TOSHIBA

FOR
AUDIO CD-BASED
EQUIPMENT

Digital Servo System for CD-Audio Use

Audio output

AMP

Head amps
TA2122FN
TA2109F
[P.7]

Single-chip processors
with built-in 1-bit D/A converter
TC9432AF/TC9462F
[P.6]

4-ch drivers
TA2058F
TA2092N
[P.9]

System controllers
TLCS-870 series
TLCS-47 series
[P.18]

Analog Servo System for CD-Audio Use

Audio output

Low-pass filter

AMP

Head amp
TA2065F
[P.8]

Single-chip processor
with built-in 1-bit D/A converter
TC9284BF
[P.8]

4-ch drivers
TA2058F
TA2092N
[P.9]

System controllers
CDS-500 series
CD-1/CD-2 series
[P.20 and 21]
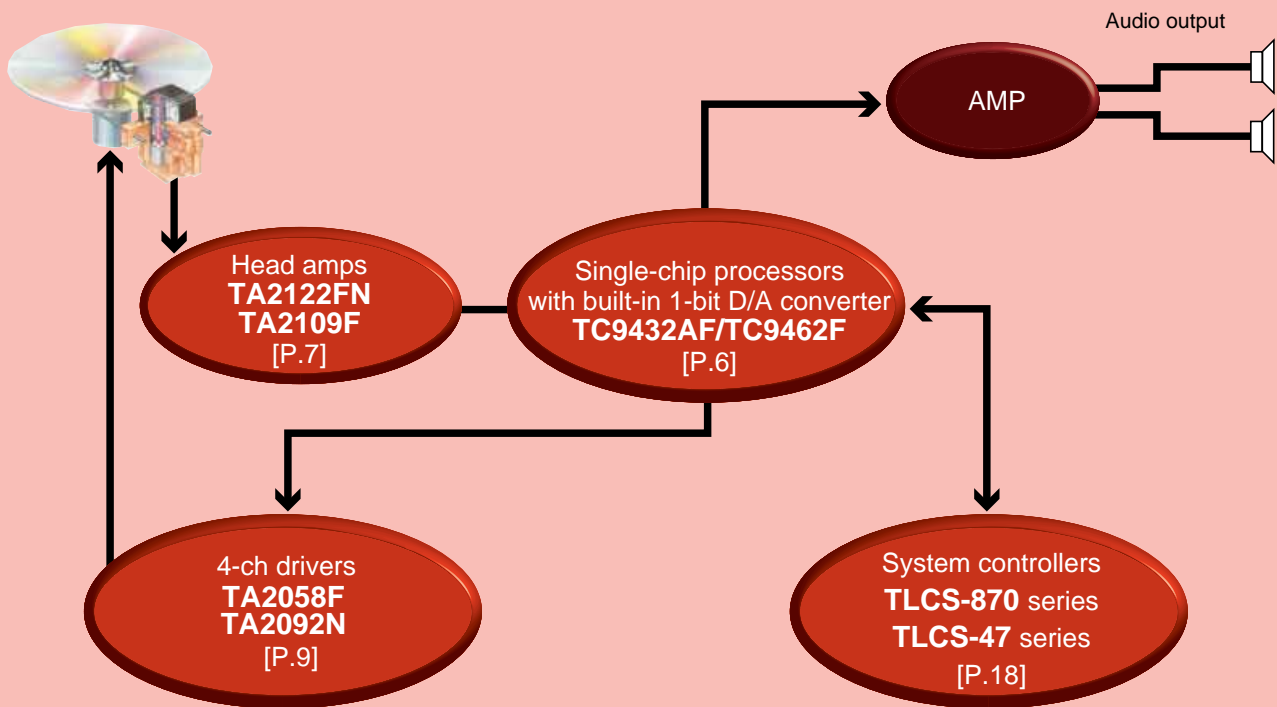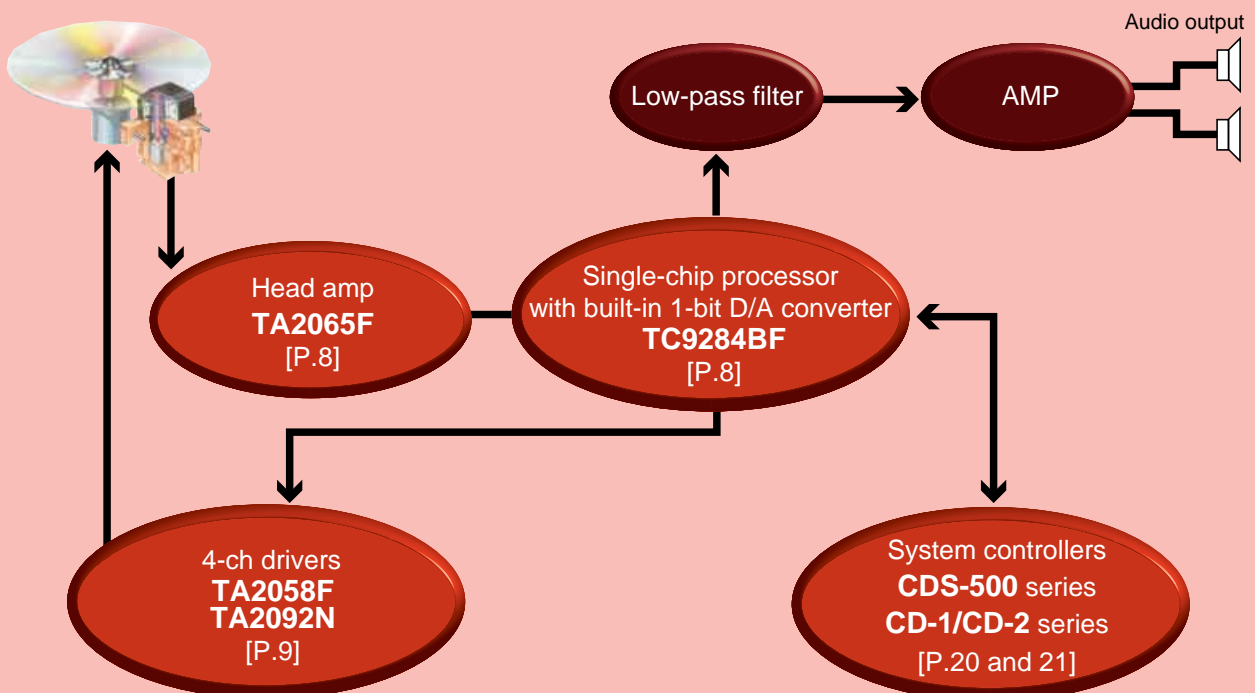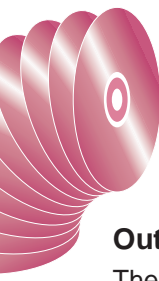
Digital Servo System for CD-Audio Use

Outline

The TC9432AF, ☆TC9462F, ☆TA2122FN and TA2109F are completely adjustment-free, digital servo systems that realize a significant reduction in the number of external components in CD player systems, enabling configuration of extremely simply CD player systems.

TC9432AF/☆TC9462F

Features
<TC9432AF/ ☆TC9462F>

● Built-in EFM demodulation and subcode demodulation circuits
● Use of CIRC correction logic and equipped with C1 correction duplex and C2 correction quadruplex correction capabilities
● Built-in digital out circuit
● Built-in independent left and right attenuation circuits
● Bilingual audio output (monaural, L-channel/R-channel interchangeable playback)
● Built-in automatic adjustment circuit (offset, gain, balance)
● Built-in servo digital equalizer
● Decoding of text data (TC9462F only)
● Built-in 8-times oversampling digital filter and 1-bit D/A converter
　　Total harmonic distortion + noise: -85 dB (typ.)
　　S/N ratio: 100 dB (typ.)
● Built-in analog filter for 1-bit D/A converter
● Built-in zero data detection output circuit
● 4 times speed playback
● Variable speed playback
● 100-pin flat package
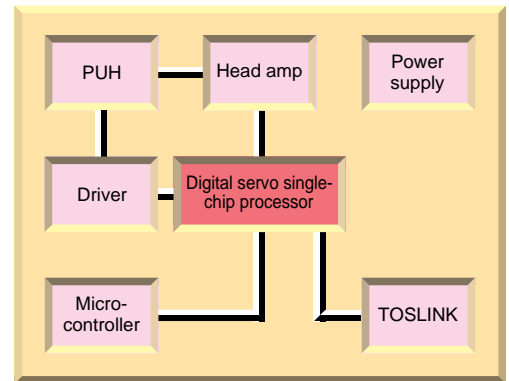
Microcontroller Board for CD Text Evaluation

