

Silicon Carbide (SiC) MOSFET – 80 mohm, 1200 V, M1, TO-247-4L

NTH4L080N120SC1

Description

Silicon Carbide (SiC) MOSFET uses a completely new technology that provide superior switching performance and higher reliability compared to Silicon. In addition, the low ON resistance and compact chip size ensure low capacitance and gate charge. Consequently, system benefits include highest efficiency, faster operation frequency, increased power density, reduced EMI, and reduced system size.

Features

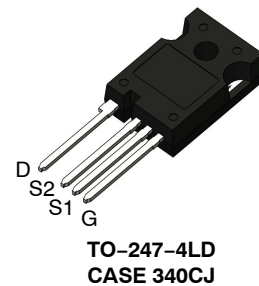
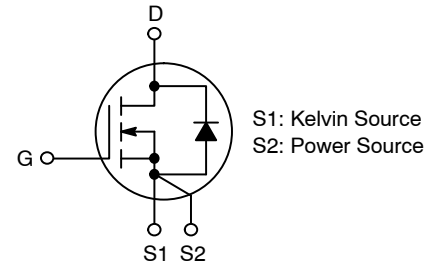
- 1200 V @ $T_J = 175^\circ\text{C}$
- Max $R_{DS(on)} = 110\text{ m}\Omega$ at $V_{GS} = 20\text{ V}$, $I_D = 20\text{ A}$
- High Speed Switching with Low Capacitance
- 100% Avalanche Tested
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb-Free 2LI (on second level interconnection)

Applications

- Industrial Motor Drive
- UPS
- Boost Inverter
- PV Charger

V_{DSS}	$R_{DS(on)}$ TYP	I_D MAX
1200 V	80 m Ω	29 A

N-CHANNEL MOSFET



MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability
NTH4L080N120SC1 = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
NTH4L080N120SC1	TO-247-4L	30 Units / Tube

NTH4L080N120SC1

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, unless otherwise noted)

Symbol	Parameter		Ratings	Unit
V_{DSmax}	Drain-to-Source Voltage		1200	V
V_{GSmax}	Max. Gate-to-Source Voltage	@ $T_C < 150^\circ\text{C}$	-15 / +25	V
$V_{GSop}(DC)$	Recommended operation Values of Gate – Source Voltage	@ $T_C < 150^\circ\text{C}$	-5 / +20	V
$V_{GSop}(AC)$	Recommended operation Values of Gate – Source Voltage ($f > 1\text{ Hz}$)	@ $T_C < 150^\circ\text{C}$	-5 / +20	V
I_D	Continuous Drain Current	$V_{GS} = 20\text{ V}, T_C = 25^\circ\text{C}$	29	A
		$V_{GS} = 20\text{ V}, T_C = 100^\circ\text{C}$	21	
$I_{D(Pulse)}$	Pulse Drain Current	Pulse width t_p limited by T_j max	125	A
E_{AS}	Single Pulse Avalanche Energy (Note 1)		171	mJ
P_{tot}	Power Dissipation	$T_C = 25^\circ\text{C}$	170	W
		$T_C = 150^\circ\text{C}$	28	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		-55 to +175	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. E_{AS} of 171 mJ is based on starting $T_j = 25^\circ\text{C}$, $L = 1\text{ mH}$, $I_{AS} = 18.5\text{ A}$, $V_{DD} = 50\text{ V}$, $R_G = 25\ \Omega$.

THERMAL CHARACTERISTICS

Symbol	Parameter	Ratings	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.88	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	40	

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ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

BV_{DSS}	Drain-to-Source Breakdown Voltage	$I_D = 100\ \mu\text{A}$, $V_{GS} = 0\ \text{V}$	1200	–	–	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 5\ \text{mA}$, Referenced to 25°C	–	0.3	–	V/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 1200\ \text{V}$, $V_{GS} = 0\ \text{V}$ $T_C = 25^\circ\text{C}$ $T_C = 150^\circ\text{C}$	– –	– –	100 1.0	μA mA
I_{GSS}	Gate-to-Source Leakage Current	$V_{GS} = 25\ \text{V}$, $V_{DS} = 0\ \text{V}$	–	–	1	μA
I_{GSSR}	Gate-to-Source Leakage Current, Reverse	$V_{GS} = -15\ \text{V}$, $V_{DS} = 0\ \text{V}$	–	–	-1	μA

