M68EM05F12
EMULATOR MODULE
USER'S MANUAL

Second Edition

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CHAPTER 1

INTRODUCTION

This user's manual explains connection, configuration, and operation information specific to the HC05F12EM Emulator Module (F12EM). The F12EM makes possible emulation and debugging of target systems based on this microcontroller unit (MCU):

<div align="center">MC68HC05F12</div>

The F12EM can be part of two development systems. This chapter describes those systems and explains the layout of the F12EM.

The MC68HC05F12 is the resident MCU in the F12 EM.

1.1 DEVELOPMENT SYSTEMS

Your F12EM 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 F12EM: a printed circuit board that enables system functionality for a specific set of MCUs. The EM fits into the station module through a sliding panel in the enclosure top. The EM has a connector for the target cable.

- **two logic clip cable 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 or 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 molded 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 F12EM gives the MMDS05 the ability to emulate the MC68HC05F12 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 F12EM 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 F12EM: a printed circuit board that enables system functionality for a specific set of MCUs. The EM fits onto the PFB. The EM has connectors for a target cable and for 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 (HC05EVSOM/D) and the appropriate EM user's manual.

As mentioned, your HC05F12 EVS emulates the MC68HC05F12 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 F12EM 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 F12EM.

Note: The F12EM is supported on a modified F32EM board.

Connectors P4 and P5, provide the interface to the target system. If you install the F12EM 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).
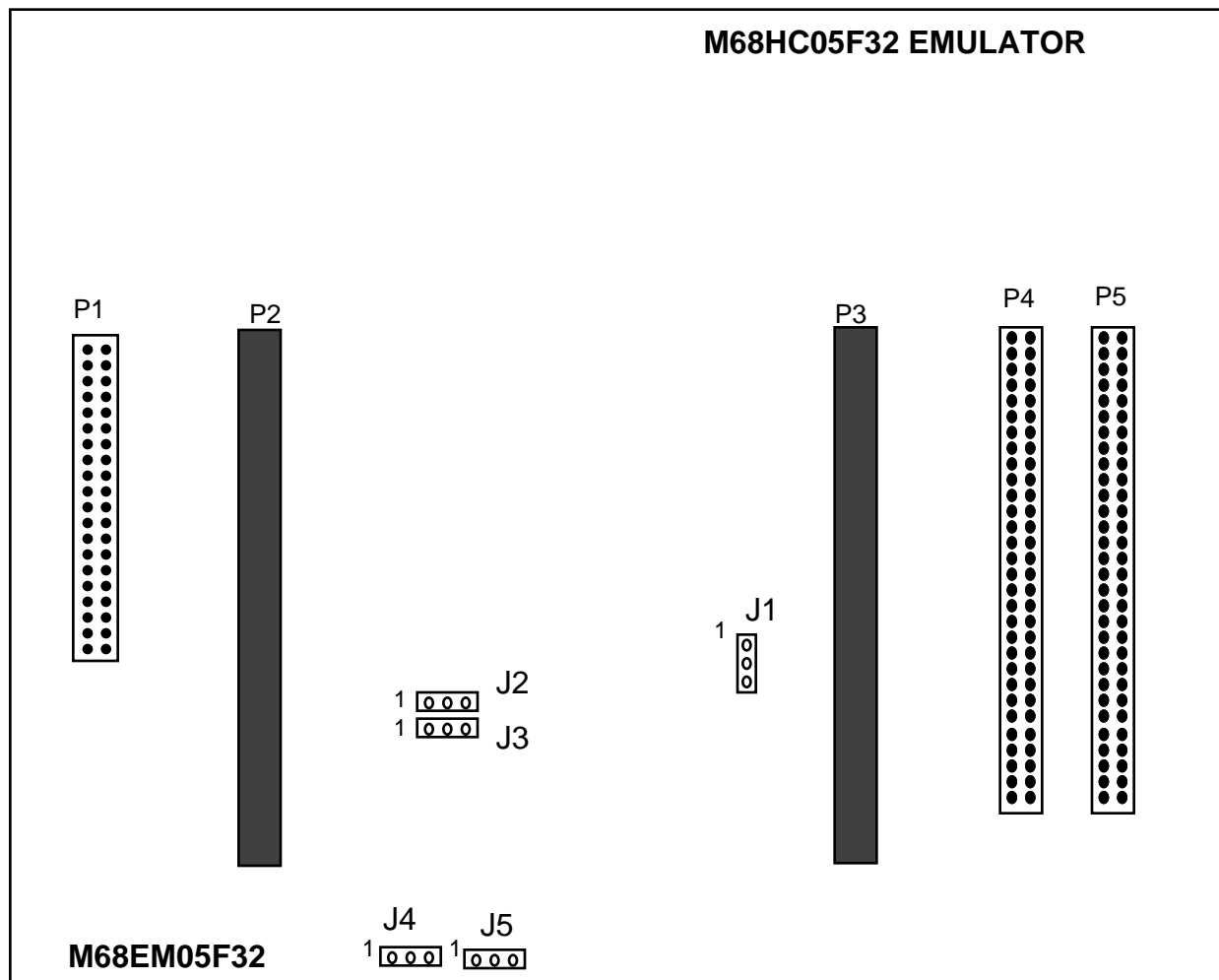

