

# MOSFET – Power, Single N-Channel, SUPERFET® V, FRFET®, TO247-3L 600 V, 55 mΩ, 45 A NVHL055N60S5F

## Description

The SUPERFET V MOSFET FRFET series has optimized body diode performance characteristics. This can allow for the removal of components in the application and improve application performance and reliability, particularly when soft switching topologies are used.

## Features

- 650 V @  $T_J = 150^\circ\text{C}$  / Typ.  $R_{DS(on)} = 44\text{ m}\Omega$
- 100% Avalanche Tested
- Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

## Applications

- Electric Vehicle On Board Chargers
- EV Main Battery DC/DC Converters

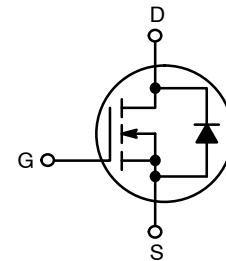
## MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	600	V
Gate-to-Source Voltage	DC	$V_{GS}$	$\pm 30$
	AC ( $f > 1\text{ Hz}$ )		$\pm 30$
Continuous Drain Current	$T_C = 25^\circ\text{C}$	$I_D$	45
	$T_C = 100^\circ\text{C}$		28
Power Dissipation	$T_C = 25^\circ\text{C}$	$P_D$	278
Pulsed Drain Current	$T_C = 25^\circ\text{C}$ , $t_p = 10\text{ }\mu\text{s}$	$I_{DM}$	159
Pulsed Source Current (Body Diode)		$I_{SM}$	159
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	45	A
Single Pulse Avalanche Energy	( $I_L = 7\text{ A}$ , $R_G = 25\text{ }\Omega$ )	$E_{AS}$	417
Avalanche Current	$I_{AS}$	7	A
Repetitive Avalanche Energy (Note 1)	$E_{AR}$	2.78	mJ
MOSFET dv/dt	dvdt	120	V/ns
Peak Diode Recovery dv/dt (Note 2)		70	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$

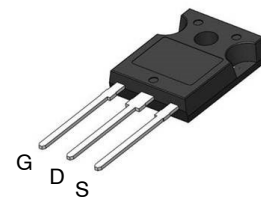
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{SD} \leq 22.5\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 400\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .

$V_{DSS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
600 V	55 mΩ @ 10 V	45 A



POWER MOSFET



TO-247 Long Leads  
CASE 340CX

## MARKING DIAGRAM



V055N60S5F = Specific Device Code  
A = Assembly Location  
YWW = Data Code (Year & Week)  
ZZ = Assembly Lot

## ORDERING INFORMATION

Device	Package	Shipping
NVHL055N60S5F	TO-247	30 Units / Tube

**THERMAL RESISTANCE**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case, Max.	$R_{\theta JC}$	0.45	°C/W
Thermal Resistance, Junction-to-Ambient, Max.	$R_{\theta JA}$	40	

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

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	600	–	–	V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$\Delta V_{(BR)DSS} / \Delta T_J$	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$	–	581	–	mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_J = 25^\circ\text{C}$	–	–	10	μA
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	–	–	±100	nA

**ON CHARACTERISTICS**

Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 22.5\text{ A}, T_J = 25^\circ\text{C}$	–	44	55	mΩ
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 5.2\text{ mA}, T_J = 25^\circ\text{C}$	3.2	–	4.8	V
Forward Trans-conductance	$g_{FS}$	$V_{DS} = 20\text{ V}, I_D = 22.5\text{ A}$	–	44.8	–	S

