

N-Channel Power MOSFET (6A, 600Volts)

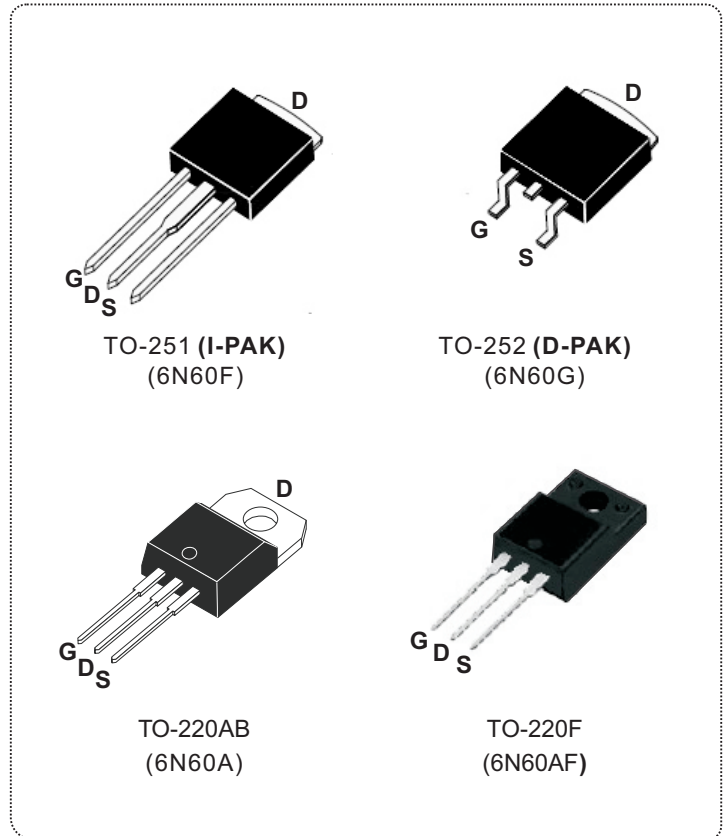
DESCRIPTION

The Nell **6N60** is a three-terminal silicon device with current conduction capability of 6A, fast switching speed, low on-state resistance, breakdown voltage rating of 600V, and max. threshold voltage of 4 volts.

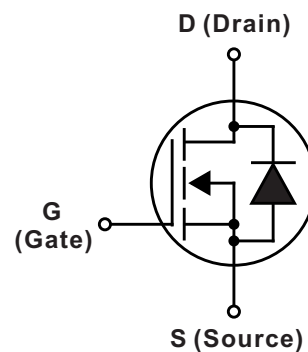
They are designed for use in applications such as switched mode power supplies, DC to DC converters, **PWM** motor controls, bridge circuits and general purpose switching applications.

FEATURES

- $R_{DS(ON)} = 1.5\Omega @ V_{GS} = 10V$
- Ultra low gate charge(25nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 10pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



| PRODUCT SUMMARY | |
|---------------------------|----------------------|
| I_D (A) | 6 |
| V_{DSS} (V) | 600 |
| $R_{DS(ON)}$ (Ω) | 1.5 @ $V_{GS} = 10V$ |
| Q_G (nC) max. | 25 |

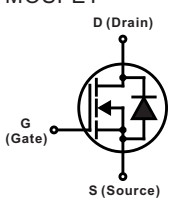


| ABSOLUTE MAXIMUM RATINGS (T _C = 25°C unless otherwise specified) | | | | | |
|---|---|---|----------------|------------|--------------|
| SYMBOL | PARAMETER | TEST CONDITIONS | | VALUE | UNIT |
| V _{DSS} | Drain to Source voltage | T _J =25°C to 150°C | | 600 | V |
| V _{DGR} | Drain to Gate voltage | R _{GS} =20KΩ | | 600 | |
| V _{GS} | Gate to Source voltage | | | ±30 | |
| I _D | Continuous Drain Current | T _C =25°C | | 6 | A |
| | | T _C =100°C | | 3.7 | |
| I _{DM} | Pulsed Drain current(Note 1) | | | 24 | |
| I _{AR} | Avalanche current(Note 1) | | | 6 | |
| E _{AR} | Repetitive avalanche energy(Note 1) | I _{AR} =6A, R _{GS} =50Ω, V _{GS} =10V | | 13 | mJ |
| E _{AS} | Single pulse avalanche energy (Note 2) | I _{AS} =6A, L = 14mH | | 440 | |
| 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 | 55 | W |
| | | | TO-220AB | 125 | |
| | | | TO-220F | 40 | |
| 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} = 6A, V_{DD} = 50V, L = 14mH, R_{GS} = 25Ω, starting T_J=25°C.
 3.I_{SD} ≤ 6A, di/dt ≤ 200A/μs, V_{DD} ≤ V_{(BR)DSS}, starting T_J=25°C.

