

## N-Channel Power MOSFET

60V, 38A, 17mΩ

### FEATURES

- 100% avalanche tested
- Suitable for 5V drive applications
- Pb-free plating
- RoHS compliant
- Halogen-free mold compound

### KEY PERFORMANCE PARAMETERS

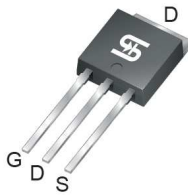
| PARAMETER          |               | VALUE | UNIT |
|--------------------|---------------|-------|------|
| $V_{DS}$           |               | 60    | V    |
| $R_{DS(on)}$ (max) | $V_{GS}=10V$  | 17    | mΩ   |
|                    | $V_{GS}=4.5V$ | 20    |      |
| $Q_g$              |               | 15    | nC   |

### APPLICATION

- SMPS Synchronous Rectification
- Networking DC-DC Power System



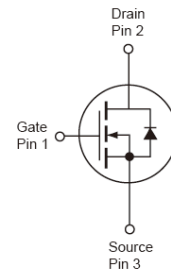
TO-251 (IPAK)



TO-251S (IPAK SL)



TO-252 (DPAK)


**Notes:** Moisture sensitivity level: level 3. Per J-STD-020

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

| PARAMETER                                          |                           | SYMBOL         | LIMIT        | UNIT             |
|----------------------------------------------------|---------------------------|----------------|--------------|------------------|
| Drain-Source Voltage                               |                           | $V_{DS}$       | 60           | V                |
| Gate-Source Voltage                                |                           | $V_{GS}$       | $\pm 20$     | V                |
| Continuous Drain Current (Note 1)                  | $T_C = 25^\circ\text{C}$  | $I_D$          | 38           | A                |
|                                                    | $T_C = 100^\circ\text{C}$ |                | 24           |                  |
| Pulsed Drain Current (Note 2)                      |                           | $I_{DM}$       | 152          | A                |
| Single Pulsed Avalanche Energy (Note 3)            |                           | $E_{AS}$       | 20           | mJ               |
| Single Pulsed Avalanche Current (Note 3)           |                           | $I_{AS}$       | 20           | A                |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ |                           | $P_{DTOT}$     | 46           | W                |
| Operating Junction and Storage Temperature Range   |                           | $T_J, T_{STG}$ | - 55 to +150 | $^\circ\text{C}$ |

### THERMAL PERFORMANCE

| PARAMETER                              | SYMBOL          | LIMIT | UNIT               |
|----------------------------------------|-----------------|-------|--------------------|
| Junction to Case Thermal Resistance    | $R_{\theta JC}$ | 2.7   | $^\circ\text{C/W}$ |
| Junction to Ambient Thermal Resistance | $R_{\theta JA}$ | 62    | $^\circ\text{C/W}$ |

