

870 Family

8-bit microcontrollers suitable for a wide range of consumer electronic appliances such as TVs, VCRs and telephones

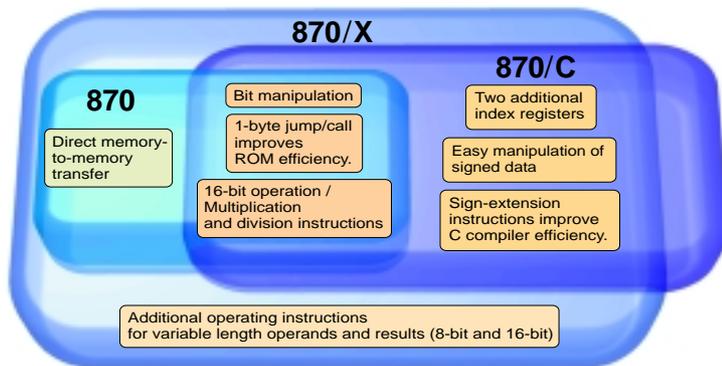
The **870** Family is made up of microcontrollers which are suitable for consumer electronic equipment such as TVs, audio equipment and telephones. Every device in this family has an AD converter, LCD drive circuit, UART and on-screen display circuit. However, each device also has unique features particularly suiting it to certain well-defined applications and operating conditions. For example, the **870** Family product line includes devices with low-voltage, low power consumption and low-noise operation features, and these are suited to a wide range of portable equipment.

In addition to the popular **870** Series, Toshiba have recently introduced the **870/X** Series with improved functionality. To round out the **870** Family, Toshiba are currently developing the **870/C** Series for small-scale applications.

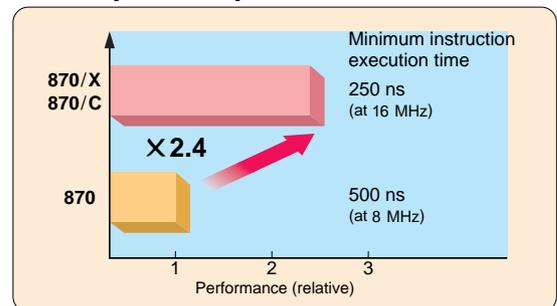
Core development



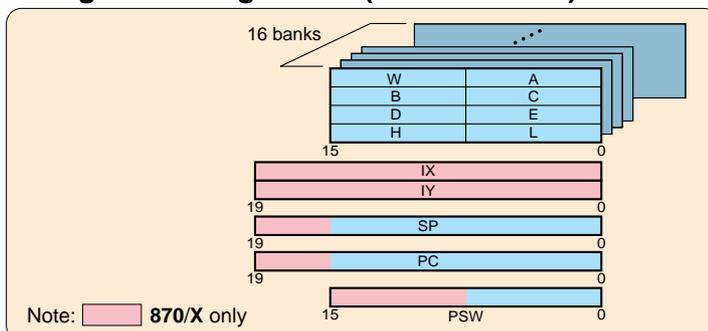
Instruction set features



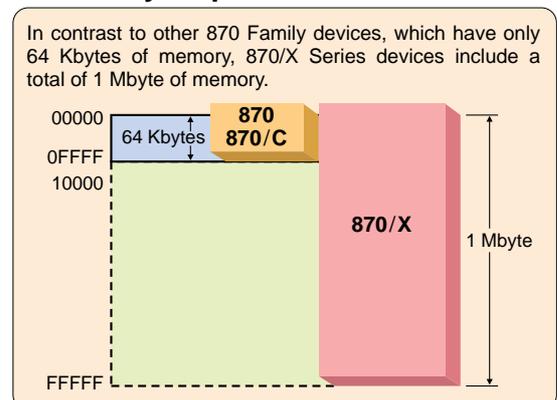
Comparative performance



Register configuration (870 and 870/X)



Memory map



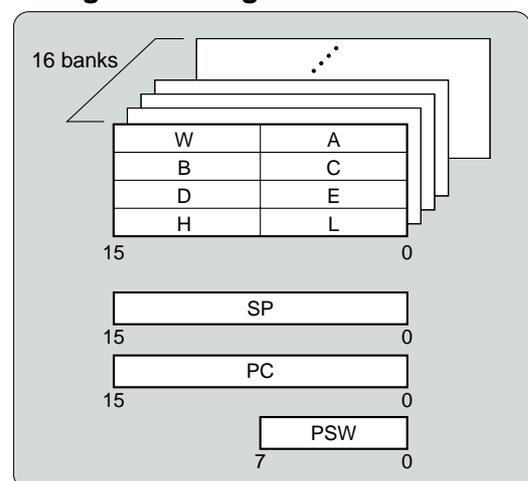
870 Series



Basic functions

- **64 Kbytes of memory space**
 - From 4 Kbytes to 60 Kbytes of ROM
 - From 256 bytes to 2 Kbytes of RAM
- **Architecture suitable for real-time control**
 - 0.5 μ s per instruction cycle at 8 MHz
 - High-speed task switching
 - High-speed Interrupt Register save/restore using register bank switching
 - Up to 15 interrupt vectors
- **Low-voltage, high-speed operation; low power consumption**
 - Wide operating voltage range: 2.7 V to 5.5 V or 2.7 V to 6.0 V (standard type)
 - Low-voltage / high-speed operation: 1.8 V / 0.95 μ s at 4.2 MHz
 - Clock gear
 - Low power consumption modes attained by switching the speed of the system clock.
 - Low-voltage AD conversion
 - Dual clock system
 - Main clock for high-speed operation (8 MHz)
 - and sub-clock for low power consumption (32.8 kHz); 5 different low power consumption modes
- **Instruction set for embedded controller: 412 instructions**
 - 1-byte jump/call instructions, direct memory-to-memory transfer instructions and arithmetic instructions to improve memory efficiency
 - Variety of bit-manipulation instructions
 - 16-bit transfer/calculation instructions
 - Multiplication and division instructions
- **One-time PROM product versions**
 - One-time PROM product versions with features compatible with mask ROM products
- **Small package**
 - Microflat package / Miniflat package
- **Well-developed support environment**
 - Assembler
 - High-level languages (C compiler, C-Like compiler)
 - High-level language debugger
 - Real-time emulator: RTE Model 10

Register configuration



Wide temperature range performance

Special products with a guaranteed operating temperature range of from -40° to 85°C can also be supplied. For information on these products please contact your nearest Toshiba office or authorized Toshiba dealer.

