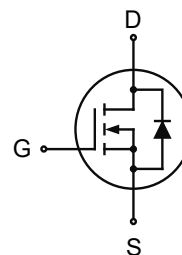


## Features

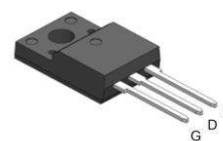
- 650V,20A  
 $R_{DS(ON)} < 210m\Omega @ V_{GS}=10V$  TYP: 181m $\Omega$
- Super junction technology
- Extremely low on resistance
- Fast Switching
- Low Gate Charge



Schematic Diagram

## Applications

- Switched mode power supplies (SMPS)
- Charger
- LED
- Power Supply



TO-220F

## Package Marking and Ordering Information

| Device Marking | Device       | Device Package | Reel Size | Tape width | Quantity (PCS) |
|----------------|--------------|----------------|-----------|------------|----------------|
| C65R210FMF     | APC65R210FMF | TO-220F        | -         | -          | 1000           |

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

| Parameter                                       | Symbol          | Value     | Unit          |
|-------------------------------------------------|-----------------|-----------|---------------|
| Drain-Source Voltage                            | $V_{DS}$        | 650       | V             |
| Gate-Source Voltage                             | $V_{GS}$        | $\pm 30$  | V             |
| Continuous Drain Current ( $T_c=25^{\circ}C$ )  | $I_D$           | 20        | A             |
| Continuous Drain Current ( $T_c=100^{\circ}C$ ) | $I_D$           | 12.6      | A             |
| Pulsed Drain Current <sup>(1)</sup>             | $I_{DM}$        | 80        | A             |
| Single Pulsed Avalanche Energy <sup>(2)</sup>   | $E_{AS}$        | 320       | mJ            |
| Drain Power Dissipation                         | $P_D$           | 29        | W             |
| Thermal Resistance from Junction to Case        | $R_{\theta JC}$ | 4.31      | $^{\circ}C/W$ |
| Thermal Resistance- Junction to Ambient         | $R_{\theta JA}$ | 82        | $^{\circ}C/W$ |
| Junction Temperature                            | $T_J$           | 150       | $^{\circ}C$   |
| Storage Temperature                             | $T_{STG}$       | -55~ +150 | $^{\circ}C$   |

