

N-Channel Power MOSFET (10A, 600Volts)

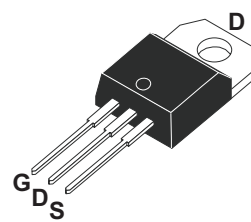
DESCRIPTION

The Nell **10N60** is a three-terminal silicon device with current conduction capability of 10A, fast switching speed, low on-state resistance, breakdown voltage rating of 600V, and max. threshold voltage of 4 volts.

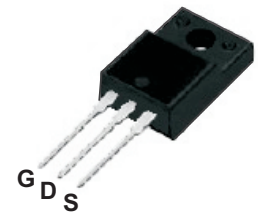
They are designed for use in applications such as switched mode power supplies, DC to DC converters, **PWM** motor controls, bridge circuits and general purpose switching applications.

FEATURES

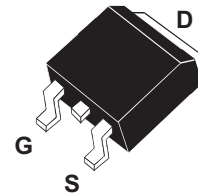
- $R_{DS(ON)} = 0.8\Omega @ V_{GS} = 10V$
- Ultra low gate charge(57nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 18pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



TO-220AB
(10N60A)

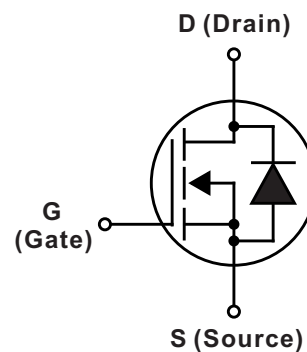


TO-220F
(10N60AF)



TO-263(D²PAK)
(10N60H)

PRODUCT SUMMARY	
I_D (A)	10
V_{DSS} (V)	600
$R_{DS(ON)}$ (Ω)	0.8 @ $V_{GS} = 10V$
Q_G (nC) max.	57

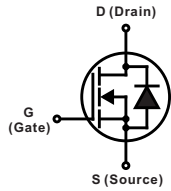


ABSOLUTE MAXIMUM RATINGS ($T_C = 25^{\circ}\text{C}$ unless otherwise specified)					
SYMBOL	PARAMETER	TEST CONDITIONS		VALUE	UNIT
V_{DSS}	Drain to Source voltage	$T_J = 25^{\circ}\text{C}$ to 150°C		600	V
V_{DGR}	Drain to Gate voltage	$R_{GS} = 20\text{K}\Omega$		600	
V_{GS}	Gate to Source voltage			± 30	
I_D	Continuous Drain Current	$T_C = 25^{\circ}\text{C}$		10	A
		$T_C = 100^{\circ}\text{C}$		6.2	
I_{DM}	Pulsed Drain current(Note 1)			40	
I_{AR}	Avalanche current(Note 1)			10	
E_{AR}	Repetitive avalanche energy(Note 1)	$I_{AR} = 10\text{A}$, $R_{GS} = 50\Omega$, $V_{GS} = 10\text{V}$		15.6	mJ
E_{AS}	Single pulse avalanche energy (Note 2)	$I_{AS} = 10\text{A}$, $L = 14.2\text{mH}$		700	
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-220AB/ TO-263	156	W
			TO-220F	50	
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. $I_{AS} = 10\text{A}$, $V_{DD} = 50\text{V}$, $L = 14.2\text{mH}$, $R_{GS} = 25\Omega$, starting $T_J = 25^{\circ}\text{C}$.
 3. $I_{SD} \leq 10\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, 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-220AB/ TO-263			0.8	$^{\circ}\text{C}/\text{W}$
		TO-220F			2.5	
$R_{th(j-a)}$	Thermal resistance, junction to ambient	TO-220AB/TO-263			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	$I_D = 250\mu\text{A}$, $V_{DS} = V_{GS}$		0.7		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	$I_D = 5\text{A}$, $V_{GS} = 10\text{V}$		0.72	0.80	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	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$		1570	2040	pF
C_{OSS}	Output capacitance			166	215	
C_{RSS}	Reverse transfer capacitance			18	24	
$t_{d(ON)}$	Turn-on delay time	$V_{DD} = 300\text{V}$, $V_{GS} = 10\text{V}$, $I_D = 10\text{A}$ $R_{GS} = 25\Omega$ (Note 1, 2)		23	55	ns
t_r	Rise time			69	150	
$t_{d(OFF)}$	Turn-off delay time			144	300	
t_f	Fall time			77	165	
Q_G	Total gate charge	$V_{DD} = 480\text{V}$, $V_{GS} = 10\text{V}$, $I_D = 10\text{A}$ (Note 1, 2)		44	57	nC
Q_{GS}	Gate to source charge			6.7		
Q_{GD}	Gate to drain charge (Miller charge)			18.5		

