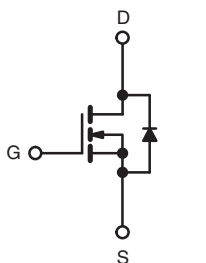
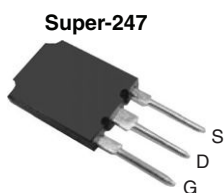


Power MOSFET

PRODUCT SUMMARY

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



N-Channel MOSFET

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)

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	46	A	
		T _C = 100 °C	29		
Pulsed Drain Current ^a		I _{DM}	180		
Linear Derating Factor			4.3	W/°C	
Single Pulse Avalanche Energy ^b		E _{AS}	920	mJ	
Repetitive Avalanche Current ^a		I _{AR}	46	A	
Repetitive Avalanche Energy ^a		E _{AR}	54	mJ	
Maximum Power Dissipation	T _C = 25 °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	°C	
Soldering Recommendations (Peak Temperature)	for 10 s		300 ^d		

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 ^a	R_{thJA}	-	40	°C/W
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.24	-	
Maximum Junction-to-Case (Drain) ^a	R_{thJC}	-	0.23	

Note

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

SPECIFICATIONS ($T_J = 25$ °C, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$		500	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	0.60	-	V/ $^\circ\text{C}$
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}	$V_{GS} = \pm 30\text{ V}$		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 500\text{ V}$, $V_{GS} = 0\text{ V}$		-	-	50	μA
		$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$		-	-	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	Ω
Forward Transconductance	g_{fs}	$V_{DS} = 50\text{ V}$, $I_D = 46\text{ A}$		21	-	-	S
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, 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	-	
			$V_{DS} = 400\text{ V}$, $f = 1.0\text{ MHz}$	-	240	-	
Effective Output Capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 0\text{ V to }400\text{ V}^c$	-	440	-	
Effective Output Capacitance (Energy Related)	$C_{oss\text{ eff. (ER)}}$		-	310	-		
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 46\text{ A}$, $V_{DS} = 400\text{ V}$, 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	$f = 1\text{ MHz}$, open drain		-	0.90	-	Ω
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250\text{ V}$, $I_D = 46\text{ A}$, $R_G = 0.85\text{ }\Omega$, $V_{GS} = 10\text{ V}$, 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	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	46	A	
Pulsed Diode Forward Current ^a	I_{SM}		-	-	180		
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}$, $I_S = 46\text{ A}$, $V_{GS} = 0\text{ V}^b$		-	-	1.5	V
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}$, $I_F = 46\text{ A}$		-	170	250	ns
		$T_J = 125\text{ }^\circ\text{C}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	220	330	
Body Diode Reverse Recovery Charge	Q_{rr}	$T_J = 25\text{ }^\circ\text{C}$, $I_S = 46\text{ A}$, $V_{GS} = 0\text{ V}^b$		-	705	1060	nC
		$T_J = 125\text{ }^\circ\text{C}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	1.3	2.0	
Reverse Recovery Current	I_{RRM}	$T_J = 25\text{ }^\circ\text{C}$		-	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

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

b. Pulse width ≤ 400 μ s; duty cycle ≤ 2 %.

c. $C_{oss\ eff.}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS} .
 $C_{oss\ eff. (ER)}$ 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)

