

N-Channel Power MOSFET (9A, 900Volts)

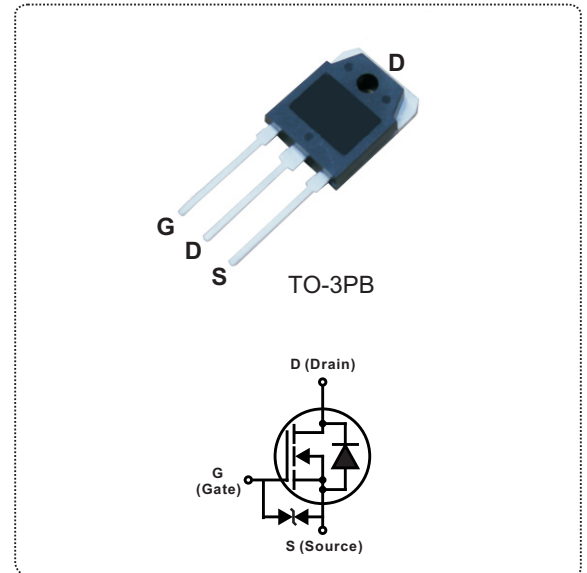
DESCRIPTION

The Nell **2SK3878** is a three-terminal silicon device with current conduction capability of 9A, fast switching speed, low on-state resistance, breakdown voltage rating of 900V, and max. threshold voltage of 4 volts.

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

FEATURES

- $R_{DS(ON)} = 1.00\Omega @ V_{GS} = 10V$
- Ultra low gate charge(60nC typical)
- Low reverse transfer capacitance ($C_{RSS} = 45pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



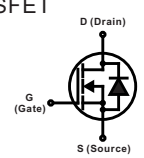
PRODUCT SUMMARY	
I_D (A)	9
V_{DSS} (V)	900
$R_{DS(ON)}$ (Ω)	1.00 @ $V_{GS} = 10V$
Q_G (nC) max.	60

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 $150^\circ C$		900	V
V_{DGR}	Drain to Gate voltage	$R_{GS} = 20K\Omega$		900	
V_{GS}	Gate to Source voltage			± 30	
I_D	Continuous Drain Current ($V_{GS} = 10V$)	$T_C = 25^\circ C$		9	A
		$T_C = 100^\circ C$		5.6	
I_{DM}	Pulsed Drain current(Note 1)			27	
I_{AR}	Avalanche current(Note 1)			9	
E_{AR}	Repetitive avalanche energy(Note 1)	$I_{AR} = 9A, R_{GS} = 50\Omega, V_{GS} = 10V$		15	mJ
E_{AS}	Single pulse avalanche energy(Note 2)	$I_{AS} = 9A, L = 17.6mH$		778	mJ
dv/dt	Peak diode recovery dv/dt(Note 3)			3.5	V/ns
P_D	Total power dissipation	$T_C = 25^\circ C$	TO-3PB	150	W
	Derating factor above $25^\circ C$			1.2	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. $I_{AS} = 9A, L = 17.6mH, V_{DD} = 90V, R_G = 25\Omega$, starting $T_J = 25^\circ C$.
 3. $I_{SD} \leq 9A, di/dt \leq 130A/\mu s, V_{DD} \leq V_{(BR)DSS}$, starting $T_J = 25^\circ C$.

THERMAL RESISTANCE					
SYMBOL	PARAMETER	Min.	Typ.	Max.	UNIT
$R_{th(j-c)}$	Thermal resistance, junction to case			0.83	°C/W
$R_{th(c-s)}$	Thermal resistance, case to heatsink		0.30		
$R_{th(j-a)}$	Thermal resistance, junction to ambient			50	

