

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

NTT2012N065M3S

Features

- Typical $R_{DS(on)} = 12.7 \text{ m}\Omega$ @ $V_{GS} = 18 \text{ V}$
- Ultra Low Gate Charge ($Q_{G(tot)} = 135 \text{ nC}$)
- High Speed Switching with Low Capacitance ($C_{oss} = 281 \text{ pF}$)
- 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 ($T_J = 25^\circ\text{C}$ unless otherwise noted)

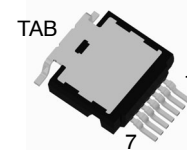
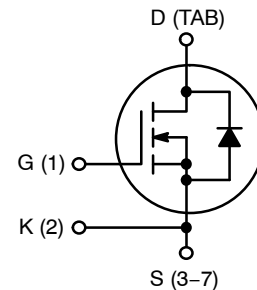
Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	V_{DSS}	650	V
Gate-to-Source Voltage	V_{GS}	-10/+22	V
Continuous Drain Current	$T_C = 25^\circ\text{C}$	I_D	112
Power Dissipation		P_D	429
Continuous Drain Current	$T_C = 100^\circ\text{C}$	I_D	81
Power Dissipation		P_D	214
Pulsed Drain Current (Note 1)	$T_C = 25^\circ\text{C}$ $t_p = 100 \mu\text{s}$	I_{DM}	237
Continuous Source-Drain Current (Body Diode)	$T_C = 25^\circ\text{C}$ $V_{GS} = -3 \text{ V}$	I_S	64
	$T_C = 100^\circ\text{C}$ $V_{GS} = -3 \text{ V}$		38
Pulsed Source-Drain Current (Body Diode) (Note 1)	$T_C = 25^\circ\text{C}$ $V_{GS} = -3 \text{ V}$ $t_p = 100 \mu\text{s}$	I_{SM}	259
Single Pulse Avalanche Energy ($I_{LPK} = 72 \text{ A}$, $L = 0.1 \text{ mH}$) (Note 2)	E_{AS}	259	mJ
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to +175	$^\circ\text{C}$
Lead Temperature for Soldering Purposes (1/8" from case for 10 seconds)	T_L	245	$^\circ\text{C}$

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. Single pulse, limited by max junction temperature.
2. E_{AS} of 259 mJ is based on starting $T_J = 25^\circ\text{C}$, $L = 0.1 \text{ mH}$, $I_{AS} = 72 \text{ A}$, $V_{DD} = 100 \text{ V}$, $V_{GS} = 18 \text{ V}$.

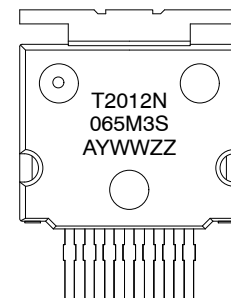
$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	I_D MAX
650 V	12.7 m Ω @ $V_{GS} = 18 \text{ V}$	112 A

N-CHANNEL MOSFET



T2PAK
CASE 763AC

MARKING DIAGRAM



NTT2012N065M3S = 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†
NTT2012N065M3S	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](http://www.onsemi.com/BRD8011/D).

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 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 ($T_J = 25\text{ °C}$ unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25\text{ °C}$	650	-	-	V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$\Delta V_{(BR)DSS} / \Delta T_J$	$I_D = 1\text{ mA}$, Referenced to 25 °C (Note 5)	-	86	-	mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 650\text{ V}, T_J = 25\text{ °C}$	-	-	10	μA
		$V_{DS} = 650\text{ V}, T_J = 175\text{ °C}$ (Note 5)	-	-	500	μA
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = -10\text{ V}, V_{DS} = 0\text{ V}$	-1	-	-	μA
		$V_{GS} = +22\text{ V}, V_{DS} = 0\text{ V}$	-	-	1	μA

ON CHARACTERISTICS

Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 25\text{ °C}$	-	12.7	16.8	mΩ
		$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 175\text{ °C}$ (Note 5)	-	18	-	
		$V_{GS} = 15\text{ V}, I_D = 40\text{ A}, T_J = 25\text{ °C}$	-	15	-	
		$V_{GS} = 15\text{ V}, I_D = 40\text{ A}, T_J = 175\text{ °C}$ (Note 5)	-	20	-	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 20\text{ mA}, T_J = 25\text{ °C}$	2.0	2.7	4.0	V
Forward Transconductance	g_{FS}	$V_{DS} = 10\text{ V}, I_D = 40\text{ A}$ (Note 5)	-	26	-	S