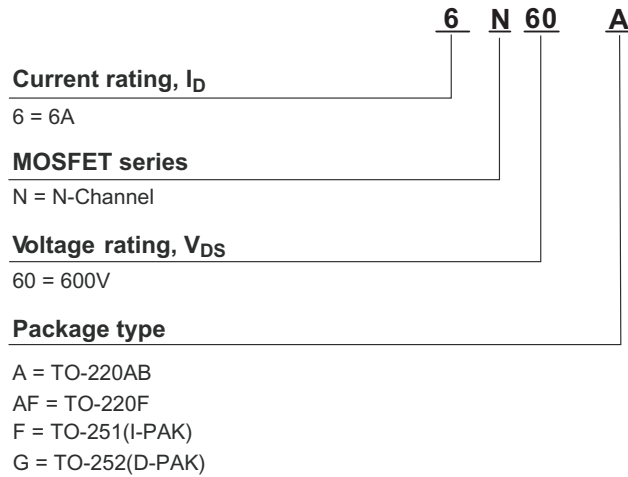
| THERMAL RESISTANCE | | | | | |
|----------------------|---|----------------|------|------|------|
| SYMBOL | PARAMETER | Min. | Typ. | Max. | UNIT |
| R _{th(j-c)} | Thermal resistance, junction to case | TO-251/ TO-252 | | 2.3 | °C/W |
| | | TO-220AB | | 1.0 | |
| | | TO-220F | | 3.3 | |
| R _{th(j-a)} | Thermal resistance, junction to ambient | TO-251/TO-252 | | 110 | |
| | | TO-220AB | | 62.5 | |
| | | TO-220F | | 62.5 | |

| ELECTRICAL CHARACTERISTICS (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} | | 0.53 | | V/°C |
| I _{DSS} | Drain to source leakage current | V _{DS} =600V, V _{GS} =0V | | | 10 | μA |
| | | V _{DS} =480V, V _{GS} =0V | | | 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 = 3A, V _{GS} = 10V | | 1.0 | 1.5 | Ω |
| V _{GS(TH)} | Gate threshold voltage | V _{GS} =V _{DS} , I _D =250μA | 2.0 | | 4.0 | V |
| C _{ISS} | Input capacitance | V _{DS} = 25V, V _{GS} = 0V, f = 1MHz | | 770 | 1000 | pF |
| C _{OSS} | Output capacitance | | | 95 | 120 | |
| C _{RSS} | Reverse transfer capacitance | | | 10 | 13 | |
| t _{d(ON)} | Turn-on delay time | V _{DD} = 300V, V _{GS} = 10V, I _D = 6A, R _{GS} = 25Ω (Note 1, 2) | | 20 | 50 | ns |
| t _r | Rise time | | | 70 | 150 | |
| t _{d(OFF)} | Turn-off delay time | | | 40 | 90 | |
| t _f | Fall time | | | 45 | 100 | |
| Q _G | Total gate charge | V _{DD} = 480V, V _{GS} = 10V, I _D = 6A (Note 1, 2) | | 20 | 25 | uC |
| Q _{GS} | Gate to source charge | | | 5 | | |
| Q _{GD} | Gate to drain charge (Miller charge) | | | 9.5 | | |

| 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} = 6A, V _{GS} = 0V | | | 1.4 | V |
| I _S (I _{SD}) | Continuous source to drain current | Integral reverse P-N junction diode in the MOSFET  | | | 6 | A |
| I _{SM} | Pulsed source current | | | | 24 | |
| t _{rr} | Reverse recovery time | I _{SD} = 6A, V _{GS} = 0V, dI _F /dt = 100A/μs | | 280 | | ns |
| Q _{rr} | Reverse recovery charge | | | | 2.3 | |

