

V_{DSS}	600V
$R_{DS(on)}$ (Max.)	0.196Ω
I_D	20A
P_D	120W

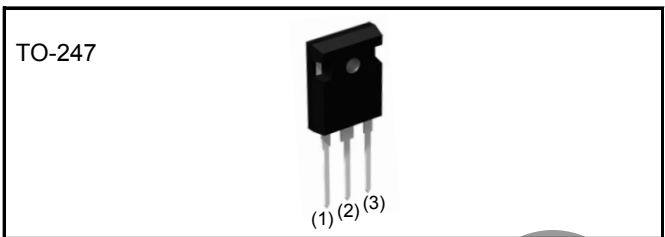
●Features

- 1) Low on-resistance.
- 2) Fast switching speed.
- 3) Gate-source voltage (V_{GSS}) guaranteed to be $\pm 20V$.
- 4) Drive circuits can be simple.
- 5) Parallel use is easy.
- 6) Pb-free lead plating ; RoHS compliant

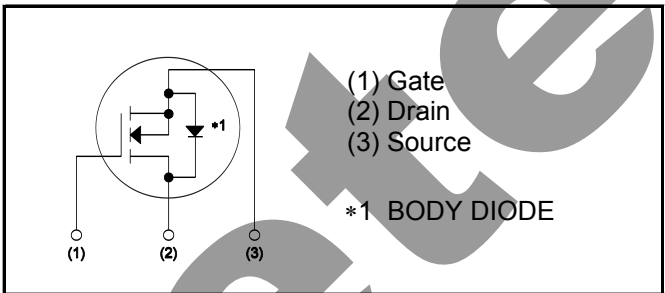
●Application

Switching Power Supply

●Outline



●Inner circuit



●Packaging specifications

Type	Packaging	Tube
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	450
	Taping code	C9
	Marking	R6020ENZ1

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

Parameter	Symbol	Value	Unit	
Drain - Source voltage	V_{DSS}	600	V	
Continuous drain current	$T_c = 25^\circ C$	I_D^{*1}	± 20	A
	$T_c = 100^\circ C$	I_D^{*1}	± 10.9	A
Pulsed drain current	$I_{D,pulse}^{*2}$	± 60	A	
Gate - Source voltage	V_{GSS}	± 20	V	
Avalanche energy, single pulse	E_{AS}^{*3}	418	mJ	
Avalanche energy, repetitive	E_{AR}^{*3}	0.63	mJ	
Avalanche current, repetitive	I_{AR}	3.4	A	
Power dissipation ($T_c = 25^\circ C$)	P_D	120	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 ^{*4}	15	V/ns	

●Absolute maximum ratings

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

●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC}	-	-	1.04	$^\circ C/W$
Thermal resistance, junction - ambient	R_{thJA}	-	-	30	$^\circ C/W$
Soldering temperature, wavesoldering for 10s	T_{sold}	-	-	265	$^\circ C$

●Electrical characteristics ($T_a = 25^\circ C$)

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}	$V_{DS} = 600V, V_{GS} = 0V$ $T_j = 25^\circ C$	-	0.1	100	μA
		$T_j = 125^\circ C$	-	-	1000	
Gate - Source leakage current	I_{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	± 100	nA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = 10V, I_D = 1mA$	2	-	4	V
Static drain - source on - state resistance	$R_{DS(on)}^{*5}$	$V_{GS} = 10V, I_D = 9.5A$ $T_j = 25^\circ C$	-	0.170	0.196	Ω
		$T_j = 125^\circ C$	-	0.360	-	
Gate input resistance	R_G	$f = 1MHz, \text{open drain}$	-	5.8	-	Ω

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs}^{*5}	$V_{DS} = 10V, I_D = 10A$	5	10	-	S
Input capacitance	C_{iss}	$V_{GS} = 0V$	-	1400	-	pF
Output capacitance	C_{oss}	$V_{DS} = 25V$	-	1200	-	
Reverse transfer capacitance	C_{rss}	$f = 1MHz$	-	130	-	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{GS} = 0V$ $V_{DS} = 0V \text{ to } 480V$	-	56	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	266	-	
Turn - on delay time	$t_{d(on)}^{*5}$	$V_{DD} \approx 480V, V_{GS} = 10V$	-	35	-	ns
Rise time	t_r^{*5}	$I_D = 10A$	-	53	-	
Turn - off delay time	$t_{d(off)}^{*5}$	$R_L = 47.5\Omega$	-	150	-	
Fall time	t_f^{*5}	$R_G = 10\Omega$	-	67	-	

●Gate Charge characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g^{*5}	$V_{DD} \approx 480V$	-	60	-	nC
Gate - Source charge	Q_{gs}^{*5}	$I_D = 20A$	-	8	-	
Gate - Drain charge	Q_{gd}^{*5}	$V_{GS} = 10V$	-	33	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} \approx 480V, I_D = 20A$	-	6.9	-	V

*1 Limited only by maximum temperature allowed.

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

*3 $I_D = 3.4A, V_{DD} = 50V$

*4 Reference measurement circuits Fig.5-1.

