TBD62502A series, TBD62503A series

Usage considerations
Function of transistor array
There are various kinds of transistor arrays depending on their functions.

- **Input active level**
  There are two types. The TBD62502A series and the TBD62503A series are high active type.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>TBD62502A/TBD62503A series</th>
</tr>
</thead>
<tbody>
<tr>
<td>High active</td>
<td>Output is ON by inputting &quot;H&quot; level to input pin</td>
<td>○</td>
</tr>
<tr>
<td>Low active</td>
<td>Output is ON by inputting &quot;L&quot; level to input pin</td>
<td>—</td>
</tr>
</tbody>
</table>

- **Output clamp diode**
  There are two types. The TBD62502A series and the TBD62503A series are non built-in type.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>TBD62502A/TBD62503A series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in</td>
<td>Best for the drive of the motor, the relay, and the solenoid. (Capable of driving the LED and the level shift circuit.)</td>
<td>—</td>
</tr>
<tr>
<td>Non Built-in</td>
<td>Best for the drive of the LED and the level shift circuit. (Incapable of driving the motor, the relay and the solenoid.)</td>
<td>○</td>
</tr>
</tbody>
</table>

- **Output current system**
  There are two types. The TBD62502A series and the TBD62503A series are sink type. Connecting point of each load is different.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>TBD62502A/TBD62503A series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sink type</td>
<td>Output of current sink type (output pull)</td>
<td>○</td>
</tr>
<tr>
<td>Source type</td>
<td>Output of current source type (output push)</td>
<td>—</td>
</tr>
</tbody>
</table>

Example of application
Dynamic drive control is possible by combining transistor arrays of the sink type and the source type.
Construction of output circuit
There are three types. The TBD62502A series and the TBD62503A series are DMOS FET type.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>TBD62502A / TBD62503A series</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMOS FET type</td>
<td>Features High current drive is possible Loss of low current range is low</td>
<td>○</td>
</tr>
<tr>
<td>Bipolar transistor</td>
<td>Features High current drive is possible</td>
<td>—</td>
</tr>
<tr>
<td>Darlington type</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Bipolar transistor</td>
<td>Features Loss of low current range is low</td>
<td>—</td>
</tr>
<tr>
<td>Single type</td>
<td></td>
<td>—</td>
</tr>
</tbody>
</table>

Reference: Characteristics graph (Feature of each type)

![Reference graph of Output voltage-Output current](attachment://graph.png)

DMOS FET type (The TBD62502A/62503A series)
High current drive is possible
Loss of low current range is low

Darlington type
High current drive is possible

Single type
Loss of low current range is low

Output current (A) vs. Output voltage (V)

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Basic circuit

![Basic Circuit Diagram]

* TBD62503A series internal resistance: \( R_1 = 11k\Omega \) (typ.), \( R_2 = 33k\Omega \) (typ.), \( R_2 = 6k\Omega \) (typ.)
* TBD62502A series internal resistance: \( R_1 = 16.5k\Omega \) (typ.), \( R_2 = 8k\Omega \) (typ.), \( R_2 = 6k\Omega \) (typ.)
* The accuracy of the internal resistance are ± 30% (reference value).
* The operation of the clamp circuit

<table>
<thead>
<tr>
<th>Product</th>
<th>Condition</th>
<th>Voltage of Va</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD62503A series</td>
<td>( VIN &gt; 4V ) (typ.)</td>
<td>The clamp circuit controls the upper limit of Va. The upper limit of the Va is about 4V.</td>
</tr>
<tr>
<td>TBD62502A series</td>
<td>( VIN &lt; 11V ) (typ.)</td>
<td>about 0V</td>
</tr>
<tr>
<td></td>
<td>( VIN \geq 11V ) (typ.)</td>
<td>The clamp circuit controls the upper limit of Va. The upper limit of the Va is about 4V.</td>
</tr>
</tbody>
</table>

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

● Control of output ON/OFF
Outputs of the TBD62502A series and the TBD62503A series are constructed by DMOS FET. ON/OFF of output is controlled according to the level of applied voltage to the input pin.

<table>
<thead>
<tr>
<th>Product</th>
<th>VIN(ON)</th>
<th>VIN(OFF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD62502A series</td>
<td>14V to 25V</td>
<td>0V to 7.0V</td>
</tr>
<tr>
<td>TBD62503A series</td>
<td>2.5V to 25V</td>
<td>0V to 0.6V</td>
</tr>
</tbody>
</table>

In case the voltage is inputted through the pull up resistance externally, confirm that it meets the condition of VIN (ON) on consideration of the voltage fall in the external resistance (Rup).

● Notes in usage
Following treatment for pins of unusage channels is recommended.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1, I2, I3, I4, I5, I6, I7</td>
<td>Output is off in the open state because input pin has pull down processing. However, it is recommended to connect to GND to avoid malfunction by noise.</td>
</tr>
<tr>
<td>O1, O2, O3, O4, O5, O6, O7</td>
<td>Open or GND connection is recommended.</td>
</tr>
</tbody>
</table>
Example of application circuit

- Drive LED

In case of driving 7 LEDs
Loss calculation of the IC

In using the IC, take enough margins to configure by referring to the PD-Ta graph after calculating the loss of the IC from below formula. In the conditioning range of the PD-Ta graph, operating the IC at 250mA (max) per 1ch is possible.