**MOSFET ELECTRICAL CHARACTERISTICS( $T_J=25^{\circ}\text{C}$  unless otherwise noted)**

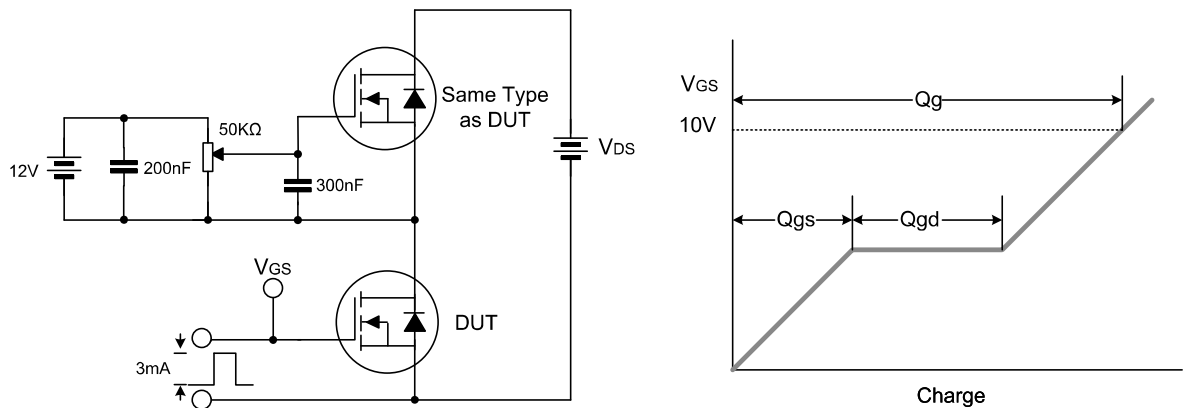
| Parameter                          | Symbol               | Test Condition                                                                       | Min | Type | Max  | Unit |
|------------------------------------|----------------------|--------------------------------------------------------------------------------------|-----|------|------|------|
| Static Characteristics             |                      |                                                                                      |     |      |      |      |
| Drain-source breakdown voltage     | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> =250μA                                          | 650 | -    | -    | V    |
| Zero gate voltage drain current    | I <sub>DSS</sub>     | V <sub>DS</sub> =650V, V <sub>GS</sub> = 0V                                          | -   | -    | 5    | uA   |
|                                    |                      | V <sub>DS</sub> =650V, V <sub>GS</sub> = 0V T <sub>J</sub> =150℃                     |     |      | 1000 | uA   |
| Gate-body leakage current          | I <sub>GSS</sub>     | V <sub>GS</sub> = ± 30V, V <sub>DS</sub> = 0V                                        | -   | -    | ±100 | nA   |
| Gate threshold voltage             | V <sub>GS(th)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                             | 3.5 | -    | 4.5  | V    |
| Drain-source on-resistance         | R <sub>DS(on)</sub>  | V <sub>GS</sub> =10V, I <sub>D</sub> =10A                                            | -   | 181  | 210  | mΩ   |
| Dynamic characteristics            |                      |                                                                                      |     |      |      |      |
| Input Capacitance                  | C <sub>iss</sub>     | V <sub>DS</sub> =100V, V <sub>GS</sub> =0V, f =1.0MHz                                | -   | 1427 | -    | pF   |
| Output Capacitance                 | C <sub>oss</sub>     |                                                                                      | -   | 67   | -    |      |
| Reverse Transfer Capacitance       | C <sub>rss</sub>     |                                                                                      | -   | 21   | -    |      |
| Gate Resistance                    | R <sub>g</sub>       | f =1.0MHz                                                                            |     | 14.5 |      | Ω    |
| Switching characteristics          |                      |                                                                                      |     |      |      |      |
| Turn-on delay time                 | t <sub>d(on)</sub>   | V <sub>DD</sub> =400V, I <sub>D</sub> =10A, R <sub>G</sub> =25Ω, V <sub>G</sub> =10V | -   | 42   | -    | ns   |
| Turn-on rise time                  | t <sub>r</sub>       |                                                                                      | -   | 58   | -    |      |
| Turn-off delay time                | t <sub>d(off)</sub>  |                                                                                      | -   | 100  | -    |      |
| Turn-off fall time                 | t <sub>f</sub>       |                                                                                      | -   | 36   | -    |      |
| Total Gate Charge                  | Q <sub>g</sub>       | V <sub>DS</sub> =400V, I <sub>D</sub> =10A, V <sub>GS</sub> =10V                     | -   | 41   | -    | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>      |                                                                                      | -   | 12   | -    |      |
| Gate-Drain Charge                  | Q <sub>gd</sub>      |                                                                                      | -   | 20   | -    |      |
| Source-Drain Diode characteristics |                      |                                                                                      |     |      |      |      |
| Diode Forward voltage              | V <sub>SD</sub>      | T <sub>c</sub> =25℃, V <sub>GS</sub> =0V, I <sub>S</sub> =9A                         | -   | 0.84 | 1.0  | V    |
| Diode Forward current              | I <sub>S</sub>       | T <sub>c</sub> =25℃                                                                  | -   | -    | 20   | A    |
| Body Diode Reverse Recovery Time   | t <sub>rr</sub>      | T <sub>c</sub> =25℃, IF=10A,di/dt=100A/us                                            |     | 108  |      | ns   |
| Body Diode Reverse Recovery Charge | Q <sub>rr</sub>      | T <sub>c</sub> =25℃, IF=10A,di/dt=100A/us                                            |     | 0.54 |      | uc   |

**Notes:**

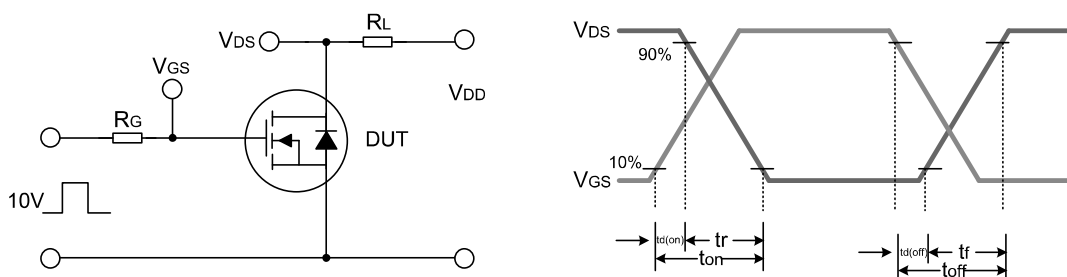
1. Pluse width limited by maximum junction temperature
2.  $L=20\text{mH}$ ,  $I_{AS}=4.8A$ ,  $V_{DD}=50V$ ,  $V_G=10V$ ,  $R_G=25\Omega$ , starting  $T_J=25^{\circ}\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$
4. Essentially independent of operating temperature

