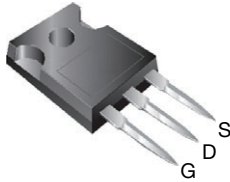


E Series Power MOSFET

TO-247AC


N-Channel MOSFET

FEATURES

- 4th 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


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. | 650 | |
| $R_{DS(on)}$ typ. (Ω) at 25 °C | $V_{GS} = 10$ V | 0.043 |
| Q_g max. (nC) | 130 | |
| Q_{gs} (nC) | 25 | |
| Q_{gd} (nC) | 19 | |
| Configuration | Single | |

ORDERING INFORMATION

| | |
|---------------------------------|-----------------|
| Package | TO-247AC |
| Lead (Pb)-free and halogen-free | SiHG050N60E-GE3 |

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


| PARAMETER | SYMBOL | LIMIT | UNIT | |
|---|------------------|----------------|------|------|
| Drain-source voltage | V_{DS} | 600 | V | |
| Gate-source voltage | V_{GS} | ± 30 | | |
| Continuous drain current ($T_J = 150$ °C) | V_{GS} at 10 V | $T_C = 25$ °C | 51 | A |
| | | $T_C = 100$ °C | 32 | |
| Pulsed drain current ^a | I_{DM} | 155 | | |
| Linear derating factor | | 2.2 | W/°C | |
| Single pulse avalanche energy ^b | E_{AS} | 427 | mJ | |
| Maximum power dissipation | P_D | 278 | 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 | 70 | V/ns |
| Reverse diode dv/dt ^d | | 50 | | |
| Soldering recommendations (peak temperature) ^c | For 10 s | 260 | °C | |

Notes

- Initial samples marked as "SiHG50N60E"
- a. Repetitive rating; pulse width limited by maximum junction temperature
- b. $V_{DD} = 120$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 5.5$ A
- c. 1.6 mm from case
- d. $I_{SD} \leq I_D$, $di/dt = 100$ A/ μ s, starting $T_J = 25$ °C



| THERMAL RESISTANCE RATINGS | | | | |
|----------------------------------|------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum junction-to-ambient | R_{thJA} | - | 40 | °C/W |
| Maximum junction-to-case (drain) | R_{thJC} | - | 0.45 | |

| SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | | | |
|---|---------------------|---|--|------|-------|-----------|---------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
| Static | | | | | | | |
| Drain-source breakdown voltage | V_{DS} | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | | 600 | - | - | V |
| V_{DS} temperature coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$ | | - | 0.60 | - | V/°C |
| Gate-source threshold voltage (N) | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | | 3.0 | - | 5.0 | V |
| Gate-source leakage | I_{GSS} | $V_{GS} = \pm 20\text{ V}$ | | - | - | ± 100 | nA |
| | | $V_{GS} = \pm 30\text{ V}$ | | - | - | ± 1 | μA |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | | - | - | 1 | μA |
| | | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | | - | - | 10 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 23\text{ A}$ | - | 0.043 | 0.050 | Ω |
| Forward transconductance ^a | g_{fs} | $V_{DS} = 20\text{ V}, I_D = 23\text{ A}$ | | - | 12 | - | S |
| Dynamic | | | | | | | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$ | | - | 3459 | - | pF |
| Output capacitance | C_{oss} | | | - | 148 | - | |
| Reverse transfer capacitance | C_{rss} | | | - | 7 | - | |
| Effective output capacitance, energy related ^a | $C_{o(er)}$ | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$ | | - | 114 | - | pF |
| Effective output capacitance, time related ^b | $C_{o(tr)}$ | | | - | 706 | - | |
| Total gate charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 23\text{ A}, V_{DS} = 480\text{ V}$ | - | 65 | 130 | nC |
| Gate-source charge | Q_{gs} | | | - | 25 | - | |
| Gate-drain charge | Q_{gd} | | | - | 19 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 480\text{ V}, I_D = 23\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$ | | - | 35 | 70 | ns |
| Rise time | t_r | | | - | 82 | 164 | |
| Turn-off delay time | $t_{d(off)}$ | | | - | 67 | 134 | |
| Fall time | t_f | | | - | 48 | 96 | |
| Gate input resistance | R_g | $f = 1\text{ MHz}, \text{open drain}$ | | 0.43 | 0.85 | 1.72 | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous source-drain diode current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 50 | A |
| Pulsed diode forward current | I_{SM} | | | - | - | 155 | |
| Diode forward voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 23\text{ A}, V_{GS} = 0\text{ V}$ | | - | - | 1.2 | V |
| Reverse recovery time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 23\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$ | | - | 435 | 870 | ns |
| Reverse recovery charge | Q_{rr} | | | - | 9.2 | 18.4 | μC |
| Reverse recovery current | I_{RRM} | | | - | 39 | - | 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}

