R6004END

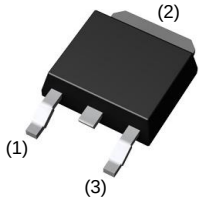
Nch 600V 4A Power MOSFET

Datasheet

V_{DSS}	600V
$R_{DS(on)}$ (Max.)	0.980Ω
I_D	4A
P_D	20W

●Outline

CPT3
(SC-63)
<SOT-428>



●Features

1) Low on-resistance.

2) Fast switching speed.

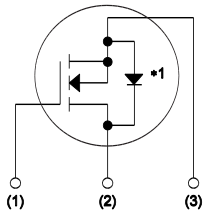
3) Gate-source voltage (V_{GSS}) guaranteed to be ±30V.

4) Drive circuits can be simple.

5) Parallel use is easy.

6) Pb-free lead plating ; RoHS compliant

●Inner circuit



(1) Gate
(2) Drain
(3) Source

*1 BODY DIODE

●Application

Switching Power Supply

●Packaging specifications

Type	Packaging	Taping
	Reel size (mm)	330
	Tape width (mm)	16
	Basic ordering unit (pcs)	2,500
	Taping code	TL
	Marking	R6004E

●Absolute maximum ratings (T_a = 25°C)

Parameter		Symbol	Value	Unit
Drain - Source voltage		V_{DSS}	600	V
Continuous drain current	T_c = 25°C	I_D *1	±4.0	A
	T_c = 100°C	I_D *1	±2.2	A
Pulsed drain current		$I_{D,pulse}$ *2	±8.0	A
Gate - Source voltage		V_{GSS}	±20	V
Avalanche energy, single pulse		E_{AS} *3	46	mJ
Avalanche energy, repetitive		E_{AR} *3	0.13	mJ
Avalanche current, repetitive		I_{AR}	0.8	A
Power dissipation (T_c = 25°C)		P_D	20	W
Junction temperature		T_j	150	°C
Range of storage temperature		T_{stg}	−55 to +150	°C
Reverse diode dv/dt		dv/dt *4	15	V/ns

●Absolute maximum ratings

Parameter	Symbol	Conditions	Values	Unit
Drain - Source voltage slope	dv/dt	V_{DS} = 480V T_j = 25°C	50	V/ns

●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC}	-	-	6.25	°C/W
Thermal resistance, junction - ambient *5	R_{thJA}	-	-	147	°C/W
Soldering temperature, wavesoldering for 10s	T_{sold}	-	-	265	°C

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 1mA	600	-	-	V
Zero gate voltage drain current	I_{DSS}	V_{DS} = 600V, V_{GS} = 0V T_j = 25°C T_j = 125°C	- -	0.1 -	100 1000	μA
Gate - Source leakage current	I_{GSS}	V_{GS} = ±20V, V_{DS} = 0V	-	-	±100	nA
Gate threshold voltage	$V_{GS\ (th)}$	V_{DS} = 10V, I_D = 1mA	2	-	4	V
Static drain - source on - state resistance	$R_{DS(on)}$ *6	V_{GS} = 10V, I_D = 1.5A T_j = 25°C T_j = 125°C	- -	0.90 1.36	0.98 -	Ω
Gate input resistance	R_G	f = 1MHz, open drain	-	16.7	-	Ω

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs} *6	V_{DS} = 10V, I_D = 2A	1.5	3.0	-	S
Input capacitance	C_{iss}	V_{GS} = 0V	-	250	-	pF
Output capacitance	C_{oss}	V_{DS} = 25V	-	250	-	
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	30	-	
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 480V	-	14	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	57	-	
Turn - on delay time	$t_{d(on)}$ *6	V_{DD} ≃ 300V, V_{GS} = 10V	-	22	-	ns
Rise time	t_r *6	I_D = 2A	-	22	-	
Turn - off delay time	$t_{d(off)}$ *6	R_L = 150Ω	-	55	-	
Fall time	t_f *6	R_G = 10Ω	-	40	-	

●Gate Charge characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *6	V_{DD} ≃ 300V	-	15	-	nC
Gate - Source charge	Q_{gs} *6	I_D = 4A	-	2.5	-	
Gate - Drain charge	Q_{gd} *6	V_{GS} = 10V	-	10	-	
Gate plateau voltage	$V_{(plateau)}$	V_{DD} ≃ 300V, I_D = 4A	-	6.5	-	V

*1 Limited only by maximum temperature allowed.

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

*3 I_D = 0.8A, V_{DD} = 50V

*4 Reference measurement circuits Fig.5-1.

*5 Mounted on a epoxy PCB FR4 (20mm × 20mm × 0.8mm)

