

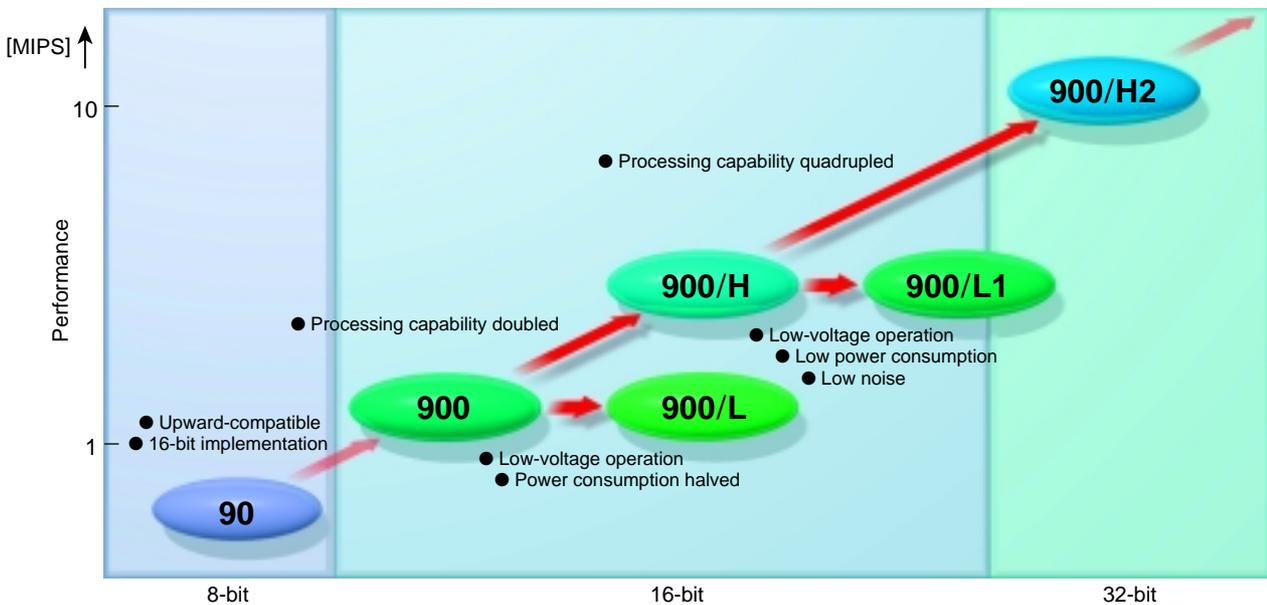
# 9000 Family

## 16-bit and 32-bit microcontrollers developed for C language code efficiency

The 9000 Family is made up of highly functional microcontrollers combining the best of Toshiba technologies.

The microcontrollers in this family are available as the processor core for a wide variety of applications, including office equipment, such as printers and fax machines, complex electronic household appliances, such as VCRs and video cameras, cellular phones and other information-based equipment.

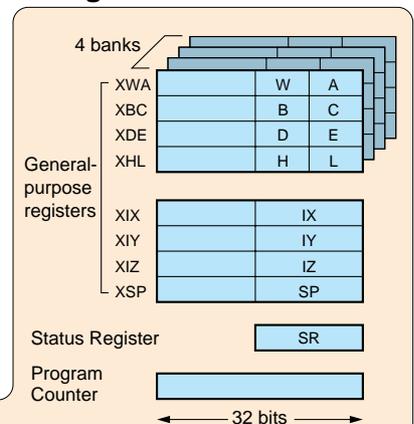
### Core expansion keeping pace with applications



### Processor core features

	900/H2 Series	900/H & 900/L1 Series	900 & 900/L Series
Maximum operating frequency (@input frequency)	20 MHz (@10 MHz)	12.5 MHz (@25 MHz)	10 MHz (@20 MHz)
Minimum instruction execution time	50 ns	160 ns	200 ns
Address space	16 Mbytes of linear address space (for program and data)		
Data transfer rate (micro DMA)	0.25 $\mu$ s	0.64 $\mu$ s	1.6 $\mu$ s
32-bit data-processing instructions	Transfer, arithmetic/logic operations and shift instructions		
Bit-processing instructions	Transfer, logic operations, test, set, reset and search		
Multiplication instruction execution time (16-bit operands, 32-bit result)	600 ns	960 ns	2.6 $\mu$ s
Dynamic bus sizing	8-/16-/32-bit	8-/16-bit	

