Tablet Device

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
Tablet Device  Details of Power supply unit

System power circuit
Method using power controller

Method without power controller

※ Click on the blue circled numbers above to view detailed descriptions.

Proposal from Toshiba

- Prevent circuit malfunctions by absorbing electrostatic discharge (ESD) from external terminals
  - TVS diodes
- Low power dissipation sets possible by means of low ON resistance
  - U-MOS series MOSFET (trench-type)
- Robust protection function

Device selection

- A low Rdyn of an electrostatic protection diode (TVS) is an important protection performance parameter.
- MOSFETs are suitable for control of USB power circuits.
- Board area reduction is possible by using small packages.
Audio circuit

- Processor
- Audio Codec
- Audio Amp.
- RC Filter
- Speaker
- Earphone
- Volume Switch
- TVS

Device selection
- A low Rdyn of an electrostatic protection diode (TVS) is an important protection performance parameter.
- Board area reduction is possible by using small packages.

Proposal from Toshiba
- Prevent circuit malfunctions by absorbing electrostatic discharge (ESD) from external terminals.
  TVS diodes

※ Click on the blue circled numbers above to view detailed descriptions.
### Touch sensor circuit

**Optical type**

- Optical Sensor Unit
- Sensor Controller
- Processor
- TVS

### Touch sensor circuit

**Capacitive type**

- Touch Capacitive Sensor Unit
- Sensor Controller
- Processor
- TVS

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### Device selection

- A low $R_{dyn}$ of an electrostatic protection diode (TVS) is an important parameter of protection performance.
- Board area reduction is possible by using small packages.

### Proposal from Toshiba

- Prevent circuit malfunctions by absorbing electrostatic discharge (ESD) from external terminals
- TVS diodes

※ Click on the blue circled numbers above to view detailed descriptions.
Display circuit

Processor

Touch Screen Controller — Display

MIPI® DSI — Interface Bridge — LVDS — Display

MIPI® DSI — Interface Bridge — DisplayPort™ — Display

Embedded DisplayPort™ — Interface Bridge — MIPI® DSI — Display

LDO — LED Backlight Controller — SBD — Display

Device selection

- A low Rdyn of an electrostatic protection diode (TVS) is an important parameter of protection performance.
- Low VF & low IR are essential for SBDs.
- Board area reduction is possible by using small packages.
- Display components can be selected without concern for interface standards.

Proposal from Toshiba

- Prevent malfunctions by absorbing external electrostatic discharge (ESD) TVS diodes
- High speed, low power Surface-mounted Schottky barrier diodes
- Resistant to power supply noise Small surface-mounted LDO regulators
- Absorb differences in interfaces Interface bridge

※ Click on the blue circled numbers above to view detailed descriptions.

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Device selection

- PSRR (Power Supply Rejection Ratio) is an important parameter for camera modules.
- Small, low Ct TVS diodes are suited for ESD protection.
- Board area reduction is possible by using small packages.
- Camera components can be selected without concern for interface standards.

Proposal from Toshiba

- Prevent circuit malfunctions by absorbing electrostatic discharge (ESD) from external terminals
  TVS diodes
- Resistant to power supply noise
  Small surface-mounted LDO regulators
- Absorb differences in interfaces
  Interface bridge

※ Click on the blue circled numbers above to view detailed descriptions.
### Tablet Device Details of Wireless Unit

#### Wireless Circuit

![Diagram of Wireless Circuit](image)

- **Processor**
- **Wi-Fi/LTE/GPS Module**
- **LDO**
- **Wi-Fi/LTE/GPS Output**
- **TVS**

#### Device Selection

- Due to small device size, small components are required.
- Wi-Fi system requires power supply with large current capability.

#### Proposal from Toshiba

- Prevent circuit malfunctions by absorbing electrostatic discharge (ESD) from external terminals
- TVS diodes
- Resistant to power supply noise
- Small surface-mounted LDO regulators

※ Click on the blue circled numbers above to view detailed descriptions.
Recommended Devices
For Tablet designs, basic solutions are proposed from the three perspectives of “Board miniaturization”, “Low set power dissipation”, “Noise immunity”.

