

N-Channel Power MOSFET (3A, 600Volts)

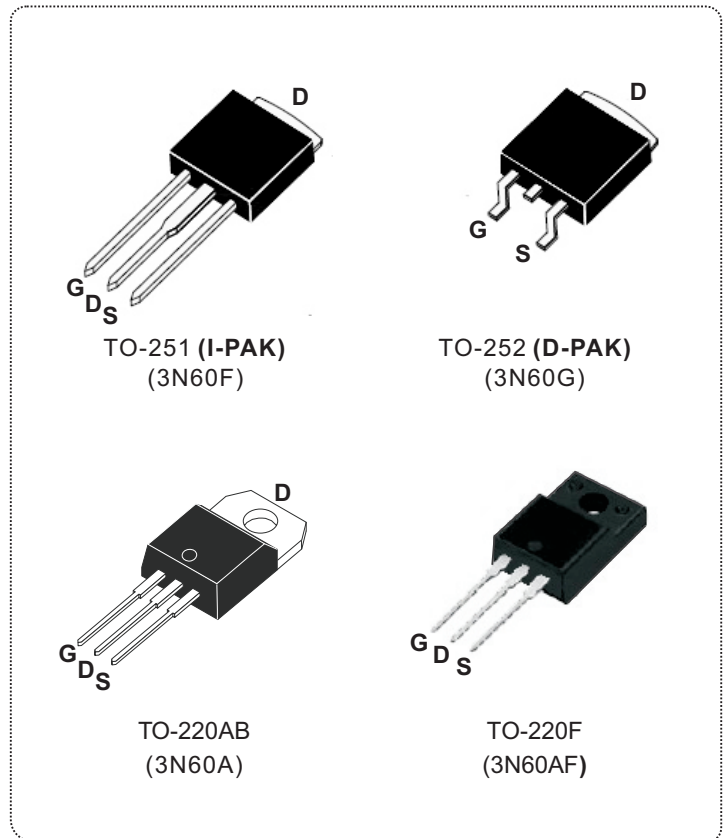
DESCRIPTION

The Nell **3N60** is a three-terminal silicon device with current conduction capability of 3A, fast switching speed, low on-state resistance, breakdown voltage rating of 600V, and max. threshold voltage of 4 volts.

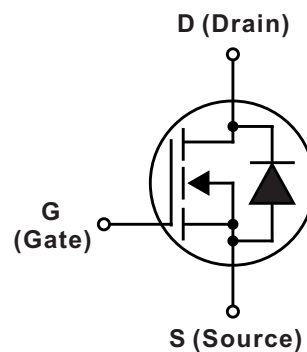
They are designed for use in applications such as switched mode power supplies, DC to DC converters, **PWM** motor controls, bridge circuits and general purpose switching applications.

FEATURES

- $R_{DS(ON)} = 3.6\Omega @ V_{GS} = 10V$
- Ultra low gate charge (13nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 5.5pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



