DATA SHEET
www.onsemi.com

Silicon Carbide (SiC) MOSFET – EliteSiC, 12.7 mohm, 650 V, M3S, T2PAK

NVT2012N065M3S

Features

- Typ. $R_{DS(on)}$ = 12.7 mΩ @ V_{GS} = 18 V
- Low Effective Output Capacitance
- Ultra Low Gate Charge
- 100% UIS Tested
- Qualified According to AECQ101
- RoHS Compliant

Applications

- Automotive On and Off Board Charger
- Automotive DC-DC Converter for EV-HEV

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

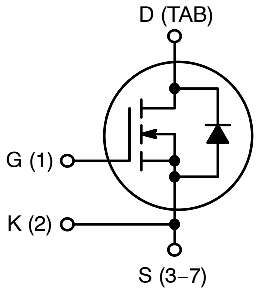
Parameter		Symbol	Value	Unit
Drain-to-Source Voltage		V_{DSS}	650	V
Gate-to-Source Voltage		V_{GS}	−10/+22	V
Continuous Drain Current	T_C = 25 °C	I_D	112	A
Power Dissipation		P_D	429	W
Continuous Drain Current	T_C = 100 °C	I_D	81	A
Power Dissipation		P_D	214	W
Pulsed Drain Current (Note 1)	T_C = 25 °C t_p = 100 μs	I_{DM}	237	A
Continuous Source-Drain Current (Body Diode)	T_C = 25 °C V_{GS} = −3 V	I_S	64	A
	T_C = 100 °C V_{GS} = −3 V		38	
Pulsed Source-Drain Current (Body Diode) (Note 1)	T_C = 25 °C V_{GS} = −3 V t_p = 100 μs	I_{SM}	259	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	245	°C

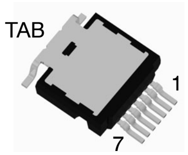
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Single pulse, limited by max junction temperature.
2. E_{AS} 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.

$V_{(BR)DSS}$	$R_{DS(ON)}$ TYP	I_D MAX
650 V	12.7 mΩ @ V_{GS} = 18 V	112 A

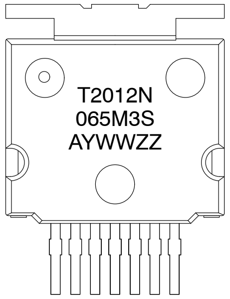
N-CHANNEL MOSFET





T2PAK
CASE 763AC

MARKING DIAGRAM



NVT2012N065M3S = Specific Device Code
A = Assembly Site
WW = Work Week Number
Y = Year of Production, Last Number
ZZ = Assembly Lot Number, Last Two Numbers

ORDERING INFORMATION

Device	Package	Shipping†
NVT2012N065M3S	T2PAK-7L	800 / Tape & Reel

† For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

October, 2025 − Rev. 2

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Note 3)	$R_{\theta JC}$	0.35	°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 OPERTATING 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
Drain-to-Source Breakdown Voltage Temperature Coefficient	$\Delta V_{(BR)DSS}/\Delta T_J$	I_D = 1 mA, Referenced to 25 °C (Note 5)	–	86	–	mV/°C
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 V, 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	–	12.7	16.8	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)	–	26	–	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, L_{stray} = 13 nH, T_J = 25 °C (Notes 4, 5)	–	38	–	ns
Turn-Off Delay Time	$t_{d(OFF)}$		–	48	–	
Rise Time	t_r		–	17.7	–	
Fall Time	t_f		–	10.9	–	
Turn-On Switching Loss	E_{ON}		–	179	–	µJ
Turn-Off Switching Loss	E_{OFF}		–	95	–	
Total Switching Loss	E_{TOT}		–	274	–	

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

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, L_{stray} = 13 nH, T_J = 175 °C (Notes 4, 5)	–	29	–	ns
Turn-Off Delay Time	$t_{d(OFF)}$		–	67	–	
Rise Time	t_r		–	18	–	
Fall Time	t_f		–	12	–	
Turn-On Switching Loss	E_{ON}		–	178	–	μJ
Turn-Off Switching Loss	E_{OFF}		–	110	–	
Total Switching Loss	E_{TOT}		–	288	–	
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

