

TOSHIBA

Leading Innovation >>>

System Catalog Dec. 2014

Motor Solutions Guide



SEMICONDUCTOR & STORAGE PRODUCTS

<http://toshiba.semicon-storage.com/>

Premier Energy-Saving Solutions Using Toshiba's semiconductors for Motor Applications

Toshiba's semiconductor devices help reduce the power consumption, reduce the size and thickness, and improve the efficiency of motor applications, contributing to the development of eco-friendly systems.

Now, energy-saving is a global issue.

The requirements for semiconductor devices for home appliance, mobile and industrial applications include high efficiency, fast response, low loss, a high level of safety, and superb environmental performance.

To meet these requirements, Toshiba offers an extensive portfolio of semiconductor devices, including vector control MCUs, high-efficiency, high-current stepping motor drivers with a current rating of up to 5.0 A, motor drivers (intelligent power devices) fabricated using a high-voltage process, and brushless DC (BLDC) motor drivers that help reduce the acoustic noise generated by motors.

Toshiba's semiconductor devices for motor applications help realize the ideal eco-friendly systems.



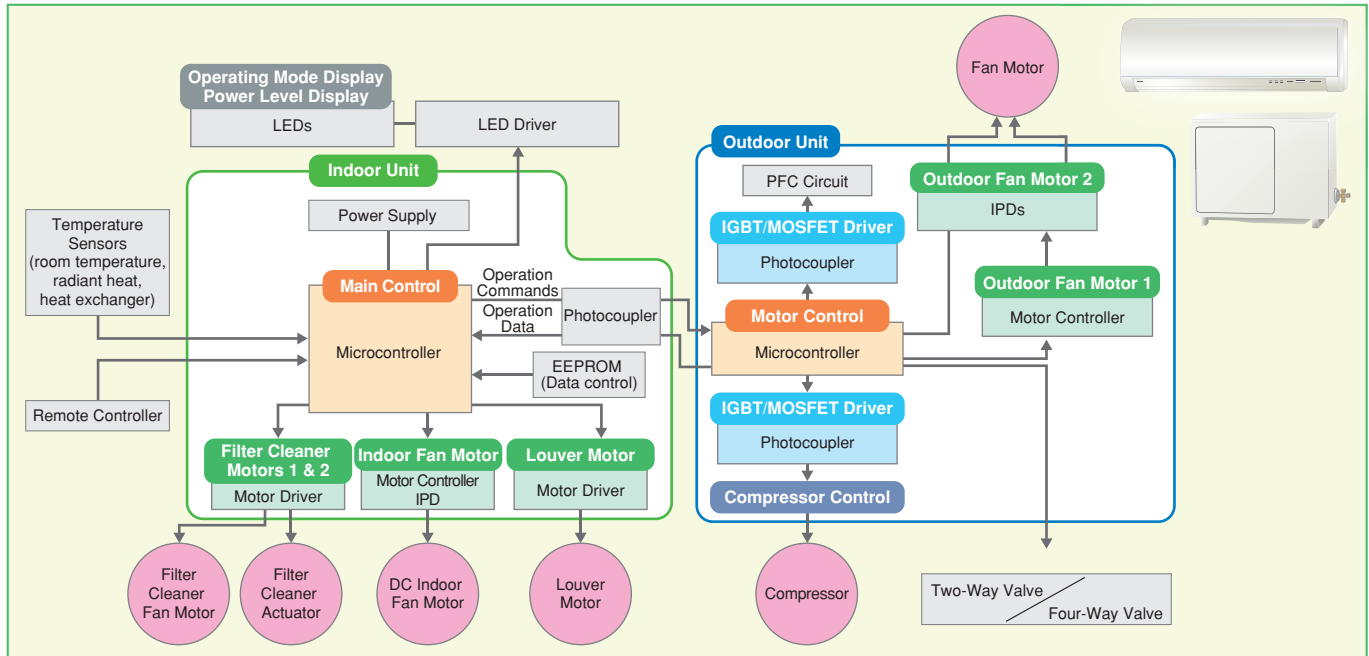
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This catalog contains the latest information available as of November 12, 2014.

Home Appliances and Consumer Electronics

Toshiba offers a suite of motor solutions suitable for DC inverter applications that require low power consumption and quiet motor control. Our product portfolio includes motor controllers, motor drivers, microcontrollers with an integrated vector engine, intelligent power devices (IPDs), IGBTs and photocouplers.

Application Example: Air Conditioner



Product Lineup

| Applications | Semiconductor | Recommended Devices | Features | End-Product Examples |
|--|--|--|---|--|
| Motor Control | Microcontrollers | TMPM370, TMPM372 TMPM373, TMPM374 TMPM375, TMPM376 | Vector Engine (VE) Vector Engine Plus (VE+) (only TMPM375) 3-phase PWM (2 channels for TMPM370 and TMPM376) | Refrigerators, air conditioners, automatic washing machines, dishwashers |
| Main Control | Microcontrollers | TMPM380, TMPM384 | Multipurpose timer for motor and IGBT control | |
| Indoor Fan Motor | Motor Controllers/Drivers | TB67B000HG | Brushless DC motor driver; sine-wave current control | |
| | | TB6584FNG/AFNG, TB6551FAG TB6631FNG, TB6634FNG | Brushless DC motor controller; sine-wave current control | |
| | | TB6586FG/AFG/BFG | Brushless DC motor controller | |
| Outdoor Fan Motor | Motor Controllers/Drivers | TB67B000HG | Brushless DC motor driver; sine-wave current control | |
| | | TB6584FNG/AFNG, TB6551FAG TB6631FNG, TB6634FNG | Brushless DC motor controller; sine-wave current control | |
| | | TB6586FG/AFG/BFG | Brushless DC motor controller | |
| Indoor Louver Motor | Motor Controllers/Drivers | TB62210FNG, TB62211FNG TC78S600FTG/FNG | Two-phase stepping motor driver | |
| | | TB62261FTAG/FTG TB62262FTAG/FTG, TB6608FNG | | |
| | | TC78H600FTG/FNG, TB6552FTG/FNG TC78H610FNG | Full-bridge driver for a brushed DC motor | |
| Indoor Filter Cleaner Motor 1 | Motor Controllers/Drivers | TB6585FG/AFTG | Brushless DC motor driver; sine-wave current control | |
| Indoor Filter Cleaner Motor 2 | Motor Controllers/Drivers | TB6608FNG, TC78S600FTG/FNG | Stepping motor driver; 4-bit microstepping | |
| Air Conditioners Indoor Fan Motors | Motor drivers (Intelligent power devices) | TPD4151K, TPD4142K | Thin package High-voltage, high-current pins and control pins are isolated on the opposite sides of a package. | Air conditioners |
| Air Conditioners Outdoor Fan Motors | Motor drivers (Intelligent power devices) | TPD4123K/AK, TPD4144K/AK TPD4135K/AK | | |
| Compressor Control | Motor drivers (Intelligent power devices) | TPD4135K/AK | | Refrigerators |
| Compressor Drive Pulsator/Drum Drive | IGBTs | GT15J341, GT20J341, GT30J121 GT30J341 | Low loss; available in insulated and non-insulated packages | Air conditioners, automatic washing machines, hand dryers |
| Circulating Pumps | Motor drivers (Intelligent power devices) | TPD4144K/AK | Thin package, High-voltage, high-current pins and control pins are isolated on the opposite sides of a package. | Automatic washing machines, dishwashers |
| IGBT and Power MOSFET Drivers for Compressor Applications | Photocouplers | TLP155E, TLP152 TLP5751, TLP5214 | Direct drive of an IGBT or a power MOSFET Peak output current: 0.6 A to 4.0 A Small low-cost SO6: 0.6-A output (TLP155E), 2.5-A output (TLP152) Isolation voltage: 5 kVrms rail-to-rail output TLP5751 in SO6L TLP5214 with overcurrent protection features in SO16L | Air conditioners, refrigerators |

Toshiba's Unique Technologies

Motor drivers

- **Sensorless PWM drive:** The back-EMF voltage from the motor coil is sensed and fed back to the commutation signals.
- **Sine-wave drive:** The motor windings are energized with sine-wave currents to reduce vibration and acoustic noise. Sine-wave PWM control is implemented as a hardware core.
- **Lead angle control:** Lead angle control and automatic lead angle correction help to improve motor efficiency.

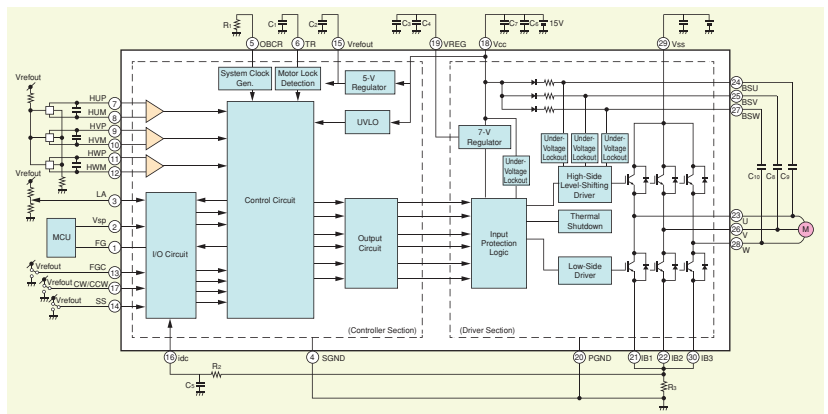
Microcontrollers

- **Vector control:** The hardware specifically designed for vector control enables sensorless sine-wave drive.

Product Overview

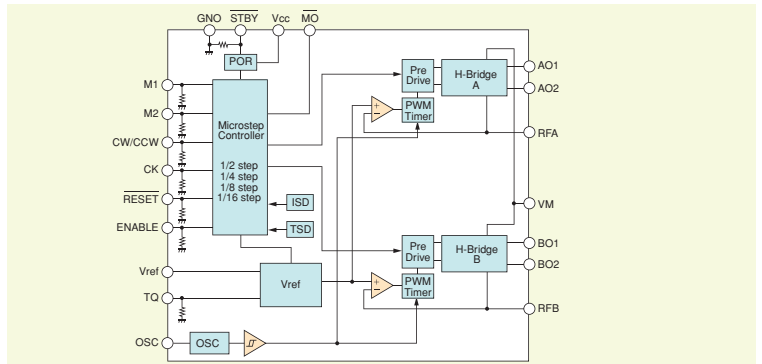
500-V Sine-Wave BLDC Motor Driver (TB67B000HG)

- High-voltage sine-wave driver (500 V/2.0 A, sine- and square-wave drive)
- Lead angle control (via an external input)
- On-chip power supply for Hall sensors and Hall ICs
- On-chip oscillator (external resistor required)
- Motor lock protection
- Current limiter
- Thermal shutdown (TSD)
- Through-hole package: HDIP30



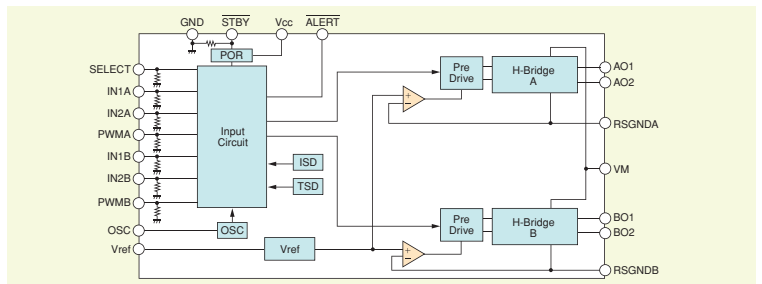
Single-Channel Stepping Motor Drivers (TC78S600FTG/FNG)

- Absolute Maximum Ratings: 18 V/1.0 A
- Half-, quarter-, 1/8- and 1/16-step drive modes
- Output Ron: 1.2 Ω typ. (high side + low side)
- Clock input control
- Constant-current PWM control
- Standby function
- Small packages: WQFN24, SSOP20



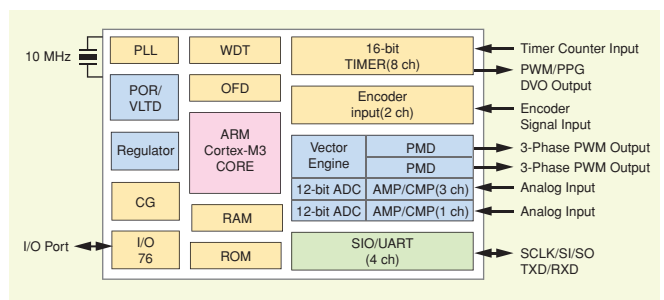
Two-Channel Brushed DC Motor Drivers (TC78H600FTG/FNG)

- Absolute Maximum Ratings: 18 V/1.0 A
- Supports direct and constant-current PWM
- Output Ron: 1.2 Ω typ. (high side + low side)
- Standby function
- Cross-conduction protection
- Small packages: WQFN24, SSOP20



Microcontrollers with Vector Engine (TMPM370FYFG/FYDFG)

- Incorporates Toshiba's original Vector Engine (VE) that implements part of the motor vector control function in hardware
- High-performance ARM® Cortex®-M3 core with a clock rate of up to 80 MHz
- High-speed programming into Toshiba's original on-chip NANO FLASH™ memory
- Various analog circuits (comparator, op-amp)
- 12-bit AD converter
- Compliant with the IEC 60730 standard of the International Electrotechnical Commission
- 5-V single power supply



