

## Silicon N-Channel Super Junction Power MOSFET

### Description

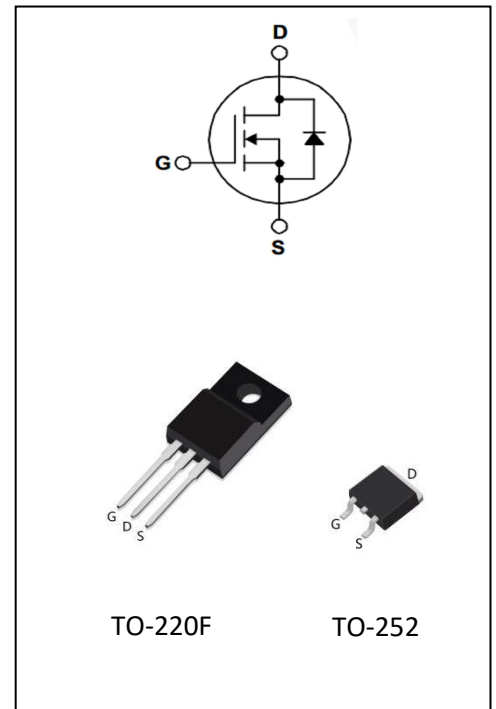
The TH60R280F TH60R280G utilizes the latest Super Junction processing techniques to achieve low on-resistance per silicon area. Additional features of this MOSFET are 150°C operating junction temperature and high repetitive peak current capability. These features combine to make this MOSFET a highly efficient, robust and reliable device. It can be used in a wide variety of applications.

### General Features

- $V_{DS}=600V, I_D=15A$
- Low ON Resistance,  $R_{DS(ON).max}=280m\Omega @ V_{GS}=10V, I_D=7.5A$
- Low reverse transfer capacitance
- Low Qg for fast response
- Short fall & rise times for fast switching
- 100% single pulse avalanche energy Test

### Application

- Power switching application
- Digital amplifier
- Adapter and charger



TO-220F

TO-252

### Product Summary

|                  |       |
|------------------|-------|
| $V_{DS}$         | 600V  |
| $R_{DS(on).max}$ | 280mΩ |
| $I_D$            | 15A   |

### Absolute Maximum Ratings

| Parameter                                                                 | Symbol         | TH60R280F  | TH60R280G | Unit       |
|---------------------------------------------------------------------------|----------------|------------|-----------|------------|
| Drain-source voltage                                                      | $V_{DS}$       | 600        |           | V          |
| Continuous drain current<br>$T_C = 25^\circ C$ (Silicon limit)            | $I_D$          | 15         |           | A          |
| Pulsed drain current ( $T_C = 25^\circ C$ , $t_p$ limited by $T_{jmax}$ ) | $I_{DM}$       | 45         |           | A          |
| Avalanche energy, single pulse ( $L=10mH$ , $R_g=25\Omega$ )              | $E_{AS}$       | 245        |           | mJ         |
| Gate-Source voltage                                                       | $V_{GS}$       | $\pm 20$   |           | V          |
| Power dissipation ( $T_C = 25^\circ C$ )                                  | $P_D$          | 32         | 118       | W          |
| Operating junction and storage temperature                                | $T_j, T_{stg}$ | -55...+150 |           | $^\circ C$ |

## Thermal Resistance

| Parameter                                              | Symbol     | TH60R280F | TH60R280G | Unit |
|--------------------------------------------------------|------------|-----------|-----------|------|
| Thermal resistance, junction – case.                   | $R_{thJC}$ | 3.9       | 1.06      | °C/W |
| Thermal resistance, junction – ambient(min. footprint) | $R_{thJA}$ | 80        | 62        |      |

## Electrical Characteristic (at $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

| Parameter | Symbol | Value |      |      | Unit | Test Condition |
|-----------|--------|-------|------|------|------|----------------|
|           |        | min.  | typ. | max. |      |                |

