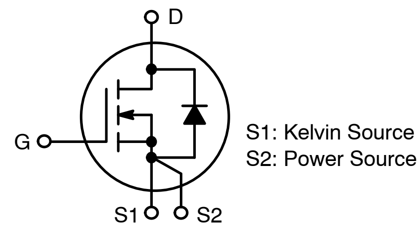
DATA SHEET
www.onsemi.com

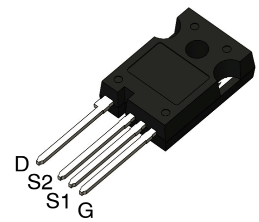
Silicon Carbide (SiC) MOSFET - EliteSiC, 12 mohm, 650 V, M3S, TO247-4L

NTH4L012N065M3S

$V_{(BR)DSS}$	$R_{DS(ON)}$ TYP	I_D MAX
650 V	12 mΩ @ 18 V	102 A



N−CHANNEL MOSFET



TO-247-4L
CASE 340CJ

Features

- Typical $R_{DS(ON)}$ = 12 mΩ @ V_{GS} = 18 V
- Ultra Low Gate Charge ($Q_{G(tot)}$ = 135 nC)
- High Speed Switching with Low Capacitance (C_{oss} = 281 pF)
- 100% Avalanche Tested
- This Device is Halide Free and RoHS Compliant with Exemption 7a, Pb-Free 2LI (on second level interconnection)

Applications

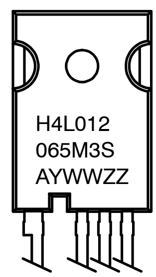
- SMPS, Solar Inverters, UPS, Energy Storage, EV Charging Infrastructure

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

Parameter		Symbol	Value	Unit
Drain-to-Source Voltage		V_{DSS}	650	V
Dynamic Gate-to-Source Voltage		V_{GS}	−10/ 22.6	V
Continuous Drain Current	T_C = 25 °C	I_D	102	A
Power Dissipation		P_D	375	W
Continuous Drain Current	T_C = 100 °C	I_D	81	A
Power Dissipation		P_D	187	W
Pulsed Drain Current (Note 1)	T_C = 25 °C t_p = 100 μs	I_{DM}	330	A
Continuous Source-Drain Current (Body Diode)	T_C = 25 °C V_{GS} = −3 V	I_S	62	A
	T_C = 100 °C V_{GS} = −3 V		35	
Pulsed Source-Drain Current (Body Diode) (Note 1)	T_C = 25 °C V_{GS} = −3 V t_p = 100 μs	I_{SM}	250	A
Single Pulse Avalanche Energy (I_{LPK} = 72 A, L = 0.1 mH) (Note 2)		E_{AS}	259	mJ
Operating Junction and Storage Temperature Range		T_J, T_{stg}	−55 to +175	°C
Lead Temperature for Soldering Purposes (1/8″ from case for 10 seconds)		T_L	270	°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. Single pulse, limited by max junction temperature.
2. EAS of 259 mJ is based on starting T_J = 25 °C, L = 0.1 mH, I_{AS} = 72 A, V_{DD} = 100 V, V_{GS} = 18 V.

MARKING DIAGRAM



H4L012065M3S = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability

ORDERING INFORMATION

Device	Package	Shipping
NTH4L012N065M3S	TO-247-4L	30 Units / Tube

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Note 3)	$R_{\theta JC}$	0.40	°C/W

3. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value	Unit
Operation Values of Gate-to-Source Voltage	V_{GSop}	–3/+18	V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ELECTRICAL CHARACTERISTICS (T_J = 25 °C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 1 mA, T_J = 25 °C	650	–	–	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 650 V, T_J = 25 °C	–	–	10	µA
		V_{DS} = 650 V, T_J = 175 °C (Note 5)	–	–	500	µA
Gate-to-Source Leakage Current	I_{GSS}	V_{GS} = –10 V, V_{DS} = 0 V	–1	–	–	µA
		V_{GS} = +22 .6V, V_{DS} = 0 V	–	–	1	
ON CHARACTERISTICS						
Drain-to-Source On Resistance	$R_{DS(on)}$	V_{GS} = 18 V, I_D = 40 A, T_J = 25 °C	–	12	17	mΩ
		V_{GS} = 18 V, I_D = 40 A, T_J = 175 °C (Note 5)	–	18	–	
		V_{GS} = 15 V, I_D = 40 A, T_J = 25 °C	–	15	–	
		V_{GS} = 15 V, I_D = 40 A, T_J = 175 °C (Note 5)	–	20	–	
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 20 mA, T_J = 25 °C	2.0	2.7	4.0	V
Forward Transconductance	g_{FS}	V_{DS} = 10 V, I_D = 40 A (Note 5)	–	45	–	S
CHARGES, CAPACITANCES & GATE RESISTANCE						
Input Capacitance	C_{ISS}	V_{DS} = 400 V, V_{GS} = 0 V, f = 1 MHz (Note 5)	–	3610	–	pF
Output Capacitance	C_{OSS}		–	281	–	
Reverse Transfer Capacitance	C_{RSS}		–	24	–	
Total Gate Charge	$Q_{G(TOT)}$	V_{DD} = 400 V, I_D = 40 A, V_{GS} = –3/18 V (Note 5)	–	135	–	nC
Gate-to-Source Charge	Q_{GS}		–	35	–	
Gate-to-Drain Charge	Q_{GD}		–	29	–	
Gate Resistance	R_G	f = 1 MHz	–	1.6	–	Ω
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(ON)}$	V_{GS} = –3/18 V, I_D = 40 A, V_{DD} = 400 V, R_G = 4.7 Ω, T_J = 25 °C (Notes 4, 5)	–	5	–	ns
Turn-Off Delay Time	$t_{d(OFF)}$		–	49	–	
Rise Time	t_r		–	23	–	
Fall Time	t_f		–	12	–	
Turn-On Switching Loss	E_{ON}		–	143	–	µJ
Turn-Off Switching Loss	E_{OFF}		–	145	–	
Total Switching Loss	E_{TOT}		–	288	–	