- **Board miniaturization**: Small packaging
- **Low set power dissipation**: High Efficiency, Low loss
- **Noise immunity**: Noise immunity
Device solutions to address customer needs

<table>
<thead>
<tr>
<th></th>
<th>Small packaging</th>
<th>Efficiency - Low loss</th>
<th>Noise immunity</th>
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<tbody>
<tr>
<td>1</td>
<td>TVS diode</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Small signal MOSFET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Schottky barrier diode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Small surface mount LDO regulator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Interface bridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Electronic Fuse eFuse IC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TVS diode
DF2B7ASL / DF2S14P1CT / DF2B5M4SL / DF2B6M4SL

Protecs devices and prevents circuit malfunctions by absorbing ESD entering from external terminals

1 Increase ESD pulse absorption
High signal quality and protection assured by means of low operating resistance and low capacitance.

2 Suppress ESD energy by means of low clamp voltage
Using original technology, provides full protection of connected circuit components.

3 High density mounting
Wide selection of packages available (single / multi flow-through).

Note: This device is for ESD protection only and cannot be used for other purposes such as, but not limited to, constant voltage source circuits.

Line up

<table>
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<tr>
<th>Part number</th>
<th>DF2B7ASL</th>
<th>DF2S14P1CT</th>
<th>DF2B5M4SL</th>
<th>DF2B6M4SL</th>
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<tr>
<td>Package</td>
<td>SL2</td>
<td>CST2</td>
<td>SL2</td>
<td>SL2</td>
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<tr>
<td>$V_{ESD}$ (Max) [kV]</td>
<td>±30</td>
<td>±30</td>
<td>±20</td>
<td>±20</td>
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<tr>
<td>$V_{RWM}$ (Max) [V]</td>
<td>5.5</td>
<td>12.6</td>
<td>3.6</td>
<td>5.5</td>
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<tr>
<td>$C_t$ (Typ.) [pF]</td>
<td>8.5</td>
<td>40</td>
<td>0.2</td>
<td>0.2</td>
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<tr>
<td>$R_{DYN}$ (Typ.) [Ω]</td>
<td>0.2</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
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</table>

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Small signal MOSFET
SSM6K513NU / SSM6N55NU / SSM6J507NU

Suitable for power management, contributes to miniaturization

1. Low voltage operation
   Operates at $V_{DS}=4.5V$

2. Low ON resistance
   By reducing source-drain ON resistance, heat radiation and power dissipation is minimized.

3. Small package
   Encapsulated in SOT-1220 (2.0x2.0mm)

SSM6K513NU equivalent circuit

<table>
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<tr>
<th>Line up</th>
<th>SSM6K513NU</th>
<th>SSM6N55NU</th>
<th>SSM6J507NU</th>
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<td>Part number</td>
<td>UDFN6B</td>
<td>UDFN6B</td>
<td>UDFN6B</td>
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<tr>
<td>$V_{DSS}$ (Max) [V]</td>
<td>30</td>
<td>30</td>
<td>-30</td>
</tr>
<tr>
<td>$I_D$ (Max) [A]</td>
<td>15</td>
<td>4</td>
<td>-10</td>
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<tr>
<td>$R_{DS(on)}$ [mΩ] @$V_{GS} = 4.5V$</td>
<td>Typ. 8.0</td>
<td>48</td>
<td>19</td>
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<tr>
<td></td>
<td>Max 12</td>
<td>64</td>
<td>28</td>
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<tr>
<td>Polarity</td>
<td>N-ch</td>
<td>N-ch x 2</td>
<td>P-ch</td>
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Schottky barrier diode
CUHS20F40 / CTS05F40

Fast, low-loss, small package and ideal for many applications

1. Fast switching
For fast switching applications.

2. High reverse voltage
Reverse voltage $V_R$ can be applied up to 40V maximum.

3. Small package
Small surface-mount packages for high-density assembly:
US2H: $2.5 \times 1.4 \times 0.6$ mm
CST2: $1.0 \times 0.6 \times 0.38$ mm

