

**TOSHIBA**

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Semiconductor Catalog 2012-2

# Analog & Imaging IC Logic LSI



ANALOG  
IMAGING  
LOGIC

The text 'ANALOG IMAGING LOGIC' is rendered in a 3D, blocky font with a textured, slightly grainy surface. The letters are arranged in three rows. The background is a light blue and white textured surface, possibly representing a circuit board or a microscopic view of a chip, with some faint white lines and shapes scattered across it.

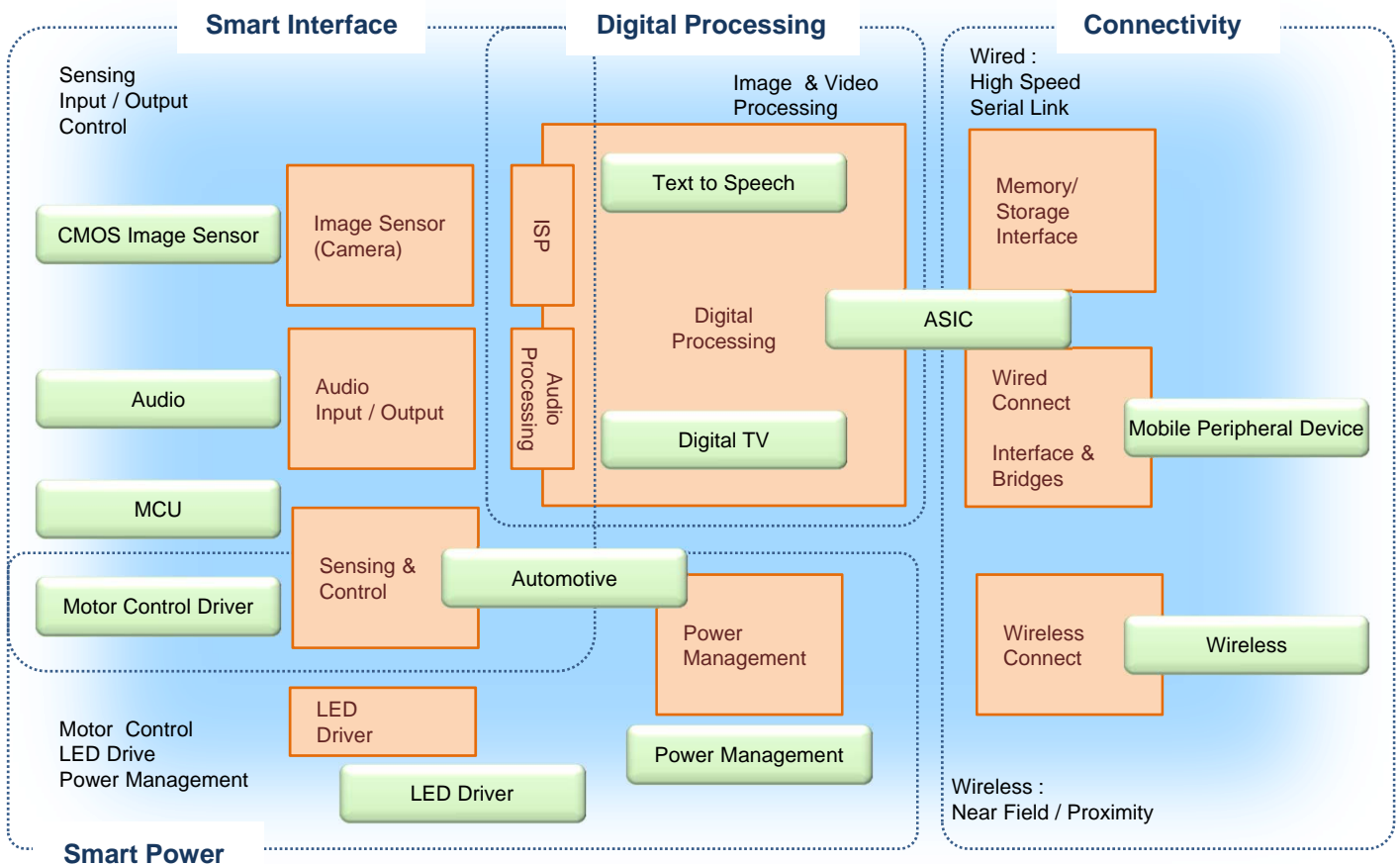
SEMICONDUCTOR & STORAGE PRODUCTS

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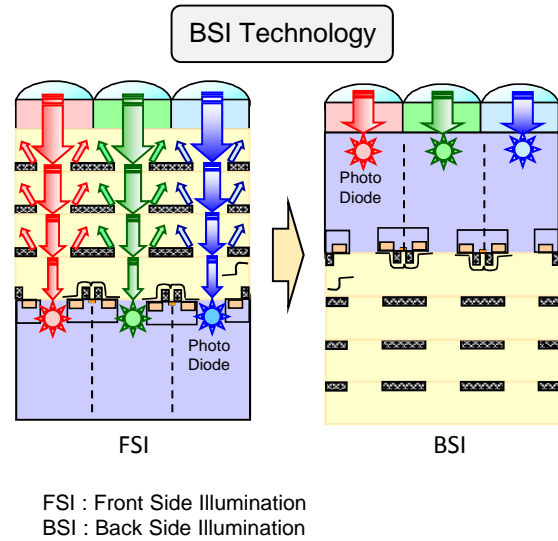
# CMOS Image Sensor

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



## 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



## 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

Resolution	Pixels	2.2 μm	1.4 μm			1.1 μm
			1st Gen. 2nd Gen. (Bright)	1st Gen. (90 nm)	2nd Gen. (65 nm)	3rd Gen. (BSI)
12 MP+						
8 MP						
5 MP						
3 MP						
2 MP						
VGA		  				

MP Available      Under Development

## 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) x480(V)	640(H) x480(V)	2056(H) x1544(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	-	-

## 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) x480(V)	1600(H) x1200(V)	2592(H) x1944(V)	2608(H) x1960(V)	2592(H) x1944(V)	
Frame rate	Full	30fps	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

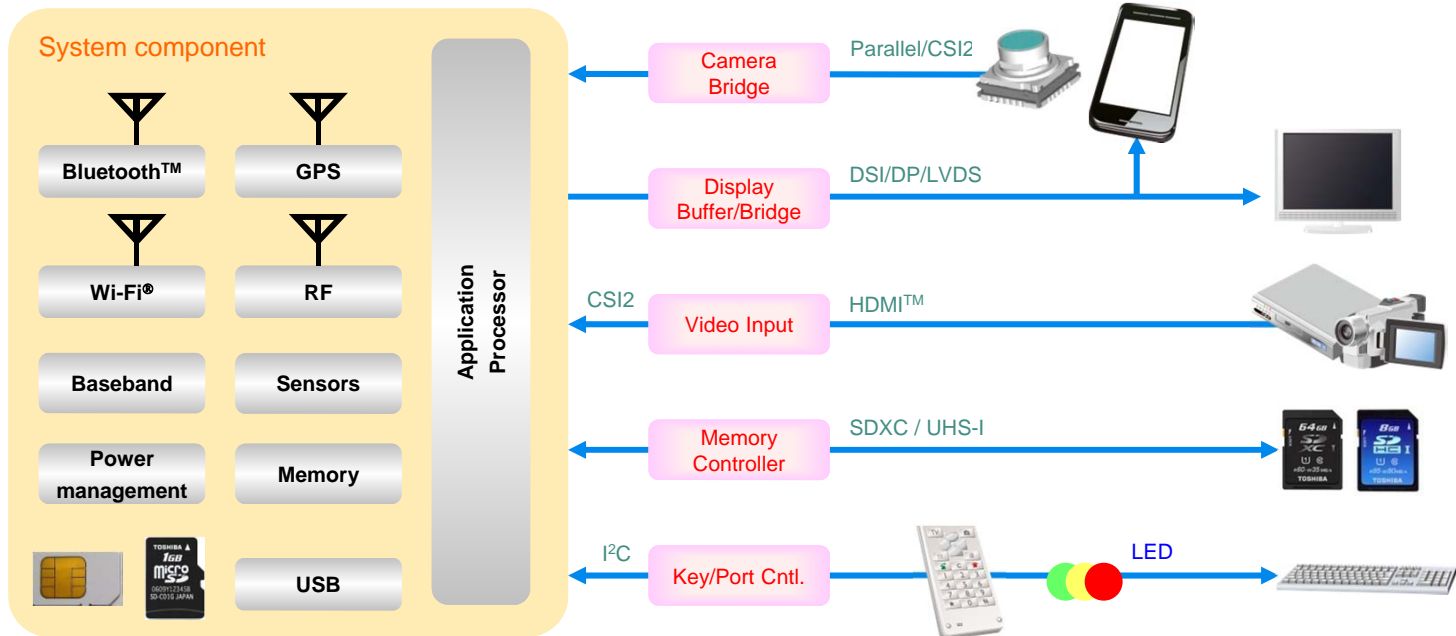
## Die/Package 8M~

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) x2464(V)	3280(H) x2464(V)	4016(H) x3016(V)	3280(H) x2464(V)	3280(H) x2464(V)	4400(H) x3316(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	120fps(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.



