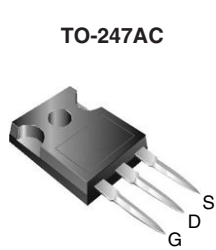


## D Series Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V) at $T_J$ max.	450
$R_{DS(on)}$ max. at 25 °C ( $\Omega$ )	$V_{GS} = 10\text{ V}$   0.17
$Q_g$ max. (nC)	88
$Q_{gs}$ (nC)	12
$Q_{gd}$ (nC)	23
Configuration	Single



### FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- Optimal Design
  - Low Area Specific On-Resistance
  - Low Input Capacitance ( $C_{iss}$ )
  - Reduced Capacitive Switching Losses
  - High Body Diode Ruggedness
  - Avalanche Energy Rated (UIS)
- Optimal Efficiency and Operation
  - Low Cost
  - Simple Gate Drive Circuitry
  - Low Figure-of-Merit (FOM):  $R_{on} \times Q_g$
  - Fast Switching
- Compliant to RoHS Directive 2011/65/EU



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### APPLICATIONS

- Consumer Electronics
  - Displays (LCD or Plasma TV)
- Lighting
- Industrial
  - Welding
  - Induction Heating
  - Motor Drives
  - Battery Chargers
- SMPS

ORDERING INFORMATION	
Package	TO-247AC
Lead (Pb)-free	SiHG25N40D-E3
Lead (Pb)-free and Halogen-free	SiHG25N40D-GE3


ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ °C}$ , unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	400	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	
Gate-Source Voltage AC ( $f > 1\text{ Hz}$ )		30	
Continuous Drain Current ( $T_J = 150\text{ °C}$ )	$V_{GS}$ at 10 V	$T_C = 25\text{ °C}$	A
		$T_C = 100\text{ °C}$	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	78	
Linear Derating Factor		2.2	W/°C
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	556	mJ
Maximum Power Dissipation	$P_D$	278	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	°C
Drain-Source Voltage Slope	$dV/dt$	$T_J = 125\text{ °C}$	V/ns
Reverse Diode $dV/dt$ <sup>d</sup>		0.6	
Soldering Recommendations (Peak Temperature)	for 10 s	300°	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ °C}$ ,  $L = 2.3\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 17\text{ A}$ .
- 1.6 mm from case.
- $I_{SD} \leq I_D$ , starting  $T_J = 25\text{ °C}$ .



THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.45	

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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		400	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 250\text{ }\mu\text{A}$		-	0.5	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		3	-	5	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}$		-	-	1	$\mu\text{A}$
		$V_{DS} = 320\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	10	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 13\text{ A}$	-	0.14	0.17	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 13\text{ A}$		-	7.4	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$		-	1707	-	$\mu\text{F}$
Output Capacitance	$C_{oss}$			-	177	-	
Reverse Transfer Capacitance	$C_{rss}$			-	19	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 13\text{ A}, V_{DS} = 320\text{ V}$	-	44	88	nC
Gate-Source Charge	$Q_{gs}$			-	12	-	
Gate-Drain Charge	$Q_{gd}$			-	23	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 320\text{ V}, I_D = 13\text{ A}, V_{GS} = 10\text{ V}, R_g = 24.6\text{ }\Omega$		-	21	42	ns
Rise Time	$t_r$			-	57	86	
Turn-Off Delay Time	$t_{d(off)}$			-	40	80	
Fall Time	$t_f$			-	37	74	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}, \text{open drain}$		-	1.8	-	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	24	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	78	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 13\text{ A}, V_{GS} = 0\text{ V}$		-	-	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 13\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 20\text{ V}$		-	353	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	4.4	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	24	-	A

