SYSTEM CATALOG

Motor Solutions Guide

http://www.semicon.toshiba.co.jp/eng
Toshiba’s Semiconductors for Motor Control

Many of the things we use in our daily lives such as mobile devices, office equipment, amusement equipment and toys are driving the need to reduce size, cut power consumption and improve performance. Toshiba offers multifaceted solutions by leveraging its unique technologies, including:

- Compact packages to allow smaller product size
- Single-chip ICs capable of driving multiple motors
- Low power consumption and high-accuracy control to extend battery life

To meet customer needs, Toshiba is developing various semiconductor devices for motor control applications that embody its state-of-the-art technologies.

Packaging Options for Motor Drivers and Microcontrollers

Motor Solutions for Home Appliance and Consumer Electronics Applications ........................................... 4

Motor Solutions for Mobile and Small-Footprint Applications ........................................................................... 6

Motor Solutions for Office and Industrial Equipment ......................................................................................... 8

Product Information

Brush Motor Drivers .......................................................... 10
Stepping Motor Drivers ....................................................... 12
Brushless Motor Drivers ..................................................... 14
Microcontrollers ................................................................. 16
Intelligent Power Devices (IPDs) ........................................... 18
Photocouplers ................................................................. 19

The above package photos are not actual size and do not reflect the relative size.
Toshiba offers a suite of motor solutions ideal for DC inverter applications that require low power consumption and quiet motor control, such as motor controllers, microcontrollers with an integrated vector engine and intelligent power devices (IPDs).

**Toshiba’s Unique Motor Control Technologies**
- **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.
- **Vector control**: The hardware specifically designed for vector control enables sensorless sine-wave drive.

**Product Overview**

### Sensorless Square-Wave PWM Three-Phase Brushless DC Motor Drivers (TB6633FNG/AFNG)
- Sensorless PWM drive
- Improved overlapping commutation (135°/150° commutation)
- Lead angle control
- FNG: FG = 3 ppr
  - AFNG: FG = 1 ppr
- Package: SSOP24-P-300-0.65A

### Sine-Wave PWM Three-Phase Brushless DC Motor Controllers (TB6584FNG/AFNG)
- Sine-wave current drive
- Automatic lead angle correction
- On-chip oscillator
  - (External resistors and capacitors required)
- On-chip power source for Hall sensors
- Programmable dead time
- Dual-phase modulation
- Package: SSOP30-P-300-0.65

### Sensorless Sine-Wave PWM Three-Phase Brushless DC Motor Controller (TC7600FNG)
- Vector control
- Sensorless sine-wave control
- On-chip oscillator
  - (External resistors required)
- RPM control
- Programmable dead time
- Package: SSOP30-P-300-0.65
### Microcontrollers with a Vector Engine (M370 Group)

- Operating voltage: 4.5 V to 5.5 V
- Maximum operating frequency: 80 MHz
- On-chip memory: Flash ROM: 128 KB/256 KB/512 KB
  RAM: 6 KB to 32 KB
- Motor controller: 1 or 2 channels
- Encoder inputs: 1 or 2 channels
- 12-bit A/D converter: 6 to 22 channels
- 16-bit timer/clock: 8 channels

### Motor Solution Example for Home Appliance and Consumer Electronics Applications

#### Block Diagram of an Air Conditioner

![Block Diagram of an Air Conditioner](image)

#### Product Lineup

<table>
<thead>
<tr>
<th>Applications</th>
<th>Semiconductor</th>
<th>Recommended Devices</th>
<th>Features</th>
<th>End-Product Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Control</td>
<td>Microcontrollers</td>
<td>TMPM370/FY/TMPM374/FW/TMPM375/FY/TMPM376/FY/TMPM377/FY** **</td>
<td>Vector engine (VE) Multiple motors controllable with PMD</td>
<td>Refrigerators Air conditioners Automatic washing machines Dishwashers</td>
</tr>
<tr>
<td>Fan and Circulating Pumps</td>
<td>Brushless motor drivers</td>
<td>TB6585FG**/TB6585SFG**</td>
<td>Sensorless DC motor driver Quiet operation</td>
<td>Refrigerators Air conditioners Automatic washing machines Dishwashers Cloth driers</td>
</tr>
<tr>
<td>Ice Makers for Refrigerators</td>
<td>Brush motor drivers</td>
<td>TA7291P/FG/SG</td>
<td>Programmable output voltage</td>
<td>Refrigerators</td>
</tr>
<tr>
<td>Motor Dampers for Refrigerators</td>
<td>Stepping motor drivers</td>
<td>TB6674PG/FG/FAG</td>
<td>Two-phase stepping motor (on-off valve)</td>
<td>Refrigerators</td>
</tr>
<tr>
<td>Filter Cleaner Motors (Actuators)</td>
<td>Micro-step driver</td>
<td>TB6608FNG</td>
<td>Two-phase stepping motor (bipolar type)</td>
<td>Air conditioners</td>
</tr>
<tr>
<td>Air Conditioners Indoor Fan Motors</td>
<td>Three-phase brushless motor drivers</td>
<td>TB6585FG/FTG**</td>
<td>Sine-wave-current PWM driver</td>
<td>Air conditioners</td>
</tr>
<tr>
<td>Air Conditioners Outdoor Fan Motors</td>
<td>IPDs</td>
<td>TPD4131K/TPD4132K</td>
<td>Thin package High-voltage, high-current pins and control pins are isolated on the opposite sides of a package.</td>
<td>Air conditioners</td>
</tr>
<tr>
<td>Compressor Control</td>
<td>IPDs</td>
<td>TPD4134K/TPD4135K/TPD4136K</td>
<td>Single-chip inverter Low loss and low noise</td>
<td>Refrigerators</td>
</tr>
<tr>
<td>Compressor Drive Pulsator/Drum Drive</td>
<td>IGBT</td>
<td>GT36J324</td>
<td>Low loss and insulated package</td>
<td>Air conditioners Automatic washing machines</td>
</tr>
<tr>
<td>Circulating Pumps</td>
<td>IPDs</td>
<td>TPD4134K/TPD4135K/TPD4136K</td>
<td>Thin package High-voltage, high-current pins and control pins are isolated on the opposite sides of a package.</td>
<td>Automatic washing machines Dishwashers Cloth driers</td>
</tr>
<tr>
<td>IGBT/MOSFET Drivers</td>
<td>Photocouplers</td>
<td>TLP155E/TLP701/TLP351</td>
<td>Direct IGBT/MOSFET drive</td>
<td>Refrigerators Air conditioners Automatic washing machines Dishwashers Cloth driers</td>
</tr>
</tbody>
</table>

*: New product  **: Under development

ARM and Cortex are trademarks or registered trademarks of ARM Limited in the EU and other countries.
Motor Solutions for Mobile and Small-Footprint Applications

Toshiba offers motor solutions ideal for mobile and small-footprint applications that require low power consumption and small form factor.

