# TK40A06N1-VB Datasheet

# N-Channel 60-V (D-S) MOSFET

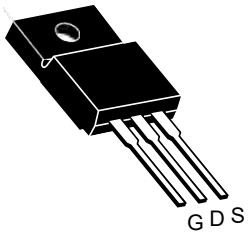
| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $I_D$ (A)[a] |
| 60 | 0.010 at $V_{GS}$ = 10 V | 70 |
| | 0.012 at $V_{GS}$ = 4.5 V | 55 |

## FEATURES

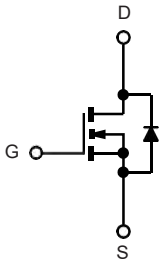
- 175 °C Junction Temperature
- Trench Power MOSFET
- Material categorization:

RoHS COMPLIANT

**TO-220 FULLPAK**




Top View




N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ($T_C$ = 25 °C, unless otherwise noted) | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | V |
| Continuous Drain Current ($T_J$ = 175 °C)[b] | $T_C$ = 25 °C | $I_D$ | 70 | A |
| | $T_C$ = 100 °C | | 50[a] | |
| Pulsed Drain Current | | $I_{DM}$ | 200 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 50[a] | |
| Avalanche Current | | $I_{AS}$ | 50 | |
| Single Avalanche Energy (Duty Cycle ≤ 1 %) | L = 0.1 mH | $E_{AS}$ | 125 | mJ |
| Maximum Power Dissipation | $T_C$ = 25 °C | $P_D$ | 136 | W |
| | $T_A$ = 25 °C | | 3[b], 8.3[b, c] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 175 | °C |

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Typical** | **Maximum** | **Unit** |
| Maximum Junction-to-Ambient[a] | t ≤ 10 sec | $R_{thJA}$ | 15 | 18 | °C/W |
| | Steady State | | 40 | 50 | |
| Maximum Junction-to-Case | | $R_{thJC}$ | 0.85 | 1.1 | |

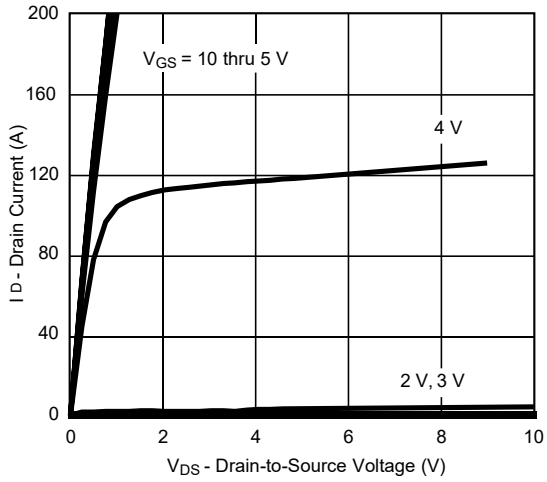
Notes:
a. Package limited.
b. Surface mounted on 1" x 1" FR4 board.
c. t ≤ 10 s.

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.[a]** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 60 | | | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 1 | 2 | 3 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | | | 1 | µA |
| | | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | | 50 | |
| | | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V, $T_J$ = 175 °C | | | 250 | |
| On-State Drain Current[b] | $I_{D(on)}$ | $V_{DS}$ = 5 V, $V_{GS}$ = 10 V | 60 | | | A |
| Drain-Source On-State Resistance[b] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 20 A | | 0.010 | | Ω |
| | | $V_{GS}$ = 10 V, $I_D$ = 20 A, $T_J$ = 125 °C | | 0.016 | | |
| | | $V_{GS}$ = 10 V, $I_D$ = 20 A, $T_J$ = 175 °C | | 0.020 | | |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 15 A | | 0.012 | | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 20 A | | 60 | | S |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1 MHz | | 2650 | | pF |
| Output Capacitance | $C_{oss}$ | | | 470 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 225 | | |
| Total Gate Charge[c] | $Q_g$ | $V_{DS}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 50 A | | 47 | 70 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | 10 | | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | 12 | | |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 30 V, $R_L$ = 0.6 Ω<br>$I_D$ ≅ 50 A, $V_{GEN}$ = 10 V, $R_g$ = 2.5 Ω | | 10 | 20 | ns |
| Rise Time[c] | $t_r$ | | | 15 | 25 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | 35 | 50 | |
| Fall Time[c] | $t_f$ | | | 20 | 30 | |
| **Source-Drain Diode Ratings and Characteristics** ($T_C$ = 25 °C) | | | | | | |
| Pulsed Current | $I_{SM}$ | | | | 70 | A |
| Diode Forward Voltage | $V_{SD}$ | $I_F$ = 20 A, $V_{GS}$ = 0 V | | 1 | 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 20 A, di/dt = 100 A/µs | | 45 | 100 | ns |

