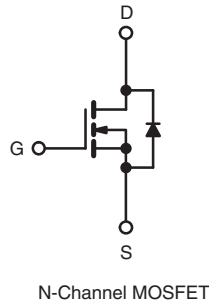
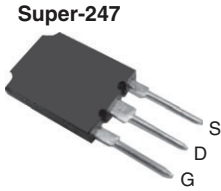




**THE DATASHEET OF  
SIHFPS38N60L-GE3**



## Power MOSFET



### FEATURES

- Superfast body diode eliminates the need for external diodes in ZVS applications
- Lower gate charge results in simple drive requirements
- Enhanced dV/dt capabilities offer improved ruggedness
- Higher gate voltage threshold offers improved noise immunity
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### PRODUCT SUMMARY

$V_{DS}$ (V)	600	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.12
$Q_g$ (Max.) (nC)	320	
$Q_{gs}$ (nC)	85	
$Q_{gd}$ (nC)	160	
Configuration	Single	

### APPLICATIONS

- Zero voltage switching SMPS
- Telecom and server power supplies
- Uninterruptible power supplies
- Motor control applications

### ORDERING INFORMATION

Package	Super-247
Lead (Pb)-free and halogen-free	SiHFPS38N60L-GE3


### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	$V_{DS}$	600	V
Gate-source voltage	$V_{GS}$	$\pm 30$	
Continuous drain current	$I_D$	$T_C = 25\text{ }^\circ\text{C}$	38
		$T_C = 100\text{ }^\circ\text{C}$	24
Pulsed drain current <sup>a</sup>	$I_{DM}$	150	A
Linear derating factor		4.3	W/ $^\circ\text{C}$
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	680	mJ
Repetitive avalanche current <sup>a</sup>	$I_{AR}$	38	A
Repetitive avalanche energy <sup>a</sup>	$E_{AR}$	54	mJ
Maximum power dissipation	$P_D$	540	W
Peak diode recovery dV/dt <sup>c</sup>	dV/dt	19	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>	
Mounting torque	6-32 or M3 screw	10	lbf · in
		1.1	N · m

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 12)
- Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 0.91\text{ mH}$ ,  $R_g = 25\text{ }^\circ\Omega$ ,  $I_{AS} = 38\text{ A}$ ,  $dV/dt = 13\text{ V/ns}$  (see fig. 14a)
- $I_{SD} \leq 38\text{ A}$ ,  $dI/dt \leq 630\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$
- 1.6 mm from case

