

V_{DSS}	-30V
$R_{DS(on)}$ (Max.)	75mΩ
I_D	-4A
P_D	2.0W

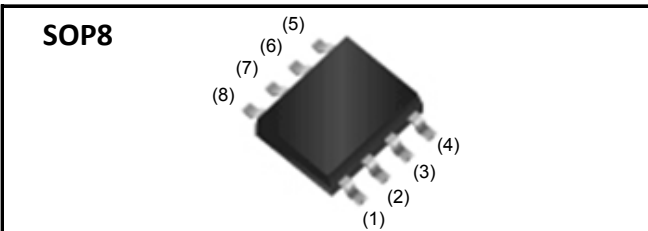
●Features

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

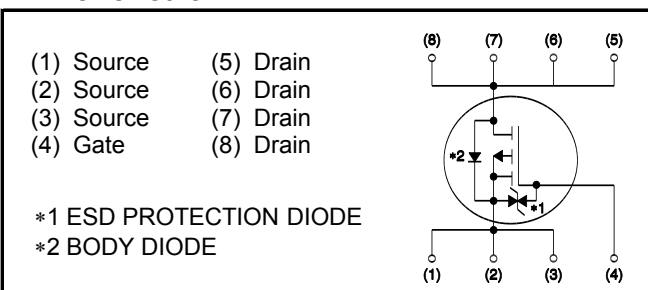
●Application

DC/DC Converter

●Outline



●Inner circuit



●Packaging specifications

Type	Packaging	Taping
	Reel size (mm)	330
	Tape width (mm)	12
	Basic ordering unit (pcs)	2,500
	Taping code	TB
	Marking	RRH040P03

●Absolute maximum ratings($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Value	Unit
Drain - Source voltage	V_{DSS}	-30	V
Continuous drain current	I_D^{*1}	±4	A
Pulsed drain current	$I_{D,pulse}^{*2}$	±16	A
Gate - Source voltage	V_{GSS}	±20	V
Avalanche energy, single pulse	E_{AS}^{*3}	0.1	mJ
Power dissipation	P_D^{*4}	2.0	W
	P_D^{*5}	0.65	W
Junction temperature	T_j	150	°C
Range of storage temperature	T_{stg}	-55 to +150	°C

●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - ambient	R_{thJA}^{*4}	-	-	62.5	°C/W
Thermal resistance, junction - ambient	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°C	-	-25	-	mV/°C
Zero gate voltage drain current	I_{DSS}	$V_{DS} = -30V, V_{GS} = 0V$	-	-	-1	μA
Gate - Source leakage current	I_{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	±10	μA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = -10V, I_D = -1mA$	-1	-	-2.5	V
Gate threshold voltage temperature coefficient	$\frac{\Delta V_{(GS)th}}{\Delta T_j}$	$I_D = -1mA$ referenced to 25°C	-	3.9	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*6}$	$V_{GS} = -10V, I_D = -4A$	-	55	75	mΩ
		$V_{GS} = -4.5V, I_D = -2A$	-	85	115	
		$V_{GS} = -4.0V, I_D = -2A$	-	95	125	
		$V_{GS} = -10V, I_D = -4A, T_j = 125^\circ\text{C}$	-	78	110	
Gate input resistance	R_G	$f = 1MHz, \text{open drain}$	-	25	-	Ω
Transconductance	g_{fs}^{*6}	$V_{DS} = -10V, I_D = -4A$	3.0	6.0	-	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}	$V_{GS} = 0V$	-	480	-	pF
Output capacitance	C_{oss}	$V_{DS} = -10V$	-	70	-	
Reverse transfer capacitance	C_{rss}	$f = 1\text{MHz}$	-	70	-	
Turn - on delay time	$t_{d(on)}^{*6}$	$V_{DD} \approx -15V, V_{GS} = -10V$	-	7	-	ns
Rise time	t_r^{*6}	$I_D = -2A$	-	18	-	
Turn - off delay time	$t_{d(off)}^{*6}$	$R_L = 7.5\Omega$	-	50	-	
Fall time	t_f^{*6}	$R_G = 10\Omega$	-	37	-	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g^{*6}	$V_{DD} \approx -15V, I_D = -4A$ $V_{GS} = -5V$	-	5.2	-	nC
		$V_{DD} \approx -15V, I_D = -4A$ $V_{GS} = -10V$	-	9.6	-	
Gate - Source charge	Q_{gs}^{*6}	$V_{DD} \approx -15V, I_D = -4A$	-	1.6	-	
Gate - Drain charge	Q_{gd}^{*6}	$V_{GS} = -5V$	-	1.6	-	

●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}	$V_{GS} = 0V, I_S = -4.0A$	-	-	-1.2	V
Reverse recovery time	t_{rr}^{*6}	$I_S = -4A$	-	20	40	ns
Reverse recovery charge	Q_{rr}^{*6}	$di/dt = 100A / \mu s$	-	10	20	μC

