



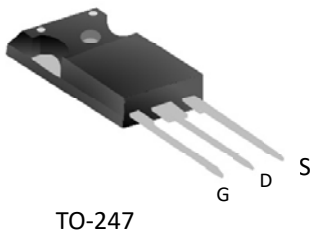
650V N-Channel Power MOSFET

Product Summary

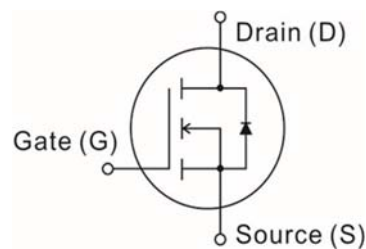
Parameter	Value	Unit
$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on),max} @ V_{GS} = 10\text{ V}$	48	mΩ
$I_D @ V_{GS} = 10\text{ V}$	60	A
P_{tot}	350	W

Features

- * Low on-resistance
- * Low switching losses
- * Excellent FOM
- * Excellent stability and uniformity



TO-247



Application

- * PC power
- * Server power
- * EV charger
- * LED lighting
- * UPS

Maximum ratings $T_A = 25^\circ\text{C}$ unless otherwise noted			
Parameter	Symbol	Limit	Unit
Drain - source voltage	V_{DS}	650	V
Continuous drain current	I_D	$T_C @ 25^\circ\text{C}$	60
		$T_C @ 100^\circ\text{C}$	35
Pulsed drain current t_p limited by T_j max (Note 1)	I_D pulsed	240	A
Single pulse avalanche energy (Note 2)	E_{AS}	900	mJ
Gate-source voltage	V_{GS}	± 30	V
Power dissipation	P_{tot}	350	W
Storage temperature range	T_{STG}	- 55 to +150	$^\circ\text{C}$
Operating junction temperature range	T_j	- 55 to +150	$^\circ\text{C}$



650V N-Channel Power MOSFET

Electrical characteristics $T_A = 25^\circ\text{C}$ unless otherwise specified						
Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Off characteristics						
Drain-source breakdown voltage	$V_{GS} = 0\text{V}, I_D = 1\text{mA}$	BV_{DSS}	650	---	---	V
Gate-source leakage	$V_{GS} = \pm 30\text{V}, V_{DS}=0\text{V}$	I_{GSS}	---	---	± 100	nA
Zero gate voltage drain current	$V_{DS}= 650\text{V}, V_{GS}= 0\text{V}, T_j=25^\circ\text{C}$	I_{DSS}	---	---	1	μA
On characteristics						
Drain-source on-state resistance	$V_{GS} = 10\text{V}, I_D = 30\text{A}, T_j=25^\circ\text{C}$	$R_{DS(on)}$	---	43	48	$\text{m}\Omega$
Gate-source threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	$V_{GS(th)}$	3	4	5	V
Gate resistance	$f = 1\text{MHz}, \text{open drain}$	R_G	---	3.2	---	Ω
Dynamic and switching characteristics-						
Gate-source charge	$V_{DD} = 400\text{V}, I_D = 30\text{A}$ $V_{GS} = 0 \text{ to } 10\text{V}$	Q_{gs}	---	35	---	nC
Gate-drain charge		Q_{gd}	---	45	---	
Gate charge total		Q_g	---	110	---	
Turn-on delay time	$V_{DD} = 400\text{V}, I_D = 30\text{A}$ $V_{GS} = 10\text{V}, R_G = 1.8\Omega$	$t_{d(on)}$	---	15	---	ns
Rise time		t_r	---	35	---	
Turn-off delay time		$t_{d(off)}$	---	87	---	
Fall time		t_f	---	6	---	
Input capacitance	$V_{GS} = 0\text{V}, V_{DS} = 35\text{V},$ $f = 1\text{MHz}$	C_{iss}	---	5300	---	pF
Output capacitance		C_{oss}	---	230	---	

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-source diode characteristics and maximum ratings						
Inverse diode forward voltage	$I_S = 30\text{A}, V_{GS} = 0\text{V}$	V_{SD}	---	0.95	1.5	V
Reverse recovery time	$V_R = 400\text{V}, I_F = 30\text{A},$ $di_F / dt = 100\text{A} / \mu\text{S}$	t_{rr}	---	180	---	ns
Reverse recovery charge		Q_{rr}	---	1.3	---	μC

Notes:

1. Repetitive rating : pulsed width limited by maximum junction temperature.
2. $V_{DD}=50\text{V}$, starting $T_j=25^\circ\text{C}$.



