

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

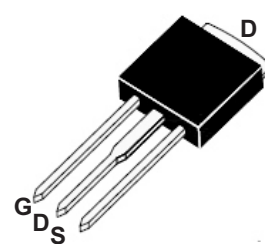
DESCRIPTION

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.

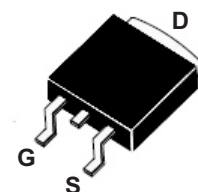
They are designed for use in applications such as switched mode power supplies, DC to DC converters, **PWM** motor controls, bridge circuits and general purpose switching applications.

FEATURES

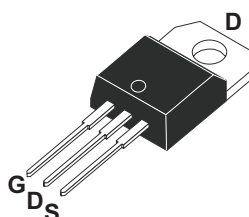
- $R_{DS(ON)} = 1.5\Omega @ V_{GS} = 10V$
- Ultra low gate charge (25nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 10pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



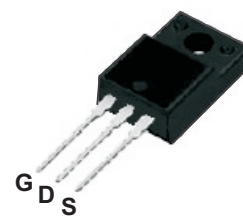
TO-251 (I-PAK)
(6N60F)



TO-252 (D-PAK)
(6N60G)

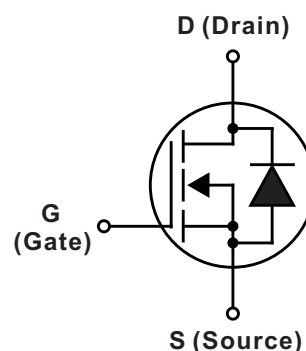


TO-220AB
(6N60A)



TO-220F
(6N60AF)

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

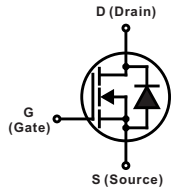


ABSOLUTE MAXIMUM RATINGS ($T_C = 25^{\circ}\text{C}$ unless otherwise specified)					
SYMBOL	PARAMETER	TEST CONDITIONS		VALUE	UNIT
V_{DSS}	Drain to Source voltage	$T_J = 25^{\circ}\text{C}$ to 150°C		600	V
V_{DGR}	Drain to Gate voltage	$R_{GS} = 20\text{K}\Omega$		600	
V_{GS}	Gate to Source voltage			± 30	
I_D	Continuous Drain Current	$T_C = 25^{\circ}\text{C}$		6	A
		$T_C = 100^{\circ}\text{C}$		3.7	
I_{DM}	Pulsed Drain current(Note 1)			24	
I_{AR}	Avalanche current(Note 1)			6	
E_{AR}	Repetitive avalanche energy(Note 1)	$I_{AR} = 6\text{A}$, $R_{GS} = 50\Omega$, $V_{GS} = 10\text{V}$		13	mJ
E_{AS}	Single pulse avalanche energy (Note 2)	$I_{AS} = 6\text{A}$, $L = 14\text{mH}$		440	
dv/dt	Peak diode recovery dv/dt (Note 3)			4.5	V / ns
P_D	Total power dissipation	$T_C = 25^{\circ}\text{C}$	TO-251/ TO-252	55	W
			TO-220AB	125	
			TO-220F	40	
T_J	Operation junction temperature			-55 to 150	$^{\circ}\text{C}$
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. $I_{AS} = 6\text{A}$, $V_{DD} = 50\text{V}$, $L = 14\text{mH}$, $R_{GS} = 25\Omega$, starting $T_J = 25^{\circ}\text{C}$.
 3. $I_{SD} \leq 6\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, starting $T_J = 25^{\circ}\text{C}$.