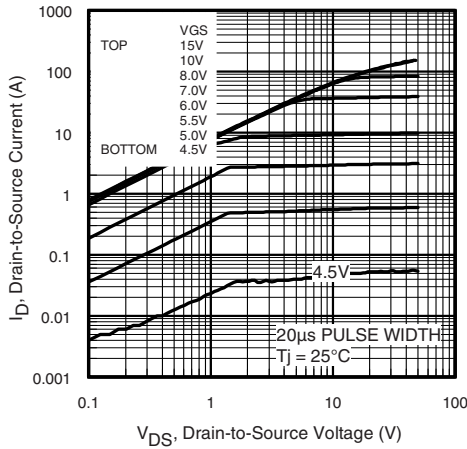
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	40	°C/W
Case-to-sink, flat, greased surface	$R_{thCS}$	0.24	-	
Maximum junction-to-case (drain)	$R_{thJC}$	-	0.22	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$		600	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	410	-	mV/°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	$I_{DSS}$	$V_{DS} = 600\text{ V}$ , $V_{GS} = 0\text{ V}$		-	-	50	$\mu\text{A}$
		$V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$		-	-	2.0	mA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 23\text{ A}^b$	-	0.12	0.15	$\Omega$
Forward transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 23\text{ A}^b$		20	-	-	S
<b>Dynamic</b>							
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5		-	7990	-	pF
Output capacitance	$C_{oss}$			-	740	-	
Reverse transfer capacitance	$C_{riss}$			-	72	-	
Effective output capacitance	$C_{oss\text{ eff.}}$	$V_{GS} = 0\text{ V}$ $V_{DS} = 0\text{ V to } 480\text{ V}^c$		-	350	-	pF
Effective output capacitance (energy related)	$C_{oss\text{ eff. (ER)}}$			-	260	-	
Total gate charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 38\text{ A}$ , $V_{DS} = 480\text{ V}$ see fig. 7 and 15 <sup>b</sup>	-	-	320	nC
Gate-source charge	$Q_{gs}$			-	-	85	
Gate-drain charge	$Q_{gd}$			-	-	160	
Gate resistance	$R_G$	$f = 1\text{ MHz}$ , open drain		-	1.2	-	$\Omega$
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 300\text{ V}$ , $I_D = 38\text{ A}$ , $R_G = 4.3\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ , see fig. 11a and 11b <sup>b</sup>		-	44	-	ns
Rise time	$t_r$			-	130	-	
Turn-off delay time	$t_{d(off)}$			-	92	-	
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 		-	-	38	A
Pulsed diode forward current <sup>a</sup>	$I_{SM}$			-	-	150	
Body diode voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = 38\text{ A}$ , $V_{GS} = 0\text{ V}^b$		-	-	1.5	V
Body diode reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = 38\text{ A}$		-	170	250	ns
		$T_J = 125\text{ }^\circ\text{C}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	420	630	
Body diode reverse recovery charge	$Q_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = 38\text{ A}$ , $V_{GS} = 0\text{ V}^b$		-	830	1240	nC
		$T_J = 125\text{ }^\circ\text{C}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	2600	3900	
Reverse recovery time	$I_{RRM}$	$T_J = 25\text{ }^\circ\text{C}$		-	9.1	14	A
Forward turn-On time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

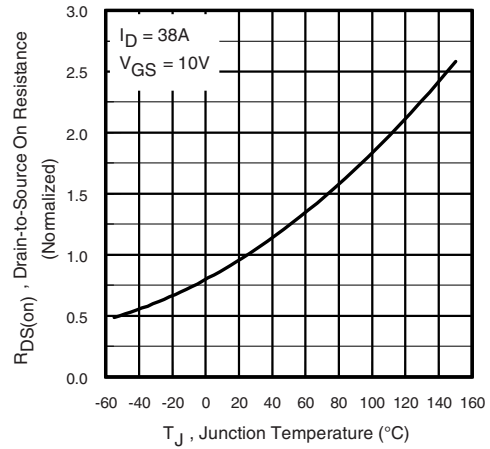
**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 12)
- Pulse width  $\leq 300\text{ }\mu\text{s}$ ; 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 %  $V_{DS}$

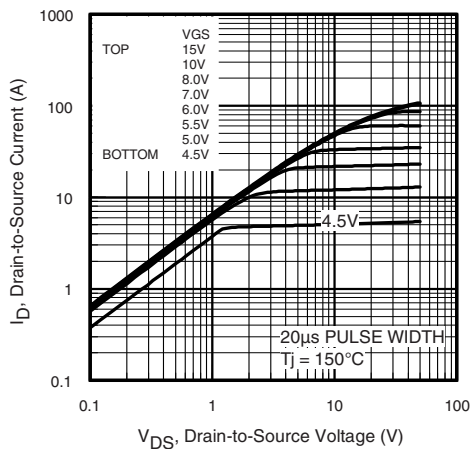
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



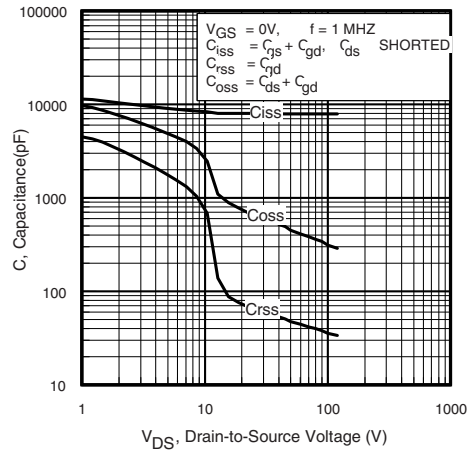
**Fig. 1 - Typical Output Characteristics**



