## General Description

The WSR28N65F is CoolFET II MOSFET family that is utilizing charge balance technology for extremely low on-resistance and low gate charge performance. P/T is suitable for applications which require superior power density and outstanding efficiency

## Features

- Low Crss
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS product

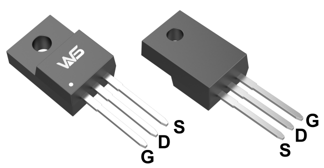
## Product Summery

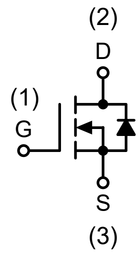
| $BV_{DSS}$ | $R_{DSON}$ | $I_D$ |
|---|---|---|
| 650V | 280mΩ | 28A |

## Applications

- Uninterruptible Power Supply(UPS)
- Power Factor Correction (PFC)

## TO-220F Pin Configuration




## Absolute Maximum Ratings (T$_C$= 25℃, Unless Otherwise Noted)

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 650 | V |
| $V_{GS}$ | Gate-Source Voltage | ±30 | V |
| $I_D$ | Continuous Drain Current | 28 | A |
| $I_{DM}$ | Pulsed Drain Current [1] | 44 | A |
| $E_{AS}$ | Single Pulse Avalanche Energy [2] | 250 | mJ |
| $P_D$ | Power Dissipation | 25.5 | W |
| $T_{STG}$ | Storage Temperature Range | -55 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -55 to 150 | ℃ |

## Thermal Data

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{θJA}$ | Junction-to-Ambient | --- | 62 | ℃/W |
| $R_{θJC}$ | Junction-to-Case | --- | 1.2 | ℃/W |

## Electrical Characteristics ($T_J$= 25℃ Unless Otherwise Noted)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=250uA | 650 | --- | --- | V |
| $\triangle BV_{DSS}/\triangle T_J$ | $BV_{DSS}$ Temperature Coefficient | ID=250uA,Reference25℃ | --- | 0.7 | --- | V/℃ |
| $R_{DS(ON)}$ | Drain-to-Source On-Resistance | $V_{GS}$=10V,$I_D$=3.2A | --- | 280 | 340 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =250uA | 2.5 | 3.3 | 4.5 | V |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$=650V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=520V , $V_{GS}$=0V , $T_C$=125℃ | --- | --- | 50 | |
| $I_{GSS}$ | Gate-Source Leakage Current, forward | $V_{GS}$=30V , $V_{DS}$=0V | --- | --- | 100 | nA |
| | Gate-Source Leakage Current, reverse | $V_{GS}$=-30V , $V_{DS}$=0V | --- | --- | -100 | nA |
| $Q_g$ | Total Gate Charge | $V_{DS}$=400V , $V_{GS}$=10V , $I_D$=7A | --- | 2.77 | --- | nC |
| $Q_{gs}$ | Gate-Source Charge | | --- | 5.8 | --- | |
| $Q_{gd}$ | Gate-Drain Charge | | --- | 20.4 | --- | |
| $T_{d(on)}$ | Turn-On Delay Time | $V_{DS}$=400V , $I_D$=7A<br>$V_{GS}$=10V , $R_G$=4.7Ω, | --- | 6.2 | --- | ns |
| $T_r$ | Rise Time | | --- | 21 | --- | |
| $T_{d(off)}$ | Turn-Off Delay Time | | --- | 28.8 | --- | |
| $T_f$ | Fall Time | | --- | 22.4 | --- | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=100V , $V_{GS}$=0V , f=1MHz | --- | 781 | --- | pF |
| $C_{oss}$ | Output Capacitance | | --- | 30.3 | --- | |
| $C_{rss}$ | Reverse Transfer Capacitance | | --- | 1.47 | --- | |

## Diode Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | $V_G$=$V_D$=0V , Force Current | --- | --- | 14 | A |
| $I_{SM}$ | Maximum Pulsed Current (Body Diode) | | --- | --- | 44 | A |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$=0V , $I_S$=7A , $T_J$=25℃ | --- | 0.7 | 1.5 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=7A,dI/dt=100A/µs,$T_J$=25℃ | --- | 218 | --- | nS |
| $Q_{rr}$ | Reverse Recovery Charge | | --- | 1.1 | --- | nC |

**Note :**

1、The data tested by surface mounted on a 1 inch2 FR-4 board with 2OZ copper.

2、The EAS data shows Max. rating . L=0.5mH, IAS =7A, VDD =50V, RG=25Ω

3、The test condition is Pulse Test: ISD ≤ ID, di/dt = 100A/us, VDD≤ BVDSS, Starting at TJ =25℃

4、The power dissipation is limited by 150℃ junction temperature

5、The data is theoretically the same as ID and IDM , in real applications , should be limited by total power dissipation.

