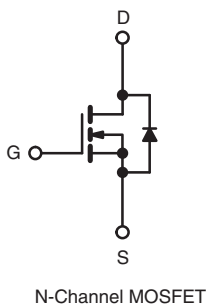
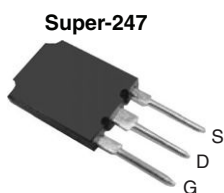


## Power MOSFET

### PRODUCT SUMMARY

$V_{DS}$ (V)	500	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	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
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  $T_J = 25^\circ\text{C}$ ,  $L = 0.86\text{ mH}$ ,  $R_g = 25\ \Omega$ ,  $I_{AS} = 46\text{ A}$  (see fig. 12).
- $I_{SD} \leq 46\text{ A}$ ,  $dI/dt \leq 550\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150^\circ\text{C}$ .
- 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
Static							
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA		500	-	-	V
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	Reference to 25 °C, I <sub>D</sub> = 1 mA		-	0.60	-	V/°C
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		3.0	-	5.0	V
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ± 30 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V		-	-	50	μA
		V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C		-	-	2.0	mA
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 28 A <sup>b</sup>	-	0.087	0.100	Ω
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 50 V, I <sub>D</sub> = 46 A		21	-	-	S
Dynamic							
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1.0 MHz, see fig. 5		-	8110	-	pF
Output Capacitance	C <sub>oss</sub>			-	960	-	
Reverse Transfer Capacitance	C <sub>rss</sub>			-	130	-	
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 1.0 V , f = 1.0 MHz	-	11200	-	
			V <sub>DS</sub> = 400 V , f = 1.0 MHz	-	240	-	
Effective Output Capacitance	C <sub>oss eff.</sub>			-	440	-	
Effective Output Capacitance (Energy Related)	C <sub>oss eff. (ER)</sub>		V <sub>DS</sub> = 0 V to 400 V <sup>c</sup>	-	310	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 46 A, V <sub>DS</sub> = 400 V, see fig. 7 and 15 <sup>b</sup>	-	-	380	nC
Gate-Source Charge	Q <sub>gs</sub>			-	-	80	
Gate-Drain Charge	Q <sub>gd</sub>			-	-	190	
Internal Gate Resistance	R <sub>G</sub>	f = 1 MHz, open drain		-	0.90	-	Ω
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 250 V, I <sub>D</sub> = 46 A, R <sub>G</sub> = 0.85 Ω, V <sub>GS</sub> = 10 V, see fig. 14a and 14b <sup>b</sup>		-	27	-	ns
Rise Time	t <sub>r</sub>			-	170	-	
Turn-Off Delay Time	t <sub>d(off)</sub>			-	50	-	
Fall Time	t <sub>f</sub>			-	69	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I <sub>S</sub>	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	46	A
Pulsed Diode Forward Current <sup>a</sup>	I <sub>SM</sub>			-	-	180	
Body Diode Voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = 46 A, V <sub>GS</sub> = 0 V <sup>b</sup>		-	-	1.5	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = 46 A		-	170	250	ns
		T <sub>J</sub> = 125 °C, dI/dt = 100 A/μs <sup>b</sup>		-	220	330	
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = 46 A, V <sub>GS</sub> = 0 V <sup>b</sup>		-	705	1060	nC
		T <sub>J</sub> = 125 °C, dI/dt = 100 A/μs <sup>b</sup>		-	1.3	2.0	
Reverse Recovery Current	I <sub>RRM</sub>	T <sub>J</sub> = 25 °C		-	9.0	-	A
Forward Turn-On Time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )					

**Notes**

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

b. Pulse width  $\leq 400\text{ }\mu\text{s}$ ; 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 %  $V_{DS}$ .  
 $C_{oss\text{ eff. (ER)}}$  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)