## Static Characteristic

|                                  |              |     |       |           |          |                                                      |
|----------------------------------|--------------|-----|-------|-----------|----------|------------------------------------------------------|
| Drain-source breakdown voltage   | $BV_{DSS}$   | 600 | -     | -         | V        | $V_{GS}=0V, I_D=250\mu A$                            |
| Gate threshold voltage           | $V_{GS(th)}$ | 2.8 | -     | 4.2       | V        | $V_{DS}=V_{GS}, I_D=250\mu A$                        |
| Zero gate voltage drain current  | $I_{DSS}$    | -   | -     | 1         | $\mu A$  | $V_{DS}=600V, V_{GS}=0V$<br>$T_j=25^{\circ}\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$    | -   | -     | $\pm 100$ | nA       | $V_{GS}=\pm 30V, V_{DS}=0V$                          |
| Drain-source on-state resistance | $R_{DS(on)}$ | -   | 0.257 | 0.28      | $\Omega$ | $V_{GS}=10V, I_D=7.5A$                               |

## Dynamic Characteristic

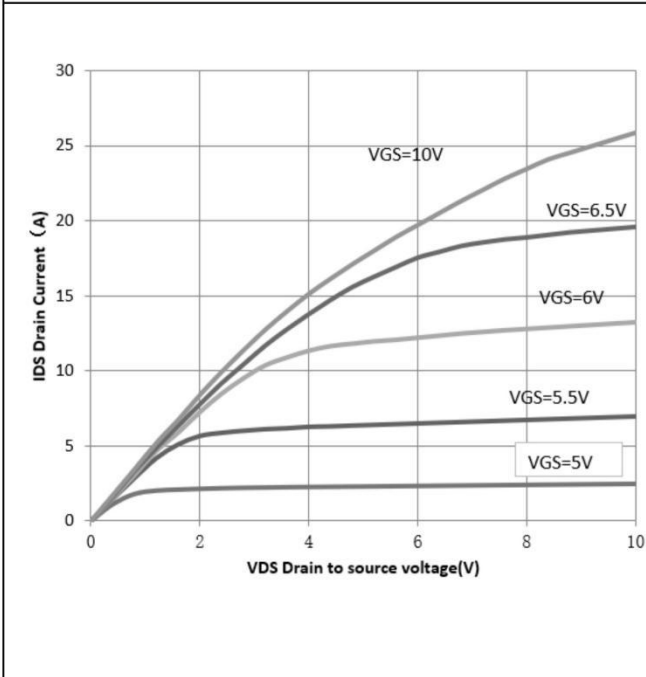
|                              |              |   |       |   |          |                                                        |
|------------------------------|--------------|---|-------|---|----------|--------------------------------------------------------|
| Input Capacitance            | $C_{iss}$    | - | 1020  | - | pF       | $V_{GS}=0V, V_{DS}=50V,$<br>$f=10kHz$                  |
| Output Capacitance           | $C_{oss}$    | - | 108   | - |          |                                                        |
| Reverse Transfer Capacitance | $C_{rss}$    | - | 5.11  | - |          |                                                        |
| Gate Total Charge            | $Q_g$        | - | 22.94 | - | nC       | $V_{DD}=400V, I_D=3.8A$<br>$V_{GS}=0\text{ to }10V$    |
| Gate-Source charge           | $Q_{gs}$     | - | 5.7   | - |          |                                                        |
| Gate-Drain charge            | $Q_{gd}$     | - | 14.3  | - |          |                                                        |
| Turn-on delay time           | $t_{d(on)}$  | - | 8.4   | - | ns       | $V_{DD}=400V, V_{GS}=13V,$<br>$I_D=3.8A, R_G=10\Omega$ |
| Rise time                    | $t_r$        | - | 21.2  | - |          |                                                        |
| Turn-off delay time          | $t_{d(off)}$ | - | 32.4  | - |          |                                                        |
| Fall time                    | $t_f$        | - | 20.8  | - |          |                                                        |
| Gate resistance              | $R_G$        | - | 5.3   | - | $\Omega$ | $f=1MHz, \text{open drain}$                            |