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

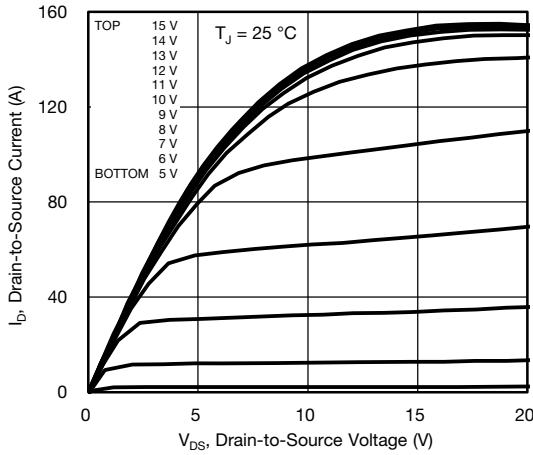


Fig. 1 - Typical Output Characteristics

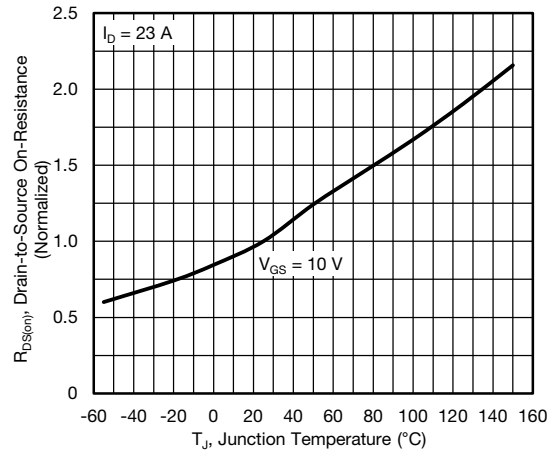


Fig. 4 - Normalized On-Resistance vs. Temperature

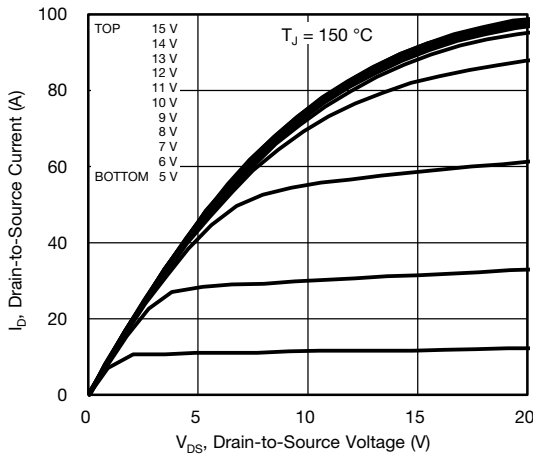


Fig. 2 - Typical Output Characteristics

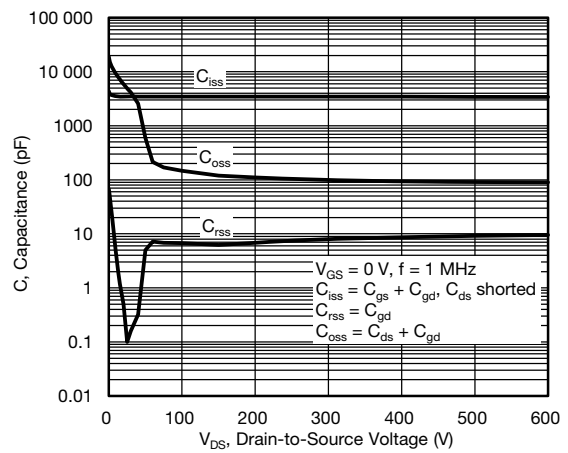


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

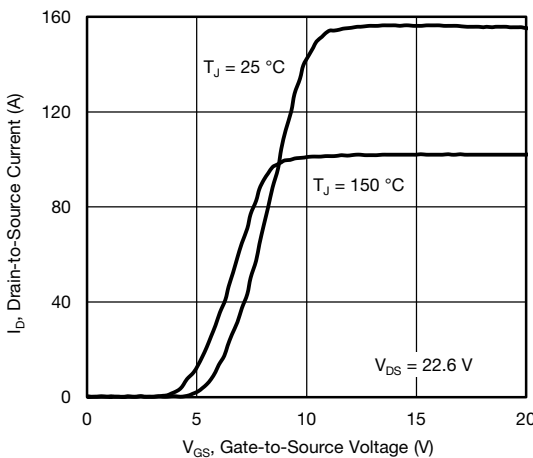


Fig. 3 - Typical Transfer Characteristics

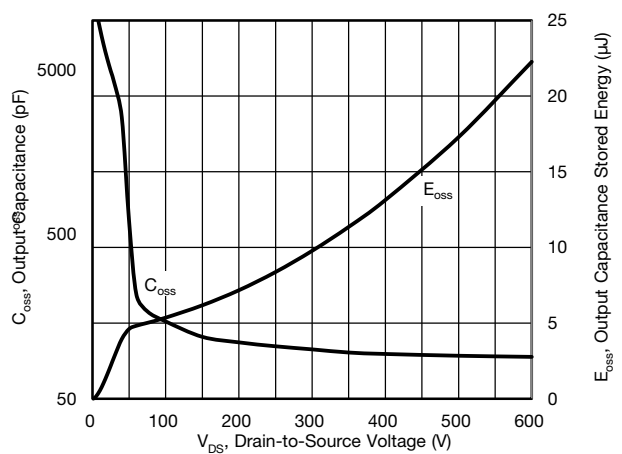


Fig. 6 - C_{oss} and E_{oss} vs. V_{ds}