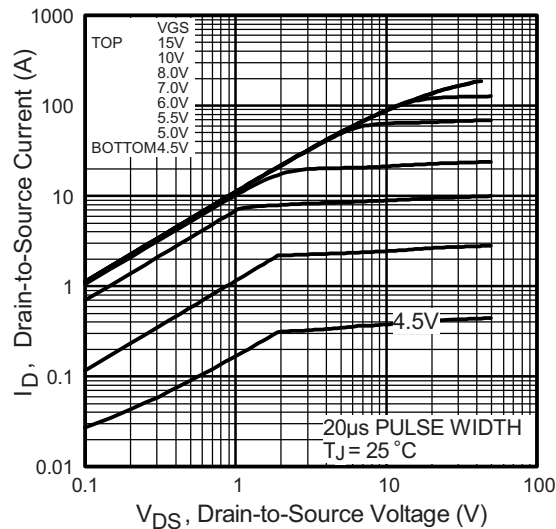


Fig. 1 - Typical Output Characteristics

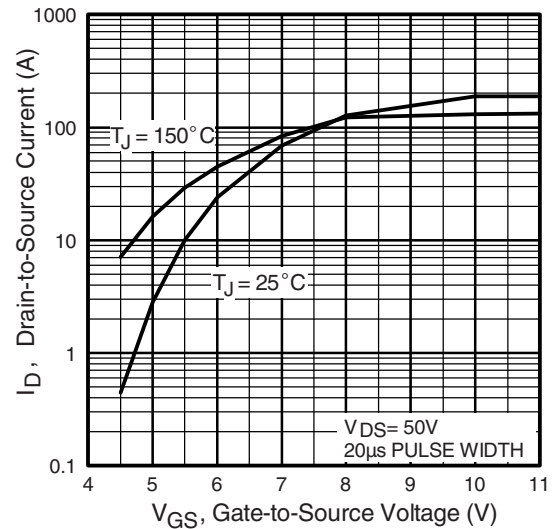


Fig. 3 - Typical Transfer Characteristics

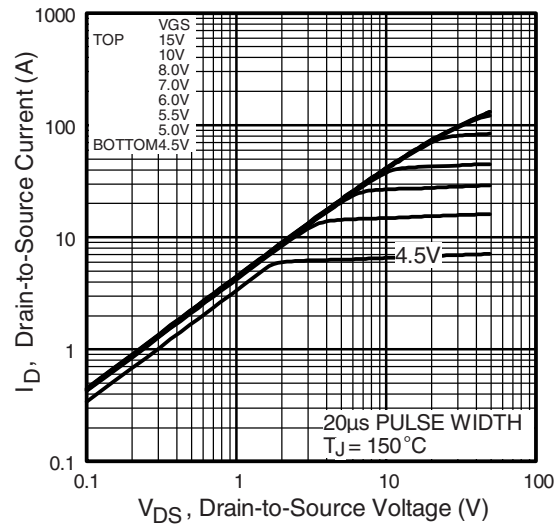


Fig. 2 - Typical Output Characteristics

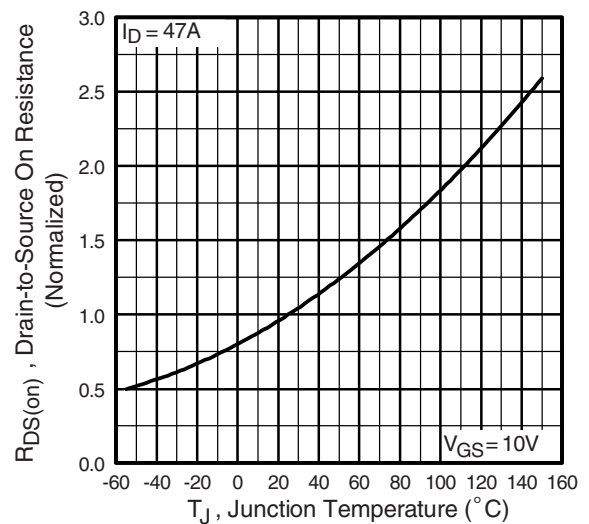


Fig. 4 - Normalized On-Resistance vs. Temperature

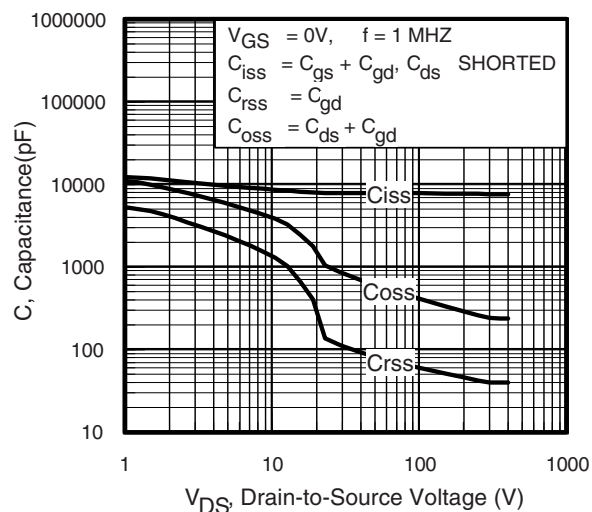