**Body Diode Characteristic**

| Parameter                          | Symbol    | Value |        |      | Unit    | Test Condition                           |
|------------------------------------|-----------|-------|--------|------|---------|------------------------------------------|
|                                    |           | min.  | typ.   | max. |         |                                          |
| Body Diode Forward Voltage         | $V_{SD}$  | -     | 0.736  | -    | V       | $V_{GS}=0V, I_F=1A$                      |
| Body Diode Reverse Recovery Time   | $t_{rr}$  | -     | 201.62 | -    | ns      | $V_R=400V, I_F=5.2A,$<br>$dI/dt=100A/us$ |
| Body Diode Reverse Recovery Charge | $Q_{rr}$  | -     | 2.174  | -    | $\mu C$ |                                          |
| Peak reverse recovery current      | $I_{rrm}$ | -     | 22.22  |      | A       |                                          |

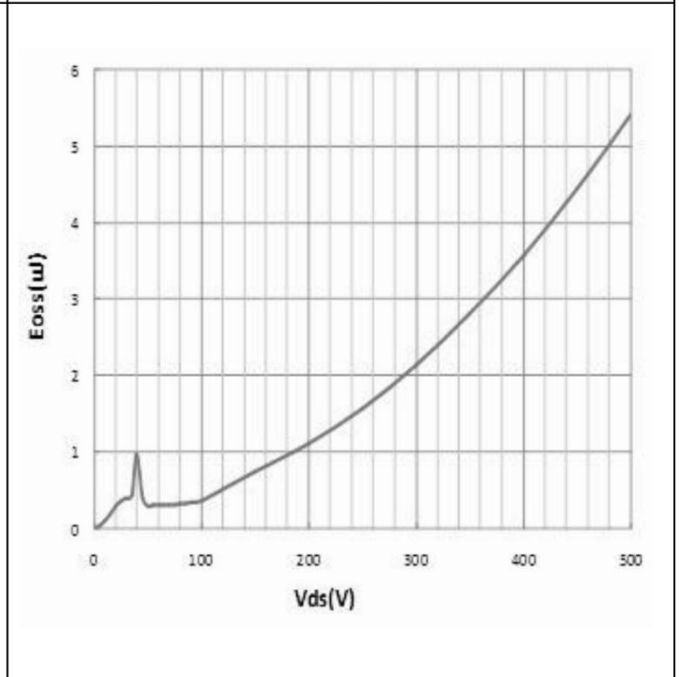
## Electrical characteristics diagram

Diagram 1: Typ. output characteristics



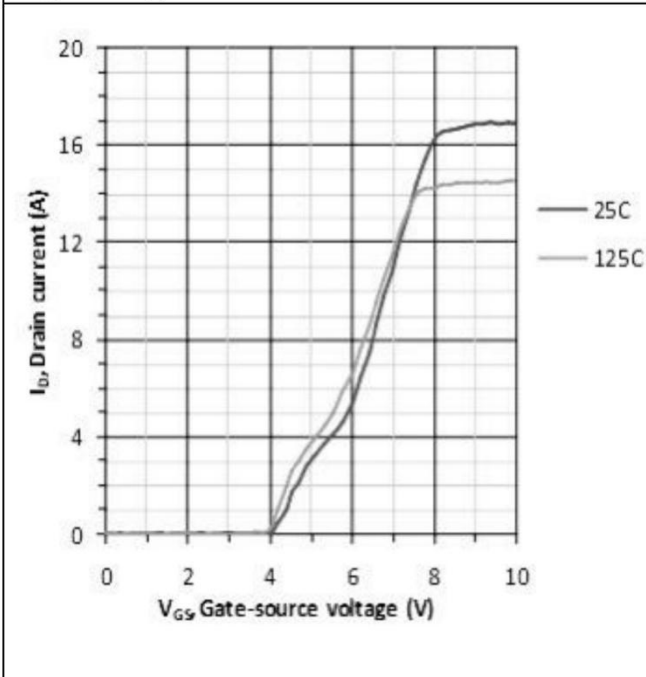
$I_D = f(V_{DS}); T_J = 25^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 2: Typ. Coss stored energy



