

N-Channel Power MOSFET 6A, 900Volts

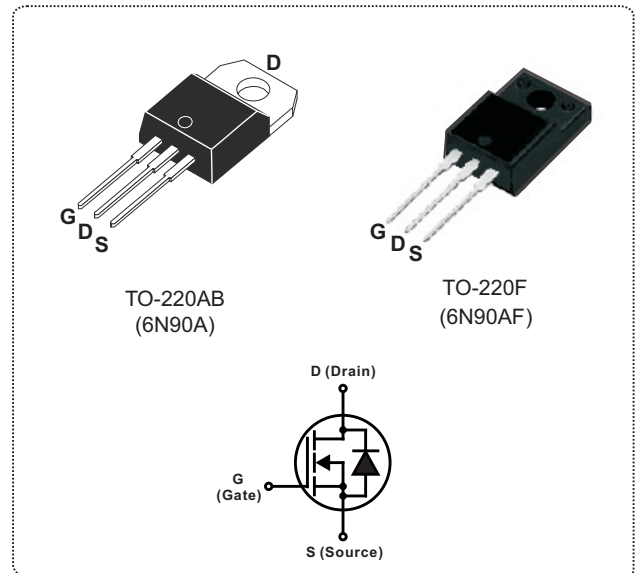
DESCRIPTION

The Nell **6N90** is a three-terminal silicon device with current conduction capability of 6A, fast switching speed, low on-state resistance, breakdown voltage rating of 900V, and max. threshold voltage of 5 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

- $R_{DS(ON)} = 2.3\Omega$ @ $V_{GS} = 10V$
- Ultra low gate charge(40nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 11pF$ 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) | 900 |
| $R_{DS(ON)}$ (Ω) | 2.3 @ $V_{GS} = 10V$ |
| Q_G (nC) max. | 40 |

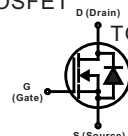
ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ C$ unless otherwise specified)

| SYMBOL | PARAMETER | TEST CONDITIONS | | VALUE | UNIT |
|------------------|---|---|----------|------------|--------------|
| V _{DSS} | Drain to Source voltage | T _J =25°C to 150°C | | 900 | V |
| V _{DGR} | Drain to Gate voltage | R _{GS} =20KΩ | | 900 | |
| V _{GS} | Gate to Source voltage | | | ±30 | |
| I _D | Continuous Drain Current | T _C =25°C | | 6 | A |
| | | T _C =100°C | | 3.8 | |
| 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 | | 16.7 | mJ |
| E _{AS} | Single pulse avalanche energy(Note 2) | I _{AS} =6A, L=34mH | | 650 | |
| dv/dt | Peak diode recovery dv/dt(Note 3) | | | 4.5 | V / ns |
| P _D | Total power dissipation | T _C =25°C | TO-220AB | 167 | W |
| | | | TO-220F | 56 | |
| | Linear derating factor above T _C =25°C | T _C =25°C | TO-220AB | 1.43 | °C/W |
| | | | TO-220F | 0.48 | |
| 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. $I_{AS} = 6A, L = 34mH, V_{DD} = 50V, R_{GS} = 25\Omega$, starting $T_J = 25^\circ C$.
 3. $I_{SD} \leq 6A, di/dt \leq 200A/\mu s, V_{DD} \leq V_{(BR)DSS}$, starting $T_J = 25^\circ C$.

