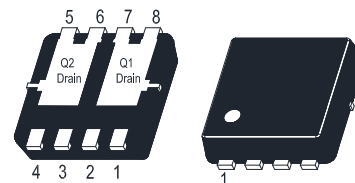
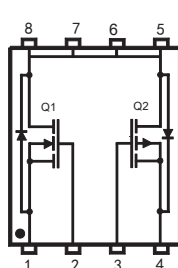


Complementary N/P-Channel Enhancement Mode MOSFET

Features

- Surface-mounted package
- Low Gate-Source Threshold Voltage
- Halogen and Antimony Free(HAF), RoHS compliant



Q1:1.Source 2.Gate 7.Drain 8.Drain
Q2:3.Gate 4.Source 5.Drain 6.Drain
DFN3030 Plastic Package

Key Parameters(Q1)

Parameter	Value	Unit
BV_{DSS}	20	V
$R_{DS(ON)} \text{ Max}$	55 @ $V_{GS} = 4.5 \text{ V}$	$m\Omega$
	65 @ $V_{GS} = 2.5 \text{ V}$	
$V_{GS(th)} \text{ typ}$	525	mV
$Q_g \text{ typ}$	11.1 @ $V_{GS} = 4.5 \text{ V}$	nC

Key Parameters(Q2)

Parameter	Value	Unit
$-BV_{DSS}$	20	V
$R_{DS(ON)} \text{ Max}$	65 @ $-V_{GS} = 4.5 \text{ V}$	$m\Omega$
	85 @ $-V_{GS} = 2.5 \text{ V}$	
$-V_{GS(th)} \text{ typ}$	647	mV
$Q_g \text{ typ}$	5.7 @ $-V_{GS} = 4.5 \text{ V}$	nC

Absolute Maximum Ratings (at $T_a = 25^\circ\text{C}$ unless otherwise specified) (Q1/Q2)

Parameter	Symbol	Value		Unit
		Q1	Q2	
Drain-Source Voltage	V_{DS}	20	- 20	V
Gate-Source Voltage	V_{GS}	± 12	± 12	V
Continuous Drain Current	I_D	15	- 10	A
		9.4	- 6.3	
Peak Drain Current, Pulsed ¹⁾	I_{DM}	60	- 36	A
Avalanche Current	I_{AS}	12	11	A
Single Pulse Avalanche Energy ²⁾	E_{AS}	7.2	6	mJ
Total Power Dissipation ²⁾	P_{tot}	8.9		W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to + 150		$^\circ\text{C}$

Thermal Characteristics (Q1/Q2)

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	14	$^\circ\text{C/W}$
Thermal Resistance from Junction to Ambient ³⁾	$R_{\theta JA}$	90	$^\circ\text{C/W}$

¹⁾ Pulse Test: Pulse Width $\leq 100 \mu\text{s}$, Duty Cycle $\leq 2\%$, Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)} = 150^\circ\text{C}$.

²⁾ Limited by $T_{J(MAX)}$, starting $T_J = 25^\circ\text{C}$, $L = 0.1 \text{ mH}$, $R_g = 25 \Omega$, $V_{GS} = 10 \text{ V}$.

³⁾ Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.

Characteristics at $T_a = 25^\circ\text{C}$ unless otherwise specified (Q1)

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at $I_D = 250\ \mu\text{A}$	BV_{DSS}	20	-	-	V
Drain-Source Leakage Current at $V_{DS} = 16\ \text{V}$	I_{DSS}	-	-	1	μA
Gate Leakage Current at $V_{GS} = \pm 10\ \text{V}$	I_{GSS}	-	-	± 100	nA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$	$V_{GS(th)}$	0.4	-	1	V
Drain-Source On-State Resistance at $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$ at $V_{GS} = 2.5\ \text{V}$, $I_D = 3\ \text{A}$	$R_{DS(on)}$	- -	42 -	55 65	$\text{m}\Omega$
DYNAMIC PARAMETERS					
Forward Transconductance at $V_{DS} = 5\ \text{V}$, $I_D = 5\ \text{A}$	g_{fs}	-	10.5	-	S
Gate Resistance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	R_g	-	0.58	-	Ω
Input Capacitance at $V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{iss}	-	533	-	pF
Output Capacitance at $V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{oss}	-	82	-	pF
Reverse Transfer Capacitance at $V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{rss}	-	63	-	pF
Gate Charge Total at $V_{DS} = 10\ \text{V}$, $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$ at $V_{DS} = 10\ \text{V}$, $V_{GS} = 2.5\ \text{V}$, $I_D = 5\ \text{A}$	Q_g	- -	11.1 6.5	- -	nC
Gate to Source Charge at $V_{DS} = 10\ \text{V}$, $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$	Q_{gs}	-	1	-	nC
Gate to Drain Charge at $V_{DS} = 10\ \text{V}$, $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$	Q_{gd}	-	3.2	-	nC
Turn-On Delay Time at $V_{DD} = 10\ \text{V}$, $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$, $R_g = 3.3\ \Omega$	$t_{d(on)}$	-	11	-	ns
Turn-On Rise Time at $V_{DD} = 10\ \text{V}$, $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$, $R_g = 3.3\ \Omega$	t_r	-	19	-	ns
Turn-Off Delay Time at $V_{DD} = 10\ \text{V}$, $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$, $R_g = 3.3\ \Omega$	$t_{d(off)}$	-	13	-	ns
Turn-Off Fall Time at $V_{DD} = 10\ \text{V}$, $V_{GS} = 4.5\ \text{V}$, $I_D = 5\ \text{A}$, $R_g = 3.3\ \Omega$	t_f	-	1.8	-	ns
Body-Diode PARAMETERS					
Drain-Source Diode Forward Voltage at $I_S = 5\ \text{A}$, $V_{GS} = 0\ \text{V}$	V_{SD}	-	-	1.2	V
Body-Diode Continuous Current	I_S	-	-	15	A
Body-Diode Continuous Current, Pulsed	I_{SM}	-	-	60	A
Body Diode Reverse Recovery Time at $I_S = 5\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	t_{rr}	-	12.3	-	ns
Body Diode Reverse Recovery Charge at $I_S = 5\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	Q_{rr}	-	5.3	-	nC

