

N-Channel Power MOSFET (5A, 600Volts)

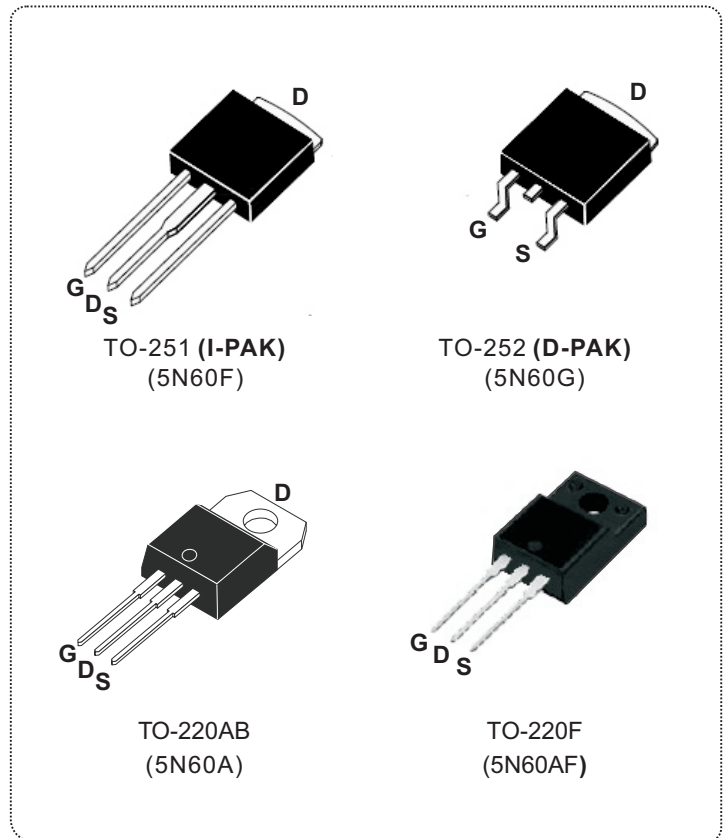
DESCRIPTION

The Nell **5N60** is a three-terminal silicon device with current conduction capability of 5A, fast switching speed, low on-state resistance, breakdown voltage rating of 600V, and max. threshold voltage of 4 volts.

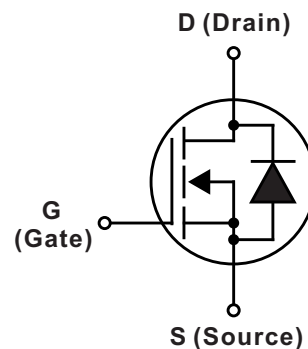
They are designed for use in applications such as switched mode power supplies, DC to DC converters, **PWM** motor controls, bridge circuits and general purpose switching applications.

FEATURES

- $R_{DS(ON)} = 2.2\Omega @ V_{GS} = 10V$
- Ultra low gate charge (20nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 6.5pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



| PRODUCT SUMMARY | |
|---------------------------|----------------------|
| I_D (A) | 5 |
| V_{DSS} (V) | 600 |
| $R_{DS(ON)}$ (Ω) | 2.2 @ $V_{GS} = 10V$ |
| Q_G (nC) max. | 20 |

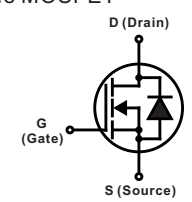


| ABSOLUTE MAXIMUM RATINGS (T _C = 25°C unless otherwise specified) | | | | | |
|---|---|---|----------------|--------------|----|
| SYMBOL | PARAMETER | TEST CONDITIONS | VALUE | UNIT | |
| V _{DSS} | Drain to Source voltage | T _J =25°C to 150°C | 600 | V | |
| V _{DGR} | Drain to Gate voltage | R _{GS} =20KΩ | 600 | | |
| V _{GS} | Gate to Source voltage | | ±30 | | |
| I _D | Continuous Drain Current | T _C =25°C | 5 | A | |
| | | T _C =100°C | 3.1 | | |
| I _{DM} | Pulsed Drain current(Note 1) | | 20 | | |
| I _{AR} | Avalanche current(Note 1) | | 5 | | |
| E _{AR} | Repetitive avalanche energy(Note 1) | I _{AR} =5A, R _{GS} =50Ω, V _{GS} =10V | 10 | | mJ |
| E _{AS} | Single pulse avalanche energy (Note 2) | I _{AS} =5A, L = 16.8mH | 210 | | |
| dv/dt | Peak diode recovery dv/dt(Note 3) | | 4.5 | V/ns | |
| P _D | Total power dissipation | T _C =25°C | TO-251/ TO-252 | 54 | W |
| | | | TO-220AB | 100 | |
| | | | TO-220F | 36 | |
| T _J | Operation junction temperature | | -55 to 150 | °C | |
| T _{STG} | Storage temperature | | -55 to 150 | | |
| T _L | Maximum soldering temperature, for 10 seconds | 1.6mm from case | 300 | | |
| | Mounting torque, #6-32 or M3 screw | | 10 (1.1) | lbf-in (N·m) | |

