

N-Channel Power MOSFET (16A, 600Volts)

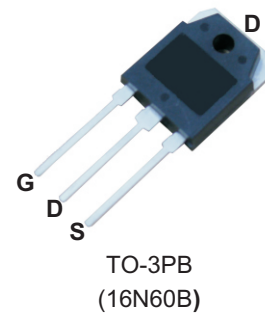
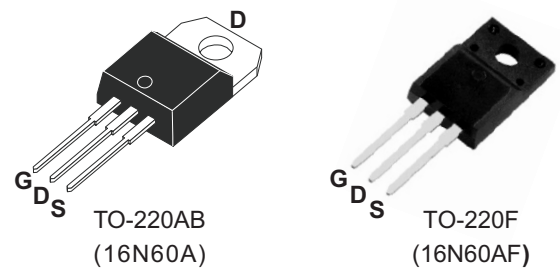
DESCRIPTION

The Nell **16N60** is a three-terminal silicon device with current conduction capability of 16A, fast switching speed, low on-state resistance, breakdown voltage rating of 600V, and max. threshold voltage of 4 volts.

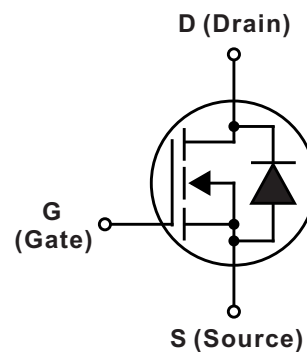
They are designed for use in applications, such as switched mode power supplies, DC to DC converters, **PWM** motor controls, server/telecom power, FPD TV power, ATX power, and industrial power applications.

FEATURES

- $R_{DS(ON)} = 0.17\Omega @ V_{GS} = 10V$
- Ultra low gate charge(52.3nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 5pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



PRODUCT SUMMARY	
I_D (A)	16
V_{DSS} (V)	600
$R_{DS(ON)}$ (Ω)	0.17 @ $V_{GS} = 10V$
Q_G (nC) max.	52.3



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	$T_C = 25^\circ\text{C}$		16	A
		$T_C = 100^\circ\text{C}$		10.1	
I_{DM}	Pulsed Drain current(Note 1)			48	
I_{AR}	Avalanche current(Note 1)			5.3	
E_{AR}	Repetitive avalanche energy(Note 1)	$I_{AR} = 16\text{A}$, $R_{GS} = 50\Omega$, $V_{GS} = 10\text{V}$		1.34	mJ
E_{AS}	Single pulse avalanche energy(Note 2)	$I_{AS} = 5.3\text{A}$, $L = 7.1\text{mH}$		355	
dv/dt	MOSFET dv/dt ruggedness(Note 3)			100	V/ns
	Peak diode recovery dv/dt(Note 3)			20	
P_D	Total power dissipation	$T_C = 25^\circ\text{C}$	TO-220AB/TO-3PB	134.4	W
			TO-220F	35.7	
	Derate above 25°C	$T_C = 25^\circ\text{C}$	TO-220AB/TO-3PB	1.08	W/ $^\circ\text{C}$
			TO-220F	0.29	
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..

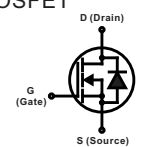
2. $I_{AS} = 5.3\text{A}$, $V_{DD} = 50\text{V}$, $R_{GS} = 25\Omega$, starting $T_J = 25^\circ\text{C}$.

3. $I_{SD} \leq 16\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} = 380\text{V}$, 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-3PB		0.93	$^\circ\text{C}/\text{W}$
		TO-220F		3.5	
$R_{th(c-s)}$	Thermal resistance, case to heatsink	TO-3PB		0.24	
		TO-220AB/TO-220F		0.5	
$R_{th(j-a)}$	Thermal resistance, junction to ambient	TO-3PB		40	
		TO-220AB/TO220F		62.5	