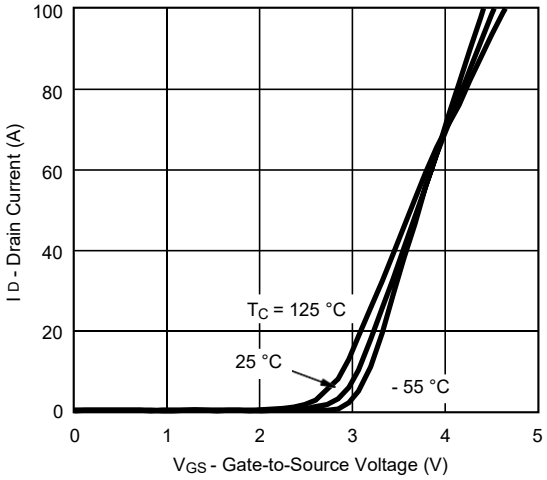
Notes:
a. For design aid only; not subject to production testing.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. Independent of operating temperature.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

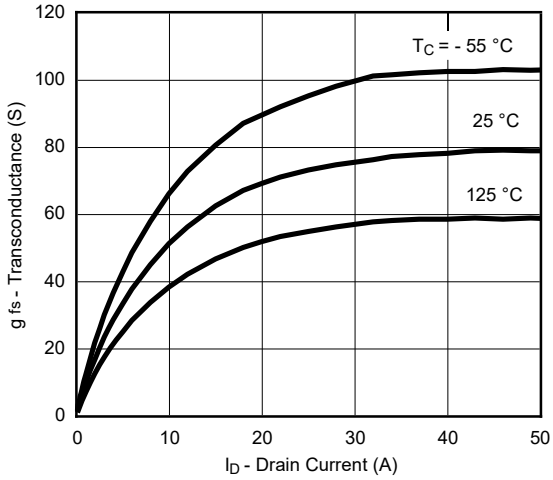
**TYPICAL CHARACTERISTICS** (25 °C unless noted)



