

# Silicon Carbide (SiC) Module – EliteSiC Power Module for OBC, 80 mohm, 1200 V, 20 A, Dual Half-Bridge, in APM32 Series NVXK2TR80WDT

## 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 AQC324

## Typical Applications

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

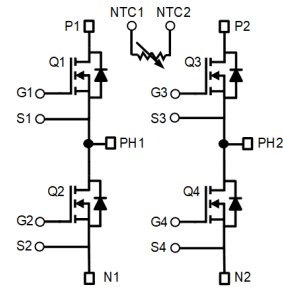
### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

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)	I <sub>D</sub>	20	A
Power Dissipation (Note 1)			
Pulsed Drain Current (Note 3)	I <sub>DM</sub>	110	A
Single Pulse Surge Drain Current Capability	I <sub>DSC</sub>	266	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>	18	A
Single Pulse Drain-to-Source Avalanche Energy (Note 4)	E <sub>AS</sub>	180	mJ

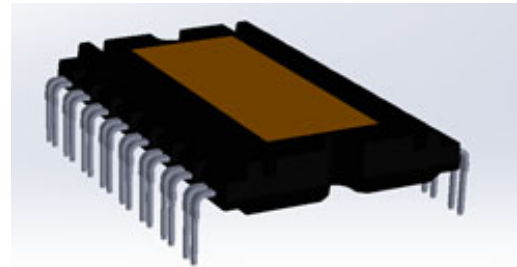
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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 AQC 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> = 19 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	116 mΩ @ 20 V	20 A



SiC MOSFET H-Bridge Module



APM32

## ORDERING INFORMATION

Device	Package	Shipping
NVXK2TR80WDT	APM32 (Pb-Free)	10 ea / Tube

# NVXK2TR80WDT

## THERMAL CHARACTERISTICS (Note 1)

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance Junction-to-Case (Note 1)	$R_{\theta JC}$	1.41	1.84	$^{\circ}\text{C}/\text{W}$
Thermal Resistance Junction-to-Sink (Note 1)	$R_{\Psi JS}$	1.84	2.26	$^{\circ}\text{C}/\text{W}$

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
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 $25^{\circ}\text{C}$		500		$\text{mV}/^{\circ}\text{C}$
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	$R_{DS(on)}$	$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 25^{\circ}\text{C}$		80	116	$\text{m}\Omega$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 175^{\circ}\text{C}$		150		$\text{m}\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = 20\text{ V}, I_D = 20\text{ A}$		11		S

## CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 800\text{ V}$		1154		$\text{pF}$
Output Capacitance	$C_{OSS}$			79		
Reverse Transfer Capacitance	$C_{RSS}$			7.9		
Total Gate Charge	$Q_G(TOT)$	$V_{GS} = -5/20\text{ V}, V_{DS} = 600\text{ V}, I_D = 20\text{ A}$		56		$\text{nC}$
Threshold Gate Charge	$Q_G(TH)$			10		
Gate-to-Source Charge	$Q_{GS}$			18		
Gate-to-Drain Charge	$Q_{GD}$			11		
Gate-Resistance	$R_G$		$V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		1.2	

## INDUCTIVE SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 800\text{ V}, I_D = 20\text{ A}, R_G = 4.7\ \Omega,$ Inductive load		12		ns	
Rise Time	$t_r$			12			
Turn-Off Delay Time	$t_{d(OFF)}$			21			
Fall Time	$t_f$			9			
Turn-On Switching Loss	$E_{ON}$			135			$\mu\text{J}$
Turn-Off Switching Loss	$E_{OFF}$			46			$\mu\text{J}$
Total Switching Loss	$E_{tot}$			181			$\mu\text{J}$

## DRAIN-SOURCE DIODE CHARACTERISTICS

Continuous Drain-Source Diode Forward Current (Note 1)	$I_{SD}$	$V_{GS} = -5\text{ V}, T_J = 25^{\circ}\text{C}$			18	A
Pulsed Drain-Source Diode Forward Current (Note 3)	$I_{SDM}$	$V_{GS} = -5\text{ V}, T_J = 25^{\circ}\text{C}$			110	A
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5\text{ V}, I_{SD} = 10\text{ A}, T_J = 25^{\circ}\text{C}$		3.9		V

# NVXK2TR80WDT

## 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	$t_{RR}$	$V_{GS} = -5\text{ V}$ , $di_S/dt = 1000\text{ A}/\mu\text{s}$ , $I_{SD} = 20\text{ A}$		16.2		ns
Peak Reverse Recovery Current	$I_{RRM}$			7.6		A
Reverse Recovery Energy	$E_{REC}$			4.1		$\mu\text{J}$
Reverse Recovery Charge	$Q_{RR}$			61.6		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  $\leq 2\%$ .

