

ON Semiconductor

Is Now

onsemi™

To learn more about onsemi™, please visit our website at
www.onsemi.com

onsemi and **onsemi** and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

MOSFET – N-Channel, Silicon Carbide

1200 V, 160 mΩ

NTC160N120SC1

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 @ $T_J = 175^\circ\text{C}$
- Typ $R_{DS(on)} = 160\text{ m}\Omega$ at $V_{GS} = 20\text{ V}$, $I_D = 10\text{ A}$
- High Speed Switching with Low Capacitance
- 100% UIL Tested
- These Devices are Pb-Free and are RoHS Compliant

Applications

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

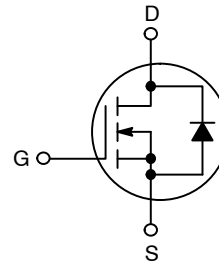


ON Semiconductor®

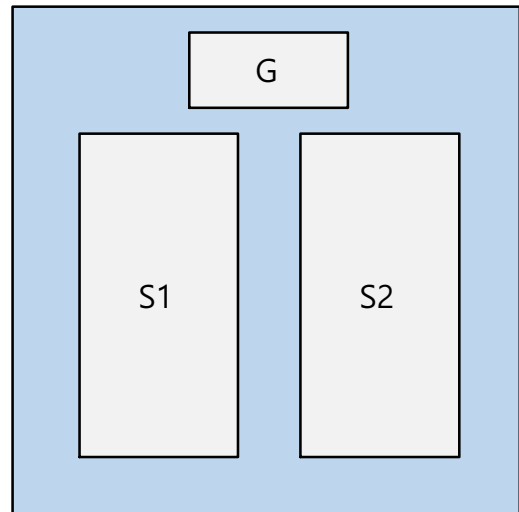
www.onsemi.com

$V_{(BR)DSS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
1200 V	224 mΩ @ 20 V	17 A

N-CHANNEL MOSFET



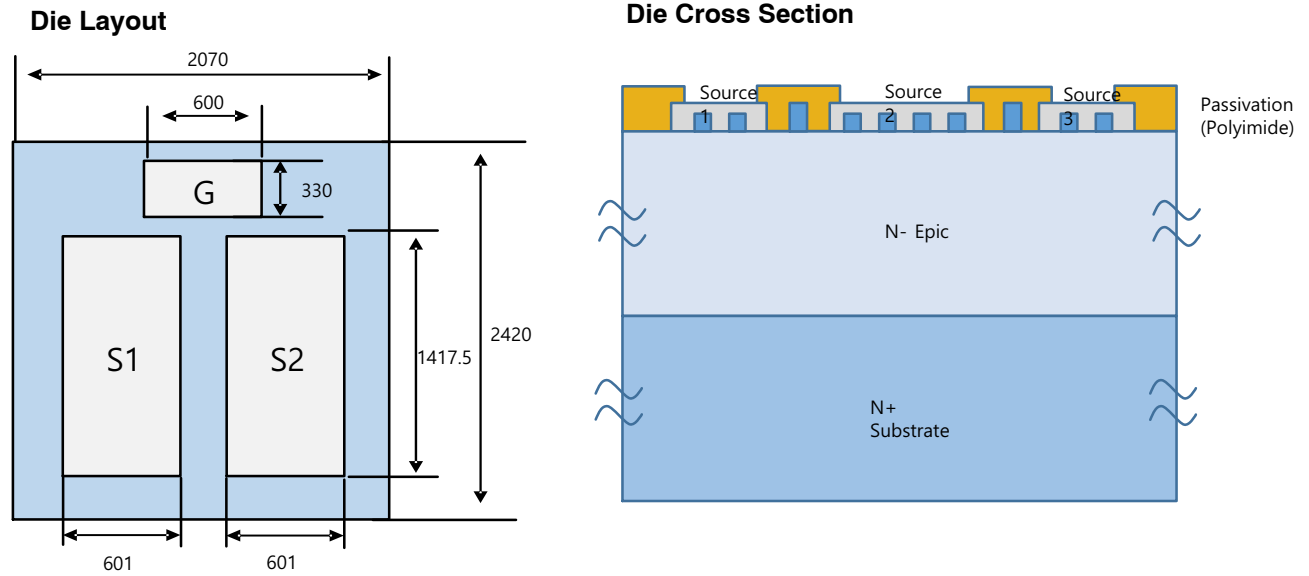
DIE DIAGRAM



Die Information

- Wafer Diameter 6 inch
- Die Size 2,070 x 2,420 μm
- Metallization
 - Top Ti/TiN/Al 5 μm
 - Back Ti/NiV/Ag
- Die Thickness Typ. 200 μm
- Gate Pad Size 600 x 330 μm

