

**TOSHIBA**

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Semiconductor Catalog 2012-10

TX00/TX03/TX04 Series  
**32-Bit Microcontrollers**



MICROCONTROLLER

SEMICONDUCTOR & STORAGE PRODUCTS

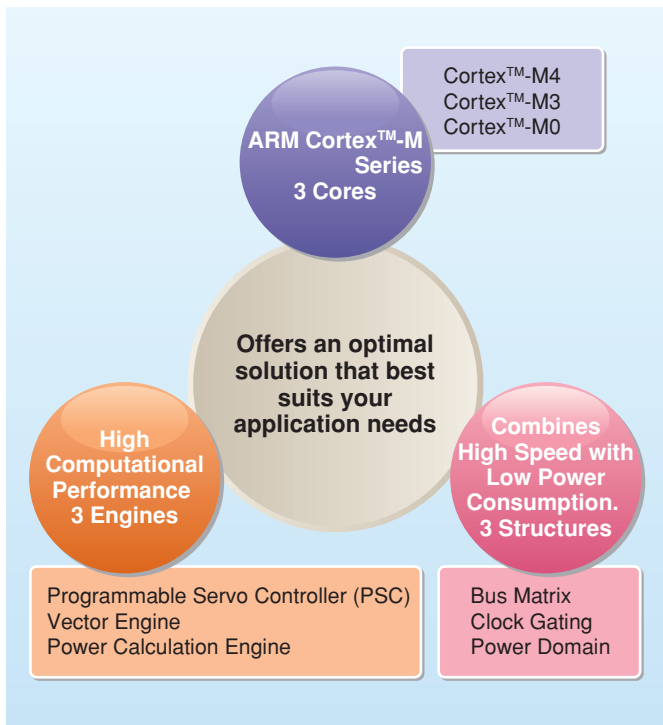
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# Toshiba's ARM Core-Based Microcontrollers

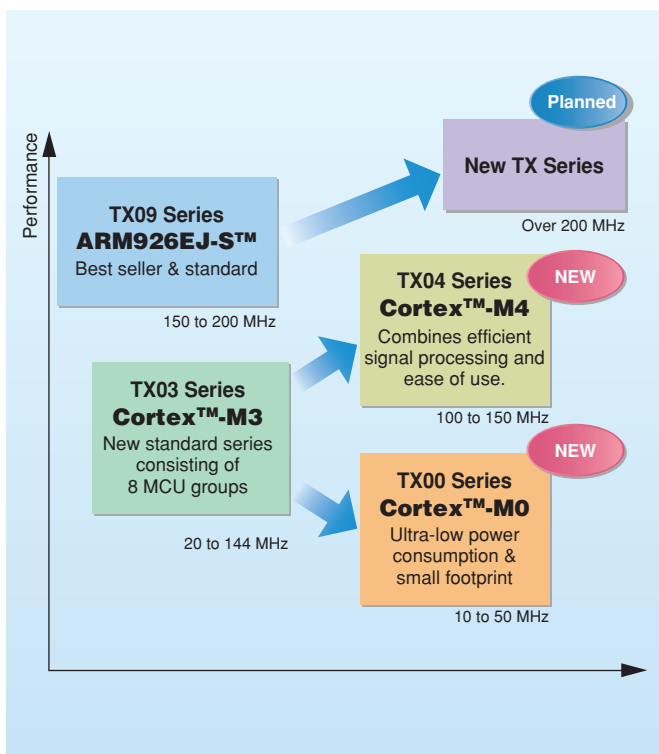
## ARM Core-Based Microcontrollers Proven in the Global Market

Microcontrollers with an ARM core are becoming increasingly popular not only for cell phone applications but also for general-purpose applications. Toshiba was the first Japanese vendor to release microcontrollers with an ARM Cortex™-M3 core. Now, Toshiba has become the first Japanese company to adopt two ARM processors, Cortex™-M0 and Cortex™-M4, in addition to Cortex™-M3 and released the TX00, TX03 and TX04 Series. Our product lineup includes microcontrollers with a broad spectrum of peripherals.

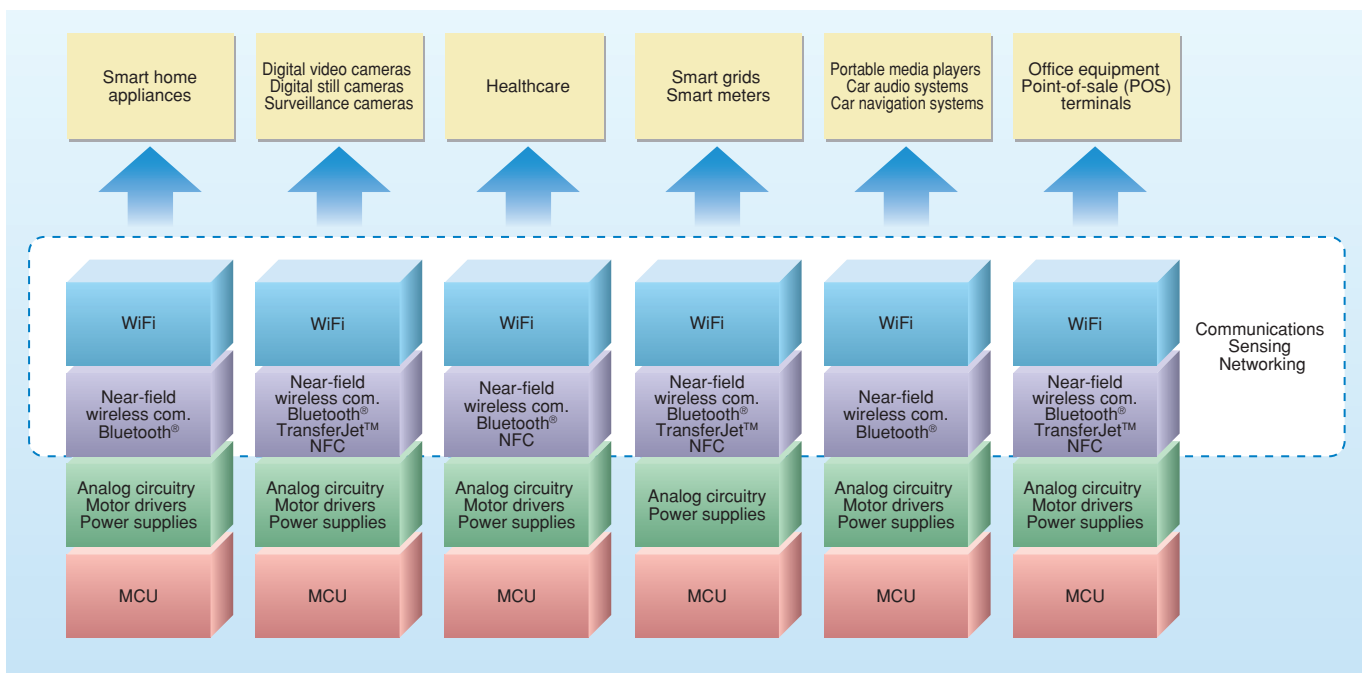
## Toshiba TX00, TX03 and TX04 Microcontrollers Series



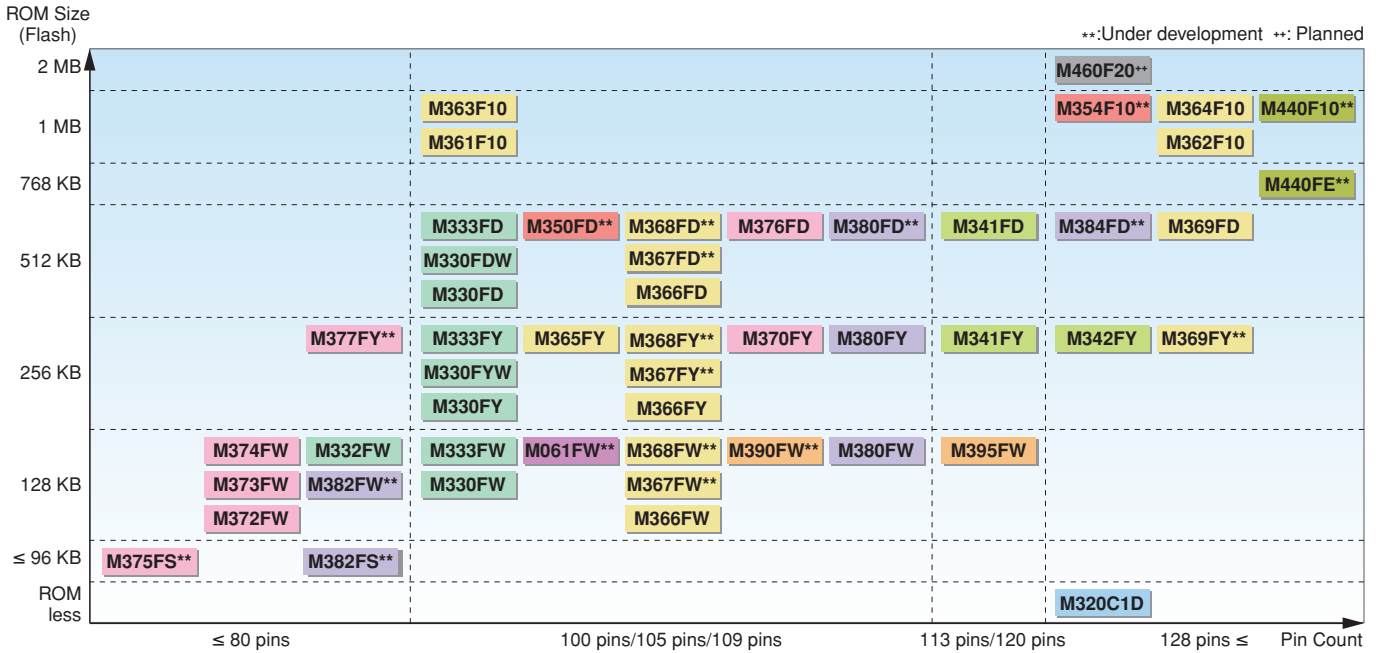
## Roadmap for ARM Core-Based Microcontrollers



## Extensive Applications Supported by Toshiba's ARM Core-Based Microcontrollers



# Toshiba's ARM Cortex™-M0/M3/M4 Core-Based Microcontroller Lineup



## Added Functions

	NEW M440 Group	NEW M060 Group	M320 Group	M330 Group	M340 Group	M350 Group	M360 Group	M370 Group	M380 Group	M390 Group
Programmable motor driver						●	●	●	●	
Vector Engine						●		●		
Programmable servo controller	●				●					
Power calculation engine		●								
Op amp/Comparator								●		
CEC (Consumer Electronic Control)				●			●			●
Remote control preprocessor				●			●		●	●
I <sup>2</sup> S (Inter-IC Sound)			●							
USB			●				●			
EtherMAC							●			
CAN						●	●			
ESIO	●									
High-resolution PPG					●					
Multi-purpose timer							●		●	
External bus interface	●		●		●		●			
Oscillation frequency detector (OFD)					●		●	●	●	●
ΔΣ AD converter		●			●					
LCD driver		●								
JTAG boundary scan	●				●		●			

There are microcontrollers that do not contain some of the peripherals shown. For details, see appropriate datasheets.

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### Note

•System block diagrams in this brochure only show the typical application examples.

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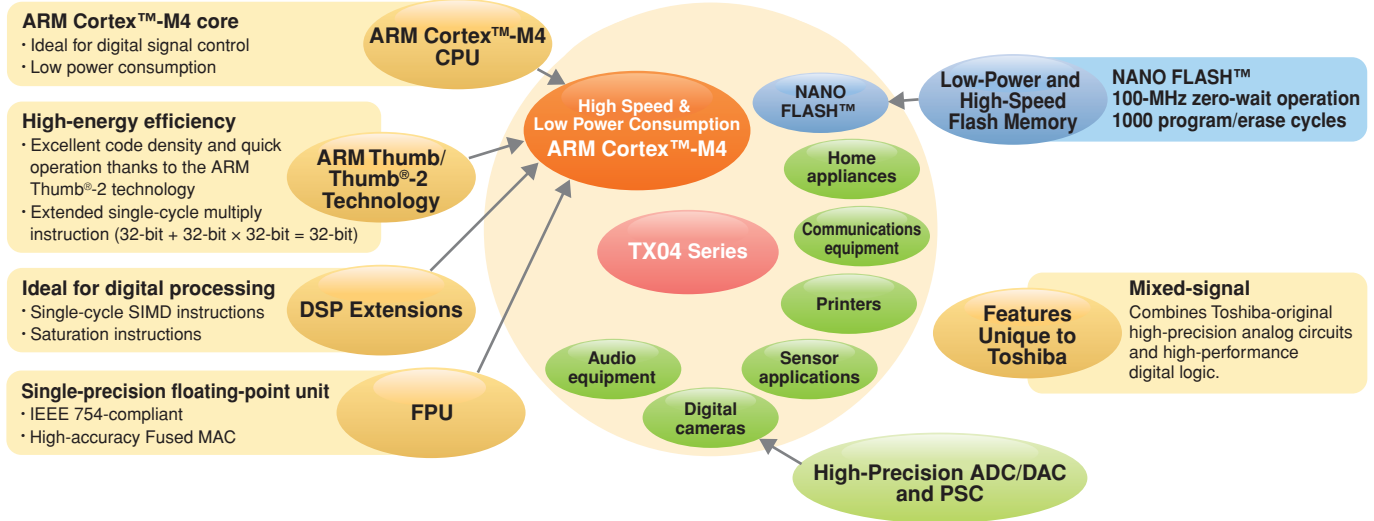
# TX04 Series/TX00 Series

## New Microcontrollers with ARM Cortex™-M4/M0 Core

### Features of the TX04 Series

The ARM Cortex™-M4 core-based TX04 Series supports the Thumb®-2 and Thumb® instruction sets and provides DSP extensions and a floating-point unit (FPU) in order to deliver high energy efficiency. The TX04 Series also integrates a selection of Toshiba-original high-precision analog circuits on the same chip, making it ideal for mixed-signal applications such as digital still cameras, audio equipment, home appliances and sensor applications.

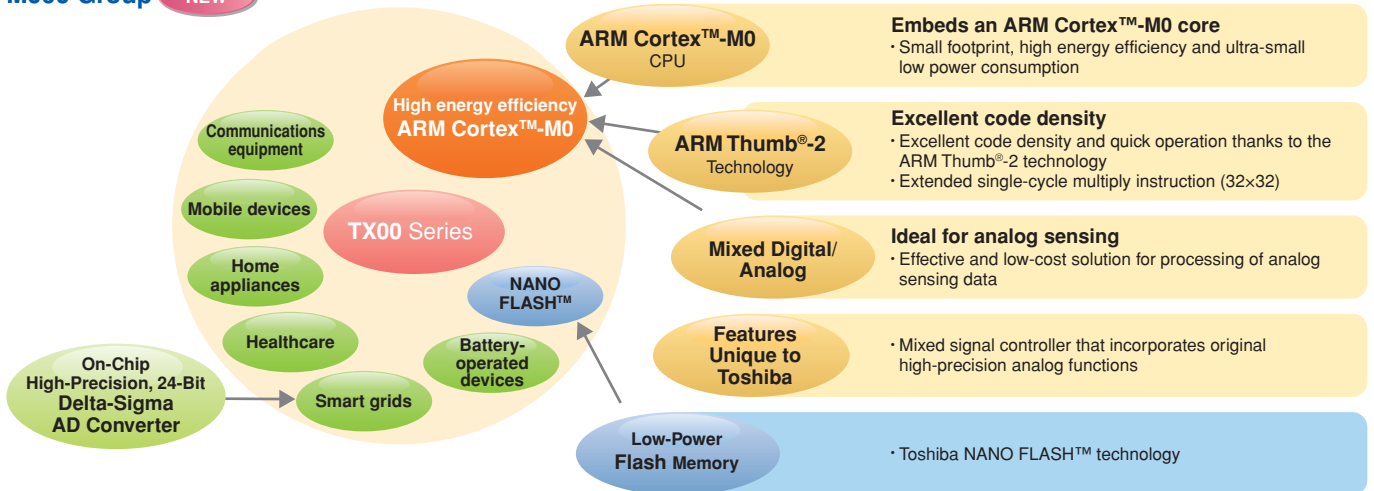
#### M440 Group NEW



### Features of the TX00 Series

The TX00 Series contains an ARM Cortex™-M0 core on-chip, and like the TX03 Series, offers the Thumb® instruction set. The Thumb®-2 technology extends the limited 16-bit instruction set of Thumb® with additional 32-bit instructions and thus provides excellent code density. This in turn leads to high energy efficiency. Additionally, the TX00 Series incorporates Toshiba-original high-precision analog functions. It is ideal for healthcare, energy measurement and portable applications.

