

$V_{DSS}$	600V
$R_{DS(on)}$ (Max.)	0.09 $\Omega$
$I_D$	46A
$P_D$	120W

#### ●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

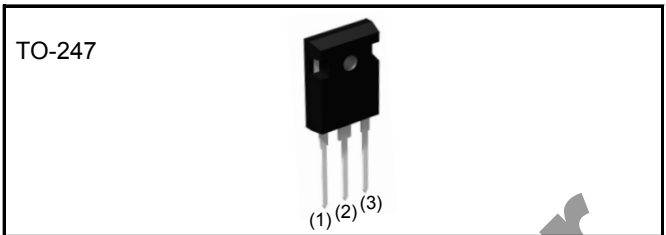
#### ●Application

Switching Power Supply

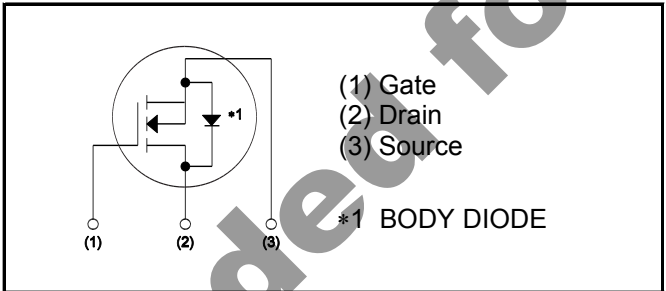
#### ●Absolute maximum ratings( $T_a = 25^\circ C$ )

Parameter	Symbol	Value	Unit	
Drain - Source voltage	$V_{DSS}$	600	V	
Continuous drain current	$T_c = 25^\circ C$	$I_D^{*1}$	$\pm 46$	A
	$T_c = 100^\circ C$	$I_D^{*1}$	$\pm 22.3$	A
Pulsed drain current	$I_{D,pulse}^{*2}$	$\pm 115$	A	
Gate - Source voltage	$V_{GSS}$	$\pm 30$	V	
Avalanche energy, single pulse	$E_{AS}^{*3}$	142	mJ	
Avalanche energy, repetitive	$E_{AR}^{*4}$	5.4	mJ	
Avalanche current	$I_{AR}^{*3}$	23	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 <sup>*5</sup>	15	V/ns	

#### ●Outline



#### ●Inner circuit



#### ●Packaging specifications

Type	Packaging	Tube
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	450
	Taping code	C9
	Marking	R6046ANZ1

### ●Absolute maximum ratings

Parameter	Symbol	Conditions	Values	Unit
Drain - Source voltage slope	dv/dt	$V_{DS} = 480V, I_D = 46A$ $T_j = 125^\circ C$	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
Drain - Source avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS} = 0V, I_D = 23A$	-	700	-	V
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$ $T_j = 25^\circ C$	-	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	$R_{DS(on)}^{*6}$	$V_{GS} = 10V, I_D = 23A$ $T_j = 25^\circ C$	-	0.069	0.09	$\Omega$
		$T_j = 125^\circ C$	-	0.145	-	
Gate input resistance	$R_G$	f = 1MHz, open drain	-	2.2	-	$\Omega$

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	$g_{fs}^{*6}$	$V_{DS} = 10\text{V}, I_D = 23\text{A}$	19	33	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$	-	6000	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = 25\text{V}$	-	3900	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	83	-	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$ $V_{DS} = 0\text{V to } 480\text{V}$	-	188	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	640	-	
Turn - on delay time	$t_{d(on)}^{*6}$	$V_{DD} \approx 300\text{V}, V_{GS} = 10\text{V}$	-	65	-	ns
Rise time	$t_r^{*6}$	$I_D = 23\text{A}$	-	120	-	
Turn - off delay time	$t_{d(off)}^{*6}$	$R_L = 13\Omega$	-	260	520	
Fall time	$t_f^{*6}$	$R_G = 10\Omega$	-	100	200	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	$Q_g^{*6}$	$V_{DD} \approx 300\text{V}$	-	150	-	nC
Gate - Source charge	$Q_{gs}^{*6}$	$I_D = 46\text{A}$	-	35	-	
Gate - Drain charge	$Q_{gd}^{*6}$	$V_{GS} = 10\text{V}$	-	56	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} \approx 300\text{V}, I_D = 46\text{A}$	-	5.9	-	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.

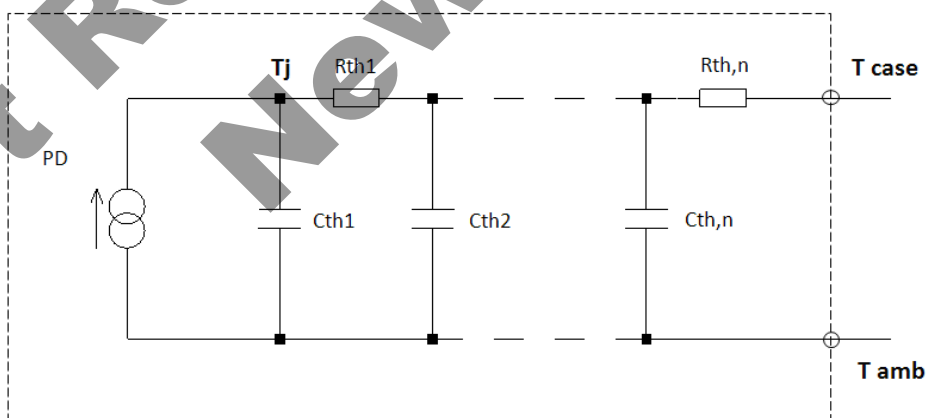
\*6 Pulsed

**●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	$I_S^{*1}$	$T_c = 25^\circ\text{C}$	-	-	46	A
Inverse diode direct current, pulsed	$I_{SM}^{*2}$		-	-	115	A
Forward voltage	$V_{SD}^{*6}$	$V_{GS} = 0\text{V}, I_S = 46\text{A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}^{*6}$	$I_S = 46\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	692	-	ns
Reverse recovery charge	$Q_{rr}^{*6}$		-	15	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}^{*6}$		-	45	-	A
Peak rate of fall of reverse recovery current	$di_{rr}/dt$	$T_j = 25^\circ\text{C}$	-	940	-	$\text{A}/\mu\text{s}$

