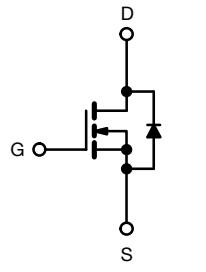


## E Series Power MOSFET



N-Channel MOSFET

### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Induction heating
  - Motor drives
  - Battery chargers
  - Renewable energy
  - Solar (PV inverters)

PRODUCT SUMMARY	
$V_{DS}$ (V) at $T_J$ max.	700
$R_{DS(on)}$ ( $\Omega$ ) typ. at 25 °C	$V_{GS} = 10$ V 0.025
$Q_g$ (nC) max.	591
$Q_{gs}$ (nC)	84
$Q_{gd}$ (nC)	160
Configuration	Single

### ORDERING INFORMATION

Package	Super-247
Lead (Pb)-free	SiHS90N65E-GE3

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	$V_{DS}$	650	V
Gate-source voltage	$V_{GS}$	$\pm 30$	
Continuous drain current ( $T_J = 150$ °C)	$V_{GS}$ at 10 V	$I_D$ 87	A
		55	
Pulsed drain current <sup>a</sup>	$I_{DM}$	323	
Linear derating factor		5	W/°C
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	1930	mJ
Maximum power dissipation	$P_D$	625	W
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +150	°C
Drain-source voltage slope	$dV/dt$	41	V/ns
Reverse diode $dV/dt$ <sup>d</sup>		4.1	
Soldering recommendations (peak temperature) <sup>c</sup>	for 10 s	300	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 140$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 11.7$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C

