-pin M68CLB05C flex cable (provided with the kit) to the connectors labeled J2 and J3 on the simulator board. (Use the same cable when emulating an MC68HC(9)08MR4/8 MCU, but connect it to J5 and J6 on the MRICS board.) Attach the other end of the cable to the appropriate connector on the target system. Target head adapters are available for the 56-pin SDIP, 28-pin DIP, 32-pin QFP, and 64-pin QFP versions of the MCU.

- Emulating using a ribbon cable

When emulating an MC68HC908MR16/32 MCU connect a 60-pin flat ribbon cable to connector J1 on the simulator board. Attach the other end of the cable to the appropriate connector on the target system. When emulating an MC68HC(9)08MR4/8 MCU connect a 28-pin DIP cable to connector J11 on the simulator board. Attach the other end of the cable to the appropriate connector on the target system.

- Using a MON08 cable to debug the target system.

*Note: An MCU must be installed in the target system. No MCU should on the MRICS.*

Connect the MON08 debug interface cable to the appropriate MON08 debug interface connector (J7 for the MR 16/32 or J8 for the MR 4/8) for communication with the target system's MCU.

*Note: For more detailed information on the MON08, refer to Section 3 of this manual.*

## 2.5 Installing the Software

For instructions for installing the ICS08 software, refer to P&E Microcomputer Systems, Inc., *M68ICS08 68HC08 In-Circuit Simulator Operator's Manual*, Motorola document order number M68ICS08OM/D.

## User's Manual — M68ICS08MR In-Circuit Simulator

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### Section 3. Support Information

#### 3.1 Introduction

This section includes data and information that can be useful in the design, installation, and operation of your application.

#### 3.2 MRICS Connector Signal Definitions

The tables in this section detail the pin assignments for the connectors on the M68ICS08MR board.

**NOTE:** *The signal descriptions in the following tables are for quick reference only. The MC68HC908MR32 User's Manual, MC68HC908MR32/D, contains a complete description of the MC68HC908MR32 MCU signals.*

**Table 3-1. MR16/32 Target Connector J2**

| Pin No. | Schematic NET                | Direction     | Signal Description             |
|---------|------------------------------|---------------|--------------------------------|
| 1       | MR32_PTB2                    | Bidirectional | Port B I/O – bit 2             |
| 2       | MR32_PTB3                    | Bidirectional | Port B I/O – bit 3             |
| 3       | MR32_PTB5                    | Bidirectional | Port B I/O – bit 5             |
| 4       | MR32_PTB6                    | Bidirectional | Port B I/O – bit 6             |
| 5       | PTC0                         | Bidirectional | Port C I/O – bit 0             |
| 6       | PTC1                         | Bidirectional | Port C I/O – bit 1             |
| 7       | GND                          | Ground        | MCU ground                     |
| 8       | NC                           |               | No connect                     |
| 9       | GND                          | Ground        | MCU ground                     |
| 10      | MR32_PTA7                    | Bidirectional | Port A I/O – bit 7             |
| 11      | MR32_PTA3                    | Bidirectional | Port A I/O – bit 3             |
| 12      | MR32_PTA4                    | Bidirectional | Port A I/O – bit 4             |
| 13      | TGT_PTA0                     | Bidirectional | Port A I/O – bit 0             |
| 14      | GND                          | Ground        | MCU ground                     |
| 15      | TGT_CLK                      | In            | Target clock                   |
| 16      | NC                           |               | No connect                     |
| 17      | $\overline{\text{TGT\_RST}}$ | In or out     | External reset                 |
| 18      | $\overline{\text{TGT\_IRQ}}$ | In            | External interrupt             |
| 19      | PTF3                         | Bidirectional | Port F I/O – bit 3             |
| 20      | PTF2                         | Bidirectional | Port F I/O – bit 2             |
| 21      | PTF0                         | Bidirectional | Port F I/O – bit 0             |
| 22      | GND                          | Ground        | MCU ground                     |
| 23      | PTE6                         | Bidirectional | Port E I/O – bit 6             |
| 24      | PTE5                         | Bidirectional | Port E I/O – bit 5             |
| 25      | PTE3                         | Bidirectional | Port E I/O – bit 3             |
| 26      | PTE2                         | Bidirectional | Port E I/O – bit 2             |
| 27      | GND                          | Ground        | MCU ground                     |
| 28      | MR32_PWM6                    | Out           | Pulse width modulation – bit 6 |

**Table 3-1. MR16/32 Target Connector J2 (Continued)**

| Pin No. | Schematic NET | Direction     | Signal Description             |
|---------|---------------|---------------|--------------------------------|
| 29      | MR32_PWM4     | Out           | Pulse width modulation – bit 4 |
| 30      | MR32_PWM3     | Out           | Pulse width modulation – bit 3 |
| 31      | PTD6          | Bidirectional | Port D I/O – bit 6             |
| 32      | GND           | Ground        | Flex cable shield ground       |
| 33      | PTD2          | Bidirectional | Port D I/O – bit 2             |
| 34      | PTD3          | Bidirectional | Port D I/O – bit 3             |
| 35      | PTD1          | Bidirectional | Port D I/O – bit 1             |
| 36      | NC            |               | No connect                     |
| 37      | PTC5          | Bidirectional | Port C I/O – bit 5             |
| 38      | GND           | Ground        | MCU ground                     |
| 39      | TGT_PTC3      | Bidirectional | Port C I/O – bit 3             |
| 40      | GND           | Ground        | MCU ground                     |

**Table 3-2. MR16/32 Target Connector J3**

| Pin No. | Schematic NET | Direction     | Signal Description             |
|---------|---------------|---------------|--------------------------------|
| 1       | GND           | Ground        | MCU ground                     |
| 2       | MR32_PT4      | Bidirectional | Port B I/O – bit 4             |
| 3       | MR32_PT7      | Bidirectional | Port B I/O – bit 7             |
| 4       | GND           | Ground        | MCU ground                     |
| 5       | NC            |               | No connect                     |
| 6       | NC            |               | No connect                     |
| 7       | MR32_PT0      | Bidirectional | Port B I/O – bit 0             |
| 8       | MR32_PT1      | Bidirectional | Port B I/O – bit 1             |
| 9       | MR32_PT5      | Bidirectional | Port A I/O – bit 5             |
| 10      | MR32_PT6      | Bidirectional | Port A I/O – bit 6             |
| 11      | MR32_PT1      | Bidirectional | Port A I/O – bit 1             |
| 12      | MR32_PT2      | Bidirectional | Port A I/O – bit 2             |
| 13      | NC            |               | No connect                     |
| 14      | NC            |               | No connect                     |
| 15      | NC            |               | No connect                     |
| 16      | NC            |               | No connect                     |
| 17      | PTF5          | Bidirectional | Port F I/O – bit 5             |
| 18      | PTF4          | Bidirectional | Port F I/O – bit 4             |
| 19      | GND           | Ground        | MCU ground                     |
| 20      | PTF1          | Bidirectional | Port F I/O – bit 1             |
| 21      | NC            |               | No connect                     |
| 22      | PTE7          | Bidirectional | Port E I/O – bit 7             |
| 23      | PTE4          | Bidirectional | Port E I/O – bit 4             |
| 24      | GND           | Ground        | MCU ground                     |
| 25      | PTE1          | Bidirectional | Port E I/O – bit 1             |
| 26      | PTE0          | Bidirectional | Port E I/O – bit 0             |
| 27      | MR32_PWM5     | Out           | Pulse width modulation – bit 5 |
| 28      | NC            |               | No connect                     |



**Table 3-2. MR16/32 Target Connector J3 (Continued)**

| Pin No. | Schematic NET | Direction     | Signal Description             |
|---------|---------------|---------------|--------------------------------|
| 29      | MR32_PWM2     | Out           | Pulse width modulation – bit 2 |
| 30      | MR32_PWM1     | Out           | Pulse width modulation – bit 1 |
| 31      | PTD4          | Bidirectional | Port D I/O – bit 4             |
| 32      | PTD5          | Bidirectional | Port D I/O – bit 5             |
| 33      | NC            |               | No connect                     |
| 34      | NC            |               | No connect                     |
| 35      | PTC6          | Bidirectional | Port C I/O – bit 6             |
| 36      | PTD0          | Bidirectional | Port D I/O – bit 0             |
| 37      | TGT_PTC4      | Bidirectional | Port C I/O – bit 4             |
| 38      | GND           | Ground        | MCU ground                     |
| 39      | TGT_PTC2      | Bidirectional | Port C I/O – bit 2             |
| 40      | GND           | Ground        | MCU ground                     |

Table 3-3. MR4/8 Target Connector J5

| Pin No. | Schematic NET | Direction     | Signal Description             |
|---------|---------------|---------------|--------------------------------|
| 1       | NC            |               | No connect                     |
| 2       | MR4_PTA1      | Bidirectional | Port A I/O – bit 1             |
| 3       | MR4_PTA6      | Bidirectional | Port A I/O – bit 6             |
| 4       | NC            |               | No connect                     |
| 5       | MR4_PTB1      | Bidirectional | Port B I/O – bit 1             |
| 6       | MR4_PTB2      | Bidirectional | Port B I/O – bit 2             |
| 7       | NC            |               | No connect                     |
| 8       | NC            |               | No connect                     |
| 9       | GND           | Ground        | MCU ground                     |
| 10      | NC            |               | No connect                     |
| 11      | MR4_PTA2      | Bidirectional | Port A I/O – bit 2             |
| 12      | NC            |               | No connect                     |
| 13      | NC            |               | No connect                     |
| 14      | GND           | Ground        | MCU ground                     |
| 15      | MR4_PWM3      | Out           | Pulse width modulation – bit 3 |
| 16      | MR4_PWM4      | Out           | Pulse width modulation – bit 4 |
| 17      | MR4_PTC0      | Bidirectional | Port C I/O – bit 0             |
| 18      | MR4_PTB0      | Bidirectional | Port B I/O – bit 0             |
| 19      | MR4_PTC1      | Bidirectional | Port C I/O – bit 1             |
| 20      | NC            |               | No connect                     |
| 21      | NC            |               | No connect                     |
| 22      | NC            |               | No connect                     |
| 23      | MR4_PTB5      | Bidirectional | Port B I/O – bit 5             |
| 24      | NC            |               | No connect                     |
| 25      | MR4_PTA0      | Bidirectional | Port A I/O – bit 0             |
| 26      | NC            |               | No connect                     |
| 27      | GND           | Ground        | MCU ground                     |
| 28      | NC            |               | No connect                     |

**Table 3-3. MR4/8 Target Connector J5 (Continued)**

| Pin No. | Schematic NET                | Direction | Signal Description |
|---------|------------------------------|-----------|--------------------|
| 29      | NC                           |           | No connect         |
| 30      | NC                           |           | No connect         |
| 31      | NC                           |           | No connect         |
| 32      | GND                          | Ground    | MCU ground         |
| 33      | NC                           |           | No connect         |
| 34      | $\overline{\text{TGT\_IRQ}}$ | In        | External interrupt |
| 35      | NC                           |           | No connect         |
| 36      | GND                          | Ground    | MCU ground         |
| 37      | NC                           |           | No connect         |
| 38      | GND                          | Ground    | MCU ground         |
| 39      | NC                           |           | No connect         |
| 40      | GND                          | Ground    | MCU ground         |

**Table 3-4. MR4/8 Target Connector J6**

| Pin No. | Schematic NET | Direction     | Signal Description             |
|---------|---------------|---------------|--------------------------------|
| 1       | GND           | Ground        | MCU ground                     |
| 2       | MR4_PTA4      | Bidirectional | Port A I/O – bit 4             |
| 3       | MR4_PTA5      | Bidirectional | Port A I/O – bit 5             |
| 4       | GND           | Ground        | MCU ground                     |
| 5       | MR4_PTB3      | Bidirectional | Port B I/O – bit 3             |
| 6       | MR4_PTB4      | Bidirectional | Port B I/O – bit 4             |
| 7       | NC            |               | No connect                     |
| 8       | NC            |               | No connect                     |
| 9       | MR4_PTA3      | Bidirectional | Port A I/O – bit 3             |
| 10      | NC            |               | No connect                     |
| 11      | NC            |               | No connect                     |
| 12      | NC            |               | No connect                     |
| 13      | MR4_PWM1      | Out           | Pulse width modulation – bit 1 |
| 14      | MR4_PWM2      | Out           | Pulse width modulation – bit 2 |
| 15      | MR4_PWM5      | Out           | Pulse width modulation – bit 5 |
| 16      | MR4_PWM6      | Out           | Pulse width modulation – bit 6 |
| 17      | NC            |               | No connect                     |
| 18      | NC            |               | No connect                     |
| 19      | GND           | Ground        | MCU ground                     |
| 20      | NC            |               | No connect                     |
| 21      | NC            |               | No connect                     |
| 22      | NC            |               | No connect                     |
| 23      | MR4_PTB6      | Bidirectional | Port B I/O – bit 6             |
| 24      | GND           | Ground        | MCU ground                     |
| 25      | NC            |               | No connect                     |
| 26      | NC            |               | No connect                     |
| 27      | NC            |               | No connect                     |
| 28      | NC            |               | No connect                     |

**Table 3-4. MR4/8 Target Connector J6 (Continued)**

| Pin No. | Schematic NET                | Direction | Signal Description |
|---------|------------------------------|-----------|--------------------|
| 29      | NC                           |           | No connect         |
| 30      | NC                           |           | No connect         |
| 31      | NC                           |           | No connect         |
| 32      | NC                           |           | No connect         |
| 33      | NC                           |           | No connect         |
| 34      | MR8/4_TGT_CLK                | In        | External clock     |
| 35      | NC                           |           | No connect         |
| 36      | $\overline{\text{TGT\_RST}}$ | In or out | External reset     |
| 37      | NC                           |           | No connect         |
| 38      | GND                          | Ground    | MCU ground         |
| 39      | NC                           |           | No connect         |
| 40      | GND                          | Ground    | MCU ground         |

