

TK31V60X

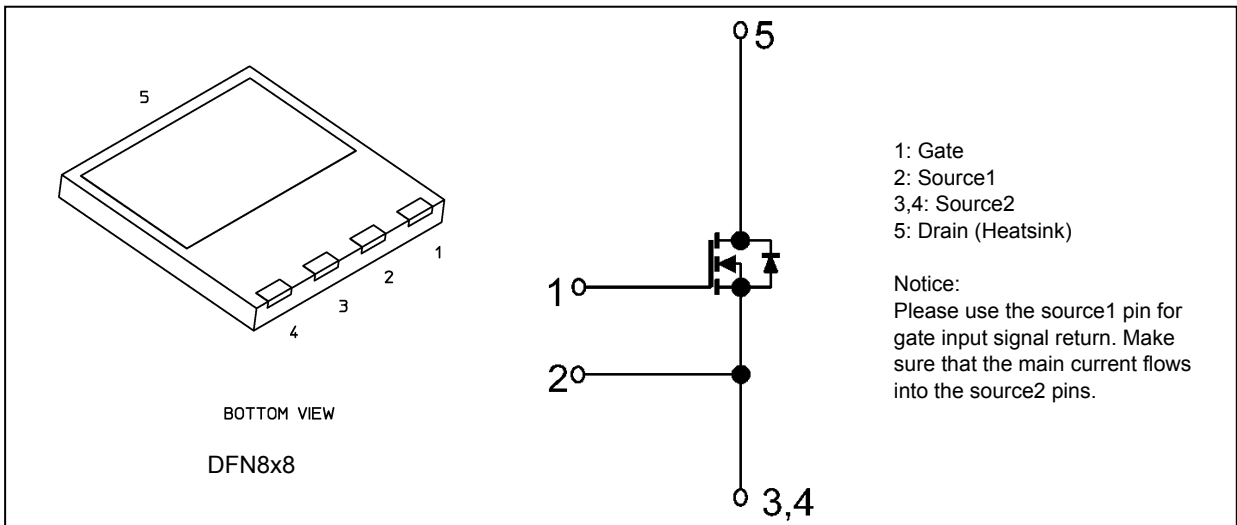
1. Applications

- Switching Voltage Regulators

2. Features

- (1) Low drain-source on-resistance: $R_{DS(ON)} = 0.078 \Omega$ (typ.)
by used to Super Junction Structure : DTMOS
- (2) High-speed switching properties with lower capacitance.
- (3) Enhancement mode: $V_{th} = 2.5$ to 3.5 V ($V_{DS} = 10$ V, $I_D = 1.5$ 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} | 600 | V |
| Gate-source voltage | V_{GSS} | ± 30 | |
| Drain current (DC) | I_D | 30.8 | A |
| Drain current (pulsed) | I_{DP} | 123 | |
| Power dissipation | P_D | 240 | W |
| Single-pulse avalanche energy | E_{AS} | 338 | mJ |
| Avalanche current | I_{AR} | 7.7 | A |
| Reverse drain current (DC) | I_{DR} | 30.8 | |
| Reverse drain current (pulsed) | I_{DRP} | 123 | |
| 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

2014-02

5. Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|------------------------------------|----------------|------|------|
| Channel-to-case thermal resistance | $R_{th(ch-c)}$ | 0.52 | °C/W |

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

Note 2: $V_{DD} = 90\text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 10\text{ mH}$, $R_G = 25\ \Omega$, $I_{AR} = 7.7\text{ A}$

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} | $V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$ | — | — | ± 1 | μA |
| Drain cut-off current | I_{DSS} | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | — | — | 10 | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$ | 600 | — | — | V |
| Gate threshold voltage | V_{th} | $V_{DS} = 10\text{ V}, I_D = 1.5\text{ mA}$ | 2.5 | — | 3.5 | |
| Drain-source on-resistance | $R_{DS(ON)}$ | $V_{GS} = 10\text{ V}, I_D = 9.4\text{ A}$ | — | 0.078 | 0.098 | Ω |

