R6024ENJ

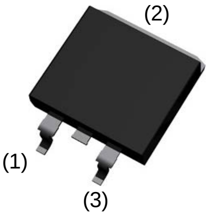
Nch 600V 24A Power MOSFET

Data Sheet

V_{DSS}	600V
$R_{DS(on)}$ (Max.)	0.165Ω
I_D	24A
P_D	40W

●Outline

LPT(S)
(SC-83)
TO-263(D2PAK)



●Features

1) Low on-resistance.

2) Fast switching speed.

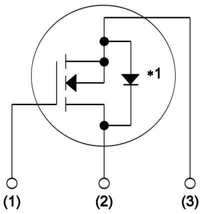
3) Gate-source voltage (V_{GSS}) guaranteed to be ±20V.

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)	24
	Basic ordering unit (pcs)	1,000
	Taping code	TL
	Marking	R6024ENJ

●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	±24	A
	T_c = 100°C	I_D *1	±13.0	A
Pulsed drain current		$I_{D,pulse}$ *2	±72	A
Gate - Source voltage		V_{GSS}	±20	V
Avalanche energy, single pulse		E_{AS} *3	497	mJ
Avalanche energy, repetitive		E_{AR} *3	0.75	mJ
Avalanche current, repetitive		I_{AR}	4.1	A
Power dissipation (T_c = 25°C)		P_D	40	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}	-	-	3.13	°C/W
Thermal resistance, junction - ambient[*5]	R_{thJA}	-	-	80	°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 = 11.3A T_j = 25°C T_j = 125°C	- -	0.150 0.320	0.165 -	Ω
Gate input resistance	R_G	f = 1MHz, open drain	-	6.1	-	Ω

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs} *6	V_{DS} = 10V, I_D = 12A	6.5	13.0	-	S
Input capacitance	C_{iss}	V_{GS} = 0V	-	1650	-	pF
Output capacitance	C_{oss}	V_{DS} = 25V	-	1350	-	
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	160	-	
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 480V	-	66	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	314	-	
Turn - on delay time	$t_{d(on)}$ *6	$V_{DD} \simeq$ 300V, V_{GS} = 10V	-	35	-	ns
Rise time	t_r *6	I_D = 12A	-	50	-	
Turn - off delay time	$t_{d(off)}$ *6	R_L = 27.4Ω	-	180	-	
Fall time	t_f *6	R_G = 10Ω	-	50	-	

●Gate Charge characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *6	$V_{DD} \simeq$ 300V	-	70	-	nC
Gate - Source charge	Q_{gs} *6	I_D = 24A	-	10	-	
Gate - Drain charge	Q_{gd} *6	V_{GS} = 10V	-	35	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} \simeq$ 300V, I_D = 24A	-	6.4	-	V

*1 Limited only by maximum temperature allowed.

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

*3 I_D = 4.1A, V_{DD} = 50V

*4 Reference measurement circuits Fig.5-1.

*5 Mounted on a epoxy PCB FR4 (25mm × 27mm × 0.8mm)

*6 Pulsed

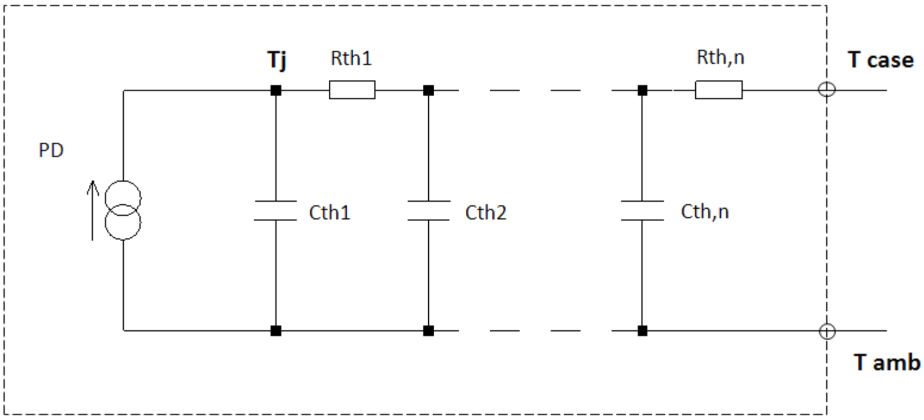
●**Body diode electrical characteristics** (Source-Drain) (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S *1	T_c = 25°C	-	-	24	A
Inverse diode direct current, pulsed	I_{SM} *2		-	-	72	A
Forward voltage	V_{SD} *6	V_{GS} = 0V, I_S = 24A	-	-	1.5	V
Reverse recovery time	t_{rr} *6	I_S = 24A di/dt = 100A/µs	-	625	-	ns
Reverse recovery charge	Q_{rr} *6		-	13.3	-	µC
Peak reverse recovery current	I_{rrm} *6		-	42	-	A

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
R_{th1}	0.0578	K/W
R_{th2}	0.218	
R_{th3}	0.604	