Table 3-5. MR16/32 MON08 Connector J7 Pin Assignments

| Pin No. | Mnemonic                    | Signal  |
|---------|-----------------------------|---|
| 1       | $\overline{\text{RST-OUT}}$ | TARGET SYSTEM RESET — Active-low, bidirectional signal from the target system to initiate an MRICS MCU reset                  |
| 2       | GND                         | GROUND  |
| 3       | $\overline{\text{RST-IN}}$  | TARGET SYSTEM RESET — Active-low, bidirectional signal from the target system to initiate an MRICS MCU reset                  |
| 4       | $\overline{\text{RST}}$     | RESET — Active-low, bidirectional signal from the MRICS MCU to initiate a target system reset                                 |
| 5       | $\overline{\text{TGT-IRQ}}$ | TARGET INTERRUPT REQUEST — Active-low input signal from the target that asynchronously provides an interrupt to the MCU       |
| 6       | $\overline{\text{IRQ}}$     | INTERRUPT REQUEST — Active-low input signal from the MRICS MCU that asynchronously provides an interrupt to the target system |
| 7       | TGT_PTA0                    | TARGET PORT A (bit 0) — General-purpose I/O signal from the target system   |
| 8       | MR32_PTA0                   | PORT A (bit 0) — General-purpose MCU I/O signal   |
| 9       | TGT_PTC2                    | TARGET PORT C (bit 2) — General-purpose I/O signal from the target system   |
| 10      | PTC2                        | PORT C (bit 2) — General-purpose MCU I/O signal   |
| 11      | TGT_PTC3                    | TARGET PORT C (bit 3) — General-purpose I/O signal from the target system   |
| 12      | PTC3                        | PORT C (bit 3) — General-purpose MCU I/O signal   |
| 13      | TGT_PTC4                    | TARGET PORT C (bit 4) — General-purpose I/O signal from the target system   |
| 14      | PTC4                        | PORT C (bit 4) — General-purpose MCU I/O signal   |
| 15      | NC                          | No connection   |
| 16      | NC                          | No connection   |

**Table 3-6. MR4/8 MON08 Connector J8 Pin Assignments**

| Pin No. | Mnemonic                    | Signal  |
|---------|-----------------------------|---|
| 1       | GND                         | GROUND  |
| 2       | NC                          | No connection   |
| 3       | MR4_PTBO                    | PORT B (bit 0) — General-purpose MCU I/O signal   |
| 4       | TGT_MR4_PTBO                | TARGET PORT B BIT 0 — General-purpose I/O signal  |
| 5       | MR4_PTB1                    | PORT B (bit 1) — General-purpose MCU I/O signal   |
| 6       | TGT_MR4_PTB1                | TARGET PORT B BIT 1 — General-purpose I/O signal  |
| 7       | $\overline{\text{IRQ}}$     | INTERRUPT REQUEST — Active-low input signal from the MRICS MCU that asynchronously provides an interrupt to the target system |
| 8       | $\overline{\text{TGT-IRQ}}$ | TARGET INTERRUPT REQUEST — Active-low input signal from the target that asynchronously provides an interrupt to the MCU       |
| 9       | $\overline{\text{RST}}$     | RESET — Active-low, bidirectional signal from the MRICS MCU to initiate a target system reset                                 |
| 10      | $\overline{\text{RST-IN}}$  | TARGET SYSTEM RESET — Active-low, bidirectional signal from the target system to initiate an MRICS MCU reset                  |
| 11      | NC                          | No connection   |
| 12      | NC                          | No connection   |
| 13      | NC                          | No connection   |
| 14      | NC                          | No connection   |
| 15      | NC                          | No connection   |
| 16      | NC                          | No connection   |

**Table 3-7. MR16/32 Target Connector J1 (Sheet 1 of 3)**

| Pin No. | Schematic NET                | Direction     | Signal Description |
|---------|------------------------------|---------------|--------------------|
| 1       | MR32_PTA2                    | Bidirectional | Port A I/O – bit 2 |
| 2       | MR32_PTA1                    | Bidirectional | Port A I/O – bit 1 |
| 3       | MR32_PTA3                    | Bidirectional | Port A I/O – bit 3 |
| 4       | MR32_PTA0                    | Bidirectional | Port A I/O – bit 0 |
| 5       | MR32_PTA4                    | Bidirectional | Port A I/O – bit 4 |
| 6       | GND                          | Ground        | MCU ground         |
| 7       | MR32_PTA5                    | Bidirectional | Port A I/O – bit 5 |
| 8       | None                         | NC            | No connection      |
| 9       | MR32_PTA6                    | Bidirectional | Port A I/O – bit 6 |
| 10      | TGT_CLK                      | In            | External clock     |
| 11      | MR32_PTA7                    | Bidirectional | Port A I/O – bit 7 |
| 12      | None                         | NC            | No connection      |
| 13      | MR32_PTB0                    | Bidirectional | Port B I/O – bit 0 |
| 14      | None                         | NC            | No connection      |
| 15      | MR32_PTB1                    | Bidirectional | Port B I/O – bit 1 |
| 16      | $\overline{\text{TGT\_RST}}$ | In or out     | External reset     |
| 17      | MR32_PTB2                    | Bidirectional | Port B I/O – bit 2 |
| 18      | $\overline{\text{TGT\_IRQ}}$ | In            | External interrupt |
| 19      | MR32_PTB3                    | Bidirectional | Port B I/O – bit 3 |
| 20      | PTF5                         | Bidirectional | Port F I/O – bit 5 |
| 21      | MR32_PTB4                    | Bidirectional | Port B I/O – bit 4 |
| 22      | PTF4                         | Bidirectional | Port F I/O – bit 4 |
| 23      | MR32_PTB5                    | Bidirectional | Port B I/O – bit 5 |
| 24      | GND                          | Ground        | MCU ground         |
| 25      | MR32_PTB6                    | Bidirectional | Port B I/O – bit 6 |
| 26      | None                         | NC            | No connection      |
| 27      | MR32_PTB7                    | Bidirectional | Port B I/O – bit 7 |
| 28      | PTE7                         | Bidirectional | Port E I/O – bit 7 |



**Table 3-7. MR16/32 Target Connector J1 (Sheet 2 of 3)**

| Pin No. | Schematic NET | Direction     | Signal Description             |
|---------|---------------|---------------|--------------------------------|
| 29      | None          | NC            | No connection                  |
| 30      | PTE6          | Bidirectional | Port E I/O – bit 6             |
| 31      | None          | NC            | No connection                  |
| 32      | PTE5          | Bidirectional | Port E I/O – bit 5             |
| 33      | GND           | Ground        | MCU ground                     |
| 34      | PTE4          | Bidirectional | Port E I/O – bit 4             |
| 35      | None          | NC            | No connection                  |
| 36      | PTE3          | Bidirectional | Port E I/O – bit 3             |
| 37      | PTC2          | Bidirectional | Port C I/O – bit 2             |
| 38      | None          | NC            | No connection                  |
| 39      | PTC3          | Bidirectional | Port C I/O – bit 3             |
| 40      | MR32_PWM6     | Out           | Pulse width modulation – bit 6 |
| 41      | PTC4          | Bidirectional | Port C I/O – bit 4             |
| 42      | MR32_PWM5     | Out           | Pulse width modulation – bit 5 |
| 43      | PTC5          | Bidirectional | Port C I/O – bit 5             |
| 44      | GND           | Ground        | MCU ground                     |
| 45      | PTC6          | Bidirectional | Port C I/O – bit 6             |
| 46      | MR32_PWM4     | Out           | Pulse width modulation – bit 4 |
| 47      | PTD0          | Bidirectional | Port D I/O – bit 0             |
| 48      | MR32_PWM3     | Out           | Pulse width modulation – bit 3 |
| 49      | PTD1          | Bidirectional | Port D I/O – bit 1             |
| 50      | MR32_PWM2     | Out           | Pulse width modulation – bit 2 |
| 51      | PTD2          | Bidirectional | Port D I/O – bit 2             |
| 52      | MR32_PWM1     | Out           | Pulse width modulation – bit 1 |
| 53      | PTD3          | Bidirectional | Port D I/O – bit 3             |
| 54      | PTD6          | Bidirectional | Port D I/O – bit 6             |

**Table 3-7. MR16/32 Target Connector J1 (Sheet 3 of 3)**

| <b>Pin No.</b> | <b>Schematic NET</b> | <b>Direction</b> | <b>Signal Description</b> |
|----------------|----------------------|------------------|---------------------------|
| 55             | PTD4                 | Bidirectional    | Port D I/O – bit 4        |
| 56             | PTD5                 | Bidirectional    | Port D I/O – bit 5        |
| 57             | GND                  | Ground           | MCU ground                |
| 58             | GND                  | Ground           | MCU ground                |
| 59             | GND                  | Ground           | MCU ground                |
| 60             | GND                  | Ground           | MCU ground                |

**Table 3-8. MR4/8 Target DIP Connector J11**

| Pin No. | Schematic NET                | Direction     | Signal Description             |
|---------|------------------------------|---------------|--------------------------------|
| 1       | None                         | NC            | No connection                  |
| 2       | $\overline{\text{TGT\_RST}}$ | In or out     | External reset                 |
| 3       | None                         | NC            | No connection                  |
| 4       | GND                          | Ground        | MCU ground                     |
| 5       | None                         | NC            | No connection                  |
| 6       | MR8/4_TGT_CLK                | In            | External clock                 |
| 7       | None                         | NC            | No connection                  |
| 8       | $\overline{\text{TGT\_IRQ}}$ | In            | External interrupt             |
| 9       | MR4_PWM1                     | Out           | Pulse width modulation – bit 1 |
| 10      | MR4_PWM2                     | Out           | Pulse width modulation – bit 2 |
| 11      | MR4_PWM3                     | Out           | Pulse width modulation – bit 3 |
| 12      | MR4_PWM4                     | Out           | Pulse width modulation – bit 4 |
| 13      | MR4_PWM5                     | Out           | Pulse width modulation – bit 5 |
| 14      | MR4_PWM6                     | Out           | Pulse width modulation – bit 6 |
| 15      | MR4_PTC0                     | Bidirectional | Port C I/O – bit 0             |
| 16      | MR4_PTB0                     | Bidirectional | Port B I/O – bit 0             |
| 17      | MR4_PTB1                     | Bidirectional | Port B I/O – bit 1             |
| 18      | MR4_PTB2                     | Bidirectional | Port B I/O – bit 2             |
| 19      | MR4_PTB3                     | Bidirectional | Port B I/O – bit 3             |
| 20      | MR4_PTB4                     | Bidirectional | Port B I/O – bit 4             |
| 21      | None                         | NC            | No connection                  |
| 22      | GND                          | Ground        | MCU ground                     |
| 23      | MR4_PTB5                     | Bidirectional | Port B I/O – bit 5             |
| 24      | MR4_PTB6                     | Bidirectional | Port B I/O – bit 6             |
| 25      | MR4_PTA0                     | Bidirectional | Port A I/O – bit 0             |
| 26      | MR4_PTA1                     | Bidirectional | Port A I/O – bit 1             |
| 27      | MR4_PTA2                     | Bidirectional | Port A I/O – bit 2             |
| 28      | MR4_PTA3                     | Bidirectional | Port A I/O – bit 3             |

Table 3-9. Power Connector J4 Pin Assignments

| Pin No. | Mnemonic | Signal  |
|---------|----------|---|
| 1       | 5VDC     | +5 VDC POWER — Input voltage (+5 Vdc @ 1.0 A) from the provided power supply used by the MRICS logic circuits |
| 2       | GND      | GROUND  |

Table 3-10. RS-232C Communication Connector J12 Pin Assignments

| Pin No. | Mnemonic | Signal   |
|---------|----------|--|
| 1       | NC       | NO CONNECT   |
| 2       | RXD      | RECEIVE DATA — Output for sending serial data to the DTE device                                |
| 3       | TXD      | TRANSMIT DATA — Input for receiving serial data output from the DTE device                     |
| 4       | DTR      | DATA TERMINAL READY — Input for receiving on-line/in-service/active status from the DTE device |
| 5       | GND      | GROUND   |
| 6       | NC       | NO CONNECT   |
| 7       | NC       | NO CONNECT   |
| 8       | NC       | NO CONNECT   |
| 9       | NC       | NO CONNECT   |

### 3.3 Target-Cable Pin Assignments

The following tables describe the pin assignments for these cables:

- Flex target cable for use with the MR16/32 56-pin SDIP and 64-pin QFP target head adapters
- Flex target cable for use with the MR4/8 28-pin DIP and 32-pin QFP target head adapters
- Target MON08 cable

