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Analog & Imaging IC
Logic LSI

SEMICONDUCTOR & STORAGE PRODUCTS

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TOSHIBA

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Smart Interface

Sensing Input / Output Control

CMOS Image Sensor — Image Sensor (Camera)

Audio — Audio Input / Output

MCU

Motor Control Driver — Sensing & Control

Motor Control LED Drive Power Management

LED Driver

LED Driver

ISP

Audio Processing

Digital Processing

Image & Video Processing

Text to Speech

Digital Processing

ASIC

Digital TV

Automotive

Power Management

Power Management

Connectivity

Wired : High Speed Serial Link

Memory/ Storage Interface

Wired Connect

Interface & Bridges

Mobile Peripheral Device

Wireless Connect

Wireless

Wireless : Near Field / Proximity

Smart Power
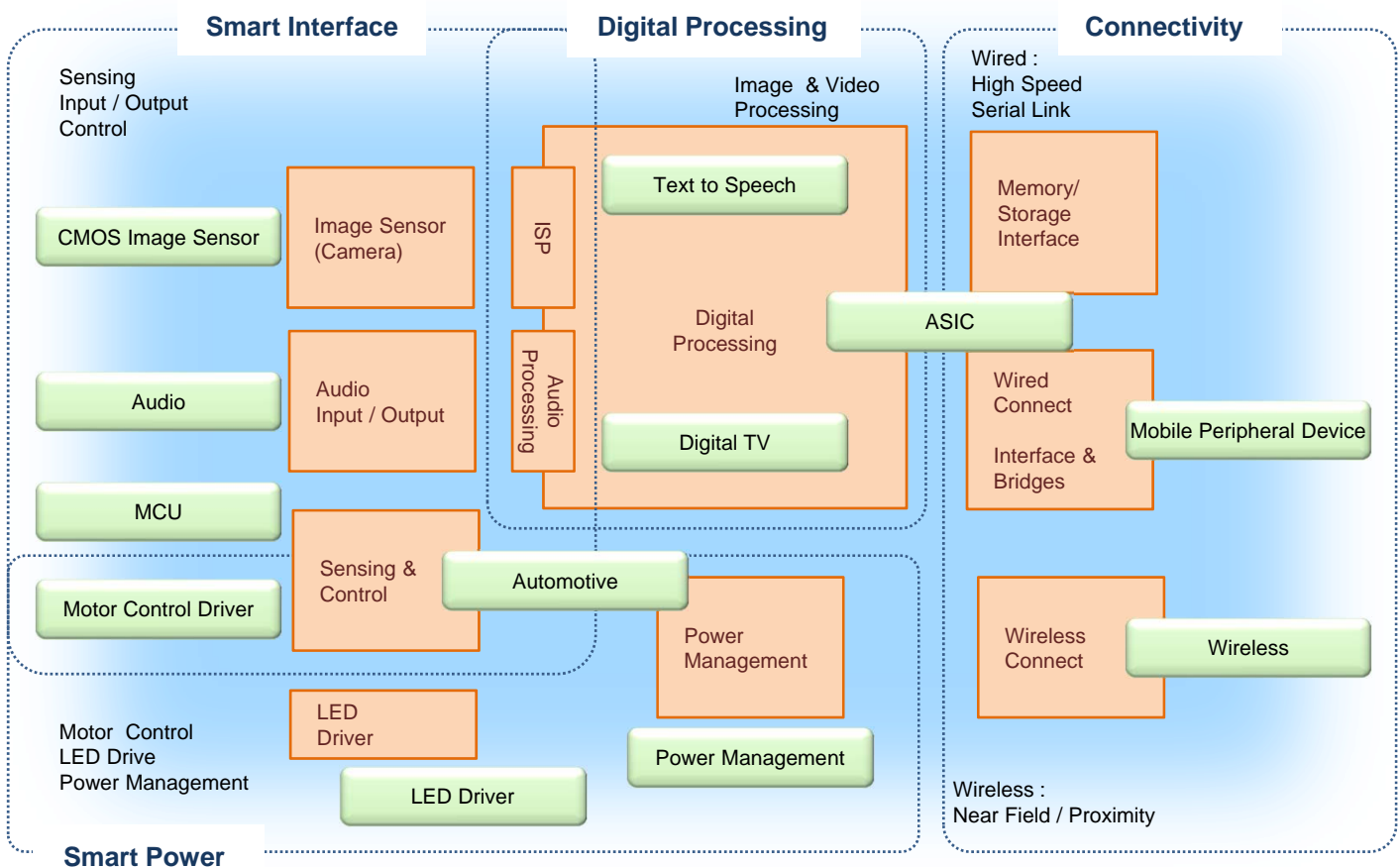
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CMOS Image Sensor

For high image quality , Toshiba has been developing BSI advanced technology (optimized process and design). And we have realized 1.12 μm pixel CMOS image sensor using this BSI technology and 65nm process.

- ●Fine pixel size (1.12μm)
- ●65nm process
- ●BSI advanced technology

- ●High image quality
  - • High sensitivity
  - • Low noise
- ●High resolution
- ●High frame rate
- ●Low Z height of camera module

BSI Technology

FSI   BSI
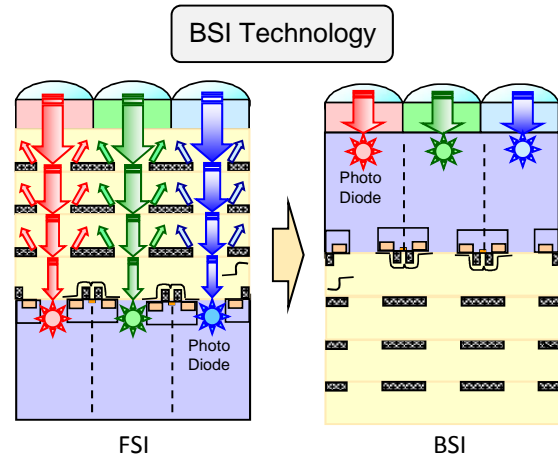
FSI : Front Side Illumination
BSI : Back Side Illumination

Photo Diode

Business Field

- ●Extensive Line up: VGA - 14M pixel ,
                       3M - 12M pixel, Bright 1.75μm
- ●One Stop Solution (Die/ CSP/ Camera Module)
- ●Designed for various application like Mobile Phone, DSC, PC, Automotive Camera and Surveillance Camera

CSP : Chip Scale Package
Bright technology : process technology with next generation
                    pixel size's technology

Example of Image Sensor Applications

Mobile Phones

PC Cameras

Smart Phones

DSC

PC

DVC

Automotive Cameras

Surveillance Cameras

Pixel Performance Summary

Pixel technology	SNR10	Sensitivity	Well capacity	Dynamic range
Bright 1.75μm	65 lx	737 mV/lx-sec	5810 e	60 dB
1.4μm	99 lx	590 mV/lx-sec	5300 e	59 dB
1.4μm BSI	70 lx	590 mV/lx-sec	5300 e	60 dB
Bright 1.4μm BSI	(60 lx)	(590 mV/lx-sec)	(5700 e)	(60 dB)
1.12μm BSI	(<100 lx)	(500 mV/lx-sec)	(4000 e)	(60 dB)

(   ): Target performance

- ●SNR10: 3200K, ES 15fps&1V suitability
- ●Sensitivity: 540nm monochromatic light, AGx1
- ●Well capacity: 5100K
- ●Dynamic range: 0lx, AGx1

Improved image quality in low light condition by BSI technology

Lineup

Module

Products	TCM9001MD	TCM8500MD	TCM9313MD
Type			
Status	MP	MP	MP
Optical size	1/10"	1/10"	1/4"
Resolution	VGA	VGA	3.2M
Pixel size[μm]	2.2	2.2	1.75
SOC/CIS	SOC	CIS	CIS
FSI/BSI	FSI	FSI	FSI
Pixel number	640(H)×480(V)	640(H)×480(V)	2056(H)×1544(V)
Frame rate — Full	30fps	30fps	15fps
1080P	-	-	-
720P	-	-	-
VGA	-	-	-
I/F — Parallel	8bit	-	-
Serial	-	CCP2 RAW8	CCP2
Power supply — VDIG	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V
VANA	2.6 to 3.0V	2.4 to 2.9V	2.4 to 2.9V
IO	1.7 to 3.0V	-	-

Lineup matrix

Pixels / Resolution	2.2 μm	1.75 μm (1st Gen. / 2nd Gen. (Bright))	1.4 μm 1st Gen. (90 nm)	1.4 μm 2nd Gen. (65 nm)	1.4 μm 3rd Gen. (BSI)	1.1 μm (BSI)
12 MP+		T8ES7 (12 MP) 1/2" CIS			TCM5101CL (14 MP) 1/2.3" CIS	
8 MP		T8ER4 1/2.5" CIS		T8EV4 1/3.2" CIS	T4K04 1/3.2" CIS	T4K05 1/4" CIS
5 MP		T8EV3 1/3.2" CIS	T8ET5 1/4" CIS	T8EV5 1/4" SOC		
3 MP		TCM9313MD 1/3.2" CIS				
2 MP		T8EX2 1/5" SOC				
VGA	T8EL6 1/10" SOC; TCM9001MD 1/10" SOC; TCM8500MD 1/10" CIS					

Legend: MP Available / Under Development

Die ～5M

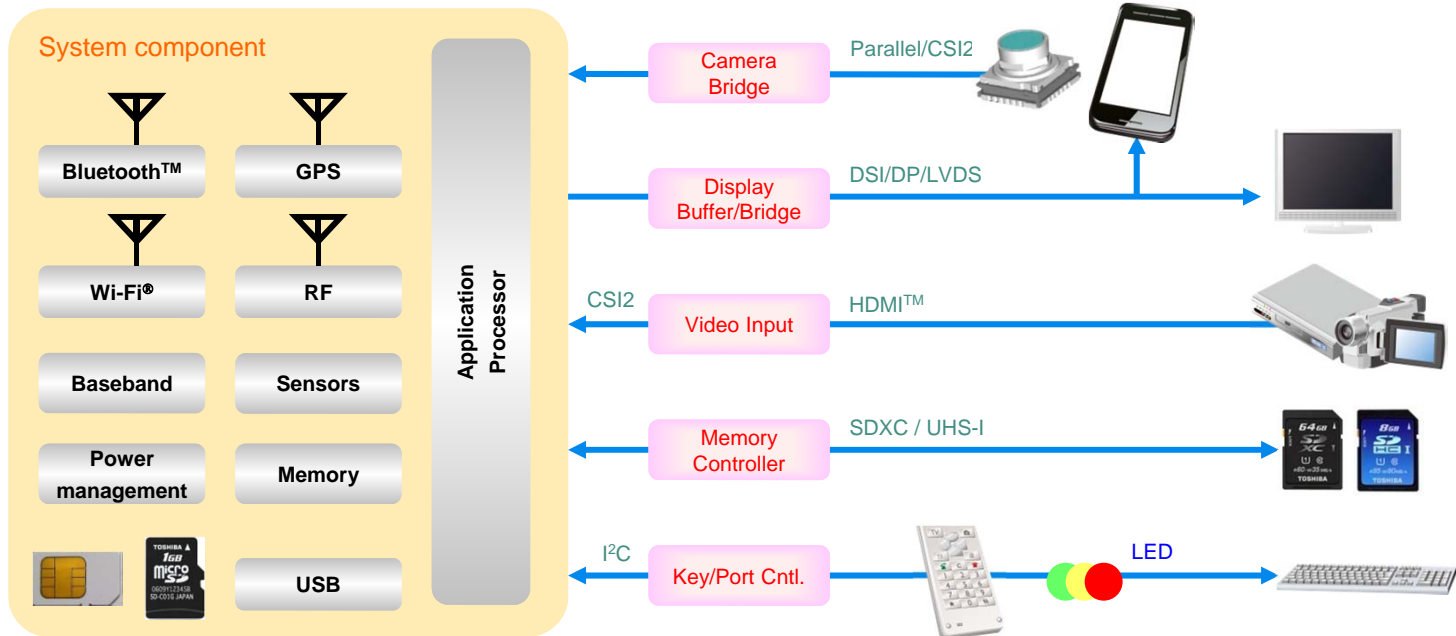| Products	T8EL6	T8EX2	T8EV3	T8ET5	T8EV5
Type					
Status	MP	MP	MP	MP	Under Development
Optical size	1/10"	1/5"	1/3.2"	1/4"	1/4"
Resolution	VGA	2M	5M	5M	5M
Pixel size[μm]	2.2	1.75	1.75	1.4	1.4
SOC/CIS	SOC	SOC	CIS	CIS	SOC
FSI/BSI	FSI	FSI	FSI	FSI	FSI
Pixel number	640(H)×480(V)	1600(H)×1200(V)	2592(H)×1944(V)	2608(H)×1960(V)	2592(H)×1944(V)
Frame rate — Full	30fps	15fps	15fps	15fps	7.5fps(YUV), 20fps(Jpeg)
1080P	-	-	15fps	-	13fps(YUV), 30fps(Jpeg)
720P	-	-	30fps	-	30fps(YUV), 60fps(Jpeg)
VGA	-	30fps	60fps	60fps	100fps
I/F — Parallel	10bit	10bit	(possible 10bit)	10bit	8bit
Serial	-	-	CSI-2, 2lane	CSI-2/2lane	CSI-2, 1lane
Power supply — VDIG	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V
VANA	2.6 to 3.0V	2.6 to 3.0V	2.6 to 3.0V	2.6 to 3.0V	2.6 to 3.0V
IO	1.7 to 3.0V	1.7 to 3.0V	1.7 to 3.0V	1.7 to 1.9V Or 2.6 to 3.0V	1.7 to 3.0V

Die/Package 8M～

Products	T8ER4	T8EV4	T8ES7	T4K04	T4K05	TCM5101CL
Type						
Status	MP	MP	MP	Under Development	Under Development	Under Development
Optical size	1/2.5"	1/3.2"	1/2"	1/3.2"	1/4"	1/2.3"
Resolution	8M	8M	12M	8M	8M	14M
Pixel size[μm]	1.75	1.4	1.75	1.4	1.1	1.4
SOC/CIS	CIS	CIS	CIS	CIS	CIS	CIS
FSI/BSI	FSI	FSI	FSI	BSI	BSI	BSI
Pixel number	3280(H)×2464(V)	3280(H)×2464(V)	4016(H)×3016(V)	3280(H)×2464(V)	3280(H)×2464(V)	4400(H)×3316(V)
Frame rate — Full	7.5fps	15fps	5fps	30fps	30fps	15fps
1080P	10fps	30fps(crop)	30fps	60fps(crop)	60fps(crop)	60fps
720P	30fps	60fps	50fps	60fps	60fps	60fps
VGA	60fps	120pfs(crop)	70fps	120fps	180fps	140fps
I/F — Parallel	10bit	10bit	10bit	N/A	N/A	N/A
Serial	CSI-2,2lane CCP2	CSI-2,2lane CCP2	CSI-2,2lane CCP2	CSI-2, 4lane	CSI-2, 4lane	CSI-2, 4lane Sub-LVDS, 8ch
Power supply — VDIG	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V	1.1 to 1.3V
VANA	2.3 to 2.9V	2.6 to 3.0V	2.3 to 2.9V	2.6 to 3.0V	2.6 to 3.0V	2.8 to 3.0V / 2.6 to 3.0V
IO	1.7 to 1.9V	1.7 to 3.0V	1.7 to 1.9V	1.7 to 1.9V	1.7 to 1.9V Or 2.6 to 3.0V	2.6 to 3.0V Or 1.65 to 1.95V

Mobile Peripheral Device

OVERVIEW

Toshiba MPD (Mobile Peripheral Device) is designed for extending interfaces of a host processor to connect various peripherals and external devices. Interface bridges, Display buffers, IOExpanders and memory interface devices are the lineup of MPDs. MPD enable users to use the latest peripheral on a system.

