

# TK75J04K3Z

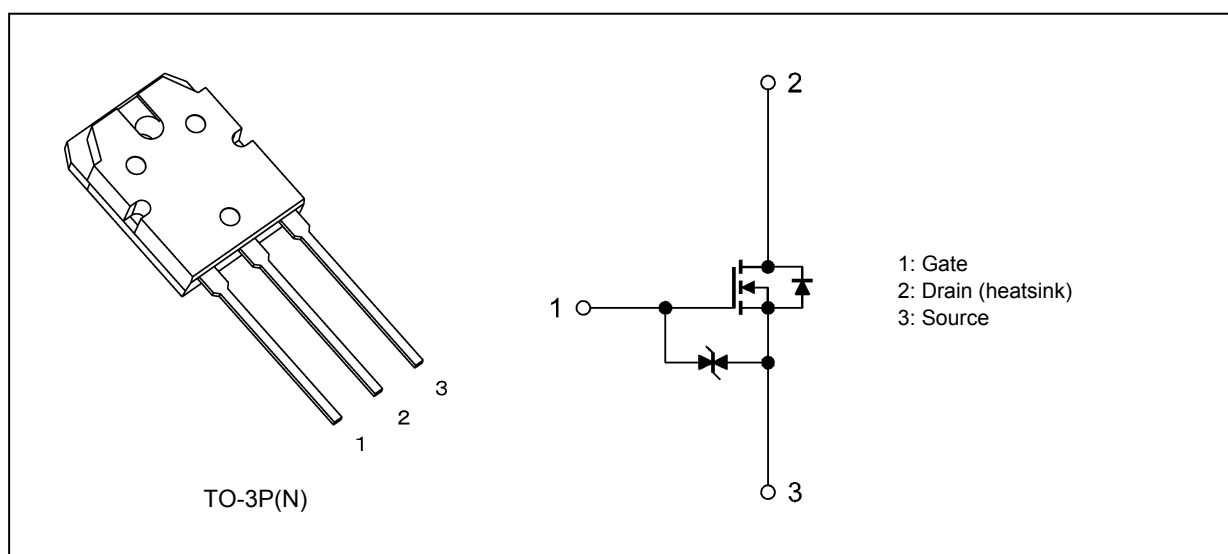
## 1. Applications

- Motor Drivers
- Switching Voltage Regulators

## 2. Features

- (1) Low drain-source on-resistance:  $R_{DS(ON)} = 2.2 \text{ m}\Omega$  (typ.) ( $V_{GS} = 10 \text{ V}$ )
- (2) Low leakage current:  $I_{DSS} = 10 \text{ }\mu\text{A}$  (max) ( $V_{DS} = 40 \text{ V}$ )
- (3) Enhancement mode:  $V_{th} = 3.0 \text{ to } 4.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

## 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                           | $V_{DSS}$ | 40         | V                |
| Gate-source voltage                            | $V_{GSS}$ | $\pm 20$   |                  |
| Drain current (DC) (Note 1)                    | $I_D$     | 75         | A                |
| Drain current (pulsed) (Note 1)                | $I_{DP}$  | 300        |                  |
| Power dissipation ( $T_c = 25^\circ\text{C}$ ) | $P_D$     | 150        | W                |
| Single-pulse avalanche energy (Note 2)         | $E_{AS}$  | 443        | mJ               |
| Avalanche current                              | $I_{AR}$  | 75         | A                |
| Channel temperature (Note 3)                   | $T_{ch}$  | 175        | $^\circ\text{C}$ |
| Storage temperature (Note 3)                   | $T_{stg}$ | -55 to 175 |                  |

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

2009-10

## 5. Thermal Characteristics

| Characteristics                       | Symbol         | Max | Unit |
|---------------------------------------|----------------|-----|------|
| Channel-to-case thermal resistance    | $R_{th(ch-c)}$ | 1.0 | °C/W |
| Channel-to-ambient thermal resistance | $R_{th(ch-a)}$ | 50  |      |

Note 1: Ensure that the channel temperature does not exceed 175°C.

Note 2:  $V_{DD} = 25\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 82\text{ }\mu\text{H}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AR} = 75\text{ A}$

Note 3: The definitions of the absolute maximum channel and storage temperatures are based on AEC-Q101.