THERMAL RESISTANCE						
SYMBOL	PARAMETER		Min.	Typ.	Max.	UNIT
$R_{th(j-c)}$	Thermal resistance, junction to case	TO-251/ TO-252			2.3	$^{\circ}\text{C}/\text{W}$
		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 ($T_C = 25^\circ\text{C}$ unless otherwise specified)						
SYMBOL	PARAMETER	TEST CONDITIONS	Min.	Typ.	Max.	UNIT
$V_{(BR)DSS}$	Drain to source breakdown voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$	600			V
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown voltage temperature coefficient	$I_D = 250\mu\text{A}$, $V_{DS} = V_{GS}$		0.53		V/ $^\circ\text{C}$
I_{DSS}	Drain to source leakage current	$V_{DS}=600\text{V}$, $V_{GS}=0\text{V}$, $T_C = 25^\circ\text{C}$			10	μA
		$V_{DS}=480\text{V}$, $V_{GS}=0\text{V}$, $T_C=125^\circ\text{C}$			100	
I_{GSS}	Gate to source forward leakage current	$V_{GS} = 30\text{V}$, $V_{DS} = 0\text{V}$			100	nA
	Gate to source reverse leakage current	$V_{GS} = -30\text{V}$, $V_{DS} = 0\text{V}$			-100	
$R_{DS(ON)}$	Static drain to source on-state resistance	$I_D = 3\text{A}$, $V_{GS} = 10\text{V}$		1.0	1.5	Ω
$V_{GS(TH)}$	Gate threshold voltage	$V_{GS}=V_{DS}$, $I_D=250\mu\text{A}$	2.0		4.0	V
C_{ISS}	Input capacitance	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$		770	1000	pF
C_{OSS}	Output capacitance			95	120	
C_{RSS}	Reverse transfer capacitance			10	13	
$t_{d(ON)}$	Turn-on delay time	$V_{DD} = 300\text{V}$, $V_{GS} = 10\text{V}$, $I_D = 6\text{A}$, $R_{GS} = 25\Omega$ (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	$V_{DD} = 480\text{V}$, $V_{GS} = 10\text{V}$, $I_D = 6\text{A}$ (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 ($T_C = 25^\circ\text{C}$ 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			6	A
I_{SM}	Pulsed source current				24	
t_{rr}	Reverse recovery time	$I_{SD} = 6\text{A}$, $V_{GS} = 0\text{V}$, $dI_F/dt = 100\text{A}/\mu\text{s}$		280		ns
Q_{rr}	Reverse recovery charge			2.3		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	60	A
Current rating, I_D				
6 = 6A				
MOSFET series				
N = N-Channel				
Voltage rating, V_{DS}				
60 = 600V				
Package type				
A = TO-220AB				
AF = TO-220F				
F = TO-251(I-PAK)				
G = TO-252(D-PAK)				