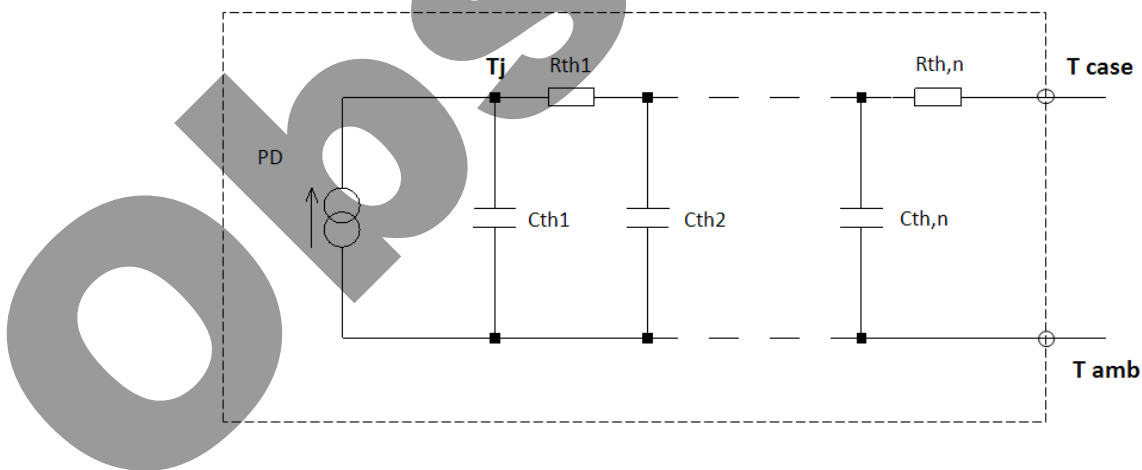
*5 Pulsed

●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}	$T_c = 25^\circ\text{C}$	-	-	20	A
Inverse diode direct current, pulsed	I_{SM}^{*2}		-	-	60	A
Forward voltage	V_{SD}^{*5}	$V_{GS} = 0\text{V}, I_S = 20\text{A}$	-	-	1.5	V
Reverse recovery time	t_{rr}^{*5}	$I_S = 20\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	550	-	ns
Reverse recovery charge	Q_{rr}^{*5}		-	10.4	-	μC
Peak reverse recovery current	I_{rrm}^{*5}		-	38	-	A

●Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
R_{th1}	0.283	K/W	C_{th1}	0.00969	Ws/K
R_{th2}	0.430		C_{th2}	0.226	
R_{th3}	0.250		C_{th3}	13.8	



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

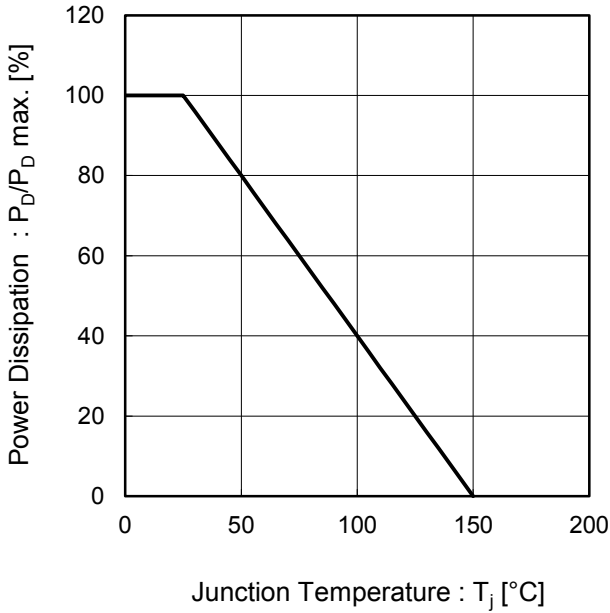


Fig.2 Maximum Safe Operating Area

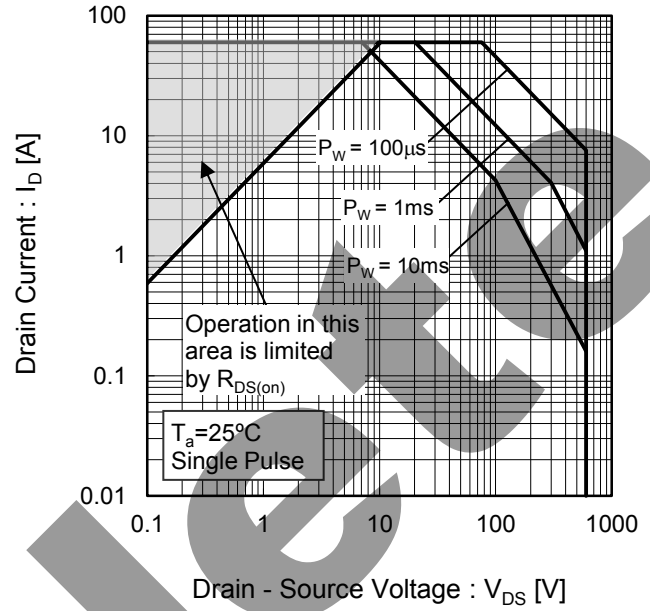


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

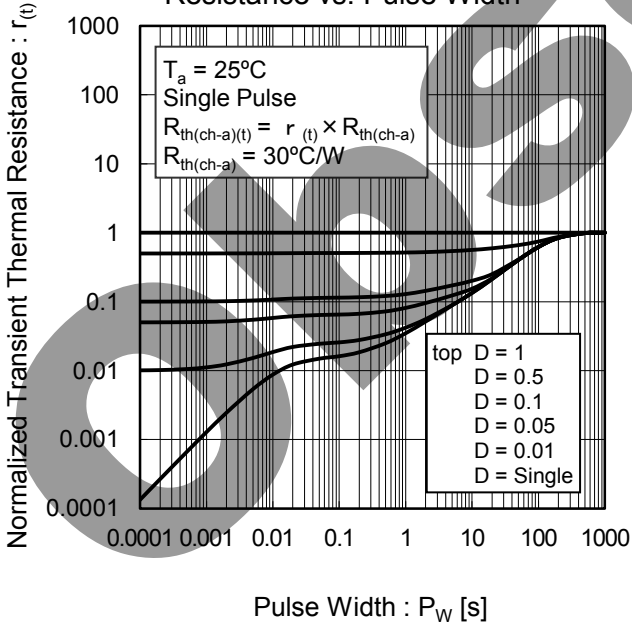
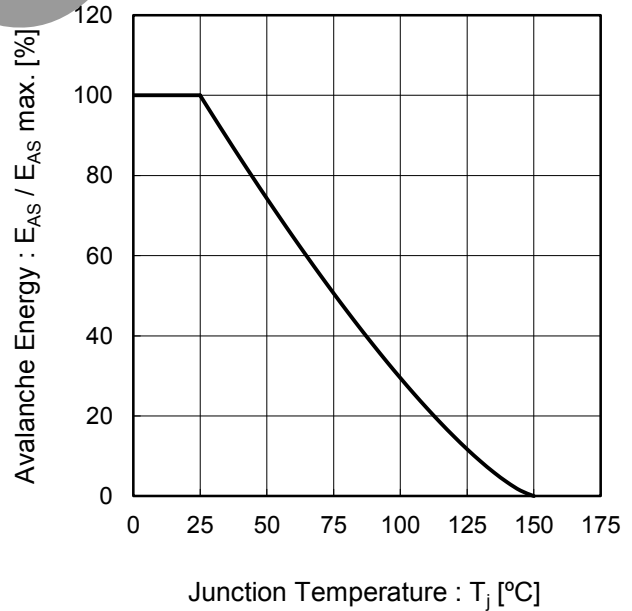