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

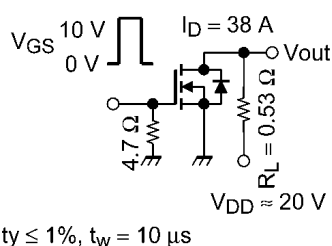
## 6. Electrical Characteristics

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

| Characteristics                | Symbol        | Test Condition                                  | Min | Typ. | Max      | Unit             |
|--------------------------------|---------------|-------------------------------------------------|-----|------|----------|------------------|
| Gate leakage current           | $I_{GSS}$     | $V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$ | —   | —    | $\pm 10$ | $\mu\text{A}$    |
| Drain cut-off current          | $I_{DSS}$     | $V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$     | —   | —    | 10       |                  |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$       | 40  | —    | —        | V                |
|                                | $V_{(BR)DSX}$ | $I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$     | 20  | —    | —        |                  |
| Gate threshold voltage         | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$       | 3.0 | —    | 4.0      |                  |
| Drain-source on-resistance     | $R_{DS(ON)}$  | $V_{GS} = 10\text{ V}, I_D = 38\text{ A}$       | —   | 2.2  | 3.0      | $\text{m}\Omega$ |

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

| Characteristics                | Symbol    | Test Condition                                                | Min | Typ. | Max | Unit |
|--------------------------------|-----------|---------------------------------------------------------------|-----|------|-----|------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | —   | 8450 | —   | pF   |
| Reverse transfer capacitance   | $C_{rss}$ |                                                               | —   | 1480 | —   |      |
| Output capacitance             | $C_{oss}$ |                                                               | —   | 2060 | —   |      |
| Switching time (rise time)     | $t_r$     | See Figure 6.2.1.                                             | —   | 35   | —   | ns   |
| Switching time (turn-on time)  | $t_{on}$  |                                                               | —   | 65   | —   |      |
| Switching time (fall time)     | $t_f$     |                                                               | —   | 50   | —   |      |
| Switching time (turn-off time) | $t_{off}$ |                                                               | —   | 150  | —   |      |



**Fig. 6.2.1 Switching Time Test Circuit**

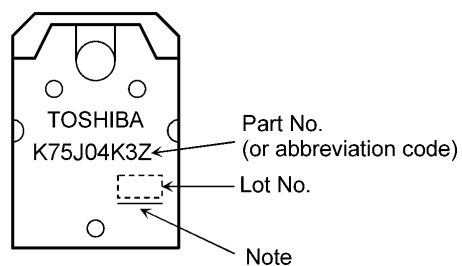
### 6.3. Gate Charge Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics                                 | Symbol   | Test Condition                                                                 | Min | Typ. | Max | Unit |
|-------------------------------------------------|----------|--------------------------------------------------------------------------------|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$    | $V_{DD} \approx 32 \text{ V}$ , $V_{GS} = 10 \text{ V}$ , $I_D = 70 \text{ A}$ | —   | 190  | —   | nC   |
| Gate-source charge                              | $Q_{gs}$ |                                                                                | —   | 108  | —   |      |
| Gate-drain charge                               | $Q_{gd}$ |                                                                                | —   | 82   | —   |      |

#### 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 (DC) (Note 4)     | $I_{DR}$  | —                                                                                         | —   | —    | 75   | A    |
| Reverse drain current (pulsed) (Note 4) | $I_{DRP}$ |                                                                                           | —   | —    | 300  |      |
| Diode forward voltage                   | $V_{DSF}$ | $I_{DR} = 75 \text{ A}, V_{GS} = 0 \text{ V}$                                             | —   | —    | -1.2 | V    |
| Reverse recovery time                   | $t_{rr}$  | $I_{DR} = 75 \text{ A}, V_{GS} = 0 \text{ V}$<br>$-dI_{DR}/dt = 50 \text{ A}/\mu\text{s}$ | —   | 65   | —    | ns   |
| Reverse recovery charge                 | $Q_{rr}$  |                                                                                           | —   | 46   | —    | nC   |

Note 4: Ensure that the channel temperature does not exceed 175°C.

**7. Marking (Note)****Fig. 7.1 Marking**

Note: A line under a Lot No. identifies the indication of product Labels.

