

$V_{DSS}$	500V
$R_{DS(on)}$ (Max.)	0.22 $\Omega$
$I_D$	21A
$P_D$	100W

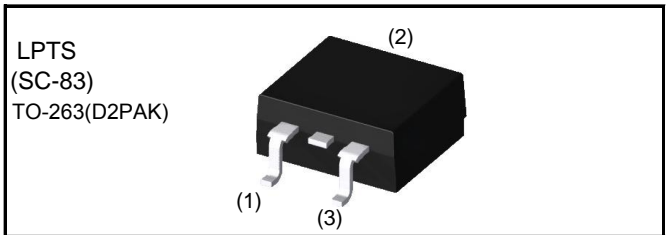
#### ●Features

- 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

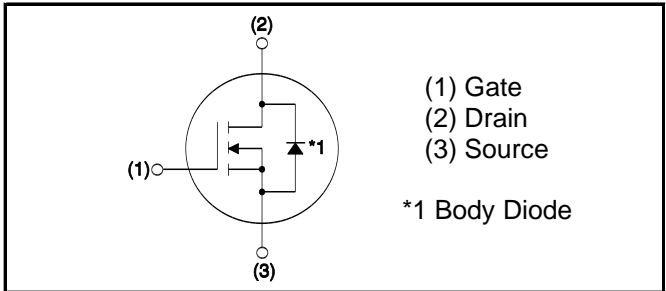
#### ●Application

Switching Power Supply

#### ●Outline



#### ●Inner circuit



#### ●Packaging specifications

Type	Packaging	Taping
	Reel size (mm)	330
	Tape width (mm)	24
	Basic ordering unit (pcs)	1,000
	Taping code	TL
	Marking	R5021ANJ

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

Parameter	Symbol	Value	Unit	
Drain - Source voltage	$V_{DSS}$	500	V	
Continuous drain current	$T_c = 25^\circ C$	$I_D^{*1}$	$\pm 21$	A
	$T_c = 100^\circ C$	$I_D^{*1}$	$\pm 10.2$	A
Pulsed drain current	$I_{D,pulse}^{*2}$	$\pm 84$	A	
Gate - Source voltage	$V_{GSS}$	$\pm 30$	V	
Avalanche energy, single pulse	$E_{AS}^{*3}$	29.6	mJ	
Avalanche energy, repetitive	$E_{AR}^{*4}$	6.7	mJ	
Avalanche current	$I_{AR}^{*3}$	10.5	A	
Power dissipation ( $T_c = 25^\circ C$ )	$P_D$	100	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 <sup>*5</sup>	15	V/ns	

### ●Absolute maximum ratings

Parameter	Symbol	Conditions	Values	Unit
Drain - Source voltage slope	dv/dt	$V_{DS} = 400V, I_D = 21A$ $T_j = 125^\circ C$	50	V/ns

### ●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	$R_{thJC}$	-	-	1.25	$^\circ C/W$
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	80	$^\circ C/W$
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	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 1mA$	500	-	-	V
Drain - Source avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS} = 0V, I_D = 21A$	-	580	-	V
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 500V, V_{GS} = 0V$ $T_j = 25^\circ C$	-	0.1	100	$\mu A$
		$T_j = 125^\circ C$	-	-	1000	
Gate - Source leakage current	$I_{GSS}$	$V_{GS} = \pm 30V, V_{DS} = 0V$	-	-	$\pm 100$	nA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = 10V, I_D = 1mA$	2.5	-	4.5	V
Static drain - source on - state resistance	$R_{DS(on)}^{*6}$	$V_{GS} = 10V, I_D = 10.5A$ $T_j = 25^\circ C$	-	0.17	0.22	$\Omega$
		$T_j = 125^\circ C$	-	0.37	-	
Gate input resistance	$R_G$	f = 1MHz, open drain	-	14.0	-	$\Omega$

**●Electrical characteristics**( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	$g_{fs}^{*6}$	$V_{DS} = 10\text{V}, I_D = 10.5\text{A}$	7	14	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$	-	2300	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = 25\text{V}$	-	1000	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	70	-	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$ $V_{DS} = 0\text{V to } 400\text{V}$	-	124	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	126	-	
Turn - on delay time	$t_{d(on)}^{*6}$	$V_{DD} \approx 250\text{V}, V_{GS} = 10\text{V}$	-	47	-	ns
Rise time	$t_r^{*6}$	$I_D = 10.5\text{A}$	-	70	-	
Turn - off delay time	$t_{d(off)}^{*6}$	$R_L = 23.8\Omega$	-	200	400	
Fall time	$t_f^{*6}$	$R_G = 10\Omega$	-	70	140	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	$Q_g^{*6}$	$V_{DD} \approx 250\text{V}$	-	64	-	nC
Gate - Source charge	$Q_{gs}^{*6}$	$I_D = 21\text{A}$	-	11	-	
Gate - Drain charge	$Q_{gd}^{*6}$	$V_{GS} = 10\text{V}$	-	27	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} \approx 250\text{V}, I_D = 21\text{A}$	-	6.2	-	V

\*1 Limited only by maximum temperature allowed.

