

1200V N-Channel Silicon Carbide Power MOSFET

1. Applications

- Asymmetrical Bridge Converter
- Inverter
- Single Switch Forward Flyback



2. Features

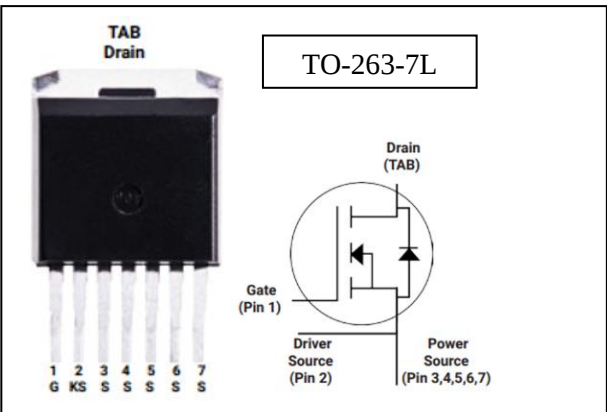
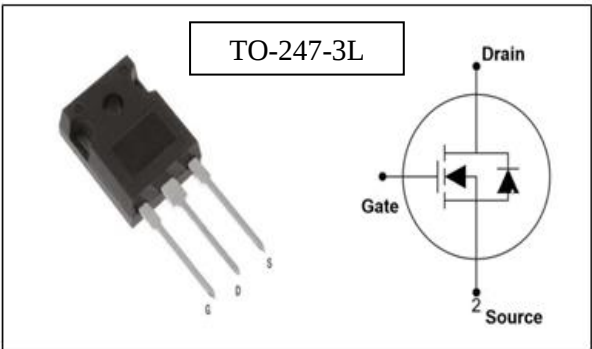
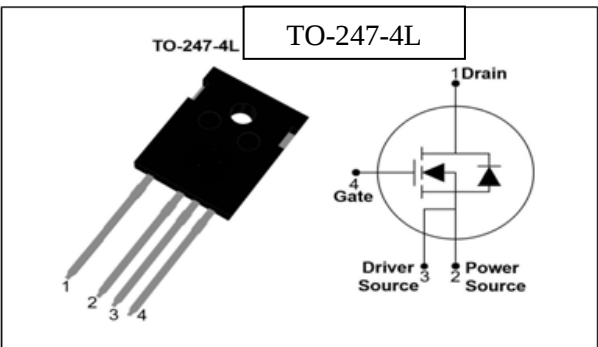
- Low drain-source on-resistance: $R_{DS(ON)} = 80\text{m}\Omega$ (typ.)
- Easy to control Gate switching
- Enhancement mode: $V_{th} = 2$ to 4 V

Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	1200	V
$R_{DS(on),max}$	100	$\text{m}\Omega$
$Q_{g,typ}$	58	nC
$I_{D,pulse}$	94	A

3. Packaging and Internal Circuit

Part Name	Package	Marking
ADQ120N080G2	TO-247-4L	ADQ120N080G2
ADW120N080G2	TO-247-3L	ADW120N080G2
ADG120N080G2	TO-263-7L	ADG120N080G2



1 Maximum ratings

at $T_j = 25^\circ\text{C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	35	A	$T_C=25^\circ\text{C}$
		-	-	26	A	$T_C=100^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	200	mJ	$T_C=25^\circ\text{C}$, $V_{DD}=50\text{V}$, $L=1\text{mH}$, $R_G=25\Omega$
Gate source voltage (static)	V_{GS}	-5	-	20	V	static;
Power dissipation	P_{tot}	-	-	188	W	$T_C=25^\circ\text{C}$
Derating factor above 25°C		-	-	1.9	W/ $^\circ\text{C}$	
Storage temperature	T_{stg}	-55	-	175	$^\circ\text{C}$	
Operating junction temperature	T_j	-55	-	175	$^\circ\text{C}$	
Soldering Temperature Distance of 1.6mm from case for 10s	T_L			300	$^\circ\text{C}$	
Transconductance	GFS	-	8.33	-	S	$V_{DS}=20\text{V}$ $I_{DS}=20\text{A}$
			7.14			$V_{DS}=20\text{V}$ $I_{DS}=20\text{A}$, $T_j=150^\circ\text{C}$

¹⁾ Limited by $T_{j,max}$. Maximum Duty Cycle $D = 0.50$

²⁾ Pulse width t_p limited by $T_{j,max}$

³⁾ Identical low side and high side switch with identical R_G

2 Thermal characteristics

Table 3 Thermal characteristics

TO247

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	0.65	0.8	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	40	°C/W	device on PCB, minimal footprint

TO263-7L

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	1.0	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	device on PCB, minimal footprint

