



## Features

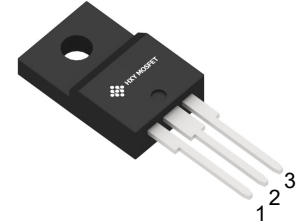
- High Speed Switching with Low Capacitances
- High Blocking Voltage with Low  $R_{DS(on)}$
- Easy to drive and parallel
- Effectively lower down  $T_j$  and  $R_{th}$ , High anti-EMI ability
- RoHS Compliant

## Benefits

- Increased Power Density
- Faster Operating Frequency
- Reduction of Heat Sink Requirements
- Higher Efficiency
- Reduced EMI

## Applications

- Power Factor Correction Modules
- Switch Mode Power Supplies
- Power Inverters
- High Voltage DC/DC Converters



TO-220F



| Ordering Part Number | Package | Brand      |
|----------------------|---------|------------|
| RM15N650TI           | TO-220F | HXY MOSFET |

## Maximum Ratings ( $T_c = 25^\circ\text{C}$ unless otherwise specified)

| Symbol         | Parameter                                  | Value       | Unit             | Test Conditions                         |
|----------------|--------------------------------------------|-------------|------------------|-----------------------------------------|
| $V_{DSmax}$    | Drain - Source Voltage                     | 650         | V                |                                         |
| $V_{GSmax}$    | Gate - Source Voltage (dynamic)            | -5/+26      | V                |                                         |
| $V_{GSop}$     | Gate - Source Voltage (static)             | 0/+15       | V                |                                         |
| $I_D$          | Continuous Drain Current                   | 20          | A                | $T_C = 25^\circ\text{C}$                |
|                |                                            | 16.5        |                  | $T_C = 100^\circ\text{C}$               |
| $I_{D(pulse)}$ | Pulsed Drain Current                       | 30          | A                | Pulse width $t_p$ limited by $T_{jmax}$ |
| $P_D$          | Power Dissipation                          | 52          | W                | $T_C = 25^\circ\text{C}$                |
|                |                                            | 25          |                  | $T_C = 100^\circ\text{C}$               |
| $T_J, T_{stg}$ | Operating Junction and Storage Temperature | -55 to +175 | $^\circ\text{C}$ |                                         |



**Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless other wise specified)

| Symbol        | Parameter                         | Min. | Typ. | Max. | Unit          | Test Conditions                                                                                        | Note    |
|---------------|-----------------------------------|------|------|------|---------------|--------------------------------------------------------------------------------------------------------|---------|
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage    | 650  |      | 850  | V             | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$                                                            |         |
| $I_{DSS}$     | Zero Gate Voltage Drain Current   |      | 2    | 100  | $\mu\text{A}$ | $V_{GS} = 0\text{ V}$ , $V_{DS} = 750\text{ V}$                                                        |         |
| $I_{GSS+}$    | Gate-Source Leakage Current       |      |      | 200  | nA            | $V_{DS} = 0\text{ V}$ , $V_{GS} = +22\text{ V}$                                                        |         |
| $I_{GSS-}$    | Gate-Source Leakage Current       |      |      | 200  | nA            | $V_{DS} = 0\text{ V}$ , $V_{GS} = -10\text{ V}$                                                        |         |
| $V_{GS(th)}$  | Gate Threshold Voltage            | 2.2  | 3.5  | 4.2  | V             | $V_{GS} = V_{DS}$ , $I_{DS} = 1\text{ mA}$ , $T_J = 25^\circ\text{C}$                                  | Fig. 14 |
|               |                                   |      | 2.6  |      |               | $V_{GS} = V_{DS}$ , $I_{DS} = 1\text{ mA}$ , $T_J = 175^\circ\text{C}$                                 |         |
| $R_{DS(on)}$  | Static Drain-Source On-Resistance |      | 160  | 180  | m $\Omega$    | $V_{GS} = 15\text{ V}$ , $I_D = 6\text{ A}$ , $T_J = 25^\circ\text{C}$                                 | Fig. 15 |
|               |                                   |      | 195  |      |               | $V_{GS} = 15\text{ V}$ , $I_D = 6\text{ A}$ , $T_J = 175^\circ\text{C}$                                |         |
| $C_{iss}$     | Input Capacitance                 |      | 208  |      | pF            | $V_{DS} = 400\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$                                   | Fig. 8  |
| $C_{oss}$     | Output Capacitance                |      | 18   |      |               |                                                                                                        |         |
| $C_{rss}$     | Reverse Transfer Capacitance      |      | 1.8  |      |               |                                                                                                        |         |
| $Q_g$         | Total Gate Charge                 |      | 10.6 |      | nC            | $V_{DD} = 400\text{ V}$ , $V_{GS} = -5/18\text{ V}$ , $I_D = 5\text{ A}$                               | Fig. 7  |
| $Q_{gs}$      | Gate-Source Charge                |      | 5.1  |      |               |                                                                                                        |         |
| $Q_{gd}$      | Gate-Drain Charge                 |      | 2.2  |      |               |                                                                                                        |         |
| $R_{G(int)}$  | Gate Input Resistance             |      | 1.2  |      | $\Omega$      | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$                                                                |         |
| $E_{on}$      | Turn-On Switching Energy          |      | 25   |      | $\mu\text{J}$ | $V_{DD} = 400\text{ V}$ , $I_D = 5\text{ A}$ , $R_G = 10\text{ }\Omega$ ,<br>$V_{GS} = -5/18\text{ V}$ | Fig. 12 |
| $E_{off}$     | Turn-Off Switching Energy         |      | 10   |      |               |                                                                                                        |         |
| $t_{d(on)}$   | Turn-On Delay Time                |      | 5    |      | ns            | $V_{DD} = 400\text{ V}$ , $I_D = 5\text{ A}$ , $R_G = 10\text{ }\Omega$ ,<br>$V_{GS} = -5/18\text{ V}$ |         |
| $t_r$         | Rise Time                         |      | 17   |      |               |                                                                                                        |         |
| $t_{d(off)}$  | Turn-Off Delay Time               |      | 8    |      |               |                                                                                                        |         |
| $t_f$         | Fall Time                         |      | 10   |      |               |                                                                                                        |         |



### Reverse SiC Diode Characteristics

| Symbol    | Parameter                        | Typ. | Max. | Unit | Test Conditions                                                      | Note    |
|-----------|----------------------------------|------|------|------|----------------------------------------------------------------------|---------|
| $V_{SD}$  | Diode Forward Voltage            | 4.0  |      | V    | $V_{GS} = -4V, I_{SD} = 5A, T_J = 25^{\circ}C$                       | Fig. 16 |
|           |                                  | 3.6  |      |      | $V_{GS} = -4V, I_{SD} = 5A, T_J = 175^{\circ}C$                      | Fig. 17 |
| $*I_{SD}$ | Continuous Diode Forward Current |      | 18   | A    | $T_C = 25^{\circ}C$                                                  |         |
|           |                                  |      | 10   |      | $T_C = 175^{\circ}C$                                                 |         |
| $t_{rr}$  | Reverse Recovery Time            | 50   |      | ns   | $I_{SD} = 5A, di/dt = 1000A/\mu s,$<br>$V_{DD} = 400V, V_{GS} = -5V$ |         |
| $Q_{rr}$  | Reverse Recovery Charge          | 38   |      | nC   |                                                                      |         |
| $I_{RRM}$ | Peak Reverse Recovery Current    | 2.4  |      | A    |                                                                      |         |

\* Depends on bonding wire

### Thermal Characteristics

| Symbol     | Parameter                                   | Typ. | Unit          | Test Conditions | Note   |
|------------|---------------------------------------------|------|---------------|-----------------|--------|
| $R_{thJC}$ | Thermal Resistance from Junction to Case    | 2.88 | $^{\circ}C/W$ |                 | Fig. 2 |
| $R_{thJA}$ | Thermal Resistance From Junction to Ambient | 40   |               |                 |        |



