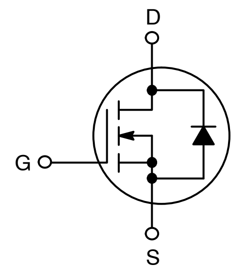
Silicon Carbide (SiC) MOSFET – EliteSiC, 40 mohm, 1200 V, M1, Die

NTC040N120SC1

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	I_D MAX
1200 V	56 mΩ @ 20 V	60 A

N−CHANNEL MOSFET



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.

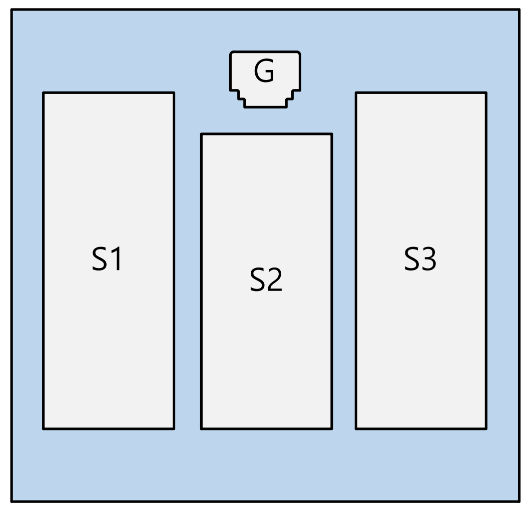
Features

- 1200 V @ T_J = 175°C
- Typ $R_{DS(on)}$ = 40 mΩ at V_{GS} = 20 V, I_D = 40 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

DIE DIAGRAM



Die Information

- Wafer Diameter: 6 inch
- Die Size: 4,270 x 3,560 μm
- Metallization
  - · Top: Ti/TiN/Al 5 μm
  - · Back: Ti/NiV/Ag
- Die Thickness: Typ. 200 μm
- Gate Pad Size: 604 x 415 μm

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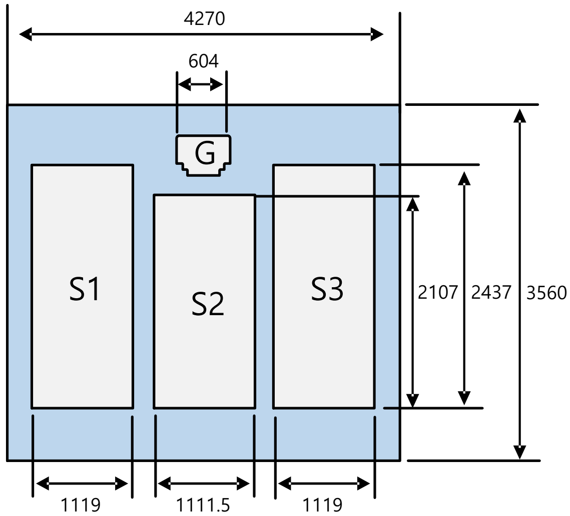
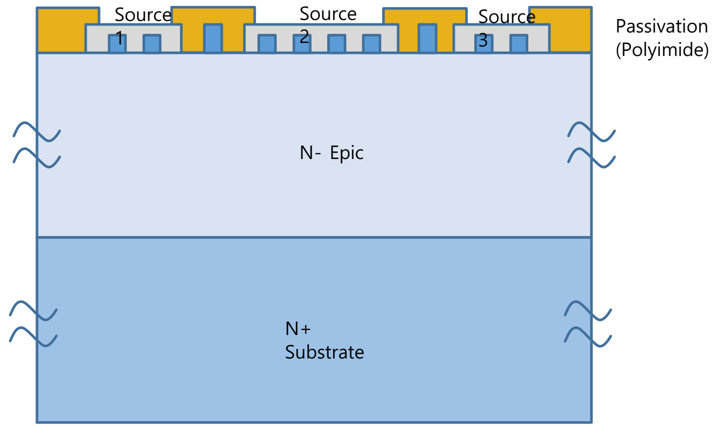
Publication Order Number:
NTC040N120SC1/D

