

Power MOSFET

TO-220 FULLPAK


N-Channel MOSFET

FEATURES

- Isolated package
- High voltage isolation = 2.5 kV_{RMS} (t = 60 s; f = 60 Hz)
- Sink to lead creepage distance = 4.8 mm
- Dynamic dV/dt rating
- Low thermal resistance
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

DESCRIPTION

Third generation power MOSFETs from Vishay provides the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost effectiveness.

The TO-220 FULLPAK eliminates the need for additional insulating hardware in commercial-industrial applications. The molding compound used provides a high isolation capability and a low thermal resistance between the tab and external heatsink. This isolation is equivalent to using a 100 micron mica barrier with standard TO-220 product. The FULLPAK is mounted to a heatsink using a single clip or by a single screw fixing.

PRODUCT SUMMARY

| | | |
|----------------------------|------------------------|-----|
| V _{DS} (V) | 800 | |
| R _{DS(on)} (Ω) | V _{GS} = 10 V | 6.5 |
| Q _g (Max.) (nC) | 38 | |
| Q _{gs} (nC) | 5.0 | |
| Q _{gd} (nC) | 21 | |
| Configuration | Single | |

ORDERING INFORMATION

| | |
|----------------|----------------|
| Package | TO-220 FULLPAK |
| Lead (Pb)-free | IRFIBE20GPbF |

ABSOLUTE MAXIMUM RATINGS T_C = 25 °C, unless otherwise noted

| PARAMETER | | | SYMBOL | LIMIT | UNIT |
|---|-------------------------|-------------------------|-----------------------------------|-------------|------|
| Drain-source voltage | | | V _{DS} | 800 | V |
| Gate-source voltage | | | V _{GS} | ± 20 | |
| Continuous drain current | V _{GS} at 10 V | T _C = 25 °C | I _D | 1.4 | A |
| | | T _C = 100 °C | | 0.86 | |
| Pulsed drain current ^a | | | I _{DM} | 5.6 | W/°C |
| Linear derating factor | | | | 0.24 | |
| Single pulse avalanche energy ^b | | | E _{AS} | 180 | mJ |
| Repetitive avalanche current ^a | | | I _{AR} | 1.4 | A |
| Repetitive avalanche energy ^a | | | E _{AR} | 3.0 | mJ |
| Maximum power dissipation | T _C = 25 °C | | P _D | 30 | W |
| Peak diode recovery dV/dt ^c | | | dV/dt | 2.0 | V/ns |
| Operating junction and storage temperature range | | | T _J , T _{stg} | -55 to +150 | °C |
| Soldering recommendations (peak temperature) ^d | For 10 s | | | 300 | |
| Mounting torque | M3 screw | | | 0.6 | Nm |

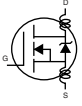

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- V_{DD} = 50 V, starting T_J = 25 °C, L = 172 mH, R_G = 25 Ω, I_{AS} = 1.4 A (see fig. 12)
- I_{SD} ≤ 1.8 A, dI/dt ≤ 80 A/μs, V_{DD} ≤ 600, T_J ≤ 150 °C
- 1.6 mm from case

THERMAL RESISTANCE RATINGS

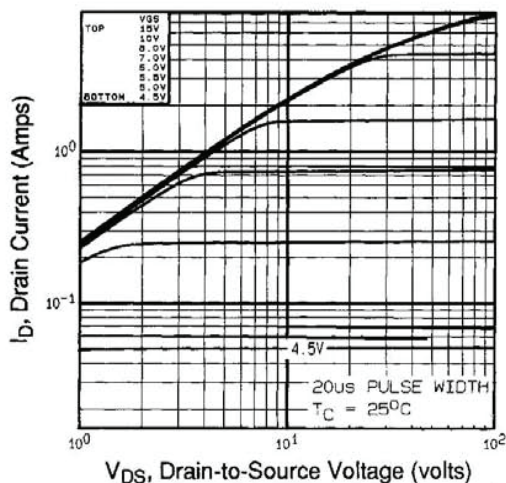
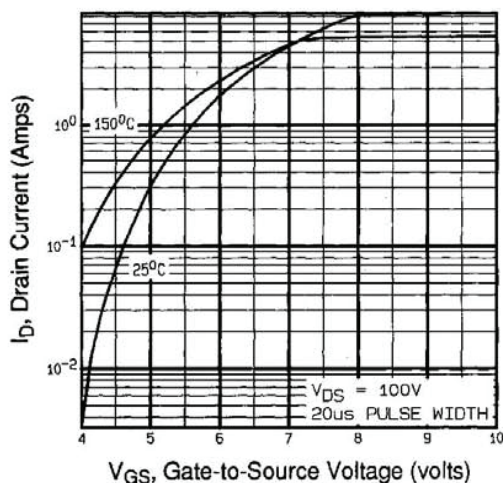
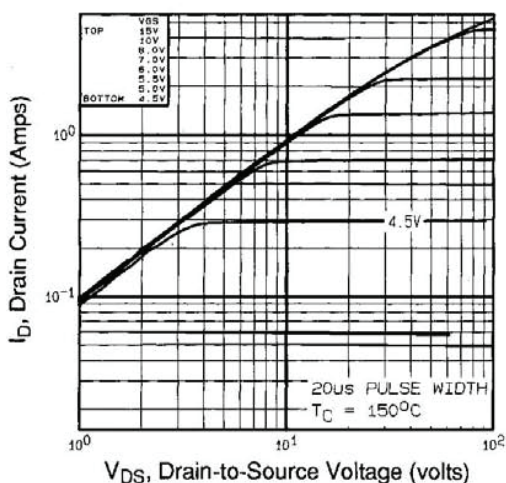
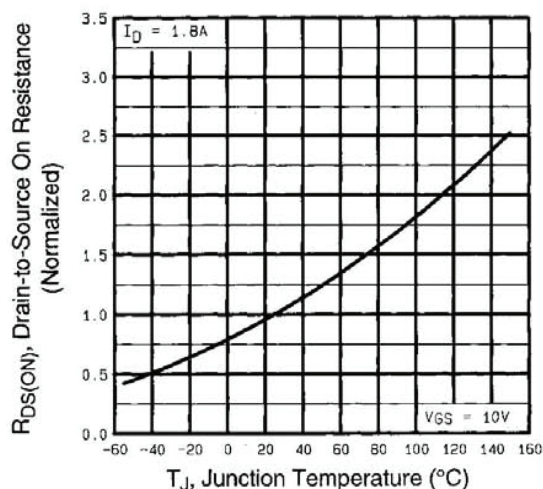
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum junction-to-ambient | R_{thJA} | - | 65 | °C/W |
| Maximum junction-to-case (drain) | R_{thJC} | - | 4.1 | |

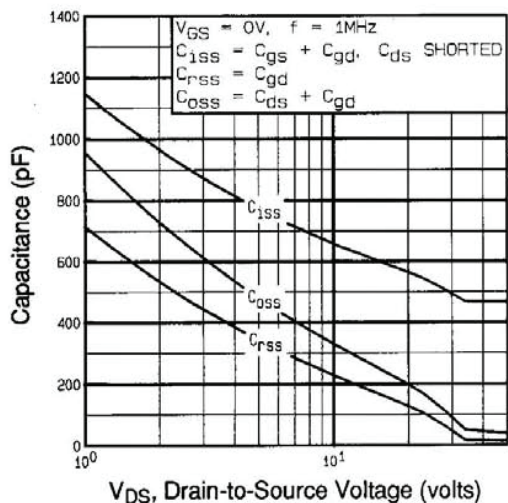
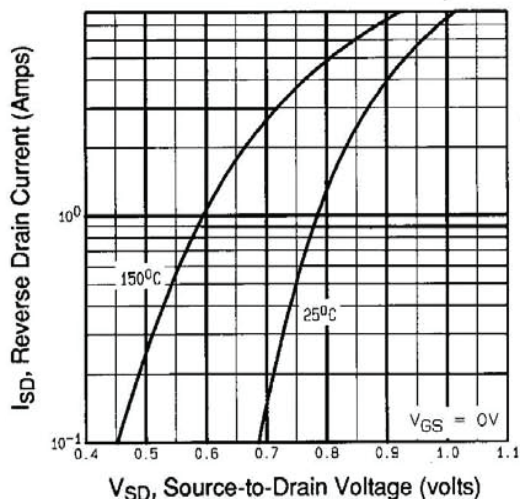
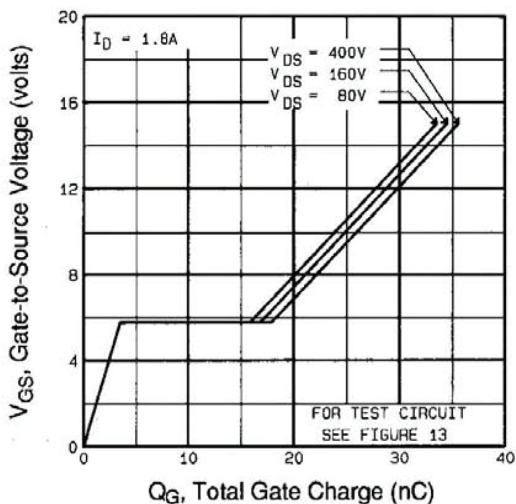
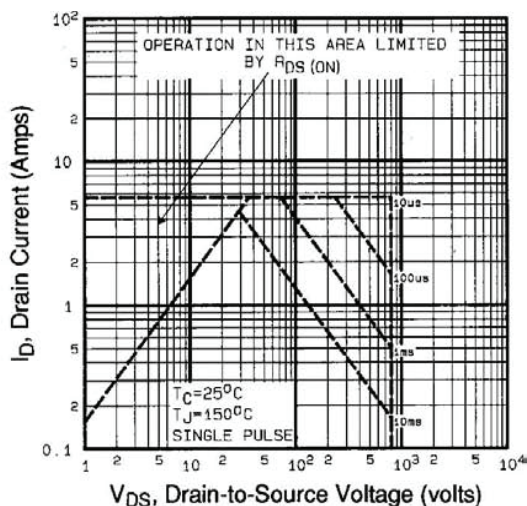
SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted

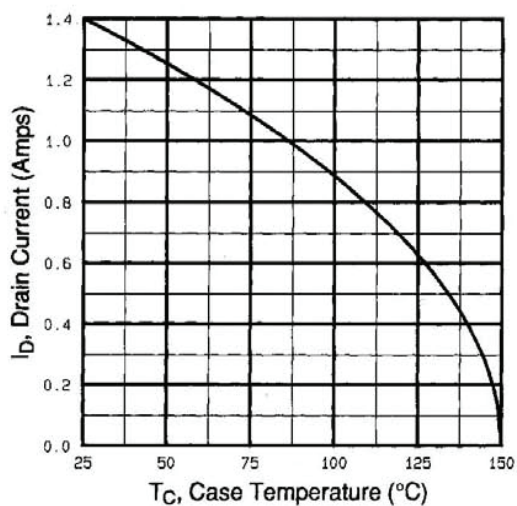
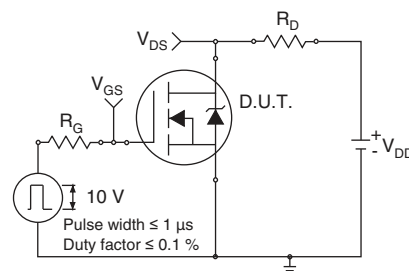
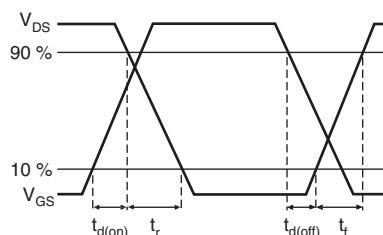
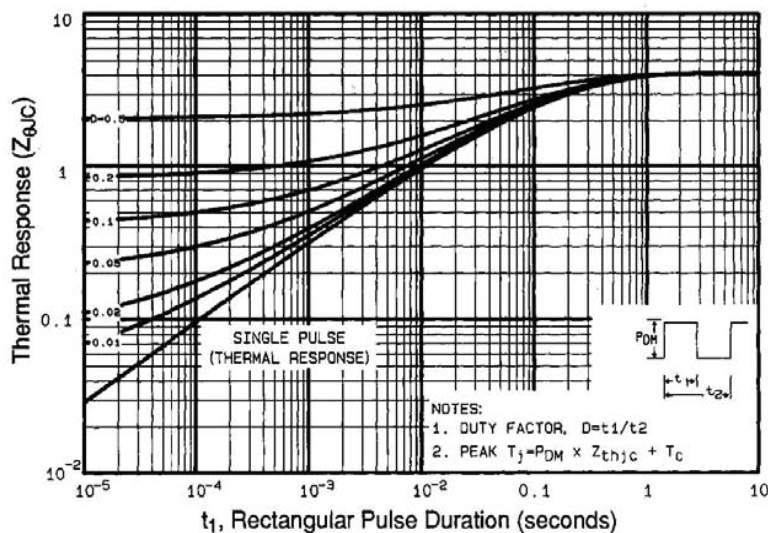
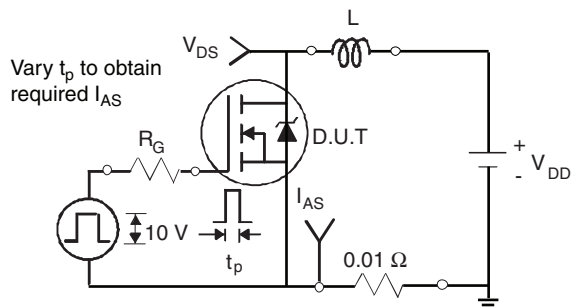
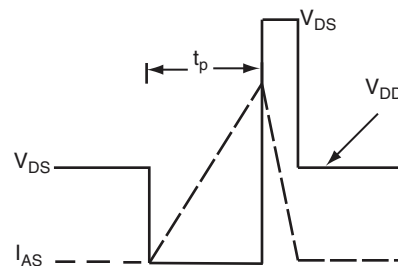
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---------------------|---|--|------|------|-----------|-----------------------|
| Static | | | | | | | |
| Drain-ssource breakdown voltage | V_{DS} | $V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$ | | 800 | - | - | V |
| V_{DS} temperature coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$, $I_D = 1\text{ mA}$ | | - | 0.98 | - | V/ $^{\circ}\text{C}$ |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | | 2.0 | - | 4.0 | V |
| Gate-source leakage | I_{GSS} | $V_{GS} = \pm 20\text{ V}$ | | - | - | ± 100 | nA |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$ | | - | - | 100 | μA |
| | | $V_{DS} = 640\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$ | | - | - | 500 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 0.84\text{ A}^b$ | - | - | 6.5 | Ω |
| Forward transconductance | g_{fs} | $V_{DS} = 10\text{ V}$, $I_D = 0.84\text{ A}^b$ | | 1.0 | - | - | S |
| Dynamic | | | | | | | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 | | - | 530 | - | pF |
| Output capacitance | C_{oss} | | | - | 150 | - | |
| Reverse transfer capacitance | C_{rss} | | | - | 90 | - | |
| Drain to sink capacitance | C | $f = 1.0\text{ MHz}$ | | - | 12 | - | |
| Total gate charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 1.8\text{ A}$, $V_{DS} = 400\text{ V}$, see fig. 6 and 13 ^b | - | - | 38 | nC |
| Gate-source charge | Q_{gs} | | | - | - | 5.0 | |
| Gate-drain charge | Q_{gd} | | | - | - | 21 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 400\text{ V}$, $I_D = 1.8\text{ A}$, $R_G = 18\text{ }\Omega$, $R_D = 230\text{ }\Omega$, see fig. 10 ^b | | - | 8.2 | - | ns |
| Rise time | t_r | | | - | 17 | - | |
| Turn-off delay time | $t_{d(off)}$ | | | - | 58 | - | |
| Fall time | t_f | | | - | 27 | - | |
| Internal drain inductance | L_D | Between lead, 6 mm (0.25") from package and center of die contact  | | - | 4.5 | - | nH |
| Internal source inductance | L_S | | | - | 7.5 | - | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous source-drain diode current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 1.4 | A |
| Pulsed diode forward current ^a | I_{SM} | | | - | - | 5.6 | |
| Body diode voltage | V_{SD} | $T_J = 25\text{ }^{\circ}\text{C}$, $I_S = 1.4\text{ A}$, $V_{GS} = 0\text{ V}^b$ | | - | - | 1.4 | V |
| Body diode reverse recovery time | t_{rr} | $T_J = 25\text{ }^{\circ}\text{C}$, $I_F = 1.8\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$ | | - | 380 | 570 | ns |
| Body diode reverse recovery charge | Q_{rr} | | | - | 0.94 | 1.4 | μC |
| Forward turn-on time | t_{on} | Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D) | | | | | |

