RTQ120N080S2, RTW120N080S2, RTG120N080S2

1200V N-Channel Silicon Carbide Power MOSFET

1. Applications

Asymmetrical Bridge
Converter
Inverter
Single Switch Forward
Flyback

2. Features

Low drain-source on-resistance: RDS(ON) = 80mΩ (typ.)
Easy to control Gate switching
Enhancement mode: Vth = 2 to 4 V

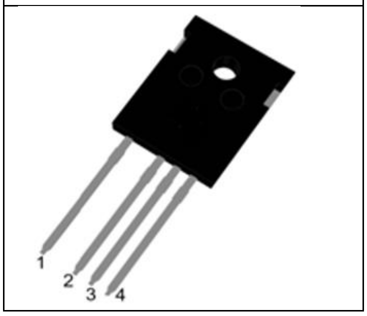
Table 1 Key Performance Parameters

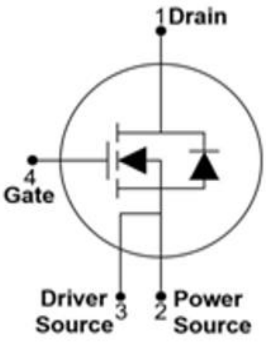
Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	1200	V
$R_{DS(on),max}$	100	mΩ
$Q_{g,typ}$	58	nC
$I_{D,pulse}$	94	A

3. Packaging and Internal Circuit

Part Name	Package	Marking
RTQ120N080S2	TO-247-4L	RTQ120N080S2
RTW120N080S2	TO-247-3L	RTW120N080S2
RTG120N080S2	TO-263-7L	RTG120N080S2

TO247-4L





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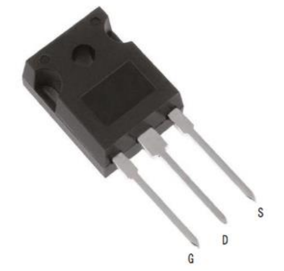

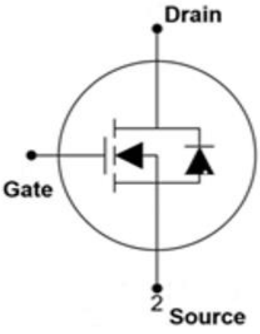

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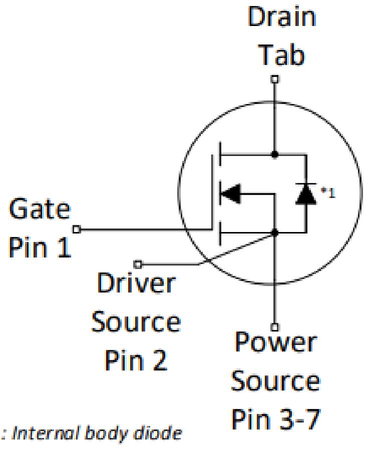


*1: Internal body diode

1 Maximum ratings

at T_j = 25°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	TC=25°C
		-	-	26	A	TC=100°C
Avalanche energy, single pulse	E_{AS}	-	-	200	mJ	Tc=25°C,VDD=50V,L=1mH, RG=25Ω
Gate source voltage (static)	V_{GS}	-5	-	20	V	static;
Power dissipation	P_{tot}	-	-	188	W	TC=25°C
Derating factor above 25°C		-	-	1.9	W/°C	
Storage temperature	T_{stg}	-55	-	175	°C	
Operating junction temperature	T_j	-55	-	175	°C	
Soldering Temperature Distance of 1.6mm from case for 10s	T_L			300	°C	
Transconductance	GFS	-	8.33	-	S	VDS=20V IDS=20A
			7.14			VDS=20V IDS=20A, Tj=150°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°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	uA	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	mΩ	V_{GS}=20V, I_D=20A, T_j=25°C
			93.1			V_{GS}=20V, I_D=20A, T_j=150℃
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=0Ω; T_J =25℃
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	Eon		748.8		uJ	
Turn-off Switching Energy	$Eoff$		31.2		uJ	

Table 6 Gate charge characteristics

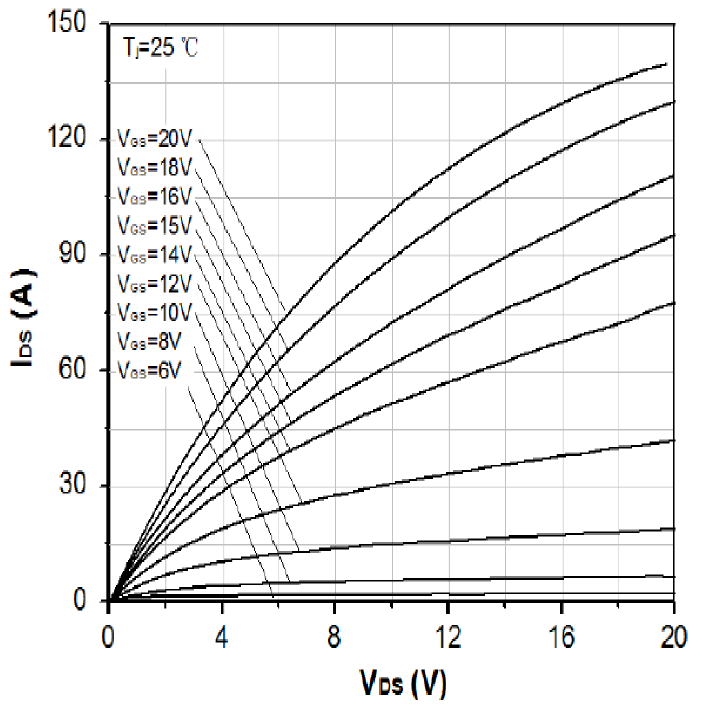
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	18	-	nC	V_{DD}=800V, I_D=20A, V_{GS}=20V
Gate to drain charge	Q_{gd}	-	17	-	nC	V_{DD}=800V, I_D=20A, V_{GS}=20V
Gate charge total	Q_g	-	58	-	nC	V_{DD}=800V, I_D=20A, V_{GS}=20V