**THERMAL RESISTANCE RATINGS**

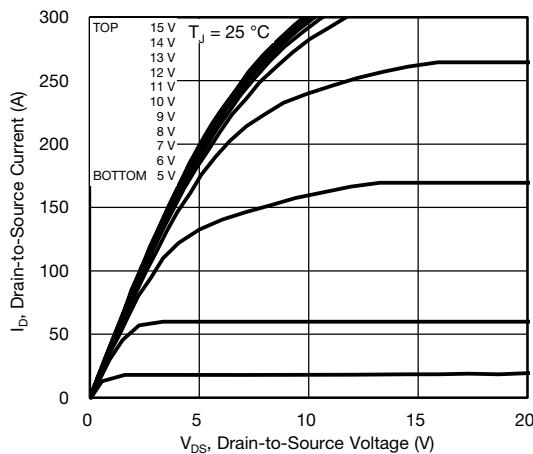
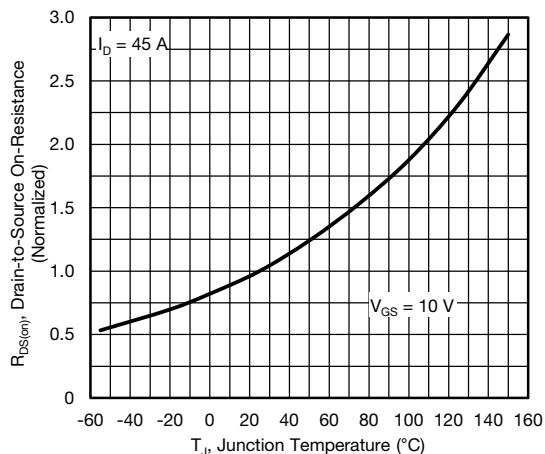
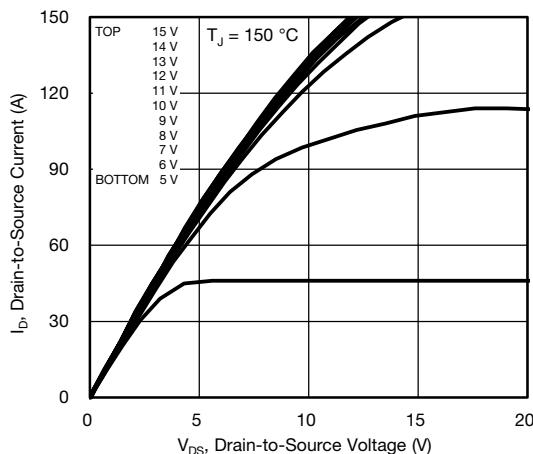
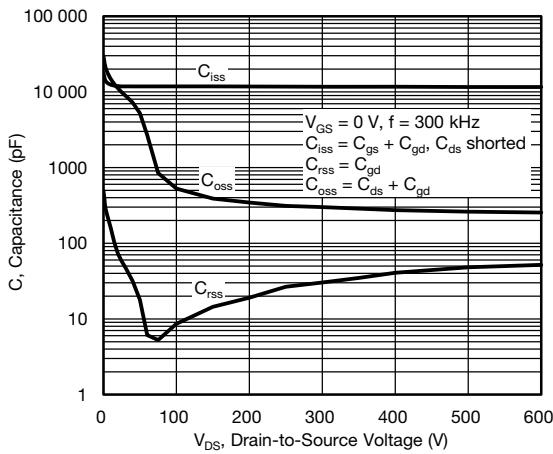
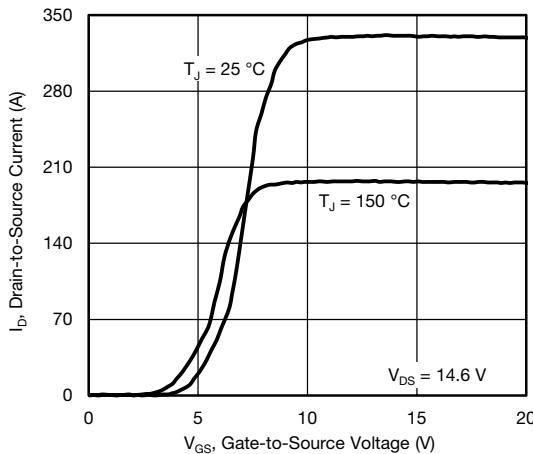
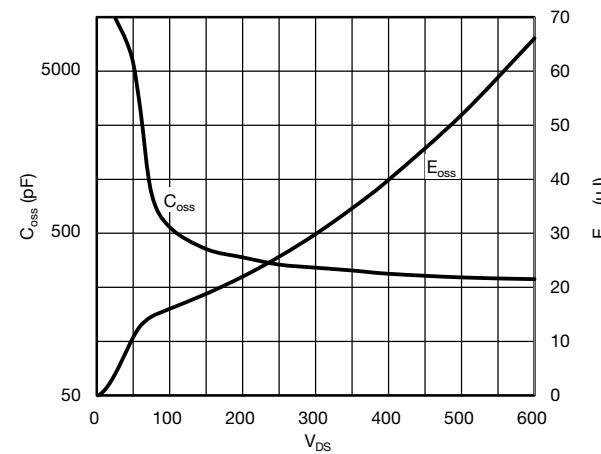
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	40	°C/W
Maximum junction-to-case (drain)	$R_{thJC}$	-	0.2	

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

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0$ V, $I_D = 250$ μA		650	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, $I_D = 1$ mA		-	0.83	-	V/°C
Gate threshold voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250$ μA		2.0	-	4.0	V
Gate-source leakage	$I_{GSS}$	$V_{GS} = \pm 20$ V		-	-	± 100	nA
		$V_{GS} = \pm 30$ V		-	-	± 1	μA
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 650$ V, $V_{GS} = 0$ V		-	-	1	μA
		$V_{DS} = 520$ V, $V_{GS} = 0$ V, $T_J = 125$ °C		-	-	25	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10$ V	$I_D = 45$ A	-	0.025	0.029	Ω
Forward transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 30$ V, $I_D = 45$ A		-	32	-	S
<b>Dynamic</b>							
Input capacitance	$C_{iss}$	$V_{GS} = 0$ V, $V_{DS} = 100$ V, $f = 300$ kHz		-	11 826	-	pF