650V N-Channel Power MOSFET

Thermal characteristics			
Thermal resistance junction-to-case	R _{thJC}	0.36	°C / W
Thermal resistance junction-to-ambient	R _{thJA}	40	

Package Marking and Ordering Information

Type / Ordering Code	Package	Packaging	Related Links
I3JA60N65QS	TO-247	Tube	see Package Outline

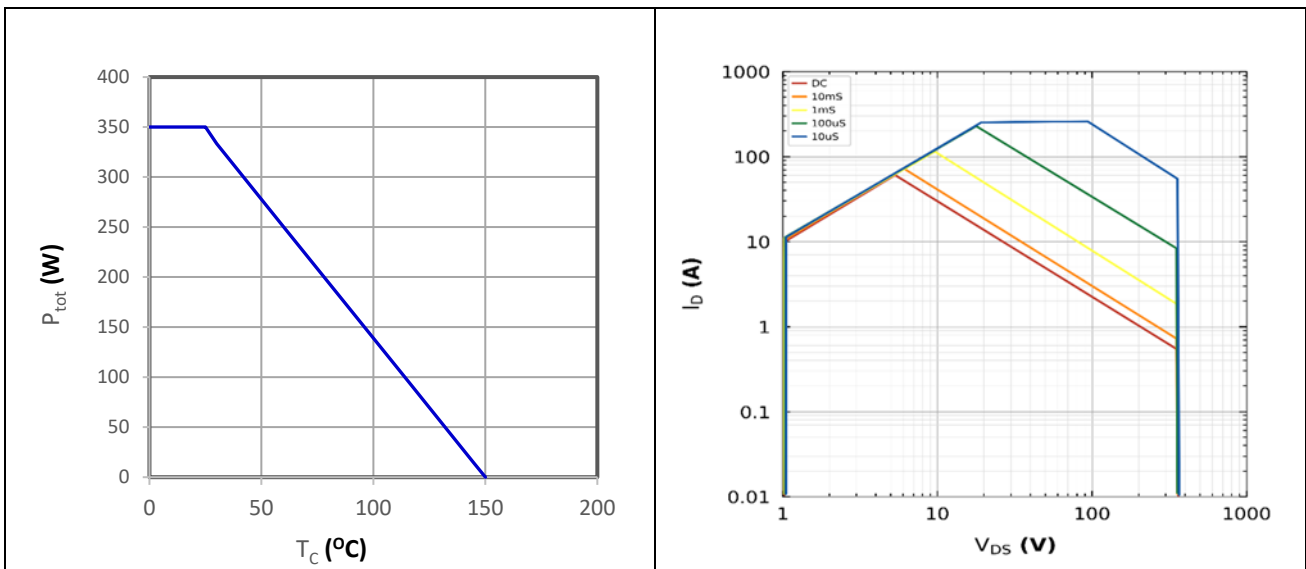
Electrical Characteristics Diagrams

Fig 1: Power dissipation

$P_{tot} = f(T_c)$

Fig 2: Safe operating area

$I_D = f(V_{DS})$; $V_{GS} > 10V$, $D = 0$, $T_c = 25^\circ C$; parameter : tp





650V N-Channel Power MOSFET

Fig 3: Typ. transfer characteristics

$I_D = f(V_{GS})$; $V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$, $T_j = 25^\circ C$

