[MOSFET](#) - SiC Power, Single N-Channel

1200 V, 40 mΩ, 60 A

NTHL040N120SC1

Features
- Typ. $R_{DS(on)}$ = 40 mΩ
- Ultra Low Gate Charge (typ. $Q_{G(tot)}$ = 106 nC)
- Low Effective Output Capacitance (typ. C_{oss} = 140 pF)
- 100% UIL Tested
- These Devices are RoHS Compliant

Typical Applications
- UPS
- DC/DC Converter
- Boost Inverter

ON Semiconductor®

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	I_D MAX
1200 V	40 mΩ @ 20 V	60 A

N−CHANNEL MOSFET
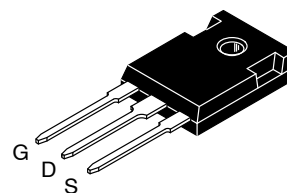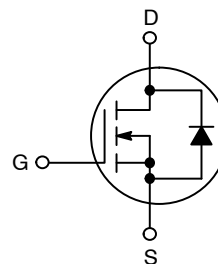
TO−247−3LD
CASE 340CX

MARKING DIAGRAM

$Y&Z&3&K
NTHL040
N120SC1

$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Data Code (Year & Week)
&K	= Lot
NTHL040N120SC1	= Specific Device Code

ORDERING INFORMATION
See detailed ordering and shipping information on page 2 of this data sheet.

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	1200	V
Gate−to−Source Voltage			V_{GS}	−15/+25	V
Recommended Operation Values of Gate−to−Source Voltage	T_C < 175°C		V_{GSop}	−5/+20	V
Continuous Drain Current $R_{\theta JC}$	Steady State	T_C = 25°C	I_D	60	A
Power Dissipation $R_{\theta JC}$			P_D	348	W
Continuous Drain Current $R_{\theta JC}$	Steady State	T_C = 100°C	I_D	42	A
Power Dissipation $R_{\theta JC}$			P_D	174	W
Pulsed Drain Current (Note 2)	T_A = 25°C		I_{DM}	240	A
Single Pulse Surge Drain Current Capability	T_A = 25°C, t_p = 10 μs, R_G = 4.7 Ω		I_{DSC}	416	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +175	°C
Source Current (Body Diode)			I_S	34	A
Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 23 A, L = 1 mH) (Note 3)			E_{AS}	613	mJ

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.

THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction−to−Case (Note 1)	$R_{\theta JC}$	0.43	°C/W
Junction−to−Ambient (Note 1)	$R_{\theta JA}$	40	°C/W

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Repetitive rating, limited by max junction temperature.
3. E_{AS} of 613 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 35 A, V_{DD} = 120 V, V_{GS} = 20 V.