■ TEST CIRCUITS AND WAVEFORMS

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

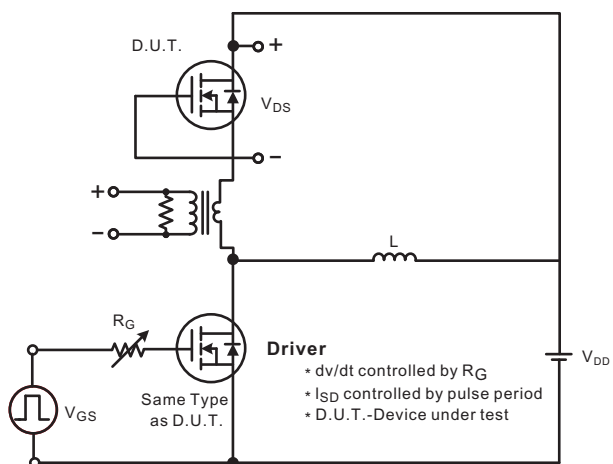
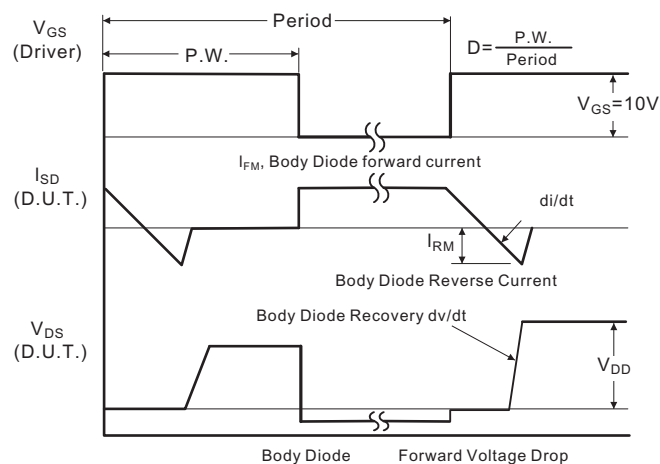
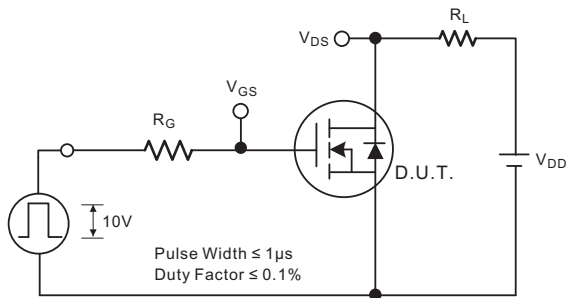
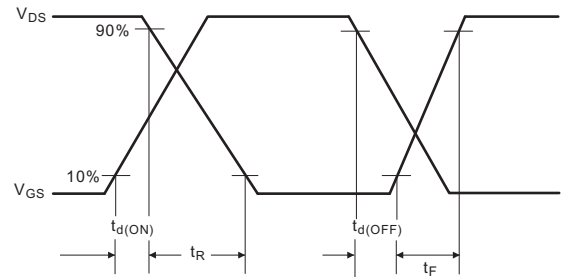
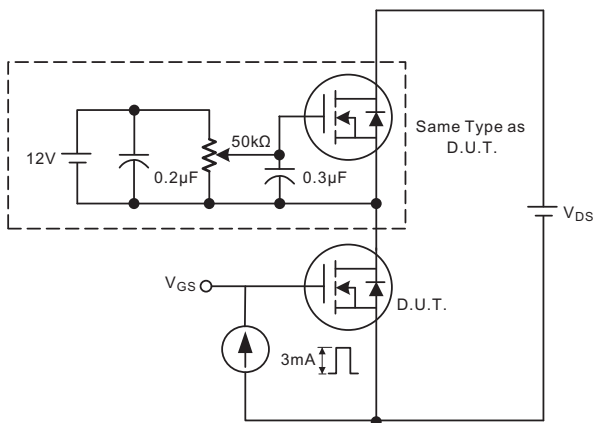
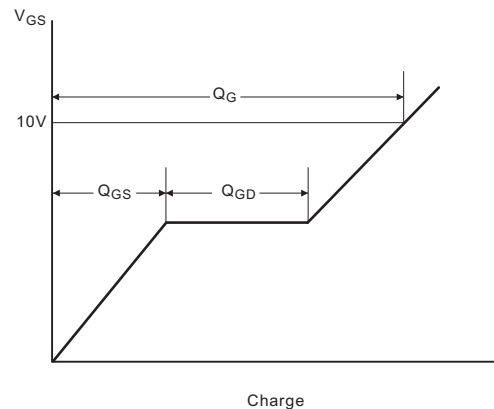
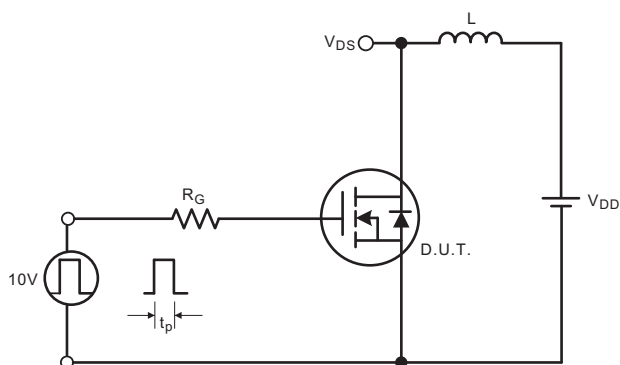
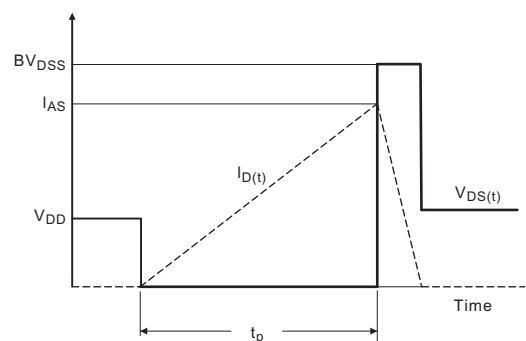