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

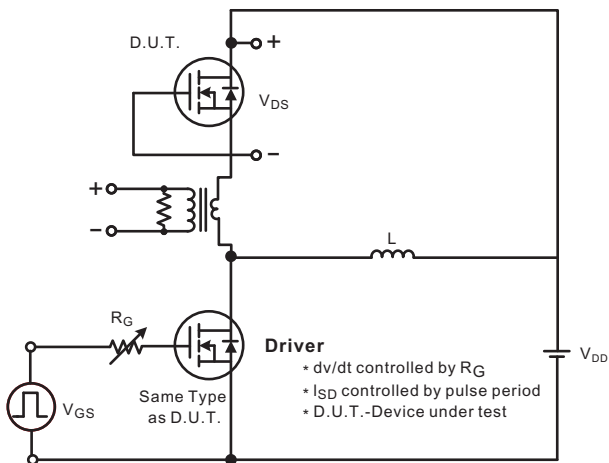
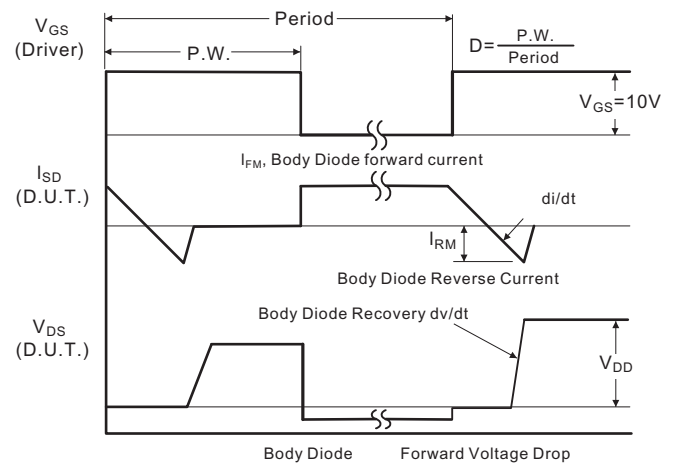


Fig.1B Peak diode recovery dv/dt waveforms



■ TEST CIRCUITS AND WAVEFORMS (Cont.)