PRODUCT SUMMARY	
I_D (A)	3
V_{DSS} (V)	600
$R_{DS(ON)}$ (Ω)	3.6 @ $V_{GS} = 10V$
Q_G (nC) max.	13

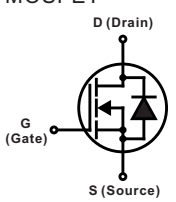


ABSOLUTE MAXIMUM RATINGS (T _C = 25°C unless otherwise specified)					
SYMBOL	PARAMETER	TEST CONDITIONS	VALUE	UNIT	
V _{DSS}	Drain to Source voltage	T _J =25°C to 150°C	600	V	
V _{DGR}	Drain to Gate voltage	R _{GS} =20KΩ	600		
V _{GS}	Gate to Source voltage		±30		
I _D	Continuous Drain Current	T _C =25°C	3	A	
		T _C =100°C	1.86		
I _{DM}	Pulsed Drain current(Note 1)		12		
I _{AR}	Avalanche current(Note 1)		3		
E _{AR}	Repetitive avalanche energy(Note 1)	I _{AR} =3A, R _{GS} =50Ω, V _{GS} =10V	7.5		mJ
E _{AS}	Single pulse avalanche energy (Note 2)	I _{AS} =3A, L = 64mH	200		
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	50	W
			TO-220AB	75	
			TO-220F	34	
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} = 3A, V_{DD} = 50V, L = 64mH, R_{GS} = 25Ω, starting T_J=25°C.
 3. I_{SD} ≤ 3A, 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		2.5	°C/W
		TO-220AB		1.7	
		TO-220F		3.7	
R _{th(j-a)}	Thermal resistance, junction to ambient	TO-251/TO-252		100	
		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			10.0	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 =1.5A, V _{GS} =10V		2.8	3.6	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} =25A, V _{GS} =0V, f=1MHz		350	450	pF
C _{OSS}	Output capacitance			50	65	
C _{RSS}	Reverse transfer capacitance			5.5	7.5	
t _{d(ON)}	Turn-on delay time	V _{DD} =300V, V _{GS} =10V, I _D =3A, R _{GS} =25Ω (Note 1, 2)		10	30	ns
t _r	Rise time			30	70	
t _{d(OFF)}	Turn-off delay time			20	50	
t _f	Fall time			30	70	
Q _G	Total gate charge	V _{DD} =480V, V _{GS} =10V, I _D =3A (Note 1,2)		10	13	nC
Q _{GS}	Gate to source charge			2.6		
Q _{GD}	Gate to drain charge (Miller charge)			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} = 3A, V _{GS} = 0V			1.4	V
I _S (I _{SD})	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET 			3	A
I _{SM}	Pulsed source current					
t _{rr}	Reverse recovery time	I _{SD} = 3A, V _{GS} = 0V, dI _F /dt = 100A/μs		210		ns
Q _{rr}	Reverse recovery charge				1.2	μC

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

ORDERING INFORMATION SCHEME

	3	N	60	A
Current rating, I_D				
3 = 3A				
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

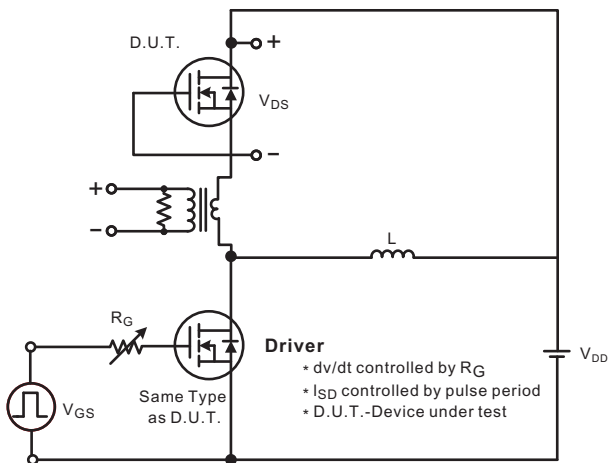
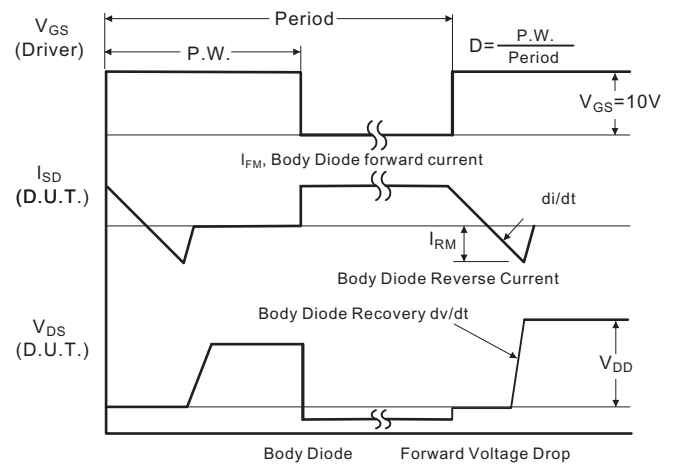


Fig.1B Peak diode recovery dv/dt waveforms



TEST CIRCUITS AND WAVEFORMS (Cont.)

