

# NVHL025N65S3

## MOSFET – Power, N-Channel, Automotive SUPERFET<sup>®</sup> III, Easy-drive

650 V, 75 A, 25 mΩ

### Description

SuperFET III MOSFET is ON Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SuperFET III MOSFET Easy-drive series helps manage EMI issues and allows for easier design implementation.

### Features

- AEC-Q101 Qualified
- Max Junction Temperature 150°C
- Typ.  $R_{DS(on)} = 19.9 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_G = 236 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{OSS(eff.)} = 2062 \text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

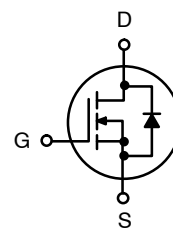
- Automotive PHEV-BEV DC-DC Converter
- Automotive Onboard Charger for PHEV-BEV



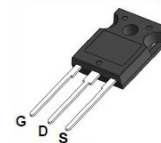
ON Semiconductor<sup>®</sup>

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$BV_{DSS}$	$R_{DS(on)} \text{ MAX}$	$I_D \text{ MAX}$
650 V	25 mΩ @ 10 V	75 A

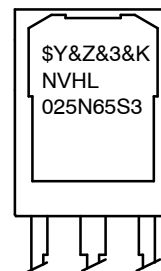


N-Channel MOSFET



TO-247-3LD  
CASE 340CX

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Numeric Date Code  
&K = Lot Code  
NVHL025N65S3 = Specific Device Code

### ORDERING INFORMATION

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

## NVHL025N65S3

### ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, Unless otherwise specified)

Symbol	Parameter		Value	Unit
V <sub>DSS</sub>	Drain to Source Voltage		650	V
V <sub>GSS</sub>	Gate to Source Voltage	DC Positive	30	V
		AC Positive, (f > 1 Hz)	30	V
		AC Negative, (f > 1 Hz)	-20	V
I <sub>D</sub>	Drain Current	Continuous (T <sub>c</sub> = 25°C)	75	A
		Continuous (T <sub>c</sub> = 100°C)	65.8	A
I <sub>DM</sub>	Pulsed Drain Current	Pulsed (Note 1)	187.5	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)		2025	mJ
E <sub>AR</sub>	Repetitive Avalanche (Note 1)		5.95	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	V/ns
P <sub>D</sub>	Power Dissipation	(T <sub>c</sub> = 25°C)	595	W
		Derate Above 25°C	4.76	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range		-55 to +150	°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		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. Repetitive rating: pulse-width limited by maximum junction temperature.
2. I<sub>AS</sub> = 15 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> < 75 A, di/dt ≤ 200 A/ms, VDD ≤ BVDSS, starting T<sub>J</sub> = 25°C.
4. Essentially independent of operating temperature typical characteristics.

### THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max	0.21	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max	40	°C/W

### PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Shipping (Qty / Packing)
NVHL025N65S3	NVHL025N65S3	TO-247-3LD	Tube	30 Units / Tube

# NVHL025N65S3

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

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

BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C	650	713	-	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C	650	755	-	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Referenced to 25°C	-	0.34	-	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V	-	0.30	1	μA
		V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V, T <sub>c</sub> = 125°C	-	7.92	-	
I <sub>GSS</sub>	Gate to Body Leakage Current	V <sub>GS</sub> = +30 V, V <sub>DS</sub> = 0 V	-	5.27	+100	nA
		V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V	-	2.65	-100	nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate to Source Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 3.0 mA	2.5	3.56	4.5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 37.5 A, T <sub>J</sub> = 25°C	-	19.9	25	mΩ
		V <sub>GS</sub> = 10 V, I <sub>D</sub> = 37.5 A, T <sub>J</sub> = 100°C	-	34.6	-	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 75 A	-	78.5	-	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 1 MHz	-	7330	-	pF
C <sub>oss</sub>	Output Capacitance		-	197	-	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		-	33.6	-	pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	-	2062	-	pF
C <sub>oss(er.)</sub>	Energy Related Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	-	285	-	pF
Q <sub>g(tot)</sub>	Total Gate Charge	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 75 A (Note 4)	-	236	-	nC
Q <sub>gs</sub>	Gate to Source Gate Charge		-	59.3	-	nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge		-	97.3	-	nC
R <sub>G</sub>	Gate Resistance		f = 1 MHz	-	0.818	-