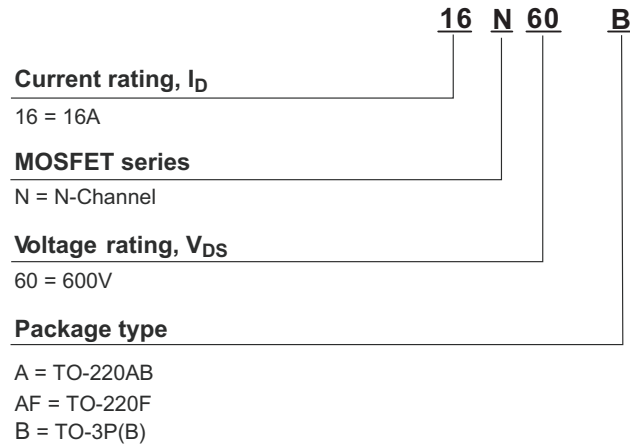
Nell High Power Products

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 = 8A		0.17	0.199	Ω
V _{GS(TH)}	Gate threshold voltage	V _{GS} = V _{DS} , I _D = 250μA	2		4	V
g _{fs}	Forward transconductance	V _{DS} = 40V I _D = 8A	TO-3PB		20	S
			TO-220AB/TO-220F		13	
DYNAMIC CHARACTERISTICS						
C _{ISS}	Input capacitance	V _{DS} = 100V, V _{GS} = 0V, f = 1MHz		1630	2170	pF
C _{OSS}	Output capacitance		70	95		
C _{RSS}	Reverse transfer capacitance		5	10		
C _{OSS}	Output capacitance	V _{DS} = 380V, V _{GS} = 0V, f = 1MHz		40	60	
C _{OSSeff.}	Effective output capacitance	V _{DS} = 0 to 480V, V _{GS} = 0V		176		
SWITCHING CHARACTERISTICS						
t _{d(ON)}	Turn-on delay time	V _{DD} = 380V, V _{GS} = 10V I _D = 8A, R _{GS} = 4.7Ω (Note1,2)		15.8	41.6	ns
t _r	Rise time		15.5	41		
t _{d(OFF)}	Turn-off delay time		60.3	130.6		
t _f	Fall time		20.2	50.4		
Q _G	Total gate charge	V _{DD} = 380V, V _{GS} = 10V I _D = 8A, (Note1,2)		40.2	52.3	nC
Q _{GS}	Gate to source charge		6.7			
Q _{GD}	Gate to drain charge (Miller charge)		12.9			
ESR	Equivalent series resistance (G-S)	Drain open		2.9		Ω

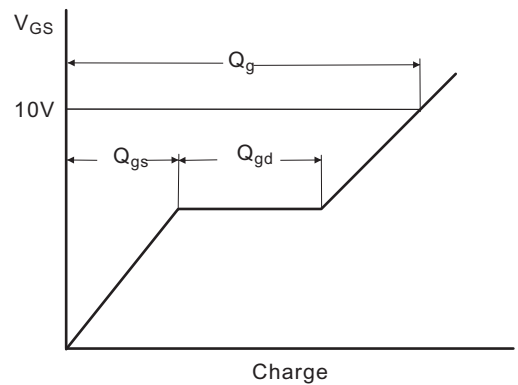
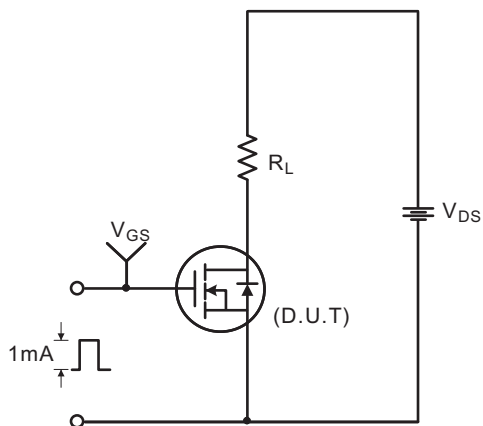
SOURCE TO DRAIN DIODE RATINGS AND CHARACTERISTICS (T _C = 25°C unless otherwise specified)						
SYMBOL	PARAMETER	TEST CONDITIONS	Min.	Typ.	Max.	UNIT
V _{SD}	Diode forward voltage	I _{SD} = 8A, V _{GS} = 0V			1.2	V
I _S (I _{SD})	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET 			16	A
I _{SM}	Pulsed source current		48			
t _{rr}	Reverse recovery time	I _{SD} = 8A, V _{GS} = 0V, dI _F /dt = 100A/μs		319		ns
Q _{rr}	Reverse recovery charge			4.4		μC