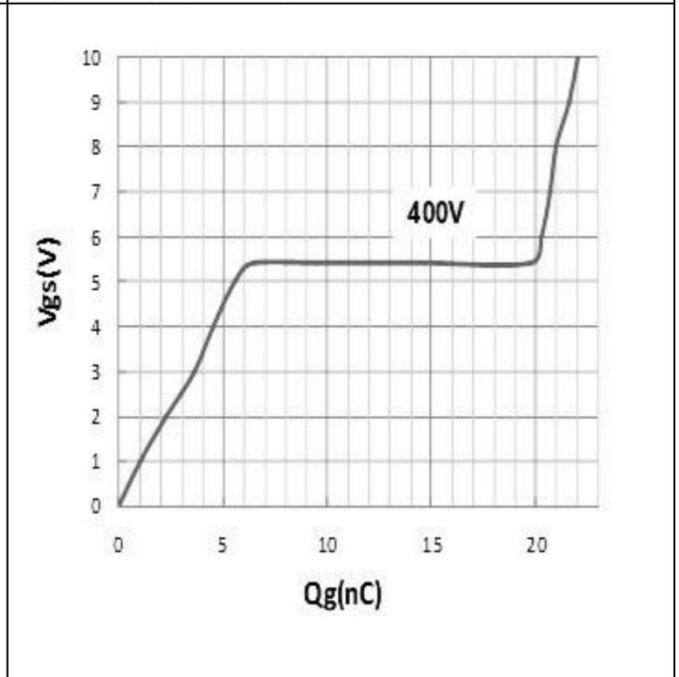
$E_{oss} = f(V_{DS})$

Diagram 3: Typ. transfer characteristics



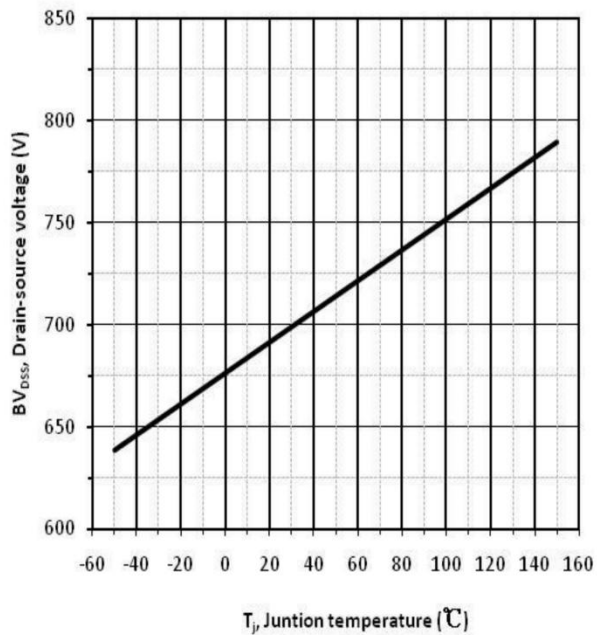
$I_D = f(V_{GS}); \text{parameter: } T_J$

Diagram 4: Typ. gate charge



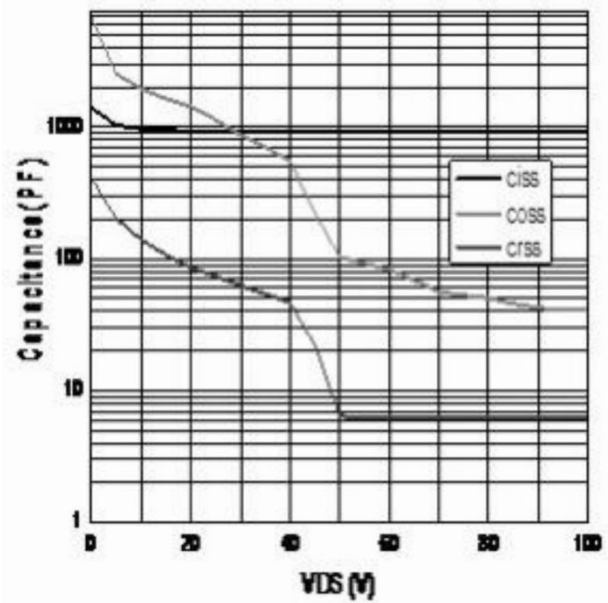
$V_{GS} = f(Q_{gate}); I_D = 3.8\text{A pulsed}; \text{parameter: } V_{DD}$

