

**HC05T7**  
**EMULATOR MODULE**  
**USER'S MANUAL**

First Edition



Motorola reserves the right to make changes without further notice to any products herein to improve reliability, function, or design. Motorola does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part.

Motorola and the Motorola logo are registered trademarks of Motorola Inc.  
Motorola Inc. is an Equal Opportunity/Affirmative Action Employer.

# CONTENTS

CHAPTER 1	INTRODUCTION .....	1-1
1.1	Development Systems .....	1-1
1.1.1	Motorola Modular Development System (MMDS05) .....	1-1
1.1.2	M68HC05EVS Evaluation System (HC05EVS) .....	1-2
1.2	EM Layout .....	1-3
1.3	Target Connectors And Cable Information .....	1-4
CHAPTER 2	MMDS05 CONFIGURATION AND OPERATION .....	2-1
2.1	Setting T7EM Jumper Headers .....	2-1
2.1.1	Reset Select Header (P4) .....	2-1
2.1.2	Clock Source Select Header (P6) .....	2-2
2.2	Installing Personality And Help Files .....	2-3
2.2.1	Personality File .....	2-3
2.2.2	Help File .....	2-3
2.3	MMDS05 Limitations .....	2-4
2.4	Remaining System Installation .....	2-4
CHAPTER 3	HC05EVS CONFIGURATION AND OPERATION .....	3-1
3.1	Setting T7EM Jumper Headers .....	3-1
3.1.1	Reset Select Header (P4) .....	3-1
3.1.2	Clock Source Select Header (P6) .....	3-2
3.2	EVS Limitations .....	3-3
3.3	Logic Analyzer Connector P1 .....	3-4
3.4	Remaining System Installation .....	3-6

## FIGURES

<b>Figure</b>		<b>Page</b>
1-1	HC05T7 Emulator Module .....	1-3
1-2	Connector P7 Pin Assignment .....	1-4
1-3	Connector P8 Pin Assignment .....	1-5
1-4	Target Cable and Head Assembly .....	1-7
3-1	Connector P1 Pin Assignment .....	3-4

## TABLES

<b>Table</b>		<b>Page</b>
1-1	Parts required to form a target cable assemble for T7EM .....	1-6
3-1	Logic Analyzer Connector P1 Signal Descriptions .....	3-5

This user's manual explains connection, configuration, and operation information specific to the M68EM05T7 Emulator Module (hereafter referred to as T7EM). The T7EM makes possible emulation and debugging of MC68HC05T7 microcontroller unit (MCU) based target systems.

The T7EM can be part of two development systems. This chapter describes those systems and explains the layout of the T7EM.

## 1.1 DEVELOPMENT SYSTEMS

Your T7EM can be part of two Motorola development tools: the HC05 Motorola Modular Development System (MMDS05) or the M68HC05EVS Evaluation System (HC05EVS).

### 1.1.1 Motorola Modular Development System (MMDS05)

The MMDS05 is an emulator system that provides a bus state analyzer and real-time memory windows. The unit's integrated design environment includes an editor, an assembler, user interface, and source-level debug. A complete MMDS05 consists of:

- **a station module** -- the metal MMDS05 enclosure, containing the control board and the internal power supply. Most system cables connect to the MMDS05 station module. (The cable to an optional target system, however, runs through an aperture in the station module enclosure to connect directly to the emulator module.)
- **an emulator module (EM)** -- such as the T7EM: a printed circuit board that enables system functionality for a specific MCU. The EM fits into the station module through a sliding panel in the enclosure top. The EM has connectors for the target cable.
- **two logic clip assemblies** -- twisted-pair cables that connect the station module to your target system, a test fixture, a clock, or any other circuitry useful for evaluation or analysis. One end of each cable assembly has a molded connector, which fits into station module pod A and pod B. Leads at the other end of each cable terminate in female probe tips. Ball clips come with the cable assemblies.
- **a 9-lead RS-232 serial cable** -- the cable that connects the station module to the host computer RS-232 port.
- **a 9 to 25-pin adapter** -- a moulded assembly that lets you connect the 9-lead cable to a 25-pin serial port.
- **system software** -- software, on 3-1/2 inch diskettes.

- **MMDS05 documentation** -- an MMDS05 operations manual (MMDS05OM/D) and the appropriate EM user's manual.

As mentioned, your T7EM gives the MMDS05 the ability to emulate the MC68HC05T7 MCU. By substituting a different EM, you can enable your MMDS05 to emulate an MCU of a different series. (Your Motorola representative can explain all the EMs available.)

