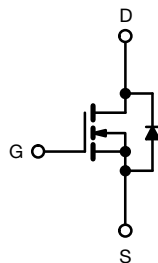
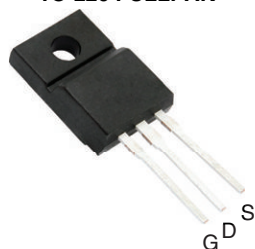


# E Series Power MOSFET

**TO-220 FULLPAK**


N-Channel MOSFET

## FEATURES

- 4<sup>th</sup> generation E series technology
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low effective capacitance ( $C_{o(er)}$ )
- Reduced switching and conduction losses
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

## APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Induction heating
  - Motor drives
  - Battery chargers
  - Solar (PV inverters)

## PRODUCT SUMMARY

|                                         |                 |       |
|-----------------------------------------|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.              | 700             |       |
| $R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C | $V_{GS} = 10$ V | 0.070 |
| $Q_g$ max. (nC)                         | 80              |       |
| $Q_{gs}$ (nC)                           | 20              |       |
| $Q_{gd}$ (nC)                           | 19              |       |
| Configuration                           | Single          |       |

## ORDERING INFORMATION

|                                 |                 |
|---------------------------------|-----------------|
| Package                         | TO-220 FULLPAK  |
| Lead (Pb)-free and halogen-free | SiHF074N65E-GE3 |

## ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

| PARAMETER                                               | SYMBOL           | LIMIT          | UNIT |
|---------------------------------------------------------|------------------|----------------|------|
| Drain-source voltage                                    | $V_{DS}$         | 650            | V    |
| Gate-source voltage                                     | $V_{GS}$         | $\pm 30$       |      |
| Continuous drain current ( $T_J = 150$ °C) <sup>e</sup> | $V_{GS}$ at 10 V | $T_C = 25$ °C  | A    |
|                                                         |                  | $T_C = 100$ °C |      |
| Pulsed drain current <sup>a</sup>                       | $I_{DM}$         | 91             |      |
| Linear derating factor                                  |                  | 2              | W/°C |
| Single pulse avalanche energy <sup>b</sup>              | $E_{AS}$         | 173            | mJ   |
| Maximum power dissipation                               | $P_D$            | 39             | W    |
| Operating junction and storage temperature range        | $T_J, T_{stg}$   | -55 to +150    | °C   |
| Drain-source voltage slope                              | $dv/dt$          | $T_J = 125$ °C | V/ns |
| Reverse diode $dv/dt$ <sup>d</sup>                      |                  |                |      |

