

## N-Channel Power MOSFET

600V, 2A, 4.4Ω

### FEATURES

- Advanced planar process
- 100% avalanche 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

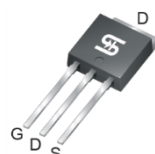
### APPLICATION

- Power Supply
- Lighting

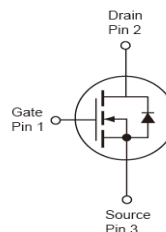
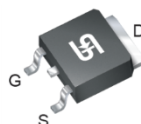
| KEY PERFORMANCE PARAMETERS |       |      |
|----------------------------|-------|------|
| PARAMETER                  | VALUE | UNIT |
| $V_{DS}$                   | 600   | V    |
| $R_{DS(on)}$ (max)         | 4.4   | Ω    |
| $Q_g$                      | 9.4   | nC   |



TO-251(IPAK)



TO-252(DPAK)



**Notes:** MSL 3 (Moisture Sensitivity Level) for TO-252 (D-PAK) per J-STD-020

| ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted) |                           |                |              |      |
|-----------------------------------------------------------------------------|---------------------------|----------------|--------------|------|
| PARAMETER                                                                   |                           | SYMBOL         | LIMIT        | UNIT |
| Drain-Source Voltage                                                        |                           | $V_{DS}$       | 600          | V    |
| Gate-Source Voltage                                                         |                           | $V_{GS}$       | ±30          | V    |
| Continuous Drain Current <sup>(Note 1)</sup>                                | $T_C = 25^\circ\text{C}$  | $I_D$          | 2            | A    |
|                                                                             | $T_C = 100^\circ\text{C}$ |                | 1.35         |      |
| Pulsed Drain Current <sup>(Note 2)</sup>                                    |                           | $I_{DM}$       | 8            | A    |
| Single Pulsed Avalanche Energy <sup>(Note 3)</sup>                          |                           | $E_{AS}$       | 55           | mJ   |
| Single Pulsed Avalanche Current <sup>(Note 3)</sup>                         |                           | $I_{AS}$       | 2            | A    |
| Repetitive Avalanche Energy <sup>(Note 2)</sup>                             |                           | $E_{AR}$       | 4.4          | mJ   |
| Peak Diode Recovery $dv/dt$ <sup>(Note 4)</sup>                             |                           | $dv/dt$        | 4.5          | V/ns |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$                          |                           | $P_{DTOT}$     | 44           | W    |
| Operating Junction and Storage Temperature Range                            |                           | $T_J, T_{STG}$ | - 55 to +150 | °C   |

**THERMAL PERFORMANCE**

| PARAMETER                              | SYMBOL          | LIMIT | UNIT                 |
|----------------------------------------|-----------------|-------|----------------------|
| Junction to Case Thermal Resistance    | $R_{\theta JC}$ | 2.87  | $^{\circ}\text{C/W}$ |
| Junction to Ambient Thermal Resistance | $R_{\theta JA}$ | 110   | $^{\circ}\text{C/W}$ |

**Notes:**  $R_{\theta JA}$  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** ( $T_A = 25^{\circ}\text{C}$  unless otherwise noted)

