

## N-Channel Power MOSFET

600V, 3A, 1.4Ω

### FEATURES

- Super-Junction technology
- High performance due to small figure-of-merit
- High ruggedness performance
- High commutation performance
- 100% UIL tested
- 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

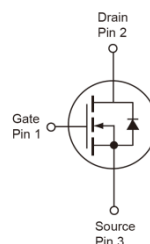
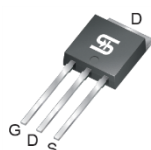
| PARAMETER          | VALUE | UNIT |
|--------------------|-------|------|
| $V_{DS}$           | 600   | V    |
| $R_{DS(on)}$ (max) | 1.4   | Ω    |
| $Q_g$              | 7.12  | nC   |

### APPLICATIONS

- Power Supply
- Lighting



TO-251 (IPAK)



### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| PARAMETER                                           |                        | SYMBOL                            | LIMIT        | UNIT |
|-----------------------------------------------------|------------------------|-----------------------------------|--------------|------|
| Drain-Source Voltage                                |                        | V <sub>DS</sub>                   | 600          | V    |
| Gate-Source Voltage                                 |                        | V <sub>GS</sub>                   | ±30          | V    |
| Continuous Drain Current <sup>(Note 1)</sup>        | T <sub>C</sub> = 25°C  | I <sub>D</sub>                    | 3            | A    |
|                                                     | T <sub>C</sub> = 100°C |                                   | 1.8          | A    |
| Pulsed Drain Current <sup>(Note 2)</sup>            |                        | I <sub>DM</sub>                   | 9            | A    |
| Total Power Dissipation @ T <sub>C</sub> = 25°C     |                        | P <sub>DTOT</sub>                 | 28.4         | W    |
| Single Pulsed Avalanche Energy <sup>(Note 3)</sup>  |                        | E <sub>AS</sub>                   | 25           | mJ   |
| Single Pulsed Avalanche Current <sup>(Note 3)</sup> |                        | I <sub>AS</sub>                   | 1.0          | A    |
| Operating Junction and Storage Temperature Range    |                        | T <sub>J</sub> , T <sub>STG</sub> | - 55 to +150 | °C   |