Characteristics at $T_a = 25^\circ\text{C}$ unless otherwise specified (Q2)

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at $-I_D = 250\ \mu\text{A}$	$-V_{(BR)DSS}$	20	-	-	V
Drain-Source On-State Current at $-V_{DS} = 16\ \text{V}$	$-I_{DSS}$	-	-	1	μA
Gate-Source Leakage Current at $V_{GS} = \pm 10\ \text{V}$	I_{GSS}	-	-	± 100	nA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $-I_D = 250\ \mu\text{A}$	$-V_{GS(th)}$	0.4	-	1	V
Drain-Source On-State Resistance at $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$ at $-V_{GS} = 2.5\ \text{V}$, $-I_D = 2\ \text{A}$	$R_{DS(ON)}$	- -	50 -	65 85	m Ω
DYNAMIC PARAMETERS					
Forward Transconductance at $-V_{DS} = 5\ \text{V}$, $-I_D = 3\ \text{A}$	g_{fs}	-	7.8	-	S
Gate resistance at $V_{DS} = 0\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	R_g	-	4.7	-	Ω
Input Capacitance at $-V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{iss}	-	524	-	pF
Output Capacitance at $-V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{oss}	-	89	-	pF
Reverse Transfer Capacitance at $-V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{rss}	-	61	-	pF
Total Gate Charge at $-V_{DS} = 10\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$ at $-V_{DS} = 10\ \text{V}$, $-V_{GS} = 2.5\ \text{V}$, $-I_D = 3\ \text{A}$	Q_g	- -	5.7 3.3	- -	nC
Gate-Source Charge at $-V_{DS} = 10\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$	Q_{gs}	-	1.1	-	nC
Gate-Drain Charge at $-V_{DS} = 10\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$	Q_{gd}	-	1.4	-	nC
Turn-On Delay Time at $-V_{DD} = 10\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$, $R_g = 3.3\ \Omega$	$t_{d(on)}$	-	9	-	ns
Turn-On Rise Time at $-V_{DD} = 10\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$, $R_g = 3.3\ \Omega$	t_r	-	14	-	ns
Turn-Off Delay Time at $-V_{DD} = 10\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$, $R_g = 3.3\ \Omega$	$t_{d(off)}$	-	11	-	ns
Turn-Off Fall Time at $-V_{DD} = 10\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$, $R_g = 3.3\ \Omega$	t_f	-	2.4	-	ns
Body-Diode PARAMETERS					
Drain-Source Diode Forward Voltage at $-I_S = 3\ \text{A}$, $V_{GS} = 0\ \text{V}$	$-V_{SD}$	-	-	1.2	V
Body-Diode Continuous Current	$-I_S$	-	-	10	A
Body-Diode Continuous Current, Pulsed	$-I_{SM}$	-	-	36	A
Body Diode Reverse Recovery Time at $-I_S = 3\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	t_{rr}	-	9.3	-	ns
Body Diode Reverse Recovery Charge at $-I_S = 3\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	Q_{rr}	-	2	-	nC

Electrical Characteristics Curves(Q1)

