# N-Channel Power MOSFET

600V, 9.5A, 0.38Ω

## FEATURES

- Super-Junction technology
- High performance due to small figure-of-merit
- High ruggedness performance
- High commutation performance
- Pb-free plating
- Compliant to RoHS Directive 2011/65/EU and in accordance to WEEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21

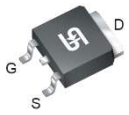
| KEY PERFORMANCE PARAMETERS | | |
|---|---|---|
| **PARAMETER** | **VALUE** | **UNIT** |
| $V_{DS}$ | 600 | V |
| $R_{DS(on)}$ (max) | 0.38 | Ω |
| $Q_g$ | 19.4 | nC |

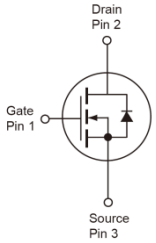
Pb-Free RoHS COMPLIANT HALOGEN FREE

## APPLICATIONS

- Power Supply
- Lighting

**TO-252 (DPAK)**




**Note:** MSL 3 (Moisture Sensitivity Level) per J-STD-020

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C unless otherwise noted) | | | | |
|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | **IPAK/DPAK** | **UNIT** |
| Drain-Source Voltage | | $V_{DS}$ | 600 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | V |
| Continuous Drain Current (Note 1) | $T_C$ = 25°C | $I_D$ | 9.5 | A |
| | $T_C$ = 100°C | | 6 | A |
| Pulsed Drain Current (Note 2) | | $I_{DM}$ | 28.5 | A |
| Total Power Dissipation @ $T_C$ = 25°C | | $P_{DTOT}$ | 83 | W |
| Single Pulsed Avalanche Energy (Note 3) | | $E_{AS}$ | 64 | mJ |
| Single Pulsed Avalanche Current (Note 3) | | $I_{AS}$ | 1.6 | A |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | - 55 to +150 | °C |

| THERMAL PERFORMANCE | | | |
|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **IPAK/DPAK** | **UNIT** |
| Junction to Case Thermal Resistance | $R_{\Theta JC}$ | 1.5 | °C/W |
| Junction to Ambient Thermal Resistance | $R_{\Theta JA}$ | 62 | °C/W |

**Thermal Performance Note:** $R_{\Theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistances. The case-thermal reference is defined at the solder mounting surface of the drain pins. $R_{\Theta JA}$ is guaranteed by design while $R_{\Theta CA}$ is determined by the user's board design. $R_{\Theta JA}$ shown below for single device operation on FR-4 PCB in still air.

| ELECTRICAL SPECIFICATIONS ($T_A$ = 25°C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **CONDITIONS** | **SYMBOL** | **MIN** | **TYP** | **MAX** | **UNIT** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250μA | $BV_{DSS}$ | 600 | -- | -- | V |
| Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | $V_{GS(TH)}$ | 2 | 3 | 4 | V |
| Gate Body Leakage | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | $I_{GSS}$ | -- | -- | ±100 | nA |
| Zero Gate Voltage Drain Current | $V_{DS}$ = 600V, $V_{GS}$ = 0V | $I_{DSS}$ | -- | -- | 1 | μA |
| Drain-Source On-State Resistance (Note 4) | $V_{GS}$ = 10V, $I_D$ = 2.85A | $R_{DS(on)}$ | -- | 0.26 | 0.38 | Ω |
| **Dynamic** (Note 5) | | | | | | |
| Total Gate Charge | $V_{DS}$ = 380V, $I_D$ = 9.5A, $V_{GS}$ = 10V | $Q_g$ | -- | 19.4 | -- | nC |
| Gate-Source Charge | | $Q_{gs}$ | -- | 3.5 | -- | |
| Gate-Drain Charge | | $Q_{gd}$ | -- | 8.9 | -- | |
| Input Capacitance | $V_{DS}$ = 100V, $V_{GS}$ = 0V, f = 1.0MHz | $C_{iss}$ | -- | 795 | -- | pF |
| Output Capacitance | | $C_{oss}$ | -- | 67 | -- | |
| Gate Resistance | F = 1MHz, open drain | $R_g$ | -- | 3.1 | -- | Ω |
| **Switching** (Note 6) | | | | | | |
| Turn-On Delay Time | $V_{DD}$ = 380V, $R_{GEN}$ = 25Ω, $I_D$ = 9.5A, $V_{GS}$ = 10V, | $t_{d(on)}$ | -- | 23.6 | -- | ns |
| Turn-On Rise Time | | $t_r$ | -- | 11.6 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 66 | -- | |
| Turn-Off Fall Time | | $t_f$ | -- | 9.6 | -- | |
| **Source-Drain Diode** | | | | | | |
| Forward Voltage (Note 4) | $I_S$ = 9.5A, $V_{GS}$ = 0V | $V_{SD}$ | -- | -- | 1.4 | V |
| Reverse Recovery Time | $V_R$ = 100V, $I_S$ = 9.5A $dI_F/dt$ = 100A/μs | $t_{rr}$ | -- | 272 | -- | ns |
| Reverse Recovery Charge | | $Q_{rr}$ | -- | 2.9 | -- | μC |