## Test Circuit

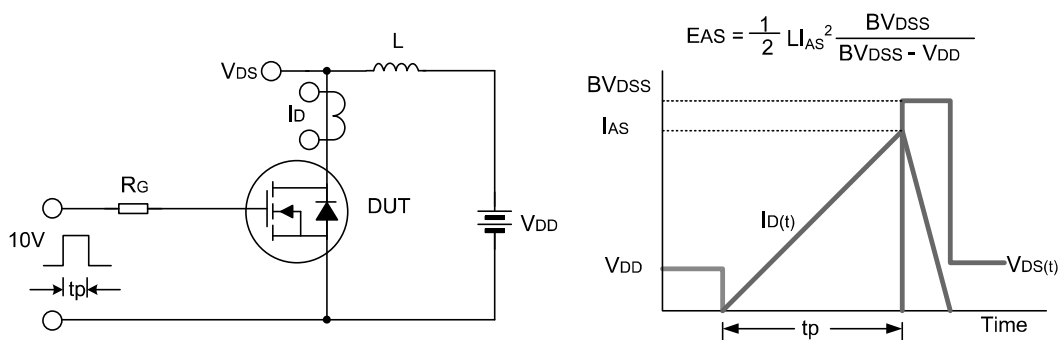
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveform



## Typical Performance Characteristics

Fig 1. Output Characteristics (Tj=25°C)

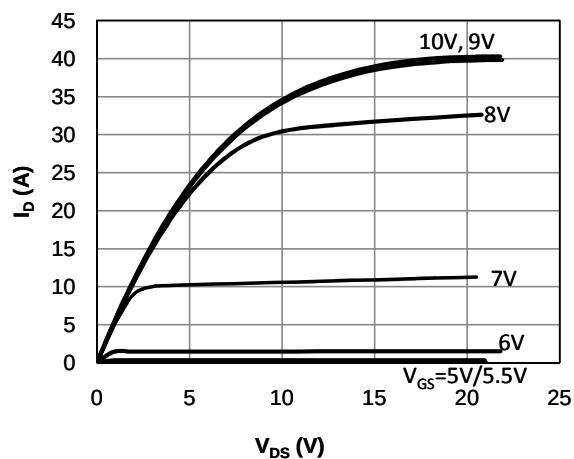


Fig 2. Output Characteristics (Tj=150°C)

