

## P-Channel Power MOSFET

-60V, -18A, 68mΩ

### FEATURES

- Improved dV/dt capability
- Fast switching
- 100% Eas Guaranteed
- Pb-free plating
- RoHS compliant
- Halogen-free mold compound

### KEY PERFORMANCE PARAMETERS

| PARAMETER          | VALUE            | UNIT |
|--------------------|------------------|------|
| $V_{DS}$           | -60              | V    |
| $R_{DS(on)}$ (max) | $V_{GS} = -10V$  | 68   |
|                    | $V_{GS} = -4.5V$ | 110  |
| $Q_g$              | 16.4             | nC   |

### APPLICATION

- Motor Drive
- Power Tools
- LED Lighting



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

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

| PARAMETER                                           |                      | SYMBOL         | IPAK/DPAK    |    | ITO-220 | TO-220 | UNIT |
|-----------------------------------------------------|----------------------|----------------|--------------|----|---------|--------|------|
| Drain-Source Voltage                                |                      | $V_{DS}$       | -60          |    |         |        | V    |
| Gate-Source Voltage                                 |                      | $V_{GS}$       | ±20          |    |         |        | V    |
| Continuous Drain Current <sup>(Note 1)</sup>        | $T_C = 25^{\circ}C$  | $I_D$          | -18          |    |         |        | A    |
|                                                     | $T_C = 100^{\circ}C$ |                | -11          |    |         |        |      |
| Pulsed Drain Current <sup>(Note 2)</sup>            |                      | $I_{DM}$       | -72          |    |         |        | A    |
| Total Power Dissipation @ $T_C = 25^{\circ}C$       |                      | $P_{DTOT}$     | 20           | 17 | 42      | W      |      |
| Single Pulsed Avalanche Energy <sup>(Note 3)</sup>  |                      | $E_{AS}$       | 12.8         |    |         |        | mJ   |
| Single Pulsed Avalanche Current <sup>(Note 3)</sup> |                      | $I_{AS}$       | -16          |    |         |        | A    |
| Operating Junction and Storage Temperature Range    |                      | $T_J, T_{STG}$ | - 55 to +150 |    |         |        | °C   |

### THERMAL PERFORMANCE

| PARAMETER                              | SYMBOL          | IPAK/DPAK | ITO-220 | TO-220 | UNIT               |
|----------------------------------------|-----------------|-----------|---------|--------|--------------------|
| Junction to Case Thermal Resistance    | $R_{\theta JC}$ | 6.1       | 7.5     | 3      | $^\circ\text{C/W}$ |
| 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** ( $T_C = 25^\circ\text{C}$  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> = -250μA               | V <sub>GS(TH)</sub> | -1.2 | -1.6 | -2.2 | 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, T <sub>C</sub> = 125°C                            |                     | --   | --   | -10  |      |
| Drain-Source On-State Resistance       | V <sub>GS</sub> = -10V, I <sub>D</sub> = -6A                              | R <sub>DS(on)</sub> | --   | 54   | 68   | mΩ   |
|                                        | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -3A                             |                     | --   | 72   | 110  |      |
| Forward Transconductance               | V <sub>DS</sub> = -10V, I <sub>D</sub> = -6A                              | g <sub>fs</sub>     | --   | 8.5  | --   | S    |
| Dynamic <sup>(Note 5)</sup>            |                                                                           |                     |      |      |      |      |
| Total Gate Charge                      | V <sub>DS</sub> = -30V, I <sub>D</sub> = -6A,<br>V <sub>GS</sub> = -10V   | Q <sub>g</sub>      | --   | 16.4 | --   | nC   |
| Gate-Source Charge                     |                                                                           | Q <sub>gs</sub>     | --   | 2.8  | --   |      |
| Gate-Drain Charge                      |                                                                           | Q <sub>gd</sub>     | --   | 3.6  | --   |      |
| Input Capacitance                      | V <sub>DS</sub> = -30V, V <sub>GS</sub> = 0V,<br>f = 1.0MHz               | C <sub>iss</sub>    | --   | 870  | --   | pF   |
| Output Capacitance                     |                                                                           | C <sub>oss</sub>    | --   | 70   | --   |      |
| Reverse Transfer Capacitance           |                                                                           | C <sub>rss</sub>    | --   | 42   | --   |      |
| Gate Resistance                        | F = 1MHz, open drain                                                      | R <sub>g</sub>      | --   | 16   | --   | Ω    |
| Switching <sup>(Note 6)</sup>          |                                                                           |                     |      |      |      |      |
| Turn-On Delay Time                     | V <sub>DD</sub> = -30V,<br>R <sub>GEN</sub> = 6Ω,<br>I <sub>D</sub> = -1A | t <sub>d(on)</sub>  | --   | 8.3  | --   | ns   |
| Turn-On Rise Time                      |                                                                           | t <sub>r</sub>      | --   | 29.6 | --   |      |
| Turn-Off Delay Time                    |                                                                           | t <sub>d(off)</sub> | --   | 51.7 | --   |      |
| Turn-Off Fall Time                     |                                                                           | t <sub>f</sub>      | --   | 15.6 | --   |      |
| Source-Drain Diode <sup>(Note 3)</sup> |                                                                           |                     |      |      |      |      |
| Forward On Voltage                     | I <sub>S</sub> = -1A, V <sub>GS</sub> = 0V                                | V <sub>SD</sub>     | --   | --   | -1   | V    |
| Reverse Recovery Time                  | I <sub>S</sub> = 1A<br>dI <sub>F</sub> /dt = 100A/μs                      | t <sub>rr</sub>     | --   | 20   | --   | ns   |
| Reverse Recovery Charge                |                                                                           | Q <sub>rr</sub>     | --   | 10   | --   | nC   |
| Maximum Continuous Forward Current     | Integral reverse diode in the MOSFET                                      | I <sub>S</sub>      | --   | --   | -13  | A    |
| Maximum Pulse Forward Current          |                                                                           | I <sub>SM</sub>     | --   | --   | -52  | A    |

