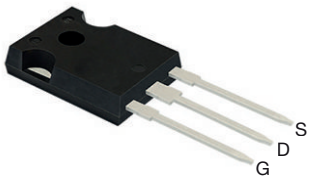
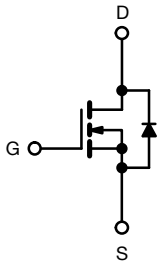
MaxSiC® 1200 V N-Channel SiC MOSFET

TO-247AD 3L





N-Channel MOSFET

Marking Code: Q120A045SW

FEATURES

- Fast switching speed
- Short circuit withstand time 3 µs
- AEC-Q101 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

RoHS COMPLIANT

HALOGEN FREE

APPLICATIONS

- Automotive on board charger
- Automotive DC/DC converter for EV/HEV
- Auxiliary drives

PRODUCT SUMMARY		
V_{DS} (V) at T_J max.	1200	
$R_{DS(on)}$ typ. (mΩ) at 25 °C	V_{GS} = 18 V	45
Q_g typ. (nC)	84	
Q_{gs} (nC)	23	
Q_{gd} (nC)	23	
Configuration	Single	

ORDERING INFORMATION	
Package	TO-247AD 3L
Lead (Pb)-free and halogen-free	MXPQ120A045SW-GE3

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-source voltage		V_{DS}	1200	V
Gate-source voltage		V_{GS}	-10 / +22	
Recommended operation voltage of gate-source		V_{GSOP}	-5 to -3 / +18	
Continuous drain current	T_C = 25 °C	I_D	51	A
Pulsed drain current [a]		I_{DM}	102	
Short-circuit withstand time [b]		T_{SC}	3	µs
Maximum power dissipation		P_D	254	W
Operating junction and storage temperature range		T_J, T_{stg}	-55 to +175	°C
Soldering recommendations (peak temperature)	For 10 s		260	°C
Single pulse avalanche energy [c]		E_{AS}	200	mJ

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature

b. V_{GS} = 18 V, V_{DS} = 800 V, $R_{g(ext)}$ = 20 Ω, verified by the design / characterization

c. T_J = 25 °C, V_{DD} = 120 V, L = 1 mH, V_{GS} = 18 V, I_{AS} = 20 A

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	0.59	

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 = 1 mA		1200	-	-	V
Gate-source threshold voltage (N)	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 5 mA		-	2.8	-	V
		V_{DS} = V_{GS}, I_D = 5 mA, T_J = 175 °C		-	1.9	-	V
Gate-source leakage	I_{GSS}	V_{GS} = 22 V, V_{DS} = 0 V		-	-	100	nA
		V_{GS} = -10 V, V_{DS} = 0 V		-	-	-100	
Zero gate voltage drain current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = 0 V		-	-	10	µA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS} = 15 V, I_D = 26 A		-	60	75	mΩ
		V_{GS} = 18 V, I_D = 26 A		-	45	56	
		V_{GS} = 18 V, I_D = 26 A, T_J = 175 °C		-	82	-	
Transconductance	g_{fs}	V_{DS} = 10 V, I_D = 26 A		-	10	-	S
Dynamic							
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 800 V, f = 100 KHz		-	2530	-	pF
Output capacitance	C_{oss}			-	98	-	
Reverse transfer capacitance	C_{rss}			-	4	-	
C_{oss} stored energy	E_{oss}			-	41	-	µJ
Total gate charge	Q_g	V_{GS} = -5 ~ 18 V, I_D = 26 A, V_{DS} = 800 V		-	84	-	nC
Gate-source charge	Q_{gs}			-	23	-	
Gate-drain charge	Q_{gd}			-	23	-	
Gate Resistance	R_g	V_{DS} = 0 V, f = 1 MHz		-	2.5	-	Ω
Switching Characteristics							
Turn-on delay time	$t_{d(on)}$	V_{GS} = -5 ~ 18 V, I_D = 26 A, V_{DS} = 800 V, $R_{g(ext)}$ = 4.4 Ω	T_J = 25 °C	-	34	-	ns
			T_J = 175 °C	-	31	-	
Rise time	t_r		T_J = 25 °C	-	16	-	
			T_J = 175 °C	-	13	-	
Turn-off delay time	$t_{d(off)}$		T_J = 25 °C	-	26	-	
			T_J = 175 °C	-	29	-	
Fall time	t_f		T_J = 25 °C	-	10	-	
			T_J = 175 °C	-	10	-	
Turn-on switching energy	E_{on}		T_J = 25 °C	-	522	-	µJ
			T_J = 175 °C	-	469	-	
Turn-off switching energy	E_{off}		T_J = 25 °C	-	70	-	
			T_J = 175 °C	-	72	-	
Body Diode Ratings and Characteristics							
Forward diode voltage	V_{SD}	V_{GS} = -5 V, I_{SD} = 13 A, T_J = 25 °C		-	4.9	-	V
Continuous diode forward current	I_{SD}	V_{GS} = -5 V, T_J = 25 °C		-	-	37	A
Pulsed diode forward current	I_{SDM}			-	-	102	
Reverse recovery time	t_{rr}	V_{GS} = -5 V, I_{SD} = 26 A, V_R = 800 V, di/dt = 1000 A/µs		-	48	-	ns
Reverse recovery charge	Q_{rr}			-	162	-	nC
Reverse recovery current	I_{rrm}			-	7	-	A