*6 Plused

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

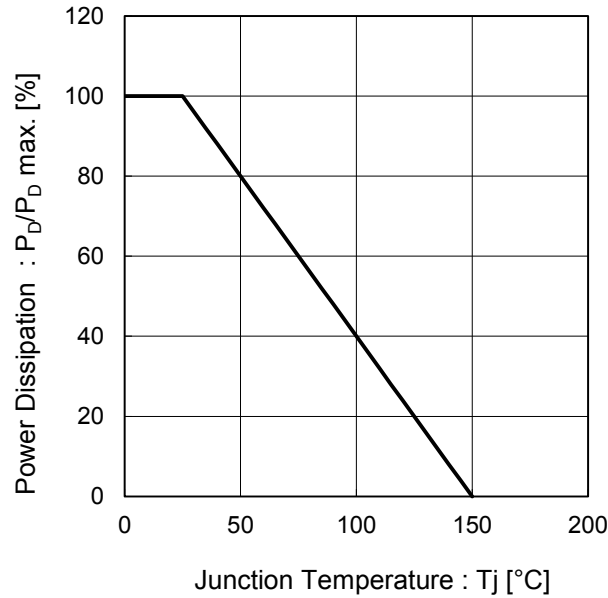


Fig.2 Maximum Safe Operating Area

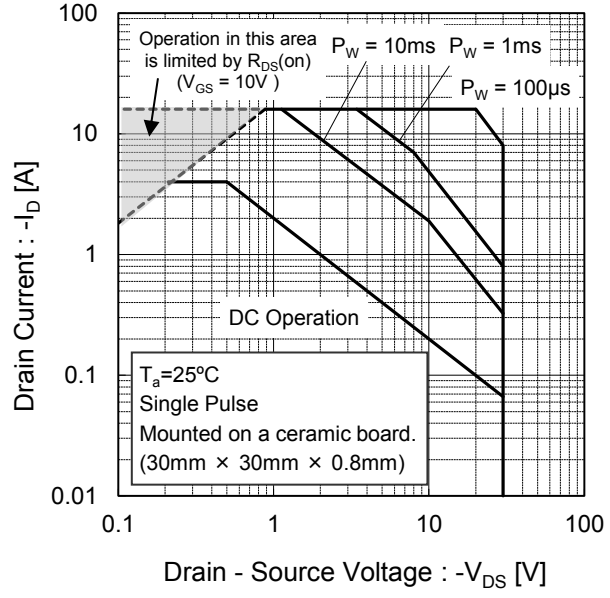


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

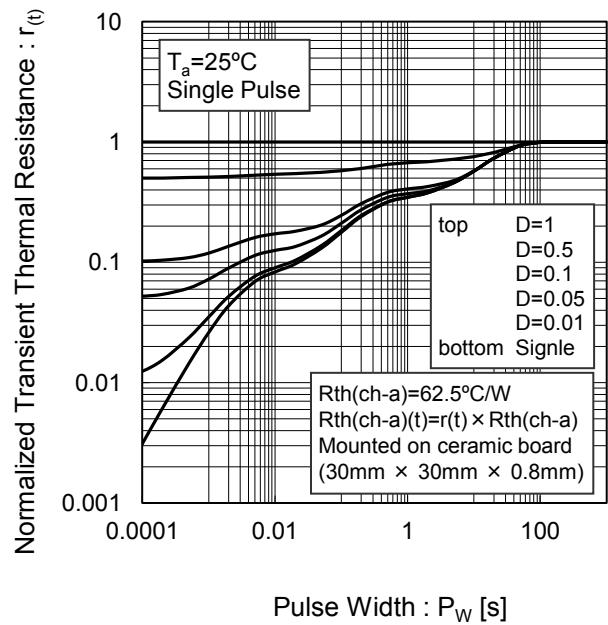
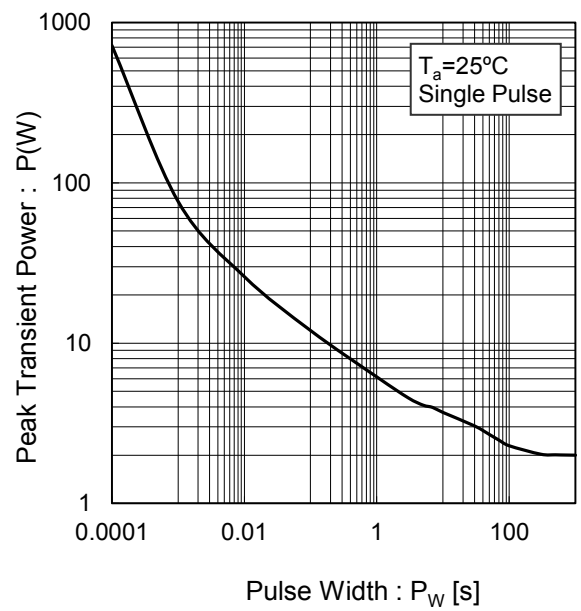


