

N-Channel Power MOSFET 13A, 600Volts

DESCRIPTION

The Nell **13N60** is a three-terminal silicon device with current conduction capability of 13A, fast switching speed, low on-state resistance, breakdown voltage rating of 600V, and max. threshold voltage of 4 volts.

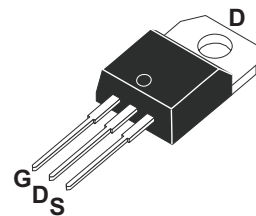
They are designed for use in applications such as switched mode power supplies. DC to DC converters, **PWM** motor controls, bridge circuits and general purpose switching applications.

FEATURES

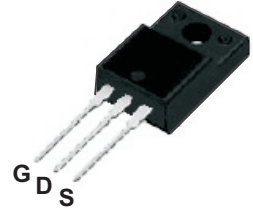
- $R_{DS(ON)} = 0.26\Omega$ @ $V_{GS} = 10V$
- Ultra low gate charge(40nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 3pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature

PRODUCT SUMMARY

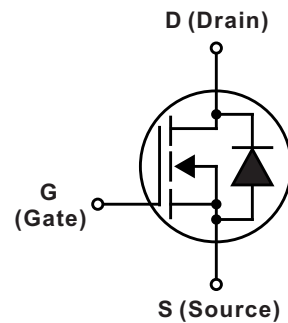
I_D (A)	13
V_{DSS} (V)	600
$R_{DS(ON)}$ (Ω)	0.26 @ $V_{GS} = 10V$
Q_G (nC) max.	40



TO-220AB
(13N60A)



TO-220F
(13N60AF)



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

SYMBOL	PARAMETER	TEST CONDITIONS		VALUE	UNIT
V_{DSS}	Drain to Source voltage	$T_J = 25^\circ C$ to $150^\circ C$		600	V
V_{DGR}	Drain to Gate voltage	$R_{GS} = 20K\Omega$		600	
V_{GS}	Gate to Source voltage			± 30	
I_D	Continuous Drain Current	$T_C = 25^\circ C$		13	A
		$T_C = 100^\circ C$		8.2	
I_{DM}	Pulsed Drain current(Note 1)			39	
I_{AR}	Avalanche current(Note 1)			4.3	mJ
E_{AR}	Repetitive avalanche energy(Note 1)	$I_{AR} = 4.3A, R_{GS} = 50\Omega, V_{GS} = 10V$		1.2	
E_{AS}	Single pulse avalanche energy (Note 2)	$I_{AS} = 4.3A$		235	
dv/dt	MOSFET dv/dt ruggedness			100	V/ns
	Peak diode recovery dv/dt (Note 3)			20	
P_D	Total power dissipation (Derate above $25^\circ C$)	$T_C = 25^\circ C$	TO-220AB	116(0.93)	W(W/ $^\circ C$)
			TO-220F	34(0.27)	
T_J	Operation junction temperature			-55 to 150	
T_{STG}	Storage temperature			-55 to 150	$^\circ C$
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)

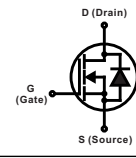
Note: 1. Repetitive rating: pulse width limited by junction temperature..

2. $I_{AS} = 4.3A, V_{DD} = 50V, R_{GS} = 25\Omega$, starting $T_J = 25^\circ C$.