ON CHARACTERISTICS

$V_{GS(th)}$	Gate-to-Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 5\ \text{mA}$	1.8	2.75	4.3	V
$R_{DS(on)}$	Static Drain-to-Source On Resistance	$V_{GS} = 20\ \text{V}$, $I_D = 20\ \text{A}$	–	80	110	m Ω
		$V_{GS} = 20\ \text{V}$, $I_D = 20\ \text{A}$, $T_C = 150^\circ\text{C}$	–	127	162	
g_{FS}	Forward Transconductance	$V_{DS} = 20\ \text{V}$, $I_D = 20\ \text{A}$	–	11.3	–	S
		$V_{DS} = 20\ \text{V}$, $I_D = 20\ \text{A}$, $T_C = 150^\circ\text{C}$	–	9.8	–	

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$V_{DS} = 800\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	–	1112	1670	pF
C_{oss}	Output Capacitance		–	80	120	pF
C_{rss}	Reverse Transfer Capacitance		–	6.5	10	pF
E_{oss}	C_{oss} Stored Energy		–	32	–	μJ

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 800\ \text{V}$, $I_C = 20\ \text{A}$, $V_{GS} = -5/20\ \text{V}$, $R_G = 4.7\ \Omega$ Inductive Load, $T_C = 25^\circ\text{C}$	–	9	18	ns
t_r	Rise Time		–	4.2	10	ns
$t_{d(off)}$	Turn-Off Delay Time		–	26.8	43	ns
t_f	Fall Time		–	5.4	11	ns
E_{on}	Turn-on Switching Loss		–	314	–	μJ
E_{off}	Turn-off Switching Loss		–	32	–	μJ
E_{ts}	Total Switching Loss	$V_{DD} = 600\ \text{V}$, $I_D = 20\ \text{A}$ $V_{GS} = -5/20\ \text{V}$	–	346	–	μJ
Q_g	Total Gate Charge		–	56	–	nC
Q_{gs}	Gate-to-Source Charge		–	11	–	nC
Q_{gd}	Gate-to-Drain Charge	$f = 1\ \text{MHz}$, D-S short	–	12	–	nC
R_G	Gate input resistance		–	1.7	–	Ω

DIODE CHARACTERISTICS

V _{SD}	Source-to-Drain Diode Forward Voltage	V _{GS} = -5 V, I _{SD} = 10 A	T _C = 25°C	–	3.7	–	V
			T _C = 150°C	–	3.3	–	
E _{rec}	Reverse Recovery Energy	I _{SD} = 20 A, V _{GS} = -5 V, V _R = 600 V, di _{SD} /dt = 1000 A/μs	T _C = 150°C	–	29	–	μJ
t _{rr}	Diode Reverse Recovery Time		T _C = 25°C	–	18	–	ns
			T _C = 150°C	–	31	–	
Q _{rr}	Diode Reverse Recovery Charge		T _C = 25°C	–	80	–	nC
			T _C = 150°C	–	212	–	
I _{rrm}	Peak Reverse Recovery Current		T _C = 25°C	–	9	–	A
		T _C = 150°C	–	14	–		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