Fig.4 Avalanche Current vs. Power dissipation



●Electrical characteristic curves

Fig.5 Avalanche Current vs Inductive Load

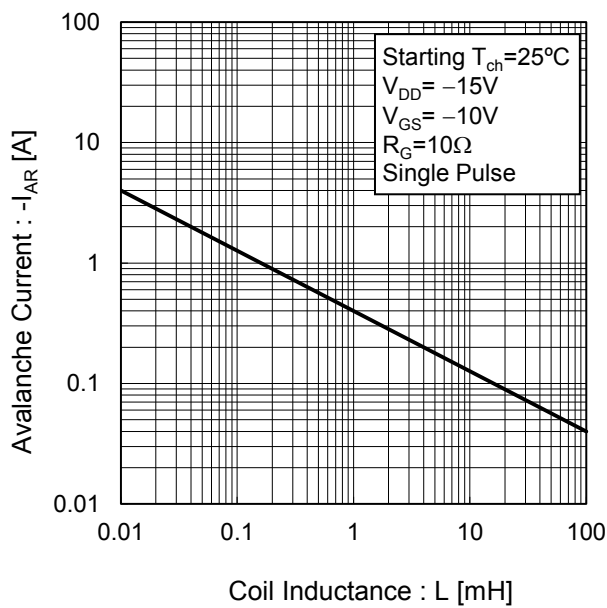


Fig.6 Avalanche Energy Derating Curve vs Junction Temperature

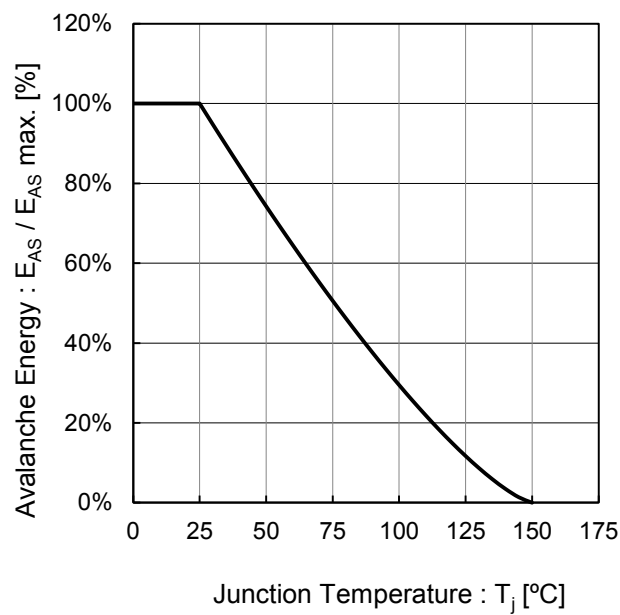


Fig.7 Typical Output Characteristics(I)

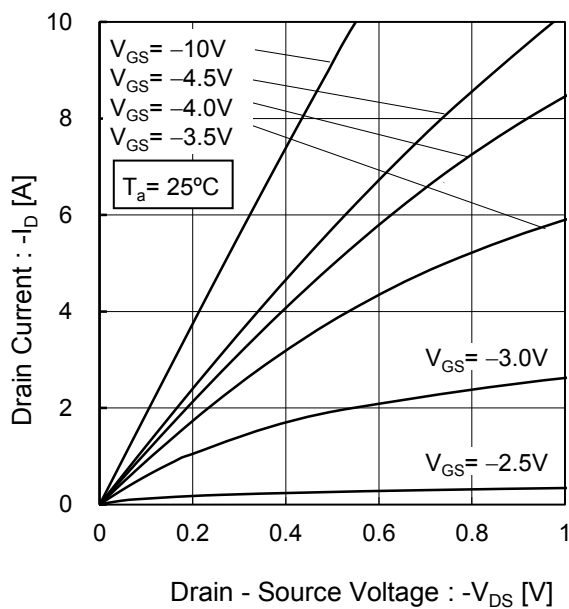
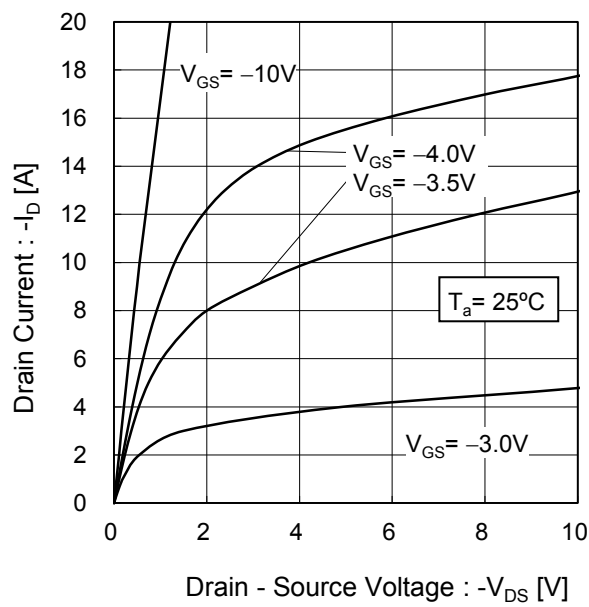