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

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

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

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

\*6 Pulsed

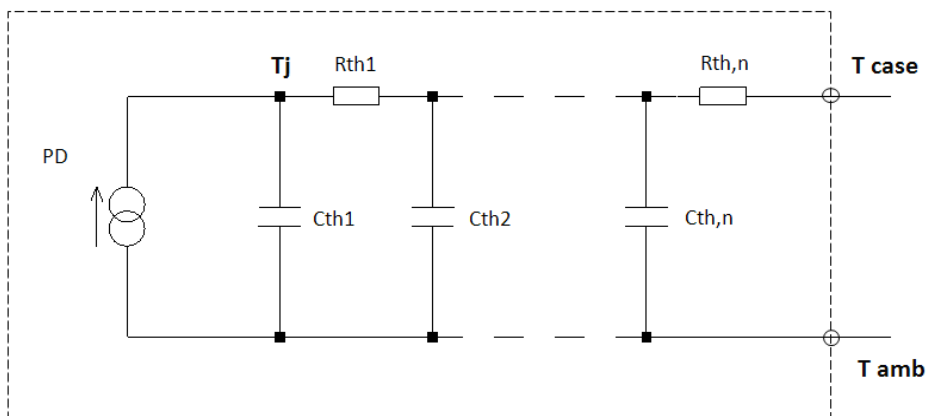
●Body diode electrical characteristics (Source-Drain)( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	$I_S^{*1}$	$T_c = 25^\circ\text{C}$	-	-	21	A
Inverse diode direct current, pulsed	$I_{SM}^{*2}$		-	-	84	A
Forward voltage	$V_{SD}^{*6}$	$V_{GS} = 0\text{V}, I_S = 21\text{A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}^{*6}$	$I_S = 21\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	521	-	ns
Reverse recovery charge	$Q_{rr}^{*6}$		-	7.7	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}^{*6}$		-	29.5	-	A
Peak rate of fall of reverse recovery current	$di_{rr}/dt$	$T_j = 25^\circ\text{C}$	-	580	-	$\text{A}/\mu\text{s}$

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
$R_{th1}$	0.0368	K/W
$R_{th2}$	0.154	
$R_{th3}$	0.614	

Symbol	Value	Unit
$C_{th1}$	0.00311	Ws/K
$C_{th2}$	0.0141	
$C_{th3}$	0.251	



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

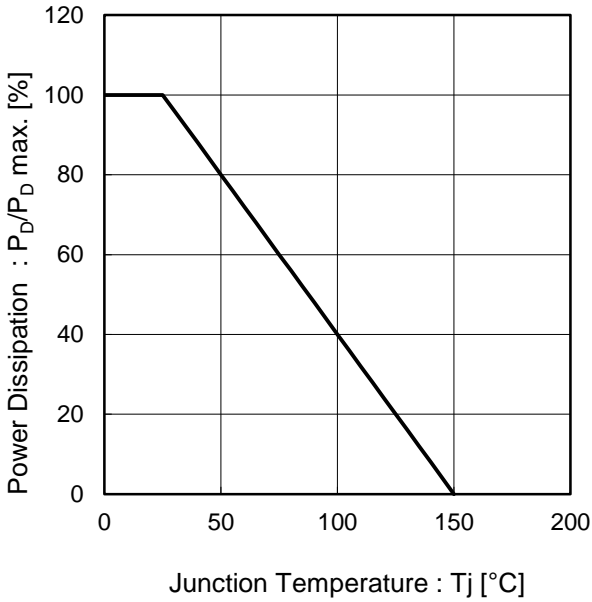


Fig.2 Maximum Safe Operating Area

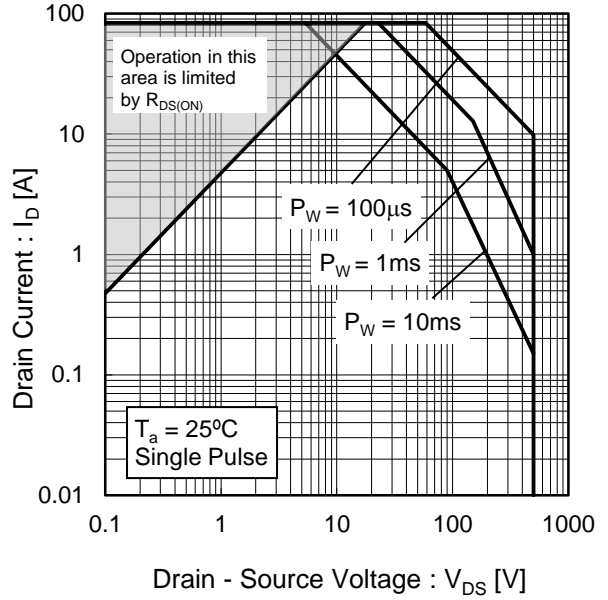
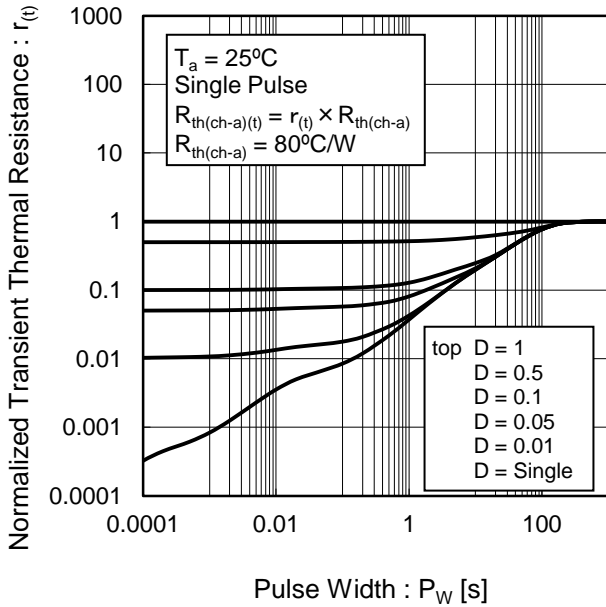