System component

Bluetooth™	GPS
Wi-Fi®	RF
Baseband	Sensors
Power management	Memory
	USB

Application Processor

Bridge block	Interface	Device
Camera Bridge	Parallel/CSI2	
Display Buffer/Bridge	DSI/DP/LVDS	
Video Input	CSI2 / HDMI™	
Memory Controller	SDXC / UHS-I	
Key/Port Cntl.	I²C / LED	

INTERFACE BRIDGE

Toshiba Interface bridge MPD supports various interface combination to connect different interfaces between a host processor and peripherals. MIPI®-DSI, MIPI®-CSI, MDDI, DisplayPort, LVDS, HDMI and several parallel interfaces shown in the table are supported. In addition to Interface bridge, Toshiba Display buffer MPD supports various display interface standardizations with a buffer memory.

		OUT							
		MDDI	DSI	DPI (RGB)	DBI-B (MPU)	CSI	Parallel Cam-I/F	LVDS	Display Port
IN	MDDI		TC358760	TC358761 TC358721/23(RAM)					
	DSI			TC358762				TC358764 TC358765	TC358767 TC358770
	DPI (RGB)		TC358761 TC358763 TC358768						TC358766
	DBI-B (MPU)		TC358761 TC358763						
	CSI	TC358740 Parallel 8bit					TC358740		
	Parallel Cam-I/F					TC358746			
	HDMI					TC358743			

Under Development   ES Available   MP

SDXC host controller with CPRM function

Host Processor → SDIO → **TC358780XBG** TOSHIBA SDXC Host Controller → UHS-I → 64GB SDXC card
→ UHS-I → 64GB SDXC card

A high-capacity memory device is being required for supporting a high speed network and huge amount of information. And a new standard is necessary to support them. Toshiba SDXC host controller enables users to use the latest memory standard on a system.

TC358780XBG

Function
- SDXC up to 2TByte
- High speed read/write (UHS-I)
- CPRM support

Feature
- 2 x UHS-I channels

Availability
- ES: Available
- MP: Available

Package
- 5.0mm x 5.0mm
- 0.5mm pitch
- 64pin BGA

Roadmap (plan)

For Mobile Phone

UHS-II/UFS SDXC USB3.0 CPRM/CPXM

UHS-I SDXC USB3.0 CPRM/CPXM

UHS-I SDXC USB2.0 CPRM/CPXM

TC358780XBG UHS-I SDXC CPRM

UHS-II SDXC CPRM/CPXM

Memory Sub System

For PC

UHS-II SDXC USB3.0 SATA/PCI-Ex

UHS-I SDXC SATA/PCI-Ex

UHS-II SDXC SATA/PCI-Ex

2011   2012   2013
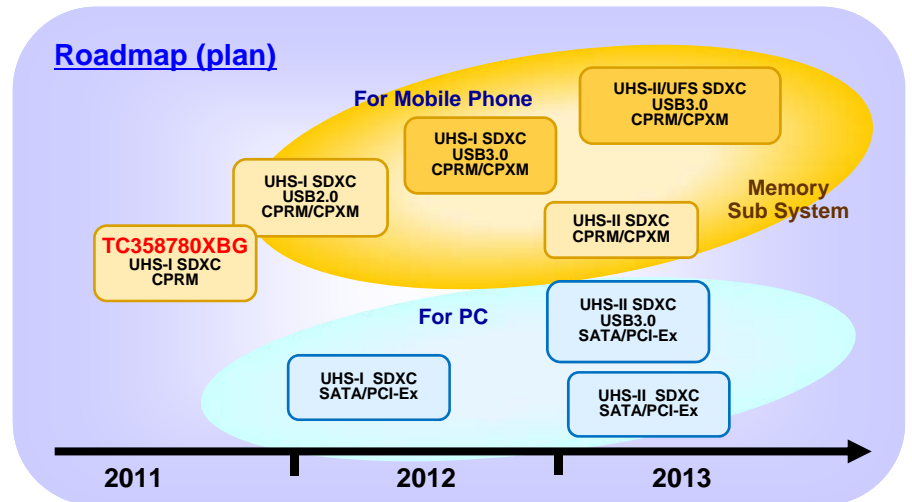
IO Expander

IO Expander supports general purpose I/Os, a key detection and PWMs function. A host processor controls these functions via an I^{2}C interface so a host processor can reduce its workload to get a key code from a keyboard and to control PWM. Application fields of IO Expander are various such as digital camera, tablet PC, cam coder, facsimile, electronic dictionary, game and etc.

I^{2}C 2-wire

Host Processor → GPIO / Key Matrix / PWM

GPIO → 20/24 port max → Sensors/Switches
Key Matrix → 8x12=96 keys max → keyboard
PWM → 3ch max. → LED

Reduce workload of host processor

Additional port control

Standalone PWM control

Key Detection control
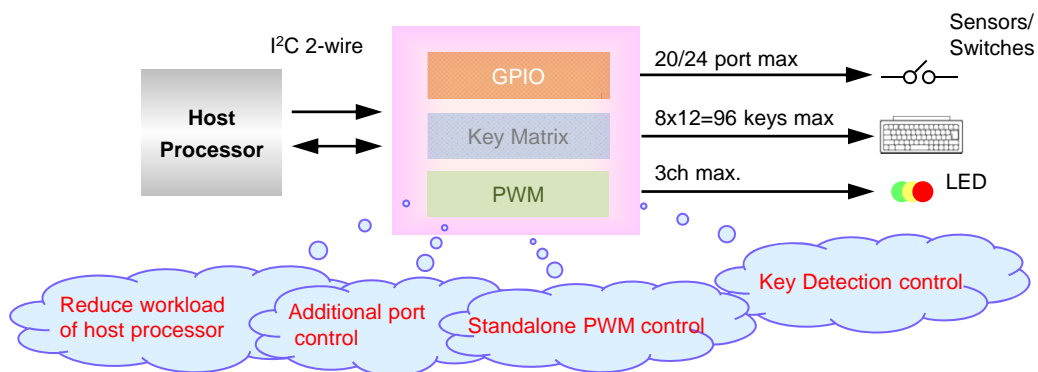
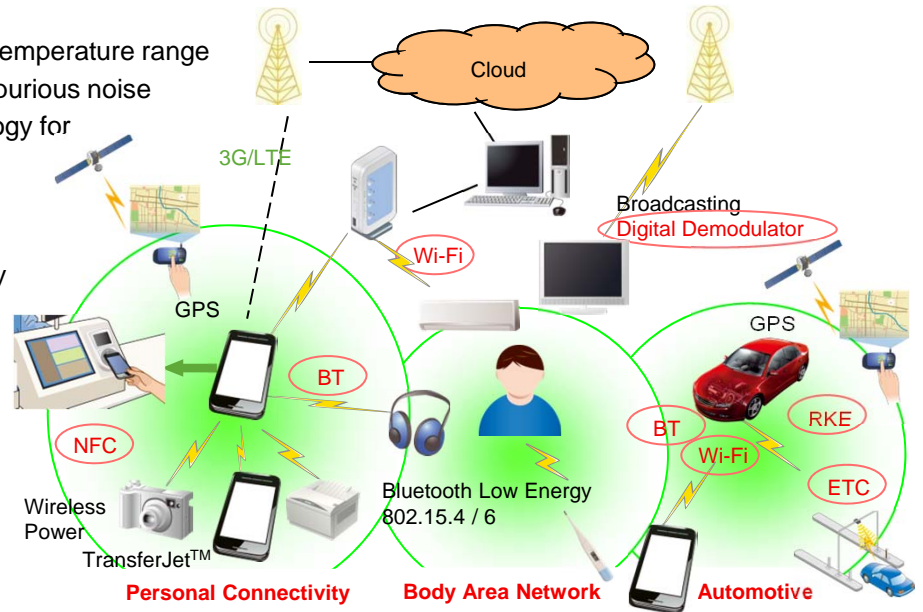|	TC35893XBG	TC35894XBG	TC35894FG	TC35895WBG
GPIO	Max 20 ports	Max 24 ports	Max 24 ports	Max 20 ports
Key matrix	Max 96 keys	Max 96 keys	Max 96 keys	Max 96 keys
PWM	Max 3 ch.	Max 3 ch.	Max 3 ch.	Max 3 ch.
Package type	BGA25	BGA36	QFP44	WLCSP25
Package size	3.0mm x 3.0mm	3.5mm x 3.5mm	10mm x 10mm	2.05mm x 2.05mm
Pin pitch	0.5mm	0.5mm	0.8mm	0.4mm

Wireless

Product Development Concept
● Feedback customer voices and latest wireless standard to new product development by engineers of skill in various wireless technologies such as Bluetooth, Wi-Fi, Digital Terrestrial Broadcasting Demodulator, RKE, and "FeliCa" IC

Technology
● Wireless design capability
   System design technology for maximizing RF and Baseband total performance
   High interoperability quality including recovery design for abnormal protocol sequence
● RFCMOS design capability
   Very high receiving sensitivity for wide temperature range
   Layout design knowhow for reducing spurious noise
● Low power consumption design technology for mobile application
● Security technology and on-chip NVM process technology
● Design technology for Automotive quality

Production
● RFCMOS process and manufacturing technology by own fab.
   ● Low power consumption
   ● Tamper resistant
   ● Communication quality improvement
   ● Contribution on standardizations

Cloud

3G/LTE

Wi-Fi

Broadcasting
Digital Demodulator

GPS

GPS

BT

BT

RKE

NFC

Wi-Fi

ETC

Wireless Power

Bluetooth Low Energy
802.15.4 / 6

TransferJet™

Personal Connectivity   **Body Area Network**   **Automotive**

Digital Terrestrial Broadcasting Demodulator

ISDB-T Demodulator (TC90527)

ISDB-T Demodulation
  • Fully compliant with ARIB-B31
High Integration
  • Built-in A/D converter
  • Built-in memory for de-interleaver
  • Built-in PLL circuit for clock generator
Excellent Receiving Performance
  • Excellent receiving performance under multipath condition with original algorithm
  • Low required C/N (realizing high sensitivity)
  • Support diversity reception (2 ICs needed)
Interface
  • Support Low IF and IQ input
  • Parallel and serial TS output
 • I²C
Low Power Consumption
  • 94mW (typ.)

MP Available

ADC	OFDM demod.	FEC
Memory		I²C
Diversity function		PLL
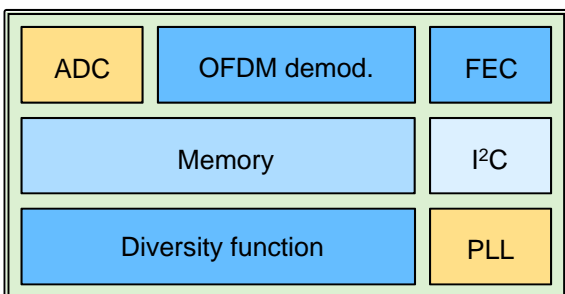
DTMB Demodulator (TC90508)

DTMB Demodulation
  • Fully compliant with GB20600-2006
High Integration
  • Built-in A/D converter
  • Built-in memory for de-interleaver
  • Built-in PLL circuit for clock generator
Excellent Receiving Performance
  • Excellent receiving performance under multipath condition with original algorithm
  • Low required C/N (realizing high sensitivity)
Interface
  • Support 36MHz IF, Low IF, and IQ input
  • Parallel and serial TS output
  • I²C
Low Power Consumption
  • 260mW (typ.)

ES: Available
MP: Apr. 2012

ADC	DTMB demod.	FEC
Memory		I²C
		PLL
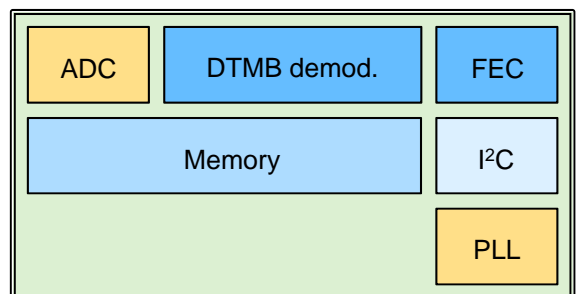
Mobile "FeliCa"

System Function
- Card emulation, Reader/Writer function support
- Compliant with Mobile "FeliCa"
- Data rate：212kbps/424kbps
- Mobile "FeliCa" / Japan Railways Group (JR) certified

Contactless Frontend
- Built-in analog and Modulation/demodulation circuit compliant with "FeliCa"
- Built-in Null point deletion system
  - Phase recovery circuit
  - Modulation and Switch circuit (SW1, SW2)
- Control ports of external circuit for adjusting resonance frequency
- HOST interface：UART

Secure Element
- CPU：ARM SC100™ (Secure Core)
- "FeliCa" OS support
- NV：EEPROM with Error Correction Circuit
- CC：EAL4+ approved

MP Available

T6ND5
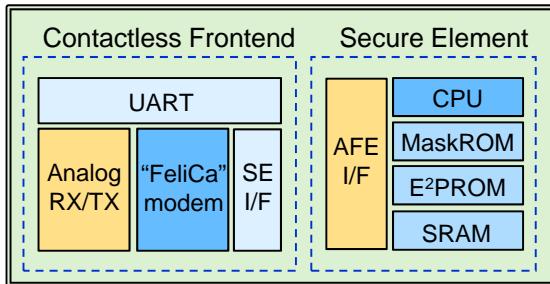
Bluetooth V4.0 EDR + LE

Bluetooth Core Spec.
- Support V4.0, EDR+LE (Dual Mode)

RF Block
- Support Class2
- Very high RX sensitivity (-95dBm)
- On chip Balun, ANT SW, LNA

Baseband Block
- High performance by ARM7TDMI®
- On chip Mask ROM, Patch RAM

Interface
- High Speed UART, SPI, USB2.0 (FS), I²C, I²S/PCM
- Wi-Fi Coexistence 2/3/4 wire
- Support Wake-Up Signal from/to Host CPU

Low Power Consumption
- Dynamic (DH5, UART=2Mbps)：30mA (typ.)
- Sleep：20μA (typ.)