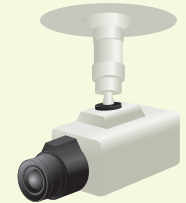
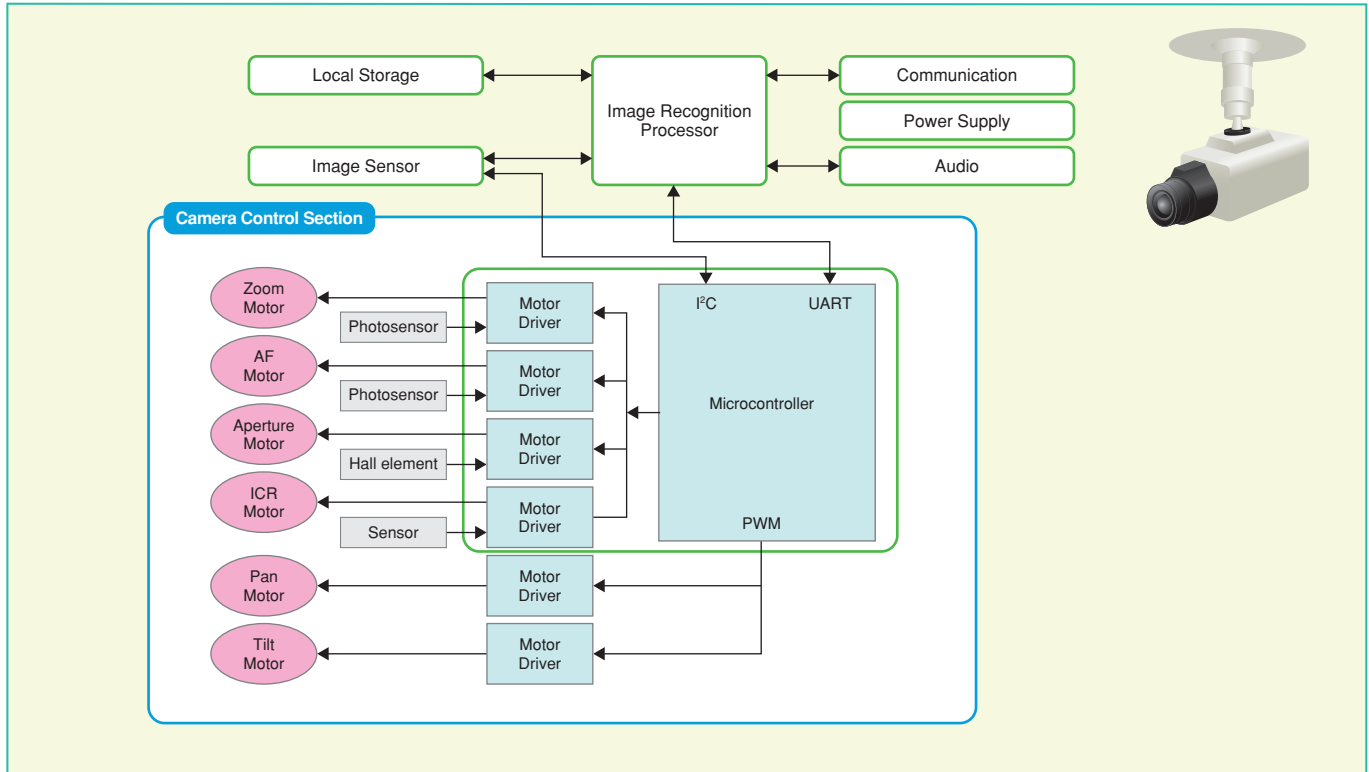
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*ARM and Cortex are registered trademarks of ARM Limited (or its subsidiaries) in the EU and/or countries elsewhere.

Mobile and Compact Equipment

Toshiba offers a portfolio of semiconductor devices ideal for mobile and compact applications requiring low power consumption and small form factor.

Application Example: Surveillance Camera



Product Lineup

| Applications | Semiconductor | Recommended Devices | Features | End-Product Examples |
|------------------------------|--|--------------------------------|--|--|
| Motor Control | Microcontrollers | TMPM341 TMPM342 TMPM343 | ARM Cortex-M3 core (54 MHz max) 12-bit AD converter, 10-bit DA converter High-resolution programmable pulse generator (PPG) with a 6-ns resolution 2-phase input pulse counter Programmable servo/sequence controller (PSC) (TMPM342, TMPM343) Microstep control and H-switch driver (TMPM342, TMPM343) Analog circuits for various sensors (TMPM342, TMPM343) | Digital video cameras, digital still cameras, surveillance cameras, camera lenses |
| | | TMPM440 | ARM Cortex-M4F core (100 MHz max) 12-bit AD converter, 10-bit DA converter Improved performance thanks to multiple computing units (MAC, FPU, PSC) | Digital video cameras, digital single-lens reflex camera, surveillance cameras, home appliances, audio equipment, sensor applications, printers, communications equipment |
| Lens Drive Actuator Drive | Brush motor drivers/ Stepping motor drivers | TB6614FNG | Single-bridge | Digital still cameras, surveillance cameras, network ip cameras, camera lenses, small scanners, mini printers |
| | | TB6612FNG TB6552FTG/FNG | Dual-bridge | |
| | | TB6613FTG | 8 channels, 6-bit microstepping, dual motor drive, serial interface | |
| | | TB6608FNG | 8 microsteps, constant-current drive | |
| | | TC78S600FTG/FNG | 16 microsteps, constant-current drive, maximum rated voltage: 18 V | |
| Pan/Tilt Drive | Stepping motor drivers | TC78H600FTG/FNG TC78H610FNG | Dual-bridge, maximum rated voltage: 18 V | |
| | | TB62269FTG | 32 microsteps, constant-current drive, maximum rated voltage: 40 V, output current: 1.8 A (max) | |
| | | TB62212FTAG/FNG | 4-channel H-bridges for driving two stepping motors | |

Toshiba's Unique Technologies

Motor drivers

- Reduced power consumption due to the use of a new process technology: Products with an LDMOS output stage featuring low power consumption
- Significantly reduced power loss and heat dissipation from the output stage: TB62269FTG: Ron = 0.8 Ω typ. (high side + low side)
- Reduced vibration due to the use of a high-resolution microstep sine-wave driver: TB62269FTG: 32 microsteps
- Small packages: Leadless WQFN packages

Microcontrollers

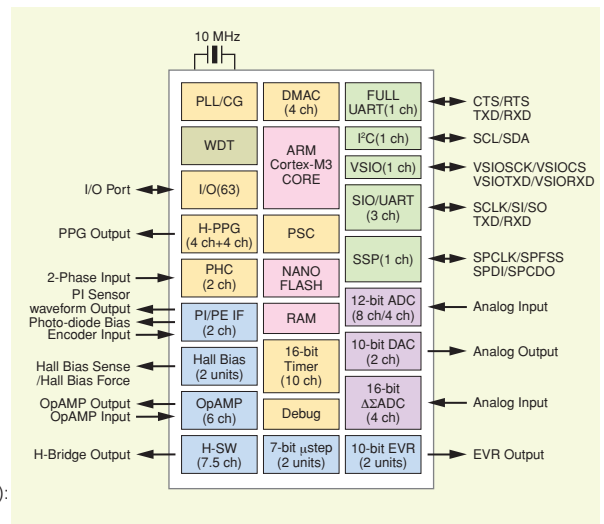
- Programmable servo/sequence controller (PSC): MCU with Toshiba's original coprocessor specifically designed for computing operations
- Ultrasonic-motor control and piezoelectric actuator support: PPG outputs with 6-ns resolution.

Product Overview

Motor Control Microcontroller (TPM342FYXBG)

The TPM342FYXBG incorporates analog circuits required for camera shake correction, lens control and overall system control. The high-performance ARM Cortex-M3 core provides high-speed computation. Additionally, a high-resolution programmable phase generator (PPG) enables smooth and quiet motor operation.

- ARM Cortex-M3 core
 - Supply voltage: 2.7 to 3.6 V (regulated on-chip)
 - Maximum operating frequency: 40 MHz
 - On-chip memory: 256-KB Flash ROM, 32-KB SRAM
- Motor driver
 - Operating voltage: 2.5 V to 5.5 V max (with the driver on), 3.1 V to 3.5 V (peripheral analog blocks)
- On-chip peripherals
 - PSC: 2 KB (instruction) + 2 KB (data) per unit
 - 16-bit delta-sigma AD converter: 1 unit (4 differential channels)
 - 12-bit AD converters: 2 units (8 channels + 4 channels)
 - 10-bit DA converter: 2 channels
 - DMA controller: 4 channels
 - 16-bit timer: 8 high-speed channels + 10 channels
 - Two-phase input pulse counter: 2 channels
 - H-switch driver: 7.5 channels (plus two 7-bit microstep controllers)
 - Hall Bias Control: 2 units
 - Op-amp: 6 channels
 - PI-PE interface: 2 channels
 - 10-bit electrical variable resistance (EVR): 2 units
- Package: VFBGA142

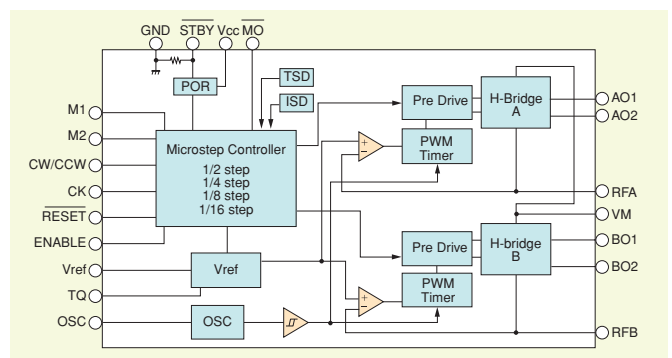


Abbreviations: PI: Photo Interrupter PE: Photo Encoder

Low-Voltage Stepping Motor Drivers (TC78S600FTG/FNG)

The TC78S600FTG/FNG supports half-, quarter-, 1/8- and 1/16-step motor drive modes, and forward/reverse direction control.

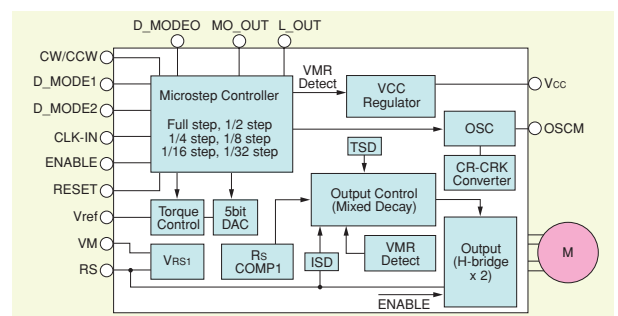
- Motor supply voltage (VM): 15 V max
- Control supply voltage (Vcc): 2.7 V to 5.5 V (operating range)
- Output current (Iout): 0.8 A max
- Output Ron: 1.2 Ω typ. (high side + low side)
- Microstep control circuit (with a clock input)
- Half-, quarter-, 1/8- and 1/16-step drive modes
- Internal pulldown resistors on input pins: 200 kΩ typ.
- Monitor output (MO) pin
- Overcurrent detection (ISD), thermal shutdown (TSD), undervoltage lockout (UVLO)
- Packages: WQFN24, SSOP20



PWM Bipolar Stepping Motor Driver (TB62269FTG)

The TB62269FTG is rated at 40 V/1.8 A. The internal voltage regulator allows control of a motor with a single VM power supply.

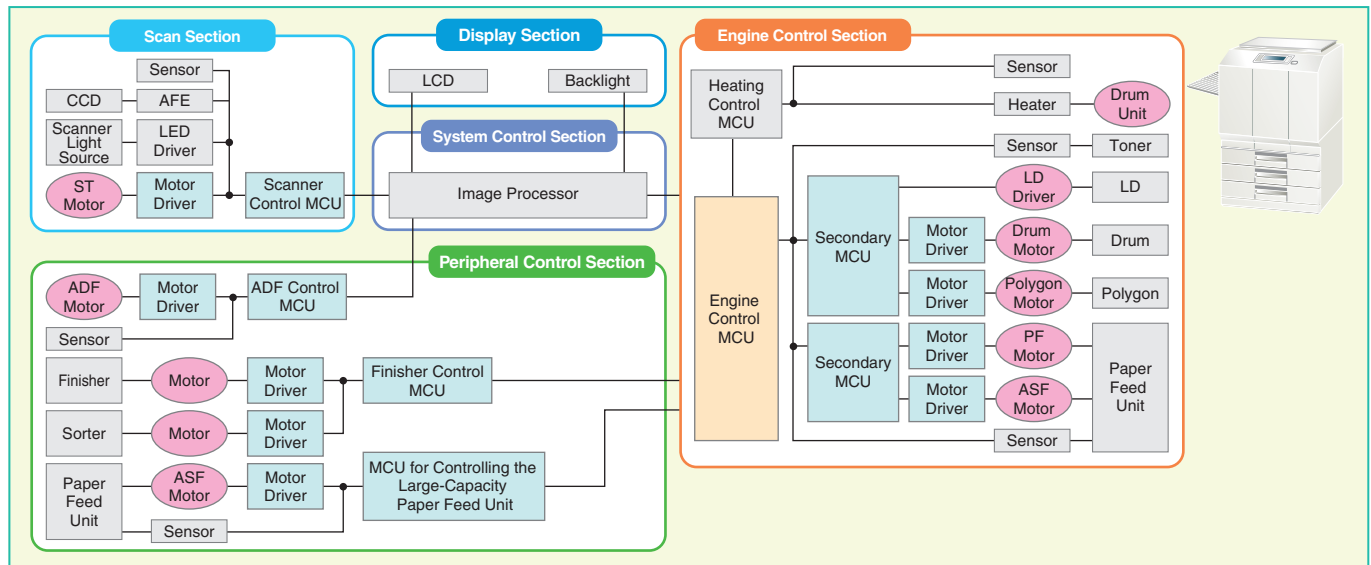
- Single-chip drive control of a bipolar stepping motor
- PWM constant-current drive
- Full-, half-, quarter-, 1/8-, 1/16- and 1/32-step drive modes
- Low output Ron due to a BiCD process: 0.8 Ω typ. (high side + low side)
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Operates with only the VM power supply because of the on-chip Vcc regulator for internal circuitry
- Chopping frequency programmable via external resistor and capacitor
- Package: WQFN48



Office Equipment

Toshiba offers various semiconductor devices for motor applications that embody its unique motor control technologies. These devices make it possible to optimize high-precision, high-speed motor control for office equipment applications.