### THERMAL PERFORMANCE

| PARAMETER                              | SYMBOL          | LIMIT | UNIT |
|----------------------------------------|-----------------|-------|------|
| Junction to Case Thermal Resistance    | $R_{\theta JC}$ | 4.4   | °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 <sub>A</sub> = 25°C unless otherwise noted) |                                                                                                   |                     |     |       |      |      |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------|-----|-------|------|------|
| PARAMETER                                                                | CONDITIONS                                                                                        | SYMBOL              | MIN | TYP   | MAX  | UNIT |
| Static                                                                   |                                                                                                   |                     |     |       |      |      |
| Drain-Source Breakdown Voltage                                           | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                                      | BV <sub>DSS</sub>   | 600 | --    | --   | V    |
| Gate Threshold Voltage                                                   | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                        | V <sub>GS(TH)</sub> | 2   | 3.3   | 4    | V    |
| Gate Body Leakage                                                        | V <sub>GS</sub> = ±30V, V <sub>DS</sub> = 0V                                                      | I <sub>GSS</sub>    | --  | --    | ±100 | nA   |
| Zero Gate Voltage Drain Current                                          | V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V                                                      | I <sub>DSS</sub>    | --  | --    | 1    | μA   |
| Drain-Source On-State Resistance<br>(Note 4)                             | V <sub>GS</sub> = 10V, I <sub>D</sub> = 0.9A                                                      | R <sub>DS(on)</sub> | --  | 1     | 1.4  | Ω    |
| Dynamic (Note 5)                                                         |                                                                                                   |                     |     |       |      |      |
| Total Gate Charge                                                        | V <sub>DS</sub> = 380V, I <sub>D</sub> = 3A,<br>V <sub>GS</sub> = 10V                             | Q <sub>g</sub>      | --  | 7.12  | --   | nC   |
| Gate-Source Charge                                                       |                                                                                                   | Q <sub>gs</sub>     | --  | 3.52  | --   |      |
| Gate-Drain Charge                                                        |                                                                                                   | Q <sub>gd</sub>     | --  | 1.62  | --   |      |
| Input Capacitance                                                        | V <sub>DS</sub> = 100V, V <sub>GS</sub> = 0V,<br>f = 1.0MHz                                       | C <sub>iss</sub>    | --  | 257.3 | --   | pF   |
| Output Capacitance                                                       |                                                                                                   | C <sub>oss</sub>    | --  | 41.5  | --   |      |
| Gate Resistance                                                          | F = 1MHz, open drain                                                                              | R <sub>g</sub>      | --  | 4.1   | --   | Ω    |
| Switching (Note 6)                                                       |                                                                                                   |                     |     |       |      |      |
| Turn-On Delay Time                                                       | V <sub>DD</sub> = 380V,<br>R <sub>GEN</sub> = 25Ω,<br>I <sub>D</sub> = 3A, V <sub>GS</sub> = 10V, | t <sub>d(on)</sub>  | --  | 13.8  | --   | ns   |
| Turn-On Rise Time                                                        |                                                                                                   | t <sub>r</sub>      | --  | 11.4  | --   |      |
| Turn-Off Delay Time                                                      |                                                                                                   | t <sub>d(off)</sub> | --  | 28    | --   |      |
| Turn-Off Fall Time                                                       |                                                                                                   | t <sub>f</sub>      | --  | 8.4   | --   |      |
| Source-Drain Diode                                                       |                                                                                                   |                     |     |       |      |      |
| Forward Voltage (Note 4)                                                 | I <sub>S</sub> = 3A, V <sub>GS</sub> = 0V                                                         | V <sub>SD</sub>     | --  | --    | 1.4  | V    |
| Reverse Recovery Time                                                    | V <sub>R</sub> = 200V, I <sub>S</sub> = 1.5A<br>dI <sub>F</sub> /dt = 100A/μs                     | t <sub>rr</sub>     | --  | 126   | --   | ns   |
| Reverse Recovery Charge                                                  |                                                                                                   | Q <sub>rr</sub>     | --  | 0.637 | --   | μC   |

**Notes:**

- Current limited by package.
- Pulse width limited by the maximum junction temperature.
- $L = 50mH, I_{AS} = 1.0A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- Pulse test:  $PW \leq 300\mu s$ , duty cycle  $\leq 2\%$ .
- For DESIGN AID ONLY, not subject to production testing.
- Switching time is essentially independent of operating temperature.

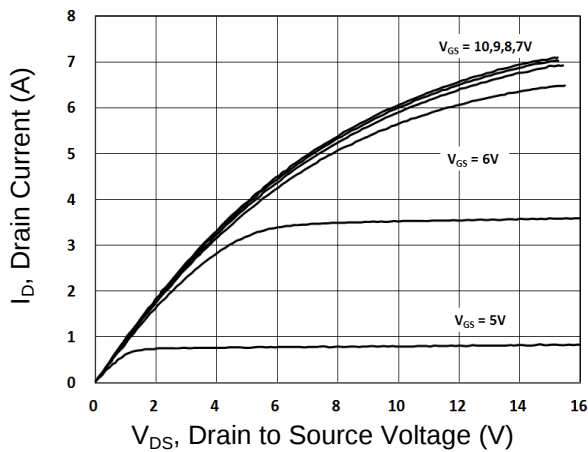
**ORDERING INFORMATION**

| PART NO.         | PACKAGE       | PACKING      |
|------------------|---------------|--------------|
| TSM60NB1R4CH C5G | TO-251 (IPAK) | 75pcs / Tube |

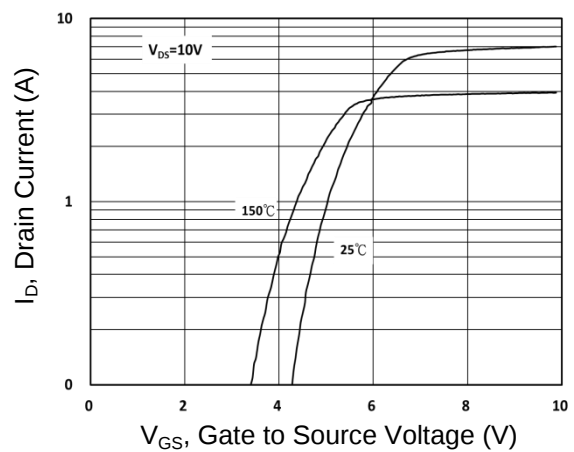
## CHARACTERISTICS CURVES

( $T_c = 25^\circ\text{C}$  unless otherwise noted)

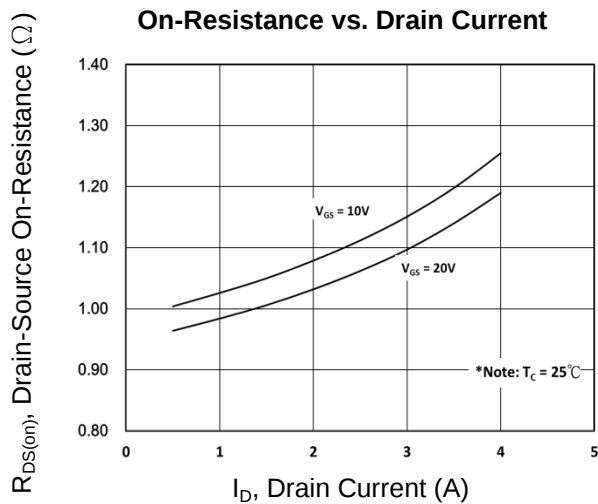
**Output Characteristics**



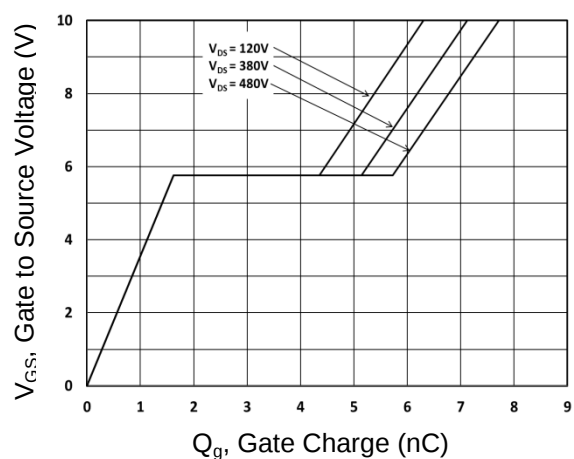
**Transfer Characteristics**



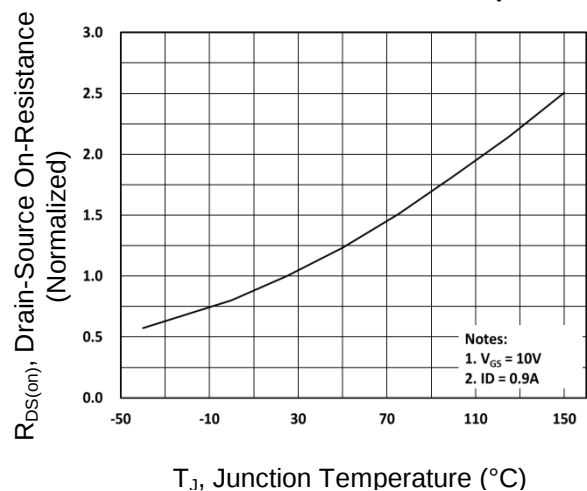
**On-Resistance vs. Drain Current**



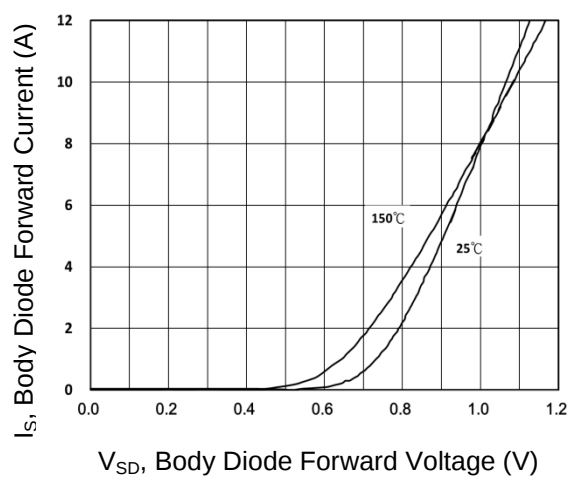