**Notes:**

- Current limited by package
- Pulse width limited by the maximum junction temperature
- $L = 0.1\text{mH}, I_{AS} = -16A, V_{DD} = -25V, R_G = 25\Omega$ , 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             |
|-----------------|-------------------|---------------------|
| TSM680P06CZ C0G | TO-220            | 50pcs / Tube        |
| TSM680P06CI C0G | ITO-220           | 50pcs / Tube        |
| TSM680P06CH C5G | TO-251S (IPAK SL) | 75pcs / Tube        |
| TSM680P06CP ROG | TO-252 (DPAK)     | 2,500pcs / 13" Reel |

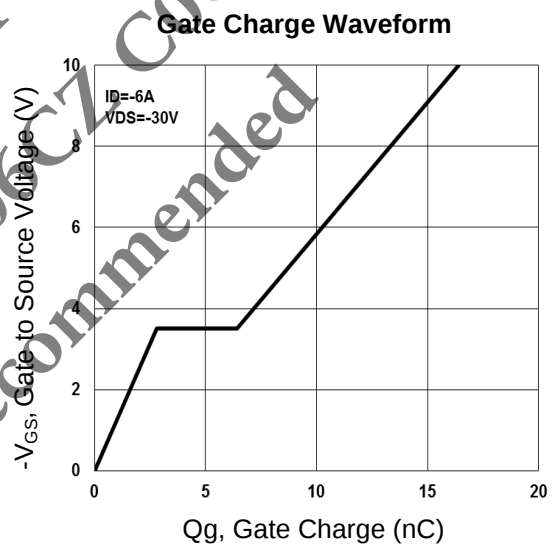
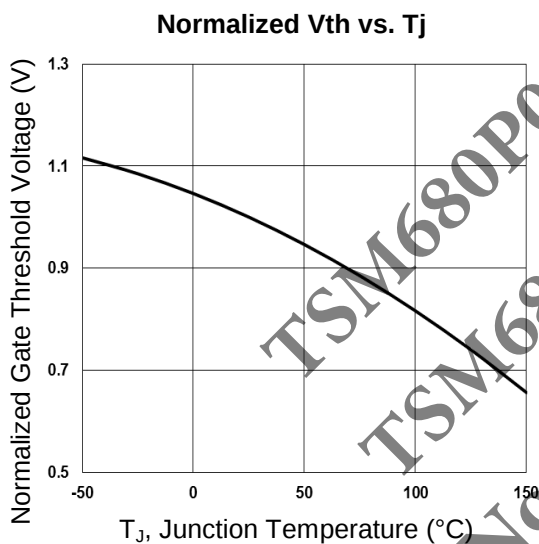
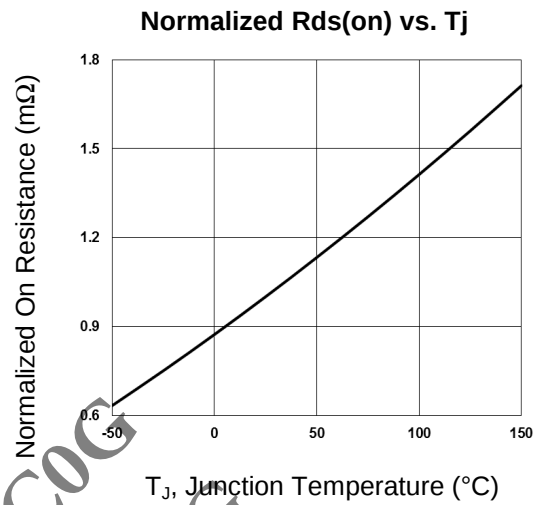
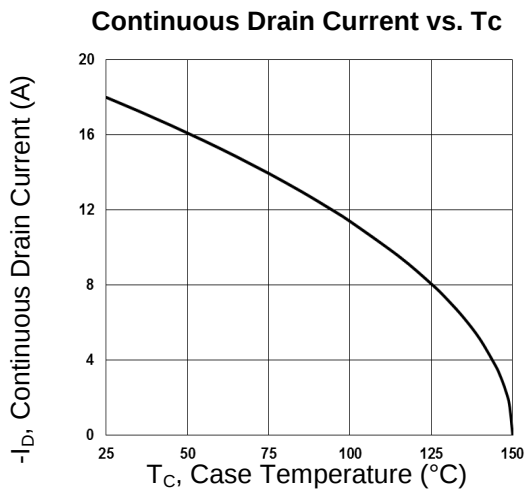
**Note:**