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

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

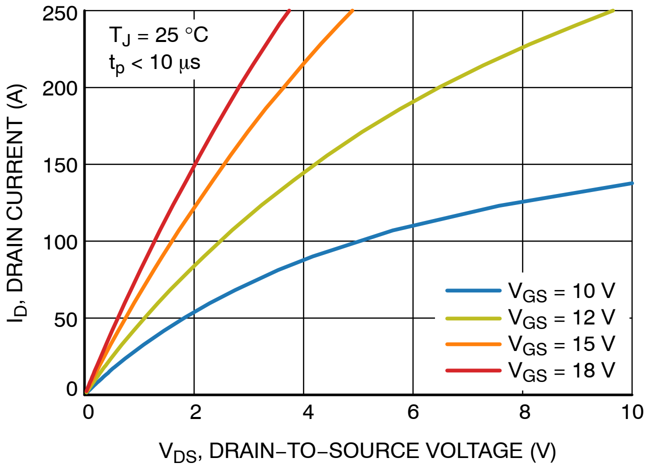


Figure 1. Output Characteristics

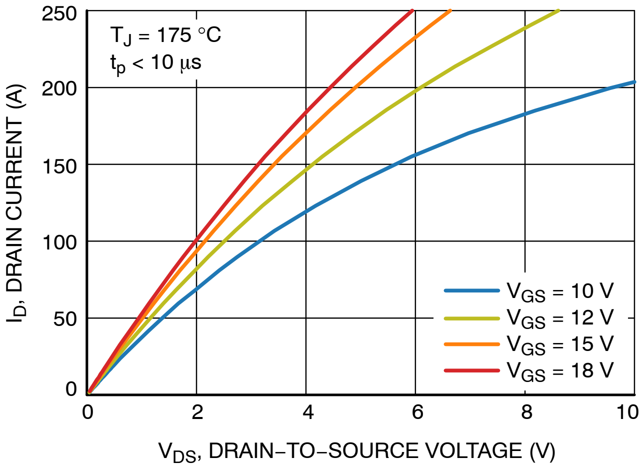


Figure 2. Output Characteristics

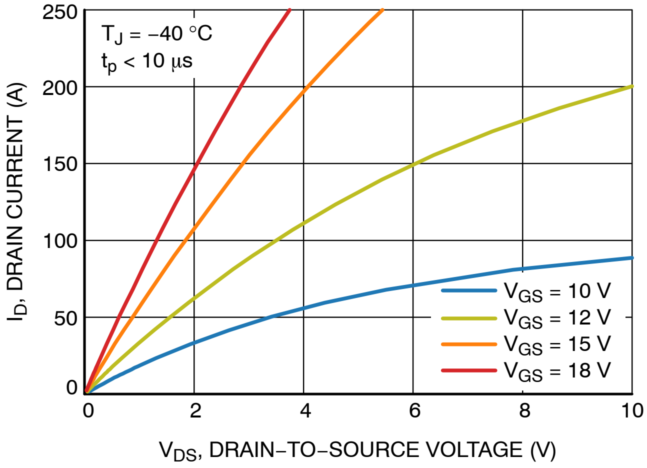


Figure 3. Output Characteristics

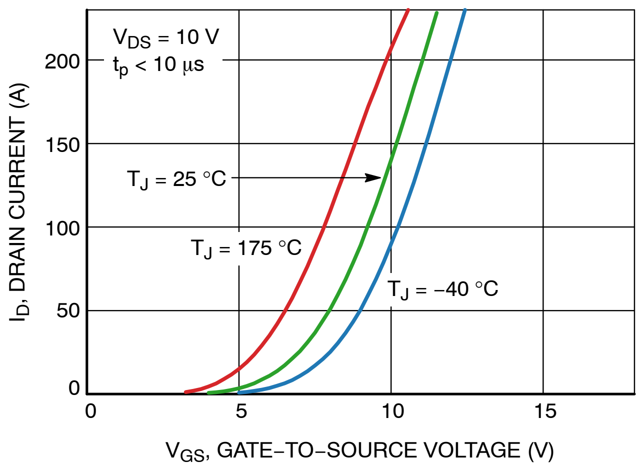


Figure 4. I_D vs. V_{GS}

