

GENERAL DESCRIPTION

This high voltage MOSFET uses an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power supplies, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.

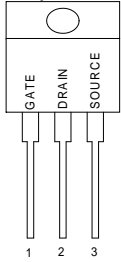
FEATURES

- ◆ Robust High Voltage Termination
- ◆ Avalanche Energy Specified
- ◆ Source-to-Drain Diode Recovery Time Comparable to a Discrete Fast Recovery Diode
- ◆ Diode is Characterized for Use in Bridge Circuits
- ◆ I_{DSS} and $V_{DS(on)}$ Specified at Elevated Temperature
- ◆ Isolated Mounting Hole Reduces Mounting Hardware

PIN CONFIGURATION

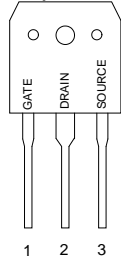
TO-220/TO-220F

Top View

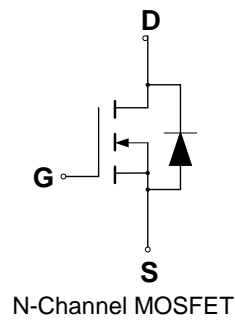


TO-3P/T-O247

Top View



SYMBOL



ABSOLUTE MAXIMUM RATINGS

| Rating | Symbol | Value | Unit | |
|---|----------------|------------|------|------|
| Drain to Current – Continuous | $I_{D(1)}$ | 28 | A | |
| – Pulsed | I_{DM} | 84 | | |
| Gate-to-Source Voltage – Continue | V_{GS} | ±20 | V | |
| Total Power Dissipation – TO220 | P_D | 245 | W | |
| – TO220FP | | 42 | | |
| –TO3P | | 255 | | |
| –TO247 | | 227 | | |
| Derate above 25°C – TO220 | | 1.96 | | |
| – TO220FP | | 0.33 | | |
| –TO3P | | 2.04 | | |
| –TO247 | 1.82 | | | |
| Junction and Storage Temperature Range | T_J, T_{STG} | -55 to 150 | °C | |
| Single Pulse Drain-to-Source Avalanche Energy – $T_J = 25^\circ\text{C}$ ($V_{DD} = 100\text{V}, V_{GS} = 10\text{V}, I_L = 8\text{A}, L = 10\text{mH}, R_G = 25$) | E_{AS} | 320 | mJ | |
| Thermal Resistance – Junction to Case -TO220 | J_C | 0.51 | °C/W | |
| – Junction to Case -TO220FP | | 3 | | |
| – Junction to Case -TO3P | | 0.49 | | |
| – Junction to Case -TO247 | | 0.55 | | |
| – Junction to Ambient -TO220, TO220FP | | J_A | | 62.5 |
| – Junction to Ambient -TO3P, TO247 | | | | 40 |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds | T_L | 260 | °C | |

(1) Drain current limited by maximum junction temperature

ORDERING INFORMATION

| Part Number | TOP MARK | Part Number | Packing Mthod | Note |
|-------------------------|----------|-------------|---------------|------|
| GP28S50XN220 (Note1) | GP28S50X | TO-220 | Tube | |
| GP28S50XN220FP (Notte1) | GP28S50X | TO-220FP | Tube | |
| GP28S50XN3P (Notte2) | GP28S50X | TO-3P | Tube | |
| GP28S50XN247 (Notte2) | GP28S50X | TO-247 | Tube | |
| GP28S50GN220 (Note2) | GP28S50G | TO-220 | Tube | |
| GP28S50GN220FP (Notte2) | GP28S50G | TO-220FP | Tube | |
| GP28S50GN3P (Notte2) | GP28S50G | TO-3P | Tube | |
| GP28S50GN247 (Notte2) | GP28S50G | TO-247 | Tube | |

Note1: X : Suffix for Halogen Free Product,

Note2: G : Suffix for PB Free Product,

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, $T_J = 25^\circ\text{C}$.

