

# ON Semiconductor

## Is Now

The logo for onsemi, featuring the word "onsemi" in a dark teal, lowercase, sans-serif font. The letter "i" is stylized with a white dot and a teal vertical bar. A small orange triangle is positioned above the top right of the "i". A trademark symbol (TM) is located to the right of the logo.

To learn more about onsemi™, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

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# MOSFET - SiC Power, Single N-Channel, TO247-3L 650 V, 12 mΩ, 163 A



ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

## NTHL015N065SC1

### Features

- Typ.  $R_{DS(on)}$  = 12 mΩ @  $V_{GS}$  = 18 V  
Typ.  $R_{DS(on)}$  = 15 mΩ @  $V_{GS}$  = 15 V
- Ultra Low Gate Charge ( $Q_{G(tot)}$  = 283 nC)
- High Speed Switching with Low Capacitance ( $C_{oss}$  = 430 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

- SMPS (Switching Mode Power Supplies)
- Solar Inverters
- UPS (Uninterruptible Power Supplies)
- Energy Storage

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

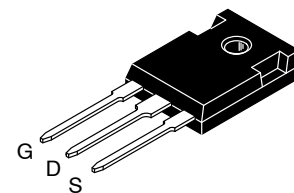
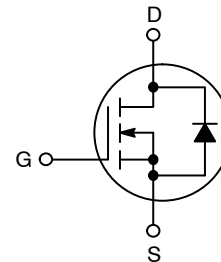
Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		$V_{DSS}$	650	V	
Gate-to-Source Voltage		$V_{GS}$	-8/+22	V	
Recommended Operation Values of Gate-to-Source Voltage		$T_C < 175^\circ\text{C}$ $V_{GSop}$	-5/+18	V	
Continuous Drain Current (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$	163	A
			$P_D$	643	W
Continuous Drain Current (Note 1)	Steady State	$T_C = 100^\circ\text{C}$	$I_D$	115	A
			$P_D$	321	W
Pulsed Drain Current (Note 2)	$T_C = 25^\circ\text{C}$		$I_{DM}$	484	A
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +175	°C	
Source Current (Body Diode)		$I_S$	157	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)}$ = 13 A, L = 1 mH) (Note 3)		$E_{AS}$	84	mJ	
Maximum Lead Temperature for Soldering (1/8" from case for 5 s)		$T_L$	300	°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. 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. EAS of 84 mJ is based on starting  $T_J = 25^\circ\text{C}$ ; L = 1 mH,  $I_{AS} = 13$  A,  $V_{DD} = 50$  V,  $V_{GS} = 18$  V.

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	$I_D$ MAX
650 V	18 mΩ @ 18 V	163 A

### N-CHANNEL MOSFET



TO-247-3LD  
CASE 340CX

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
 &Z = Assembly Plant Code  
 &3 = Data Code (Year & Week)  
 &K = Lot  
 HL015N065SC1 = Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

# NTHL015N065SC1

## THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Junction-to-Case - Steady State (Note 1)	$R_{\theta JC}$	0.24	°C/W
Junction-to-Ambient - Steady State (Note 1)	$R_{\theta JA}$	40	

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650	-	-	V	
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 20\text{ mA}$ , referenced to $25^\circ\text{C}$	-	0.12	-	V/°C	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$	$T_J = 25^\circ\text{C}$	-	-	10	$\mu\text{A}$
			$T_J = 175^\circ\text{C}$	-	-	1	mA
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +22/-8\text{ V}, V_{DS} = 0\text{ V}$	-	-	250	nA	

### ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 25\text{ mA}$	1.8	2.63	4.3	V
Recommended Gate Voltage	$V_{GOP}$		-5	-	+18	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 15\text{ V}, I_D = 75\text{ A}, T_J = 25^\circ\text{C}$	-	15	-	m $\Omega$
		$V_{GS} = 18\text{ V}, I_D = 75\text{ A}, T_J = 25^\circ\text{C}$	-	12	18	
		$V_{GS} = 18\text{ V}, I_D = 75\text{ A}, T_J = 175^\circ\text{C}$	-	16	-	
Forward Transconductance	$g_{FS}$	$V_{DS} = 10\text{ V}, I_D = 75\text{ A}$	-	44	-	S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 325\text{ V}$	-	4790	-	pF
Output Capacitance	$C_{OSS}$		-	430	-	
Reverse Transfer Capacitance	$C_{RSS}$		-	33	-	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5/18\text{ V}, V_{DS} = 520\text{ V}, I_D = 75\text{ A}$	-	283	-	nC
Gate-to-Source Charge	$Q_{GS}$		-	72	-	
Gate-to-Drain Charge	$Q_{GD}$		-	64	-	
Gate-Resistance	$R_G$	$f = 1\text{ MHz}$	-	1.6	-	$\Omega$

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5/18\text{ V}, V_{DS} = 400\text{ V}, I_D = 75\text{ A}, R_G = 2.2\text{ }\Omega$ inductive load	-	25	-	ns
Rise Time	$t_r$		-	77	-	
Turn-Off Delay Time	$t_{d(OFF)}$		-	47	-	
Fall Time	$t_f$		-	11	-	
Turn-On Switching Loss	$E_{ON}$		-	1371	-	$\mu\text{J}$
Turn-Off Switching Loss	$E_{OFF}$		-	470	-	
Total Switching Loss	$E_{tot}$		-	1841	-	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Continuous Source-Drain Diode Forward Current	$I_{SD}$	$V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$	-	-	157	A
Pulsed Source-Drain Diode Forward Current (Note 2)	$I_{SDM}$		-	-	484	
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5\text{ V}, I_{SD} = 75\text{ A}, T_J = 25^\circ\text{C}$	-	4.6	-	V

# NTHL015N065SC1

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified) (continued)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>SOURCE-DRAIN DIODE CHARACTERISTICS</b>						
Reverse Recovery Time	$t_{RR}$	$V_{GS} = -5/18\text{ V}, I_{SD} = 75\text{ A},$ $dI_S/dt = 1000\text{ A}/\mu\text{s}$	-	33	-	ns
Reverse Recovery Charge	$Q_{RR}$		-	261	-	nC
Reverse Recovery Energy	$E_{REC}$		-	9.2	-	$\mu\text{J}$
Peak Reverse Recovery Current	$I_{RRM}$		-	16	-	A
Charge time	$T_a$		-	19	-	ns
Discharge time	$T_b$		-	15	-	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