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0$ V, $I_D = 1$ mA	1200	–	–	V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1$ mA, referenced to 25°C	–	450	–	mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0$ V, $V_{DS} = 1200$ V, $T_J = 25$°C	–	–	100	µA
		$V_{GS} = 0$ V, $V_{DS} = 1200$ V, $T_J = 175$°C	–	–	250	
Gate−to−Source Leakage Current	I_{GSS}	$V_{GS} = +25/−15$ V, $V_{DS} = 0$ V	–	–	±1	µA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$, $I_D = 10$ mA	1.8	2.97	4.3	V
Recommended Gate Voltage	V_{GOP}		−5	–	+20	V
Drain−to−Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20$ V, $I_D = 35$ A, $T_J = 25$°C	–	39	56	mΩ
		$V_{GS} = 20$ V, $I_D = 35$ A, $T_J = 175$°C	–	67	100	
Forward Transconductance	g_{FS}	$V_{DS} = 20$ V, $I_D = 35$ A	–	20	–	S
CHARGES, CAPACITANCES & GATE RESISTANCE						
Input Capacitance	C_{ISS}	$V_{GS} = 0$ V, f = 1 MHz, $V_{DS} = 800$ V	–	1781	–	pF
Output Capacitance	C_{OSS}		–	140	–	
Reverse Transfer Capacitance	C_{RSS}		–	12	–	
Total Gate Charge	$Q_{G(tot)}$	$V_{GS} = −5/20$ V, $V_{DS} = 600$ V, $I_D = 47$ A	–	106	–	nC
Threshold Gate Charge	$Q_{G(th)}$		–	16	–	
Gate−to−Source Charge	Q_{GS}		–	34	–	
Gate−to−Drain Charge	Q_{GD}		–	26	–	
Gate Resistance	R_G	f = 1 MHz	–	2.2	–	Ω
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = −5/20$ V, $V_{DS} = 800$ V, $I_D = 47$ A, $R_G = 4.7$ Ω, Inductive Load	–	18	–	ns
Rise Time	t_r		–	41	–	
Turn−Off Delay Time	$t_{d(off)}$		–	33	–	
Fall Time	t_f		–	10.4	–	
Turn-On Switching Loss	E_{ON}		–	1003	–	µJ
Turn-Off Switching Loss	E_{OFF}		–	247	–	
Total Switching Loss	E_{TOT}		–	1248	–	
DRAIN−SOURCE DIODE CHARACTERISTICS						
Continuous Drain−to−Source Diode Forward Current	I_{SD}	$V_{GS} = −5$ V, $T_J = 25$°C	–	–	34	A
Pulsed Drain−to−Source Diode Forward Current (Note 2)	I_{SDM}	$V_{GS} = −5$ V, $T_J = 25$°C	–	–	240	A
Forward Diode Voltage	V_{SD}	$V_{GS} = −5$ V, $I_{SD} = 17.5$ A, $T_J = 25$°C	–	3.8	–	V
Reverse Recovery Time	t_{RR}	$V_{GS} = −5/20$ V, $I_{SD} = 47$ A, $dI_S/dt = 1000$ A/µs	–	24	–	ns
Reverse Recovery Charge	Q_{RR}		–	125	–	nC
Reverse Recovery Energy	E_{REC}		–	8.5	–	µJ
Peak Reverse Recovery Current	I_{RRM}		–	10.4	–	A
Charge Time	t_a		–	12.4	–	ns
Discharge Time	t_b		–	11.6	–	ns

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.
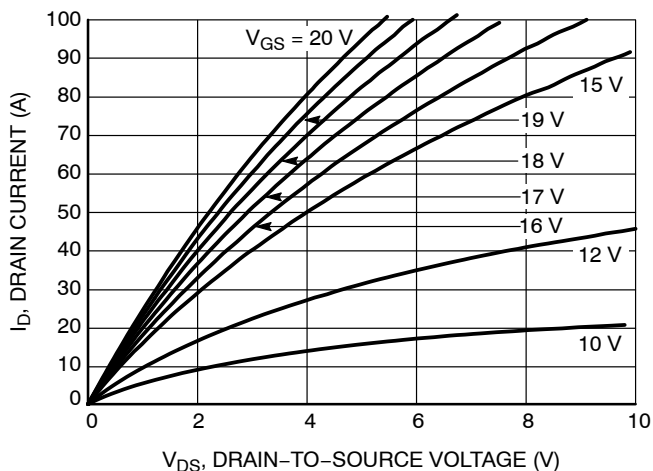
TYPICAL CHARACTERISTICS

