

MOSFET – Power, N-Channel, SUPERFET® V, FAST

600 V, 41 mΩ, 57 A



ON Semiconductor®

www.onsemi.com

NTHL041N60S5H

Description

The SUPERFET V MOSFET is the fifth generation high voltage super-junction (SJ) MOSFET family from ON Semiconductor. SUPERFET V delivers best-in-class FOMs ($R_{DS(ON)} \cdot Q_G$ and $R_{DS(ON)} \cdot E_{OSS}$) to improve not only heavy load but also light load efficiency. The 600 V SUPERET V series provides design benefits through reduced conduction and switching losses, while supporting extreme MOSFET dV_{DS}/dt ratings at 120 V/ns. Consequently, the SUPERFET V MOSFET FAST series helps maximize system efficiency and power density.

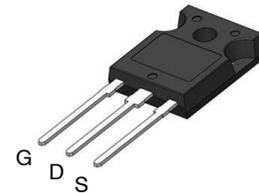
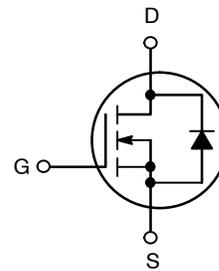
Features

- 650 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 32.8 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 108 \text{ nC}$)
- Low Time Related Output Capacitance (Typ. $C_{oss(tr.)} = 1451 \text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- EV Charger
- UPS / Solar

V_{DSS}	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
600 V	41 mΩ @ 10 V	57 A



TO-247 Long Leads
CASE 340CX

MARKING DIAGRAM



T041N60S5H = Specific Device Code
 A = Assembly Plant Code
 YWW = Data Code (Year & Week)
 ZZ = Lot

ORDERING INFORMATION

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

NTHL041N60S5H

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless otherwise noted)

Symbol	Parameter	Value	Unit
V _{DSS}	Drain to Source Voltage	600	V
V _{GSS}	Gate to Source Voltage	- DC	±30
		- AC (f > 1 Hz)	±30
I _D	Drain Current	- Continuous (T _C = 25°C)	57
		- Continuous (T _C = 100°C)	36
I _{DM}	Drain Current	- Pulsed (Note 1)	200
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	560	mJ
I _{AS}	Avalanche Current (Note 2)	8	A
E _{AR}	Repetitive Avalanche Energy (Note 1)	3.29	mJ
dv/dt	MOSFET dv/dt	120	V/ns
	Peak Diode Recovery dv/dt (Note 3)	20	
P _D	Power Dissipation	(T _C = 25°C)	329
		- Derate Above 25°C	2.63
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +150	°C
T _L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 seconds	260	°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. Repetitive rating: pulse-width limited by maximum junction temperature.
2. I_{AS} = 8 A, R_G = 25 Ω, starting T_J = 25°C.
3. I_{SD} ≤ 28.5 A, di/dt ≤ 200 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R _{θJC}	Thermal Resistance, Junction to Case, Max.	0.38	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient, Max.	40	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTHL041N60S5H	T041N60S5H	TO-247	Tube	N/A	N/A	30 Units

NTHL041N60S5H

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
--------	-----------	-----------------	-----	-----	-----	------

