onsemi

<u>Silicon Carbide (SiC)</u> <u>MOSFET</u> – EliteSiC, 40 mohm, 1200 V, M1, Die

NTC040N120SC1

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

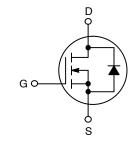
- 1200 V @ $T_J = 175^{\circ}C$
- Typ $R_{DS(on)} = 40 \text{ m}\Omega$ at $V_{GS} = 20 \text{ V}$, $I_D = 40 \text{ A}$
- High Speed Switching with Low Capacitance
- 100% UIL Tested
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb–Free 2LI (on second level interconnection)

Applications

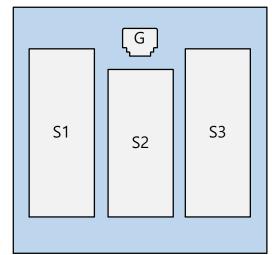
- Industrial Motor Drive
- UPS
- Boost Inverter
- PV Charger

V _{(BR)DSS}	R _{DS(on)} MAX	I _D MAX
1200 V	56 mΩ @ 20 V	60 A

N-CHANNEL MOSFET







Die Information

- Wafer Diameter
- 4,270 x 3,560 μm

6 inch

Ti/TiN/Al

Ti/NiV/Aq

 $5 \,\mu m$

- Die SizeMetallization
 - · Top
 - · Back

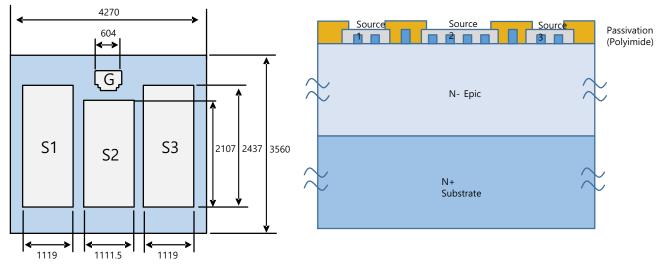
Gate Pad Size

- Die Thickness Typ. 200 μm
 - 604 x 415 μm

Semiconductor Components Industries, LLC, 2018 January, 2023 – Rev. 2

Die Layout

Die Cross Section



Passivation Information

- Passivation Material: Polymide (PSPI)
- Passivation Type: Local Passivation
- Passivation Thickness 10 μm
 - : Passivation Area

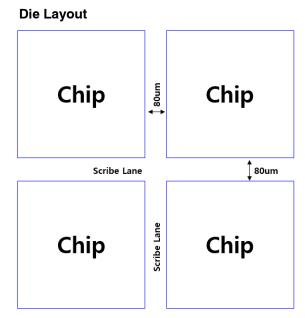


Figure 1. Bare Die Dimensions

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

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			V _{DSS}	1200	V
Gate-to-Source Voltage			V _{GS}	-15/+25	V
Recommended Operation Values of Gate-to-Source Voltage	T _C < 175°C		V _{GSop}	-5/+20	V
Continuous Drain Current $R_{\theta JC}$	Steady State	$T_{\rm C} = 25^{\circ}{\rm C}$	۱ _D	60	A
Power Dissipation $R_{\theta JC}$			PD	348	W
Continuous Drain Current $R_{\theta JC}$	Steady State	T _C = 100°C	۱ _D	42	A
Power Dissipation $R_{\theta JC}$			P _D	174	W
Pulsed Drain Current (Note 2)	$T_{\rm C} = 25^{\circ}{\rm C}$		I _{DM}	240	А
Single Pulse Surge Drain Current Capability	T_C = 25°C, t_p = 10 µs, R_G = 4.7 Ω		I _{DSC}	416	А
Operating Junction and Storage Temperature Range			T _J , T _{stg}	-55 to +175	°C
Source Current (Body Diode)			I _S	34	А
Single Pulse Drain-to-Source Avalanche Energy ($I_{L(pk)} = 35 \text{ A}, L = 1 \text{ mH}$) (Note 3)			E _{AS}	613	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)	$R_{ heta JC}$	0.43	°C/W