870 Family

870/C Series

Suitable for home appliances and cellular equipment which require low-voltage operation capability and low power consumption

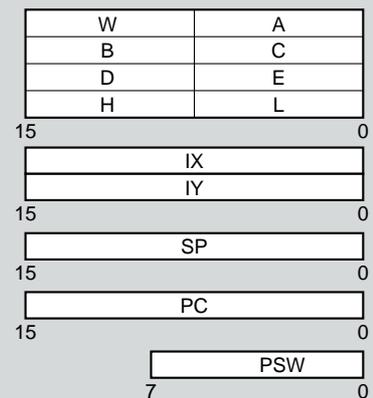


Basic functions

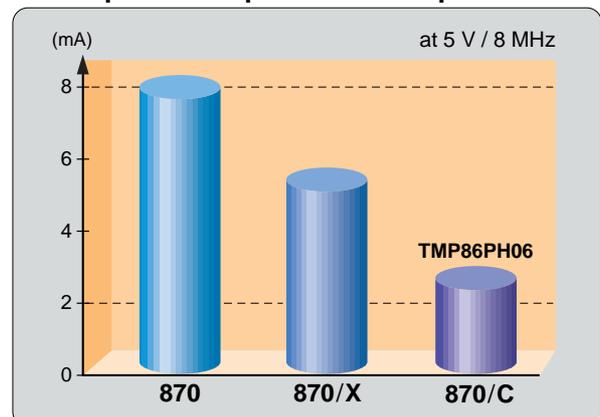
- **64 Kbytes of memory space**
 - ROM-less version and versions including up to 60 Kbytes of ROM (all devices at planning stage)
- **Architecture suitable for real-time control**
 - 0.25 μ s per instruction cycle at 16 MHz
 - Up to 15 interrupt vectors (23 with multiplexing between interrupt sources)
- **Low-voltage, high-speed operation; low power consumption**
 - Wide operating voltage range: 1.8 V to 5.5 V (standard type)
 - Reduced power consumption (2/3 less than the TLCS-870)
 - Clock gear built-in
- **Instruction set for embedded controller: 731 instructions**
 - Registers: isolated from memory space
 - Variety of bit-manipulation instructions
 - 16-bit transfer/calculation instructions
 - Multiplication and division instructions
- **One-time PROM or flash E²PROM product versions**
 - PROM or E²PROM product versions with features compatible with those of mask ROM products
- **Small package**
 - Microflat package / Miniflat package
- **Measures to combat electrical noise**
 - Reduced spontaneous noise, resistance to noise
- **Improved compilation of C source code**
(30% reduction in source code size compared to TLCS-870 and TLCS-870/X)
- **Well-developed support environment**
 - Assembler
 - High-level languages (C compiler, C-Like compiler)
 - High-level language debugger
 - Real-time emulator: RTE Model 15

Register configuration

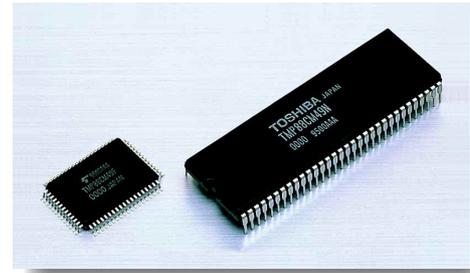
(Only a single general register bank is shown here.)



Comparison of power consumption levels



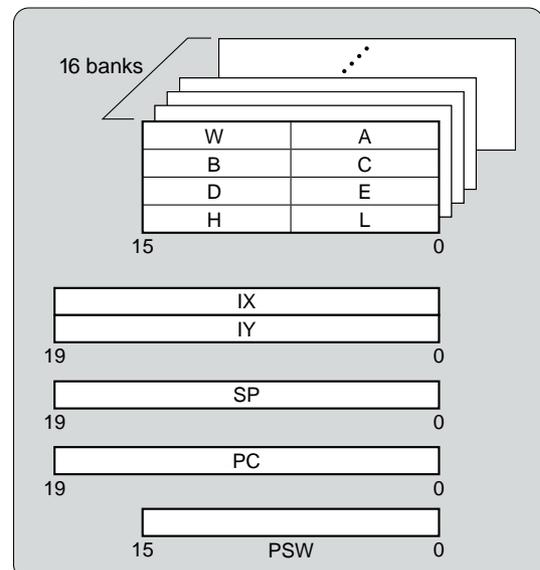
870 Family 870/X Series



Basic functions

- **1-Mbyte memory space**
 - Planned products range from devices without any ROM to others with high-capacity ROMs.
- **Architecture suitable for real-time control**
 - 0.25 μ s per instruction cycle at 16 MHz
 - High-speed task switching
 - High-speed Interrupt Register save/restore using *automatic* register bank switching
 - Up to 63 interrupt vectors
- **Low-voltage, high-speed operation; low power consumption**
 - Wide operating voltage range: 2.7 V to 5.5 V (standard type)
 - 1.8 V / 0.95 μ s at 4.2 MHz (low-voltage type)
 - Dual clock system
 - Main clock for high-speed operation (16 MHz)
 - and sub-clock for low-power operation (32.768 kHz)
 - Power consumption can be reduced by changing the instruction execution speed.
- **Instruction set for embedded controller: 842 instructions**
 - 1-byte jump/call instructions, direct memory-to-memory transfer instructions and arithmetic instructions to improve memory efficiency
 - Variety of bit-manipulation instructions
 - 16-/20-bit transfer/operation instructions
 - Multiplication and division instructions (one 16-bit operand, one 8-bit operand)
 - Enhanced arithmetic, logic, bit-manipulation and sign-handling instructions
 - Additional instructions to improve the efficiency of the C compiler in generating object code
- **One-time PROM product versions**
 - One-time PROM product versions with features compatible with mask ROM products
- **Well-developed support environment**
 - Assembler
 - High-level languages (C compiler, C-Like compiler)
 - High-level language debugger
 - Real-time emulator: RTE Model 25