**Diagram 5: Drain-source breakdown voltage**



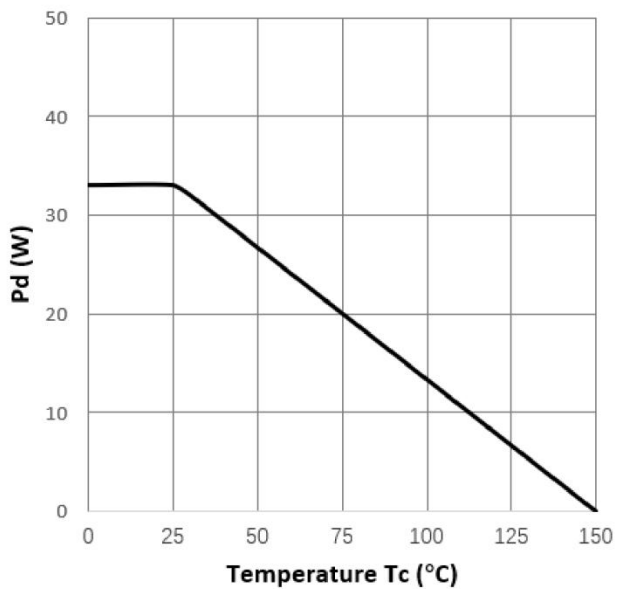
$V_{BR(DSS)} = f(T_j); I_D = 10\text{mA}$

**Diagram 6: Typ. capacitances**



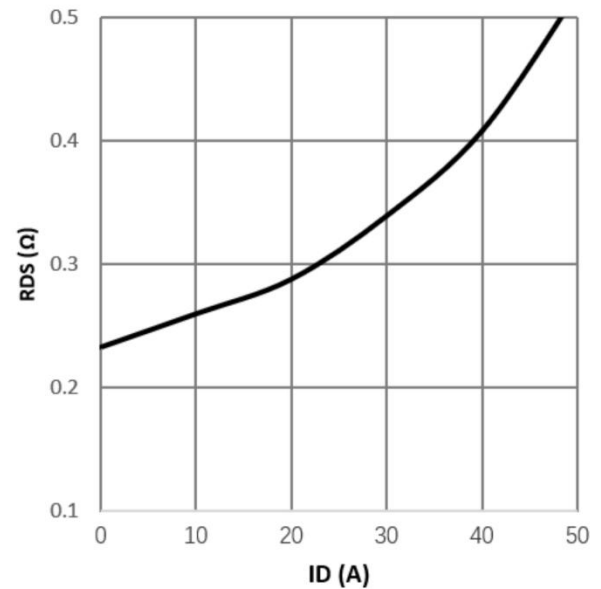
$C = f(V_{DS}); V_{GS} = 0\text{V}; f = 10\text{ kHz}$