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

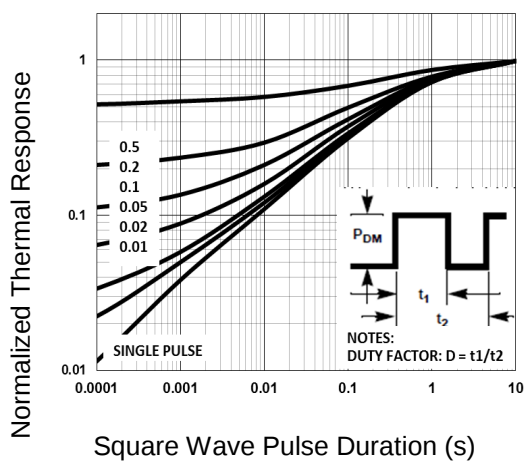
TSM680P06CI C0G  
TSM680P06CZ C0G  
Not Recommended

## CHARACTERISTICS CURVES

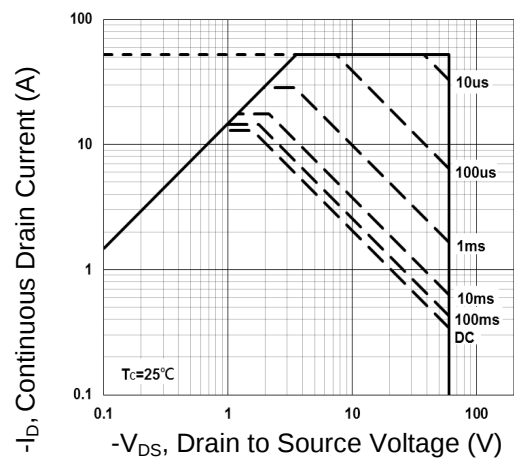
( $T_C = 25^\circ\text{C}$  unless otherwise noted)



### Normalized Transient Impedance (TO-251S)



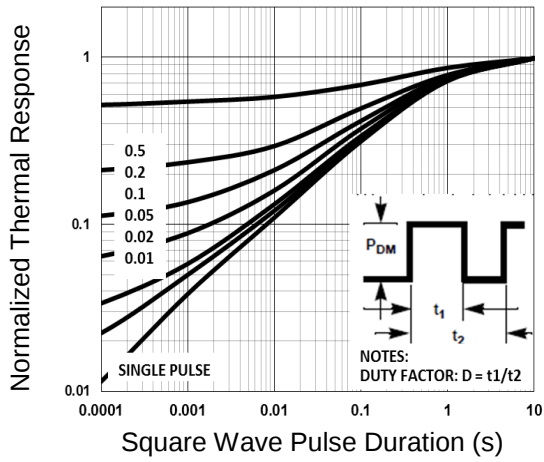
### Maximum Safe Operation Area (TO-251S)