## Typical Characteristics

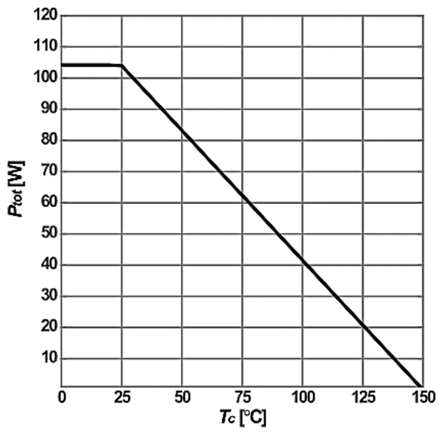



**Figure1: Power dissipation (Non FullPAK)**

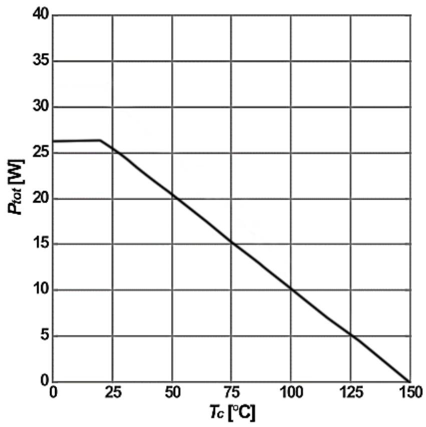



**Figure2: Power dissipation (FullPAK)**

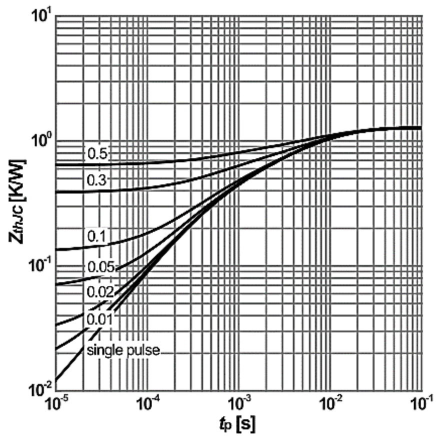



**Figure3:Max. transient thermal impedance**

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

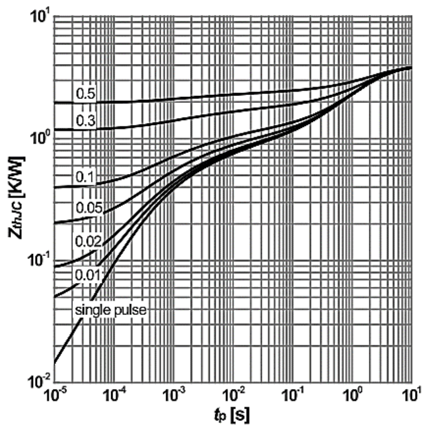



**Figure4:Max. transient thermal impedance**

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

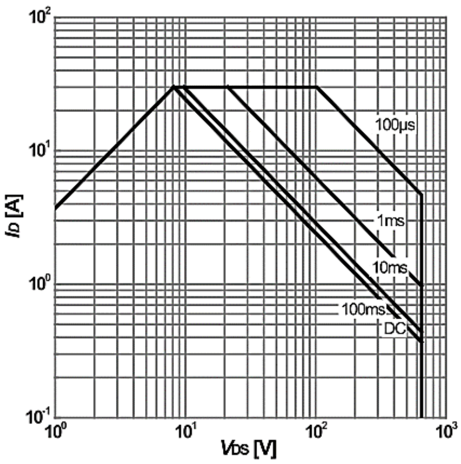



**Figure5: Safe operating area (Non FullPAK)**

$I_D$=f($V_{DS}$); $T_j$=25°C; D=0; parameter: $t_p$

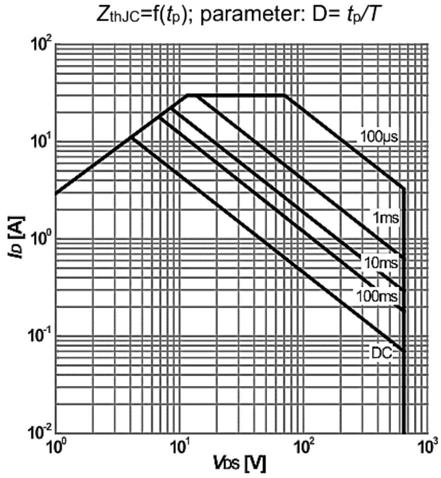



**Figure6: Safe operating area (FullPAK)**

$I_D$=f($V_{DS}$); $T_j$=25°C; D=0; parameter: $t_p$

## Typical Characteristics (Cont.)

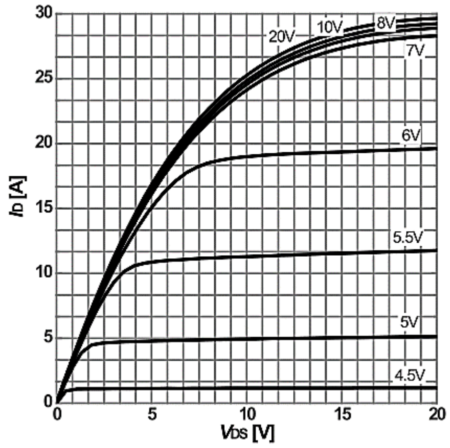