Die Layout



Die Cross Section



Passivation Information

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

: Passivation Area

Die Layout

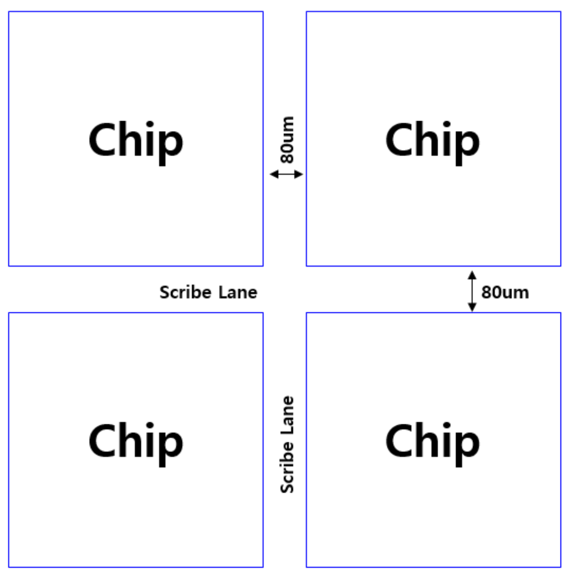


Figure 1. Bare Die Dimensions

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_C = 25°C	I_D	60	A
Power Dissipation $R_{\theta JC}$			P_D	348	W
Continuous Drain Current $R_{\theta JC}$	Steady State	T_C = 100°C	I_D	42	A
Power Dissipation $R_{\theta JC}$			P_D	174	W
Pulsed Drain Current (Note 2)	T_C = 25°C		I_{DM}	240	A
Single Pulse Surge Drain Current Capability	T_C = 25°C, t_p = 10 μs, R_G = 4.7 Ω		I_{DSC}	416	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +175	°C
Source Current (Body Diode)			I_S	34	A
Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 35 A, L = 1 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)	$R_{\theta JC}$	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°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	Typ	Max	Unit
OFF CHARACTERISTICS						
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 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°C	–	–	100	μA
		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 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°C	–	39	56	mΩ
		V_{GS} = 20 V, I_D = 35 A, T_J = 150°C	–	60	–	
Forward Transconductance	g_{FS}	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						
Turn-On Delay Time	$t_{d(on)}$	V_{GS} = −5/20 V, V_{DS} = 800 V, I_D = 47 A, R_G = 4.7 Ω, Inductive Load	–	18	–	ns
Rise Time	t_r		–	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 CHARACTERISTICS						
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, dI_S/dt = 1000 A/μs	–	24	–	ns
Reverse Recovery Charge	Q_{RR}		–	125	–	nC
Reverse Recovery Energy	E_{REC}		–	8.5	–	μJ
Peak Reverse Recovery Current	I_{RRM}		–	10.4	–	A
Charge Time	t_a		–	12.4	–	ns
Discharge Time	t_b		–	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)