**Diagram 7: Typ. Power Dissipation**



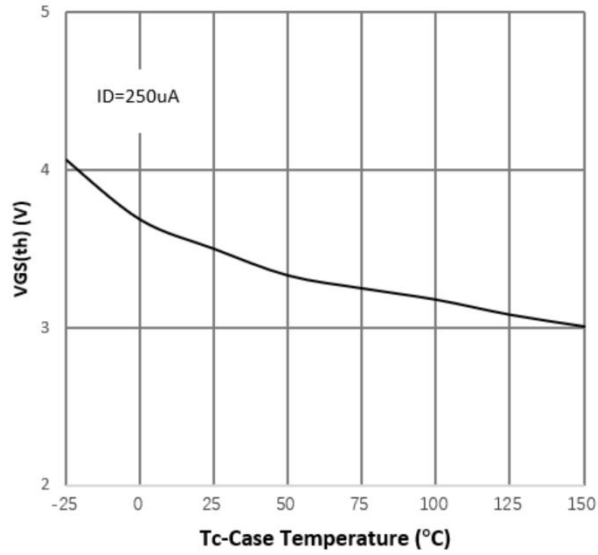
$P_{tot} = f(T_c);$

**Diagram 8: Typ. Rdson vs. Drain Current**



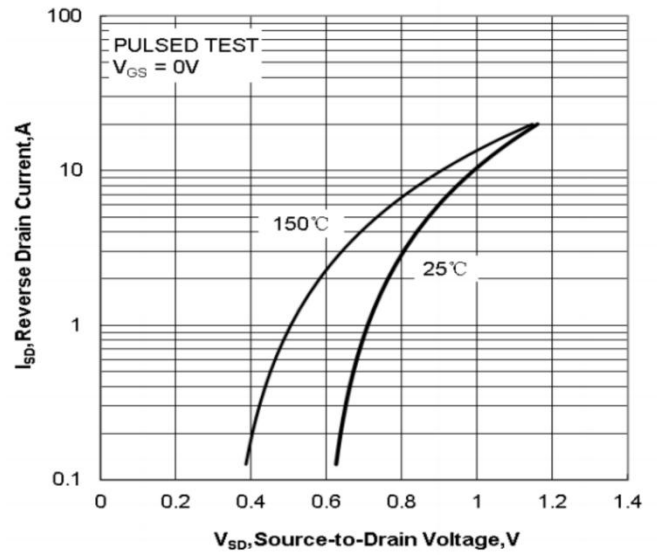
$R_{ds(on)} = f(I_D); V_{GS} = 10\text{V}$

