

Symbol	Tr1:Pch	Tr2:Nch
$V_{DSS}$	-30V	30V
$R_{DS(on)}(Max.)$	80mΩ	35mΩ
$I_D$	±5.5A	±7.0A
$P_D$	4.0W	

### ●特長

- 1) 低オン抵抗
- 2) 小型面実装パッケージで省スペース
- 3) 鉛フリー対応済み、RoHS準拠
- 4) ハロゲンフリー

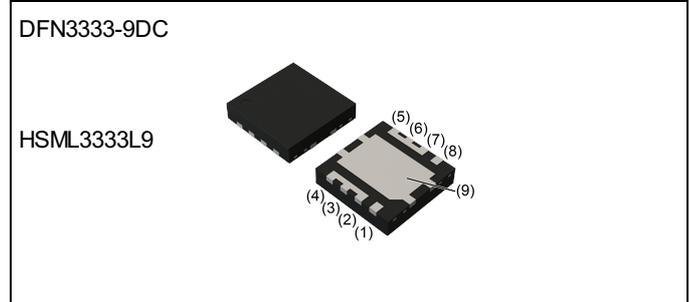
### ●用途

スイッチング  
モーター駆動用

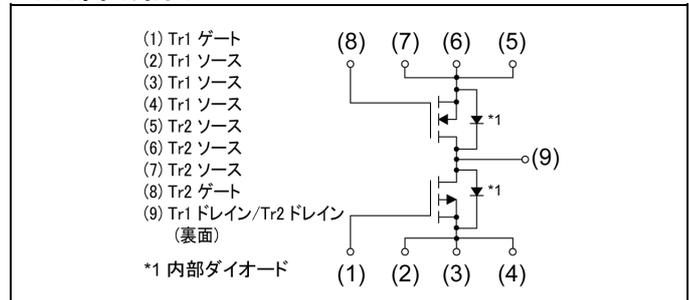
### ●絶対最大定格 ( $T_a = 25^\circ\text{C}$ 、特に指定のない限り)

Parameter	Symbol	Value		Unit
		Tr1:Pch	Tr2:Nch	
ドレイン・ソース間電圧	$V_{DSS}$	-30	30	V
ドレイン電流 (直流)	$I_D^{*1}$	±5.5	±7.0	A
ドレイン電流 (パルス)	$I_{DP}^{*2}$	±30	±30	A
ゲート・ソース間電圧	$V_{GSS}$	±20	±20	V
全許容損失	トータル	$P_D^{*1}$	4.0	W
		$P_D^{*3}$	2.0	
ジャンクション温度	$T_j$	150		°C
保存温度	$T_{stg}$	-55 ~ +150		°C

### ●外形図



### ●内部回路図



### ●包装仕様

タイプ	包装形態	Embossed Tape
	リールサイズ (mm)	180
	テープ幅 (mm)	12
	包装数量 (個)	1000
	テーピングコード	TCR1
	標印	HS8MA2

## ●熱抵抗

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
熱抵抗 (ジャンクション・外気間)	$R_{thJA}^{*3}$	-	-	83.3	°C/W

●電気的特性 ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Type	Conditions	Values			Unit
				Min.	Typ.	Max.	
ドレイン・ソース降伏電圧	$V_{(BR)DSS}$	Tr1	$V_{GS} = 0V, I_D = -1mA$	-30	-	-	V
		Tr2	$V_{GS} = 0V, I_D = 1mA$	30	-	-	
ドレイン・ソース降伏電圧 温度係数	$\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$	Tr1	$I_D = -1mA$ , referenced to $25^\circ\text{C}$	-	-22	-	mV/°C
		Tr2	$I_D = 1mA$ , referenced to $25^\circ\text{C}$	-	21	-	
ドレイン遮断電流	$I_{DSS}$	Tr1	$V_{DS} = -30V, V_{GS} = 0V$	-	-	-1	μA
		Tr2	$V_{DS} = 30V, V_{GS} = 0V$	-	-	1	
ゲート漏れ電流	$I_{GSS}$	Tr1	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	±100	nA
		Tr2	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	±100	
ゲートしきい値電圧	$V_{GS(th)}$	Tr1	$V_{DS} = -10V, I_D = -1mA$	-1.0	-	-2.5	V
		Tr2	$V_{DS} = 10V, I_D = 1mA$	1.0	-	2.5	
ゲートしきい値電圧 温度係数	$\frac{\Delta V_{GS(th)}}{\Delta T_j}$	Tr1	$I_D = -1mA$ , referenced to $25^\circ\text{C}$	-	2.9	-	mV/°C
		Tr2	$I_D = 1mA$ , referenced to $25^\circ\text{C}$	-	-3	-	
ドレイン・ソース間 オン抵抗	$R_{DS(on)}^{*4}$	Tr1	$V_{GS} = -10V, I_D = -5.5A$	-	55	80	mΩ
			$V_{GS} = -4.5V, I_D = -5.5A$	-	80	115	
		Tr2	$V_{GS} = 10V, I_D = 7.0A$	-	25	35	
			$V_{GS} = 4.5V, I_D = 7.0A$	-	40	56	
ゲート抵抗	$R_G$	Tr1	f=1MHz, open drain	-	10	-	Ω
		Tr2		-	3	-	
順伝達アドミタンス	$ Y_{fs} ^{*4}$	Tr1	$V_{DS} = -5V, I_D = -3A$	1.9	-	-	S
		Tr2	$V_{DS} = 5V, I_D = 4.5A$	1.4	-	-	

\*1  $P_w \leq 1s$ , ジャンクション温度が $150^\circ\text{C}$ を超えることのない放熱条件でご使用下さい。

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

\*3 セラミック基板実装時 (30×30×0.8mm)

\*4 パルス

●電気的特性 ( $T_a = 25^\circ\text{C}$ )

## &lt;Tr1&gt;

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
入力容量	$C_{iss}$	$V_{GS} = 0V$	-	320	-	pF
出力容量	$C_{oss}$	$V_{DS} = -10V$	-	68	-	
帰還容量	$C_{riss}$	$f = 1\text{MHz}$	-	54	-	
ターンオン遅延時間	$t_{d(on)}^{*4}$	$V_{DD} \approx -15V, V_{GS} = -10V$	-	7.9	-	ns
上昇時間	$t_r^{*4}$	$I_D = -1.5A$	-	16.8	-	
ターンオフ遅延時間	$t_{d(off)}^{*4}$	$R_L = 10\Omega$	-	27.6	-	
下降時間	$t_f^{*4}$	$R_G = 10\Omega$	-	8.5	-	

## &lt;Tr2&gt;

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
入力容量	$C_{iss}$	$V_{GS} = 0V$	-	365	-	pF
出力容量	$C_{oss}$	$V_{DS} = 10V$	-	62	-	
帰還容量	$C_{riss}$	$f = 1\text{MHz}$	-	50	-	
ターンオン遅延時間	$t_{d(on)}^{*4}$	$V_{DD} \approx 15V, V_{GS} = 10V$	-	7.2	-	ns
上昇時間	$t_r^{*4}$	$I_D = 2.2A$	-	8.0	-	
ターンオフ遅延時間	$t_{d(off)}^{*4}$	$R_L = 6.8\Omega$	-	12.0	-	
下降時間	$t_f^{*4}$	$R_G = 10\Omega$	-	5.7	-	

●ゲート電荷量特性 ( $T_a = 25^\circ\text{C}$ )

&lt;Tr1&gt;

Parameter	Symbol	Conditions	Values			Unit	
			Min.	Typ.	Max.		
ゲート総電荷量	$Q_g^{*4}$	$V_{DD} \approx -15\text{V}$ $I_D = -3\text{A}$	$V_{GS} = -10\text{V}$	-	7.8	-	nC
ゲート・ソース間電荷量	$Q_{gs}^{*4}$		$V_{GS} = -4.5\text{V}$	-	4.3	-	
ゲート・ドレイン間電荷量	$Q_{gd}^{*4}$			-	1.6	-	

&lt;Tr2&gt;

Parameter	Symbol	Conditions	Values			Unit	
			Min.	Typ.	Max.		
ゲート総電荷量	$Q_g^{*4}$	$V_{DD} \approx 15\text{V}$ $I_D = 4.5\text{A}$	$V_{GS} = 10\text{V}$	-	8.4	-	nC
ゲート・ソース間電荷量	$Q_{gs}^{*4}$		$V_{GS} = 4.5\text{V}$	-	4.7	-	
ゲート・ドレイン間電荷量	$Q_{gd}^{*4}$			-	1.7	-	

●内部ダイオード特性 (ソース・ドレイン間) ( $T_a = 25^\circ\text{C}$ )

&lt;Tr1&gt;

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
ソース電流 (直流)	$I_S$	$T_a = 25^\circ\text{C}$	-	-	-1.0	A
ソース電流 (パルス)	$I_{SP}^{*2}$		-	-	-30	
順方向電圧	$V_{SD}^{*4}$	$V_{GS} = 0\text{V}, I_S = -1.0\text{A}$	-	-	-1.2	V

&lt;Tr2&gt;