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ (Note 5)	-	3610	-	pF
Output Capacitance	C_{OSS}		-	281	-	
Reverse Transfer Capacitance	C_{RSS}		-	24	-	
Total Gate Charge	$Q_{G(TOT)}$	$V_{DD} = 400\text{ V}, I_D = 40\text{ A}, V_{GS} = -3/18\text{ V}$ (Note 5)	-	135	-	nC
Gate-to-Source Charge	Q_{GS}		-	35	-	
Gate-to-Drain Charge	Q_{GD}		-	29	-	
Gate Resistance	R_G	$f = 1\text{ MHz}$	-	1.6	-	Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -3/18\text{ V}, I_D = 40\text{ A}, V_{DD} = 400\text{ V}, R_G = 4.7\text{ Ω}, L_{stray} = 13\text{ nH}, T_J = 25\text{ °C}$ (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.

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -3/18\text{ V}$, $I_D = 40\text{ A}$, $V_{DD} = 400\text{ V}$, $R_G = 4.7\text{ }\Omega$, $L_{stray} = 13\text{ nH}$, $T_J = 175\text{ }^{\circ}\text{C}$ (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}	$I_{SD} = 40\text{ A}$, $V_{GS} = -3\text{ V}$, $T_J = 25\text{ }^{\circ}\text{C}$	–	4.5	6.0	V
		$I_{SD} = 40\text{ A}$, $V_{GS} = -3\text{ V}$, $T_J = 175\text{ }^{\circ}\text{C}$ (Note 5)	–	4.2	–	
Reverse Recovery Time	t_{RR}	$V_{GS} = -3\text{ V}$, $I_S = 40\text{ A}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $V_{DS} = 400\text{ V}$, $T_J = 25\text{ }^{\circ}\text{C}$ (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