Chapter 2 explains how to configure and use your T7EM as part of an MMDS05 system. For information about MMDS05 software or the station module, see the MMDS05 operations manual. For layout and configuration information pertaining to a different EM, see the corresponding EM user's manual.

### 1.1.2 M68HC05EVS Evaluation System (HC05EVS)

An HC05EVS is an economical, two-board tool for designing, debugging, and evaluating target systems based on an MC68HC05 MCU. A complete HC05EVS consists of:

- **a platform board (PFB)** -- the bottom board, which supports the emulator module. The platform board has connectors for power and for the terminal or host computer.
- **an emulator module (EM)** -- such as the T7EM: a printed circuit board that enables system functionality for a specific MCU. The EM fits onto the PFB. The EM has connectors for a target cable and a cable to a logic analyzer.
- **an RS-232 serial cable** -- the cable that connects the PFB to the host computer RS-232 port.
- **system software** -- software, on 3-1/2 inch diskettes.
- **HC05EVS documentation** -- an HC05EVS operations manual and the appropriate EM user's manual.

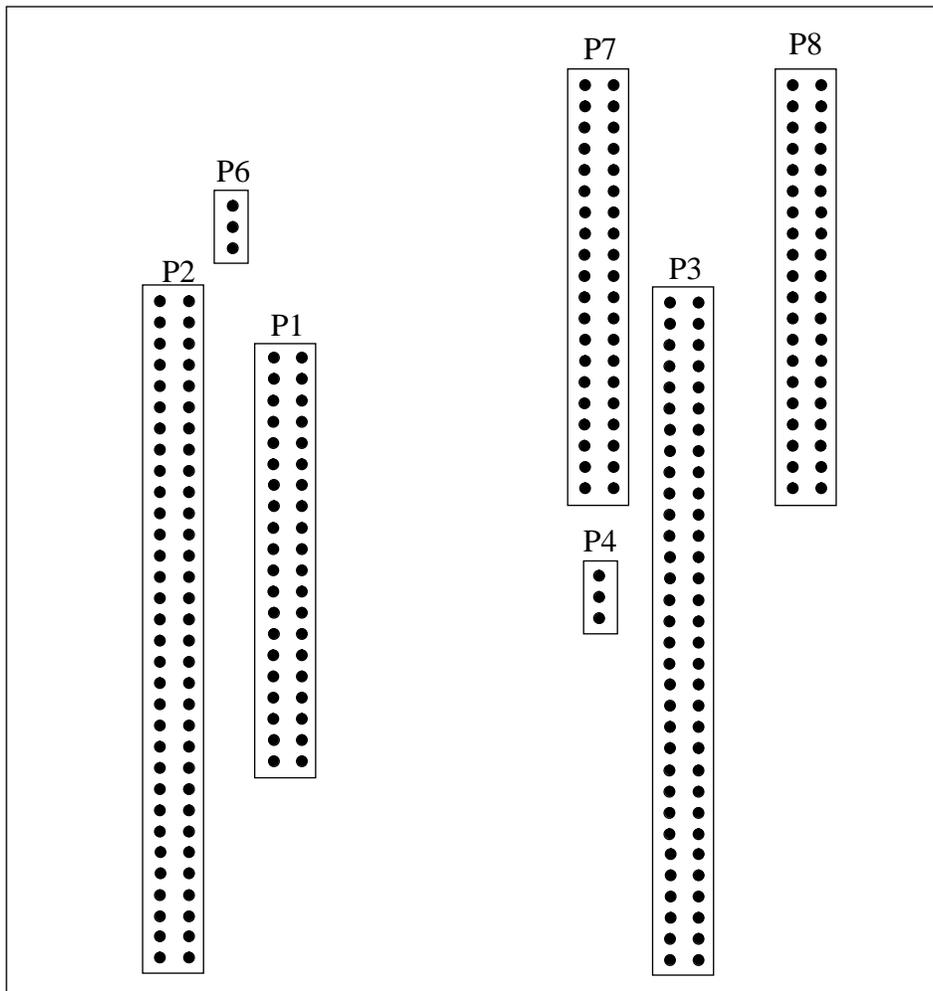
As mentioned, your T7EM emulates the MC68HC05T7 MCU. By substituting a different EM, you can enable your HC05EVS to emulate an MCU of a different series. (Your Motorola representative can explain all the EMs available.)