**Table 3-11. Flex Target Cable (M68CBL05C) for QFP Target Head Adapter B**

| QFP Package (UX1) Pin No. | M68ICS08MR Board Label | MR/32 MCU Signal Name | QFP Package (UX1) Pin No. | M68ICS08MR Board Label | MR/32 MCU Signal Name |
|---------------------------|------------------------|-----------------------|---------------------------|------------------------|-----------------------|
| 1                         | MR32_PTA2              | PTA2                  | 29                        | PTD5                   | PTD5/IS2#             |
| 2                         | MR32_PTA3              | PTA3                  | 30                        | PTD6                   | PTD6/IS3#             |
| 3                         | MR32_PTA4              | PTA4                  | 31                        | MR32_PWM1              | PWM1                  |
| 4                         | MR32_PTA5              | PTA5                  | 32                        | MR32_PWM2              | PWM2                  |
| 5                         | MR32_PTA6              | PTA6                  | 33                        | MR32_PWM3              | PWM3                  |
| 6                         | MR32_PTA7              | PTA7                  | 34                        | MR32_PWM4              | PWM4                  |
| 7                         | MR32_PTB0              | PTB0/ATD0             | 35                        | GND                    | PWMGND                |
| 8                         | MR32_PTB1              | PTB1/ATD1             | 36                        | MR32_PWM5              | PWM5                  |
| 9                         | MR32_PTB2              | PTB2/ATD2             | 37                        | MR32_PWM6              | PWM6                  |
| 10                        | MR32_PTB3              | PTB3/ATD3             | 38                        | NC                     | No Connect            |
| 11                        | MR32_PTB4              | PTB4/ATD4             | 39                        | PTE3                   | PTE3/TCLKA            |
| 12                        | MR32_PTB5              | PTB5/ATD5             | 40                        | PTE4                   | PTE4/TCLK0A           |
| 13                        | MR32_PTB6              | PTB6/ATD6             | 41                        | PTE5                   | PTE5/TCH1A            |
| 14                        | MR32_PTB7              | PTB7/ATD7             | 42                        | PTE6                   | PTE6/TCH2A            |
| 15                        |                        |                       | 43                        | PTE7                   | PTE7/TCH3A            |
| 16                        | VDD_SW                 | VDDAD                 | 44                        | VDD_SW                 | VDD                   |
| 17                        | GND                    | VSSAD/VREFL           | 45                        | GND                    | VSS                   |
| 18                        | VDD_SW                 | VREFH                 | 46                        | PTF4                   | PTF4/RXD              |
| 19                        | PTC2                   | PTC2                  | 47                        | PTF5                   | PTF5/TXD              |
| 20                        | PTC3                   | PTC3                  | 48                        | IRQ#                   | IRQ#                  |
| 21                        | PTC4                   | PTC4                  | 49                        | RST#                   | RST#                  |
| 22                        | PTC5                   | PTC5                  | 50                        | VDD_SW                 | VDDA                  |
| 23                        | PTC6                   | PTC6                  | 51                        | GND                    | CGMXFC                |
| 24                        | PTD0                   | PTD0/FAULT1           | 52                        | 4.9152MHz              | OSC1                  |
| 25                        | PTD1                   | PTD1/FAULT2           | 53                        | No Connect             | OSC2                  |
| 26                        | PTD2                   | PTD2/FAULT3           | 54                        | GND                    | VSSA                  |
| 27                        | PTD3                   | PTD3/FAULT4           | 55                        | MR32_PTA0              | PTA0                  |
| 28                        | PTD4                   | PTD4/IS1#             | 56                        | MR32_PTA1              | PTA1                  |

**Table 3-12. Flex Target Cable (M68CBL05C) for DIP Target Head Adapter A**

| DIP Package (UX2) Pin No. | M68ICS08MR Board Label | MR4/8 MCU Signal Name | DIP Package (UX2) Pin No. | M68ICS08MR Board Label | MR4/8 MCU Signal Name |
|---------------------------|------------------------|-----------------------|---------------------------|------------------------|-----------------------|
| 1                         | VDD_SW                 | VREFH                 | 15                        | MR4_PTC0               | PTC0/FAULT1           |
| 2                         | RST#                   | RST#                  | 16                        | MR4_PTB0               | PTB0/RXD              |
| 3                         | VDD_SW                 | VDDA                  | 17                        | MR4_PTB1               | PTB1/TXD              |
| 4                         | GND                    | VSSA                  | 18                        | MR4_PTB2               | PTB2/TCLK             |
| 5                         | No Connect             | OSC2                  | 19                        | MR4_PTB3               | PTB3/TCHD             |
| 6                         | 4.0000MHz              | OSC1                  | 20                        | MR4_PTB4               | PTB4/TCH1             |
| 7                         | GND                    | CGMXFC                | 21                        | VDD_SW                 | VDD                   |
| 8                         | IRQ#                   | IRQ#                  | 22                        | GND                    | VSS                   |
| 9                         | MR4_PWM1               | PWM1                  | 23                        | MR4_PTB5               | PTB5/TCH2             |
| 10                        | MR4_PWM2               | PWM2                  | 24                        | MR4_PTB6               | PTB6/TCH3             |
| 11                        | MR4_PWM3               | PWM3                  | 25                        | MR4_PTA0               | PTA0/ATD0             |
| 12                        | MR4_PWM4               | PWM4                  | 26                        | MR4_PTA1               | PTA1/ATD1             |
| 13                        | MR4_PWM5               | PWM5                  | 27                        | MR4_PTA2               | PTA2/ATD2             |
| 14                        | MR4_PWM6               | PWM6                  | 28                        | MR4_PTA3               | PTA3/ATD3             |

**Table 3-13. Flex Target Cable (M68CBL05C) for QFP Target Head Adapter B**

| QFP Package (UX3) Pin No. | M68ICS08MR Board Label | MR32 MCU Signal Name | QFP Package (UX3) Pin No. | M68ICS08MR Board Label | MR32 MCU Signal Name |
|---------------------------|------------------------|----------------------|---------------------------|------------------------|----------------------|
| 1                         | MR32_PT B2             | PTB2/ATD2            | 33                        | PTE1                   | PTE1/TCH0B           |
| 2                         | MR32_PT B3             | PTB3/ATD3            | 34                        | PTE2                   | PTE2/TCH1B           |
| 3                         | MR32_PT B4             | PTB4/ATD4            | 35                        | PTE3                   | PTE3/TCLKA           |
| 4                         | MR32_PT B5             | PTB5/ATD5            | 36                        | PTE4                   | PTE4/TCLK0A          |
| 5                         | MR32_PT B6             | PTB6/ATD6            | 37                        | PTE5                   | PTE5/TCH1A           |
| 6                         | MR32_PT B7             | PTB6/ATD7            | 38                        | PTE6                   | PTE6/TCH2A           |
| 7                         | PTC0                   | PTC0/FAULT1          | 39                        | PTE7                   | PTE7/TCH3A           |
| 8                         | PTC1                   | PTC1/FAULT4          | 40                        | VDD_SW                 | VDD                  |
| 9                         | VDD_SW                 | VDDAD                | 41                        | GND                    | VSS                  |
| 10                        | GND                    | VSSAD                | 42                        | PTF0                   | PTF0/SPSCK           |
| 11                        | GND                    | VREFL                | 43                        | PTF1                   | PTF1/SS#             |
| 12                        | VDD_SW                 | VREFH                | 44                        | PTF2                   | PTF2/MOSI            |
| 13                        | PTC2                   | PTC2                 | 45                        | PTF3                   | PTF3/MISO            |
| 14                        | PTC3                   | PTC3                 | 46                        | PTF4                   | PTF4/RXD             |
| 15                        | PTC4                   | PTC4                 | 47                        | PTF5                   | PTF5/TXD             |
| 16                        | PTC5                   | PTC5                 | 48                        | IRQ#                   | IRQ#                 |
| 17                        | PTC6                   | PTC6                 | 49                        | RST#                   | RST#                 |
| 18                        | PTD0                   | PTD0/FAULT1          | 50                        | VDD_SW                 | VDDA                 |
| 19                        | PTD1                   | PTD1/FAULT2          | 51                        | GND                    | CGMXFC               |
| 20                        | PTD2                   | PTD2/FAULT3          | 52                        | 4.9152MHz              | OSC1                 |
| 21                        | PTD3                   | PTD3/FAULT4          | 53                        | OSC2                   | No Connect           |
| 22                        | PTD4                   | PTD4/IS1#            | 54                        | VSSA                   | GND                  |
| 23                        | PTD5                   | PTD5/IS2#            | 55                        | MR32_PTA0              | PTA0                 |
| 24                        | PTD6                   | PTD6/IS3#            | 56                        | MR32_PTA1              | PTA1                 |
| 25                        | MR32_PWM1              | PWM1                 | 57                        | MR32_PTA2              | PTA2                 |
| 26                        | MR32_PWM2              | PWM2                 | 58                        | MR32_PTA3              | PTA3                 |
| 27                        | MR32_PWM3              | PWM3                 | 59                        | MR32_PTA4              | PTA4                 |
| 28                        | MR32_PWM4              | PWM4                 | 60                        | MR32_PTA5              | PTA5                 |
| 29                        | GND                    | PWMGND               | 61                        | MR32_PTA6              | PTA6                 |
| 30                        | MR32_PWM5              | PWM5                 | 62                        | MR32_PTA7              | PTA6                 |
| 31                        | MR32_PWM6              | PWM6                 | 63                        | MR32_PT B0             | PTB0/ATD0            |
| 32                        | PTE0                   | PTE0/CLKB            | 64                        | MR32_PT B1             | PTB1/ATD1            |

**Table 3-14. Flex Target Cable (M68CBL05C) for DIP/QFP Target Head Adapter B**

| QFP Package (UX4) Pin No. | M68ICS08MR Board Label | MR4/8 MCU Signal Name | QFP Package (UX4) Pin No. | M68ICS08MR Board Label | MR4/8 MCU Signal Name |
|---------------------------|------------------------|-----------------------|---------------------------|------------------------|-----------------------|
| 1                         | VSSA                   | GND                   | 17                        | MR4_PT3                | PTB3/TCHD             |
| 2                         | No Connect             | OSC2                  | 18                        | MR4_PT4                | PTB4/TCH1             |
| 3                         | 4.0000MHz              | OSC1                  | 19                        | VDD_SW                 | VDD                   |
| 4                         | GND                    | CGMXFC                | 20                        | GND                    | VSS                   |
| 5                         | IRQ#                   | IRQ#                  | 21                        | MR4_PT5                | PTB5/TCH2             |
| 6                         | MR4_PWM1               | PWM1                  | 22                        | MR4_PT6                | PTB6/TCH3             |
| 7                         | MR4_PWM2               | PWM2                  | 23                        | MR4_PTA0               | PTA0/ATD0             |
| 8                         | MR4_PWM3               | PWM3                  | 24                        | MR4_PTA1               | PTA1/ATD1             |
| 9                         | MR4_PWM4               | PWM4                  | 25                        | MR4_PTA2               | PTA2/ATD2             |
| 10                        | MR4_PWM5               | PWM5                  | 26                        | MR4_PTA3               | PTA3/ATD3             |
| 11                        | MR4_PWM6               | PWM6                  | 27                        | MR4_PTA4               | PTA4/ATD4             |
| 12                        | MR4_PTC0               | PTC0/FAULT1           | 28                        | MR4_PTA5               | PTA5/ATD5             |
| 13                        | MR4_PTC1               | PTC1/FAULT4           | 29                        | MR4_PTA6               | PTA6/ATD6             |
| 14                        | MR4_PT0                | PTB0/RXD              | 30                        | VDD_SW                 | VREFH                 |
| 15                        | MR4_PT1                | PTB1/TXD              | 31                        | RST#                   | RST#                  |
| 16                        | MR4_PT2                | PTB2/TCLK             | 32                        | VDD_SW                 | VDDA                  |



### 3.4 Parts List

**Table 3-15. Bill of Materials (Sheet 1 of 3)**

| Reference Designator  | Description                                       | Manufacturer | Part Number      |
|---|---|--------------|------------------|
|   | Printed circuit board assembly                    |              | 01-RE10033W01    |
|   | Test procedure, ICS08MR                           |              | 12ASE10033W      |
|   | Test fixture, ICS08MR                             |              | 81ASE10033W      |
|   | Printed wiring board, ICS08MR                     |              | 84-RE10033W01    |
| -   | Feet Rubber 0.5-inch tapered squares              | Fastex       | 4009-00-5072     |
| C1-C4, C7, C9-C14, C17, C18, C20-C23, C25-C36, C38, C39, C41, C42 | Capacitor, 0.1 $\mu$ F, +80–20, 50 V, Z5U, C0805  | AVX          | 08055E104ZAT2A   |
| C5, C16   | Capacitor, tantalum, 47 $\mu$ F, 20%, 16 V, C6032 | AVX          | TPSD476M016R0150 |
| C6, C19   | Capacitor, tantalum, 10 $\mu$ F, 20%, 16 V, C6032 | AVX          | TAJC106M016      |
| C8, C24, C37, C40   | Capacitor, 22000 pF, 20%, 16 V, X7R, C0805        | AVX          | 0805YC223MAT2A   |
| C43-C46   | Capacitor, tantalum, 1 $\mu$ F, 20%, 16 V, C3216  | AVX          | TAJC106M016      |
| C15   | Capacitor, 560 pF, 50 V, COG, C0805               | AVX          | 08055A561KAT2A   |
| D1  | Diode, zener, 1SMA6.0AT3, SMA                     | Motorola     | 1SMA6.0AT3       |
| D2, D4  | Diode, Schottky, MBRA130, SMA                     | Motorola     | MBRA130          |
| D3  | Diode, Schottky, MBRA0520, SOD-123                | Motorola     | MBRA0520         |
| DS1   | LED, green, 5 mm, T1-3/4                          | Dialight     | 521-9173         |
| DS2   | LED, yellow, 5 mm, T1-3/4                         | Dialight     | 521-9174         |
| F1  | Fuse, 0.5 A, 250 V, 5X20 mm, FAST                 | Schurter     | 34.1513          |
| J1  | Connector, 60-pin, ribbon, with ejector           | Amp          | 1-499922-1       |
| J11   | Socket, 28-pin DIP, machine-pin, DIP28-600        | Augat        | 828-AG11D        |
| J12   | Connector, DE, R/A, socket                        | Cinch        | DEKL-9SAT-F1     |
| J2, J3, J5, J6  | Header, 2 x 20, 100, shrouded                     | 3M           | 2540-6002-UG     |