Symbol	Value	Unit
C_{th1}	0.00248	Ws/K
C_{th2}	0.00916	
C_{th3}	0.209	



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

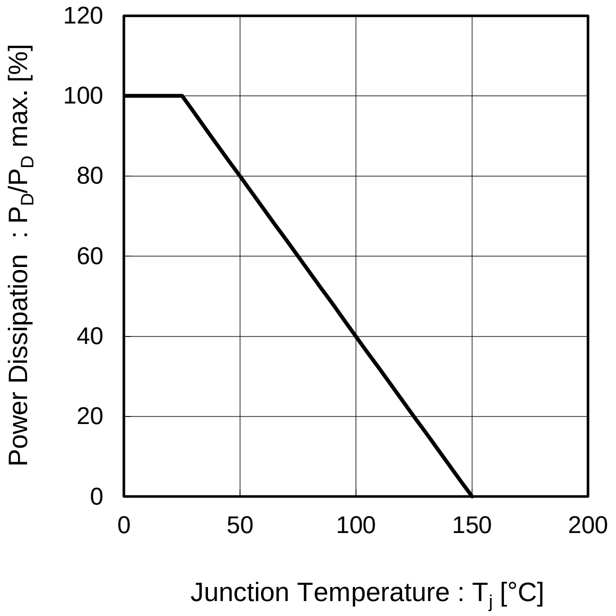


Fig.2 Normalized Transient Thermal Resistance vs. Pulse Width

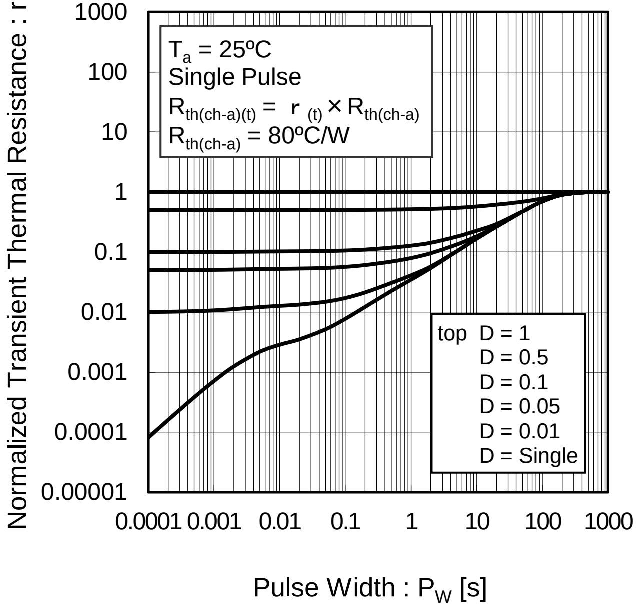
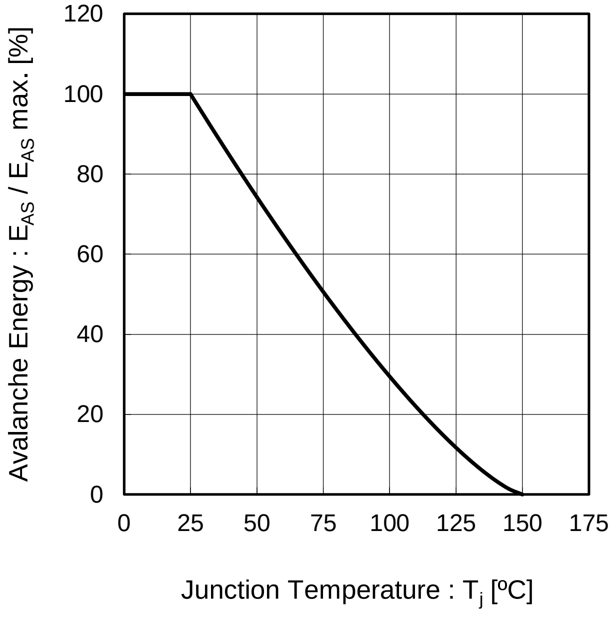


Fig.3 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

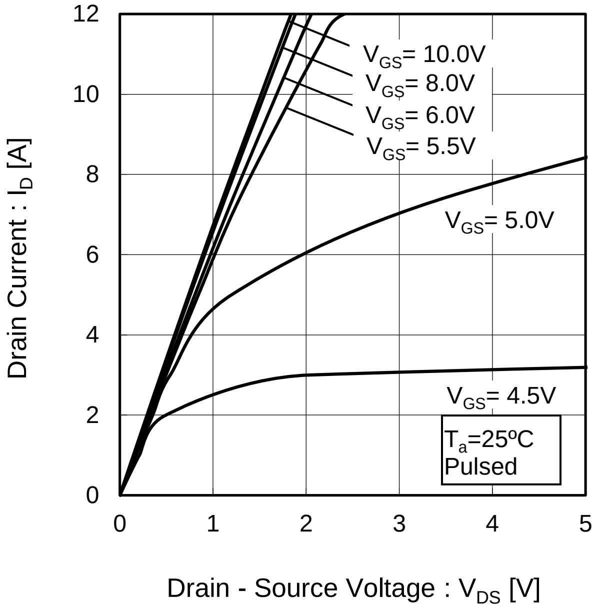


Fig.5 Typical Output Characteristics(II)

