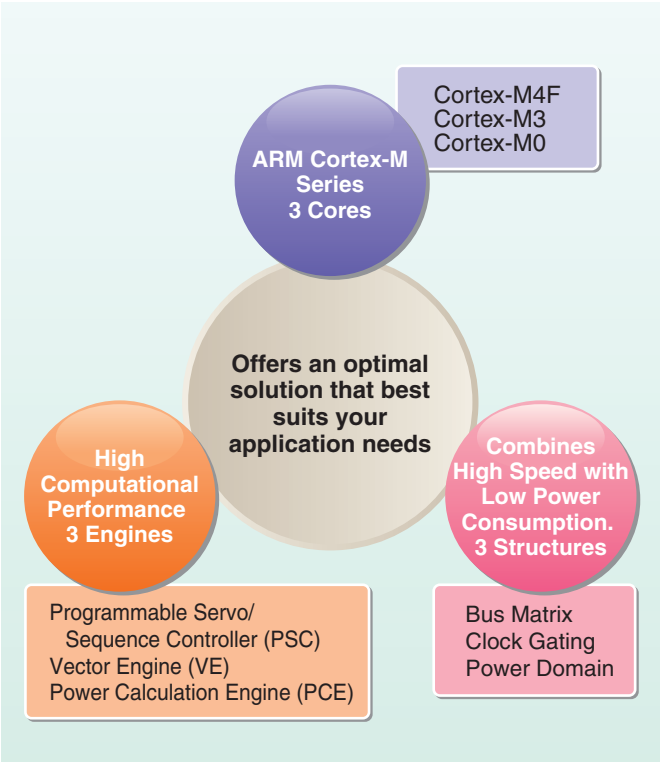
ARM Core-Based Microcontrollers

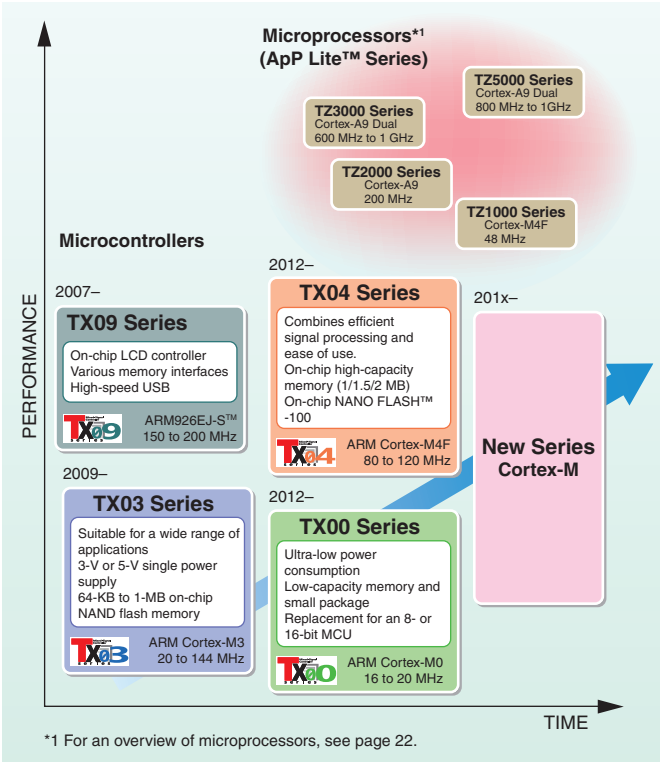
ARM® Core-Based Microcontrollers Proven in the Global Market

Microcontrollers with an ARM core are becoming increasingly popular not only for cell phone applications but also for general-purpose applications.
In addition to its TX03 series with ARM® Cortex®-M3 core, Toshiba now offers new product lineups-the TX00 series, which incorporates an ARM Cortex-M0 core and the TX04 series, which incorporates an ARM Cortex-M4F core. Based on the CPU core manufactured by ARM Ltd., the product groups are mixed signal controllers that combine a broad spectrum of peripheral IPs fully utilizing analog technology unique to Toshiba.

TX00, TX03 and TX04 Microcontrollers Series

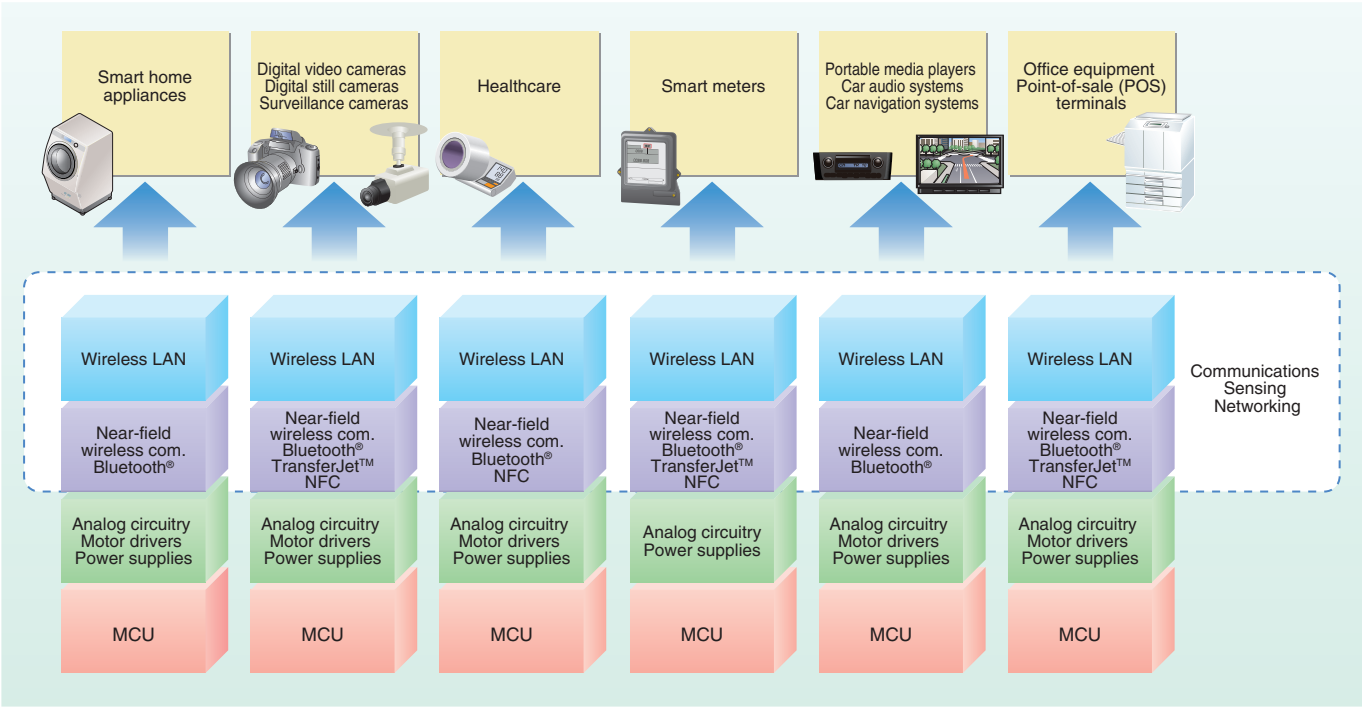


Roadmap for ARM Core-Based Products



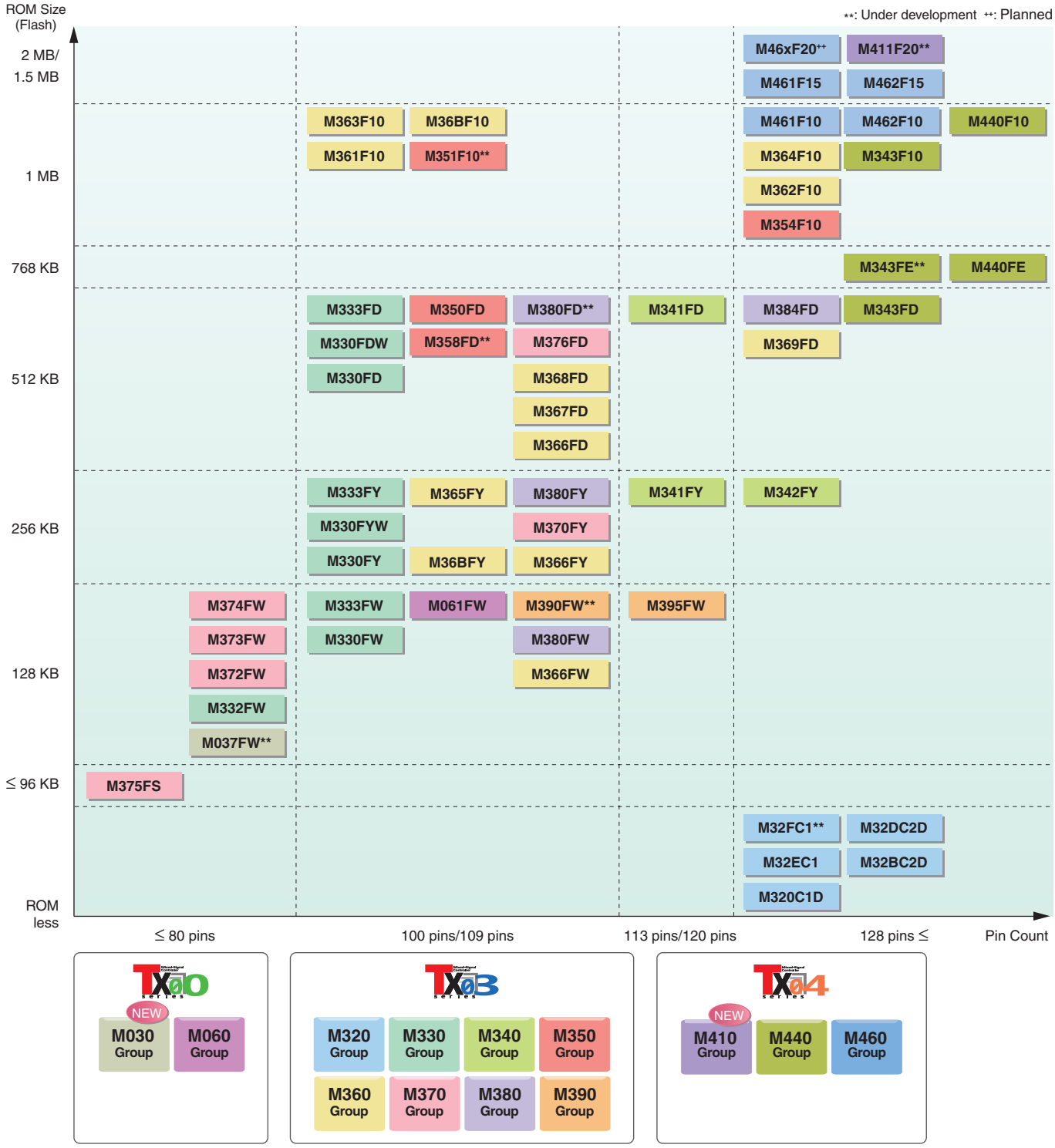
*1 For an overview of microprocessors, see page 22.

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



This catalog contains the latest information available as of September 01, 2014.

ARM Cortex-M0/M3/M4F Core-Based Microcontroller Lineup



CONTENTS

Note

- System block diagrams in this brochure only show the typical application examples.
- NANO FLASH is a trademark of Toshiba Corporation.
- ApP Lite is a trademark of Toshiba Corporation.
- ARM, Cortex, Thumb, Keil and ARM926EJ-S are registered trademarks of ARM Limited (or its subsidiaries) in the EU and/or elsewhere.
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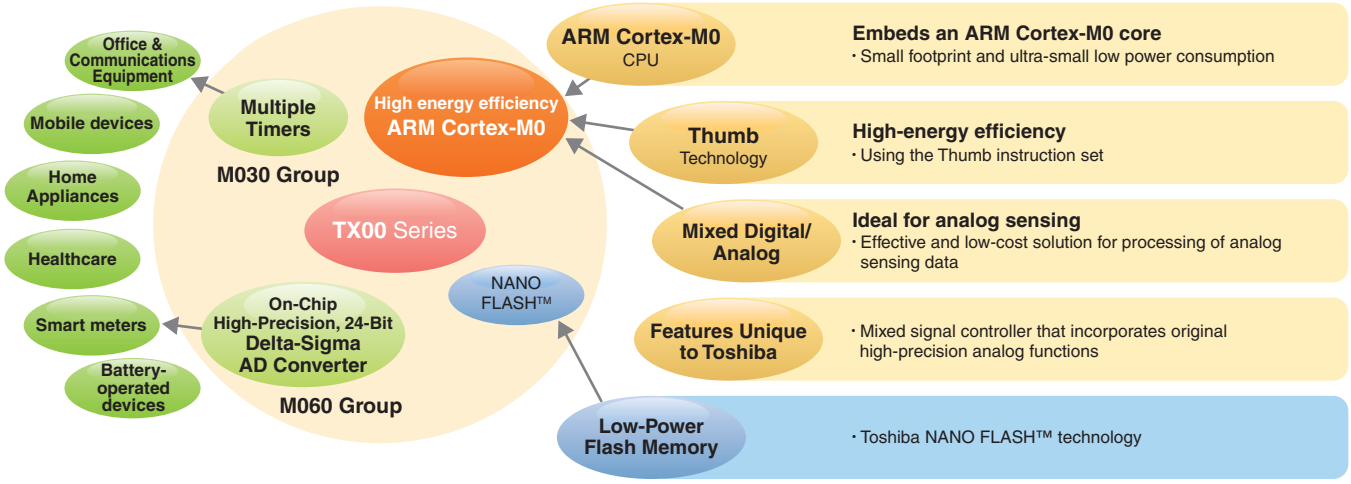
TX00 Series

Features of the TX00 Series

The ARM Cortex-M0 core-based TX00 Series supports the Thumb® instruction set and delivers high energy efficiency. Additionally, the TX00 Series incorporates Toshiba's original high-precision analog functions. It is ideal for healthcare, energy measurement and portable applications.