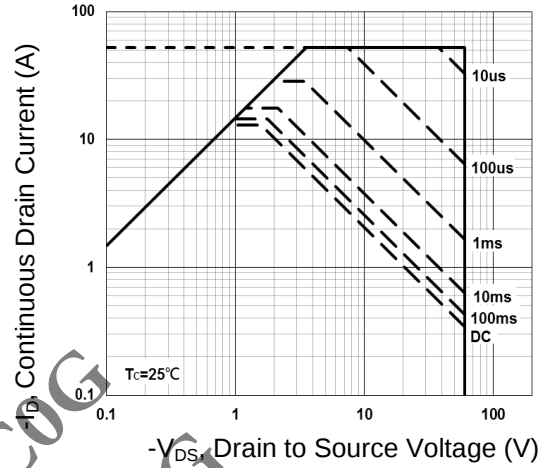
## CHARACTERISTICS CURVES

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

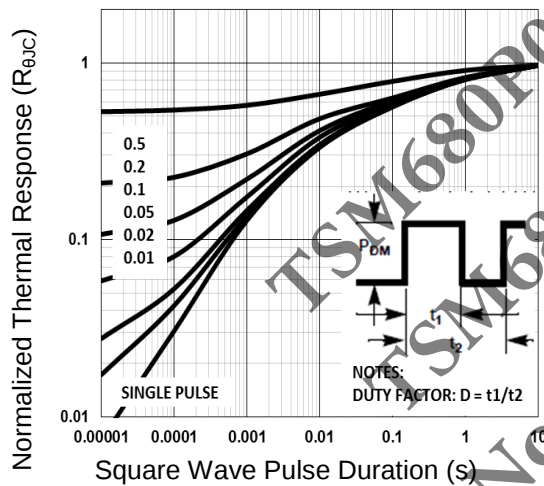
**Normalized Transient Impedance (TO-252)**



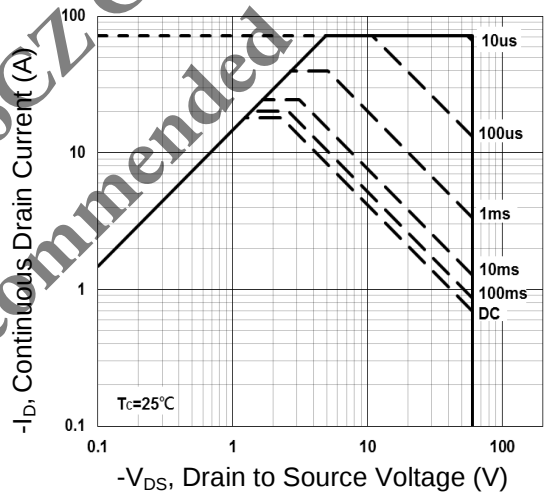
**Maximum Safe Operation Area (TO-252)**



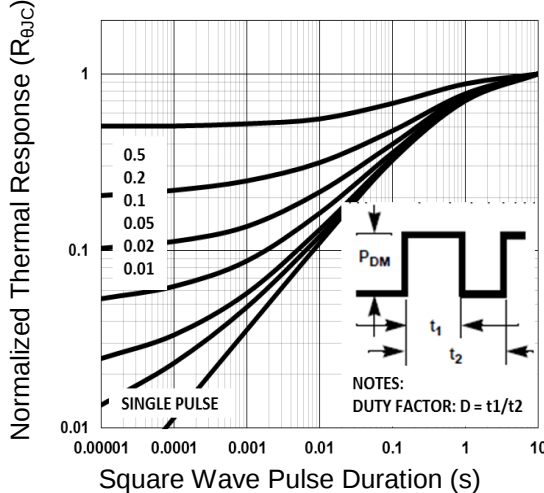
**Normalized Transient Impedance (TO-220)**



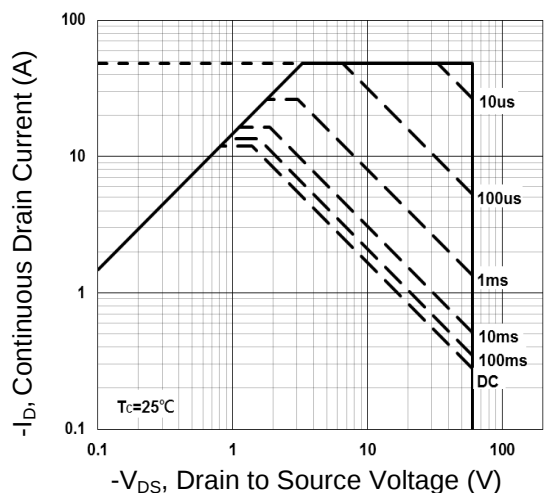
**Maximum Safe Operation Area (TO-220)**



