TOSHIBA

Programmable Logic Controller

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
Programmable Logic Controller – Digital input module section detail

Criteria for device selection
- A TVS for internal protection is required at the signal input.
- Inter-module communication with backplane connection is possible by user-designed ASIC

Proposal from Toshiba
- Prevent circuit malfunctions by absorbing electrostatic discharge (ESD) from external terminals
  TVS diodes
- High light output, high gain, high speed photocoupler
  Transistor output photocoupler
  High-speed IC output photocoupler
- Small, thin, low voltage, small surface mounting
  One-gate CMOS logic

Digital Input Module Circuit

※ Click on the blue circled numbers above to view detailed descriptions.
Programmable Logic Controller - Digital output module section detail

Digital output module circuit

Criteria for device selection
- The external signal (output) line needs to be isolated from the main unit.
- Inter-module communication with backplane connection is possible by user-designed ASIC.

Proposal from Toshiba
- High light output, high gain, high speed photocoupler
  Transistor output photocoupler
  High-speed IC output photocoupler
- Small, thin, low voltage, small surface mounting
  One-gate CMOS logic
- Low power dissipation sets possible by means of low ON resistance
  U-MOS series MOSFET (trench-type)
- High withstand voltage, high current using DMOS FET output
  Transistor array

※ Click on the blue circled numbers above to view detailed descriptions.
Programmable Logic Controller – MCU module section detail

**MCU Module Circuit**
Using full custom ASIC

**Back Plane**
- DC
- Control

**MCU Module**
- DC-DC
- Logic
- ASIC
- RS-485
- Ethernet
- USB
- SD

**Proposal from Toshiba**
- Small, thin, low voltage, small surface mounting
- One-gate CMOS logic

**Criteria for device selection**
- The full custom ASIC can achieve sequence operation at high speed.
- Inter-module communication with backplane connection is possible by user-designed ASIC

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

Ethernet is a registered trademark of Fuji Xerox Corporation.
SD is a trademark of SD Association.
Programmable Logic Controller – Power supply module section detail

Criteria for device selection
- A low loss MOSFET suited for switching is required for efficient AC-DC power supply.
- Isolation is required between the primary and secondary of the AC-DC power supply.

Proposal from Toshiba
- Low power dissipation sets possible by means of low ON resistance
  π-MOSVIII series MOSFET (planar-type)
- Photocoupler with excellent environmental resistance
  Transistor output photocoupler

※ Click on the blue circled numbers above to view detailed descriptions.
Recommended Devices
Device solutions to address customer needs

As described above, in the design of PLC, “High reliability, environmentally friendly”, “Set power consumption reduction” and “Board miniaturization” are important factors. Toshiba’s proposals are based on these three solution perspectives.

- Advanced functions
- Stable operation
- High reliability and environmentally friendly

- Reduce set power consumption
- High Efficiency
- Low loss

- Board miniaturization
- Small packaging

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Device solutions to address customer needs

<table>
<thead>
<tr>
<th>1</th>
<th>TVS diode</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Transistor output photocoupler (AC input)</td>
</tr>
<tr>
<td>3</td>
<td>High speed IC output photocoupler (AC input)</td>
</tr>
<tr>
<td>4</td>
<td>One gate CMOS logic</td>
</tr>
<tr>
<td>5</td>
<td>Small signal MOSFET</td>
</tr>
<tr>
<td>6</td>
<td>Transistor Array</td>
</tr>
<tr>
<td>7</td>
<td>π-MOS series MOSFET</td>
</tr>
<tr>
<td>8</td>
<td>Transistor-output photocoupler (DC input)</td>
</tr>
</tbody>
</table>

- **Advanced functions**: •
- **Stable operation**: •
- **High Efficiency**: •
- **Low loss**: •
- **Small packaging**: •
Value provided

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

1. **Increase ESD pulse absorption**
   - Compared to our earlier products, ESD absorption is improved (operating resistance reduced by 50%). 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).

**Line up**

<table>
<thead>
<tr>
<th>Part number</th>
<th>DF2B7ASL</th>
<th>DF2B7AFS</th>
<th>DF2B7ACT</th>
<th>DF2B7AE</th>
<th>DF2B7AFU</th>
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<tbody>
<tr>
<td>Package</td>
<td>SL2</td>
<td>fSC</td>
<td>CST2</td>
<td>ESC</td>
<td>USC</td>
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<tr>
<td>$V_{RWM}$ (Max) [V]</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>$C_t$ (Typ.) [pF]</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>$R_{DYN}$ (Typ.) [Ω]</td>
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<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>$V_C$ (Typ.) [V] @$I_D = 1$ A</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

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.