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
ソース電流 (直流)	$I_S$	$T_a = 25^\circ\text{C}$	-	-	1.0	A
ソース電流 (パルス)	$I_{SP}^{*2}$		-	-	30	
順方向電圧	$V_{SD}^{*4}$	$V_{GS} = 0\text{V}, I_S = 1.0\text{A}$	-	-	1.2	V

●電氣的特性曲線 <Tr1>

Fig.1 Power Dissipation Derating Curve

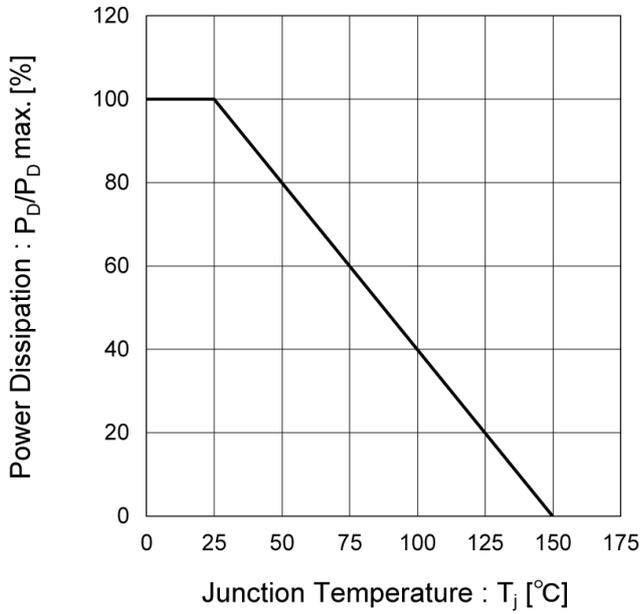


Fig.2 Maximum Safe Operating Area

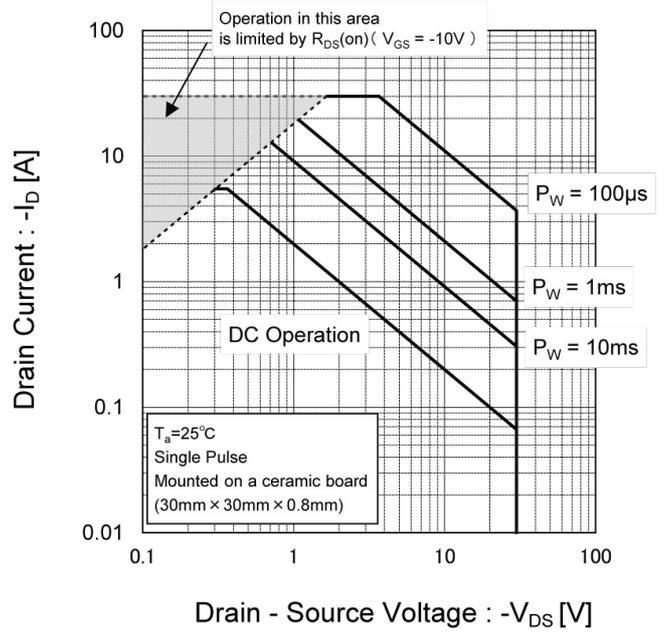


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

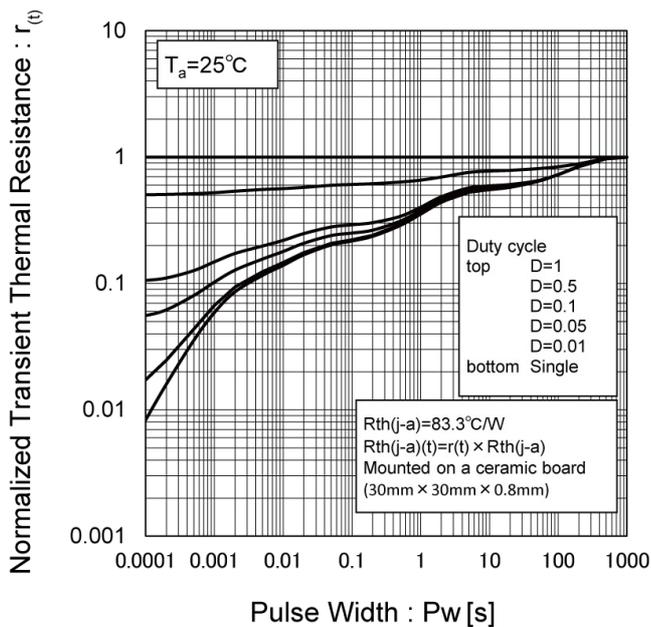
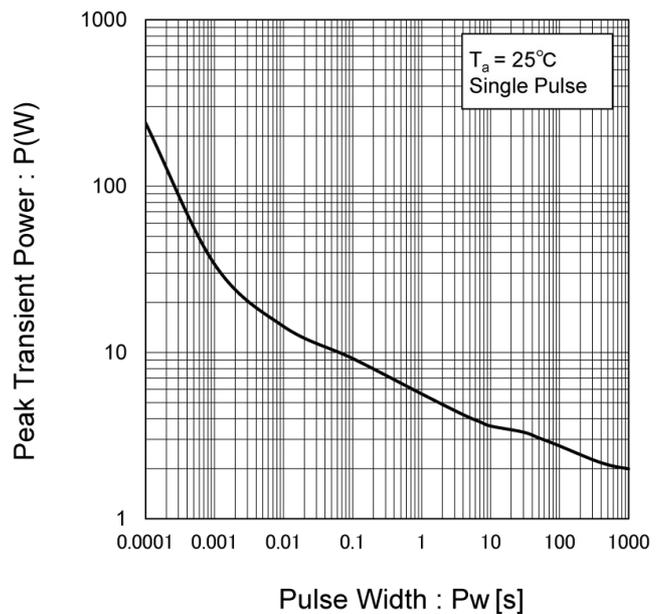


Fig.4 Single Pulse Maximum Power Dissipation



●電氣的特性曲線 <Tr1>

Fig.5 Typical Output Characteristics(I)

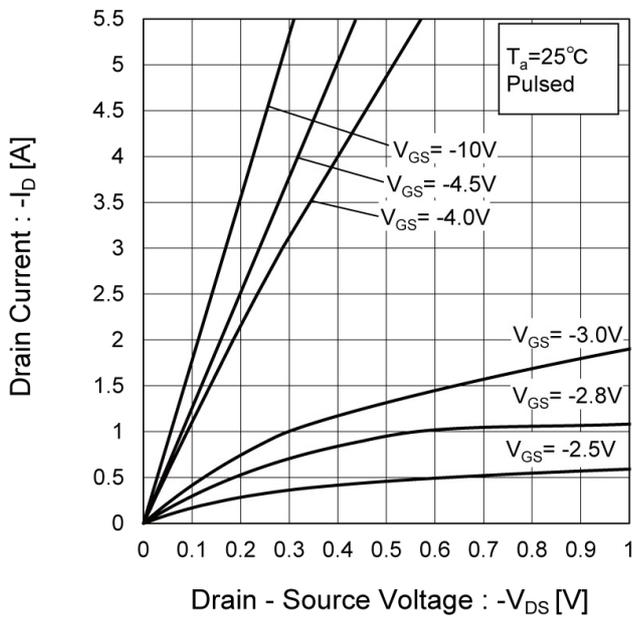


Fig.6 Typical Output Characteristics(II)

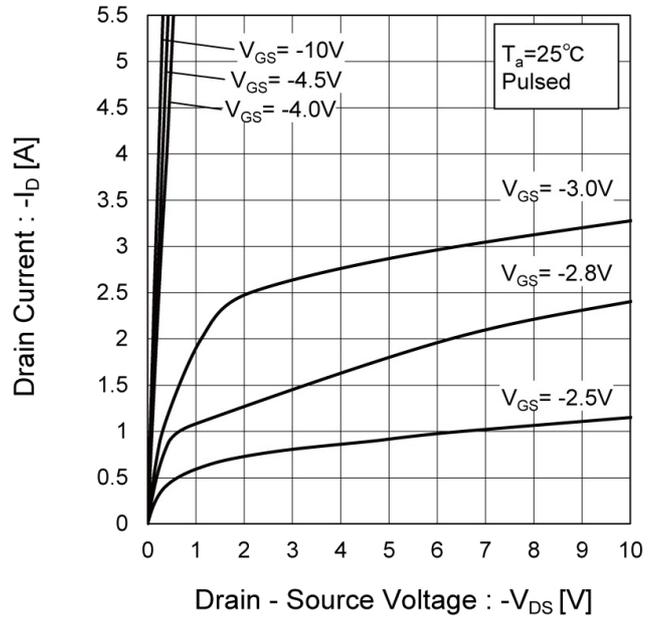
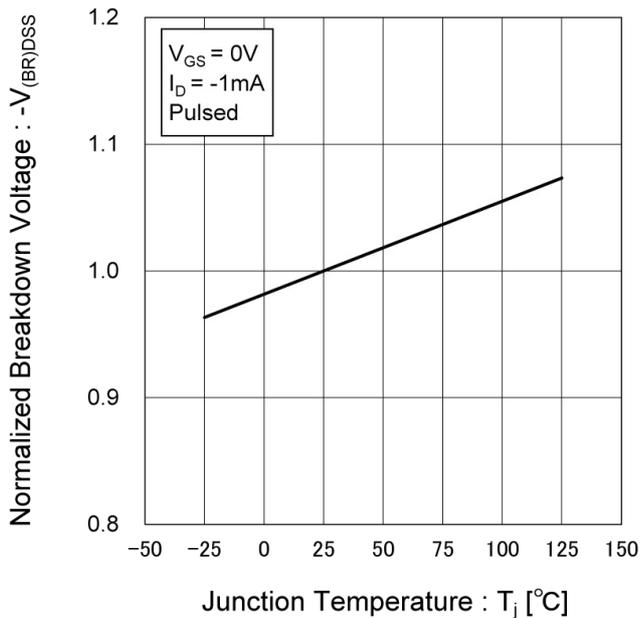