Register configuration



870 Series Selection Guide ①

ROM (bytes)	RAM (bytes)	Product No.	Minimum Instruction Execution Time (μs)	Driver		SIO Channels	UART Channels	I ² C Bus Channels Note 2	High-Speed Serial Output	AD Converter		AD Conversion Input	DA Converter Channels	Timer/ Counter	16-bit channels	8-bit channels	Remote Control Pulse Detector	Watchdog Timer	OSD	Dual Clock	Clock Gear	Number of I/O Ports	Power Supply Voltage (V)	Operating Temperature (°C)	Version with Built-in OTP	Packages		
				LED	VFT					10-bit channels	8-bit channels																	
4K	256	TMP87C405AM/AN	0.50	6										2				●			●		4.5 to 5.5	-30 to 70	TMP87P808M/N	SOP28/ SDIP28		
		TMP87C408M/N/DM <small>Note 4</small>	0.95	6	1										2				●		●		2.7 to 5.5	-40 to 125	TMP87P808M/N	SSOP30/ SOP28/ SDIP28		
		*TMP87C408SM/SN		6	1										2				●		●			1.8 to 4.0		TMP87P808LM/LN		
		TMP87C408LM/LN	0.95	6	1										2				●		●			4.5 to 5.5 2.2 to 5.5		TMP87P809M/N	SOP28/ SDIP28	
		TMP87C409AM/AN	0.50 0.95	6			1			8					1	2			●					4.5 to 5.5 2.2 to 5.5		TMP87P844N		
		TMP87C444N	0.50			1		1	4				8	2				●				34	4.5 to 5.5		TMP87P844N	SDIP42		
	512	TMP87C446N	0.50/122 0.95/122	8		1			●	8				2	2			●		●		35	4.5 to 5.5	-30 to 70	TMP87PH46N			
		TMP87C447U		8		1				●	8				2	2			●		●		37	2.7 to 5.5		TMP87PH47U	μQFP44 (10 x 10 mm)	
8K	256	TMP87C800N/F/DF	0.50/122 0.95/122	8		2								2	2			●		●		58	4.5 to 6.0 2.7 to 6.0		TMP87PH00N/F/DF	SDIP64/ QFP64/ LQFP64		
		TMP87C807U		8		1					●				2	2			●		●		37	4.5 to 5.5 2.7 to 5.5		TMP87PH47U	μQFP44 (10 x 10 mm)	
		TMP87C808M/N	0.50	6		1					●				2						●			4.5 to 5.5 2.7 to 5.5	-40 to 125	TMP87P808M/N		
		TMP87C808SM/SN	0.95	6		1					●				2				●		●				1.8 to 4.0		TMP87P808LM/LN	SOP28/ SDIP28
		TMP87C809M/N	0.50 0.95	6				1			●				1	2			●			●		4.5 to 5.5 2.2 to 5.5	-30 to 70	*TMP87P809M/N		
			TMP87C840N/F	0.50/122 0.95/122	8		2				●				2	2			●		●		56	4.5 to 6.0 2.7 to 6.0		TMP87PH40AN/AF	SDIP64/ QFP64	
			TMP87C841N/F/U	0.50/122 0.95/122	8		2								2	2			●		●			4.5 to 5.5 2.7 to 5.5	-40 to 85	TMP87PM41N/F/U	SDIP64/ QFP64/ μQFP64 (10 x 10 mm)	
			TMP87C844N	0.50			1		1	4				8	2				●				34	4.5 to 5.5		TMP87P844N	SDIP42	
		512	TMP87C814N/F	0.50/122 0.95/122			16	1			●				2	2			●		●		55	4.5 to 5.5 2.7 to 5.5		TMP87PM14N/F	SDIP64/ QFP64	
			TMP87C846N		8		1				●	8				2	2			●		●		35	4.5 to 5.5 2.7 to 5.5		TMP87PH46N	SDIP42
		TMP87C847U	0.95/122	8		1				●				2	2			●		●		37	1.8 to 4.0	-30 to 70	TMP87PH47U	μQFP44 (10 x 10 mm)		
		TMP87C847LU	0.95/122	8		1				●				2	2			●		●			1.8 to 4.0		TMP87PH47LU	μQFP44 (10 x 10 mm)		
12K	256	TMP87CC31N	0.50	4									4	2	2			●		●		34	4.5 to 5.5		TMP87PM36N	SDIP42		
	512	TMP87CC20F	0.50/122 0.95/122	2	32	1								1	4				●		●		45	4.5 to 6.0 2.7 to 6.0		TMP87PH20F	QFP80	
		TMP87CC40N/F		8		2				8					2	2			●		●			4.5 to 6.0 2.7 to 6.0		TMP87PH40AN/AF	SDIP64/ QFP64	
		TMP87CC41N/F/U		8		2						●				2	2			●		●		56	4.5 to 5.5 2.7 to 5.5	-40 to 85	TMP87PM41N/F/U	SDIP64/ QFP64/ μQFP64 (10 x 10 mm)
		TMP87CC78F				40	2			●				2	2			●		●		89	2.7 to 5.5		TMP87PM78F	QFP100		
16K	256	TMP87CH00N/F/DF	0.50/122 0.95/122	8		2								2	2			●		●		58	4.5 to 6.0 2.7 to 6.0		TMP87PH00N/F/DF	SDIP64/ QFP64/ LQFP64		
		TMP87CH00LF		4		2									2	2			●		●			4.5 to 5.5 1.8 to 5.5		TMP87PH00LF	QFP64	
		TMP87CH31N	0.50	4										4	2	2			●		●		34	4.5 to 5.5	-30 to 70	TMP87PM36N	SDIP42	
			TMP87CH14N/F	0.50/122 0.95/122			16	1			●				2	2			●		●		55	4.5 to 5.5 2.7 to 5.5		TMP87PM14N/F	SDIP64/ QFP64	
			TMP87CH20F	0.50/122 0.95/122	2	32	1								1	4			●		●		45	4.5 to 6.0 2.7 to 6.0		TMP87PH20F	QFP80	
			TMP87CH38N/F	0.50	4				2	6					2	2			●		●		33	4.5 to 5.5		TMP87PS38N/F	SDIP42/ QFP44	
			TMP87CH40N/F	0.50/122 0.95/122	8		2				●				2	2			●		●			4.5 to 6.0 2.7 to 6.0		TMP87PH40AN/AF	SDIP64/ QFP64	
			TMP87CH41N/F/U		8		2									2	2			●		●		56	4.5 to 5.5 2.7 to 5.5	-40 to 85	TMP87PM41N/F/U	SDIP64/ QFP64/ μQFP64 (10 x 10 mm)
		512	TMP87CH46N	0.50/122 0.95/122	8		1				●	8			2	2			●		●		35	4.5 to 5.5 2.7 to 5.5		TMP87PH46N	SDIP42	
			TMP87CH47U		8		1					●	8			2	2			●		●		37	1.8 to 4.0	-30 to 70	TMP87PH47U	μQFP44
			TMP87CH47LU	0.50/122 0.95/122	8		1				●	8			2	2			●		●			1.8 to 4.0		TMP87PH47LU	μQFP44 (10 x 10 mm)	
			TMP87CH48U/DF	0.50/122 0.95/122	8			1	1			16			2	2			●		●			4.5 to 5.5 2.7 to 5.5	-40 to 85	TMP87PH48U/DF	μQFP64 (10 x 10 mm) /LQFP64	
			TMP87CH48IU		8			1	1				16			2	2			●		●		56	4.5 to 5.5 2.7 to 5.5		TMP87PM70F	QFP80
			*TMP87CH48SU		8			1	1			16			2	2			●		●			4.5 to 5.5 2.7 to 5.5	-40 to 125	TMP87PM74F	QFP80	
			TMP87CH70BF				16	1			●		6		2	2			●		●		73	4.5 to 5.5 2.7 to 5.5		TMP87PM75F	QFP100	
			TMP87CH74AF				37	1	1			12			2	2			●		●		71	4.5 to 5.5 2.7 to 5.5		TMP87PM78F	QFP100	
			*TMP87CH75F				51	1	1			16			2	2			●		●		89	4.5 to 5.5 2.7 to 5.5	-30 to 70	TMP87PM75F	QFP100	
		TMP87CH78F				40	2				8			2	2			●		●			4.5 to 5.5		TMP87PM78F	QFP100		
768		TMPA8701CHN/F	0.50	4				2			6			2	2			●		●		33	4.5 to 5.5		TMPA8700PSN/F	SDIP42/ QFP44		

 Purchase of Toshiba I²C components conveys a license under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to the I²C Standard Specification as defined by Philips.