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

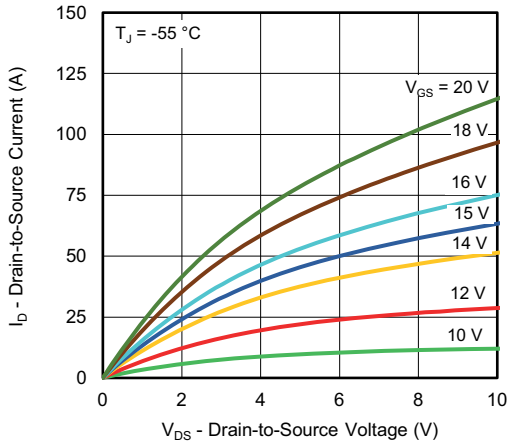


Fig. 1 - Typical Output Characteristics

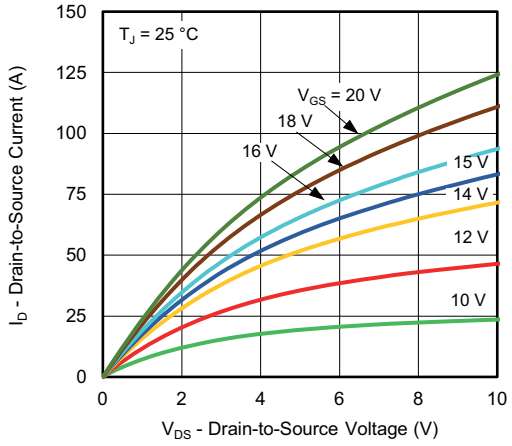


Fig. 2 - Typical Output Characteristics

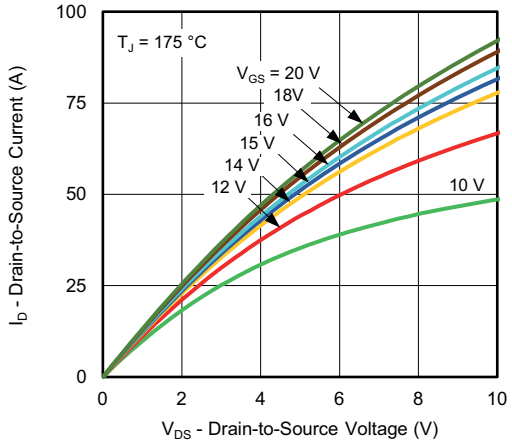


Fig. 3 - Typical Output Characteristics

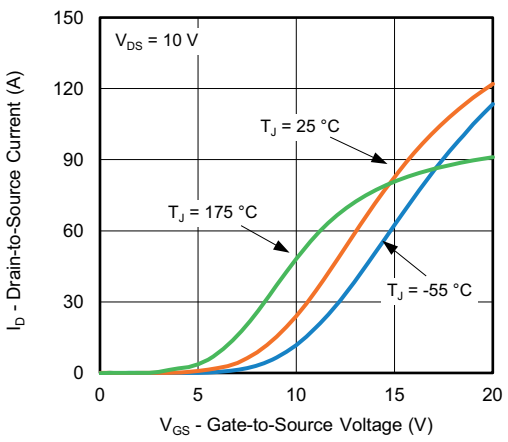


Fig. 4 - Typical Transfer Characteristics

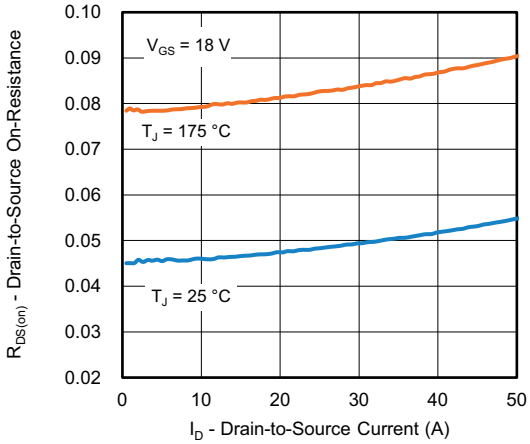