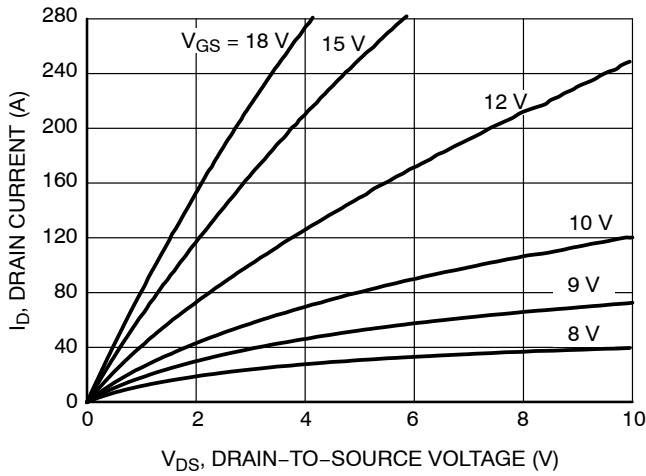


Figure 1. On-Region Characteristics

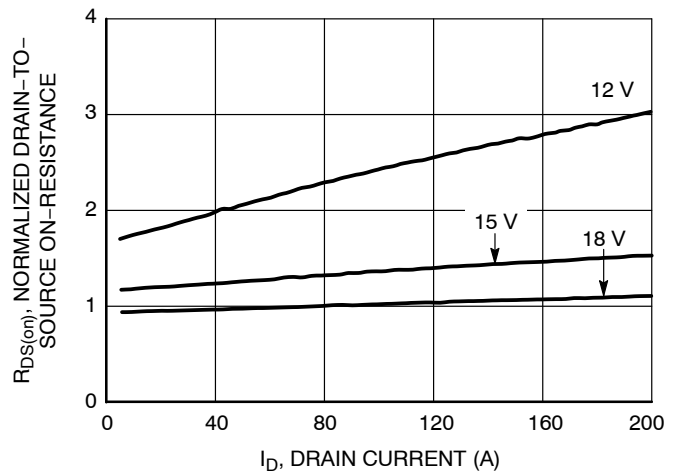


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

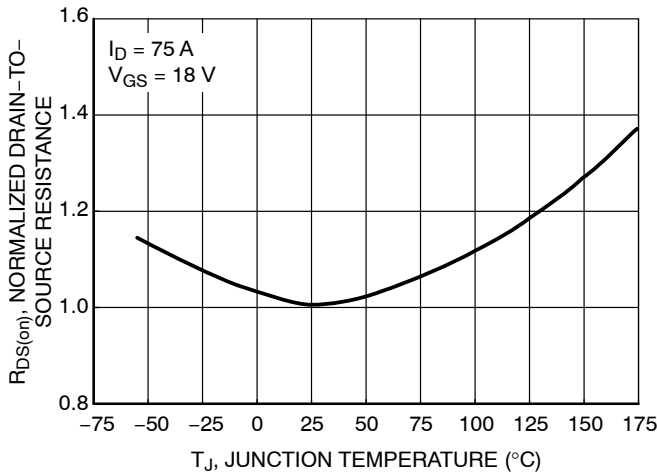


Figure 3. On-Resistance Variation with Temperature

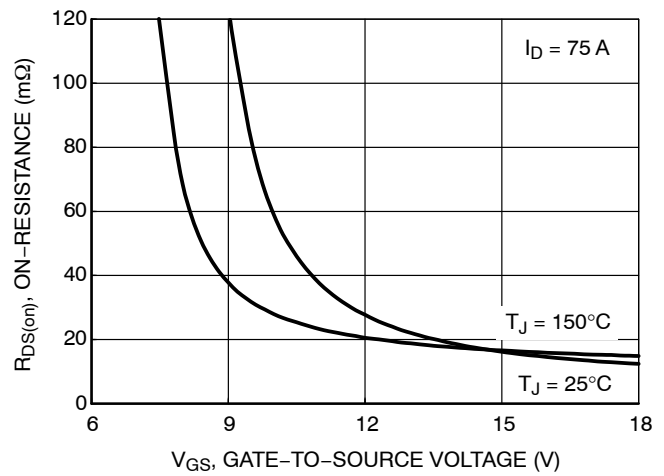


Figure 4. On-Resistance vs. Gate-to-Source Voltage

