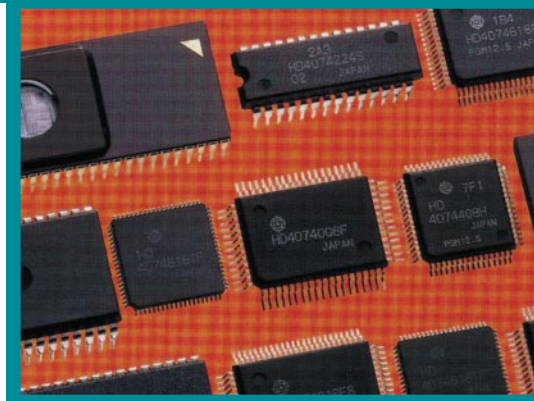


November 1998



H 4 0 0 S e r i e s

4 - B i t M i c r o c o n t r o l l e r s

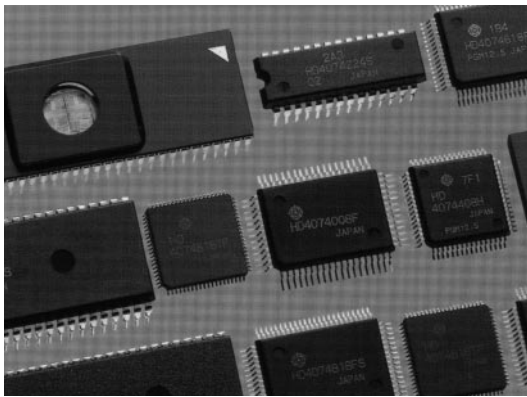
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H400 Series

4-bit microcontrollers



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H 4 0 0 S e r i e s

WELCOME

Welcome to Hitachi's 4-bit microcontroller family H400. Hitachi is the third biggest supplier of 4-bit microcontrollers to the European market. Additionally, Hitachi is the sixth biggest supplier for 8-bit microcontrollers (H8/300, H8/300L), the second for 16-bit (H8/300H, H8S) and number 2 for 32-bit RISC microcontrollers (SH series). (All data according to Dataquest).

The H-series product concept incorporates the H8-CPU family of 8-bit and 16-bit microcontrollers as well as the H4-CPU family of 4-bit microcontrollers.

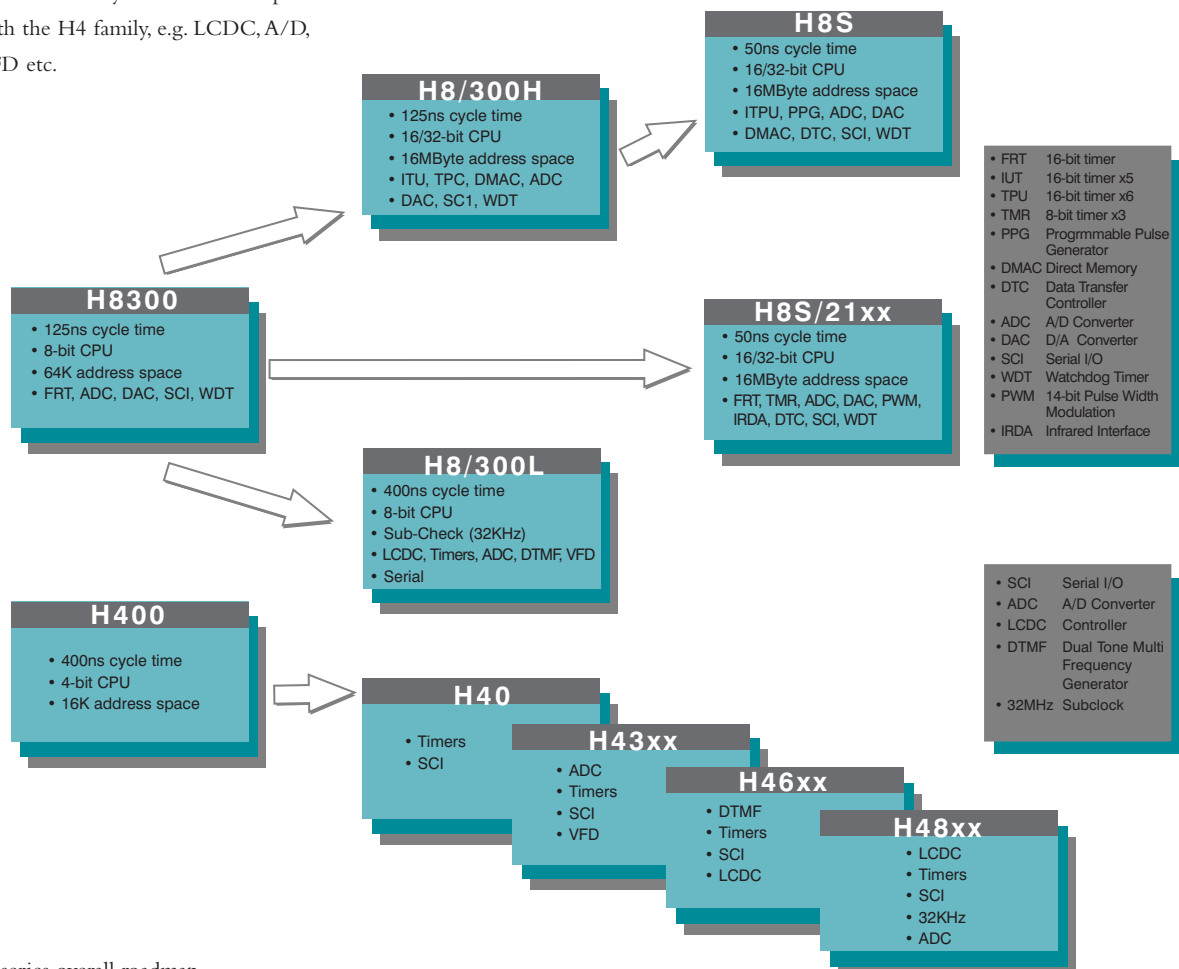
There is no Software compatibility between H4 and H8. However, the H8/300L family is function-compatible with the H4 family, e.g. LCDC, A/D, VFD etc.