Fig.2A Switching test circuit

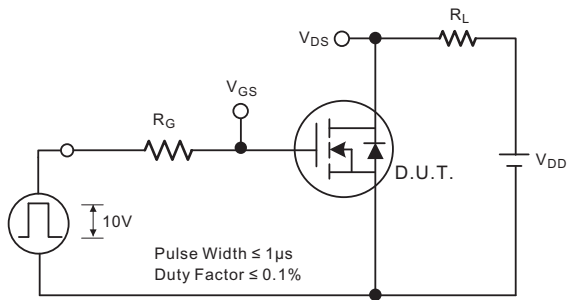


Fig.2B Switching Waveforms

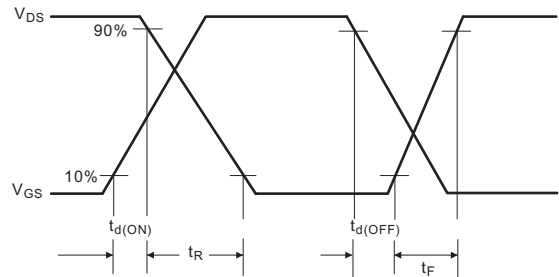


Fig.3A Gate charge test circuit

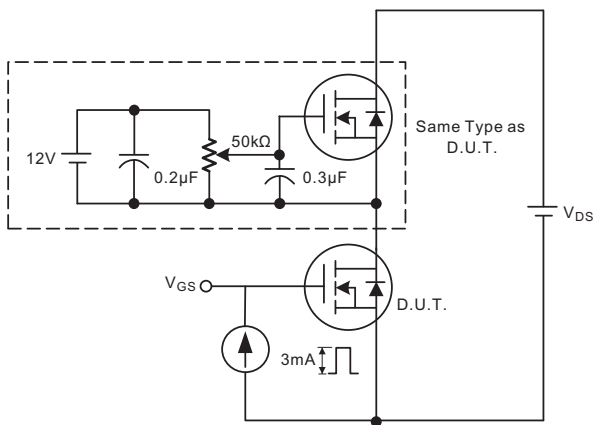


Fig.3B Gate charge waveform

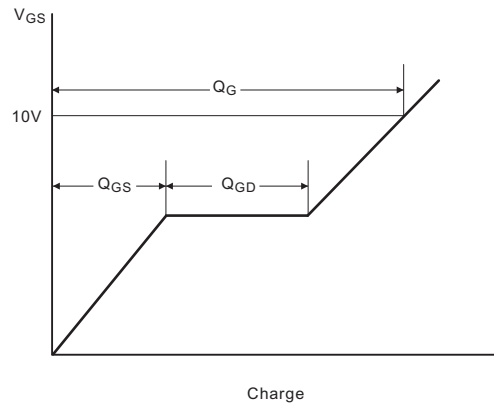


Fig.4A Unclamped Inductive switching test circuit

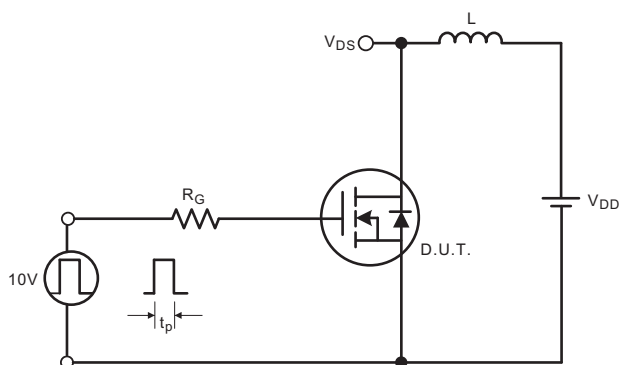
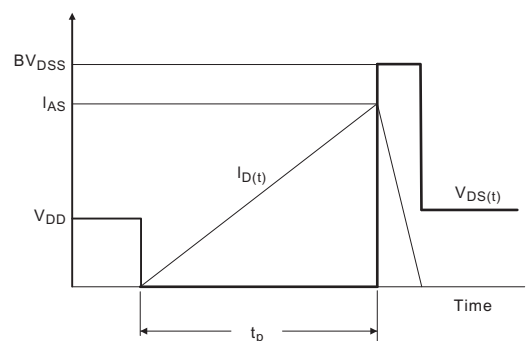