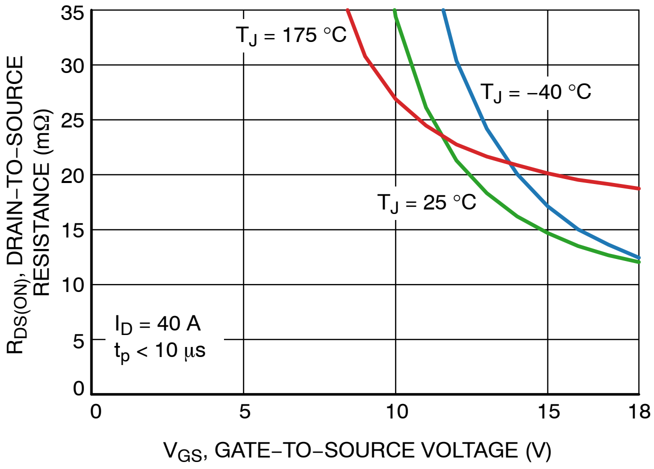


Figure 5. $R_{DS(ON)}$ vs. V_{GS}

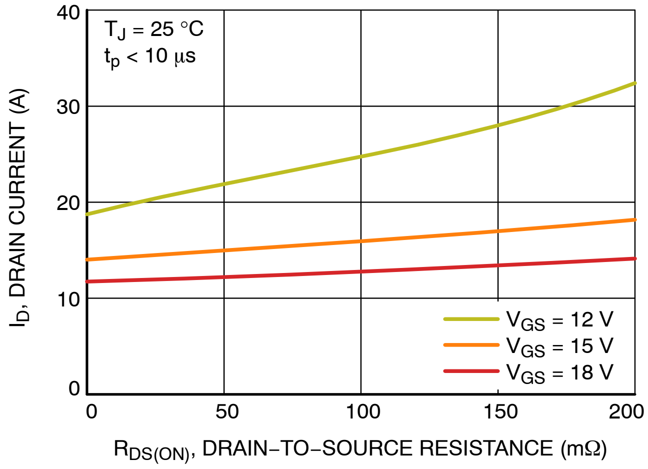


Figure 6. I_D vs. $R_{DS(ON)}$

TYPICAL CHARACTERISTICS

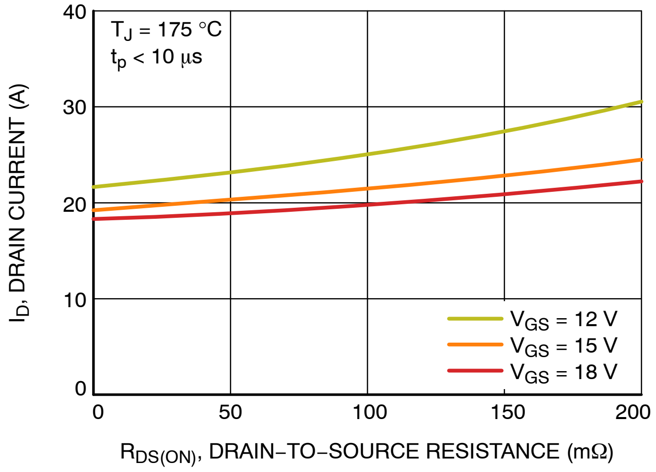


Figure 7. I_D vs. $R_{DS(ON)}$

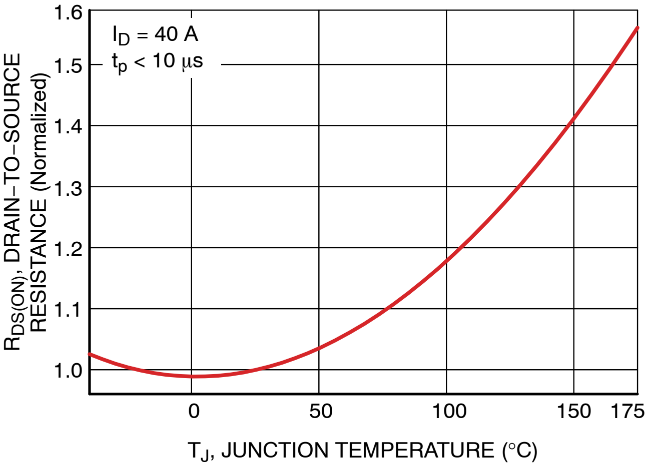


Figure 8. $R_{DS(ON)}$ vs. T_J

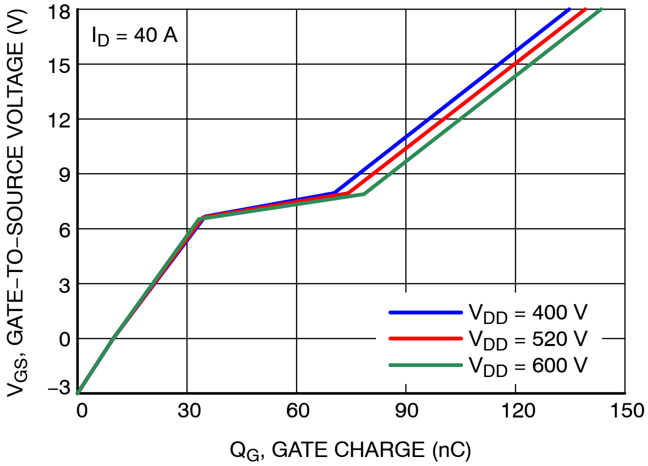


Figure 9. Gate Charge Characteristics