For applications which need higher CPU performance than 4-bit and real Ansi-C programmability, H8/300L is the perfect choice.

4-bit MCU's are dedicated for special, cost sensitive applications rather than general purpose products for the mass market. That is why Hitachi offers 4-bit microcontrollers with specific on-chip features, like LCDC, DTMF, A/D etc. This product concept is called ASSP standing for Application Specific Standard Product.

Per definition, a H400 ASSP is a standard microcontroller core with, all around, all the peripheral features necessary for the micro to cover a specific type of application. To enable the end user to

design-in his own system customisation, the micros have on-chip ROM, or more important, EPROM. The incorporation of EPROM on-chip means that the designer has the flexibility to build 1K or 16K of his system without having to commit to a Mask.



H-series overall roadmap

CPU and Peripherals

The H400 series have an ideal architecture for controllers in which bit I/O and status flag processing in software are important.

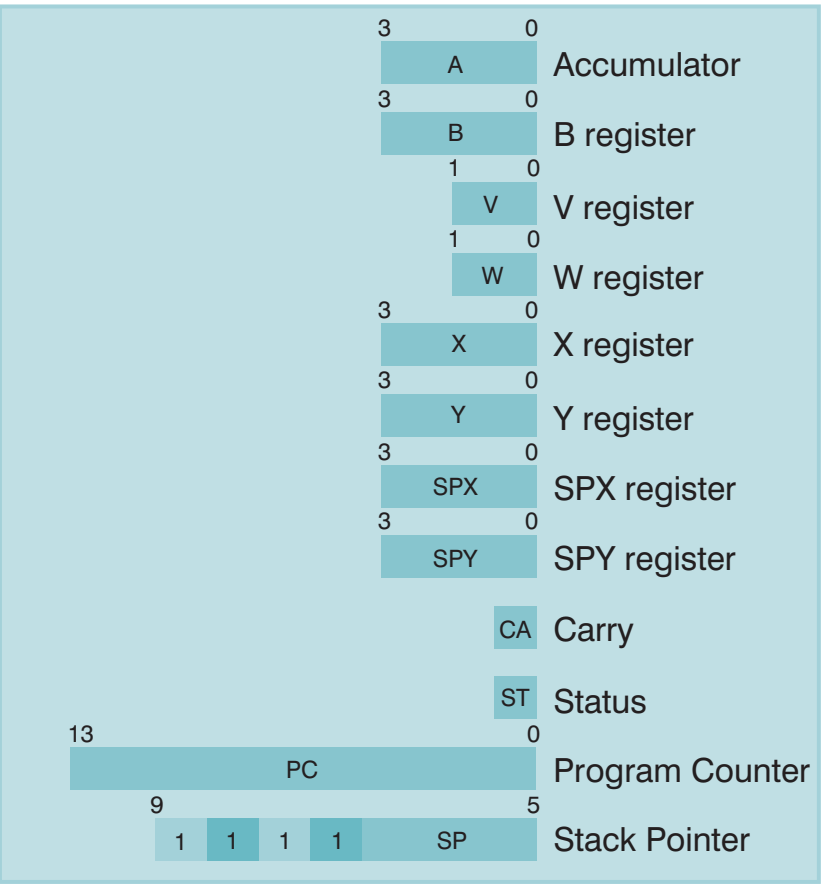
- Highly efficient 10bit wide ROM making 80% of instructions single cycle and single word.
- Direct addressing to both ROM and RAM.
- Bit manipulation for both RAM and I/O.
- Direct branch to all ROM areas.
- Binary or BCD Arithmetic operation.
- Powerful Logical Arithmetic operation.
- Pattern Generation - look-up table capability