Fig.4 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

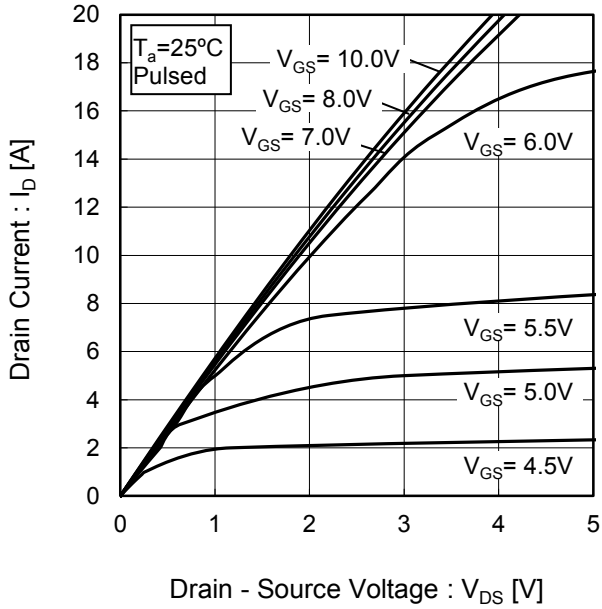


Fig.6 Typical Output Characteristics(II)

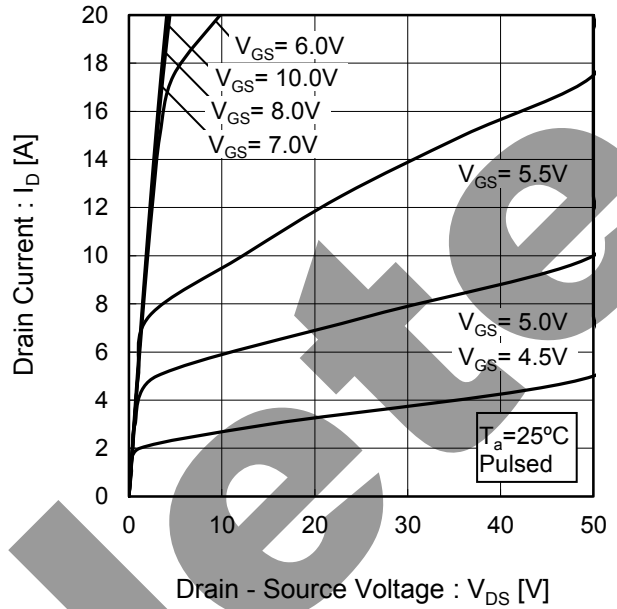


Fig.7 $T_j = 150^\circ\text{C}$ Typical Output Characteristics(I)

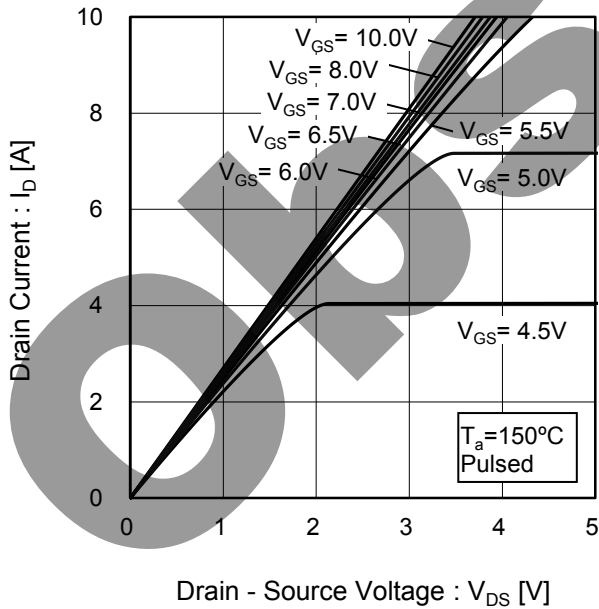
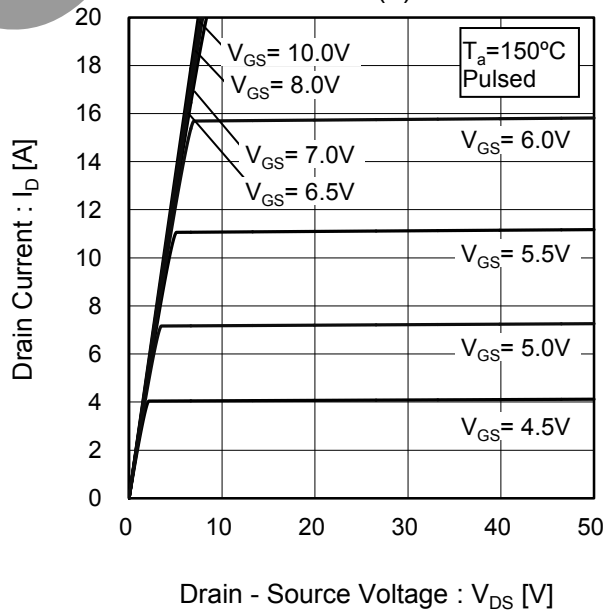