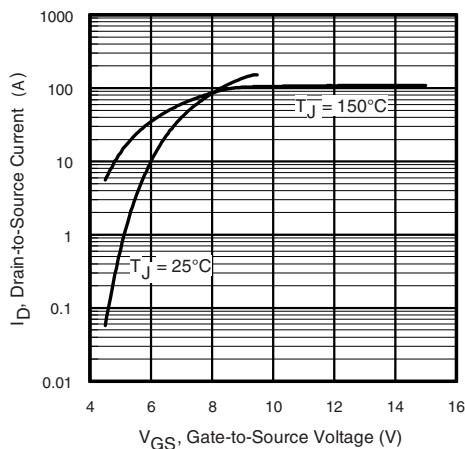
**Fig. 4 - Normalized On-Resistance vs. Temperature**



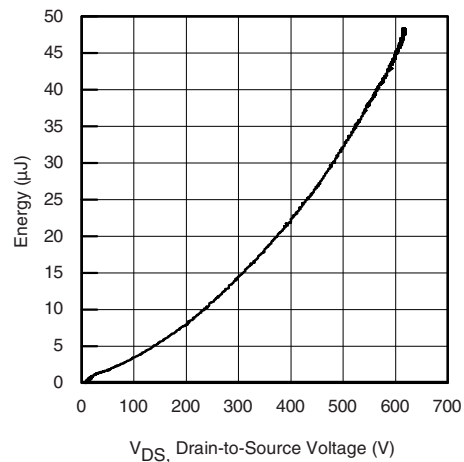
**Fig. 2 - Typical Output Characteristics**



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



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 1 - Typical Output Capacitance Stored Energy vs.  $V_{DS}$**