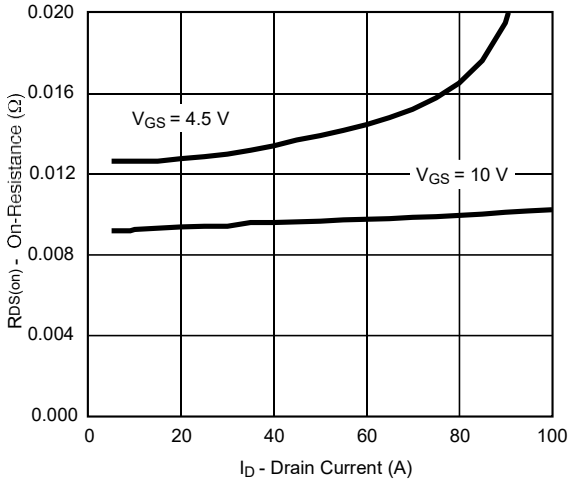

**Output Characteristics**



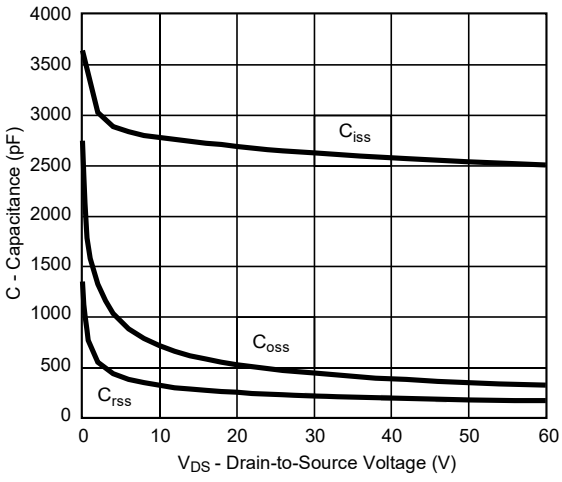

**Transfer Characteristics**



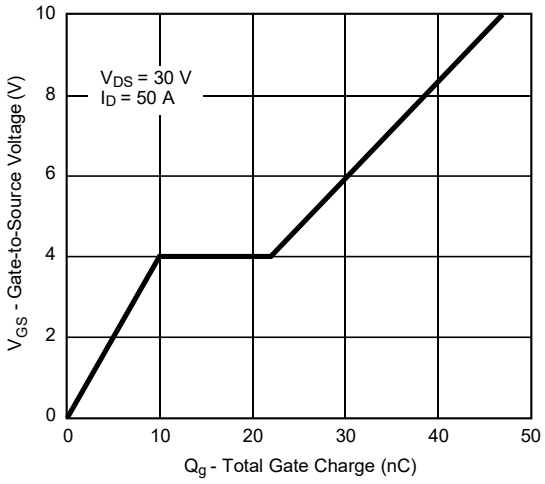

**Transconductance**




**On-Resistance vs. Drain Current**

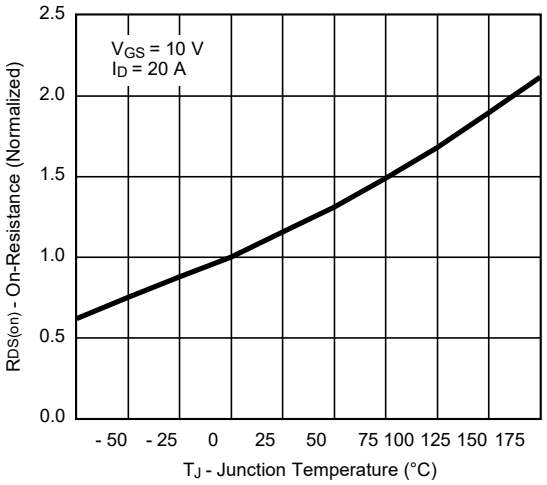



**Capacitance**

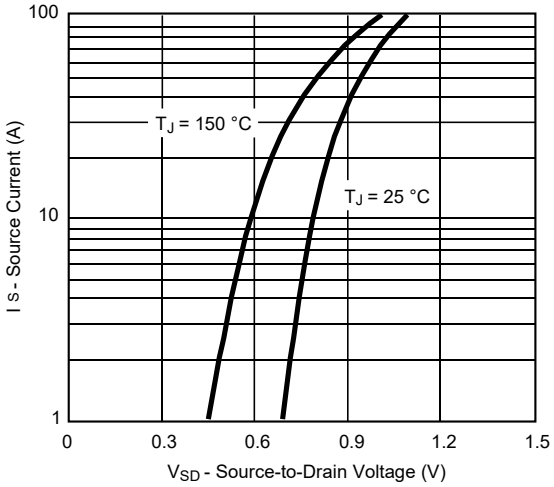



**Gate Charge**

**TYPICAL CHARACTERISTICS** (25 °C unless noted)

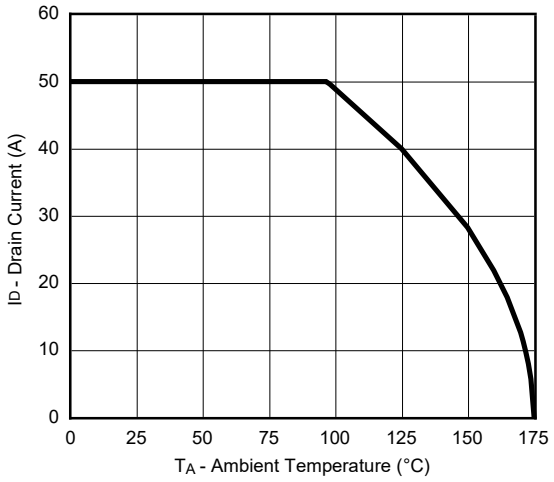



**On-Resistance vs. Junction Temperature**

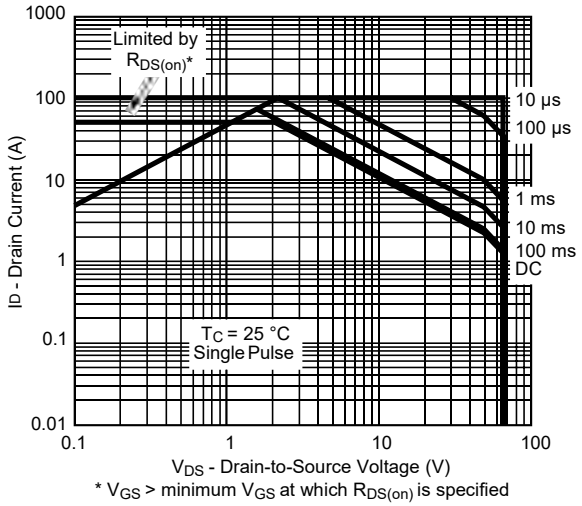



**Source-Drain Diode Forward Voltage**

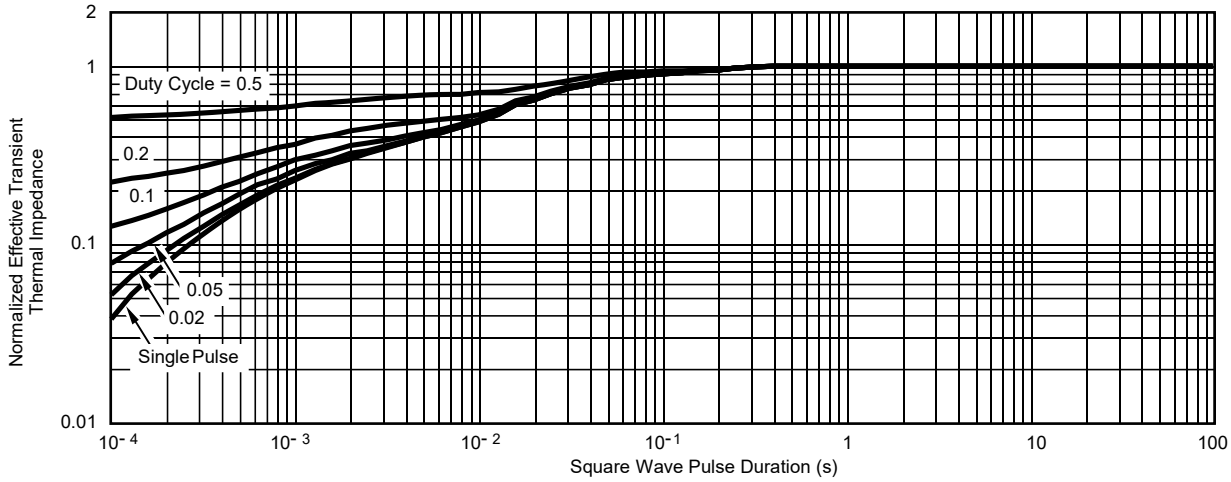