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise specified)							
SYMBOL	PARAMETER	TEST CONDITIONS	Min.	Typ.	Max.	UNIT	
◎ STATIC							
$V_{(BR)DSS}$	Drain to source breakdown voltage	$I_D = 10\text{mA}, V_{GS} = 0\text{V}$	900			V	
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown voltage temperature coefficient	$I_D = 250\mu\text{A}, V_{DS} = V_{GS}$		0.99		V/°C	
I_{DSS}	Drain to source leakage current	$V_{DS}=900\text{V}, V_{GS}=0\text{V}$ $T_C = 25^\circ\text{C}$			50.0	μA	
		$V_{DS}=720\text{V}, V_{GS}=0\text{V}$ $T_C=125^\circ\text{C}$			500		
I_{GSS}	Gate to source forward leakage current	$V_{GS} = 30\text{V}, V_{DS} = 0\text{V}$			10	μA	
	Gate to source reverse leakage current	$V_{GS} = -30\text{V}, V_{DS} = 0\text{V}$			-10		
$R_{DS(ON)}$	Static drain to source on-state resistance	$I_D = 4.0\text{A}, V_{GS} = 10\text{V}$		1.00	1.30	Ω	
$V_{GS(TH)}$	Gate threshold voltage	$V_{GS}=V_{DS}=10\text{V}, I_D=1\text{mA}$	2.0		4.0	V	
g_{fs}	Forward transconductance	$V_{DS}=15\text{V}, I_D=4\text{A}$	3.5	7.0		S	
◎ DYNAMIC							
C_{ISS}	Input capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		2200		pF	
C_{OSS}	Output capacitance				190		
C_{RSS}	Reverse transfer capacitance				45		
$t_{d(ON)}$	Turn-on delay time	$V_{DD} = 400\text{V}, V_{GS} = 10\text{V}$ $I_D = 4\text{A}, R_G = 4.7\Omega, R_D = 100\Omega,$ (Note 1,2)		25		ns	
t_r	Rise time			65			
$t_{d(OFF)}$	Turn-off delay time			20			
t_f	Fall time			120			
Q_G	Total gate charge	$V_{DD} = 400\text{V}, V_{GS} = 10\text{V},$ $I_D = 9\text{A}$ (Note 1,2)		60		nC	
Q_{GS}	Gate to source charge			34			
Q_{GD}	Gate to drain charge (Miller charge)			26			
L_D	Internal drain inductance	Between lead, 6mm(0.25") from package and center of die contact		5		nH	
L_S	Internal source inductance			13			

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	$I_{SD} = 9\text{A}, V_{GS} = 0\text{V}$			1.7	V
$I_S(I_{SD})$	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET 			9	A
I_{SM}	Pulsed source current				27	
t_{rr}	Reverse recovery time	$I_{SD} = 9\text{A}, V_{GS} = 0\text{V},$ $dI_F/dt = 100\text{A}/\mu\text{s}$		1400		ns
Q_{rr}	Reverse recovery charge			16		μC

Note: 1. Pulse test: Pulse width $\leq 10\mu\text{s}$, duty cycle $\leq 1\%$.
2. Essentially independent of operating temperature.