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

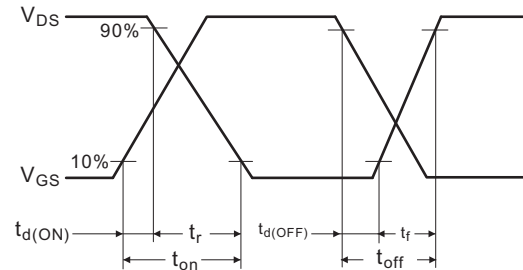
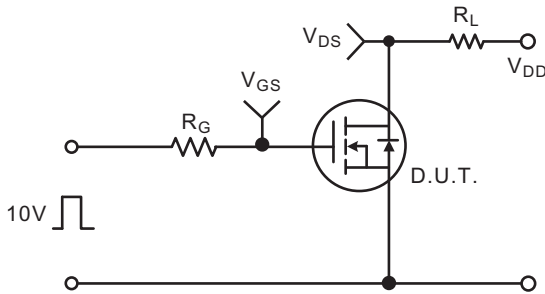
ORDERING INFORMATION SCHEME



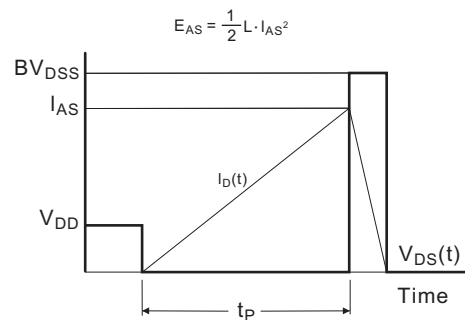
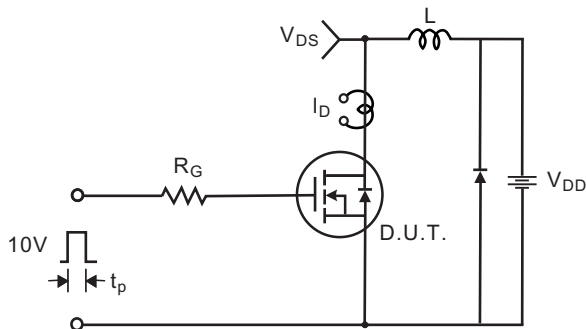
■ Gate charge test circuit & waveform



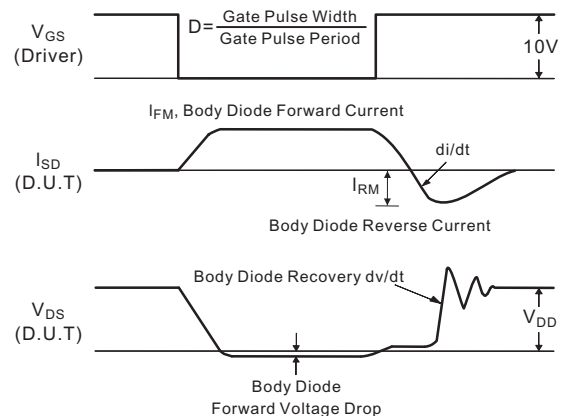
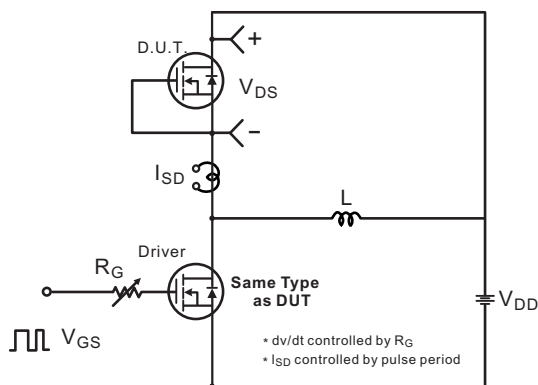
RESISTIVE SWITCHING TEST CIRCUIT & WAVEFORM