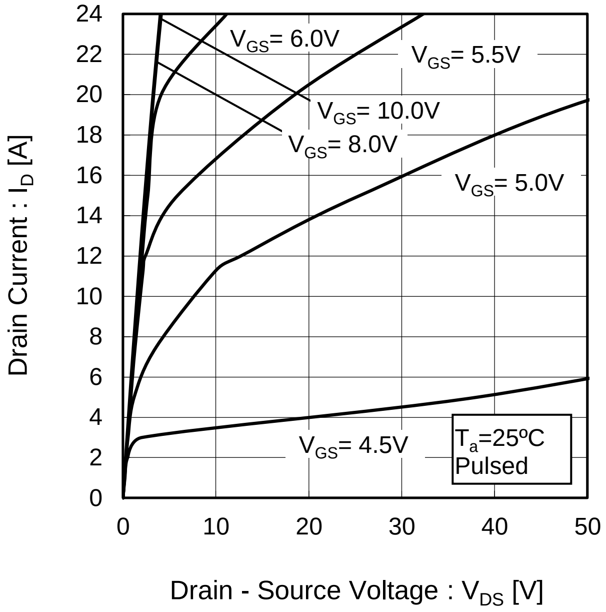


Fig.6 T_j = 150°C Typical Output Characteristics(I)

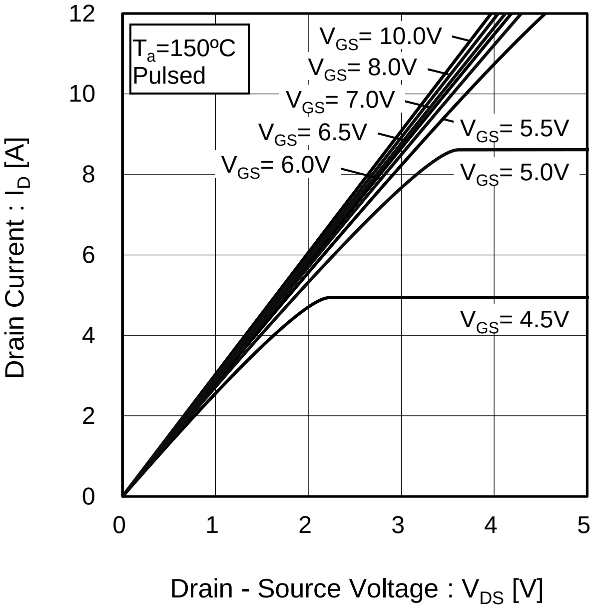
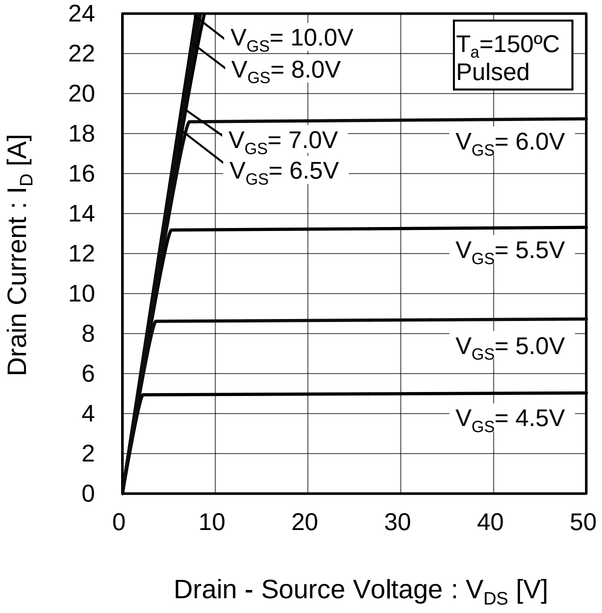


Fig.7 T_j = 150°C Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.8 Breakdown Voltage vs. Junction Temperature

