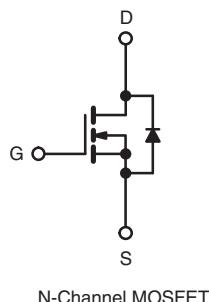
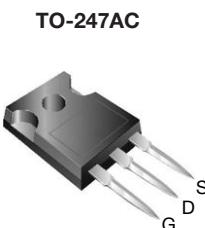


Power MOSFET

PRODUCT SUMMARY	
V _{DS} (V)	500
R _{DSON} (Ω)	V _{GS} = 10 V 0.190
Q _g (Max.) (nC)	150
Q _{gs} (nC)	44
Q _{gd} (nC)	72
Configuration	Single



N-Channel MOSFET



RoHS*
COMPLIANT

FEATURES

- Superfast Body Diode Eliminates the Need for External Diodes in ZVS Applications
- Lower Gate Charge Results in Simpler Drive Requirements
- Enhanced dV/dt Capabilities Offer Improved Ruggedness
- Higher Gate Voltage Threshold Offers Improved Noise Immunity
- Compliant to RoHS Directive 2002/95/EC

APPLICATIONS

- Zero Voltage Switching SMPS
- Telecom and Server Power Supplies
- Uninterruptible Power Supplies
- Motor Control Applications

ORDERING INFORMATION

Package	TO-247AC
Lead (Pb)-free	IRFP23N50LPbF SiHFP23N50L-E3
SnPb	IRFP23N50L SiHFP23N50L

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V _{DS}	500	V
Gate-Source Voltage	V _{GS}	± 30	
Continuous Drain Current	V _{GS} at 10 V	T _C = 25 °C	I _D
		T _C = 100 °C	15
Pulsed Drain Current ^a	I _{DM}	92	A
Linear Derating Factor		2.9	W/°C
Single Pulse Avalanche Energy ^b	E _{AS}	410	mJ
Repetitive Avalanche Current ^a	I _{AR}	23	A
Repetitive Avalanche Energy ^a	E _{AR}	37	mJ
Maximum Power Dissipation	T _C = 25 °C	P _D	W
Peak Diode Recovery dV/dt ^c		dV/dt	V/ns
Operating Junction and Storage Temperature Range	T _J , T _{stg}	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s	300 ^d	
Mounting Torque	6-32 or M3 screw	10	lbf · in
		1.1	N · m

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. Starting T_J = 25 °C, L = 1.5 mH, R_g = 25 Ω, I_{AS} = 23 A (see fig. 12).

c. I_{SD} ≤ 23 A, dI/dt ≤ 650 A/μs, V_{DD} ≤ V_{DS}, T_J ≤ 150 °C.