**Notes:**

1. Current limited by package.
2. Pulse width limited by the maximum junction temperature.
3. L = 50mH, $I_{AS}$ = 1.6A, $V_{DD}$ = 50V, $R_G$ = 25Ω, Starting $T_J$ = 25°C
4. Pulse test: PW ≤ 300μs, duty cycle ≤ 2%.
5. For DESIGN AID ONLY, not subject to production testing.
6. Switching time is essentially independent of operating temperature.

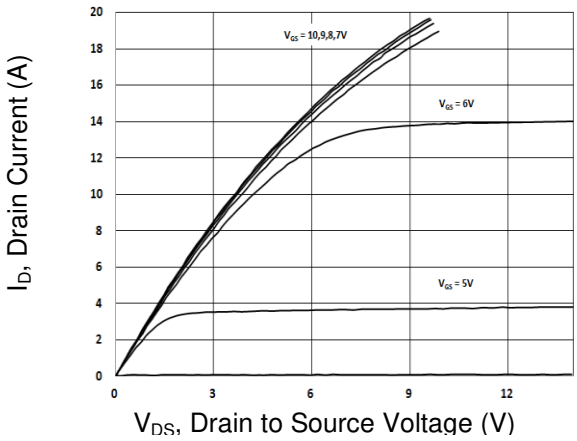
## ORDERING INFORMATION

| PART NO. | PACKAGE | PACKING |
|---|---|---|
| TSM60NB380CP ROG | TO-252 (DPAK) | 2,500pcs / 13” Reel |

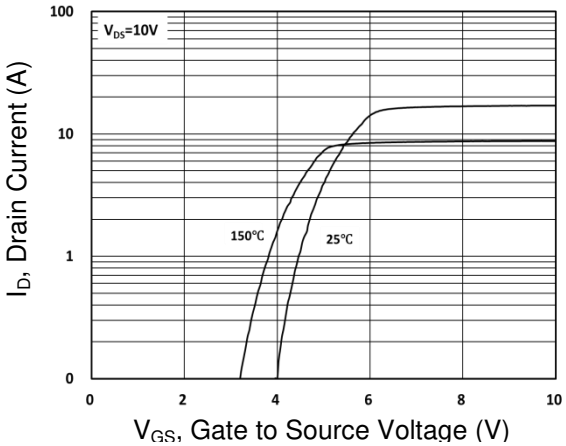
## CHARACTERISTICS CURVES

($T_C$ = 25°C unless otherwise noted)

