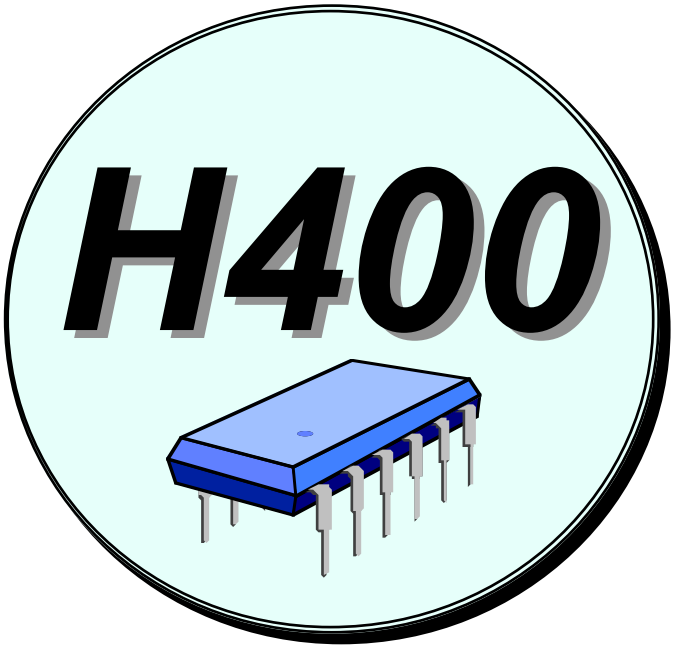


4-Bit Microcontrollers

Contents

INTRODUCTION

The selection of a microcontroller for a particular design has never been an easy task. There have always been the standard questions such as does it have enough ROM, RAM, I/O, etc. Perhaps, however, the biggest question that needs to be asked nowadays is:

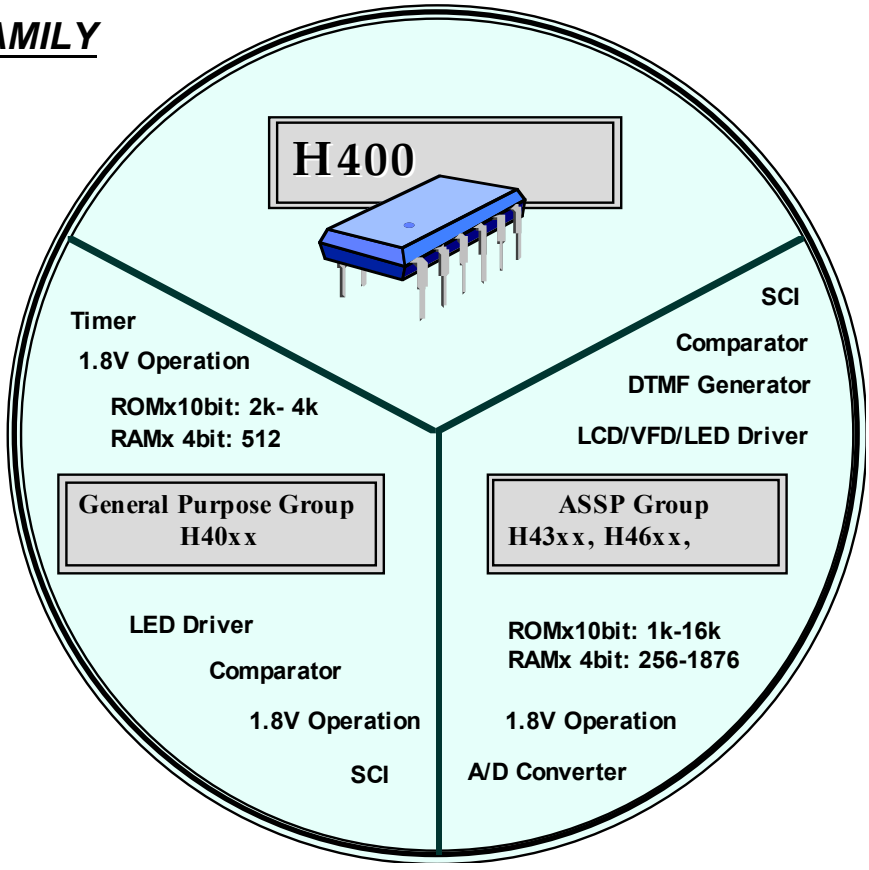
Does the microcontroller perform its task cost effectively?

