

# Real-time Emulator Motorola MC68010

Model 64245AA

Model 64245AB



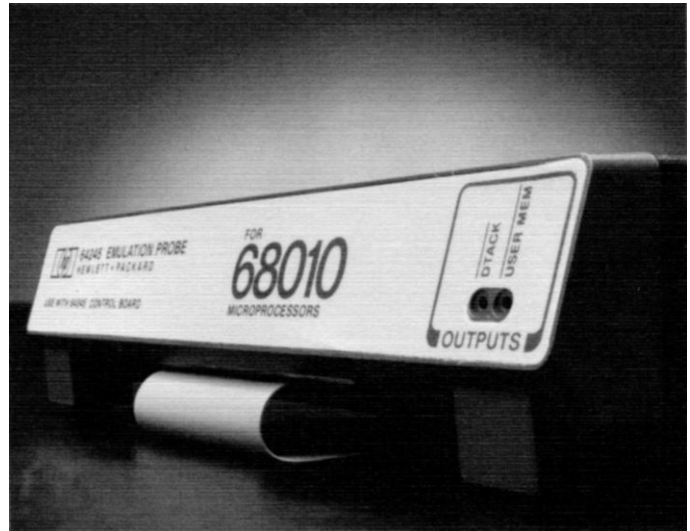
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## Description

The Model 64245 Emulator provides real-time, transparent emulation for Motorola MC68010 microprocessor-based systems. As an integrated subsystem of the HP 64000 Logic Development System, the HP 64245 adds the power of emulation to all phases of MC68010 product design, development, and maintenance.

The Model 64245 consists of an emulation control card, emulation pod, and HP 64000 operating system software. Connection to the target system is made with a 305 mm (12 in.) cable that terminates in either a 64-pin DIP probe for the HP 64245AA or a 68-pin PGA probe for the HP 64245AB. A typical MC68010 emulation system includes an HP 64245 Emulation Subsystem, HP 64156S Emulation Memory, and Model 64302A Emulation Bus Analyzer. With this configuration, the HP 64000 system's extensive set of development aids can be readily applied to MC68010-based designs.

HP 64000 features include directed-syntax softkeys and an easy-to-use editor to streamline software development and documentation. High-level software, logic state, and timing analyzers can be combined with the emulator for a wide variety of interactive, cross-triggered measurements. With the Model 64245 Emulator and the many compatible HP 64000 development tools, you can produce a better MC68010-based product in less time, to gain a competitive edge.



## Features

- Real-time execution up to 12.5 MHz
- Real-time MC68010 instruction execution and bus cycle analysis
- Up to 896 kbytes of emulation memory
- No modification to user vector table for emulator operation
- Function code mapping for emulator and target system memory
- Both DIP and PGA versions of the MC68010 are supported
- Simulated I/O supports software debugging before target system hardware is operational
- Full use of DMA arbitration
- Expanded measurement systems through interactive operation with other HP 64000 subsystems:
  - Another MC68010 emulator or any other HP 64000 emulator
  - HP 64610S High-speed Timing/State Analyzer
  - HP 64620S Logic State/Software Analyzer
  - HP 64310A Software Performance Analyzer
  - HP 64334B High-level Software Analyzer

## Getting Started

Analysis and debugging can begin as soon as the first code is written. A 10 MHz internal clock and the appropriate emulation memory provide a method for exercising software with or without functional target system hardware. Real-time software execution is fully maintained to ensure accurate duplication of the final MC68010 product performance.

Flexible mapping allows you to assign memory to the emulation or target system in 4-kbyte blocks. Blocks are assigned as guarded access, RAM, or ROM across the full address range of the MC68010 (figure 1). The 4-kbyte blocks are a convenient size for efficiently transferring resources from the emulator to the newly developed target system.

The HP 64245 provides additional support for MC68010 systems using function codes to partition memory. Blocks can be assigned to emulation memory as supervisor, user, program, data, CPU space, supervisor program, supervisor data, user program, user data, and function codes (000, 011, 100, and all).

Simulated I/O supports concurrent software and hardware development and debugging. Program development can continue uninterrupted using the HP 64000 facilities for I/O signals. Your printer, display, keyboard, disc, and RS-232 channel can all be simulated on the HP 64000 development station.

## Nonintrusive Analysis: A Must for Real-time Systems

Many MC68010-based products are applied to controlling or monitoring critical real-time processes. With an HP 64245 Emulator, your development tools support a wide variety of real-time measurements without intruding on target system operation. The Model 64245 allows you to monitor all MC68010 memory activity nonintrusively and in real time while the target system is operating at full speed.