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

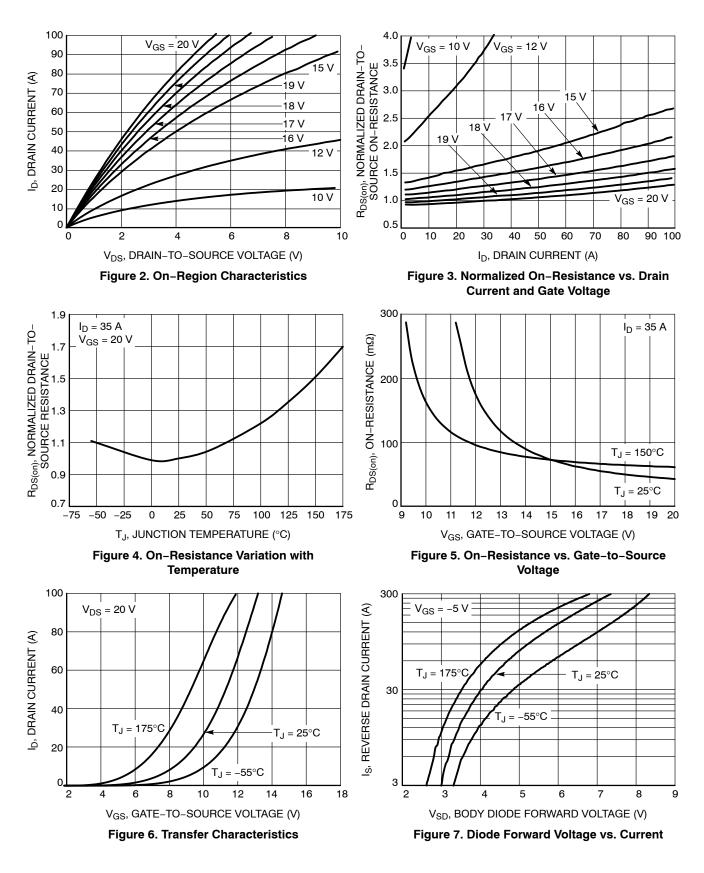
2. Repetitive rating, limited by max junction temperature. 3. E_{AS} of 613 mJ is based on starting $T_J = 25^{\circ}C$; L = 1 mH, $I_{AS} = 35$ A, $V_{DD} = 120$ V, $V_{GS} = 20$ V.

ELECTRICAL CHARACTERISTICS (T_J = 25° C unless otherwise noted)

