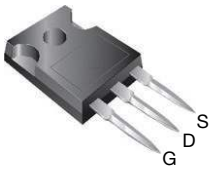
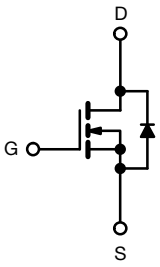
E Series Power MOSFET

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

RoHS COMPLIANT
HALOGEN FREE Available

APPLICATIONS

- 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.	650	
$R_{DS(on)}$ max. (Ω) at 25 °C	V_{GS} = 10 V	0.064
Q_g max. (nC)	220	
Q_{gs} (nC)	29	
Q_{gd} (nC)	57	
Configuration	Single	

ORDERING INFORMATION	
Package	TO-247AC
Lead (Pb)-free	SiHG47N60E-E3
Lead (Pb)-free and halogen-free	SiHG47N60E-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	47	A
		T_C = 100 °C		30	
Pulsed drain current [a]			I_{DM}	145	
Linear derating factor				3	W/°C
Single pulse avalanche energy [b]			E_{AS}	1800	mJ
Maximum power dissipation			P_D	357	W
Operating junction and storage temperature range			T_J, T_{stg}	-55 to +150	°C
Drain-source voltage slope	V_{DS} = 0 V to 80 % V_{DS}		dV/dt	70	V/ns
Reverse diode dV/dt [d]				11	
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 = 73.5 mH, R_g = 25 Ω, I_{AS} = 7 A
c. 1.6 mm from case
d. $I_{SD} \leq I_D$, dI/dt = 100 A/µs, starting T_J = 25 °C

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THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R_{thJA}	-	40	°C/W
Maximum junction-to-case (drain)	R_{thJC}	-	0.33	

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 = 250 µA	-	0.66	-	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 = 24 A	-	0.053	0.064	Ω
Forward transconductance	g_{fs}	V_{DS} = 8 V, I_D = 3 A	-	6.8	-	S
Dynamic						
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz	2405	4810	9620	pF
Output capacitance	C_{oss}		115	230	460	
Reverse transfer capacitance	C_{rss}		1.7	5	10	
Effective output capacitance, energy related [a]	$C_{o(er)}$	V_{DS} = 0 V to 480 V, V_{GS} = 0 V	-	170	-	
Effective output capacitance, time related [b]	$C_{o(tr)}$		-	604	-	
Total gate charge	Q_g	V_{GS} = 10 V; I_D = 24 A, V_{DS} = 480 V	74	148	220	nC
Gate-source charge	Q_{gs}		14.5	29	58	
Gate-drain charge	Q_{gd}		28.5	57	86	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 480 V, I_D = 24 A, V_{GS} = 10 V, R_g = 4.4 Ω	14	28	56	ns
Rise time	t_r		36	72	108	
Turn-off delay time	$t_{d(off)}$		47	93	140	
Fall time	t_f		41	82	123	
Gate input resistance	R_g	f = 1 MHz, open drain	0.13	0.65	1.3	Ω
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	47	A
Pulsed diode forward current	I_{SM}		-	-	140	
Diode forward voltage	V_{SD}	T_J = 25 °C, I_S = 24 A, V_{GS} = 0 V	-	-	1.2	V
Body diode reverse recovery time	t_{rr}	T_J = 25 °C, I_F = I_S = 24 A, dI/dt = 100 A/µs, V_R = 25 V	-	582	1164	ns
Body diode reverse recovery charge	Q_{rr}		-	11	22	µC
Reverse recovery current	I_{RRM}		-	31	62	A
Body diode reverse recovery time	t_{rr}	T_J = 25 °C, I_F = I_S = 24 A, dI/dt = 100 A/µs, V_R = 400 V	-	550	1164	ns
Body diode reverse recovery charge	Q_{rr}		-	10.7	22	µC
Reverse recovery current	I_{RRM}		-	38	62	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}

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TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