Toshiba provides evaluation boards as shown on page 20 for use as a development environment required for developing digital servo systems.
In addition to these evaluation boards, Toshiba also offers a dedicated microcontroller board for evaluating CD text functions.
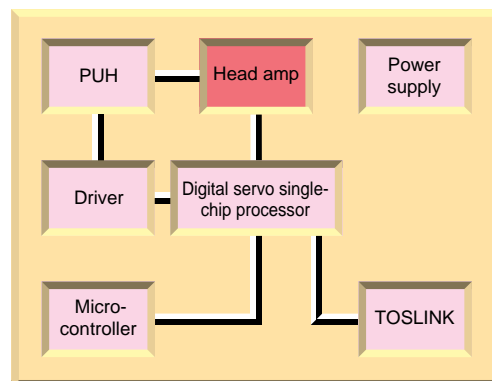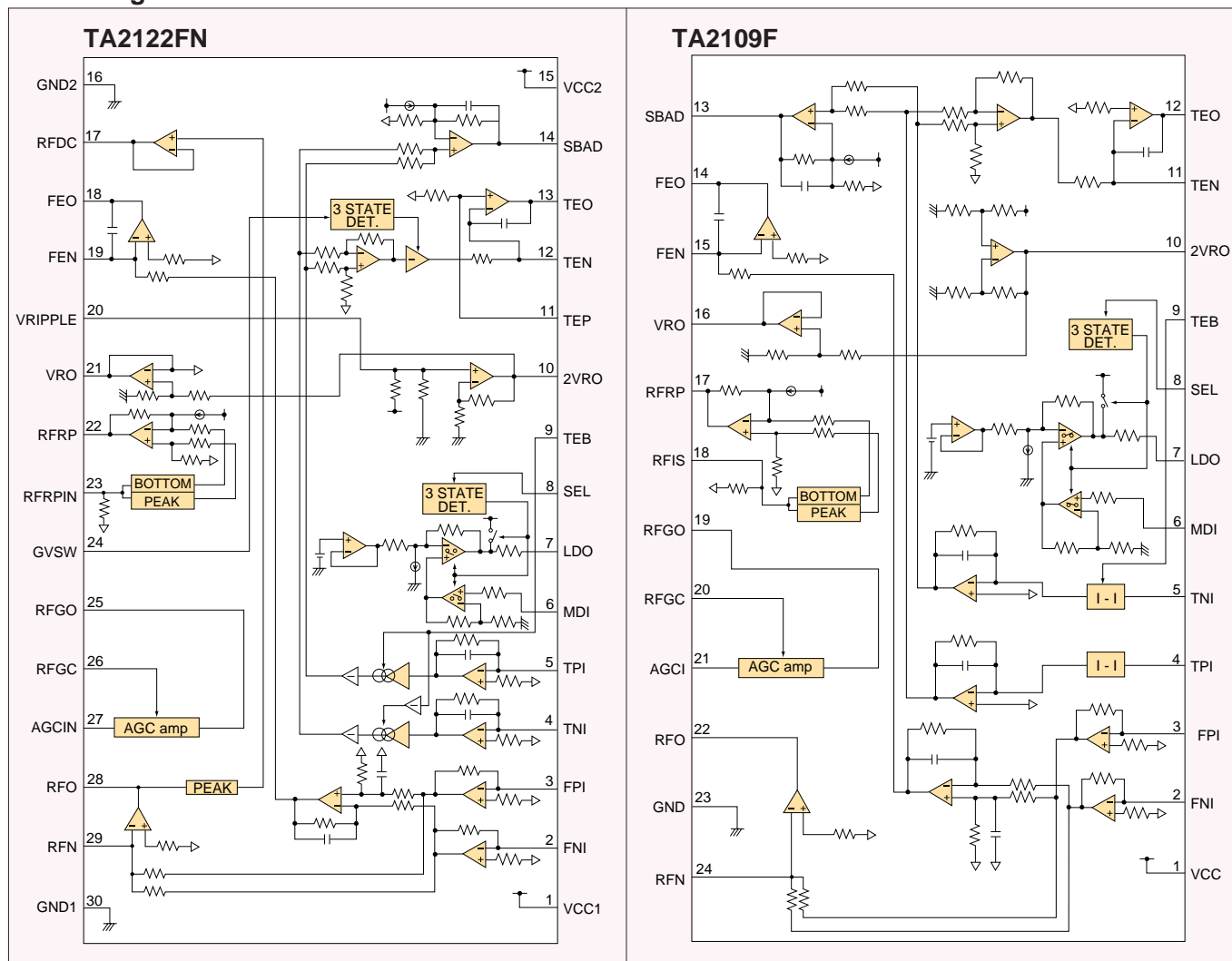

☆ : Under development

☆TA2122FN/TA2109F

Features

- Built-in focus error and tracking error generation circuits
- Built-in RF signal generator circuit
- Built-in signal generator circuit for track counting
- Built-in tracking balance adjustment and RF gain adjustment circuits
- Built-in ALPC (auto range power control) circuit
- 4 times speed playback
- ☆ TA2122FN compatible with 3-beam and 1-beam pickups
- 30-pin mini-flat package for the ☆TA2122FN and 24-pin mini-flat package for the TA2109F

Block Diagram

☆ : Under development
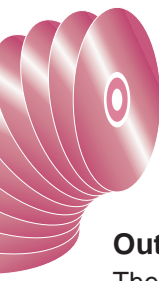
Analog Servo System for CD-Audio Use

Outline

The TC9284BF is a single-chip processor for synchronous separation protection, EFM demodulation, error correction and compensation, microcontroller interface, CLV servo and focus/tracking servo in CD player systems that also features a built-in 1-bit D/A converter.

The TA8191F and TA2065F series are LSI chips for focus/tracking servos for 3-beam PUH.

Combining members of the TC9284BF, TA8191F and TA2065F series enables configuration of extremely simple CD player systems.

TC9284BF/ TA8191F • TA2065F Series

Features

<TC9284BF>

- Reliable synchronous pattern detection and synchronous signal protection
- Built-in EFM demodulation and subcode demodulation circuits
- Use of CIRC correction logic
- Built-in muting circuit
- Built-in attenuation circuit
- Built-in 16K RAM, digital out circuit, data slicer and analog PLL circuit (using adjustment-free VCO)
- Built-in automatic adjustment functions for focus and tracking gain
- Built-in AFC and APC circuits for disc motor CLV servo
- 2 times speed playback
- Built-in 8-times oversampling digital filter and 1-bit D/A converter
  Total harmonic distortion + noise: -85 dB (typ.)
  S/N ratio: 98 dB (typ.)

<TA8191F • TA2065F Series>

- Compatible with 3-beam pickups
- Built-in RF amp, focus error amp, tracking error amp, ALPC amp, focus tracking servo amp and feed motor amp
- Built-in phase compensation amp and LPF amp
- Connection between PUH and power driver ICs for driving the motor simplifies system configuration
- Differences between each product are shown in the table below.

Device	Reference voltage terminal		Package	Power supply (V)	Remarks
	V_{REF}	$2 V_{REF}$			
TA8190F	Equipped	Not equipped	QFP44	± 5 V dual power supply	—
TA8191F	Equipped	Equipped	QFP44 (small package)	+5 V single power supply	—
TA2031F					Compatible with holographic pickups
TA2035F			QFP48		Compatible with low voltage operation (3.5 V)
TA2065F					

8

Drivers

5-ch Driver IC for Car-CD Use ☆TA2125F

Outline
The TA2125F is a 5-ch driver IC equipped with a built-in 4-ch BTL driver for focus, tracking, spindle and feed, as well as a 1-ch reversible motor driver for tray driving.

Features
● 4-ch BTL driver (Vout = 5.4 Vp (Vcc = 8 V, f = 1 kHz, RL = 8 Ω))
● Front-end op-amp
  Plus/minus 2-channel + output terminal type (2 ch)
  Buffer input type (2 ch)
● Built-in 5 V regulator output (driver: external transistor)
  Control SW (REGCONT)
● Standby switch
● 1-ch reversible motor driver
  Power supply terminal for output range adjustment (VM)
  Output mode controlled with input logic
  Built-in surge absorbing diode
● Built-in 2-ch power supply
  Complete isolation of power terminals of 4-ch driver and 1-ch driver
● Built-in thermal protection circuit
● Operating power supply voltage range: 4 to 13 V

☆: Under development
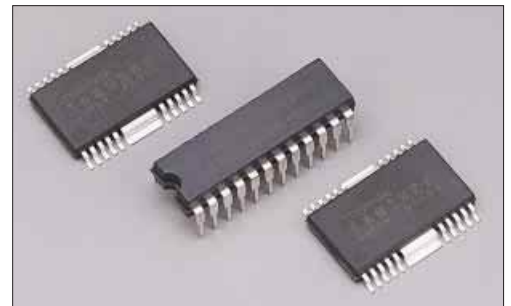
Block Diagram
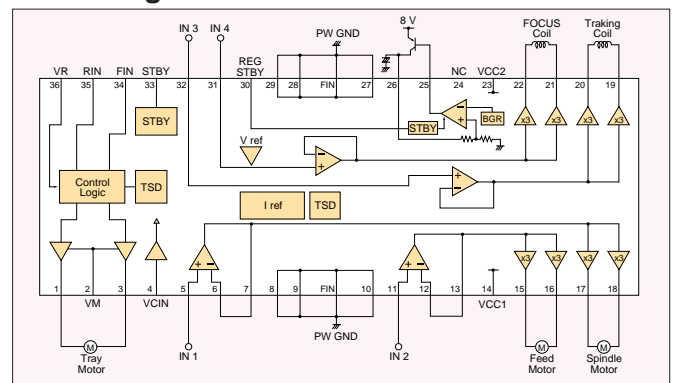
Power Drivers for CD Use TA2058F/TA2092N/TA8192F

Outline
The TA2058F, TA2092N and TA8192F are power drivers developed for driving the focus coil and tracking coil of 3-beam PUH, as well as driving the feed motor and disc motor in CD player systems.

Features
● Bootstrap-less design allows a reduction in the number of external components
● High output voltage
● High output current
● Built-in thermal shutdown circuit

Device	Channels	Operating power supply voltage range	Package	Remarks
TA2058F	BTL 4 ch	4.0 to 10.0 V	HSOP20	—
TA2092N			SDIP24	—
TA8192F	BTL 2 ch	4.0 to 12.0 V	HSOP20	Allows switching of gain and control of VR fixed output

TA2058F Block Diagram
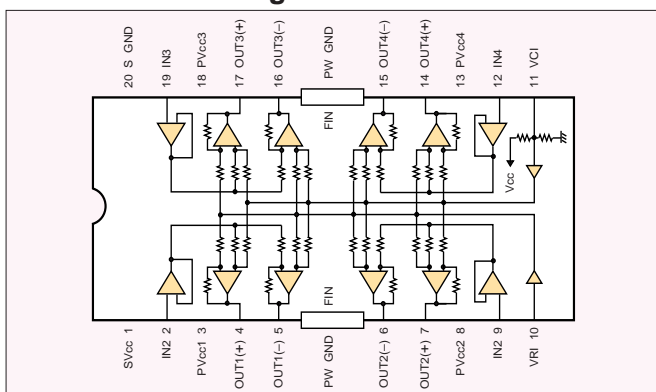
TA8192F Block Diagram
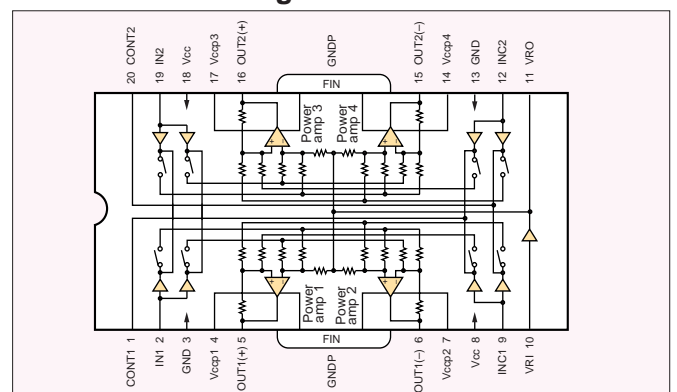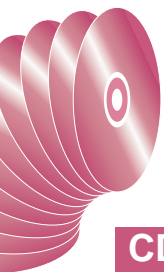
Drivers

CD-ROM/DVD Actuator Driver IC ☆TA2121F

Outline

The TA2121F is a 4-ch actuator driver IC for high-speed CD-ROM use. It contains a built-in 4-ch BTL amp for driving the focus/tracking coil, feed motor and tray motor.