Chapter 3 explains how to configure and use your T7EM as part of an HC05EVS system. For information about HC05EVS software or the platform board, see the HC05EVS operations manual. For layout and configuration information pertaining to a different EM, see the corresponding EM user's manual.

## 1.2 EM LAYOUT

Figure 1-1 shows the layout of the T7EM. Jumper header P4 controls the path of a target reset. Jump header P6 lets you select the clock-signal source.

Connectors P7 and P8, for a 64-pin SDIP cable assembly, (purchased separately from the T7EM.) provide an interface to your target system. If you install the T7EM in the MMDS05 station module, the target cable passes through the slit in the station module enclosure. Connector P1 connects to a logic analyzer. (Connector P1 has more significance for an EVS system, as an MMDS05 system includes a bus analyzer.) Expansion header connectors P2 and P3 connect together the EM and the control board (for an MMDS05) or the EM and the platform board (for an EVS).



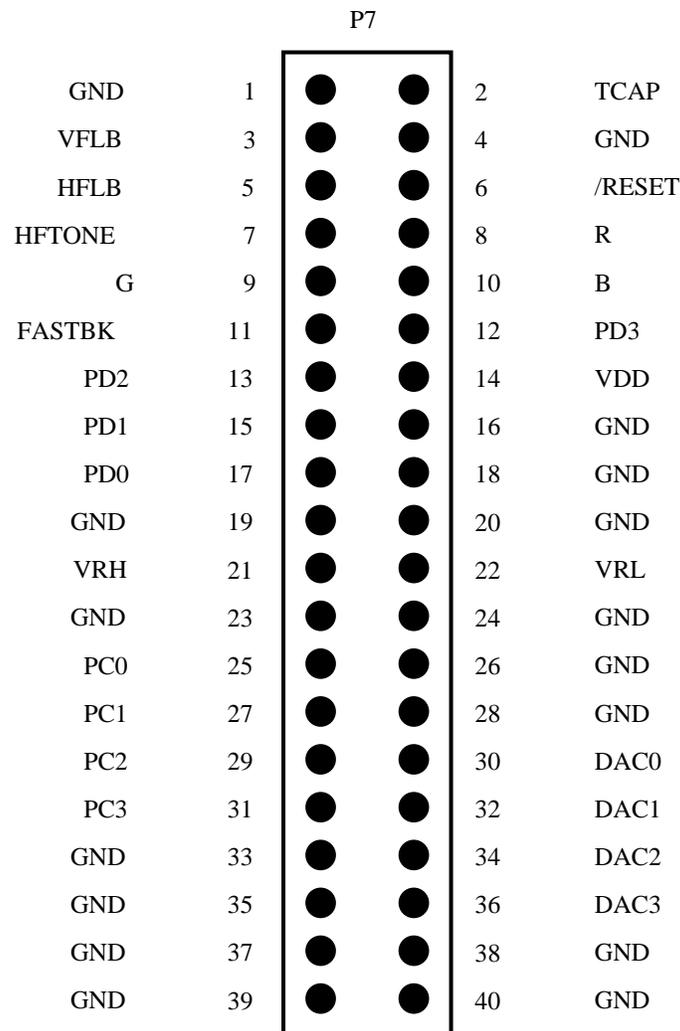
**Figure 1-1. HC05T7 Emulator Module**

## 1.3 TARGET CONNECTORS AND CABLE INFORMATION

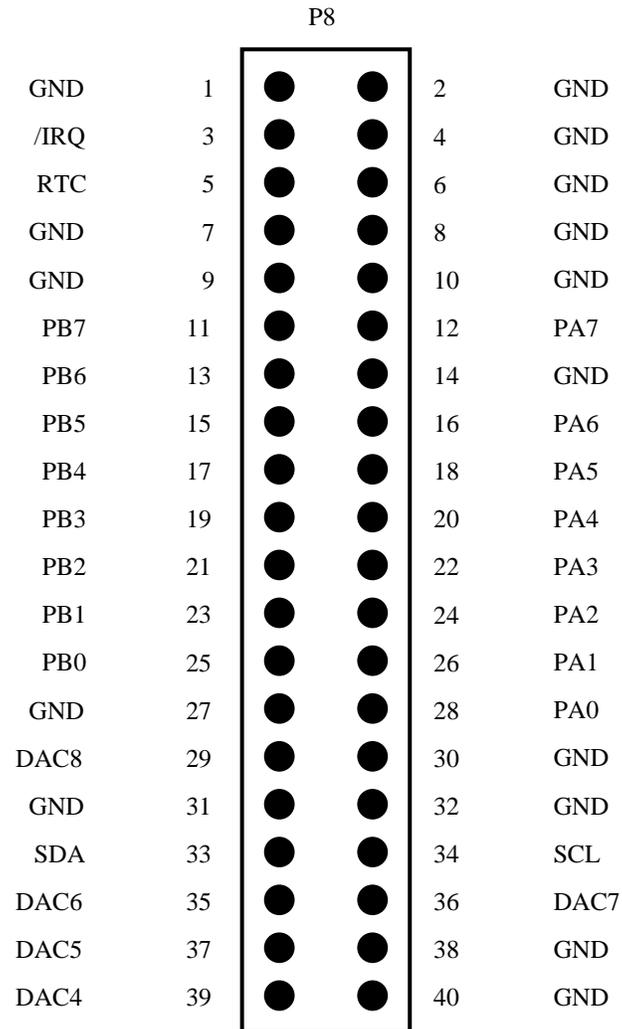
Figure 1-2 and 1-3 show the pin assignments for connectors P7 and P8. For signal descriptions, consult the technical data book for the M68HC05T7 MCU.

