inVinci Semiconductor Corporation

I3JA78N65Q

650V N-Channel Power MOSFET

Product Summary

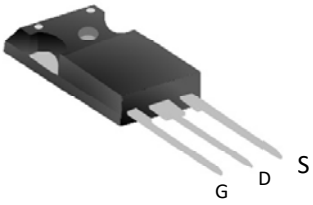
Parameter	Value	Unit
VDS @ Tjmax	650	V
RDS(on), Max.	0.035	Ω
Qg. Typ.	172	nC
ID, pulse	255	A
Qrr	1.3	uC

Features

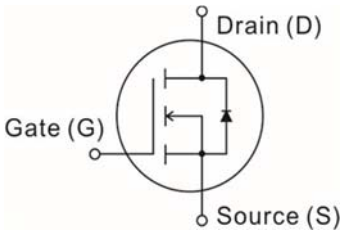
* Ultra fast body diode
* Best-in-class reverse recovery charge
* Low gate charge
* Low on-resistance

Application

* ZVS Phase-Shift Converter
* LLC application-Telecom, Server EV Charging



TO-247



Package Marking and Ordering Information

Type / Ordering Code	Package	Packaging	Related Links
I3JA78N65Q	TO-247	Tube	see Package outline

Maximum ratings T_A = 25℃ unless otherwise noted				
Parameter		**Symbol**	**Limit**	**Unit**
Drain - source voltage		V_{DSS}	650	V
Continuous drain current	T_C @ 25℃	I_D	72	A
	T_C @ 100℃		46	
Pulsed drain current tp limited by Tj max (Note 1)	T_C @ 25℃	I_D pulsed	255	A
Single pulse avalanche energy (Note 2)		E_{AS}	2300	mJ
Avalanche current, repetitive		I_{AR}	13.7	A
MOSFET dv/dt ruggedness	VDS = 0 ~ 400V	dv/dt	50	V/ns
Gate-source voltage		V_{GS}	± 30	V
Power dissipation	T_C @ 25℃	P_{tot}	500	W
Storage temperature range		T_{STG}	- 55 to +150	℃
Continuous diode forward current	T_C @ 25℃	I_S	72	A
Diode pulse current	T_C @ 25℃	I_S pulsed	255	A

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Electrical characteristics T_A = 25℃ unless otherwise specified						
Parameter	**Test Conditions**	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**
On / Off characteristics						
Drain-source breakdown voltage	V_{GS} = 0V, I_D = 1mA	BV_{DSS}	650	---	---	V
Gate-source leakage	V_{GS} = ± 30V, V_{DS}=0V	I_{GSS}	---	---	± 100	nA
Zero gate voltage drain current	V_{DS}= 650V, V_{GS}= 0V, Tj=25℃	I_{DSS}	---	---	10	uA
	V_{DS}= 520V, V_{GS}= 0V,Tj=125℃		---	350	---	
Drain-source on-state resistance	V_{GS} = 10V, I_D= 34A, Tj=25℃	$R_{DS(on)}$	---	0.031	0.035	Ω
	V_{GS} = 10V, I_D= 34A, T_j=150℃		---	0.078	---	
Gate-source threshold voltage	V_{DS} = V_{GS}, I_D = 250uA	$V_{GS(th)}$	3.5	4.0	4.5	V
Dynamic characteristics						
Input capacitance	V_{GS} = 0V , V_{DS} = 100V , F = 1MHz	C_{iss}	---	8100	---	pF
Output capacitance		C_{oss}	---	290	---	
Effective output capacitance, energy related	V_{GS}=0V, V_{DD}=0~400V	$C_{O(er)}$	---	300	---	
Effective output capacitance, time related	I_D =I_{CONST}, V_{GS}=0V,V_{DD}=0~400V	$C_{O(tr)}$	---	1400	---	
Turn-on delay time	V_{DD} = 400V, I_D = 50A, V_{GS} = 13V, R_G = 1.8Ω	$t_{d(on)}$	---	32	---	ns
Rise time		t_r	---	23	---	
Turn-off delay time		$t_{d(off)}$	---	91.6	---	
Fall time		t_f	---	6.8	---	
Gate resistance	F = 1MHz, oper drain	R_G	---	1.2	---	Ω
Gate-source charge	V_{DD} = 480V, I_D = 50A, V_{GS} = 0 to 10V	Q_{gs}	---	50	---	nC
Gate-drain charge		Q_{gd}	---	65	---	
Gate charge total		Q_g	---	172	---	
Gate plateau voltage		Vp	---	6.2	---	V