870 Series Selection Guide ②

ROM (bytes)	RAM (bytes)	Product No.	Minimum Instruction Execution Time (μs)	Driver			SIO Channels	UART Channels	I ² C Bus Channels	AD Converter High-Speed Serial Output	AD Converter 10-bit channels	DA Converter Channels	Timer/ Counter 18-bit channels	8-bit channels	Remote Control Pulse Detector	Watchdog Timer	OSD	Dial Clock	Clock Gear	Number of I/O Ports	Power Supply Voltage (V)	Operating Temperature (°C)	Version with Built-in OTP	Packages			
				LED	LCD	VFT																					
16K	1K	TMP87CH21F/DF	0.50/122	32	2								2	2		●	●			52	4.5 to 5.5	-30 to 70	TMP87PP21F/DF	QFP80/ QFP80 (12 x 12 mm)			
		*TMP87CH21AF/ADF		32	2									2	2		●	●					52	TMP87PM29N/U	SDIP64/ μQFP64 (10 x 10 mm)		
		TMP87CH29N/U	0.95/122	3	24			1						1	4		●	●			43			TMP87PM34AN	SDIP42		
		TMP87CH34BN	0.50	4					2			4		2	2	●	●	●			33			TMP87PM36N	SDIP42		
		TMP87CH36N		4					1			4		2	2	●	●	●			34			TMPA8700PSN/F	SDIP42/ QFP44		
TMPA8700CHN/F	4							2		6		2	2	●	●	●			33			TMPA8700PSN/F	SDIP42/ QFP44				
24K	1K	TMP87CK38N/F	0.50/122	4				2		6		2	2	●	●	●				33	4.5 to 5.5	-30 to 70	TMP87PM14N/F	SDIP64/ QFP64			
		TMPA8701CKN/F		4					2		6		2	2	●	●	●			33			TMP87PM20F	QFP80			
		TMP87CK14N/F	0.95/122		16	1					8			2	2	●	●	●			55			TMP87PM29N/U	SDIP64/ μQFP64 (10 x 10 mm)		
		TMP87CK20AF	0.50/122	2	32			1						1	4	●	●	●			45			TMP87PM34AN	SDIP42		
		TMP87CK29N/U	0.95/122	3	24						5			1	4	●	●	●			43			TMP87PM36N	SDIP42		
		TMP87CK34BN	0.50	4						2		4		2	2	●	●	●			33			TMP87PM40AN/AF	SDIP64/ QFP64		
		TMP87CK36N		4						1		4		2	2	●	●	●			34			TMP87PM41N/F/U	SDIP64/ QFP64/ μQFP64 (10 x 10 mm)		
		TMP87CK40AN/AF		8							2		8		2	2	●	●	●			56			TMP87PM43N	SDIP42	
		TMP87CK41N/F/U	0.50/122	8							2			2	2	●	●	●						TMP87PM43N	SDIP42		
		TMP87CK43N	0.95/122							2		6		2	2	●	●	●			35			*TMP87PM78F	QFP100		
TMP87CK78F	0.50		40	2					8			2	2	●	●	●			89			TMPA8700PSN/F	SDIP42/ QFP44				
TMPA8700CKN/F		4						2		6		2	2	●	●	●			33			TMP87PM70F	QFP80				
TMP87CM70BF		0.50/122		16	1			●		6			2	2	●	●	●			73			TMP87PM14N/F	SDIP64/ QFP64			
32K	1K	TMPA8701CMN/F	0.95/122	4				2		6			2	2	●	●	●			33			TMP87PM20F	QFP80			
		TMP87CM14N/F	0.50/122		16	1				8			2	2	●	●	●			55			TMP87PM29N/U	SDIP64/ μQFP64 (10 x 10 mm)			
		TMP87CM20AF	0.95/122	2	32			1						1	4	●	●	●			45			TMP87PS38N/F	SDIP42/ QFP44		
		TMP87CM21F/DF	0.50/122	1	32					8				2	2	●	●	●			52			TMP87PS39N	SDIP64		
		TMP87CM23F	0.95/122	1	40			2			8			2	2	●	●	●			70			TMP87PM40AN/AF	SDIP64/ QFP64		
		TMP87CM29N/U	0.50/122	3	24					1		5		1	4	●	●	●			43			TMP87PM41N/F/U	SDIP64/ QFP64/ μQFP64 (10 x 10 mm)		
		TMP87CM34BN	0.50	4						2		4		2	2	●	●	●			33			TMP87PS71F	QFP80		
		TMP87CM36N		4						1		4		2	2	●	●	●			34			*TMP87PP24AF	QFP100 (14 x 14 mm)		
		TMP87CM38N/F		4						2		6		2	2	●	●	●			33			TMP87PS71F	QFP80		
		TMP87CM39N	0.50/122	4						2		8		2	2	●	●	●			55			TMP87PS71F	QFP80		
		TMP87CM40AN/AF	122	8						2		8		2	2	●	●	●						TMP87PS71F	QFP80		
		TMP87CM41N/F/U	0.50/122	8					2		16			2	2	●	●	●			56			TMP87PS71F	QFP80		
		TMP87CM43N	0.95/122							2		6		2	2	●	●	●			35			TMP87PS71F	QFP80		
		TMP87CM45N	0.50/122	4						2		8		2	2	●	●	●			55			TMP87PS71F	QFP80		
		TMP87CM48U/DF	122	8			1	1	1		16			2	2	●	●	●			56			TMP87PS71F	QFP80		
		TMP87CM53F	0.50/122	7			1	1			8			2	2	●	●	●			72			4.5 to 5.5	-30 to 60	TMP87PM53F	QFP80
		TMP87CM64F		16			3				16			2	3	●	●	●			90			2.2 to 5.5		TMP87PS64F	QFP100
		TMP87CM74AF		16	37	1		1			12			2	2	●	●	●			71			4.5 to 5.5		TMP87PM74F	QFP80
		*TMP87CM75F		16	51	1		1			16			2	2	●	●	●			89			2.7 to 5.5		TMP87PM75F	QFP100
		TMP87CM78F				40	2					8			2	2	●	●	●								TMP87PM78F
TMPA8700CMN/F	0.95/122	4							2		6		2	2	●	●	●			33			4.5 to 5.5	-30 to 70	TMPA8700PSN/F	SDIP42/ QFP44	
TMP87CM71F	1.5K			16	1				●		6		2	2	●	●	●			73			4.5 to 5.5		TMP87PS71F	QFP80	
2K	TMP87CM24AF		1	40					8			2	2	●	●	●			69			4.5 to 5.5		*TMP87PP24AF	QFP100 (14 x 14 mm)		
40K	1.5K	TMP87CN71F						●				2	2	●	●	●							4.5 to 5.5		TMP87PS71F	QFP80	

