

# Silicon Carbide (SiC) MOSFET - EliteSiC, 23 mohm, 650 V, M3S, T2PAK

## NTT2023N065M3S

### Features

- Typ.  $R_{DS(on)} = 23 \text{ m}\Omega @ V_{GS} = 18 \text{ V}$
- Low Effective Output Capacitance
- Ultra Low Gate Charge
- 100% UIS Tested
- RoHS Compliant

### Applications

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

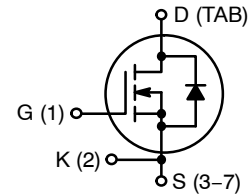
### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DS}$	650	V
Gate-to-Source Voltage	$V_{GS}$	-8/+22	V
Continuous Drain Current	$T_C = 25^\circ\text{C}$	$I_D$	72 A
Power Dissipation		$P_D$	288 W
Continuous Drain Current	$T_C = 100^\circ\text{C}$	$I_D$	53 A
Power Dissipation		$P_D$	144 W
Pulsed Drain Current (Note 1)	$T_C = 25^\circ\text{C}$ $t_p = 100 \mu\text{s}$	$I_{DM}$	174 A
Continuous Source-Drain Current (Body Diode)	$T_C = 25^\circ\text{C}$ $V_{GS} = -3 \text{ V}$	$I_S$	43 A
	$T_C = 100^\circ\text{C}$ $V_{GS} = -3 \text{ V}$		24 A
Pulsed Source-Drain Current (Body Diode) (Note 1)	$T_C = 25^\circ\text{C}$ $t_p = 100 \mu\text{s}$	$I_{SM}$	155 A
Single Pulse Avalanche Energy ( $I_{LPK} = 46 \text{ A}$ , $L = 0.1 \text{ mH}$ ) (Note 2)	$E_{AS}$	106	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)	$T_L$	260	$^\circ\text{C}$

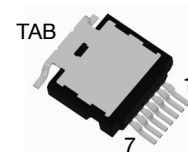
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Single pulse, limited by max junction temperature.
2.  $E_{AS}$  of 106 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.1 \text{ mH}$ ,  $I_{AS} = 46 \text{ A}$ ,  $V_{DD} = 100 \text{ V}$ ,  $V_{GS} = 18 \text{ V}$ .

$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
650 V	23 m $\Omega$ @ $V_{GS} = 18 \text{ V}$	72 A

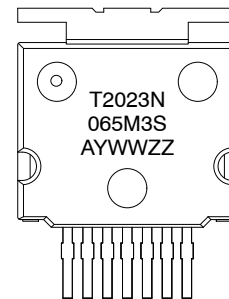


N-CHANNEL MOSFET



T2PAK  
CASE 763AC

### MARKING DIAGRAM



NTT2023N065M3S = 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†
NTT2023N065M3S	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.

### THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Note 3)	$R_{\theta JC}$	0.52	$^{\circ}\text{C/W}$

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

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^{\circ}\text{C}$	650	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650\text{ V}, T_J = 25^{\circ}\text{C}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 650\text{ V}, T_J = 175^{\circ}\text{C}$ (Note 5)	-	-	500	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = -8\text{ V}, V_{DS} = 0\text{ V}$	-1	-	-	$\mu\text{A}$
		$V_{GS} = +22\text{ V}, V_{DS} = 0\text{ V}$	-	-	1	

#### ON CHARACTERISTICS

Drain-to-Source On Resistance	$R_{DS(ON)}$	$V_{GS} = 18\text{ V}, I_D = 21\text{ A}, T_J = 25^{\circ}\text{C}$	-	23	32.6	$\text{m}\Omega$
		$V_{GS} = 18\text{ V}, I_D = 21\text{ A}, T_J = 175^{\circ}\text{C}$ (Note 5)	-	34	-	
		$V_{GS} = 15\text{ V}, I_D = 21\text{ A}, T_J = 25^{\circ}\text{C}$	-	29	-	
		$V_{GS} = 15\text{ V}, I_D = 21\text{ A}, T_J = 175^{\circ}\text{C}$ (Note 5)	-	37	-	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 10\text{ mA}, T_J = 25^{\circ}\text{C}$	2	2.8	4	V
Forward Transconductance	$g_{FS}$	$V_{DS} = 10\text{ V}, I_D = 21\text{ A}$ (Note 5)	-	16	-	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)	-	1950	-	$\text{pF}$
Output Capacitance	$C_{OSS}$		-	152	-	
Reverse Transfer Capacitance	$C_{RSS}$		-	13	-	
Total Gate Charge	$Q_{G(TOT)}$	$V_{DD} = 400\text{ V}, I_D = 21\text{ A}, V_{GS} = -3/18\text{ V}$ (Note 5)	-	74	-	$\text{nC}$
Gate-to-Source Charge	$Q_{GS}$		-	15	-	
Gate-to-Drain Charge	$Q_{GD}$		-	13	-	
Gate Resistance	$R_G$	$f = 1\text{ MHz}$	-	4.0	-	$\Omega$

#### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -3/18\text{ V}, I_D = 21\text{ A}, V_{DD} = 400\text{ V}, R_G = 4.7\text{ }\Omega, L_{stray} = 13\text{ nH}, T_J = 25^{\circ}\text{C}$ (Notes 4, 5)	-	24	-	$\text{ns}$
Turn-Off Delay Time	$t_{d(OFF)}$		-	50	-	
Rise Time	$t_r$		-	16	-	
Fall Time	$t_f$		-	10	-	
Turn-On Switching Loss	$E_{ON}$		-	98	-	$\mu\text{J}$
Turn-Off Switching Loss	$E_{OFF}$		-	29	-	
Total Switching Loss	$E_{TOT}$		-	127	-	

4.  $E_{ON}/E_{OFF}$  result is with body diode.

5. Defined by design, not subject to production test.

**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 <sub>d(ON)</sub>	V <sub>GS</sub> = -3/18 V, I <sub>D</sub> = 21 A, V <sub>DD</sub> = 400 V, R <sub>G</sub> = 4.7 Ω, L <sub>stray</sub> = 13 nH, T <sub>J</sub> = 175 °C (Notes 4, 5)	-	55	-	ns
Turn-Off Delay Time	t <sub>d(OFF)</sub>		-	24	-	
Rise Time	t <sub>r</sub>		-	15	-	
Fall Time	t <sub>f</sub>		-	11	-	
Turn-On Switching Loss	E <sub>ON</sub>		-	93	-	μJ
Turn-Off Switching Loss	E <sub>OFF</sub>		-	33	-	
Total Switching Loss	E <sub>TOT</sub>		-	126	-	
SOURCE-TO-DRAIN DIODE CHARACTERISTICS						
Forward Diode Voltage	V <sub>SD</sub>	I <sub>SD</sub> = 21 A, V <sub>GS</sub> = -3 V, T <sub>J</sub> = 25 °C	-	4.5	-	V
		I <sub>SD</sub> = 21 A, V <sub>GS</sub> = -3 V, T <sub>J</sub> = 175 °C (Note 5)	-	4.2	-	
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = -3 V, I <sub>S</sub> = 21 A, di/dt = 1000 A/μs, V <sub>DS</sub> = 400 V, T <sub>J</sub> = 25 °C (Note 5)	-	24	-	ns
Charge Time	t <sub>a</sub>		-	10	-	
Discharge Time	t <sub>b</sub>		-	14	-	
Reverse Recovery Charge	Q <sub>RR</sub>		-	113	-	nC
Reverse Recovery Energy	Q <sub>REC</sub>		-	8.4	-	
Peak Reverse Recovery Current	I <sub>RRM</sub>		-	9.8	-	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