3 Electrical characteristics

at $T_j=25^{\circ}\text{C}$, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	1200	-	-	V	$V_{GS}=0V$, $I_D=1mA$
Gate threshold voltage	$V_{(GS)th}$	2.0	2.8	4.0	V	$V_{DS}=V_{GS}$, $I_D=10mA$
Zero gate voltage drain current	I_{DSS}	-	-	1	μA	$V_{DS}=1200V$, $V_{GS}=0V$
Gate-source leakage current	I_{GSS+}	-	-	100	nA	$V_{GS}=20V$, $V_{DS}=0V$
Gate-source leakage current	I_{GSS-}	-	-	-100	nA	$V_{GS}=-5V$, $V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	80	100	$m\Omega$	$V_{GS}=20V$, $I_D=20A$, $T_j=25^{\circ}\text{C}$
		-	93.1	-		$V_{GS}=20V$, $I_D=20A$, $T_j=150^{\circ}\text{C}$
Gate resistance (Intrinsic)	R_G	-	4.5	-	Ω	$f=1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	1377	-	pF	$V_{GS}=0V$, $V_{DS}=1000V$, $f=200KHz$
Output capacitance	C_{oss}	-	62	-	pF	$V_{GS}=0V$, $V_{DS}=1000V$, $f=200KHz$
Reverse transfer capacitance	C_{rss}	-	4	-	pF	$V_{GS}=0V$, $V_{DS}=1000V$, $f=200KHz$
Turn-on delay time	$t_{d(on)}$	-	10	-	ns	$V_{DD}=800V$, $V_{GS}=20V$, $I_D=20A$, $R_G=0\Omega$; $T_j=25^{\circ}\text{C}$
Rise time	t_r	-	6	-	ns	
Turn-off delay time	$t_{d(off)}$	-	16	-	ns	
Fall time	t_f	-	10	-	ns	
Turn-on Switching Energy	E_{on}		748.8		μJ	
Turn-off Switching Energy	E_{off}		31.2		μJ	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	18	-	nC	$V_{DD}=800V$, $I_D=20A$, $V_{GS}=20V$
Gate to drain charge	Q_{gd}	-	17	-	nC	$V_{DD}=800V$, $I_D=20A$, $V_{GS}=20V$
Gate charge total	Q_g	-	58	-	nC	$V_{DD}=800V$, $I_D=20A$, $V_{GS}=20V$

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous Source Current	I_{SD}	-	-	35	A	
Diode forward voltage	V_{SD}	-	3.8	-	V	$I_S = 10A, V_{GS} = 0V, T_j=25^{\circ}C$
Reverse recovery time	t_{rr}	-	57	-	ns	$V_{DD} = 800V, I_D = 20A, +V_{GS} = +15V, -V_{GS} = -4V$ $L_{Load} = 500\mu H, R_g = 0\Omega, T_j = 25^{\circ}C$
Reverse recovery charge	Q_{rr}	-	195	-	nC	
Peak reverse recovery current	I_{rrm}	-	6.84	-	A	