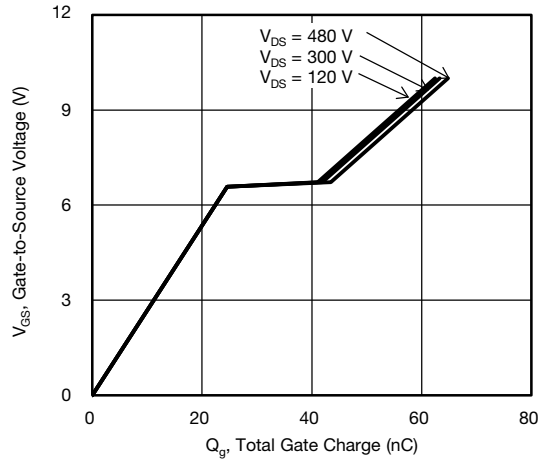


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

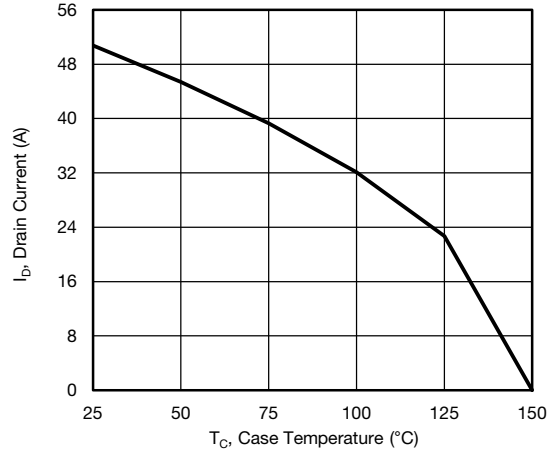


Fig. 10 - Maximum Drain Current vs. Case Temperature

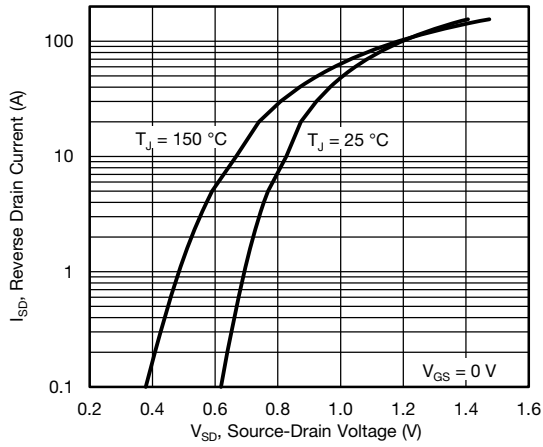


Fig. 8 - Typical Source-Drain Diode Forward Voltage

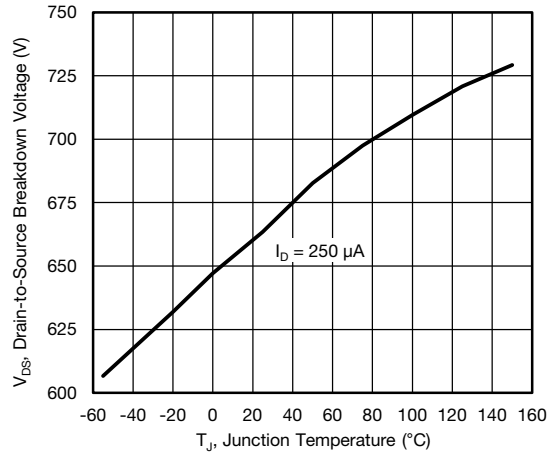


Fig. 11 - Temperature vs. Drain-to-Source Voltage

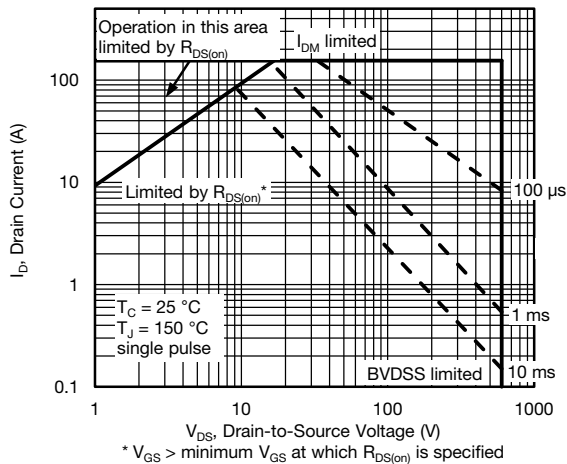


Fig. 9 - Maximum Safe Operating Area

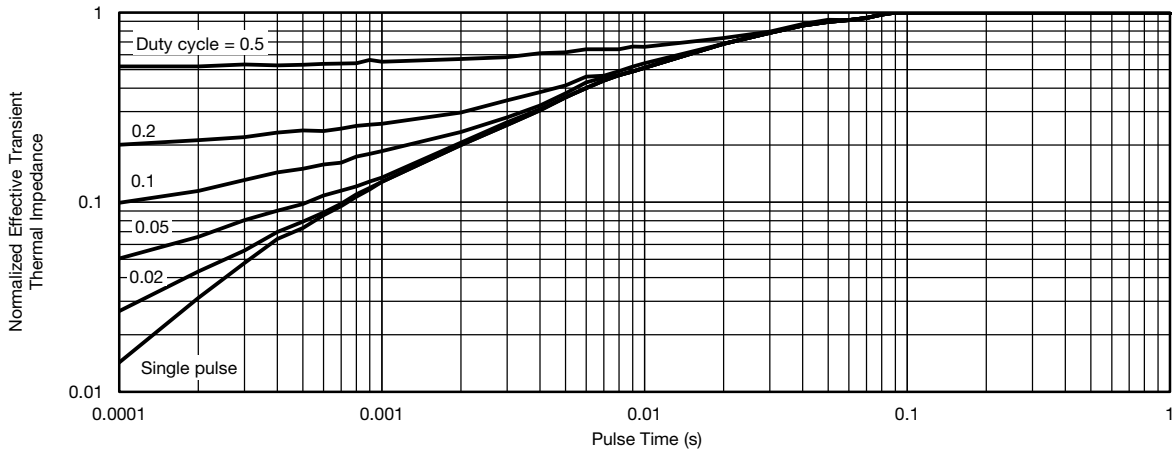


Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case