Drain-source diode characteristics						
Inverse diode forward voltage	I_S = 50A , V_{GS} = 0V, T_j=25℃	V_{SD}	---	1.0	---	V
Reverse recovery time	V_R=400V , I_F = 10A, di $_F$/ dt = 100A / uS	t_{rr}	---	190	---	ns
Reverse recovery charge		Q_{rr}	---	1.3	---	uC
Peak reverse recovery current		Irm	---	13	---	A

Notes:

1. **Repetitive rating : pulsed width limited by maximum junction temperature.**
2. **VDD=50V,starting TJ=25℃.**

Thermal characteristics			
Thermal resistance junction-to-case	R_{thJC}	0.25	℃ / W
Thermal resistance junction-to-ambient	R_{thJA}	62	

Electrical characteristics diagrams

Fig 1: Power dissipation
Ptot = f (TC)

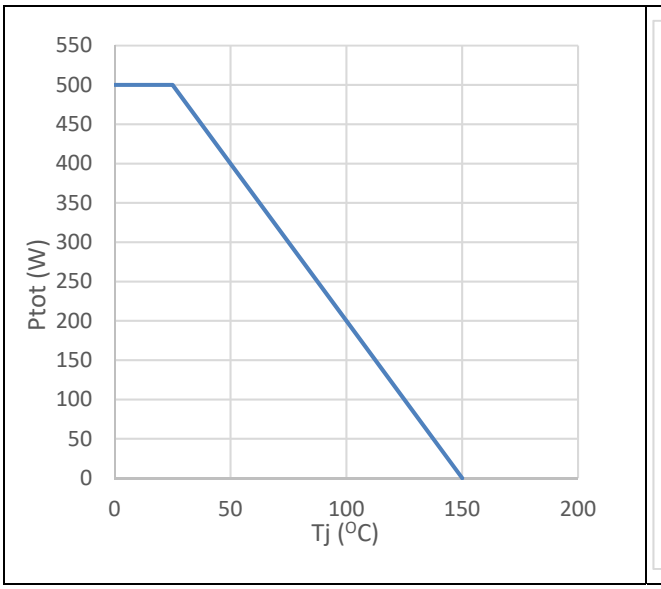


Fig 2: Transient thermal impedance
Z_{thJC} = f $_{(tp);}$ parameter : D = tp / T

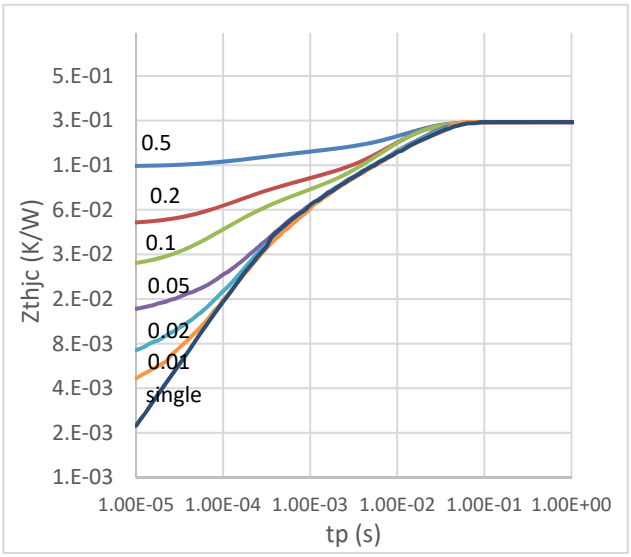


Fig 3: Safe operating area
I_D= f $_{(VDS)}$, D = 0, TC=25℃; parameter : tp, V_{GS} > 7.5V

