

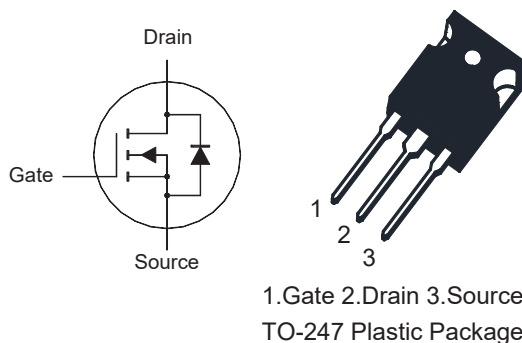
N-Channel Enhancement Mode MOSFET

Features

- Low $R_{DS(on)}$
- AEC-Q101 Qualified
- Halogen and Antimony Free(HAF),
RoHS compliant

Application

- DC-DC Converters



Key Parameters

Parameter	Value	Unit
BV_{DSS}	600	V
$R_{DS(ON)}$ Max	160 @ $V_{GS} = 10\text{ V}$	$m\Omega$
$V_{GS(th)}$ typ	3.1	V
Q_g typ	44.6 @ $V_{GS} = 10\text{ V}$	nC

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	600	V
Gate-Source Voltage	V_{GS}	± 30	V
Drain Current	I_D	23	A
		14.5	
Peak Drain Current, Pulsed ¹⁾	I_{DM}	68	A
Avalanche Current	I_{AS}	4.7	A
Single Pulse Avalanche Energy ²⁾	E_{AS}	869	mJ
Power Dissipation	P_{tot}	208.3	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to + 150	$^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.6	$^\circ\text{C/W}$
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$	35	$^\circ\text{C/W}$

¹⁾ Pulse Test: Pulse Width $\leq 100\text{ }\mu\text{s}$, 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 $T_J = 25^\circ\text{C}$, $L = 79\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 4.7\text{ A}$, $V_{GS} = 10\text{ V}$.

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

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at $I_D = 250\ \mu\text{A}$	BV_{DSS}	600	-	-	V
Drain-Source Leakage Current at $V_{DS} = 600\ \text{V}$	I_{DSS}	-	-	1	μA
Gate Leakage Current at $V_{GS} = \pm 30\ \text{V}$	I_{GSS}	-	-	± 100	nA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$	$V_{GS(th)}$	2	-	4	V
Drain-Source On-State Resistance at $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$	$R_{DS(on)}$	-	140	160	m Ω
DYNAMIC PARAMETERS					
Forward Transconductance at $V_{DS} = 5\ \text{V}$, $I_D = 10\ \text{A}$	g_{fs}	-	14.6	-	S
Gate Resistance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	R_g	-	1.2	-	Ω
Input Capacitance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 300\ \text{V}$, $f = 1\ \text{MHz}$	C_{iss}	-	1485	-	pF
Output Capacitance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 300\ \text{V}$, $f = 1\ \text{MHz}$	C_{oss}	-	70	-	pF
Reverse Transfer Capacitance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 300\ \text{V}$, $f = 1\ \text{MHz}$	C_{rss}	-	9	-	pF
Gate charge total at $V_{DS} = 300\ \text{V}$, $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$	Q_g	-	44.6	-	nC
Gate to Source Charge at $V_{DS} = 300\ \text{V}$, $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$	Q_{gs}	-	9.3	-	nC
Gate to Drain Charge at $V_{DS} = 300\ \text{V}$, $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$	Q_{gd}	-	20.4	-	nC
Turn-On Delay Time at $V_{DS} = 300\ \text{V}$, $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$, $R_g = 24\ \Omega$	$t_{d(on)}$	-	76	-	ns
Turn-On Rise Time at $V_{DS} = 300\ \text{V}$, $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$, $R_g = 24\ \Omega$	t_r	-	10	-	ns
Turn-Off Delay Time at $V_{DS} = 300\ \text{V}$, $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$, $R_g = 24\ \Omega$	$t_{d(off)}$	-	57	-	ns
Turn-Off Fall Time at $V_{DS} = 300\ \text{V}$, $V_{GS} = 10\ \text{V}$, $I_D = 12\ \text{A}$, $R_g = 24\ \Omega$	t_f	-	27	-	ns
Body-Diode PARAMETERS					
Drain-Source Diode Forward Voltage at $I_S = 1\ \text{A}$, $V_{GS} = 0\ \text{V}$	V_{SD}	-	-	1.4	V
Body-Diode Continuous Current	I_S	-	-	23	A
Body-Diode Continuous Current, Pulsed	I_{SM}	-	-	68	A
Body Diode Reverse Recovery Time at $I_S = 12\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	t_{rr}	-	400	-	ns
Body Diode Reverse Recovery Charge at $I_S = 12\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	Q_{rr}	-	5.7	-	μC

Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

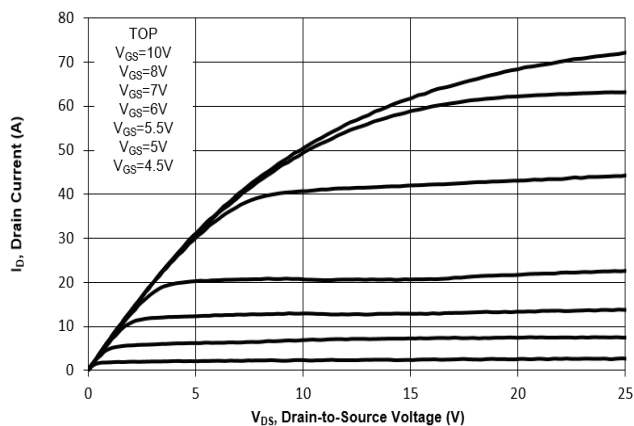


Fig. 2 Typical Transfer Characteristics

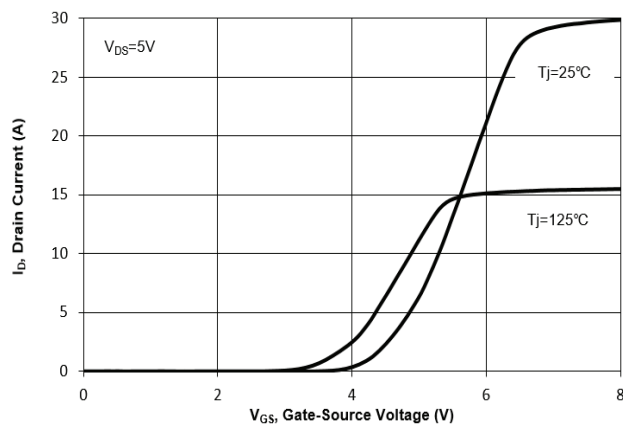


Fig. 3 On-Resistance vs. Drain Current

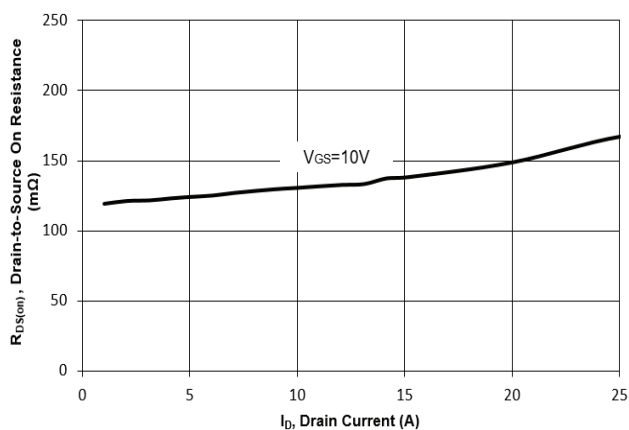


Fig. 4 On-Resistance vs. Gate to Source Voltage

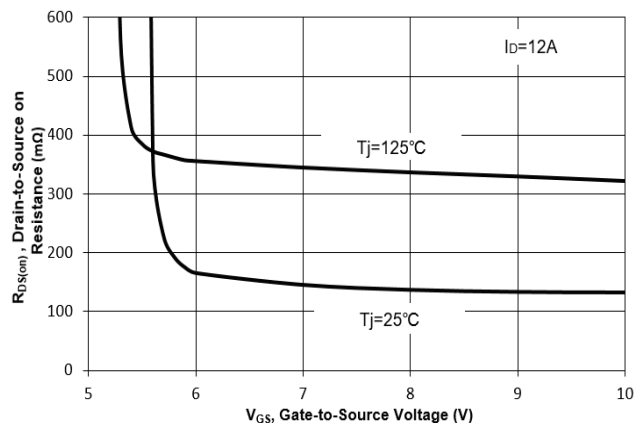


Fig. 5 On-Resistance vs. T_J

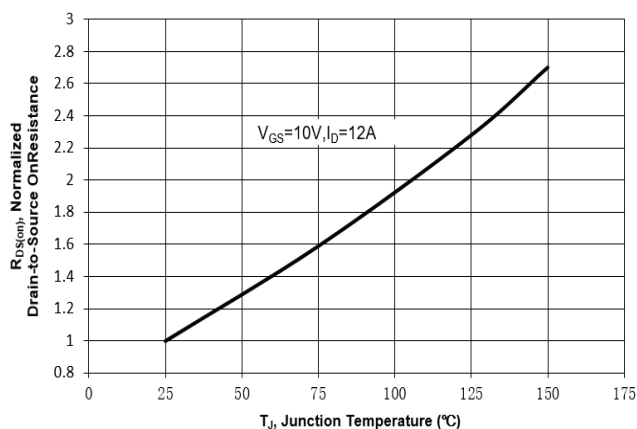
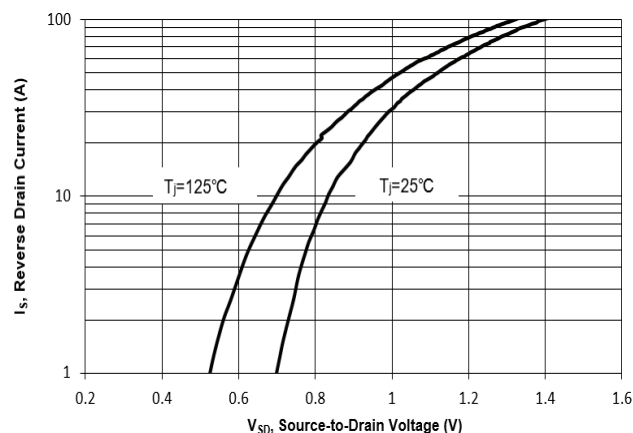