In the past it has been all too common for the system designer to have been put in the position of having to select a general purpose microcontroller, and then having to use external devices to fulfill such features as LCD drive, A/D, I/O control etc.
Or just as bad, he has had to select a micro with more features than he needs. This means that he ends up paying for features he does not use, or that the micro's lack of peripherals / performance impairs the system performance.

For this reason, Hitachi has introduced the Application Specific Standard Product (ASSP).

This is one of the most fundamental design concepts utilized in the production of the H400 series of microcontrollers.The definition of a H400 ASSP is that it is a standard microcontroller core around which is added 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 customization, the micros have on-chip ROM, or more importantly, 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.

THE FAMILY



General Purpose Series		
H40xx	**HD404052 HD404054**	**HD404092 HD404094**
ROM x 10 Bit	2048 / 4096	
RAM x 4 Bit	512	
Total Timers PWM WDT	3 2 1	
8-Bit SCI	1	
Total Interrupts External Internal	6 2 4	
Total I/O High Voltage I/O High Current I/O	32 - 10	32 4 6
Additional Features	2ch comparator 1.8V operation	
Supply Voltage	1.8V to 6.0V	
Low Power Dissipation Modes	Stop Standby	
Package Types	DP-42S FP-44A	
ZTAT (OTP)	HD4074054	HD4074094

Family Overview

ASSP Series		
H43xx (1) A/D converter	**HD404314 HD404316 HD404318**	**HD404324 HD404326 HD404328**
ROM x 10 Bit	4096 / 6144 / 8192	4096 / 6144 / 8192
RAM x 4 Bit	384	256
Total Timers PWM WDT	3 1 1	3 - 1
8-Bit SCI	1	
Total Interrupts External Internal	7 2 5	8 2 6
Total I/O High Voltage I/O High Current I/O	33 25 -	33 - 8
Additional Features	8ch A/D VFD driver Buzzer	4ch A/D LCD 24seg x 4com Buzzer 32 KHz clock
Supply Voltage	4.0 V to 5.5V	2.7 V to 6.0 V
Low Power Dissipation Modes	Stop Standby	Stop Watch Standby Subactive
Package Types	DP-42S FP-44A	DP-64S FP-64B
ZTAT (OTP)	HD4074318	HD4074329

ASSP Series

H43xx (2) A/D converter	HD404338 HD4043312 HD404339	HD404341 HD404342 HD404344	HD404391 HD404392 HD404394
ROM x 10 Bit	8192 / 12288 / 16384	1024 / 2048 / 4096	
RAM x 4 Bit	512	256	
Total Timers **PWM** **WDT**	3 1 1	2 1 1	
8-Bit SCI	1		
Total Interrupts **External** **Internal**	7 2 5	5 1 4	
Total I/O **High Voltage I/O** **High Current I/O**	56 30 -	22 - 10	21 3 7
Additional Features	12ch A/D VFD driver Buzzer 32 KHz clock	4ch A/D LED driver	3ch A/D + Vref + 12 V I/O
Supply Voltage	4.0 V to 5.5V	2.7 V to 5.5 V	
Low Power Dissipation Modes	Stop Watch Standby Subactive	Stop Standby	
Package Types	DP-64S FP-64B	DP-28S FP-28A FP-30D	
ZTAT (OTP)	HD4074339	HD4074394	HD4074394

ASSP Series

H43xx (3) A/D converter	HD404364 HD404368 HD4043612 HD404369	HD404354 HD404356 HD404358
ROM x 10 Bit	4096 / 8192/ 12288 /16384	4096 / 6144 / 8192
RAM x 4 Bit	512	384
Total Timers **PWM** **WDT**	3 1 1	3 1 1
8-Bit SCI	1	
Total Interrupts **External** **Internal**	7 2 5	7 2 5
Total I/O **High Voltage I/O** **High Current I/O**	54 8 -	34 4 -
Additional Features	12ch A/D + 12V I/O Buzzer 32KHz clock	8ch A/D + 12V I/O Buzzer
Supply Voltage	2.7 V to 6.0 V	2.7 V to 6.0 V
Low Power Dissipation Modes	Stop Watch Standby Subactive	Stop Standby
Package Types	DP-64S FP-64B	DP-42S FP-44A
ZTAT (OTP)	HD407A4369	HD407A4359