Note: 1.Repetitive rating: pulse width limited by junction temperature.
 2. I_{AS} = 5A, V_{DD} = 50V, L = 16.8mH, R_{GS} = 25Ω, starting T_J=25°C.
 3. I_{SD} ≤ 5A, di/dt ≤ 200A/μs, V_{DD} ≤ V_{(BR)DSS}, starting T_J=25°C.

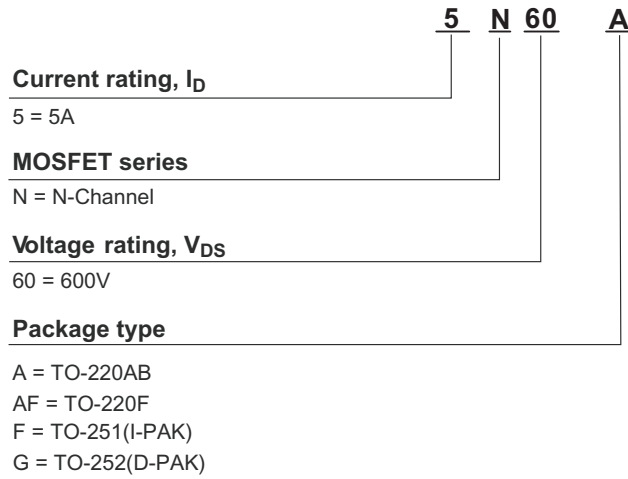
| THERMAL RESISTANCE | | | | | |
|----------------------|---|----------------|------|------|------|
| SYMBOL | PARAMETER | Min. | Typ. | Max. | UNIT |
| R _{th(j-c)} | Thermal resistance, junction to case | TO-251/ TO-252 | | 2.3 | °C/W |
| | | TO-220AB | | 1.25 | |
| | | TO-220F | | 3.5 | |
| R _{th(j-a)} | Thermal resistance, junction to ambient | TO-251/TO-252 | | 160 | |
| | | TO-220AB | | 62.5 | |
| | | TO-220F | | 62.5 | |

| ABSOLUTE MAXIMUM RATINGS (T _C = 25°C unless otherwise specified) | | | | | | |
|---|--|---|------|------|------|------|
| SYMBOL | PARAMETER | TEST CONDITIONS | Min. | Typ. | Max. | UNIT |
| V _{(BR)DSS} | Drain to Source breakdown voltage | I _D =250μA, V _{GS} =0V | 600 | | | V |
| ΔV _{(BR)DSS/ΔT_J} | Breakdown voltage temperature coefficient | I _D =250μA, V _{DS} =V _{GS} | | 0.6 | | V/°C |
| I _{DSS} | Drain to source leakage current | V _{DS} =600V, V _{GS} =0V, T _C =25°C | | | 10 | μA |
| | | V _{DS} =480V, V _{GS} =0V, T _C =125°C | | | 100 | |
| I _{GSS} | Gate to source forward leakage current | V _{GS} =30V, V _{DS} =0V | | | 100 | nA |
| | Gate to source reverse leakage current | V _{GS} =-30V, V _{DS} =0V | | | -100 | |
| R _{DS(ON)} | Static drain to source on-state resistance | I _D =2.5A, V _{GS} =10V | | 1.8 | 2.2 | Ω |
| V _{GS(TH)} | Gate threshold voltage | V _{GS} =V _{DS} , I _D =250μA | 2 | | 4.0 | V |
| C _{ISS} | Input capacitance | V _{DS} =25V, V _{GS} =0V, f=1MHz | | 515 | 670 | pF |
| C _{OSS} | Output capacitance | | | 55 | 72 | |
| C _{RSS} | Reverse transfer capacitance | | | 6.5 | 8.5 | |
| t _{d(ON)} | Turn-on delay time | V _{DD} =300V, V _{GS} =10V, I _D =5A, R _{GS} =25Ω (Note 1, 2) | | 10 | 30 | ns |
| t _r | Rise time | | | 42 | 90 | |
| t _{d(OFF)} | Turn-off delay time | | | 38 | 85 | |
| t _f | Fall time | | | 45 | 100 | |
| Q _G | Total gate charge | V _{DD} =480V, V _{GS} =10V, I _D =5A (Note 1,2) | | 15 | 20 | nC |
| Q _{GS} | Gate to source charge | | | 2.5 | | |
| Q _{GD} | Gate to drain charge (Miller ccharge) | | | 6.5 | | |