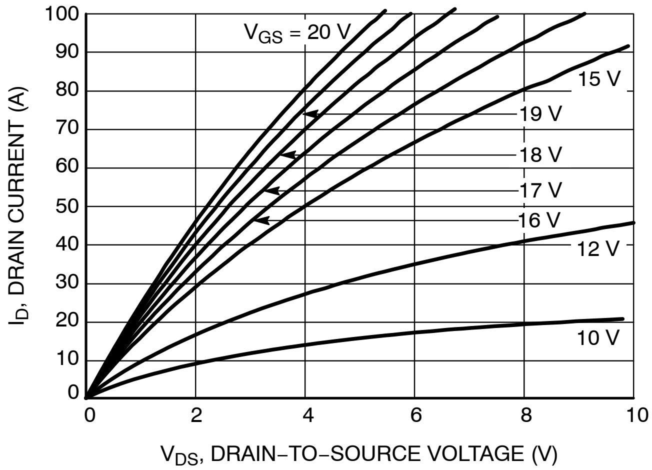


Figure 2. On−Region Characteristics

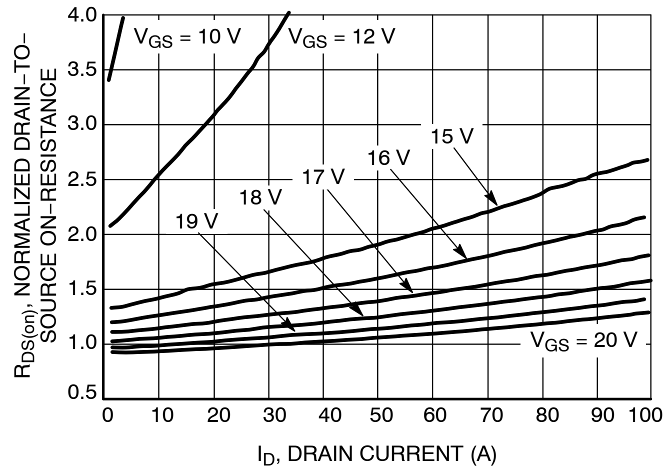


Figure 3. Normalized On−Resistance vs. Drain Current and Gate Voltage

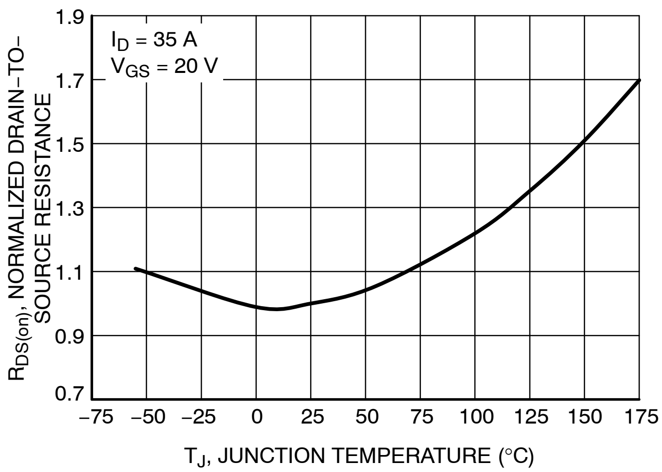


Figure 4. On−Resistance Variation with Temperature

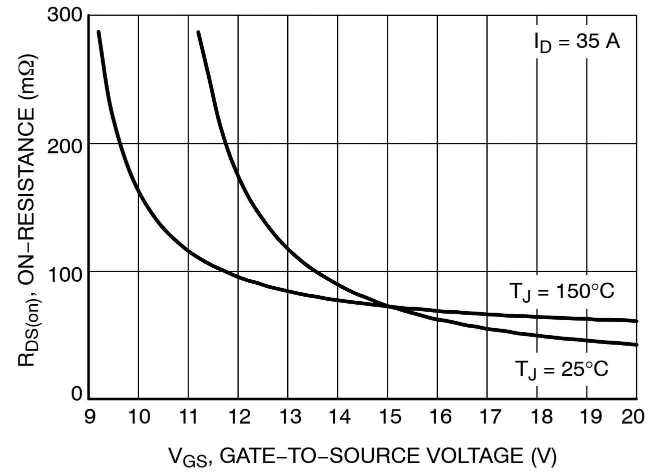


Figure 5. On−Resistance vs. Gate−to−Source Voltage

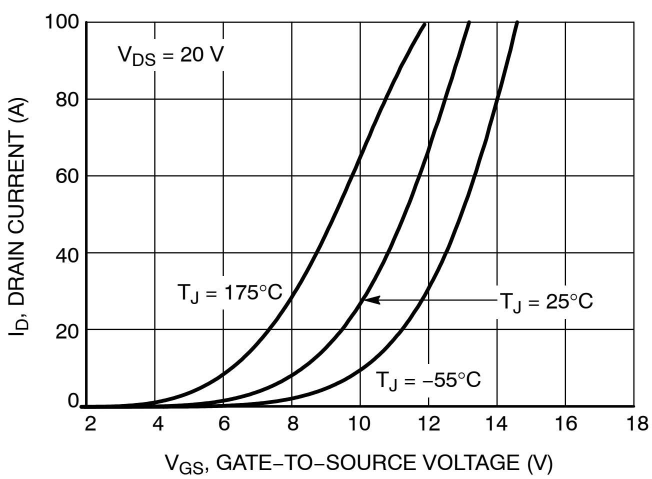


Figure 6. Transfer Characteristics

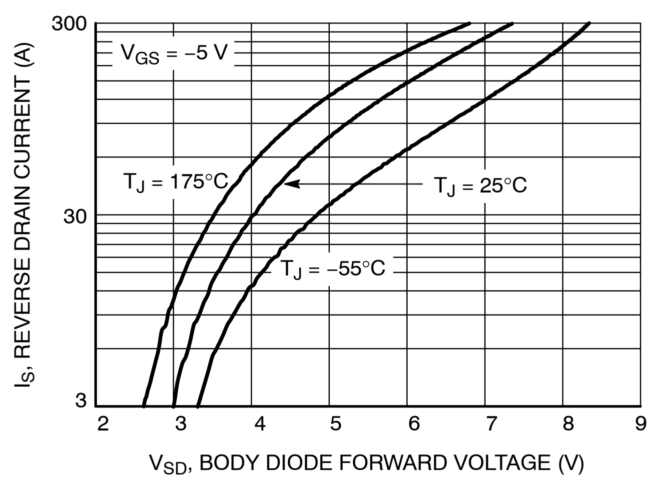