Application Example: Printer



Product Lineup

| Applications | Semiconductor | Recommended Devices | Features | End-Product Examples |
|--|-----------------------------------|--|---|--|
| Engine Control Section | Microcontrollers | TMPM362 | ARM Cortex-M3 core (64 MHz max), 18 serial channels, Sixteen 16-bit timer channels, Consumer Electronics Control (CEC) interface, remote control preprocessor | Multifunction printers, printers, audio-visual (AV) equipment, digital equipment, PC peripherals, industrial equipment, networking equipment, office equipment |
| | | TMPM369 | ARM Cortex-M3 core (80 MHz max), multipurpose timer suitable for various motor and IGBT control, USB, USB Embedded Host, dual AD converter, programmable motor driver (PMD), CAN, EtherMAC | |
| | | TMPM461 TMPM462 | ARM Cortex-M4F core (120 MHz max), multipurpose timer suitable for various motor and IGBT control, 3 DMA units, 20 serial channels, CEC interface, remote control preprocessor, large-capacity memory | |
| | Brush Motor Drivers | TB6568KQ, TB6643KQ | Single full bridge, direct PWM control | |
| | | TB6569FTG/FG, TB6641FTG/FG TB67H301FTG/FNG** TB67H400AFTG/FNG/FG**/HG/NG | Single full bridge, emergency output, Direct PWM control, Constant-current PWM control Direct PWM control, Constant-current PWM control, Standby function Dual full bridge, Constant-current PWM control, Direct PWM control, Parallel control of two channels (Large mode) | |
| Scanner Peripheral Control Section | Microcontrollers | TMPM037 | ARM Cortex-M0 core (20 MHz max), 1 DMA unit, bit-banding | Multifunction printers, printers, audio-visual (AV) equipment, digital equipment, PC peripherals, industrial equipment, networking equipment, office equipment |
| | | TMPM36B | ARM Cortex-M3 core (80 MHz max), multipurpose timer suitable for various motor and IGBT control, PMD, 2 DMA units, remote control preprocessor | |
| | | TMPM330 | ARM Cortex-M3 core (40 MHz max), CEC interface, remote control preprocessor | |
| | | TMPM361 | ARM Cortex-M3 core (64 MHz max), CEC interface, remote control preprocessor, large-capacity memory | |
| | | TMPM461 TMPM462 | ARM Cortex-M4F core (120 MHz max), multipurpose timer suitable for various motor and IGBT control, 3 DMA units, 20 serial channels, CEC interface, remote control preprocessor, large-capacity memory | |
| | Stepping Motor Drivers (Bipolar) | TB6560AFTG/FG/HQ | Clock input, micro-stepping drive (1/16 step) | Plain paper copiers (PPCs), printers, fax machines, vending machines, ATMs, amusement equipment, card readers, bank note recognition machines, etc. |
| | | TB62211FNG, TB62214AFTG/FNG/FG TB62215AFTG/FNG/FG/HQ, TB62262FTAG/FTG | Clock input, micro-stepping drive (1/4 step) | |
| | | TB67S102AFTG/FNG/FG**/HG**/NG | Clock input, micro-stepping drive (1/4 step), ADMD | |
| | | TB62210FNG, TB6562AFNG/NG TB62218AFTG/FNG/FG TB62213AFTG/FNG/FG/HQ, TB62261FTAG/FTG/SFG | Phase inputs, micro-stepping drive (1/4 step) | |
| | | TB67S101AFTG/FNG/FG**/HG**/NG | Phase inputs, micro-stepping drive (1/4 step), ADMD | |
| | | TB62269FTG | Clock input, micro-stepping drive (1/32 step) | |
| | | TB67S141FTG/FG**/HG/NG | Phase input interface, 84 V/3.0 A, micro-stepping drive (1/4 step) | |
| | Stepping Motor Drivers (Unipolar) | TB67S142FTG/FG**/HG/NG | Clock input interface, 84 V/3.0 A, micro-stepping drive (1/4 step) | |
| Stepping Motor Drivers/Brush Motor Drivers | TB62212FTAG/FNG | Phase inputs, micro-stepping drive (1/2 step) Four on-chip H-bridge channels allow control of either up to four brushed DC motors or up to two stepping motors. | | |

**: Planned **: Under development

Toshiba's Unique Technologies

Motor drivers

- Reduced power consumption due to the use of a new process:
Products with an LDMOS output stage featuring low power consumption
- Significantly reduced power loss and heat dissipation from the output stage: TB62269FTG: $R_{on} = 0.8 \Omega$ typ. (high side + low side)
- Reduced vibration due to the use of a high-resolution microstep sine-wave driver: TB62269FTG: 32 microsteps
- Small packages: Leadless WQFN packages
- High-efficiency control of a high-rpm motor: Advanced Mixed Decay (ADMD) technology

Product Overview

40-V/1.8-A Bipolar Stepping Motor Drivers (TB62261FTG, TB62262FTG, TB62269FTG)

- Full-, half-, quarter-, 1/8-, 1/16- and 1/32-step drive modes
- Low output R_{on} due to a BiCD process: 0.8Ω typ. (high side + low side)
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Supports a clock input and a phase-input interface
- Package: WQFN48

84-V/3.0-A Unipolar Stepping Motor Drivers (TB67S141FTG/FG⁺⁺/HG/NG, TB67S142FTG/FG⁺⁺/HG/NG, TB67S149FTG/FG⁺⁺/HG)

- Requires no current-sensing resistor
- Full-, half-, quarter-, 1/8-, 1/16- and 1/32-step drive modes
- Low output R_{on} due to a BiCD process: 0.25Ω typ.
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Supports a clock input and a phase-input interface
- Package: WQFN48, HSOP28, HZIP25, SDIP24

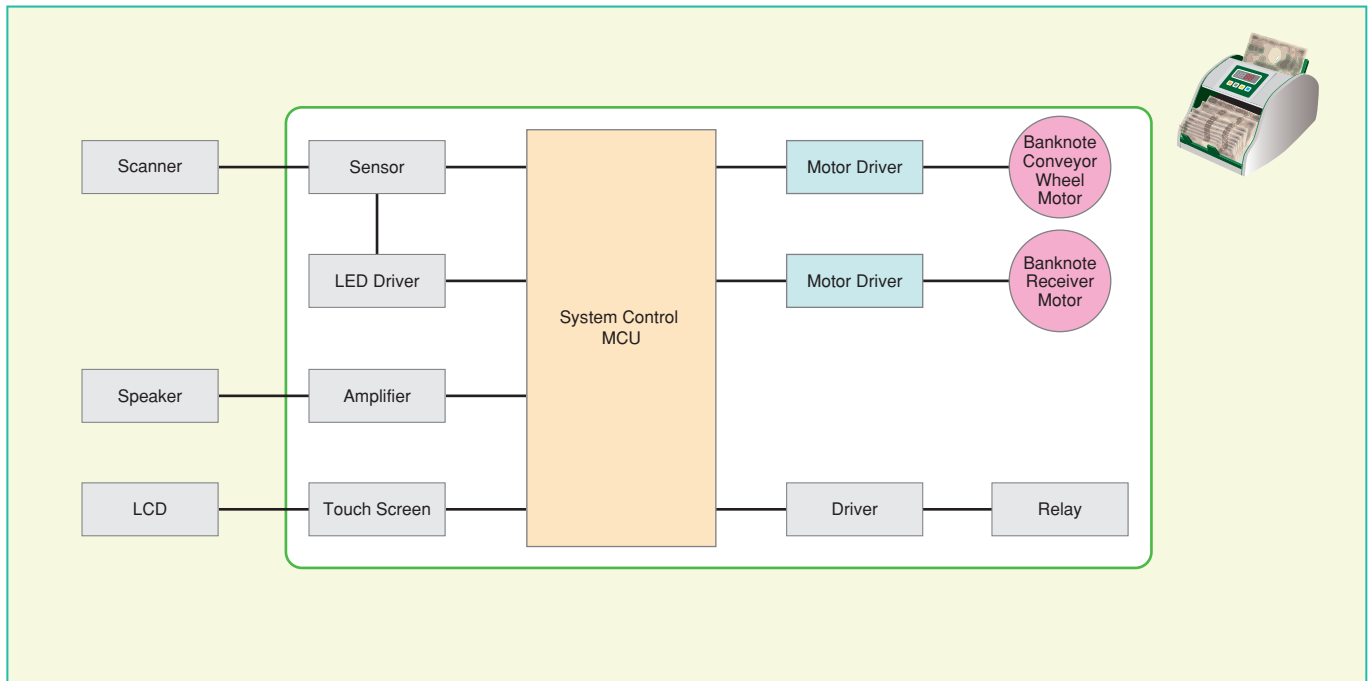
50-V/4.0-A Two-Channel Brushed DC Motor Drivers (TB67H400AFTG/FNG/FG⁺⁺/HG/NG)

- Configurable as an 8.0-A single-channel motor driver in Large mode
- Low output R_{on} due to a BiCD process: 0.49Ω typ. (high side + low side)
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Package: WQFN48, HTSSOP48, HSOP28, HZIP25, SDIP24

⁺⁺: Planned

Toshiba offers motor solutions for industrial applications that require high current, quick control and high accuracy.

Application Example: Currency Counter



Product Lineup

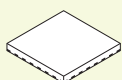
| Applications | Semiconductor | Recommended Devices | Features | End-Product Examples |
|------------------|--|--|--|---|
| Motor Controller | Stepping Motor Drivers (Unipolar) | TB67S141FTG/FG**/HG/NG | Phase input interface, 84 V/3.0 A, 1/4 step | Currency counters, banking terminals, industrial weaving machines, sewing machines, embroidery machines, surface-mounting machines, POS systems, ticket-vending machines, amusement equipment |
| | | TB67S142FTG/FG**/HG/NG | Clock input interface, 84 V/3.0 A, 1/4 step | |
| | | TB67S149FTG/FG**/HG | Clock input interface, 84 V/3.0 A, 1/32 step | |
| | | TB67S158FTG/NG | 80 V/1.5 A, 2 ch | |
| | Stepping Motor Drivers (Bipolar) | TB62261FTG/FTAG | Phase input interface, 40 V/1.8 A, 1/4 step | |
| | | TB62262FTG/FTAG | Clock input interface, 40 V/1.8 A, 1/4 step | |
| | | TB62269FTG | Clock input interface, 40 V/1.8 A, 1/32 step | |
| | | TB67S213FTAG | Phase input interface, 40 V/2.5 A, 1/4 step | |
| | | TB67S215FTAG | Clock input interface, 40 V/2.5 A, 1/4 step | |
| | | TB67S101AFTG/FNG/FG**/HG**/NG | Phase input interface, 50 V/4.0 A, 1/4 step, ADMD | |
| | | TB67S102AFTG/FNG/FG**/HG**/NG | Clock input interface, 50 V/4.0 A, 1/4 step, ADMD | |
| | | TB67S103AFTG | Serial and clock input interfaces, 50 V/4.0 A, 1/32 step, ADMD | |
| | | TB67S109AFTG/FNG/HG** | Clock input interface, 50 V/4.0 A, 1/32 step, ADMD | |
| | Brush Motor Drivers | TB6600FG/HG | Clock input interface, 50 V/5.0 A, 1/16 step | |
| | | TB67H301FTG/FNG** | 40 V/3.0 A | |
| | | TB67H302HG | 50 V/5.0 A | |
| | | TB67H303HG | 50 V/10.0 A | |
| | Photocouplers | TB67H400AFTG/FNG/FG**/HG/NG | 50 V/4.0 A, 2 ch | |
| | | TLP5214, TLP5754 | Direct drive of an IGBT or a power MOSFET Peak output current: 4.0 A, Isolation voltage: 5 kVrms Overcurrent protection (TLP5214), rail-to-rail output (TLP5754) | |
| TLP2345, TLP2348 | | Direct IPM drive, Supply voltage: 4.5 V to 30 V High speed: 10 Mbps, Small SO6 package, active-high IPM input (TLP2345), active-low IPM input (TLP2348) | | |
| TLP715, TLP718 | Direct IPM drive, Supply voltage: 4.5 V to 20 V Isolation voltage: 5 kVrms, 5-Mbps data rate, active-high IPM input (TLP715), active-low IPM input (TLP718) | | | |

** : Planned ** : Under development

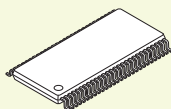
Toshiba's Unique Technologies

Motor drivers

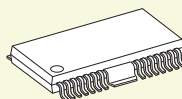
- Fabricated using a high-voltage and low on-resistance process: Rated at either 84 V or 50 V and provides high output current
- Synchronous rectification PWM control: Reduces power loss (heat dissipation) during PWM control.
- Various protection features help improve system safety: All motor drivers for industrial applications provide thermal shutdown (TSD), overcurrent detection (ISD) and VM power-on reset (POR).
- Available in multiple packages



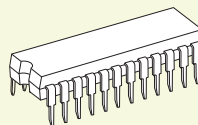
WQFN



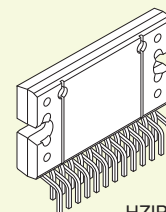
HTSSOP



HSOP



SDIP



HZIP

Product Overview

84-V/3.0-A Unipolar Stepping Motor Drivers

(TB67S141FTG/FG⁺⁺/HG/NG, TB67S142FTG/FG⁺⁺/HG/NG, TB67S149FTG/FG⁺⁺/HG)

- Requires no current-sensing resistor
- Full-, half-, quarter-, 1/8-, 1/16- and 1/32-step drive modes
- Low output Ron due to a BiCD process: 0.25 Ω typ.
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Supports a clock input and a phase-input interface
- Packages: WQFN48, HSOP28, HZIP25, SDIP24

80-V/1.5-A Dual Unipolar Stepping Motor Drivers (TB67S158FTG/NG)

- Constant-voltage drive
- Low output Ron due to a BiCD process: 0.5 Ω typ.
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Supports a clock input, a serial input and a parallel-input interface
- Packages: WQFN48, SDIP24