Fig.7 Breakdown Voltage vs. Junction Temperature



●電気的特性曲線 <Tr1>

Fig.8 Typical Transfer Characteristics

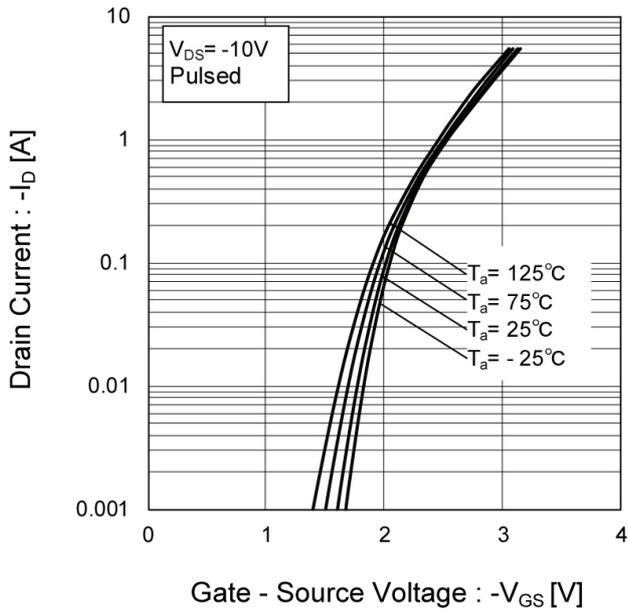


Fig.9 Gate Threshold Voltage vs. Junction Temperature

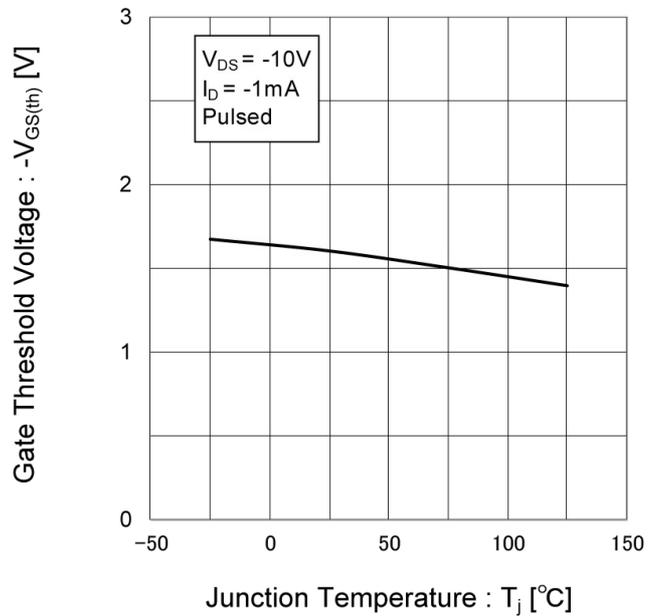
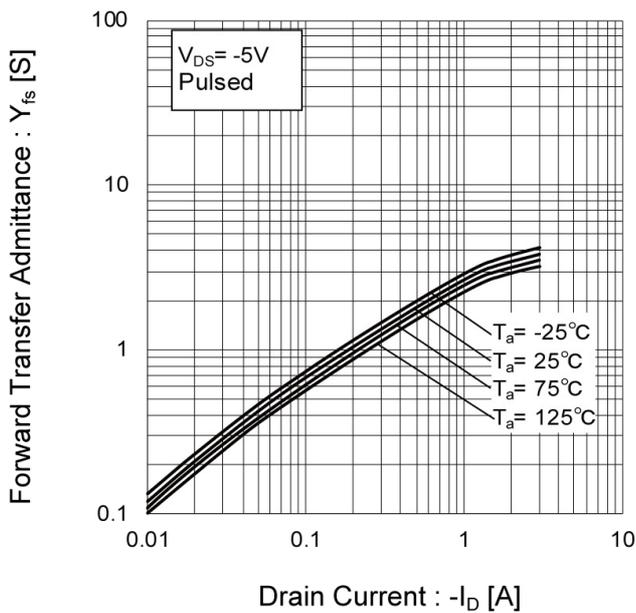


Fig.10 Forward Transfer Admittance vs. Drain Current



●電気的特性曲線 <Tr1>

Fig.11 Drain Current Derating Curve

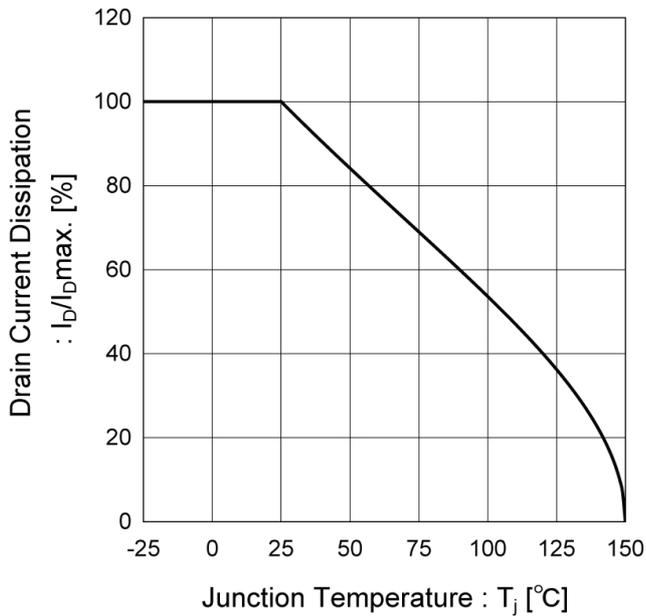


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

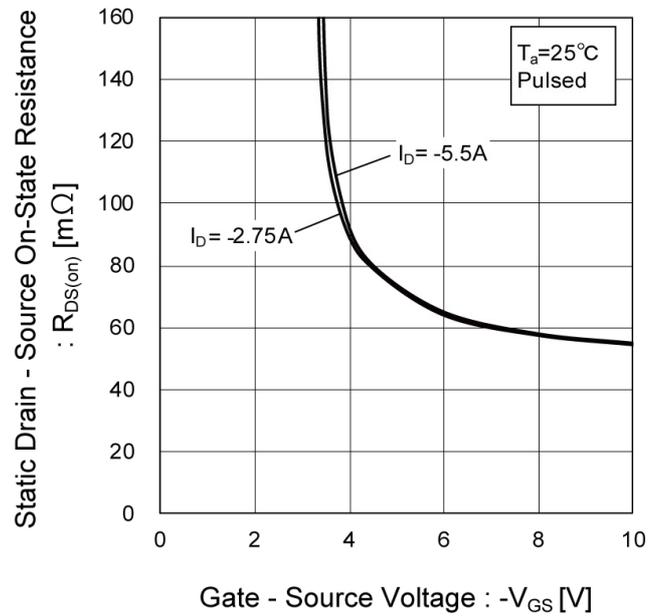
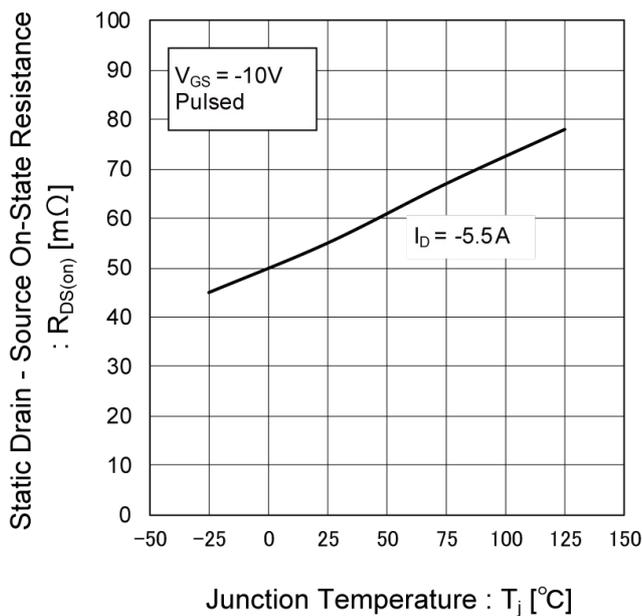