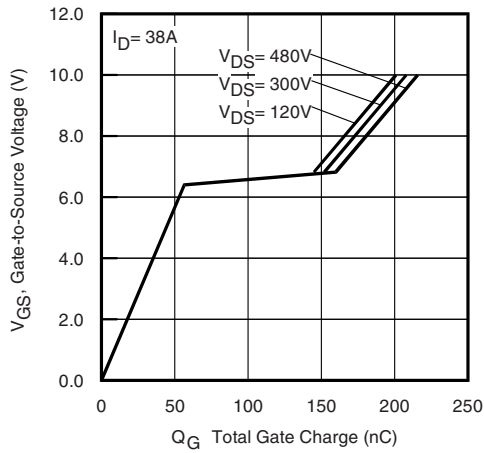


Fig. 2 - Typical Gate Charge vs. Gate-to-Source Voltage

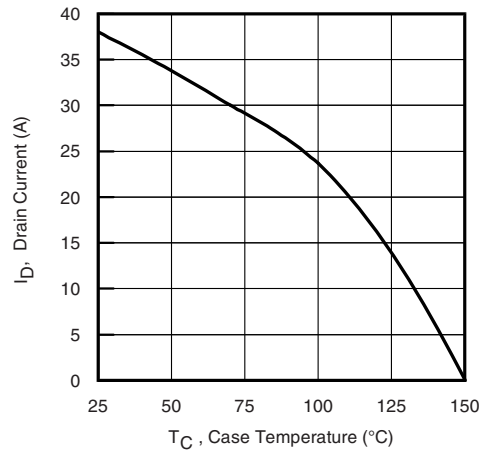


Fig. 10 - Maximum Drain Current vs. Case Temperature

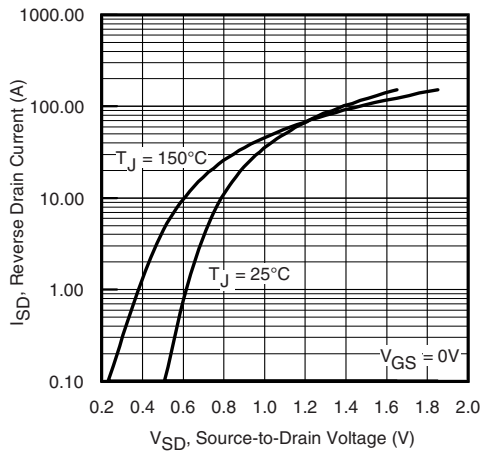


Fig. 8 - Typical Source-Drain Diode Forward Voltage

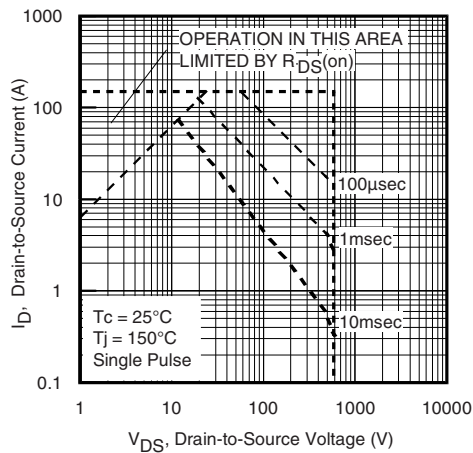


Fig. 9 - Maximum Safe Operating Area

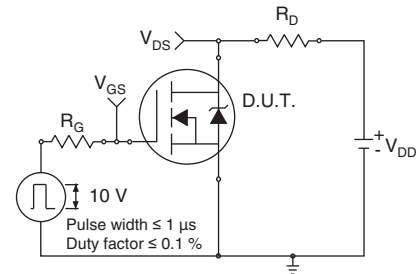


Fig. 11a - Switching Time Test Circuit

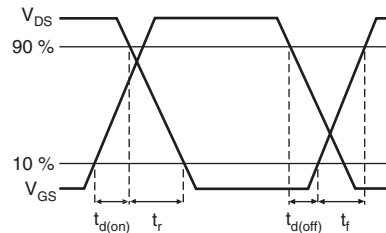


