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
IH Rice Cooker  Detail of IH coil drive unit

IH coil drive circuit (using gate driver coupler)

IH coil drive circuit (using discrete components)

Criteria for device selection
- Fast switching and low saturation voltage characteristics are required for IGBT.
- Use of small package enables to reduce the circuit board area.
- Rail-to-Rail output, low voltage driving and low current consumption are required for gate driver to realize low power consumption of the set.
- Monitoring sensor, high speed data processing and various heaters control are needed for system control.

Proposals from Toshiba
- Fast and high efficiency switching are realized
  Silicon N-ch discrete IGBT
- Higher efficiency is realized
  IGBT gate driver coupler (Rail-to-Rail output type)
- Contribute to reduction of switching loss
  Bipolar transistor for IGBT gate drive
- High efficient processing of a few input and output data
  Main control MCU

※ Click the number in the circuit diagram to jump to the detailed description page
IH Rice Cooker    Detail of fan motor drive / LED drive unit

Criteria for device selection
- Low on-resistance characteristic contributes to low loss of the set.
- Use of small package enables to reduce the circuit board area.
- Monitoring sensor, high speed data processing and various heaters control are needed for system control.

Proposals from Toshiba
- High current transfer ratio and high temperature operation makes easy to design. Transistor output photocouplers
- Low on-resistance realizes a set with low power consumption
  U-MOS series MOSFET (Trench type)
- Small surface mount package suitable for high density mounting
  Rectifier diode
- High efficient processing of a few input and output data
  Main control MCU

Fan motor drive circuit
- 100 V AC
- AC-DC
- DC-DC
- MOSFET
- Fan Motor
- Photocoupler
- Current Detection
- Main Control MCU

LED driving circuit
- 100 V AC
- Rectifier Diode
- DC-DC
- LDO
- Status LED
- Display Control MCU
- MOSFET

※ Click the number in the circuit diagram to jump to the detailed description page
Heater control circuit

Criteria for device selection
- A phototriac coupler is suitable to control AC load.
- Monitoring sensor, high speed data processing and various heaters control are needed for system control.

Proposals from Toshiba
- Efficient control of AC load is realized.
  Triac output photo couplers
- High efficient processing of a few input and output data
  Main control MCU

※ Click the number in the circuit diagram to jump to the detailed description page
IH Rice Cooker  Detail of operation panel unit

Operation panel section

Criteria for device selection
- Driving series connection Hi-current type white LEDs for an LCD back light

Proposals from Toshiba
- 1ch type LED driver is suitable for a small LCD for its back light.
  Step up type LED driver

※ Click the number in the circuit diagram to jump to the detailed description page
Recommended Devices
As described above, in order to design IH Rice Cooker, “Compatibility with AC voltage in each country”, “Low power consumption of set” and “Miniaturization of circuit boards” are important factors. Toshiba’s proposals are based on these three solution perspectives.

**Device solutions to address customer needs**

<table>
<thead>
<tr>
<th>Compatibility with AC voltage in each country</th>
<th>Low power consumption of the set</th>
<th>Miniaturization of circuit boards</th>
</tr>
</thead>
<tbody>
<tr>
<td>High breakdown voltage</td>
<td>High efficiency · Low loss</td>
<td>Compatible with compact packages</td>
</tr>
</tbody>
</table>
Device solutions to address customer needs

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>High breakdown voltage</th>
<th>High efficiency</th>
<th>Compatible with compact packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Silicon N-ch discrete IGBT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>IGBT gate driver coupler</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Bipolar transistor for IGBT gate drive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Transistor output photocouplers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>U-MOS series MOSFET (Trench type)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Rectifier diode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Triac output photo couplers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Main control MCU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>LED driver for white LEDs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
High speed switching and low saturation voltage characteristics contribute to high efficiency.

1 High speed switching

Reducing switching loss through high speed operation contributes to higher power supply efficiency.

2 Low saturation voltage

Saturation voltage is kept low while realizing high speed switching.

3 Enhancement type

Enhancement type is easy to handle because no collector current flows when no gate voltage is applied.

GT60PR21
Characteristics Curves

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>GT50N324</th>
<th>GT60PR21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>TO-3P(N)</td>
<td></td>
</tr>
<tr>
<td>$V_{CES}$ (Max) [V]</td>
<td>1000</td>
<td>1100</td>
</tr>
<tr>
<td>$t_f$ (Typ.) [μs] @$I_C = 60$ A</td>
<td>0.11</td>
<td>0.16</td>
</tr>
<tr>
<td>$V_{CE(sat)}$ (Typ.) [V] @$I_C = 60$ A</td>
<td>1.9</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Rail-to-rail output enables the system to operate safely and reduce conduction losses.

1. Rail-to-rail output

TLP577X and TLP575X generate a full-swing voltage output signal and contributes to low power consumption.