Toshiba’s Unique Motor Control Technologies

- 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: TB6614FNG: Output Ron = 0.3 Ω (typ.)
- High-speed PWM control: TB6614FNG: fPWM = Up to 400 kHz
- Small packages: Leadless QON and QFN packages
- Ultrasonic-motor control and piezoelectric actuator support: PPG outputs with 6-ns resolution.

Product Overview

**DC Motor Driver for Low-Power Applications (TB6614FNG)**

The TB6614FNG is a DC motor driver using low-ON-resistance LDMOS transistors at the output stage. The IN1 and IN2 input terminals allow selection of one of the four modes: Forward, Reverse, Short Brake or Stop.

- Output current: Io = 1.2 A (typ.), 3.2 A (repetitive pulse peak)
- Operating voltage: Vcc = 2.7 to 5.5 V
  VM = 2.5 to 13.5 V
- Output Ron: 0.3 Ω typ. (high side + low side)
- Direct PWM, fPWM max = 400 kHz
- Standby function
- Thermal shutdown circuitry, overcurrent protection circuitry, undervoltage lockout circuitry
- Package: SSOP16-P-225-0.65

**8-Channel Motor Driver for a Digital Still Camera (DSC) (TB6613FTG)**

- Absolute maximum ratings: 6 V/0.8 A
- 8-channel single-chip driver (Independently controllable)
  - Channels A, B, C and D: 6-bit micro-step STM (Configurable to operate as four independent DCM drivers)
  - Channel E: PWM constant-current H-bridge driver
  - Channels F, G and H: Direct PWM H-bridge drivers
- 3-wire serial interface
- Standby function
- Thermal shutdown circuitry, undervoltage lockout circuitry
- Package: VQON44-P-0606-0.4

**Motor Control Microcontrollers (TMPM341FDXBG, TMPM341FYXBG <Under Development>)**

- Operating voltage: 2.7 to 3.6 V
- Maximum operating frequency: 54 MHz
- On-chip memory: Flash ROM: 512 KB/256 KB
  RAM: 32 KB
- 12-bit AD converter: 15 channels
- 10-bit DA converter: 2 channels
- High-resolution PPG output: 2 channels (Resolution: 6 ns max)
- Two-phase pulse counter: 4 channels
- Serial interfaces: SIO/UART: 5 channels
  I2C (100 kHz/400 kHz)/SIO: 2 channels
  SSP: 1 channel
- Package: P-TFBGA113-0606-0.50AZ

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Motor Solution Example for Mobile and Small-Footprint Applications

Block Diagram of a Digital Still Camera

Motor Driver/Power Block

Microcontroller

Product Lineup

Applications | Semiconductor | Recommended Device | Features | End-Product Examples
---|---|---|---|---
Motor Control | Microcontrollers | TMPM341FDXBG, TMPM341FYXBG | ARM Cortex™-M3 core, 54 MHz (max), 12-bit ADC: 15 channels, 10-bit DAC: 2 channels, High-resolution PPG output (Resolution: 6 ns) | Digital still camera (DSLR) lens

Lens Drive Actuator Drive | Brush motor drivers | TB6593FNG, TB6614FNG, TB6617FNG | Single-bridge | Digital still cameras (DSC, DSLR), small printers, lens control, security cameras, network cameras, small scanners
| Stepping motor | TB6612FNG | Dual-bridge |
| | TB6552FNG/FLG/FTG | Dual-bridge, small package: VQON16 (3 mm²) |
| | TB6590FTG | Dual-bridge, small package: VQON16 (3 mm²) |
| | TB6607FLG | 5 channels in 1 chip, Serial interface + 6-bit DAC |
| | TB6596FLG, TB6609FLG | 6 channels in 1 chip, Serial interface + 6-bit DAC |
| | TB6613FTG, TB6608FNG | 8 channels in 1 chip, 6-bit micro-step control for two motors, serial interface |
| | TB6608FNG | 2W1-2-phase excitation, constant-current drive |

*: New Product **: Under development
Toshiba offers motor solutions for office and industrial applications that require high current, quick control and high accuracy.

**Toshiba’s Unique Motor Control Technologies**

- **Low-Ron process**: Supports high-current, high-power outputs.
- **Synchronous rectification PWM control**: Reduces power loss (heat dissipation) during PWM control.
- **High-accuracy micro-stepping**: Reduces the acoustic noise and vibration of a motor.

![Diagrams of motor control technologies](image)

**Product Overview**

- **High-Current Motor Driver with Low Power Consumption (TB6569FG)**
  - Reduced power consumption due to the use of a BICD process
  - Output Ron: 0.55 Ω typ. (high side + low side)
  - Constant-current PWM control
  - Absolute maximum ratings: 50 V/4.0 A, 36 V/4.5 A
  - Package: HSOP16-P-300-1.00

- **Constant-Current Motor Drivers (TB62216FNG/FTG/FG)**
  - 2-channel DC motor drivers (with a programmable digital blanking time)
  - Reduced power consumption due to the use of a BICD process
  - Four selectable control modes (Forward, Reverse, Short Brake, Stop)
  - Direct PWM and constant-current (current feedback) control
  - Output Ron: 1.0 Ω (high side + low side)
  - Absolute maximum ratings: 40 V/2.5 A
  - Packages: HTSSOP48-P-300-0.50, QFN48-P-0707-0.50, HSOP28-P-450-0.80

- **Micro-Step Motor Drivers (TB6560AHQ/AFG/AFTG)**
  - 4-bit (1/16) micro-stepping
  - Clock input
  - Absolute maximum ratings: 40 V/3.5 A (AHQ), 2.5 A (AFG), 2.5 A (AFTG)
  - Packages: HZIP25-P-1.27, HQFP64-P-1010-0.50, QFN48-P-0707-0.50
Motor Solutions for Office and Industrial Equipment