OFF CHARACTERISTICS

BV _{DSS}	Drain to Source Breakdown Voltage	V _{GS} = 0 V, I _D = 1 mA, T _J = 25°C	600	-	-	V
		V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C	650	-	-	V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 10 mA, Referenced to 25°C	-	0.63	-	V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 600 V, V _{GS} = 0 V	-	-	2	μA
		V _{DS} = 480 V, T _C = 125°C	-	2.9	-	
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±30 V, V _{DS} = 0 V	-	-	±100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 6.7 mA	2.7	-	4.3	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 28.5 A	-	32.8	41	mΩ
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 28.5 A	-	66	-	S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	V _{DS} = 400 V, V _{GS} = 0 V, f = 250 kHz	-	5840	-	pF
C _{oss}	Output Capacitance		-	92	-	pF
C _{oss(tr.)}	Time Related Output Capacitance	I _D = Constant, V _{DS} = 0 V to 400 V, V _{GS} = 0 V	-	1451	-	pF
C _{oss(er.)}	Energy Related Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V	-	155	-	pF
Q _{g(tot)}	Total Gate Charge	V _{DD} = 400 V, I _D = 28.5 A, V _{GS} = 10 V	-	108	-	nC
Q _{gs}	Gate to Source Charge		-	28	-	nC
Q _{gd}	Gate to Drain Charge		-	29	-	nC
ESR	Equivalent Series Resistance	f = 1 MHz	-	0.6	-	Ω

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	V _{DD} = 400 V, I _D = 28.5 A, V _{GS} = 10 V, R _g = 2.2 Ω	-	33	-	ns
t _r	Turn-On Rise Time		-	11	-	ns
t _{d(off)}	Turn-Off Delay Time		-	81	-	ns
t _f	Turn-Off Fall Time		-	2	-	ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current	-	-	57	A	
I _{SM}	Maximum Pulsed Source to Drain Diode Forward Current	-	-	200	A	
V _{SD}	Source to Drain Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 28.5 A	-	-	1.2	V
t _{rr}	Reverse Recovery Time	V _{DD} = 400 V, I _{SD} = 28.5 A, dI _F /dt = 100 A/μs	-	461	-	ns
Q _{rr}	Reverse Recovery Charge		-	9.6	-	μC

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.