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature



●電氣的特性曲線 <Tr1>

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

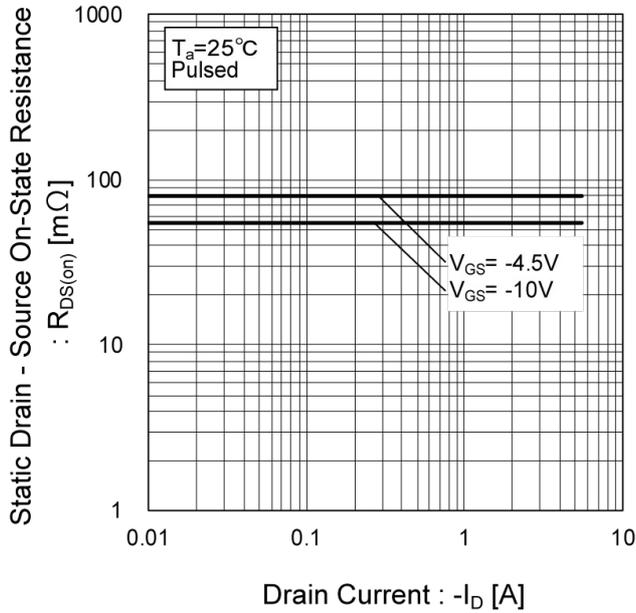


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current (II)

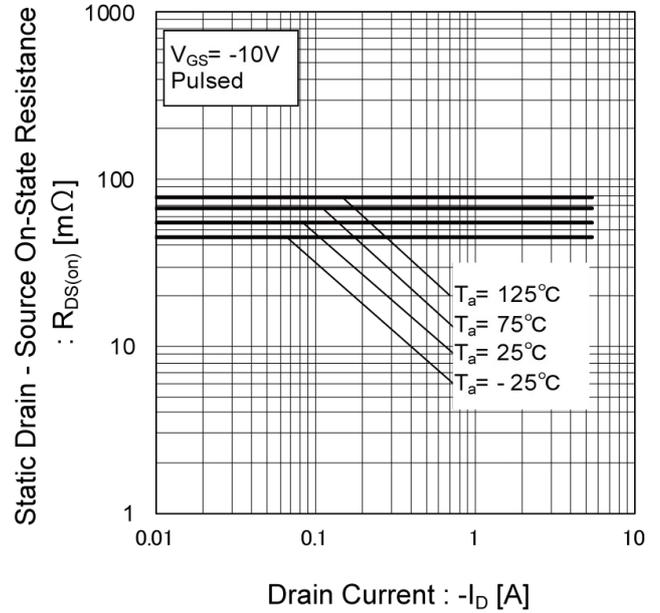
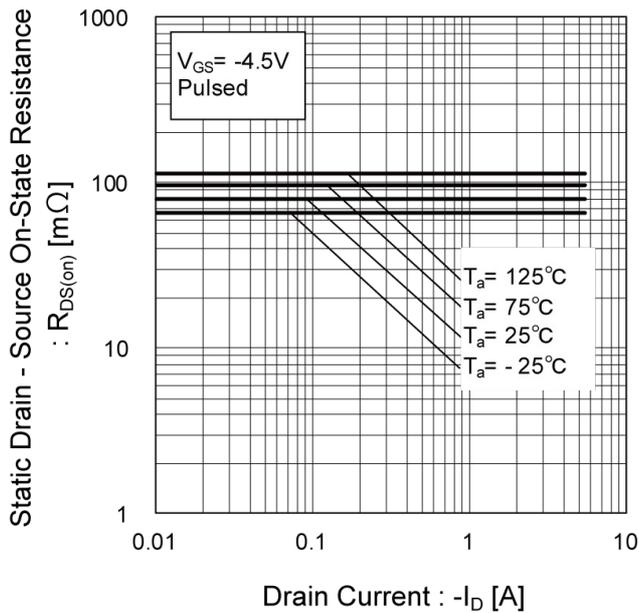


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current (III)



●電気的特性曲線 <Tr1>

Fig.17 Typical Capacitances vs. Drain - Source Voltage

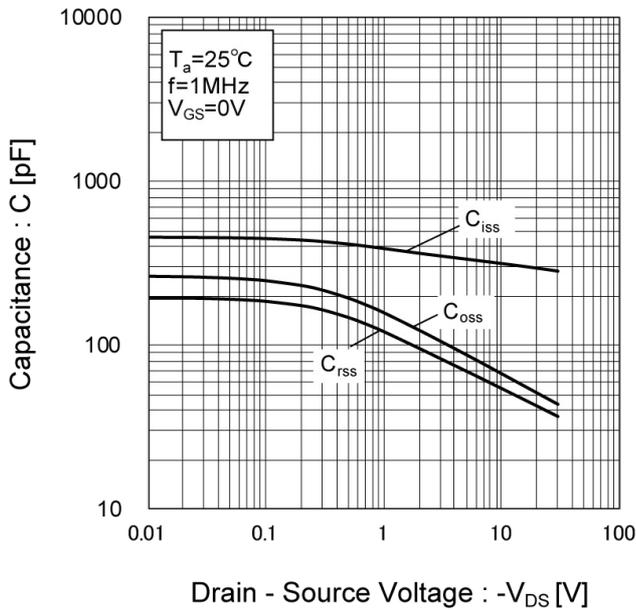


Fig.18 Switching Characteristics

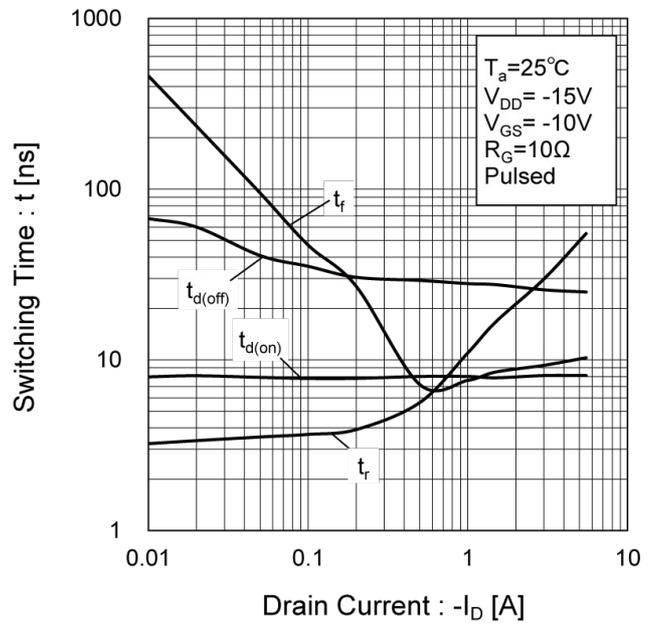


Fig.19 Typical Gate Charge

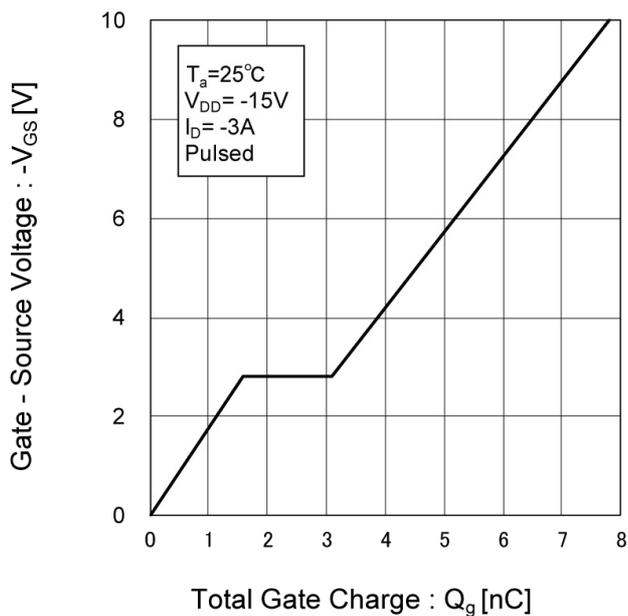
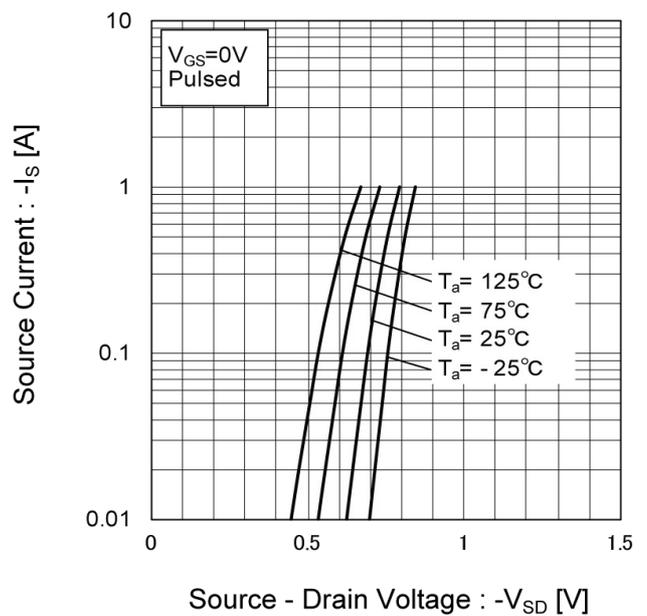