Output capacitance	$C_{oss}$			-	528	-	
Reverse transfer capacitance	$C_{rss}$			-	9	-	
Effective output capacitance, energy related <sup>a</sup>	$C_{o(er)}$	$V_{GS} = 0$ V, $V_{DS} = 0$ V to 520 V		-	384	-	
Effective output capacitance, time related <sup>b</sup>	$C_{o(tr)}$			-	1502	-	
Total gate charge	$Q_g$		$V_{GS} = 10$ V, $I_D = 45$ A, $V_{DS} = 520$ V	-	394	591	nC
Gate-source charge	$Q_{gs}$			-	84	-	
Gate-drain charge	$Q_{gd}$			-	160	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 520$ V, $I_D = 45$ A, $V_{GS} = 10$ V, $R_g = 9.1$ Ω		-	85	128	ns
Rise time	$t_r$			-	152	228	
Turn-off delay time	$t_{d(off)}$			-	323	485	
Fall time	$t_f$			-	267	401	
Gate input resistance	$R_g$	$f = 1$ MHz, open drain		0.6	1.2	2.4	Ω
<b>Drain-Source Body Diode Characteristics</b>							
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode		-	-	87	A
Pulsed diode forward current	$I_{SM}$			-	-	323	
Diode forward voltage	$V_{SD}$	$T_J = 25$ °C, $I_S = 45$ A, $V_{GS} = 0$ V		-	0.9	1.2	V
Reverse recovery time	$t_{rr}$	$T_J = 25$ °C, $I_F = I_S = 45$ A, $dl/dt = 100$ A/μs, $V_R = 25$ V		-	971	1942	ns
Reverse recovery charge	$Q_{rr}$			-	26	52	μC
Reverse recovery current	$I_{RRM}$			-	42	-	A