In addition, this IC is also perfect for combining with high-speed, low-voltage DSP systems.
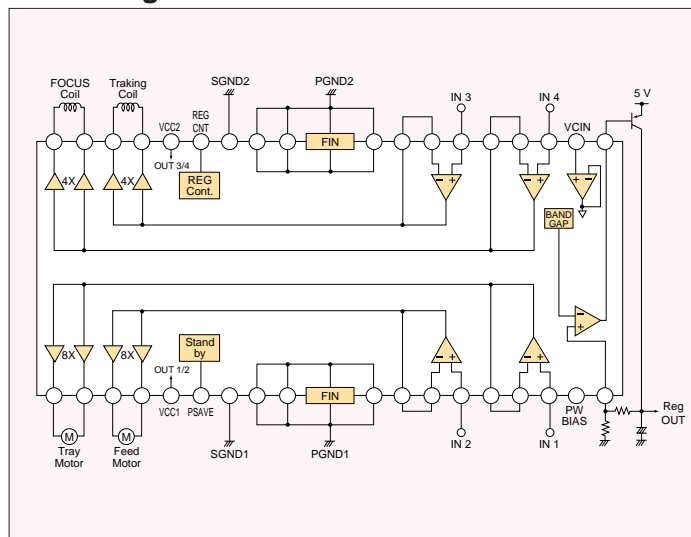
Features

● Wide output dynamic range: Vout = 4 Vp-p(typ.)
   (PVcc1, 2 = 5 V, PWBIAS = 12 V, RL = 8 Ω)
● Gain — Actuator system, 2 ch: 4 times
            Motor system, 2 ch: 8 times
● Built-in 4-ch, front-end op-amp
   Wide maximum input voltage range:
   VIN(min.) = 0.3 V
● Built-in 3.6 V regulator output
   (external transistor used for the driver)
   Control switch (REG CNT)
● Three types of power supply terminals
      12 V power supply terminal (VCC1)
       5 V power supply terminal (VCC2)
      12 V small signal power supply (PWBIAS)
● Built-in standby function
● Built-in thermal protection circuit
● Operating power supply voltage range: 4 to 13 V

☆ : Under development

Block Diagram

## CD-ROM Spindle Motor Driver TA8493F

Outline

The TA8493F is a spindle motor driver IC for high-speed CD-ROM use. The use of MCP construction and a direct PWM system results in highly efficient driving.
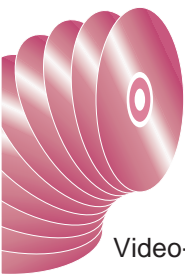
Features

● Multi-chip structure (2SJ465 x 3 pcs)
● Direct PWM control system
● Reversing brake/short brake system
● FG output
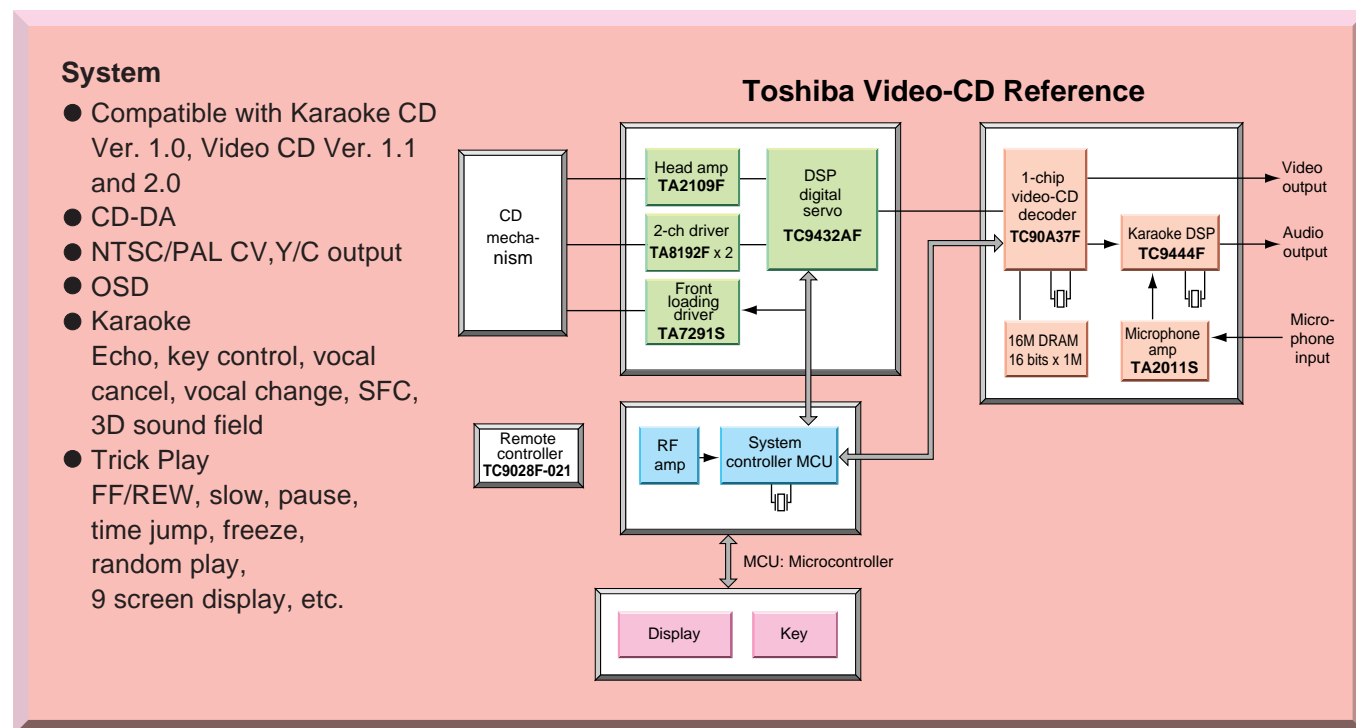● Built-in Hall bias
● Package: MFP-30

Block Diagram

10
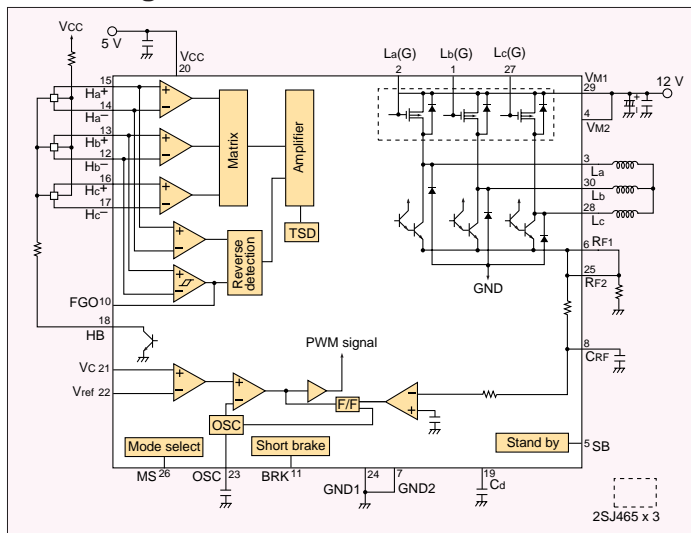
Video-CD System

Video-CDs are one form of media that supports multi-media. MPEG1 animated image and audio compression and expansion technology enables a maximum of 74 minutes of video and audio data to be enjoyed with an optical disc identical to a CD. Toshiba offers a complete lineup of LSIs required for video-CDs, including single-chip video-CD decoder LSIs, CD control LSIs, audio DSP and general-purpose microcontrollers.

System

- Compatible with Karaoke CD Ver. 1.0, Video CD Ver. 1.1 and 2.0
- CD-DA
- NTSC/PAL CV,Y/C output
- OSD
- Karaoke
  Echo, key control, vocal cancel, vocal change, SFC, 3D sound field
- Trick Play
  FF/REW, slow, pause, time jump, freeze, random play, 9 screen display, etc.

Toshiba Video-CD Reference

TC90A37F Single-chip Video-CD Decoder

Functions and Features

- Compatible with Karaoke CD Ver. 1.0, Video CD Ver. 1.1 and 2.0
- CD-DA
- PBC function
- Various trick play functions
  Slow, pause, scan, time jump, freeze, random play, 9 screen display, etc.
- NTSC/PAL automatic conversion function
- OSD function (bit map type)
- Built-in video encoder (CVBS, Y/C output)
- Power supply voltage: 3 V (interface: 5 V)
- Package: 100-pin QFP

Block Diagram
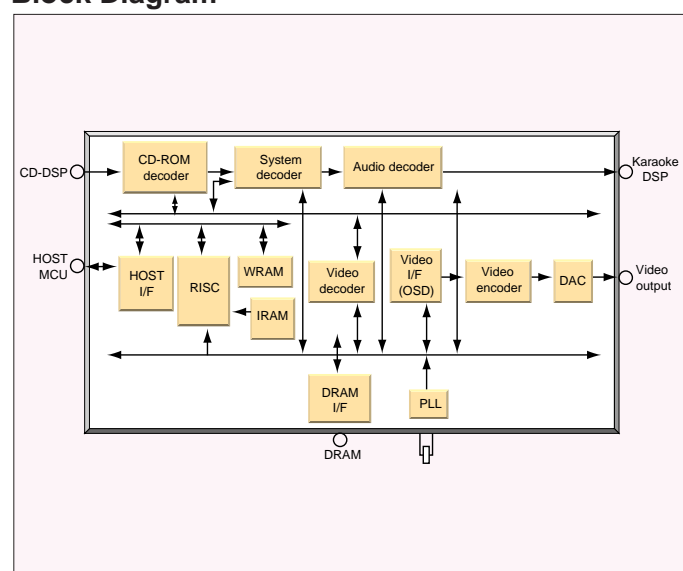
Other LSI

Device	Functions	Package
TC9432AF	CD digital servo single-chip processor	QFP100-P-1420-0.65A
TA2109F	CD digital servo head amp	SSOP24-P-300-1.00
TC9444F	Single-chip Karaoke DSP (echo, key control, vocal cancel, vocal change, SFC, 3D sound field)	QFP60-P-1414-0.80D
TA2011S	Built-in microphone amp ALC	SIP7-P-2.54A
TA7291S	DC motor driver, H switch	SIP9-P-2.54A

11
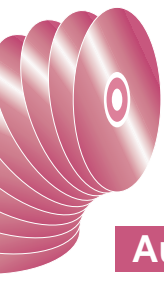
Audio Signal Processors (ICs for Karaoke Use)

Audio Signal Processor (Audio DSP for Karaoke Use)

These processors realize Karaoke functions, sound field control (SFC) or surround functions on a single chip by digital processing of audio signals using a built-in A/D-D/A converter.