**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 <sub>A</sub> = 25°C unless otherwise noted) |                                                                                        |                     |     |      |      |      |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------|-----|------|------|------|
| PARAMETER                                                                | CONDITIONS                                                                             | SYMBOL              | MIN | TYP  | MAX  | UNIT |
| Static <sup>(Note 4)</sup>                                               |                                                                                        |                     |     |      |      |      |
| Drain-Source Breakdown Voltage                                           | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                           | BV <sub>DSS</sub>   | 60  | --   | --   | V    |
| Gate Threshold Voltage                                                   | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250uA                             | V <sub>GS(TH)</sub> | 1.2 | 1.7  | 2.5  | V    |
| Gate Body Leakage                                                        | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V                                           | I <sub>GSS</sub>    | --  | --   | ±100 | nA   |
| Zero Gate Voltage Drain Current                                          | V <sub>DS</sub> = 60V, V <sub>GS</sub> = 0V                                            | I <sub>DSS</sub>    | --  | --   | 1    | μA   |
|                                                                          | V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C                    |                     | --  | --   | 10   |      |
| Drain-Source On-State Resistance                                         | V <sub>GS</sub> = 10V, I <sub>D</sub> = 20A                                            | R <sub>DS(ON)</sub> | --  | 15   | 17   | mΩ   |
|                                                                          | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 10A                                           |                     | --  | 17.5 | 20   |      |
| Dynamic <sup>(Note 5)</sup>                                              |                                                                                        |                     |     |      |      |      |
| Total Gate Charge                                                        | V <sub>DS</sub> = 30V, I <sub>D</sub> = 10A, V <sub>GS</sub> = 4.5V                    | Q <sub>g</sub>      | --  | 15   | --   | nC   |
| Gate-Source Charge                                                       |                                                                                        | Q <sub>gs</sub>     | --  | 5.5  | --   |      |
| Gate-Drain Charge                                                        |                                                                                        | Q <sub>gd</sub>     | --  | 5    | --   |      |
| Input Capacitance                                                        | V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz                                | C <sub>iss</sub>    | --  | 900  | --   | pF   |
| Output Capacitance                                                       |                                                                                        | C <sub>oss</sub>    | --  | 130  | --   |      |
| Reverse Transfer Capacitance                                             |                                                                                        | C <sub>rss</sub>    | --  | 90   | --   |      |
| Gate Resistance                                                          | F = 1MHz, open drain                                                                   | R <sub>g</sub>      | --  | 2.2  | --   | Ω    |
| Switching <sup>(Note 6)</sup>                                            |                                                                                        |                     |     |      |      |      |
| Turn-On Delay Time                                                       | V <sub>GS</sub> = 10V, V <sub>DS</sub> = 15V, R <sub>G</sub> = 6Ω, I <sub>D</sub> = 1A | t <sub>d(on)</sub>  | --  | 8.6  | --   | ns   |
| Turn-On Rise Time                                                        |                                                                                        | t <sub>r</sub>      | --  | 24.2 | --   |      |
| Turn-Off Delay Time                                                      |                                                                                        | t <sub>d(off)</sub> | --  | 32.3 | --   |      |
| Turn-Off Fall Time                                                       |                                                                                        | t <sub>f</sub>      | --  | 7.9  | --   |      |
| Source-Drain Diode <sup>(Note 4)</sup>                                   |                                                                                        |                     |     |      |      |      |
| Diode Forward Voltage                                                    | V <sub>GS</sub> =0V, I <sub>S</sub> =10A                                               | V <sub>SD</sub>     | --  | --   | 1    | V    |
| Reverse Recovery Time                                                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 10A                                             | t <sub>rr</sub>     | --  | 18   | --   | ns   |
| Reverse Recovery Charge                                                  | dl <sub>F</sub> /dt = 100A/μs                                                          | Q <sub>rr</sub>     | --  | 10   | --   | nC   |

**Notes:**

1. Current limited by package
2. Pulse width limited by the maximum junction temperature
3.  $L = 0.1\text{mH}, I_{AS} = 20A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse test:  $PW \leq 300\mu s$ , duty cycle  $\leq 2\%$
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             |
|-----------------|------------------|---------------------|
| TSM170N06CP ROG | TO-252(DPAK)     | 2,500pcs / 13" Reel |
| TSM170N06CH C5G | TO-251(IPAK)     | 75pcs / Tube        |
| TSM170N06CH X0G | TO-251S(IPAK SL) | 75pcs / Tube        |

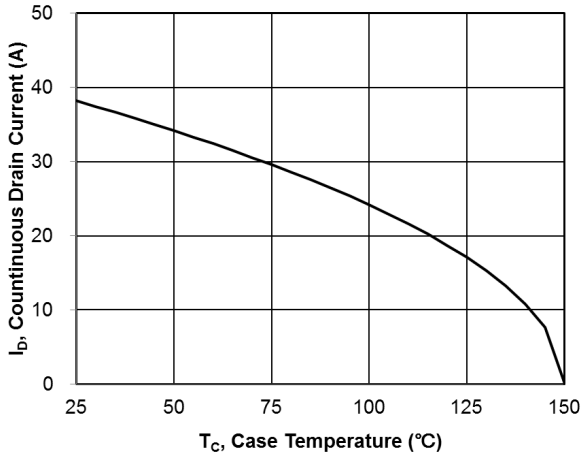
**Note:**

1. Compliant to RoHS Directive 2011/65/EU and in accordance to WEEE 2002/96/EC
2. Halogen-free according to IEC 61249-2-21 definition