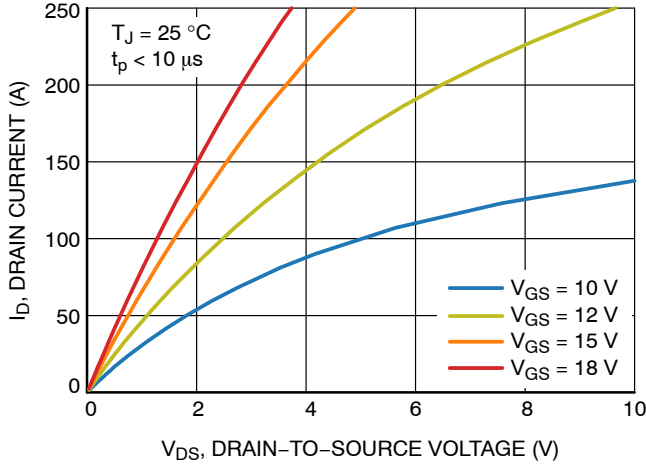


Figure 1. Output Characteristics

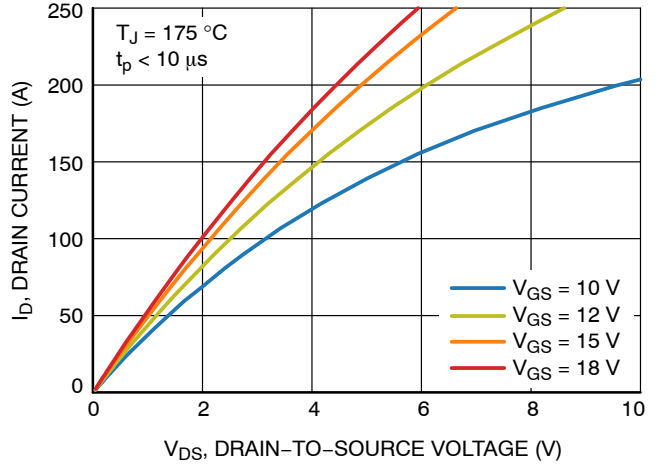


Figure 2. Output Characteristics

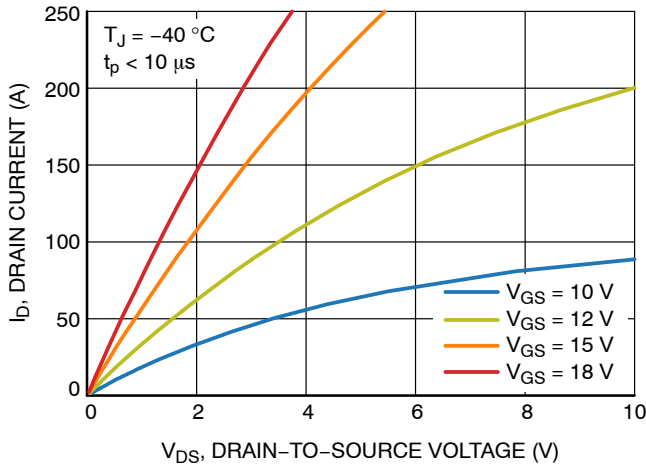


Figure 3. Output Characteristics

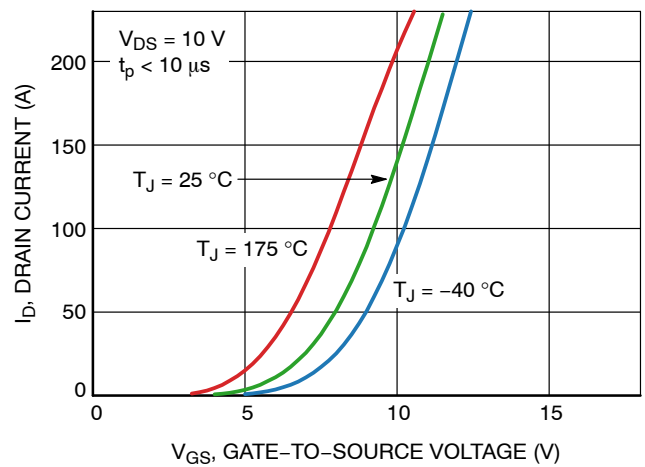


Figure 4. I_D vs. V_{GS}

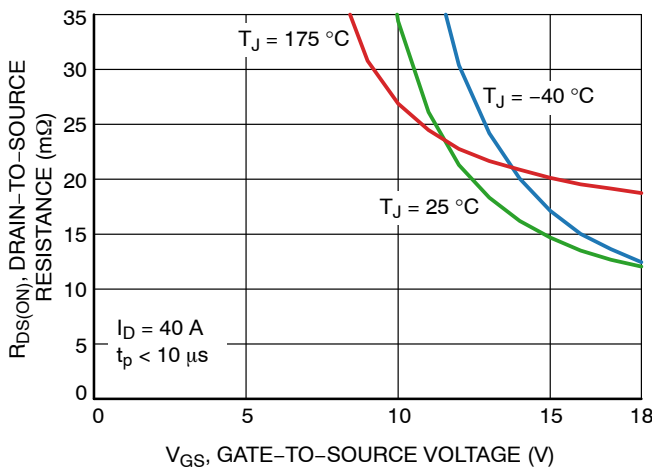


Figure 5. $R_{DS(ON)}$ vs. V_{GS}