*6 Pulsed

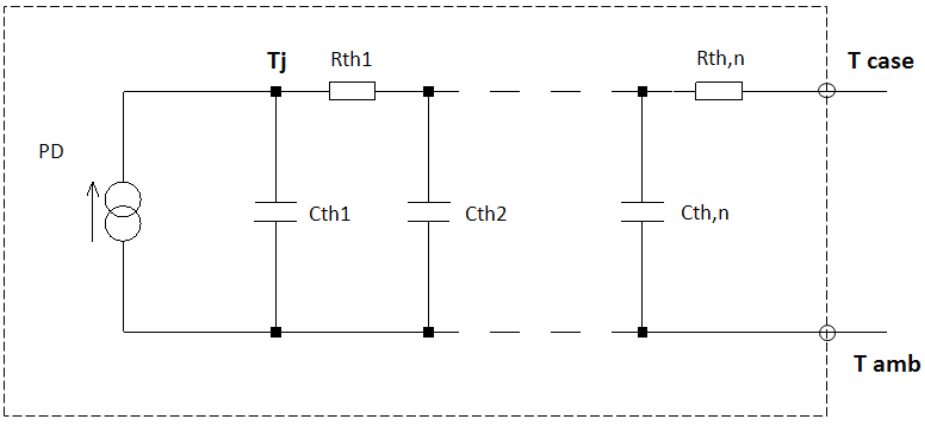
●Body diode electrical characteristics (Source-Drain) (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S *1	T_c = 25°C	-	-	4.0	A
Inverse diode direct current, pulsed	I_{SM} *2		-	-	8.0	A
Forward voltage	V_{SD} *6	V_{GS} = 0V, I_S = 4A	-	-	1.5	V
Reverse recovery time	t_{rr} *6	I_S = 4A di/dt = 100A/μs	-	320	-	ns
Reverse recovery charge	Q_{rr} *6		-	2.4	-	μC
Peak reverse recovery current	I_{rrm} *6		-	15	-	A

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
R_{th1}	1.3	K/W
R_{th2}	2.3	
R_{th3}	21.7	
R_{th4}	48.3	

Symbol	Value	Unit
C_{th1}	0.0015	Ws/K
C_{th2}	0.0102	
C_{th3}	0.127	
C_{th4}	1.220	



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

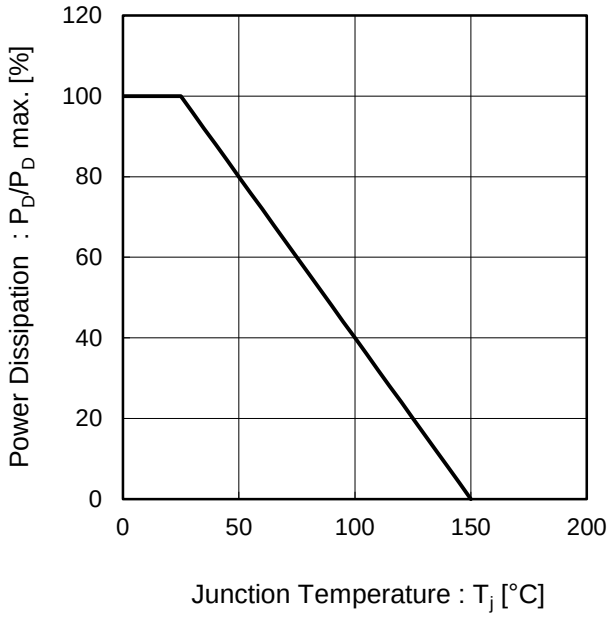


Fig.2 Normalized Transient Thermal Resistance vs. Pulse Width

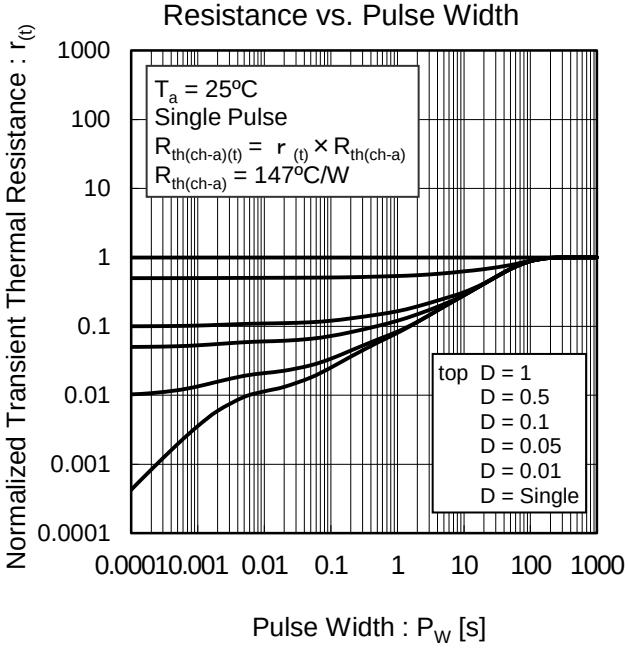
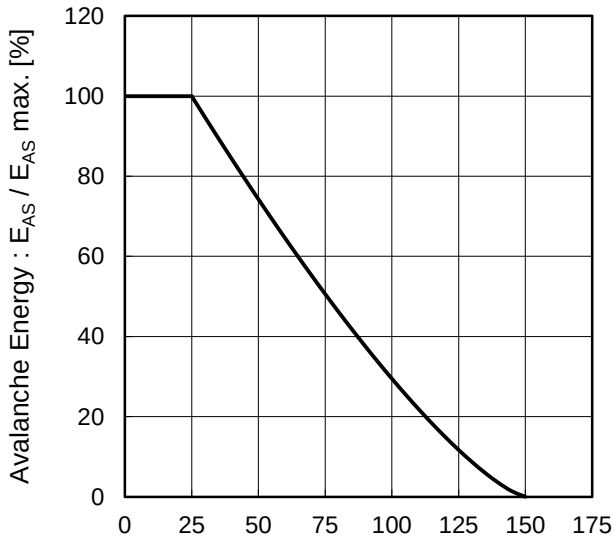