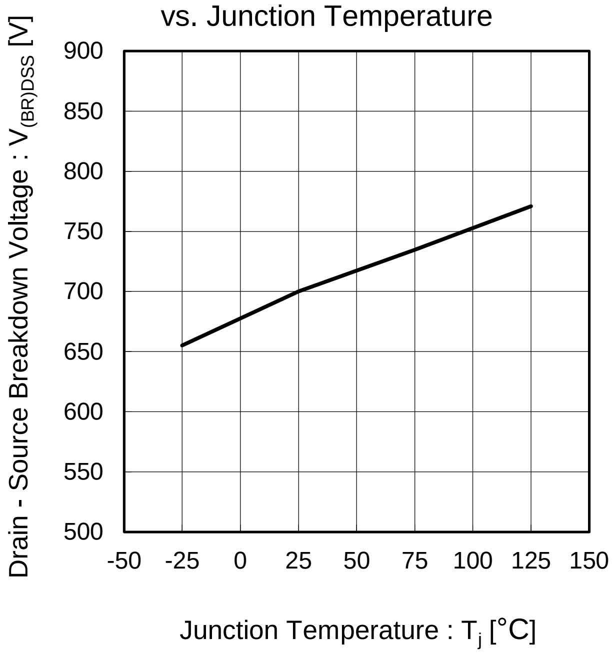


Fig.9 Typical Transfer Characteristics

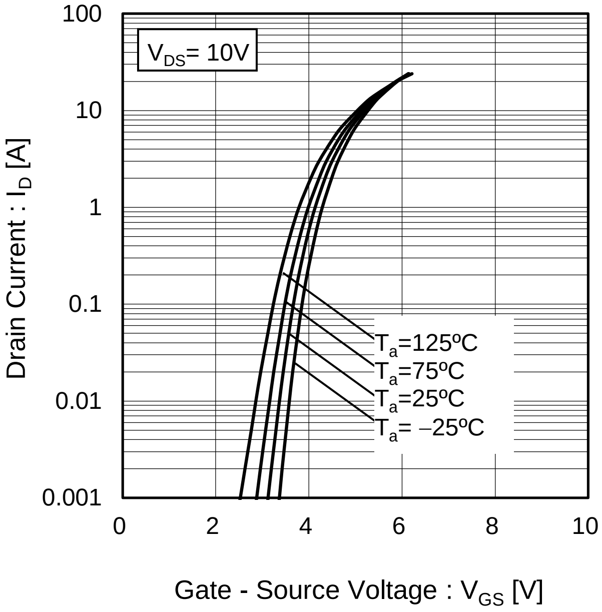


Fig.10 Gate Threshold Voltage vs. Junction Temperature

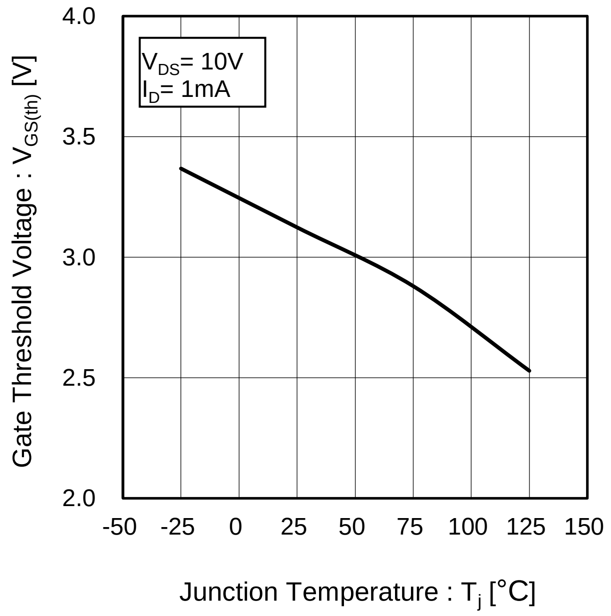
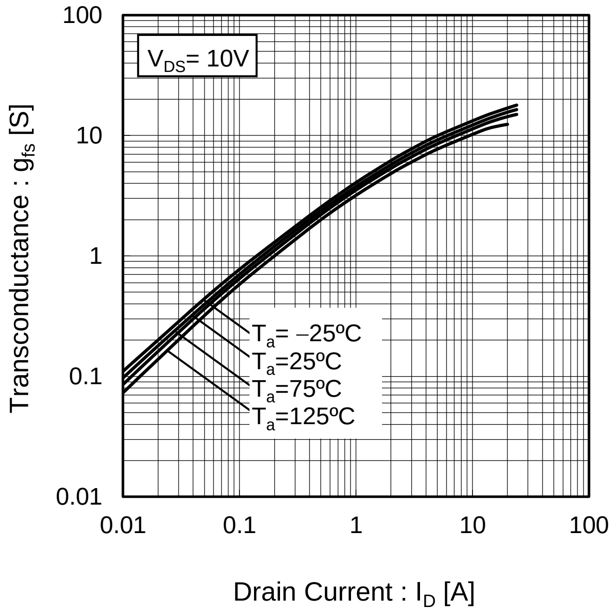
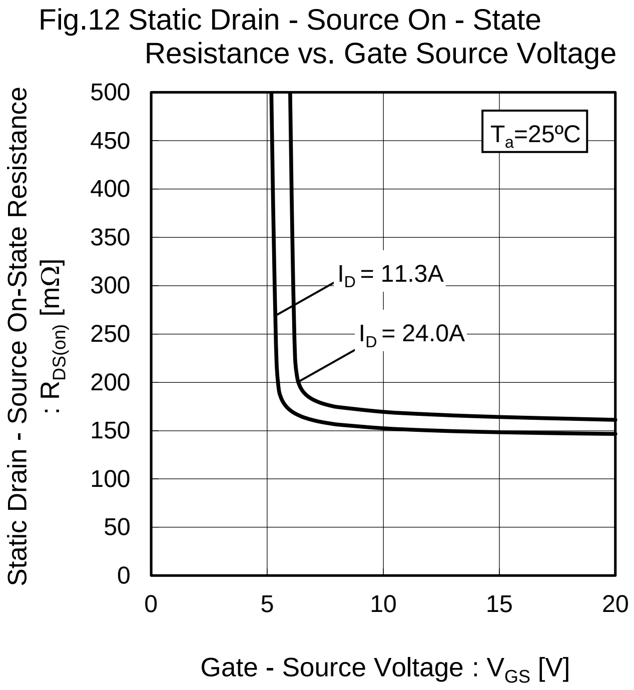
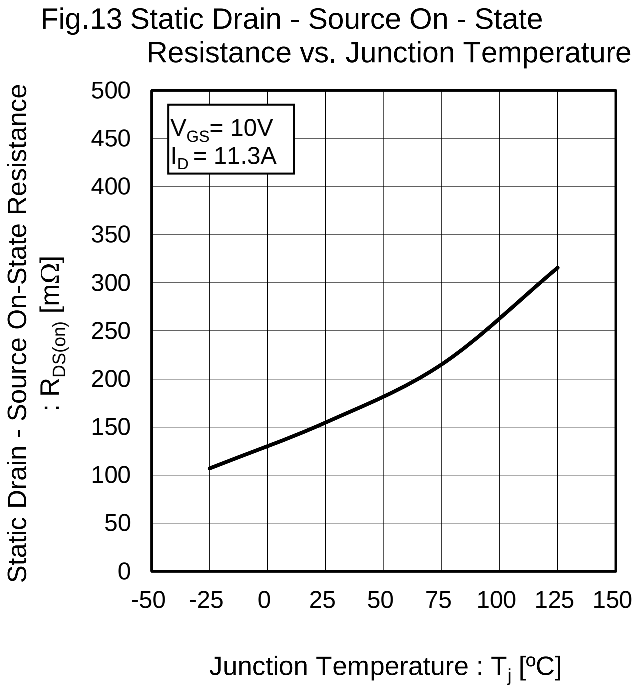