Fig. 11b - Switching Time Waveforms

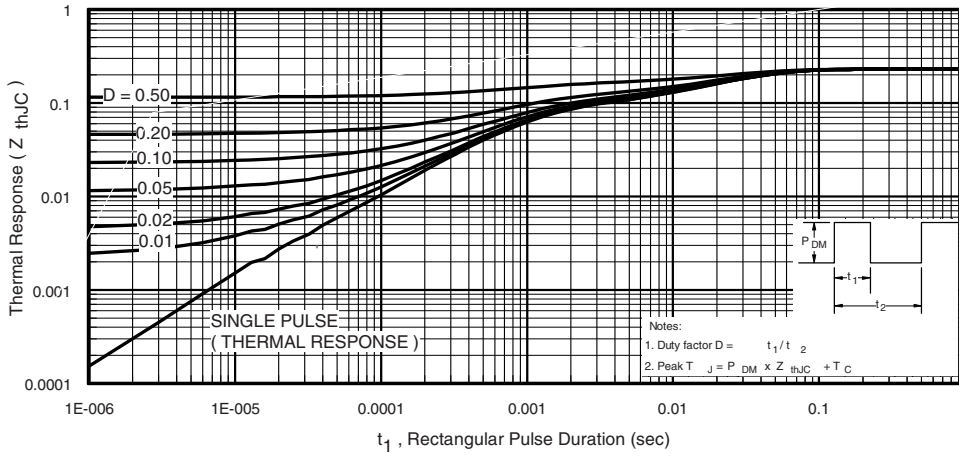


Fig. 10 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

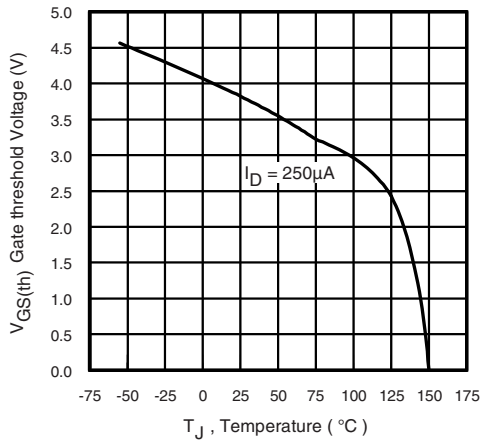


Fig. 13 - Threshold Voltage vs. Temperature

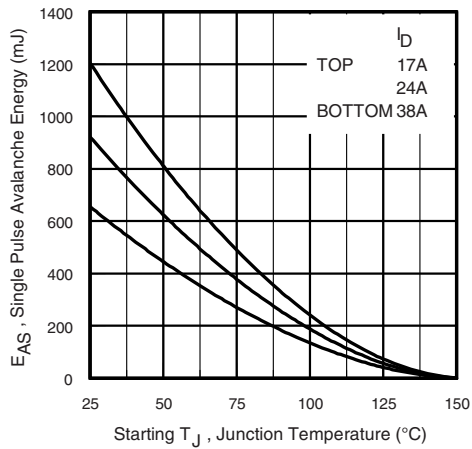


Fig. 14a - Maximum Avalanche Energy vs. Drain Current

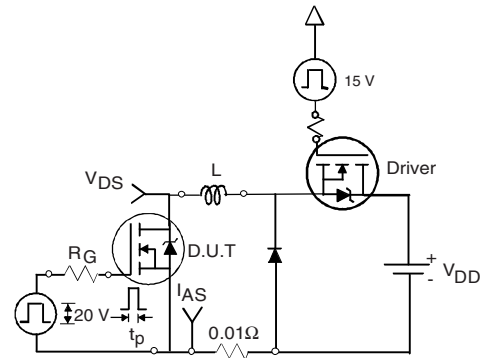


Fig. 14b - Unclamped Inductive Test Circuit

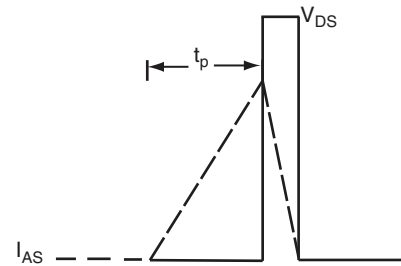


