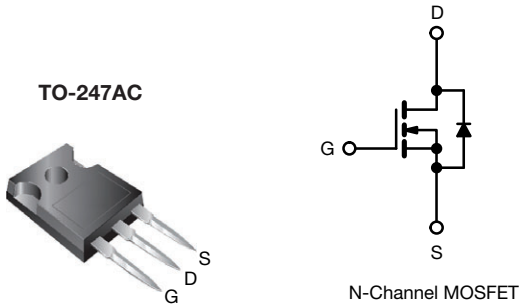


## E Series Power MOSFET with Fast Body Diode

PRODUCT SUMMARY	
$V_{DS}$ (V) at $T_J$ max.	700
$R_{DS(on)}$ max. ( $\Omega$ ) at 25 °C	$V_{GS} = 10$ V   0.156
$Q_g$ max. (nC)	122
$Q_{gs}$ (nC)	17
$Q_{gd}$ (nC)	36
Configuration	Single



### FEATURES

- Fast body diode MOSFET using E series technology
- Reduced  $t_{rr}$ ,  $Q_{rr}$ , and  $I_{RRM}$
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Low switching losses due to reduced  $Q_{rr}$
- 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  
HALOGEN  
FREE

### APPLICATIONS

- Telecommunications
  - Server and telecom power supplies
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Consumer and computing
  - ATX power supplies
- Industrial
  - Welding
  - Battery chargers
- Renewable energy
  - Solar (PV inverters)
- Switch mode power supplies (SMPS)
  - Applications using the following topologies
    - LCC
    - Phase shifted bridge (ZVS)
    - 3-level inverter
    - AC/DC bridge

ORDERING INFORMATION	
Package	TO-247AC
Lead (Pb)-free and halogen-free	SiHG24N65EF-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	$T_C = 25$ °C	24
		$T_C = 100$ °C	15
Pulsed drain current <sup>a</sup>	$I_{DM}$	65	A
Linear derating factor		2	W/°C
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	691	mJ
Maximum power dissipation	$P_D$	250	W
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +150	°C
Drain-source voltage slope	$dV/dt$	$T_J = 125$ °C	70
Reverse diode $dV/dt$ <sup>d</sup>		50	
Soldering recommendations (peak temperature) <sup>c</sup>	for 10 s	300	°C

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 7$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $dI/dt = 900$  A/ $\mu$ s, starting  $T_J = 25$  °C



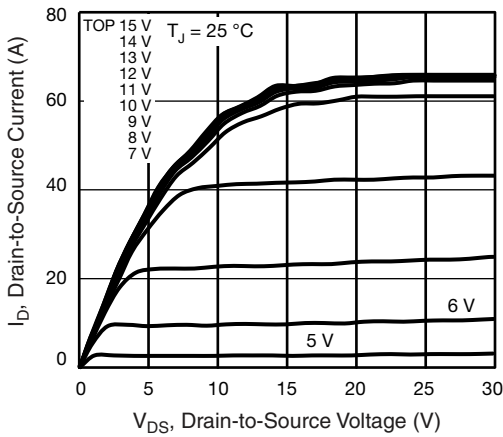
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R <sub>thJA</sub>	-	40	°C/W
Maximum junction-to-case (drain)	R <sub>thJC</sub>	-	0.5	

SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)									
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT		
<b>Static</b>									
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA		650	-	-	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		-	0.68	-	V/°C		
Gate-source threshold voltage (N)	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		2	-	4	V		
Gate-source leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ± 20 V		-	-	± 100	nA		
		V <sub>GS</sub> = ± 30 V		-	-	± 1	μA		
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V		-	-	1	μA		
		V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C		-	-	500			
Drain-source on-state resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 12 A	-	0.13	0.156	Ω		
Forward transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 30 V, I <sub>D</sub> = 12 A		-	7.2	-	S		
<b>Dynamic</b>									
Input capacitance	C <sub>iSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 100 V, f = 1 MHz		-	2774	-	pF		
Output capacitance	C <sub>oss</sub>			-	128	-			
Reverse transfer capacitance	C <sub>rSS</sub>			-	4	-			
Effective output capacitance, energy related <sup>a</sup>	C <sub>o(er)</sub>			V <sub>DS</sub> = 0 V to 520 V, V <sub>GS</sub> = 0 V		-		96	-
Effective output capacitance, time related <sup>b</sup>	C <sub>o(tr)</sub>			V <sub>DS</sub> = 0 V to 520 V, V <sub>GS</sub> = 0 V		-		333	-
Total gate charge	Q <sub>g</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 12 A, V <sub>DS</sub> = 520 V	-	81	122	nC		
Gate-source charge	Q <sub>gs</sub>			-	17	-			
Gate-drain charge	Q <sub>gd</sub>			-	36	-			
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = 520 V, I <sub>D</sub> = 12 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 9.1 Ω		-	24	48	ns		
Rise time	t <sub>r</sub>			-	34	68			
Turn-off delay time	t <sub>d(off)</sub>			-	80	120			
Fall time	t <sub>f</sub>			-	46	92			
Gate input resistance	R <sub>g</sub>			f = 1 MHz, open drain		0.2		0.5	1.0
<b>Drain-Source Body Diode Characteristics</b>									
Continuous source-drain diode current	I <sub>S</sub>	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	24	A		
Pulsed diode forward current	I <sub>SM</sub>			-	-	65			
Diode forward voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = 12 A, V <sub>GS</sub> = 0 V		-	0.9	1.2	V		
Reverse recovery time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 12 A, di/dt = 100 A/μs, V <sub>R</sub> = 400 V		-	151	288	ns		
Reverse recovery charge	Q <sub>rr</sub>			-	0.9	2.1	μC		
Reverse recovery current	I <sub>RRM</sub>			-	13	-	A		

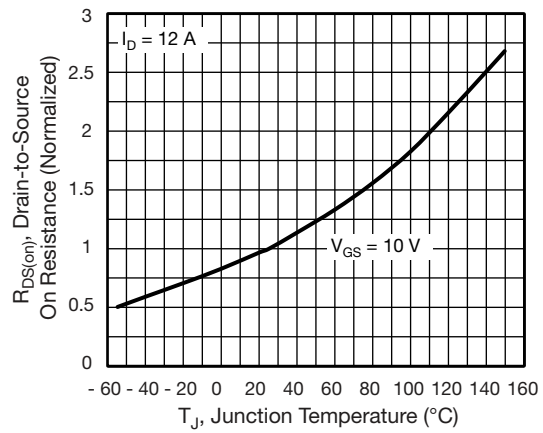
**Notes**

- a. C<sub>oss(er)</sub> is a fixed capacitance that gives the same energy as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 % to 80 % V<sub>DSS</sub>
- b. C<sub>oss(tr)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 % to 80 % V<sub>DSS</sub>

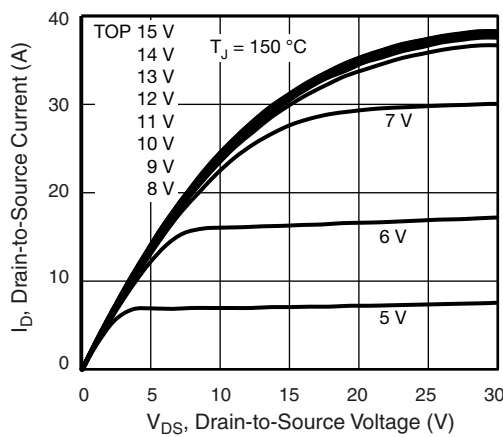
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



