

7 M68HC16 and M68300 Development Systems and Tools

The following systems and tools for use with Motorola's M68HC16 and M68300 microcontroller families are described in this section:

- **Motorola Modular Development System (MMDS1632)** – This powerful, full-featured development system supports hardware and software emulation for target systems based on an MCU of either family.
- **Modular Evaluation Board (MEVB1632)** – Developers can economically design, debug, and evaluate target M68HC16- and M68300-based systems using this MEVB.
- **Serial Debug Interface (SDI)** – Suitable for development for all devices within the M68HC16 and M68300 MCU families, the SDI makes use of the background debug mode (BDM) to dramatically reduce development time.
- **M68300 development system products** – These systems provide low-cost solutions for evaluating the M68331, M68332A, and M68332G devices of the M68300 family.

In addition to describing the M68HC16 and M68300 development systems and tools, this section explains how to identify and order the components needed to use the systems for a particular development effort.

MMDS1632 Modular Development System

The MMDS1632 enables complete MCU emulation, including analog and digital functions. It uses an active probe with a variety of microcontroller personality modules to emulate different devices. An integrated development environment (IDE) significantly reduces the time required for developing and debugging an embedded MCU application.

The MMDS1632 features:

- real-time, nonintrusive, in-circuit emulation at the MCU's operating frequency
- real-time bus state analysis
- real-time read/write emulation memory
- complete MCU emulation, including reset and analog/digital functions
- four hardware breakpoints
- background debug mode operation
- C source-level debug with HI-CROSS C compiler

- two cables and 16 logic clips for individual signal selection
- built-in power supply
- power-on self test

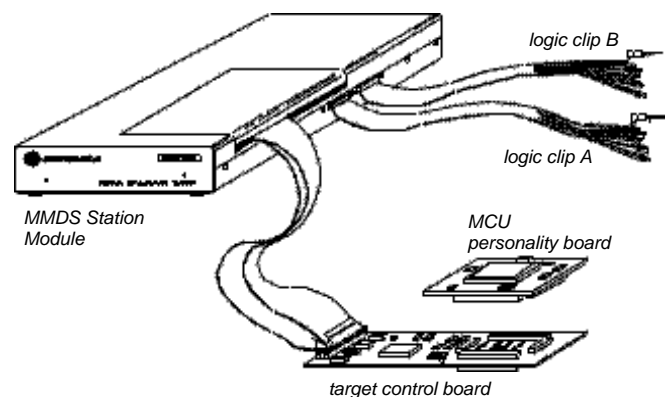
Hardware and Software Components

The MMDS1632 hardware comprises three *separately purchased* components:

- **Station module (M68MMDS1632)** – This metal case contains the target control board (TCB) and a 90- to 264-volt AC internal power supply. The station module comes with this equipment:
 - two TCB ribbon cables
 - two logic clip cable assemblies
 - RS-232C serial cable (9-lead)
 - RS-232C adapter (9- to 25-pin)
 - an AC power cable.

A connector on the enclosure provides +5-volt DC power.

The station module works across all devices of the M68HC16 and M68300 families, and once purchased it can be used to develop any number of applications based on an MCU of these families.

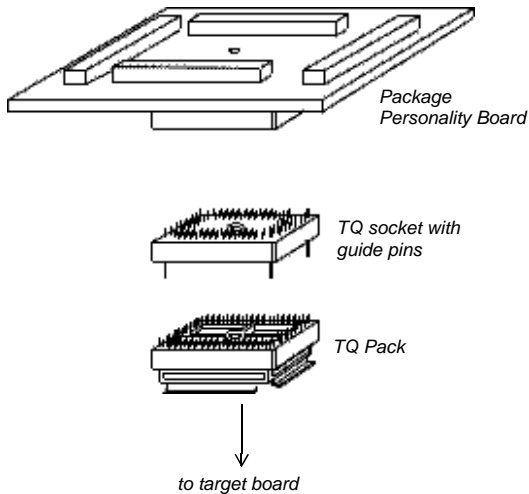


- **MCU personality board (MPB)** – A device- and package-specific board that defines the MCU to be evaluated. *The MPB must be purchased separately.*