UNCLAMPED INDUCTIVE SWITCHING TEST CIRCUIT & WAVEFORMS



PEAK DIODE RECOVERY dv/dt TEST CIRCUIT & WAVEFORMS



■ TYPICAL CHARACTERISTICS

Fig.1 On-State characteristics

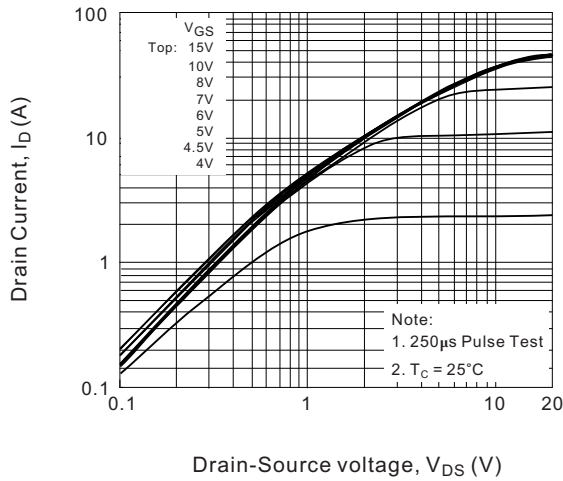


Fig.2 Transfer characteristics

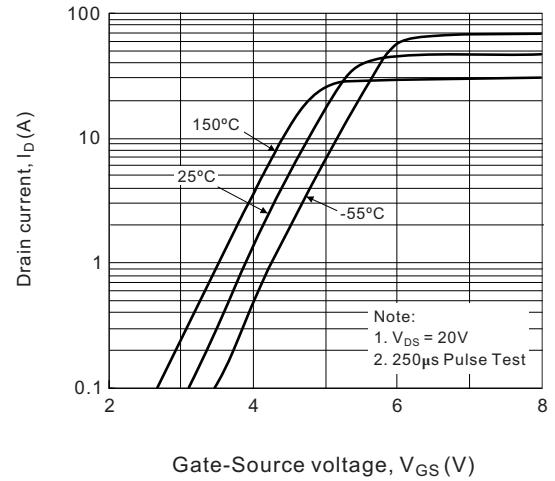


Fig.3 On-Resistance variation vs. drain current and gate voltage

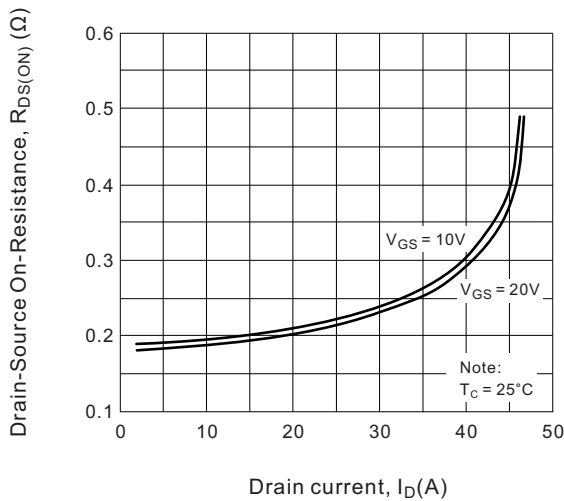


Fig.4 Body diode forward voltage variation vs. Source current and Temperature

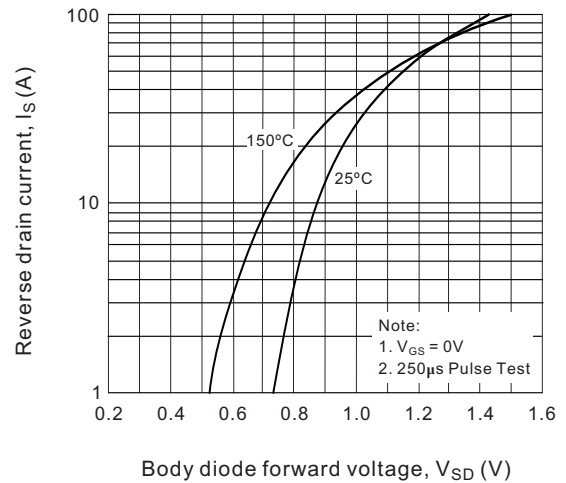