**●Typical Transient Thermal Characteristics**

Symbol	Value	Unit	Symbol	Value	Unit
$R_{th1}$	0.055	K/W	$C_{th1}$	0.0236	Ws/K
$R_{th2}$	0.164		$C_{th2}$	0.134	
$R_{th3}$	0.821		$C_{th3}$	1.09	



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

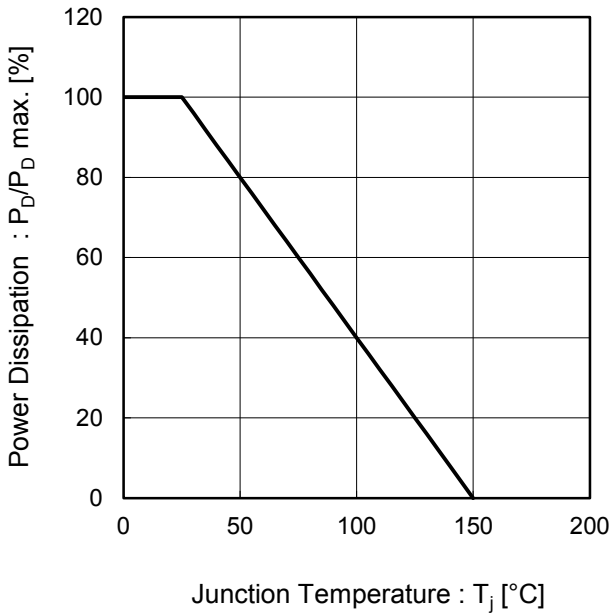


Fig.2 Maximum Safe Operating Area

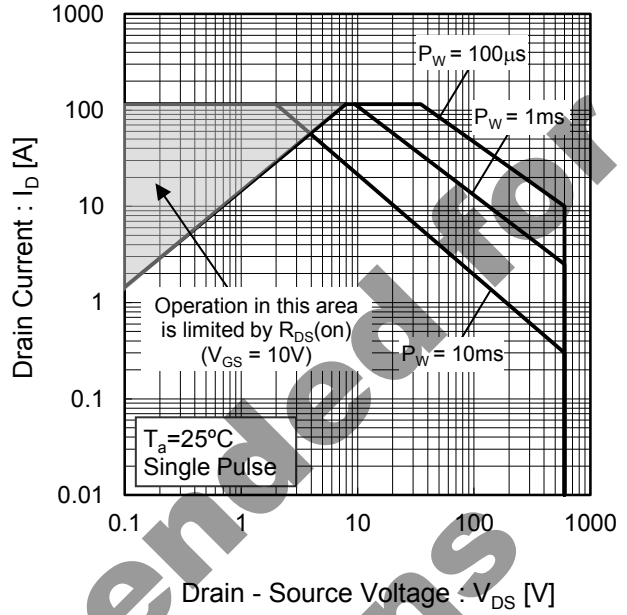
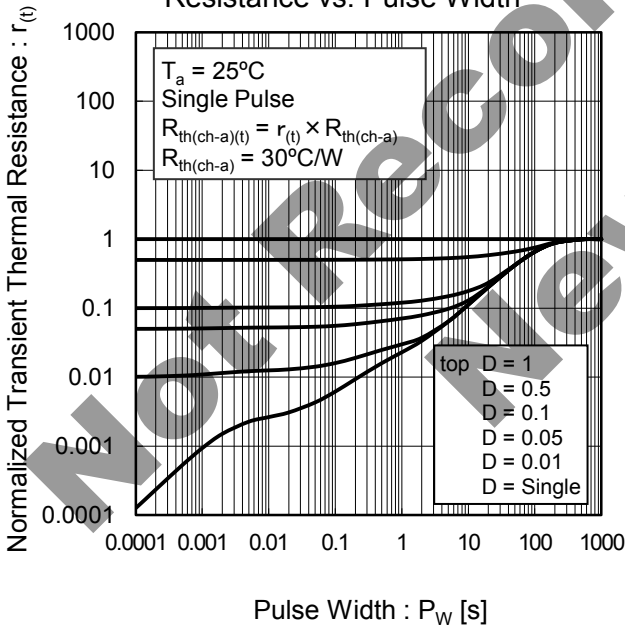