NTHL041N60S5H

TYPICAL CHARACTERISTICS

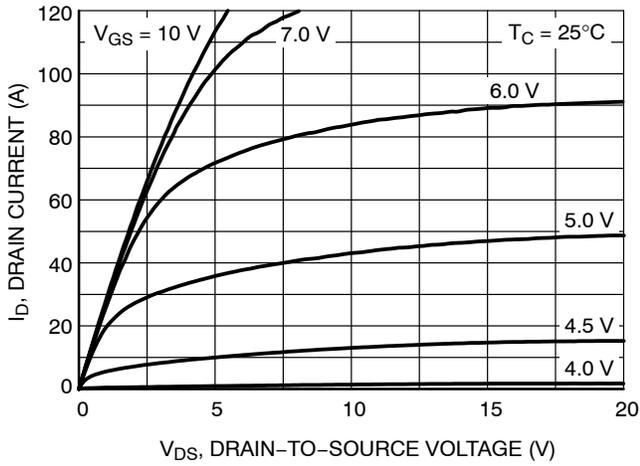


Figure 1. On-Region Characteristics

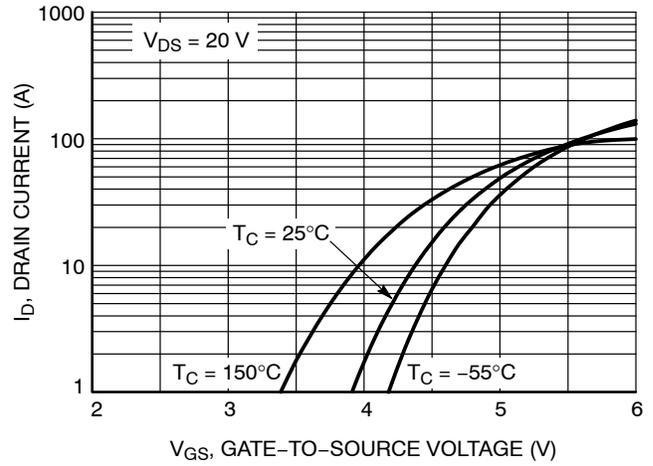


Figure 2. Transfer Characteristics

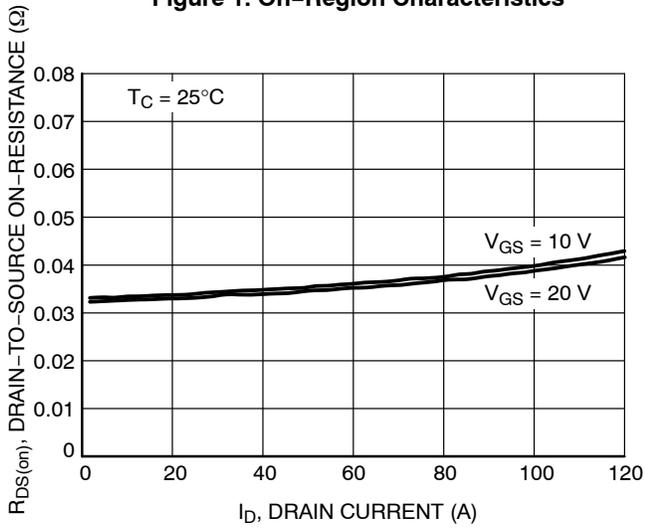


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

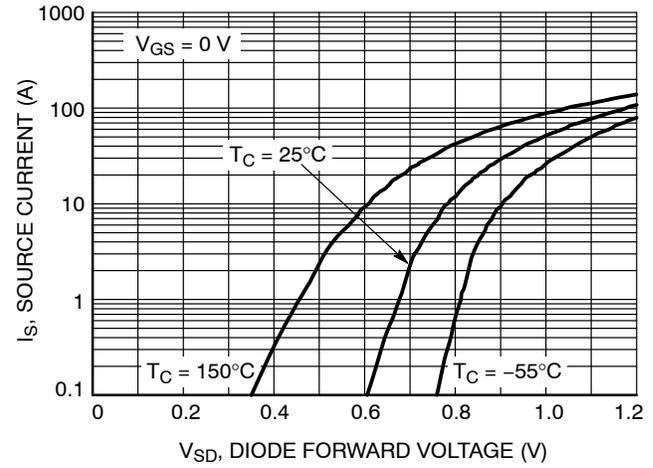


Figure 4. Diode Forward Voltage vs. Source Current