3. $I_{SD} \leq 13A, di/dt \leq 200A/\mu s, V_{DD} \leq V_{(BR)DSS}$, 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			1.07	°C/W
		TO-220F			3.7	
$R_{th(j-a)}$	Thermal resistance, junction to ambient	TO-220AB			62.5	°C/W
		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 = 1mA, V _{GS} = 0V		600			V
ΔV _{(BR)DSS} /ΔT _J	Breakdown voltage temperature coefficient	I _D = 1mA, V _{DS} =V _{GS}			0.73		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	
◎ ON CHARACTERISTICS							
R _{DS(ON)}	Static drain to source on-state resistance	V _{GS} = 10V, I _D = 6.5A			0.24	0.26	Ω
V _{GS(TH)}	Gate threshold voltage	V _{GS} =V _{DS} , I _D =250μA		2		4	V
gfs	Forward transconductance	V _{DS} =40V, I _D =6.5A			16.3		S
◎ DYNAMIC CHARACTERISTICS							
C _{ISS}	Input capacitance	V _{DS} = 100V, V _{GS} = 0V, f = 1MHz		1325	1765	pF	
C _{OSS}	Output capacitance			50	65		
C _{RSS}	Reverse transfer capacitance			3	5		
C _{OSS}	Output capacitance	V _{DS} = 380V, V _{GS} = 0V, f = 1MHz		30			
C _{OSS} eff	Effective output capacitance	V _{DS} = 0 to 480V, V _{GS} = 0V			145		
Q _G	Total gate charge	V _{DD} = 380V, V _{GS} = 10V I _D = 6.5A, (Note1,2)		30.5	40	nC	
Q _{GS}	Gate to source charge			6.0			
Q _{GD}	Gate to drain charge (Miller charge)			9.5			
ESR	Equivalent series resistance (G-S)	Drain open			2.8		Ω
◎ SWITCHING CHARACTERISTICS							
t _{d(ON)}	Turn-on delay time	V _{DD} = 380V, V _{GS} = 10V I _D = 6.5A, R _G =4.7Ω (Note1,2)		14.5	39	ns	
t _r	Rise time			10.5	31.5		
t _{d(OFF)}	Turn-off delay time			45	100		
t _f	Fall time			10	30		

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	$I_{SD} = 6.5\text{A}$, $V_{GS} = 0\text{V}$			1.2	V
$I_S(I_{SD})$	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET 			13	A
I_{SM}	Pulsed source current				39	
t_{rr}	Reverse recovery time	$I_{SD} = 6.5\text{A}$, $V_{GS} = 0\text{V}$, $di_F/dt = 100\text{A}/\mu\text{s}$		280		ns
Q_{rr}	Reverse recovery charge			3.5		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

13 N 60 A

Current rating, I_D
13 = 13A

MOSFET series
N = N-Channel

Voltage rating, V_{DS}
60 = 600V

Package type
A = TO-220AB
AF = TO-220F

■ TEST CIRCUITS AND WAVEFORMS

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

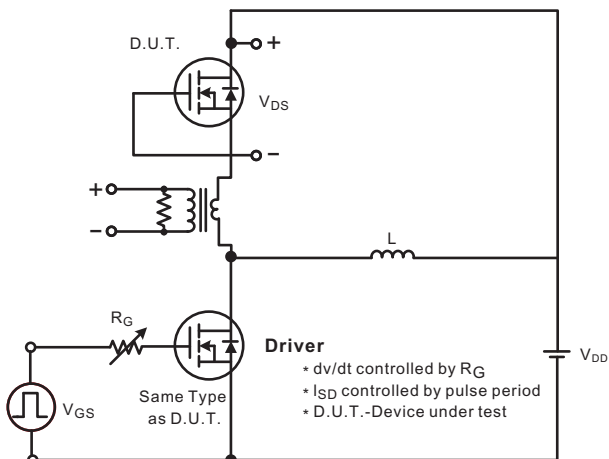
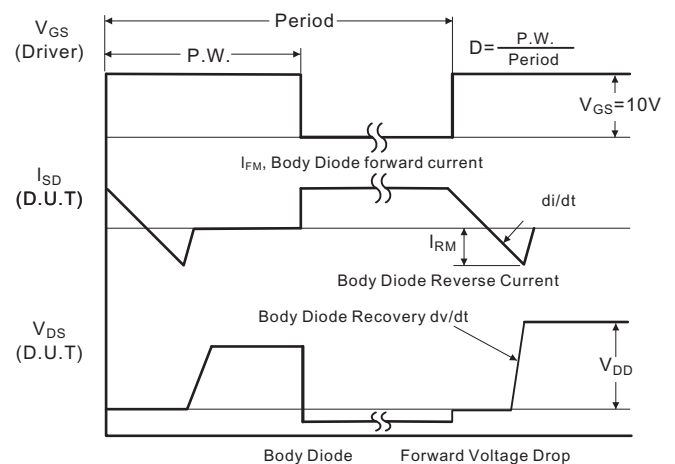