ASSP Series

H46xx (1) DTMF generator	HD404612 HD404614	HD404616 HD404618	HD404628 HD4046212 HD404629
ROM x 10 Bit	2048 / 4096	6144 / 8192	8192 / 12288 16384
RAM x 4 Bit	1184		1876
Total Timers	3		4
PWM	1		2
WDT	1		1
8-Bit SCI	1		
Total Interrupts	6		11
External	2		5
Internal	4		6
Total I/O	30		44
High Voltage I/O	-		-
High Current I/O	10		10
Additional Features	DTMF Generator LCD 32seg x 4com 2ch comparator 32KHz clock		DTMF Generator LCD 52seg x 4com 4ch A/D 32KHz clock
Supply Voltage	2.7V to 6.0V		
Low Power Dissipation Modes	Stop Watch Standby Subactive		
Package Types	FP-80A FP-80B	FP-80A/B TFP-80	FP-100A/B TFP-100
ZTAT (OTP)	HD4074618		HD4074629

ASSP Series

H46xx(2) DTMF generator	HD404652 HD404654	HD404638 HD404639	HD404688 HD4046812 HD404689
ROM x 10 Bit	2048 / 4096	8192 / 16384	8192 / 12288 / 16384
RAM x 4 Bit	512	1024	786
Total Timers	3	4	3
PWM	2	2	2
WDT	1	1	1
8-Bit SCI	1	2	1
Total Interrupts	6	11	9
External	2	5	5
Internal	4	6	4
Total I/O	32	68	56
High Voltage I/O	-	-	-
High Current I/O	10	12	10
Additional Features	DTMF generator 2ch comparator LED driver	DTMF generator 4ch comparator LED driver 32 KHz clock	
Supply Voltage	1.8V to 6.0V	2.7 V to 6.0V	
Low Power Dissipation Modes	Stop Standby	Stop Standby Watch Subactive	
Package Types	DP-42S FP-44A	FP-80B	
ZTAT (OTP)	HD4074654	HD407A4639	HD407A4689

ASSP Series

H48xx LCD controller	**HD404812 HD40L4812 HD404814 HD40L4814**	**HD404816 HD40L4816 HD404818 HD40L4818**	**HD404828 HD4048212 HD404829**	**HD404848* HD4048412* HD404849***
ROM x 10 Bit	2048 / 4096	6144 / 8192	8192 / 12288 16384	8192 / 12288 16384
RAM x 4 Bit	1184	1184	1876	1876
Total Timers **PWM** **WDT**	3 1 1		4 2 1	4 1 1
8-Bit SCI	1			
Total Interrupts **External** **Internal**	6 2 4		11 5 6	10 4 6
Total I/O **High Voltage I/O** **High Current I/O**	30 - 10		44 - 10	35 - 10
Additional Features	LCD 32seg x 4com 2ch comparator 32 KHz clock		LCD 52x4 4ch A/D 32 KHz clock	LCD 32x4 8ch A/D 32 KHz clock
Supply Voltage	4.0V to 6.0V / 2.7V to 6.0V (L)		2.7 V to 6.0 V	
Low Power Dissipation Modes	Stop Watch Standby Subactive			
Package Types	FP-80A FP-80B	FP-80A FP-80B TFP-80	FP-100A FP-100B TFP-100	FP-80A FP-80B
ZTAT (OTP)	HD4074818 HD407L4818		HD4074829	HD4074849*

***contact Hitachi Sales office about availability**

ASSP Series

H400A High speed controllers	**HD40A4354 HD40A4356 HD40A4358**	**HD40A4364 HD40A4368 HD40A43612 HD40A4369**	**HD40A4688 HD40A46812 HD40A4689**
Specification	See HD40435x series	See HD40436x series	See HD40468x series
Additional Features	High speed operation (tcyc=470ns at Vcc=5V or tcyc=800ns at 2.7V)		
ZTAT (OTP)	HD407A4359	HD407A4369	HD407A4689

ON-CHIP FEATURES

Hitachi has a range of devices offering flexibility in I/O with both high and low voltage drive capability, LCD drive, timers, serial communications, RAM, ROM and a large range of other peripherals. All members are produced using Hitachi's high performance CMOS process for high speed with low power, further reduced by SUBACTIVE, STANDBY, WATCH and STOP low power operating modes.
The family ranges from the very cost efficient HD404341 via the HD404654 with 1.8V operation to the highly integrated HD404629. With operating voltage ranges of Vcc=(1.8-6.0)V for the Mask ROM/ZTAT devices (HD404889/HD4074889), these devices are clearly suited for use in low voltage/low power applications.
The H400 series has an architecture ideal for controllers in which bit I/O and status flag processing in software are important.

