MOSFET - Power, N-Channel, SUPERFET® V, Easy Drive
600 V, 120 mΩ, 28 A

NTHL120N60S5Z

Description

SUPERFET V MOSFET Easy Drive series combines excellent switching performance without sacrificing ease of use and EMI issues for both hard and soft switching topologies.

Features

- 650 V @ T_J = 150°C
- Typ. $R_{DS(on)}$ = 96 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 39 nC)
- Low Time Related Output Capacitance (Typ. $C_{OSS(tr.)}$ = 547 pF)
- 100% Avalanche Tested
- Pb−Free, Halogen Free/BFR Free and RoHS Compliant

Applications

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

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	±20	V
		– AC (f > 1 Hz)	±20	
I_D	Drain Current	– Continuous (T_C = 25°C)	28*	A
		– Continuous (T_C = 100°C)	17*	
I_{DM}	Drain Current	– Pulsed (Note 1)	81*	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		191	mJ
I_{AS}	Avalanche Current (Note 2)		4.6	A
E_{AR}	Repetitive Avalanche Energy (Note 1)		1.6	mJ
dv/dt	MOSFET dv/dt		120	V/ns
	Peak Diode Recovery dv/dt (Note 3)		50	
P_D	Power Dissipation	(T_C = 25°C)	160	W
		– Derate Above 25°C	1.28	W/°C
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.

*Drain current limited by maximum junction temperature.

1. Repetitive rating: pulse−width limited by maximum junction temperature.
2. I_{AS} = 4.6 A, R_G = 25 Ω, starting T_J = 25°C.
3. I_{SD} ≤ 11.5 A, di/dt ≤ 200 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.78	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

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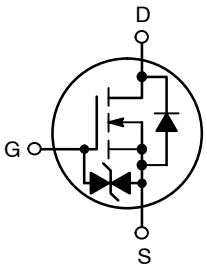
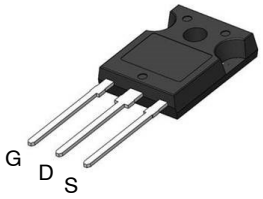
V_{DSS}	$R_{DS(ON)}$ MAX	I_D MAX
600 V	120 mΩ @ 10 V	28 A





TO−247 Long Leads
CASE 340CX

MARKING DIAGRAM

T120N60S5Z	= Specific Device Code
A	= Assembly Location
YWW	= Data Code (Year & Week)
ZZ	= Assembly Lot

ORDERING INFORMATION

Device	Package	Shipping
NTHL120N60S5Z	TO−247	30 Units / Tube

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
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 10 mA, Referenced to 25°C	–	0.6		V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	–	–	1	μA
		V_{DS} = 480 V, T_C = 125°C	–	1	–	
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	–	–	±5	μA
ON CHARACTERISTICS						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 2.2 mA	2.4	–	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 11.5 A	–	96	120	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 20 V, I_D = 11.5 A	–	17.1	–	S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 400 V, V_{GS} = 0 V, f = 250 kHz	–	2088	–	pF
C_{oss}	Output Capacitance		–	35	–	pF
$C_{oss(tr.)}$	Time Related Output Capacitance	I_D = Constant, V_{DS} = 0 V to 400 V, V_{GS} = 0 V	–	547	–	pF
$C_{oss(er.)}$	Energy Related Output Capacitance	V_{DS} = 0 V to 400 V, V_{GS} = 0 V	–	59	–	pF
$Q_{g(tot)}$	Total Gate Charge	V_{DD} = 400 V, I_D = 11.5 A, V_{GS} = 10 V	–	40	–	nC
Q_{gs}	Gate to Source Charge		–	9	–	nC
Q_{gd}	Gate to Drain Charge		–	11	–	nC
ESR	Equivalent Series Resistance	f = 1 MHz	–	3.5	–	Ω
SWITCHING CHARACTERISTICS						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400 V, I_D = 11.5 A, V_{GS} = 10 V, R_g = 7.5 Ω	–	23	–	ns
t_r	Turn-On Rise Time		–	13	–	ns
$t_{d(off)}$	Turn-Off Delay Time		–	78	–	ns
t_f	Turn-Off Fall Time		–	3	–	ns
SOURCE-DRAIN DIODE CHARACTERISTICS						
I_S	Maximum Continuous Source to Drain Diode Forward Current		–	–	28	A
I_{SM}	Maximum Pulsed Source to Drain Diode Forward Current		–	–	81	A
V_{SD}	Source to Drain Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 11.5 A	–	–	1.2	V
t_{rr}	Reverse Recovery Time	V_{DD} = 400 V, I_{SD} = 11.5 A, dI_F/dt = 100 A/μs	–	227	–	ns
Q_{rr}	Reverse Recovery Charge		–	3.2	–	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