## THERMAL RATINGS




**Maximum Drain Current vs. Ambient Temperature**

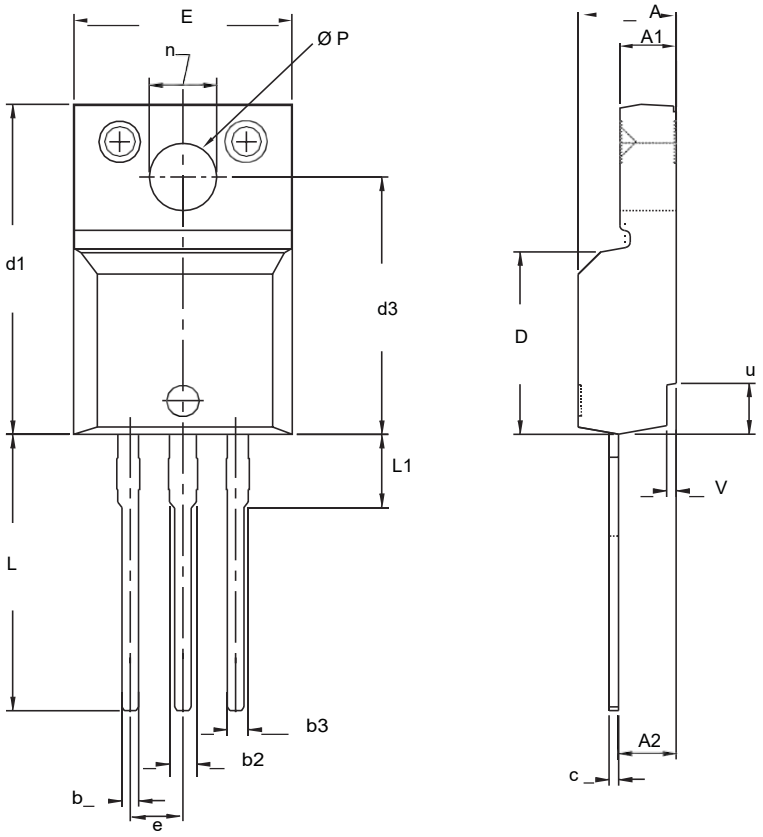



**Safe Operating Area**




**Normalized Thermal Transient Impedance, Junction-to-Case**

## TO-220 FULLPAK (HIGH VOLTAGE)




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| **DIM.** | **MIN.** | **MAX.** | **MIN.** | **MAX.** |
| A | 4.570 | 4.830 | 0.180 | 0.190 |
| A1 | 2.570 | 2.830 | 0.101 | 0.111 |
| A2 | 2.510 | 2.850 | 0.099 | 0.112 |
| b | 0.622 | 0.890 | 0.024 | 0.035 |
| b2 | 1.229 | 1.400 | 0.048 | 0.055 |
| b3 | 1.229 | 1.400 | 0.048 | 0.055 |
| c | 0.440 | 0.629 | 0.017 | 0.025 |
| D | 8.650 | 9.800 | 0.341 | 0.386 |
| d1 | 15.88 | 16.120 | 0.622 | 0.635 |
| d3 | 12.300 | 12.920 | 0.484 | 0.509 |
| E | 10.360 | 10.630 | 0.408 | 0.419 |
| e | 2.54 BSC | | 0.100 BSC | |
| L | 13.200 | 13.730 | 0.520 | 0.541 |
| L1 | 3.100 | 3.500 | 0.122 | 0.138 |
| n | 6.050 | 6.150 | 0.238 | 0.242 |
| Ø P | 3.050 | 3.450 | 0.120 | 0.136 |
| u | 2.400 | 2.500 | 0.094 | 0.098 |
| v | 0.400 | 0.500 | 0.016 | 0.020 |
| ECN: X09-0126-Rev. B, 26-Oct-09<br>DWG: 5972 | | | | |

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet $C_{pk}$ > 1.33.
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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