As connector P1 has more importance to an HC05EVS than to an MMDS05, pin assignments for connector P1 are in Chapter 3.

To configure your T7EM for use as part of an MMDS05, follow the instructions of Chapter 2. To configure your T7EM as part of an HC05EVS, follow the instructions of Chapter 3.



**Figure 1-2. Connector P7 Pin Assignments**



**Figure 1-3. Connector P8 Pin Assignments**

To connect your T7EM to your target system via a separately purchased, target cable and head assembly, follow the instructions below.

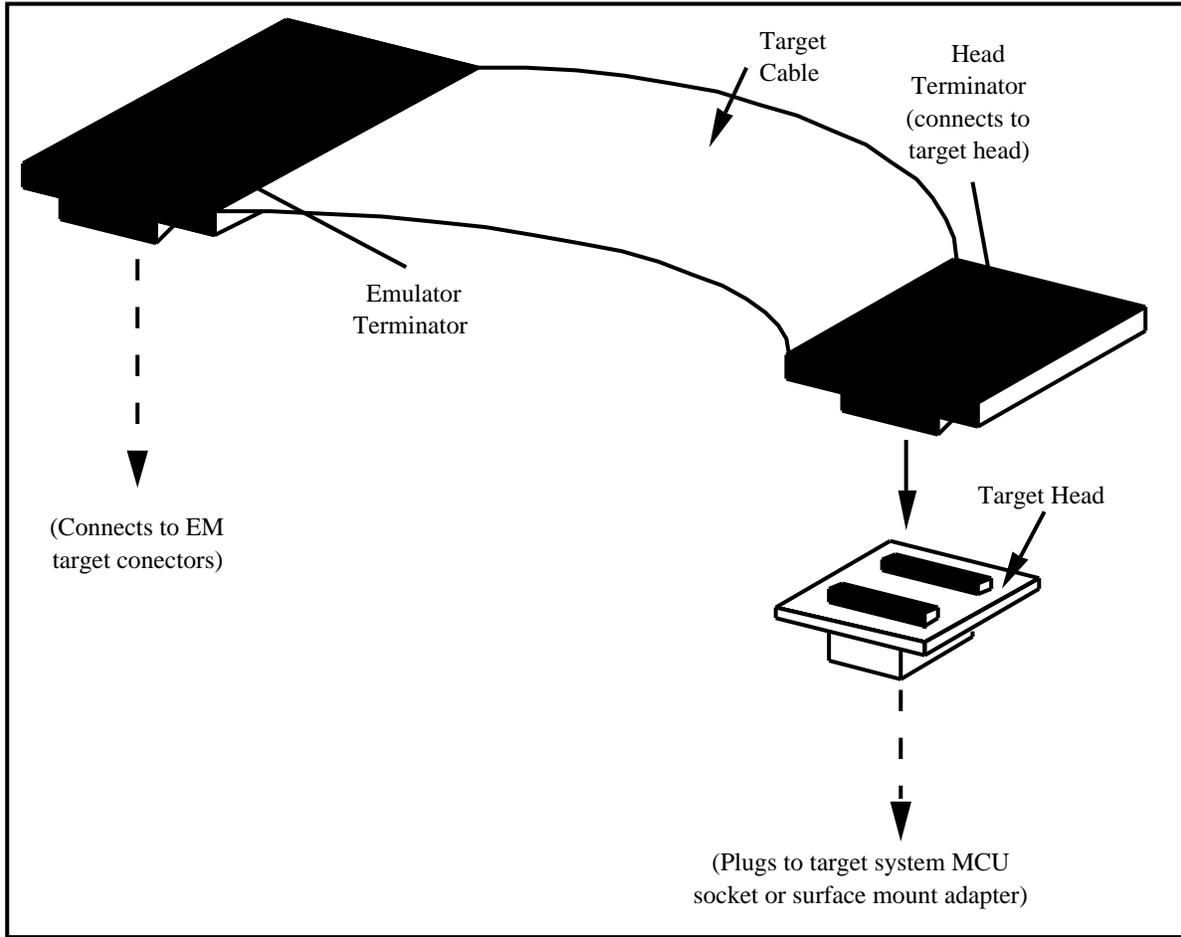
Figure 1-4 is a generic representation of a Motorola supplied target cable assembly, which consists of a flexible cable and a SDIP target head. Emulation of a SDIP device is achieved by fitting the SDIP target head into the MCU socket of the target system. Table 1-1 shows the target cable and head part numbers required to form a 56-pin SDIP target cable assembly for the T7EM.