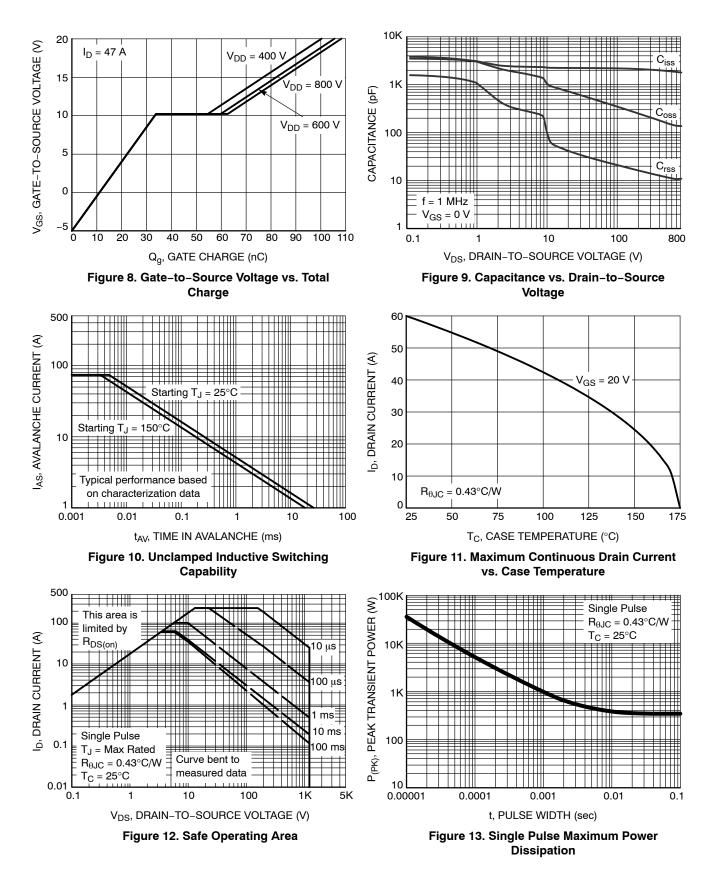
Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit	
OFF CHARACTERISTICS	1						
Drain-to-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0 V, I _D = 1 mA	1200	-	-	V	
Drain-to-Source Breakdown Voltage Temperature Coefficient	V _{(BR)DSS} /T _J	$I_D = 1 \text{ mA}$, referenced to 25°C	-	450	-	mV/°C	
Zero Gate Voltage Drain Current	I _{DSS}	V_{GS} = 0 V, V_{DS} = 1200 V, T_J = 25 $^\circ C$	-	-	100	00 μΑ	
		V_{GS} = 0 V, V_{DS} = 1200 V, T_{J} = 175°C	-	-	250		
Gate-to-Source Leakage Current	I _{GSS}	V_{GS} = +25/-15 V, V_{DS} = 0 V	-	-	±1	μA	
ON CHARACTERISTICS							
Gate Threshold Voltage	V _{GS(th)}	$V_{GS} = V_{DS}, I_D = 10 \text{ mA}$	1.8	2.97	4.3	V	
Recommended Gate Voltage	V _{GOP}		-5	-	+20	V	
Drain-to-Source On Resistance	R _{DS(on)}	V_{GS} = 20 V, I_D = 35 A, T_J = 25 $^{\circ}C$	_	39	56	mΩ	
		V_{GS} = 20 V, I _D = 35 A, T _J = 150°C	-	60	-		
Forward Transconductance	9fs	V _{DS} = 20 V, I _D = 35 A	-	20	-	S	
CHARGES, CAPACITANCES & GATE	RESISTANCE						
Input Capacitance	C _{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V	-	1781	-	pF	
Output Capacitance	C _{OSS}		-	140	-	-	
Reverse Transfer Capacitance	C _{RSS}		-	12	-		
Total Gate Charge	Q _{G(tot)}	$V_{GS} = -5/20$ V, $V_{DS} = 600$ V, $I_D = 47$ A	_	106	_	nC	
Threshold Gate Charge	Q _{G(th)}		_	16	_	-	
Gate-to-Source Charge	Q _{GS}		-	34	-		
Gate-to-Drain Charge	Q _{GD}		-	26	-		
Gate Resistance	R _G	f = 1 MHz	-	2.2	-	Ω	
SWITCHING CHARACTERISTICS		1					
Turn-On Delay Time	t _{d(on)}	$V_{GS} = -5/20 \text{ V}, V_{DS} = 800 \text{ V},$	_	18	_	ns	
Rise Time	t _r	$I_D = 47 \text{ A}, \text{ R}_G = 4.7 \Omega,$ Inductive Load	_	41	_	-	
Turn–Off Delay Time	t _{d(off)}		_	33	_		
Fall Time	t _f		-	10.4	-		
Turn-On Switching Loss	E _{ON}		-	1003	-	μJ	
Turn-Off Switching Loss	E _{OFF}		_	247	_	-	
Total Switching Loss	E _{TOT}		_	1248	_	-	
DRAIN-SOURCE DIODE CHARACTEI	RISTICS	1					
Continuous Drain-to-Source Diode Forward Current	I _{SD}	$V_{GS} = -5 V$	_	-	34	A	
Pulsed Drain-to-Source Diode Forward Current (Note 2)	I _{SDM}	$V_{GS} = -5 V$	-	-	240	A	
Forward Diode Voltage	V _{SD}	V _{GS} = -5 V, I _{SD} = 17.5 A	_	3.8	-	V	
Reverse Recovery Time	t _{RR}	V _{GS} = -5/20 V, I _{SD} = 47 A,	-	24	-	ns	
Reverse Recovery Charge	Q _{RR}	dl _S /dt = 1000 A/μs	_	125	-	nC	
Reverse Recovery Energy	E _{REC}	1	_	8.5	_	μJ	
Peak Reverse Recovery Current	I _{RRM}	1	_	10.4	_	A	
Charge Time	ta	1		12.4	_	ns	
Discharge Time	t _b	4	_	11.6		ns	

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°C unless otherwise noted)



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



TYPICAL CHARACTERISTICS ($T_J = 25^{\circ}C$ unless otherwise noted) (continued)

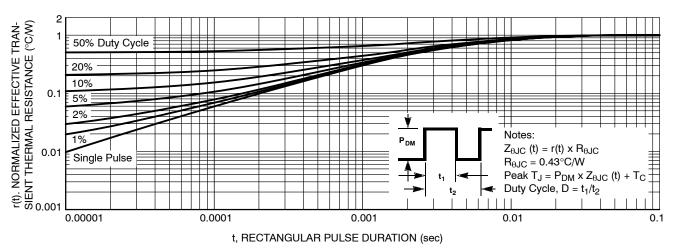


Figure 14. Junction-to-Ambient Thermal Response

ORDERING INFORMATION AND PACKAGE MARKING

Orderable Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTC040N120SC1	No Marking	Die	Wafer	N/A	N/A	N/A

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