

**S C b (S C)**  
**MOSFET - E S C,**  
**23 m m , 650 V, M3S, TOLL**  
**NTBL023N065M3S**

Features

- -Source Voltage

		V <sub>GS</sub>	-8/+22	V
Continuous Drain Current	T <sub>C</sub> = 25°C	I <sub>D</sub>	77	A
Power Dissipation		P <sub>D</sub>	312	W
Continuous Drain Current	T <sub>C</sub> = 100°C	I <sub>D</sub>	54	A
Power Dissipation		P <sub>D</sub>	156	W

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## THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Note 3)	$R_{\theta JC}$	0.48	$^{\circ}C/W$
Thermal Resistance, Junction-to-Ambient (Note 3)	$R_{\theta JA}$	43	$^{\circ}C/W$

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	$V_{GSop}$	-5...-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 ( $T_J = 25^{\circ}C$ unless otherwise stated)

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0 V, I_D = 1 mA$	650			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$\Delta V_{(BR)DSS} / \Delta T_J$	$I_D = 1 mA$ , Referenced to $25^{\circ}C$		89		$mV/^{\circ}C$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650 V, T_J = 25^{\circ}C$			10	$\mu A$
		$V_{DS} = 650 V, T_J = 175^{\circ}C$ (Note 5)			500	$\mu A$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = -8/+22 V, V_{DS} = 0 V$			$\pm 1$	$\mu A$

### ON CHARACTERISTICS

Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 18 V, I_D = 20 A, T_J = 25^{\circ}C$		23	32.6	m $\Omega$
		$V_{GS} = 18 V, I_D = 20 A, T_J = 175^{\circ}C$		34		
		$V_{GS} = 15 V, I_D = 20 A, T_J = 25^{\circ}C$		29		
		$V_{GS} = 15 V, I_D = 20 A, T_J = 175^{\circ}C$		37		
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 10 mA$	2		4	V
Forward Transconductance	$g_{FS}$	$V_{DS} = 10 V, I_D = 20 A$		14		S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0 V, f = 1 MHz, V_{DS} = 400 V$ (Note 5)		1950		pF
Output Capacitance	$C_{OSS}$			152		
Reverse Transfer Capacitance	$C_{RSS}$			13		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -3/18 V, V_{DD} = 400 V, I_D = 20 A$ (Note 5)		69		nC
Gate-to-Source Charge	$Q_{GS}$			19		
Gate-to-Drain Charge	$Q_{GD}$			18		
Gate-Resistance	$R_G$	$f = 1 MHz$		4.0		$\Omega$

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -3/18 V, V_{DD} = 400 V, I_D = 20 A, R_G = 4.7 \Omega, T_J = 25^{\circ}C$ , (Notes 4, 5)		11		ns
Turn-Off Delay Time	$t_{d(OFF)}$			35		
Rise Time	$t_r$			15		
Fall Time	$t_f$			9.6		
Turn-On Switching Loss	$E_{ON}$			51		
Turn-Off Switching Loss	$E_{OFF}$		29			
Total Switching Loss	E					

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## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = -3/18 V, V <sub>DS</sub> = 400 V, I <sub>D</sub> = 20 A, R <sub>G</sub> = 4.7 Ω, T <sub>J</sub> = 175°C, (Notes 4, 5)		9.6		ns
Turn-Off Delay Time	t <sub>d(OFF)</sub>			41		
Rise Time	t <sub>r</sub>			14		
Fall Time	t <sub>f</sub>			12		
Turn-On Switching Loss	E <sub>ON</sub>			51		μJ
Turn-Off Switching Loss	E <sub>OFF</sub>			45		
Total Switching Loss	E <sub>TOT</sub>			96		

## SOURCE-TO-DRAIN DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = -3 V, I <sub>SD</sub> = 20 A, T <sub>J</sub> = 25°C		4.5	6.0	V
		V <sub>GS</sub> = -3 V, I <sub>SD</sub> = 20 A, T <sub>J</sub> = 175°C		4.2		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = -3 V, I <sub>S</sub> = 20 A, di/dt = 1000 A/μs, V <sub>DS</sub> = 400 V (Note 5)		19		ns
Charge Time	t <sub>a</sub>			11		
Discharge Time	t <sub>b</sub>			8		
Reverse Recovery Charge	Q <sub>RR</sub>			97		nC
Reverse Recovery Energy	E <sub>REC</sub>			8.7		μJ
Peak Reverse Recovery Current	I <sub>RRM</sub>			11		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<sub>ON</sub>/E<sub>OFF</sub> result is with body diode.

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

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## TYPICAL CHARACTERISTICS

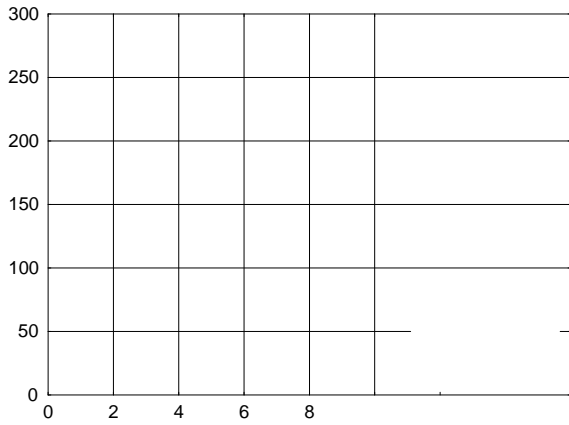


Figure 1. On-Region Characteristics

Figure 2. Output Characteristics

Figure 3. Transfer Characteristics

Figure 4. On-Resistance vs. Gate Voltage

Figure 5. On-Resistance vs. Drain Current

Figure 6. On-Resistance vs. Junction Temperature



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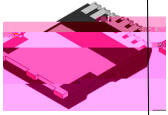
## TYPICAL CHARACTERISTICS

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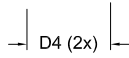
Figure 19. Switching Loss vs. Gate Resistance

Figure 20. Thermal Response Characteristics



**H-PSOF8L 9.90x10.38x2.30, 1.20P**  
CASE 100DC  
ISSUE D

DATE 30 JUL 2024



LAND PATTERN  
RECOMMENDATION



- H/2

**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.



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