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	$I_{SD} = 10\text{A}$, $V_{GS} = 0\text{V}$			1.4	V
I_S (I_{SD})	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET			10	A
I_{SM}	Pulsed source current				40	
t_{rr}	Reverse recovery time	$I_{SD} = 10\text{A}$, $V_{GS} = 0\text{V}$, $dI_F/dt = 100\text{A}/\mu\text{s}$		420		ns
Q_{rr}	Reverse recovery charge			4.2		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

	10	N	60	A
Current rating, I_D				
10 = 10A				
MOSFET series				
N = N-Channel				
Voltage rating, V_{DS}				
60 = 600V				
Package type				
A = TO-220AB				
AF = TO-220F				
H = TO-263P(D ² PAK)				

■ TEST CIRCUITS AND WAVEFORMS

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

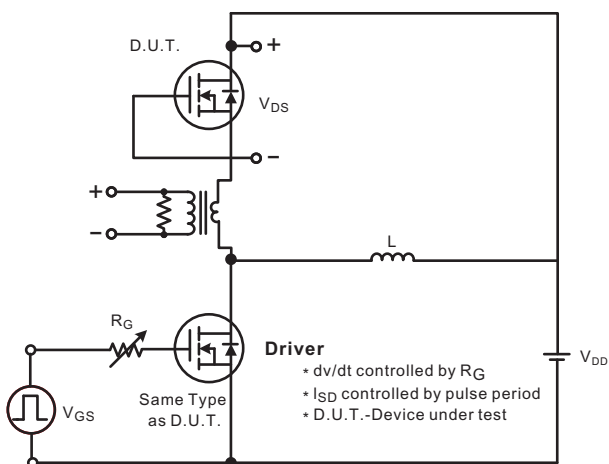
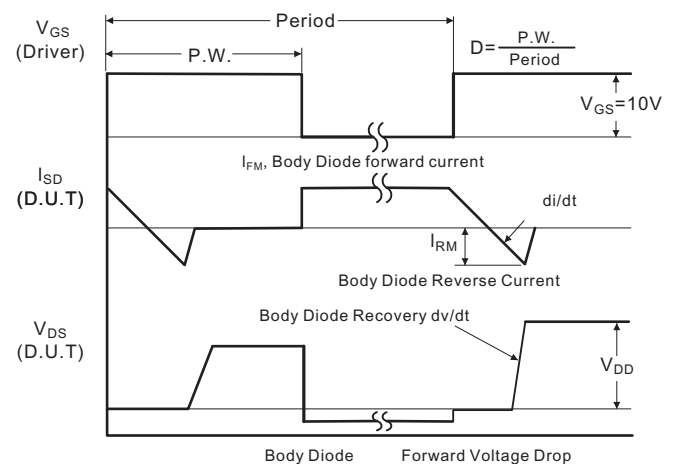


Fig.1B Peak diode recovery dv/dt waveforms



■ TEST CIRCUITS AND WAVEFORMS (Cont.)