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



●Electrical characteristic curves

Fig.4 Avalanche Current vs Inductive Load

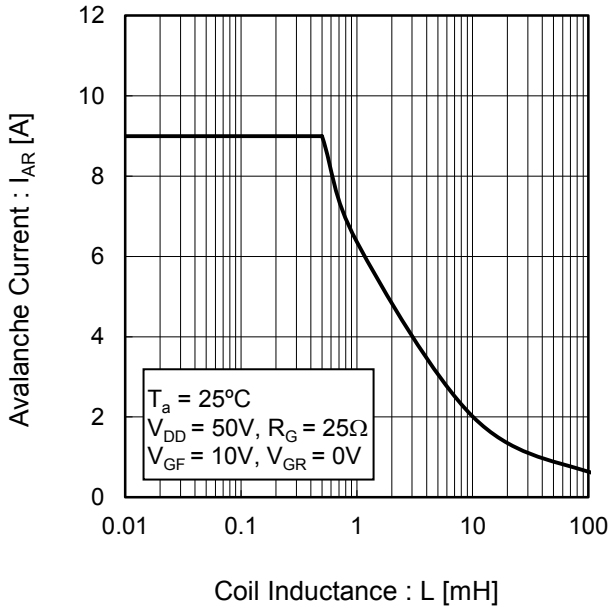


Fig.5 Avalanche Power Losses

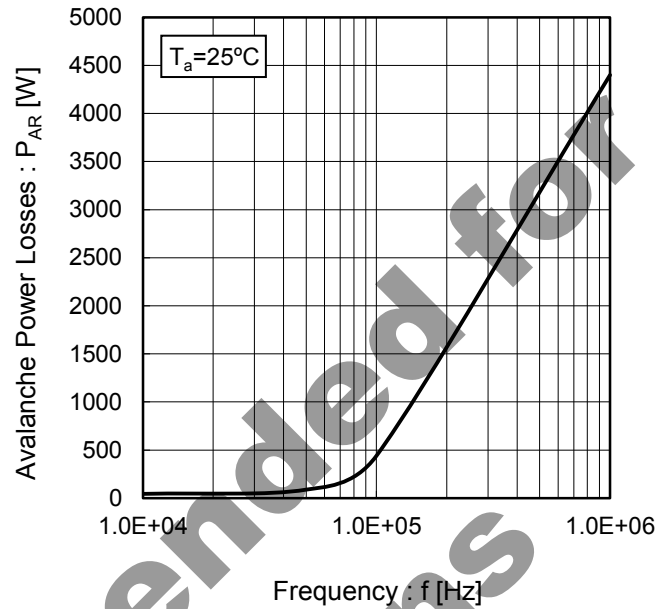
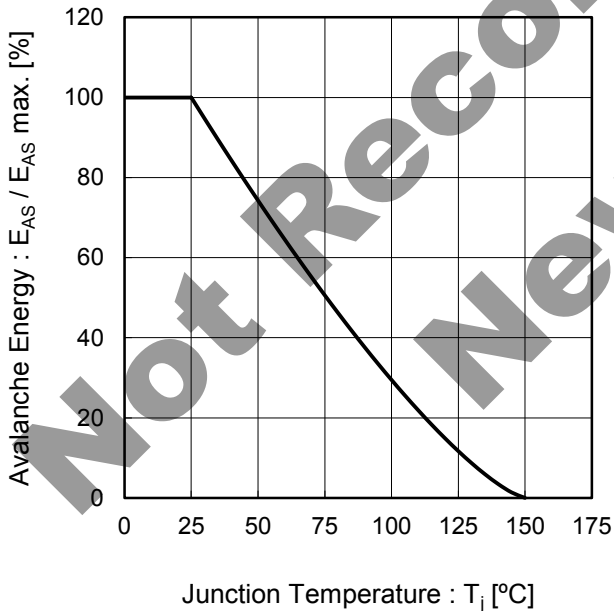


Fig.6 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

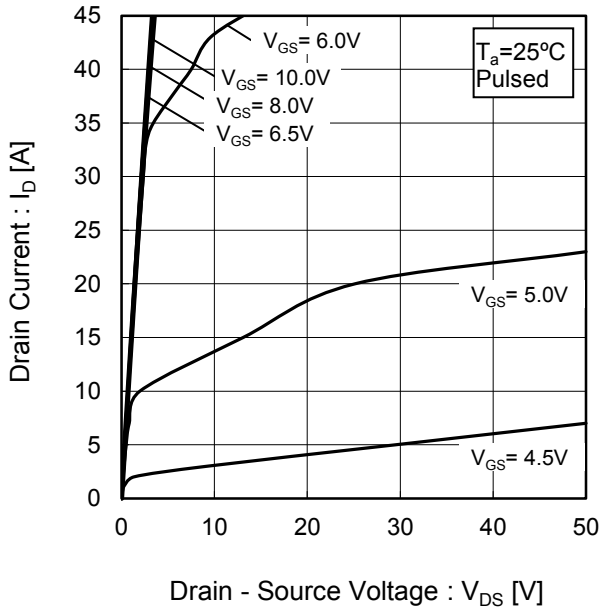


Fig.8 Typical Output Characteristics(II)

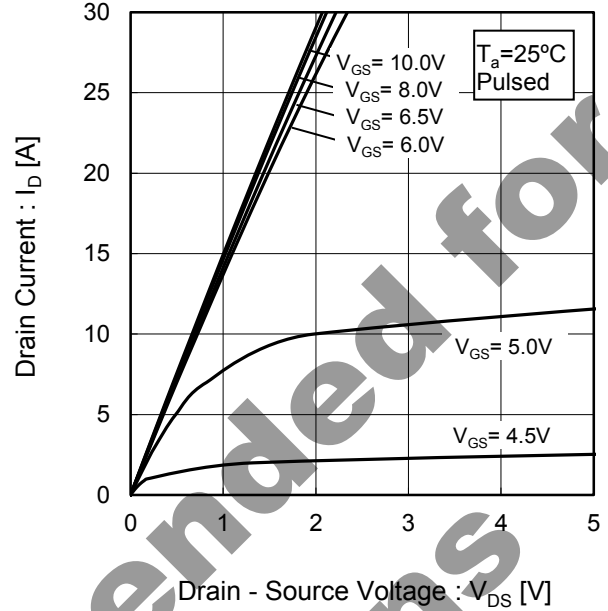


Fig.9  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(I)