Fig.3 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

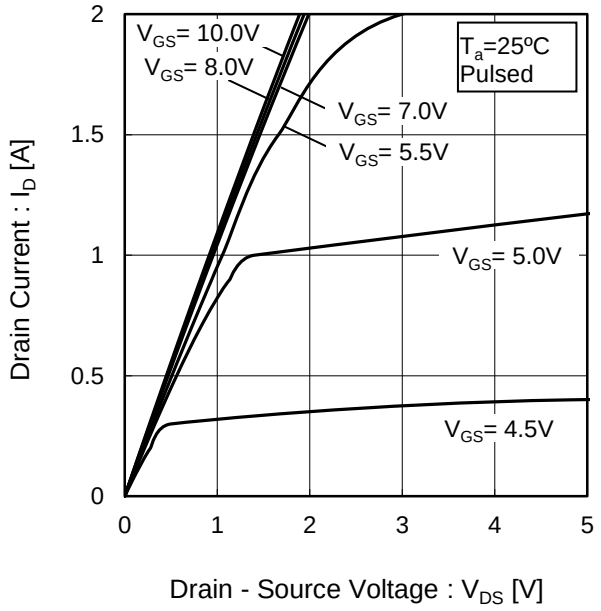


Fig.5 Typical Output Characteristics(II)

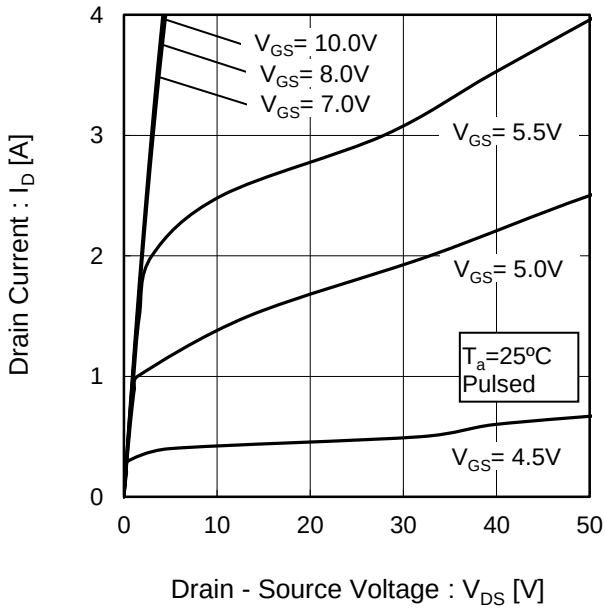


Fig.6 T_j = 150°C Typical Output Characteristics(I)

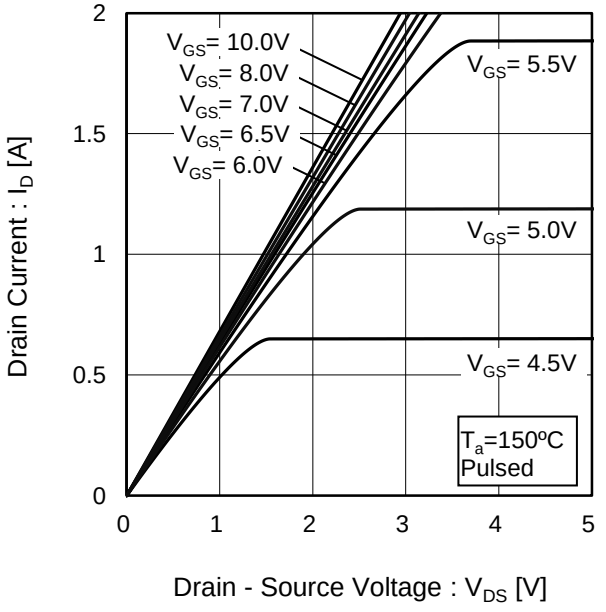
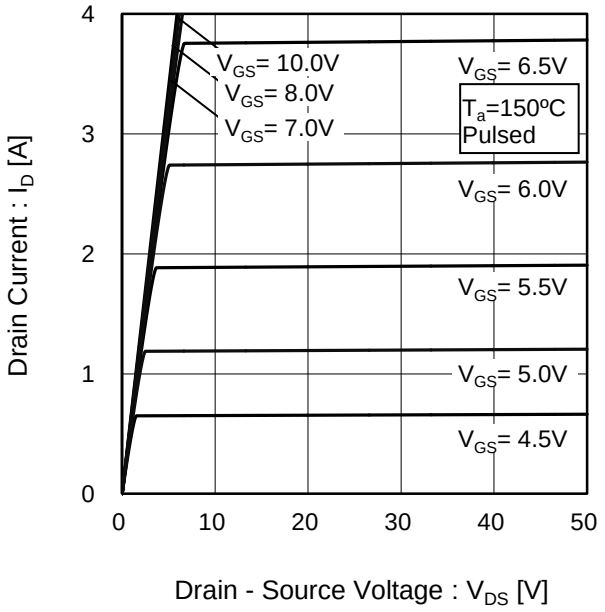


Fig.7 T_j = 150°C Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.8 Breakdown Voltage vs. Junction Temperature