50-V/4.0-A Two-Phase Bipolar Stepping Motor Drivers

(TB67S101AFTG/FNG/FG⁺⁺/HG^{**}/NG, TB67S102AFTG/FNG/FG⁺⁺/HG^{**}/NG, TB67S103AFTG, TB67S109AFTG/FNG/HG⁺⁺)

- High-efficiency constant-current control (Advanced Dynamic Mixed Decay)
- Full-, half-, quarter-, 1/8-, 1/16- and 1/32-step drive modes
- Low output Ron due to a BiCD process: 0.49 Ω typ. (high side + low side)
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Supports a clock input, a serial input and a phase-input interface
- Packages: WQFN48, HTSSOP48, HSOP28, HZIP25, SDIP24

50-V/5.0-A Bipolar Stepping Motor Drivers (TB6600FG/HG)

- Full-, half-, quarter-, 1/8- and 1/16- step drive modes
- Low output Ron due to a BiCD process: 0.4 Ω typ. (high side + low side)
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Supports a clock input interface
- Packages: HQFP64, HZIP25

50-V/10.0-A Large-Current Brushed DC Motor Driver (TB67H303HG)

- Low output Ron due to a BiCD process: 0.2 Ω typ. (high side + low side)
- Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Package: HZIP25

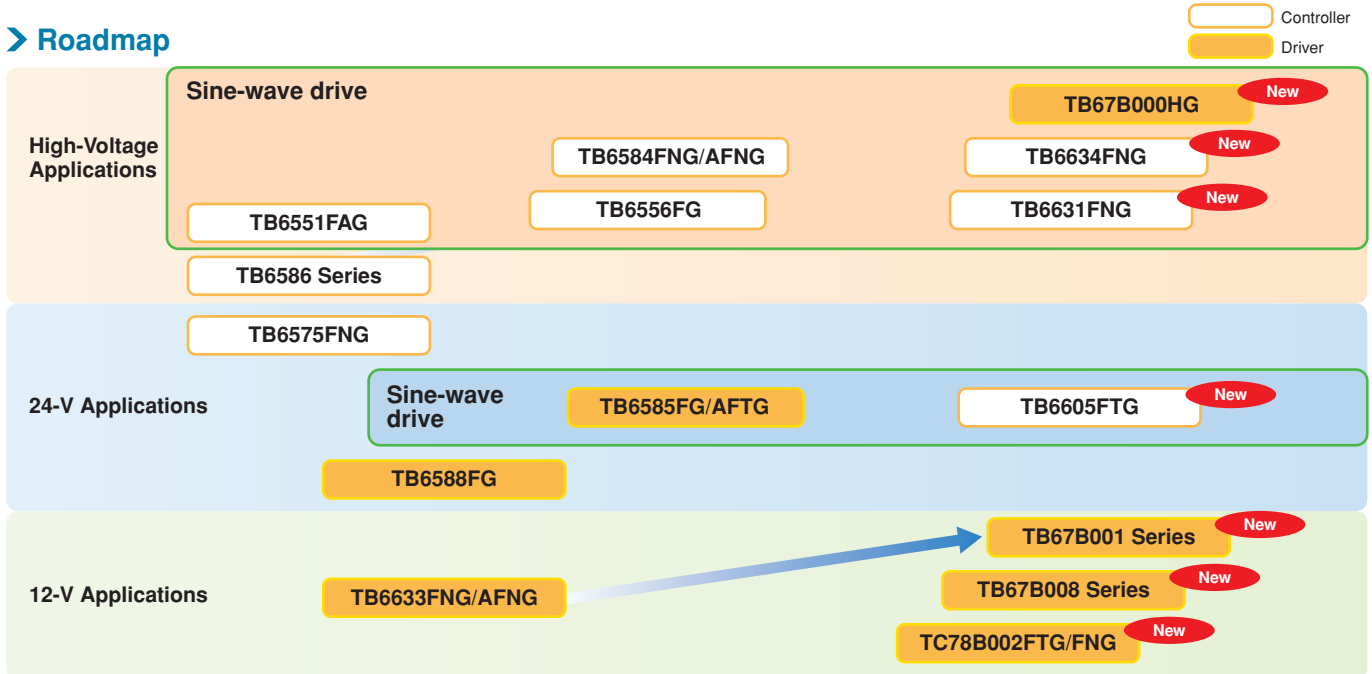
: Planned *: Under development

Brushless Motor Drivers

Brushless Motor Controller and Driver Series

Leveraging sensorless drive and sine-wave drive technologies, Toshiba has been developing a broad array of brushless DC motor drivers ideal for applications that require low power consumption and silent operation.

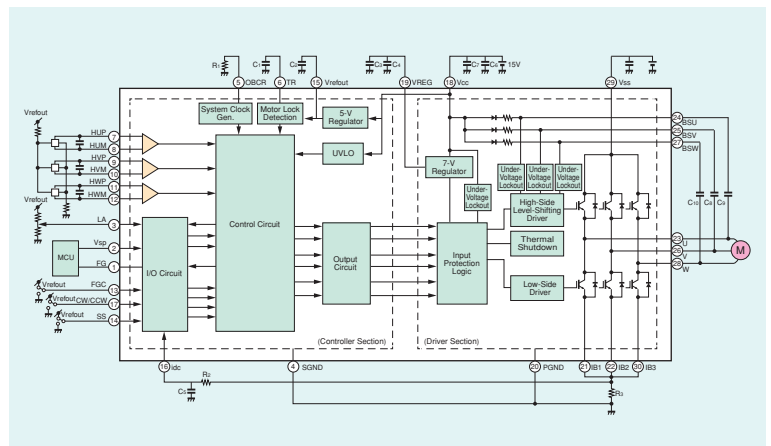
► Roadmap



► Product Overview

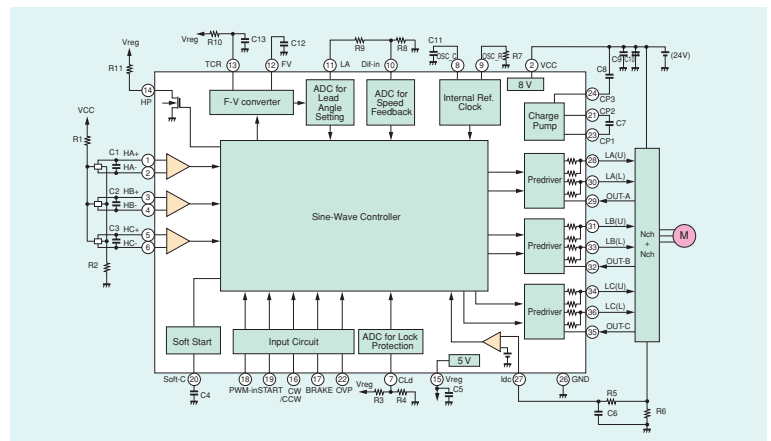
500-V Sine-Wave BLDC Motor Driver (TB67B000HG)

- High-voltage sine-wave driver (Absolute Maximum Ratings: 500 V/2.0 A, sine- and square-wave drive)
- Lead angle control (via an external input)
- Motor speed control via an analog voltage input
- On-chip power supply for Hall sensors and Hall ICs
- Motor lock protection
- Through-hole package: HDIP30



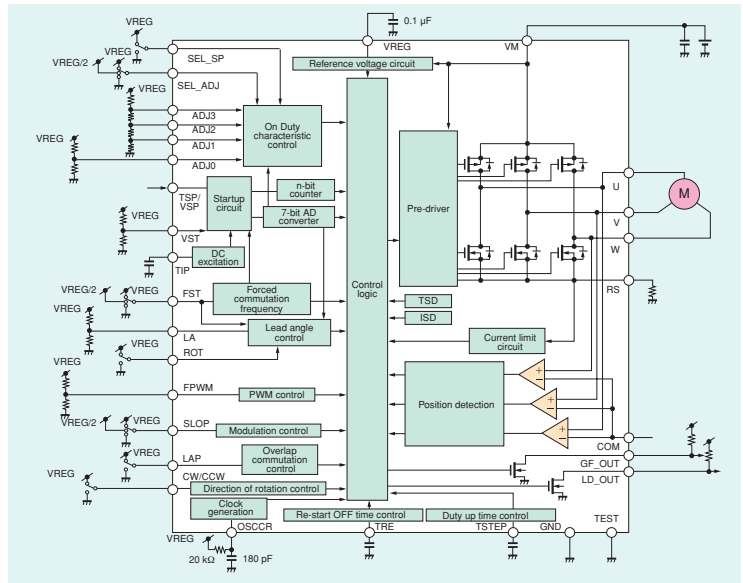
Sine-Wave Three-Phase BLDC Motor Driver (TB6605FTG)

- Ideal for use with a 12-V or 24-V power supply (Absolute maximum rating: 30 V)
- Charge pump: Designed to switch external high-side (n-channel) and low-side (n-channel) FETs
- Auto lead angle control
- Motor speed control via a PWM duty cycle input
- Motor lock protection
- Small package: QFN36



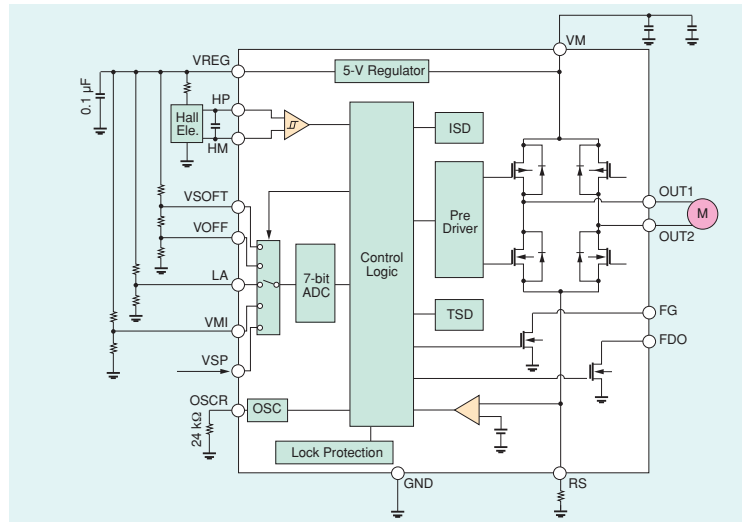
Three-Phase Sensorless BLDC Motor Drivers (TB67B001FTG/AFTG)

- Ideal for use with a 12-V power supply (Absolute maximum rating: 25 V/3.0 A)
- Supports high-rpm motors (even 30-krpm four-pole motors)
- Supports soft-switching trapezoidal commutation
- Supports auto lead angle control
- Motor speed control: Selectable from PWM duty cycle and analog voltage inputs
- Externally adjustable output duty cycle
- Motor lock protection
- Small package: QFN36



Single-Phase Pseudo-Sine-Wave BLDC Motor Driver (TC78B002FTG/FNG)

- Ideal for use with a 12-V power supply (Absolute maximum rating: 18 V/1.5 A)
- Capable of driving a BLDC motor with a sine wave by shaping the commutation waveform
- Motor speed control via an analog voltage input
- On-chip power supply for Hall sensors (and Hall-effect elements)
- Motor lock protection
- Small packages: WQFN16, SSOP16



Product Lineup

| Part Number | Function | Absolute Maximum Ratings | | Hall Inputs | Commutation | Lead Angle Control | Packages |
|----------------------------|------------------------|--------------------------|-------------------|----------------------|------------------|-------------------------------|---------------|
| | | Supply Voltage(V) | Output Current(A) | | | | |
| TC78B002FTG/FNG | Single-phase driver | 18 | 1.5 | Hall sensors | Pseudo-sine wave | External input | WQFN16/SSOP16 |
| TC78B006FTG**/FNG** | Single-phase predriver | 40 | External FET | Hall sensors | Pseudo-sine wave | External input | WQFN16/SSOP16 |
| TB6633FNG/AFNG | Three-phase driver | 25 | 1.0 | Sensorless | Square-wave | External input | SSOP24 |
| TB67B001FTG/AFTG | Three-phase driver | 25 | 3.0 | Sensorless | Square-wave | External input | QFN36 |
| TB67B008FTG/AFTG/BFTG/CFTG | Three-phase driver | 25 | 3.0 | Sensorless | Square-wave | External input | WQFN24 |
| TB67B008FNG/AFNG/BFNG/CFNG | | | | | | | SSOP24 |
| TB6588FG | Three-phase driver | 50 | 2.5 | Sensorless | Square-wave | External input | HSOP36 |
| TB6585FG | Three-phase driver | 45 | 1.8 | Hall sensors | Sine-wave | Auto (current feedback) | HSOP36 |
| TB6585AFTG | | | | | | | QFN48 |
| TB6605FTG | Three-phase predriver | 30 | External FET | Hall sensors | Sine-wave | Auto (rpm feedback) | QFN36 |
| TB6575FNG | Three-phase controller | 5.5 | - | Sensorless | Square-wave | External input | SSOP24 |
| TB6586FG/AFG/BFG | Three-phase controller | 15 | - | Hall IC | Square-wave | External input | SSOP24 |
| TB6551FAG | Three-phase controller | 12 | - | Hall IC | Sine-wave | External input | SSOP24 |
| TB6556FG | Three-phase controller | 12 | - | Hall IC | Sine-wave | Auto (current feedback + VSP) | SSOP30 |
| TB6584FNG/AFNG | Three-phase controller | 15 | - | Hall sensors/Hall IC | Sine-wave | Auto (current feedback + VSP) | SSOP30 |
| TB6631FNG | Three-phase controller | 15 | - | Hall sensors/Hall IC | Sine-wave | Auto ((rpm feedback) | SSOP30 |
| TB6634FNG | Three-phase controller | 15 | - | Hall sensors/Hall IC | Sine-wave | Auto (current feedback + VSP) | SSOP30 |
| TB67B000HG | Three-phase driver | 500 | 2.0 | Hall sensors/Hall IC | Sine-wave | External input | HDIP30 |
| TB67Z800FTG | 3-channel half-bridge | 25 | 3.0 | - | - | - | QFN36 |