Fig.8 $T_j = 150^\circ\text{C}$ Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.9 Breakdown Voltage vs. Junction Temperature

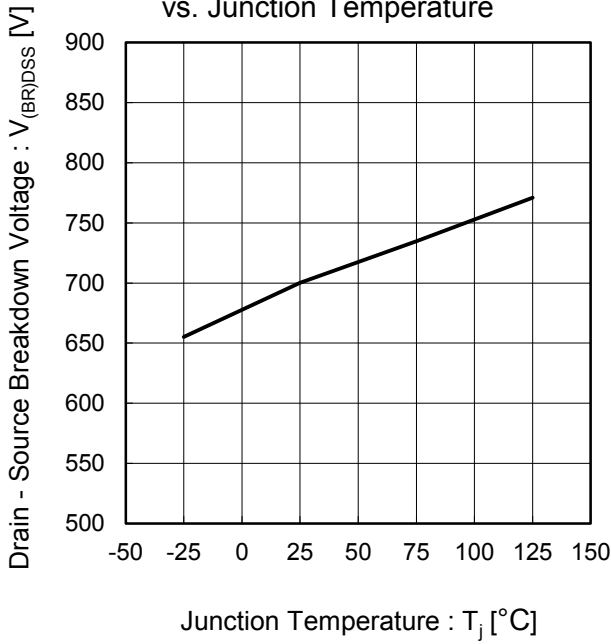


Fig.10 Typical Transfer Characteristics

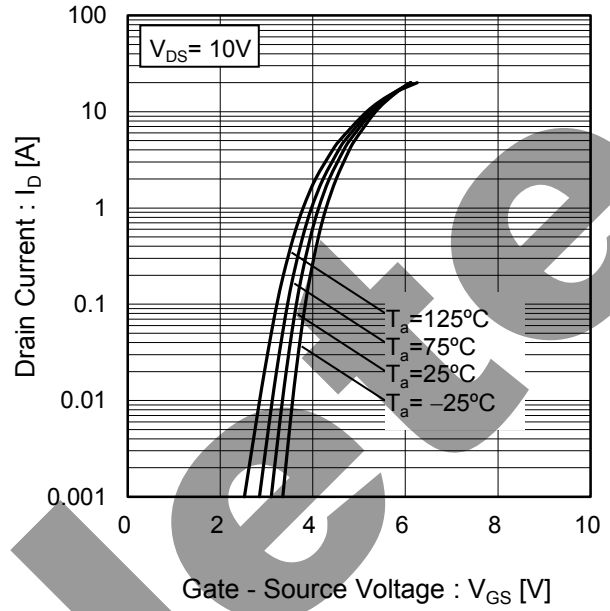


Fig.11 Gate Threshold Voltage vs. Junction Temperature

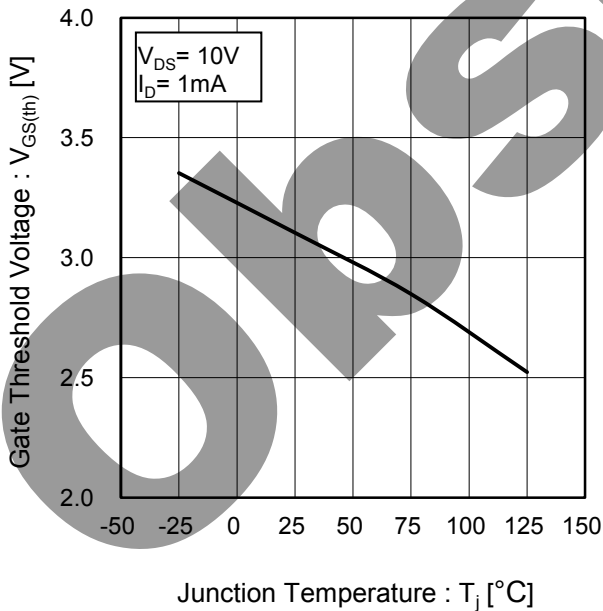
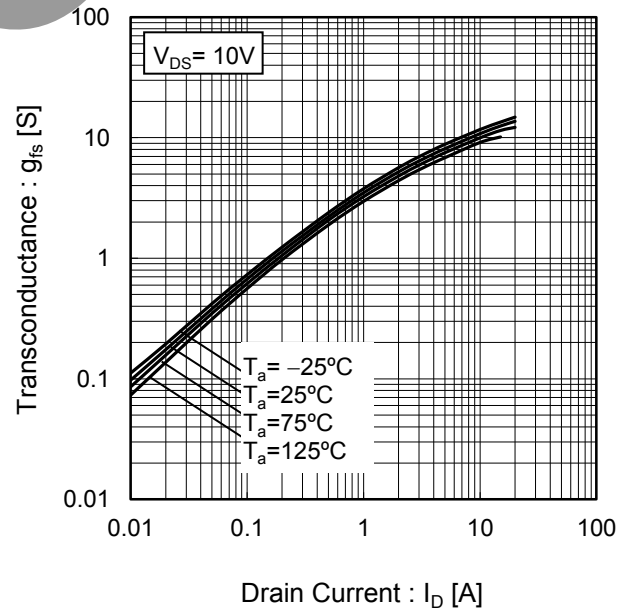