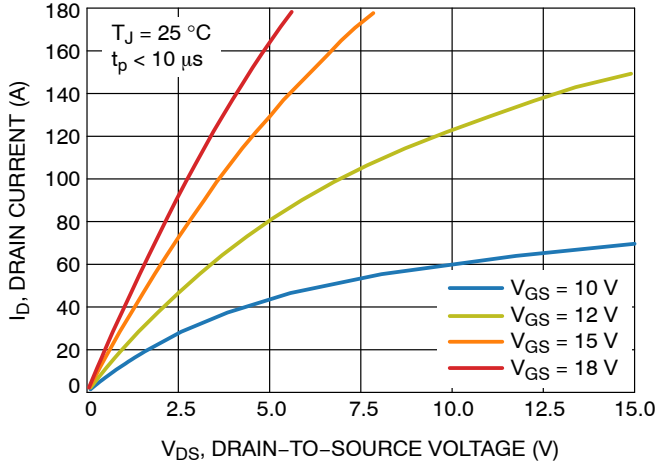


Figure 1. Output Characteristics

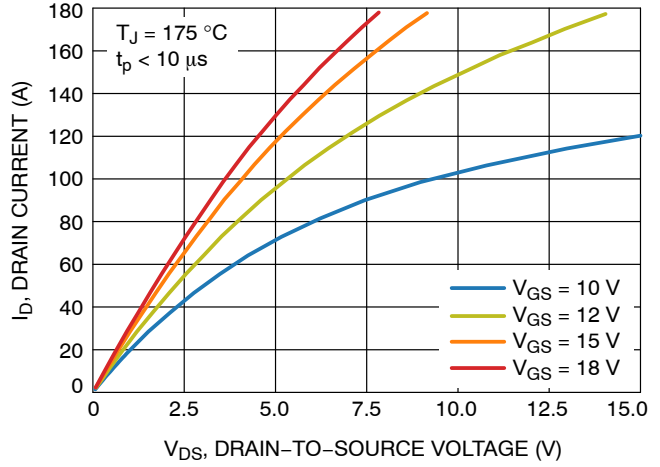


Figure 2. Output Characteristics

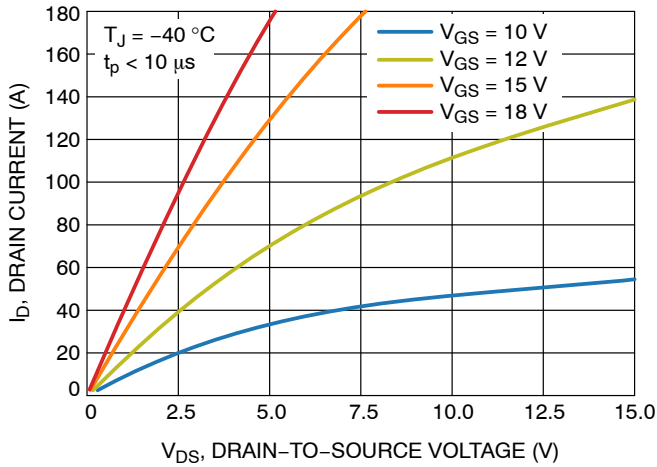


Figure 3. Output Characteristics

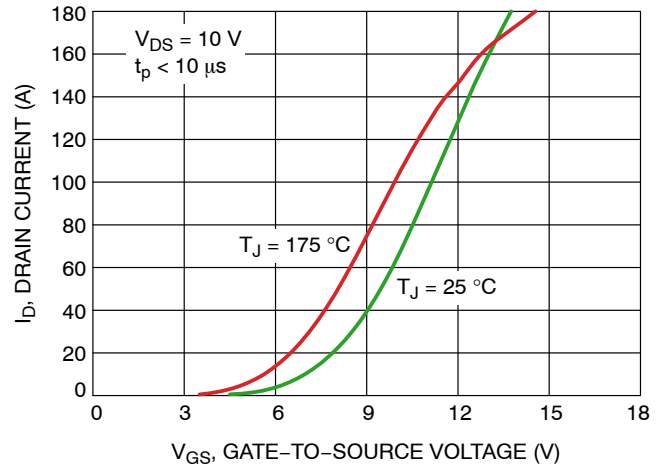


Figure 4.  $I_D$  vs.  $V_{GS}$

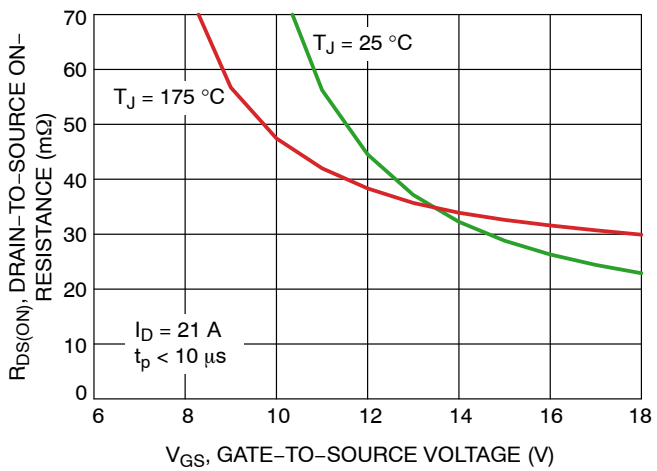