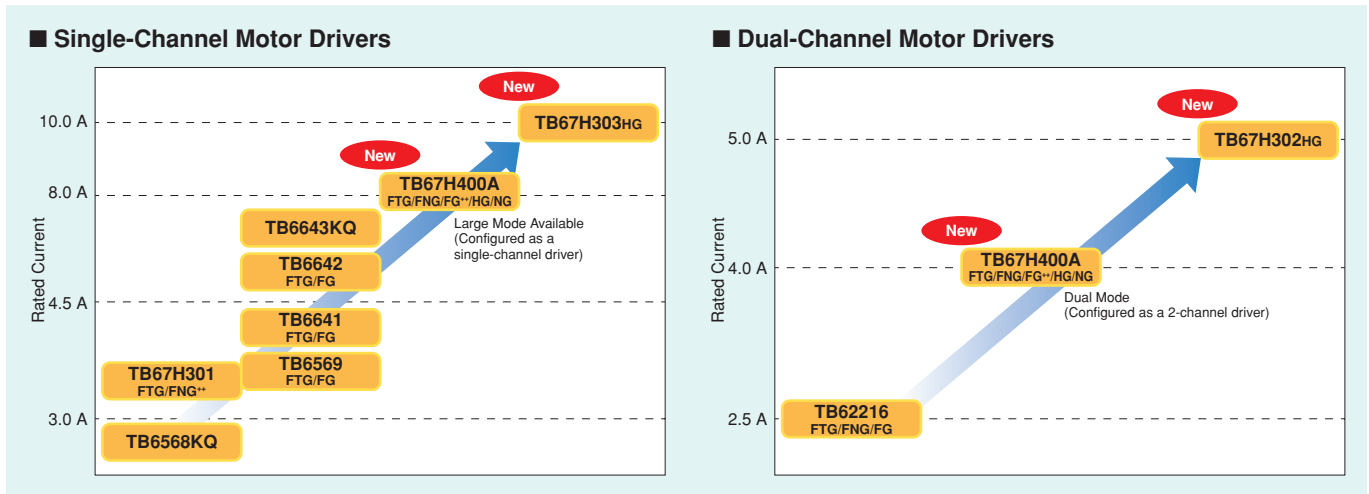
** : Under development

Brushed Motor Drivers

Brushed DC Motor Driver Series

Toshiba offers brushed motor drivers fabricated using a BiCD process that exhibits low on-resistance and thus helps reduce power consumption. Toshiba's product portfolio contains a wide range of brushed motor drivers with extensive supply voltage, output current and channel count options. Toshiba's product offerings include motor drivers that consist of multiple H-bridges that can be combined in a flexible manner according to the types of motors driven (stepping motors and brushed DC motors) and the required current capabilities.

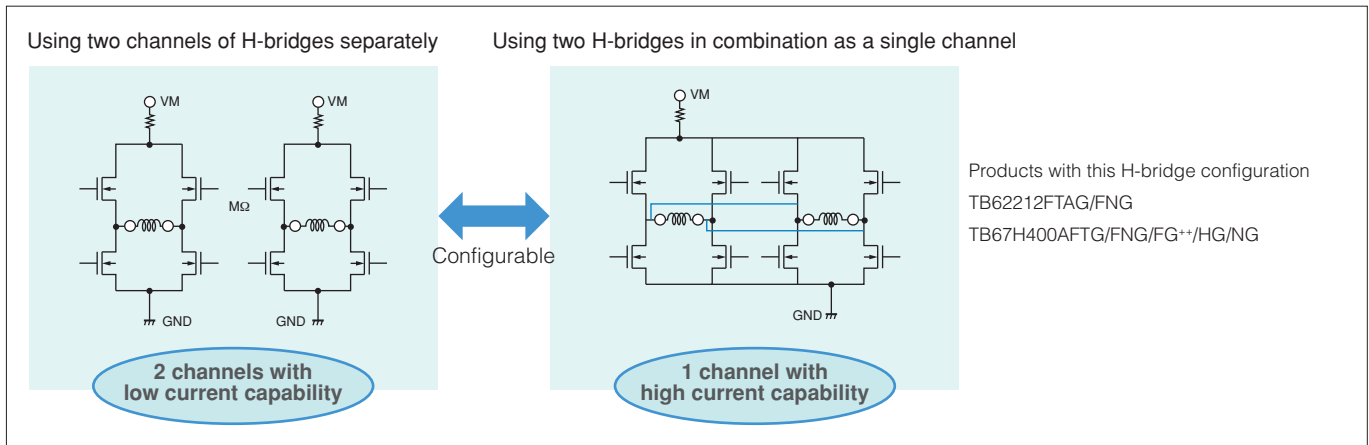
➤ Roadmap



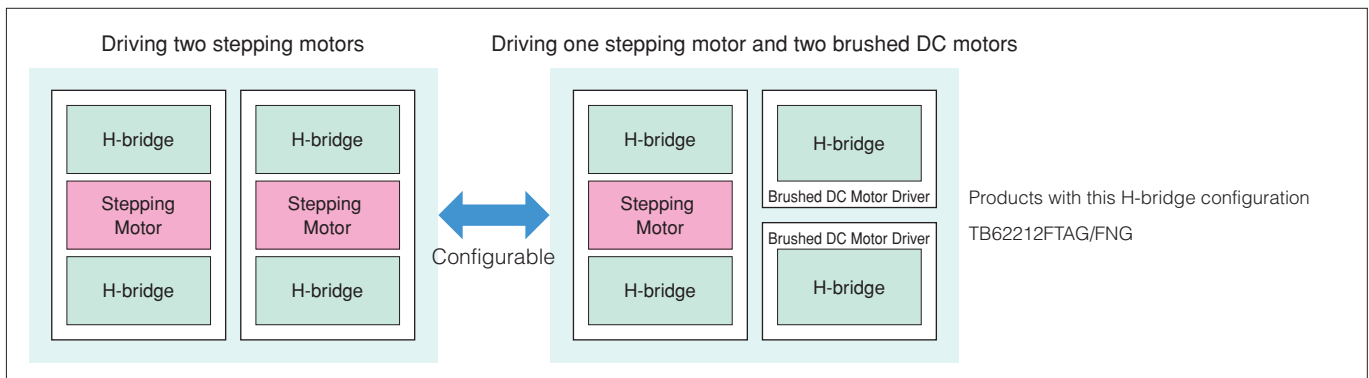
➤ Configurable Motor Drivers

The on-chip H-bridges can be configured according to the types of motors driven (stepping motors and brushed DC motors) and the required current capabilities to suit the needs of various motor applications.

● Case 1: Switching between different current capabilities



● Case 2: Selecting the types of motors to be driven



**: Planned

Brushed DC Motor Driver (TB67H303HG)

The TB67H303HG is a high-efficiency brushed DC motor driver for use with a PWM drive. Incorporating low on-resistance DMOS output drivers, the TB67H303HG can drive a motor rated at up to 50 V/10.0 A.

- Forward, reverse, short-circuit brake and stop; standby mode
- Low output Ron: 0.2 Ω typ. (high side + low side)
- Supply voltage (Vcc) = 50 V, output current (I_{OUT}) = 10.0 A (absolute maximum ratings, peak)
- Various fault detection features: Thermal shutdown (TSD), undervoltage lockout (UVLO), overcurrent detection (ISD)
- Package: HZIP25

PWM Chopper-Type Brushed DC Motor Drivers (TB67H400AFTG/FNG/FG⁺⁺/HG/NG)

Incorporating two channels of output drivers, the TB67H400A can drive up to two brushed DC motors. It can also be configured into an 8.0-A single-channel motor driver in Large mode. The TB67H400A is rated at 50 V, and 4.0 A (per channel in dual-channel mode) or 8.0 A (in single-channel Large mode).

- Low output Ron: 0.49 Ω typ. (high side + low side)
- Four operating modes: forward, reverse, short-circuit brake, stop (off)
- Various fault detection features: Thermal shutdown (TSD), overcurrent detection (ISD), VM power-on reset (POR)
- Packages: WQFN48, HTSSOP48, HSOP28, HZIP25, SDIP24

Product Lineup

| Part Number | Absolute Maximum Ratings | | Output Ron (H + L) (Ω) | # Circuits (ch) | Constant-Current PWM Control | Detection Circuits | | Packages |
|--|--------------------------|--------------------------|------------------------|-----------------|------------------------------|--------------------|----------------|---|
| | Supply Voltage (V) | Output Current (A) | | | | ISD | TSD | |
| TB6568KQ | 50 | 3.0 | 0.55 | 1 | – | Y (Latch) | Y (Latch) | HSIP7 |
| TB6643KQ | 50 | 4.5 | 0.55 | 1 | – | Y (Latch) | Y (Latch) | HSIP7 |
| TB6559FG | 50 | 2.5 | 1.3 | 1 | Y | Y (Auto) | Y (Auto) | HSOP16 |
| TB6617FNG | 50 | 2.0 | 1.4 | 1 | – | Y (Auto) | Y (Auto) | SSOP16 |
| TB6569FTG/FG | 50 | 4.5 | 0.55 | 1 | Y | Y (Latch) | Y (Latch) | VQFN32/HSOP16 |
| TB6641FTG/FG | 50 | 4.5 | 0.55 | 1 | Y | Y (Latch) | Y (Latch) | VQFN32/HSOP16 |
| TB6642FTG/FG | 50 | 4.5 | 0.55 | 1 | – | Y (Latch/Auto) | Y (Latch/Auto) | VQFN32/HSOP16 |
| TB6640FTG/AFTG | 40 | 3.0 | 1.0 | 1 | Y | Y (Latch/Auto) | Y (Latch/Auto) | WQFN48 |
| TB67H301FTG/FNG ⁺⁺ | 40 | 3.0 | 1.0 | 1 | Y | Y (Latch/Auto) | Y (Latch/Auto) | WQFN24/HTSSOP24 |
| TB67H303HG | 50 | 10 | 0.2 | 1 | Y | Y (Latch) | Y (Latch) | HZIP25 |
| TB6561NG/FG | 40 | 1.5 | 1.5 | 2 | – | Y (Auto) | Y (Auto) | SDIP24/SSOP30 |
| TB62216FTG/FNG/FG | 40 | 2.5 | 1.0 | 2 | Y | Y (Latch) | Y (Latch) | QFN48/HTSSOP48/HSOP28 |
| TB62212FTAG/FNG | 40 | 4.0 (2 ch) 2.0 (4 ch) | 2.2 | 2 4 | Y | Y (Latch) | Y (Latch) | QFN48/HTSSOP48 |
| TB67H302HG | 50 | 5.0 | 0.4 | 2 | Y | Y (Latch) | Y (Latch) | HZIP25 |
| TB67H400AFTG/FNG/FG ⁺⁺ /HG/NG | 50 | 8.0 (1 ch) 4.0 (2 ch) | 0.49 | 1 2 | Y | Y (Latch) | Y (Latch) | WQFN48/HTSSOP48/HSOP28/ HZIP25 /SDIP24 |
| TB6552FTG/FNG | 15 | 1.0 | 1.5 | 2 | – | – | Y (Auto) | WQFN16/SSOP16 |
| TB6593FNG | 15 | 3.2 | 0.35 | 1 | – | – | Y (Auto) | SSOP20 |
| TB6612FNG | 15 | 3.2 | 0.5 | 2 | – | – | Y (Auto) | SSOP24 |
| TB6614FNG | 15 | 3.2 | 0.3 | 1 | – | Y (Auto) | Y (Auto) | SSOP16 |
| TC78H600FTG/FNG | 18 | 1.0 | 1.2 | 2 | Y | Y (Latch) | Y (Auto) | WQFN24/SSOP20 |
| TC78H610FNG | 18 | 1.0 | 1.2 | 2 | – | Y (Latch) | Y (Auto) | SSOP16 |

Abbreviations: ISD: Overcurrent detection, TSD: Thermal shutdown

⁺⁺: Planned

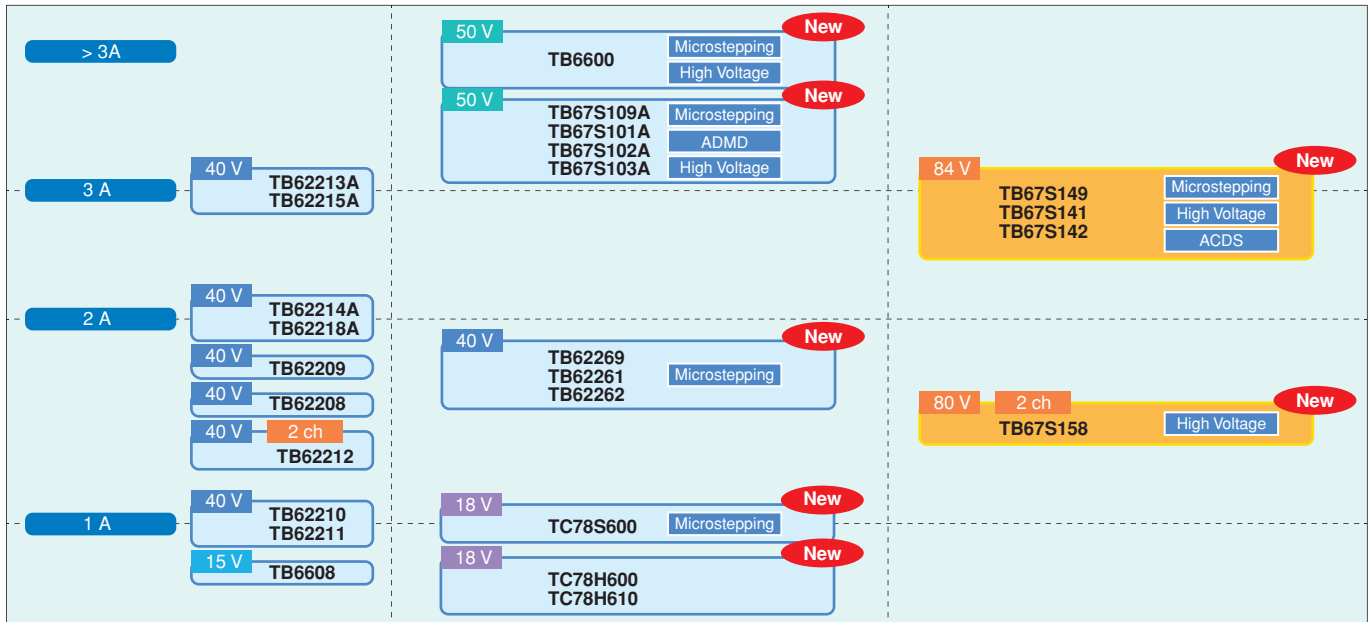
Stepping Motor Drivers

Stepping Motor Driver Series

Toshiba offers an extensive lineup of stepping motor drivers fabricated using a BiCD process that provides high accuracy and high-current capability. Toshiba's stepping motor drivers are available in bipolar and unipolar configurations.