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



●Electrical characteristic curves

Fig.4 Avalanche Current vs Inductive Load

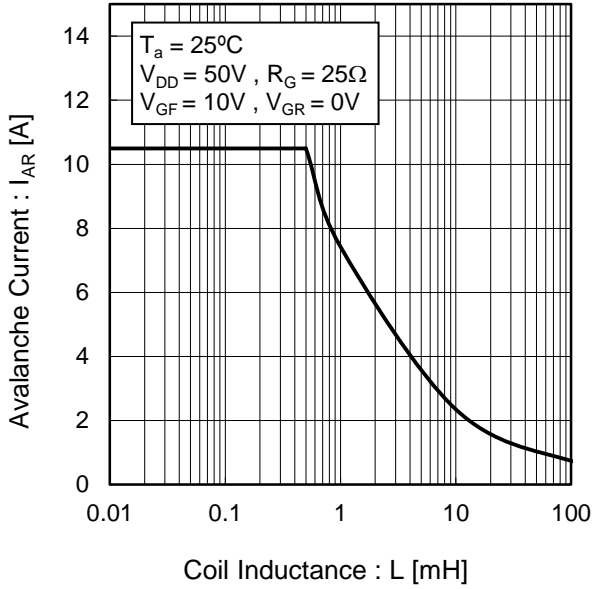


Fig.5 Avalanche Power Losses

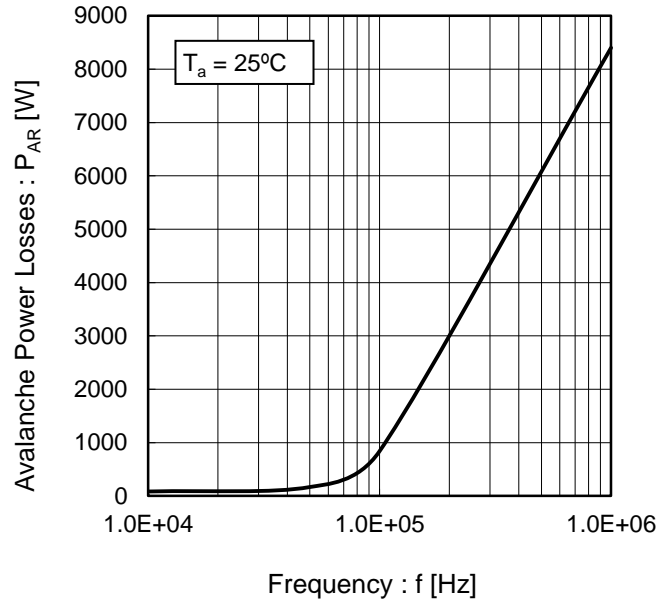
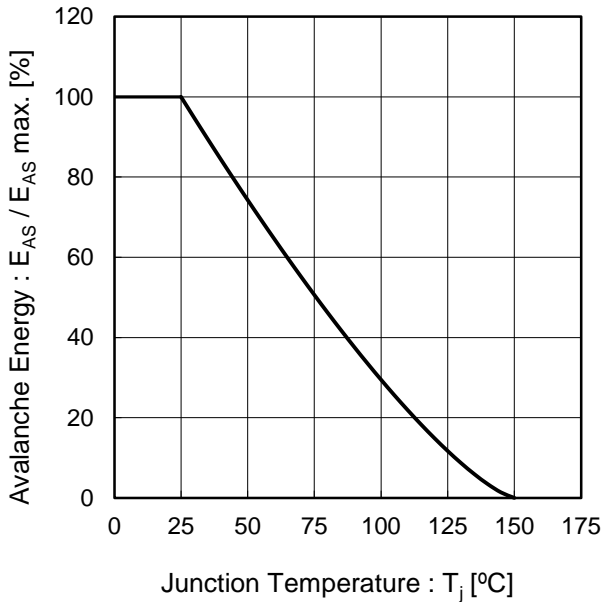


Fig.6 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

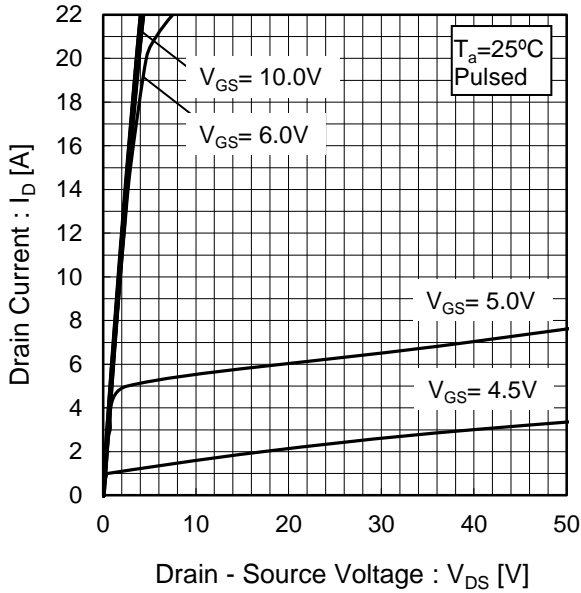


Fig.8 Typical Output Characteristics(II)

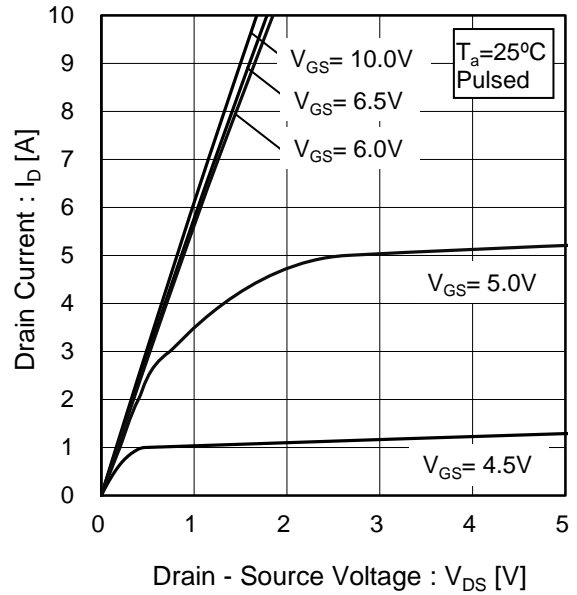


Fig.9  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(I)