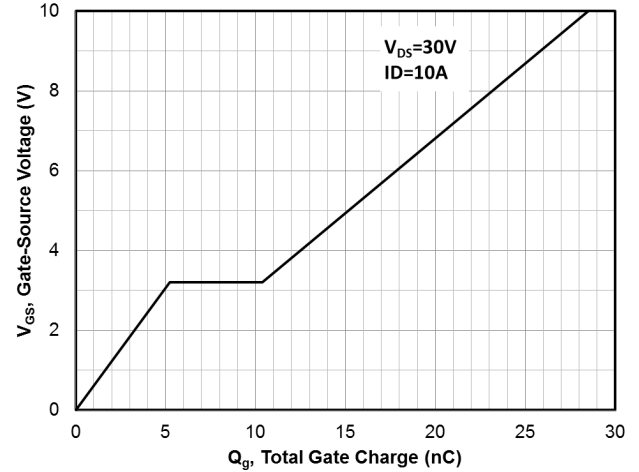
## CHARACTERISTICS CURVES

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

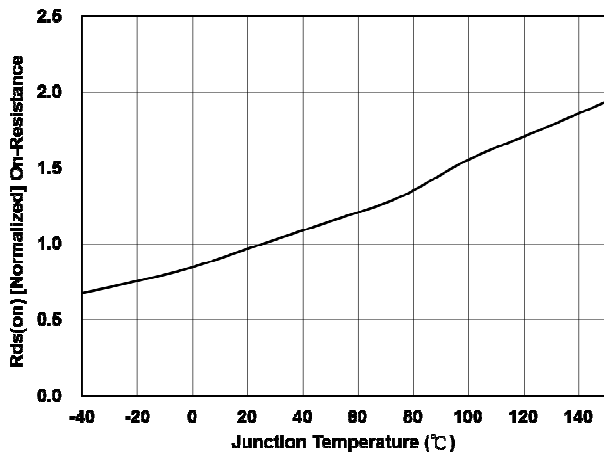
**Continuous Drain Current vs.  $T_C$**



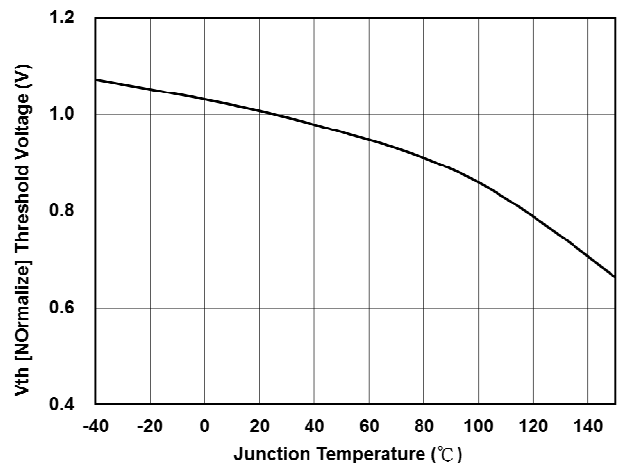
**Gate Charge**



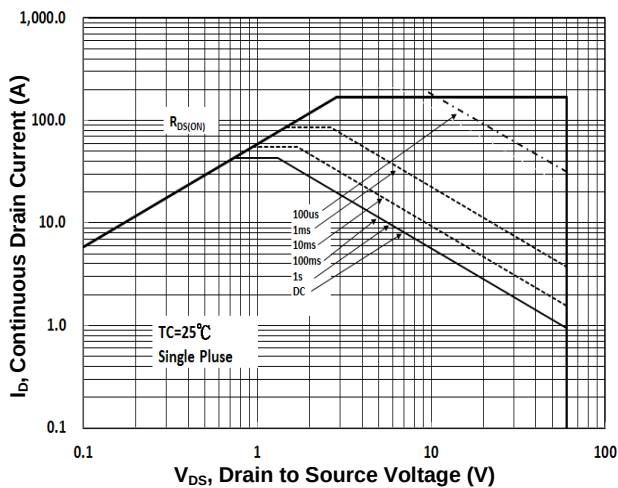