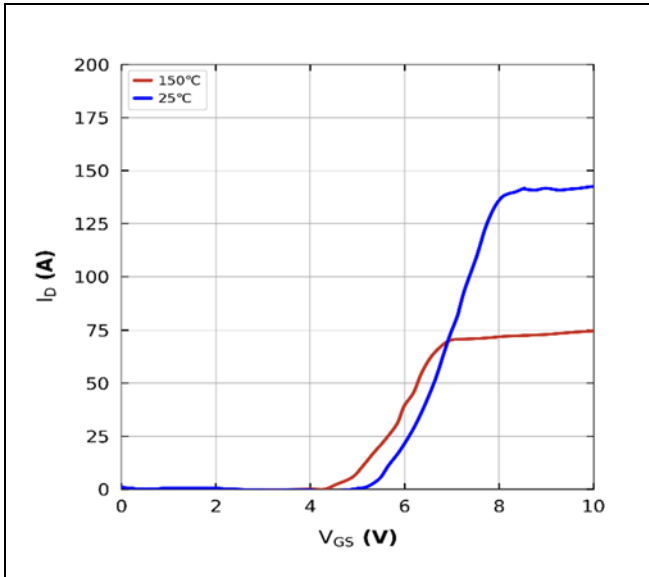


Fig 4: Typ. output characteristics

$I_D = f(V_{DS})$; $T_j = 25^\circ C$; parameter: V_{GS}

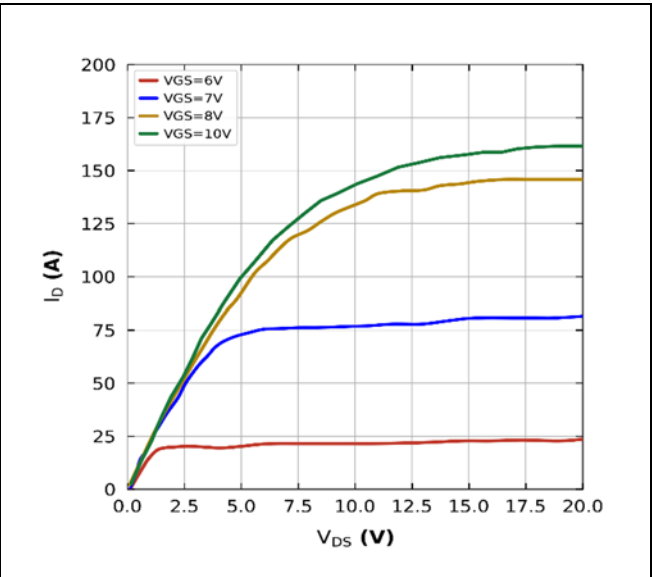


Fig 5: Forward characteristics of body diode

$I_F = f(V_{SD})$; parameter: T_j

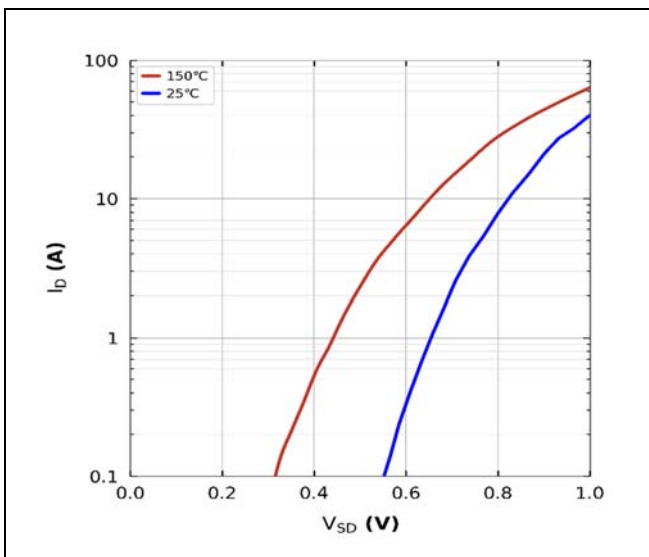
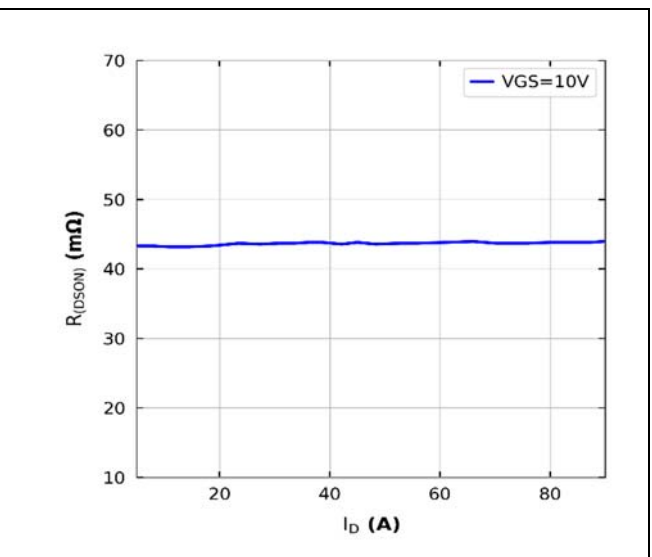