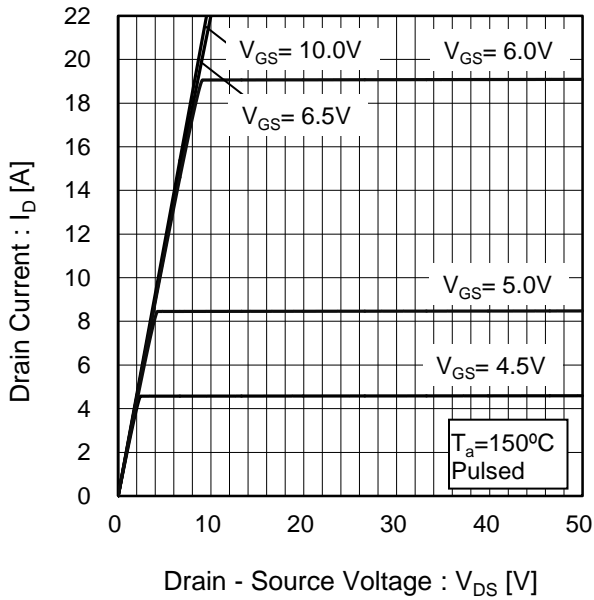
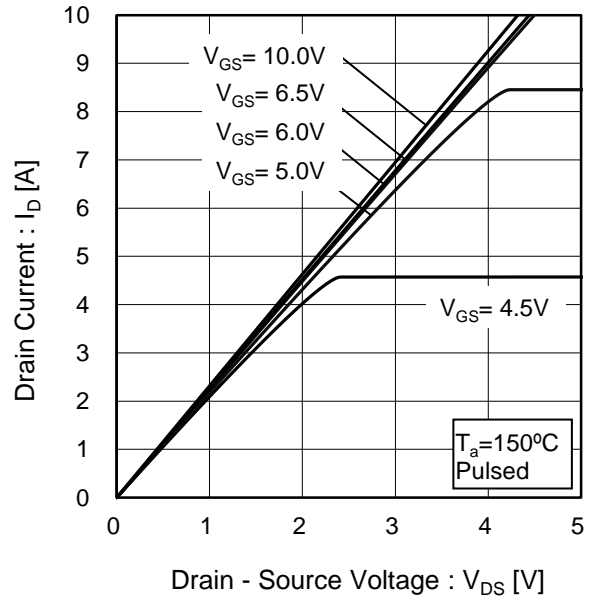