Block Diagram of a Printer

Image Output Engine Control Section

Input Section

- CCD
- Analog Front End
- Scanner Light Source
- LED Driver
- Stepping Motor
- Motor Driver
- External Interface
- Power Supply

System Control

- Indicator

- System Control
- Interface Control

Image Output Engine Control Section

- Motor Driver
- Head Motor
- Paper Transport Motor
- Motor Driver
- Auto Paper Feed Motor
- A/D Converter
- Sensors
- Photocoupler
- Fixation Heater
- Drum Unit
- Toner Detection

Product Lineup

<table>
<thead>
<tr>
<th>Applications</th>
<th>Semiconductor</th>
<th>Recommended Device</th>
<th>Features</th>
<th>End-Product Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Image Output Engine Control Section</strong></td>
<td><strong>Brush Motor Drivers</strong></td>
<td>TA7291SG (I)/FG/P</td>
<td>Single full bridge, output voltage control</td>
<td>Plain paper copiers (PPCs), printers, scanners, fax machines, vending machines, ATMs, amusement equipment, card readers, robots, bank note recognition machines, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TA8429KFQ</td>
<td>Single full bridge</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6564F92/GF/HQ</td>
<td>Single full bridge, direct PWM control</td>
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<tr>
<td></td>
<td></td>
<td>TB6569KQ*</td>
<td>Single full bridge, direct PWM control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6559FQ</td>
<td>Single full bridge, Constant-current PWM control/direct PWM control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6564FQ*</td>
<td>Single full bridge, emergency output, Direct PWM control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6569FQ*</td>
<td>Single full bridge, emergency output, Direct PWM control, Constant-current PWM control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6561FQ/G</td>
<td>Single full bridge, emergency output, Direct PWM control, Constant-current PWM control, Reference voltage output</td>
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<tr>
<td></td>
<td></td>
<td>TB6561FG/G</td>
<td>Dual full bridge</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>TB6572FG</td>
<td>Sine-wave PWM controllers</td>
<td>Industrial fans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6603FTG*</td>
<td>Sine-wave PWM controllers, RPM control</td>
<td>Office printers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6604FG*</td>
<td>Sine-wave PWM controller, RPM control</td>
<td></td>
</tr>
<tr>
<td><strong>Fans</strong></td>
<td><strong>Brushless Motor Drivers</strong></td>
<td>TB6588FG</td>
<td>Sensorless control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6551FG</td>
<td><strong>Image Output Engine Control Section</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6564FQ*</td>
<td>Single full bridge, emergency output, Direct PWM control, Reference voltage output</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6569FQ*</td>
<td>Single full bridge, emergency output, Direct PWM control, Constant-current PWM control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6561FG/G</td>
<td>Single full bridge, emergency output, Direct PWM control, Constant-current PWM control, Reference voltage output</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6561FG/G</td>
<td>Dual full bridge</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6572FG</td>
<td>Sine-wave PWM controllers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6603FTG*</td>
<td>Sine-wave PWM controllers, RPM control</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>TB6604FG*</td>
<td>Sine-wave PWM controller, RPM control</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>TB6615PG</td>
<td>Controller</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6650AFG/AFG*</td>
<td>Clock input, micro-stepping drive (W1-2-phase excitation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6621AFQ*</td>
<td>Clock input, micro-stepping drive (W1-2-phase excitation)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>TB6621AFG*</td>
<td>Pin, functionally- and package-compatible version of TB6621AF with low Ron</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6621AFG*</td>
<td>Pin, functionally- and package-compatible version of TB6621AF with low Ron</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6620FG</td>
<td>Phase inputs, 1-2-phase excitation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6621AFG*</td>
<td>Phase inputs, 1-2-phase excitation, BCD process, Four H-bridges Controls up to four brush DC motors or up to two stepping motors.</td>
<td>Multi-function printers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB6621AFG*</td>
<td>Phase inputs, 1-2-phase excitation, BCD process, Four H-bridges Controls up to four brush DC motors or up to two stepping motors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TLP300J/TLP560U</td>
<td></td>
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</tr>
</tbody>
</table>

*: New product
Toshiba offers a wide range of brush motor drivers to meet various supply voltage, output current and channel count requirements. They feature low power consumption due to the use of a BiCD process at the output stage that provides low on-resistance.

### Next-Generation Brush DC Motor Driver Series

<table>
<thead>
<tr>
<th>Ratings</th>
<th>15 V</th>
<th>25 V to 30 V</th>
<th>50 V</th>
<th>6 V to 15 V</th>
<th>40 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 4.0 A</td>
<td>TA8429 HQ HZIP12</td>
<td>TB6549 HQ HZIP25</td>
<td>TB6569 FG HSOP16</td>
<td>TB6641 FG HSOP16</td>
<td>TB6642 FG HSOP16</td>
</tr>
<tr>
<td>4.0 A to 3.0 A</td>
<td>TB6593 FNG SSOP20</td>
<td>TB6614 FNG SSOP16</td>
<td>TA7267 BP HSIP7</td>
<td>TA8428K BP HSIP7</td>
<td>TB6549 FG/P/G HSOP20/DIP16</td>
</tr>
<tr>
<td>3.0 A to 2.0 A</td>
<td>TA7291 P HSIP10</td>
<td>TA8428 FG HSOP20</td>
<td>TB6617 FNG SSOP16</td>
<td>TB6559 FG HSOP16</td>
<td>TB6552 FNG/F/LG HSOP16/SSOP16/QON24/QFN24</td>
</tr>
<tr>
<td>≤ 1.5 A</td>
<td>TA7291 FG/SG HSOP16 SIP9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Channel | 2 Channels | 4 Channels