ELECTRICAL CHARACTERISTICS (T_J = 25 °C unless otherwise specified) (continued)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(ON)}$	V_{GS} = –3/18 V, I_D = 40 A, V_{DD} = 400 V, R_G = 4.7 Ω, T_J = 175 °C (Notes 4, 5)	–	3.6	–	ns
Turn-Off Delay Time	$t_{d(OFF)}$		–	60	–	
Rise Time	t_r		–	23	–	
Fall Time	t_f		–	13	–	
Turn-On Switching Loss	E_{ON}		–	142	–	μJ
Turn-Off Switching Loss	E_{OFF}		–	172	–	
Total Switching Loss	E_{TOT}		–	314	–	
SOURCE-TO-DRAIN DIODE CHARACTERISTICS						
Forward Diode Voltage	V_{SD}	I_{SD} = 40 A, V_{GS} = –3 V, T_J = 25 °C	–	4.5	6.0	V
		I_{SD} = 40 A, V_{GS} = –3 V, T_J = 175 °C (Note 5)	–	4.2	–	
Reverse Recovery Time	t_{RR}	V_{GS} = –3 V, I_S = 40 A, dI/dt = 1000 A/μs, V_{DS} = 400 V, T_J = 25 °C (Note 5)	–	26	–	ns
Charge Time	t_a		–	15	–	
Discharge Time	t_b		–	11	–	
Reverse Recovery Charge	Q_{RR}		–	195	–	nC
Reverse Recovery Energy	E_{REC}		–	16	–	μJ
Peak Reverse Recovery Current	I_{RRM}		–	13	–	A

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.