Fig.2A Switching test circuit

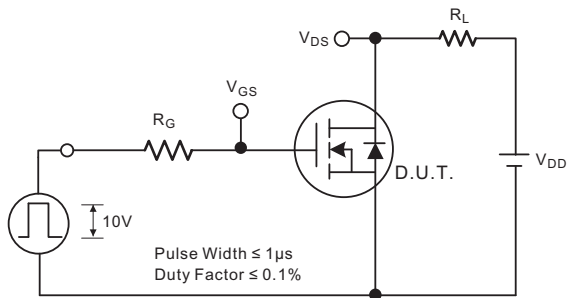


Fig.2B Switching Waveforms

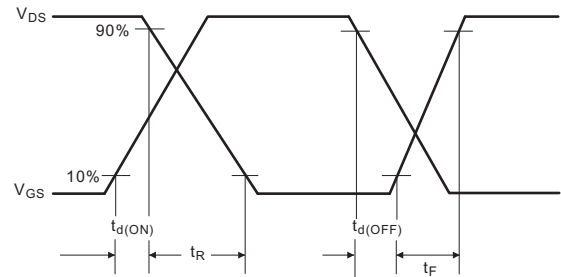


Fig.3A Gate charge test circuit

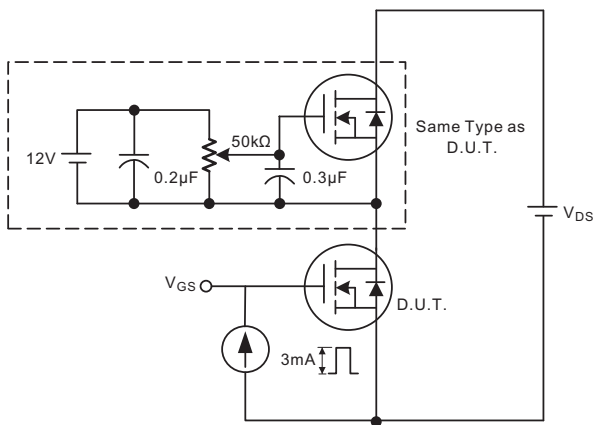


Fig.3B Gate charge waveform

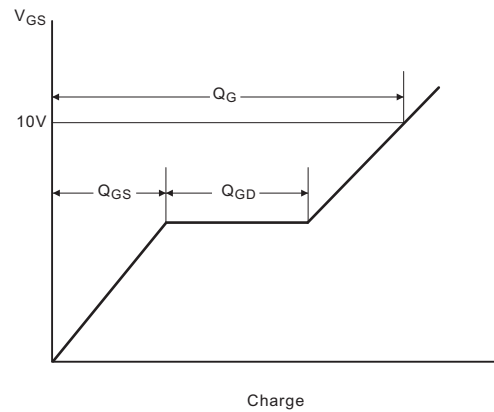


Fig.4A Unclamped Inductive switching test circuit

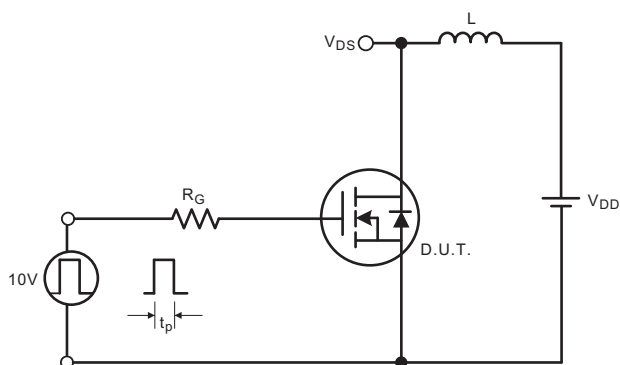
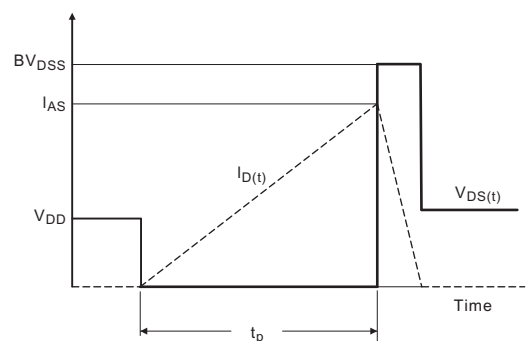