### TB6568KQ/TB6569FG/TB6641FG/TB6642FG/TB6643KQ 50 V Single-Channel DC Motor Drivers

**Features**

- Low power consumption thanks to low-Ron outputs: 0.55 Ω (high-side + low-side)
- High output current
  - 3.0 A (TB6568KQ)
  - 4.0 A/4.5 A (TB6569FG/TB6641FG/TB6642FG/TB6643KQ)
- Wide supply voltage range: 10 to 45 V
- Support for direct PWM drive
- Support for constant-current PWM control (TB6569FG/TB6641FG)
- Various abnormal condition detection
  - ISD (overcurrent protection), TSD (thermal shutdown), UVLO (undervoltage lockout), VSD (overvoltage detection)
  - ISD/TSD latched/auto recovery selectable (TB6642FG)
  - Externally programmable ISD threshold (TB6569FG/TB6642FG)
- The on-chip high-accuracy voltage regulator eliminates the need for a logic power supply.
  - On-chip voltage regulator output pin (TB6641FG)
Features
- 2-channel DC motor drivers with a maximum current rating of 2.5 A
- Four selectable control modes (Forward, Reverse, Short Brake, Stop)
- Direct PWM and constant-current (current feedback) control
- Programmable digital blanking time
- Power sequence-free thanks to the on-chip high-accuracy voltage regulator
- Low power consumption thanks to low-Ron outputs: 1.0 Ω (high-side + low-side)
- Packaging options that meet various PCB board, application and assembly requirements

Features
- 4-channel DC motor drivers with a maximum current rating of 2.0 A (Small Mode) or 4.0 A (Large Mode)
- H-bridges with 6 selectable operating modes
  - Two high-power DC motors: Maximum current rating = 4.0 A
  - Four low-power DC motors: Maximum current rating = 2.0 A
- One high-power DC motor + one low-power stepping motor
- Two low-power DC motor + one low-power stepping motor
- Two low-power stepping motors: Maximum current rating = 1.5 A
- One high-power stepping motor: Maximum current rating = 1.8 A

Features
- Rated at up to 50 V and operates with a wide range of supply voltage from 4.5 V to 45 V.
- Saves board space due to the use of a small SSOP16 package (with 0.65-mm lead pitch).
- Output Ron: 1.4 Ω (high-side + low-side)
- High-accuracy current control with a high-speed PWM (fPWM max = 350 kHz)
- Capable of driving ceramic piezoelectric actuators.

Product Lineup

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Number of Circuits</th>
<th>Absolute Maximum Ratings</th>
<th>PWM Drive</th>
<th>Abnormality Detection</th>
<th>Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB62216FNG/FTG/FG</td>
<td>40 V/2.5 A 2-Channel DC Motor Drivers (with Phase Inputs)</td>
<td>HTSSOP48-P-300-0.50</td>
<td>Standard thermally enhanced package</td>
<td>QFN48-P-0707-0.50</td>
<td>HSOP28-P-450-0.80</td>
</tr>
<tr>
<td>TB62216FTAG/FG</td>
<td>40 V/2.0 A Configurable 4-Channel H-Bridges (40 V/1.5 A 2-Channel Stepping Motor Drivers)</td>
<td>SSOP16-P-225-0.65B</td>
<td>Latched, Latched</td>
<td>Latched, Latched</td>
<td>QFN48-P-0707-0.50/HTSSOP48-P-300-0.50</td>
</tr>
<tr>
<td>TB6617FNG</td>
<td>50 V/2.0 A 1-Channel DC Motor Driver (with Phase Inputs)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>


*: New product

Latched: Latched recovery, DC: DC motor driver, ST: Stepping motor driver
Toshiba offers an extensive product portfolio of stepping motor drivers with bipolar constant-current control fabricated using a BiCD process, which provides improved accuracy and high-current drive.

For each current rating, various packaging options are available to meet diverse pcb board and assembly requirements.

### Features

- Various shutdown circuits for safety precautions (TSD/ISD/POR*)
- Mixed Decay mode for reducing current distortions at high RPMs
- Micro-stepping (quarter-step) drive for vibration and acoustic noise reductions
- Fabricated using a low-Ron process (40 V 0.6 μm BiCD process) to achieve high accuracy and high-current capacity.

### Packaging Options

Toshiba offers packaging options that meet various pc board, application and assembly requirements.

<table>
<thead>
<tr>
<th>Current Rating</th>
<th>0.4 A</th>
<th>0.8 A</th>
<th>1.0 A</th>
<th>1.5 A</th>
<th>1.6 A</th>
<th>2.0 A</th>
<th>2.5 to 3.5 A</th>
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<tr>
<td>Through-Hole</td>
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<tr>
<td>DIP/SDIP</td>
<td>TB6674 FG Full step</td>
<td>TB6652 ANG 1/4 step</td>
<td>TB62210 FG 1/4 step</td>
<td>TB62211 FG 1/4 step</td>
<td>TB62212 FG 1/4 step</td>
<td>TB62213 FG 1/4 step</td>
<td></td>
</tr>
<tr>
<td>HZIP</td>
<td></td>
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<tr>
<td>QFN</td>
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</tr>
<tr>
<td>SSOP/HSOP</td>
<td>TB6674 FNG Full step</td>
<td>TB6608 FNG 1/8 step</td>
<td>TB62206 FG 1/2 step</td>
<td>TB62208 FG 1/2 step</td>
<td>TB62209 FG 1/2 step</td>
<td>TB62210 FG 1/2 step</td>
<td></td>
</tr>
<tr>
<td>HTSSOP</td>
<td>TB6674 FNG Full step</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Quarter-Step Stepping Motor Drivers

#### Flow-solderable package

The 0.8-mm lead pitch of the HSOP28 makes it ideal for reflow soldering onto paper phenol boards and the like.

#### Space-saving package

The QFN48 is a small leadless package measuring approx. 7.0 X 7.0 mm. It is ideal for a high-density assembly onto glass-epoxy PCBs.

#### Standard thermally enhanced package

The HTSSOP48 is ideal for board designs where thermal performance is a critical factor.

### TB62210FNG, TB62218AFG/AFTG/AFNG and TB62213AFG/AFTG/AFNG

#### 40 V Single-Channel Phase-In Stepping Motor Drivers

- Output current: 1.0 A (TB62210FNG)
- 2.0 A (TB62218AFG/AFTG/AFNG)
- 3.0 A (TB62213AFG/AFTG/AFNG)
- Interface: Phase inputs
- Fabricated using a low-Ron process (40 V 0.6 μm BiCD process) to achieve high accuracy and high-current capacity.
- Micro-stepping (quarter-step) drive for vibration and acoustic noise reductions
- Mixed Decay mode for reducing current distortions at high RPMs
- Various shutdown circuits for safety precautions (TSD/ISD/POR*)
- The on-chip voltage regulator eliminates the need for a logic power supply (VDD).
- The charge pump-less design reduces the number of external components required.

