

$V_{DSS}$	500V
$R_{DS(on)}$ (Max.)	0.5 $\Omega$
$I_D$	$\pm 11A$
$P_D$	75W

### ●Features

- 1) Low on-resistance.
- 2) Fast switching speed.
- 3) Gate-source voltage ( $V_{GSS}$ ) guaranteed to be  $\pm 30V$ .
- 4) Drive circuits can be simple.
- 5) Parallel use is easy.
- 6) Pb-free lead plating ; RoHS compliant

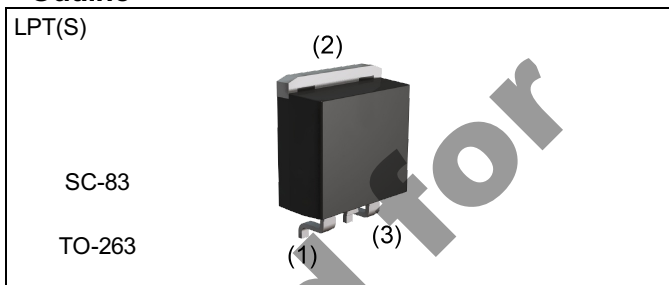
### ●Application

Switching Power Supply

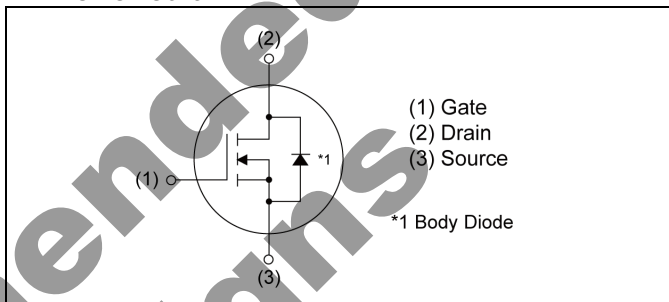
### ●Absolute maximum ratings ( $T_a = 25^{\circ}C$ )

Parameter	Symbol	Value	Unit
Drain - Source voltage	$V_{DSS}$	500	V
Continuous drain current	$T_C = 25^{\circ}C$ $I_D$ *1	$\pm 11$	A
	$T_C = 100^{\circ}C$ $I_D$ *1	$\pm 5.3$	A
Pulsed drain current	$I_{D,pulse}$ *2	$\pm 44$	A
Gate - Source voltage	$V_{GSS}$	$\pm 30$	V
Avalanche energy, single pulse	$E_{AS}$ *3	8.1	mJ
Avalanche energy, repetitive	$E_{AR}$ *4	6.5	mJ
Avalanche current	$I_{AR}$ *3	5.5	A
Power dissipation ( $T_c = 25^{\circ}C$ )	$P_D$	75	W
Junction temperature	$T_j$	150	$^{\circ}C$
Range of storage temperature	$T_{stg}$	-55 to +150	$^{\circ}C$
Reverse diode dv/dt	dv/dt	15	V/ns

### ●Outline



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	330
	Tape width (mm)	24
	Basic ordering unit (pcs)	1000
	Taping code	TL
	Marking	R5011ANJ

**● Absolute maximum ratings**

Parameter	Symbol	Conditions	Values	Unit
Drain - Source voltage slope	dv/dt	V <sub>DS</sub> = 400V, I <sub>D</sub> = 11A T <sub>j</sub> = 125°C	50	V/ns

**● Thermal resistance**

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R <sub>thJC</sub>	-	-	1.67	°C/W
Thermal resistance, junction - ambient	R <sub>thJA</sub>	-	-	80	°C/W
Soldering temperature, wavesoldering for 10s	T <sub>sold</sub>	-	-	265	°C

**● Electrical characteristics (T<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1mA	500	-	-	V
Drain - Source avalanche breakdown voltage	V <sub>(BR)DS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 5.5A	-	580	-	V
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = 500V, V <sub>GS</sub> = 0V T <sub>j</sub> = 25°C	-	0.1	100	μA
		T <sub>j</sub> = 125°C	-	-	1000	
Gate - Source leakage current	I <sub>GSS</sub>	V <sub>GS</sub> = ±30V, V <sub>DS</sub> = 0V	-	-	±100	nA
Gate threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = 10V, I <sub>D</sub> = 1mA	2.5	-	4.5	V
Static drain - source on - state resistance	R <sub>DS(on)</sub> <sup>*6</sup>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 5.5A T <sub>j</sub> = 25°C	-	0.38	0.5	Ω
		T <sub>j</sub> = 125°C	-	0.79	-	
Gate input resistance	R <sub>G</sub>	f = 1MHz, open drain	-	9.0	-	Ω

**● Electrical characteristics (T<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	$g_{fs}^{*6}$	$V_{DS} = 10V, I_D = 5.5A$	3.5	8	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0V$	-	1000	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = 25V$	-	400	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1MHz$	-	35	-	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{GS} = 0V,$ $V_{DS} = 0V \text{ to } 400V$	-	44.1	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	114	-	
Turn - on delay time	$t_{d(on)}^{*6}$	$V_{DD} \approx 250V, V_{GS} = 10V$	-	26	-	ns
Rise time	$t_r^{*6}$	$I_D = 5.5A$	-	28	-	
Turn - off delay time	$t_{d(off)}^{*6}$	$R_L \approx 45.5\Omega$	-	75	150	
Fall time	$t_f^{*6}$	$R_G = 10\Omega$	-	30	60	

**● Gate charge characteristics (T<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	$Q_g^{*6}$	$V_{DD} \approx 250V$	-	30	-	nC
Gate - Source charge	$Q_{gs}^{*6}$	$I_D = 11A$	-	7	-	
Gate - Drain charge	$Q_{gd}^{*6}$	$V_{GS} = 10V$	-	12	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} \approx 250V, I_D = 11A$	-	6.7	-	V

\*1 Limited only by maximum temperature allowed.

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

\*3  $L \approx 500\mu H$ ,  $V_{DD} = 50V$ ,  $R_G = 25\Omega$ , starting  $T_j = 25^\circ C$

\*4  $L \approx 500\mu H$ ,  $V_{DD} = 50V$ ,  $R_G = 25\Omega$ , starting  $T_j = 25^\circ C$ ,  $f = 10kHz$

\*5 Reference measurement circuits Fig.5-1.

