

## NTHL020N120SC1-VB Datasheet

### N-Channel 1200V (D-S) SiC Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	1200	
$R_{DS(on)}$ at 25 °C ( $\Omega$ )	$V_{GS} = 18$ V	0.016
$Q_g$ (nC)	200	

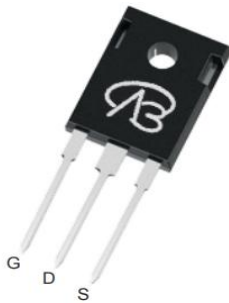
#### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Higher robustness and system reliability
- Kelvin source provides up to 4 times lower switching losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

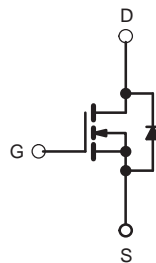
#### APPLICATIONS

- Server and telecom power supplies
- EV charging infrastructure
- Solar PV inverters
- DC/DC converter

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Top View



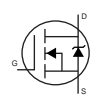
N-Channel MOSFET

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	
Continuous Drain Current ( $T_J = 175$ °C)	$V_{GS}$ at 18 V	$T_C = 25$ °C	142
		$T_C = 100$ °C	100
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	310	A
Linear Derating Factor		2.1	W/°C
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	625	mJ
Maximum Power Dissipation	$P_D$	535	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175	°C
Drain-Source Voltage Slope	$dV/dt$	$T_J = 125$ °C	150
Reverse Diode $dV/dt$ <sup>d</sup>		100	
Soldering Recommendations (Peak Temperature) <sup>c</sup>	for 10 s	260	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 0.5$  mH,  $R_g = 25$   $\Omega$ .
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

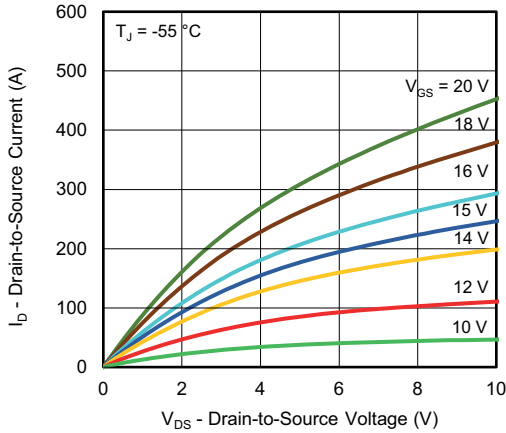
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.28	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$		1200	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 5\text{ mA}$		2	-	4	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = +18\text{ V}$		-	-	100	nA
		$V_{GS} = -8\text{ V}$		-	-	100	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$		-	-	100	$\mu\text{A}$
		$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	200	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}$	$I_D = 100\text{ A}$	-	0.016	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 0\text{ V}, I_D = 100\text{ A}$		-	50	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V},$ $V_{DS} = 800\text{ V},$ $f = 100\text{ KHz}$		-	6800	-	pF
Output Capacitance	$C_{oss}$			-	300	-	
Reverse Transfer Capacitance	$C_{rss}$			-	15	-	
Effective Output Capacitance, Energy Related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 800\text{ V}, V_{GS} = 0\text{ V}$		-	230	-	
Effective Output Capacitance, Time Related <sup>b</sup>	$C_{o(tr)}$			-	320	-	
Total Gate Charge	$Q_g$	$V_{GS} = -5/18\text{ V}$	$I_D = 50\text{ A}, V_{DS} = 800\text{ V}$	-	200	-	nC
Gate-Source Charge	$Q_{gs}$			-	80	-	
Gate-Drain Charge	$Q_{gd}$			-	60	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 800\text{ V}, I_D = 50\text{ A}$  $V_{GS} = -5/18\text{ V}$		-	15	20	ns
Rise Time	$t_r$			-	40	-	
Turn-Off Delay Time	$t_{d(off)}$			-	60	-	
Fall Time	$t_f$			-	30	-	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}, \text{ open drain}$		-	8.5	-	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	60	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	150	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 50\text{ A}, V_{GS} = 0$		-	-	4.1	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 50\text{ A},$ $di/dt = 1000\text{ A}/\mu\text{s}, V_R = 800\text{ V}$		-	35	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	1.5	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	15	-	A