### TB62211FNG, TB62214AFG/AFTG/AFNG and TB62215AFG/AFTG/AFNG

#### 40 V Single-Channel Stepping Motor Drivers with a Clock Input

- Output current: 1.0 A (TB62211FNG)
- 2.0 A (TB62214AFG/AFTG/AFNG)
- 3.0 A (TB62215AFG/AFTG/AFNG)
- Interface: Clock input supported by the on-chip micro-step decoder
- Fabricated using a low-Ron process (40 V 0.6 μm BiCD process) to achieve high accuracy and high-current capacity.
- Micro-stepping (quarter-step) drive for vibration and acoustic noise reductions
- Mixed Decay mode for reducing current distortions at high RPMs
- Various shutdown circuits for safety precautions (TSD/ISD/POR*)
- The on-chip voltage regulator eliminates the need for a logic power supply (VDD).
- The charge pump-less design reduces the number of external components required.
Half-Step Stepping Motor Drivers

**TB62212FTAG/FNG 40 V/2.0 A Configurable 4-Channel H-Bridges (40 V/1.5 A 2-Channel Stepping Motor Drivers)**

The TB62212FTAG/FNG contain four channels of H-bridges, making it possible to drive up to two stepping motors or up to four brush DC motors simultaneously. They can also be configured as a dual brush DC motor driver with a maximum current rating of 4.0 A.

**Features**
- Supports full-step and half-step drives in Stepping mode.
- H-bridges with 6 selectable operating modes:
  1. Two high-power DC motors: Maximum current rating = 4.0 A
  2. Four low-power DC motors: Maximum current rating = 2.0 A
  3. One high-power DC motor + one low-power stepping motor
  4. Two low-power DC motor + one low-power stepping motor
  5. Two low-power stepping motors: Maximum current rating = 1.5 A
  6. One high-power stepping motor: Maximum current rating = 1.8 A
- Various shutdown circuits: Overcurrent protection, thermal shutdown, power-on reset
- Output R(on): 2.2 Ω (high side + low side)
- Supports full-step and half-step drives in Stepping mode.
- 4.0 A.
- a dual brush DC motor driver with a maximum current rating of
- 4.0 A.

**Product Lineup**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Interface</th>
<th>Absolute Maximum Ratings</th>
<th>Stepping Mode</th>
<th>Detection Circuits</th>
<th>Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB6674PG:FG:FG:FG:</td>
<td>Phase</td>
<td>24 V</td>
<td>Full step</td>
<td>Y</td>
<td>DIP16-P-300-2.54A/HSOP16-P-300-1.00/SSOP16-P-225-1.00</td>
</tr>
<tr>
<td>TB62210FNG</td>
<td>Phase</td>
<td>40 V</td>
<td>1/4 step</td>
<td>Latched</td>
<td>P-HTSSOP24-0508-0.5-001</td>
</tr>
<tr>
<td>TB6562ANG:FG:FG:</td>
<td>Phase</td>
<td>40 V</td>
<td>1/4 step</td>
<td>Auto</td>
<td>SDIP24-P-300-1.78/SSOP30-P-375-1.00</td>
</tr>
<tr>
<td>TB62212FTAG:FG:FG:</td>
<td>Phase</td>
<td>40 V</td>
<td>1/2 step</td>
<td>Latched</td>
<td>QFN48-P-0707-0.5/HTSSOP48-P-300-0.50</td>
</tr>
<tr>
<td>TB62206FG</td>
<td>Phase</td>
<td>40 V</td>
<td>1/2 step</td>
<td>Latched</td>
<td>HSOP20-P-450-1.00</td>
</tr>
<tr>
<td>TB62208FG:FTG:FG:</td>
<td>Phase</td>
<td>40 V</td>
<td>1/2 step</td>
<td>Latched</td>
<td>HSOP28-P-450-0.8QFN48-P-0707-0.5/HTSSOP48-P-300-0.50</td>
</tr>
<tr>
<td>TB62218AFG:AFTG:AFTG:</td>
<td>Phase</td>
<td>40 V</td>
<td>1/4 step</td>
<td>Latched</td>
<td>HSOP28-P-450-0.8QFN48-P-0707-0.5/HTSSOP48-P-300-0.50</td>
</tr>
<tr>
<td>TB62213AFG:AFTG:AFTG:</td>
<td>Phase</td>
<td>40 V</td>
<td>1/4 step</td>
<td>Latched</td>
<td>HSOP28-P-450-0.8QFN48-P-0707-0.5/HTSSOP48-P-300-0.50</td>
</tr>
<tr>
<td>TB6608FNG</td>
<td>Clock</td>
<td>15 V</td>
<td>1/8 step</td>
<td>Y</td>
<td>SSOP20-P-225-0.65A</td>
</tr>
<tr>
<td>TB62211FNG</td>
<td>Clock</td>
<td>40 V</td>
<td>1/4 step</td>
<td>Latched</td>
<td>P-HTSSOP24-0508-0.65-001</td>
</tr>
<tr>
<td>TB62209FG</td>
<td>Clock</td>
<td>40 V</td>
<td>1/6 step</td>
<td>Y</td>
<td>HSOP36-P-450-0.65</td>
</tr>
<tr>
<td>TB62214AFG:AFTG:AFTG:</td>
<td>Clock</td>
<td>40 V</td>
<td>1/4 step</td>
<td>Y</td>
<td>HSOP28-P-450-0.8QFN48-P-0707-0.5/HTSSOP48-P-300-0.50</td>
</tr>
<tr>
<td>TB62215AFG:AFTG:AFTG:</td>
<td>Clock</td>
<td>40 V</td>
<td>1/4 step</td>
<td>Y</td>
<td>HSOP28-P-450-0.8QFN48-P-0707-0.5/HTSSOP48-P-300-0.50</td>
</tr>
<tr>
<td>TB6560AHQ:AFG:AFTG:</td>
<td>Clock</td>
<td>40 V</td>
<td>1/6 step</td>
<td>–</td>
<td>HZIP25-P-1.27/HPF64-P-1010-0.5/HTSSOP48-P-0707-0.50</td>
</tr>
</tbody>
</table>


**Transistor Array Series**

Transistor arrays designed for stepping motor driving 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.