### Register model



### Main applications

**Office equipment**

Printers

Fax machines

**Home electronics**

DVD players

Digital video cameras

**Portable devices**

PICs

Cellular phones  
e.g. PHS

- **32-bit wide general-purpose registers**  
Can be used for address calculations.  
Code size reduction is possible.
- **Numerous general-purpose registers**  
Flexible code generation by compiler  
Code size reduction is possible.
- **Register bank method**  
Ideal for real-time processing

900 Family

# 900/H Series

*High-performance devices ideally suited to high-end office equipment*

- Enhanced **TLCS-900** architecture
  - TLCS-900 instruction compatibility
  - 32-bit general-purpose registers / register banks
- Linear address space: 16 MB
- Processing performance doubled (compared to 900 Series)
- Direct connection to various types of DRAM possible
- Because refresh is asynchronous with CPU operations, performance does not degrade as a result of accesses to memory devices other than DRAM.
- Applications
  - Serial printers
  - CD-ROM drives / DVD-ROM drives
  - Electronic musical instruments
  - HDDs



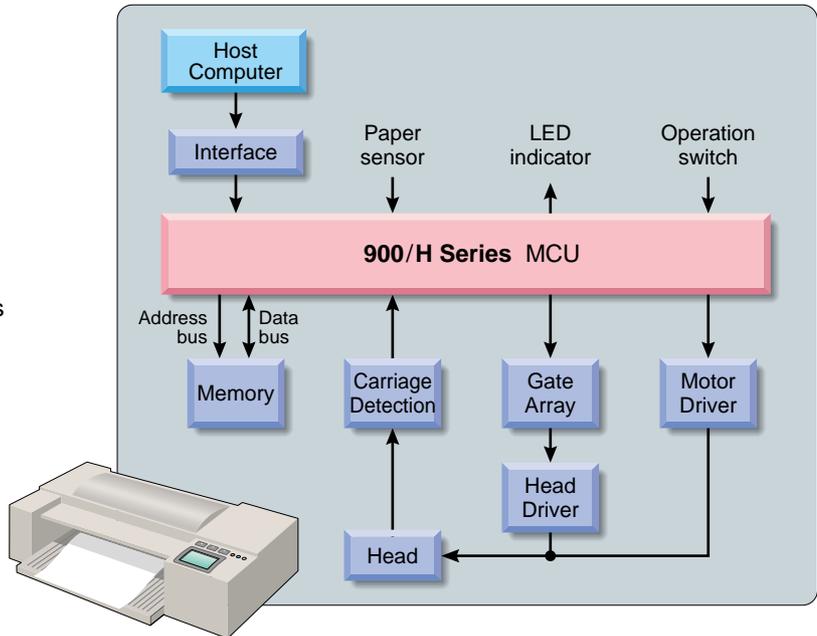
CD-ROM drives



Electronic musical instruments



## ■ Block diagram of serial printer



900 Family

# 900/L Series

*Low power consumption design ideal for high-performance portable equipment*

- Enhanced **TLCS-900** architecture
  - TLCS-900 instruction compatibility
  - 32-bit general-purpose registers / register banks
- Linear address space: 16 MB
- Low-voltage operation
  - Operating supply voltage: 4.5 V ~ 5.5 V @20 MHz
  - 2.7 V ~ 5.5 V @12.5 MHz
- Designed for low power consumption
- Minimum instruction execution time: 200 ns (when operating at 20 MHz)



Digital movie cameras



Cellular 'phones

Portable MD players



900 Family

# 900/L1 Series

**Next-generation 16-bit microprocessors offering both high performance and low-power operation**



- Low-voltage operation: 1.8 V ~ 5.5 V
- Low power consumption: 3.0 mA (when operating at 3 V and 16 MHz)
- Low noise (EMC register)
  - EMI: reduced by 30%
  - EMS: noise filter, protection register