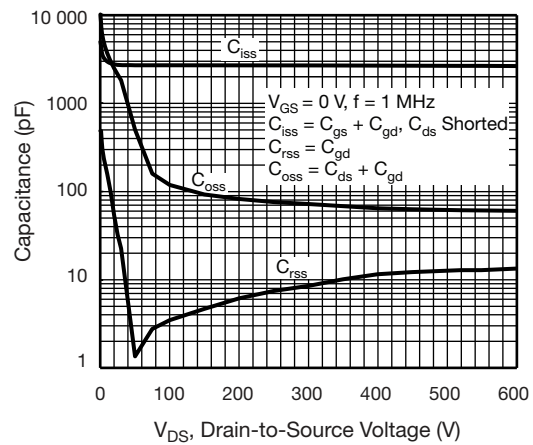
**Fig. 1 - Typical Output Characteristics**



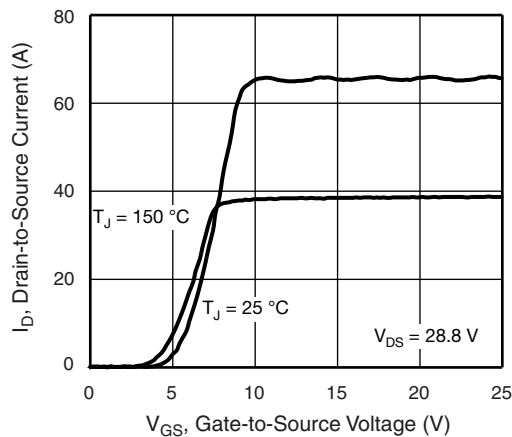
**Fig. 4 - Normalized On-Resistance vs. Temperature**



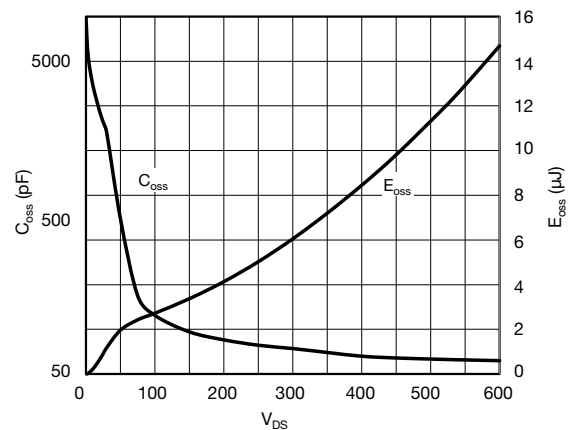
**Fig. 2 - Typical Output Characteristics**



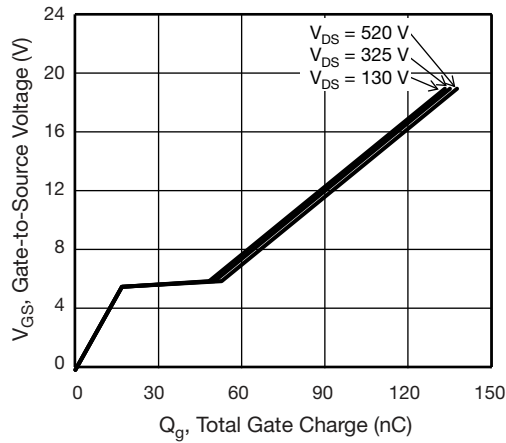
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



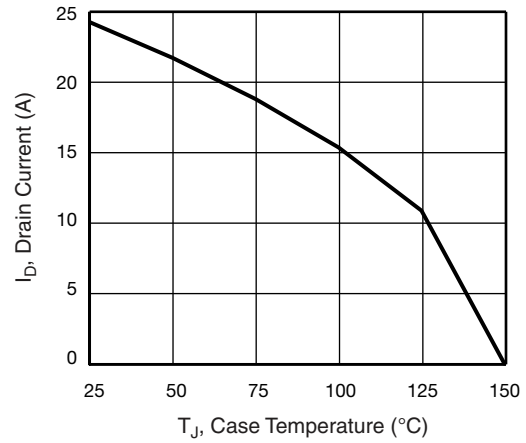
**Fig. 3 - Typical Transfer Characteristics**



