

### GENERAL DESCRIPTION

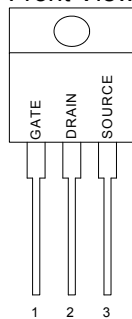
This advanced high voltage MOSFET is designed to withstand high energy in the avalanche mode and switch efficiently. This new high energy device also offers a drain-to-source diode with fast recovery time. Designed for high voltage, high speed switching applications such as power supplies, converters, power motor controls and bridge circuits.

### FEATURES

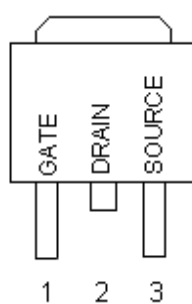
- ◆ Higher Current Rating
- ◆ Lower  $R_{ds(on)}$
- ◆ Lower Capacitances
- ◆ Lower Total Gate Charge
- ◆ Tighter VSD Specifications
- ◆ Avalanche Energy Specified

### PIN CONFIGURATION

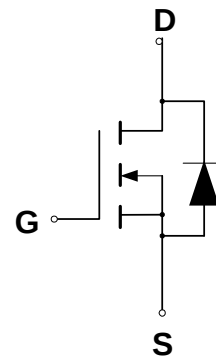
TO-220/TO-220FP  
Front View



TO-252  
Front View



### SYMBOL



N-Channel MOSFET

### ABSOLUTE MAXIMUM RATINGS

| Rating                                                                                                                                                                                      | Symbol         | Value      | Unit                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------|-----------------------------|
| Drain to Current — Continuous                                                                                                                                                               | $I_D$          | 4.0        | A                           |
| — Pulsed                                                                                                                                                                                    | $I_{DM}$       | 14         |                             |
| Gate-to-Source Voltage — Continue                                                                                                                                                           | $V_{GS}$       | $\pm 30$   | V                           |
| — Non-repetitive                                                                                                                                                                            | $V_{GSM}$      | $\pm 40$   | V                           |
| Total Power Dissipation                                                                                                                                                                     | $P_D$          |            | W                           |
| TO-220                                                                                                                                                                                      |                | 83         |                             |
| TO-220FP                                                                                                                                                                                    |                | 30         |                             |
| Operating and Storage Temperature Range                                                                                                                                                     | $T_J, T_{STG}$ | -55 to 150 | $^{\circ}\text{C}$          |
| Single Pulse Drain-to-Source Avalanche Energy — $T_J = 25^{\circ}\text{C}$<br>( $V_{DD} = 100\text{V}$ , $V_{GS} = 10\text{V}$ , $I_L = 4\text{A}$ , $L = 10\text{mH}$ , $R_G = 25\Omega$ ) | $E_{AS}$       | 80         | mJ                          |
| Thermal Resistance — Junction to Case                                                                                                                                                       | $\theta_{JC}$  | 1.30       | $^{\circ}\text{C}/\text{W}$ |
| — Junction to Ambient                                                                                                                                                                       | $\theta_{JA}$  | 100        |                             |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds                                                                                                              | $T_L$          | 260        | $^{\circ}\text{C}$          |

### ORDERING INFORMATION

| Part Number      | Package             |
|------------------|---------------------|
| CMT04N60GN220*   | TO-220              |
| CMT04N60XN220*   | TO-220              |
| CMT04N60GN220FP* | TO-220 Full Package |
| CMT04N60XN220FP* | TO-220 Full Package |
| CMT04N60GN252*   | TO-252              |
| CMT04N60XN252*   | TO-252              |

\*Note: G : Suffix for Pb Free Product

X : Suffix for Halogen and Pb Free Product

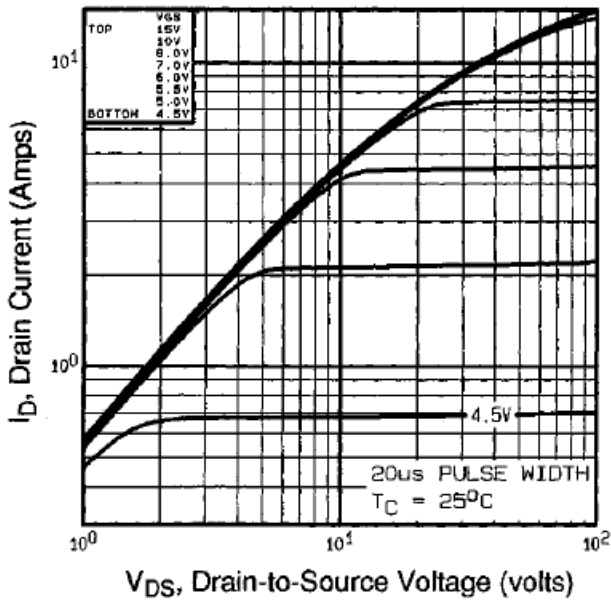
### ELECTRICAL CHARACTERISTICS (Unless otherwise specified, $T_J = 25^{\circ}\text{C}$ .)