Portable communications

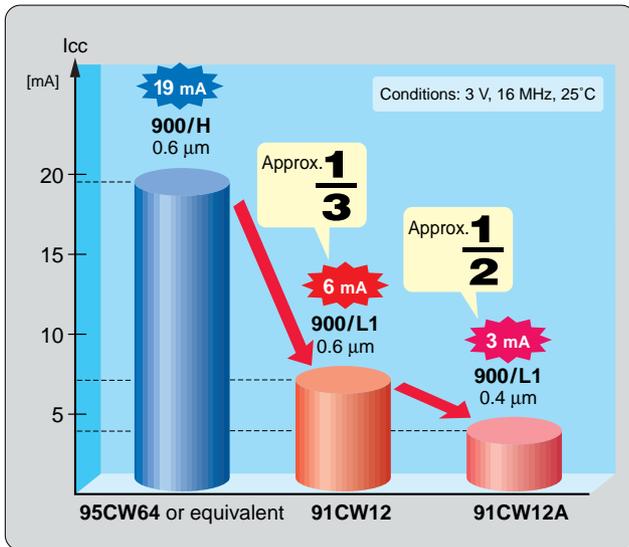


DSCs

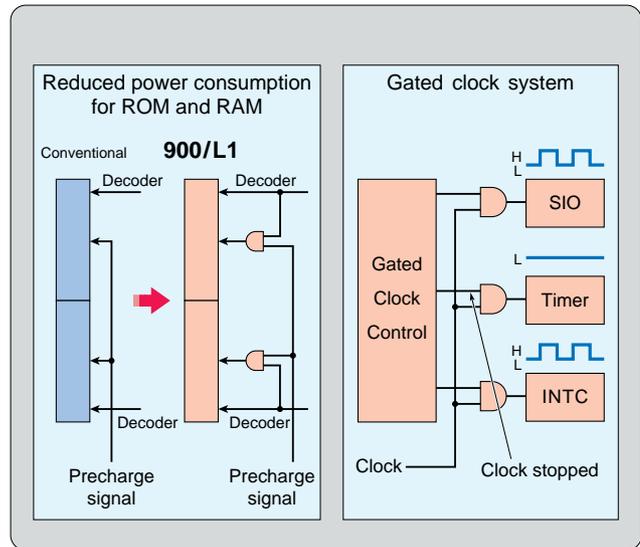


DVCs

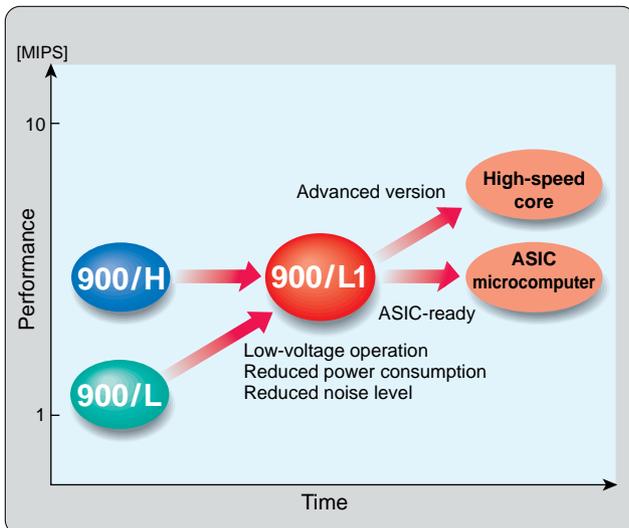
## Low power consumption design



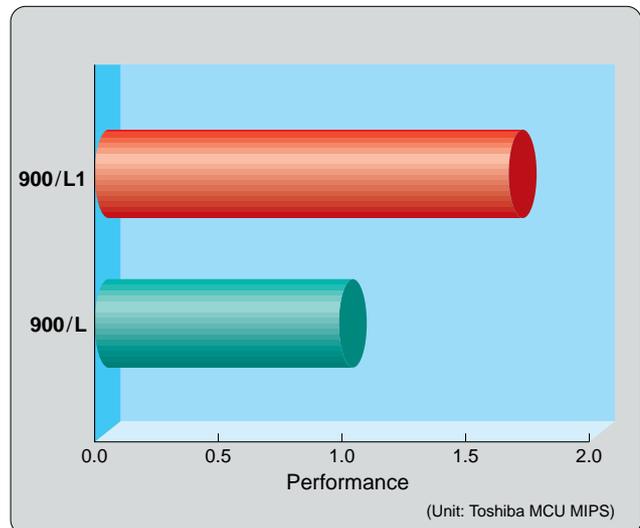
## Typical techniques for low power consumption design



## Core expansion plan



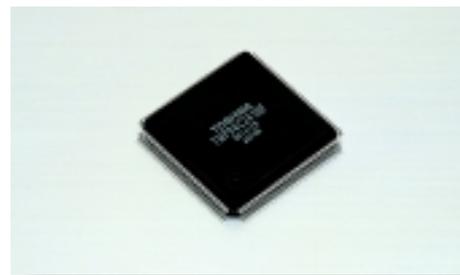
## Comparison of core performance (with 900/L)



