E Series Power MOSFET

PRODUCT SUMMARY

V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ max. at 25 °C (Ω)	V_{GS} = 10 V	0.158
Q_g max. (nC)	95	
Q_{gs} (nC)	16	
Q_{gd} (nC)	25	
Configuration	Single	

TO-247AC

N-Channel MOSFET
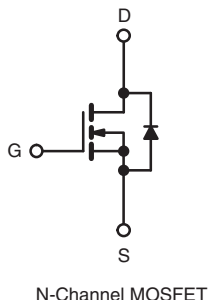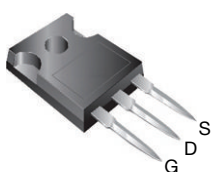
FEATURES

- Low figure-of-merit (FOM) R_{on} x 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

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)

RoHS
COMPLIANT
HALOGEN
FREE

ORDERING INFORMATION

Package	TO-247AC
Lead (Pb)-free and Halogen-free	SiHG23N60E-GE3

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

| PARAMETER				SYMBOL	LIMIT	UNIT
Drain-Source Voltage				V_{DS}	600	V
Gate-Source Voltage				V_{GS}	± 30	
Continuous Drain Current (T_J = 150 °C)	V_{GS} at 10 V	T_C = 25 °C		I_D	23	A
		T_C = 100 °C			15	
Pulsed Drain Current [a]				I_{DM}	63	
Linear Derating Factor					1.8	W/°C
Single Pulse Avalanche Energy [b]				E_{AS}	353	mJ
Maximum Power Dissipation				P_D	227	W
Operating Junction and Storage Temperature Range				T_J, T_{stg}	-55 to +150	°C
Drain-Source Voltage Slope		T_J = 125 °C		dV/dt	37	V/ns
Reverse Diode dV/dt [d]					34	
Soldering Recommendations (Peak Temperature) [c]		for 10 s			300	°C

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature.
b. V_{DD} = 50 V, starting T_J = 25 °C, L = 28.2 mH, R_g = 25 Ω, I_{AS} = 5 A.
c. 1.6 mm from case.
d. $I_{SD} \leq I_D$, dI/dt = 100 A/μs, 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}	-	0.55	

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 V, I_D = 250 µA		600	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA		-	0.72	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		2	-	4	V
Gate-Source Leakage	I_{GSS}	V_{GS} = ± 20 V		-	-	± 100	nA
		V_{GS} = ± 30 V		-	-	± 1	µA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 600 V, V_{GS} = 0 V		-	-	1	µA
		V_{DS} = 480 V, V_{GS} = 0 V, T_J = 125 °C		-	-	10	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 12 A	-	0.132	0.158	Ω
Forward Transconductance	g_{fs}	V_{DS} = 30 V, I_D = 12 A		-	6.4	-	S
Dynamic							
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz		-	2418	-	pF
Output Capacitance	C_{oss}			-	119	-	
Reverse Transfer Capacitance	C_{rss}			-	4	-	
Effective Output Capacitance, Energy Related [a]	$C_{o(er)}$	V_{DS} = 0 V to 480 V, V_{GS} = 0 V		-	107	-	
Effective Output Capacitance, Time Related [b]	$C_{o(tr)}$			-	320	-	
Total Gate Charge	Q_g	V_{GS} = 10 V	I_D = 12 A, V_{DS} = 480 V	-	63	95	nC
Gate-Source Charge	Q_{gs}			-	16	-	
Gate-Drain Charge	Q_{gd}			-	25	-	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 480 V, I_D = 12 A, V_{GS} = 10 V, R_g = 9.1 Ω		-	22	44	ns
Rise Time	t_r			-	38	76	
Turn-Off Delay Time	$t_{d(off)}$			-	66	99	
Fall Time	t_f			-	34	68	
Gate Input Resistance	R_g	f = 1 MHz, open drain		-	0.73	-	Ω
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	23	A
Pulsed Diode Forward Current	I_{SM}			-	-	63	
Diode Forward Voltage	V_{SD}	T_J = 25 °C, I_S = 12 A, V_{GS} = 0 V		-	0.9	1.2	V
Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = I_S = 12 A, dI/dt = 100 A/µs, V_R = 25 V		-	384	768	ns
Reverse Recovery Charge	Q_{rr}			-	6.4	12.8	µC
Reverse Recovery Current	I_{RRM}			-	30	-	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_{DSS}.

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_{DSS}.

