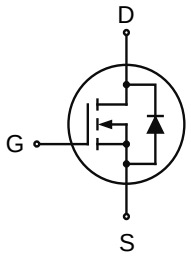
## Feature

- 650V,20 A
  RDS(ON) ≤ 0.45 Ω @ VGS=10V, TYP=0.35 Ω
- Fast Switching
- Low ON Resistance(Rdson≤0.45Ω)
- Low Gate Charge (Typical Data:57nC)
- 100% Single Pulse avalanche energy Test
- Halogen Free




**Schematic Diagram**


TO-220F

## Application

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)

## Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity (PCS) |
|---|---|---|---|---|---|
| 20N65F | AP20N65F | TO-220F | - | - | 1000 |

## ABSOLUTE MAXIMUM RATINGS ($T_J$=25℃ unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 650 | V |
| Gate-Source Voltage | $V_{GS}$ | ±30 | V |
| Continuous Drain Current ($T_C$ =25℃) | $I_D$ | 20 | A |
| Continuous Drain Current ($T_C$ =100℃) | $I_D$ | 12.6 | A |
| Pulsed Drain Current[1] | $I_{DM}$ | 80 | A |
| Power Dissipation | $P_D$ | 83 | W |
| Single Pulse Avalanche Energy[2] | $E_{AS}$ | 550 | mJ |
| Junction to case[4] | $R_{\theta JC}$ | 1.5 | ℃/W |
| Junction to Ambient[4] | $R_{\theta JA}$ | 65 | ℃/W |
| Junction Temperature | $T_J$ | 150 | ℃ |
| Storage Temperature | $T_{STG}$ | -55~ +150 | ℃ |

## MOSFET ELECTRICAL CHARACTERISTICS($T_J$=25℃ unless otherwise noted)

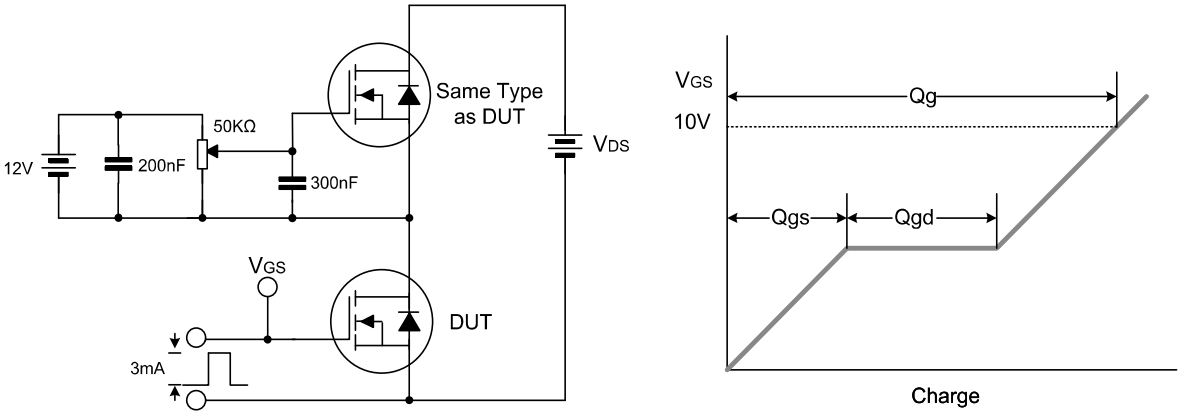
| Parameter | Symbol | Test Condition | Min | Type | Max | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0V, $I_D$ =250μA | 650 | - | - | V |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ =650V, $V_{GS}$ = 0V，Tj=25℃ | - | - | 1 | μA |
| Gate-body leakage current | $I_{GSS}$ | $V_{GS}$ =±30V,$V_{DS}$ = 0V | - | - | ±100 | nA |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}$ =$V_{GS}$, $I_D$ =250μA | 2.0 | - | 4 | V |
| Drain-source on-resistance | $R_{DS(on)}$ | $V_{GS}$ =10V, $I_D$ =10A | - | 0.35 | 0.45 | Ω |
| **Dynamic characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ =25V, $V_{GS}$ =0V, f =1MHz | - | 2890 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 280 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 11 | - | |
| Forward Transconductance | $G_{fs}$ | $V_{DS}$ =15V, $I_D$ =10A | | 18 | | S |
| **Switching characteristics** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=350V, $I_D$=20A, $V_{GS}$=10V, $R_G$=25Ω | - | 44 | - | ns |
| Turn-on rise time | $t_r$ | | - | 64 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 170 | - | |
| Turn-off fall time | $t_f$ | | - | 73 | - | |
| Total Gate Charge | Qg | VDS=560V, ID=20A, VGS=10V | - | 57 | - | nC |
| Gate-Source Charge | Qgs | | - | 18 | - | |
| Gate-Drain Charge | Qgd | | - | 18.5 | - | |
| **Source-Drain Diode characteristics** | | | | | | |
| Diode Forward voltage | $V_{SD}$ | $V_{GS}$ =0V, $I_S$=10A | - | - | 1.4 | V |
| Diode Forward current | $I_S$ | | - | - | 20 | A |
| Body Diode Reverse Recovery Time | trr | VGS=0V, IF=20A, dIF/dt=100A/μs | | 680 | | ns |
| Body Diode Reverse Recovery Charge | Qrr | | | 9.3 | | uC |