Fig.2A Switching test circuit

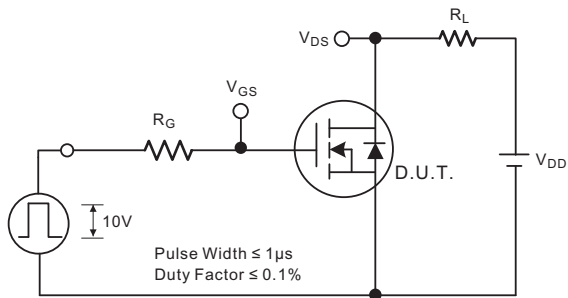


Fig.2B Switching Waveforms

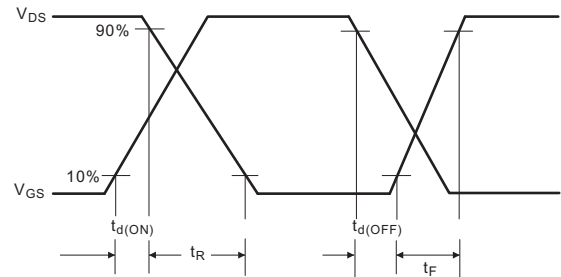


Fig.3A Gate charge test circuit

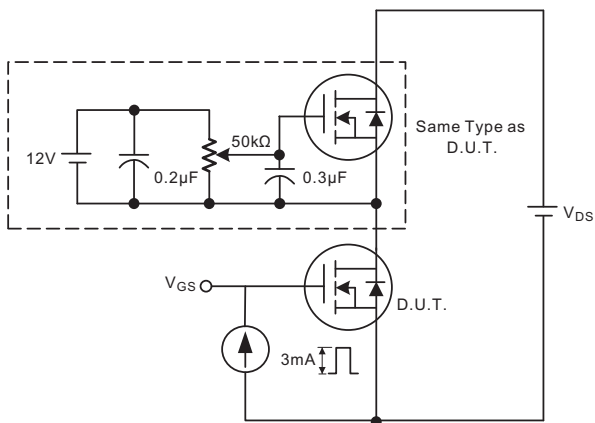


Fig.3B Gate charge waveform

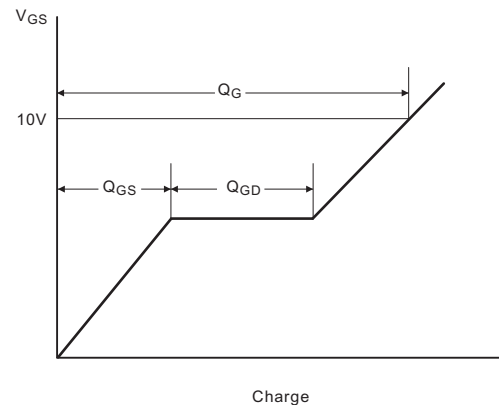


Fig.4A Unclamped Inductive switching test circuit

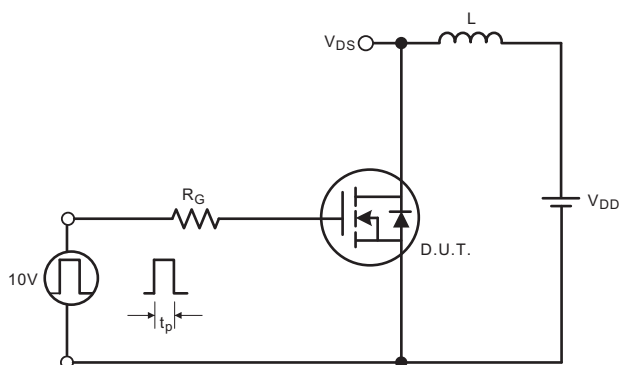
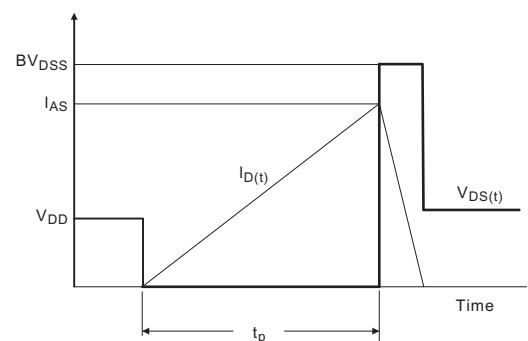