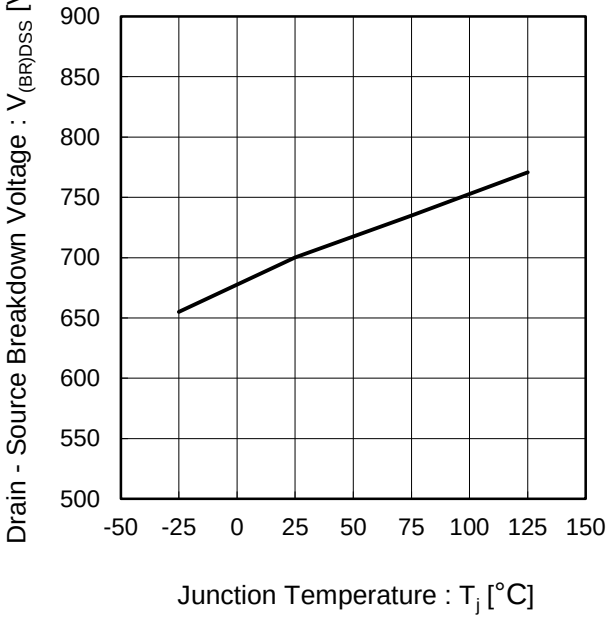


Fig.9 Typical Transfer Characteristics

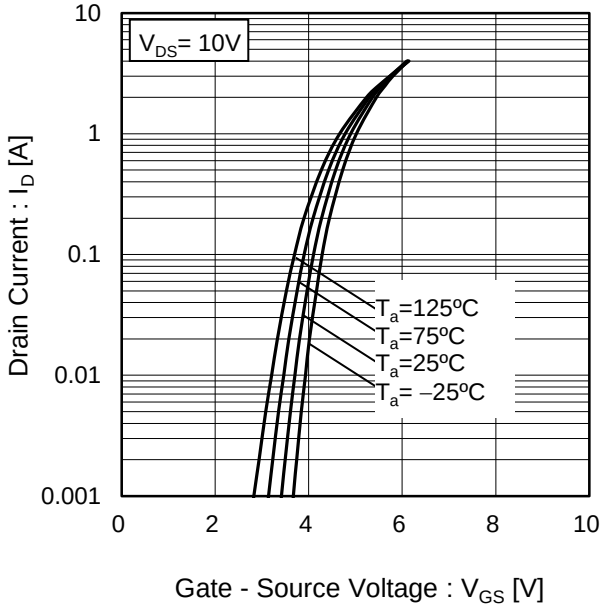


Fig.10 Gate Threshold Voltage vs. Junction Temperature

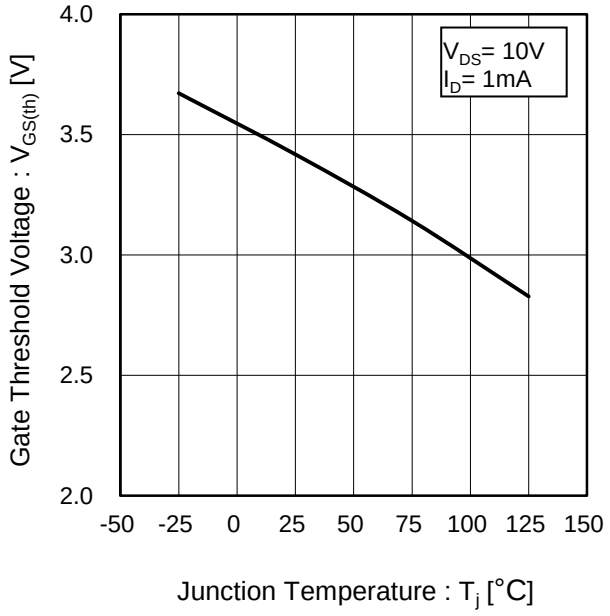
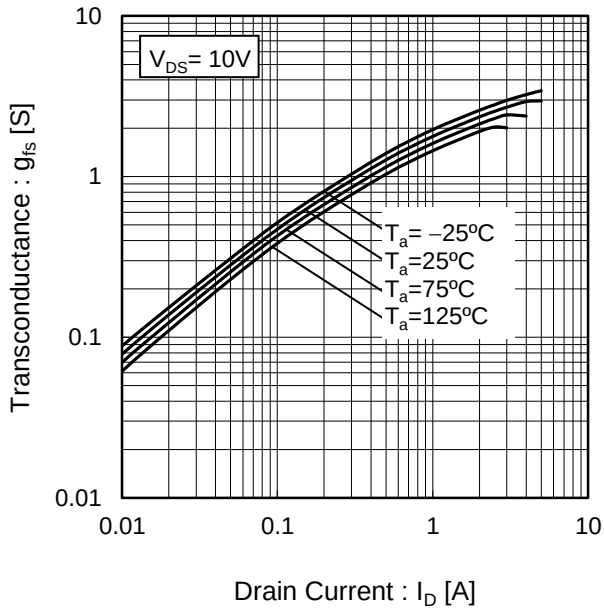