## Typical Performance

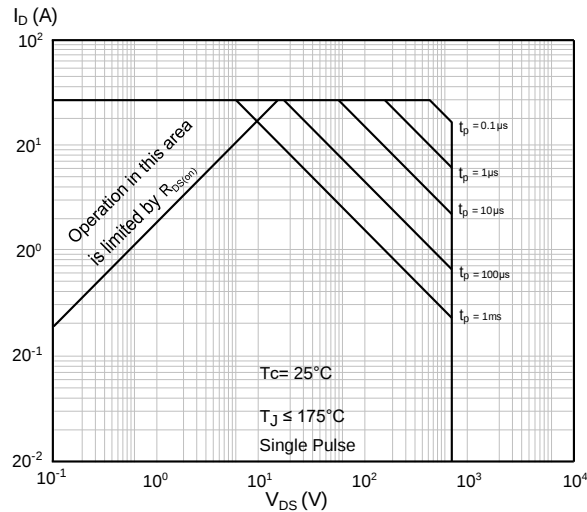


Figure 1. Safe Operating Area

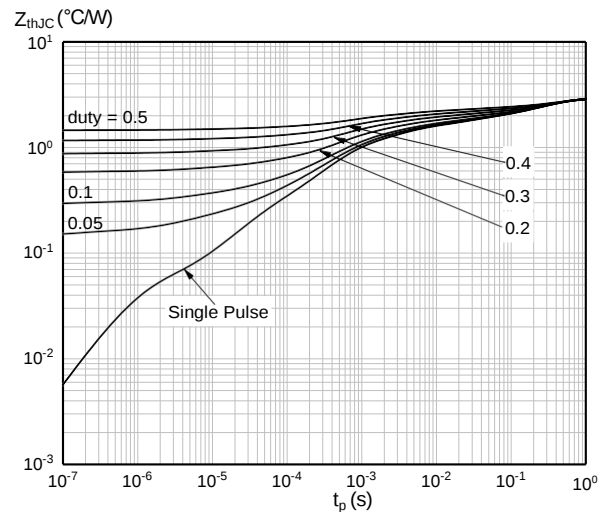


Figure 2. Maximum Transient Thermal Impedance

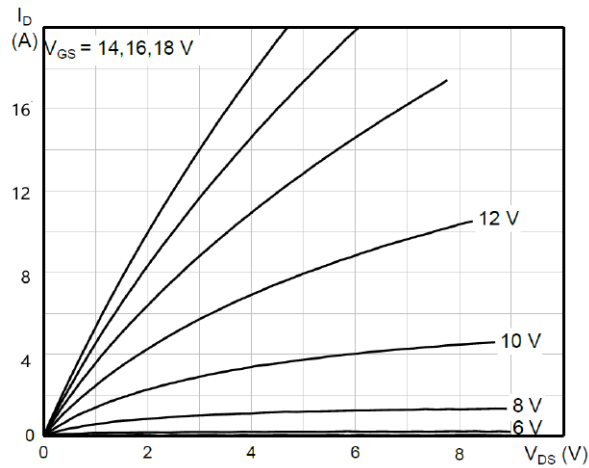


Figure 3. Typical Output Characteristics,  $T_J = 25^\circ\text{C}$

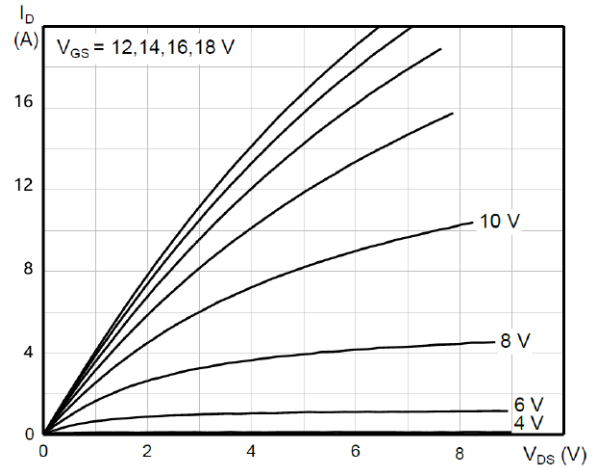


Figure 4. Typical Output Characteristics,  $T_J = 175^\circ\text{C}$

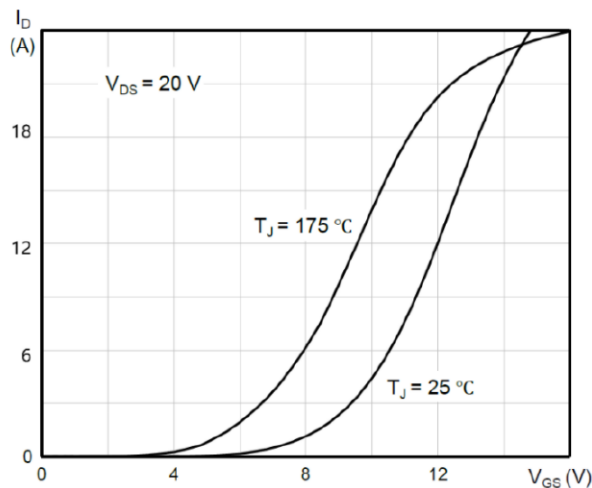


Figure 5. Typical Transfer Characteristics

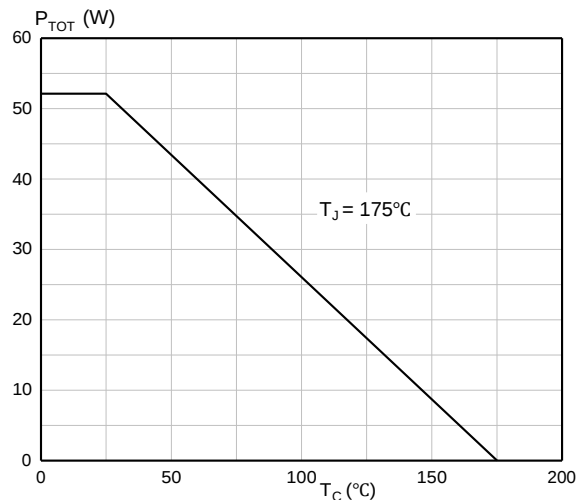