Information monitored by the emulator is passed to the HP 64302A Emulation Bus Analyzer, where trigger and storage directives are applied. Triggers can be defined for any event and set for the start, center, or end of the trace measurement. Storage qualifiers let you specify which kinds of events are captured and stored in analyzer memory. Commands are entered with easy-to-use softkeys. Trigger and store specifications can include address, data, status, ranges, don't-care bits, and occurrence counts.

The MC68010 processor has a two-word prefetch that allows the processor to fetch instructions before using the information. Normally, a display of all bus activity would include the prefetches along with the executed instructions. This makes it difficult to analyze software execution (figure 2). The HP 64245 has an execution mode which provides instruction stream dequeuing. This shows the instructions actually executed for an easy-to-understand display (figure 3). A bus cycle mode is also available when needed to monitor all bus activity.

```

Emulation memory blocks: available= 0 mapped= 8 size= 4K bytes
entry range type blocks entry range type blocks
1 0- 1FFF RAM/EM/SUPR 000-001 :
2 2000- 3FFF RAM/EM/USER 002-002 :
3 3000- 3FFF RAM/EM/PROG 003-003 :
4 4000- 4FFF RAM/EM/DATA 004-004 :
5 5000- 1FFFF RAM/TR/ALL - :
6 20000- 20FFF RAM/EM/UD 005-005 :
7 21000- 21FFF RAM/EM/SP 006-006 :
8 22000- 22FFF RAM/EM/CPU 007-007 :
9 300000-FFBFFF GUARDED - :

STATUS: Mapping emulation memory, default blocks: target/ram _____ 0:10
  _20000H user_data.emulation_ram

<ADDRESS> default delete _____ end
  
```

Figure 1. Flexible mapping allows assignment of memory as ROM, RAM, or guarded access in 4-kbyte blocks.

```

Trace: bus cycle data break: none count:
line# address opc/data mnemonic opcode or status time, relative
+001 001764 207C MOVEA.L #00000178EH,A0
+001 001766 0000 supr program read <1. uS
+002 001768 178E supr program read 1. uS
+003 00176A 4279 CLR.W 000178AH 1. uS
+004 00176C 0000 supr program read <1. uS
+005 00176E 178A supr program read 1. uS
+006 001770 6702 BEQ.B 0001774H <1. uS
+007 001772 3018 MOVE.W [A0],D0 1. uS
+008 001774 4579 NOT.W 000178AH 1. uS
+009 001776 0000 supr program read <1. uS
+010 001778 178A supr program read 1. uS
+011 00177A 6702 BEQ.B 000177EH <1. uS
+012 00177C 0000 supr data read 1. uS
+013 00177E 3420 MOVE.W -(A0),D2 1. uS
+014 001780 0000 supr data write <1. uS
+015 001782 FFFF supr data write 1. uS

STATUS: M68010--Running Trace complete _____ 0:15
_run from START

<Fwd trace step display modify break end ---ETC---
  
```

Figure 2. A measurement trace of an MC68010 instruction stream shows all activity in bus cycle mode, including memory accesses and instruction prefetches.

```

Trace: execution data break: none count:
line# address opc/data mnemonic opcode or status time, relative
+003 00176A 4279 CLR.W 000178AH 1. uS
+006 00177A 0000 supr data write 2. uS
+007 001770 6702 BEQ.B 0001774H <1. uS
+008 001774 4579 NOT.W 000178AH 1. uS
+011 00177A 0000 supr data read 1. uS
+012 001780 FFFF supr data write 1. uS
+013 00177A 6702 BEQ.B 000177EH 1. uS
+014 00177C 3420 MOVE.W -(A0),D2 1. uS
+015 00178C 0000 supr data read <1. uS
+016 00177E 283A MOVE.L 000178EH(PC1),D4 1. uS
+018 00178E 0000 supr data read 1. uS
+019 001790 0000 supr data read 1. uS
+020 001782 4E71 NOP 1. uS
+021 001784 60DE BRA.B 0001764H <1. uS
+022 001764 207C MOVEA.L #00000178EH,A0 1. uS

STATUS: M68010--Running Trace complete _____ 0:21
_run from START

<Fwd trace step display modify break end ---ETC---
  
```

Figure 3. Execution mode shows actual instructions executed by the MC68010. This provides for accurate analysis and display.