*: Under development Note 1: Product number suffixes N: Plastic shrink dual in-line package (SDIP) F: Plastic quad flat package (QFP)
†: I/W/S version M: Plastic small-outline package (SOP) U: Plastic microflat package (μQFP)
Note 2: I²C bus circuit can be switched between I²C bus circuit and SIO circuit in software. Note 3: USP 4,382,279 owned by BULL CPB.
Note 4: There is also a 125°C heat-proof version of the **TMP87C408DM**.
For further information about the 125°C heat-proof version, please contact your nearest Toshiba office or authorized Toshiba dealer.
◆ For further information about the I/W/S version, please contact your nearest Toshiba office or authorized Toshiba dealer.
◆ OTP (one-time PROM) versions are supported for development and testing purposes only. There are no I/W/S OTP versions.

870 Family Selection Guide

▶ 870 Series Selection Guide ③

ROM (bytes)	RAM (bytes)	Product No.	Minimum Instruction Execution Time (μs)	Driver			SIO Channels	I ² C Bus Channels ²	UART Channels ²	High-Speed Serial Output	AD Converter 8-bit channels	AD Conversion Input 10-bit channels	DA Conversion Channels	Timer/ Counter 18-bit channels	Timer/ Counter 16-bit channels	8-bit channels	8-bit channels	Watchdog Timer	Dual Clock	Clock Gear	Number of I/O Ports	Power Supply Voltage (V)	Operating Temperature (°C)	Version with Built-in OTP	Packages
				LED	VFT	LCD																			
48K	1.5K	TMP87CP71F	0.50/122		16	1				●		6		2	2			●	●	●	73	4.5 to 5.5	-30 to 70	TMP87PS71F	QFP80
		TMP87CP23F	0.95/122	40		2				8				2	2			●	●	70	2.7 to 5.5	TMP87PP23F		QFP100	
		TMP87CP24AF		1	40	2				8				2	2			●	●	69	4.5 to 5.5 2.2 to 5.5	*TMP87PP24AF		QFP100 (14 x 14 mm)	
		TMP87CP38N/F	0.50	4			2			6				2	2	●	●	●	●	33	4.5 to 5.5	TMP87PS38N/F		SDIP42/ QFP44	
		TMP87CP39N	0.50/122 122	4			2			8				2	2	●	●	●	●	55	4.5 to 5.5	TMP87PS39N		SDIP64	
		TMP87CP64F	0.50/122 0.95/122	16			3			16				2	3	●	●	●	●	90	2.7 to 5.5	TMP87PS64F		QFP100	
		TMPA8700CPN/F	0.50	4			2			6				2	2	●	●	●	●	33	4.5 to 5.5	TMPA8700PSN/F		SDIP42/ QFP44	
60K	2K	TMP87CS38N/F	0.50	4			2		6		6		2	2	●	●	●	●	33	4.5 to 5.5	TMP87PS38N/F	SDIP42/ QFP44			
		TMP87CS39N	0.50/122 122	4			2		8				2	2	●	●	●	●	55	4.5 to 5.5	TMP87PS39N	SDIP64			
		TMP87CS64F	0.50/122 0.95/122	16			3			16				2	3	●	●	●	●	90	2.7 to 5.5	TMP87PS64F	QFP100		
		TMP87CS68DF		7		1	1			8				2	2	●	●	●	●	72	4.5 to 5.5	TMP87PS68DF	QFP80 (12 x 12 mm)		
		TMP87CS71F			16	1				●		6		2	2	●	●	●	●	73	4.5 to 5.5	TMP87PS71F	QFP80		
		TMPA8700CSN/F	0.50	4			2			6				2	2	●	●	●	●	33	4.5 to 5.5	TMPA8700PSN/F	SDIP42/ QFP44		

▶ 870/C Series Selection Guide

ROM (bytes)	RAM (bytes)	Product No.	Minimum Instruction Execution Time (μs)	Driver			SIO Channels	I ² C Bus Channels ²	Sync. Processor	PWM Channels	AD Converter 8-bit channels	AD Conversion Input 10-bit channels	Timer/ Counter 18-bit channels	Timer/ Counter 16-bit channels	8-bit channels	8-bit channels	Watchdog Timer	Dual Clock	Clock Gear	Number of I/O Ports	Power Supply Voltage (V)	Operating Temperature (°C)	Version with Built-in OTP	Packages				
				LED	VFT	LCD																						
4K	256	*TMP86C420U/F	0.25/122	4	32	1					8		1	2	●	●	●	●			1.8 to 5.5	-40 to 85	*TMP86PM29U/F	μQFP64 (10 x 10 mm) /LQFP64				
8K		*TMP86C820U/F		4	32	1					8		1	2	●	●	●	●		39								
	512	*TMP86C829U/F		4	32		1	Note 4			8		1	4	●	●	●	●										
16K		*TMP86CH06N/U		8			2	Note 3						1	2	●	●	●	●					35			*TMP86PH06N/U	SDIP42/ μQFP44
	1.5K	*TMP86CH29U/F		4	32		1	Note 4			8		1	4	●	●	●	●						39				
		*TMP86CM29U/F		4	32		1	Note 4			8		1	4	●	●	●	●										*TMP86PM29U/F
32K	1K	TMP86CM41F	8			1				16		2	4	●	●	●	●			55	4.5 to 5.5			*TMP86FS41F	LQFP64			
	2K	*TMP86CM25F	4	60	1	1				8		4	4	●	●	●	●			42	1.8 to 5.5			*TMP86PS25F	QFP100			
48K	512	*TMP86CP11N	0.33			1		3	Note 5	8	3		2	●	●	●	●			35	4.5 to 5.5			*TMP86PP11N	SDIP42			