Features of Product Groups NEW

	M030 Group	M060 Group
Power calculation engine (PCE)		●
AD converter	● (SAR)	● (ΔΣ,SAR)
LCD driver		●
Timer	●	●
Serial interface	●	●

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

M030 Group NEW

・Features
On-chip low-capacity flash memory and SRAM
Simple and high-performance base product
・Application examples
Printers, home appliances, digital appliances, industrial equipment.

M060 Group

・Features
On-chip power calculation engine (PCE)
On-chip 24-bit delta-sigma AD converter
・Application examples
Smart meters, In-system power monitoring, healthcare devices, HEMS appliances, measuring instruments

TX00 Series M030 Group NEW

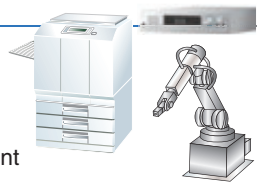
- Incorporates ARM Cortex-M0 core, and low-capacity flash memory and SRAM
- Simple and high performance

Features

- High-efficiency operation, low-capacity memory and low pin count
- Enhanced timer functions

Applications

- Printers
- Home appliances
- Digital appliances
- Industrial equipment



Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM037FWUG**	128 KB	16 KB	LQFP64 (10 x 10 mm)	High-performance ARM Cortex-M0 core with a clock rate of up to 20 MHz Low-capacity memory: 128-KB flash, 16-KB SRAM Timer: Easy to use for motor control

**: Under development

TX00 Series M060 Group

The TMPM061FWFG 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.

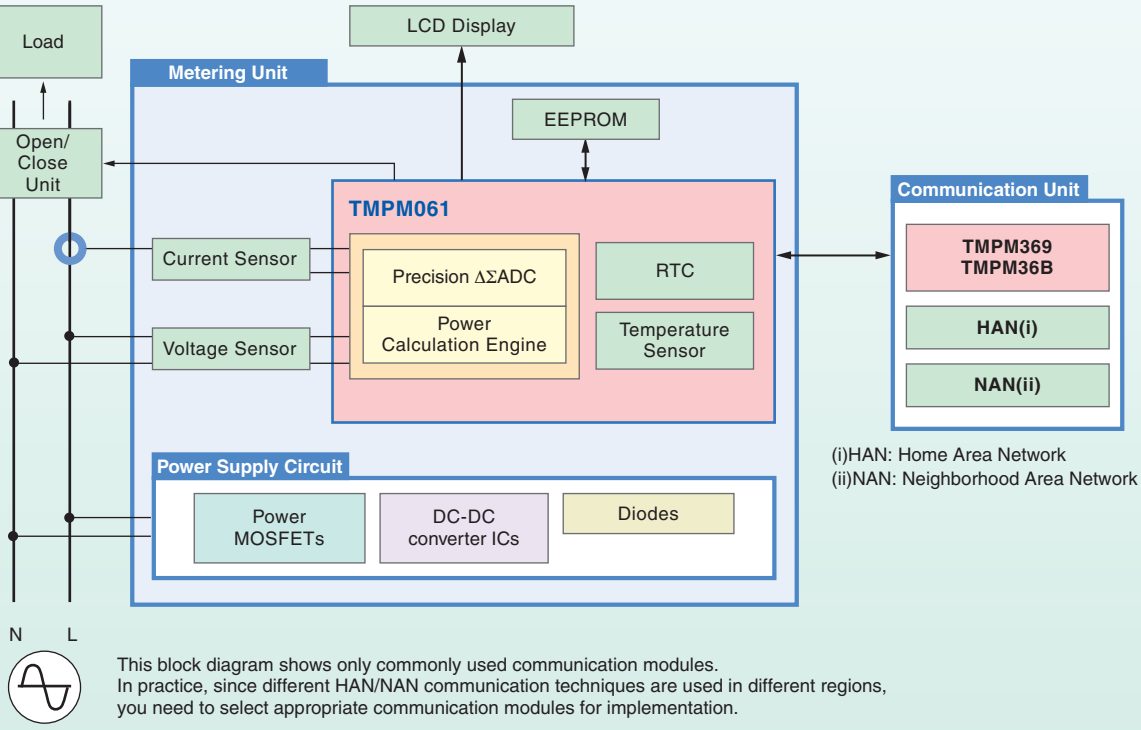
Features

- 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
- Monitoring of power inside equipment
- Healthcare products
- HEMS equipment
- Measuring instruments

System Block Diagram (Smart meters)



(i)HAN: Home Area Network
(ii)NAN: Neighborhood Area Network

This block diagram shows only commonly used communication modules.
In practice, since different HAN/NAN communication techniques are used in different regions, you need to select appropriate communication modules for implementation.

Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM061FWFG	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

Evaluation Kit

IAR Starter Kit for TMPM061

- Included hardware:
  TMPM061 evaluation board
  IAR J-Link Lite
  USB cable
  IAR Embedded Workbench for ARM KickStart edition

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.

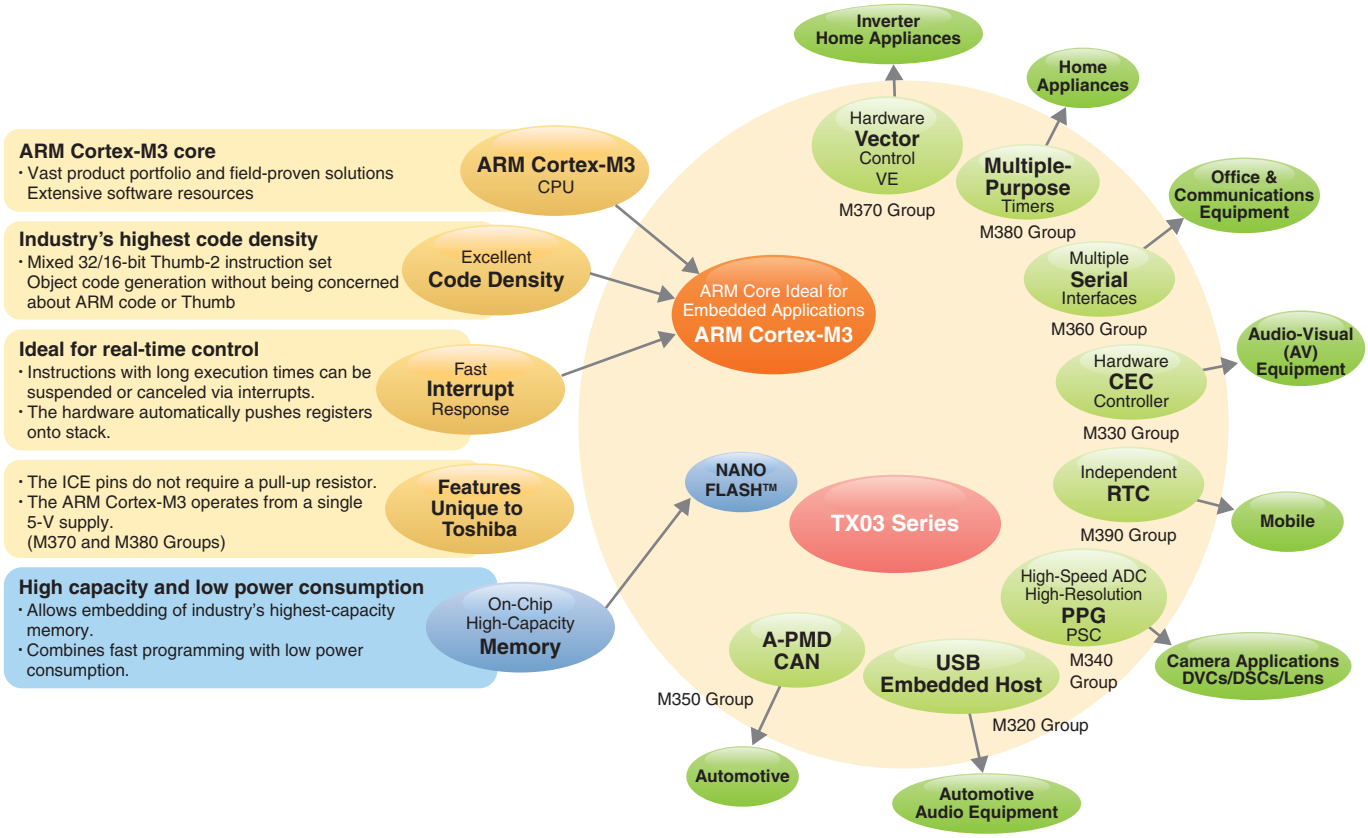
ARM Cortex-M3 core
- Vast product portfolio and field-proven solutions
- Extensive software resources

Industry's highest code density
- Mixed 32/16-bit Thumb-2 instruction set
- Object code generation without being concerned about ARM code or Thumb

Ideal for real-time control
- Instructions with long execution times can be suspended or canceled via interrupts.
- The hardware automatically pushes registers onto stack.

- The ICE pins do not require a pull-up resistor.
- The ARM Cortex-M3 operates from a single 5-V supply. (M370 and M380 Groups)

High capacity and low power consumption
- Allows embedding of industry's highest-capacity memory.
- Combines fast programming with low power consumption.



Features of Product Groups

	M320 Group	M330 Group	M340 Group	M350 Group	M360 Group	M370 Group	M380 Group	M390 Group
Programmable motor driver				●	●	●	●	
Vector Engine (VE)				●		●		
PSC (i)			●					
Op amp/Comparator			●			●		
CEC (ii)		●			●			●
Remote control preprocessor		●			●		●	●
I²S (Inter-IC Sound)	●							
USB	●				●			
EtherMAC					●			
CAN	●			●	●			
High-resolution PPG			●					
Multi-purpose timer					●		●	
External bus interface	●		●		●			
Oscillation frequency detector (OFD)			●		●	●	●	●
ΔΣ AD converter			●					

(i)PSC: Programmable Servo/Sequence Controller
(ii)CEC: Consumer Electronic Control
There are microcontrollers that do not contain some of the peripherals shown. For details, see appropriate datasheets.

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

M320 Group — USB Embedded Host

- Features
  USB Embedded Host
  System solutions that combine a MCU and an audio DSP
- Application examples
  Car and home audio systems

M330 Group — Power-saving modes CEC controller

- Features
  Dedicated controller compliant with HDMI 1.3a (CEC)
  Remote control signal preprocessor essential for digital consumer electronics
- Application examples
  Digital TVs, projectors, Blu-ray recorders, AV systems, printers, home appliances, factory equipment, office equipment

M340 Group — High-resolution PPG

- Features
  High-accuracy analog control interface
  Small package (6 x 6 mm TFBGA113)
  High-resolution PPG ideal for motor control
- Application examples
  DVCs, DSLR cameras, camera lens controllers

M360 Group — Multiple serial interfaces

- Features
  Large-capacity Flash memory
  Up to 7 communication interfaces
  (SIO, I²C, SPI, UART, CAN, USB, EtherMAC)
  Programmable Motor Driver (PMD)
  Multi-purpose timer capable of IGBT control
  Small package (9 x 9 mm TFBGA109)
- Application examples
  Printers, AV systems, digital appliances, PC peripherals, industrial equipment, networking equipment, office equipment

M390 Group — 1.8-V operation

- Features
  Power-saving modes for 1.8-V operation
  High-speed on-chip oscillator
  Small package (6 x 6 mm TFBGA120)
- Application examples
  Power supply monitors, battery-operated devices, remote-controlled equipment, game consoles, AV systems

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

M370 Group — On-chip vector engine

- 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 (SSOP30)
- Application examples
  Washing machines, air conditioners, refrigerators, heat pumps, inverter-motor-controlled equipment

M380 Group — Multi-purpose timers for IGBT control

- 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
- Application examples
  Air conditioners, refrigerators, electric oven-grills, rice cookers, induction cooktops

Note 1: There are microcontrollers that do not contain some of the peripherals shown. For details, see appropriate datasheets.

Automotive Applications

M350 Group — Automotive Applications

M350

- Features
  Programmable Motor Driver (PMD), CAN controllers, timers, 12-bit AD converter, crossbar switches, functional safety capabilities and 5-V I/Os
- Application examples
  Electric power steering (EPS) systems and other automotive applications

M354

- 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
- Application examples
  HEV, EV and other automotive applications

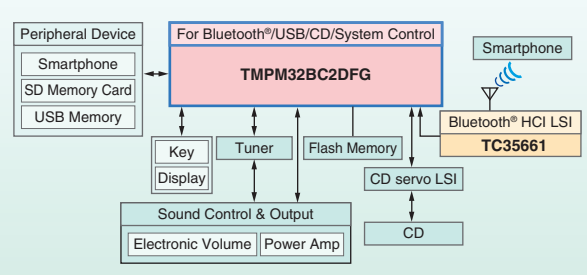
TX03 Series M320 Group (for Audio Applications)

The TMPM32BC2DFG in the M320 Group is a microcontroller that can easily implement Bluetooth® audio, hands-free speech and other functions by combining a Bluetooth® HCI LSI (TC35661), in addition to control various conventional audio systems. The DSP provided in this microcontroller processes various signals of a high workload, to lessen the CPU workload.