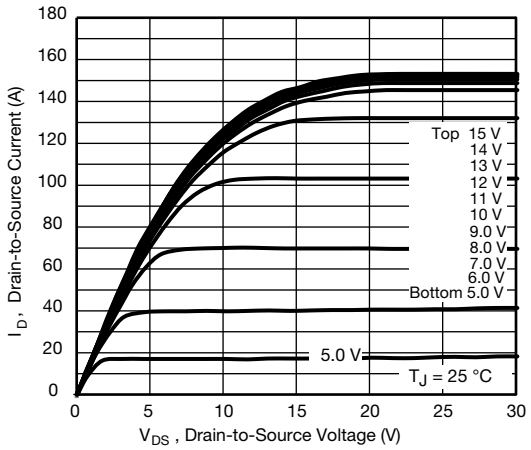

Fig. 1 - Typical Output Characteristics, T_C = 25 °C

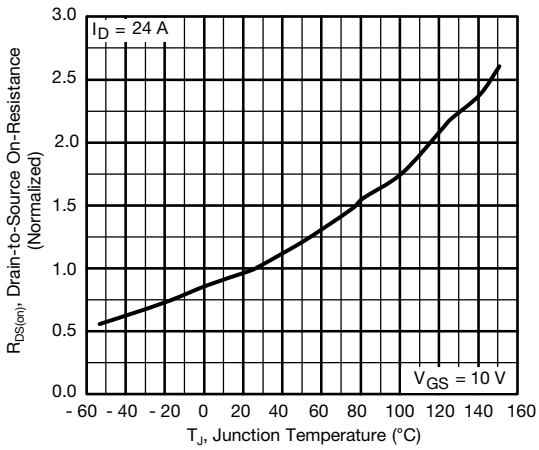

Fig. 4 - Normalized On-Resistance vs. Temperature

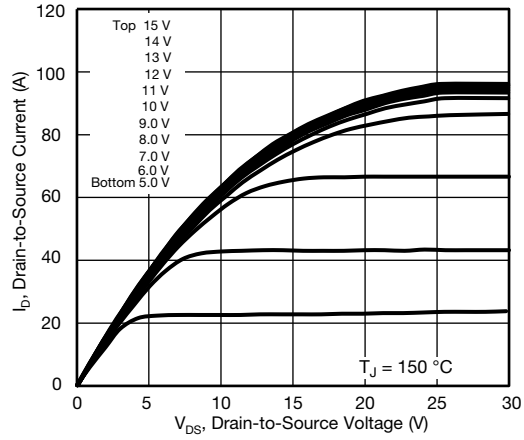

Fig. 2 - Typical Output Characteristics, T_C = 150 °C

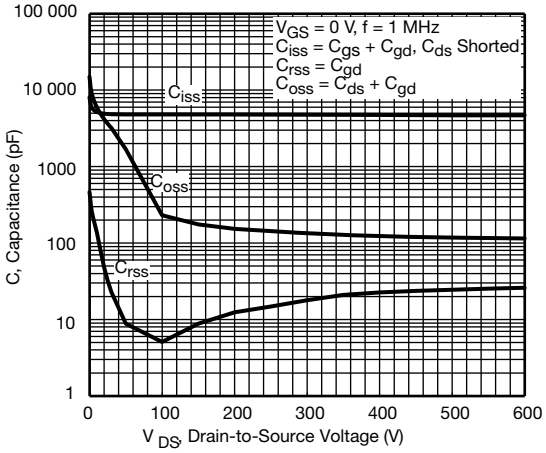

Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

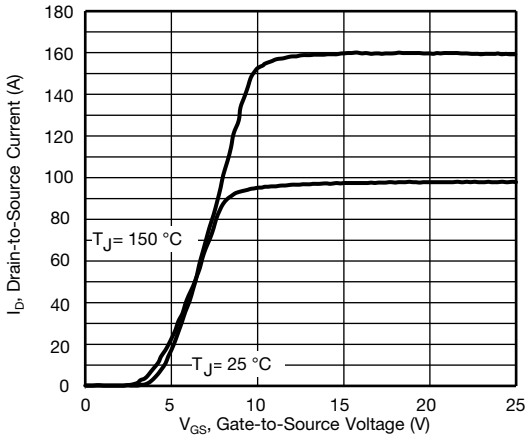

Fig. 3 - Typical Transfer Characteristics

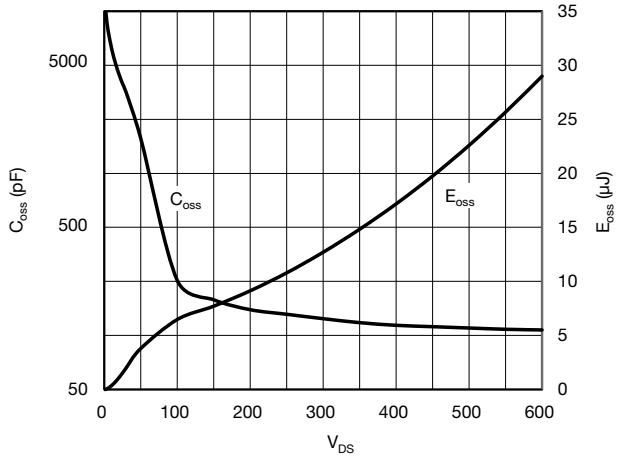

Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

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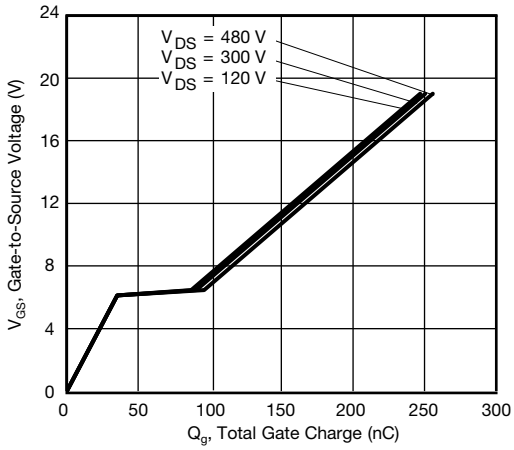

Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

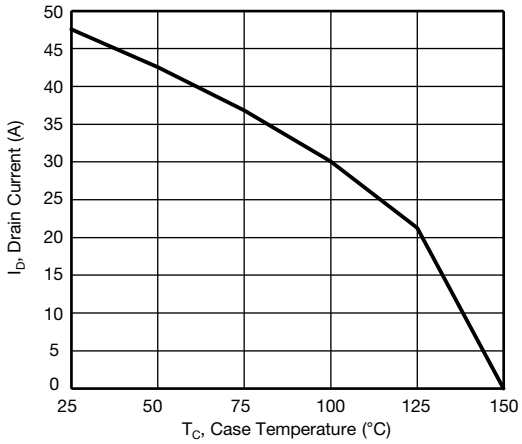

Fig. 10 - Maximum Drain Current vs. Case Temperature

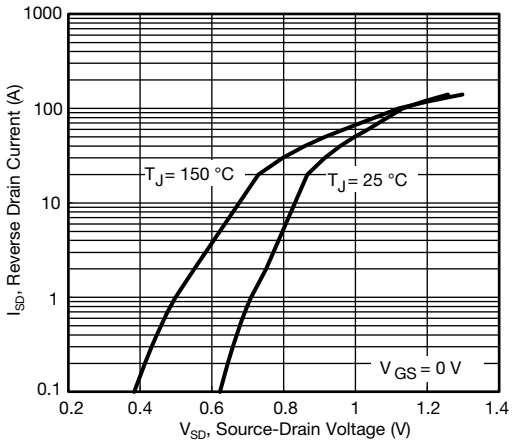

Fig. 8 - Typical Source-Drain Diode Forward Voltage

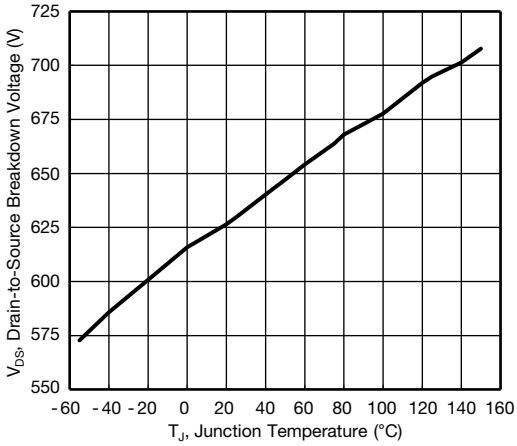

Fig. 11 - Temperature vs. Drain-to-Source Voltage

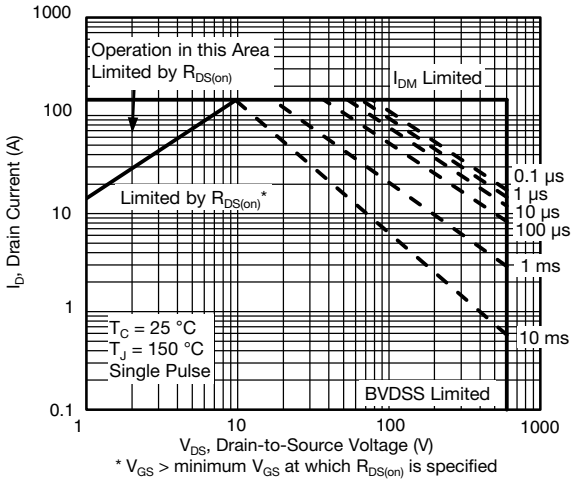

Fig. 9 - Maximum Safe Operating Area

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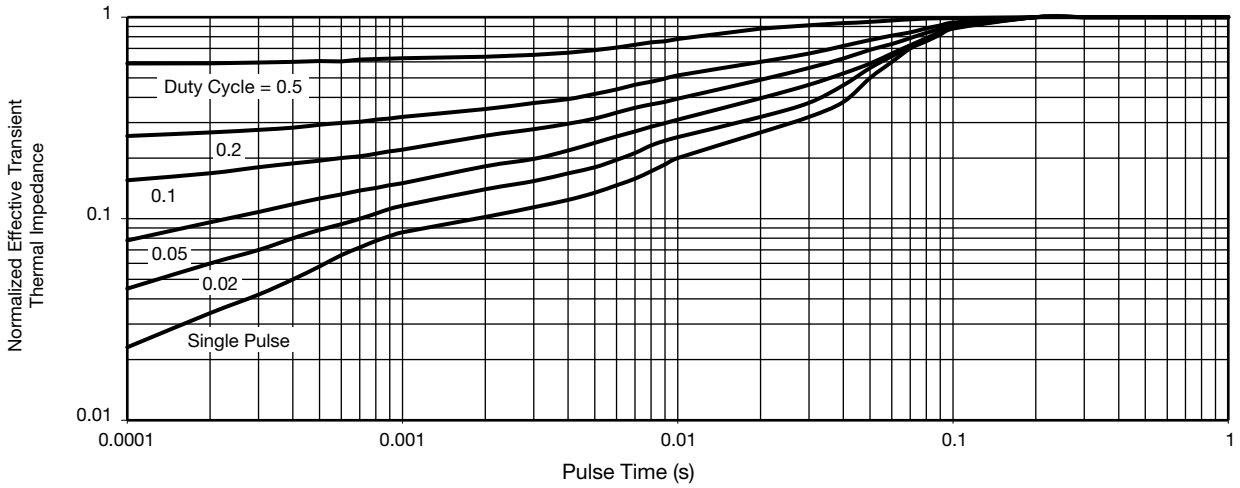

Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

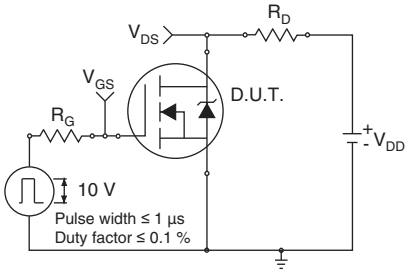

Fig. 13 - Switching Time Test Circuit

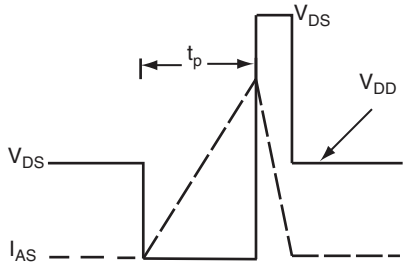

Fig. 16 - Unclamped Inductive Waveforms

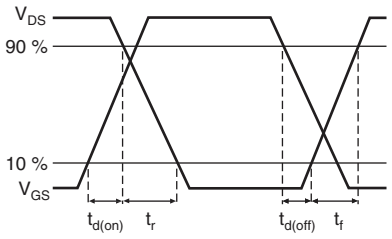

Fig. 14 - Switching Time Waveforms

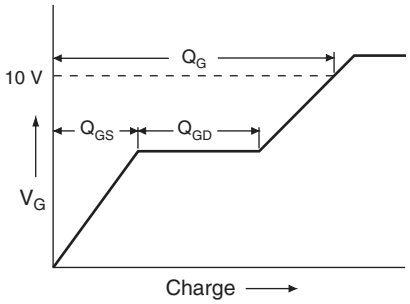

Fig. 17 - Basic Gate Charge Waveform

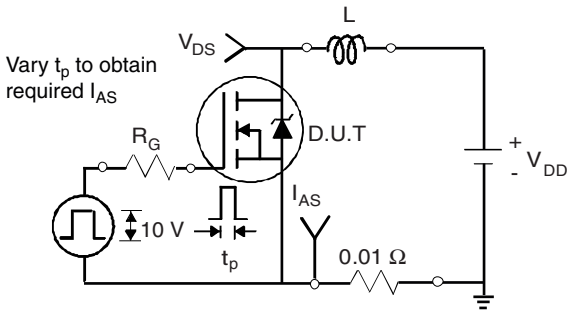

Fig. 15 - Unclamped Inductive Test Circuit

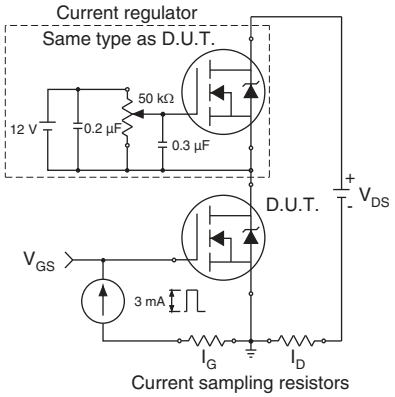

Fig. 18 - Gate Charge Test Circuit

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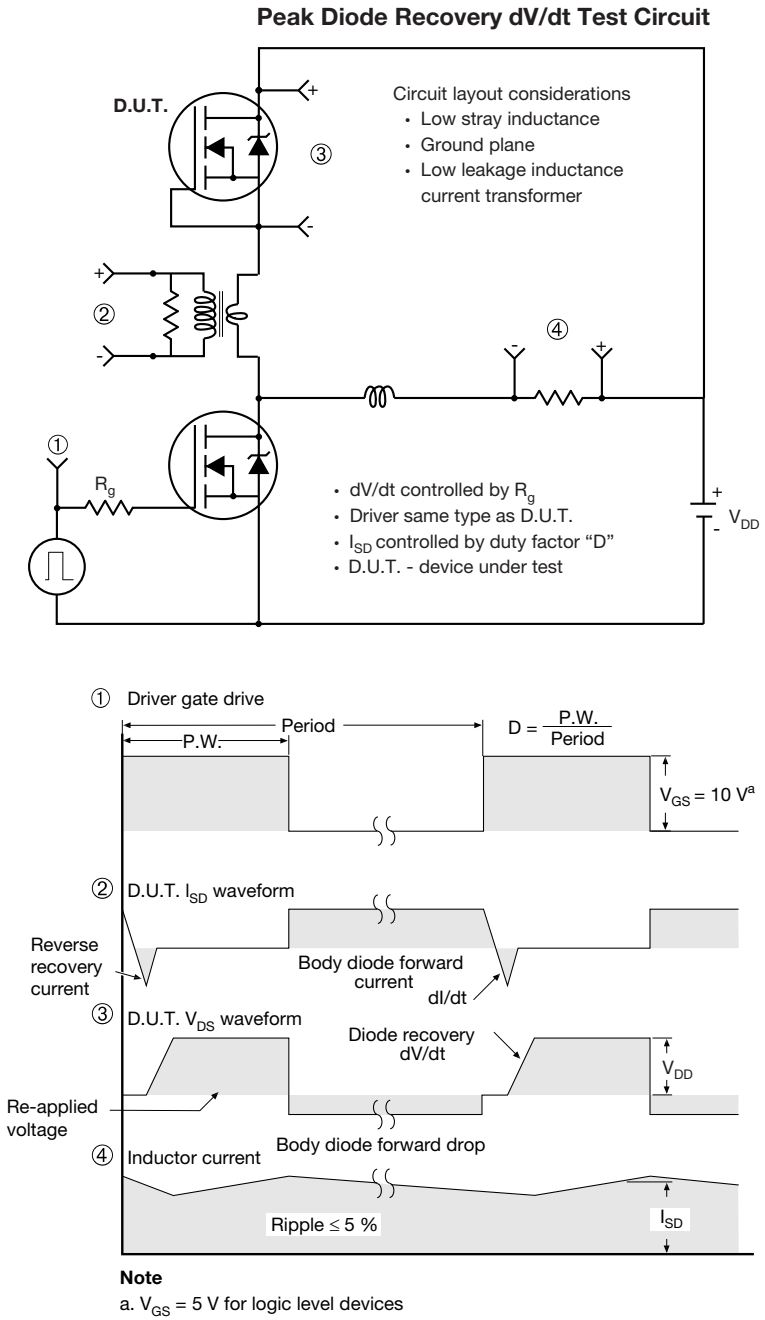