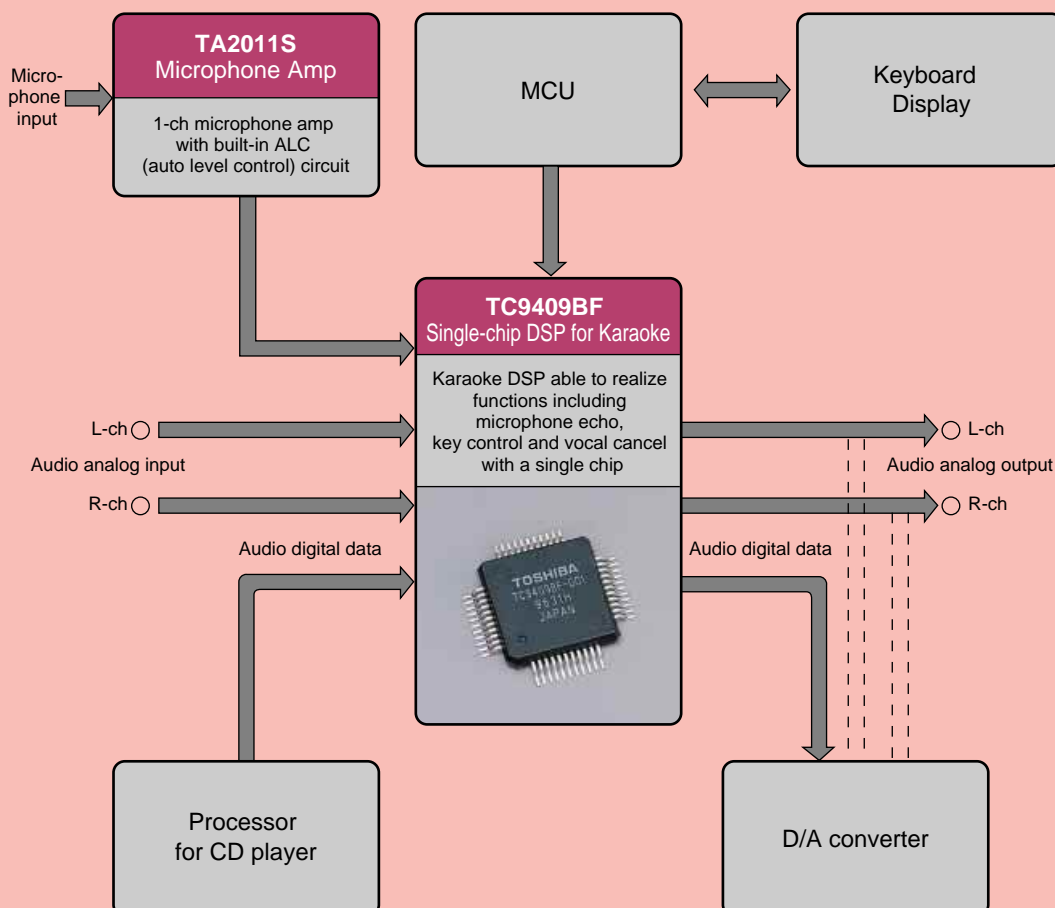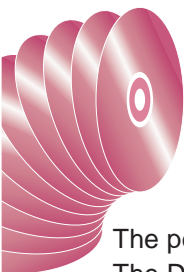| Device	Functions	Package	Power supply (V)
☆ TC9444F	Single-chip Karaoke DSP Microphone echo, vocal cancel, key control or SFC Built-in 3-ch A/D converter and 2-ch D/A converter Built-in 64K-bit delay RAM Built-in booting RAM, Toshiba BUS/I^{2}C BUS format	60-pin QFP	4.5 to 5.5 V
TC9409BF	Single-chip Karaoke DSP Microphone echo, vocal cancel, key control or SFC Built-in 3-ch A/D converter and 2-ch D/A converter Built-in 64K-bit delay RAM	44-pin QFP	4.5 to 5.5 V
TC9452F	Single-chip Karaoke DSP SFC and microphone echo, vocal cancel Built-in 3-ch A/D converter and 2-ch D/A converter Built-in 64K-bit delay RAM Pin-compatible with TC9409BF	44-pin QFP	4.5 to 5.5 V
TC9465F	Single-chip Karaoke DSP Microphone echo, vocal cancel or SFC Built-in 3-ch A/D converter and 2-ch D/A converter Built-in 64K-bit delay RAM Pin-compatible and microcontroller software-compatible with TC9409BF	44-pin QFP	4.5 to 5.5 V

☆ : Under development

TC9409BF Karaoke DSP System

TA2011S
Microphone Amp

1-ch microphone amp with built-in ALC (auto level control) circuit

Micro-phone input

MCU

Keyboard Display

TC9409BF
Single-chip DSP for Karaoke

Karaoke DSP able to realize functions including microphone echo, key control and vocal cancel with a single chip

L-ch ○

Audio analog input

R-ch ○

Audio digital data

Processor for CD player

○ L-ch

Audio analog output

○ R-ch

Audio digital data

D/A converter

D/A Converters

The performance of the D/A converter is an important factor in determining the sound quality of a CD player. The D/A converter is responsible for converting digital signals into analog signals. D/A converters used in recent CD players include conventional integral types and capacitor-segment types, as well as those using the Σ-Δ modulation method (1-bit D/A converters).

Toshiba offers various types of 1-bit D/A converters to match the particular system in addition to its TC9250F/P R-string type. In particular, the TC9293AF/AFN/AN and TC9404FN feature a built-in analog filter, which is required for the final stage of D/A conversion.

Some features of Toshiba's 1-bit D/A converters are as follows:

● A secondary Σ-Δ modulation circuit operates at a high frequency of 384 fs (192 fs).
  → This results in a shifting of noise in the audible band to a higher band.

● Micro signals are faithfully reproduced by PDM output.
  → This results in output of analog waveforms yielding high-quality acoustic sound.

IC/LSI Family

Device	Name	Functions	Process	Package	Remarks
TC9268F/P TC9278F/P	1-bit D/A converter with built-in digital filter	8-times oversampling digital filter, de-emphasis filter, double-speed operation, THD+N: -90 dB (typ.), S/N ratio: 98 dB (typ.), TC9268F/P: L ch data when LRCK is "H", TC9278F/P: L ch data when LRCK is "L"	CMOS	SOP20 DIP20	Current consumption 12 mA (typ.) at V_{DD} = 5 V
TC9276F/P		8-times oversampling digital filter, de-emphasis filter, with soft muting, THD+N: -90 dB (typ.), S/N ratio: 98 dB (typ.), TC9267F/P: L ch data when LRCK is "H"			
TC9270F/N	1-bit D/A converter with built-in digital filter	8-times oversampling digital filter, digital attenuator, de-emphasis filter, THD+N: -90 dB (typ.), S/N ratio: 100 dB (typ.), L ch data when LRCK is "H"	CMOS	SOP28 SDIP28	—
TC9293AF/ AFN/AN	1-bit D/A converter with built-in digital and analog filters	8-times oversampling digital filter, analog filter, digital attenuator, THD+N: -85 dB (typ.), S/N ratio: 96 dB (typ.), TC9404FN: Equipped with zero data detection output	CMOS	SSOP24 (1.0 pitch) SSOP24 (0.65 pitch) SDIP24	Low voltage operation
TC9404FN					
TC9400F/N	1-bit D/A converter with built-in digital filter	8-times oversampling digital filter, digital attenuator, THD+N: -90 dB (typ.), S/N ratio: 100 dB (typ.)	CMOS	SOP28 SDIP28	Low voltage operation
TC9250F/P	Resistor string-type D/A converter	Compatible with up to 8-times oversampling digital filter, 16-bit D/A converter	CMOS	SOP16 DIP16	—

TC9404FN and TC9293AF/AFN/AN

These are 1-bit D/A converters featuring a built-in tertiary low-pass filter and built-in 8-times oversampling digital filter. The oversampling ratio of the D/A converter is 192 fcs, enabling noise in the audible band to shift to higher bands. (The TC9404FN is equipped with a zero data detection output.) These also contain a built-in digital attenuator enabling output to be varied in 128 steps.

AC Characteristics: S/N ratio: 96 dB (typ.), THD+N: -85 dB (typ.)

The AFN/FN use a 24-pin shrink DIP package (pitch: 0.65 mm), the AF a 24-pin shrink DIP package (pitch: 1.0 mm), and the AN a 24-pin shrink DIP package.

13
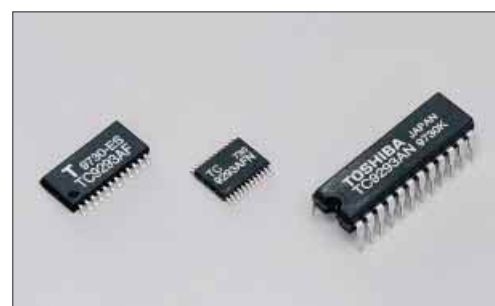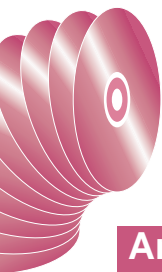
Analog Switches/Electronic Volumes

Analog Switches and Electronic Volumes

Electronic volumes and analog switches are becoming increasingly indispensable in the systems of today that employ electronic control. Toshiba offers a wide range of ICs, including electronic volumes and analog switch arrays, that are able to accommodate a diverse range of specifications.