**Notes**

a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$   
b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging 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. 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. 6 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**

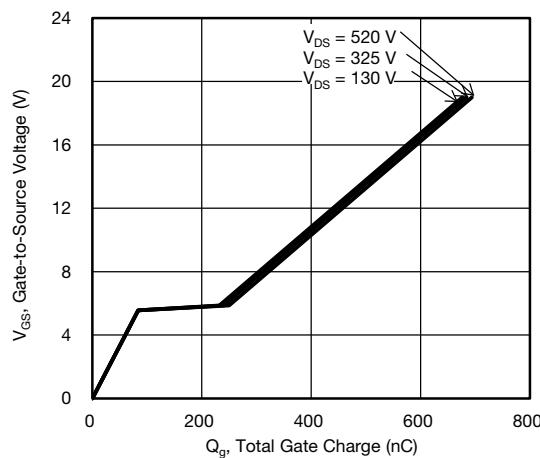


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

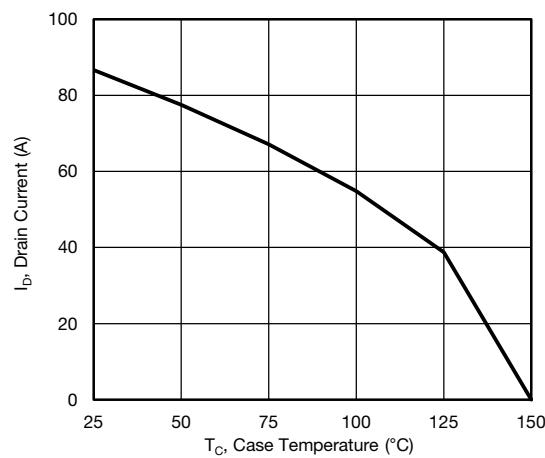


Fig. 10 - Maximum Drain Current vs. Case Temperature

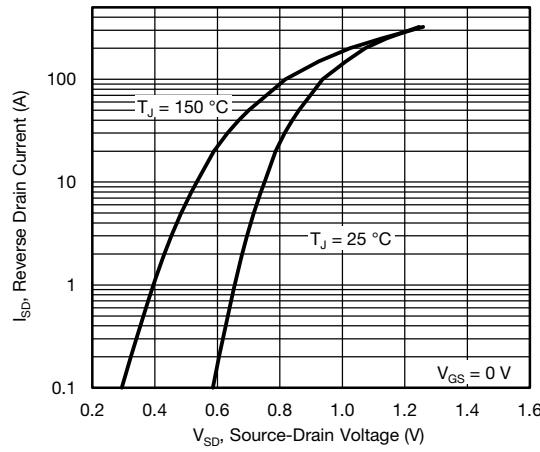


Fig. 8 - Typical Source-Drain Diode Forward Voltage

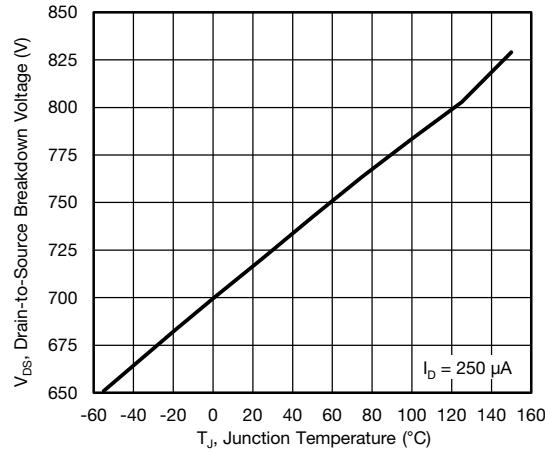


Fig. 11 - Temperature vs. Drain-to-Source Voltage

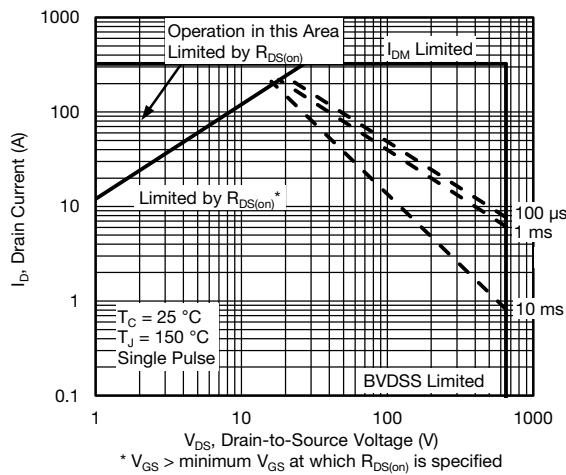
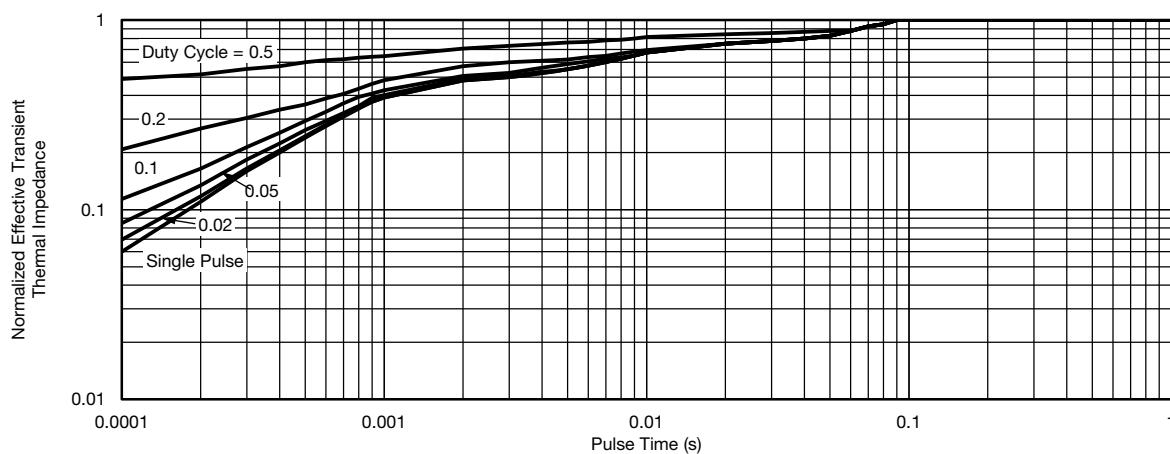
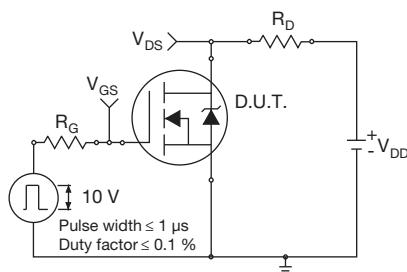