Fig. 5 - Normalized On-Resistance vs. Drain Current

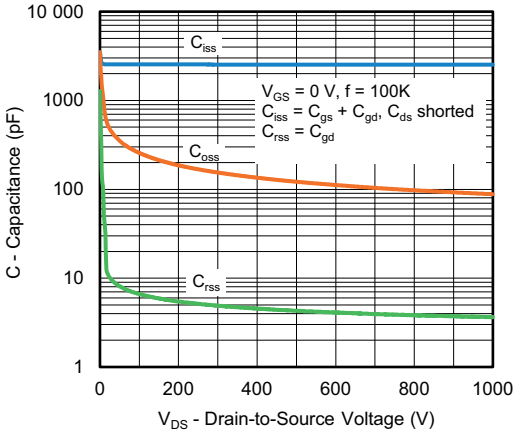


Fig. 6 - Typical Capacitance vs. Drain-to-Source Voltage

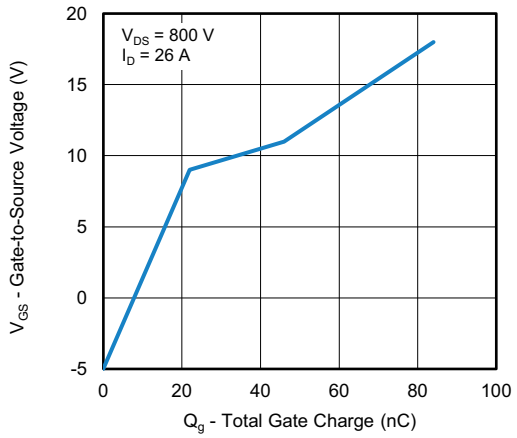


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

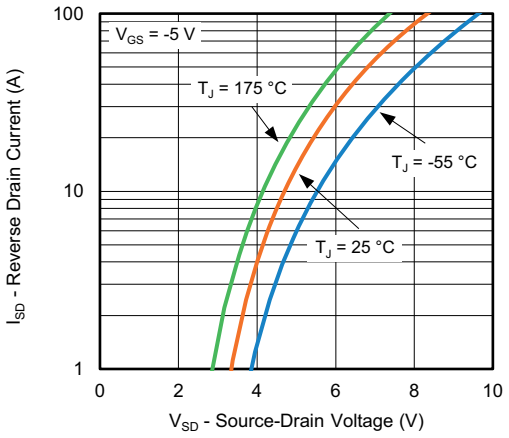


Fig. 10 - Typical Source-Drain Diode Forward Voltage

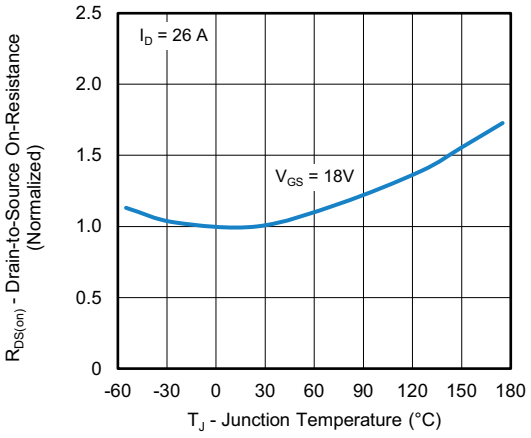


Fig. 8 - Normalized On-Resistance vs. Temperature

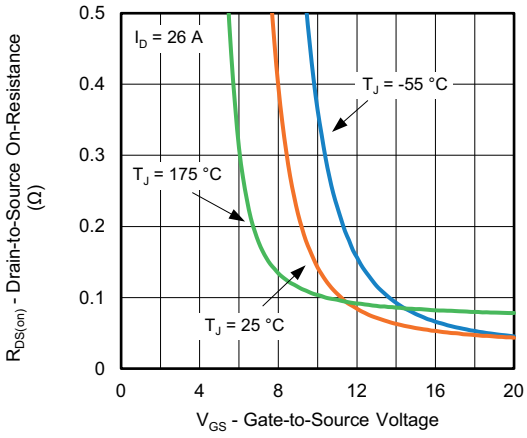