Figure 1-1. HC05F12 Emulator Module

1.3 CONNECTORS P4 AND P5 PIN ASSIGNMENTS

Figure 1-2 shows the pin assignments for connectors P4 and P5. The italic numbers correlate the P4 and P5 pins with the pins of your MCU (in 100pin QFP). For signal descriptions, consult the technical data book for the specific MCU.
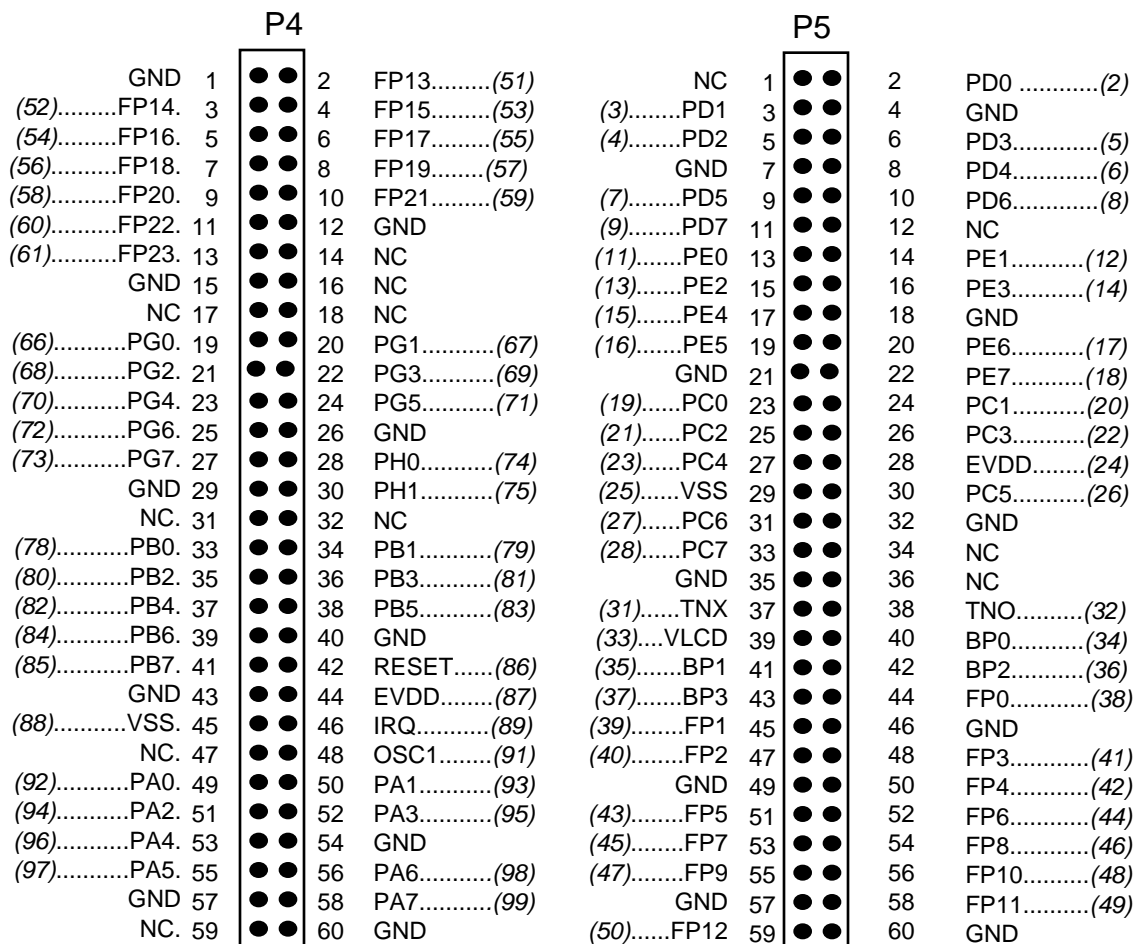

