

# SiC Power MOSFET Module

**1200 V, 40 mΩ, 27 A  
H-Bridge Power Module**

## NVXK2TR40WXT

### Features

- DIP Silicon Carbide H-Bridge Power Module for On-board Charger (OBC) for xEV Applications
- Creepage and Clearance per IEC 60664-1, IEC 60950-1
- Compact Design for Low Total Module Resistance
- Module Serialization for Full Traceability
- Lead Free, ROHS and UL94V-0 Compliant
- Automotive Qualified per AEC-Q101 and AQG324

### Typical Applications

- DC-DC and On-Board Charger in xEV Applications

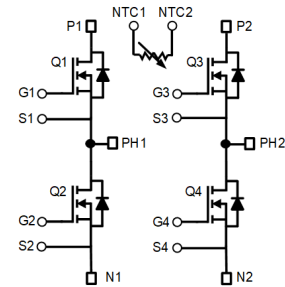
### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	V <sub>DSS</sub>	1200	V	
Gate-to-Source Voltage	V <sub>GS</sub>	+25/-15	V	
Recommended Operation Values of Gate-to-Source Voltage, T <sub>J</sub> ≤ 175°C	V <sub>GSop</sub>	+20/-5	V	
Continuous Drain Current (Notes 1, 2)	T <sub>C</sub> = 25°C	I <sub>D</sub>	27	A
Power Dissipation (Note 1)		P <sub>D</sub>	319	W
Pulsed Drain Current (Note 3)	T <sub>C</sub> = 25°C	I <sub>DM</sub>	240	A
Single Pulse Surge Drain Current Capability	T <sub>C</sub> = 25°C, t <sub>p</sub> = 10 μs, R <sub>G</sub> = 4.7 Ω	I <sub>DSC</sub>	495	A
Operating Junction and Storage Temperature	T <sub>J</sub> , T <sub>stg</sub>	-55 to 175	°C	
Source Current (Body Diode) (Note 2)	I <sub>S</sub>	27	A	
Single Pulse Drain-to-Source Avalanche Energy (Note 4)	E <sub>AS</sub>	338	mJ	

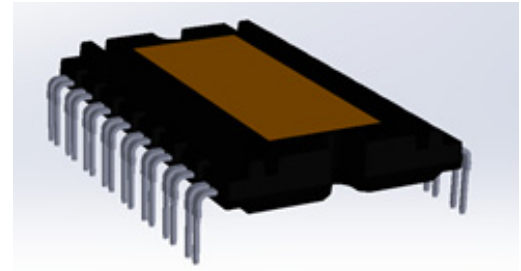
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Particular conditions specified determine thermal resistance values shown. Infinite heatsink with T<sub>C</sub> = 100°C for R<sub>θJC</sub>. For R<sub>ψJS</sub> assembled to 3 mm thick aluminum heatsink with infinite cooling bottom surface at 85°C, through 38 μm thick TIM with 6.5 W/mK thermal conductivity.
2. Qualified per ECPE Guideline AQG 324.
3. Repetitive rating limited by maximum junction temperature and transconductance.
4. E<sub>AS</sub> based on initial T<sub>J</sub> = 25°C, L = 1 mH, I<sub>AS</sub> = 26 A, V<sub>DD</sub> = 120 V, V<sub>GS</sub> = 18 V.

V <sub>(BR)DSS</sub>	R <sub>DS(on)</sub> Max	I <sub>D</sub> Max
1200 V	59 mΩ @ 20 V	27 A



SiC MOSFET H-Bridge Module



APM32

### ORDERING INFORMATION

Device	Package	Shipping
NVXK2TR40WXT	APM32 (Pb-Free)	10 ea / Tube

# NVXK2TR40WXT

## THERMAL CHARACTERISTICS (Note 1)

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance Junction-to-Case (Note 1)	$R_{\theta JC}$	0.37	0.47	$^{\circ}\text{C}/\text{W}$
Thermal Resistance Junction-to-Sink (Note 1)	$R_{\theta JS}$	0.84	0.95	$^{\circ}\text{C}/\text{W}$