Fig 6: Typ. drain source on-resistance

$R_{DS(on)} = f(I_D)$; $T_j = 25^\circ C$; parameter: V_{GS}





650V N-Channel Power MOSFET

Fig 7: Drain-source on-state resistance

$R_{DS(on)} = f(T_j)$; $I_D = 30A$, $V_{GS} = 10V$

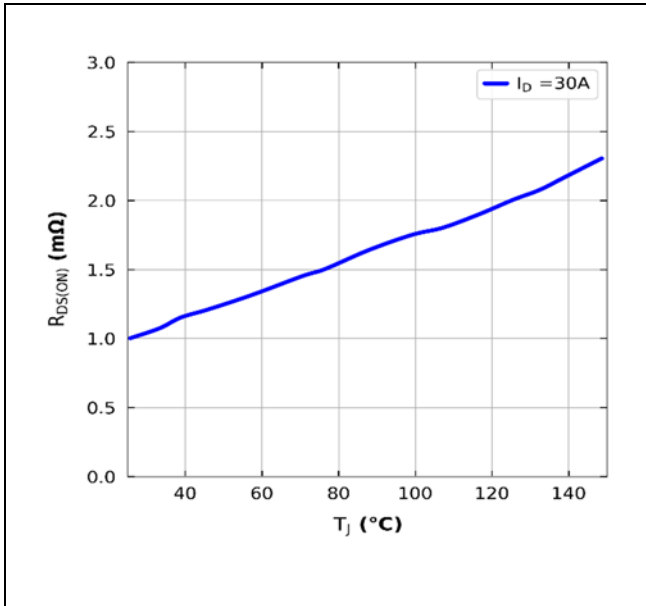


Fig 8: Typ. capacitances

$C = f(V_{DS})$; parameter: $V_{GS} = 0V$, $f = 1MHz$

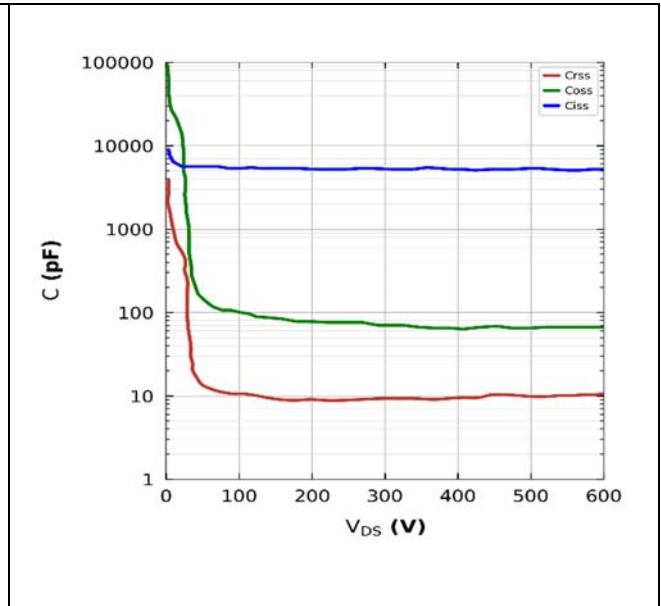
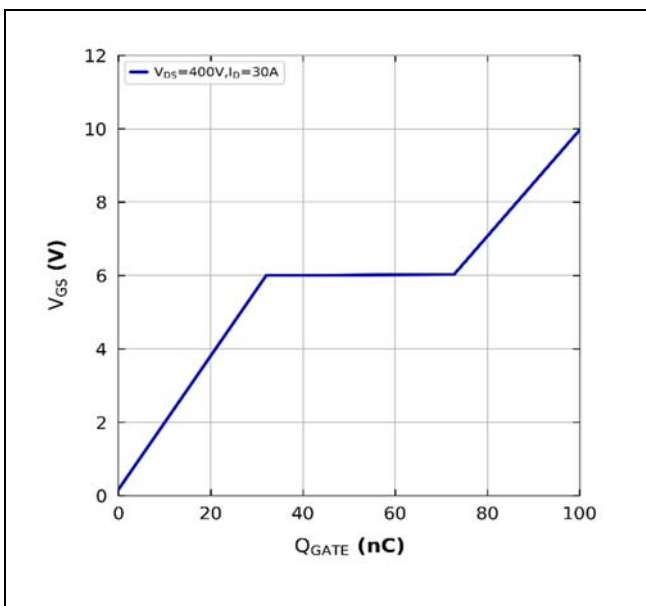