Fig. 1 Typical Output Characteristics

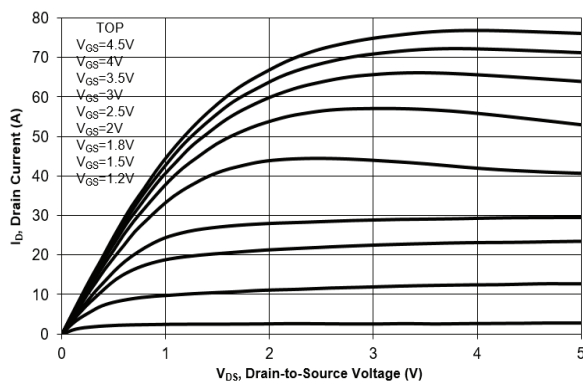


Fig. 2 Typical Transfer Characteristics

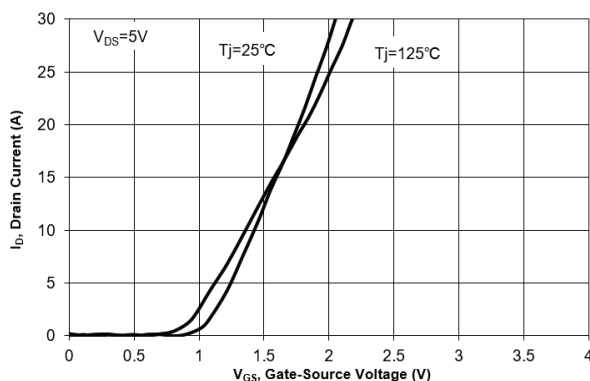


Fig. 3 on-Resistance vs. Drain Current

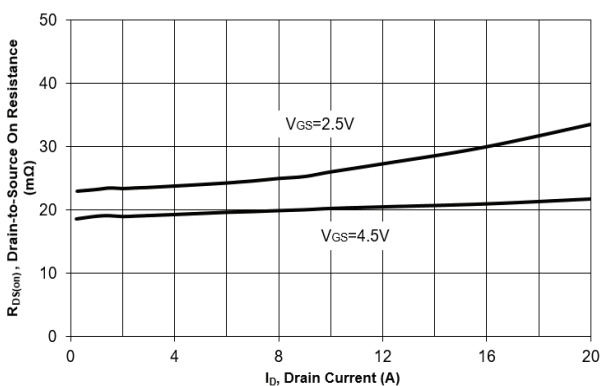


Fig. 4 on-Resistance vs. Gate to Source Voltage

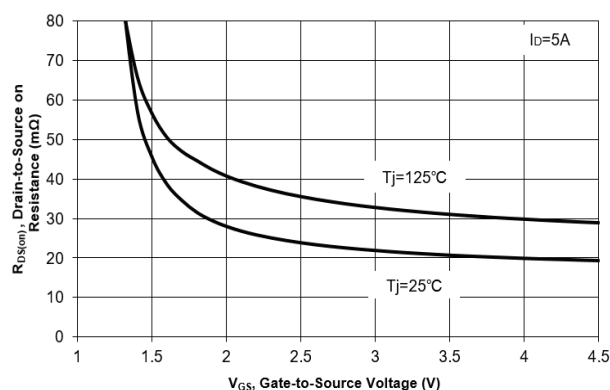


Fig. 5 on-Resistance vs. Tj

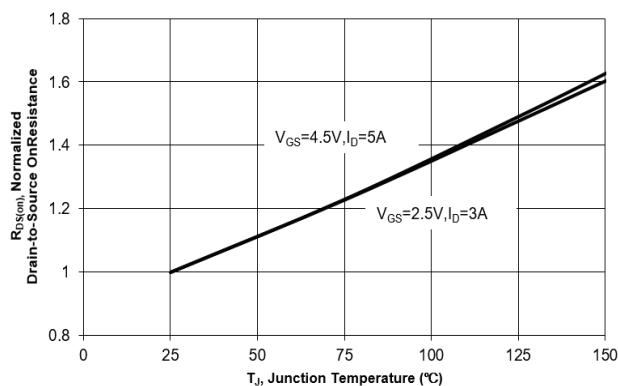
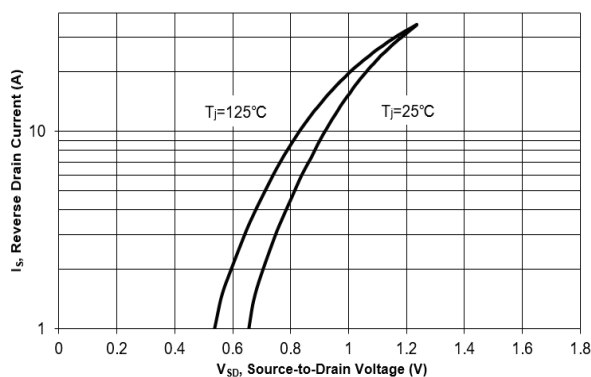


Fig. 6 Typical Body-Diode Forward Characteristics



Electrical Characteristics Curves(Q1)

Fig. 7 Typical Junction Capacitance

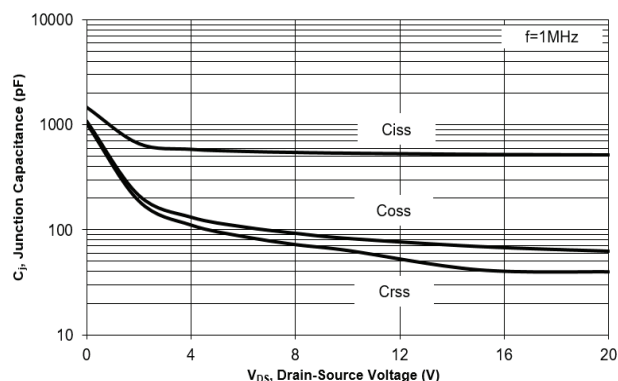


Fig. 8 Drain-Source Leakage Current vs. T_J

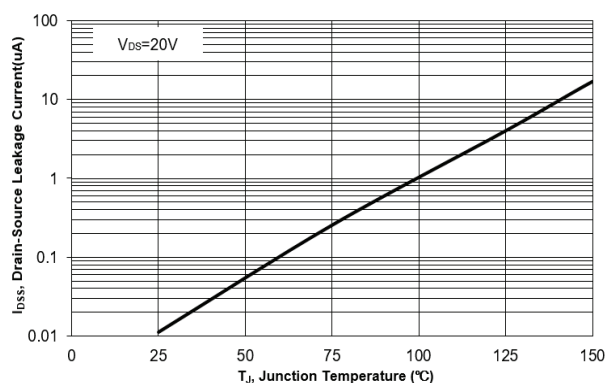


Fig. 9 V_{(BR)DSS} vs. Junction Temperature

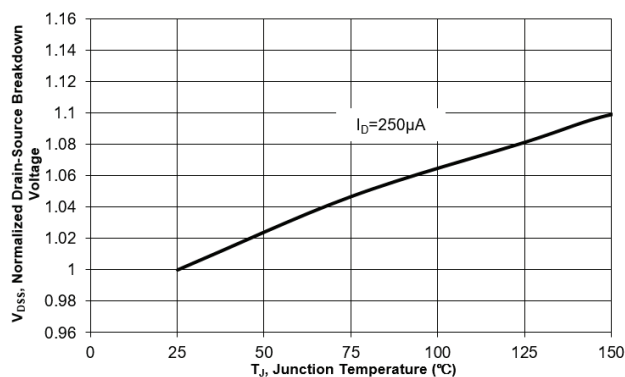


Fig. 10 Gate Threshold Variation vs. T_J

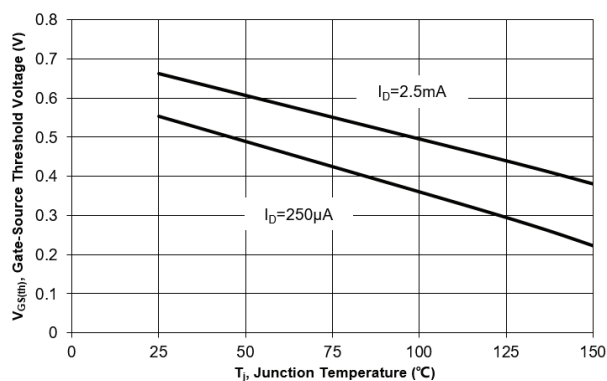


Fig. 11 Gate Charge

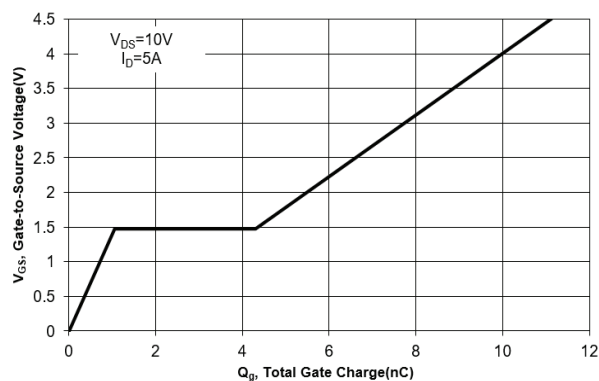


Fig. 12 Safe Operation Area

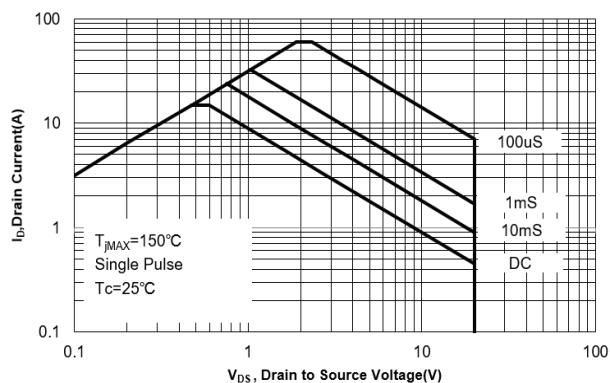


Fig. 13 Normalized Maximum Transient Thermal Impedance($Z_{\theta JC}$)