2. Small package

The mounting area of SO6L package is 50% smaller than that of DIP8. And these gate driver coupler comply with reinforced insulation class of overseas safety standards.

3. High temperature of 110°C (ambient) operation

These photocouplers are designed to operate under severe ambient temperature conditions.

---

### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TLP577X series</th>
<th>TLP575X series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SO6L</td>
<td></td>
</tr>
<tr>
<td>$I_{op}$ (Max) [A]</td>
<td>±1 / ±2.5 / ±4</td>
<td></td>
</tr>
<tr>
<td>$t_{pHL}$, $t_{pLH}$ (Max) [ns]</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>$B V_{E}$ (Min) [VRms]</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>$T_{op}$ [$^\circ$C]</td>
<td>~40 to 110</td>
<td></td>
</tr>
<tr>
<td>$V_{cc}$ [V]</td>
<td>10 to 30</td>
<td>15 to 30</td>
</tr>
<tr>
<td>$I_{FLH}$ (Max) [mA]</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

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High speed switching characteristics and high $h_{FE}$ performance enable the system to have higher frequencies and lower losses.

1. **High speed switching operation**

These transistors have high speed switching characteristic suitable for high frequency equipment.

2. **High DC current gain ($h_{FE}$)**

Maximum rating of collector current and DC amplification factor are improved for larger IGBT gate capacity.

3. **Compact and thin package**

Both PNP and NPN type are mounted on one small surface mount package to reduce mounting area.

---

**Line up**

<table>
<thead>
<tr>
<th>Part number</th>
<th>HN4B101J</th>
<th>HN4B102J</th>
<th>TPCP8901</th>
<th>TPCP8902</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SMV</td>
<td>PS-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal structure (Top View)</td>
<td><img src="image" alt="Internal Structure" /></td>
<td><img src="image" alt="Internal Structure" /></td>
<td><img src="image" alt="Internal Structure" /></td>
<td><img src="image" alt="Internal Structure" /></td>
</tr>
<tr>
<td>$V_{CEO}$ (PNP/NPN) (Max) [V]</td>
<td>-30 / 30</td>
<td>-30 / 30</td>
<td>-50 / 50</td>
<td>-30 / 30</td>
</tr>
<tr>
<td>$I_{CP}$ (PNP/NPN) (Max) [A]</td>
<td>-5 / 5</td>
<td>-8 / 8</td>
<td>-5 / 5</td>
<td>-8 / 8</td>
</tr>
</tbody>
</table>

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4 Transistor output photocouplers
TLP183 / TLP185(SE)

High CTR (Current Transfer Ratio) is realized even in low input current range (I_F=0.5 mA).

1 High current transfer ratio (I_F=0.5 mA in low input current range)

Phototransistor and infrared light emitting diode are optically coupled. Highly insulated photocouplers realize higher conversion efficiency than conventional electromagnetic relays or insulated transformers.

2 High temperature of 125°C operation

It is designed to operate even under severe ambient temperature conditions, such as inverter equipment, robots, machine tools and high-output power supplies.

<table>
<thead>
<tr>
<th>Line up</th>
<th>TLP183</th>
<th>TLP185(SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>4pin SO6</td>
<td>4pin SO6</td>
</tr>
<tr>
<td>BV_s (Min) [Vrms]</td>
<td>3750</td>
<td>3750</td>
</tr>
<tr>
<td>T_{opr} (^°C)</td>
<td>-55 to 125</td>
<td>-55 to 110</td>
</tr>
</tbody>
</table>

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U-MOS series MOSFET contributes to energy saving and miniaturization by improving the trade-off characteristics between on-resistance and capacitance.

1. **Low on-resistance**
   By keeping the drain-source on-resistance low, heat generation and power consumption can be reduced and contributes to miniaturization.

2. **Small gate input charge**
   Reducing gate input charge needed for driving MOSFET improves switching characteristic.

3. **Fast switching speed**
   Reducing switching loss by high speed operation contributes to higher efficiency.

### Trade-off characteristics of on-resistance and gate input charge

#### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>SSM3K56MFV</th>
<th>SSM6N56FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>VESM</td>
<td>ES6</td>
</tr>
<tr>
<td>V_{DS} (Max) [V]</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>I_{D} (Max) [A]</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>R_{DS(on)} [Ω] @V_{GS} = 10 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typ.</td>
<td>0.186</td>
<td>0.360</td>
</tr>
<tr>
<td>Max</td>
<td>0.235</td>
<td>0.840</td>
</tr>
<tr>
<td>Polarity</td>
<td>N-ch</td>
<td>N-ch x 2</td>
</tr>
</tbody>
</table>
Wide range of products are provided, mainly compact package that is suitable for high-density assembly.