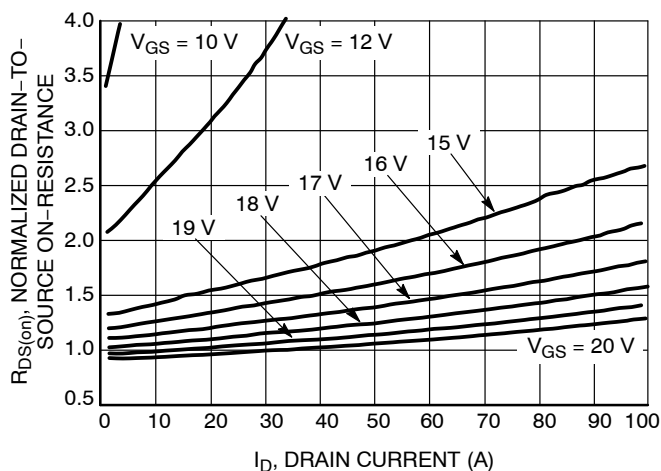
Figure 1. On−Region Characteristics

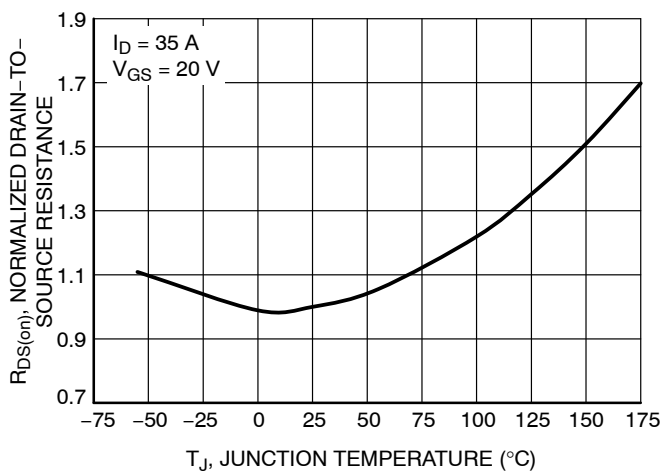Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

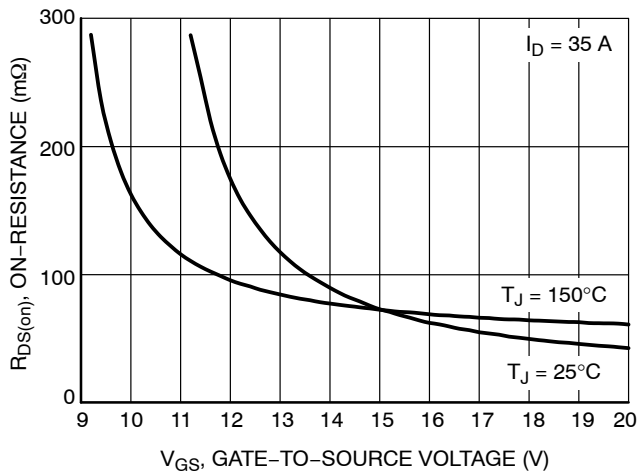Figure 3. On−Resistance Variation with Temperature

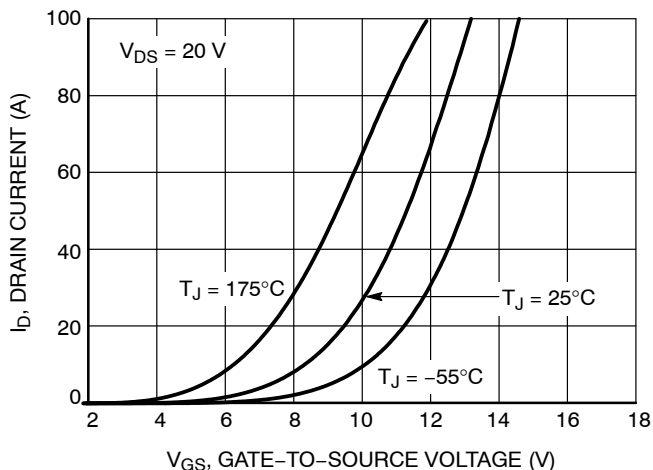Figure 4. On−Resistance vs. Gate−to−Source Voltage
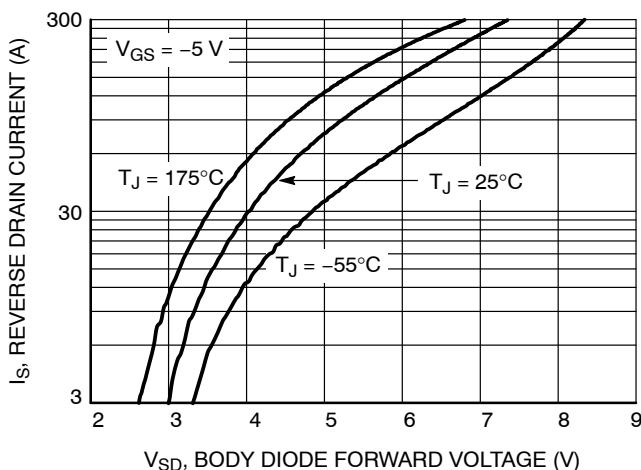