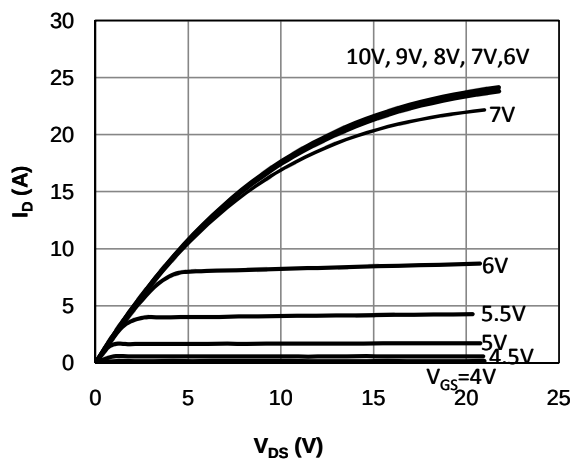


Fig 3: Transfer Characteristics

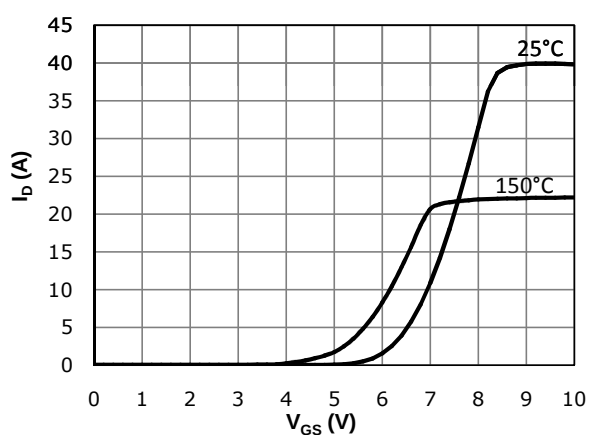


Fig 4:  $V_{TH}$  Vs  $T_j$  Temperature Characteristics

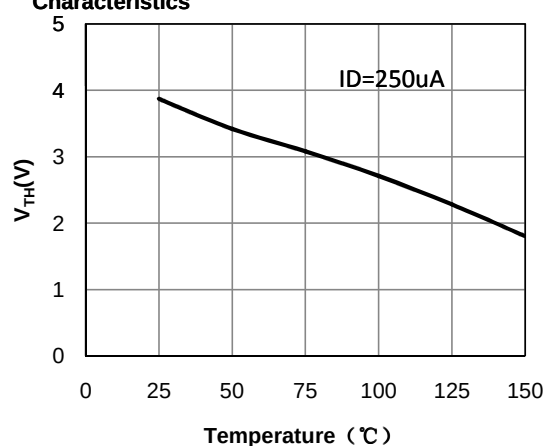


Fig 5:  $R_{DS(on)}$  Vs  $I_{DS}$  Characteristics ( $T_c = 25^\circ\text{C}$ )

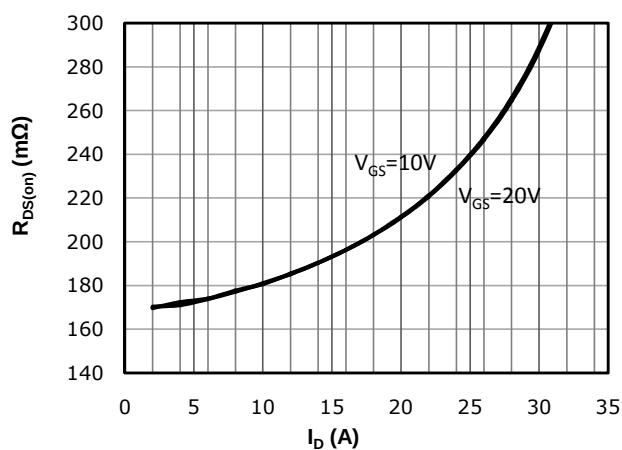
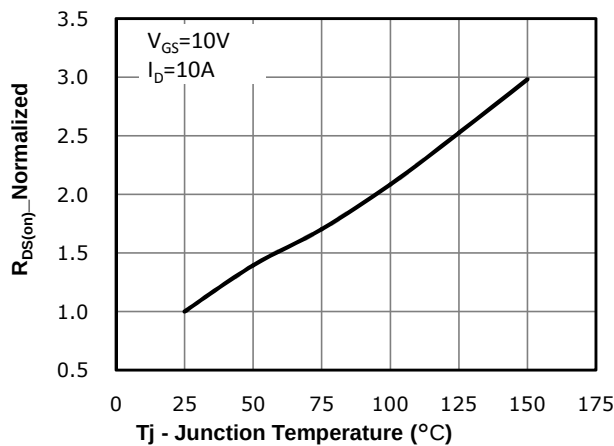
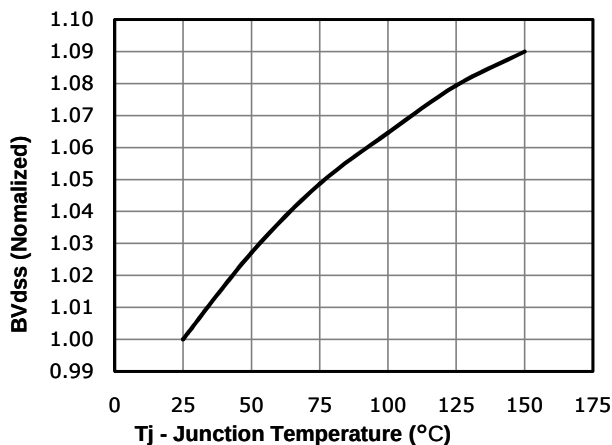