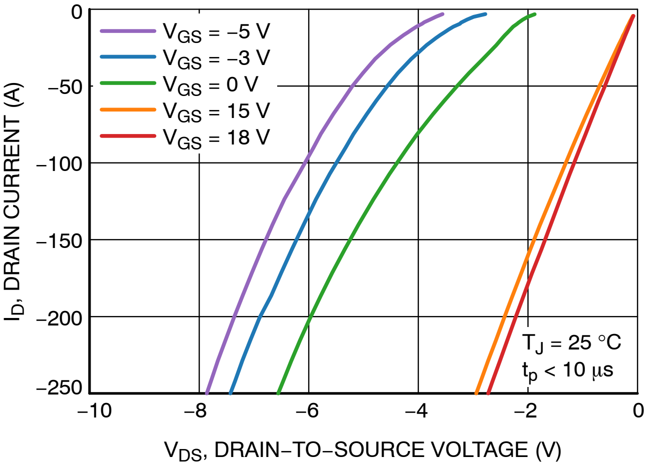


Figure 10. I_D vs. V_{DS}

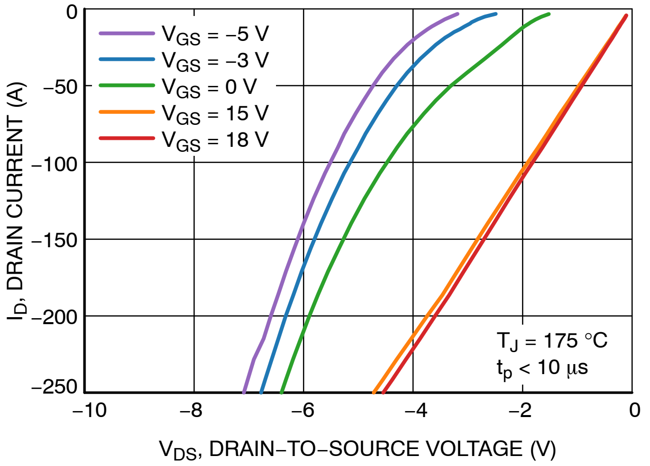


Figure 11. I_D vs. V_{DS}

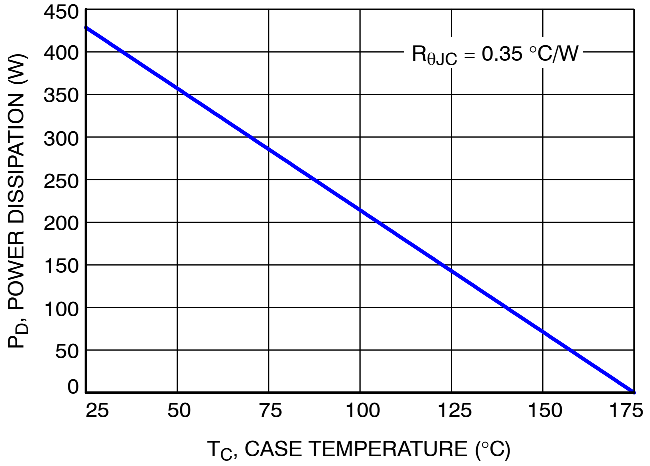


Figure 12. Maximum Power Dissipation vs. Case Temperature

TYPICAL CHARACTERISTICS

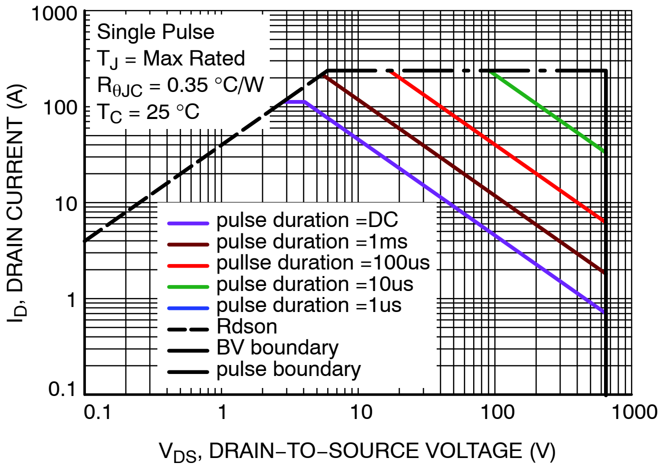


Figure 13. Safe Operating Area

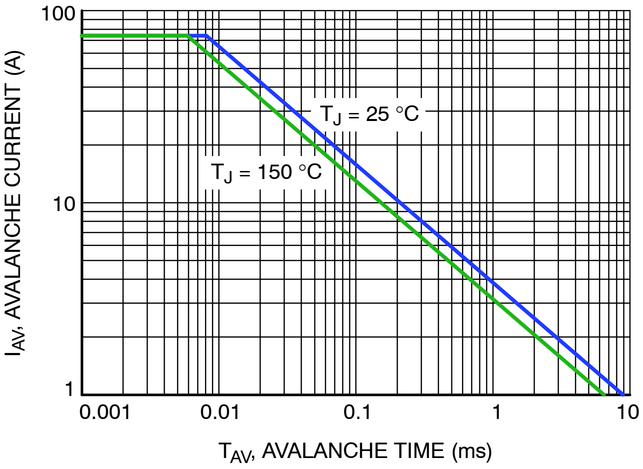


Figure 14. Avalanche Current vs. Pulse Time (UIS)