d. 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS

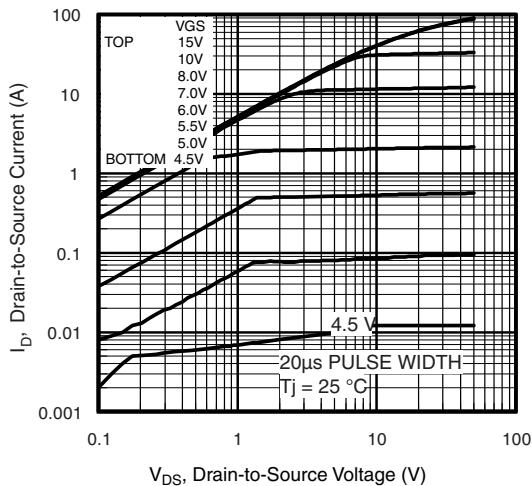
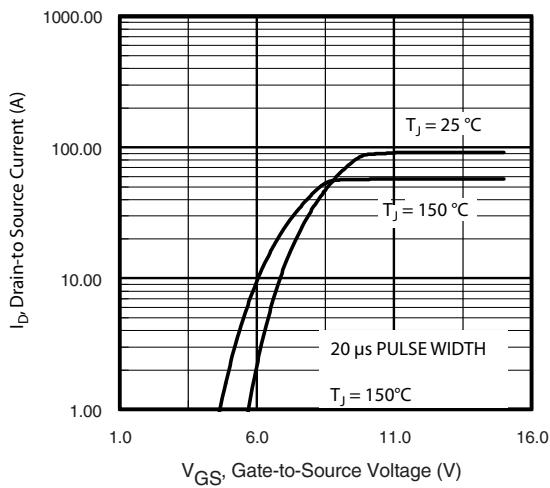
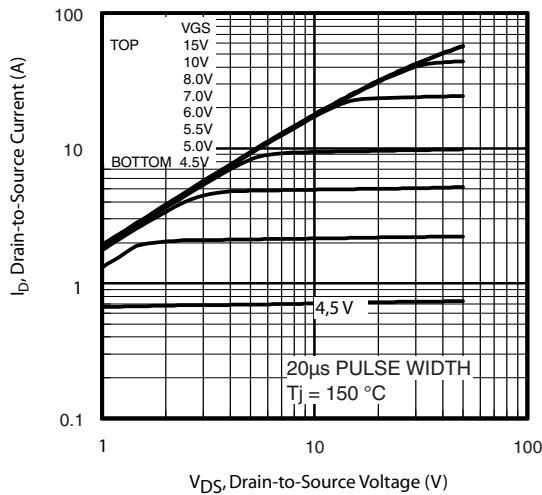
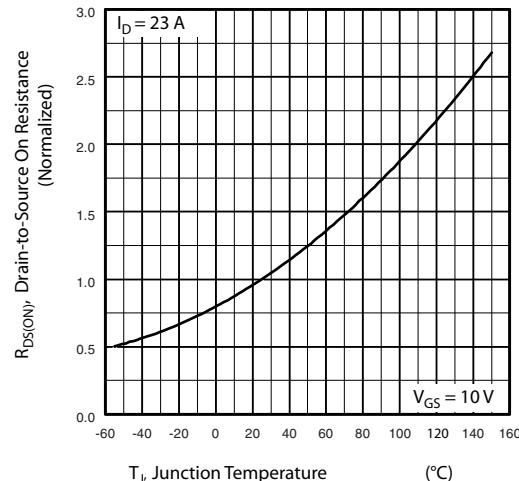
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	°C/W
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.24	-	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.34	

SPECIFICATIONS ($T_J = 25^\circ\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT	
Static								
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0 \text{ V}$	$I_D = 250 \mu\text{A}$	500	-	-	V	
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25°C , $I_D = 1 \text{ mA}^d$		-	0.27	-	$\text{V}/^\circ\text{C}$	
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$	$I_D = 250 \mu\text{A}$	3.0	-	5.0	V	
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 30 \text{ V}$		-	-	± 100	nA	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 500 \text{ V}$, $V_{GS} = 0 \text{ V}$		-	-	50	μA	
		$V_{DS} = 400 \text{ V}$, $V_{GS} = 0 \text{ V}$, $T_J = 125^\circ\text{C}$		-	-	2.0	mA	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10 \text{ V}$	$I_D = 14 \text{ A}^b$	-	0.190	0.235	Ω	
Forward Transconductance	g_{fs}	$V_{DS} = 50 \text{ V}$, $I_D = 14 \text{ A}^b$		12	-	-	S	
Dynamic								
Input Capacitance	C_{iss}	$V_{GS} = 0 \text{ V}$, $V_{DS} = 25 \text{ V}$, $f = 1.0 \text{ MHz}$, see fig. 5		-	3600	-	pF	
Output Capacitance	C_{oss}			-	380	-		
Reverse Transfer Capacitance	C_{rss}			-	37	-		