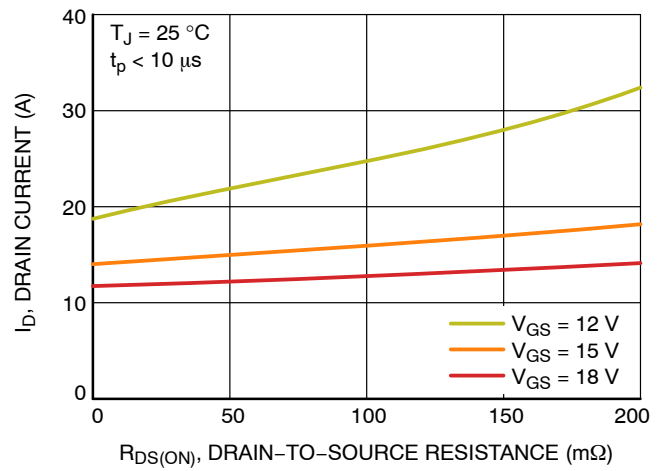


Figure 6. I_D vs. $R_{DS(ON)}$

TYPICAL CHARACTERISTICS

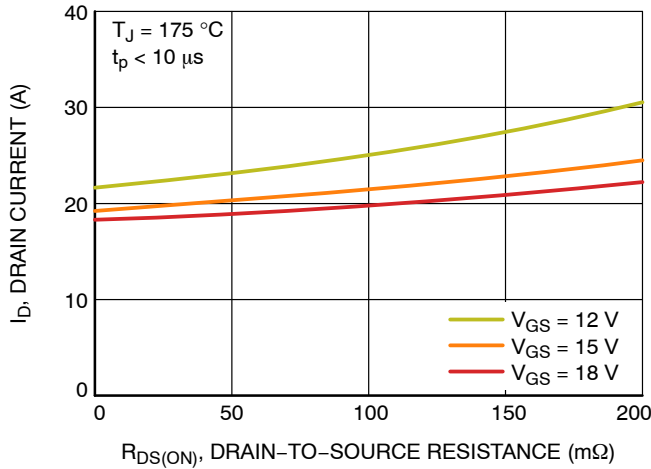


Figure 7. I_D vs. $R_{DS(ON)}$

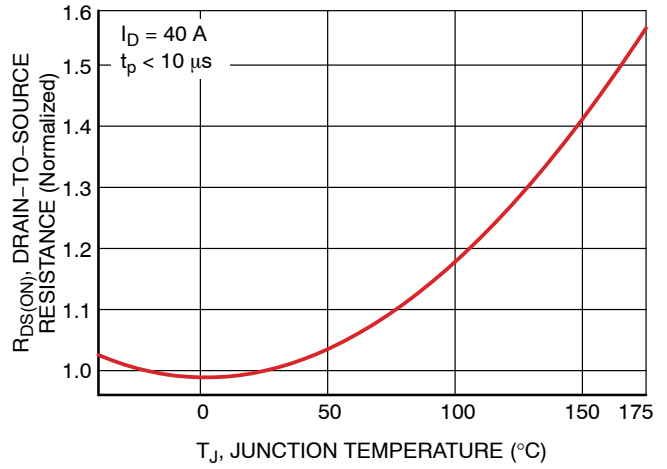


Figure 8. $R_{DS(ON)}$ vs. T_J

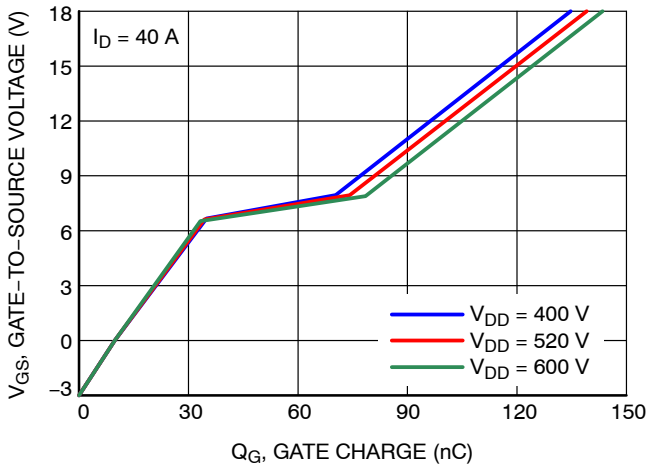


Figure 9. Gate Charge Characteristics

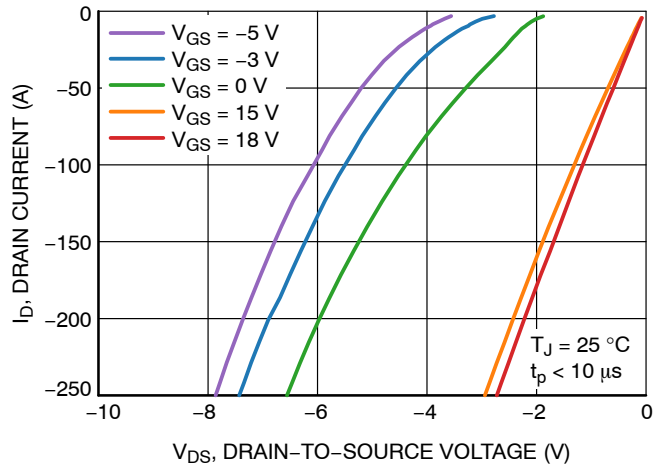