Fig.4B Unclamped Inductive switching waveforms



■ TYPICAL CHARACTERISTICS

Fig.1 On-State characteristics

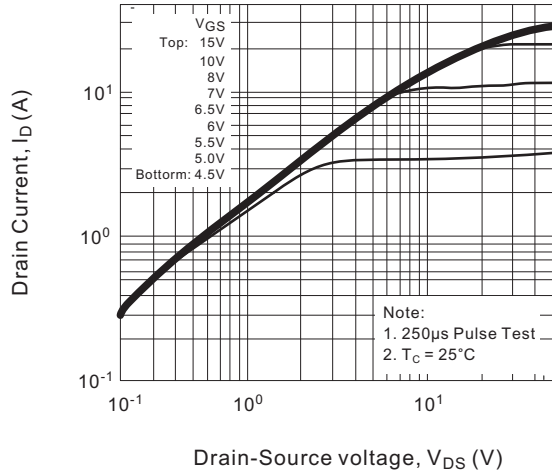


Fig.2 Transfer characteristics

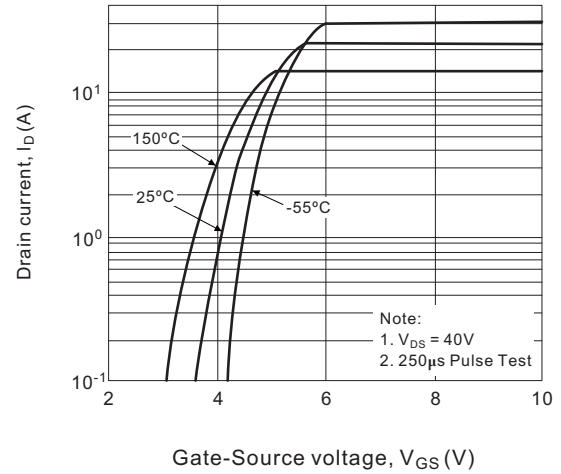


Fig.3 On-Resistance variation vs. drain current and gate voltage

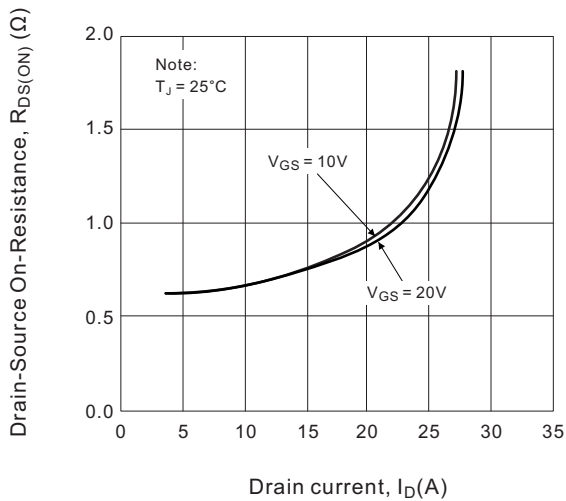