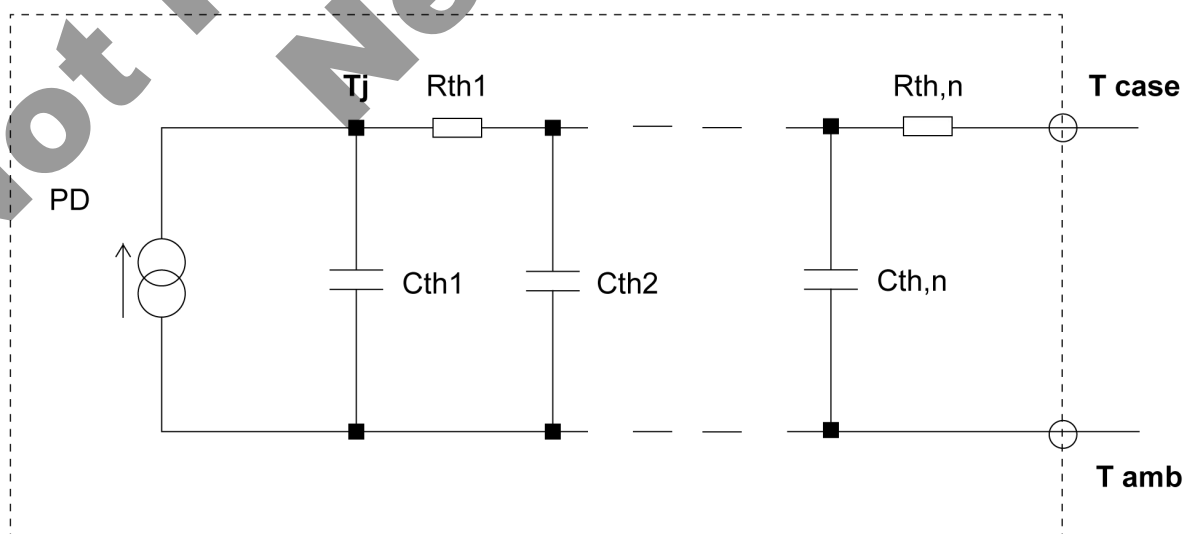
\*6 Pulsed

●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	$I_S^{*1}$	$T_C = 25^{\circ}\text{C}$	-	-	11	A
Inverse diode direct current, pulsed	$I_{SM}^{*2}$		-	-	44	A
Forward voltage	$V_{SD}^{*6}$	$V_{GS} = 0\text{V}, I_S = 11\text{A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}^{*6}$	$I_S = 11\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	343	-	ns
Reverse recovery charge	$Q_{rr}^{*6}$		-	3.1	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rm}^{*6}$		-	18.1	-	A
Peak rate of fall of reverse recovery current	$di_{rr}/dt$	$T_j = 25^{\circ}\text{C}$	-	500	-	A/ $\mu\text{s}$

●Typical transient thermal characteristics

Symbol	Value	Unit	Symbol	Value	Unit
$R_{th1}$	0.0868	K/W	$C_{th1}$	0.00172	Ws/K
$R_{th2}$	0.340		$C_{th2}$	0.00589	
$R_{th3}$	0.613		$C_{th3}$	0.18	



● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

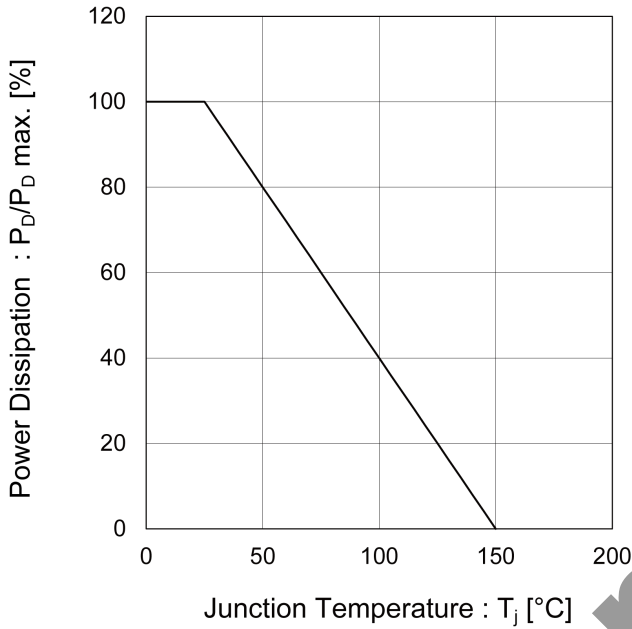


Fig.2 Maximum Safe Operating Area

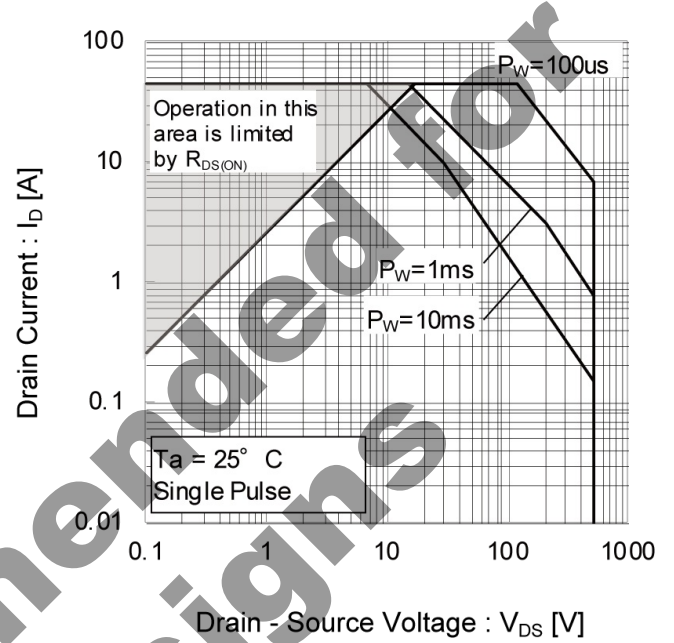
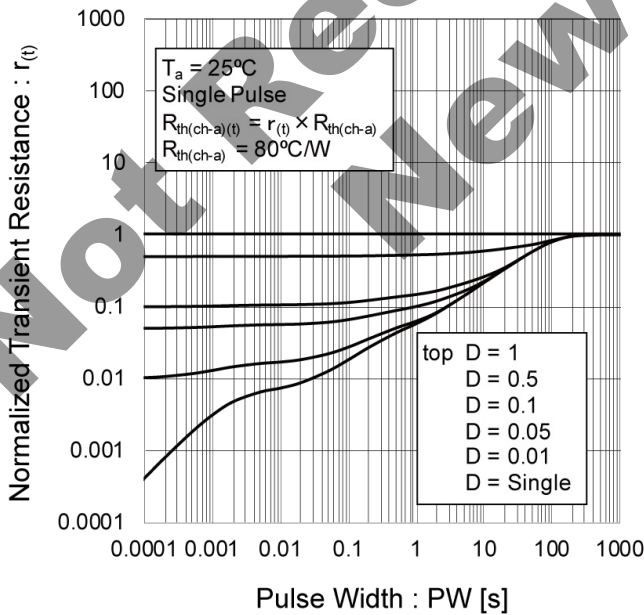