**Product Lineup**

<table>
<thead>
<tr>
<th>Part Number</th>
<th># of Circuits</th>
<th>Package</th>
<th>Absolute Maximum Ratings</th>
<th>Structure/Configuration</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD62604APG:BPG</td>
<td>4</td>
<td>DIP16-P-300-2.54A</td>
<td>50V/80V 1.5 A/ch</td>
<td>Active-high transistor array</td>
<td></td>
</tr>
<tr>
<td>TD62604APG:BF</td>
<td>4</td>
<td>HSOP16-P-300-1.00</td>
<td>50V/80V 1.5 A/ch</td>
<td>Active-low transistor array</td>
<td></td>
</tr>
<tr>
<td>TD62508APG:BPG</td>
<td>7</td>
<td>DIP16-P-300-2.54A</td>
<td>50 V/80 V 0.5 A/ch</td>
<td>Active-high transistor array</td>
<td></td>
</tr>
<tr>
<td>TD62508APG:BF</td>
<td>7</td>
<td>SOP16-P-225-1.27</td>
<td>50 V/80 V 0.5 A/ch</td>
<td>Active-high transistor array</td>
<td></td>
</tr>
<tr>
<td>TD62503APG:TD62004APG</td>
<td>8</td>
<td>DIP16-P-300-2.54A</td>
<td>50V/80V 0.5 A/ch</td>
<td>Active-high transistor array</td>
<td></td>
</tr>
</tbody>
</table>
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.

**Features**
- Sine-wave drive helps to reduce acoustic noise significantly, compared to square-wave (120-degree) drive.
- The lead angle and PWM control capabilities help to improve efficiency and reduce power consumption.
- The lead angle is programmable between 0° and 58° in 32 discrete steps, making it possible to control a motor efficiently through appropriate output driver selection.
- Dead-time insertion is incorporated to prevent cross conduction of high-side and low-side drivers.
- Overcurrent protection, undervoltage lockout and reverse rotation detection.
- Small package: SSOP30-P-300-0.65

**TC7600FNG 5 V/2 mA Sensorless Sine-Wave PWM Three-Phase Brushless DC Motor Controller**

**Features**
- Sine-wave drive can be used for sensorless control of three-phase brushless DC motors.
- Sine-wave drive helps to reduce acoustic noise and vibration significantly, compared to square-wave (120-degree) drive.
- Small package: SSOP30-P-300-0.65
**Features**

- Sine-wave drive helps to reduce acoustic noise and vibration significantly, compared to square-wave (120-degree) drive.
- Lead angle control helps to improve efficiency.
- The on-chip integration of output drivers reduces the number of external components required.
- Output $R_{ON}$: 0.7 $\Omega$ typ. (high side + low side)
- Small packages
- TB6585FG: HSOP36-P-450-0.65
- TB6585FTG: QFN48-P-0707-0.5

**TB6633FNG/AFNG 25 V/1.0 A Sensorless PWM Three-Phase Brushless DC Motor Drivers**

**Features**

- Combines sensorless drive with PWM drive, facilitating the use of smaller motors (without Hall sensors) and reducing power consumption.
- Three-phase, full-wave sensorless drive eliminates the need for position sensors, reducing wires between a motor and a motor driver.
- The on-chip integration of output drivers reduces the number of external components required.
- TB6633FNG/AFNG: 25 V/1.0 A
- The lap turn-on function provides a quiet motor drive.
- FG signal according to the rotation speed
  - TB6633FNG: 3 pulses per electrical degree
  - TB6633AFNG: 1 pulse per electrical degree
- Small package
  - SSOP24-P-300-0.65A

**Product Lineup**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Function</th>
<th>Supply Voltage</th>
<th>Output Current</th>
<th>Commutation</th>
<th>Hall Input</th>
<th>Packages</th>
</tr>
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<tbody>
<tr>
<td>TB6551FG</td>
<td>Controller</td>
<td>12 V</td>
<td>2 mA</td>
<td>Sine-wave</td>
<td>Hall IC</td>
<td>SSOP24-P-300-1.00</td>
</tr>
<tr>
<td>TB6565FG</td>
<td>Controller</td>
<td>12 V</td>
<td>2 mA</td>
<td>Sine-wave</td>
<td>Hall IC</td>
<td>SSOP30-P-375-1.00</td>
</tr>
<tr>
<td>TB6586F/AFG/BFG</td>
<td>Controller</td>
<td>18 V</td>
<td>35 mA</td>
<td>Square-wave (150°)</td>
<td>Hall IC/Hall element</td>
<td>SSOP24-P-300-1.00B</td>
</tr>
<tr>
<td>TB6585FG/FTG</td>
<td>Driver</td>
<td>45 V</td>
<td>1.8 A/1.0 A</td>
<td>Sine-wave</td>
<td>Hall IC/Hall element</td>
<td>HSP30-450-0.65/QFN48-P-0707-0.50</td>
</tr>
<tr>
<td>TB6584F/AFG</td>
<td>Controller</td>
<td>18 V</td>
<td>2 mA</td>
<td>Sine-wave</td>
<td>Hall IC/Hall element</td>
<td>SSOP24-P-300-0.65</td>
</tr>
<tr>
<td>TB6572AFG</td>
<td>Pre-Driver</td>
<td>30 V</td>
<td>20 mA</td>
<td>Sine-wave</td>
<td>Hall element</td>
<td>QFP38-P-1010-0.65</td>
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<tr>
<td>TB6603FTG</td>
<td>Pre-Driver</td>
<td>30 V</td>
<td>20 mA</td>
<td>Sine-wave</td>
<td>Hall element</td>
<td>QFP36-P-0606-0.65</td>
</tr>
<tr>
<td>TB6604FTG</td>
<td>Pre-Driver</td>
<td>30 V</td>
<td>20 mA</td>
<td>Sine-wave</td>
<td>Hall element</td>
<td>QFP46-P-0707-0.50</td>
</tr>
<tr>
<td>TC7600FNG</td>
<td>Controller</td>
<td>5.5 V</td>
<td>2 mA</td>
<td>Sine-wave</td>
<td>Sensorless</td>
<td>SSOP24-P-300-0.65</td>
</tr>
<tr>
<td>TB6575FNG</td>
<td>Controller</td>
<td>5.5 V</td>
<td>20 mA</td>
<td>Square-wave (142°)</td>
<td>Sensorless</td>
<td>SSOP24-P-300-0.65A</td>
</tr>
<tr>
<td>TB6588FG</td>
<td>Driver</td>
<td>50 V</td>
<td>2.5 A</td>
<td>Square-wave (150°)</td>
<td>Sensorless</td>
<td>HSP36-P-450-0.65</td>
</tr>
<tr>
<td>TB6633F/AFNG</td>
<td>Driver</td>
<td>25 V</td>
<td>1.0 A</td>
<td>Square-wave (150°)</td>
<td>Sensorless</td>
<td>SSOP24-P-300-0.65A</td>
</tr>
</tbody>
</table>

*: New product
Toshiba offers PMD microcontrollers that contain one or more programmable motor drivers (PMDs) 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.