| THERMAL RESISTANCE | | | | | | |
|--------------------|---|----------|------|------|------|----------------------|
| SYMBOL | PARAMETER | | MIN. | TYP. | MAX. | UNIT |
| $R_{th(j-c)}$ | Thermal resistance, junction to case | TO-220AB | | | 0.75 | $^{\circ}\text{C/W}$ |
| | | TO-220F | | | 2.25 | |
| $R_{th(j-a)}$ | Thermal resistance, junction to ambient | 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 |
| ◎ OFF CHARACTERISTICS | | | | | | | |
| V _{(BR)DSS} | Drain to source breakdown voltage | I _D = 250μA, V _{GS} = 0V | | 900 | | | V |
| ΔV _{(BR)DSS} /ΔT _J | Breakdown voltage temperature coefficient | I _D = 250μA, V _{DS} = V _{GS} | | | 1.07 | | V/°C |
| I _{DSS} | Drain to source leakage current | V _{DS} =900V, V _{GS} =0V | T _C =25°C | | | 10 | μA |
| | | V _{DS} =720V, 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 | |
| ◎ ON CHARACTERISTICS | | | | | | | |
| R _{DS(ON)} | Static drain to source on-state resistance | V _{GS} =10V, I _D =3A | | | 1.95 | 2.3 | Ω |
| V _{GS(TH)} | Gate threshold voltage | V _{GS} =V _{DS} , I _D =250μA | | 3 | | 5 | V |
| g _{FS} | Forward transconductance | V _{DS} =50V, I _D =3A | | | 5.5 | | S |
| ◎ DYNAMIC CHARACTERISTICS | | | | | | | |
| C _{ISS} | Input capacitance | V _{DS} =25V, V _{GS} =0V, f=1MHz | | | 1360 | 1770 | pF |
| C _{OSS} | Output capacitance | | | | 110 | 145 | |
| C _{RSS} | Reverse transfer capacitance | | | | 11 | 15 | |
| ◎ SWITCHING CHARACTERISTICS | | | | | | | |
| t _{d(ON)} | Turn-on delay time | V _{DD} =450V, V _{GS} =10V I _D =6A, R _{GS} =25Ω (Note1,2) | | | 35 | 80 | ns |
| t _r | Rise time | | | | 90 | 190 | |
| t _{d(OFF)} | Turn-off delay time | | | | 55 | 120 | |
| t _f | Fall time | | | | 60 | 130 | |
| Q _G | Total gate charge | V _{DD} = 720V, V _{GS} =10V I _D =6A, (Note1,2) | | | 30 | 40 | nC |
| Q _{GS} | Gate to source charge | | | | 9.0 | | |
| Q _{GD} | Gate to drain charge (Miller charge) | | | | 12 | | |

| SOURCE TO DRAIN DIODE RATINGS AND CHARACTERISTICS ($T_C = 25^{\circ}\text{C}$ unless otherwise specified) | | | | | | |
|--|------------------------------------|---|------|------|------|---------------|
| SYMBOL | PARAMETER | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
| V_{SD} | Diode forward voltage | $I_{SD} = 6\text{A}$, $V_{GS} = 0\text{V}$ | | | 1.4 | V |
| I_S (I_{SD}) | Continuous source to drain current | Integral reverse P-N junction diode in the MOSFET  TO-220F | | | 6 | A |
| I_{SM} | Pulsed source current | | | | 24 | |
| t_{rr} | Reverse recovery time | $I_{SD} = 6\text{A}$, $V_{GS} = 0\text{V}$, $dI_F/dt = 100\text{A}/\mu\text{s}$ | | 630 | | ns |
| Q_{rr} | Reverse recovery charge | | | 6.9 | | μC |

Note: 1. Pulse test: Pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.
2. Essentially independent of operating temperature.

ORDERING INFORMATION SCHEME

| | | | | |
|--|----------|----------|-----------|----------|
| | 6 | N | 90 | A |
| Current rating, I_D | | | | |
| 6 = 6A | | | | |
| MOSFET series | | | | |
| N = N-Channel | | | | |
| Voltage rating, V_{DS} | | | | |
| 90 = 900V | | | | |
| Package type | | | | |
| A = TO-220AB | | | | |
| AF = TO-220F | | | | |

