

# Silicon Carbide (SiC) MOSFET - EliteSiC, 80 mohm, 1200 V, M1, Die NTC080N120SC1

#### **Description**

Silicon Carbide (SiC) MOSFET uses a completely new technology that provide superior switching performance and higher reliability compared to Silicon. In addition, the low ON resistance and compact chip size ensure low capacitance and gate charge. Consequently, system benefits include highest efficiency, faster operation frequency, increased power density, reduced EMI, and reduced system size.

#### **Features**

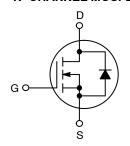
- Typ  $R_{DS(on)} = 80 \text{ m}\Omega$  at  $V_{GS} = 20 \text{ V}$ ,  $I_D = 20 \text{ A}$
- High Speed Switching with Low Capacitance
- 100% UIL Tested
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb–Free 2LI (on second level interconnection)

#### **Applications**

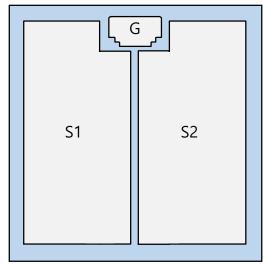
- Industrial Motor Drive
- UPS
- Boost Inverter
- PV Charger

V <sub>(BR)DSS</sub>	R <sub>DS(on)</sub> MAX	I <sub>D</sub> MAX	
1200 V	110 mΩ @ 20 V	31 A	

#### **N-CHANNEL MOSFET**



#### **DIE DIAGRAM**



#### **Die Information**

Gate Pad Size

Wafer Diameter 6 inch
 Die Size 2,900 x 2,900 µm
 Metallization

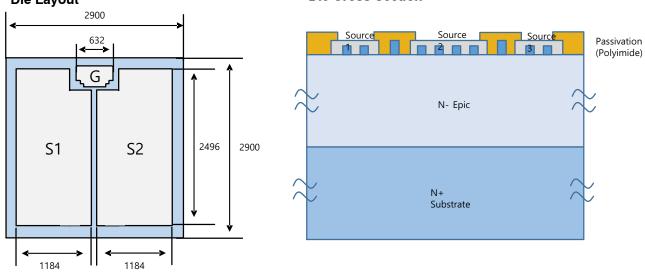
 Top Ti/TiN/Al 5 µm
 Back Ti/V/Ni/Ag

 Die Thickness Typ. 200 µm

632 x 242.5 μm

# **Die Layout**

#### **Die Cross Section**



## **Passivation Information**

- Passivation Material: Polymide (PSPI)
- Passivation Type: Local Passivation
- Passivation Thickness 10  $\mu m$ 
  - : Passivation Area

## **Die Layout**

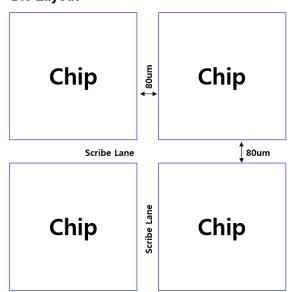


Figure 1. Bare Die Dimensions

#### **MAXIMUM RATINGS** (T<sub>C</sub> = 25°C unless otherwise noted)

Parame	Symbol	Value	Unit		
Drain-to-Source Voltage	V <sub>DSS</sub>	1200	V		
Gate-to-Source Voltage	V <sub>GS</sub>	-15/+25	V		
Recommended Operation Values of Gate- to-Source Voltage	T <sub>C</sub> < 175°C		$V_{GSop}$	-5/+20	V
Continuous Drain Current $R_{\theta JC}$	Steady State	T <sub>C</sub> = 25°C	I <sub>D</sub>	31	Α
Power Dissipation $R_{\theta JC}$	1		P <sub>D</sub>	178	W
Continuous Drain Current $R_{\theta JC}$	Steady State	T <sub>C</sub> = 100°C	I <sub>D</sub>	22	Α
Power Dissipation $R_{\theta JC}$	1		P <sub>D</sub>	89	W
Pulsed Drain Current (Note 2)	Т	<sub>C</sub> = 25°C	I <sub>DM</sub>	132	Α
Single Pulse Surge Drain Current Capability	$T_C$ = 25°C, $t_p$ = 10 μs, $R_G$ = 4.7 $\Omega$		I <sub>DSC</sub>	132	Α
Operating Junction and Storage Temperature Range			T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°C
Source Current (Body Diode)			Is	18	Α
Single Pulse Drain-to-Source Avalanche Energy (I <sub>L(pk)</sub> = 18.5 A, L = 1 mH) (Note 3)			E <sub>AS</sub>	171	mJ

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.

#### THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Note 1)	$R_{ hetaJC}$	0.84	°C/W

<sup>1.</sup> The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular

<sup>2.</sup> Repetitive rating, limited by max junction temperature. 3.  $E_{AS}$  of 171 mJ is based on starting  $T_J = 25^{\circ}C$ ; L = 1 mH,  $I_{AS} = 18.5$  A,  $V_{DD} = 120$  V,  $V_{GS} = 18$  V.

# **ELECTRICAL CHARACTERISTICS** ( $T_J = 25^{\circ}C$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
OFF CHARACTERISTICS				•	l	1
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA	1200	_	_	V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>	I <sub>D</sub> = 1 mA, referenced to 25°C	-	700	-	mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 1200 V, T <sub>J</sub> = 25°C	1	_	100	μΑ
		V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 1200 V, T <sub>J</sub> = 175°C	1	_	250	μΑ
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = +25/-15 V, V <sub>DS</sub> = 0 V	1	_	±1	μΑ
ON CHARACTERISTICS	•					
Gate Threshold Voltage	V <sub>GS(th)</sub>	$V_{GS} = V_{DS}$ , $I_D = 5 \text{ mA}$	1.8	2.7	4.3	V
Recommended Gate Voltage	V <sub>GOP</sub>		-5	-	+20	V
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 25°C	-	80	110	mΩ
		V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 150°C	-	114	_	
Forward Transconductance	9FS	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 20 A	-	13	_	S
CHARGES, CAPACITANCES & GATE	RESISTANCE				I	1
Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> = 0 V, f = 1 MHz, V <sub>DS</sub> = 800 V	-	1112	_	pF
Output Capacitance	C <sub>OSS</sub>		-	80	-	
Reverse Transfer Capacitance	C <sub>RSS</sub>		_	6.5	_	
Total Gate Charge	Q <sub>G(tot)</sub>	$V_{GS} = -5/20 \text{ V}, V_{DS} = 600 \text{ V}, I_D = 20 \text{ A}$	_	56	_	nC
Gate-to-Source Charge	Q <sub>GS</sub>		_	11	_	
Gate-to-Drain Charge	Q <sub>GD</sub>		_	12	_	
Gate Resistance	R <sub>G</sub>	f = 1 MHz	_	1.7	_	Ω
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	t <sub>d(on)</sub>	$V_{GS} = -5/20 \text{ V}, V_{DS} = 800 \text{ V},$	-	13	_	ns
Rise Time	t <sub>r</sub>	$I_D = 20$ A, $R_G = 4.7$ Ω, Inductive Load	-	20	_	
Turn-Off Delay Time	t <sub>d(off)</sub>		_	22	_	
Fall Time	t <sub>f</sub>		_	10	_	
Turn-On Switching Loss	E <sub>ON</sub>		_	258	_	μJ
Turn-Off Switching Loss	E <sub>OFF</sub>		_	52	_	
Total Switching Loss	E <sub>TOT</sub>		_	311	_	
DRAIN-SOURCE DIODE CHARACTE	RISTICS			l		1
Continuous Drain-to-Source Diode Forward Current	I <sub>SD</sub>	V <sub>GS</sub> = -5 V	-	_	18	А
Pulsed Drain-to-Source Diode Forward Current (Note 2)	I <sub>SDM</sub>	V <sub>GS</sub> = -5 V	-	-	132	Α
Forward Diode Voltage	V <sub>SD</sub>	$V_{GS} = -5 \text{ V}, I_{SD} = 10 \text{ A}$	-	4	-	V
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = -5/20 V, I <sub>SD</sub> = 20 A,	-	16	-	ns
Reverse Recovery Charge	Q <sub>RR</sub>	- dI <sub>S</sub> /dt = 1000 A/μs	-	62	_	nC
Reverse Recovery Energy	E <sub>REC</sub>	]	-	5	-	μJ
Peak Reverse Recovery Current	I <sub>RRM</sub>	1	-	8	-	Α
	•			•		

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** ( $T_J = 25^{\circ}C$ unless otherwise noted)