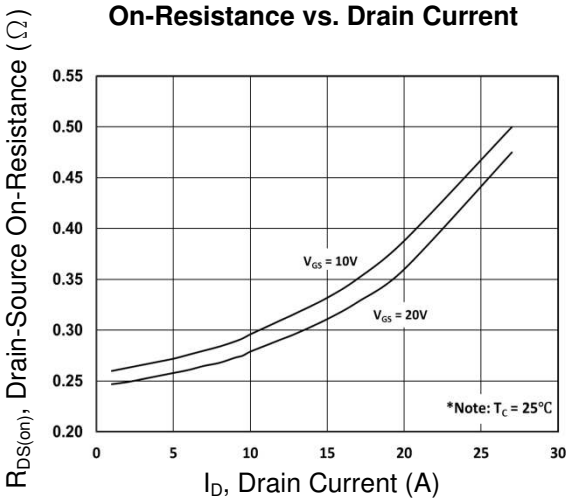
### Output Characteristics



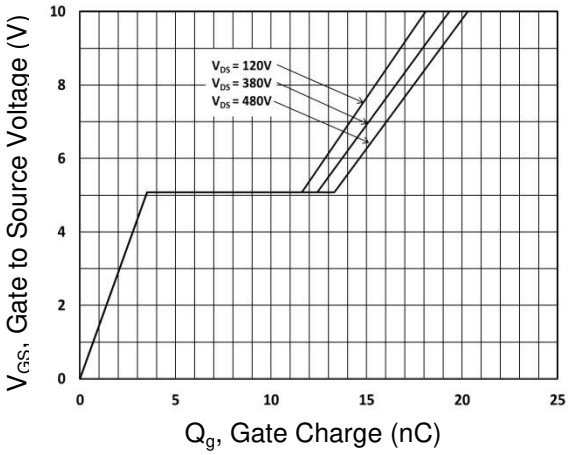

### Transfer Characteristics



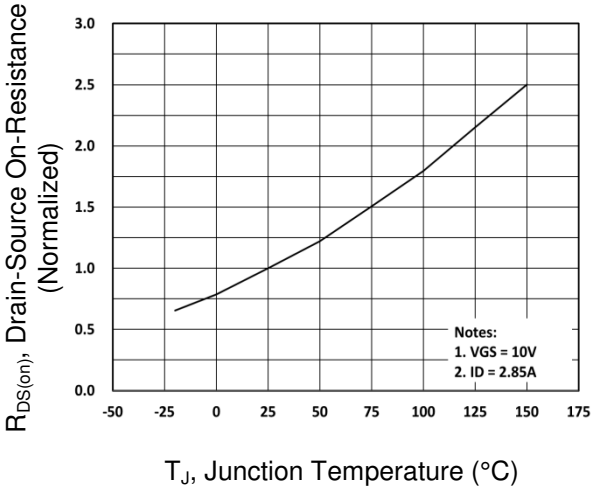

### On-Resistance vs. Drain Current



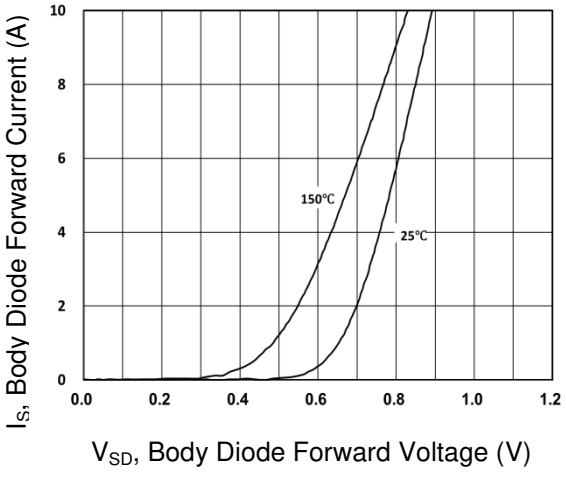

### Gate-Source Voltage vs. Gate Charge




### On-Resistance vs. Junction Temperature



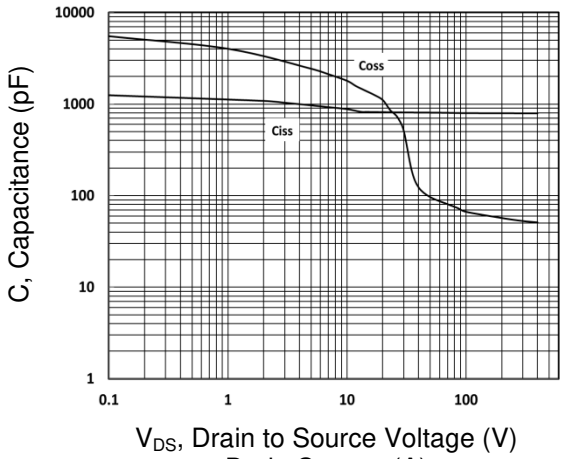

### Source-Drain Diode Forward Current vs. Voltage



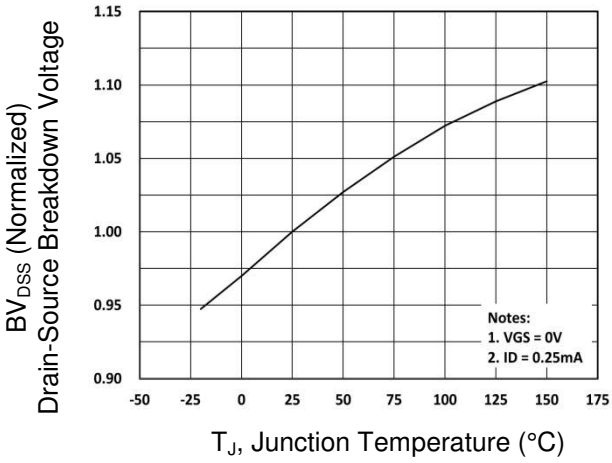
## CHARACTERISTICS CURVES

($T_C$ = 25°C unless otherwise noted)

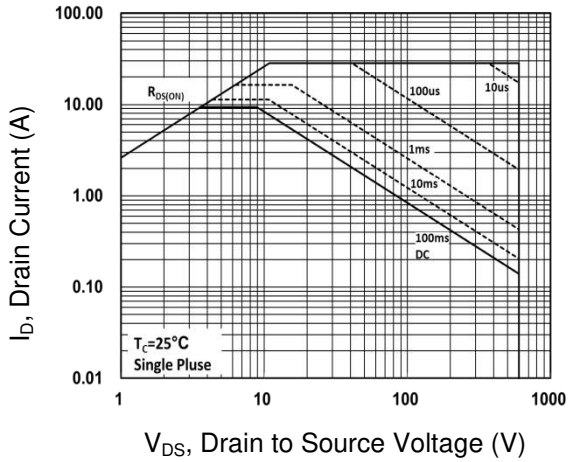
**Capacitance vs. Drain-Source Voltage**



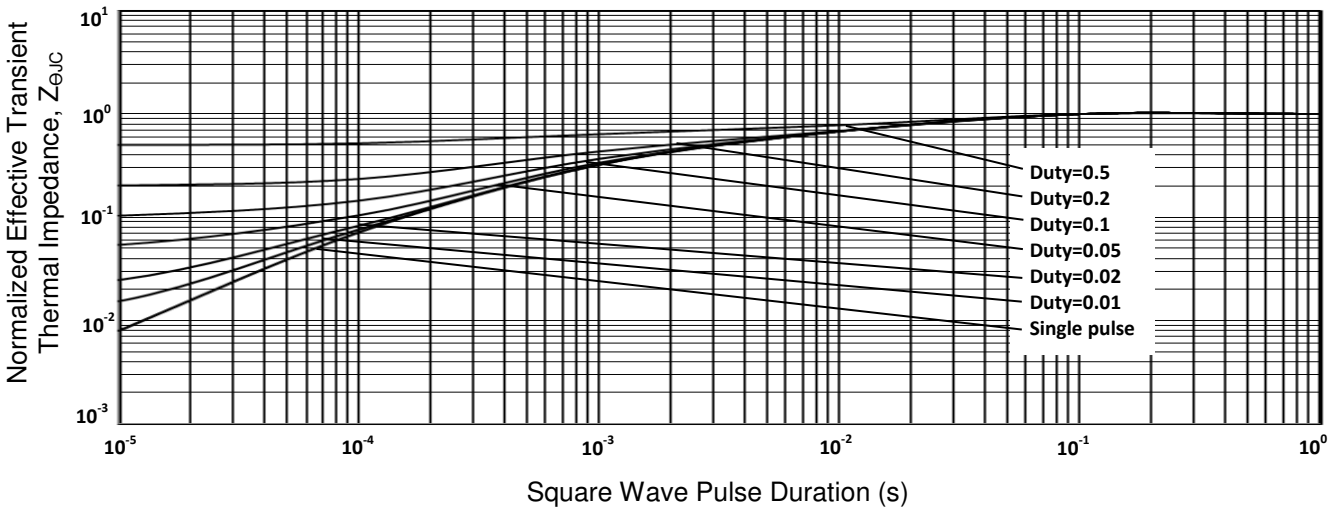

**$BV_{DSS}$ vs. Junction Temperature**




**Maximum Safe Operating Area**

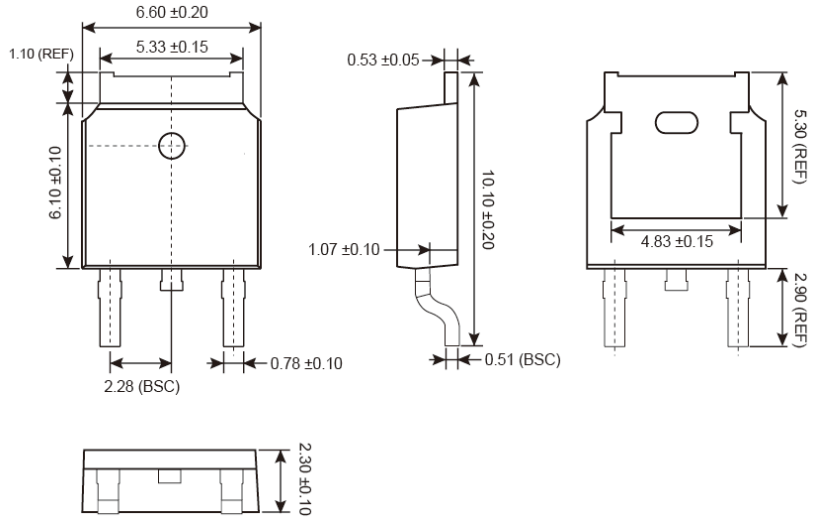



**Normalized Thermal Transient Impedance, Junction-to-Case**

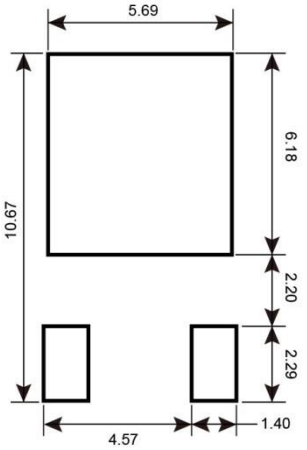


## PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

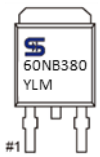
**TO-252 (DPAK)**




## SUGGESTED PAD LAYOUT (Unit: Millimeters)




## MARKING DIAGRAM




**Y** = Year Code
**M** = Month Code

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **O** | =Jan | **P** | =Feb | **Q** | =Mar | **R** | =Apr |
| **S** | =May | **T** | =Jun | **U** | =Jul | **V** | =Aug |
| **W** | =Sep | **X** | =Oct | **Y** | =Nov | **Z** | =Dec |

**L** = Lot Code (1~9, A~Z)

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