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°C
Reverse recovery time	t_{rr}	-	57	-	ns	V_{DD} =800V，I_D =20A, +V_{GS} =+15V,-V_{GS} =-4V L_{Load}=500uH，Rg=0Ω，T_J =25℃
Reverse recovery charge	Q_{rr}	-	195	-	nC	
Peak reverse recovery current	I_{rrm}	-	6.84	-	A	

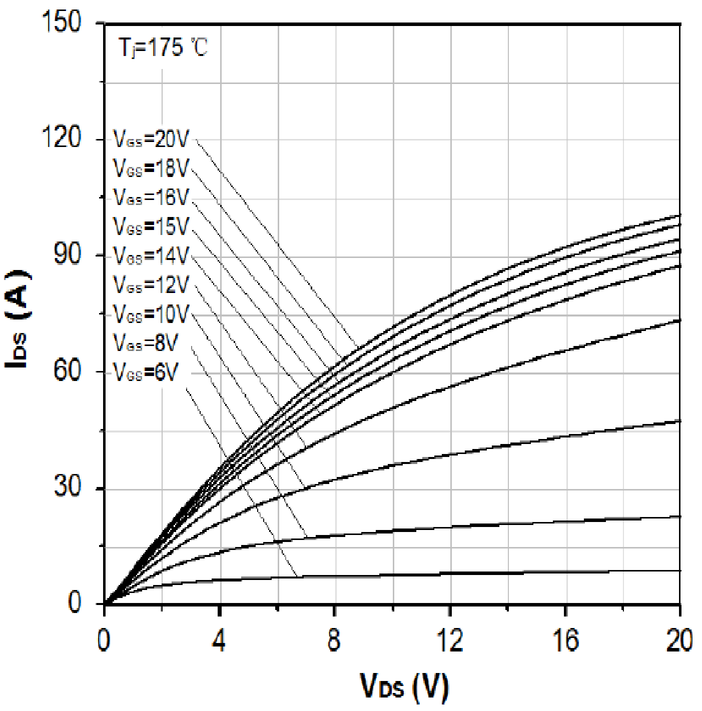
4 Electrical characteristics diagram

Diagram 1: Typ. output characteristics



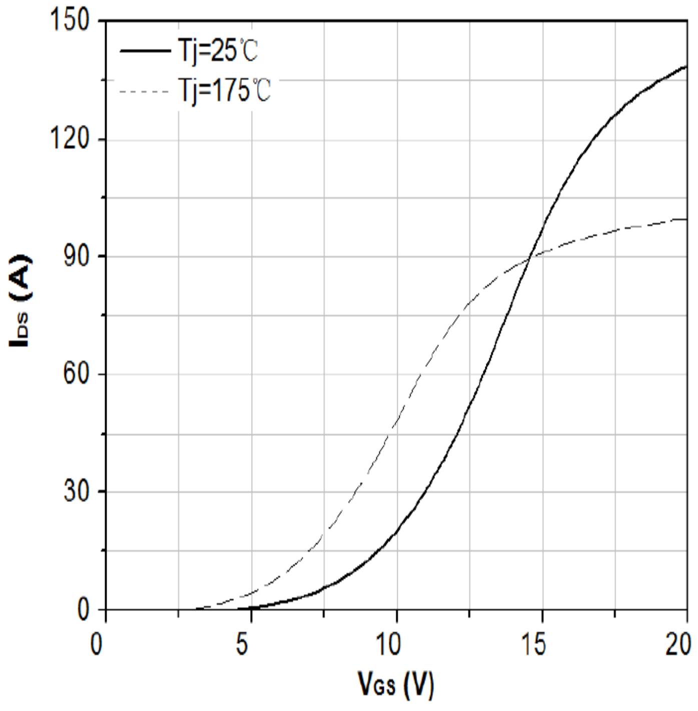
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 2: Typ. output characteristics



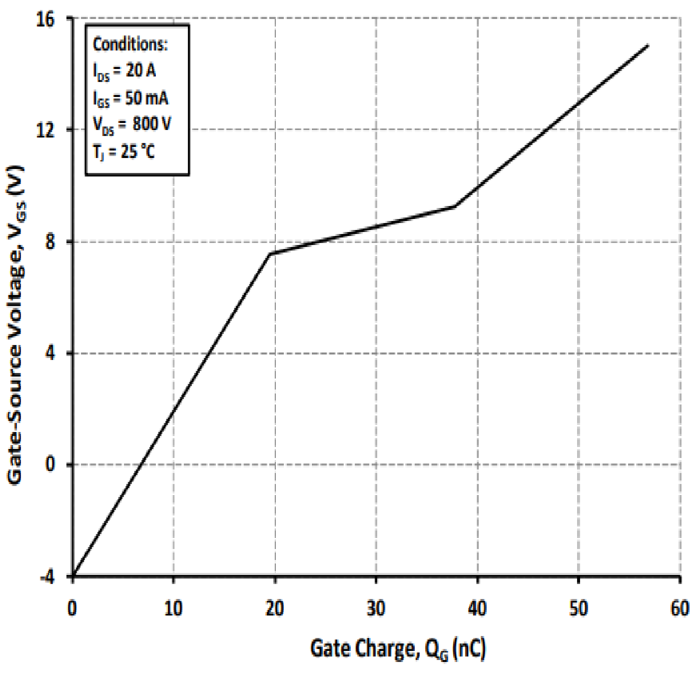
$I_D=f(V_{DS})$; $T_j=175$ °C; parameter: V_{GS}