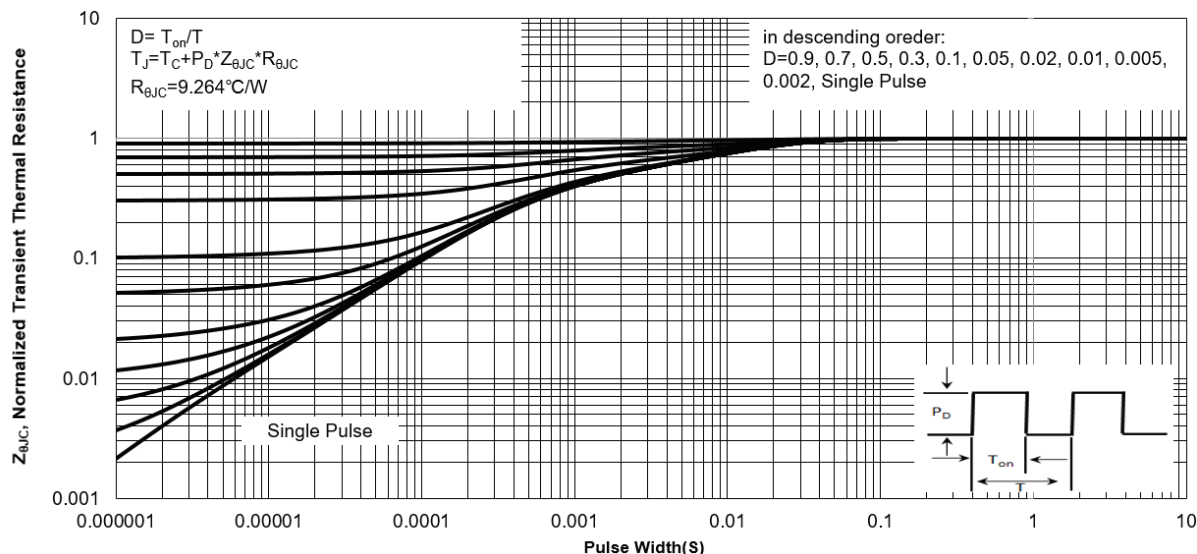
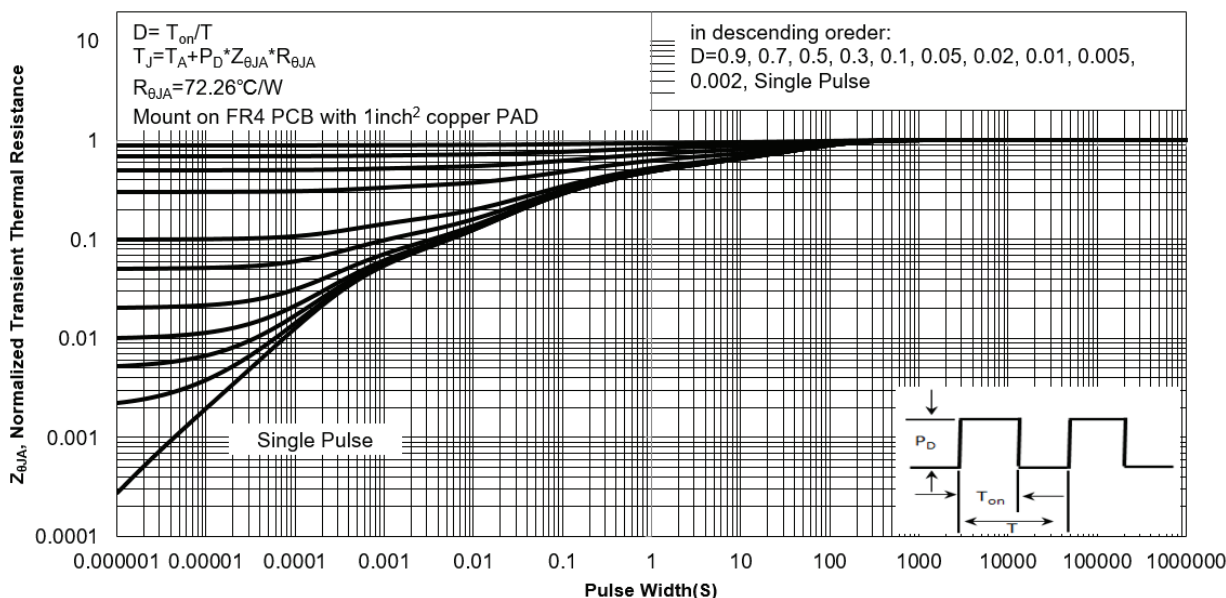


Fig. 14 Normalized Maximum Transient Thermal Impedance($Z_{\theta JA}$)



Electrical Characteristics Curves(Q2)