Note

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

Fig. 19 - For N-Channel

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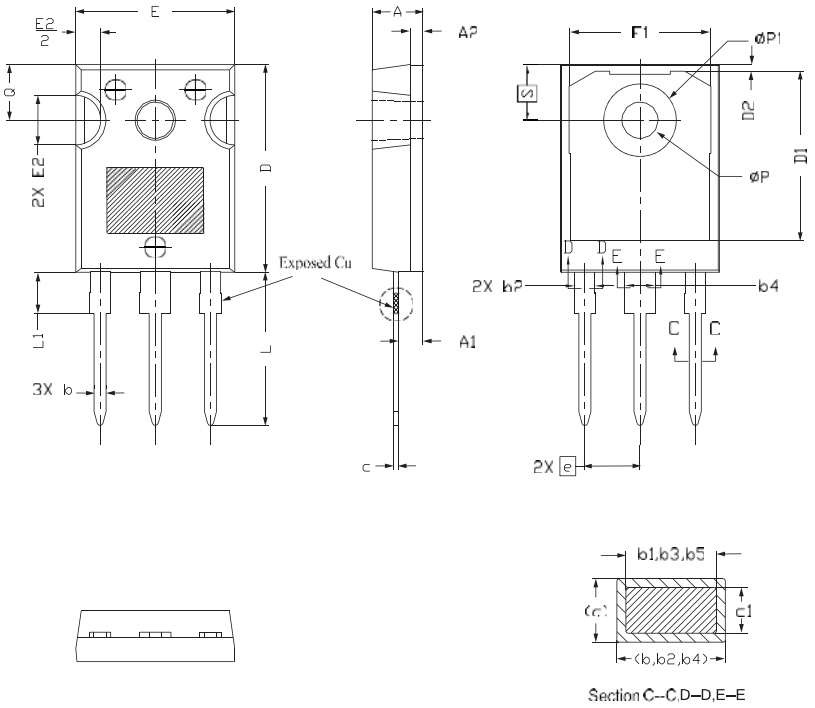
TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



	MILLIMETERS			
DIM.	MIN.	NOM.	MAX.	NOTES
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

	MILLIMETERS			
DIM.	MIN.	NOM.	MAX.	NOTES
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