Fig. 14c - Unclamped Inductive Waveforms

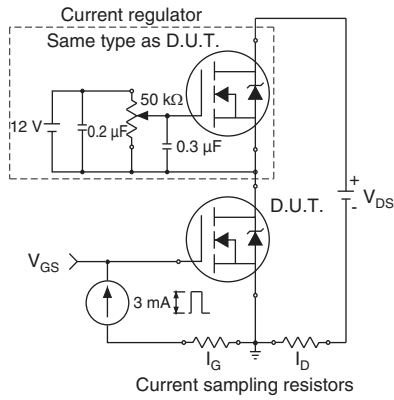


Fig. 15a - Basic Gate Charge Waveform

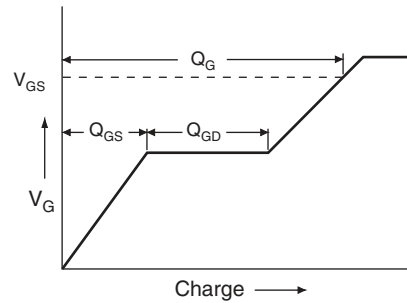
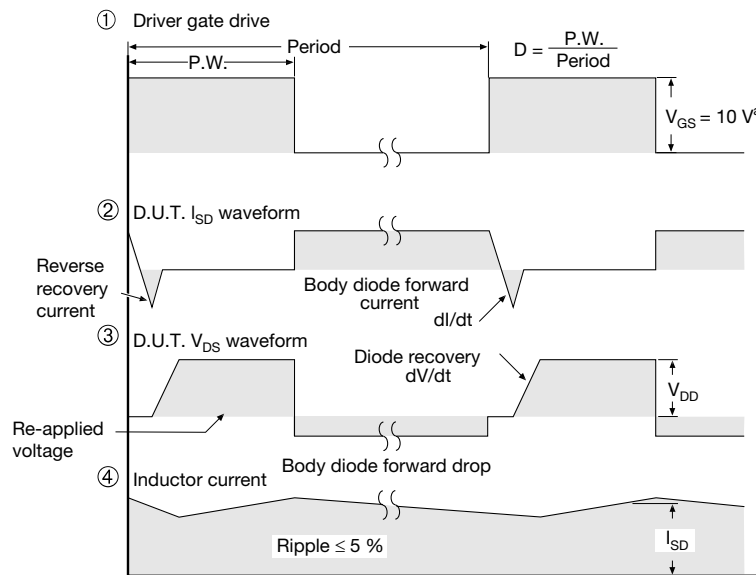
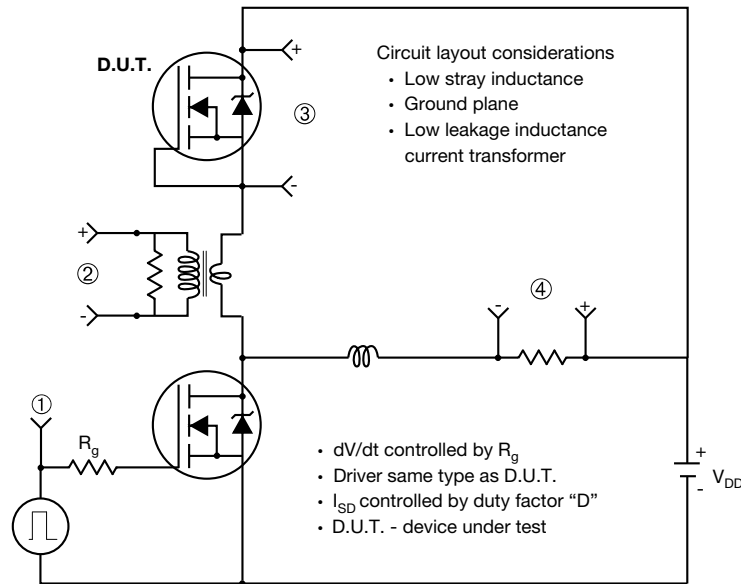


Fig. 15b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note

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

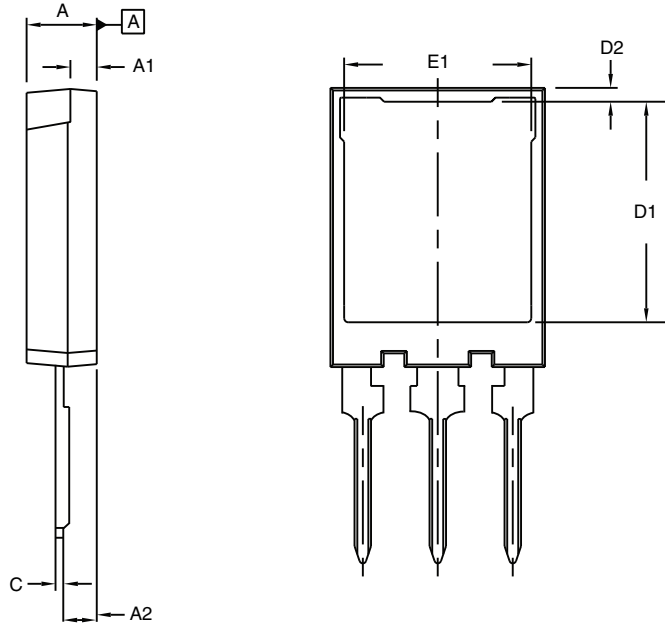
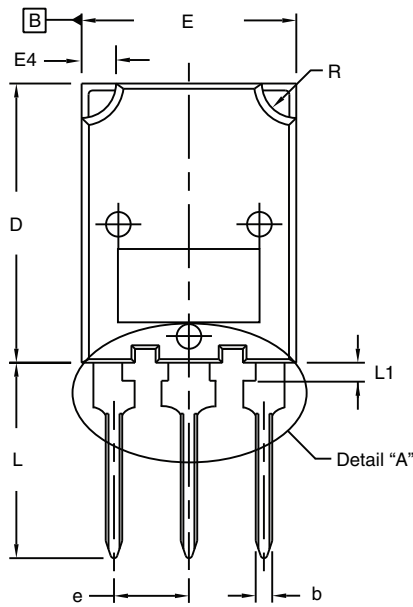
Fig. 16 - For N-Channel