**Notes:**

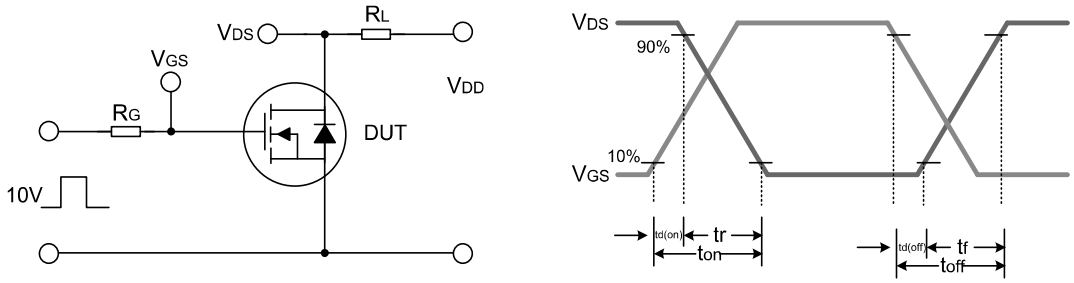
1. Repetitive Rating:pulse width limited by maximum junction temperature.
2. L=10mH,Rg=25Ω,IAS=10.5A , starling TJ=25℃.
3. ISD=20A,dI/dt≤100A/us,VDD≤BVDSS,starting TJ=25℃.
4. Repetitive rating; pulse width limited by maximum junction tempera