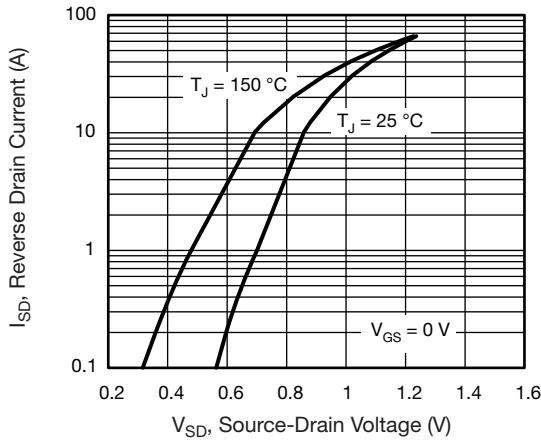
**Fig. 6 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**



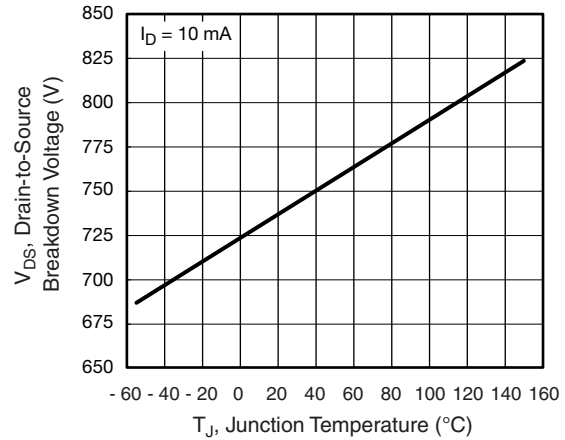
**Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage**



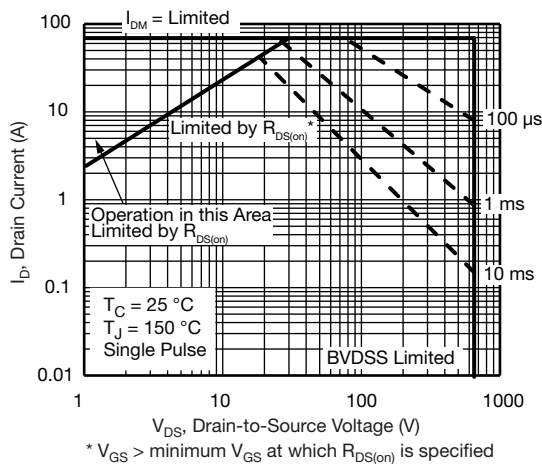
**Fig. 10 - Maximum Drain Current vs. Case Temperature**