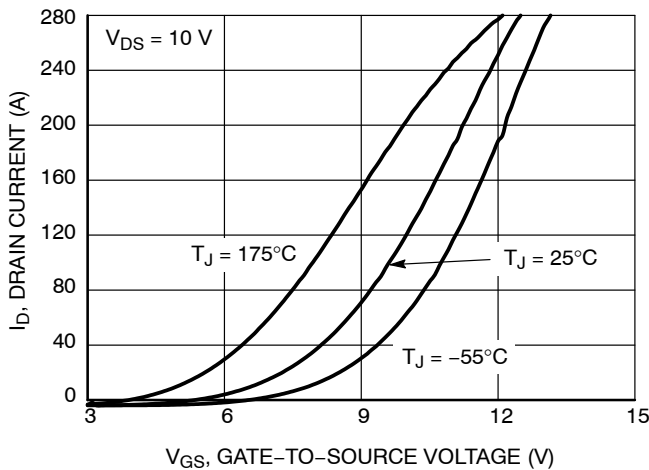


Figure 5. Transfer Characteristics

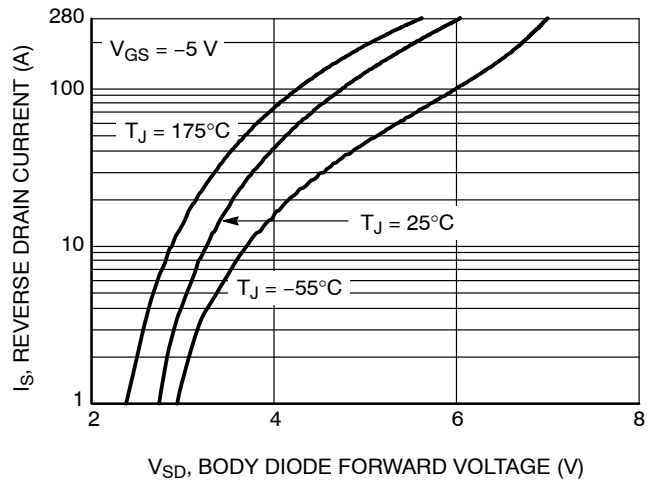


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

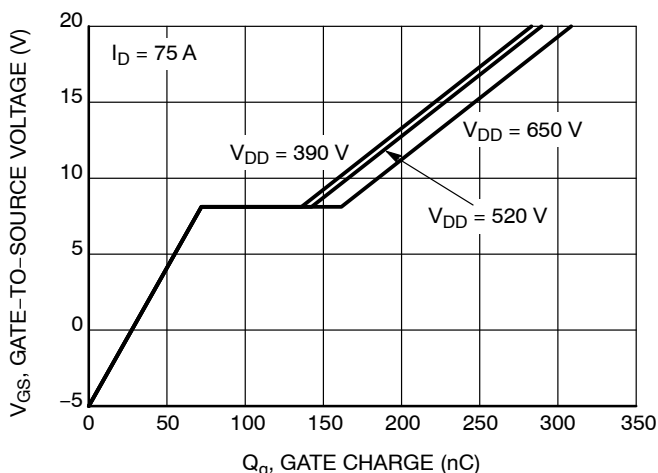


Figure 7. Gate-to-Source Voltage vs. Total Charge

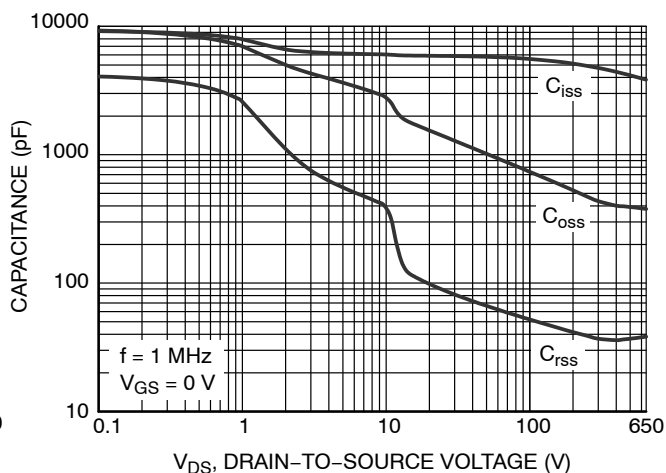


Figure 8. Capacitance vs. Drain-to-Source Voltage

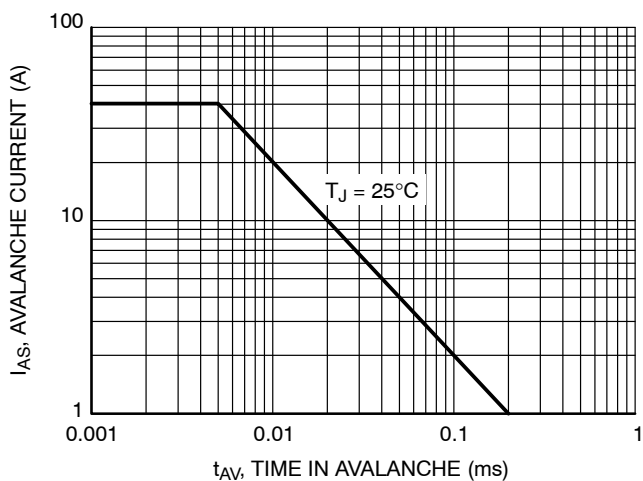