Fig. 6 Typical Body-Diode Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

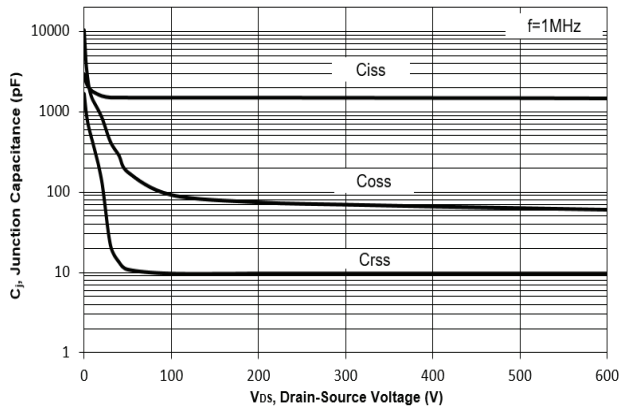


Fig. 8 Drain-Source Leakage Current vs. T_j

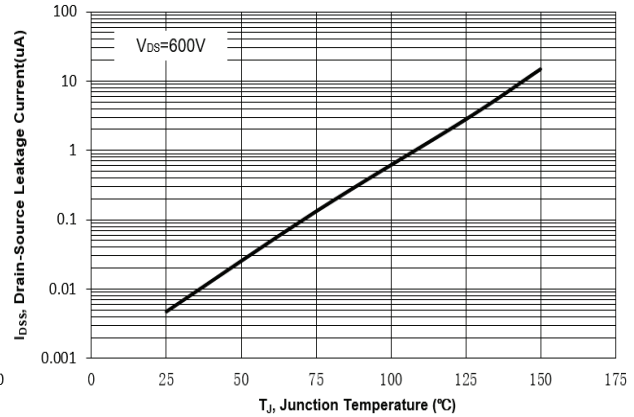