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

Under Development

ES Available

MP

## SDXC host controller with CPRM function



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

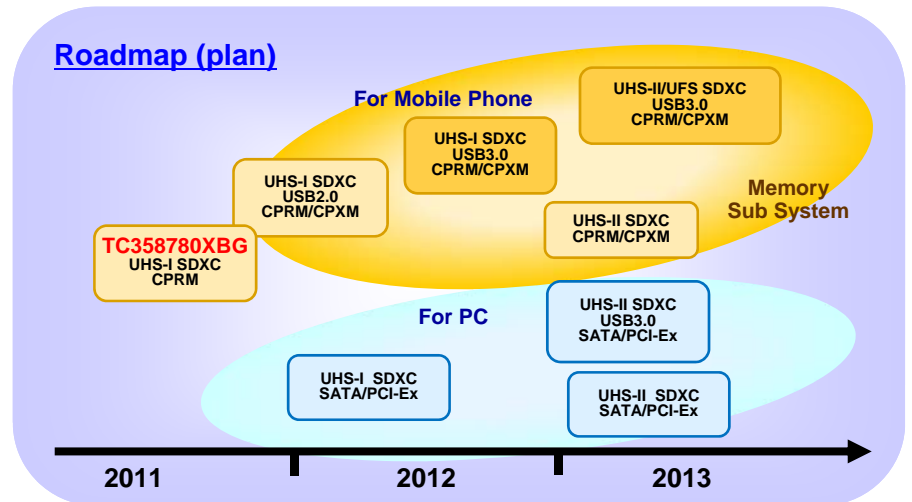
#### Availability

- ES: Available
- MP: Available

#### Package

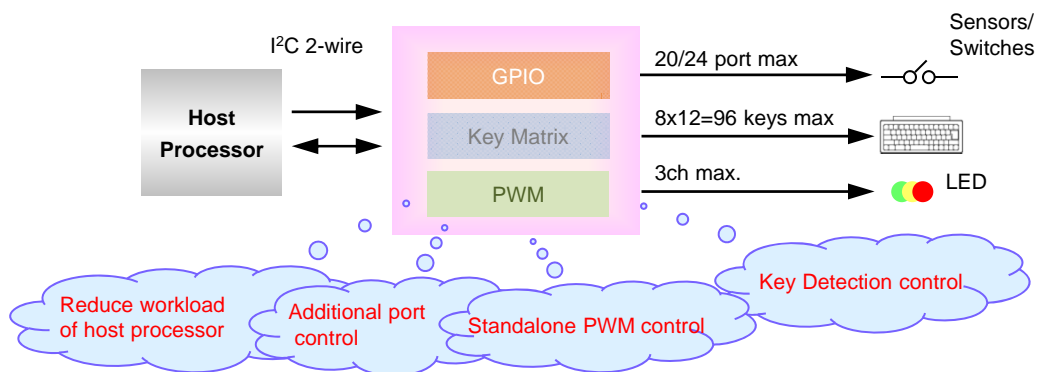
- 5.0mm x 5.0mm
- 0.5mm pitch
- 64pin BGA

### Roadmap (plan)



## IO Expander

IO Expander supports general purpose I/Os, a key detection and PWMs function. A host processor controls these functions via an I<sup>2</sup>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.



	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

## Product Development Concept

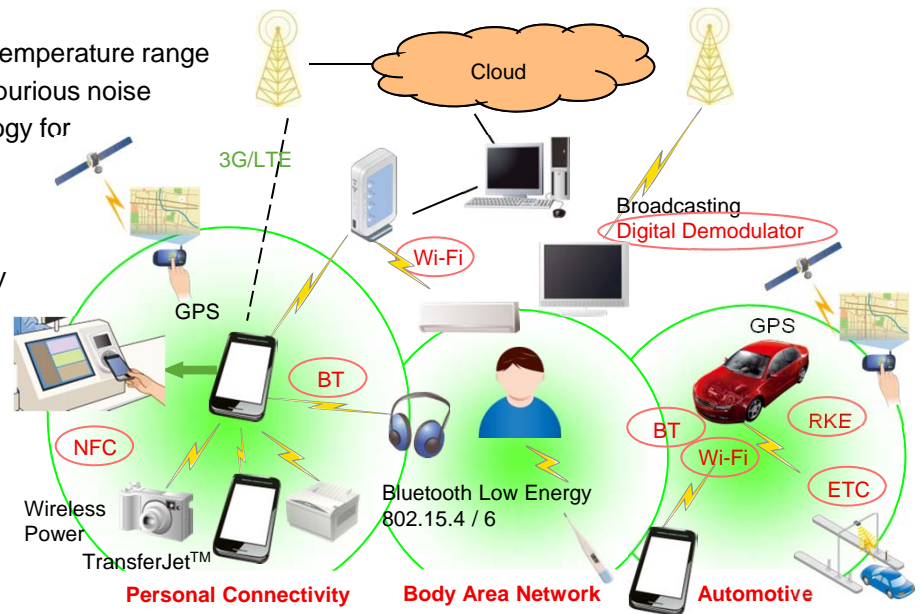
- Feedback customer voices and latest wireless standard to new product development by engineers of skill in various wireless technologies such as Bluetooth, Wi-Fi, Digital Terrestrial Broadcasting Demodulator, RKE, and "FeliCa" IC

## 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

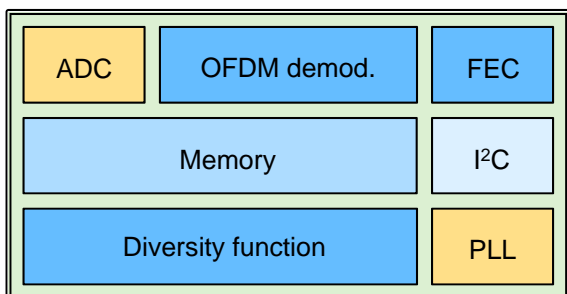


## Digital Terrestrial Broadcasting Demodulator

### 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
  - I<sup>2</sup>C
- Low Power Consumption
  - 94mW (typ.)

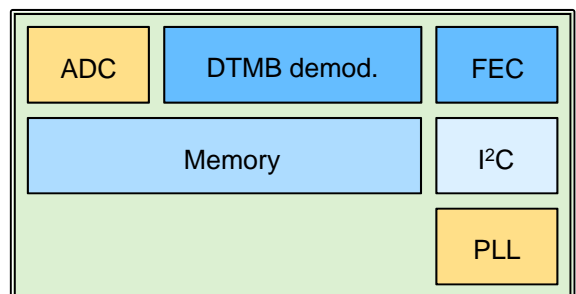
MP Available



### 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
  - I<sup>2</sup>C
- Low Power Consumption
  - 260mW (typ.)

ES: Available  
MP: Apr. 2012



## 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

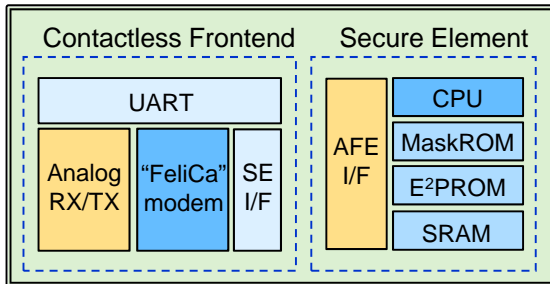
- Built-in analog and Modulation/demodulation circuit compliant with "FeliCa"
- Built-in Null point deletion system
  - Phase recovery circuit
  - Modulation and Switch circuit (SW1, SW2)
- Control ports of external circuit for adjusting resonance frequency
- HOST interface: UART