ORDERING INFORMATION SCHEME

2SK 3878

MOSFET series

N-Channel, Toshiba series

Current & Voltage rating, I_D & V_{DS}

9A / 900V

Fig.1 Typical output characteristics, $T_C=25^\circ\text{C}$

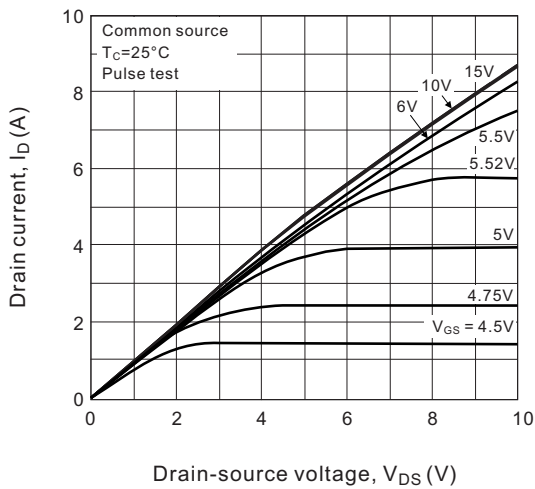


Fig.2 Typical output characteristics, $T_C=25^\circ\text{C}$

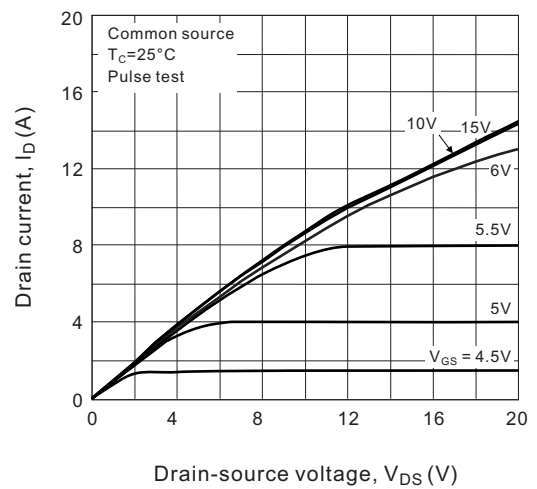


Fig.3 Typical transfer characteristics

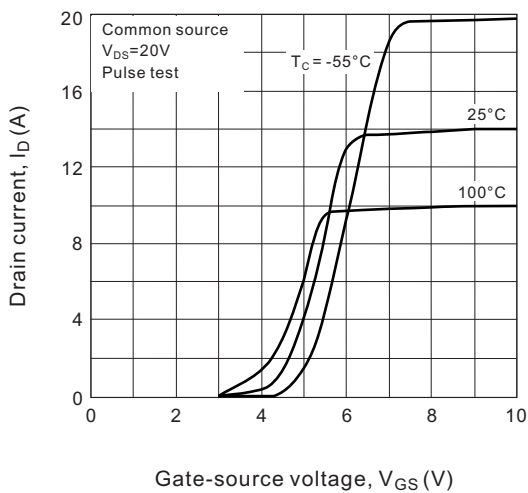