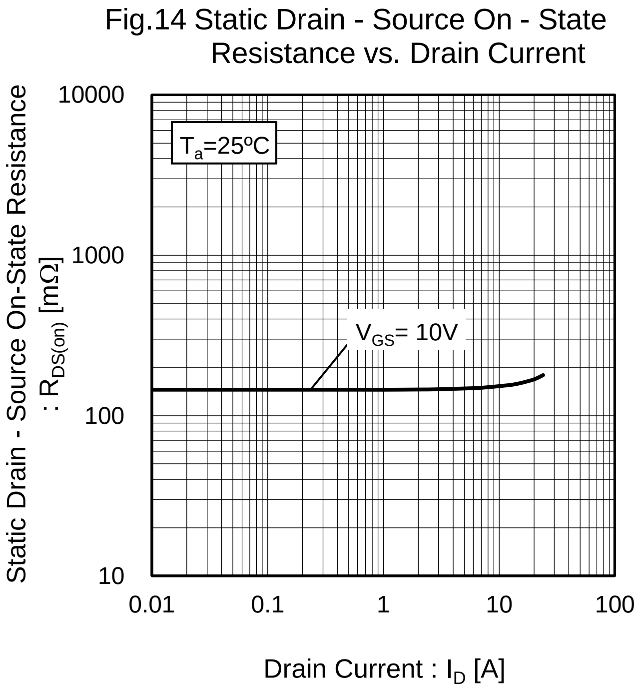
Fig.11 Transconductance vs. Drain Current