**CHARGES, CAPACITANCES & GATE RESISTANCE**

Input Capacitance	$C_{ISS}$	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 250\text{ kHz}$	–	4603	–	pF
Output Capacitance	$C_{OSS}$		–	72.9	–	
Time Related Output Capacitance	$C_{OSS(tr.)}$	$I_D = \text{Constant}, V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	–	1114	–	
Energy Related Output Capacitance	$C_{OSS(er.)}$		–	125	–	
Total Gate Charge	$Q_{G(tot)}$	$V_{DD} = 400\text{ V}, I_D = 22.5\text{ A}, V_{GS} = 10\text{ V}$	–	85.2	–	nC
Gate-to-Source Charge	$Q_{GS}$		–	26.2	–	
Gate-to-Drain Charge	$Q_{GD}$		–	24.9	–	
Gate Resistance	$R_G$	$f = 1\text{ MHz}$	–	4.32	–	Ω

**SWITCHING CHARACTERISTICS**

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 0/10\text{ V}, V_{DD} = 400\text{ V}, I_D = 22.5\text{ A}, R_G = 4.7\text{ }\Omega$	–	44	–	ns
Rise Time	$t_r$		–	26.2	–	
Turn-Off Delay Time	$t_{d(off)}$		–	108	–	
Fall Time	$t_f$		–	2.6	–	

**SOURCE-TO-DRAIN DIODE CHARACTERISTICS**

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_{SD} = 22.5\text{ A}, T_J = 25^\circ\text{C}$	–	–	1.2	V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, I_{SD} = 22.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 400\text{ V}$	–	128	–	ns
Reverse Recovery Charge	$Q_{RR}$		–	758	–	nC