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} | $V_{DS} = 300\text{ V}, V_{GS} = 0\text{ V}, f = 100\text{ kHz}$ | — | 3000 | — | pF |
| Reverse transfer capacitance | C_{rss} | | — | 7 | — | |
| Output capacitance | C_{oss} | | — | 70 | — | |
| Effective output capacitance | $C_{o(er)}$ | $V_{DS} = 0\text{ to }400\text{ V}, V_{GS} = 0\text{ V}$ | — | 123 | — | |
| Gate resistance | r_g | $V_{DS} = \text{OPEN}, f = 1\text{ MHz}$ | — | 1.8 | — | Ω |
| Switching time (rise time) | t_r | See Figure 6.2.1 | — | 22 | — | ns |
| Switching time (turn-on time) | t_{on} | | — | 55 | — | |
| Switching time (fall time) | t_f | | — | 6 | — | |
| Switching time (turn-off time) | t_{off} | | — | 130 | — | |
| MOSFET dv/dt ruggedness | dv/dt | $V_{DD} = 0\text{ to }400\text{ V}, I_D = 7.7\text{ A}$ | 50 | — | — | V/ns |

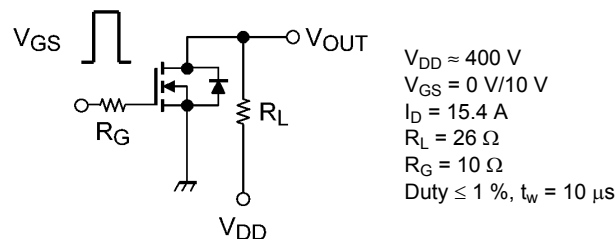


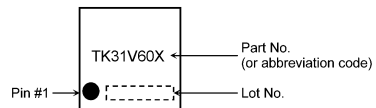
Fig. 6.2.1 Switching Time Test Circuit

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 | $V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V}, I_D = 30.8\text{ A}$ | — | 65 | — | nC |
| Gate-source charge 1 | Q_{gs1} | | — | 19 | — | |
| Gate-drain charge | Q_{gd} | | — | 22 | — | |

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|-------------------------------|-----------|--|-----|------|------|---------------|
| Diode forward voltage | V_{DSF} | $I_{DR} = 30.8\text{ A}, V_{GS} = 0\text{ V}$ | — | — | -1.7 | V |
| Reverse recovery time | t_{rr} | $I_{DR} = 15.4\text{ A}, V_{GS} = 0\text{ V}$ $-dI_{DR}/dt = 50\text{ A}/\mu\text{s}$ | — | 410 | — | ns |
| Reverse recovery charge | Q_{rr} | | — | 3.5 | — | μC |
| Peak reverse recovery current | I_{rr} | | — | 17 | — | A |
| Diode dv/dt ruggedness | dv/dt | $I_{DR} = 15.4\text{ A}, V_{GS} = 0\text{ V}, V_{DD} = 400\text{ V}$ | 15 | — | — | V/ns |