Roadmap

Bipolar
 Unipolar

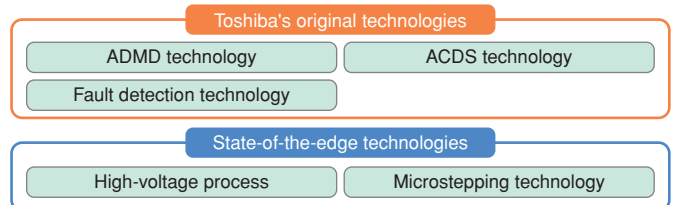


Features of Toshiba's Stepping Motor Drivers

Extensive product lineup



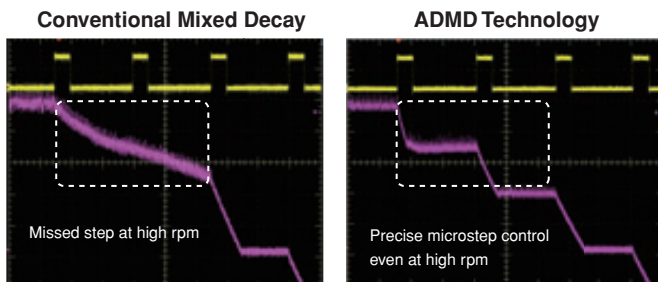
Solutions for customers' needs and issues based on leading-edge technologies



Toshiba's Original Technologies

1. Advanced Dynamic Mixed Decay (ADMD) Technology

Toshiba's original ADMD technology tracks input current more closely than the conventional mixed-decay mode, making highly efficient motor control possible at high rpm.



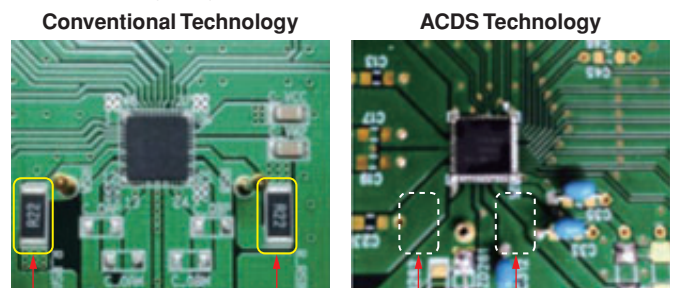
Products incorporating the ADMD technology:

- TB67S101AFTG/FNG/FG**/HG**/NG
- TB67S102AFTG/FNG/FG**/HG**/NG
- TB67S103AFTG
- TB67S109AFTG/FNG/HG**

2. Advanced Current Detect System (ACDS) Technology

Toshiba's original ACDS technology enables motor drive with highly accurate constant current without requiring external current-sensing resistors.

The reduced part count also helps reduce the board area and the bill-of-material (BOM) cost.



Two resistors with high electrical ratings are necessary.

No external resistor is required.

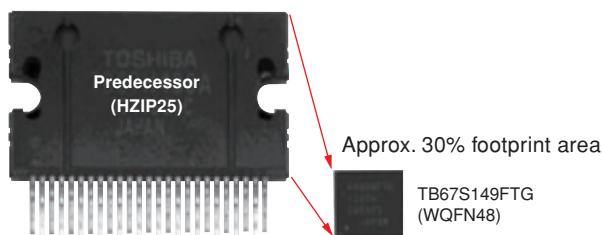
Products incorporating the ACDS technology

- TB67S141FTG/FG**/HG/NG
- TB67S142FTG/FG**/HG/NG
- TB67S149FTG/FG**/HG

**: Planned **: Under development

3. High-Voltage Analog Process Technology

Fabricated using a state-of-the-art high-voltage analog process (130-nm BiCD process), Toshiba's stepping motor drivers combine low-voltage control circuitry with high-voltage DMOS output drivers on the same monolithic structure. Consequently, high-voltage motor drivers rated at 84 V can be housed in the small WQFN48 (7 mm × 7 mm) package, which helps reduce the solution size.



[Products fabricated with the 130-nm BiCD process]

- Maximum rated voltage: 40 V
TB62261, TB62262, TB62269, TB67S213, TB67S215
- Maximum rated voltage: 50 V
TB6600, TB67S101A, TB67S102A, TB67S103A, TB67S109A
- Maximum rated voltage: 80 V
TB67S158
- Maximum rated voltage: 84 V
TB67S141, TB67S142, TB67S149

4. Package Lineup

Toshiba's stepping motor drivers are available in various package styles, including small surface-mount and through-hole packages, that are suitable for diverse printed circuit boards, assembly methods and system applications.

➤ Product Lineup (Bipolar)

| Part Number | Interface | Absolute Maximum Ratings | | Stepping Mode | Detection Circuits | | | Packages |
|-------------------------------|-------------------------|--------------------------|------------------------|---------------|--------------------|-----|-----|--|
| | | Output Breakdown (V) | Output Current (A) | | POR | ISD | TSD | |
| TB62211FNG | Clock input | 40 | 1.0 | 1/4 step | ✓ | ✓ | ✓ | HTSSOP24 |
| TB62262FTAG/FTG | Clock input | 40 | 1.5(FTAG) 1.8(FTG) | 1/4 step | ✓ | ✓ | ✓ | WQFN36/WQFN48 |
| TB62209FG | Clock input | 40 | 1.8 | 1/16 step | ✓ | ✓ | ✓ | HSOP36 |
| TB62269FTG | Clock input | 40 | 1.8 | 1/32 step | ✓ | ✓ | ✓ | WQFN48 |
| TB62214AFTG/FNG/FG | Clock input | 40 | 2.0 | 1/4 step | ✓ | ✓ | ✓ | QFN48/HTSSOP48/HSOP28 |
| TB67S215FTAG | Clock input | 40 | 2.5 | 1/4 step | ✓ | ✓ | ✓ | WQFN36 |
| TB62215AFTG/FNG/FG/HQ | Clock input | 40 | 3.0 | 1/4 step | ✓ | ✓ | ✓ | QFN48/HTSSOP48/HSOP28/HZIP25 |
| TB6560AFTG/FG/HQ | Clock input | 40 | 2.5(FTG/FG) 3.5(HQ) | 1/16 step | | | ✓ | QFN48/HQFP64/HZIP25 |
| TB67S102AFTG/FNG/FG**/HG**/NG | Clock input | 50 | 4.0 | 1/4 step | ✓ | ✓ | ✓ | WQFN48/HTSSOP48/HSOP28/HZIP25/ SDIP24 |
| TB67S103AFTG | Serial + clock input | 50 | 4.0 | 1/32 step | ✓ | ✓ | ✓ | WQFN48 |
| TB67S109AFTG/FNG/HG** | Clock input | 50 | 4.0 | 1/32 step | ✓ | ✓ | ✓ | WQFN48/HTSSOP48/HSOP28/HZIP25 |
| TB6600FG/HG | Clock input | 50 | 5.0 | 1/16 step | ✓ | ✓ | ✓ | HQFP64/HZIP25 |
| TB6608FNG | Clock input | 15 | 0.8 | 1/8 step | ✓ | | ✓ | SSOP20 |
| TC78S600FTG/FNG | Clock input | 18 | 1.0 | 1/16 step | ✓ | ✓ | ✓ | WQFN24/SSOP20 |
| TB6674PG/FG/FAG | Phase input | 24 | 0.4(PG/FG) 0.2(FAG) | Full step | ✓ | ✓ | ✓ | DIP16/HSOP16/SSOP16 |
| TB62210FNG | Phase input | 40 | 1.0 | 1/4 step | ✓ | ✓ | ✓ | HTSSOP24 |
| TB6562ANG/AFG | Phase input | 40 | 1.5 | 1/4 step | | ✓ | ✓ | SDIP24/SSOP30 |
| TB62206FG | Phase input | 40 | 1.8 | 1/2 step | ✓ | ✓ | ✓ | HSOP20 |
| TB62208FTG/FNG/FG | Phase input | 40 | 1.8 | 1/4 step | ✓ | ✓ | ✓ | QFN48/HTSSOP48/HSOP28 |
| TB62261FTAG/FTG | Phase input | 40 | 1.5(FTAG) 1.8(FTG) | 1/4 step | ✓ | ✓ | ✓ | WQFN36/WQFN48 |
| TB62218AFTG/FNG/FG | Phase input | 40 | 2.0 | 1/4 step | ✓ | ✓ | ✓ | QFN48/HTSSOP48/HSOP28 |
| TB67S213FTAG | Phase input | 40 | 2.5 | 1/4 step | ✓ | ✓ | ✓ | WQFN36 |
| TB62213AFTG/FNG/FG/HQ | Phase input | 40 | 3.0 | 1/4 step | ✓ | ✓ | ✓ | QFN48/HTSSOP48/HSOP28/HZIP25 |
| TB67S101AFTG/FNG/FG**/HG**/NG | Phase input | 50 | 4.0 | 1/4 step | ✓ | ✓ | ✓ | WQFN48/HTSSOP48/HSOP28/ HZIP25/SDIP24 |
| TC78H610FNG | Phase input | 18 | 1.0 | 1/2 step | ✓ | ✓ | ✓ | SSOP16 |
| TB62212FTAG/FNG | Phase input | 40 | 1.5 × 2 ch | 1/2 step | ✓ | ✓ | ✓ | QFN48/HTSSOP48 |

➤ Product Lineup (Unipolar)

| Part Number | Interface | Absolute Maximum Ratings | | Stepping Mode | Detection Circuits | | | Packages |
|------------------------|---|--------------------------|--------------------|---------------|--------------------|-----|-----|-----------------------------|
| | | Output Breakdown (V) | Output Current (A) | | POR | ISD | TSD | |
| TB67S141FTG/FG**/HG/NG | Phase input | 84 | 3.0 | 1/4 step | ✓ | ✓ | ✓ | WQFN48/HSOP28/HZIP25/SDIP24 |
| TB67S142FTG/FG**/HG/NG | Clock input | 84 | 3.0 | 1/4 step | ✓ | ✓ | ✓ | WQFN48/HSOP28/HZIP25/SDIP24 |
| TB67S149FTG/FG**/HG | Clock input | 84 | 3.0 | 1/32 step | ✓ | ✓ | ✓ | WQFN48/HSOP28/HZIP25 |
| TB67S158FTG/NG | Clock input Parallel input Serial input | 80 | 1.5 × 2 ch | 1/2 step | ✓ | ✓ | ✓ | WQFN48/SDIP24 |

Abbreviations: POR: Power-on reset, ISD: Overcurrent detection, TSD: Thermal shutdown

: Planned *: Under development

Transistor Arrays

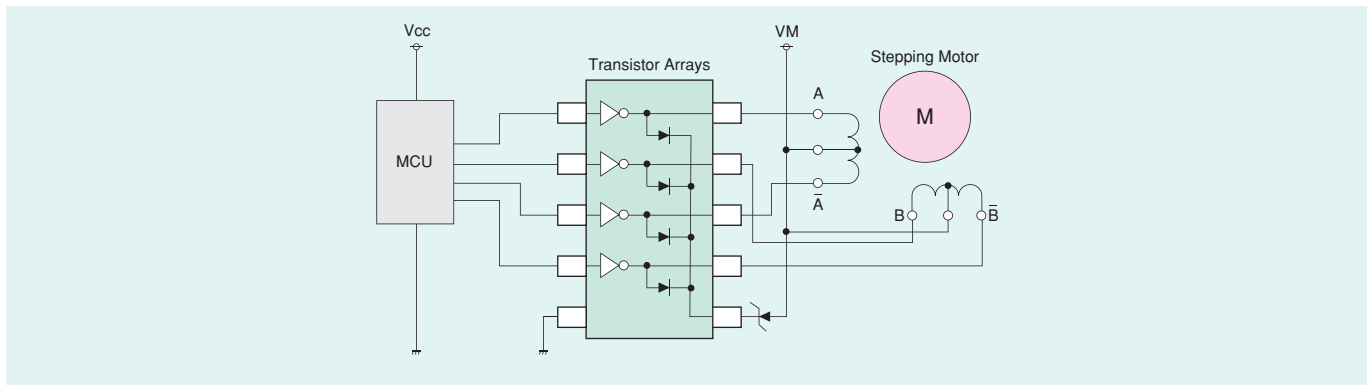
Transistor Arrays

Transistor arrays designed for stepping motor driving applications are available with a variety of functions, circuit counts, voltage and current ratings, packages and so on. Small, surface-mount SSOP packages help reduce the size of end products.