| Characteristic | Symbol | GP28S50 | | | Units |
|---|---|--------------|--------|-----|---------------|
| | | Min | Typ | Max | |
| Drain-Source Breakdown Voltage ($V_{GS} = 0\text{ V}$, $I_D = 250\ \mu\text{A}$) | $V_{(BR)DSS}$ | 500 | | | V |
| Drain-Source Leakage Current ($V_{DS} = 500\text{ V}$, $V_{GS} = 0\text{ V}$) | I_{DSS} | | | 1 | μA |
| Gate-Source Leakage Current-Forward ($V_{gsf} = 20\text{ V}$, $V_{DS} = 0\text{ V}$) | I_{GSSF} | | | 100 | nA |
| Gate-Source Leakage Current-Reverse ($V_{gsr} = -20\text{ V}$, $V_{DS} = 0\text{ V}$) | I_{GSSR} | | | 100 | nA |
| Gate Threshold Voltage ($V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$) | $V_{GS(th)}$ | 2 | 3 | 4 | V |
| Static Drain-Source On-Resistance ($V_{GS} = 10\text{ V}$, $I_D = 15\text{A}$) * | $R_{DS(on)}$ | | | 125 | m |
| Gate resistance ($f=1\text{MHz}$, open drain) | R_G | | 2.7 | | |
| Input Capacitance | $(V_{DS} = 25\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1.0\text{ MHz}$) | C_{iss} | 1517.7 | | pF |
| Output Capacitance | | C_{oss} | 1766.7 | | pF |
| Reverse Transfer Capacitance | | C_{rss} | 50.3 | | pF |
| Turn-On Delay Time | $(V_{DD} = 250\text{ V}$, $I_D = 20\text{ A}$, $R_G = 25\ \Omega$) * | $t_{d(on)}$ | 34.9 | | ns |
| Rise Time | | t_r | 104.5 | | ns |
| Turn-Off Delay Time | | $t_{d(off)}$ | 97.4 | | ns |
| Fall Time | | t_f | 65.0 | | ns |
| Total Gate Charge | $(V_{DS} = 400\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = 10\text{ V}$)* | Q_g | 40.7 | | nC |
| Gate-Source Charge | | Q_{gs} | 10.1 | | nC |
| Gate-Drain Charge | | Q_{gd} | 18.7 | | nC |
| SOURCE-DRAIN DIODE CHARACTERISTICS | | | | | |
| Forward On-Voltage(1) | $(I_S = 20\text{ A}$, $d_I/d_t = 100\text{A}/\mu\text{s}$) | V_{SD} | | 1.5 | V |
| Forward Turn-On Time | | t_{on} | | ** | ns |
| Reverse Recovery Time | | t_{rr} | | 741 | ns |

* Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$

** Negligible, Dominated by circuit inductance

TYPICAL ELECTRICAL CHARACTERISTICS

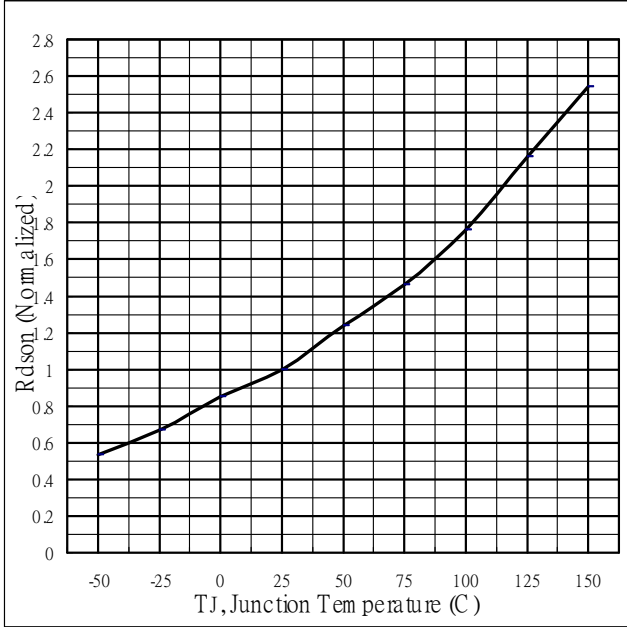


Fig 1. On-Resistance Variation with vs. Temperature

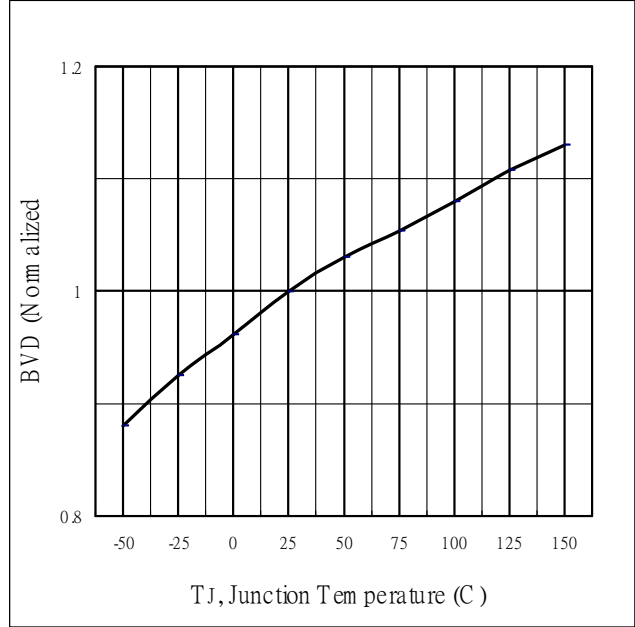


Fig.2 Breakdown Voltage Variation vs. Temperature