Figure 7. Diode Forward Voltage vs. Current

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

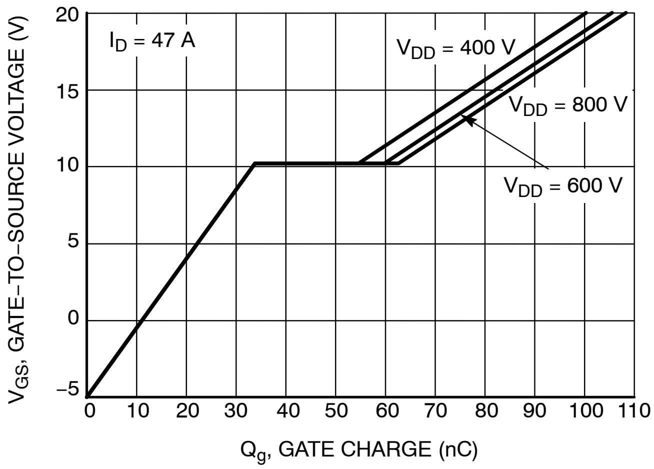


Figure 8. Gate−to−Source Voltage vs. Total Charge

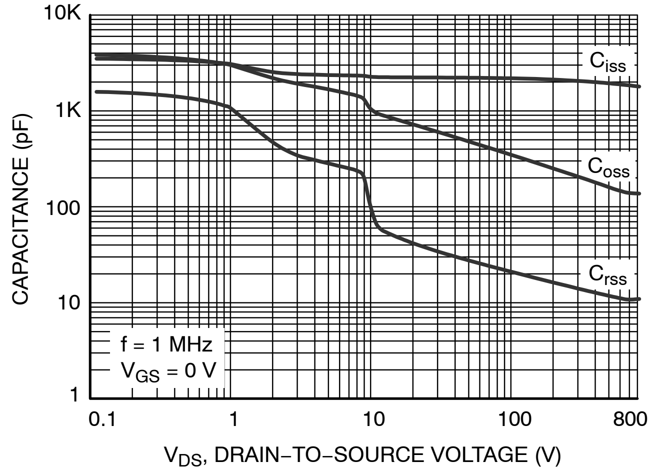


Figure 9. Capacitance vs. Drain−to−Source Voltage

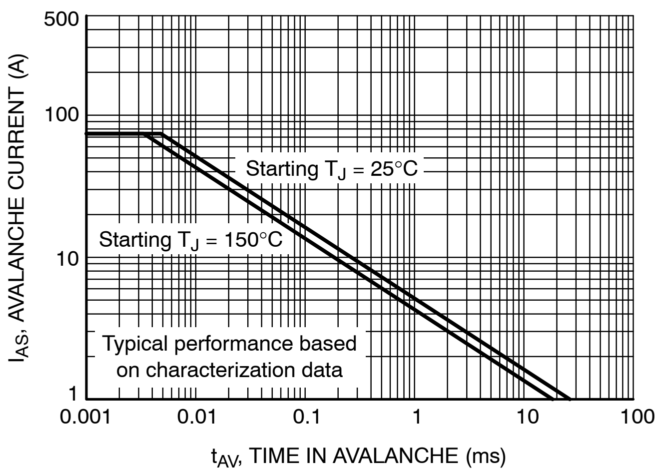


Figure 10. Unclamped Inductive Switching Capability

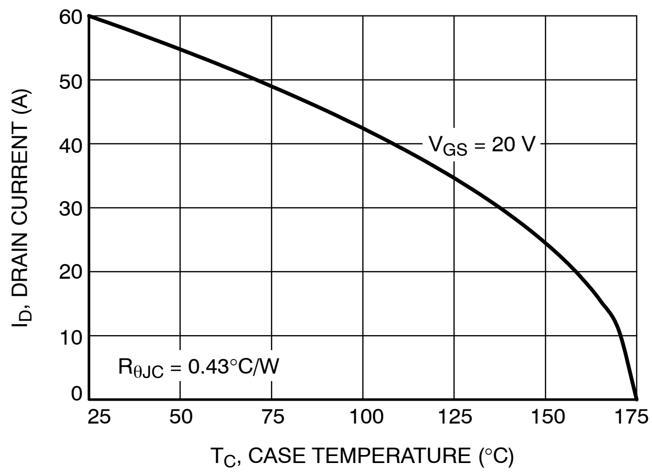


Figure 11. Maximum Continuous Drain Current vs. Case Temperature