Fig.1B Peak diode recovery dv/dt waveforms



■ 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

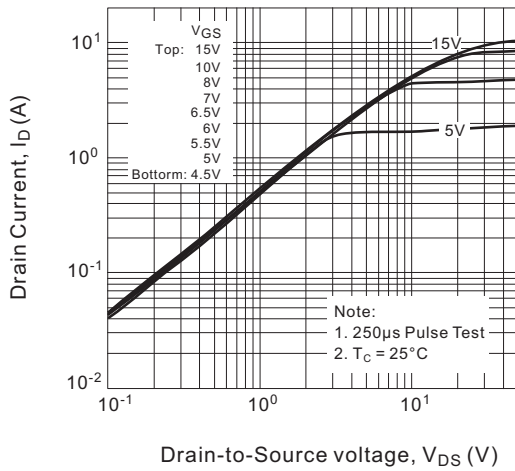


Fig.2 Transfer characteristics

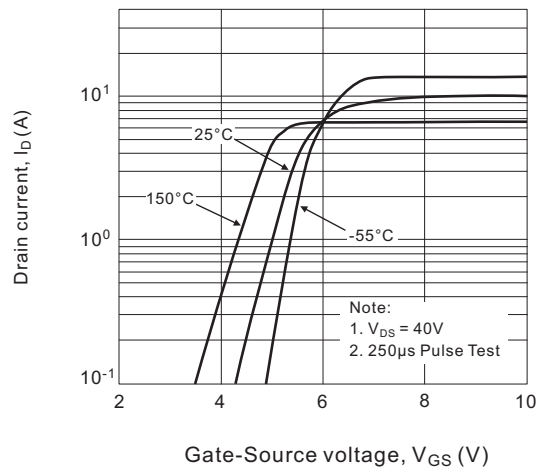


Fig.3 On-Resistance variation vs drain current and gate voltage

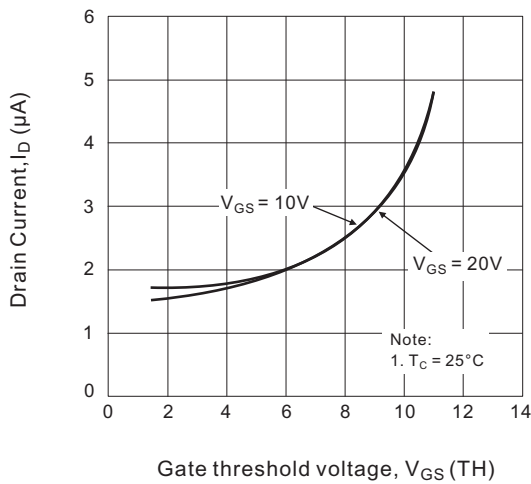


Fig.4 Body diode forward voltage variation vs. source current and temperature

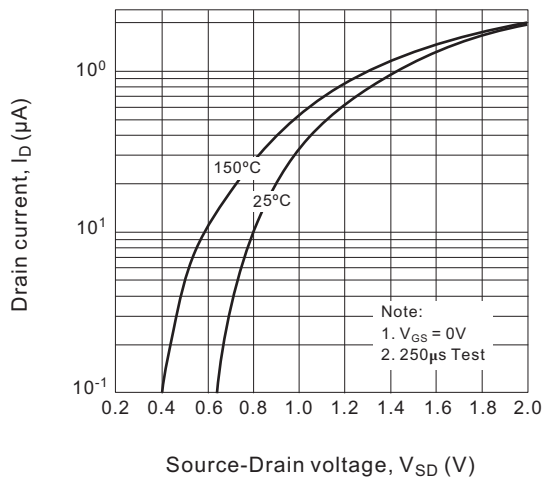


Fig.5 Capacitance characteristics