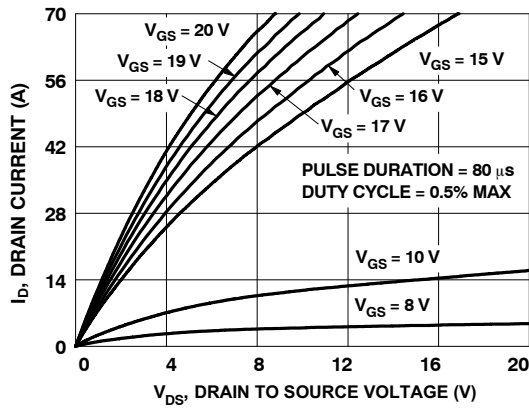


Figure 1. On Region Characteristics

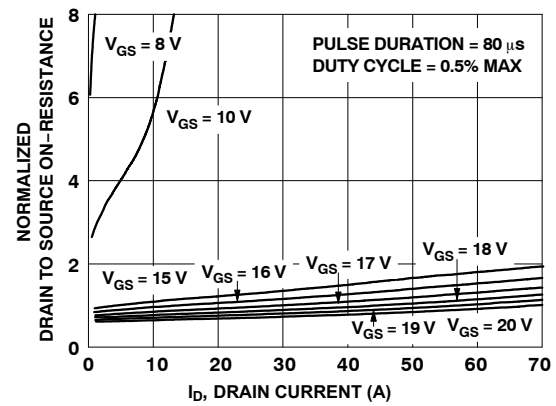


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

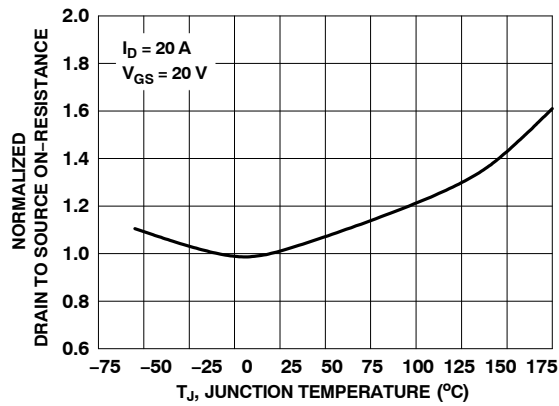


Figure 3. Normalized On Resistance vs. Junction Temperature

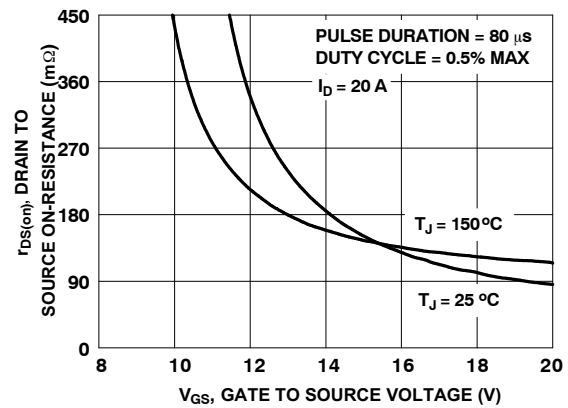


Figure 4. On-Resistance vs. Gate-to-Source Voltage

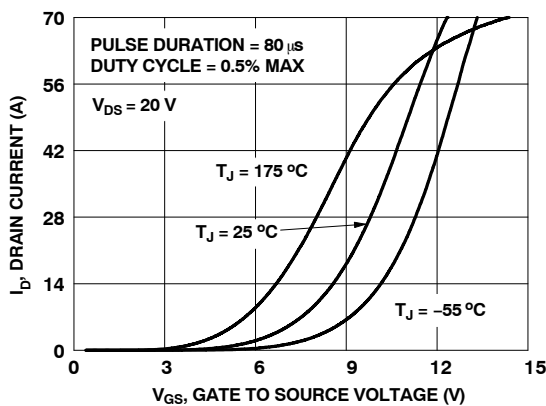


Figure 5. Transfer Characteristics

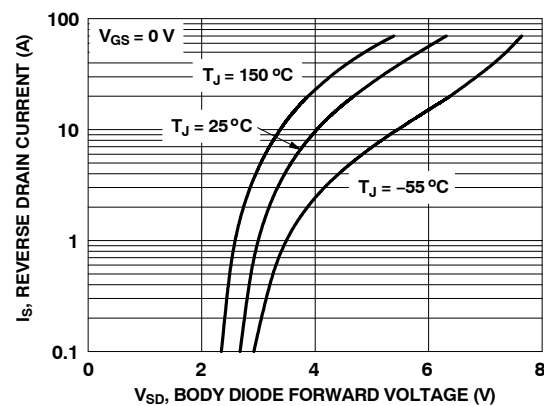