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



●Electrical characteristic curves

Fig.4 Avalanche Current vs. Inductive Load

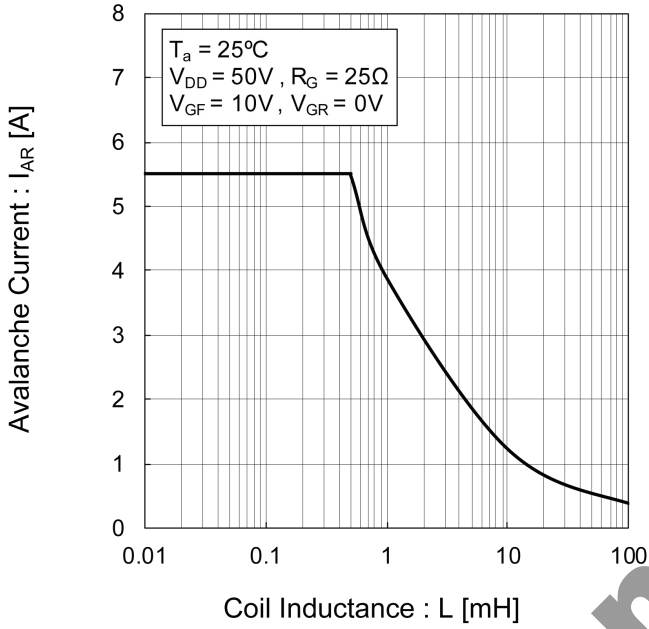


Fig.5 Avalanche Power Losses

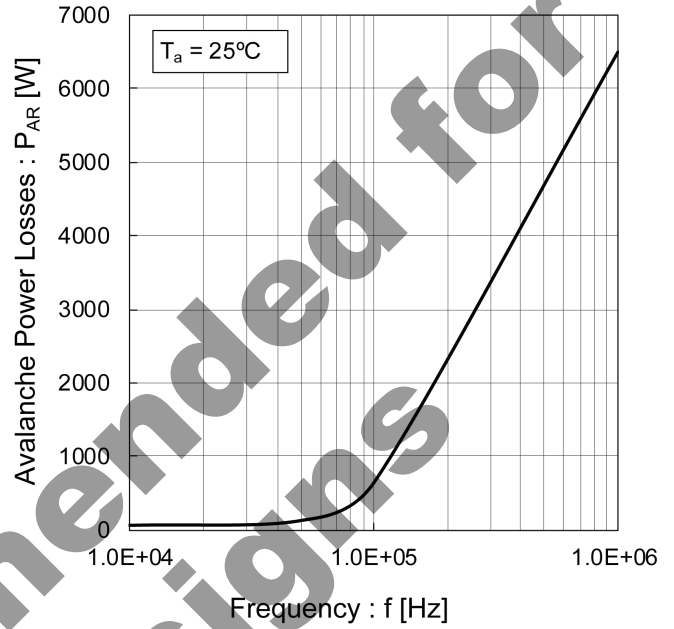
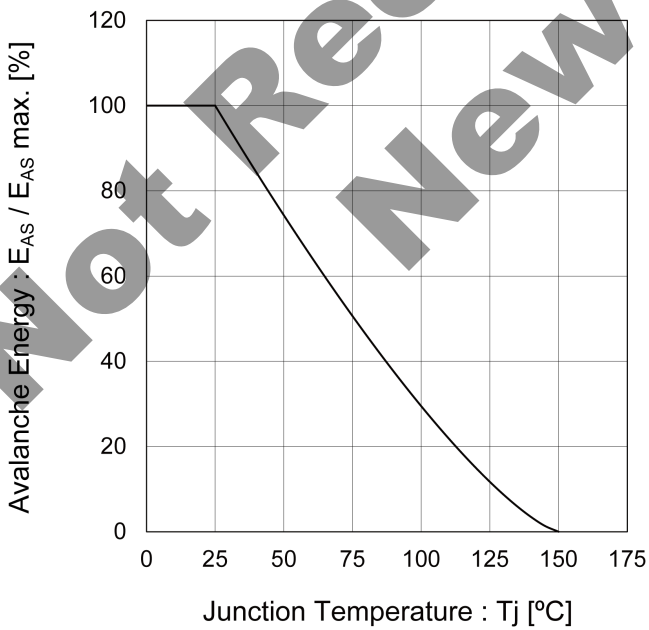