### 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

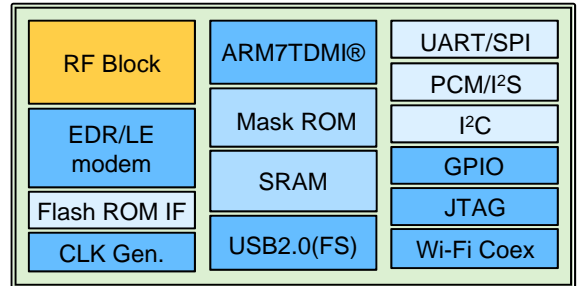
- High Speed UART, SPI, USB2.0 (FS), I2C, I2S/PCM
- Wi-Fi Coexistence 2/3/4 wire
- Support Wake-Up Signal from/to Host CPU

### 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

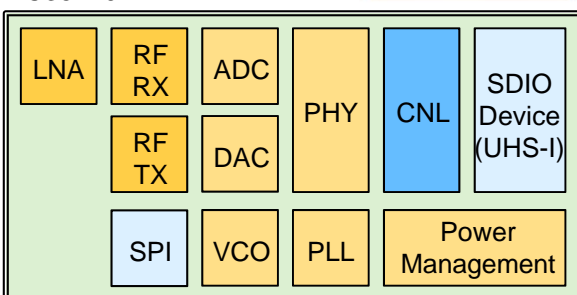
- -78dBm (Rate65)

### 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

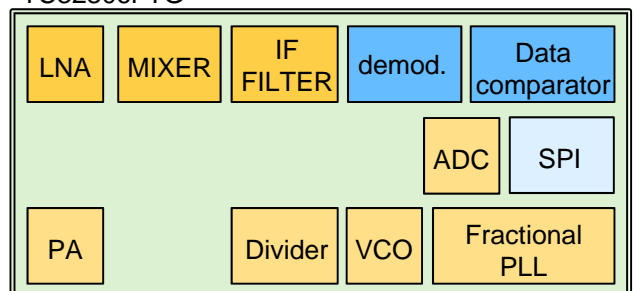
### Low Power Consumption

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

Control Interface: SPI (4wire) , EEPROM

ES: Available  
MP: Mar. 2012

TC32306FTG

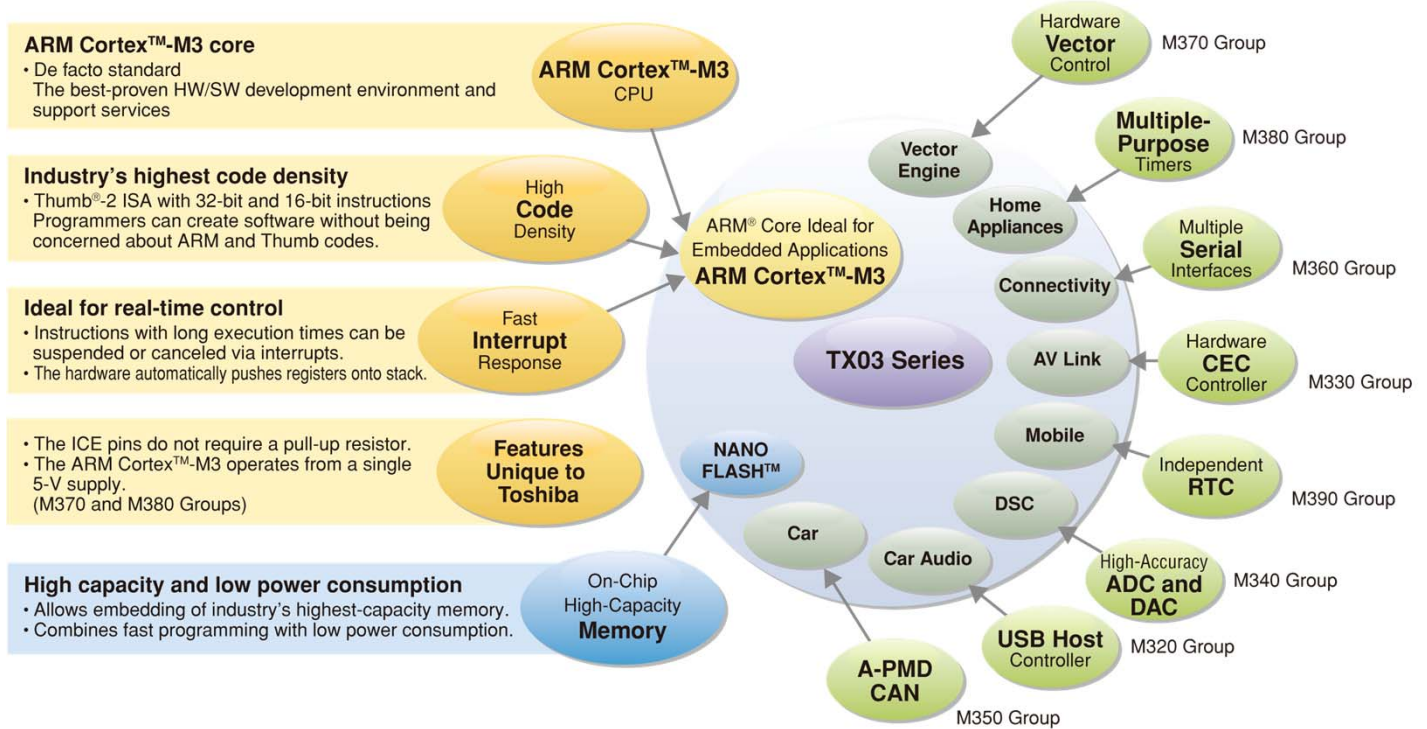


# MCU (32-Bit Microcontrollers)

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

PLL/CG	ARM Cortex™-M3	SIO/UART	M370
Debug	FLASH	Vector Engine	
WDT	RAM	PMD1	
RTC	12bit A/D 1	PMD2	
OFD	12bit A/D 2	Encoder	
16bit Timer	GPIO	AMP/CMP	

### 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

PLL/CG	ARM Cortex™-M3	I <sup>2</sup> C/SIO	M380
Debug	FLASH	SIO/UART	
WDT	RAM   DMA	SSP	
RTC	12bit A/D	MPT	
OFD	RMC	PMD/Encoder	
16bit Timer	GPIO	AMP/CMP	

## 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

PLL/CG	ARM Cortex™-M3	I <sup>2</sup> C/SIO	M330
Debug	FLASH	SIO/UART	
WDT	RAM	CEC	
RTC	10bit A/D	RMC	
16bit Timer	GPIO		

### 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	I <sup>2</sup> C/SIO
Debug	FLASH	SIO/UART
WDT	RAM	SSP
RTC	10bit A/D	CEC
OFD	GPIO	RMC
16bit Timer		

### 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	I <sup>2</sup> C/SIO
Debug	FLASH	SIO/UART
WDT	RAM	SSP
RTC	DMA	GPIO
16bit Timer	12bit A/D	
2-Phase Pulse Counter	10bit D/A	

### 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	I <sup>2</sup> C/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

PLL/CG	ARM Cortex™-M3	I <sup>2</sup> C/SIO	M369
Debug	FLASH	SIO/UART	
WDT	RAM	SSP	
RTC	DMA	CAN	
16bit Timer	12bit A/D	USB	
MPT/PMD	10bit D/A	EtherMAC	
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				●	●			
EtherMAC					●			
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 (Note 3)	●	●			●		●	●
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 I<sup>2</sup>S 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.

