Automotive Engine Control

Solution Proposal by Toshiba
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.
Block Diagram
Direct injection engine control  Output drive circuit (1)

Fuel injection system

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Battery (12V)

Control unit.

Injector

Device selection points
- It is necessary to select the product with the optimum current rating for each application.
- It is necessary to select a small surface mount package suitable for miniaturization of the ECU.
- Products with higher breakdown-voltage must be selected according to the power supply voltages.

Proposals from Toshiba
- Low power consumption of the system is realized by low on-resistance
  U-MOS series 40V N-ch power MOSFET
  U-MOS series 100V N-ch power MOSFET

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page
Device selection points
- It is necessary to select a device with a protection function against surge voltage generated from inductance of inductive load.
- It is necessary to select a small surface mount package suitable for miniaturization of the ECU.

Proposals from Toshiba
- Built-in active clamp circuit and pull-down resistor for relay drive
  U-MOSIV series active clamp MOSFET
- Driver with protection function
  Low-side switch / High-side switch (~1A)
- Various product lineups and small packages
  General-purpose small-signal MOSFET
  General-purpose small-signal bipolar transistor
  General-purpose small-signal bias resistor built-in transistor (BRT)
  One-gate logic (L-MOS)
- Both device protection and signal quality is realized
  TVS diode (for CAN communication)

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page.
Device selection points
- It is necessary to select the product with the optimum current rating for each application.
- It is necessary to select a small surface mount package suitable for miniaturization of the ECU.

Proposals from Toshiba
- **Driver with protection function**
  - Low-side switch / High-side switch (~1A)
  - Low-side switch / High-side switch (1 ~ 5A)

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page
Device selection points
- With the use of small packages, it is necessary to design heat dissipation in consideration of reliability.

Proposals from Toshiba
- **H-Bridge Driver using PWM**
  Motor controller (for brush motor)

Motor Valve for engine

- Battery (12V)
- Power Supply
- MCU
- MCD
- Motor

The number of loading = 1~3 ch

For an electronic throttle
For a swirl control
For an exhaust shutter valve

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page
SW for power supply ON/OFF control and reverse connection protection (1)

Power supply ON/OFF control and reverse connection protecting circuit (P-ch method)

Device selection points
- It is necessary to select the product with the optimum current rating for each application.
- It is necessary to select a gate driver according to the performance of the switching device to be driven.
- It is necessary to select a small surface mount package suitable for miniaturization of the ECU.

Proposals from Toshiba
- Low power consumption of the system is realized by low on-resistance
  U-MOS series -40V / -60V P-ch power MOSFET
- Various product lineups and small packages
  General-purpose small-signal MOSFET
  General-purpose small-signal bipolar transistor
  General-purpose small-signal bias resistor built-in transistor (BRT)
  One-gate logic (L-MOS)
- Both device protection and signal quality is realized
  TVS diode (for CAN communication)

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page.
Power supply ON/OFF control and reverse connection protecting circuit (N-ch method)

Device selection points
- It is necessary to select the product with the optimum current rating for each application.
- It is necessary to select a gate driver according to the performance of the switching device to be driven.
- It is necessary to select a small surface mount package suitable for miniaturization of the ECU.

Proposals from Toshiba
- Low power consumption of the system is realized by low on-resistance U-MOS series 40V N-ch power MOSFET
- Gate driver with protection diagnostic function
  Gate driver (for switch)
- Various product lineups and small packages
  General-purpose small-signal MOSFET
  General-purpose small-signal bipolar transistor
  General-purpose small-signal bias resistor built-in transistor (BRT)
  One-gate logic (L-MOS)
- Both device protection and signal quality is realized
  TVS diode (for CAN communication)

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page
Recommended Devices
Device solutions to address customer needs

As described above, in the design of Engine Control, “Improvement of safety”, “Reduction of power consumption” and “Miniaturization” are important factors. Toshiba’s proposals are based on these three solution perspectives.
### Device solutions to address customer needs

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Protection and diagnosis</th>
<th>High efficiency Low loss</th>
<th>Small size package</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>U-MOS series 40V N-ch power MOSFET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>U-MOS series 100V N-ch power MOSFET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>U-MOSIV series active clamp MOSFET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Low-side switch / High-side switch (~1A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Low-side switch / High-side switch (1 ~ 5A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>U-MOS series -40V / -60V P-ch power MOSFET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Gate driver (for switch)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>General-purpose small-signal MOSFET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>General-purpose small-signal bipolar transistor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Small-signal bias resistor built-in transistor (BRT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>One-gate logic (LMOS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>TVS diode (for CAN communication)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Motor controller (for brush motor)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The advanced U-MOS IX-H processes enables low on-resistance and low noise, thereby reducing power consumption.