TYPICAL CHARACTERISTICS (T_J = 25 °C, unless otherwise noted)
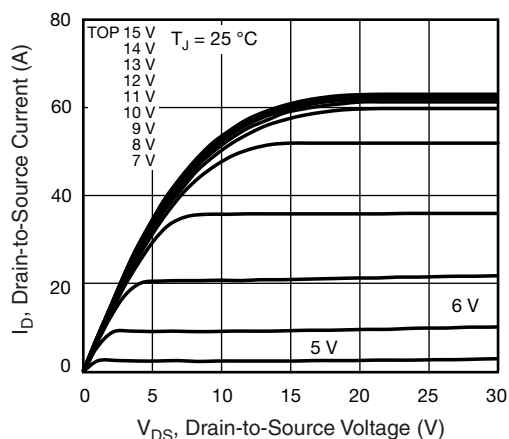
Fig. 1 - Typical Output Characteristics

Fig. 2 - Typical Output Characteristics

Fig. 3 - Typical Transfer Characteristics
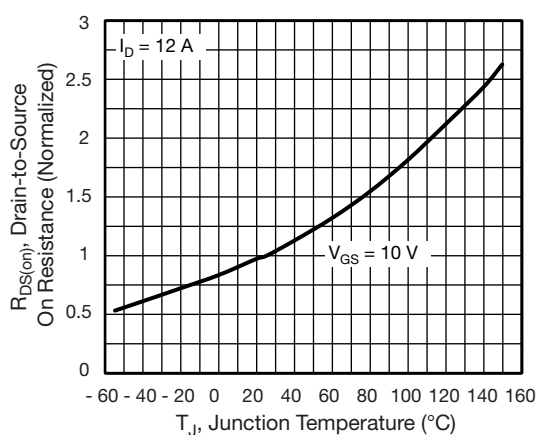
Fig. 4 - Normalized On-Resistance vs. Temperature
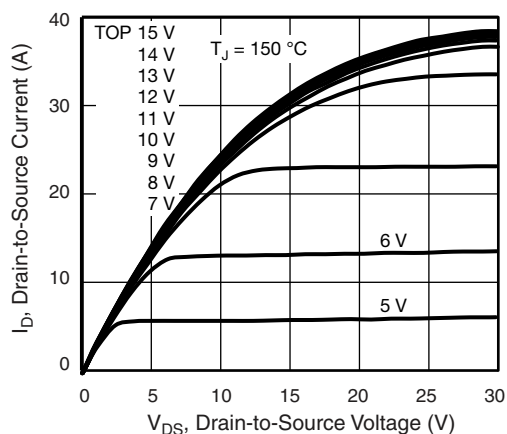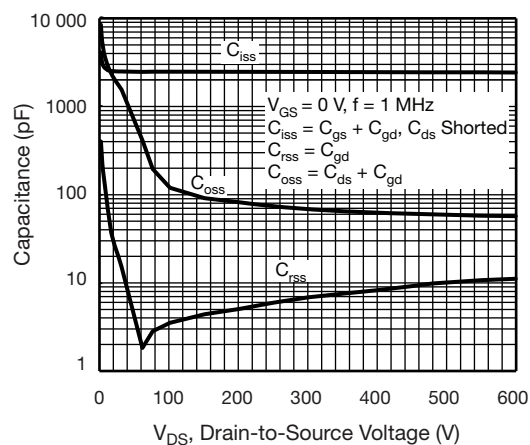
Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage
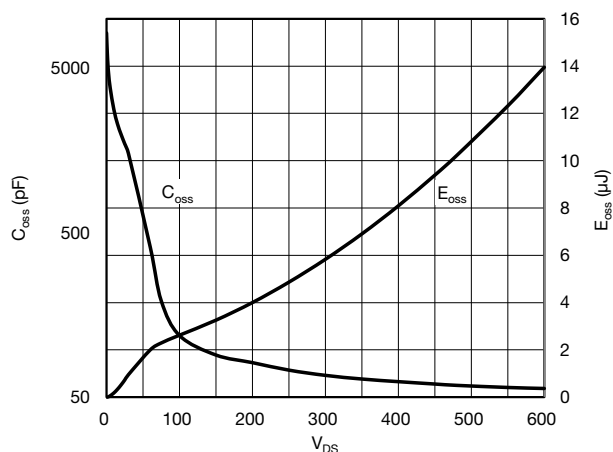
Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}
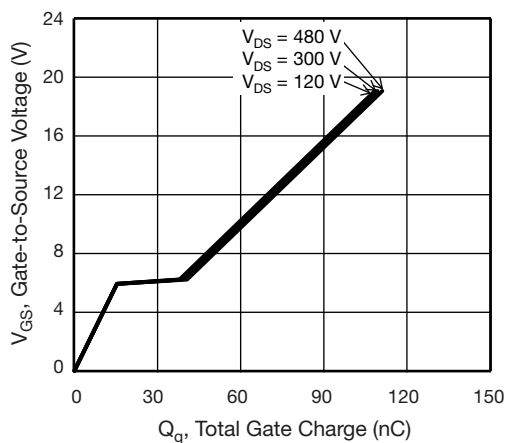
Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage
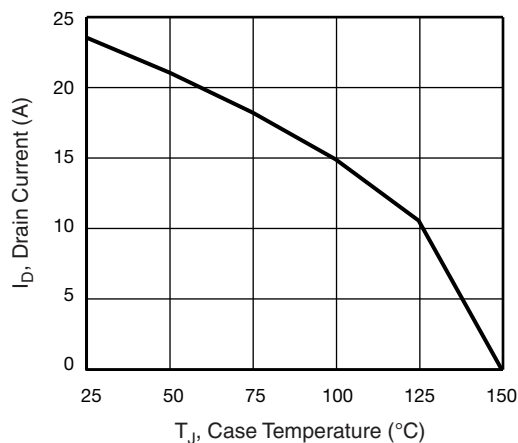
Fig. 10 - Maximum Drain Current vs. Case Temperature
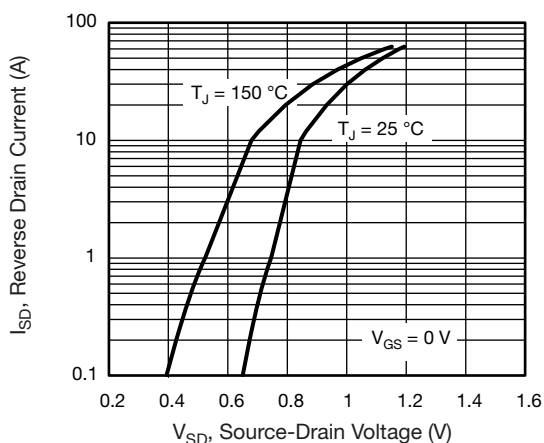
Fig. 8 - Typical Source-Drain Diode Forward Voltage
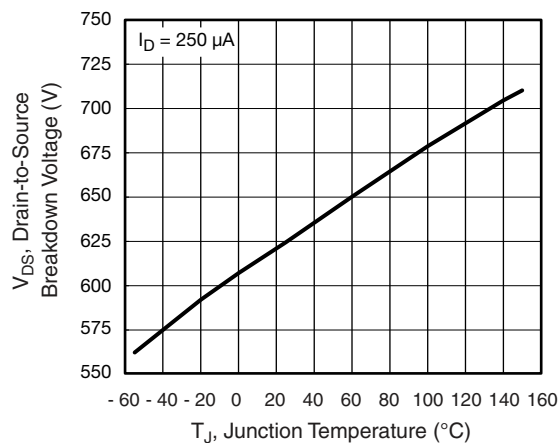
Fig. 11 - Temperature vs. Drain-to-Source Voltage

* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified
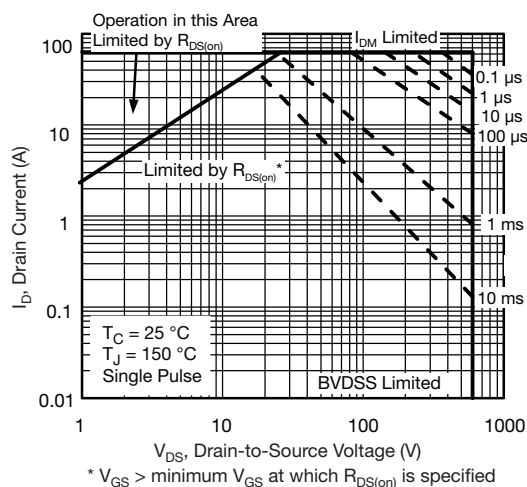
Fig. 9 - Maximum Safe Operating Area
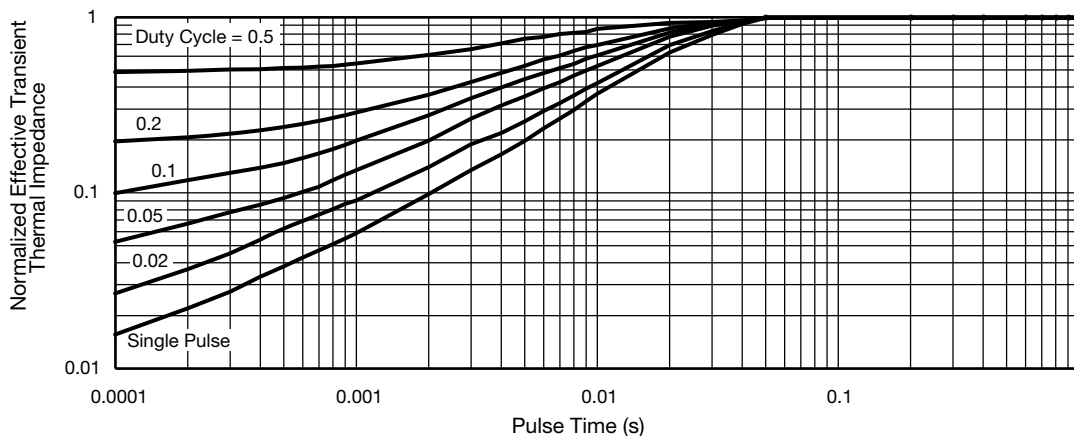
Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case
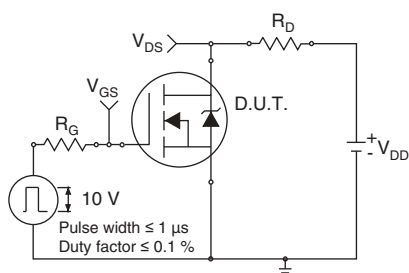
Fig. 13 - Switching Time Test Circuit
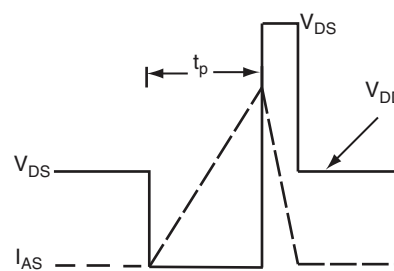
Fig. 16 - Unclamped Inductive Waveforms
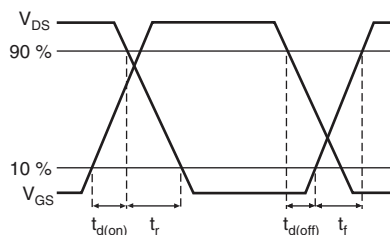
Fig. 14 - Switching Time Waveforms
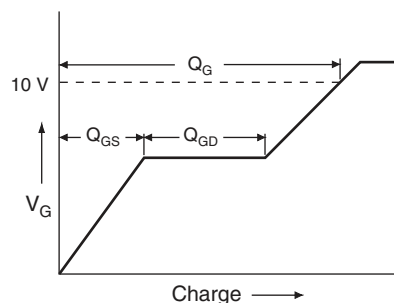
Fig. 17 - Basic Gate Charge Waveform
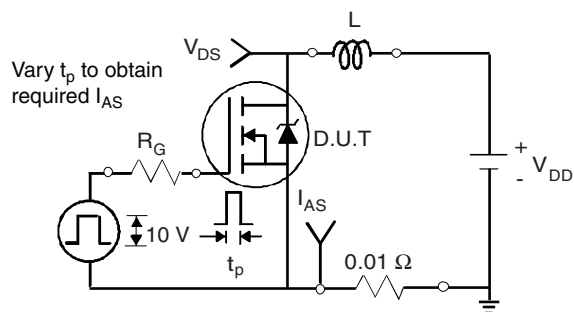
Fig. 15 - Unclamped Inductive Test Circuit
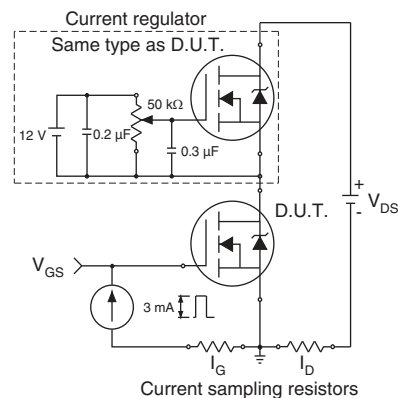
Fig. 18 - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