Fig.4 Body diode forward voltage variation with Source current and Temperature

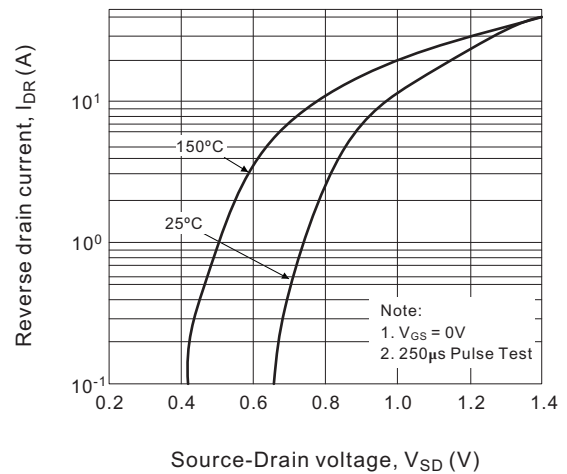


Fig.5 Capacitance characteristics

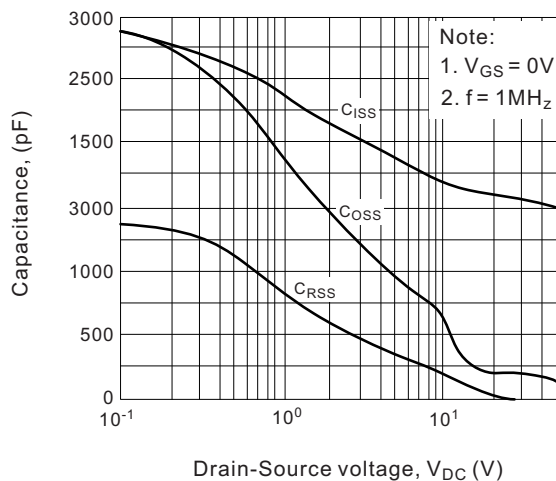


Fig.6 Gate charge characteristics

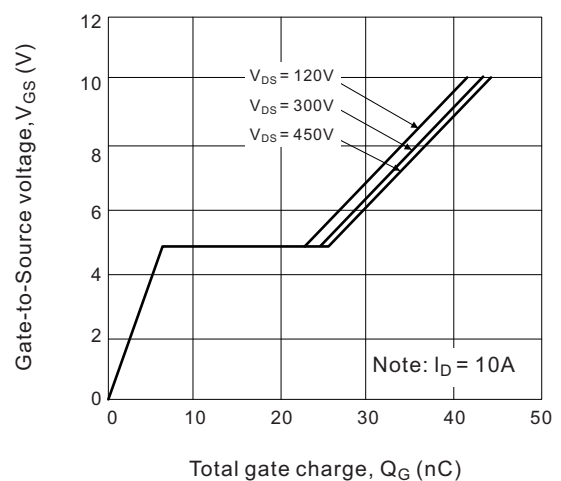


Fig.7 Breakdown voltage variation vs. Temperature

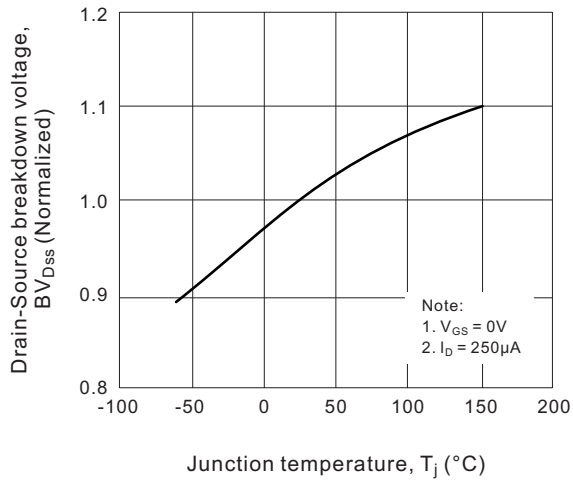