Diagram 3: Typ. transfer characteristics



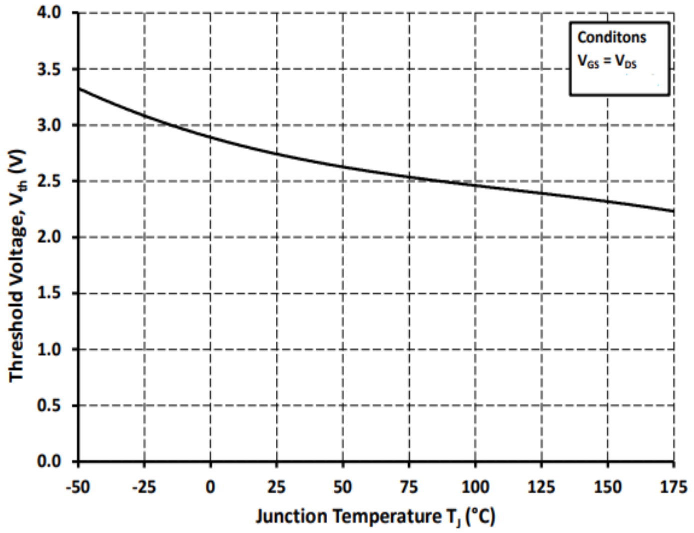
$I_D=f(V_{GS})$; $V_{DS}=20$V; parameter: T_j

Diagram 4: Typ. gate charge



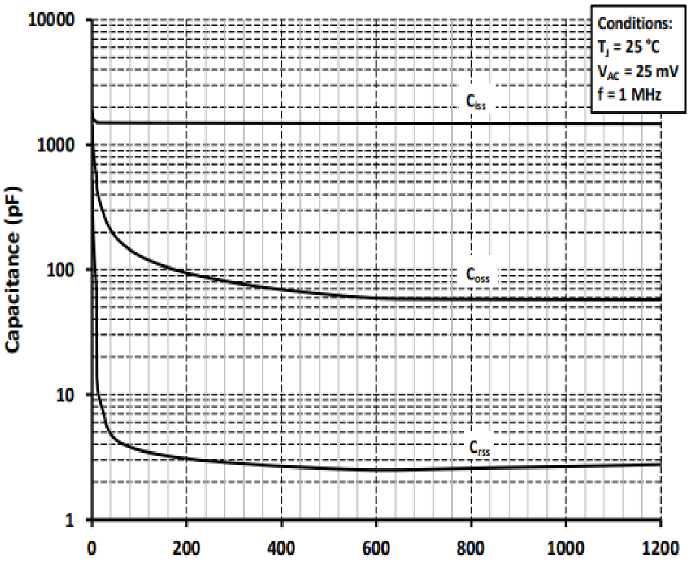
$V_{GS}=f(Q_{gate})$; $I_D=20$A ; $V_{DS}=800$V; turn-on pulse

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



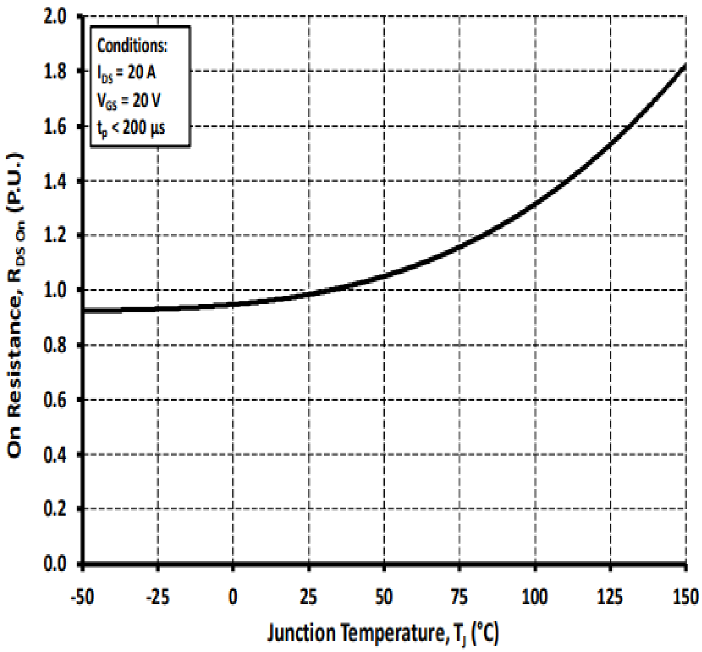
$V_{GS(th)}$=f(T_j); I_{DS}=10mA; V_{GS}=V_{DS}