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

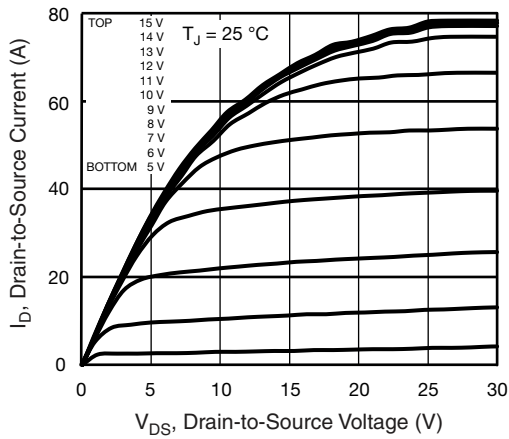


Fig. 1 - Typical Output Characteristics

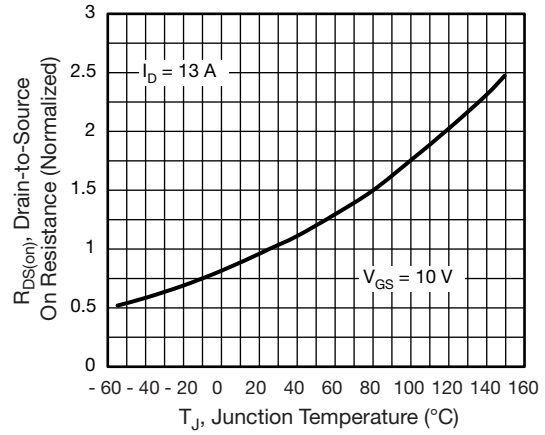


Fig. 4 - Normalized On-Resistance vs. Temperature

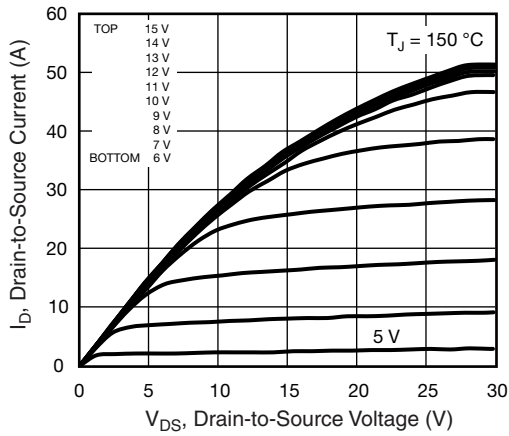


Fig. 2 - Typical Output Characteristics

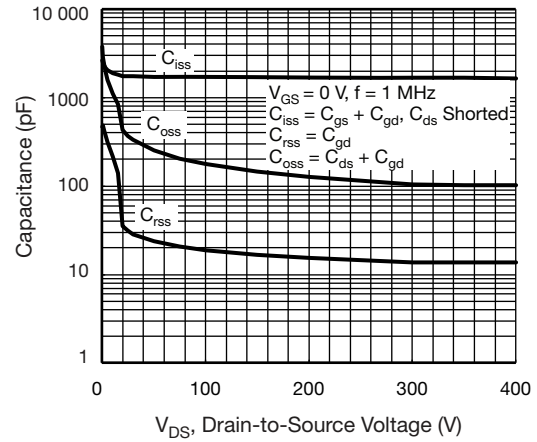


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

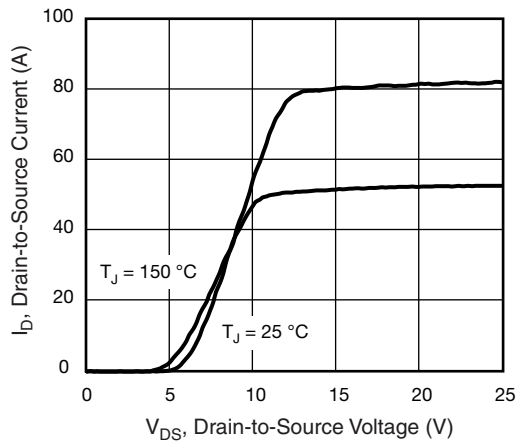


Fig. 3 - Typical Transfer Characteristics

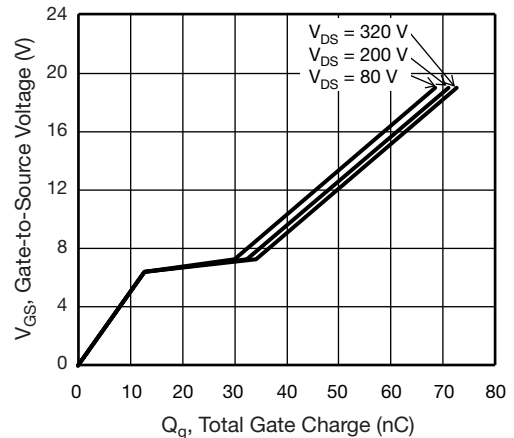


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

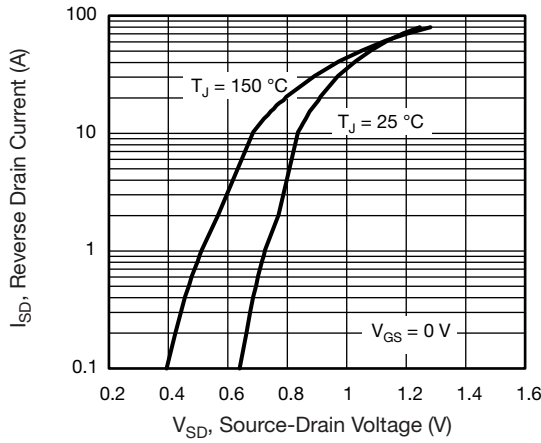


Fig. 7 - Typical Source-Drain Diode Forward Voltage

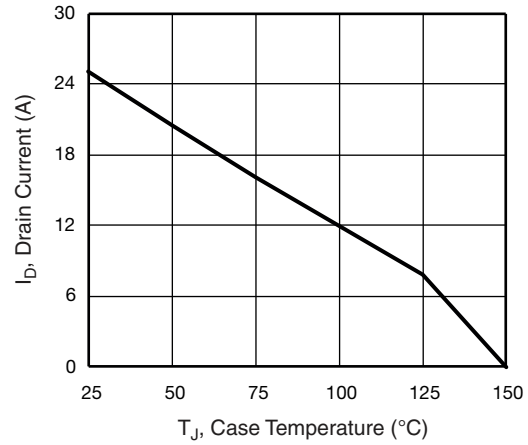


Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 8 - Maximum Safe Operating Area

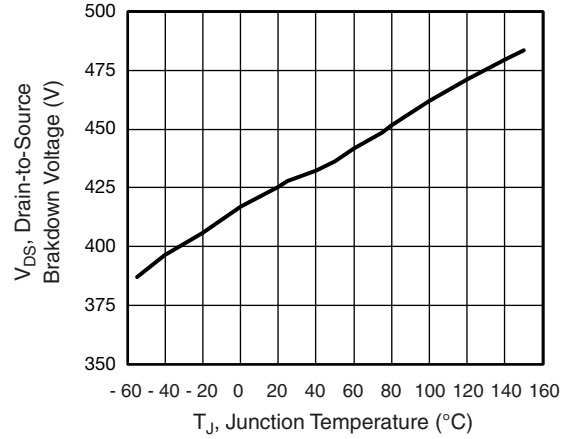


Fig. 10 - Temperature vs. Drain-to-Source Voltage