Fig.4B Unclamped Inductive switching waveforms



■ TYPICAL CHARACTERISTICS

Fig.1 On-state characteristics

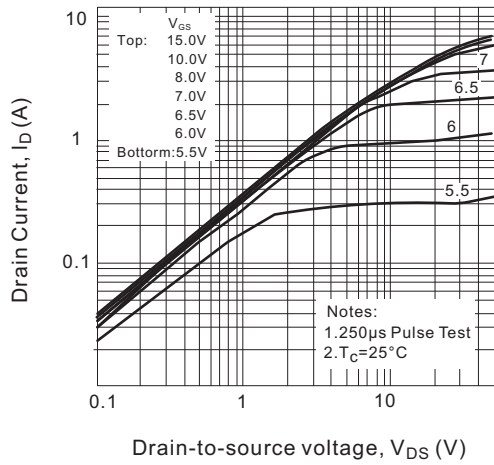


Fig.2 Transfer characteristics

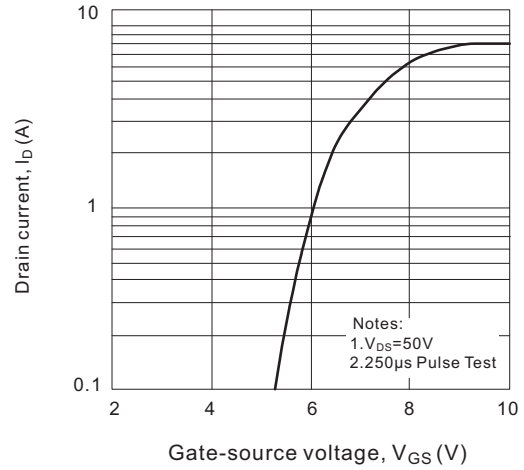


Fig.3 On-resistance variation vs. drain current and gate voltage

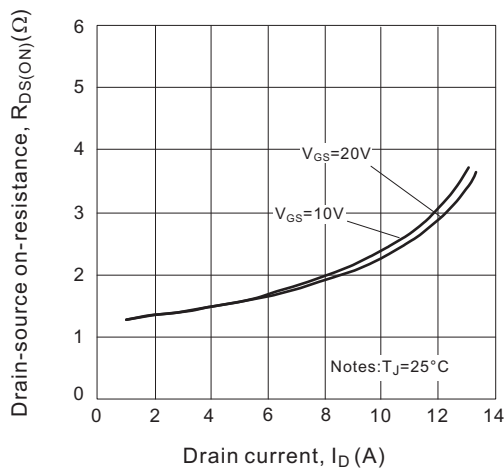


Fig.4 Reverse drain current vs. source-drain voltage

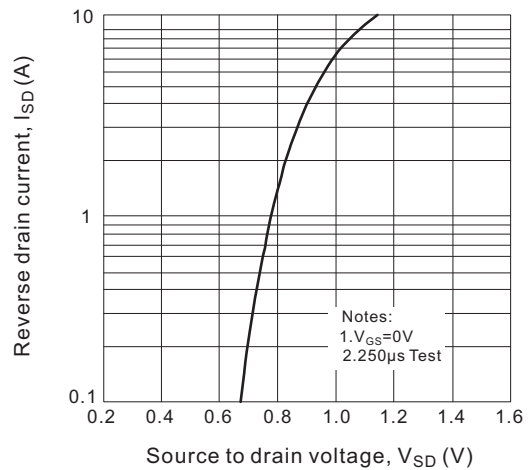


Fig.5 Capacitance characteristics (non-repetitive)

