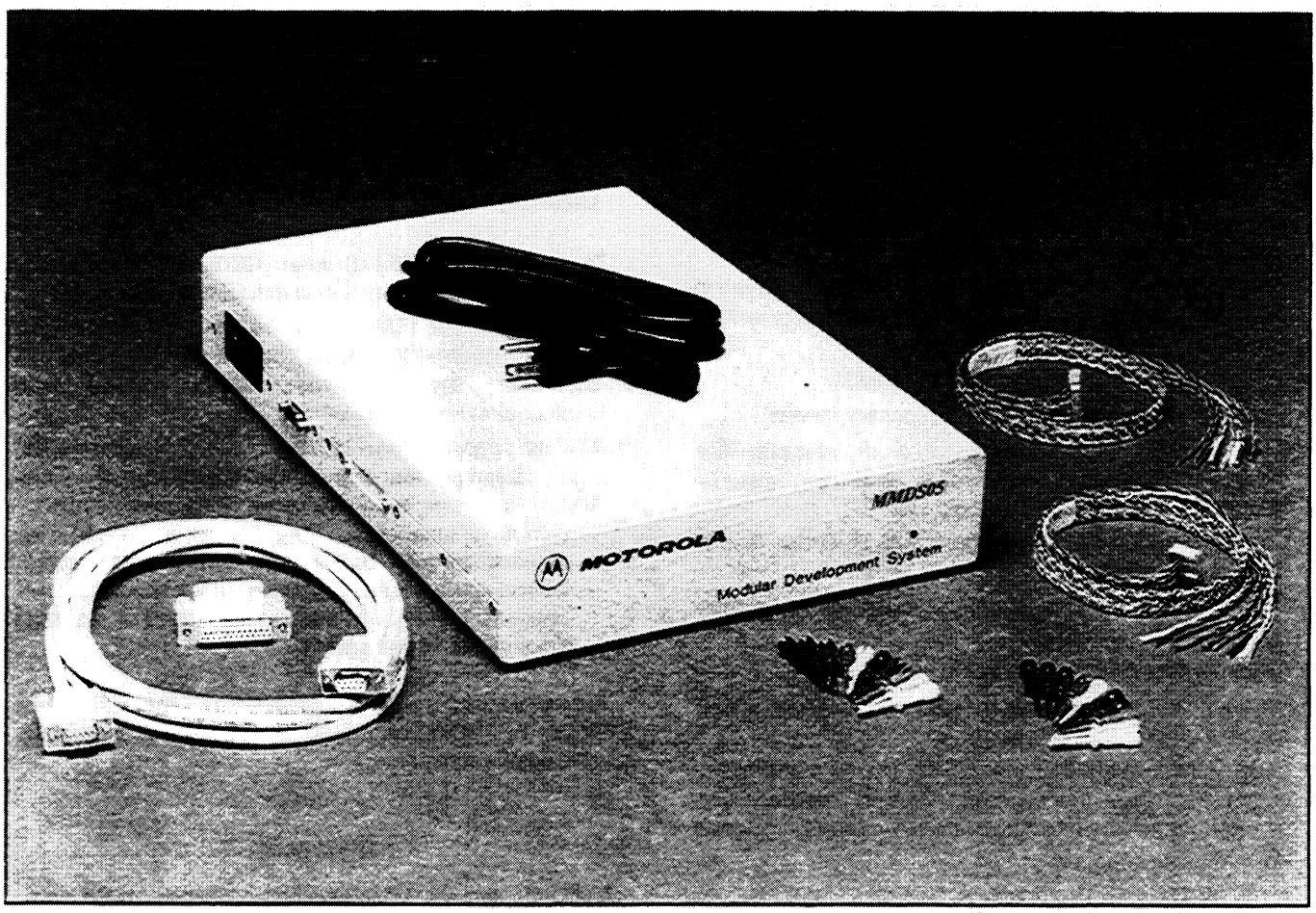
MMDS05

Motorola Modular Development System



The M68MMDS05 Motorola Modular Development System (MMDS05) is an emulator system for developing embedded systems based on an M68HC05 microcontroller unit (MCU). The MMDS05 provides a bus state analyzer (BSA) and real-time memory windows. The unit's integrated development environment includes an editor, an assembler, user interface, and source-level debug. These features significantly reduce the time necessary to develop and debug an embedded MCU system. The unit's compact size requires a minimum of desk space.