4 Electrical characteristics diagram

Diagram 1: Typ. output characteristics

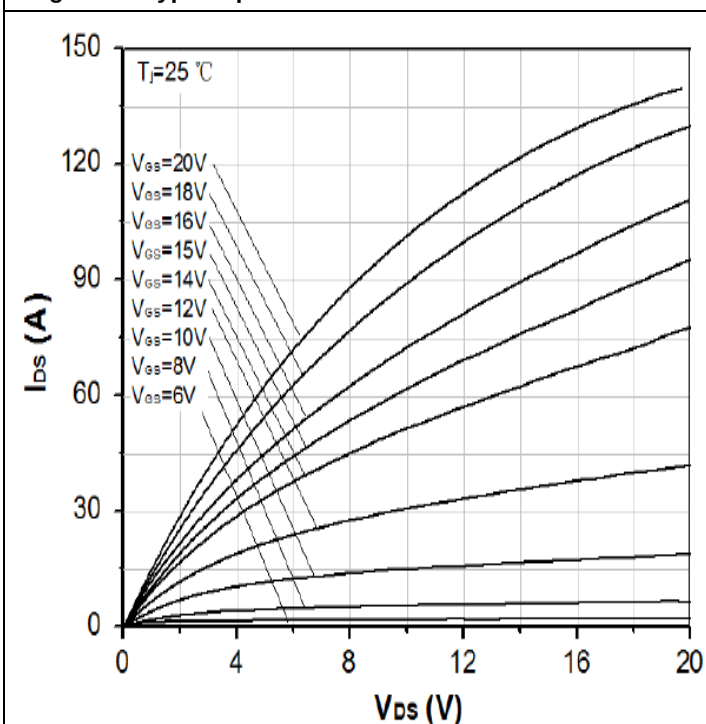

 $I_D = f(V_{DS}); T_j = 25\text{ °C}; \text{parameter: } V_{GS}$

Diagram 2: Typ. output characteristics

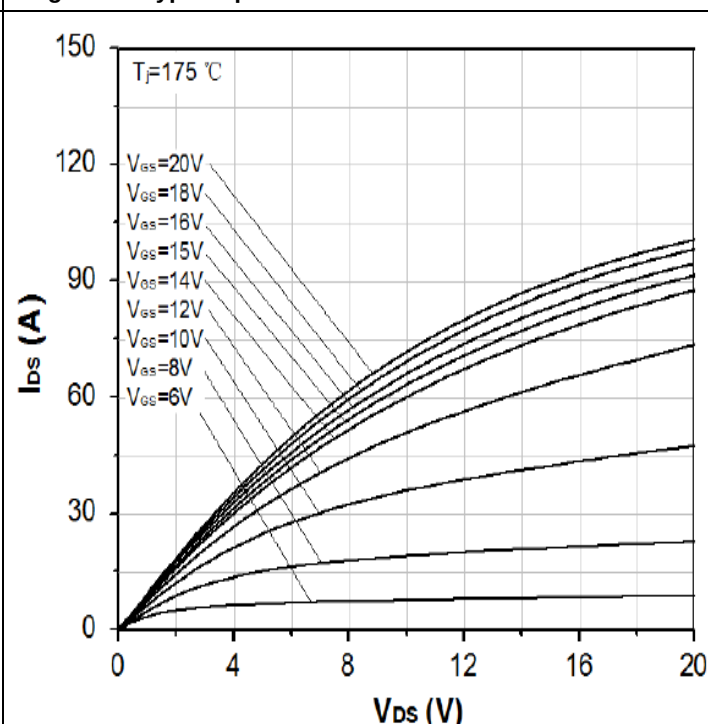

 $I_D = f(V_{DS}); T_j = 175\text{ °C}; \text{parameter: } V_{GS}$

Diagram 3: Typ. transfer characteristics

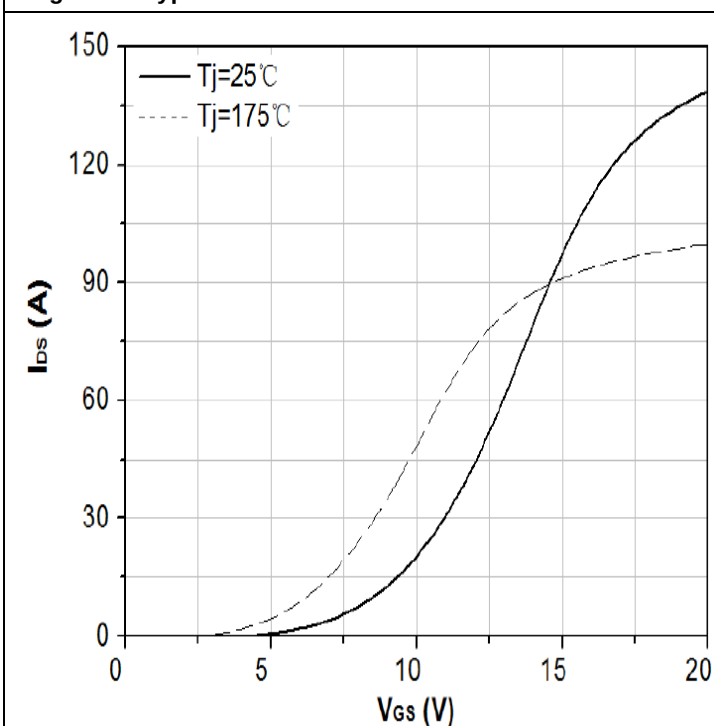

 $I_D = f(V_{GS}); V_{DS} = 20\text{ V}; \text{parameter: } T_j$

Diagram 4: Typ. gate charge

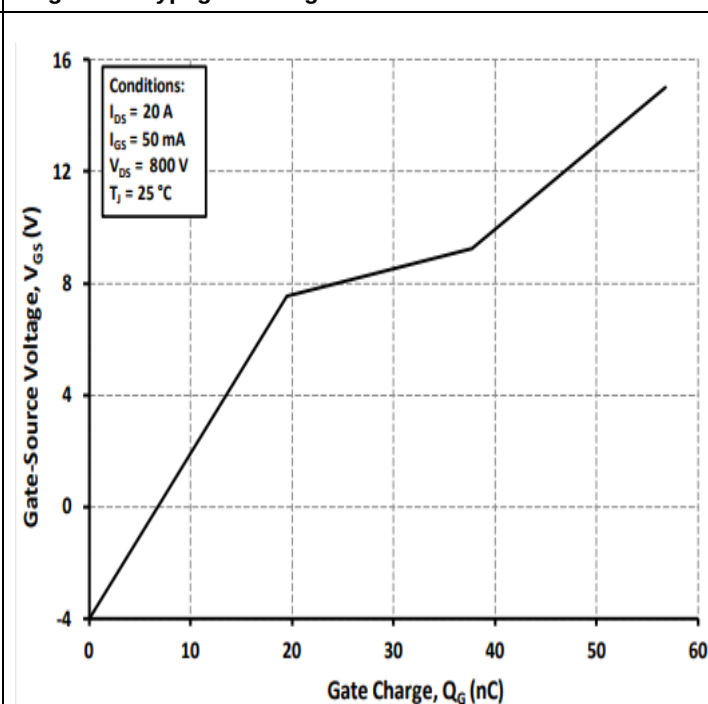
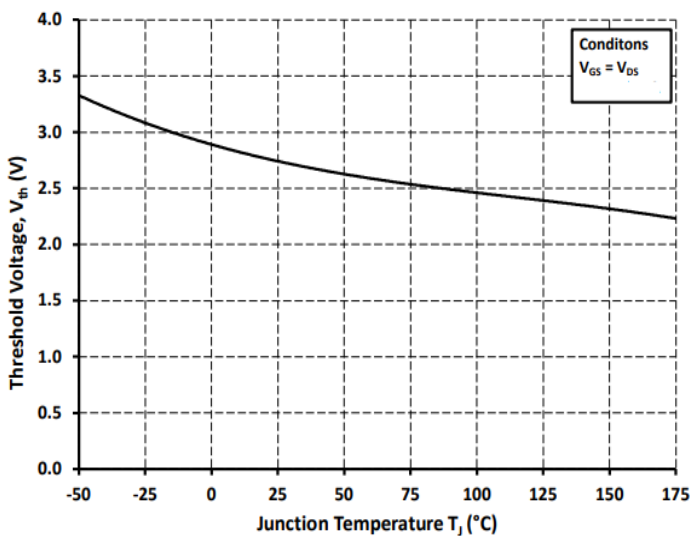
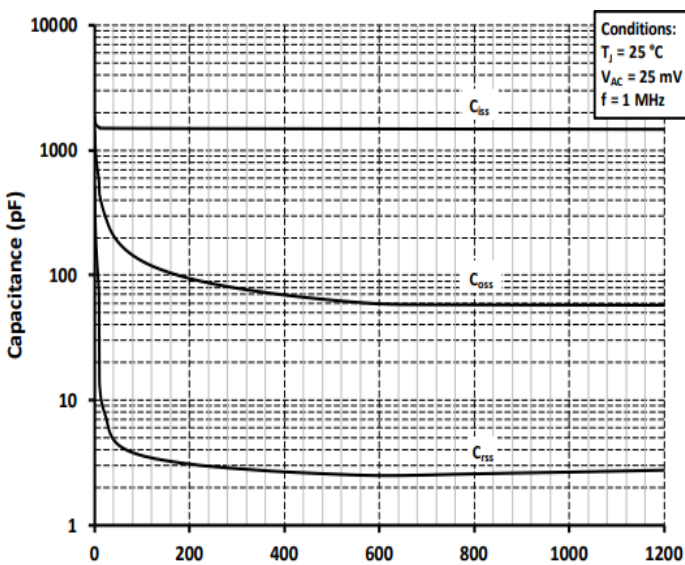