Figure 6. Total Power Dissipation

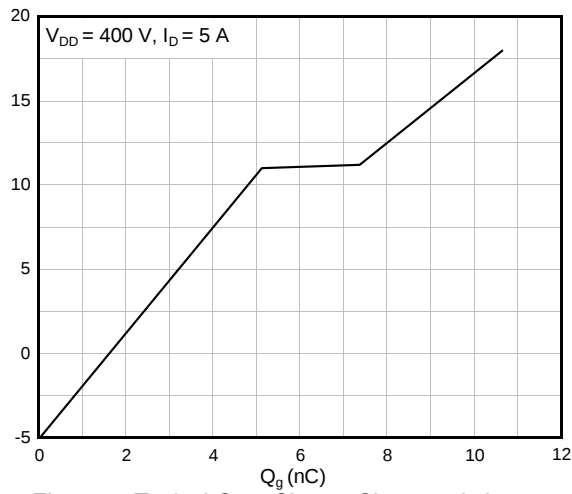


Figure 7. Typical Gate Charge Characteristics

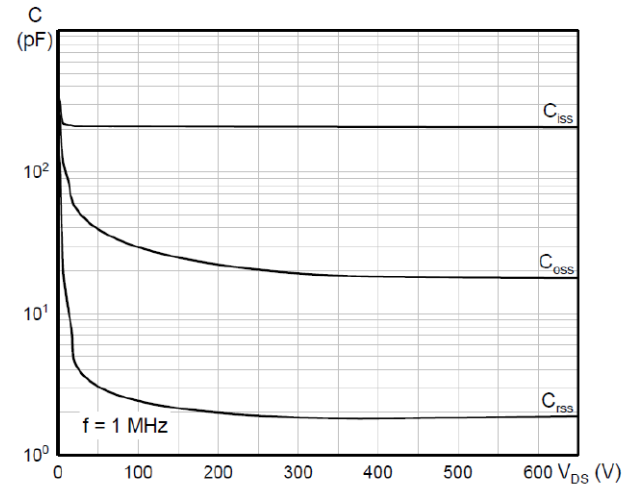


Figure 8. Typical Capacitance Characteristics

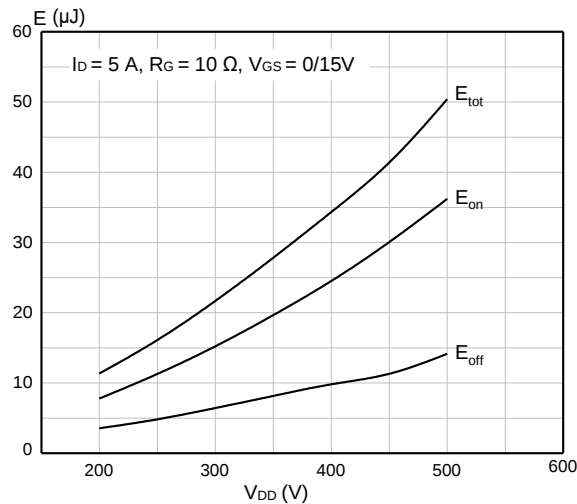


Figure 9. Typical Switching Energy vs. Supply Voltage

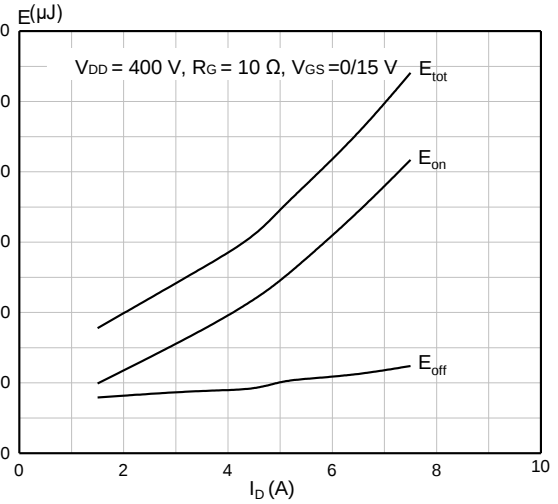


Figure 10. Typical Switching Energy vs. Drain Current

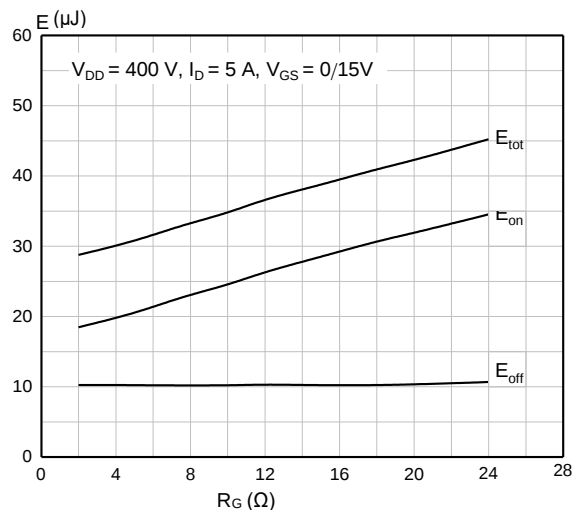


Figure 11. Switching Energy vs. Gate Resistance

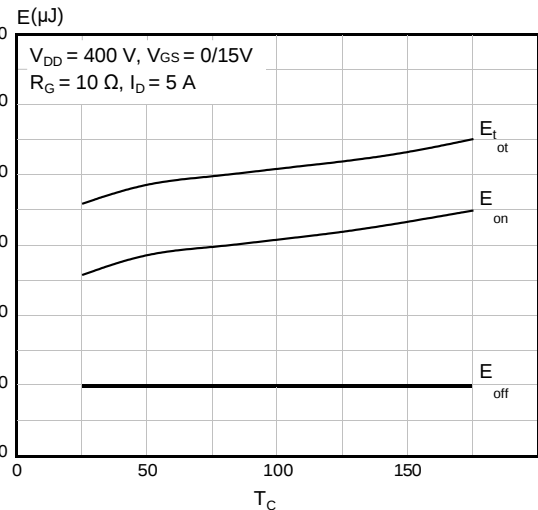


Figure 12. Typical Switching Energy vs. Temperature