Fig. 1 Typical Output Characteristics

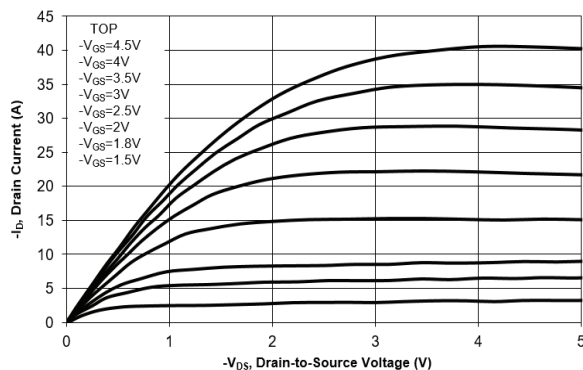


Fig. 2 Typical Transfer Characteristics

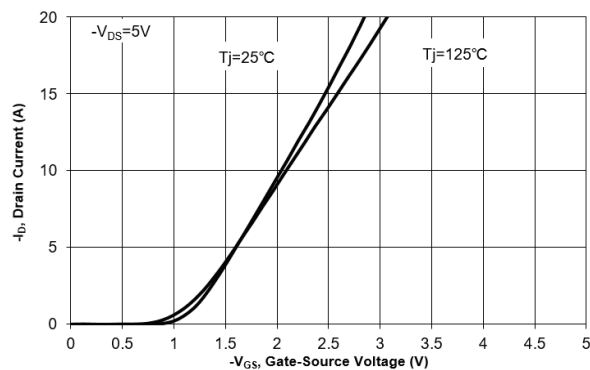


Fig. 3 On-Resistance vs. Drain Current

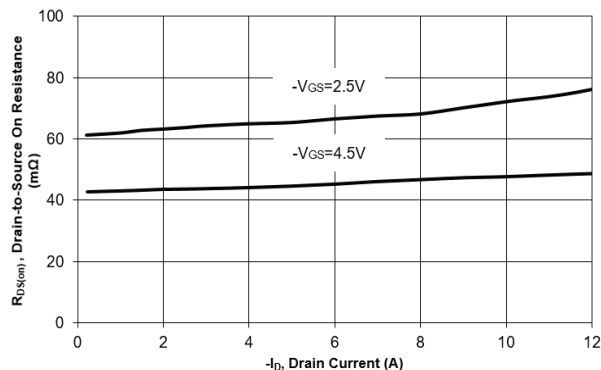


Fig. 4 On-Resistance vs. Gate to Source Voltage

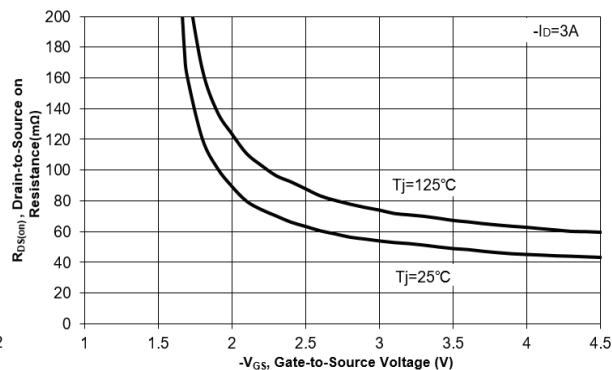


Fig. 5 On-Resistance vs. T_J

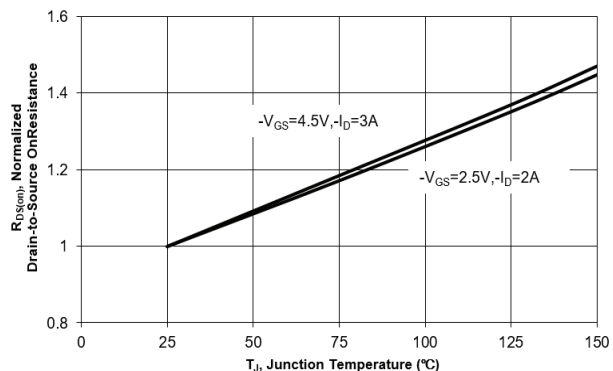
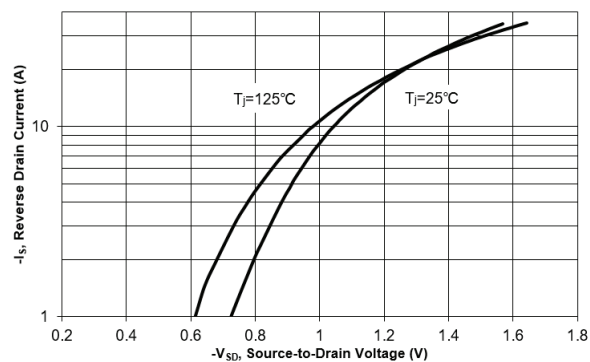


Fig. 6 Typical Body-Diode Forward Characteristics



Electrical Characteristics Curves(Q2)

