

# TPCC8065-H

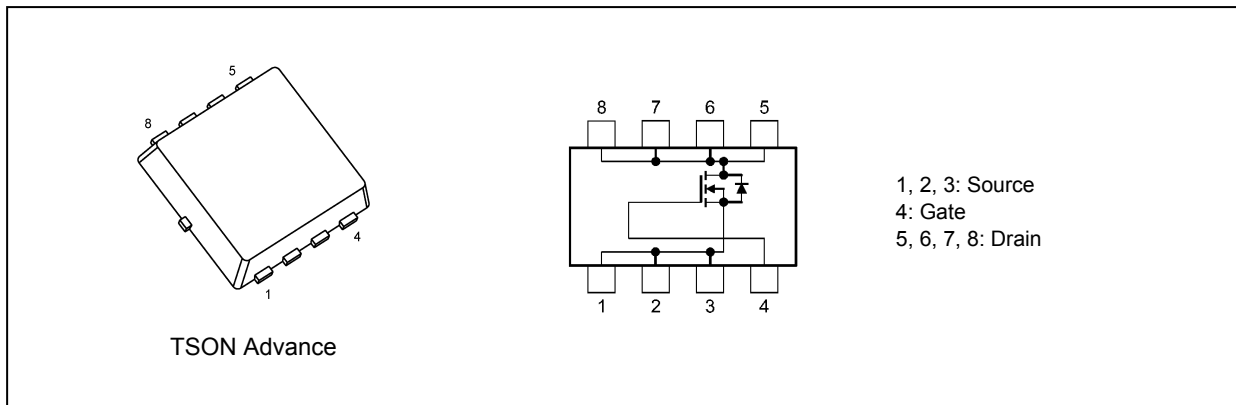
## 1. Applications

- High-Efficiency DC-DC Converters
- Notebook PCs
- Mobile Handsets

## 2. Features

- (1) Small, thin package
- (2) High-speed switching
- (3) Small gate charge:  $Q_{SW} = 4.3 \text{ nC (typ.)}$
- (4) Low drain-source on-resistance:  $R_{DS(ON)} = 11.7 \text{ m}\Omega \text{ (typ.) (} V_{GS} = 4.5 \text{ V)}$
- (5) Low leakage current:  $I_{DSS} = 10 \text{ }\mu\text{A (max) (} V_{DS} = 30 \text{ V)}$
- (6) Enhancement mode:  $V_{th} = 1.3 \text{ to } 2.3 \text{ V (} V_{DS} = 10 \text{ V, } I_D = 0.2 \text{ mA)}$

## 3. Packaging and Internal Circuit



## 4. Absolute Maximum Ratings (Note) ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics               | Symbol                                | Rating     | Unit             |
|-------------------------------|---------------------------------------|------------|------------------|
| Drain-source voltage          | $V_{DSS}$                             | 30         | V                |
| Gate-source voltage           | $V_{GSS}$                             | $\pm 20$   |                  |
| Drain current (DC)            | $I_D$ (Note 1)                        | 13         | A                |
| Drain current (pulsed)        | $I_{DP}$ (Note 1)                     | 39         |                  |
| Power dissipation             | $P_D$ ( $T_c = 25^\circ\text{C}$ )    | 18         | W                |
| Power dissipation             | $P_D$ ( $t = 10 \text{ s}$ ) (Note 2) | 1.9        | W                |
| Power dissipation             | $P_D$ ( $t = 10 \text{ s}$ ) (Note 3) | 0.7        | W                |
| Single-pulse avalanche energy | $E_{AS}$ (Note 4)                     | 43         | mJ               |
| Avalanche current             | $I_{AR}$                              | 13         | A                |
| Channel temperature           | $T_{ch}$                              | 150        | $^\circ\text{C}$ |
| Storage temperature           | $T_{stg}$                             | -55 to 150 |                  |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Start of commercial production

2010-07

**5. Thermal Characteristics**

| Characteristics  | Symbol                | Max  | Unit |
|--|-----------------------|------|------|
| Channel-to-case thermal resistance (T <sub>c</sub> = 25°C) | R <sub>th(ch-c)</sub> | 6.94 | °C/W |
| Channel-to-ambient thermal resistance (t = 10 s) (Note 2)  | R <sub>th(ch-a)</sub> | 65.7 | °C/W |
| Channel-to-ambient thermal resistance (t = 10 s) (Note 3)  | R <sub>th(ch-a)</sub> | 178  | °C/W |

Note 1: Ensure that the channel temperature does not exceed 150°C.