ES: Available
MP: May. 2012

TC35661
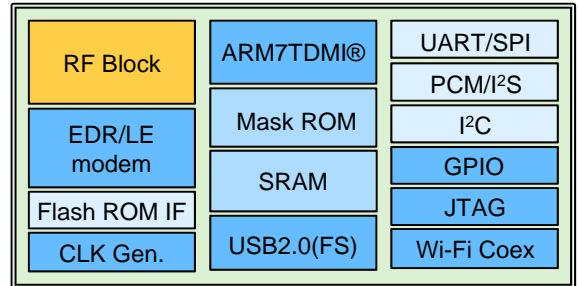
TransferJet™

Single Chip Solution
- RF and digital baseband are implemented into monolithic

Built-in RF Components
- RF switch, matching circuit, LNA

Very High Speed HOST I/F
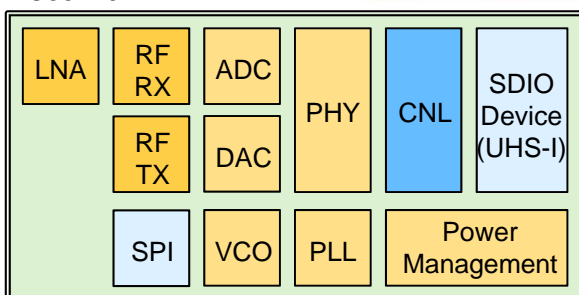- SDIO interface supporting UHS-I (104MByte/s)

Very High RX Sensitivity
- -78dBm (Rate65)

Small Package
- 4.0 x 4.0 x 0.5mm LGA (Ball pitch 0.4mm)

ES: Available
MP: Apr. 2012

TC35420

Remote Keyless Entry

Demodulator：   FSK, OOK (ASK)
Data Rate：   600bps-10kbps
Multiband：   315MHz/434MHz/868MHz/915MHz
Multi Channel
- Fractional PLL
- Frequency step 5KHz

Selectable IF Filter Band Width
- 2band selectable BW=260/320KHz, IF=280/230KHz

Very Short Latency
- Built-in high speed digital comparator

High RX Sensitivity
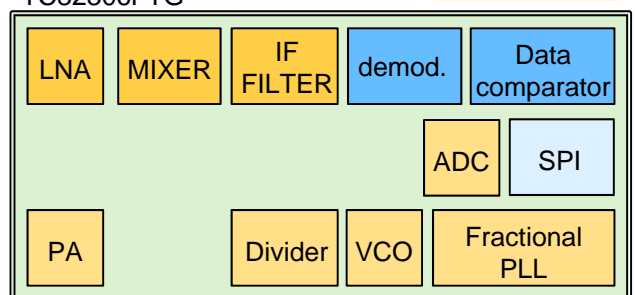- -116dBm@IFBW=320KHz, -117dBm@IFBW=260KHz

Low Power Consumption
- RX 9.7mA (FSK), TX 12mA@+10dBm output power
- BS：0μA (typ.)

Control Interface：SPI (4wire) , EEPROM

ES: Available
MP: Mar. 2012

TC32306FTG

MCU (32-Bit Microcontrollers)

Toshiba has been expanding its portfolio of application-specific standard products (ASSPs) that combine an ARM Cortex™-M3 core, which features high performance, high code density and low power consumption, with a Toshiba-original NANO FLASH™ memory, which features high-speed programming and low power consumption. With Toshiba's wide range of low-cost ARM Cortex™-M3 core-based ASSP offerings covering 8-bit to 32-bit, you can find the optimum solutions for your applications. Our product portfolio includes ASSPs specifically designed for digital TV, digital audio and motor applications, kitchen and home appliances, as well as industrial, office and automotive applications.

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.
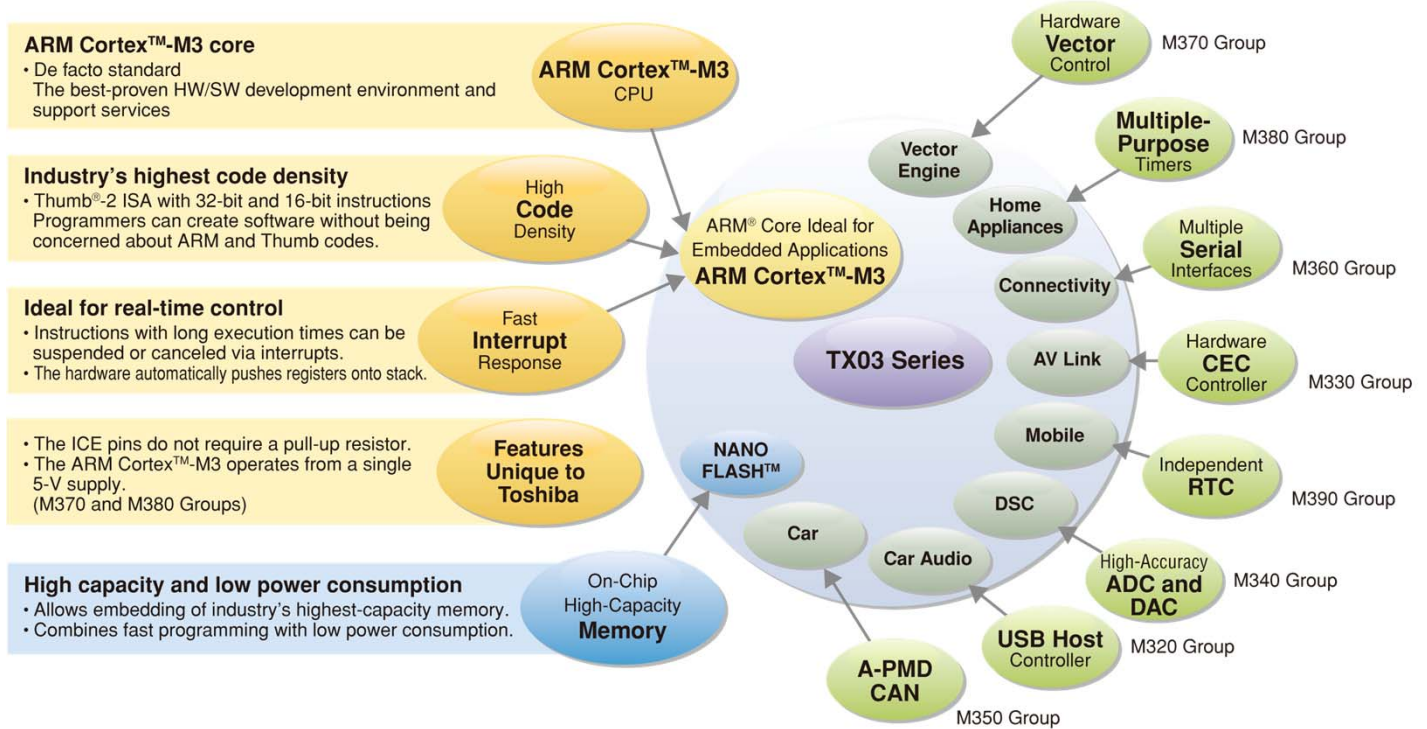
Product Groups with a 5-V Supply

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 (7 x 7 mm LQFP48)
● Application examples
 Washing machines, air conditioners, refrigerators, heat pumps, inverter-motor-controlled equipment

M370

PLL/CG	ARM Cortex™-M3	SIO/UART
Debug		Vector Engine
WDT	FLASH	PMD1
RTC	RAM	PMD2
OFD	12bit A/D 1	Encoder
16bit Timer	12bit A/D 2	AMP/CMP
	GPIO	

M380 Group — Multi-purpose timer 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

M380

PLL/CG	ARM Cortex™-M3		I²C/SIO
Debug			SIO/UART
WDT	FLASH		SSP
RTC	RAM	DMA	MPT
OFD	12bit A/D		PMD/Encoder
16bit Timer	RMC		AMP/CMP
	GPIO		

Product Groups with a 3-V Supply

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

M330

PLL/CG	ARM Cortex™-M3	I²C/SIO
Debug	FLASH	SIO/UART
WDT	RAM	
RTC	10bit A/D	CEC
16bit Timer	GPIO	RMC

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

PLL/CG	ARM Cortex™-M3	I²C/SIO
Debug	FLASH	SIO/UART
WDT	RAM / DMA	
RTC	12bit A/D	SSP
16bit Timer		
2-Phase Pulse Counter	10bit D/A	GPIO

M320 Group — USB-Host

● Features
   USB host controller
   System solutions that combine an MCU and an audio DSP
● Application examples
   Car and home audio systems

PLL/CG	ARM Cortex™-M3	I²C/SIO
Debug	eDRAM	SIO/UART
WDT	RAM	SSP
Ext BUS	10bit A/D	USB Host
16bit Timer	GPIO	SD Host

M360 Group — Multiple serial interfaces

● Features
   Large-capacity Flash memory
   Multiple serial interfaces (exp. CAN/USB/EtherMAC)
   Multi-purpose timer for Motor and IGBT control
● Application examples
   Printers, AV systems, digital appliances, PC peripherals,
   industrial equipment, network equipment, office equipment

M369

PLL/CG	ARM Cortex™-M3	I²C/SIO
Debug	FLASH	SIO/UART
WDT	RAM / DMA	SSP
RTC	12bit A/D	CAN
16bit Timer	10bit D/A	USB
MPT/PMD		
GPIO	RMC	EtherMAC

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

PLL/CG	ARM Cortex™-M3	I²C/SIO
Debug	FLASH	SIO/UART
WDT	RAM	SSP
RTC	10bit A/D	CEC
OFD		
16bit Timer	GPIO	RMC

Functions

Common Functions

● Cortex™-M3 core
● High-speed writing by NANO-Flash™ technology
● On-chip debug function
● ETM (embedded trace macro cell)
   Except some microcontrollers in the M370 Group
● Watchdog timer

Added Functions (Note 1)

	M320 Group	M330 Group	M340 Group	M350 Group	M360 Group	M370 Group	M380 Group	M390 Group
High-speed operation clock (80MHz or higher)	●			●	●	●		
Large-capacity Flash ROM (1MB or more)				●	●			
On-chip DRAM	●							
USB device / host	●				●			
CAN				●	●			
EhterMAC					●			
Motor control			● (Note 4)	●	●	●	●	
Vector Engine				●		●		
Low-voltage operation (1.7V or higher)								●
Single 5-V power supply						●	●	
High-accuracy analog IP (Note 2)			●	●	●	●		
Functions for audiovisual and home appliances (Note3)	●	●			●		●	●
Compact package (Note 5)			●		●			●
External bus interface	●		●		●			
JTAG boundary scan			●		●			

Note 1 : There are microcontrollers that do not contain some of the peripherals shown.
            For details, see appropriate datasheet.
Note 2 : Contains either analog circuitry for motor control or a 12-bit AD converter.
Note 3 : Contains a Consumer Electronics Control (CEC) unit, a remote control signal
            preprocessor or an I²S interface.
Note 4 : Ultrasonic motor controller
Note 5 : 9 x 9 mm or smaller packages

ASICs

To ensure competitiveness in the marketplace, one needs to produce more sophisticated, more technology-intensive and higher value-added products, using a process of technological innovation and systematic marketing. Toshiba's application-specific integrated circuits (ASICs) will give you an edge beyond your expectations. You can select from gate arrays that feature short turnaround times; cell-based ICs that are suitable for increased system integration and aggressive performance goals; and embedded arrays and universal arrays that combine high-performance functions of cell-based ICs with the gate array advantage of quick turnaround.

Benefits

### Comprehensive ASIC Capabilities from Design to Manufacture

Various Design Interface Levels from ASIC to COT-based Design

Toshiba provides a number of customer interface levels. You can select your level of design participation to push your design to optimal performance and make the best use of your in-house capabilities. You can involve with us as early or as late as you choose, at a variety of levels in the sequence of ASIC development, such as initial specification development; RTL design and verification; gate-level design; place-and-route; and prototyping.
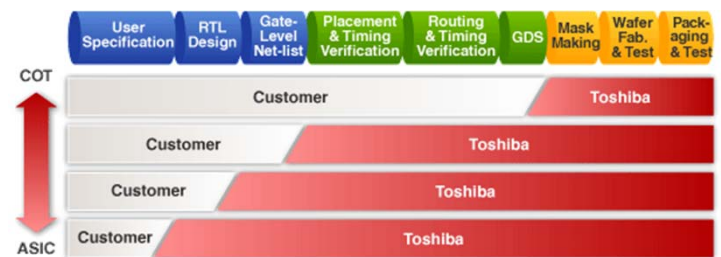

High-level Design Approaches

Toshiba has a lot of experiences of the high speed design like as the Cell processor. Toshiba realizes the design of GHz or more by using an original cell development technology and the unique design methodologies.


ARM Cortex™-A9 Processor
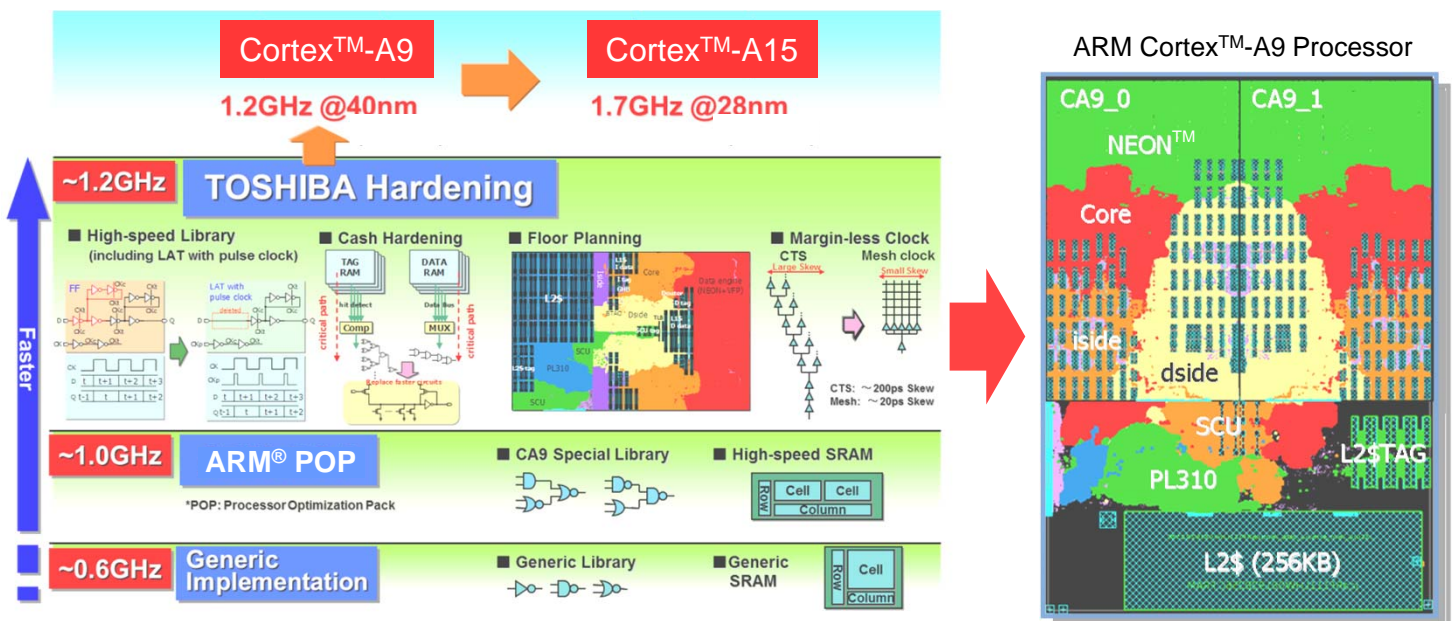
Lineup

Product Lineup

Toshiba's ASIC offers gate arrays that feature short turnaround times; cell-based ICs that are suitable for increased system integration and aggressive performance goals; and embedded arrays and universal arrays that combine high-performance functions of cell-based ICs with the gate array advantage of quick turnaround. You can choose an ASIC technology that best suits your schedule and design objective.
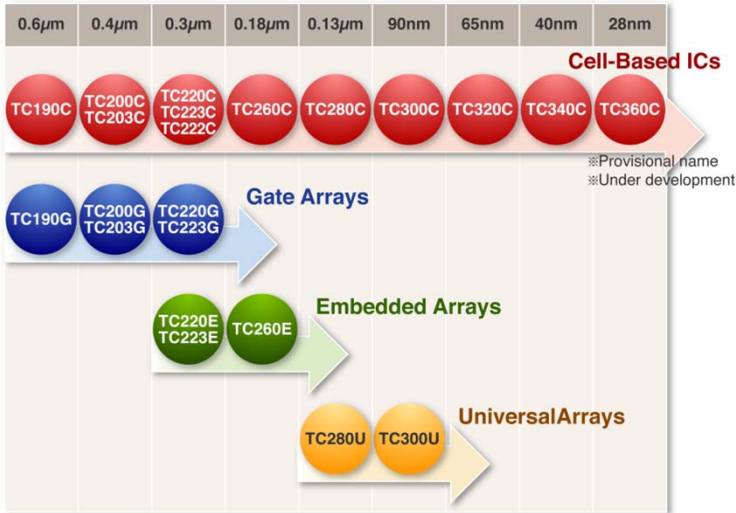