Features (TMPM32BC2DFG)

- High-performance ARM Cortex-M3 core: 96-MHz operation (max)
- DSP incorporated, and 144 MHz operation (max)
- Asynchronous sampling rate converter
- PCM interface
- USB Embedded Host (Full-Speed)
- SD host controller
- Serial flash interface
- Power-saving mode by cutting off internal power supply

System Block Diagram (Car Audio System)



Applications

- Car audio
- Home audio

Audio Features

- Audio replay by Bluetooth® connection
- Hands-free speech (Echo canceling (EC) and noise reduction (NR) processing)
- Audio replay from USB memory or SD card (Various audio decoding modes by decompression)
- Compatible with CDDA and CD-MP3 (In combination with CD servo LSI)

Product Lineup

Part Number	ROM Size	RAM Size	Package	Features
TMPM32BC2DFG	–	2560 KB	LQFP176 (20 × 20 mm)	Bluetooth® HCI Control, DSP incorporated, PCM interface, USB Embedded Host (Full-Speed)
TMPM32DC2DFG				Bluetooth® HCI Control, DSP incorporated, PCM interface, USB Embedded Host (Full-Speed), CAN
TMPM32EC1EFG	–	1664 KB	LQFP144 (20 × 20 mm)	DSP incorporated, PCM interface, USB Embedded Host (Full-Speed)
TMPM32FC1EFG **				DSP incorporated, PCM interface, USB Embedded Host (Full-Speed), CAN

**: Under development

TX03 Series M350 Group (for Automotive Applications)

The TMPM350FDTFG and TMPM351F10TFG microcontrollers of the M350 Group are pin-compatible and specifically designed for automotive applications.The TMPM350FDTFG/TMPM351F10TFG provides various peripheral functions, such as CAN controllers and AD converters, as well as a Toshiba-original Programmable Motor Driver (PMD). Additionally, the TMPM350FDTFG/TMPM351F10TFG offers functional safety features.
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.

Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM350FDTFG	512 KB	48 KB	LQFP100 (14 x 14 mm)	• ARM Cortex-M3 plus Toshiba-original Programmable Motor Driver (PMD) • 2-channel CAN controller and 2 units of AD Converter • Functional safety: Optimized tightly coupled fault supervisors • 88-MHz operation (max), and high temperature operation (Ta: up to 105˚C max) • 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).
TMPM351F10TFG **	1 MB	64 KB	LQFP100 (14 x 14 mm)	• ARM Cortex-M3 plus Toshiba-original Advanced Programmable Motor Driver (A-PMD) • 2-channel CAN controller and 2 units of AD Converter • Functional safety: Optimized tightly coupled fault supervisors • 144-MHz operation (max), and high temperature operation (Ta: up to 125˚C max) • The CAN controllers and the blocks that implement functional safety contain logic specifically designed for automotive applications, making the TMPM351F10TFG suitable for motor applications in safety-related systems such as electronic power steering (EPS).
TMPM354F10TAFG	1 MB	64 KB	HQFP144 (20 x 20 mm)	• ARM Cortex-M3 plus Toshiba-original Advanced Programmable Motor Driver (A-PMD) • 3-channel CAN controller and 4 units of AD Converter • Vector engine • Functional safety: Optimized tightly coupled fault supervisors • Reduced part count and improved noise immunity due to Toshiba-original RDC • 96-MHz operation (max), and high temperature operation (Ta: up to 125˚C max) • Ideal for motor control applications in HEVs and EVs owing to enhanced motor controllers, angle sensor computation, in-vehicle networking, etc.
TMPM358FDTFG **	512 KB	80 KB	LQFP100 (14 x 14 mm)	• A sleep mode is provided in ARM Cortex-M3 allowing RAM backup (16 KB) • 3-channel CAN controller and 2 units of AD Converter, 80-KB RAM including a backup RAM for 16 KB • Functional safety: Optimized tightly coupled fault supervisors • 40-MHz operation (max), and high temperature operation (Ta: up to 105˚C max) • The CAN controllers and the blocks that implement functional safety contain logic specifically designed for automotive applications, making the TMPM358FDTFG suitable for control applications such as battery power monitoring.

**: 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.

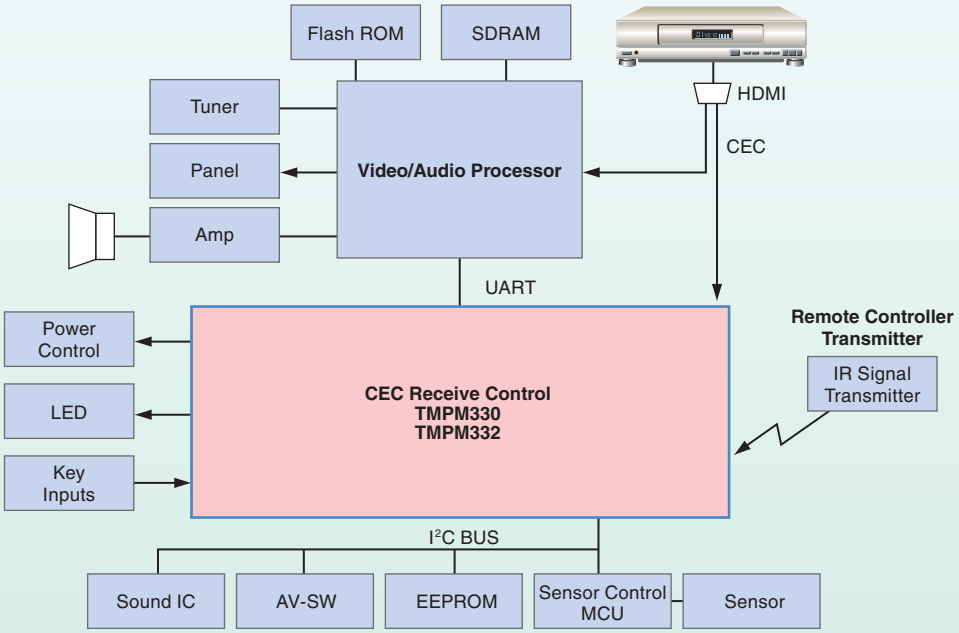
Features

- 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)	
TMPM330FDFG	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)	
TMPM333FDFG	512 KB	32 KB	LQFP100 (14 x 14 mm)	

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

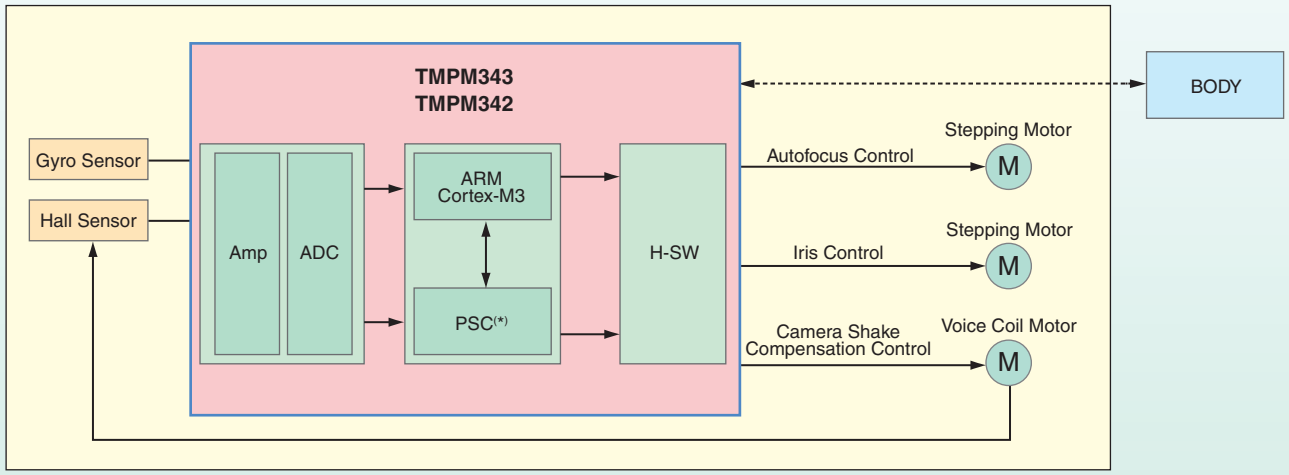
Features

- High-performance ARM Cortex-M3 core: 54-MHz operation (max)
- Zero-wait flash memory with a capacity of up to 1 MB
- Up to 4 programmable servo/sequence controller (PSC) units
  (Suitable for servo computation, motor control and communication sequencing for camera shake compensation)
- High-resolution PPG (programmable phase difference of up to ± 90°): 200 MHz (max)
- High-speed, high-accuracy 12-bit AD converter; 10-bit DA converter
- Various timers and serial interfaces
- 2-phase pulse counter
- On-chip sensor amplifier and high-side switch (H-SW) for motor drive (TMPM342, TMPM343)
- Small package

Applications

- Digital video cameras
- Digital still cameras
- Camera lens

System Block Diagram (Camera Lens)



* **The TMPM343** contains four PSC units.
The TMPM342 contains one PSC unit.

Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM341FYXBG	256 KB	32 KB	TFBGA113 (6 x 6 mm)	54-MHz operation (max) 12-bit AD converter (1 μs), 10-bit DA converter High-resolution PPG: 160 MHz (max); ideal for ultrasonic motor control
TMPM341FDXBG	512 KB	32 KB	TFBGA113 (6 x 6 mm)	
TMPM342FYXBG	256 KB	32 KB + 4 KB	VFBGA142 (7 x 7 mm)	40-MHz operation (max) 16-bit delta-sigma AD converter (40 μs) 12-bit AD converter (1 μs), 10-bit DA converter Hall sensor interface, gyro sensor amplifier High-resolution PPG: 160 MHz (max); ideal for ultrasonic motor control 7.5-ch H-SW driver (incl. two microstep units)
TMPM343FDXBG	512 KB	48 KB + 32 KB	VFBGA162 (7 x 7 mm)	50-MHz operation (max) PSC (4 units) 12-bit AD converter, 10-bit DA converter Hall sensor interface, gyro sensor amplifier, magnetic resistance (MR) sensor amplifier 8-ch H-SW driver (including μstep 3 units) Large-capacity ROM (compliant to OS and capable of data holding for a high-magnification lens) High-resolution PPG: 200 MHz (max); ideal for ultrasonic motor control
TMPM343FEXBG**	768 KB	64 KB + 32 KB		
TMPM343F10XBG	1 MB			

**: Under development

Programmable Servo/Sequence Controller (PSC)

The PSC is a coprocessor that is totally independent of the CPU core and has its own instruction set architecture.
The PSC significantly reduces the CPU workload by offloading it from computing and sequencing operations such as CPU-intensive tasks, regularly scheduled computing routines, and unscheduled operations.
Consequently, the PSC makes it possible to reduce the operating frequency of the CPU core (by using a clock gear divider) as well as the overall power consumption of an MCU. The CPU resources can also be allocated to other processes or utilized to add new features.

PSC Application Examples

- Camera shake compensation control and autofocus control
- DC-iris lens control for surveillance cameras
- Motor position and speed control
- Stepping motor control
- Peripheral device control (port, serial communication and other control applications)
- Flexible data transfer

Evaluation Kit

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 KickStart edition

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 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.

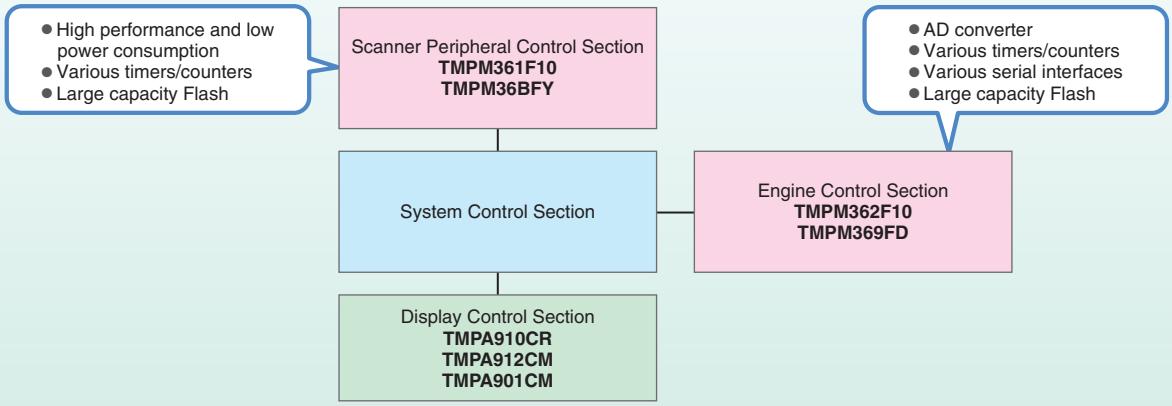
Features

- 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

Applications

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

System Block Diagram (Printer)