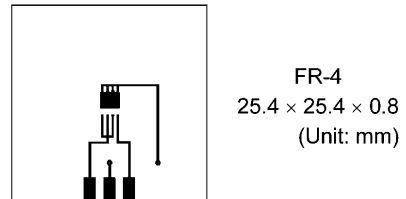
Note 2: Device mounted on a glass-epoxy board (a), Figure 5.1

Note 3: Device mounted on a glass-epoxy board (b), Figure 5.2

Note 4: V<sub>DD</sub> = 24 V, T<sub>ch</sub> = 25°C (initial), L = 0.2 mH, R<sub>G</sub> = 1.2 Ω, I<sub>AR</sub> = 13 A



**Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)**



**Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)**

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

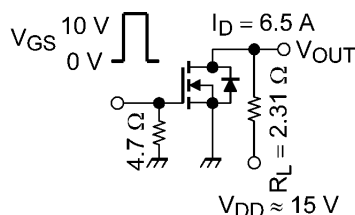
**6. Electrical Characteristics**

**6.1. Static Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                | Symbol        | Test Condition                                  | Min | Typ. | Max       | Unit             |
|--------------------------------|---------------|---|-----|------|-----------|------------------|
| Gate leakage current           | $I_{GSS}$     | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$ | —   | —    | $\pm 0.1$ | $\mu\text{A}$    |
| Drain cut-off current          | $I_{DSS}$     | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$     | —   | —    | 10        |                  |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$       | 30  | —    | —         | V                |
|                                | $V_{(BR)DSX}$ | $I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$     | 15  | —    | —         |                  |
| Gate threshold voltage         | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 0.2\text{ mA}$     | 1.3 | —    | 2.3       |                  |
| Drain-source on-resistance     | $R_{DS(ON)}$  | $V_{GS} = 4.5\text{ V}, I_D = 6.5\text{ A}$     | —   | 11.7 | 14.5      | $\text{m}\Omega$ |
|                                |               | $V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$      | —   | 9.4  | 11.4      |                  |

**6.2. Dynamic Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                | Symbol    | Test Condition  | Min | Typ. | Max | Unit        |
|--------------------------------|-----------|---|-----|------|-----|-------------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | —   | 1350 | —   | $\text{pF}$ |
| Reverse transfer capacitance   | $C_{rss}$ |   | —   | 63   | —   |             |
| Output capacitance             | $C_{oss}$ |   | —   | 240  | —   |             |
| Gate resistance                | $r_g$     | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 5\text{ MHz}$ | 1.0 | 1.4  | 2.1 | $\Omega$    |
| Switching time (rise time)     | $t_r$     | See Figure 6.2.1.   | —   | 2.0  | —   | ns          |
| Switching time (turn-on time)  | $t_{on}$  |   | —   | 8.1  | —   |             |
| Switching time (fall time)     | $t_f$     |   | —   | 2.1  | —   |             |
| Switching time (turn-off time) | $t_{off}$ |   | —   | 17   | —   |             |



Duty  $\leq 1\%$ ,  $t_w = 10\ \mu\text{s}$   
**Fig. 6.2.1 Switching Time Test Circuit**

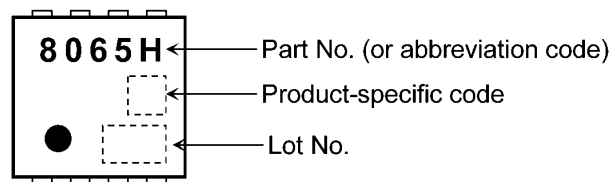
**6.3. Gate Charge Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                                 | Symbol    | Test Condition  | Min | Typ. | Max | Unit |
|---|-----------|---|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$     | $V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 13\text{ A}$ | —   | 20   | —   | nC   |
|   |           | $V_{DD} \approx 24\text{ V}, V_{GS} = 5\text{ V}, I_D = 13\text{ A}$  | —   | 9.9  | —   |      |
| Gate-source charge 1                            | $Q_{gs1}$ | $V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 13\text{ A}$ | —   | 4.4  | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |   | —   | 2.1  | —   |      |
| Gate switch charge                              | $Q_{sw}$  |   | —   | 4.3  | —   |      |