NTC160N120SC1



Passivation Information

- Passivation Material: Polyimide (PSPi)
- Passivation Type: Local Passivation
- Passivation Thickness 10 μm
- : Passivation Area

Die Layout

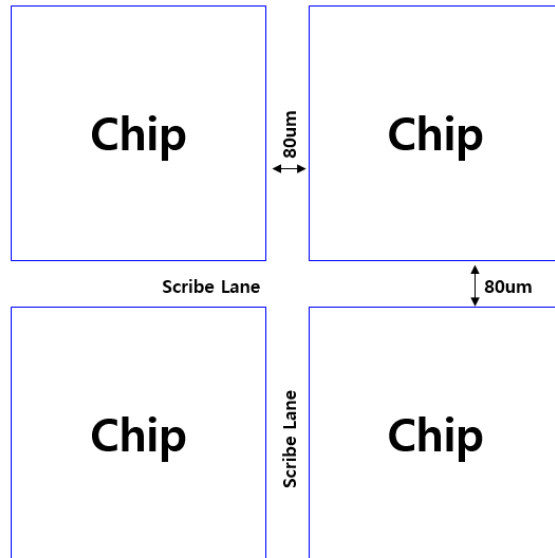


Figure 1. Bare Die Dimensions

NTC160N120SC1

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 _{θJC}	Steady State T _C = 25°C	I _D	17	A
Power Dissipation R _{θJC}		P _D	119	W
Continuous Drain Current R _{θJC}	Steady State T _C = 100°C	I _D	12	A
Power Dissipation R _{θJC}		P _D	59	W
Pulsed Drain Current (Note 2)	T _C = 25°C	I _{DM}	69	A
Single Pulse Surge Drain Current Capability	T _C = 25°C, t _p = 10 μs, R _G = 4.7 Ω	I _{DSC}	140	A
Operating Junction and Storage Temperature Range		T _J , T _{stg}	-55 to +175	°C
Source Current (Body Diode)		I _S	11	A
Single Pulse Drain-to-Source Avalanche Energy (I _{L(pk)} = 16 A, L = 1 mH) (Note 3)		E _{AS}	128	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 _{θJC}	1.3	°C/W

- The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
- Repetitive rating, limited by max junction temperature.
- E_{AS} of 128 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 16 A, V_{DD} = 120 V, V_{GS} = 18 V.

NTC160N120SC1

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
-----------	--------	-----------------	-----	-----	-----	------

OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200	-	-	V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$, referenced to 25°C	-	600	-	mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_J = 25^\circ\text{C}$	-	-	100	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_J = 175^\circ\text{C}$	-	-	250	
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = +25/-15\text{ V}, V_{DS} = 0\text{ V}$	-	-	± 1	μA

ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 2.5\text{ mA}$	1.8	3.1	4.3	V
Recommended Gate Voltage	V_{GOP}		-5	-	+20	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20\text{ V}, I_D = 12\text{ A}, T_J = 25^\circ\text{C}$	-	162	224	m Ω
		$V_{GS} = 20\text{ V}, I_D = 12\text{ A}, T_J = 150^\circ\text{C}$	-	247	-	
Forward Transconductance	g_{FS}	$V_{DS} = 10\text{ V}, I_D = 12\text{ A}$	-	3	-	S

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 800\text{ V}$	-	665	-	μF
Output Capacitance	C_{OSS}		-	50	-	
Reverse Transfer Capacitance	C_{RSS}		-	5	-	
Total Gate Charge	$Q_{G(tot)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 600\text{ V}, I_D = 16\text{ A}$	-	34	-	nC
Threshold Gate Charge	$Q_{G(th)}$		-	6	-	
Gate-to-Source Charge	Q_{GS}		-	12.5	-	
Gate-to-Drain Charge	Q_{GD}		-	9.6	-	
Gate Resistance	R_G	$f = 1\text{ MHz}$	-	1.4	-	Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 800\text{ V}, I_D = 16\text{ A}, R_G = 6\text{ }\Omega$, Inductive Load	-	11	-	ns
Rise Time	t_r		-	19	-	
Turn-Off Delay Time	$t_{d(off)}$		-	15	-	
Fall Time	t_f		-	8	-	
Turn-On Switching Loss	E_{ON}		-	200	-	μJ
Turn-Off Switching Loss	E_{OFF}		-	34	-	
Total Switching Loss	E_{TOT}		-	234	-	