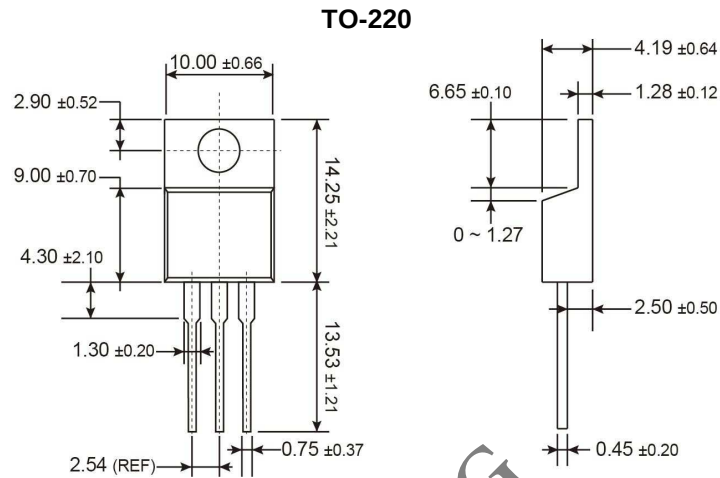
**Normalized Transient Impedance (ITO-220)**



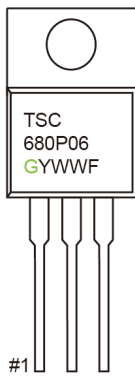
**Maximum Safe Operation Area (ITO-220)**



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



**MARKING DIAGRAM**



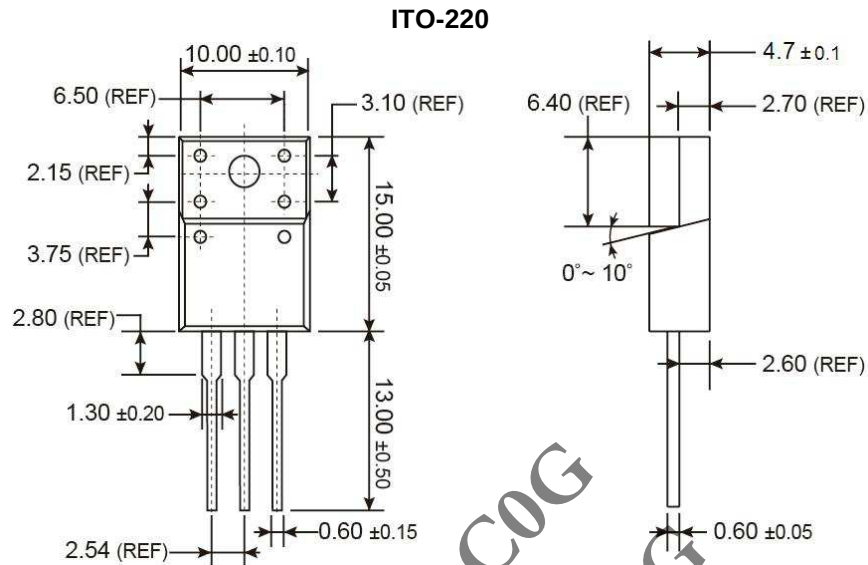
- G** = Halogen Free
- Y** = Year Code
- WW** = Week Code (01~52)
- F** = Factory Code