Figure 10. I_D vs. V_{DS}

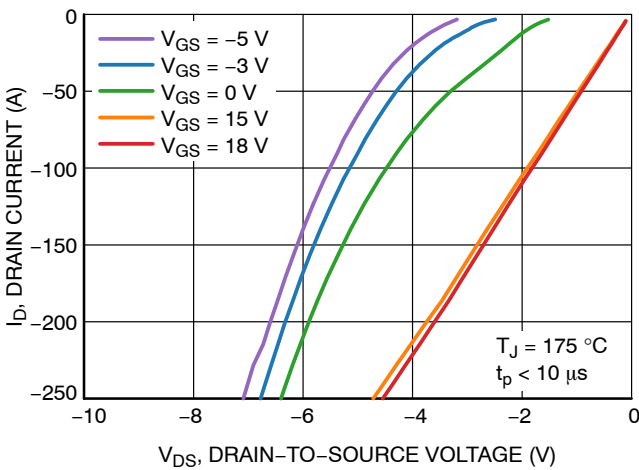


Figure 11. I_D vs. V_{DS}

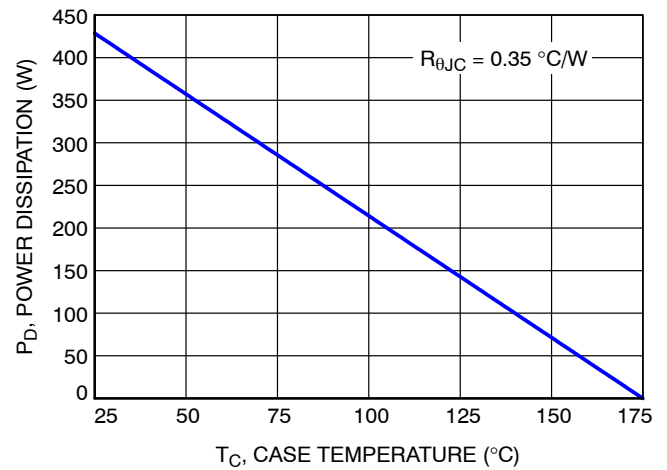


Figure 12. Maximum Power Dissipation vs. Case Temperature

TYPICAL CHARACTERISTICS

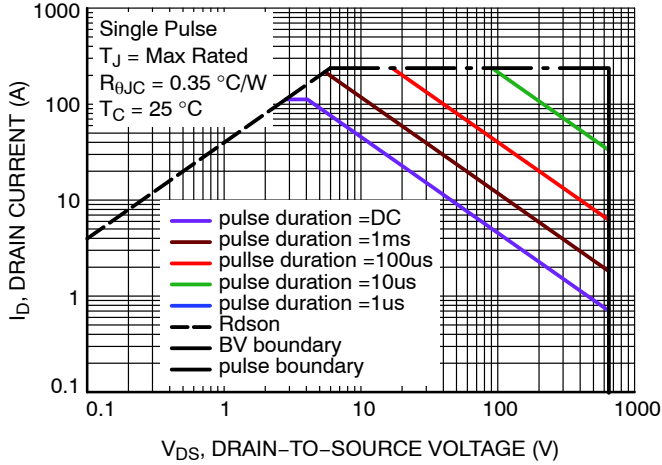


Figure 13. Safe Operating Area

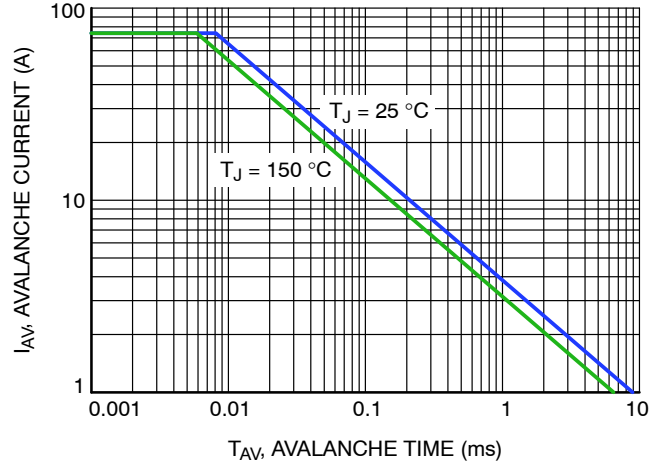


Figure 14. Avalanche Current vs. Pulse Time (UIS)