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

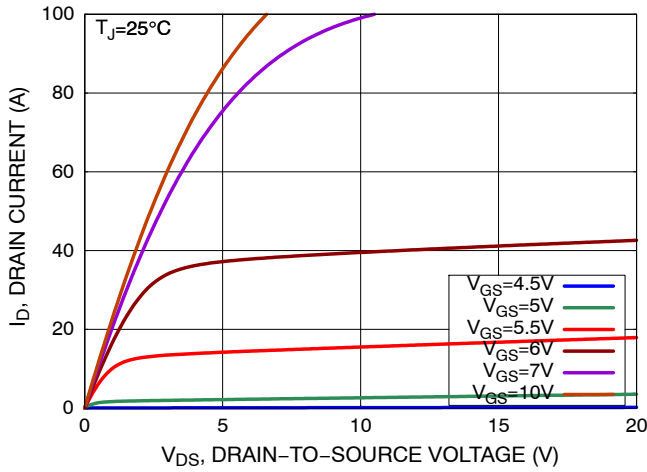


Figure 1. On-Region Characteristics

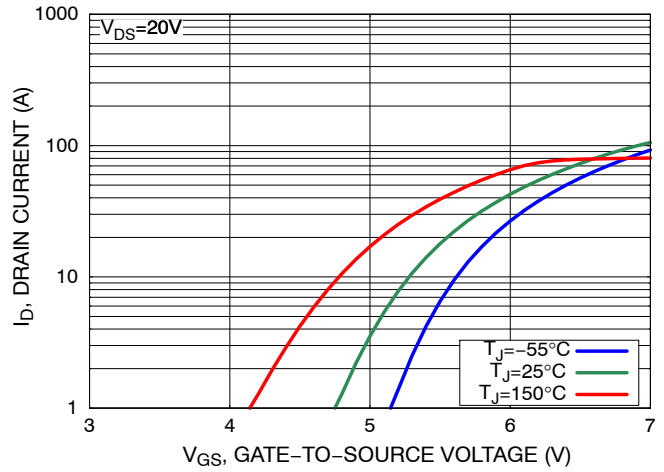


Figure 2. Transfer Characteristics

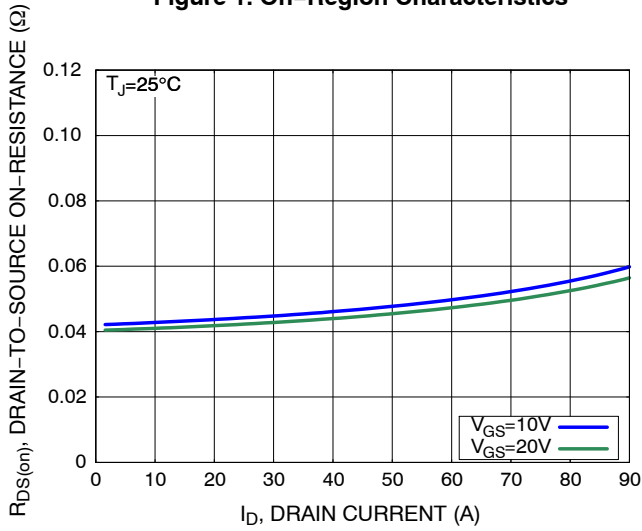


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

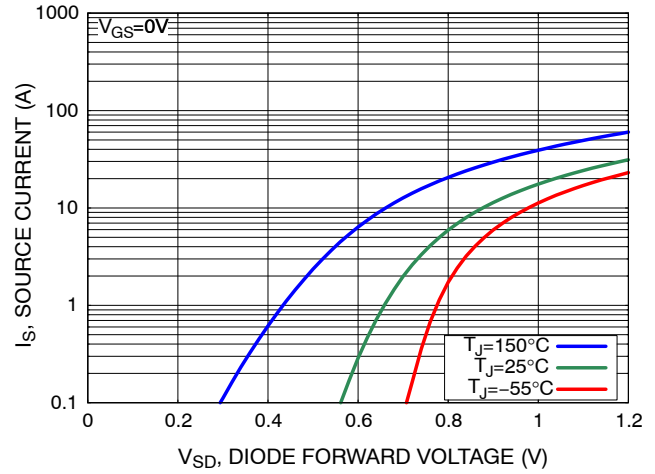