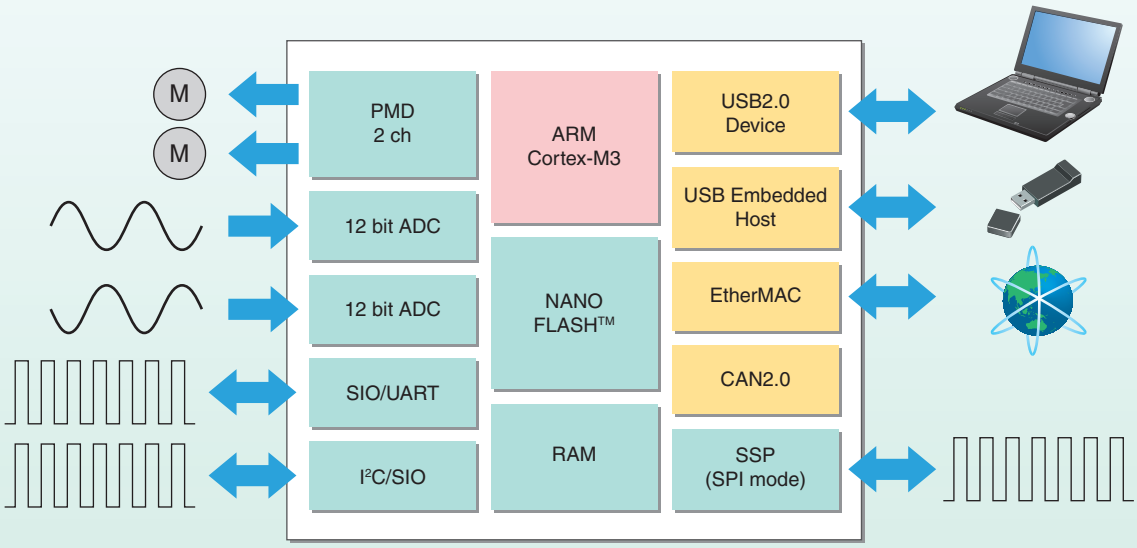
Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Packages	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)	CEC, remote control preprocessor 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,12-bit AD Converter
TMPM366FWFG	128 KB	32 KB	LQFP100(14×14 mm)	USB DMA controller Full UART
TMPM366FYFG/FYXBG	256 KB	48 KB	LQFP100 (14 x 14 mm) TFBGA109 (9 x 9 mm)	
TMPM366FDFG/FDXBG	512 KB	64 KB		
TMPM367FDFG/FDXBG	512 KB	128 KB	LQFP100 (14 x 14 mm) TFBGA109 (9 x 9 mm)	USB Dual AD converter 3-Phase PWM generator (PMD)
TMPM368FDFG/FDXBG	512 KB	128 KB	LQFP100 (14 x 14 mm) TFBGA109 (9 x 9 mm)	USB Dual AD converter 3-Phase PWM generator (PMD), CAN
TMPM369FDFG/FDXBG	512 KB	128 KB	LQFP144 (20 x 20 mm) TFBGA177 (11 x 11 mm)	USB, USB Embedded Host, Dual AD converter PMD, CAN, EtherMAC
TMPM36BFYFG	256 KB	66 KB	LQFP100 (14 x 14 mm)	12-bit AD converter Multi-purpose timers for 3-phase PWM and IGBT control
TMPM36BF10FG	1 MB	258 KB		1-MB Flash ROM and 258-KB SRAM 12-bit AD converter Multi-purpose timers for 3-phase PWM and IGBT control

Features of the TMPM369FDFG and TMPM369FDXBG

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

The TMPM369 has various external communication interfaces such as USB, USB Embedded Host, CAN, EtherMAC, SIO/UART, I²C/SIO and SSP (SPI mode). Additionally, the TMPM369 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 TMPM369 provides Flash ROM of up to 512 KB and SRAM of up to 128 KB to facilitate the use of the various communication interfaces.

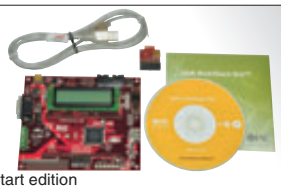


Evaluation Kit

ARM Starter Kit for TMPM362/TMPM364

- Included hardware:
  TMPM362/TMPM364 evaluation board
  ARM® Keil® ULINK-ME™
  USB cables (for tools and USB Embedded Host)
  MDK-ARM (Microcontroller Development Kit) download

IAR Starter Kit for TMPM364



- Included hardware:
  TMPM364-SK evaluation board
  IAR J-Link Lite
  USB cable
  IAR Embedded Workbench for ARM KickStart edition

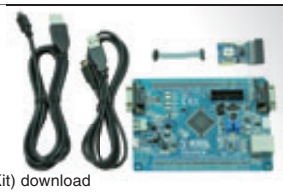
IAR Starter Kit for TMPM365

- Included hardware:
  TMPM365 evaluation board
  IAR J-Link Lite
  USB cable
  IAR Embedded Workbench for ARM KickStart edition

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 KickStart edition

ARM Starter Kit for TMPM369



- Included hardware:
  TMPM369 evaluation board
  ULINK-ME™
  USB cable
  MDK-ARM (Microcontroller Development Kit) download

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 KickStart edition

Kiban Honpo Starter Kit for TMPM36B

- Included hardware:
  TMPM36B evaluation board
  USB cable

TX03 Series M370 Group

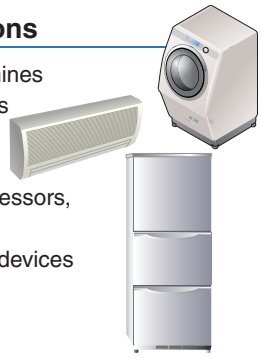
The M370 Group of microcontrollers contain a Vector Engine (VE) that implements the common computation functionality for motor vector control. Additionally, the VE is closely coupled with a three-phase PWM timer and a 12-bit AD converter for motor current sensing. The M370 Group are designed to improve 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

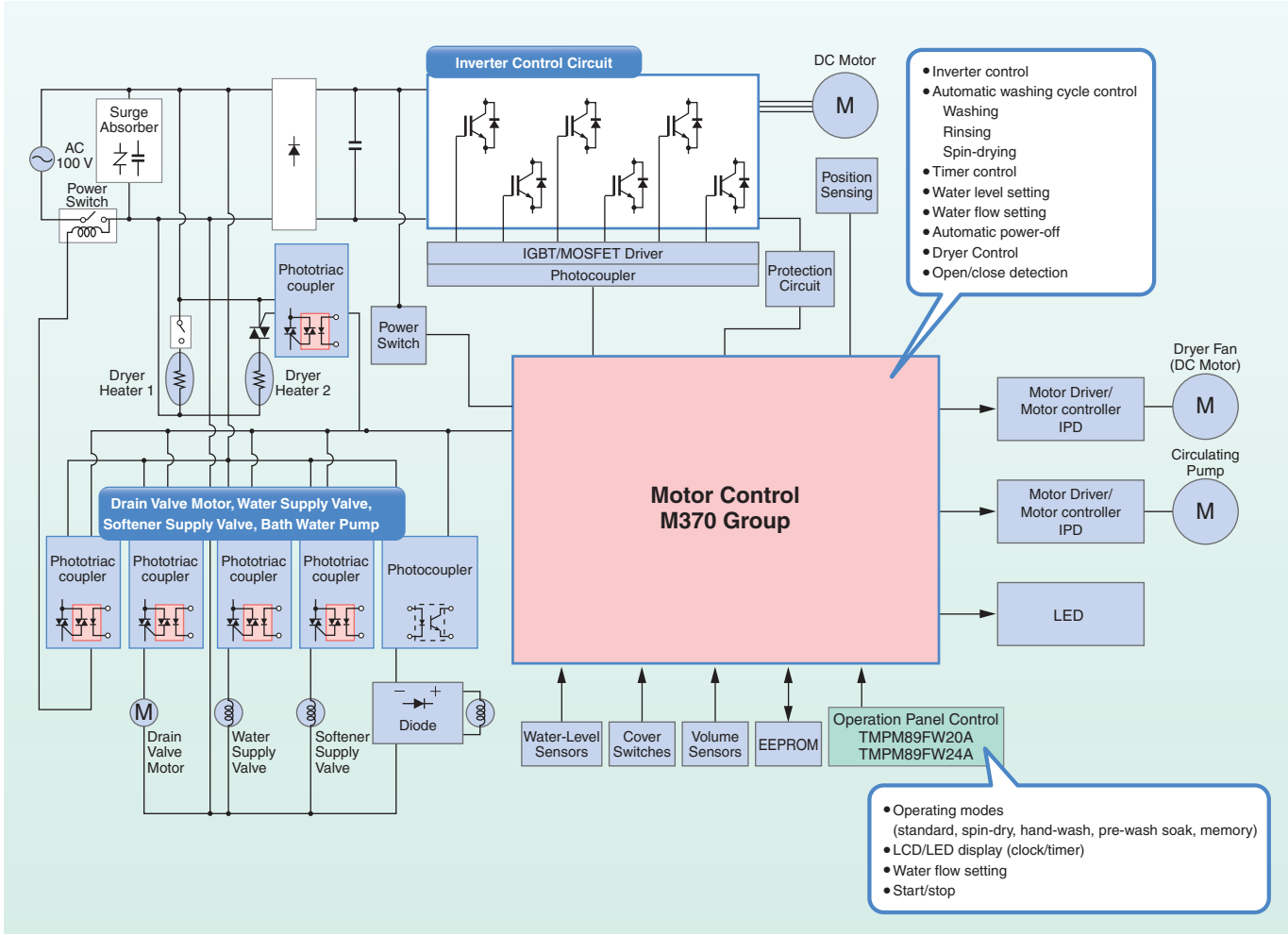
- High-performance ARM Cortex-M3 core: 80-MHz operation (max)
- Toshiba-original NANO FLASH™ memory: Fast programming
- Toshiba-original Vector Engine (VE) that implements part of motor vector control as hardware
- Various analog circuits* (comparators, op amps) * TMPM370 only
- 12-bit AD converter
- Oscillation frequency detection (OFD); compliant with the IEC 60730 standard
- Single 5-V power supply
- Small package (SSOP30) Note: TMPM375FSDMG

Applications

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



System Block Diagram (Washing Machine)



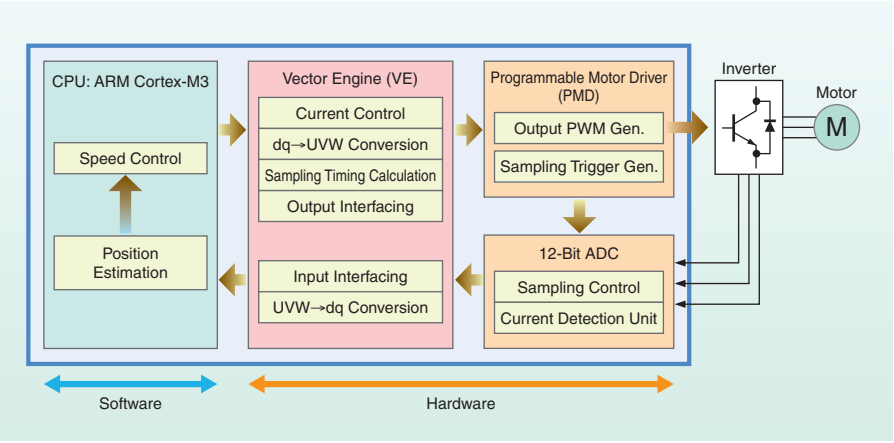
Product Lineup

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)	
TMPM372FWUG	128 KB	6 KB	LQFP64 (10 x 10 mm)	Low-pin-count MCUs for single motor control Ideal for compressor control for refrigerators, etc.
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 (5.6 x 10 mm)	
TMPM376FDFG	512 KB	32 KB	LQFP100 (14 x 14 mm)	Capable of controlling two motors for a wide range of inverter applications.
TMPM376FDDFG	512 KB	32 KB	QFP100 (14 x 20 mm)	

Features of the Vector Engine (VE)

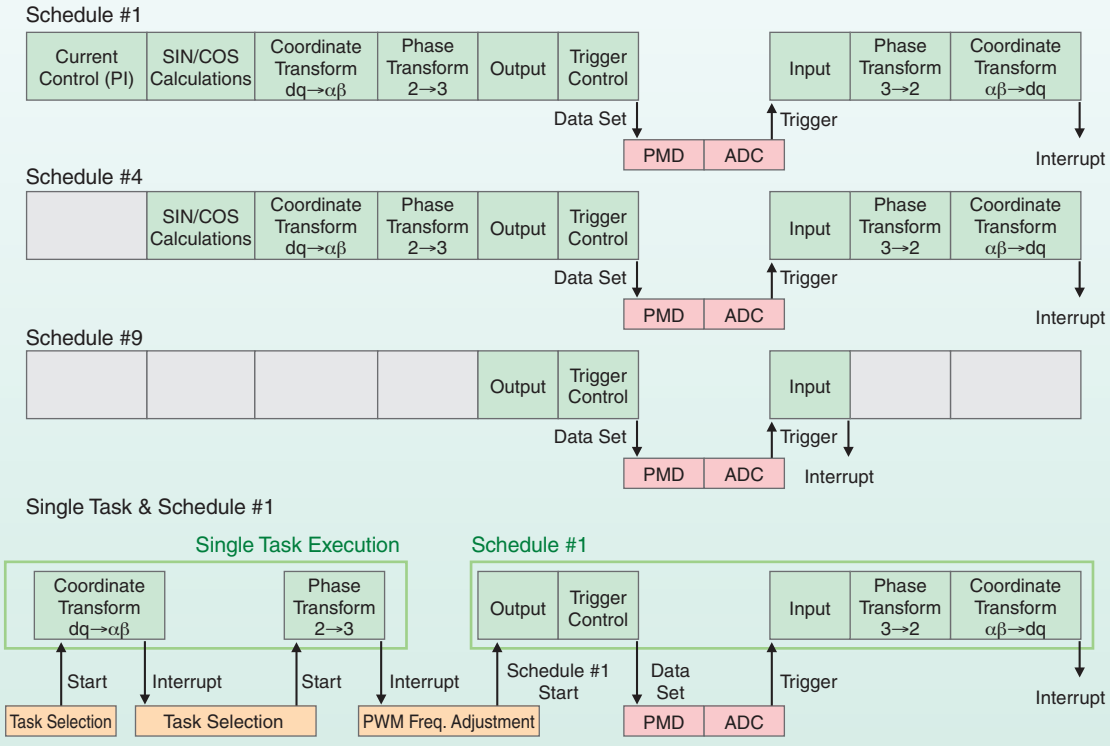
High-efficiency motor control, reducing the CPU workload

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.



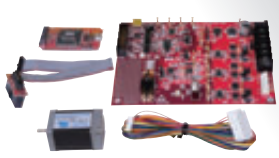
Evaluation Kit

IAR Starter Kit for TMPM370

- Included hardware:
  TMPM370-SK evaluation board
  J-Link for Toshiba Cortex-M3
  USB cable
  IAR Embedded Workbench for ARM KickStart edition

IAR Starter Kit for TMPM375

- Included hardware:
  TMPM375-SK evaluation board
  DC motor, connection cable, I-Jet Lite,
  USB cable, AC adapter
  IAR Embedded Workbench for ARM KickStart edition



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.