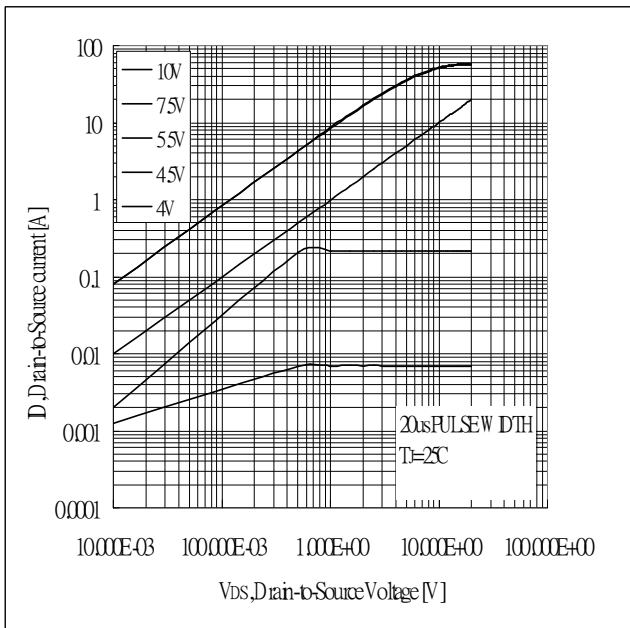


Fig 3. Typical Output Characteristics

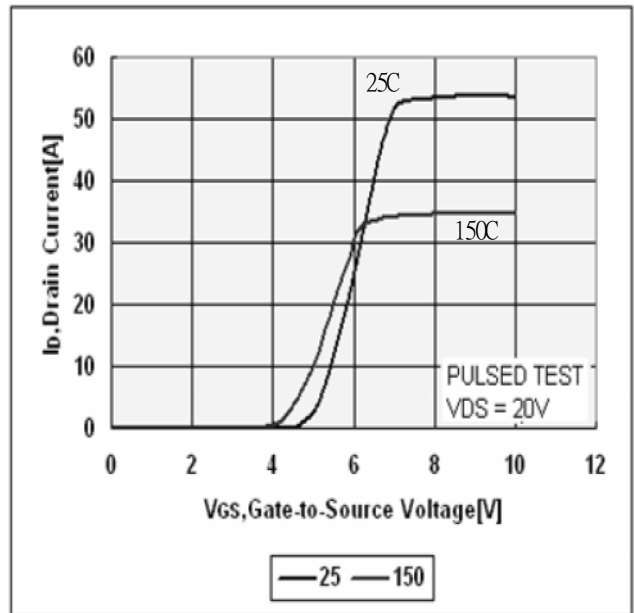


Fig 4. Typical Transfer Characteristics

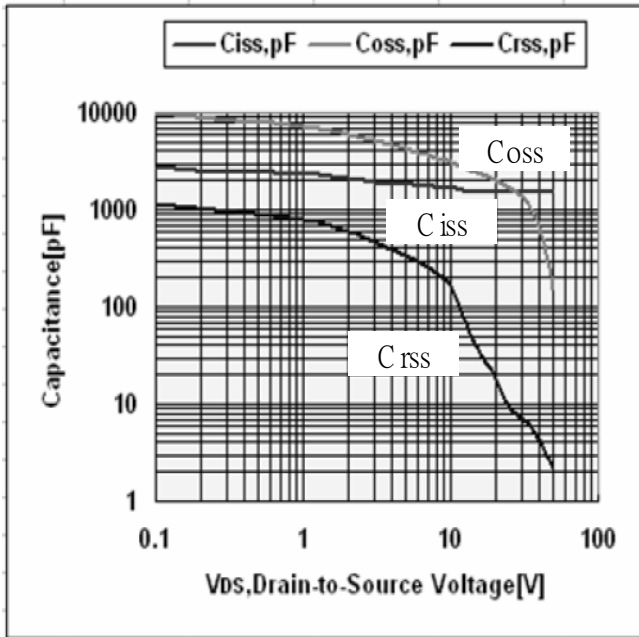


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

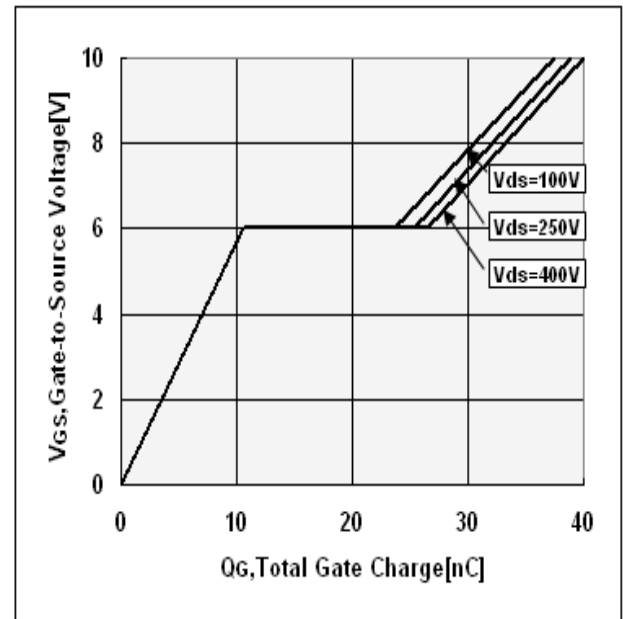
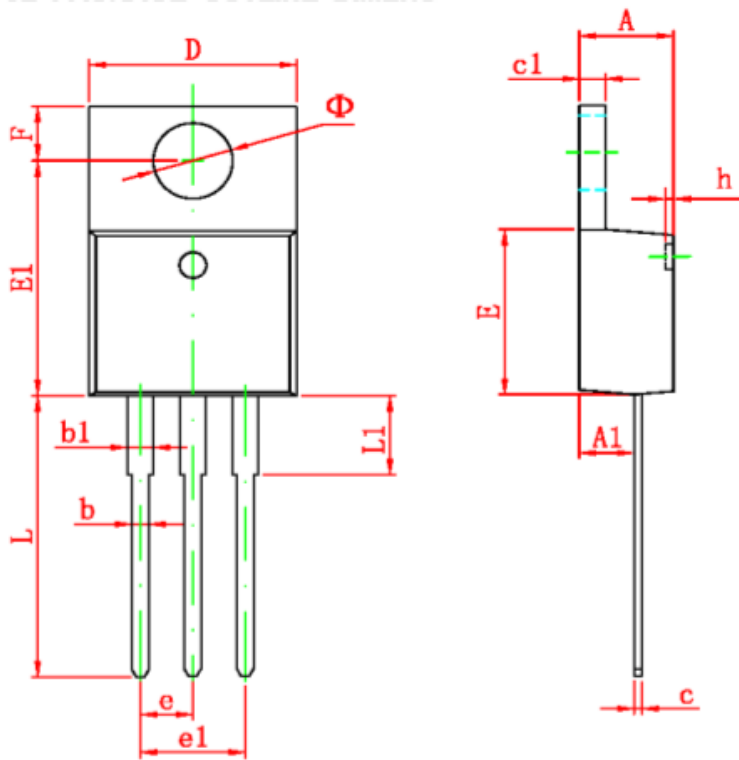