Fig.20 Source Current vs. Source Drain Voltage



●電氣的特性曲線 <Tr2>

Fig.1 Power Dissipation Derating Curve

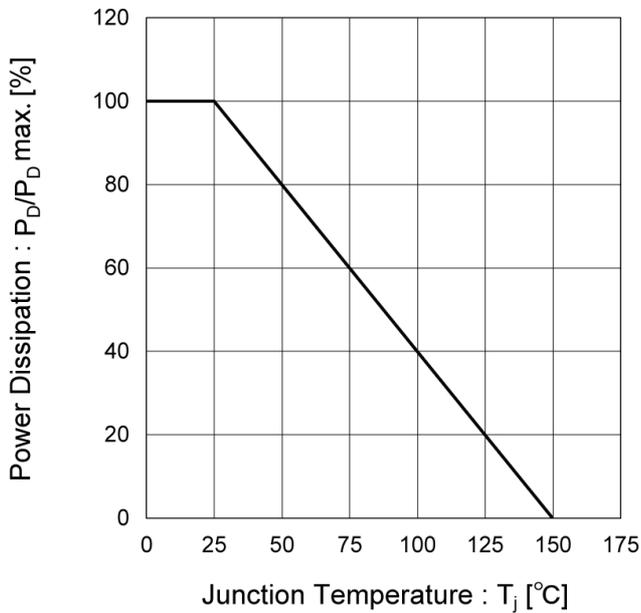


Fig.2 Maximum Safe Operating Area

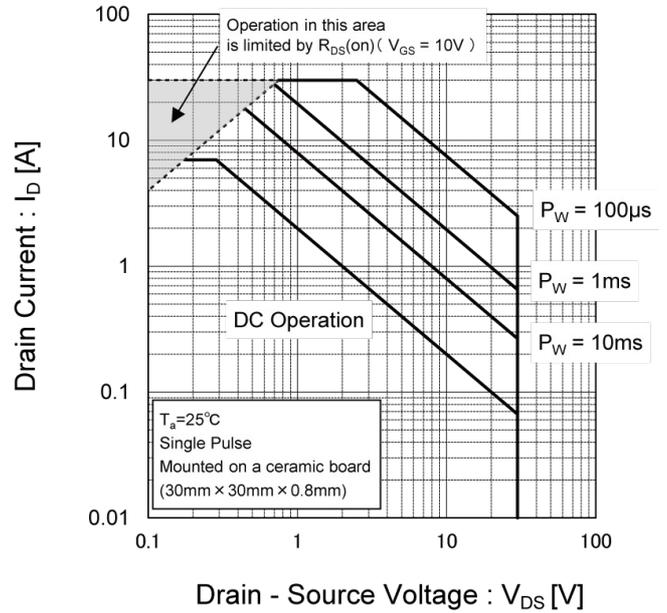


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

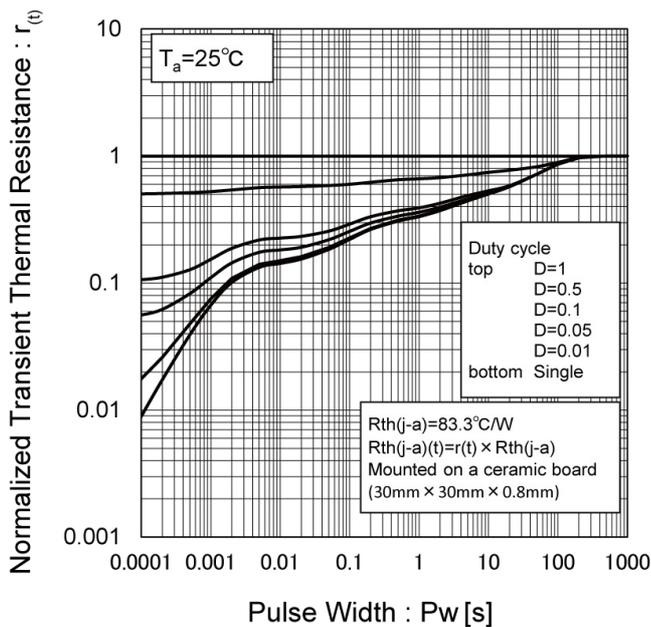
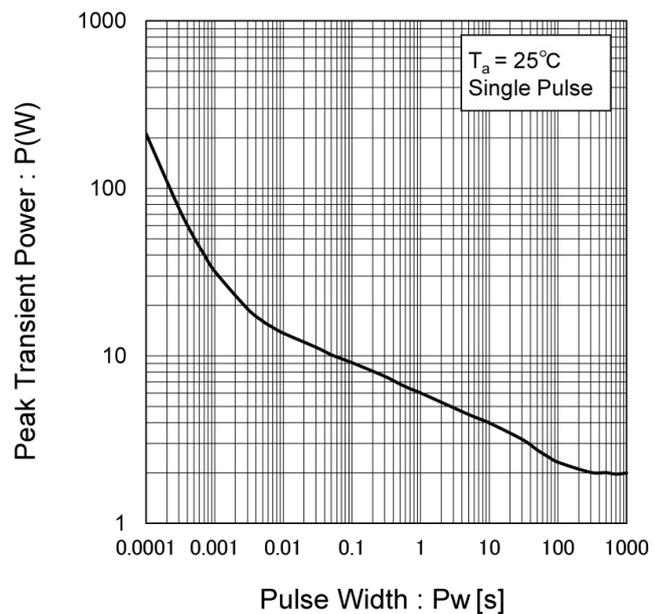


Fig.4 Single Pulse Maximum Power Dissipation



●電氣的特性曲線 <Tr2>

Fig.5 Typical Output Characteristics(I)

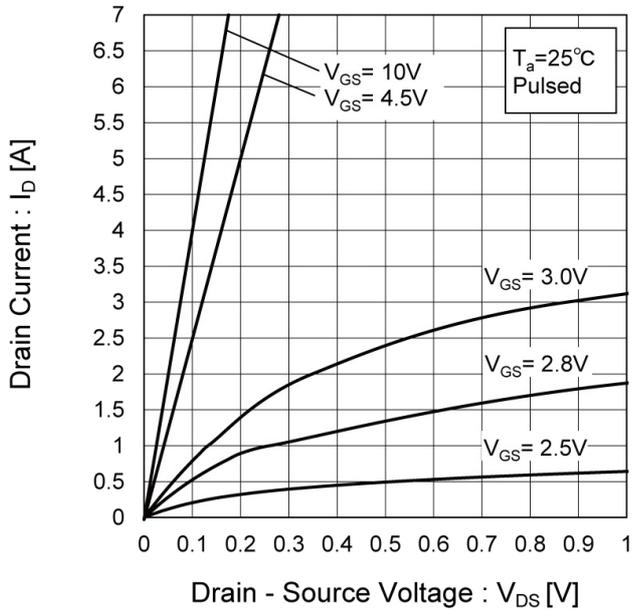


Fig.6 Typical Output Characteristics(II)

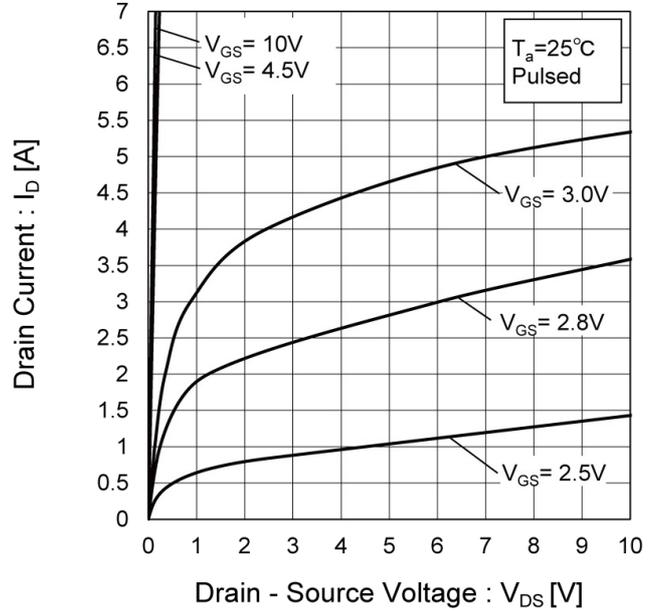
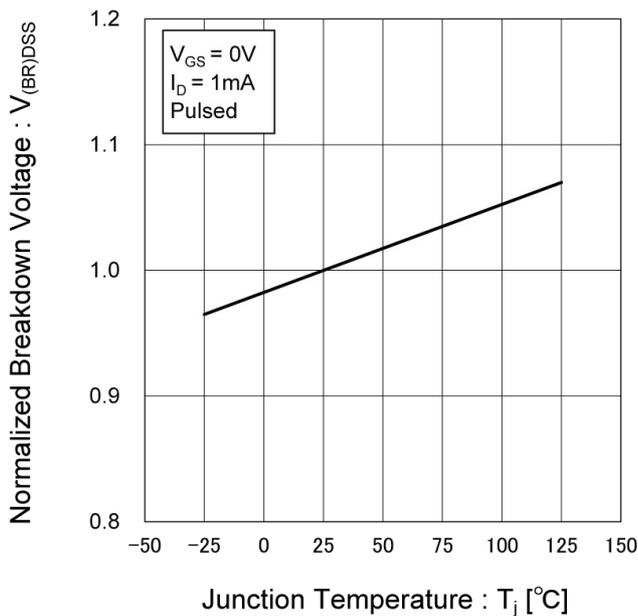