Fig.1B Peak diode recovery dv/dt waveforms



■ TEST CIRCUITS AND WAVEFORMS (Cont.)

Fig.2A Switching test circuit

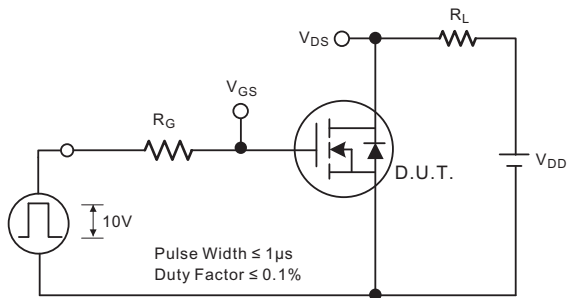


Fig.2B Switching Waveforms

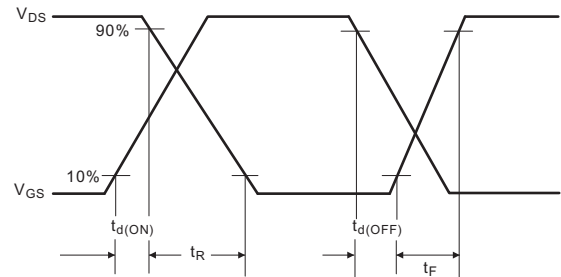


Fig.3A Gate charge test circuit

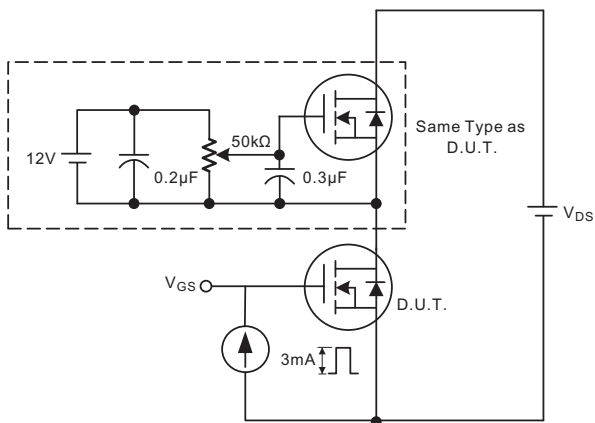


Fig.3B Gate charge waveform

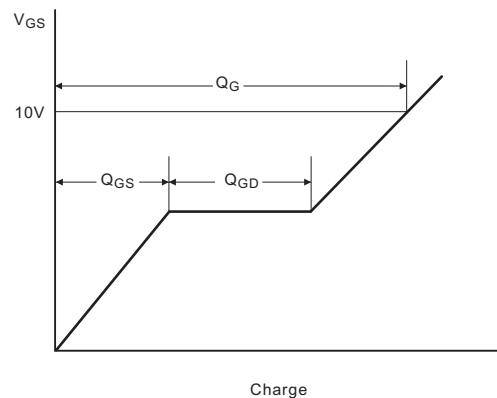


Fig.4A Unclamped Inductive switching test circuit

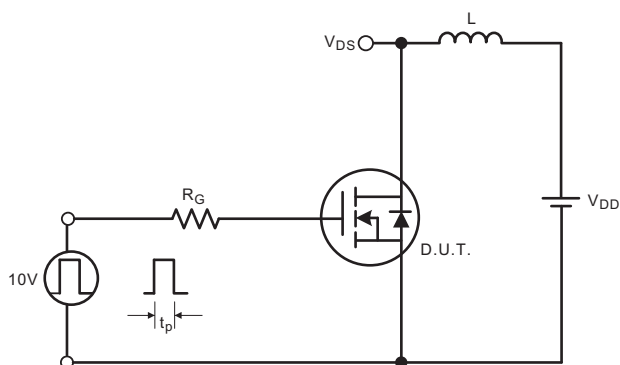
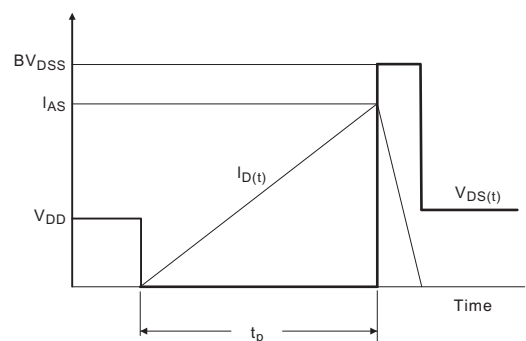