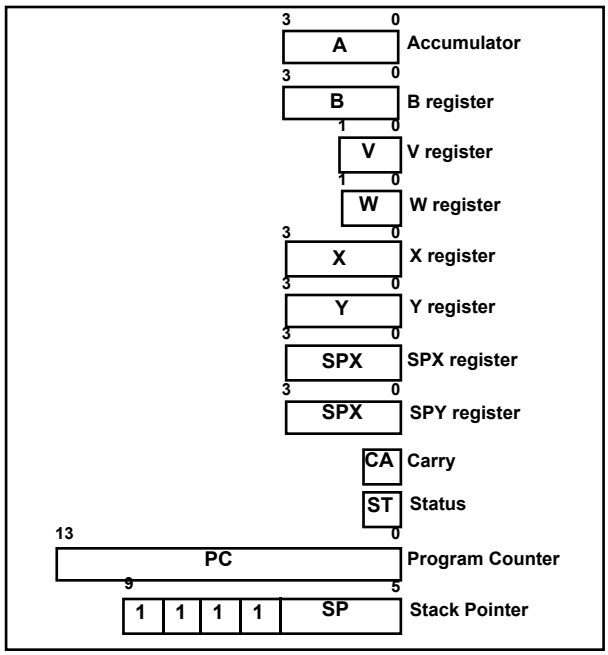
- Highly efficient 10bit wide ROM making 80% of instructions single cycle and single word.
- Direct addressing to both ROM and RAM.
- Bit manipulation for both RAM and I/O.
- Direct branch to all ROM areas.
- Binary or BCD Arithmetic operation.
- Powerful Logical Arithmetic operation.
- Pattern Generation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

For example, the HD40A4689 has in total 101 instructions, of which 75% are single cycle instructions and 23% are two cycle instructions.
Cycle times down to t=0.47***m***s combined with the efficient code, results in a 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.



Development Support Tools

Hardware

The choice of a microcomputer family is made not only on the excellence of the silicon itself but also on the quality of the development support. The software to run on these advanced microcontrollers must bewritten, tested and debugged. To do this efficiently, in terms of time and costs, it is important that the right sort of equipment is available. 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.

H400 IN CIRCUIT EMULATOR SYSTEM
This system consists of an emulator unit (HS400EUA02H) with a selection of target probes (HS400ETA01H, HS461ETA01H) for different types of microcontrollers and user cables for different types of packages. In order to support the new H400A/1.8V products, Hitachi developed the new E400 In circuit emulator.
E400 fully supports the H400A series, the 1.8V series and all existing H400 devices which need the general purpose target probe HS400ETA01H.

Main features of both systems 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

Software

H400 STRUCTURED CROSS ASSEMBLER
It 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 reloctable and supports the use of Macros. The structured side of the assembler translates a range of high level constructs into 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 programming in a high level language to be gained. Examples of structured statements are: LET, IFSO, WHILE, REPEAT, FOR, THRU, BEGIN, LEAVE, RESTART

H400 APPLICATIONS LIBRARY
The most important function included in this library is the software emulation of an asynchronous serial interface. All parameters (baud rate, no. of stop bits etc.) are variable.
The maximum data transfer rate is 9600 Baud in half-duplex mode and 1200 Baud in full-duplex mode (at 4MHz).

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 for any external or additional hardware. The menu-driven simulation software efficiently brings 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	
Software Simulator	SE400SIMPC	
Cross Assembler + Linker + Utilities + Software Simulator	SE400SDKPC	
Applications Library	SE400APPSPC	
C--Compiler (Third Party Tool)	TBD	Contact: AND Software Tel. ++44/1992/814655