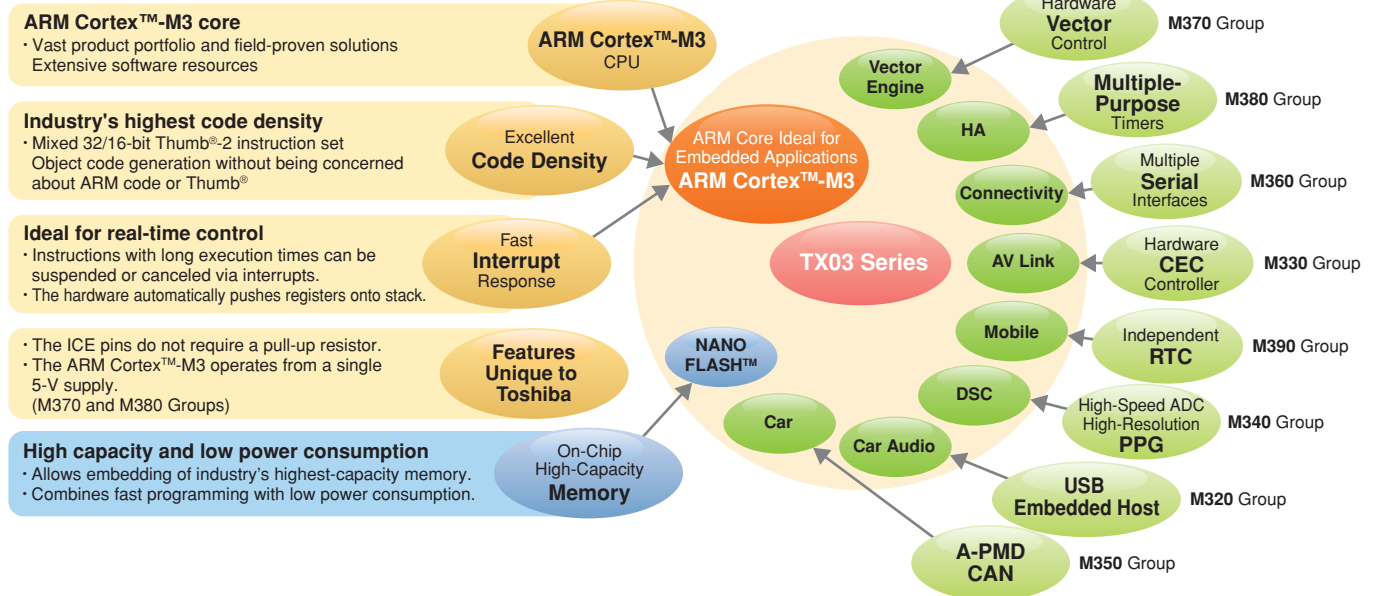
#### M060 Group NEW



# TX03 Series

## Features of the TX03 Series

The TX03 microcontroller series embeds an ARM Cortex™-M3 core, which provides high code density and fast interrupt response times required for real-time applications. The TX03 Series also incorporates a Toshiba-proprietary NANO FLASH™ memory featuring high capacity and low power consumption.



## Product Groups with a 3-V Supply (Note 1)

<p><b>M320 Group</b> (USB Embedded Host)</p> <ul style="list-style-type: none"> <li>Features: USB Embedded Host, System solutions that combine a MCU and an audio DSP</li> <li>Application examples: Car and home audio systems</li> </ul>	<p><b>M330 Group</b> (Power-saving modes, CEC controller)</p> <ul style="list-style-type: none"> <li>Features: Dedicated controller compliant with HDMI 1.3a (CEC), Remote control signal preprocessor essential for digital consumer electronics</li> <li>Application examples: Digital TVs, projectors, Blu-ray recorders, AV systems, printers, home appliances, factory equipment, office equipment</li> </ul>	<p><b>M340 Group</b> (High-resolution PPG)</p> <ul style="list-style-type: none"> <li>Features: High-accuracy analog control interface, Small package (6 x 6 mm TFBGA113), High-resolution PPG ideal for motor control</li> <li>Application examples: DVCs, DSLR cameras, camera lens controllers</li> </ul>
<p><b>M360 Group</b> (Multiple serial interfaces)</p> <ul style="list-style-type: none"> <li>Features: Large-capacity Flash memory, Up to 7 communication interfaces (SIO, I<sup>2</sup>C, SPI, UART, CAN, USB, EtherMAC), Programmable Motor Driver (PMD)</li> <li>Application examples: Printers, AV systems, digital appliances, PC peripherals, industrial equipment, networking equipment, office equipment</li> </ul>	<p><b>M390 Group</b> (1.8-V operation)</p> <ul style="list-style-type: none"> <li>Features: Power-saving modes for 1.8-V operation, High-speed on-chip oscillator, Small package (6 x 6 mm TFBGA120)</li> <li>Application examples: Power supply monitors, battery-operated devices, remote-controlled equipment, game consoles, AV systems</li> </ul>	

## Automotive Applications

## Product Groups with a 5-V Supply (Note 1)

<p><b>M370 Group</b> (On-chip vector engine)</p> <ul style="list-style-type: none"> <li>Features: Toshiba-original vector engine (VE), Single 5-V supply operation with high market demands, System solutions that combine an MCU with motor drivers, Small package (7 x 7 mm LQFP48)</li> <li>Application examples: Washing machines, air conditioners, refrigerators, heat pumps, inverter-motor-controlled equipment</li> </ul>	<p><b>M380 Group</b> (Multi-purpose timers for IGBT control)</p> <ul style="list-style-type: none"> <li>Features: Multi-purpose timers for motor and IGBT control, Single 5-V supply operation with high market demands, System solutions that combine an MCU with various peripheral ICs</li> <li>Application examples: Air conditioners, refrigerators, electric oven-grills, rice cookers, induction cooktops</li> </ul>	<p><b>M350 Group</b> (Automotive Applications)</p> <p><b>M350</b></p> <ul style="list-style-type: none"> <li>Features: Programmable Motor Driver (PMD), CAN controllers, timers, 12-bit AD converter, crossbar switches, functional safety capabilities and 5-V I/Os</li> <li>Application examples: Electric power steering (EPS) systems and other automotive applications</li> </ul> <p><b>M354</b></p> <ul style="list-style-type: none"> <li>Features: Advanced PMD (A-PMD), VE, CAN controllers, timers, 12-bit AD converters, resolver-to-digital converter, crossbar switches, functional safety capabilities and 5-V I/O</li> <li>Application examples: HEV, EV and other automotive applications</li> </ul>
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Note 1: There are microcontrollers that do not contain some of the peripherals shown. For details, see appropriate datasheets.

# TX04 Series M440 Group NEW

The M440 Group of microcontrollers are ideal for digital video camera and digital still camera applications. They incorporate analog circuits required for optical image stabilization, autofocus and auto-exposure control. The high-performance ARM Cortex™-M4 core provides high-speed computation functionality. Additionally, the servo controller (PSC) helps to improve system performance and reduce the CPU workload through parallel processing.

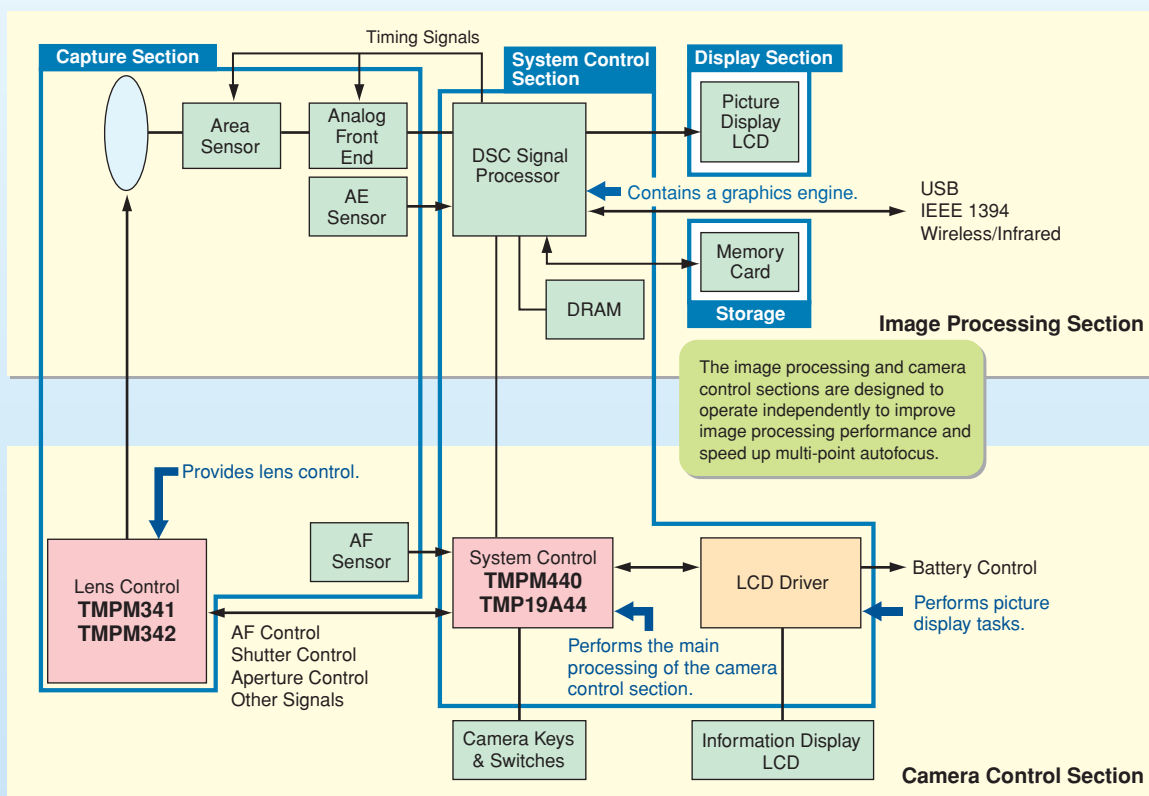
## Features

- High-performance ARM Cortex™-M4 core: 100-MHz operation (max)
- Improved performance thanks to multiple computing units (MAC, FPU, PSC)
- Toshiba-original NANO FLASH™: 100-MHz operation with zero wait states, small block size support
- Various serial interface channels suitable for communications with multiple timers and sensors
- High-speed, high-accuracy 12-bit AD converter; 10-bit DA converter
- 228 I/O pins

## Applications

- Digital video cameras
- Digital still cameras
- Home appliances
- Audio equipment
- Sensor applications
- Printers
- Communications equipment

## System Block Diagram (Digital Still Camera)



## Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
<b>TMPM440FEXBG **</b>	768 KB	64 KB + 16 KB	VFPGA289 (11 x 11 mm)	100-MHz, zero-wait Flash (NANO FLASH™) Programmable servo controller (PSC) 12-bit AD converter 10-bit DA converter ESIO Key scan
<b>TMPM440F10XBG **</b>	1024 KB	64 KB + 16 KB	VFPGA289 (11 x 11 mm)	

\*\* : Under development

# TX00 Series M060 Group NEW

The TPM061FWFG of the M060 Group is a microcontroller with a Cortex™-M0 core specifically designed for smart metering applications. It contains a Toshiba-original 24-bit delta-sigma AD converter and a power calculation engine for high-accuracy electricity metering.

The Cortex™-M0 core provides high computational performance and low power consumption, but its cost is as low as that of conventional 8-bit and 16-bit microcontrollers. Moreover, the Cortex™-M0 core is supported by extensive software resources and an integrated development environment. This also helps to reduce non-recurring engineering (NRE) costs.

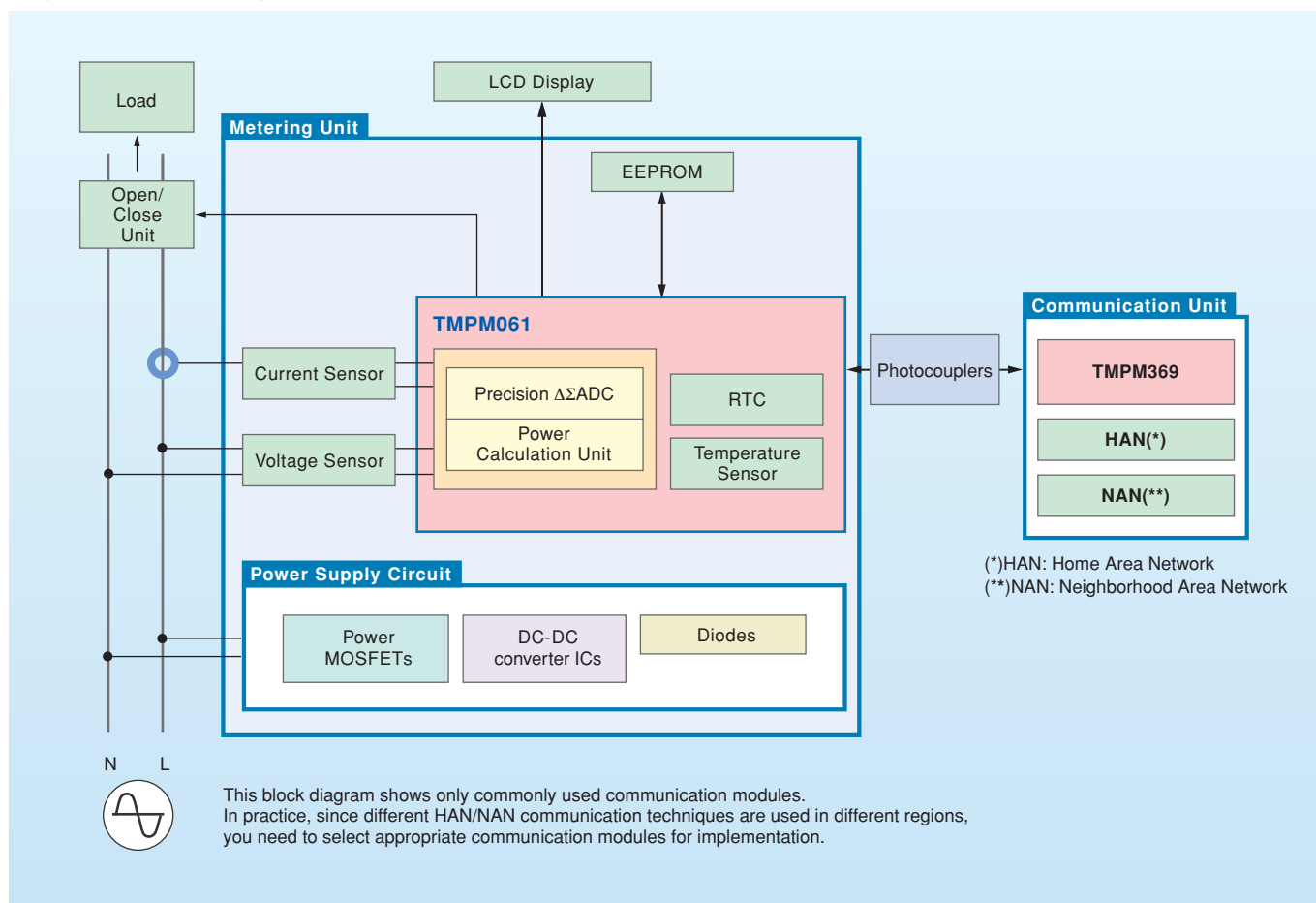
## Features

- High-performance ARM Cortex™-M0 core: 16-MHz operation (max)
- Toshiba-original NANO FLASH™ memory: Fast programming
- 24-bit delta-sigma AD converter
- LCD driver
- Power calculation engine
- Real-time clock (RTC)
- Temperature sensor

## Applications

- Smart meters
- Healthcare products

## System Block Diagram (Smart meters)



## Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
<b>TPM061FWFG **</b>	128 KB	8 KB	LQFP100 (14 x 14 mm)	24-bit delta-sigma AD converter LCD driver Power calculation engine Real-time clock (RTC) Temperature sensor

\*\* : Under development

# TX03 Series M330 Group

The M330 Group of microcontrollers are ideal for audiovisual applications. They incorporate a remote control signal receiving function and a Consumer Electronics Control (CEC) interface that remain active even in 32-kHz SLEEP mode. This helps to reduce standby power consumption of audiovisual systems.