Output Capacitance	C_{oss}	$V_{GS} = 0 \text{ V}$		$V_{DS} = 1.0 \text{ V}$, $f = 1.0 \text{ MHz}$	-	4800	pF	
				$V_{DS} = 400 \text{ V}$, $f = 1.0 \text{ MHz}$	-	100		
Effective Output Capacitance	$C_{oss \text{ eff.}}$			$V_{DS} = 0 \text{ V}$ to 400 V^c	-	220		
Effective Output Capacitance (Energy Related)	$C_{oss \text{ eff. (ER)}}$			$V_{DS} = 0 \text{ V}$ to 400 V^d	-	160		
Internal Gate Resistance	R_G	$f = 1 \text{ MHz}$, open drain		-	1.2	-	Ω	
Total Gate Charge	Q_g	$V_{GS} = 10 \text{ V}$	$I_D = 23 \text{ A}$, $V_{DS} = 400 \text{ V}$ see fig. 6 and 13 ^b	-	-	150	nC	
Gate-Source Charge	Q_{gs}			-	-	44		
Gate-Drain Charge	Q_{gd}			-	-	72		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250 \text{ V}$, $I_D = 23 \text{ A}$ $R_g = 6.0$, $V_{GS} = 10 \text{ V}$ see fig. 10 ^b		-	26	-	ns	
Rise Time	t_r			-	94	-		
Turn-Off Delay Time	$t_{d(off)}$			-	53	-		
Fall Time	t_f			-	45	-		
Drain-Source Body Diode Characteristics								
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	23	A	
Pulsed Diode Forward Current ^a	I_{SM}			-	-	92		
Body Diode Voltage	V_{SD}	$T_J = 25^\circ\text{C}$, $I_S = 14 \text{ A}$, $V_{GS} = 0 \text{ V}^b$	-	-	1.5	V		
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25^\circ\text{C}$	$I_F = 23 \text{ A}$, $dI/dt = 100 \text{ A}/\mu\text{s}^b$	-	170	250	ns	
		$T_J = 125^\circ\text{C}$		-	220	330		
Body Diode Reverse Recovery Charge	Q_{rr}	$T_J = 25^\circ\text{C}$		-	560	840	μC	
		$T_J = 125^\circ\text{C}$		-	980	1500		
Reverse Recovery Current	I_{RRM}	$T_J = 25^\circ\text{C}$		-	7.6	11	A	
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)						