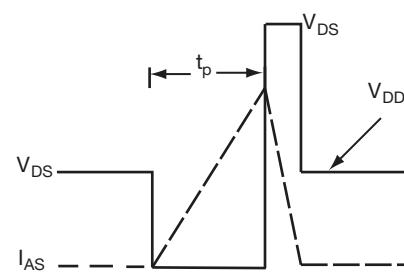
Fig. 9 - Maximum Safe Operating Area



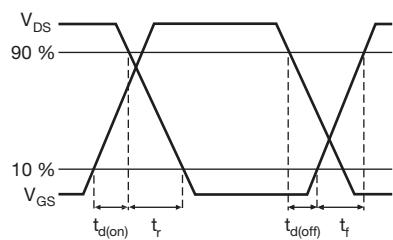
**Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case**



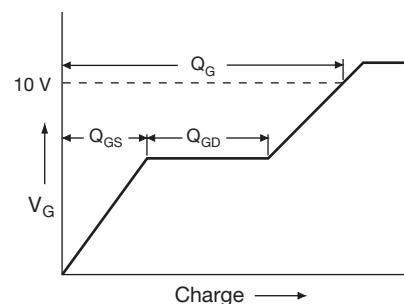
**Fig. 13 - Switching Time Test Circuit**



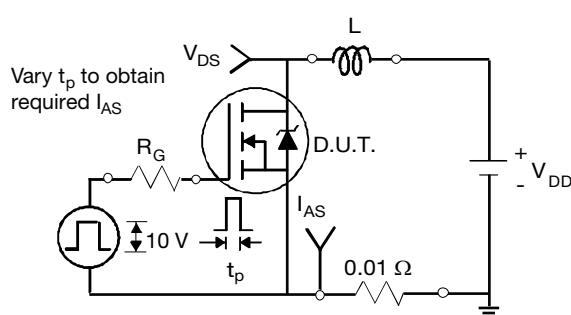
**Fig. 16 - Unclamped Inductive Waveforms**



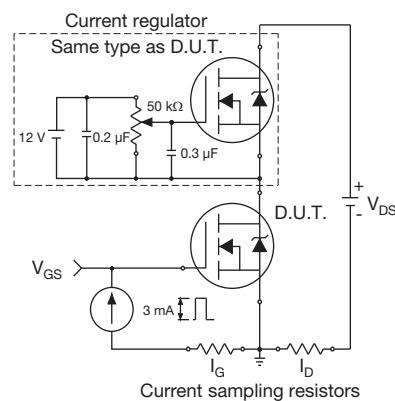
**Fig. 14 - Switching Time Waveforms**



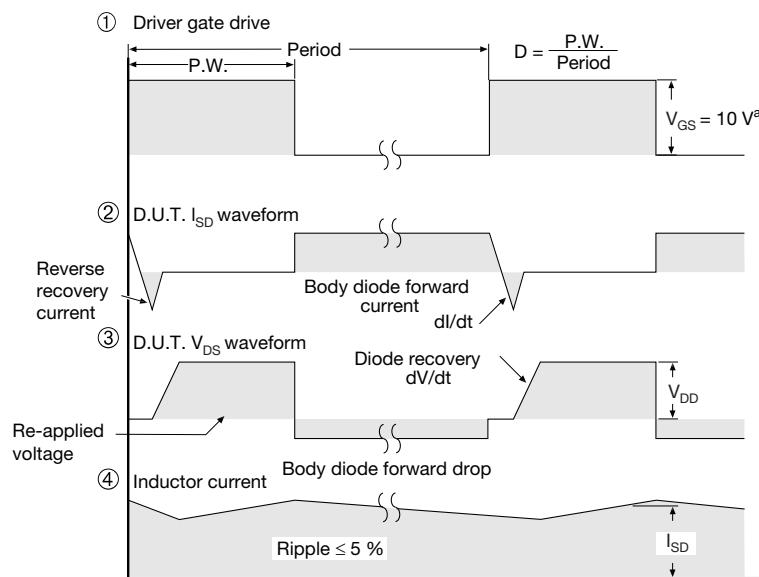
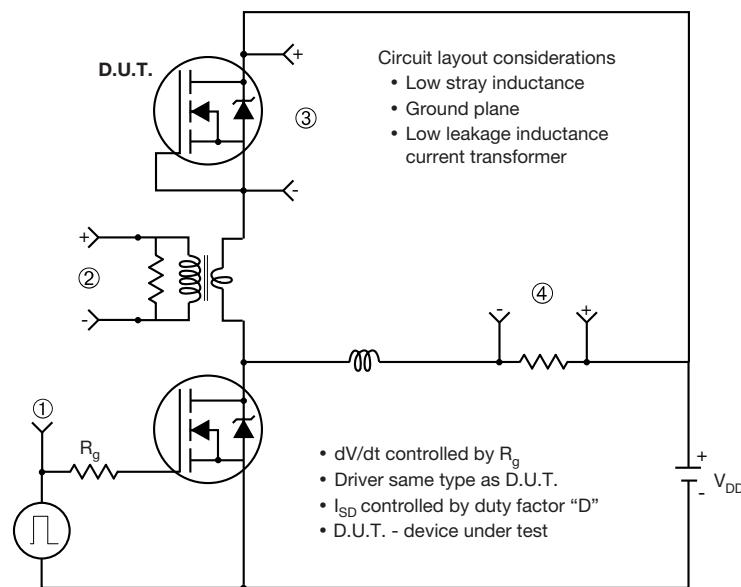
**Fig. 17 - Basic Gate Charge Waveform**