Fig.6 Avalanche Energy Derating Curve vs. Junction Temperature



## ● Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

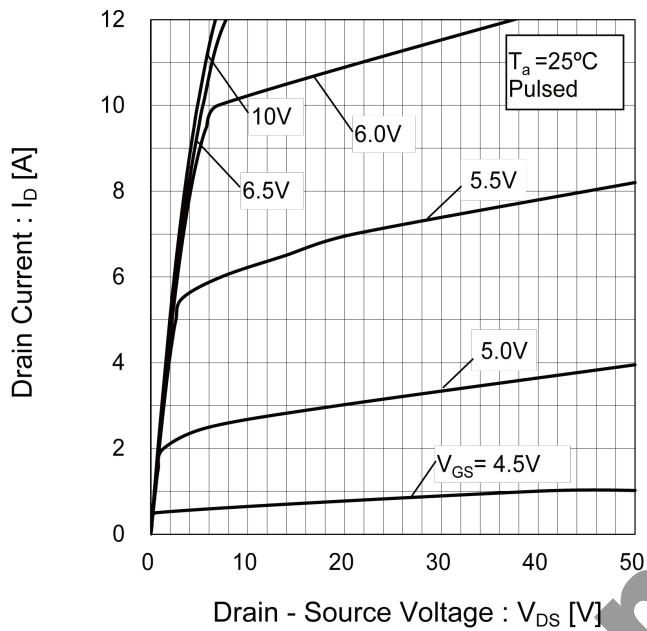
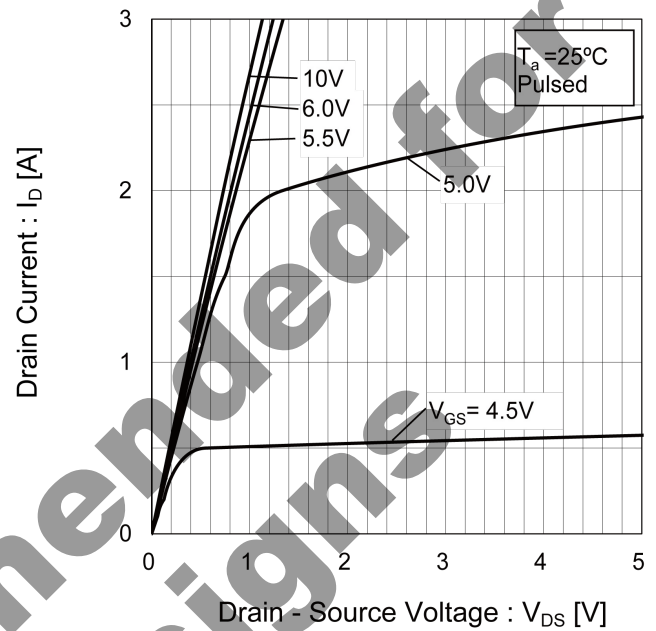
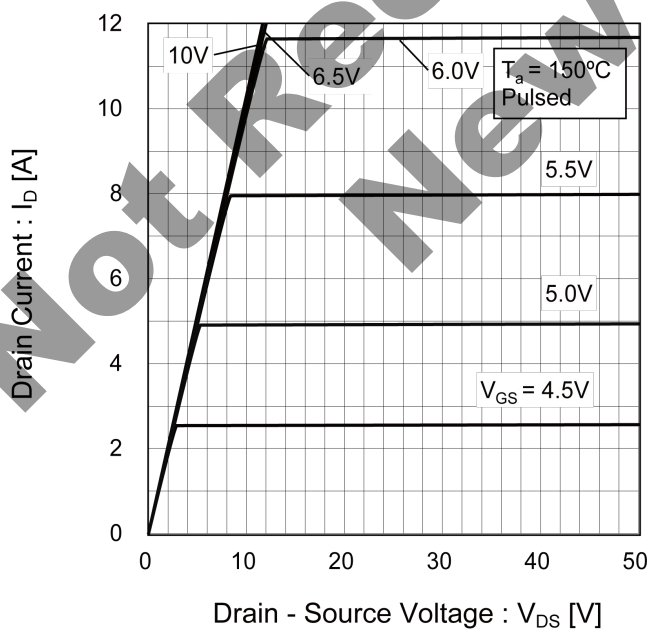
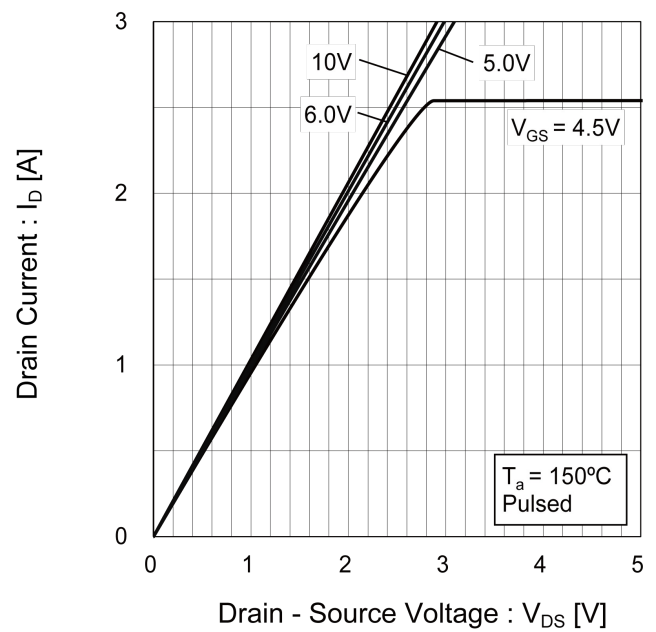


Fig.8 Typical Output Characteristics(II)

Fig.9  $T_j = 150^\circ\text{C}$  Typical Output Characteristics (I)Fig.10  $T_j = 150^\circ\text{C}$  Typical Output Characteristics (II)

●Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

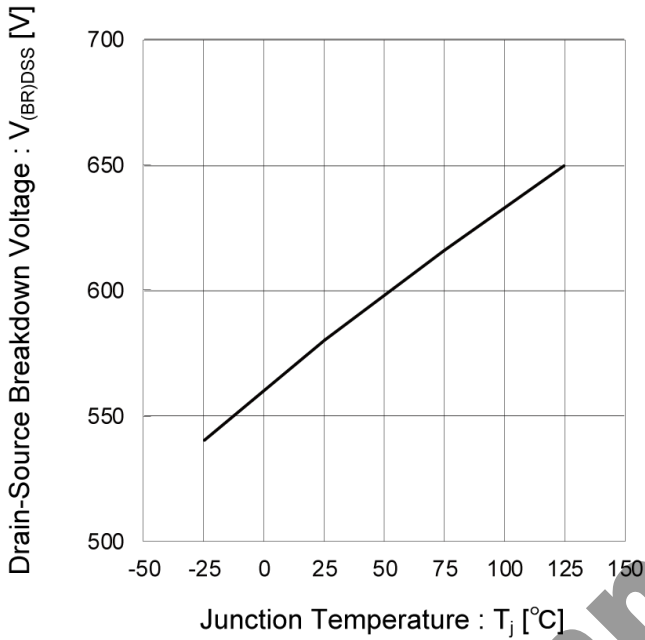


Fig.12 Typical Transfer Characteristics

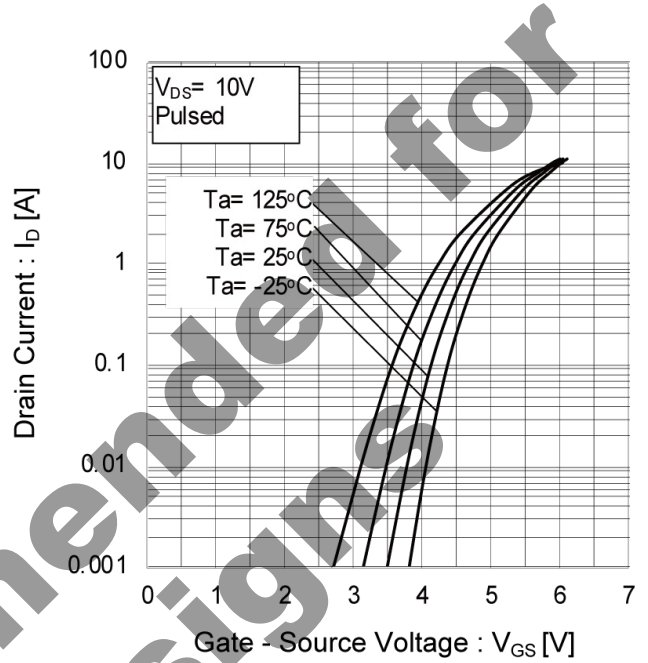


Fig.13 Gate Threshold Voltage vs. Junction Temperature

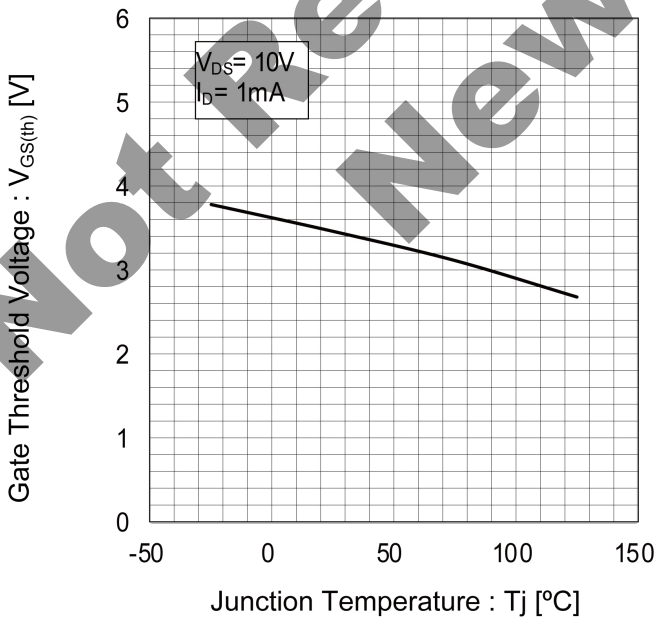
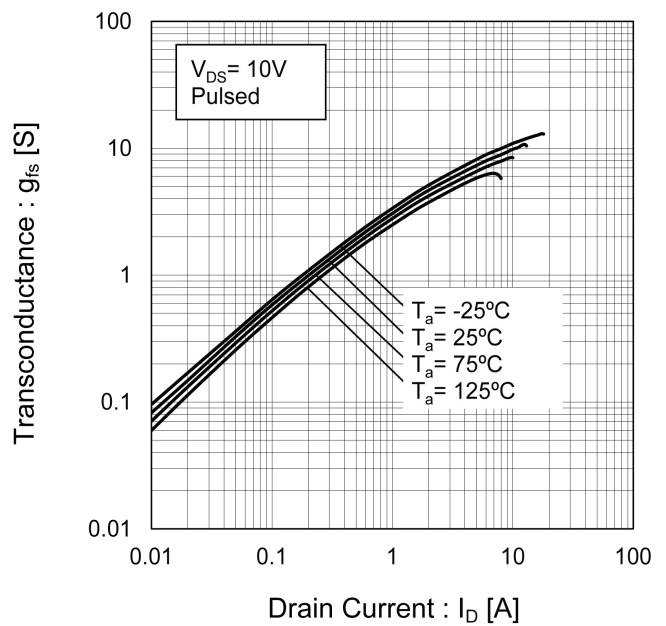


Fig.14 Transconductance vs. Drain Current





● Electrical characteristic curves

Fig.15 Static Drain - Source On - State Resistance vs. Gate Source Voltage

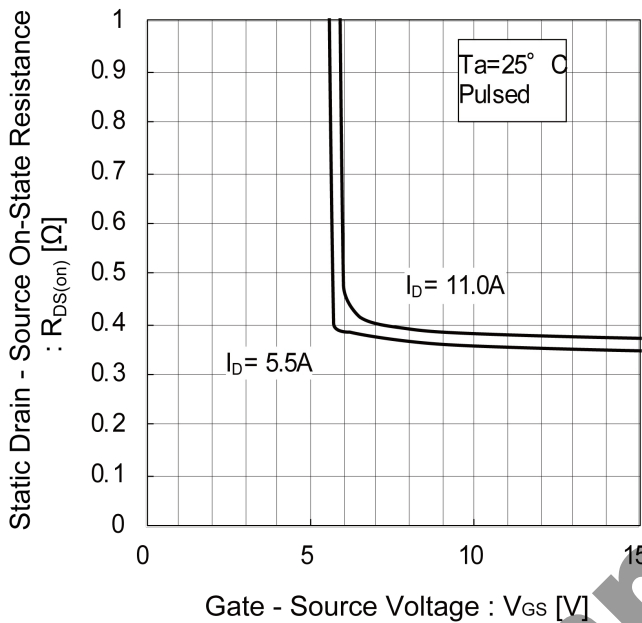


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

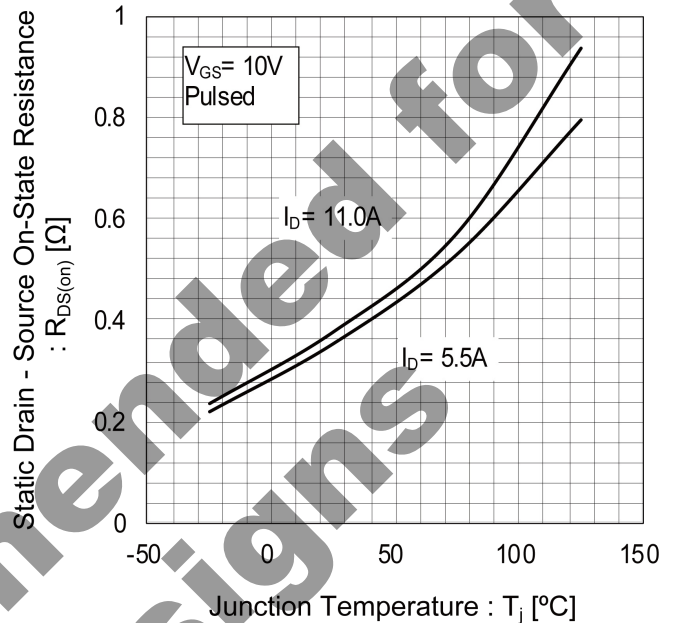
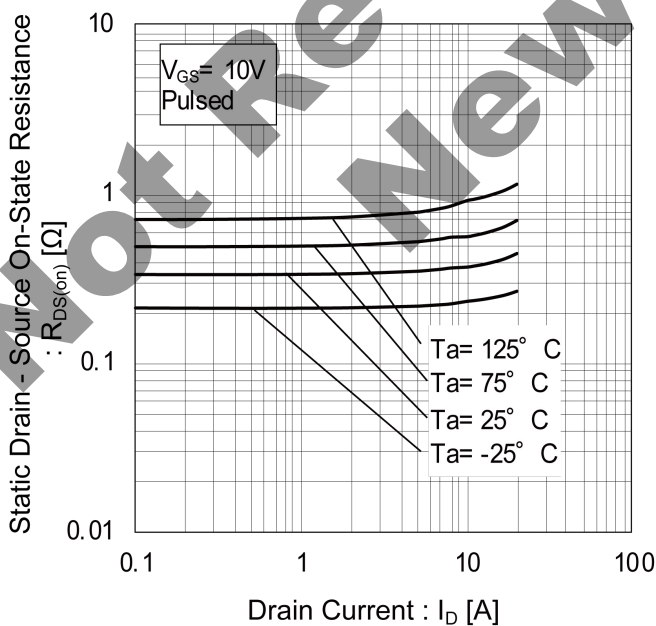