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 75 A, V <sub>GS</sub> = 10 V, R <sub>G</sub> = 2 Ω (Note 4)	-	43.3	-	ns
t <sub>r</sub>	Turn-On Rise Time		-	109	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	120	-	ns
t <sub>f</sub>	Fall Time		-	107	-	ns

### DRAIN-SOURCE DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current	-	-	75	A	
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	-	-	300	A	
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 37.5 A	-	0.88	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 75 A dI <sub>F</sub> /dt = 100 A/μs	-	714	-	nS
Q <sub>rr</sub>	Reverse Recovery Charge		-	26.4	-	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.

TYPICAL CHARACTERISTICS

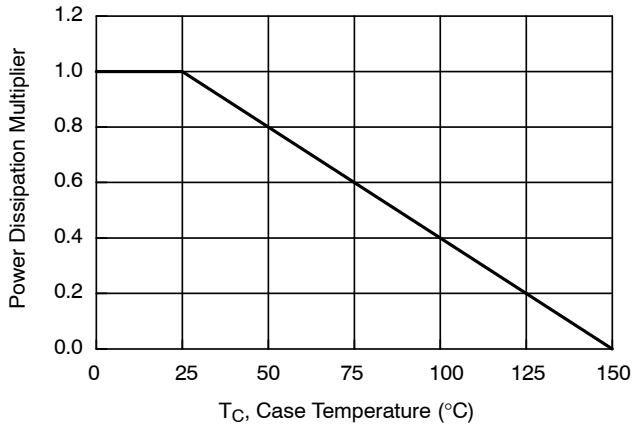


Figure 1. Normalized Power Dissipation vs. Case Temperature

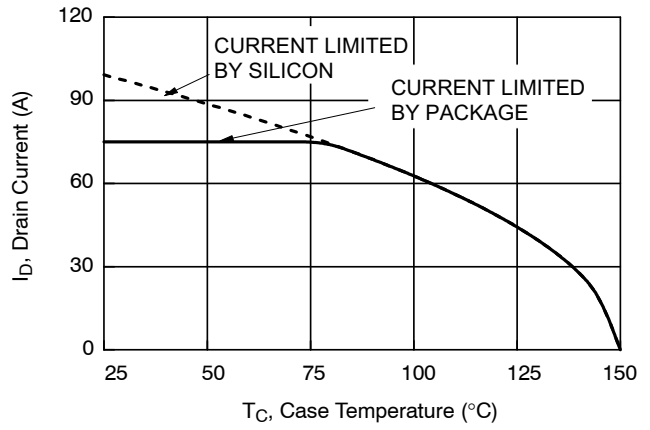


Figure 2. Maximum Continuous Drain Current vs. Case Temperature

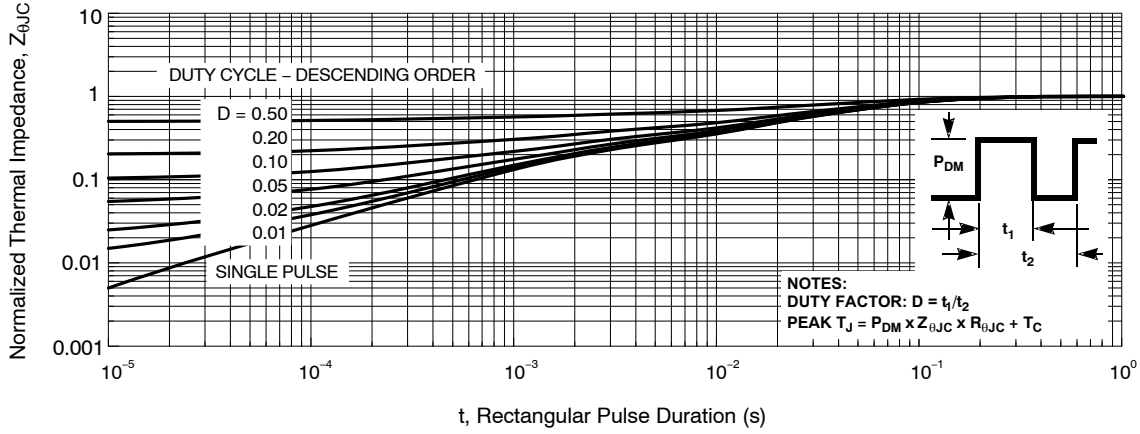


Figure 3. Normalized Maximum Transient Thermal Impedance

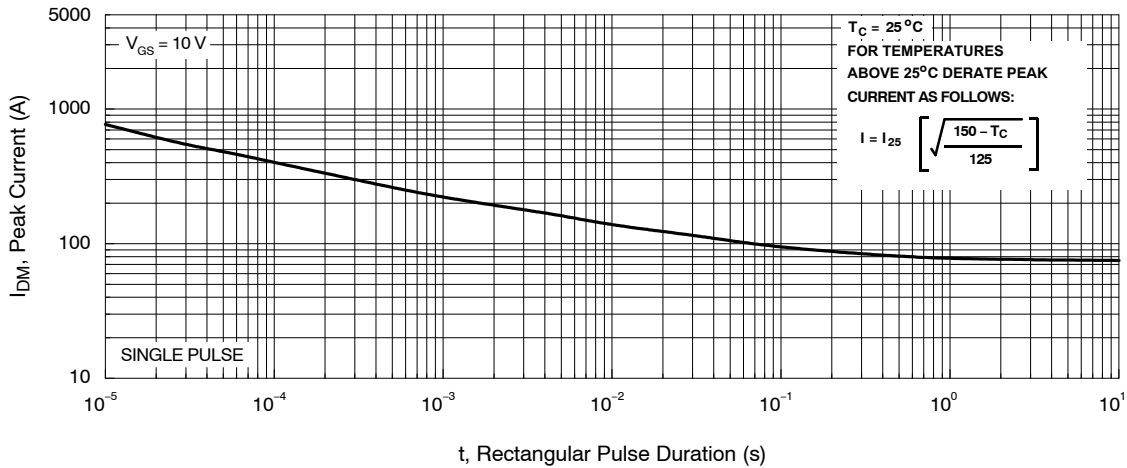


Figure 4. Peak Current Capability

TYPICAL CHARACTERISTICS (continued)

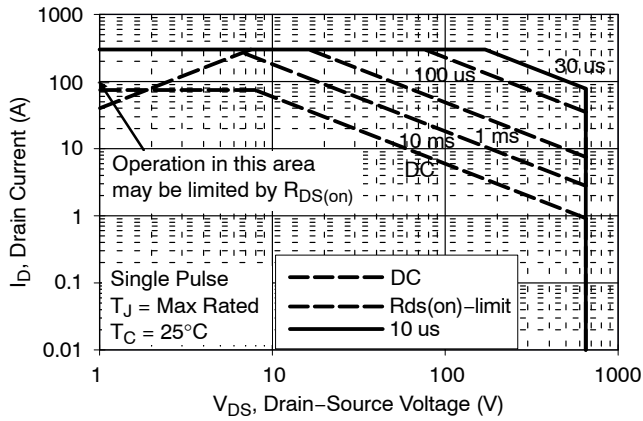
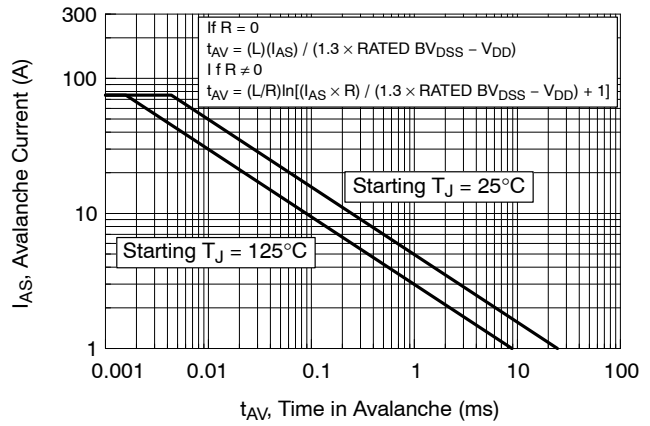