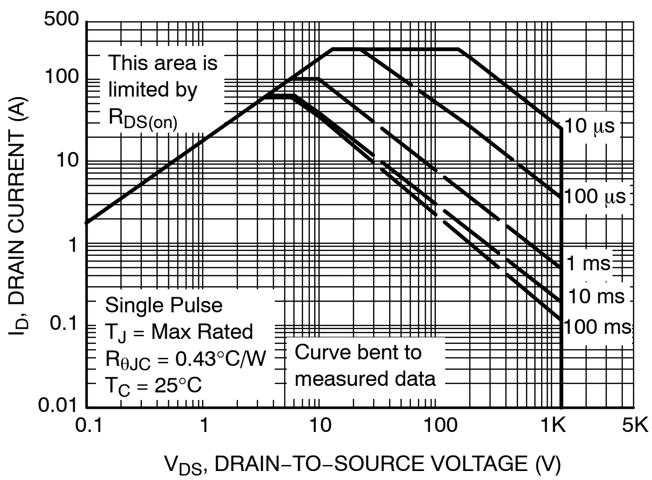


Figure 12. Safe Operating Area

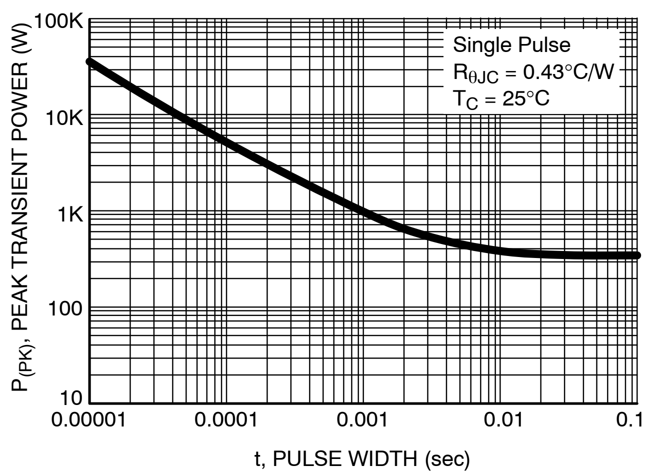


Figure 13. Single Pulse Maximum Power Dissipation

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

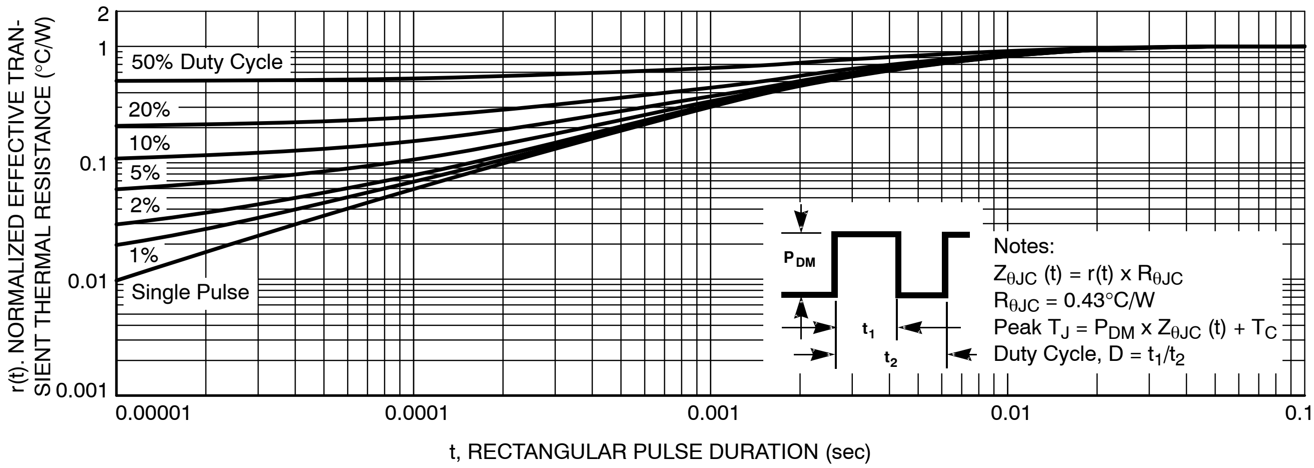


Figure 14. Junction−to−Ambient Thermal Response

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

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
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