Figure 5. Transfer Characteristics

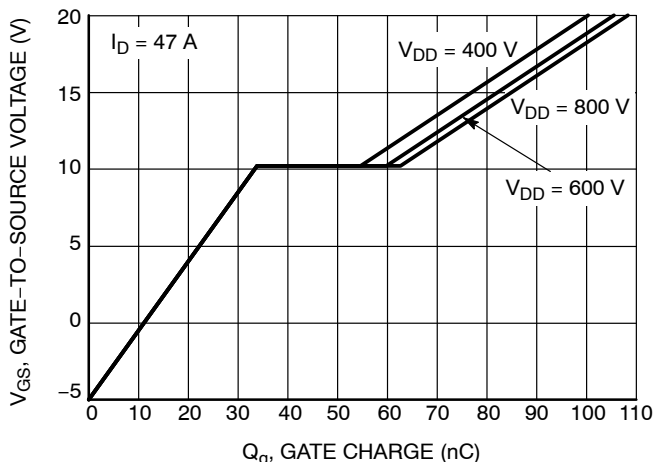Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS
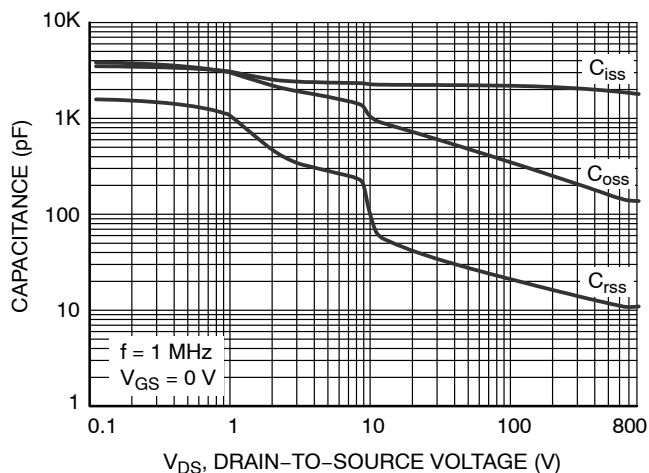

Figure 7. Gate–to–Source Voltage vs. Total Charge
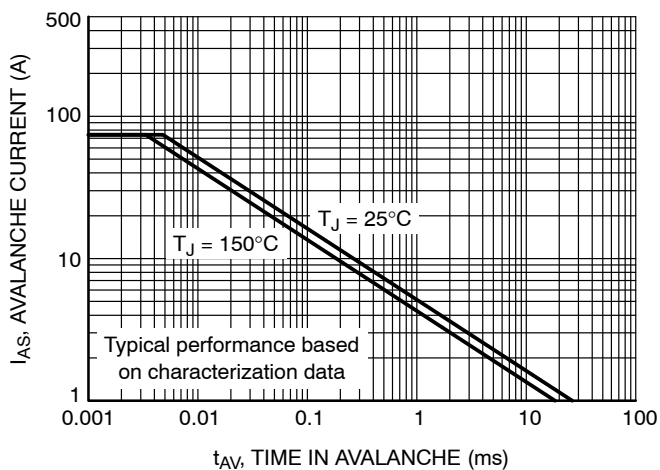

