

# TPCA8057-H

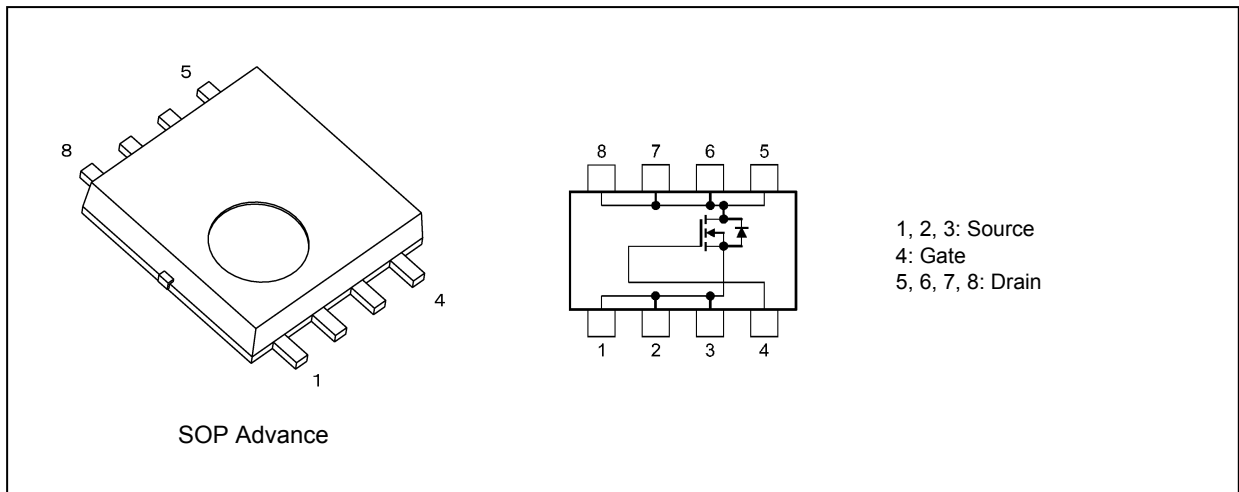
## 1. Applications

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

## 2. Features

- (1) Small footprint due to a small and thin package
- (2) High-speed switching
- (3) Small gate charge:  $Q_{SW} = 14 \text{ nC}$  (typ.)
- (4) Low drain-source on-resistance:  $R_{DS(ON)} = 2.6 \text{ m}\Omega$  (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:  $V_{th} = 1.3 \text{ to } 2.3 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 0.5 \text{ mA}$ )

## 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) (Note 1)                    | $I_D$     | 42         | A                |
| Drain current (pulsed) (Note 1)                | $I_{DP}$  | 126        |                  |
| Power dissipation ( $T_c = 25^\circ\text{C}$ ) | $P_D$     | 57         | W                |
| Power dissipation ( $t = 10$ s) (Note 2)       | $P_D$     | 2.8        | W                |
| Power dissipation ( $t = 10$ s) (Note 3)       | $P_D$     | 1.6        | W                |
| Single-pulse avalanche energy (Note 4)         | $E_{AS}$  | 229        | mJ               |
| Avalanche current                              | $I_{AR}$  | 42         | 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).

**5. Thermal Characteristics**

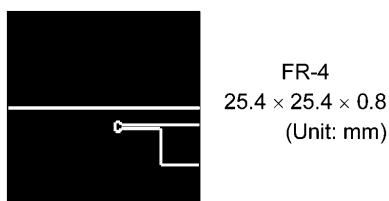
| Characteristics   | Symbol         | Max  | Unit               |
|---|----------------|------|--------------------|
| Channel-to-case thermal resistance ( $T_c = 25^\circ\text{C}$ ) | $R_{th(ch-c)}$ | 2.19 | $^\circ\text{C/W}$ |
| Channel-to-ambient thermal resistance ( $t = 10$ s) (Note 2)    | $R_{th(ch-a)}$ | 44.6 |                    |
| Channel-to-ambient thermal resistance ( $t = 10$ s) (Note 3)    | $R_{th(ch-a)}$ | 78.1 | $^\circ\text{C/W}$ |

Note 1: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

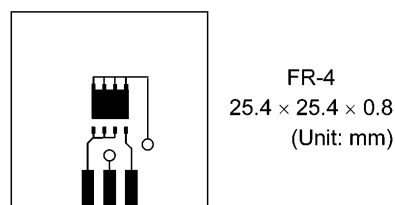
Note 2: Device mounted on a glass-epoxy board (a), Figure 5.1

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

Note 4:  $V_{DD} = 24$  V,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.1$  mH,  $R_G = 1$   $\Omega$ ,  $I_{AR} = 42$  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.