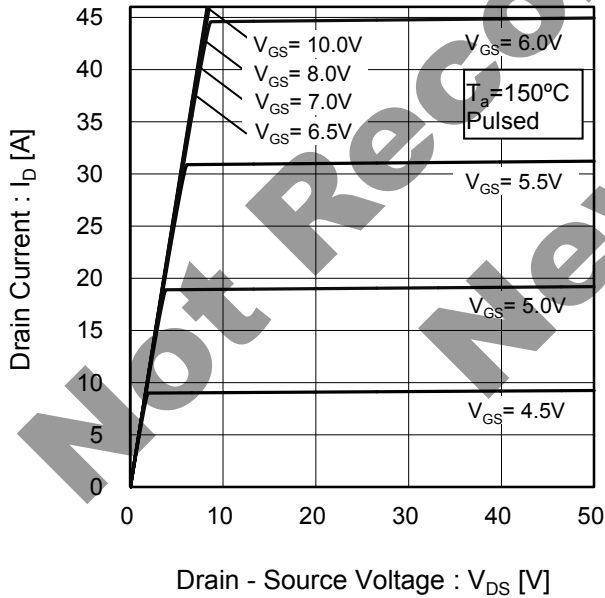
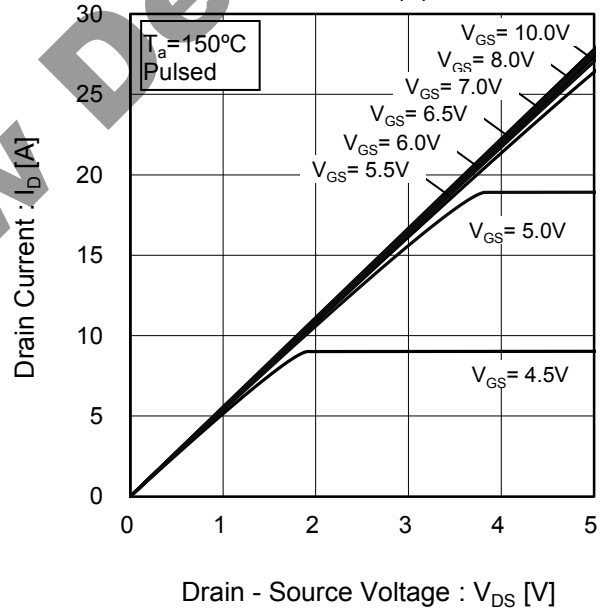