## Test Circuit

Gate Charge Test Circuit & Waveform

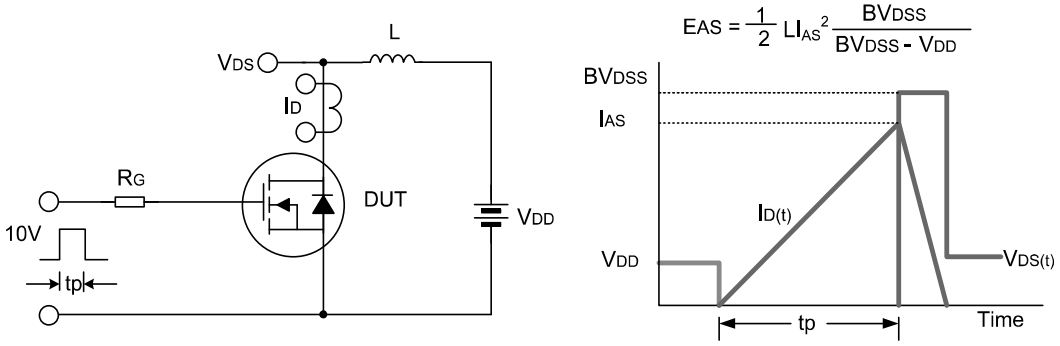



Resistive Switching Test Circuit & Waveform




Unclamped Inductive Switching Test Circuit & Waveform

$$EAS = \frac{1}{2} LI_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



## Typical Performance Characteristics

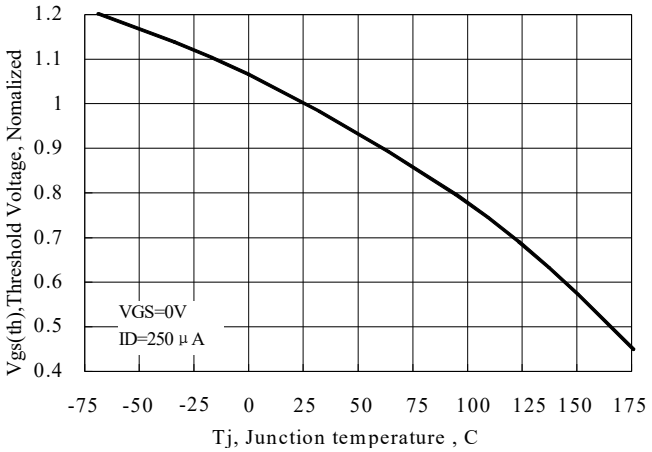



Figure 1 Typical Theshold Voltage vs Junction Temperature

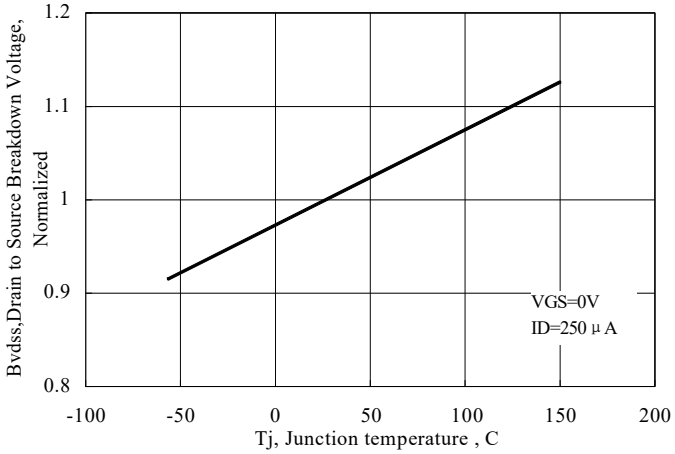



Figure 2 Typical Breakdown Voltage vs Junction Temperature

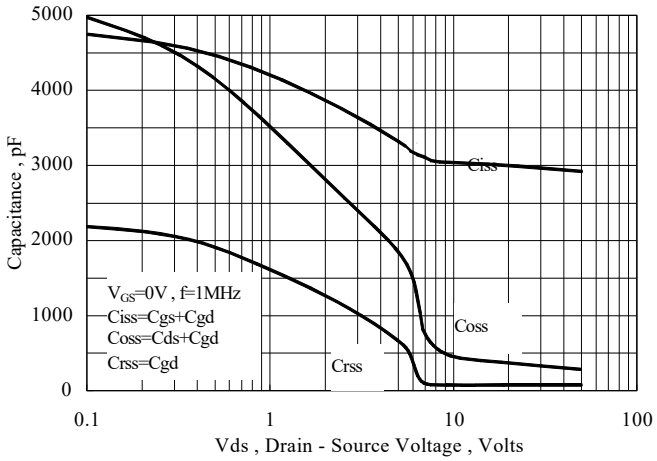



