

$V_{DSS}$	-30V
$R_{DS(on)(Max.)}$	15.4m $\Omega$
$I_D$	$\pm 9A$
$P_D$	2W

### ●Features

- 1) Low on - resistance.
- 2) Built-in G-S Protection Diode.
- 3) Small Surface Mount Package (SOP8).
- 4) Pb-free lead plating ; RoHS compliant

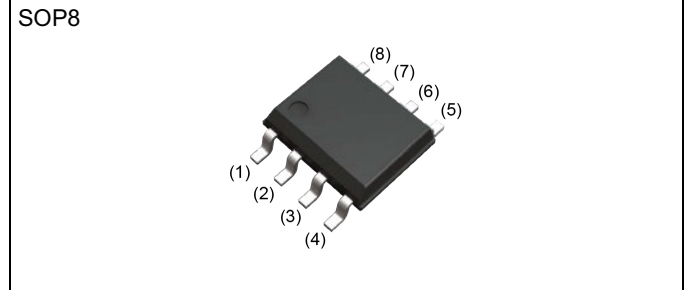
### ●Application

DC/DC Converter

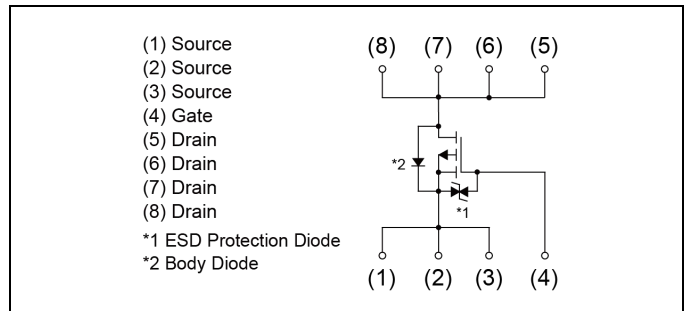
### ●Absolute maximum ratings ( $T_a = 25^\circ C$ )

Parameter	Symbol	Value	Unit
Drain - Source voltage	$V_{DSS}$	-30	V
Continuous drain current	$I_D^{*1}$	$\pm 9$	A
Pulsed drain current	$I_{D,pulse}^{*2}$	$\pm 36$	A
Gate - Source voltage	$V_{GSS}$	$\pm 20$	V
Avalanche energy, single pulse	$E_{AS}^{*3}$	0.6	mJ
Power dissipation	$P_D^{*4}$	2	W
	$P_D^{*5}$	0.65	W
Junction temperature	$T_j$	150	$^\circ C$
Range of storage temperature	$T_{stg}$	-55 to +150	$^\circ C$

### ●Outline



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	330
	Tape width (mm)	12
	Basic ordering unit (pcs)	2500
	Taping code	TB1
	Marking	RRH090P03

### ● Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - ambient	$R_{thJA}^{*4}$	-	-	62.5	°C/W
	$R_{thJA}^{*5}$	-	-	192	°C/W

### ● Electrical characteristics ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = -1mA$	-30	-	-	V
Breakdown voltage temperature coefficient	$\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$	$I_D = -1mA$ referenced to $25^\circ\text{C}$	-	-25	-	mV/°C
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = -30V, V_{GS} = 0V$	-	-	-1	$\mu\text{A}$
Gate - Source leakage current	$I_{GSS}$	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	$\pm 10$	$\mu\text{A}$
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = -10V, I_D = -1mA$	-1.0	-	-2.5	V
Gate threshold voltage temperature coefficient	$\frac{\Delta V_{GS(th)}}{\Delta T_j}$	$I_D = -1mA$ referenced to $25^\circ\text{C}$	-	3.9	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*6}$	$V_{GS} = -10V, I_D = -9A$	-	11	15.4	m $\Omega$
		$V_{GS} = -4.5V, I_D = -4.5A$	-	15	21	
		$V_{GS} = -4V, I_D = -4.5A$	-	17	24	
		$V_{GS} = , I_D =$	-	-	-	
Gate input resistance	$R_G$	$f = 1MHz, \text{open drain}$	-	3.0	-	$\Omega$
Forward Transfer Admittance	$ Y_{fs} ^{*6}$	$V_{DS} = -10V, I_D = -9A$	10	20	-	S

\*1 Limited only by maximum temperature allowed.

\*2  $P_w \leq 10\mu\text{s}$ , Duty cycle  $\leq 1\%$

\*3  $L \approx 10\mu\text{H}$ ,  $V_{DD} = -15V$ ,  $R_G = 25\Omega$ , starting  $T_j = 25^\circ\text{C}$

\*4 Mounted on a ceramic board (30×30×0.8mm)

\*5 Mounted on a FR4 (20×20×0.8mm)

**●Electrical characteristics** ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input capacitance	$C_{iss}$	$V_{GS} = 0V$	-	3000	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = -10V$	-	360	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	360	-	
Turn - on delay time	$t_{d(on)}^{*6}$	$V_{DD} \approx -15V, V_{GS} = -10V$	-	20	-	ns
Rise time	$t_r^{*6}$	$I_D = -4.5A$	-	30	-	
Turn - off delay time	$t_{d(off)}^{*6}$	$R_L \approx 3.3\Omega$	-	135	-	
Fall time	$t_f^{*6}$	$R_G = 10\Omega$	-	80	-	

**●Gate charge characteristics** ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit	
			Min.	Typ.	Max.		
Total gate charge	$Q_g^{*6}$	$V_{DD} \approx -15V$	$V_{GS} = -10V$	-	56	-	nC
Gate - Source charge	$Q_{gs}^{*6}$	$I_D = -9A$	$V_{GS} = -5V$	-	30	-	
Gate - Drain charge	$Q_{gd}^{*6}$			-	7	-	
				-	11	-	