P4

Left	Pin		Pin	Right
GND	1	● ●	2	FP13.........(51)
(52).........FP14.	3	● ●	4	FP15.........(53)
(54).........FP16.	5	● ●	6	FP17.........(55)
(56).........FP18.	7	● ●	8	FP19........(57)
(58).........FP20.	9	● ●	10	FP21.........(59)
(60).........FP22.	11	● ●	12	GND
(61).........FP23.	13	● ●	14	NC
GND	15	● ●	16	NC
NC	17	● ●	18	NC
(66).........PG0.	19	● ●	20	PG1..........(67)
(68).........PG2.	21	● ●	22	PG3..........(69)
(70).........PG4.	23	● ●	24	PG5..........(71)
(72).........PG6.	25	● ●	26	GND
(73).........PG7.	27	● ●	28	PH0..........(74)
GND	29	● ●	30	PH1..........(75)
NC.	31	● ●	32	NC
(78).........PB0.	33	● ●	34	PB1..........(79)
(80).........PB2.	35	● ●	36	PB3..........(81)
(82).........PB4.	37	● ●	38	PB5..........(83)
(84).........PB6.	39	● ●	40	GND
(85).........PB7.	41	● ●	42	RESET......(86)
GND	43	● ●	44	EVDD........(87)
(88).........VSS.	45	● ●	46	IRQ..........(89)
NC.	47	● ●	48	OSC1........(91)
(92).........PA0.	49	● ●	50	PA1..........(93)
(94).........PA2.	51	● ●	52	PA3..........(95)
(96).........PA4.	53	● ●	54	GND
(97).........PA5.	55	● ●	56	PA6..........(98)
GND	57	● ●	58	PA7..........(99)
NC.	59	● ●	60	GND

P5

Left	Pin		Pin	Right
NC	1	● ●	2	PD0 ....(2)
(3).........PD1	3	● ●	4	GND
(4).........PD2	5	● ●	6	PD3.............(5)
GND	7	● ●	8	PD4.............(6)
(7).........PD5	9	● ●	10	PD6.............(8)
(9).........PD7	11	● ●	12	NC
(11).......PE0	13	● ●	14	PE1...........(12)
(13).......PE2	15	● ●	16	PE3...........(14)
(15).......PE4	17	● ●	18	GND
(16).......PE5	19	● ●	20	PE6...........(17)
GND	21	● ●	22	PE7...........(18)
(19)......PC0	23	● ●	24	PC1...........(20)
(21)......PC2	25	● ●	26	PC3...........(22)
(23)......PC4	27	● ●	28	EVDD........(24)
(25)......VSS	29	● ●	30	PC5...........(26)
(27)......PC6	31	● ●	32	GND
(28)......PC7	33	● ●	34	NC
GND	35	● ●	36	NC
(31)......TNX	37	● ●	38	TNO.........(32)
(33)....VLCD	39	● ●	40	BP0...........(34)
(35).......BP1	41	● ●	42	BP2...........(36)
(37).......BP3	43	● ●	44	FP0............(38)
(39)........FP1	45	● ●	46	GND
(40)........FP2	47	● ●	48	FP3............(41)
GND	49	● ●	50	FP4............(42)
(43)........FP5	51	● ●	52	FP6............(44)
(45)........FP7	53	● ●	54	FP8............(46)
(47)........FP9	55	● ●	56	FP10..........(48)
GND	57	● ●	58	FP11..........(49)
(50)......FP12	59	● ●	60	GND

Figure 1-2. Connectors P4 and P5 Pin Assignments

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 F12EM for use as part of an MMDS05, follow the instructions of Chapter 2. To configure your F12EM for use as part of an HC05EVS, follow the instructions of Chapter 3.

CHAPTER 2

MMDS05 CONFIGURATION AND OPERATION

This chapter explains how to configure and use your F12EM 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 F12EM as part of an HC05EVS system, go to Chapter 3 for corresponding information.)