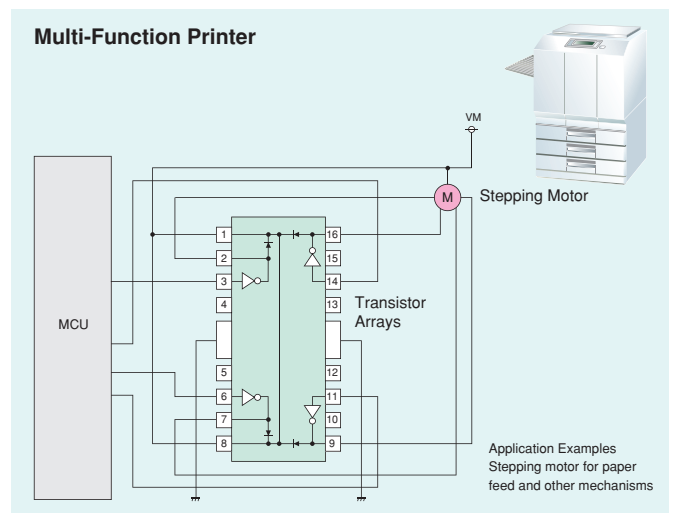
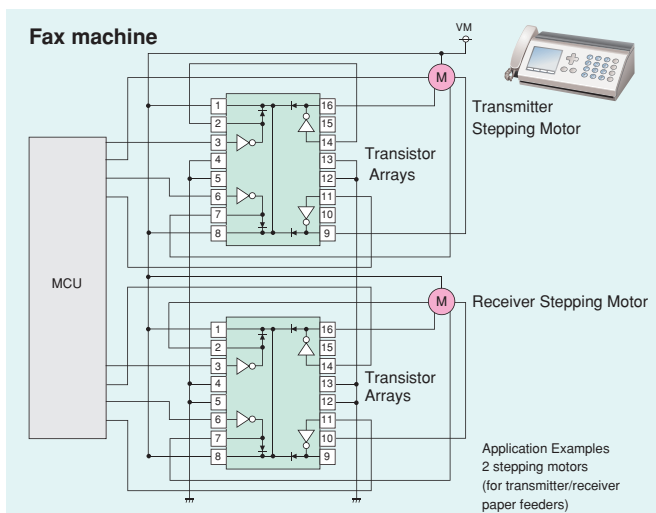
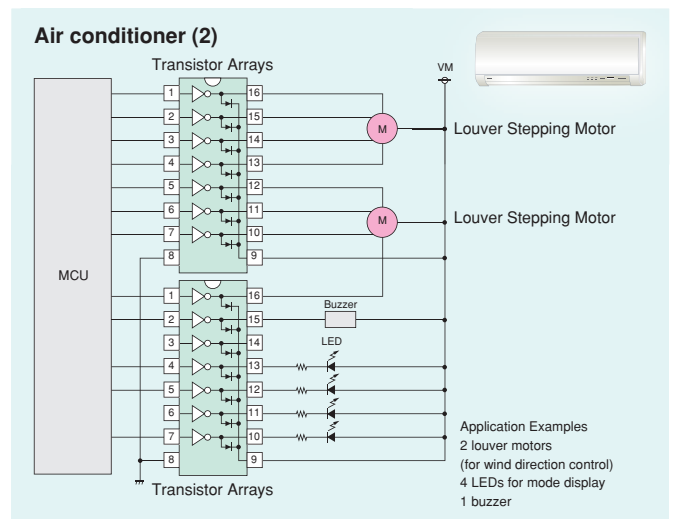
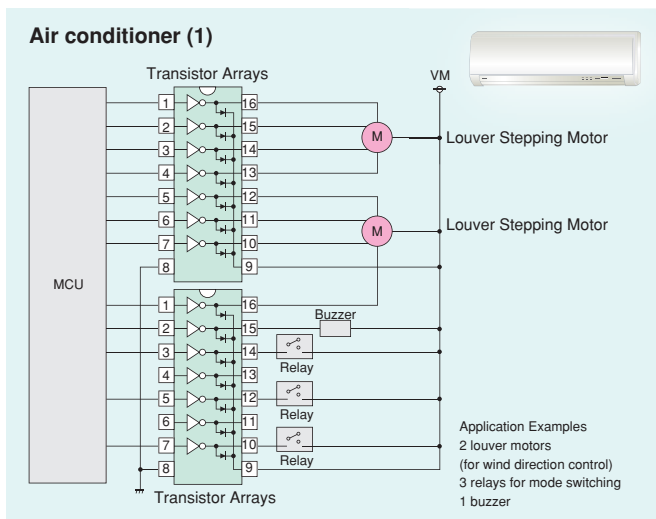
Features

- High-voltage and high-current drive
- Widely adopted in the market because of proven reliability
- Offers a robust product lineup in various packages to meet diverse customer needs

➤ Motor Drive Application Example



➤ Applications

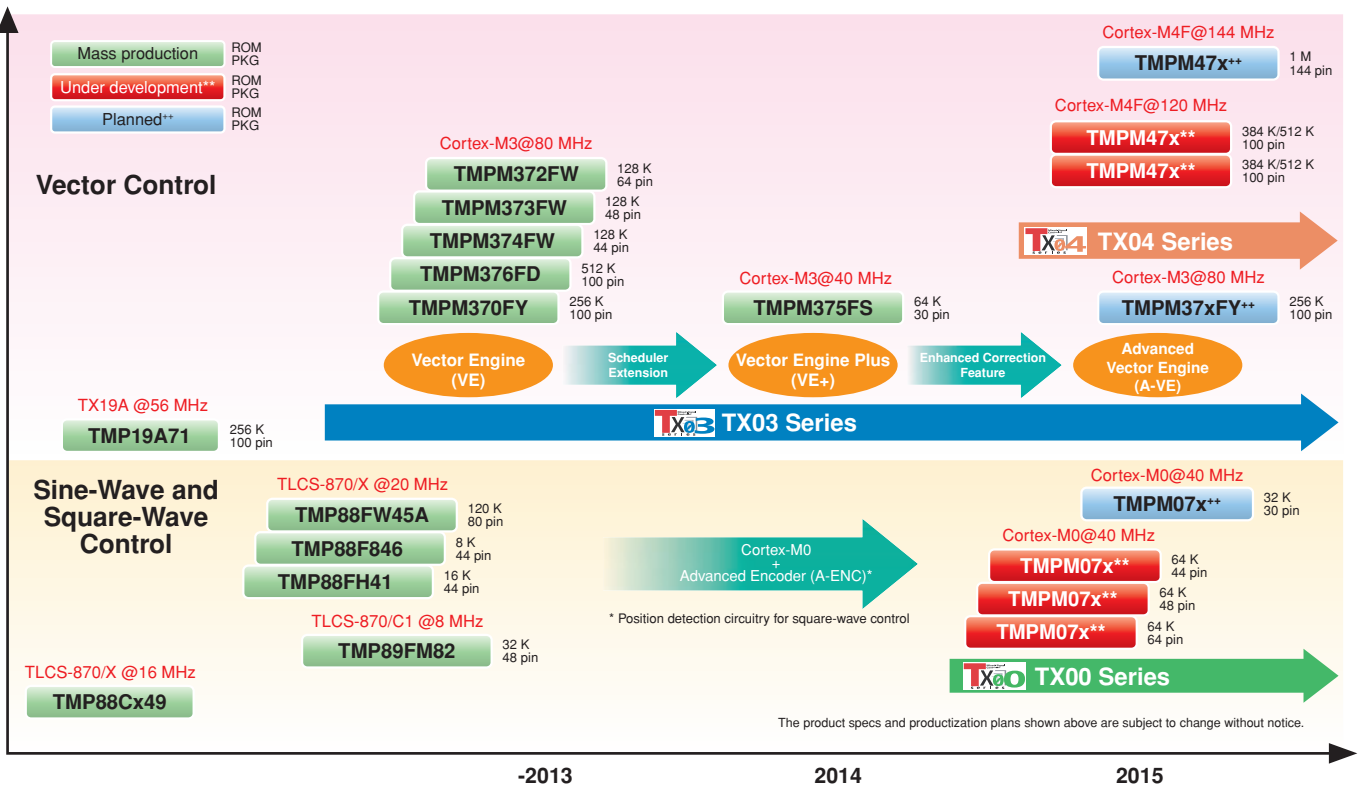


Microcontrollers

Microcontrollers Designed for Motor Applications

Toshiba offers PMD microcontrollers that contain programmable motor driver (PMD) specifically designed for inverter control of three-phase motors, reducing the CPU workload for motor control. There are two kinds of PMD microcontrollers: those with an ARM Cortex-M3 core that features an integrated vector engine and those with an 8-bit TLCS-870/X or TLCS-870/C1 core that provides 180° commutation via interrupts raised every 60° electrical of rotation.

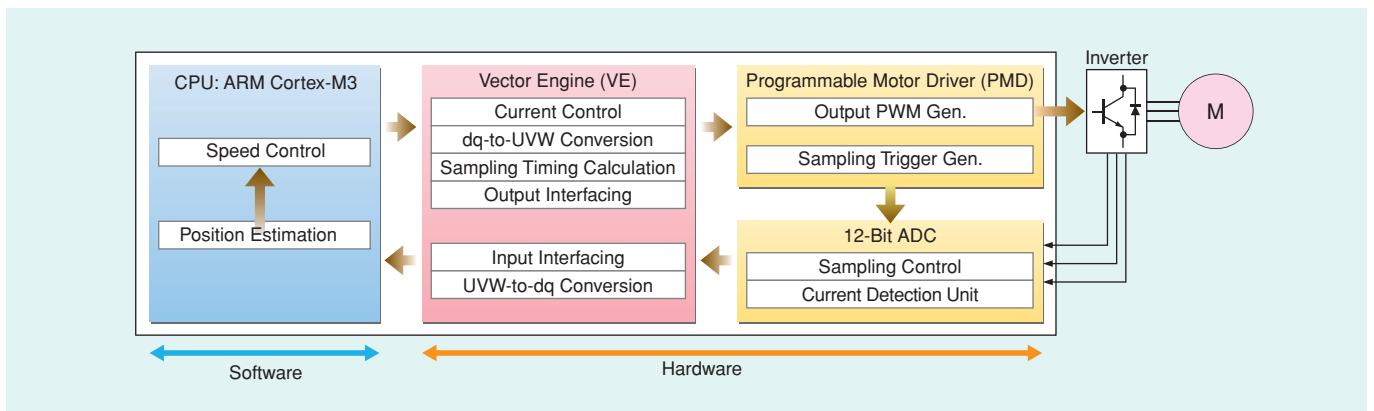
Roadmap



Vector Engine (VE)

The vector engine is a dedicated hardware unit that automatically performs basic vector control operations (such as coordinate transformations, phase transformations and sine/cosine calculations) and a PI algorithm for current control.

Block Diagram of a Motor Control System (Example)



The vector engine is a computation unit designed to perform various operations for motor vector control. It executes 1) routine operations, 2) peripheral interface operations, and 3) a scheduler that controls the sequence of these operations. Since the vector engine has the capability for performing basic vector control operations (such as coordinate transformations, phase transformations and sine/cosine calculations); a PI algorithm for current control; and PMD and high-speed ADC interface operations, it helps to reduce the software workload significantly. On the other hand, speed control and position estimation operations greatly depend on system configurations and the control methods used; thus, these operations can be freely implemented as software.

Microcontroller with Vector Engine (M370 Group)

Features

- Toshiba's original Vector Engine (VE)
 - High-speed processing using dedicated hardware
 - Completes servo computation routine in 5.0 μ s
- Supports a commonly used single 5-V power supply
 - Allows the reuse of the conventional platform

Specification Overview

- High-performance ARM Cortex-M3 core with a clock rate of up to 80 MHz
- Vector Engine (VE)
- On-chip analog circuits (comparator, op-amp, encoder input)
- Available in various packages (SSOP30, LQFP44, LQFP48, LQFP64, LQFP100, QFP100)

TMPM375FSDMG with Vector Engine Plus

- High-performance Cortex-M3 core with low power consumption
- Motor control circuits (PMD, VE, ADC)
- Small package: SSOP30

Cortex-M3 Core

- Operating voltage: 4.5 V to 5.5 V
- Maximum operating frequency: 40 MHz
- Operating temperature: -40°C to 105°C
- On-chip ROM: 64 KB
- On-chip RAM: 4 KB
- Debug units: SWD/SWW
- On-chip high-speed oscillator

Peripheral Units

- Programmable motor driver (PMD): 1 unit
- Vector Engine Plus (VE+): 1 unit
- 12-bit AD converter: 1 unit (with a conversion time of 2.0 μ s)
- Op-amp (AMP): 1 channel
- SIO/UART: 2 channels
- Power-on reset (POR)
- Low-voltage detection (LVD) circuit
- Oscillation frequency detector (OFD)
- 16-bit timer: 4 channels
- I²C/SIO: 1 channel

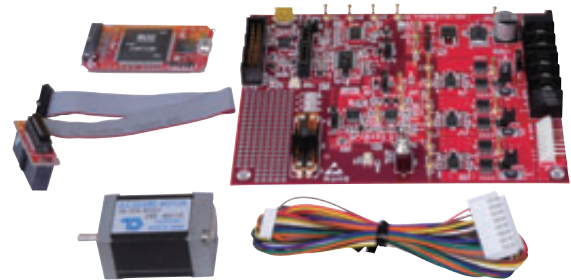
Product Lineup

| Part Number | Maximum Operating Frequency (MHz) | ROM (KB) | Motor Controller (ch) | 12-Bit AD Converter (Conversion Time) | Encoder Input Logic (ch) | I/O Ports (ch) | Package |
|--------------|-----------------------------------|-----------|-----------------------|---------------------------------------|--------------------------|----------------|---------|
| TMPM370FYDFG | 80 | Flash 256 | 2 | 22 (2 μ s) | 2 | 76 | QFP100 |
| TMPM370FYFG | 80 | Flash 256 | 2 | 22 (2 μ s) | 2 | 76 | LQFP100 |
| TMPM372FWUG | 80 | Flash 128 | 1 | 11 (2 μ s) | 1 | 53 | LQFP64 |
| TMPM373FWDUG | 80 | Flash 128 | 1 | 7 (2 μ s) | 1 | 37 | LQFP48 |
| TMPM374FWUG | 80 | Flash 128 | 1 | 6 (2 μ s) | 1 | 33 | LQFP44 |
| TMPM376FDDFG | 80 | Flash 512 | 2 | 22 (2 μ s) | 2 | 82 | QFP100 |
| TMPM376FDFG | 80 | Flash 512 | 2 | 22 (2 μ s) | 2 | 82 | LQFP100 |
| TMPM375FSDMG | 40 | Flash 64 | 1 | 4 (2 μ s) | 1 | 21 | SSOP30 |

Application Examples



Evaluation Kit (included with a motor)