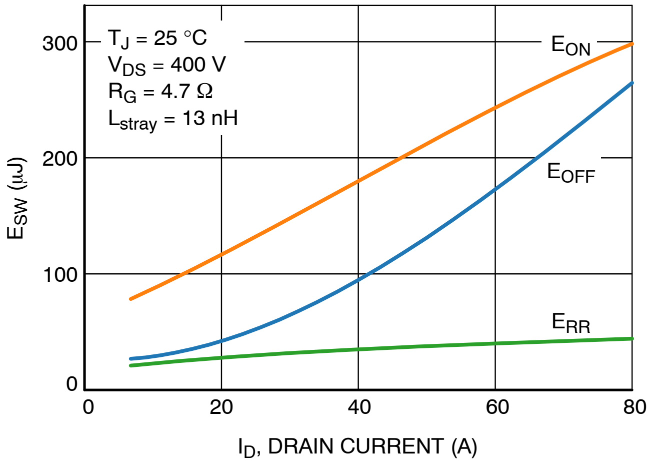


Figure 15. E_{SW} vs. I_D

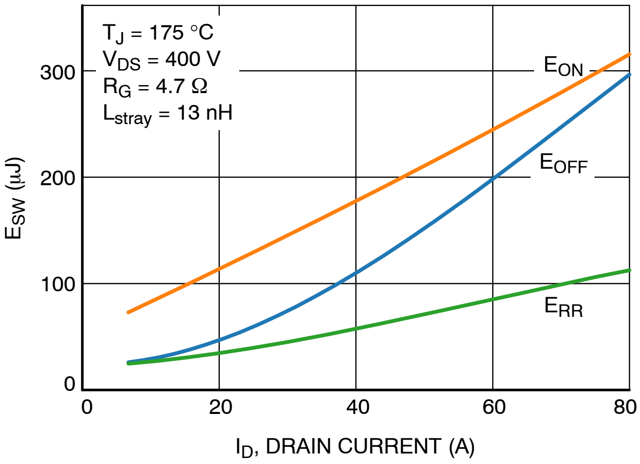


Figure 16. E_{SW} vs. I_D

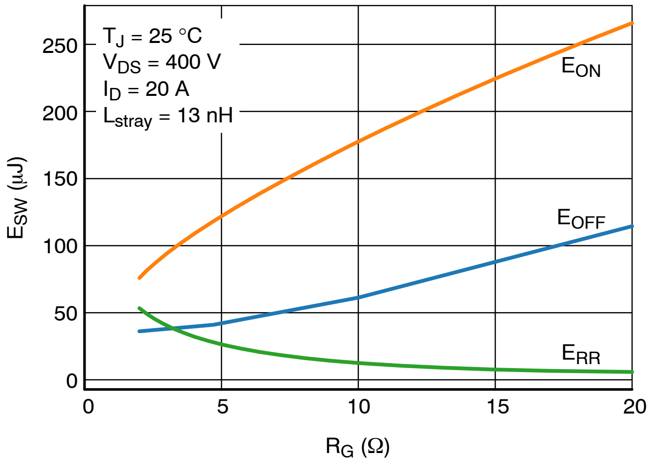


Figure 17. E_{SW} vs. R_G

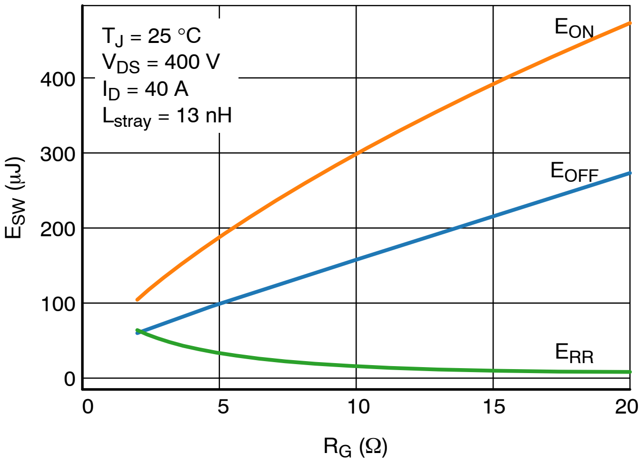


Figure 18. E_{SW} vs. R_G

TYPICAL CHARACTERISTICS

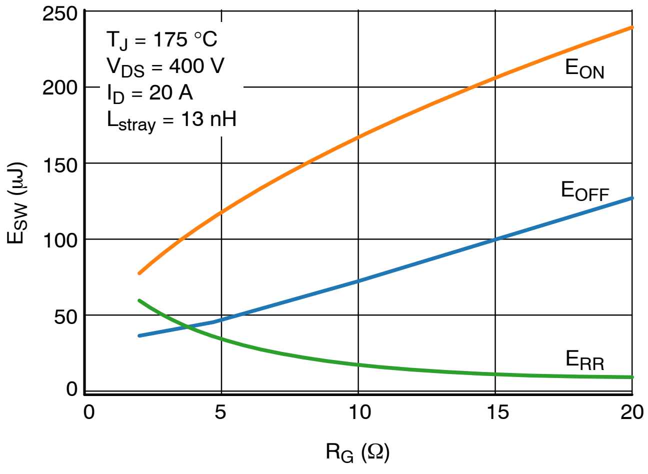


Figure 19. E_{SW} vs. R_G