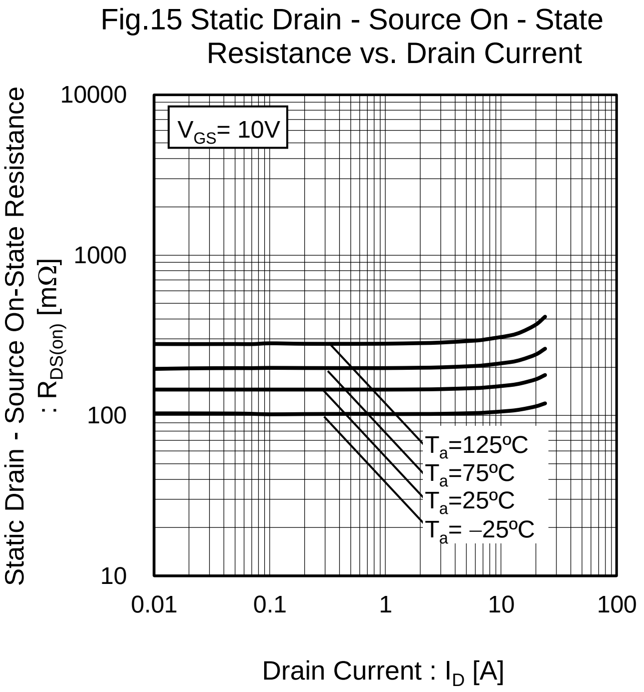


●Electrical characteristic curves









●Electrical characteristic curves

Fig.16 Typical Capacitance vs. Drain - Source Voltage

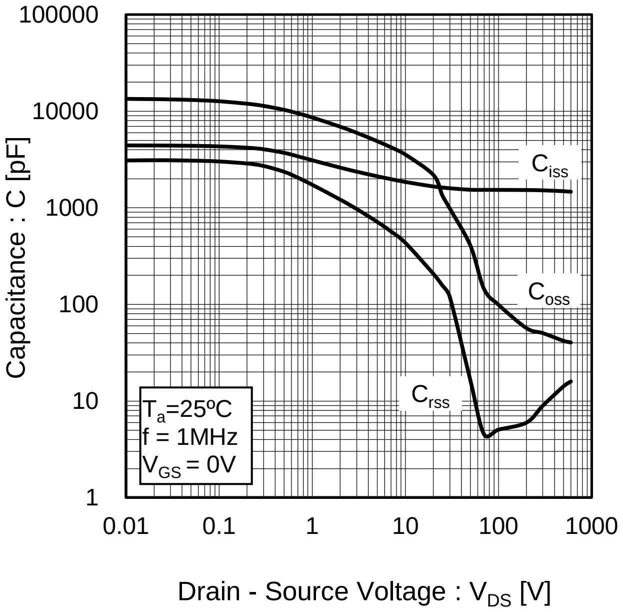


Fig.17 Coss Stored Energy

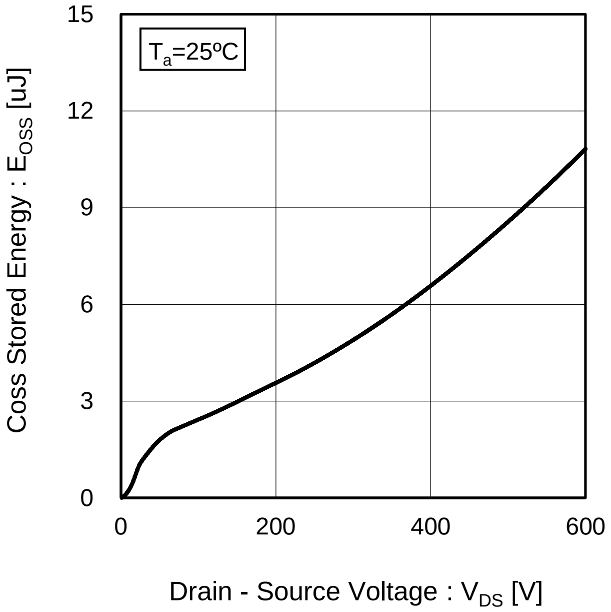


Fig.18 Switching Characteristics

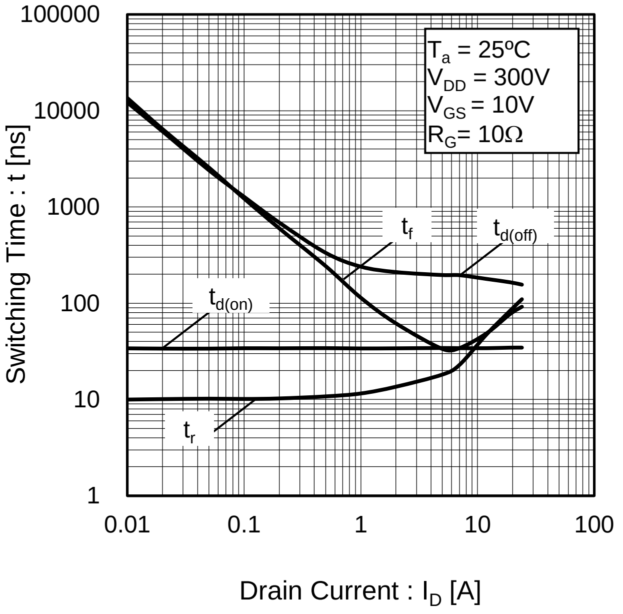
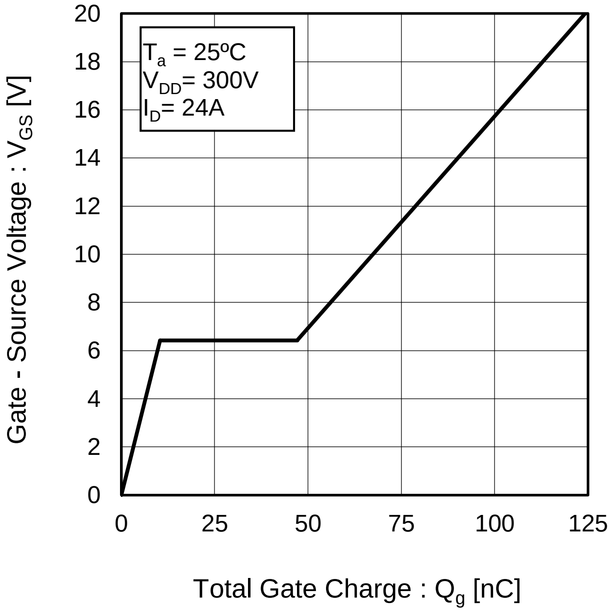


Fig.19 Dynamic Input Characteristics



●Electrical characteristic curves

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

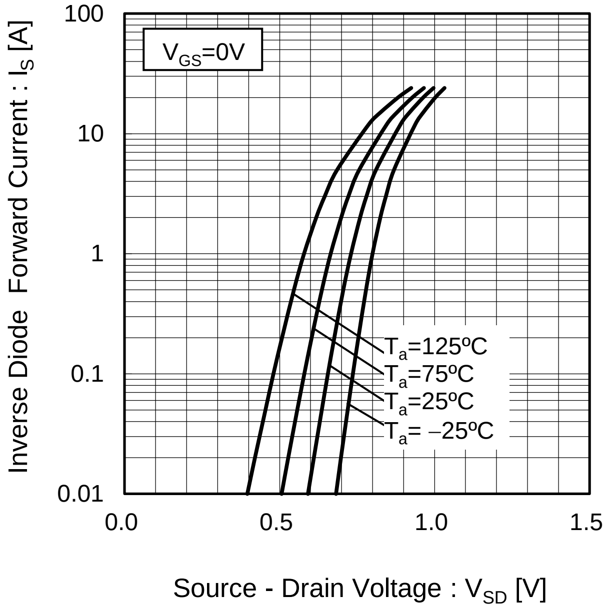
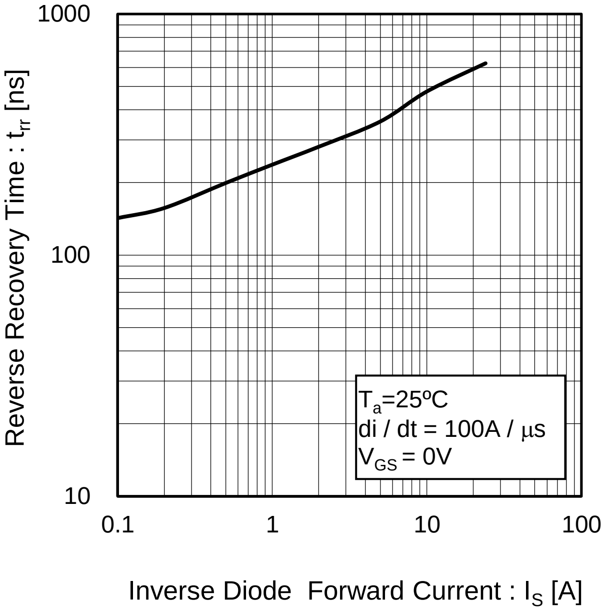


Fig.21 Reverse Recovery Time vs.Inverse Diode Forward Current



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

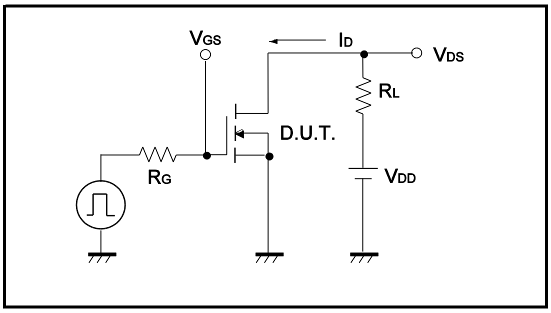


Fig.1-2 Switching Waveforms

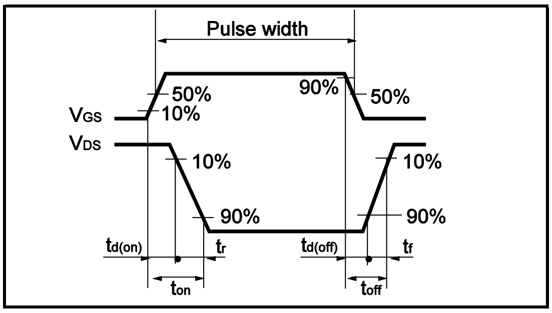


Fig.2-1 Gate Charge Measurement Circuit

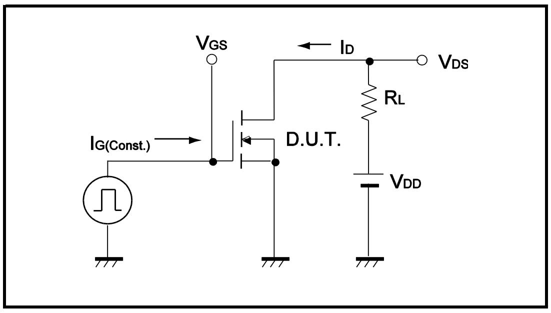


Fig.2-2 Gate Charge Waveform

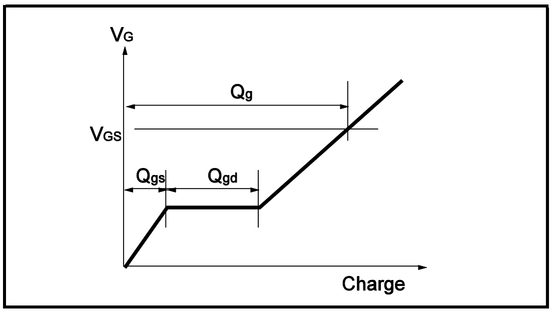


Fig.3-1 Avalanche Measurement Circuit

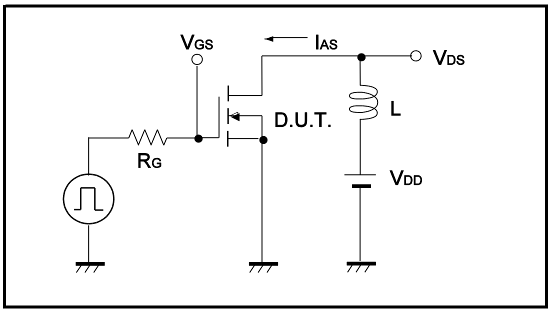
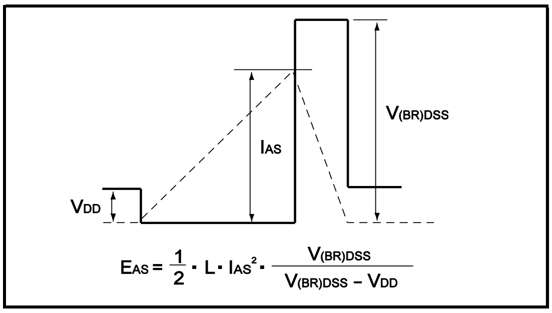


Fig.3-2 Avalanche Waveform



$$E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}{}^{2} \cdot \frac{V_{(BR)DSS}}{V_{(BR)DSS} - V_{DD}}$$