| SOURCE TO DRAIN DIODE RATINGS AND CHARACTERISTICS (T _C = 25°C unless otherwise specified) | | | | | | |
|--|------------------------------------|---|------|------|------|------|
| SYMBOL | PARAMETER | TEST CONDITIONS | Min. | Typ. | Max. | UNIT |
| V _{SD} | Diode forward voltage | I _{SD} = 5A, V _{GS} = 0V | | | 1.4 | V |
| I _S (I _{SD}) | Continuous source to drain current | Integral reverse P-N junction diode in the MOSFET  | | | 5 | A |
| I _{SM} | Pulsed source current | | | | 20 | |
| t _{rr} | Reverse recovery time | I _{SD} = 5A, V _{GS} = 0V, dI _F /dt = 100A/μs | | 300 | | ns |
| Q _{rr} | Reverse recovery charge | | | | 2.2 | μC |

Note: 1. Pulse test: Pulse width ≤ 300μs, duty cycle ≤ 2%.
2. Essentially independent of operating temperature.

ORDERING INFORMATION SCHEME



■ TEST CIRCUITS AND WAVEFORMS

Fig.1A Peak diode recovery dv/dt test circuit

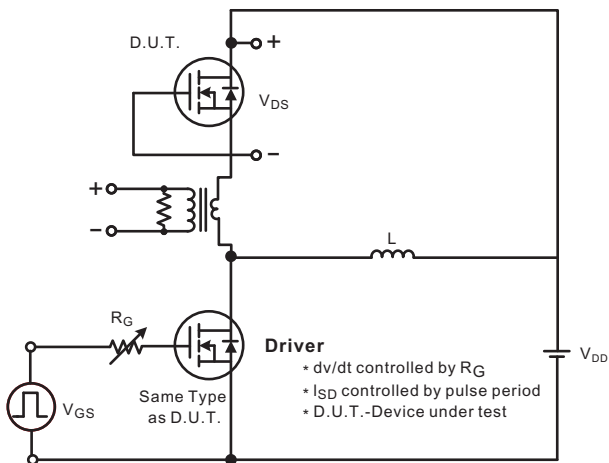
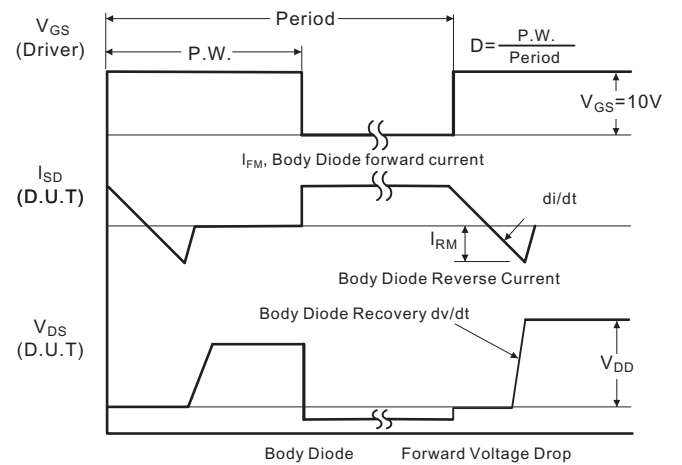


Fig.1B Peak diode recovery dv/dt waveforms



TEST CIRCUITS AND WAVEFORMS (Cont.)