Figure 5.  $R_{DS(ON)}$  vs.  $V_{GS}$

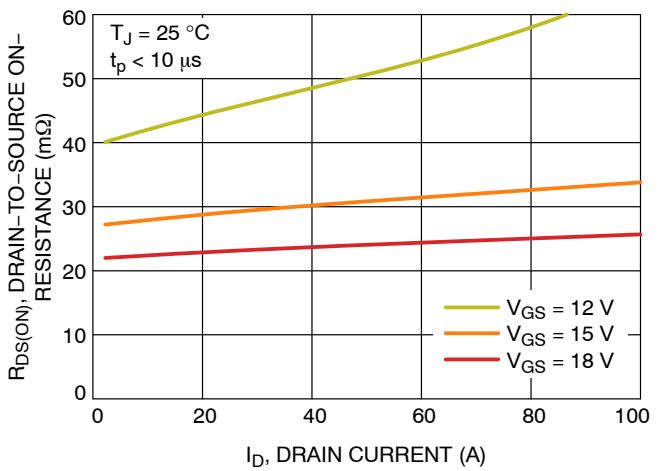


Figure 6.  $R_{DS(ON)}$  vs.  $I_D$

TYPICAL CHARACTERISTICS

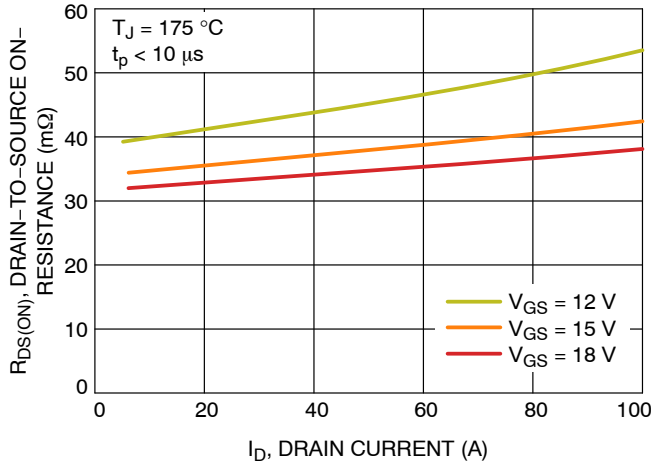


Figure 7.  $R_{DS(ON)}$  vs.  $I_D$

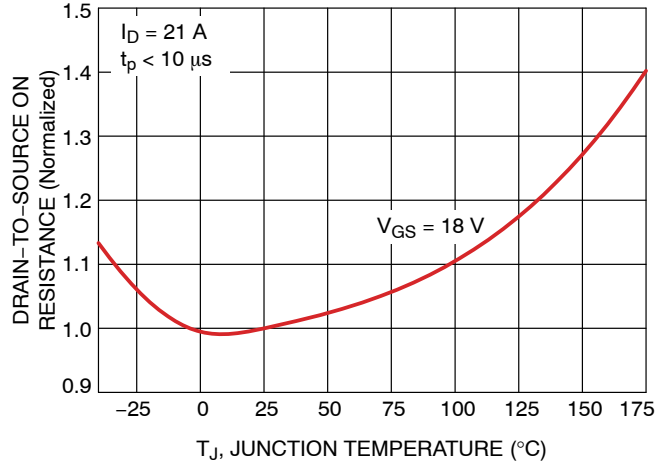


Figure 8.  $R_{DS(ON)}$  vs.  $T_J$

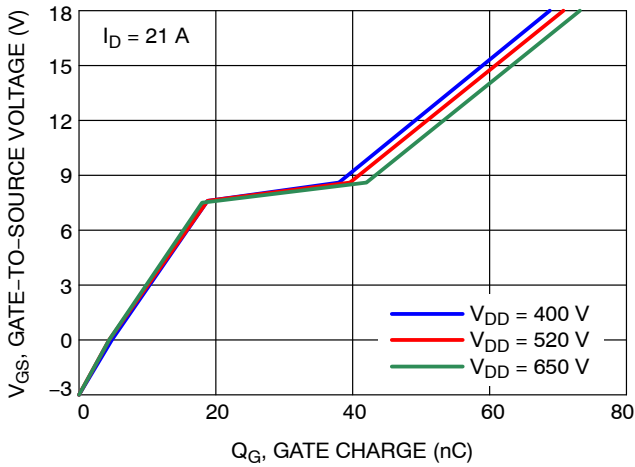


Figure 9. Gate Charge Characteristics