Figure 3 Typical Capacitance vs Drain to Source Voltage

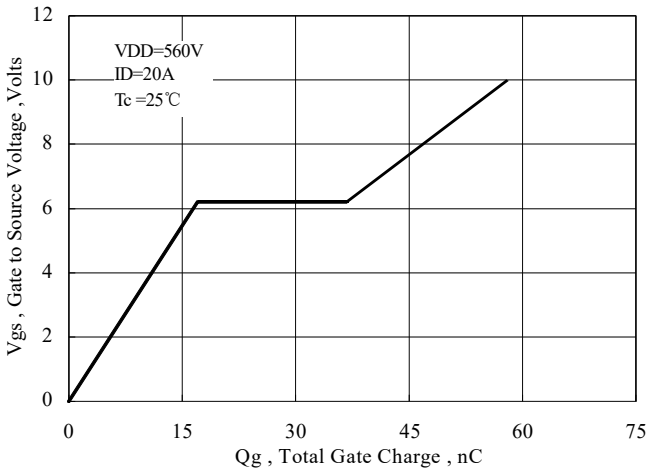



Figure 4 Typical Gate Charge vs Gate to Source Voltage

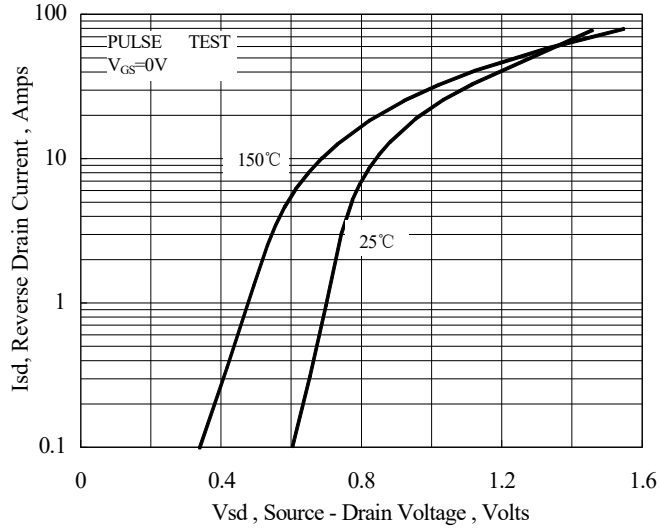



Figure 5 Typical Body Diode Transfer Characteristics

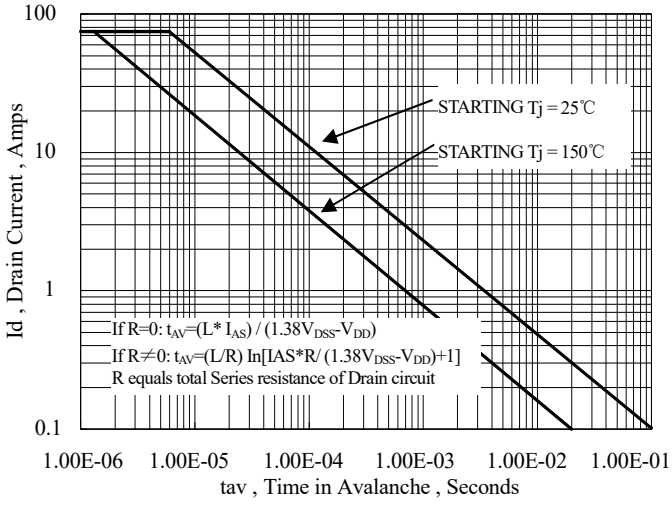



Figure 6 Unclamped Inductive Switching Capability

## Typical Performance Characteristics

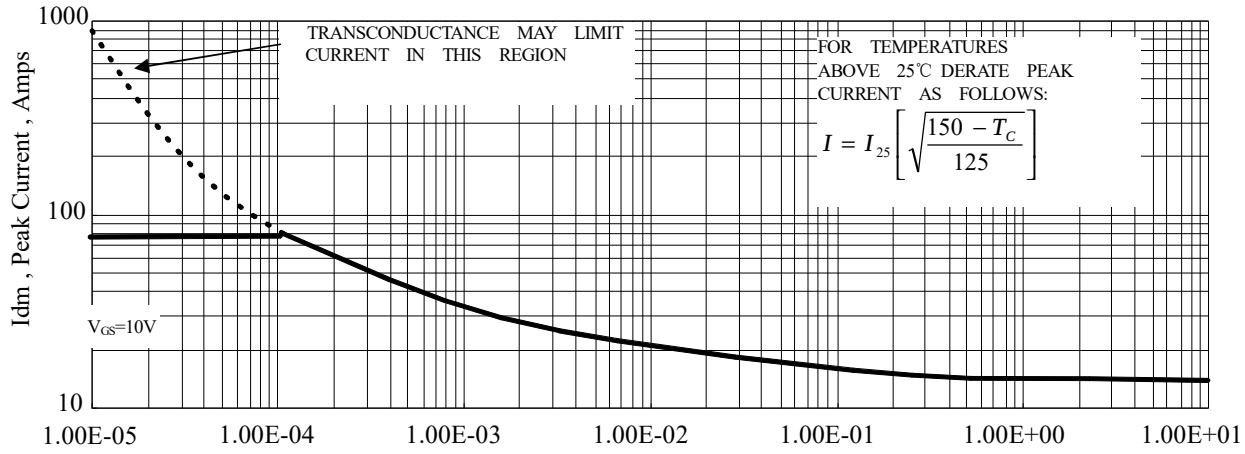



Figure 7 MaximumPeak Current Capability

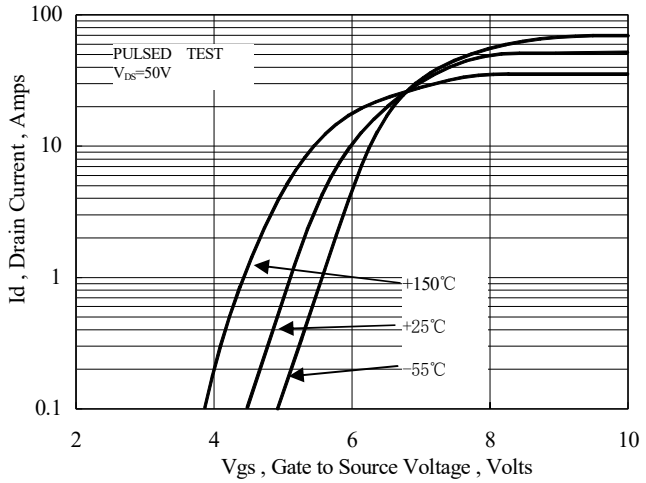



Figure 8 Typical Transfer Characteristics

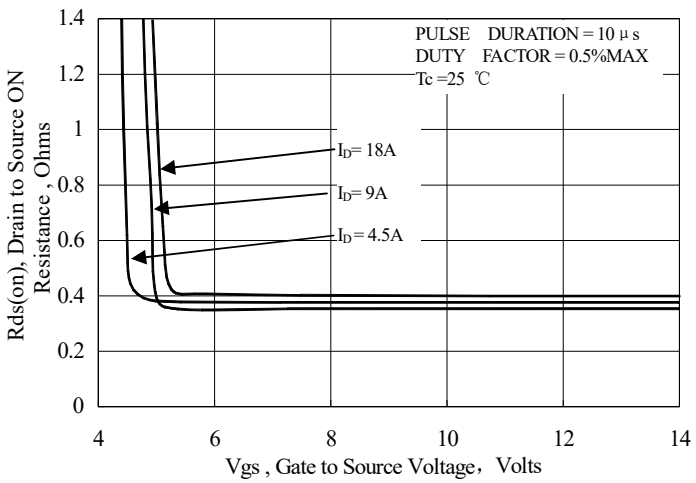