Fig.4 Drain-source voltage vs. gate-source voltage and drain current

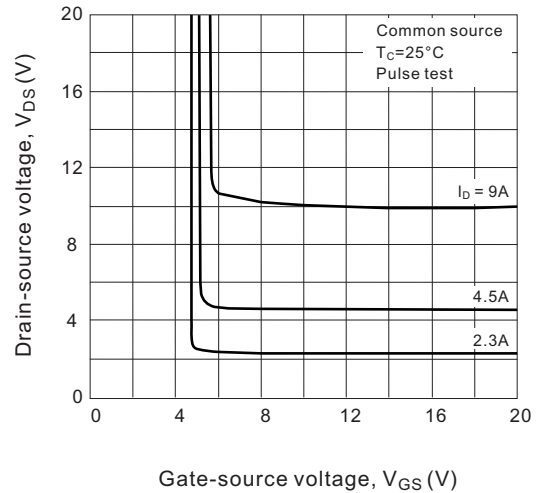


Fig.5 Forward transconductance characteristics

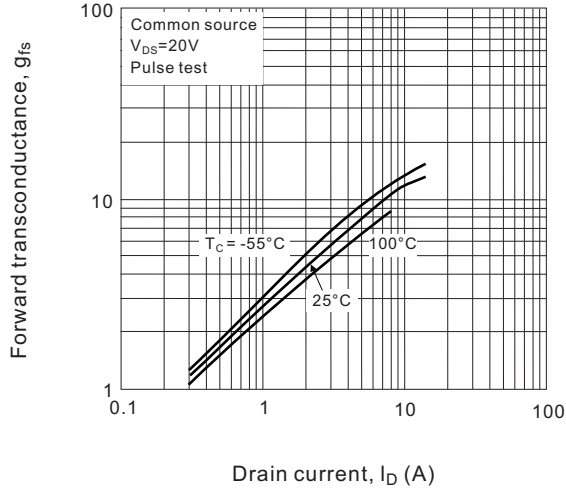


Fig.6 On-Resistance variation vs. Drain current and gate voltage

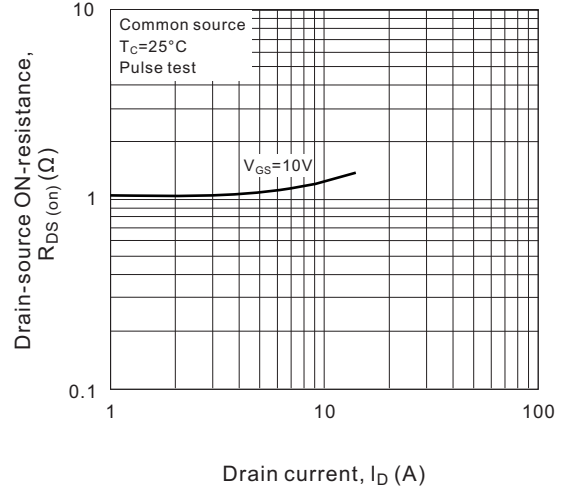


Fig.7 On-Resistance variation vs. case temperature

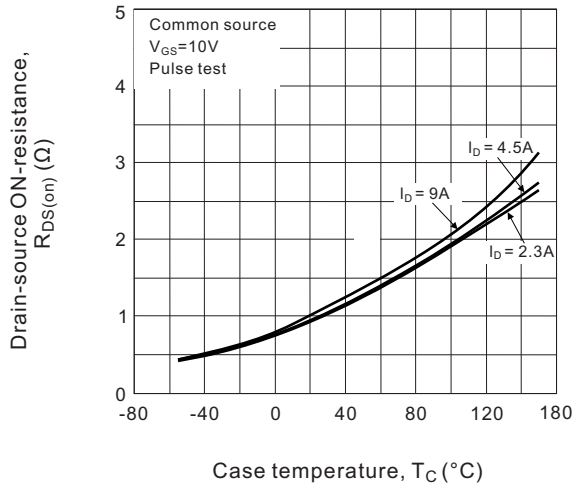


Fig.8 Drain reverse current vs. Drain-Source voltage