|                                                                                                 |                                                                                                        | CMT04N60     |     |     |               |
|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|--------------|-----|-----|---------------|
| Characteristic                                                                                  | Symbol                                                                                                 | Min          | Typ | Max | Units         |
| Drain-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$ )    | $V_{(BR)DSS}$                                                                                          | 600          |     |     | V             |
| Drain-Source Leakage Current<br>( $V_{DS} = 600\text{ V}$ , $V_{GS} = 0\text{ V}$ )             | $I_{DSS}$                                                                                              |              |     | 1   | $\mu\text{A}$ |
| Gate-Source Leakage Current-Forward<br>( $V_{gsf} = 30\text{ V}$ , $V_{DS} = 0\text{ V}$ )      | $I_{GSSF}$                                                                                             |              |     | 100 | nA            |
| Gate-Source Leakage Current-Reverse<br>( $V_{gsr} = -30\text{ V}$ , $V_{DS} = 0\text{ V}$ )     | $I_{GSSR}$                                                                                             |              |     | 100 | nA            |
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$ )                | $V_{GS(th)}$                                                                                           | 2.0          |     | 4.0 | V             |
| Static Drain-Source On-Resistance ( $V_{GS} = 10\text{ V}$ , $I_D = 2.0\text{ A}$ ) *           | $R_{DS(on)}$                                                                                           |              |     | 2.2 | $\Omega$      |
| Forward Transconductance ( $V_{DS} = 50\text{ V}$ , $I_D = 2.0\text{ A}$ ) *                    | $g_{FS}$                                                                                               | 2.5          |     |     | mhos          |
| Input Capacitance                                                                               | $(V_{DS} = 25\text{ V}$ , $V_{GS} = 0\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ )                            | $C_{iss}$    | 540 | 760 | pF            |
| Output Capacitance                                                                              |                                                                                                        | $C_{oss}$    | 125 | 180 | pF            |
| Reverse Transfer Capacitance                                                                    |                                                                                                        | $C_{rss}$    | 8.0 | 20  | pF            |
| Turn-On Delay Time                                                                              | $(V_{DD} = 300\text{ V}$ , $I_D = 4.0\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ ,<br>$R_G = 9.1\Omega$ ) * | $t_{d(on)}$  | 12  | 20  | ns            |
| Rise Time                                                                                       |                                                                                                        | $t_r$        | 7.0 | 10  | ns            |
| Turn-Off Delay Time                                                                             |                                                                                                        | $t_{d(off)}$ | 19  | 40  | ns            |
| Fall Time                                                                                       |                                                                                                        | $t_f$        | 10  | 20  | ns            |
| Total Gate Charge                                                                               | $(V_{DS} = 480\text{ V}$ , $I_D = 4.0\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ ) *                        | $Q_g$        | 5.0 | 10  | nC            |
| Gate-Source Charge                                                                              |                                                                                                        | $Q_{gs}$     | 2.7 |     | nC            |
| Gate-Drain Charge                                                                               |                                                                                                        | $Q_{gd}$     | 2.0 |     | nC            |
| Internal Drain Inductance<br>(Measured from the drain lead 0.25" from package to center of die) | $L_D$                                                                                                  |              | 4.5 |     | nH            |
| Internal Drain Inductance (Measured from the source lead 0.25" from package to source bond pad) | $L_S$                                                                                                  |              | 7.5 |     | nH            |
| <b>SOURCE-DRAIN DIODE CHARACTERISTICS</b>                                                       |                                                                                                        |              |     |     |               |
| Forward On-Voltage(1)                                                                           | $(I_S = 4.0\text{ A}$ ,<br>$d_iS/d_t = 100\text{ A}/\mu\text{s}$ )                                     | $V_{SD}$     |     | 1.5 | V             |
| Forward Turn-On Time                                                                            |                                                                                                        | $t_{on}$     | **  |     | ns            |
| Reverse Recovery Time                                                                           |                                                                                                        | $t_{rr}$     | 655 |     | ns            |