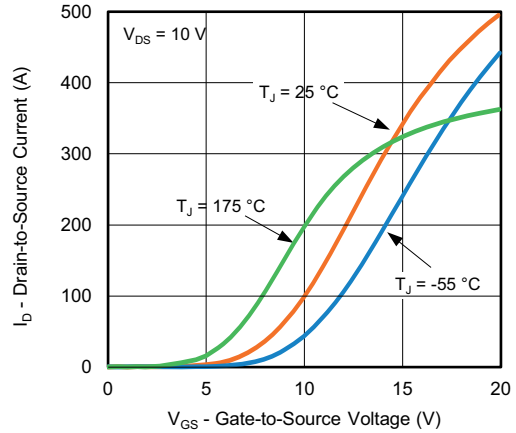
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 60 %  $V_{DSS}$ .
- 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 60 %  $V_{DSS}$ .

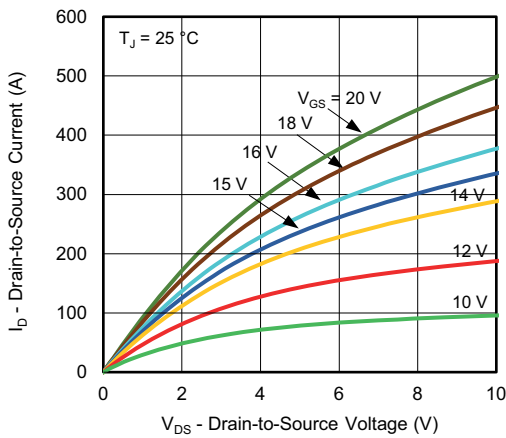
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Fig. 1 - Typical Output Characteristics**



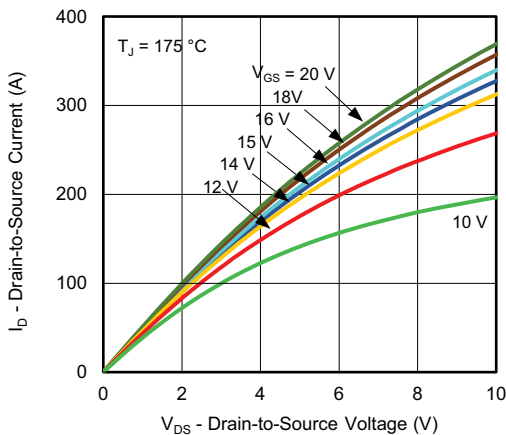
**Fig. 4 - Typical Transfer Characteristics**



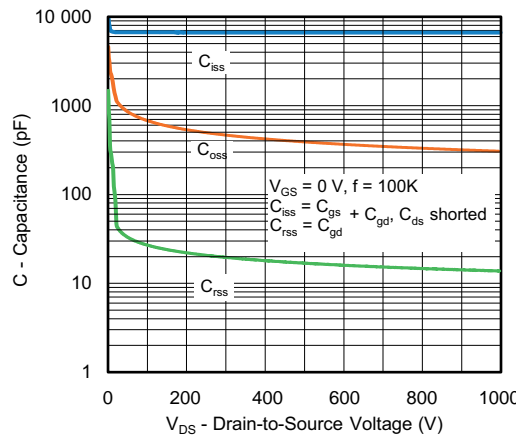
**Fig. 2 - Typical Output Characteristics**