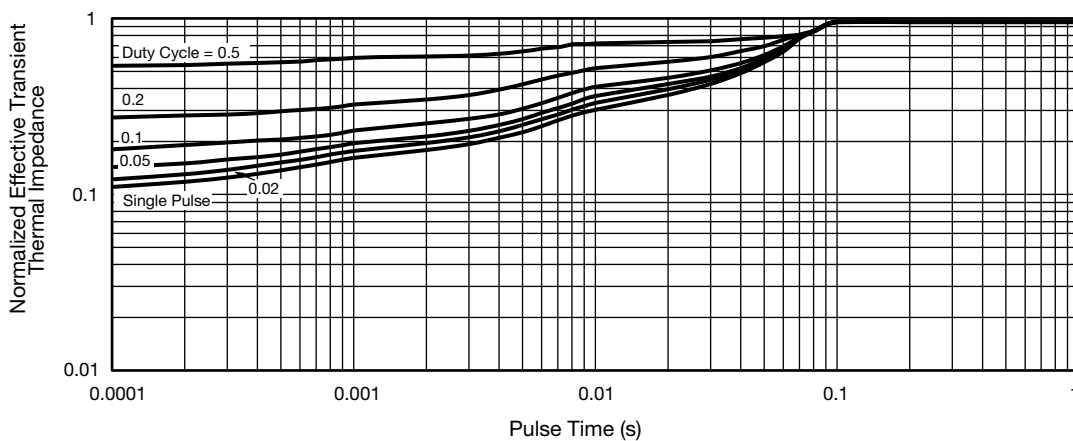


Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case



Fig. 12 - Switching Time Test Circuit

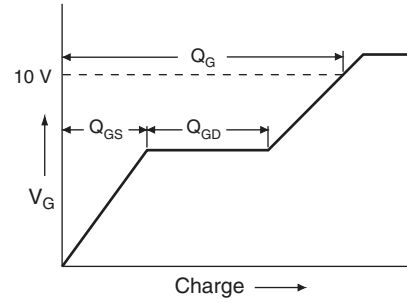


Fig. 16 - Basic Gate Charge Waveform



Fig. 13 - Switching Time Waveforms



Fig. 17 - Gate Charge Test Circuit



Fig. 14 - Unclamped Inductive Test Circuit



Fig. 15 - Unclamped Inductive Waveforms

Peak Diode Recovery dV/dt Test Circuit



Note

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

Fig. 18 - For N-Channel

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# TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



DIM.	MILLIMETERS			NOTES
	MIN.	NOM.	MAX.	
A	4.83	5.02	5.21	
A1	2.29	2.41	2.55	
A2	1.17	1.27	1.37	
b	1.12	1.20	1.33	
b1	1.12	1.20	1.28	
b2	1.91	2.00	2.39	6
b3	1.91	2.00	2.34	
b4	2.87	3.00	3.22	6, 8
b5	2.87	3.00	3.18	
c	0.40	0.50	0.60	6
c1	0.40	0.50	0.56	
D	20.40	20.55	20.70	4

