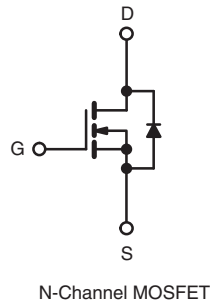
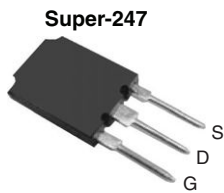


## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	500	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10$ V	0.087
$Q_g$ (Max.) (nC)	380	
$Q_{gs}$ (nC)	80	
$Q_{gd}$ (nC)	190	
Configuration	Single	



### 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



**RoHS\***  
COMPLIANT

### APPLICATIONS

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

ORDERING INFORMATION	
Package	Super-247
Lead (Pb)-free	IRFPS40N50LPbF
	SiHFPS40N50L-E3
SnPb	IRFPS40N50L
	SiHFPS40N50L

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise noted)				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	$V_{DS}$	500	V	
Gate-Source Voltage	$V_{GS}$	$\pm 30$		
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25^\circ\text{C}$	A	
		$T_C = 100^\circ\text{C}$		
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	180		
Linear Derating Factor		4.3	W/ $^\circ\text{C}$	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	920	mJ	
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	46	A	
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	54	mJ	
Maximum Power Dissipation	$T_C = 25^\circ\text{C}$	$P_D$	540	W
Peak Diode Recovery $dV/dt^c$		$dV/dt$	34	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^\circ\text{C}$	
Soldering Recommendations (Peak Temperature)	for 10 s	300 <sup>d</sup>		

#### Notes


- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.86$  mH,  $R_g = 25 \Omega$ ,  $I_{AS} = 46$  A (see fig. 12).
- $I_{SD} \leq 46$  A,  $di/dt \leq 550$  A/ $\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150^\circ\text{C}$ .
- 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 <sup>a</sup>	$R_{thJA}$	-	40	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.24	-	
Maximum Junction-to-Case (Drain) <sup>a</sup>	$R_{thJC}$	-	0.23	

**Note**

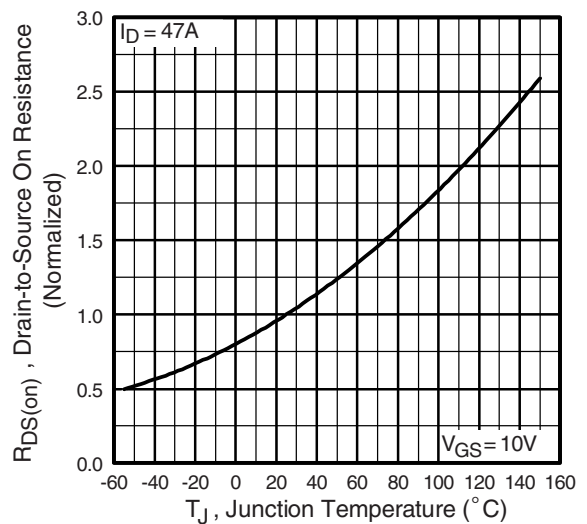
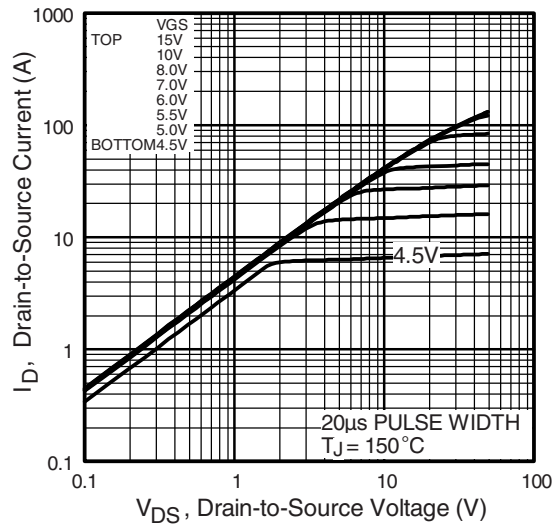
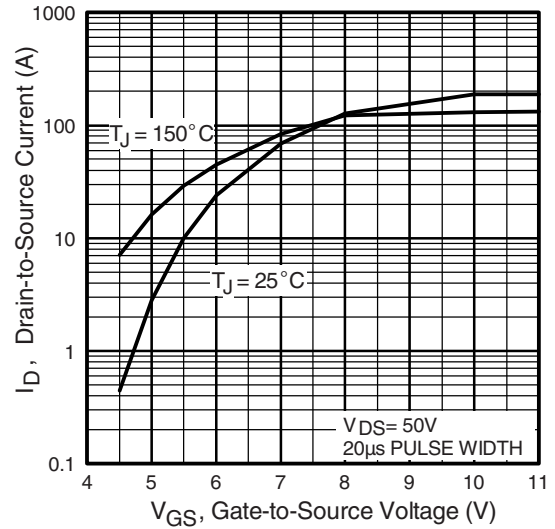
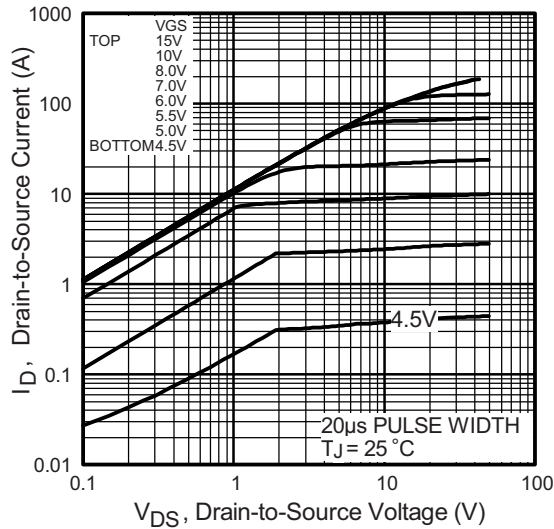
a.  $R_{th}$  is measured at  $T_J$  approximately 90 °C.