### Notes

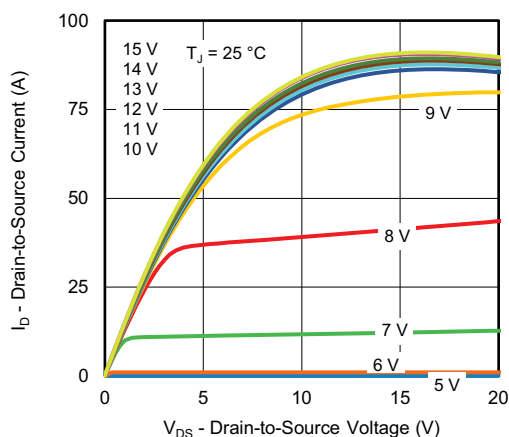
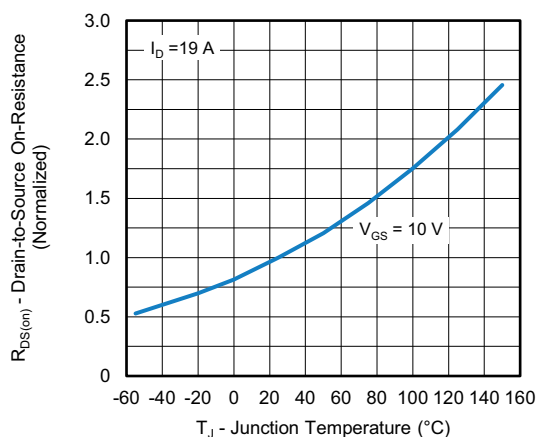
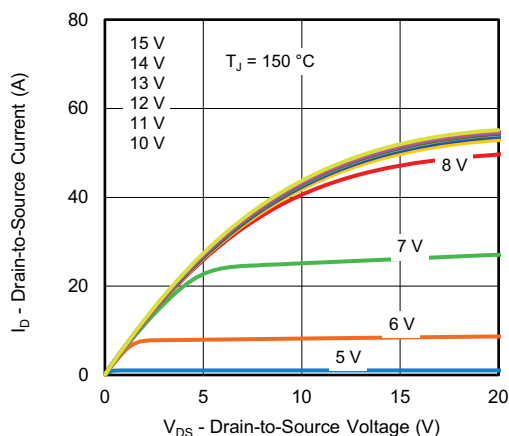
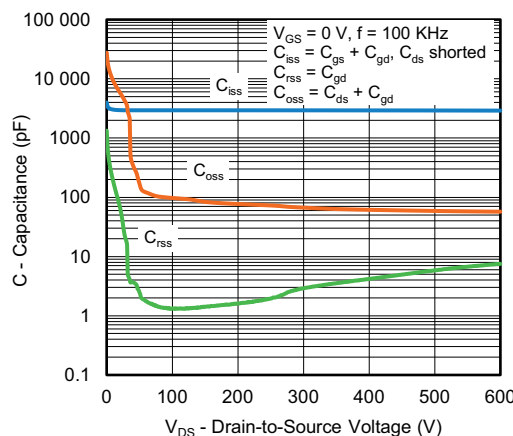
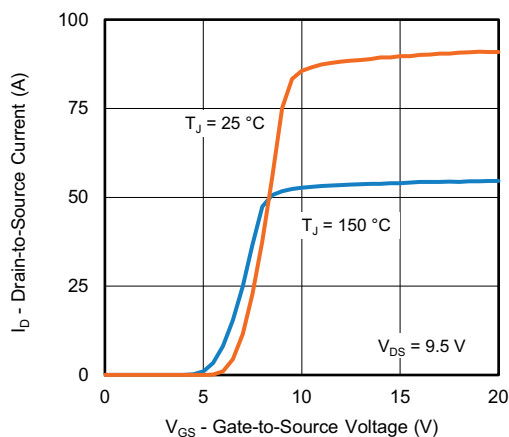
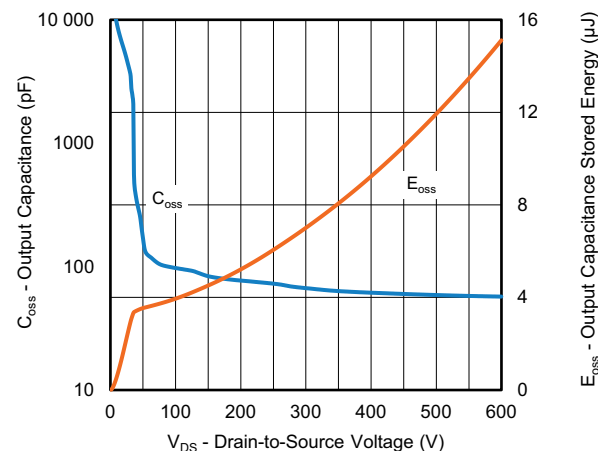
- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 120$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 3.5$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $di/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C
- Limited by maximum junction temperature