**●Body diode electrical characteristics** (Source-Drain) ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	$I_S^{*1}$	$T_a = 25^\circ\text{C}$	-	-	-1.6	A
Forward voltage	$V_{SD}^{*6}$	$V_{GS} = 0V, I_S = -9A$	-	-	-1.2	V
Reverse recovery time	$t_{rr}^{*6}$	$I_S = -9A, V_{GS} = 0V$	-	35	70	ns
Reverse recovery charge	$Q_{rr}^{*6}$	$di/dt = 100A/\mu\text{s}$	-	30	60	$\mu\text{C}$

● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

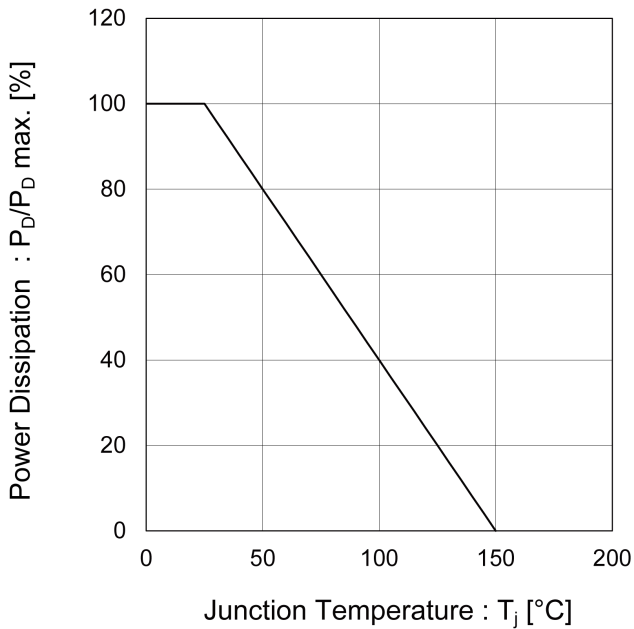


Fig.2 Maximum Safe Operating Area

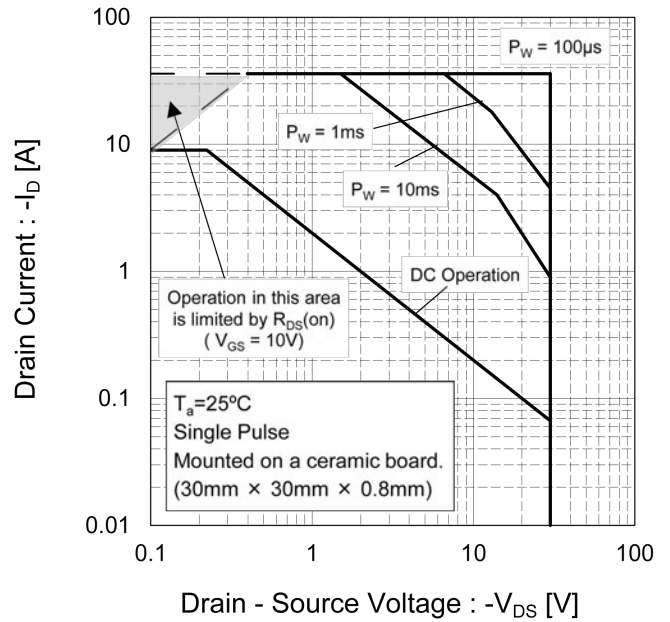


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

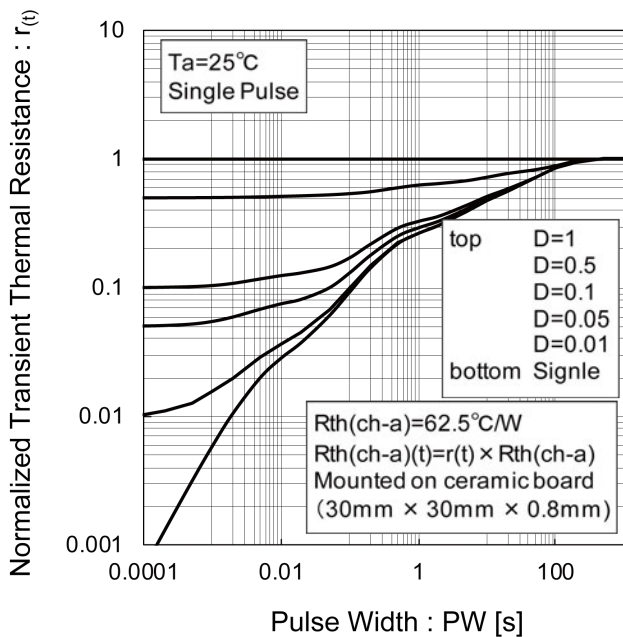
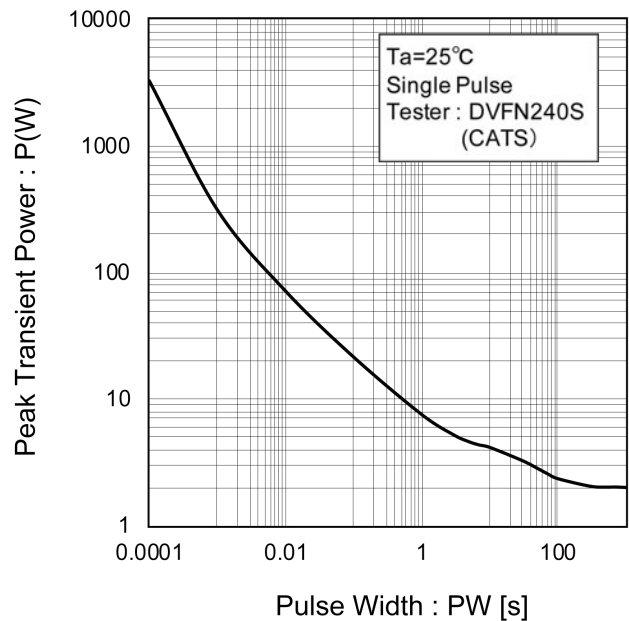