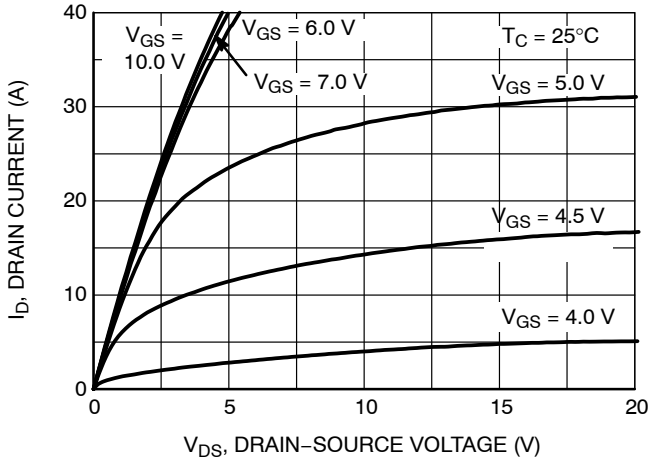


Figure 1. On−Region Characteristics

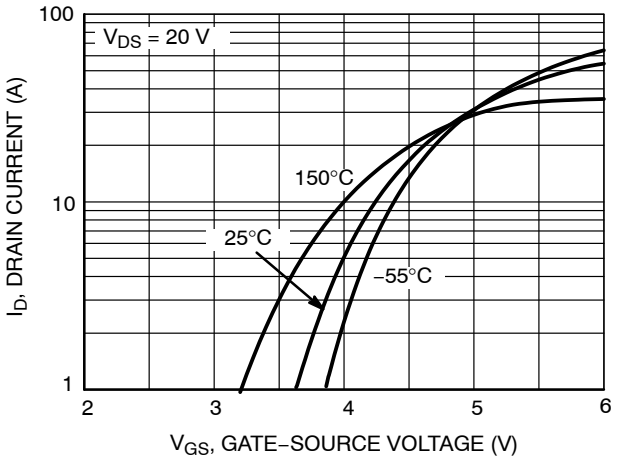


Figure 2. Transfer Characteristics

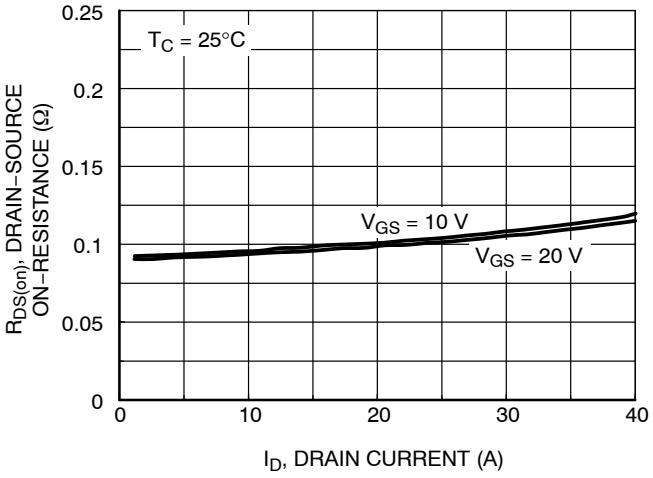


Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage

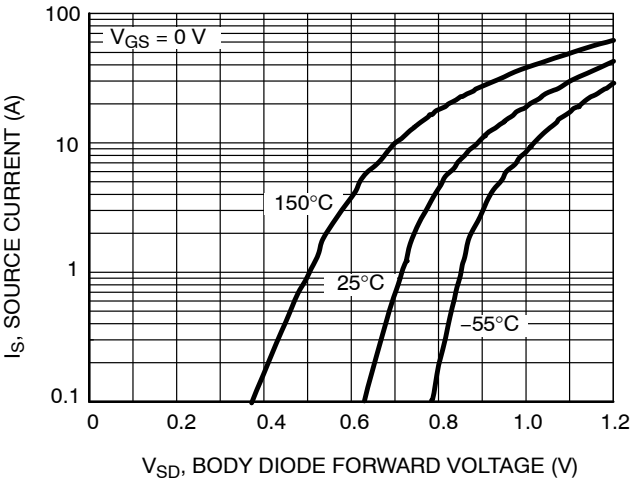


