

## N-Channel Power MOSFET (20A, 500Volts)

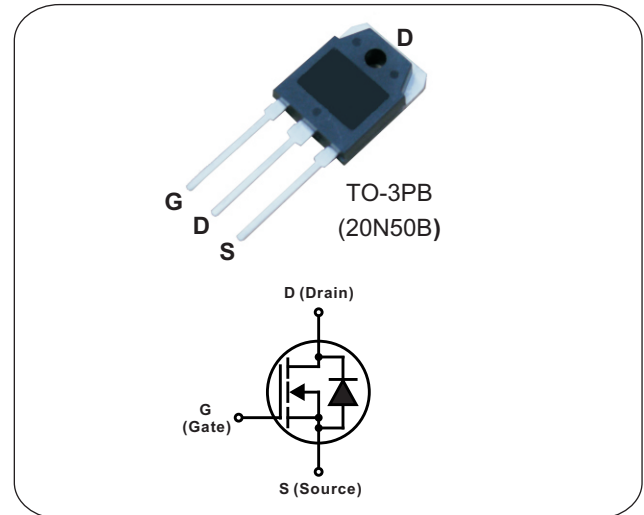
### DESCRIPTION

The Nell **20N50** is a three-terminal silicon device with current conduction capability of 20A, fast switching speed, low on-state resistance, breakdown voltage rating of 500V, and max. threshold voltage of 5 volts.

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

### FEATURES

- $R_{DS(ON)} = 0.23\Omega @ V_{GS} = 10V$
- Ultra low gate charge(60nC max.)
- Low reverse transfer capacitance ( $C_{RSS} = 27pF$  typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



### PRODUCT SUMMARY

$I_D$ (A)	20
$V_{DSS}$ (V)	500
$R_{DS(ON)}$ ( $\Omega$ )	0.23 @ $V_{GS} = 10V$
$Q_G$ (nC) max.	60

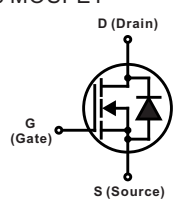
### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ C$ unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	VALUE	UNIT
$V_{DSS}$	Drain to Source voltage	$T_J = 25^\circ C$ to $150^\circ C$	500	V
$V_{DGR}$	Drain to Gate voltage	$R_{GS} = 20K\Omega$	500	
$V_{GS}$	Gate to Source voltage		$\pm 30$	
$I_D$	Continuous Drain Current	$T_C = 25^\circ C$	20	A
		$T_C = 100^\circ C$	12.4	
$I_{DM}$	Pulsed Drain current(Note 1)		80	
$I_{AR}$	Avalanche current(Note 1)		20	
$E_{AR}$	Repetitive avalanche energy(Note 1)	$I_{AR} = 20A, R_{GS} = 50\Omega, V_{GS} = 10V$	25	mJ
dv/dt	Peak diode recovery dv/dt(Note 2)		4.6	V / ns
$P_D$	Total power dissipation (Derating factor above $25^\circ C$ )	$T_C = 25^\circ C$	280 (2.3)	W(W/ $^\circ C$ )
$T_J$	Operation junction temperature		-55 to 150	$^\circ C$
$T_{STG}$	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.  $I_{SD} \leq 20A$ ,  $di/dt \leq 200A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ , starting  $T_J = 25^\circ C$ .

THERMAL RESISTANCE						
SYMBOL	PARAMETER		Min.	Typ.	Max.	UNIT
$R_{th(j-c)}$	Thermal resistance, junction to case	TO-3P(B)			0.44	°C/W
$R_{th(c-s)}$	Thermal resistance, case to heatsink			0.5		
$R_{th(j-a)}$	Thermal resistance, junction to ambient	TO-3P(B)			40	