Figure 8. Capacitance vs. Drain–to–Source Voltage

Figure 9. Unclamped Inductive Switching Capability
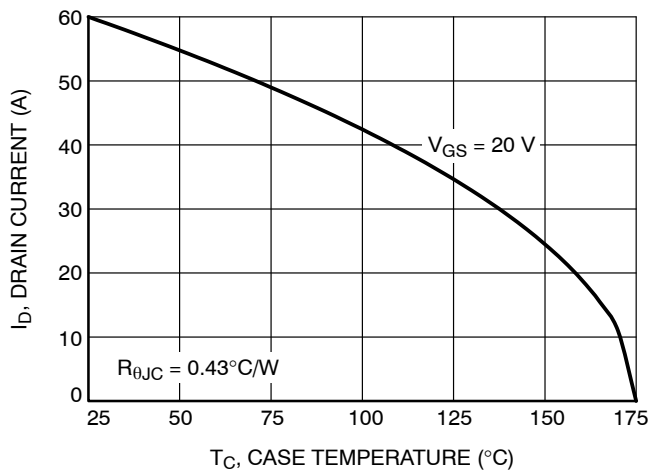
Figure 10. Maximum Continuous Drain Current vs. Case Temperature
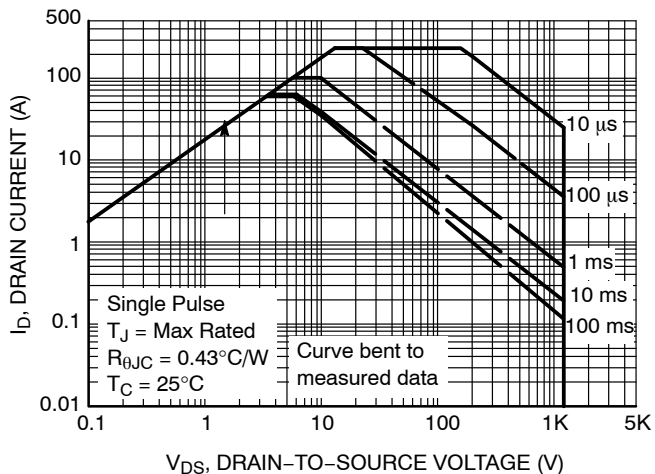
Figure 11. Safe Operating Area
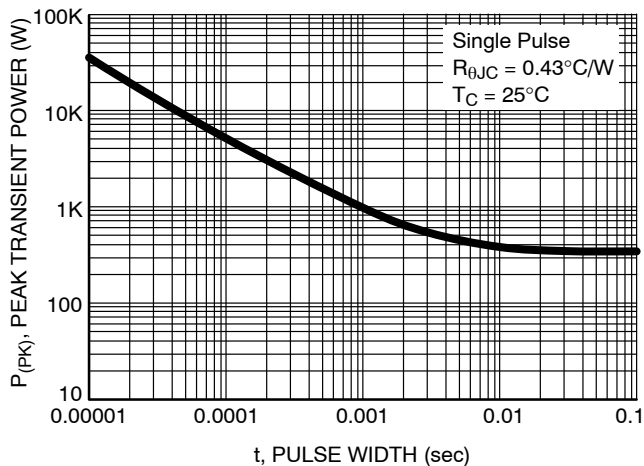
Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS

The figure is a log-log plot titled axes:
y-axis: r(t). NORMALIZED EFFECTIVE TRANSIENT THERMAL RESISTANCE (°C/W)
x-axis: t, RECTANGULAR PULSE DURATION (sec)

Curves labeled: 50% Duty Cycle, 20%, 10%, 5%, 2%, 1%, Single Pulse

Notes:
$Z_{\theta JC}(t) = r(t) \times R_{\theta JC}$
$R_{\theta JC} = 0.43°C/W$
Peak $T_J = P_{DM} \times Z_{\theta JC}(t) + T_C$
Duty Cycle, $D = t_1/t_2$
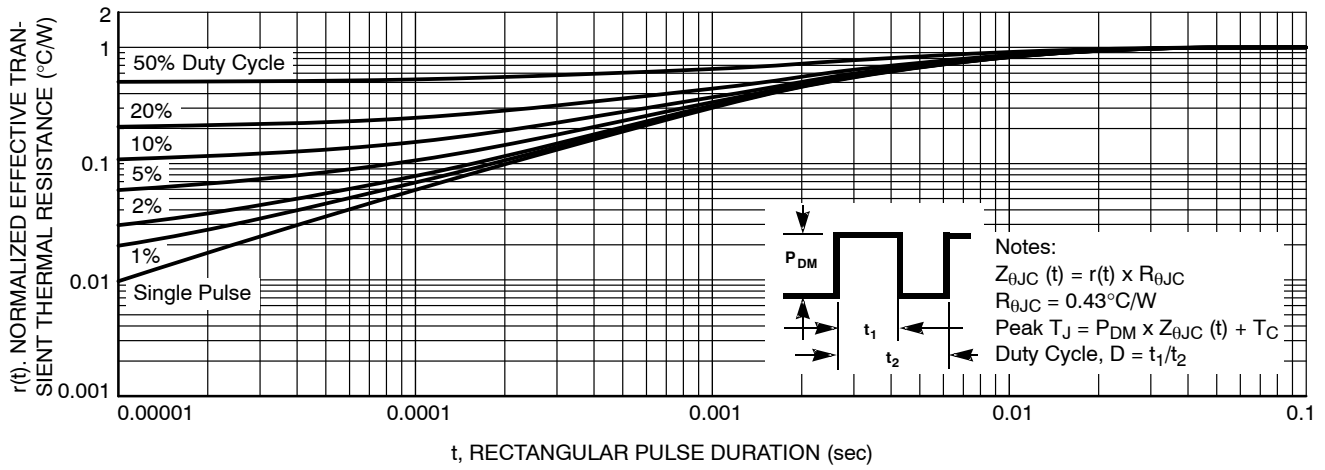
Figure 13. Junction−to−Ambient Thermal Response