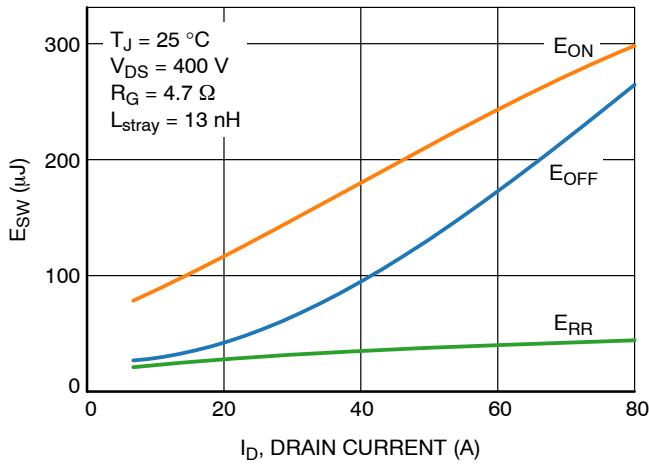


Figure 15. E_{SW} vs. I_D

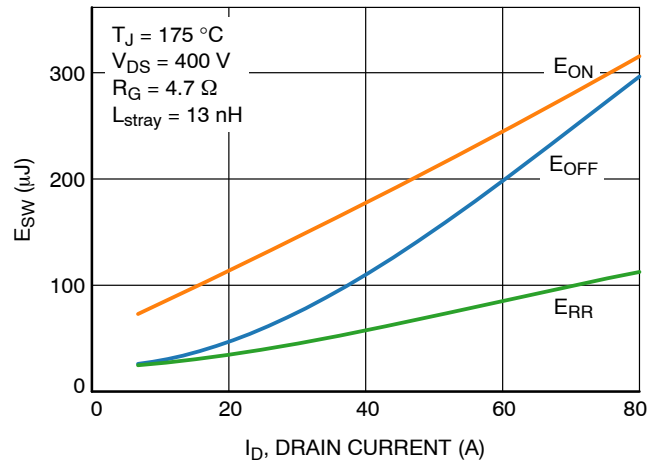


Figure 16. E_{SW} vs. I_D

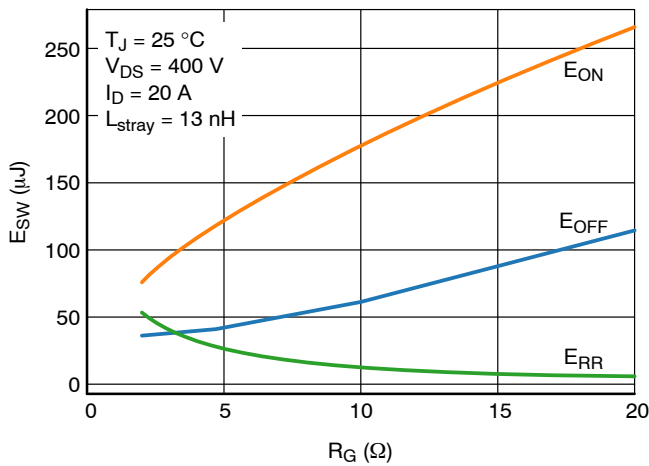


Figure 17. E_{SW} vs. R_G

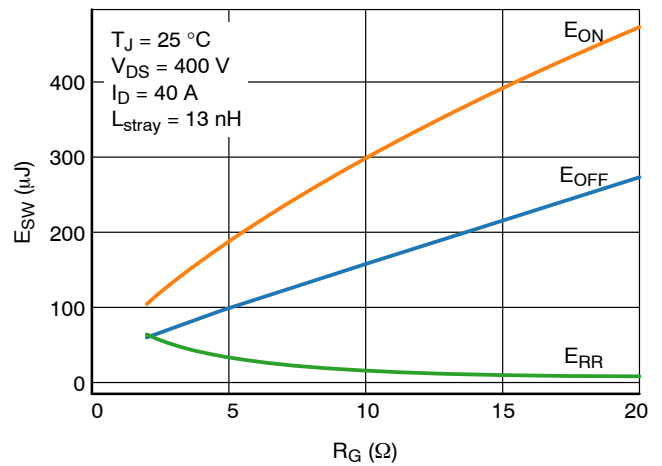


Figure 18. E_{SW} vs. R_G

TYPICAL CHARACTERISTICS

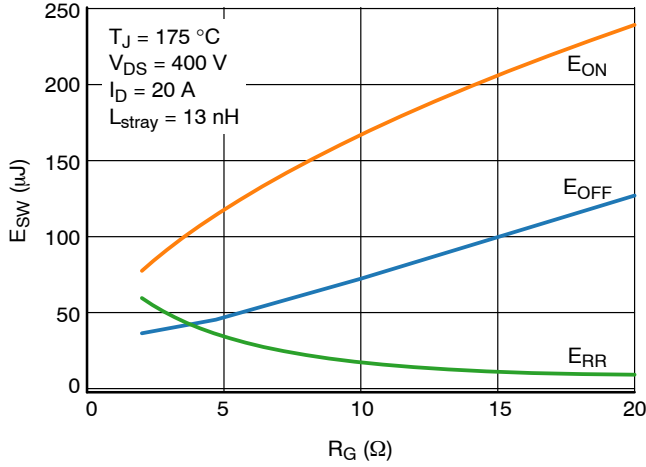


Figure 19. E_{sw} vs. R_g

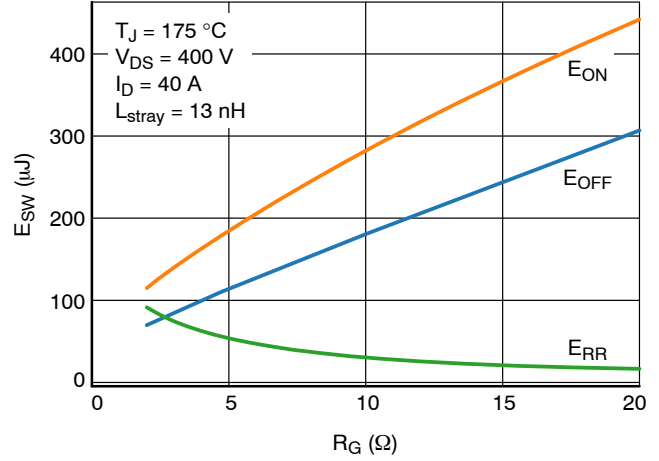


Figure 20. E_{sw} vs. R_g

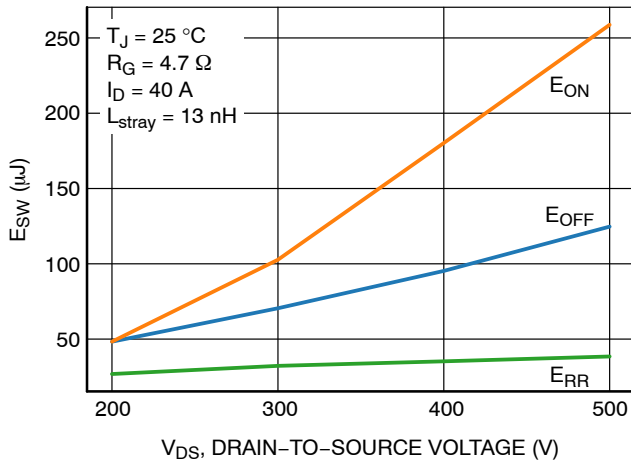


Figure 21. E_{sw} vs. V_{DS}

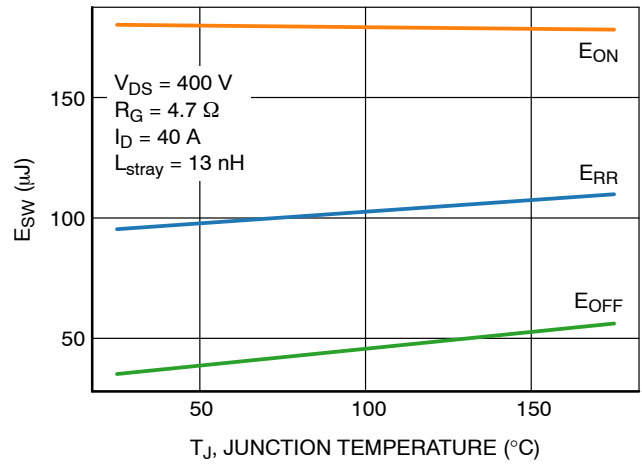


Figure 22. E_{sw} vs. T_J

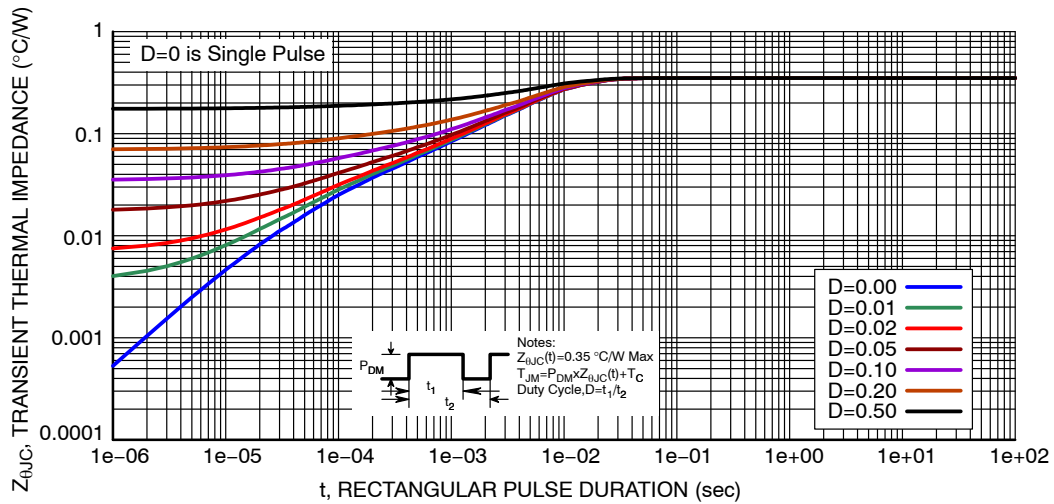


Figure 23. Transient Thermal Response