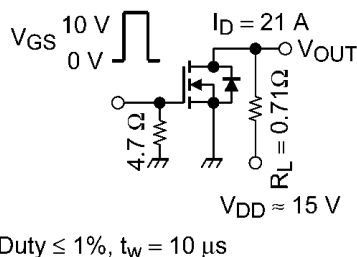
**6. Electrical Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

**6.1. Static Characteristics**

| 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         | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 0.5\text{ mA}$     | 1.3 | —    | 2.3       |                  |
| Drain-source on-resistance     | $R_{DS(ON)}$  | $V_{GS} = 4.5\text{ V}, I_D = 21\text{ A}$      | —   | 2.6  | 3.2       | $\text{m}\Omega$ |
|                                |               | $V_{GS} = 10\text{ V}, I_D = 21\text{ A}$       | —   | 2.0  | 2.6       |                  |

**6.2. Dynamic Characteristics**

| Characteristics                | Symbol    | Test Condition  | Min | Typ. | Max  | Unit        |
|--------------------------------|-----------|---|-----|------|------|-------------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | —   | 4300 | 5200 | $\text{pF}$ |
| Reverse transfer capacitance   | $C_{rss}$ |   | —   | 240  | 370  |             |
| Output capacitance             | $C_{oss}$ |   | —   | 810  | —    |             |
| Gate resistance                | $r_g$     | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 5\text{ MHz}$ | —   | 1.4  | 2.1  | $\Omega$    |
| Switching time (rise time)     | $t_r$     | See Figure 6.2.1.   | —   | 4.3  | —    | ns          |
| Switching time (turn-on time)  | $t_{on}$  |   | —   | 14   | —    |             |
| Switching time (fall time)     | $t_f$     |   | —   | 6.3  | —    |             |
| Switching time (turn-off time) | $t_{off}$ |   | —   | 52   | —    |             |



**Fig. 6.2.1 Switching Time Test Circuit**

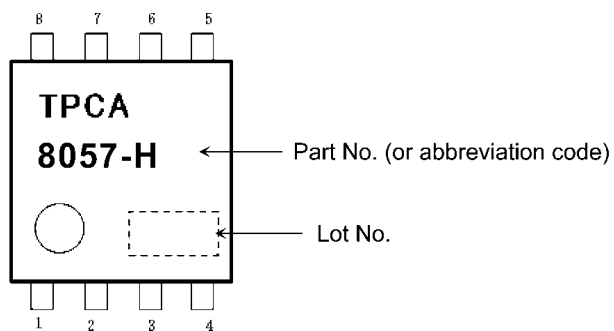
**6.3. Gate Charge Characteristics**

| Characteristics                                 | Symbol    | Test Condition  | Min | Typ. | Max | Unit |
|---|-----------|---|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$     | $V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 42\text{ A}$ | —   | 61   | —   | nC   |
|   |           | $V_{DD} \approx 24\text{ V}, V_{GS} = 5\text{ V}, I_D = 42\text{ A}$  | —   | 31   | —   |      |
| Gate-source charge 1                            | $Q_{gs1}$ | $V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 42\text{ A}$ | —   | 13   | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |   | —   | 7.7  | —   |      |
| Gate switch charge                              | $Q_{sw}$  |   | —   | 14   | —   |      |

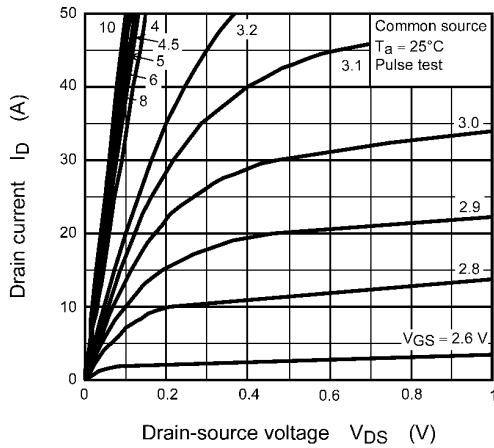
**6.4. Source-Drain Characteristics**

| Characteristics                       | Symbol    | Test Condition                              | Min | Typ. | Max  | Unit |
|---------------------------------------|-----------|---|-----|------|------|------|
| Pulsed reverse drain current (Note 5) | $I_{DRP}$ | —   | —   | —    | 126  | A    |
| Diode forward voltage                 | $V_{DSF}$ | $I_{DR} = 42\text{ A}, V_{GS} = 0\text{ V}$ | —   | —    | -1.2 | V    |

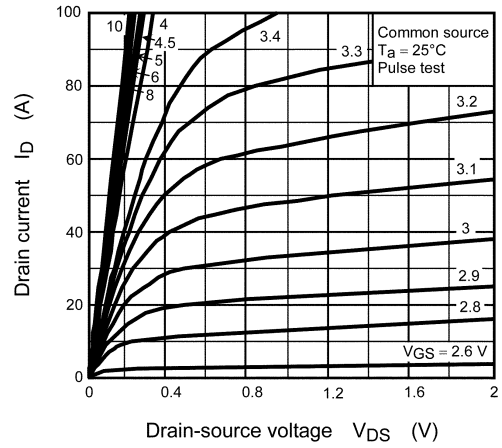
Note 5: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

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

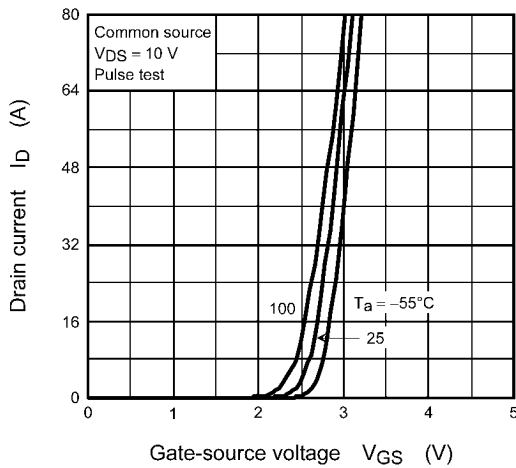
**8. Characteristics Curves (Note)**



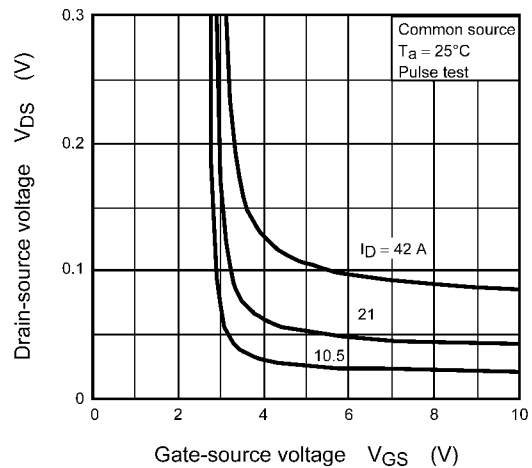
**Fig. 8.1  $I_D - V_{DS}$**



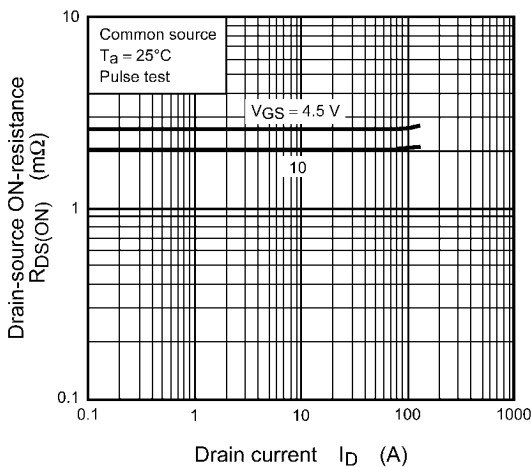
**Fig. 8.2  $I_D - V_{DS}$**



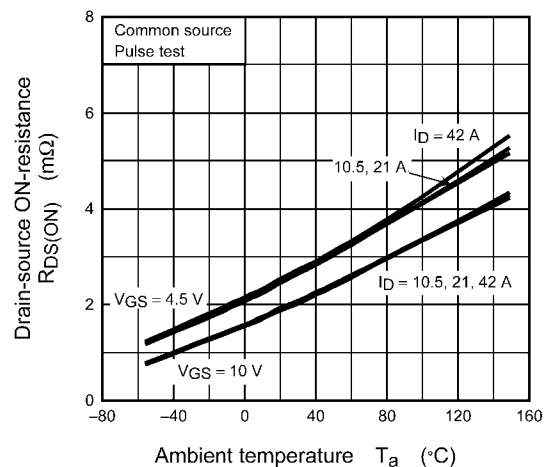
**Fig. 8.3  $I_D - V_{GS}$**



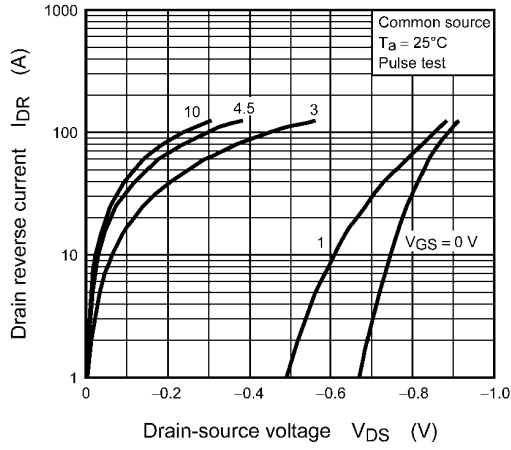
**Fig. 8.4  $V_{DS} - V_{GS}$**



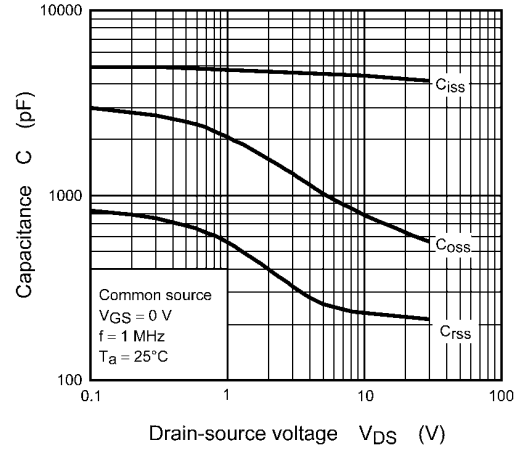
**Fig. 8.5  $R_{DS(ON)} - I_D$**



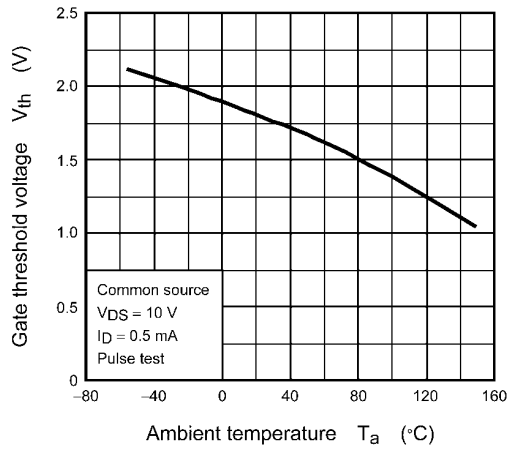
**Fig. 8.6  $R_{DS(ON)} - T_a$**



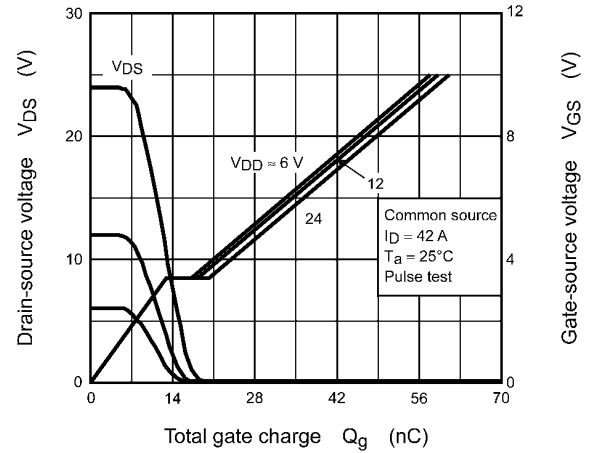
**Fig. 8.7  $I_{DR} - V_{DS}$**



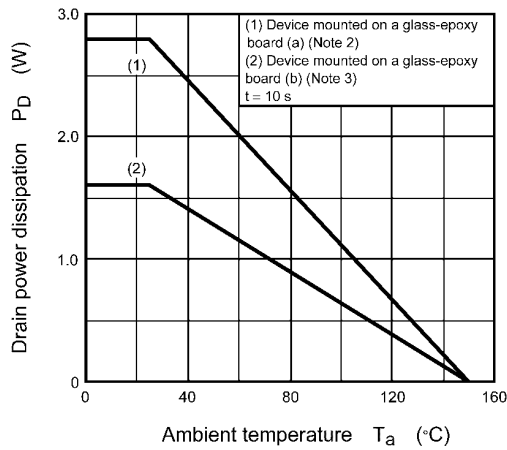
**Fig. 8.8 Capacitance -  $V_{DS}$**



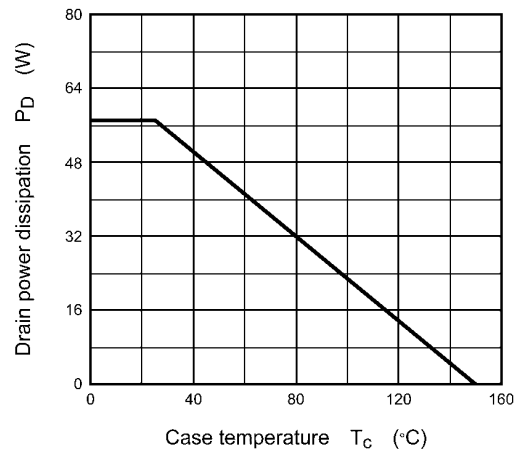
**Fig. 8.9  $V_{th} - T_a$**



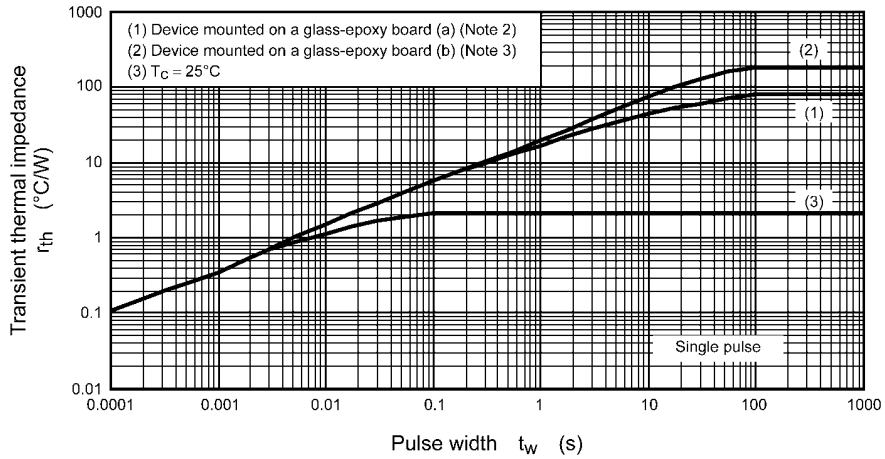
**Fig. 8.10 Dynamic Input/Output Characteristics**



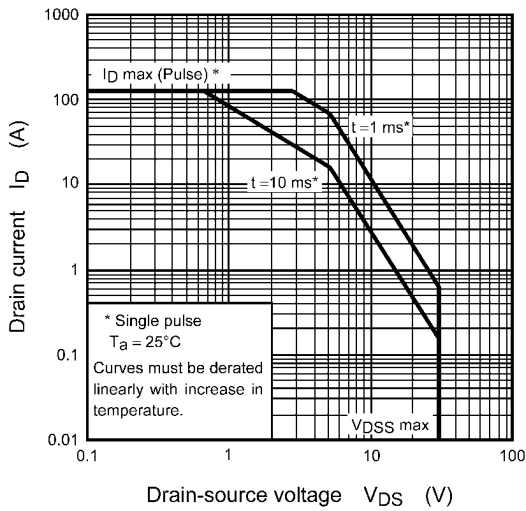
**Fig. 8.11  $P_D - T_a$   
(Guaranteed Maximum)**



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



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

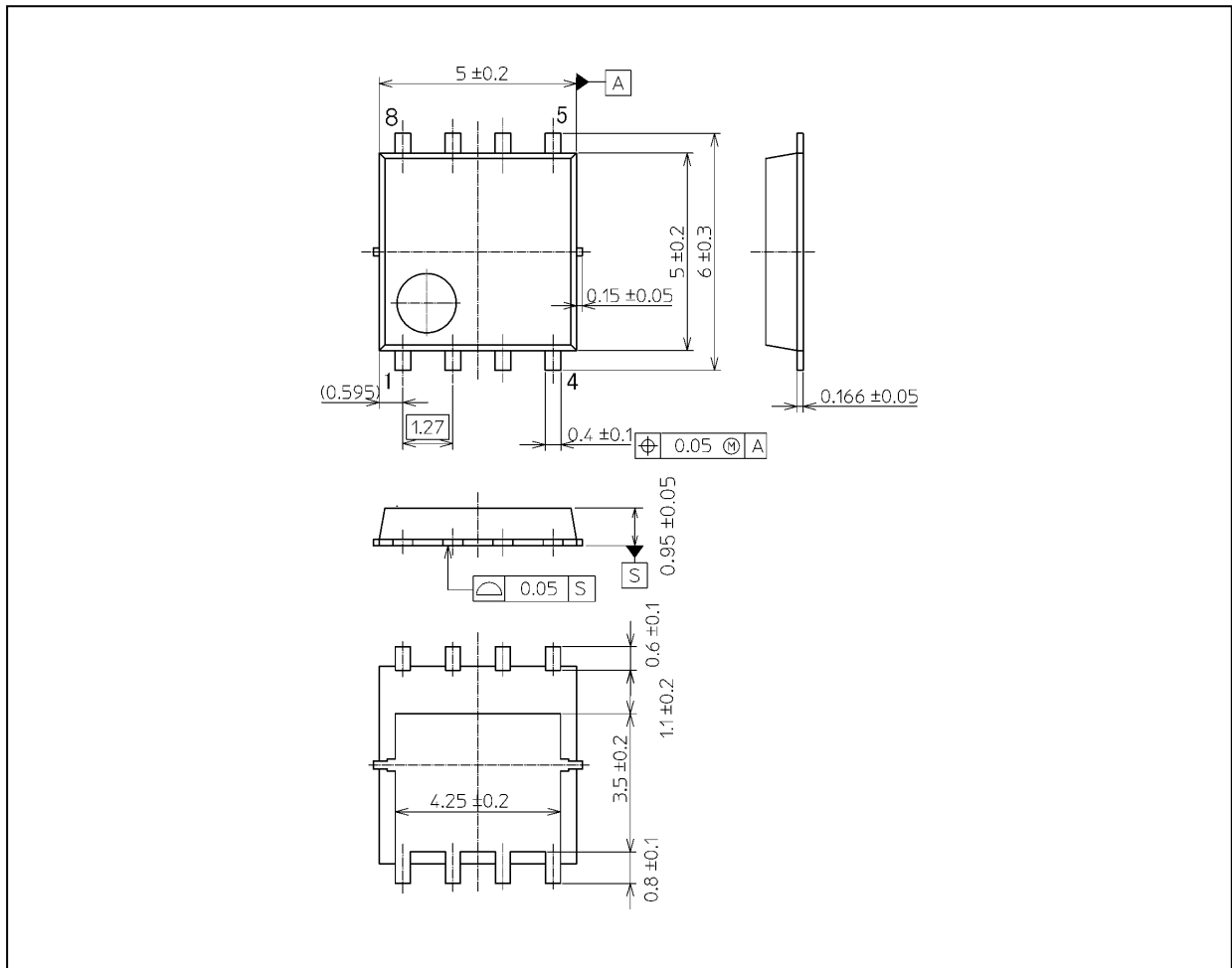


**Fig. 8.14 Safe Operating Area**  
(Guaranteed Maximum)

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

**Package Dimensions**

Unit: mm



Weight: 0.069 g (typ.)

| Package Name(s)       |
|-----------------------|
| TOSHIBA: 2-5Q1S       |
| Nickname: SOP Advance |



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