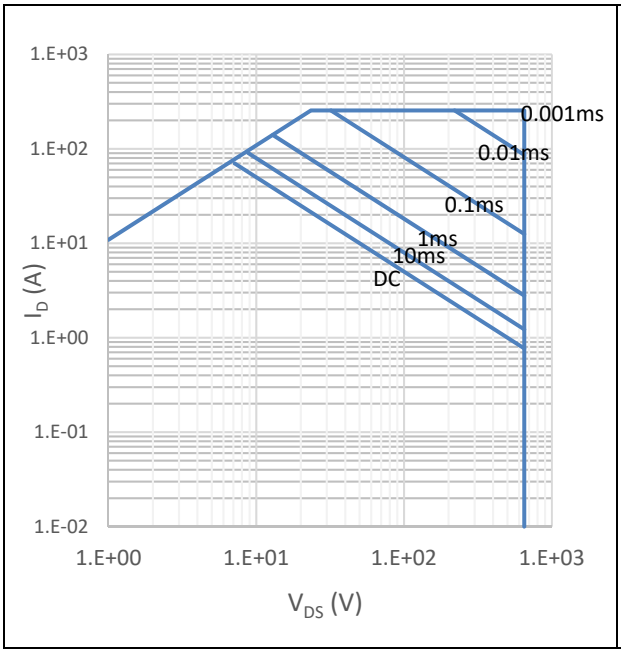


Fig 4: Typ. output characteristics
I_D = f $_{(VDS)}$; Tj = 25℃; parameter: V_{GS}

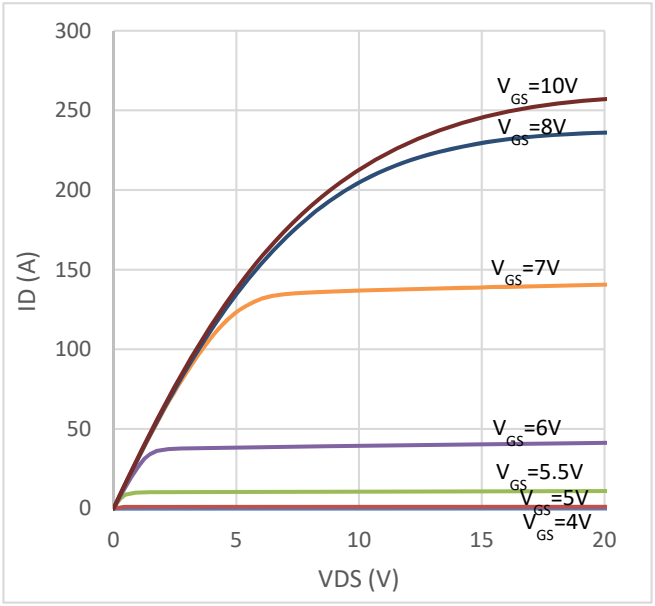


Fig 5: Typ. output characteristics
ID = f (V_{DS}) ; Tj = 125℃; parameter: V_{GS}

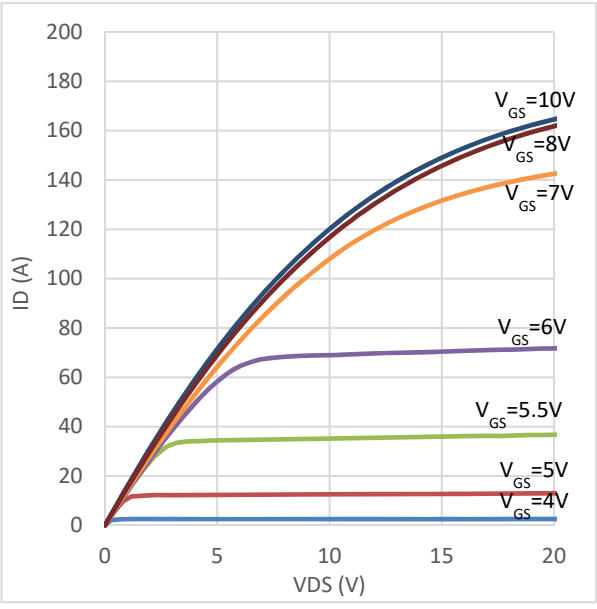


Fig 6: Forward characteristics of body diode
IF = f(V_{SD}); parameter : Tj

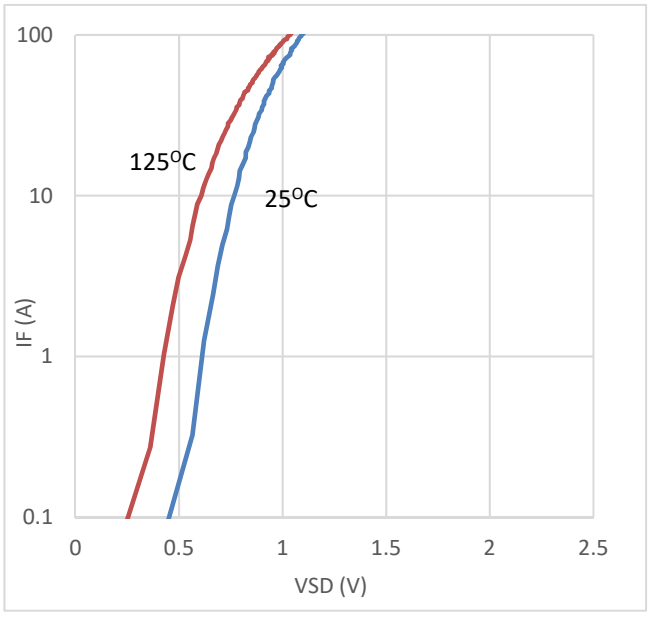


Fig 7: Typ. Drain source on-resistance
$R_{DS(on)}$= f (I_D), Tj = 125℃; parameter : V_{GS}

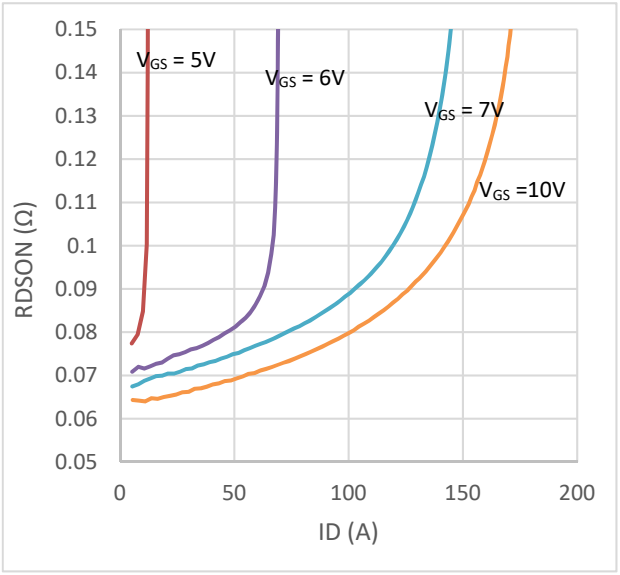


Fig 8: Drain-source on-state resistance
$R_{DS(on)}$ = f (Tj), ID = 34A, V_{GS} = 10V