Analog Switches

Classification	Device	Functions	Package
Analog switch	TC9162AN/AF	High breakdown voltage, analog function switch array	SDIP28-P-400-1.78 SOP28-P-450-1.27
	TC9163AN/AF		
	TC9164AN/AF		
	TC9208N	6-circuit stereo, high breakdown voltage analog switch	SDIP28-P-400-1.78
	TC9209N	4-circuit tape monitor stereo, high breakdown voltage analog switch	
	TC9214AP/AF	High breakdown voltage, low distortion rate analog switch 1-contact point, analog switch x 3, 2-contact point analog switch x 1	DIP16-P-300-2.54A SOP16-P-300-1.27
	TC9215AP/AF	High breakdown voltage, low distortion rate analog switch 2-circuit, 1-contact point analog switch x 1, 2-circuit analog switch x 1	DIP28-P-300-2.54A SOP16-P-300-1.27
	TC9273N/F	High breakdown voltage analog switch array Compatible with semi-customization	SDIP28-P-400-1.78 SOP28-P-450-1.27
	TC9274N/F		SDIP42-P-600-1.78 QFP44-P-1414-0.80D

Electronic Volumes

Classification	Device	Functions	Package
Volume	TC9235P/F	Up/down type electronic volume	DIP16-P-300-2.54A
	TC9260P/F	Serial data control type electronic volume	SOP16-P-300-1.27
Tone Control	TC9184AP	Serial data control type electronic tone control	DIP16-P-300-2.54A
High Breakdown Voltage Volume	TC9210P	High breakdown voltage, serial data control type electronic volume	DIP16-P-300-2.54A
	TC9211P	High breakdown voltage, serial data control type electronic volume + loudness	DIP20-P-300-2.54A
	TC9299P	High breakdown voltage, serial data control type electronic volume	DIP16-P-300-2.54A
	TC9412AP	High breakdown voltage, serial data control type electronic volume + loudness	DIP20-P-300-2.54A
	TC9412AF		SOP24-P-450-1.27A
	TC9413AP	High breakdown voltage, serial data control type electronic volume	DIP16-P-300-2.54A
	▼ TC9459N	High breakdown voltage, serial data control type electronic volume + loudness	SDIP28-P-400-1.78
	▼ TC9459F		SOP24-P-450-1.27A
	☆ TC9463N	6-ch, high breakdown voltage, serial data control type electronic volume	SDIP28-P-400-1.78
	☆ TC9463F		SOP28-P-450-1.27
Single-chip Volume	▼ TC9421F	Volume, 2-band tone control, 4-input selector, fader	QFP44-P-1414-0.80D
	☆ TC9422N	Volume, 2-band tone control, 4-input selector	SDIP28-P-400-1.78
	☆ TC9422F		SOP28-P-450-1.27
	☆ TC9448F	7-band graphic equalizer, 0 to ±14 dB in 2 dB steps	QFP60-P-1414-0.80D

▼ : New product   ☆ : Under development

Interface

Digital-In TC9245F/N

Outline

The TC9245F/N is a receiving and demodulating IC for digital audio interfaces that conforms to EIAJ standard CP-340.
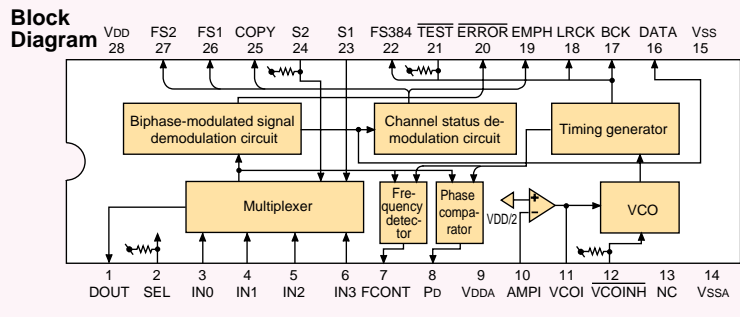
Features

- Compatible with SCMS (serial copy management system)
- Four inputs for compatibility with both coaxial and optical input
- Two types of error detection consisting of synchronous signal detection and parity check, and when an error is detected, muting is applied to the output data for a fixed period of time.
- Built-in VCO enables simple PLL configuration
- Built-in pseudo-locking prevention function for reliable locking
- Equipped with a VCO oscillation terminating function
- Choice of 28-pin flat package or 28-pin shrink DIP package

Block Diagram

VDD 28 FS2 27 FS1 26 COPY 25 S2 24 S1 23 FS384 22 TEST 21 ERROR 20 EMPH 19 LRCK 18 BCK 17 DATA 16 VSS 15

- Biphase-modulated signal demodulation circuit
- Channel status de-modulation circuit
- Timing generator
- Multiplexer
- Frequency detector
- Phase comparator
- VDD/2
- VCO

1 DOUT 2 SEL 3 IN0 4 IN1 5 IN2 6 IN3 7 FCONT 8 PD 9 VDDA 10 AMPI 11 VCOI 12 VCOINH 13 NC 14 VSSA

Digital-Out TC9271F/N/FS

Outline

The TC9271F/N/FS is a modulating and transmitting IC for digital audio interfaces conforming to EIAJ standard CP-1201.
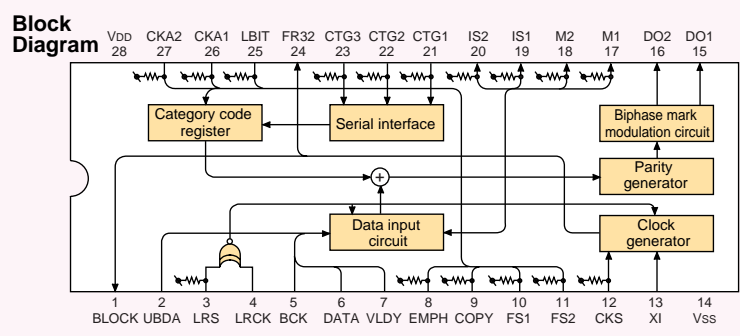
Features

- Selection of MSB first or LSB first for data input format, and data length compatible up to 24 bits.
- Compatible with both 2-channel and 4-channel modes
- Channel status data can be set easily by using an external terminal, and all data can be input serially through the operation of a microcontroller when setting.
- Enables transmission of user data
- Double-speed operation
- Selection of LRCK polarity
- Two types of packages available consisting of 28-pin (pitch: 1.27 mm) and 30-pin (pitch: 0.65 mm) flat packages and a 28-pin shrink DIP package.

Block Diagram

VDD 28 CKA2 27 CKA1 26 LBIT 25 FR32 24 CTG3 23 CTG2 22 CTG1 21 IS2 20 IS1 19 M2 18 M1 17 DO2 16 DO1 15

- Category code register
- Serial interface
- Biphase mark modulation circuit
- Parity generator
- Data input circuit
- Clock generator

1 BLOCK 2 UBDA 3 LRS 4 LRCK 5 BCK 6 DATA 7 VLDY 8 EMPH 9 COPY 10 FS1 11 FS2 12 CKS 13 XI 14 VSS

Clock Generator IC TC9246F/P

Outline

The TC9246F/P is a clock generator IC that generates the master clock required by the system.
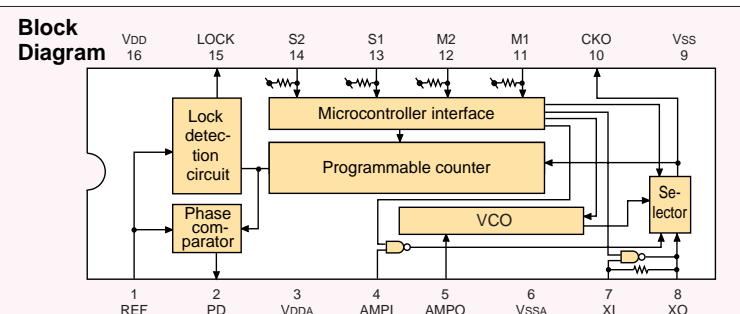
Features

- Master clock required by the system can be generated by input of reference clock pulses
- Built-in VCO enables easy PLL configuration
- Built-in amp for external oscillator enables generation of master clock drive pulses with an external crystal oscillator by microcontroller operation, while the built-in VCO allows switching of the master clock drive pulse.
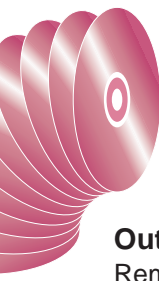- PLL lock detection
- Serial connection with the TC9245F/N (Digital-In) allows use as a 2nd PLL
- Choice of 16-pin MFP or 16-pin DIP package

Block Diagram

VDD 16 LOCK 15 S2 14 S1 13 M2 12 M1 11 CKO 10 VSS 9

- Lock detection circuit
- Microcontroller interface
- Programmable counter
- Phase comparator
- VCO
- Selector

1 REF 2 PD 3 VDDA 4 AMPI 5 AMPO 6 VSSA 7 XI 8 XO

Remote Controls

Outline

Remote controls are considered to be indispensable components of the CD player systems of today. As a result, they must provide increasingly diverse functions as well as be compact in size and deliver outstanding performance. As the number of types of remote controls increases, including those for use with televisions, video decks, stereo systems and telephones, the degree of precision of transmission and reception will become an important issue. Toshiba offers a full lineup of high-performance semiconductor devices and ICs for use in remote controls to provide support in creating remote controls that promote enhanced music enjoyment.
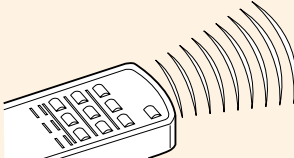
Transmitters for Remote Controls (Infrared LEDs)

Device	Package	Outline Drawing	Characteristics (Ta = 25°C)					
			Po (typ.) (mW)	I_F (mA)	IE (min.) (mW/sr)	I_F (mA)	λp (nm)	$\theta\frac{1}{2}$ (°)
TLN105B	Plastic		11	50	12	50	950	±23.5
TLN115A			13	50	15	50	950	±21

Remote Control Detectors (Photodiodes)

Device	Package	Outline Drawing	Characteristics (Ta = 25°C)						
			Isc (min.) (μA)	E(mW/cm²)	I_D (max.) (nA)	V_R(V)	V_R (max.) (V)	$\theta\frac{1}{2}$ (°)	Sensitivity wavelength
TPS703	Plastic		0.9	0.1	30	10	20	±65	λ > 700(nm)
TPS704			0.5						λ > 800(nm)
TPS705			0.5	0.1	30	10	20	±65	λ > 800(nm)
TPS706			1.0						

Infrared Remote Controls (Transmitters)

| Device	TC9243P/F	TC9028P/F	TC9290P/F
Package	DIP20/SOP20	DIP20/SOP20	DIP20/SOP20
Operating power supply (V)	2.0 to 4.0 V	2.0 to 4.0 V	3.0 to 5.5 V
Oscillation frequency	400 to 800 kHz	400 to 800 kHz (455 kHz typ.)	400 to 800 kHz
Subcarrier wave frequency	fosc/12	fosc/12, fosc/8 (optional: fosc/24, fosc/16)	None
Transmitting format	Fixed	Programmable	Fixed
No. of key functions	32 keys	Typ. 32 keys	32 keys
No. of key inputs (input ports)	8	4	8
No. of key outputs (output ports)	4	—	4
No. of I/O ports	—	8	—
No. of double-press operation keys	4 priority keys x 28 combination keys	—	4 priority keys x 28 combination keys
No. of internal system codes	16	—	16
ROM size		768 x 8 bits	
RAM size		16 x 4 bits	
Instruction execution time		11μs (fosc = 455 kHz)	Optimum for expansion of key inputs in wired remote controls and DTS/microcontrollers
No. of basic instructions		44 types	
Subroutines		1 level	
Timer divider		During 1-bit reading: 8 levels can be selected from 10 to 14 levels During 4-bit reading: 12 to 15 levels	
Reception decoder	TC9244P (9 functions) TC9285P (11 functions) TC9259N (17 functions)	General-purpose microcontroller	TC9244P (9 functions) TC9285P (11 functions) TC9259N (17 functions)

Remote Control Photo IC TPS832

- Photodiode, amp and BPF configured with a single chip
- Power supply voltage: Vcc = 5 V
- Carrier frequency: fo = 38 kHz
- Current consumption: Icc = 3 mA (max.)
- Transmission range: 8 m (min.)