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



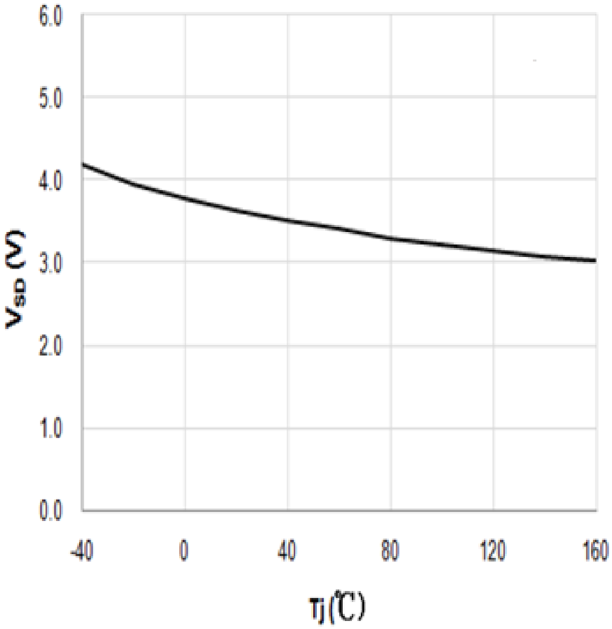
C=f(V_{DS});V_{GS}=0V; f=1MHz

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



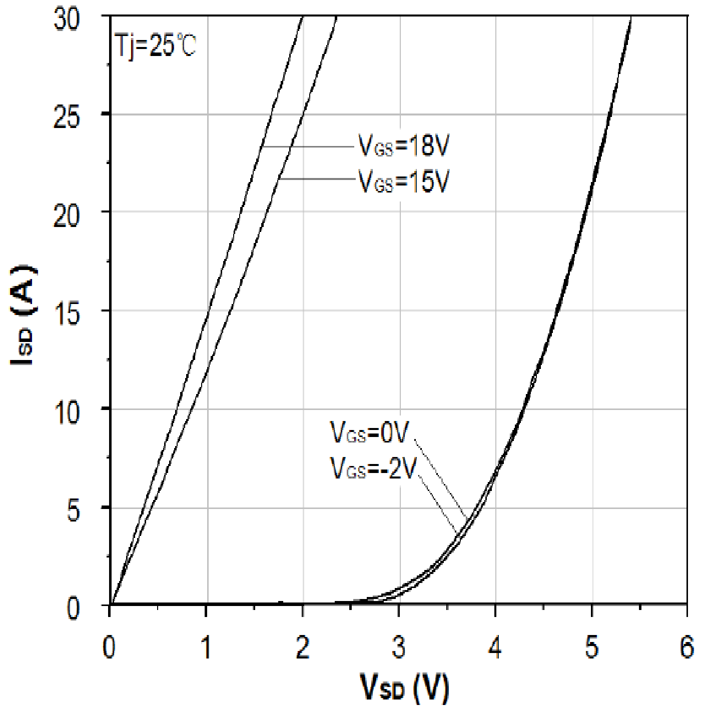
$R_{DS(ON)}$=f(T_j);I_{DS}=20A

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



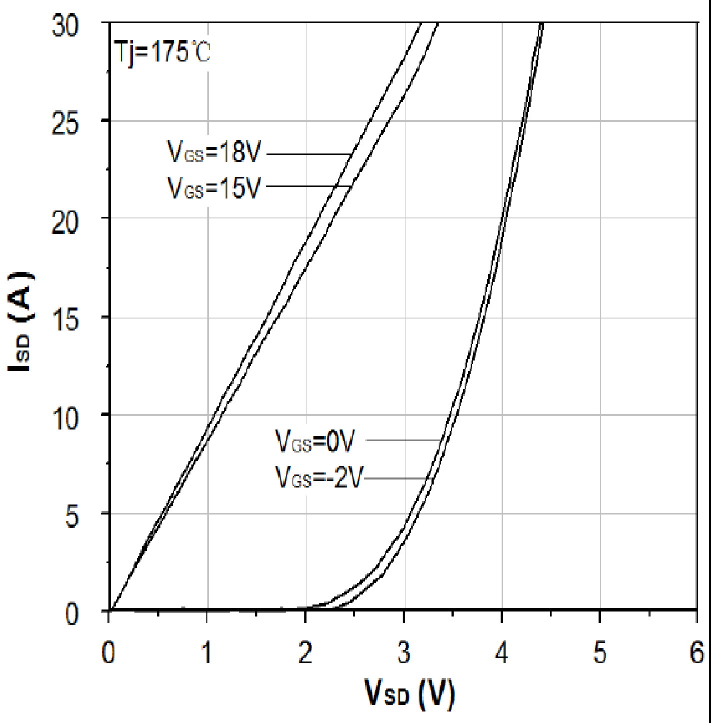
V_{SD}=f(T_j);V_{GS}=0V; I_{SD}=10A

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