Fig.10  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

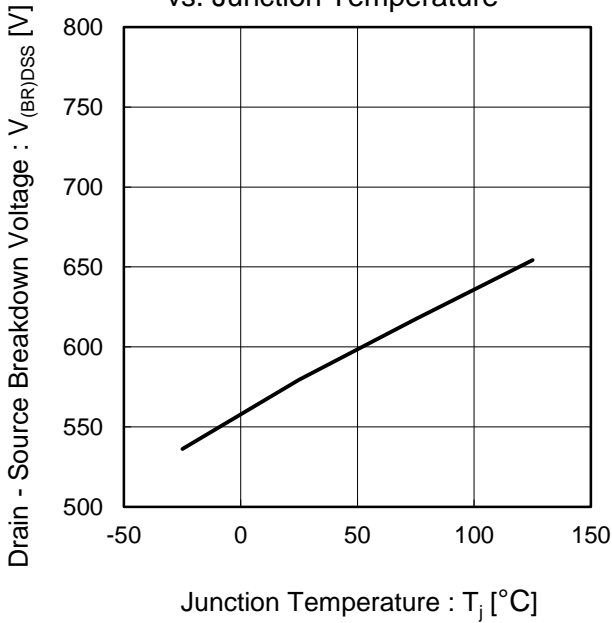


Fig.12 Typical Transfer Characteristics

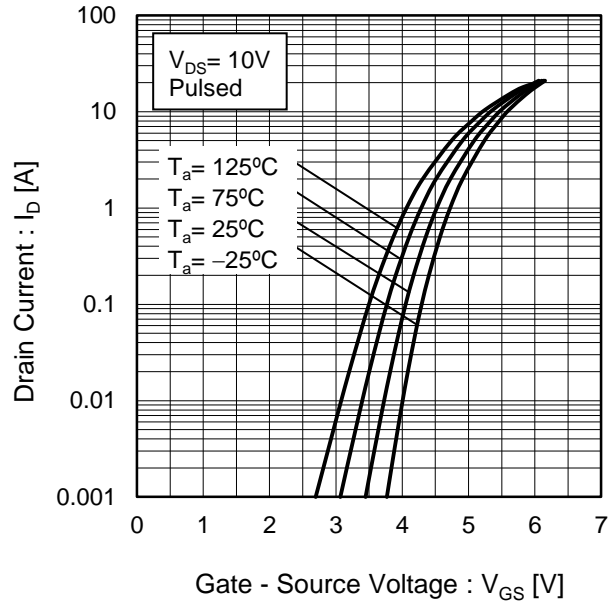


Fig.13 Gate Threshold Voltage vs. Junction Temperature

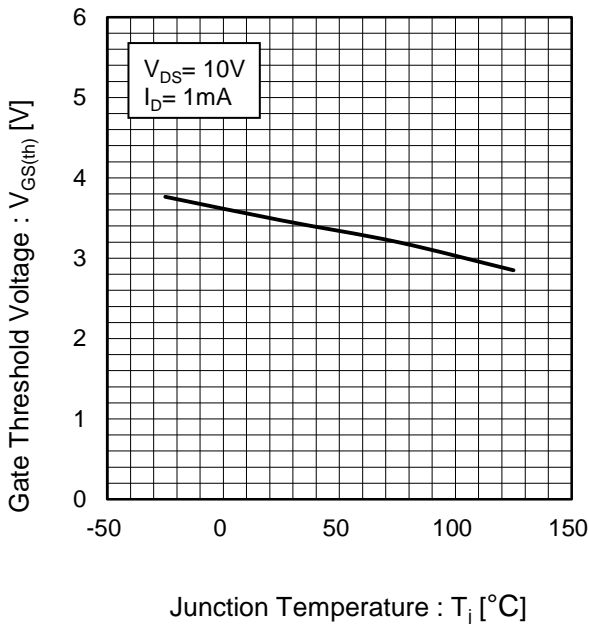
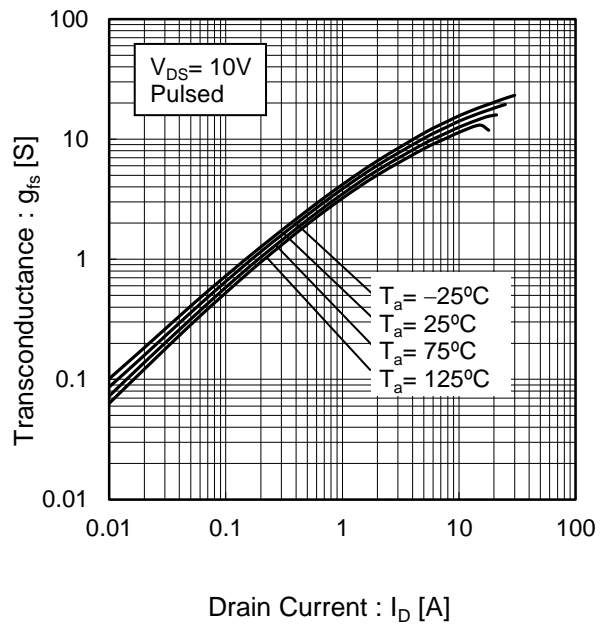


Fig.14 Transconductance vs. Drain Current





●Electrical characteristic curves

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

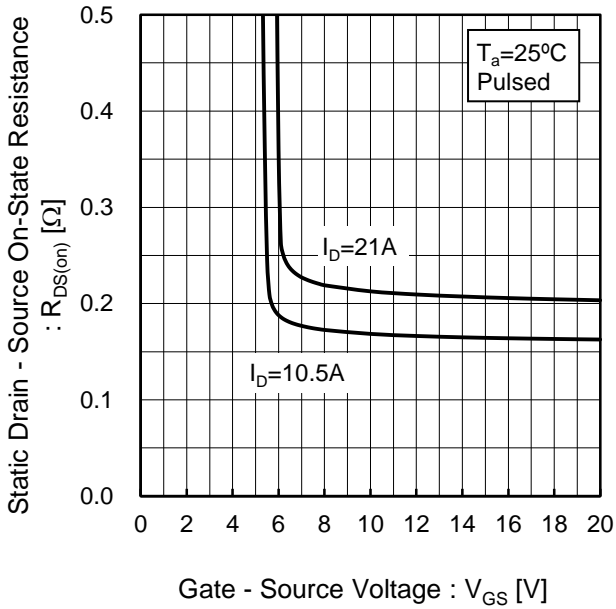


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

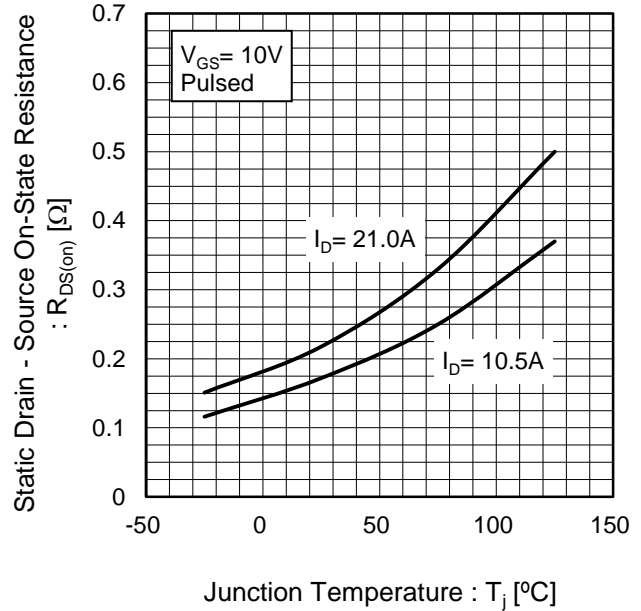
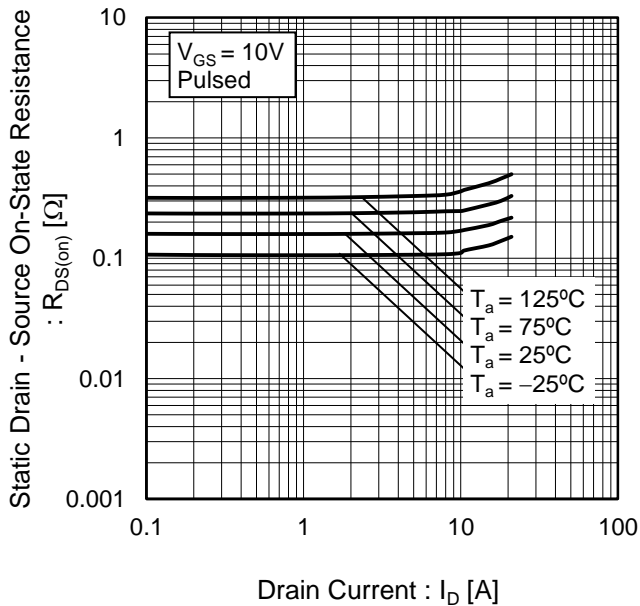