Paragraph 2.1 explains how to set F12EM jumper headers. Paragraph 2.2 explains considerations pertaining to the MCU you emulate. Paragraph 2.3 explains remaining system installation.

Note that you can configure a F12EM already installed in the MMDS05 station module enclosure. To do so, switch off station-module power, remove the panel, 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 F32EM JUMPER HEADERS

Your F12EM has five jumper headers, J1 to J5. Paragraphs 2.1.1. and 2.1.4 explain how to configure these headers.

2.1.1 Target Reset Header (J1)

Jumper header J1 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 J1 configuration for a F12EM that is part of an MMDS05.
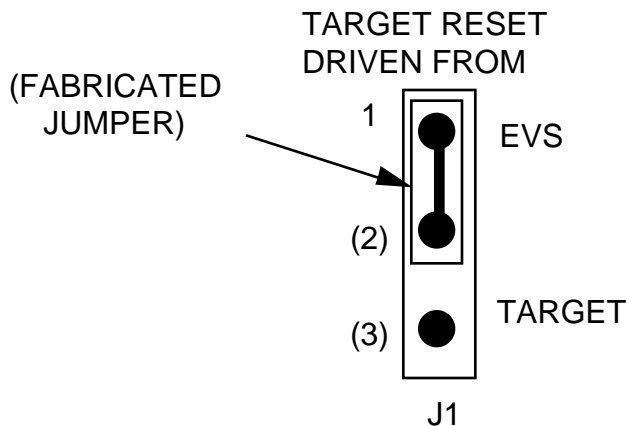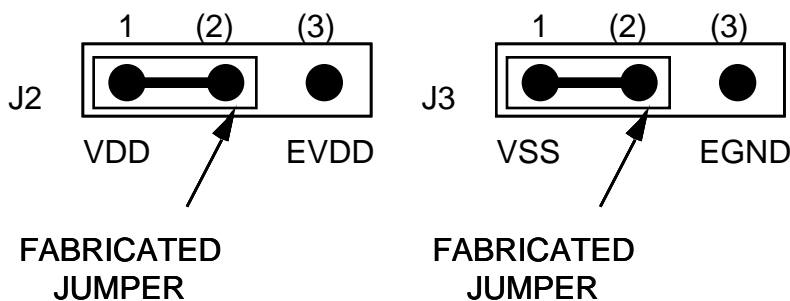

NOTE

The J1 pins 2-and-3 configuration is not correct for a F12EM that is part of an MMDS05 system. Such a configuration would interfere with correct operation of the RESETIN and RESETOUT commands.

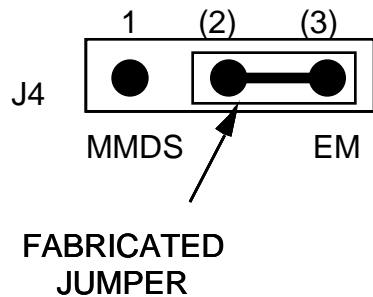## 2.1.2 Analog Supply Headers (J2 and J3)

These jumpers serve no purpose when emulating an HC05F12. The position of the jumpers are not important.
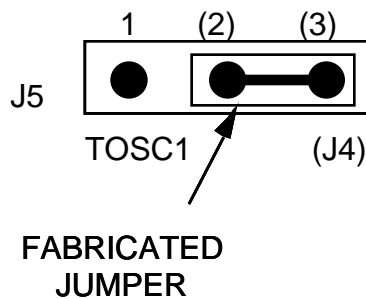
2.1.3 Clock Select Header (J4)

Jumper headers J4 and J5 determine the source of the clock signal. This header allows the selection of the MMDS or EM clock source The diagram below shows the factory configuration: the fabricated jumper between pins 2 and 3 selects the F12EM oscillator clock source.

 Warning: Due to the DTMF block it is not advisable to use the MMDS as the clock source.

```
        1     (2)     (3)
      ┌──────────────────┐
J4    │  ●   ●━━━━━●     │
      └──────────────────┘
       MMDS    ↗      EM
            FABRICATED
             JUMPER
```

2.1.4 Clock Select Header (J5)

Jumper header J5 allows the user to select either the J4 header selection or the target header to be the source for the clock.The diagram below shows the factory configuration: the fabricated jumper between pin 2 and 3 selects header J4 as the source of the clock.

```
        1     (2)     (3)
      ┌──────────────────┐
J5    │  ●   ●━━━━━●     │
      └──────────────────┘
       TOSC1   ↗     (J4)
            FABRICATED
             JUMPER
```

2.2 THE EMULATED MCU

Your MMDS05 system uses a specific personality file for the MCU type being emulated. For example, to emulate an MC68HC705F32 or MC68HC05F32, the system uses personality file 00225Vxx.MEM. Table 2-1 lists all the personality files that pertain to the F12EM. Note that personality file names follow the pattern **OOZZZVxx.MEM**, where **ZZZ** is the EM identifier or MCU name, and **xx** is the version of the file.

Table 2-1. MCUs and Personality Files

EMULATED MCU	PERSONALITY FILE	RESIDENT MCU	COMMENTS
MC68HC05F12	0MF12Vxx.MEM	MC68HC05F12	See paragraphs 2.2.1

MMDS05 software loads the personality file upon powerup; the default personality file is 00225Vxx.MEM for the F32 (as the F12EM is based on a modified F32EM board). To replace the default personality file with a different one, use the LOADMEM command. (For more information about the LOADMEM command, see the explanation in the MMDS05 operations manual.)

Alternatively, you can insert the line LOADMEM 00ZZZVxx.MEM in the STARTUP.05 script file. This way, the system automatically loads the specified personality file as part of system startup. (For more information about the STARTUP.05 script file, see the SCRIPT command explanation in the MMDS05 operations manual.)

2.2.1 MC68HC05F12 Emulation

When emulating a MC68HC05F12 using the F12EM you should not to write to location $001F as this may cause a system malfunction. Also S-records downloads should avoid this location or write 0 into it. For more information about the MC68HC05F12 features, see the corresponding technical data books. The Computer Operating Properly (COP) is currently not supported.

2.3 REMAINING SYSTEM INSTALLATION

When you have configured headers J1 to J5, you are through with F32EM configuration:

- To install the F12EM 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 corners of the EM onto the plastic standoffs. Connect the target cable, if appropriate. 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).

CHAPTER 3

HC05EVS CONFIGURATION AND OPERATION

This chapter explains how to configure your F12EM for use as part of an HC05EVS. For other parts of system installation or configuration, see the HC05EVS operations manual (HC05EVSOM/D). (If you will use your F12EM as part of an MMDS05 system, go to Chapter 2 for configuration information.)

Paragraph 3.1 explains how to set F12EM jumper headers. Paragraph 3.2 explains considerations pertaining to the MCU you emulate. Paragraph 3.3 lists limitations on using the F12EM in an HC05EVS. Paragraph 3.4 explains pin assignments and signal descriptions for the logic analyzer connector (P1). Paragraph 3.5 explains remaining system configuration.

Note that you can configure a F12EM already installed on the HC05EVS platform board. To do so, disconnect platform-board power, then follow the guidance of this chapter.
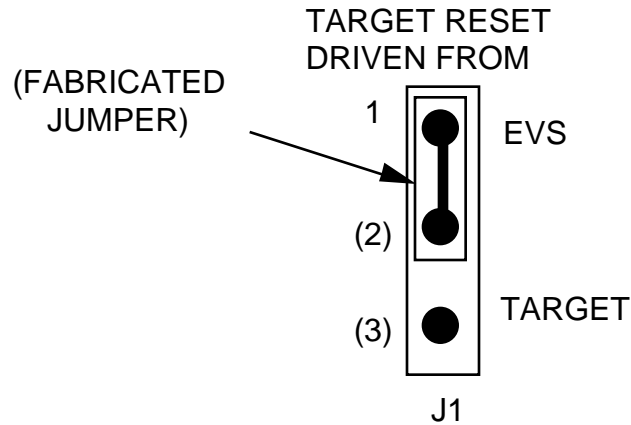
CAUTION

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 F12EM JUMPER HEADERS

Your F32EM has five jumper headers, J1 to J5. Paragraphs 3.1.1. and 3.1.4 explain how to configure these headers.

3.1.1 Target Reset Header (J1)

Jumper header J1 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.

TARGET RESET
DRIVEN FROM

(FABRICATED
JUMPER)

1 EVS

(2)

(3) TARGET

J1

3.1.2 Analog Supply Headers (J2 and J3)

These jumpers serve no purpose when emulating an HC05F12. The position of the jumpers are not important.

J2   1   (2)   (3)
      VDD   EVDD

J3   1   (2)   (3)
      VSS   EGND

FABRICATED
JUMPER
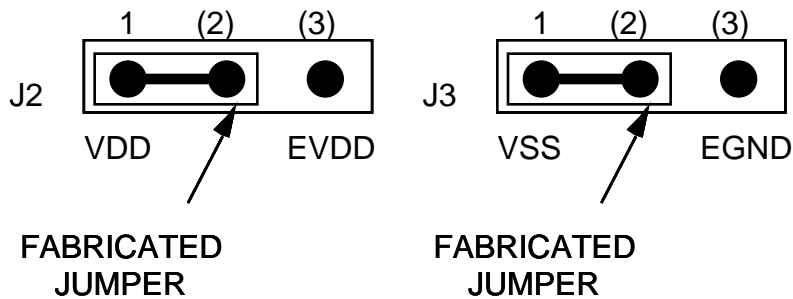
FABRICATED
JUMPER

3.1.3 Clock Select Header (J4)

Jumper headers J4 and J5 determine the source of the clock signal. This header allows the selection of the MMDS or EM clock source The diagram below shows the factory configuration: the fabricated jumper between pins 2 and 3 selects the F12EM oscillator clock source. This is the only correct position for the jumper when using an EVS system.
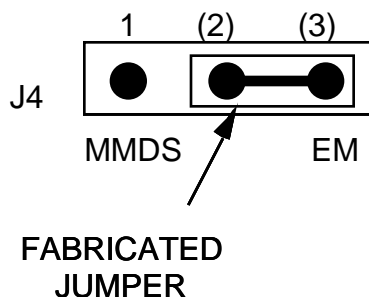
3.1.4 Clock Select Header (J5)

Jumper header J5 allows the user to select either the J4 header selection or the target header to be the source for the clock.The diagram below shows the factory configuration: the fabricated jumper between pin 2 and 3 selects header J4 as the source of the clock.
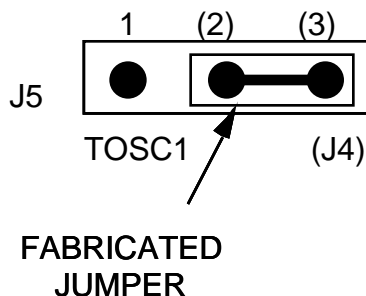
3.2 THE EMULATED MCU

 The factory ships the F12EM with an MC68HC05F12 resident MCU, which is appropriate for emulating the MC68HC05F12 MCU.

3.2.1 MC68HC05F12 Emulation

When emulating a MC68HC05F12 using the F12EM you should not to write to location $001F as this may cause a system malfunction. Also S-records downloads should avoid this location or write 0 into it. For more information about the MC68HC05F12 features, see the corresponding technical data books. The Computer Operating Properly (COP) is currently not supported.

3.3 EVS LIMITATIONS

This paragraph explains the limitations that apply to using your F12EM 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.)

Limitation 5. COP. The COP is not supported by the current platform board.

Limitation 6. At slow E clock rates the MCU will be unable to load S-records correctly. This is due to communication overruns, due to the inability of the MCU to service the ccommunication chip fast enough. To avoid this problem you can slow the transmission rate (not baud rate) or use a faster clock to load the MCU and then slow the clock down.