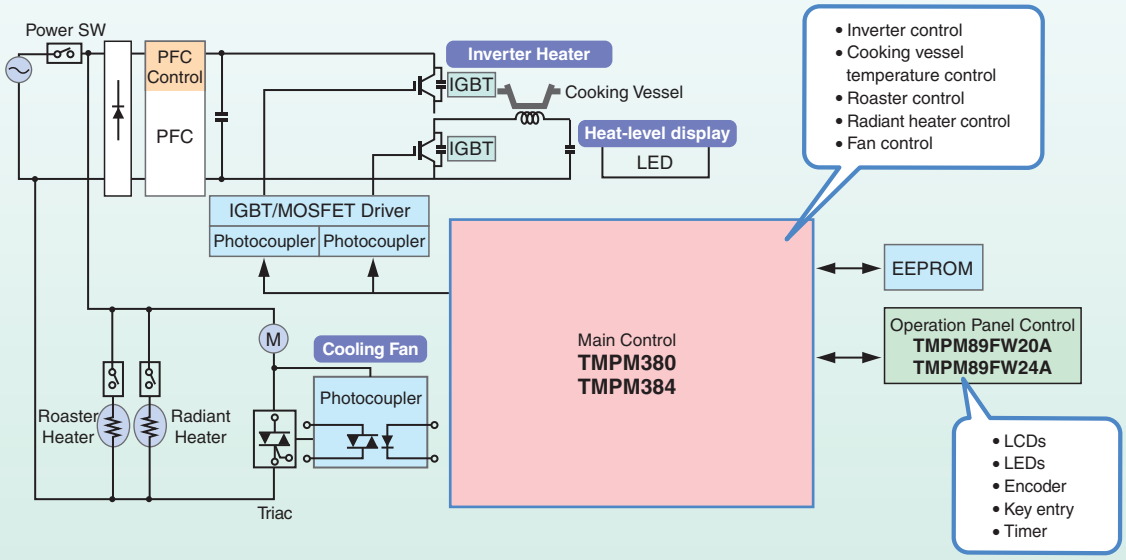
Features

- 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

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

System Block Diagram (Induction Cooktops)



Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM380FDFG **	512 KB	32 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.
TMPM380FWFG	128 KB	12 KB	LQFP100 (14 x 14 mm)	
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)	
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

Evaluation Kit

IAR Starter Kit for TMPM380

- Included hardware:
  TMPM380-SK evaluation board
  J-Link for Toshiba Cortex-M3
  USB cable
  IAR Embedded Workbench for ARM KickStart edition

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.

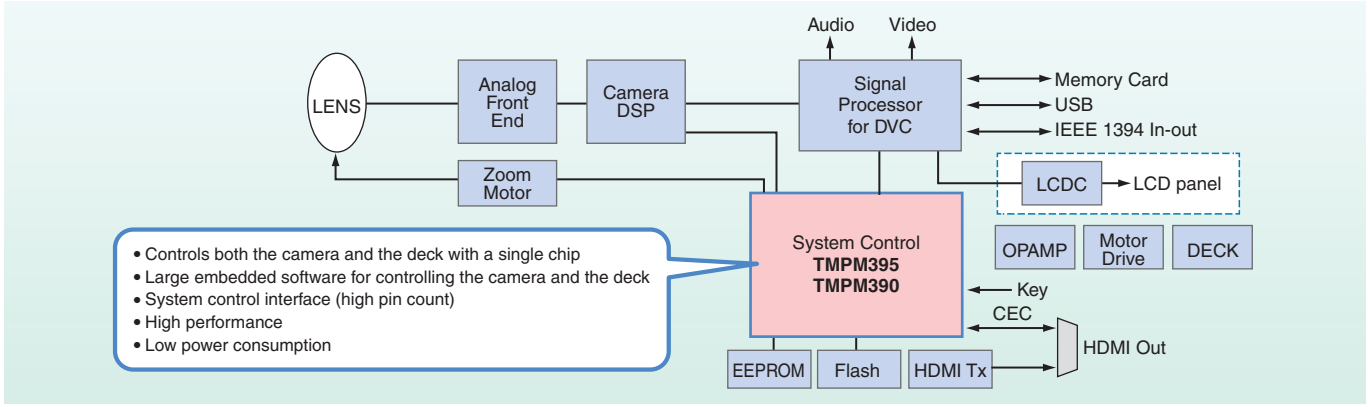
Features

- 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 μA 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 ± 3% @ 0 to 70˚C)
- Oscillation frequency detection (OFD); compliant with the IEC 60730 standard
- Small package (6 x 6 mm TFBGA120)

Applications

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

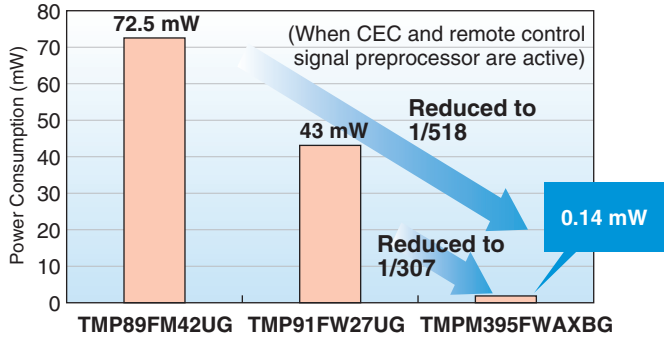
System Block Diagram (Digital Video Camera)



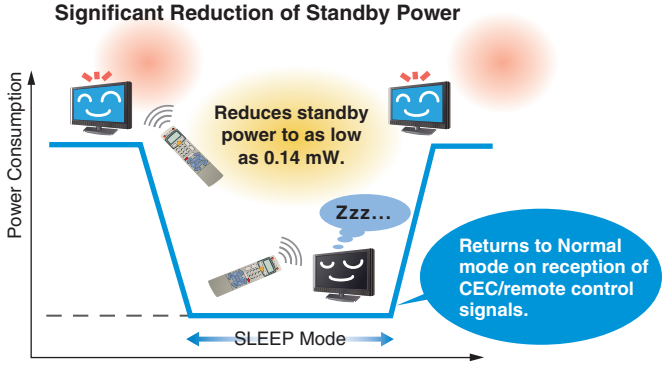
Low-Power MCUs

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
TMPM390FWFG **	128 KB	8 KB	LQFP100 (14 x 14 mm)	1.8-V low-power (RTC) mode (1.3 μA typ.)
TMPM395FWAXBG	128 KB	8 KB	TFBGA120 (6 x 6 mm)	Housed in a small package. 1.8-V low-power (RTC) mode (1.3 μA typ.)

**: Under development

Evaluation Kit

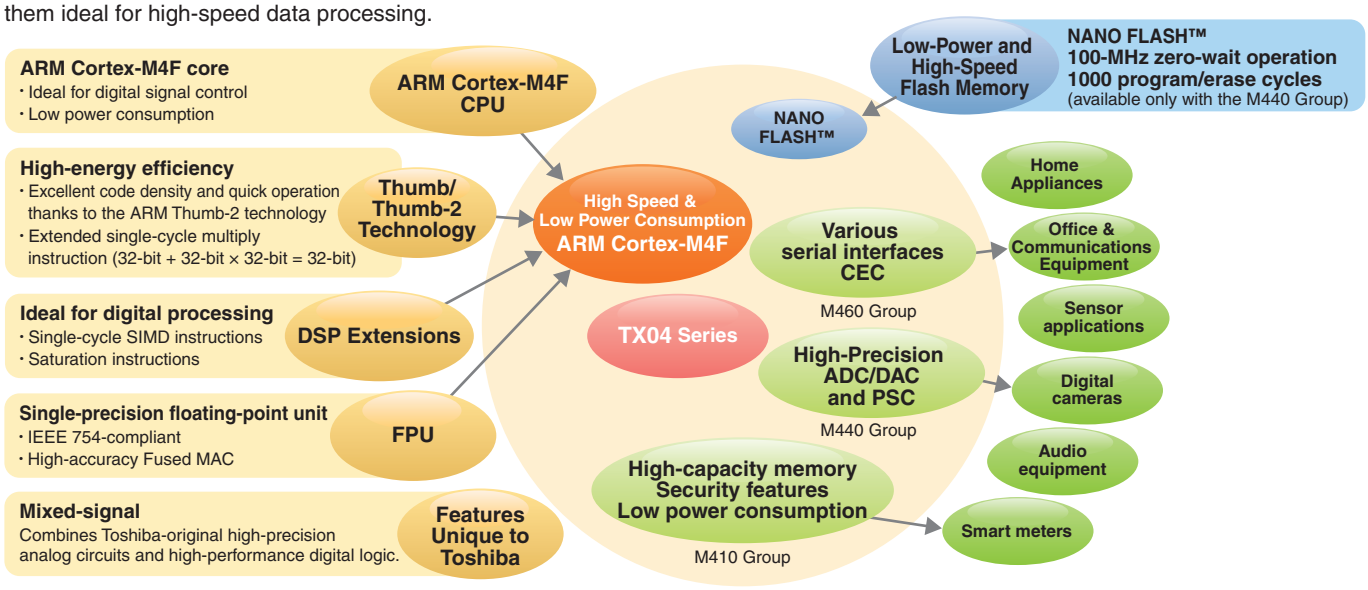
ARM Starter Kit for TMPM395

- Included hardware:
  - TMPM395 evaluation board
  - ULINK-ME™
  - USB cable
  - MDK-ARM (Microcontroller Development Kit) download

TX04 Series

Features of the TX04 Series

The ARM Cortex-M4F 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 includes microcontrollers that also integrate a selection of peripheral circuits such as high-speed NANO FLASH™-100 (440 Group only) and high-performance coprocessors, making them ideal for high-speed data processing.



Features of Product Groups NEW

	M410 Group	M440 Group	M460 Group
PSC(i)		●	
CEC(ii)			●
Remote control preprocessor			●
ESIO		●	
Multi-purpose timer			●
External bus interface		●	●
Oscillation frequency detector (OFD)			●
Security features	●		
LCD driver	●		

(i) PSC: Programmable Servo/Sequence Controller
(ii) CEC: Consumer Electronic Control
There are microcontrollers that do not contain some of the peripherals shown. For details, see appropriate datasheets.

M410 Group NEW

・Features
High-capacity memory, security features, low power consumption
・Application examples
Smart meters, devices with sensing and communication functions (Internet of Things (IoT) devices)

M440 Group

・Features
Programmable servo/sequence controller (PSC)
・Application examples
Digital single-lens reflex camera, digital video camera and other applications

M460 Group

・Features
Large-capacity memory
・Application examples
Printers,AV systems, industrial equipment and other applications

TX04 Series M410 Group NEW

The M410 Group of microcontrollers are ideal for smart metering and communication control applications.

Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM411F20XBG **	2 MB	290 KB	VFBGA193 (14 x 14 mm)	Incorporates two instances of the high-performance ARM Cortex-M4F core with a clock rate of up to 80 MHz High-capacity memory Security features, low power consumption

**: Under development

TX04 Series M440 Group

The M440 Group of microcontrollers are ideal for digital video camera and digital single-lens reflex camera applications. They incorporate analog circuits required for lens and system control. The high-performance ARM Cortex-M4F core provides high-speed computation functionality. Additionally, Toshiba-original coprocessor PSC (Programmable Servo/Sequence Controller) helps to improve system performance and reduce the CPU workload through parallel processing.

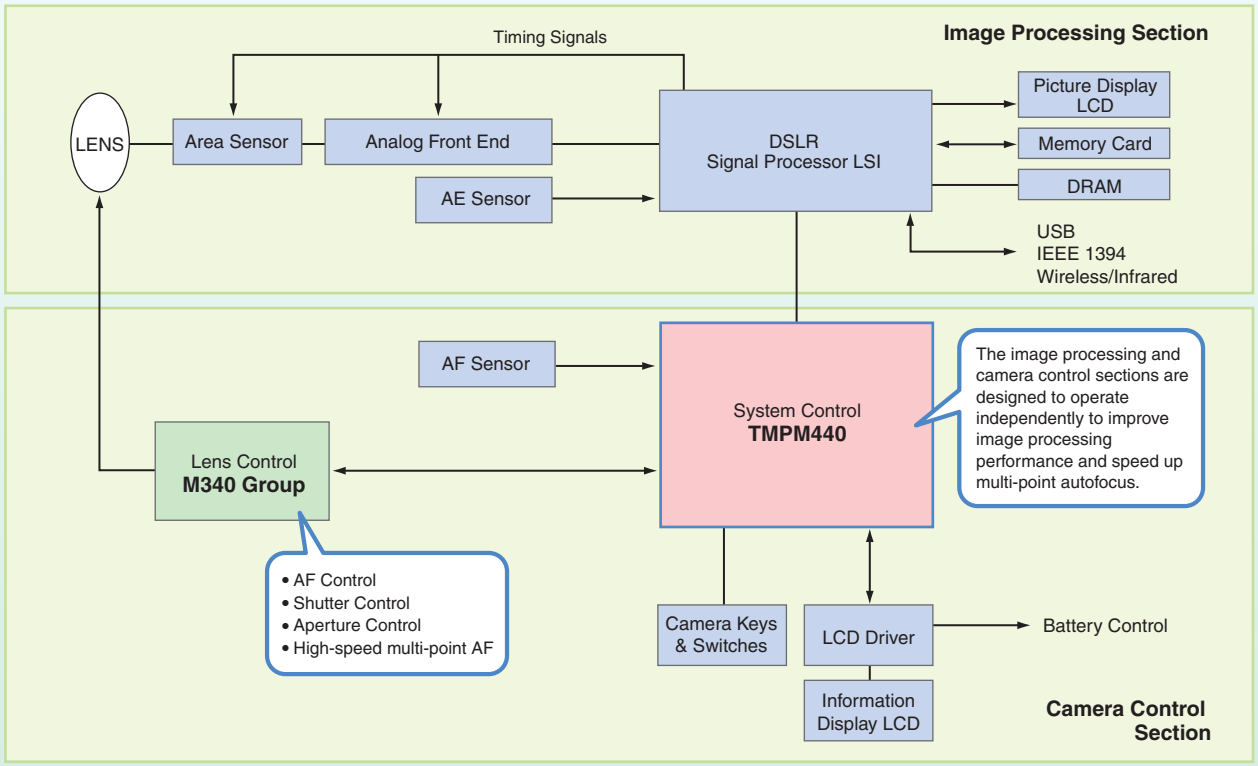
Features

- High-performance ARM Cortex-M4F core: 100-MHz operation (max)
- Improved performance thanks to multiple computing units (MAC, FPU, PSC)
- Toshiba-original NANO FLASH™-100: 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 single-lens reflex cameras
- Home appliances
- Audio equipment
- Sensor applications
- Printers
- Communications equipment

System Block Diagram (Digital Single-Lens Reflex Camera)



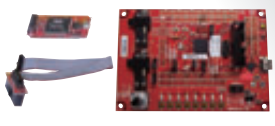
Product Lineup

Part Number	ROM (Flash) Size	RAM Size	Package	Features
TMPM440FEXBG	768 KB	64 KB + 16 KB	VFBGA289 (11 x 11 mm)	100 MHz No Wait Flash (NANO FLASH™-100) Programmable Servo/Sequence Controller (PSC) 12-bit AD converter, 10-bit DA converter Enhanced serial interface I/O (ESIO) Key matrix scanning (KSCAN)
TMPM440F10XBG	1024 KB	64 KB + 16 KB	VFBGA289 (11 x 11 mm)	

Evaluation Kit

IAR Starter Kit for TMPM440

- Included hardware:
  TMPM440-SK evaluation board
  I-Jet Lite
  USB cable
  IAR Embedded Workbench for ARM KickStart edition



TX04 Series M460 Group

The M460 Group of microcontrollers are best suited to applications such as printers, AV systems and industrial equipment.