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



**Fig. 3 - Typical Output Characteristics**



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

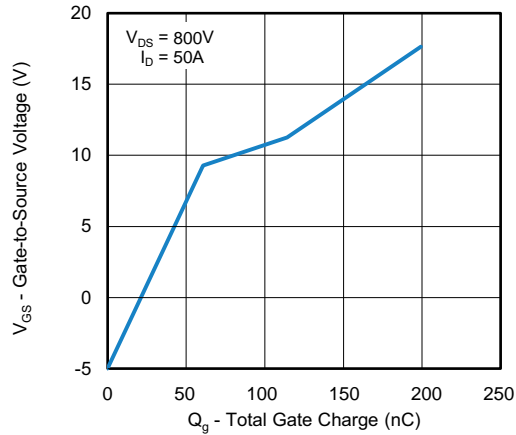


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

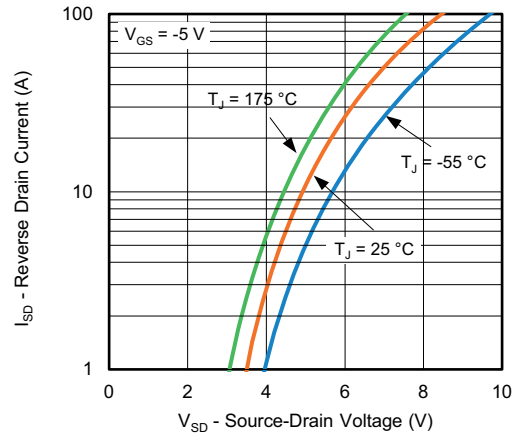


Fig. 10 - Typical Source-Drain Diode Forward Voltage

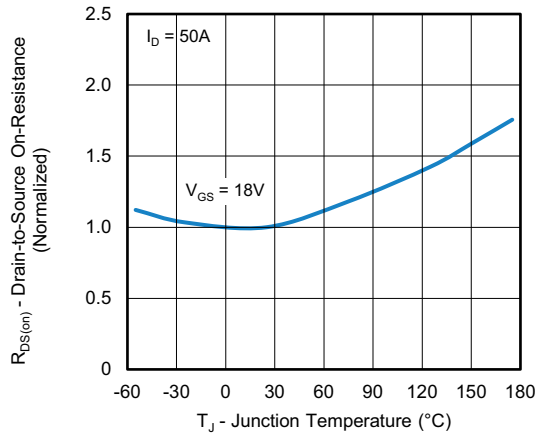


Fig. 8 - Normalized On-Resistance vs. Temperature

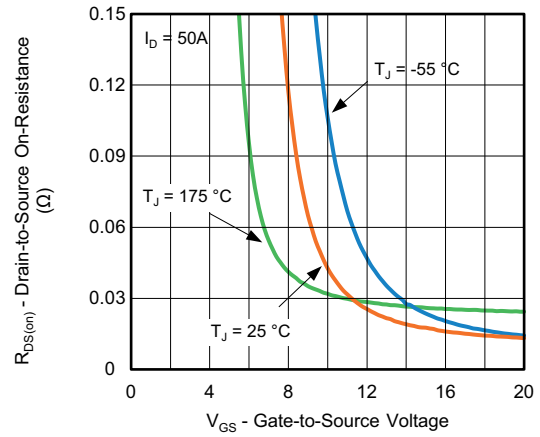


Fig. 11 - On-Resistance vs. Gate-to-Source Voltage



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