Fig. 11 - On-Resistance vs. Gate-to-Source Voltage

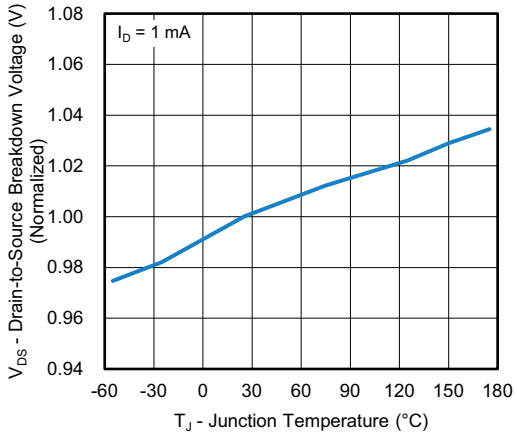


Fig. 9 - Drain-to-Source Voltage vs. Temperature

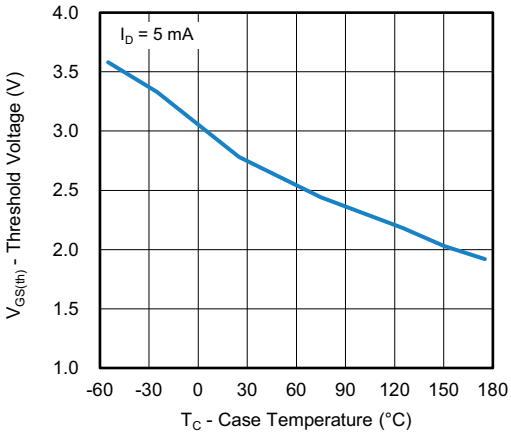


Fig. 12 - Threshold Voltage vs. Case Temperature

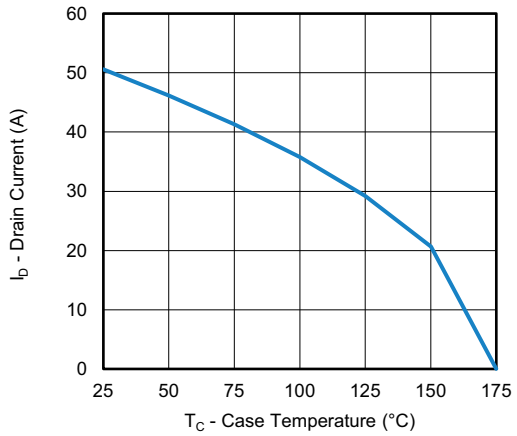


Fig. 13 - Drain Current vs. Case Temperature

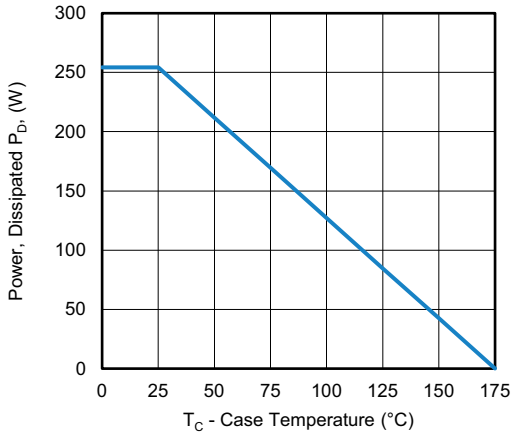


Fig. 15 - Power, Dissipated P_D vs. Case Temperature

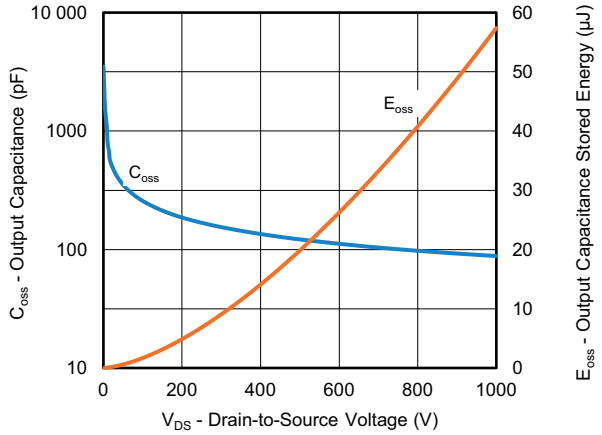