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>CUHS20F40</th>
<th>CTS05F40</th>
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<tbody>
<tr>
<td>Package</td>
<td>US2H</td>
<td>CST2</td>
</tr>
<tr>
<td>$I_D$ (Max) [A]</td>
<td>2.0</td>
<td>0.5</td>
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<tr>
<td>$V_R$ (Max) [V]</td>
<td>40</td>
<td>40</td>
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<tr>
<td>$V_f$ (Typ.) [V]</td>
<td>0.39 @$I_f = 1.0$ A</td>
<td>0.74 @$I_f = 0.5$ A</td>
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<tr>
<td>$I_R$ (Max) [μA] @$V_R = 40$ V</td>
<td>60</td>
<td>15</td>
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</table>

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Return to Block Diagram TOP
Small surface mount LDO regulator
TCR5AM / TCR15AG / TCR4DG / TCR3DG Series

For high performance requirements from general purpose to ultra small packages

1. Low dropout voltage

Dropout characteristics are greatly improved using new generation process.

2. High ripple compression

With a high ripple compression R.R, ripple is efficiently removed.

3. External ceramic capacitors

With improved dropout characteristics, it is now possible to use external ceramic capacitors.

Line up

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<th>TCR5AM</th>
<th>TCR15AG</th>
<th>TCR4DG</th>
<th>TCR3DG</th>
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<tr>
<td>Package</td>
<td>DFNSB</td>
<td>WCSP6F</td>
<td>WCSP4E</td>
<td>WCSP4E</td>
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<tr>
<td>$V_{IN}$ (Max) [V]</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>$I_{OUT}$ (Max) [mA]</td>
<td>0.5</td>
<td>1.5</td>
<td>0.4</td>
<td>0.3</td>
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<tr>
<td>Output range [V]</td>
<td>0.55 to 3.6</td>
<td>0.65 to 3.6</td>
<td>1.0 to 4.5</td>
<td>1.0 to 4.5</td>
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</table>

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Eliminating the interface gap between host and display/camera allows more freedom of component selection

1. **Wider component selection**
   Conversion of the interface allows shared procurement with other products as well as adoption of less inexpensive parts.

2. **Noise immunity**
   Converting parallel communication to serial improves noise immunity and suppresses noise generation to the surroundings.

3. **Less cabling**
   Converting from parallel communication to serial reduces total wiring the risks of wire breakage.

### Display interface
- X Std.
- Y Std.

### Camera interface
- X Std.
- Y Std.

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eFuse IC (electronic fuses) can protect circuits from abnormal conditions such as overcurrent and overvoltage repeatedly.

1. Repeated use

When excessive current flows through the eFuse IC, the internal detection circuit operates and turns off the internal MOS. It is not destroyed by a single overcurrent and can be used repeatedly.

2. High-speed short-circuit protection

The cut-off time at the time of output short-circuit is 150ns (Typ.), and the output current is cut-off at high speed at the time of short-circuit detection.

3. Rich protection functions

In addition to short-circuit protection, the circuit is protected by overcurrent clamp (OCC), overvoltage clamp (OVC), Thermal shut down (TSD), inrush current suppression, Reverse current protection (optional), and other functions.

Example of reference circuit

![Diagram of eFuse IC Reference Circuit]

- **MOSFET for preventing reverse current**
- **Option**
- **Setting the limiting current**
- **EN/UVLO**
- **OUT**
- **VOUT**

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TCKE800NA/NL*</th>
<th>TCKE805NA/NL</th>
<th>TCKE812NA/NL*</th>
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<tr>
<td><strong>Package</strong></td>
<td>WSON10B</td>
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<td></td>
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<td><strong>3.0x3.0x0.7mm</strong></td>
<td>4.4 to 18</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td><strong>V_{IN} [V]</strong></td>
<td>NA</td>
<td>Latch type</td>
<td></td>
</tr>
<tr>
<td><strong>3.0x3.0x0.7mm</strong></td>
<td>Automatic return</td>
<td>Latch type (external signal control)</td>
<td></td>
</tr>
<tr>
<td><strong>V_{OVC} (Typ.) [V]</strong></td>
<td>-</td>
<td>6.04</td>
<td>15.0</td>
</tr>
</tbody>
</table>

* Under development

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