Fig.4 Single Pulse Maximum Power dissipation



● Electrical characteristic curves

Fig.5 Avalanche Current vs. Inductive Load

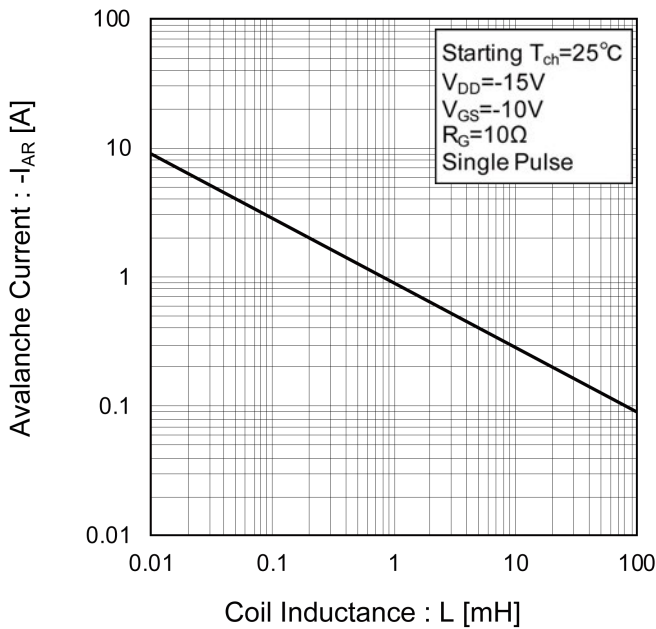


Fig.6 Avalanche Energy Derating Curve vs. Junction Temperature

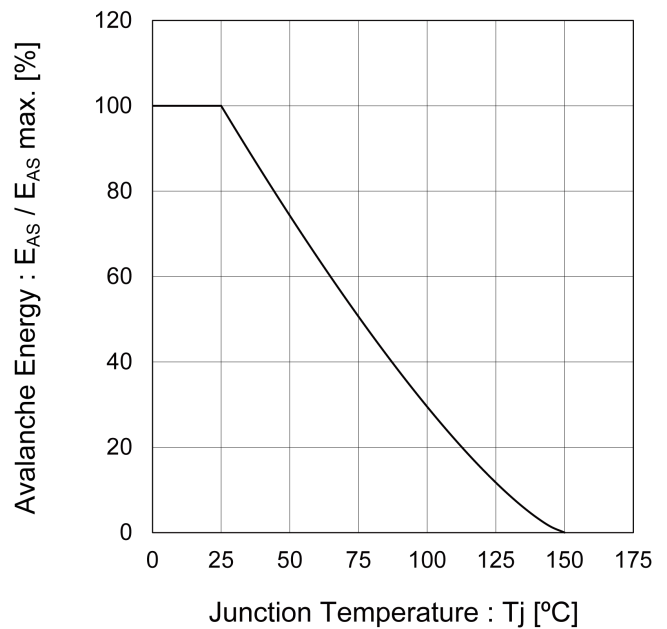


Fig.7 Typical Output Characteristics(I)

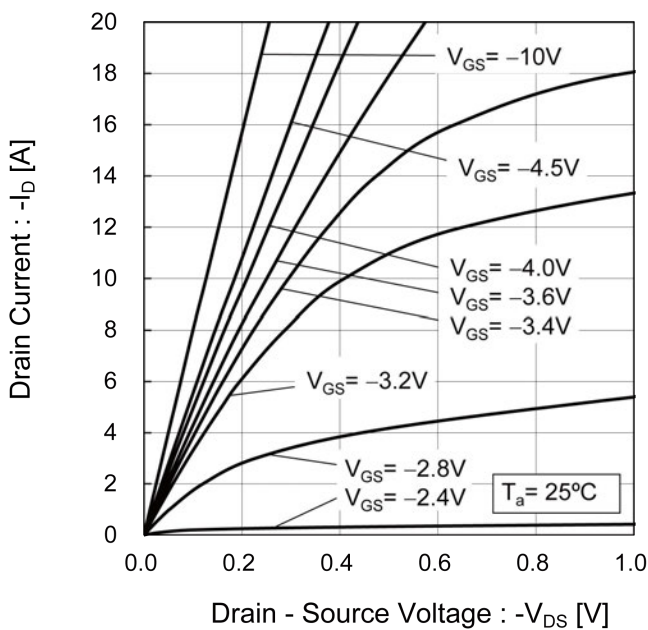
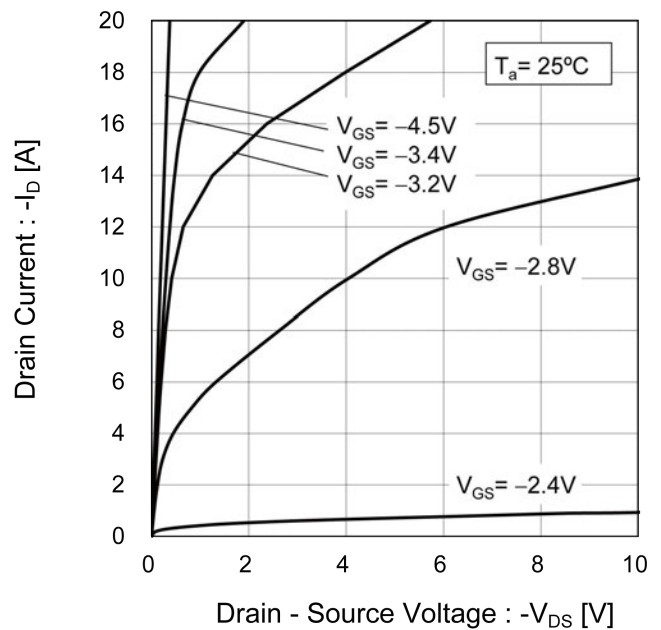