Fig.8 On-Resistance variation vs. Temperature

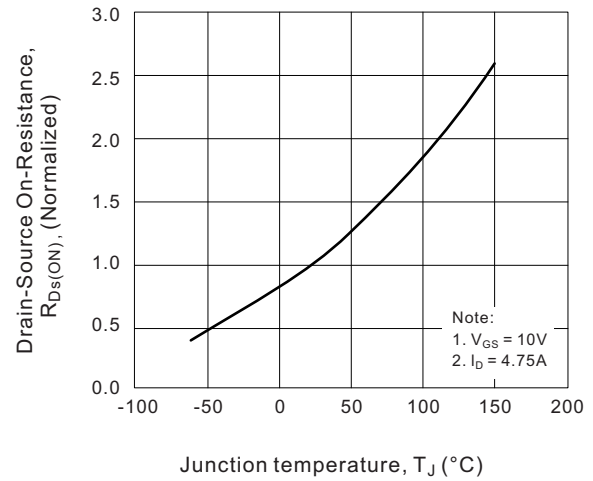


Fig.9 Maximum safe operating area

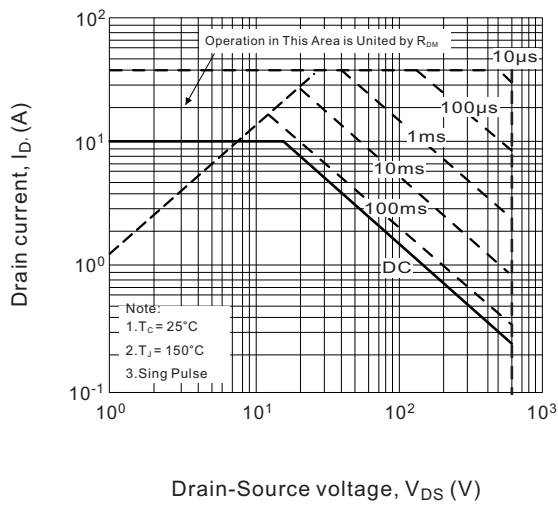


Fig.10 Maximum drain current vs. Case temperature

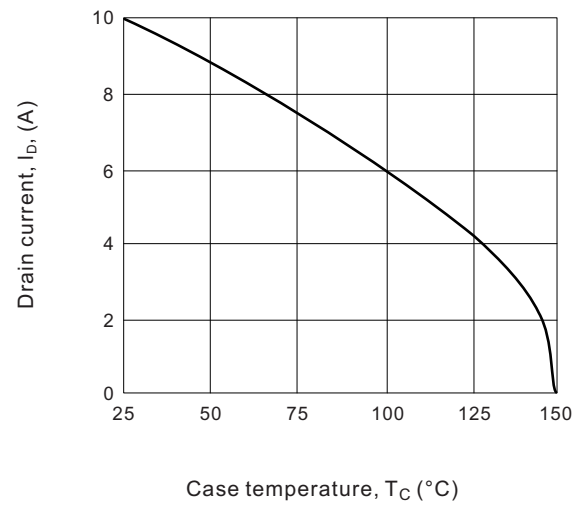
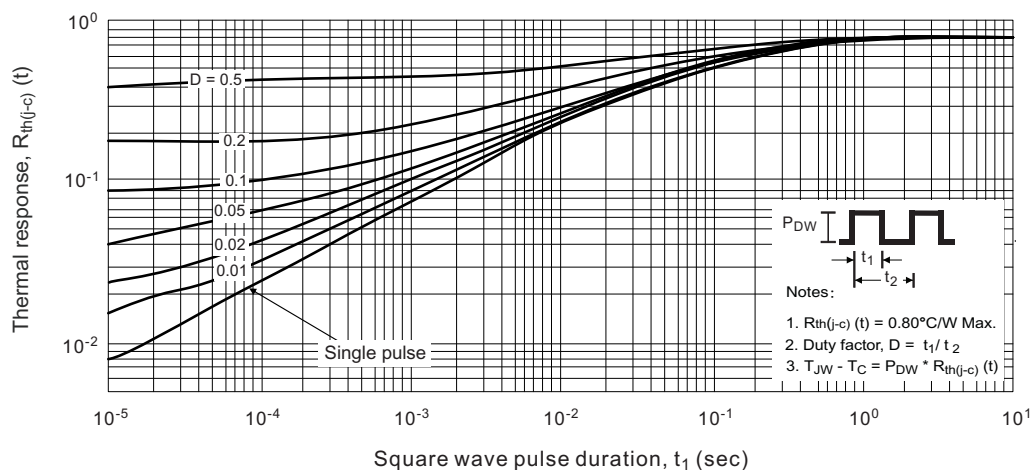
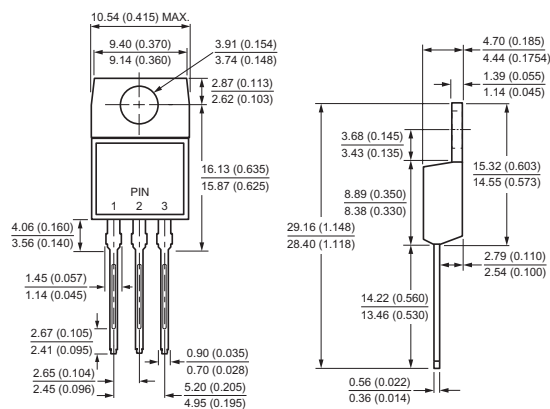