Fig.7 Breakdown Voltage vs. Junction Temperature



●電気的特性曲線 <Tr2>

Fig.8 Typical Transfer Characteristics

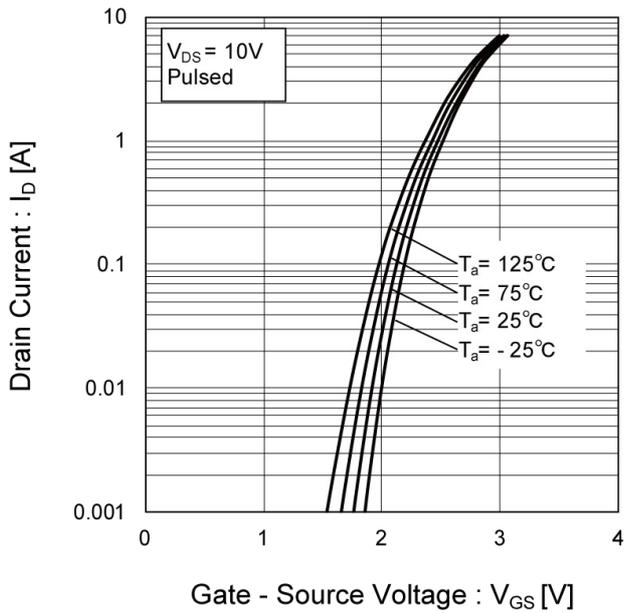


Fig.9 Gate Threshold Voltage vs. Junction Temperature

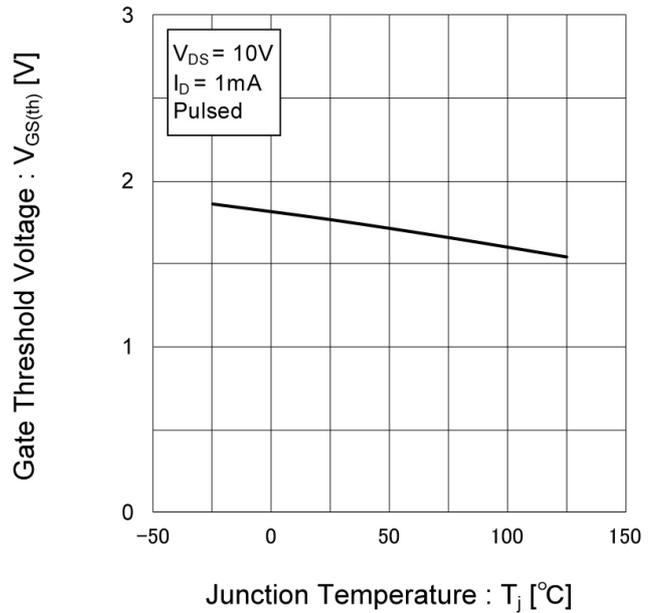
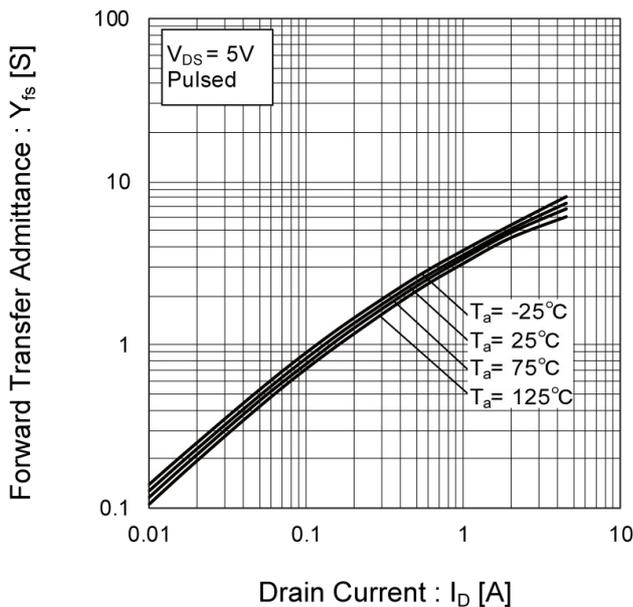


Fig.10 Forward Transfer Admittance vs. Drain Current



●電氣的特性曲線 <Tr2>

Fig.11 Drain Current Derating Curve

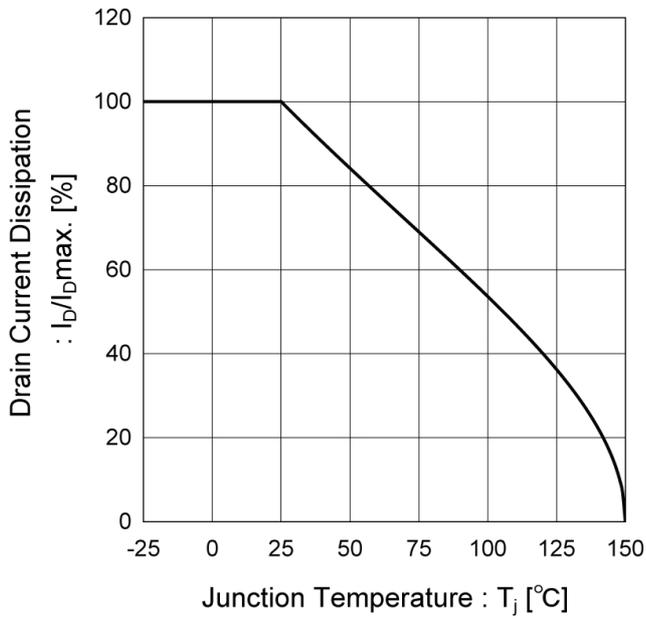


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

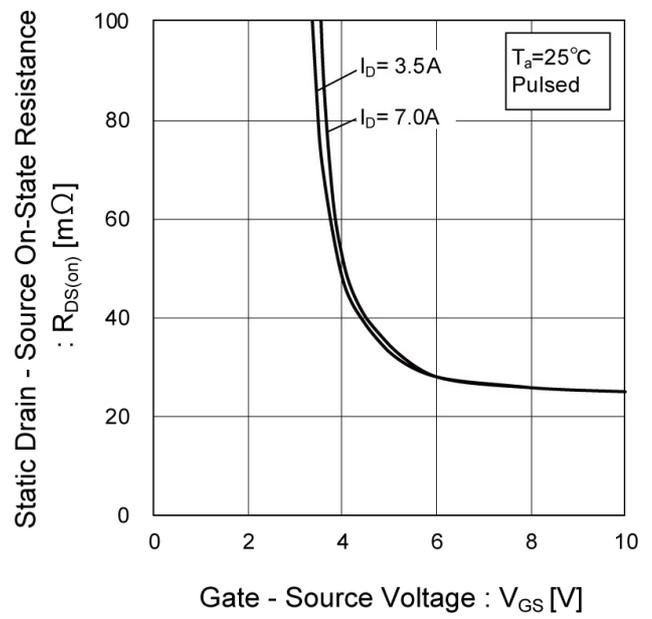
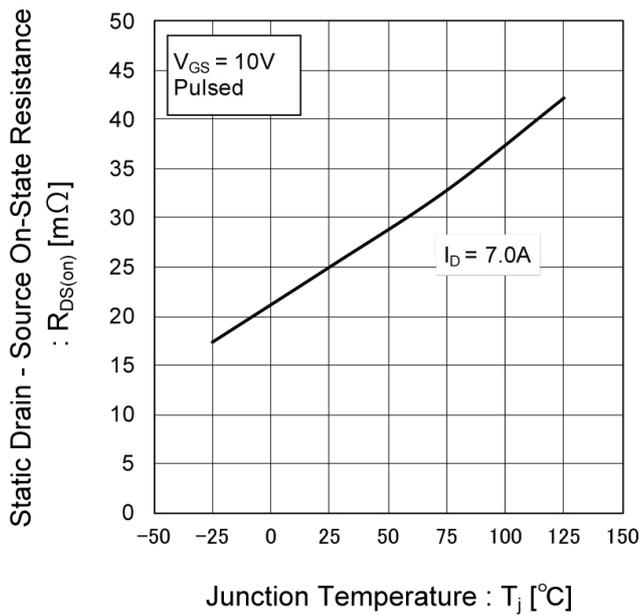