Fig.4B Unclamped Inductive switching waveforms



■ TYPICAL CHARACTERISTICS

Fig.1 On-state characteristics

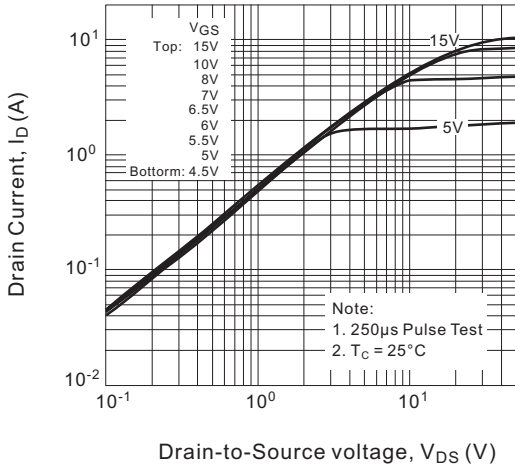


Fig.2 Transfer characteristics

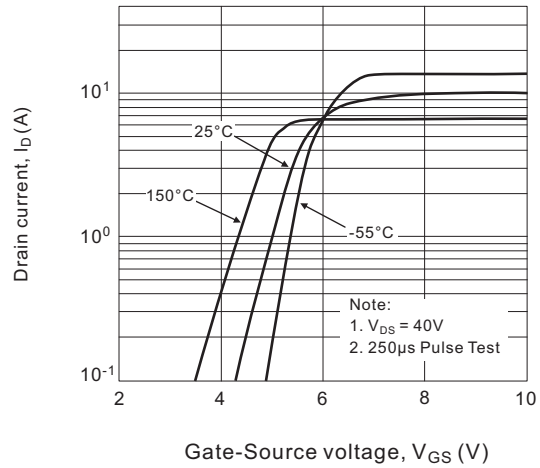


Fig.3 On-Resistance variation vs drain current and gate voltage

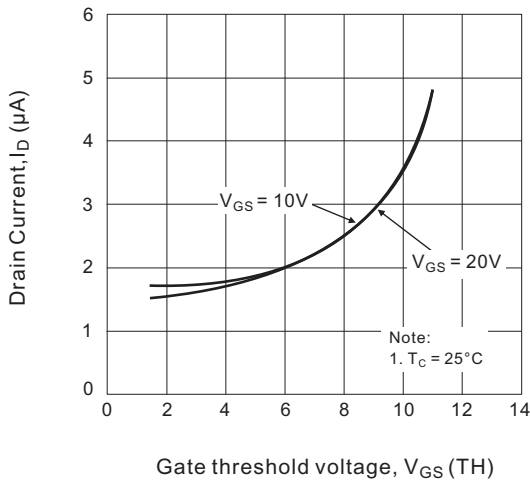


Fig.4 Body diode forward voltage variation vs. source current and temperature

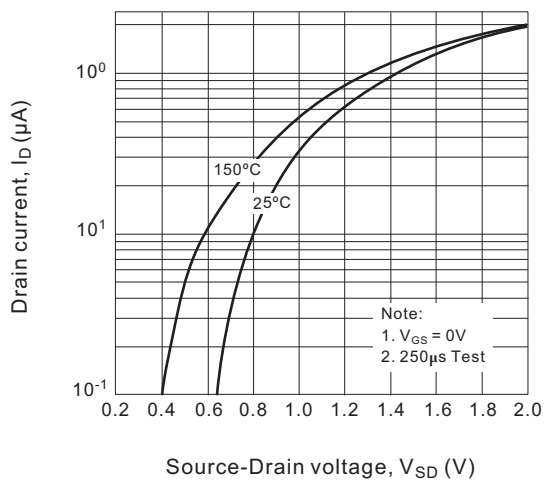


Fig.5 Capacitance characteristics

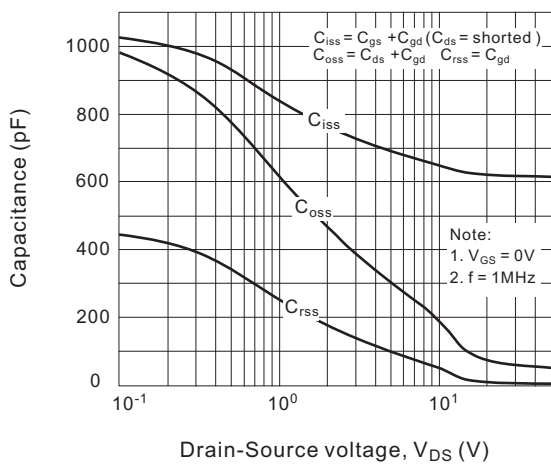
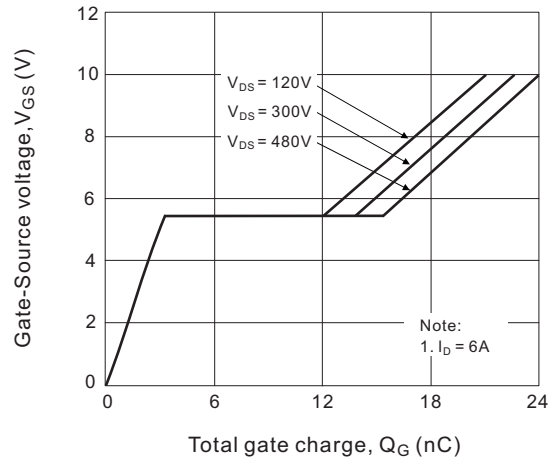


Fig.6 Gate charge characteristics



■ TYPICAL CHARACTERISTICS

Fig.7 Breakdown voltage variation vs. Temperature

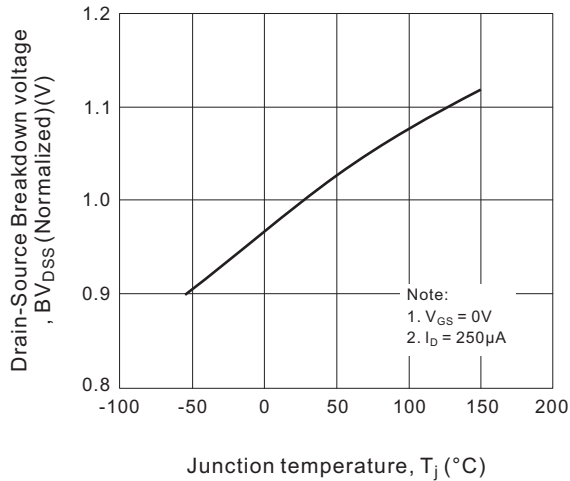


Fig.8 On-Resistance variation vs. junction temperature

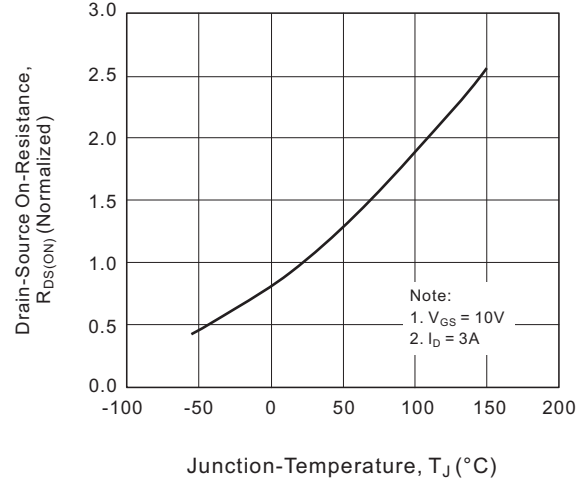


Fig.9-1 Maximum Safe operating area (for 6N60A)