Fig.12 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.13 Static Drain - Source On - State Resistance vs. Gate Source Voltage

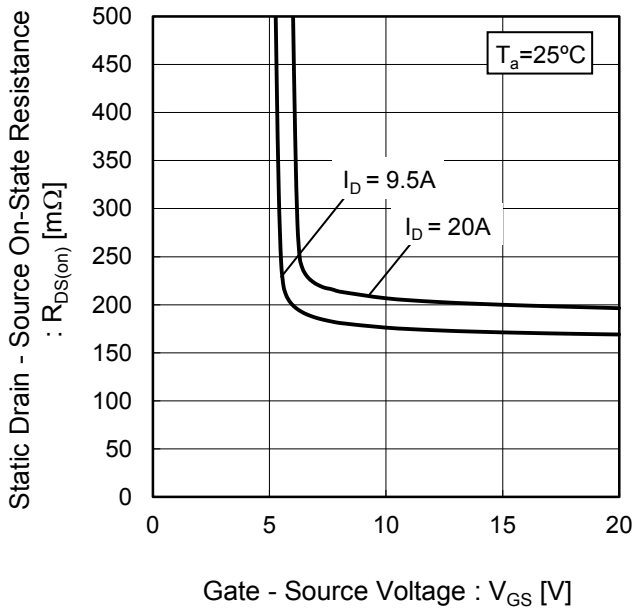


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature

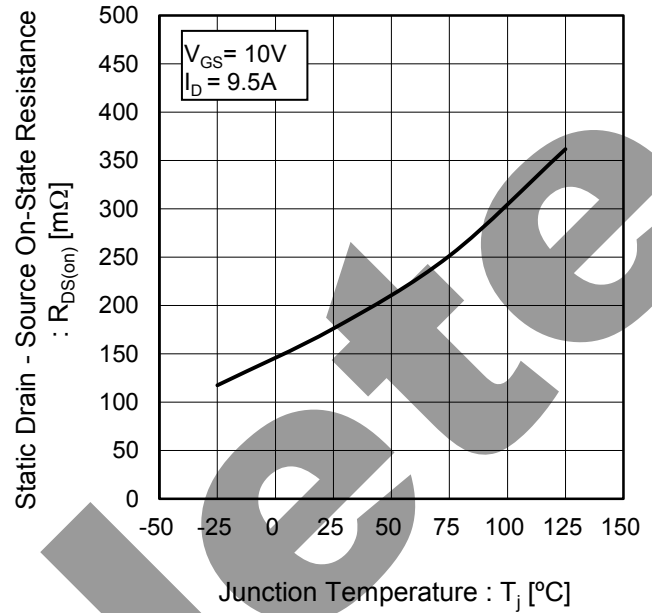


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current

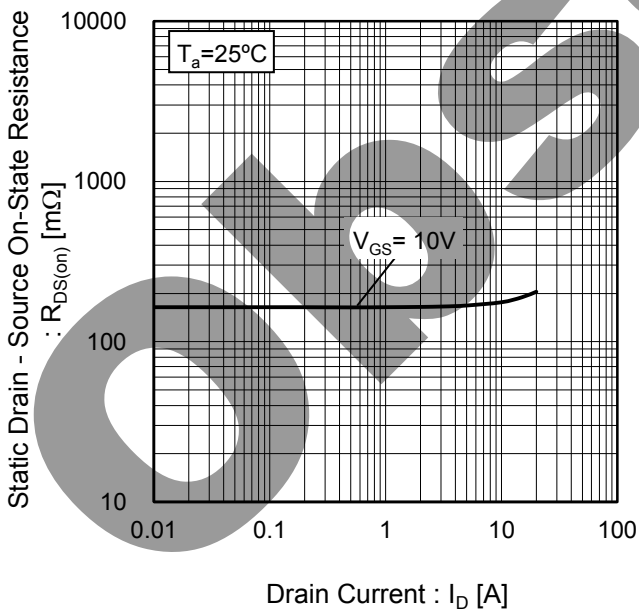
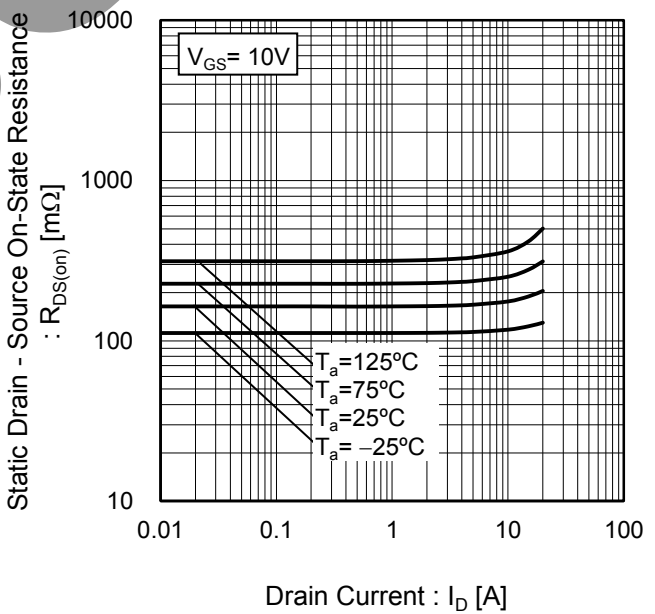


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.17 Typical Capacitance vs. Drain - Source Voltage