1 Surface mount / compact package

Surface Mounting: Adopting S-FLAT™ / M-FLAT™ package which is lower in height compared to the conventional lead type contributes to the space saving of the equipment.

2 Wide Product Line-up

Wide Product Line-up
- Reverse voltage: 200 V ~ 1000 V
- Average forward current: 0.5 ~ 3 A

Suitable product can be selected according to requirements.

<table>
<thead>
<tr>
<th>Line up</th>
<th>CRG05</th>
<th>CMG08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>S-FLAT</td>
<td>M-FLAT</td>
</tr>
<tr>
<td>$I_{F(AV)}$ (Max) [A]</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$V_{RRM}$ (Max) [V]</td>
<td>800</td>
<td>600</td>
</tr>
</tbody>
</table>

• CRG05 forward characteristic

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This photo coupler consists of a non zero crossing photo triac, optically coupled to an infrared light emitting diode.

1. Non zero cross type
   This photo coupler is suitable for the case where the operation time is short and phase control is necessary.

2. Switching characteristic
   It has excellent features such as high speed, low noise and silence.

3. Miniaturization of mounting area
   4pin SO6 packages have a size of about 3.7 × 7.0 × 2.1 mm.

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TLP267J</th>
<th>TLP560J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SO6</td>
<td>DIP6</td>
</tr>
<tr>
<td>$V_{DRM}$ (Max) [V]</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>$BV_s$ (Min) [Vrms]</td>
<td>3750</td>
<td>2500</td>
</tr>
<tr>
<td>$T_{op}$ [°C]</td>
<td>-40 to 100</td>
<td>-40 to 100</td>
</tr>
<tr>
<td>Feature</td>
<td>Non-zero-voltage turn-on</td>
<td>Non-zero-voltage turn-on</td>
</tr>
</tbody>
</table>

(Not) When a VDE approved type is needed, please designate the Option (V4).
System control at low power consumption by various timers and ADCs

1 Built-in ARM® Cortex®-M3 CPU core

TMPM383FSUG implements Cortex®-M3 core with 80MHz maximum operation frequency. Various development tool and their partners allow users many options.

2 System cost down and development efficiency improvement

TMPM383FSUG executes sensing data monitoring and processing efficiently by combining built-in analog function such as ADC and comparator, and CPU system. The original NANO FLASH™ is possible to rewrite at high-speed. It reduces user software development time period.

3 Small size package and low power consumption

TMPM383FSUG supports low power consumption library and stand by function. These contribute to reduce low power consumption. The package is small LQFP64.

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TMPM383FSUG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum operation frequency</td>
<td>40 MHz</td>
</tr>
<tr>
<td>Instruction ROM</td>
<td>64 KB</td>
</tr>
<tr>
<td>RAM</td>
<td>8 KB</td>
</tr>
<tr>
<td>Thumb-2 Instruction set</td>
<td>Available</td>
</tr>
<tr>
<td>Timer</td>
<td>16 bit x 8 ch</td>
</tr>
<tr>
<td>I2C</td>
<td>1 ch</td>
</tr>
<tr>
<td>ADC</td>
<td>10 ch (12 bit)</td>
</tr>
</tbody>
</table>

*LQFP64

* Arm and Cortex are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.
Driving series connection Hi-current type white LEDs. There are 1ch and 4ch drive type drivers.

### 1. Suitable driving a white LED for an LCD back light

Line up are 1ch and 4ch type drivers. 1ch type is suitable for mobile LCD and 4ch one is for small LCD PC.

### 2. Capable driving series connection white LEDs

1ch type maximum driving number of series connection LED is 6, 4ch one is 9/ch. Built-in step up type power supply adjusts LED driving voltage according to the LED Vf.

### 3. PWM dimming function

Minimum high level time period is 330ns about 4ch PWM control based on constant current power supply. 1ch type is possible to dim by few kHz PWM.

### Line up

<table>
<thead>
<tr>
<th></th>
<th>TB62763FMG</th>
<th>TB62771FTG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part number</td>
<td>TB62763FMG</td>
<td>TB62771FTG</td>
</tr>
<tr>
<td>Package</td>
<td>SON8</td>
<td>WQFN24</td>
</tr>
<tr>
<td>Driving ch number</td>
<td>1 ch</td>
<td>4 ch</td>
</tr>
<tr>
<td>Maximum LED driving number</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>Operation voltage</td>
<td>2.8 to 5.5 V</td>
<td>4.75 to 40 V</td>
</tr>
<tr>
<td>LED driving current</td>
<td>~80 mA</td>
<td>~150 mA</td>
</tr>
<tr>
<td>Built-in constant current power supply</td>
<td>N/A</td>
<td>Available</td>
</tr>
<tr>
<td>Built-in FET for stepping up power supply</td>
<td>Available</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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