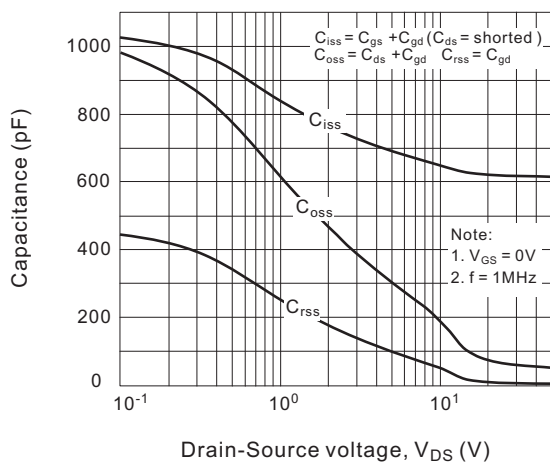
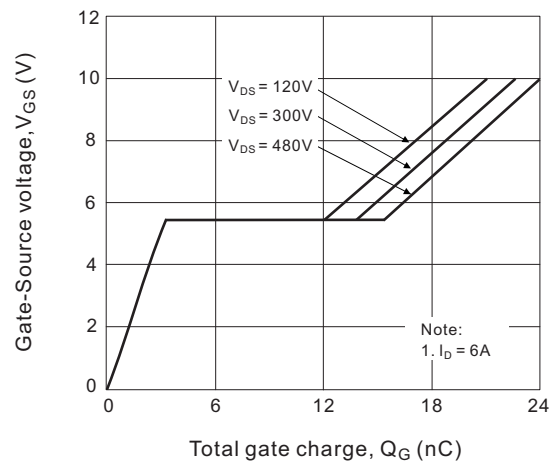


Fig.6 Gate charge characteristics



■ TYPICAL CHARACTERISTICS

Fig.7 Breakdown voltage variation vs. Temperature

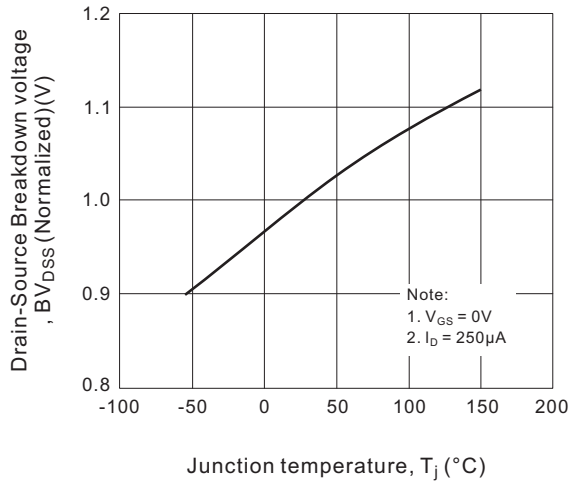


Fig.8 On-Resistance variation vs. junction temperature

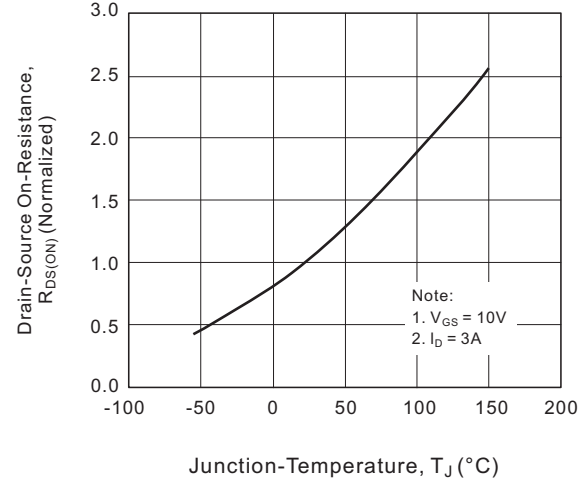


Fig.9-1 Maximum Safe operating area (for 6N60A)

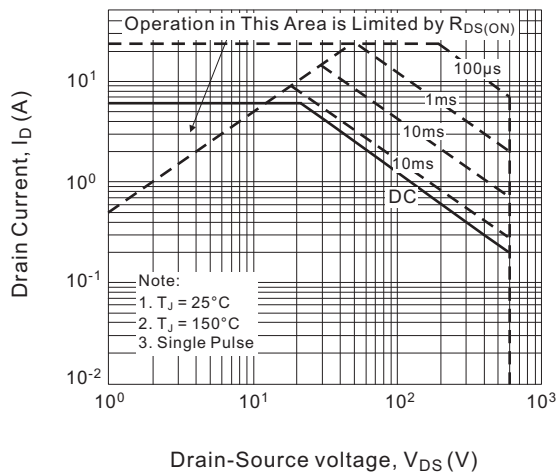


Fig.9-2 Maximum Safe operating area (for 6N60AF)