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. Pulse width $\leq 300 \mu\text{s}$; duty cycle $\leq 2 \%$.
c. $C_{oss \text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS} .
d. $C_{oss \text{ eff. (ER)}}$ is a fixed capacitance that stores the same energy time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS} .

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Fig. 1 - Typical Output Characteristics

Fig. 3 - Typical Transfer Characteristics

Fig. 2 - Typical Output Characteristics

Fig. 4 - Normalized On-Resistance vs. Temperature

IRFP23N50L, SiHFP23N50L

Vishay Siliconix

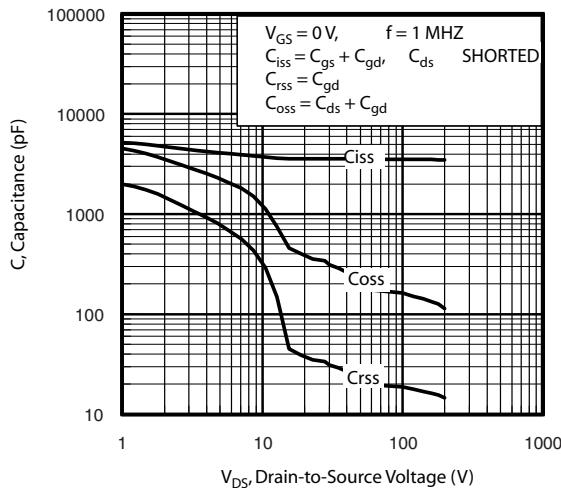


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

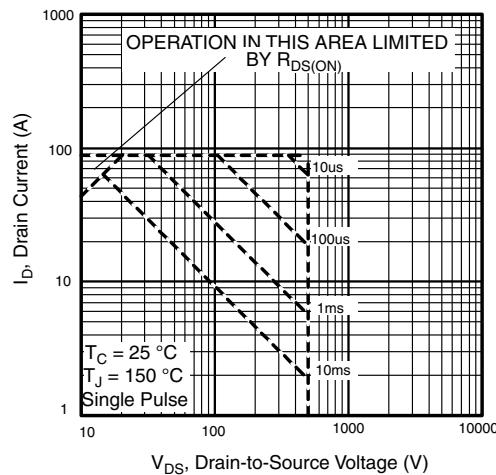


Fig. 7 - Maximum Safe Operating Area

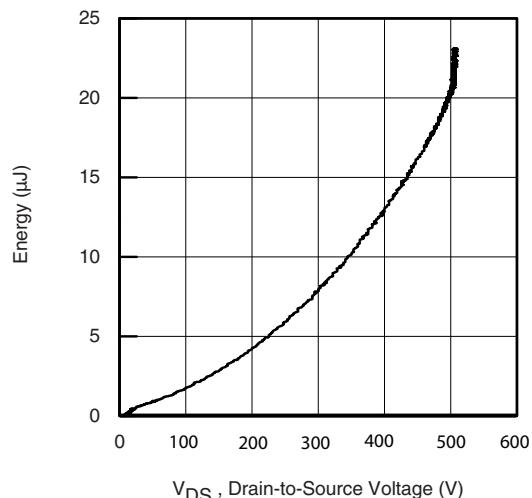


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

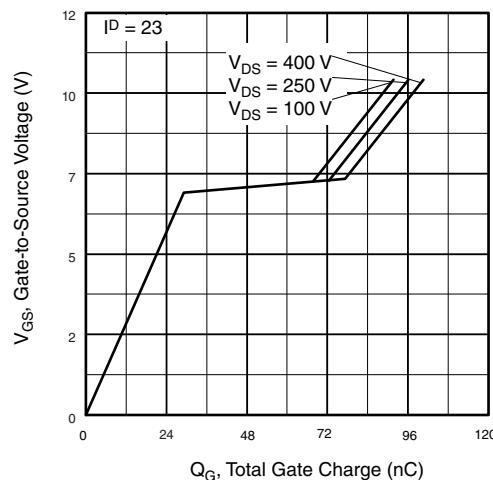
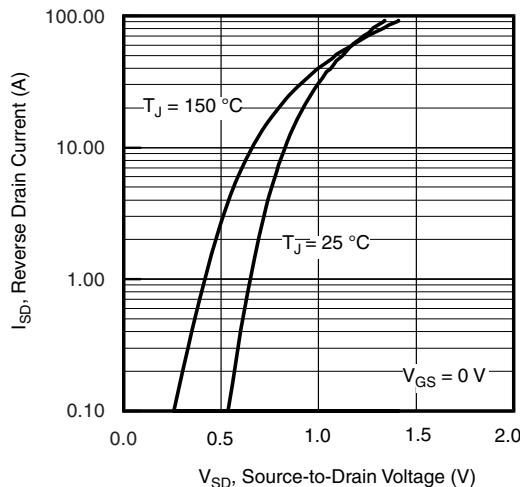
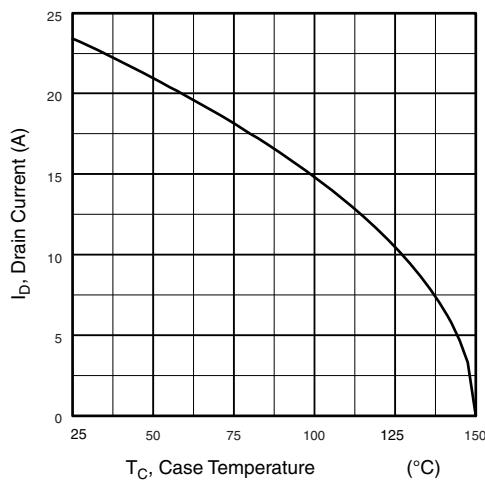
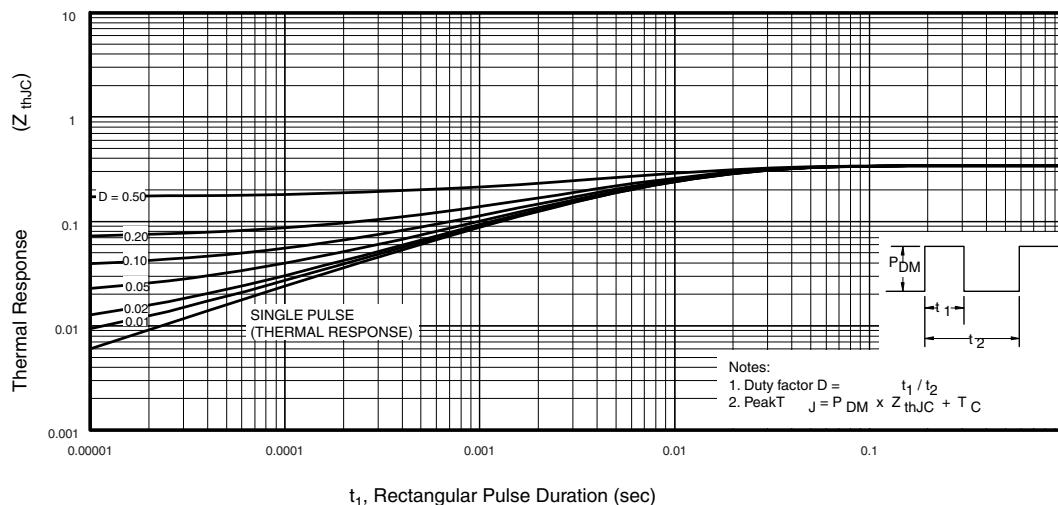