Fig.8 Typical Output Characteristics(II)



● Electrical characteristic curves

Fig.9 Breakdown Voltage vs. Junction Temperature

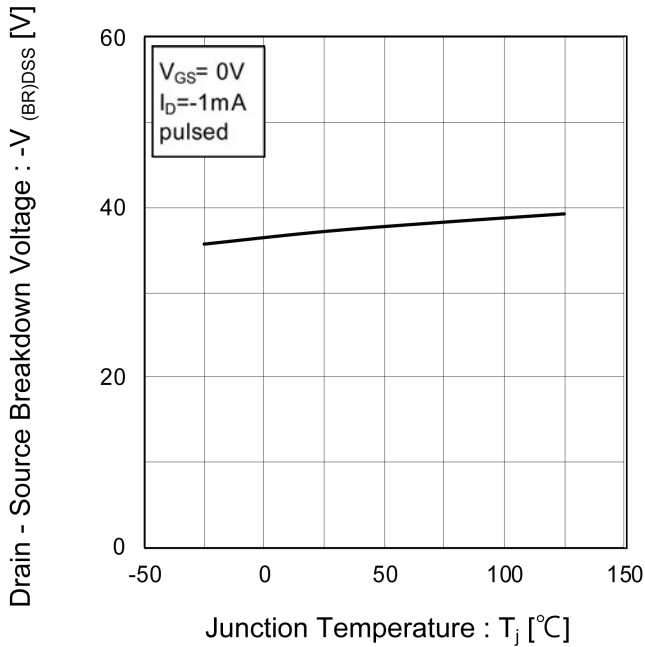


Fig.10 Typical Transfer Characteristics

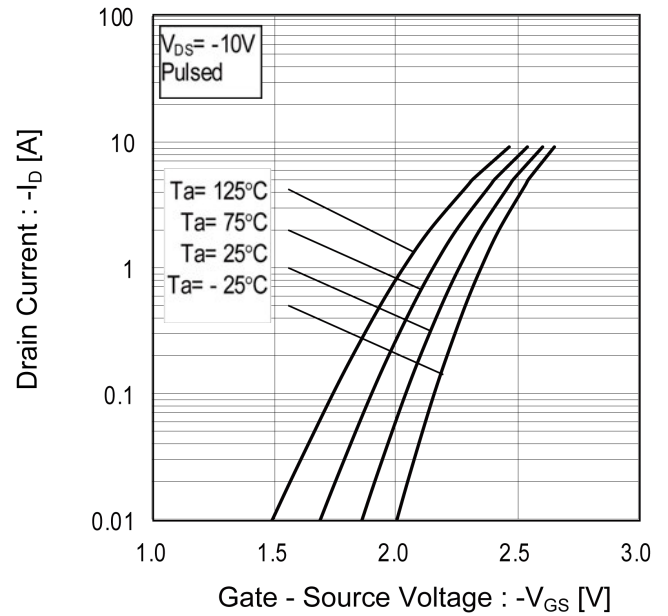


Fig.11 Gate Threshold Voltage vs. Junction Temperature

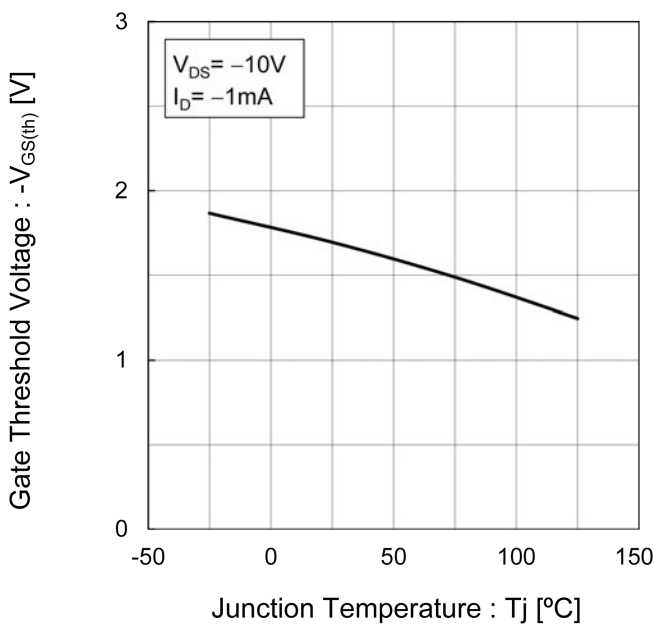
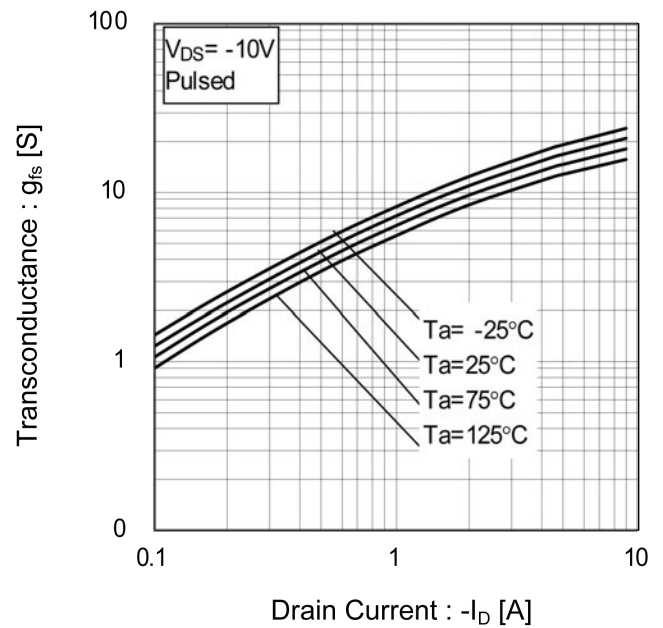