900 Family

# 900/H2 Series

**High-performance microcontrollers  
incorporating a 32-bit CPU core**



- Approximately four times the processing performance of conventional products (e.g. the 900/H Series)

## Comparison of instruction execution times

Instruction	Operand Size		
	8-bit	16-bit	32-bit
● Data transfer 1 LD reg, reg	50 (900/H2 Series), 160 (Conventional products)	50 (900/H2 Series), 160 (Conventional products)	50 (900/H2 Series), 160 (Conventional products)
● Data transfer 2 LD reg, mem	100, 320	100, 320	100, 480
● Arithmetic operation ADD reg, imm	50, 240	50, 320	50, 480
● Bit manipulation SET imm, reg	50, 240	50, 240	
● Branching JR disp8	100, 400		

Unit: ns

- Enhanced high-speed data transfer function (micro DMA)

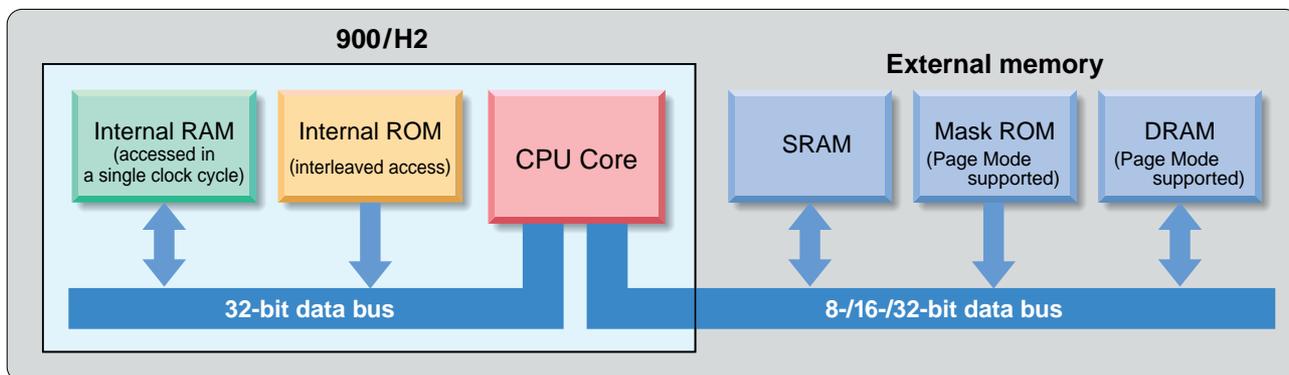
**900/H2** Series microcontrollers come with a high-speed data transfer function, equivalent to that of a DMAC (direct memory access controller), as standard.

## Function and performance comparison

Parameter	900 Series 900/L Series	900/H Series 900/L1 Series	900/H2 Series
Number of channels	4 channels	4 channels	8 channels
Minimum transfer time	1600 ns (2 bytes)	640 ns (2 bytes)	250 ns (4 bytes)
Initiated by	Interrupt	Interrupt and software trigger	Interrupt and software trigger
Continuous Transfer Mode	NA	NA	Available

- Diverse memory types fully utilized

The **900/H2** Series architecture allows various kinds of external memory chip to be connected directly to the CPU core without the need for an external circuit. Furthermore, the internal memory is connected to the CPU core via a 32-bit data bus and the internal RAM can be accessed in a single clock cycle.



# 900 Family Selection Guide

## 900 Family Selection Guide

ROM (bytes)	RAM (bytes)	Product No.	Minimum Instruction Execution Time (ns)		CAN	SEI	SIO/UART	Synchronous SIO	FC Bus / SIO	DRAM Controller	AD Converter		8-Bit DAC Converter	LCD Driver	V/F Driver	Timer/Counter	Clock timer	Timebase Counter	Stepping Motor Controller	Pattern Generator	PWM Timer	CS/Wait Controller			Watchdog Timer	Dual Clock	Click Gear	I/O Port	Operating Temperature (°C)	Version with Built-in OTP	Packages (mm)
			5 V ± 10%	3 V ± 10%							8-bit channels	10-bit channels										14-bit	12-bit	8-bit							

### 900 Series

NA	NA	TMP96C041BF	200	-	-	-	2	-	-	-	-	4	-	-	2	2	-	2	-	2	-	3	-	●	-	-	47	-	QFP80 (14 X 20)
		TMP96C0312F			-	-	2	-	1	4	-	-	-	4	1	-	2	-	-	-	4	-	-	-	4	-	●	-	-
32K	1K	TMP96C141BF	200	-	-	-	2	-	-	-	-	4	-	-	2	2	-	2	-	2	-	3	-	●	-	-	47	-	QFP80 (14 X 20)
		TMP96CM40F			-	-	2	-	-	-	-	4	-	-	2	2	-	2	-	2	-	3	-	●	-	-	-	65	TMP96PM40F

