

# MDP5N50F / MDF5N50F

## N-Channel MOSFET 500V, 4.5 A, 1.55Ω

### General Description

The MDP5N50F/MDF5N50F use advanced Magnachip's MOSFET Technology, which provides low on-state resistance, high switching performance and excellent quality.

MDP5N50F/MDF5N50F are suitable device for SMPS, HID and general purpose applications.

### Features

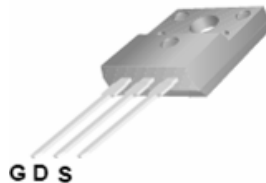
- $V_{DS} = 500V$
- $I_D = 4.5A$  @  $V_{GS} = 10V$
- $R_{DS(ON)} \leq 1.55\Omega$  @  $V_{GS} = 10V$

### Applications

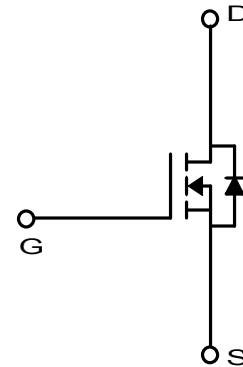
- Power Supply
- PFC
- Ballast



TO-220  
MDP Series



TO-220F  
MDF Series



### Absolute Maximum Ratings ( $T_a = 25^\circ C$ )

| Characteristics                              |                           | Symbol         | MDP5N50F | MDF5N50F | Unit |
|----------------------------------------------|---------------------------|----------------|----------|----------|------|
| Drain-Source Voltage                         |                           | $V_{DSS}$      | 500      |          | V    |
| Gate-Source Voltage                          |                           | $V_{GSS}$      | $\pm 30$ |          | V    |
| Continuous Drain Current                     | $T_C = 25^\circ C$        | $I_D$          | 4.5      | 4.5*     | A    |
|                                              | $T_C = 100^\circ C$       |                | 2.8      | 2.8*     | A    |
| Pulsed Drain Current <sup>(1)</sup>          |                           | $I_{DM}$       | 18       | 18*      | A    |
| Power Dissipation                            | $T_C = 25^\circ C$        | $P_D$          | 93       | 27       | W    |
|                                              | Derate above $25^\circ C$ |                | 0.74     | 0.22     | W/°C |
| Repetitive Avalanche Energy <sup>(1)</sup>   |                           | $E_{AR}$       | 93       |          | mJ   |
| Peak Diode Recovery $dv/dt$ <sup>(3)</sup>   |                           | $dv/dt$        | 4.5      |          | V/ns |
| Single Pulse Avalanche Energy <sup>(4)</sup> |                           | $E_{AS}$       | 230      |          | mJ   |
| Junction and Storage Temperature Range       |                           | $T_J, T_{stg}$ | -55~150  |          | °C   |

\*  $I_D$  limited by maximum junction temperature

### Thermal Characteristics

| Characteristics                                        | Symbol          | MDP5N50F | MDF5N50F | Unit |
|--------------------------------------------------------|-----------------|----------|----------|------|
| Thermal Resistance, Junction-to-Ambient <sup>(1)</sup> | $R_{\theta JA}$ | 62.5     | 62.5     | °C/W |
| Thermal Resistance, Junction-to-Case <sup>(1)</sup>    | $R_{\theta JC}$ | 1.35     | 4.6      |      |

## Ordering Information

| Part Number | Temp. Range | Package | Packing | RoHS Status  |
|-------------|-------------|---------|---------|--------------|
| MDP5N50FTH  | -55~150°C   | TO-220  | Tube    | Halogen Free |
| MDF5N50FTH  | -55~150°C   | TO-220F | Tube    | Halogen Free |

