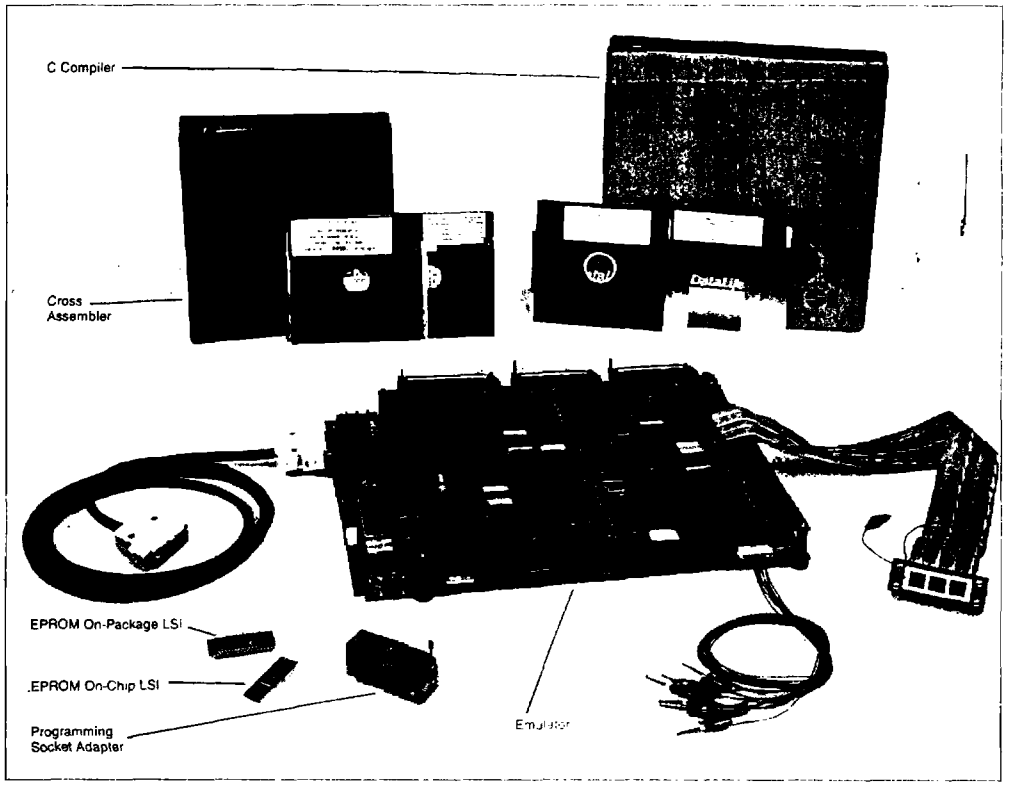
Device Availability

	Description	HD6303R	HD6303X	HD6303Y	HD6305X2 HD6305Y2	HD64180R	HD64180S
HARDWARE	Emulator	HS31VEML04H[1] (H31MIX4)[2]	HS31XEML02H[1] (H31MIX2)[2]	HS31YEML03H[1] (H31MIX3)[2]	HD35YEML05H[1] (H35MIX5)[2]	HD180ABX02H[4]	HS180ABX05H[4]
	ASE (Adaptive System Emulator)					HS180AST01H	HS180AST01H
	User Cable					HS180ACUC1H	
	Emulation Memory Board up to 64K Byte		H64EMB02	H64EMB02			
	Emulation Memory Board					H680SM01S[6]	H680SM01S[6]
	Evaluation Board						US180EVB01H
	Programming Socket Adapter			HS31YESS11H			
	Programming Socket Adapter						
	Programming Socket Adapter						
SOFTWARE	Cross Assembler (IBM-PC)	S31IBMPC[3]	S31IBMPC[3]	S31IBMPC[3]	S35IBMPC[3]		
	C Compiler (IBM-PC)	US31PCLI1SF	US31PCLI1SF	US31PCLI1SF			
LITERATURE	Data Sheet	M21T006 M21T132	M21T006 M21T132	M21T006 M21T132	M21T006 M21T132	M21T132	M21T132
	Hand Book	M21T019[5]	M21T019[5]	M21T019[5]	M21T020[5]		
	Specification Sheet					M21T011	M21T013
	Hardware Manual					M21T053	M21T053
	Product Brief					M21T025	

HD641180X HD643180X HD647180X	HD64180Z	HD648180W*	HD6309**	HD68HC000**	HD68000**	HD6802**	HD6803	HD6809**
HS180ABX04H(4)	HS180ABX03H(4)						HG1EVT2I(1)	
HS180AST01H	HS180AST01H							
	HS180ACUC1M							
							H64EMB01	
H680SM01S(6)	H680SM01S(7)							
HS18XESF01H HS18XESC01H								
HS18XESS01H								
HS18XESG01H								
M21T132	M21T132	M21T132	M21T132	M21T132 M22T003	M21T132 M22T003	M21T132	M21T006 M21T132	M21T132
M21T012	M21T011							
M21T113	M21T053							
M21T026	M21T025							