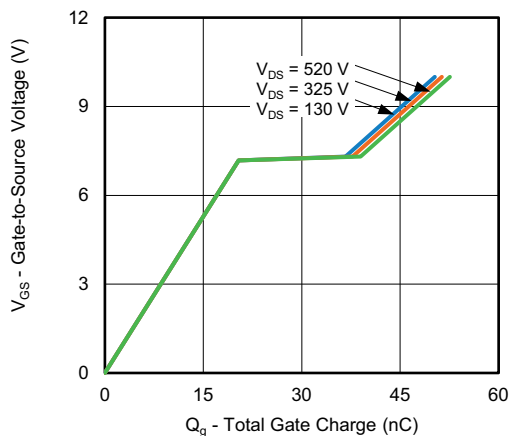
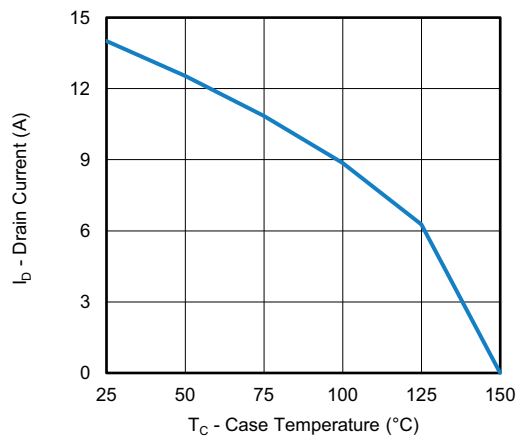
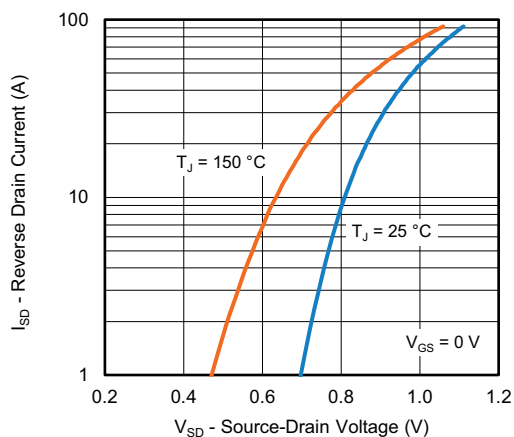
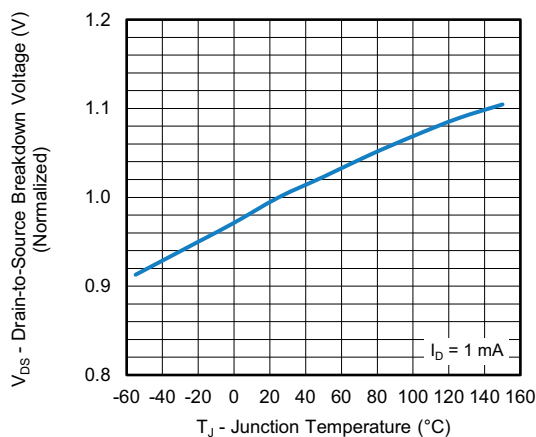
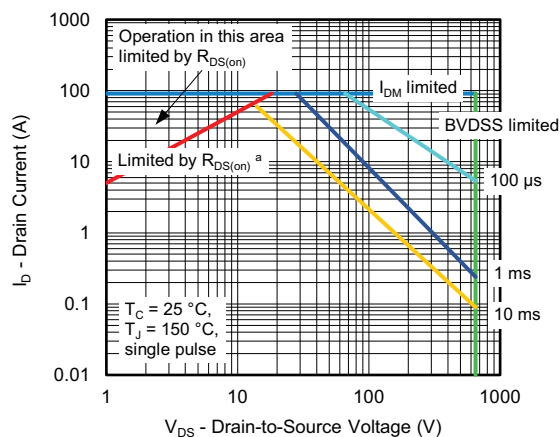
**THERMAL RESISTANCE RATINGS**

| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 65   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 3.2  |      |

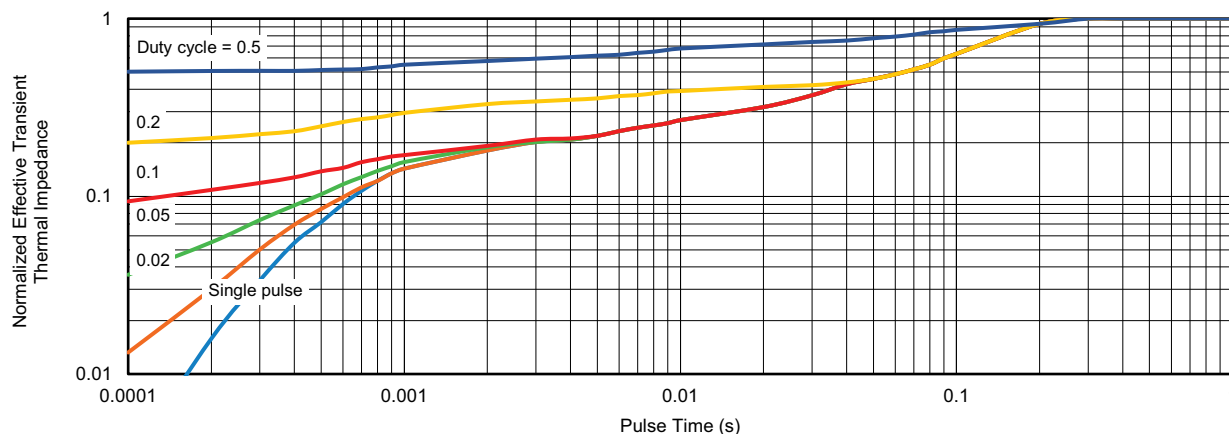
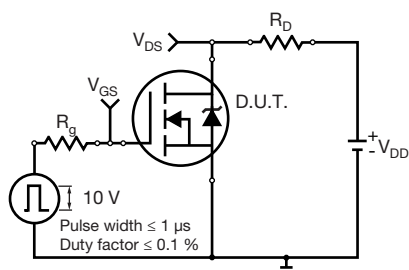
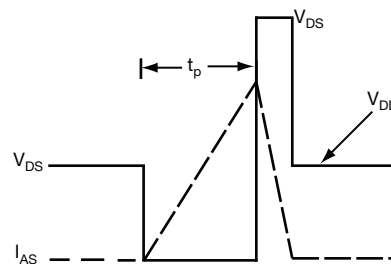
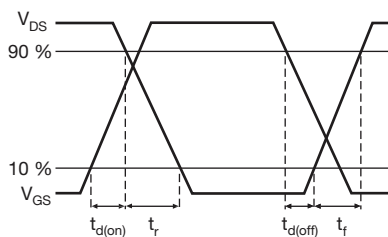
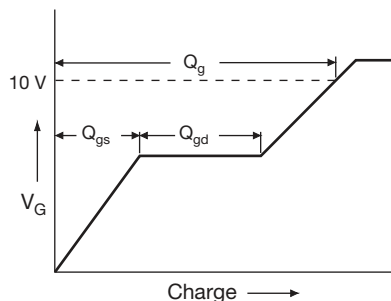
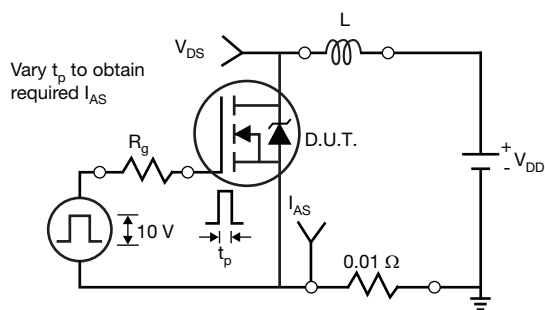
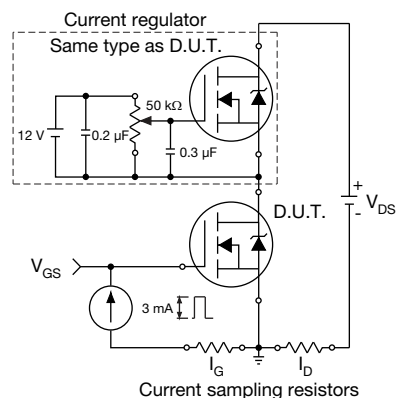
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

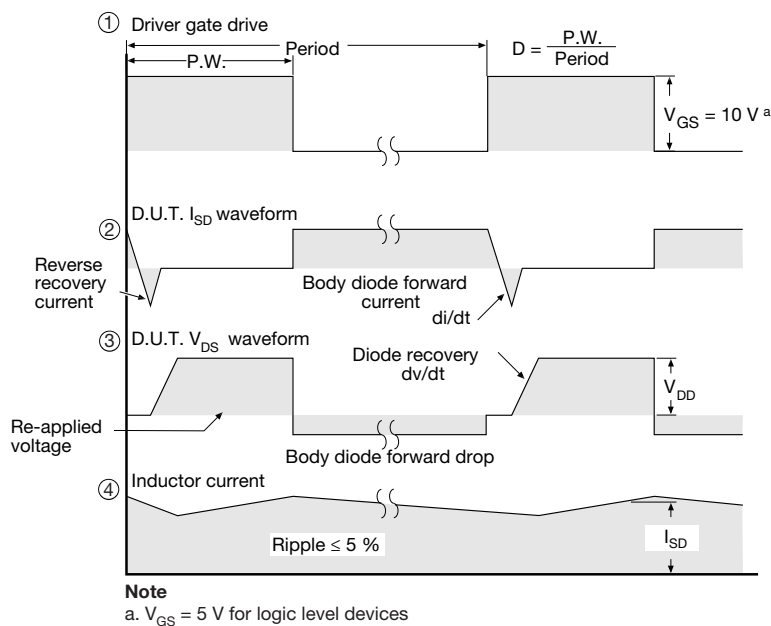
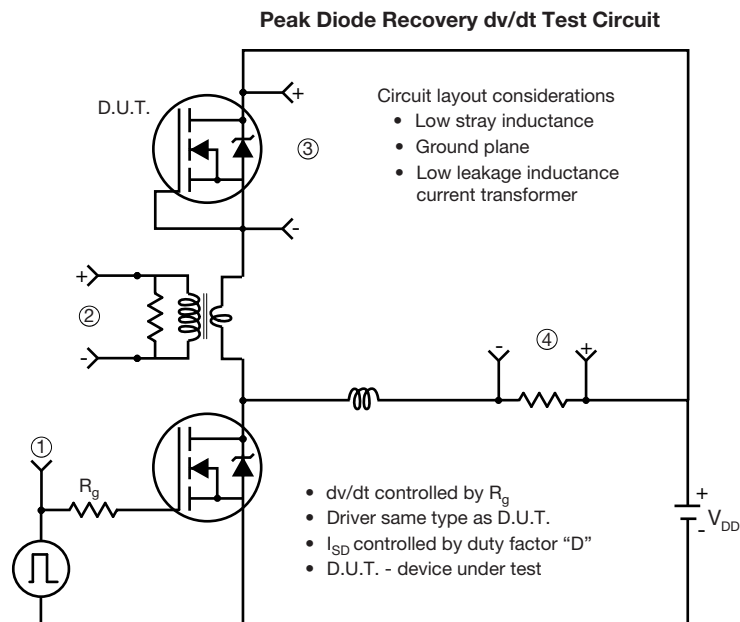
| PARAMETER                                    | SYMBOL                           | TEST CONDITIONS                                                                                                                                       |                                                | MIN. | TYP.  | MAX.  | UNIT |
|----------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|------|-------|-------|------|
| Static                                       |                                  |                                                                                                                                                       |                                                |      |       |       |      |
| Drain-source breakdown voltage               | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                                                        |                                                | 650  | -     | -     | V    |
| V <sub>DS</sub> temperature coefficient      | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = 1 mA                                                                                                             |                                                | -    | 0.63  | -     | V/°C |
| Gate-source threshold voltage (N)            | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                                                           |                                                | 3.0  | -     | 5.0   | V    |
| Gate-source leakage                          | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                                              |                                                | -    | -     | ± 100 | nA   |
|                                              |                                  | V <sub>GS</sub> = ± 30 V                                                                                                                              |                                                | -    | -     | ± 1   | μA   |
| Zero gate voltage drain current              | I <sub>DSS</sub>                 | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V                                                                                                        |                                                | -    | -     | 1     | μA   |
|                                              |                                  | V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                               |                                                | -    | -     | 10    |      |
| Drain-source on-state resistance             | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                                                | I <sub>D</sub> = 15 A                          | -    | 0.070 | 0.079 | Ω    |
| Forward transconductance                     | g <sub>fs</sub>                  | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 19 A                                                                                                         |                                                | -    | 16    | -     | S    |
| Dynamic                                      |                                  |                                                                                                                                                       |                                                |      |       |       |      |
| Input capacitance                            | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 100 V,<br>f = 100 KHz                                                                                     |                                                | -    | 2904  | -     | pF   |
| Output capacitance                           | C <sub>Oss</sub>                 |                                                                                                                                                       |                                                | -    | 106   | -     |      |
| Reverse transfer capacitance                 | C <sub>rss</sub>                 |                                                                                                                                                       |                                                | -    | 2     | -     |      |
| Effective output capacitance, energy related | C <sub>O(er)</sub>               | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                                                                                                 |                                                | -    | 115   | -     |      |
| Effective output capacitance, time related   | C <sub>O(tr)</sub>               |                                                                                                                                                       |                                                | -    | 772   | -     |      |
| Total gate charge                            | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                | I <sub>D</sub> = 19 A, V <sub>DS</sub> = 520 V | -    | 53    | 80    | nC   |
| Gate-source charge                           | Q <sub>gs</sub>                  |                                                                                                                                                       |                                                | -    | 20    | -     |      |
| Gate-drain charge                            | Q <sub>gd</sub>                  |                                                                                                                                                       |                                                | -    | 19    | -     |      |
| Turn-on delay time                           | t <sub>d(on)</sub>               | V <sub>DD</sub> = 520 V, I <sub>D</sub> = 19 A,<br>V <sub>GS</sub> = 10 V, R <sub>g</sub> = 9.1 Ω                                                     |                                                | -    | 29    | 58    | ns   |
| Rise time                                    | t <sub>r</sub>                   |                                                                                                                                                       |                                                | -    | 53    | 106   |      |
| Turn-off delay time                          | t <sub>d(off)</sub>              |                                                                                                                                                       |                                                | -    | 42    | 84    |      |
| Fall time                                    | t <sub>f</sub>                   |                                                                                                                                                       |                                                | -    | 29    | 58    |      |
| Gate input resistance                        | R <sub>g</sub>                   | f = 1 MHz, open drain                                                                                                                                 |                                                | 0.3  | 0.6   | 1.2   | Ω    |
| Drain-Source Body Diode Characteristics      |                                  |                                                                                                                                                       |                                                |      |       |       |      |
| Continuous source-drain diode current        | I <sub>S</sub>                   | MOSFET symbol showing the integral reverse p - n junction diode  |                                                | -    | -     | 35    | A    |
| Pulsed diode forward current                 | I <sub>SM</sub>                  |                                                                                                                                                       |                                                | -    | -     | 91    |      |
| Diode forward voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 19 A, V <sub>GS</sub> = 0 V                                                                                  |                                                | -    | -     | 1.2   | V    |
| Reverse recovery time                        | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 19 A,<br>di/dt = 100 A/μs, V <sub>R</sub> = 25 V                                            |                                                | -    | 447   | 894   | ns   |
| Reverse recovery charge                      | Q <sub>rr</sub>                  |                                                                                                                                                       |                                                | -    | 7     | 14    | μC   |
| Reverse recovery current                     | I <sub>RRM</sub>                 |                                                                                                                                                       |                                                | -    | 25    | -     | A    |

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics**

**Fig. 4 - Normalized On-Resistance vs. Temperature**

**Fig. 2 - Typical Output Characteristics**

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 6 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**


**Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage**

**Fig. 9 - Maximum Drain Current vs. Case Temperature**

**Fig. 8 - Typical Source-Drain Diode Forward Voltage**

**Fig. 10 - Temperature vs. Drain-to-Source Voltage**

**Fig. 11 - Maximum Safe Operating Area**
**Note**

a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified


**Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case**

**Fig. 13 - Switching Time Test Circuit**

**Fig. 16 - Unclamped Inductive Waveforms**

**Fig. 14 - Switching Time Waveforms**

**Fig. 17 - Basic Gate Charge Waveform**

**Fig. 15 - Unclamped Inductive Test Circuit**

**Fig. 18 - Gate Charge Test Circuit**



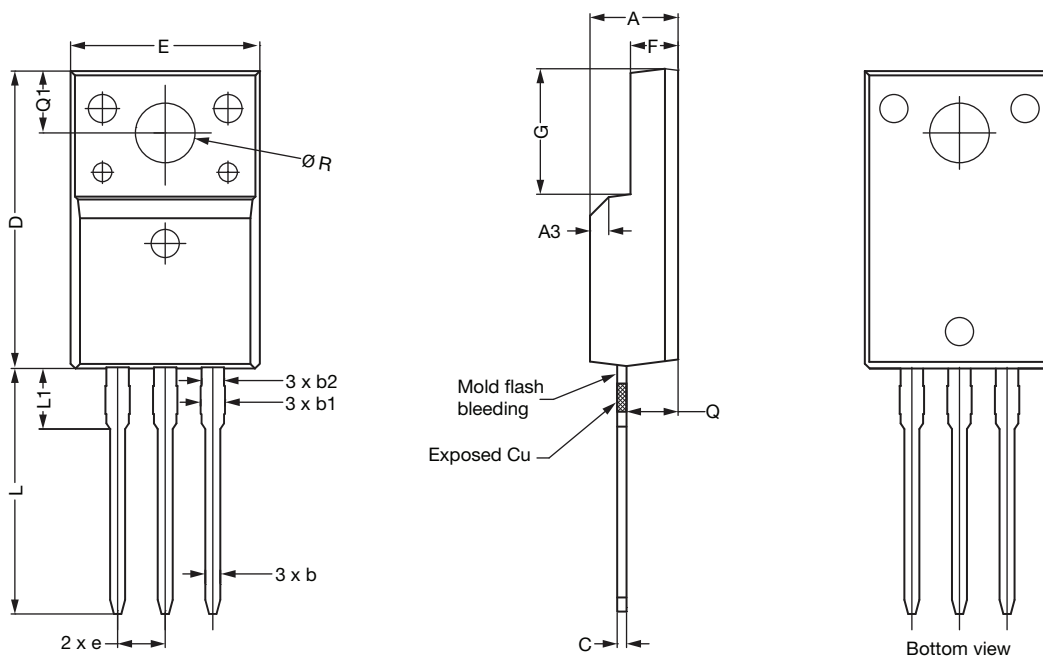
**Fig. 19 - For N-Channel**

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## TO-220 FULLPAK (High Voltage)

### OPTION 1: FACILITY CODE = 9



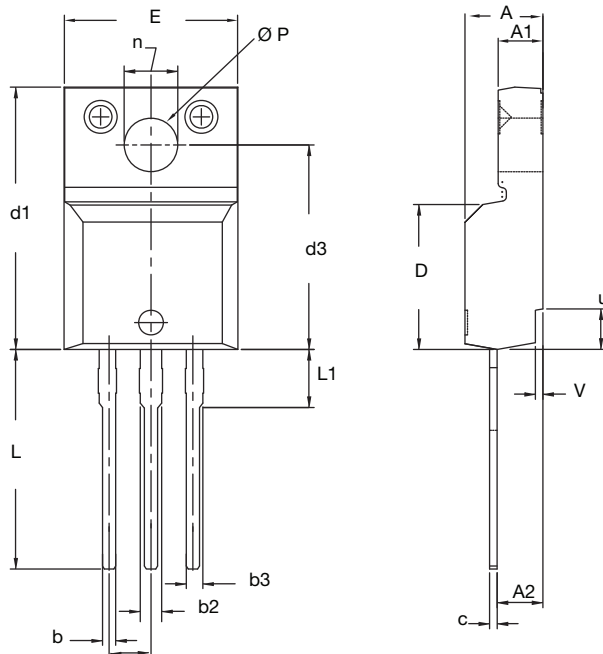
| DIM. | MILLIMETERS |       |       |
|------|-------------|-------|-------|
|      | MIN.        | NOM.  | MAX.  |
| A    | 4.60        | 4.70  | 4.80  |
| b    | 0.70        | 0.80  | 0.91  |
| b1   | 1.20        | 1.30  | 1.47  |
| b2   | 1.10        | 1.20  | 1.30  |
| C    | 0.45        | 0.50  | 0.63  |
| D    | 15.80       | 15.87 | 15.97 |
| e    | 2.54 BSC    |       |       |
| E    | 10.00       | 10.10 | 10.30 |
| F    | 2.44        | 2.54  | 2.64  |
| G    | 6.50        | 6.70  | 6.90  |
| L    | 12.90       | 13.10 | 13.30 |
| L1   | 3.13        | 3.23  | 3.33  |
| Q    | 2.65        | 2.75  | 2.85  |
| Q1   | 3.20        | 3.30  | 3.40  |
| Ø R  | 3.08        | 3.18  | 3.28  |

#### Notes

1. To be used only for process drawing
2. These dimensions apply to all TO-220 FULLPAK leadframe versions 3 leads
3. All critical dimensions should C meet  $C_{pk} > 1.33$
4. All dimensions include burrs and plating thickness
5. No chipping or package damage
6. Facility code will be the 1<sup>st</sup> character located at the 2<sup>nd</sup> row of the unit marking



## OPTION 2: FACILITY CODE = Y



| DIM. | MILLIMETERS |        | INCHES    |       |
|------|-------------|--------|-----------|-------|
|      | MIN.        | MAX.   | MIN.      | MAX.  |
| A    | 4.570       | 4.830  | 0.180     | 0.190 |
| A1   | 2.570       | 2.830  | 0.101     | 0.111 |
| A2   | 2.510       | 2.850  | 0.099     | 0.112 |
| b    | 0.622       | 0.890  | 0.024     | 0.035 |
| b2   | 1.229       | 1.400  | 0.048     | 0.055 |
| b3   | 1.229       | 1.400  | 0.048     | 0.055 |
| c    | 0.440       | 0.629  | 0.017     | 0.025 |
| D    | 8.650       | 9.800  | 0.341     | 0.386 |
| d1   | 15.88       | 16.120 | 0.622     | 0.635 |
| d3   | 12.300      | 12.920 | 0.484     | 0.509 |
| E    | 10.360      | 10.630 | 0.408     | 0.419 |
| e    | 2.54 BSC    |        | 0.100 BSC |       |
| L    | 13.200      | 13.730 | 0.520     | 0.541 |
| L1   | 3.100       | 3.500  | 0.122     | 0.138 |
| n    | 6.050       | 6.150  | 0.238     | 0.242 |
| Ø P  | 3.050       | 3.450  | 0.120     | 0.136 |
| u    | 2.400       | 2.500  | 0.094     | 0.098 |
| V    | 0.400       | 0.500  | 0.016     | 0.020 |

ECN: E19-0180-Rev. D, 08-Apr-2019  
DWG: 5972

### Notes

1. To be used only for process drawing
2. These dimensions apply to all TO-220 FULLPAK leadframe versions 3 leads
3. All critical dimensions should C meet  $C_{pk} > 1.33$
4. All dimensions include burrs and plating thickness
5. No chipping or package damage
6. Facility code will be the 1<sup>st</sup> character located at the 2<sup>nd</sup> row of the unit marking





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