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature



●電氣的特性曲線 <Tr2>

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

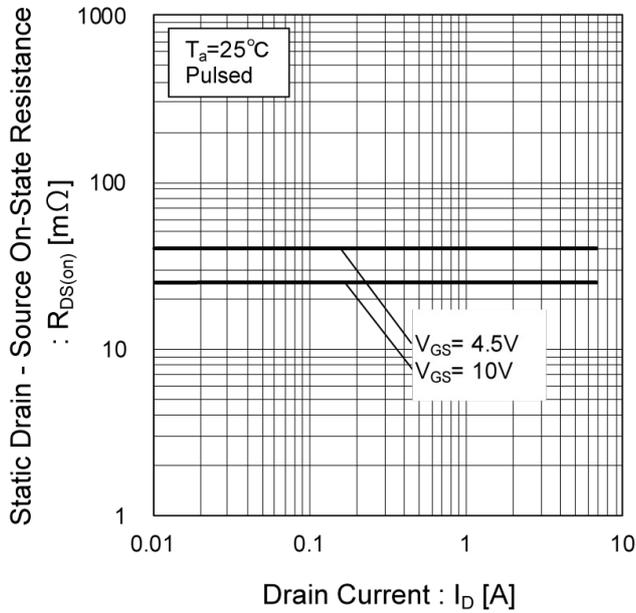


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current (II)

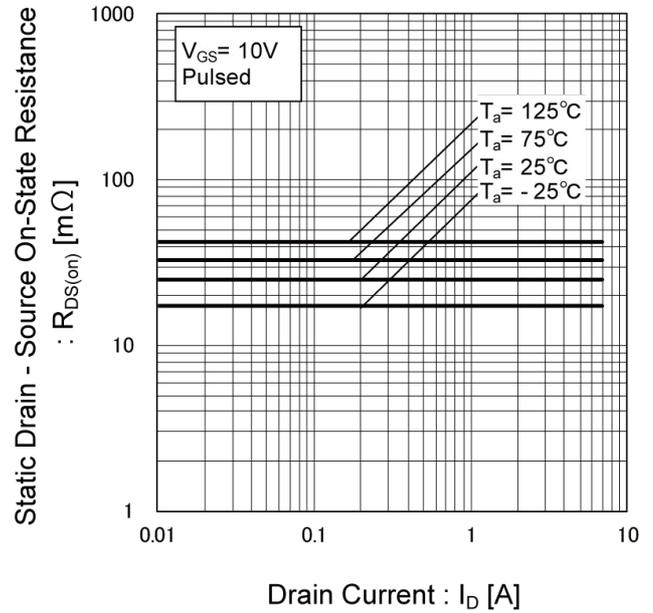
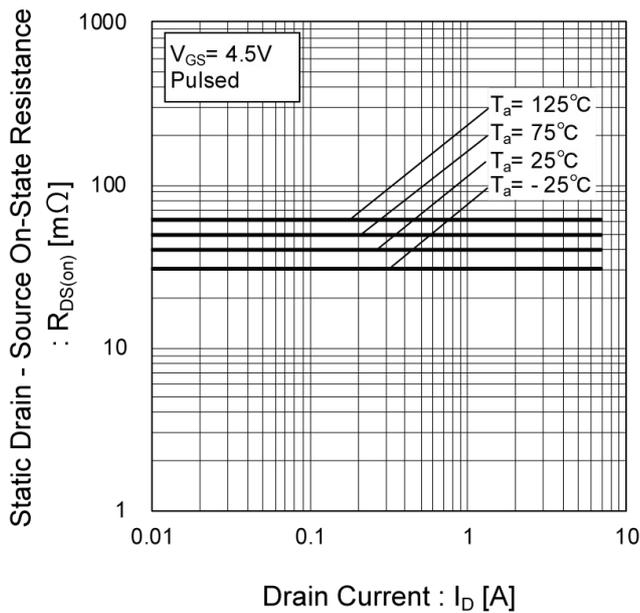


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current (III)



●電氣的特性曲線 <Tr2>

Fig.17 Typical Capacitances vs. Drain - Source Voltage

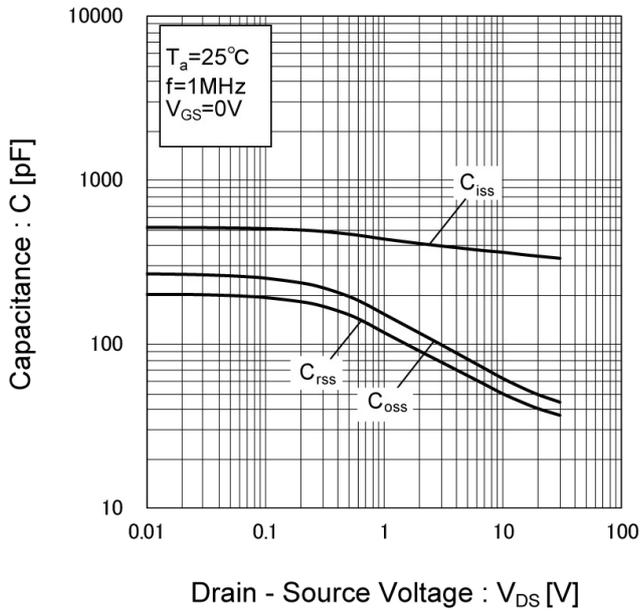


Fig.18 Switching Characteristics

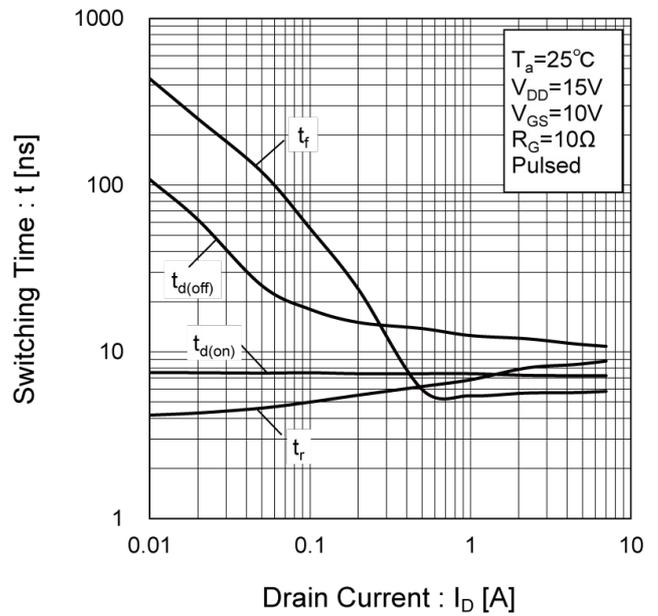


Fig.19 Typical Gate Charge

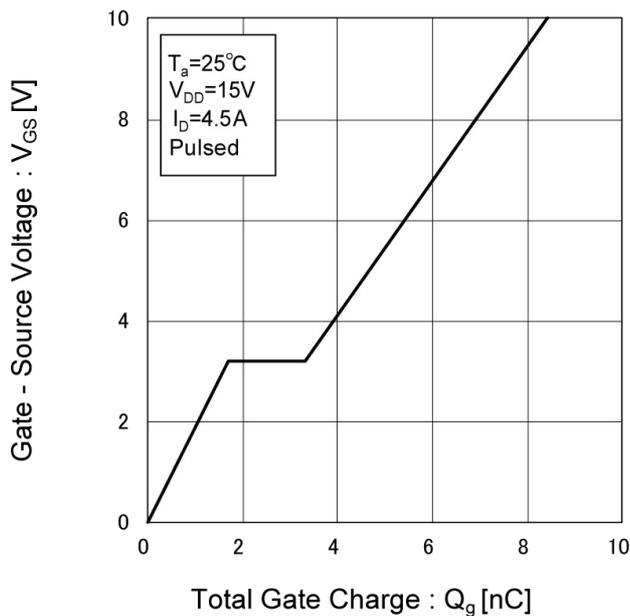
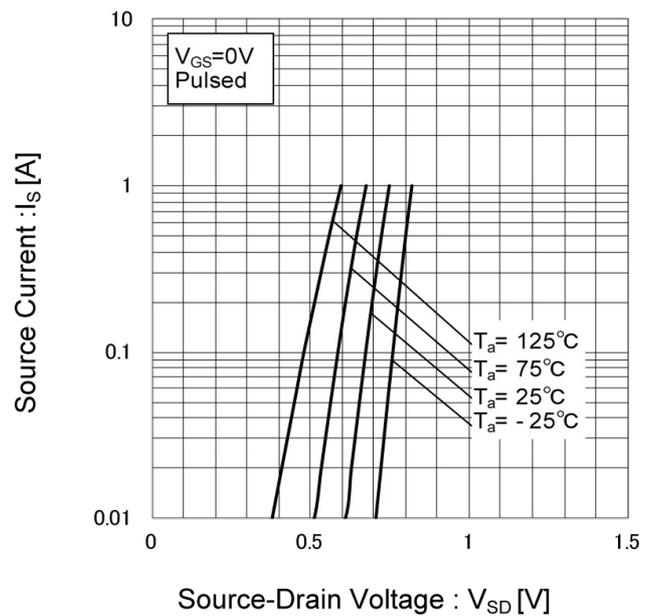