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



● Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

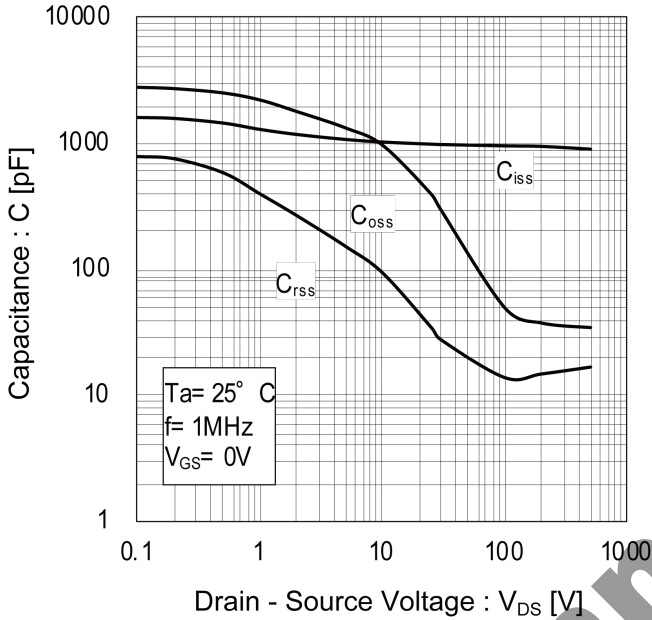


Fig.19 Coss Stored Energy

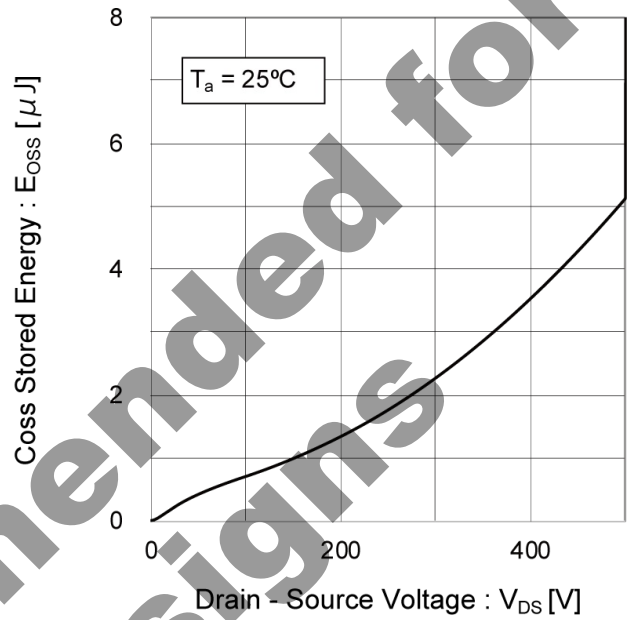


Fig.20 Switching Characteristics

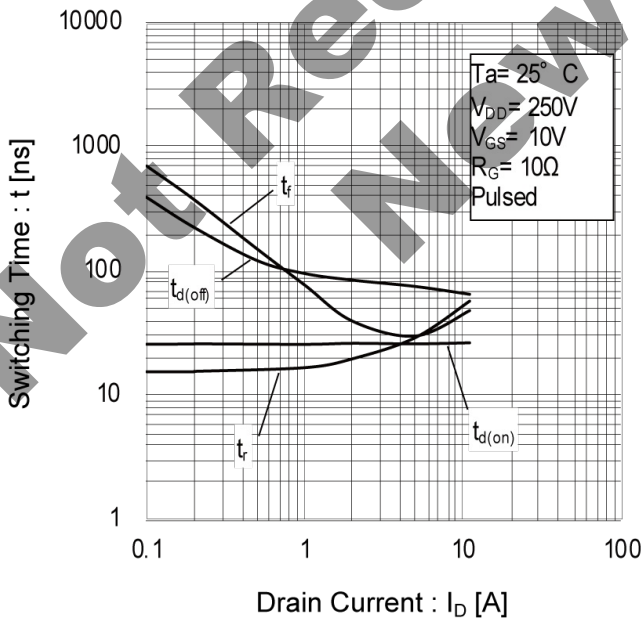
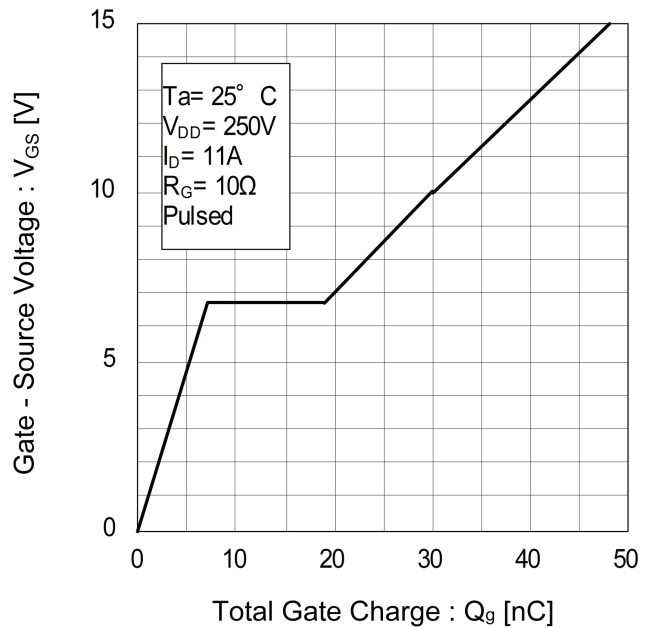