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### 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 $25^{\circ}\text{C}$		450		$\text{mV}/^{\circ}\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}$ $V_{DS} = 1200\text{ V}$	$T_J = 25^{\circ}\text{C}$		100	$\mu\text{A}$
			$T_J = 175^{\circ}\text{C}$		1	$\text{mA}$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +25/-15\text{ V}, V_{DS} = 0\text{ V}$			$\pm 1$	$\mu\text{A}$

### ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 10\text{ mA}$	1.8	3	4.3	V
Recommended Gate Voltage	$V_{GOP}$		-5		+20	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20\text{ V}, I_D = 35\text{ A}, T_J = 25^{\circ}\text{C}$		40	59	$\text{m}\Omega$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20\text{ V}, I_D = 35\text{ A}, T_J = 175^{\circ}\text{C}$		71		$\text{m}\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = 20\text{ V}, I_D = 35\text{ A}$		20		S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz},$ $V_{DS} = 800\text{ V}$		1789		$\text{pF}$
Output Capacitance	$C_{OSS}$			139		
Reverse Transfer Capacitance	$C_{RSS}$			12.5		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 600\text{ V},$ $I_D = 47\text{ A}$		106		$\text{nC}$
Threshold Gate Charge	$Q_{G(TH)}$			18		
Gate-to-Source Charge	$Q_{GS}$			34		
Gate-to-Drain Charge	$Q_{GD}$			26		
Gate-Resistance	$R_G$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		2		$\Omega$

### INDUCTIVE SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5 / 20\text{ V}, V_{DS} = 800\text{ V},$ $I_D = 47\text{ A}, R_G = 4.7\ \Omega,$ Inductive load		17		ns	
Rise Time	$t_r$			20			
Turn-Off Delay Time	$t_{d(OFF)}$			30			
Fall Time	$t_f$			9			
Turn-On Switching Loss	$E_{ON}$			366			$\mu\text{J}$
Turn-Off Switching Loss	$E_{OFF}$			200			$\mu\text{J}$
Total Switching Loss	$E_{tot}$			566			$\mu\text{J}$

### DRAIN-SOURCE DIODE CHARACTERISTICS

Continuous Drain-Source Diode Forward Current (Note 1)	$I_{SD}$	$V_{GS} = -5\text{ V}, T_J = 25^{\circ}\text{C}$			27	A
Pulsed Drain-Source Diode Forward Current (Note 3)	$I_{SDM}$	$V_{GS} = -5\text{ V}, T_J = 25^{\circ}\text{C}$			240	A
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5\text{ V}, I_{SD} = 17.5\text{ A},$ $T_J = 25^{\circ}\text{C}$		3.7		V

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Reverse Recovery Time	$t_{RR}$	$V_{GS} = -5\text{ V}$ , $di_S/dt = 1000\text{ A}/\mu\text{s}$ , $I_{SD} = 17.5\text{ A}$		24		ns
Peak Reverse Recovery Current	$I_{RRM}$			10.4		A
Charge Time	$t_a$			12.4		ns
Discharge Time	$t_b$			11.6		ns
Reverse Recovery Charge	$Q_{RR}$			125		nC

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.