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

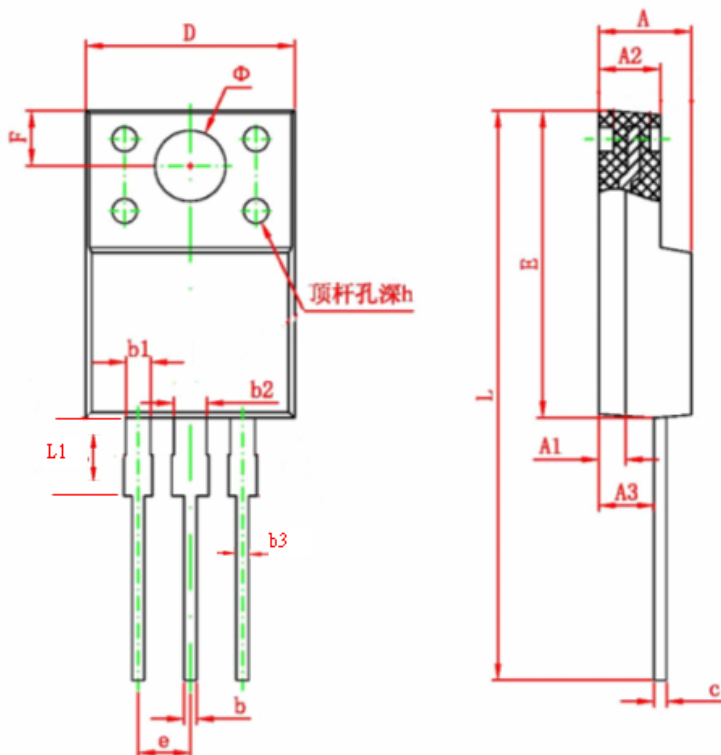
PACKAGE DIMENSION

TO-220



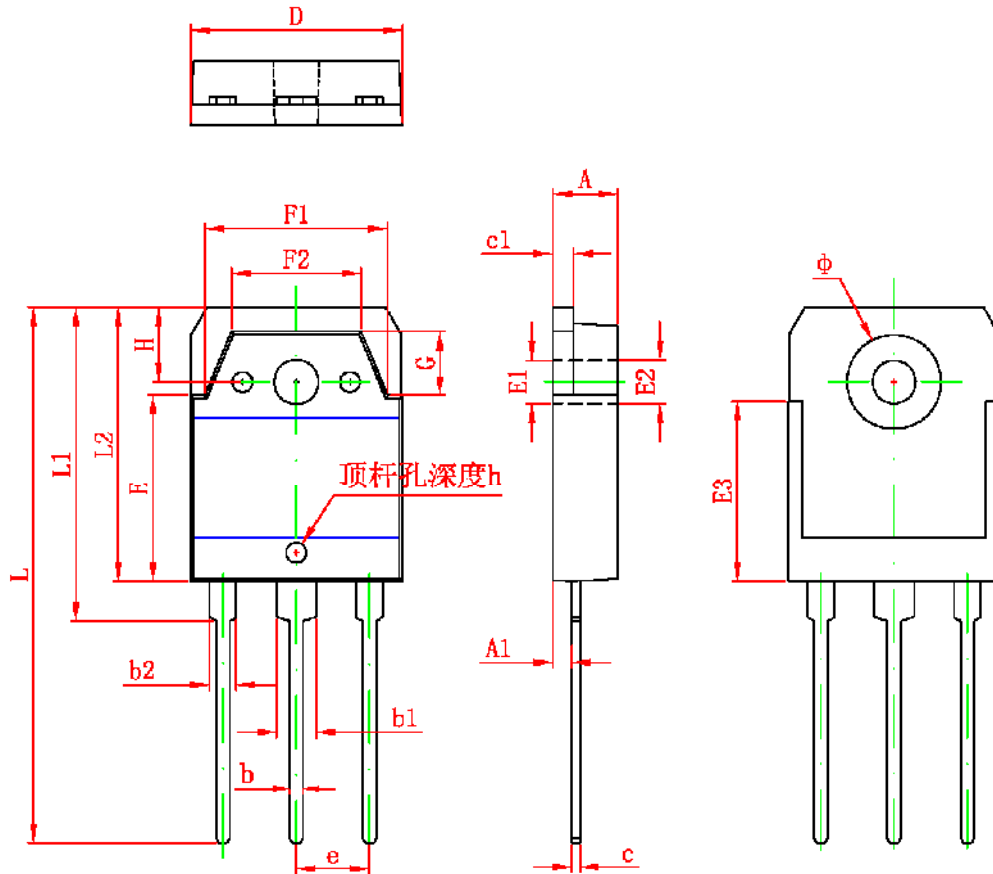
| Symbol | Dimensions In Millimeters | |
|--------|---------------------------|-------|
| | Min. | Max |
| A | 4.40 | 4.80 |
| A1 | 2.10 | 2.84 |
| b | 0.71 | 0.91 |
| b1 | 1.17 | 1.37 |
| c | 0.30 | 0.60 |
| c1 | 1.17 | 1.47 |
| D | 9.40 | 10.60 |
| E | 8.40 | 9.60 |
| e | 2.54 TYP. | |
| e1 | 4.90 | 5.60 |
| F | 3.00 REF. | |
| Φ | 3.50 REF. | |
| h | 0.00 | 0.30 |