D.U.T.

③

+

−

Circuit layout considerations
- Low stray inductance
- Ground plane
- Low leakage inductance current transformer

②
+
−

④
− +

①

R_g

- dV/dt controlled by R_g
- Driver same type as D.U.T.
- I_{SD} controlled by duty factor "D"
- D.U.T. - device under test

+
− V_{DD}

① Driver gate drive

$D = \dfrac{P.W.}{Period}$

P.W.

Period

$V_{GS} = 10\ V^a$

② D.U.T. I_{SD} waveform

Reverse recovery current

Body diode forward current

dI/dt

③ D.U.T. V_{DS} waveform

Diode recovery dV/dt

V_{DD}

Re-applied voltage

Body diode forward drop

④ Inductor current

Ripple ≤ 5 %

I_{SD}

Note

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

Fig. 19 - For N-Channel

TO-247AC (High Voltage)

Lead Assignments
1. Gate
2. Drain
3. Source
4. Drain

See view B

View B

View A - A

Thermal pad

Section C - C, D - D, E - E
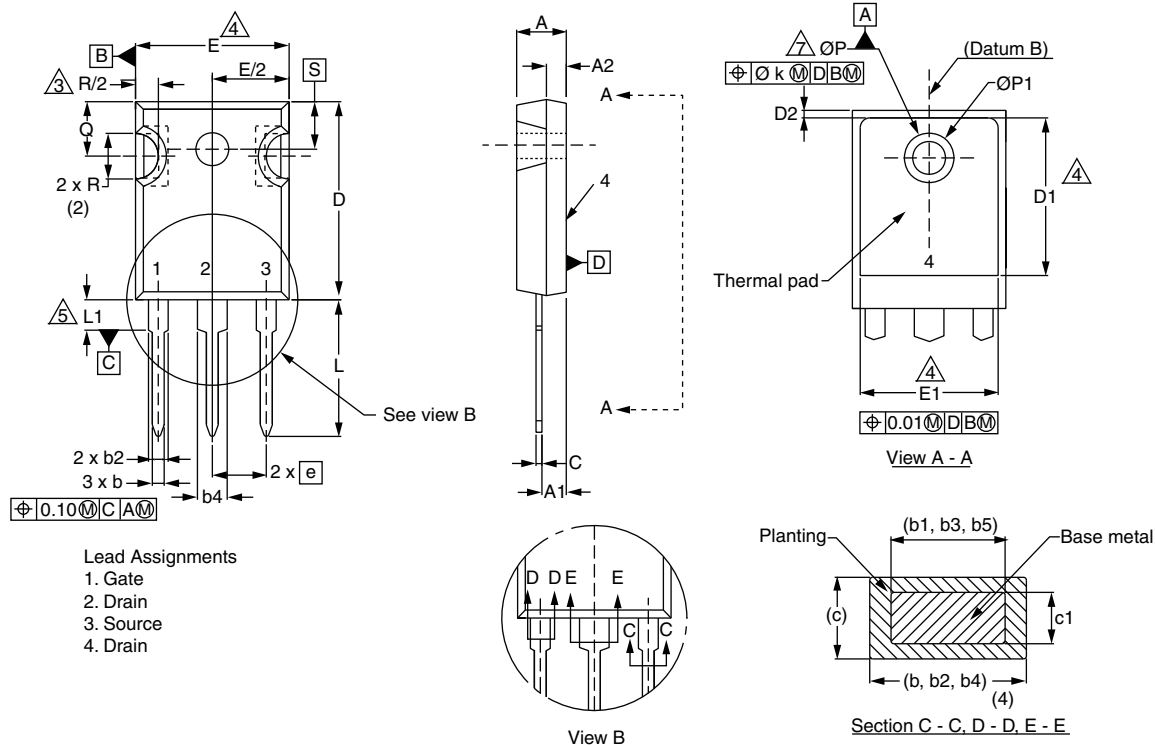
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.58	5.31	0.180	0.209
A1	2.21	2.59	0.087	0.102
A2	1.17	2.49	0.046	0.098
b	0.99	1.40	0.039	0.055
b1	0.99	1.35	0.039	0.053
b2	1.53	2.39	0.060	0.094
b3	1.65	2.37	0.065	0.093
b4	2.42	3.43	0.095	0.135
b5	2.59	3.38	0.102	0.133
c	0.38	0.86	0.015	0.034
c1	0.38	0.76	0.015	0.030
D	19.71	20.82	0.776	0.820
D1	13.08	-	0.515	-

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D2	0.51	1.30	0.020	0.051
E	15.29	15.87	0.602	0.625
E1	13.72	-	0.540	-
e	5.46 BSC		0.215 BSC	
Ø k	0.254		0.010	
L	14.20	16.25	0.559	0.640
L1	3.71	4.29	0.146	0.169
N	7.62 BSC		0.300 BSC	
Ø P	3.51	3.66	0.138	0.144
Ø P1	-	7.39	-	0.291
Q	5.31	5.69	0.209	0.224
R	4.52	5.49	0.178	0.216
S	5.51 BSC		0.217 BSC	

ECN: X13-0103-Rev. D, 01-Jul-13
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").
7. Outline conforms to JEDEC outline TO-247 with exception of dimension c.
8. Xian and Mingxin actually photo.

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