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

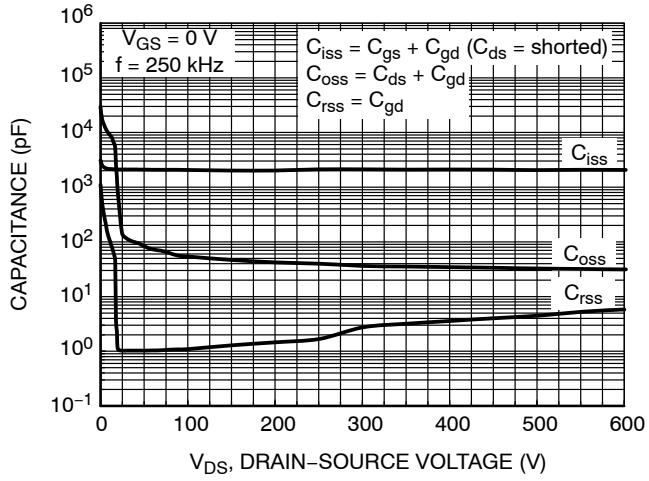


Figure 5. Capacitance Characteristics

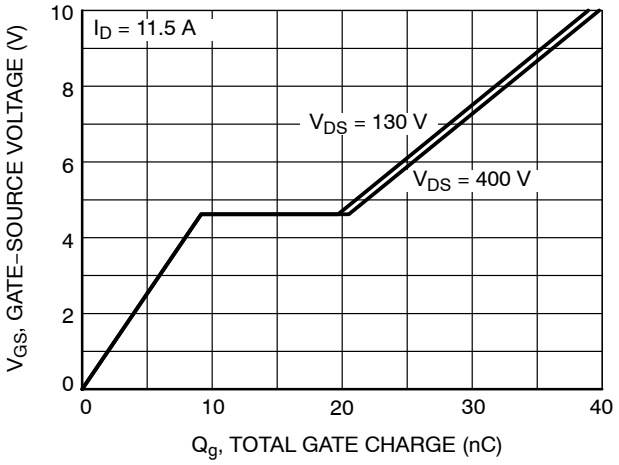


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

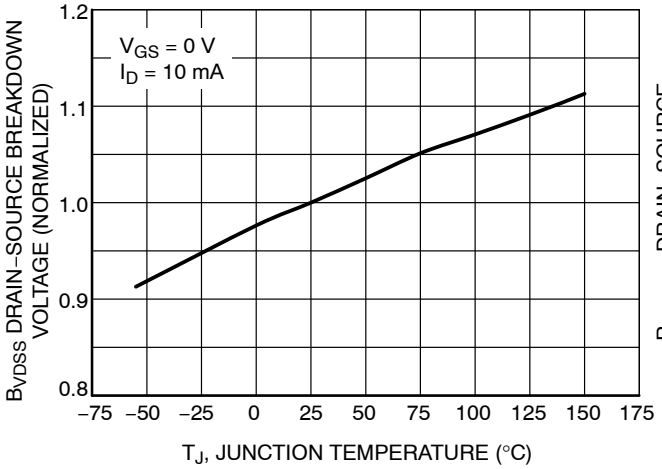


Figure 7. Breakdown Voltage Variation vs. Temperature