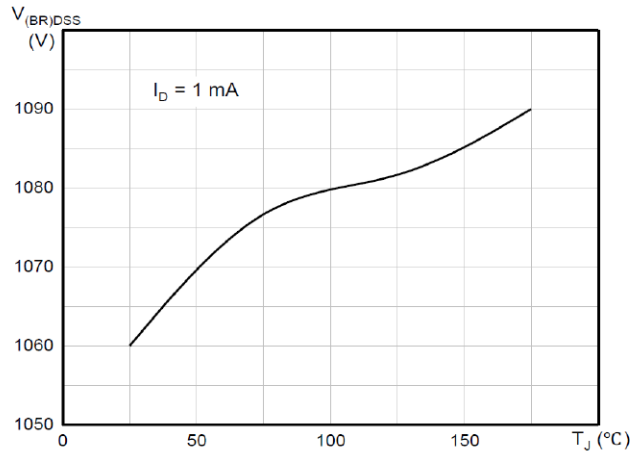


Figure 13. Breakdown Voltage vs. Temperature



Figure 14. Gate Threshold vs. Temperature

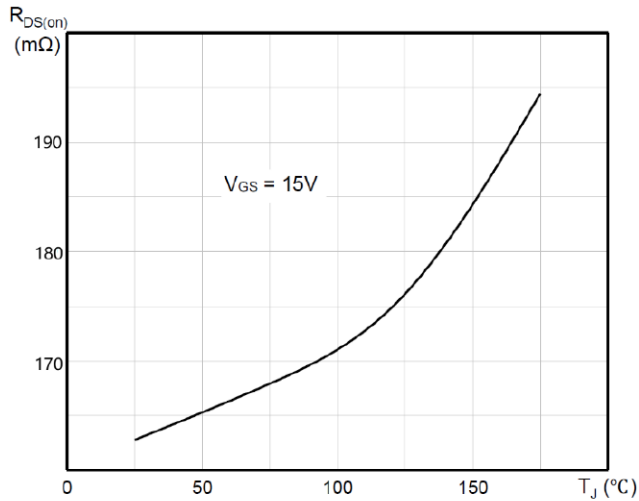


Figure 15. On-Resistance vs. Temperature

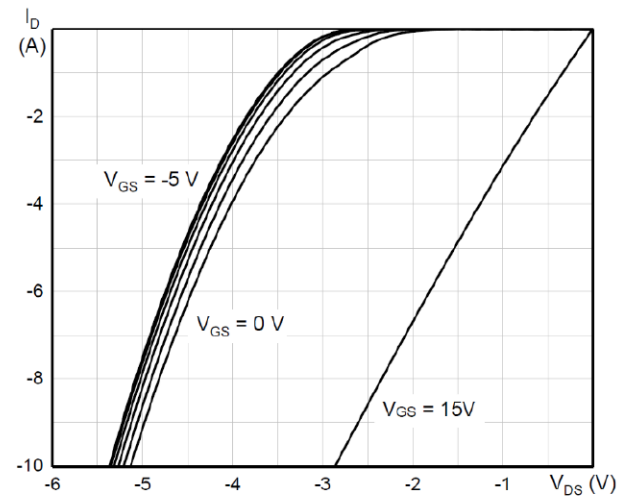
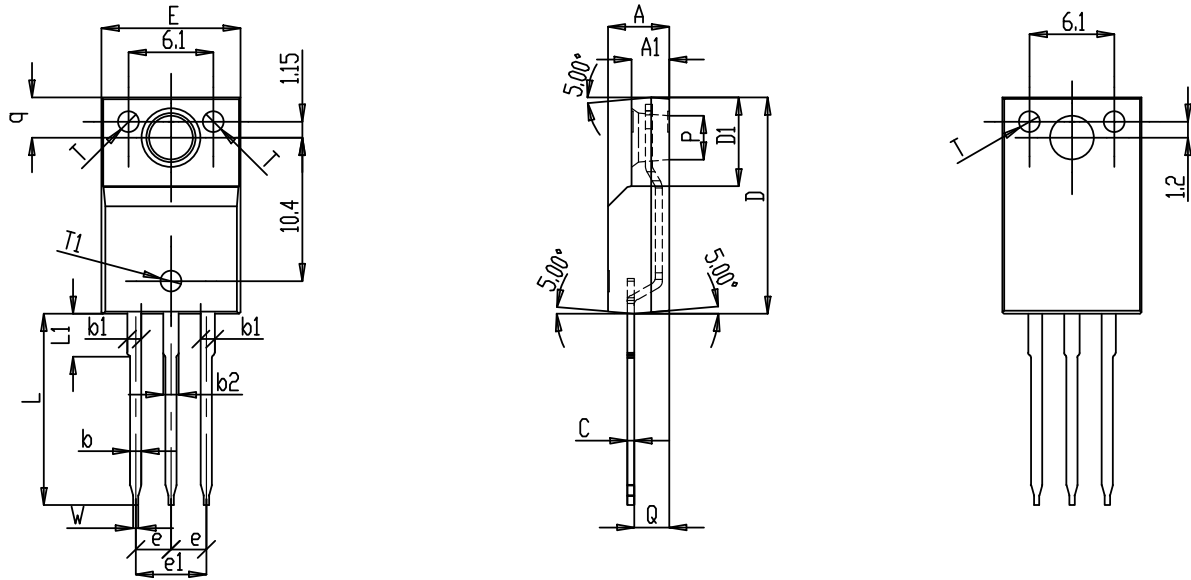


Figure 16. Body Diode Characteristics, T<sub>J</sub>=25°C

## Package Dimensions

Package TO-220F



| SYMBOL | MILLIMETERS |      |      | NOTES | SYMBOL | MILLIMETERS |      |      | NOTES |
|--------|-------------|------|------|-------|--------|-------------|------|------|-------|
|        | Normal      | MIN. | MAX. |       |        | Normal      | MIN. | MAX. |       |
| A      | 4.4         | 4.2  | 4.6  |       | e1     | 5.08        | 5    | 5.12 |       |
| A1     | 2.7         | 2.5  | 2.9  |       | L      | 13.90       | 13.5 | 14.4 |       |
| b      | 0.8         | 0.7  | 0.9  |       | L1     | 3.12        | 2.8  | 3.3  |       |
| b1     | 1.07        | 0.9  | 1.3  |       | P      | 3.14        | 3.00 | 3.20 |       |
| b2     | 1.17        | 1    | 1.4  |       | Q      | 2.44        | 2.3  | 2.6  |       |
| C      | 0.5         | 0.4  | 0.6  |       | q      | 2.87        | 2.6  | 3    |       |
| D      | 15.63       | 15.4 | 15.8 |       | W      | 0.37        | 0.3  | 0.5  |       |
| D1     | 6.22        | 6    | 6.4  |       | T      | 1.52        | 1.3  | 1.7  |       |
| E      | 10.06       | 9.7  | 10.3 |       | T1     | 1.20        | 1.1  | 1.3  |       |
| e      | 2.54        | 2.5  | 2.58 |       |        |             |      |      |       |



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