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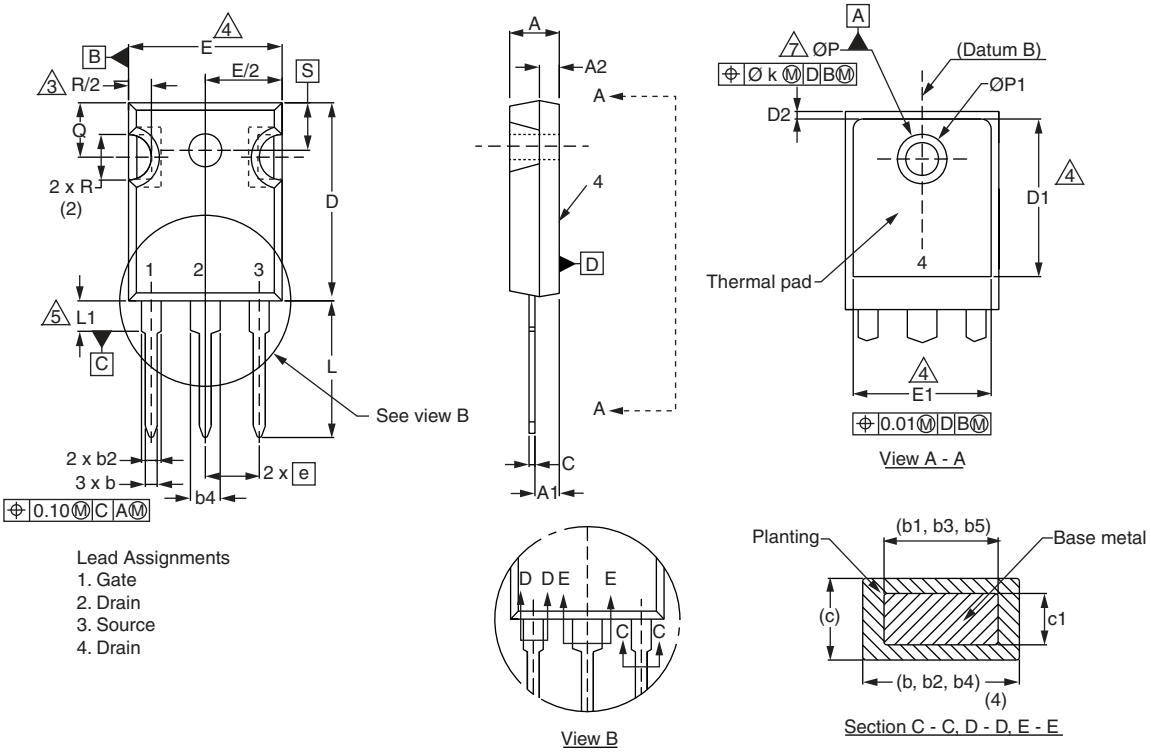

Lead Assignments
1. Gate
2. Drain
3. Source
4. Drain

	MILLIMETERS		
DIM.	MIN.	MAX.	NOTES
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	-	

	MILLIMETERS		
DIM.	MIN.	MAX.	NOTES
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

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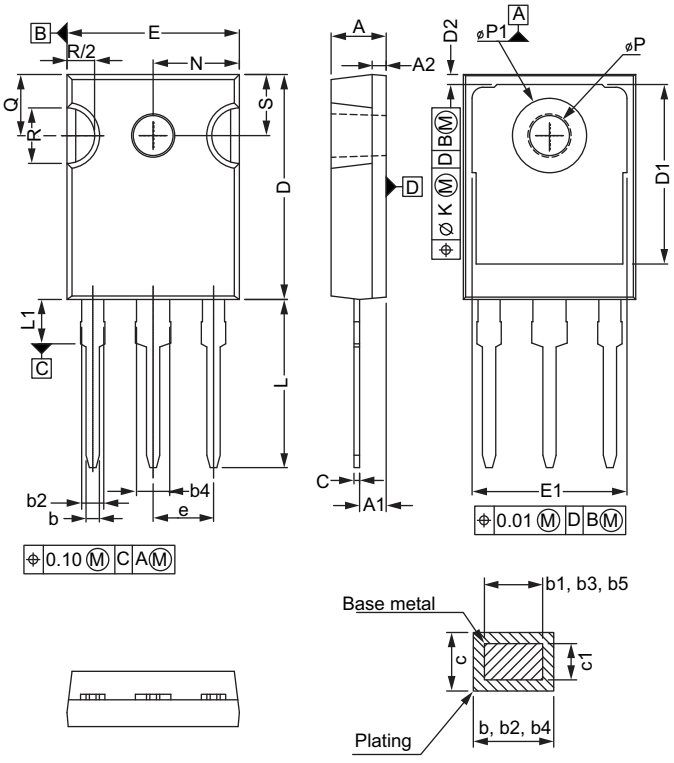

	MILLIMETERS	
DIM.	MIN.	MAX.
A	4.65	5.31
A1	2.21	2.59
A2	1.17	1.37
b	0.99	1.40
b1	0.99	1.35
b2	1.65	2.39
b3	1.65	2.34
b4	2.59	3.43
b5	2.59	3.38
c	0.38	0.89
c1	0.38	0.84
D	19.71	20.70
D1	13.08	-

	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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