(Note) 1. Emulator includes an RS-232 port for connection to IBM PC or PC compatible machines. Software not included.
2. Same as footnote (1) above, but shipped with cross assembler (8" floppy disk) that operates with Hitachi's H68SD5 development system.
3. Developed by one of Hitachi's engineering subsidiaries. Cross assembler include software utility to download/upload code between PC host and emulator.
4. Must be used with ASE station (P/N: HS180AST01H).
5. Includes user's manual, hardware and software application notes, and other relevant information.
6. 64K bytes user memory is provided in standard configuration. Can be expanded up to 512K bytes. Maximum of two 256K byte memory boards can be installed (optional).

**Contact Marketing.*
***Refers to third-party support tools.*



Typical Support Tools for HD6303/05 Series

■ SINGLE-CHIP MICROCOMPUTER SUPPORT SYSTEMS

Hitachi and its engineering subsidiaries make hardware and software support tools to operate with many popular host computers and expedite the development of the microcomputer-based target system. The support system includes in-circuit emulators, cross assemblers, passive socket adapters for easily programming EPROM on chip devices, and documentation

In addition to hardware and software support, Hitachi has Field Application Engineers (FAE) to help identify the most cost-effective IC(s) for your application and answer your technical questions.

■ IN-CIRCUIT EMULATOR FUNCTIONS FOR HD6303/05 Series*

- Serial interface connection to many host computers via RS-232C port.
- Executes user's program in real-time on some emulators, or when loaded in emulator's memory starting from a selected address. Execution is interrupted when breakpoints are detected, or when RESET or ABORT is switched
- Single step tracing of user's program is possible. Data in registers and data in memory are displayed after every execution.
- Breakpoints can be set in user's program by using the program counter address, data bus, or external signal probes. Breakpoints can be displayed and changed.
- Data in internal registers of the subject microcomputer can be displayed or changed.
- Real-time tracing is possible on most emulators; the emulator stores and displays bus data and external signals for up to 1011 machine cycles on some emulators, or 2035 machine cycles on other emulators before and after the address where a breakpoint is set
- Line assembler and disassembler on some emulators

*Functions listed in the overview may not exactly apply to all emulators. Refer to the applicable emulator user's manual for further information

■ CROSS ASSEMBLER FUNCTIONS (PC-DOS)

The software is divided into six main parts.

- **Structured Relocatable Cross Macro Assembler**
  The cross assembler is designed to meet the specification outlined in Hitachi's HD6303 and HD6305 assembler user's manual, which means that mnemonic, macro and directive compatibility is maintained.

  The assembler also offers a structured code facility, similar to that found in some high level languages. The main structured features are listed below.
  IF . . . THEN . . ELSE . . . DO . . WHILE . . . REPEAT . . . UNTIL . . FOR . . TO
  CALL (with parameters passed on the stack)
- **Linker**
  The linker concatenates and locates all relocatable modules into

an executable object file (Motorola S-type format). Start addresses of relocatable program and data sections can be entered at linkage time.

- **Macro Librarian**
  Named libraries of useful macros can be built by the user, saving time during generation of source code. The macro librarian is searched during assembly time for the appropriate macro definitions that do not appear in the source file.
- **Object Module Librarian**
  Named libraries of useful object modules can be built by the user. The libraries called up at linkage time are searched by the linker to see if unsatisfied external references can be resolved. Object modules which satisfy the unresolved references are automatically included in the executable object file (S-record format).
- **Emulator Interface Software**
  The interface software allows connection between Hitachi's serially linked emulators and the IBM PC using an RS232 asynchronous interface.

  Commands from the PC keyboard are directed to the emulator and responses are displayed on the screen. File upload and download in Motorola S-type format enables assembled and linked programs to be run on the emulator. Real time trace facilities are available on all serial linked emulators.
- **EPROM Programmer Interface Software**
  The interface software allows connection to most proprietary EPROM Programmers for downloading (or uploading) executable object modules in Motorola S-type* data format. The programmers can be run either in REMOTE CONTROL or LOCAL mode.

  In local mode, programmer commands can be entered on the programmer keyboard and upload/download of object modules can be activated using the IBM PC keyboard.

  In remote control mode, all programmer commands are entered via the IBM PC keyboard.

  All programmer commands will be specific to the particular programmer used.

■ C COMPILER FUNCTIONS (PC-DOS)

The HD6303 and HD6305** compiler comprises three programs, a pre-processor, the main compiler and an optimiser. The system also provides standard library files (which facilitates I/O and floating point operations), the standard "include" files which contain the necessary declarations for the usage of library function. Runtime object files for integer and floating point arithmetic are included. Compatible with Hitachi and Microtec Research*** assemblers.