Fig.11 Transient thermal response curve

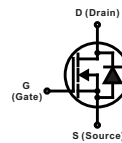


Case Style

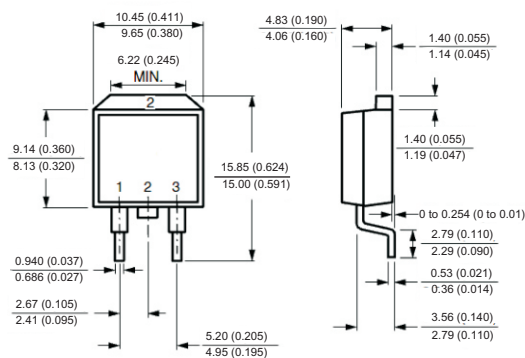
TO-220AB



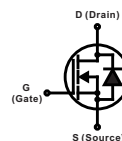
All dimensions in millimeters(inches)



TO-263(D²PAK)

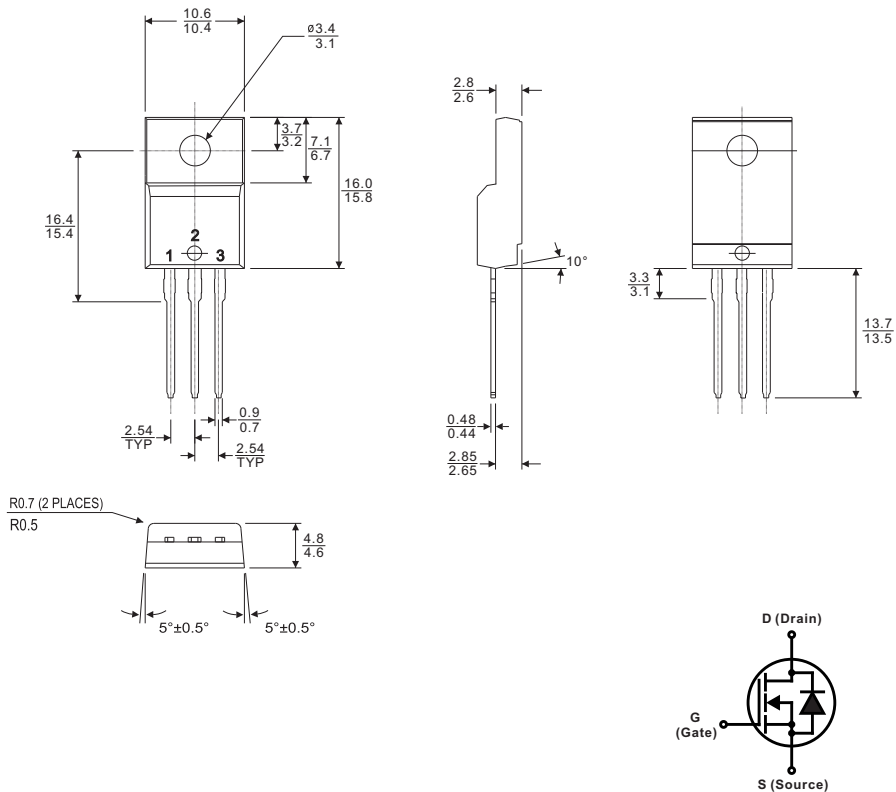


All dimensions in millimeters(inches)



Case Style

TO-220F



All dimensions in millimeters