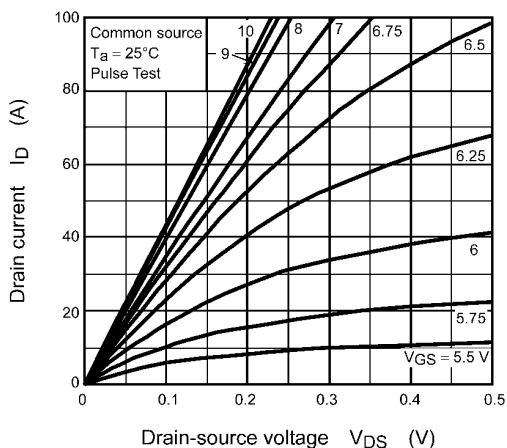
Not underlined: [[Pb]]/INCLUDES > MCV

Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

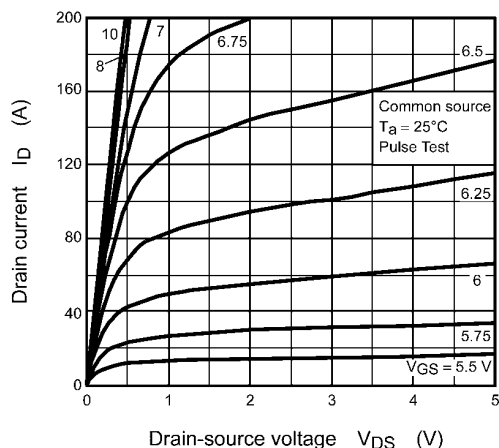
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

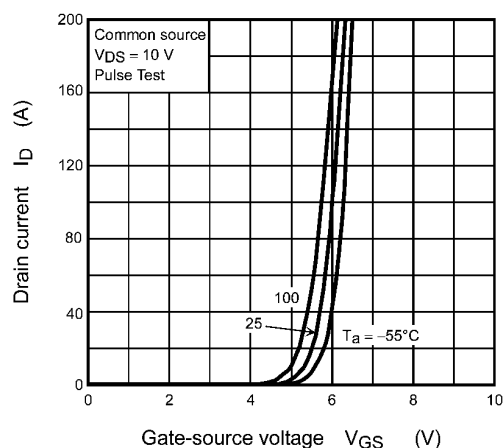
# 8. Characteristics Curves (Note)



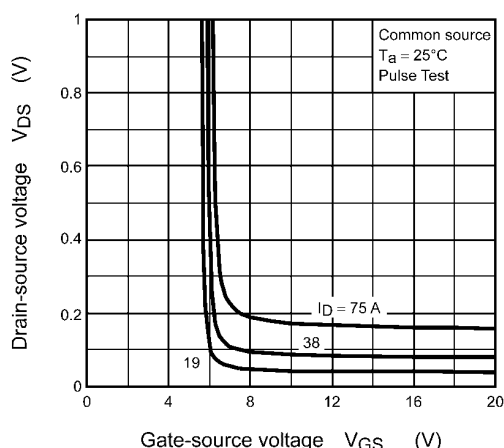
**Fig. 8.1  $I_D - V_{DS}$**



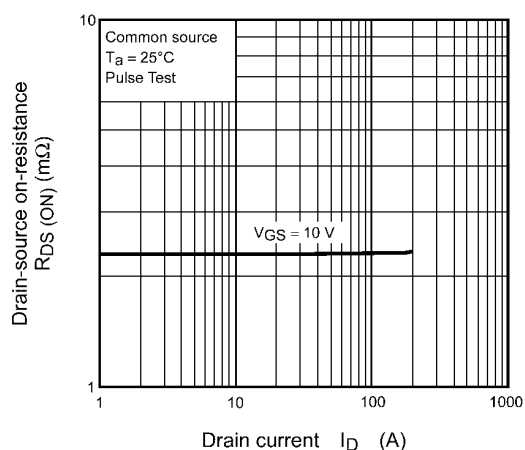
**Fig. 8.2  $I_D - V_{DS}$**



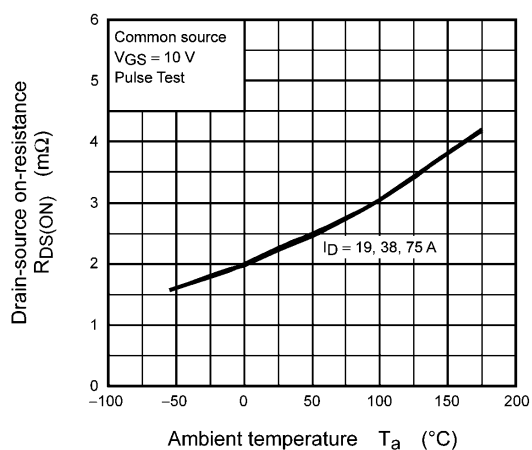
**Fig. 8.3  $I_D - V_{GS}$**



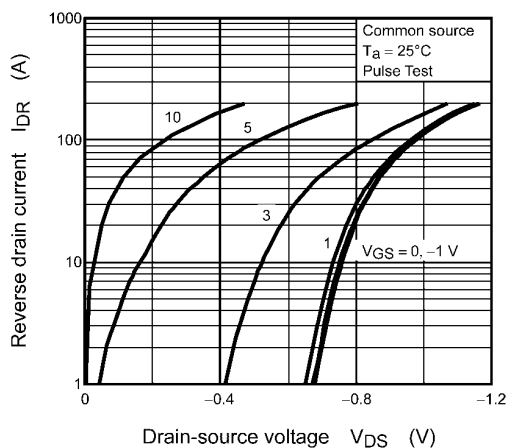
**Fig. 8.4  $V_{DS} - V_{GS}$**



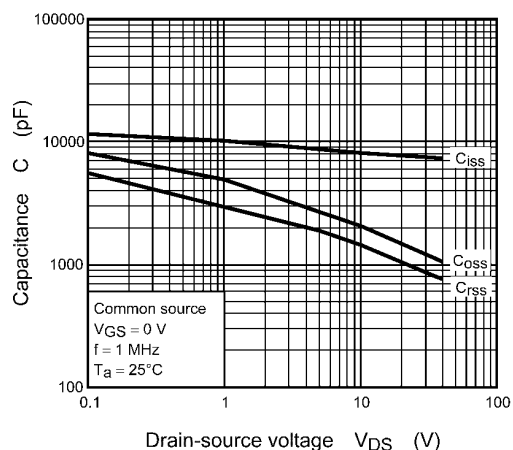
**Fig. 8.5  $R_{DS(ON)} - I_D$**



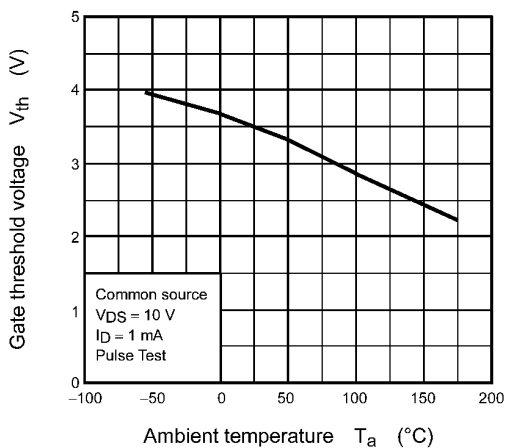
**Fig. 8.6  $R_{DS(ON)} - T_a$**



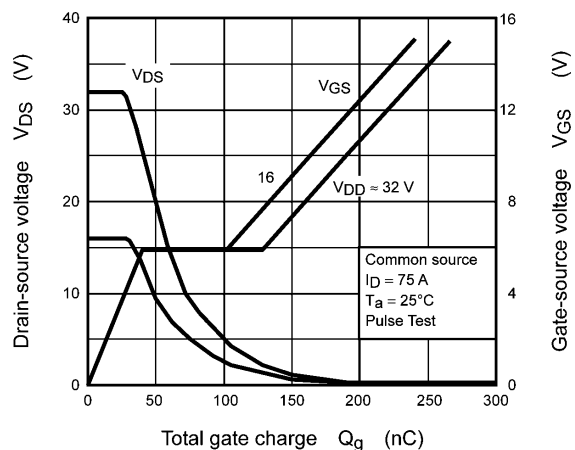
**Fig. 8.7  $I_{DR} - V_{DS}$**



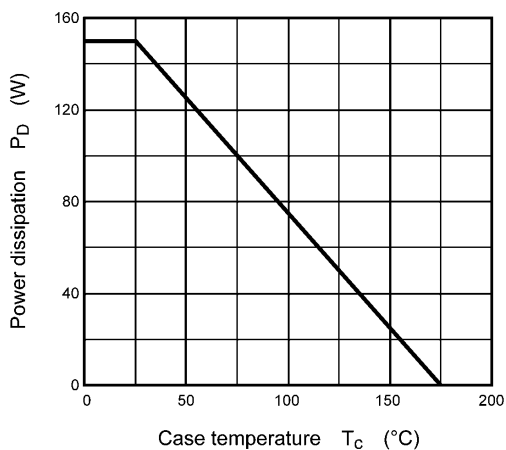
**Fig. 8.8 Capacitance -  $V_{DS}$**



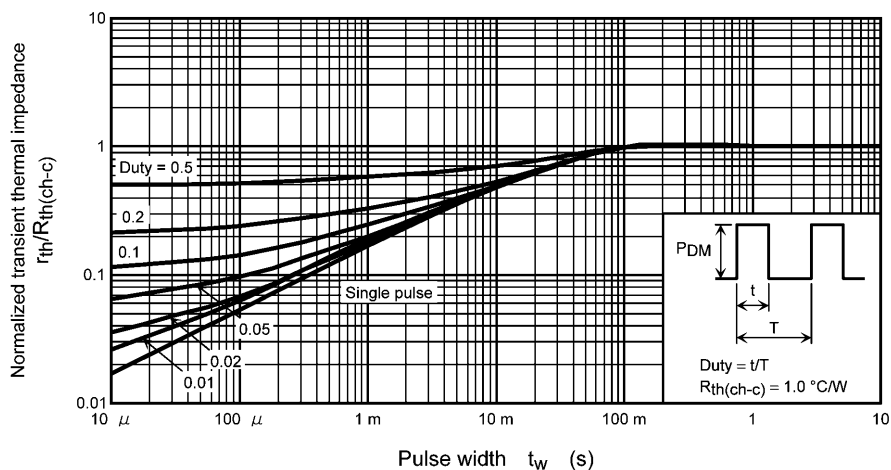
**Fig. 8.9  $V_{th} - T_a$**



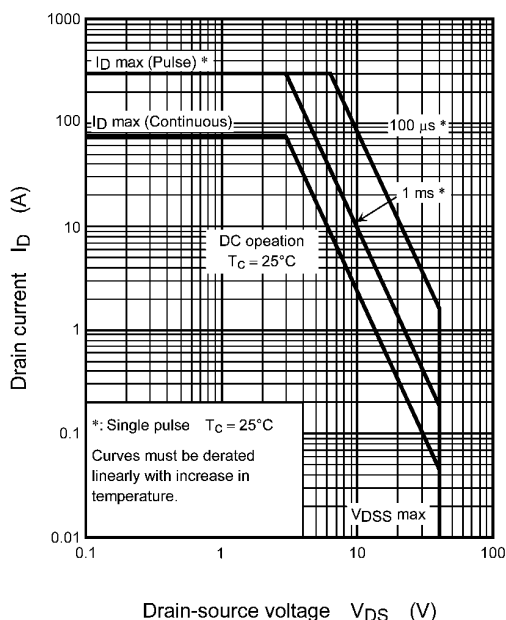