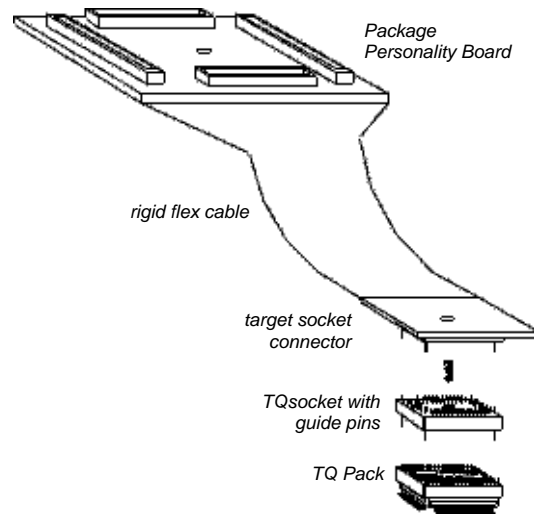
Note: The following components must be purchased separately from the station module. Consult the table on page 33 to correctly order the appropriate MMDS1632 system.

■ **Package-specific personality board (PPB)** – The PPB provides the connection between the station module and the target system. Two types of PPB are available, each using a different connection method:

- **Direct Connect** – The most economical PPB



- **Rigid flex cable** – The most advanced PPB, providing optimal impedance advantages



MMDS1632 software components, which come with the system, include:

- **HIWARE** integrated design environment (IDE). An editor, assembler, and graphical C source-level debugger significantly reduce development time.
- **MCUinit** register initialization software lets developers generate startup code, edit registers, and access online reference manuals.

System Requirements

The MMDS1632 requires a 486-based PC running DOS 5.0 or later or Windows 3.1 or later. The software requires about 20 MB hard disk space. Also required are 8 MB RAM and a serial communication port (COM1, COM2, COM3, or COM4).

The Key Is MODULARITY

Devising an MMDS1632 Development System

The MMDS1632 core station module covers the entire spectrum of devices in the M68HC16 and M68300 microcontroller families and can be reused for multiple development projects involving these devices. The modular components—the MPB and the PPB—must be ordered separately.

Here are the steps for putting together a complete MMDS1632 system. The table below, *Selecting MMDS1632 Components*, helps with the details. Using the table as a guide, follow these steps:

Step 1. Order the MMDS1632 station module.

Regardless of which M68HC16 or M68300 MCU is right for a project, the core station module is always the same: the M68MMDS1632.

Step 2. Select the microcontroller personality board (MPB) that goes with the device.

Each device requires its own MPB, which is used *only* with that device. Each time a different MCU of either family is emulated, a new MPB must be ordered.

Step 3. Decide which connection method is most appropriate.

Choose from among the lowest-cost Direct Connect, the higher-speed woven cable, and the most advanced rigid flex connection methods.

Step 4. Pick the PPB that provides the desired connection method.

Note: As you consult this table, remember that all MMDS1632 systems require the core station module: M68MMDS1632. Choose other components based on the device to be emulated and the appropriate connection method.

Selecting MMDS1632 Components

Device	Package	MMDS Station Module	MPB	PPB (Connection Method)
68HC16S2	100 TQFP (PU)	M68MMDS1632	M68MPB16S2B	X68PPB16PUBG (Rigid-Flex)
68HC16Y1	160 QFP (FT)	M68MMDS1632	M68MPB16Y1B	X68PPB16FTAD (TQ PACK) M68PPB16FTAG (Rigid-Flex)
68HC16Z1	132 PQFP (FC)	M68MMDS1632	M68MPB16Z1B	X68PPB16FCAD (TQ PACK) M68PPB16FCAG (Rigid-Flex)
68331	132 PQFP (FC)	M68MMDS1632	M68MPB331B	M68PPB32FCAD (TQ PACK) M68PPB32FCAG (Rigid-Flex)
68332A	132 PQFP (FC)	M68MMDS1632	M68MPB332AB	M68PPB32FCAD (TQ PACK) M68PPB32FCAG (Rigid-Flex)
68332G	132 PQFP (FC)	M68MMDS1632	M68MPB332GB	M68PPB32FCAD (TQ PACK) M68PPB32FCAG (Rigid-Flex)
68F333C	160 QFP (FT)	M68MMDS1632	M68MPBF333C	X68PPB32FTAD (TQ PACK) M68PPB32FTBG (Rigid-Flex)
68376	160 QFP (FT)	M68MMDS1632	M68MPB376GB	M68PPB32FTCG (Rigid-Flex)