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

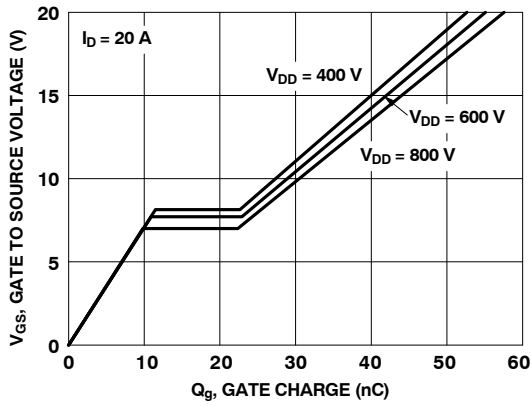


Figure 7. Gate Charge Characteristics

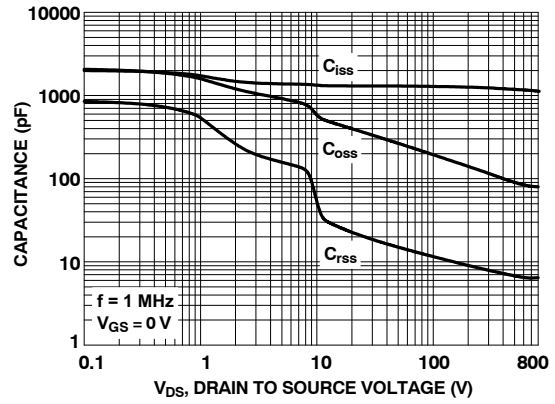


Figure 8. Capacitance vs. Drain-to-Source Voltage

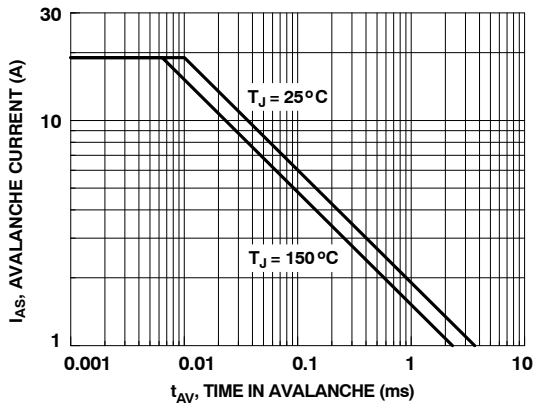


Figure 9. Unclamped Inductive Switching Capability

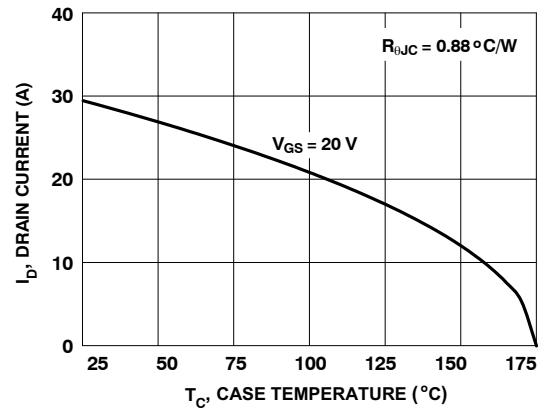


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

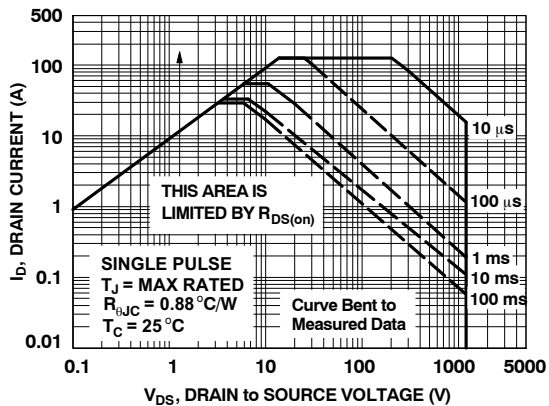


Figure 11. Forward Bias Safe Operating Area

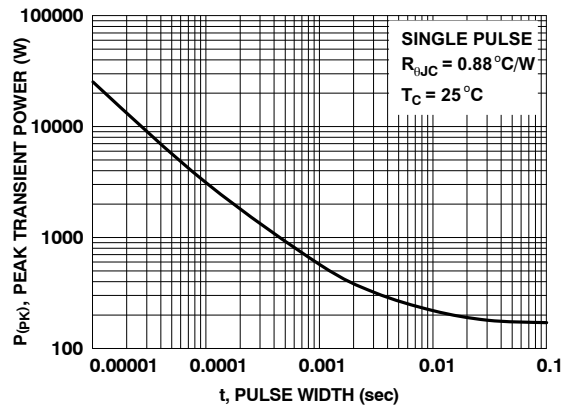