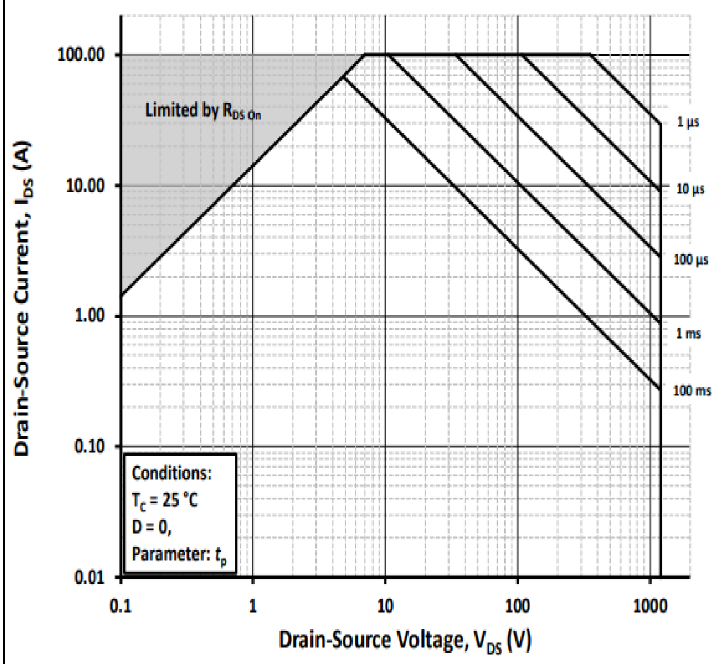
I_{SD}=f(V_{SD});T_j=25 °C

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



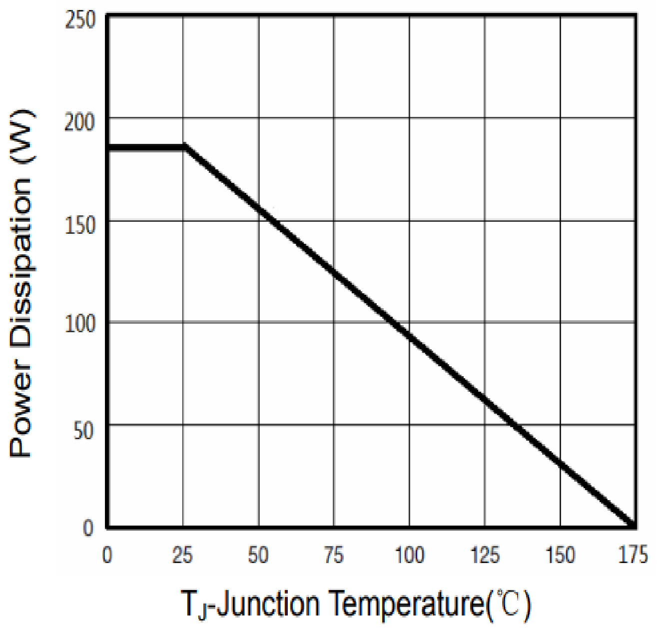
I_{SD}=f(V_{SD});T_j=175 °C

Diagram 11: Safe operating area(SOA)



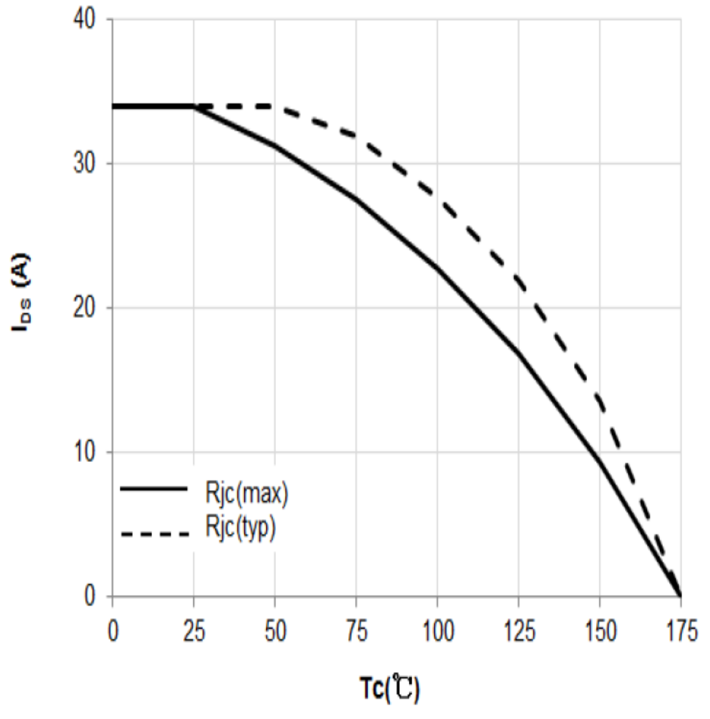
V_{GS}=0/18V; T_C=25 °C; T_j<175 °C

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



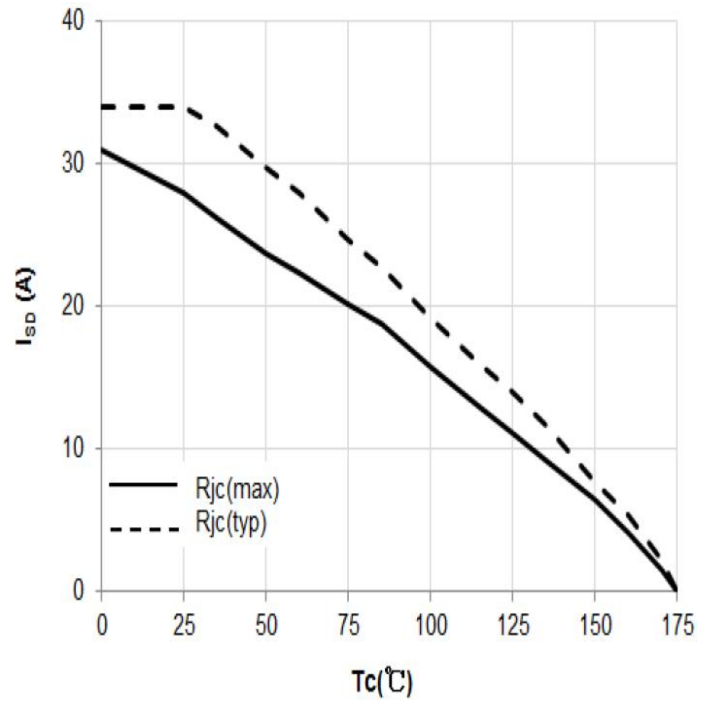
P_{tot}= f(T_C)