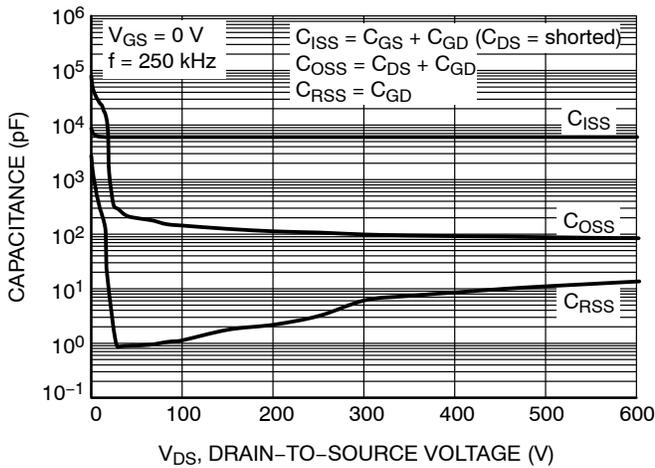


Figure 5. Capacitance Characteristics

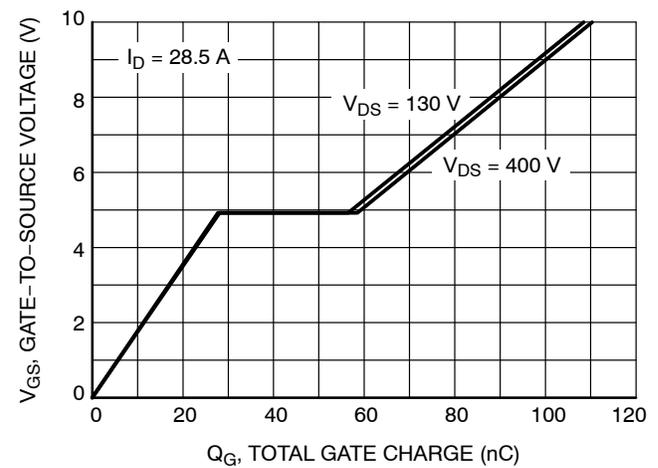


Figure 6. Gate Charge Characteristics

NTHL041N60S5H

TYPICAL CHARACTERISTICS

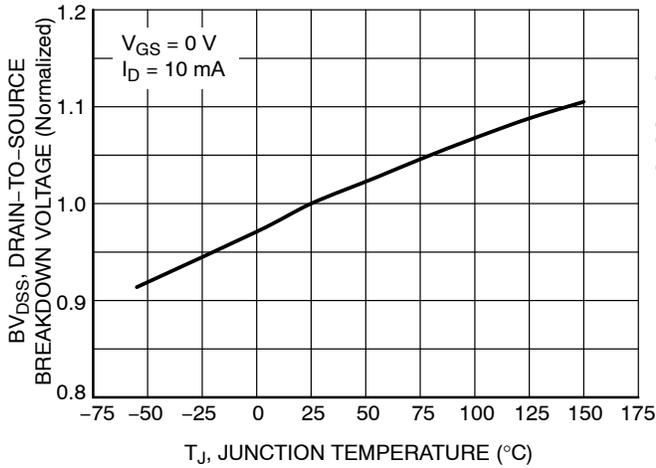


Figure 7. Breakdown Voltage Variation vs. Temperature

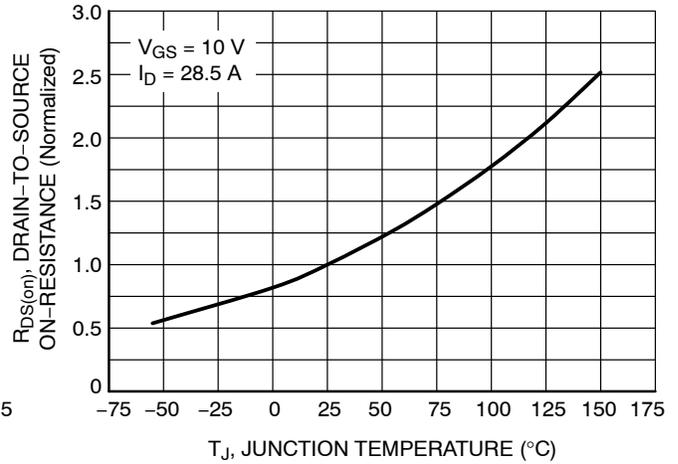


Figure 8. On-Resistance Variation vs. Temperature