▶ 870/X Series Selection Guide

ROM (bytes)	RAM (bytes)	Product No.	Minimum Instruction Execution Time (μs)	Driver			SIO Channels	I ² C Bus Channels ²	UART Channels ²	AD Converter 8-bit channels	AD Conversion Input 10-bit channels	Timer/ Counter 18-bit channels	Timer/ Counter 16-bit channels	8-bit channels	8-bit channels	Motor Control	External Memory Interface	EEPROM	Remote Control Pulse Detector	Watchdog Timer	Dual Clock	Clock Gear	Number of I/O Ports	Power Supply Voltage (V)	Operating Temperature (°C)	Version with Built-in OTP	Packages
				LED	VFT	LCD																					
NA		TMP88C060F	0.32/122 0.95/122	8			1	1		8	2	4								●	●	●	●	42	4.5 to 5.5 2.7 to 5.5	-	QFP80 (12 x 12 mm)
16K	512	*TMP88CH21AF/ADF	0.5/122 0.95/122		40	1	1		8	2	2										●	●	●	47	4.5 to 5.5 2.7 to 4.5	*TMP88PM21AF/ADF	QFP80/ LQFP80 (12 x 12 mm)
		TMP88CH47N/F		8			1	1		8	2	1	1								●	●	●	34	4.5 to 5.5	TMP88PH47N/F	SDIP42/ QFP44
24K		TMP88CK48N/F	0.25	8			1	1		16	2	2	1								●	●	●	56	4.5 to 5.5	TMP88PS49N/F	SDIP64/ QFP64
		TMP88CK49N/F		8			1	1		16	2	2	2								●	●	●				
32K	1K	*TMP88CM21AF/ADF	0.5/122 0.95/122		40	1	1		8	2	2										●	●	●	47	4.5 to 5.5 2.7 to 4.5	*TMP88PM21AF/ADF	QFP80/ LQFP80 (12 x 12 mm)
		TMP88CM48N/F	0.25	8			1	1		16	2	2	1								●	●	●	56	4.5 to 5.5	TMP88PS49N/F	SDIP64/ QFP64
		TMP88CM49N/F		8			1	1		16	2	2	2							●	●	●					
48K	1K	TMP88CP76F	0.32/122	40	1	1	1	12		3	1										●	●	●	68	4.5 to 5.5 2.7 to 5.5	TMP88PS76F	QFP80
		*TMP88CP77F		53	2	1	12		3	1											●	●	●	88		*TMP88PU77F	QFP100
64K	2K	TMP88CS76F		40	1	1	1	12		3	1										●	●	●	68		TMP88PS76F	QFP80
		*TMP88CS77F		53	2	1	12		3	1											●	●	●	88		*TMP88PU77F	QFP100
96K	2K	TMP88CU74F		37			1	1	12		2	2								●	●	●	71		TMP88PU74F	QFP80	

*: Under development

Note 1: Product number suffixes

N: Plastic shrink dual in-line package (SDIP)

F: Plastic quad flat package (QFP)

U: Plastic microflat package (μQFP)

Note 2: I²C bus circuit or SIO circuit can be selected in software.

◆ For further information about the I/W/S version, please contact your nearest Toshiba office or authorized Toshiba dealer.

◆ OTP (one-time PROM) versions are supported for development and testing purposes only. There are no I/W/S OTP versions.

Note 3: Either of the two UART channels can be selected in software as the SIO channel.

Note 4: SIO circuit or UART can be selected in software.

Note 5: One channel supporting two slaves devices

Note 6: Maximum of 960 LCD segments (16 com. X 60 seg)

870/C Series device with sync. processor

NEW

TMP86CP11N*

* Under development

■ 8-bit microcontroller with sync. processor, two-slave I²C bus and 8-bit PWM

Built around the **TLCS-870/C** core, the **TMP86CP11N** 8-bit microcontroller is ideal for use in monitors. Features include a sync processor, 8-bit PWM, an I²C bus (one of the I²C bus's three channels has a two-slave address function) and an 8-bit AD converter.



- Internal ROM: 48 Kbytes
- Internal RAM: 512 bytes
- I/O port: 35 pins
- Minimum instruction execution time: 0.33 μs (at 12 MHz)
- Sync. processor
- 8-bit AD converter: 3 channels
- 8-bit PWM: 8 channels
- Serial interface
 - I²C bus: 3 channels
(One channel supports two slaves.)
 - 8-bit SIO: 1 channel
- Timebase timer
- Watchdog timer
- 42-pin SDIP
- OTP version: **TMP86PP11N***

870/C Series device with built-in LCD driver

NEW

TMP86CM25F*

* Under development

■ 8-bit microcontroller with voltage booster LCD driver

The **TMP86CS25F** is a high-speed, highly functional 8-bit microcontroller built around the **TLCS-870/C** core. It incorporates such features as a voltage booster dot matrix LCD driver (up to 960 segments: 16 com. × 60 seg.), a serial interface and an 8-bit AD converter.



- Internal ROM: 32 Kbytes
- Internal RAM: 2 Kbytes
- I/O ports: 42 pins
- Minimum instruction execution time: 0.25 μs (at 16 MHz)
- LCD driver with voltage booster: 60 segment outputs
16 common outputs
- 8-bit AD converter: 8 channels
- Serial interface
 - 8-bit SIO: 1 channel
 - 8-bit UART/SIO: 1 channel
- 18-bit timer/counter: 1 channel
- Timebase timer
- Watchdog timer
- 100-pin QFP
- OTP version: **TMP86PS25F***



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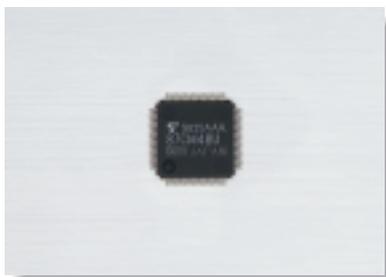
870 Series device with built-in UART and 10-bit AD converter

NEW

TMP87CM48U

■ Mini-package 8-bit microcontroller with low power consumption

The **TMP87CM48U** is an 8-bit microcontroller which incorporates a 10-bit AD converter, a UART / I²C bus interface and an advanced function timer which make it ideal for such applications as portable information terminal equipment, battery charging controllers and power supply monitoring control.



(Actual size)

- Internal ROM: 32 Kbytes
- Internal RAM: 1 Kbyte
- I/O port: 56 pins
- Minimum instruction execution time:
 - 0.50 μs (at 8 MHz and 4.5 V to 5.5 V)
 - 0.95 μs (at 4.2 MHz and 2.7 V to 5.5 V)
 - 122 μs (at 32.768 kHz and 2.7 V to 5.5 V)
- 10-bit AD converter: 16 channels
- DA conversion (pulse width modulation) output: 4 channels
- 8-bit serial interface
- UART: 1 channel
- I²C bus / Synchronous SIO: 1 channel
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 2 channels
- Timebase timer
- Watchdog timer
- 64-pin μQFP package (10 X 10 mm)
- OTP version: **TMP87PM48U**

870/C Series devices with built-in LCD driver
(inexpensive version of TMP86C829 with fewer functions)

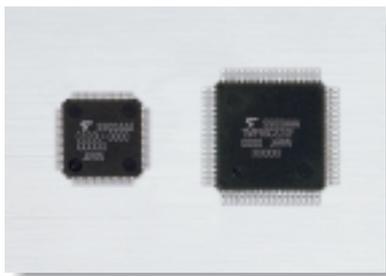
NEW

TMP86C420U*/F* C820U*/F*

* Under development

■ Low-voltage 8-bit microcontrollers with built-in LCD driver

The **TMP86C420/C820** contain LCD driver circuitry which includes a voltage booster enabling them to drive an LCD continuously, even when battery power is low. This 8-bit microcontroller also incorporates multi-function timer/counters, a synchronous serial interface, an 8-bit AD converter and two types of oscillator.