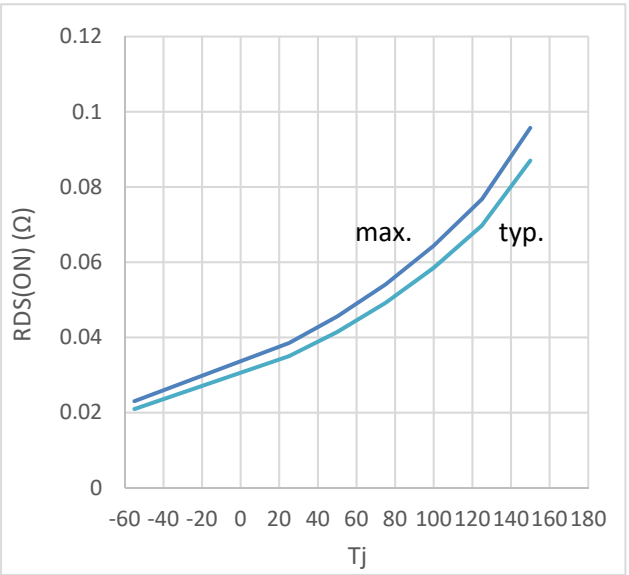


Fig 9: Typ. transfer characteristics
I_D = f (V_{GS}); V_{DS} = 20V; parameter : Tj

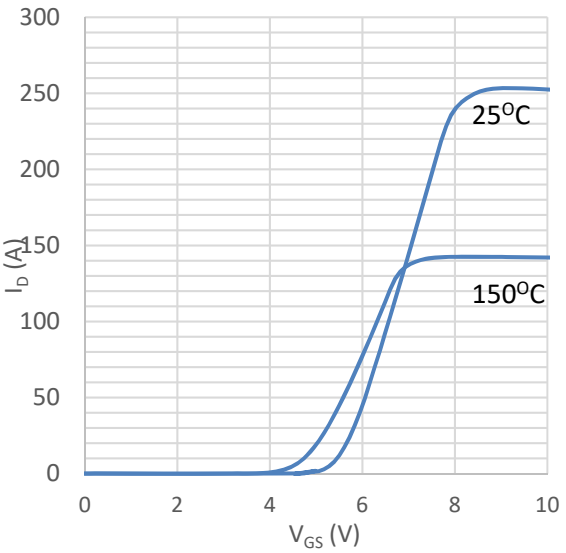


Fig 10: Typ. gate charge
V_{GS} = f(Q_{GATE}); I_D = 50A pulsed parameter : V_{DD}