**Table 1-1.** Parts required to form a target cable assembly for T7EM

Cable No.	Target Head No.	Notes
M68CBL05B	M68TB05T7B56	56-pin SDIP cable assembly

To use a SDIP target cable, connect the large cable terminator of M68CLB05B to M68TB05T7B56. They should be connected in such a way that the arrow marked on the target head is pointing to the target cable. Next, connect the small cable terminator to the T7EM target connectors P7 and P8. The connector at the far end of the cable should be connected to P7 and the other to P8. Plug the target head into the MCU socket of your target system.

If you install the T7EM in the MMDS05 station module, run the target cable through the slit in the station module enclosure.



This chapter explains how to configure and use your T7EM as part of an MMDS05. For other parts of system installation or configuration, see the MMDS05 operations manual (MMDS05OM/D). (If you will use your T7EM as part of an HC05EVS system, go to Chapter 3 for corresponding information.)

Paragraph 2.1 explains how to set T7EM jumper headers. Paragraph 2.2 explains how to install personality and help files pertaining to the T7EM. Paragraph 2.3 lists the limitations on using the T7EM in an MMDS05. Paragraph 2.4 explains remaining system installation.

Note that you can configure a T7EM already installed in the MMDS05 station module enclosure. To do so, switch off station-module power, remove the hatch, then follow the guidance of this chapter.

### CAUTION

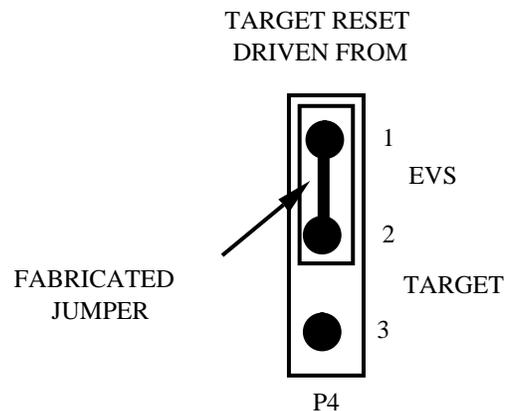
Be sure to switch off power if you reconfigure an installed EM. Reconfiguring EM jumper headers with power left on can damage MMDS05 circuits.

## 2.1 SETTING T7EM JUMPER HEADERS

Your T7EM has three jumper headers, P4 and P6. Paragraphs 2.1.1 through 2.1.2 explain how to configure these headers.

### 2.1.1 Reset Select Header (P4)

Jumper header P4 controls the path of a target reset. The diagram below shows the factory configuration: the fabricated jumper between pins 1 and 2 enables your software to control resets. This is the only correct P4 configuration for a T7EM that is part of an MMDS05.

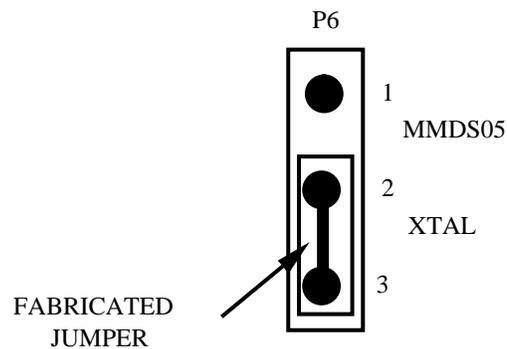


**NOTE**

The P4 pins 2 and 3 configuration is not correct for a T7EM that is part of an MMDS05 system. Such a configuration would interfere with correct operation of the RESETIN and RESETOUT commands.