Figure 4. Diode Forward Voltage vs. Source Current

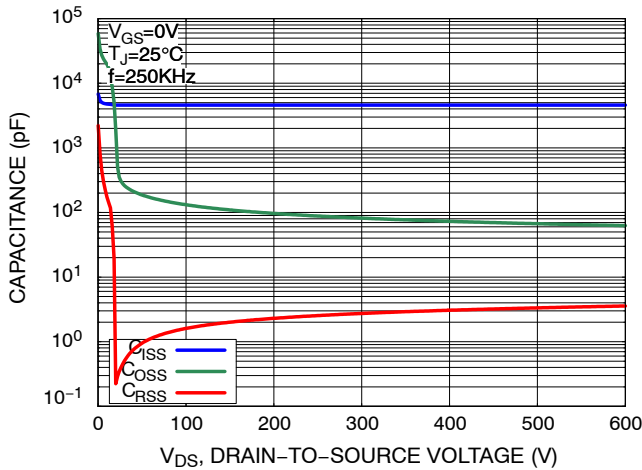


Figure 5. Capacitance Characteristics

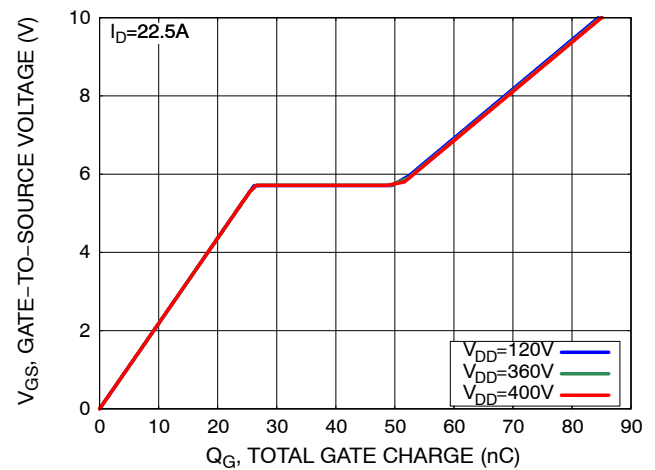


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

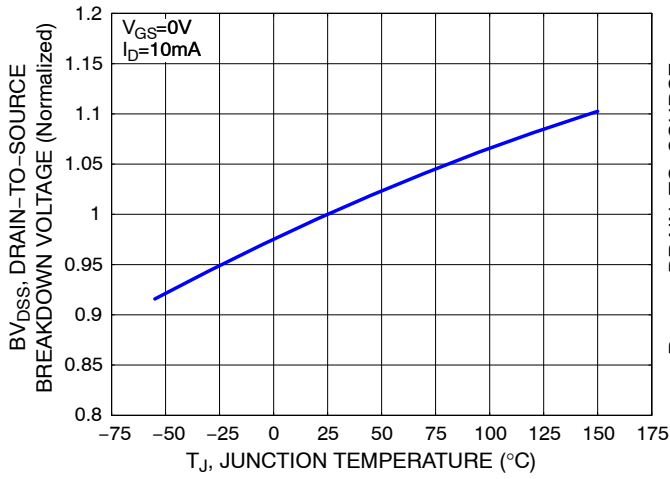


Figure 7. Breakdown Voltage Variation vs. Temperature

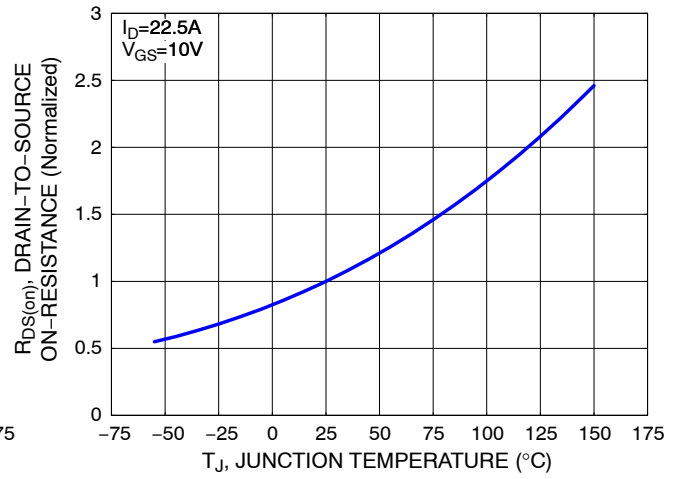