# NVXK2TR80WDT

## TYPICAL CHARACTERISTICS

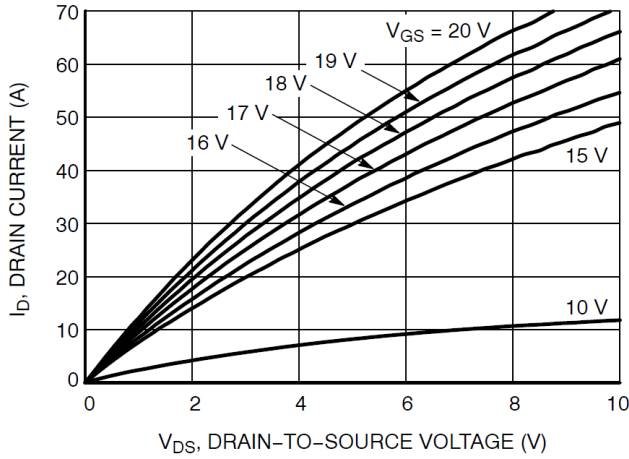


Figure 1. On-Region Characteristics

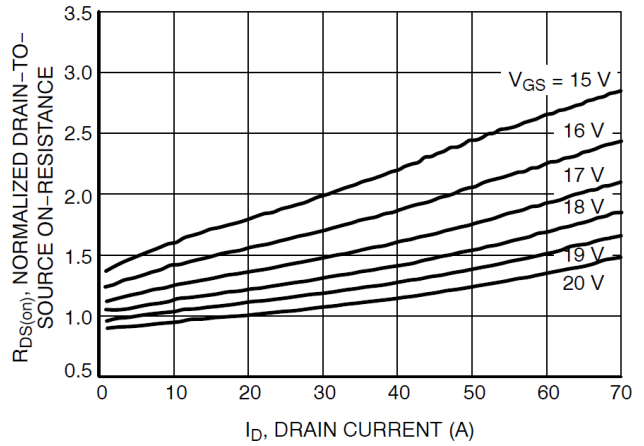


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

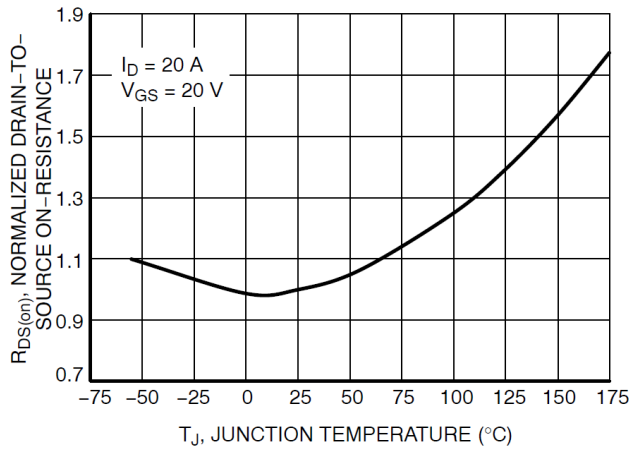


Figure 3. On-Resistance Variation with Temperature

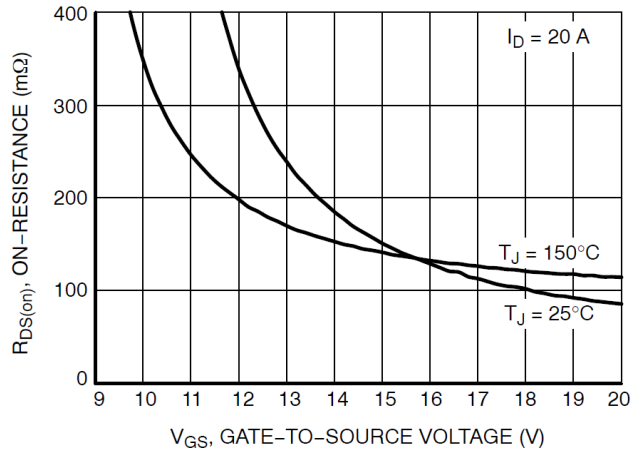


Figure 4. On-Resistance vs. Gate-to-Source Voltage