Fig.4B Unclamped Inductive switching waveforms



■ TYPICAL CHARACTERISTICS

Fig.1 On-State characteristics

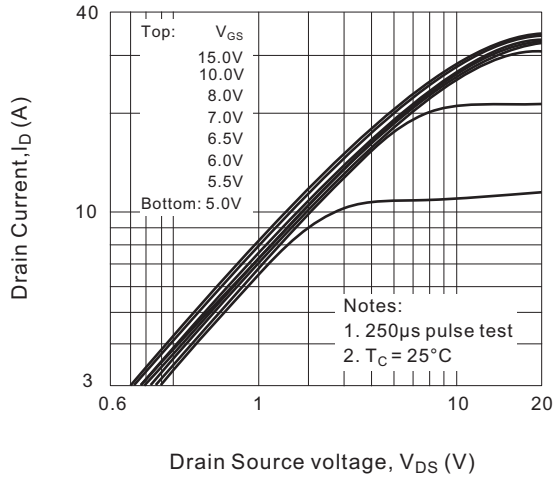


Fig.2 Transfer characteristics

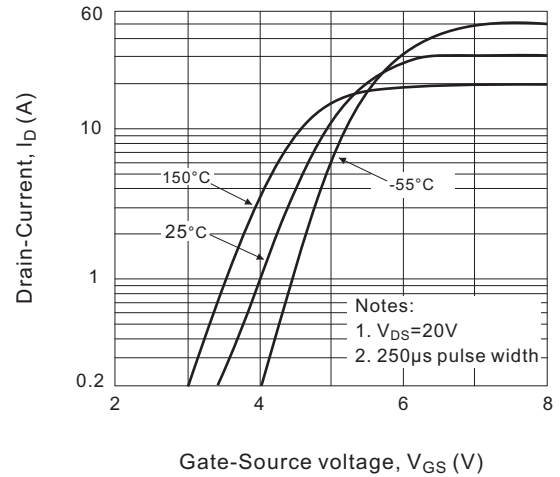


Fig.3 On-Resistance variation vs. Drain current and Gate voltage