IP Lineup

While ASIC designs are becoming increasingly more complex, it is required to shorten their time-to-market. To address such situations, Toshiba offers various preverified IP, such as processors, digital and analog IP for the interface.
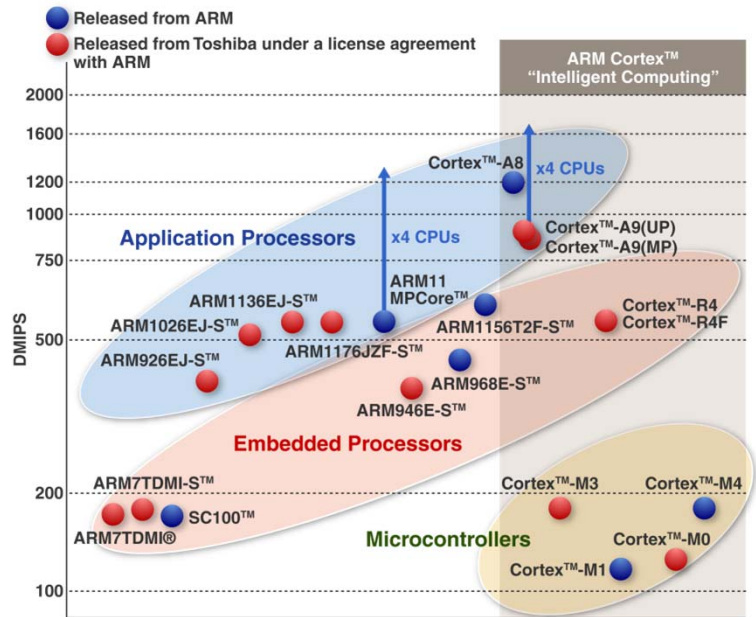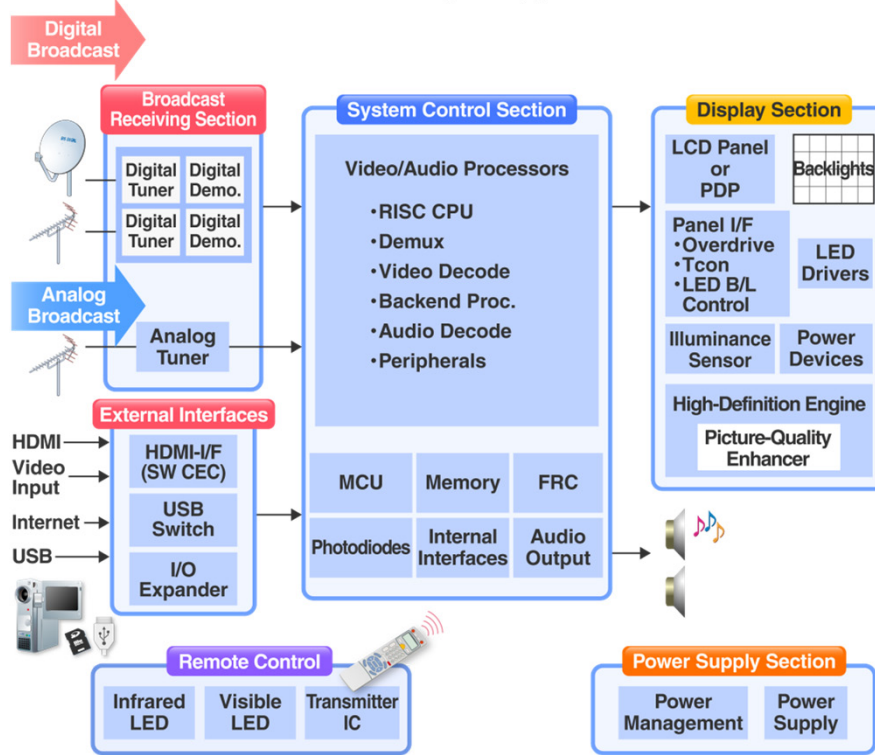

Packaging

Package requirements vary with each application system in which ASICs are incorporated. To satisfy all application needs, Toshiba offers a broad range of packaging options, based on small-form-factor and lightweight, low-profile, high-pin-count, high-speed and thermal dissipation technologies.
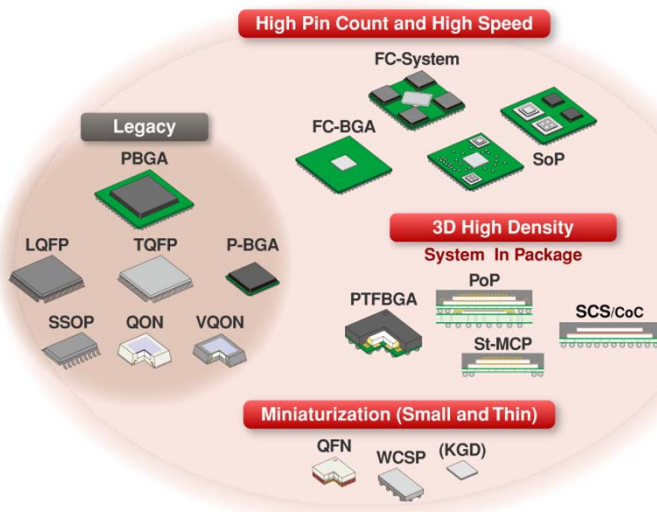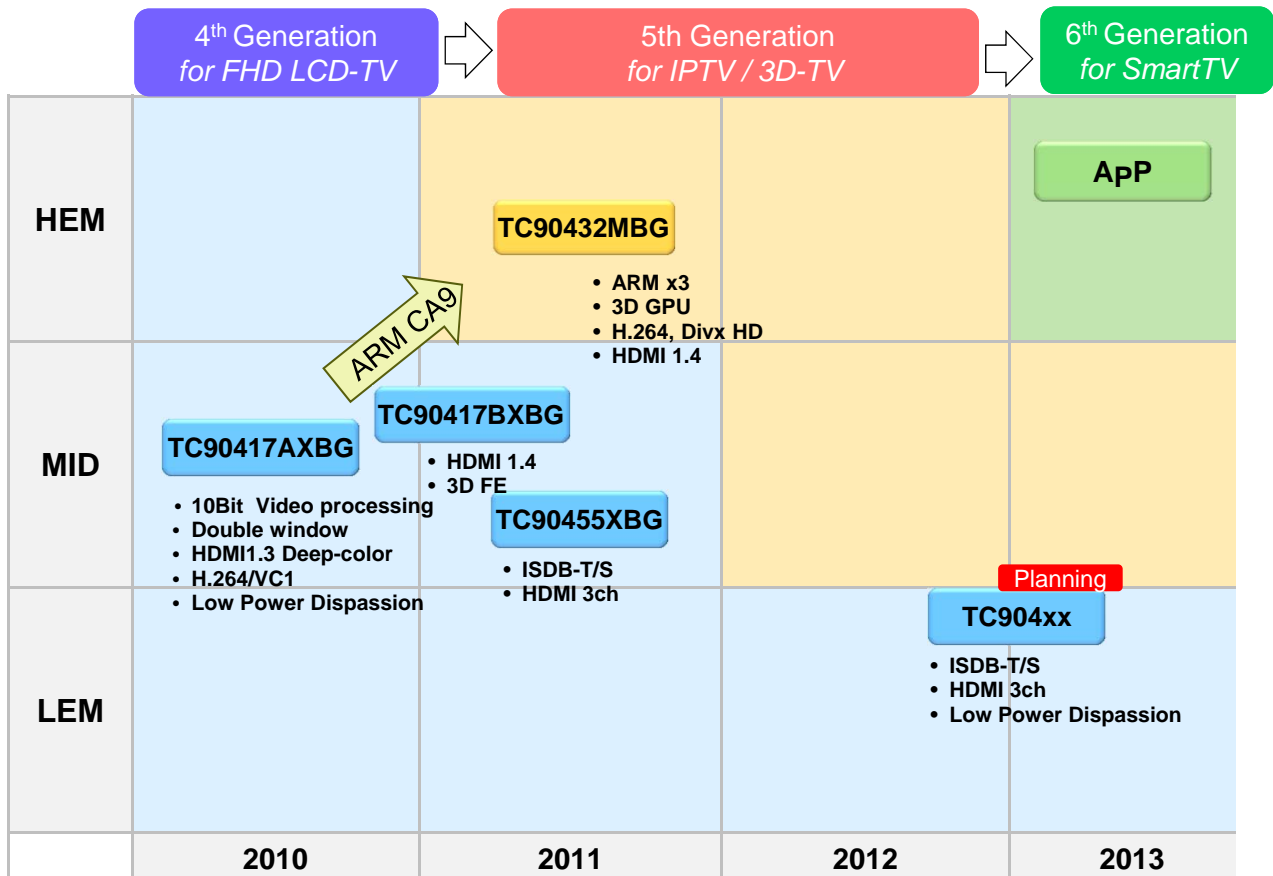

	Link	PHY		
	(Controller)	90nm	65nm	40nm
USB2.0 Host/Device (480Mbps)	Host : Available OTG : Available Device : Available	Available	Available	Available
USB3.0 Host/Device (5Gbps)	Host : Available Device : Available			Available
PCI Express® RC/EP (2.5Gbps)	Root : Available Endpoint : Available	Available	Available	Available
PCI Express® RC/EP (5.0Gbps)	Root : ~1Q/2012 Endpoint : ~1Q/2012			~1Q/2012
PCI Express® RC/EP (8.0Gbps)	Root : ~1Q/2012 Endpoint : ~1Q/2012			~1Q/2012
Serial ATA (1.5/3.0Gbps)	Host : Available	Available	Available	Available
Serial ATA (6.0Gbps)	Host : ~1Q/2012			~1Q/2012
HDMI™ Source (1.485Gbps)	Rev.1.4 : Available		Available	Available
HDMI™ Source (2.97Gbps)	Rev.1.4 : Available			
HDMI™ Sink (2.2275Gbps)	Rev.1.4 : Available	Available	Available	Available
HDMI™ Sink (2.97Gbps)	Rev.1.4 : Available			~1Q/2012
DDR2 (~667Mbps)	Available	Available	Available	
DDR2 (~800Mbps)	Available			Available
LPDDR21 (~667Mbps)	Available			Available
LPDDR2 (~800Mbps)	Available			~2Q/2012
DDR32 (800~1333Mbps)	Available		Available	Available
DDR32 (1066~1600Mbps)	Available			~1Q/2012
MIPI® D-PHY	Customization	Available	Available	Available
MIPI® M-PHY	Customization		~1Q/2012	
SD/SDIO Ver.2 HOST	Available			
SD/SDIO Ver.3 HOST (UHS-I)	Available			Available
UHS-II			~1Q/2012	

Digital TV

The evolution of television services knows no bounds. High-definition TV broadcasting provides outstanding picture and sound quality. Standard-definition broadcasting offers multichannel program and various data services, as well as television services for cell phones and moving vehicles such as automobiles. Additionally, we have Internet Protocol television (IPTV) services that provide a mixture of TV and Internet content, LED-backlit televisions, 3D televisions and so on. They are now used to enjoy pictures and videos from digital cameras, to record hours of TV programs and to send information bidirectionally via the Internet connection. Televisions are increasingly becoming more like "multimedia home stations." Toshiba offers total solutions for a wide range of applications from traditional analog TVs to state-of-the-art digital TVs.

Digital TV SoC Roadmap

|	4th Generation for FHD LCD-TV	5th Generation for IPTV / 3D-TV		6th Generation for SmartTV
HEM		**TC90432MBG** • ARM x3 • 3D GPU • H.264, Divx HD • HDMI 1.4		**ApP**
MID	**TC90417AXBG** • 10Bit Video processing • Double window • HDMI1.3 Deep-color • H.264/VC1 • Low Power Dispassion	**TC90417BXBG** • HDMI 1.4 • 3D FE **TC90455XBG** • ISDB-T/S • HDMI 3ch		
LEM				**Planning** **TC904xx** • ISDB-T/S • HDMI 3ch • Low Power Dispassion
	2010	**2011**	**2012**	**2013**

ARM CA9

TC90708FNG/FLG HDMI 1.4 Adapter

The HDMI 1.4 adapter IC can be used as an add-on to existing HDMI 1.3 systems to provide HDMI 1.4 compliance.

- Can be used as an add-on to existing HDMI 1.3 systems to provide HDMI 1.4 compliance.
- Supports HEC(HDMI Ethernet Channel) and ARC(Audio Return Channel).

Key Features and General Specifications
- Conversion between Ethernet and HEC
- S/PDIF support
- HDMI sink and source capabilities
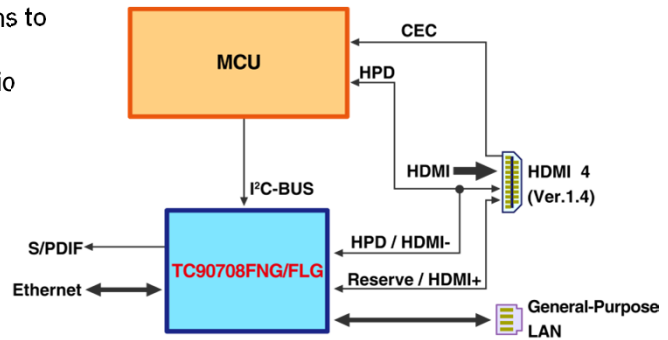
LED Driver

Part Number	Function	Input Voltage	Data Rate	Output Ratings	Package
TC62D722CFG / CFNG	16-ch, 16-bit PWM	3.0 to 5.5 V	30 MHz (max)	Output ratings: 17 V/ 90 mA × 16 ch 8-bit (256-step) output current calibration 16/14/12/10-bit PWM control	MFP / HTSSOP

Demodulation and Error Correction ICs

Toshiba leads the market for ISDB-T (digital terrestrial broadcast) and ISDB-S (digital satellite broadcast) demodulation ICs designed for digital TV (DTV), set-top box (STB), cellular phone, PC, automotive TV and other applications.

Part Number	Feature / Function	TV Standard	Output Format	Applications
TC90527	Single ISDB-T	ISDB-T	MPEG-2 TS	Digital Home Appliances
TC90532	Double Demodulator	ISDB-T ISDB-S	MPEG-2 TS	Digital Home Appliances
TC90522	Quad Demodulator	ISDB-T ISDB-S	MPEG-2 TS	Digital Home Appliances
TC90514	4-Branch Diversity + 1Segment	ISDB-T	MPEG-2 TS	Automotive Equipment
				Portable Equipment
TC90508	DTMB Demodulator	DTMB	MPEG-2 TS	Digital Home Appliances

● TC90508 : for China Digital Terrestrial Multimedia Broadcasting GB 20600-2006 (DTMB)

Full compliance with GB 20600-2006

Excellent C/N ratio and multipath reception performance

High-performance demodulator for real reception environments
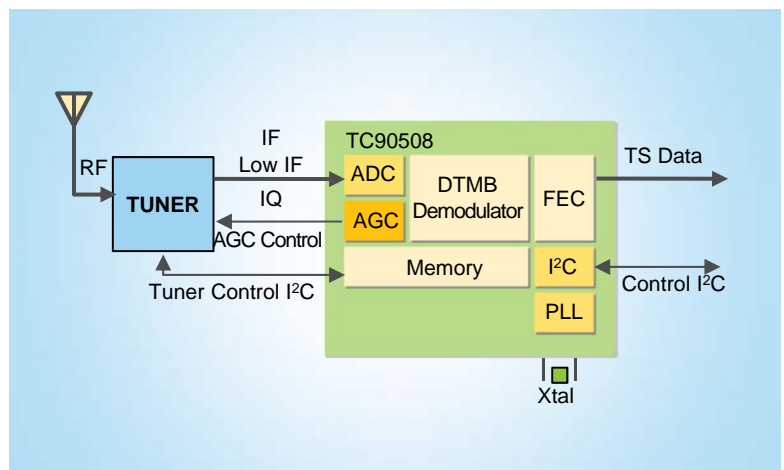
LED Driver

LED drivers are used in an increasingly wide variety of applications.
Toshiba offers a broad array of LED drivers featuring constant-current drivers with excellent LED current accuracy. Included in Toshiba's LED driver portfolio are not only standard LED drivers but also those with PWM dimming control, current gain control and various error detection functions. Toshiba's product lineups also include LED drivers with a DC-DC converter that are ideal for mobile equipment applications.

Panel Lineup

16 outputs

Product	MP Status	Gain Control	Error Detect	PWM Control	Output Current (mA)	Output Voltage (V)	Package
TB62747AFG	✓				45	26	SSOP24
TB62747AFNG	✓				45	26	VSOP24
TC62D748CFG	✓				90	17	SSOP24
TC62D748CFNAG	✓				90	17	QSOP24
TC62D749CFG	✓				90	17	SSOP24
TC62D749CFNAG	1Q/2012				90	17	QSOP24
TC62D776CFG	1Q/2012	✓	✓		90	17	SSOP24
TC62D776CFNAG	1Q/2012	✓	✓		90	17	QSOP24
TC62D776CFNG	1Q/2012	✓	✓		90	17	HTSSOP24
TC62D722CFG	1Q/2012	✓	✓	✓	90	17	SSOP24
TC62D722CFNAG	1Q/2012	✓	✓	✓	90	17	QSOP24
TC62D722CFNG	✓	✓	✓	✓	90	17	HTSSOP24
TC62D723FG	1Q/2012	✓	✓	✓	90	17	SSOP24
TC62D723FNAG	1Q/2012	✓	✓	✓	90	17	QSOP24
TC62D723FTAG/FTBG	1Q/2012	✓	✓	✓	90	17	QFN24
TC62D723FNG	1Q/2012	✓	✓	✓	90	17	HTSSOP24
TB62720FG	✓	✓	✓	✓	90	26	HQFP64

8 outputs

Product	MP Status	Gain Control	Error Detect	PWM Control	Output Current (mA)	Output Voltage (V)	Package
TB62777FNG	✓				50	25	VSOP16
TB62777FG	✓				50	25	MFP16
TB62783FNG	✓				50	25	VSOP16
TB62596FNG	✓				50	38	VSOP16

9 outputs

Product	MP Status	Gain Control	Error Detect	PWM Control	Output Current (mA)	Output Voltage (V)	Package
TB62779FNG	✓			✓	50	28	VSOP20
TB62781FNG	✓			✓	50	28	VSOP20

3ch LED Driver

Product	Function	Vin(V)	Output Current	Number of LED	Package
TCA62723FMG	3ch Driver	2.8 to 5.5	150mA(max)/ch	3 parallel	SON10
TCA62724FMG	3ch (I^{2}C Interface)	2.8 to 5.5	150mA(max)/ch	3 parallel	SON10

LCD Backlighting Lineup

For portable type LCD	For middle size LCD	For large size LCD
1-4 inch	4-15 inch	More than15 inch

DSC
Mobile Phone
Digital Audio Player
Portable Game
DVD Player
Car Navigation
Note PC
PC Monitor
LCD TV

LED2-10pcs IF=10-30mA	LED 8-75pcs IF=20-150mA	LED More than 75pcs IF= More than 100mA

TB62752AFUG/755FPG

TB62771FTG (Under development)

TB62758FTG
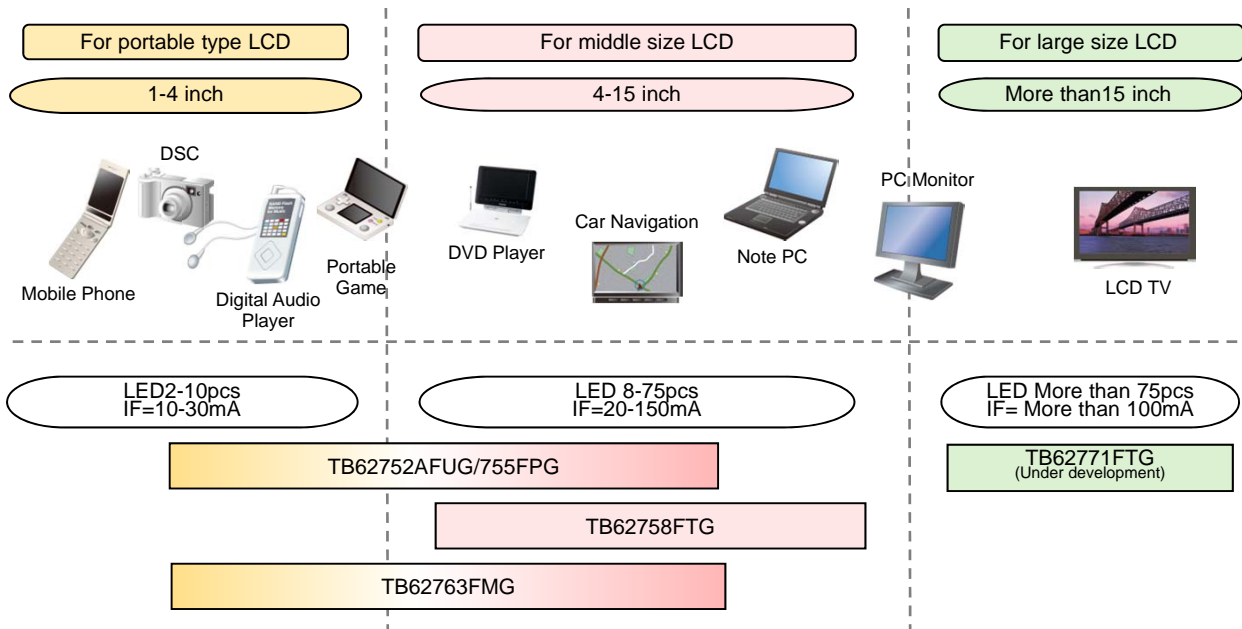
TB62763FMG

White LED Driver

Product	Function	Vin(V)	Output Current	Number of LED	Package
TB62752AFUG	Switching type DC-DC Converter	2.8 to 5.5	20mA(typ.)	2-8 series	SOT23-6
TB62755FPG	Switching type DC-DC Converter	2.8 to 5.5	20mA(typ.)	2-8 series	PLP-6
TB62763FMG	Switching type DC-DC Converter	5	80mA	2-6 series	SON8
TB62758FTG	Switching type DC-DC Converter	6.8 to 22	25mA(max)	6chx10series	VQON24

3ch LED Driver

Product	Function	Vin(V)	Output Current	Number of LED	Package
TCA62723FMG	3ch Driver	2.8 to 5.5	150mA(max)/ch	3 parallel	SON10
TCA62724FMG	3ch (I^{2}C Interface)	2.8 to 5.5	150mA(max)/ch	3 parallel	SON10

Power Management

Business Field

System Regulator

DSC/DSLR

DSLR：TC7733FTG

TV, AV

Mobile

USB DC/DC Quick Charge：TC7710WBG

Wireless Charger：TB6860WBG/TB6865FG

for DDR Memory
for Graphic Chip ：TC7731FTG

Sub-regulator：TC7732FTG

Digital Regulator

Communication/
Server

PFC

AC-DC
LED Lighting/Adapter

Network

PFC：TB6818/19FTG

Digital Regulator(DC-DC)：TC7750/51FTG
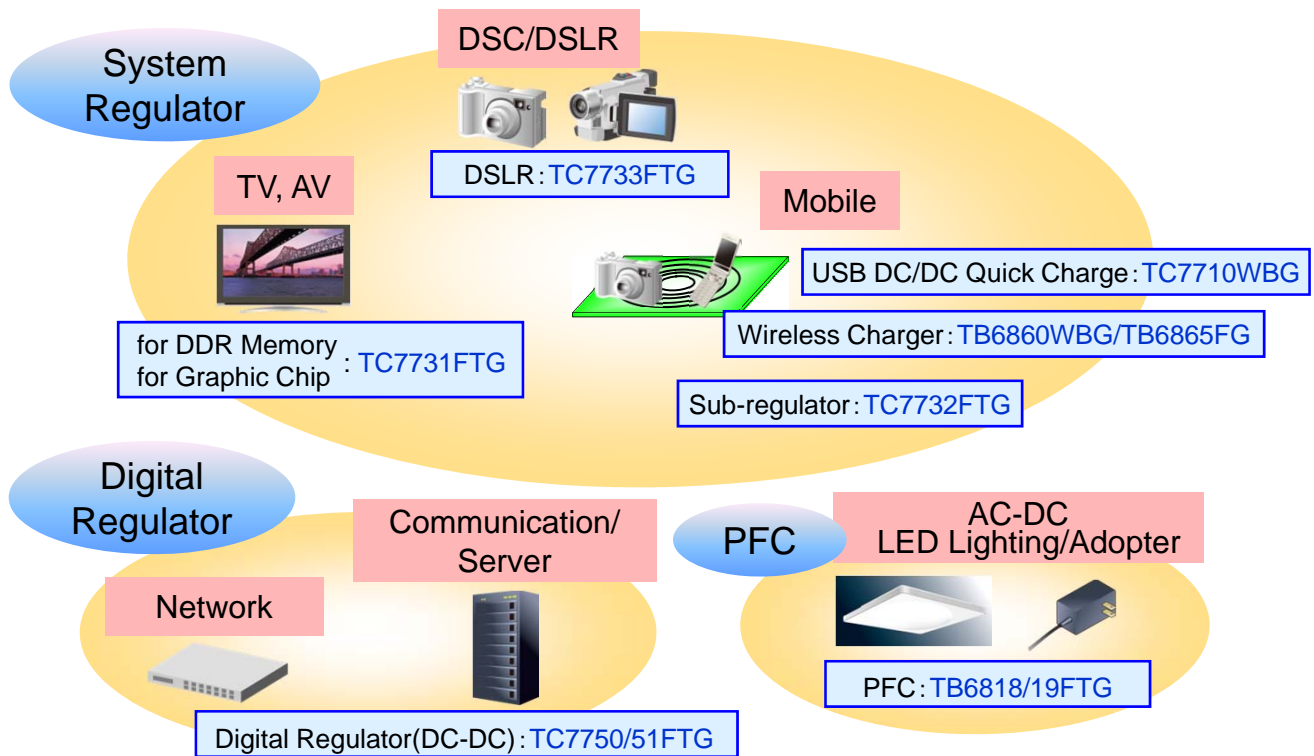
Features & Technologies

System regulators

For various kind of applications
  • Digital TV (DDR2/DDR3 memory)
  • WiMAX™
  • Mobile phone
  • Digital still camera (DSC)
  • Digital single-lens reflex camera (DSLR)
  • Car audio head unit

Digital DC/DC Converters

Dynamic voltage selection & Diagnostic functions
  • Bus communication function
  • Sequencer (Rise/ Fall time setting)
  • Dynamic voltage selection
  • Diagnostic for output voltage, current & temperature
  • Log function of trouble records (External E^2PROM)
Low current consumption and die size reduction by hard logic structure

PFCs

  • CCM for high power applications
  • CRM for mid to low power applications
     (CCM : Continuous Conduction Mode)
     (CRM : Critical Conduction Mode)

Wireless Power Charger

WPC compliance (Qi)
Inductive coupling method
Free positioning charger system

Lineup

Category	Parts Number	ES	CS
System Regulator	TC7731FTG (for DDR2/3)	Available	2Q/2012
	TC7732FTG (for Mobile)	Jan/2012	2Q/2012
	TC7733FTG (for 2-cell)	2Q/2012	3Q/2012
	TC7710WBG (for 1Cell Charger)	Feb/2012	3Q/2012
	TB6860WBG (Wireless Charger RX)	Feb/2012	2Q/2012
	TB6865FG (Wireless Charger TX)	Feb/2012	2Q/2012
Digital DC/DC Converter	TC7750FTG (3A)	Available	2Q/2012
	TC7751FTG (Controller-IC)	Available	2Q/2012
PFC	TB6818FG (CCM)	Available	Available
	TB6819FG (CRM)	Available	Available

Audio

Product Development Concept

Various types of digital audio systems have been brought to the market along with the advancement in digital technology.
Particularly, the popularity of portable digital audio players has been soaring today. Those players use a memory card or HDD as recording media to store music data with such high-level compression formats as MP3, WMA, or AAC.
Digital audio systems are spreading into the world of not only portable audio players but also car audio equipment.
Toshiba provides dedicated ICs to support those systems, and also an extensive lineup of peripheral devices.

For Mobile Phone
- Headphone Amp
- Speaker Amp
- Microphone Amplifier
- Noise/Echo Cancellation

For Car audio
- MP3/WMA/AAC/SBC
- DRM
- CD/SD/USB System
- 4ch Power Amplifier
- Digital Tuning System

High quality sound

For Portable audio
- MP3/WMA/AAC
- NAND Flash Controller
- AD/DA Converter
- Headphone Amplifier

- Surround system (Dolby®/dts™)
- Virtual sound
- D-class Amplifier
- MP3/WMA/AAC/SBC
- DRM
- CD/SD/USB system

For Home audio & TV

Mobile Audio

Toshiba is developing Echo and Noise Cancel Audio Codec ICs for Mobile and Smart Phone .

Amplifier for
- Headphone (Class-G)
- Speaker (Class-G, Class-D)
- Microphone (with ADC)

Audio codec
- 1Mic Noise & Echo cancellation
- For Mobile phone/ portable audio
- I²S I/F
- AD/DA converter

Audio CODEC (Under Development)

Base Band Processor

Application Processor

Audio Codec
AD/DA
Audio DSP
(Echo canceller/ Noise Canceller, Equalizer, etc)

Speaker Amp

TC94B06WBG G-Class
TC94B15WBG DAC+G-Class
Headphone Amp

JBTC94B12
Digital Mic. Amp

TC94B23WBG
Speaker Amp
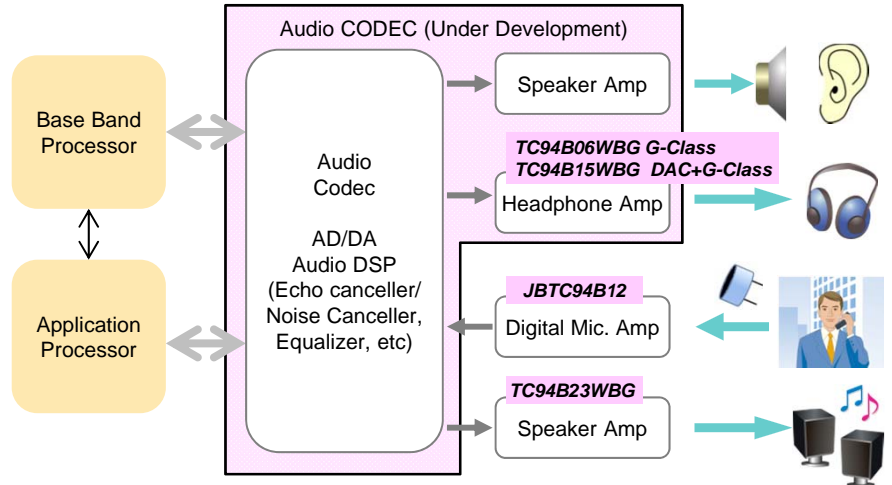
Audio Codec , Headphone Amp and Speaker Amp RoadMap

Digital Microphone Amp	**JBTC94B12-AS** 1st Gene: Low Noise PDM Output	**S/N Improvement**	**JBTC94Bxx-AS** ES: 3Q/2012 MP: 4Q/2012 2nd Gene: Low Ultra Noise PDM Output
Headphone Amp	**TC94B06WBG** G-Class Stereo Amp Electric Volume	**+DAC** → **TC94B15WBG** G-Class Stereo Amp DAC Electric Volume	
Speaker Amp		**TC94B23WBG** ES: 1Q/2012 MP: 2Q/2012 1.7W D-Class Mono Amp DC-DC Conv.	**TC94ByyWBG** **Stereo** 2W D-Class Stereo Amp DC-DC Conv.
CODEC	**MP** **Under Development** **Planning**	**TC94B24WBG** ES: 1Q/2012 MP: 4Q/2012 2-ADC(Mic-in), 2-DAC(Line out) Mono SP Amp, Stereo HP Amp DSP with Echo & Noise cancel	**TC94BzzWBG** **Cut Down** 1ADC(Mic-in) 2-DAC(Line out) SP Amp, HP Amp
	2010	**2011**	**2012**

Home and Car Audio

Toshiba is No1 Audio semiconductor solution provider by CD, MP3, Power Amp, MCU, USB Audio, BT Audio, SW, Volume Technology for Home Audio and Car Audio. Toshiba can provide whole Audio solution.
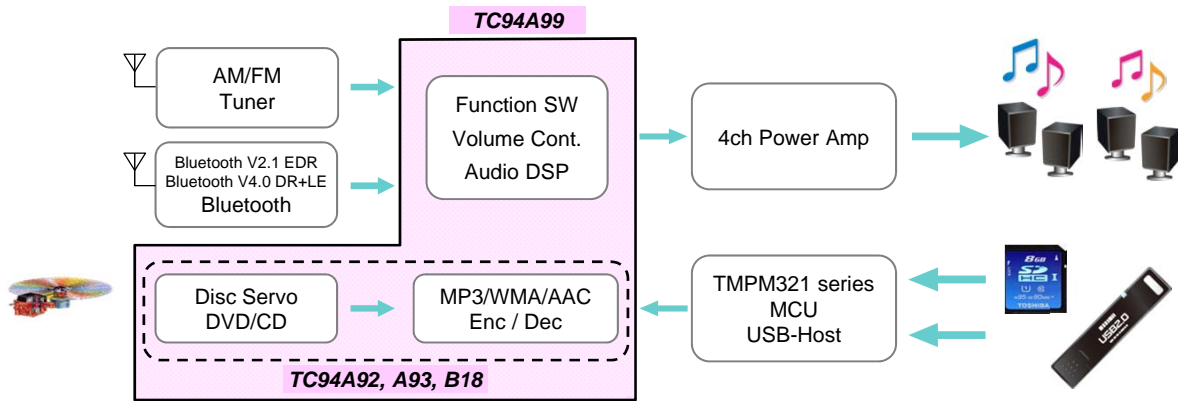
CDMP3/CD less Car Audio system
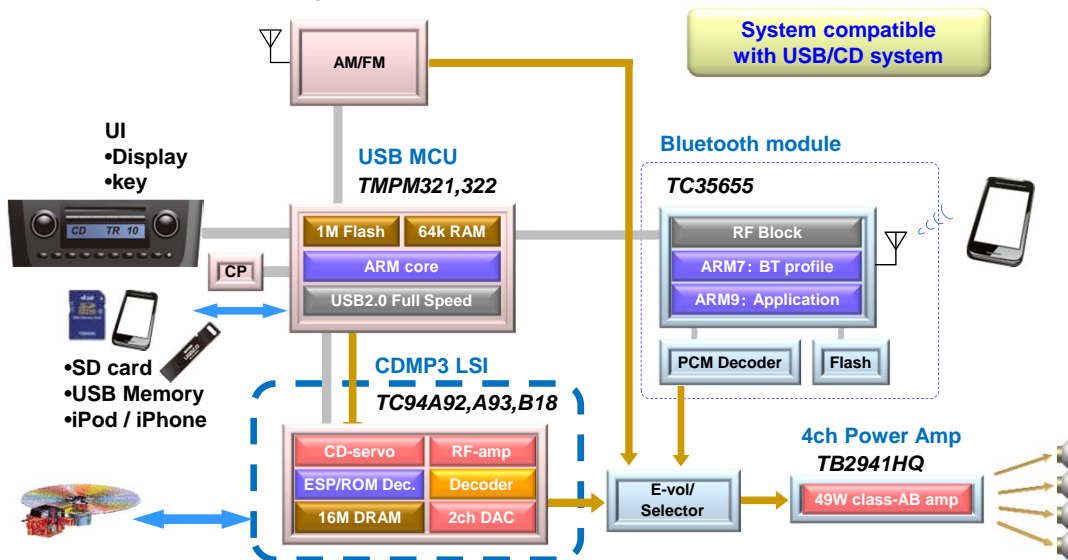
4ch Power Amp for Car audio RoadMap

*Maximum Output Power @ Vcc=15.2V, RL=4Ω

	BiCD 0.13 Process		
High Power & Premium Sound	**TB2931HQ** *49Wx4ch 2Ω load drive capability 25pin:offset,short, Rareshort det. **TB2938HQ** *49Wx4ch 25pin:offset,short, Rareshort det. Speaker current limiting	**TB2941HQ** ES: Available MP: 2Q/2012 *49Wx4ch 2Ω load drive capability 25pin:HSW,offset ES: 2Q/2012 MP: 3Q/2012	**Class-D** *100Wx4ch ES: 1Q/2013 MP: 3Q/2013 **Class-KB I²S, Self Diag** *49Wx4ch ES: 3Q/2013 MP: 1Q/2014
Intelligent Power		**TB2952HQ** *49W × 4ch Class AB + I²C	ES: Available MP: 1Q/2013
Class KB		**TB2925HQ** *49W × 4ch ES: 2Q/2012 Class KB MP: 4Q/2012	**TB2975HQ** *49W × 4ch Class KB + I²C **MP** **Under Development**
Slim Power	**TB2959HQ** *47W × 4ch, 25pin:AUX-IN	**TB2959KG** ES: Available MP: 2Q/2012	**Planning**
	2011	**2012**	**2013 -**

- 16 -

Automotive

Business Field

▶ Powertrain
- Combustion engine control system
- Automatic transmission
- Hybrid car motor
- Brushless DC motor for mileage management
- Brushless DC motor for fuel pumps
- Oxygen sensor for air-fuel ratio

▶ Chassis and Safety Systems
- Anti-lock brake system (ABS)
- Electronic stability control (ESC)
- Electronic power steering system (EPS)
- Airbags
- Collision avoidance: Millimeter-wave radar
- Collision avoidance: Ultrasonic sonar
- Four-wheel-drive (4WD) control

▶ Body
- Battery and energy management
- Body control unit
- Air-conditioner flap motor
- Air-conditioner blower motor (brushless/brushed)
- Brushless DC motor for water pumps
- Brushless DC motor for oil pumps
- Adaptive Front-lighting System (AFS)
- Door mirrors
- Power windows
- LED headlights

Mixed-signal Devices

To meet the needs of many automotive electronic systems, Toshiba offers hybrid ICs that integrate analog, digital and power devices all on the same chip.

In recent years, market demands are growing for mixed digital/analog devices and on-chip integration of a power output circuit. To meet these demands, Toshiba employs a BiCD process, which integrates bipolar transistors, CMOS logic and a high-voltage and huge-current power MOSFET. The integration of low on-resistance power MOSFET helps reduce power consumption. This simplifies thermal design, making it possible to use smaller packages.

□ **BiCD combines Bipolar, CMOS and DMOS**

Toshiba developed the BiCD process to improve current drive efficiency and reduce power consumption.

High-Accuracy Analog Circuitry
Bipolar

Large Logic
CMOS

High Power & High Breakdown Voltage
DMOS

Bipolar: Analog Circuit
CMOS: Large-Scale Integration
DMOS: High Voltage & High Current Drive

Toshiba offers high-quality and high-performance devices that integrate various interfaces, power drivers and complex logic blocks on a single chip. Toshiba supports custom development of various automotive ICs and SoCs. In recent years, Toshiba has offered custom development services for ICs and SoCs targeted for next-generation eco-friendly cars such as hybrid electric vehicles (HEVs), plug-in hybrid vehicles (PHVs) and electric vehicles (EVs).

Mixed-signal ASSPs

☐ Motor Driver ICs

Toshiba offers a wide spectrum of three-phase BLDC and brushed DC motor driver ICs. Toshiba is expanding its product portfolio with motor drivers featuring an output stage as well as those which integrate an MCU in a system-in-package (SiP).

Brushed DC Motor Driver IC Lineup

Part Number	Input	Output Current	Output	Power Supply	Features & Functions	Package	Status
TB9056FNG	LIN	±0.3 A	Direct	BATT (On-chip 5-V reg.)	H bridge (1 ch) LIN 1.3 (slave)	SSOP24-P-300-0.65A	MP available
TB9100FNG	SPI	±0.5A	Direct	BATT	H-bridge (3 ch) SPI interface	SSOP24-P-300-0.65A	Under development
TB9110FNG	PWM	±0.02A	Predrivers N-ch	BATT (On-chip 5-V reg.)	1-channel brushed DC motor predriver On-chip charge pump (An external N-channel FET required)	SSOP24-P-300-0.65A	Under development
TB9101FNG	Direct	±0.5A	Direct	BATT	H-bridge (2 ch) DMOS power transistor version of the TA8083FG	SSOP24-P-300-0.65A	Planning

Brush-less DC Motor Driver IC Lineup

Part Number	Input	Commutation	Output	Power Supply	Features & Functions	Package	Status
TB9060FNG	PWM	120°	5V CMOS	5 V	Simple logic IC consisting of only a 3-phase sensorless controller	SSOP24-P-300-0.65A	MP available
TB9061FNG	PWM, DC voltage	120°	Predrivers P-ch/N-ch	BATT (On-chip 5-V reg.)	Simple application circuit with only a few external parts Support for slow PWM inputs; overcurrent detection; sensorless control	SSOP24-P-300-0.65A	MP available
TB9065FG	UVW phase signals	External control	Predrivers N-ch/N-ch	BATT (On-chip 5-V reg.)	All-in-one charge-pump predriver used in tandem with an MCU; LIN 1.2 transceiver; 5-V regulator; watchdog timer; comparators for sensors	QFP64-P-1212-0.65A	MP available
TB9067FNG	PWM, DC voltage	120°	Predrivers P-ch/N-ch	BATT (On-chip 5-V reg.)	Only a few external parts required; support for both PWM and DC inputs; 120° six-step commutation; comparators for sensors	SSOP24-P-300-0.65A	MP available
TB9068FG	PWM, phase signals	120° External control	Direct	BATT (On-chip 5-V reg.)	Allows direct drive of a motor with on-chip 0.3-A drivers. LIN 1.3 transceiver; 5-V regulator	LQFP48-P-0707-0.50	MP available
TB9080FG	PWM	Sine wave	Predrivers N-ch/N-ch	BATT (On-chip 5-V reg.)	Quiet motor operation due to the use of sine-wave current High drive efficiency thanks to auto lead angle control	QFP64-P-1010-0.50C	Under development
TB9063	PWM, DC voltage	Pseudo-sine wave	Predrivers N-ch/N-ch	BATT (On-chip 5-V reg.)	Sensorless drive and quiet motor operation Auto lead angle control and pseudo-sine-wave drive	Under review	Planning

☐ System Power Supply ICs

As an increasing number of electronic devices find their way into automobiles, it is becoming an urgent requirement to reduce their operating current. To address this need, Toshiba offers the TB900x low-standby-current system power supply IC series featuring industry-leading operating current.

System Regulator IC Lineup   *: Under Development

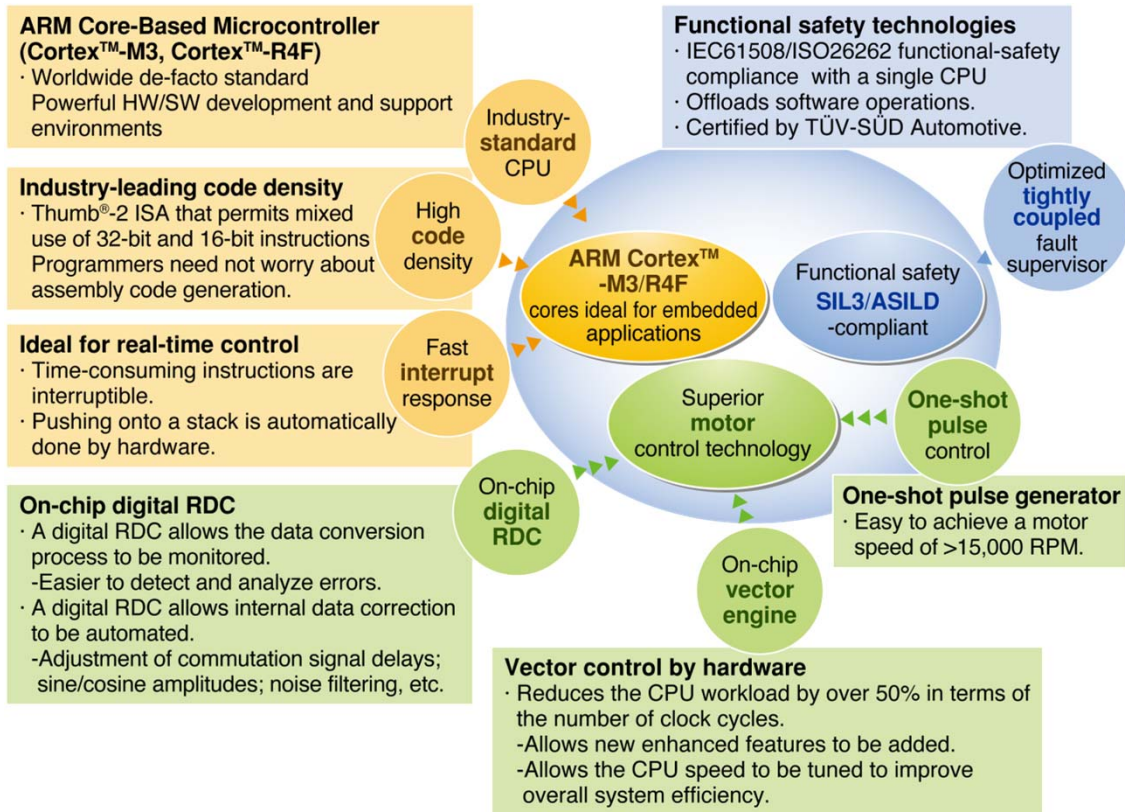| Part Number	Package	Functions	Characteristics				Remarks	Supply Voltage (V)
			Output Voltage Typ. (V)	Output Current (mA)	Input Voltage Max (V)	Power Dissipation Max (W)		
TB9000FG	SSOP16-P-225-1.00A	CPU voltage regulator, Watchdog timer	5.0	10 (Max)	45 (1 sec.)	0.6	•Low current consumption: 120 µA (typ.) •Watchdog timer enable/disable •Reset detection: 4.7 V •External transistor required	6 to 16
TB9000AFG	SSOP16-P-225-1.00A	CPU voltage regulator, Watchdog timer	5.0	10 (Max)	45 (1 sec.)	0.6	•Low current consumption: 120 µA (typ.) •Watchdog timer enable/disable •Reset detection: 4.2 V •External transistor required	6 to 16
TB9000CFNG	SSOP20-P-225-0.65A	CPU voltage regulator, Watchdog timer	5.0	10 (Max)	45 (1 sec.)	0.6	•Low current consumption: 120 µA (typ.) •Watchdog timer enable/disable •Reset detection: 4.7 V •External transistor required	6 to 16
TB9001FNG	SSOP20-P-225-0.65A	CPU voltage regulator, Watchdog timer	5.0	5 (Max)	45 (1 sec.)	0.6	•Low current consumption: 95 µA (typ.) •Internal 32-kHz clock •External transistor required	6 to 16
TB9004FNG	SSOP24-P-300-0.65A	CPU voltage regulator, Watchdog timer	3.4/2.5/1.5 5.0	10 10 (Min)	45 (1 sec.)	0.85	•Low current consumption: 0 µA (VCC1/2: off) (typ.) •3.4/2.5/1.5 V selectable •Two reset pins •External transistor required	6 to 16
TB9005FNG *	SSOP20-P-225-0.65A	CPU voltage regulator, Watchdog timer	5.0	10 (Min)	45 (1 sec.)	0.6	•Low current consumption: 90 µA (typ.) •Watchdog timer enable/disable •Reset detection: 4.7 V or 4.2 V (selectable) •External transistor required	6 to 18
TB9006FG	HSOP36-P-225-0.65A	CPU voltage regulator, Watchdog timer	5.0 5.0	250 250 (Max)	45 (1 sec.)	2.0	•Low current consumption: 0 µA (Regulator function: OFF) •On-chip output transistor 5V regulator •5V tracking regulator •VTH : Selectable from 4.2 V and 4.7 V	7 to 18

Switching Regulator IC Lineup   *: Under Development

Part Number	Package	Functions	Characteristics				Remarks	Supply Voltage (V)
			Output Voltage Typ. (V)	Output Current (mA)	Input Voltage Max (V)	Power Dissipation Max (W)		
TB9040FTG *	QFN36-P-0606-0.50	Low output voltage two regulators, Switching power supply and series regulator	2.8 1.5	50 130 (Max)	40 (1 sec.)	4.5	•Low voltage output and high efficiency two regulators •On-chip output transistor •Voltage monitor function	6 to 18
TB9041FTG *	QFN36-P-0606-0.50	CPU voltage regulator, Switching power supply and series regulator, On-chip watchdog timer	3.3/1.5/1.2 5.0 5.0	200 400 100 (Max)	40 (1 sec.)	4.5	•Low current consumption: 0 µA (Regulator function : OFF) •Selectable from 3.3 V, 1.5 V and 1.2 V. •Two reset pins •On-chip output driver (External transistor is supported.)	7 to 18

Automotive

Microcontrollers

Toshiba has been moving host processors to RISC architecture. After acquiring a license for the ARM Cortex™ series, Toshiba has further sped up the migration to RISC.

ARM Core-Based Microcontroller (Cortex™-M3, Cortex™-R4F)
· Worldwide de-facto standard
  Powerful HW/SW development and support environments

Industry-leading code density
· Thumb®-2 ISA that permits mixed use of 32-bit and 16-bit instructions
  Programmers need not worry about assembly code generation.

Ideal for real-time control
· Time-consuming instructions are interruptible.
· Pushing onto a stack is automatically done by hardware.

On-chip digital RDC
· A digital RDC allows the data conversion process to be monitored.
  -Easier to detect and analyze errors.
· A digital RDC allows internal data correction to be automated.
  -Adjustment of commutation signal delays; sine/cosine amplitudes; noise filtering, etc.

Functional safety technologies
· IEC61508/ISO26262 functional-safety compliance with a single CPU
· Offloads software operations.
· Certified by TÜV-SÜD Automotive.

One-shot pulse generator
· Easy to achieve a motor speed of >15,000 RPM.

Vector control by hardware
· Reduces the CPU workload by over 50% in terms of the number of clock cycles.
  -Allows new enhanced features to be added.
  -Allows the CPU speed to be tuned to improve overall system efficiency.

❑ Lineup

Toshiba is expanding its portfolio of automotive microcontrollers, ranging from its original 8-bit MCUs to the ARM Cortex™-based ones.

Flash Memory	Frequency	Application			
		EPS	HEV/EV 1Motor	HEV/EV 2Motor	VSC/ABS
1MB	160MHz			TMPM45X A-PMDx2 RDCx2 fR 176pin	
1MB	up to 100MHz		TMPM354 A-PMD RDC fR 144pin		Flexray fR 144pin
512KB	up to 64MHz	TMPM350 PMD fR 100pin	A-PMD RDC fR 144pin		
256KB	up to 64MHz	PMD RDC fR 64pin	A-PMD RDC 100pin		fR 100pin
128KB	up to 20MHz	PMD RDC 64pin			

Cortex™-R4
Cortex™-M3

PMD : **P**rogrammable **M**otor **D**river
A-PMD : **A**dvanced **PMD**
RDC : **R**esolver to **D**igital **C**onverter
fR : fault **R**obustness

M350 Group

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

Instrument Cluster & Head-up Display (HUD)

The evolution of automobiles is spurring the need for an instrument panel capable of displaying new kind of information such as the amount of regenerative energy generated by hybrid electric vehicles (HEVs) or presenting driving information on a head-up display (HUD).
Using a graphic display provides greater design flexibility since it can dynamically change the displayed information according to situations.

◻ High-End Instrument Panel

Illustrated in figure is a fully digital instrument panel that uses computer graphics to present all information such as a speedometer on a TFT LCD panel as large as DVGA. Use of computer graphics helps realize a flexible instrument panel that displays information only when necessary or uses different colors during daytime and nighttime. High image rendering performance is required to display the rotating meter needles smoothly. In addition, it is necessary to make provision for using an HUD and a standard instrument panel simultaneously. The TX4966XBG-280 and the TMPA970C20XBG provide two graphic display controllers (GDCs), thereby making it possible to connect two TFT LCD panels. In addition to a 2D graphics accelerator, the TX4966XBG-280 and the TMPA970C20XBG contain a 3D graphics accelerator ideal for high-resolution digital instrument panel applications.
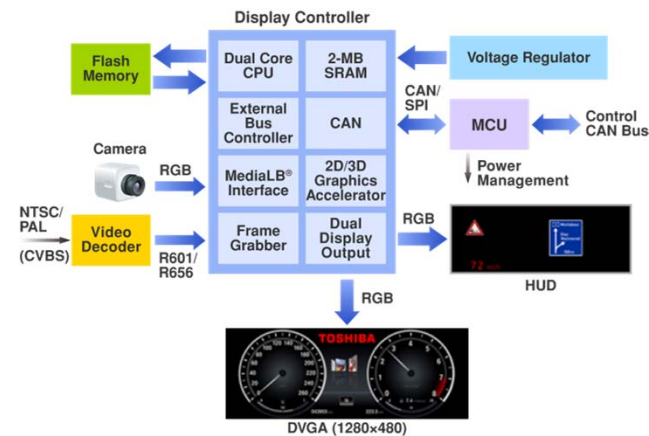
◻ Low-End to Mid-Range Instrument Panels

Illustrated in figure is an instrument panel that consists of a WQVGA to WVGA TFT LCD panel and mechanical meters. In order to present various information, it is necessary to connect the instrument panel to an in-vehicle LAN via a CAN bus. In addition, video inputs are required to display images from external video sources such as cameras and a car navigation system. The TX4961XBG-240 and TX4964FG-120 provide not only a 2D graphics accelerator and a display controller but also all the functions needed to realize such an instrument panel, including a CAN controller, an I^2C interface and timers.
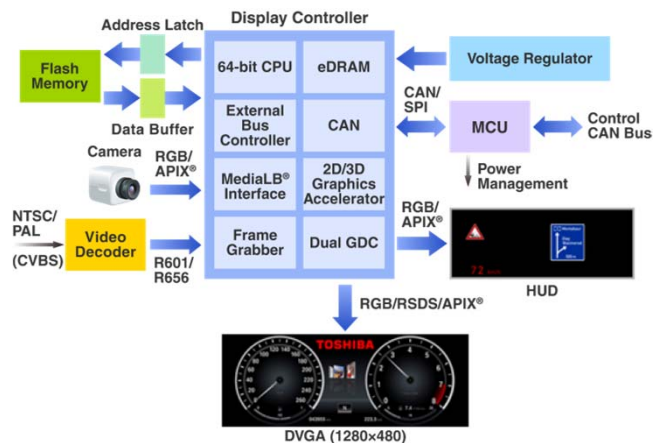
◻ Lineup

Display Controllers for High-End Instrument Panel

Part Number	Operating Frequency [MHz]	Embedded RAM	External DRAM	Graphics Accelerator	Display Output	Frame Grabber	Package
TX4961XBG-240	240	-	DDR-I	2D	1ch	1ch	PBGA456
TX4966XBG-280	280	8MByte	SDRAM	2D/3D	2ch	2ch	PBGA456
TMPA970C20XBG	336	2Mbyte	DDR-2	2D/3D	2ch	2ch	PBGA516

Display Controllers for Low-End to Mid-Range Instrument Panels

Part Number	Operating Frequency [MHz]	Embedded RAM	External DRAM	Graphics Accelerator	Display Output	Frame Grabber	Package
TX4961XBG-240	240	-	DDR-I	2D	1ch	1ch	PBGA456
TX4964FG-120	120	4MByte	-	2D	1ch	1ch	LQFP176

Video Decoders

Part Number	Package	Features & Functions	Operating Temperature	Supply Voltage
TC90105FG	LQFP80	2-channel color decoder; 2-channel AD converter ; newly developed HV dynamic enhancer ; color management ; dynamic YC gamma correction ; horizontal aberration correction ; 2.5-V voltage regulator	-40 to 85℃	1.4 to 1.6V 3.0 to 3.6V
TC90107FG	LQFP64	1-channel color decoder; 4-channel video input selector ; newly developed HV dynamic enhancer ; color management ; dynamic YC gamma correction ; horizontal aberration correction ; 2.5-V voltage regulator		

Motor Control Driver

Toshiba offers a range of motor drivers for various types of motors that are designed to meet the large-current, quick-control and high-precision needs of many kind of applications.

Business Field

DC Motor
- Brushed DC Motor
- Brush-less DC Motor
- Stepping Motor

Motor Driver IC
- H-bridge Driver
- Brush-less Motor Driver
- Stepping Motor Driver

OA Equipment
- Scanner
- Printers
- PPCs

Industrial Equipment
- Vending machines
- Slot machines
- Cashing machines
- Projectors

Battery Powered Appliance
- Play things
- DSCs
- Video recorders

Consumer Equipment & Home Appliance
- Washing machines
- Sewing machines
- Refrigerators
- Air conditioners
- Audio equipments

Advanced technologies

- Low Ron DMOS mixed process（BiCD)
- Micro-stepping for stepping motors
- Sine-wave PWM Drive for brush-less motors
- Automatic Lead Angle Control for brush-less motors
- Sensor-less driver with PWM operation
- Sensor-less drive with sine-wave current → Vector Control
- Safety measures
- Various kind of Package lineup

For OA and Industrial Equipment

Stepping Motor Driver IC Lineup
2 Phase Stepping Motor Control Driver IC [Phase Input Type]

* Mark: Under Development

	TB6562ANG /AFG	TB62206FG	TB62208FG /FTG/FNG	TB62218AFG /AFTG/AFNG	TB62213AFNG /AFTG/AFG /AHQ*	TB62210FNG	TB6674PG/FG /FAG
Process	40V	40V	40V	40V	40V	40V	24V
Motor Drive Current	1.5A	1.8A	1.8A	2.0A	3.0A	1.0A	0.4A(PG/FG) / 0.2A（FAG)
RON (H side + L side)	1.5Ω	1.1Ω	1.2Ω	1.0Ω	0.6Ω	1.2Ω	2.9Ω / 7.9Ω (power save)
Drive Mode	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor
Excitation Mode	W1-2 (1/4 Step)	1-2 (1/2 Step)	1-2 (1/2 Step)	W1-2 (1/4 Step)	W1-2 (1/4 Step)	W1-2 (1/4 Step)	2 (Full Step)
Interface	Phase (3bit)	Phase (2bit)	Phase(2bit)	Phase(3bit)	Phase(3bit)	Phase(3bit)	Phase(1bit)
Mixed Decay	-	✓	✓	✓	✓	✓	-
Package	SDIP24(1.78) /SSOP30(1.0)	HSOP20(1.0)	HSOP28(0.8) /QFN48(0.5) /HTSSOP(0.5)	HSOP28(0.8) /QFN48(0.5) /HTSSOP(0.5)	HTSSOP(0.5) /QFN48(0.5) /HSOP28(0.8) /HZIP25(1.27)*	HTSSOP24 (0/65)	DIP16(2.54) /HSOP16(1.00) /SSOP16(1.00)
Shutdown Circuit	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal

2 Phase Stepping Motor Control Driver IC [Clock Input Type]

	TB6608FNG	TC78S600FNG*/FTG*	TB62209FG	TB62214AFG/AFTG/AFNG	TB62215AFNG/AFTG/AFG/AHQ*	TB62210FNG	TB6560AHQ/AFG/AFTG	TB6600G*
Process	15V	18V	40V	40V	40V	40V	40V	50V
Motor Drive Current	0.8A	1.0A	1.8A	2.0A	3.0A	1.0A	3.5A/2.5A	5.0A
RON (H side + L side)	1.5Ω	1.2Ω	1.0Ω	1.0Ω	0.6Ω	1.2Ω	0.6Ω／0.7Ω	0.4Ω
Drive Mode	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor	1 Stepping Motor
Excitation Mode	2W1-2 (1/8 Step)	4W1-2 (1/16 Step)	4W1-2 (1/16 Step)	W1-2 (1/4 Step)	W1-2 (1/4 Step)	W1-2 (1/4 Step)	4W1-2 (1/16 Step)	4W1-2 (1/16 Step)
Package	SSOP20（0.65）	SSOP20（0.65）*/QFN24(0.5)*	HSOP36(0.65)	HSOP28(0.8)/QFN48(0.5)/HTSSOP(0.5)	HTSSOP(0.5)/QFN48(0.5)/HSOP28(0.8)/HZIP25(1.27)*	HTSSOP24 (0/65)	HZIP25 (1.27)/THQFP64 (0.5)/QFN48 (0.5)	HZIP25 (1.0)*
Shutdown Circuit	·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Over Current ·Thermal	·Thermal	·Over Current ·Thermal

2 Phase Stepping Motor Control Driver IC [4 in 1 type]

	TB62212FTAG/FNG
Process	40V
Motor Drive Current	1.5A(2 Stepping Motors) 2.0A(4 DC Motors)
RON (H side + L side)	2.2Ω(typ.) / H-bridge
Drive Mode	4DC Motors or 2Stepping Motors
Excitation Mode	1-2
Interface	Phase(2bit)
Package	QFN48(0.5) / HTSSOP48(0.5)
Shutdown Circuit	- Over Current - Thermal

Brushed DC Motor Driver IC Lineup

	TA8428FG/K	TB6549FG/PG/HQ
Process	Bipolar	BiCD0.8
VM	30V	30V
IO	2.4A / 3A	3.5A / 4.5A
Ch	1ch	1ch
PWM drive	Impossible	Direct PWM
I/F	Phase input (2bit)	Phase input (2bit)
ISD	✓	✓
TSD	✓	✓
Package	HSOP20(1.0)/HSIP-7(2.54)	HSOP20(1.0)/DIP16(2.54)/HZIP25(1.0)
RoHS	✓ (FG) Included only inside (K)	✓ (FG/PG) Included only inside (HQ)

ISD: Over current detection   TSD: Over heat detection

	TB6561NG/FG	TB6559FG	TB6568KQ	TB6643KQ	TB6569FG	TB6641FG	TB6642FG	TB6640FTG	TB6617FNG	TB6601HG*	TB62212FTAG/FNG
Process	BiCD0.6	BiCD0.6	BiCD0.6	BiCD0.6	BiCD0.6	BiCD0.6	BiCD0.6	BiCD0.13	BiCD0.6	BiCD0.13	BiCD0.6
VM	40V	50V	50V	50V	50V	50V	50V	40V	50V	50V	40V
IO	1.5A	2.5A	3.0A	4.0A/4.5A	4.0A/4.5A	4.0A/4.5A	4.0A/4.5A	3.0A	2.0A	5.0A	2.0A
ON resistance (Upper+Lower)	1.5Ω	1.3Ω	0.55Ω	0.55Ω	0.55Ω	0.55Ω	0.55Ω	1.0Ω	1.4Ω	0.4Ω	2.2Ω
Ch	2ch	1ch	1ch	1ch	1ch	1ch	1ch	1ch	1ch		4ch
PWM drive	Direct PWM	Direct PWM & Constant current PWM	Direct PWM	Direct PWM	Direct PWM & Constant current PWM	Direct PWM & Constant current PWM	Direct PWM	Direct PWM & Constant current PWM	Direct PWM	Direct PWM & Constant current PWM	Direct PWM & Constant current PWM
I/F	Phase input (2bit/ch)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)	Phase input (2bit)
ISD	✓	✓	✓ (Latch)	✓ (Latch)	✓ (Latch)	✓ (Latch)	✓ (Latch/Auto)	✓ (Latch/Auto)	✓ (Latch)	✓ (Latch)	✓ (Latch)
TSD	✓	✓	✓ (Latch)	✓ (Latch)	✓ (Latch)	✓ (Latch)	✓ (Latch/Auto)	✓ (Latch/Auto)	✓ (Latch)	✓ (Latch)	✓ (Latch)
Package	SDIP24 (1.78)/SSOP30 (0.65)	HSOP16 (1.0)	HSIP-7 (2.54)	HSIP-7 (2.54)	HSOP16 (1.0)	HSOP16 (1.0)	HSOP16 (1.0)	QFN48(0.5)	SSOP16 (0.65)	HZIP25(1.0)	QFN48 (0.5)/HTSSOP48(0.5)

3-phase Brush-less DC Motor Driver IC Lineup (1)
Sine Wave Drive

	TB6551FAG	TB6584FNG/AFNG	TB6631FNG	TB6586FG/AFG/BFG	TB6603FTG	TB6604FTG	TB6585FG/FTG
Function	Controller	Controller	Controller	Controller	Controller	Controller	Driver
VM (VCC)	12V	12V	12V	18V	30V	30V	45V
IO	2mA	2mA	2mA	35mA	20mA	20mA	1.8A/1A
Output control signals	H:5V L:0V	H:5V L:0V	H:5V L:0V	H:5V L:0V	U→H:VG /L:0V L→H:8V /L:0V	U→H:VG /L:0V L→H:8V /L:0V	-
Sine-wave current	✓	✓	✓	(150-deg)	✓	✓	✓
Sensor- less	-	-	-	-	-	-	-
Magnet -detect	Hall IC	Hall ele. /Hall IC	Hall ele. /Hall IC	Hall ele. /Hall IC	Hall ele.	Hall ele.	Hall ele.
Package	SSOP24 (1.0)	SSOP30 (0.65)	SSOP30 (0.65)	SSOP24 (1.0)	QFN36(0.5)	QFN48(0.5)	HSOP36 (0.65)/QFN48
lead angle control	External input	Auto	Auto	External input	External input	Auto	Auto
RoHS	✓			✓	✓	✓	✓

Motor Control Driver

3-phase Brush-less DC Motor Driver IC Lineup (2)

Sensor-less Drive

	TB6575FNG	TB6633FNG/AFNG	TB6588FG	TC7600FNG
Function	Controller	Driver	Driver	Controller
VM	5.5V	25V	50V	5.5V
IO	20mA	1.0A	2.5A	2mA
Output control signals	H:5V L:0V	-	-	H:5V L:0V
Sine-wave current	-	-	-	✓
Sensor-less	✓	✓	✓	✓
Package	SSOP24 (0.65)	SSOP24 (0.65)	HSOP36 (0.65)	SSOP30 (0.65)
lead angle control	External input	External input	External input	Auto

For Home Appliance

3-phase Brush-less DC Motor Driver IC Lineup

Square Wave Drive

	TB6586FG/ AFG/BFG	TB6575FNG	TB6633FNG/AFNG	TB6588FG
Function	Controller	Controller	Driver	Driver
VM	18V	5.5V	25V	50V
IO	2mA	20mA	1.0A	2.5A
Output control signals	H:5V L:0V	H:5V L:0V	-	-
Sinusoidal current wave	-	-	-	-
Sensor-less	-	✓	✓	✓
Magnet-detect	Hall ele./ Hall IC	-	-	-
Package	SSOP24	SSOP24 (Pin pitch 0.65)	SSOP24 (Pin pitch 0.65)	HSOP36 (Pin pitch 0.65)

Sine Wave Drive

	TB6551FAG	TB6556FG	TB6584FNG/AFNG	TB6631FNG	TB6585FG/FTG	TC7600FNG
Function	Controller	Controller	Controller	Controller	Driver	Controller
VM	12V	12V	18V	18V	45V	5V
IO	2mA	2mA	2mA	2mA	1.8A/1.0A	2mA
Output control signals	H:5V L:0V	H:5V L:0V	H:5V L:0V	H:5V L:0V	-	H:5V L:0V
Sinusoidal current wave	✓	✓	✓	✓	✓	✓
Sensor-less	-	-	-	-	-	✓
Magnet-detect	Hall IC	Hall IC	Hall ele. / Hall IC	Hall ele. / Hall IC	Hall ele.	-
Package	SSOP24	SSOP30	SSOP30 (Pin pitch 0.65)	SSOP30 (Pin pitch 0.65)	HSOP36/QFN48 (Pin pitch 0.65)	SSOP30 (Pin pitch 0.65)
Lead free	✓	✓	✓	✓	✓	✓

For Battery Powered Applications

Low Voltage Simple H-bridge Driver IC Lineup

* Mark: Under Development

Product	PKG	VM	Io	Ch	Ron(H+L)	Functions	Schedule ES	Schedule CS
TB6593FNG	SSOP20-P-225-0.65		3.2A	1	0.35Ω	Direct PWM Function	✓	✓
TB6552FNG	SSOP16-P-225-0.65		1A	2	1.5Ω	Direct PWM Function, 2ch	✓	✓
TB6552FTG	WQFN16-3030-0.5-0.3	15V	1A	2	1.5Ω	Direct PWM Function, 2ch	✓	✓
TB6612FNG	SSOP24-P-300-0.65		2.8A	2	0.5Ω	Direct PWM Function, 2ch	✓	✓
TB6614FNG	SSOP16-P-225-0.65		3.2A	1	0.3Ω	Direct PWM Function	✓	✓
TB6590FTG	VQON16-P-0303-0.50	6V	0.5A	2	2.5Ω	2ch, Small package 3mm□	✓	✓
TB6608FNG	SSOP20-P-225-0.65	15V	0.8A	2	1.5Ω	STM 3bit μ step control	✓	✓
TC78S600FNG*/FTG*	SSOP20-P-225-0.65/WQFN24-P-0404-0.50	18V	1.0A	2	1.1Ω	STM 4bit μ step control	1Q/2012	3Q/2012
TC78H600FNG*/FTG*	SSOP20-P-225-0.65/WQFN24-P-0404-0.50	18V	1.0A	2	1.1Ω	Direct PWM Function, 2ch	2Q/2012	3Q/2012

1chip Combination Driver IC Lineup

Product	Driver Total	Driver H-bridge	Driver CC	Vcc (V)	VM (V)	Iout (A)	Function
TB6613FTG	8	3 *Direct PWM	5	2.7～6	2.2～6	0.8	・Serial I/F ・μ-step STM Drive

Text To Speech Middleware

What is Text To Speech (TTS)?

Text To Speech (TTS) is a media conversion technology from text to speech. TTS is suitable for many information systems whose messages are difficult to be pre-recorded.

Voice Activated Dialing / Incoming Call Notification :
- **To dial by combination with voice recognition technology**
- **To tell who calls now**

Navigation :
- **To inform a right direction to the user**

Information Reader :
- **To tell schedule to the user**
- **To read e-mail**

Telematics Service :
- **To inform traffic jam condition, weather forecast, news**

ToSpeak™ Feature

ToSpeak™ is the Toshiba TTS middleware for embedded systems. ToSpeak™ achieves high-quality sound with small amount of memory. ToSpeak™ uses a new Toshiba-proprietary technology to reduce sound-quality variations. This technology selects plural speech units and fuses them together to make the synthesized voice sound more realistic and natural. ToSpeak™ is composed of Text Analyzer and Voice Synthesizer. Text Analyzer analyzes plain text based on text analysis dictionary and user's lexicon and outputs phonetics with high accuracy. Voice synthesizer generates high-quality speech from phonetics with various kind of speech by switching speech database.

Comparisons of Sound Quality and Memory Requirement between the Conventional and New Speech Synthesis Technologies

Roadmap

	~2010	2011	2012
Multi speaking style TTS	MP Under Development	Multi speaking style →	**ToSpeak™ G2 Japanese** — ES: 1Q/2012, MP: 2Q/2012 ToSpeak™ G2 provides a custom-made TTS with the voice of a specified person.
Multi language TTS	**ToSpeak™ G1 Japanese** Memory footprint : around 5MB MIPS : around 30MIPS	**Multi language** → **ToSpeak™ G1 Chinese Mandarin** Memory footprint : around 8MB MIPS : around 30MIPS **ToSpeak™ G1 US English** Memory footprint : around 8.5MB MIPS : around 80MIPS	

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
- 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
- Bloomington
  Tel: (952)842-2400 Fax: (952)893-8031
- San Diego
  Tel: (858)385-5900 Fax: (858)674-7606

Toshiba Electronics do Brasil Ltda.
Tel: (011)2539-6681 Fax: (011)2539-6675

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
- Spain Branch
  Tel: (91)660-6798 Fax: (91)660-6799
- U.K. Branch
  Tel: (0870)060-2370 Fax: (01252)53-0250
- Sweden Branch
  Tel: (08)704-0900 Fax: (08)80-8459

Toshiba Electronics Asia (Singapore) Pte. Ltd.
Tel: (6278)5252 Fax: (6271)5155

Toshiba Electronics Service (Thailand) Co., Ltd.
Tel: (02)501-1635 Fax: (02)501-1638

Toshiba Electronics Trading (Malaysia) Sdn. Bhd.
- Kuala Lumpur Head Office
  Tel: (03)5631-6311 Fax: (03)5631-6307
- Penang Office
  Tel: (04)226-8523 Fax: (04)226-8515

Toshiba India Private Ltd.
Tel: (0124)499-6600 Fax: (0124)499-6611

Toshiba Electronics Asia, Ltd.
- Hong Kong Head Office
  Tel: 2375-6111 Fax: 2375-0969
- Beijing Office
  Tel: (010)6590-8796 Fax: (010)6590-8791
- Chengdu Office
  Tel: (028)8675-1773 Fax: (028)8675-1065
- Qingdao Office
  Tel: (532)8579-3328 Fax: (532)8579-3329

Toshiba Electronics (Shanghai) Co., Ltd.
- Shanghai PUXI Branch
  Tel: (021)6139-3888 Fax: (021)6190-8288
- Shenzhen Branch
  Tel: (0755)2399-6897 Fax: (0755)2399-5573
- Hangzhou Office
  Tel: (0571)8717-5004 Fax: (0571)8717-5013
- Nanjing Office
  Tel: (025)8689-0070 Fax: (025)8689-0070

Toshiba Electronics (Dalian) Co., Ltd.
Tel: (0411)8368-6882 Fax: (0411)8369-0822

Tsurong Xiamen Xiangyu Trading Co., Ltd.
Tel: (0592)226-1398 Fax: (0592)226-1399

Toshiba Electronics Korea Corporation
Tel: (02)3484-4334 Fax: (02)3484-4302

Toshiba Electronics Taiwan Corporation
Tel: (02)2508-9988 Fax: (02)2508-9999

TOSHIBA

TOSHIBA CORPORATION
Semiconductor & Storage Products Company

Website: http://www.semicon.toshiba.co.jp/eng