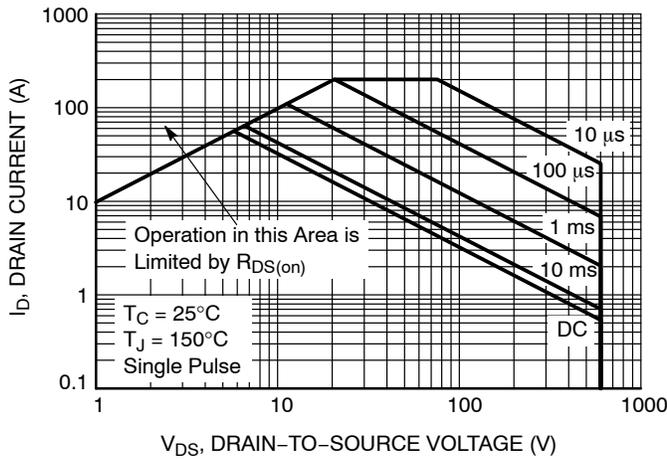


Figure 9. Maximum Safe Operating Area

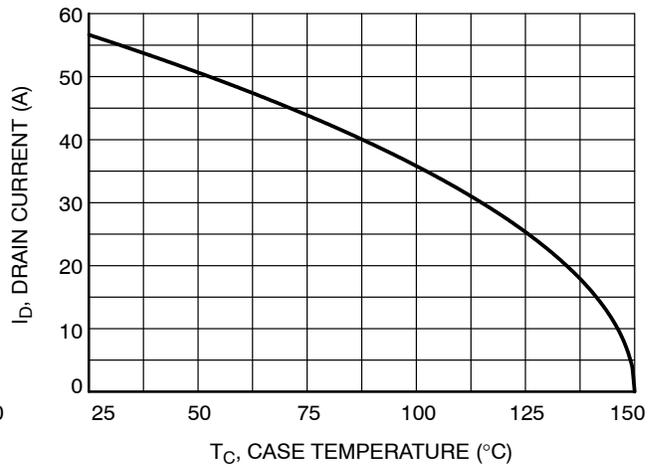


Figure 10. Maximum Drain Current vs. Case Temperature

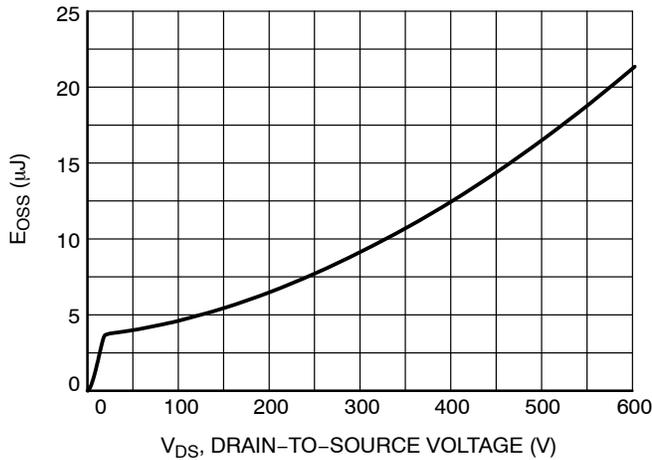


Figure 11. E_{OSS} vs. Drain-to-Source Voltage

NTHL041N60S5H

TYPICAL CHARACTERISTICS

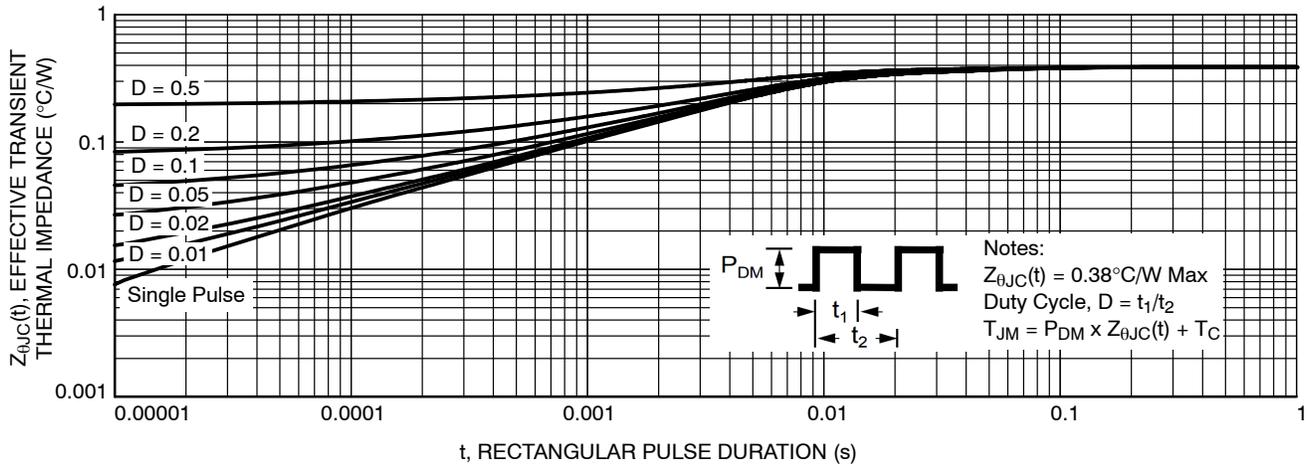


Figure 12. Transient Thermal Impedance