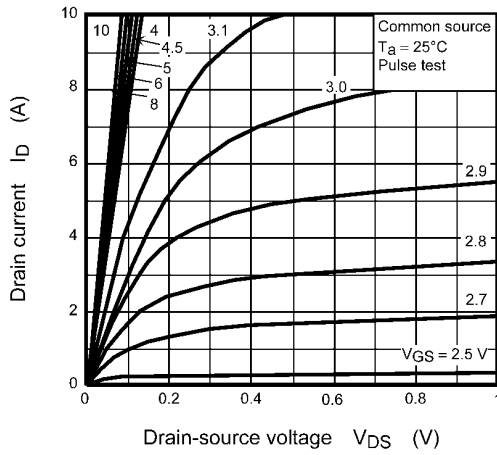
**6.4. Source-Drain Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                         | Symbol    | Test Condition                              | Min | Typ. | Max  | Unit |
|---|-----------|---|-----|------|------|------|
| Reverse drain current (pulsed) (Note 5) | $I_{DRP}$ | —   | —   | —    | 39   | A    |
| Diode forward voltage                   | $V_{DSF}$ | $I_{DR} = 13\text{ A}, V_{GS} = 0\text{ V}$ | —   | —    | -1.2 | V    |

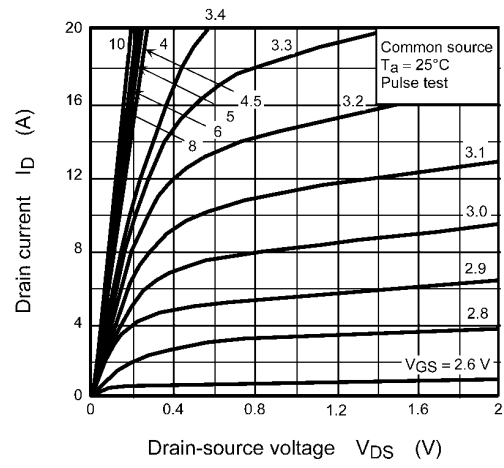
Note 5: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