7. Marking**Fig. 7.1 Marking**

8. Characteristics Curves (Note)

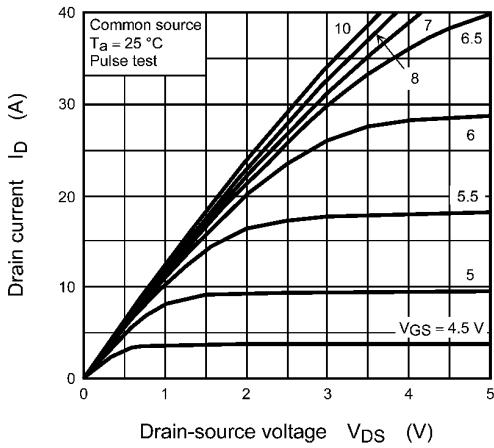


Fig. 8.1 $I_D - V_{DS}$

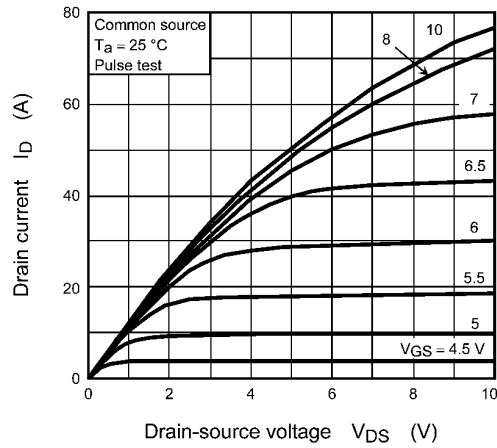


Fig. 8.2 $I_D - V_{DS}$

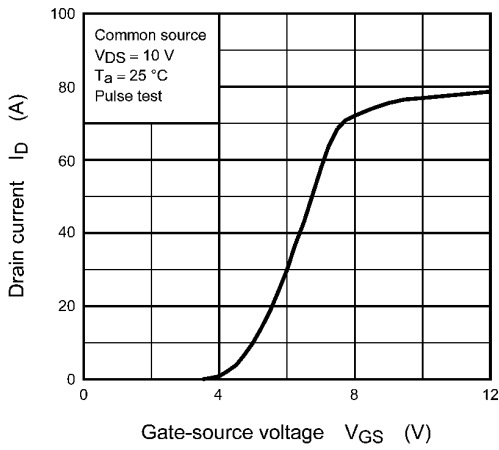


Fig. 8.3 $I_D - V_{GS}$

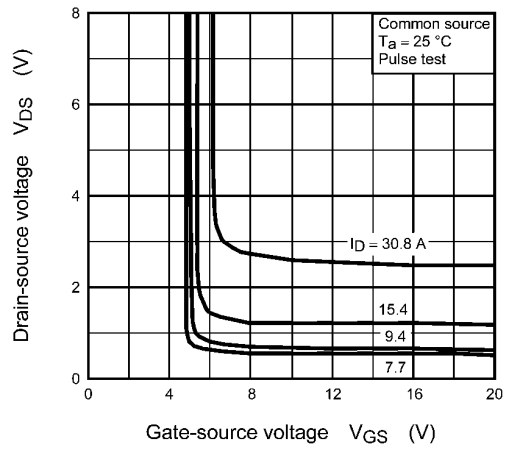


Fig. 8.4 $V_{DS} - V_{GS}$

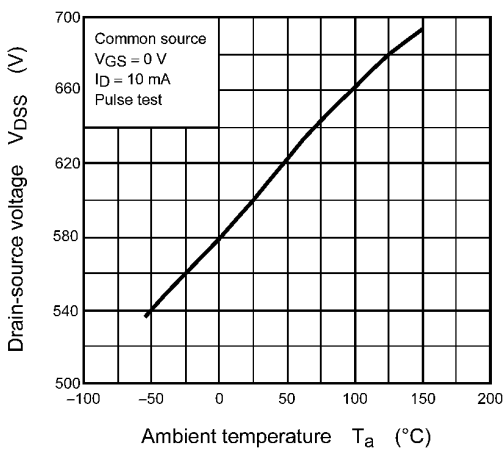


Fig. 8.5 $V_{DSS} - T_a$

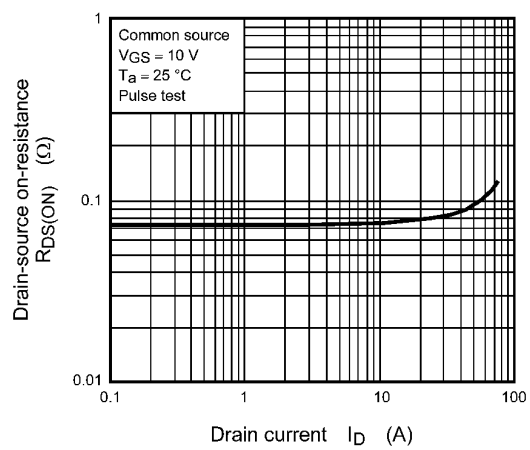


Fig. 8.6 $R_{DS(ON)} - I_D$

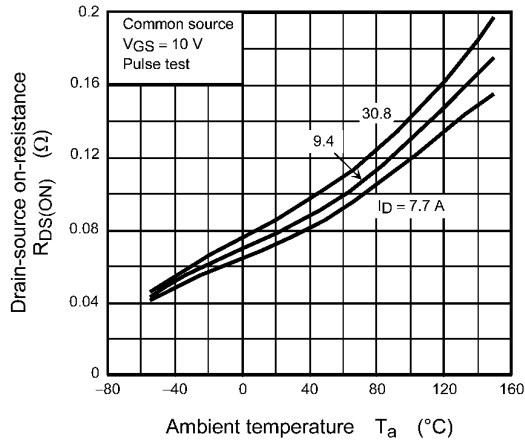