Fig. 7 Typical Junction Capacitance

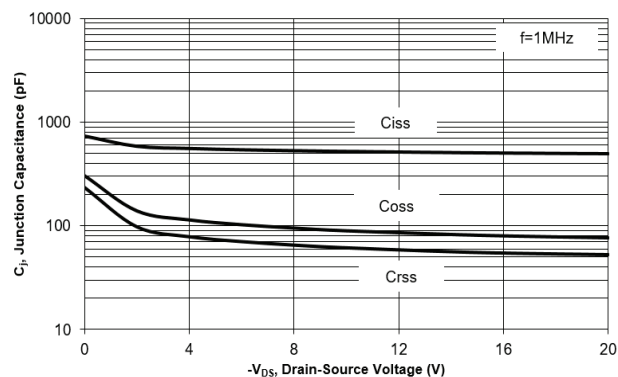


Fig. 8 Drain-Source Leakage Current vs. T_J

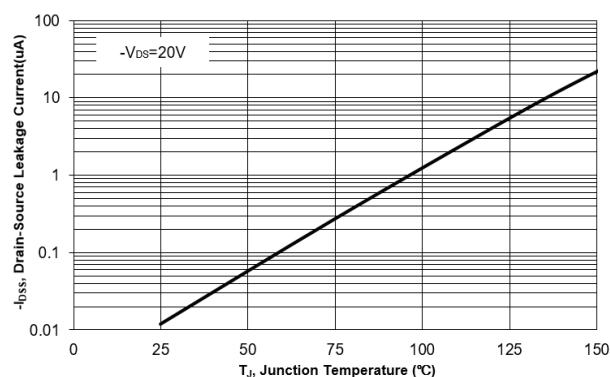


Fig. 9 V_{(BR)DSS} vs. Junction Temperature

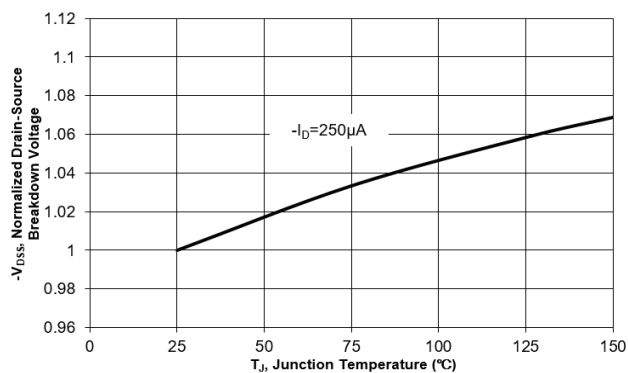


Fig. 10 Gate Threshold Variation vs. T_J

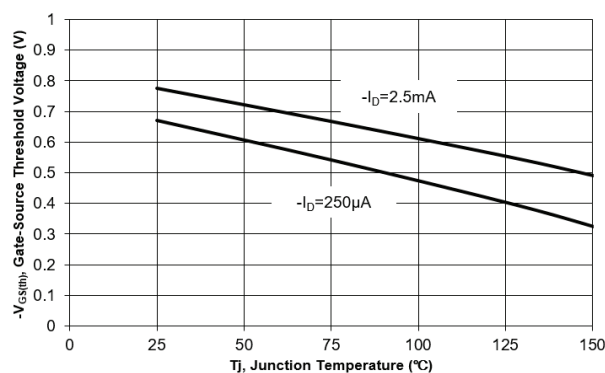


Fig. 11 Gate Charge

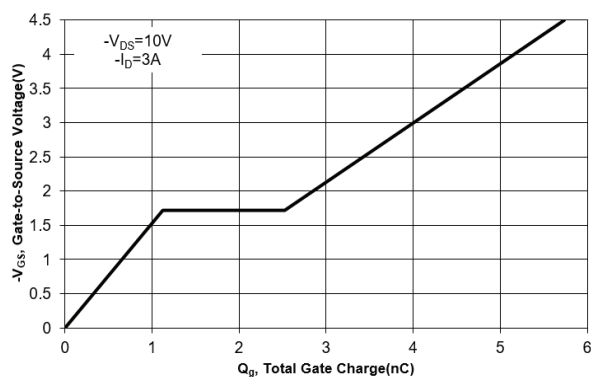
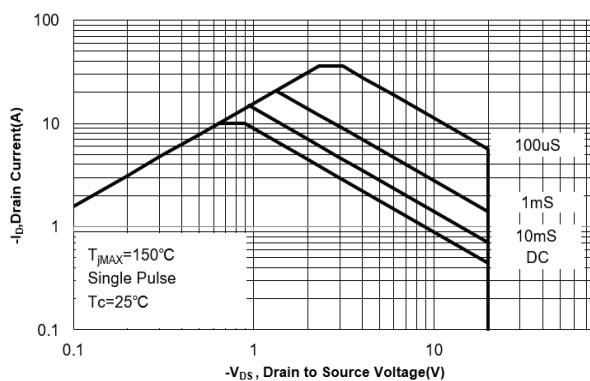


Fig. 12 Safe Operation Area



Electrical Characteristics Curves(Q2)

Fig. 13 Normalized Maximum Transient Thermal Impedance($Z_{\theta JC}$)

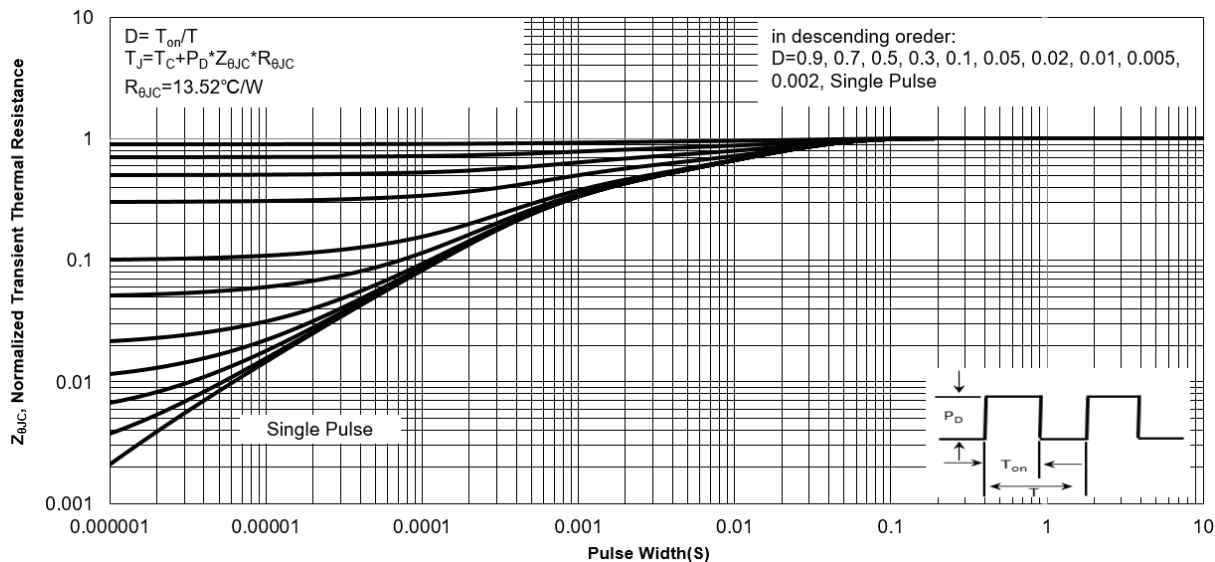
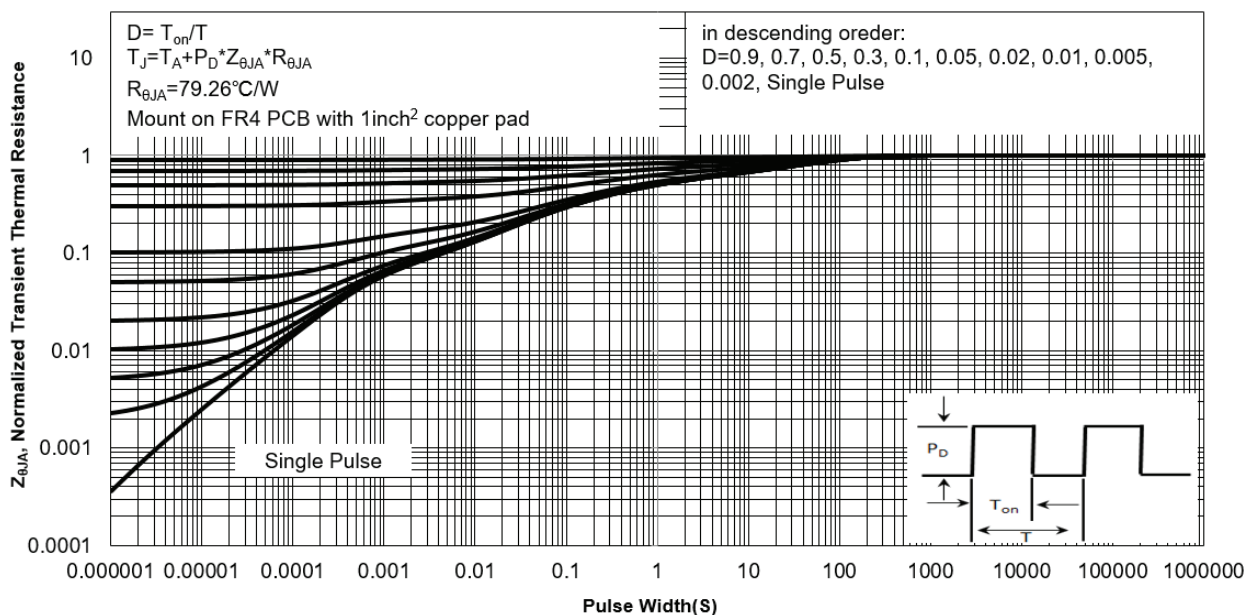