SPECIFICATIONS ( $T_J = 25\text{ °C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	500	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, $I_D = 1\text{ mA}$	-	0.60	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3.0	-	5.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	-	-	50	$\mu\text{A}$
		$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ °C}$	-	-	2.0	mA
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 28\text{ A}^b$	-	0.087	0.100	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 46\text{ A}$	21	-	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$	-	8110	-	pF
Output Capacitance	$C_{oss}$		-	960	-	
Reverse Transfer Capacitance	$C_{rss}$		-	130	-	
Output Capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$	-	11200	-
Effective Output Capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 400\text{ V}, f = 1.0\text{ MHz}$	-	240	-
Effective Output Capacitance (Energy Related)	$C_{oss\text{ eff. (ER)}}$		$V_{DS} = 0\text{ V to } 400\text{ V}^c$	-	310	-
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}, I_D = 46\text{ A}, V_{DS} = 400\text{ V}, \text{ see fig. 7 and 15}^b$	-	-	380	nC
Gate-Source Charge	$Q_{gs}$		-	-	80	
Gate-Drain Charge	$Q_{gd}$		-	-	190	
Internal Gate Resistance	$R_G$	$f = 1\text{ MHz}, \text{ open drain}$	-	0.90	-	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250\text{ V}, I_D = 46\text{ A}, R_G = 0.85\text{ }\Omega, V_{GS} = 10\text{ V}, \text{ see fig. 14a and 14b}^b$	-	27	-	ns
Rise Time	$t_r$		-	170	-	
Turn-Off Delay Time	$t_{d(off)}$		-	50	-	
Fall Time	$t_f$		-	69	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	46	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	180	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ °C}, I_S = 46\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	1.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ °C}, I_F = 46\text{ A}$	-	170	250	ns
		$T_J = 125\text{ °C}, di/dt = 100\text{ A}/\mu\text{s}^b$	-	220	330	
Body Diode Reverse Recovery Charge	$Q_{rr}$	$T_J = 25\text{ °C}, I_S = 46\text{ A}, V_{GS} = 0\text{ V}^b$	-	705	1060	nC
		$T_J = 125\text{ °C}, di/dt = 100\text{ A}/\mu\text{s}^b$	-	1.3	2.0	
Reverse Recovery Current	$I_{RRM}$	$T_J = 25\text{ °C}$	-	9.0	-	A
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Pulse width  $\leq 400\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .  $C_{oss\text{ eff. (ER)}}$  is a fixed capacitance that stores the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