### 2.1.2 Clock Source Select Header (P6)

Jumper header P6 determines the source of the clock signal. The diagram below shows the factory configuration: the fabricated jumper between pins 2 and 3 selects the T7EM canned oscillator clock source.



Alternatively, you may use a clock source originating from the control board. To do so, reposition the P6 jumper between pins 1 and 2, then use the MMDS05 OSC command to select a frequency.

## 2.2 INSTALLING PERSONALITY AND HELP FILES

T7EM software, on a 3.5" diskette, consists of these files (where xx denotes a version number):

- 0030BVxx.MEM Personality file (Each personality file customizes the MMDS05 host software for one or more specific MCUs.) for MC68HC05T7 emulation.
- 00T10Vxx.MEM Personality file for MC68HC05T10 emulation.
- 0030BVxx.HLP HELP windows specific to the MC68HC05T7 personality file.
- 00T10Vxx.HLP HELP windows specific to the MC68HC05T10 personality file.

Note that files 0030BVxx.MEM, 00T10Vxx.MEM, 0030BVxx.HLP and 00T10Vxx.HLP are specific to the T7EM. You will receive corresponding personality and help files for each additional EM you order.

MMDS05 software loads the personality file upon powerup; the default personality file is 0030BVxx.MEM. To replace this file with a different one, use the LOADMEM command. (For more information about the LOADMEM command, see the explanation in the MMDS05 operations manual.)

### 2.2.1 Personality File

Installation of the personality files (0030BVxx.MEM and 00T10Vxx.MEM) consists of copying the files from the distribution diskette to a hard disk. Personality files are usually installed in the directory from which the MMDS05 software is executed. If a personality file is not located in that directory, the MMDS05 software displays a window with which the user can search the directory structure to find the correct file.

More than one personality file can be installed; the MMDS05 operating software automatically loads the personality file that corresponds to the currently-connected EM board upon powerup.

### 2.2.2 Help File

Installation of the help files (0030BVxx.HLP and 00T10Vxx.HLP) consists of copying the files from the distribution diskette to a hard disk. These files must be installed in the directory from which the MMDS05 software is executed. If they are not located in that directory, no help information pertaining to the MC68HC05T7/T10 MCU will be displayed when the CHIPSINFO command is used.

### 2.3 MMDS05 LIMITATIONS.

This paragraph explains the limitations that apply to using your T7EM in an MMDS05 system.

- **Limitaion 1. Keyboard Interrupt:**

Setting the KEYE bit (bit 3) in the Micellaneous Register (\$1C) will not automatically configure the five least significant I/O lines of Port A as input lines. The user must configure these lines as inputs explicitly in their software before setting the KEYE bit to ensure proper operation of the keyboard interrupt function.

- **Limitaion 2. OSD EPROM:**

To ensure proper display of OSD characters on a TV set, the user is required to program the desired character patterns into the OSD EPROM of the resident MCU (U12) before using the T7EM for emulation (the resident MCU shipped with the T7EM is an OTP device with a blank EPROM array).

### 2.4 REMAINING SYSTEM INSTALLATION.

When you have configured headers P4 and P6, you are through with T7EM configuration:

- To install the T7EM in an MMDS05 station module, remove the panel from the station-module top. Fit together EM connectors P2 and P3 (on the bottom of the board) and control-board connectors P11 and P12. Snap the mounting holes of the EM onto the plastic standoffs. Connect the target cable, if appropriate. Replace the panel.
- If your T7EM already is installed in the station module, reconnect the target cable, (if necessary). Replace the panel.

At this point, you are ready to make remaining cable connections, as necessary, and restore power. For instructions, consult the MMDS05 operations manual (MMDS05OM/D).

This chapter explains how to configure and use your T7EM as part of an HC05EVS. For other parts of system installation or configuration, see the HC05EVS operations manual. (If you will use your T7EM as part of an MMDS05 system, go to Chapter 2 for corresponding information.)

Paragraph 3.1 explains how to set T7EM jumper headers. Paragraph 3.2 lists limitations on using the T7EM in an HC05EVS. Paragraph 3.3 explains pin assignments and signal descriptions for the logic analyzer connector (P1). Paragraph 3.4 explains remaining system configuration.

Note that you can configure a T7EM already installed on the HC05EVS platform board. To do so, disconnect platform-board power, then follow the guidance of this chapter.