■ TEST CIRCUITS

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

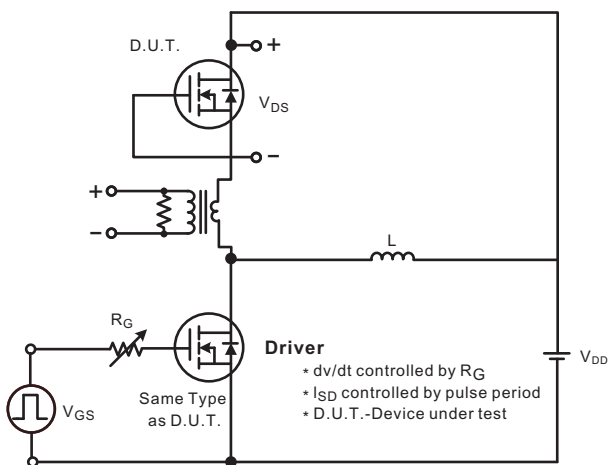
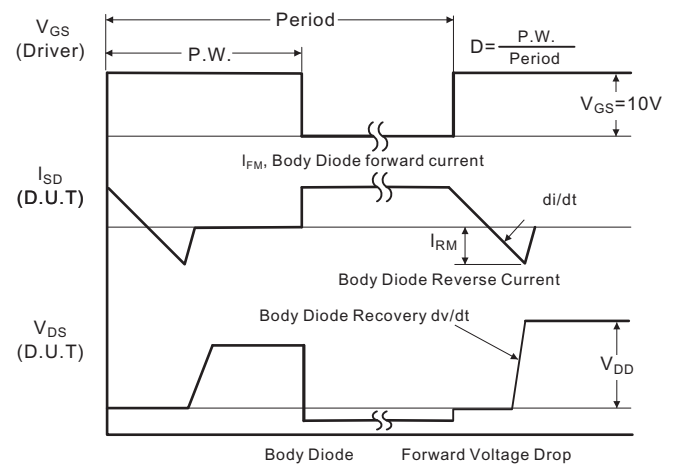
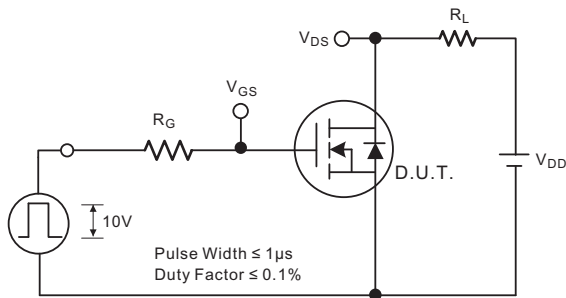
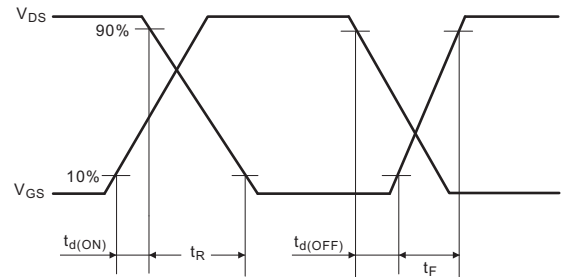
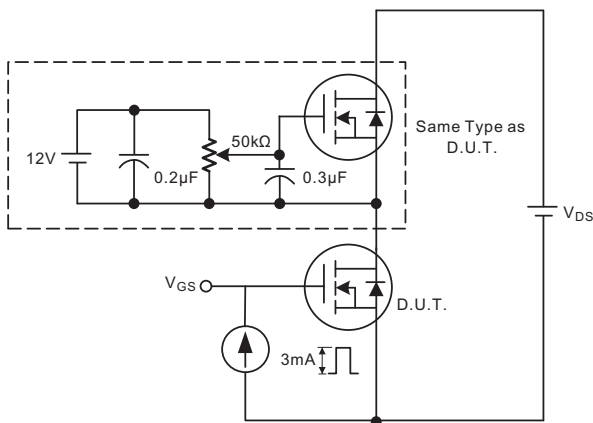
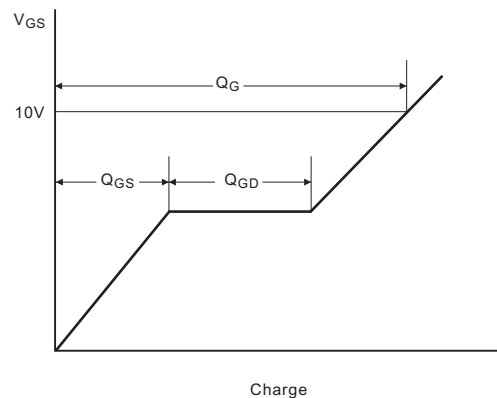
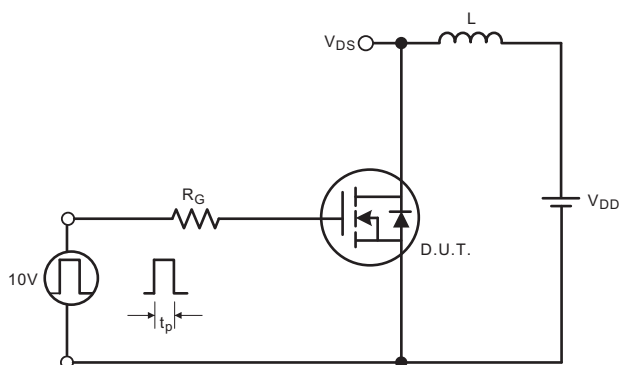
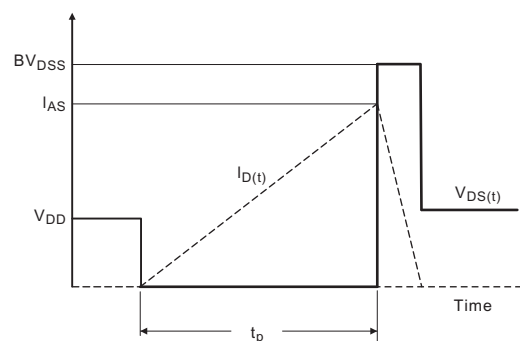