**Fig. 8 - Typical Source-Drain Diode Forward Voltage**



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



**Fig. 9 - Maximum Safe Operating Area**

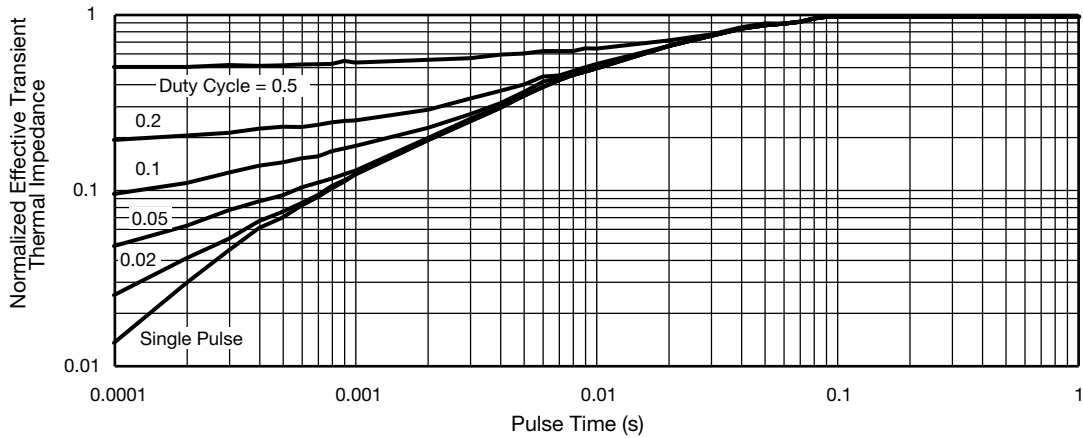


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case



Fig. 13 - Switching Time Test Circuit

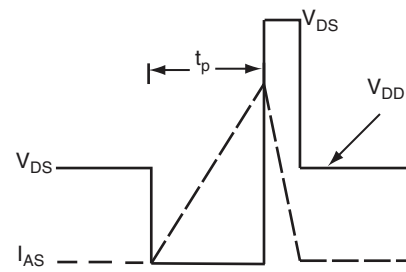


Fig. 16 - Unclamped Inductive Waveforms

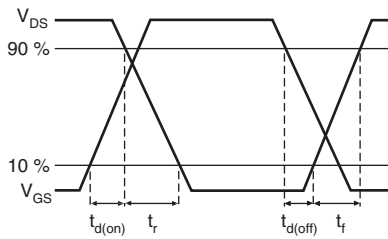


Fig. 14 - Switching Time Waveforms

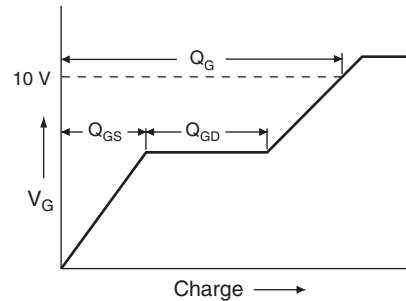


Fig. 17 - Basic Gate Charge Waveform

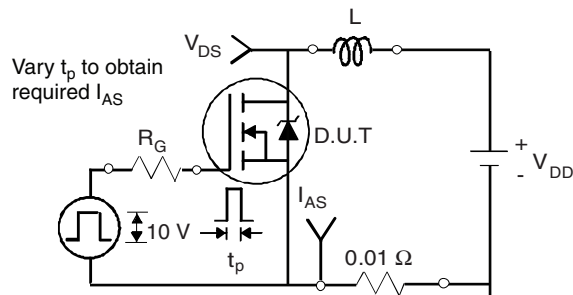


Fig. 15 - Unclamped Inductive Test Circuit

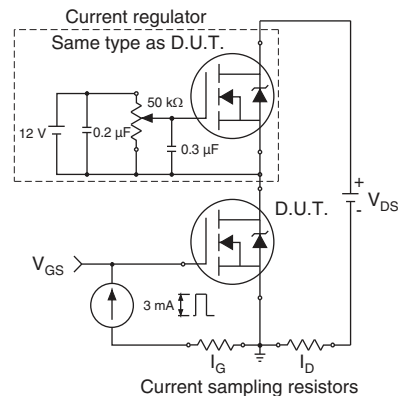


Fig. 18 - Gate Charge Test Circuit

**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-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



Section C--C, D--D, E--E

DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
A	4.83	5.21	
A1	2.29	2.55	
A2	1.50	2.49	
b	1.12	1.33	
b1	1.12	1.28	
b2	1.91	2.39	6
b3	1.91	2.34	
b4	2.87	3.22	6, 8
b5	2.87	3.18	
c	0.55	0.69	6
c1	0.55	0.65	
D	20.40	20.70	4

DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
D1	16.25	16.85	5
D2	0.56	0.76	
E	15.50	15.87	4
E1	13.46	14.16	5
E2	4.52	5.49	3
e	5.44 BSC		
L	14.90	15.40	
L1	3.96	4.16	6
Ø P	3.56	3.65	7
Ø P1	7.19 ref.		
Q	5.31	5.69	
S	5.54	5.74	

**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: E20-0545-Rev. F, 19-Oct-2020  
 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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