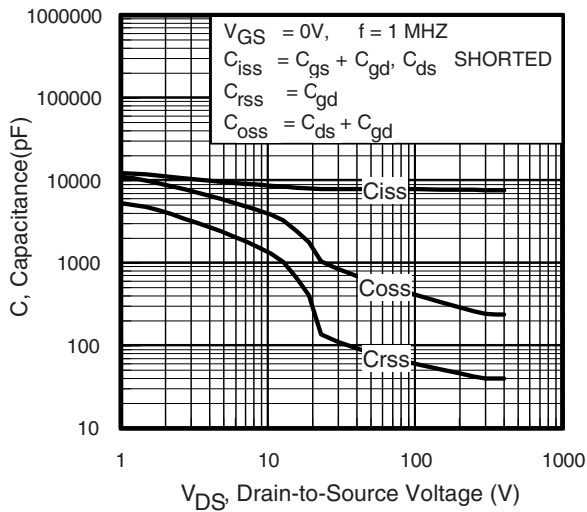


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

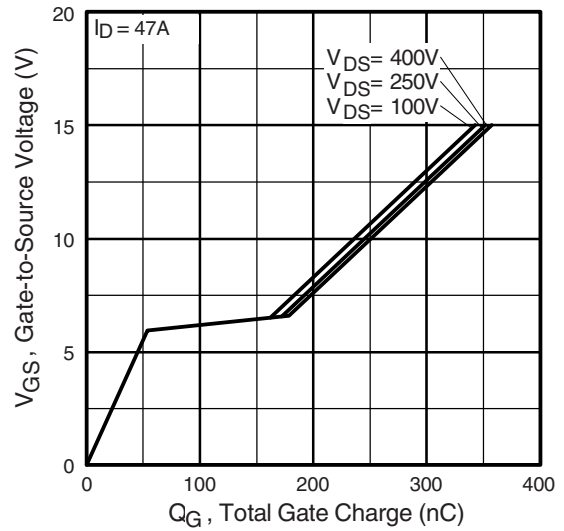


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

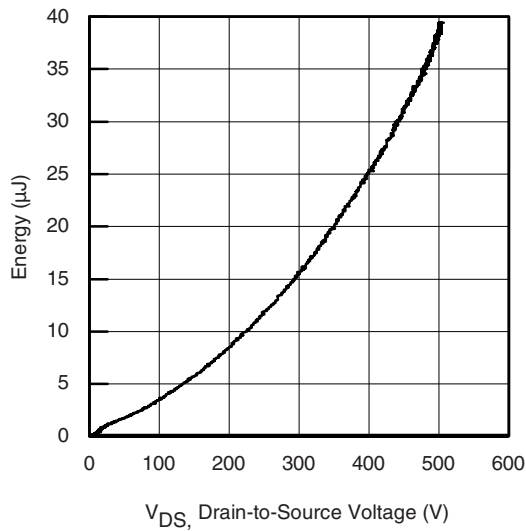


Fig. 6 - Typical Output Capacitance Stored Energy vs.  $V_{DS}$

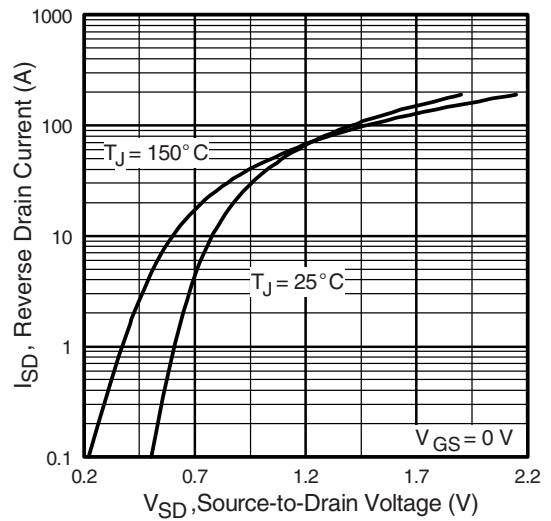


Fig. 8 - Typical Source Drain Diode Forward Voltage