5. Pulse test: pulse width  $\leq 300\ \mu\text{s}$ , duty ratio  $\leq 2\%$ .

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## TYPICAL CHARACTERISTICS

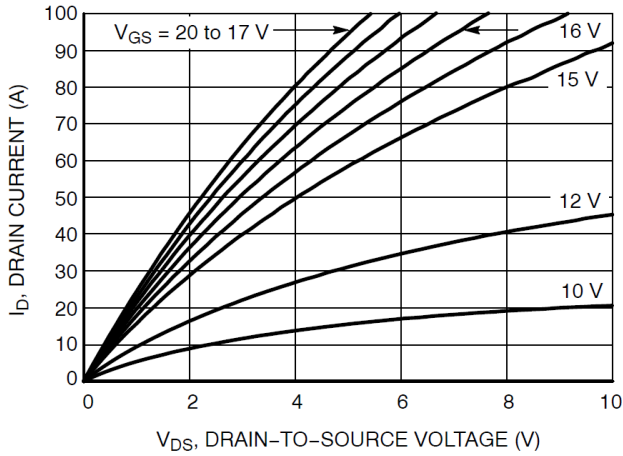


Figure 1. On-Region Characteristics

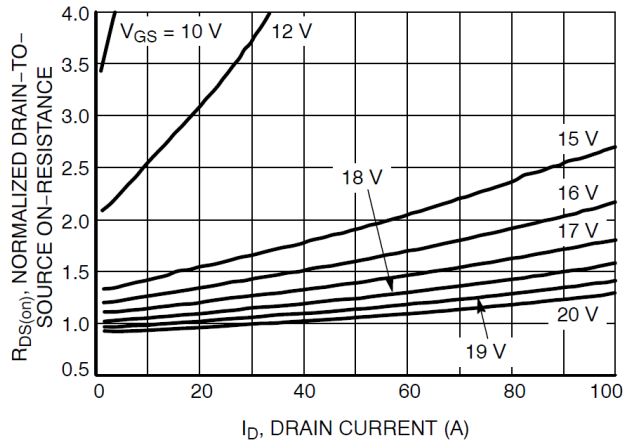


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

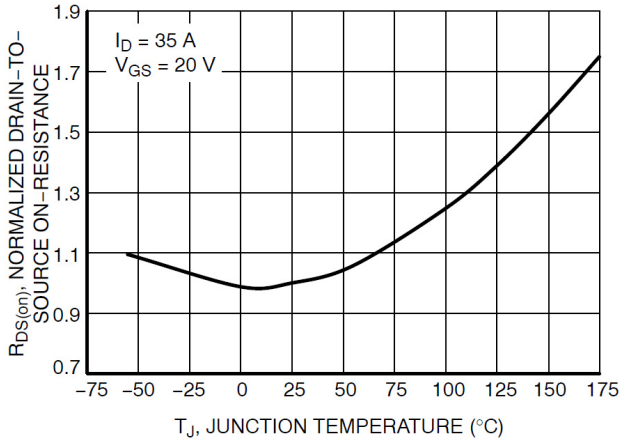


Figure 3. On-Resistance Variation with Temperature

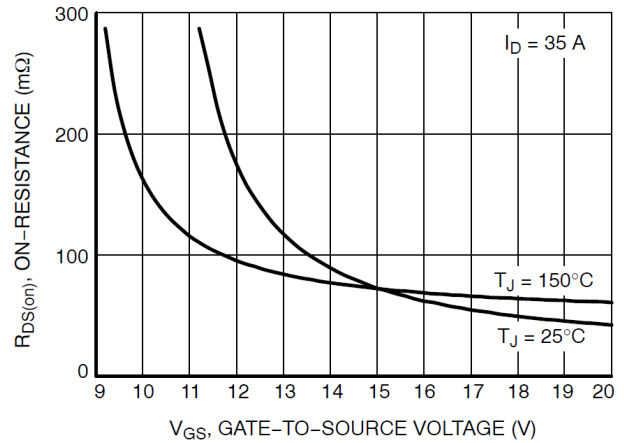


Figure 4. On-Resistance vs. Gate-to-Source Voltage

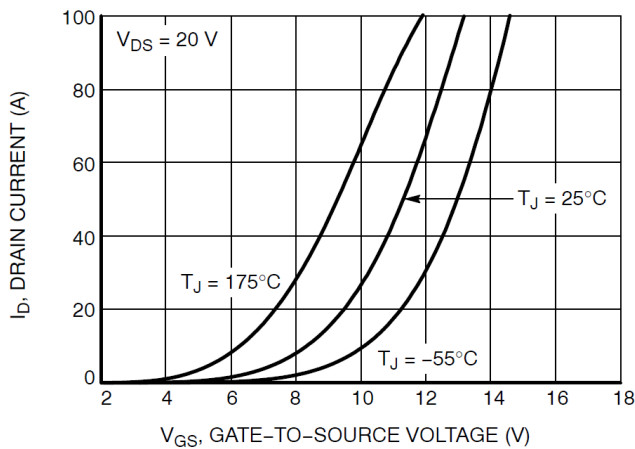


Figure 5. Transfer Characteristics

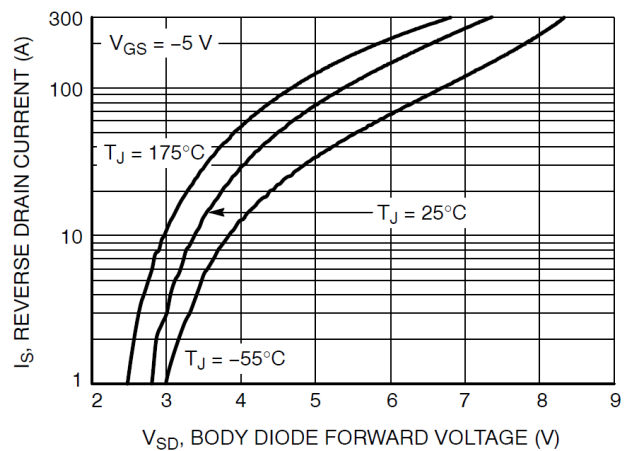


Figure 6. Diode Forward Voltage vs. Current

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## TYPICAL CHARACTERISTICS (CONTINUED)