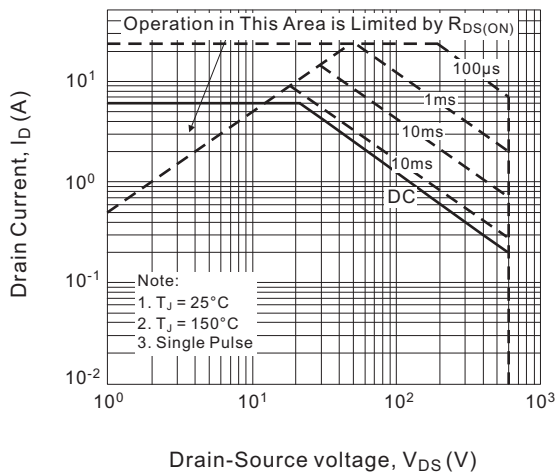


Fig.9-2 Maximum Safe operating area (for 6N60AF)

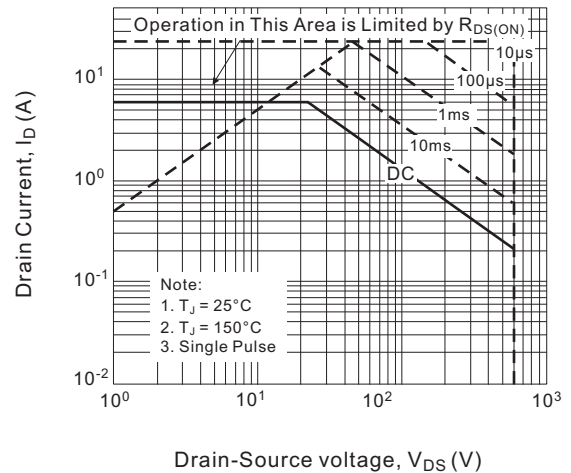


Fig.9-3 Maximum Safe operating area (for 6N60F/6N60G)

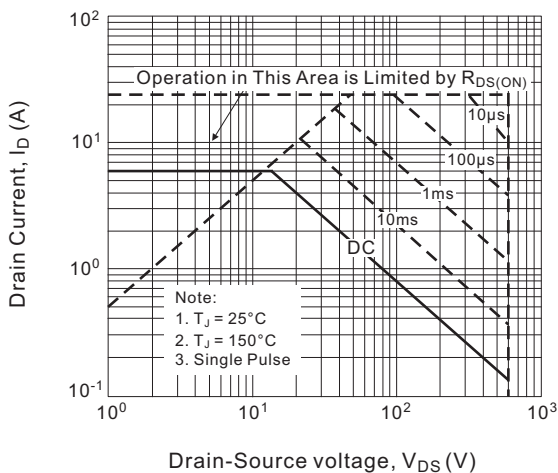
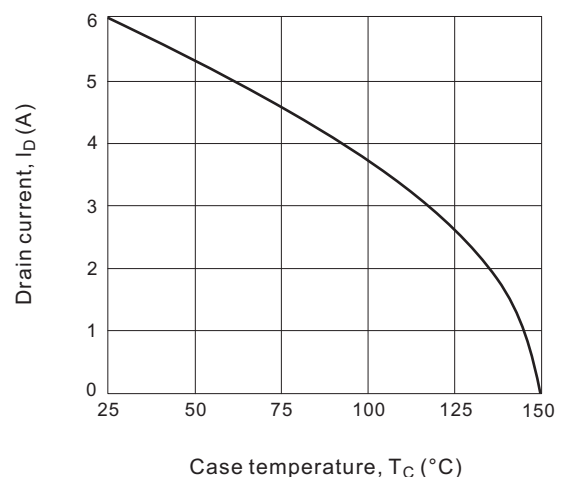


Fig.10 Maximum drain current vs. case temperature



TYPICAL CHARACTERISTICS

Fig.11-1 Transient thermal response curve for 6N60A

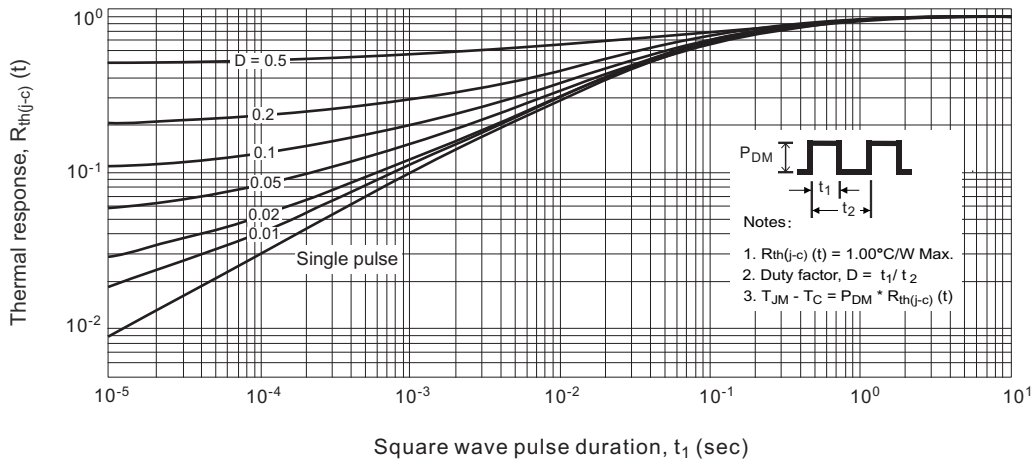


Fig.11-2 Transient thermal response curve for 6N60AF

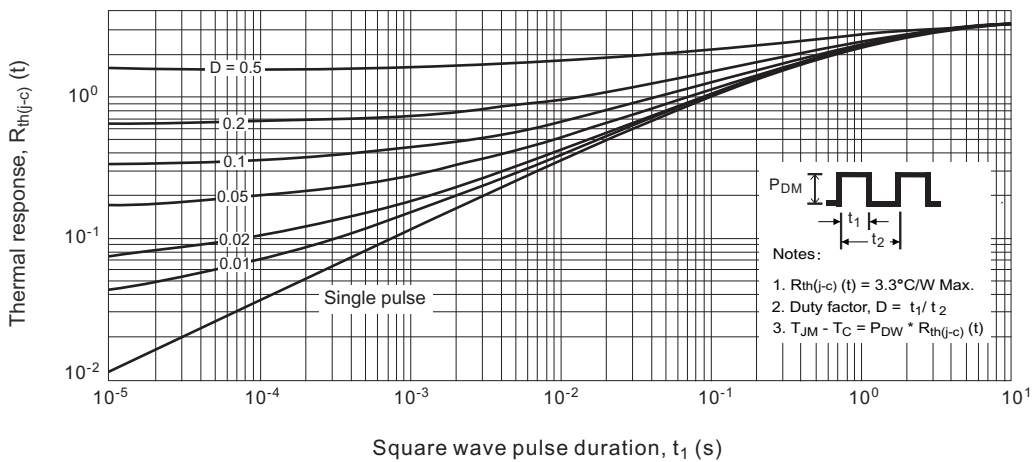
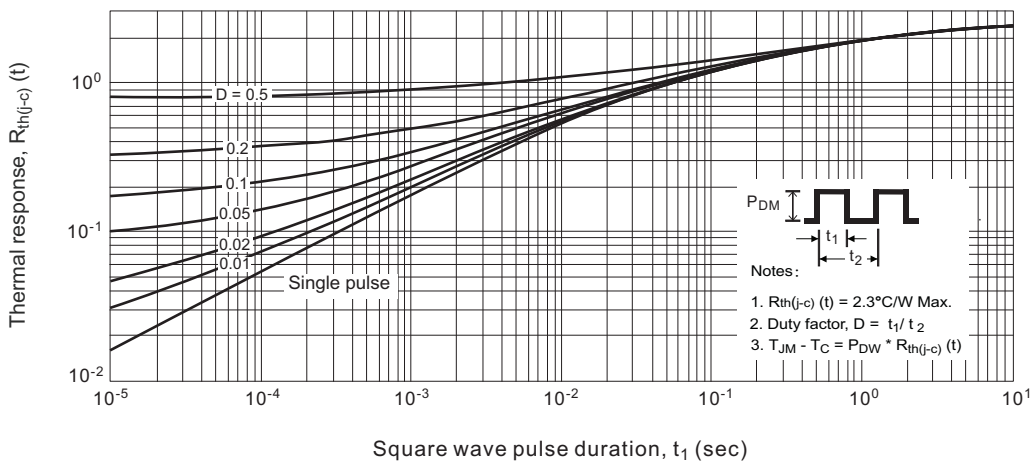
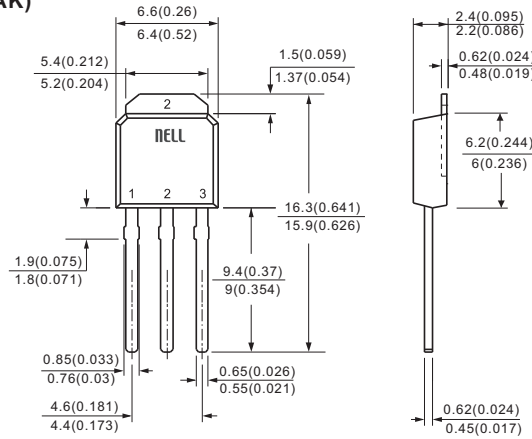