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTHL040N120SC1	NTHL040N120SC1	TO−247 Long Lead	Tube	N/A	N/A	30 Units

NTHL040N120SC1

PACKAGE DIMENSIONS

TO−247−3LD
CASE 340CX
ISSUE O
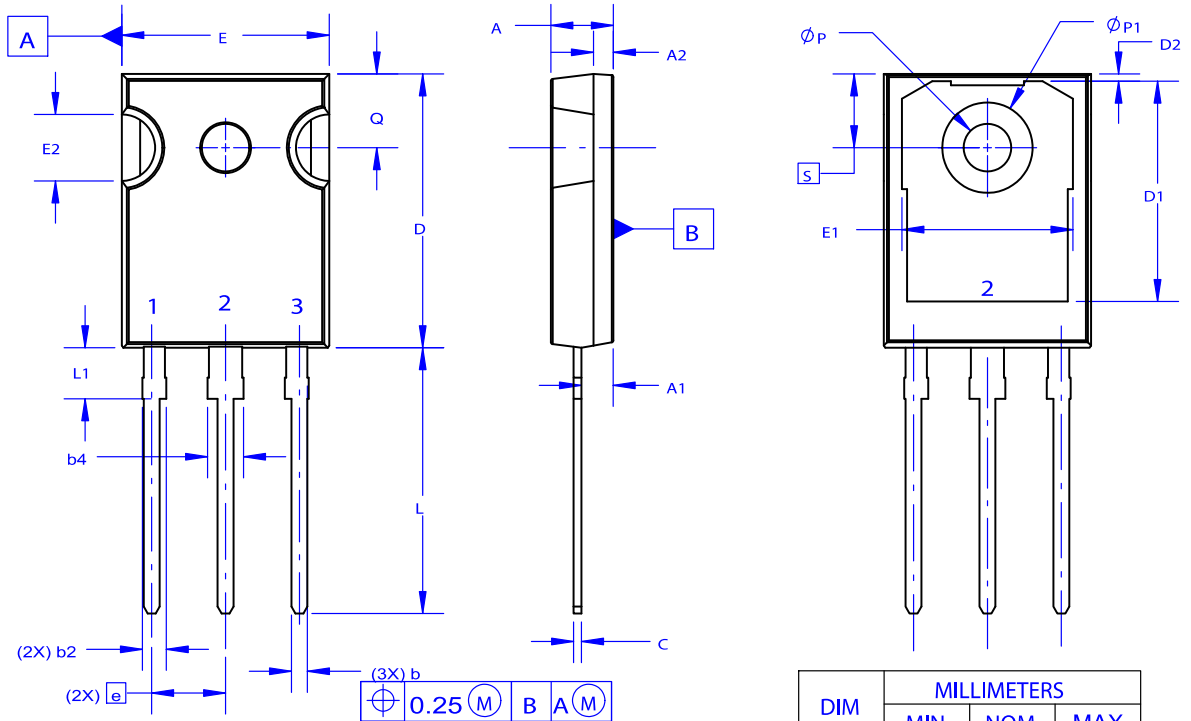
NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD
   FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
⌀P	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
⌀P1	6.60	6.80	7.00

NTHL040N120SC1

PUBLICATION ORDERING INFORMATION

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