Fig.12 Transconductance vs. Drain Current



● Electrical characteristic curves

Fig.13 Drain Current Derating Curve

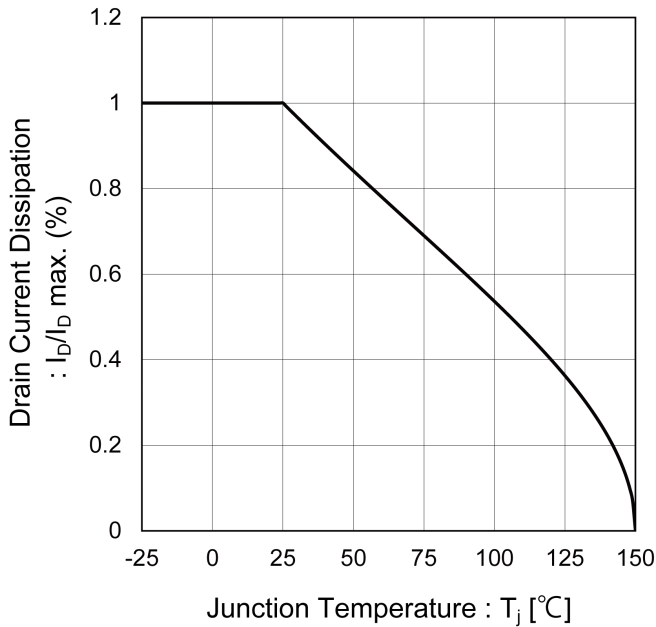


Fig.14 Static Drain - Source On - State Resistance vs. Gate Source Voltage

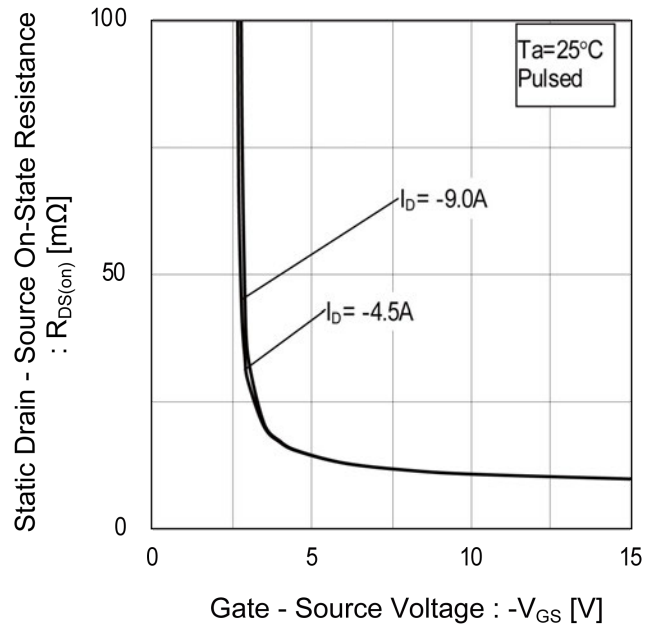


Fig.15 Static Drain - Source On - State Resistance vs. Junction Temperature

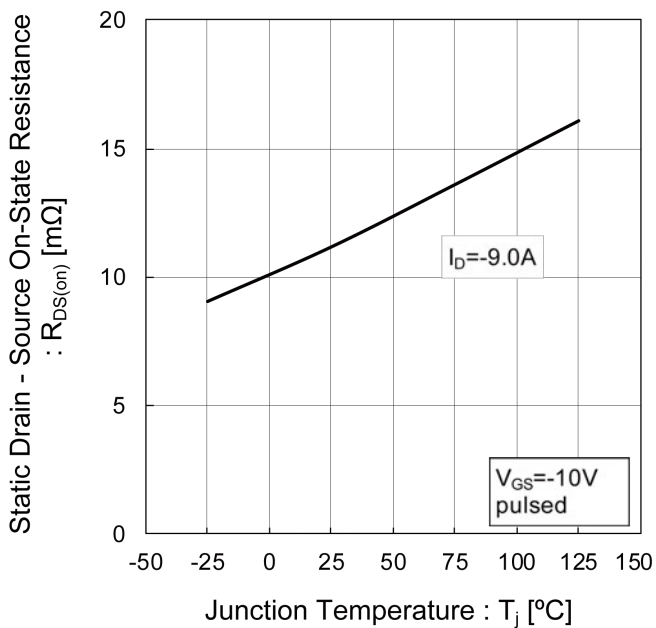
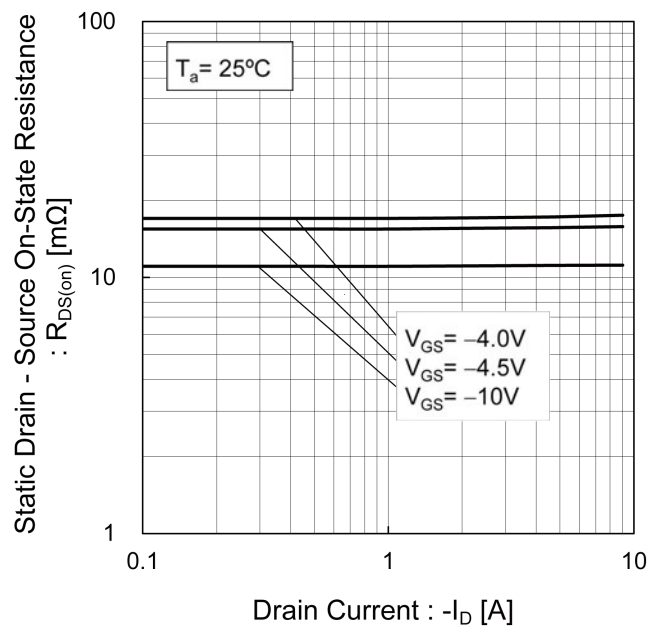


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current(I)



● Electrical characteristic curves

Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(II)