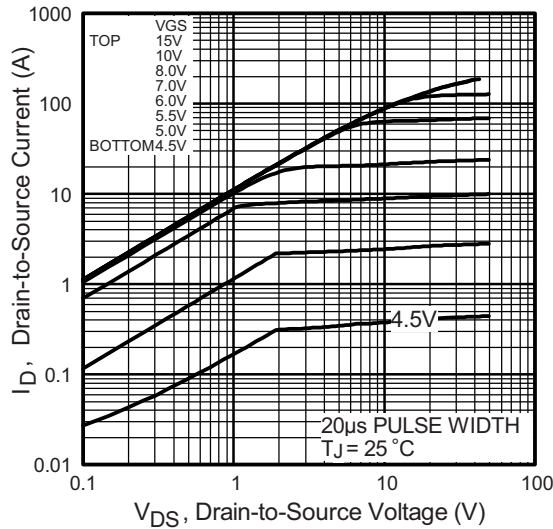


Fig. 1 - Typical Output Characteristics

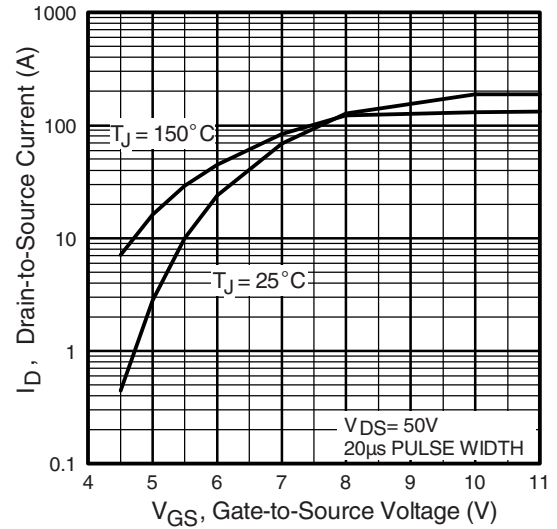


Fig. 3 - Typical Transfer Characteristics

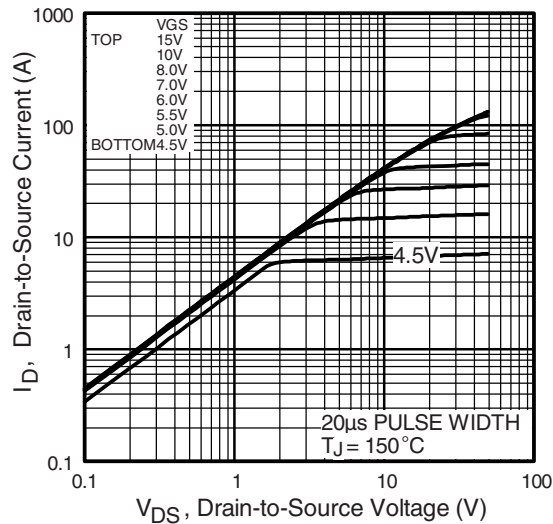


Fig. 2 - Typical Output Characteristics

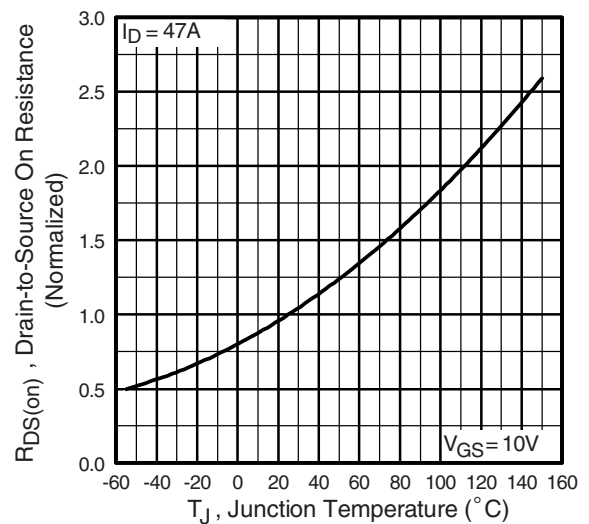


Fig. 4 - Normalized On-Resistance vs. Temperature

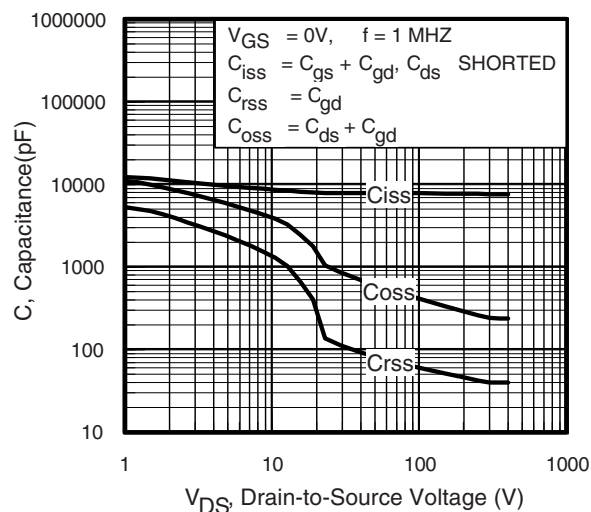


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

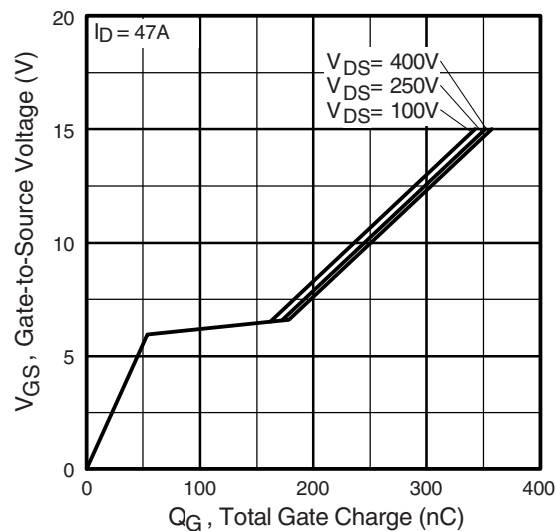


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

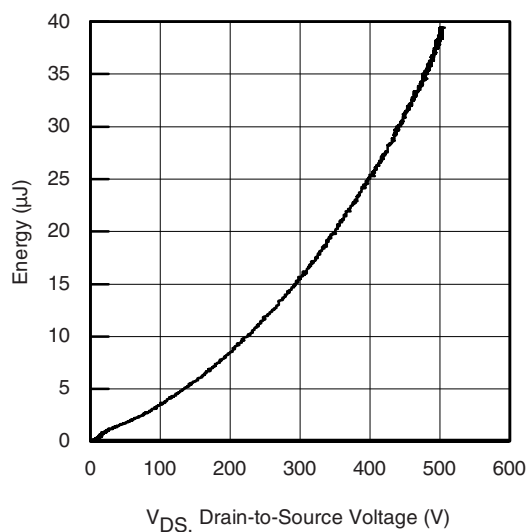


Fig. 6 - Typical Output Capacitance Stored Energy vs.  $V_{DS}$

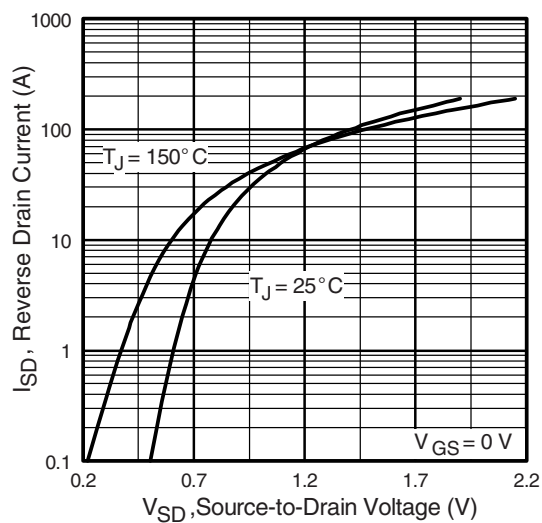


Fig. 8 - Typical Source Drain Diode Forward Voltage

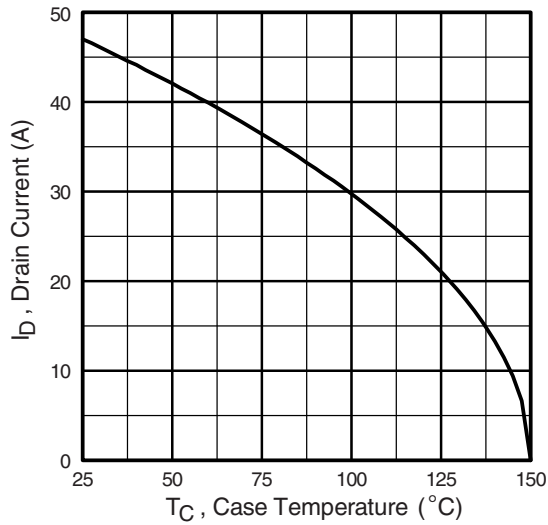


Fig. 9 - Maximum Drain Current vs. Case Temperature

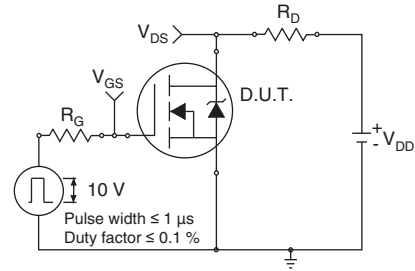


Fig. 10a - Switching Time Test Circuit

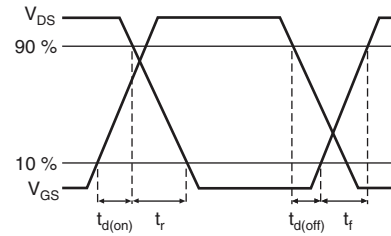


Fig. 10b - Switching Time Waveforms

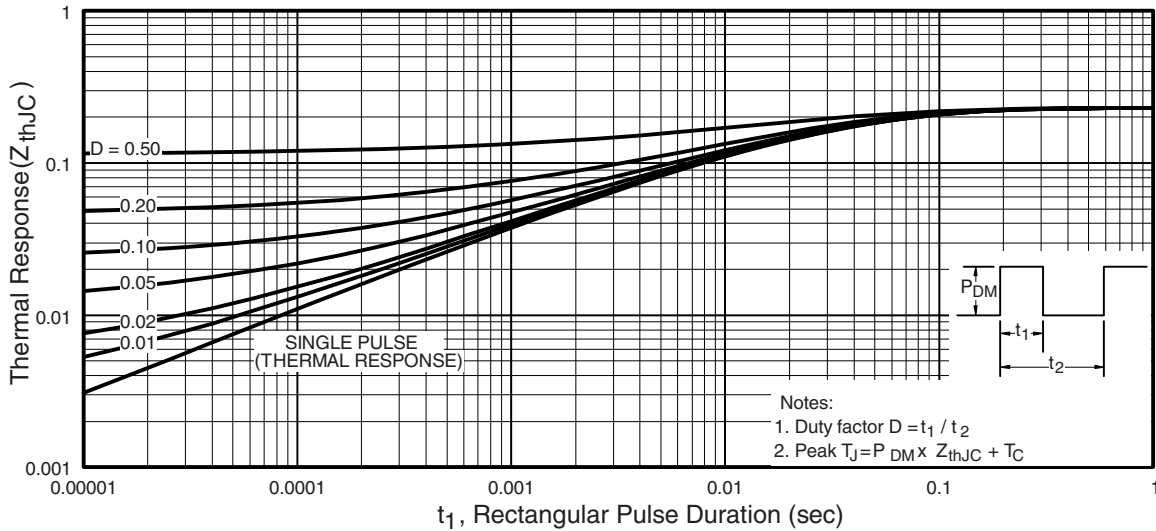


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

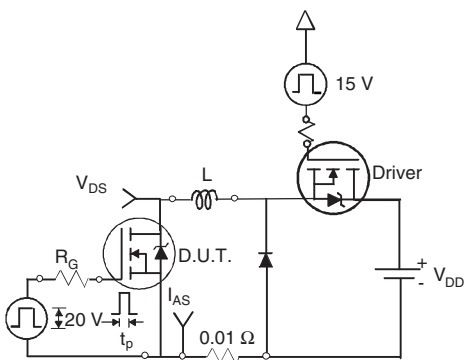


Fig. 12a - Unclamped Inductive Test Circuit

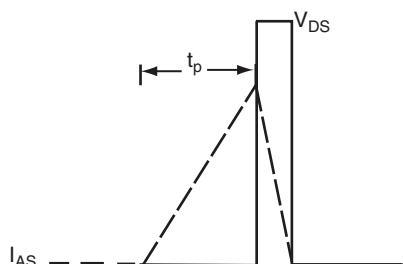


Fig. 12b - Unclamped Inductive Waveforms

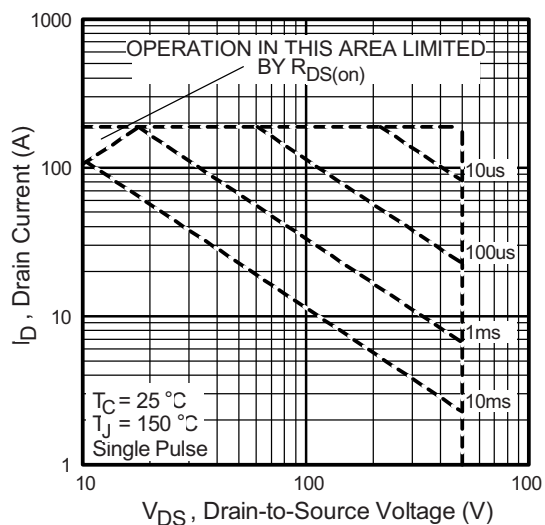


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

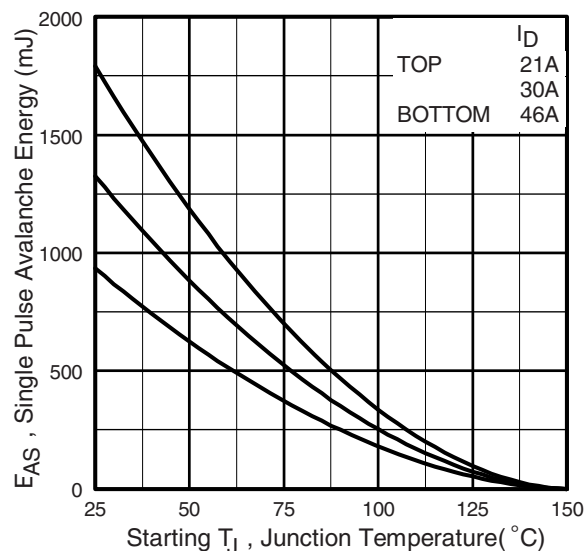


Fig. 12d - Maximum Safe Operating Area

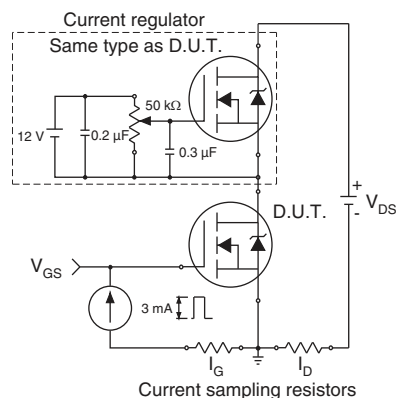


Fig. 13a - Gate Charge Test Circuit

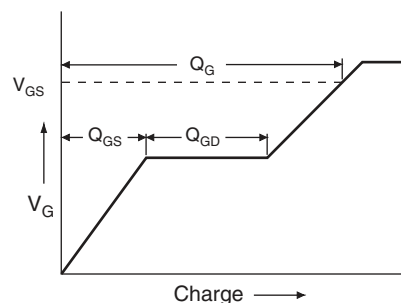
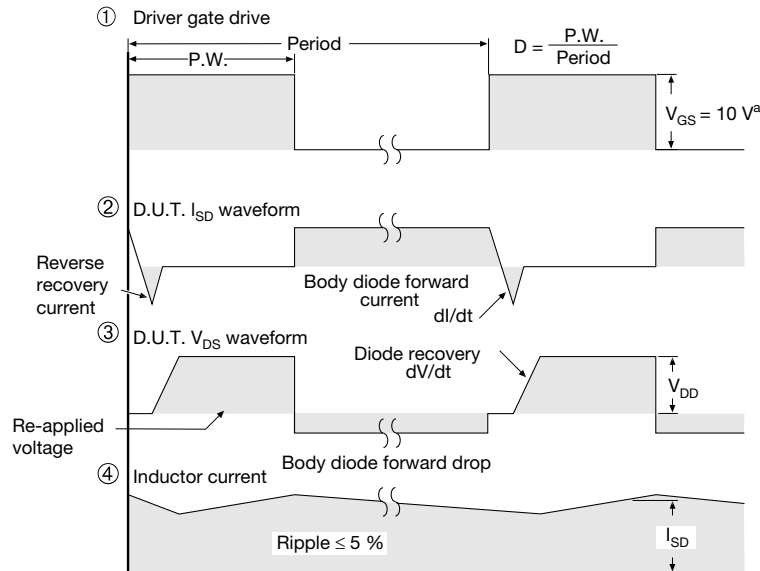
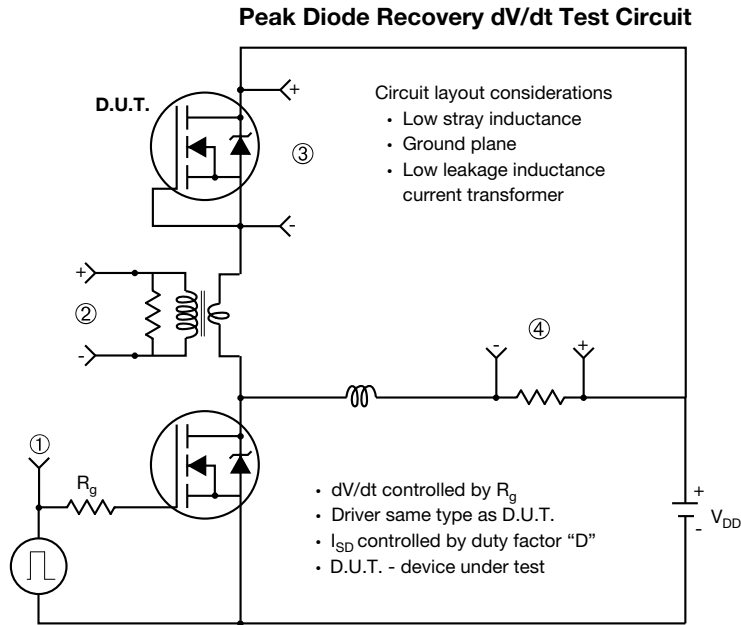


Fig. 13b - Basic Gate Charge Waveform



**Note**

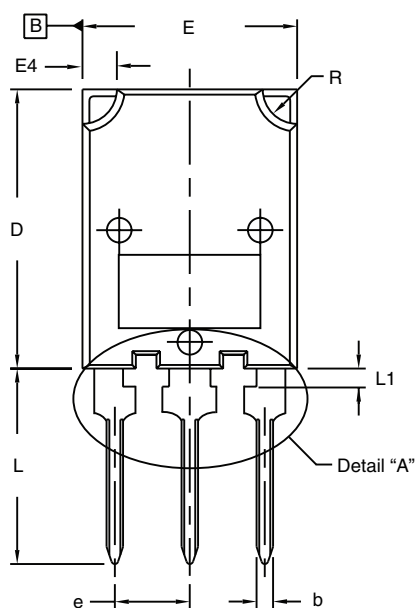
a.  $V_{GS} = 5 V$  for logic level devices

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

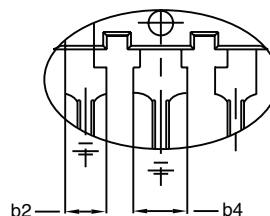
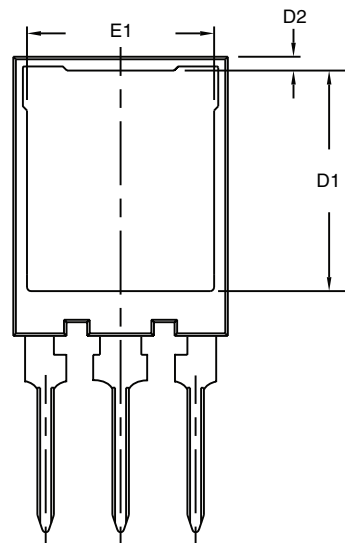
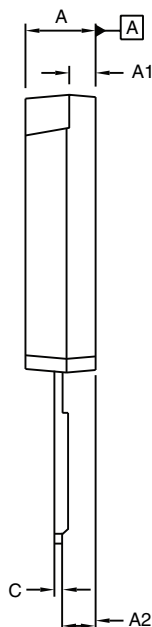
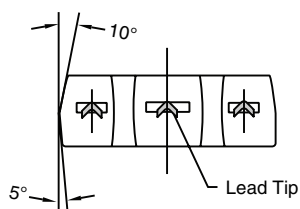
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## TO-274AA (HIGH VOLTAGE)



⌀ 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	0.80	1.20	0.031	0.047
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: S-82247-Rev. A, 06-Oct-08  
DWG: 5975

### Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. 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.
3. Outline conforms to JEDEC outline to TO-274AA.





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