Fig.8 Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.9 Breakdown Voltage
vs. Junction Temperature

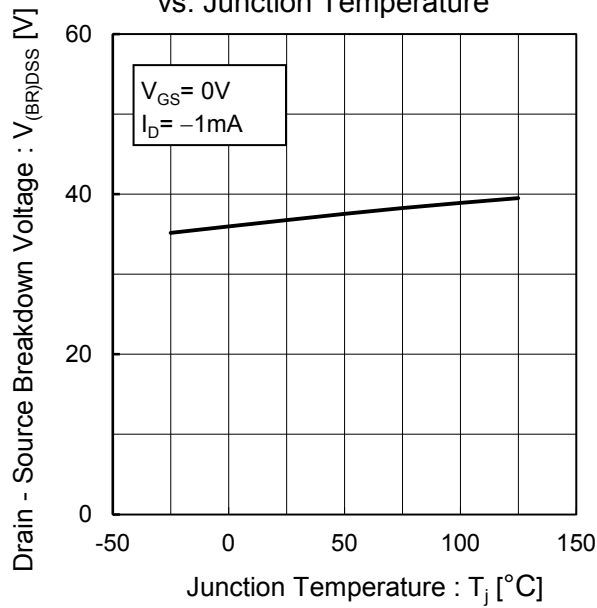


Fig.10 Typical Transfer Characteristics

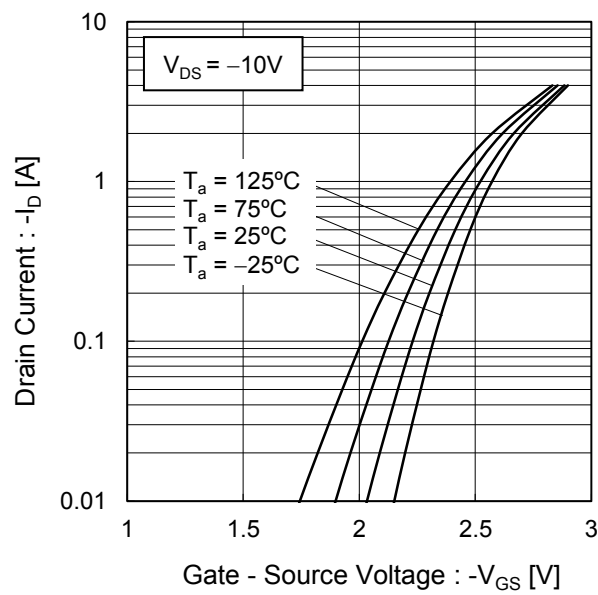


Fig.11 Gate Threshold Voltage
vs. Junction Temperature

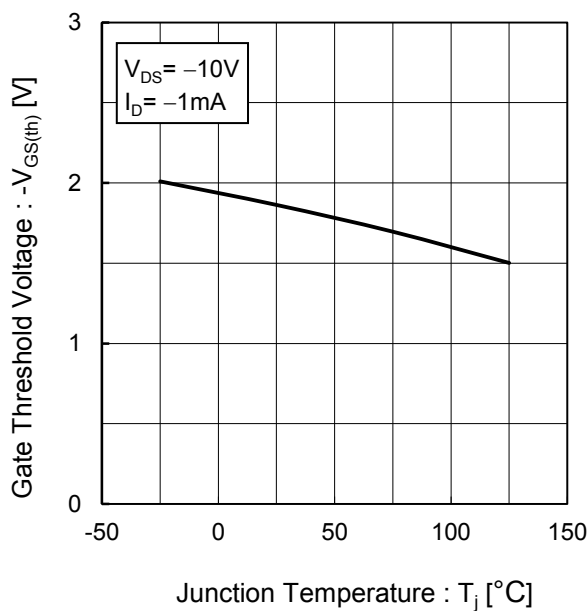
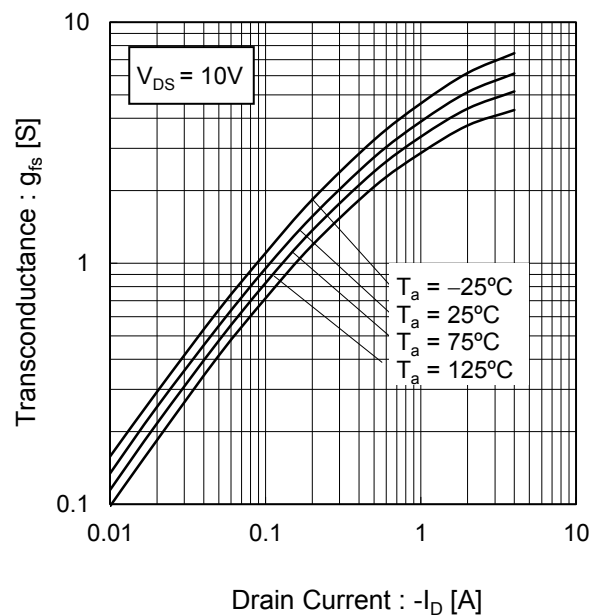