Fig.10  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

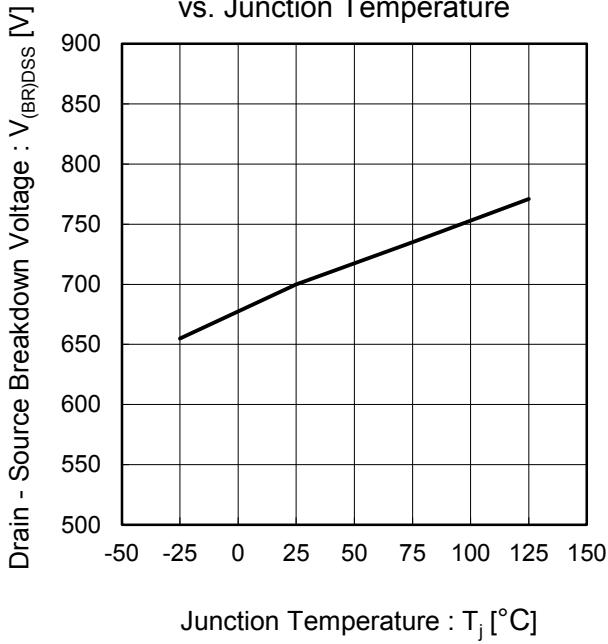


Fig.12 Typical Transfer Characteristics

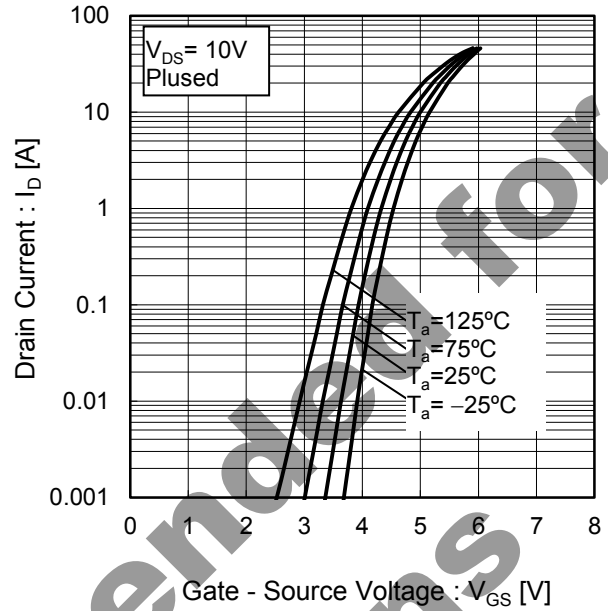


Fig.13 Gate Threshold Voltage vs. Junction Temperature

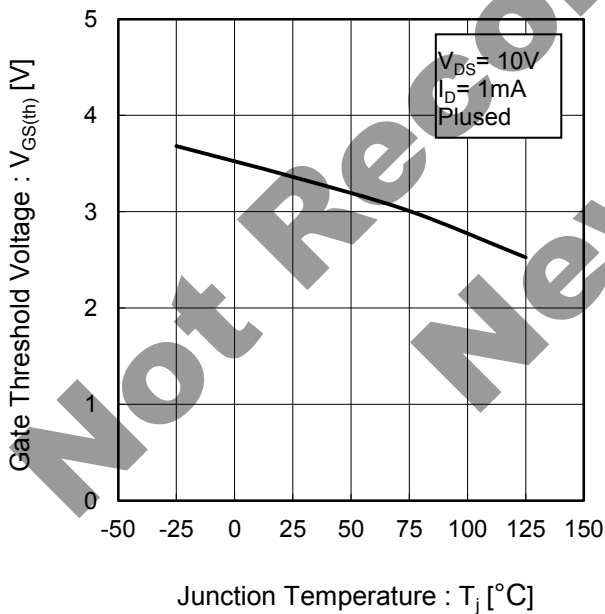
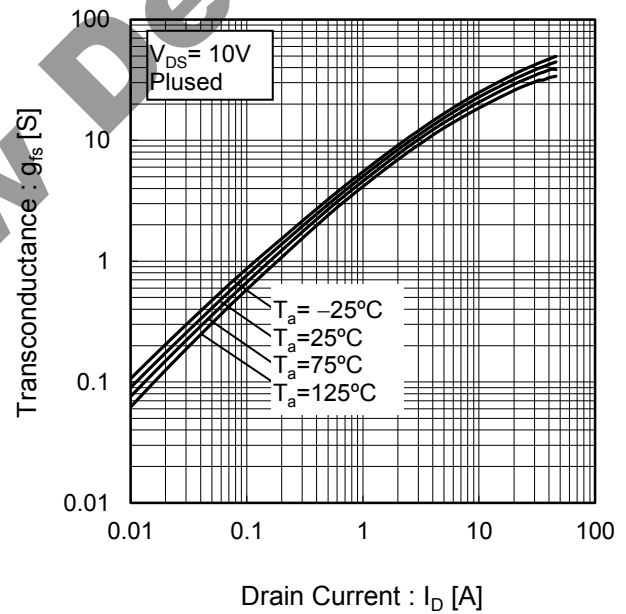


Fig.14 Transconductance vs. Drain Current





●Electrical characteristic curves

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

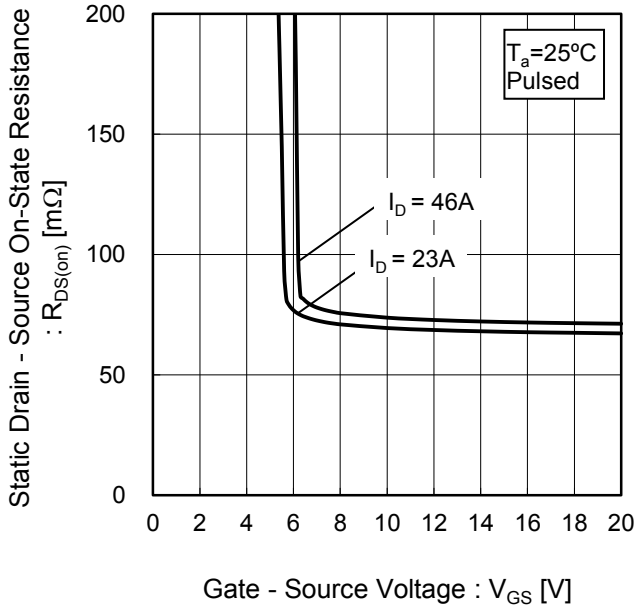


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

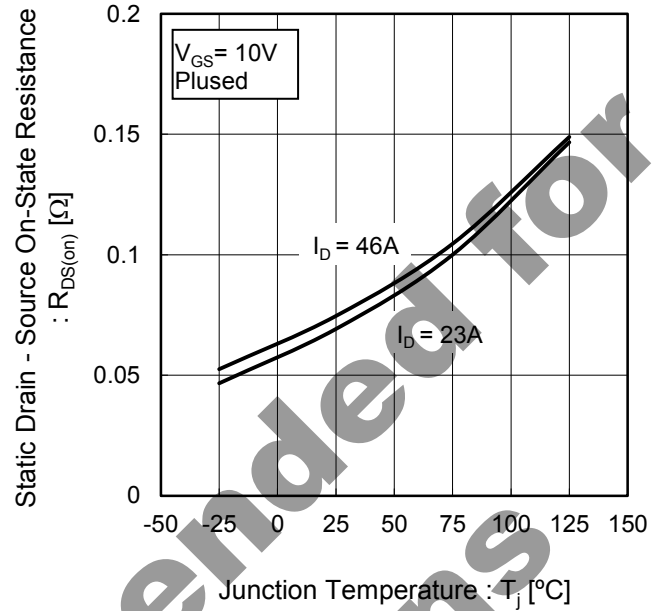
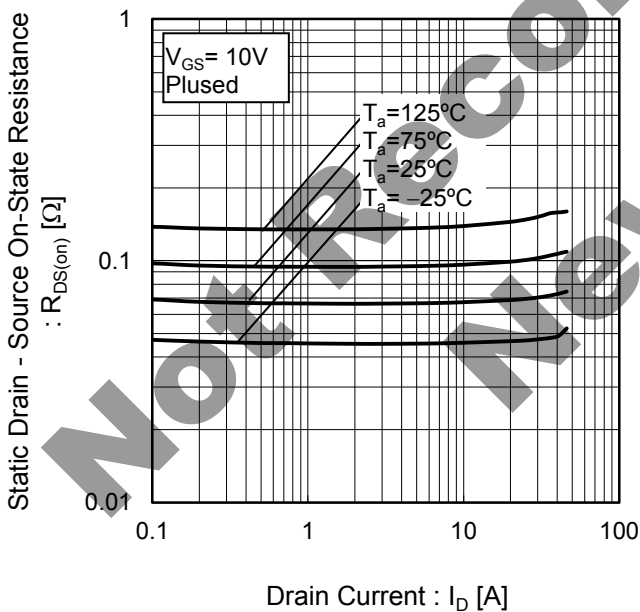