Fig.11-3 Transient thermal response curve (for 6N60F/6N60G)

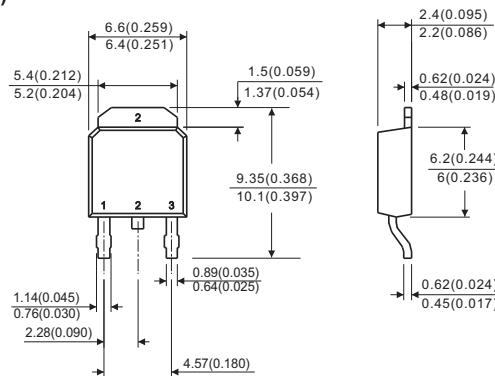


Case Style

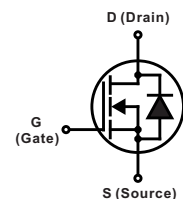
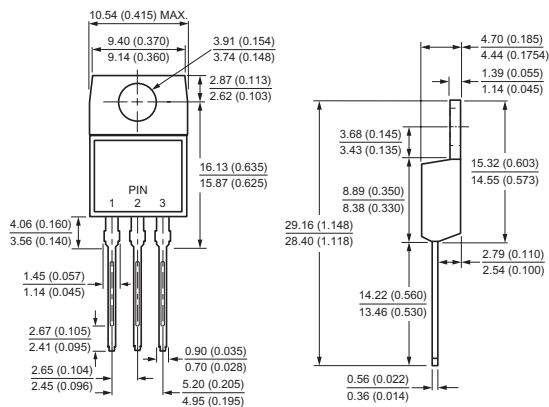
TO-251 (I-PAK)



TO-252 (D-PAK)



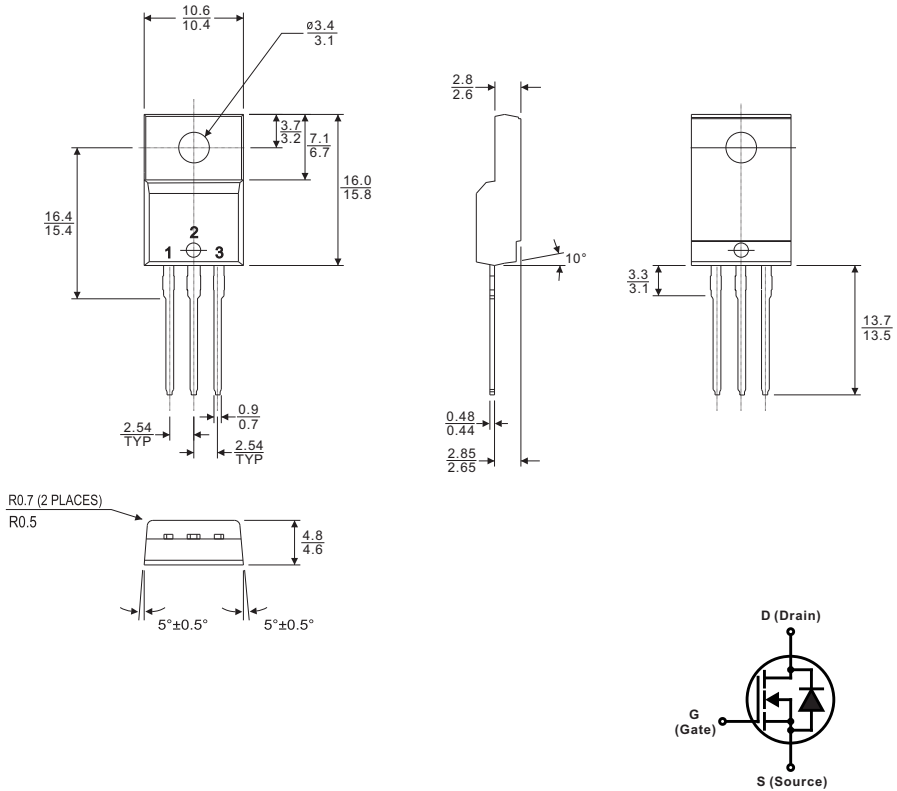
TO-220AB



All dimensions in millimeters(inches)

Case Style

TO-220F



All dimensions in millimeters