● Loss calculation

$$\text{PD}@(W) = I_{\text{OUT}}(A) \times I_{\text{OUT}}(A) \times R_{\text{ON}}(\Omega) \times \text{ONDuty} \times \text{Ch} + \text{VIN}(V) \times I_{\text{IN}}(A) \times \text{ONDuty} \times \text{Ch}$$

* $R_{\text{ON}}$: Please refer to an electrical characteristic of a data seat.
* $\text{ONDuty}$: Apply ON term/cycle
  However, when ON term is 25ms or more, apply 1 for $\text{ONDuty}$.
* $\text{Ch}$: number of driving channels.

● PD-Ta graph

Conditions: Absolute maximum rating of the junction temperature ($T_j$) is 150°C.

![PD-Ta Graph](image)

- (1) PG type alone
- (2) When mounted on FWG type, JEDEC 2s2p
- (3) When mounted on FNG type (50 x 50 x 1.6 mm Cu 40%, single-side glass epoxy)
- (4) When mounted on FG type (30 x 30 x 1.6 mm Cu 50%, single-side glass epoxy)

● Thermal resistance

- PG type: $R_{\text{th(-a)}} = 85^\circ\text{C/W (alone)}$
- FG type: $R_{\text{th(-a)}} = 200^\circ\text{C/W (30 x 30 x 1.6 mm Cu 50% single-side glass epoxy)}$
- FNG type: $R_{\text{th(-a)}} = 160^\circ\text{C/W (50 x 50 x 1.6 mm Cu 40% single-side glass epoxy)}$
- FWG type: $R_{\text{th(-a)}} = 100^\circ\text{C/W (JEDEC 2s2p)}$
**TBD62502A series, TBD62503A series**

*The data is for reference, not guaranteed.*

**Reference data**

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**IOUT-DUTY CYCLE**
Mounted on the board of TBD62502AFG/TBD62503AFG

- $T_j=120^\circ C, T_a=25^\circ C$, pulse width: 25ms or less

- Current per ch when number of operating ch=N

- Board condition: 30 x 30 x 1.6 mm Cu 50%, single-side glass epoxy

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**IOUT-DUTY CYCLE**
Mounted on the board of TBD62502AFGW/TBD62503AFGW

- $T_j=120^\circ C, T_a=25^\circ C$, pulse width: 25ms or less

- Current per ch when number of operating ch=N

- Board condition: JEDEC 2s2p

---

**IOUT-DUTY CYCLE**
Mounted on the board of TBD62502AFNG/TBD62503AFNG

- $T_j=120^\circ C, T_a=25^\circ C$, pulse width: 25ms or less

- Current per ch when number of operating ch=N

- Board condition: 50 x 50 x 1.6 mm Cu 40%, single-side glass epoxy
*The data is for reference, not guaranteed.

**TBD62502A series, TBD62503A series**

**IOUT-DUTY CYCLE**

TBD62502APG/TBD62503APG alone

Tj=120°C, Ta=25°C, pulse width: 25ms or less

**IOUT-DUTY CYCLE**

TBD62502APG/TBD62503APG alone

Tj=120°C, Ta=85°C, pulse width: 25ms or less

**VIN - IIN**

TBD62502A

Ta=25°C, VOUT=2V

**VIN - IIN**

TBD62503A

Ta=25°C, VOUT=2V

**VOUT - IOUT**

TBD62502A

VIN=14V

Ta=-40°C, Ta=85°C, Ta=25°C

**VOUT - IOUT**

TBD62503A

VIN=8V

Ta=-40°C, Ta=85°C, Ta=25°C

Current per ch when number of operating ch=N
TBD62502A series, TBD62503A series

*The data is for reference, not guaranteed.
Land pattern dimension (Reference)

Unit: mm

TBD62502AFWG, TBD62503AFWG

TBD62502AFG, TBD62503AFG

TBD62502AFNG, TBD62503AFNG

Notes

- All linear dimensions are given in millimeters unless otherwise specified.
- This drawing is based on JEITA E1-7501 Level3 and should be treated as a reference only.
- TOSHIBA is not responsible for any incorrect or incomplete drawings and information.
- You are solely responsible for all aspects of your own land pattern, including but not limited to soldering processes.
- The drawing shown may not accurately represent the actual shape or dimensions.
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Evaluation board

● Drawing

Evaluation board of the TBD62502APG and the TBD62503APG

Evaluation board of the TBD62502AFNG and the TBD62503AFNG

● Circuit
Notes on Contents

1. Pin Connection Diagrams
The pin connection diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

2. Basic Circuits
The basic circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Test Circuits
The test circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

4. Timing Charts
Timing charts may be simplified or some parts of them may be omitted for explanatory purposes.

IC Usage Considerations

Notes on handling of ICs

[1] The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied in the wrong orientation or incorrectly even just one time.

[3] Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

[4] If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

[5] Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.
If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

Points to remember on handling of ICs

Heat Radiation Design
In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (Tj) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

Back-EMF
When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor’s power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device’s motor power supply and output pins might be exposed to conditions beyond absolute maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.
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TBD62502A series, TBD62503A series

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