Fig.2A Switching test circuit

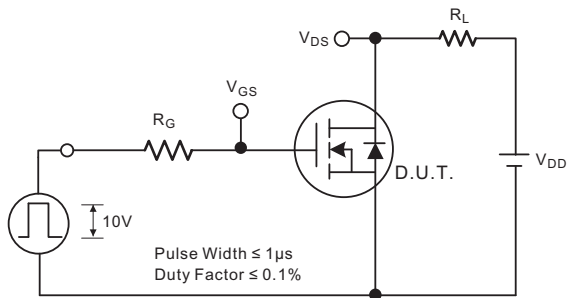


Fig.2B Switching Waveforms

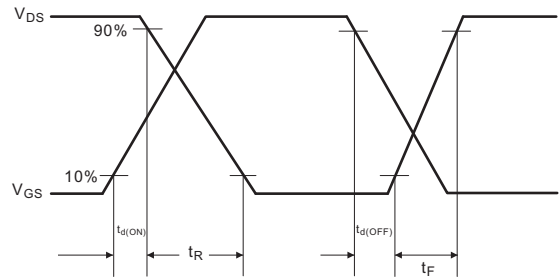


Fig.3A Gate charge test circuit

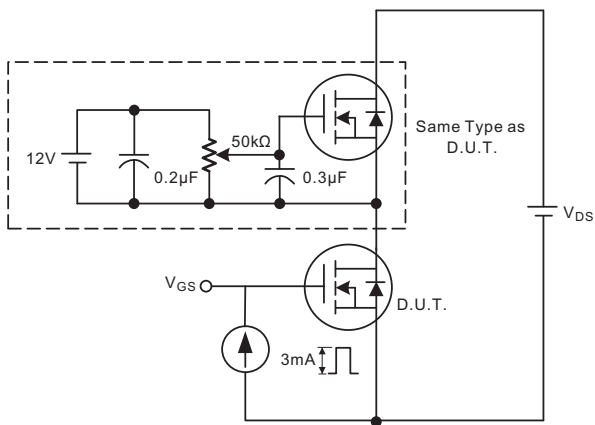


Fig.3B Gate charge waveform

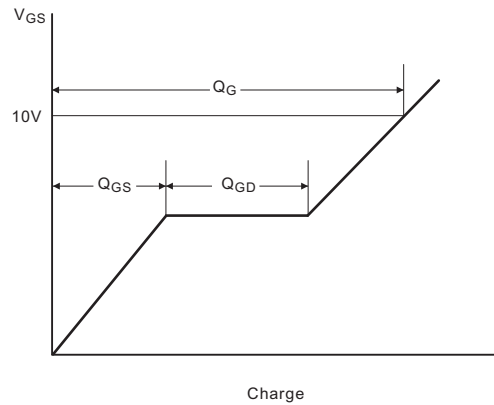


Fig.4A Unclamped Inductive switching test circuit

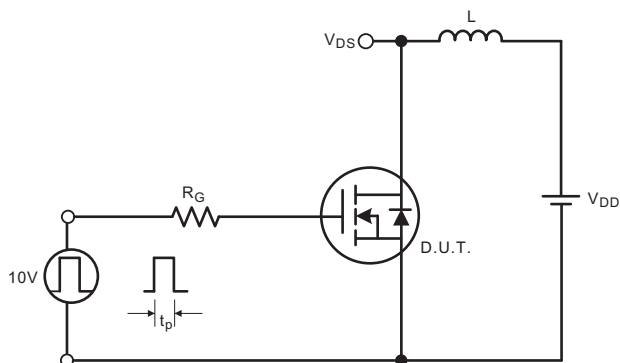
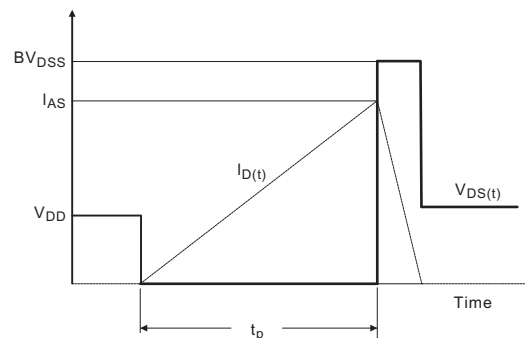