**Figure 7: Typ. outp ut characteristics**

$I_D$=f($V_{DS}$); $T_j$=25°C; parameter: $V_{GS}$

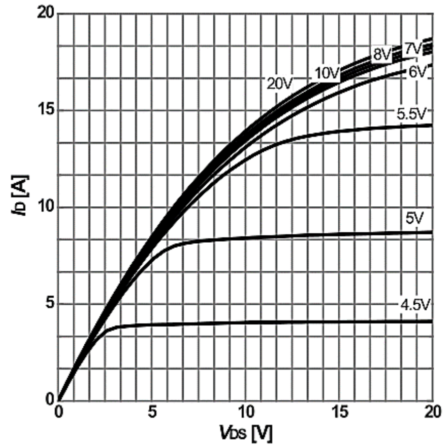



**Figure8 : Typ. output characteristics**

$I_D$=f($V_{DS}$); $T_j$=125°C; parameter: $V_{GS}$

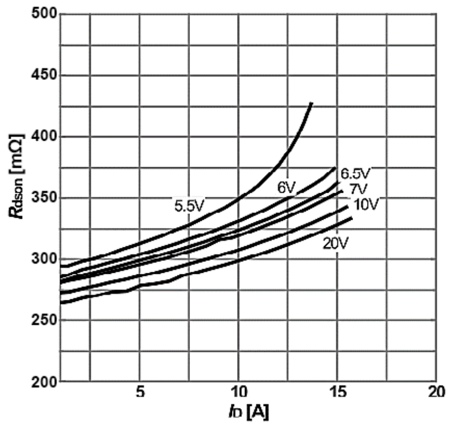



**Figure9 : Typ. drain-source on-state resistance**

$R_{DS}$(on)=f($I_D$); $T_j$=25°C; parameter: $V_{GS}$

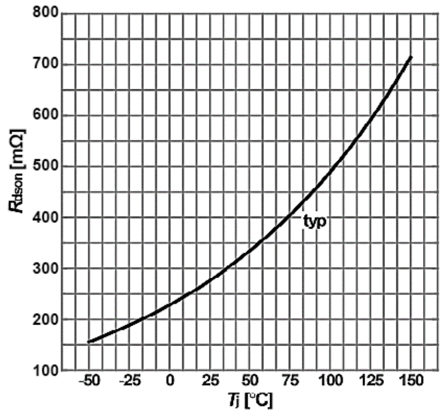



**Figure 10: drain -source on-state resistance**

$R_{DS}$(on)=f($T_j$); $I_D$=3.2A; $V_{GS}$=10V

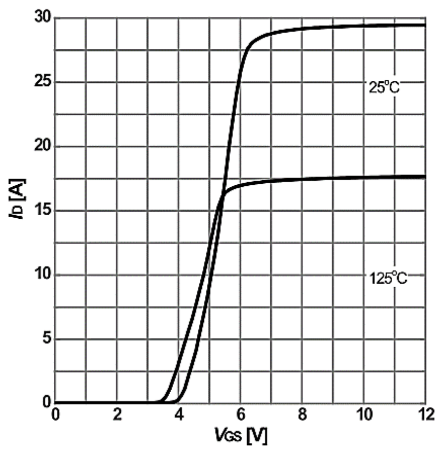



**Figure 11: Type. transfer characteristics**

$I_D$=f($V_{GS}$); $V_{DS}$=20V; parameter: $T_j$

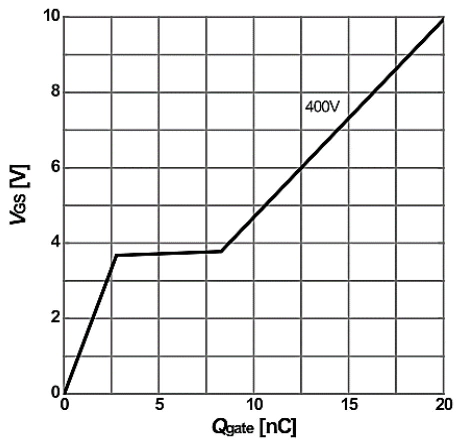
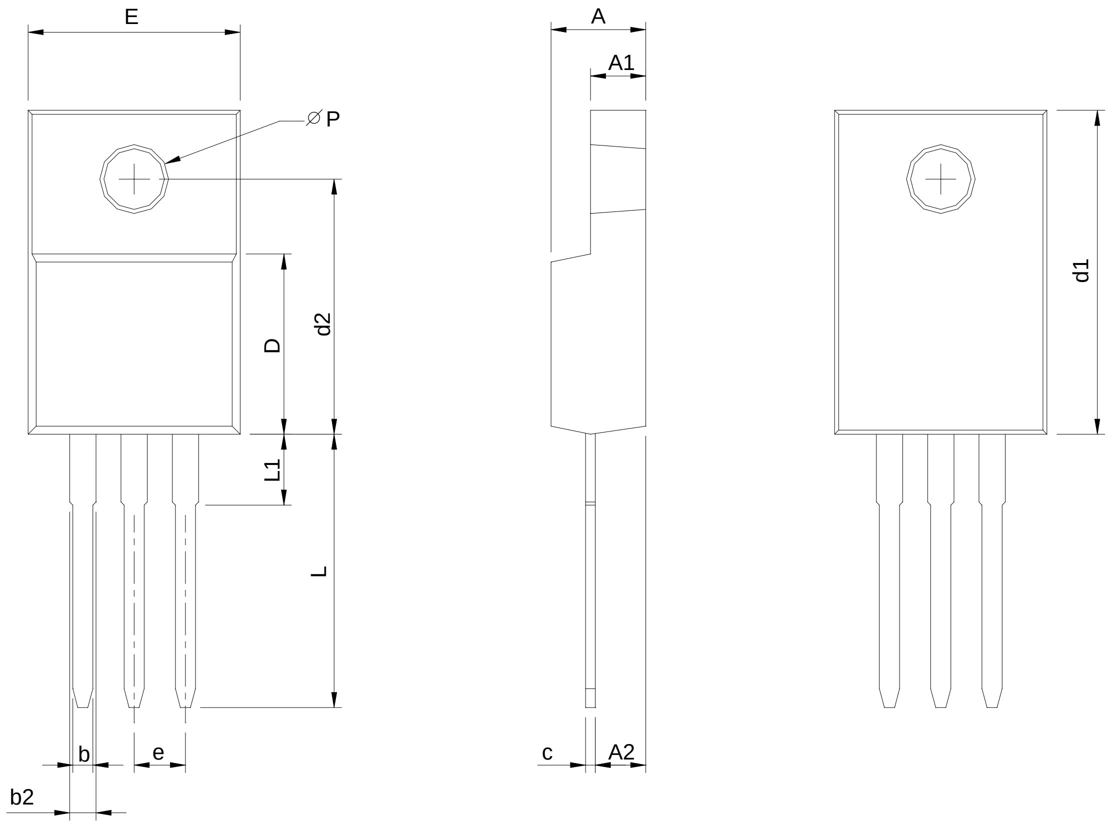



**Figure 12: Type. gate charge**

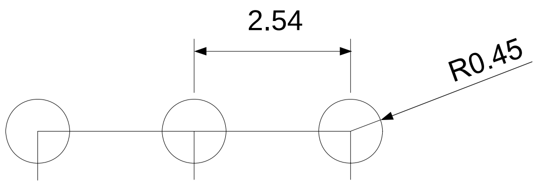