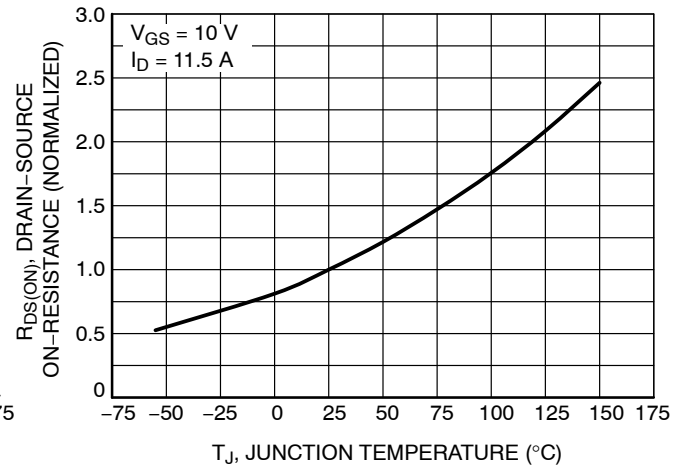


Figure 8. On−Resistance Variation vs. Temperature

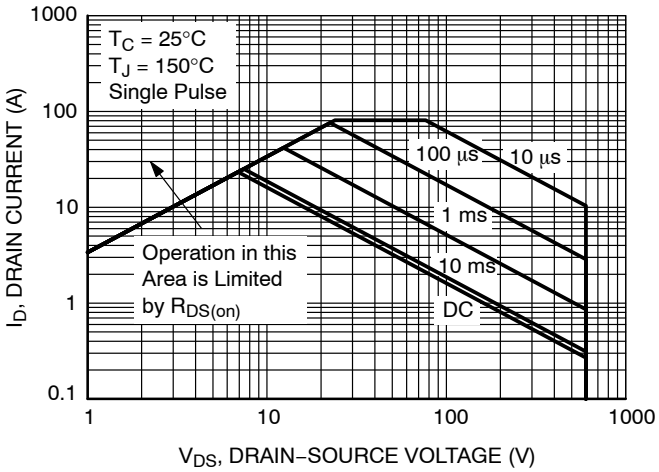


Figure 9. Maximum Safe Operating Area

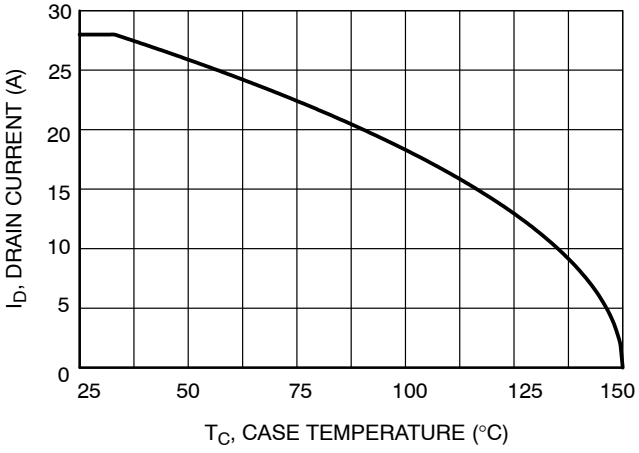


Figure 10. Maximum Drain Current vs. Case Temperature