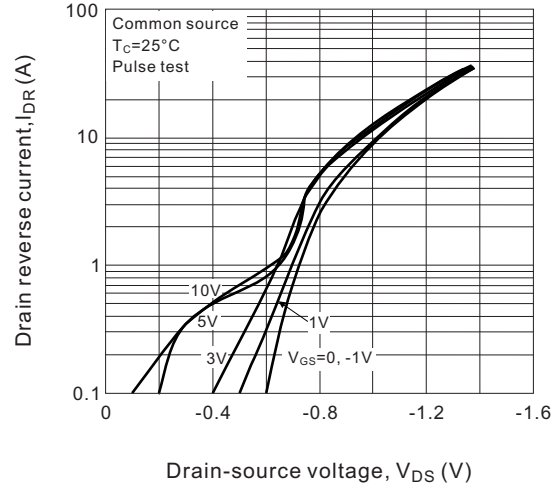


Fig.9 Capacitance characteristics

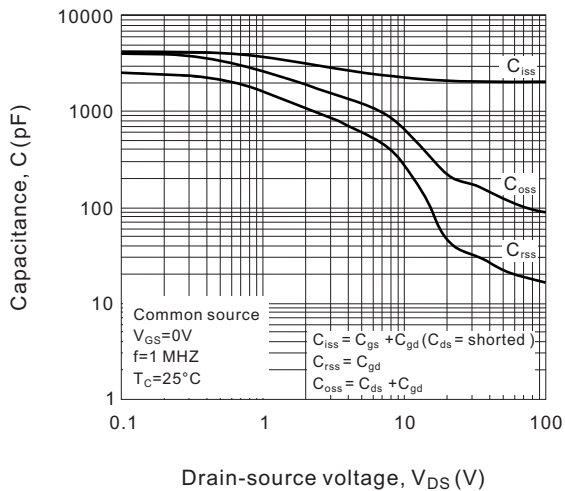


Fig.10 Gate threshold voltage vs. case temperature

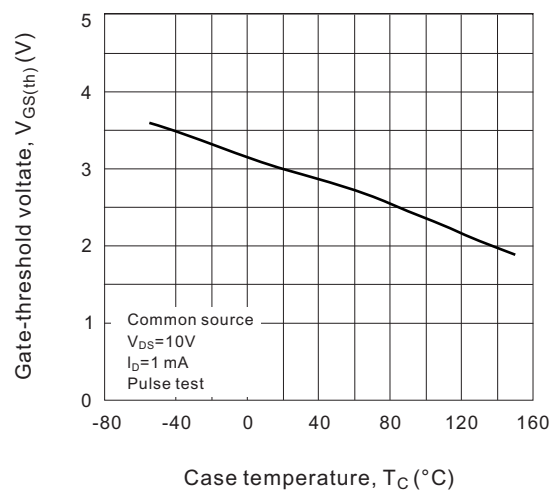


Fig.11 Drain power dissipation vs. case temperature

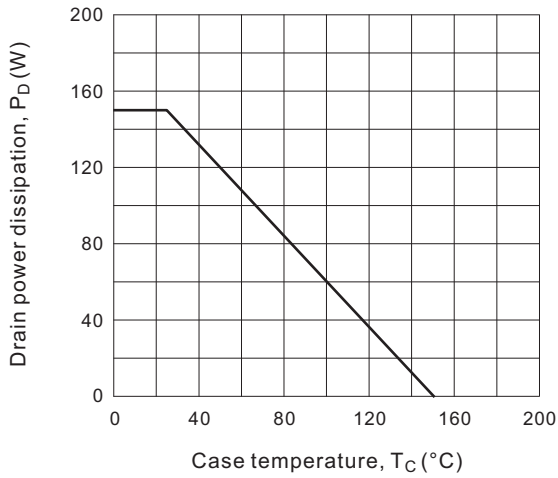


Fig.12 Dynamic input/output characteristics

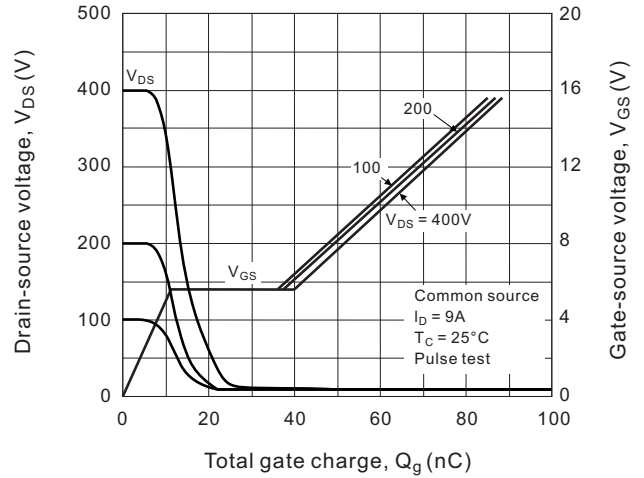


Fig.13 Transient thermal response curve

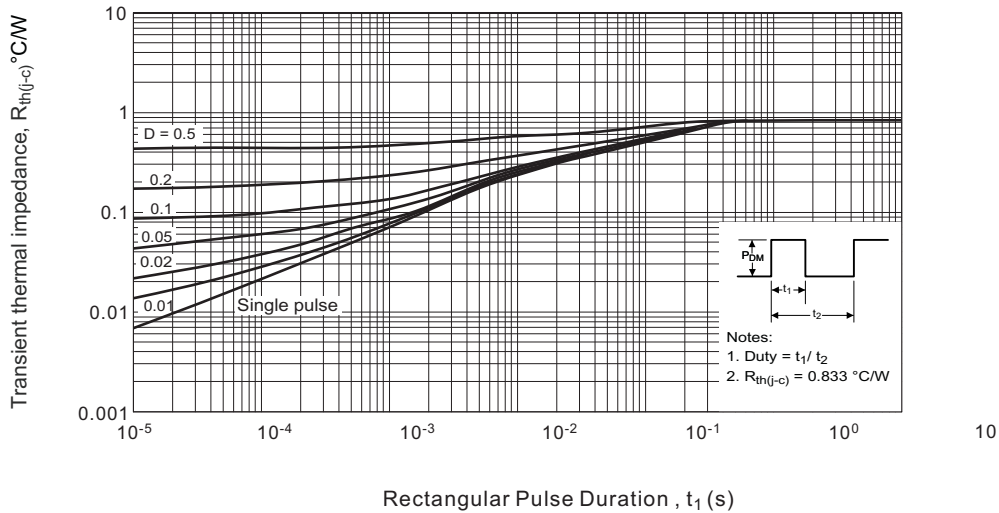