* ARM and Cortex are trademarks or registered trademarks of ARM Limited in the EU and other countries.

**PMD Microcontroller Product Lineup**

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.

**Vector Engine (VE)**

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.
### TX03 Series: M370 Group [New Products]

#### TMPM372FWUG <Under development>/TMPM373FWDUG <Under development>/ TMPM374FWUG

PMD microcontrollers with a vector engine
High-efficiency motor control that reduces the CPU workload

- **ARM Cortex™ M3 Core**
  - Operating voltage: 4.5 V to 5.5 V (Single supply; on-chip voltage regulator)
  - Maximum operating frequency: 80 MHz (Ta = -40 to 85°C)
    - 32 MHz (Ta = -40 to 105°C)
  - On-chip memory: flash ROM: 128 KB, RAM: 6 KB
  - High-speed computation: Multiplier (1-7 cycles), divider (2-12 cycles)
  - On-chip debug logic: JTAG/SWD/SWV
  - Low-power: Clock gearing (Can be divided down to 1/2, 1/4, 1/8 and 1/16)
  - Operation modes (NORMAL/IDLE/STOP)

- **On-chip peripheral logic**
  - Next-generation Programmable Motor Driver (PMD): 1 channel
  - Vector engine (VE): 1 unit
  - Encoder inputs: 1 channel
  - 12-bit A/D converter: conversion time: 2 μs
  - TMPM372: 11 channels
  - TMPM373: 7 channels
  - TMPM374: 6 channels
  - 16-bit timer/counter: 8 channels (Free-run, output compare, PPG, input capture)
  - TMPM372: 7 inputs and 7 outputs
  - TMPM373: 5 inputs and 3 outputs
  - TMPM374: 4 inputs and 2 outputs
  - Serial interface: SIO/UART: 4 channels
  - M373/M374: SIO/UART: 3 channels
  - Watchdog timer
  - Power-on reset (POR)
  - Voltage detection circuit (VLTD)
  - Oscillation frequency detection (OFD)
  - On-chip high-speed oscillator

#### Product Lineup

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Maximum Operating Frequency (MHz)</th>
<th>ROM (KB)</th>
<th>Motor Controller (ch)</th>
<th>12-Bit A/D Converter (Conversion Time)</th>
<th>Encoder Input Logic (ch)</th>
<th>I/O Ports (ch)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMPM370FYDFG</td>
<td>80</td>
<td>Flash 256</td>
<td>2</td>
<td>22 (2 μs)</td>
<td>2</td>
<td>76</td>
<td>OFP100-P-1420-0.65Q</td>
</tr>
<tr>
<td>TMPM370FFFG</td>
<td>80</td>
<td>Flash 256</td>
<td>2</td>
<td>22 (2 μs)</td>
<td>2</td>
<td>76</td>
<td>LQFP100-P-1414-0.50H</td>
</tr>
<tr>
<td>TMPM372FWUG **</td>
<td>80</td>
<td>Flash 128</td>
<td>1</td>
<td>11 (2 μs)</td>
<td>1</td>
<td>53</td>
<td>LQFP64-P-1010-0.50E</td>
</tr>
<tr>
<td>TMPM373FWDUG **</td>
<td>80</td>
<td>Flash 128</td>
<td>1</td>
<td>7 (2 μs)</td>
<td>1</td>
<td>37</td>
<td>LQFP44-P-0707-0.50C</td>
</tr>
<tr>
<td>TMPM374FWUG</td>
<td>80</td>
<td>Flash 128</td>
<td>1</td>
<td>6 (2 μs)</td>
<td>1</td>
<td>33</td>
<td>LQFP44-P-1010-0.80A</td>
</tr>
<tr>
<td>TMPM376FDDFG **</td>
<td>80</td>
<td>Flash 512</td>
<td>2</td>
<td>22 (2 μs)</td>
<td>2</td>
<td>82</td>
<td>OFP100-P-1420-0.65Q</td>
</tr>
<tr>
<td>TMPM376FDGF **</td>
<td>80</td>
<td>Flash 512</td>
<td>2</td>
<td>22 (2 μs)</td>
<td>2</td>
<td>82</td>
<td>LQFP100-P-1414-0.50H</td>
</tr>
<tr>
<td>TMPM377FDFG **</td>
<td>80</td>
<td>Flash 256</td>
<td>2</td>
<td>11 (2 μs)</td>
<td>2</td>
<td>63</td>
<td>LQFP80-P-1414-0.65</td>
</tr>
<tr>
<td>TMPM377FFYG **</td>
<td>80</td>
<td>Flash 256</td>
<td>2</td>
<td>11 (2 μs)</td>
<td>2</td>
<td>63</td>
<td>LQFP80-P-1212-0.50F</td>
</tr>
</tbody>
</table>