MEVB Modular Evaluation Board

The MEVB is an integrated solution for designing, debugging, and evaluating MCU operations of the M68HC16 and M68300 families. It also helps developers evaluate and debug code to be programmed into these MCUs. To simplify and speed evaluations, the MEVB provides microcontroller timing and port replacement circuitry.

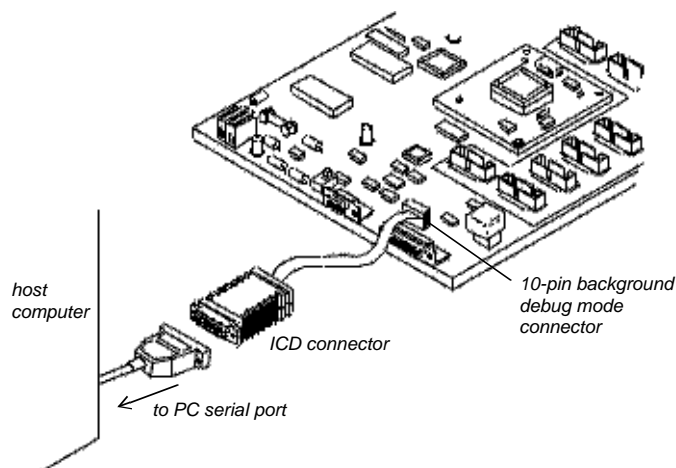
Additional MEVB features include:

- support for several sizes and types of memory device (RAM, EPROM, flash EEPROM), selectable via jumpers.
- seven software breakpoints
- logic analyzer connection for all MCU pins
- on-board MCU and flash EEPROM programming
- wire-wrap area
- background debug mode operation

Hardware and Software Components

A complete MEVB consists of three components, all of which come with the package (ordered with a single part number—see the table on page 35):

- **Modular Platform Board (MPFB1632)** – Printed circuit board that provides interface and power connections for the MPB. The MPFB is not device-specific; it works with the full spectrum of devices of the M68HC16 and M68300 MCU families. Moreover, an MPFB can be reused in multiple projects involving different devices in these families.
- **MCU Personality Board (MPB)** – A device- and package-specific board that defines the MCU to be evaluated. A plastic overlay is also included, which labels pin-outs for the MPFB logic analyzer connectors specific to the MCU.
- **In-circuit debugger (ICD16 and ICD32)** – Full background debugger, also not device-specific, which consists of a printed circuit board, a cable, and development software. The circuit board and cable connect a host computer's parallel port to the MPFB background debug mode connector. ICD16 is for MCUs in the M68HC16 family; ICD32 is for M68300 MCUs.



The M68HC1632 MEVB ICD software lets users:

- single-step through code
- trace instructions
- modify memory
- set and count passes through breakpoints
- measure time between breakpoints
- step through RAM
- debug source code

MEVB System Requirements

The MEVB requires a 386-based or higher host PC running DOS 3.3 or later, at least 1 MB RAM, at least 10 MB hard disk space, a parallel communication port, and this external power supply: +5-volt DC ($\pm 10\%$) @ 1.0 amp (max.) current limited @ 1.5 amps.

ICD type	MCU family used with	Programmer included	Assembler included
ICD16	M68HC16	PROG16	IASM16
ICD32	M68300	PROG32	IASM32

Ordering an MEVB1632 Modular Evaluation Board

The MPFB core module covers the entire spectrum of devices in the 68HC16 and 68300 microcontroller families and can be used for multiple development projects involving these devices. The modular components—the MPB and the ICD—must be ordered separately.

To put together a complete MEVB1632 system, consult the table below, **Ordering an MEVB1632 Modular Evaluation Board**, as you follow these steps:

Step 1. Order the M68MPFB1632 core module.