**Table 3-15. Bill of Materials (Sheet 2 of 3)**

| Reference Designator                                     | Description                                       | Manufacturer | Part Number   |
|--|---|--------------|---------------|
| J4   | Connector, PWR_JACK, 2.5 mm, center               | Cui Stack    | PJ-202B       |
| J7, J8   | Header, 8 x 2, 100, shrouded                      | 3M           | 2516-6002-UG  |
| L1   | Inductor, 180 $\mu$ H, L1812                      | Murata       | LQH4N181K04   |
| L2   | Inductor, 10 $\mu$ H, L1206                       | Murata       | LQH1N100K04   |
| L3-L15   | Inductor, ferrite, 170 $\Omega$ , L1206           | Murata       | BLM31A700S    |
| Q1, Q3   | Transistor, PFET, MMBF0201, SOT-23                | Motorola     | MMBF0201      |
| Q2   | Transistor, PFET, MMFT5P03, SOT-223               | Motorola     | MMFT5P03HD    |
| Q4   | Transistor, NPN, MMBT3904, SOT-23                 | Motorola     | MMBT3904      |
| R1, R25  | Resistor, 100 k, 5%, 1/8W, R0805                  | Dale         | CRCW0805104J  |
| R2, R12, R31   | Resistor, 5 k, 5%, R0805                          | Dale         | CRCW0805332J  |
| R20, R22, R23  | Resistor, 10 $\Omega$ , 1%, R1206                 | Dale         | CRCW120610R0F |
| R21  | Resistor, 59.0 k, 1%, R0805                       | Dale         | CRCW08055902F |
| R24  | Resistor, 150 $\Omega$ , 1%, R0805                | Dale         | CRCW08051500F |
| R3, R4, R6-R11, R13-R17, R19, R26-R30, R32, R34, R36-R38 | Resistor, 10 k, 5%, R0805                         | Dale         | CRCW0805103J  |
| R33, R35   | Resistor, 33 $\Omega$ , 5%, 1/8W, R0805           | Dale         | CRCW0805330J  |
| R5, R18  | Resistor, 470 $\Omega$ , 5%, R0805                | Dale         | CRCW0805471J  |
| U10  | IC, 12-bit, ripple, AC4040, SO-14                 | Fairchild    | MM74AC4040    |
| U11  | IC, 5 V, supervisor, SOT-223                      | Dallas Semi  | DS1233Z-5     |
| U13  | IC, MC34063A, SO8                                 | Motorola     | MC34063AD     |
| U14  | IC, buffer, three-state, SO14                     | Motorola     | MC74ACT125D   |
| U16  | IC, LOW_POWER, RS232 driver, SO16W                | Linear Tech  | LT1181ACSW    |
| U5, U12, U15   | IC, hex, inverter, 74AC05, SOIC-14                | Motorola     | MC74AC05D     |
| U6   | IC, NC7SZ38, SOT23-5                              | Fairchild    | NC7SZ38M5     |
| U7   | IC, NC7SZ32, SOT23-5                              | Fairchild    | NC7SZ32M5     |
| U8   | IC, tripple, 2:1, multiplexor/demultiplexor, SO16 | Motorola     | MC74LVX8053D  |

**Table 3-15. Bill of Materials (Sheet 3 of 3)**

| Reference Designator | Description                                   | Manufacturer       | Part Number       |
|----------------------|---|--------------------|-------------------|
| U9                   | IC, 74AC00, quad NAND, SO-14                  | Motorola           | MC74AC00D         |
| W1-W7, J9, J10       | HDR, 3X1, 0.23", GOLD_PLATED                  | 3M                 | 2403-6112TG       |
| XF1                  | Fuse, holder, 5 x 20, 3AC                     | Schurter           | ODG 0031.8231     |
| XU1                  | Socket, 56-pin SDIP                           | Berg               | DIP 70-6056-340B  |
| XU2                  | Socket, 64-pin QFP, clamshell                 | Yamichi            | IC51-0644-824-1   |
| XU3                  | Socket, 32-pin QFP,<br>YAM_ICS51-0324-1498    | Yamichi            | ICS51-0324-1498   |
| XU4                  | Socket, 28-pin DIP, SCREW_MACH                | Robinson<br>Nugent | ICE-286-S-TG30    |
| XW1-XW7              | Shunt, with handle                            | Amp                | 881545-1          |
| XY1, XY2             | Socket, 14-pin DIP, machine-pin,<br>DIP14-300 | Augat              | 814-AG11D         |
| Y1                   | Oscillator, 4.9152 MHz, DIP8                  | Epson              | SG-531P-4.9152MC2 |
| Y2                   | Oscillator, 4.000 MHz, DIP8                   | Epson              | SG-531P-4.000MC2  |

### 3.5 MRICS Printed Circuit Board Layout and Schematic Diagrams

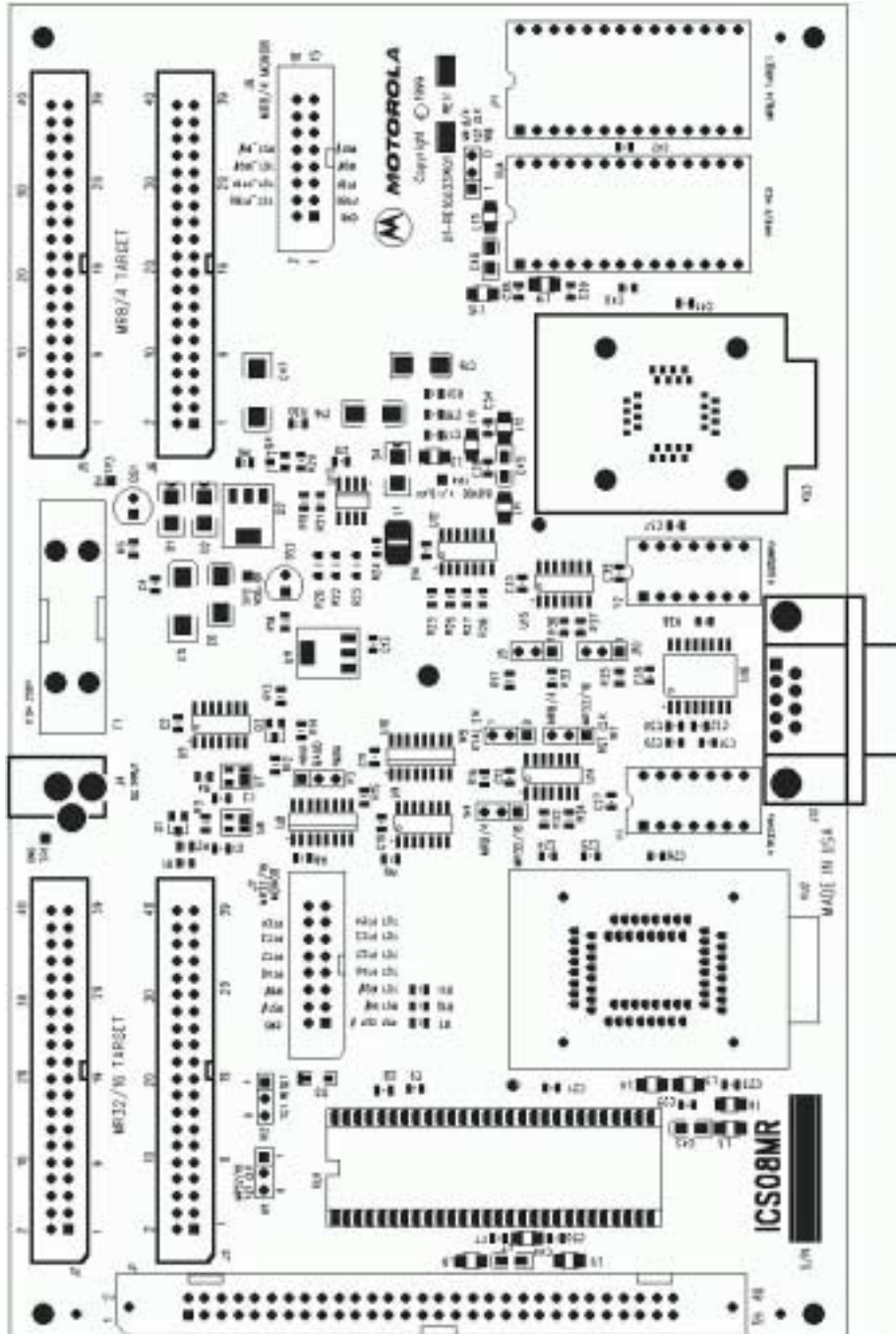
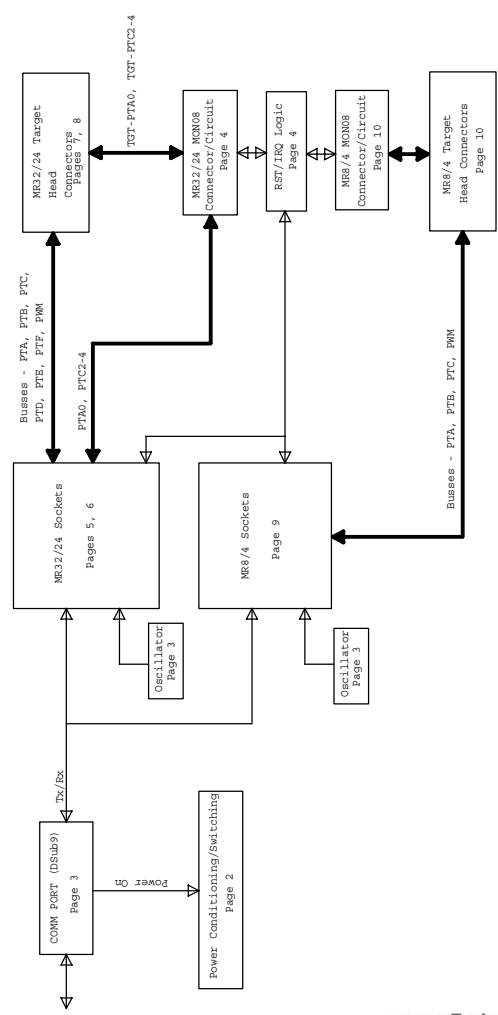


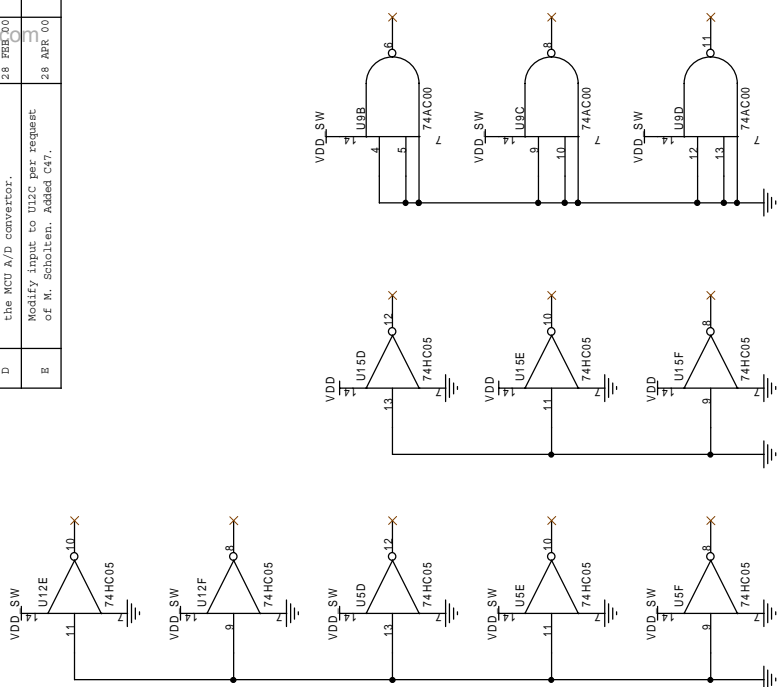
Figure 3-1. MRICS Board Layout

**NOTES:**

- UNLESS OTHERWISE SPECIFIED:  
RESISTORS ARE IN OHMS, 5%, 1/10W  
CAPACITORS ARE IN MICROFARADS, 50V
- DEVICE TYPE NUMBER IS FOR REFERENCE  
ONLY THE NUMBER VARIES WITH THE  
PART MANUFACTURER.
- SPECIAL SYMBOL USAGE:  
# DENOTES ACTIVE LOW SIGNAL.  
[ ] DENOTES VECTORED SIGNAL.
- INTERPRET DIAGRAM IN ACCORDANCE WITH  
ANSI SPECIFICATIONS WITH THE  
EXCEPTION OF LOGIC BLOCK SYMBOLLOGY.



**SPARE GATES**



| REV | DESCRIPTION   | DATE      | BY |
|-----|---|-----------|----|
| 0   | RELEASE TO LAYOUT   |           |    |
| A   | BACK ANNOTATE REEDES FROM LAYOUT  | 11/10/99  |    |
| B   | Change Power Control and update layout. BACK ANNOTATE REFERENCE DESIGNATORS FROM LAYOUT | 7 JAN00   |    |
| C   | Change pin-outs for PTB and PTE1 on MR4/8 Target Head Connectors.                       | 11 FEB00  |    |
| D   | Modify power connections for the MCI A/D converter.                                     | 28 FEB00  |    |
| E   | Modify input to U12C per request of M. Scholten. Added C47.                             | 28 APR 00 |    |