| PARAMETER                        | CONDITIONS                                              | SYMBOL       | MIN | TYP  | MAX       | UNIT     |
|----------------------------------|---------------------------------------------------------|--------------|-----|------|-----------|----------|
| <b>Static</b> (Note 5)           |                                                         |              |     |      |           |          |
| Drain-Source Breakdown Voltage   | $V_{GS} = 0V, I_D = 250\mu A$                           | $BV_{DSS}$   | 600 | --   | --        | V        |
| Gate Threshold Voltage           | $V_{DS} = V_{GS}, I_D = 250\mu A$                       | $V_{GS(TH)}$ | 2.5 | 3.6  | 4.5       | V        |
| Gate Body Leakage                | $V_{GS} = \pm 30V, V_{DS} = 0V$                         | $I_{GSS}$    | --  | --   | $\pm 100$ | nA       |
| Zero Gate Voltage Drain Current  | $V_{DS} = 600V, V_{GS} = 0V$                            | $I_{DSS}$    | --  | --   | 10        | $\mu A$  |
| Drain-Source On-State Resistance | $V_{GS} = 10V, I_D = 1A$                                | $R_{DS(ON)}$ | --  | 3.9  | 4.4       | $\Omega$ |
| Forward Transfer Conductance     | $V_{DS} = 40V, I_D = 1A$                                | $g_{fs}$     | --  | 1.5  | --        | S        |
| <b>Dynamic</b> (Note 6)          |                                                         |              |     |      |           |          |
| Total Gate Charge                | $V_{DS} = 480V, I_D = 2A, V_{GS} = 10V$                 | $Q_g$        | --  | 9.4  | --        | nC       |
| Gate-Source Charge               |                                                         | $Q_{gs}$     | --  | 2.2  | --        |          |
| Gate-Drain Charge                |                                                         | $Q_{gd}$     | --  | 4.7  | --        |          |
| Input Capacitance                | $V_{DS} = 25V, V_{GS} = 0V, f = 1.0\text{MHz}$          | $C_{iss}$    | --  | 249  | --        | pF       |
| Output Capacitance               |                                                         | $C_{oss}$    | --  | 30.7 | --        |          |
| Reverse Transfer Capacitance     |                                                         | $C_{rss}$    | --  | 5    | --        |          |
| Gate Resistance                  | $F = 1\text{MHz, open drain}$                           | $R_g$        | --  | 8.5  | --        | $\Omega$ |
| <b>Switching</b> (Note 7)        |                                                         |              |     |      |           |          |
| Turn-On Delay Time               | $V_{GS} = 10V, I_D = 2A, V_{DD} = 300V, R_G = 25\Omega$ | $t_{d(on)}$  | --  | 9.1  | --        | ns       |
| Turn-On Rise Time                |                                                         | $t_r$        | --  | 9.8  | --        |          |
| Turn-Off Delay Time              |                                                         | $t_{d(off)}$ | --  | 17.4 | --        |          |
| Turn-Off Fall Time               |                                                         | $t_f$        | --  | 12.4 | --        |          |

**ELECTRICAL SPECIFICATIONS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

| PARAMETER                          | CONDITIONS                                                                        | SYMBOL   | MIN | TYP | MAX | UNIT          |
|------------------------------------|-----------------------------------------------------------------------------------|----------|-----|-----|-----|---------------|
| <b>Source-Drain Diode</b> (Note 5) |                                                                                   |          |     |     |     |               |
| Diode Forward Voltage              | $I_S = 2\text{A}$ , $V_{GS} = 0\text{V}$                                          | $V_{SD}$ | --  | 0.9 | 1.4 | V             |
| Reverse Recovery Time              | $V_{GS} = 0\text{V}$ , $I_S = 2\text{A}$ ,<br>$dI_F/dt = 100\text{A}/\mu\text{s}$ | $t_{rr}$ | --  | 490 | --  | ns            |
| Reverse Recovery Charge            |                                                                                   | $Q_{rr}$ | --  | 0.8 | --  | $\mu\text{C}$ |
| Source Current                     | Integral reverse diode<br>in the MOSFET                                           | $I_S$    | --  | --  | 2   | A             |
| Source Current (Pulse)             |                                                                                   | $I_{SM}$ | --  | --  | 8   | A             |

**Notes:**

- Current limited by package.
- Pulse width limited by the maximum junction temperature.
- $L = 25\text{mH}$ ,  $I_{AS} = 2\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$ .  
100% Eas Test Condition:  $L = 25\text{mH}$ ,  $I_{AS} = 1\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- $I_{SD} \leq 2\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$ .
- Pulse test:  $PW \leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- For DESIGN AID ONLY, not subject to production testing.
- Switching time is essentially independent of operating temperature.