### CAUTION

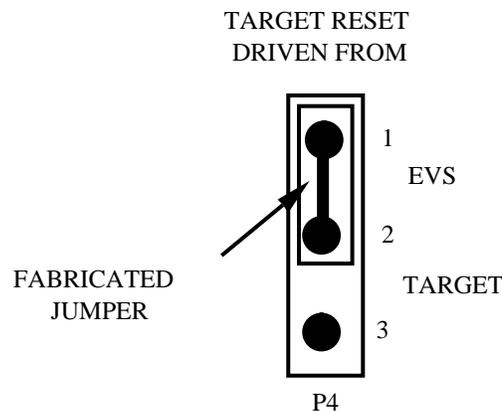
Be sure to disconnect power if you reconfigure an installed EM. Reconfiguring EM jumper headers with power left on can damage HC05EVS circuits.

## 3.1 SETTING T7EM JUMPER HEADERS

Your T7EM has three jumper headers, P4 and P6. Paragraphs 3.1.1 through 3.1.2 explain how to configure these headers.

### 3.1.1 Reset Select Header (P4)

Jumper header P4 controls the path of a target reset. The diagram below shows the factory configuration: the fabricated jumper between pins 1 and 2 enables your T7EM to reset the target when you press the user or master reset switch.

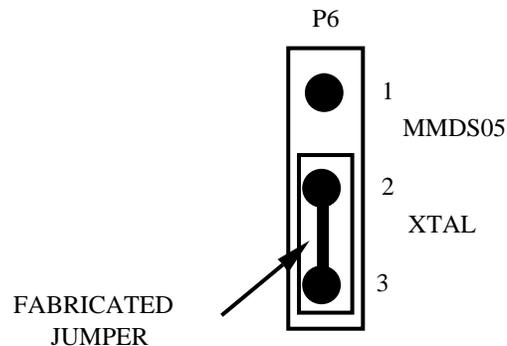


Alternatively, you may enable the target system to reset the T7EVS. To do so:

- Reposition the T7EM P4 jumper between pins 2 and 3, and
- Insert a fabricated jumper into platform-board header J3.

### 3.1.2 Clock Source Select Header (P6)

Jumper header P6 determines the source of the clock signal. The diagram below shows the factory configuration: the fabricated jumper between pins 2 and 3 selects the T7EM canned oscillator clock source. This is the only correct configuration for a T7EM that is part of an HC05EVS.



#### NOTE

The P6 pins 1 and 2 configuration is not correct for a T7EM that is part of an HC05EVS system.

This paragraph explains the limitations that apply to using your T7EM in an HC05EVS.

- **Limitation 1. CLI/RTI:**

You may not trace a clear interrupt mask (CLI) or return from interrupt (RTI) instruction with an interrupt enabled and pending, due to MCU interrupt handling. Attempting such a trace causes an interrupt in the monitor map; this forces a software reset of the HC05EVS. User breakpoints remain in the user map as SWI instructions; You must remove such SWI instructions.

- **Limitation 2. Branch:**

Do not trace a conditional branch instruction (such as BRCLR) that branches to itself. As the monitor places an SWI instruction on the object of the branch, the system never would execute the instruction. However, it would appear to you that the instruction had executed. You may enter a G command while the PC points to this type of instruction as long as the instruction is not a breakpoint address.

- **Limitation 3. IRQ/SWI:**

Whenever possible, avoid mixing interrupt requests (IRQs) and user software interrupts (SWIs). This prevents a possible IRQ-SWI timing problem: a concurrent hardware interrupt and SWI could cause an HC05EVS failure that could stop program execution. To recover from such a failure (which occurs very infrequently, statistically), press the master reset switch (SW3).

- **Limitation 4. Memory Map:**

You must be aware of the memory map of the MCU being simulated; be sure to use only valid ROM locations. The HC05EVS does not provide protection to limit user programs to the exact amount of MCU ROM available. (For information about memory maps, consult the technical data book for the MCU.)

- **Limitaion 5. Keyboard Interrupt:**

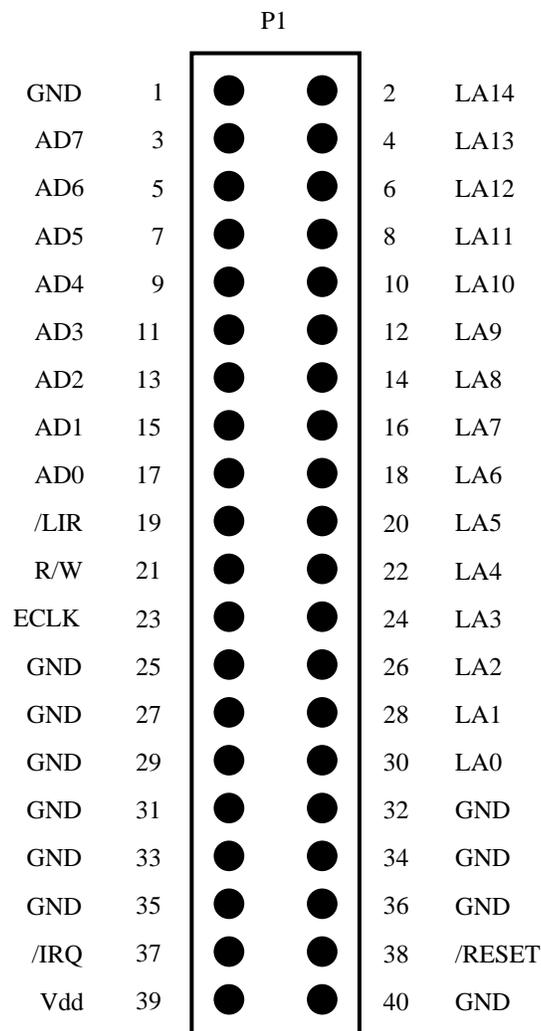
Setting the KEYE bit (bit 3) in the Micellaneous Register (\$1C) will not automatically configure the five least significant I/O lines of Port A as input lines. The user must configure these lines as inputs explicitly in their software before setting the KEYE bit to ensure proper operation of the keyboard interrupt function.

- **Limitaion 6. OSD EPROM:**

To ensure proper display of OSD characters on a TV set, the user is required to program the desired character patterns into the OSD EPROM of the resident MCU (U12) before using the T7EM for emulation (the resident MCU shipped with the T7EM is an OTP device with a blank EPROM array).

### 3.3 LOGIC ANALYZER CONNECTOR P1

Figure 3-1 shows the pin assignments for logic analyzer connector P1. Table 3-1 lists signal descriptions for this connector.



**Figure 3-1. Connector P1 Pin Assignments**

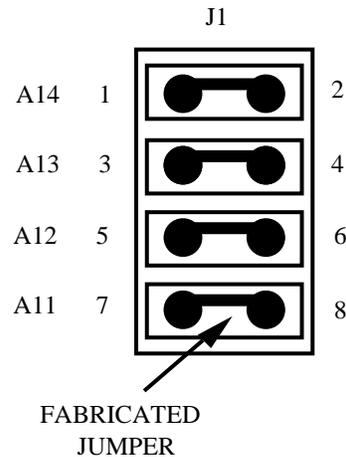
**Table 3-1. Logic Analyzer Connector P1 Signal Descriptions**

Pin Number	Signal Mnemonic	Signal Name and Description
3, 5, 7, 9, 11, 13, 15, 17	AD7-AD0	<i>Data bus</i> :- MCU bidirectional data bus.
2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30	LA14-LA0	<i>Address bus</i> :- MCU output address bus.
19	/LIR	<i>Load Instruction Register</i> :- Active-low output signal, asserted when an instruction starts.
21	R/W	<i>Read/Write</i> :- Output signal that indicates the direction of data transfer.
37	/IRQ	<i>MCU Interrupt Request</i> :- Active-low input signal from the target that asynchronously applied an MCU interrupt.
38	/RESET	<i>Reset</i> :- Active-low bidirectional signal for starting an EVS reset.
23	ECLK	<i>ECLK clock</i> :- Internally generated output clock signal used as a timing reference.
1, 25, 27, 29, 31, 32, 33, 34, 35, 36, 40	GND	<i>Ground</i>
39	Vdd	<i>+5Vdc power</i> :- Input voltage (+5Vdc @ 1A(max)) used by the EVS logic circuits.

### 3.4 REMAINING SYSTEM INSTALLATION

When you have configured headers P4 and P6, you are through with T7EM configuration.

Find jumper header J1 of the HC05EVS platform board. Make sure that four fabricated jumpers are installed, per the diagram below.



To install the T7EM on an HC05EVS platform, fit together EM connectors P2 and P3 (on the bottom of the board) and platform-board connectors P3 and P4. Snap the mounting holes of the EM onto the plastic standoffs.

At this point, you are ready to make remaining cable connections, as necessary, and restore power. For instructions, consult the HC05EVS operations manual.