TSM680P06C1 C0G

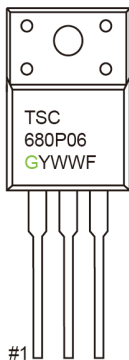
TSM680P06CZ C0G

Not Recommended

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

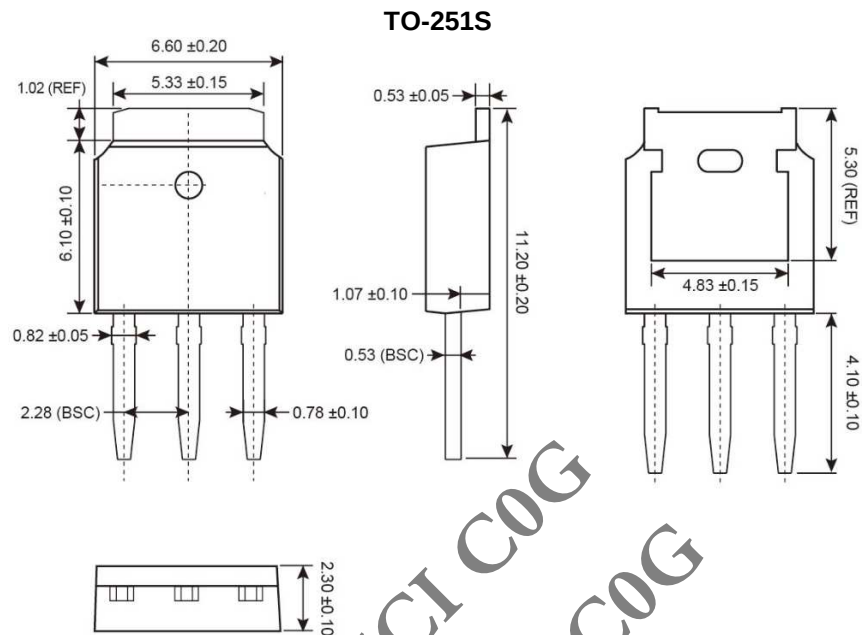


**MARKING DIAGRAM**

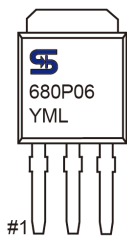


- G** = Halogen Free
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**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)



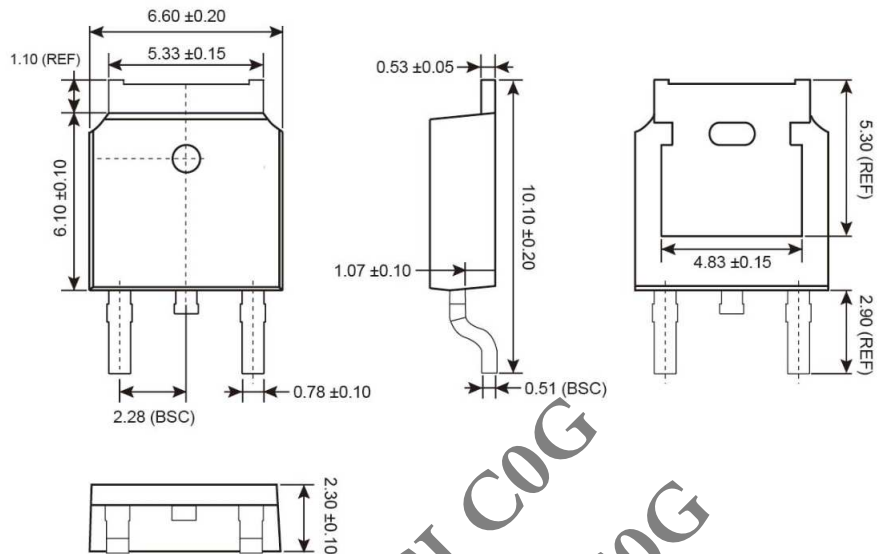
**MARKING DIAGRAM**



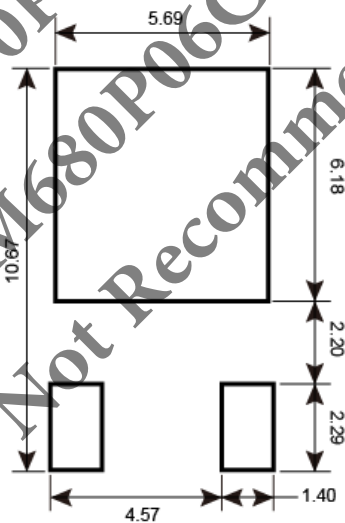
**Y** = Year Code  
**M** = Month Code for Halogen Free Product  
**O** = Jan    **P** = Feb    **Q** = Mar    **R** = Apr  
**S** = May    **T** = Jun    **U** = Jul    **V** = Aug  
**W** = Sep    **X** = Oct    **Y** = Nov    **Z** = Dec  
**L** = Lot Code (1~9, A~Z)

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

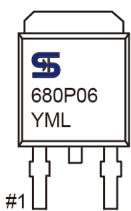
**TO-252**



**SUGGESTED PAD LAYOUT**



**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)

TSM680P06CI C0G  
TSM680P06CZ C0G  
Not Recommended

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