Fig. 8.7 $R_{DS(ON)} - T_a$

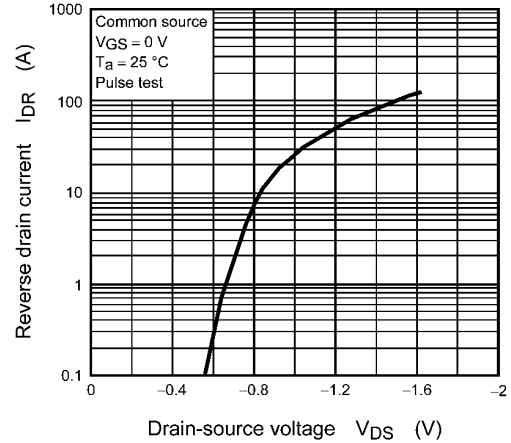


Fig. 8.8 $I_{DR} - V_{DS}$

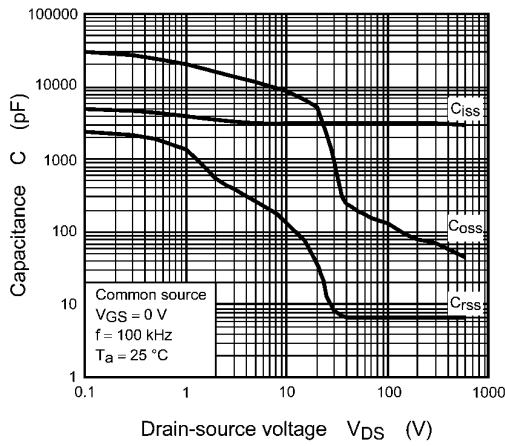


Fig. 8.9 $C - V_{DS}$

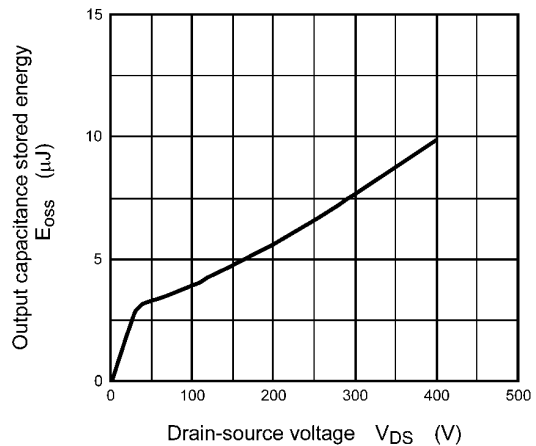


Fig. 8.10 $E_{oss} - V_{DS}$

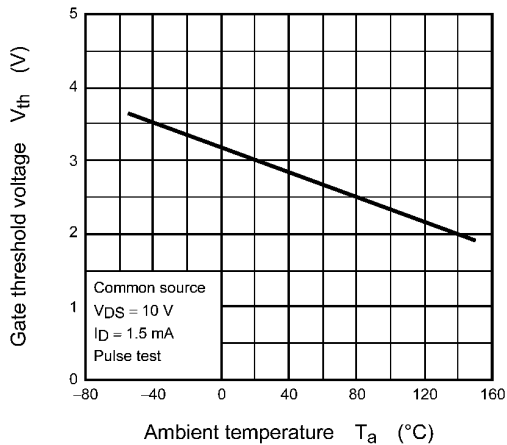


Fig. 8.11 $V_{th} - T_a$

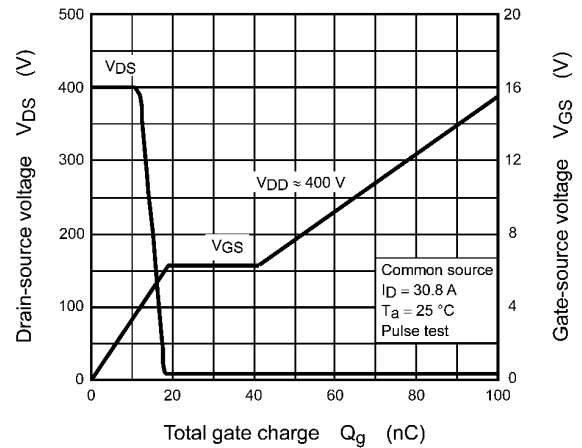


Fig. 8.12 Dynamic Input/Output Characteristics

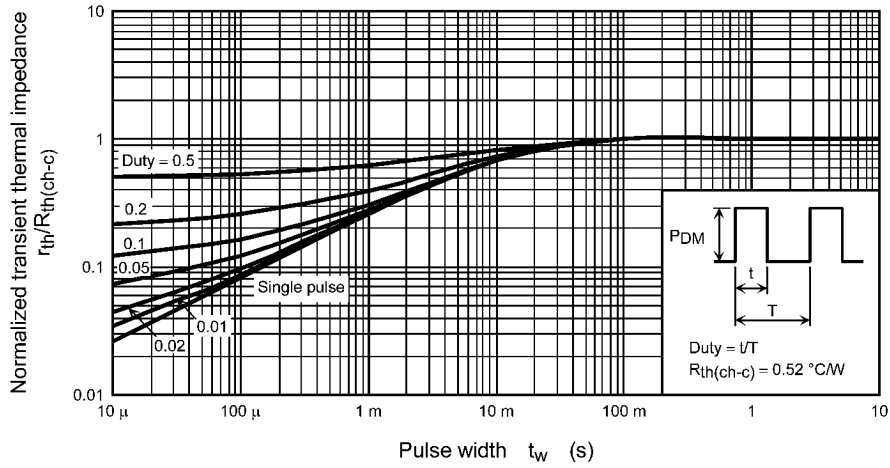


Fig. 8.13 $r_{th} - t_w$
(Guaranteed Maximum)

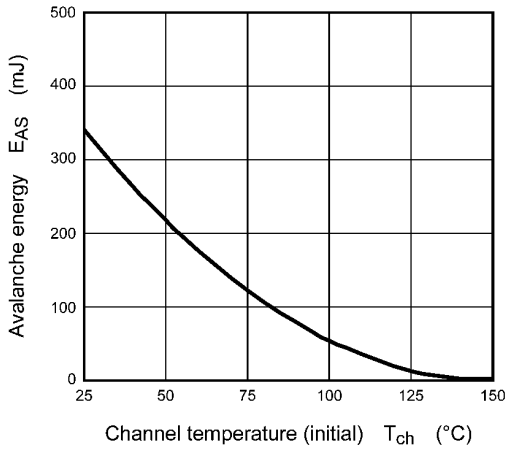


Fig. 8.14 $E_{AS} - T_{ch}$