 $V_{GS} = f(Q_{gate}); I_D = 20\text{ A}; V_{DS} = 800\text{ V}; \text{turn-on pulse}$

Diagram 5: Typical gate-source threshold voltage as a function of junction temperature



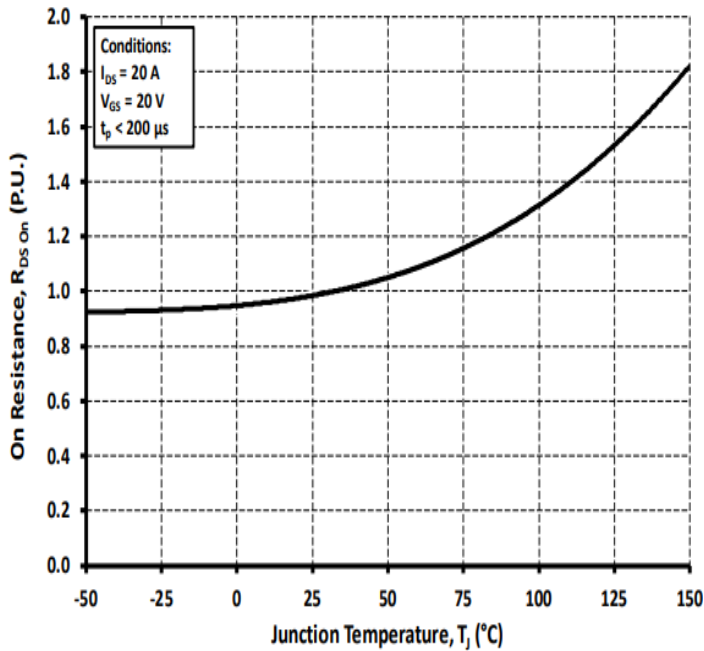
$V_{GS(th)}=f(T_j); I_{DS}=10mA; V_{GS}=V_{DS}$