DEVELOPMENT SUPPORT TOOLS

ZTAT	ASE BOARD	TARGET PROBE	EVA CHIP SET	USER CABLE	PROGRAMMING SOCKET
HD40754/94	HS400EUA02H	HS400ETA01H	HS4654ERS01H	HS4654ECS42H	HS4654ESS01H (DIP-42S)
"	"	"	"	"	HS4654ESH01H (FP-44A)
HD4074318	HS400EUA02H	HS400ETA01H	HS4339ERS01H	HS4318ECS42H	HS4318ESS01H (DIP-42)
"	"	"	"	HS4318ECH01H	HS4318ESH01H (FP-44A)
HD4074329	"	"	HS432ERS01H	HS400ECS64H	HS432ESS01 (DIP-64S)
"	"	"	"	HS400ECAA0H	HS432ESF01H (FP-64B)
HD4074339	"	"	HS4339ERS01H	HS400ECS64H	HS4339ESS01H (DIP-64S)
"	"	"	"	HS400ECAA0H	HS432ESF01H (FP-64B)
HD4074339	"	"	HS4339ERS01H	HS400ECS64H	HS4339ESS01H (DIP-64S)
"	"	"	"	HS400ECAA0H	HS4339ESH01H (FP-64B)
HD4074344/94	"	"	"	HS4344ECS28H	HS4344ESS01H (DIP-28S)
"	"	"	"	HS400ECAA0H	HS4344ESP01H (FP-28)
"	"	"	"	HS4344ECF01H	HS4344ESF01H (FP-30D)
HD407A4359	"	"	"	HS4359ECS42H	HS4359ESS01H (DIP-42S)
"	"	"	"	HS4359ECH01H	HS4359ESH01H (FP-44A)
HD407A43464	"	"	"	HS4369ECS64H	HS4369ESS01H (DIP-64S)
"	"	"	"	HS4369ECH01H	HS4369ESF01H (FP-64B)
HD4074618	HS400EUA02H	HS461ETA01H	-	HS471ECF80H	HS460ESF01H (FP-80B)
"	"	"	-	HS4719ECH80H	HS460ESH01H (FP-80A)
"	"	"	-	HS400ECA80H	HS461EST01H (TFP-80)
HD4074629	"	HS400ETA01H	HS462ERS01H	HS4000ECF10H	HS462ESF01H (FP-100A)
"	"	"	"	HS400ECHA0H	HS462ESH01H (FP-100B)
"	"	"	"	HS400ECHA0H	HS4629ESN01H (TFP-100)
HD407A4639R	"	"	HS4639ERS02H	HS400ECF80H	HS4639ESF01H (FP-80B)
HD407A4689	"	"	"	HS400ECF80H	HS4639ESF01H (FP-80B)
HD4074654	"	"	HS4654ERS01H	HS4654ECS42H	HS4654ESS01H (DP-42S)
"	"	"	"	"	HS454ESH01H (FP-44A)
HD4074818	HS400EUA02H	HS461ETA01H	-	HS471ECF80H	HS460ESF01H (FP-80B)
"	"	"	-	HS4719ECH80H	HS460ESH01H (FP-80A)
"	"	"	-	HS400ECA80H	HS461EST01H (TFP-80)
HD4074829	"	HS400ETA01H	HS462ERS01H	HS4000ECF10H	HS462ESF01H (FP-100A)
"	"	"	"	HS4000ECHA0H	HS462ESH01H (FP-100B)
"	"	"	"	HS4000ECHA0H	HS4629ESN01H (TFP-100)
HD4074849*	"	"	HS4849ERS01H*	HS4000ECH80H	HS4849ESH01H (FP-80A)
"	"	"	"	HS4000ECF80H	HS4849ESF01H (FP-80B)

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NEW TOOLS

DESCRIPTION	PART NAME
E400 Emulator for H400/H400A series	HS4000EPI01HD
I/O board for different I/O mask options	HS4000EIO01H
Bus monitor board	HS4000ELD01H

NEW PRODUCTS

Nowadays, battery-powered equipment require microcontrollers which consume less power by keeping high speed CPU processing and full functionality of on-chip features.

Typical requirements of battery-driven applications are:

- Reduced number of batteries / lower supply voltage
- reduced current consumption
- variety of low power modes
- no reduction of CPU speed / functionality of on-chip Features in regard to lower supply voltage

Right in time Hitachi launch new 4-bit microcontrollers which operate in the supply voltage range of 1.8V to 6.0V without any restriction regarding CPU speed or functionality of on-chip functions. The variety of features like LCD controller, A/D converter and DTMF Generator ensure a great suitability to applications in the industrial and telecom segment.

1,8V Series

General Purpose/ ASSP series	HD404068* HD4040612* HD404069*	HD404668* HD4046612* HD404669*	HD404888* HD4048812* HD404889*
ROM x 10 Bit	8192 / 12288 / 16384		
RAM x 4 Bit	1024	1024	1344
Total Timers **PWM** **WDT**	3 1 1		4 1 1
8-Bit SCI	1		
Total Interrupts **External** **Internal**	9 5 4		
Total I/O **High Voltage I/O** **High Current I/O**	56 - 10	52 - 10	46 - 10
Additional Features	Comparator 32KHz clock LED driver	DTMF Generator Comparator LED driver 32 KHz clock	LCD 32 x 4 6 ch A/D LED driver 32 KHz clock
Supply Voltage	1.8V to 6.0V	1.8V to 6.0V	1.8V to 6.0V
Low Power Dissipation Modes	Stop Standby Watch Subactive		
Package Types	FP-64A		FP-80A TFP-80C
ZTAT (OTP)	HD4074069*	HD4074669*	HD4074889*