Fig 6:  $R_{DS(on)}$  vs. Temperature

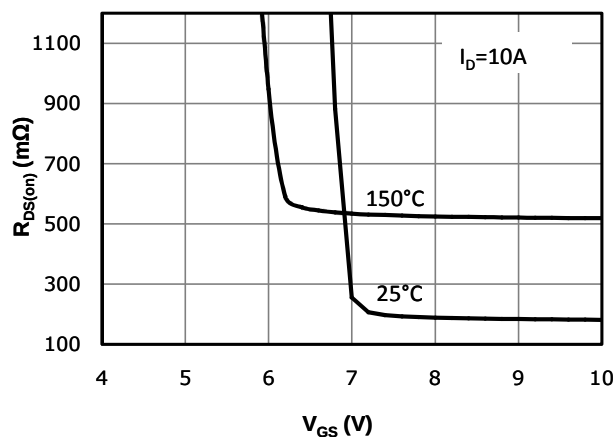


## Typical Performance Characteristics

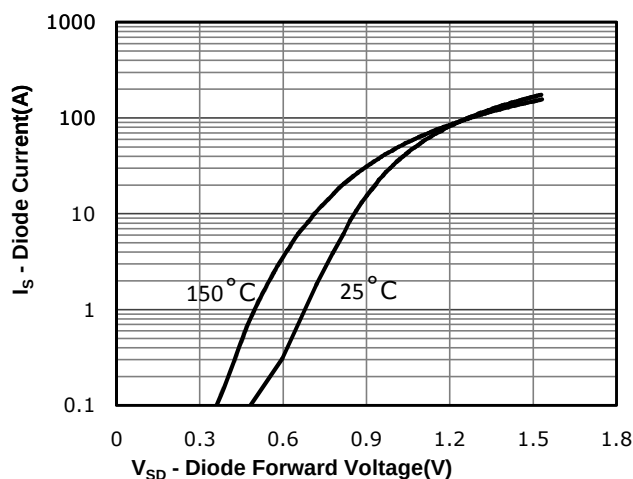
**Fig 7: BVDSS vs. Temperature**



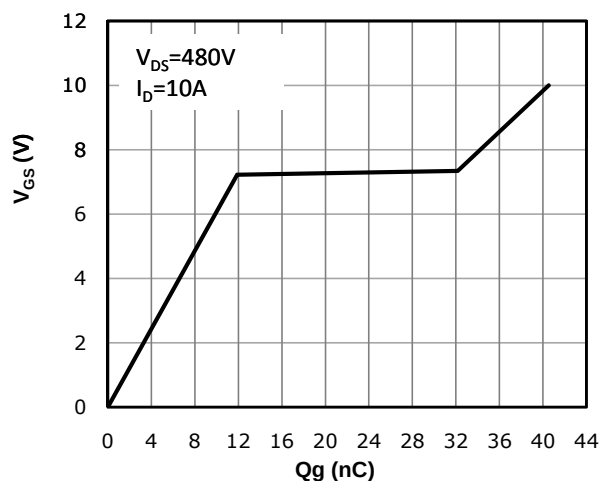
**Fig 8: Rds(on) vs Gate Voltage**



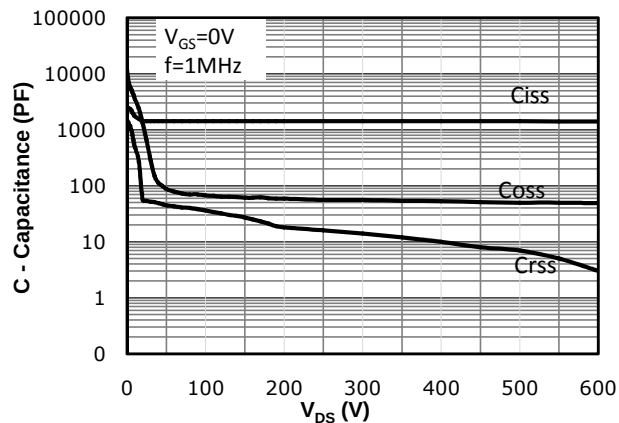
**Fig 9: Body-diode Forward Characteristics**