4. E_{ON}/E_{OFF} result is with body diode.
5. Defined by design, not subject to production test.

TYPICAL CHARACTERISTICS

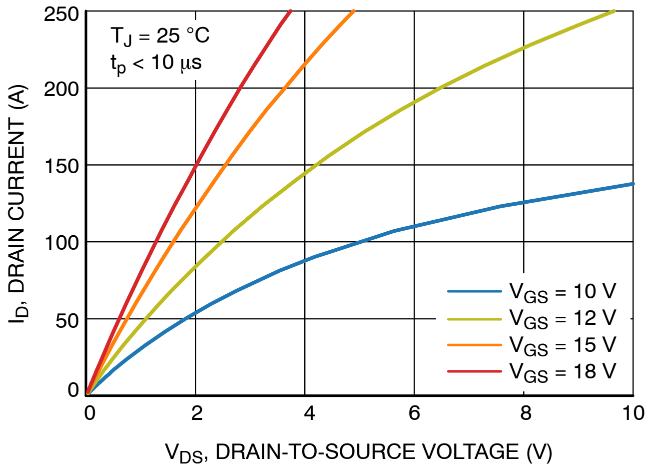


Figure 1. Output Characteristics

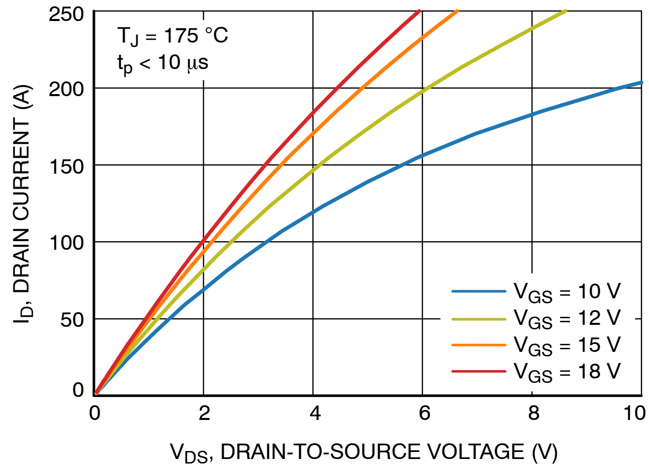


Figure 2. Output Characteristics

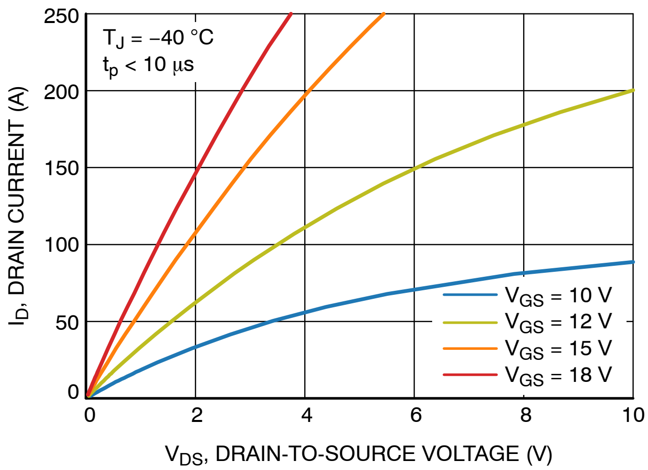


Figure 3. Output Characteristics

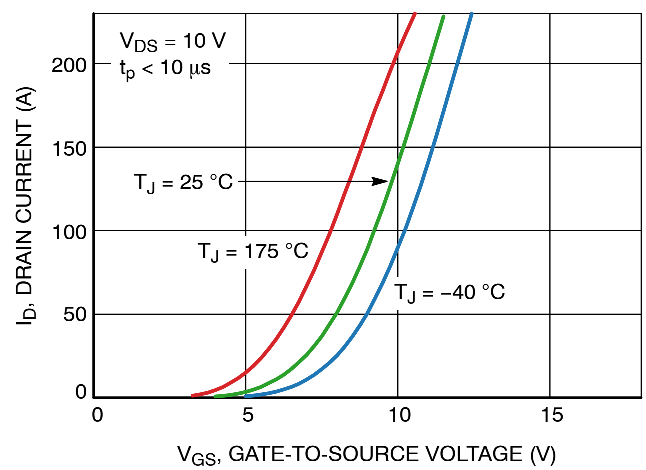


Figure 4. I_D vs. V_{GS}

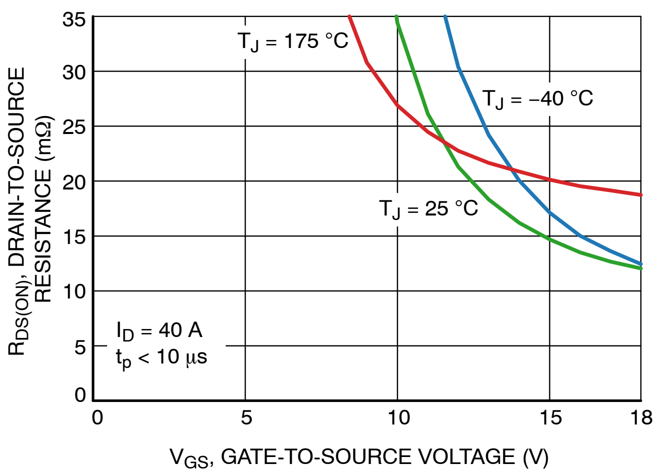