NTHL041N60S5H

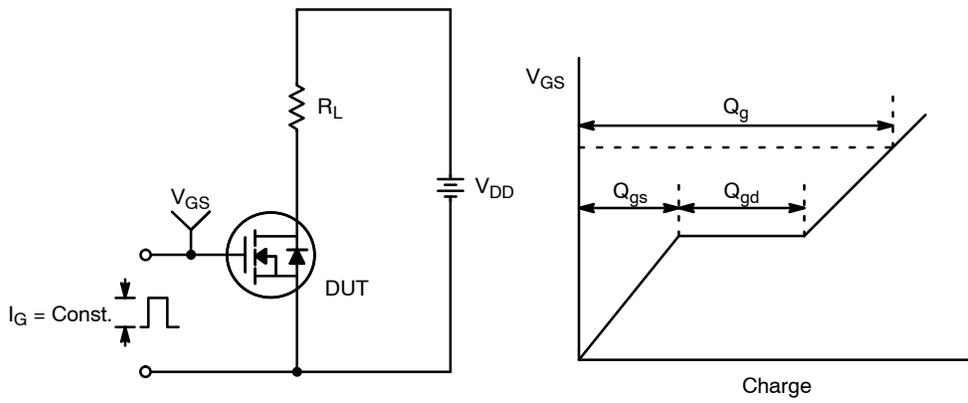


Figure 13. Gate Charge Test Circuit & Waveform

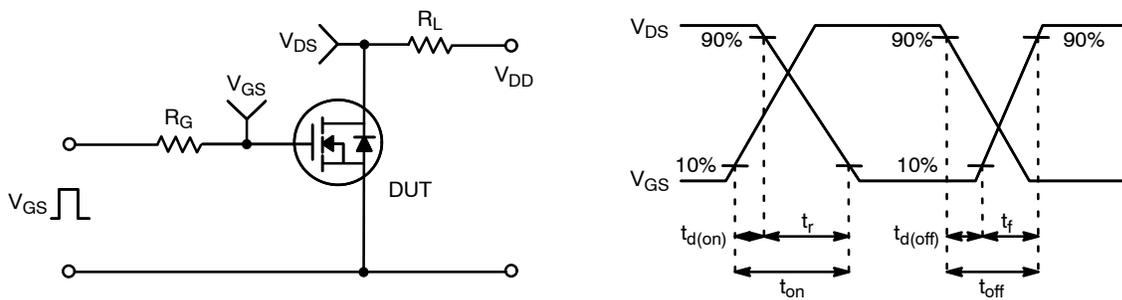


Figure 14. Resistive Switching Test Circuit & Waveforms

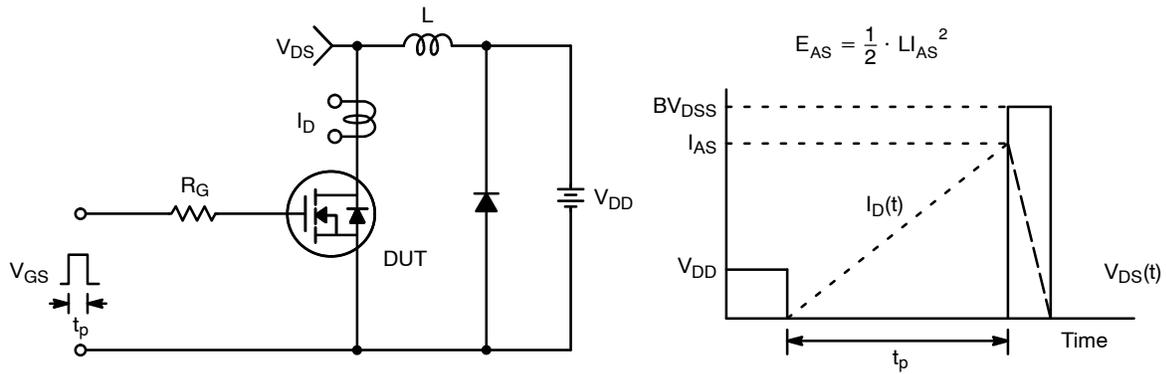


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

NTHL041N60S5H

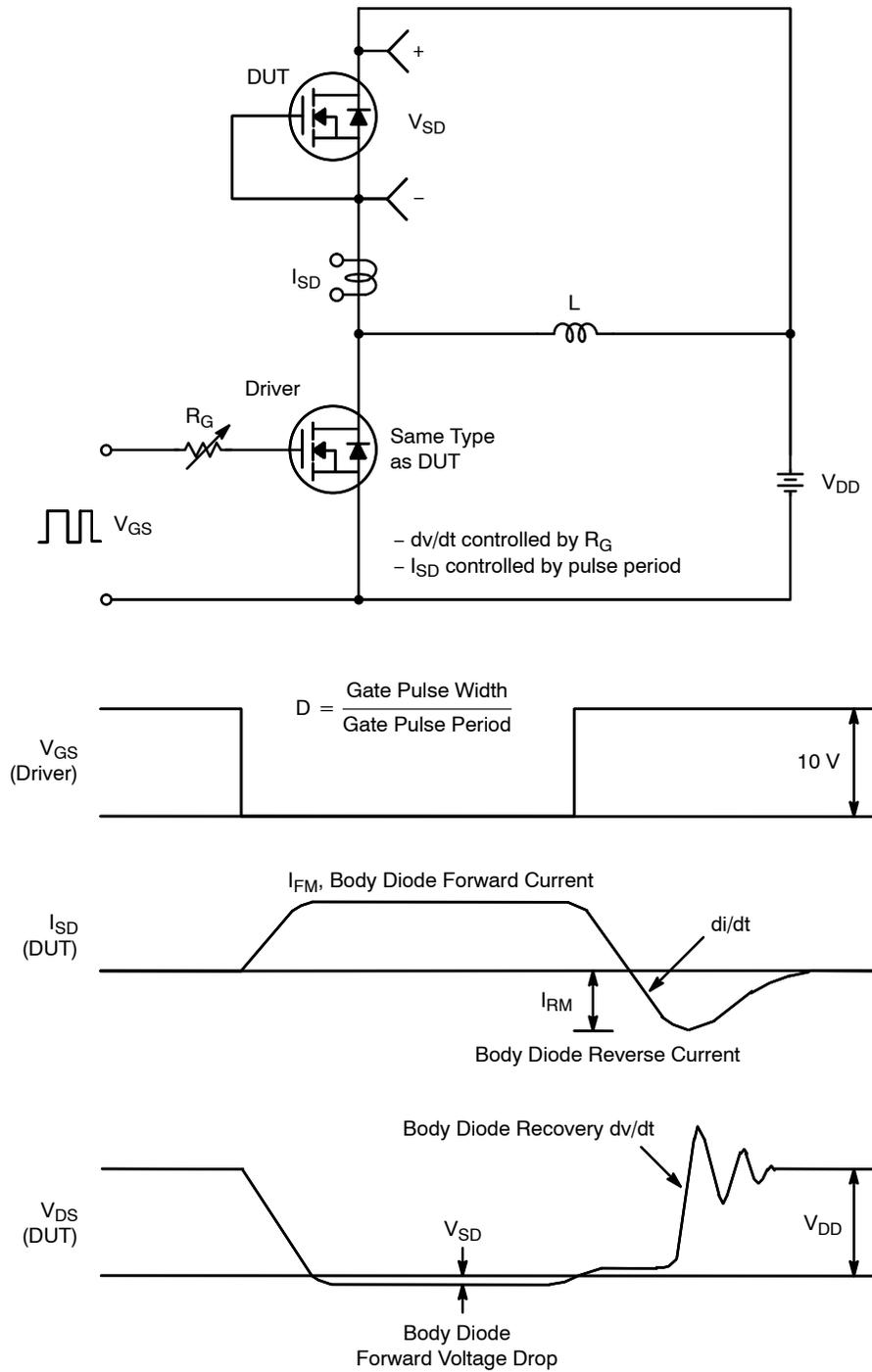