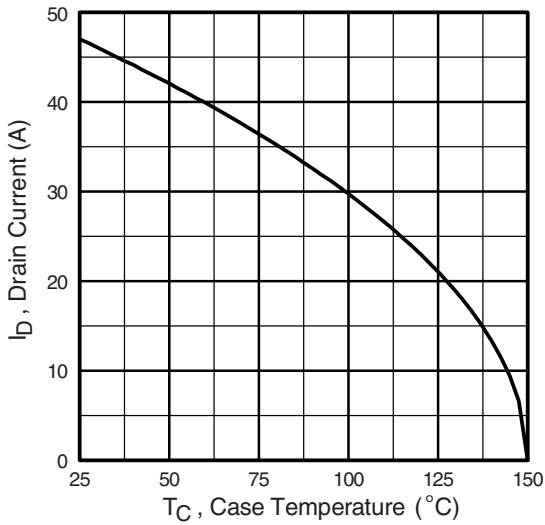


Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

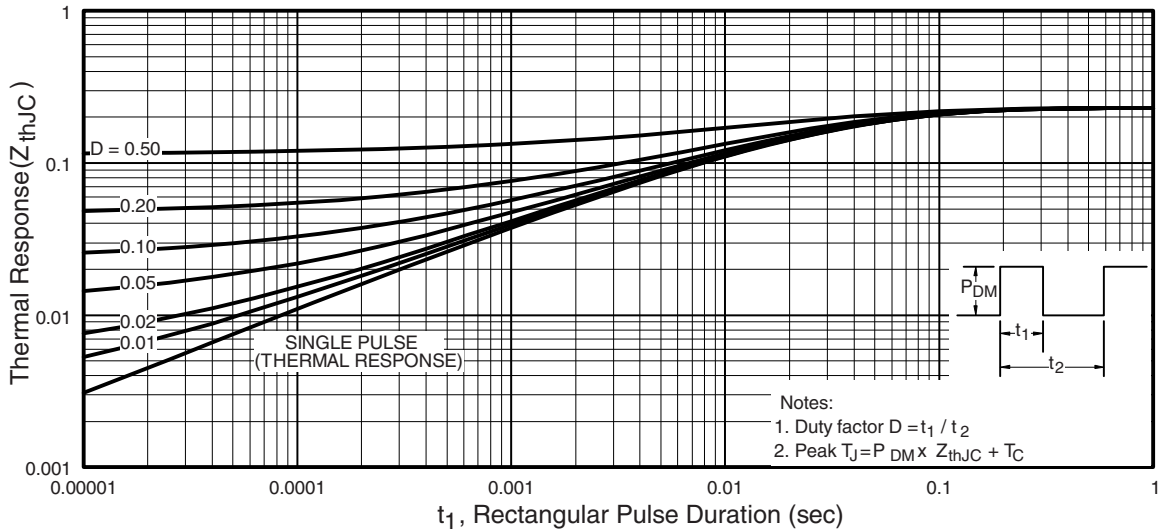


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

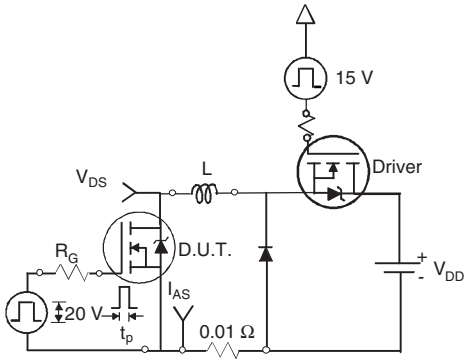


Fig. 12a - Unclamped Inductive Test Circuit

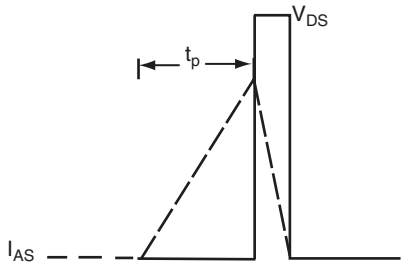


Fig. 12b - Unclamped Inductive Waveforms

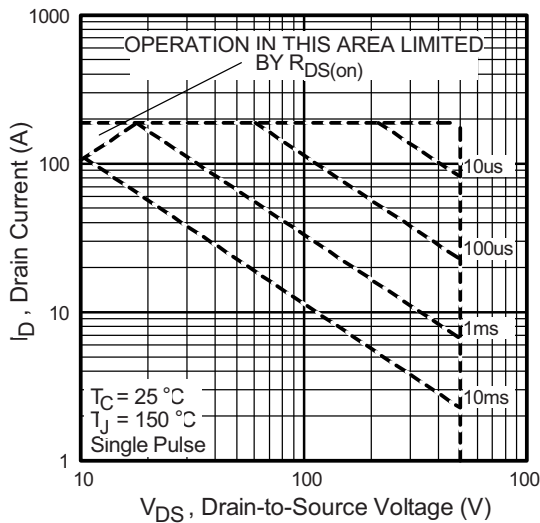


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

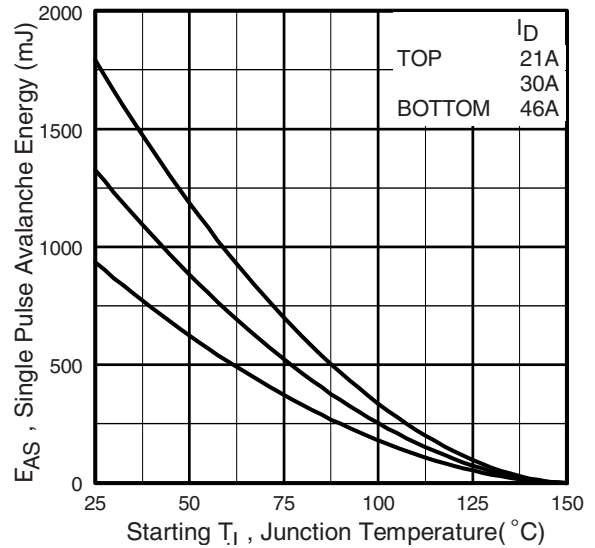


Fig. 12d - Maximum Safe Operating Area

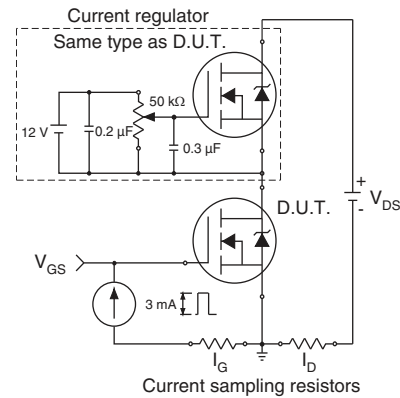


Fig. 13a - Gate Charge Test Circuit

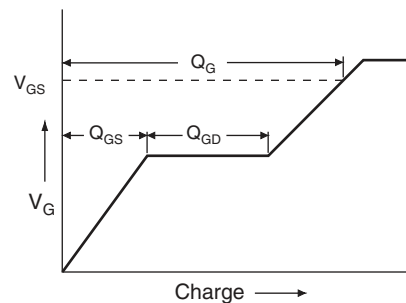
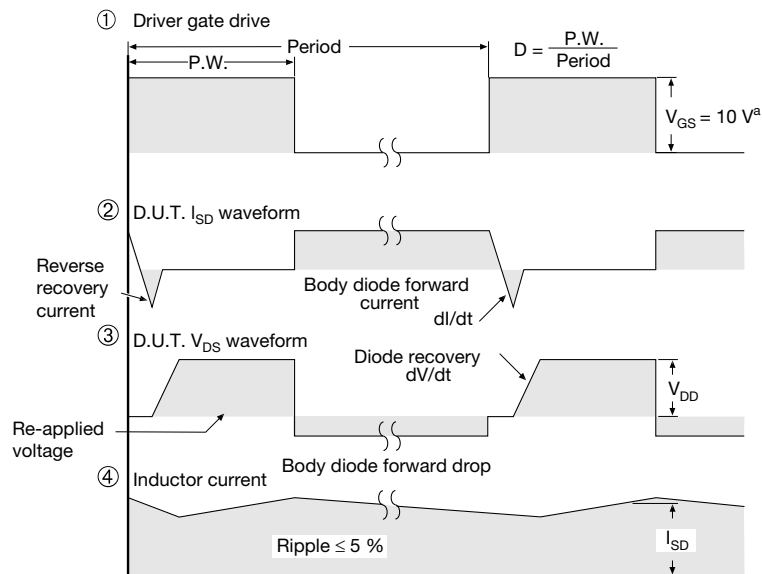
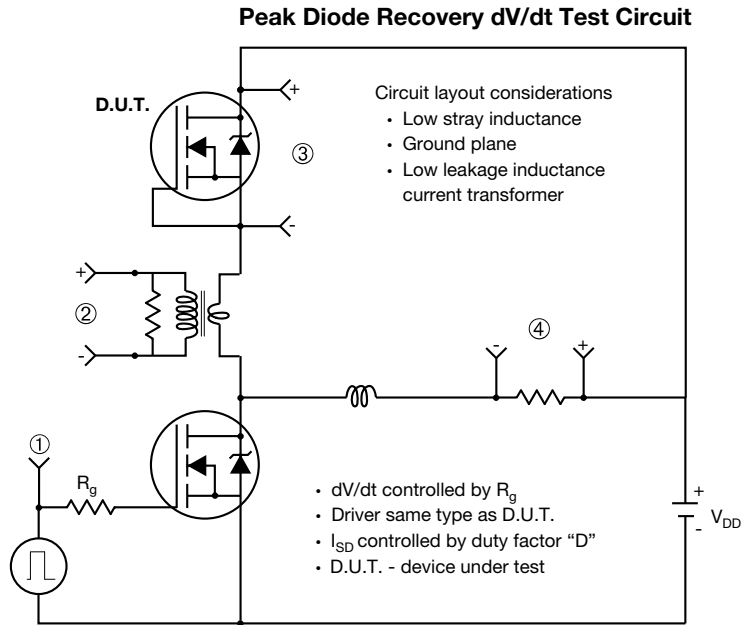


Fig. 13b - Basic Gate Charge Waveform



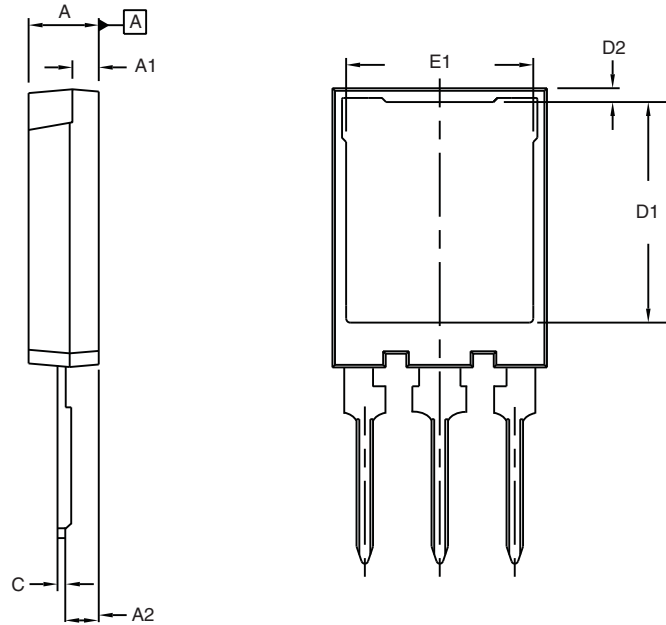
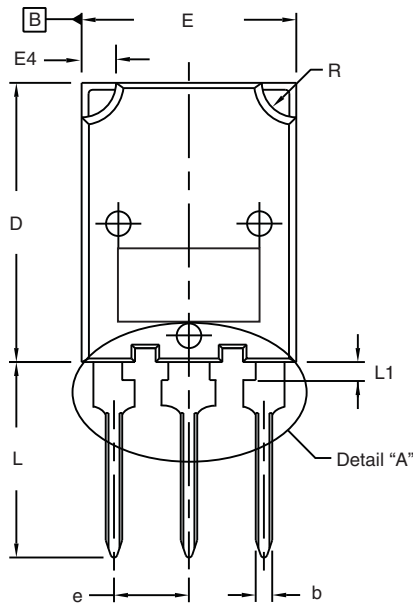
**Note**  
 a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

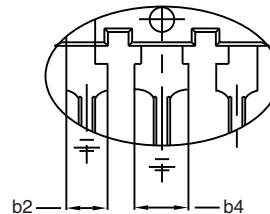
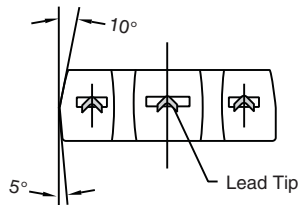
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# TO-274AA (High Voltage)



⊕ 0.10 (0.25) Ⓜ B A Ⓜ



Detail "A"  
Scale: 2:1

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.70	5.30	0.185	0.209
A1	1.50	2.50	0.059	0.098
A2	2.25	2.65	0.089	0.104
b	1.30	1.60	0.051	0.063
b2	1.80	2.20	0.071	0.087
b4	3.00	3.25	0.118	0.128
c <sup>(1)</sup>	0.38	0.89	0.015	0.035
D	19.80	20.80	0.780	0.819

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D1	15.50	16.10	0.610	0.634
D2	0.70	1.30	0.028	0.051
E	15.10	16.10	0.594	0.634
E1	13.30	13.90	0.524	0.547
e	5.45 BSC		0.215 BSC	
L	13.70	14.70	0.539	0.579
L1	1.00	1.60	0.039	0.063
R	2.00	3.00	0.079	0.118

ECN: X17-0056-Rev. B, 27-Mar-17  
DWG: 5975

**Notes**

- Dimensioning and tolerancing per ASME Y14.5M-1994
- 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 outer extremes of the plastic body
- Outline conforms to JEDEC® outline to TO-274AA
- (1) Dimension measured at tip of lead





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