Fig. 14 Normalized Maximum Transient Thermal Impedance($Z_{\theta JA}$)



Test Circuits (Q1)

Fig.1-1 Switching times test circuit

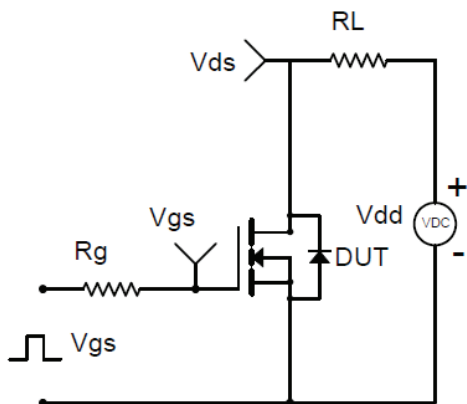


Fig.1-2 Switching Waveform

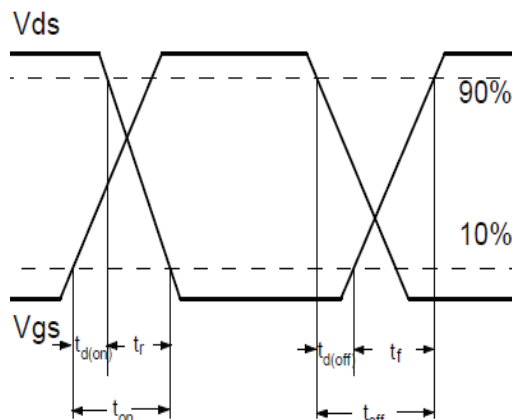


Fig.2-1 Gate charge test circuit

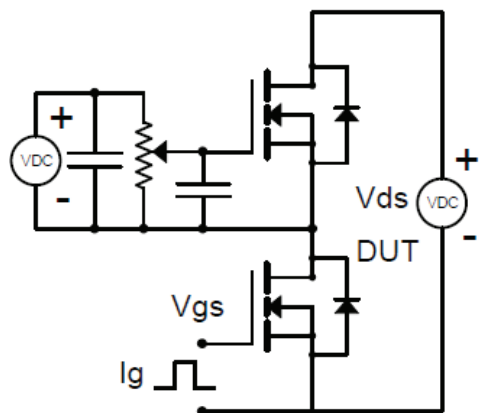


Fig.2-2 Gate charge waveform

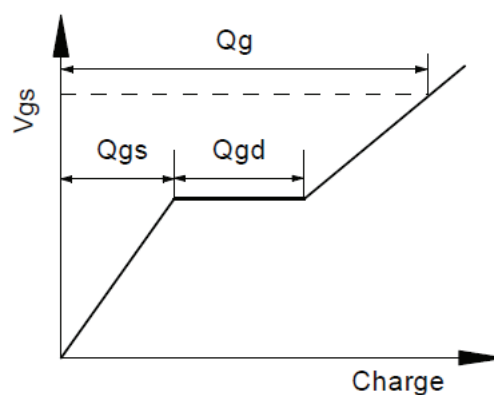


Fig.3-1 Avalanche test circuit

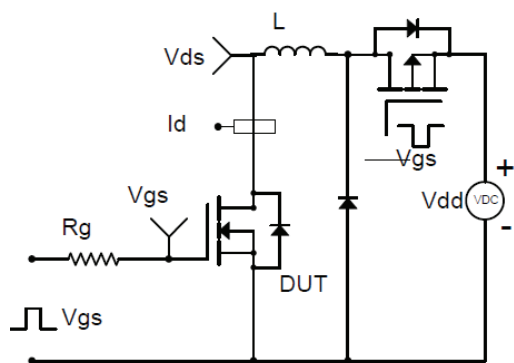
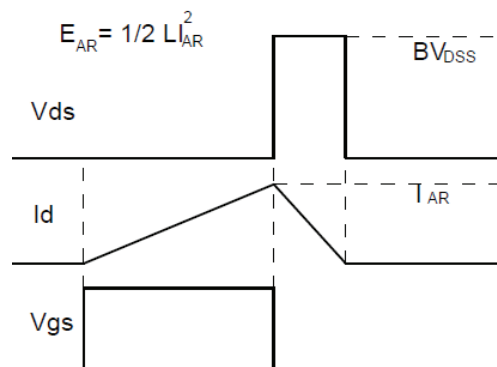