Fig. 9 $V_{(BR)DSS}$ vs. Junction Temperature

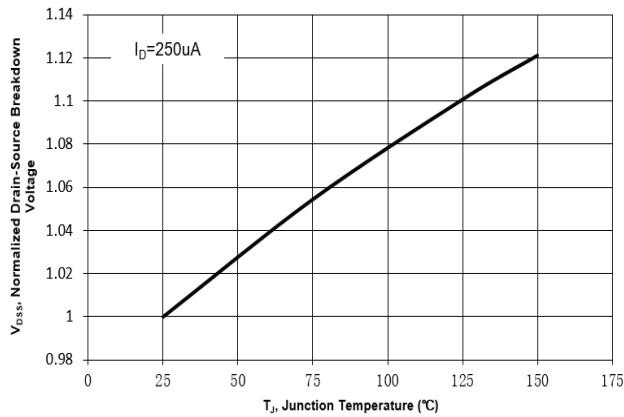


Fig. 10 Gate Threshold Variation vs. T_j

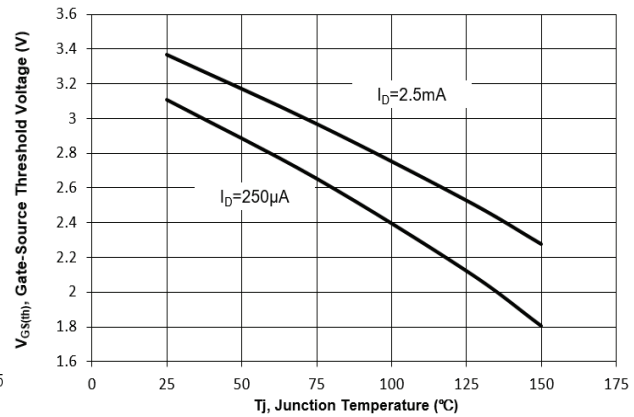


Fig. 11 Gate Charge

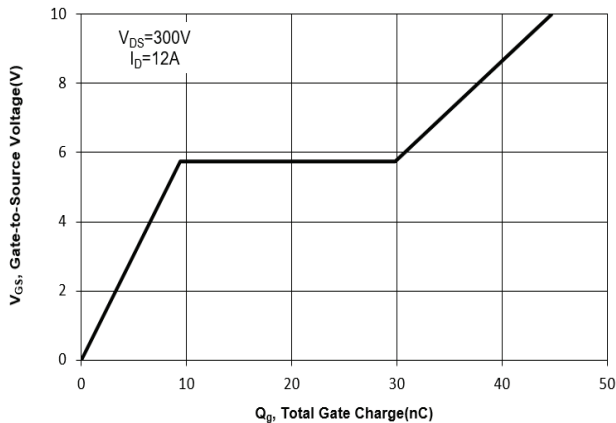