For example, the HD404629 has in total 101 instructions, among them 75% are single cycle instructions and 23% are two cycle instructions.

Cycle times down to $t = 0.47\mu s$ combined with the efficient code, make the device ideal for control applications. There are three RAM and four ROM addressing modes.

- RAM
- Indirect register addressing
 - Direct addressing
 - Memory register addressing
- ROM
- Direct addressing
 - Current page addressing
 - Zero page addressing
 - Table data addressing

The H400 processor core consists of an accumulator, B, V, W, X, Y, SPX, SPY registers, Carry and Status bit, as well as a Stack Pointer register.

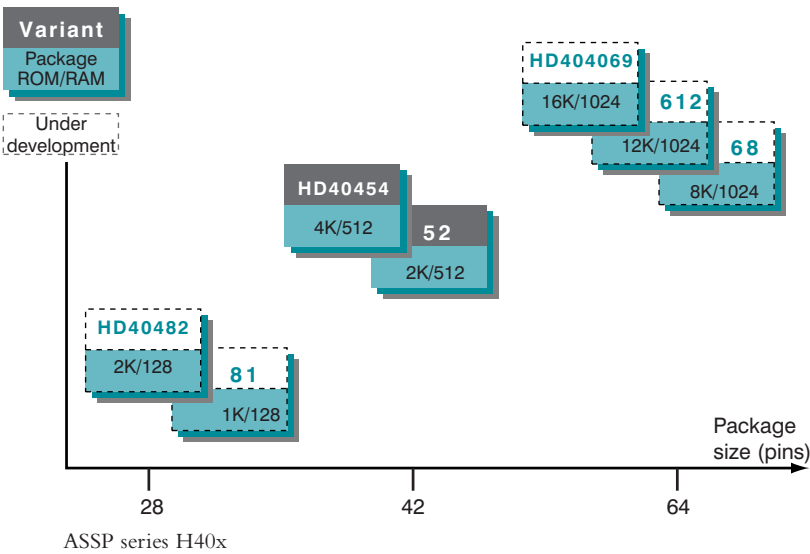


ASSP Series

ASSP Series H40xx

H40xx microcontrollers are dedicated to cost-sensitive applications. Their structure of on-chip features allows the coverage of many different design variations in the same application segment.

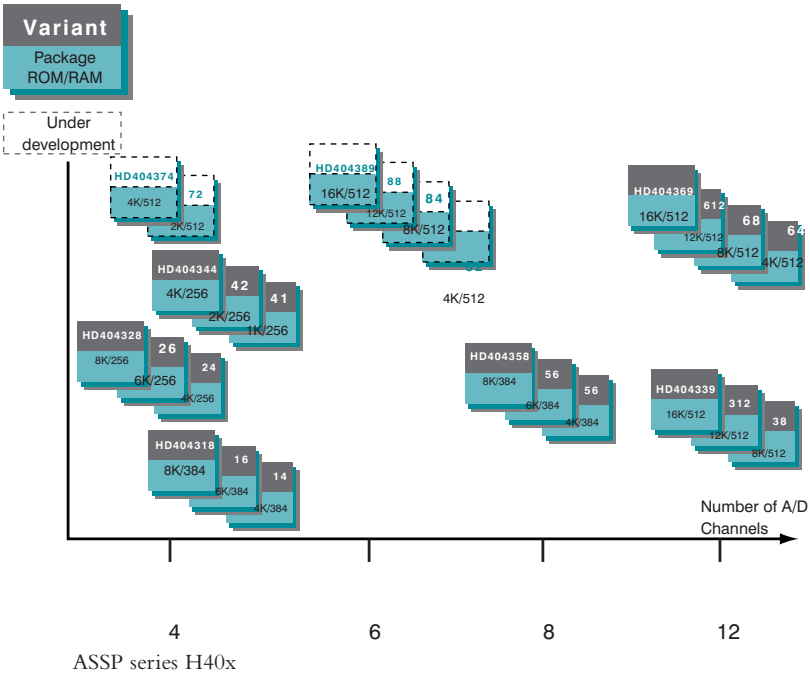
Functions like PWM and WD Timers, external/internal interrupts as well as high-current I/O's are obvious.