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

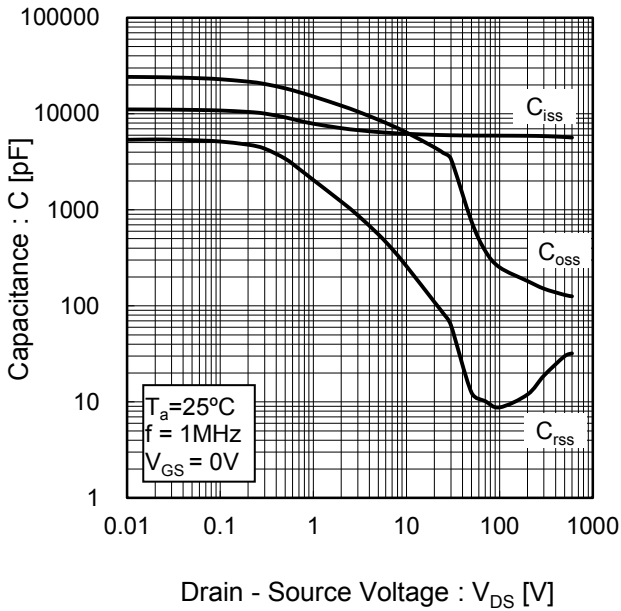


Fig.19 Coss Stored Energy

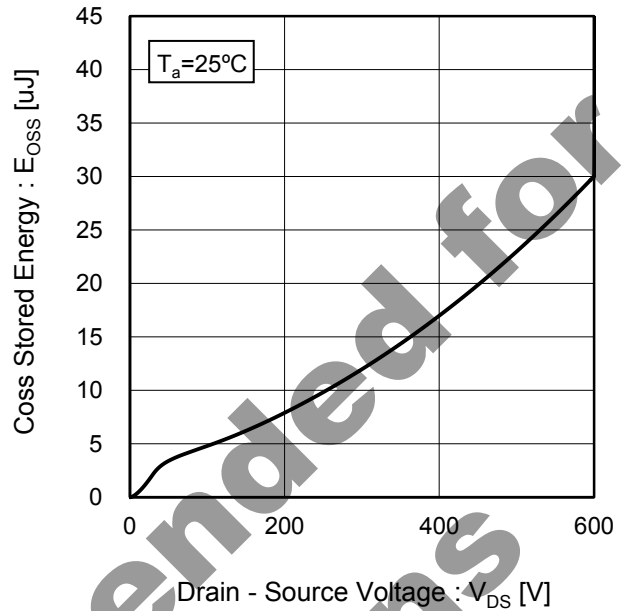


Fig.20 Switching Characteristics

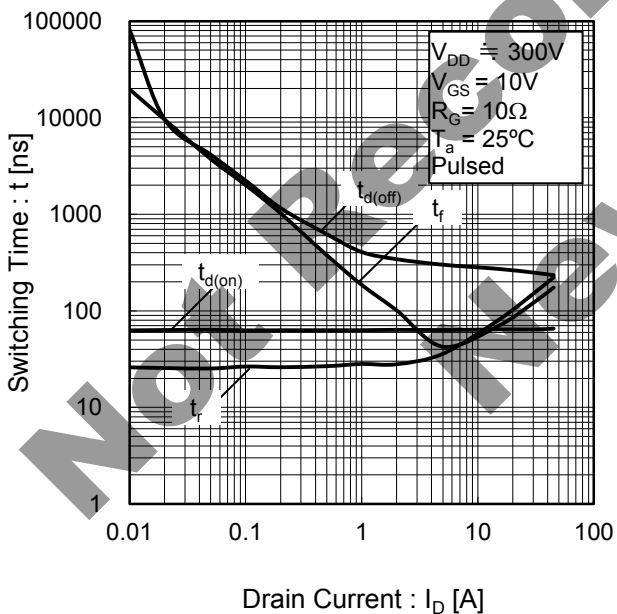
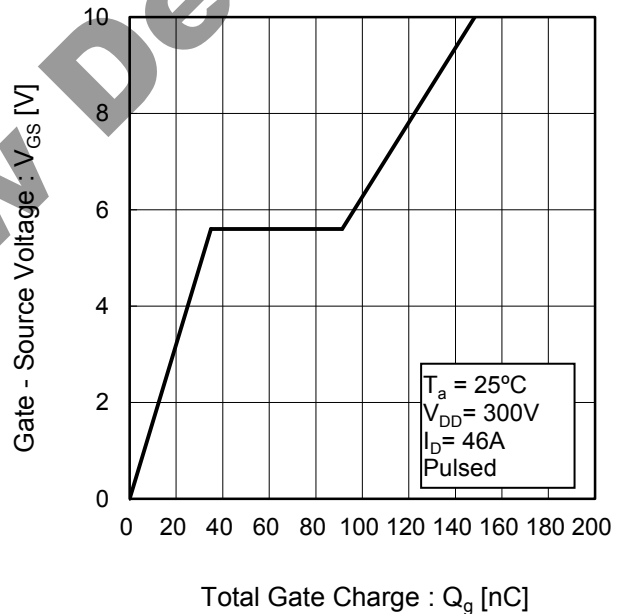


Fig.21 Dynamic Input Characteristics



●Electrical characteristic curves

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

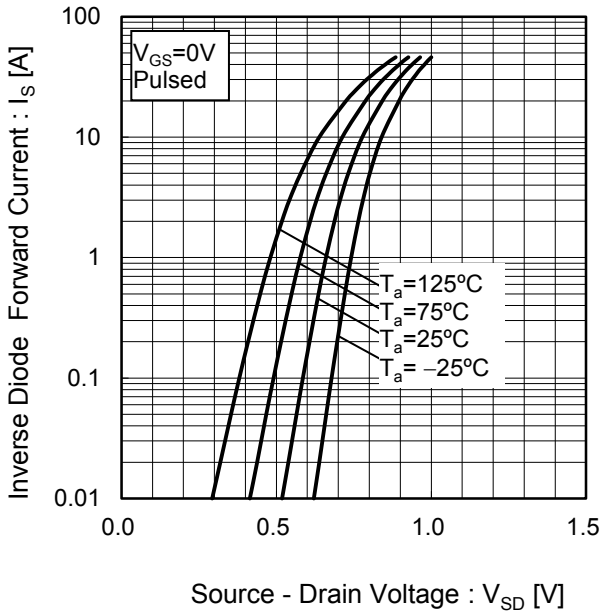
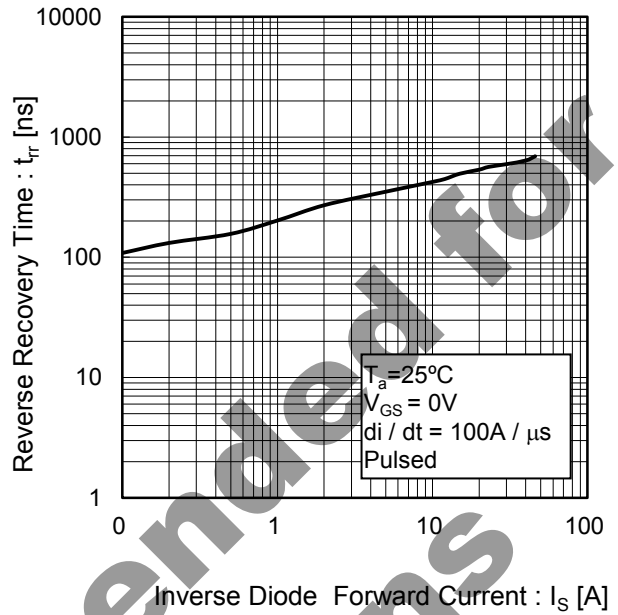


Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



Not Recommended for New Designs

● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

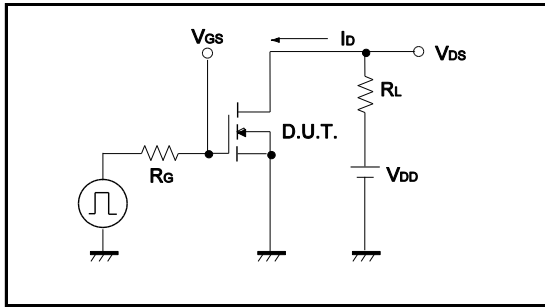


Fig.1-2 Switching Waveforms

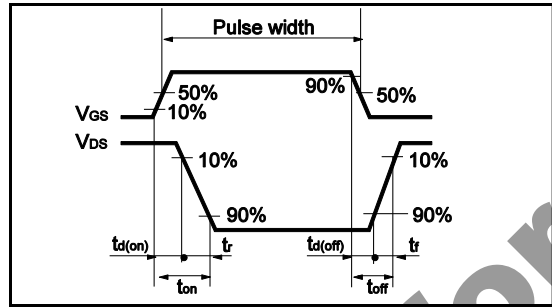


Fig.2-1 Gate Charge Measurement Circuit

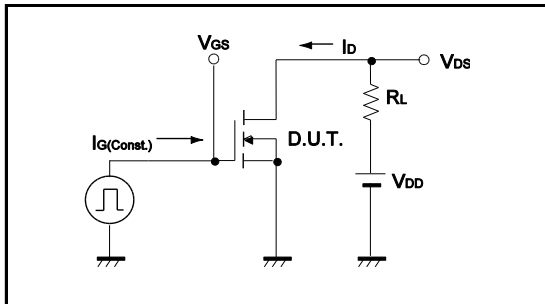


Fig.2-2 Gate Charge Waveform

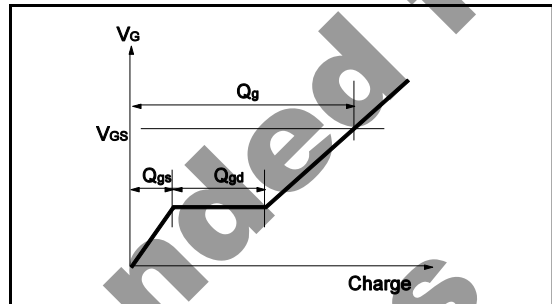


Fig.3-1 Avalanche Measurement Circuit

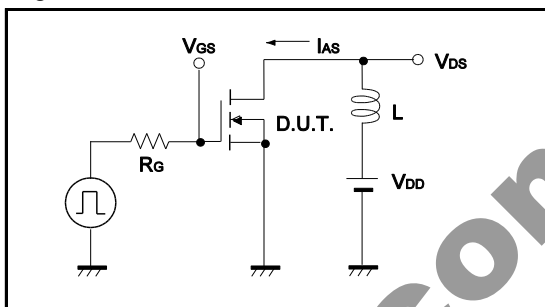


Fig.3-2 Avalanche Waveform

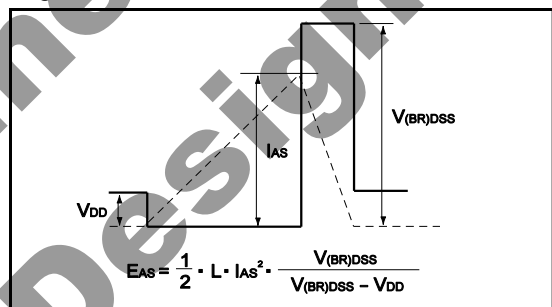


Fig.4-1 dv/dt Measurement Circuit

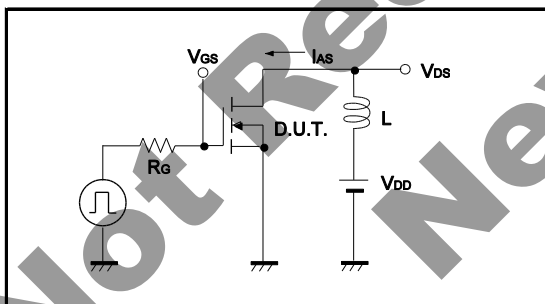


Fig.4-2 dv/dt Waveform

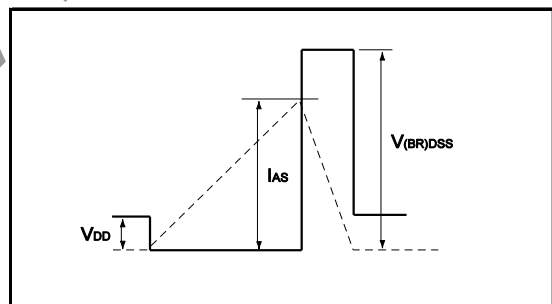


Fig.5-1 di/dt Measurement Circuit

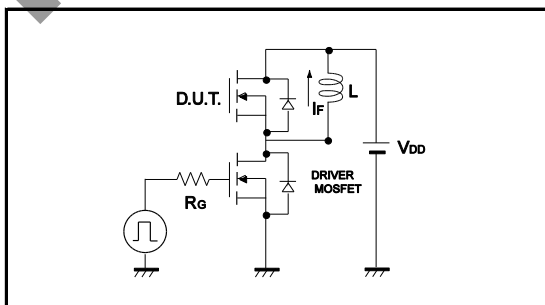
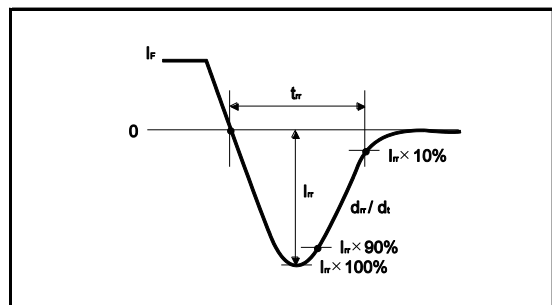
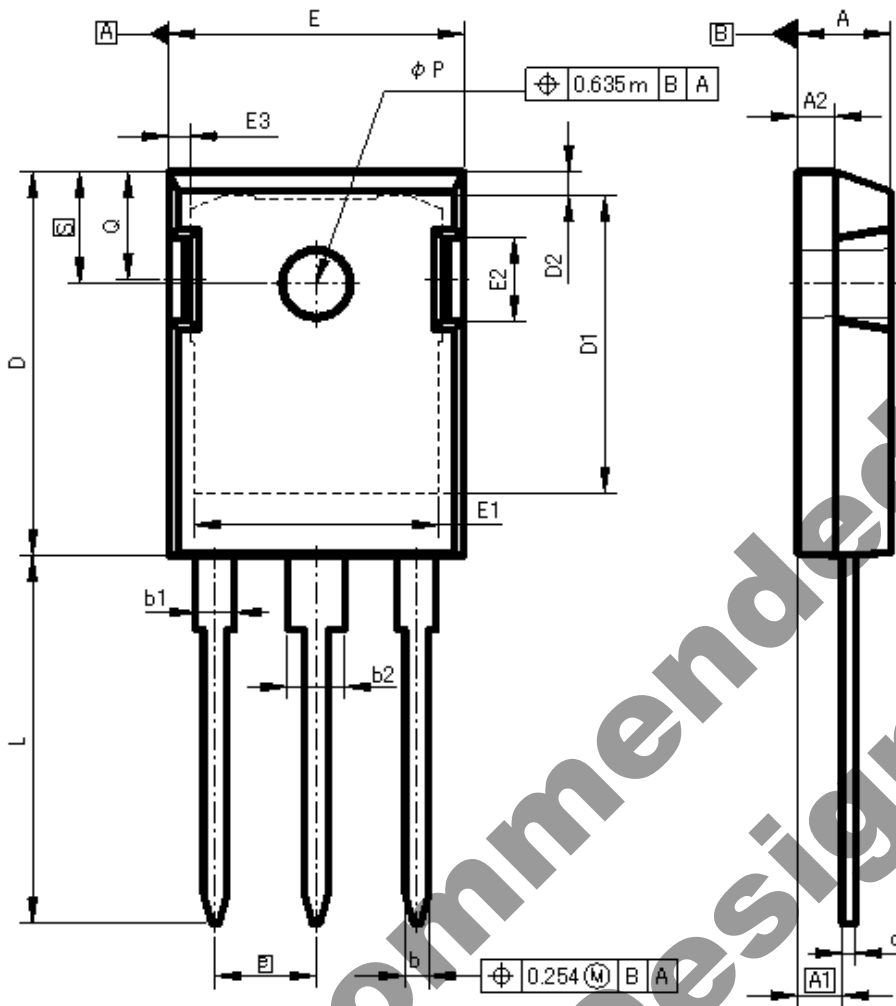


Fig.5-2 di/dt Waveform



●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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