**On-Resistance vs. Junction Temperature**



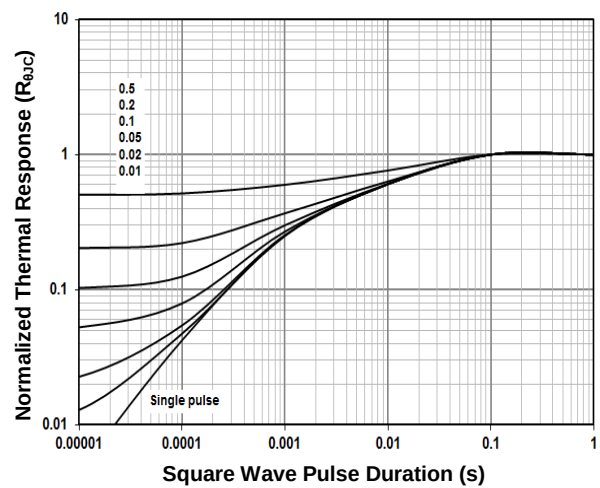
**Threshold Voltage vs. Junction Temperature**



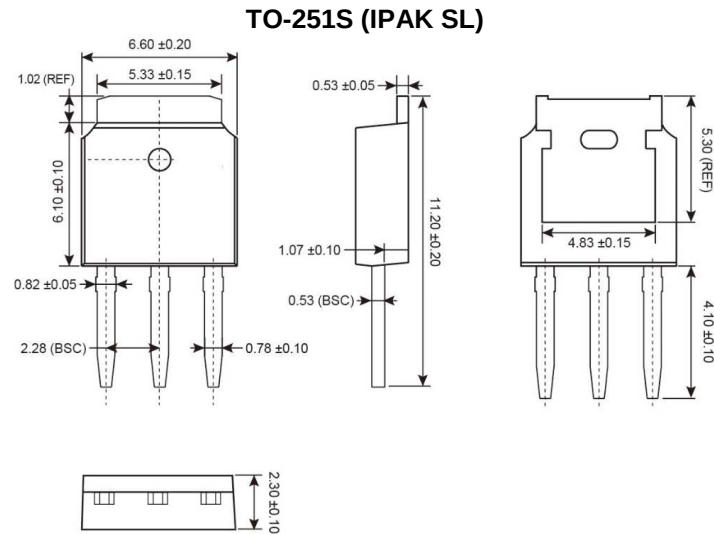
**Maximum Safe Operating Area**



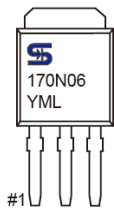
**Normalized Thermal Transient Impedance Curve**



PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

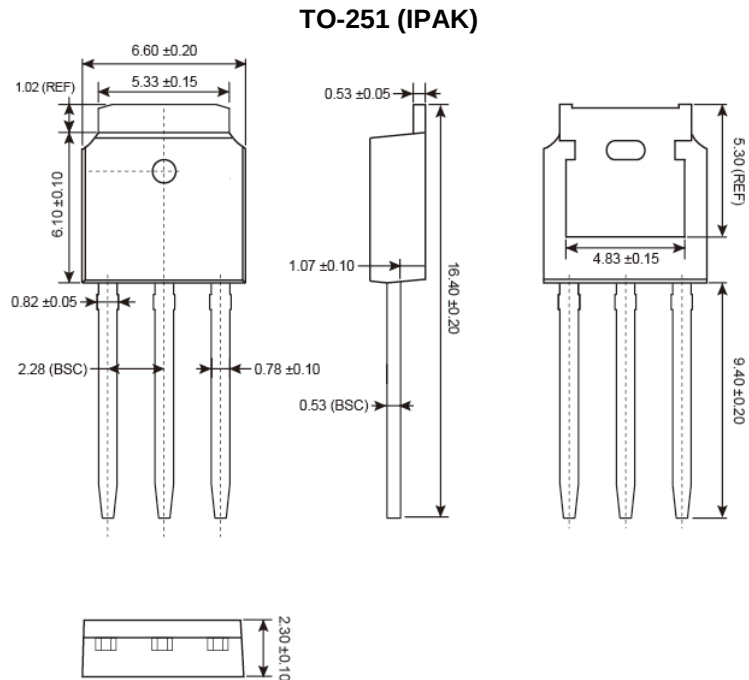


MARKING DIAGRAM

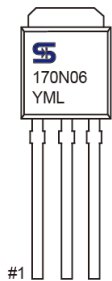


**Y** = Year Code  
**M** = Month Code for Halogen Free Product  
**O** =Jan   **P** =Feb   **Q** =Mar   **R** =Apr  
**S** =May   **T** =Jun   **U** =Jul   **V** =Aug  
**W** =Sep   **X** =Oct   **Y** =Nov   **Z** =Dec  
**L** = Lot Code (1~9, A~Z)

PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)



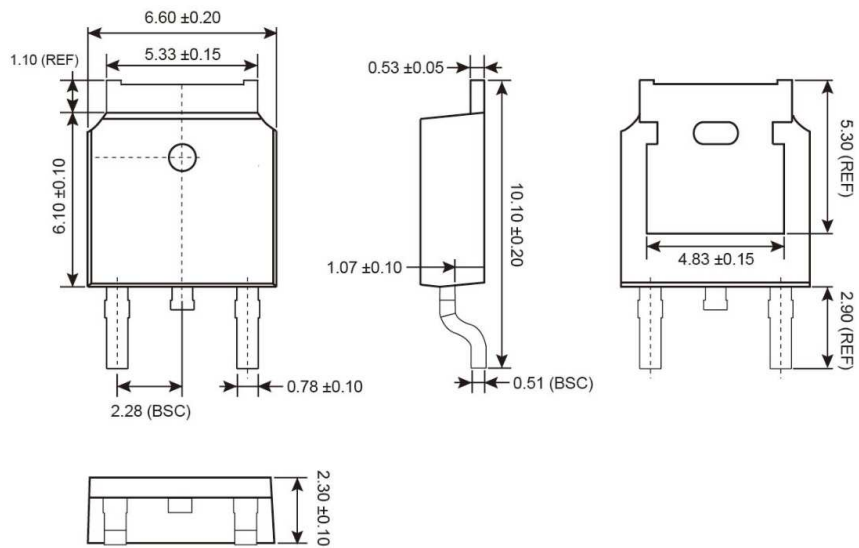
MARKING DIAGRAM



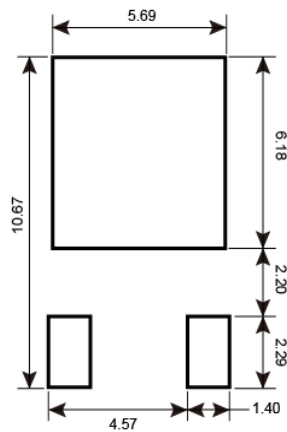
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PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

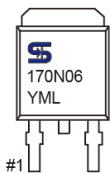
**TO-252 (DPAK)**



SUGGESTED PAD LAYOUT (Unit: Millimeters)



MARKING DIAGRAM



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