Fig. 12 Safe Operation Area

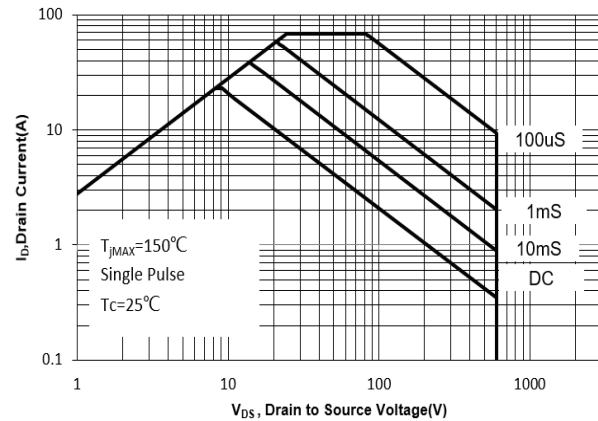


Fig. 13 Normalized Maximum Transient Thermal Impedance($Z_{\theta JC}$)

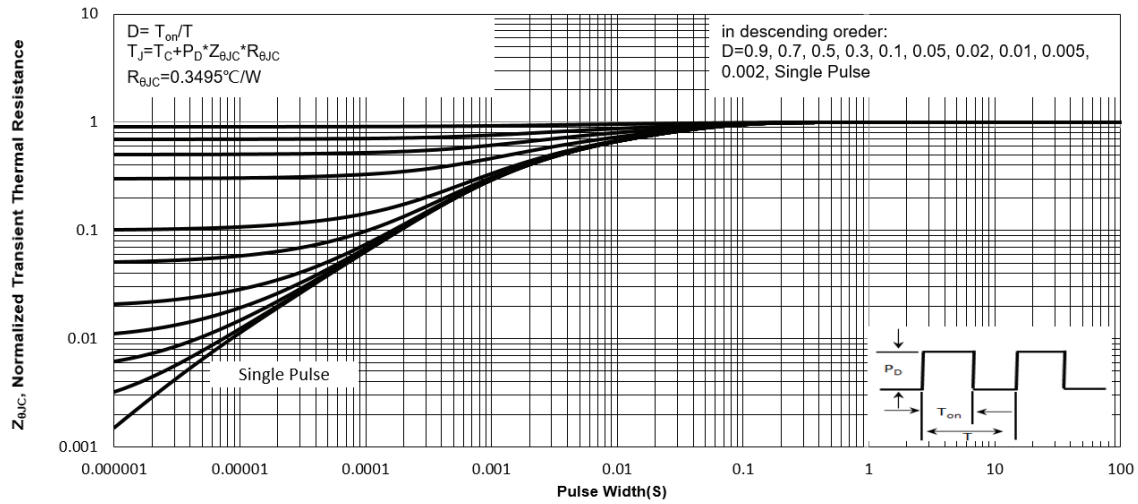
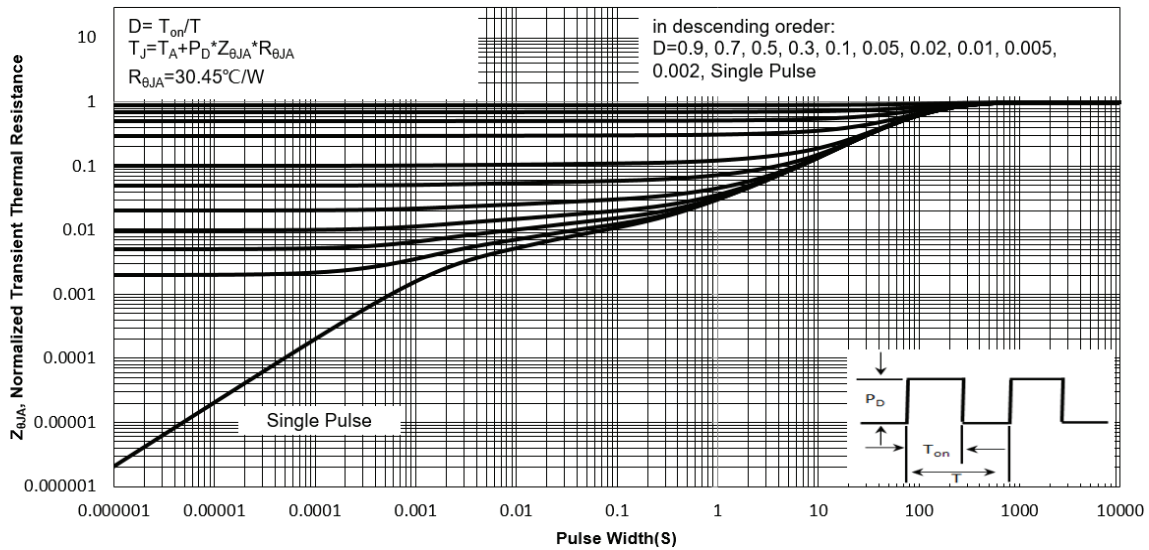