Diagram 6: Typ. Capacitance as a function of drain-source voltage



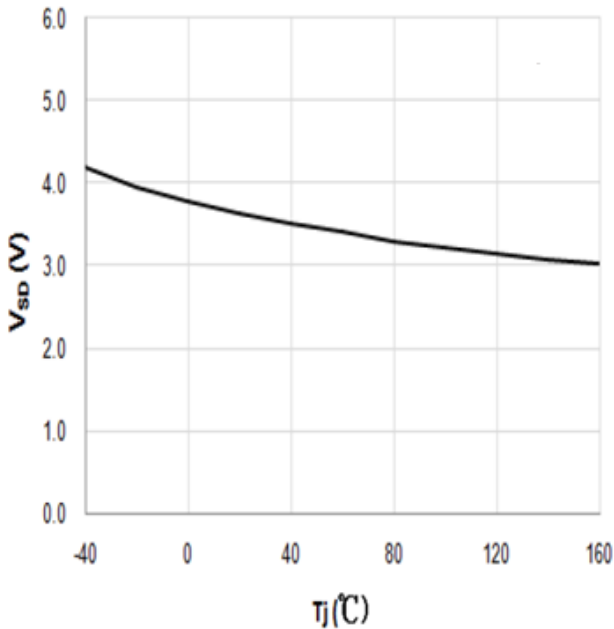
$C=f(V_{DS}); V_{GS}=0V; f=1MHz$

Diagram 7: Normalized on-resistance as a function of junction temperature



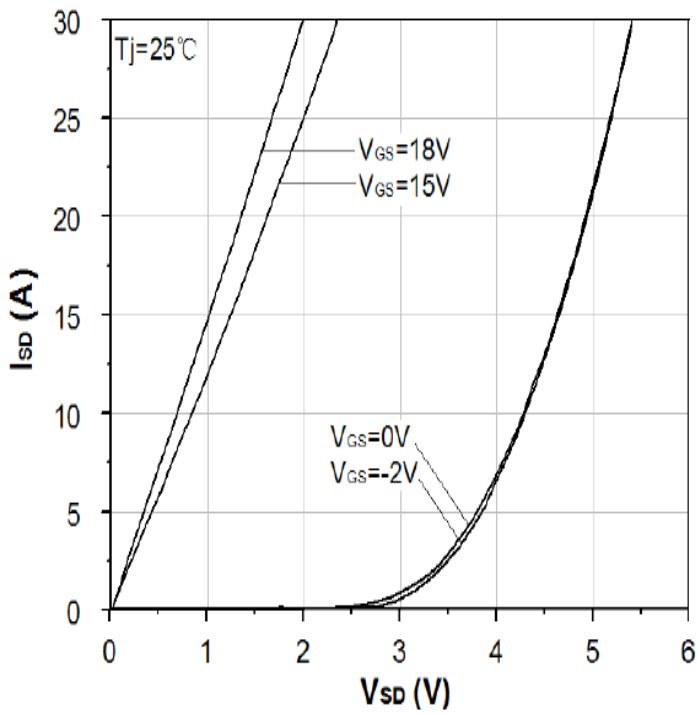
$R_{DS(ON)}=f(T_j); I_{DS}=20A$

Diagram 8: Typical body diodes forward voltage as function of junction temperature



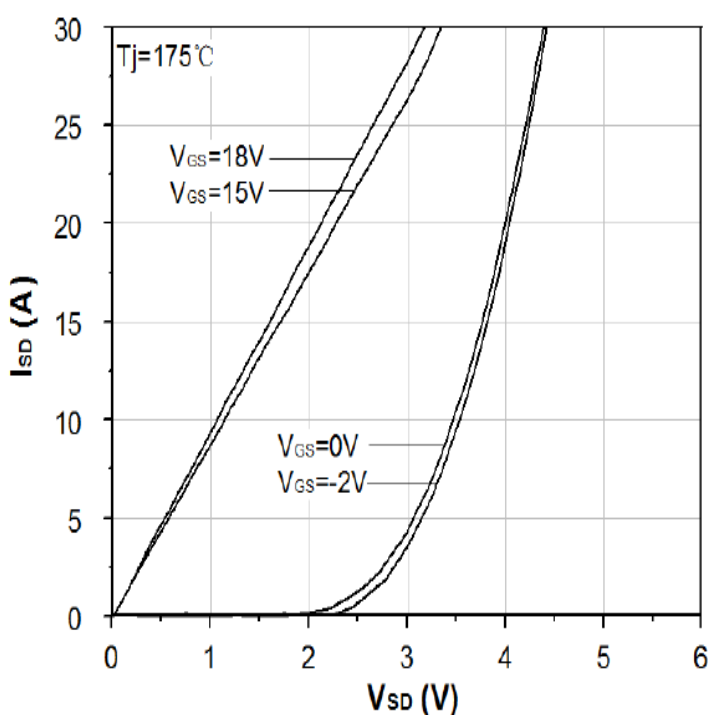
$V_{SD}=f(T_j); V_{GS}=0V; I_{SD}=10A$

Diagram 9: Typical body diodes forward current as function of forward voltage, V_{GS} as parameter



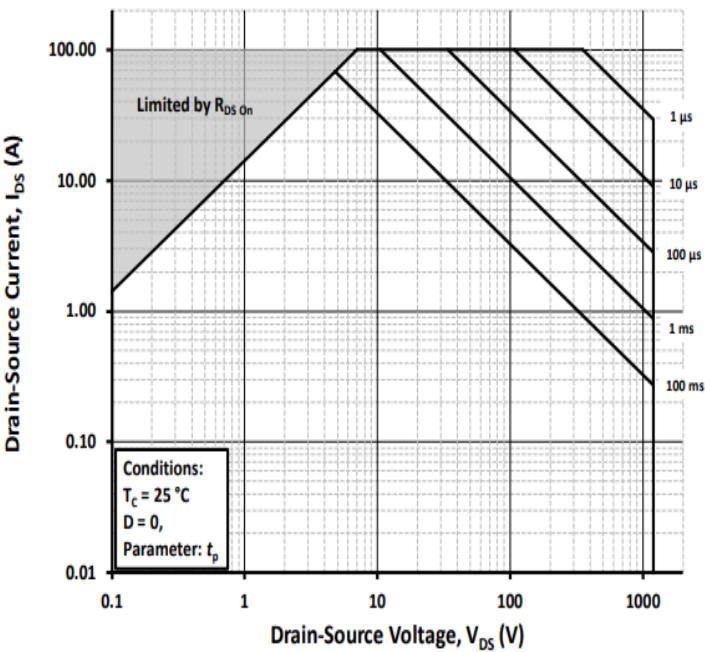
$I_{SD} = f(V_{SD}); T_j = 25^\circ\text{C}$

Diagram 10: Typical body diodes forward current as function of forward voltage, V_{GS} as parameter



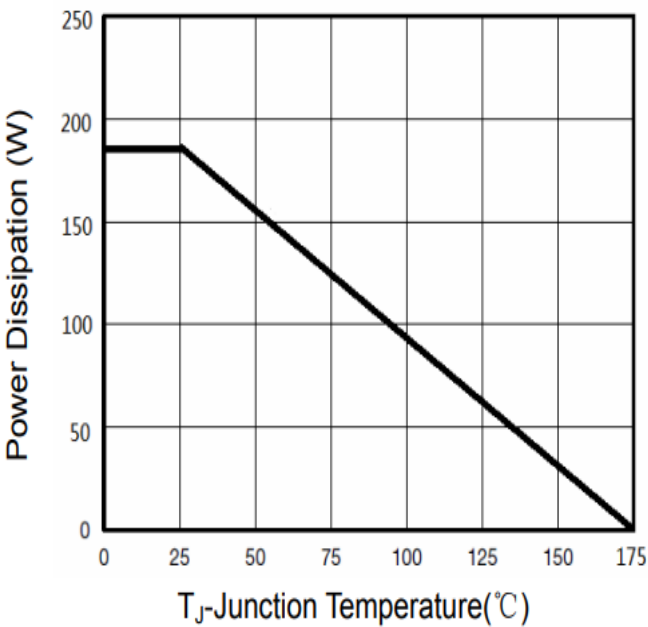
$I_{SD} = f(V_{SD}); T_j = 175^\circ\text{C}$