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

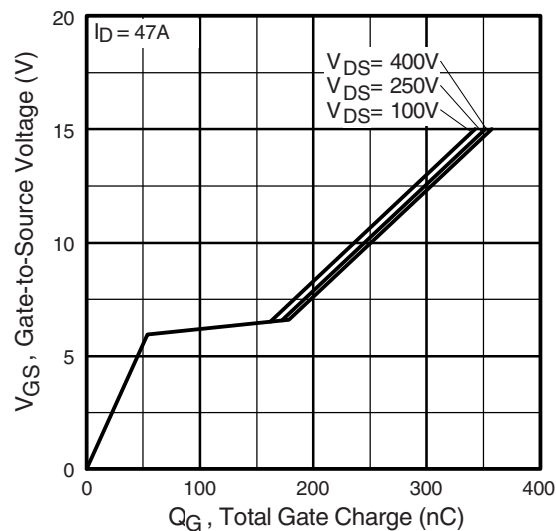


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

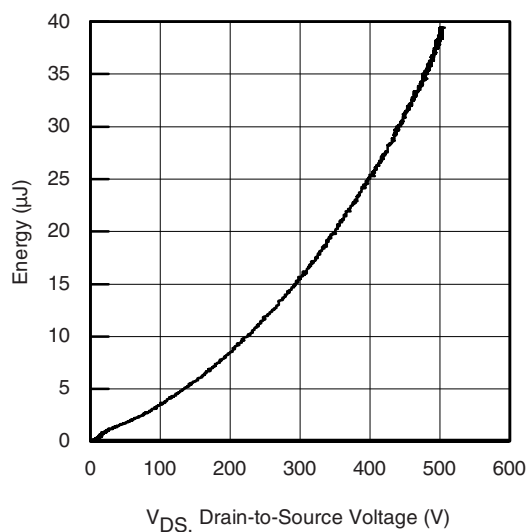


Fig. 6 - Typical Output Capacitance Stored Energy vs. V_{DS}

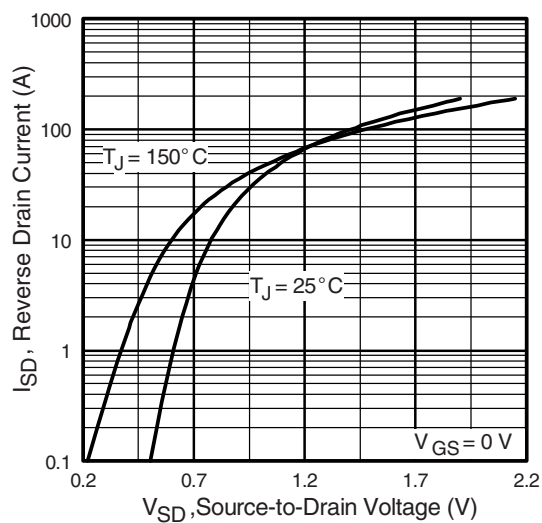


Fig. 8 - Typical Source Drain Diode Forward Voltage

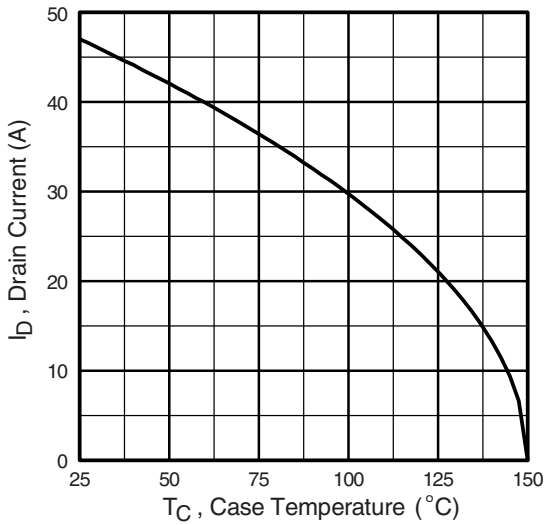


Fig. 9 - Maximum Drain Current vs. Case Temperature