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**



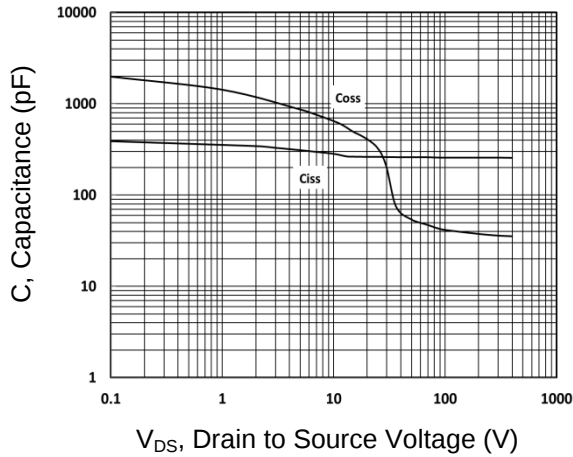
**Source-Drain Diode Forward Current vs. Voltage**



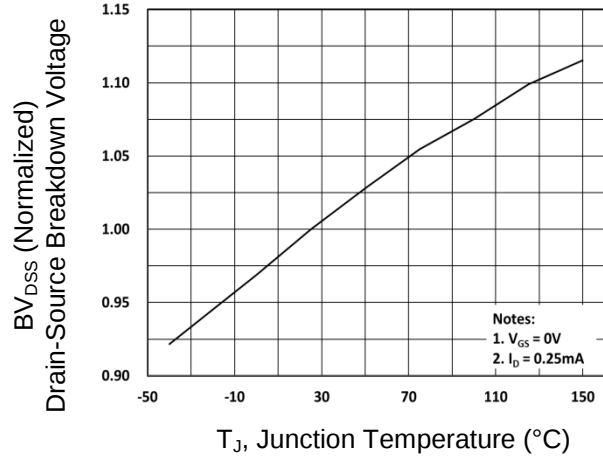
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( $T_c = 25^\circ\text{C}$  unless otherwise noted)

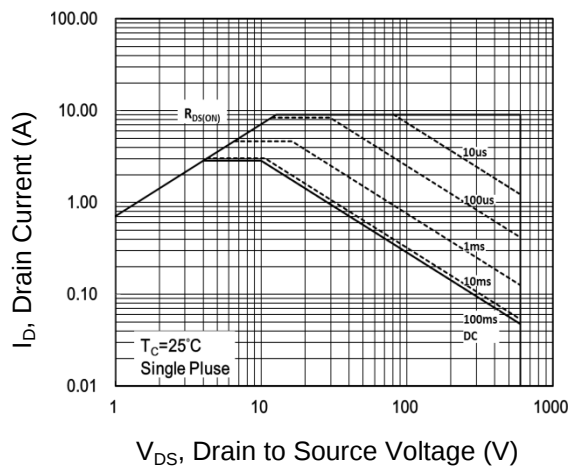
**Capacitance vs. Drain-Source Voltage**