Fig.11 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

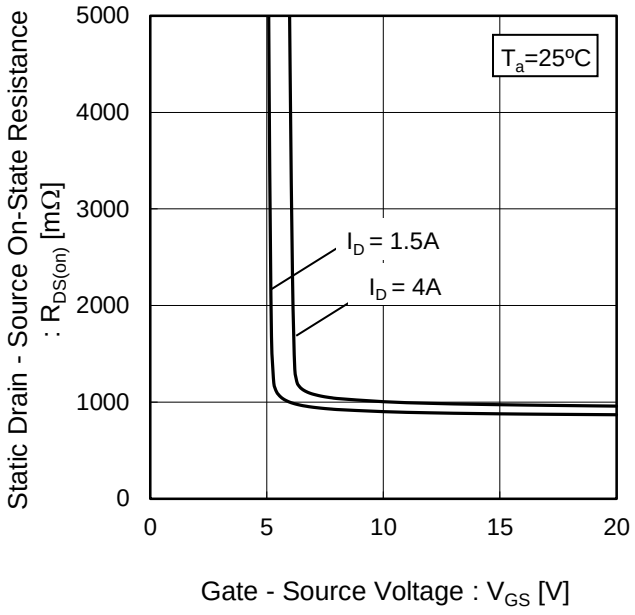


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature

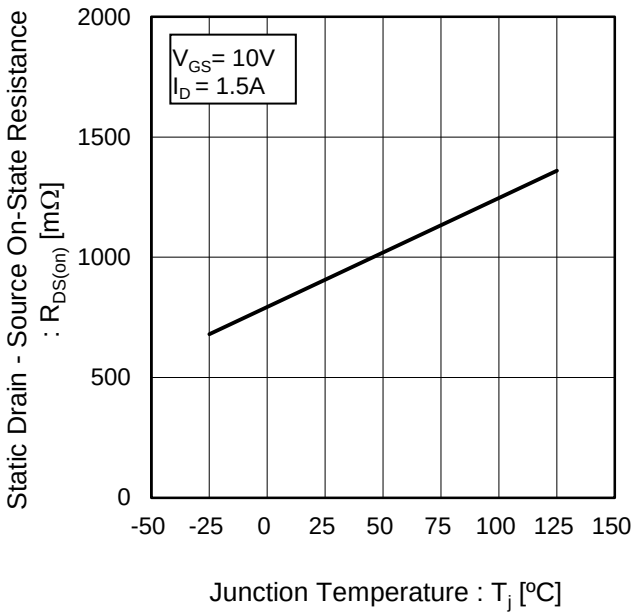


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current

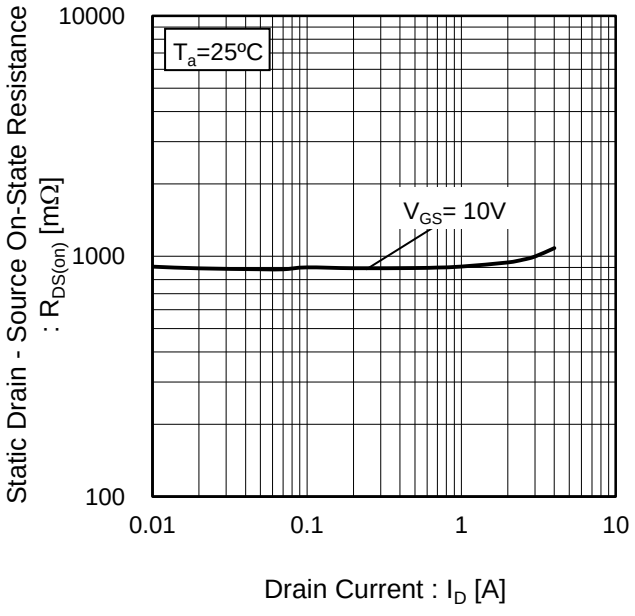
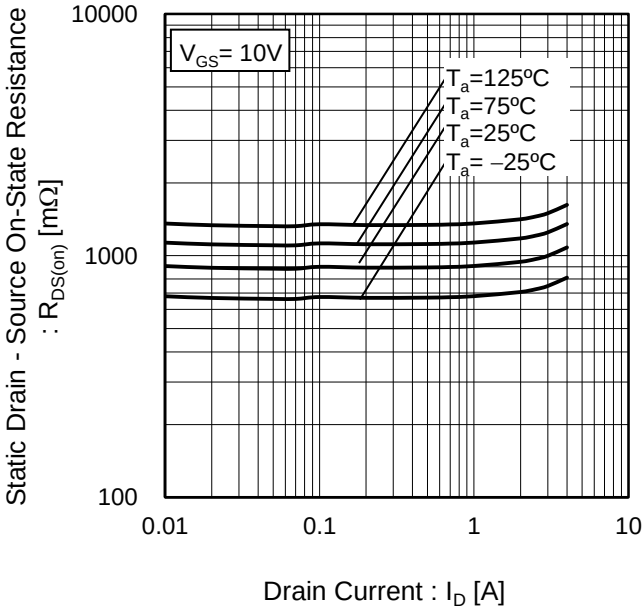


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.16 Typical Capacitance vs. Drain - Source Voltage