Diagram 11: Safe operating area(SOA)



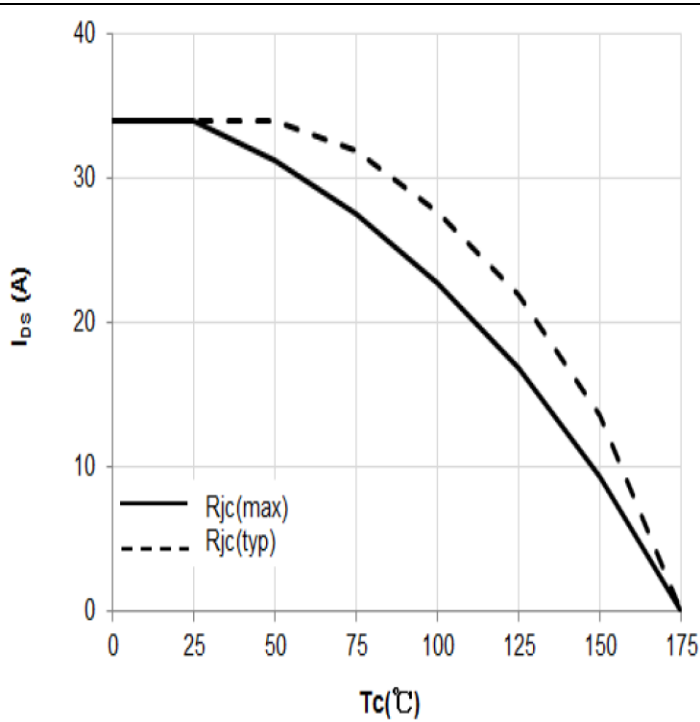
$V_{GS} = 0/18\text{V}; T_c = 25^\circ\text{C}; T_j < 175^\circ\text{C}$

Diagram 12: Power dissipation as a function of case temperature limited by bond wire



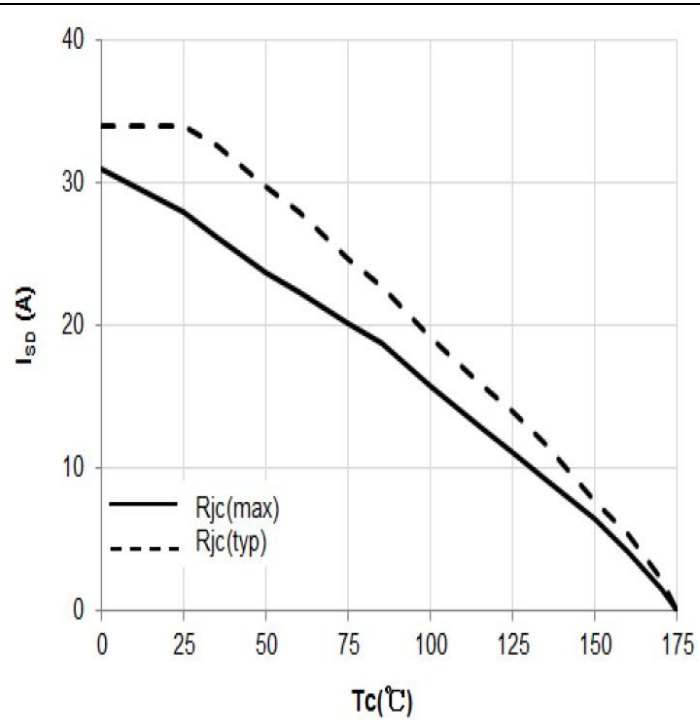
$P_{tot} = f(T_c)$

Diagram 13: Maximum DC drain to source current as a function of case temperature limited by bond wire