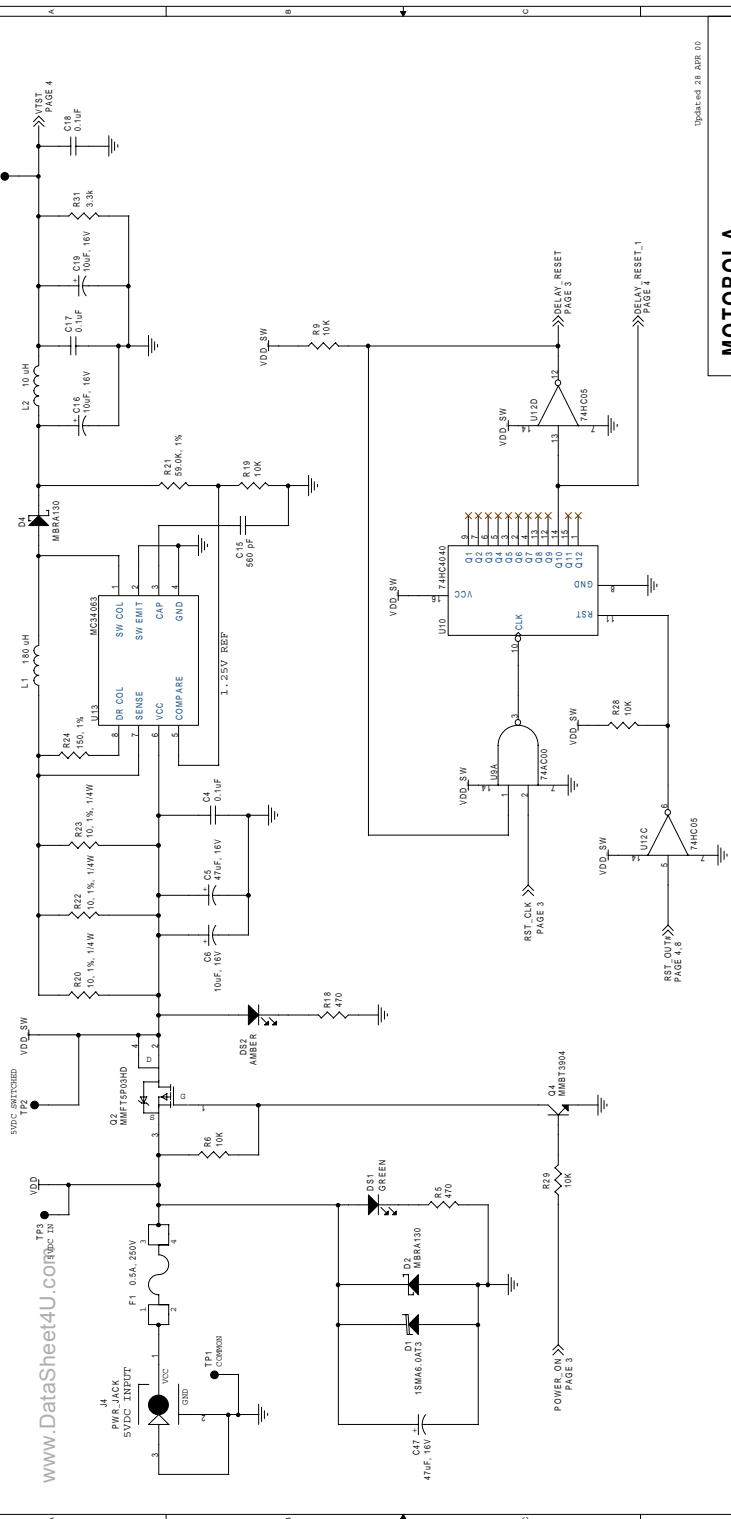
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 CHECKED:  
 APPROVED:  
 DATE: **9/99**  
 DATE:  
 DATE:

**MOTOROLA**  
 SEMICONDUCTOR PRODUCTS SECTOR  
 6501 WILLIAM CANNON DRIVE WEST  
 AUSTIN, TX 78755 USA

Title: **IN CIRCUIT SIMULATOR - ICS08MR**  
 Size: **B**  
 Dwg. No.: **63BSE10033W**  
 Rev: **E**

TP4  
8.4VDC +/-0.0V TEST

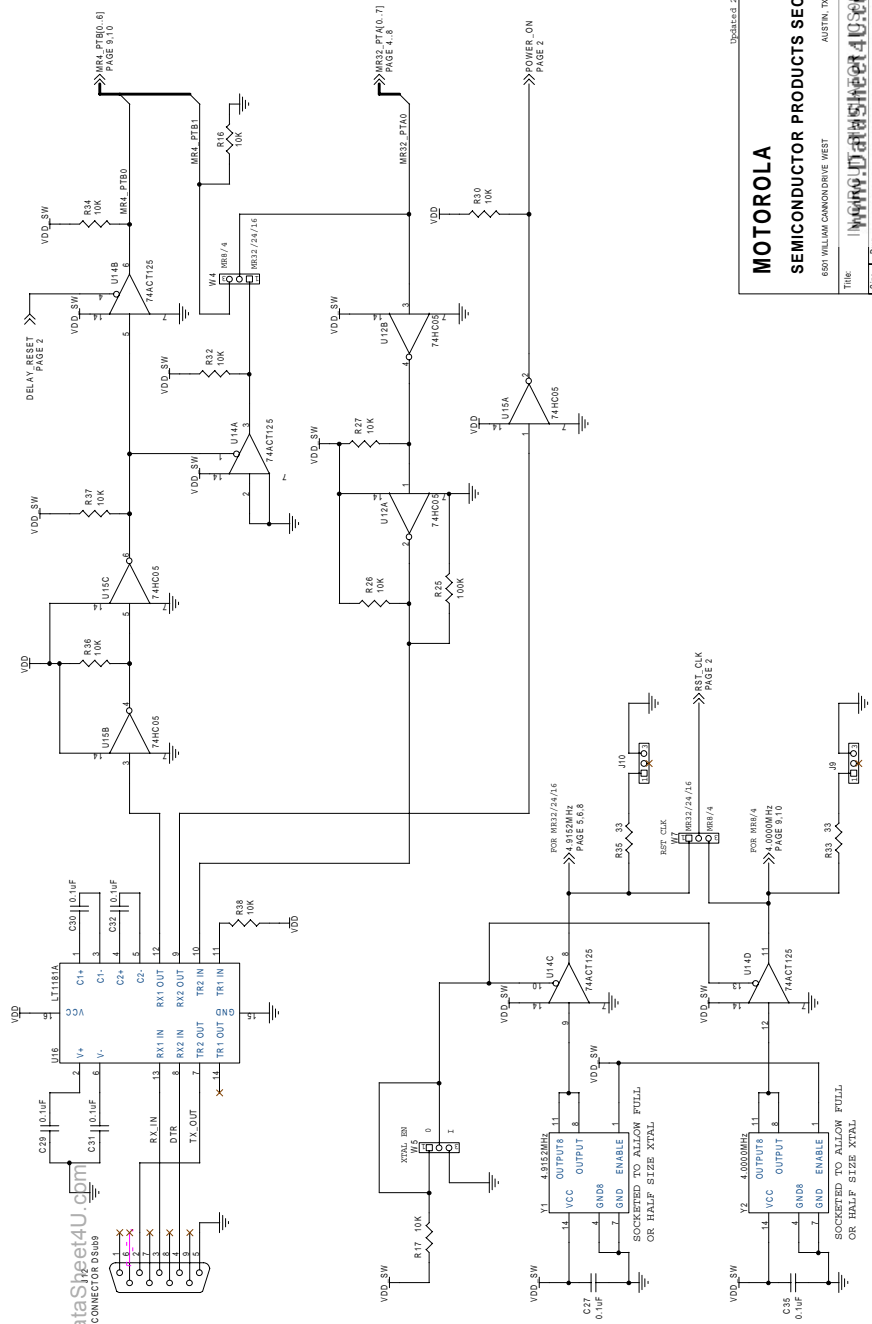


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| Title     | INTEGRATED CIRCUITS |
| Size      | 1000                |
| Rev.      | 1                   |
| Doc. No.  | 63BSE10033W         |
| Doc. ID   | 63BSE10033W         |
| Doc. Rev. | 1                   |
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| Doc. Rev. | 1                   |



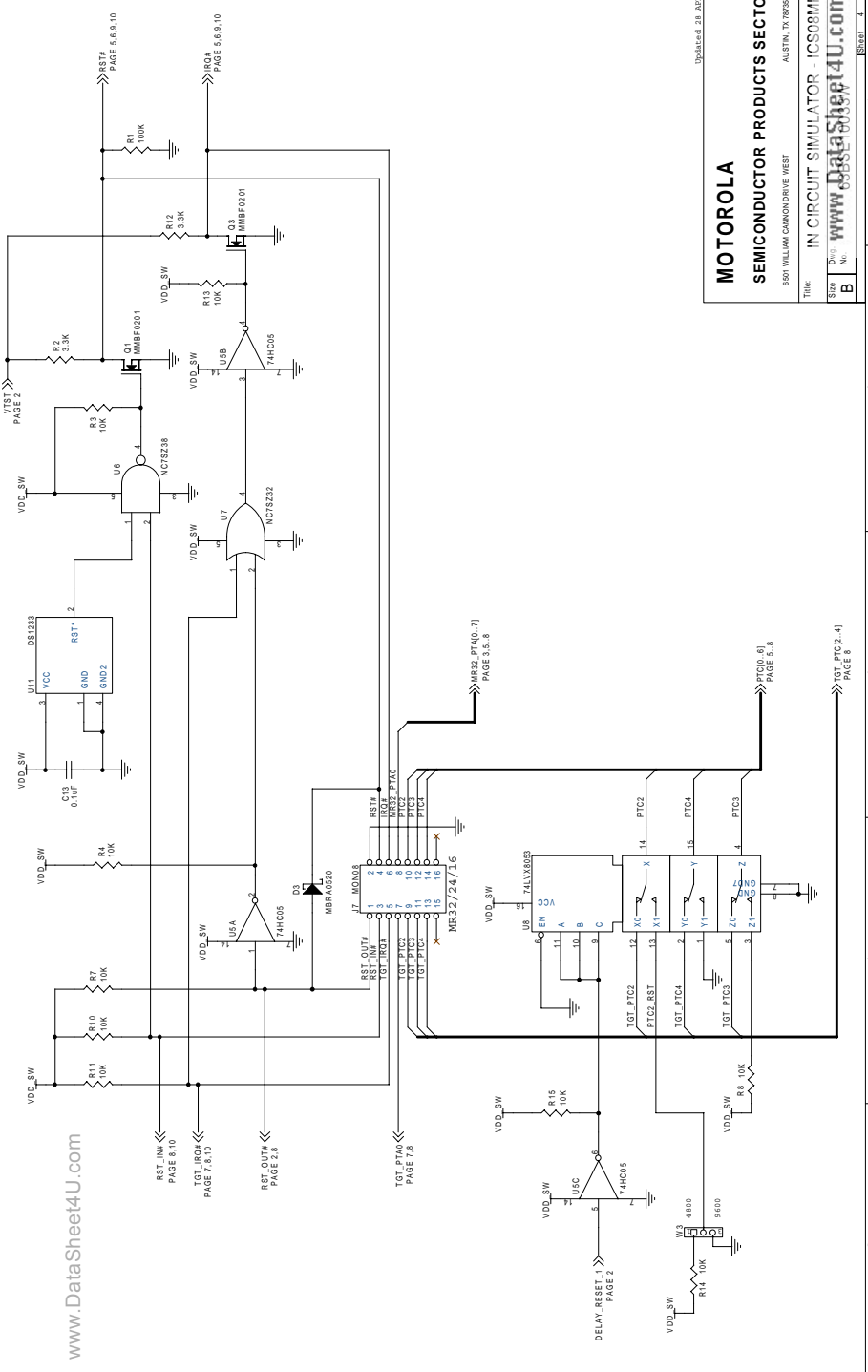
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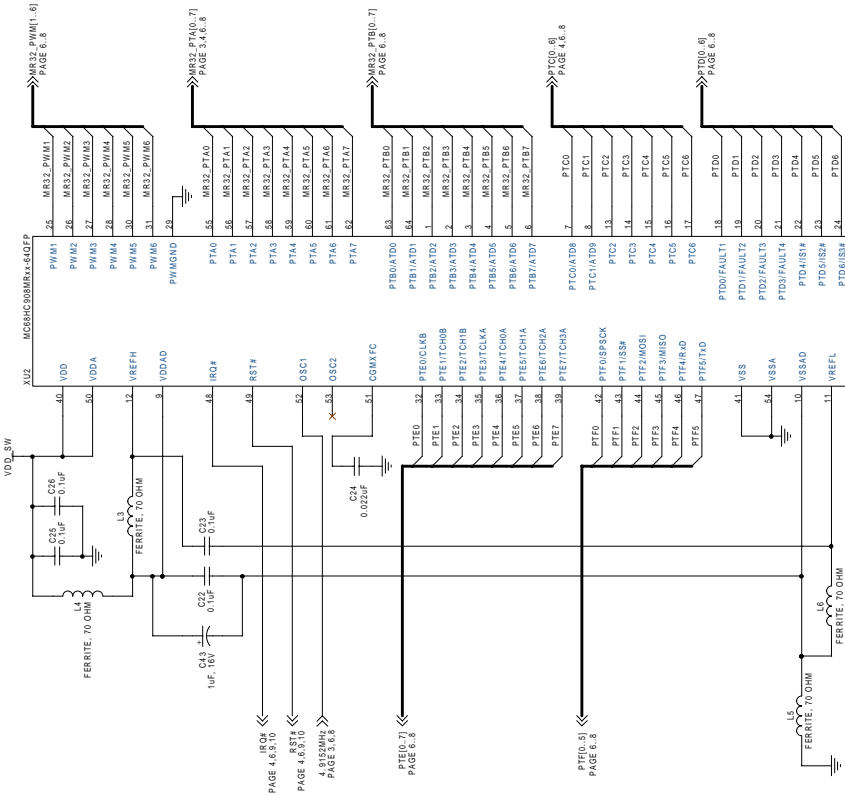
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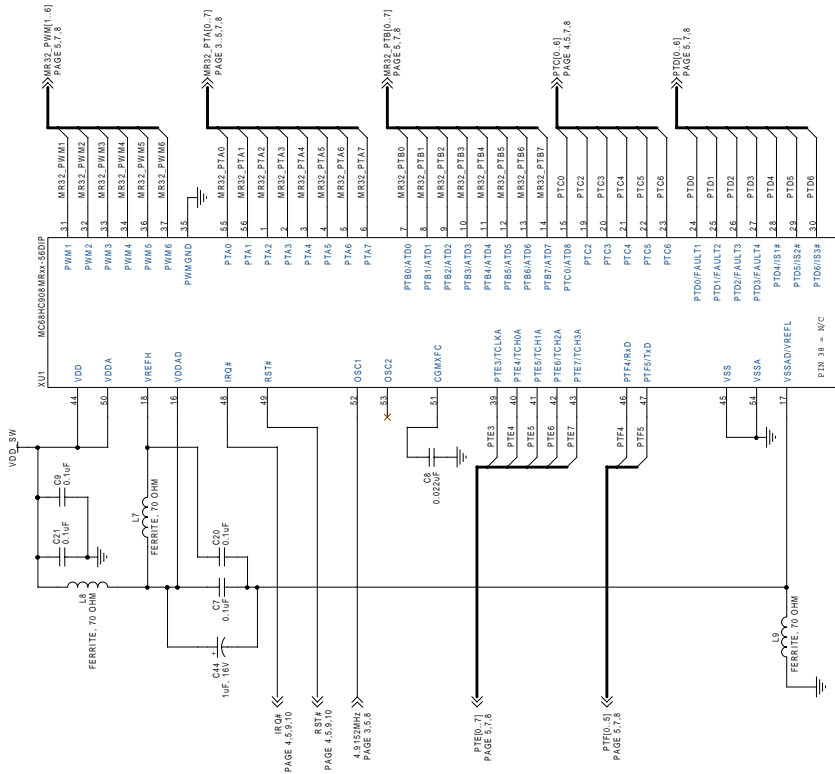
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 650 WILLIAM CANNON DRIVE WEST  
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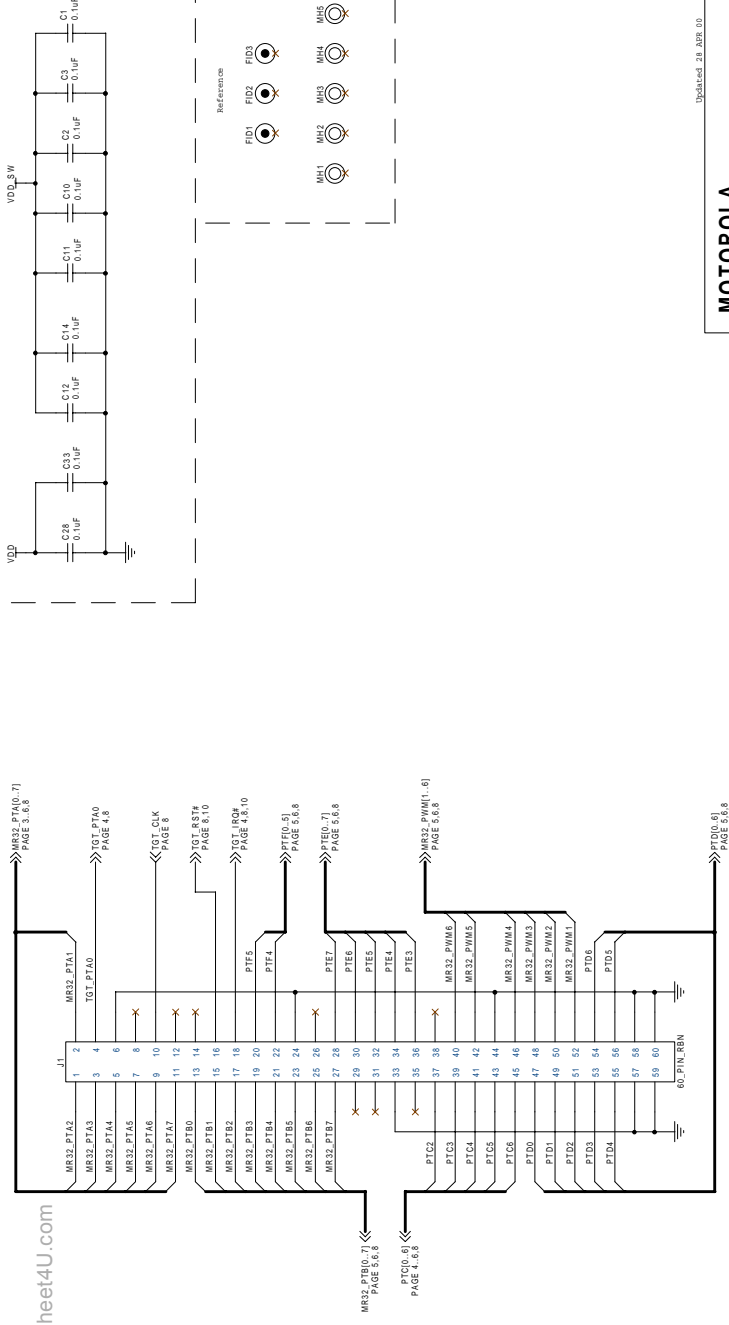