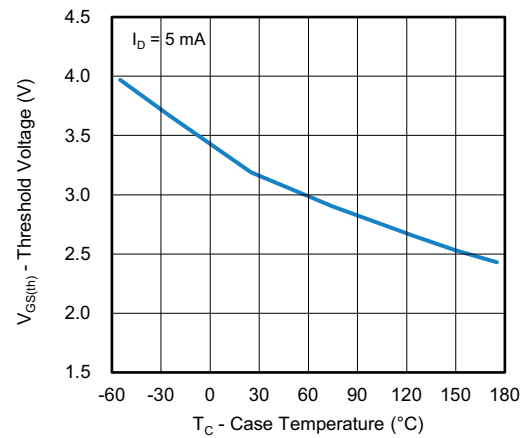


Fig. 12 - Threshold Voltage vs. Case Temperature

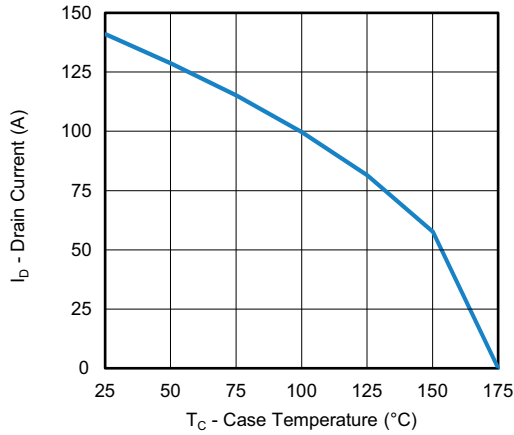


Fig. 13 - Drain Current vs. Case Temperature

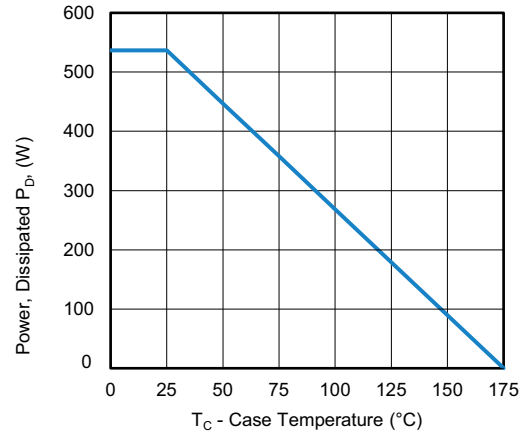


Fig. 15 - Power, Dissipated  $P_D$  vs. Case Temperature

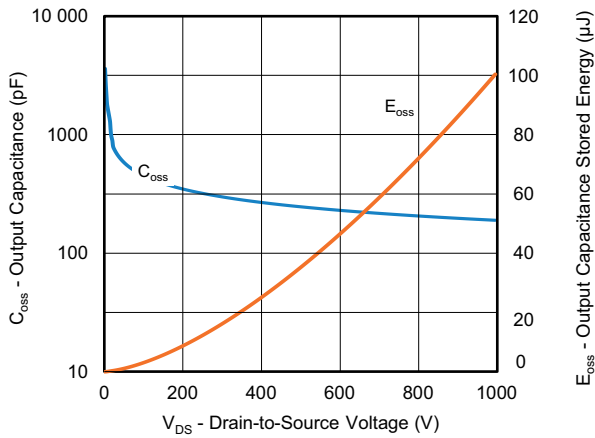


Fig. 14 - Output Capacitance and its Stored Energy vs. Drain-to-Source Voltage

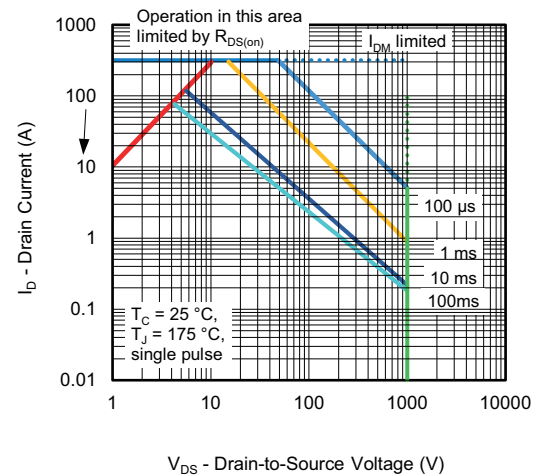


Fig. 16 - Safe Operating Area

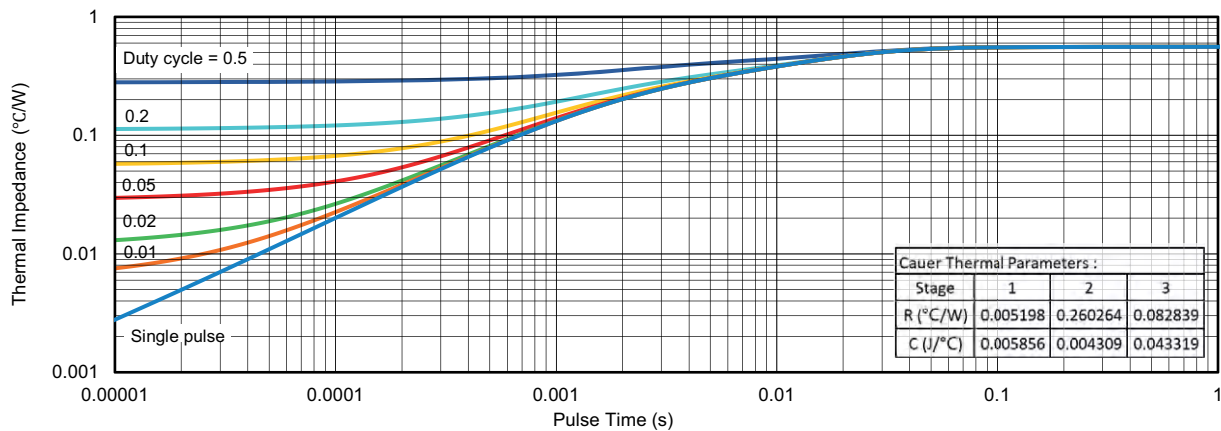


Fig. 17 - Transient Thermal Impedance

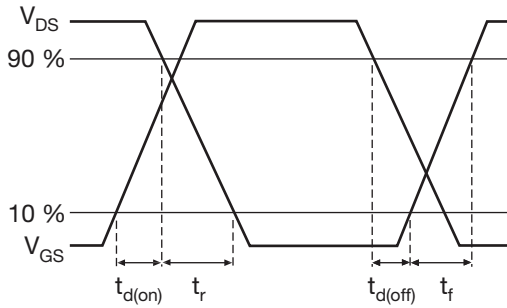