DRAIN-SOURCE DIODE CHARACTERISTICS

Continuous Drain-to-Source Diode Forward Current	I_{SD}	$V_{GS} = -5\text{ V}$	-	-	11	A
Pulsed Drain-to-Source Diode Forward Current (Note 2)	I_{SDM}	$V_{GS} = -5\text{ V}$	-	-	69	A
Forward Diode Voltage	V_{SD}	$V_{GS} = -5\text{ V}, I_{SD} = 6\text{ A}$	-	4	10	V
Reverse Recovery Time	t_{RR}	$V_{GS} = -5/20\text{ V}, I_{SD} = 16\text{ A}, di_s/dt = 1000\text{ A}/\mu\text{s}$	-	15	-	ns
Reverse Recovery Charge	Q_{RR}		-	45	-	nC
Reverse Recovery Energy	E_{REC}		-	3.9	-	μJ
Peak Reverse Recovery Current	I_{RRM}		-	6.2	-	A
Charge Time	T_a		-	7.4	-	ns
Discharge Time	T_b		-	7	-	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.

NTC160N120SC1

TYPICAL CHARACTERISTICS $T_J = 25^\circ\text{C}$ unless otherwise noted

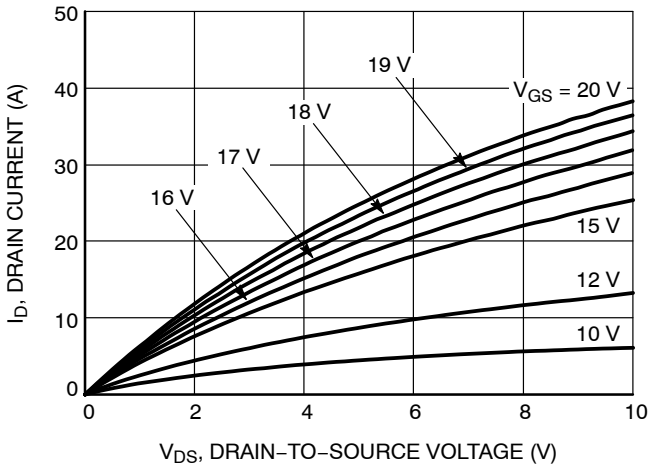


Figure 2. On-Region Characteristics

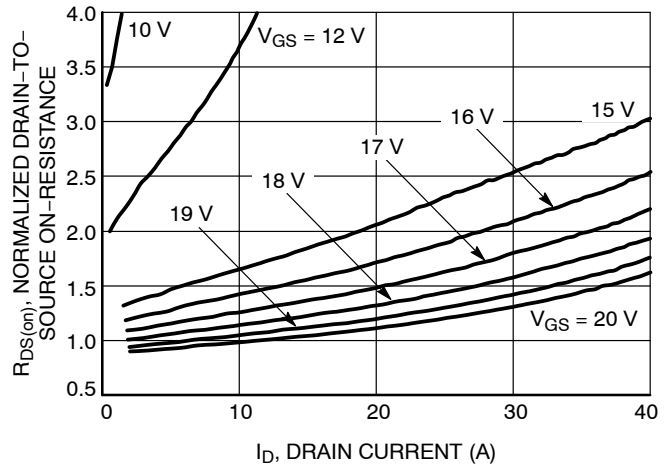


Figure 3. Normalized On-Resistance vs. Drain Current and Gate Voltage

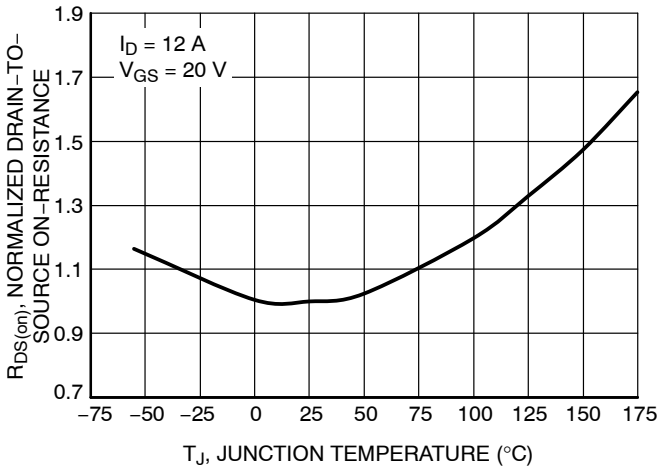


Figure 4. On-Resistance Variation with Temperature

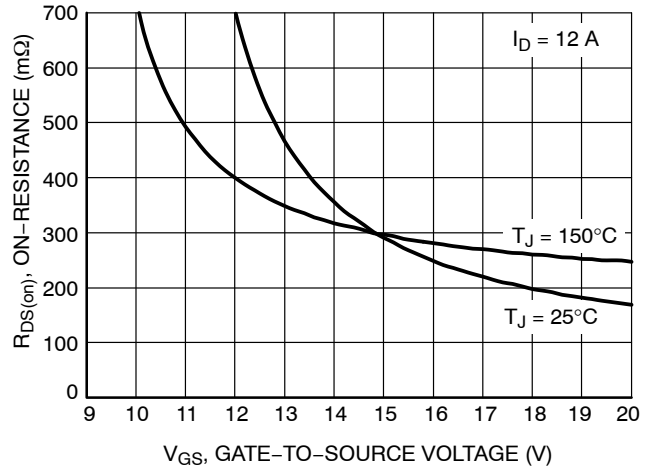


Figure 5. On-Resistance vs. Gate-to-Source Voltage

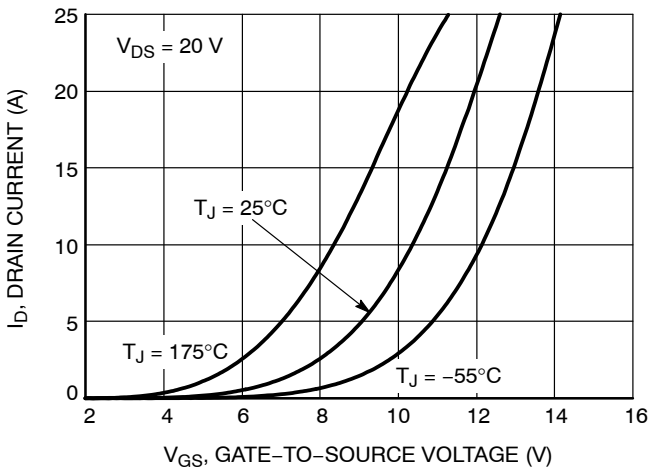


Figure 6. Transfer Characteristics