ASSS Series H40xx

Dedicated applications in the industrial segment require A/D converters or comparators in order to measure analogue signals. H43xx micros incorporate 8-bit and 10-bit A/D converters according to the successive approximation method.

The number of input channels differs from 4ch to 12ch and allows direct conversion of analogue signals into respective digital signals.



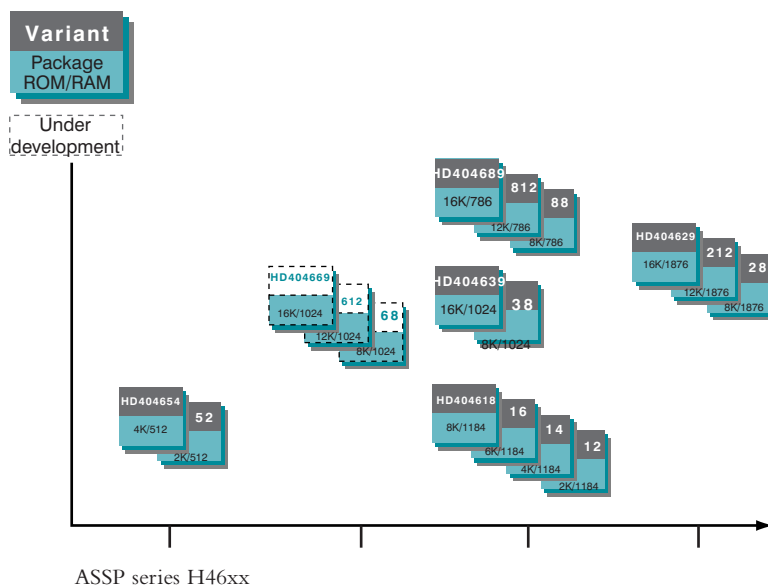
ASSP Series

ASSS Series

H46xx

H46xx micros with on-chip DTMF generator are dedicated to telecommunication applications such as analogue feature phones, analogue mobile phones etc.

Having the functionality coming from LCD controllers, A/D converters, multi-functional timers and serial communication interfaces, these products are perfectly designed for embedded solutions in the telecommunication area.

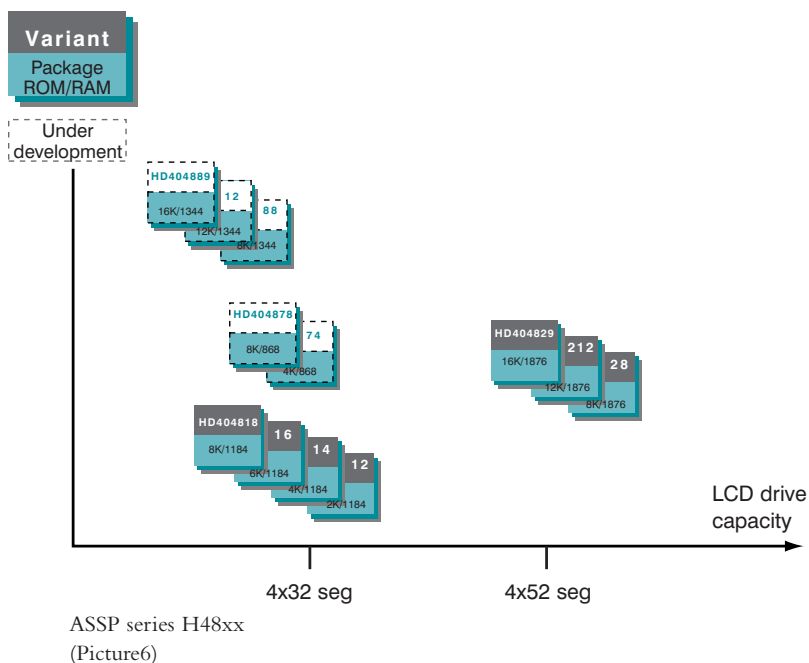


ASSS Series

H48xx

More and more applications incorporate a LCM in order to provide detailed visual information to the user. For complex LCD systems such as Dot Matrix Character or Graphics, external LCD Controllers are required. For more simple 7-Segment Display, the best solution from technical and commercial point of view are on-chip LCD Controllers.