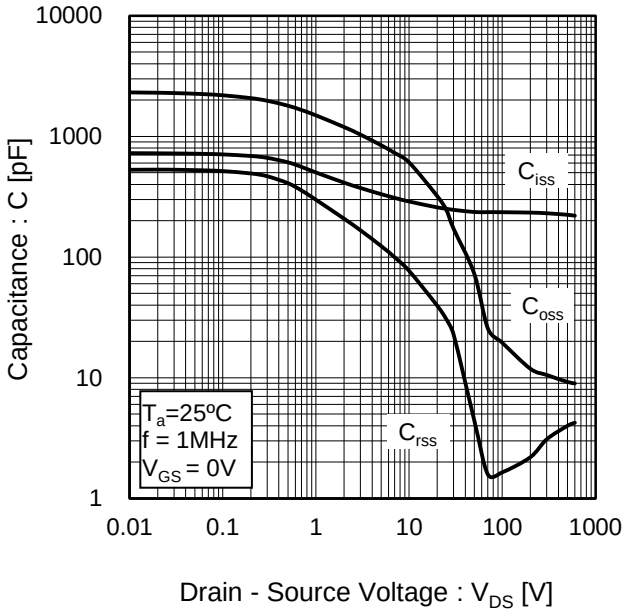


Fig.17 Coss Stored Energy

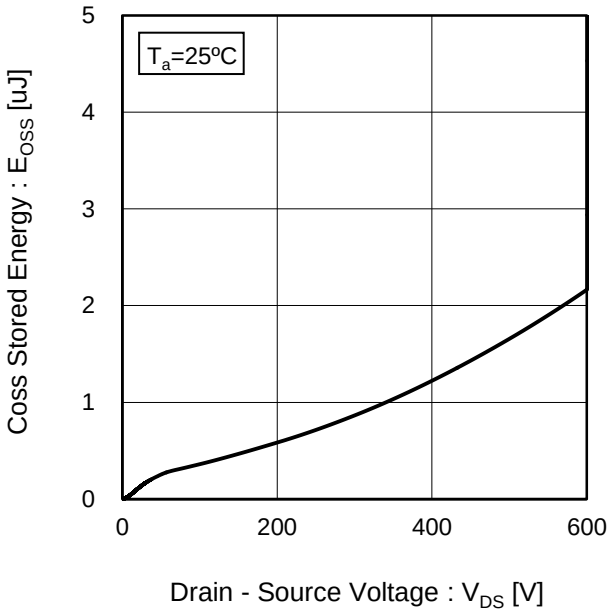


Fig.18 Switching Characteristics

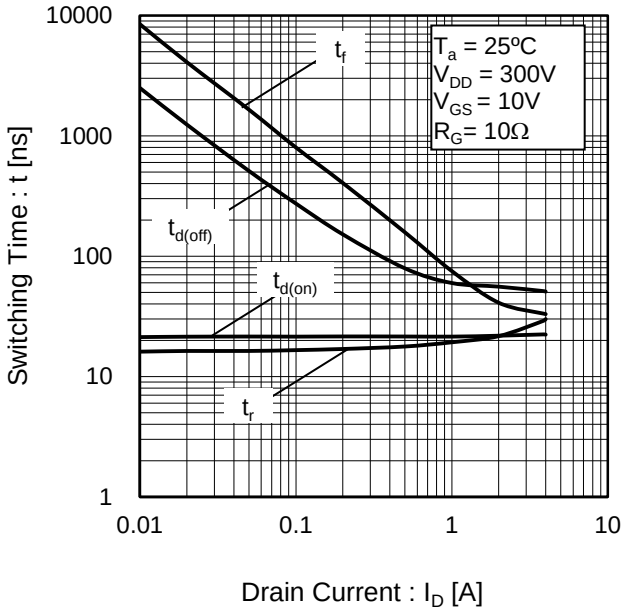
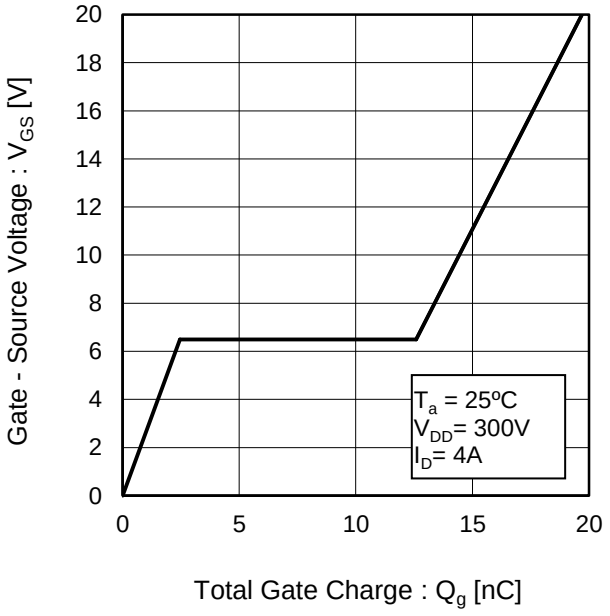


Fig.19 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.20 Inverse Diode Forward Current vs. Source - Drain Voltage

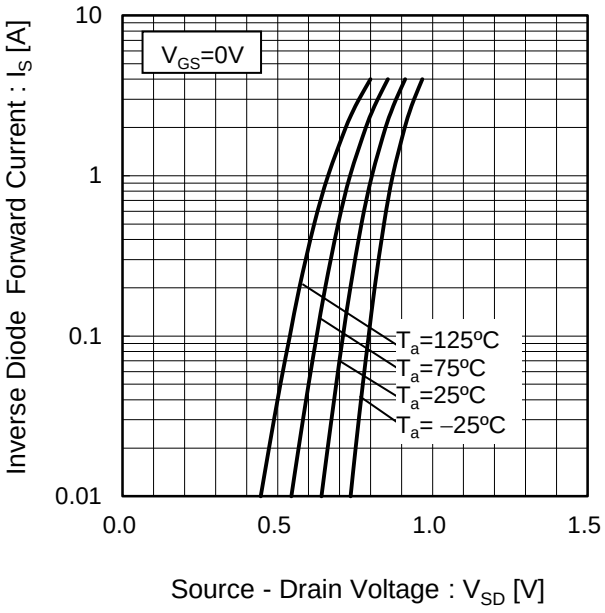
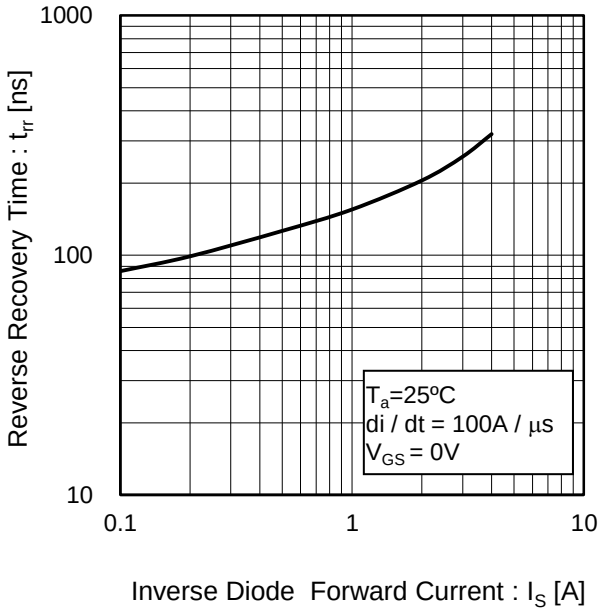