## Electrical Characteristics (Ta =25°C)

| Characteristics                                          | Symbol       | Test Condition                                                  | Min | Typ  | Max   | Unit     |
|----------------------------------------------------------|--------------|-----------------------------------------------------------------|-----|------|-------|----------|
| Static Characteristics                                   |              |                                                                 |     |      |       |          |
| Drain-Source Breakdown Voltage                           | $BV_{DSS}$   | $I_D = 250\mu A, V_{GS} = 0V$                                   | 500 | -    | -     | V        |
| Gate Threshold Voltage                                   | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\mu A$                               | 2.5 | -    | 4.5   |          |
| Drain Cut-Off Current                                    | $I_{DSS}$    | $V_{DS} = 500V, V_{GS} = 0V$                                    | -   | -    | 10    | $\mu A$  |
| Gate Leakage Current                                     | $I_{GSS}$    | $V_{GS} = \pm 20V, V_{DS} = 0V$                                 | -   | -    | 100   | $\mu A$  |
| Drain-Source ON Resistance                               | $R_{DS(ON)}$ | $V_{GS} = 10V, I_D = 2.5A$                                      |     | 1.25 | 1.55  | $\Omega$ |
| Forward Transconductance                                 | $g_{fs}$     | $V_{DS} = 30V, I_D = 2.5A$                                      | -   | 3.3  | -     | S        |
| Dynamic Characteristics                                  |              |                                                                 |     |      |       |          |
| Total Gate Charge                                        | $Q_g$        | $V_{DS} = 500V, I_D = 5.0A, V_{GS} = 10V^{(3)}$                 | -   | 12.1 | 15.73 | nC       |
| Gate-Source Charge                                       | $Q_{gs}$     |                                                                 | -   | 3.6  | -     |          |
| Gate-Drain Charge                                        | $Q_{gd}$     |                                                                 | -   | 4.3  | -     |          |
| Input Capacitance                                        | $C_{iss}$    | $V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz$                         | -   | 500  | 650   | pF       |
| Reverse Transfer Capacitance                             | $C_{rss}$    |                                                                 | -   | 1.5  | 2.25  |          |
| Output Capacitance                                       | $C_{oss}$    |                                                                 | -   | 65   | 84.5  |          |
| Turn-On Delay Time                                       | $t_{d(on)}$  | $V_{GS} = 10V, V_{DS} = 250V, I_D = 5.0A, R_G = 25\Omega^{(3)}$ | -   | 23   | 48.3  | ns       |
| Rise Time                                                | $t_r$        |                                                                 | -   | 30   | 60    |          |
| Turn-Off Delay Time                                      | $t_{d(off)}$ |                                                                 | -   | 37   | 77.7  |          |
| Fall Time                                                | $t_f$        |                                                                 | -   | 29   | 60.9  |          |
| Drain-Source Body Diode Characteristics                  |              |                                                                 |     |      |       |          |
| Maximum Continuous Drain to Source Diode Forward Current | $I_S$        |                                                                 | -   | 4.5  | -     | A        |
| Source-Drain Diode Forward Voltage                       | $V_{SD}$     | $I_S = 5.0A, V_{GS} = 0V$                                       | -   |      | 1.4   | V        |
| Body Diode Reverse Recovery Time                         | $t_{rr}$     | $I_F = 5.0A, di/dt = 100A/\mu s^{(3)}$                          | -   | 80   |       | ns       |
| Body Diode Reverse Recovery Charge                       | $Q_{rr}$     |                                                                 | -   | 1.6  |       | $\mu C$  |

Note :

1. Pulse width is based on R  $\theta_{JC}$  & R  $\theta_{JA}$  and the maximum allowed junction temperature of 150°C.
2. Pulse test: pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$ , pulse width limited by junction temperature  $T_J(MAX)=150^\circ C$ .
3.  $I_{SD} \leq 4.5A$ ,  $di/dt \leq 200A/\mu s$ ,  $V_{DD}=50V$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ C$
4.  $L=20.5mH$ ,  $I_{AS}=4.5A$ ,  $V_{DD}=50V$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ C$

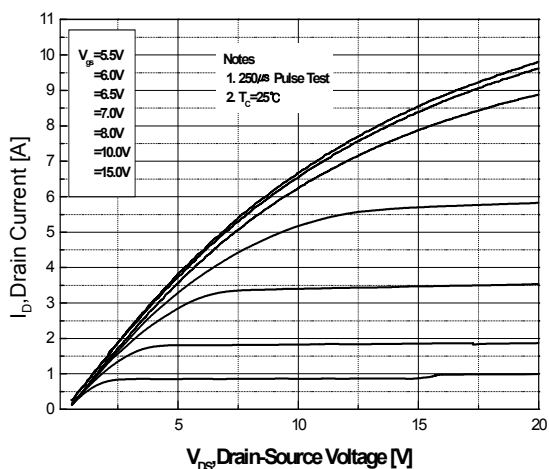


Fig.1 On-Region Characteristics

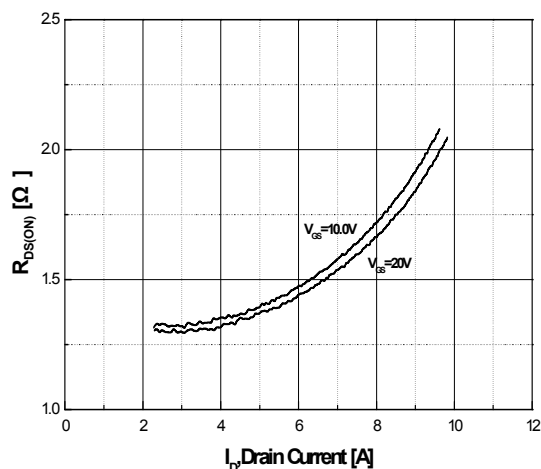


Fig.2 On-Resistance Variation with Drain Current and Gate Voltage

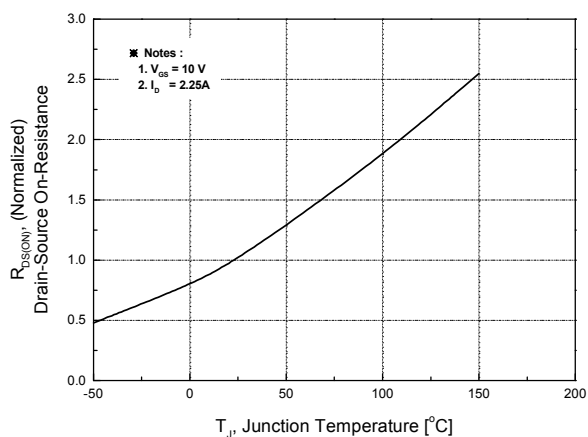


Fig.3 On-Resistance Variation with Temperature

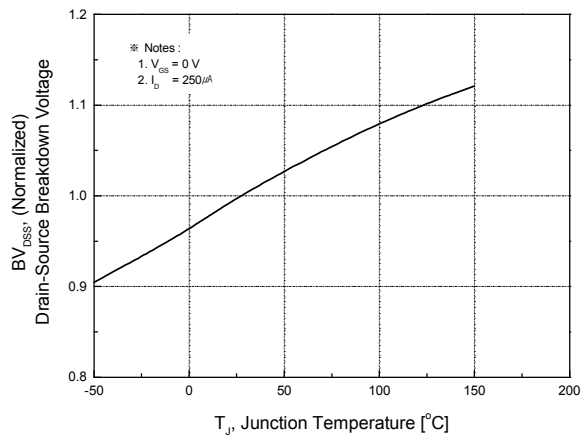


Fig.4 Breakdown Voltage Variation vs. Temperature

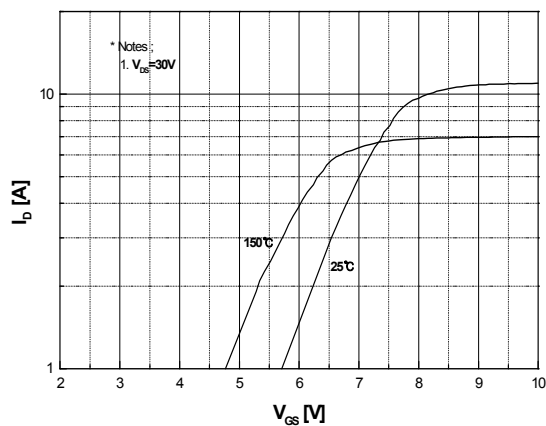


Fig.5 Transfer Characteristics

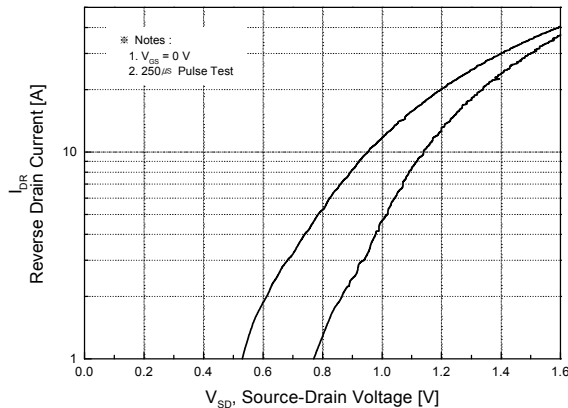


Fig.6 Body Diode Forward Voltage Variation with Source Current and Temperature

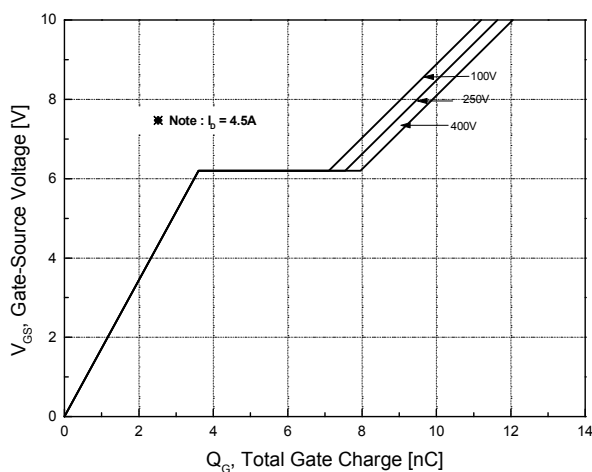


Fig.7 Gate Charge Characteristics

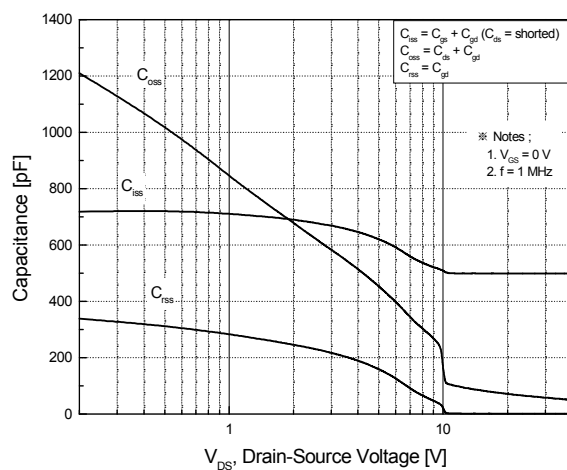


Fig.8 Capacitance Characteristics

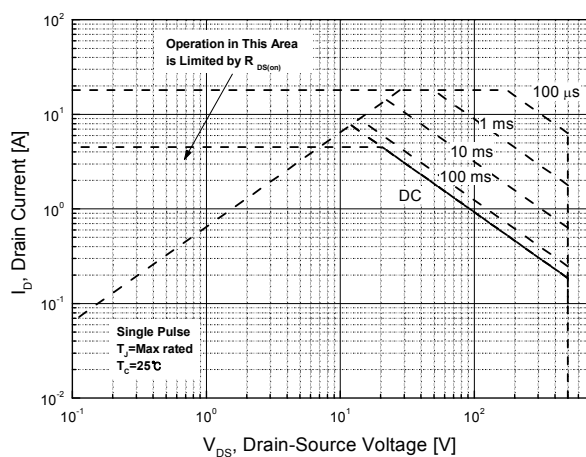
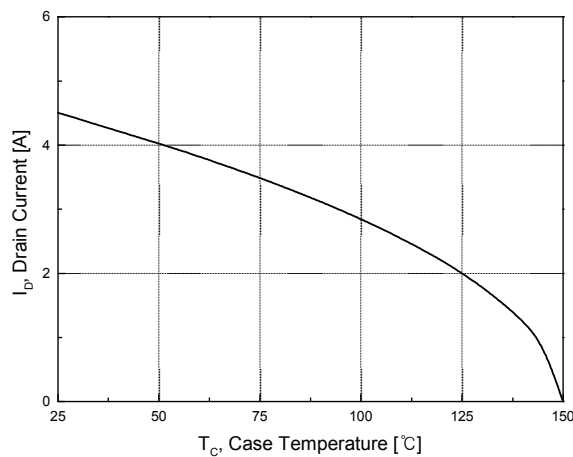
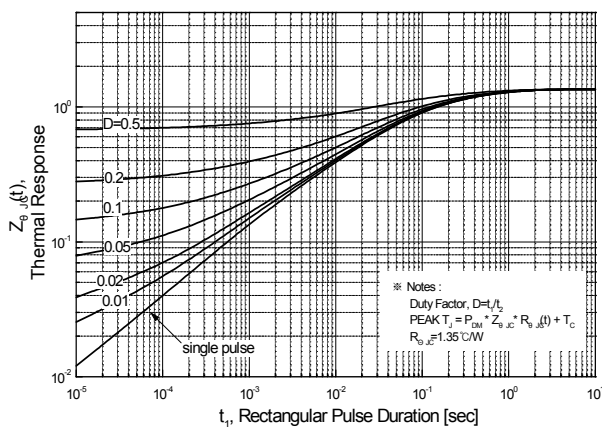
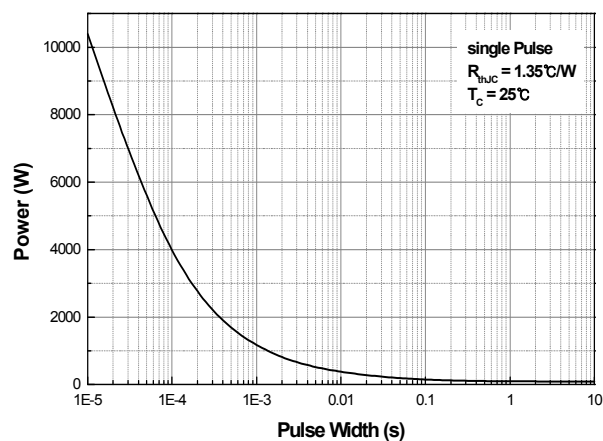
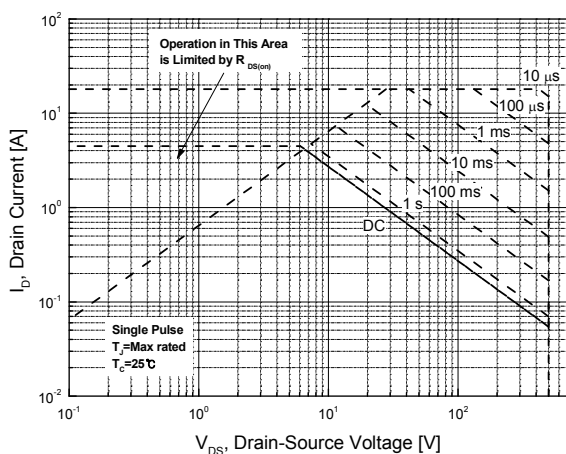
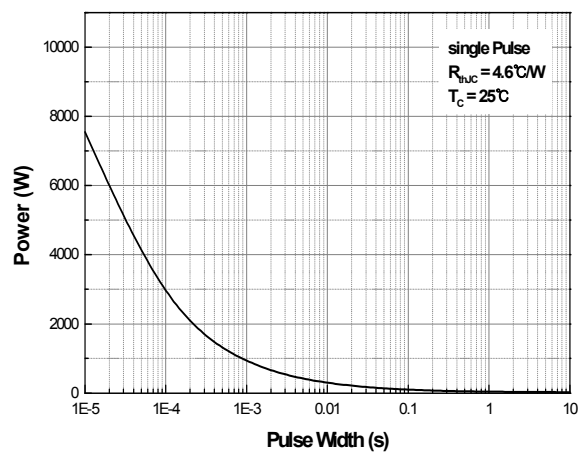
Fig.9 Maximum Safe Operating Area  
MDP5N50F (TO-220)

Fig.10 Maximum Drain Current vs. Case Temperature

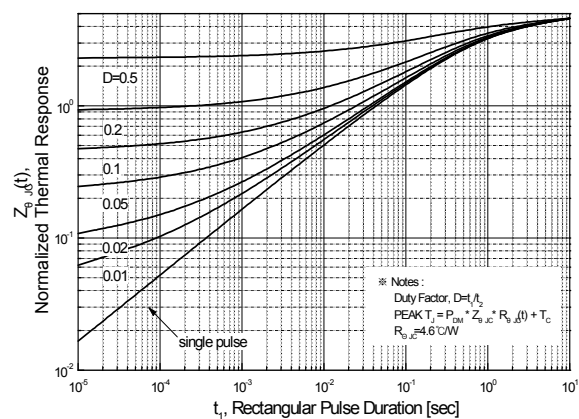
Fig.11 Transient Thermal Response Curve  
MDP5N50F (TO-220)Fig.12 Single Pulse Maximum Power  
Dissipation – MDP5N50F (TO-220)



**Fig.13 Maximum Safe Operating Area  
MDF5N50F (TO-220F)**



**Fig.12 Single Pulse Maximum Power  
Dissipation- MDF5N50F (TO-220F)**



**Fig.11 Transient Thermal Response Curve  
MDF5N50F (TO-220F)**

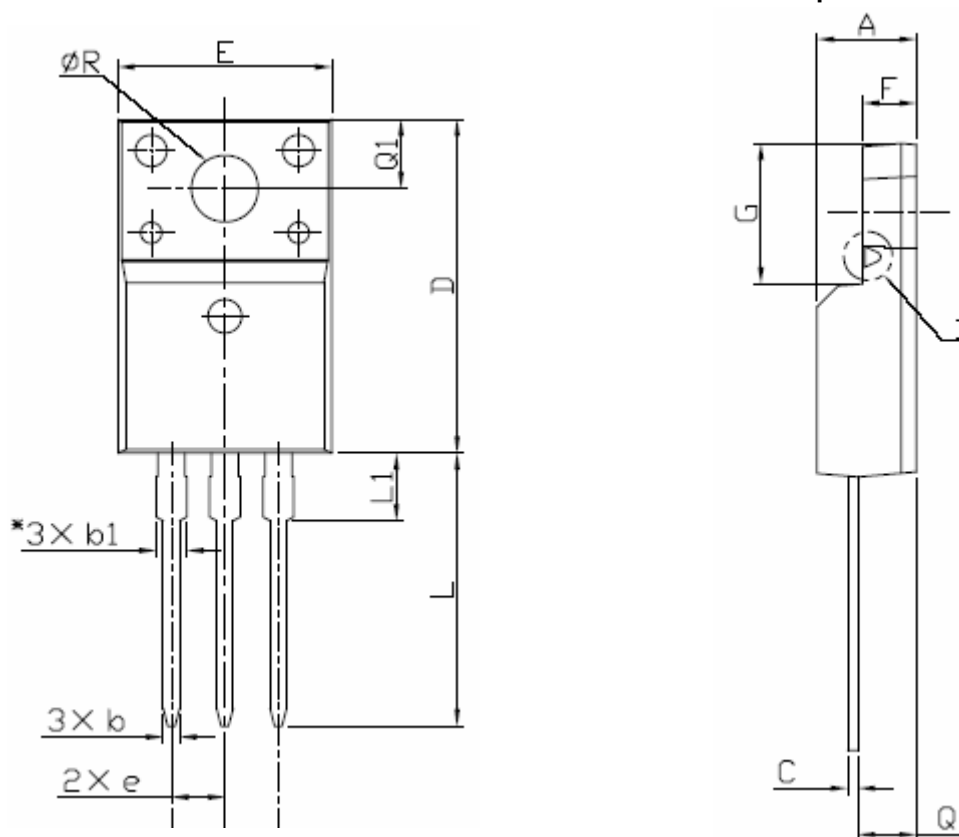
Technical drawing of a 3-pin connector. The drawing includes three views: a front view (left), a side view (middle), and a top view (right). Dimensions are provided in inches (top) and millimeters (bottom) for each feature.

- Front View (Left):**
  - Overall width: 10.67 in (271 mm)
  - Pin spacing (1-2): 2.54 in (64 mm)
  - Pin spacing (2-3): 2.54 in (64 mm)
  - Pin spacing (1-3): 5.08 in (128 mm)
  - Pin diameter:  $\phi 1.09$  in (27.5 mm)
  - Pin length: 6.35 in (161 mm) MAX
  - Pin 1 length: 1.78 in (45 mm)
  - Pin 2 length: 1.02 in (26 mm)
  - Pin 3 length: 1.14 in (29 mm)
  - Pin 1 offset: 1.91 in (48 mm)
  - Pin 2 offset: 2.54 in (64 mm)
  - Pin 3 offset: 3.08 in (78 mm)
  - Pin 1 offset (bottom): 1.73 in (44 mm)
  - Pin 2 offset (bottom): 2.70 in (69 mm)
  - Pin 3 offset (bottom): 1.02 in (26 mm)
  - Pin 1 offset (bottom): 0.38 in (9.5 mm)
  - Pin 2 offset (bottom): 0.38 in (9.5 mm)
  - Pin 3 offset (bottom): 0.38 in (9.5 mm)
  - Pin 1 offset (bottom): 0.38 in (9.5 mm)
  - Pin 2 offset (bottom): 0.38 in (9.5 mm)
  - Pin 3 offset (bottom): 0.38 in (9.5 mm)
  - Pin 1 offset (bottom): 0.38 in (9.5 mm)
  - Pin 2 offset (bottom): 0.38 in (9.5 mm)
  - Pin 3 offset (bottom): 0.38 in (9.5 mm)
- Side View (Middle):**
  - Overall height: 4.83 in (123 mm)
  - Pin 1 height: 1.40 in (35 mm)
  - Pin 2 height: 6.86 in (174 mm)
  - Pin 3 height: 5.84 in (148 mm)
  - Pin 1 offset: 0.61 in (15 mm)
  - Pin 2 offset: 0.33 in (8.4 mm)
  - Pin 3 offset: 2.92 in (74 mm)
  - Pin 1 offset (bottom): 2.03 in (51 mm)
  - Pin 2 offset (bottom): 2.03 in (51 mm)
  - Pin 3 offset (bottom): 2.03 in (51 mm)
- Top View (Right):**
  - Overall width: 8.89 in (226 mm)
  - Pin spacing (1-2): 2.54 in (64 mm)
  - Pin spacing (2-3): 2.54 in (64 mm)
  - Pin spacing (1-3): 5.08 in (128 mm)
  - Pin 1 length: 13.40 in (340 mm)
  - Pin 2 length: 12.18 in (309 mm)
  - Pin 3 length: 12.18 in (309 mm)

## Physical Dimensions

## 3 Leads, TO-220F

Dimensions are in millimeters unless otherwise specified



| Symbol | Min   | Nom  | Max   |
|--------|-------|------|-------|
| A      | 4.50  |      | 4.93  |
| b      | 0.63  |      | 0.91  |
| b1     | 1.15  |      | 1.47  |
| C      | 0.33  |      | 0.63  |
| D      | 15.47 |      | 16.13 |
| E      | 9.60  |      | 10.71 |
| e      |       | 2.54 |       |
| F      | 2.34  |      | 2.84  |
| G      | 6.48  |      | 6.90  |
| L      | 12.24 |      | 13.72 |
| L1     | 2.79  |      | 3.67  |
| Q      | 2.52  |      | 2.96  |
| Q1     | 3.10  |      | 3.50  |
| ØR     | 3.00  |      | 3.55  |