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	$I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$	500			V
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown voltage temperature coefficient	$I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$		0.5		V/°C
$I_{DSS}$	Drain to source leakage current	$V_{DS}=500\text{V}$ , $V_{GS}=0\text{V}$ , $T_C = 25^\circ\text{C}$			25	$\mu\text{A}$
		$V_{DS}=400\text{V}$ , $V_{GS}=0\text{V}$ , $T_C=150^\circ\text{C}$			250	
$I_{GSS}$	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	$I_D = 10\text{A}$ , $V_{GS} = 10\text{V}$		0.20	0.23	$\Omega$
$V_{GS(TH)}$	Gate threshold voltage	$V_{GS}=V_{DS}$ , $I_D=250\mu\text{A}$	3.0		5.0	V
$g_{FS}$	Forward transconductance	$V_{DS}=40\text{V}$ , $I_D=10\text{A}$		24.6		S
$C_{ISS}$	Input capacitance	$V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$		2400	3120	pF
$C_{OSS}$	Output capacitance			355	465	
$C_{RSS}$	Reverse transfer capacitance			27		
$t_{d(ON)}$	Turn-on delay time	$V_{DD} = 250\text{V}$ , $V_{GS} = 10\text{V}$ , $I_D = 20\text{A}$ $R_{GS} = 25\Omega$ (Note 1, 2)		95	200	ns
$t_r$	Rise time			375	760	
$t_{d(OFF)}$	Turn-off delay time			100	210	
$t_f$	Fall time			105	220	
$Q_G$	Total gate charge	$V_{DD} = 400\text{V}$ , $V_{GS} = 10\text{V}$ , $I_D = 20\text{A}$ (Note 1, 2)		46	60	nC
$Q_{GS}$	Gate to source charge			15		
$Q_{GD}$	Gate to drain charge (Miller charge)			22		
$E_{AS}$	Single pulse avalanche energy (Note 3)	$I_{AS} = 20\text{A}$ , $L = 5.0\text{mH}$			1110	mJ

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	$I_{SD} = 20\text{A}$ , $V_{GS} = 0\text{V}$			1.4	V
$I_S (I_{SD})$	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET 			20	A
$I_{SM}$	Pulsed source current				80	
$t_{rr}$	Reverse recovery time	$I_{SD} = 20\text{A}$ , $V_{GS} = 0\text{V}$ , $dI_F/dt = 100\text{A}/\mu\text{s}$		500		ns
$Q_{rr}$	Reverse recovery charge			7.2		$\mu\text{C}$

Note: 1. Pulse test: Pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .

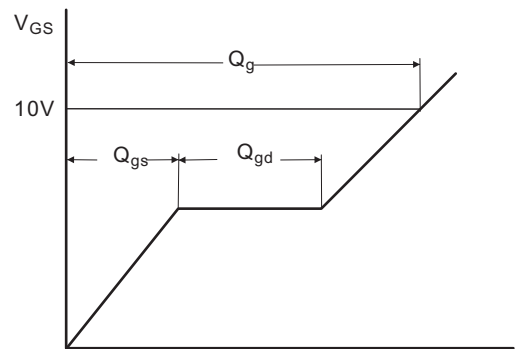
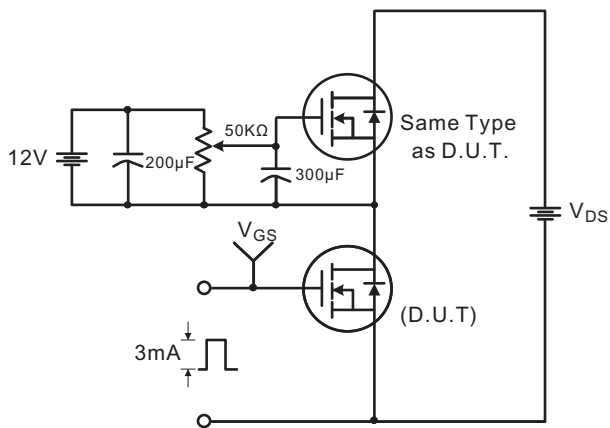
2. Essentially independent of operating temperature.