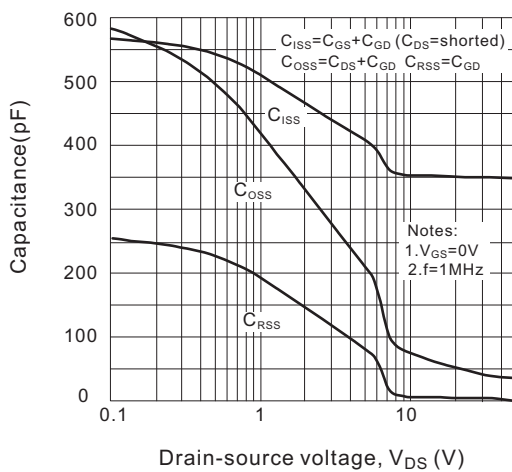
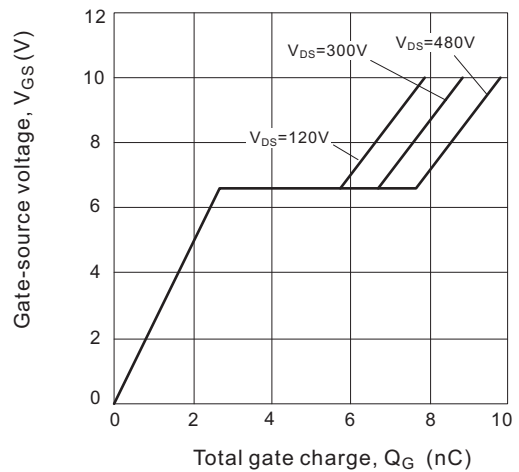