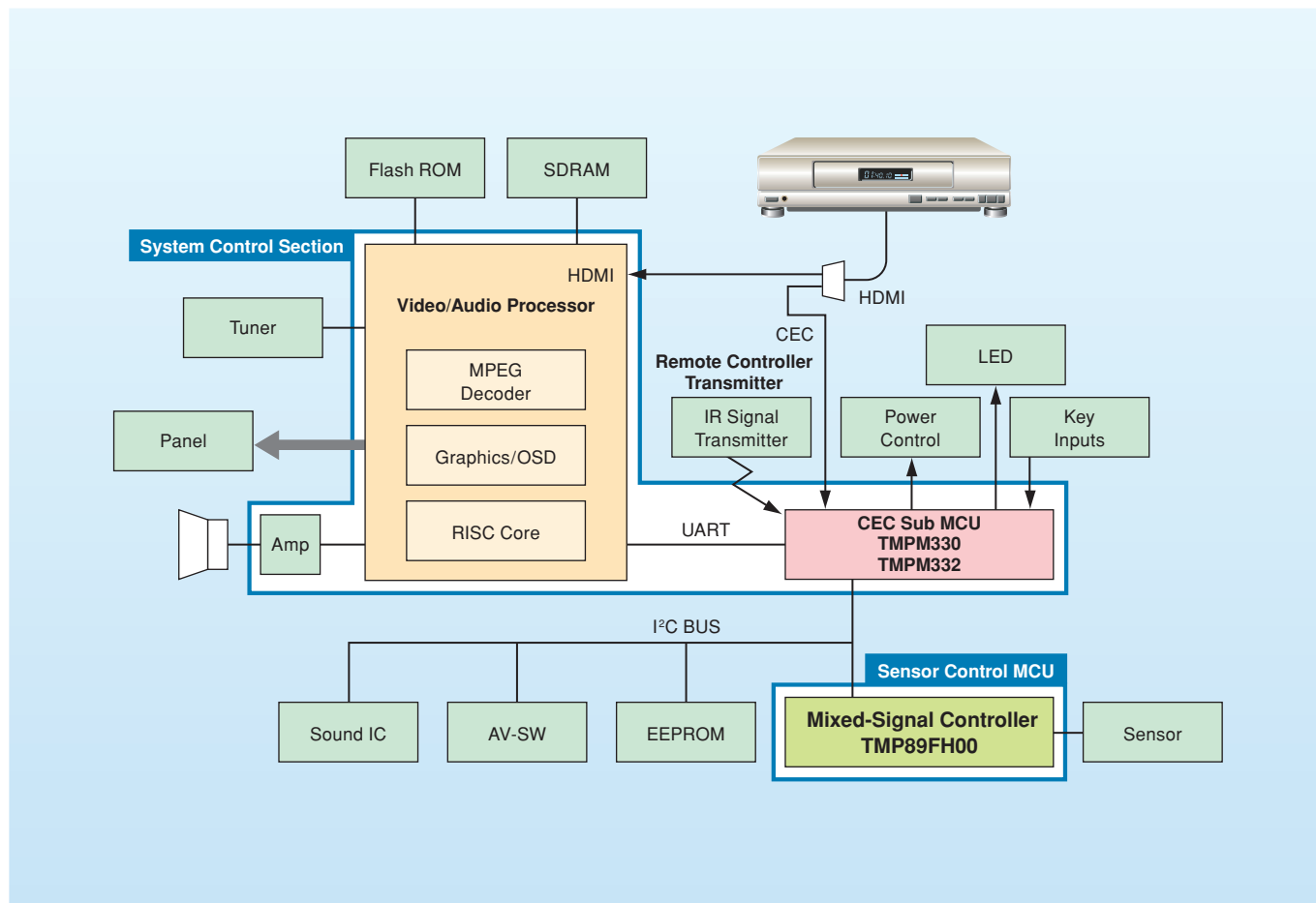
## Features

- High-performance ARM Cortex™-M3 core: 40-MHz operation (max)
- Toshiba-original low-power consumption NANO FLASH™ memory: Fast programming
- Various serial interfaces
- CEC interface and remote control signal preprocessor that remain active even in SLEEP mode
- High-speed, high-accuracy 10-bit AD converter (1.15-μs conversion time @40 MHz)
- Real-time clock (RTC)

## Applications

- Digital TVs
- Harddisk recorders
- Projectors
- Blu-ray players
- Set-top boxes
- AV systems
- Home appliances
- Factory equipment
- Office equipment

## System Block Diagram (Digital TV)



## Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM330FWFG	128 KB	8 KB	LQFP100 (14 x 14 mm)	CEC Remote control signal preprocessor Real-time clock (RTC) * The TMPM330FDWFG and TMPM330FYWFG support an extended temperature range.
TMPM330FYFG	256 KB	16 KB	LQFP100 (14 x 14 mm)	
TMPM330FYWFG	256 KB	16 KB	LQFP100 (14 x 14 mm)	
TMPM330DFDG	512 KB	32 KB	LQFP100 (14 x 14 mm)	
TMPM330FDWFG	512 KB	32 KB	LQFP100 (14 x 14 mm)	
TMPM332FWUG	128 KB	8 KB	LQFP64 (10 x 10 mm)	
TMPM333FWFG	128 KB	8 KB	LQFP100 (14 x 14 mm)	Real-time clock (RTC)
TMPM333FYFG	256 KB	16 KB	LQFP100 (14 x 14 mm)	
TMPM333DFDG	512 KB	32 KB	LQFP100 (14 x 14 mm)	



# TX03 Series M340 Group

The M340 Group of microcontrollers are ideal for digital video camera, digital still camera and camera lens control applications. They incorporate analog circuits required for optical image stabilization, autofocus and auto-exposure control. The high-performance ARM Cortex™-M3 core provides high-speed computation functionality. Additionally, a high-resolution programmable phase generator (PPG) enables smooth and quiet motor operation.

## Features

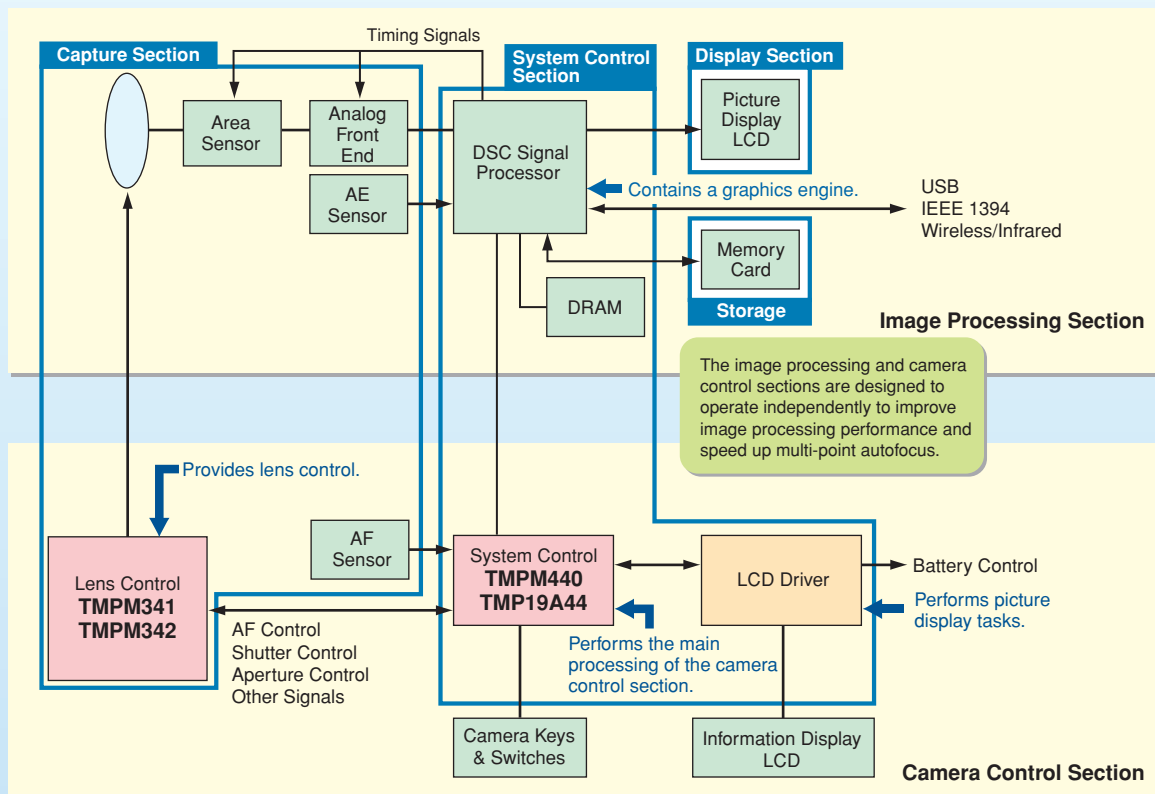
- High-performance ARM Cortex™-M3 core: 54-MHz operation (max)
- Toshiba-original NANO FLASH™ memory: Fast programming
- High-resolution PPG (programmable phase difference of up to  $\pm 90^\circ$ ): 160 MHz (max)
- High-speed, high-accuracy 12-bit AD converter; 10-bit DA converter
- Oscillation frequency detection (OFD)
- Various timers and serial interfaces
- 2-phase pulse counter
- Small package (6 x 6 mm TFBGA113)

Note: TFBGA package of the TMPM341 only

## Applications

- Digital video cameras
- Digital still cameras
- Camera lens

## System Block Diagram (Digital Still Camera)



## Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
<b>TMPM341FYXBG</b>	256 KB	32 KB	TFBGA113 (6 x 6 mm)	12-bit AD converter (1 $\mu$ s), 10-bit DA converter High-resolution PPG: 160 MHz (max); ideal for ultrasonic motor control
<b>TMPM341FDXBG</b>	512 KB	32 KB	TFBGA113 (6 x 6 mm)	
<b>TMPM342FYXBG</b>	256 KB	32 KB	VFBGA142 (7 x 7 mm)	16-bit delta-sigma AD converter (40 $\mu$ s) 12-bit AD converter (1 $\mu$ s) 10-bit DA converter 7.5-ch H-SW driver (incl. two microstep units)

# TX03 Series M360 Group

The base versions of the M360 Group include microcontrollers that offer large-capacity Flash ROM and up to 18 serial interface channels. The advanced versions also provide USB, CAN and EtherMAC interfaces, which are becoming de facto standards in embedded systems, as well as motor control capabilities. The M360 Group are ideal for a wide range of applications such as multifunction printers, audiovisual systems, industrial equipment and digital appliances.

## Features

- High-performance ARM Cortex™-M3 core: 80-MHz operation (max)
- Large-capacity embedded Flash ROM fabricated using Toshiba-original NANO FLASH™ technology
- Various serial interfaces (up to 18 channels)
- USB, USB Embedded Host, CAN and EtherMAC controllers suitable for multi-connection systems
- External bus interface that can be connected to SoCs and external extended memory
- Multi-purpose timers capable of controlling various motors and IGBTs
- CEC interface and remote control signal preprocessor that remain active even in SLEEP mode
- Oscillation frequency detection (OFD)
- Small package (9 x 9 mm TFBGA109 (Note1), LFBGA105 (Note2))

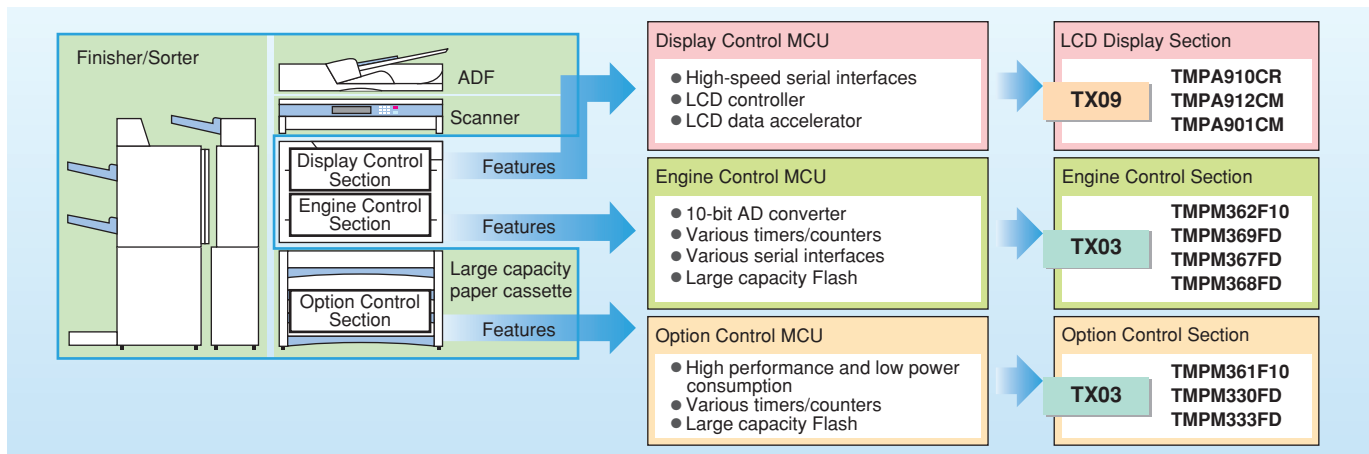
Note 1: TFBGA package of the TMPM366, TMPM367 and TMPM368 only

Note 2: LFBGA105 package of the TMPM365

## Applications

- Printers
- AV systems
- Digital appliances
- PC peripherals
- Industrial equipment
- Networking equipment
- Office equipment

## System Block Diagram (Printer)



## Product Lineup

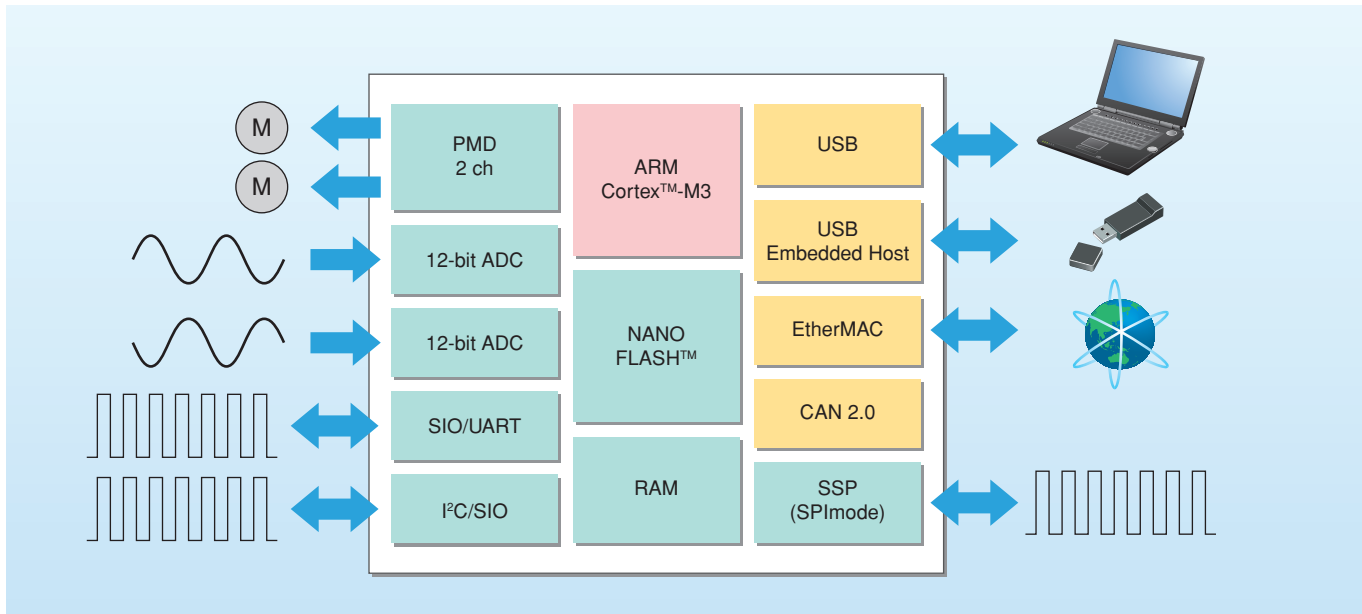
Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM361F10FG	1 MB	64 KB	LQFP100 (14 x 14 mm)	CEC; remote control preprocessor
TMPM362F10FG	1 MB	64 KB	LQFP144 (20 x 20 mm)	CEC; remote control preprocessor 18 serial interface channels
TMPM363F10FG	1 MB	64 KB	LQFP100 (14 x 14 mm)	CAN USB Embedded Host
TMPM364F10FG	1 MB	64 KB	LQFP144 (20 x 20 mm)	
TMPM365FYXBG	256 KB	24 KB	LFBGA105 (9 x 9 mm)	USB DMA controller
TMPM366FWFG/XBG	128 KB	32 KB	LQFP100 (14 x 14 mm) TFBGA109 (9 x 9 mm)	USB DMA controller Full UART
TMPM366FYFG/XBG	256 KB	48 KB		
TMPM366FDFG/XBG	512 KB	64 KB		
TMPM367FWFG **/XBG **	128 KB	50 KB	LQFP100 (14 x 14 mm) TFBGA109 (9 x 9 mm)	USB Dual AD converter 3-Phase PWM generator(PMD)
TMPM367FYFG **/XBG **	256 KB	66 KB		
TMPM367FDFG **/XBG **	512 KB	128 KB		
TMPM368FWFG **/XBG **	128 KB	50 KB	LQFP100 (14 x 14 mm) TFBGA109 (9 x 9 mm)	USB Dual AD converter 3-Phase PWM generator(PMD) CAN
TMPM368FYFG **/XBG **	256 KB	66 KB		
TMPM368FDFG **/XBG **	512 KB	128 KB		
TMPM369FYFG **/XBG **	256 KB	66 KB	LQFP144 (20 x 20 mm) TFBGA177 (11 x 11 mm)	USB USB Embedded Host Dual AD converter PMD CAN EtherMAC
TMPM369FDFG/XBG **	512 KB	128 KB		