Fig. 8 - Typical Gate Charge vs. Gate-to-Source Voltage


Fig. 9 - Typical Source-Drain Diode Forward Voltage

Fig. 10 - Maximum Drain Current vs. Case Temperature

Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

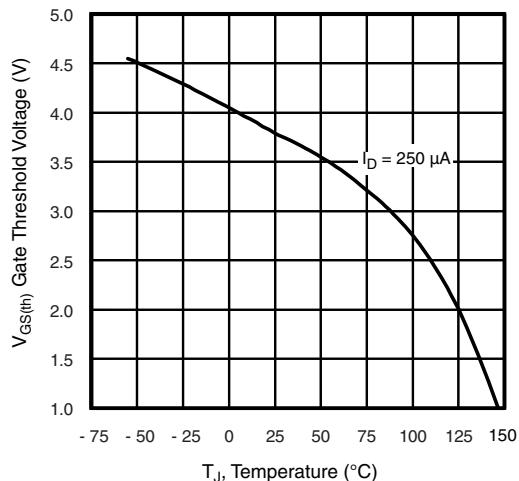


Fig. 13 - Threshold Voltage vs. Temperature

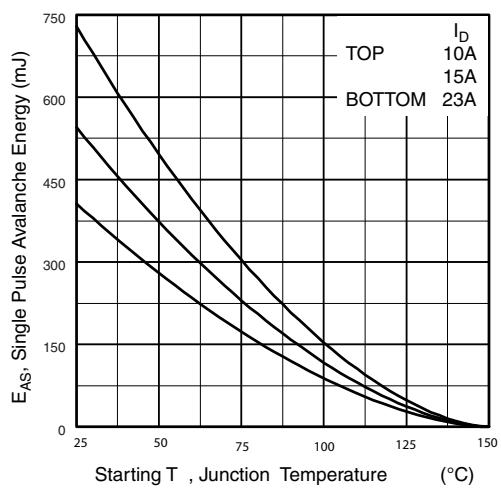


Fig. 14 - Maximum Avalanche Energy s. Drain Current

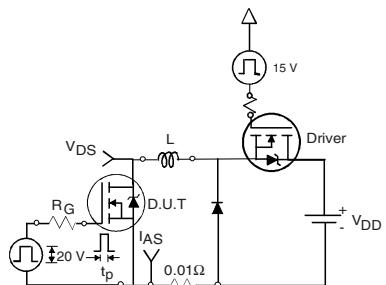


Fig. 15a - Unclamped Inductive Test Circuit

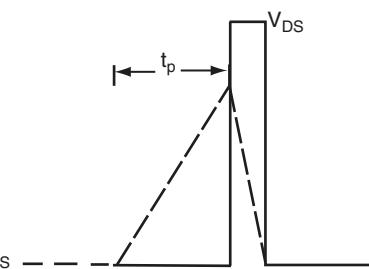


Fig. 15b - Unclamped Inductive Waveforms

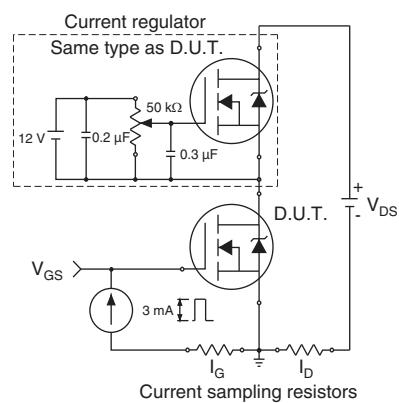


Fig. 16a - Gate Charge Test Circuit

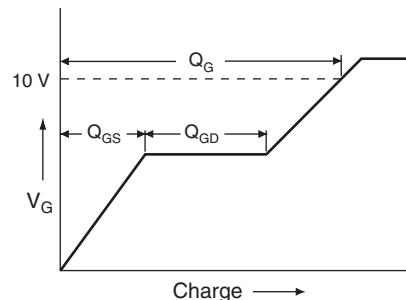
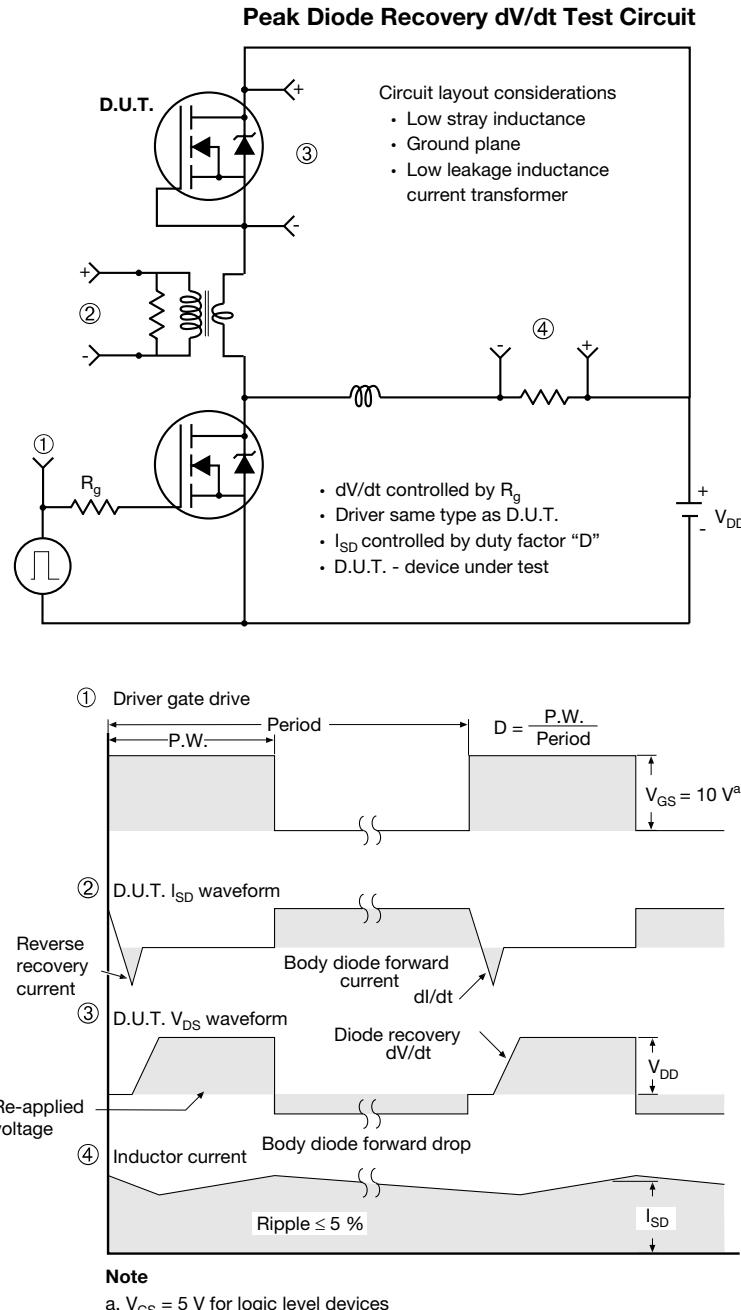