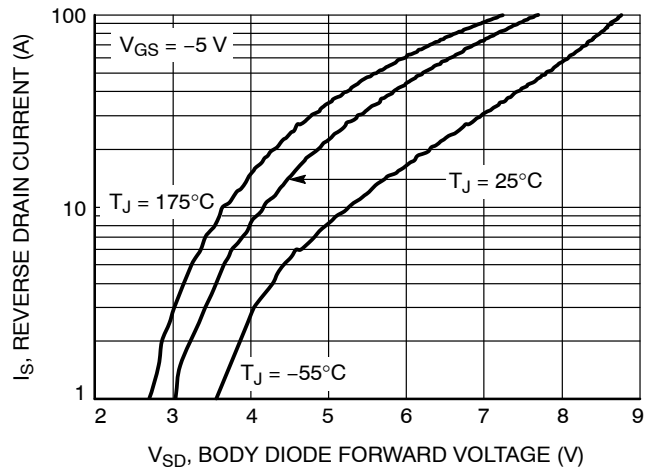


Figure 7. Diode Forward Voltage vs. Current

NTC160N120SC1

TYPICAL CHARACTERISTICS $T_J = 25^\circ\text{C}$ unless otherwise noted

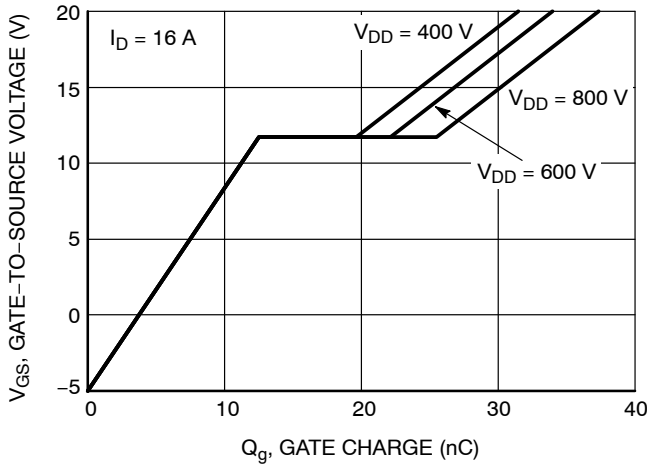


Figure 8. Gate-to-Source Voltage vs. Total Charge

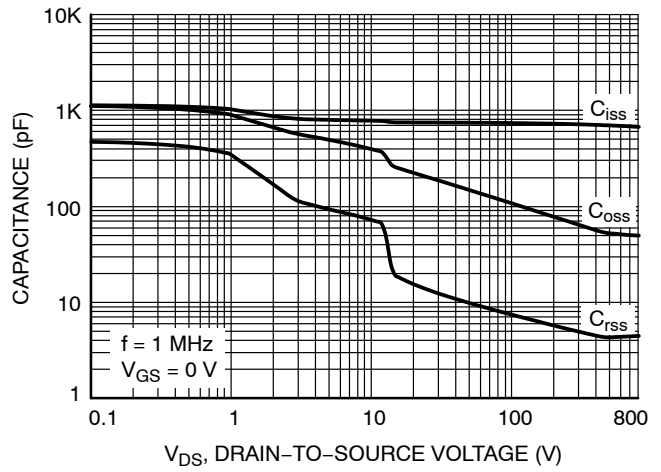


Figure 9. Capacitance vs. Drain-to-Source Voltage

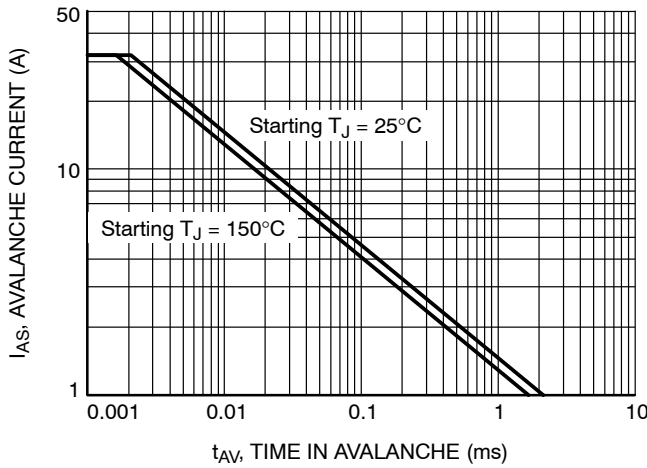


Figure 10. Unclamped Inductive Switching Capability

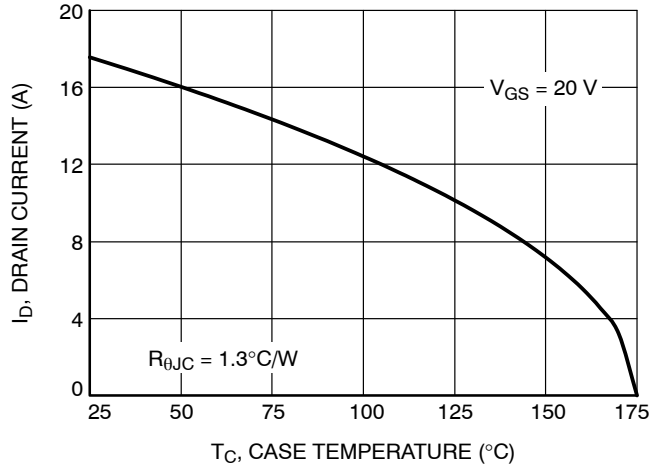


Figure 11. Maximum Continuous Drain Current vs. Case Temperature

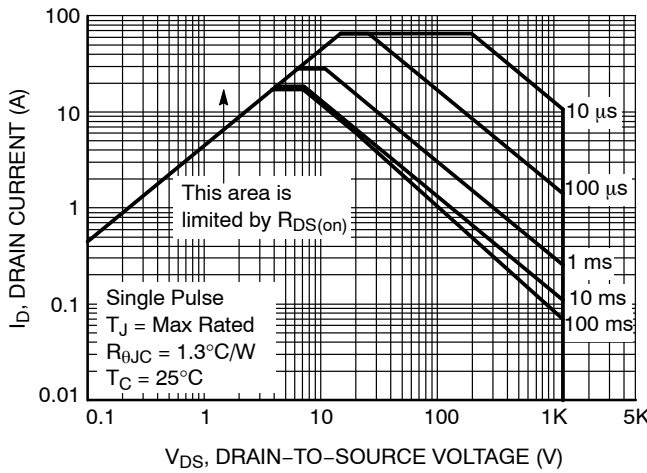