H48xx microcontrollers have on-chip 7-segment LCD controllers which allow direct connection to the Liquid Crystal Glass.



Tools

Hardware

Not only the excellence of the silicon itself is determinant in the choice of a microcomputer family but also the quality of the development support. The software running on these advanced microcontrollers must be written, tested and debugged. To do this efficiently, in terms of time and costs, it is important to dispose of the right kind of equipment. For this reason, Hitachi has concentrated its efforts in providing a good level of software and hardware support for these machines. Hitachi's investment in development equipment is matched by our support of third-party development routes.

Software

H400 STRUCTURED CROSS ASSEMBLER

This assembler runs on the IBM-PC compatible machine under the operating system MS-DOS, and processes assembly language program files of the H400 series. It is fully reliable and it supports the use of Macros. The structured side of the assembler translates a range of high level constructs into an equivalent appropriate sequence of assembler statements. The constructs are very similar in form to those in a high level language and allow many of the benefits of the high level language programming. Some examples of structured statements are: LET, IFSO, WHILE, REPEAT, FOR, THRU, BEGIN, LEAVE, RESTART.

H400 IN CIRCUIT EMULATOR SYSTEM "E400"

The current system consists of an emulator unit (HS400EUA02H) with a selection of target probes (HS400ETA01H, HS461ETA01H) for different types of micro-controllers and user cables for different types of packages.

In order to support the new H400 products more cost-effectively, Hitachi developed the new E400 In-Circuit Emulator (HS4000EPI01H). E400 fully supports the H400A series, the 1.8V series and all existing H400 devices which needed the general purpose target probe HS400ETA01H in the past.

Main features of E400 are:

- Combination breakpoints
- Real-time trace
- Trace viewing
- Single-step trace
- Symbolic debugging
- Displaying/Modifying of ROM, RAM, registers and I/O's
- Execution time measurement
- Assembler
- Disassembler

H400 SOFTWARE SIMULATOR

The H400 simulator runs on the IBM-PC and compatible computers. The simulations are comprehensive and are performed completely in software without the need of any external or additional hardware. The menu-driven simulation software brings efficiently a new microprocessor to life inside the PC, allowing programs for it to be run, tested and demonstrated directly.

Some of the features available are on-line help facilities, single line assemble and disassemble, full symbolic working, with single step and trace commands.

DESCRIPTION Software Tools	PART NAME	COMMENTS
Cross Assembler + Linker + Utilities	SE400PC	Contact: AND Software Tel. ++44/1992/814655
Software Simulator	SE400SIMPC	
Cross Assembler + Linker + Utilities + Software Simulator	SE400SDKPC	
C--Compiler (Third Party Tool)	TBD	