Fig.5 Capacitance characteristics

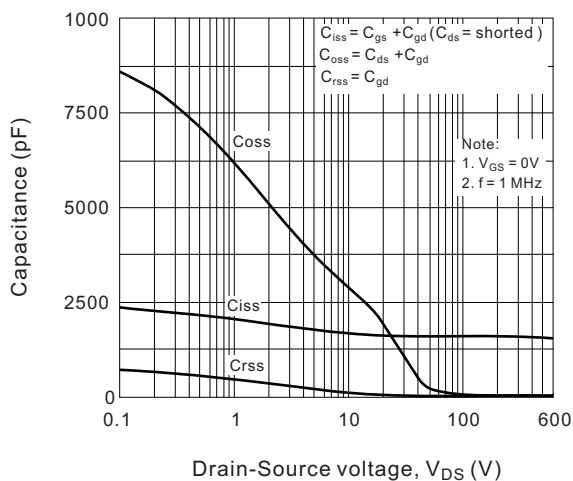


Fig.6 Gate charge characteristics

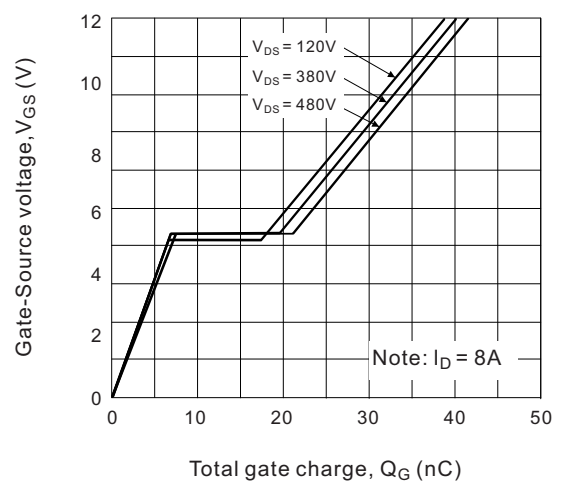


Fig.7 Breakdown voltage variation vs. Temperature

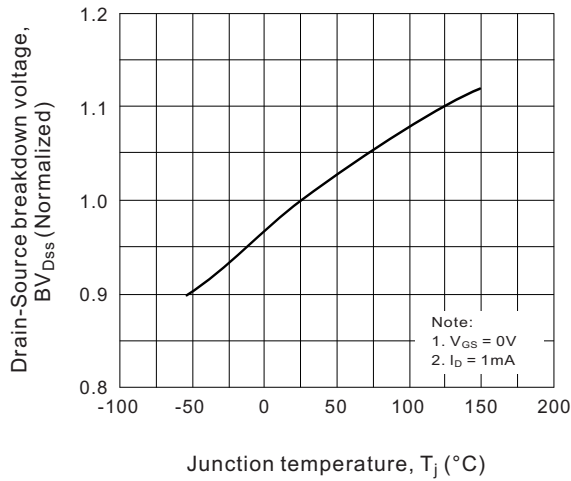


Fig.8 On-Resistance variation vs. Temperature

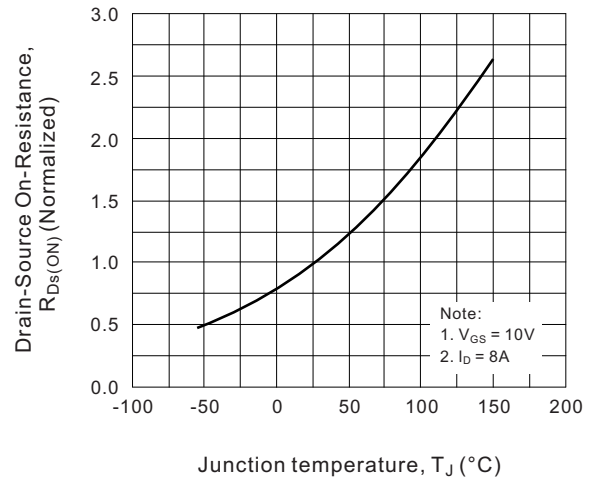


Fig.9 Maximum safe operating area (16N60A/16N60B)

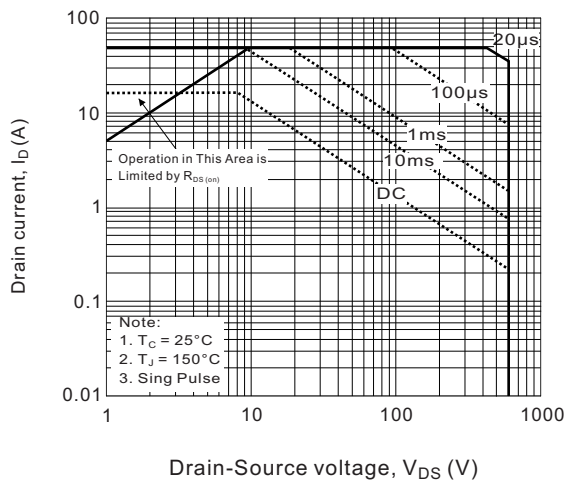


Fig.10 Maximum safe operating area (16N60AF)