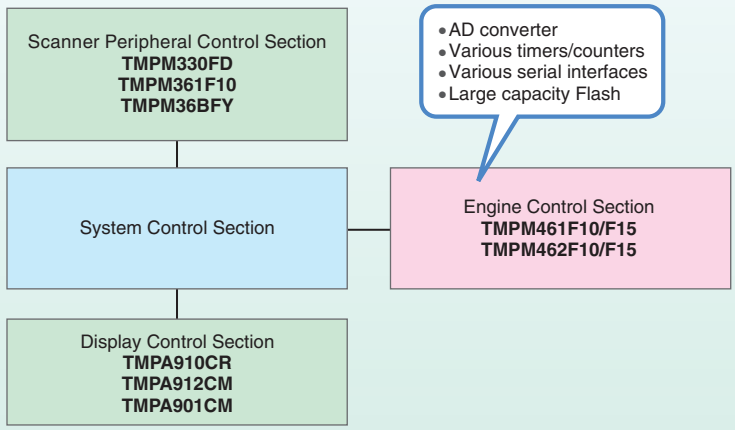
Features

- High-performance ARM Cortex-M3 core: 120-MHz operation (max)
- High-capacity flash memory: Up to 1.5 Mbytes
- Various serial interfaces (up to 20 channels)
- External bus interface that can be connected to SoCs and external extended memory
- Multi-purpose timer capable of IGBT control
- CEC interface and remote control signal preprocessor that remain active even in SLEEP mode
- Oscillation frequency detection (OFD)

Applications

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

System Block Diagram (Printer)



Product Lineup

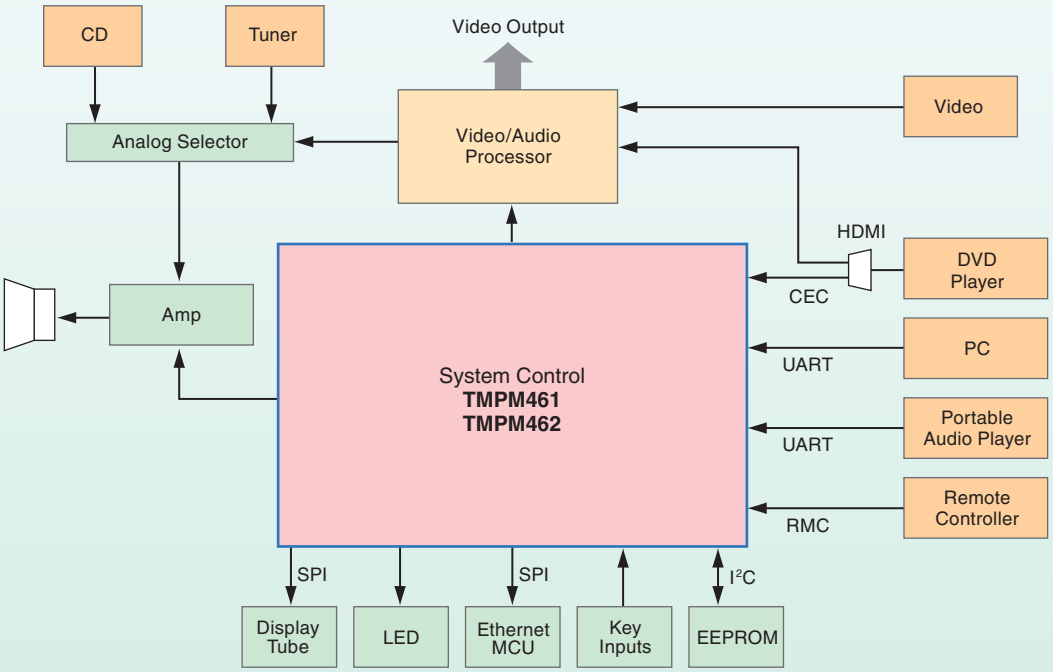
Part Number	ROM (Flash) Size	RAM Size	Packages	Features
TMPM461F10FG	1 MB	193 KB	LQFP144(20 x 20 mm)	High-performance ARM Cortex-M4F core: 120-MHz operation (max) Large-capacity memory Multi-purpose timer (MPT) Up to 20 serial channels 3 DMA controller units
TMPM461F15FG	1.5 MB	193 KB		
TMPM462F10FG **TMPM462F10XBG****	1 MB	193 KB	LQFP176(20 x 20 mm) TFBGA189(11 x 11 mm)	
TMPM462F15FG **TMPM462F15XBG****	1.5 MB	193 KB		

**: Under development

Features of the TMPM461F10FG, TMPM461F15FG, TMPM462F10FG and TMPM462F15FG

The TMPM461 and TMPM462 incorporate up to 1.5 Mbytes of flash memory, 193-Kbyte SRAM, 20 serial interface channels and 20 high-resolution 12-bit AD converter channels. These on-chip functional blocks eliminate the need for external memory and interface expansion ICs, reducing system costs. Additionally, the on-chip memories help improve system performance. Communication bottlenecks can also be minimized by allocating serial interfaces to a multi-layered bus system.

System Block Diagram (AV Amplifier)



Evaluation Kit

IAR Starter Kit for TMPM462

- Included hardware:
  TMPM462-SK evaluation board
  USB cable
  IAR Embedded Workbench for ARM KickStart edition

ApP Lite Application Processor Series

As Internet connections become more and more common, the Internet of Things is just around the corner — a concept in which all digital devices are interconnected.
Instead of sending the raw captured audio/video data to a server on the cloud, Toshiba's ApP Lite Series of application processors perform signal processing and image recognition to extract data to be kept on the cloud in order to alleviate traffic loads for data transfer.

For the latest information, visit Toshiba's website.
http://toshiba.semicon-storage.com/ap-en/product/assp/applite.html

Features of the TZ1000 Series

Product Lineup

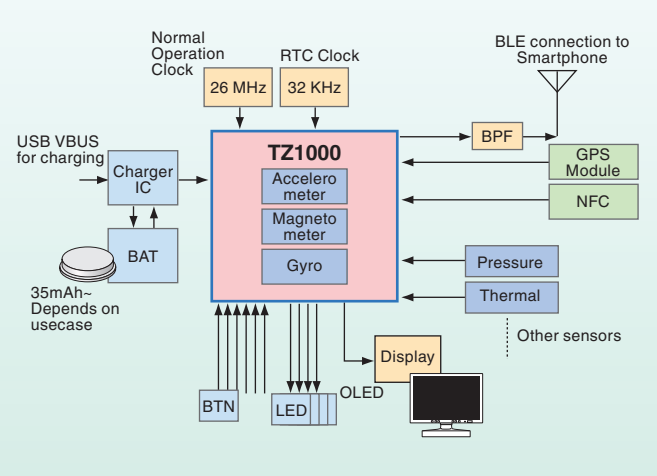
Part Number	TZ1001MBG**	TZ1011MBG**
CPU	ARM Cortex-M4F 48 MHz	
Communications	Bluetooth Low Energy Controller	
Sensing	Acceleration	Acceleration, angular speed, geomagnetism
Flash Memory	8 Mbits	
I/O	USB, SPI, I²C, UART, 12-bit ADC, 24-bitΔΣ ADC	

**: Under development **: Planned

Applications

- Fitness trackers
- Smart watches
- Wearable devices, etc.

Block Diagram



Features of the TZ2000 Series

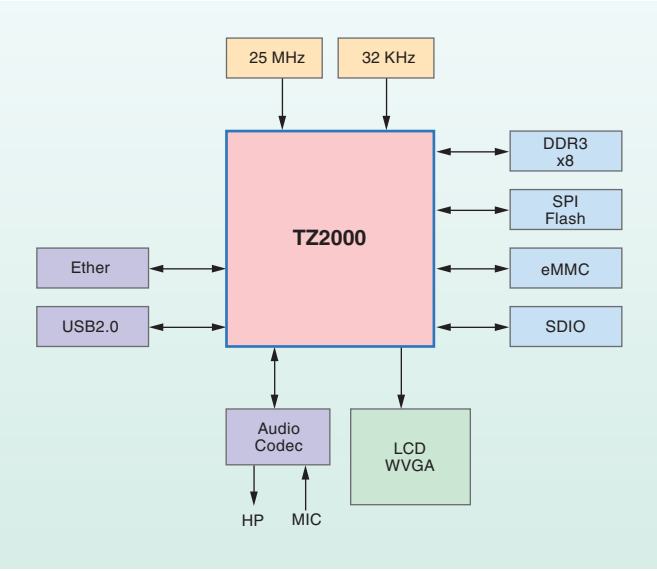
Product Lineup

Part Number	TZ2002XBG	TZ2003XBG
CPU	ARM Cortex-A9 200 MHz	
Graphics	2D Graphics (BitBLT)	
Security	—	Secure Engine
LCD	WVGA 60 fps 24 bit Parallel I/F	
Main memory	DDR3/DDR3L I/F (8 bit)	
On-chip memory	1 MBSRAM	
Main I/O	USB2.0, SPI, I²C, UART, Ether, SDIO/eMMC, I²S	

Applications

- Industrial equipment
  Data concentrators
  Barcode readers
  POS systems, etc.
- Amusement equipment, educational aids, etc.
- Home appliances
  Refrigerators
  Washing machines
  Air conditioners, etc.

Block Diagram



Product Lineup of the TZ3000 and TZ5000 Series

Part Number	Package	Features	Applications
TZ3000XBG	TFBGA458 (19 x 19 mm, 0.8 mm)	ARM Cortex-A9 Dual 1 GHz, DDR3/3L x32, PCIe, USB3.0, GbEther, SD, Video Codec	Surveillance cameras, teleconferencing systems, industrial equipment, signage systems, etc.
TZ5000MBG**	TFBGA457 (13 x 12 mm, 0.5 mm)	ARM Cortex-A9 Dual 1 GHz, DDR3/3L x32, Video Decoder, USB2.0OTG. CSIx2, DSIx4, HDMI-Tx, SD/SDIO/eMMC, SPI, UART, I²S, SPDIF	Over-the-top content (OTT) tuners, wearable devices, IP media boxes, signage systems, etc.
TZ5001MBG**	TFBGA457 (13 x 12 mm, 0.5 mm)		Over-the-top content (OTT) tuners, wearable devices, IP media boxes, signage systems, etc.

**: Under development

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.

Toshiba Website Pages on ARM Core-Based MCU Development Systems

IDE/Compiler	Introduces the vendors, suppliers and distributors of integrated development environments (IDEs) and compilers. Some companies lend versatile and reliable IDEs/compilers free of charge.
Debugger	Introduces the vendors and distributors of debugger software, JTAG in-circuit emulators (ICEs) and other tools Many tools have their own unique features. Select the one that best suits your development and evaluation needs.
Simulator	Introduces CPU code simulators, standalone verification tools, etc. A simulator is used together with a compiler.
OS	Introduces the vendors, suppliers and distributors of real-time operating systems (RTOSes), as well as porting services Various RTOSes with unique characteristics are commercially available under various licensing schemes, such as μITRON-compliant RTOSes and those widely used throughout the world.
Middleware	Introduces the licensing and customization services for drivers, protocol stacks and other middleware for USB, Ethernet and other communication protocols Middleware is bundled with RTOSes and tools in various manners.
Software development /SI	Introduces various system and solution proposals, as well as platform and software development services Each design house has its own characteristics. Select the one that best suits your needs.
Board/Evaluation kit	Introduces the board development and prototyping services as well as sales of evaluation kits Starter and evaluation kits are also available from the vendors listed on this web page.
FLASH programmer /Writer	Introduces the vendors and distributors of flash programming tools Both on-board and off-board programmers are available. On-board programming refers to the programming of a microcontroller after it is mounted on the target board. Off-board programming refers to the programing of a microcontroller prior to being mounted on the target board. Many vendors offer unique flash programmers. Select a flash programmer that best suits your intended programming process.
FLASH programming service	Introduces flash programming services Some companies support the programming of serial numbers. Select a company that meets your requirements.
Teaching Materials /Seminar	Introduces seminars for which ARM Ltd. provides teaching materials, as well as hands-on seminars on the tools and solutions from various vendors Select the one that best suits your needs.

Development Environment

Development Environment Ecosystems

The following table shows the tools and services offered by our development tool partners.
For details of these products and services, visit Toshiba's website.
http://toshiba.semicon-storage.com/ap-en/product/microcomputer/designsupport/partner-list.html

	IDE/Compiler	Debugger	Simulator	OS	Middleware	Software development /SI	Board/Evaluation kit	FLASH programmer /Writer	FLASH programming service	Teaching Materials /Seminar
A.I. Corporation				●	●					
Andor System Support Co., Ltd.						●		ON board	●	●
ARM Ltd.	●	●	●	●	●		●			
Atollic AB	●	●	●							
BITRAN CORPORATION		●						ON board		
Computex Co.,Ltd.	●	●					●	ON board		
Coocox	●	●		●				ON board		
eForce Co., Ltd.				●	●					
Elnec s.r.o								OFF board		
eSOL Co., Ltd.	●	●		●	●	●				
ESP Co., Ltd				●		●	●			●
Falcon Denshi K.K.								OFF board	●	
GAIO TECHNOLOGY CO.,LTD.	●	●	●			●				●
GRAPE SYSTEMS INC.				●	●					
Green Hills Software/Advanced Data Controls Corp.	●	●	●	●						
HI-LO SYSTEMS RESEARCH CO.,LTD								OFF board		
IAR Systems AB	●	●	●	●	●		●			●
Kiban Honpo							●			
KYOEI co.,LTD.								ON board		
Kyoto Microcomputer Co.,Ltd.	●	●								
Lauterbach Japan Ltd.		●								
MICROTEK Inc.									●	
MINATO ELECTRONICS INC.								OFF board	●	
SEGGER Microcontroller GmbH & Co. KG		●		●	●			●		
Sohwa & Sophia Technologies Co.,Ltd.	●	●						ON board		
Techno Mathematical Co.,Ltd.					●	●	●			
TOA ELECTRONICS Inc. Flash Support Group Company.								ON board OFF board	●	
TOSHIBA INFORMATION SYSTEMES (JAPAN) CORPORATION				●	●	●	●	ON board OFF board		
TOSHIBA PERSONAL COMPUTER SYSTEM CORPORATION						●	●			
Ubiquitous Computing Technology Corporation				●						
VAMOS									●	
Yokogawa Digital Computer Corporation	●	●					●	ON board		●
ZLG	●	●						ON board		

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^2C 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.
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 reuse and reducing the learning time for new microcontroller developers. Toshiba offers peripheral drivers compliant with CMSIS.
These drivers and sample programs using them are also available for download from ARM's onARM website.

ARM Web site http://www.arm.com/

Evaluation Kits and Reference Boards

Evaluation Kits

In order to evaluate whether to use Toshiba's microcontroller, it is advisable to use an entry-level evaluation kit (such as a starter kit) to start software development. Starter kits are available from development environment and evaluation kit vendors.
Various evaluation kits are available, ranging from the kits that are bundled with an IDE and an emulator to those that are compliant with an on-board emulator standard called CMSIS-DAP.
Moreover, feature-rich solution packages incorporating peripheral functions are also available. For detailed information, contact a partner listed in the "Boards/Evaluation Kits" column of the "Evaluation Environment Ecosystems" table on the previous page.
For evaluation kits supported by each microcontroller, see the pages that describe individual microcontrollers.

Reference Boards

In order to help you evaluate whether to use Toshiba's microcontroller, Toshiba offers reference boards that allow you to evaluate the functionality of its microcontrollers in the real-world environment.
Contact your local Toshiba sales representative when you have decided on your system applications and need to create a system quickly.

Microcomputer web page

The Toshiba Microcomputer website provides the latest information on our products.

Toshiba Semiconductor & Storage Company web page; http://toshiba.semicon-sto

1 Various search facilities

The following search engines are available:

- Part number search
  You can find information about any of our products by typing in a few characters of the part number.
- Parametric search
  You can progressively narrow down a list of products by choosing a product category and your electrical requirements.
- Cross Reference Search
  As soon as you type in a few characters of the part number of another company's product, a list of Toshiba products with similar specifications appears.

2 Latest news, topics, and new product highlights

The latest news and new product highlights are available here.

3 Product Lineup

Describes the features and characteristics of Toshiba's microcontroller series

4 Development Support

Provides application notes and sample programs to assist you in understanding Toshiba's microcontrollers and creating software

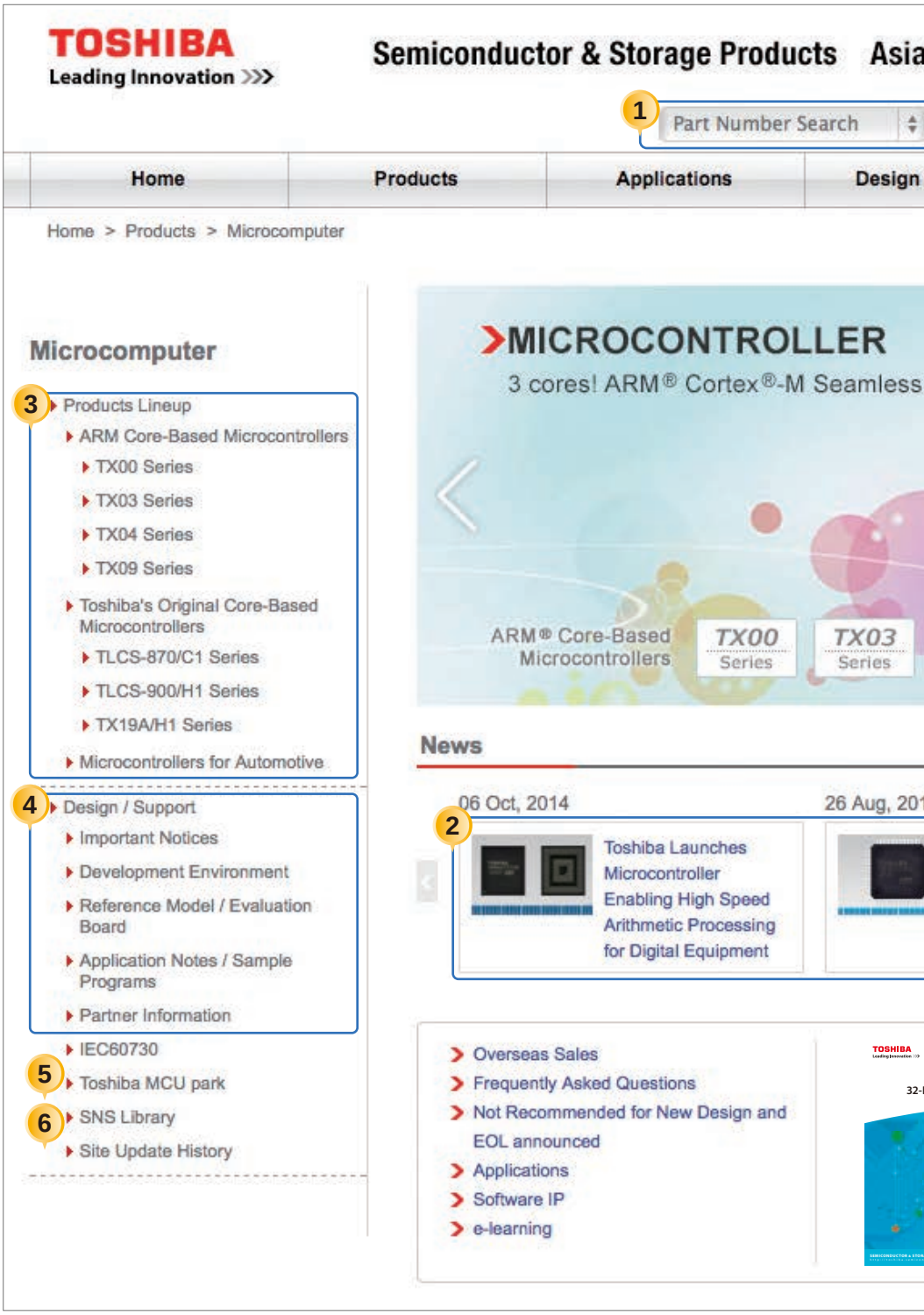
For details, see page 25.

5 Toshiba MCU Park

Explains the underlying technologies that power Toshiba's microcontrollers

6 SNS Library

Provides the YouTube channel and our Facebook page about Toshiba microcontrollers



ARM Core-Based Microcontroller Lineup

32-Bit Microcontrollers

TX00 Series

Flash Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	LED Driver (ch)	LCD Driver (Seg. x Com.)	SSP (ch) (1)	UART/SIO (ch)	UART (ch)	I²C (ch)	I²C/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 Calculation 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)	Operating Voltage Range (V)	Operating Temperature (˚C)	Package
TMPM061FWFG	128K	8K	16		40 x 4		4			1				2		3		9					Yes	Yes	4	1	Yes				Yes	64	1.8 to 3.6	−40 to 85	LQFP100 (14 x 14 mm)
TMPM037FWUG **		16K	20				5		1					8				10							6						Yes	52	2.3 to 3.6		LQFP64 (10 x 10 mm)

See page 31 for an explanation of the footnotes.
**: Under development
· Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

TX03 Series

Flash Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz) (3)	DMA Controller (ch)	SSP (ch) (1)	UART/SIO (ch)	UART (ch)	I²C (ch)	I²C/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) (5)	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)	Oscillation Frequency Detector	I/O Port (Pins)	Operating Voltage Range (V)	Operating Temperature (˚C)	Package
TMPM375FSDMG	64K	4K	40			(4) 2			1						4		4				Yes	1		1	1		3			Yes	21	4.5 to 5.5	−40 to 105	SSOP30 (5.6 x 10 mm)
TMPM372FWUG	128K	6K	(a) 80 (b) 32			4									11		8				Yes	1		1			10			Yes	53		(a) −40 to 85 (b) −40 to 105	LQFP64 (10 x 10 mm)
TMPM373FWDUG			(a) 80 (b) 32			3									7		8				Yes	1		1			8			Yes	37			LQFP48 (7 x 7 mm)
TMPM374FWUG			(a) 80 (b) 32			3									6		8				Yes	1		1			7			Yes	33			LQFP44 (10 x 10 mm)
TMPM330FWFG		8K	40			3			3					12			10		1	2							8		1		78	2.7 to 3.6	−20 to 85	LQFP100 (14 x 14 mm)
TMPM332FWUG			40			2			2					8			10		1	1							5		1		44			LQFP64 (10 x 10 mm)
TMPM333FWFG			40			3			3					12			10										8		1		78			LQFP100 (14 x 14 mm)
TMPM390FWFG **			20		1	3		1	1					12			10		1	2							8		1	Yes	74	1.7 to 3.6	−40 to 85	
TMPM395FWAXBG			20		4	3		1	1					12			10		1	2							11		1	Yes	91			TFBGA120 (6 x 6 mm)
TMPM380FWDFG		12K	40	2	2	5			2						18		8			1		(2) 2	3	2			16		1	Yes	84	4.0 to 5.5		QFP100 (14 x 20 mm)
TMPM380FWFG			40	2	2	5			2						18		8			1		(2) 2	3	2			16		1	Yes	84			LQFP100 (14 x 14 mm)

See page 31 for an explanation of the footnotes.
**: Under development
· Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

Flash Versions (Continued)

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (ch)	SSP (ch) (1)	UART/SIO (ch)	UART (ch)	I²C (ch)	I²C/SIO (ch)	TSPI (ch) (13)	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)	2-Phase Pulse Counter (PHC) (ch)	CEC (ch) (5)	Remote Control Preprocessor (ch)	Vector Engine (VE)	3-Phase PWM Generator (PMD) (ch)	Programmable Servo/Sequence controller (PSC) (ch)	Motor Driver (MCD) (ch)	Multi-Purpose Timer (MPT) (ch)	Incremental Encoder Input (ch)	Op Amp (ch)	Variable Gain Control Amp (ch)	Comparator (ch)	External Interrupt Pins (Pins)	CS/WAIT Controller (ch)	RTC (ch)	Oscillation Frequency Detector	I/O Port (Pins)	Operating Voltage Range (V)	Operating Temperature (˚C)	Package
TMPM366FWFG	128K	32K	48	4	3	2	1		2				1			12		10														10	2			74	(6) 2.7 to 3.6	−40 to 85	LQFP100 (14 x 14 mm)
TMPM370FYDFG	256K	10K	80			4										22		8					Yes	2				2	4		4	16			Yes	76	4.5 to 5.5		QFP100 (14 x 20 mm)
TMPM370FYFG			80			4										22		8					Yes	2				2	4		4	16			Yes	76			LQFP100 (14 x 14 mm)
TMPM330FYFG		16K	40			3			3						12			10			1	2										8		1		78	2.7 to 3.6	−20 to 85	
TMPM330FYWFG			40			3			3						12			10			1	2										8		1		78		−40 to 85	
TMPM333FYFG			40			3			3						12			10														8		1		78		−20 to 85	
TMPM380FYDFG			40	2	2	5			2							18		8				1		(2) 2			3	2				16		1	Yes	84	4.0 to 5.5	−40 to 85	QFP100 (14 x 20 mm)
TMPM380FYFG			40	2	2	5			2							18		8				1		(2) 2			3	2				16		1	Yes	84			LQFP100 (14 x 14 mm)
TMPM365FYXBG		24K	48	2		2			2				1			12		10														10				74	(6) 2.7 to 3.6		LFBGA105 (9 x 9 mm)
TMPM341FYXBG		32K	54	4	1	5			2							15	2	10	2													12	2		Yes	86	(7) 1.65 to 3.6		TFBGA113 (6 x 6 mm)
TMPM342FYXBG		36K	40	4	1	3	1	1		(11) 1						(12) 16	2	10	8	2					1	7.5			6		2	8				63	(8) 2.7 to 3.6	(9) −40 to 85	VFBGA142 (7 x 7 mm)
TMPM366FYFG		48K	48	4	3	2	1		2				1			12		10														10	2			74	(6) 2.7 to 3.6	−40 to 85	LQFP100 (14 x 14 mm)
TMPM366FYXBG			48	4	3	2	1		2				1			12		10														10	2			74			TFBGA109 (9 x 9 mm)
TMPM36BFYFG		66K	80	32	3	4	2		3							16		8				1		(2) 1			4	1				16	4	1	Yes	74	2.7 to 3.6		LQFP100 (14 x 14 mm)
TMPM330FDFG	512K	32K	40			3			3						12			10			1	2										8		1		78	2.7 to 3.6	−20 to 85	LQFP100 (14 x 14 mm)
TMPM330FDWFG			40			3			3						12			10			1	2										8		1		78		−40 to 85	
TMPM333FDFG			40			3			3						12			10														8		1		78		−20 to 85	
TMPM341FDXBG			54	4	1	5			2							15	2	10	2													12	2		Yes	86	(7) 1.65 to 3.6	−40 to 85	TFBGA113 (6 x 6 mm)
TMPM376FDDFG			80			4			1							22		8					Yes	2				2				16			Yes	82	4.5 to 5.5		QFP100 (14 x 20 mm)
TMPM376FDFG			80			4			1							22		8					Yes	2				2				16			Yes	82			LQFP100 (14 x 14 mm)
TMPM380FDFG **			40	2	2	5			2							18		8				1		(2) 2			3	2				16		1	Yes	84	4.0 to 5.5		
TMPM384FDFG			40	2	2	5			2							22		12				1		(2) 2			4	2				16		1	Yes	121			LQFP144 (20 x 20 mm)
TMPM366FDFG		64K	48	4	3	2	1		2				1			12		10														10	2			74	(6) 2.7 to 3.6		LQFP100 (14 x 14 mm)
TMPM366FDXBG			48	4	3	2	1		2				1			12		10														10	2			74			TFBGA109 (9 x 9 mm)
TMPM343FDXBG		80K	50	6		1	1	1		5						16	6	16	8	(14) 3					4	8			6	4	4	16				59	(10) 2.7 to 3.6		VFBGA162 (7 x 7 mm)

See page 31 for an explanation of the footnotes.

**: Under development

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

ARM Core-Based Microcontroller Lineup

Flash Versions (Continued)

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (ch)	SSP (ch) (1)	UART/SIO (ch)	UART (ch)	I²C (ch)	I²C/SIO (ch)	TSPI (ch) (13)	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)	2-Phase Pulse Counter (PHC)	CEC (ch) (5)	Remote Control Preprocessor (ch)	Vector Engine (VE)	3-Phase PWM Generator (PMD) (ch)	Programmable Servo/Sequence controller (PSC) (ch)	Motor Driver (MCD) (ch)	Multi-Purpose Timer (MPT) (ch)	Incremental Encoder Input (ch)	Op Amp (ch)	Variable Gain Control Amp (ch)	Comparator (ch)	External Interrupt Pins (Pins)	CS/WAIT Controller (ch)	RTC (ch)	Oscillation Frequency Detector	I/O Port (Pins)	Operating Voltage Range (V)	Operating Temperature (˚C)	Package
TMPM367FDFG	512K	128K	80	32	3	4	2		3				1			8	2	8				1		(2) 1			4	1				14	4	1	Yes	60	(6) 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		(2) 1			4	1				14	4	1	Yes	60			TFBGA109 (9 x 9 mm)
TMPM368FDFG			80	32	3	4	2		3		1	1	1			8	2	8				1		(2) 1			4	1				14	4	1	Yes	60			LQFP100 (14 x 14 mm)
TMPM368FDXBG			80	32	3	4	2		3		1	1	1			8	2	8				1		(2) 1			4	1				14	4	1	Yes	60			TFBGA109 (9 x 9 mm)
TMPM369FDFG			80	32	3	4	2		3		1	1	1	1		16	2	8				1		(2) 2			4	2				16	4	1	Yes	102			LQFP144 (20 x 20 mm)
TMPM369FDXBG			80	32	3	4	2		3		1	1	1	1		16	2	8				1		(2) 2			4	2				16	4	1	Yes	102			TFBGA177 (11 x 11 mm)
TMPM343FEXBG **	768K	96K	50	6		1	1	1		5						16	6	16	8	(14) 3					4	8			6	4	4	16				59	(10) 2.7 to 3.6		VFBGA162 (7 x 7 mm)
TMPM361F10FG	1024K	64K	64	2	1	5		1	3						8			16			1	1										10	4	1		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		120			LQFP144 (20 x 20 mm)
TMPM363F10FG			(15) 64	2	1	5		1	3		1	1			8			16			1	1										8	4	1		74	(6) 2.7 to 3.6	−40 to 85	LQFP100 (14 x 14 mm)
TMPM364F10FG			(15) 64	2	1	12			5		1	1			16			16			1	2										14	4	1		118			LQFP144 (20 x 20 mm)
TMPM343F10XBG		96K	50	6		1	1	1		5						16	6	16	8	(14) 3					4	8			6	4	4	16				59	(10) 2.7 to 3.6		VFBGA162 (7 x 7 mm)
TMPM36BF10FG		258K	64	32	3	4	2		3							16		8				1		(2) 1			4	1				16	4	1	Yes	74	2.7 to 3.6		LQFP100 (14 x 14 mm)

See page 31 for an explanation of the footnotes.
**: Under development
· Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

TX03 Series

ROM-Less Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	DRAM (Bytes)	Maximum Operating Frequency (MHz)	Audio DSP (unit)	DMA Controller (ch)	Static Memory Controller (ch)	Serial Flash controller (ch)	Sampling rate converter (ch)	SSP (ch) (1)	UART (ch)	SIO/UART (ch)	I²C/SIO (ch)	I²C (ch)	PCM interface (unit)	CAN (ch)	USB Embedded Host (Full-Speed) (ch)	USB Embedded Host (High-Speed) (ch)	SD Host controller (ch)	10-Bit AD Converter (ch)	16-Bit Timer/Counter (ch)	Remote Control Preprocessor (ch)	External Interrupt Pins (Pins)	RTC (ch)	Watch dog Timer (ch)	On-Chip Debug Unit	Trace Function	I/O Port (Pins)	Operating Voltage Range (V)	Operating Temperature (˚C)	Package
TMPM320C1DFG	NA	320K	1024K	144		8	2			4	4			2				1	1	4	8		4		Yes	Yes	Yes	55	(16)	−40 to 85	LQFP144 (20 x 20 mm)
TMPM32EC1EFG		1664K	NA	96	1	16		1	1	2	2	4	5		2		1		1	8	8	1	10	1	Yes	Yes	Yes	87	3.0 to 3.6 1.1 to 1.3		
TMPM32FC1EFG**			NA	96	1	16		1	1	2	2	4	5		2	2	1		1	8	8	1	10	1	Yes	Yes	Yes	87			
TMPM32BC2DFG		2560K	NA	96	1	16		1	2	2	2	4	5		5		1		1	8	8	1	10	1	Yes	Yes	Yes	112			LQFP176 (20 x 20 mm)
TMPM32DC2DFG			NA	96	1	16		1	2	2	2	4	5		5	2	1		1	8	8	1	10	1	Yes	Yes	Yes	112			

See page 31 for an explanation of the footnotes.
**: Under development
· Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components.

TX04 Series

Flash Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	DMA Controller (ch)	SSP (ch) (1)	UART/SIO (ch)	UART (ch)	I²C (ch)	I²C/SIO (ch)	CAN (ch)	Enhanced Serial I/O (ESIO) (ch)	USB Embedded Host (Full-Speed) (ch)	USB (Full-Speed) (ch)	LCD Driver (Seg. x Com.)	10-Bit AD Converter (ch)	12-Bit AD Converter (ch)	10-Bit DA Converter (ch)	16-Bit Timer/Counter (ch)	32-Bit Timer (unit)	High-Res. 16-Bit Timer/PPG Gen. (ch)	2-Phase Pulse Counter (PHC) (ch)	Enhanced 2-phase pulse counter (EPHC) (ch)	Programmable Servo/Sequence controller (PSC) (ch)	CEC (ch) (5)	Remote Control Preprocessor (ch)	Multi-Purpose Timer (MPT) (ch)	External Interrupt Pins (Pins)	Key-On Wake-Up (KWUP) (ch)	Key Matrix Scan (KSCAN) (Column x Row)	CS/WAIT Controller (ch)	RTC (ch)	Trace Function	Oscillation Frequency Detector	Power-On Reset	Low Voltage Detection Circuit (LVD)	I/O Port (Pins)	Operating Voltage Range (V)	Operating Temperature (˚C)	Package
TMPM411F20XBG**	2M	290K	80	36	4	6	2	1						32 ×4		9	9	5						1	1		9				1	Yes		Yes	Yes	93	2.7 to 3.6	−40 to 85	VFBGA193 (14 x 14 mm)
TMPM440FEXBG	768K	80K	100	6		6	2	1			3					20	2	20	1	4	2	1	1				24	40	8 x 8	2	1	Yes		Yes		228			VFBGA289 (11 x 11 mm)
TMPM440F10XBG	1024K	80K	100	6		6	2	1			3					20	2	20	1	4	2	1	1				24	40	8 x 8	2	1	Yes		Yes		228			
TMPM461F10FG		193K	120	32	3	6	2	5								20		16						1	1	(17) 2	16			4	1	Yes	Yes	Yes	Yes	111			LQFP144 (20 x 20 mm)
TMPM462F10FG			120	32	3	10	2	5								20		16						1	2	(17) 2	16			4	1	Yes	Yes	Yes	Yes	139			LQFP176 (20 x 20 mm)
TMPM461F15FG	1536K		120	32	3	6	2	5								20		16						1	1	(17) 2	16			4	1	Yes	Yes	Yes	Yes	111			LQFP144 (20 x 20 mm)
TMPM462F15FG			120	32	3	10	2	5								20		16						1	2	(17) 2	16			4	1	Yes	Yes	Yes	Yes	139			LQFP176 (20 x 20 mm)

· Contact the Toshiba sales representative for information about RoHS compliance before you purchase any components. **: Under development

32-Bit Microcontrollers for Automotive

TX03 Series

Flash Versions

Part Number	ROM (Bytes)	SRAM (Bytes)	Maximum Operating Frequency (MHz)	CAN (ch)	DMA Controller (ch)	ESEI (ch)	UART/SIO (ch)	12-Bit AD Converter (ch)	Timer/Compare (32 bit) (ch)	Timer/Capture (32 bit) (ch)	PWM (24bit) (ch)	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
TMPM350FDTFG	512K	48K	88	2	32	1	2	20	3	7	6		1		(18) 1	Yes	Yes	Yes	43	(21)	−40 to 105	LQFP100 (14 x 14 mm)
TMPM351F10TFG**	1024K	64K	144	2	32	1	2	20	3	7	6		1		(18) 1	Yes	Yes	Yes	43	(24)	−40 to 125	
TMPM358FDTFG** (23)	512K	80K	40	3	32	3	2	20	5	3	3				(19) 1	Yes	Yes	Yes	35	4.5 to 5.5	−40 to 105	
TMPM354F10TAFG	1024K	64K	96	3	64	2	3	21	5	6	4	Yes	1	1	(20) 1	Yes	Yes	Yes	54	(22)	−40 to 125	HQFP144 (20 x 20 mm)

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Note (1): SSP: Synchronous Serial Port
(2): Either the Programmable Motor Driver (PMD) or the Multi-Purpose Timer (MPT) is selectable.
(3): Minimum instruction execution times (a) and (b) correspond to (a) and (b) of operating temperature.
(4): One channel is configurable only as UART.
(5): CEC: Consumer Electronics Control
(6): 3.0 to 3.45 V when USB is used.
(7): 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.
(8): MCD analog supply voltage: 3.1 V to 3.5 V
MCD motor supply voltage: 2.5 V to 5.5 V
(9): The operating temperature of the Motor Control Driver (MCD) and the operating temperature of the D/A converter of the MCU are between –25 and 85°C.
When the operating temperature is between –40 and –25°C, the MCD is used in stand-by state, and the D/A converter of the MCU is used in stop state.
(10): MCD motor supply voltage: 2.5 V to 5.5 V
(11): Variable-Length Data Serial Interface (VSIO) is available.
(12): Built-in 12-bit SAR type AD converter: 3 units/12 (8+4) channels.
Built-in 16-bit ΔΣ type AD converter: 1 unit/4 channels.
(13): TSPI: Toshiba Serial Peripheral Interface
(14): Enhanced 2-phase pulse counter (EPHC) is available.
(15): 48 MHz when USB is used.
(16): The following three power supplies are available:
(i) For general ports, and A/D converter: 3.0 V to 3.6 V
(ii) For USB Embedded Host: 3.15 V to 3.45 V
(iii) For internal circuitry: 1.1 V to 1.3 V
(17): 16-bit timer mode and IGBT mode are available.
(18): The seven capture inputs of the timer can be programmed as external maskable interrupts.
(19): The three capture inputs of the timer can be programmed as external maskable interrupts.
(20): The six capture inputs of the timer can be programmed as external maskable interrupts.
(21): The following two power supplies are available:
(i) For internal circuitry: 1.4 V to 1.65 V
(ii) For general ports and A/D converter: 4.5 V to 5.5 V
(22): The following two power supplies are available:
(i) For internal circuitry: 1.35 V to 1.65 V
(ii) For general ports and A/D converter: 4.5 V to 5.5 V
(23): Low-power modes are available.
(24): The following two power supplies are available:
(i) For internal circuitry: 1.08 V to 1.32 V
(ii) For general ports and A/D converter: 4.5 V to 5.5 V

· Contact the Toshiba sales representative about a product that is not listed or about a product whose information is different between the list and product introduction page.

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