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

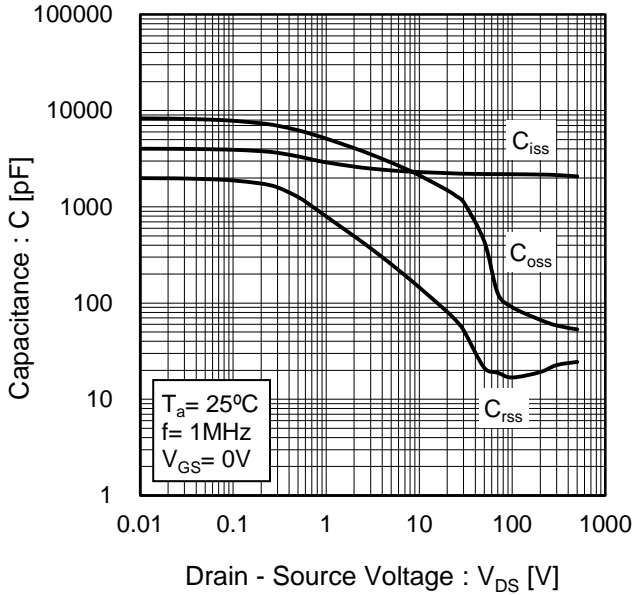


Fig.19 Coss Stored Energy

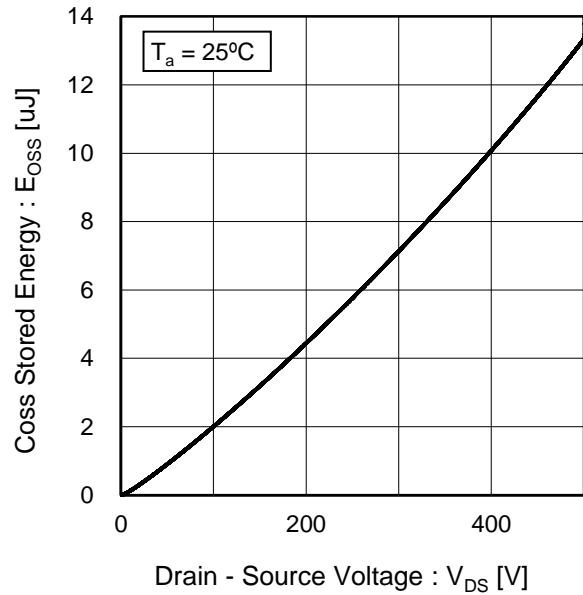


Fig.20 Switching Characteristics

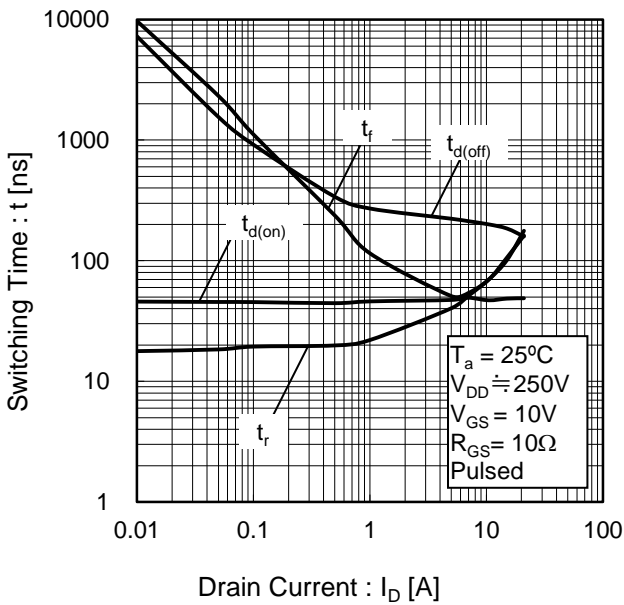
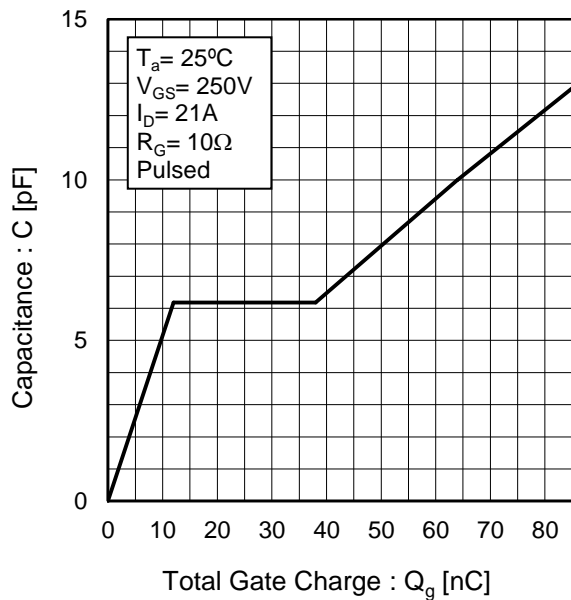