Fig.6 Gate charge characteristics



■ TYPICAL CHARACTERISTICS

Fig.7 Breakdown voltage variation vs. junction temperature

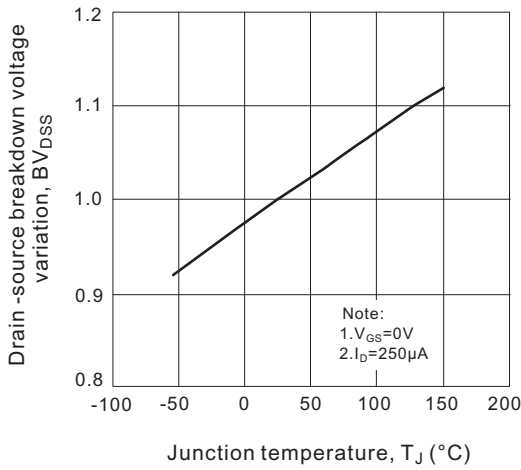


Fig.8 On-resistance variation vs. junction temperature

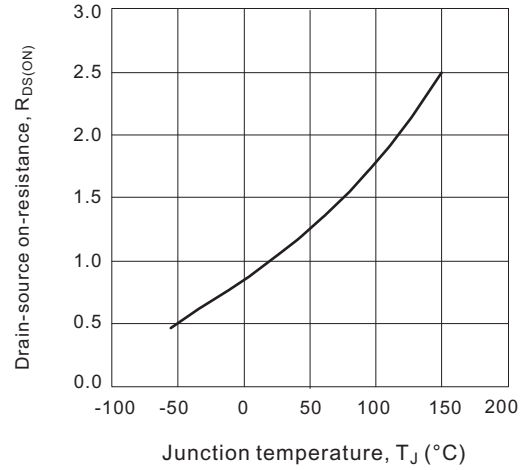


Fig.9 Transient thermal response curve

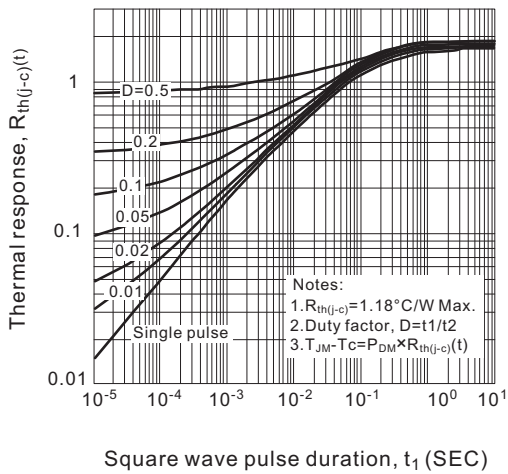


Fig.10 Maximum drain current vs. case temperature

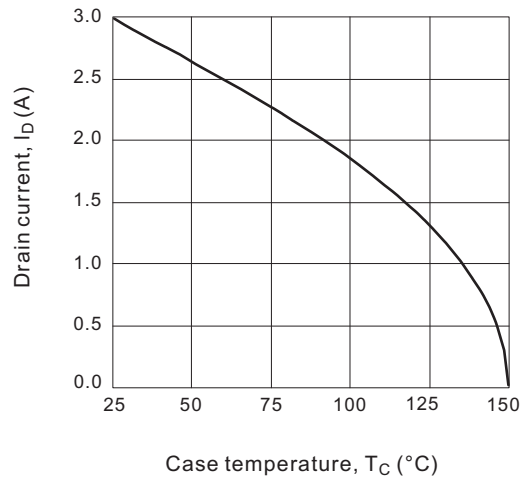
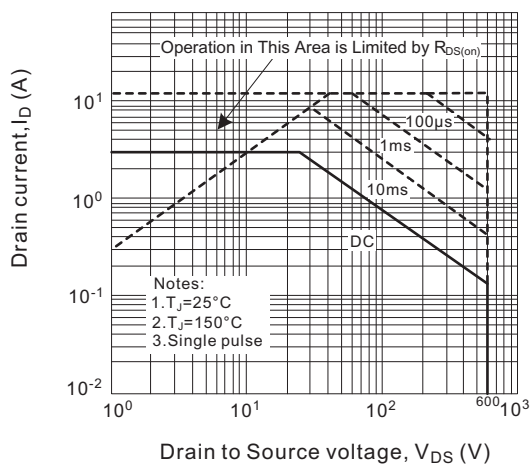
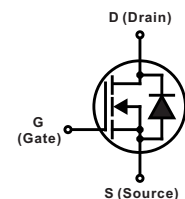
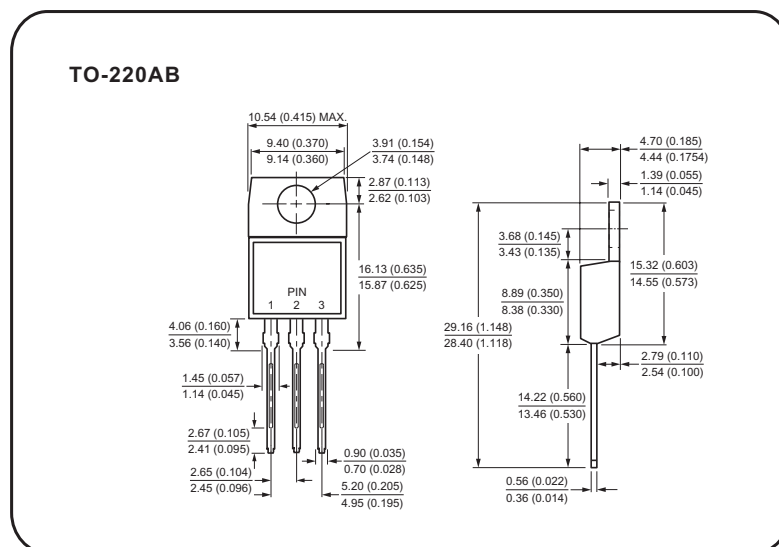
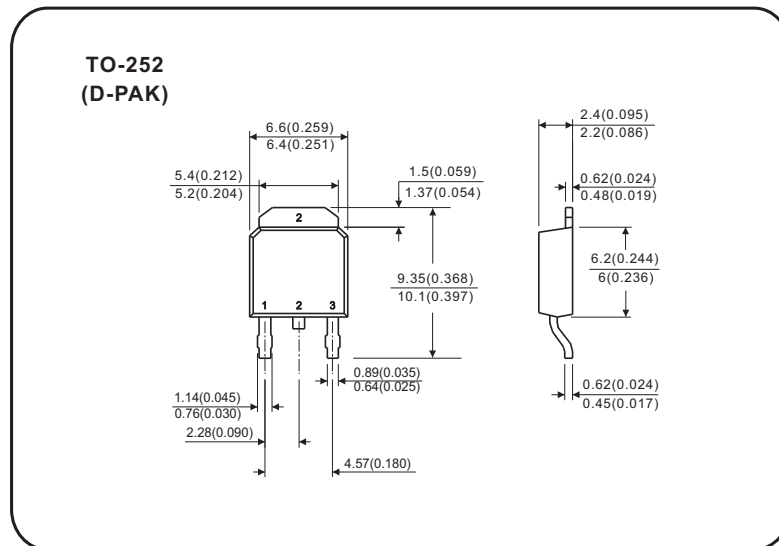
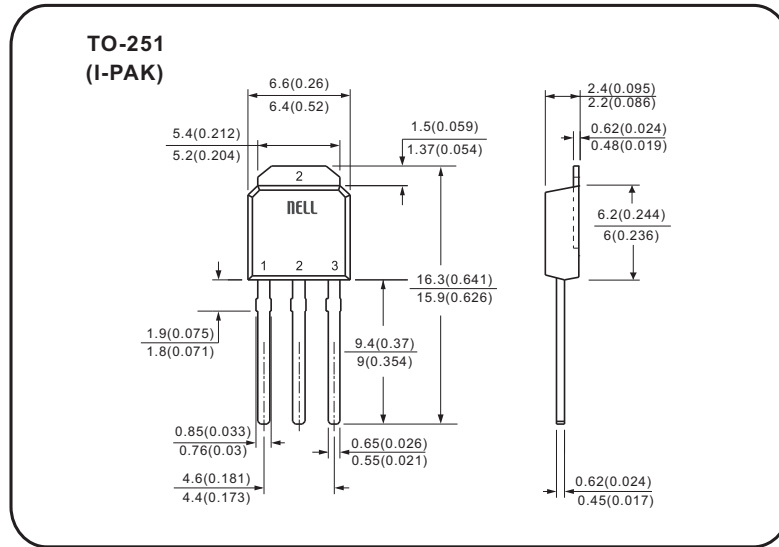