Figure 8. On-Resistance Variation vs. Temperature

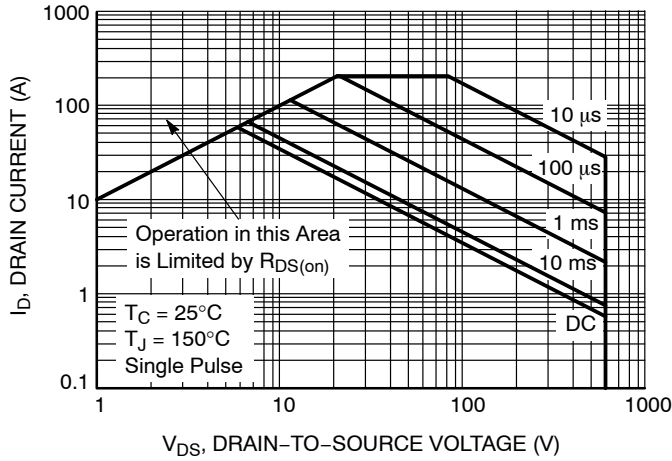


Figure 9. Maximum Safe Operating Area

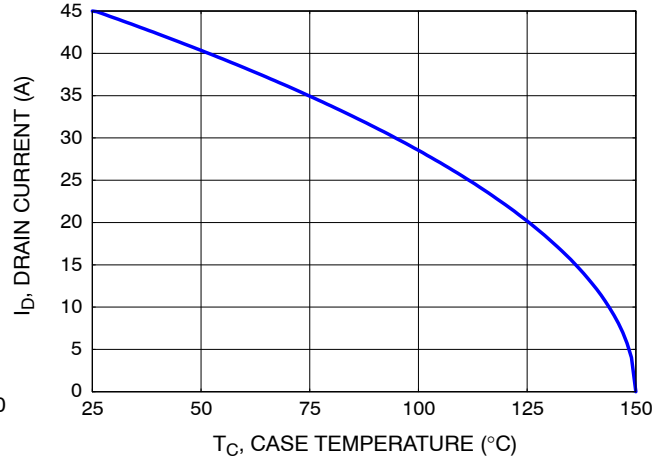


Figure 10. Maximum Drain Current vs. Case Temperature

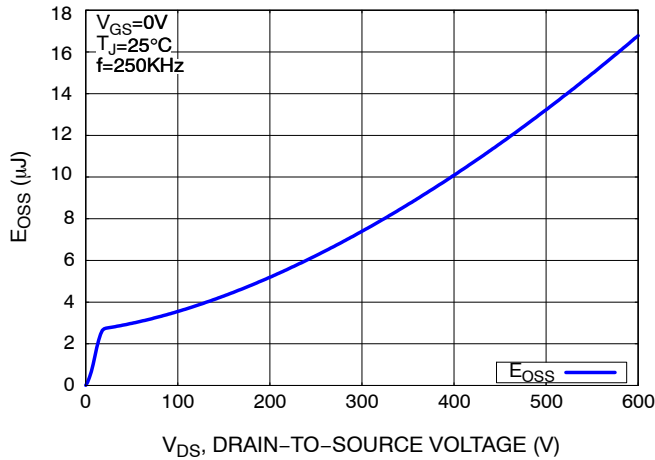


Figure 11.  $E_{OSS}$  vs. Drain-to-Source Voltage

TYPICAL CHARACTERISTICS