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

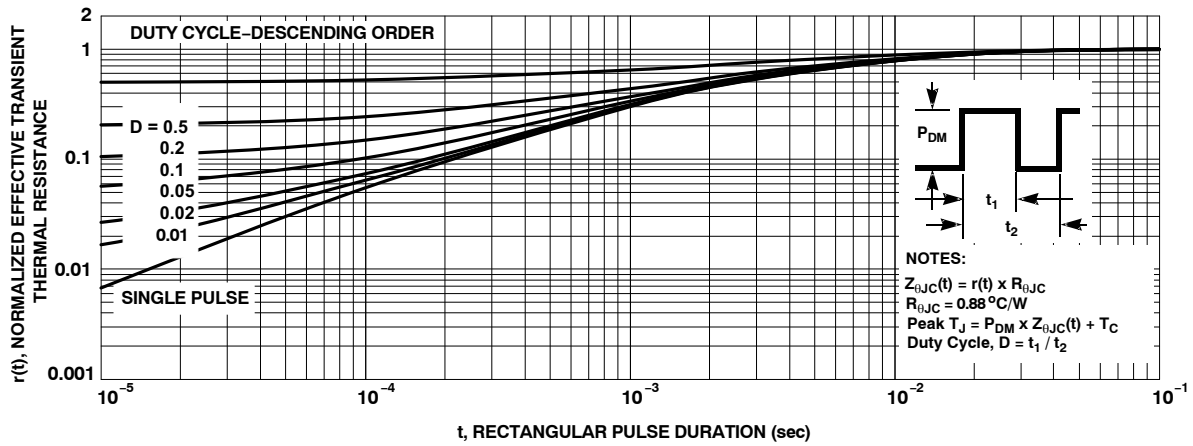
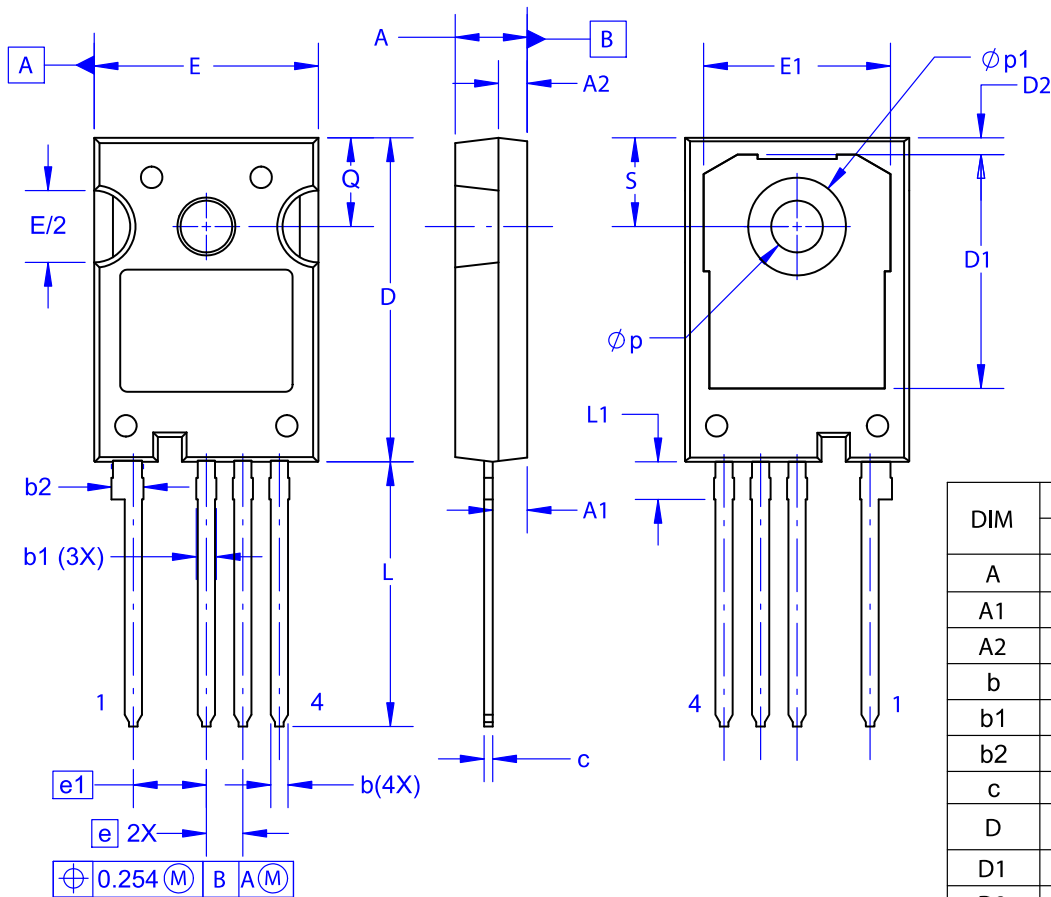


Figure 13. Junction-to-Case Transient Thermal Response Curve

TO-247-4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019



NOTES:

- A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
B. DIMENSIONS ARE EXCLUSIVE OF BURRS,MOLD
FLASH,AND TIE BAR EXTRUSIONS.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

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