\*\* : Under development

**► Features of the TPM369DFG/XBG (Under Development) and TPM369FYFG(Under Development)/XBG (Under Development)**

**Controls various interfaces independently – Contributing to reduction of the CPU workload**

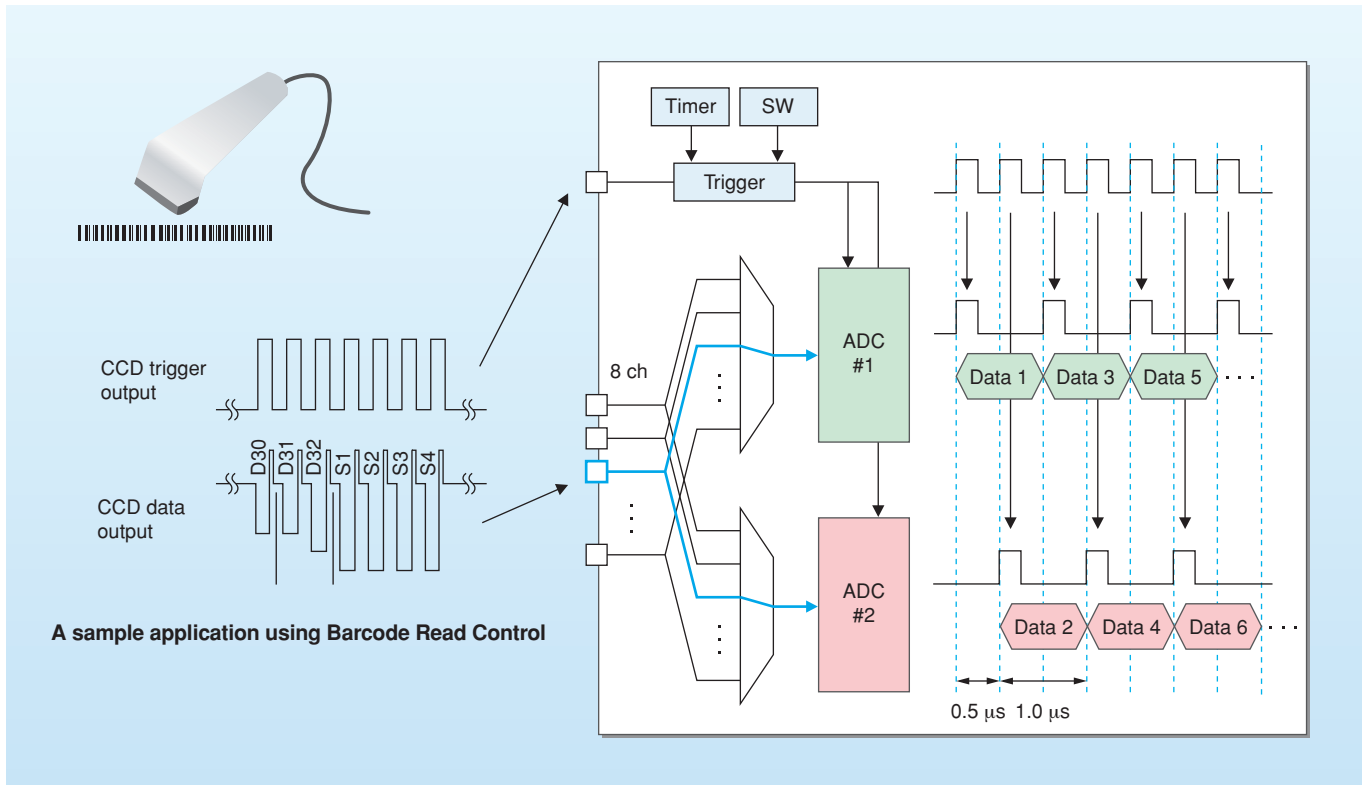
The TPM369 has various external communication interfaces such as USB, USB Embedded Host, CAN, EtherMAC, SIO/UART, I<sup>2</sup>C/SIO and SSP (SPI mode). Additionally, the TPM369 contains 2 units of AD converter and a programmable motor driver (PMD). All of them are designed to operate independently, significantly reducing the software workload. The TPM369 provides Flash ROM of up to 512 KB and SRAM of up to 128 KB to facilitate the use of the various communication interfaces.



**High-speed AD conversion – Using 2 units of AD converter**

The TPM369 contains 2 units of ADC. Their combined use provides high-speed AD conversion. While a single ADC offers a minimum conversion time of 1.0 μs at 80 MHz, applying an analog signal to 2 units of ADC and using them in a time-interleaved manner significantly reduces the conversion time required\*.

\*0.5 μs minimum



# TX03 Series M370 Group

The M370 Group of microcontrollers contain a Vector Engine (VE) that implements the common computation functionality for motor vector control. Additionally, the VE is closely coupled with a three-phase PWM timer and a 12-bit AD converter for motor current sensing. The M370 Group are designed to improve motor control efficiency while reducing software workload. The M370 Group operate with a single 5-V supply and provide analog comparators and amplifiers to help cut system costs.

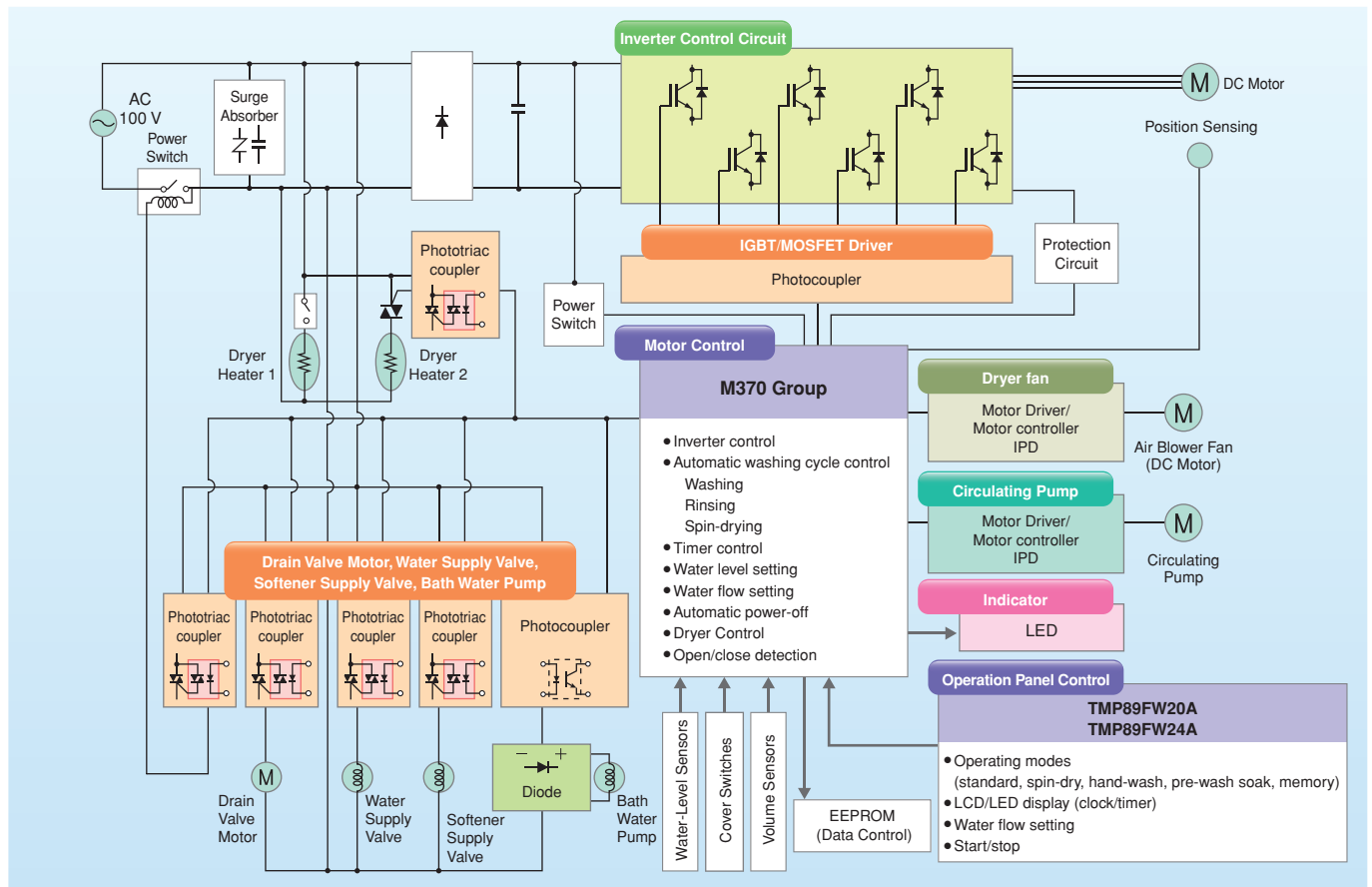
## Features

- High-performance ARM Cortex™-M3 core: 80-MHz operation (max)
- Toshiba-original NANO FLASH™ memory: Fast programming
- Toshiba-original Vector Engine (VE) that implements part of motor vector control as hardware
- Various analog circuits\* (comparators, op amps) \* TMPM370 only
- 12-bit AD converter
- Oscillation frequency detection (OFD); compliant with the IEC 60730 standard
- Single 5-V power supply
- Small package (7 x 7 mm LQFP48) Note: TMPM373FWDUG only

## Applications

- Washing machines
- Air conditioners
- Refrigerators
- Heat pumps
- Pumps, compressors, air blowers
- Other rotating devices

## System Block Diagram (Washing Machine)



## Product Lineup

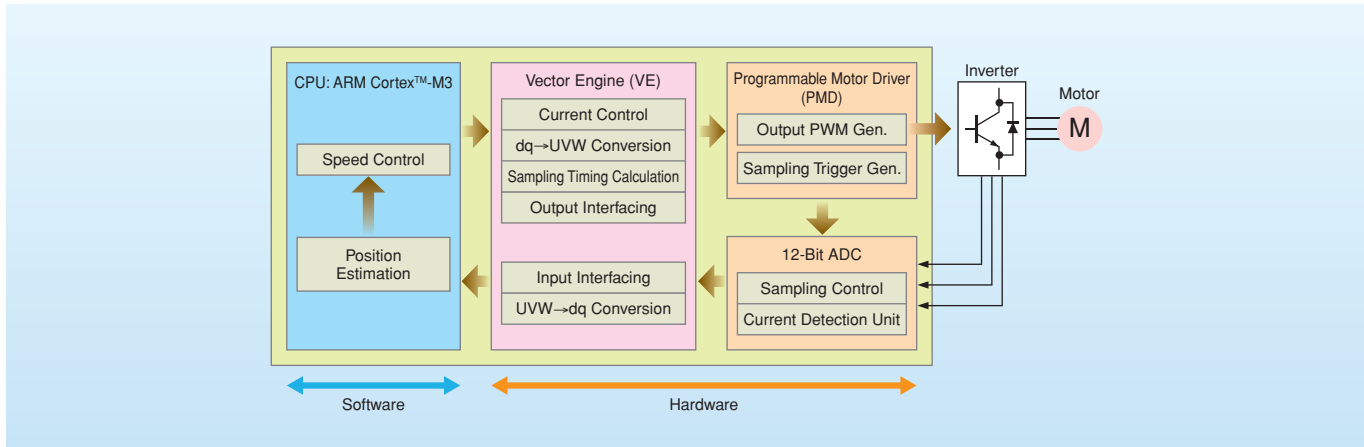
Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM370FYFG	256 KB	10 KB	LQFP100 (14 x 14 mm)	Capable of controlling two motors for a wide range of inverter applications. Contributing to the system cost reduction by incorporating various analog circuits
TMPM370FYDFG	256 KB	10 KB	QFP100 (14 x 20 mm)	
TMPM372FWFG **	128 KB	6 KB	QFP64 (14 x 14 mm)	Low-pin-count MCUs for single motor control Ideal for compressor control for refrigerators, etc.
TMPM372FWUG	128 KB	6 KB	LQFP64 (10 x 10 mm)	
TMPM373FWDUG	128 KB	6 KB	LQFP48 (7 x 7 mm)	
TMPM374FWUG	128 KB	6 KB	LQFP44 (10 x 10 mm)	
TMPM375FSDMG **	64 KB	4 KB	SSOP30	Capable of controlling two motors for a wide range of inverter applications.
TMPM376FDFG	512 KB	32 KB	LQFP100 (14 x 14 mm)	
TMPM376FDDFG	512 KB	32 KB	QFP100 (14 x 20 mm)	
TMPM377FYFG **	256 KB	16 KB	LQFP80 (12 x 12 mm)	
TMPM377FYDFG **	256 KB	16 KB	LQFP80 (14 x 14 mm)	

\*\* : Under development

## Features of the Vector Engine (VE)

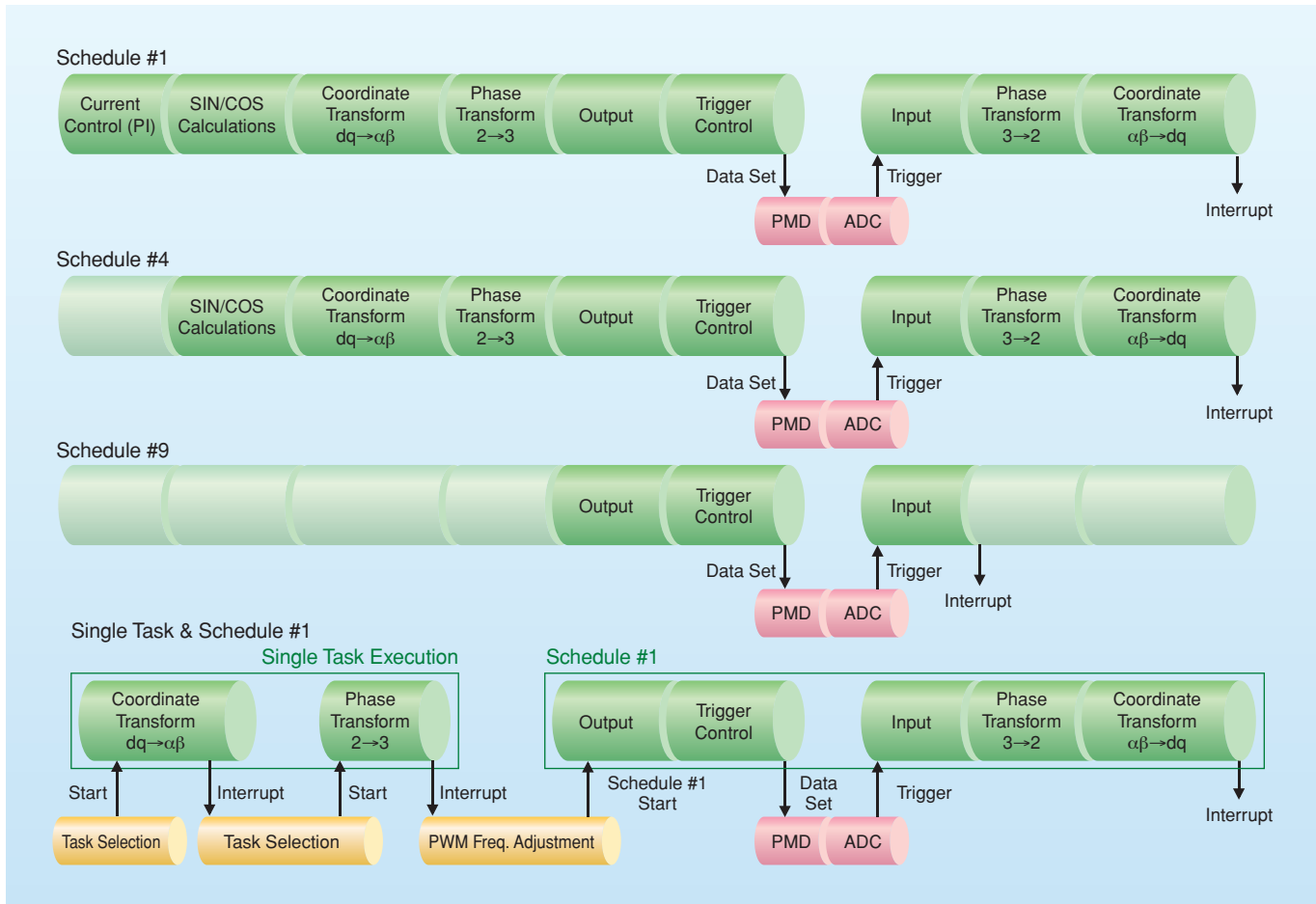
### High-efficiency motor control, reducing the CPU workload

The vector engine is a dedicated hardware unit designed to perform various operations for motor vector control. Since the vector engine has the capability for performing basic vector control operations (such as coordinate transformations, phase transformations and sine/cosine calculations), a PI algorithm for current control, and PMD and high-speed ADC interface operations, it helps to reduce the software workload significantly.



### Highly flexible hardware

Since the requirements for speed control and position estimation differ greatly among individual applications and users, they can be implemented via software. The vector engine provides great flexibility in allowing you to create various schedules that define a combined sequence of VE and user's software operations to perform. The vector engine supports two operating modes: Scheduled mode that executes a series of operations consecutively and Single Task mode that executes individual tasks one by one. Schedules can select a task that causes the vector engine to start execution.



# TX03 Series M380 Group

The M380 Group consists of high-performance microcontrollers that provide multi-purpose timers capable of controlling power devices used in home appliances, thereby enabling motor and induction heating (IH) control. Since they operate with a single 5-V supply, new designs can be created without replacing 5-V peripheral ICs. Additionally, a wide variety of on-chip timers and serial interfaces makes the M380 suitable for a broad range of applications, including housing and industrial equipment. The oscillation frequency detection (OFD) circuit allows the M380 to detect abnormal oscillation at the hardware level.

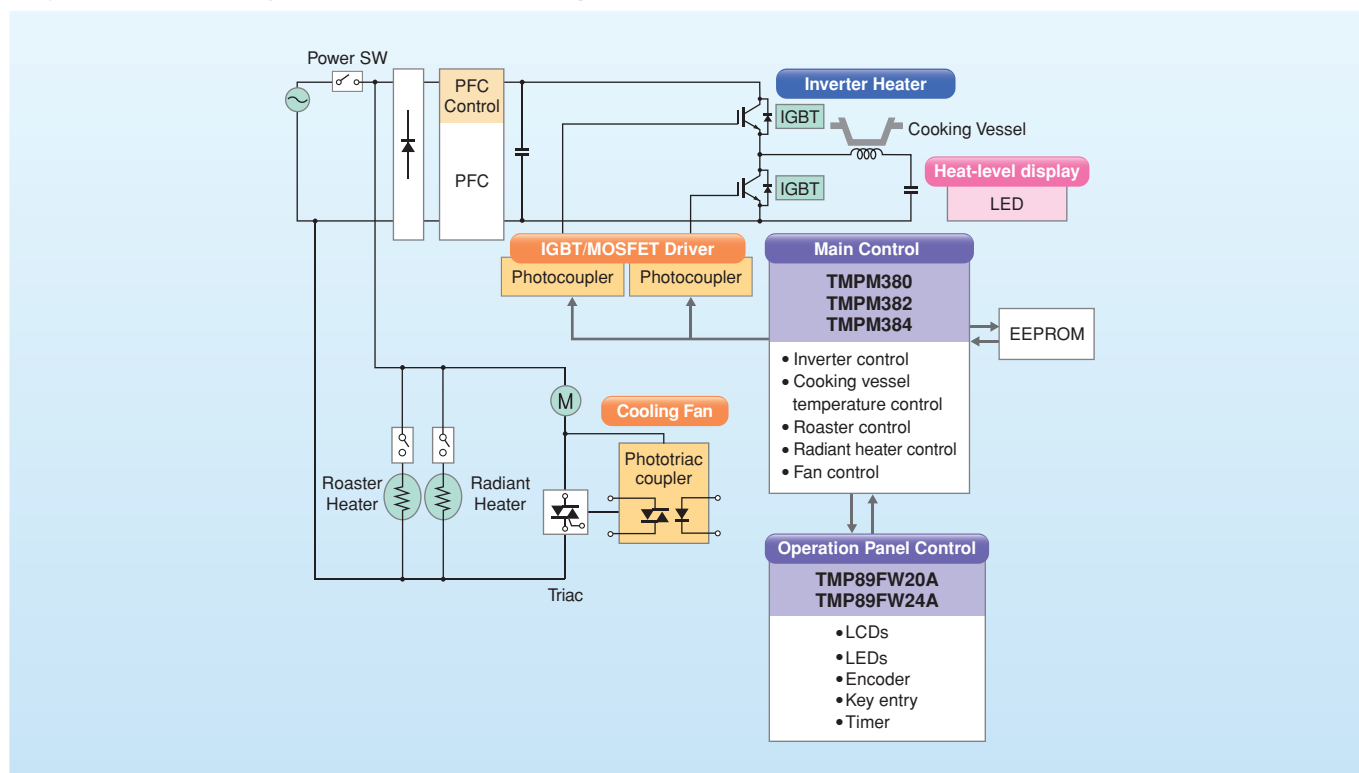
## Features

- High-performance ARM Cortex™-M3 core: 40-MHz operation (max)
- Toshiba-original NANO FLASH™ memory: Fast programming
- Multi-purpose timers (IGBT and motor control modes)
- Various serial interfaces
- AD converter with data monitoring function
- Oscillation frequency detection (OFD); compliant with the IEC 60730 standard
- High-speed oscillator; power-on reset; voltage detection circuit
- Single 5-V power supply

## Applications

- Air conditioners
- Refrigerators
- Dishwashers
- Induction cooktops
- Microwave ovens
- Water heaters
- Rice cookers
- Bidet toilets

## System Block Diagram (Induction Cooktops)



## Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM380FWFG	128 KB	12 KB	LQFP100 (14 x 14 mm)	Capable of controlling three-channel half bridges or two-channel motors with multi-purpose timers. The emergency protection circuit can disable the PWM output immediately.
TMPM380FWDFG	128 KB	12 KB	QFP100 (14 x 20 mm)	
TMPM380FYFG	256 KB	16 KB	LQFP100 (14 x 14 mm)	
TMPM380FYDFG	256 KB	16 KB	QFP100 (14 x 20 mm)	
TMPM380FDFG **	512 KB	32 KB	LQFP100 (14 x 14 mm)	
TMPM382FSFG **	64 KB	8 KB	QFP64 (14 x 14 mm)	Low-pin-count MCUs with multi-purpose timers designed to control a single-channel half bridge or motor
TMPM382FWFG **	128 KB	12 KB	QFP64 (14 x 14 mm)	
TMPM384FDFG **	512 KB	32 KB	LQFP144 (20 x 20 mm)	High-pin-count MCU with multi-purpose timers designed to control up to four-channel half bridges or a two motors

\*\* : Under development

# TX03 Series M390 Group

The 1.8-V low-power mode of the M390 Group makes it ideal for battery-operated applications. The on-chip high-speed, high-accuracy oscillator helps reduce product costs. The M390 Group are available in standard and small packages.

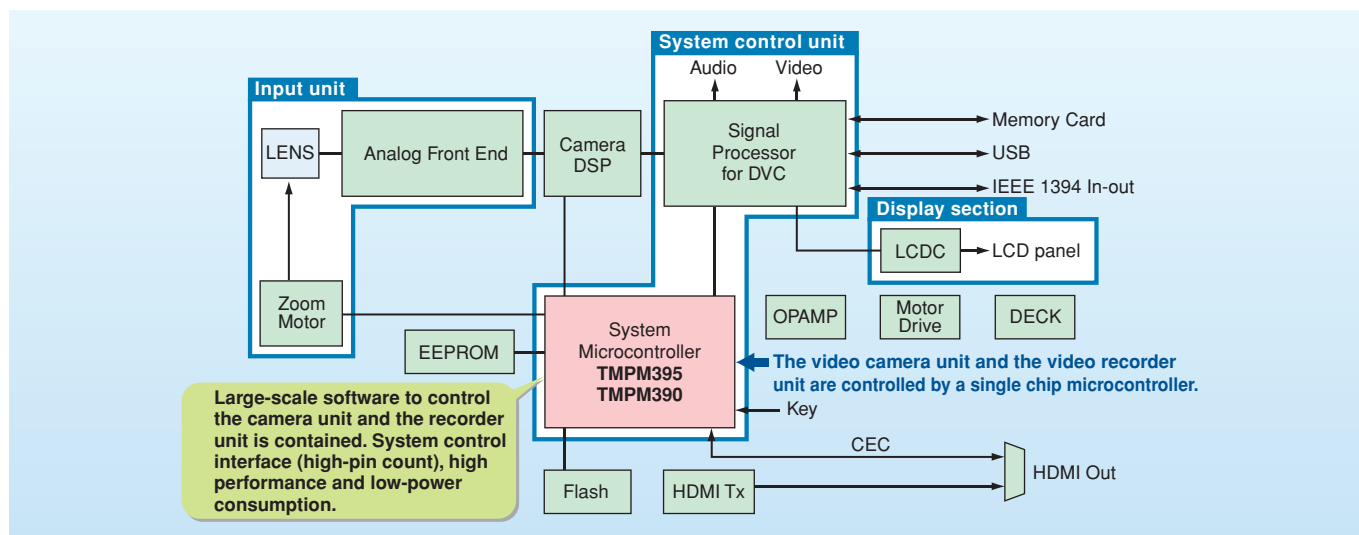
## Features

- High-performance ARM Cortex™-M3 core: 20-MHz operation (max)
- Toshiba-original NANO FLASH™ memory: Fast programming
- 1.8-V low-power (RTC) mode (1.3  $\mu$ A typ.)
- Various serial interfaces
- CEC interface and remote control signal preprocessor that remain active even in low-power mode
- On-chip high-speed oscillator (9.91 MHz  $\pm$  3% @ 0 to 70°C)
- Oscillation frequency detection (OFD); compliant with the IEC 60730 standard
- Small package (6 x 6 mm TFBGA120) Note: TMPM395FWAXBG only

## Applications

- Health care equipment
- Game consoles
- AV systems
- Power monitoring devices
- Battery-operated devices
- Remote-controlled equipment

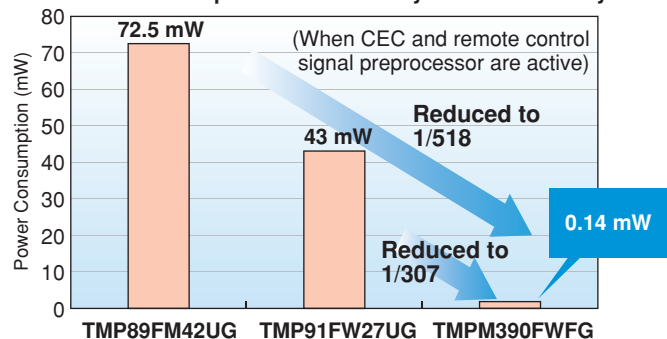
## System Block Diagram (Digital Video Camera)



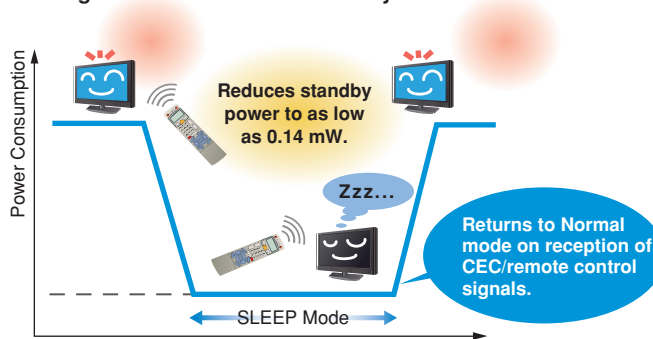
## Low-Power MCUs

Audiovisual systems must be able to receive Consumer Electronics Control (CEC) commands and remote control signals even when they are off. While the predecessor microcontrollers, the TLCS-900/L1 and TLCS-870/C Series, need to keep these functions in normal operating mode even when off, the M390 Group of microcontrollers can do them in low-power mode at 32.768 kHz, significantly reducing standby power consumption.

MCU Power Consumption When an AV System is in Standby Mode



Significant Reduction of Standby Power



## Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
<b>TMPM390FWFG **</b>	128 KB	8 KB	LQFP100 (14 x 14 mm)	1.8-V low-power (RTC) mode (1.3 $\mu$ A typ.)
<b>TMPM395FWAXBG</b>	128 KB	8 KB	TFBGA120 (6 x 6 mm)	Housed in a small package. 1.8-V low-power (RTC) mode (1.3 $\mu$ A typ.)

\*\* : Under development

# TX03 Series M320 Group (for Audio Applications)

The TMPM320C1DFG of the M320 Group incorporates a USB Embedded Host and an SD host controller. Additionally, it has a 1-MB DRAM to process a large amount of data. The TMPM320C1DFG can be used in tandem with a system MCU and a CD processor to play back music content from USB memory, etc.

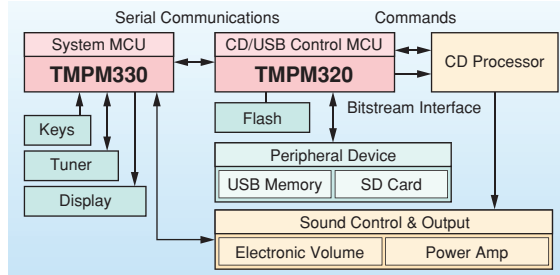
## Features

- High-performance ARM Cortex™-M3 core: 144-MHz operation (max)
- USB Embedded Host (High-Speed)
- SD host controller
- 320-KB SRAM and 1-MB DRAM

## Applications

Car audio systems  
Home audio systems

## System Block Diagram (Car Audio System)



## USB/SD Audio Features

- Music content playback from an USB memory
- Music content playback from an SD card (SDHC and SDXC\* supported)
- Quick USB/SD analysis
- PlayList playback\*
- Alphabetical sorting
- Supports MP3, WMA, AAC and WAV.

\* Enhancements will be added.

## Product Lineup

Part Number	ROM Size	RAM Size	DRAM Size	Package	Features
TMPM320C1DFG	–	320 KB	1 MB	LQFP144 (20 x 20 mm)	USB Embedded Host (High-Speed) SD host controller DRAM 1 MB

# TX03 Series M350 Group (for Automotive Applications)

The TMPM350FDTFG microcontroller of the M350 Group is specifically designed for automotive applications. The TMPM350FDTFG provides various peripheral functions, such as CAN controllers and AD converters, as well as a Toshiba-original Programmable Motor Driver (PMD).

The TMPM354F10TAFG is designed for automotive motor control applications. It contains a Vector Engine (VE) that enables efficient motor control, a Toshiba-original motor controller that supports one-shot pulse control, CAN controllers, and a resolver-to-digital converter (RDC). Additionally, the TMPM354F10TAFG offers functional safety features.

Because Toshiba's functional safety technology is compliant with ISO 26262, using the TMPM354F10TAFG will facilitate certification of your product.

## Features (TMPM350FDTFG)

- High-performance ARM Cortex™-M3 core: 88-MHz operation (max)
  - Motor control circuits
    - Programmable Motor Driver (PMD)
    - 12-bit AD converters: 10 ch x 2 units
    - Resolver excitation circuit
  - CAN controller: 2 channels (V2.0 B)
  - High temperature operation (Ta: 105°C max)
  - Functional safety: Optimized tightly coupled fault supervisors (ISO 26262-compliant)
- Fault supervisors with different algorithms monitor the detailed operation of each block integrated in an MCU. This architecture provides a low-cost, single-CPU solution for functional safety.

## Applications

- Electric power steering (EPS) and other automotive control applications

## Features (TMPM354F10TAFG)

- High-performance ARM Cortex™-M3 core: 96 -MHz operation (max)
  - Advanced motor control circuits
    - Advanced Programmable Motor Driver (A-PMD)
    - Vector Engine (VE): The increased hardware computation for motor vector control reduces the CPU workload approx. 50% (compared to the predecessor).
    - One-shot pulse control: Almost the same CPU workload at high rpms as for mid-rpms
    - Resolver-to-digital converter (RDC): Increases design flexibility, reduces system costs and improves noise immunity.
  - High-temperature operation (Ta: 125°C max)
  - Functional safety: Optimized tightly coupled fault supervisors (ISO 26262-compliant)
- Fault supervisors with different algorithms monitor the detailed operation of each block integrated in an MCU. This architecture provides a low-cost, single-CPU solution for functional safety.

## Applications

- HEV, EV and other automotive control applications

## Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM350FDTFG **	512 KB	48 KB	LQFP100 (14 x 14 mm)	<ul style="list-style-type: none"> <li>• ARM Cortex™-M3 plus Toshiba-original Programmable Motor Driver (PMD)</li> <li>• 2-channel CAN controller and 2 units of AD Converter</li> <li>• Functional safety: Optimized tightly coupled fault supervisors</li> </ul> The CAN controllers and the blocks that implement functional safety contain logic specifically designed for automotive applications, making the TMPM350FDTFG suitable for motor applications in safety-related systems such as electronic power steering (EPS).
TMPM354F10TAFG **	1 MB	64 KB	HQFP144 (20 x 20mm)	<ul style="list-style-type: none"> <li>• ARM Cortex™-M3 plus Toshiba-original Advanced Programmable Motor Driver (A-PMD)</li> <li>• 3-channel CAN controller and 4 units of AD Converter</li> <li>• Toshiba-original Vector Engine</li> <li>• Reduced part count and improved noise immunity due to the built-in RDC</li> </ul> Ideal for motor control applications in HEVs and EVs owing to enhanced motor controllers, angle sensor computation, in-vehicle networking, etc.

\*\* : Under development



# Development Environment

## Toshiba Application Notes and Sample Programs

Application notes and sample programs are available for download from our Web site. Application notes will help you better understand Toshiba's microcontrollers. You can use sample programs as a guide for creating software. Toshiba offers header files and startup routines for each microcontroller as well as sample programs for on-chip peripherals that combine multiple drivers. You can use them to control on-chip peripherals without being concerned about registers.

Visit our Web site for information on the availability of sample programs and the supported microcontrollers.

### Sample Program Examples

- Reading ADC data from an analog input pin
- Switching between NORMAL and STOP modes
- Generating a sawtooth waveform from the DA pin
- UART initialization and receive/transmit operation using the DMAC
- Reading and writing an SRAM connected to the external bus
- Executing a program out of the on-chip RAM to erase and program the on-chip Flash memory
- I<sup>2</sup>C master/slave configuration
- SSP initialization and self-loopback test
- Generating timer interrupts at an interval of 500 ms
- Generating square-wave forms with variable duty cycles using the PPG
- Watchdog timer initialization

## CMSIS-Compliant Drivers

Toshiba's sample programs and drivers are compliant with the Cortex™ Microcontroller Software Interface Standard (CMSIS) defined by ARM Ltd.

The CMSIS is a software interface standard, which enables consistent and simple software interfaces to the processor for interface peripherals, real-time operating systems and middleware, simplifying software re-use and reducing the learning time for new microcontroller developers.

Toshiba's sample programs and drivers are also available for download from ARM's onARM Web site.

onARM Web site <http://www.onarm.com/>

## Toshiba Semiconductor & Storage Products Company Web site

<http://www.semicon.toshiba.co.jp/eng/>

## Toshiba Microcomputer Web page

<http://www.semicon.toshiba.co.jp/eng/product/micro/index.html>



Products Lineup>>  
>32-bit ARM Core-Based  
Microcontrollers

Resources>>  
>Reference Model / Evaluation Board  
Starter Kits for Toshiba ARM core based microcontrollers  
Reference models proposed by Toshiba  
Reference Board  
>Application Notes / Sample Program



Product Name	Contents	Form	Update	Download File	Reference Document
T3200 Series	Start-up guide (English)				
	Start-up guide (Japanese)				
	Reader - Sample program	zip	October 2011	<a href="#">Download</a>	
	Driver - Sample program	zip		<a href="#">Download</a>	
	Library (PDF)			<a href="#">Download</a>	
	Application note		May 2011	<a href="#">Download</a>	

These files can be downloaded from the "Application Notes / Sample Programs" page.

- Drivers and sample programs
- CMSIS-SVD
- Application notes

# Development Environment

## Microcontroller Starter Kits

For Toshiba's ARM core-based TX00, TX03 and TX04 Series, starter kits are available from development tool partners. They will come in handy for microcontroller selection and evaluation purposes prior to development. A starter kit consists of a CPU board, an integrated development environment (IDE), and a suite of sample programs such as a header file and drivers. It allows you to start empirical evaluation quickly and facilitate development. Starter kits are also ideal for use as educational tools.

For the latest information, visit Toshiba's Web site.

Toshiba Semiconductor & Storage Products Company Web site: <http://www.semicon.toshiba.co.jp/>

Toshiba Microcomputer Web page: <http://www.semicon.toshiba.co.jp/product/micro/index.html>

For details of starter kits, please contact tool vendors.

Company names, logos and product names mentioned herein may be trademarks or registered trademarks of respective companies.

### IAR Starter Kit for TMPM330



- Included hardware: TMPM330-SK evaluation board
- J-Link for Toshiba Cortex-M3
- USB cable
- IAR Embedded Workbench for ARM 32KB limited edition
- Key features of the evaluation board
  - USB driver and connector / UART1
  - RS232 driver
  - Power jack/Power LED
  - 4 tactile switches
  - 2 UART connectors
  - Reset button
  - 10-MHz crystal oscillator (with socket, changeable), 32-kHz crystal oscillator
  - 8 user LEDs
  - Potentiometer input analog signal
  - LCD module

### ARM Starter Kit for TMPM330



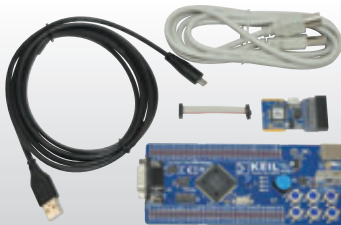
- Included hardware: TMPM330 evaluation board
- ULINK-ME™
- USB cable
- MDK-ARM (Microcontroller Development Kit) download
- Key features of the evaluation board
  - Reset button
  - USB BUS Power/Power LED
  - 1 tactile switch
  - 10-MHz and 32-kHz crystal oscillators
  - 3 user LEDs
  - Potentiometer for ADC input

### IAR Starter Kit for TMPM341



- Included hardware: IAR KickStart Kit for TMPM341
- IAR J-Link on-board (on-board ICE)
- USB cable
- IAR Embedded Workbench for ARM 32 KB KickStart edition
- Key features of the evaluation board
  - Optical rotary encoder
  - USB/UART serial converter
  - Potentiometer (slider)
  - Tactile switch
  - Reset button
  - 10-MHz crystal oscillator
  - 1 user LED
  - Power LED

### ARM Starter Kit for TMPM362/TMPM364



- Included hardware: TMPM362/TMPM364 evaluation board
- ULINK-ME™
- USB cables (for tools and USB Embedded Host)
- MDK-ARM (Microcontroller Development Kit) download
- Key features of the evaluation board
  - USB Embedded Host connector (M364)
  - CAN interface (M364)
  - Potentiometer for ADC input
  - 6 tactile switches
  - Reset button
  - 10-MHz crystal oscillator
  - 5 LEDs
  - USB BUS Power

### IAR Starter Kit for TMPM364



- Included hardware: TMPM364-SK evaluation board
- IAR J-Link Lite
- USB cable
- IAR Embedded Workbench for ARM 32 KB limited edition
- Key features of the evaluation board
  - USB Embedded Host connector
  - USB/UART serial converter
  - CAN interface
  - Tactile switch
  - Power LED
  - Potentiometer input analog signal
  - 12-MHz and 32-kHz crystal oscillators
  - 8 user LEDs
  - Reset button

Company names, logos and product names mentioned herein may be trademarks or registered trademarks of respective companies.

### IAR Starter Kit for TMPM366



- Included hardware: TMPM366-SK evaluation board  
IAR J-Link on-board (on-board ICE)  
USB cable  
IAR Embedded Workbench for ARM 32KB limited edition
- Key features of the evaluation board
  - USB connector
  - USB/UART serial converter
  - UART interface x2
  - 2 tactile switches
  - Power LED
  - Potentiometer input analog signal
  - 12-MHz crystal oscillator
  - 8 user LEDs
  - SD card slot (SSP)
  - Reset button

### IAR Starter Kit for TMPM369



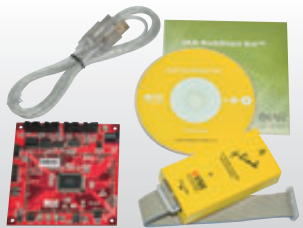
- Included hardware: TMPM369-SK evaluation board  
IAR J-Link on-board (on-board ICE)  
USB cable  
IAR Embedded Workbench for ARM 32KB limited edition
- Key features of the evaluation board
  - USB Embedded Host connector
  - Ethernet connector
  - 2 UART interfaces
  - JOY Stick
  - LCD module
  - Power LED
  - USB connector
  - CAN interface
  - 8 user LEDs
  - SD card slot (SSP)
  - Reset button
  - DC Power Jack

### IAR Starter Kit for TMPM370



- Included hardware: TMPM370-SK evaluation board  
J-Link for Toshiba Cortex-M3  
USB cable  
IAR Embedded Workbench for ARM 32KB limited edition
- Key features of the evaluation board
  - 4 tactile switches
  - Isolated JTAG interface
  - DC Power Jack
  - 3 user LEDs
  - Reset button

### IAR Starter Kit for TMPM376



- Included hardware: TMPM376-SK evaluation board  
J-Link for Toshiba Cortex-M3  
USB cable  
IAR Embedded Workbench for ARM 32KB limited edition
- Key features of the evaluation board
  - 4 tactile switches
  - Isolated JTAG interface
  - DC Power Jack
  - 3 user LEDs
  - Reset button
  - EEPROM

### IAR Starter Kit for TMPM380



- Included hardware: TMPM380-SK evaluation board  
J-Link for Toshiba Cortex-M3  
USB cable  
IAR Embedded Workbench for ARM 32KB limited edition
- Key features of the evaluation board
  - 16-bit external serial Flash ROM
  - Power LED
  - 3 seven-segment LEDs
  - SD/MMC card slot
  - Reset switch
  - Slide volume (speaker loudness)
  - Speaker amp
  - USB/UART serial converter
  - 8 user LEDs
  - 10-MHz ceramic resonator, 32-kHz crystal oscillator
  - 3 toggle switches
  - Potentiometer for ADC input (slide)
  - 2 low-pass filters
  - Speaker output connector

### ARM Starter Kit for TMPM395



- Included hardware: TMPM395 evaluation board  
ULINK-ME™  
USB cable  
MDK-ARM (Microcontroller Development Kit) download
- Key features of the evaluation board
  - USB/UART serial converter
  - HDMI interface (CEC)
  - 2 LEDs
  - Reset switch
  - CR1220 lithium-ion battery
  - SD/MMC card slot (SSP)
  - Potentiometer for ADC input
  - 4 tactile switches
  - DC Power Jack

# Development Environment

You can choose among a wide range of development tool partners for ARM-based microcontroller development systems. Choose the best development tools and partners that suit your needs.


	Compiler	Debugger	In-circuit emulator	Flash programmer	Starter kit	Real-time OS	Middleware	Verification tool	Flash programming service
ARM Ltd. (KEIL)	●	●	●		●	●	●	●	
Atollic AB	●	●						●	
BITRAN CORPORATION		●	●						
COMPUTEX CO., LTD.		●	●	ON board					
eForce Co.,Ltd.						●	●		
Elnec s.r.o				OFF board					
Falcon Denshi K.K.				OFF board					●
Flash Support Group, Inc.				ON board OFF board					●
GAIO TECHNOLOGY CO., LTD								●	
Green Hills Software/Advanced Data Controls Corp.	●	●							
GRAPE SYSTEM INC.						●	●		
HI-LO SYSTEMS RESEARCH CO., LTD				OFF board					
IAR Systems AB	●	●	●	ON board	●	●	●		
KYOEI co.,LTD.				ON board					
Kyoto Microcomputer Co., Ltd.	●	●	●						
MICROTEK Inc.									●
MINATO ELECTRONICS INC.				OFF board					●
MiSPO Co.,Ltd.						●	●		
Sophia Systems Co., Ltd.		●	●	ON board					
TOSHIBA INFORMATION SYSTEMES (JAPAN) CORPORATION						●	●		
Ubiquitous Computing Technology Corporation						●	●		
VAMOS									●
Yokogawa Digital Computer Corporation		●	●	ON board					
ZLG (GUANGZHOU ZHIYUAN ELECTRONICS CO., LTD)	●	●	●	ON board					

## Partner Information

For the support status and other details, please contact tool vendors directly. (Listed in alphabetical order)


Company names, logos and product names mentioned herein may be trademarks or registered trademarks of respective companies.

**ARM Ltd. (KEIL)** <http://www.arm.com/>



Keil MDK-ARM™ is a complete software development environment for Cortex™-M, ARM7™ and ARM9™ processor-based devices. MDK-ARM, which is specifically optimized for microcontroller applications, contains the ARM C/C++ Compiler, the μVision IDE and Debugger, the Keil RTX real-time operating system and middleware libraries. ARM DS-5™ (Development Studio 5) is a software development tool suite for ARM processor-based ASICs and standard devices. ARM provides versatile, high-performance and easy-to-use development environments for software developers.

**Atollic AB** <http://www.atollic.com/>



The Atollic TrueSTUDIO® is an embedded system tool that will meet your needs for the next 10 years. Built on the ECLIPSE IDE framework, TrueSTUDIO® can be seamlessly integrated with existing embedded systems, improving development productivity and user-friendliness. TrueSTUDIO® provides C/C++, build/debug and simulation tools for the Toshiba TX processors and enables algorithm testing even before a hardware interface is available. Additionally, it supports features that facilitate team collaboration such as migration paths from UML models to software solutions, a version management system and a bug/task database system.

Company names, logos and product names mentioned herein may be trademarks or registered trademarks of respective companies.

● BITRAN CORPORATION

<http://www.bitran.co.jp/ccd/english/>



JeRana is a JTAG emulator that supports the TX03 Series. Designed specifically for Cortex™-M3, JeRana is priced lower than its predecessors. Above all, JeRana is small and easy to use. To improve your productivity, JeRana provides basic debugging features and is capable of directly programming Flash ROM integrated in MCUs.

● COMPUTEX CO., LTD.

<http://www.computex.co.jp/eg/>



Computex manufactures development support systems that assist in debugging embedded software. A seamless development environment is available for the TX03 Series that encompasses everything from evaluation and development to the production phase. The PALMiCE3 JTAG emulators support various target interfaces such as JTAG and ETM. The on-chip flash programmer, FP-10, provides a standalone mode that does not require a host PC and operates at 3 to 5 V. ROMiCEmini supports the TX19A and TLCS-900/H1 Series.

● eForce Co., Ltd.

<http://www.eforce.co.jp/english.htm/>



eForce offers  $\mu$ C3/Compact, a  $\mu$ TRON-compliant compact RTOS,  $\mu$ NET3/Compact, a TCP/IP protocol stack that operates only with a CPU's internal memory, etc. eForce supports ARM Cortex™-M and other ARM core-based microcontrollers to address customer needs to reduce development time and win a valuable time-to-market edge. It offers  $\mu$ C3/Compact for the TX03 Series and  $\mu$ C3/Standard for the TX09 Series.

● Elnec s.r.o.

<http://www.elnec.com/>



Elnec develops and manufactures universal programmers for engineering and volume production. The company offers high-quality and well-designed products at affordable prices. Most Elnec device programmers include a 3-year warranty. Updates of programmer's software are released according to the customers' needs (in many cases daily) and download of the new software version is available free of charge. For more information, please visit Elnec's website. Elnec supports an extensive range of Toshiba programmable devices and support grows with each version of a new programmer's software.

● Falcon Denshi K.K.

<http://www.falcon-denshi.co.jp/en/>



Falcon Denshi is a subsidiary of Hi-Lo Systems in Japan. It offers device programmers and automated programming systems worldwide under the brand names of Hi-Lo Systems and FALCON. It also offers device programming services using its facilities in Japan, Taiwan, Hong Kong, China, Singapore, etc. Falcon Denshi supports the ARM core-based TX03 Series, TLCS-900/H1Series, TLCS-47E Series, TLCS-870/C1 Series and so on. Its product portfolio includes ALL-100AX, a single-device programmer for engineering, gang programmers that allow simultaneous programming of 4 to 8 devices for medium-scale production, and automated programming systems that support programming of 900 to 2200 devices per hour. Falcon Denshi also offers custom algorithm development services.

● Flash Support Group, Inc.

<http://www.j-fsg.co.jp/en/>



Flash Support Group offers various semiconductor device tools mainly for Flash microcontrollers. The company's product portfolio includes auto programming systems, a wide variety of programmers (covering low-cost on-board programming to development and mass-production programming) and peripheral tools. The programmers support an extensive range of devices including Toshiba's TX19, TLCS-900 and TLCS-870 Families. Speedy and flexible programming services are also available.

● GAI0 TECHNOLOGY CO., LTD

<http://www.gai0.com/>



GAIO TECHNOLOGY is an embedded development tool provider. One of our best selling products is the unit test tool CoverageMaster, the first product in the Asia-Pacific region to obtain tool certification (by TUV SUD Germany) for the ISO 26262 automotive functional safety standard. CoverageMaster is increasing its share of the market not only in the Japanese domestic region, but also being marketed overseas with a focus on the European region. Supported devices include TLCS-870/TLCS-900/TX19 and the latest ARM core-based TX03/TX04R microcontrollers.

● Green Hills Software/Advanced Data Controls Corp.

<http://www.ghs.com/> <http://www.adac.co.jp/eng/>



Advanced Data Controls Corporation (ADaC) has been a partner of Green Hills Software (GHS) for 20 years in sales and technical support in Japan and other Asian countries. GHS offers total solution support for compilers, debuggers and JTAG probes to help you create applications for Toshiba's ARM core-based microcontrollers. It delivers overwhelming compiler performance in terms of speed and code size. GHS MULTI Tool Chain has received the highest level of certification ISO 26262 ASIL D for tool qualification requirements from TUV Nord on September 2012. ADaC and GHS provide technical support to help you improve your application performance.

● GRAPE SYSTEMS INC.

<http://www.grape.co.jp/english/index.html>



Grape Systems offers the GR-USB USB stack series for the TX03 Series, various class drivers such as a Mass Storage Class driver, the GR-FILE FAT system, the ThreadX high-speed real-time operating system, the NetX networking protocol, etc. Grape Systems also provides custom development services. Contact Grape Systems for details.