3.  $I_{AS}=20\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $L=5.0\text{mH}$ ,  $R_{GS}= 25\Omega$ , starting  $T_J=25^\circ\text{C}$ .

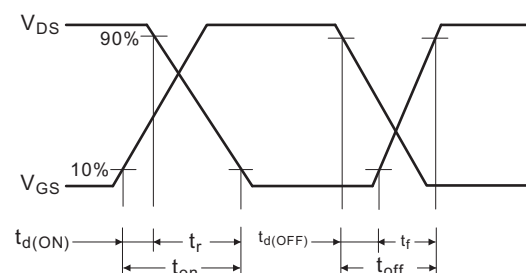
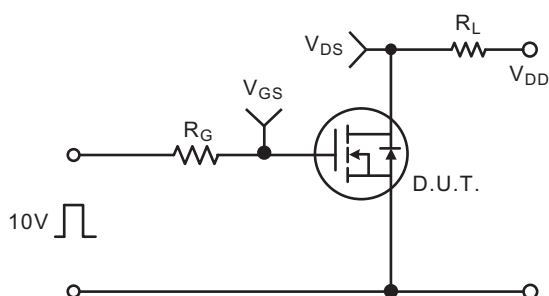
## ORDERING INFORMATION SCHEME

	<b>20</b>	<b>N</b>	<b>50</b>	<b>B</b>
<b>Current rating, <math>I_D</math></b>				
20 = 20A				
<b>MOSFET series</b>				
N = N-Channel				
<b>Voltage rating, <math>V_{DS}</math></b>				
50 = 500V				
<b>Package type</b>				
B = TO-3P(B)				

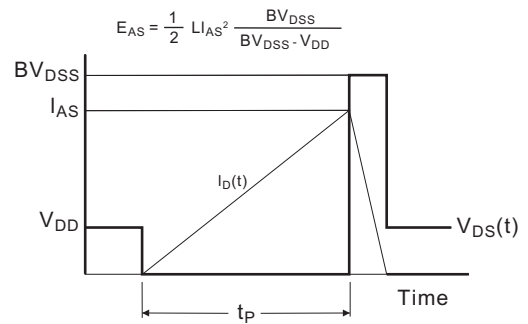
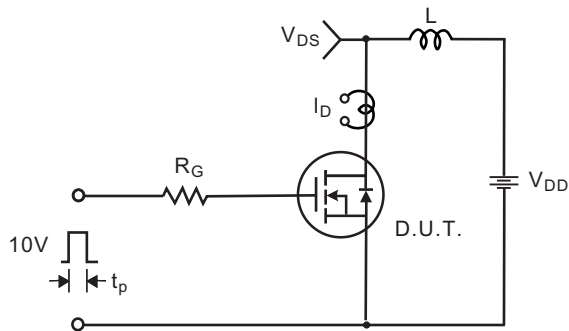
### ■ Gate charge test circuit & waveform



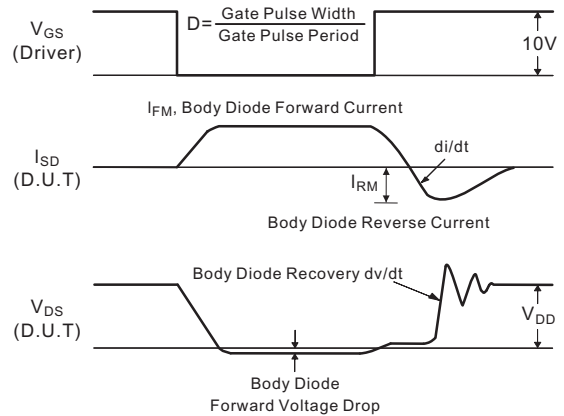
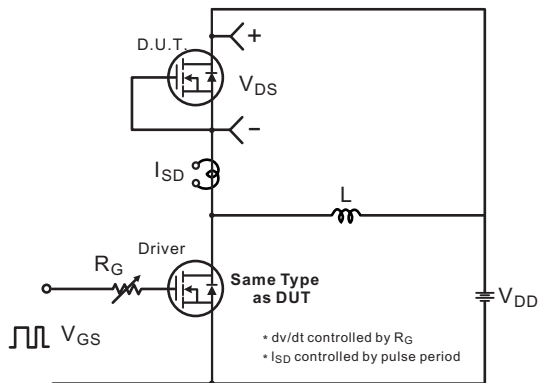
### ■ RESISTIVE SWITCHING TEST CIRCUIT & WAVEFORM