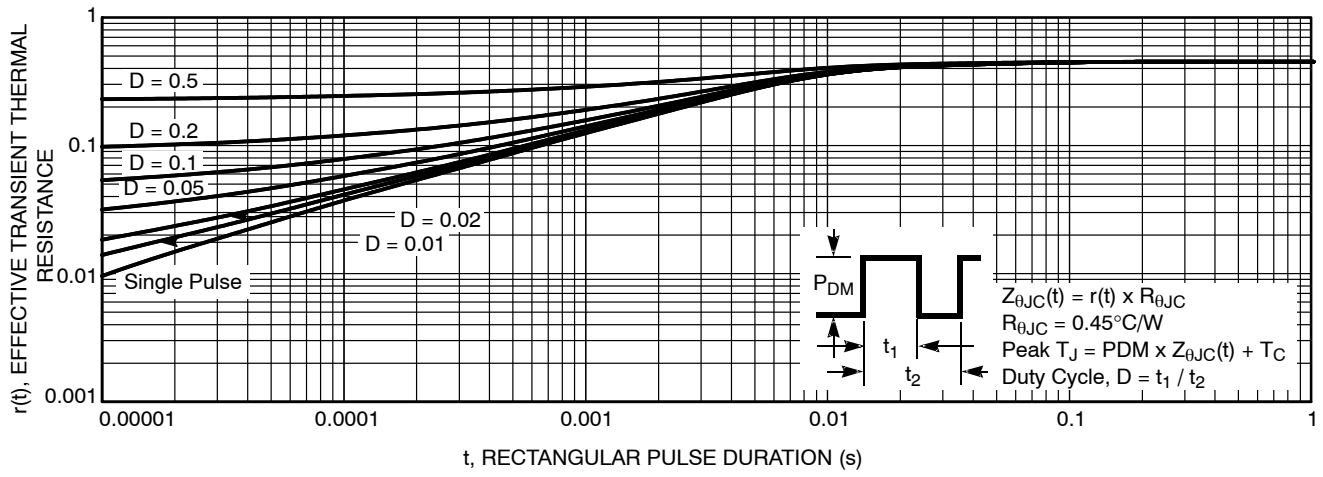


Figure 12. Transient Thermal Impedance

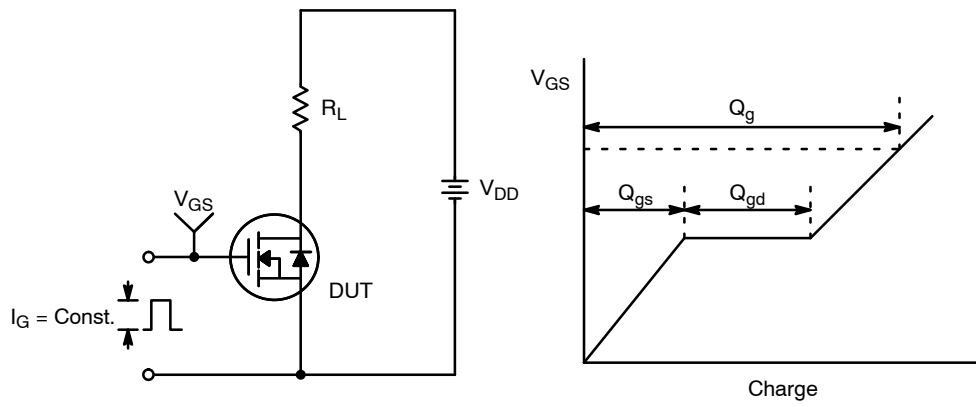


Figure 13. Gate Charge Test Circuit & Waveform

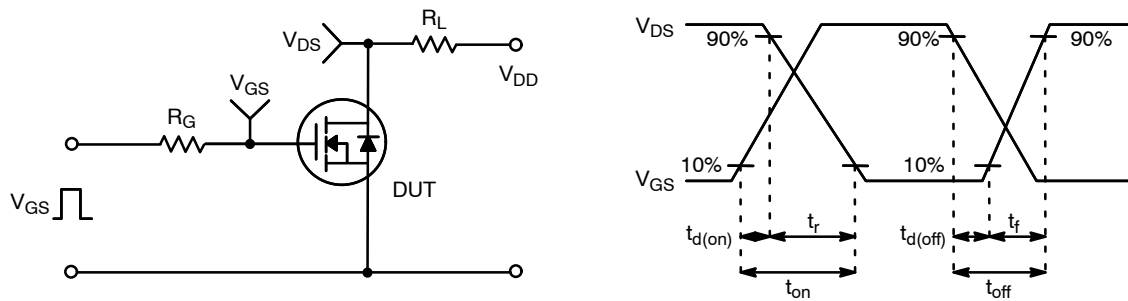


Figure 14. Resistive Switching Test Circuit & Waveforms

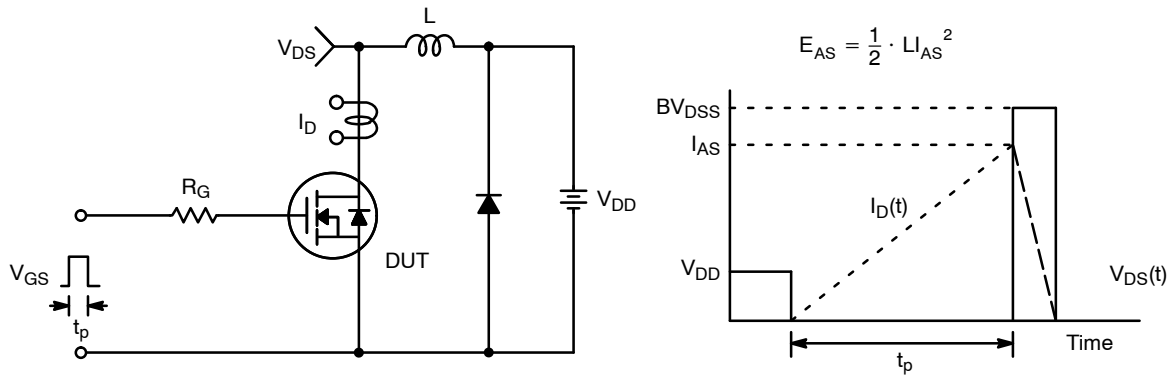
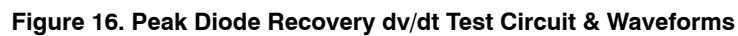


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

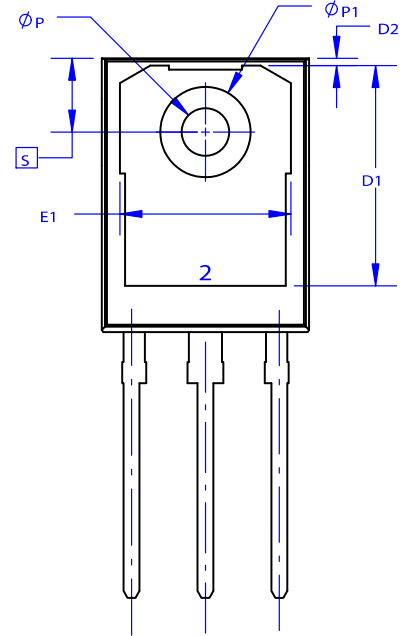
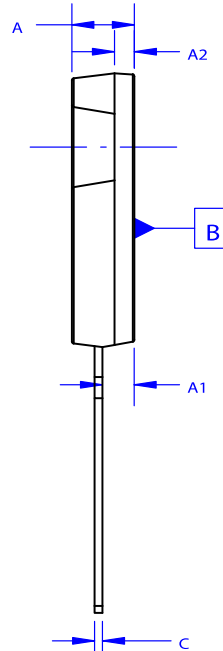
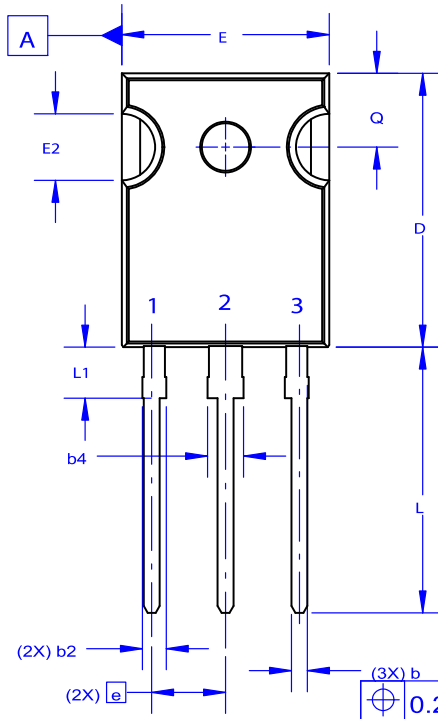
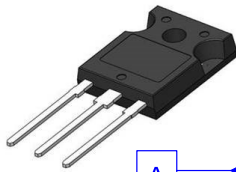
The diagram shows a switching circuit. A MOSFET labeled "DUT" has its gate connected to its drain. The source of the DUT is connected to the drain of a second MOSFET labeled "Driver". The gate of the Driver MOSFET is connected to a pulse voltage source  $V_{GS}$  through a resistor  $R_G$ . The source of the Driver MOSFET is connected to ground. The drain of the Driver MOSFET is connected to the source of the DUT and to one end of an inductor  $L$ . The other end of the inductor  $L$  is connected to a supply voltage  $V_{DD}$ . The DUT's drain is also connected to  $V_{DD}$ . The DUT's source is labeled  $V_{SD}$  and the current through it is  $I_{SD}$ . The Driver MOSFET is noted to be "Same Type as DUT".

–  $dv/dt$  controlled by  $R_G$   
–  $I_{SD}$  controlled by pulse period



**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.

**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.

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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