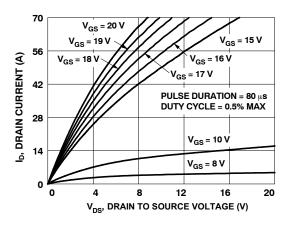
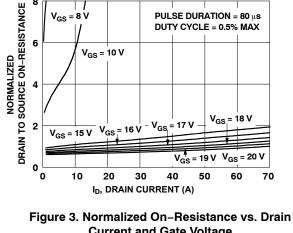


Figure 2. On Region Characteristics



**Current and Gate Voltage** 

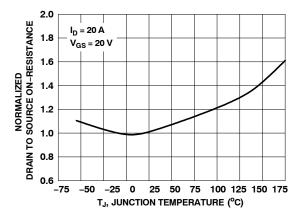


Figure 4. Normalized On Resistance vs. **Junction Temperature** 

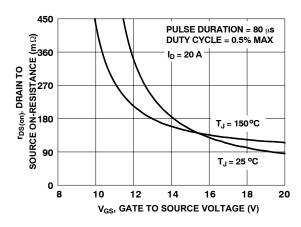


Figure 5. On-Resistance vs. Gate-to-Source Voltage

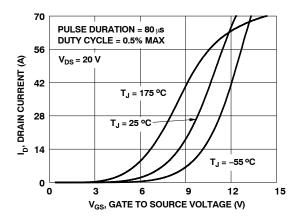


Figure 6. Transfer Characteristics

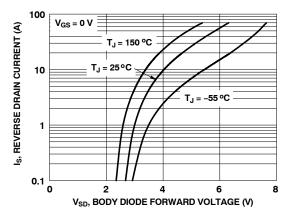


Figure 7. Source-to-Drain Diode Forward Voltage vs. Source Current

#### TYPICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted) (continued)

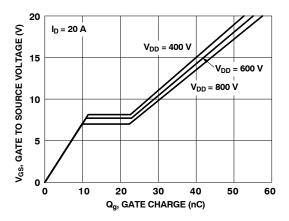


Figure 8. Gate Charge Characteristics

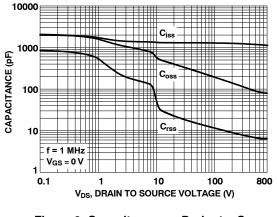


Figure 9. Capacitance vs. Drain-to-Source Voltage

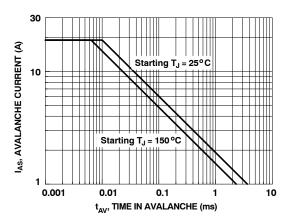


Figure 10. Unclamped Inductive Switching Capability

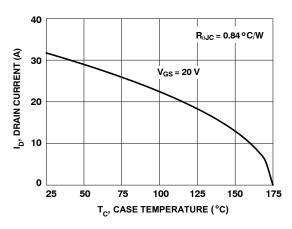


Figure 11. Maximum Continuous Drain Current vs. Case Temperature

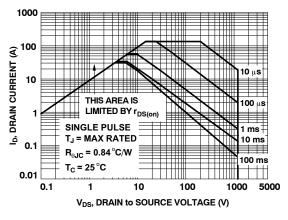


Figure 12. Forward Bias Safe Operating Area

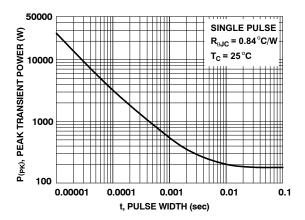


Figure 13. Single Pulse Maximum Power Dissipation

# **TYPICAL CHARACTERISTICS** ( $T_J = 25$ °C unless otherwise noted) (continued)

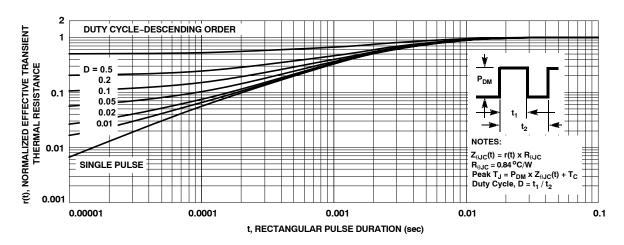


Figure 14. Junction-to-Case Transient Thermal Response Curve

#### **ORDERING INFORMATION AND PACKAGE MARKING**

Ordera	able Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTO	C080N120SC1	N/A	Die	Wafer	N/A	N/A	N/A

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