### 900/L Series

NA	2K	TMP93CS41F/DF	200	320	-	-	2	-	-	-	-	8	-	-	2	2	-	2	-	2	-	3	-	●	●	●	61	-	QFP100 (14 X 14)				
		TMP93CS45F			-	-	2	-	1	-	-	8	-	-	4	2	-	-	-	-	-	-	-	-	-	●	●	●	44	-	QFP80 (12 X 12)		
	TMP93CW41DF	-			-	2	-	-	-	-	8	-	-	2	2	-	2	-	2	-	3	-	●	●	●	-	-	61	-	QFP100 (14 X 14)			
	TMP93C071F	-			-	1	2	1	-	-	16	-	-	-	1	5	●	●	-	9	-	3	3	●	●	●	-	69	-	QFP120 (28 X 28)			
8K	1K	*TMP93C852F	200	400	-	-	-	6	-	-	-	-	-	-	-	-	4	-	-	4	-	3	-	●	-	●	88	-	QFP160 (28 X 28)				
32K	2K	TMP93CM40F			-	-	2	-	-	-	-	8	-	-	2	2	-	2	-	2	-	3	-	●	●	●	-	79	TMP93PS40F	QFP100 (14 X 14)			
		TMP93CS20F			-	-	2	-	1	-	-	8	-	●	-	4	4	●	-	-	-	-	-	-	-	●	●	●	88	TMP93PW20AF	QFP144 (16 X 16)		
64K	2K	TMP93CS32F			200	320	-	-	2	-	-	-	-	6	-	-	4	2	-	-	-	-	-	-	-	-	●	-	●	49	-	QFP64 (14 X 14)	
		TMP93CS40F/DF	-	-			2	-	-	-	-	8	-	-	2	2	-	2	-	2	-	3	-	●	●	●	-	79	TMP93PS40F/DF	QFP100 (14 X 14)			
		TMP93CS42AF	-	-			2	-	-	-	-	5	-	-	2	2	-	-	-	-	2	-	3	-	●	-	●	-	80	TMP93PS42AF	QFP100 (14 X 14)		
		TMP93CS44F	-	-			2	-	1	-	-	8	-	-	4	2	-	-	-	-	-	-	-	-	-	-	●	●	●	62	TMP93PS44F	QFP80 (12 X 12)	
72K	-	*TMP93CT76F	250	-	-	-	-	1	1	-	-	10	-	-	●	1	5	●	●	-	1	-	3	-	●	●	●	85	-	QFP100 (14 X 20)			
96K	2.5K	TMP93CU76F			200	320	-	-	-	1	1	-	-	10	-	-	●	1	5	●	●	-	1	-	3	-	●	●	●	85	-	QFP80 (14 X 20)	
	3K	TMP93CU44DF					-	-	2	-	1	-	-	8	-	-	4	2	●	●	-	-	-	-	-	-	●	●	●	62	TMP93PW44ADF	QFP80 (14 X 20)	
128K	4K	TMP93CW76F			250	-	-	-	-	1	1	-	-	10	-	-	●	1	5	●	●	-	1	-	3	-	●	●	●	85	-	QFP100 (14 X 20)	
		TMP93CW40DF	200	320			-	-	2	-	-	-	8	-	-	2	2	-	2	-	2	-	3	-	●	●	●	-	79	TMP93PW40DF	QFP100 (14 X 14)		
		TMP93CW46AF					-	-	5	-	-	-	-	8	-	-	2	2	-	-	-	-	2	-	3	-	●	●	●	-	79	TMP93PW46AF	QFP100 (14 X 14)
		TMP93CW44DF					-	-	2	-	1	-	-	8	-	-	4	2	-	-	-	-	-	-	-	-	-	-	●	●	●	62	TMP93PW44ADF