Fig.21 Dynamic Input Characteristics



●Electrical characteristic curves

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

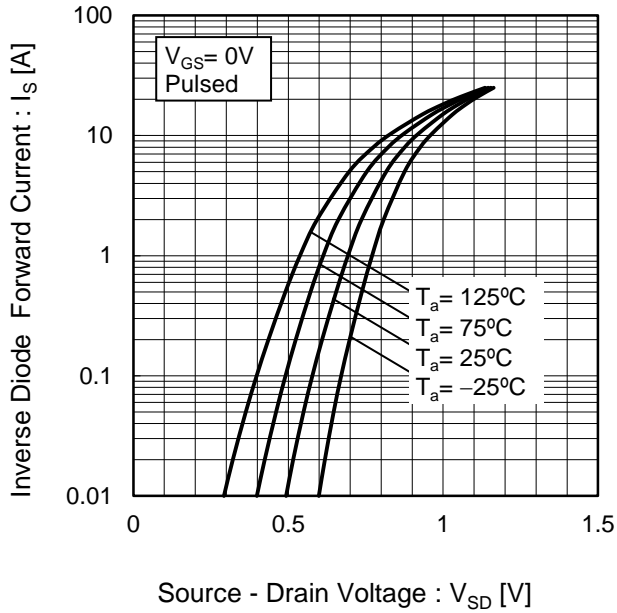
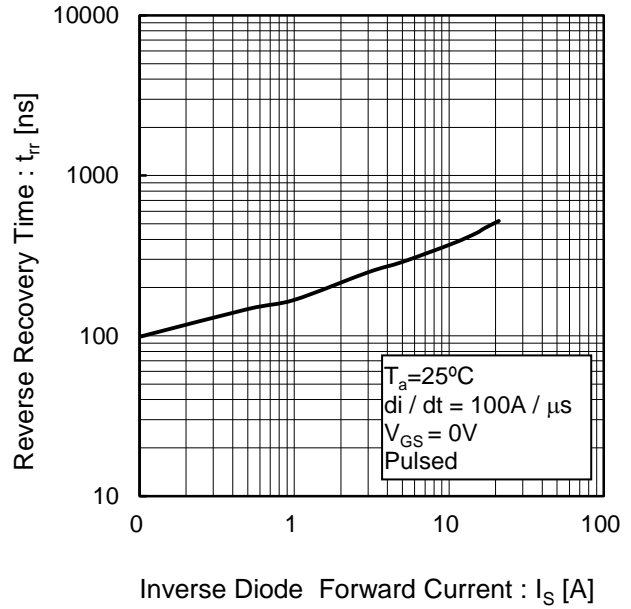


Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

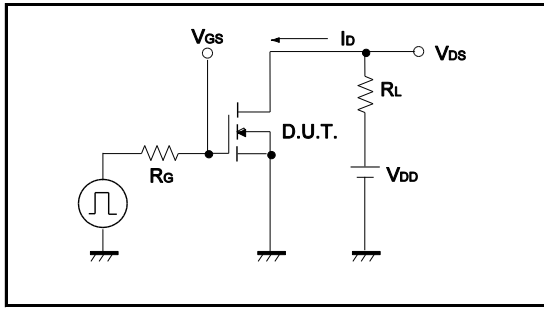


Fig.1-2 Switching Waveforms

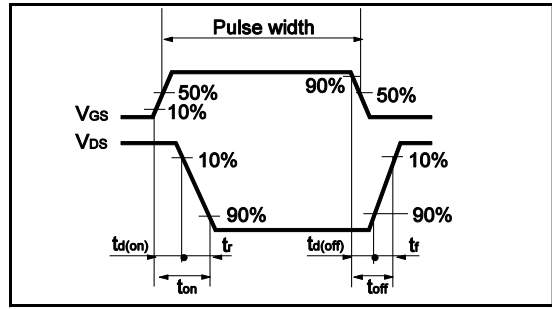


Fig.2-1 Gate Charge Measurement Circuit

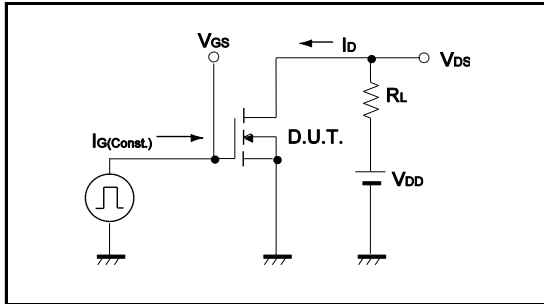


Fig.2-2 Gate Charge Waveform

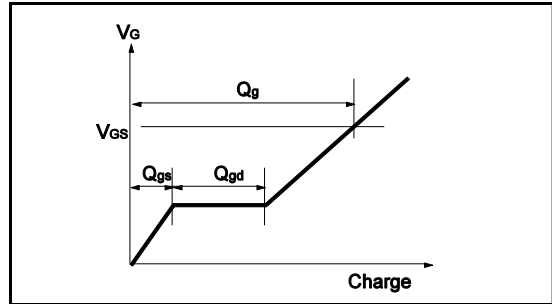


Fig.3-1 Avalanche Measurement Circuit

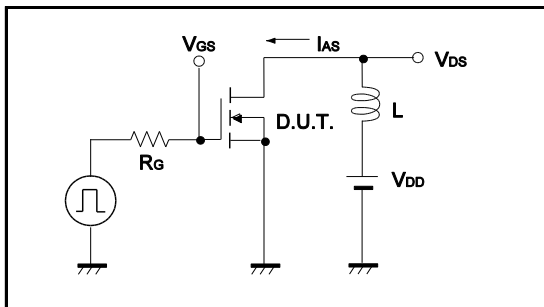


Fig.3-2 Avalanche Waveform

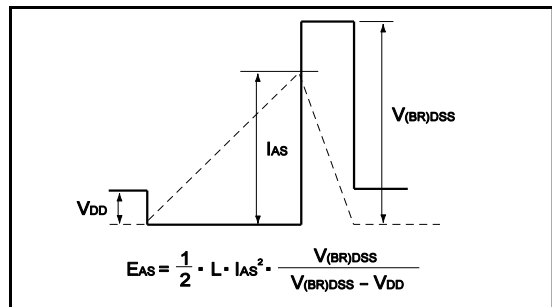


Fig.4-1 dv/dt Measurement Circuit

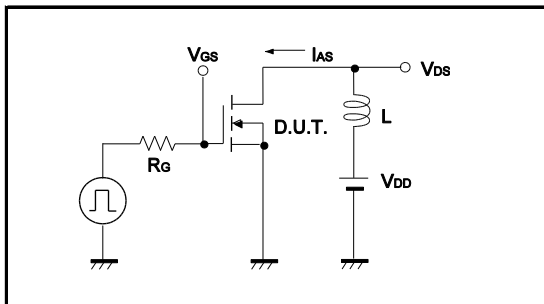


Fig.4-2 dv/dt Waveform

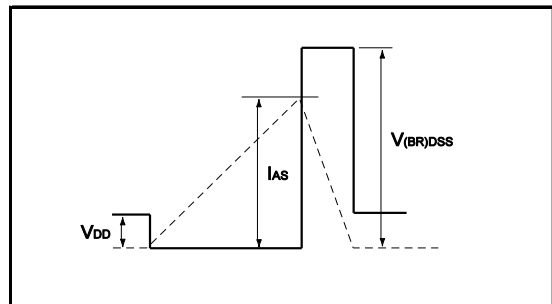


Fig.5-1 di/dt Measurement Circuit

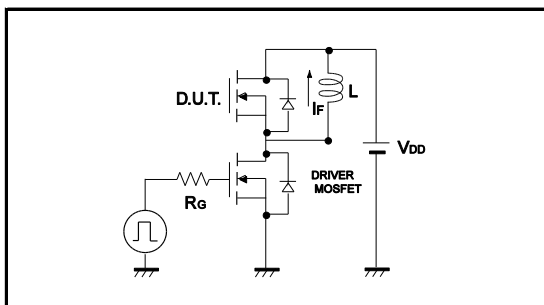
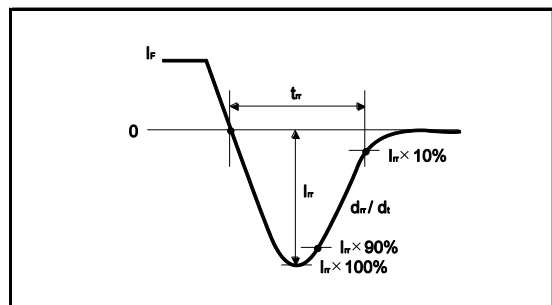
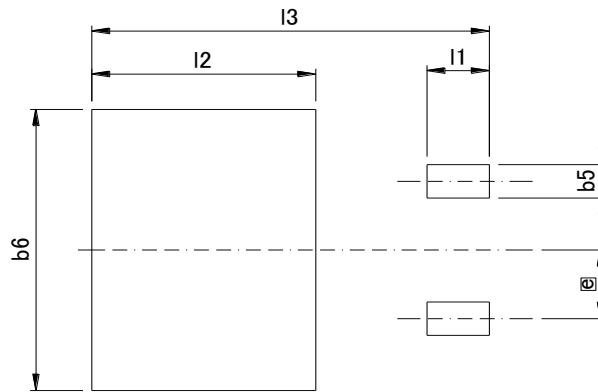
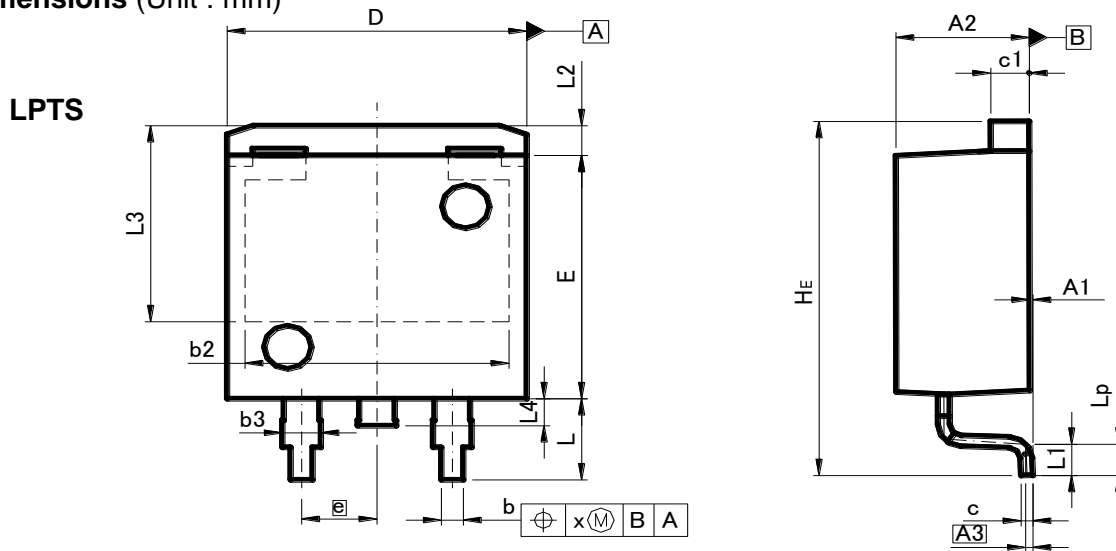


Fig.5-2 di/dt Waveform



●Dimensions (Unit : mm)



Pattern of terminal position areas

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A1	0.00	0.30	0	0.012
A2	4.30	4.70	0.169	0.185
A3	0.25		0.01	
b	0.68	0.98	0.027	0.039
b2	8.90		0.35	
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		0.10	
HE	12.80	13.40	0.504	0.528
L	2.70	3.30	0.106	0.13
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	-	0.01

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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