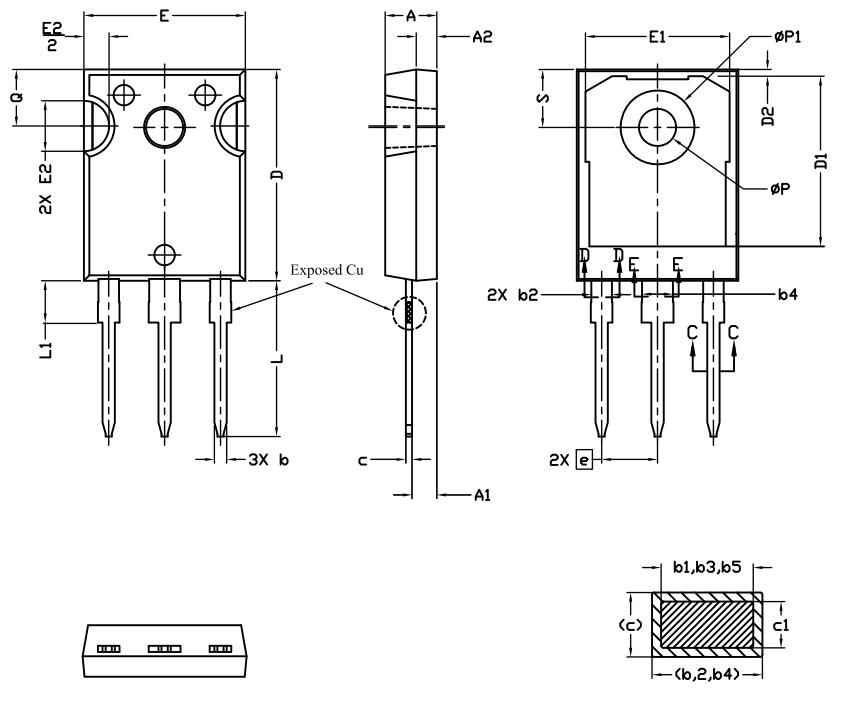
Fig. 16b - Basic Gate Charge Waveform


Fig. 17 - For N-Channel

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TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



Section C--C, D--D, E--E

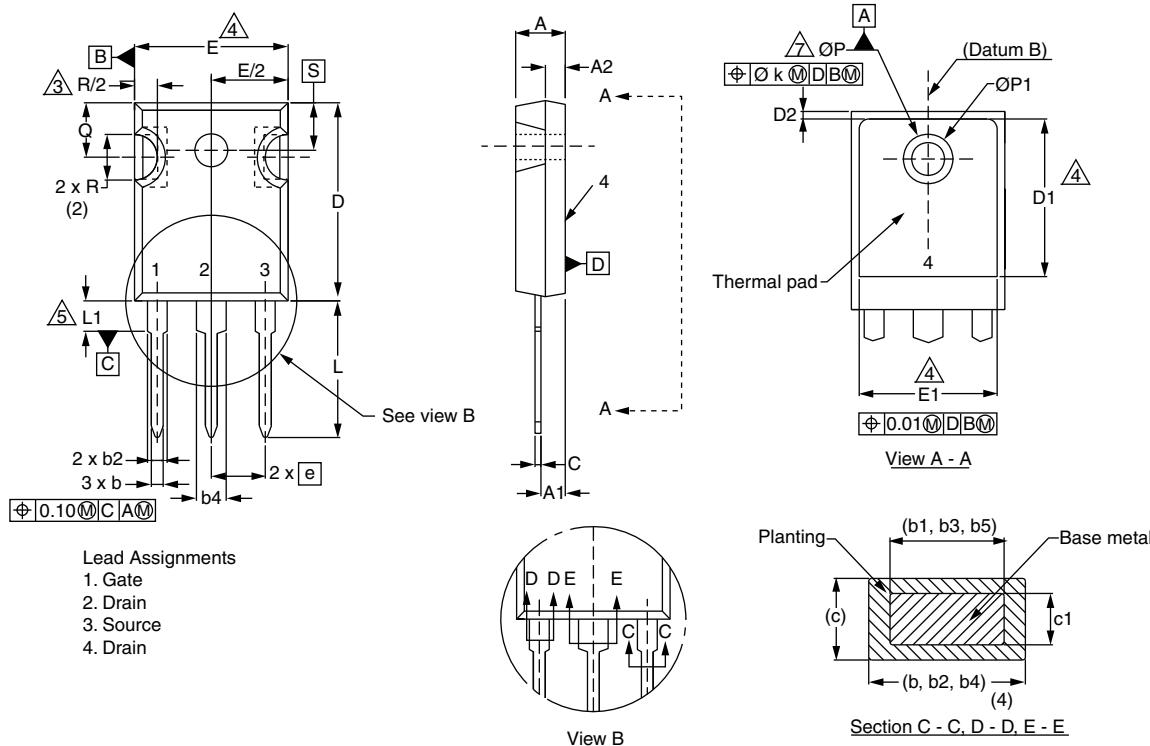
MILLIMETERS			
DIM.	MIN.	MAX.	NOTES
A	4.83	5.21	
A1	2.29	2.55	
A2	1.50	2.49	
b	1.12	1.33	
b1	1.12	1.28	
b2	1.91	2.39	6
b3	1.91	2.34	
b4	2.87	3.22	6, 8
b5	2.87	3.18	
c	0.55	0.69	6
c1	0.55	0.65	
D	20.40	20.70	4

MILLIMETERS			
DIM.	MIN.	MAX.	NOTES
D1	16.25	16.85	5
D2	0.56	0.76	
E	15.50	15.87	4
E1	13.46	14.16	5
E2	4.52	5.49	3
e	5.44 BSC		
L	14.90	15.40	
L1	3.96	4.16	6
Ø P	3.56	3.65	7
Ø P1	7.19 ref.		
Q	5.31	5.69	
S	5.54	5.74	