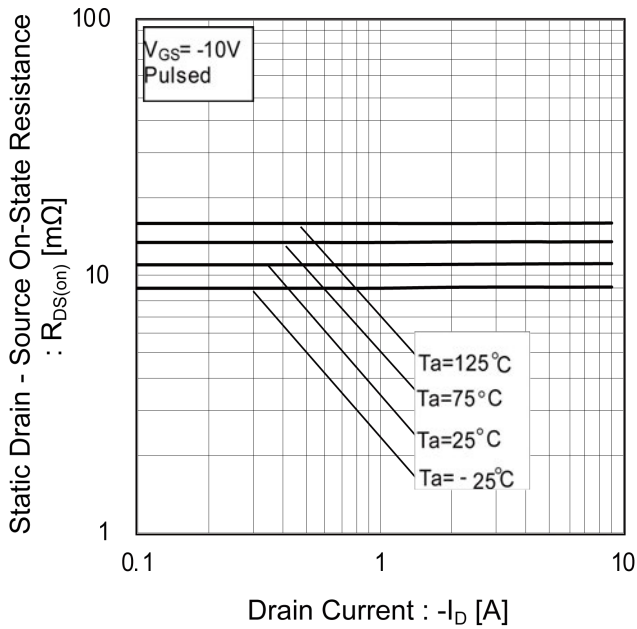


Fig.18 Static Drain - Source On - State Resistance vs. Drain Current(III)

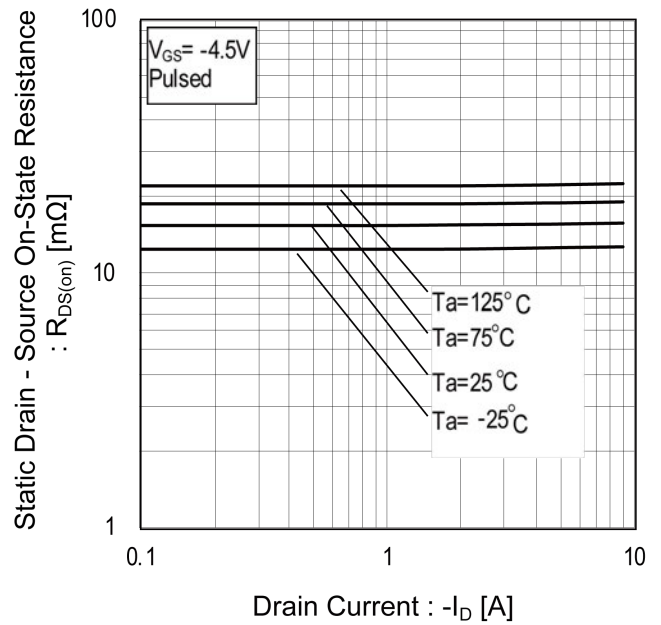
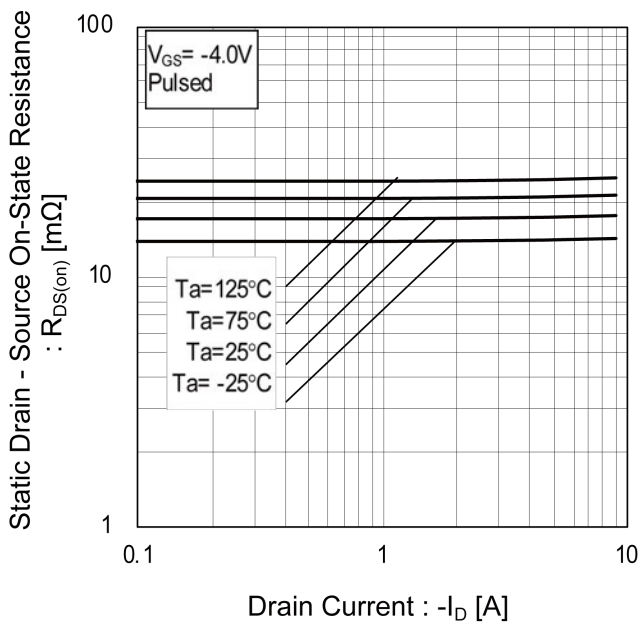


Fig.19 Static Drain - Source On - State Resistance vs. Drain Current(IV)