Figure 9. Unclamped Inductive Switching Capability

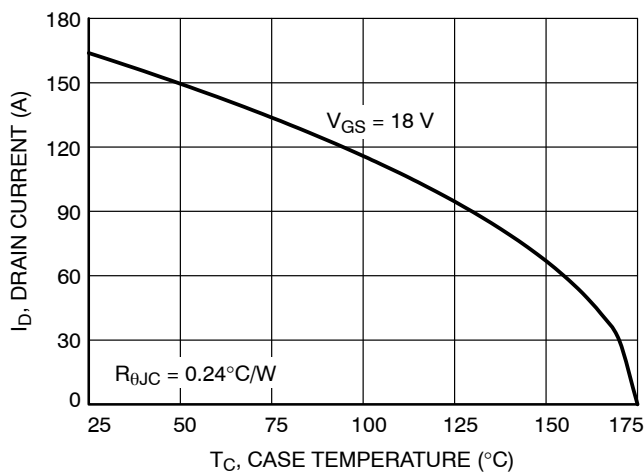


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

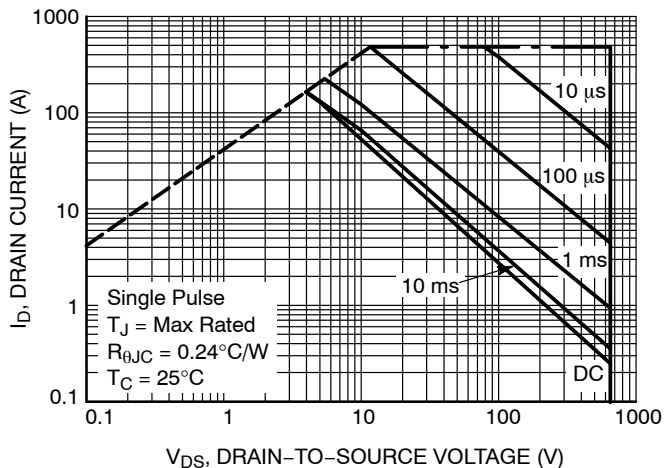


Figure 11. Safe Operating Area

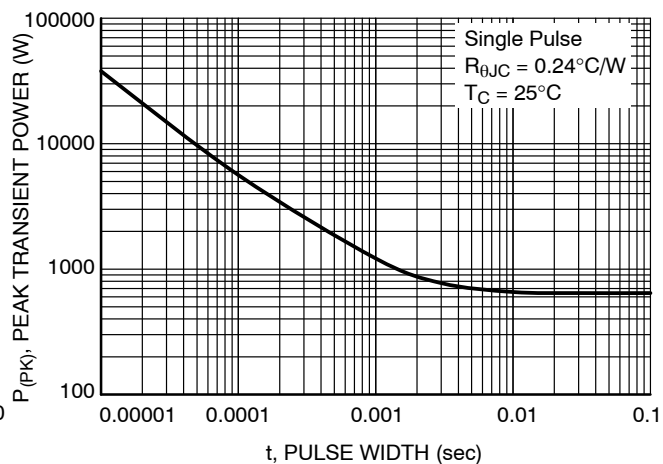


Figure 12. Single Pulse Maximum Power Dissipation

# NTHL015N065SC1

## TYPICAL CHARACTERISTICS

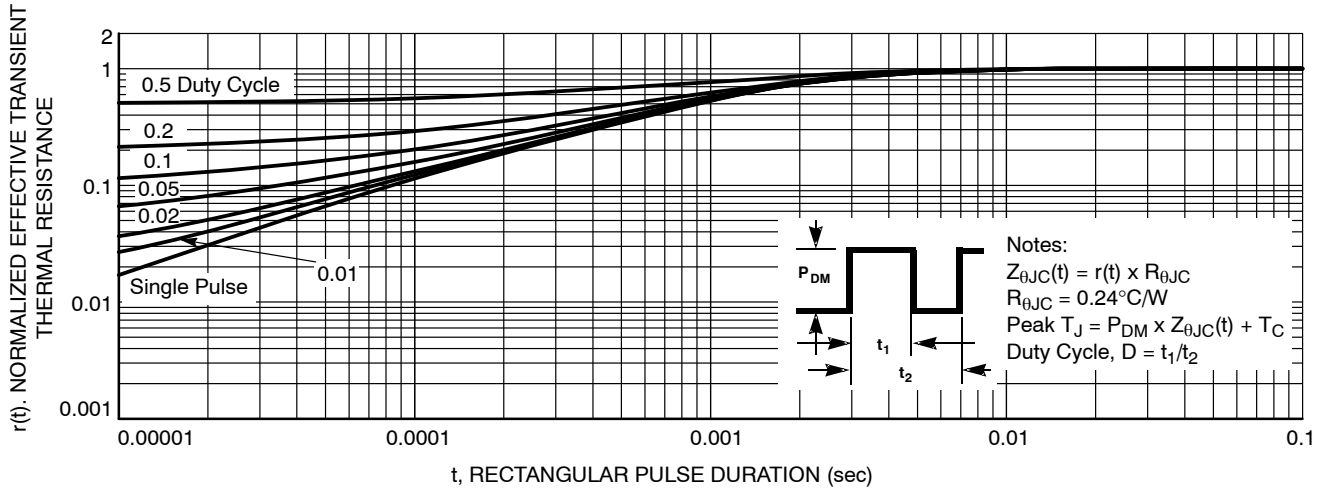