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REVISION HISTORY

Revision	Description of Changes	Date
0	Initial data sheet release	9/29/2025
1	Figure 16 update	10/16/2025

PACKAGE DIMENSIONS

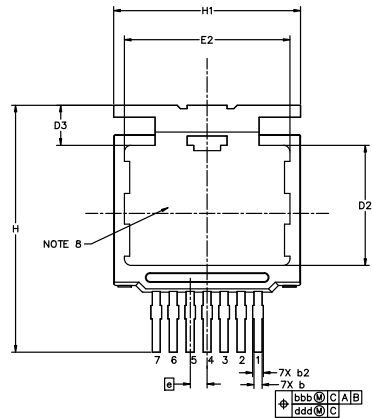
T2PAK-7 11.80x14.00x3.50, 1.27P
CASE 763AC
ISSUE A

NOTES:

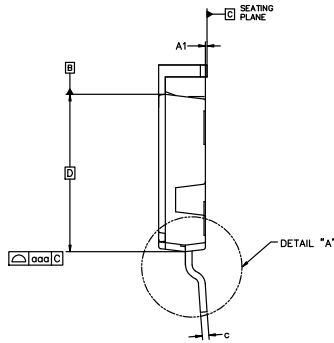
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b, b2, b3 AND c TO BE MEASURED ON FLAT SECTION OF THE LEAD BETWEEN 0.13 AND 0.25mm FROM LEAD TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. POSITIONAL TOLERANCE 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 $\phi 12.5$ mm 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		