Regardless of which 68HC16 or 68300 MCU is right for a project, the core module is always the **M68MPFB1632**.

Step 2. Select the microcontroller personality board (MPB) that goes with the device.

Each device requires its own MPB, which is used *only* with that device. Each time a different MCU of either family is emulated, a new MPB must be ordered.

Step 3. Select the appropriate in-circuit debugger (ICD).

The ICD16 is for use with the M68HC16 family of microcontrollers. The ICD32 is for use with the M68300 family of microcontrollers.

Ordering an MEVB1632 Modular Evaluation Board

Emulated MCU (Package)	In addition to the MPFB (M68MPFB1632):	
	MPB	ICD
68HC916X1 [120 PQFP (FH)]	M68MPB916X1C	M68ICD16
68HC16S2 [100 TQFP (PU)]	M68MPB16S2B	M68ICD16
68HC16Y1 [160 PQFP (FT)]	M68MPB16Y1B	M68ICD16
68HC16Z1 [132 PQFP (FC)]	M68MPB16Z1B	M68ICD16
68331 [132 PQFP (FC)]	M68MPB331B	M68ICD32
68332A [132 PQFP (FC)]	M68MPB332AB	M68ICD32
68332G [132 PQFP (FC)]	M68MPB332GB	M68ICD32
68F333 [160 PQFP (FT)]	M68MPB333C	M68ICD32
68334 [132 PQFP (FC)]	M68MPB334B	M68ICD32
68336 [160 PQFP (FT)]	M68MPB336GB	M68ICD32
68376 [160 QFP (FT)]	M68MPB376GB	M68ICD32

Serial Debug Interface (SDI)

Motorola’s SDI is a serial in-circuit debugger that makes use of the background debug mode (BDM) on M68HC12, M68HC16, and M68300 microcontrollers, allowing quick verification and updating of embedded software applications. When used with compatible debug software, the SDI allows users to view and modify applications on the fly—reducing development time and speeding time to market.

For a full description of this powerful debugging tool with ordering information, see “Serial Debug Interface (SDI)” on page 30.

M68300 Development Systems

The 68300 development systems provide low-cost solutions for evaluating the 68331, 68332A, and 68332G devices of the M68300 family.

Hardware and Software

M68300 development system hardware comprises these components, *all ordered separately*:

- **Platform board (PFB)** – Printed circuit board that has connectors for the Business Card Computer (BCC), an external power connector, two RS-232C I/O ports, a background debug mode interface port, an M68881 or an M68882 coprocessor, and a logic interface. Sockets on the PFB allow the user to increase BCC memory via RAM or EPROM.
- **Business Card Computer (BCC)** – Small printed circuit board that plugs into the PFB. The BCC contains this equipment:
 - microcontroller
 - on-board memory
 - serial-level converter circuitry
 - 4-pin serial-communication connector
 - RS-232C terminal/host computer I/O port
 - background debug mode interface port.

Two types of BCC are available:

- M68BCC331, which includes:
 - MC68331 MCU
 - 65K x 16-bit MCU
 - 32K x 16-bit byte-addressable RAM
- M68BCC332A and M68BCC332G, which include:
 - MC68332A or MC68332G MCU
 - 64K x 16-bit RROMs, programmed with the Debug Monitor
 - 32K x 16-bit byte-addressable RAM

Development software for use with the M68300 family is the **Debug Monitor**. Contained in the BCC EPROM, Debug Monitor is a software evaluation and debug tool. The developer can enter commands at the computer or at a to perform these actions:

- display and modify memory
- control breakpoint
- assemble/disassemble code (useful for patching programs)
- verify system integrity (a powerful self-test feature)
- debug software
- customize parameters

System Requirements

Using an M68300 development system requires a terminal or a host computer with terminal emulation. Also required are an RS-232C communications cable and a +5-volt DC at 500 MA power supply.

Ordering M68300 Development System Components

First, order the M68300PFB platform board. Then order BCCs as follows:

Device	In addition to the M68300PFB:
	BCC
68331	M68BCC331
68332A	M68BCC332A
68332G	M68BCC332G