### ■ UNCLAMPED INDUCTIVE SWITCHING & WAVEFORMS

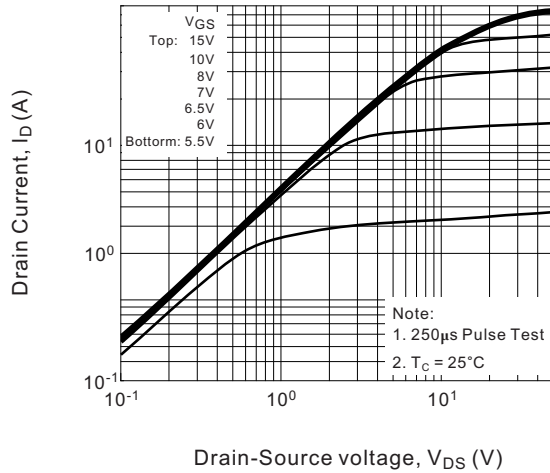


### ■ PEAK DIODE RECOVERY dv/dt TEST CIRCUIT & WAVEFORMS

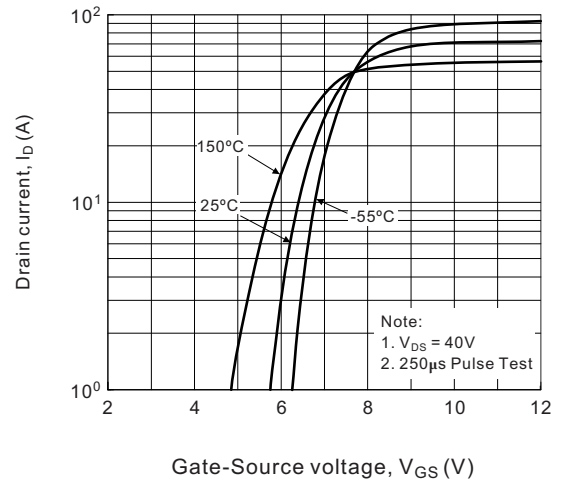


### ■ TYPICAL CHARACTERISTICS

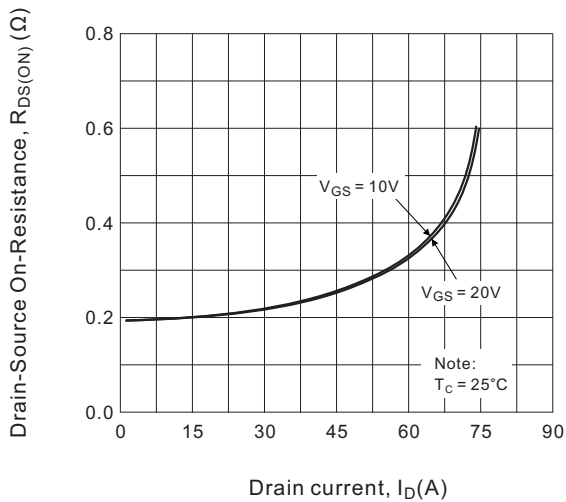
**Fig.1 On-State characteristics**



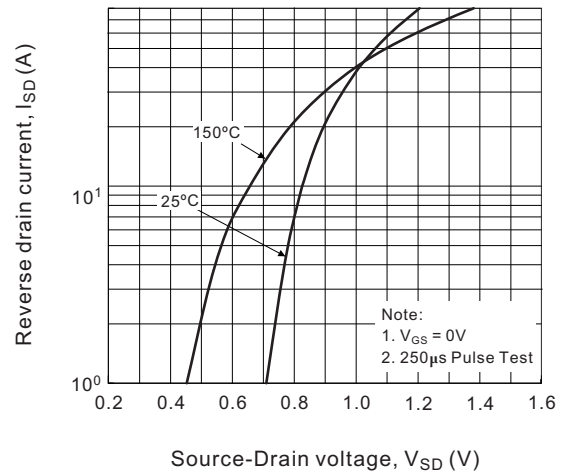