**Fig. 8.10 Dynamic Input/Output Characteristics**



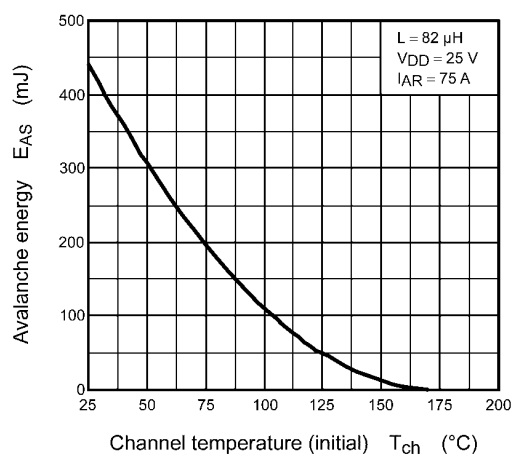
**Fig. 8.11  $P_D - T_c$   
(Guaranteed Maximum)**



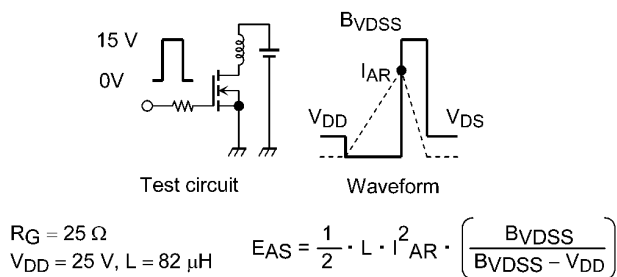
**Fig. 8.12  $r_{th}/R_{th(ch-c)} - t_w$**   
(Guaranteed Maximum)



**Fig. 8.13 Safe Operating Area**  
(Guaranteed Maximum)



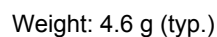
**Fig. 8.14  $E_{AS} - T_{ch}$**   
(Guaranteed Maximum)



**Fig. 8.15 Test Circuit/Waveform**

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

## Unit: mm



| Package Name(s)    |
|--------------------|
| JEITA: SC-65       |
| TOSHIBA: 2-16C1S   |
| Nickname: TO-3P(N) |

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