ORDERING INFORMATION

Target Series	Emulator Unit E400	Target Probe	EVA Chip Set	User Cable	Programming Socket
H4054 series	HS4000EP101H	HS4654ERS01H	HS4654ECS42H	HS4654ESS01H (DIP)-42S)	HS4654ESH01H(FP-44A)
H4069 series	"	-	HS4669ECH01H	HS4669ECH01H	Minato/Data I/O (FP-64A)2
H4082 series	"	-	HS4374ERS01H	TBD★	Minato/Data I/O (FP-30D)2
H4318 series	"	-	HS4339ERS01H	HS4318ECS42H	HS4318ESS01H (DIP-42)
"	"	-	"	HS4318ECH01H	HS4318ESHO1H (FP-44A)
H4329 series	"	-	HS432ERSO1H	HS400ECS64H	HS432ESSO1 (DIP-64S)
"	"	-	"	HS400ECAA0H	HS432ESF01H (FP-64B)
H4339 series	"	-	HS4339ERS01H	HS400ECS64H	HS4339ESSO1H (DIP-64S)
"	"	-	"	HS400ECAA0H	HS432ESF01H (FP-64B)
H4339 series	"	-	HS4339ERS01H	HS400ECS64H	HS4339ESSO1H (DIP-64S)
"	"	-	"	HS400ECAA0H	HS4339ESHO1H (FP-64B)
H4344 series	"	-	"	HS4344ECS28H	HS4344ESSO1H (DIP-28S)
"	"	-	"	HS400ECAA0H	HS4344ESPO1H (FP-28)
"	"	-	"	HS4344ECFO1H	HS4344ESF01H (FP-30D)
H4358 series	"	-	"	HS4359ECS42H	HS4359ESSO1H (DIP-42S)
"	"	-	"	HS4359ECH01H	HS4359ESHO1H (FP-44A)
H4369 series	"	-	"	HS4369ECS64H	HS4369ESSO1H (DIP-64S)
"	"	-	"	HS4369ECH01H	HS4369ESFO1H (FP-64B)
H4374 series	"	-	HS4374ERSO1H	HS4374ECFO1H★	Minato/Data I/O (FP-30D) (2)
H4389 series	"	-	"	HS4374ECFO1H★	Minato/Data I/O (DP-28S) (2)
"	"	"	"	HS4384ECS01H★	Minato/Data I/O (FP-30D) (2)
H4618 series	HS400EUA02H(1)	HS461ETA01H(1)	-	HS471ECF80H	HS460ESF01H (FP-80B)
"	"	HS461ETA01H(1)	-	HS4719ECH80H	HS460ESH01H (FP-80A)
"	"	HS461ETA01H(1)	-	HS400ECA80H	HS461EST01H (TFP-80)
H4629 series	HS400EP101H	-	HS462ERS02H	HS4000ECF10H	HS462ESF01H (FP-100A)
"	"	-	"	HS400ECHA0H	HS462ESH01H (FP-100B)
"	"	-	"	HS400ECHA0H	HS4629ESN01H (TFP-100)
H4639 series	"	-	HS4369ERSO2H	HS400ECF80H	HS4639ESF01H (FP-80B)
H4669 series	"	-	HS4669ERSO1H★	HS4669ECH01H★	Minato/Data I/O (FP-64A) (2)
H4689 series	"	-	"	HS400ECF80H	HS4639ESF01H (FP-80B)
H4654 series	"	-	HS4654ECS42H	HS4654ECS42H	HS4654ESSO1H (DP-42S)
"	"	-	"	"	HS454ESH01H (FP-44A)
H4818 series	HS400EUA02H(1)	HS461ETA01H(1)	-	HS471ECF80H	HS460ESF01H(FP-80B)
"	"	HS461ETA01H(1)	-	HS4719ECH80H	HS460ESH01H(FP-80A)
"	"	HS461ETA01H(1)	-	HS400ECA80H	HS4610EST01H(TFP-80)
H4829 series	HS4000EPI01H	-	HS462ERS01H	HS4000ECF10H	HS462ESF01H(FP-100A)
"	"	-	"	HS4000ECHA0H	HS462ESH01H(FP-100B)
"	"	-	"	HS4000ECHA0H	HS4629ESN01H(TFP-100)
H4878 series	"	-	HS4889ERS01H★	HS4000ECH80H	Minato/Data I/O (FP-80A)(2)
"	"	-	"	HS4000ECN80H	Minato/Data I/O (TFP-80C)(2)
H4889 series	"	-	"	HS4000ECH80H	Minato/Data I/O (FP-80A)(2)
"	"	-	"	HS4000ECN80H	Minato/Data I/O (TFP-80C)(2)

★ Please contact Hitachi Sales office about availability

(1) Please note that E400 (HS4000EP101A) does not need a Target Probe. The complete kit consists of Emulator unit and EVA Chip set and cable. Only HS400EUA02H has to be combined with Target Probe HS461ETA01H. HS461ETA01H contains the respective EVA Chip.

(2) Please contact Minato or Data I/O for part names, availability and prices of programming sockets.

RELATED LITERATURE / INTERNET / CD-ROM / APPLICATION NOTES

Hitachi CD-ROM

“Hitachi Electronic Components Databook” (16-007)

This CD-ROM is available free of charge by Hitachi or our authorised distributors. Please ring +49-(0)89-99180-128 to order your copy or send a fax to +49-(0)89-99180-265.

It contains appr. 20.000 pages of Hitachi documentation about microcontrollers, H400 series, memories and packages.