● Electrical characteristic curves

Fig.20 Typical Capacitance vs. Drain - Source Voltage

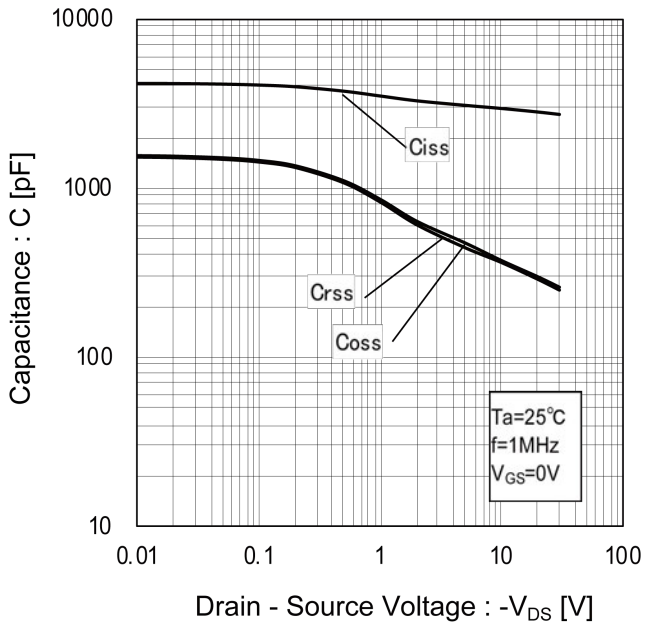


Fig.21 Switching Characteristics

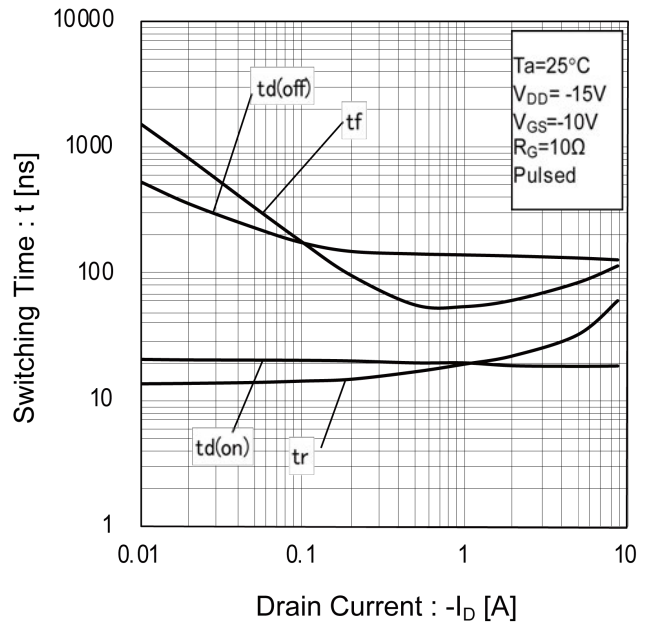


Fig.22 Dynamic Input Characteristics

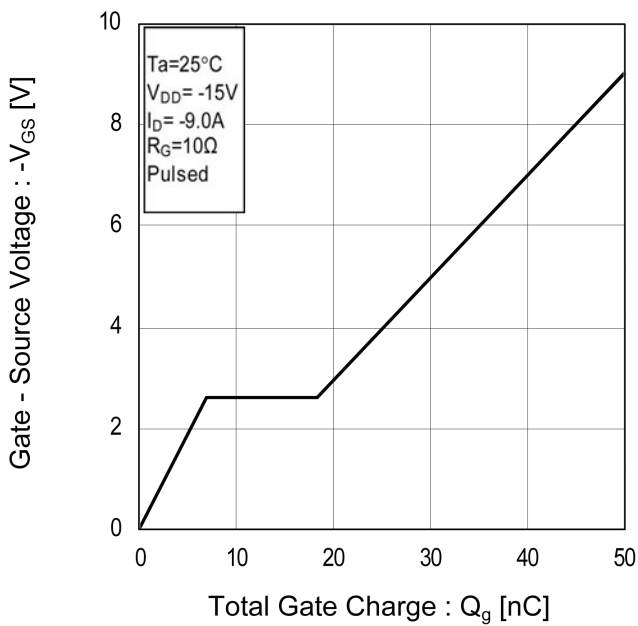
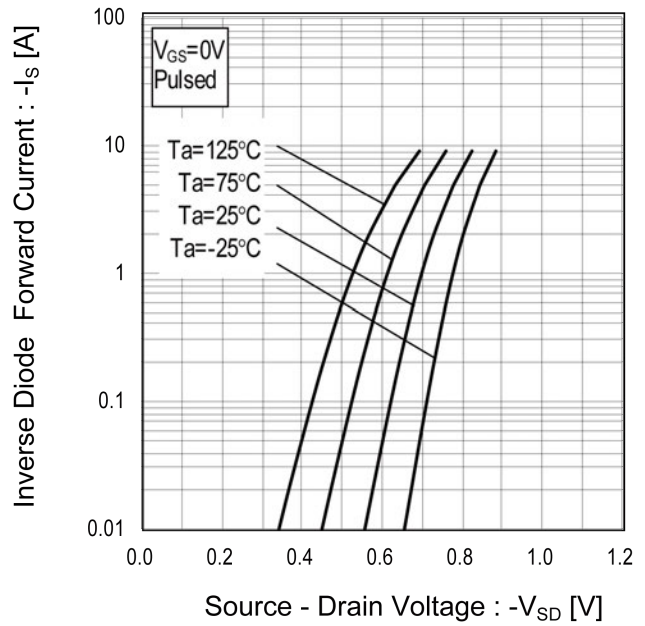