## Controlling Your MC68010 System

With the HP 64245 Emulator, you have direct control over your evolving MC68010 system. You can display and modify any register or memory location. You also have complete control of the program flow with step, run-from, and run-until directives. Run controls initiate or terminate program execution at a specified address or symbol. These functions allow you to thoroughly investigate the details of target system operation at the early design stages.

Register displays are comprehensive, yet easily understood. All registers are clearly identified, and status bits are labeled for easy interpretation (figure 4).

Memory displays show you any location or range of locations. Display selections include bytes, words, and ASCII equivalents, or memory locations translated into MC68010 mnemonics. Memory modifications are allowed in either single- or multiple-word ranges.

## Advanced Analysis Power — from Micro to Macro Measurements

As your MC68010 system grows, it becomes increasingly more complex. You can add correspondingly more powerful HP 64000 measurement tools as they are needed to serve new levels of analysis. Analyzers are available for the whole spectrum of logic measurements—from a bit-by-bit analysis of individual signal lines for a micro view to a total system performance analysis for a macro view.

An HP 64334B High-level Software Analyzer offers HP 64000 system users an advanced, yet easy-to-use feature set for analysis of programs written in Pascal or C. Programs are debugged using source-level constructs such as functions, procedures, statements, variables, and data structures. This simplifies correlations between executing software and written programs, making the analyzer a powerful tool for testing and revising high-level software (figure 5).

As target system hardware evolves, a Model 64610S High-speed Timing/State Analyzer can be added to check timing relationships at speeds up to 400 MHz. Postprocessing capabilities capture and hold timing measurements in order to store timing traces, compare measurements, mark significant signal combinations, and compute means and variances of specified intervals. With an HP 64610S analyzer you can closely examine the detail of the executing system. An external clock mode provides state analysis capabilities at clock speeds up to 125 MHz with up to 32 input channels. This allows you to analyze the operation of high-speed logic in bit-slice and state machines in real time.

At the next level of measurement, a Model 64620S Logic State/Software Analyzer has the functions to support intricate analysis modes: up to 120 input channels, 15 levels of sequential triggering, broad definitions for storage qualifiers, and measurement window specifications. The HP 64620S analyzer can be connected to the emulation subsystem through the HP 64304A Emulation Bus Preprocessor to enhance or replace the HP 64302A Emulation Bus Analyzer.

For optimizing and characterizing software performance, the HP 64310A Software Performance Analyzer provides macro views of total system performance by activity, interaction, or duration. The performance analyzer becomes an integral part of

```
MC68010 Registers
Next PC 00177A STATUS 2708 ( s n ) USPT 0000161A SSPT 0000161A
D0-D7 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
A0-A7 000017BE 00000000 00000000 00000000 00000000 00000000 00000000 0000161A
VBR 00000000 SFC 000b DFC 000b

PC 00177A Opcode 0B00 BTST.L D5,D0
Next PC 00177C STATUS 2708 ( s n ) USPT 0000161A SSPT 0000161A
D0-D7 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
A0-A7 000017BE 00000000 00000000 00000000 00000000 00000000 00000000 0000161A
VBR 00000000 SFC 000b DFC 000b

PC 00177C Opcode 0B32 BTST.B D5,000H[A2,D0.L]
Next PC 00177E STATUS 2704 ( s z ) USPT 0000161A SSPT 0000161A
D0-D7 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
A0-A7 000017BC 00000000 00000000 00000000 00000000 00000000 00000000 0000161A
VBR 00000000 SFC 000b DFC 000b

STATUS: MC68010--Step complete Trace complete 0:26

_step 2

_run _trace _step _display _modify _break _end ---F10---
```

Figure 4. Register displays are labeled for easy interpretation of all registers and status bits.

```
64334 Software Analyzer: Slot 7 with em68010 Emulator: Slot 3
Symbol Stat Source
SEARCH exit
SEARCH entry 60 SEARCH( 9.4450); (...THEN FIND THIRD VALUE
SEARCH exit
MULTIPLY entry 62 MULTIPLY; (MPY OPERAND_A * OPERAND_B)
OVERFLOW_TEST entry 32 OVERFLOW_TEST; (DID MPY OVERFLOW?)
OVERFLOW_TEST exit
MULTIPLY exit
PLACE entry 63 PLACE(OPERAND_A); (PUT OPERAND "A" ON STACK)
PLACE exit
PLACE entry 64 PLACE(OPERAND_B); (PUT OPERAND "B" ON STACK)
PLACE exit
FACTORIAL entry 65 OPERAND_B := FACTORIAL(OPERAND_A); (COMP
FACTORIAL entry 49 ELSE FACTORIAL := VALUE * FACTORIAL(VALUE-
FACTORIAL entry 49 ELSE FACTORIAL := VALUE * FACTORIAL(VALUE-
FACTORIAL entry 49 ELSE FACTORIAL := VALUE * FACTORIAL(VALUE-

STATUS: Awaiting command 20 0:50

(STATE) _display _copy _show _end
```

Figure 5. The addition of an HP 64334B High-level Software Analyzer provides source code level debugging.

the emulation system, so you can begin optimizing your MC68010 programs early in the design cycle.