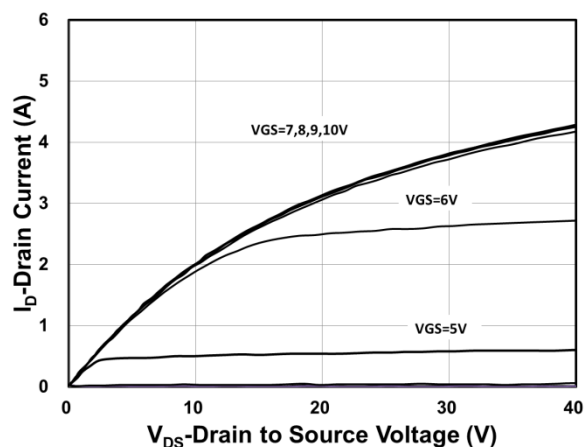
**ORDERING INFORMATION**

| PART NO.       | PACKAGE       | PACKING             |
|----------------|---------------|---------------------|
| TSM2NB60CH C5G | TO-251 (IPAK) | 75pcs / Tube        |
| TSM2NB60CP ROG | TO-252 (DPAK) | 2,500pcs / 13" Reel |

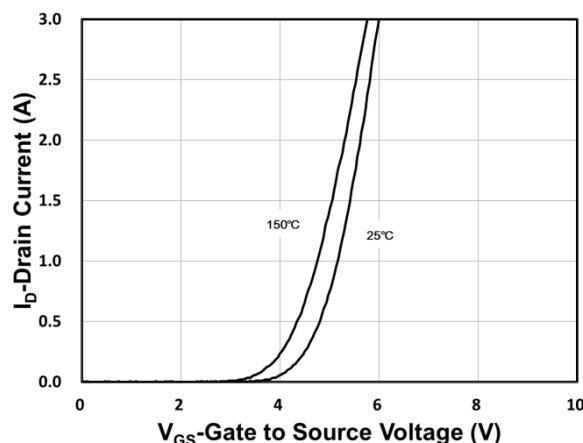
## CHARACTERISTICS CURVES

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

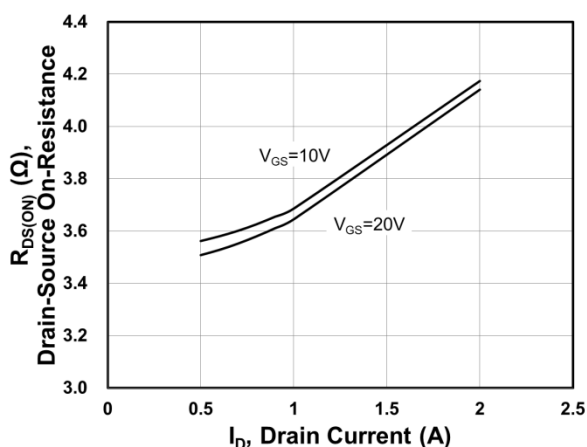
Output Characteristics