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



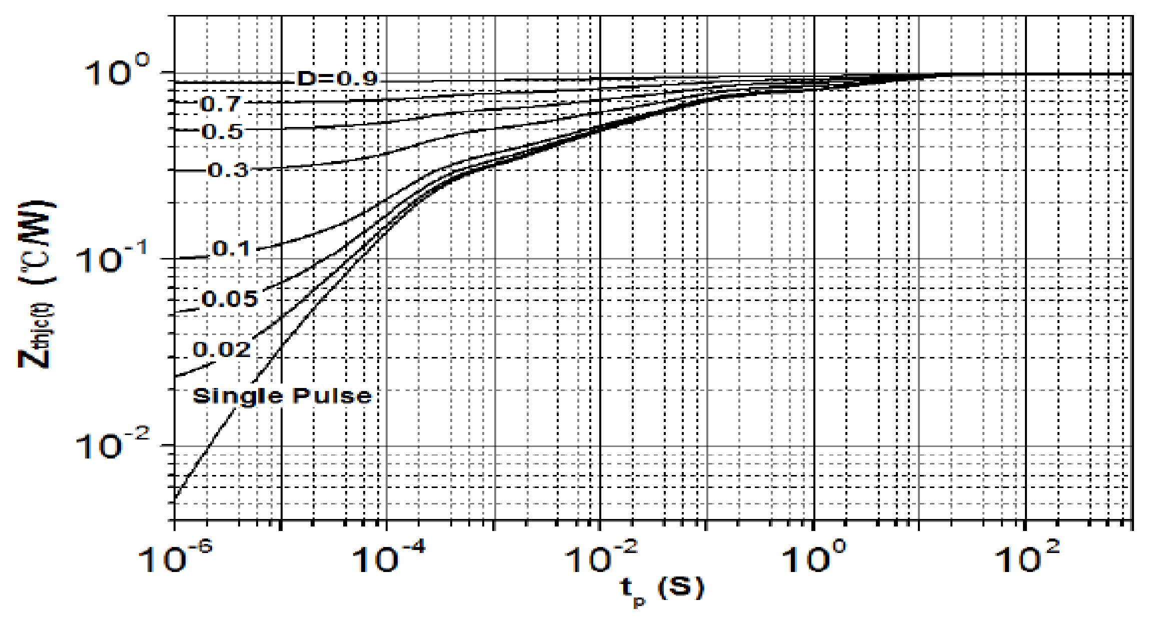
I_{DS}= f(T_C)

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)



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

5 Test Circuits

Table 8 Diode characteristics

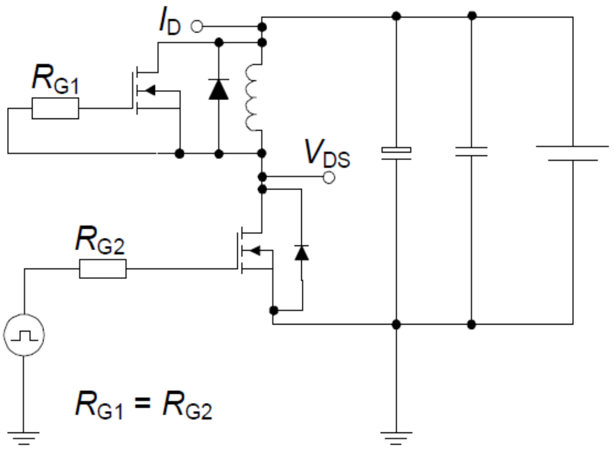
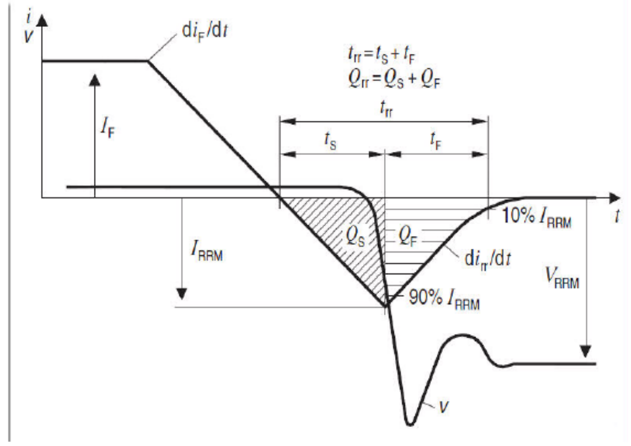
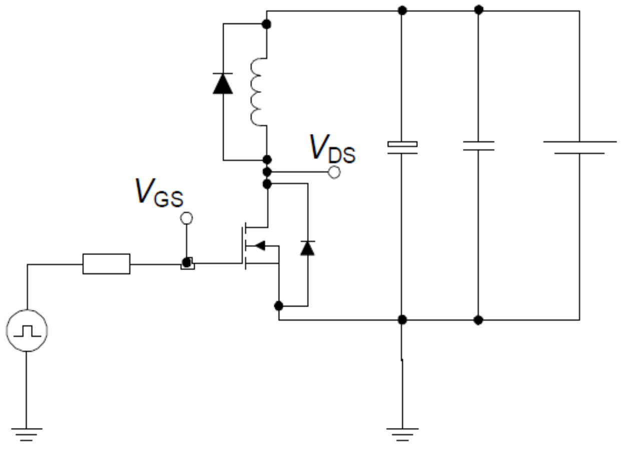
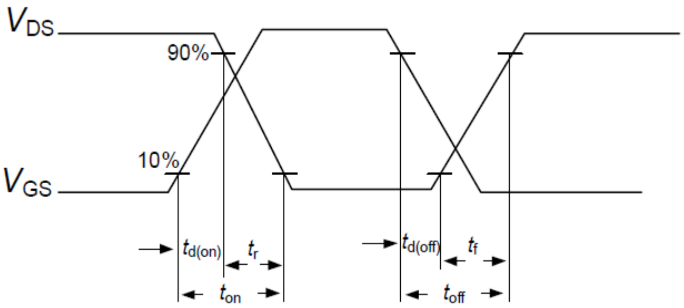
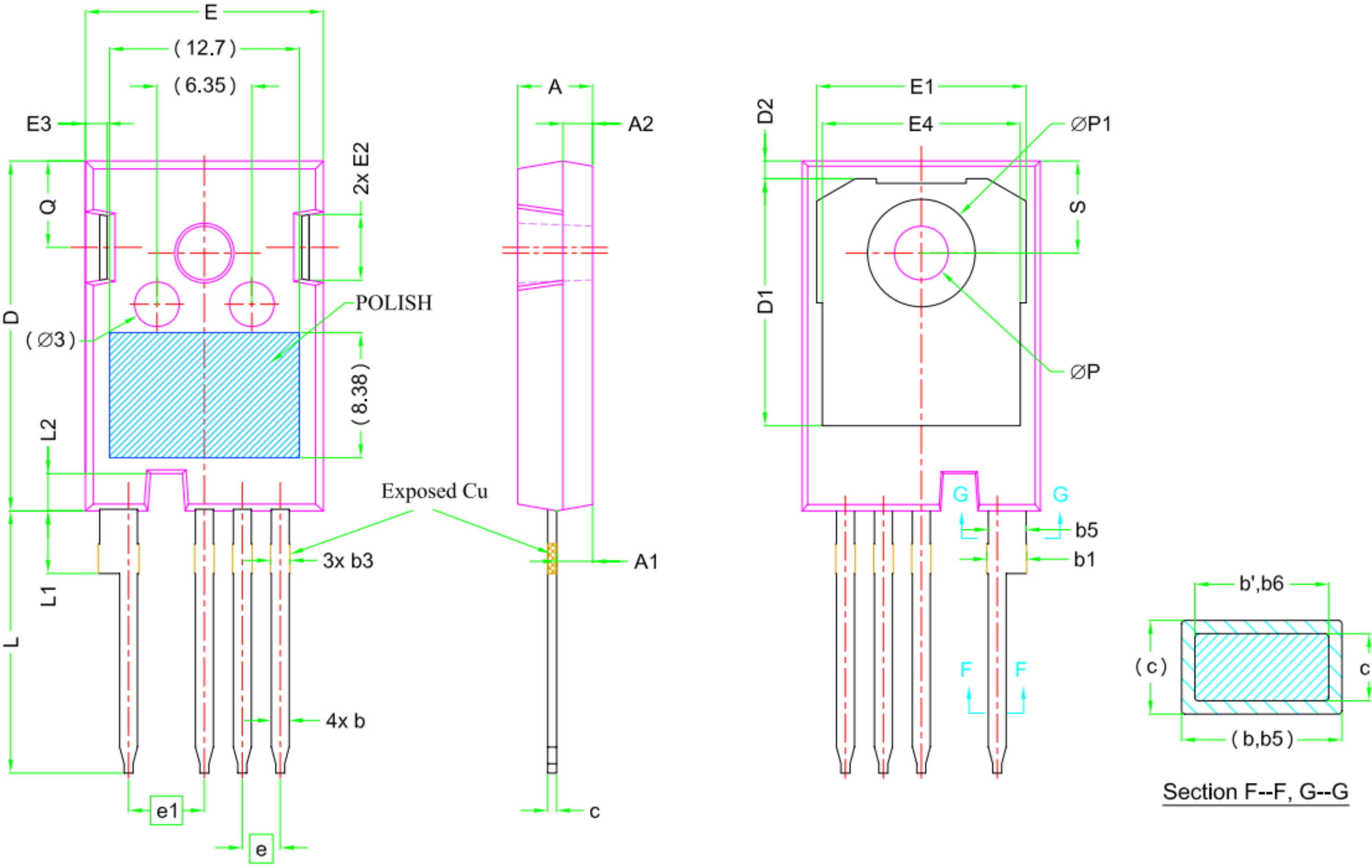
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