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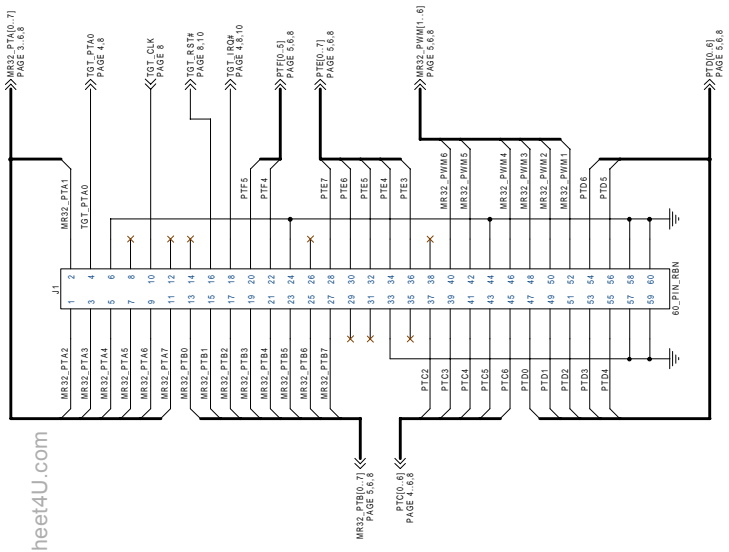


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VDD\_SW

VDD

Reference



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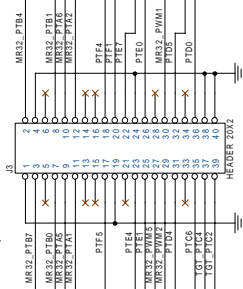
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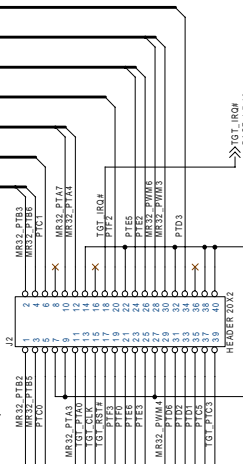
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- PTF0..4I
- PTF0..4I
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- TGT\_PTB4..4I
- PAGE 4

MR32/16 TARGET HEADER A



MR32/16 TARGET HEADER B



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TGT\_RST# PAGE 7,10

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690 WILLIAM CANNON DRIVE WEST

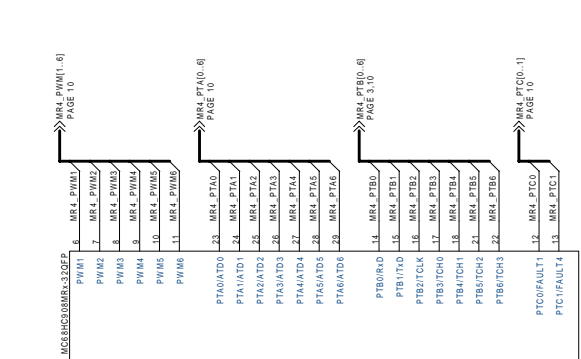
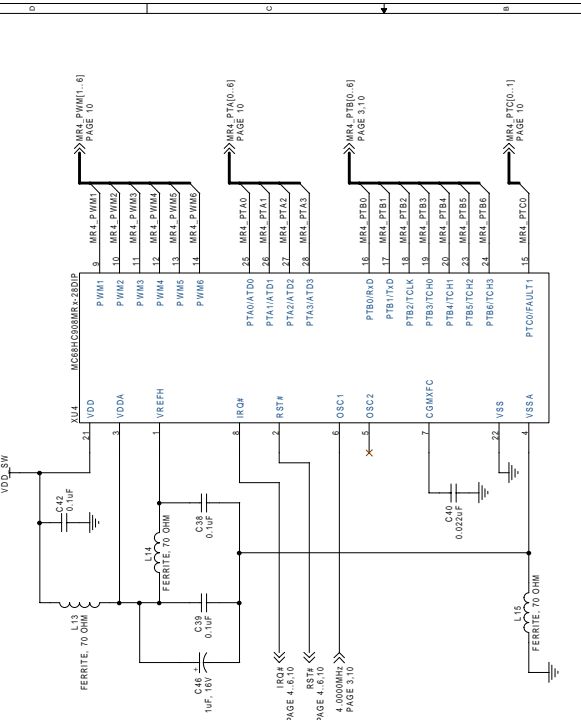
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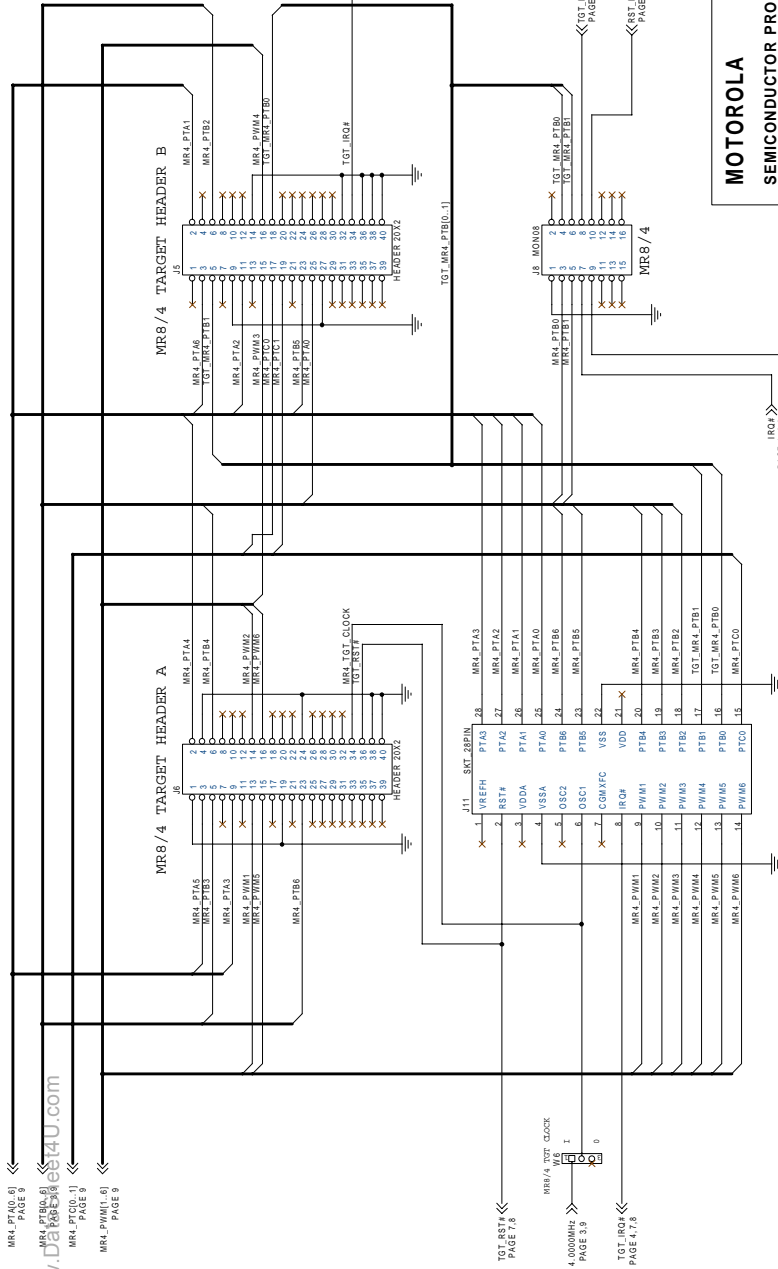
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MR4\_PT40\_6] PAGE 9  
 MR4\_PT80\_6] PAGE 9  
 MR4\_PT00\_1] PAGE 9  
 MR4\_PWH1\_6] PAGE 9

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 Part No.: **www.DataSheet4U.com**

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 RST# PAGE 4, 6, 9

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MR8/4 TARGET HEADER B

MR8/4 TARGET HEADER A

TGT\_MR4\_PT80\_1]

MR8/4

HEADER 20V2

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## User's Manual — M68ICS08MR In-Circuit Simulator

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# Section 4. Using the MON08 Interface

## 4.1 Introduction

The MON08 debugging interface is used to debug and program an MCU that is installed on your target application. To facilitate this operation, your target board MCU must be connected to the appropriate MRICS's MON08 connector by a MON08 interface cable. This section explains how to accomplish the MON08 interface connection.

## 4.2 Target System Header Placement

Two headers are available for use on the target board, however only one is used at a time for a given application. The header used is dependent upon which MCU is selected for installation.

- MR16/32 — 16-pin header, such as Berg Electronics part number 67997-616, installed in J7 (**Table 4-1**)
- MR4/8 — 16-pin header, such as Berg Electronics part number 67997-616, installed in J8 (**Table 4-2**)

**Table 4-1. MR16/32 MON08 Target System Connector J7**

| Pin No. | M68ICS08MR Label            | Direction      | Target System Connection  |
|---------|-----------------------------|----------------|---|
| 1       | $\overline{\text{RST-OUT}}$ | Out to target  | Connect to logic that is to receive the $\overline{\text{RST}}$ signal.   |
| 2       | GND                         | Ground         | Connect to ground ( $V_{SS}$ ).   |
| 3       | $\overline{\text{RST-IN}}$  | In from target | Connect to all logic that generates resets.   |
| 4       | $\overline{\text{RST}}$     | Bidirectional  | Connect to MCU $\overline{\text{RST}}$ pin and P1 pin 1. No other target-system logic should be tied to this signal. It will swing from 0 to +8.6 Vdc.                  |
| 5       | $\overline{\text{TGT-IRQ}}$ | In from target | Connect to logic that generates interrupts.   |
| 6       | $\overline{\text{IRQ}}$     | Out to target  | Connect to MCU $\overline{\text{IRQ}}$ pin. No other target-system logic should be tied to this signal. It will swing from 0 to +8.6 Vdc.                               |
| 7       | TGT-PTA0                    | Bidirectional  | Connect to user circuit that would normally be connected to PTA0 on the MCU. This circuit will not be connected to the MCU when the in-circuit simulator is being used. |
| 8       | PTA0                        | Bidirectional  | Connect to MCU PTA0 pin. No other target-system logic should be tied to this signal. Host I/O present on this pin.  |
| 9       | TGT-PTB0                    | Bidirectional  | Connect to user circuit that normally would be connected to PTB0 on the MCU.  |
| 10      | PTB0                        | Bidirectional  | Connect to MCU PTB0 pin. No other target-system logic should be tied to this signal. Grounded during reset and for 256 cycles after reset.                              |
| 11      | TGT-PTB2                    | Bidirectional  | Connect to user circuit that normally would be connected to PTB2 on the MCU.  |
| 12      | PTB2                        | Bidirectional  | Connect to MCU PTB2 pin. No other target-system logic should be tied to this signal. Held at +5 Vdc during reset.   |
| 13      | TGT-PTB3                    | Bidirectional  | Connect to user circuit that normally would be connected to PTB3 on the MCU.  |
| 14      | PTB3                        | Bidirectional  | Connect to MCU PTB3 pin. No other target-system logic should be tied to this signal. Grounded during reset.   |
| 15      | NC                          | NC             | Not connected   |
| 16      | NC                          | NC             | Not connected   |



**Table 4-2. MR4/8 MON08 Target System Connector J8**

| Pin No. | M68ICS08MR Label            | Direction      | Target System Connection   |
|---------|-----------------------------|----------------|--|
| 1       | $\overline{\text{RST-OUT}}$ | Out to target  | Connect to logic that is to receive the $\overline{\text{RST}}$ signal.  |
| 2       | GND                         | Ground         | Connect to ground ( $V_{SS}$ ).  |
| 3       | MR4_PTBO                    | Bidirectional  | Connect to MCU PTB0 pin. No other target-system logic should be tied to this signal. Grounded during reset and for 256 cycles after reset.             |
| 4       | TGT_MR4_PTBO                | Bidirectional  | Connect to user circuit that normally would be connected to PTB0 on the MCU.   |
| 5       | MR4_PTBB                    | Bidirectional  | Connect to MCU PTB1 pin. No other target-system logic should be tied to this signal. Held at +5 Vdc during reset.                                      |
| 6       | TGT_MR4_PTBB                | Bidirectional  | Connect to user circuit that normally would be connected to PTB1 on the MCU.   |
| 7       | $\overline{\text{IRQ}}$     | Out to target  | Connect to MCU $\overline{\text{IRQ}}$ pin. No other target-system logic should be tied to this signal. It will swing from 0 to +8.6 Vdc.              |
| 8       | $\overline{\text{TGT-IRQ}}$ | In from target | Connect to logic that generates interrupts.  |
| 9       | $\overline{\text{RST}}$     | Bidirectional  | Connect to MCU $\overline{\text{RST}}$ pin and P1 pin 1. No other target-system logic should be tied to this signal. It will swing from 0 to +8.6 Vdc. |
| 10      | $\overline{\text{RST-IN}}$  | In from target | Connect to all logic that generates resets.  |
| 11      | NC                          | NC             | Not connected  |
| 12      | NC                          | NC             | Not connected  |
| 13      | NC                          | NC             | Not connected  |
| 14      | NC                          | NC             | Not connected  |
| 15      | NC                          | NC             | Not connected  |
| 16      | NC                          | NC             | Not connected  |

### 4.3 Target Requirements for Using MON08

The MRICS connects PTB1..3 to TGT-PTB1..3, except during reset. During reset, PTB1..3 have voltages placed on them that configure the processor to enter the proper mode when coming out of reset. (The preceding is true for the MR16/32 but not the MR4/8) Refer to Section 9, Monitor ROM, in the Motorola MC68HC908MR manual for more information. PTB0 will not be connected to TGT-PTB0 because this signal is used for serial communications with the debugging software. (This sentence should refer to PTA0 and TGT\_PTA0 for the MR16/32. For the MR4/8 it should be PTB0 and PTB1 not connected to TGT\_MR4\_PTBO and TGTMR4\_PTBI)

Any pullups on the reset and  $\overline{IRQ}$  signals should be on the target board side of the MON08 connector and not on the MCU side. Any connections to  $\overline{RST}$  or  $\overline{IRQ}$  may cause MON08 debugging to fail and may damage components on the target since these signals will go up to 8.6 Vdc.

### 4.4 Connecting to the In-Circuit Simulator

Using the 16-pin cable provided with the MRICS kit, connect one end of the cable to the MRICS board at J7 (for the MR16/32) or J8 (for the MR4/8). Connect the other end to connector P1 on the target-system board. The pin-1 indicators on each cable end must correspond to the pin-1 indicators on the headers. P2 is not used when connecting to the MRICS board.

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# Appendix A. S-Record Information

## A.1 Introduction

The Motorola S-record format was devised to encode programs or data files in a printable format for transport between computer platforms. The format also supports editing S-records and monitoring cross-platform transfer processes.

## A.2 S-Record Contents

Each S record (**Table A-1**) is a character string composed of several fields which identify:

- Record type
- Record length
- Memory address
- Code/data
- Checksum

Each byte of binary data is encoded in the S record as a 2-character hexadecimal number:

- The first character represents the high-order four bits of the byte.
- The second character represents the low-order four bits of the byte.

**Table A-1. S-Record Fields**

| Record Type | Record Length | Memory Address | Code/Data | Checksum |
|-------------|---------------|----------------|-----------|----------|
|-------------|---------------|----------------|-----------|----------|

The S-record fields are described in **Table A-2**.

**Table A-2. S-Record Field Contents**

| Field         | Printable Characters | Contents  |
|---------------|----------------------|---|
| Type          | 2                    | S-record type — S0, S1, etc.  |
| Record Length | 2                    | Character pair count in the record, excluding the type and record length  |
| Address       | 4, 6, or 8           | 2-, 3-, or 4-byte address at which the data field is to be loaded into memory   |
| Code/Data     | 0 – 2n               | From 0 to n bytes of executable code, memory loadable data, or descriptive information. For compatibility with teletypewriter, some programs may limit the number of bytes to as few as 28 (56 printable characters in the S-record). |
| Checksum      | 2                    | Least significant byte of the one's complement of the sum of the values represented by the pairs of characters making up the record length, address, and the code/data fields   |

Each record may be terminated with a CR/LF/NULL. Additionally, an S-record may have an initial field to accommodate other data such as the line number generated by some time-sharing systems.

Accuracy of transmission is ensured by the record length (byte count) and checksum fields.

## A.3 S-Record Types

Eight types of S-records have been defined to accommodate the several needs of the encoding, transport, and decoding functions. The various Motorola upload, download, and other record transport control programs (as well as cross assemblers, linkers, and other file-creating or debugging programs) utilize only those S-records which serve the purpose of the program.

For specific information on which S-records are supported by a particular program, consult the user manual for the program.

**NOTE:** *The ICS08MR supports only the S0, S1, and S9 record types. All data before the S1 record is ignored. Thereafter, all records must be S1 type until the S9 record, which terminates data transfer.*

An S-record format may contain the record types in **Table A-3**.

**Table A-3. S-Record Types**

| Record Type | Description   |
|-------------|---|
| S0          | Header record for each block of S-records. The code/data field may contain any descriptive information identifying the following block of S records. The address field is normally 0s.  |
| S1          | Code/data record and the 2-byte address at which the code/data is to reside   |
| S2 – S8     | Not applicable to MRICS   |
| S9          | Termination record for a block of S1 records. Address field may optionally contain the 2-byte address of the instruction to which control is to be passed. If not specified, the first interplant specification encountered in the input will be used. There is no code/data field. |

Only one termination record is used for each block of S-records. Normally, only one header record is used, although it is possible for multiple header records to occur.

## A.4 S Record Creation

S-record format programs may be produced by dump utilities, debuggers, cross assemblers, or cross linkers. Several programs are available for downloading a file in the S-record format from a host system to an 8- or 16-bit microprocessor-based system.

## A.5 S-Record Example

A typical S-record format, as printed or displayed, is shown in this example:

```
S00600004844521B
S1130000285F245F2212226A00042429008237C2A
```

```
S11300100002000800082529001853812341001813
S113002041E900084#42234300182342000824A952
S107003000144ED492
S9030000FC
```

In the example, the format consists of:

- An S0 header
- Four S1 code/data records
- An S9 termination record

## A.5.1 S0 Header Record

The S0 header record is described in **Table A-4**.

**Table A-4. S0 Header Record**

| Field         | S-Record Entry | Description  |
|---------------|----------------|--|
| Type          | S0             | S-record type S0, indicating a header record                                       |
| Record Length | 06             | Hexadecimal 06 (decimal 6), indicating six character pairs (or ASCII bytes) follow |
| Address       | 00<br>00       | 4-character, 2-byte address field; 0s  |
| Code/Data     | 48<br>44<br>52 | Descriptive information identifies these S1 records:<br>ASCII H<br>D<br>R — “HDR”  |
| Checksum      | 1B             | Checksum of S0 record  |

## A.5.2 First S1 Record

The first S1 record is described in **Table A-5**.

**Table A-5. S1 Header Record**

| Field         | S-Record Entry |    |       | Description   |                 |
|---------------|----------------|----|-------|---|-----------------|
| Type          | S1             |    |       | S-record type S1, indicating a code/data record to be loaded/verified at a 2-byte address                               |                 |
| Record Length | 13             |    |       | Hexadecimal 13 (decimal 19), indicating 19 character pairs, representing 19 bytes of binary data, follow                |                 |
| Address       | 0000           |    |       | 4-character, 2-byte address field; hexadecimal address 0000 indicates location where the following data is to be loaded |                 |
| Code/Data     | Opcode         |    |       | Instruction   |                 |
|               | 28             | 5F |       | BHCC  | \$0161          |
|               | 24             | 5F |       | BCC   | \$0163          |
|               | 22             | 12 |       | BHI   | \$0118          |
|               | 22             | 6A |       | BHI   | \$0172          |
|               | 00             | 04 | 24    | BRSET   | 0, \$04, \$012F |
|               | 29             | 00 |       | BHCS  | \$010D          |
| 08            | 23             | 7C | BRSET | 4, \$23, \$018C   |                 |
| Checksum      | 2A             |    |       | Checksum of the first S1 record   |                 |

The 16 character pairs shown in the code/data field of **Table A-5** are the ASCII bytes of the actual program.

The second and third S1 code/data records each also contain \$13 (19T) character pairs and are ended with checksum 13 and 52, respectively. The fourth S code/data record contains 07 character pairs and has a checksum of 92.

### A.5.3 S9 Termination Record

The S9 termination record is described in **Table A-6**.

**Table A-6. S9 Header Record**

| Field | S-Record Entry |  |  | Description                                       |  |
|-------|----------------|--|--|---|--|
| Type  | S9             |  |  | S-record type S9, indicating a termination record |  |

**Table A-6. S9 Header Record**

| Field         | S-Record Entry | Description   |
|---------------|----------------|---|
| Record Length | 03             | Hexadecimal 04, indicating three character pairs (three bytes) follow |
| Address       | 00<br>00       | 4-character, 2-byte address field; zeroes                             |
| Code/Data     |                | There is no code/data in an S9 record.                                |
| Checksum      | FC             | Checksum of S9 record   |

## A.5.4 ASCII Characters

Each printable ASCII character in an S record is encoded in binary. **Table A-5** gives an example of encoding for the S1 record. The binary data is transmitted during a download of an S record from a host system to a 9- or 16-bit microprocessor-based system. For example, the first S1 record in **Table A-5** is sent as shown in **Figure A-1**.

| TYPE |      | LENGTH |      | ADDRESS |      |      |      | CODE/DATA |      |      |      | ...  | CHECKSUM |      |      |      |      |      |      |      |      |     |      |      |      |      |
|------|------|--------|------|---------|------|------|------|-----------|------|------|------|------|----------|------|------|------|------|------|------|------|------|-----|------|------|------|------|
| S    | 1    | 1      | 3    | 0       | 0    | 0    | 0    | 2         | 8    | 5    | F    | ...  | 2        | A    |      |      |      |      |      |      |      |     |      |      |      |      |
| 5    | 3    | 3      | 1    | 3       | 1    | 3    | 3    | 3         | 0    | 3    | 0    | 3    | 0        | 3    | 2    | 3    | 8    | 3    | 5    | 4    | 6    | ... | 3    | 2    | 4    | 1    |
| 0101 | 0011 | 0011   | 0001 | 0011    | 0001 | 0011 | 0011 | 0011      | 0000 | 0011 | 0000 | 0011 | 0000     | 0011 | 0010 | 0011 | 1000 | 0011 | 0101 | 0100 | 0110 | ... | 0011 | 0010 | 0100 | 0001 |

**Figure A-1. S-1 Record Example**



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# Appendix B. Quick Start Hardware Configuration Guide

## B.1 Introduction

This quick start guide explains the:

- Configuration of the M68ICS08MR in-circuit simulator (MRICS) board
- Installation of the hardware
- Connection of the board to a target system

There are four methods for configuring the MRICS: standalone, simulation, evaluation, and programming.

- Standalone — ICS08MRZ.exe is running on the host computer (the MRICS is not connected). Emulation of the M68HC(9)08MR MCU CPU, registers, and I/O ports within the host computer environment.
- Simulation — Host computer is connected to the MRICS via the RS-232 cable and the ICS08MRZ.exe is running on the host computer. This provides access to the M68HC(9)08MR MCU CPU, internal registers, and I/O ports.
- Evaluation — Host computer is connected to the MRICS and the MRICS is 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 is connected to the MRICS, and the MRICS is 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 MR24/32, and port B0 and port B1 on the MR4/8 are used for communications, so they are unavailable for emulation).

**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*

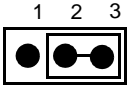
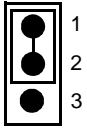
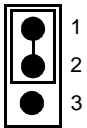
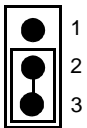
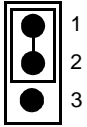
*sensitive to electrostatic discharge (ESD). Wear a grounding wrist strap whenever handling any printed circuit board. This strap provides a conductive path for safely discharging static electricity to ground.*

### B.1.1 MRICS Configurable Jumper Headers

Configure the seven jumper headers on the MRICS for your application according to the tables in this section.