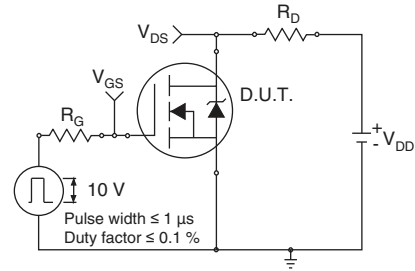


Fig. 10a - Switching Time Test Circuit

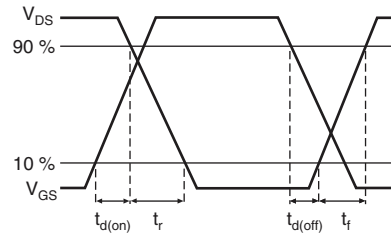


Fig. 10b - Switching Time Waveforms

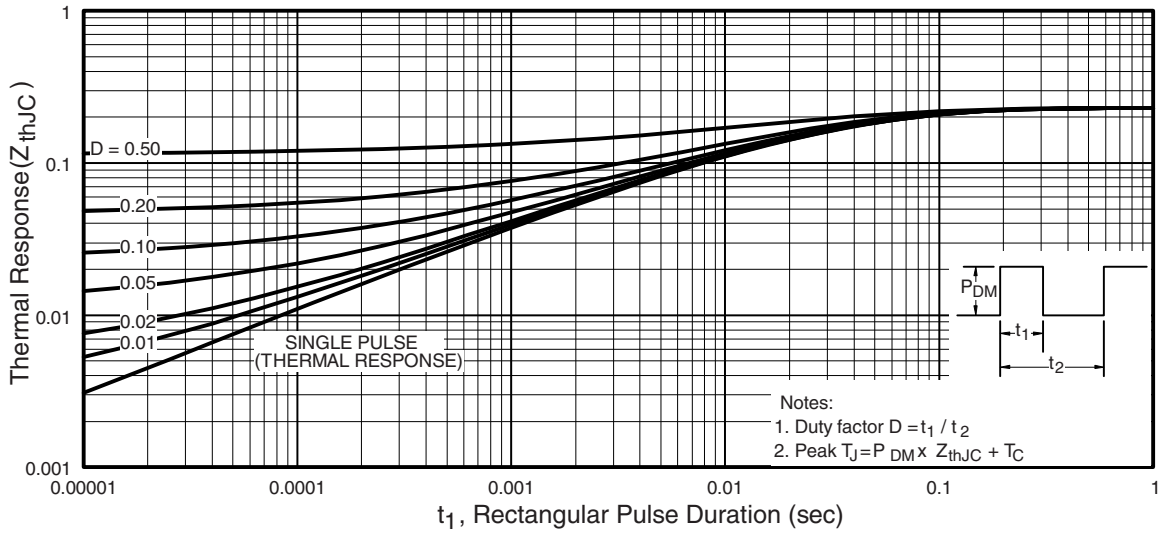


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

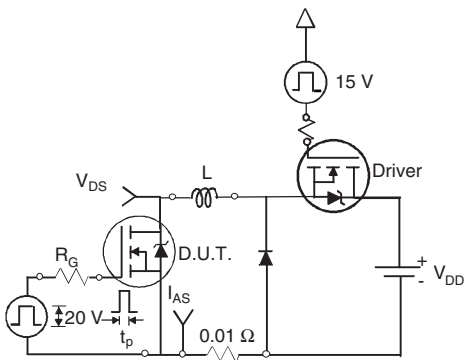


Fig. 12a - Unclamped Inductive Test Circuit

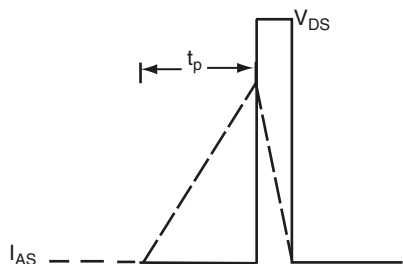