Switching times test circuit for inductive load	Switching times waveform
	

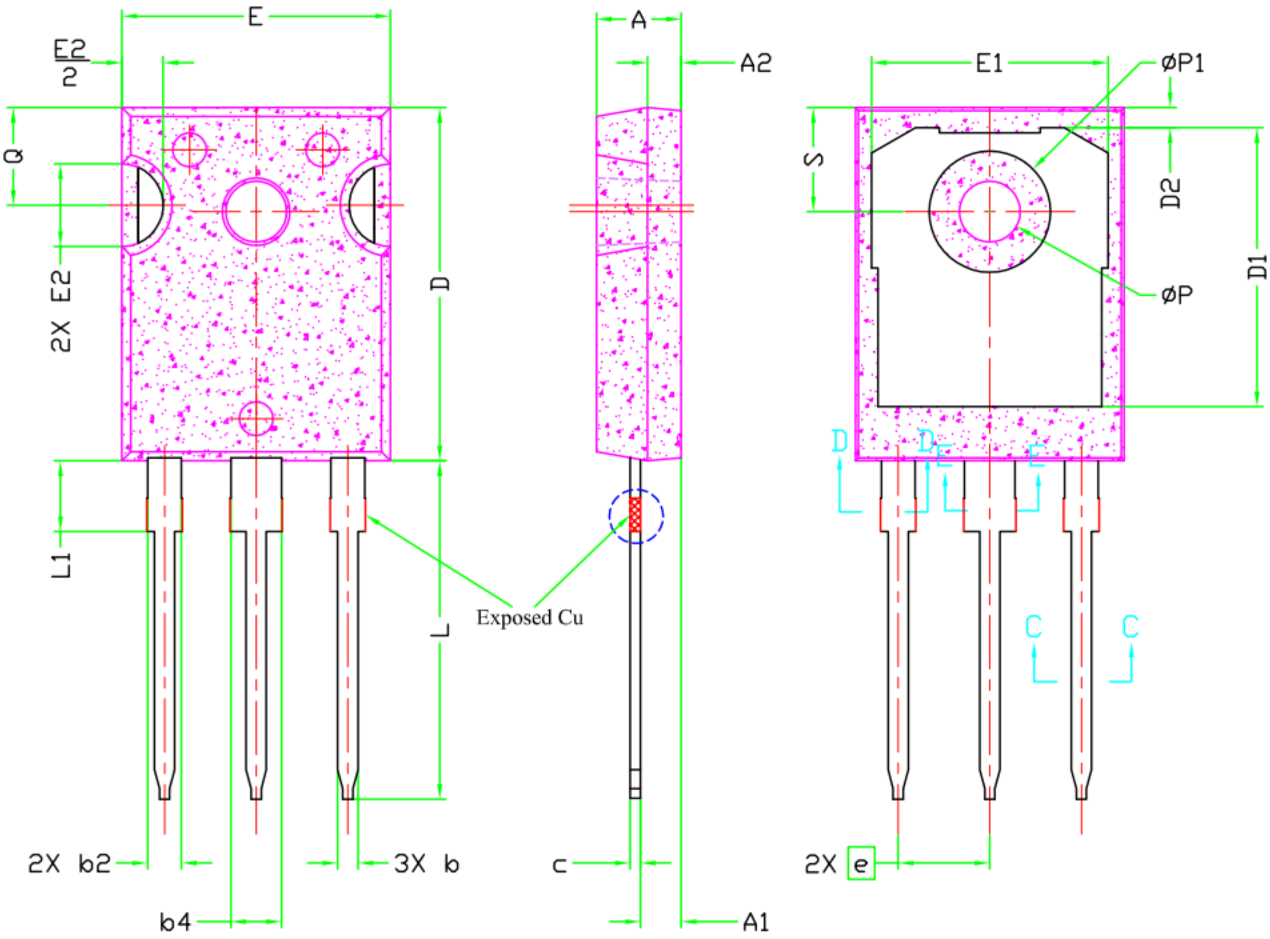
6 Package Outlines

TO-247-4L



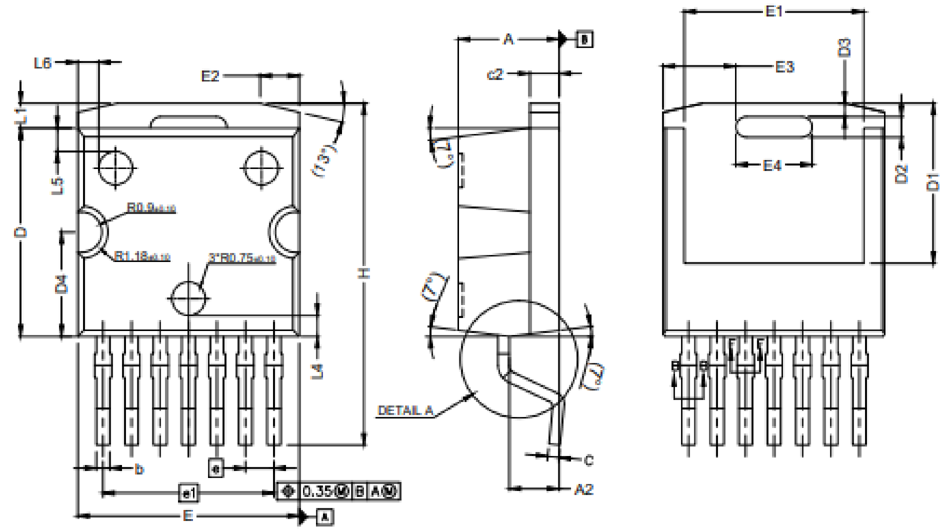
SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b'	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b3	1.07	1.30	1.60
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	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
ØP	3.51	3.61	3.65
ØP1	7.19 REF.		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

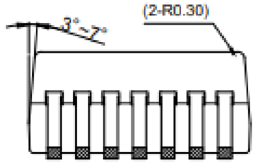
TO-247-3L

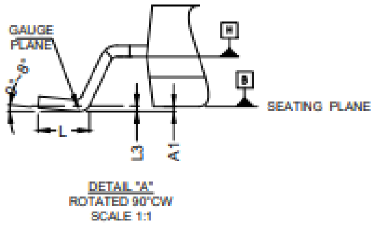


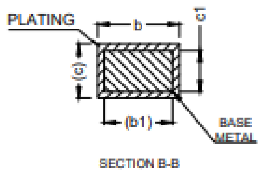
SYMBOL	DIMENSIONS			NOTES
	MIN.	NOM.	MAX.	
A	4.83	5.02	5.21	
A1	2.29	2.41	2.55	
A2	1.50	2.00	2.49	
b	1.12	1.20	1.33	
b1	1.12	1.20	1.28	
b2	1.91	2.00	2.39	6
b3	1.91	2.00	2.34	
b4	2.87	3.00	3.22	6, 8
b5	2.87	3.00	3.18	
c	0.55	0.60	0.69	6
c1	0.55	0.60	0.65	
D	20.80	20.95	21.10	4
D1	16.25	16.55	17.65	5
D2	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
∅P	3.56	3.61	3.65	7
∅P1	7.19REF.			
Q	5.39	5.79	6.20	
S	6.04	6.17	6.30	

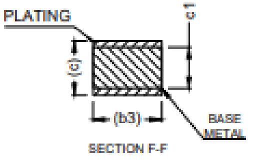
TO-263-7L











SYMBOL	MIN	MAX
A	4.30	4.70
A1	-	0.25
A2	2.02	2.42
b	0.50	0.70
b1	0.50	0.65
b3	0.60	0.75
c	0.45	0.60
c1	0.45	0.55
c2	1.25	1.40
D	9.10	9.50
D1	6.86	7.42
D2	0.72	1.12
D3	0.40	0.80
D4	4.45	4.85
E	9.68	10.08
E1	7.70	8.30
E2	1.55	1.95
E3	3.04	3.44
E4	3.21	3.61
e	1.27 BSC	
e1	7.62 BSC	

SYMBOL	MIN	MAX
L	1.78	2.79
L1	-	1.60
L3	0.25BSC	
L4	0.93BSC	
L5	1.04BSC	
L6	0.93BSC	
H	14.61	15.88

Revision History

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