Fig.1B Peak diode recovery dv/dt waveforms



■ TEST CIRCUIT(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 Typical output characteristics

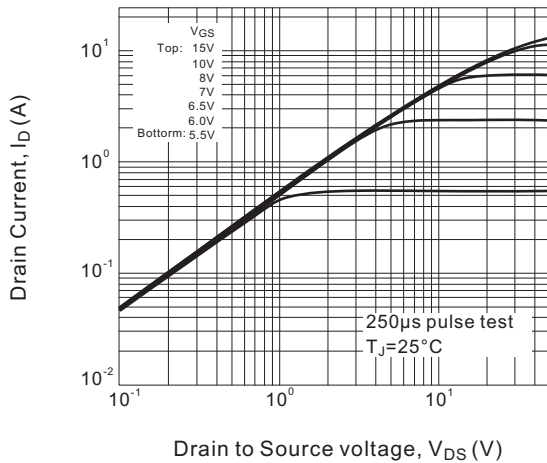


Fig.2 Typical transfer characteristics

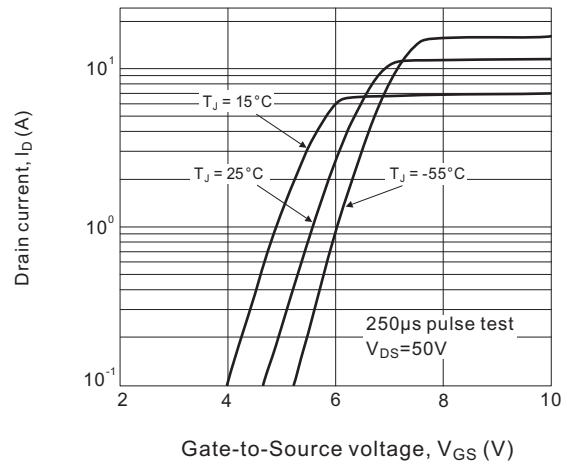