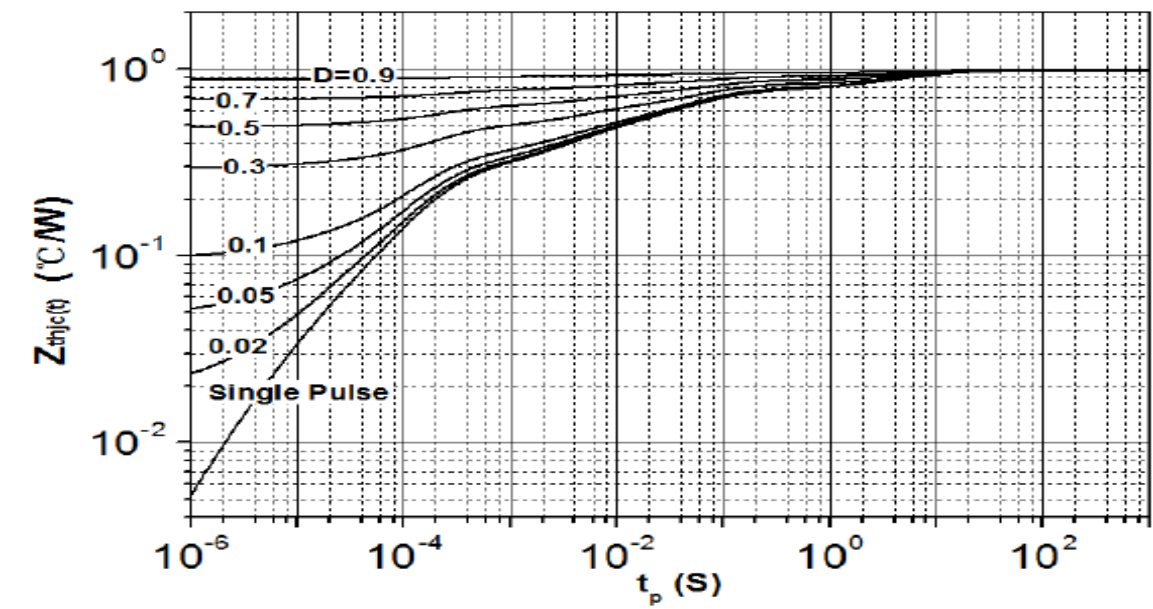
$I_{DS} = f(T_c)$

Diagram 14: Maximum source to drain current as a function of case temperature limited by bond wire



$I_{SD} = f(T_c), V_{GS} = 0V$

Diagram 15: Max. transient thermal resistance(MOSFET/diodes)



$Z_{th(j-c, \text{max})} = f(t_p), \text{parameter } D = t_p / T$

5 Test Circuits

Table 8 Diode characteristics

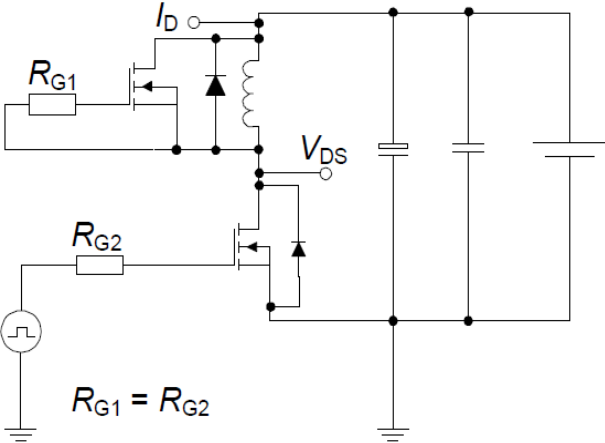
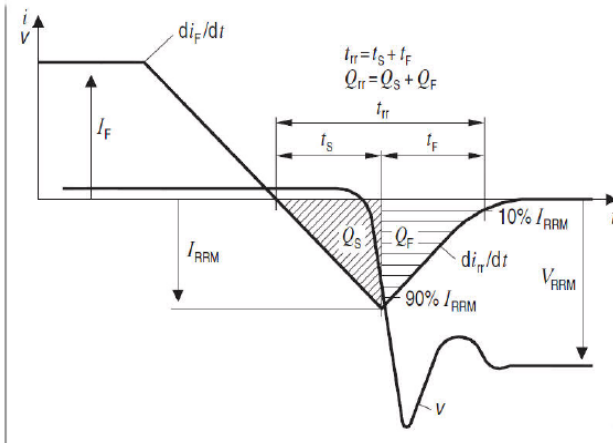
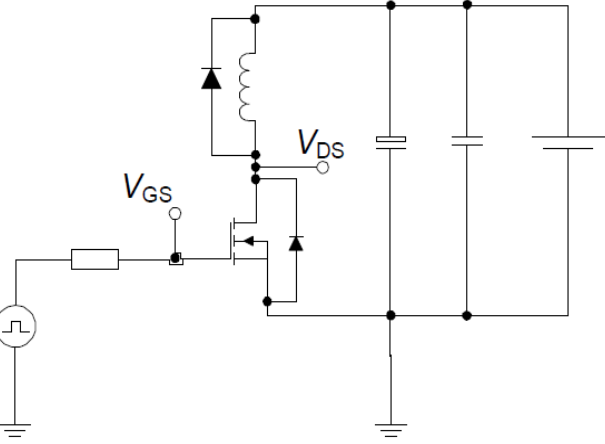
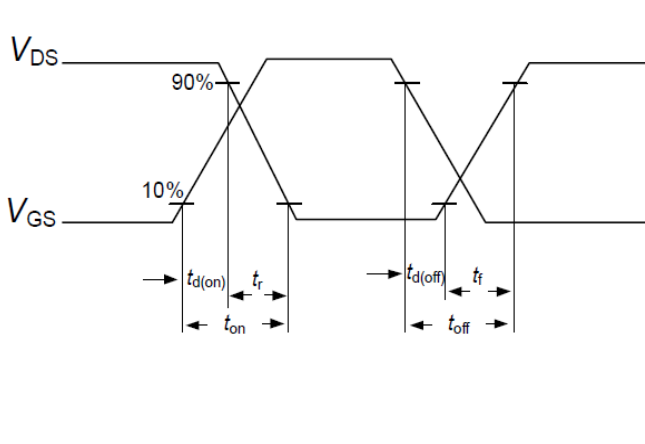
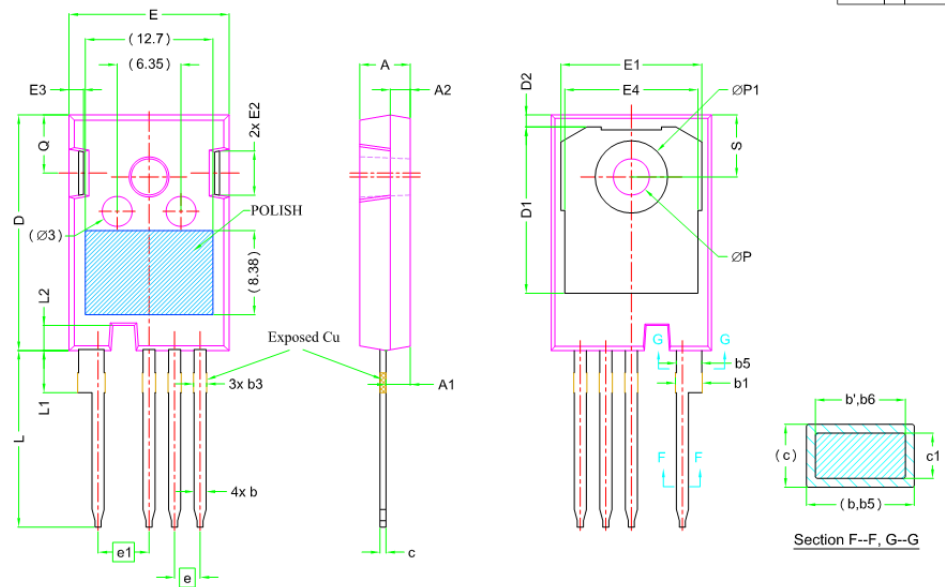
Test circuit for diode characteristics	Diode recovery waveform
 $R_{G1} = R_{G2}$	