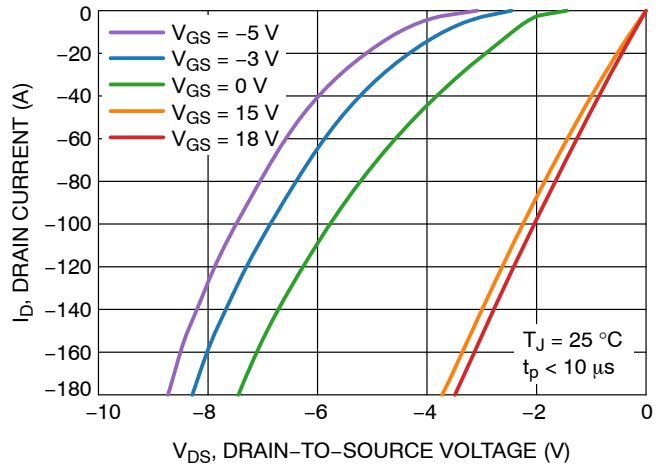


Figure 10.  $I_D$  vs.  $V_{DS}$

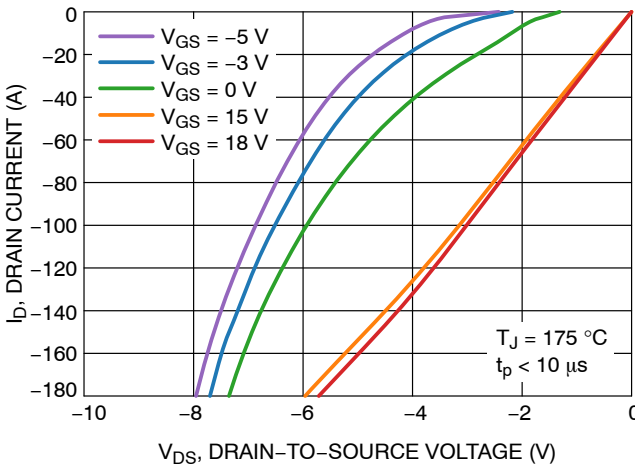


Figure 11.  $I_D$  vs.  $V_{DS}$

TYPICAL CHARACTERISTICS

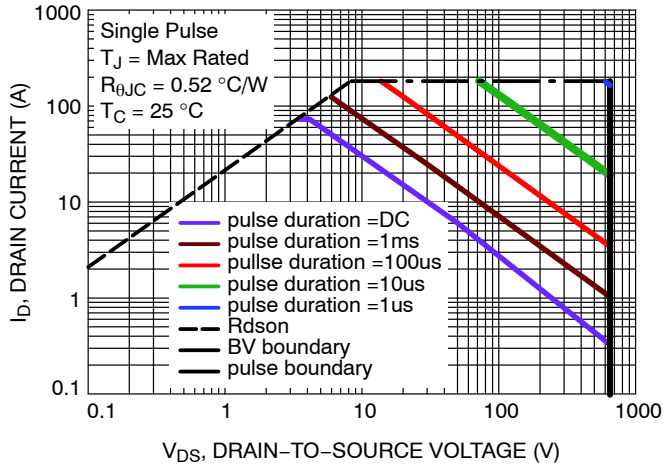


Figure 12. Safe Operating Area

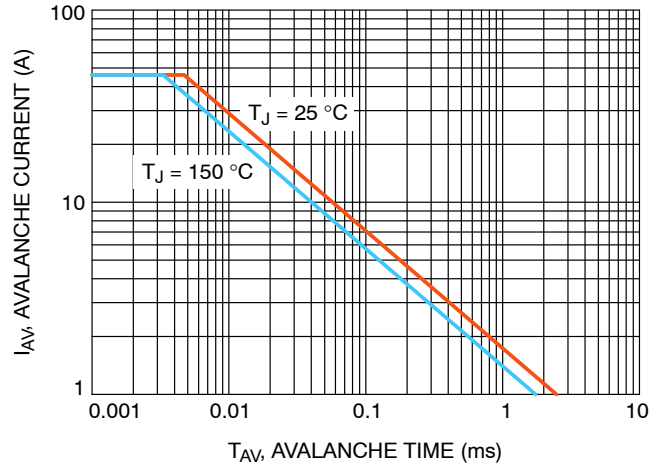


Figure 13. Avalanche Current vs. Pulse Time (UIS)