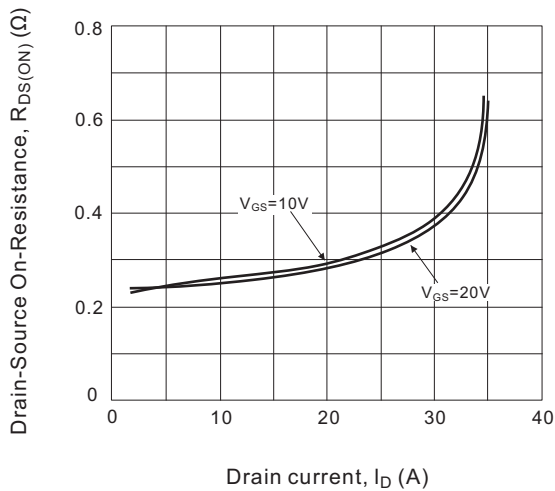


Fig.4 Body diode forward voltage variation vs. Source current and Temperature

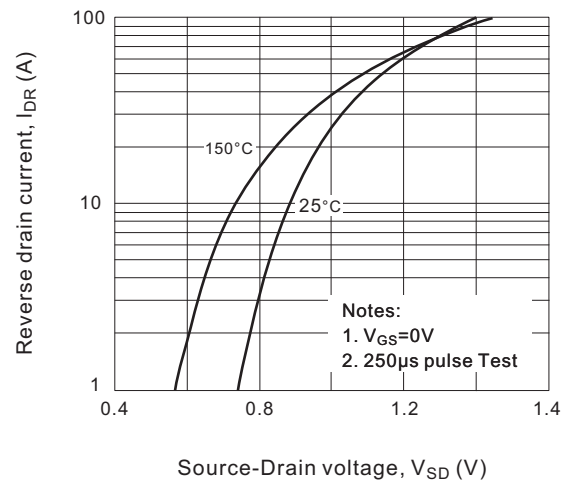


Fig.5 Capacitance characteristics

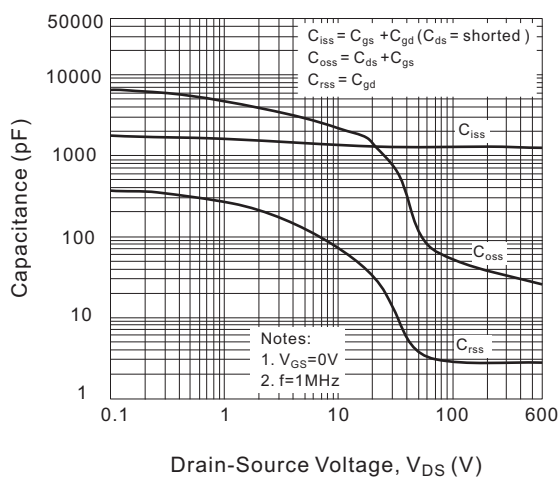


Fig.6 Gate charge characteristics

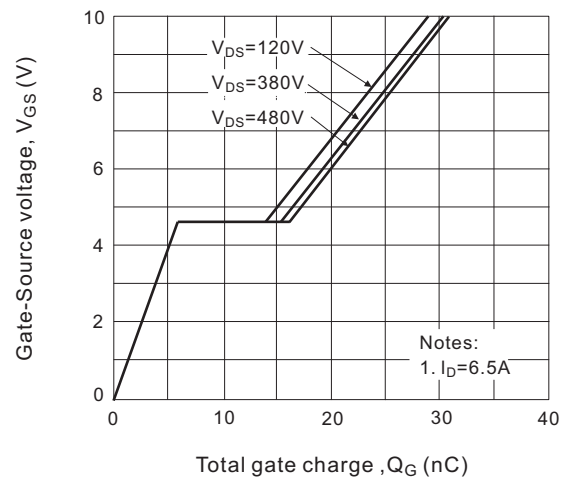