Fig.3-2 Avalanche waveform



Test Circuits (Q2)

Fig.1-1 Switching times test circuit

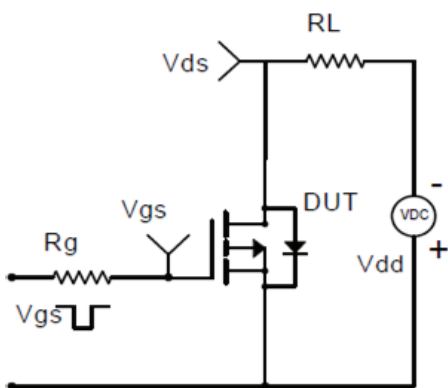


Fig.1-2 Switching Waveform

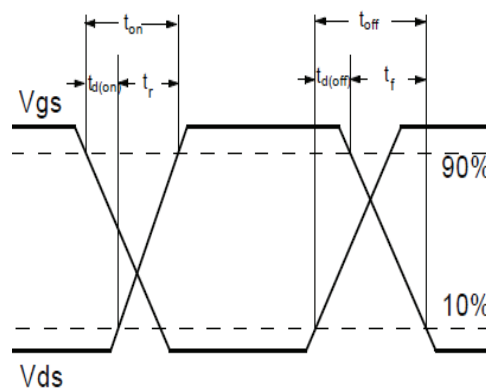


Fig.2-1 Gate charge test circuit

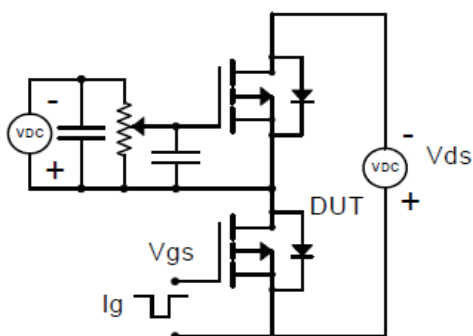


Fig.2-2 Gate charge waveform

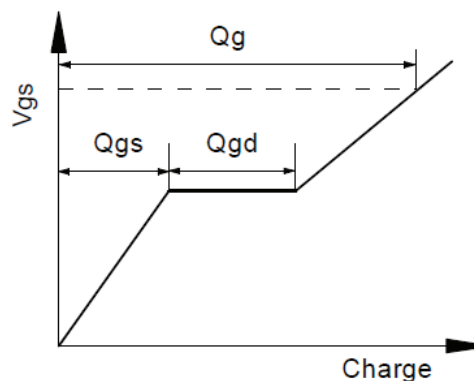


Fig.3-1 Avalanche test circuit

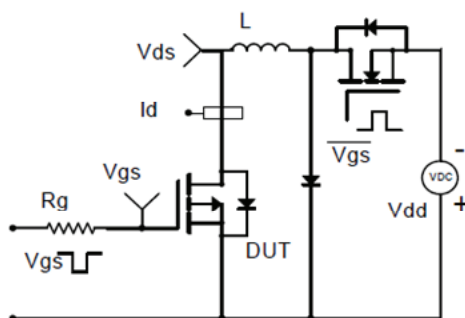
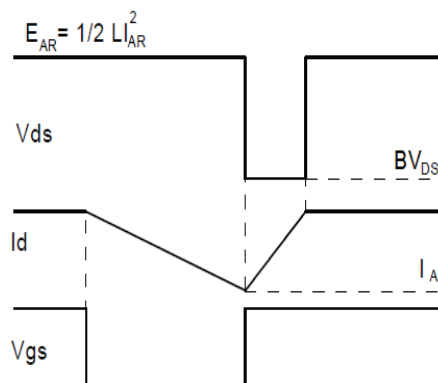
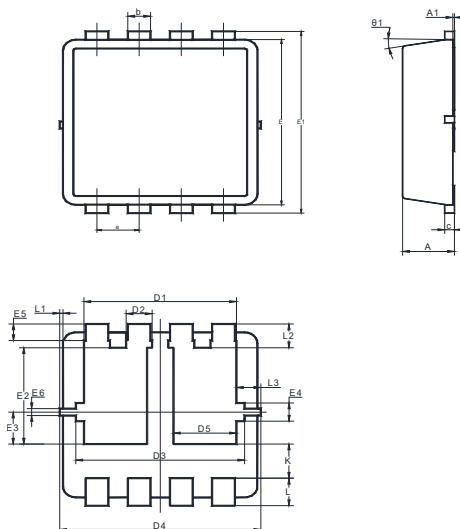


Fig.3-2 Avalanche waveform



Package Outline Dimensions (Units: mm)

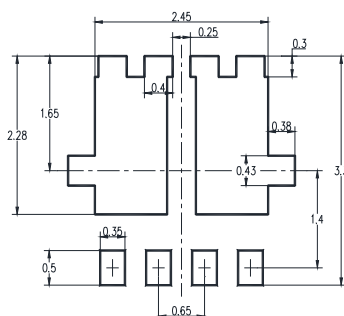
DFN3030



UNIT	A	A1	b	c	D1	D2	D3	D4	D5	E	E1	E2	E3
mm	0.9	0.05	0.35	0.25	2.6	0.5	2.7	3.2	1.135	3.1	3.3	1.85	0.68
	0.7	0	0.24	0.1	2.4	0.3	2.5	3	0.935	2.9	3.1	1.65	0.48

UNIT	E4	E5	E6	e	K	L	L1	L2	L3	θ1
mm	0.43	0.4	0.25	0.7	0.72	0.5	0.1	0.53	0.475	12°
	0.23	0.2	0.15	0.6	0.52	0.3	0	0.33	0.275	0°

Recommended Soldering Footprint



Packing information

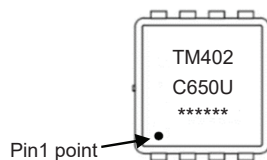
Package	Tape Width (mm)	Pitch		Reel Size		Per Reel Packing Quantity
		mm	inch	mm	inch	
DFN3030	12	8 ± 0.1	0.315 ± 0.004	330	13	5,000

Marking information

" TM402C650U " = Part No.

" ***** " = Date Code Marking

Font type: Arial



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