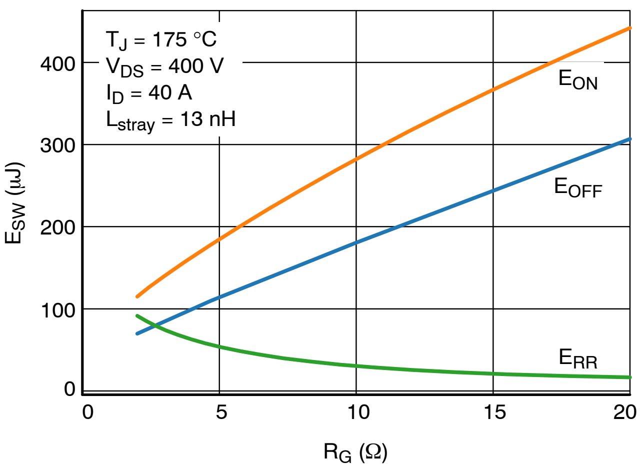


Figure 20. E_{SW} vs. R_G

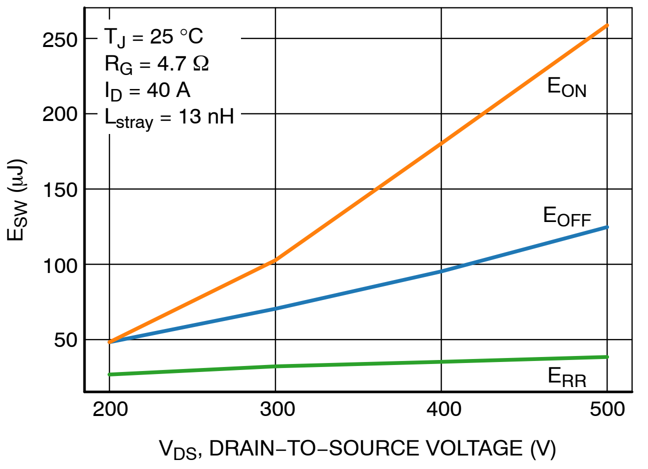


Figure 21. E_{SW} vs. V_{DS}

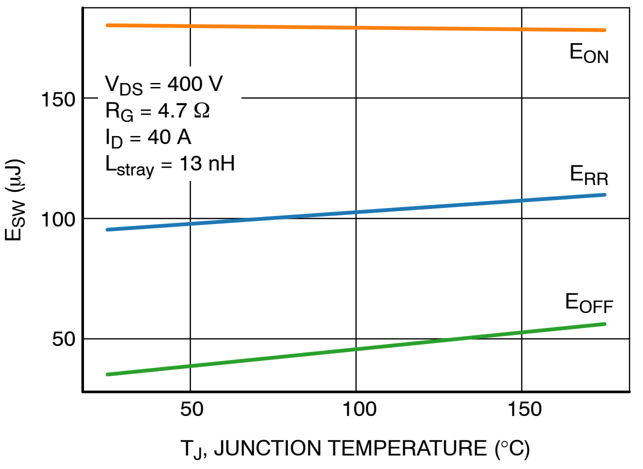
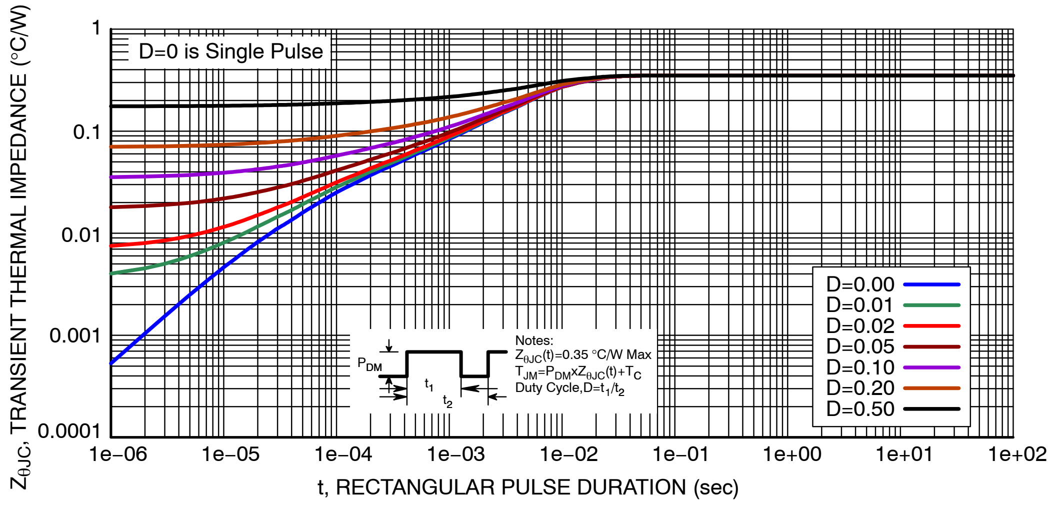


Figure 22. E_{SW} vs. T_J



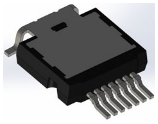
Notes:
$Z_{\theta JC}(t)$=0.35 °C/W Max
$T_{JM}=P_{DM} x Z_{\theta JC}(t)+T_C$
Duty Cycle,$D=t_1/t_2$

Figure 23. Transient Thermal Response

REVISION HISTORY

Revision	Description of Changes	Date
0	Initial data sheet release	9/29/2025
1	Figure 16 update	10/16/2025
2	Typ. $R_{DS(on)}$ update in the Features section on the front page	10/29/2025

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS



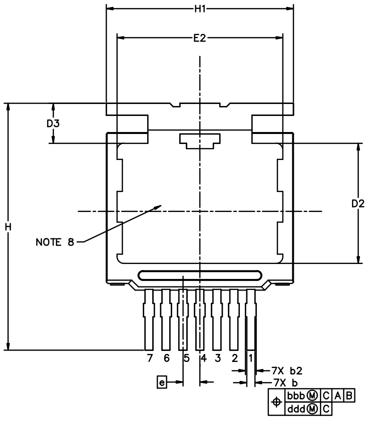
T2PAK-7 11.80x14.00x3.50, 1.27P
CASE 763AC
ISSUE A

