



## Features

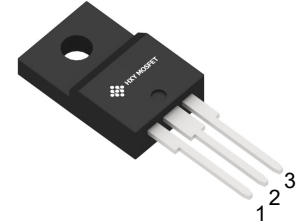
- High Speed Switching with Low Capacitances
- High Blocking Voltage with Low  $R_{DS(on)}$
- Easy to drive and parallel
- Effectively lower down  $T_j$  and  $R_{th}$ , High anti-EMI ability
- RoHS Compliant

## 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      |
|-----------------------|---------|------------|
| PJMF210N65EC_T0_00601 | TO-220F | HXY MOSFET |

## Maximum Ratings (T<sub>c</sub> = 25 °C unless otherwise specified)

| Symbol                            | Parameter                                  | Value       | Unit | Test Conditions                                         |
|-----------------------------------|--------------------------------------------|-------------|------|---------------------------------------------------------|
| V <sub>DSmax</sub>                | Drain - Source Voltage                     | 650         | V    |                                                         |
| V <sub>GSmax</sub>                | Gate - Source Voltage (dynamic)            | -5/+26      | V    |                                                         |
| V <sub>GSop</sub>                 | Gate - Source Voltage (static)             | 0/+15       | V    |                                                         |
| I <sub>D</sub>                    | Continuous Drain Current                   | 20          | A    | T <sub>C</sub> = 25°C                                   |
|                                   |                                            | 16.5        |      | T <sub>C</sub> = 100°C                                  |
| I <sub>D(pulse)</sub>             | Pulsed Drain Current                       | 30          | A    | Pulse width t <sub>p</sub> limited by T <sub>Jmax</sub> |
| P <sub>D</sub>                    | Power Dissipation                          | 52          | W    | T <sub>C</sub> = 25°C                                   |
|                                   |                                            | 25          |      | T <sub>C</sub> = 100°C                                  |
| T <sub>J</sub> , T <sub>stg</sub> | Operating Junction and Storage Temperature | -55 to +175 | °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

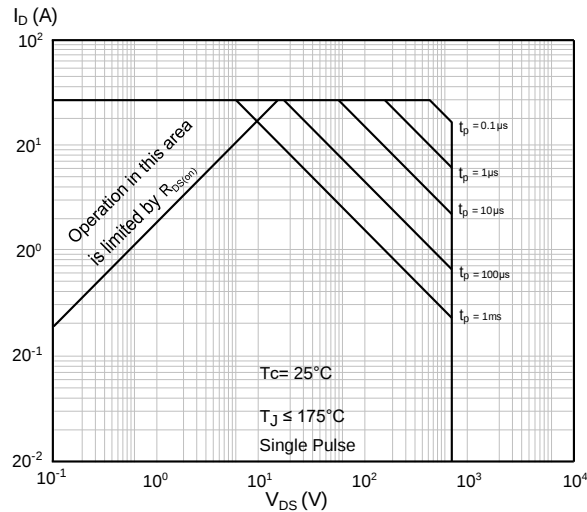


Figure 1. Safe Operating Area

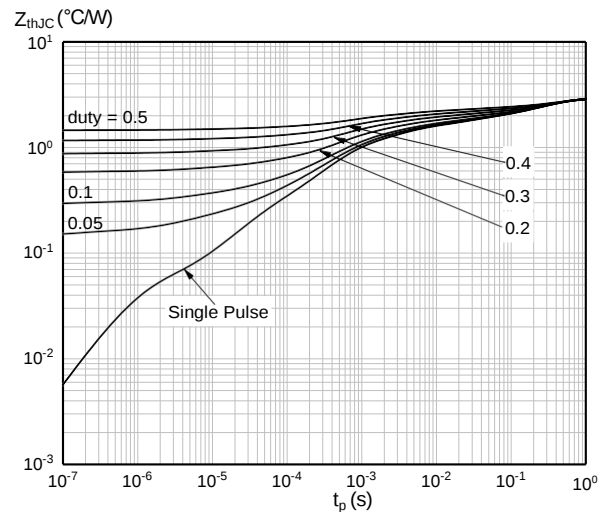


Figure 2. Maximum Transient Thermal Impedance



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

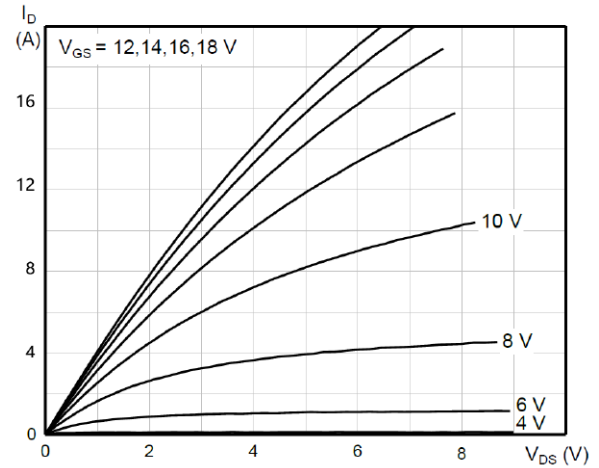


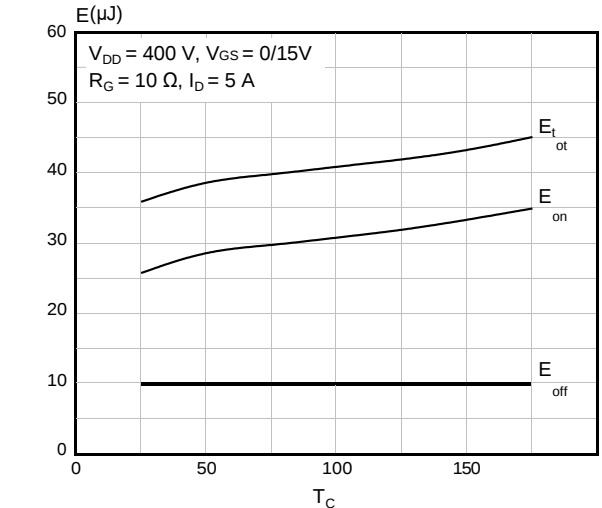
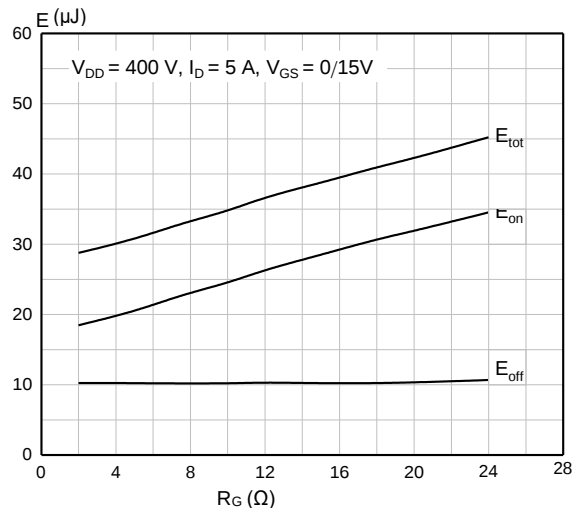
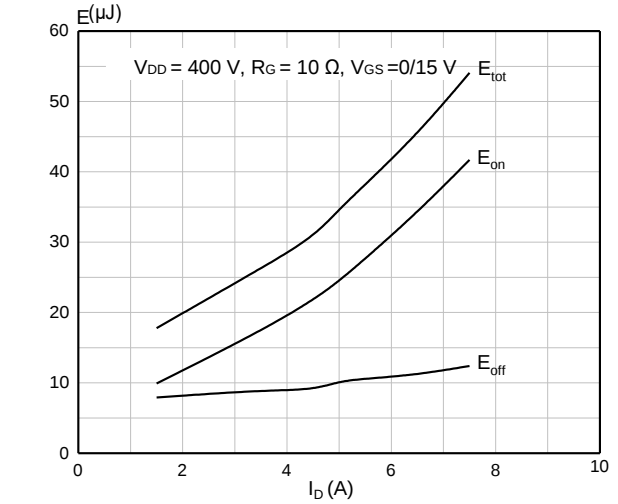
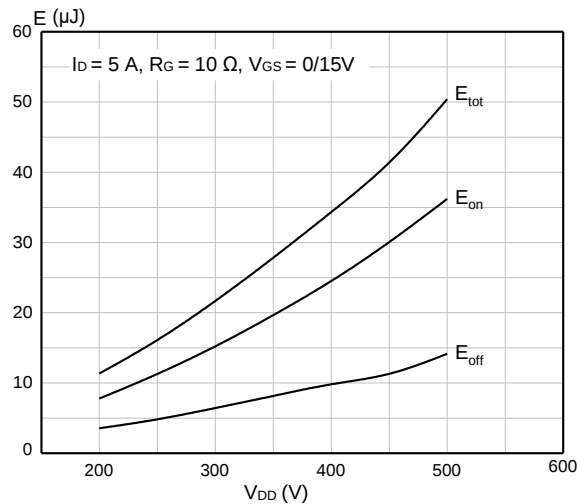
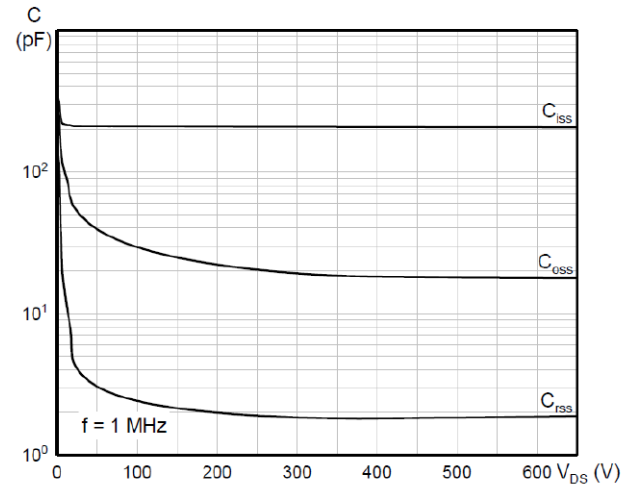
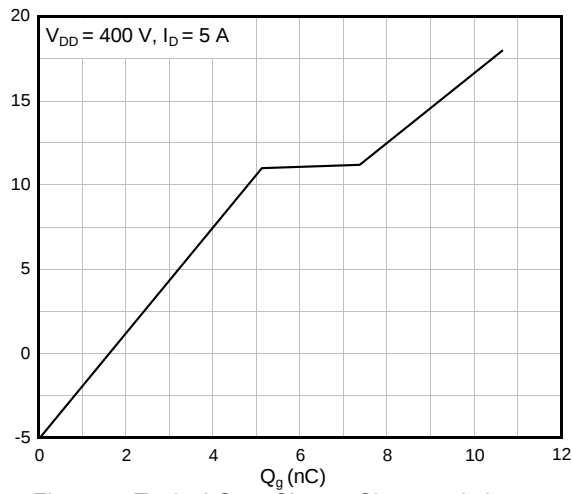
Figure 4. Typical Output Characteristics,  $T_J = 175^\circ\text{C}$



Figure 5. Typical Transfer Characteristics



Figure 6. Total Power Dissipation



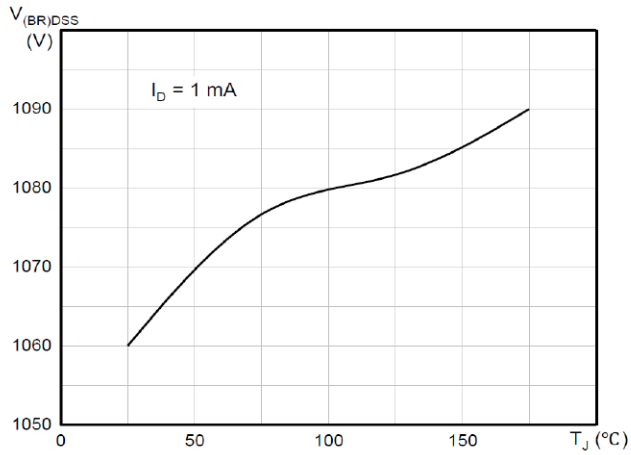


Figure 13. Breakdown Voltage vs. Temperature



Figure 14. Gate Threshold vs. Temperature

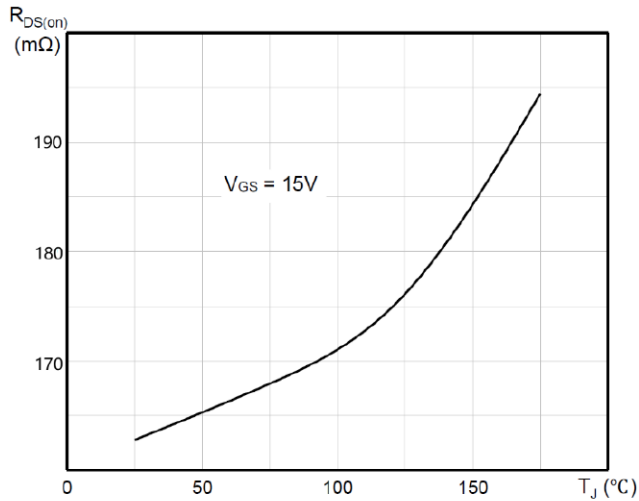


Figure 15. On-Resistance vs. Temperature

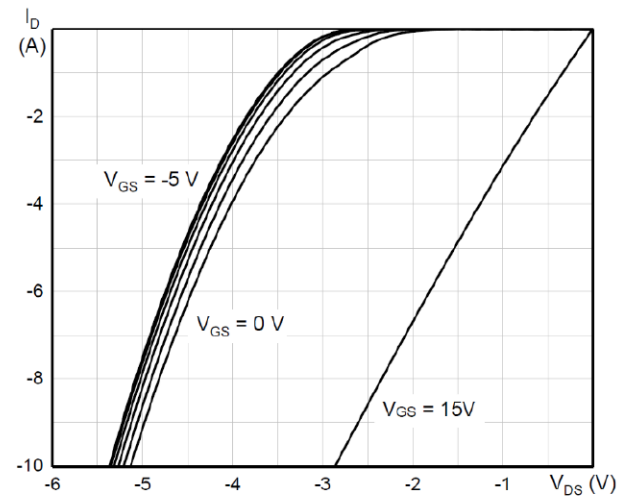
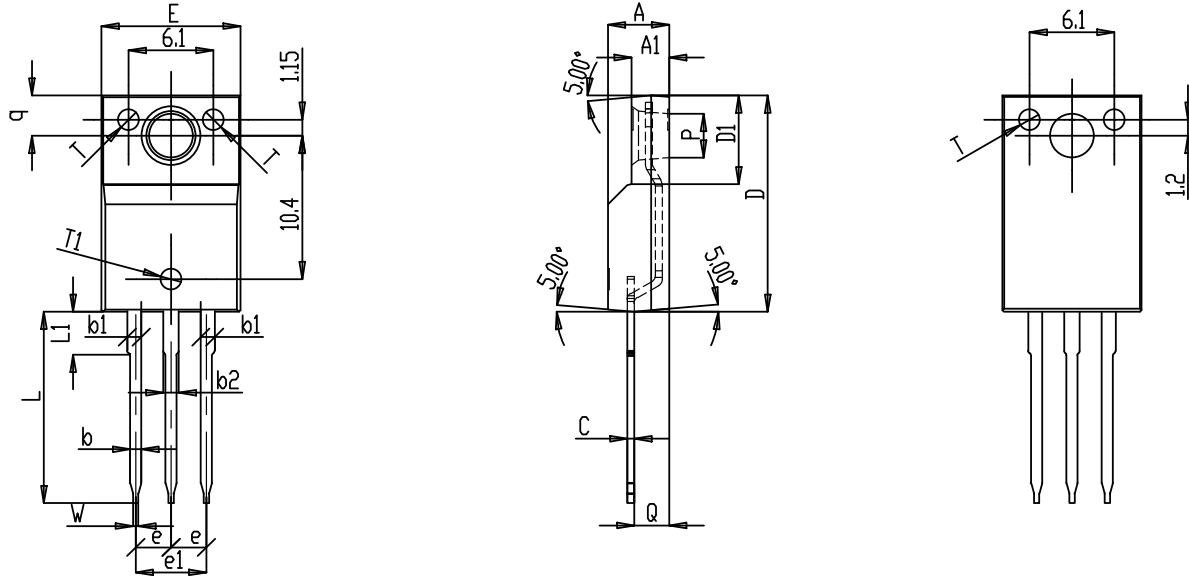


Figure 16. Body Diode Characteristics, T<sub>J</sub>=25°C



## 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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