Fig.7a Maximum safe operating area for 13N60A

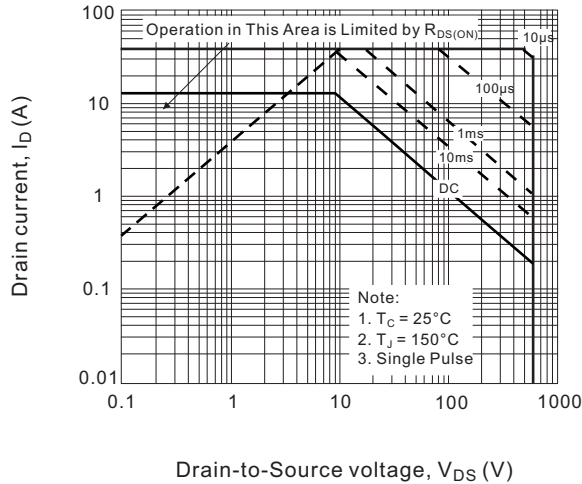


Fig.7b Maximum safe operating area for 13N60AF

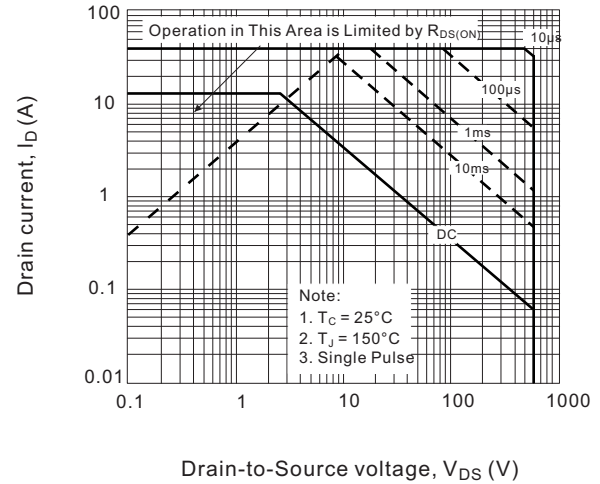


Fig.8a Transient thermal response curve for 13N60A

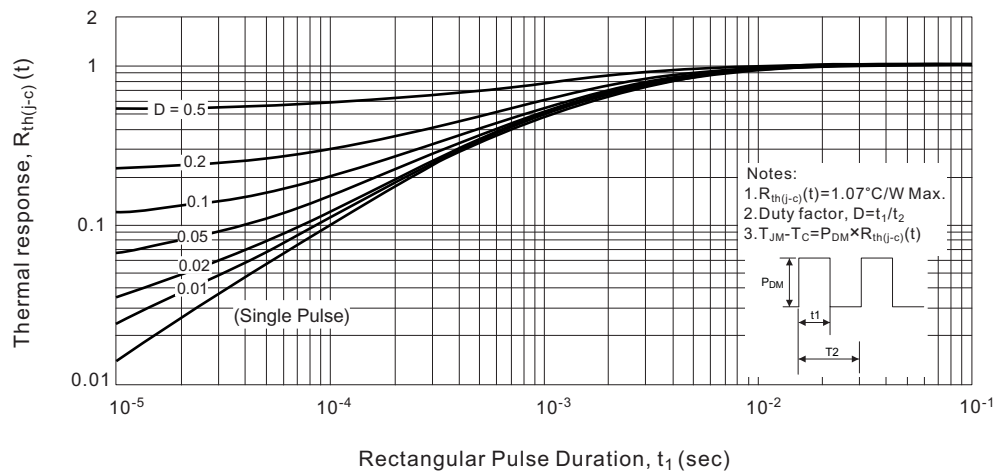


Fig.8b Transient thermal response curve for 13N60AF

