Blood Glucose Meter

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
Criteria for device selection
- TVS diode protects signal line from external ESD.
- PSRR is a key characteristic of microcomputer.

Proposals from Toshiba
- Static electricity (ESD) from external terminals is absorbed to prevent circuit malfunction and device breakdown. TVS diode
- Optimum power supply for environments with high power supply noise
  Small surface mount LDO regulator

ESD protection

Control MCU power supply

※ Click the number in the circuit diagram to jump to the detailed description page
Blood Glucose Meter  Detail of sensor unit

Criteria for device selection
- It is necessary to protect against surge voltage such as ESD from external terminals.
- PSRR is a key characteristic for power supply of sensor circuit.
- Low-noise operational amplifiers are required to improve measurement accuracy.

Proposals from Toshiba
- Static electricity (ESD) from external terminals is absorbed to prevent circuit malfunction and device breakdown. TVS diode
- Optimum power supply for environments with high power supply noise
  Small surface mount LDO regulator
- Amplify the detected small signal with low noise
  Small operational amplifier
- Low supply current and I/O full range type Comparator

Sensor circuit

※ Click the number in the circuit diagram to jump to the detailed description page
Recommended Devices
As described above, in the design of a blood glucose meter, “Miniaturization of circuit boards”, “Low power consumption of the set” and “Robust operation” 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>TVS diode</th>
<th>Small surface mount LDO regulator</th>
<th>Ultra-low noise operational amplifier</th>
<th>Comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Compatible with compact packages</td>
<td>Noise immunity</td>
<td>High efficiency ・ Low loss</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<td>4</td>
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</table>

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

1. **Improved ESD pulse absorption**
   - Both low operating resistance and low capacitance are realized and ensures high signal protection performance and signal quality.

2. **Suppress ESD energy by low clamp voltage**
   - Steadily protect the connected circuits/devices using proprietary technology.

3. **Optimal for high-density mounting**
   - A wide range of packages (single to multi flow through) are available.

### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>DF2B7ASL</th>
<th>DF2B7AFU</th>
<th>DF2B20M4SL</th>
<th>DF2S14P2CTC</th>
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</thead>
<tbody>
<tr>
<td>Package</td>
<td>SL2</td>
<td>USC</td>
<td>SL2</td>
<td>CST2</td>
</tr>
<tr>
<td>$V_{ESD}$ (Max) [kV]</td>
<td>±30</td>
<td>±30</td>
<td>±15</td>
<td>±30</td>
</tr>
<tr>
<td>$V_{RWM}$ (Max) [V]</td>
<td>5.5</td>
<td>5.5</td>
<td>18.5</td>
<td>13</td>
</tr>
<tr>
<td>$C_t$ (Typ.) [pF]</td>
<td>8.5</td>
<td>8.5</td>
<td>0.2</td>
<td>270</td>
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<tr>
<td>$R_{DYN}$ (Typ.) [Ω]</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.23</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 voltage regulation diode applications).
Small current LDO regulator  
TCR3UG / TCR3UM series

Value provided

This ideal LDO eliminates switching noise and realizes power saving and long-life operation with low output voltage fluctuation.

1 High ripple rejection

This LDO regulator has a high ripple rejection and realizes stable power supply by eliminating switching noise generated in the power supply circuit.

2 Low loss (low quiescent current)

This LDO regulator can minimize current consumption and maximize operating time with limited battery.

3 Optimal for high-density mounting

Various type of small packages are available.

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TCR3UG series</th>
<th>TCR3UM series</th>
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<tr>
<td>Package</td>
<td>WCSP4F</td>
<td>DFN4</td>
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<tr>
<td>I_{OUT} (Max) [mA]</td>
<td>300</td>
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<tr>
<td>V_{DO} (Typ.) [mV]</td>
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<tr>
<td>R.R. (Typ.) [dB]</td>
<td>70</td>
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<tr>
<td>I_{ON1} (Typ.) [μA]</td>
<td>0.34</td>
<td>0.34</td>
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</table>

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**Ultra-low noise operational amplifier**

TC75S67TU

Value provided

Very small signals detected by various sensors can be amplified with very low noise.

1. **Ultra-low noise**
   
   \[ V_{NI}(\text{Typ.}) = 6.0 \, \text{[nV/\sqrt{Hz}]} \]  
   \[ @f = 1 \, \text{kHz} \]

   Very small signals detected by various sensors [Note 1] can be amplified with low noise using CMOS Op-amp by optimizing the processing. We achieved one of the industry's lowest [Note 2] input equivalent noise voltage.

   **Ultra-low noise characteristic**

   (Company Comparison)

   ![Graph showing ultra-low noise characteristic]

   [Note 1] Various sensors: vibration detection sensors, shock sensors, acceleration sensors, pressure sensors, infrared sensors, and temperature sensors
   [Note 2] Based on our survey (as of May 2017)

2. **Low supply current**

   \[ I_{DD}(\text{Typ.}) = 430 \, \text{[\muA]} \]

   The low current consumption characteristics of CMOS processing contributes to the extension of battery life of the compact IoT devices [Note 3].

3. **Enhancement type**

   It is easy to handle because it is an enhancement type in which no drain current flows when no gate voltage is applied.

### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TC75S67TU</th>
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<tbody>
<tr>
<td>Package</td>
<td>UFV</td>
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<tr>
<td>( V_{DD,SS} ) (Max) [V]</td>
<td>( \pm 2.75 )</td>
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<tr>
<td>( V_{DD,SS} ) (Min) [V]</td>
<td>( \pm 1.1 )</td>
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<tr>
<td>( I_{DD} ) (Max) [\muA]</td>
<td>700</td>
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<tr>
<td>( V_{NI} ) (Typ.) [nV/\sqrt{Hz}] @f = 1 , \text{kHz}</td>
<td>6</td>
</tr>
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</table>

[Note 1] Various sensors: vibration detection sensors, shock sensors, acceleration sensors, pressure sensors, infrared sensors, and temperature sensors
[Note 2] Based on our survey (as of May 2017)
[Note 3] Comparison with our bipolar process operational amplifier
This full-range input/output comparator uses CMOS processes that operate at low power supply voltages with low current consumption.

1. Low power supply voltage operation

\[ V_{DD} = 1.3 \text{ V to } 5.5 \text{ V.} \]

2. Low supply current

\[ I_{DD} \text{ (Typ.)} = 18 \mu\text{A} \]

Can be used for wide applications because of its low supply current characteristic.

3. \( V_{IO} \text{ (Typ.)} = \pm 1.0 \text{ [mV]} \)

Since the input offset voltage is small, the accuracy of the comparison result can be improved.

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**Line up**

<table>
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<th>Part number</th>
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</thead>
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<tr>
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<td>MP6C</td>
</tr>
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<td>( V_{CC,EE} \text{ (Max) [V]} )</td>
<td>( \pm 2.75 )</td>
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<td>( V_{CC,EE} \text{ (Min) [V]} )</td>
<td>( \pm 0.65 )</td>
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<tr>
<td>( I_{DD} \text{ (Max) [\mu A]} )</td>
<td>35</td>
</tr>
<tr>
<td>( V_{IO} \text{ (Max) [mV]} )</td>
<td>( \pm 6 )</td>
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</tbody>
</table>
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