Fig.4B Unclamped Inductive switching waveforms



■ TYPICAL CHARACTERISTICS

Fig.1 On-State characteristics

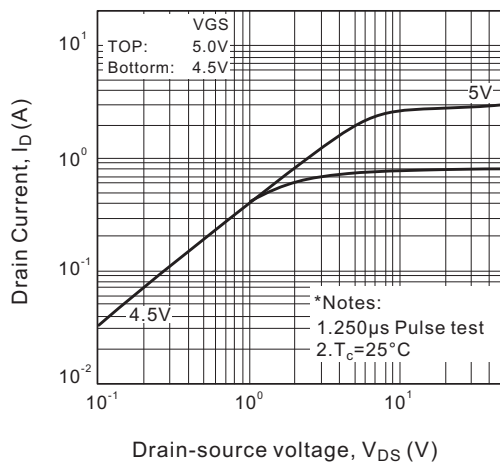


Fig.2 Transfer characteristics

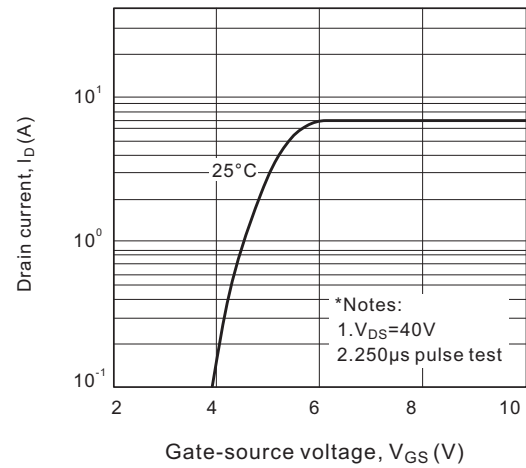


Fig.3 On-resistance variation vs. drain current and gate voltage

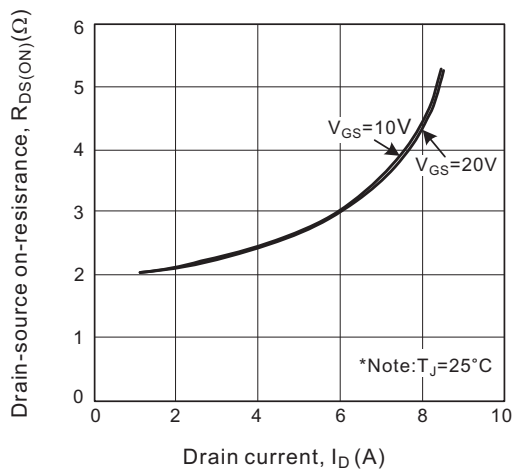
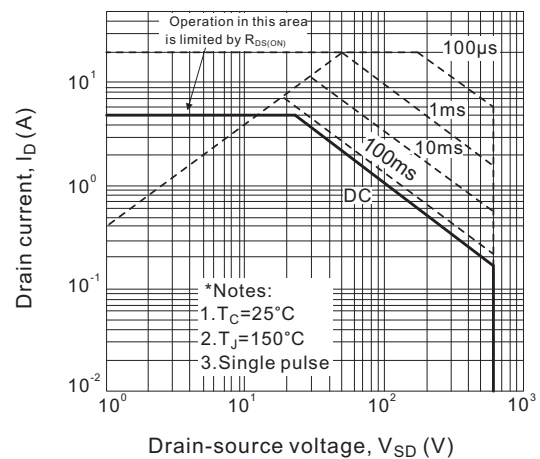
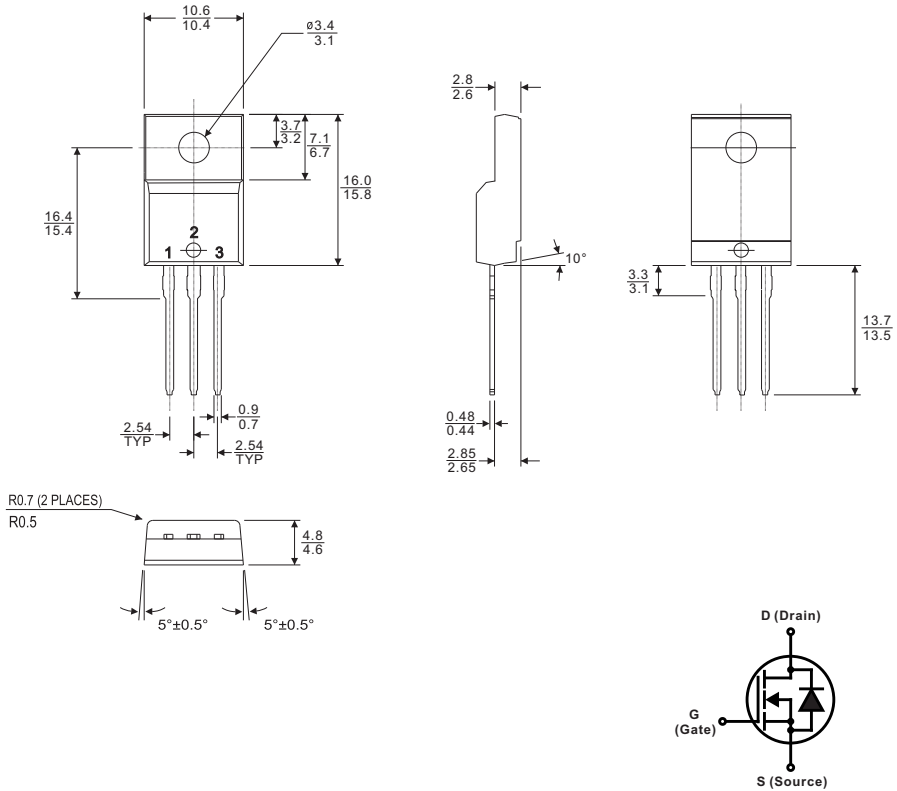