DATE 20 JUN 2025

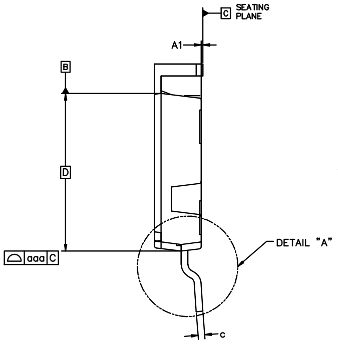
NOTES:
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b, b2, b3 AND c TO BE MEASURED ON FLAT SECTION OF THE LEAD BETWEEN 0.13 AND 0.25mm FROM LEAD TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. POSITIONAL TOLERANCE APPLIES TO THE TERMINALS AND EXPOSED PAD.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
7. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
8. ALLOWABLE ENCROACHED FLASH ON HEAT SINK AREA MAXIMUM OF 0.05mm.
9. EJECTOR PINS ⌀12.5mm REF.

	MILLIMETERS		
DIM	MIN	NOM	MAX
A	3.53	3.63	3.73
A1	0.07	0.13	0.18
A2	3.40	3.50	3.60
b	0.50	0.60	0.70
b2	0.50	0.75	1.00
b3	0.80	0.90	1.00
c	0.40	0.50	0.60
c2	0.40	0.50	0.60
D	11.80 BSC		
D2	8.90	9.00	9.10
D3	3.00	3.10	3.20
D4	3.80	3.90	4.00
D5	2.10	2.20	2.30
E	14.00 BSC		
E2	12.30	12.40	12.50
e	1.27 BSC		

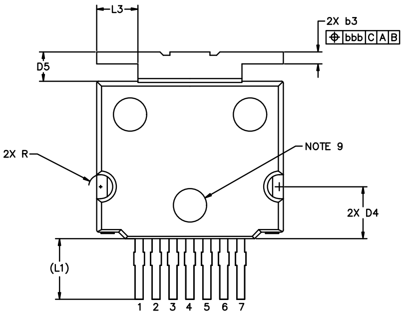
	MILLIMETERS		
DIM	MIN	NOM	MAX
H	18.00	18.50	19.00
H1	13.80	14.00	14.20
L	2.42	2.52	2.62
L1	4.53 REF		
L2	0.25 BSC		
L3	3.00	3.10	3.20
R	0.80	---	1.00
Θ	0°	---	8°
Θ1	0°	---	8°
TOLERANCE FORM AND POSITION			
aaa	0.10		
bbb	0.10		
ccc	0.10		
ddd	0.05		
eee	0.05		



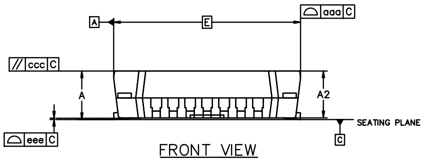
TOP VIEW



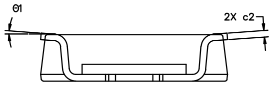
SIDE VIEW



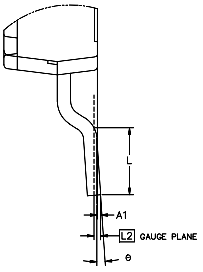
BOTTOM VIEW



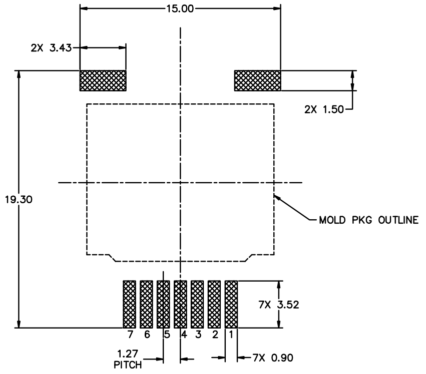
FRONT VIEW



END VIEW



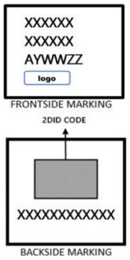
DETAIL "A"
SCALE 2:1



RECOMMENDED MOUNTING FOOTPRINT

*For additional information on our Pb−Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



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

*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:	**98AON60982H**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	**T2PAK-7 11.80x14.00x3.50, 1.27P**	**PAGE 1 OF 1**

onsemi, onsemi, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba “**onsemi**” or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**’s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided “as−is” and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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 **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. “Typical” parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** 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 **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

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