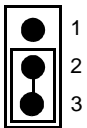
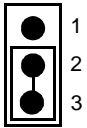
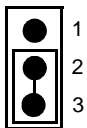
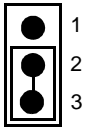
*B.1.1.1 MC68HC908MR16/32 Quick Start Configuration - Standalone Mode*

**Table B-1. MC68HC908MR16/32 Quick Start Jumper Header Configuration**

| Jumper Header                                     | Type  | Description  |
|---|---|--|
| W1<br>MR16/32<br>clock<br>selection               |    | Jumper on pins 2 and 3 — Disconnects the MC68HC908MR16/32 clock from the target system. This position is labeled O.  |
| W2<br>Target<br>reset<br>selection                | NA  | Not applicable when using an MC68HC908MR16/32 MCU in standalone mode.  |
| W3<br>I/O baud rate<br>selection:<br>MR16/32 only |    | Jumper on pins 1 and 2 (factory default) — MR16/32 I/O baud rate is set to 9600. This position is labeled 9600.  |
| W4<br>Serial<br>communication<br>selection        |   | Jumper on pins 1 and 2 (factory default) — MC68HC908MR16/32 MCU is installed. This position is labeled MR32/16.  |
| W5<br>XTAL<br>clock<br>enable                     |  | Jumper on pins 2 and 3 (factory default) — MRICS XTAL clocks are enabled: 4.9152 MHz for the MC68HC908MR16/32 MCUs. This position is labeled I.                    |
| W6<br>MR4/8<br>target<br>clock                    | NA  | Not applicable when using an MC68HC908MR16/32 MCU in standalone mode.  |
| W7<br>MRICS<br>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. |

*B.1.1.2 MC68HC908MR4/8 Quick Start Configuration - Standalone Mode*

**Table B-2. MC68HC(9)08MR4/8 Quick Start Jumper Header Configuration**

| Jumper Header                                     | Type  | Description   |
|---|---|---|
| W1<br>MR16/32<br>clock<br>selection               | NA  | Not applicable when using an MC68HC(9)08MR4/8 MCU in standalone mode.   |
| W2<br>Target<br>reset<br>selection                | NA  | Not applicable when using an MC68HC(9)08MR4/8 MCU in standalone mode.   |
| W3<br>I/O baud rate<br>selection:<br>MR16/32 only | NA  | Not applicable when using an MC68HC(9)08MR4/8 MCU in standalone mode.   |
| W4<br>Serial<br>communication<br>selection        |    | Jumper on pins 2 and 3 — MC68HC(9)08MR4/8 is installed. This position is labeled MR8/4.                                     |
| W5<br>XTAL<br>clock<br>enable                     |   | Jumper on pins 2 and 3 — MRICS XTAL clock is enabled: 4.0000 MHz for the MC68HC(9)08MR4/8 MCUs. This position is labeled I. |
| W6<br>MR4/8<br>target<br>clock                    |  | Jumper on pins 2 and 3: Disconnects the MC68HC(9)08MR4/8 clock from the target system. This position is labeled O.          |
| W7<br>MRICS<br>reset clock                        |  | Jumper on pins 2 and 3: Reset clock set at 4.000 MHz. This position is labeled MR8/4.                                       |

## B.1.2 Target Interface Cable Connections

**Table B-3. MCU Version to Cable/Connector Configuration**

| MCU           | Flex Cable<br>M68CLB05C | Ribbon Cable<br>(User Supplied) | 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          |

## B.1.3 Host Computer — MRICS Interconnection (J12)

Connect the DE9 serial cable. Connect one end of this cable to your host PC and the other end to connector J12 on the MRICS board.

## B.2 Installing the Hardware

For installing Motorola development tools, the following steps provide installation instructions for the MRICS hardware.

Before beginning, locate these items:

- 9-pin RS-232 serial connector on the board, labeled J12
- 5-volt circular power-input connector on the MRICS (J4)

To prepare the MRICS for use with a host PC:

1. Install the MCU into the M68ICS08MR board.

Locate the appropriate socket on the board:

- For 56-pin SDIP MC68HC908MR16/32, locate XU1
- For 28-pin DIP MC68HC(9)08MR4/8, locate XU4
- For 64-pin QFP MC68HC908MR16/32, locate XU2 (a 64-pin QFP MC68HC908MR32 is provided in the kit)
- For 32-pin QFP MC68HC(9)08MR4/8, locate XU3

Install an MCU (provided with the MRICS package) into the appropriate socket, observing the pin 1 orientation with the silkscreened dot. The top (label side) of the MCU package must be visible when looking at the component side of the board.

2. Connect the board to the host PC.

Locate the 9-pin connector labeled J12 on the board. Using the cable provided, connect it to a serial COM port on the host PC.

3. Apply power to the board.

Connect the 5-volt power supply to the round connector on the board, J4. Plug the power supply into an ac power outlet, using one of the country-specific adapters provided. The ICS power LED on the board should light.

## B.3 Installing the Software

For instructions for installing the ICS08 software, refer to P&E Microcomputer Systems, Inc., *M68ICS08 68HC08 In-Circuit Simulator Operator's Manual*, Motorola document order number M68ICS08OM/D.

## B.4 Connecting to a Target System

The three ways to connect the M68ICS08MR simulator board to a target system are via:

- The flex cable
- The ribbon cable
- The MON08 cable

Connect the simulator board to the target system using one of these methods:

- Using a flex cable

When emulating an MC68HC908MR16/32 MCU, connect the 80-pin M68CLB05C flex cable (provided with the kit) to the connectors labeled J2 and J3 on the simulator board. (Use the same cable when emulating an MC68HC(9)08MR4/8 MCU, but connect it to J5 and J6 on the MRICS board.) Attach the other end of the cable to the appropriate connector on the target system. Target head adapters are available for the 56-pin SDIP, 28-pin DIP, 32-pin QFP, and 64-pin QFP versions of the MCU.

- Using a ribbon cable

When emulating an MC68HC908MR16/32 MCU connect a 60-pin flat ribbon cable to connector J1 on the simulator board. Attach the other end of the cable to the appropriate connector on the target system. When emulating an MC68HC(9)08MR4/8 MCU connect a 28-pin DIP cable to connector J11 on the simulator board. Attach the other end of the cable to the appropriate connector on the target system.

- Using a MON08 cable

Connect the MON08 debug interface cable to the appropriate MON08 debug interface connector (either J7 or J8) for communication with the target system's MCU. The MON08 cable lets you program and debug the target system's MCU FLASH. An MCU must be installed in the target system while the MRICS board's MCU must be removed.



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### Glossary

**8-bit MCU** — A microcontroller whose data is communicated over a data bus made up of eight separate data conductors. Members of the MC68HC(9)08 Family of microcontrollers are 8-bit MCUs.

**A** — An abbreviation for the accumulator of the HC08 MCU.

**accumulator** — An 8-bit register of the HC08 CPU. The contents of this register may be used as an operand of an arithmetic or logical instruction.

**assembler** — A software program that translates source code mnemonics into opcodes that can then be loaded into the memory of a microcontroller.

**assembly language** — Instruction mnemonics and assembler directives that are meaningful to programmers and can be translated into an object code program that a microcontroller understands. The CPU uses opcodes and binary numbers to specify the operations that make up a computer program. Humans use assembly language mnemonics to represent instructions. Assembler directives provide additional information such as the starting memory location for a program. Labels are used to indicate an address or binary value.

**ASCII** — American Standard Code for Information Interchange. A widely accepted correlation between alphabetic and numeric characters and specific 7-bit binary numbers.

**breakpoint** — During debugging of a program, it is useful to run instructions until the CPU gets to a specific place in the program, and then enter a debugger program. A breakpoint is established at the desired address by temporarily substituting a software interrupt (SWI) instruction for the instruction at that address. In response to the SWI, control is passed to a debugging program.

**byte** — A set of exactly eight binary bits.

**clock** — A square wave signal that is used to sequence events in a computer.

**command set** — The command set of a CPU is the set of all operations that the CPU knows how to perform. One way to represent an instruction set is with a set of shorthand mnemonics such as LDA meaning load A. Another representation of an instruction set is the opcodes that are recognized by the CPU.

**CPU** — Central processor unit. The part of a computer that controls execution of instructions.

**CPU cycles** — A CPU clock cycle is one period of the internal bus-rate clock. Normally, this clock is derived by dividing a crystal oscillator source by two or more so the high and low times will be equal. The length of time required to execute an instruction is measured in CPU clock cycles.

**CPU registers** — Memory locations that are wired directly into the CPU logic instead of being part of the addressable memory map. The CPU always has direct access to the information in these registers. The CPU registers in an MC68HC908 are A (8-bit accumulator), X (8-bit index register), CCR (condition code register containing the H, I, N, Z, and C bits), SP (stack pointer), and PC (program counter).

**cycles** — See CPU cycles.

**data bus** — A set of conductors that are used to convey binary information from a CPU to a memory location or from a memory location to a CPU; in the HC08, the data bus is 8-bits.

**development tools** — Software or hardware devices used to develop computer programs and application hardware. Examples of software development tools include text editors, assemblers, debug monitors, and simulators. Examples of hardware development tools include simulators, logic analyzers, and PROM programmers. An in-circuit simulator combines a software simulator with various hardware interfaces.

**DIP** — Dual in-line package.

**DTR** — Data transfer request.

**EPROM** — Erasable, programmable read-only memory. A non-volatile type

of memory that can be erased by exposure to an ultra-violet light source. MCUs that have EPROM are easily recognized by their packaging: a quartz window allows exposure to UV light. If an EPROM MCU is packaged in an opaque plastic package, it is termed a one-time-programmable OTP MCU, since there is no way to erase and rewrite the EPROM.

**EEPROM** — Electrically erasable, programmable read-only memory.

**ESD** — Electrostatic discharge.

**IC** — Integrated circuit.

**index register** — An 8-bit CPU register in the HC08 that is used in indexed addressing mode. The index register (X) also can be used as a general-purpose 8-bit register in addition to the 8-bit accumulator.

**input-output (I/O)** — Interfaces between a computer system and the external world. For example, a CPU reads an input to sense the level of an external signal and writes to an output to change the level on an external signal.

**instructions** — Instructions are operations that a CPU can perform. Instructions are expressed by programmers as assembly language mnemonics. A CPU interprets an opcode and its associated operand(s) as an instruction.

**listing** — A program listing shows the binary numbers that the CPU needs alongside the assembly language statements that the programmer wrote. The listing is generated by an assembler in the process of translating assembly language source statements into the binary information that the CPU needs.

**LSB** — Least significant bit.

**MCU – Microcontroller unit** — Microcontroller. A complete computer system including CPU, memory, clock oscillator, and I/O on a single integrated circuit.

**MRICS** — M68ICS08MR in-circuit simulator and programmer board.

**MR4/8** — MCUs MC68HC08MR4 and MC68HC908MR8.

**MR32** — MCU MC68HC908MR32.

**MSB** — Most significant bit.

**N** — Abbreviation for negative, a bit in the condition code register of the HC08. In two's-complement computer notation, positive signed numbers have a 0 in their MSB (most significant bit) and negative numbers have a 1 in their MSB. The N condition code bit reflects the sign of the result of an operation. After a load accumulator instruction, the N bit will be set if the MSB of the loaded value was a 1.

**object code file** — A text file containing numbers that represent the binary opcodes and data of a computer program. An object code file can be used to load binary information into a computer system. Motorola uses the S-record file format for object code files.

**operand** — An input value to a logical or mathematical operation.

**opcode** — A binary code that instructs the CPU to do a specific operation in a specific way. The HC08 CPU recognizes 210 unique 8-bit opcodes that represent addressing mode variations of 62 basic instructions.

**OTPROM** — A non-volatile type of memory that can be programmed but cannot be erased. An OTPROM is an EPROM MCU that is packaged in an opaque plastic package. It is called a one-time-programmable MCU because there is no way to expose the EPROM to a UV light.

**PC** — Abbreviation for program counter CPU register of the HC08.

**PCBA** — Printed circuit board assembly.

**PLL** — Phase-locked loop.

**program counter** — The CPU register that holds the address of the next instruction or operand that the CPU will use.

**QFP** — Quad flat pack.

**RAM** — Random access memory. Any RAM location can be read or written by the CPU. The contents of a RAM memory location remain valid until the CPU writes a different value or until power is turned off.

**registers** — Memory locations that are wired directly into the CPU logic

instead of being part of the addressable memory map. The CPU always has direct access to the information in these registers. The CPU registers in the HC08 are A (8-bit accumulator), X (8-bit index register), CCR (condition code register containing the H, I, N, Z, and C bits), SP (stack pointer), and PC (program counter). Memory locations that hold status and control information for on-chip peripherals are called I/O and control registers.

**reset** — Reset is used to force a computer system to a known starting point and to force on-chip peripherals to known starting conditions.

**S record** — A Motorola standard format used for object code files.

**SDIP** — Skinny dual in-line package.

**simulator** — A computer program that copies the behavior of a real MCU.

**source code** — See source program.

**SP** — Abbreviation for stack pointer CPU register in the HC08 MCU.

**source program** — A text file containing instruction mnemonics, labels, comments, and assembler directives. The source file is processed by an assembler to produce a composite listing and an object file representation of the program.

**stack pointer** — A CPU register that holds the address of the next available storage location on the stack.

**TTL** — Transistor-to-transistor logic.

**TVS** — Transient voltage suppression.

**V<sub>DD</sub>** — The positive power supply to a microcontroller (typically 5 volts dc).

**V<sub>SS</sub>** — The 0-volt dc power supply return for a microcontroller.

**Word** — A group of binary bits. Some larger computers consider a set of 16 bits to be a word but this is not a universal standard.

**X** — Abbreviation for index register, a CPU register in the HC08.

**Z** — Abbreviation for zero, a bit in the condition code register of the HC08. A

compare instruction subtracts the contents of the tested value from a register. If the values were equal, the result of this subtraction would be 0 so the Z bit would be set; after a load accumulator instruction, the Z bit will be set if the loaded value was \$00.

## User's Manual — M68ICS08MR In-Circuit Simulator

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