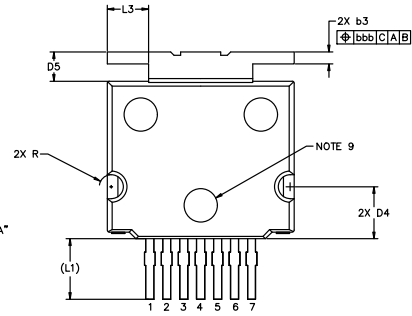
MILLIMETERS			
DIM	MIN	NOM	MAX
H	18.00	18.50	19.00
H1	13.80	14.00	14.20
L	2.42	2.52	2.62
L1	4.53 REF		
L2	0.25 BSC		
L3	3.00	3.10	3.20
R	0.80	---	1.00
θ	0°	---	8°
$\theta 1$	0°	---	8°
TOLERANCE FORM AND POSITION			
aaa	0.10		
bbb	0.10		
ccc	0.10		
ddd	0.05		
eee	0.05		



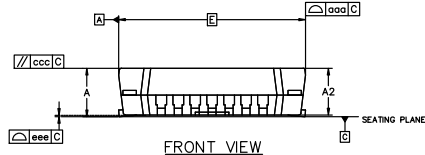
TOP VIEW



SIDE VIEW



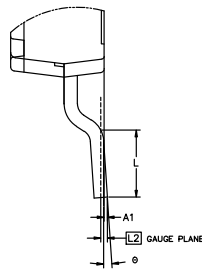
BOTTOM VIEW



FRONT VIEW

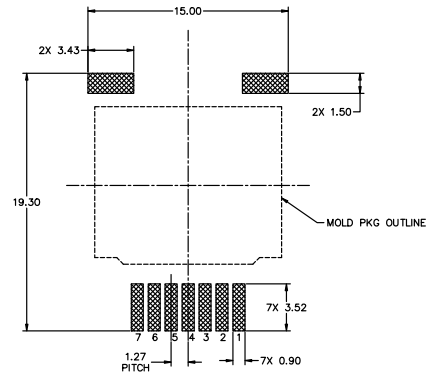


END VIEW



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.

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