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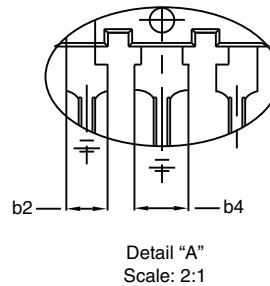
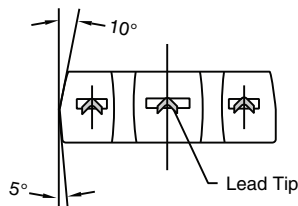


# TO-274AA (High Voltage)

## VERSION 1: FACILITY CODE = Y



⊕ 0.10 (0.25) ⊖ B|A ⊕



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

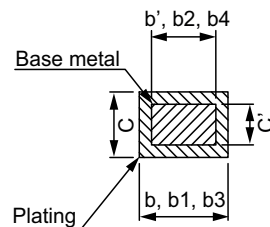
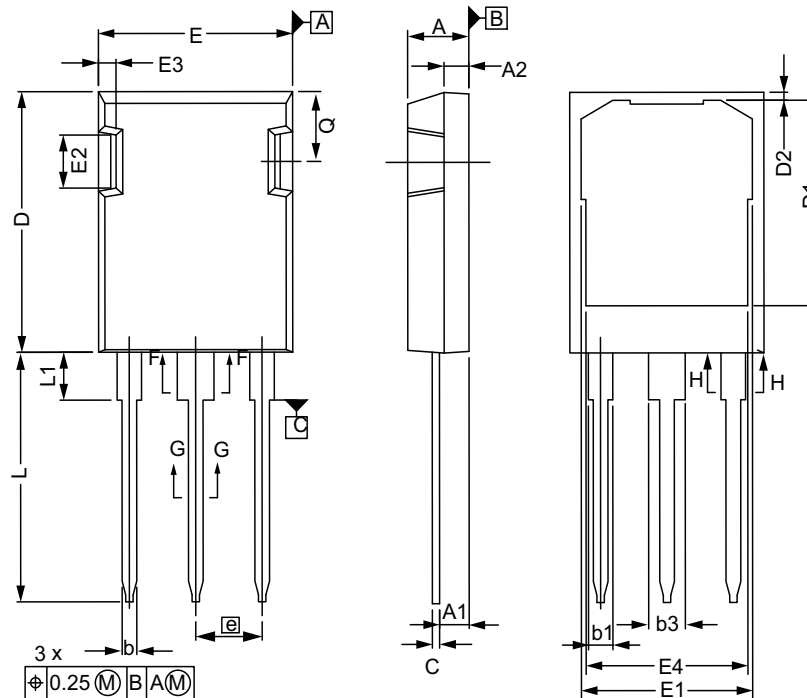
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D1	15.50	16.10	0.610	0.634
D2	0.70	1.30	0.028	0.051
E	15.10	16.10	0.594	0.634
E1	13.30	13.90	0.524	0.547
e	5.45 BSC		0.215 BSC	
L	13.70	14.70	0.539	0.579
L1	1.00	1.60	0.039	0.063
R	2.00	3.00	0.079	0.118

### 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



VERSION 2: FACILITY CODE = N



SECTION "F-F", "G-G" AND "H-H"  
SCALE: NONE

MILLIMETERS		
DIM.	MIN.	MAX.
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	1.91	2.41
b2	1.91	2.16
b3	2.87	3.38
b4	2.87	3.13
c'	0.55	0.65
c	0.55	0.68
D	20.80	21.10

MILLIMETERS		
DIM.	MIN.	MAX.
D1	16.25	17.65
D2	0.50	0.80
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	5.44 BSC	
N	3	
L	19.81	20.32
L1	3.70	4.00
Q	5.49	6.00

ECN: E20-0538-Rev. C, 19-Oct-2020  
DWG: 5975

Notes

- Dimensioning and tolerancing per ASME Y14.5M-1994
- Outline conforms to JEDEC® outline to TO-274AD
- Dimensions are measured in mm, angles are in degree
- Metal surfaces are tin plated, except area of cut



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