**Diagram 9: Typ. Threshold voltage**



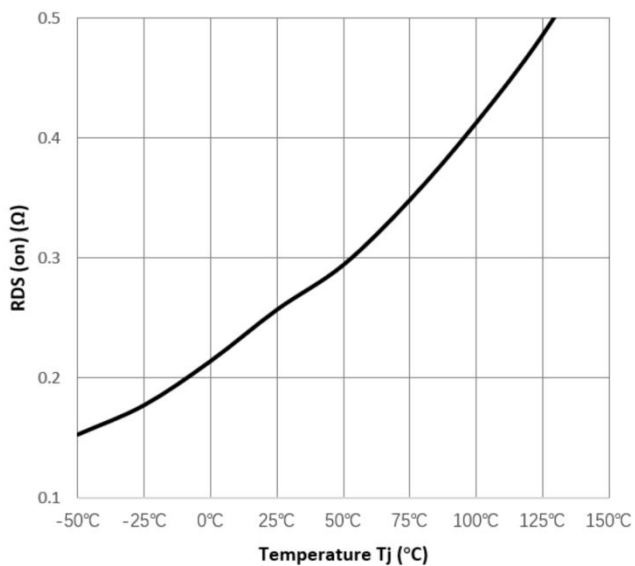
$V_{th}=f(T_c); I_D=250\mu A$

**Diagram 10: Typ. Body-Diode Characteristics**



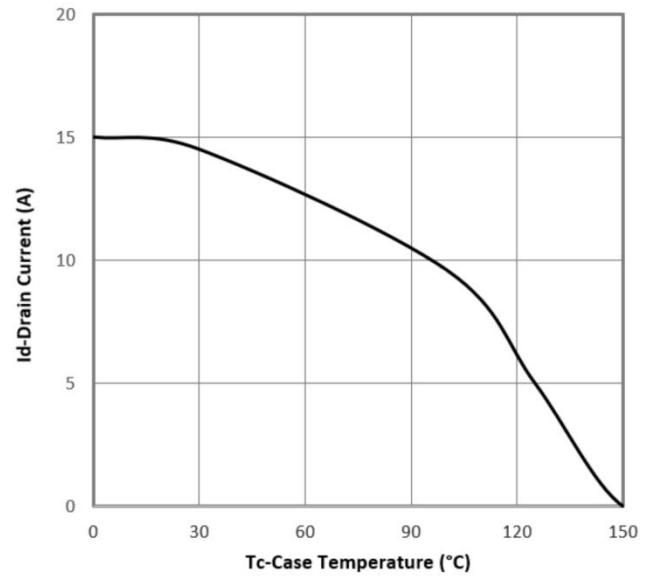
$I_F=f(V_{DS}); \text{parameter: } T_j$

**Diagram 11: Typ. Rdson – Junction Temperature**



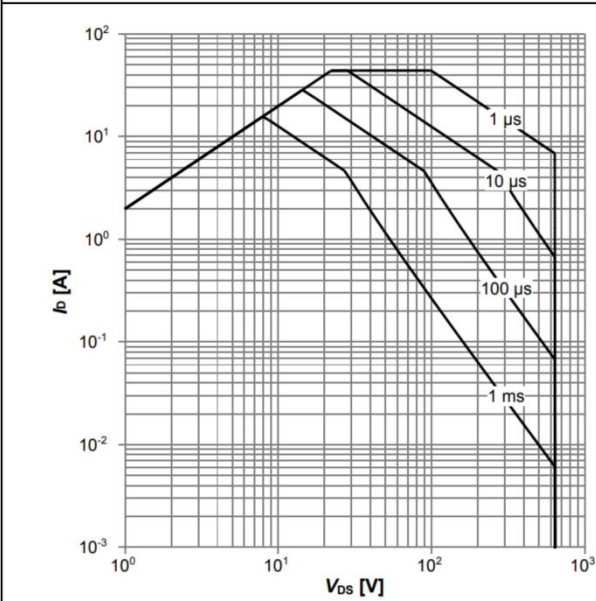
$(R_{ds(on)}=f(T_j); V_{GS}=10V/I_D=7.5A$