Fig. 12b - Unclamped Inductive Waveforms

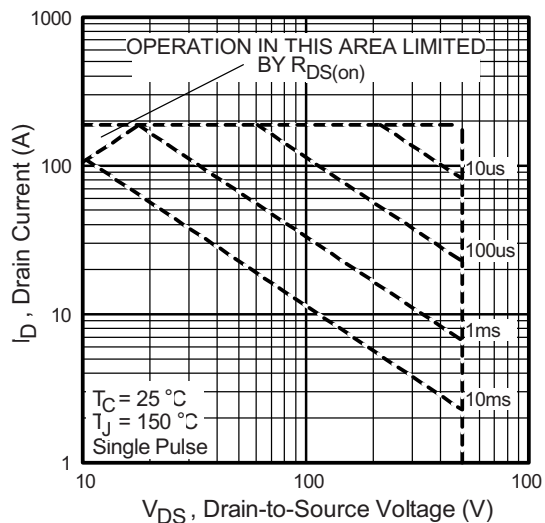


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

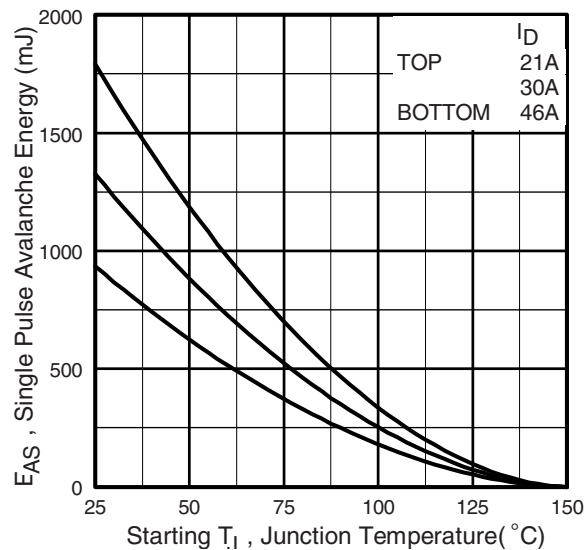


Fig. 12d - Maximum Safe Operating Area

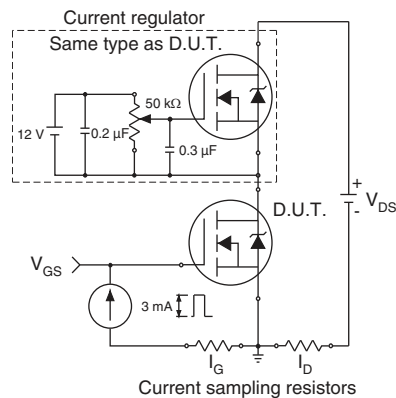


Fig. 13a - Gate Charge Test Circuit

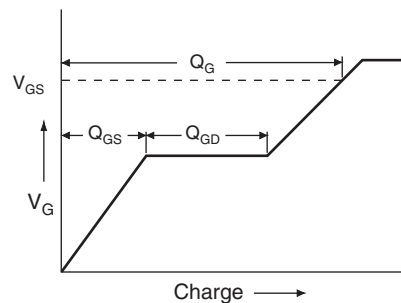
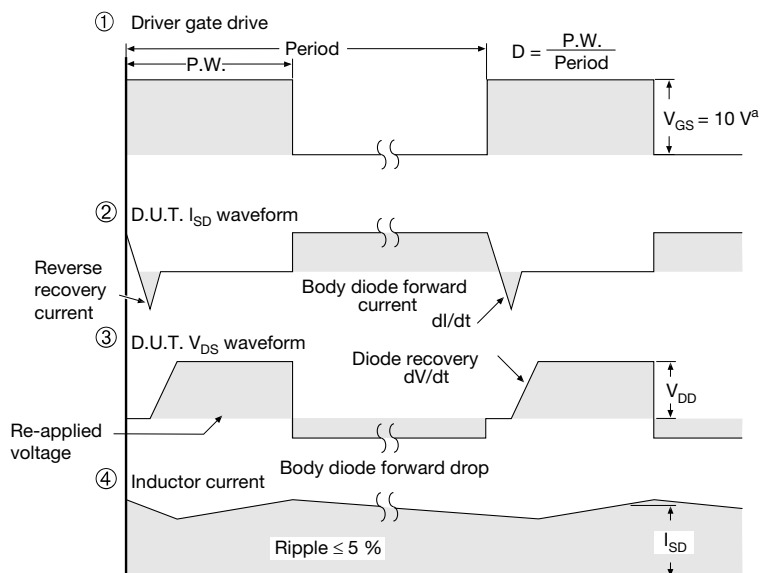
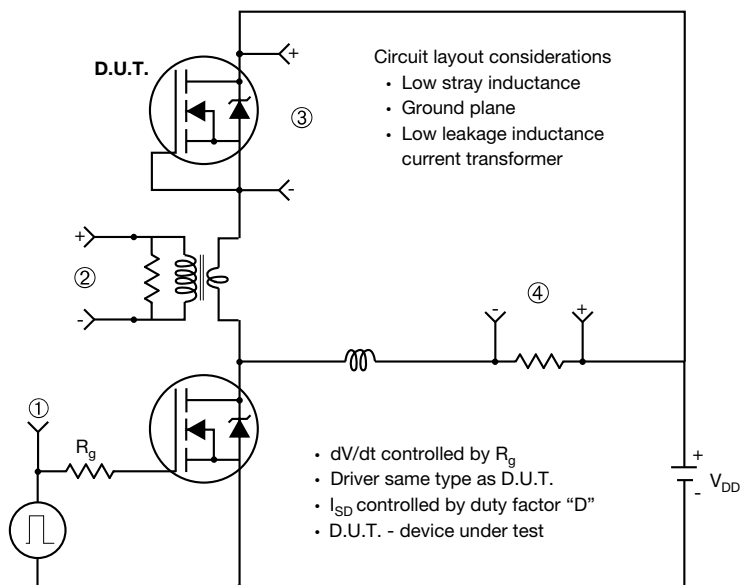