1. **Low loss (reduced chip resistance)**
   - Using low chip resistance technology to contribute to reduced power consumption systems.
   - Chip resistance of 61% reduction per unit area (compared to UMOSIV)

2. **Compact, low-loss package**
   - By adopting a Cu connector structure and a double-sided heat dissipation structure.
   - Development of low-loss, high-heat-dissipation packages

3. **Low noise (low EMI)**
   - Optimized chip process, reduce surge voltage and ringing time.

### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>Drain current</th>
<th>On-resistance (Max) @VGS=10V</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>XPN3R804NC</td>
<td>40A</td>
<td>3.8mΩ</td>
<td>TSON Advance(WF)</td>
</tr>
<tr>
<td>TK1R4S04PB</td>
<td>120A</td>
<td>1.35mΩ</td>
<td>DPAK+</td>
</tr>
<tr>
<td>TPHR7904PB</td>
<td>150A</td>
<td>0.79mΩ</td>
<td>SOP Advance(WF)</td>
</tr>
<tr>
<td>TPWR7904PB</td>
<td>150A</td>
<td>0.79mΩ</td>
<td>DSOP Advance(WF)</td>
</tr>
<tr>
<td>TKR74F04PB</td>
<td>250A</td>
<td>0.74mΩ</td>
<td>TO-220SM(W)</td>
</tr>
<tr>
<td>TK1R5R04PB</td>
<td>160A</td>
<td>1.5mΩ</td>
<td>D2PAK+</td>
</tr>
</tbody>
</table>
Low on-resistance contributes to reduced system power consumption.

1 Low loss (reduced chip resistance)

Using low chip resistance technology to contribute to reduced power consumption systems

2 Small, high-heat-dissipation package

Development of low-loss, high-heat-dissipation packages by adopting a Cu connector structure
Ensuring mountability by using the Wettable Flank (WF) structure

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>Drain current</th>
<th>On-resistance (Max) @Vgs=10V</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TK60S10N1L</td>
<td>60A</td>
<td>6.31mΩ</td>
<td>DPAK+</td>
</tr>
<tr>
<td>XPH4R10ANB</td>
<td>70A</td>
<td>4.1mΩ</td>
<td>SOP Advance(WF)</td>
</tr>
<tr>
<td>XPW4R10ANB</td>
<td>70A</td>
<td>4.1mΩ</td>
<td>DSOP Advance(WF)</td>
</tr>
<tr>
<td>TK160F10N1L</td>
<td>160A</td>
<td>2.4mΩ</td>
<td>TO-220SM(W)</td>
</tr>
<tr>
<td>TK60R10N1L</td>
<td>60A</td>
<td>6.31mΩ</td>
<td>D2PAK+</td>
</tr>
</tbody>
</table>

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These devices have a built-in active clamp circuit to reduce the number of components and to save mounting space.

1. **Built-in active clamp circuit**
   An active clamp circuit MOSFET with a zener between the drain-gate terminals prevents damage due to voltage surges during inductive loads driving.

2. **Built-in pull-down resistor**
   A 47kΩ pull-down resistor is built in between the gate-source terminals, which reduces required components and mounting space. (SSM3K347R)

3. **Low voltage drive**
   The gate-source voltage can be driven at a low voltage of 4.0 V

### Internal circuit

#### Pin Assignment
1. Gate
2. Source
3. Drained

#### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>SSM3K347R</th>
<th>SSM3K337R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SOT-23F</td>
<td>SOT-23F</td>
</tr>
<tr>
<td>V(DS,ON) [V]</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>I(D) [A]</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>R(ON) @VGS=4.0V [mΩ]</td>
<td>Typ. 350</td>
<td>161</td>
</tr>
<tr>
<td></td>
<td>Max 480</td>
<td>200</td>
</tr>
<tr>
<td>MOS Type</td>
<td>N-channel</td>
<td>N-channel</td>
</tr>
</tbody>
</table>

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*Return to Block Diagram TOP*
Protection and diagnostic output functions are built-in and can be directly controlled at the logic level, contributing to improved reliability and miniaturization of the equipment.

1. Built-in protection and diagnostic output function

Overcurrent and overheat protection in the event of a load error (short circuit, etc.) and feedback (diagnostic output) to the microcomputer are built-in. This contributes to the reliability of the equipment.