Fig.23 Source Current vs. Source Drain Voltage



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

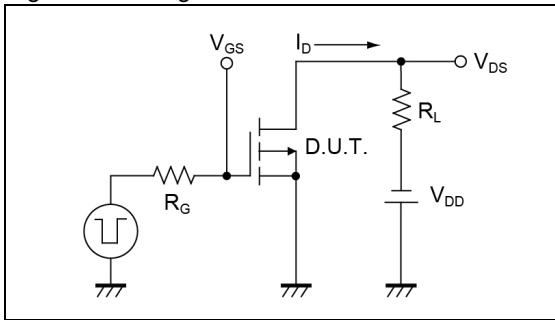


Fig.1-2 Switching Waveforms

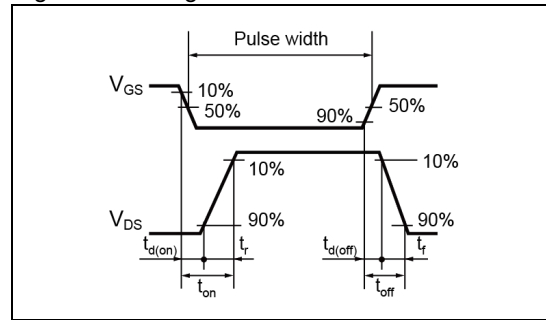


Fig.2-1 Gate Charge Measurement Circuit

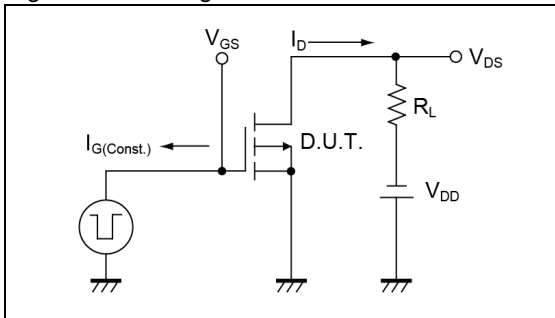


Fig.2-2 Gate Charge Waveform

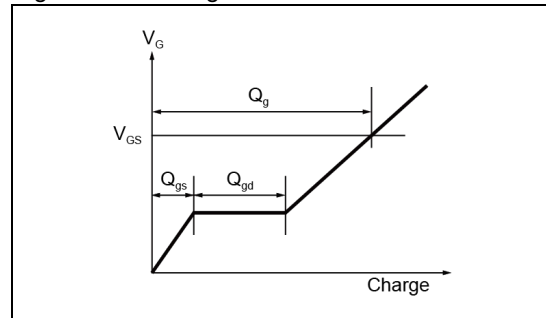


Fig.3-1 Avalanche Measurement Circuit

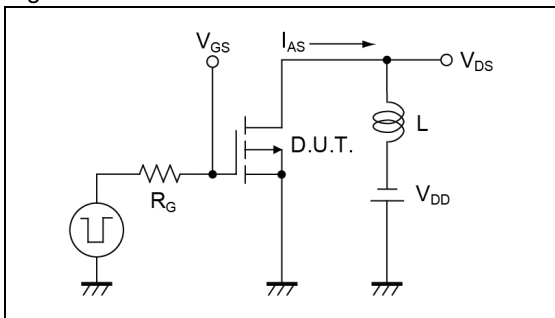
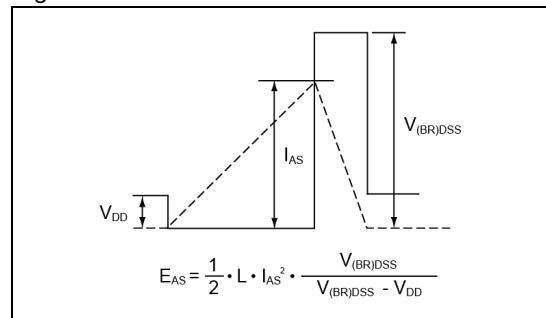
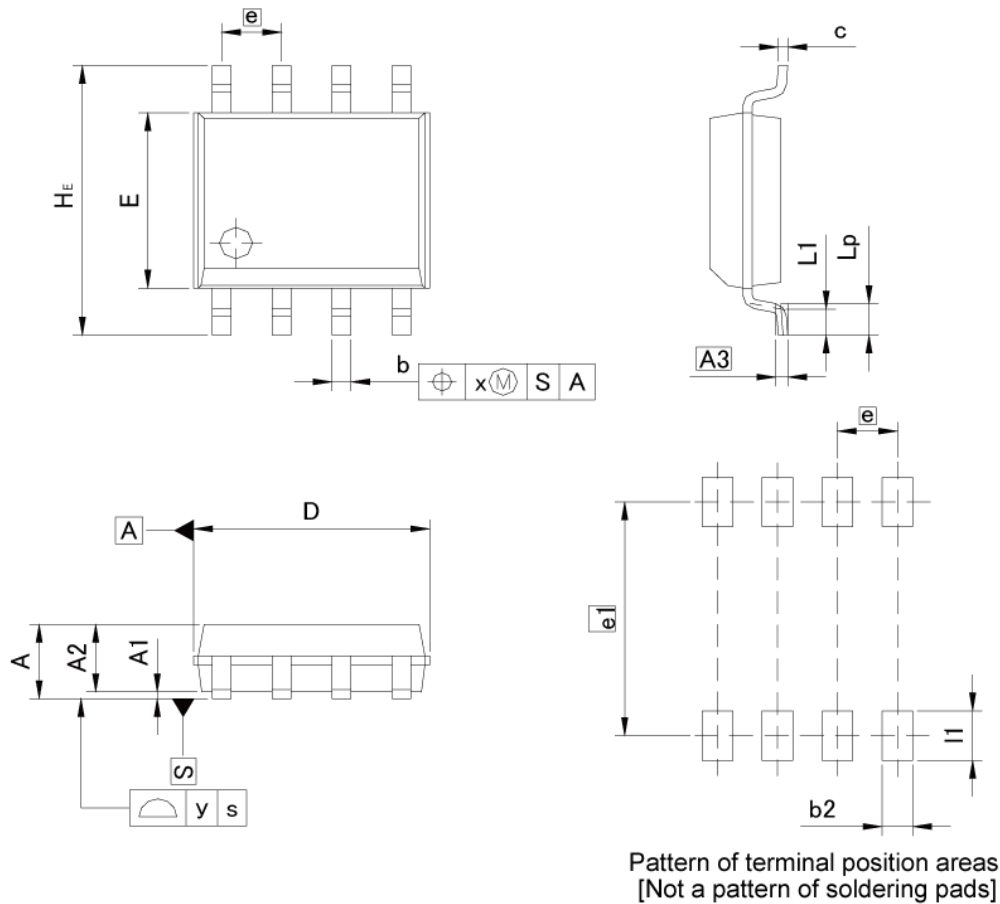


Fig.3-2 Avalanche Waveform



●Dimensions

SOP8



Pattern of terminal position areas [Not a pattern of soldering pads]

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	-	1.75	-	0.069
A1	0.15		0.006	
A2	1.40	1.60	0.055	0.063
A3	0.25		0.010	
b	0.30	0.50	0.012	0.020
c	0.10	0.30	0.004	0.012
D	4.80	5.20	0.189	0.205
E	3.75	4.05	0.148	0.159
e	1.27		0.050	
HE	5.70	6.30	0.224	0.248
L1	0.50	0.70	0.020	0.028
Lp	0.65	0.85	0.026	0.033
x	0.15		0.006	
y	0.10		0.004	

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
b2	-	0.65	-	0.026
e1	5.15		0.203	
l1	-	1.15	-	0.045

Dimension in mm/inches

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