Fig. 13b - Basic Gate Charge Waveform

Peak Diode Recovery dV/dt Test Circuit



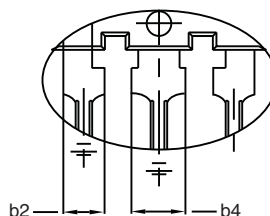
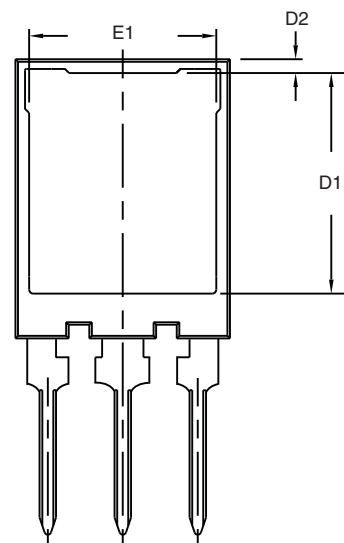
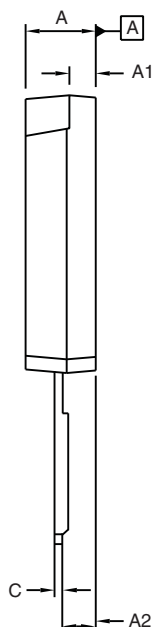
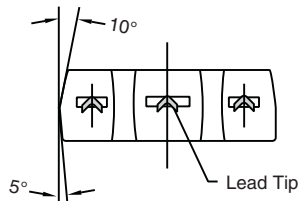
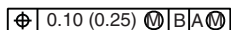
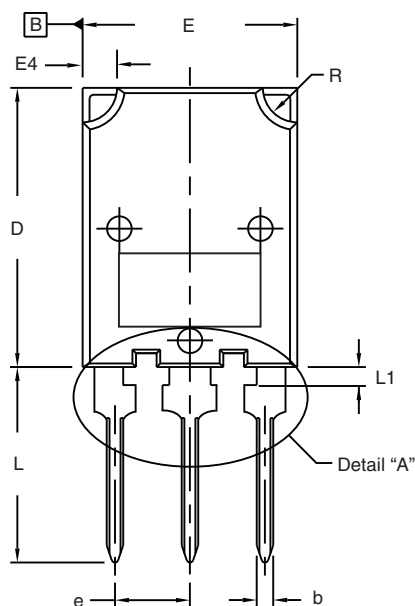
Note

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

Fig. 14 - For N-Channel

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TO-274AA (High Voltage)



Detail "A"
Scale: 2:1

	MILLIMETERS		INCHES	
DIM.	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 ⁽¹⁾	0.38	0.89	0.015	0.035
D	19.80	20.80	0.780	0.819

	MILLIMETERS		INCHES	
DIM.	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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