IAR System AB

Microcontrollers with PSC (M340/M440 Group)

Features

- Incorporates a Programmable Servo/Sequence Controller (PSC) that acts as a sub-processor to an Cortex-M3/M4 core-based MCU
 - Runs computational tasks in parallel at high speed
 - Reduces overall power consumption by offloading the CPU from motor servo routines and sequencing operations

Specification Overview

- High-performance Cortex-M3 core with a clock rate of up to 54 MHz (M340 Group)
Cortex-M4F core with a clock rate of up to 100 MHz (M440 Group)
- High-resolution PPG (programmable phase difference of up to $\pm 90^\circ$)
- High-speed 12-bit AD converter and 10-bit DA converters
- Housed in a small fine-pitch BGA packages

TMPM440FEXBG/F10XBG with High-Speed NANO-FLASH™-100

- Cortex-M4F core with a clock rate of up to 100 MHz and zero-wait flash access
- Low power consumption due to parallel operation of FPU and PSC
- Various analog functions
(Three 12-bit AD converters, two 10-bit DA converters)

Cortex-M4F Core

- Operating voltage: 2.7 to 3.6 V (regulated by the on-chip DC-DC converter)
- Maximum operating frequency: 100 MHz
- On-chip ROM: 1024 KB/768 KB
- On-chip RAM: 80 KB
- Debug units: JTAG/SWD/SWV, Trace4 bit

Peripheral Units

- One PSC unit with 16-KB SRAM
- External bus interface
- 12-bit AD converter
- 10-bit DA converter
- 32-bit and 16-bit timers
- PPG, HS PPG, 2-phase input pulse counter
- Real-time clock (RTC), timebase timer (TBT), watchdog timer (WDT)
- Serial interfaces: SIO/UART, Enhanced SIO (ESIO), I²C
- Key scan matrix: 8 inputs and 8 outputs

Product Lineup

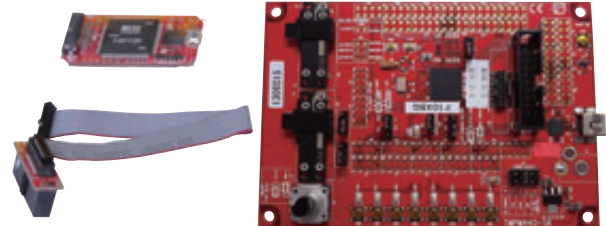
| Part Number | Maximum Operating Frequency (MHz) | ROM (KB) | SRAM (KB) | PSC (ch) | PPG (ch) | PHC (ch) | I/O Ports (ch) | Package |
|------------------|-----------------------------------|----------|-----------|----------|----------|------------------|----------------|----------|
| TMPM342FYXBG | 40 | 256 | 36 | 1 | 8 | 2 | 63 | VFPGA142 |
| TMPM343FDXBG | 50 | 512 | 80 | 4 | 8 | 3 | 59 | VFPGA162 |
| TMPM343FEXBG ** | | 768 | 96 | | | | | |
| TMPM343F10XBG ** | | 1024 | | | | | | |
| TMPM440FEXBG | 100 | 768 | 80 | 1 | 4 | PHC: 2 EPH: 1 | 228 | VFPGA289 |
| TMPM440F10XBG | | 1024 | | | | | | |

** : Under development

Application Examples



Evaluation Kit



IAR System AB

Motor Drivers (Intelligent Power Devices)

Toshiba offers 250-V and 500-V motor drivers fabricated using its unique high-voltage Silicon-On-Insulator (SOI) IC process.

Intelligent Power Devices (IPDs): High-Voltage PWM Brushless Motor Drivers

Previously, a variable-voltage switching power supply and other circuits were necessary to drive a BLDC motor. Now, intelligent power devices (IPDs) fabricated using a high-voltage IC process allow the use of mains power to drive a BLDC motor without requiring a step-down voltage converter.

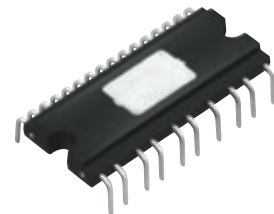
Toshiba's IPDs are housed in the small, thin DIP26 package that provides isolation between control and high-voltage pins to simplify board layout.

Features

- High withstand voltage due to the use of the SOI process and trench isolation structure
- Available with ratings from 250 V/1.0 A to 500 V/3.0 A
- Internal bootstrap power supply for the high-side gate drives

DIP26 Package

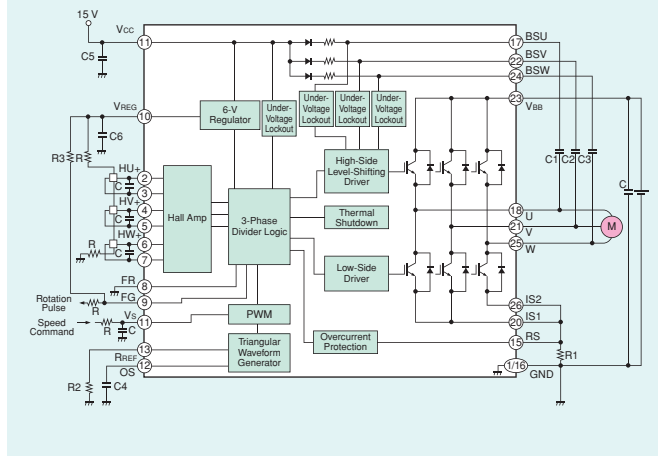
- Package body thickness: 3.8 mm max
- 16 control pins and 10 high-voltage pins are isolated on the opposite sides of the package.
(The complete isolation of these pins simplifies board trace routing.)
- Improved thermal resistance



DIP26

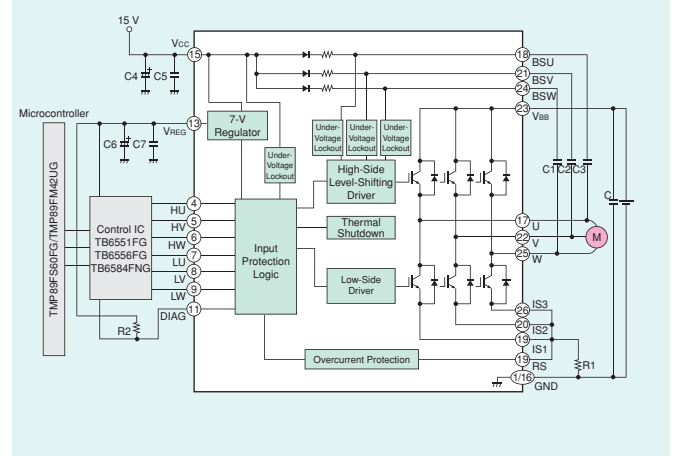
TPD4151K/TPD4142K Block Diagram

- Variable-speed brushless motor drive via the Hall sensor or Hall IC inputs



TPD4123K/TPD4144K/TPD4135K Block Diagram

- Sine-wave drive in combination with a controller
- The TPD4123K, TPD4134K and TPD4135K are pin-compatible and interchangeable according to the motor ratings.



Product Lineup

| Part Number | Ratings | Features | | | | | | |
|-------------|-------------|--------------------------------|----------|---|---------------|---------------------------|---------------------|----------------------------|
| | | Hall Sensor/ Hall IC Inputs | 6 Inputs | Three-Phase Distribution PWM Circuit | Level Shifter | Overcurrent Protection | Thermal Shutdown | Undervoltage Protection |
| TPD4151K | 250 V/1.0 A | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| TPD4142K | 500 V/1.0 A | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| TPD4123K | 500 V/1.0 A | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| TPD4123AK | 500 V/1.0 A | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| TPD4144K | 500 V/2.0 A | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| TPD4144AK | 500 V/2.0 A | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| TPD4135K | 500 V/3.0 A | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| TPD4135AK | 500 V/3.0 A | | ✓ | | ✓ | ✓ | ✓ | ✓ |

Photocouplers

Next-Generation IGBT/MOSFET-Drive Photocouplers

Toshiba offers IGBT/MOSFET-drive photocouplers fabricated using the latest 0.13- μm BiCD process. Overcurrent protection, rail-to-rail output and a thin package with a thickness of 2.3 mm help improve the efficiency and reduce the size of system applications.

IGBT/MOSFET-Drive Photocoupler with Overcurrent Protection (TLP5214)

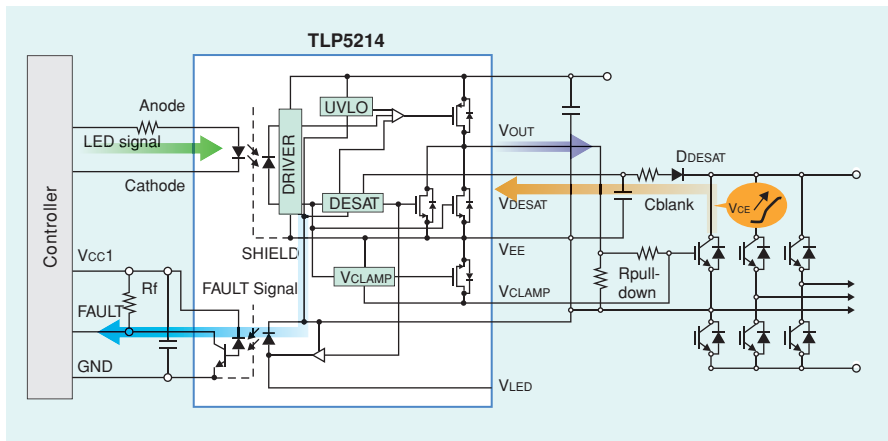
The TLP5214 monitors the saturation voltage, $V_{CE(sat)}$, of an IGBT and shuts down its output when $V_{CE(sat)}$ exceeds 6.5 V typical in the event of an overcurrent condition.

Additionally, the TLP5214 is housed in the thin SO16L package and provides active mirror clamping, rail-to-rail output and other features, reducing the number of external components compared with that previously required. This helps reduce bill-of-material (BOM) costs and board size. Despite the low-profile package, the TLP5214 provides a clearance distance of 8 mm and guarantees an isolation voltage of up to 5 kVrms, making it suitable for applications requiring higher insulation performance.

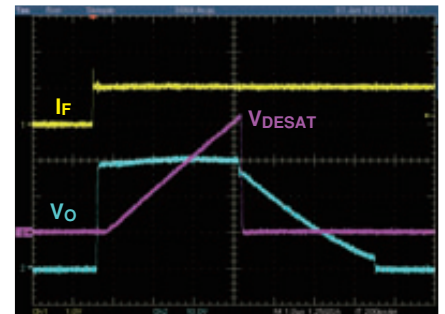
- $V_{CE(sat)}$ detection and shutdown protect an IGBT/MOSFET in the event of overcurrent.
- The FAULT signal is fed back to the controller at high speed.
- Active mirror clamping prevents IGBT/MOSFET failures due to mirror current.
- A rail-to-rail output reduces power loss.
- Maximum output peak current: 4.0 A
- Propagation delay (t_{pHL} / t_{pLH}): 150 ns max



SO16L



Soft Shutdown Waveform Example

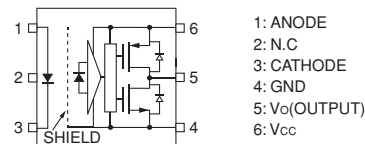


Conditions:
 $I_F = 10 \text{ mA}$, $V_{CC} = 30 \text{ V}$, $R_G = 10 \Omega$, $C_G = 25 \text{ nF}$, $T_a = 25^\circ\text{C}$
 I_F : 10 mA/div, V_o : 10 V/div, V_{DESAT} : 2 V/div, 1 $\mu\text{s/div}$

Rail-to-Rail Output Photocoupler for IGBT/MOSFET Drive (TLP575x Series)

Generally, the high-level output voltage (V_{OH}) of an IGBT-drive photocoupler is a few volts lower than the power supply voltage. In contrast, the TLP575x Series in the thin SO6L package provides a full-swing (i.e., rail-to-rail) output from ground to almost the supply voltage. The rail-to-rail output helps reduce the power loss of both the photocoupler and the IGBT during switching. Despite the low-profile package, the TLP575x Series provides a clearance distance of 8 mm and guarantees an isolation voltage of up to 5 kVrms, making it suitable for applications requiring higher insulation performance.

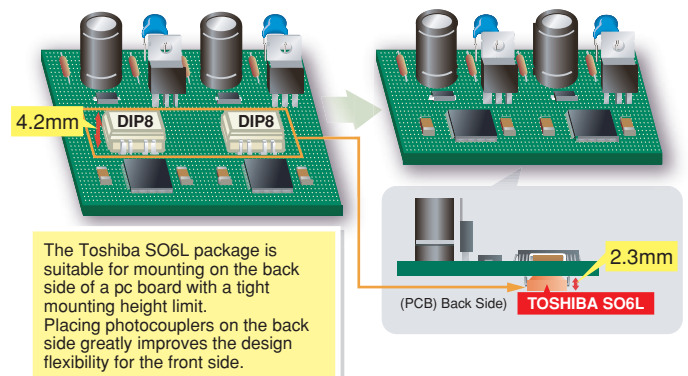
- A rail-to-rail output reduces power loss.
- Maximum output peak current: 1.0 A to 4.0 A
- Propagation delay (t_{pHL} / t_{pLH}): 150 ns max
- Propagation delay skew (t_{psk}): ± 80 ns



SO6L

| Part Number | TLP5751 | TLP5752 | TLP5754 |
|--|---------|----------------|---------|
| Peak current (A) | 1.0 | 2.5 | 4.0 |
| V_{OH} (V) | | $V_{CC} - 0.3$ | |
| V_{OL} (V) | | 0.2 | |
| Operating temperature range ($^\circ\text{C}$) | | -40 to 110 | |
| t_{pHL}/t_{pLH} (ns) | | 150 | |
| t_{psk} (ns) | | ± 80 | |
| V_{CC} (V) | | 15 to 30 | |
| BVs (Vrms) | | 5000 | |

Benefits of the Thin SO6L Package with a Thickness of 2.3 mm



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