Fig.3 On-resistance variation vs. drain current and gate voltage

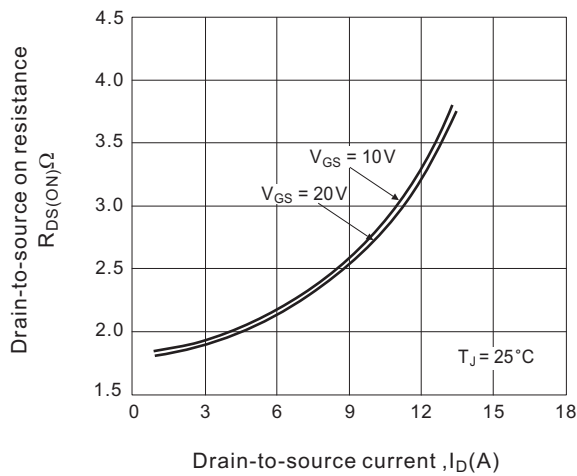


Fig.4 Body diode forward voltage variation with source current and temperature

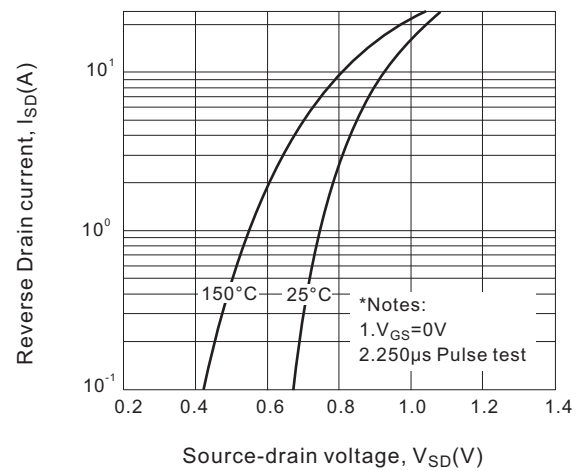


Fig.5 Typical capacitance characteristics

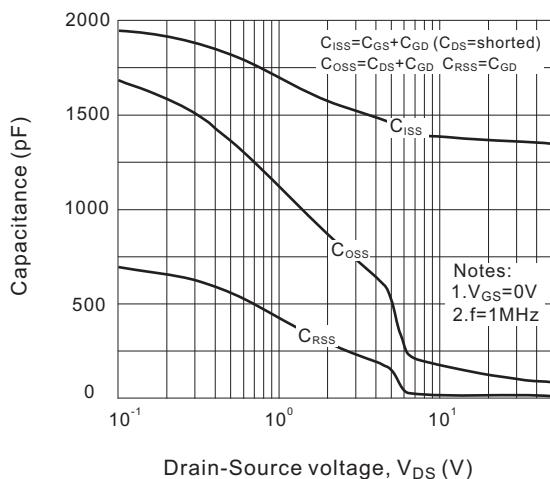