Figure 13. Junction-to-Case Thermal Response

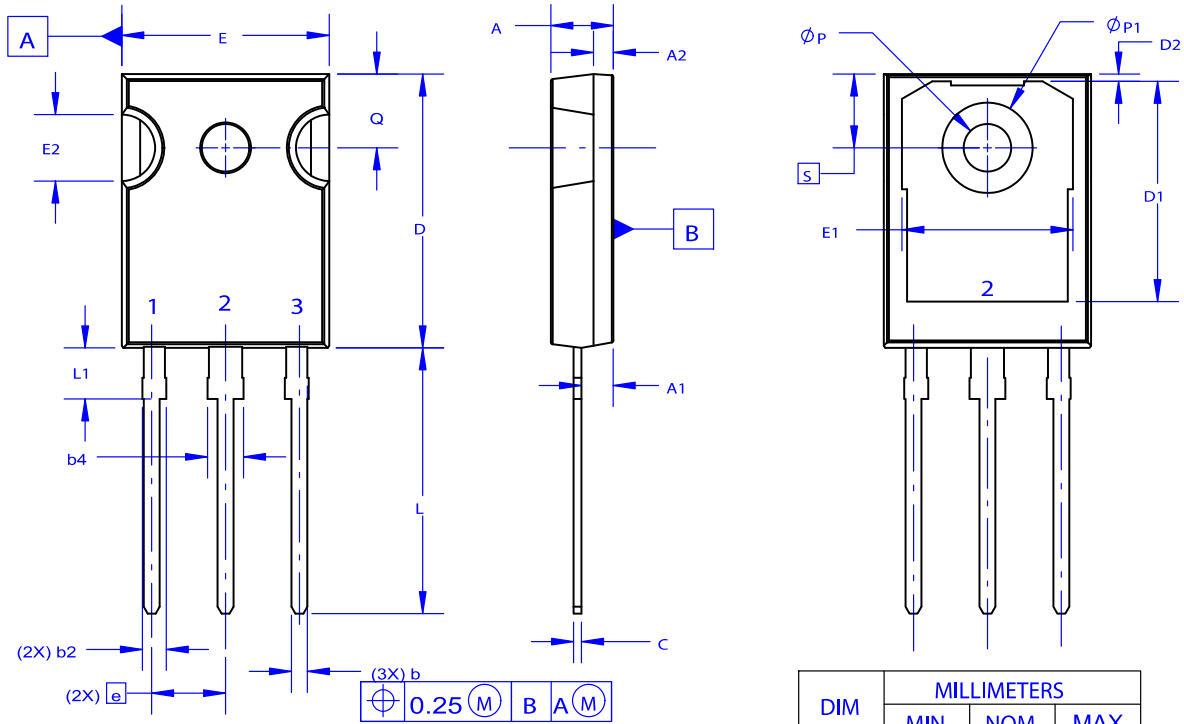
### PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTHL015N065SC1	NTHL015N065SC1	TO-247 Long Lead	Tube	N/A	N/A	30 Units

# NTHL015N065SC1

## 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.



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