| L | 12.50 | 14.00 |
| L1 | 3.50 | 4.00 |

TO-220FP



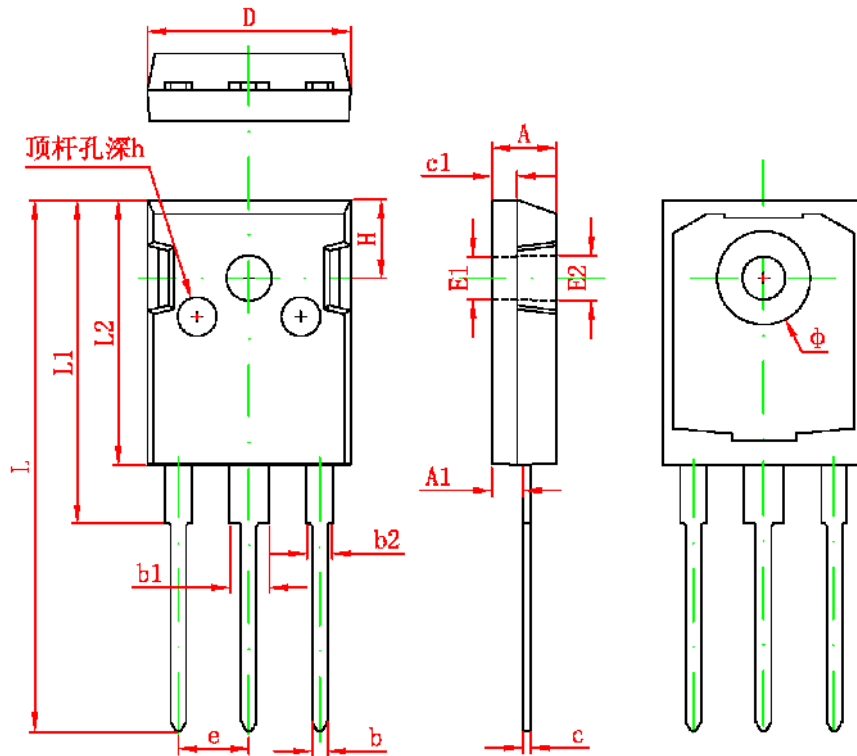
| Symbol | Dimensions In Millimeters | |
|--------|---------------------------|-------|
| | Min. | Max |
| A | 3.80 | 4.70 |
| A1 | 1.3 REF. | |
| A2 | 2.20 | 3.20 |
| A3 | 2.10 | 3.20 |
| b | 0.30 | 0.95 |
| b1 | 1.00 | 1.75 |
| b2 | 1.00 | 1.75 |
| b3 | 0.50 | 0.80 |
| c | 0.30 | 0.90 |
| D | 9.90 | 10.40 |
| E | 14.60 | 16.20 |
| e | 2.54 TYP. | |
| F | 3.00 REF. | |
| Φ | 3.50 REF. | |
| h | 0.00 | 0.30 |
| L | 28.00 | 30.00 |
| L1 | 3.20 | 3.55 |

TO-3P



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 4.600 | 5.000 | 0.181 | 0.197 |
| A1 | 1.200 | 1.600 | 0.047 | 0.063 |
| b | 0.800 | 1.200 | 0.031 | 0.047 |
| b1 | 2.800 | 3.200 | 0.110 | 0.126 |
| b2 | 1.800 | 2.200 | 0.071 | 0.087 |
| c | 0.500 | 0.700 | 0.020 | 0.028 |
| c1 | 1.450 | 1.850 | 0.057 | 0.065 |
| D | 15.450 | 15.850 | 0.606 | 0.622 |
| E | 13.700 | 14.100 | 0.539 | 0.555 |
| E1 | 3.200 REF | | 0.126 REF | |
| E2 | 3.300 REF | | 0.130 REF | |
| E3 | 13.450 REF | | 0.530 REF | |
| F1 | 13.400 | 13.800 | 0.528 | 0.543 |
| F2 | 9.400 | 9.800 | 0.370 | 0.386 |
| L | 39.900 | 40.300 | 1.571 | 1.687 |
| L1 | 23.200 | 23.600 | 0.913 | 0.929 |
| L2 | 20.300 | 20.600 | 0.799 | 0.811 |
| phi | 6.900 | 7.100 | 0.272 | 0.280 |
| G | 5.150 | 5.550 | 0.203 | 0.219 |
| e | 5.450 TYP | | 0.215 TYP | |
| H | 5.000 REF | | 0.197 REF | |
| h | 0.000 | 0.300 | 0.000 | 0.012 |

TO-247



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 4.850 | 5.150 | 0.191 | 0.200 |
| A1 | 2.200 | 2.600 | 0.087 | 0.102 |
| b | 1.000 | 1.400 | 0.039 | 0.055 |
| b1 | 2.800 | 3.200 | 0.110 | 0.126 |
| b2 | 1.800 | 2.200 | 0.071 | 0.087 |
| c | 0.500 | 0.700 | 0.020 | 0.028 |
| c1 | 1.900 | 2.100 | 0.075 | 0.083 |
| D | 15.450 | 15.750 | 0.608 | 0.620 |
| E1 | 3.500 REF | | 0.138 REF | |
| E2 | 3.600 REF | | 0.142 REF | |
| L | 40.900 | 41.300 | 1.610 | 1.626 |
| L1 | 24.800 | 25.100 | 0.976 | 0.988 |
| L2 | 20.300 | 20.600 | 0.799 | 0.811 |
| ϕ | 7.100 | 7.300 | 0.280 | 0.287 |
| e | 5.450 TYP | | 0.215 TYP | |
| H | 5.980 REF | | 0.235 REF | |
| h | 0.000 | 0.300 | 0.000 | 0.012 |

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