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

MECHANICAL CASE OUTLINE

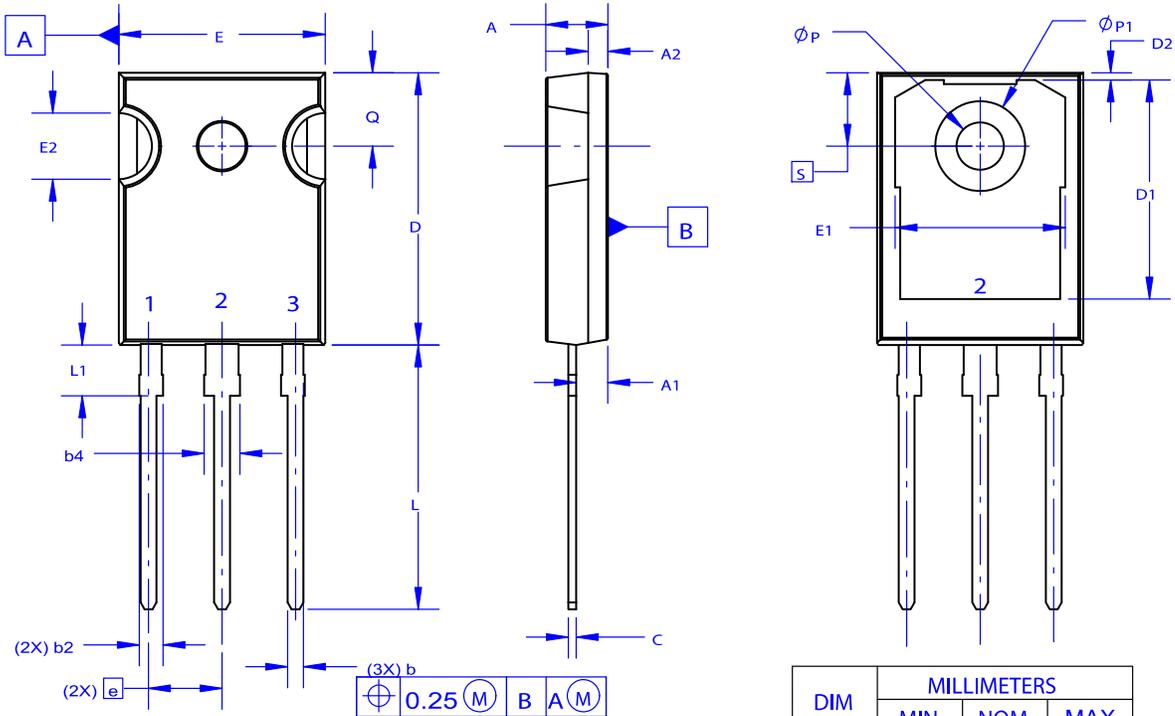
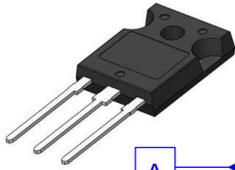
PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020



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

GENERIC MARKING DIAGRAM*



- XXXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- WW = Work Week
- G = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	98AON93302G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO-247-3LD	PAGE 1 OF 1

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Email Requests to: orderlit@onsemi.com

ON Semiconductor Website: www.onsemi.com

TECHNICAL SUPPORT

North American Technical Support:
Voice Mail: 1 800-282-9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative