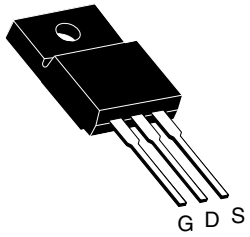
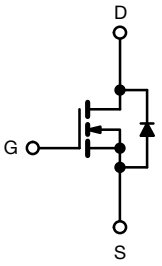
# E Series Power MOSFET

**TO-220 FULLPAK**




N-Channel MOSFET

## FEATURES

- Low figure-of-merit (FOM) $R_{on}$ x $Q_g$
- Low input capacitance ($C_{iss}$)
- Reduced switching and conduction losses
- Ultra low gate charge ($Q_g$)
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE Available

## 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
  - Renewable energy
  - Solar (PV inverters)

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) at $T_J$ max. | 650 | |
| $R_{DS(on)}$ max. (Ω) at 25 °C | $V_{GS}$ = 10 V | 0.6 |
| $Q_g$ max. (nC) | 40 | |
| $Q_{gs}$ (nC) | 5 | |
| $Q_{gd}$ (nC) | 9 | |
| Configuration | Single | |

| ORDERING INFORMATION | |
|---|---|
| Package | TO-220 FULLPAK |
| Lead (Pb)-free | SiHF7N60E-E3 |
| Lead (Pb)-free and Halogen-free | SiHF7N60E-GE3 |

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

| PARAMETER | | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DS}$ | 600 | V |
| | $T_C$ = -25 °C, $I_D$ = 250 µA | | | 575 | |
| Gate-Source Voltage | | | $V_{GS}$ | ± 30 | |
| Continuous Drain Current ($T_J$ = 150 °C) [e] | $V_{GS}$ at 10 V | $T_C$ = 25 °C | $I_D$ | 7 | A |
| | | $T_C$ = 100 °C | | 5 | |
| Pulsed Drain Current [a] | | | $I_{DM}$ | 18 | |
| Linear Derating Factor | | | | 0.25 | W/°C |
| Single Pulse Avalanche Energy [b] | | | $E_{AS}$ | 43 | mJ |
| Maximum Power Dissipation | | | $P_D$ | 31 | W |
| Operating Junction and Storage Temperature Range | | | $T_J$, $T_{stg}$ | -55 to +150 | °C |
| Drain-Source Voltage Slope | $T_J$ = 125 °C | | dV/dt | 70 | V/ns |
| Reverse Diode dV/dt [d] | | | | 3 | |
| Soldering Recommendations (Peak temperature) [c] | For 10 s | | | 300 | °C |
| Mounting Torque | M3 screw | | | 0.6 | Nm |

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature.
b. $V_{DD}$ = 50 V, starting $T_J$ = 25 °C, L = 13.8 mH, $R_g$ = 25 Ω, $I_{AS}$ = 2.5 A.
c. 1.6 mm from case.
d. $I_{SD} \leq I_D$, dI/dt = 100 A/µs, starting $T_J$ = 25 °C.
e. Limited by maximum junction temperature.



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| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TYP.** | **MAX.** | **UNIT** |
| Maximum Junction-to-Ambient | $R_{thJA}$ | - | 65 | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | - | 4.0 | |

| SPECIFICATIONS ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 609 | - | - | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D$ = 1 mA | - | 0.68 | - | V/°C |
| Gate-Source Threshold Voltage (N) | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | - | 4 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$ = ± 20 V | - | - | ± 100 | nA |
| | | $V_{GS}$ = ± 30 V | - | - | ± 1 | µA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | - | - | 1 | µA |
| | | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | - | - | 10 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V; $I_D$ = 3.5 A | - | 0.5 | 0.6 | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 50 V, $I_D$ = 3.5 A | - | 1.9 | - | S |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 100 V, f = 1 MHz | - | 680 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 39 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 5 | - | |
| Effective Output Capacitance, Energy Related [a] | $C_{o(er)}$ | $V_{DS}$ = 0 V to 480 V, $V_{GS}$ = 0 V | - | 34 | - | |
| Effective Output Capacitance, Time Related [b] | $C_{o(tr)}$ | | - | 100 | - | |
| Total Gate Charge | $Q_g$ | $V_{GS}$ = 10 V; $I_D$ = 3.5 A, $V_{DS}$ = 480 V | - | 20 | 40 | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 5 | - | |
| Gate-Drain Charge | $Q_{gd}$ | | - | 9 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 480 V, $I_D$ = 3.5 A, $V_{GS}$ = 10 V, $R_g$ = 9.1 Ω | - | 13 | 26 | ns |
| Rise Time | $t_r$ | | - | 13 | 26 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 24 | 48 | |
| Fall Time | $t_f$ | | - | 14 | 28 | |
| Gate Input Resistance | $R_g$ | f = 1 MHz, open drain | - | 1.1 | - | Ω |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 7 | A |
| Pulsed Diode Forward Current | $I_{SM}$ | | - | - | 18 | |
| Diode Forward Voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 3.5 A, $V_{GS}$ = 0 V | - | - | 1.2 | V |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = $I_S$ = 3.5 A, dI/dt = 100 A/µs, $V_R$ = 20 V | - | 230 | - | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | - | 1.9 | - | µC |
| Reverse Recovery Current | $I_{RRM}$ | | - | 14 | - | A |

**Notes**

a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as $C_{oss}$ while $V_{DS}$ is rising from 0 % to 80 % $V_{DSS}$.

b. $C_{oss(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 % to 80 % $V_{DSS}$.



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

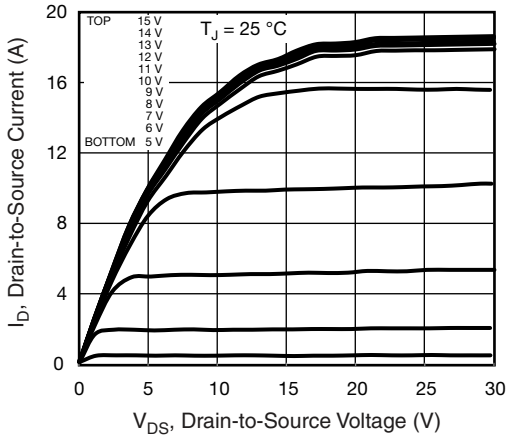



**Fig. 1 - Typical Output Characteristics**

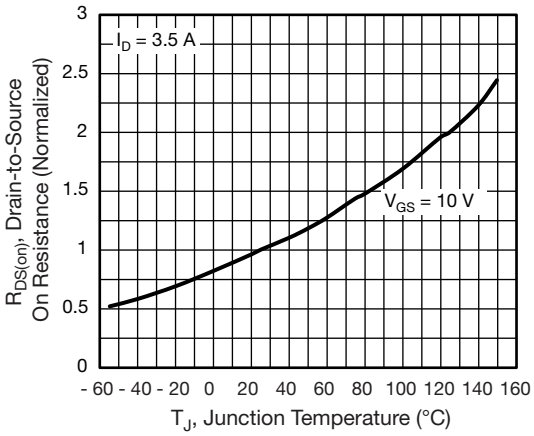



**Fig. 4 - Normalized On-Resistance vs. Temperature**

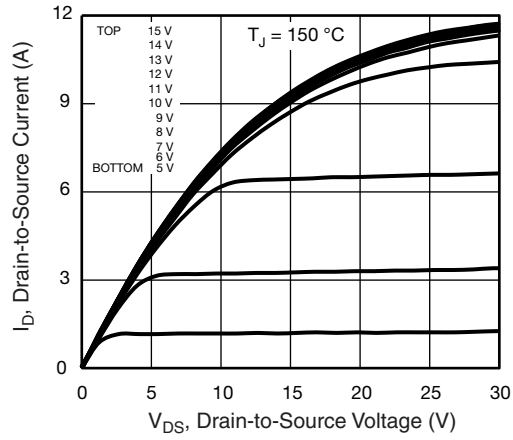



**Fig. 2 - Typical Output Characteristics**

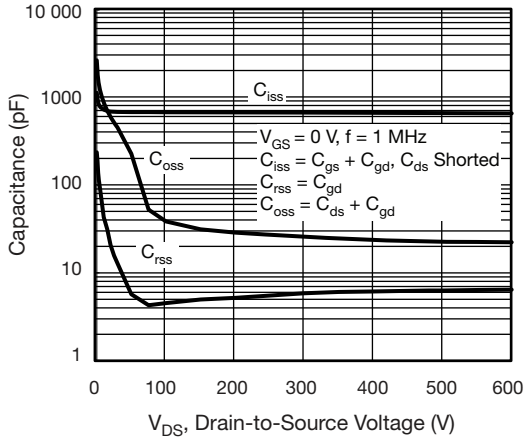



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

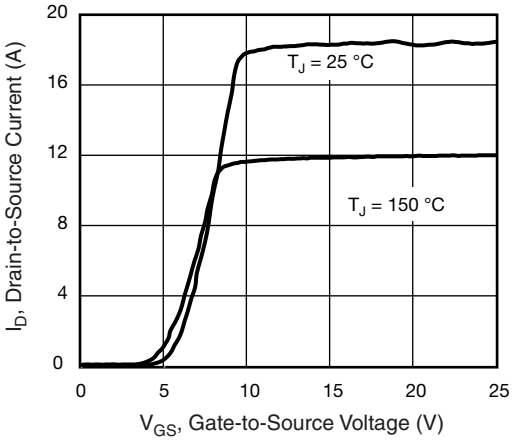



**Fig. 3 - Typical Transfer Characteristics**

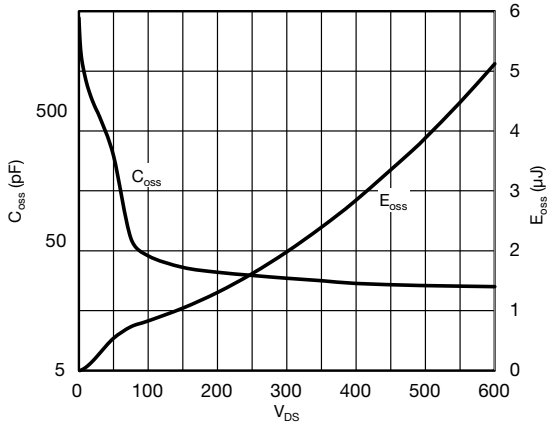



**Fig. 6 - $C_{oss}$ and $E_{oss}$ vs. $V_{DS}$**


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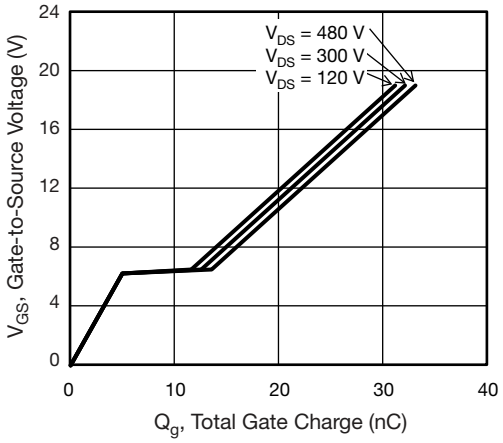



**Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage**

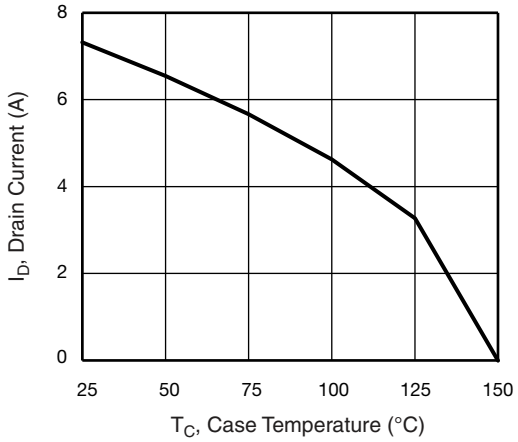



**Fig. 10 - Maximum Drain Current vs. Case Temperature**

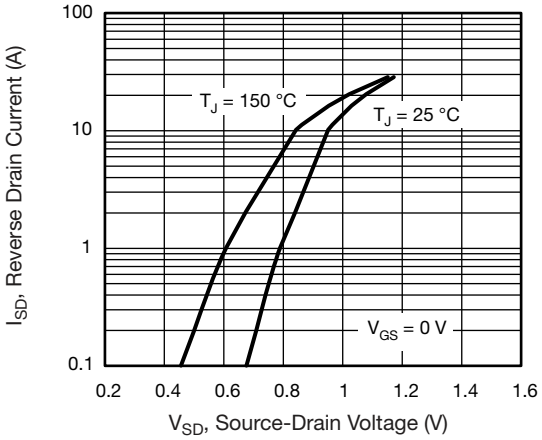



**Fig. 8 - Typical Source-Drain Diode Forward Voltage**

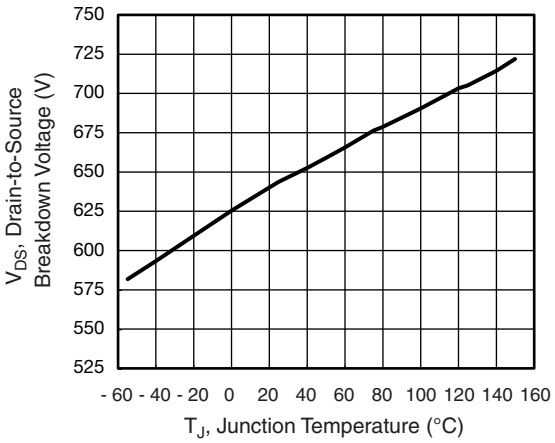



**Fig. 11 - Temperature vs. Drain-to-Source Voltage**

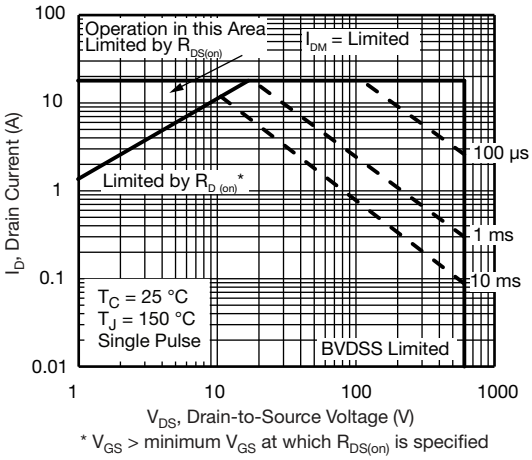



**Fig. 9 - Maximum Safe Operating Area**


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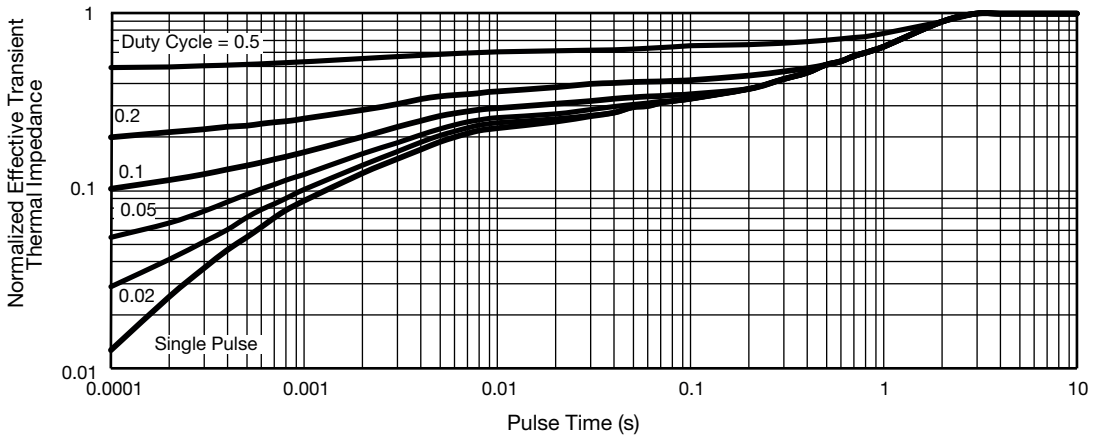



**Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case**

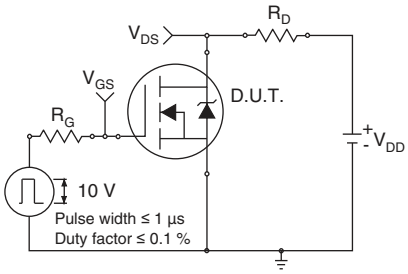



**Fig. 13 - Switching Time Test Circuit**

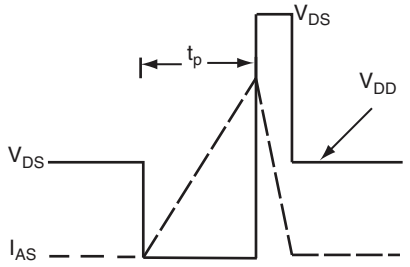



**Fig. 16 - Unclamped Inductive Waveforms**

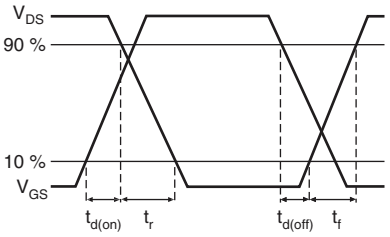



**Fig. 14 - Switching Time Waveforms**

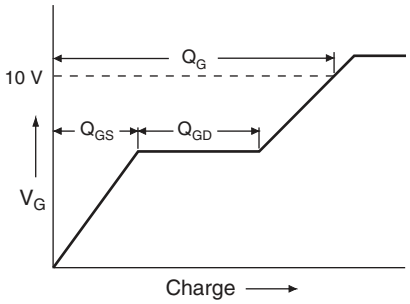



**Fig. 17 - Basic Gate Charge Waveform**

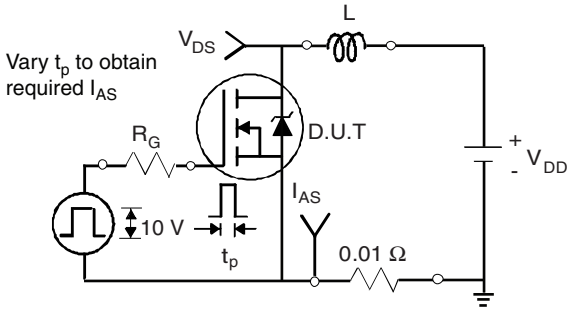



**Fig. 15 - Unclamped Inductive Test Circuit**

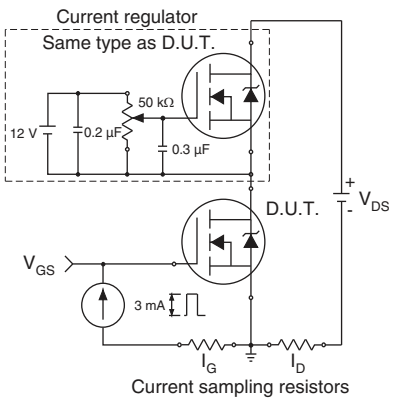
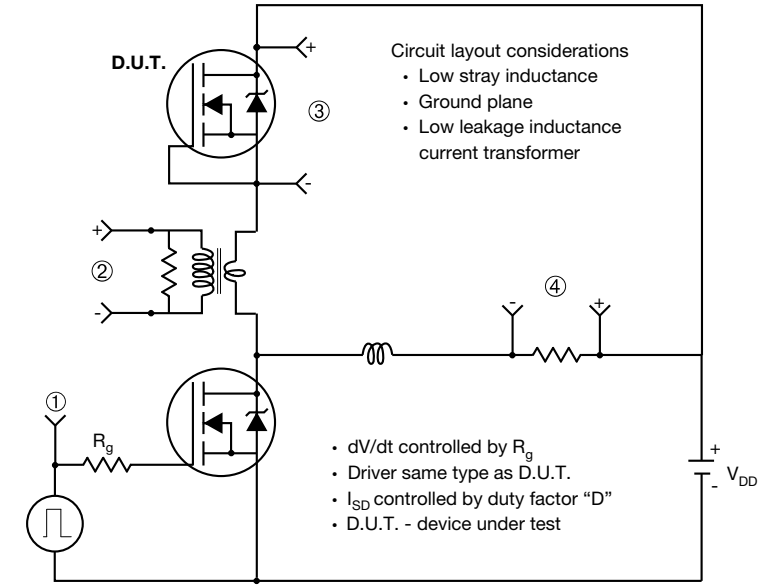
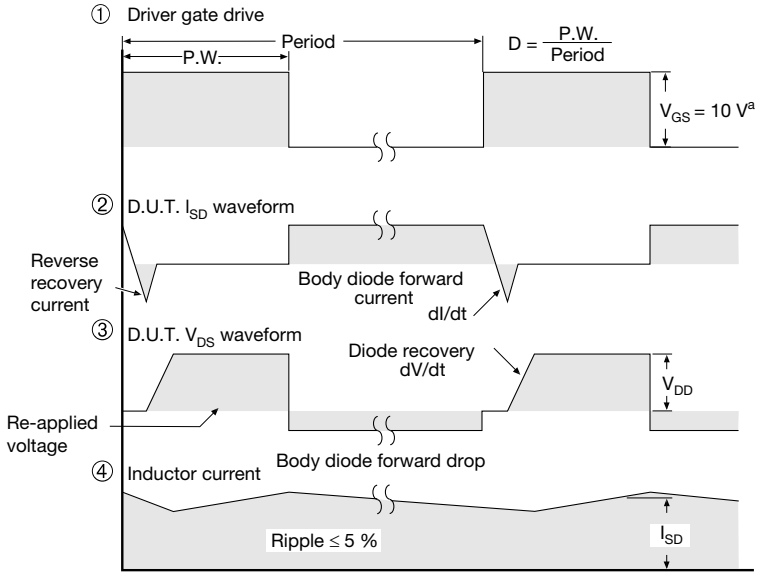



**Fig. 18 - Gate Charge Test Circuit**


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**Peak Diode Recovery dV/dt Test Circuit**




**Note**

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

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

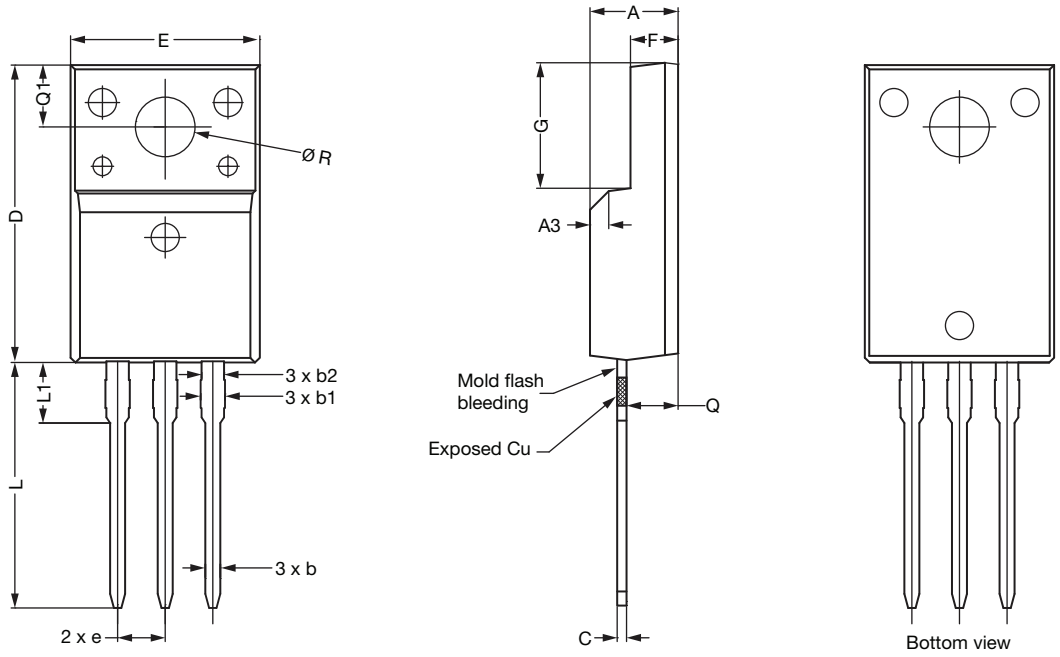
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# TO-220 FULLPAK (High Voltage)

## OPTION 1: FACILITY CODE = 9




| | MILLIMETERS | | |
|---|---|---|---|
| **DIM.** | **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**

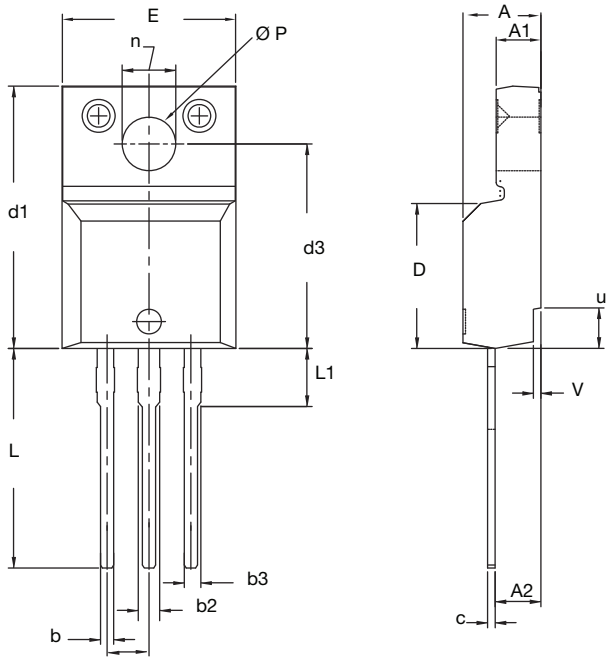
1. To be used only for process drawing
2. These dimensions apply to all TO-220 FULLPAK leadframe versions 3 leads
3. All critical dimensions should C meet $C_{pk} > 1.33$
4. All dimensions include burrs and plating thickness
5. No chipping or package damage
6. Facility code will be the 1st character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



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## OPTION 2: FACILITY CODE = Y




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| **DIM.** | **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<br>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 1st character located at the 2nd row of the unit marking



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ENTEGRECİ

Bu belge www.entegreci.com üzerinden sunulmaktadır.

# Elektronik komponent tedarikinde Entegreci

Entegreci, Eskişehir merkezli, Türkiye geneline satış yapan bir elektronik komponent mağazasıdır. Entegreler (IC), mikrodenetleyiciler, transistörler, diyotlar, pasif elemanlar, konnektörler, modüller ve geliştirme kartları tek adetten seri üretim adetlerine kadar satılır. Ürün sayfalarında güncel stok durumunu, fiyatı ve datasheet bağlantısını bulabilirsiniz.

### Parça koduyla arama

Üretici parça numarasını yazın; stok ve fiyatı hemen görün.

**www.entegreci.com**

### Ürün kategorileri

Entegreden kapasitöre tüm elektronik komponent kategorileri.

**Kategorilere göz atın**

### Üreticiler

Aradığınız üreticinin ürünlerini tek sayfada inceleyin.

**Üreticileri görün**

### Toplu alım ve teklif

Listede olmayan ya da yüksek adetli parçalar için teklif isteyin.

**Teklif isteyin**

**www.entegreci.com** | **destek@entegreci.com** | **0850 305 90 34**

Entegreci is an online electronic components store based in Türkiye. Search by manufacturer part number to see stock, prices and datasheets for integrated circuits, microcontrollers, transistors, passive components and connectors, or request a quote for parts that are not listed.

Bu sayfa Entegreci tarafından eklenmiştir. Belgenin önceki sayfaları asıl yayıncısına aittir ve içeriği değiştirilmemiştir; en güncel sürüm için belgenin yayıncısına başvurun.