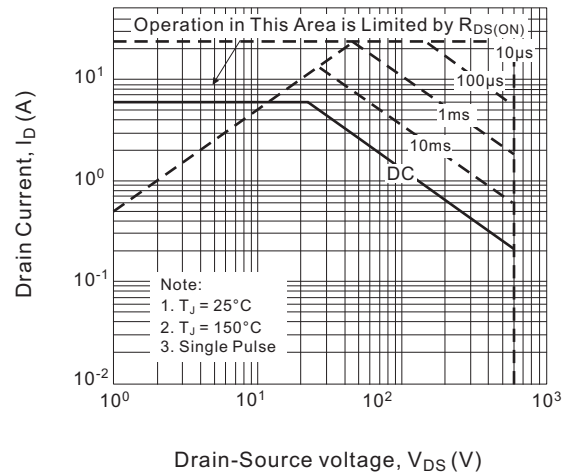


Fig.9-3 Maximum Safe operating area (for 6N60F/6N60G)

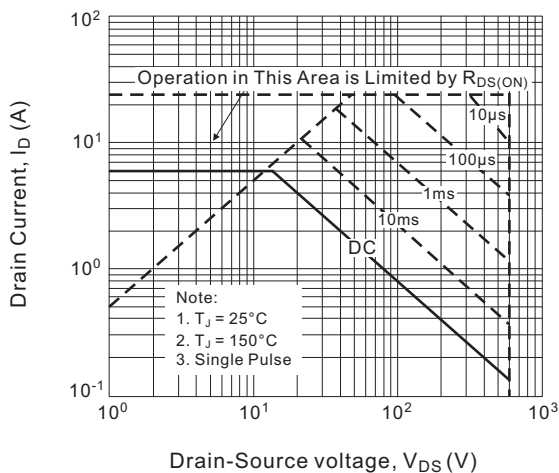
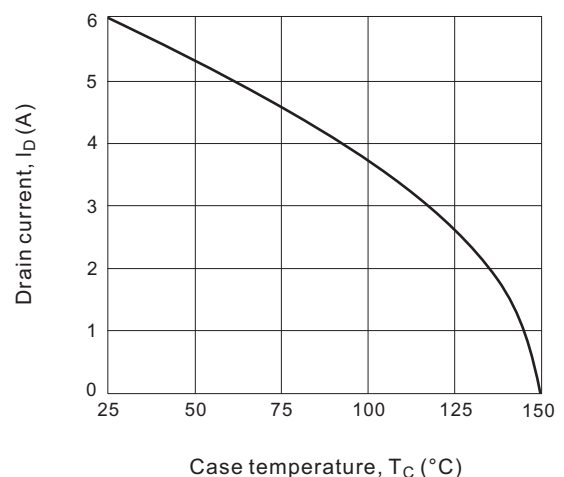