Block Diagram

Outline Drawing

1. Vo
2. GND
3. Vcc
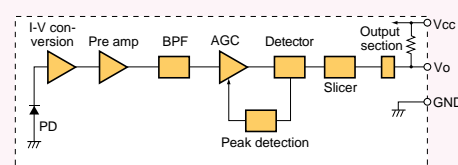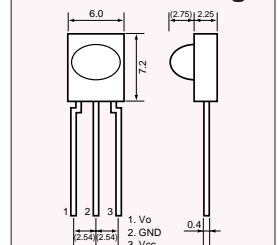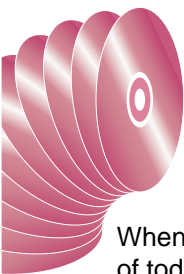
Microcontrollers

When selecting a microcontroller for control of the increasingly diverse and multi-functional personal audio systems of today, we strongly recommend our complete lineup of high-performance microcontrollers. In addition, together with offering OTP (one-time PROM) for functional evaluation of application systems that can be used in the initial production stage, Toshiba also has available a complete assortment of support tools (RTE) that provide powerful support in developing application software.

Microcontroller Lineup

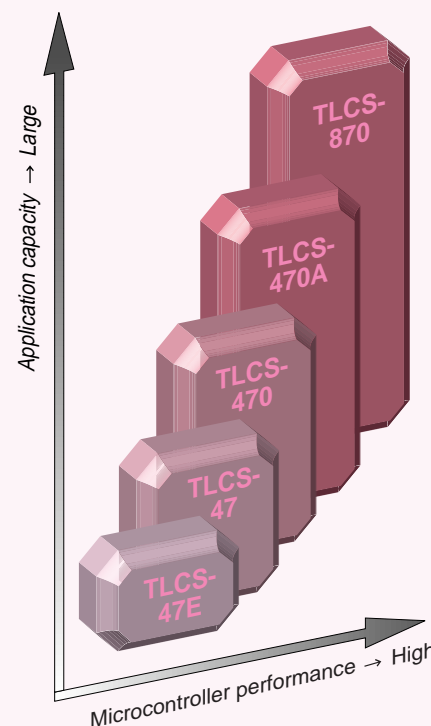|	TLCS-47E	TLCS-47	TLCS-470	TLCS-470A	TLCS-870
ROM	4KB max.		8KB max.	16KB max.	64KB max.
RAM	256 W max.		512 W max.	768 W max.	
Min. instruction execution time	1.9 μs @ 4.2 MHz		1.3 μs @ 6 MHz 244 μs @ 32.8 kHz		0.5 μs @ 8 MHz 122 μs @ 32.8 kHz
No. of instructions	90 types		92 types	105 types	129 types
Interrupts	6 sources max.				15 sources max.
Basic internal functions (※ see next page)	Interval timer				Time-based timer
	※		Watchdog timer		
	12-bit timer/counter x 2 channels				※
	4-bit serial interface		8-bit serial interface		

Wide Variety of Support Tools for Development of Application Software

Toshiba offers various types of highly functional support tools for development of application software.

Please refer to the "Toshiba Microcomputer Products Guide" for further details regarding support tool products.

Application capacity → Large

TLCS-870
TLCS-470A
TLCS-470
TLCS-47
TLCS-47E

Microcontroller performance → High

Toshiba accepts orders for original software development.

Toshiba offers a special service for the development of microcontroller software for original applications.
Please inquire at your nearest dealer for details.
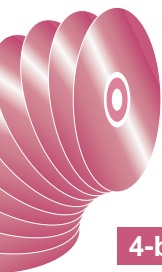
Microcontrollers

Device	OTP	Display driver	Additional functions		ROM (bytes)	RAM (nibbles)	I/O ports	Package
TMP47C222N/F	TMP47P422VN/VF	LCD	8-bit A/D converter x 4 channels, zero-cross detection circuit, pulsed output circuit		2K	192	20/22	SDIP42/ QFP44
TMP47C422N/F					4K	256		
TMP47C620DF	TMP47P820VDF		8-bit, high-speed timer/counter x 2 channels, watchdog timer		6K	384	36	QFP80
TMP47C820DF					8K	512		
TMP47C446ADF	TMP47P446VDF		8-bit A/D converter x 4 channels, watchdog timer		4K	256	24	QFP64
TMP47C670N	TMP47P870N	VFT	4-bit A/D conversion input x 4 channels, 14-bit PWM output, remote control judgment circuit	Watch-dog timer	6K	384	53	SDIP64
TMP47C870N					8K	512		
TMP47C1270AN	TMP47P1670VN				12K	768		
TMP47C1670AN					16K			
TMP47C662AN	TMP47P862VN		8-bit A/D converter x 8 channels, 12-bit PPG output x 2 channels		6K	384	55	
TMP47C862AN					8K	512		
TMP47C660AN/AF	TMP47P860VN/VF	LED	8-bit A/D converter x 8 channels, remote control judgment circuit		6K	384	56	SDIP64 QFP64
TMP47C860AN/AF					8K	512		
TMP47C1260N/F	TMP47P1660VN/VF				12K	768		
TMP47C1660N/F					16K			

Package Types N/E: SDIP, F/G: QFP

Device	OTP	Display driver	Additional functions	ROM (bytes)	RAM (bytes)	I/O ports	Package
TMP87C800N/F	TMP87PH00N/F	LED	Timer/counter x 4 channels, serial interface x 2 channels	8K	256	58	SDIP64 QFP64
TMP87CH00N/F				16K			
TMP87CC20F	TMP87PH20F	LCD	8-bit PWM output, timer/counter x 5 channels, serial interface x 1 channel	12K	512	45	QFP80
TMP87CH20F				16K			
TMP87CK20AF	TMP87PM20F			24K	1K		
TMP87CM20AF				32K			
TMP87CH21F/DF	TMP87PP21F/DF		8-bit PWM output, timer/counter x 4 channels, serial interface x 2 channels, 8-bit A/D converter x 8 channels	16K	1K	52	QFP80
TMP87CM21F/DF				32K			
TMP87CM23F	TMP87PP23F		8-bit PWM output, timer/counter x 4 channels, serial interface x 2 channels, 8-bit A/D converter x 8 channels	32K	1K	70	QFP100
TMP87CP23F				48K	2K		
TMP87CH29U	TMP87PM29U		8-bit PWM output, timer/counter x 5 channels, UART x 1 channel, 8-bit A/D converter x 5 channels	16K	1K	43	SVFP64
TMP87CK29U				24K			
TMP87CM29U				32K			
TMP87C874F	TMP87PM74F	VFT	I²C bus x 1 channel, timer/counter x 4 channels, serial interface x 1 channel, 8-bit A/D converter x 12 channels	8K	512	71	QFP80
TMP87CH74F				16K			
TMP87CH75F	TMP87PM75F		I²C bus x 1 channel, timer/counter x 4 channels, serial interface x 1 channel, 8-bit A/D converter x 16 channels	16K	512	89	QFP100
TMP87CM75F				32K	1K		
TMP87C840N/F	TMP87PH40N/F	LED	Timer/counter x 4 channels, serial interface x 2 channels, 8-bit A/D converter x 8 channels	8K	256	56	SDIP64 QFP64
TMP87CC40N/F				12K	512		
TMP87CH40N/F				16K			
TMP87CK40N/F	TMP87PM40N/F			24K	1K		
TMP87CM40AN/F				32K			
TMP87C446N	TMP87PH46N		Timer/counter x 4 channels, serial interface x 1 channel, serial output x 1 channel, 8-bit A/D converter x 8 channels	4K	512	35	SDIP42
TMP87C846N				8K			
TMP87CH46N				16K			
TMP87C447U	TMP87PH47U			4K	512	37	QFP44
TMP87C847U				8K			
TMP87CH47U				16K			
TMP87CM64F	TMP87PS64F		Timer/counter x 5 channels, serial interface x 3 channels, 8-bit A/D converter x 16 channels	32K	1K	90	QFP100
TMP87CP64F				48K	2K		
TMP87CS64F				60K			

Package Types P:DIP,N/E:SDIP,F/G:QFP
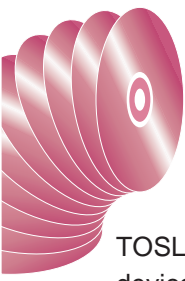
Optical I/O Interface TOSLINK™

TOSLINK™ fiber-optic modules for digital audio interfaces are ideal devices for transmitting signals from these interfaces.
The optical interface levels and optical connector shapes conform to EIAJ standards CP-1201 and RC-5720.
These fiber-optic modules for digital audio interfaces include panel-mounted types as well as types able to operate at high temperatures of up to 85°C, enabling them to be used over a broad range of application fields, from CD players, DVD and other AV systems to car audio and car navigation systems.

Fiber-optic Modules for Digital Audio Interfaces

TOSLINK for Digital Audio Interfaces — Product Lineup

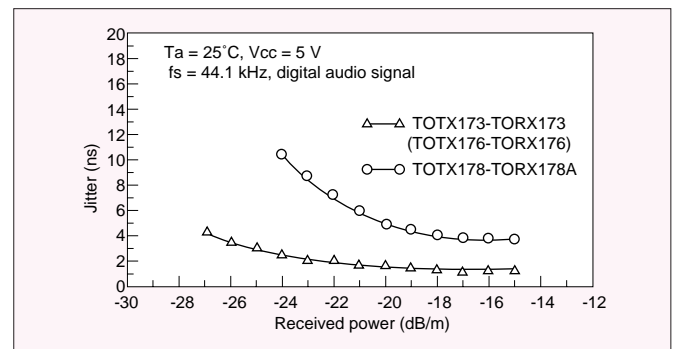| Fiber-optic Trans-mitting Module	Fiber-optic Receiving Module	Data Rate (Mb/s, NRZ)	Peak Emission Wavelength (nm)	Transmission Distance (m)[1]	Pulse Width Distortion (ns)[1]	Operating Temperature (°C)
TOTX173	TORX173	DC to 6	660	up to 10	±20	−20 to 70
TOTX176	TORX176	DC to 6	660	up to 10	±20	−20 to 70
TOTX178	TORX178A	0.1 to 6	660	up to 5	±30	−20 to 70
TOTX193	TORX193	DC to 6	660	up to 10	±25	−40 to 85
TOTX193K	TORX193K	DC to 6	660	up to 10	±25	−40 to 85

Note (1): Values when Ta = 25°C
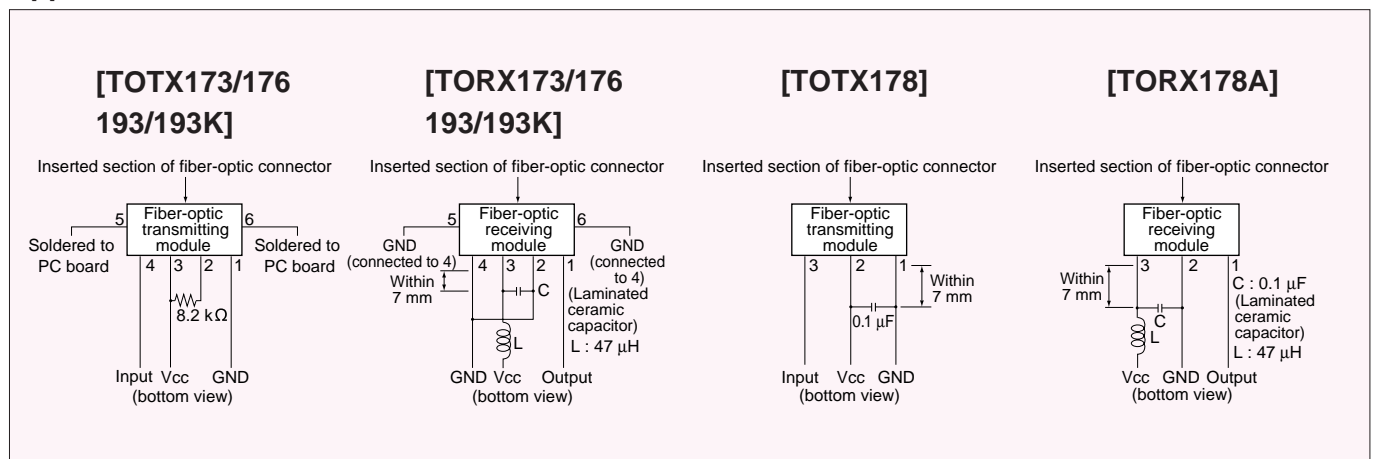
Example of Characteristics (Jitter)

In the case of digital audio systems, the amount of jitter associated with the optic module changes the sound quality of the system.
An example of measurement of jitter during digital audio signal transmission is shown in the graph.

Example of Jitter Characteristics of a Fiber-optic Module for General Audio Use

Ta = 25°C, Vcc = 5 V
fs = 44.1 kHz, digital audio signal

△ TOTX173-TORX173 (TOTX176-TORX176)
○ TOTX178-TORX178A

Jitter (ns) vs Received power (dB/m)

Application Circuits

[TOTX173/176 193/193K]

Inserted section of fiber-optic connector

Fiber-optic transmitting module

5 — Soldered to PC board   6 — Soldered to PC board

4 3 2 1

8.2 kΩ

Input (bottom view) Vcc GND

[TORX173/176 193/193K]

Inserted section of fiber-optic connector

Fiber-optic receiving module

5   6

GND (connected to 4)   GND (connected to 4)

Within 7 mm

4 3 2 1   C

L

GND Vcc Output (bottom view)

C (Laminated ceramic capacitor)
L : 47 µH

[TOTX178]

Inserted section of fiber-optic connector

Fiber-optic transmitting module

3 2 1   Within 7 mm

0.1 µF

Input (bottom view) Vcc GND

[TORX178A]

Inserted section of fiber-optic connector

Fiber-optic receiving module

Within 7 mm

3 2 1   C

L

C : 0.1 µF (Laminated ceramic capacitor)
L : 47 µH

Vcc GND Output (bottom view)

GaAs components are used for the material of the LED in the TOSLINK fiber-optic transmitting modules. Consideration must be given to other persons and the environment during disposal and final processing. Jitter characteristics are shown in the form of a representative example. This example is not intended to guarantee those characteristics.
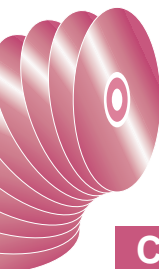
Software for CD-Based Equipment (Microcontrollers)

CDS-500/700/800 Series

Outline

Members of the CDS-500/700/800 series are application software for CD player systems that provide optimum control of our TC9284BF, TC9296AF and TC9432AF LSIs for CD players using our 4-bit and 8-bit microcontrollers (TLCS-47 and 870 series). In addition, since functional upgrades are based on these software products, the use of this application software results in improved development efficiency along with shorter development times.

Features

- LCD display (28 segments, 3 common)
- Music calendar display function (display of up to 20 selections)
- Up/down direct selection function
- Direct selection function by keyboard entry
- Fast-forward and reverse functions
- Remainder display function
- Program memory registration function
- Repeat function (1 selection, all selections or repeating between A and B)
- Random play function
- Index search function
- Automatic spacing function (inserts 4 seconds of blank space between selections)
- Automatic pause function

System Configuration

Series Name	CDS-541	CDS-581	CDS-760	CDS-7C0	CDS-840	☆CDS-8H0
MCU	TMP47C421ADF-VA37	TMP47C820DF-NA21	TMP47C820DF	TMP87CC20F	TMP47C422F	TMP87CH20F
Single-chip processor for CD use	TC9284BF	TC9284BF	TC9296AF	TC9296AF	TC9432AF	TC9432AF
Applicable system	Portable CD players, CD-radio-cassettes	Console-type CD-radio-cassettes	Portable CD players, CD-radio-cassettes	Console-type CD-radio-cassettes	Portable CD players, CD-radio-cassettes	Console-type CD-radio-cassettes
Front loading function		●				
Selection search function	●	●	●	●	●	●
Fast-forward/reverse	●	●	●	●	●	●
Random play function		●		●		●
Repeat function	1 selection, all selections	1 selection, all selections	1 selection, all selections	1 selection, all selections, A-B	1 selection, all selections	1 selection, all selections
Memory function (max. no. of selections)	20	20	20	30		30
Remainder display function		●		●		●
Introduction scan		●		●		●
Music calendar		●		●		●
Automatic spacing function		●		●		●
Automatic pause function		●		●		●
Remote control function		●		●		

☆: Under development

Example of Application Software Development Environment

Microcontroller board for digital servo system evaluation

Software for CD-Based Equipment (DTS)

CD-1/CD-2 System Controllers

Outline

Microcontrollers for controlling CD-1 and CD-2 systems consist of 4-bit microcontrollers for single-chip digital tuning systems that contain a built-in prescaler, PLL and LCD driver.
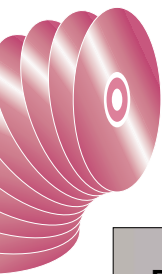
Consequently, instead of a system configuration that consists of a two-chip microcontroller for CD control and DTS controller as in the past, a single-chip configuration is employed that controls a CD system with a DTS controller, resulting in simplified system configuration.

In addition, Toshiba offers OTP microcontrollers that can be used for evaluation of application system functions and in the initial stages of production. Moreover, a full range of support tools is also available, which provide powerful support for development of application software.

Features

	CD-1	CD-2
Device	TC9309AF	TC9314F
Package	QFP80-P-1420-0.80A	
Function	4-bit single-chip DTS microcontroller	
ROM size	16 bits x 3968 steps	16 bits x 6144 steps
RAM size	4 bits x 256 words	4 bits x 384 words
No. of instructions	61	54
Instruction execution time	11.1 µS	40 µS
Subroutines	2	4
Key inputs	4	
Input ports	1($\overline{\text{INH}}$)+2	max. 5
Output ports	12	max. 11
I/O ports	15	max. 28
Display	1/2 duty, 1/2 bias	1/3 duty, 1/2 bias
Segments	64 Seg.	90 Seg.
Crystal oscillation frequency	7.2 MHz	75 KHz
Reference frequency	1, 3.125, 5, 6.25, 9, 10 12.5, 25, 50, 100 KHz	1, 3, 3.125, 5, 6.25, 12.5, 25 KHz
Programmable counter	16-bit pulse swallow, 12-bit direct divider	
Prescaler	Internal (max. 185 MHz)	Internal (max. 130 MHz)
IF counter	20 MHz, 16-bit general-purpose counter	12 MHz, 20-bit general-purpose counter
CD servo IC	TA8191F, TA2031F, TA2065F	
CD processor IC	TC9284BF	
Remote control IC	TC9028P/F, TC9243P/F	
OTP version	TC93P09F	☆TC93P14F

☆ : Under development

Toshiba also welcomes commissioned development of DTS software for CD-1 and CD-2 systems.
For further details, please consult your Toshiba dealer.

CD-1/CD-2 System Block Diagram

Development Environment (Evaluation Board)

Digital Servo System Development Environment for CD-Audio Use

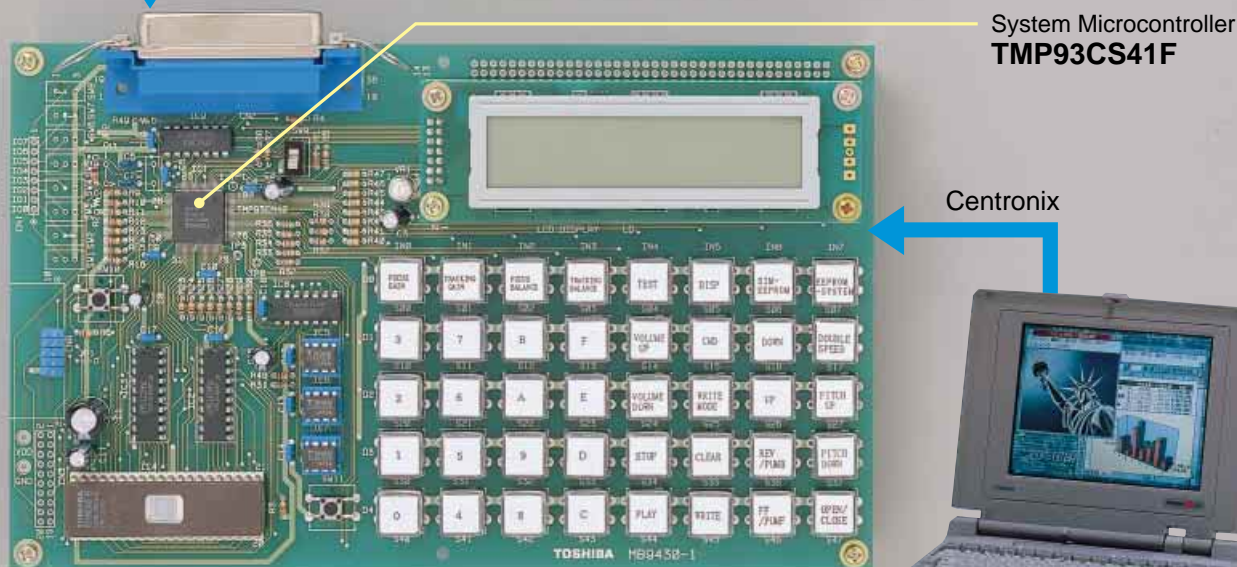Toshiba provides an environment for development of servo systems.
The use of this environment enables system development corresponding to various types of pickups.

Digital Servo Single-Chip Processor
TC9432AF

4-ch Driver
TA2092N

Head Amp
TA2109F

Digital Servo System Evaluation Board
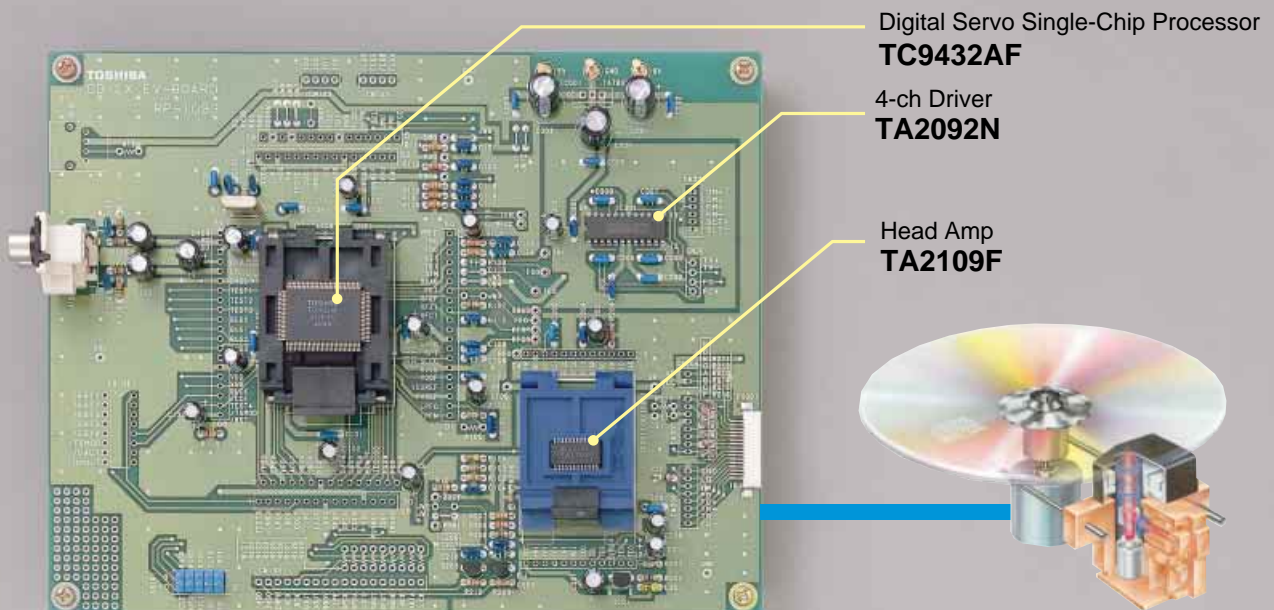
System Microcontroller
TMP47P422VF

Microcontroller Board for CDS-840 Evaluation

System Microcontroller
TMP93CS41F

Centronix

Microcontroller Board for Digital Servo System Evaluation

Digital Servo Simulator

OVERSEAS SUBSIDIARIES AND AFFILIATES

980807 (F)

Toshiba America Electronic Components, Inc.

Headquarters-Irvine, CA
9775 Toledo Way, Irvine,
CA 92718, U.S.A.
Tel: (714)455-2000 Fax: (714)859-3963

Altamonte Springs, FL(Orland)
600 S, North Lake Blvd., Suite 250,
Altamonte Springs, FL 32701, U.S.A.
Tel: (407)332-0966 Fax: (407)339-3777

Deerfield, IL(Chicago)
One Pkwy., North, Suite 500, Deerfield,
IL 60015-2547, U.S.A.
Tel: (847)945-1500 Fax: (847)945-1044

Denver, CO
8400 E, Prentice Englewood, CO 80111, U.S.A.
Tel: (303)220-9848 Fax: (303)220-9856

Edison, NJ
2035 Lincoln Hwy. Ste. #3000, Edison
NJ 08817, U.S.A.
Tel: (908)248-8070 Fax: (908)248-8030

Irvine, CA
2 Venture Plaza, Suite 500, Irvine,
CA 92718, U.S.A.
Tel: (714)453-0224 Fax: (714)453-0125

Microelectronics Center-Sunnyvale, CA
1220 Midas Way, Sunnyvale,
CA 94088-3509, U.S.A.
Tel: (408)739-0560 Fax: (408)746-0577

Norcross, GA(Atlanta)
655 Engineering Dr. #160, Norcross,
GA 30092, U.S.A.
Tel: (404)368-0203 Fax: (404)368-0075

Richardson, TX(Dallas)
777 East Campbell Rd., Suite 650, Richardson,
TX 75081, U.S.A.
Tel: (214)480-0470 Fax: (214)235-4114

Wakefield, MA(Boston)
401 Edgewater Place, Suite #360, Wakefield,
Essex, MA 01880-6229, U.S.A.
Tel: (617)224-0074 Fax:(617)224-1095

San Jose Engineering Center, CA
1060 Rincon Circle, San Jose,
CA 95131, U.S.A.
Tel: (408)456-8900 Fax: (408)456-8910

Toshiba Electronics Europe GmbH

Düsseldorf Head Office
Hansaallee 181, D-40549 Düsseldorf
Germany
Tel: (0211)5296-0 Fax: (0211)5296-400

München Office
Büro München Hofmannstrasse 52,
D-81378, München, Germany
Tel: (089)748595-0 Fax: (089)748595-42

Toshiba Electronics France SARL
Immeuble Robert Schumann 3 Rue de Rome,
F-93561, Rosny-Sous-Bois, Cedex, France
Tel: (1)48-12-48-12 Fax: (1)48-94-51-15

Toshiba Electronics Italiana S.R.L.
Centro Direzionale Colleoni
Palazzo Perseo Ingr. 2-Piano 6,
Via Paracelso n.12,
1-20041 Agrate Brianza Milan, Italy
Tel: (039)68701 Fax:(039)6870205

Toshiba Electronics España, S.A.
Parque Empresarial San Fernando Edificio Europa,
1^a Planta, ES-28831 Madrid, Spain
Tel: (91)660-6700 Fax:(91)660-6799

Toshiba Electronics(UK) Limited
Riverside Way, Camberley Surrey,
GU15 3YA, U.K.
Tel: (01276)69-4600 Fax: (01276)69-4800

Toshiba Electronics Scandinavia AB
Gustavslundsvägen 12, 2nd Floor
S-161 15 Bromma, Sweden
Tel: (08)704-0900 Fax: (08)80-8459

Toshiba Electronics Asia (Singapore) Pte. Ltd.

Singapore Head Office
438B Alexandra Road, #06-08/12 Alexandra
Technopark, Singapore 119968
Tel: (278)5252 Fax: (271)5155, (270)6056

Bangkok Office
135 Moo 5 Bangkadi Industrial Park, Tivanon Rd.,
Bangkadi Amphur Muang Pathumthani 12000, Thailand
Tel: (2)501-1635 Fax: (2)501-1638

Toshiba Electronics Trading (Malaysia)Sdn. Bhd.

Kuala Lumpur Head Office
Suite W1203, Wisma Consplant, No.2,
Jalan SS 16/4, Subang Jaya, 47500 Petaling Jaya,
Selangor Darul Ehsan, Malaysia
Tel: (3)731-6311 Fax: (3)731-6307

Penang Office
Suite 13-1, 13th Floor, Menard Penang Garden,
42-A, Jalan Sultan Ahmad Shah,
100 50 Penang, Malaysia
Tel: 4-226-8523 Fax: 4-226-8515

Toshiba Electronics Asia, Ltd.

Hong Kong Head Office
Level 11, Top Glory Insurance Building,
Grand Century Place,
No.193, Prince Edward Road West,
Mong Kok, Kowloon, Hong Kong
Tel: 2375-6111 Fax: 2375-0969

Seoul Branch
14/F, KEC B/D, 257-7 Yangjae-dong,
Seocho-ku, Seoul, Korea
Tel: (02)589-4334 Fax: (02)589-4302

Seoul Branch, Gumi Office
6/F, Ssangyong Investment Securities B/D,
56 Songjung-Dong, Gumi City
Kyeongbuk, Korea
Tel: (0645)456-7613-6 Fax: (0546)456-7617

Shenzhen Office
Rm 3010-3012, Shun Hing Square,
Di Wang Commercial Centre,
333 Shennan Road East,
Shenzhen, China, 518008
Tel: (0755)246-1582 Fax: (0755)246-1581

Toshiba Technology Development (Shanghai) Co., Ltd.
23F, Shanghai Senmao International Building, 101
Yin Cheng East Road, Pudong New Area, Shanghai,
200120, China
Tel: (21)6841-0666 Fax: (21)6841-5002

Tsurong Xiamen Xiangyu Trading Co., Ltd.
8N, Xiamen Sez Bonded Goods Market Building,
Xiamen, Fujian, China
Tel: (0592)562-3798 Fax: (0592)562-3799

Beijing Office
Rm 714, Beijing Fortune Building,
No.5 Dong San Huan Bei-Lu, Chao Yang District,
Beijing, China, 10004
Tel: (010)6595-8795 Fax: (010)6590-8791

Toshiba Electronics Taiwan Corporation

Taipei Head Office
17F, Union Enterprise Plaza Bldg. 109
Min Sheng East Rd., Section 3, 0446 Taipei,
Taiwan R.O.C.
Tel: (02)514-9988 Fax: (02)514-7892

Kaohsiung Office
16F-A, Chung-Cheng Bldg., Chung-Cheng 3Rd.,
80027, Kaohsiung, Taiwan R.O.C.
Tel: (07)222-0826 Fax: (07)223-0046

Toshiba Display Devices (Thailand) Co., Ltd.
142 Moo 5, Bangkadi Industrial Park,
Tivanon Rd., Pathumthani 12000, Thailand
Tel: (2)501-1200 Fax: (2)501-1209

In Touch with Tomorrow
TOSHIBA
TOSHIBA CORPORATION
Electronic Devices Sales & Marketing Group
1-1, Shibaura 1-chome, Minato-ku, Tokyo, 105-8001, Japan
Tel: (03)3457-3405 Fax: (03)5444-9324

©1998 TOSHIBA CORPORATION
Printed in Japan