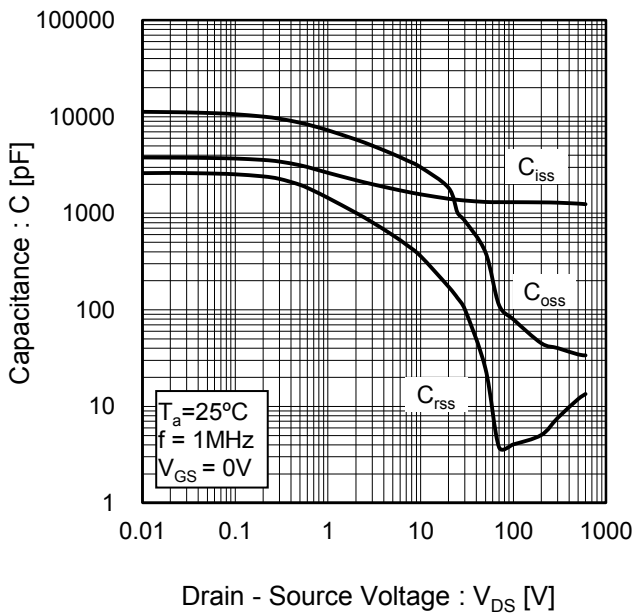


Fig.18 Coss Stored Energy

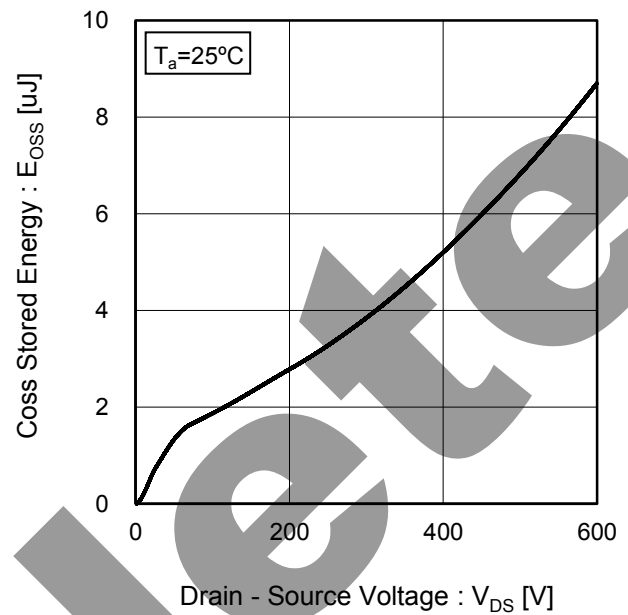


Fig.19 Switching Characteristics

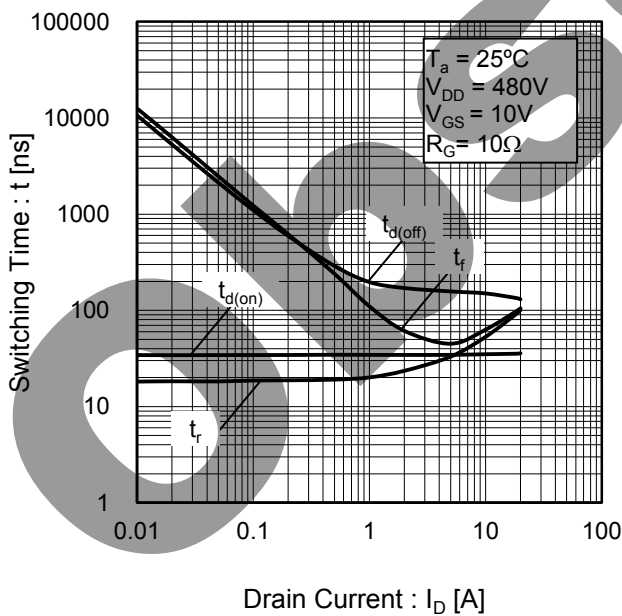
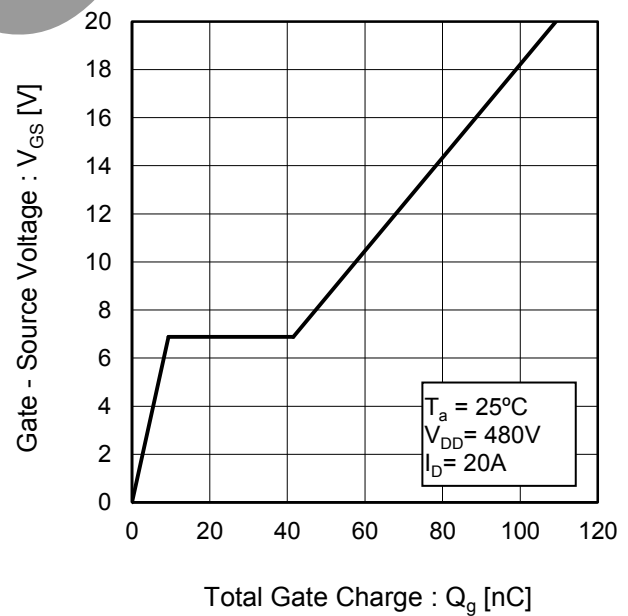


Fig.20 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.21 Inverse Diode Forward Current vs. Source - Drain Voltage

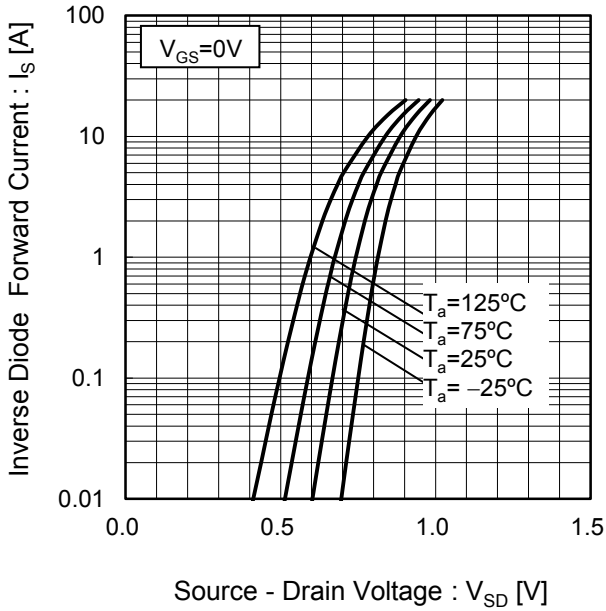
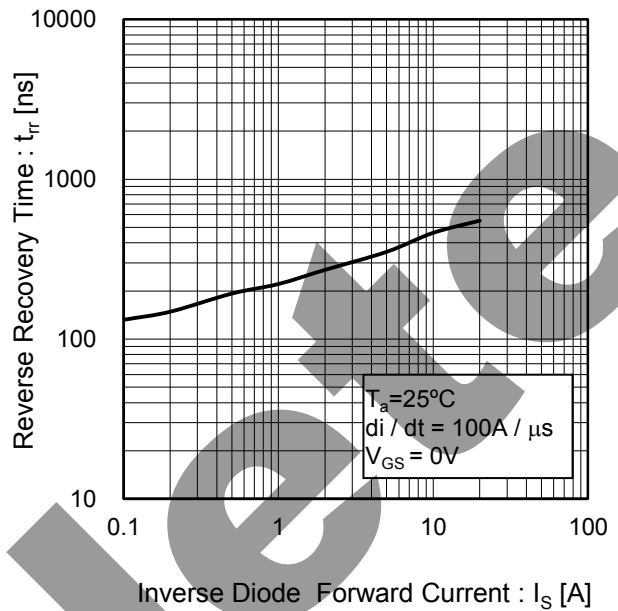