Figure 5. Forward Bias Safe Operating Area



NOTES: Refer to ON Semiconductor Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching Capability

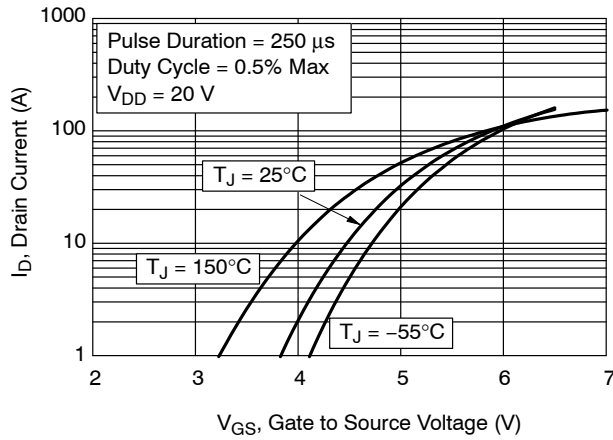


Figure 7. Transfer Characteristic

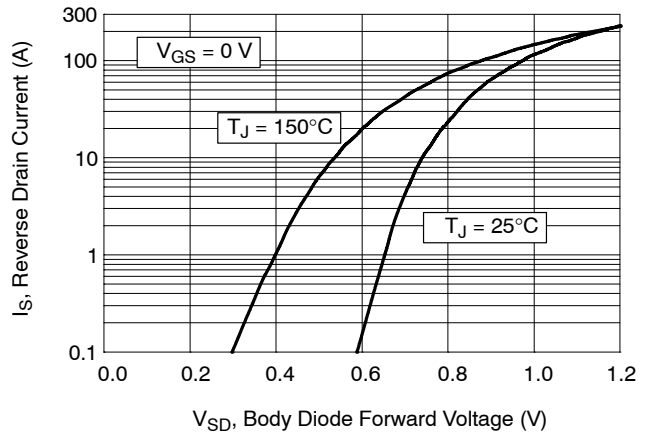


Figure 8. Forward Diode Characteristics

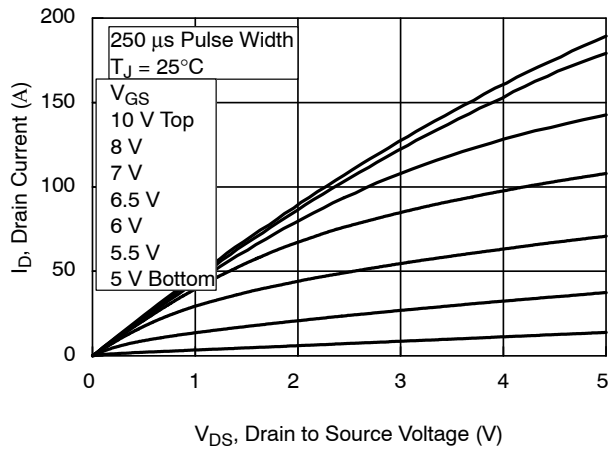


Figure 9. Saturation Characteristics

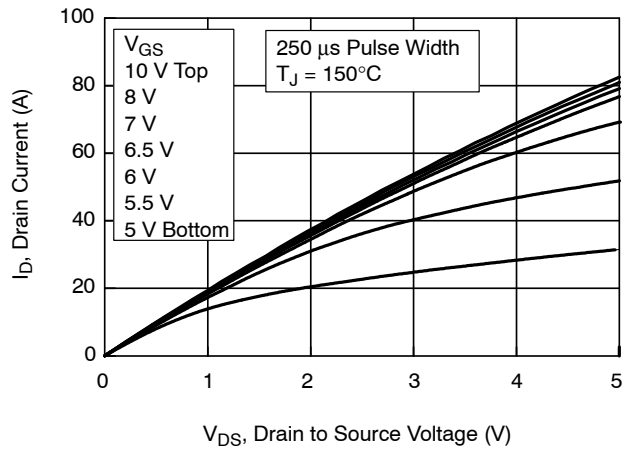


Figure 10. Saturation Characteristics

TYPICAL CHARACTERISTICS (continued)

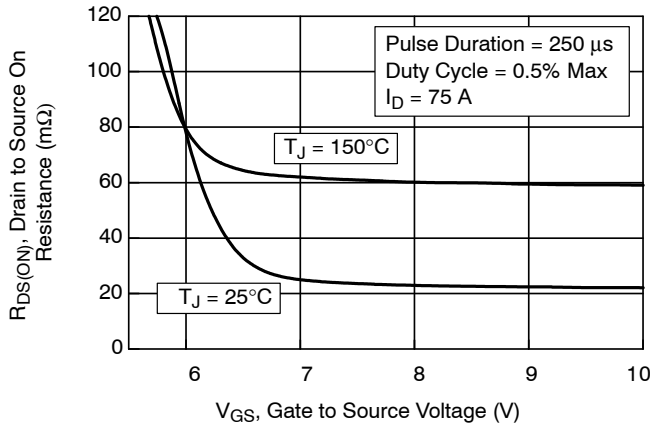


Figure 11.  $R_{DS(on)}$  vs. Gate Voltage

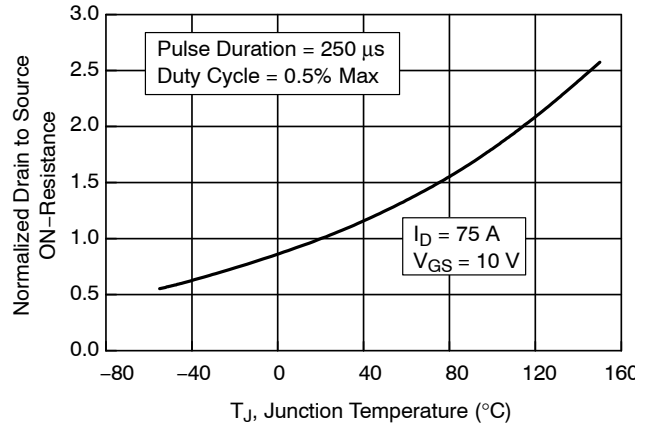


Figure 12. Normalized  $R_{DS(on)}$  vs. Junction Temperature

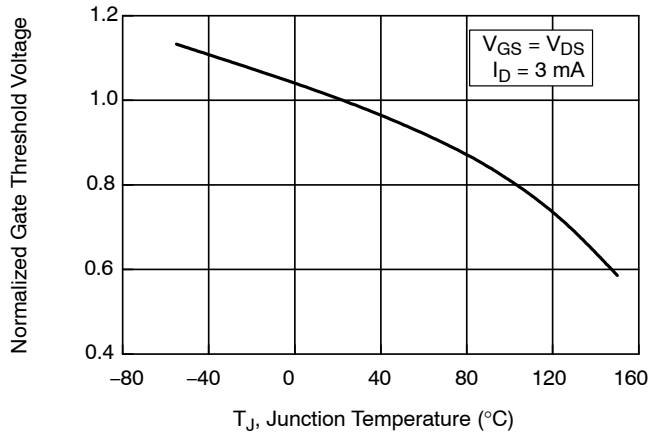


Figure 13. Normalized Gate Threshold Voltage vs. Temperature

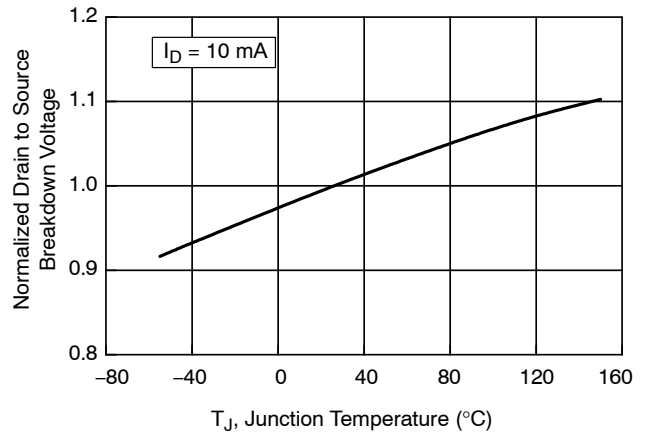


Figure 14. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature

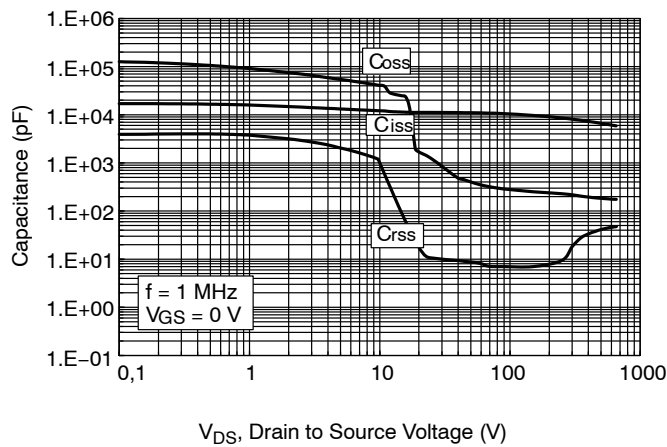


Figure 15. Capacitance vs. Drain to Source Voltage

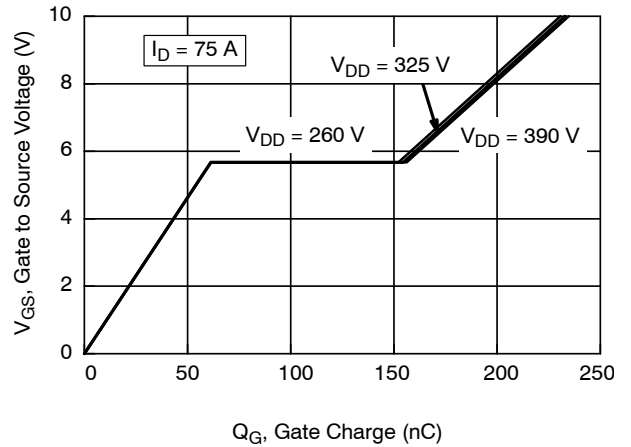


Figure 16. Gate Charge vs. Gate to Source Voltage

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## TYPICAL CHARACTERISTICS (continued)

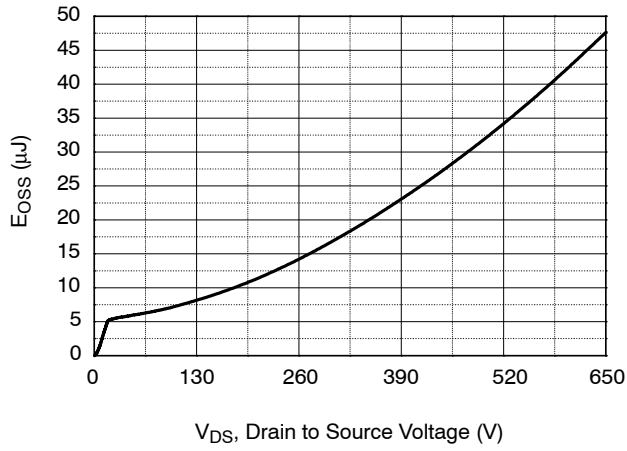


Figure 17. E<sub>OSS</sub> vs. Drain to Source Voltage

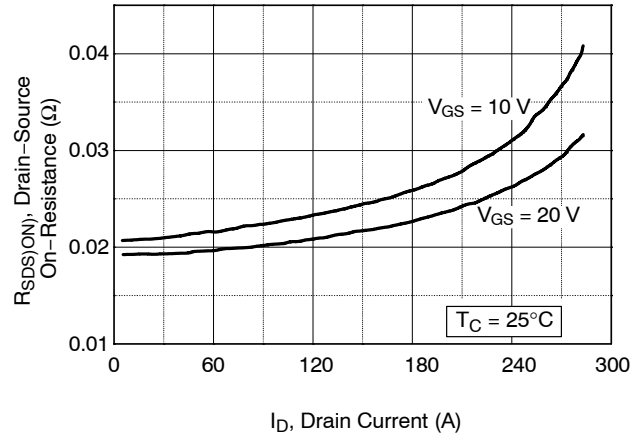
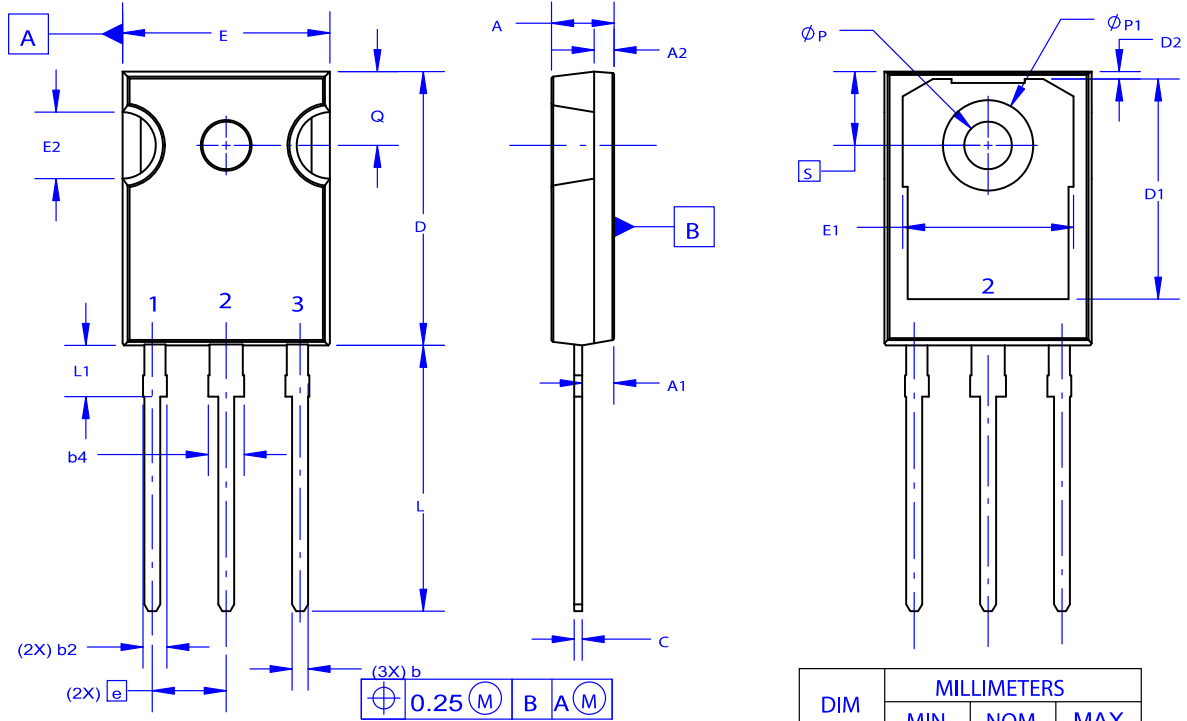


Figure 18. On-Resistance Variation vs. Drain Current and Gate Voltage

# NVHL025N65S3

## 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
ØP	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	~	~
ØP1	6.60	6.80	7.00



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