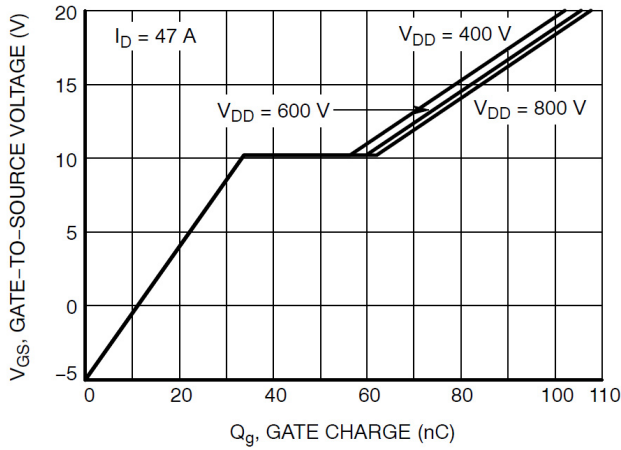


Figure 7. Gate-to-Source Voltage vs. Total Charge

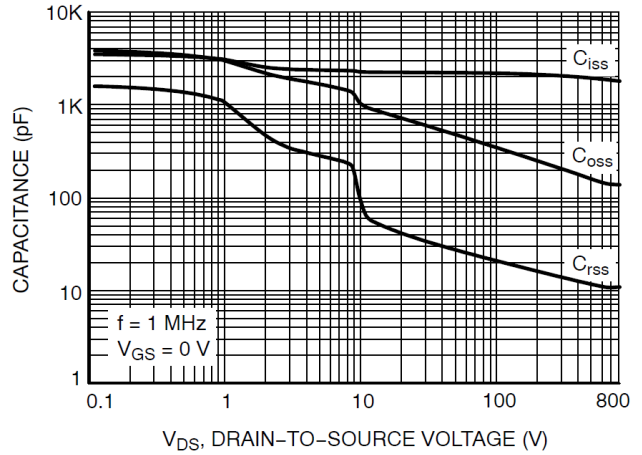


Figure 8. Capacitance vs. Drain-to-Source Voltage

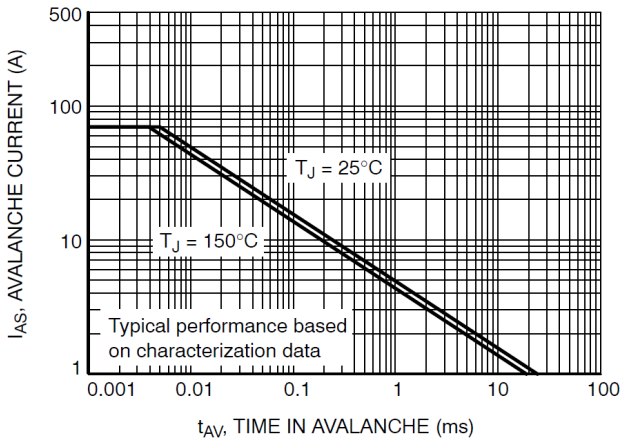


Figure 9. Unclamped Inductive Switching Capability

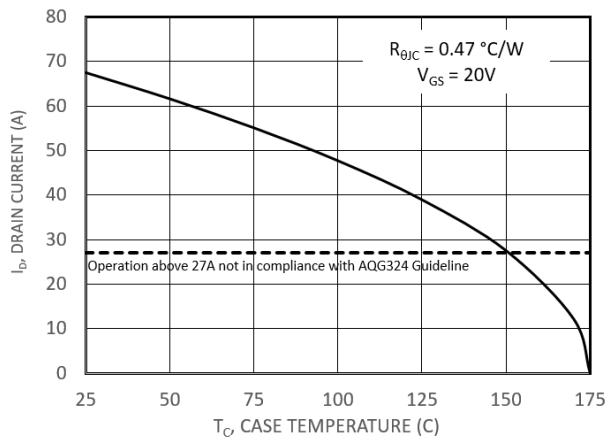