DIM.	MILLIMETERS			NOTES
	MIN.	NOM.	MAX.	
D1	16.46	16.76	17.06	5
D2	0.56	0.66	0.76	
E	15.50	15.70	15.87	4
E1	13.46	14.02	14.16	5
E2	4.52	4.91	5.49	3
e	5.46 BSC			
L	14.90	15.15	15.40	
L1	3.96	4.06	4.16	6
Ø P	3.56	3.61	3.65	7
Ø P1	7.19 ref.			
Q	5.31	5.50	5.69	
S	5.51 BSC			

**Notes**

- (1) Package reference: JEDEC® TO247, variation AC
- (2) All dimensions are in mm
- (3) Slot required, notch may be rounded
- (4) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outermost extremes of the plastic body
- (5) Thermal pad contour optional with dimensions D1 and E1
- (6) Lead finish uncontrolled in L1
- (7) Ø P to have a maximum draft angle of 1.5° to the top of the part with a maximum hole diameter of 3.91 mm
- (8) Dimension b2 and b4 does not include dambar protrusion. Allowable dambar protrusion shall be 0.1 mm total in excess of b2 and b4 dimension at maximum material condition



**VERSION 2: FACILITY CODE = Y**



DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
A	4.58	5.31	
A1	2.21	2.59	
A2	1.17	2.49	
b	0.99	1.40	
b1	0.99	1.35	
b2	1.53	2.39	
b3	1.65	2.37	
b4	2.42	3.43	
b5	2.59	3.38	
c	0.38	0.86	
c1	0.38	0.76	
D	19.71	20.82	
D1	13.08	-	

DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
D2	0.51	1.30	
E	15.29	15.87	
E1	13.72	-	
e	5.46 BSC		
Ø k	0.254		
L	14.20	16.25	
L1	3.71	4.29	
Ø P	3.51	3.66	
Ø P1	-	7.39	
Q	5.31	5.69	
R	4.52	5.49	
S	5.51 BSC		

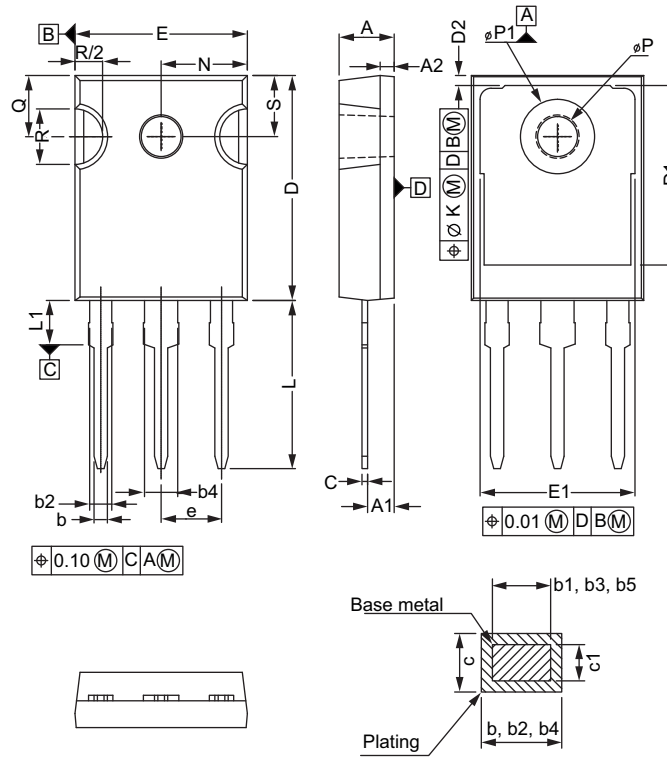
**Notes**

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) 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 outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC outline TO-247 with exception of dimension c





**VERSION 3: FACILITY CODE = N**



MILLIMETERS		
DIM.	MIN.	MAX.
A	4.65	5.31
A1	2.21	2.59
A2	1.17	1.37
b	0.99	1.40
b1	0.99	1.35
b2	1.65	2.39
b3	1.65	2.34
b4	2.59	3.43
b5	2.59	3.38
c	0.38	0.89
c1	0.38	0.84
D	19.71	20.70
D1	13.08	-

MILLIMETERS		
DIM.	MIN.	MAX.
D2	0.51	1.35
E	15.29	15.87
E1	13.46	-
e	5.46 BSC	
k	0.254	
L	14.20	16.10
L1	3.71	4.29
N	7.62 BSC	
P	3.56	3.66
P1	-	7.39
Q	5.31	5.69
R	4.52	5.49
S	5.51 BSC	

ECN: E22-0452-Rev. G, 31-Oct-2022  
 DWG: 5971

**Notes**

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) 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 outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")



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