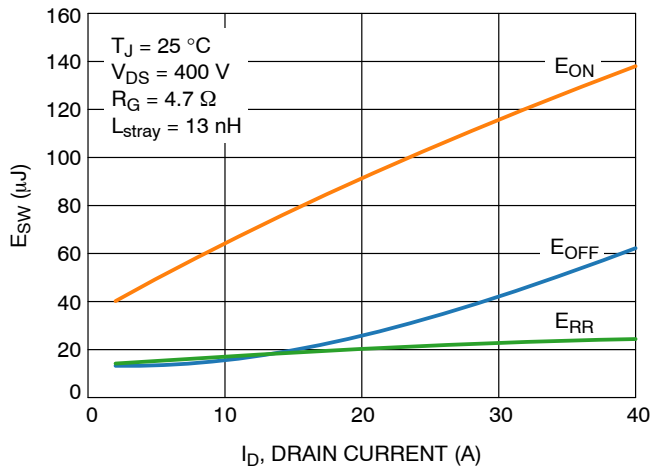


Figure 14.  $E_{SW}$  vs.  $I_D$

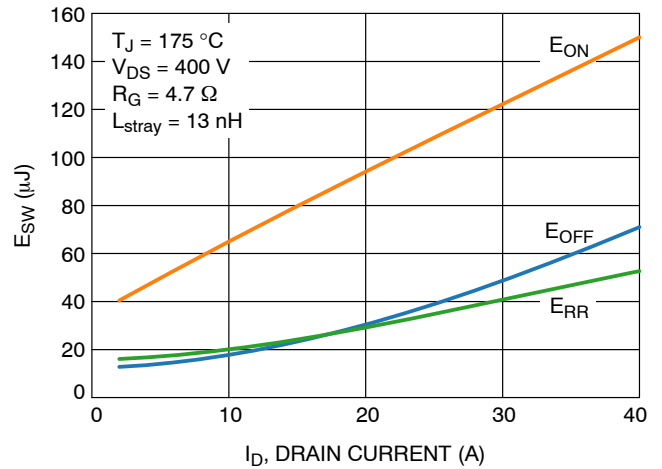


Figure 15.  $E_{SW}$  vs.  $I_D$

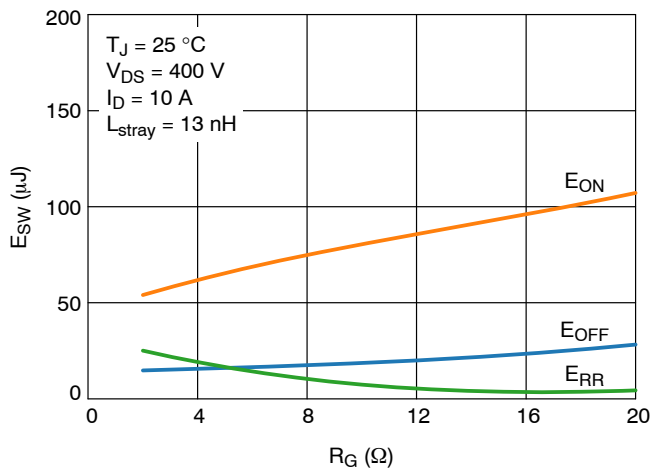


Figure 16.  $E_{SW}$  vs.  $R_G$

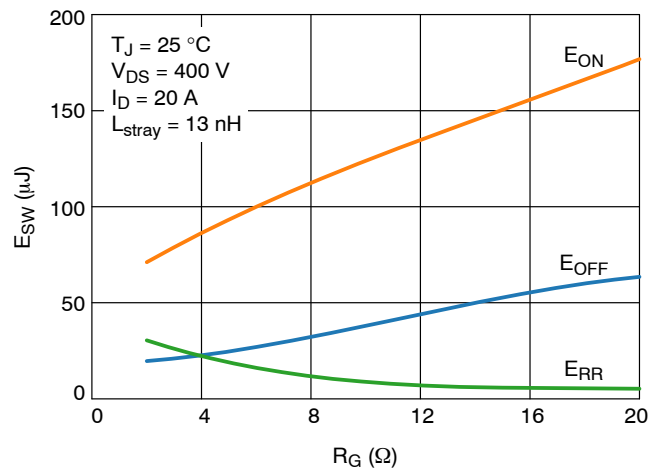


Figure 17.  $E_{SW}$  vs.  $R_G$

TYPICAL CHARACTERISTICS

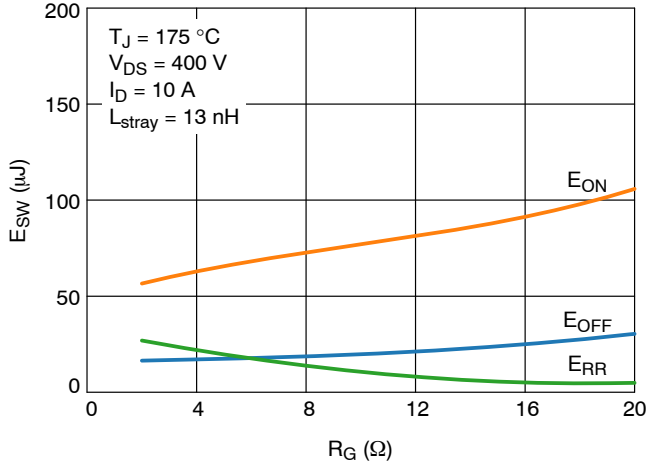


Figure 18.  $E_{sw}$  vs.  $R_g$

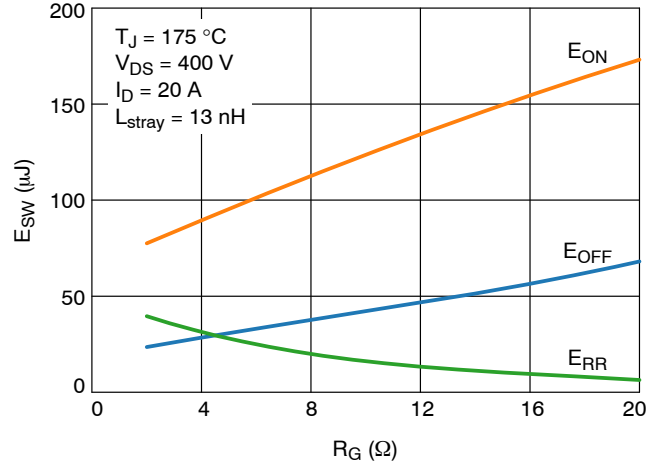


Figure 19.  $E_{sw}$  vs.  $R_g$

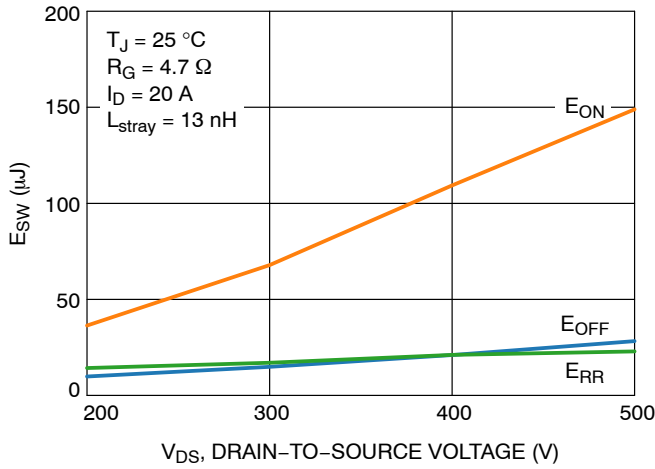


Figure 20.  $E_{sw}$  vs.  $V_{DS}$

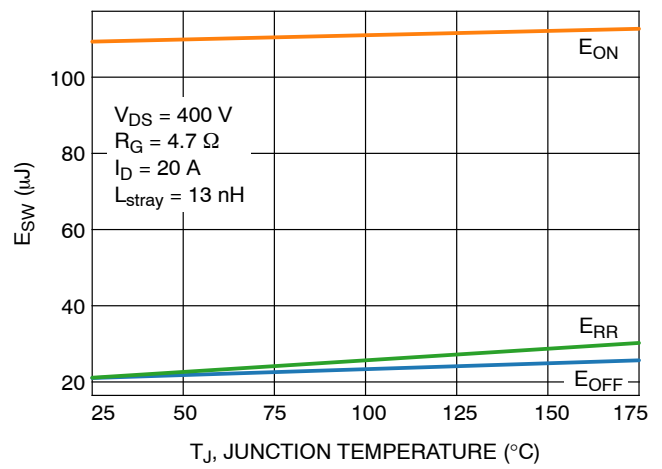


Figure 21.  $E_{sw}$  vs.  $T_J$