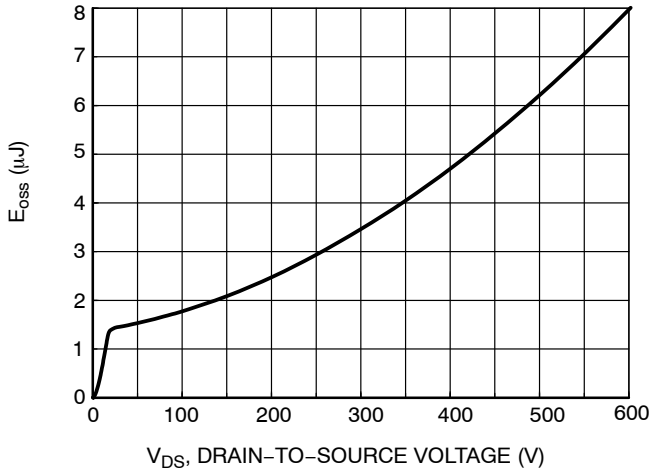


Figure 11. E_{OSS} vs. Drain to Source Voltage

TYPICAL CHARACTERISTICS

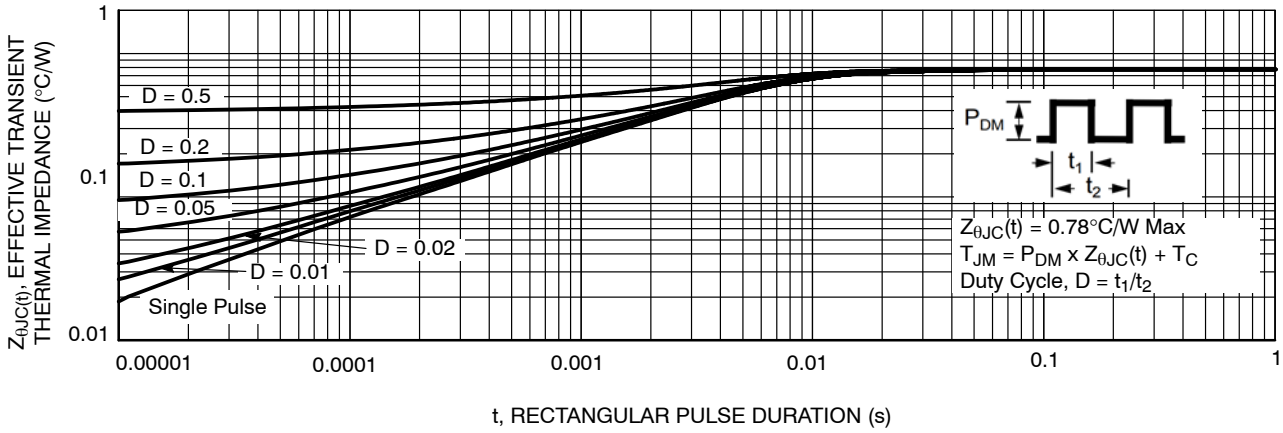


Figure 12. Thermal Response

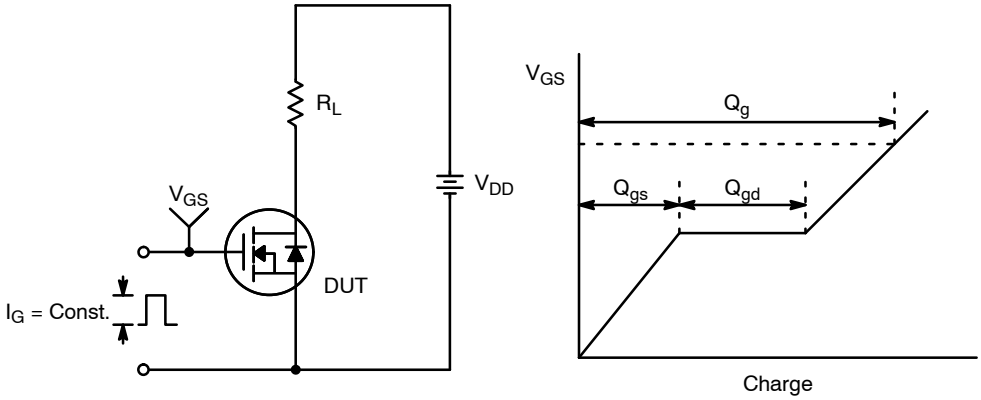


Figure 13. Gate Charge Test Circuit & Waveform

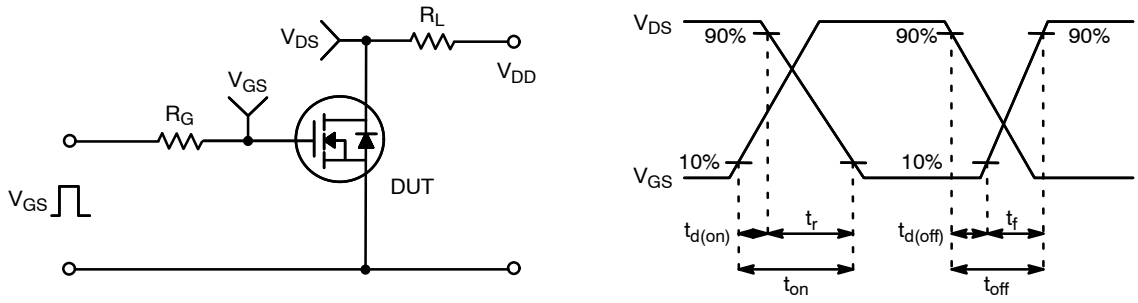


Figure 14. Resistive Switching Test Circuit & Waveforms

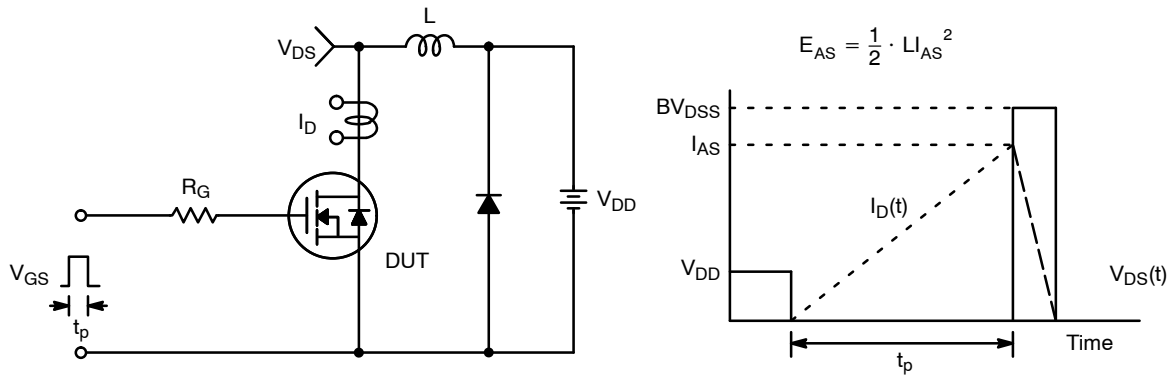


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

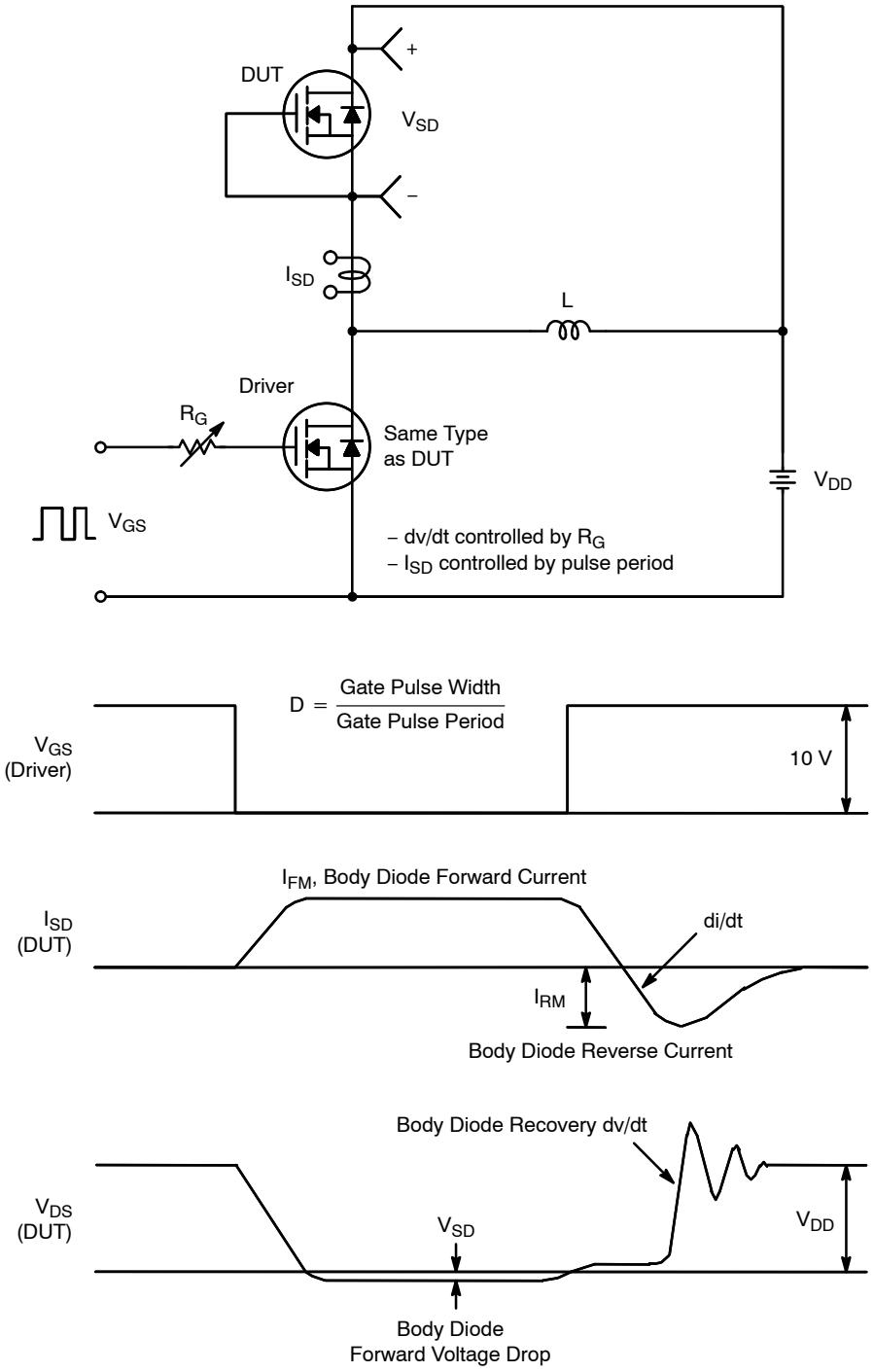


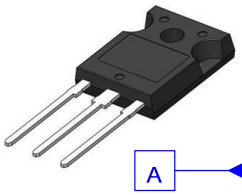
Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