Fig.22 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

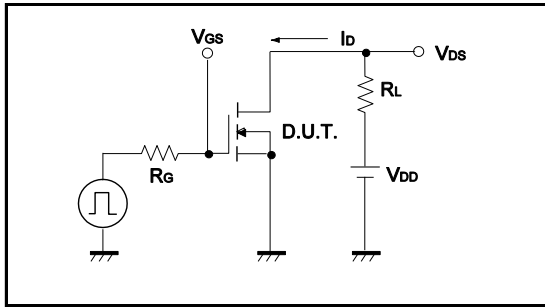


Fig.1-2 Switching Waveforms

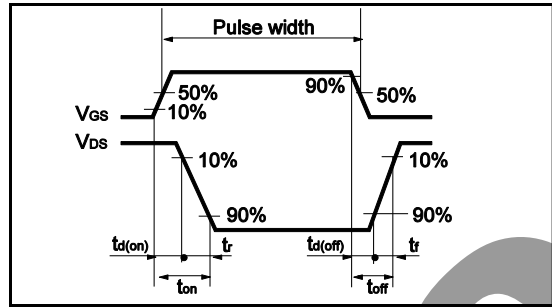


Fig.2-1 Gate Charge Measurement Circuit

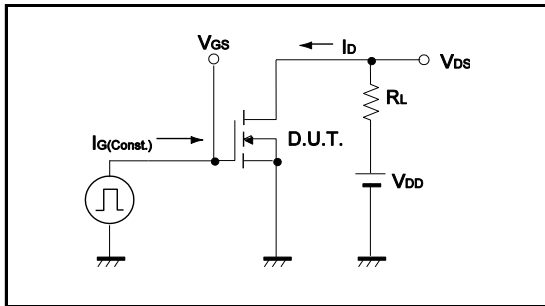


Fig.2-2 Gate Charge Waveform

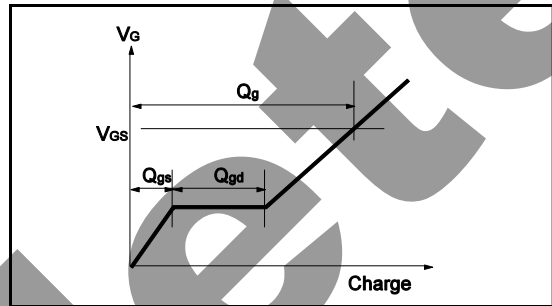


Fig.3-1 Avalanche Measurement Circuit

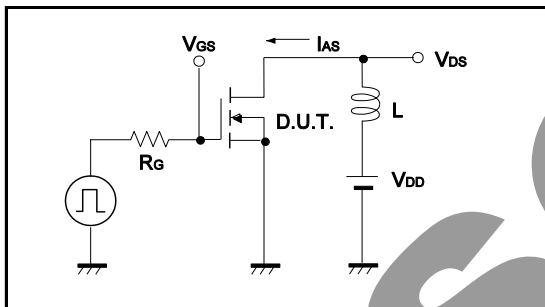


Fig.3-2 Avalanche Waveform

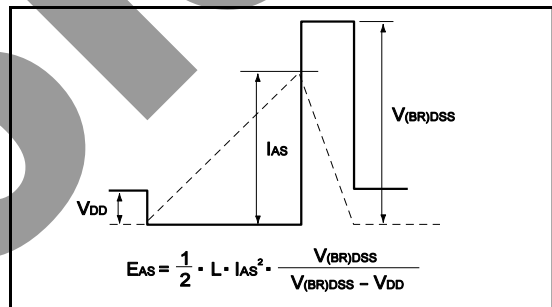


Fig.4-1 dv/dt Measurement Circuit

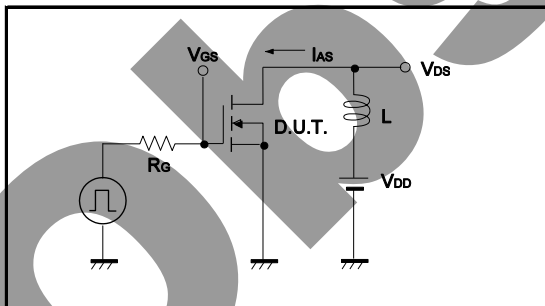


Fig.4-2 dv/dt Waveform

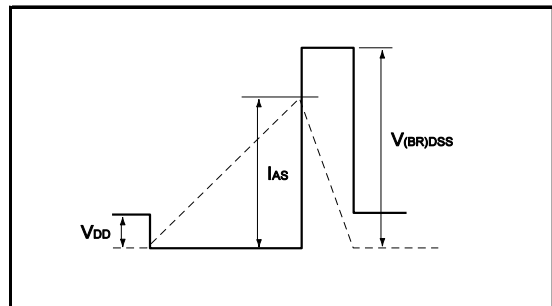


Fig.5-1 di/dt Measurement Circuit

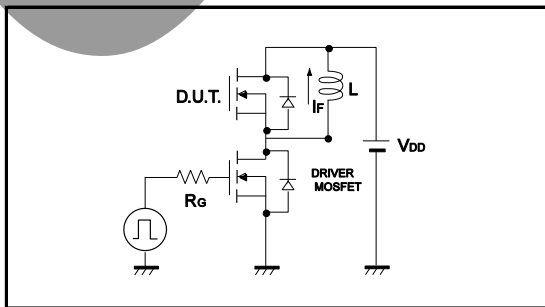
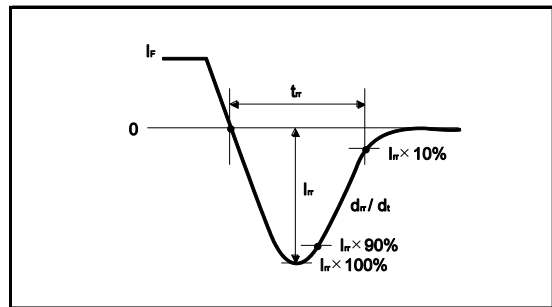
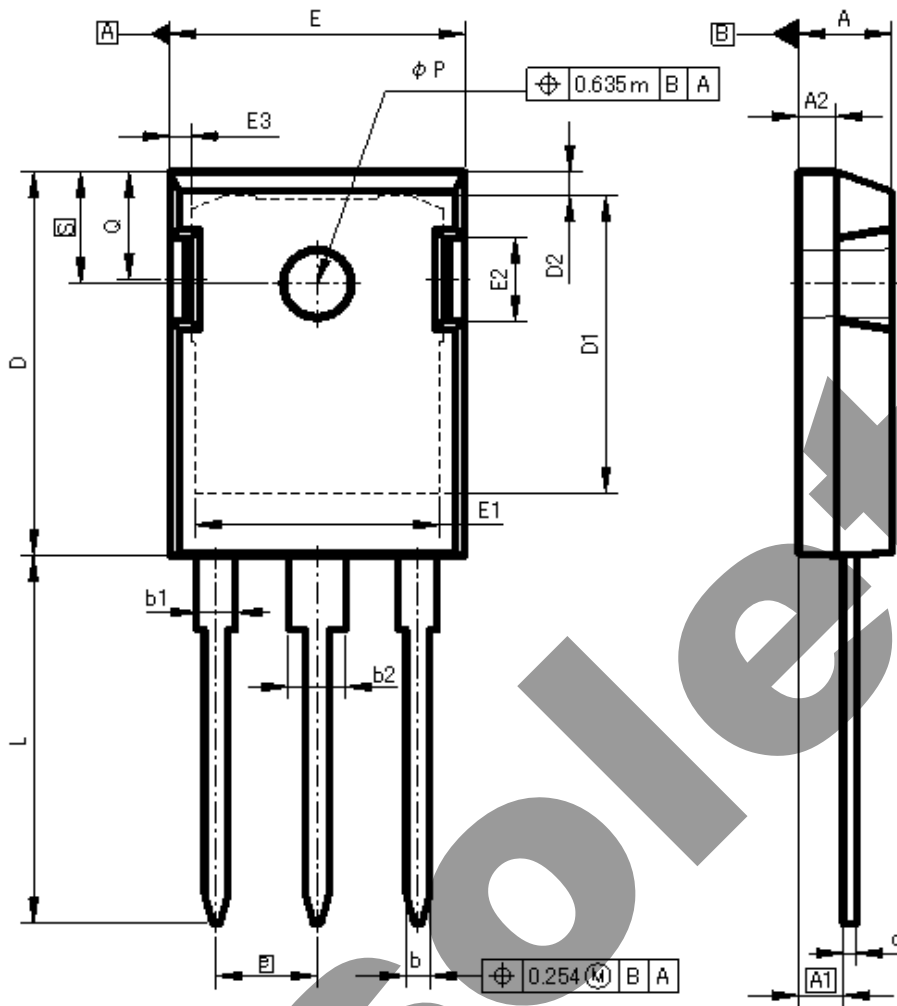


Fig.5-2 di/dt Waveform



●Dimensions (Unit : mm)

TO-247



DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.29	2.54	0.090	0.100
A2	1.91	2.16	0.075	0.085
b	1.14	1.40	0.045	0.055
b1	1.91	2.20	0.075	0.087
b2	2.92	3.20	0.115	0.126
c	0.61	0.80	0.024	0.031
D	20.80	21.34	0.819	0.840
D1	17.43	17.83	0.686	0.702
E	15.75	16.13	0.620	0.635
e	5.45		0.215	
N	3.00		3.000	
L	19.81	20.57	0.780	0.810
L1	3.81	4.32	0.150	0.170
ΦP	3.55	3.65	0.140	0.144
Q	5.59	6.20	0.220	0.244
S	6.15		0.240	

Dimension in mm / inches

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JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

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 - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - Sealing or coating our Products with resin or other coating materials
 - Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.) ; or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
 - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse, is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
 - [a] the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [b] the temperature or humidity exceeds those recommended by ROHM
 - [c] the Products are exposed to direct sunshine or condensation
 - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

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