Fig.6 Typical gate charge characteristics

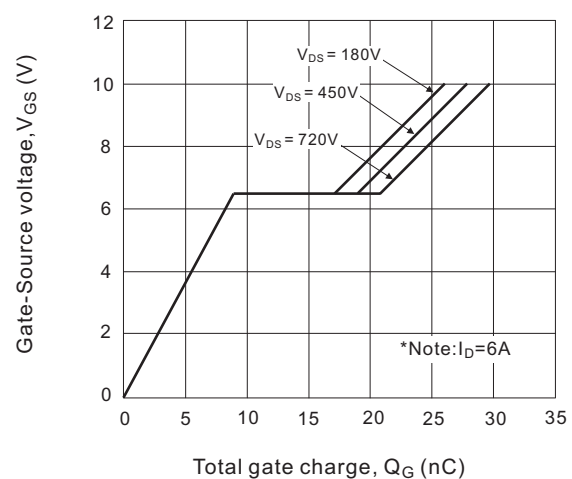


Fig.7 Breakdown voltage variation vs. Junction temperature

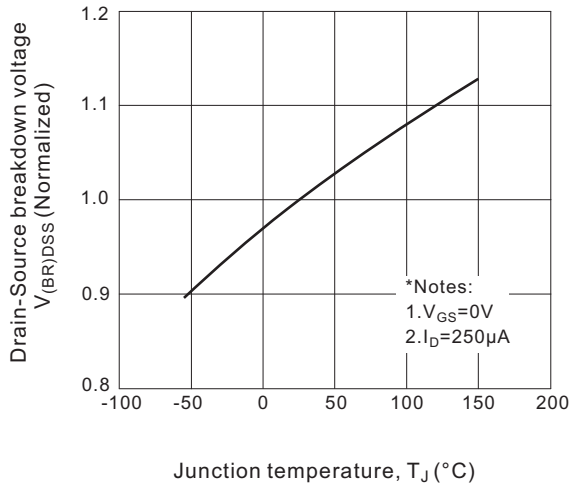


Fig.8 On-resistance variation vs. Junction temperature

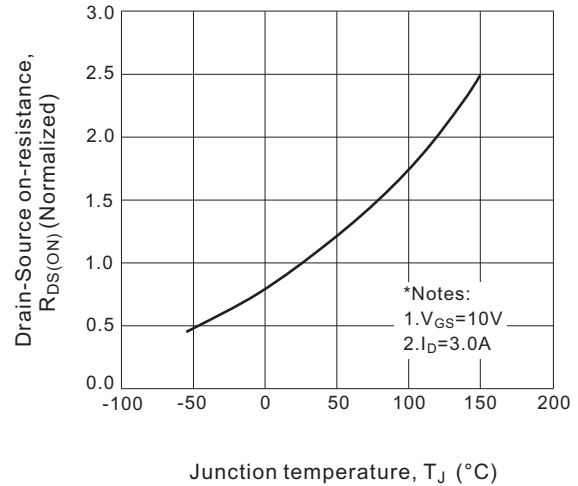


Fig.9 Maximum safe operating area for 6N90A