Fig.4 Maximum safe operating area



Case Style

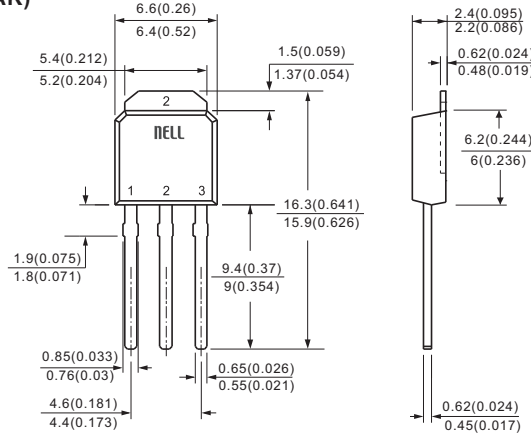
TO-220F



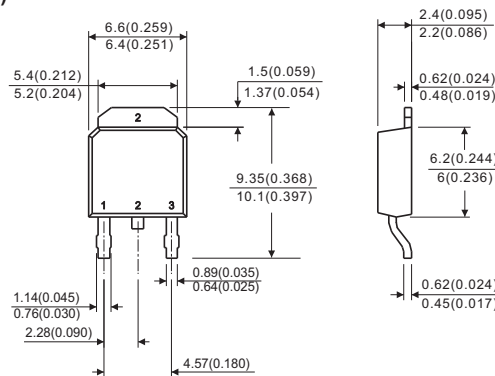
All dimensions in millimeters

Case Style

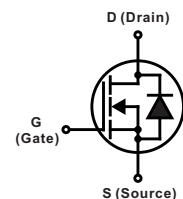
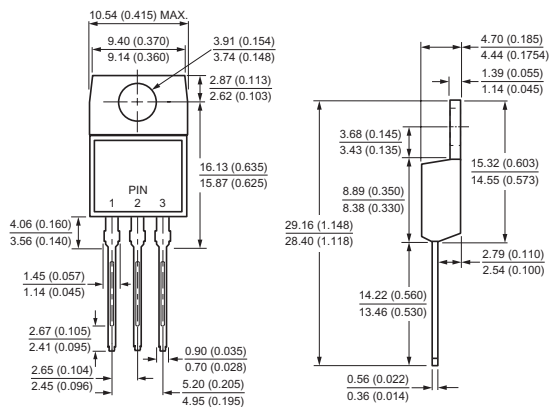
**TO-251
(I-PAK)**



**TO-252
(D-PAK)**



TO-220AB



All dimensions in millimeters(inches)