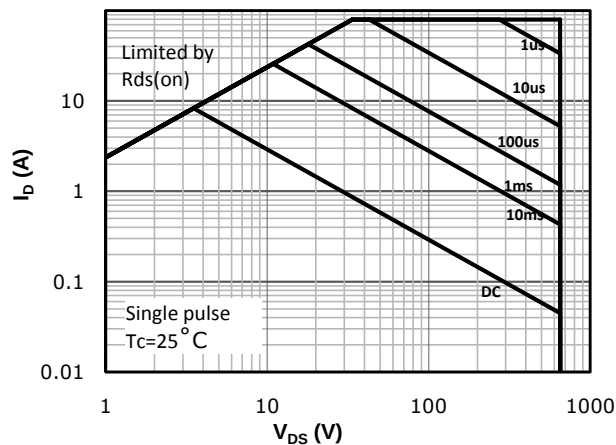
**Fig 10: Gate Charge Characteristics**



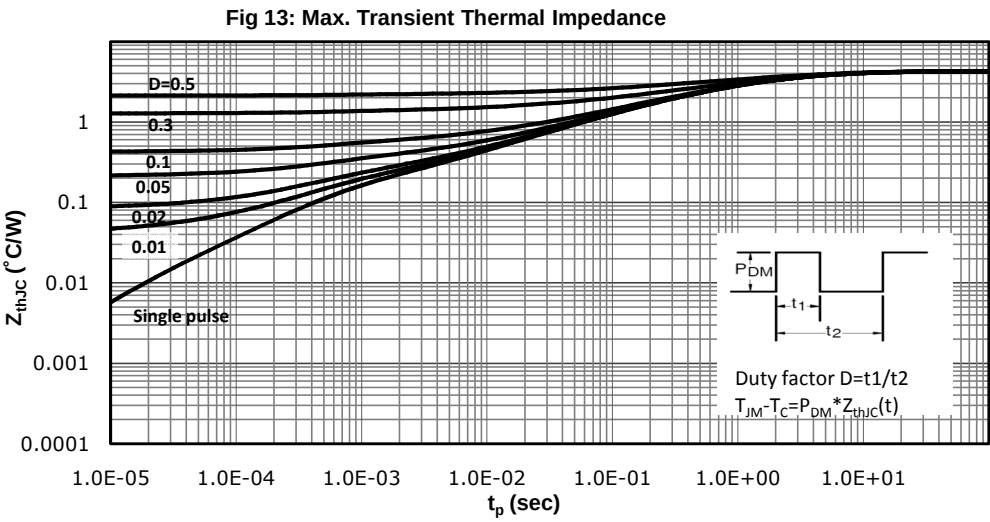
**Fig 11: Capacitance Characteristics**



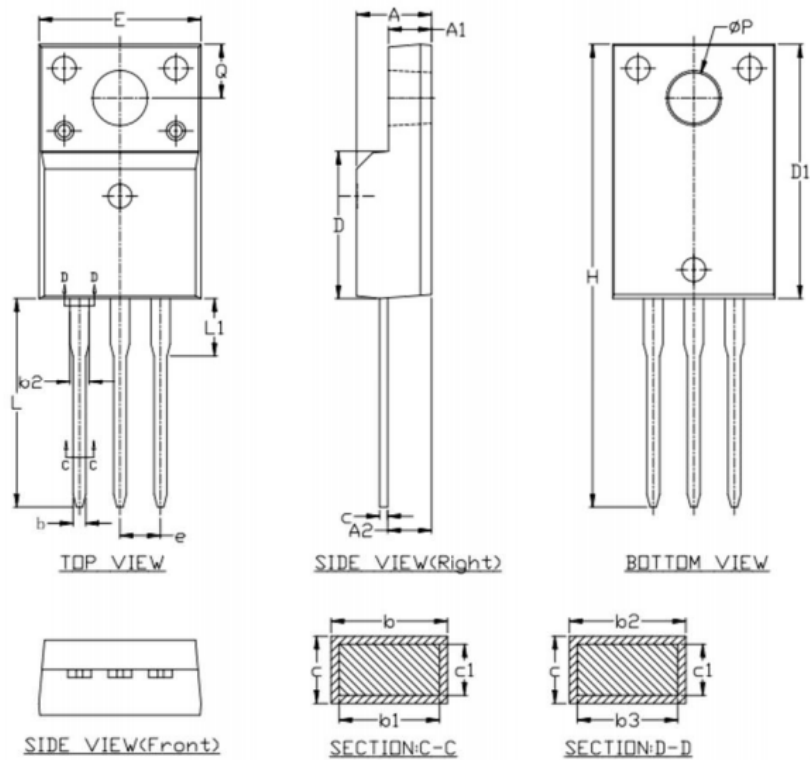
**Fig 12: Safe Operating Area**



Typical Performance Characteristics



Package Dimensions  
TO-220F



| 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          | 2.540 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     | 2024/05/11 | 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.

The product described in this specification is not applicable for aerospace or other applications which requires high reliability. Customers using or selling these products for use in medical, life-saving, or life-sustaining applications do so at their own risk and agree to fully indemnify.

Due to product or technical improvements, the information described or contained herein may be changed without prior notice.