Fig. 14 Normalized Maximum Transient Thermal Impedance($Z_{\theta JA}$)



Test Circuits

Fig.1-1 Switching times test circuit

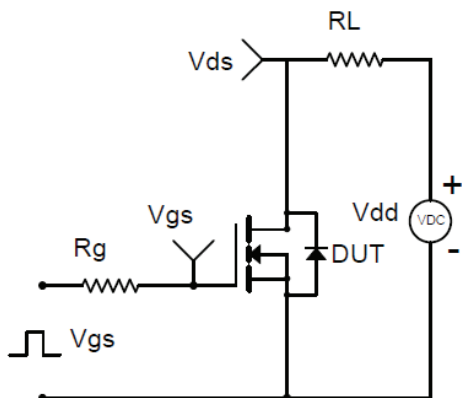


Fig.1-2 Switching Waveform

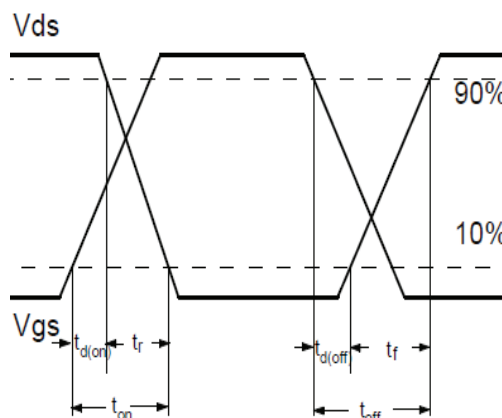


Fig.2-1 Gate charge test circuit

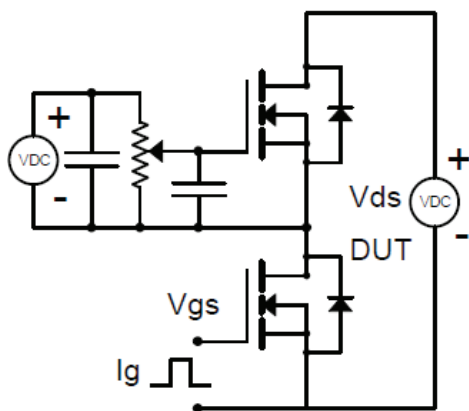


Fig.2-2 Gate charge waveform

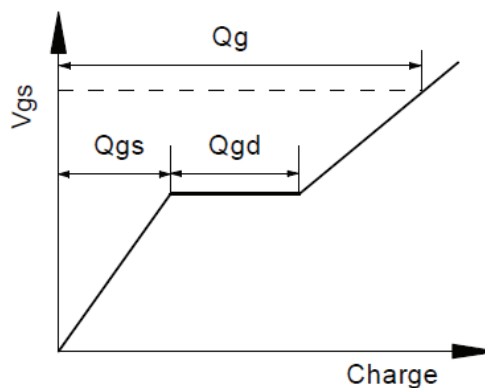


Fig.3-1 Avalanche test circuit

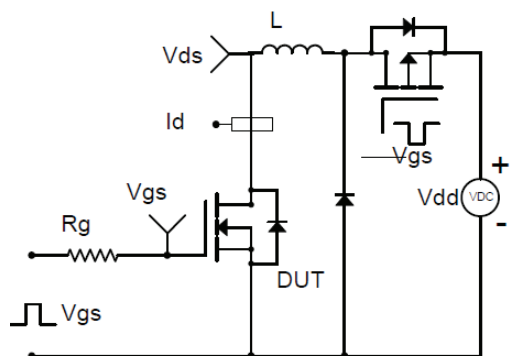
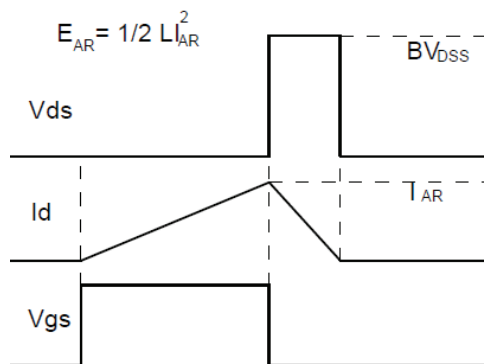
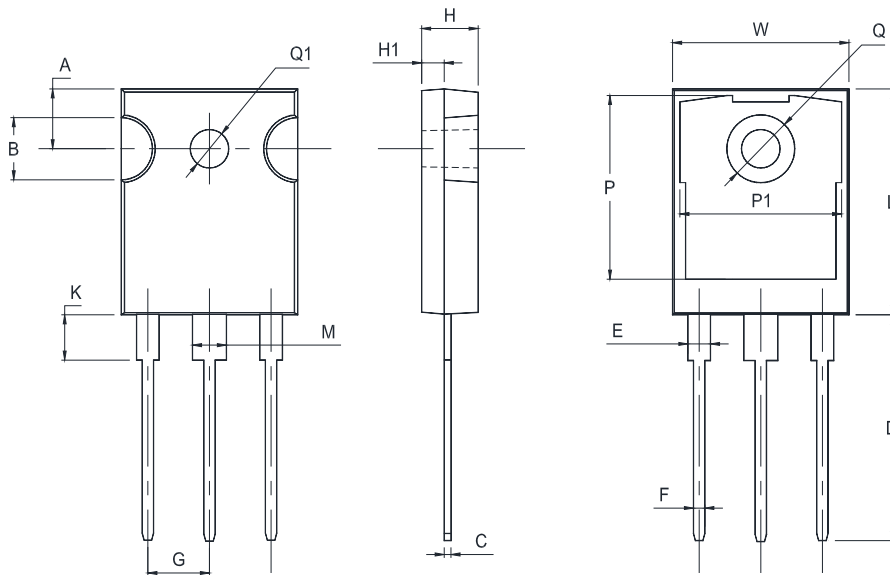


Fig.3-2 Avalanche waveform



Package Outline Dimensions (Units: mm)
TO-247


UNIT	A	B	C	D	E	F	G	W	H	H1	K	L	M	P
mm	6.5	5.2	0.7	20.3	2.2	1.3	5.7	16.2	5.3	2.4	4.45	21.3	3.2	16.6
	5.9	4.6	0.5	19.7	1.8	1.1	5.1	15.8	4.7	1.8	4.05	20.7	2.8	16.2

UNIT	P1	Q	Q1
mm	14.2	7.35	4.2
	13.8	7.05	3.6

Packing information

Package	Carton Quantity	Box Quantity	Base Quantity	Delivery Mode
TO-247	2.88 K / Carton	720 pcs / Box	30 pcs / Tube	Tube

Marking information

" PPT60N160 " = Part No

" ***** " = Date Code Marking

Font type: Arial



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