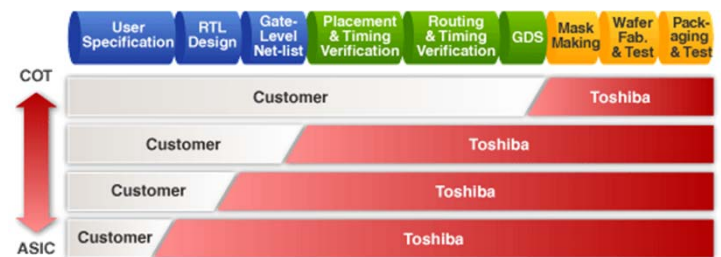
## Benefits

### Comprehensive ASIC Capabilities from Design to Manufacture



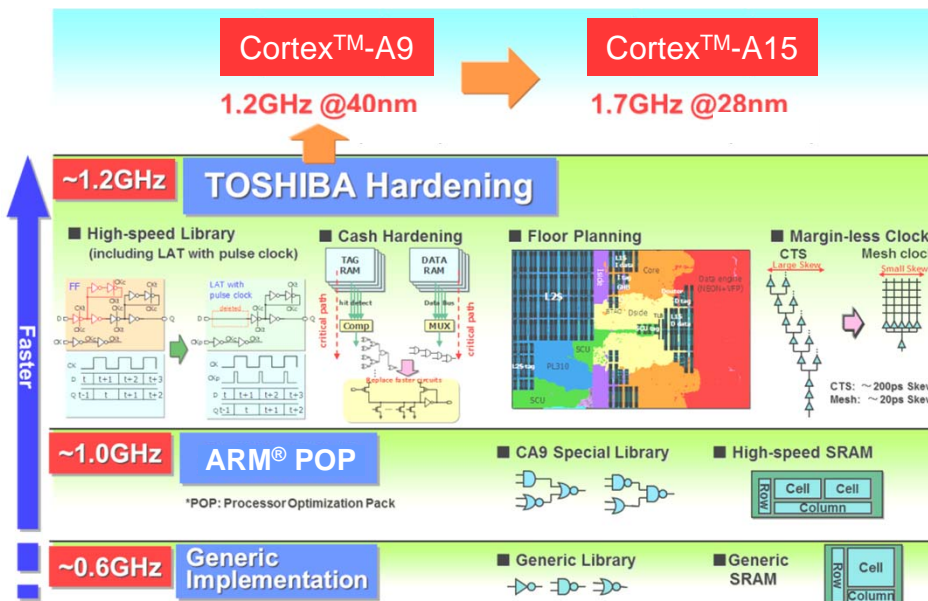
### Various Design Interface Levels from ASIC to COT-based Design

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.

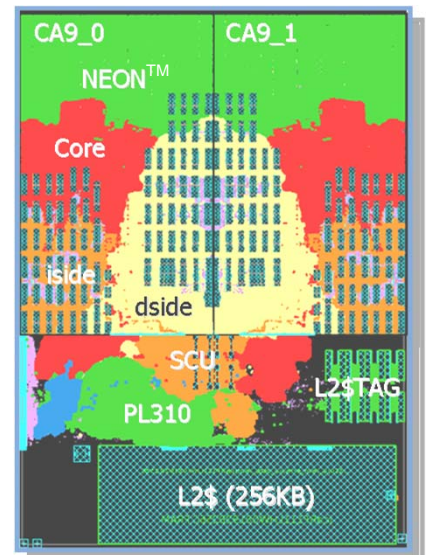


### High-level Design Approaches

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.



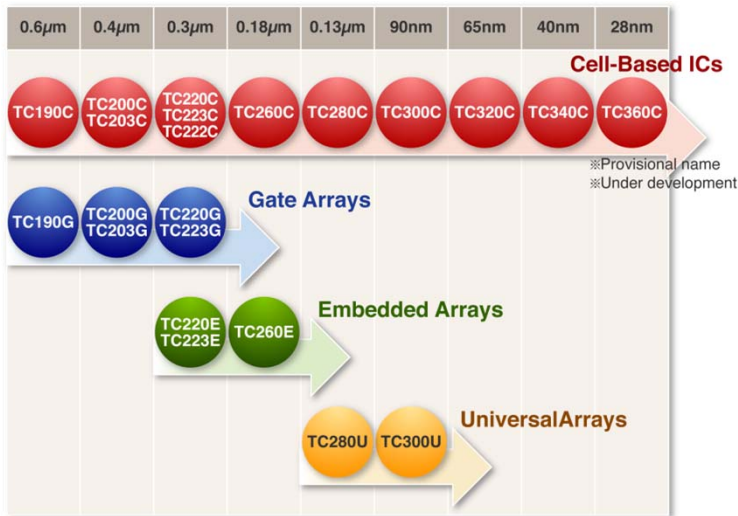
### ARM Cortex™-A9 Processor



# Lineup

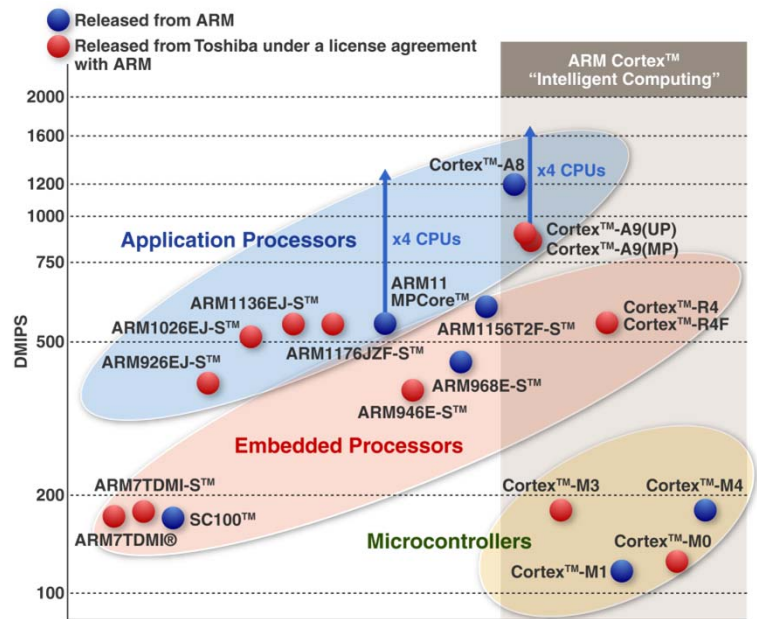
## Product Lineup

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.



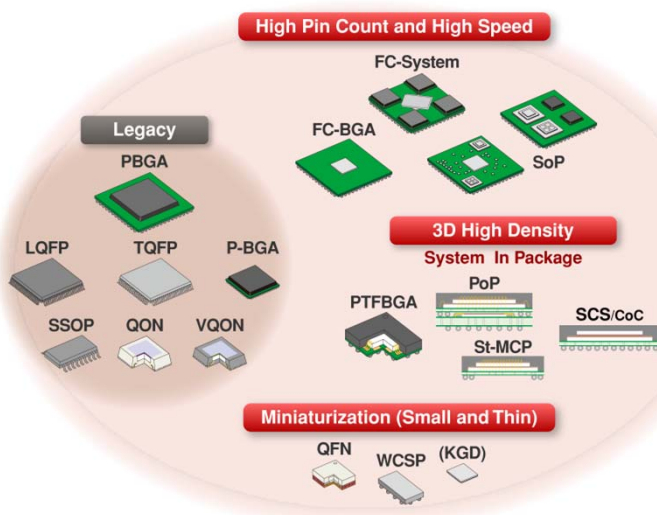
## IP Lineup

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

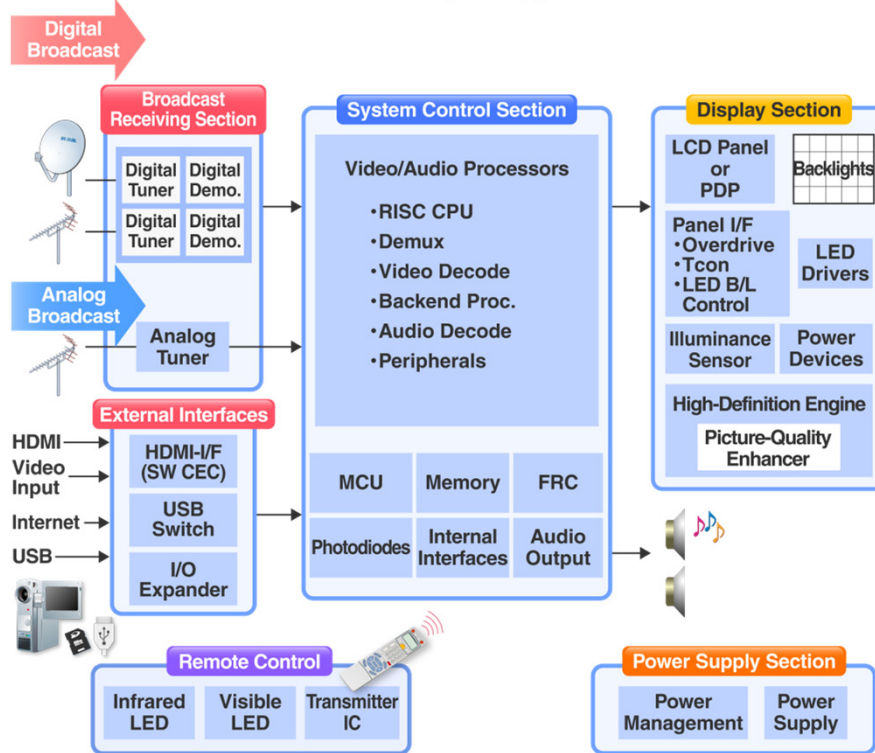
Package requirements vary with each application system in which ASICs are incorporated. To satisfy all application needs, Toshiba offers a broad range of packaging options, based on small-form-factor and lightweight, low-profile, high-pin-count, high-speed and thermal dissipation technologies.