Fig.21 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.22 Inverse Diode Forward Current vs. Source - Drain Voltage

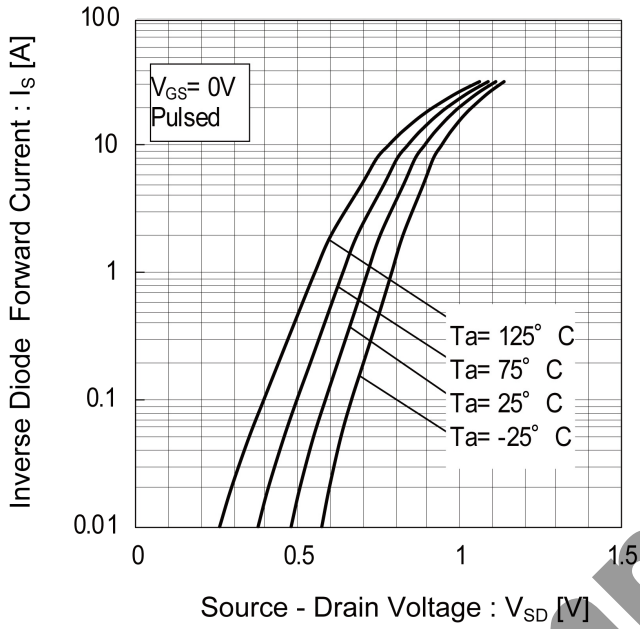
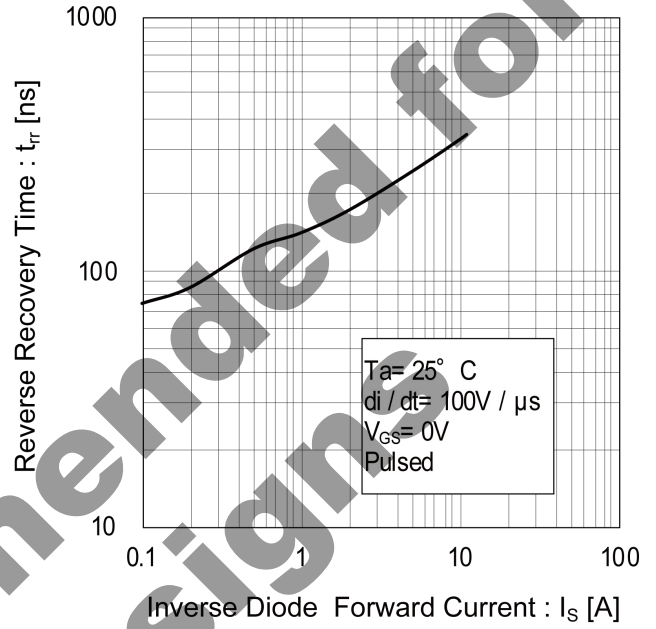


Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



Not Recommended for New Design

● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

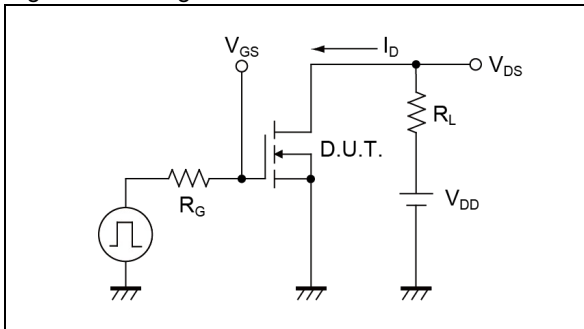


Fig.1-2 Switching Waveforms

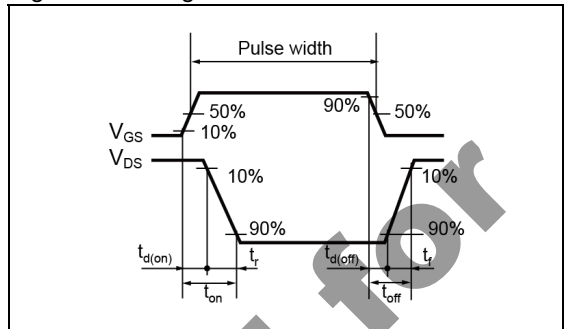


Fig.2-1 Gate Charge Measurement Circuit

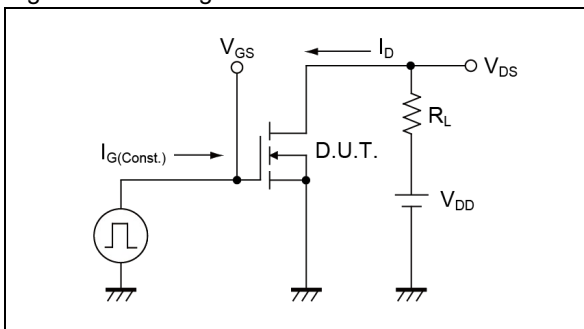


Fig.2-2 Gate Charge Waveform

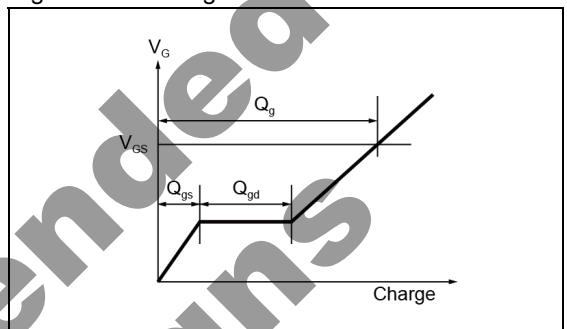


Fig.3-1 Avalanche Measurement Circuit

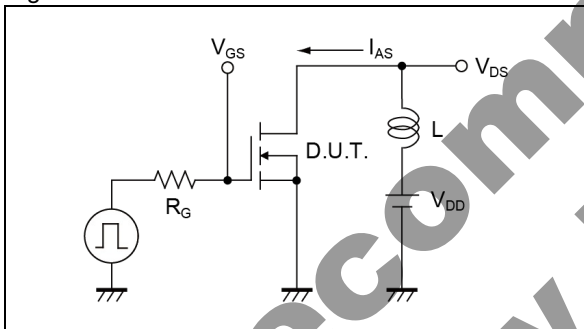


Fig.3-2 Avalanche Waveform

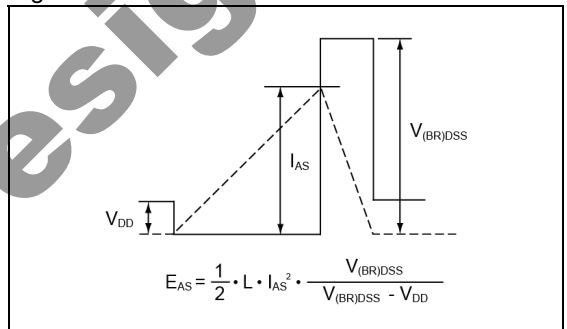


Fig.4-1 dv/dt Measurement Circuit

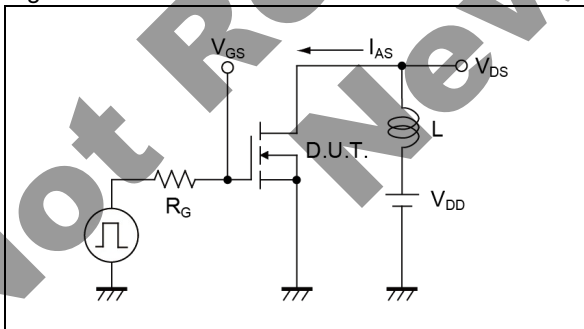


Fig.4-2 dv/dt Waveform

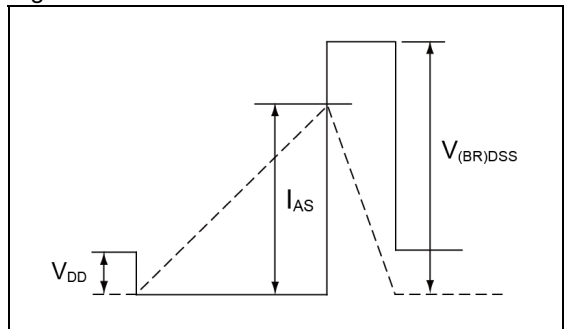


Fig.5-1 di/dt Measurement Circuit

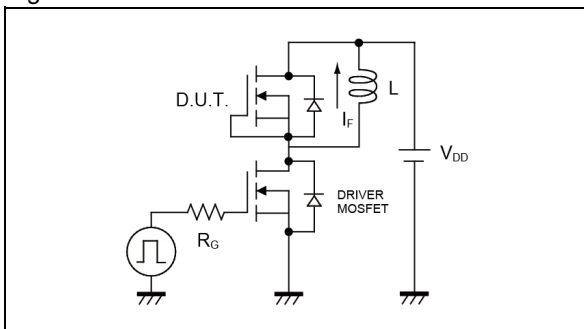
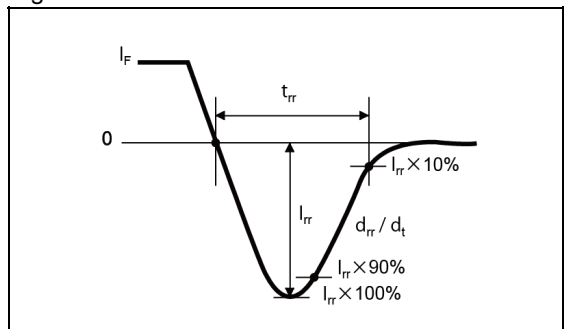
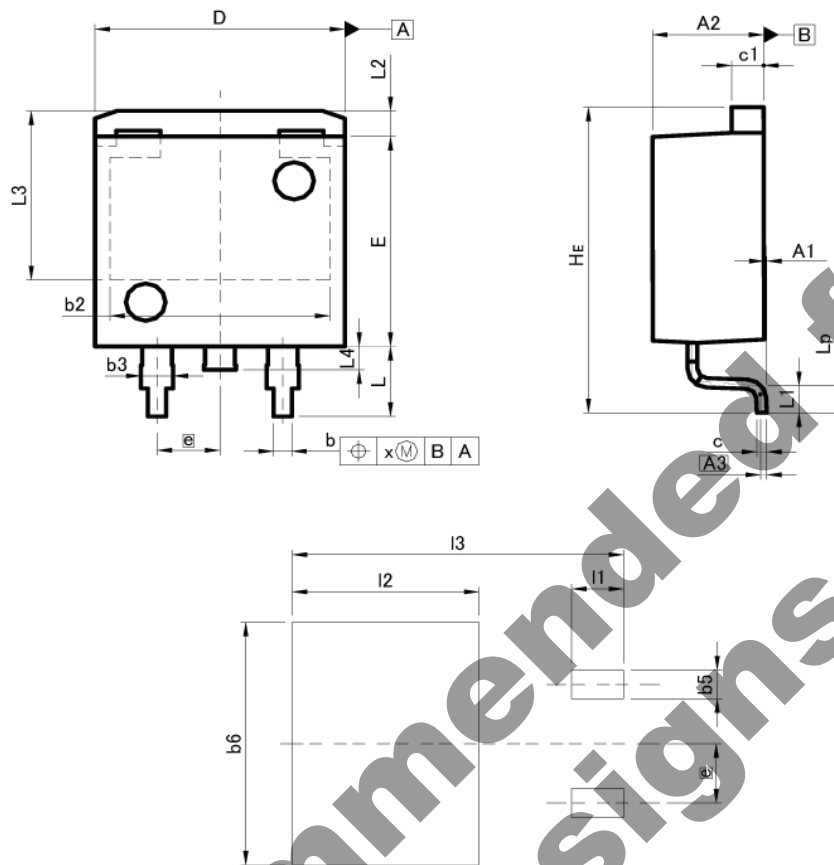


Fig.5-2 di/dt Waveform



●Dimensions

LPTS  
< TO-263 >  
( D2PAK )



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

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A1	0.00	0.30	0.000	0.012
A2	4.30	4.70	0.169	0.185
A3		0.25		0.010
b	0.68	0.98	0.027	0.039
b2		8.90		0.350
b3	1.14	1.44	0.045	0.057
c	0.30	0.60	0.012	0.024
c1	1.10	1.50	0.043	0.059
D	9.80	10.40	0.386	0.409
E	8.80	9.20	0.346	0.362
e		2.54		0.100
HE	12.80	13.40	0.504	0.528
L	2.70	3.30	0.106	0.130
L1	0.90	1.50	0.035	0.059
L2		1.10		0.043
L3		7.25		0.285
L4		1.00		0.039
Lp	0.90	1.50	0.035	0.059
x	-	0.25	-	0.010

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
b5	-	1.23	-	0.049
b6	-	10.40	-	0.409
I1	-	2.10	-	0.083
I2	-	7.55	-	0.297
I3	-	13.40	-	0.528

Dimension in mm/inches

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