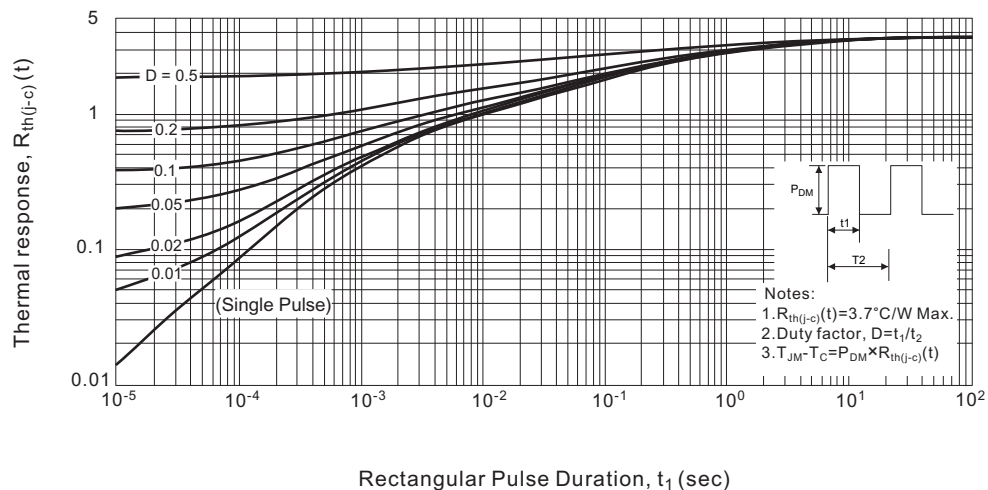


Fig.9 Breakdown voltage variation vs. temperature

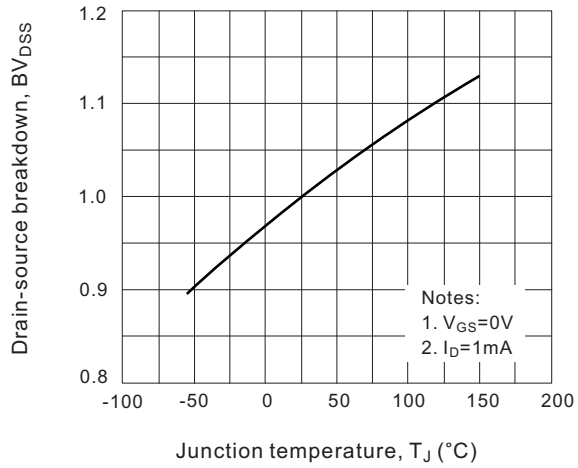


Fig.10 On-resistance variation vs. temperature

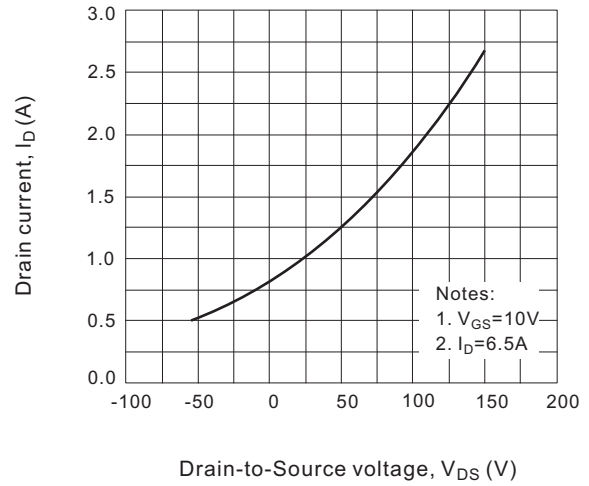
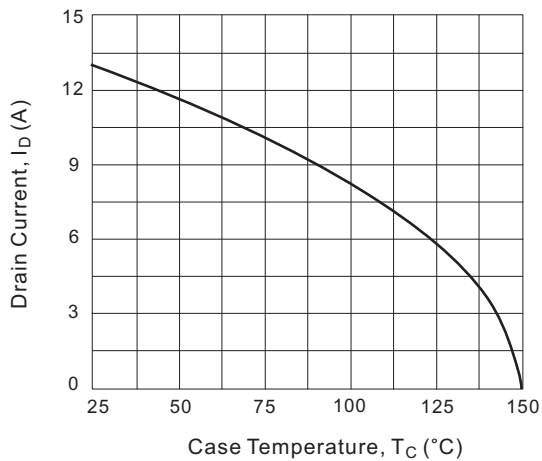
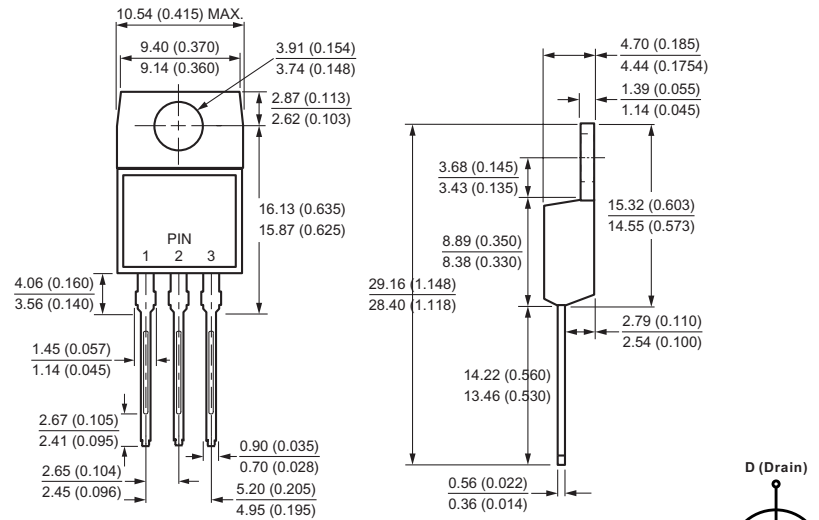