$V_{GS}$=f($Q_{gate}$); $I_D$=3.2A pulsed; $V_{DS}$=480V

## Packaging information




| SYMBOL | TO-220F-3L | | | |
|---|---|---|---|---|
| | MILLIMETERS | | INCHES | |
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.20 | 4.80 | 0.165 | 0.189 |
| A1 | 2.34 | 3.20 | 0.092 | 0.126 |
| A2 | 2.10 | 2.90 | 0.083 | 0.114 |
| b | 0.50 | 0.90 | 0.020 | 0.035 |
| b2 | 0.91 | 1.90 | 0.035 | 0.075 |
| c | 0.30 | 0.80 | 0.012 | 0.031 |
| D | 8.10 | 9.40 | 0.319 | 0.370 |
| d1 | 14.50 | 16.50 | 0.571 | 0.650 |
| d2 | 12.10 | 12.90 | 0.476 | 0.508 |
| E | 9.70 | 10.70 | 0.382 | 0.421 |
| e | 2.54 BSC | | 0.100 BSC | |
| L | 13.00 | 14.50 | 0.512 | 0.570 |
| L1 | 1.60 | 4.00 | 0.063 | 0.157 |
| P | 3.00 | 3.60 | 0.118 | 0.142 |

## RECOMMENDED LAND PATTERN




UNIT: mm

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