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High conversion efficiency even for low input current (I_F = 0.5 mA)

1. Guaranteed conversion efficiency at low input current (I_F = 0.5 mA)

By adopting a high output LED, high conversion efficiency is achieved even under low input current conditions of I_F = 0.5 mA. In addition to I_F = 5 mA, conversion efficiency at I_F = 0.5 mA is guaranteed, allowing easy design.

2. Operation guaranteed up to 125°C

The operating temperature range is guaranteed from -55 °C to 125 °C to ensure operation under severe environments such as inverter devices, robots, machine tools, and high-output power supplies.

<table>
<thead>
<tr>
<th>Line up</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Part number</td>
<td>TLP292</td>
<td>TLP292-4</td>
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<tr>
<td>Package</td>
<td>SO4 (4pin)</td>
<td>SO16</td>
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<tr>
<td>BVS (Min) [Vrms]</td>
<td>3750</td>
<td>3750</td>
</tr>
<tr>
<td>T_{top} [°C]</td>
<td>-55 to 125</td>
<td>-55 to 125</td>
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</tbody>
</table>

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High speed IC output photocoupler (AC input)
TLP2395/TLP2398

A photocoupler that combines a high-power infrared LED (bi-directional input) with a high-gain, high-speed integrated circuit light-receiving IC chip.

1. **Direct connection to both sink/source logic signals**

AC input is supported by adding a reverse parallel LED on the LED side of the photocoupler. Output can support both sink and source logic signals without adding a bridge circuit.

2. **Guaranteed operation up to 125 °C ambient temperature**

Can operate in extreme ambient temperature environments such as inverter devices, robots, machine tools, and high output power supplies.

3. **Wide supply voltage 3～20V**

Operation with a supply voltage from 3.0 V is possible, as well as in mixed 3.3 V / 5.0 V systems, enabling the use of shared, common components.

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**Line up**

<table>
<thead>
<tr>
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<th>TLP2395</th>
<th>TLP2398</th>
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<tbody>
<tr>
<td>Package</td>
<td>SO6 (Spin)</td>
<td>SO6 (Spin)</td>
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<tr>
<td>BVs (Min) [Vrms]</td>
<td>3750</td>
<td>3750</td>
</tr>
<tr>
<td>T_{op} [°C]</td>
<td>-40 to 125</td>
<td>-40 to 125</td>
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<tr>
<td>Output type</td>
<td>Buffer logic</td>
<td>Inverter logic</td>
</tr>
</tbody>
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UL certification UL1577, File No.E67349
cUL certified CSA Component Acceptance Service No.5A, File No.E67349
VDE certified EN60747-5-5, EN60065, EN60950-1 (Note1)
EN62368-1 (applied) (Note1)
(Note): To select a VDE certified device, specify the “Option (V4) ”.
One gate CMOS logic TC7WZ series

TC7WZ07FK/TC7WZ00FK

Value provided

Line-up using small, common packages with low voltage operation offers good ease-of-use

1. Low power and high speed
   High speed operation is achieved with the low power of CMOS.

2. Compatible with low voltage systems
   The operating voltage range of 1.65V to 5.5V can be used with low voltage systems.

3. Power down protection function
   The output terminal has a 5.5V power-down protection function to protect the device when the power is off.

TC7WZ07FK

IN A  \hspace{1cm} 1 \hspace{1cm} OUT Y

TC7WZ00FK

IN A \hspace{1cm} \& \hspace{1cm} OUT Y

IN B

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TC7WZ07FK</th>
<th>TC7WZ00FK</th>
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<tbody>
<tr>
<td>Package</td>
<td>USB</td>
<td>USB</td>
</tr>
<tr>
<td>$V_{CC}$ [V]</td>
<td>1.65 to 5.5</td>
<td>1.65 to 5.5</td>
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<tr>
<td>$t_{PD}$/$t_{PO}$ (Typ.) [ns] @$V_{CC}$ = 5 V</td>
<td>2.3</td>
<td>2.4</td>
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<tr>
<td>$T_{OPR}$ (Max) [°C]</td>
<td>125</td>
<td>125</td>
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<tr>
<td>Function</td>
<td>Non-Inverter (Open Drain)</td>
<td>2-Input NAND</td>
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Return to Block Diagram TOP
Value provided

Suitable for power management switches, contributing to miniaturization.

1 High temperature compatible

A channel temperature up to 175 °C and ambient from -55 to 175 °C are supported, designed for extreme environments such as inverters, robots, machine tools, and high-output power supplies.

2 Low ON resistance

By reducing the ON-resistance between the source and drain, heat generation and power consumption can be reduced, in keeping with the trend of declining system power consumption.