**Fig. 15 - Unclamped Inductive Test Circuit**



**Fig. 18 - Gate Charge Test Circuit**

**Peak Diode Recovery dV/dt Test Circuit**

**Note**

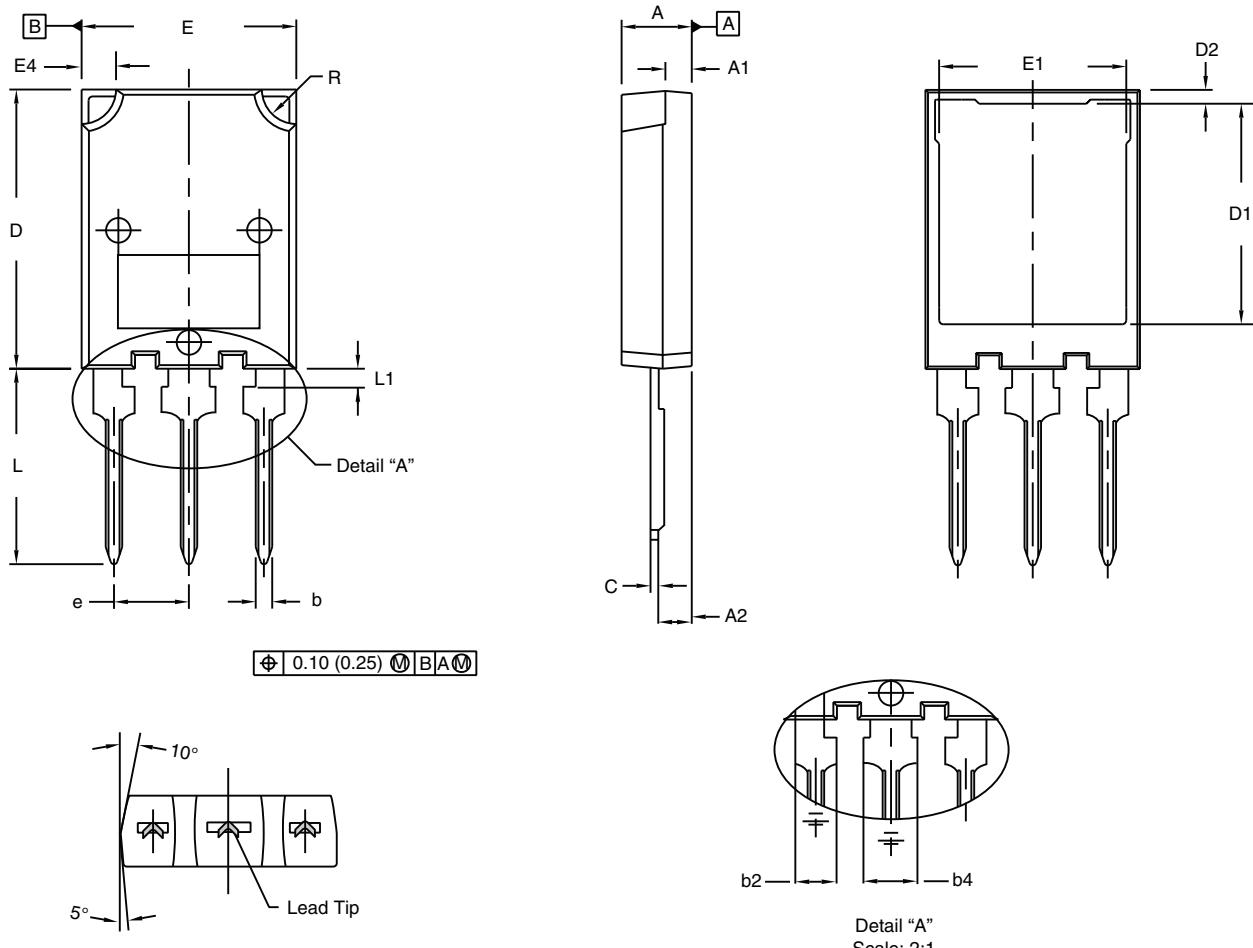
a.  $V_{GS} = 5 \text{ V}$  for logic level devices