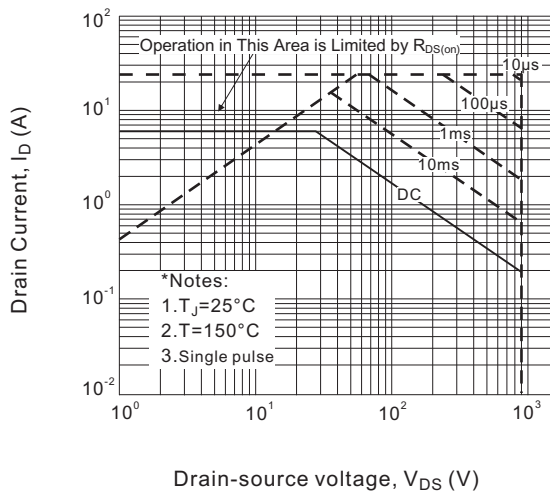


Fig.9-2 Maximum safe operating area for 6N90AF

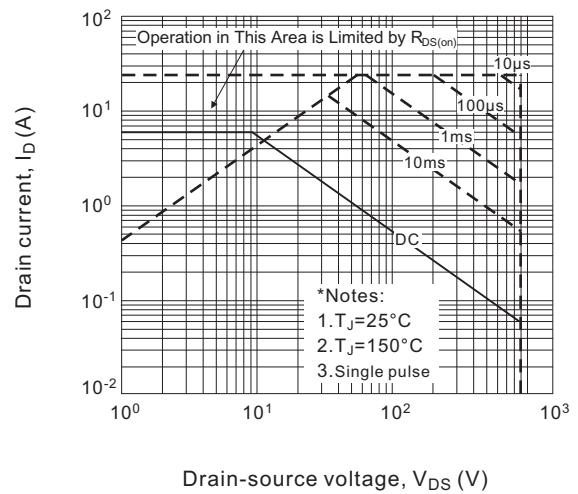


Fig.10 Maximum drain current vs. Case temperature

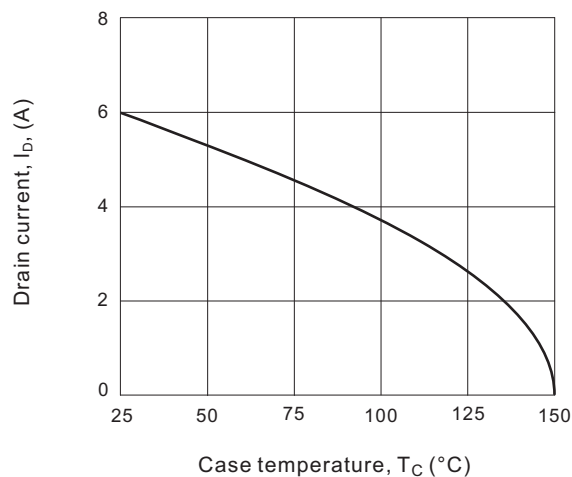


Fig.11 Transient thermal response curve for 6N90A