- **Compiler Options**
  The following tables indicate the options available during pre-processing and compiling.

Table 1. Pre-processor Options

No.	Option	Description
1	A	Issues error messages to the pre-processor source program file.
2	D	Defines a macro name
3	L	Inserts the original source program lines into the pre-processed source program as comments.

Table 2. Compiler Options

No.	Option	Description
1	P	Generates object code which calls a profiler routine (a routine which profiles the history of the program execution) everytime a function is called (see Note 1).
3	L	Generates object code which calls a stack check routine everytime a function is called (see Note 1).

Note 1: The profiler routine and the stack check routine should be prepared in a separate module for your own target system.

- **Limits in Compilation**
  (1) Length of an input line: 512 characters
  (2) Length of a character string: 510 characters
  (3) Number of external names: 156
  (4) Effective length of identifiers: 8 characters
  (5) Effective length of external identifiers: 6
  (6) Nest of conditional complication: 32 level
  (7) Nesting of file inclusion: 14 level
  (8) Number of macro parameters: 32
  (9) Length of a macro definition: 512 characters
  (10) Recursive expansion of a macro name: 32 times

- **Data Size**
  (1) Char type: 8 bit
  (2) Short type, int type: 16 bit
  (3) Long type: 32 bit
  (4) Float type: 32 bit
  (5) Double type: 64 bit
  (6) Pointer type: 16 bit

  No data alignment is done in allocation of structured data

*Motorola S-type is a trademark of Motorola, Inc.
**Conforms to Kerninghan and Ritchie C programming language standard rather than ANSI C programming language standard.
***Microtec Research is a trademark of Microtec Research, Inc.

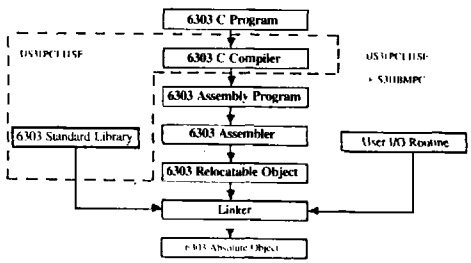
(3) *Character Handling Library Functions*
isalnum, isalpha, issascii, iscntl, isdigit, islower, isprint, ispunct, isspace, isupper, tolower, toupper.

(4) *Character String Handling Library Functions*
index, rindex, strcat, strcmp, strcpy, strlen, strncat, strncopy

(5) *Data Conversion Library Function*
atoi, atol

(6) *Memory Allocation Library Functions (see Note 2)*
malloc, calloc, free, cfree

(7) *Miscellaneous Library Functions*
NOTE 2: To use the I/O library functions and Memory allocation library functions, low level routines must be prepared by the user according to the target system requirements.



■ IN-CIRCUIT EMULATOR FOR HD64180 SERIES

Hitachi's hardware emulator consists of the Adaptive System Emulator (ASE) plus emulator box for the corresponding microprocessor. The emulator supports hardware and software development when connected to a Vax-II, IBM-PC, or PC compatible host machine.

■ ASE FEATURES

- Serial connection to host computer, or console via RS-232C port allows loading, saving, and verifying of user programs.
- Object formats: Intel HEX; and Motorola S.
- Connects to centronics printer.
- Includes 3.5 inch floppy disk drive.

■ EMULATOR BOX FEATURES

- Executes program in realtime from 0.5 MHz to 8 MHz for all emulators except HS180 ABX05H which executes in realtime from 0.5 MHz to 10 MHz.
- Memory:
  —Includes 64-kbyte user memory
  —Expandable to 512 kbytes with an optional memory board (up to 6 MHz without wait states)

■ EMULATOR BOX FUNCTIONS

- Executes user's program loaded in emulator's memory:
  —Realtime
  —Single step
- Breaks on combination of specified number of the following conditions:
  —Program counter (logical or physical address)
  —Access to specified memory area
  —DMAC transfer request or completion
  —Eight external probe signals
- Up to 255 software breakpoints on RAM area
- Multi-break function: In multi-MPU system using several ASEs, an ASE break acts as a trigger which causes other ASEs to break. (HS180ABX05H).
- Sequential break: Analyzes order in which up to 4 software breakpoints were passed (HS180ABX04H/05H).
- Realtime tracing:
  —Stores or displays bus information, external signal, or I/O signals for up to 2048 machine cycles
  —Traces by bus cycle or 125 ns after user program execution stops at breakpoint
  —Trace starting or extracting condition can be specified
- Pseudo-I/O emulation function (HS180ABX04H/05H)
- Disassembler
- Line assembler
- Symbolic debugger
- Execution time measurement
- Displays, sets, changes, or transfers data in memory