Fig 9: Typ. gate charge

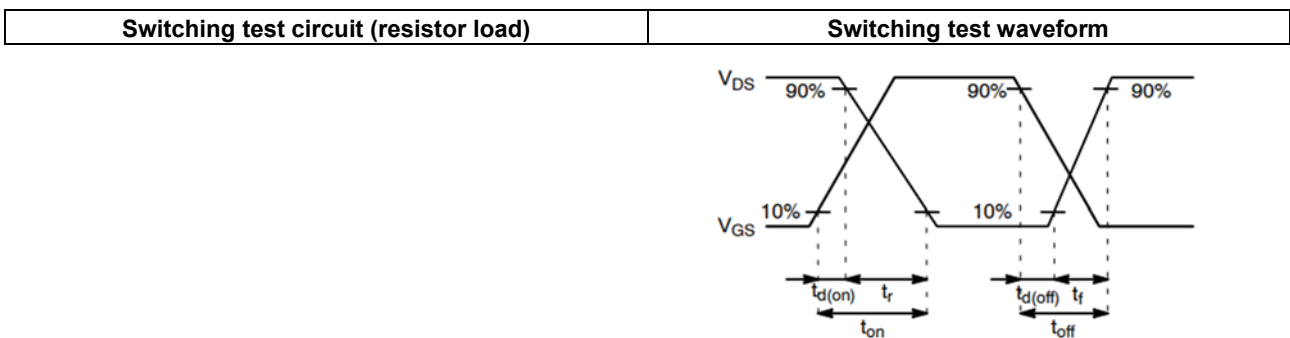
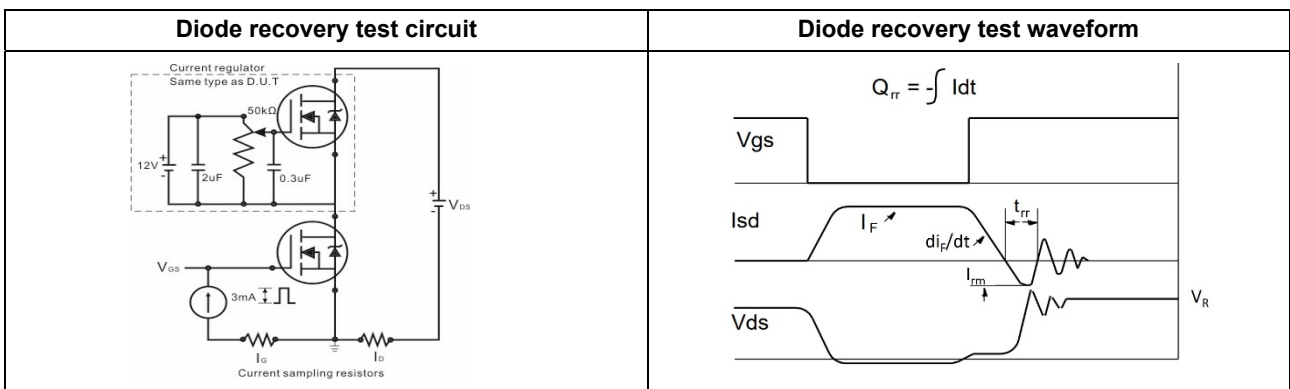