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

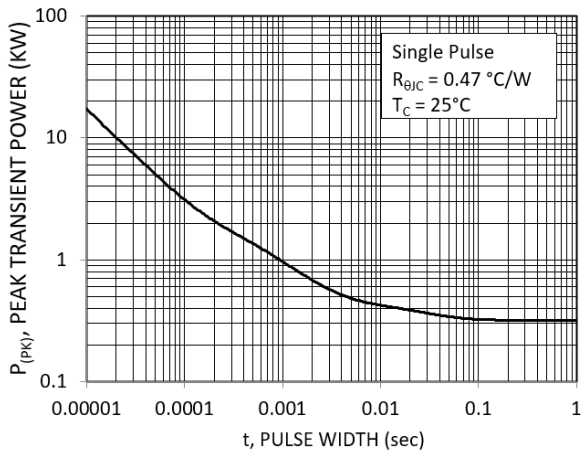


Figure 11. Single Pulse Maximum Power Dissipation

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## TYPICAL CHARACTERISTICS (CONTINUED)

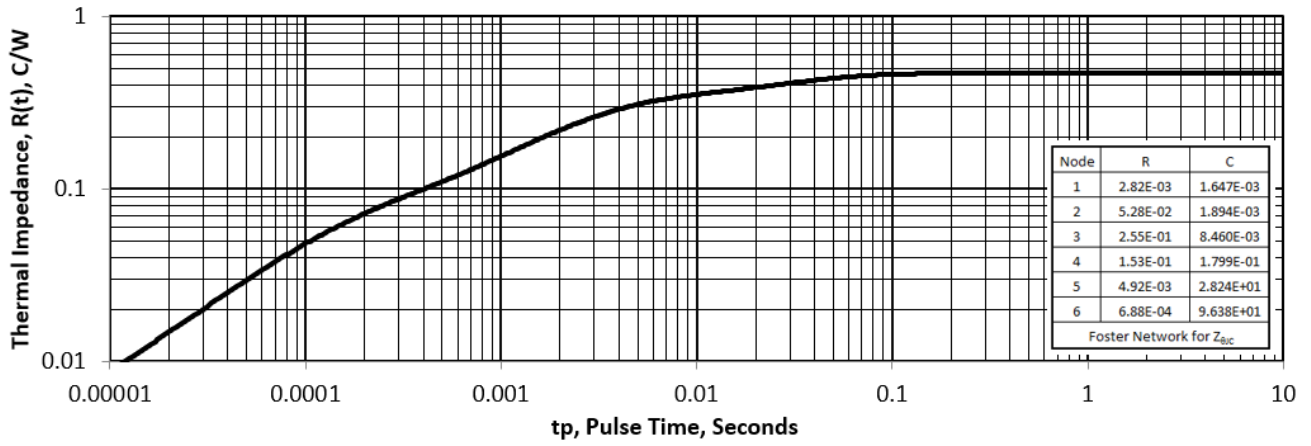


Figure 12. Thermal Response

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