Fig. 14 - Output Capacitance and its Stored Energy vs. Drain-to-Source Voltage

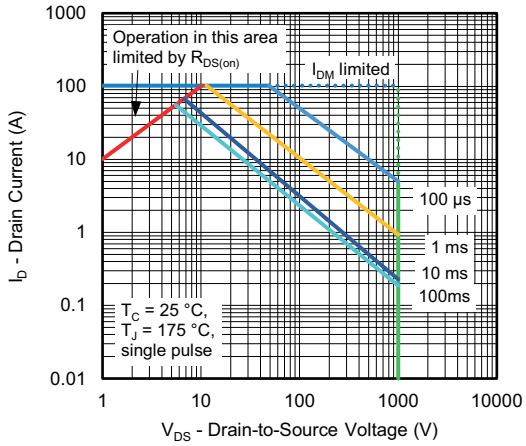


Fig. 16 - Safe Operating Area

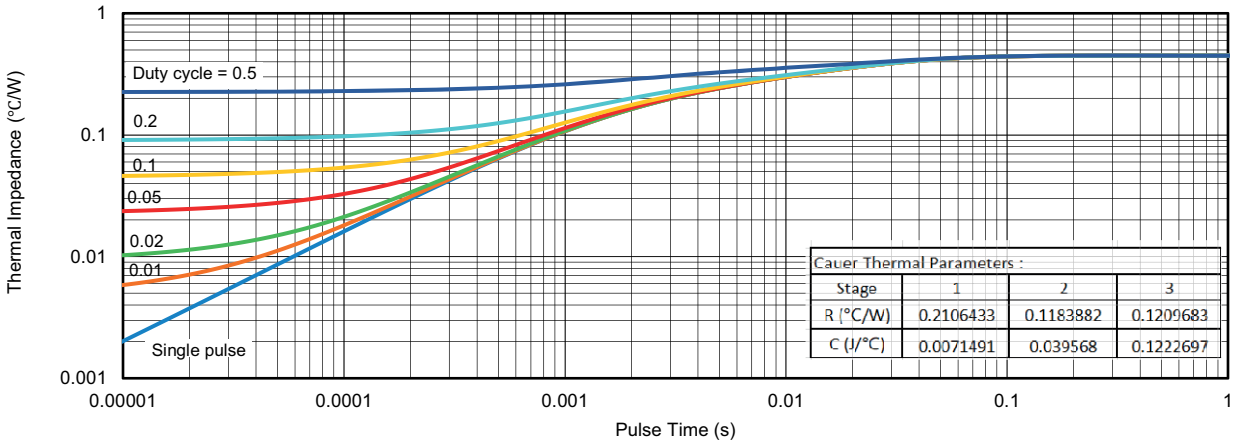


Fig. 17 - Transient Thermal Impedance

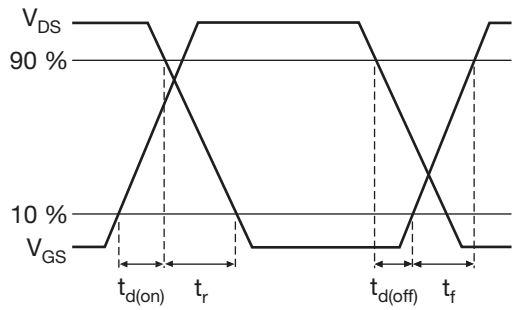


Fig. 18 - Waveforms of Switching Time

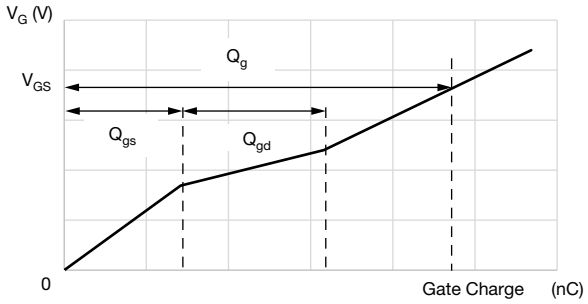


Fig. 21 - Waveforms for Gate Charge

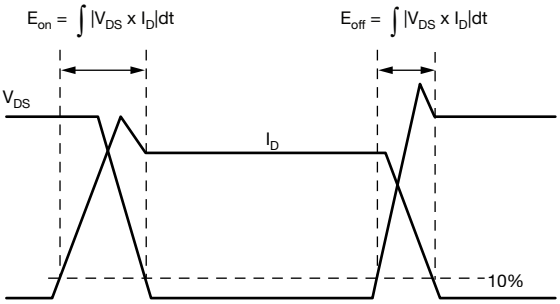