(Guaranteed Maximum)

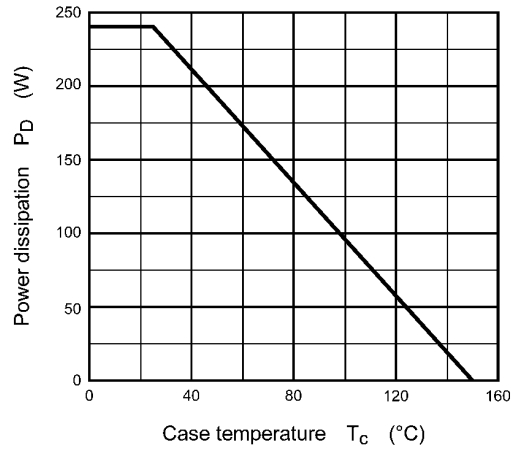
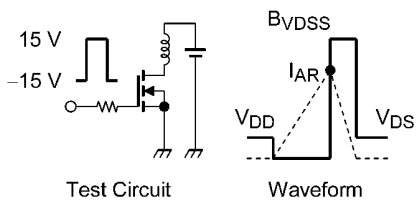


Fig. 8.15 $P_D - T_c$
(Guaranteed Maximum)



$$R_G = 25 \Omega, V_{DD} = 90 \text{ V} \quad E_{AS} = \frac{1}{2} \cdot L \cdot I_{AR}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

Fig. 8.16 Test Circuit/Waveform

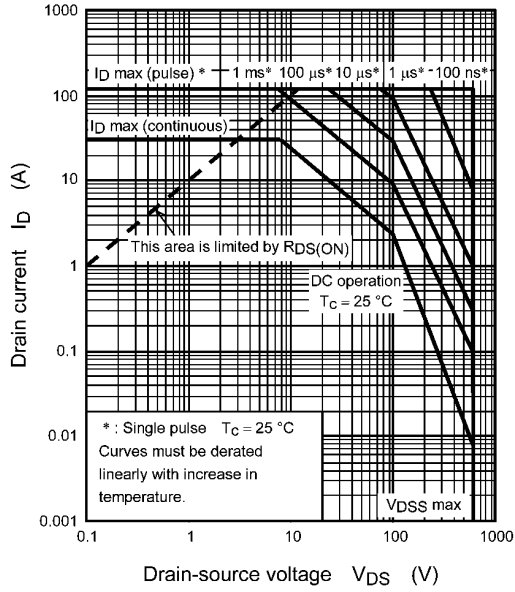


Fig. 8.17 Safe Operating Area (Guaranteed Maximum)

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

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