Fig.14 Maximum safe operating area

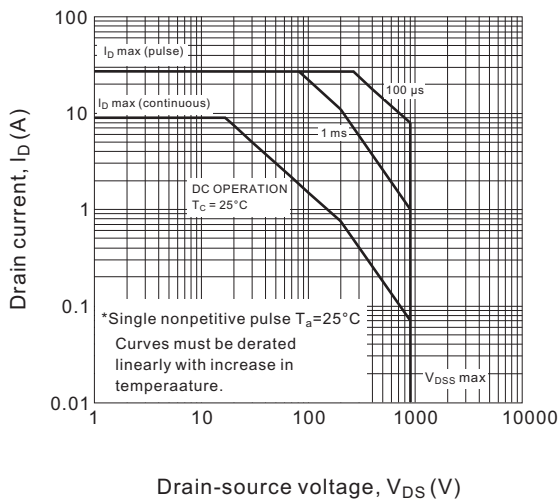


Fig.15 Single pulse avalanche energy vs. Junction temperature

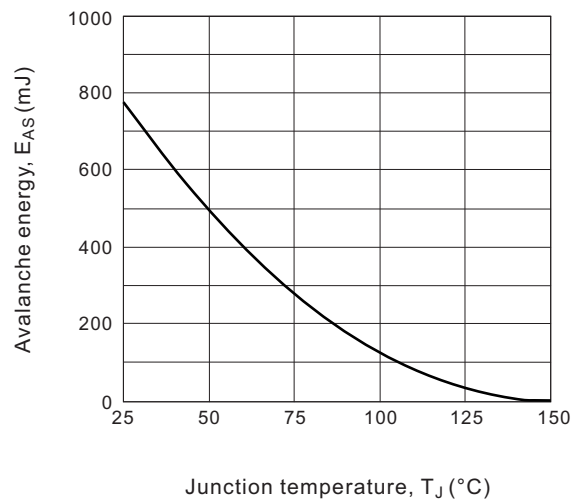
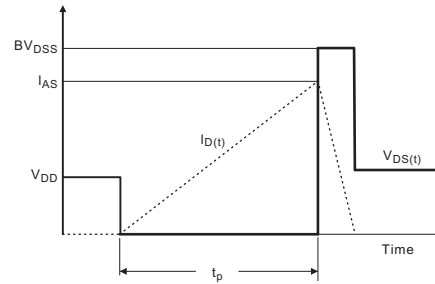
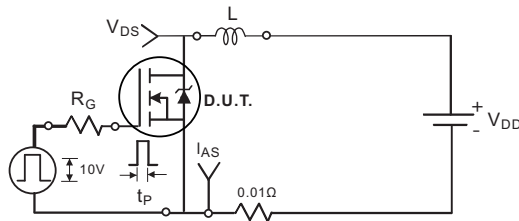


Fig.16 Unclamped inductive test circuit and waveforms



$R_G = 25\Omega$
 $V_{DD} = 90V, L = 17.6\text{ mH}$

$$E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

TO-3PB