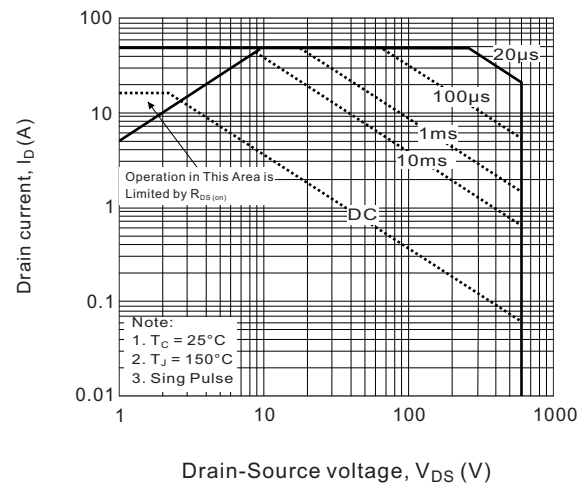


Fig.11 Maximum drain current vs. Case temperature

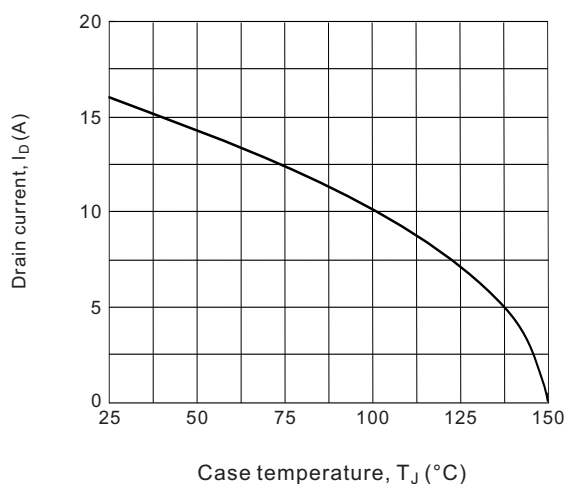


Fig.11-1 Transient thermal response curve for 16N60B & 16N60A

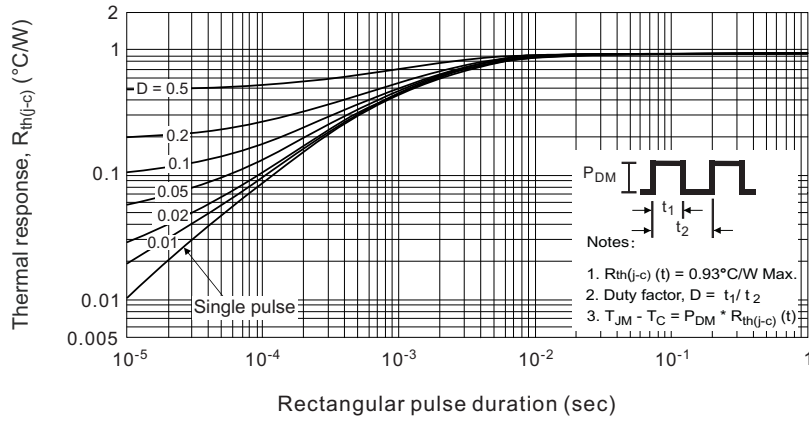
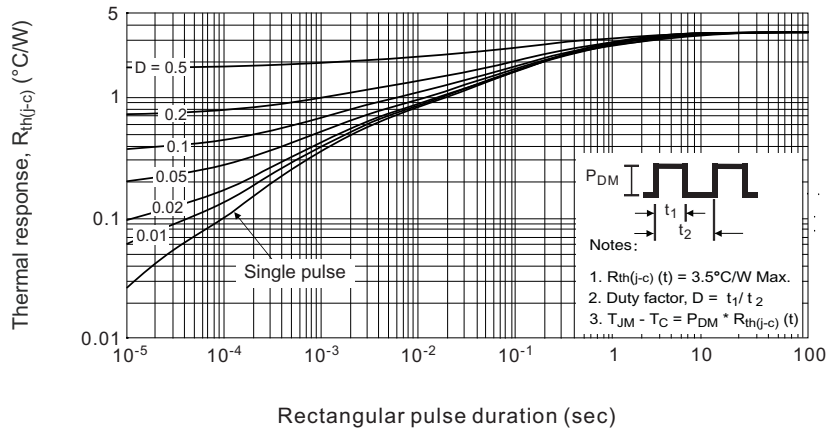
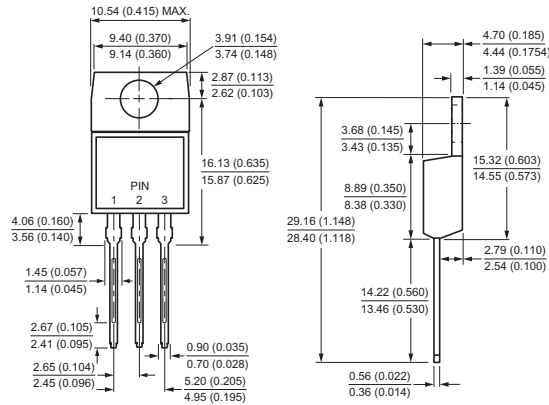