Fig.20 Source Current vs. Source Drain Voltage



●測定回路図 <Tr1>

図 1-1 スイッチング時間測定回路

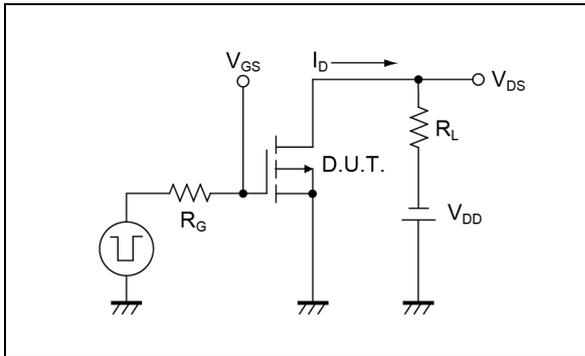


図 1-2 スイッチング波形

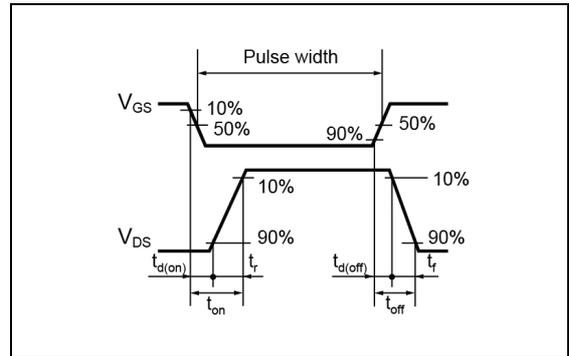


図 2-1 ゲート電荷量測定回路

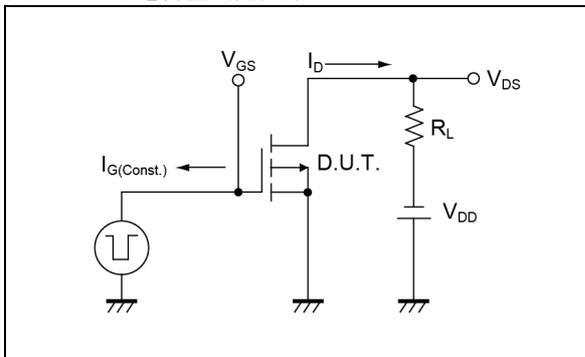
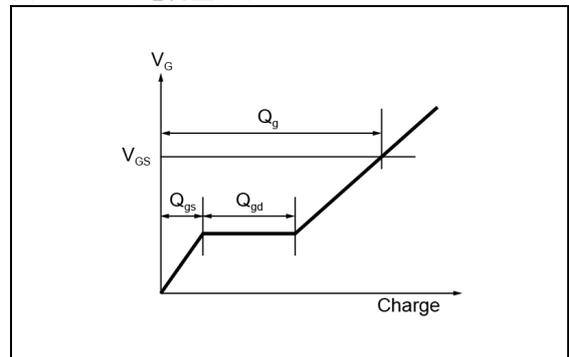


図 2-2 ゲート電荷量波形



●測定回路図 <Tr2>

図 3-1 スイッチング時間測定回路

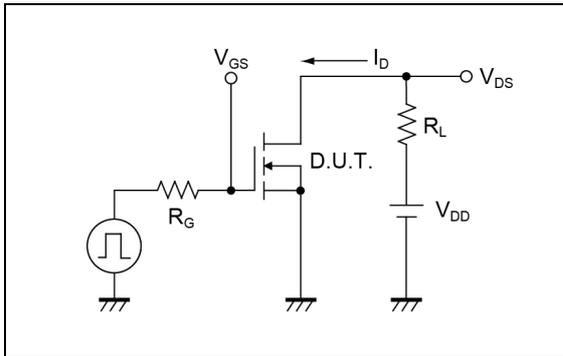


図 3-2 スイッチング波形

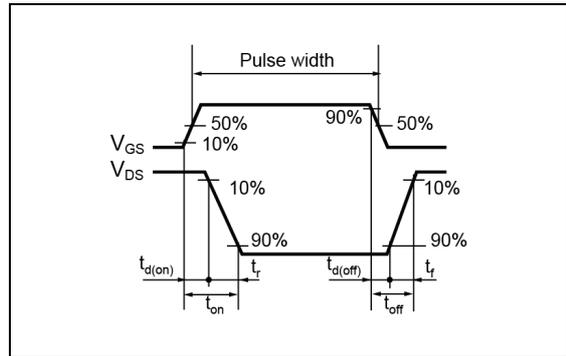


図 4-1 ゲート電荷量測定回路

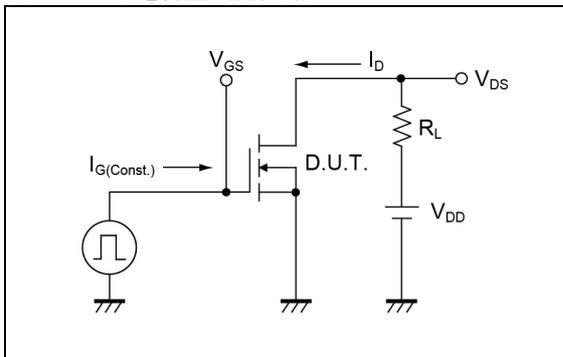
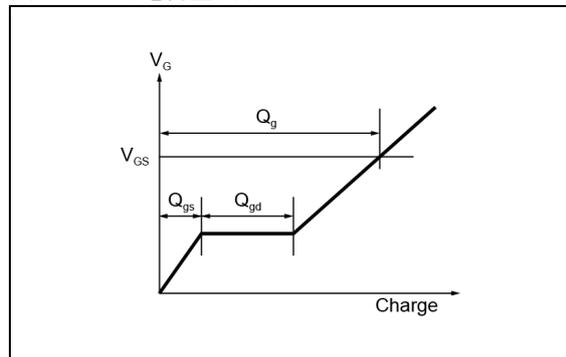


図 4-2 ゲート電荷量波形



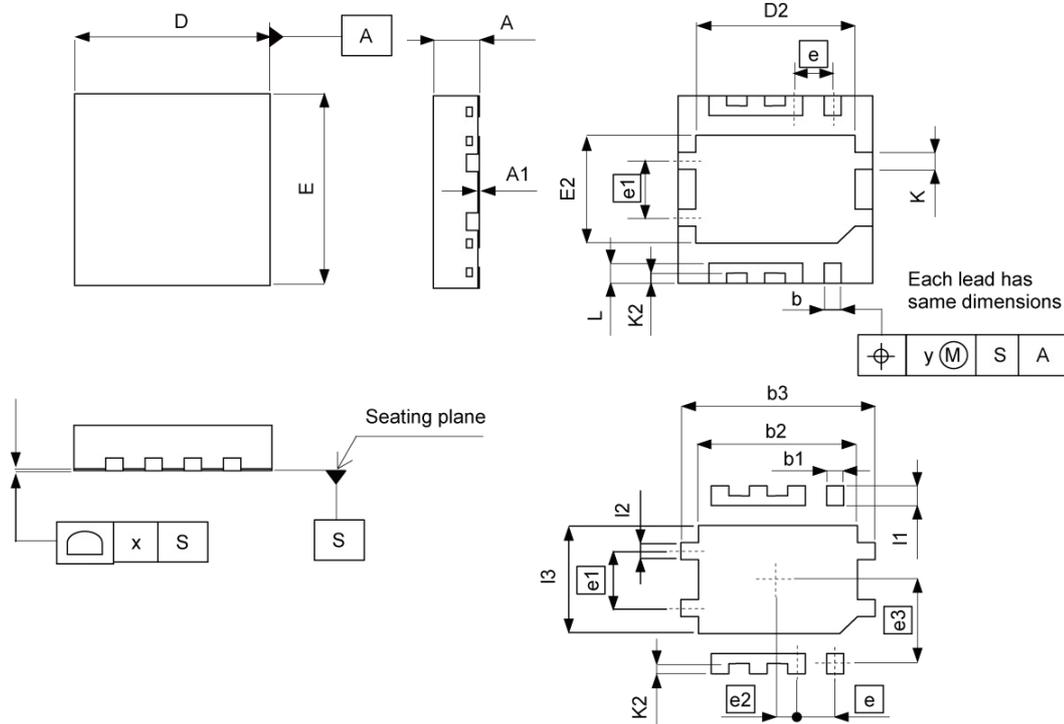
●使用上の注意

本製品は、帯電性の大きな環境では素子の劣化・破壊の恐れがあるので、取り扱い時には必ず静電対策を講じてください。

●外形寸法図

HSML3333L9

(Drain common)



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

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.70	0.80	0.028	0.032
A1	0.00	0.05	0.000	0.002
b	0.25	0.35	0.010	0.014
D	3.20	3.40	0.126	0.134
D2	2.65	2.75	0.104	0.108
E	3.20	3.40	0.126	0.134
E2	1.80	2.00	0.071	0.079
e	0.65		0.026	
e1	1.00		0.039	
K	0.30		0.012	
K2	0.175		0.007	
L	0.30	0.40	0.012	0.016
x	0.10		0.004	
y	0.10		0.004	

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
b1	-	0.45	-	0.018
b2	-	2.75	-	0.108
b3	-	3.40	-	0.134
e2	0.325		0.013	
e3	1.45		0.057	
l1	-	0.50	-	0.020
l2	-	0.35	-	0.014
l3	-	2.00	-	0.079

Dimension in mm/inches