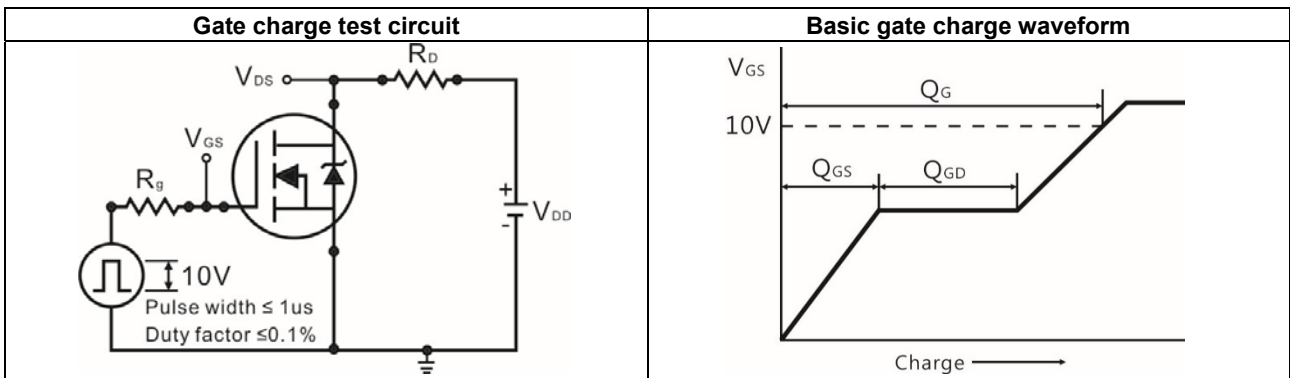
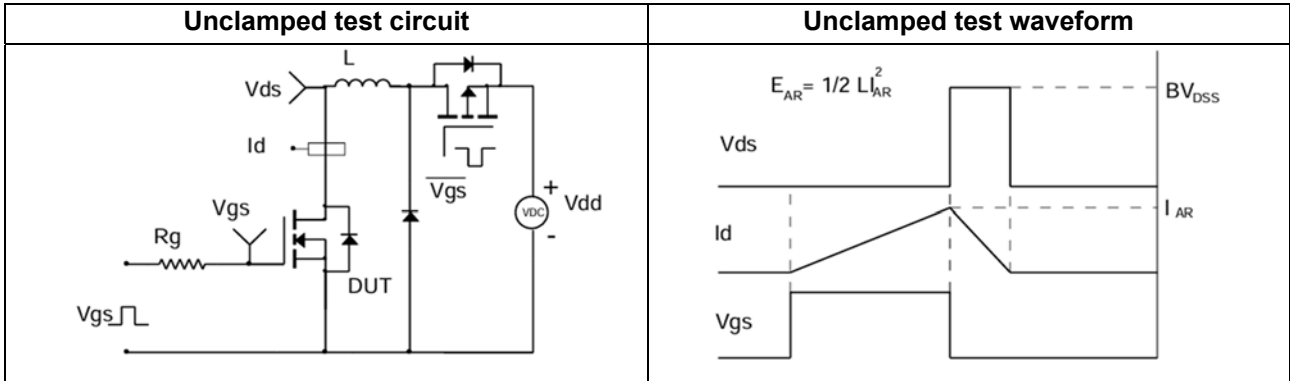
$V_{GS} = f(Q_{GATE})$; $I_D = 30A$ pulsed