Fig.11-2 Transient thermal response curve for 16N60AF

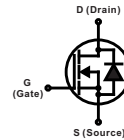


Case Style

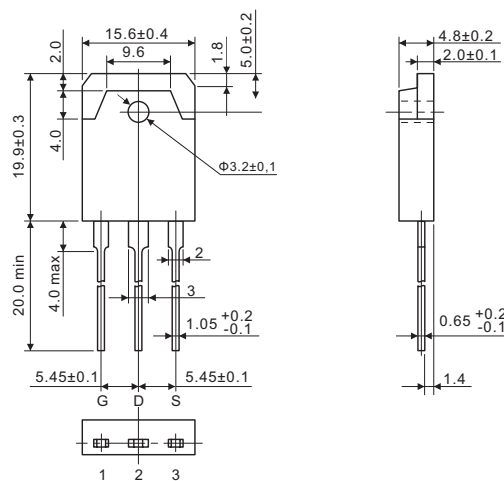
TO-220AB



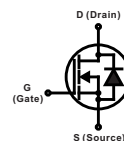
All dimensions in millimeters(inches)



TO-3P(B)

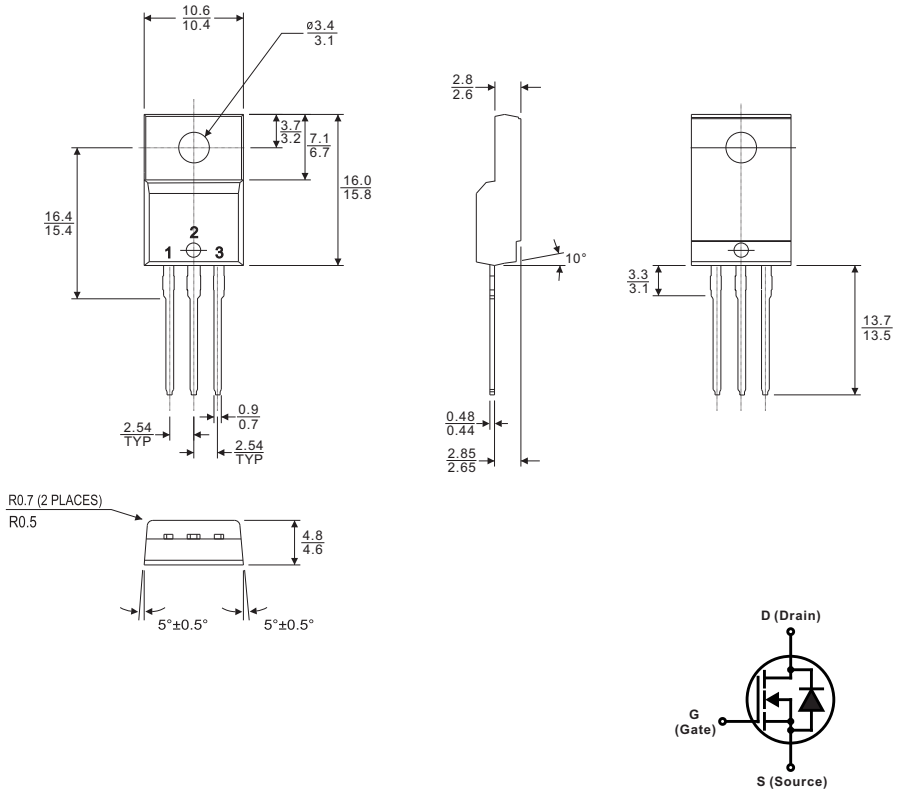


All dimensions in millimeters(inches)



Case Style

TO-220F



All dimensions in millimeters