Figure 5. $R_{DS(ON)}$ vs. V_{GS}

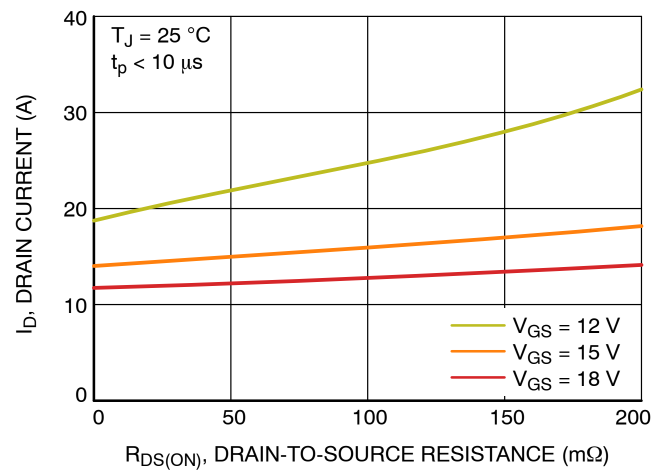


Figure 6. I_D vs. $R_{DS(ON)}$

TYPICAL CHARACTERISTICS

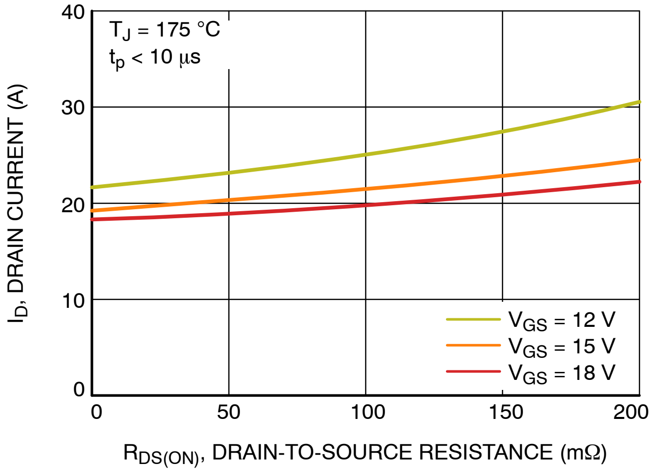


Figure 7. I_D vs. $R_{DS(ON)}$

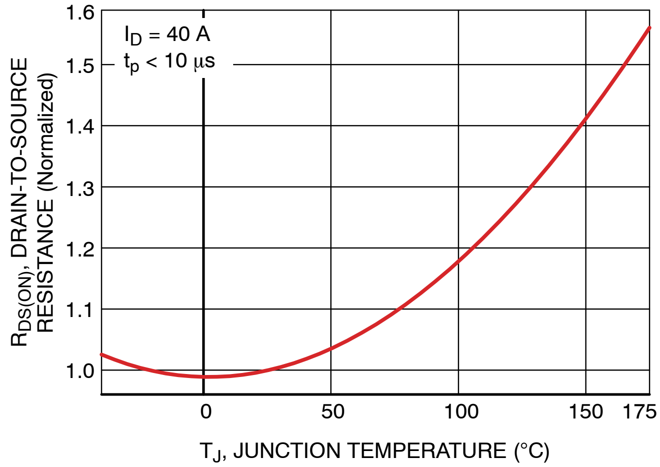


Figure 8. $R_{DS(ON)}$ vs. T_J

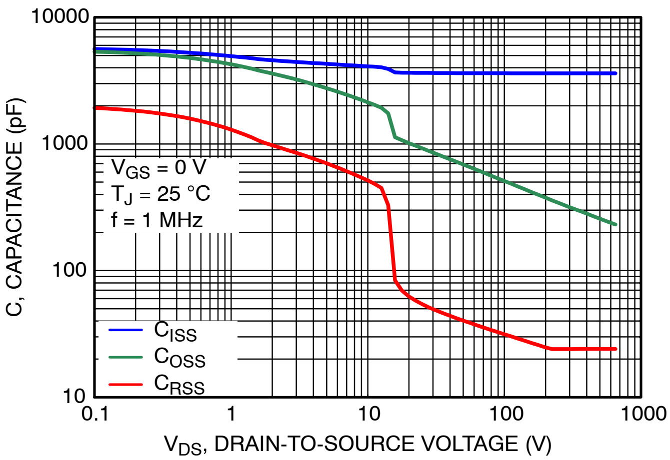


Figure 9. Capacitance Characteristics

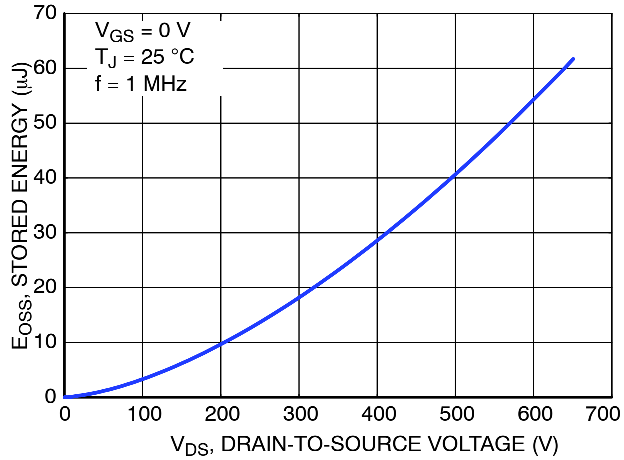


Figure 10. Stored Energy vs. Drain to Source Voltage

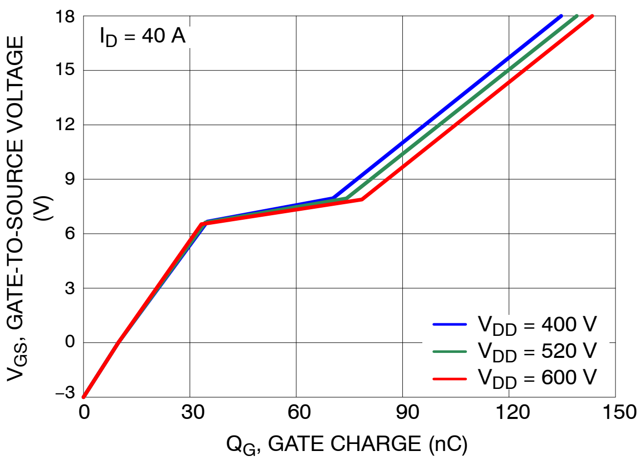


Figure 11. Gate Charge Characteristics

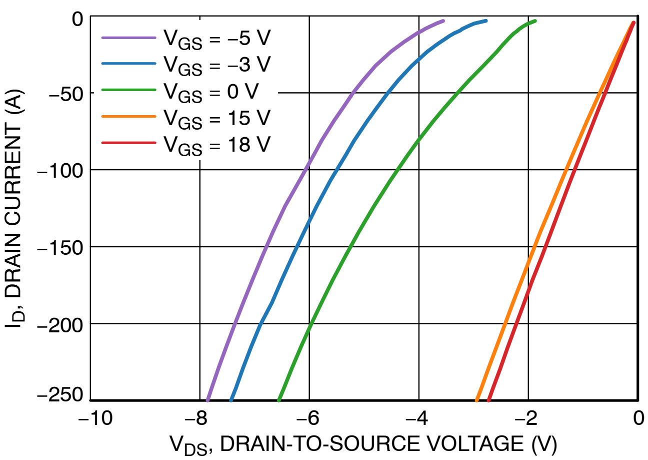


Figure 12. Reverse Conduction Characteristics

TYPICAL CHARACTERISTICS

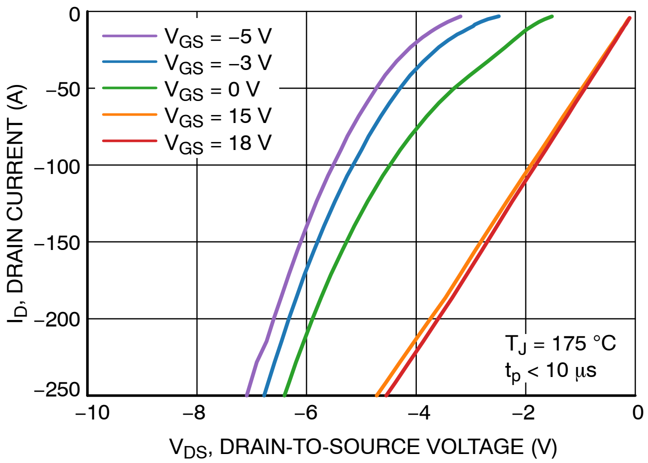


Figure 13. Reverse Conduction Characteristics

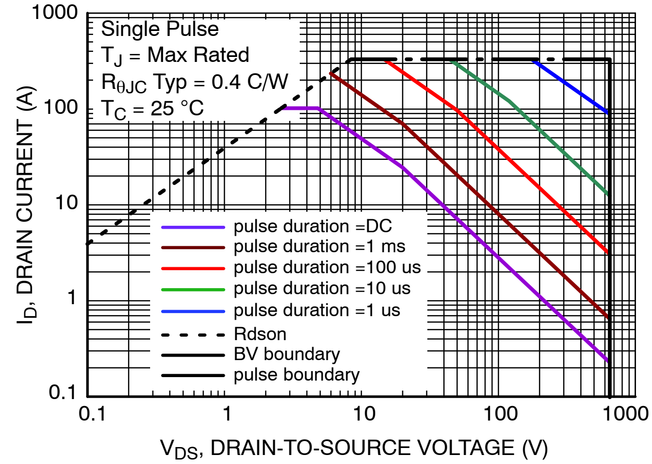


Figure 14. Safe Operating Area

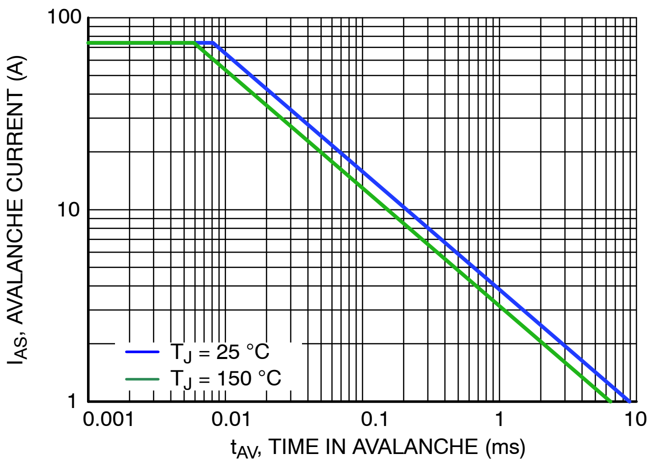


Figure 15. Avalanche Current vs. Pulse Time (UIS)

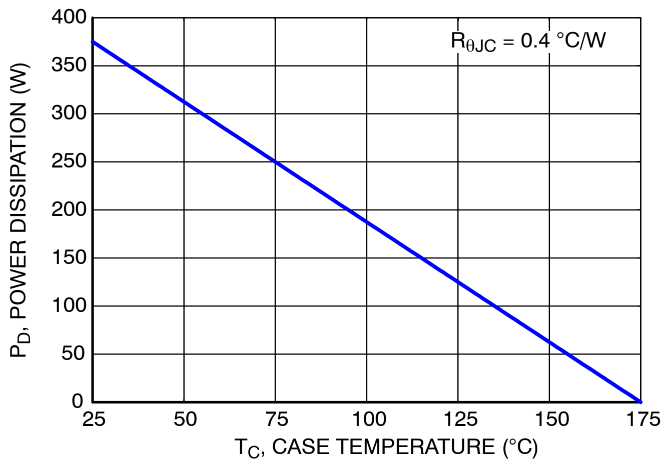


Figure 16. Maximum Power Dissipation vs. Case Temperature

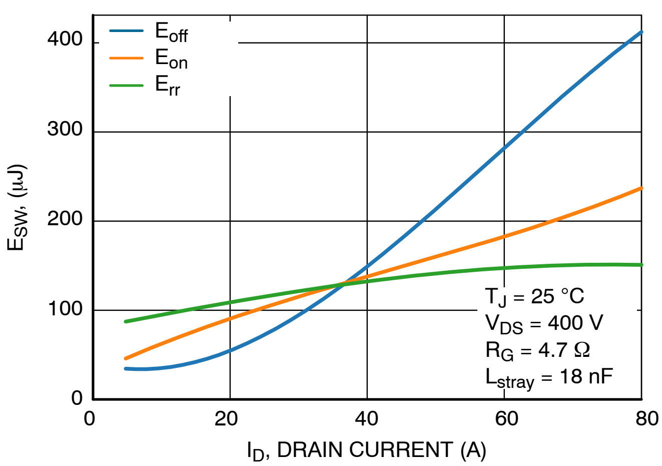


Figure 17. Inductive Switching Loss vs. Drain Current

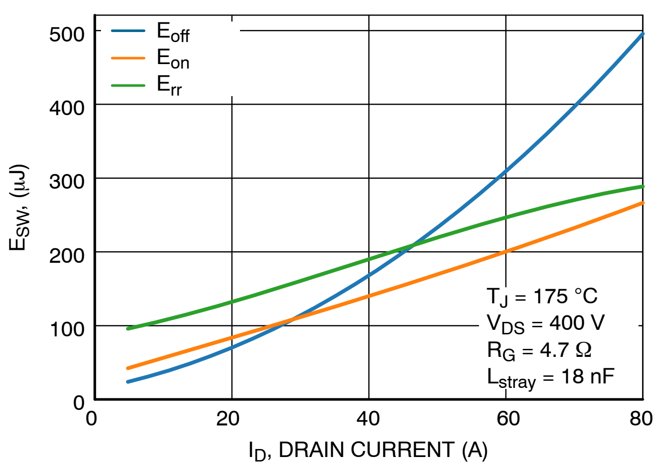


Figure 18. Inductive Switching Loss vs. Drain Current

TYPICAL CHARACTERISTICS

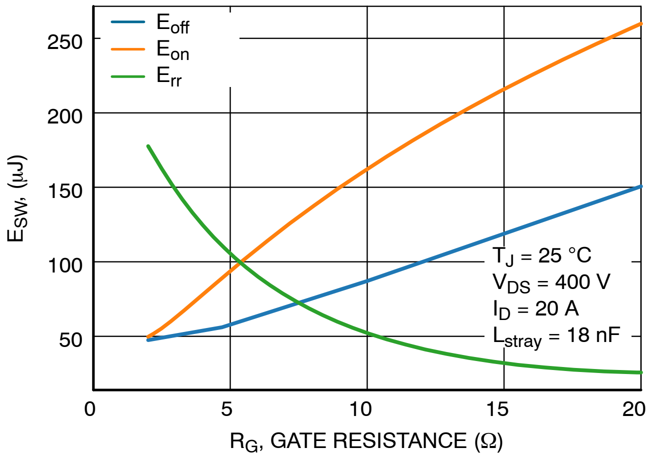


Figure 19. Inductive Switching Loss vs. Gate Resistance

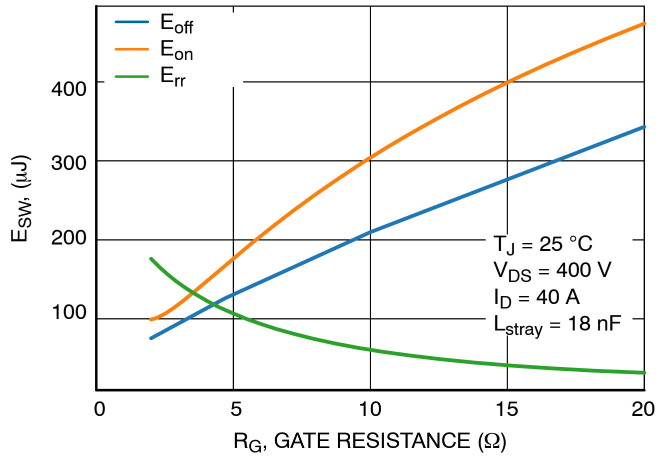