:: Under development

### TLCS-870/X and TLCS-870/C1 Series

#### Product Lineup

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Maximum Operating Frequency (MHz)</th>
<th>ROM (KB)</th>
<th>Motor Controller (ch)</th>
<th>10-Bit A/D Converter (Conversion Time)</th>
<th>I/O Ports (ch)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMP88CH40MG</td>
<td>20</td>
<td>16</td>
<td>1</td>
<td>4 (15.6 μs)</td>
<td>19</td>
<td>SOF28-P-450-1.27B</td>
</tr>
<tr>
<td>TMP88CH40NG</td>
<td>20</td>
<td>16</td>
<td>1</td>
<td>4 (15.6 μs)</td>
<td>19</td>
<td>SDFP28-P-400-1.78</td>
</tr>
<tr>
<td>TMP88CH41NG</td>
<td>20</td>
<td>16</td>
<td>1</td>
<td>8 (15.6 μs)</td>
<td>33</td>
<td>SDFP42-P-600-1.78</td>
</tr>
<tr>
<td>TMP88CH41UG</td>
<td>20</td>
<td>16</td>
<td>1</td>
<td>8 (15.6 μs)</td>
<td>33</td>
<td>LQFP44-P-1010-0.80B</td>
</tr>
<tr>
<td>TMP88FH41UG</td>
<td>20</td>
<td>Flash 16</td>
<td>1</td>
<td>8 (15.6 μs)</td>
<td>33</td>
<td>LQFP44-P-1010-0.80B</td>
</tr>
<tr>
<td>TMP88CS42FG</td>
<td>20</td>
<td>64</td>
<td>2</td>
<td>16 (15.6 μs)</td>
<td>55</td>
<td>LQFP44-P-1420-1.00A</td>
</tr>
<tr>
<td>TMP88CS42UG</td>
<td>20</td>
<td>64</td>
<td>2</td>
<td>16 (15.6 μs)</td>
<td>55</td>
<td>LQFP44-P-1420-1.00A</td>
</tr>
<tr>
<td>TMP88CS43FG</td>
<td>20</td>
<td>64</td>
<td>2</td>
<td>16 (15.6 μs)</td>
<td>71</td>
<td>OF880-P-1420-0.80B</td>
</tr>
<tr>
<td>TMP88FW46AFG</td>
<td>20</td>
<td>Flash 120</td>
<td>2</td>
<td>16 (15.6 μs)</td>
<td>71</td>
<td>OF880-P-1420-0.80B</td>
</tr>
<tr>
<td>TMP88F846UG</td>
<td>20</td>
<td>Flash 8</td>
<td>1</td>
<td>8 (15.6 μs)</td>
<td>33</td>
<td>OQFP44-P-1010-0.80B</td>
</tr>
<tr>
<td>TMP89FM82DUG</td>
<td>8</td>
<td>Flash 32</td>
<td>1</td>
<td>8 (9.75 μs)</td>
<td>39</td>
<td>LQFP44-P-0707-0.50D</td>
</tr>
</tbody>
</table>
Traditionally, a variable-voltage switching power supply was required to drive brushless DC motors. Toshiba’s single-chip inverters, fabricated using a high-voltage monolithic process, eliminate the need for a buck converter, making it possible for the brushless DC motors to be directly powered from commercial mains. Single-chip inverters are available in the new DIP26 package, which exhibits improved physical and thermal characteristics compared to the conventional HZIP23 package.

Features
- High withstand voltage due to the use of the SOI process and trench isolation structure
- Available with ratings from 250 V/1 A to 500 V/3 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

TPD4131K/TPD4132K Block Diagram
• Variable-speed brushless DC motor drive via the Hall amplifier or Hall IC inputs

TPD4123K/TPD4134K/TFD4135K 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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Ratings</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPD4131K</td>
<td>250 V/1 A</td>
<td>Hall-Effect Sensor Input</td>
</tr>
<tr>
<td>TPD4132K</td>
<td>500 V/1 A</td>
<td>Y</td>
</tr>
<tr>
<td>TPD4133K</td>
<td>500 V/1 A</td>
<td>–</td>
</tr>
<tr>
<td>TPD4134K</td>
<td>500 V/2 A</td>
<td>–</td>
</tr>
<tr>
<td>TPD4135K</td>
<td>500 V/3 A</td>
<td>–</td>
</tr>
<tr>
<td>TPD4135K</td>
<td>500 V/3 A</td>
<td>–</td>
</tr>
</tbody>
</table>
Toshiba is expanding its portfolio of photocouplers so that you can find solutions that best suit your needs. The new additions to our product portfolio include two photocouplers suitable for the gate drive of a power device, the TLP155E in the SO6 small, thin package and the TLP352 featuring high-speed operation and an extended operating temperature range, as well as two photocouplers ideal for high-speed communications, the TLP2309 and TLP2362 with mixed 3.3/5-V supply voltages.

### IGBT/Power MOSFET Gate Driver Photocouplers

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>TLP155E</th>
<th>TLP705A</th>
<th>TLP352</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak output current (max)</td>
<td>0.6 A</td>
<td>0.6 A</td>
<td>2.5 A</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>10 to 30 V</td>
<td>10 to 30 V</td>
<td>15 to 30 V</td>
</tr>
<tr>
<td>Propagation delay time (max)</td>
<td>200 ns</td>
<td>200 ns</td>
<td>200 ns</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>–40 to 100°C</td>
<td>–40 to 100°C</td>
<td>–40 to 125°C</td>
</tr>
<tr>
<td>Supply current (max)</td>
<td>3 mA</td>
<td>3 mA</td>
<td>3 mA</td>
</tr>
<tr>
<td>Threshold input current (max)</td>
<td>±15 kV/μs</td>
<td>±15 kV/μs</td>
<td>±15 kV/μs</td>
</tr>
<tr>
<td>Common-mode transient immunity (min)</td>
<td>±15 kV/μs</td>
<td>±15 kV/μs</td>
<td>±15 kV/μs</td>
</tr>
<tr>
<td>Isolation voltage (min)</td>
<td>3750 Vrms</td>
<td>5000 Vrms</td>
<td>3750 Vrms</td>
</tr>
<tr>
<td>Package</td>
<td>SO6</td>
<td>SDIP6</td>
<td>DIP8</td>
</tr>
</tbody>
</table>

### Photocouplers for High-Speed Communications

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>TLP2309</th>
<th>TLP2362</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data rate (typ.)</td>
<td>1 Mbps</td>
<td>10 Mbps</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>2.7 to 20 V</td>
<td>2.7 to 5.5 V</td>
</tr>
<tr>
<td>Propagation delay time (max)</td>
<td>0.8 μs</td>
<td>60 ns</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>–40 to 110°C</td>
<td>–40 to 125°C</td>
</tr>
<tr>
<td>Current transfer ratio (min)</td>
<td>15%</td>
<td>–</td>
</tr>
<tr>
<td>Threshold input current (max)</td>
<td>–</td>
<td>5 mA</td>
</tr>
<tr>
<td>Common-mode transient immunity (min)</td>
<td>±15 kV/μs</td>
<td>±15 kV/μs</td>
</tr>
<tr>
<td>Isolation voltage (min)</td>
<td>3750 Vrms</td>
<td>3750 Vrms</td>
</tr>
<tr>
<td>Package</td>
<td>SO6</td>
<td>SO6</td>
</tr>
</tbody>
</table>
OVERSEAS SUBSIDIARIES AND AFFILIATES

(As of April 1, 2011)

Motor Solutions Guide

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