### 900/H Series

NA	NA	TMP95C001F	160	320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	QFP64 (14 X 14)			
		TMP95C061BF			-	-	2	-	1	-	-	4	-	-	4	2	-	-	-	-	-	-	-	-	-	4	-	●	-	56	-	QFP100 (14 X 14)
	TMP95C063F	-			-	2	-	2	-	-	8	2	-	8	2	-	2	-	-	-	-	-	-	-	-	4	-	●	-	91	-	QFP144 (20 X 20)
	TMP95C265F	-			-	3	-	-	-	-	8	2	-	8	2	-	-	-	-	-	-	-	-	-	-	-	4	-	●	-	55	-
64K	2K	TMP95CS54F	167	400	-	1	1	2	-	-	-	8	-	-	8	2	-	-	-	-	-	-	-	-	●	-	-	81	-	QFP100 (14 X 14)		
		TMP95CS64F			-	-	3	-	-	-	-	8	2	-	8	2	-	-	-	-	-	-	-	-	-	-	4	-	●	-	81	TMP95PS54F
128K	4K	TMP95CW64F	160	400	-	-	3	-	-	-	-	8	2	-	8	2	-	-	-	-	-	-	-	-	-	4	-	●	-	81	TMP95PW64F	QFP100 (14 X 14)
		TMP95FW54AF			-	1	1	2	-	-	-	-	8	-	-	8	2	-	-	-	-	-	-	-	-	-	-	●	-	81	TMP95PW64F	QFP100 (14 X 14)
256K	8K	TMP95FY64F	160	-	-	-	3	-	-	-	-	8	2	-	8	2	-	-	-	-	-	-	-	-	4	-	●	-	81	-	QFP100 (14 X 14)	

### 900/L1 Series

64K	2K	*TMP91CS14F	160	250	-	-	4	-	-	-	-	16	-	-	6	4	●	-	-	-	3	-	-	●	●	●	81	-	*TMP91FY14F	QFP100 (14 X 14)				
96K	3K	TMP91CU10F	-	296	-	-	3	-	-	-	-	8	-	-	8	2	-	-	-	-	-	-	-	3	-	●	●	●	80	-	TMP91PW10F	QFP100 (14 X 14)		
128K	4K	TMP91CW11F	160	320	-	-	3	2	1	-	-	8	-	-	2	2	●	-	-	-	2	2	-	3	-	●	●	●	79	-	TMP91PW11F	QFP100 (14 X 14)		
		TMP91CW12F			-	-	2	-	1	-	-	8	-	-	8	2	●	-	-	-	-	-	-	-	-	-	4	-	●	●	●	81	-	TMP91PW12F
	*TMP91CW12AF	-		150	-	-	2	-	1	-	-	-	8	-	-	8	2	●	-	-	-	-	-	-	-	4	-	●	●	●	81	-	-	QFP100 (14 X 14)
	*TMP91CW14F	-		160	-	-	4	-	-	-	-	-	16	-	-	6	4	●	-	-	-	-	-	-	-	3	-	-	●	●	●	81	-	*TMP91FY14F
256K	4K	TMP91CY13F	-	-	-	-	3	2	1	-	-	12	-	-	2	3	●	-	-	-	2	2	-	3	-	●	●	●	94	-	TMP91FY13F (flash E <sup>2</sup> PROM)	QFP120 (14 X 14)		
		*TMP91FY14F	-	160	-	-	4	-	-	-	-	-	16	-	-	6	4	●	-	-	-	-	-	-	-	-	-	●	●	●	81	-	-	QFP100 (14 X 14)

### 900/H2 Series

NA	2K	TMP94C241CF	50	-	-	-	2	-	-	2	-	8	2	-	4	4	-	-	-	-	-	-	-	-	6	-	●	-	64	-	QFP160 (28 X 28)
		*TMP94C251AF			-	-	2	-	-	2	-	8	2	-	4	4	-	-	-	-	-	-	-	-	-	-	6	-	●	-	64
96K	3K	*TMP94FU81F	-	50	-	-	2	-	-	-	-	8	-	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	72	-	QFP100 (14 X 14)

\*: Under development

Note 1: The suffix F in a product number denotes a quad flat package (QFP).

Note 2: Guaranteed minimum instruction execution time is 200 ns when device is operating at temperatures of -20° to 70°C, or 250 ns when device is operating at temperatures of -40° to 85°C.

Note 3: Operating voltage is 5 V ± 10%

Note 5: Product with built-in flash E<sup>2</sup>PROM (USP 4,382,279 owned by Bull CP8.)