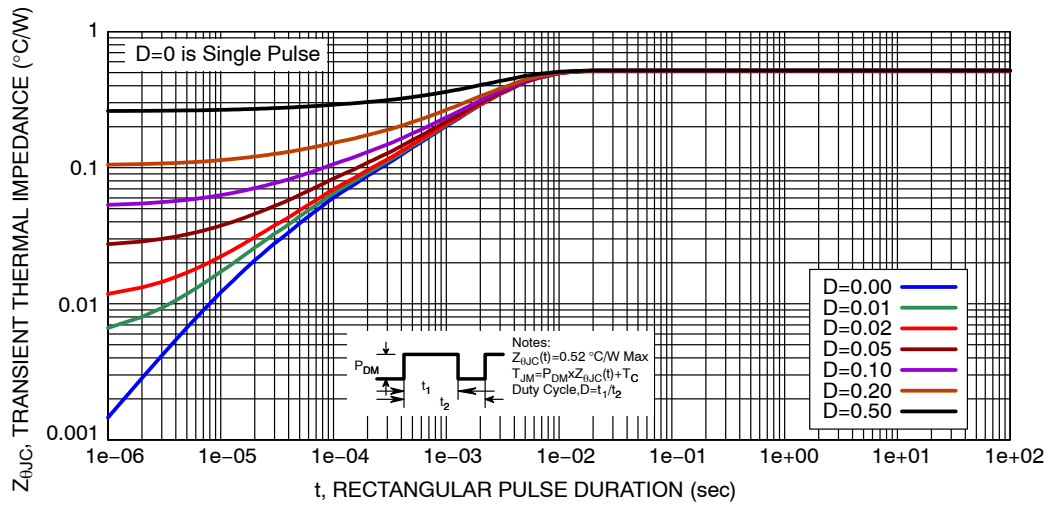


Figure 22. Transient Thermal Response

**REVISION HISTORY**

Revision	Description of Changes	Date
0	Initial data sheet release	8/15/2025

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

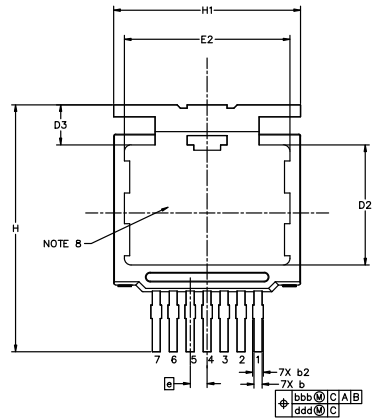
T2PAK-7 11.80x14.00x3.50, 1.27P  
CASE 763AC  
ISSUE A

NOTES:

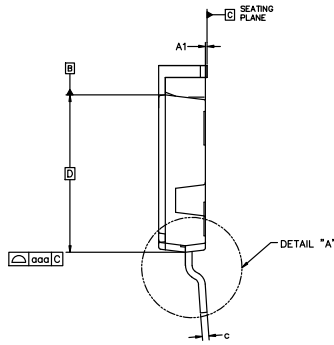
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b, b2, b3 AND c TO BE MEASURED ON FLAT SECTION OF THE LEAD BETWEEN 0.13 AND 0.25mm FROM LEAD TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. POSITIONAL TOLERANCE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