Example of Low-side switch application (Block diagram of TPD1054F)

Suitable for applications with small current load below 1A, such as mechanical relay

2. Logic level drive

Direct control is possible using a microcomputer and CMOS logic chip.

3. Small package

Product line-up includes small surface mount package PS8 and dual-output type. This contributes to equipment miniaturization.

Line up

<table>
<thead>
<tr>
<th>Function</th>
<th>Low-side switch</th>
<th>High-side switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of output</td>
<td>1 output</td>
<td>2 outputs</td>
</tr>
<tr>
<td>Part number</td>
<td>TPD1044F</td>
<td>TPD1054F</td>
</tr>
<tr>
<td>Package</td>
<td>PS8 (2.8 x 2.9 mm)</td>
<td>PS8 (2.8 x 2.9 mm)</td>
</tr>
<tr>
<td>Features</td>
<td>Overcurrent/overheat protection, Active clamp, on-resistance: 0.6 Ω</td>
<td>Overcurrent/overheat protection, Active clamp, Diagnostic output function, on-resistance: 0.8 Ω</td>
</tr>
</tbody>
</table>
Protection and diagnostic output functions are built-in and can be directly controlled at the logic level, contributing to improved reliability and miniaturization of the equipment.

**1 Built-in protection and diagnostic output function**

Overcurrent and overheat protection in the event of a load error (short circuit, etc.) and feedback (diagnostic output) to the microcomputer are built-in. This contributes to the reliability of the equipment.

Example of Low-side switch application (Block diagram of TPD1058A)

Suitable for valve timing and solenoid drive of transmission.

**2 Logic level drive**

Direct control is possible using a microcomputer and CMOS logic chip.

**3 Small package**

Product lineup includes small and high heat dissipation package WSON10 and dual-output type. This contributes to equipment miniaturization.

---

**Line up**

<table>
<thead>
<tr>
<th>Function</th>
<th>Low-side switch</th>
<th>High-side switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of output</td>
<td>1 output</td>
<td>2 outputs</td>
</tr>
<tr>
<td>Part number</td>
<td>TPD1058FA</td>
<td>TPD1046F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TPD1055FA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TPD1060F</td>
</tr>
<tr>
<td>Package</td>
<td>Back surface</td>
<td>Back surface</td>
</tr>
<tr>
<td></td>
<td>WSON10 (3 x 3 mm)</td>
<td>WSON10 (3 x 3 mm)</td>
</tr>
<tr>
<td></td>
<td>SOP8 (3 x 6 mm)</td>
<td>SOP8 (3 x 6 mm)</td>
</tr>
<tr>
<td>Feature</td>
<td>Overcurrent/overheat protection</td>
<td>Overcurrent/overheat protection</td>
</tr>
<tr>
<td></td>
<td>Active clamp</td>
<td>Active clamp</td>
</tr>
<tr>
<td></td>
<td>Diagnostic output function</td>
<td>Diagnostic output function</td>
</tr>
<tr>
<td></td>
<td>on-resistance: 0.1 Ω</td>
<td>on-resistance: 0.2 Ω</td>
</tr>
<tr>
<td></td>
<td>Overcurrent/overheat protection</td>
<td>Overcurrent/overheat protection</td>
</tr>
<tr>
<td></td>
<td>Active clamp</td>
<td>Diagnostic output function</td>
</tr>
<tr>
<td></td>
<td>on-resistance: 0.12 Ω</td>
<td>on-resistance: 0.12 Ω</td>
</tr>
</tbody>
</table>

Return to Block Diagram TOP
Value provided

Low on-resistance contributes to reduced system power consumption.

1. Low-loss (reduced chip resistance), logic-level response

Using low chip resistance technology to contribute to reduced power consumption systems
Lineup of Logic-level-drive types

Low Loss: RonA Reduction Trend

Large current, small size, high heat dissipation package

2. Small surface mount package developed

Development of low-loss, high-heat-dissipation packages by adopting a Cu connector structure
Ensuring mountability by using the Wettable Flank (WF) structure

<table>
<thead>
<tr>
<th>Part number</th>
<th>Drain-source Voltage</th>
<th>Drain current</th>
<th>On-resistance (Max) @VGS=10V</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJ90S04M3L</td>
<td>-40V</td>
<td>-90A</td>
<td>4.3mΩ</td>
<td>DPAK+</td>
</tr>
<tr>
<td>TJ60S06M3L</td>
<td>-60V</td>
<td>-60A</td>
<td>11.2mΩ</td>
<td>DPAK+</td>
</tr>
<tr>
<td>XPH3R114MC</td>
<td>-40V</td>
<td>-100A</td>
<td>3.1mΩ</td>
<td>SOP Advance(WF)</td>
</tr>
<tr>
<td>TJ200F04M3L</td>
<td>-40V</td>
<td>-200A</td>
<td>1.8mΩ</td>
<td>TO-220SM(W)</td>
</tr>
<tr>
<td>TJ150F06M3L</td>
<td>-60V</td>
<td>-150A</td>
<td>5.6mΩ</td>
<td>TO-220SM(W)</td>
</tr>
</tbody>
</table>

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A charge pump for the FET gate drive is built-in, allowing for easy semiconductor relay configuration.

1. **Built-in charge pump**
   No external add-ons required for driving the N-channel on the high side, making it easy to configure a semiconductor relay.

2. **Logic level drive**
   Direct control is possible from microcomputer and CMOS logic.

3. **Small package**
   The small surface mount PS8 contributes to the miniaturization of equipment.

---

**Line up**

<table>
<thead>
<tr>
<th>Part number</th>
<th>TPD7104AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>High-side gate driver</td>
</tr>
<tr>
<td>Number of output</td>
<td>1 output</td>
</tr>
</tbody>
</table>
| Features       | • Operating power supply voltage range: 5 to 18 V  
                 • Built-in charge pump  
                 • Built-in power supply reverse connection protection function  
                 (Supported for power supply reverse connection protection FET applications) |

**Package**

PS8 (2.8 x 2.9 mm)
### General-purpose small-signal MOSFET

SSM3K7002KF / SSM3J168F / SSM3J66MFV

#### Value provided

Choose from a wide array of small packages which contribute to the miniaturization and reduction of power consumption of equipment.

1. **Small package**

Starting with the SOT-723 (VESM 1.2mm² package), a lineup of various small packages is available, contributing to space savings during mounting.

2. **Low voltage drive**

The gate-source voltage can be driven at a low voltage of 1.2 V(SSM3J66MFV).

3. **AEC-Q101 qualified**

AEC-Q101 qualified and can be used for a wide range of automotive applications.

### Small signal package lineup

<table>
<thead>
<tr>
<th>Package</th>
<th>S-Mini (SOT-346)</th>
<th>S-Mini (SOT-346)</th>
<th>VESM (SOT-723)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V(DS(on))</td>
<td>60 (-60)</td>
<td>-20</td>
<td></td>
</tr>
<tr>
<td>I_D (A)</td>
<td>0.4 (-0.4)</td>
<td>-0.8</td>
<td></td>
</tr>
<tr>
<td>R_D(on) @V_GS=4.5 V (Ω)</td>
<td>Typ. 1.2</td>
<td>1.4</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Max. 1.75</td>
<td>1.9</td>
<td>0.39</td>
</tr>
<tr>
<td>Drive voltage (V)</td>
<td>4.5</td>
<td>-4.0</td>
<td>-1.2</td>
</tr>
<tr>
<td>MOS Type</td>
<td>N-channel</td>
<td>P-channel</td>
<td>P-channel</td>
</tr>
</tbody>
</table>

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Extensive product lineup to meet all your needs.

1. Extensive lineup of packages

Various package lineups, such as 1in1, 2in1 are provided and suitable product for circuit board design can be selected.

2. Various product lineup

Various product lineups, such as general-purpose, low-noise, low $V_{CE(sat)}$ and high-current types, are provided. Products can be selected depending on the application.

3. AEC-Q101 qualified

AEC-Q101 qualified and can be used for a wide range of automotive applications.
**1 Built-in bias resistor type (BRT)**

The BRT reduces the number of parts contributing to miniaturization and shorter production times.

**2 Extensive lineup of package and pin assignment**

Various package lineups, such as 1in1, 2in1 are provided and suitable product for circuit board design can be selected.

**3 AEC-Q101 qualified**

AEC-Q101 qualified and can be used for a wide range of automotive applications.

---

**Value provided**

**Extensive product lineup to meet all your needs.**

---

**Line up**

<table>
<thead>
<tr>
<th>Package</th>
<th>Part number</th>
<th>NPN (BRT)</th>
<th>PNP (BRT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSM (SOT-416)</td>
<td>RN1114</td>
<td>RN2114</td>
<td></td>
</tr>
<tr>
<td>S-Mini (SOT-346)</td>
<td>RN1414</td>
<td>RN2414</td>
<td></td>
</tr>
<tr>
<td>$V_{CEO}$ (Max)</td>
<td>50</td>
<td>-50</td>
<td></td>
</tr>
<tr>
<td>$I_C$ [mA]</td>
<td>100</td>
<td>-100</td>
<td></td>
</tr>
</tbody>
</table>

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Value provided

One-gate logic (L-MOS)
TC7SH / TC7WH / TC7SZ / TC7WZ series

Extensive product lineup to meet all your needs.

1 Small package
A standard multi gate CMOS is separated into individual or dual gates and embedded in a small package. This can be suited for simpler designs and contributes to miniaturization.

2 Extensive lineup
The VHS/SHS series, which is widely used in Automotive, offers a wide range of functions, including a total of 230 products.

3 AEC-Q100 qualified (reliability levels)
AEC-Q100 qualified and can be used for a wide range of automotive applications.

Protection and diagnosis
High efficiency
Low loss
Small size package

- Protection and diagnosis
- High efficiency
- Low loss
- Small size package

- Protection
- Diagnosis
- High
- Efficiency
- Low
- Loss
- Small
- Size
- Package

- Protection
- Diagnosis
- High
- Efficiency
- Low
- Loss
- Small
- Size
- Package

- Protection
- Diagnosis
- High
- Efficiency
- Low
- Loss
- Small
- Size
- Package

- Protection
- Diagnosis
- High
- Efficiency
- Low
- Loss
- Small
- Size
- Package

- Protection
- Diagnosis
- High
- Efficiency
- Low
- Loss
- Small
- Size
- Package

Line up

<table>
<thead>
<tr>
<th>Package</th>
<th>VHS series</th>
<th>SHS series</th>
</tr>
</thead>
<tbody>
<tr>
<td>USV (SOT-353)</td>
<td>TC7SH series</td>
<td>TC7SZ series</td>
</tr>
<tr>
<td>US8 (SOT-765)</td>
<td>TC7WH Series</td>
<td>TC7WZ series</td>
</tr>
<tr>
<td>Vcc [V]</td>
<td>2.0 ~ 5.5</td>
<td>1.65/1.8 ~ 5.5</td>
</tr>
<tr>
<td>Io[mA]</td>
<td>8</td>
<td>24</td>
</tr>
</tbody>
</table>

* Compliant products with AEC-Q100’s reliability test only
TVS diode (for CAN communication)
DF3D18FU / DF3D29FU / DF3D36FU

Value provided

TVS diode absorbs static electricity (ESD) from external terminals, prevents circuit malfunction and protects devices.

1. Improve ESD absorbability

Improved absorption of ESD through our proprietary Zener process. (Both low operating resistance $R_{DYN}$ and low capacitance $C_t$)

2. Ensuring high signal integrity

Supports in-vehicle LAN communication such as CAN, CAN-FD, FlexRay. Lower capacitance ensures higher signal integrity.

3. High ESD immunity

Compliant products with ISO10605 Standard > ±20 kV
IEC61000-4-2 Standard > ±20 kV (L4)

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>DF3D18FU</th>
<th>DF3D29FU</th>
<th>DF3D36FU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>USM (SOT-323)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{ESD}$ [kV] @ISO10605</td>
<td>±30</td>
<td>±30</td>
<td>±20</td>
</tr>
<tr>
<td>$V_{RMA}$ (Max) [V]</td>
<td>12</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>$C_t$ (Typ./Max) [pF]</td>
<td>9 / 10</td>
<td>6.5 / 8</td>
<td></td>
</tr>
<tr>
<td>$R_{DYN}$ (Typ.) [Ω]</td>
<td>0.8</td>
<td>1.1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

(NOTE): This product is an ESD protection diode and cannot be used for purposes other than ESD protection (including but not limited to constant voltage diode applications).

*1:TOSHIBA Electronic Device & Storage Corporation
*2:Measurements of the commercial product

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Motor controller (for brush motor) TB9051FTG

**Value provided**

The motor drivers for DC brush motor packaged in small packages optimized for controlling valves such as an engine throttle valve.

1. **1ch H-Bridge Driver using PWM**
   - Low Ron Pch + Nch DMOS configured as H-Bridge and PWM operation for efficient drive

2. **Various of abnormal status detection features**
   - Integrated overcurrent detection, over-temperature detection, VCC overvoltage / undervoltage detection and shoot-through current protection

3. **Small package**
   - PQFN28(6mmx6mm) allows an ECU to downsize.

---

**Part number**
- TB9051FTG

**Line up**

<table>
<thead>
<tr>
<th>Part number</th>
<th>Package</th>
<th>Operating range [V]</th>
<th>Over-current</th>
<th>Over-temperature detection</th>
<th>DIAG Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PQFN28</td>
<td>4.5~28</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

### Return to Block Diagram TOP
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