**7. Marking****Fig. 7.1 Marking**

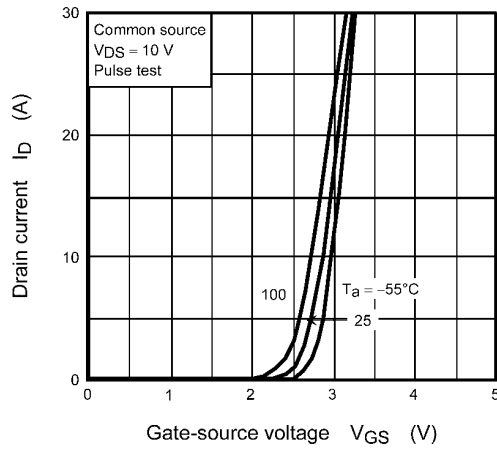
**8. Characteristics Curves (Note)**



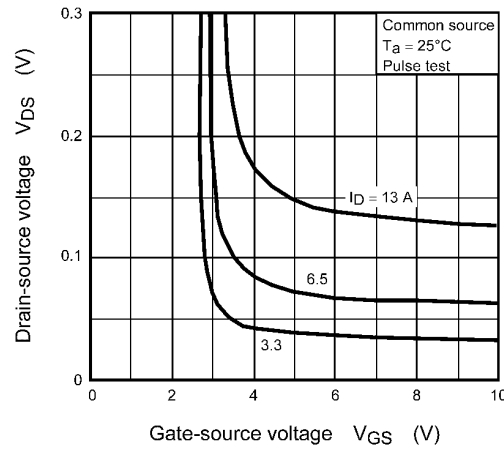
**Fig. 8.1  $I_D - V_{DS}$**



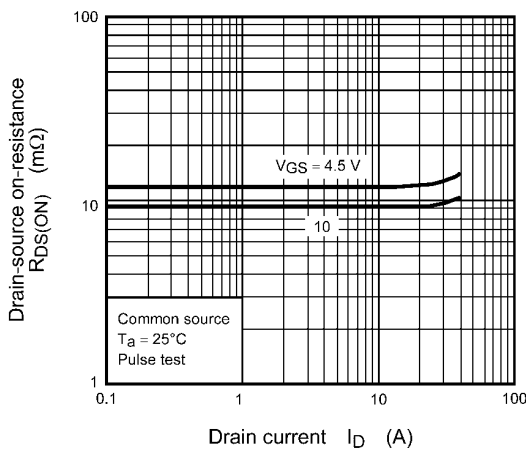
**Fig. 8.2  $I_D - V_{DS}$**



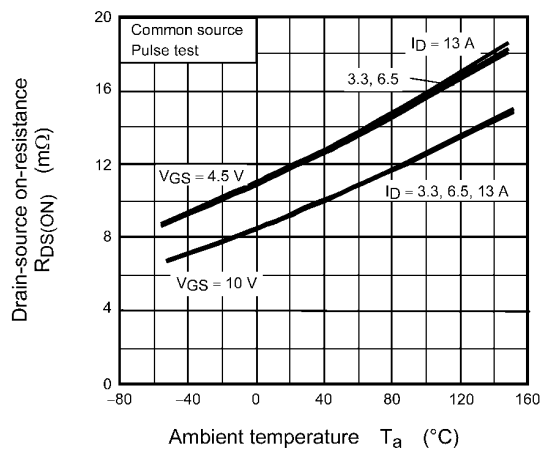
**Fig. 8.3  $I_D - V_{GS}$**



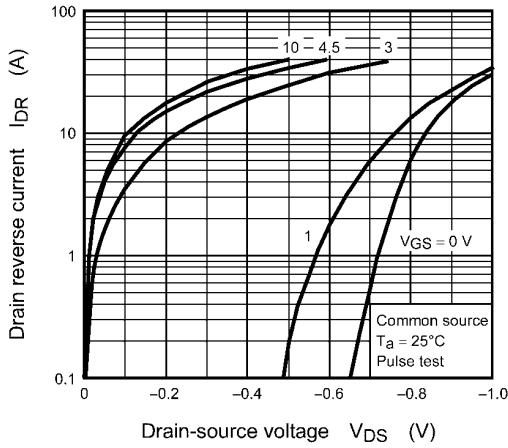
**Fig. 8.4  $V_{DS} - V_{GS}$**



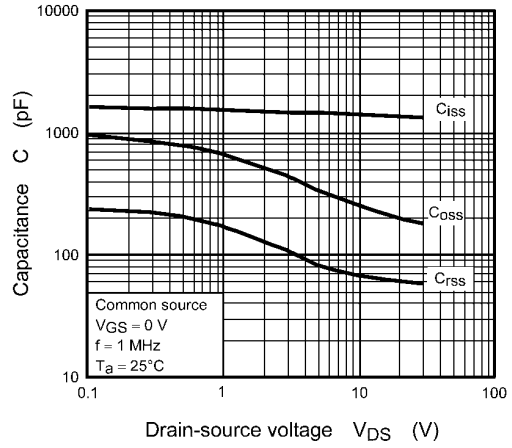
**Fig. 8.5  $R_{DS(ON)} - I_D$**



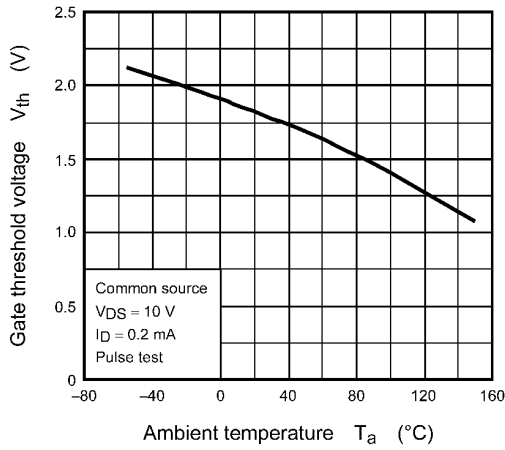
**Fig. 8.6  $R_{DS(ON)} - T_a$**



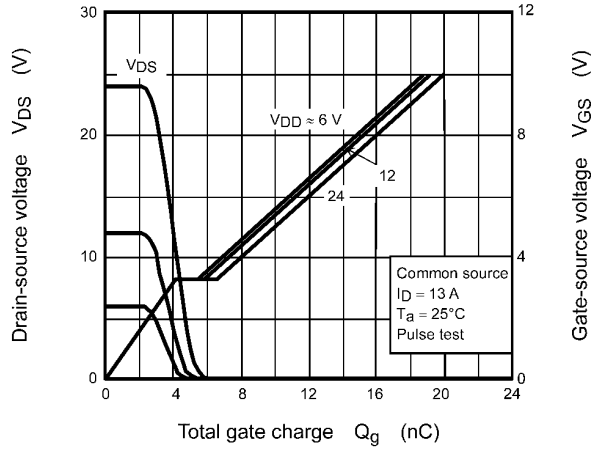
**Fig. 8.7  $I_{DR} - V_{DS}$**



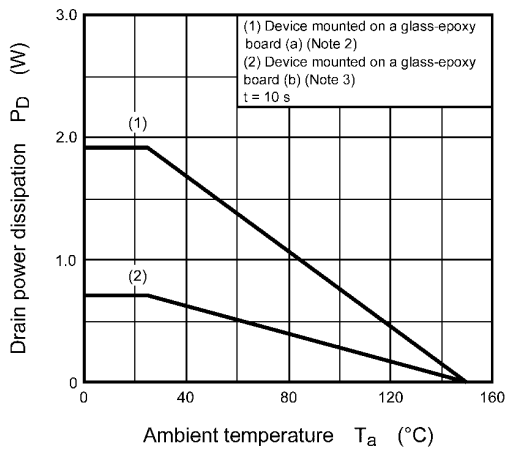
**Fig. 8.8 Capacitance -  $V_{DS}$**



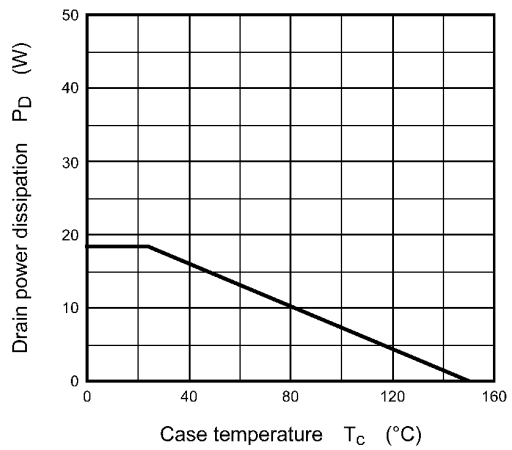
**Fig. 8.9  $V_{th} - T_a$**



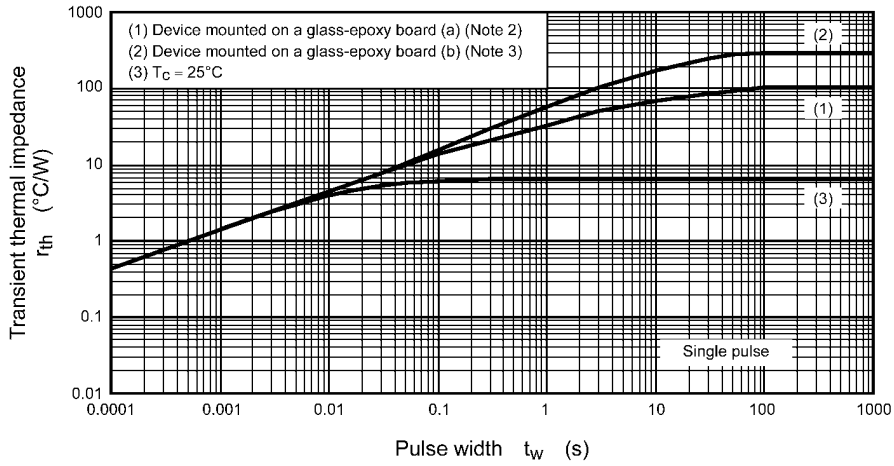
**Fig. 8.10 Dynamic Input/Output Characteristics**



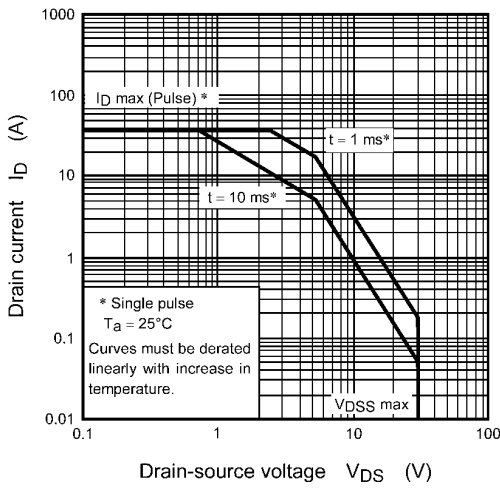
**Fig. 8.11  $P_D - T_a$   
(Guaranteed Maximum)**