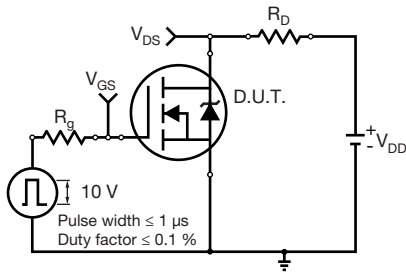


Fig. 13 - Switching Time Test Circuit

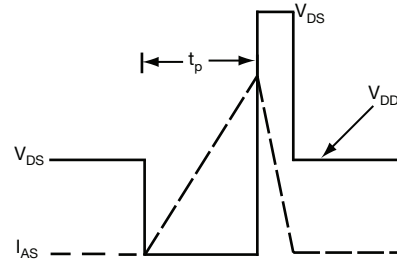


Fig. 16 - Unclamped Inductive Waveforms

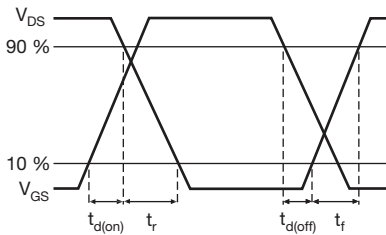


Fig. 14 - Switching Time Waveforms

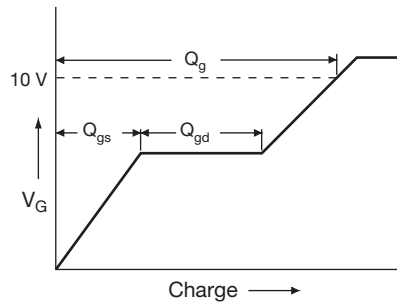


Fig. 17 - Basic Gate Charge Waveform

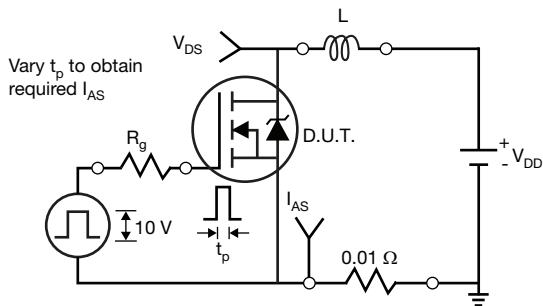


Fig. 15 - Unclamped Inductive Test Circuit



Fig. 18 - Gate Charge Test Circuit



Note

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

Fig. 19 - For N-Channel

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TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



| DIM. | MILLIMETERS | | | NOTES |
|------|-------------|-------|-------|-------|
| | MIN. | NOM. | MAX. | |
| A | 4.83 | 5.02 | 5.21 | |
| A1 | 2.29 | 2.41 | 2.55 | |
| A2 | 1.17 | 1.27 | 1.37 | |
| b | 1.12 | 1.20 | 1.33 | |
| b1 | 1.12 | 1.20 | 1.28 | |
| b2 | 1.91 | 2.00 | 2.39 | 6 |
| b3 | 1.91 | 2.00 | 2.34 | |
| b4 | 2.87 | 3.00 | 3.22 | 6, 8 |
| b5 | 2.87 | 3.00 | 3.18 | |
| c | 0.40 | 0.50 | 0.60 | 6 |
| c1 | 0.40 | 0.50 | 0.56 | |
| D | 20.40 | 20.55 | 20.70 | 4 |

| DIM. | MILLIMETERS | | | NOTES |
|------|-------------|-------|-------|-------|
| | MIN. | NOM. | MAX. | |
| D1 | 16.46 | 16.76 | 17.06 | 5 |
| D2 | 0.56 | 0.66 | 0.76 | |
| E | 15.50 | 15.70 | 15.87 | 4 |
| E1 | 13.46 | 14.02 | 14.16 | 5 |
| E2 | 4.52 | 4.91 | 5.49 | 3 |
| e | 5.46 BSC | | | |
| L | 14.90 | 15.15 | 15.40 | |
| L1 | 3.96 | 4.06 | 4.16 | 6 |
| Ø P | 3.56 | 3.61 | 3.65 | 7 |
| Ø P1 | 7.19 ref. | | | |
| Q | 5.31 | 5.50 | 5.69 | |
| S | 5.51 BSC | | | |

Notes

- (1) Package reference: JEDEC® TO247, variation AC
- (2) All dimensions are in mm
- (3) Slot required, notch may be rounded
- (4) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outermost extremes of the plastic body
- (5) Thermal pad contour optional with dimensions D1 and E1
- (6) Lead finish uncontrolled in L1
- (7) Ø P to have a maximum draft angle of 1.5° to the top of the part with a maximum hole diameter of 3.91 mm
- (8) Dimension b2 and b4 does not include dambar protrusion. Allowable dambar protrusion shall be 0.1 mm total in excess of b2 and b4 dimension at maximum material condition



VERSION 2: FACILITY CODE = Y



| DIM. | MILLIMETERS | | NOTES |
|------|-------------|-------|-------|
| | MIN. | MAX. | |
| A | 4.58 | 5.31 | |
| A1 | 2.21 | 2.59 | |
| A2 | 1.17 | 2.49 | |
| b | 0.99 | 1.40 | |
| b1 | 0.99 | 1.35 | |
| b2 | 1.53 | 2.39 | |
| b3 | 1.65 | 2.37 | |
| b4 | 2.42 | 3.43 | |
| b5 | 2.59 | 3.38 | |
| c | 0.38 | 0.86 | |
| c1 | 0.38 | 0.76 | |
| D | 19.71 | 20.82 | |
| D1 | 13.08 | - | |

| DIM. | MILLIMETERS | | NOTES |
|------|-------------|-------|-------|
| | MIN. | MAX. | |
| D2 | 0.51 | 1.30 | |
| E | 15.29 | 15.87 | |
| E1 | 13.72 | - | |
| e | 5.46 BSC | | |
| Ø k | 0.254 | | |
| L | 14.20 | 16.25 | |
| L1 | 3.71 | 4.29 | |
| Ø P | 3.51 | 3.66 | |
| Ø P1 | - | 7.39 | |
| Q | 5.31 | 5.69 | |
| R | 4.52 | 5.49 | |
| S | 5.51 BSC | | |

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC outline TO-247 with exception of dimension c



VERSION 3: FACILITY CODE = N



| MILLIMETERS | | |
|-------------|-------|-------|
| DIM. | MIN. | MAX. |
| A | 4.65 | 5.31 |
| A1 | 2.21 | 2.59 |
| A2 | 1.17 | 1.37 |
| b | 0.99 | 1.40 |
| b1 | 0.99 | 1.35 |
| b2 | 1.65 | 2.39 |
| b3 | 1.65 | 2.34 |
| b4 | 2.59 | 3.43 |
| b5 | 2.59 | 3.38 |
| c | 0.38 | 0.89 |
| c1 | 0.38 | 0.84 |
| D | 19.71 | 20.70 |
| D1 | 13.08 | - |

| MILLIMETERS | | |
|-------------|----------|-------|
| DIM. | MIN. | MAX. |
| D2 | 0.51 | 1.35 |
| E | 15.29 | 15.87 |
| E1 | 13.46 | - |
| e | 5.46 BSC | |
| k | 0.254 | |
| L | 14.20 | 16.10 |
| L1 | 3.71 | 4.29 |
| N | 7.62 BSC | |
| P | 3.56 | 3.66 |
| P1 | - | 7.39 |
| Q | 5.31 | 5.69 |
| R | 4.52 | 5.49 |
| S | 5.51 BSC | |

ECN: E22-0452-Rev. G, 31-Oct-2022
 DWG: 5971

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")



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