This includes the actual hardware manuals for almost all our microcontrollers, as well as application notes, programming manuals and overviews. A powerful selection tool allows you to run a selection to find out which Hitachi microcontroller is suitable for your application.

The CD-ROM is usable under Windows and Macintosh. It also includes a 10 minute video about Hitachi Europe Manufacturing Plant in Landshut.

Data books

Hitachi H400 Series microcontrollers
H42xx,H43xx,H44xx 11-001D (1)
H46xx,H47xx,H48xx 11-001D(2)

H400 Series Overview 11-004G

Application notes

Technical Q&A HMCS400

Series 11-014

HMCS400 Series Software 11-021A

Internet access / WWW

Under Hitachi's Electronic Components Group (ECG) homepage (address URL: <http://www.hitachi-eu.com/hel/ecg/index.htm>) you can access to detailed technical product information about Hitachi's microcontrollers, H400 Series, memory, displays, ASIC, discrete & power modules and optoelectronic components. For memory and microcontroller products each user can download complete data sheets and application notes in PDF format.

You will also find a complete overview over Hitachi's European Microcontroller Development Tools with a short description, the package contents and the ordering information (part names)

Shortforms for Hitachi Microcontroller

“H400 Series” 11-004
Hitachi's 4-bit family

“LCD controllers/drivers” 06-003

“H8/300” & “H8/300L” 21-017
Hitachi's 8-bit H8 family

“Microcontrollers support tools” 17-001

“μCBIC customised Microcontroller” 02-038

“SuperH RISC engine” 19-017

Device	H4052,54	*H4081,82 ✱	*H4068,612,69 ✱	H4314,16,18	H4324,26,28	H4334,36,38,312,39	H4341,42,44 ✱	H4354,56,58	H436468,612,69	*H4372,74 ✱	*H4382,84,88,89 ✱
ROM x 10 bit	2k, 4k	1k,2k	8k,12k, 16k	4k, 6k, 8k	4k, 6k, 8k	4k, 6k, 8k, 12k, 16k	1k, 2k, 4k	4k, 6k, 8k	4k, 8k 12k, 16k	2k, 4k	4k, 8k, 12k, 16k
RAM x 4 bit	512	128	1024	384	256	512	256	384	512	512	512
Z-TAT (OTP)	HD4074054S/H	HD4074384S	HD407A4069H	HD4074318S/H	HD4074328US/FS	HD4074339S/FS	HD4074344S/FP/FT	HD407A4358S/H	HD407A4369S/SF	HD407A4374S/FT	HD407A4389S/FT
8-bit Timer	3	3	3	3	3	3	2	3	3	3	3
Watchdog Timer	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sync Serial Port (SCI)	1	1	1	1	1	1	1	1	1	1	1
DTMF Generator	...	...	...	...	...	...	...	...	...	...	...
A/D Convertor	...	...	...	8ch / 8-bit	4ch / 8-bit	12ch / 8-bit	4ch / 8-bit	8ch / 8-bit	12ch / 8-bit	4ch / 10-bit	4-6ch / 10-bit
I.C.D Controller	...	...	...	...	24seg x 4com	...	...	...	...	...	...
Interrupts	6	3	9	7	8	7	5	7	7	5	5
Other Features	Comparator	LED driver	Comparator	VFD driver	LED driver	VFD driver	LED driver	LED driver	LED driver	LED driver	LED driver
	Input Capture	PWM	32 KHz clock	Buzzer	Buzzer	Input Capture	PWM	Input Capture	Input Capture	32KHz clock	PWM
	LED driver		Input Capture	Input Capture	32 KHz clock	Buzzer		Buzzer	Buzzer	PWM	
	PWM		LED driver	PWM	Zero Cross	32 KHz clock		PWM	PWM, 32KHz clock		
I/O Lines	35	22	55	34	35	54	22	34	54	20	20
Supply Voltage (V)	1.8 to 6.0	1.8 to 6.0	1.8 to 6.0	4.0 to 5.5	2.7 to 6.0	4.0 to 5.5	2.5 to 6.0	2.7 to 6.0	2.7 to 6.0	1.8 to 6.0	1.8 to 6.0
Lower Power Dissipation Modes	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
	Standby	Standby	Watch	Standby	Watch	Watch	Standby	Standby	Watch	Watch	Standby
			Standby		Standby	Standby			Standby	Standby	
			Subactive		Subactive	Subactive			Subactive	Subactive	
Package	DP-42S	DP-28S	FP-64A	DP-42S	DP-64S	DP-64S		DP-42S	DP-64S	DP-28S	DP-28S
	FP-44A	FP-30D		FP-44A	FP-64B	FP-64B	FP-28A	FP-44A	FP-64B	FP-30D	FP-30D
							FP-30D				
Ordering Information	HD40405xS	HD40408xS	HD40406xH	HD40431xS	HD40432xUS	HD40433xS	HD40434xRS	HD40435xS	HD40436xS	HD40437xS	HD40438xS
	HD40405xH	TBD		HD40431xH	HD40432xUFS	HD40433xFS	HD40434xRFP HD40434xRFT	HD40435xH	HD40436xFS	HD40437xFT	HD40438xFT