(Actual size)

- Internal ROM **TMP86C420U/F**: 4 Kbytes
TMP86C820U/F: 8 Kbytes
- Internal RAM **TMP86C420U/F**: 256 bytes
TMP86C820U/F: 256 bytes
- I/O ports: 39 pins (24 ports also function as SEG pins.)
- Minimum instruction execution time:
 - 0.25 μs (at 16 MHz and 4.5 V to 5.5 V)
- LCD driver: LCD driver with voltage booster
 - 8 to 32 segment outputs
 - 4 common outputs
- 8-bit AD converter: 8 channels
- 18-bit timer/counter: 1 channel
- 8-bit timer/counter: 2 channels
(The timer/counters can be cascaded to form a single 16-bit timer/counter channel.)
- Serial interface
 - 8-bit SIO: 1 channel
- Timebase timer
- Divider output function
- Watchdog timer
- 64-pin LQFP/QFP
(pin-compatible with the **TMP86CM29U/F**)
- OTP version: **TMP86PM29U*/F*** (pin-compatible)



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NEW PRODUCTS

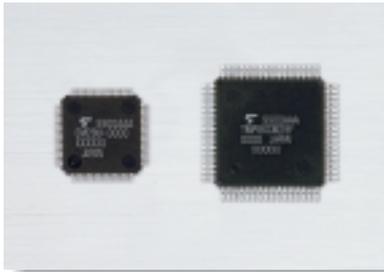
870/C Series devices with built-in LCD driver

NEW

TMP86C829U*/F* CH29U*/F* CM29U*/F* * Under development

Low-voltage 8-bit microcontrollers with built-in LCD driver

The **TMP86C829/CH29/CM29** incorporate LCD driver circuitry which includes a voltage booster allowing them to maintain a stable LCD display, even at low voltages. This high-speed, advanced-function 8-bit microcontroller also incorporates multi-function timer/counters, an asynchronous serial interface, a 10-bit AD converter and two types of oscillator.



(Actual size)

- Internal ROM **TMP86C829U/F:** 8 Kbytes
TMP86CH29U/F: 16 Kbytes
TMP86CM29U/F: 32 Kbytes
- Internal RAM **TMP86C829U/F:** 512 Kbytes
TMP86CH29U/F: 1.5 Kbytes
TMP86CM29U/F: 1.5 Kbytes
- I/O ports: 39 pins (24 ports also function as SEG pins.)
- Minimum instruction execution time:
0.25 μ s (at 16 MHz and 4.5 V to 5.5 V)
- LCD driver: LCD driver with voltage booster
8 to 32 segment outputs
4 common outputs
- 10-bit AD converter: 8 channels
- 18-bit timer/counter: 1 channel
- 8-bit timer/counter: 4 channels
(The timer/counters can be cascaded to form two 16-bit timer/counter channels.)
- Serial interface
8-bit UART/SIO: 1 channel (switchable)
- Timebase timer
- Divider output function
- 64-pin LQFP/QFP
- Watchdog timer
- OTP version: **TMP86PM29U*/F***

870/C Series device with built-in clock gear and UART

NEW

TMP86CH06N*/U*

* Under development

Next-generation 8-bit microcontroller with even lower power consumption

Based on the newly developed **TLCS-870/C** core, the **TMP86CH06N/U** is an 8-bit microcontroller ideal for use in portable equipment applications and in home appliances where low power consumption operation is required. The device achieves low power consumption through clock gearing and incorporates features such as a UART, an advanced-function timer and external memory expansion capability.



(Actual size)

- Internal ROM: 16 Kbytes
- Internal RAM: 512 bytes
- I/O ports: 35 pins
- Minimum instruction execution time:
0.25 μ s (at 16 MHz and 4.5 V to 5.5 V)
0.95 μ s (at 4.2 MHz and 1.8 V to 5.5 V)
122 μ s (at 32.768 kHz and 1.8 V to 5.5 V)
- Low power consumption operation using a clock gear system
- External memory extension function
- 8-bit serial interface
UART: 2 channels
Sync. SIO: 1 channel
- 16-bit timer/counter: 1 channel
- 8-bit timer/counter: 2 channels
(The timer/counters can be cascaded to form a single 16-bit timer/counter channel.)
- Timebase timer
- Watchdog timer
- 42-pin SDIP (1.78 mm pitch)
44-pin QFP (10 x 10 mm, 0.8 mm pitch)
- OTP version: **TMP86PH06N*/U***

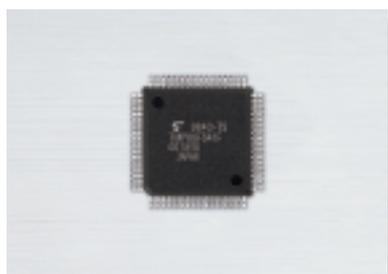
870/C Series device with built-in 10-bit AD converter and UART

NEW

TMP86CM41F

Low power consumption 8-bit microcontroller with built-in 10-bit AD converter and UART

Based on the **TLCS-870/C** core, the **TMP86CM41F** is a low power consumption 8-bit microcontroller with a built-in 10-bit AD converter and UART. This device also comes in a flash memory version which allows the rewriting of embedded programs.



(Actual size)

- Internal ROM: 32 Kbytes
- Internal RAM: 1 Kbytes
- I/O ports: 55 pins
- Minimum instruction execution time:
 - 0.25 μ s (at 16 MHz and 4.5 V to 5.5 V)
 - 122 μ s (at 32.768 kHz and 4.5 V to 5.5 V)
- Low power consumption operation using a clock gear system
- Serial interface
 - 8-bit UART: 1 channel
 - 8-bit synchronous SIO: 1 channel
- 10-bit AD converter: 16 channels
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 4 channels
- Timebase timer
- Watchdog timer
- 64-pin QFP (14 x 14 mm, 0.8 mm pitch)
- Flash memory version: **TMP86FS41F***
 - On-board flash memory: 60 Kbytes
 - Internal RAM: 2 Kbytes
 - Operating voltage: 4.5 V to 5.5 V at 1 MHz to 16 MHz

870/X Series devices with built-in LCD driver

NEW

TMP88CH21AF*/ADF* CM21AF*/ADF*

* Under development

Low-voltage 8-bit microcontrollers with built-in LCD driver

The **TMP88CH21/CM21** contain LCD driver circuitry which includes a voltage booster enabling them to drive an LCD continuously, even when battery power is low.