3.4 LOGIC ANALYZER CONNECTOR P1

Figure 3-1 shows the pin assignments for logic analyzer connector P1. Table 3-2 lists signal descriptions for this connector.
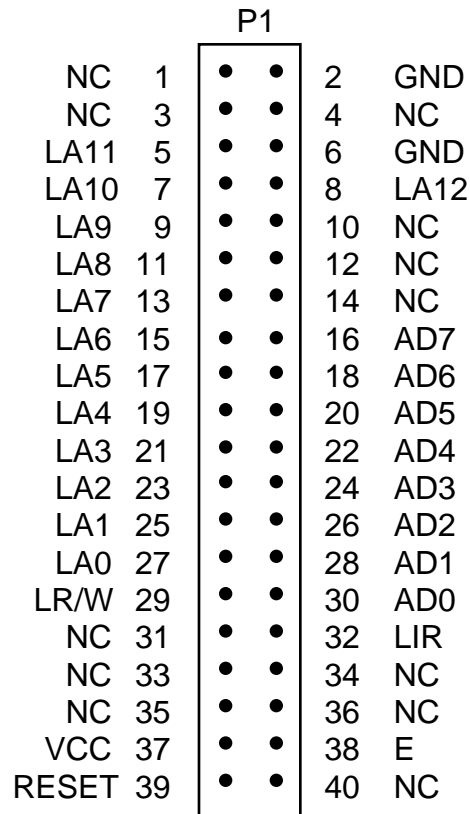
```
                P1

   NC     1  | ● ● |  2   GND
   NC     3  | ● ● |  4   NC
   LA11   5  | ● ● |  6   GND
   LA10   7  | ● ● |  8   LA12
   LA9    9  | ● ● | 10   NC
   LA8   11  | ● ● | 12   NC
   LA7   13  | ● ● | 14   NC
   LA6   15  | ● ● | 16   AD7
   LA5   17  | ● ● | 18   AD6
   LA4   19  | ● ● | 20   AD5
   LA3   21  | ● ● | 22   AD4
   LA2   23  | ● ● | 24   AD3
   LA1   25  | ● ● | 26   AD2
   LA0   27  | ● ● | 28   AD1
   LR/W  29  | ● ● | 30   AD0
   NC    31  | ● ● | 32   LIR
   NC    33  | ● ● | 34   NC
   NC    35  | ● ● | 36   NC
   VCC   37  | ● ● | 38   E
   RESET 39  | ● ● | 40   NC
```

Figure 3-1. Connector P1 Pin Assignments

Table 3-1. Logic Analyzer Connector P1 Signal Descriptions

PIN	MNEMONIC	SIGNAL
1, 3, 4, 31, 33 — 36, 40	-----	No connection
2, 6	GND	GROUND
5, 7, 9, 11. 13. 15. 17, 19, 21, 23, 25, 27	LA11 — LA0	LATCHED ADDRESSES (bits 11—0) - MCU latched output address bus.
8, 10,12,14	LA12,LA13, LA14,LA!5	LATCHED ADDRESSES (bits 12--- 15) - MCU latched output address bus.
16, 18, 20, 22, 24, 26, 28, 30	AD7 — AD0	DATA BUS (bits 7—0) - MCU multiplexed I/O data bus.
29	LR/W	LATCHED READ/WRITE - Active-high output signal that indicates the direction of data transferred on the bus.
32	LIR	LOAD INSTRUCTION REGISTER - Open-drain, active-low output signal that indicates an instruction is starting.
37	VCC	+5 VDC POWER - Input voltage (+5 Vdc @ 1.0 A) used by EVS logic circuits.
38	E	EXTERNAL CLOCK - Internally generated output clock signal used as a timing reference. The frequency of E clock is 1/2 the input frequency of the signal on the OSC2 pin.
39	RESET	RESET - Active-low bidirectional signal for starting an EVS reset.

3.5 REMAINING SYSTEM INSTALLATION

When you have configured headers J1 to J5, you are through with F12EM configuration.

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

J1

A14	1	● — ●	2
A13	3	● — ●	4
A12	5	● — ●	6
A11	7	● — ●	8

FABRICATED
JUMPERS
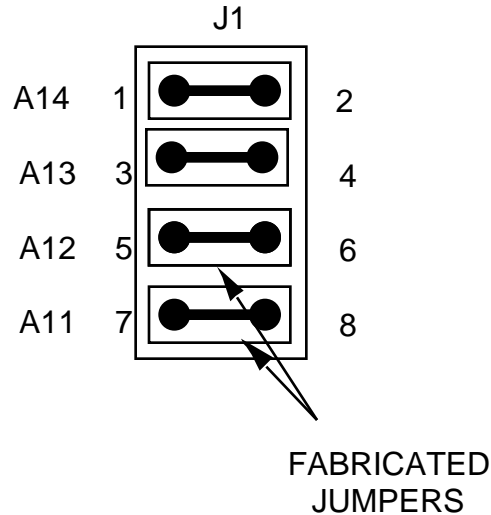
To install the F12EM on an HC05EVS platform board, fit together EM connectors P2 and P3 (on the bottom of the board) and platform-board connectors P3 and P4. Snap the corners of the EM onto the plastic standoffs.

At this point, you are ready to make remaining cable connections, as necessary, and restore power. For instructions, consult the HC05EVS operations manual (HC05EVSOM/D).