**Diagram 12: Typ. Drain Current De-rating**



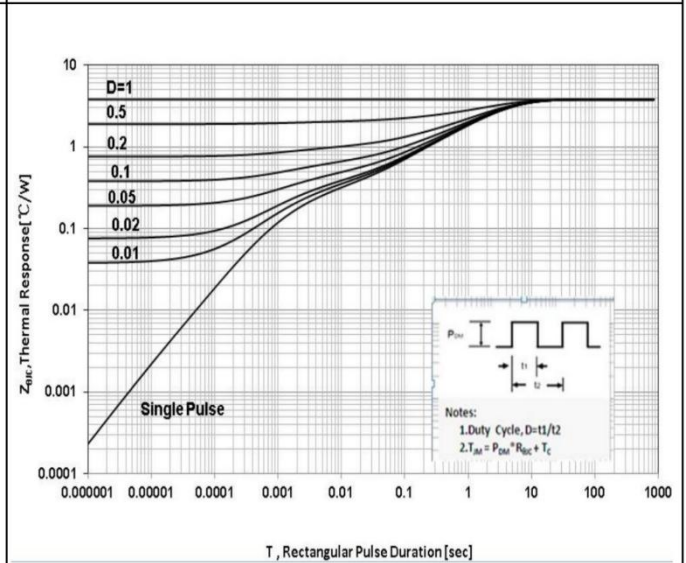
$I_D=f(T_c);$

Diagram 13: Typ. Maximum Safe Operating Area



$I_D = f(V_{DS})$ ;  $T_C = 25^\circ\text{C}$ ;  $D = 0$ ; parameter  $t_p$

Diagram 14: Max. transient thermal impedance



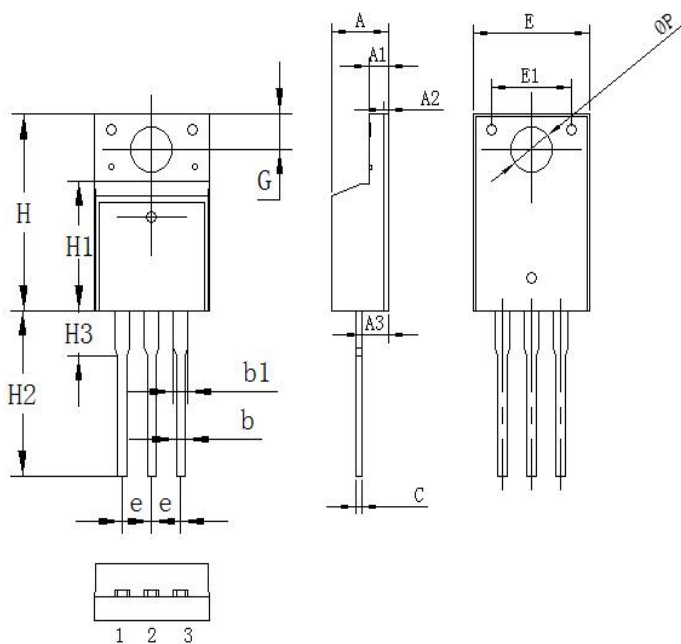
$Z_{thJC} = f(t_p)$ ; parameter:  $D = t_p/T$



## Package Information

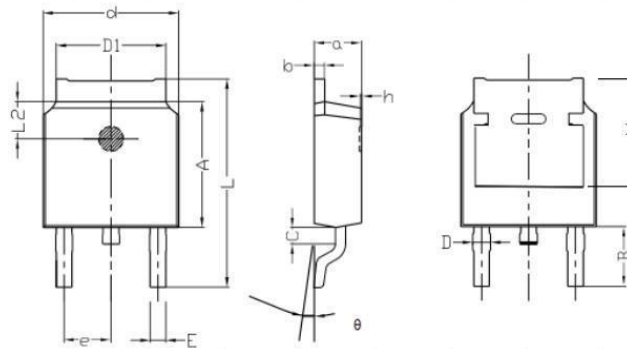
### TO-220F PACKAGE

### 基本尺寸



| Symbol   | 单位 mm |      |      |
|----------|-------|------|------|
|          | Min   | Nom  | Max  |
| A        | 4.55  | 4.75 | 4.95 |
| A1       | 2.40  | 2.60 | 2.80 |
| A2       | 0.40  | 0.60 | 0.80 |
| A3       | 2.10  | 2.30 | 2.50 |
| b1       | 1.10  | 1.30 | 1.50 |
| b        | 0.60  | 0.80 | 1.00 |
| c        | 0.42  | 0.50 | 0.58 |
| e        | 2.34  | 2.54 | 2.74 |
| E        | 9.9   | 10.1 | 10.3 |
| E1       | 6.8   | 7    | 7.2  |
| H        | 15.8  | 16.0 | 16.2 |
| H1       | 9.10  | 9.30 | 9.50 |
| H2       | 12.5  | 13.0 | 13.5 |
| H3       | 3.10  | 3.30 | 3.50 |
| G        | 3.00  | 3.20 | 3.40 |
| $\Phi P$ | 3.00  | 3.20 | 3.40 |

## TO-252 PACKAGE



| ITEM | SPEC (mm) |       |
|------|-----------|-------|
|      | MIN       | MAX   |
| a    | 2.15      | 2.50  |
| b    | 0.41      | 0.61  |
| c    | 0.70      | 0.90  |
| D    | 0.6       | 1.14  |
| d    | 6.35      | 6.80  |
| D1   | 5.10      | 5.53  |
| A    | 5.40      | 6.40  |
| e    | 2.09      | 2.49  |
| L    | 9.25      | 10.41 |
| B    | 2.40      | 3.40  |
| L2   | 1.5       | 1.8   |
| θ    | 0         | 8     |
| h    | 0         | 0.15  |
| V    | 5.30REF   |       |
| E    | 0.50      | 0.90  |

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