Fig. 19 - Waveforms for Switching Energy

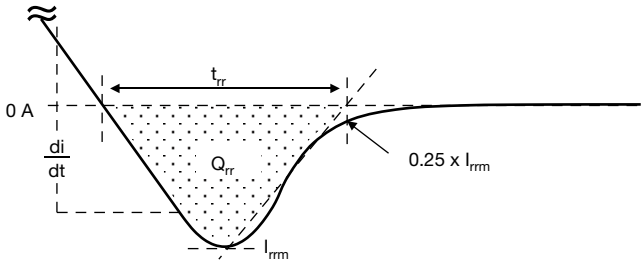


Fig. 22 - Waveforms for Reverse Recovery

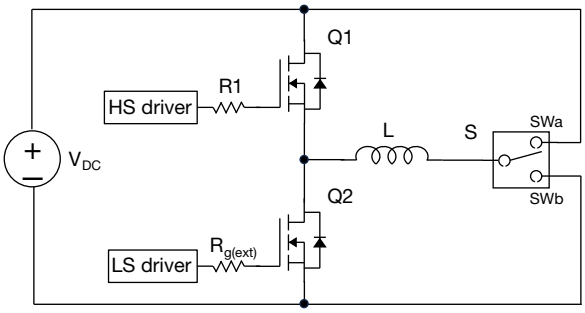


Fig. 20 - Switching and Reverse Diode Characteristics Measurement Circuit

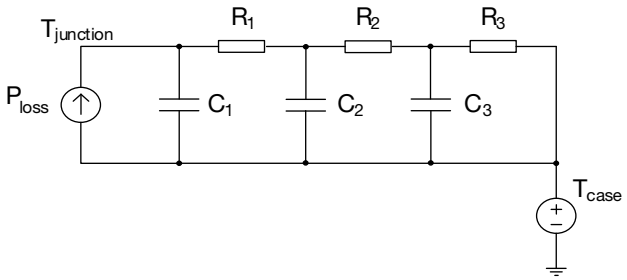


Fig. 23 - Thermal Equivalent Circuit

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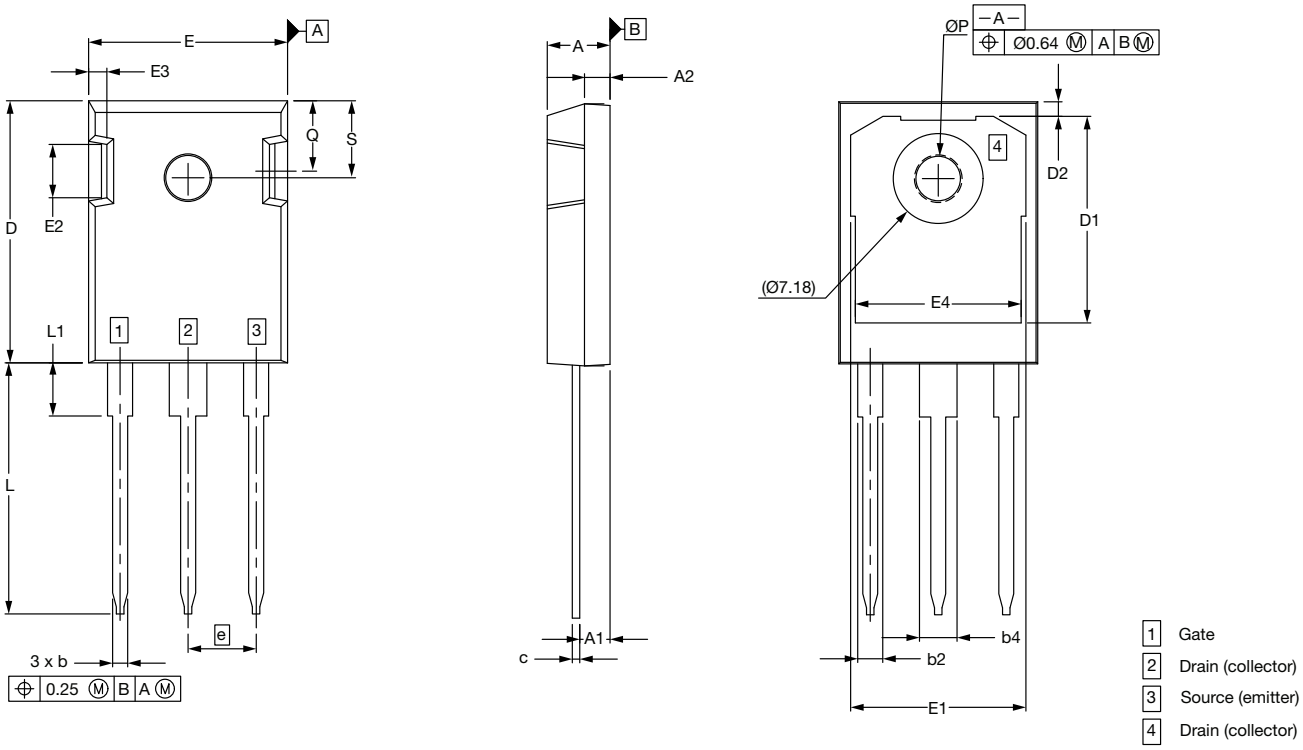
Case Outline for TO-247AD 3L