**Fig. 8.12  $P_D - T_c$   
(Guaranteed Maximum)**



**Fig. 8.13  $r_{th} - t_w$**   
(Guaranteed Maximum)

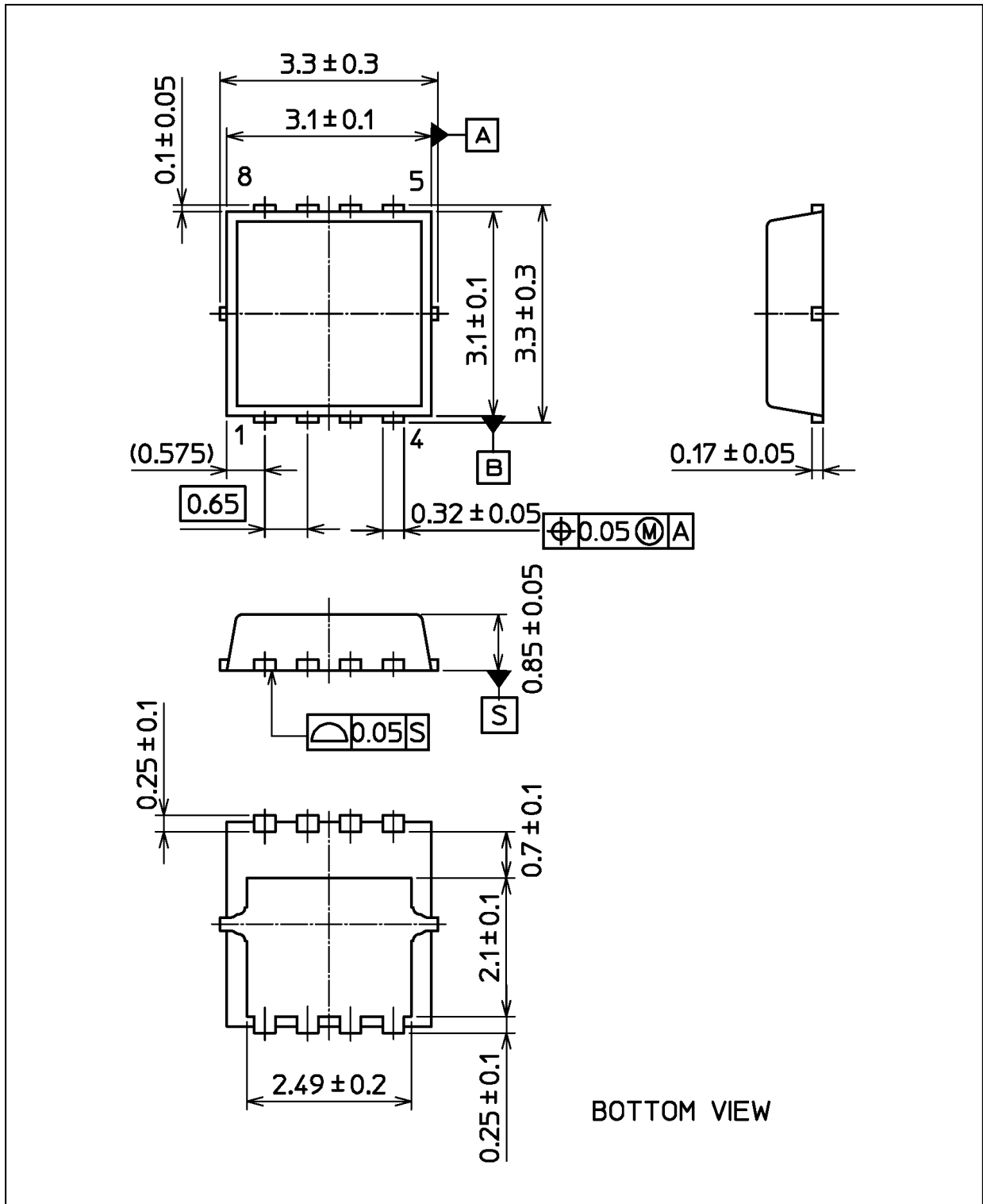


**Fig. 8.14 Safe Operating Area**  
(Guaranteed Maximum)

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package Dimensions

Unit: mm



Weight: 0.02 g (typ.)

|                        |
|------------------------|
| Package Name(s)        |
| TOSHIBA: 2-3X1S        |
| Nickname: TSON Advance |



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