Fig. 18 - Waveforms of Switching Time

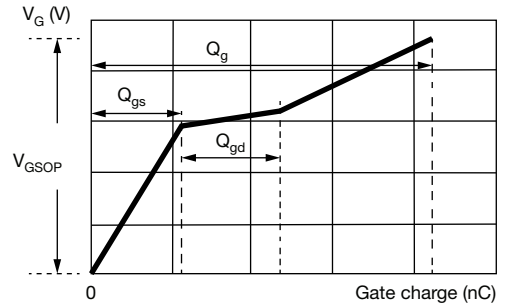


Fig. 21 - Waveforms for Gate Charge

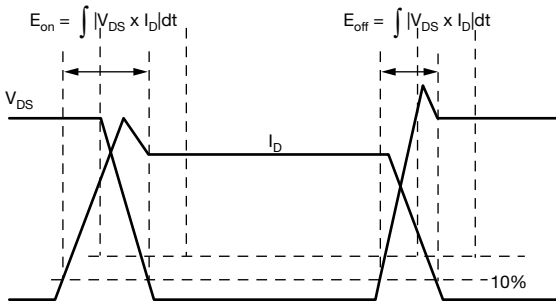


Fig. 19 - Waveforms for Switching Energy

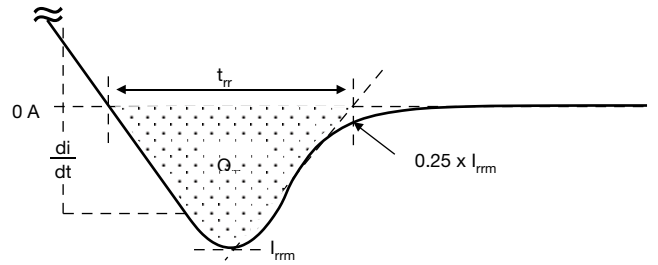


Fig. 22 - Waveforms for Reverse Recovery

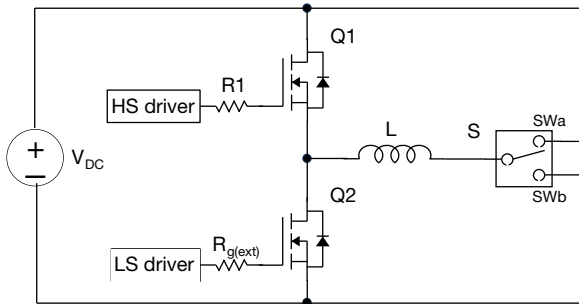


Fig. 20 - Switching and Reverse Diode Characteristics Measurement Circuit

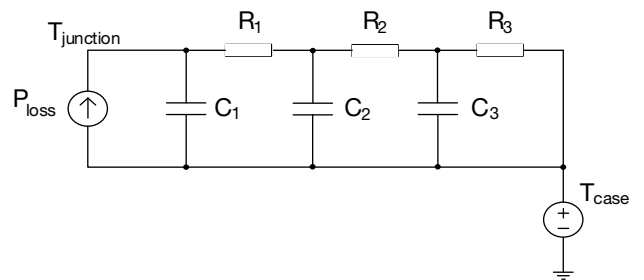
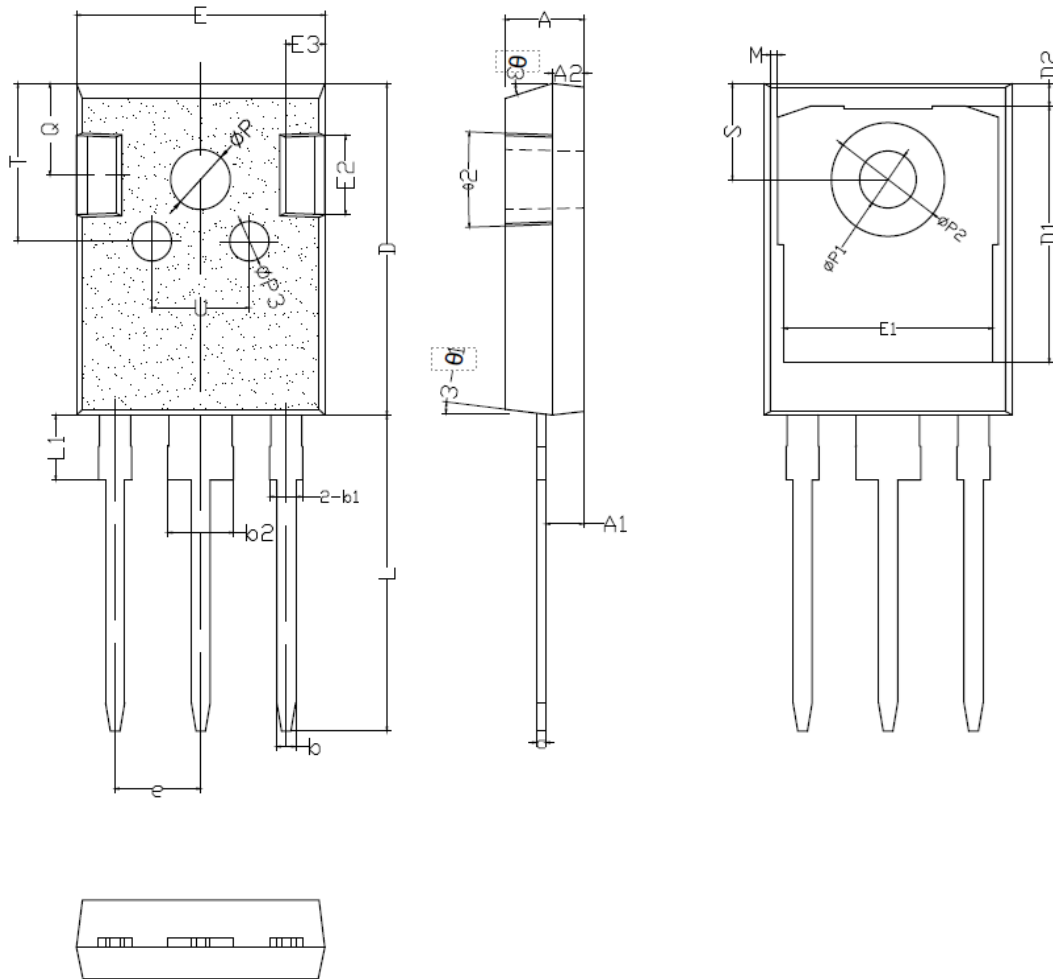


Fig. 23 - Thermal Equivalent Circuit

TO-247 PACKAGE OUTLINE DIMENSIONS



SYMBOL	mm		
	MIN	NOM	MAX
*A	4.90	5.00	5.10
*A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
*b	1.15	1.20	1.25
*b1	1.95	2.10	2.25
*b2	2.95	3.10	3.25
*c	0.55	0.60	0.65
*D	20.90	21.00	21.10
D1	16.35	16.55	16.75
D2	1.05	1.20	1.35

*E	15.70	15.80	15.90
E1	13.10	13.25	13.40
E2	4.85	4.95	5.10
E3	2.40	2.50	2.60
*e	5.40	5.44	5.48
*L	19.80	19.98	20.15
*L1	-	-	4.30
*ΦP	3.40	3.50	3.60
*ΦP1	6.90	7.10	7.30
ΦP2	2.40	2.50	2.60
ΦP3	2.40	2.50	2.60
Q	5.60	5.80	6.00
*S	6.05	6.15	6.25
T	9.80	10.00	10.20
U	6.00	6.20	6.40
θ1	5°	7°	9°
θ2	1°	3°	5°
θ3	13°	15°	17°

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