In Low Power Mode the microcontrollers reduce their own internal clock frequency (clock gear).



(Actual size)

- Internal ROM
 - TMP88CM21AF/ADF:** 32 Kbytes
 - TMP88CH21AF/ADF:** 16 Kbytes
- Internal RAM
 - TMP88CM21AF/ADF:** 1 Kbyte
 - TMP88CH21AF/ADF:** 512 bytes
- Minimum instruction execution time:
 - 0.50 μ s (at 8 MHz and 4.5 V to 5.5 V)
 - 122 μ s (at 32.768 kHz)
- LCD driver: LCD driver with voltage booster
 - 16 to 40 segment outputs
 - 4 common outputs
- 8-bit AD converter: 8 channels
- Low power consumption modes (attained using clock gearing)
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 2 channels
- Serial interface
 - 8-bit UART: 1 channel
 - 8-bit synchronous SIO: 1 channel
- AC zero-cross: 2 channels
- Key-on wake-up: 4 channels
- 80-pin QFP: 14 x 14 mm (0.65 mm pitch)
12 x 12 mm (0.5 mm pitch)
- OTP version: **TMP88PM21F/DF***

870/X Series device with built-in motor controller

NEW

TMP88CH47N/F*

* Under development

High-speed 8-bit microcontroller with high memory capacity capable of controlling DC and AC motors

The **TMP88CH47N/F** is a high-speed **870/X** Series product capable of operating at 0.25 μ s / 5.0 V and incorporating sensor/sensorless DC motor control capability, AC motor inverter control capability, a 10-bit AD converter and a serial interface.



- Internal ROM: 16 Kbytes
- Internal RAM: 512 bytes
- I/O ports: 34 pins
- Minimum instruction execution time: 0.25 μ s (at 16 MHz and 4.5 V to 5.5 V)
- Motor control circuits: 1 channel
- 10-bit AD converter: 8 channels
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 1 channel
- Serial interface
 - 8-bit SIO/I²C bus: 1 channel
 - UART: 1 channel
- Timebase timer
- Watchdog timer
- 42-pin SDIP/44-pin QFP (14 x 14 mm)
- OTP version: **TMP87PH47N*/F***

870/X Series device with built-in VFT driver

NEW

TMP88CU74F

8-bit microcontroller capable of programmable grid scan output

The **TMP88CU74F** is an 8-bit microcontroller with a VFT driver control circuit which provides programmable grid scan output. It features an 8-bit AD converter, an I²C bus interface and other features making it suitable for displays for audio and video equipment.



- Internal ROM: 96 Kbytes
- Internal RAM: 2 Kbytes
- I/O ports: 71 pins
- High breakdown voltage output ports: 37 pins
- Minimum instruction execution time: 0.32 μ s (at 12.5 MHz and 4.5 V to 5.5 V)
- 8-bit AD converter: 12 channels
- 16-bit timer/counter: 2 channels
- 8-bit timer/counter: 2 channels
- Serial interface
 - 8-bit SIO and I²C bus: 1 channel each
- Watchdog timer
- 80-pin QFP
- Emulation pod: **BM88CU74F0A**
- OTP version: **TMP88PU74F**



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NEW PRODUCTS

870/X Series devices with built-in VFT driver

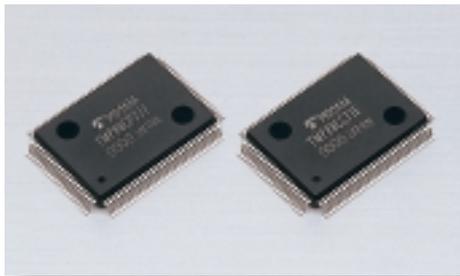
NEW

TMP88CP77F* CS77F*

* Under development

8-bit microcontrollers capable of programmable grid scan outputs

The **TMP88CP77F/CS77F** are advanced-function 8-bit microcontrollers with 53 high breakdown voltage ports and a built-in programmable grid scan VFT driver controller. Incorporating peripheral functions such as 16-bit extended timer/counters, an 8-bit AD converter and an I²C bus interface, these microcontrollers are ideal for decoding remote control signals and controlling the displays of audio and video equipment.



- Internal ROM **TMP88CP77F:** 48 Kbytes
TMP88CS77F: 64 Kbytes
- Internal RAM **TMP88CP77F:** 1 Kbyte
TMP88CS77F: 2 Kbytes
- I/O ports: 88 pins
- Minimum instruction execution time:
0.32 μs (at 12.5 MHz and 4.5 V to 5.5 V)
- Programmable grid scan VFT driver:
53 pins (high breakdown voltage) /
support for grids of up to 18 segments
- 8-bit AD converter: 12 channels
- 16-bit timer/counter: 2 channels
- 16-bit extended timer/counter: 1 channel
(2 compare outputs / 2 capture inputs)
- 8-bit timer/counter: 2 channels
- Serial interface
8-bit SIO / I²C bus: 1 channel (switchable)
8-bit SIO: 2 channels
- Timebase timer ● Watchdog timer ● 100-pin QFP
- Emulation pod: **BM88CP77F0A**
- OTP version: **TMP88PU77F**

870/X Series devices with built-in VFT driver

NEW

TMP88CP76F CS76F

8-bit microcontrollers capable of programmable grid scan outputs

The **TMP88CP76F/CS76F** are 80-pin versions of the **TMP88CP77F/CS77F** microcontrollers; these microcontrollers, however, also offer programmable grid scan output. Like the **TMP88CP77F/CS77F**, the **TMP88CP76F/CS76F** incorporate peripherals such as 16-bit extended timer/counters, an 8-bit AD converter and an I²C bus interface, making them ideal for controlling the displays of audio and video equipment.



- Internal ROM **TMP88CP76F:** 48 Kbytes
TMP88CS76F: 64 Kbytes
- Internal RAM **TMP88CP76F:** 1 Kbyte
TMP88CS76F: 2 Kbytes
- I/O ports: 68 pins
- Minimum instruction execution time:
0.32 μs (at 12.5 MHz and 4.5 V to 5.5 V)
- Programmable grid scan VFT driver:
40 pins (high breakdown voltage) /
support for grids of up to 18 segments
- 8-bit AD converter: 12 channels
- 16-bit timer/counter: 2 channels
- 16-bit extended timer/counter: 1 channel
(1 compare output / 2 capture inputs)
- 8-bit timer/counter: 2 channels
- Serial interface
8-bit SIO / I²C bus: 1 channel (switchable)
8-bit SIO: 1 channel
- Timebase timer ● Watchdog timer ● 80-pin QFP
- Emulation pod: **BM88CP77F0A**
- OTP version: **TMP88PU76F**



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