Note 4: Operating voltage is 4.7 V to 5.3 V

Note 6: 3.3 V ± 0.3 V for internal; 5 V ± 10% for input / output interface

# NEW PRODUCTS

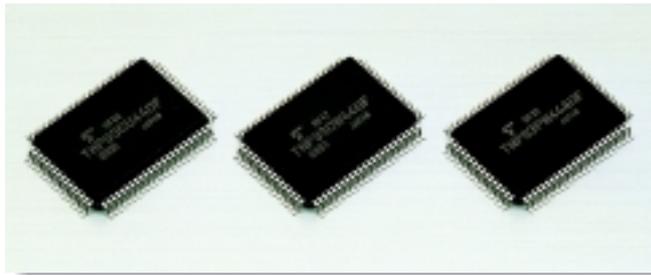
Low-noise 900/L Series microcontrollers with I<sup>2</sup>C bus interface

**NEW**

## TMP93CU44DF/CW44DF/PW44ADF

### Multi-function, high-capacity, low-noise, low-voltage\*, low power dissipation 16-bit microcontrollers

The **TMP93CU44DF/CW44DF/PW44ADF** are low-voltage, low power dissipation 16-bit microcontrollers based on the 900/H CPU and incorporating an I<sup>2</sup>C bus interface and a high-capacity memory. To reduce unnecessary radiated noise and to enable low-noise operation, a decoupling capacitor has been incorporated and the number of wiring harnesses has been optimized. With lower noise levels than existing products, these microcontrollers are suitable for a wider range of applications.



- Internal ROM
  - TMP93CU44DF:** mask ROM, 96 Kbytes
  - TMP93CW44DF:** mask ROM, 128 Kbytes
  - TMP93PW44ADF:** OTP ROM, 128 Kbytes
- Internal RAM
  - TMP93CU44DF:** 3 Kbytes
  - TMP93CW44DF/PW44ADF:** 4 Kbytes
- I<sup>2</sup>C bus / SIO: 1 channel
- SIO/UART: 2 channels
- 10-bit AD converter: 8 channels
- High-current output port: 8 pins
- Clock gear/Dual clock function
- Watchdog timer
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 4 channels
- 80-pin miniflat package  
(14 X 20 mm, 0.8-mm pitch, 2.7 mm thick)

\*: **TMP93PW44ADF** operating voltage is 5 V ± 10%

900/L Series

**NEW**

## TMP93CT76F\*/CU76F/CW76F/PW76F \* Under development

### 16-bit microcontroller incorporating a VCR servo controller and fluorescent display tube driver

The **TMP93CT76F/CU76F/CW76F/PW76F** are low power consumption, high-speed, advanced-function 16-bit microcontrollers built around the original Toshiba **TLCS-900/L** CPU core. They incorporate a fluorescent display tube driver and peripheral circuits ideal for controlling VCR systems and servos. These microcontrollers can be connected to multiple memory devices and can enhance the capability of dedicated VCR system control hardware; thus they are suitable for a wide range of applications.



- Internal ROM
  - TMP93CT76F:** 72 Kbytes
  - TMP93CU76F:** 96 Kbytes
  - TMP93CW76F/PW76F:** 128 Kbytes
- Internal RAM
  - TMP93CT76F:** 2 Kbytes
  - TMP93CU76F/CW76F/PW76F:** 2.5 Kbytes
- 16-bit timer/counter: 5 channels
- 8-bit timer/counter: 1 channel
- Timing pulse generator: 2 channels
- Time-base capture: 3 channels
- 8-bit/14-bit PWM output: 1/3 channels
- VISS/VASS detector ● Sync. signal separator
- Pseudo sync. signal output
- Color rotary controller for head amp
- Standby modes: 4
- I<sup>2</sup>C bus / SIO: 1 channel each
- P-ch high breakdown voltage output ports: 24
- 8-bit AD converter inputs: 10 channels
- 100-pin flat package  
(14 X 20 mm, 0.65-mm pitch, 2.7 mm thick)



Purchase of Toshiba I<sup>2</sup>C components conveys a license under the Philips I<sup>2</sup>C Patent Rights to use these components in an I<sup>2</sup>C system, provided that the system conforms to the I<sup>2</sup>C Standard Specification as defined by Philips.

900/H Series devices with built-in CAN controller and flash E<sup>2</sup>PROM

**NEW**

## TMP95FW54AF\*

\* Under development

### ■ 16-bit microcontrollers with built-in CAN controller

The **TMP95FW54AF** is 16-bit microcontroller based on the **900/H** CPU, incorporating a single 5-V flash memory and the controller area network (CAN) communications protocol, the standard European protocol for vehicle LANs. The CAN has a maximum transfer rate of 1 Mbps.

The **TMP95FW54AF** also offer enhanced communications functions in the shape of a built-in serial expansion interface (SEI) for synchronous serial communications.