Fig.11 Maximum drain current vs. case temperature

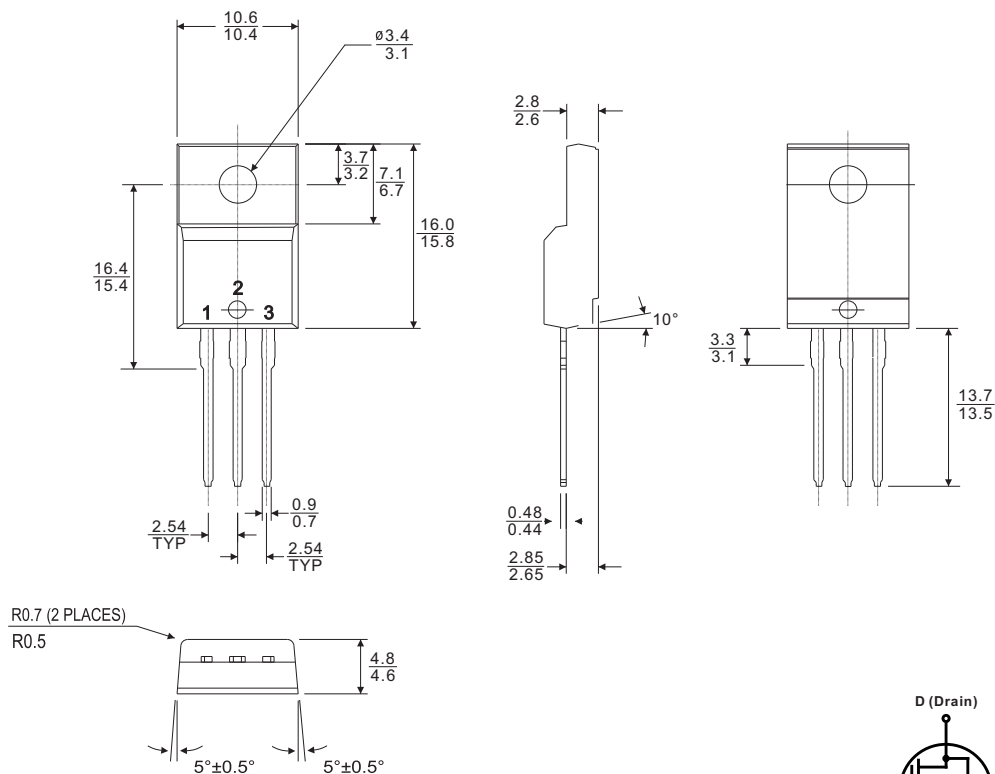


TO-220AB



All dimensions in millimeters(inches)

TO-220F



All dimensions in millimeters