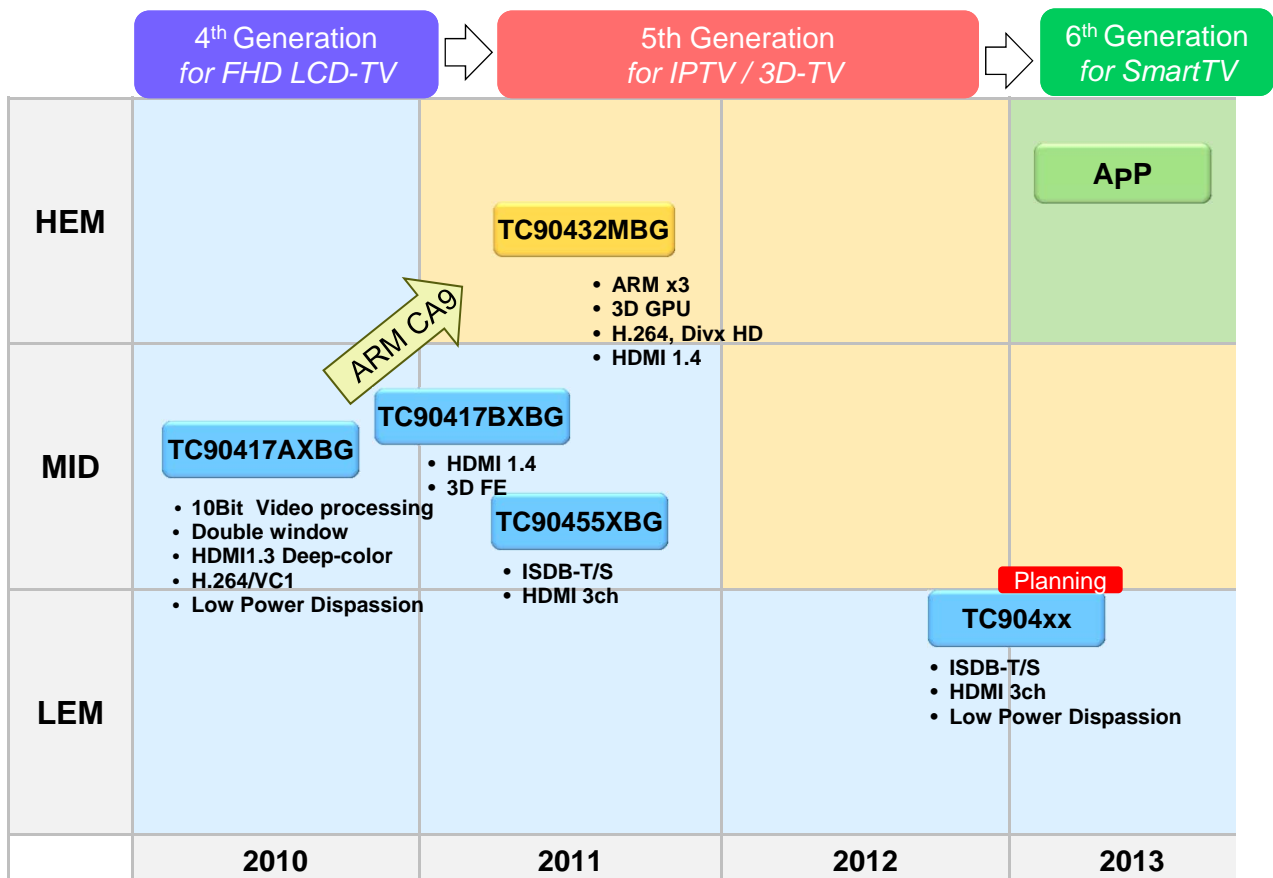
	Link (Controller)	PHY		
		90nm	65nm	40nm
USB2.0 Host/Device (480Mbps)	Host: Available	Available	Available	Available
	OTG: Available			
	Device: Available			
USB3.0 Host/Device (5Gbps)	Host: Available			Available
	Device: Available			
PCI Express® RC/EP (2.5Gbps)	Root: Available	Available	Available	Available
	Endpoint: Available			
PCI Express® RC/EP (5.0Gbps)	Root: ~1Q/2012			~1Q/2012
	Endpoint: ~1Q/2012			
PCI Express® RC/EP (8.0Gbps)	Root: ~1Q/2012			~1Q/2012
	Endpoint: ~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
LPDDR1 (~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



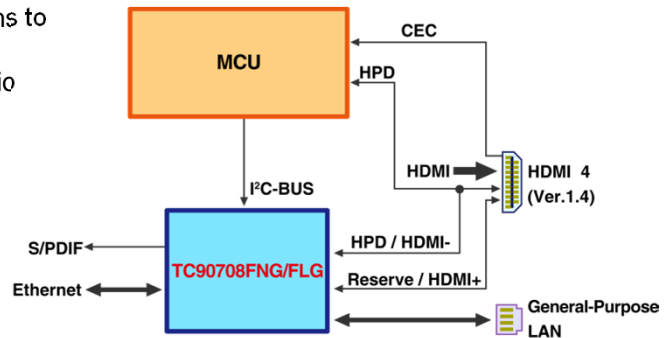
## TC90708FNG/FLG HDMI 1.4 Adapter

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.

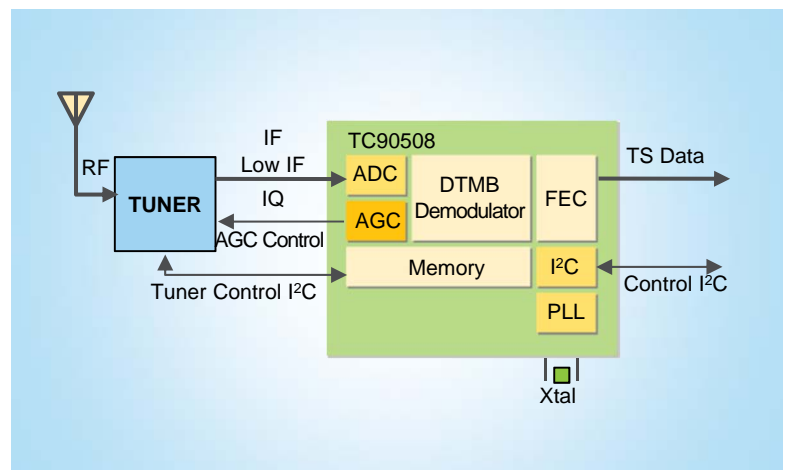
Part Number	Feature / Function	TV Standard	Output Format	Applications
TC90527	Single ISDB-T	ISDB-T	MPEG-2 TS	Digital Home Appliances
TC90532	Double Demodulator	ISDB-T ISDB-S	MPEG-2 TS	Digital Home Appliances
TC90522	Quad Demodulator	ISDB-T ISDB-S	MPEG-2 TS	Digital Home Appliances
TC90514	4-Branch Diversity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

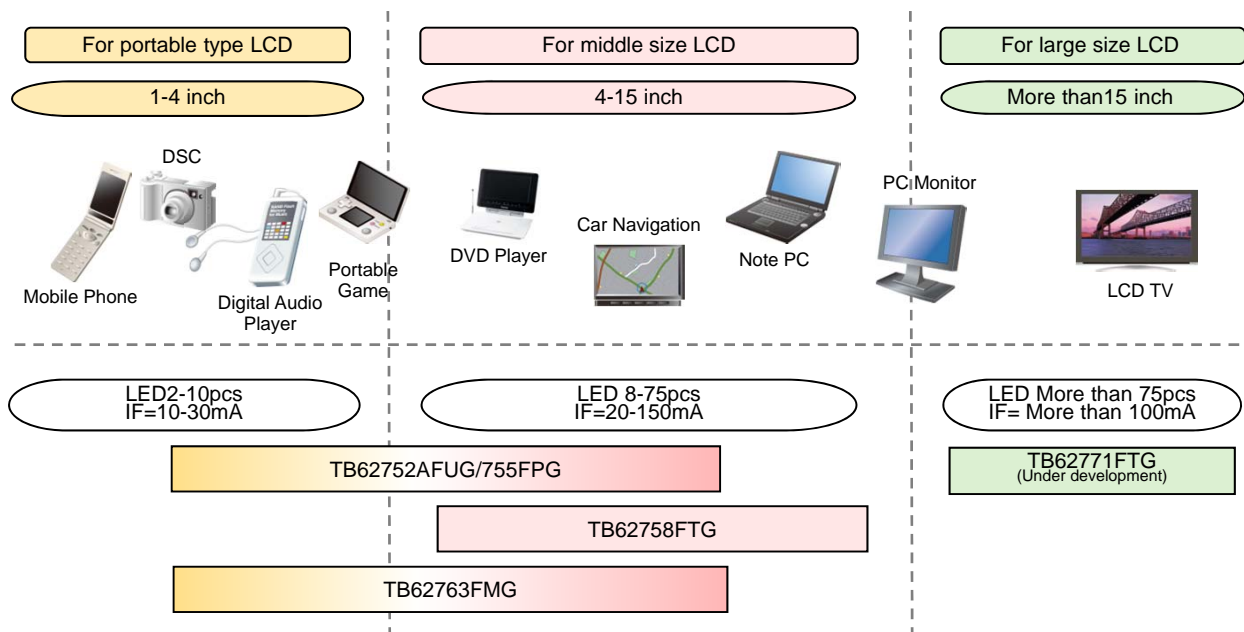
### 9 outputs

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 <sup>2</sup> C Interface)	2.8 to 5.5	150mA(max)/ch	3 parallel	SON10

## LCD Backlighting Lineup



### White LED Driver

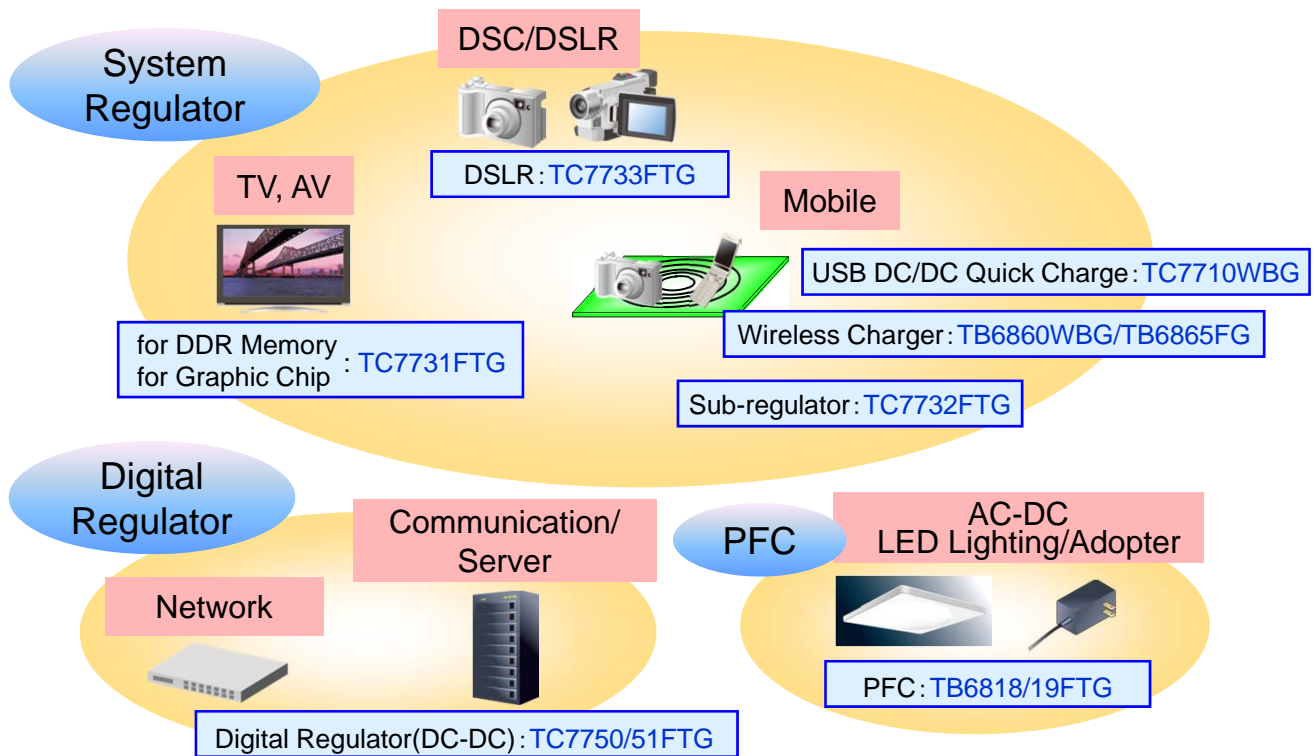
Product	Function	Vin(V)	Output Current	Number of LED	Package
TB62752AFUG	Switching type DC-DC Converter	2.8 to 5.5	20mA(typ.)	2-8 series	SOT23-6
TB62755FPG	Switching type DC-DC Converter	2.8 to 5.5	20mA(typ.)	2-8 series	PLP-6
TB62763FMG	Switching type DC-DC Converter	5	80mA	2-6 series	SON8
TB62758FTG	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 <sup>2</sup> C Interface)	2.8 to 5.5	150mA(max)/ch	3 parallel	SON10

# Power Management

## Business Field



## 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<sup>2</sup>PROM)

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

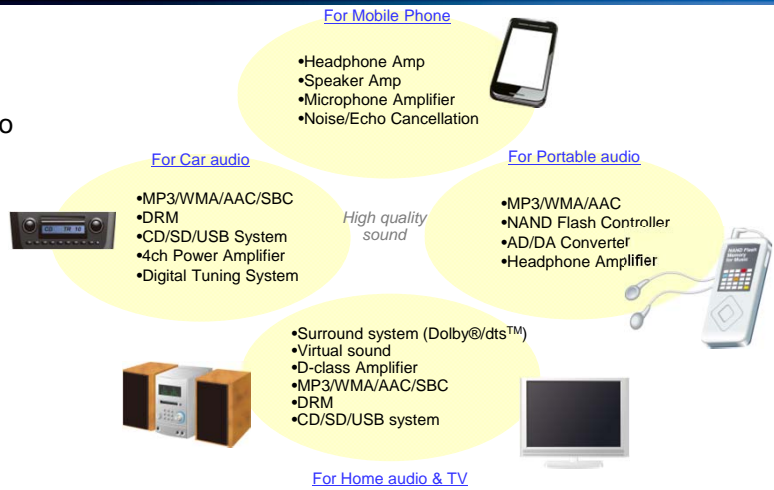
- WPC compliance (Qi)
- Inductive coupling method
- Free positioning charger system

## 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

## 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.



## Mobile Audio

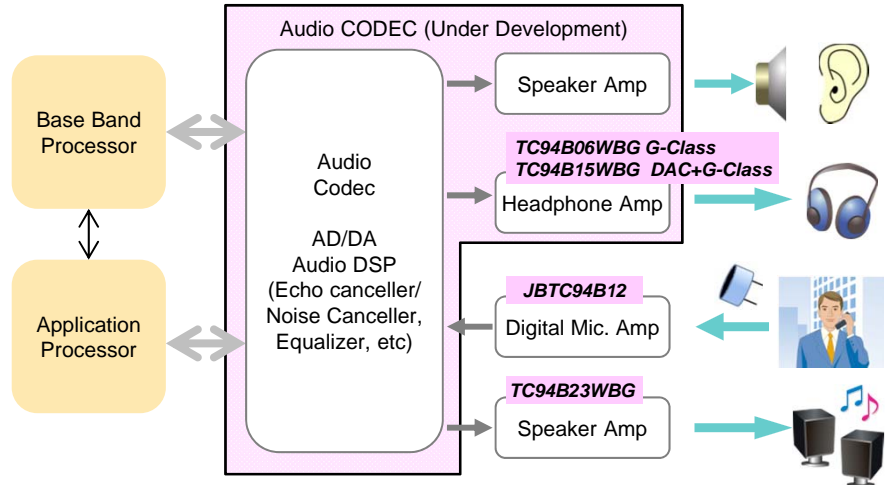
Toshiba is developing Echo and Noise Cancel Audio Codec ICs for Mobile and Smart Phone .

### Amplifier for

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

### Audio codec

- 1Mic Noise & Echo cancellation
- For Mobile phone/ portable audio
- I<sup>2</sup>S I/F
- AD/DA converter

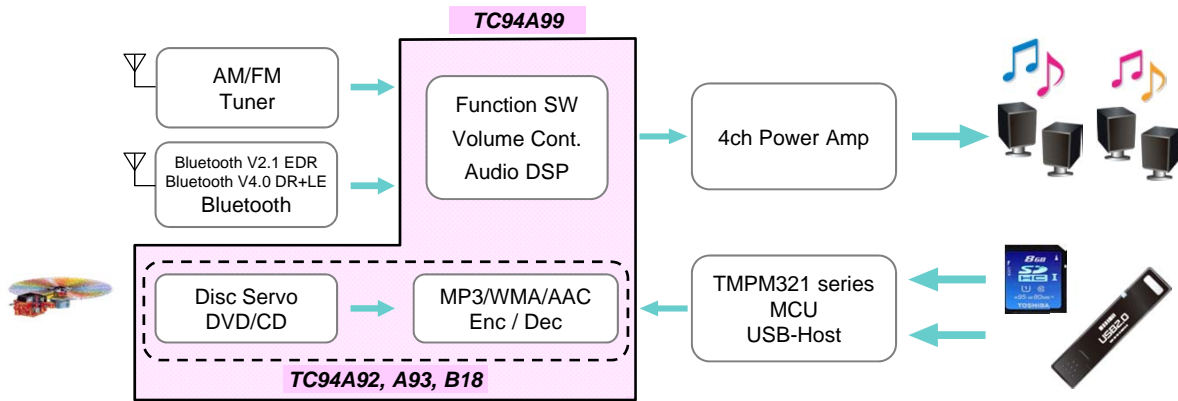


## Audio Codec , Headphone Amp and Speaker Amp RoadMap

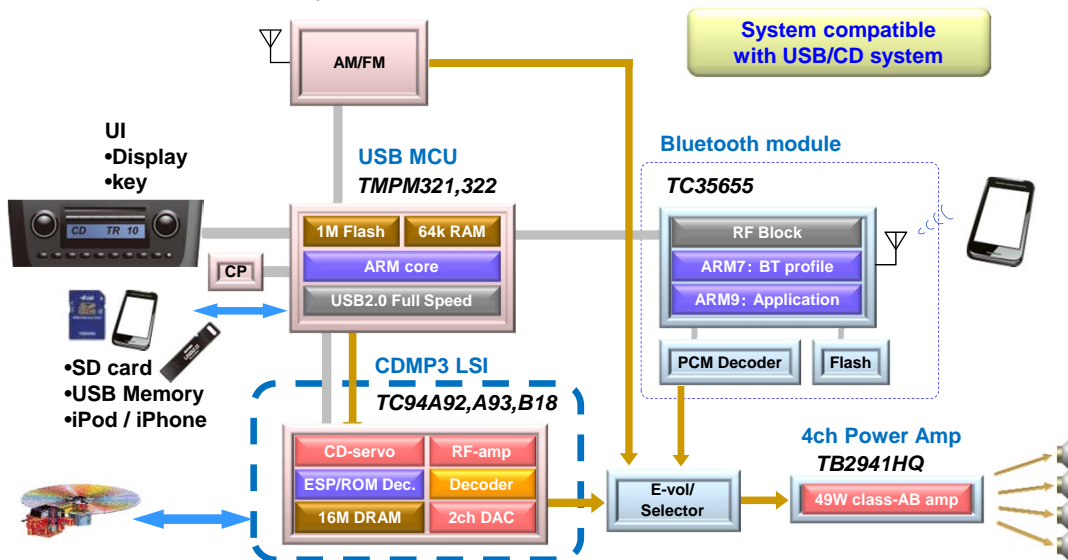
Digital Microphone Amp	<b>JBTC94B12-AS</b> 1 <sup>st</sup> Gene: Low Noise PDM Output	<b>S/N Improvement</b>	<b>JBTC94Bxx-AS</b> ES: 3Q/2012 MP: 4Q/2012 2 <sup>nd</sup> Gene: Low Ultra Noise PDM Output
Headphone Amp	<b>TC94B06WBG</b> G-Class Stereo Amp Electric Volume	<b>+DAC</b>	<b>TC94B15WBG</b> G-Class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

# 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	<b>TB2931HQ</b> *49Wx4ch 2Ω load drive capability 25pin:offset,short, Rareshort det.	<b>TB2941HQ</b> ES: Available MP: 2Q/2012 *49Wx4ch 2Ω load drive capability 25pin:HSW,offset	<b>Class-D</b> *100Wx4ch ES: 1Q/2013 MP: 3Q/2013
	<b>TB2938HQ</b> *49Wx4ch 25pin:offset,short, Rareshort det. Speaker current limiting	<b>TB2952HQ</b> *49W × 4ch Class AB + I <sup>2</sup> C ES: 2Q/2012 MP: 3Q/2012	<b>Class-KB I<sup>2</sup>S, Self Diag</b> *49Wx4ch ES: 3Q/2013 MP: 1Q/2014
Intelligent Power		<b>TB2975HQ</b> ES: Available MP: 1Q/2013	
Class KB		<b>TB2925HQ</b> *49W × 4ch Class KB ES: 2Q/2012 MP: 4Q/2012	<b>MP</b> <b>Under Development</b>
Slim Power	<b>TB2959HQ</b> *47W × 4ch, 25pin:AUX-IN	<b>TB2959KG</b> ES: Available MP: 2Q/2012	<b>Planning</b>
	2011	2012	2013 -

## 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.



**B**ipolar: Analog Circuit

**C**MOS: Large-Scale Integration

**D**MOS: 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 (V <sub>CC</sub> 1/2: 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

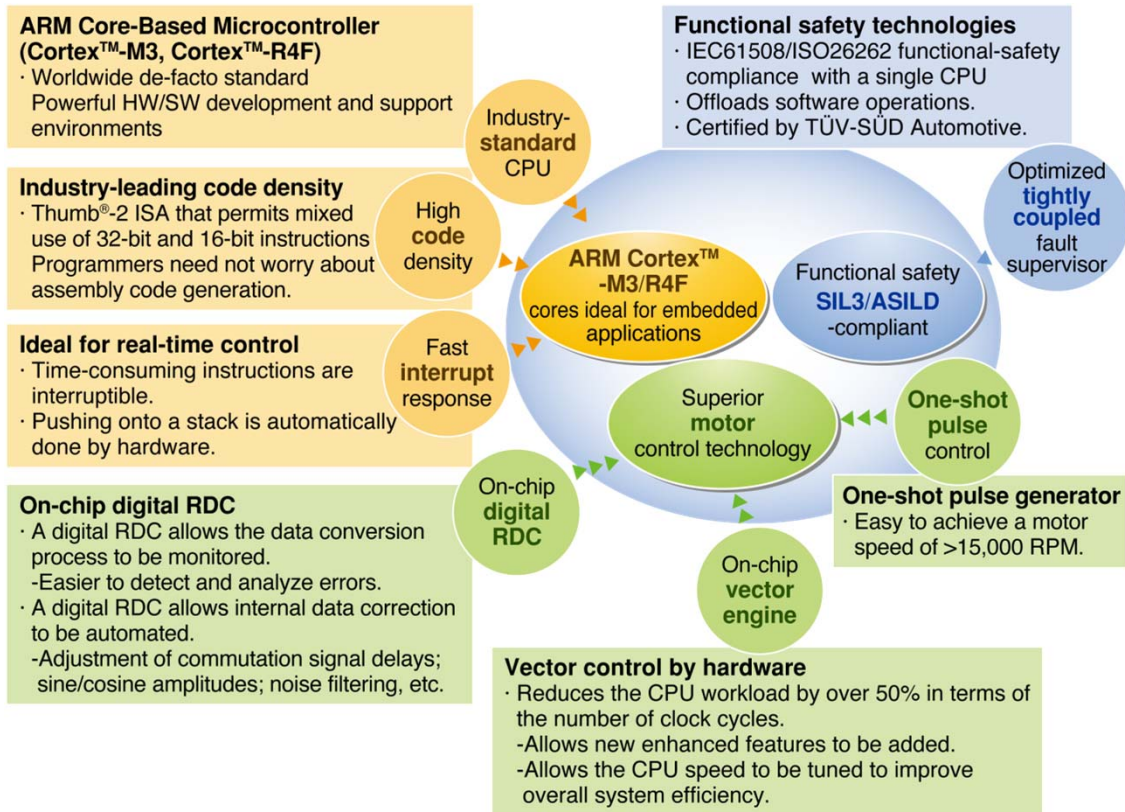
### Switching Regulator IC Lineup

\*: 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

## 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.



### 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			<b>TMPM45X</b> A-PMDx2 RDCx2 fR 176pin	
	up to 100MHz		<b>TMPM354</b> A-PMD RDC fR 144pin		<b>Flexray fR</b> 144pin
512KB	up to 64MHz	<b>TMPM350</b> PMD fR 100pin	A-PMD RDC fR 144pin		
256KB		PMD RDC fR 64pin	A-PMD RDC 100pin		fR 100pin
128KB	up to 20MHz	PMD RDC 64pin			

Cortex™-R4  
Cortex™-M3

**PMD** : Programmable Motor Driver  
**A-PMD** : Advanced PMD  
**RDC** : Resolver to Digital Converter  
**fR** : fault Robustness

### 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

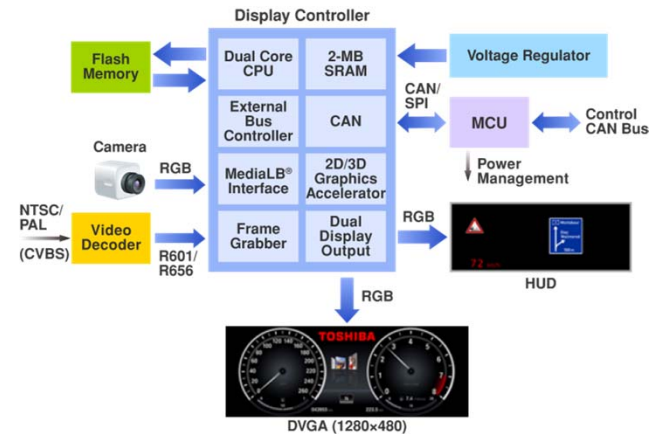
# Instrument Cluster & Head-up Display (HUD)

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.

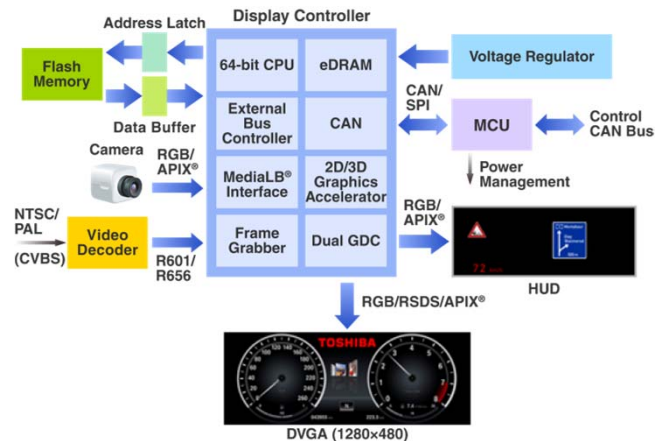
## High-End Instrument Panel

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<sup>2</sup>C 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-1	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-1	2D	1ch	1ch	PBGA456
TX4964FG-120	120	4MByte	-	2D	1ch	1ch	LQFP176

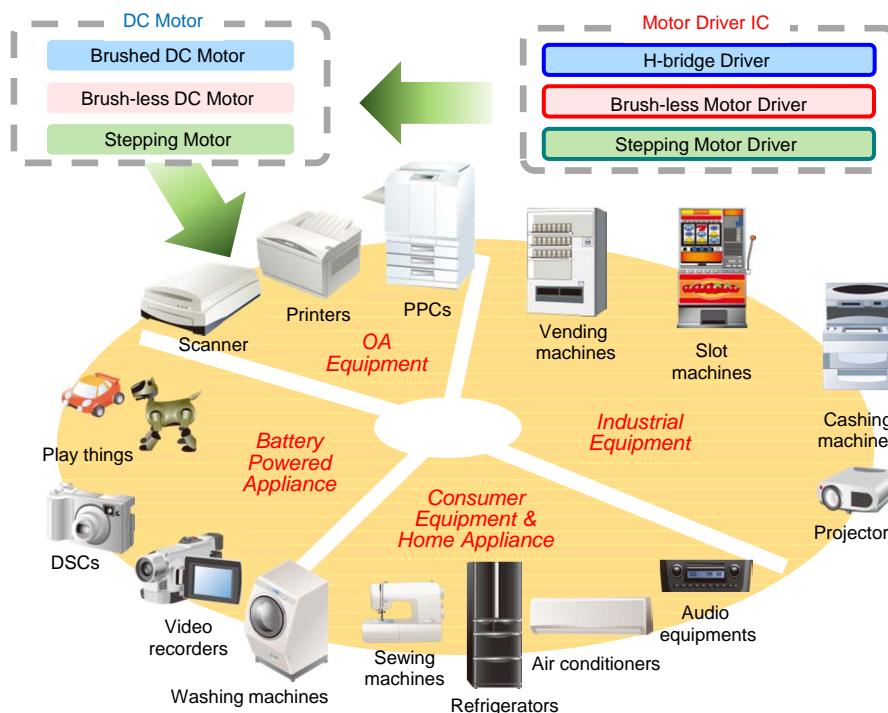
## Video Decoders

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°C	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



## 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]

\* Mark: Under Development

	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

\* Mark: Under Development

	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	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	CS
TB6593FNG	SSOP20-P-225-0.65	15V	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		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			Vcc (V)	VM (V)	Iout (A)	Function
	Total	H-bridge	CC				
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



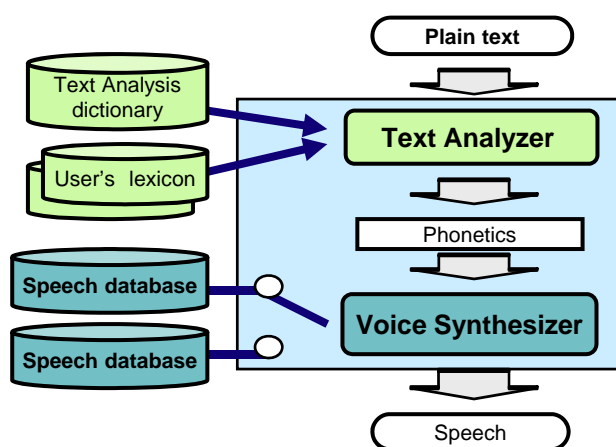
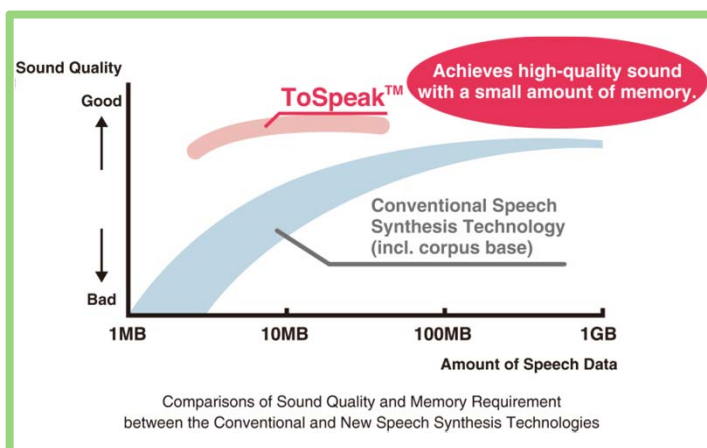
**Telematics Service :**

- 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.



## Roadmap

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.
	ToSpeak™ G1 Japanese Memory footprint : around 5MB MIPS : around 30MIPS		ToSpeak™ G1 Chinese Mandarin Memory footprint : around 8MB MIPS : around 30MIPS
Multi language TTS		Multi language	
	~2010	2011	2012

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