Figure 12. Safe Operating Area

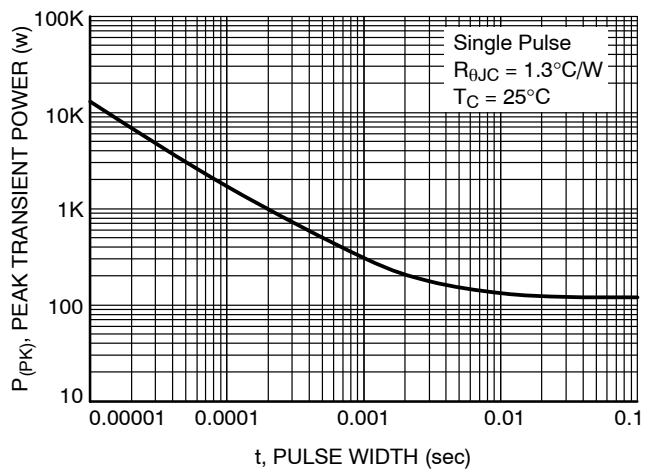


Figure 13. Single Pulse Maximum Power Dissipation

NTC160N120SC1

TYPICAL CHARACTERISTICS

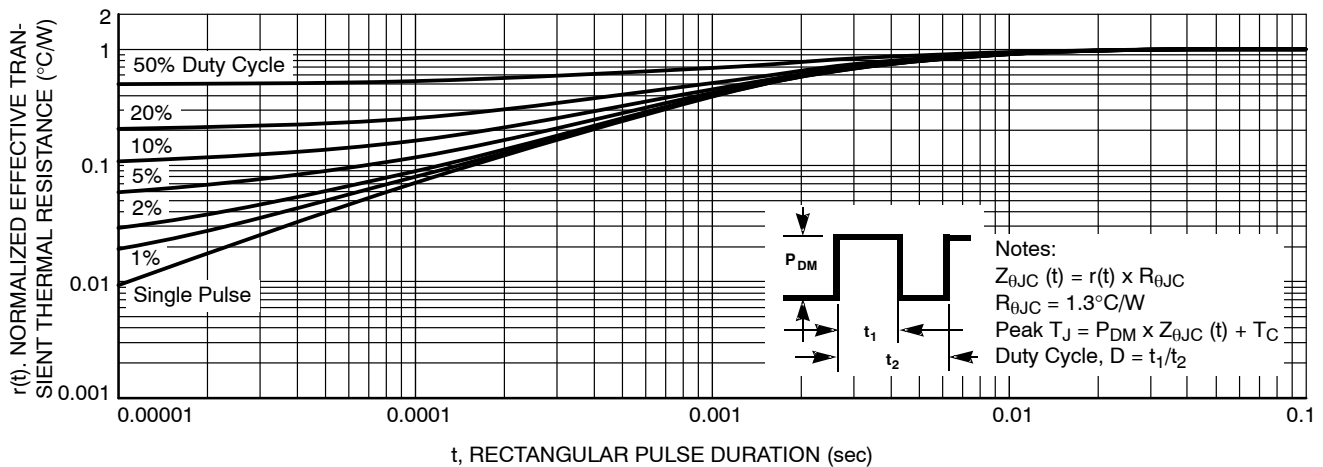


Figure 14. Junction-to-Ambient Thermal Response

ORDERING INFORMATION AND PACKAGE MARKING

Orderable Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTC160N120SC1	N/A	Die	Wafer	N/A	N/A	N/A

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marketing.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
Voice Mail: 1 800-282-9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative