Automotive Power Sliding Door

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.
Automotive Power Sliding Door   Overall block diagram (example)

- Meter Computer
- Electronic Key
- Indoor Tuner
- Verification ECU
- Shift Position Sensor
- Slide Door Unlock Detection Switch
- Foot Brake Detection Switch
- Parking Brake Detection Switch
- Power Switch
- Power Slide Door Switch
- Power Slide Door ECU
- Slide Door Motor
- Closer Motor
- Lock/Release Motor
- Fuel Lid Closed Detection Switch
- Steering Wheel Switch
- Power Supply
- Pinch Detection Signal Touch Sensor
- Main Switch

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Proposals from Toshiba
- Low power consumption of the system is realized by low on-resistance U-MOS series 40V N-ch power MOSFET
- H-bridge drive circuit is realized
  Motor controller (for brush motor)

Device selection points
- It is necessary to select the product with the optimum current rating for each application.
- It is necessary to select a motor controller 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

* 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 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

- **Both device protection and signal quality is realized**
  TVS diode (for CAN communication)
- **Built-in active clamp circuit and pull-down resistor for relay drive**
  U-MOSIV series active clamp MOSFET
- **Low power consumption of the system is realized by low on-resistance**
  U-MOS series 40V N-ch power MOSFET

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page
Brushless motor drive circuit

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 motor)
- Full-bridge drive circuit is realized
  Motor controller (for brushless motor)

* 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
Device solutions to address customer needs

As described above, in the design of Power Sliding Door, “Ensuring tolerance to motor lock current and immunity. Capable with functional safety”, “Reduction of power consumption” and “Miniaturization” are important factors. Toshiba’s proposals are based on these three solution perspectives.

- Robustness
- High efficiency, Low loss
- Small size package

Ensuring tolerance to motor lock current and immunity. Capable with functional safety
Reduction of power consumption
Miniaturization
Device solutions to address customer needs

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Robustness</th>
<th>High efficiency</th>
<th>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>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Motor controller (for brush motor)</td>
<td></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>
<td></td>
</tr>
<tr>
<td>4</td>
<td>General-purpose small-signal MOSFET</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gate driver (for motor)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Motor controller (for brushless motor)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>U-MOS series -40V / -60V P-ch power MOSFET</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Gate driver (for switch)</td>
<td></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>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Small-signal bias resistor built-in transistor (BRT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>One-gate logic (L-MOS)</td>
<td></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>
<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.

<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>DZPAK+</td>
</tr>
</tbody>
</table>

- Robustness
- High efficiency
- Low loss
- Small size package

UMOS series 40V N-ch power MOSFET
XPN3R804NC / TK1R4S04PB / TPHR7904PB / TPWR7904PB / TKR74F04PB / TK1R5R04PB

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Motor controller (for brush motor)
TB9057FG

Value provided

Functional safety (ASIL-D capable) and built-in motor-current detecting function

1. Functional safety
ISO26262 compliant. FMEDA and safety manuals can be provided.

2. Built-in current detection amplifier
Two channels of current detection amplifiers are built in to make them redundant.

3. AEC-Q100 qualified
It is compatible with the AEC-Q100 and can be used for a wide range of Automotive applications.

TB9057FG Typical Connection Diagram

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TB9057FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>LQFP48</td>
</tr>
<tr>
<td>Package body size</td>
<td>7.0 x 7.0 mm</td>
</tr>
</tbody>
</table>

Function

<table>
<thead>
<tr>
<th>Control method</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>External MOSFET</td>
<td>N-ch / N-ch</td>
</tr>
<tr>
<td>Detection of overheating, low voltage and short circuit</td>
<td>✔</td>
</tr>
<tr>
<td>Output of detection function diagnosis result</td>
<td>✔</td>
</tr>
</tbody>
</table>

Return to Block Diagram TOP

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Value provided

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>$V_{DS(OC)}$ [V]</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>$I_D$ [A]</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>$R_{DS(ON)}$ @$V_{DS}=4.0$V [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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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**

- **Power dissipation (W)**
  - S-Mini (SOT-346): 60, 0.4, 1.2
  - S-Mini (SOT-346): 60, 0.4, 1.2
  - VESM (SOT-723): 1.75, 1.9, 0.39

- **Mounting area (mm²)**
  - Small packages lineup (Small signal device)

**Line up**

<table>
<thead>
<tr>
<th>Part number</th>
<th>SSM3K7002KF</th>
<th>SSM3J168F</th>
<th>SSM3J66MFV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>S-Mini (SOT-346)</td>
<td>S-Mini (SOT-346)</td>
<td>VESM (SOT-723)</td>
</tr>
<tr>
<td>$V_{DSS}$ (V)</td>
<td>60</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>$I_D$ (A)</td>
<td>0.4</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>$R_{DS(ON)}$ Typ.</td>
<td>1.2</td>
<td>1.4</td>
<td>0.31</td>
</tr>
<tr>
<td>$R_{DS(ON)}$ Max.</td>
<td>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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Gate driver (for motor)
TPD7211F / TPD7212F

Value provided

The large gate drive-current capability reduces power MOSFET losses and improves the efficiency of equipment.