Fig.4-1 dv/dt Measurement Circuit

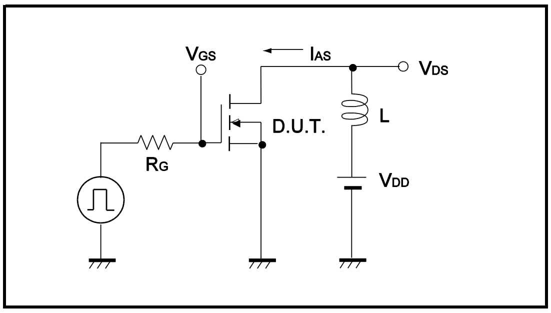


Fig.4-2 dv/dt Waveform

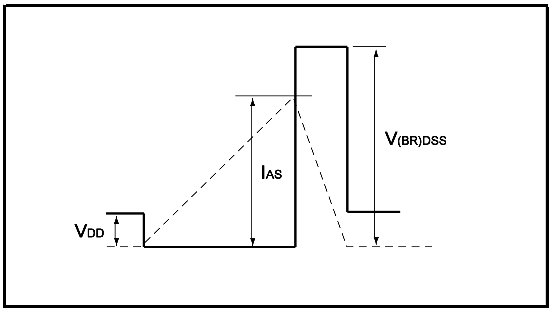


Fig.5-1 di/dt Measurement Circuit

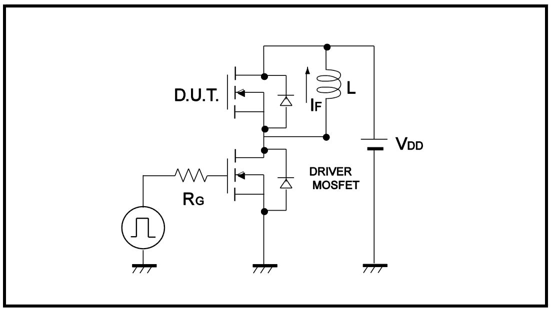
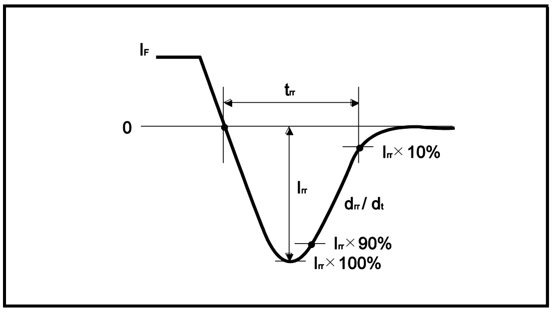
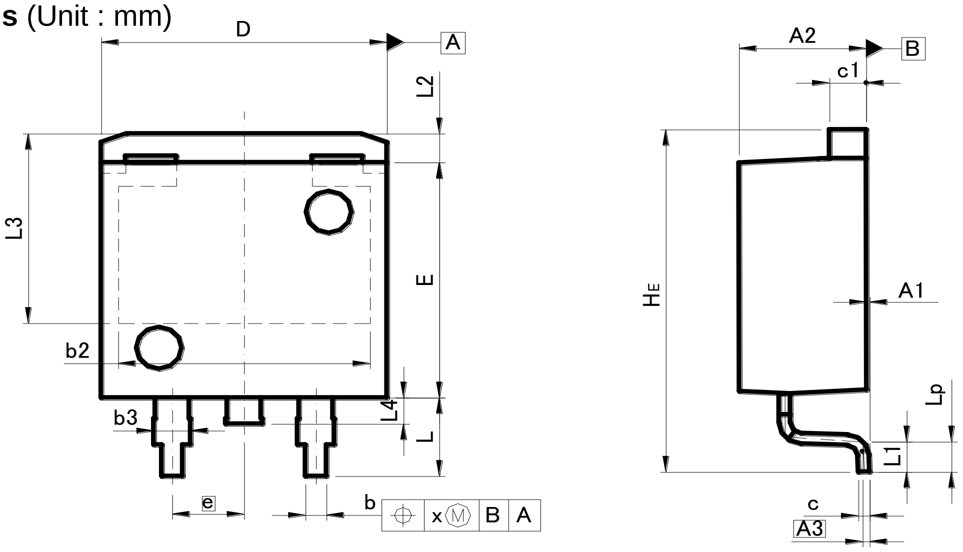


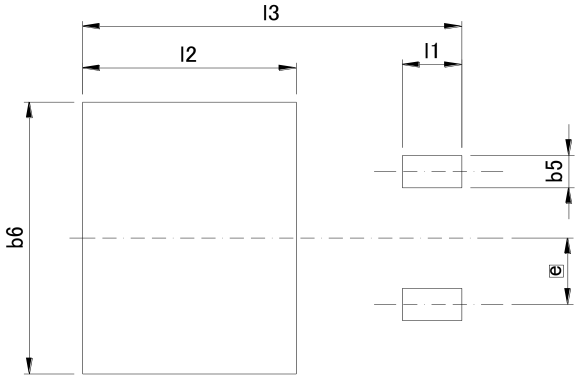
Fig.5-2 di/dt Waveform



●Dimensions (Unit : mm)

LPTS





Pattern of terminal position areas
[Not a recommended pattern of soldering

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
l1	–	2.10	–	0.083
l2	–	7.55	–	0.297
l3	–	13.40	–	0.528

Dimension in mm / inches