Figure 9 Typical Drain to Source ON Resistance vs Gate Voltage and Drain Current

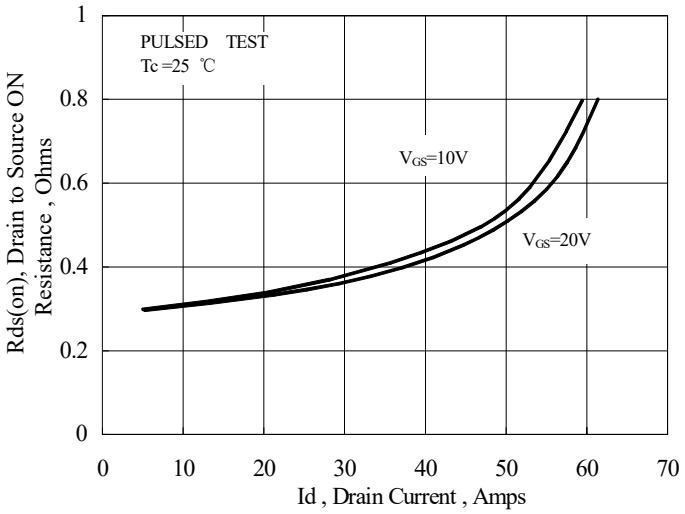



Figure 10 Typical Drain to Source ON Resistance vs Drain Current

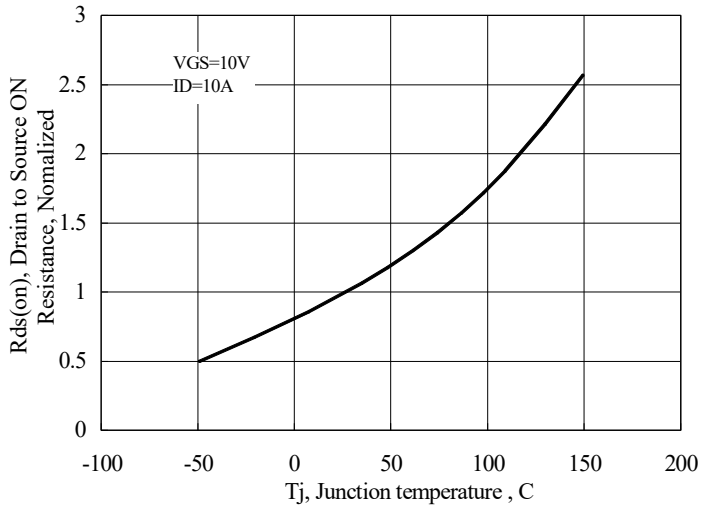



Figure 11 Typical Drian to Source on Resistance vs Junction Temperature

## Typical Performance Characteristics

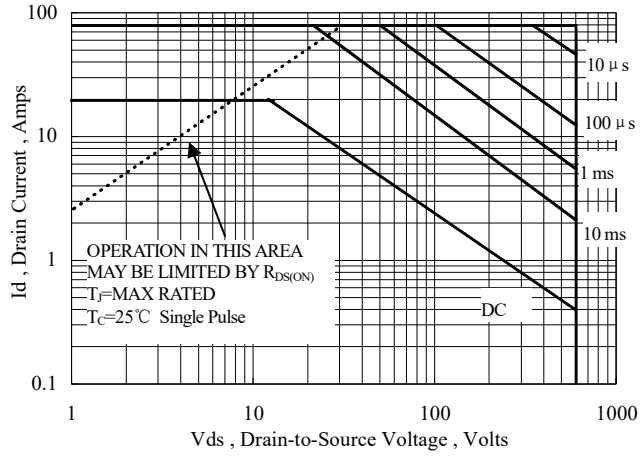



Figure 12 Maximum Forward Bias Safe Operating Area

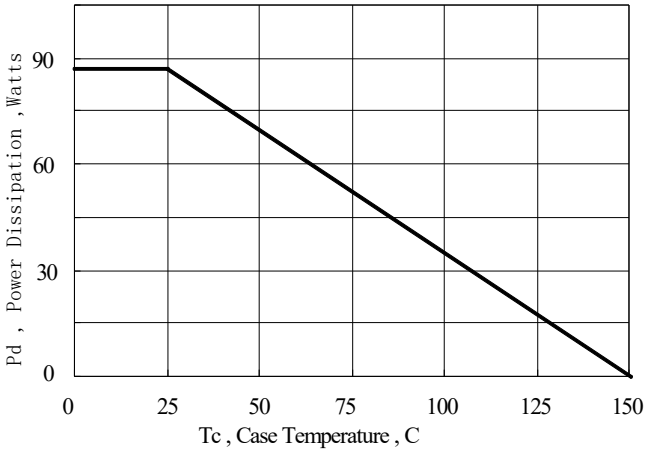



Figure 13 Maximum Power Dissipation vs Case Temperature

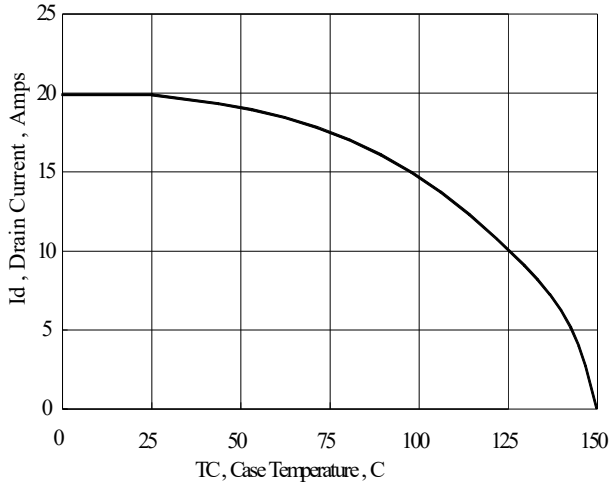