1 Large gate drive current

Improves efficiency of high-speed FET switching.
- TPD7211F: ±0.5 A
- TPD7212F: ±1 / ±1.5 A

2 Built-in protection / diagnostic output function

- Hi-Lo side short is prevented and FET is switched off.
- Functions to monitor abnormalities of the power supply voltage and output voltage are built-in.

3 Small package

Small surface mount package PS8 and WQFN32

Example of application and block diagram of TPD7212F (Three-phase brushless motor control)

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>Function</th>
<th>Number of output</th>
<th>Package</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPD7211F</td>
<td>Half bridge output gate driver</td>
<td>2 outputs</td>
<td>PS8 (2.8 x 2.9 mm)</td>
<td>• For high-side P-channel MOSFET drive</td>
</tr>
<tr>
<td>TPD7212F</td>
<td>Gate driver for three-phase brushless motor</td>
<td>6 outputs</td>
<td>Back surface WQFN32 (≥ 5 mm)</td>
<td>• For driving high-side N-channel MOSFET (with built-in charge pumps) • Built-in voltage monitoring function (power supply, output)</td>
</tr>
</tbody>
</table>

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Motor controller (for brushless motor)
TB9081FG / TB9083FTG*

1. Functional safety
   - ISO26262 compliant. FMEDA and safety manuals can be provided.

2. Built-in safety relay driver and current detection amplifier
   - The safety relay driver is built in for the power supply side FET and the motor phase cut FET. In addition, a 3-channel current detection amplifier is built in to support 3 shunts.

3. AEC-Q100 qualified
   - It is compatible with the AEC-Q100 and can be used for a wide range of Automotive applications.

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TB9081FG</th>
<th>TB9083FTG*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>LQFP64</td>
<td>WQFN48</td>
</tr>
<tr>
<td>Package body size</td>
<td>10.0 x 10.0 mm</td>
<td>7.0 x 7.0 mm</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>Tj=-40~150°C</td>
<td>Tj=-40~175°C</td>
</tr>
<tr>
<td>Control method</td>
<td>Direct</td>
<td>Direct</td>
</tr>
<tr>
<td>External MOSFET</td>
<td>N-ch / N-ch</td>
<td>N-ch / N-ch</td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection of overheating, low voltage and short circuit</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Output of detection function diagnosis result</td>
<td>✔ (Built-in BIST)</td>
<td>✔ (Built-in BIST)</td>
</tr>
</tbody>
</table>

* TB9083FTG: Under development

Robustness
High efficiency
Low loss
Small size package

High efficiency
Low loss
Small size package

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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

Line up

<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) |

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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 $V_{CE\text{(sat)}}$ 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.

Line up

<table>
<thead>
<tr>
<th>Classification</th>
<th>$V_{CE\text{(sat)}}$</th>
<th>$I_c$ [mA]</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>50</td>
<td>150</td>
<td>NPN</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>500</td>
<td>PNP</td>
</tr>
<tr>
<td>Low noise</td>
<td>120</td>
<td>100</td>
<td>2SC417</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2SA1587</td>
</tr>
<tr>
<td>High-current</td>
<td>50</td>
<td>1700</td>
<td>2SC2713</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2SA1613</td>
</tr>
</tbody>
</table>

Robustness  •  High efficiency  •  Low loss  •  Small size package

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Small-signal bias resistor built-in transistor (BRT)
RN1114 / RN2114 / RN1414 / RN2414 series

Value provided

Extensive product lineup to meet all your needs.

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.

### Line up

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

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Return to Block Diagram TOP
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.

AEC-Q100 qualified* (Rev. H)

Line up

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

* Compliant products with AEC-Q100's reliability test only

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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)

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**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>USM (SOT-323)</td>
<td>USM (SOT-323)</td>
</tr>
<tr>
<td>$V_{ESD}$ [kV] @ISO10605</td>
<td>±30</td>
<td>±30</td>
<td>±20</td>
</tr>
<tr>
<td>$V_{RMS}$ (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>1.5 / 1.5</td>
</tr>
<tr>
<td>$R_{DYN}$ (Typ.) [Ω]</td>
<td>0.8</td>
<td>1.1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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(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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