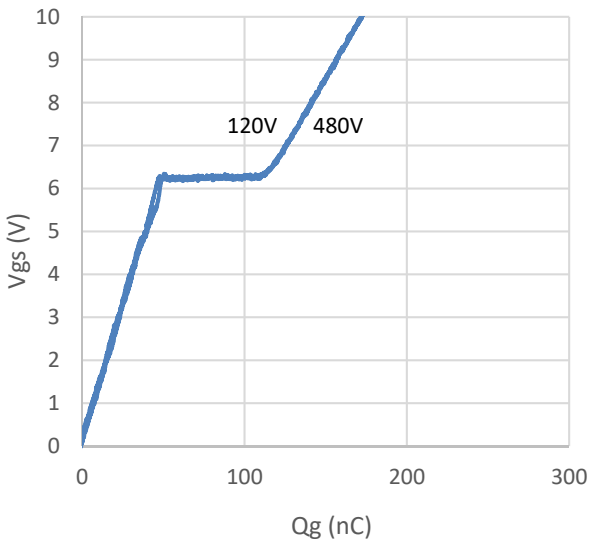


Fig 11: Avalanche energy
E_{AS} = f(Tj); I_D = 13.7A; V_{DD} = 50A

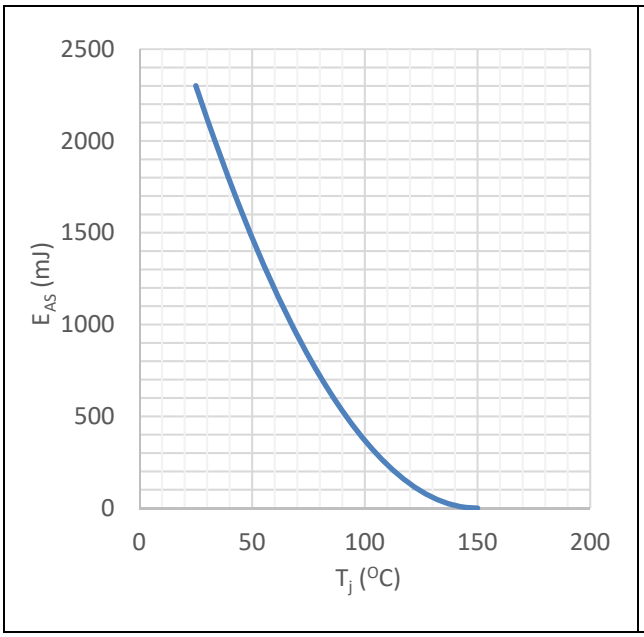


Fig 12: Typ. coss stored energy
E_{oss} = f (V_{DS})

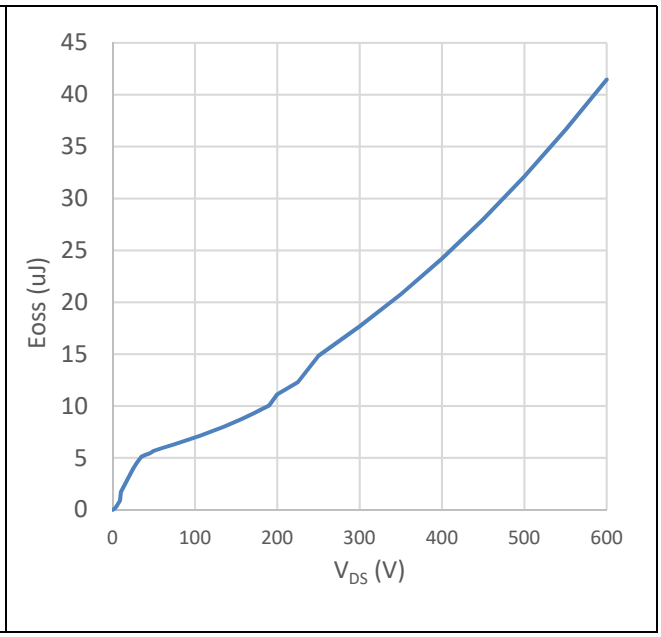
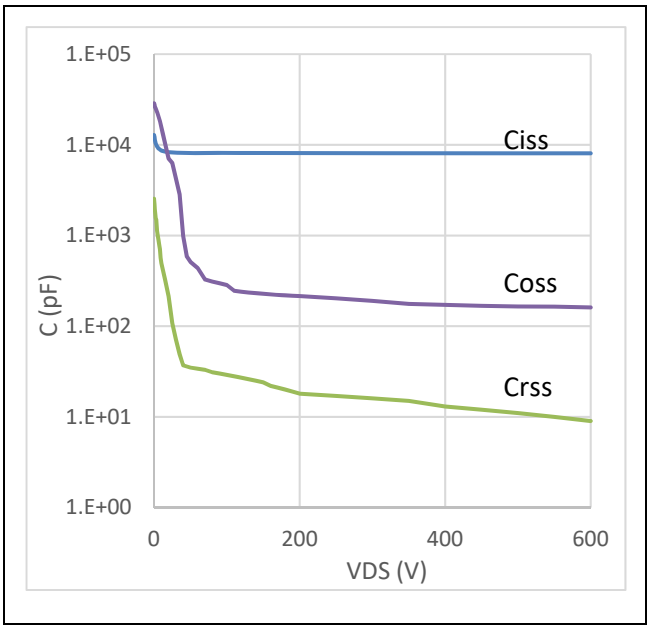