***contact Hitachi Sales office about availability**

LINE-UP / PRODUCT CODES

ROM	DEVICE	RAM x 4 Bit							FEATURES																PACKAGE
		256	384	512	720	1024	1184	1876	LCD	LED	VFD	4-ch A/D	8-ch A/D	12-ch A/D	COMP.	PWM	SCI	WDT	32 KHz OSC.	DTMF	1.8V operation	3 V operation	5 V operation	H.speed operation	
1K	HD404341/91	■		■						■		■				■	■	■				■			DP-28, FT-30, FP-28
2K	HD404052/92			■						■					■	■	■	■			■			■	DP-/FP-42
	HD404342/92	■								■		■				■	■	■				■			DP-/FP-28, FT-30
	HD404612				■				■	■					■	■	■	■	■	■		■			FP-80
	HD404652			■						■					■	■	■	■		■	■				DP-/FP-42
	HD404812				■				■	■					■	■	■	■	■			■	■		FP-80
4K	HD404054/94			■						■					■	■	■	■			■			■	DP-/FP-42
	HD404314		■							■	■		■			■	■	■					■		DP-/FP-42
	HD404324	■							■	■		■				■	■	■	■			■			DP-/FP-64
	HD404344/94	■								■		■				■	■	■				■			DP-/FP-28, FT-30
	HD404354		■							■			■			■	■	■				■		■	DP-/FP-42
	HD404364			■						■				■		■	■	■	■			■		■	DP-/FP-64
	HD404614				■		■		■	■					■	■	■	■	■	■		■			FP-/TFP-80
	HD404654			■						■					■	■	■	■		■	■				DP-/FP-42
	HD404814				■		■		■	■					■	■	■	■	■			■	■		FP-/TFP-80
6K	HD404316	■									■		■			■	■	■					■		DP-/FP-42
	HD404356		■							■			■			■	■	■				■		■	DP-/FP-42
	HD404326	■							■	■		■				■	■	■	■			■			DP-/FP-64
	HD404616						■		■	■					■	■	■	■	■	■		■			FP-/TFP-80
	HD404816						■		■	■					■	■	■	■	■			■			FP-/TFP-80
8K	HD404318		■								■		■			■	■	■					■		DP-/FP-42
	HD404328	■							■	■		■					■	■	■			■			DP-/FP-64
	HD404338			■							■			■		■	■	■	■				■		DP-/FP-64
	HD404358		■							■			■			■	■	■				■		■	DP-/FP-42
	HD404368			■						■				■		■	■	■	■			■		■	DP-/FP-64
	HD404618						■		■	■					■	■	■	■	■	■		■			FP-/TFP-80
	HD404638R					■				■					■	■	■	■	■	■		■		■	FP-80
	HD404688				■					■					■	■	■	■	■	■		■		■	FP-80
	HD404628/4828							■	■	■		■				■	■	■	■	■		■			FP/TFP 100
	HD404818						■		■	■					■	■	■	■	■			■			FP-/TFP-80
	HD404848*						■		■	■			■			■	■	■	■			■			FP-80
12K	HD4043312			■							■			■		■	■	■					■		DP-/FP-64
	HD4043512			■						■			■			■	■	■						■	DP-/FP-42
	HD4046212/48212							■	■	■		■				■	■	■	■	■		■			FP/TFP 100
	HD4046812				■					■					■	■	■	■	■	■		■		■	FP-80
	HD4043612			■						■				■		■	■	■	■			■		■	DP-/FP-64
	HD4048412*						■		■	■			■			■	■	■	■			■			FP-80
16K	HD404339			■							■			■		■	■	■	■				■		DP-/FP-64
	HD404369			■						■				■		■	■	■	■			■		■	DP-/FP-64
	HD404629/4829							■	■	■		■				■	■	■	■	■		■			FP/TFP 100
	HD404639R					■				■					■	■	■	■	■	■		■		■	FP-80
	HD404689				■					■					■	■	■	■	■	■		■		■	FP-80
	HD404849						■		■	■			■			■	■	■	■			■			FP-80

*** Please contact Hitachi Sales office about availabily**