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

Fig. 3 - Typical Transfer Characteristics

Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

Fig. 4 - Normalized On-Resistance vs. Temperature


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

Fig. 7 - Typical Source-Drain Diode Forward Voltage

Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

Fig. 8 - Maximum Safe Operating Area


Fig. 9 - Maximum Drain Current vs. Case Temperature

Fig. 10a - Switching Time Test Circuit

Fig. 10b - Switching Time Waveforms

Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

Fig. 12a - Unclamped Inductive Test Circuit

Fig. 12b - Unclamped Inductive Waveforms

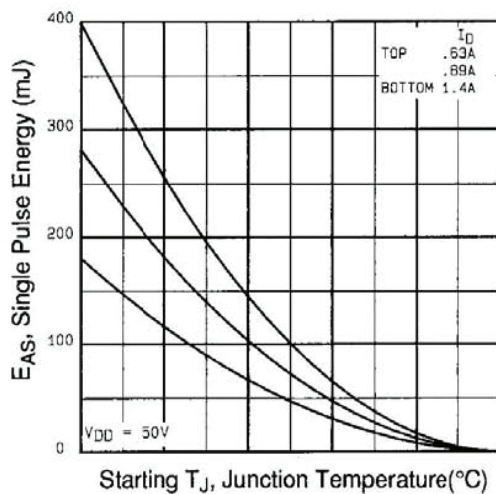


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

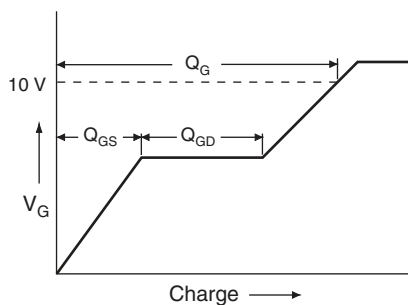


Fig. 13a - Basic Gate Charge Waveform

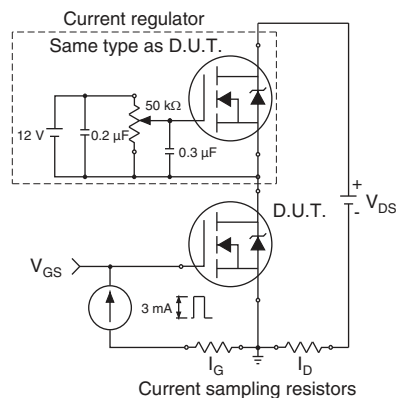
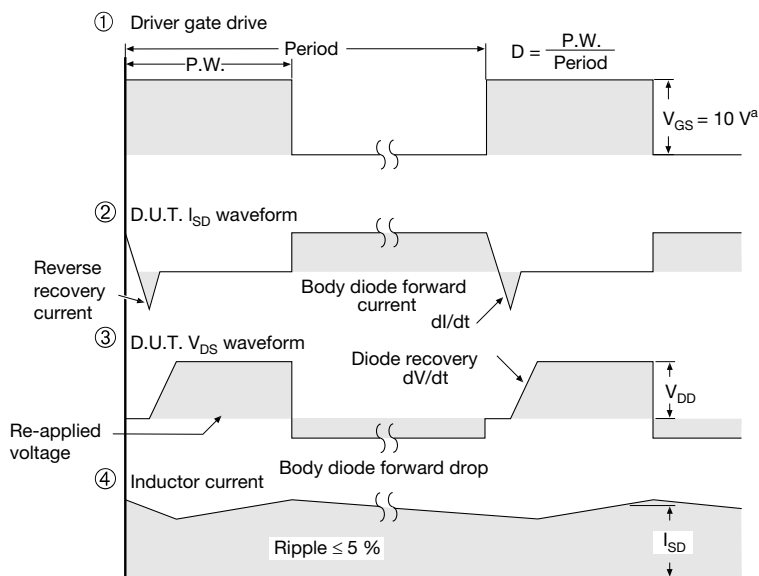
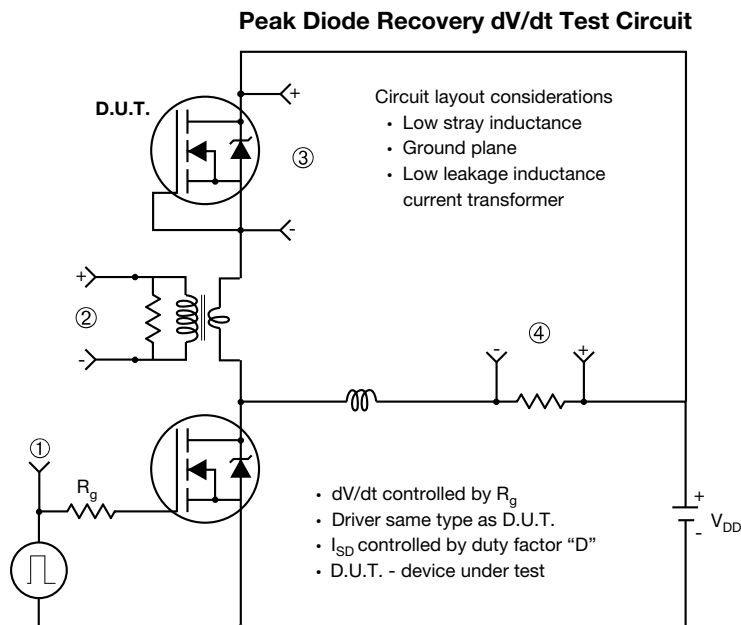


Fig. 13b - Gate Charge Test Circuit


Note

a. $V_{GS} = 5\text{ V}$ for logic level devices

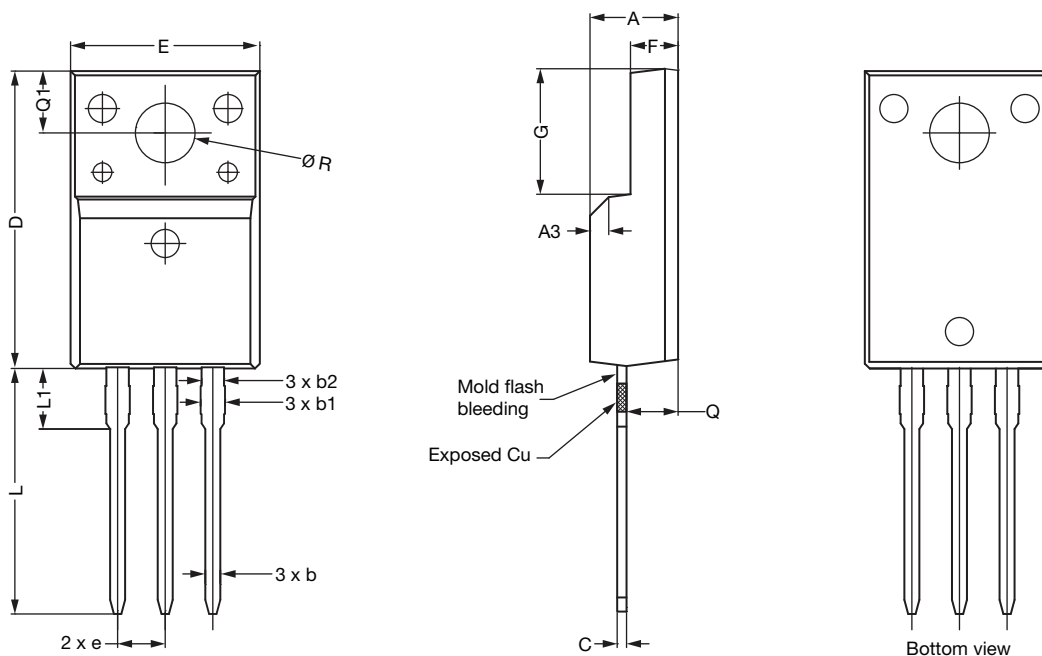
Fig. 14 - For N-Channel

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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 1st character located at the 2nd 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

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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 1st character located at the 2nd row of the unit marking



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