Fig.10 Maximum drain current vs. case temperature



■ TYPICAL CHARACTERISTICS

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

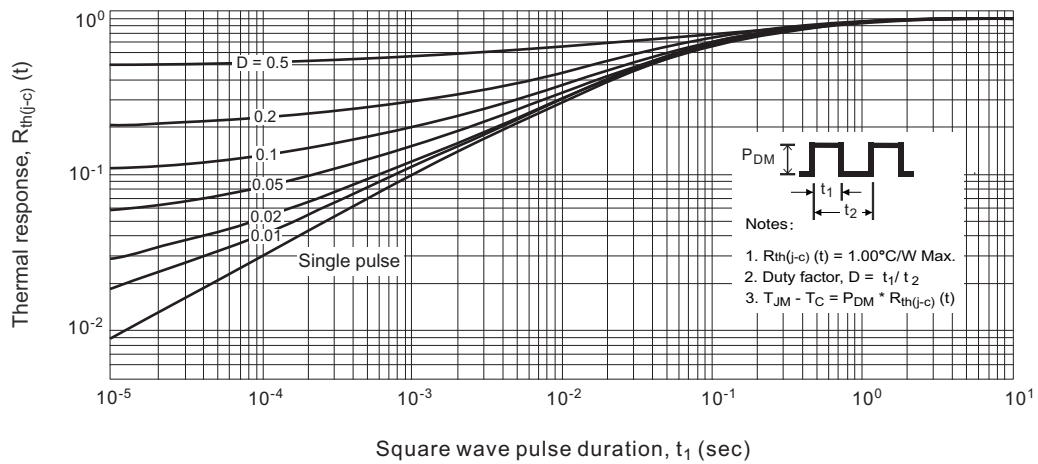


Fig.11-2 Transient thermal response curve for 6N60AF

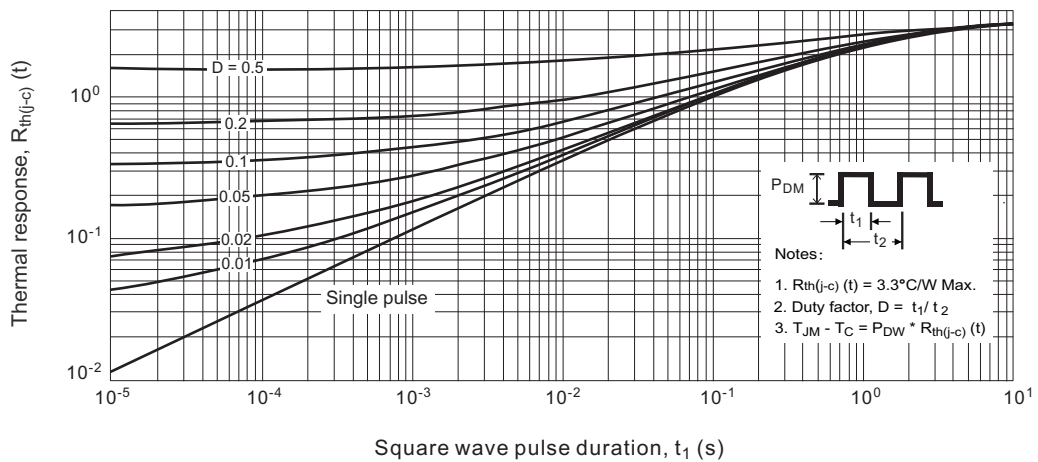
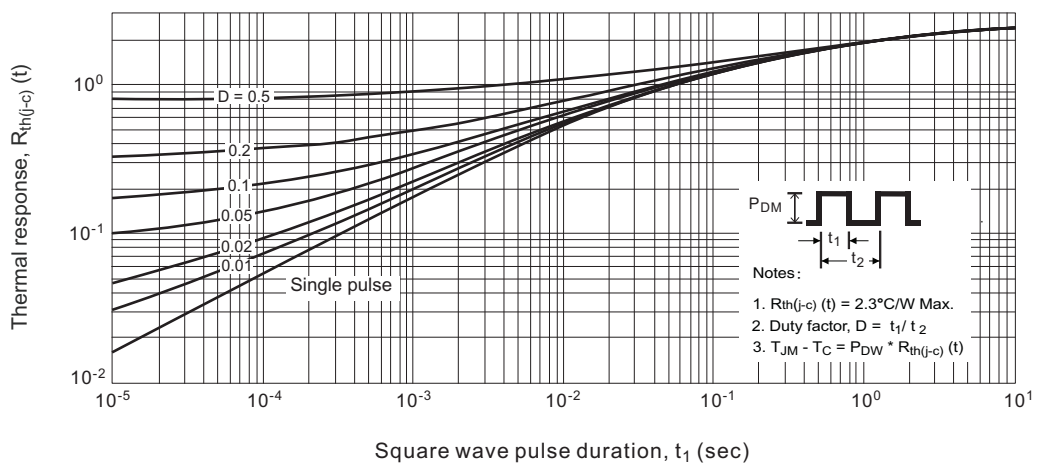
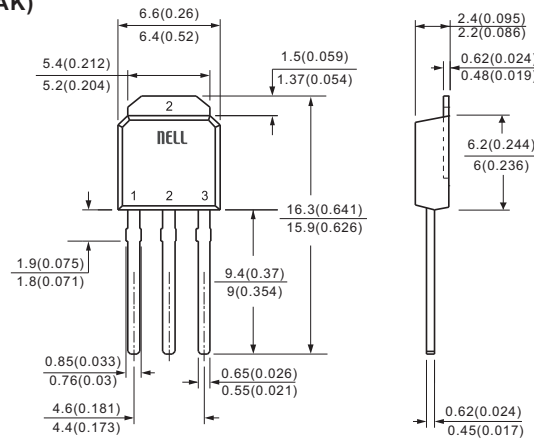