Table 9 Switching times

Switching times test circuit for inductive load	Switching times waveform
	

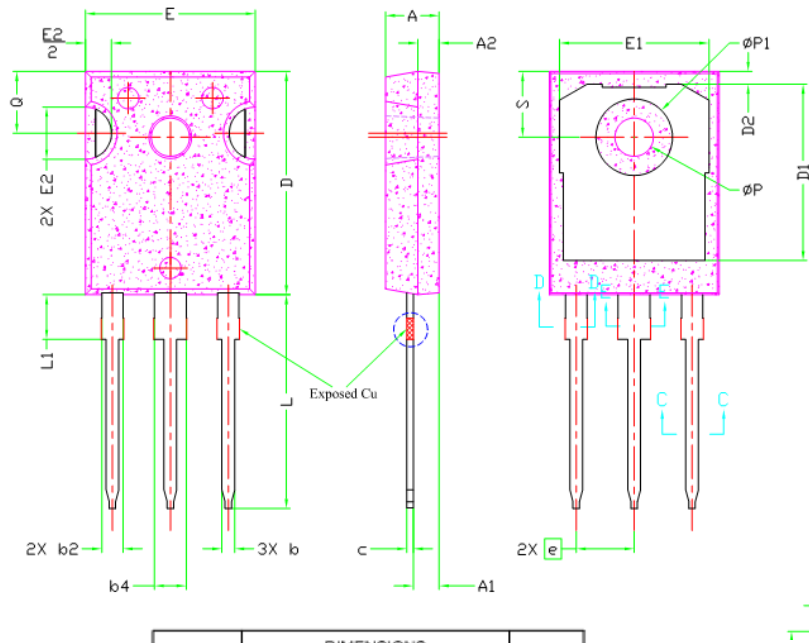
6 Package Outlines

TO-247-4L



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b'	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b3	1.07	1.30	1.60
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e	2.54 BSC		
e1	5.08 BSC		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
∅P	3.51	3.61	3.65
∅P1	7.19 REF.		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

TO-247-3L



SYMBOL	DIMENSIONS			NOTES
	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	
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	0.55	0.60	0.69	6
c1	0.55	0.60	0.65	
D	20.80	20.95	21.10	4
D1	16.25	16.55	17.65	5
D2	0.51	1.19	1.35	
E	15.75	15.94	16.13	4
E1	13.46	14.02	14.16	5
E2	4.32	4.91	5.49	3
e	5.44BSC			
L	19.81	20.07	20.32	
L1	4.10	4.19	4.40	6
ØP	3.56	3.61	3.65	7
ØP1	7.19REF.			
Q	5.39	5.79	6.20	
S	6.04	6.17	6.30	

Note:

1. Package Reference: JEDEC TO247, Variation AD.
2. All Dimensions Are In mm.
3. Slot Required, Notch May Be Rounded
4. Dimension D & E Do Not Include Mold Flash. Mold Flash Shall Not Exceed 0.127mm Per Side. These Dimensions Are Measured At The Outermost Extreme Of The Plastic Body.
5. Thermal Pad Contour Optional Within Dimension D1 & E1.
6. Lead Finish Uncontrolled In L1.
7. ØP To Have A Maximum Draft Angle Of 1.5° To The Top Of The Part With A Maximum Hole Diameter Of 3.91mm.
8. Dimension "b2" And "b4" Does Not Include Dambar Protrusion. Allowable Dambar Protrusion Shall Be 0.10mm Total In Excess Of "b2" And "b4" Dimension At Maximum Material Condition.

9. ASTERISKED QUOTES ARE SUBJECTED TO THE SPC CALCULATION (Cp,K,Cpk).

Revision History

Revision	Date	Subjects (major changes since last revision)
1.0	2022-05-27	Preliminary version