Fig.12 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.13 Drain Current Derating Curve

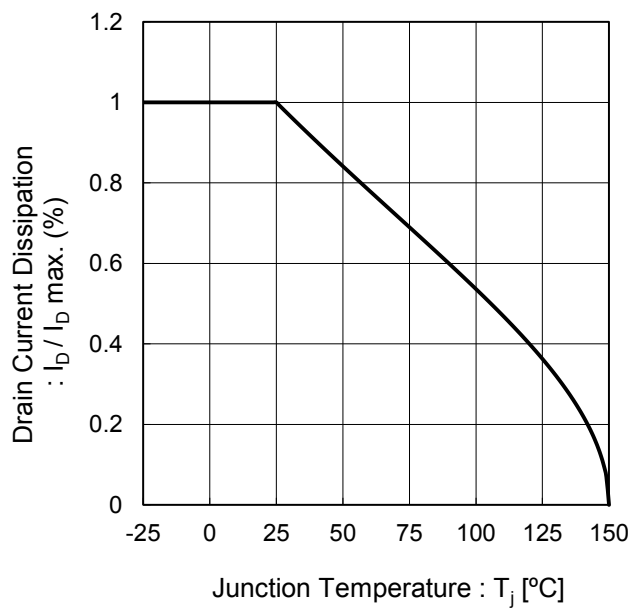


Fig.14 Static Drain - Source On - State Resistance vs. Gate Source Voltage

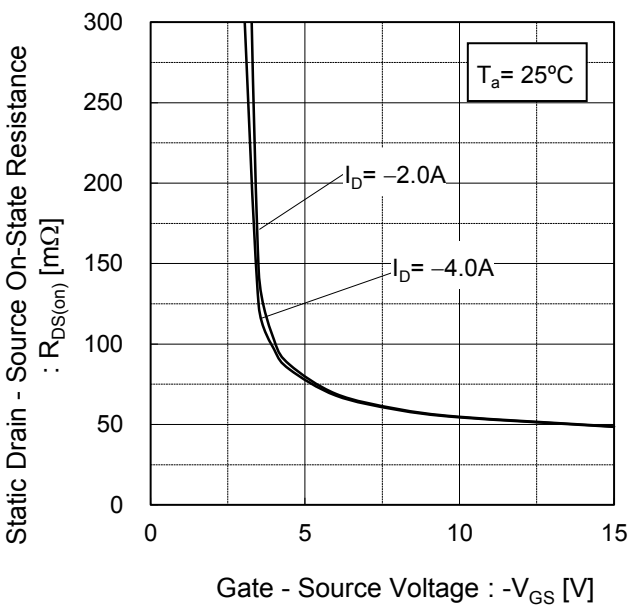


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current(I)

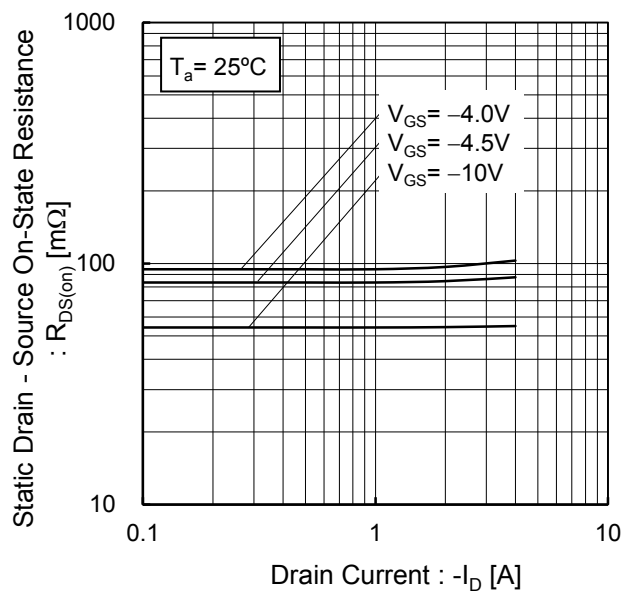
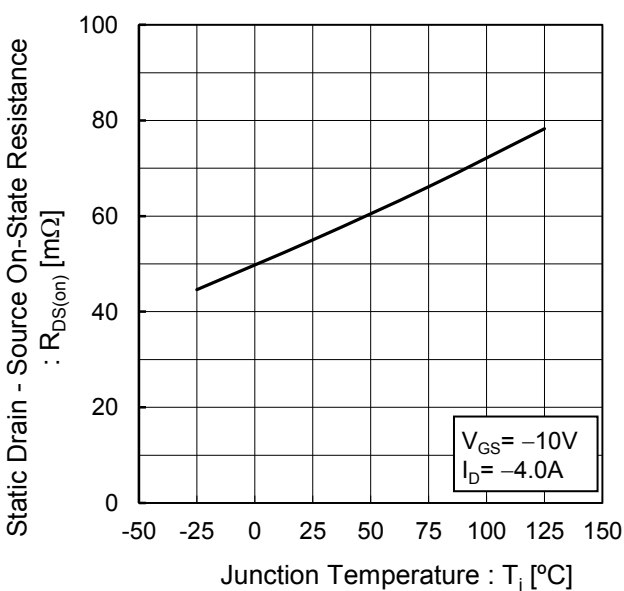