# Development Environment

Company names, logos and product names mentioned herein may be trademarks or registered trademarks of respective companies.

## ● HI-LO SYSTEMS RESEARCH CO., LTD

<http://www.hilosystems.com.tw/>



The ALL-100A programmer from Hi-Lo Systems has 68 sets of Precise Universal Pin Driver to provide high-speed, low-noise, accurate and reliable programming signals for various IC products including high-speed, low-power devices recently released to the market. ALL-100A can be set up for either single-site programming for engineering or multi-site programming for production. If required, up to 8 sets of ALL-100A can be set up for multi-set operation so up to 64 sites can be programmed simultaneously to maximize production. Supporting software for the ARM core-based TX03 Series, TLCS-900/H1 Series, TLCS-870/C1 Series, etc. is available now. Device support on the website for check/retrieve is updated weekly.

## ● IAR Systems AB

<http://www.iar.com/>



IAR Systems offers comprehensive solutions for the entire development cycle of Toshiba's ARM core-based microcontrollers, from conception and evaluation through prototyping and development. IAR Systems provides a comprehensive optimized environment for your product development, such as various evaluation kits and an integrated development environment that works seamlessly with various in-circuit emulators (ICEs), real-time operating systems (RTOS) and middleware. Its ARM solution is well proven in markets worldwide.

## ● KYOEI co.,LTD.

<http://www.k-kyoei.jp/>



Kyoei designs and develops measurement control systems and Flash memory programming systems. Kyoei offers an on-board Flash programmer called I.S.P-310, which supports various Flash microcontrollers such as the Toshiba TX03 ARM core-based microcontroller series. The I.S.P-310 is small and lightweight and powered by two AA batteries. It is a standalone system and easily portable. You can use it in production lines and in the field.

## ● Kyoto Microcomputer Co., Ltd.

<http://www.kmckk.co.jp/eng/>



As a company specializing in debugger software and in-circuit emulators, Kyoto Microcomputer has been engaged in the improvement of embedded development environments. Its JTAG ICE, "PARTNER-Jet", offers a powerful and efficient debug environment incorporating advanced features ahead of other companies, such as support for multi-core processors and operating systems with an MMU (Linux, Windows CE, T-Engine, etc.) that are recently adopted in high-end embedded environments. PARTNER-Jet supports the TX49 and TX99 Families.

## ● MICROTEK Inc.

<http://www.microtek.co.jp/english/>



Microtek embarked on contract IC programming in 2000. Since then, the company has been building a successful track record in a wide range of fields, including communications, home information appliances and automotive applications, as a reliable provider of IC programming services.

## ● MINATO ELECTRONICS INC.

<http://www.minato.co.jp/en/>



Minato Electronics developed the first "device programmer" in Japan when PROM first came on the market. Since then, the company has been occupying the leading position in the programmer field. Its product line includes not only programmers but also auto programming equipment and exchange adapters for a wide variety of packages to meet various programming needs of customers. Minato's programmers support the ARM core-based TX03 series, as well as the TX19, TLCS-900, and TLCS-870 Families. Programming services using these products are also available.

## ● MISPO Co., Ltd.

<http://www.mispo.co.jp/>



MiSPO specializes in embedded operating systems. The NORTI<sup>®</sup> real-time operating system, which has long been popular among many users, now provides support for the TX03 Series. A new product called NORTi<sup>®</sup> Oceans (TX03/EW) is an ultra-light kernel specifically designed for the TMPM330 that runs with only 32 Kbytes of on-chip RAM. Although this kernel is a subset of  $\mu$ TRON4.0, it provides all basic functions. For the TMPM320 with large-capacity on-chip RAM, MiSPO offers NORTi<sup>®</sup> Professional II (ARM/EW) that provides comprehensive support for an ARM processor with fully fledged TCP/IP stacks.

## ● Sophia Systems Co., Ltd.

<http://www.sophia-systems.com/>



Sophia Systems offers embedded development solutions for Toshiba microcontrollers, such as Flash writers, emulators for the TX03 Series (ARM core-based microcontrollers), etc. Sophia Systems has a proven track record in the design and development of custom boards and systems using Toshiba's microcontrollers. Being an authorized distributor of the ARM products (KEIL and DS-5), Sophia Systems can provide a comprehensive solution, including an integrated development environment and a compile environment.

## ● TOSHIBA INFORMATION SYSTEMS (JAPAN) CORPORATION

<http://www.tjsys.co.jp/english/>



Toshiba Information Systems develops, sells and offers support services for  $\mu$ TRON4.0-compliant real-time operating systems (RTOS). It offers standard UDEOS4/Cortex<sup>™</sup>-M3 (compliant with  $\mu$ TRON4.0) for the TX03 Series that operates with on-chip ROM/RAM and UDEOS4/ARM (compliant with  $\mu$ TRON4.0), an enhanced version, for the TX09 Series. Also included among its product offerings is the compact UDEOS4/Lite for Cortex<sup>™</sup>-M0 and Cortex<sup>™</sup>-M3.

Company names, logos and product names mentioned herein may be trademarks or registered trademarks of respective companies.

Ubiquitous Computing Technology Corporation

<http://ts.uctec.com/uctec/index-e.php>

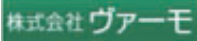


UC Technology offers the source code of  $\mu$ T-Kernel, a tuned-up version of the latest  $\mu$ T-Kernel RTOS being standardized by the T-Engine Forum, as well as various sample programs. Since  $\mu$ T-Kernel comes with a project file for the integrated development environment, you can start creating  $\mu$ T-Kernel drivers and application software right after you have installed software without performing any complicated setup.

You can purchase a royalty-free project license for  $\mu$ T-Kernel for mass production at a reasonable price.

VAMOS

<http://www.vamos-net.jp/>



With over 25 years of experience in EPROM programming, VaMos has been engaged in programming on-chip EPROM of Toshiba microcontrollers ever since its establishment in 1985. VaMos has been highly acclaimed by many customers for quick-turnaround, low-cost and high-quality services.

Its mottoes are "Readiness," "Quick Turnaround," and "From Small Engineering Lots to Production Lots." VaMos offers various adapters for Toshiba's OTP microcontrollers, Flash microcontrollers and ARM core-based microcontrollers. Contact VaMos if you need EPROM or Flash programming service.

Yokogawa Digital Computer Corporation

<http://www2.yokogawa-digital.com/en>



Yokogawa Digital Computer specializes in embedded solutions and offers an extensive range of products related to the design and development of microcomputer and peripheral systems. Included among its products are the "advice" series of in-circuit emulators, the NETIMPRESS series of flash microcontroller programmers, Windows Embedded CE starter kits and development process improvement tools. Yokogawa provides the ideal development environment by leveraging its experience and expertise. Yokogawa Digital Computer is an authorized distributor of and a certified training center for the ARM KEIL and DS-5. Thus, it can offer optimal solutions that best suit your need.

ZLG (GUANGZHOU ZHIYUAN ELECTRONICS CO., LTD)

<http://www.embedtools.com/>



Guangzhou Zhiyuan Electronics founded in May 2001 is engaged in design, production, and sales. It is a member of Field-bus DeviceNet ODVA China. The company has departments dedicated to development in specific fields, including the Industrial Communication Network Department, the Building Automation Department, the Measuring Instrument Technology Department, the Embedded System Application Department, the Power Supply Department, the OEM/ODM Product Department, the Computer Software Development Center, and the Industrial Design Center. The Measuring Technology Department focuses on the design and development of measuring and testing instruments and related development tools. It currently offers over ten types of products, including digital oscilloscopes, logic analyzers, protocol analyzers, digital multimeters, signal generators, universal emulators, and data collection cards. The products are widely applied in electronics design, manufacturing, industrial control, network communication, and scientific research. In accordance with its business philosophy, Guangzhou Zhiyuan Electronics emphasizes a faithful, customer-oriented approach.

Proud of its tradition of high quality and excellent service, the company is ready to serve every customer in a spirit of wholehearted cooperation.

# Toshiba's ARM Core-Based Microcontroller Lineup

## 32-Bit Microcontrollers

### TX04 Series

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (Ch)	SSP(ch)	UART/SIO(ch)	Full UART(ch)	I <sup>2</sup> C(ch)	I <sup>2</sup> C/SIO(ch)	CAN(ch)	USB Embedded Host(Full-Speed)(ch)	USB (Full-Speed)(ch)	EtherMAC(ch)	10-Bit AD Converter (Ch)	12-Bit AD Converter (Ch)	10-Bit DA Converter (Ch)	10-Bit DA Converter (Ch)	16-Bit Timer/Counter (Ch)	High-Res. 16-Bit Timer/PPG Gen. (Ch)	2-Phase Pulse Counter (PHC) (Ch)	CEC (ch)	Remote Control Preprocessor (Ch)	Vector Engine (VE)	3-Phase PWM Generator (PMD) (Ch)	Programmable Servo Controller (PSC) (ch)	Multi-Purpose Timer (MPT) (Ch)	Incremental Encoder Input (Ch)	Op Amp (Ch)	Comparator (Ch)	External Interrupt Pins (Pins)	Key-on Wake-up (KWUP) (Ch)	Key Scan (KSCAN) (Columns by Rows)	CS/WAIT Controller (Ch)	RTC(ch)	Dual Clocks	Trace Function	Oscillation Frequency Detector	Power-On Reset	Voltage Detecting Circuit	I/O Port (Pins)	Supply Voltage (V)	Operating Temperature (°C)	Package
TMPM440FEXBG**	768K	64K	100	6	6	2	1							20	2	20	2	20	4	3				1					22	40	8x8	2	1	Y	Y	Y	Y	228	2.7 to 3.6	-40 to 85	VFPGA289 (11 x 11 mm)		
TMPM440F10XBG**	1024K	64K	100	6	6	2	1							20	2	20	2	20	4	3				1					22	40	8x8	2	1	Y	Y	Y	Y	228	2.7 to 3.6	-40 to 85	VFPGA289 (11 x 11 mm)		

\* The letter "Y" in the above table means "available."

\* Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

\*\* : Under development

### TX00 Series

#### Flash Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	LED Driver (Ch)	LCD Driver (Ch)	SSP (ch)	UART/SIO(ch)	Full UART(ch)	I <sup>2</sup> C(ch)	I <sup>2</sup> C/SIO(ch)	CAN(ch)	USB Embedded Host (Full-Speed)(ch)	USB (Full-Speed)(ch)	10-Bit AD Converter (Ch)	12-Bit AD Converter (Ch)	24-Bit ΔΣ AD Converter (Ch)	10-Bit DA Converter (Ch)	16-Bit Timer/Counter (Ch)	High-Res. 16-Bit Timer/PPG Gen. (Ch)	3-Phase PWM Generator (PMD) (Ch)	Multi-Purpose Timer (MPT) (Ch)	Incremental Encoder Input (Ch)	Power Calc. Engine	Temp. Sensor	External Interrupt Pins (Pins)	RTC(ch)	Dual Clocks	Trace Function	Oscillation Frequency Detector	Power-On Reset	Voltage Detecting Circuit	I/O Port (Pins)	Supply Voltage (V)	Operating Temperature (°C)	Package
TMPM061FWFG **	128K	8K	16	40	4		4			1				2	3		9						Y	Y	4	4	1	Y			Y	64	1.8 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)

\* The letter "Y" in the above table means "available."

\* All products on this page incorporate a watchdog timer, a clock gear and an on-chip debug unit.

\* Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

\*\* : Under development

### TX03 Series

#### Flash Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (ch)	SSP(ch)	UART/SIO(ch)	Full UART(ch)	I <sup>2</sup> C (ch)	I <sup>2</sup> C/SIO(ch)	CAN(ch)	USB Embedded Host (Full-Speed)(ch)	USB (Full-Speed)(ch)	EtherMAC(ch)	10-Bit AD Converter (Ch)	12-Bit AD Converter (Ch)	10-Bit DA Converter (Ch)	16-Bit Timer/Counter (Ch)	High-Res. 16-Bit Timer/PPG Gen. (Ch)	CEC(ch)	Remote Control Preprocessor (Ch)	Vector Engine (VE)	3-Phase PWM Generator (PMD) (Ch)	Multi-Purpose Timer (MPT) (Ch)	Incremental Encoder Input (Ch)	Op Amp (Ch)	Comparator (Ch)	External Interrupt Pins (Pins)	CS/WAIT Controller (Ch)	RTC (ch)	Dual Clocks	Trace Function	Oscillation Frequency Detector	Power-On Reset	Voltage Detecting Circuit	I/O Port (Pins)	Supply Voltage (V)	Operating Temperature (°C)	Package
TMPM375FSDMG**	64K	4K	40			(Note3) 2			1					4	4					Y	1	1	1	1	1	3				Y	Y	Y	Y	21	4.5 to 5.5	-40 to 105	SSOP30	
TMPM382FSFG **		8K	40	2	1	3			1					10	8				1		(Note1) 1	1	1	1	1	8	1	Y	Y	Y	Y	Y	Y	48	4.0 to 5.5	-40 to 85	QFP64 (14 x 14 mm)	
TMPM372FWFG**	128K	6K	(1) 80 (2) 32			4								11	8					Y	1	1	1	1	10				Y	Y	Y	Y	Y	53	4.5 to 5.5	(1) -40 to 85 (2) -40 to 105	QFP64 (14 x 14 mm)	
TMPM372FWUG			(1) 80 (2) 32			4									11	8				Y	1	1	1	1	10				Y	Y	Y	Y	53	LQFP64 (10 x 10 mm)				
TMPM373FWDUG			(1) 80 (2) 32			3									7	8				Y	1	1	1	1	8				Y	Y	Y	Y	37	LQFP48 (7 x 7 mm)				
TMPM374FWUG			(1) 80 (2) 32			3									6	8				Y	1	1	1	1	7				Y	Y	Y	Y	33	LQFP44 (10 x 10 mm)				

Note 1) The same logic is shared between the 3-Phase PWM Generator (PMD) and the Multi-Purpose Timer (MPT).

Note 2) Maximum Operating Frequency (1) and (2) correspond to Operating Temperatures (1) and (2).

Note 3) One channel is usable only as a UART channel.

\* The letter "Y" in the above table means "available."

\* All products on this page incorporate a watchdog timer, a clock gear and an on-chip debug unit.

\* Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

\*\* : Under development



## Flash Versions (Continued)

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (Ch)	SSP(ch)	UART/SIO(ch)	Full UART(ch)	I <sup>2</sup> C (ch)	I <sup>2</sup> C/SIO(ch)	Variable-Length Data Serial Interface (VSI/O) (Ch)	CAN(ch)	USB Embedded Host (Full-Speed)(ch)	USB (Full-Speed)(ch)	EtherMAC(ch)	10-Bit AD Converter (Ch)	12-Bit AD Converter (Ch)	16-Bit ΔΣ AD Converter (Ch)	10-Bit DA Converter (Ch)	16-Bit Timer/Counter (Ch)	High-Res. 16-Bit Timer/PPG Gen. (Ch)	2-Phase Pulse Counter (PHC) (Ch)	CEC (Ch)	Remote Control Preprocessor (Ch)	Vector Engine (VE)	3-Phase PWM Generator (PMD) (Ch)	Programmable Servo Controller (PSC) (ch)	Motor Driver (MCD)(ch)	Multi-Purpose Timer (MPT) (Ch)	Incremental Encoder Input (Ch)	Op Amp (Ch)	Comparator (Ch)	External Interrupt Pins (Pins)	CSMA/IT Controller (Ch)	RTC (Ch)	Dual Clocks	Trace Function	Oscillation Frequency Detector	Power-On Reset	Voltage Detecting Circuit	I/O Port (Pins)	Supply Voltage (V)	Operating Temperature (°C)	Package
TMPM330FWFG		40		3	3										12			10			1	2									8	1	Y	Y					78	2.7 to 3.6	-20 to 85	LQFP100 (14 x 14 mm)	
TMPM332FWUG		40		2	2										8			10			1	1									5	1	Y	Y					44	2.7 to 3.6	-20 to 85	LQFP64 (10 x 10 mm)	
TMPM333FWFG		40		3	3										12			10													8	1	Y	Y					78	2.7 to 3.6	-20 to 85	LQFP100 (14 x 14 mm)	
TMPM390FWFG **		20	1	3	1	1									12			10			1	2								8	1	Y	Y	Y	Y	Y	Y	74	1.7 to 3.6	-20 to 85	LQFP100 (14 x 14 mm)		
TMPM395FWAXBG		20	4	3	1	1									12			10			1	2								11	1	Y	Y	Y	Y	Y	Y	91	1.7 to 3.6	-20 to 85	TFBGA120 (6 x 6 mm)		
TMPM380FWDFG		40	2	2	5	2										18		8			1		(Note 1) 2				3	2		16	1	Y	Y	Y	Y	Y	Y	84	4.0 to 5.5	-40 to 85	QFP100 (14 x 20 mm)		
TMPM380FWFG		40	2	2	5	2										18		8			1		(Note 1) 2				3	2		16	1	Y	Y	Y	Y	Y	Y	84	4.0 to 5.5	-40 to 85	LQFP100 (14 x 14 mm)		
TMPM382FWFG **		40	2	1	3	1									10			8			1		(Note 1) 1				1			8	1	Y	Y	Y	Y	Y	Y	48	4.0 to 5.5	-40 to 85	QFP64 (14 x 14 mm)		
TMPM366FWFG		48	4	3	2	1	2								12			10												10	2			Y				74	(Note 2) 2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)		
TMPM366FWXBG		48	4	3	2	1	2								12			10												10	2			Y				74	(Note 2) 2.7 to 3.6	-40 to 85	TFBGA109 (9 x 9 mm)		
TMPM367FWFG **		80	32	3	4	2	3								8		2	8			1		(Note 1) 1				4	1		14	4	1		Y	Y	Y	Y	Y	60	(Note 2) 2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)	
TMPM367FWXBG **		80	32	3	4	2	3								8		2	8			1		(Note 1) 1				4	1		14	4	1		Y	Y	Y	Y	Y	60	(Note 2) 2.7 to 3.6	-40 to 85	TFBGA109 (9 x 9 mm)	
TMPM368FWFG **		80	32	3	4	2	3	1	1	1					8		2	8			1		(Note 1) 1				4	1		14	4	1		Y	Y	Y	Y	Y	60	(Note 2) 2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)	
TMPM368FWXBG **		80	32	3	4	2	3	1	1	1					8		2	8			1		(Note 1) 1				4	1		14	4	1		Y	Y	Y	Y	Y	60	(Note 2) 2.7 to 3.6	-40 to 85	TFBGA109 (9 x 9 mm)	
TMPM370FYDFG		80		4												22		8				Y	2					2	4	4	16			Y	Y	Y	Y	Y	76	4.5 to 5.5	-20 to 85	QFP100 (14 x 20 mm)	
TMPM370FYFG		80		4												22		8				Y	2					2	4	4	16			Y	Y	Y	Y	Y	76	4.5 to 5.5	-20 to 85	QFP100 (14 x 20 mm)	
TMPM330FYFG		40		3	3										12			10			1	2								8	1	Y	Y					78	2.7 to 3.6	-20 to 85	LQFP100 (14 x 14 mm)		
TMPM330FYWFG		40		3	3										12			10			1	2							8	1	Y	Y					78	2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)			
TMPM333FYFG		40		3	3										12			10												8	1	Y	Y					78	2.7 to 3.6	-20 to 85	LQFP100 (14 x 14 mm)		
TMPM342FYXBG		32K	40	4	1	3	1	1	1						12	4	2	10	8	2					1	7.5		6	2	8			Y						63	(Note 4) 2.7 to 3.6	-25 to 85	VFBGA142 (7x7 mm)	
TMPM377FYDFG **		80		3	1										12			8				Y	2					2		5			Y	Y	Y	Y	Y	63	4.5 to 5.5	-40 to 85	LQFP80 (14 x 14 mm)		
TMPM377FYFG **		80		3	1										12			8				Y	2					2		5			Y	Y	Y	Y	Y	63	4.5 to 5.5	-40 to 85	LQFP80 (12 x 12 mm)		
TMPM380FYDFG		40	2	2	5	2									18			8			1		(Note 1) 2				3	2		16	1	Y	Y	Y	Y	Y	Y	84	4.0 to 5.5	-40 to 85	QFP100 (14 x 20 mm)		
TMPM380FYFG		40	2	2	5	2									18			8			1		(Note 1) 2				3	2		16	1	Y	Y	Y	Y	Y	Y	84	4.0 to 5.5	-40 to 85	LQFP100 (14 x 14 mm)		
TMPM365FYXBG		24K	48	2	2										12			10												10			Y					74	(Note 2) 2.7 to 3.6	-40 to 85	LFBGA105 (9 x 9 mm)		
TMPM341FYXBG		32K	54	4	1	5	2								15	2	10	2												12	2		Y	Y				86	(Note 3) 1.65 to 3.6	-40 to 85	TFBGA113 (6 x 6 mm)		
TMPM366FYFG		48	4	3	2	1	2								12			10												10	2		Y					74	(Note 2) 2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)		
TMPM366FYXBG		48	4	3	2	1	2								12			10												10	2		Y					74	(Note 2) 2.7 to 3.6	-40 to 85	TFBGA109 (9 x 9 mm)		

Note 1) The same logic is shared between the 3-Phase PWM Generator (PMD) and the Multi-Purpose Timer (MPT).

Note 2) 3.0 to 3.45 V when USB is used.

Note 3) When the supply voltage is less than 2.7 V, part of the peripheral blocks (the external bus interface and the SSP) can be used.

Note 4) MCD analog power supply: 3.1 to 3.5 V

MCD motor power supply: 2.5 to 5.5 V

The letter "Y" in the above table means "available."

All products on this page incorporate a watchdog timer, a clock gear and an on-chip debug unit.

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\*\* : Under development

# Toshiba's ARM Core-Based Microcontroller Lineup

## Flash Versions (Continued)

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (Ch)	SSP(ch)	UART/SIO (ch)	Full UART(ch)	I <sup>2</sup> C/SIO(ch)	CAN(ch)	Variable-Length Data Serial Interface (VSIO) (Ch)	USB Embedded Host (Full-Speed)(ch)	USB (Full-Speed)(ch)	EtherMAC(ch)	10-Bit AD Converter (Ch)	12-Bit AD Converter (Ch)	16-Bit ΔΣ AD Converter (Ch)	10-Bit DA Converter (Ch)	16-Bit Timer/Counter (Ch)	High-Res. 16-Bit Timer/PPG Gen. (Ch)	2-Phase Pulse Counter (PHC) (Ch)	CEC(ch)	Remote Control Preprocessor (Ch)	Vector Engine (VE)	3-Phase PWM Generator (PMD) (Ch)	Programmable Servo Controller (PSC) (ch)	Motor Driver (MCD)(ch)	Multi-Purpose Timer (MPT) (Ch)	Incremental Encoder Input (Ch)	Op Amp (Ch)	Comparator (Ch)	External Interrupt Pins (Pins)	CSWAIIT Controller (Ch)	RTC(ch)	Dual Clocks	Trace Function	Oscillation Frequency Detector	Power-On Reset	Voltage Detecting Circuit	I/O Port (Pins)	Supply Voltage (V)	Operating Temperature (°C)	Package		
TMPM367FYFG **	256K	66K	80	32	3	4	2	3			1			8		2	8				1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y	Y	60	(Note 2) 2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)					
TMPM367FYXBG **			80	32	3	4	2	3				1			8		2	8				1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y	Y			60	TFBGA109 (9 x 9 mm)				
TMPM368FYFG **			80	32	3	4	2	3	1		1	1			8		2	8					1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y			Y	60	LQFP100 (14 x 14 mm)			
TMPM368FYXBG **			80	32	3	4	2	3	1		1	1			8		2	8					1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y			Y	60	TFBGA109 (9 x 9 mm)			
TMPM369FYFG **			80	32	3	4	2	3	1		1	1	1		16		2	8						1		(Note 1) 2		4	2		16	4	1	Y	Y	Y			Y	Y	102	LQFP144 (20 x 20 mm)		
TMPM369FYXBG **			80	32	3	4	2	3	1		1	1	1		16		2	8						1		(Note 1) 2		4	2		16	4	1	Y	Y	Y			Y	Y	102	TFBGA177 (11 x 11 mm)		
TMPM330FDFG	32K		40		3		3							12			10				1	2								8	1	Y	Y					78	2.7 to 3.6	-20 to 85	LQFP100 (14 x 14 mm)			
TMPM330FDWFG			40		3		3								12			10				1	2							8	1	Y	Y					78				-40 to 85		
TMPM333FDFG			40		3		3									12			10											8	1	Y	Y					78				-20 to 85		
TMPM341FDXBG	32K		54	4	1	5		2						15		2	10	2												12	2		Y	Y					86	(Note 4) 1.65 to 3.6	-40 to 85	TFBGA113 (6 x 6 mm)		
TMPM376FDDFG			80		4		1								22		8						Y	2			2		16			Y	Y	Y	Y	Y	82	4.5 to 5.5	QFP100 (14 x 20 mm)					
TMPM376FDFG			80		4		1								22		8						Y	2			2		16			Y	Y	Y	Y	Y	82		LQFP100 (14 x 14 mm)					
TMPM366FDFG			64K		48	4	3	2	1	2			1			12		10													10	2		Y						74		-40 to 85	TFBGA109 (9 x 9 mm)	
TMPM366FDXBG					48	4	3	2	1	2			1				12		10												10	2		Y						74			LQFP100 (14 x 14 mm)	
TMPM367FDFG **			512K		80	32	3	4	2	3			1			8		2	8					1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y	Y	Y	60		(Note 2) 2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)
TMPM367FDXBG **	80	32			3	4	2	3			1				8		2	8					1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y	Y	60	TFBGA109 (9 x 9 mm)					
TMPM368FDFG **	128K				80	32	3	4	2	3	1		1	1		8		2	8					1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y	Y	60	LQFP100 (14 x 14 mm)				
TMPM368FDXBG **					80	32	3	4	2	3	1		1	1			8		2	8					1		(Note 1) 1		4	1		14	4	1	Y	Y	Y	Y	Y	60	TFBGA109 (9 x 9 mm)			
TMPM369FDFG					80	32	3	4	2	3	1		1	1	1		16		2	8						1		(Note 1) 2		4	2		16	4	1	Y	Y	Y	Y	Y	102			LQFP144 (20 x 20 mm)
TMPM369FDXBG **					80	32	3	4	2	3	1		1	1	1		16		2	8						1		(Note 1) 2		4	2		16	4	1	Y	Y	Y	Y	Y	102			TFBGA177 (11 x 11 mm)
TMPM380FDFG **	32K		40	2	2	5		2						18		8						1		(Note 1) 2		3	2		16	1	Y	Y	Y	Y	Y	Y	84	4.0 to 5.5	-40 to 85	LQFP100 (14 x 14 mm)				
TMPM384FDFG **			40	2	2	5		2							22		12						1		(Note 1) 2		4	2		16	1	Y	Y	Y	Y	Y	Y			121	LQFP144 (20 x 20 mm)			
TMPM361F10FG	1024K	64K	64	2	1	5		1	3					8			16					1	1						10	4	1	Y	Y						76	2.7 to 3.6	-20 to 85	LQFP100 (14 x 14 mm)		
TMPM362F10FG			64	2	1	12		5							16		16						1	2					16	4	1	Y	Y						120			LQFP144 (20 x 20 mm)		
TMPM363F10FG			(Note 3) 64	2	1	5		1	3	1		1				8		16						1	1					8	4	1	Y	Y						74	(Note 2) 2.7 to 3.6	-40 to 85	LQFP100 (14 x 14 mm)	
TMPM364F10FG			(Note 3) 64	2	1	12		5	1		1					16		16						1	2					14	4	1	Y	Y						118	LQFP144 (20 x 20 mm)			

Note 1) The same logic is shared between the 3-Phase PWM Generator (PMD) and the Multi-Purpose Timer (MPT).

Note 2) 3.0 to 3.45 V when USB is used.

Note 3) Limited to 48 MHz when the USB Embedded Host is used.

Note 4) When the supply voltage is less than 2.7 V, part of the peripheral blocks (the external bus interface and the SSP) can be used.

- The letter "Y" in the above table means "available."

- All products on this page incorporate a watchdog timer, a clock gear and an on-chip debug unit.

- Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

\*\* : Under development

## TX03 Series

### ROM-Less Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	DRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (Ch)	USB Embedded Host (High-Speed) (ch)	SD Host Controller (Ch)	SSP (SPI/MicroWire) (ch)	UART(ch)	I <sup>2</sup> C(ch)	10-Bit AD Converter (Ch)	16-Bit Timer/Counter (Ch)	External Interrupt Pins (Pins)	Watchdog Timer	Static Memory Controller (Ch)	On-Chip Debug Unit	Trace Function	I/O Port (Pins)	Supply Voltage (V)	Operating Temperature (°C)	Package
<b>TMPM320C1DFG</b>	NA	320K	1024K	144	8	1	1	4	4	2	4	8	4	Y	2	Y	Y	55	(Note 1)	-40 to 85	LQFP144 (20 x 20 mm)

Note 1) The following three power supplies are available:  
 (1) For general port, AD converter: 3.0 V to 3.6 V  
 (2) For USB Embedded Host: 3.15 V to 3.45 V  
 (3) For internal circuitry: 1.1 V to 1.3 V

· The letter "Y" in the above table means "available."

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## 32-Bit Microcontrollers for Automotive

## TX03 Series

### Flash Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	CAN(ch)	DMA Controller (Ch)	SEI (ch)	UART/SIO(ch)	12-Bit AD Converter (Ch)	Timer/Compare (32 bit) (Ch)	Timer/Capture (32 bit) (Ch)	PWM(24bit)	Vector Engine (VE)	3-Phase PWM Generator (PMD) (Ch)	Resolver/Digital Converter (RDC)	External Interrupt Pins (Pins)	Watchdog Timer	On-Chip Debug Unit	Trace Function	I/O Port (Pins)	Supply Voltage (V)	Operating Temperature (°C)	Package
<b>TMPM350FDTFG **</b>	512K	48K	88	2	32	1	2	20	7	1	6		1		(Note1) 1	Y	Y	Y	43	(Note 2)	-40 to 105	LQFP100 (14 x 14 mm)
<b>TMPM354F10TAFG **</b>	1024K	64K	96	3	64	2	3	21	5	2	4	Y	1	1	(Note) 1	Y	Y	Y	56	(Note 3)	-40 to 125	HQFP144 (20 x 20 mm)

Note 1) The seven capture inputs of the timer can be programmed as external maskable interrupts.

Note 2) The following two power supplies are available:

(1) For internal circuitry: 1.4 V to 1.65 V

(2) For general port & AD converter: 4.5 V to 5.5 V

Note 3) The following two power supplies are available:

(1) For internal circuitry: 1.35 V to 1.65 V

(2) For general port & AD converter: 4.5 V to 5.5 V

· The letter "Y" in the above table means "available."

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**Toshiba America****Electronic Components, Inc.**

- Irvine, Headquarters  
Tel: (949)623-2900 Fax: (949)474-1330
- Buffalo Grove (Chicago)  
Tel: (847)484-2400 Fax: (847)541-7287
- Duluth/Atlanta  
Tel: (770)931-3363 Fax: (770)931-7602
- El Paso  
Tel: (915)771-8156
- Marlborough  
Tel: (508)481-0034 Fax: (508)481-8828  
Tel: (508)303-5041 Fax: (508)481-8890
- Parsippany  
Tel: (973)541-4715 Fax: (973)541-4716
- San Jose  
Tel: (408)526-2400 Fax: (408)526-2410
- Wixom (Detroit)  
Tel: (248)347-2607 Fax: (248)347-2602

**Toshiba Electronics do Brasil Ltda.**

Tel: (011)2539-6681 Fax: (011)2539-6675

**Toshiba India Private Ltd.**

- New Deli Office  
Tel: (0124)499-6600 Fax: (0124)499-6611
- Bangalore Office  
Tel: (080)251-90800 Fax: (080)490-91945

**Toshiba Electronics Europe GmbH**

- Düsseldorf Head Office  
Tel: (0211)5296-0 Fax: (0211)5296-400
- France Branch  
Tel: (1)47282181
- Italy Branch  
Tel: (039)68701 Fax: (039)6870205
- Munich Office  
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- Spain Branch  
Tel: (91)660-6798 Fax: (91)660-6799
- Sweden Branch  
Tel: (08)704-0900 Fax: (08)80-8459
- U.K. Branch  
Tel: (0870)060-2370 Fax: (01252)53-0250

**Toshiba Vietnam Consumer Products Co.,Ltd.**

Tel: (043)776-5950 Fax: (043)776-5956

**Toshiba Electronics Asia (Singapore) Pte. Ltd.**

Tel: (6278)5252 Fax: (6271)5155

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Tel: (02)501-1634 Fax: (02)501-1638

**Toshiba Electronics Trading (Malaysia)Sdn. Bhd.**

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**Toshiba Electronics (Shanghai) Co., Ltd.**

- Shanghai Head Office  
Tel: (021)6139-3888 Fax: (021)6190-8288
- Beijing Branch  
Tel: (010)6590-8796 Fax: (010)6590-8791
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Tel: (532)8579-3328 Fax: (532)8579-3329
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Tel: (0755)2399-6897 Fax: (0755)2399-5573

**Toshiba Electronics Asia, Ltd.**

Tel: 2375-6111 Fax: 2375-0969

**Toshiba Electronics (Dalian) Co., Ltd.**

Tel: (0411)8368-6882 Fax: (0411)8369-0822

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Tel: (0592)226-1398 Fax: (0592)226-1399

**Toshiba Electronics Korea Corporation**

Tel: (02)3484-4334 Fax: (02)3484-4302

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Tel: (02)2508-9988 Fax: (02)2508-9999

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