The MMDS05 is one component of Motorola's modular approach to MCU-based product development. This modular approach allows easy configuration of the MMDS05 to fit a wide range of requirements. It also reduces development system cost by allowing the user to purchase only the modular components necessary to support the particular MCU derivative.

The station module is a metal enclosure that contains a printed circuit board (the control board), an M68HC05P9EM emulator module, and an internal power supply. A power cable, an RS-232 serial cable, two logic clip cables (with clips), and a 9- to 25-pin RS-232 adapter come with the MMDS05. The system requires an IBM-PC (or compatible) host computer.

While the M68HC05P9EM is shipped with the MMDS05, other EMs (purchased separately) are available that provide system emulation of a variety of different M68HC05 MCUs. Connection to a target system is made with a separately purchased cable (with the appropriate connector) which connects the EM to the target system.

MMDS05 features include:

- Real-time, non-intrusive, in-circuit emulation at the MCU's operating frequency

- Real-time bus state analyzer
  - — 8K x 64 real-time trace buffer
  - — Display of real-time trace data as raw data, disassembled instructions, raw data and disassembled instructions, or assembly-language source code
  - — Four hardware triggers for commencing trace and to provide breakpoints
  - — Nine triggering modes
  - — As many as 8190 pre- or post-trigger points for trace data
  - — 16 general-purpose logic clips, five of which can be used to trigger the bus state analyzer sequencer
  - — 16-bit time tag, or an optional 24-bit time tag that reduces the logic clips traced from sixteen to eight
- Four data breakpoints (hardware breakpoints)
- 64 instruction breakpoints (software breakpoints)
- Thirty-two real-time variables, nine of which can be displayed in the variables window. These variables may be read or written while the MCU is running.
- Thirty-two bytes of real-time memory can be displayed in the memory window. This memory may be read or written while the MCU is running.
- 64K bytes of fast emulation memory (SRAM)
- Target input/output connections are current limited
- Six software-selectable oscillator clock sources: five internally generated frequencies and an external frequency via a bus analyzer logic clip
- Command and response logging to MS DOS disk files to save session history
- SCRIPT command for automatic execution of a sequence of MMDS05 commands
- Assembly source-level debugging
- Host/emulator communications speeds as high as 57600 baud for quick program loading
- Extensive on-line MCU information via the CHIPINFO command. View memory-map, vectors, register, and pin-out information pertaining to the device being emulated
- Host software supports
  - — An editor
  - — An assembler, user interface, and
  - — Source-level debug
  - — Bus state analysis
  - — IBM/Microsoft/Logitech mouse

HARDWARE

An MMDS05 system consists of:

- **Station module** — the MMDS05 enclosure, containing the control board and the internal power supply. A panel in the enclosure top opens to allow easy access for installing or replacing EMs.
- **Two logic clip cable assemblies** — twisted-pair cables that connect the station module to the target system, a test fixture, a clock, an oscillator, or any other circuitry useful for evaluation or analysis. One end of each cable assembly has a molded connector, which fits into pod A or pod B of the station module. Leads at the other end of each cable terminate in female probe tips. Ball clips come with the cables.

Inputs from the logic clip cable assemblies are used as trigger terms by the BSA. The trigger terms, address, data, and bus control signals are recorded by the BSA for later analysis.

- **9-lead RS-232 serial cable** — the cable that connects the station module to the host computer RS-232 port.
- **9- to 25-pin adapter** — a molded assembly that connects the nine-lead cable to a 25-pin serial port.
- **System software** — station software, on a 3.5-inch, high density diskette.
- **MMDS05 documentation** — an MMDS05 operations manual, MMDS05OM/D and Rapid integrated .
- **M68HC05P9EM emulator module** — a printed circuit board that completes MMDS05 functionality. The EM fits onto the 64-pin connectors of the control board and lets the user emulate M68HC05P1, M68HC05P4, M68HC05P7, M68HC05P9, and M68HC705P9 MCUs.

To use an MMDS05 with other HC05 MCUs requires a separately-purchased, device-specific EM and target cable:

- Emulator module (EM) — a device specific printed circuit board for other HC05 MCUs. The EM has a target cable connector. The appropriate user's manual and configuration files come with the EM.
- Modular target cable — a device and package specific cable assembly that connect the target system to the MMDS05 system. A modular target cable consists of:
  - — Controlled-impedance, flexible-circuit cable — connects between the EM and a target-head adapter.
  - — Device and package specific target-head adapter — connects the target cable to a wide range of package types on the target system.

To program user's code into an M68HC05 MCU with internal EPROM, EEPROM, or OTPROM requires a separately purchased programmer.

SOFTWARE

MMDS05 software is supplied on a 3.5-inch 1.44Mb high-density diskette. The software's integrated design environment includes an editor, an assembler, user interface, and source-level debugger. The installation utility automatically installs the software and all related files to quickly get the system up and running. When started, the software automatically establishes communications with the station module at the maximum available baud rate.

MMDS05 software consists of a main debug screen (shown in Figure 1) which supports several interactive screens. The debug screen implements these features:

- Command input area
- Debug assembly-language programs
- View and modify variables, using their source language names
- Provide help dialogs for all commands
- Display register contents
- Display memory contents
- Display emulator status

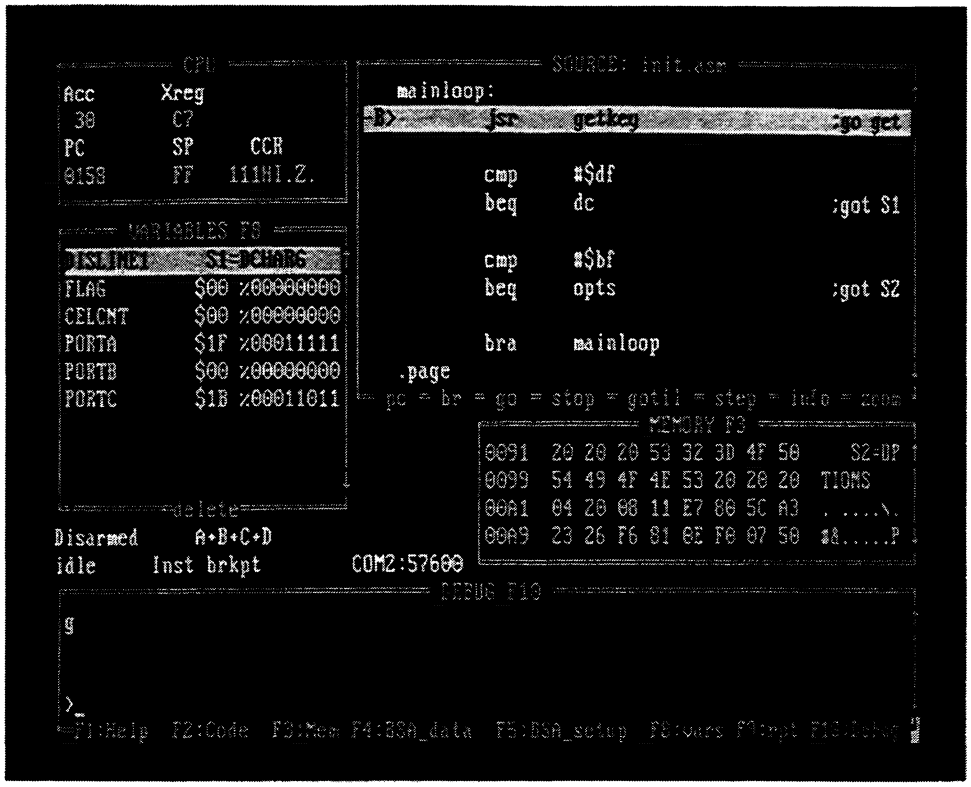


Figure 1. Debug Screen

DEBUG SCREEN

The Debug Screen consists of a status area and five windows that display the CPU registers, source or object code, variables, memory contents, commands, and results. To carry out actions associated with a window of the debug screen, select (or move to) the window. To select a window, press the numbered function key indicated in the window title.

The status area displays several items of status information, such as command history, error messages and system status.

The CPU window displays the contents of the A accumulator, the X index register, the program counter (PC), the stack pointer (SP), and the condition code register (CCR). As a new value is entered for any of these registers, the new value appears in the window.

The source/object code window shows source or object code. At start-up the source/object code window default display is object code. The source/object code window contents are a disassembled representation of MCU memory. In this object code display, the disassembled instructions change when corresponding bytes of memory change.

Thirty-two variables, nine of which can be displayed in the variables window, may be specified using the VAR or RTVAR command. The variables appear with their current values in hexadecimal, binary, decimal, or ASCII format. Using the RTVAR command establishes a variable as a real-time variable, so that variables can be monitored and changed during program execution.

The memory window displays the contents of 32 bytes of memory locations using the MD or RTMEM commands. This window may be set or scrolled to any location within the 64K byte memory map. Using the RTMEM command establishes memory as real-time, so that memory can be monitored and changed during program execution.

Several temporary windows appear near the center of the debug screen when certain commands are executed. These temporary windows display the contents of the stack pointer, stack, and analyzer trace data. Other windows display and allow modification of the memory map organization, host communication baud rate, MCU system emulator clock frequency, and BSA time tag.

BUS STATE ANALYZER

The MMDS05 bus state analyzer (BSA) records the logical state of the target MCU control signals and address/data bus. Using the logic clip cables (pods A and B), the BSA also records the logical state of as many as 16 other target signals. At the end of each MCU bus cycle, the BSA takes a snapshot of the logical state of the target MCU bus and logic clip information. The analyzer stores the snapshots in the trace buffer, according to the selected mode (see the analyzer modes table). The trace buffer can hold information on as many as 8190 MCU clock cycles.

The BSA functions by first defining as many as four events that trigger it to start recording MCU bus and logic clip information. (Figure 2 shows the BSA setup window.) An event consists of a specific combination of the MCU control signals, address/data bus, and five of the logic clips. Two events can be combined to define a range of MCU bus activity that triggers the BSA. The analyzer mode is selected once an event is defined.

The BSA provides several ways to view collected data: raw data, disassembled instructions, mixed raw data and disassembled instructions, or source code. Figure 3 shows the BSA data window (mixed data).

Mode	Description
Continuous: all cycles	The trace buffer stores data from all cycles.
Continuous: events only	The trace buffer stores data from all cycles that match an event definition.
Counted: all cycles	The trace buffer stores data from the specified number of all cycles.
Counted: events only	The trace buffer stores data from the specified number of cycles that match an event definition.
A+B+C+D	The trace buffer stores data from all cycles. This continues through the occurrence of event A, B, C, or D. Data storage ends after the specified number of post-trigger cycles.
A+B→C+D	The trace buffer stores data from all cycles. This continues through the occurrence of two events: A or B, followed by C or D. Data storage ends after the specified number of post-trigger cycles.
A→B→C!D	The trace buffer stores data from all cycles. This continues through the occurrence of three events, A, B, and C, in order, if event D does not occur (if event D occurs the sequencer resets and starts over looking for event A). Data storage ends after the specified number of post-trigger cycles.
A→B→C→D	The trace buffer stores data from all cycles. This continues through the occurrence of four events, A, B, C, and D, in order. Data storage ends after the specified number of post-trigger cycles.
Nth event: A+B+C+D	The trace buffer stores data from N occurrences of cycles that match the definitions of events A, B, C, or D (whichever are enabled). Then the bus state analyzer captures the next 4096 cycles. Data storage ends after the specified number of post-trigger cycles.

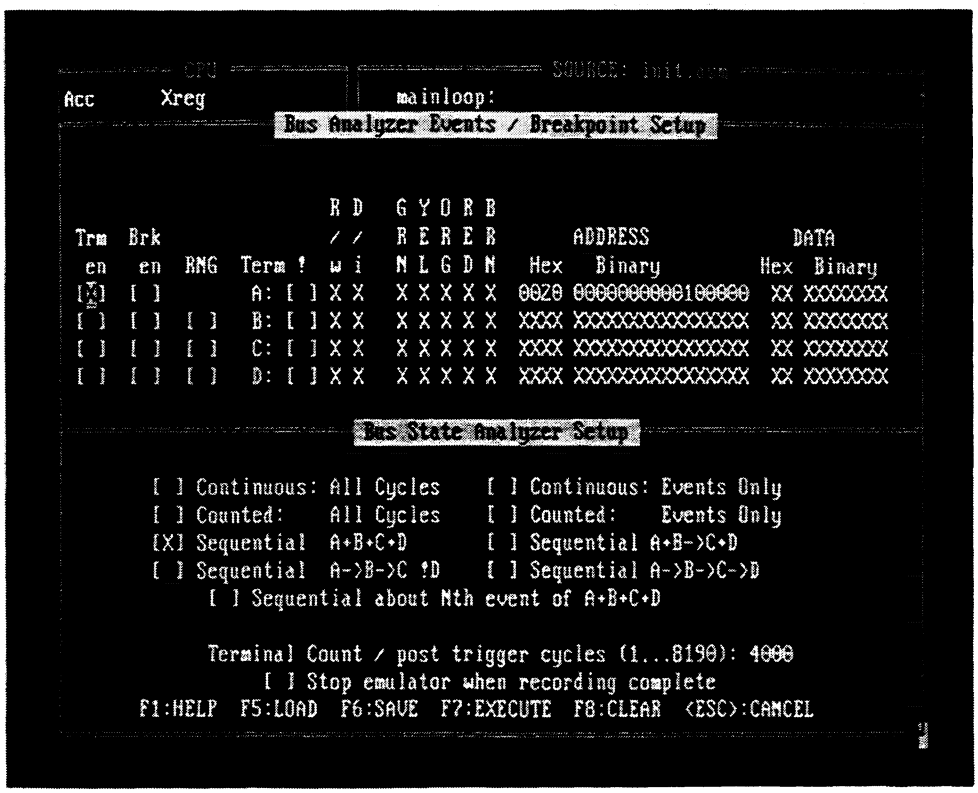


Figure 2. BSA Setup Window

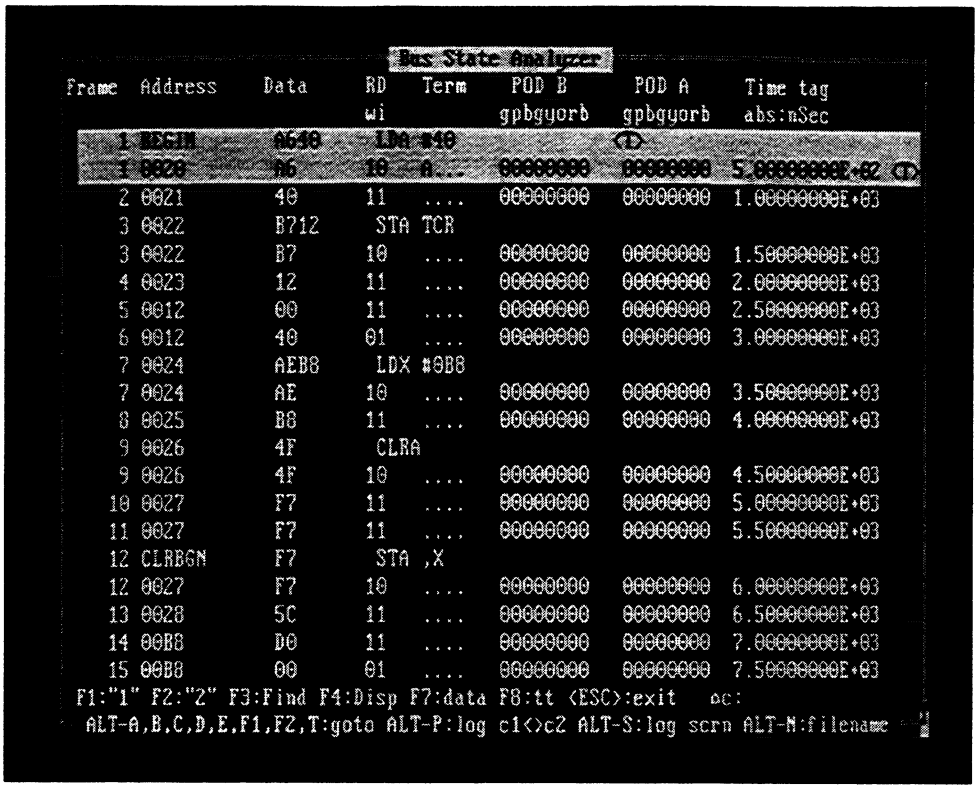


Figure 3. Bus State Analyzer Data Window

COMMANDS

Command	Description
A	Set accumulator A
ARM	Arm bus state analyzer
ASM	Assemble instructions
BAUD	Set communications baud rate
BAUDCHK	Baud rate check
BELL	Sound bell
BF	Block fill
BR	Set instruction breakpoint
C	Set/clear C bit
CCR	Set condition code register
CHIPINFO	Chip help information
CLEARMAP	Remove symbols
COLORS	Set screen colors
DARM	Disarm bus state analyzer
DASM	Disassemble instructions
ENDBSA	Go to trace buffer end
EVAL	Evaluate argument
EXIT	Terminate host session
G	Begin program execution
GETBSA	Upload trace buffer
GO	Begin program execution
GOTIL	Execute program until address
H	Set/clear H bit
HELP	Display help information
HOMEBSA	Go to trace buffer start
I	Set/clear I bit
INFO	Display line information
LF	Log file
LOAD	Load S19 file
LOADMAP	Load symbols
LOADMEM	Load personality file
LOADTRIGGERS	Load bus state analyzer setup
MD	Memory display
MM	Memory modify
N	Set/clear N bit
NEXTA	Go to next A event
NEXTB	Go to next B event
NEXTC	Go to next C event

Command	Description
NEXTD	Go to next D event
NEXTE	Go to next event
NOBR	Clear breakpoints
OSC	Select emulator clock frequency
PC	Set program counter
QUIT	Terminate host session
REG	Display registers
REM	Add comment to script file
RESET	Reset emulation MCU
RESETGO	Reset and restart MCU
RESETIN	Reset input enable
RESETOUT	Reset output enable
RTMEM	Set real-time memory block
RTVAR	Display real-time variable
SCREENBSA	Log bus state analyzer screen
SCRIPT	Execute script file
SATMEM	Customize memory map
SHELL	Access DOS
SHOWMEM	Display memory map
SHOWTRIGGER	Print trigger
SOURCE	Source window display
STACK	Display stack
STEP	Single step (Trace)
STEPFOR	Step forever
STEPTIL	Single step to address
STOP	Stop program execution
SXB	Set multiplexer
SYSINFO	System information
T	Single step (Trace)
TIMETAG	Time tag clock source
VAR	Display variable
VERSION	Display version
WAIT	Pause between commands