- Internal ROM: flash E<sup>2</sup>PROM, 128 Kbytes
- Internal RAM: 4 Kbytes
- CAN controller: 1 channel  
supports version 2.0B  
(standard and extended formats)  
16 mailboxes built in
- SEI: 1 channel
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 8 channels
- SIO/UART: 2 channels
- 10-bit AD converter: 8 channels
- Operating voltage: 4.5 V ~ 5.5 V
- Operating temperature: -40°C ~ +85°C
- 100-pin miniflat package  
(14 X 14 mm, 0.5-mm pitch, 2.7 mm thick)

900/H Series with flash E<sup>2</sup>PROM

**NEW**

## TMP95FY64F

### ■ 16-bit microcontrollers with built-in flash E<sup>2</sup>PROM

The **TMP95FY64F** is a 16-bit microcontroller based on the **900/H** CPU and incorporating a single 5-V flash memory.

This microcontroller incorporates all of the **900 Family's** standard functions. It is easy to reprogram the microcontroller without removing it from the PCB on which it is mounted.



- Internal ROM: flash E<sup>2</sup>PROM, 256 Kbytes  
Memory block organization  
(16KB, 8KB X 2, 32KB, 64KB X 3)
- Internal RAM: 8 Kbytes
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 8 channels
- SIO/UART: 3 channels
- 10-bit AD converter: 8 channels
- 8-bit DA converter: 2 channels
- CS/Wait controller: 4 blocks
- 100-pin miniflat package  
(14 X 14 mm, 0.5-mm pitch, 2.7 mm thick)

# NEW PRODUCTS

900/L1 Series product with ultra-low power consumption and low noise

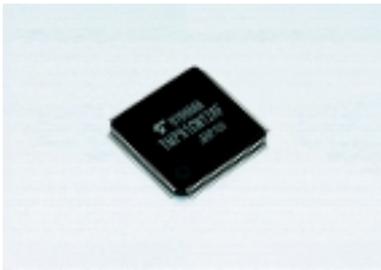
**NEW**

## TMP91CW12AF\*

\* Under development

### ■ Low-voltage operation, low power consumption and low-noise technology combined in one device

The **TMP91CW12AF** is a new product which improves still further on the low-voltage performance of the TMP91CW12F. Low-voltage operation is 1.7X faster than the TMP91CW12F. The supply voltage can range from 1.8 V (fmax = 10 MHz) to 2.7 V (fmax = 27 MHz), while power consumption is about half that of the TMP91CW12F. This device is ideal for battery-driven equipment, particularly portable equipment like personal intelligent communicators (PICs), cellular 'phones, and digital cameras.



- Internal ROM: mask ROM, 128 Kbytes
- Internal RAM: 4 Kbytes
- Timer
- Programmable Idle Mode  
Clock to any peripheral can be stopped to achieve low-power operation.
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 8 channels
- SIO / UART: 2 channels
- I<sup>2</sup>C bus / SIO: 1 channel
- 10-bit AD converter: 8 channels
- 100-pin miniflat package  
(14 X 14 mm, 0.5-mm pitch, 1.4 mm thick)

900/L1 Series low power consumption microcontrollers

**NEW**

## TMP91CY13F/FY13F

### ■ 16-bit microcontrollers with high-capacity flash E<sup>2</sup>PROM

The **TMP91CY13F** is a low-voltage, low power consumption 16-bit microcontroller built around a **900/L1** CPU core. It incorporates 8 KB of RAM and 256 KB of ROM. Features such as a 6-channel serial interface, a 12-channel 10-bit AD converter and a real-time clock make this product ideal for multimedia devices such as digital cameras.

The **TMP91FY13F**'s on-board program can be rewritten.



- Internal ROM:  
**TMP91CY13F**: mask ROM, 256 Kbytes  
**TMP91FY13F**: flash ROM, 256 Kbytes
- Internal RAM: 8 Kbytes
- I<sup>2</sup>C bus / SIO: 1 channel
- 10-bit AD converter: 12 channels
- Clock gear / Dual clock function
- 120-pin miniflat package  
**TMP91CY13F**  
(14 X 14 mm, 0.4-mm pitch, 1.4 mm thick)  
**TMP91FY13F**  
(14 X 14 mm, 0.4-mm pitch, 2.0 mm thick)



Purchase of Toshiba I<sup>2</sup>C components conveys a license under the Philips I<sup>2</sup>C Patent Rights to use these components in an I<sup>2</sup>C system, provided that the system conforms to the I<sup>2</sup>C Standard Specification as defined by Philips.