Fig 13: Typ. Capacitances
C = f (V_{DS}) parameter : V_{GS} = 0V, f = 1MHz



Test Circuit
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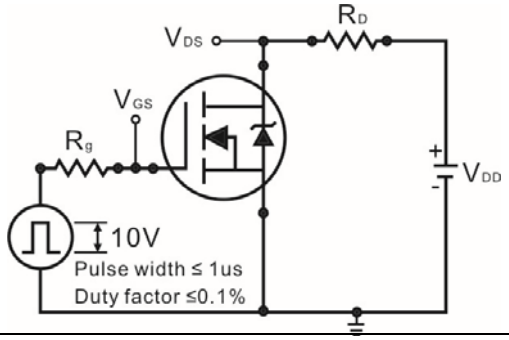
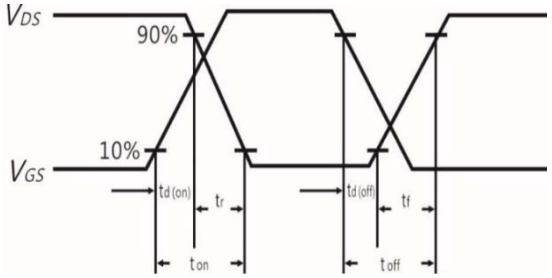
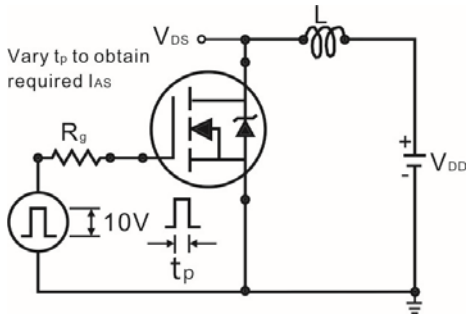
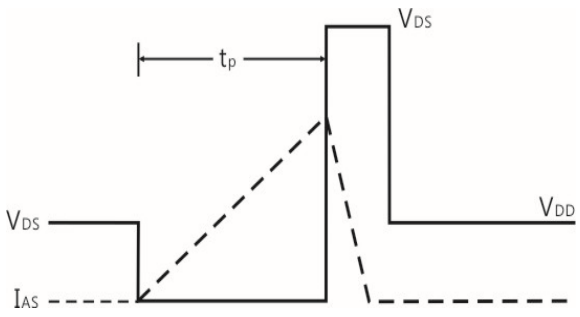
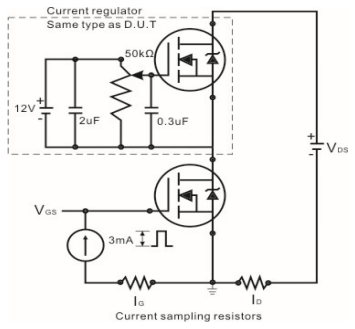
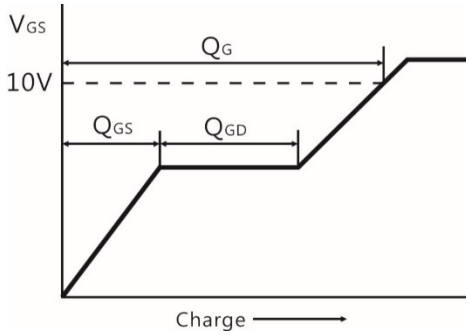
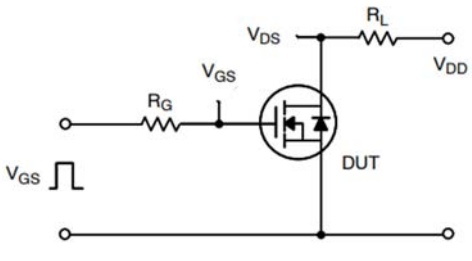
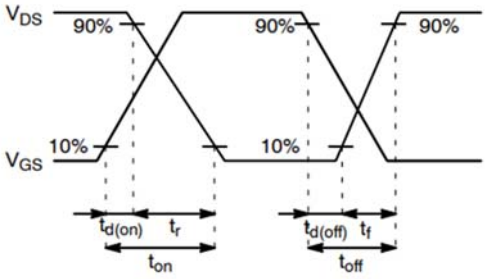
Unclamped test circuit	Unclamped test waveform
	