✱ Key Products

H4612,14,16,18	H4628,212,29	H4638,39	H4652,54	*H4668,612,69	H4688,812,89	H4812,14,16,18	H4828,212,29	*H4874,78 [★]	H4888,812,89 [★]	Device
2k, 4k, 6k, 8k	8k, 12k, 16k	8k,16k	2k, 4k	8k, 12k, 16k	8k, 12k, 16k	2k, 4k, 6k, 8k	8k,12k,16k	4k, 8k	8k, 12k, 16k	ROM x 10 bit
1184	1876	1024	512	1024	786	1184	1876	868	1344	RAM x 4 bit
HD4074618FS/H/TF	HD4074629H/FS/TF	HD407A4639RFS	HD4074654S/H	HD407A4669H	HD407A4689FS	HD4074818FS/H/TF	HD4074829H/FS/TF	HD4074878H/TF	HD4074889H/TF	Z-TAT (OTP)
3	4	4	3	3	3	3	4	3	4	8-bit Timer
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	Watchdog Timer
1	1	2	1	1	1	1	1	1	1	Sync Serial Port (SCI)
yes	yes	yes	yes	yes	yes	...	...	...	...	DTMF Generator
...	4ch / 8-bit	...	...	...	...	...	4ch / 8-bit	...	6ch / 8-bit	A/D Convertor
32seg x 4com	52seg x 4com	...	...	...	...	32seg x 4com	52seg x 4com	32seg x 4com	32seg x 4com	I.C.D Controller
6	11	11	6	9	9	6	11	8	9	Interrupts
LED driver	LED driver	LED driver	LED driver	Comparator	Comparator	Comparator	LED driver	LED driver	LED driver	Other Features
Comparator	32KHz clock	Comparator	Comparator	LED driver	LED driver	LED driver	32 KHz clock	32 KHz clock	32 KHz clock	
32KHz clock	Input Capture	LED driver	Input Capature	32 KHz clock	32KHz clock	32 KHz clock	Input Capture	Input Capture	Input Capture	
PWM	PWM	32KHz clock	PWM	Input Capture	Input Capture	PWM	PWM	PWM	PWM	
30	44	68	32	52	56	30	44	46	46	I/O Lines
2.7 to 6.0	2.7 to 6.0	2.7 to 6.0	1.8 to 6.0	1.8 to 6.0	2.7 to 6.0	4.0 to 6.0, 2.7 to 6.0 (L)	2.7 to 6.0	1.8 to 6.0	1.8 to 6.0	Supply Voltage (V)
Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Lower Power Dissipation Modes
Watch	Watch	Watch	Standby	Watch	Watch	Watch	Watch	Watch	Watch	
Standby	Standby	Standby		Standby	Standby	Standby	Standby	Standby	Standby	
Subactive	Subactive	Subactive		Subactive	Subactive	Subactive	Subactive	Subactive	Subactive	
FP-80A	FP-100A	FP-80B	DP-42S	FP-64A	FP-80B	FP-80A	FP-100A	FP-80A	FP-80A	Package
FP-80B	FP-100B		FP-44			FP-80B	FP-100B	TFP-80C	TFP-80C	
TFP-80	TFP-100					TFP-80	TFP-100			
HD40461xH	HD40462xRH	HD40463xRFS	HD40465xS	HD40466xH	HD40468xFS	HD40481xH	HD40482xRH	HD40487xH	HD40488xH	Ordering Information
HD40461xSF	HD40462xRFS		HD40465xH			HD40481xFS	HD40482xRFS	HD40487xTF	HD40488xTF	
HD40461xTF	HD40462xRTF					HD40481xTF	HD40482xRTF			

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