Fig.21 Reverse Recovery Time vs.Inverse Diode Forward Current



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

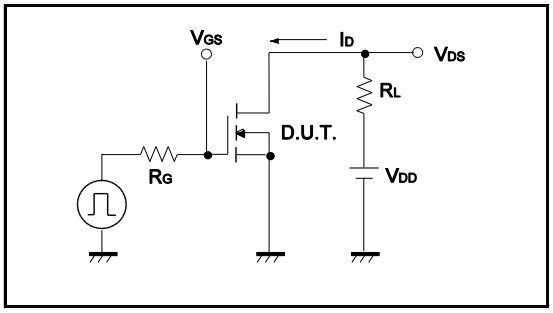


Fig.1-2 Switching Waveforms

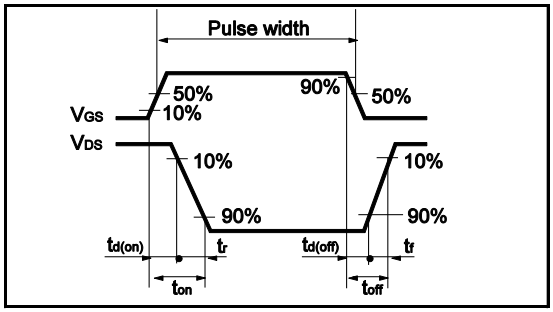


Fig.2-1 Gate Charge Measurement Circuit

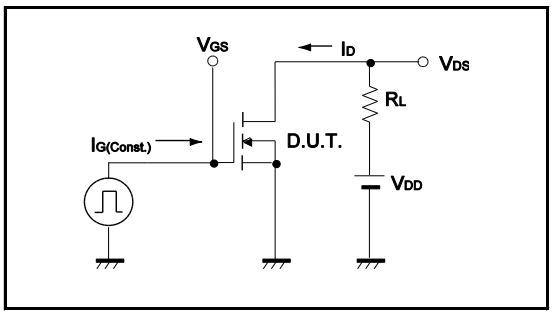


Fig.2-2 Gate Charge Waveform

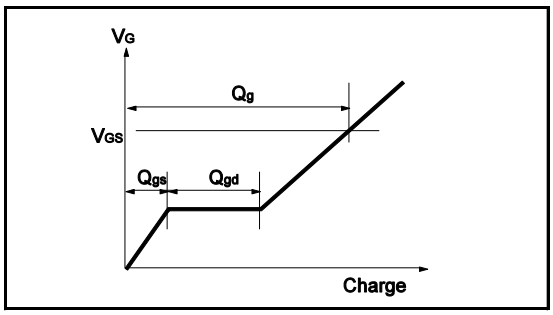


Fig.3-1 Avalanche Measurement Circuit

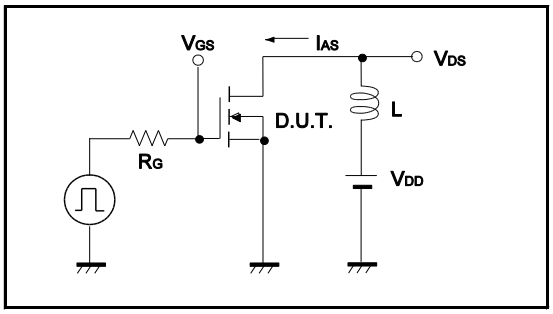


Fig.3-2 Avalanche Waveform

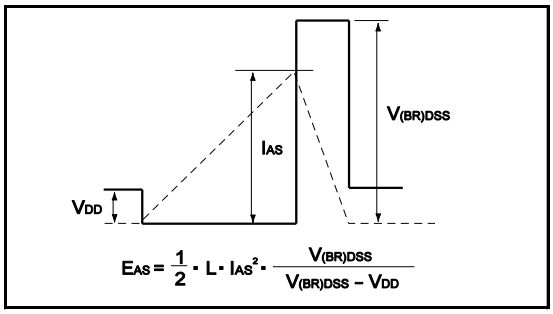


Fig.4-1 dv/dt Measurement Circuit

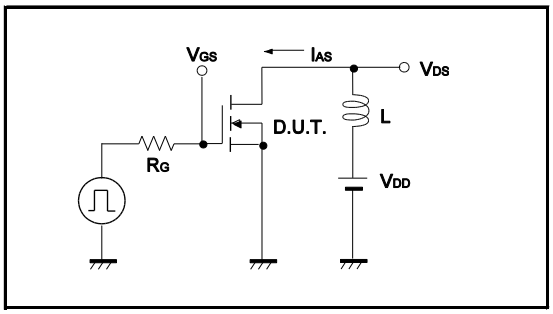


Fig.4-2 dv/dt Waveform

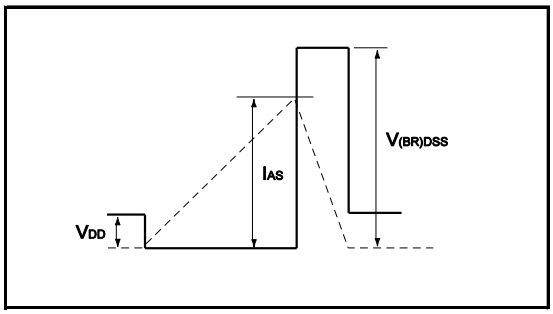


Fig.5-1 di/dt Measurement Circuit

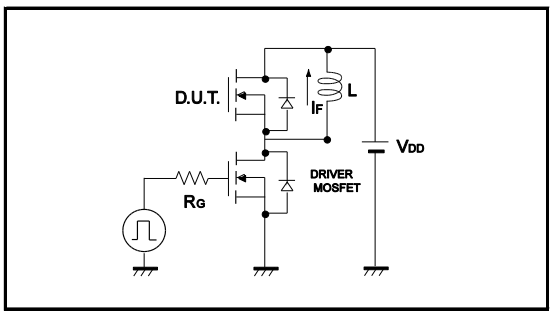
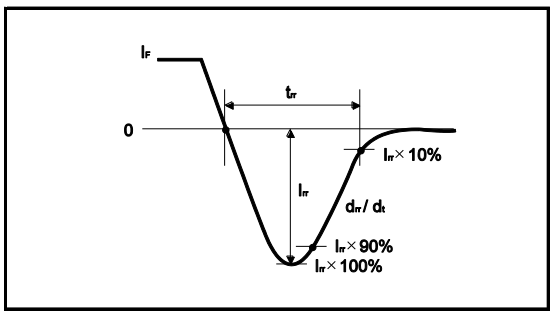
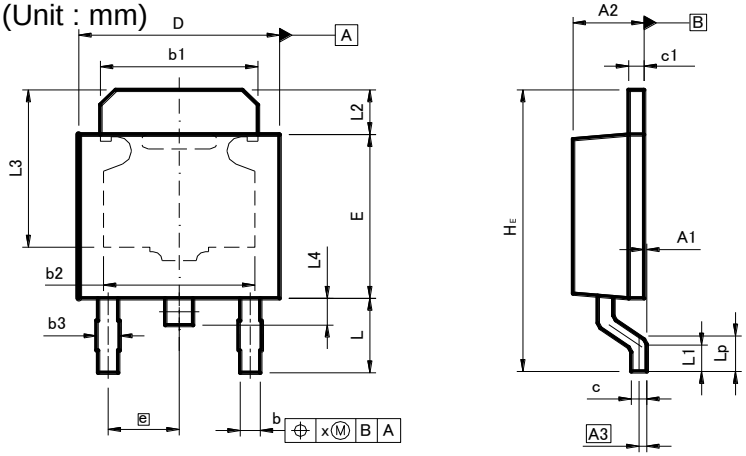


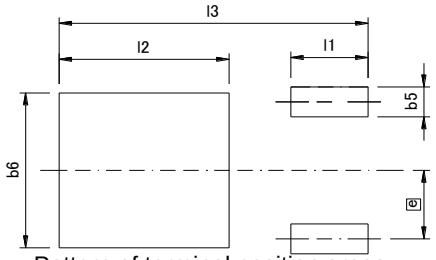
Fig.5-2 di/dt Waveform



●**Dimensions** (Unit : mm)

CPT3





Pattern of terminal position areas
[Not a recommended pattern of

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A1	0.00	0.15	0.000	0.006
A2	2.20	2.50	0.087	0.098
A3	0.25		0.010	
b	0.55	0.75	0.022	0.030
b1	5.00	5.30	0.197	0.209
b2	5.00		0.197	
b3	0.75		0.030	
c	0.40	0.60	0.016	0.024
c1	0.40	0.60	0.016	0.024
D	6.30	6.70	0.248	0.264
E	5.40	5.80	0.213	0.228
e	2.30		0.091	
HE	9.00	10.00	0.354	0.394
L	2.20	2.80	0.087	0.110
L1	0.80	1.40	0.031	0.055
L2	1.20	1.80	0.047	0.071
L3	5.30		0.209	
L4	0.90		0.035	
Lp	1.00	1.60	0.039	0.063
x	–	0.25	–	0.010

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
b5	–	1.00	–	0.04
b6	–	5.20	–	0.205
l1	–	2.50	–	0.098
l2	–	5.50	–	0.217
l3	–	10.00	–	0.394

Dimension in mm / inches

Notes

1) The information contained herein is subject to change without notice.

2) Before you use our Products, please contact our sales representative and verify the latest specifications :

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.

4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.

6) The Products are intended for use in general electronic equipment (i.e. AV/OA devices, communication, consumer systems, gaming/entertainment sets) as well as the applications indicated in this document.

7) The Products specified in this document are not designed to be radiation tolerant.

8) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.

9) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

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