**Fig.2 Transfer characteristics**



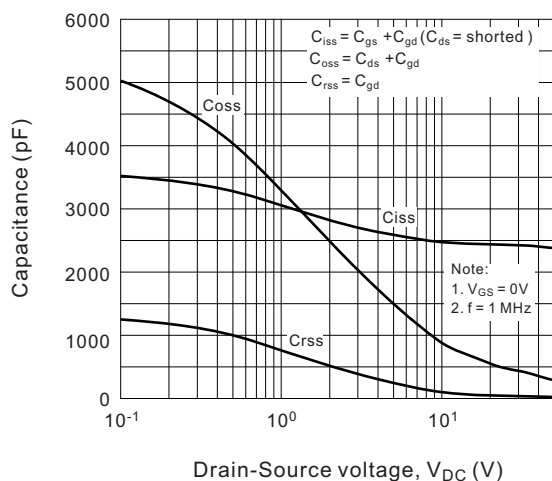
**Fig.3 On-Resistance variation vs. drain current and gate voltage**



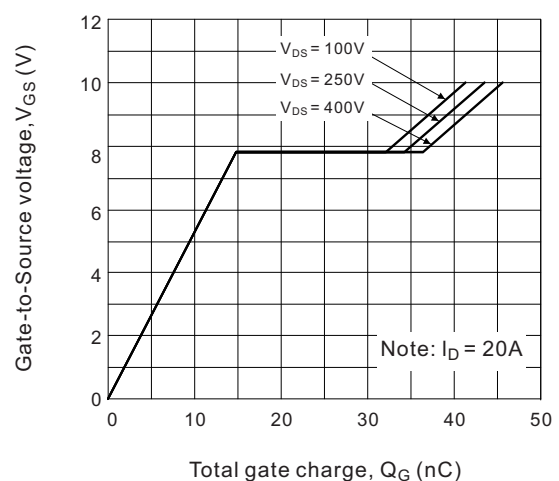
**Fig.4 Body diode forward voltage variation vs. Source current and Temperature**