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature



●Electrical characteristic curves

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

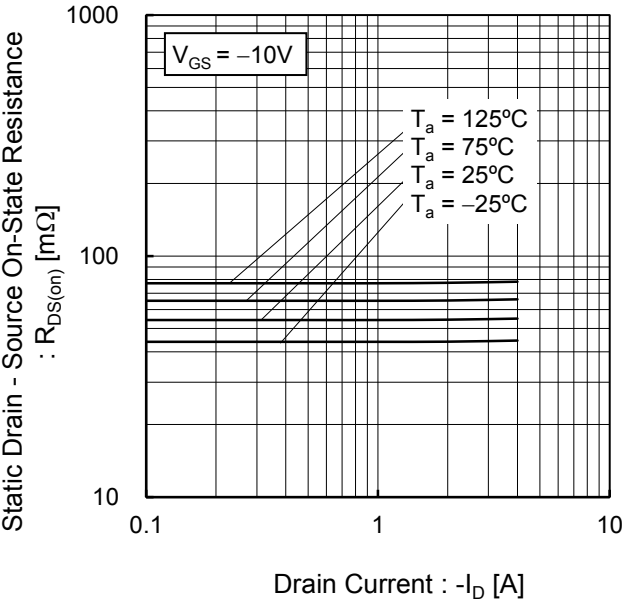


Fig.18 Static Drain - Source On - State Resistance vs. Drain Current(III)

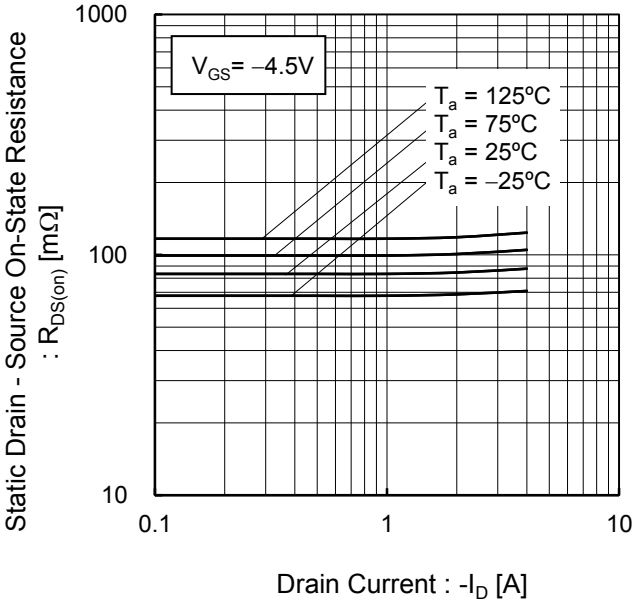
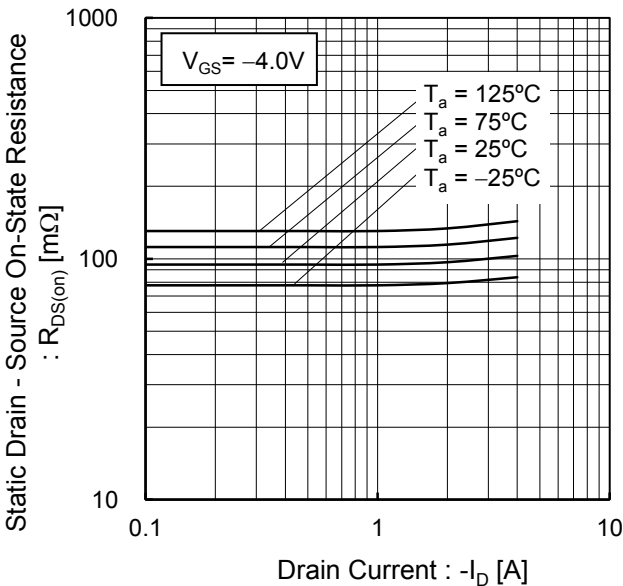


Fig.19 Static Drain - Source On - State Resistance vs. Drain Current(IV)