Fig.11 Safe operating area - 600V



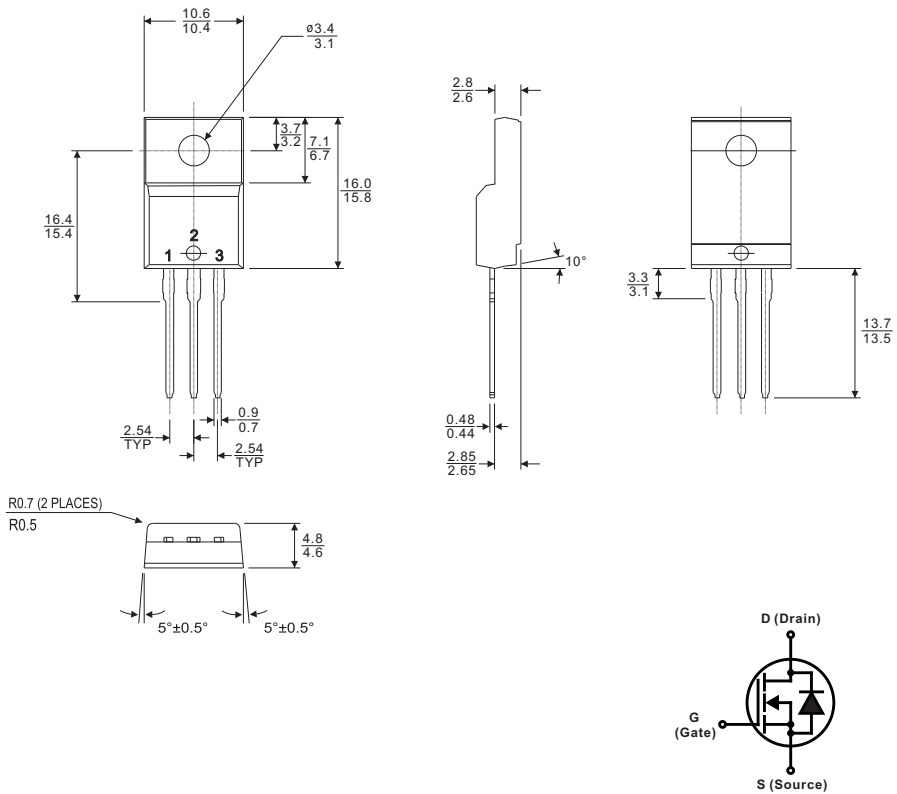
Case Style



All dimensions in millimeters(inches)

Case Style

TO-220F



All dimensions in millimeters