Figure 20. Inductive Switching Loss vs. Gate Resistance

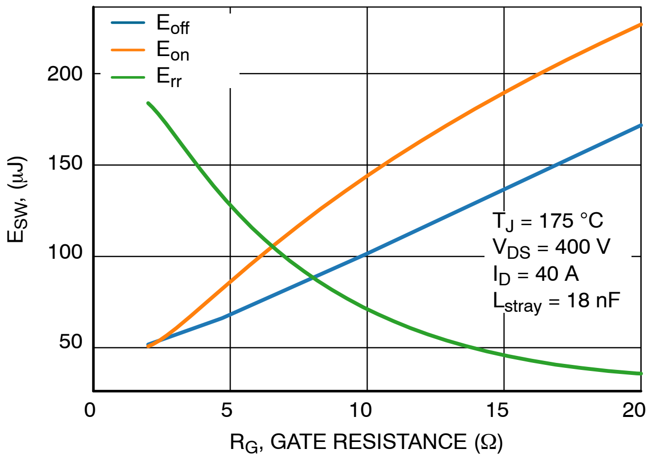


Figure 21. Inductive Switching Loss vs. Gate Resistance

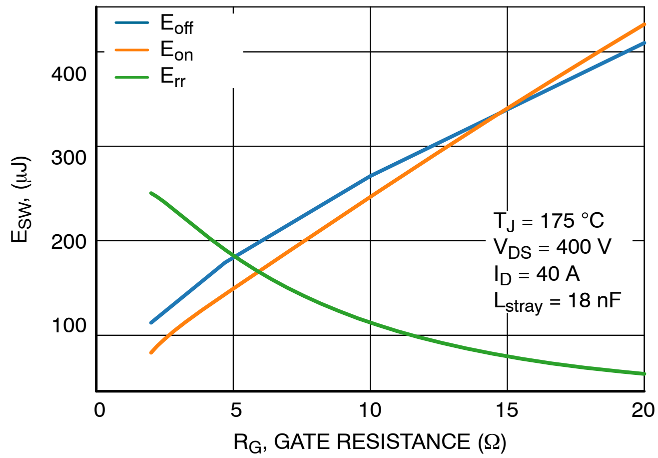


Figure 22. Inductive Switching Loss vs. Gate Resistance

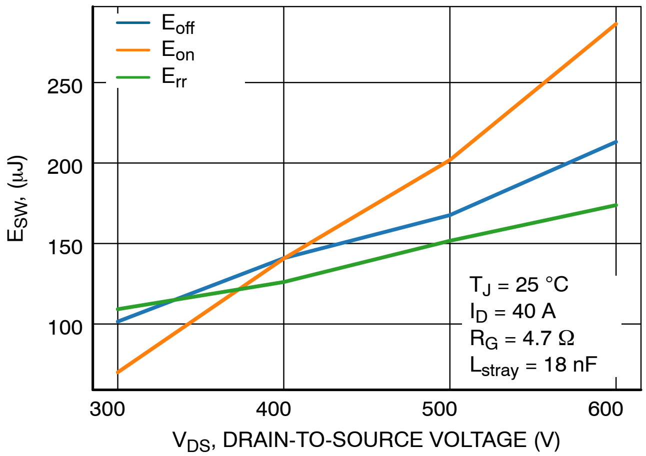


Figure 23. Inductive Switching Loss vs. Drain Voltage

TYPICAL CHARACTERISTICS

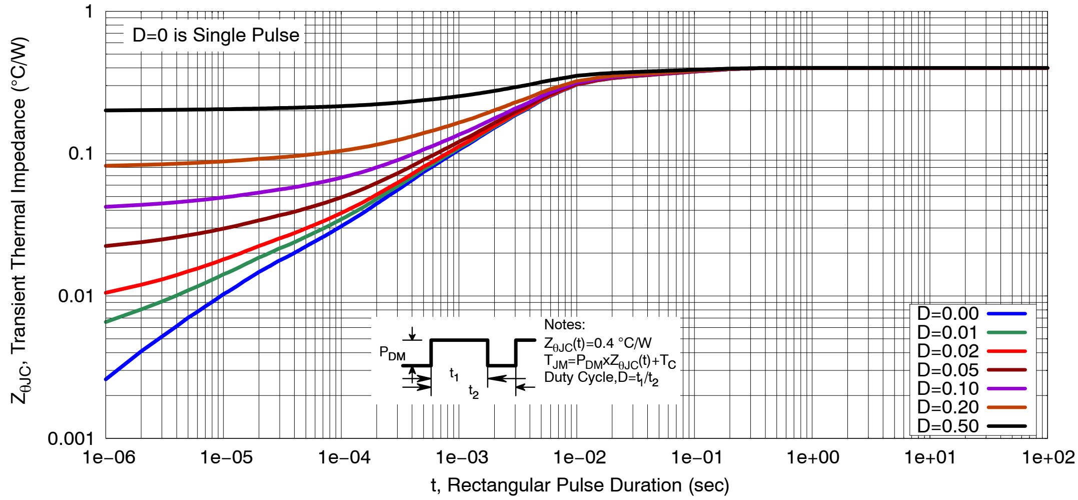


Figure 24. Thermal Response Characteristics

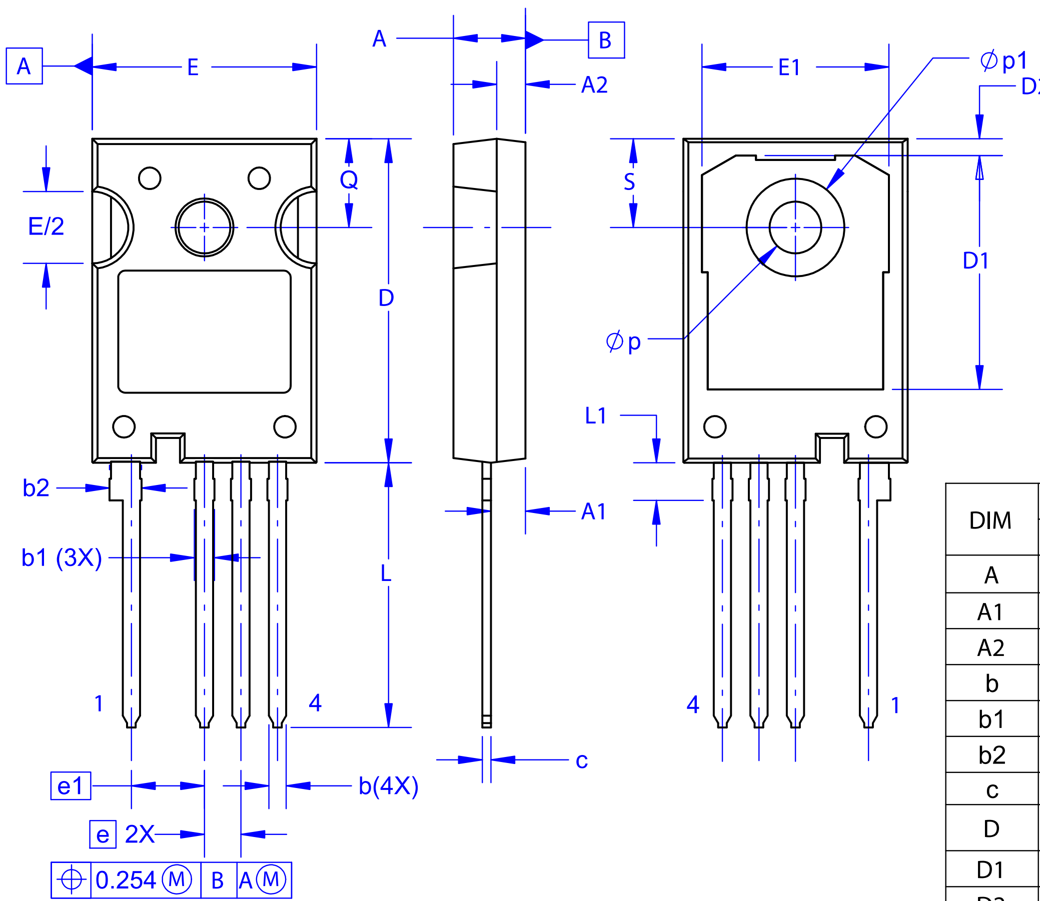
REVISION HISTORY

Revision	Description of Changes	Date
0	Initial data sheet release.	10/30/2025

This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.

PACKAGE DIMENSIONS

TO−247−4LD
CASE 340CJ
ISSUE A



NOTES:

A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
B. DIMENSIONS ARE EXCLUSIVE OF BURRS,MOLD FLASH,AND TIE BAR EXTRUSIONS.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e		2.54 BSC	
e1		5.08 BSC	
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales

◊