●Electrical characteristic curves

Fig.20 Typical Capacitance
vs. Drain - Source Voltage

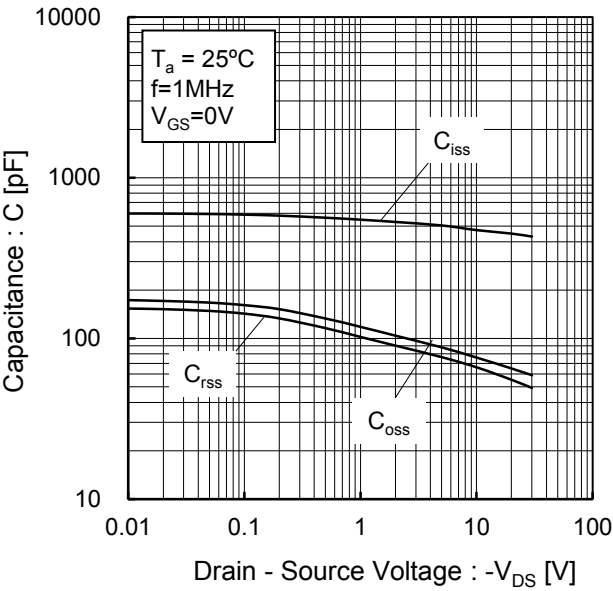


Fig.21 Switching Characteristics

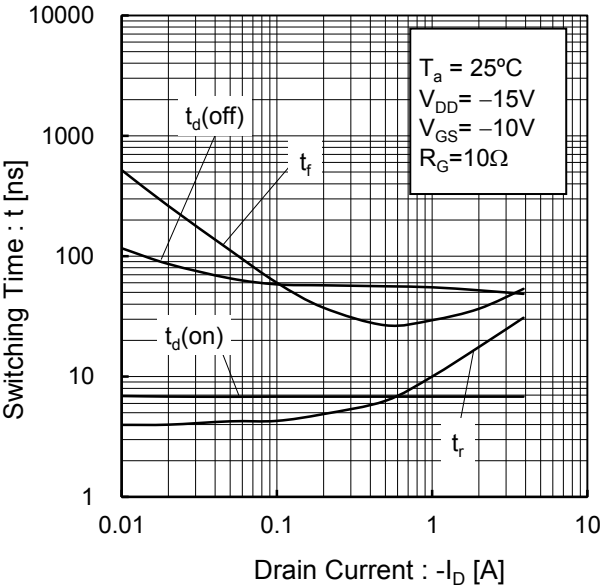


Fig.22 Dynamic Input Characteristics

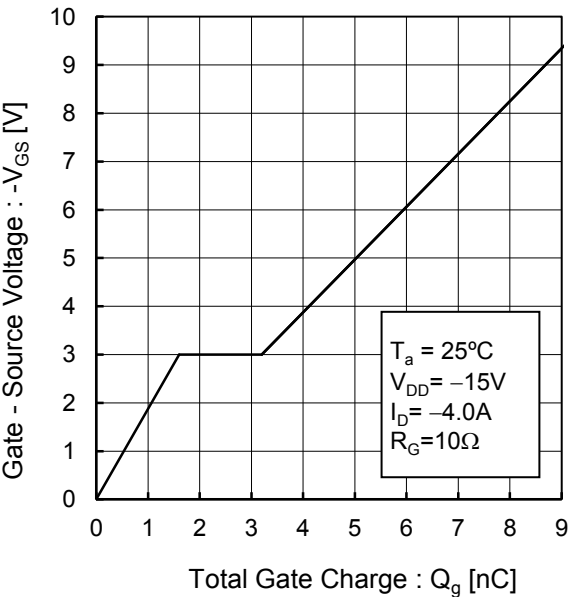
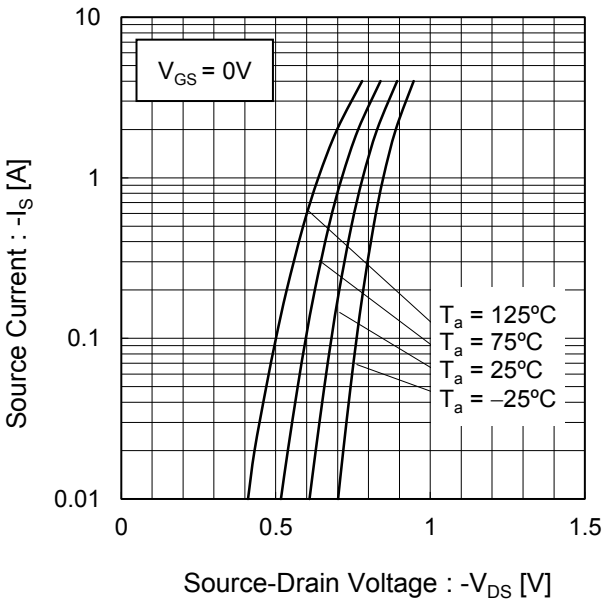


Fig.23 Source Current
vs. Source Drain Voltage



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit



Fig.1-2 Switching Waveforms



Fig.2-1 Gate Charge Measurement Circuit

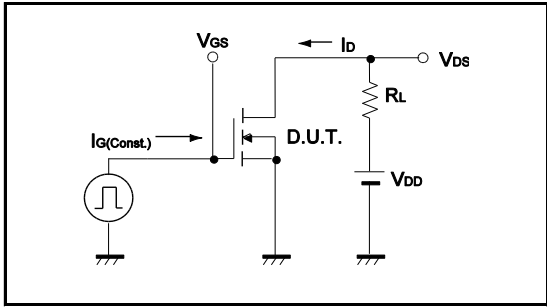


Fig.2-2 Gate Charge Waveform



Fig.3-1 Avalanche Measurement Circuit

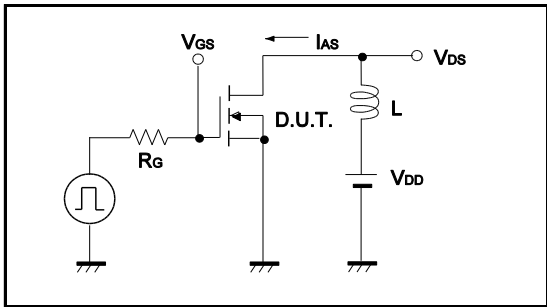
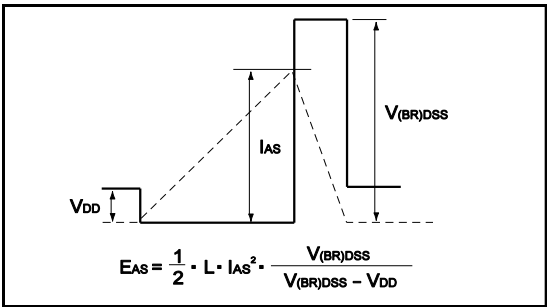
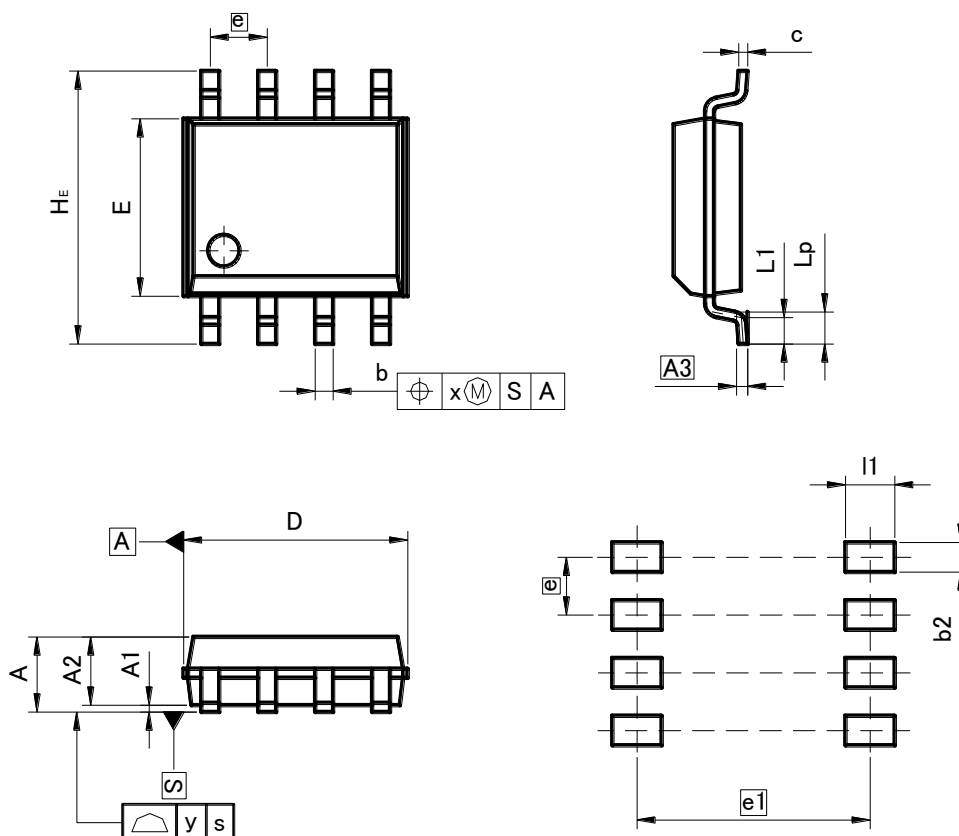


Fig.3-2 Avalanche Waveform



●Dimensions (Unit : mm)

SOP8



Pattern of terminal position areas

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		0.01	
b	0.30	0.50	0.012	0.02
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		0.05	
H_E	5.70	6.30	0.224	0.248
L_1	0.50	0.70	0.02	0.028
L_p	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
b_2	—	0.65	—	0.026
e_1	5.15		0.203	
l_1	—	1.15	—	0.045

Dimension in mm/inches

Notes

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