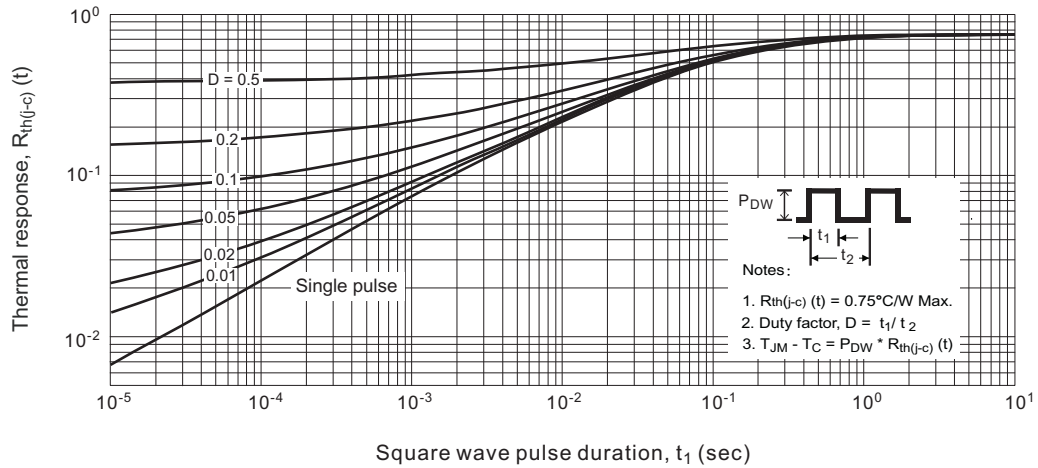
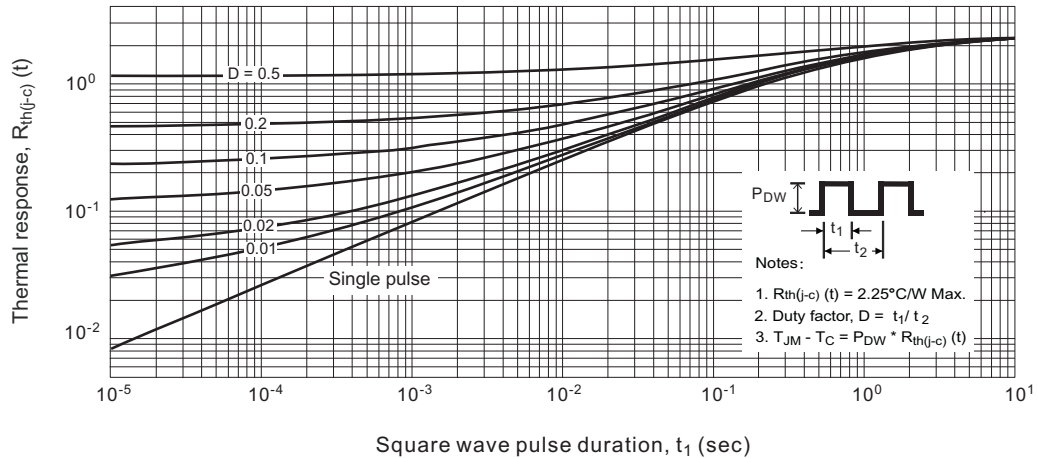
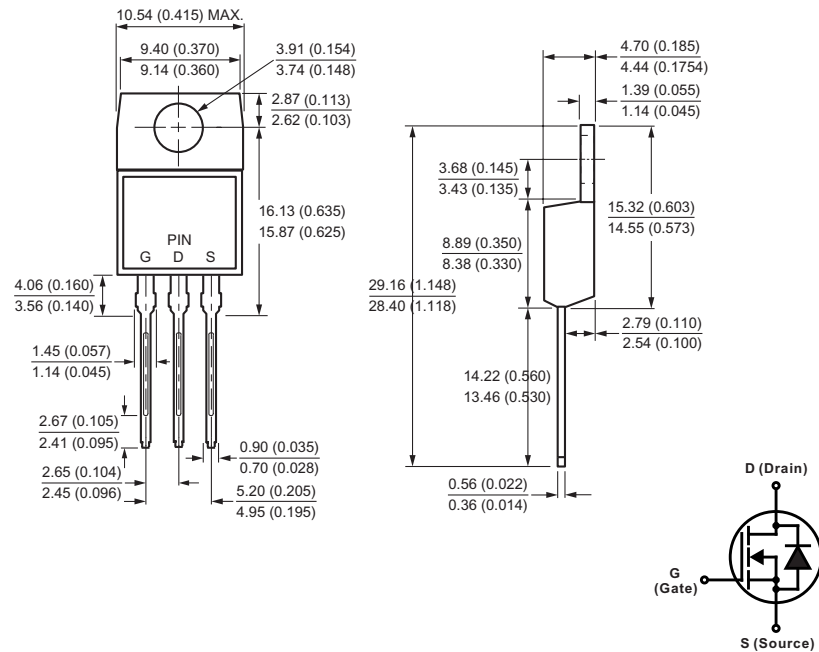
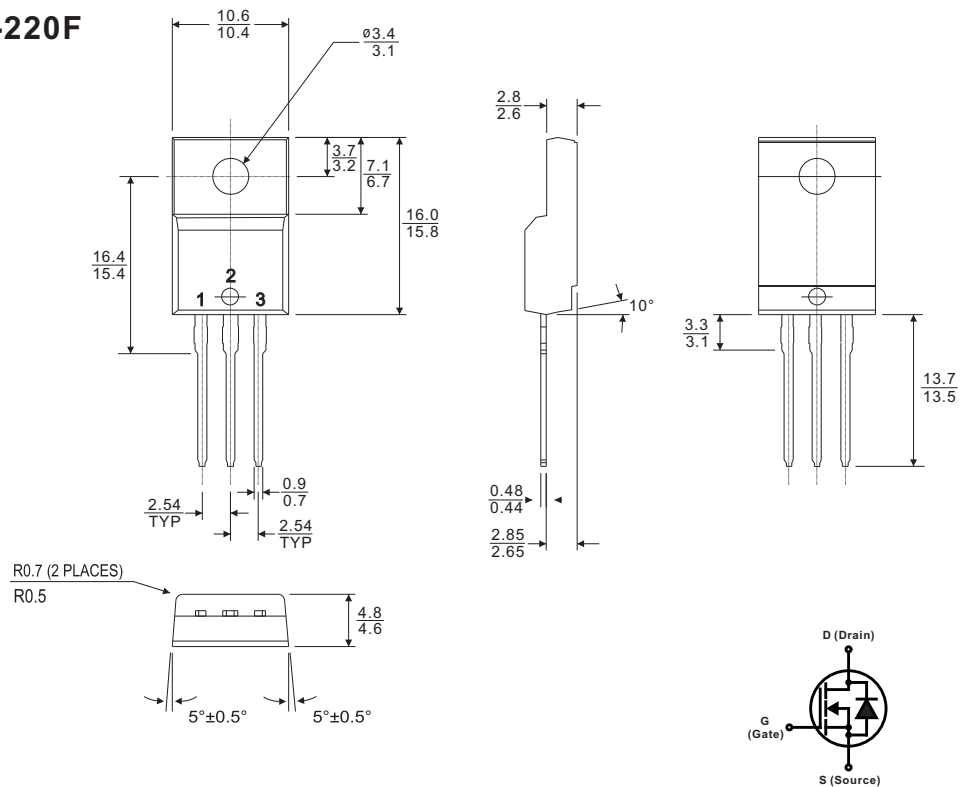


Fig.12 Transient thermal response curve for 6N90AF



TO-220AB


All dimensions in millimeters(inches)

TO-220F


All dimensions in millimeters