Gate charge test circuit	Basic gate charge waveform
	

Diode recovery test circuit	Diode recovery test waveform
	

Switching test circuit (resistor load)	Switching test waveform
	

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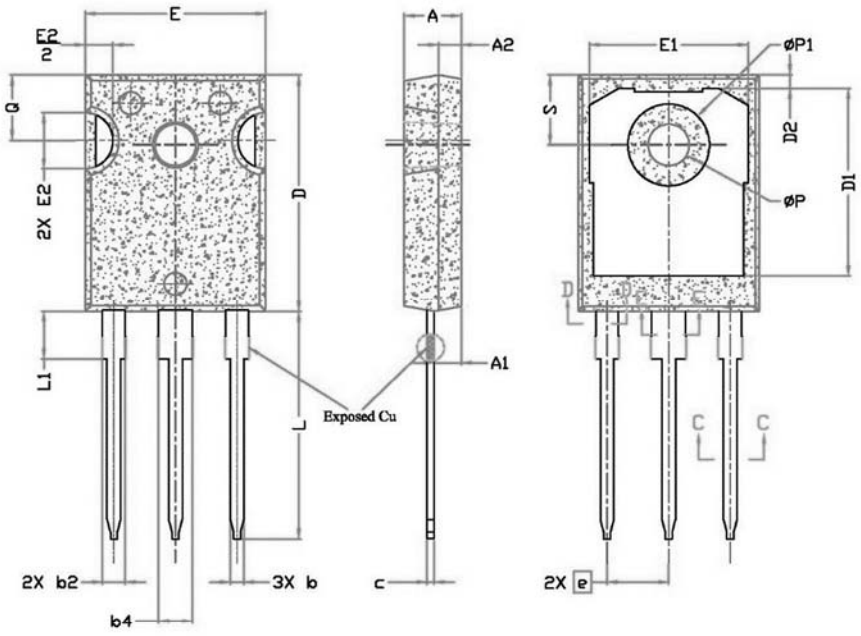
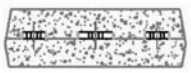
Package outline





Note:
1. Package Reference: JEDEC TO247, Variation AD.
2. All Dimensions Are In mm.
3. Slot Required, Notch May Be Rounded
4. Dimension D & E Do Not Include Mold Flash. Mold Flash Shall Not Exceed 0.127mm Pre Side. These Dimensions Are Measured At The Outermost Extreme Of The Plastic Body.
5. Thermal Pad Contour Optional Within Dimension D1 & E1.
6. Lead Finish Uncontrolled In L1.
7. ØP To Have A Maximum Draft Angle Of 1.5° To The Top Of The Part With A Maximum Hole Diameter Of 3.91mm.
8. Dimension "b2" And "b4" Does Not Include Dambar Protrusion. Allowable Dambar Protrusion Shall Be 0.10mm Total In Excess Of "b2" And "b4" Dimension At Maximum Material Condition.

SYMBOL	DIMENSIONS			NOTES
	MIN.	NOM.	MAX.	
A	4.83	5.02	5.21	
A1	2.29	2.41	2.55	
A2	1.50	2.00	2.49	
b	1.12	1.20	1.33	
b1	1.12	1.20	1.28	
b2	1.91	2.00	2.39	6
b3	1.91	2.00	2.34	
b4	2.87	3.00	3.22	6, 8
b5	2.87	3.00	3.18	
c	0.55	0.60	0.69	6
c1	0.55	0.60	0.65	
D	20.80	20.95	21.10	4
D1	16.25	16.55	17.65	5
D2	0.51	1.19	1.35	
E	15.75	15.94	16.13	4
E1	13.46	14.02	14.16	5
E2	4.32	4.91	5.49	3
e	5.44BSC			
L	19.81	20.07	20.32	
L1	4.10	4.19	4.40	6
ØP	3.56	3.61	3.65	7
ØP1	7.19REF.			
Q	5.39	5.79	6.20	
S	6.04	6.17	6.30	