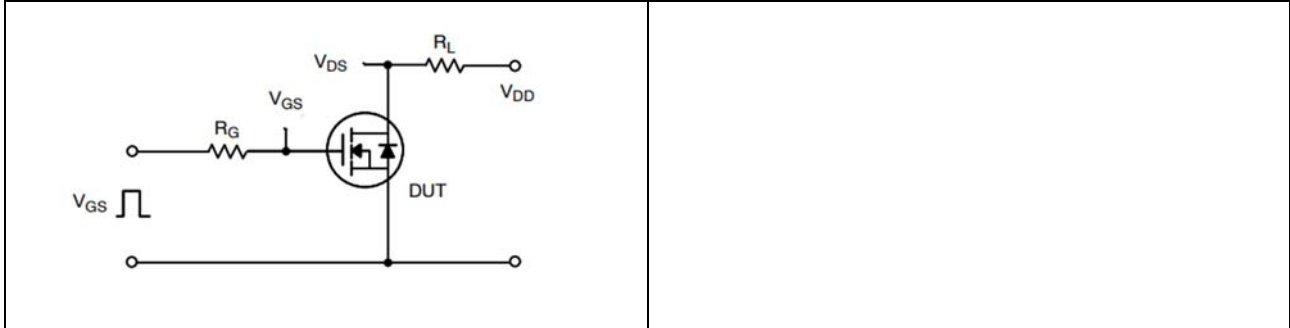
650V N-Channel Power MOSFET

Test Circuit

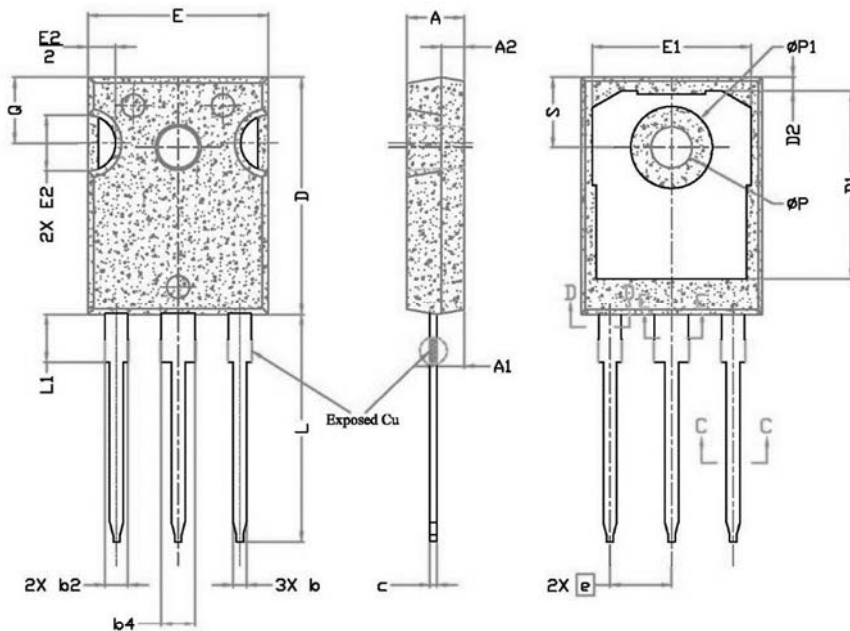




650V N-Channel Power MOSFET



Package Outline



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
a	5.44BSC			
L	19.81	20.07	20.32	
L1	4.10	4.18	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	

- 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.