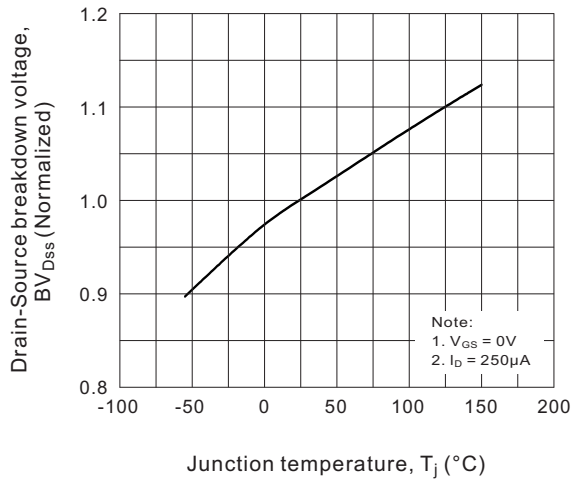
**Fig.5 Capacitance characteristics**



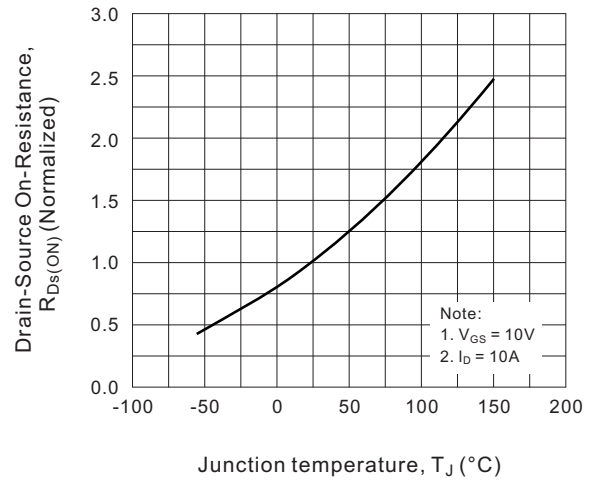
**Fig.6 Gate charge characteristics**



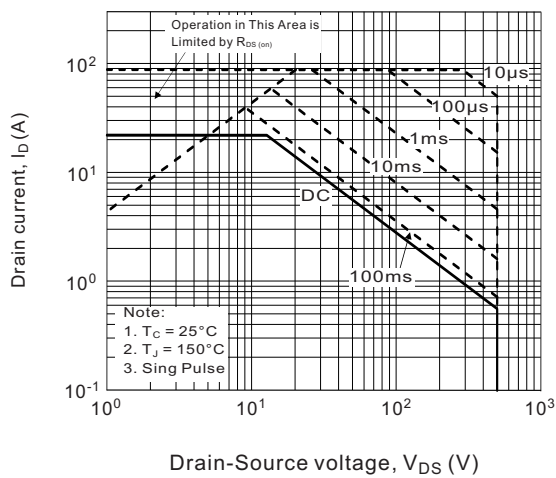
**Fig.7 Breakdown voltage variation vs. Temperature**



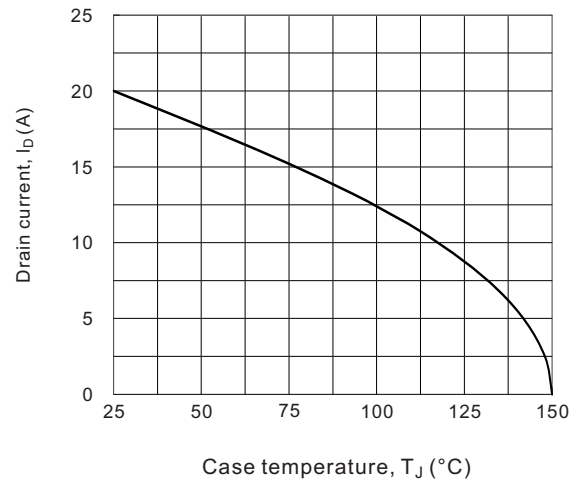
**Fig.8 On-Resistance variation vs. Temperature**



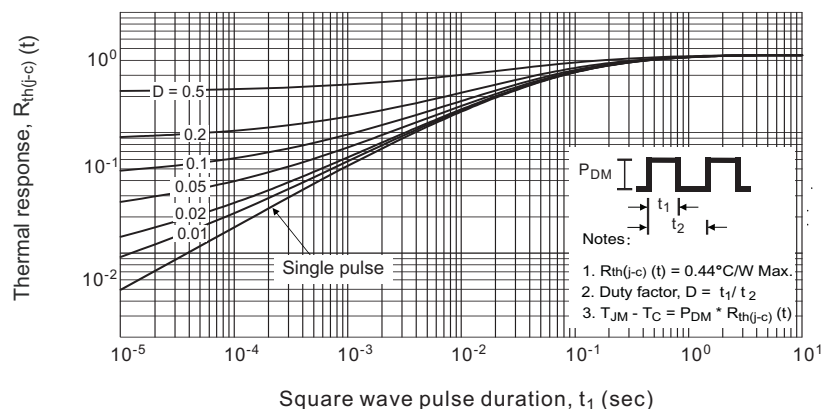
**Fig.9 Maximum safe operating area**



**Fig.10 Maximum drain current vs. Case temperature**



**Fig.11 Transient thermal response curve**



## Case Style

### TO-3PB