Figure 14 Maximum Continuous Drain Current vs Case Temperature

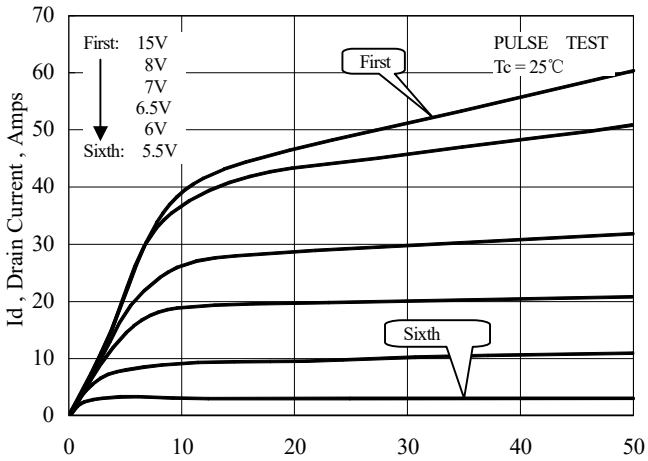



Figure 15 Typical Output Characteristics

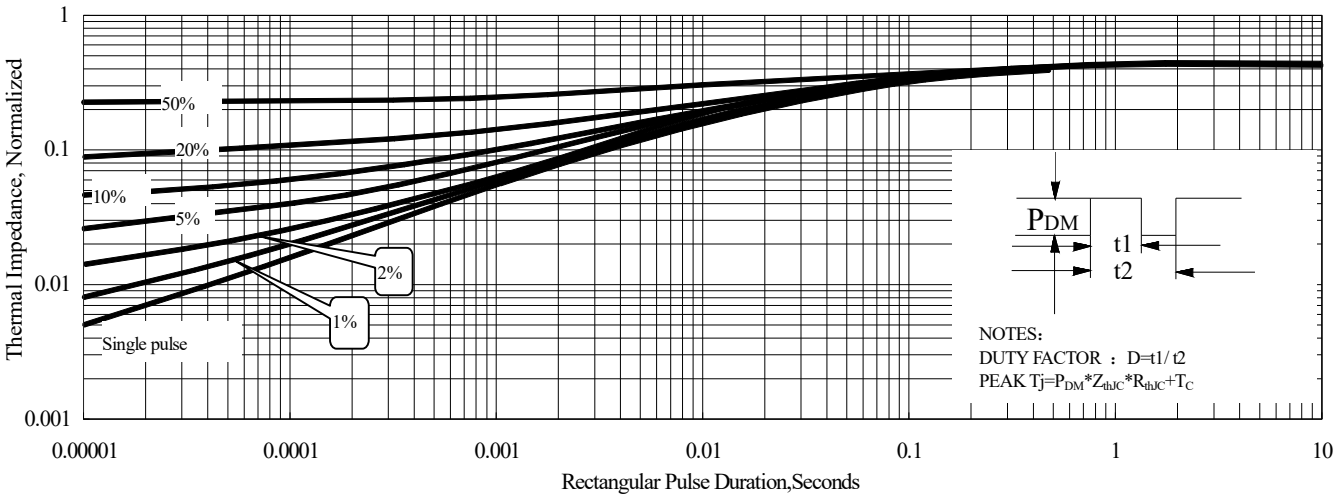
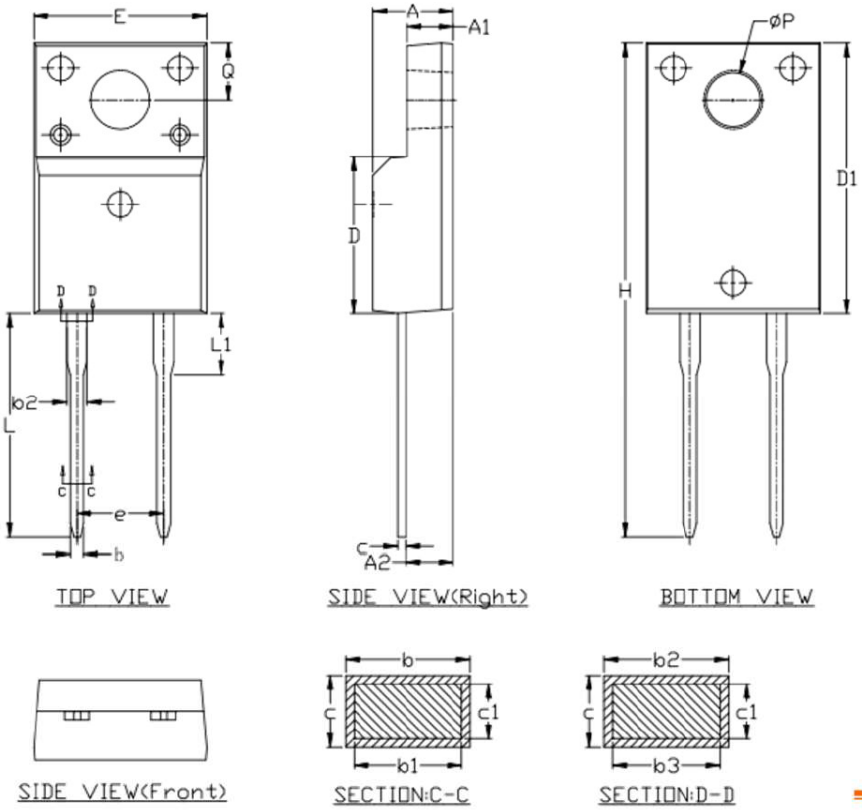



Figure 16 Maximum Effective Thermal Impendance , Junction to Case

## Package Dimensions of TO-220F

Note: UNIT: mm




| DIM / SYMBOL | MIN. | NOM. | MAX. |
|---|---|---|---|
| A | 4.600 | 4.700 | 4.800 |
| A1 | 2.600 | 2.700 | 2.800 |
| A2 | 2.660 | 2.760 | 2.860 |
| b | 0.740 | 0.840 | 0.940 |
| b1 | 0.700 | 0.800 | 0.900 |
| b2 | 1.140 | 1.240 | 1.340 |
| b3 | 1.100 | 1.200 | 1.300 |
| c | 0.440 | 0.540 | 0.640 |
| c1 | 0.400 | 0.500 | 0.600 |
| D | 9.090 | 9.190 | 9.290 |
| D1 | 15.770 | 15.870 | 15.970 |
| E | 10.060 | 10.160 | 10.260 |
| e | 5.080 BSC. | | |
| H | 28.800 | 29.000 | 29.200 |
| L | 12.930 | 13.130 | 13.330 |
| L1 | 3.400 | 3.600 | 3.800 |
| øP | 3.080 | 3.180 | 3.280 |
| Q | 3.150 | 3.350 | 3.550 |

## Revision History

| Revision | Release | Remark |
|---|---|---|
| V1.0 | 2023/10/07 | Initial Release |

## Disclaimer

**The information given in this document describes the independent performance of the product,but similar performance is not guaranteed under other working conditions,and cannot be guaranteed when installed with other products or equipment.To achieve the required performance of the product in actual scenarios,the customer should conduct a complete application test to assess the functionality of the product.**

**Allpower assumes no responsibility for equipment failures result from using products at values that exceed the ratings,operating conditions,or other parameters listed in the product specifications.**

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