3 Miniature package

In addition to the industry standard SOT-23F package, a smaller UFM package is also available maintaining the same level of power consumption, contributing to overall set miniaturization.

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>SSM3K341R</th>
<th>SSM3K341TU</th>
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<tbody>
<tr>
<td>Package</td>
<td>SOT-23F</td>
<td>UFM</td>
</tr>
<tr>
<td>Polarity</td>
<td>N-ch</td>
<td>N-ch</td>
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<td>R_DSON (Typ.) [Ω] @VGS = 10 V</td>
<td>28</td>
<td>28</td>
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<td>ID (Max) [A]</td>
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<td>6</td>
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<tr>
<td>V_DSS (Max) [V]</td>
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<td>60</td>
</tr>
<tr>
<td>V_GSS (Max) [V]</td>
<td>±20</td>
<td>±20</td>
</tr>
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</table>

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Transistor array
TBD62xxxA series

1 High withstand voltage & high current
Adoption of the BiCD, which is a high-withstand voltage monolithic process, an FET output is possible with an absolute maximum voltage of 50V and selectable current rating types of 0.3A, 0.5A and 1.5A.

2 Wide line-up
Selections include input type (buffer, inverter), output type (sink, source), number of channels (4 to 8). A total of 55 products are available, including DIP packages and built-in D-FF products.

3 Low loss
Low loss is achieved by the low Ron of the output circuit. Power loss is reduced by approximately 40% compared to conventional products. (Conditions: $T_a = 25 \, ^\circ C$, $I_{OUT} = 200mA$)

### Line up

<table>
<thead>
<tr>
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<th>TBD62083AFNG</th>
<th>TBD62783AFNG</th>
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<tbody>
<tr>
<td>Function</td>
<td>Sink output transistor array</td>
<td>Source output transistor array</td>
</tr>
<tr>
<td>Outputs</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Ratings</td>
<td>50 V</td>
<td>50 V</td>
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<tr>
<td></td>
<td>500 mA (Max)</td>
<td>-500 mA (Max)</td>
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<tr>
<td>Output On resistance</td>
<td>2.0 Ω (Typ.)</td>
<td>1.6 Ω (Typ.)</td>
</tr>
<tr>
<td>Clamp diode</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Package</td>
<td>SSOP18</td>
<td>SSOP18</td>
</tr>
</tbody>
</table>

Efficiency
Low loss
Small package

Return to Block Diagram TOP
**π-MOSⅧ series MOSFET TK10A80E**

### Value provided

**Suitable for switching regulators, which are easy to handle and contributes to miniaturization.**

1. **Low ON resistance**
   - By reducing the ON-resistance between the source and drain, heat generation and power dissipation is reduced.

2. **Low leakage current**
   - Drain leakage current $IDSS = 10 \mu A$ (max) (at $VDS = 640 \text{ V}$)

3. **Enhancement type**
   - Easy to operate enhancement type FET where no collector current flows when no gate voltage is applied.

### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>Part number</th>
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<tbody>
<tr>
<td>TK10A80E</td>
<td>TK10A80E</td>
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<table>
<thead>
<tr>
<th>Package</th>
<th>TO-220SIS</th>
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<td>$V_{DS}$ [V]</td>
<td>800</td>
</tr>
<tr>
<td>$I_D$ [A]</td>
<td>10</td>
</tr>
<tr>
<td>$P_D$ [W]</td>
<td>50</td>
</tr>
<tr>
<td>$C_{iss}$ [pF]</td>
<td>2000</td>
</tr>
<tr>
<td>$R_{DS(on)}$ (Max) [Ω]</td>
<td>0.7</td>
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<tr>
<td>Polarity</td>
<td>N-ch</td>
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</tbody>
</table>

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Transistor output photocoupler (DC input)
TLP383

Value provided

Reduced board area and maintenance-free operation thanks to improved reliability

1. High isolation voltage in a small thin package

A high isolation optocoupler with a phototransistor optically coupled to an infrared light emitting diode with a guaranteed breakdown voltage of 5000 Vrms. Due to the small and thin DIP package, high density board mounting is possible.

2. Guaranteed operation up to an ambient temperature of 125 °C

Designed to operate in harsh environments, for applications such as inverters, robots, machine tools, and high output power supplies.

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TLP383</th>
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<tbody>
<tr>
<td>Package</td>
<td>SO6L (4pin)</td>
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<tr>
<td>BV_s (Min) [Vrms]</td>
<td>5000</td>
</tr>
<tr>
<td>T_{opr} [°C]</td>
<td>-55 to 125</td>
</tr>
</tbody>
</table>

Industrial equipment
Inverters
Servo amps
Robots
FA
High power supplies
Security
Semiconductor testers
PLC
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