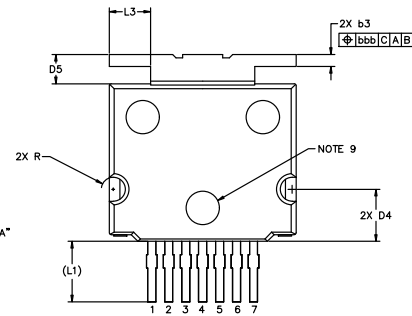
MILLIMETERS			
DIM	MIN	NOM	MAX
H	18.00	18.50	19.00
H1	13.80	14.00	14.20
L	2.42	2.52	2.62
L1	4.53 REF		
L2	0.25 BSC		
L3	3.00	3.10	3.20
R	0.80	---	1.00
$\theta$	0°	---	8°
$\theta 1$	0°	---	8°
TOLERANCE FORM AND POSITION			
aaa	0.10		
bbb	0.10		
ccc	0.10		
ddd	0.05		
eee	0.05		



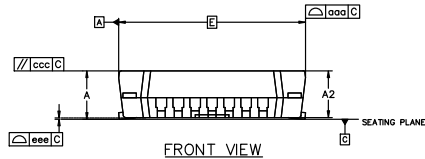
TOP VIEW



SIDE VIEW



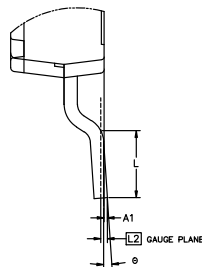
BOTTOM VIEW



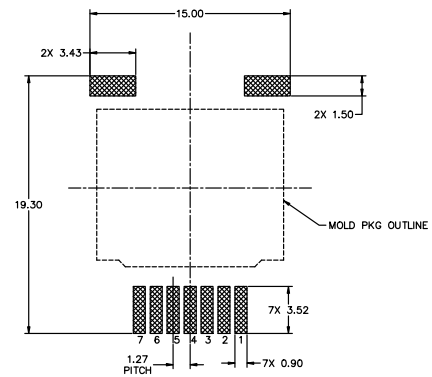
FRONT VIEW



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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