WAIT4RESET	Wait for target reset
WHEREIS	Display symbol value
X	Set X index register
Z	Set/clear Z bit
ZOOM	Re-size source window

SPECIFICATIONS SUMMARY

The tables below summarize MMDS05 requirements.

MMDS05 Specifications

Characteristic	Specification
Temperature Operating Storage	 0° to 50°C –40° to 85°C
Physical dimensions Depth Width Height	 15.38 in. (390.6 mm) 10.19 in. (258.83 mm) 2.75 in. (69.85 mm)
Power Requirements Power Supply Input	 85 to 264 VAC, 50–60 Hz (1.5 Amp fused)
Power Output	+5 Vdc @ 150 milliamps

Minimum Host PC Requirements

Characteristic	Specification
Compatibility	80386
DOS Version	3.3 or later
Disk Storage	Hard disk drive — software requires 1.5 MB
Memory	640K (128K available for user)
Input/Output	Serial communication port COM1, COM2, COM3, or COM4

Enhanced Host PC Requirements

Characteristic	Specification
Compatibility	80486
Monitor	High-resolution color monitor with either an EGA or VGA graphics adapter card
Mouse	Microsoft, Logitech, or IBM mouse. (Other mice may be acceptable, but Motorola does not guarantee their satisfactory performance with MMDS05 software.)
Memory	1 megabyte

ORDERING INFORMATION

Description	Part Number
MMDS05 Emulator — System consisting of: a station module with M68HC05P9EM emulator module installed, an ac power cable, a serial interface cable and 9- to 25-pin adapter, two logic clip cable assemblies, system software on one 3.5-inch, HD diskette, and operation manuals	M68MMDS05

For example, a complete Modular Development System order for the MC68HC705J2P (20-pin DIP with internal EPROM or OTPROM) will be:

Component	Example Part Number
The basic system	M68MMDS05
An emulator module	M68HC05JPEM
A target cable	M68CBL05A
A target head	M68TA05J2P20
Programmer	M68HC705J2PGMR

Contact a Motorola authorized distributor or a Motorola sales office for ordering information and availability of a complete development system solution for other Motorola M68HC05 microcontrollers.

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MMDS05/D

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