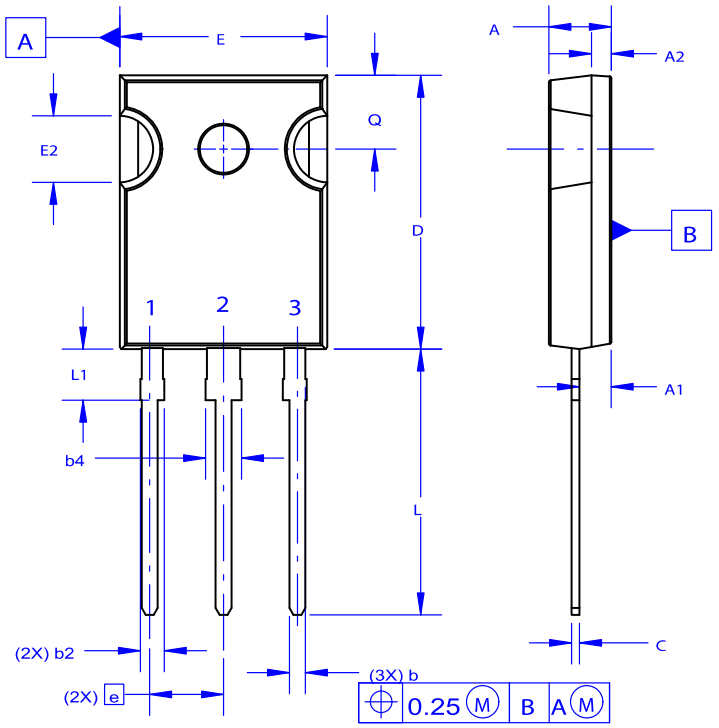
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

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
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

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.

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