**Fig. 19 - For N-Channel**

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### TO-274AA (High Voltage)

#### VERSION 1: FACILITY CODE = Y



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

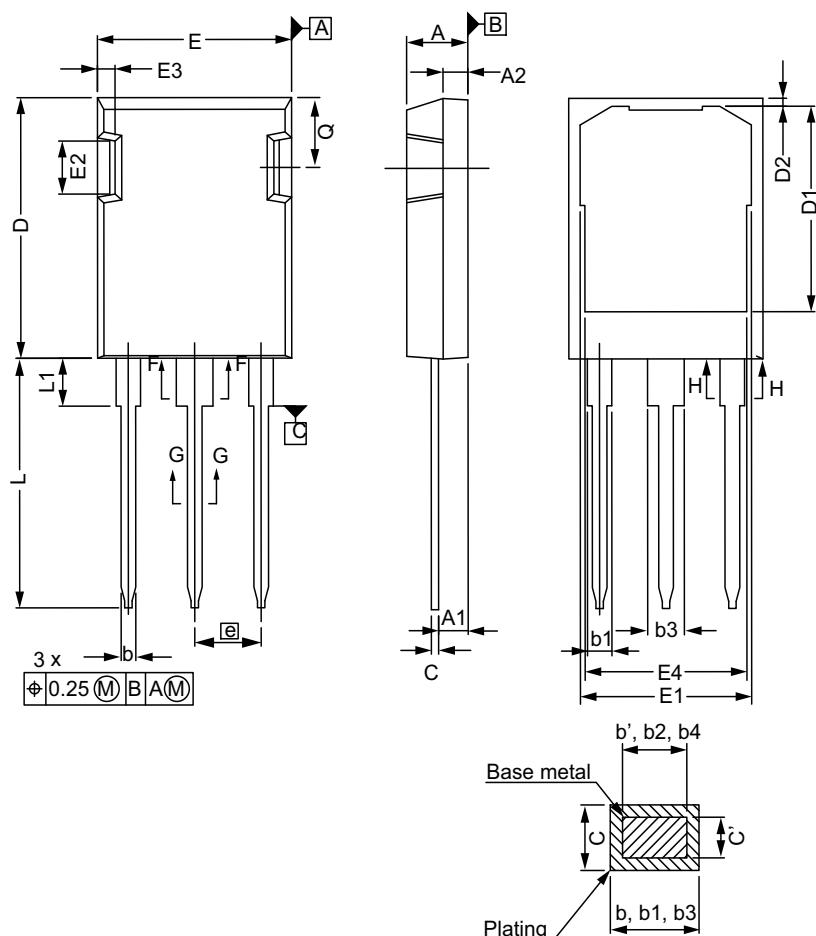
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D1	15.50	16.10	0.610	0.634
D2	0.70	1.30	0.028	0.051
E	15.10	16.10	0.594	0.634
E1	13.30	13.90	0.524	0.547
e	5.45 BSC		0.215 BSC	
L	13.70	14.70	0.539	0.579
L1	1.00	1.60	0.039	0.063
R	2.00	3.00	0.079	0.118

#### 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

<sup>(1)</sup> 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

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

DWG: 5975

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

#### 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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