For multiprocessor applications, the HP 64245 Emulator can be used interactively with other HP 64000 system emulators through the HP 64964A Intermodule Bus (IMB). The IMB also supports cross-triggering between analysis tools and emulators. The larger measurement system possible with the HP 64000 is not restricted to analysis and emulation subsystems in a single development station; the HP 64303A IMB Extender Board gives you access to measurement tools resident in other development stations.

## Making a Difference

The Model 64245 Emulator offers development support for all phases of MC68010 microprocessor-based designs. HP 64000 tools have the flexibility, power, and convenience required for designing and implementing effective MC68010-based products, quickly and efficiently. Friendliness and the powerful measurement subsystems of the logic development system foster good design practices and complete debugging, from the first design statements to the finished product.

## Specifications

**Processor compatibility:** compatible with Motorola MC68010 microprocessor and any other processor that complies with the specifications of these devices.

## Electrical

**Maximum clock speed:** 12.5 MHz. (No wait states when executing from user memory; one wait state from emulation memory above 10 MHz.)

**Data inputs:** all inputs meet Motorola specifications plus one ALS TTL load and approx 40 pF capacitance.

**Power:** 6 mA drawn from the target system; all other power supplied by the development station.

## Physical

**Cable length:** development station to emulation pod, approx 1.5 m (5 ft); emulation pod to target system interface, approx 305 mm (1 ft).

## Environmental

**Temperature:** operating, 0° to 40°C (32° to 104°F); non-operating, -40° to 75°C (-40° to 167°F).

**Altitude:** operating, 4600 m (15 000 ft); nonoperating, 15 300 m (50 000 ft).

**Relative humidity:** 5% to 80%.

## Accessories Supplied

Model 64245 Emulation Subsystem includes an emulation control board, emulation pod, and operating system software; appropriate cables for connections from the control board to the pod and from the pod to the target system; operating software supplied on flexible disc; and operator and service manuals. Emulation/Analysis Bus cables must be ordered separately.

## Ordering Information

Model	Description
64245AA	MC68010 Emulation Subsystem (configured with 64-pin DIP probe)
64245AB	MC68010 Emulation Subsystem (configured with 68-pin PGA probe)
64156S	Emulation Memory System, 32 kbytes
Opt 011	Expand to 64 kbytes
Opt 012	Expand to 128 kbytes
Opt 013	Expand to 256 kbytes
Opt 014	Expand to 512 kbytes
Opt 015	Expand to 1024 kbytes
64302A	48-channel Emulation Bus Analyzer
64845S	MC68010 Assembler/Linker System
64845SR	Right-to-reproduce HP 64845S
64845SX	One-time Update of HP 64845S
64815S	MC68010 Pascal Language System
64815SR	Right-to-reproduce HP 64815S
64815SX	One-time Update of HP 64815S
64819S	MC68010 C Language System
64819SR	Right-to-reproduce HP 64819S
64819SX	One-time Update of HP 64819S

## Software Support

Model	Description
64245AX	One-time Update of HP 64245 operating system software
64245A/S00	Monthly Software Materials Subscription for HP 64245 operating system software
64245A/W00	Extended Software Materials Subscription for HP 64245A/S00

## Accessories

Model	Description
64960A	2-position Emulation/Analysis Bus Cable
Opt 001	3-position Emulation/Analysis Bus Cable
Opt 002	4-position Emulation/Analysis Bus Cable

Printed in U.S.A.  
5953-9282

Data subject to change.



For more information, call your local HP Sales Office or nearest Regional Office: Eastern (301) 258-2000; Midwestern (312) 255-9800; Southern (404) 955-1500; Western (818) 506-3700; Canadian (416) 678-9430. Ask the operator for Instrument Sales. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. In Europe: Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box CH-1217 Meyrin 2, Geneva, Switzerland. In Japan: Yokogawa-Hewlett-Packard Ltd., 29-21, Takaido-Higashi 3-chome, Suginami-ku, Tokyo, 168.