FACILITY CODE: N

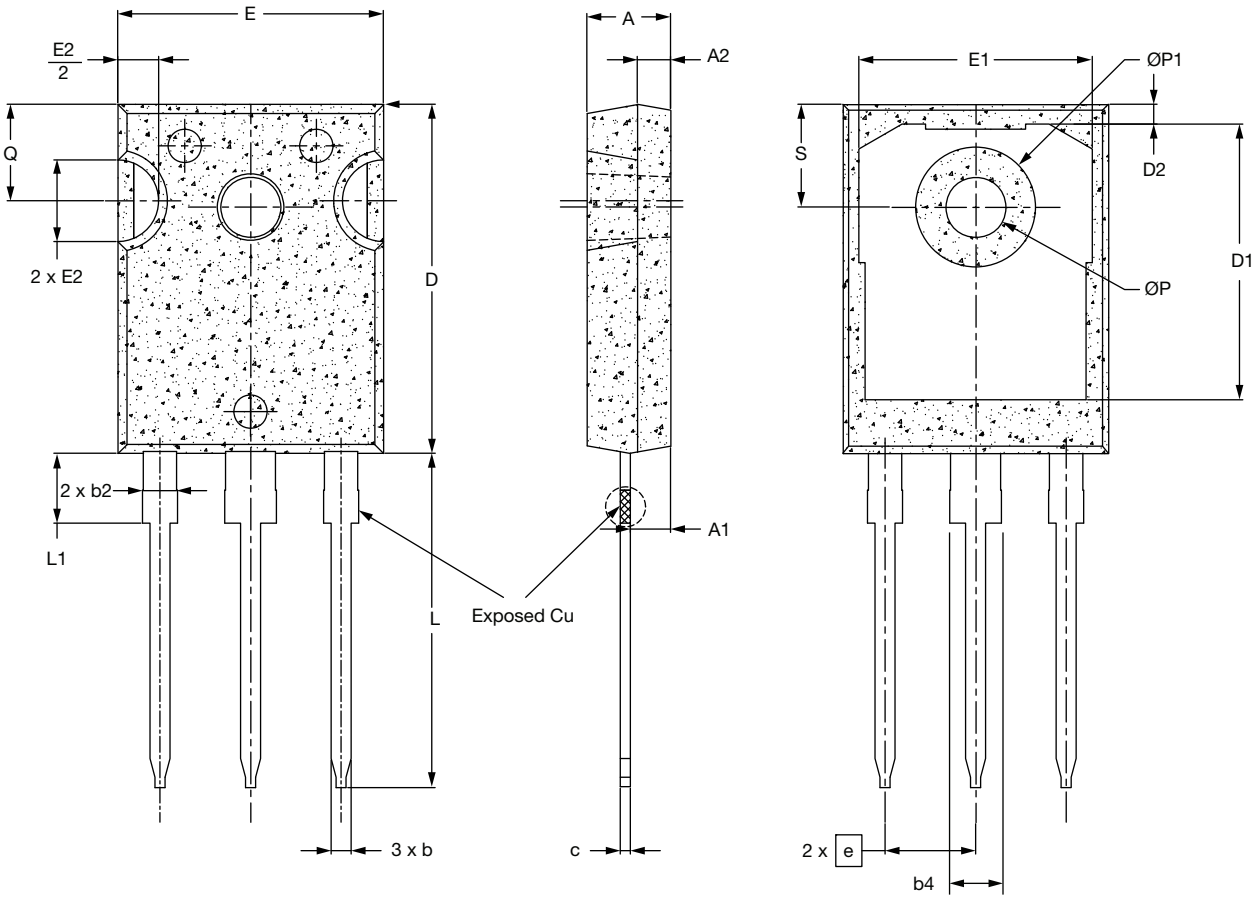


DIM.	MILLIMETERS	
	MIN.	MAX.
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b	1.07	1.33
b2	1.91	2.41
b4	2.87	3.38
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	5.44 BSC.	
N	3	
L	19.81	20.32
L1	4.10	4.40
ØP	3.51	3.65
Q	5.49	6.00
S	6.04	6.30

Notes

- All metal surfaces: tin plated (MATTE), except area of cut
- Dimensioning and toleranceing confirm to ASME Y14.5M-1994
- All dimensions are in millimeters
- This drawing will meet all dimensions requirement of JEDEC outlines TO-247 AD
- Dimension b2 and b4 does not include dambar protrusion

FACILITY CODE: 9



DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.55
A2	1.50	2.00	2.49
b	1.12	1.20	1.33
b2 (1)	1.91	2.00	2.39
b4 (1)	2.87	3.00	3.22
c	0.55	0.60	0.69
D (2)	20.80	20.95	21.10
D1 (3)	16.25	16.55	17.65
D2	0.51	1.19	1.35
E (2)	15.75	15.94	16.13
E1 (3)	13.46	14.02	14.16
E2	4.32	4.91	5.49
e	5.44 BSC.		
L	19.81	20.07	20.32
L1 (4)	4.10	4.19	4.40
ØP (5)	3.56	3.61	3.65
ØP1	7.19 ref.		
Q	5.39	5.79	6.20
S	6.04	6.17	6.30
ECN: E24-0303-Rev. B, 19-Aug-2024 DWG: 6118			

Notes

- Package reference: JEDEC TO-247, variation AD
- All dimensions are in mm
- Slot required, notch may be rounded

(1) Dimension b2 and b4 does not include dambar protrusion

(2) Dimension D and E do not include mold flash

(3) Thermal pad contour optional within dimension D1 and E1

(4) Lead Finish Uncontrolled In L1

(5) ØP to have a draft angle of 1.5 ° ref. to the top of the part with hole diameter of 3.91mm

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