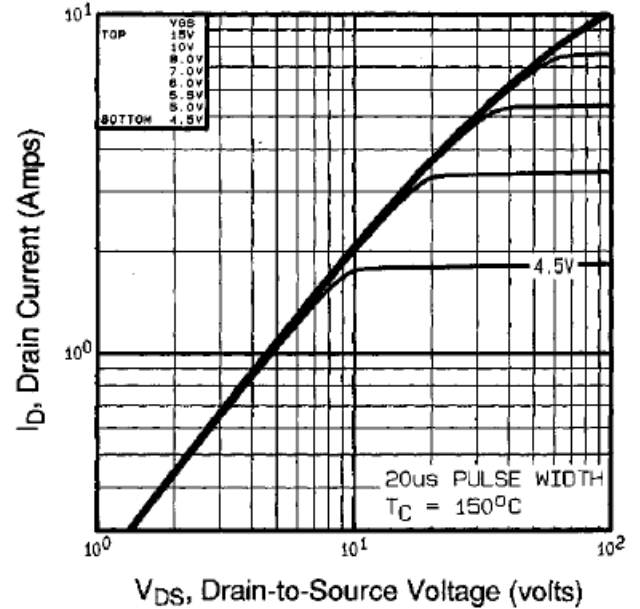
\* Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$

\*\* Negligible, Dominated by circuit inductance

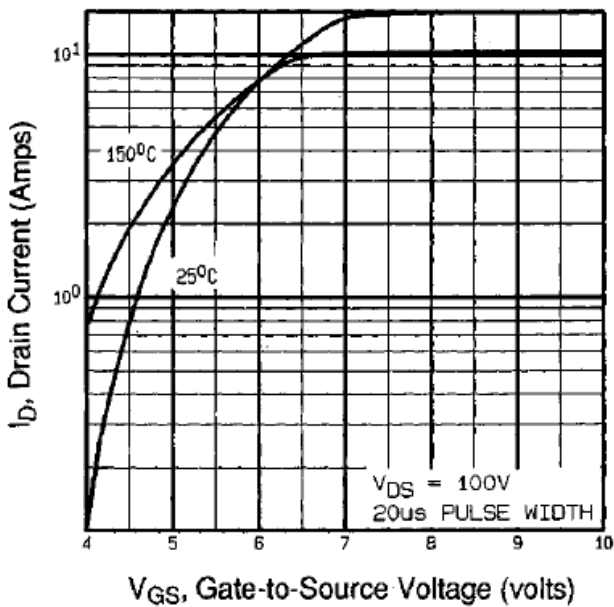
### TYPICAL CHARACTERISTICS



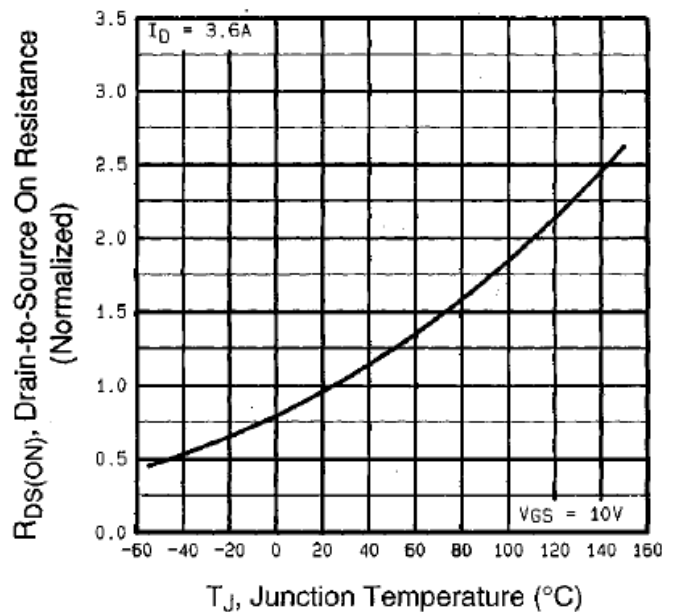
**Fig 1.** Typical Output Characteristics,  
 $T_C = 25^\circ\text{C}$



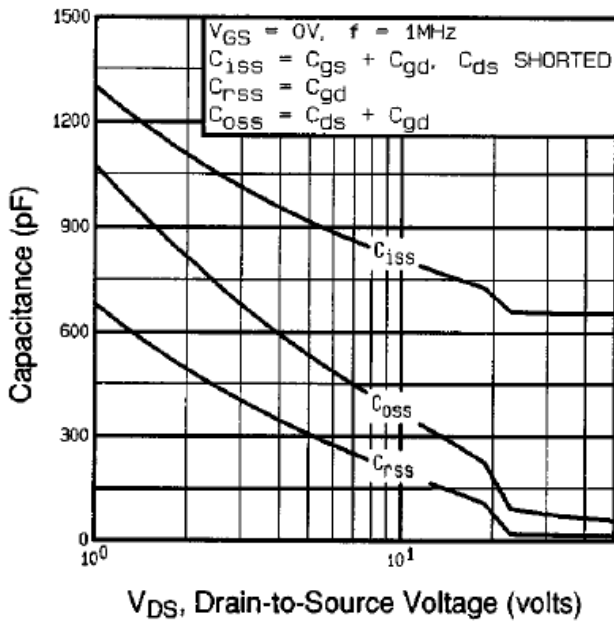
**Fig 2.** Typical Output Characteristics,  
 $T_C = 150^\circ\text{C}$



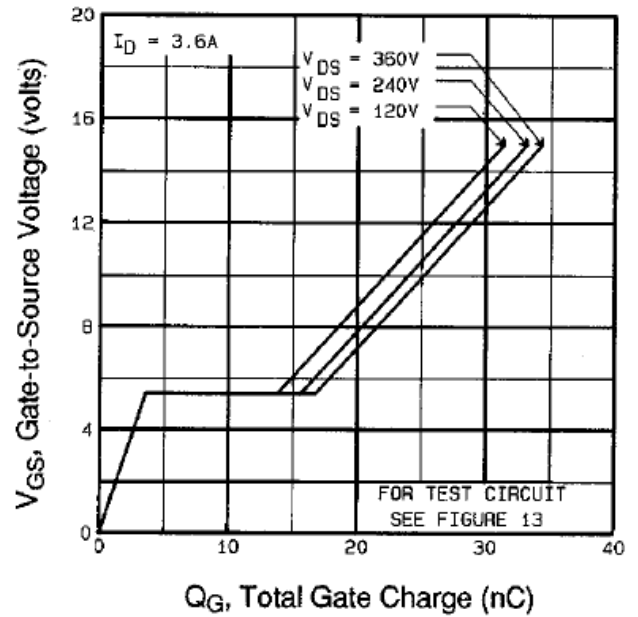
**Fig 3.** Typical Transfer Characteristics



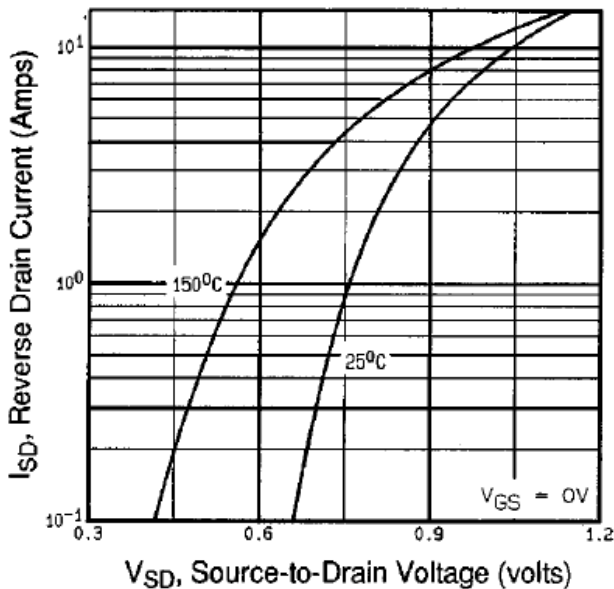
**Fig 4.** Normalized On-Resistance  
Vs. Temperature



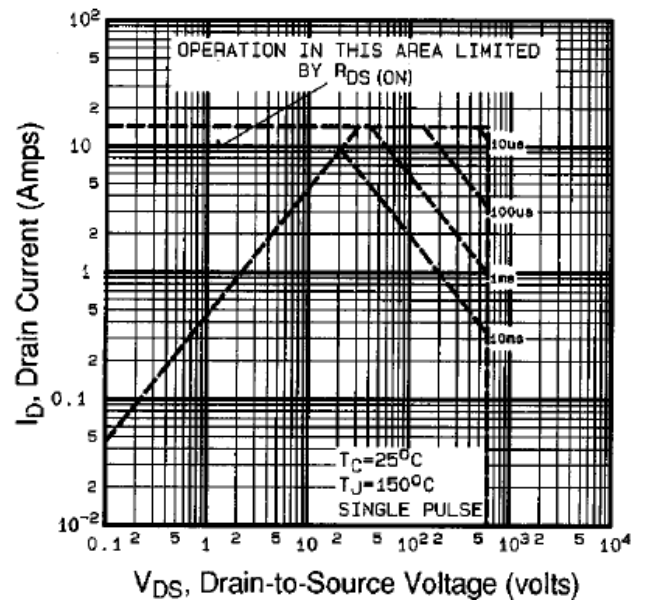
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



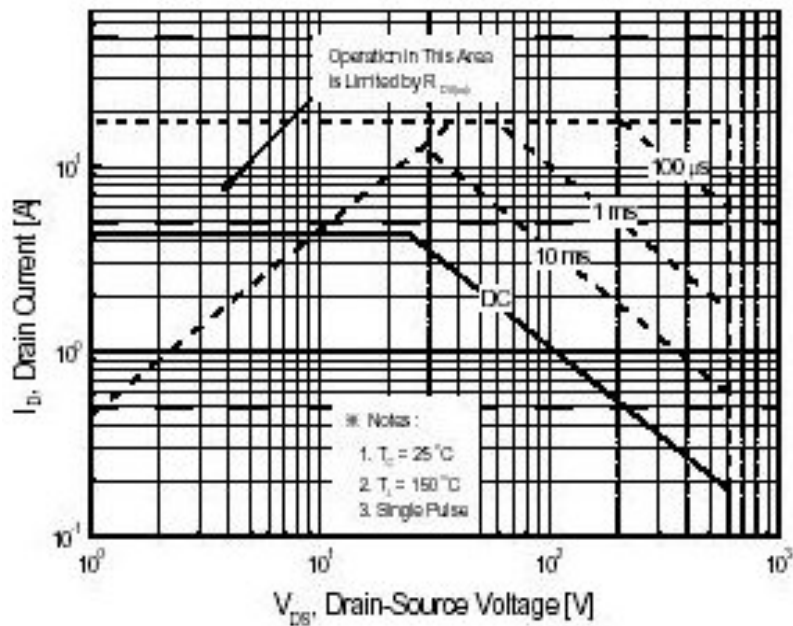
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



**Fig 7.** Typical Source-Drain Diode Forward Voltage

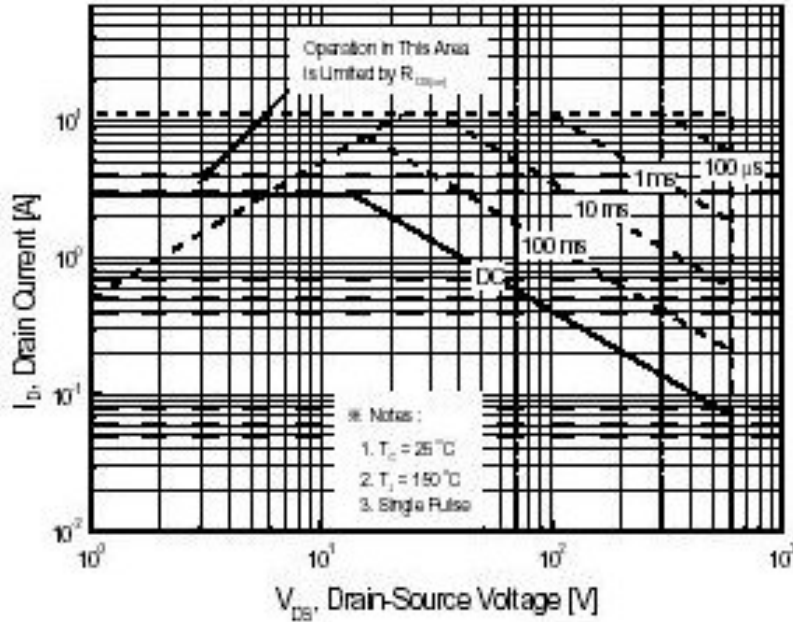


**Fig 8.** Maximum Safe Operating Area



### Maximum Safe Operating Area

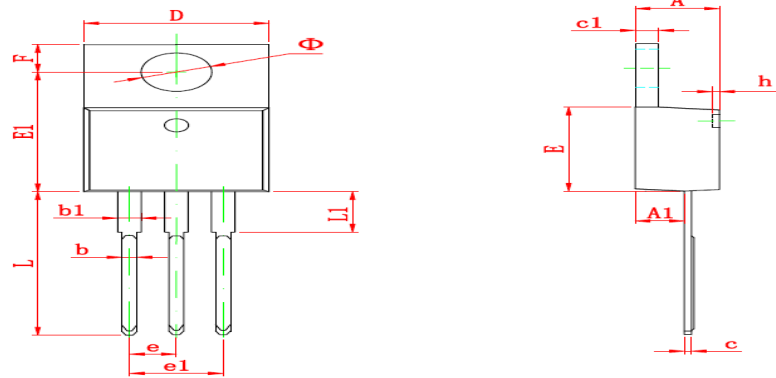
TO-220



### Maximum Safe Operating Area

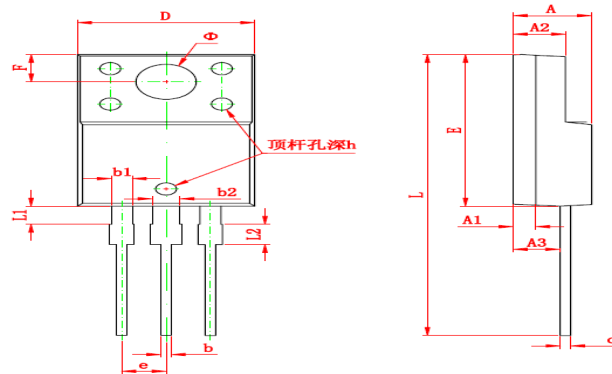
### PACKAGE DIMENSION

#### TO-220

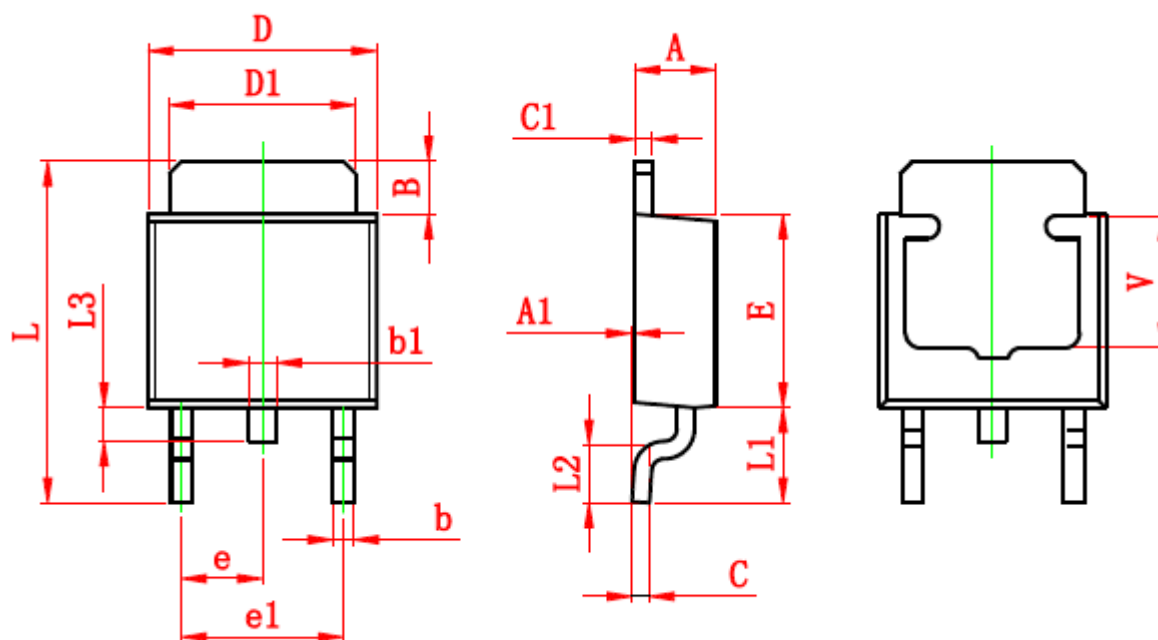


| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min                       | Max    | Min                  | Max   |
| A      | 4.470                     | 4.670  | 0.176                | 0.184 |
| A1     | 2.520                     | 2.820  | 0.099                | 0.111 |
| b      | 0.710                     | 0.910  | 0.028                | 0.036 |
| b1     | 1.170                     | 1.370  | 0.046                | 0.054 |
| c      | 0.310                     | 0.530  | 0.012                | 0.021 |
| c1     | 1.170                     | 1.370  | 0.046                | 0.054 |
| D      | 10.010                    | 10.310 | 0.394                | 0.406 |
| E      | 8.500                     | 8.900  | 0.335                | 0.350 |
| E1     | 12.060                    | 12.460 | 0.475                | 0.491 |
| e      | 2.540 TYP                 |        | 0.100 TYP            |       |
| e1     | 4.980                     | 5.180  | 0.196                | 0.204 |
| F      | 2.590                     | 2.890  | 0.102                | 0.114 |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| L      | 13.400                    | 13.800 | 0.528                | 0.543 |
| L1     | 3.560                     | 3.960  | 0.140                | 0.156 |
| Φ      | 3.735                     | 3.935  | 0.147                | 0.155 |

#### TO-220FP



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min                       | Max    | Min                  | Max   |
| A      | 4.300                     | 4.700  | 0.169                | 0.185 |
| A1     | 1.300 REF                 |        | 0.051 REF            |       |
| A2     | 2.800                     | 3.200  | 0.110                | 0.126 |
| A3     | 2.500                     | 2.900  | 0.098                | 0.114 |
| b      | 0.500                     | 0.750  | 0.020                | 0.030 |
| b1     | 1.100                     | 1.350  | 0.043                | 0.053 |
| b2     | 1.500                     | 1.750  | 0.059                | 0.069 |
| c      | 0.500                     | 0.750  | 0.020                | 0.030 |
| D      | 9.960                     | 10.360 | 0.392                | 0.408 |
| E      | 14.800                    | 15.200 | 0.583                | 0.598 |
| e      | 2.540 TYP                 |        | 0.100 TYP            |       |
| e1     | 2.700 REF                 |        | 0.106 REF            |       |
| Φ      | 3.500 REF                 |        | 0.138 REF            |       |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| L      | 28.000                    | 28.400 | 1.102                | 1.118 |
| L1     | 1.700                     | 1.900  | 0.067                | 0.075 |
| L2     | 1.900                     | 2.100  | 0.075                | 0.083 |

**TO-252**


| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 2.200                     | 2.400 | 0.087                | 0.094 |
| A1     | 0.000                     | 0.127 | 0.000                | 0.005 |
| B      | 1.350                     | 1.650 | 0.053                | 0.065 |
| b      | 0.500                     | 0.700 | 0.020                | 0.028 |
| b1     | 0.700                     | 0.900 | 0.028                | 0.035 |
| c      | 0.430                     | 0.580 | 0.017                | 0.023 |
| c1     | 0.430                     | 0.580 | 0.017                | 0.023 |
| D      | 6.350                     | 6.650 | 0.250                | 0.262 |
| D1     | 5.200                     | 5.400 | 0.205                | 0.213 |
| E      | 5.400                     | 5.700 | 0.213                | 0.224 |
| e      | 2.300 TYP.                |       | 0.091 TYP.           |       |
| e1     | 4.500                     | 4.700 | 0.177                | 0.185 |
| L      | 9.500                     | 9.900 | 0.374                | 0.390 |
| L1     | 2.550                     | 2.900 | 0.100                | 0.114 |
| L2     | 1.400                     | 1.780 | 0.055                | 0.070 |
| L3     | 0.600                     | 0.900 | 0.024                | 0.035 |
| V      | 3.800 REF.                |       | 0.150 REF.           |       |

## IMPORTANT NOTICE

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