Notes

- Notes**

 - (1) Package reference: JEDEC® TO247, variation AC
 - (2) All dimensions are in mm
 - (3) Slot required, notch may be rounded
 - (4) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outermost extremes of the plastic body
 - (5) Thermal pad contour optional with dimensions D1 and E1
 - (6) Lead finish uncontrolled in L1
 - (7) Ø P to have a maximum draft angle of 1.5° to the top of the part with a maximum hole diameter of 3.91 mm
 - (8) Dimension b2 and b4 does not include dambar protrusion. Allowable dambar protrusion shall be 0.1 mm total in excess of b2 and b4 dimension at maximum material condition

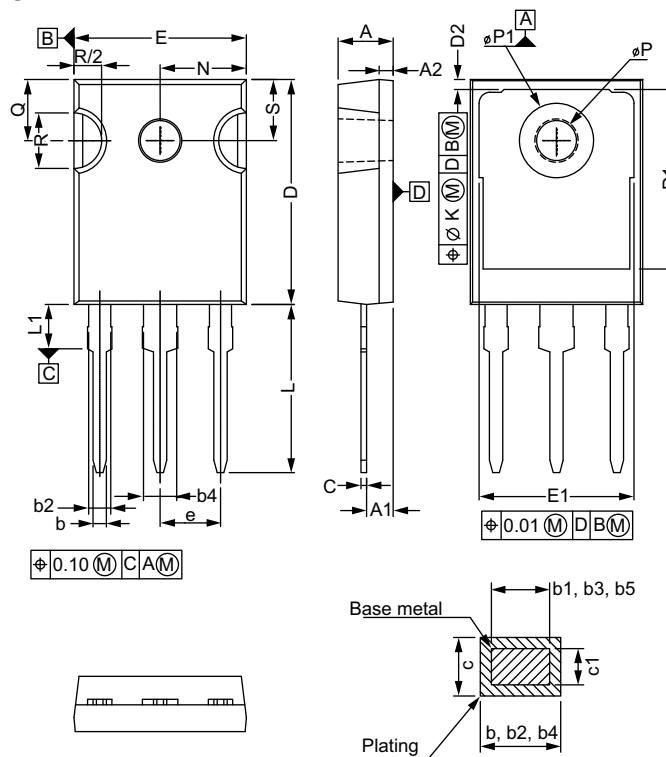
VERSION 2: FACILITY CODE = Y


MILLIMETERS			
DIM.	MIN.	MAX.	NOTES
A	4.58	5.31	
A1	2.21	2.59	
A2	1.17	2.49	
b	0.99	1.40	
b1	0.99	1.35	
b2	1.53	2.39	
b3	1.65	2.37	
b4	2.42	3.43	
b5	2.59	3.38	
c	0.38	0.86	
c1	0.38	0.76	
D	19.71	20.82	
D1	13.08	-	

MILLIMETERS			
DIM.	MIN.	MAX.	NOTES
D2	0.51	1.30	
E	15.29	15.87	
E1	13.72	-	
e	5.46 BSC		
Ø k	0.254		
L	14.20	16.25	
L1	3.71	4.29	
Ø P	3.51	3.66	
Ø P1	-	7.39	
Q	5.31	5.69	
R	4.52	5.49	
S	5.51 BSC		

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC outline TO-247 with exception of dimension c

VERSION 3: FACILITY CODE = N


MILLIMETERS		
DIM.	MIN.	MAX.
A	4.65	5.31
A1	2.21	2.59
A2	1.17	1.37
b	0.99	1.40
b1	0.99	1.35
b2	1.65	2.39
b3	1.65	2.34
b4	2.59	3.43
b5	2.59	3.38
c	0.38	0.89
c1	0.38	0.84
D	19.71	20.70
D1	13.08	-

ECN: E20-0545-Rev. F, 19-Oct-2020

DWG: 5971

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")

MILLIMETERS		
DIM.	MIN.	MAX.
D2	0.51	1.35
E	15.29	15.87
E1	13.46	-
e	5.46 BSC	
k	0.254	
L	14.20	16.10
L1	3.71	4.29
N	7.62 BSC	
P	3.56	3.66
P1	-	7.39
Q	5.31	5.69
R	4.52	5.49
S	5.51 BSC	



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