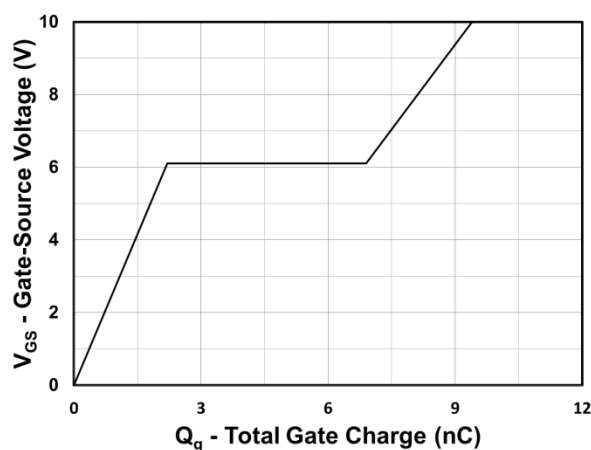
Transfer Characteristics



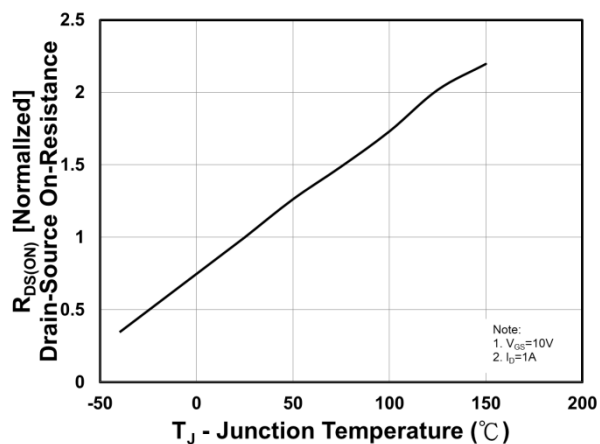
On-Resistance vs. Drain Current



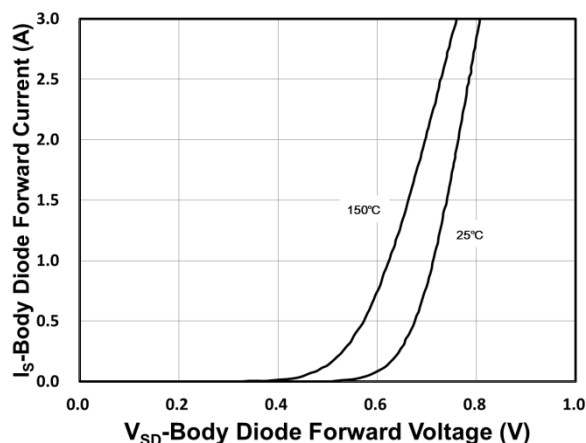
Gate-Source Voltage vs. Gate Charge



On-Resistance vs. Junction Temperature



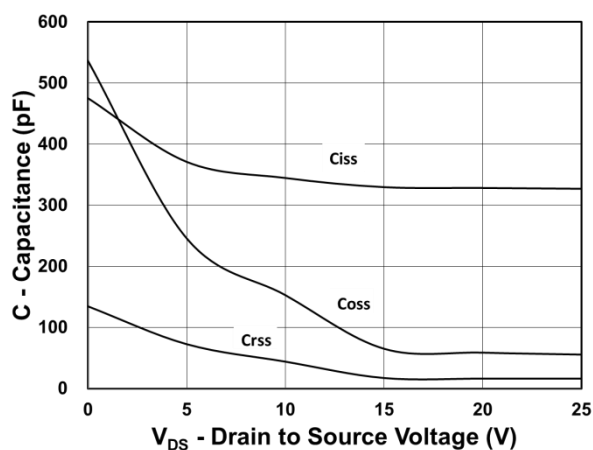
Source-Drain Diode Forward Current vs. Voltage



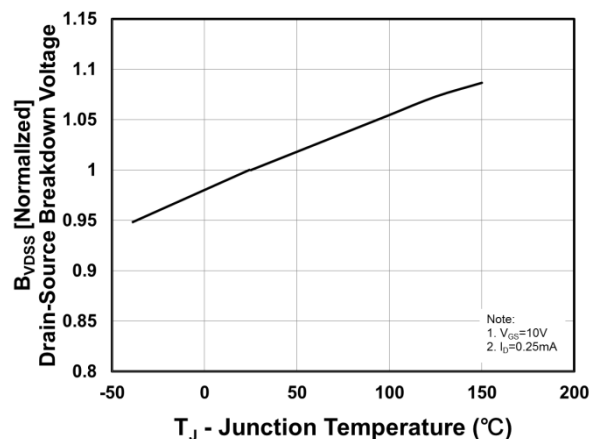
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( $T_c = 25^\circ\text{C}$  unless otherwise noted)

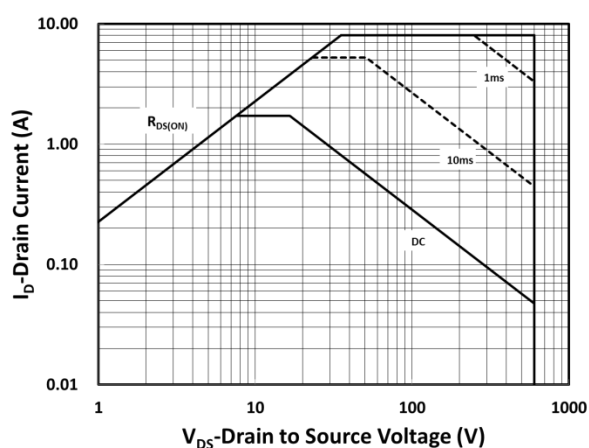
**Capacitance vs. Drain-Source Voltage**



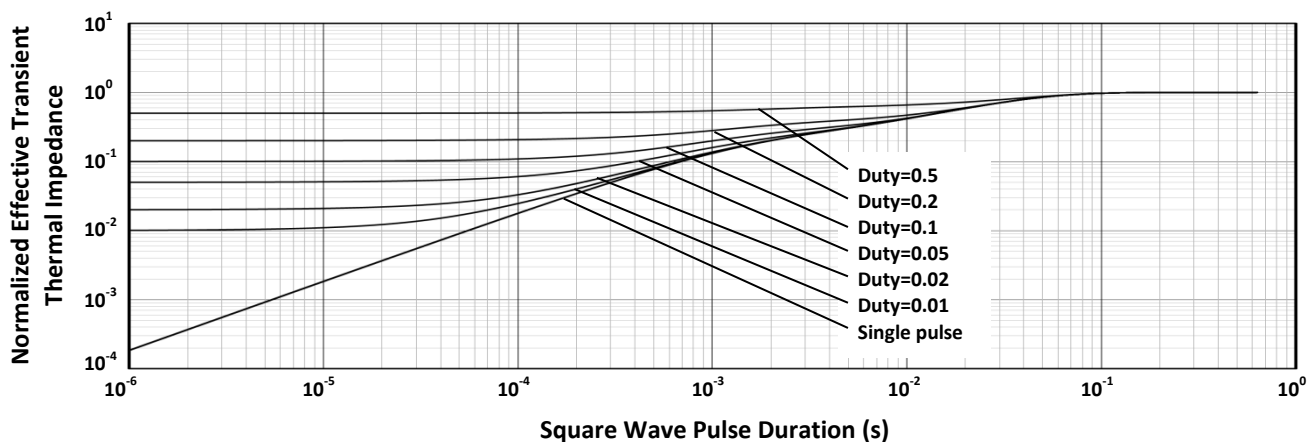
**$BV_{DSS}$  vs. Junction Temperature**



**Maximum Safe Operating Area**

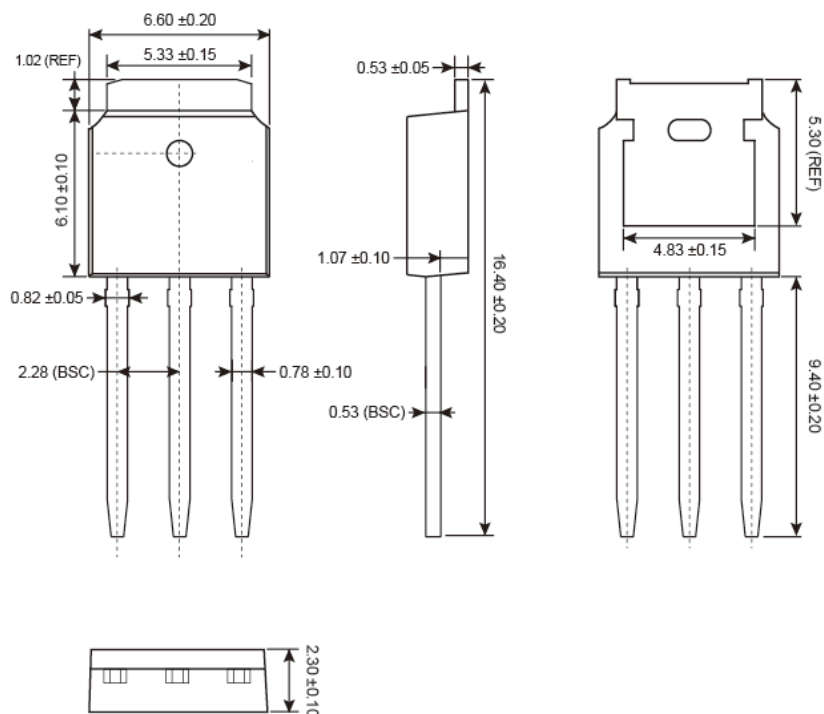


**Normalized Thermal Transient Impedance, Junction-to-Case**

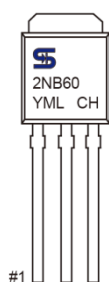


**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

**TO-251(IPAK)**



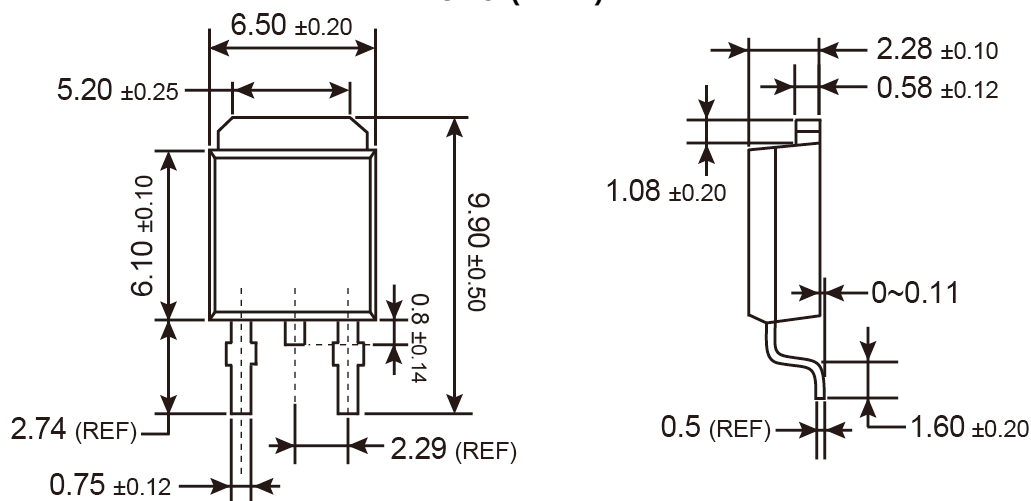
**MARKING DIAGRAM**



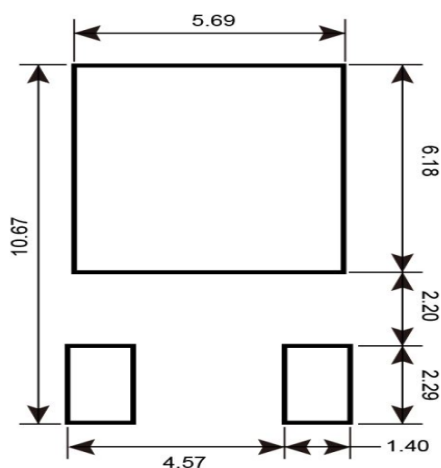
**Y** = Year Code  
**M** = Month Code for Halogen Free Product  
**O** =Jan    **P** =Feb    **Q** =Mar    **R** =Apr  
**S** =May    **T** =Jun    **U** =Jul    **V** =Aug  
**W** =Sep    **X** =Oct    **Y** =Nov    **Z** =Dec  
**L** = Lot Code (1~9, A~Z)

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

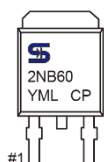
**TO-252(DPAK)**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



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