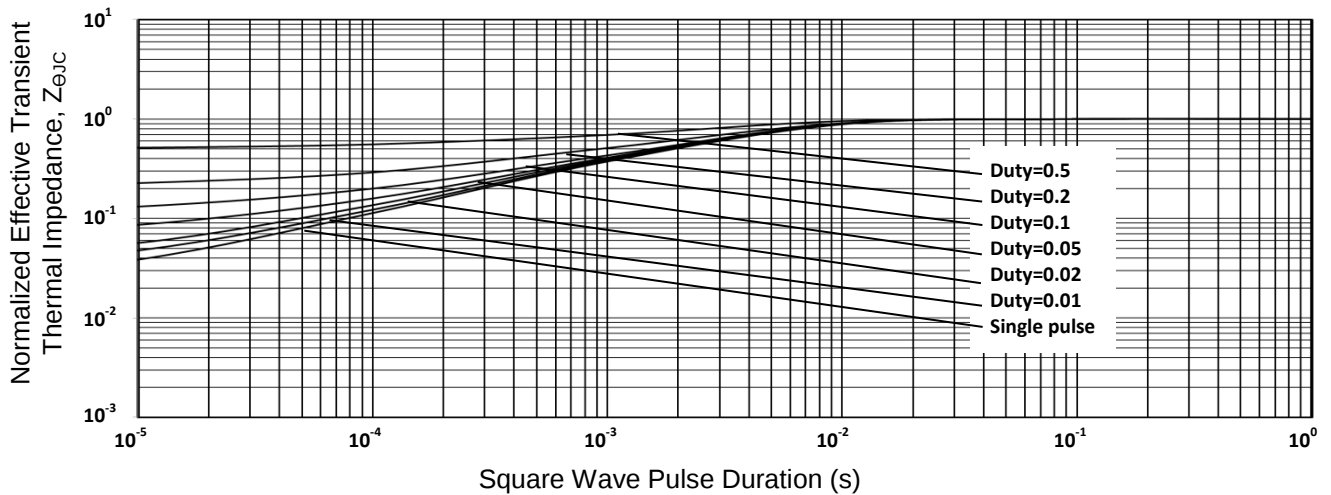
**$BV_{DSS}$  vs. Junction Temperature**



**Maximum Safe Operating Area**

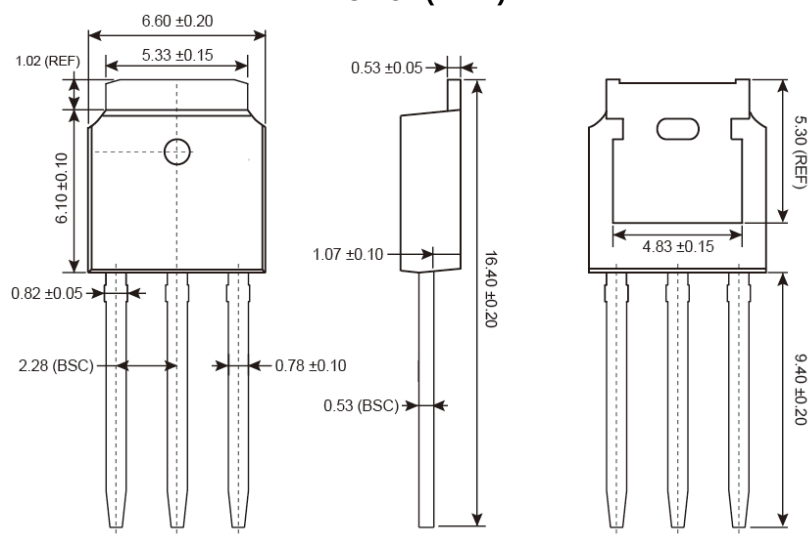


**Normalized Thermal Transient Impedance, Junction-to-Case**

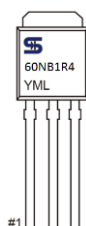


**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

**TO-251 (IPAK)**



**MARKING DIAGRAM**



**Y** = Year Code

**M** = Month Code for Halogen Free Product

**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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