Fig.11-3 Transient thermal response curve (for 6N60F/6N60G)

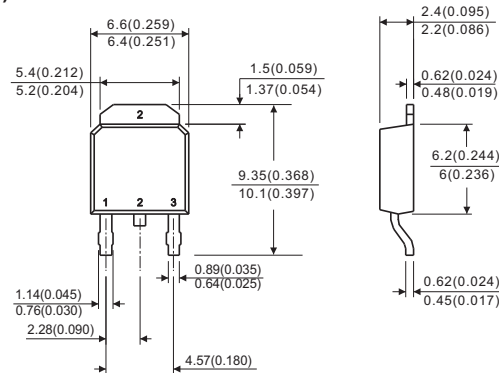


Case Style

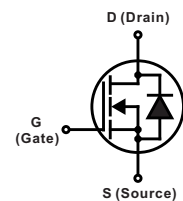
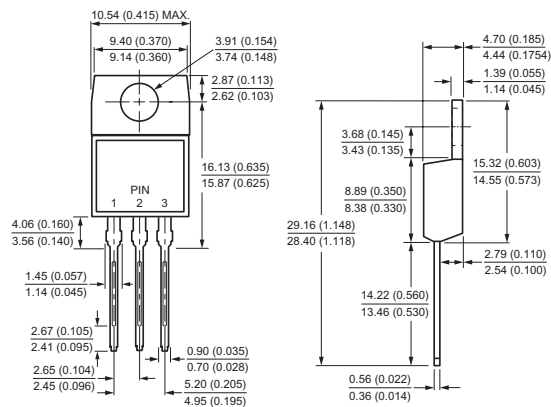
TO-251 (I-PAK)



TO-252 (D-PAK)



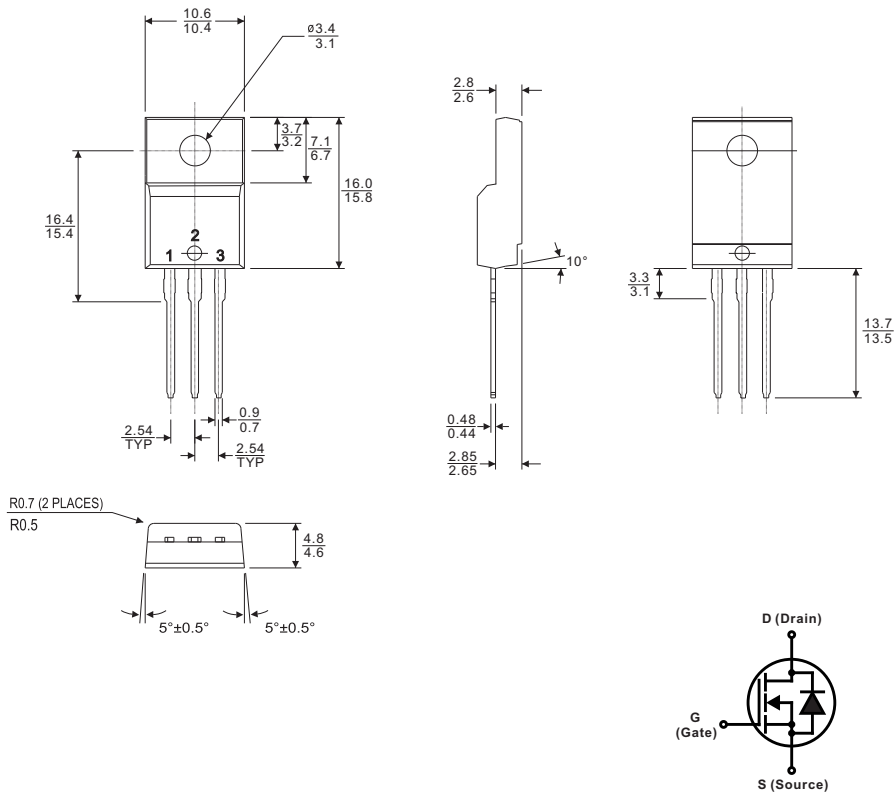
TO-220AB



All dimensions in millimeters(inches)

Case Style

TO-220F



All dimensions in millimeters