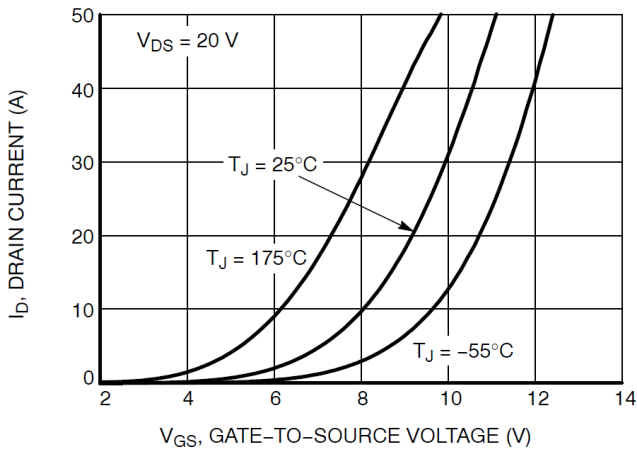


Figure 5. Transfer Characteristics

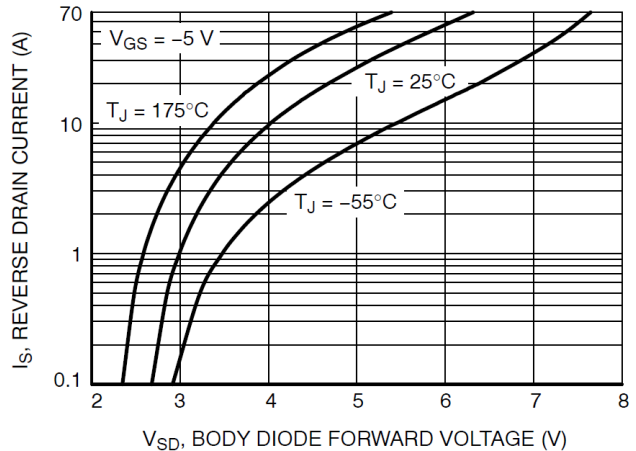
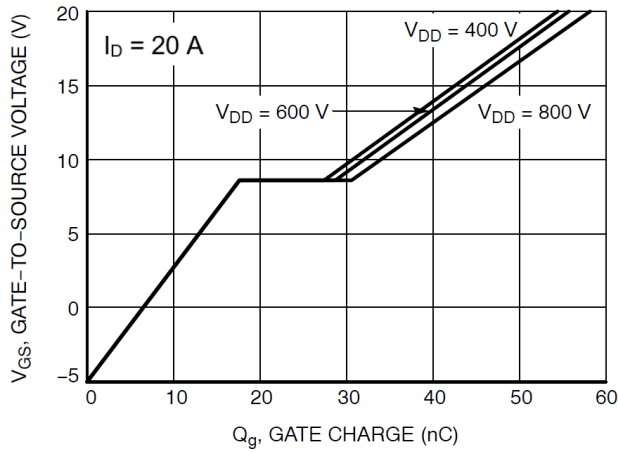


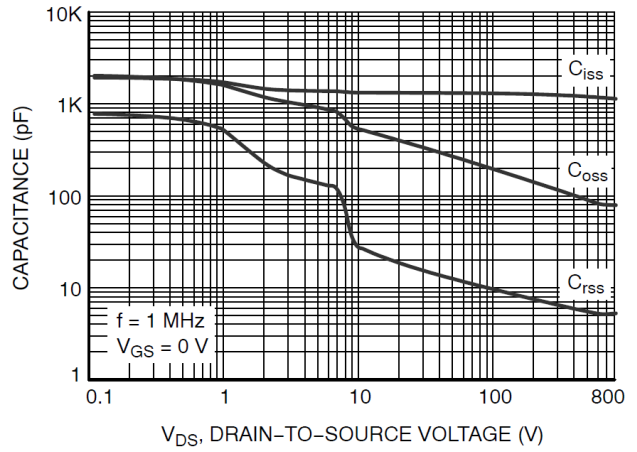
Figure 6. Diode Forward Voltage vs. Current

# NVXK2TR80WDT

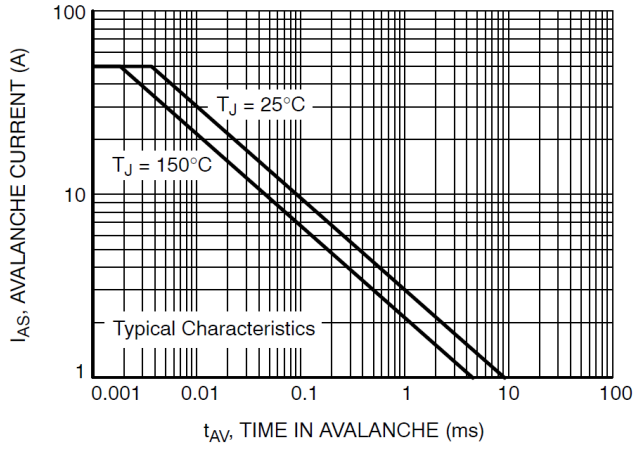
## TYPICAL CHARACTERISTICS (CONTINUED)



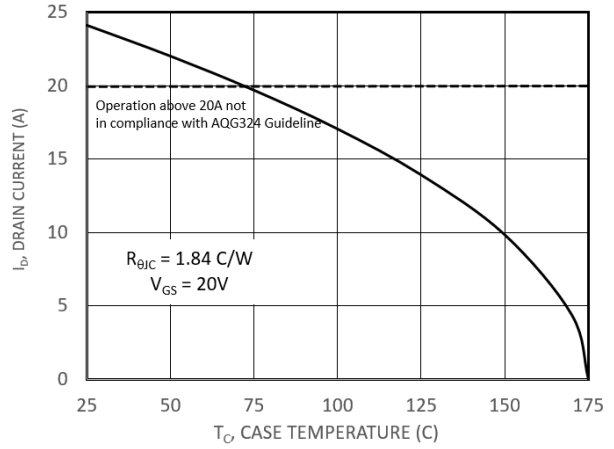
**Figure 7. Gate-to-Source Voltage vs. Total Charge**



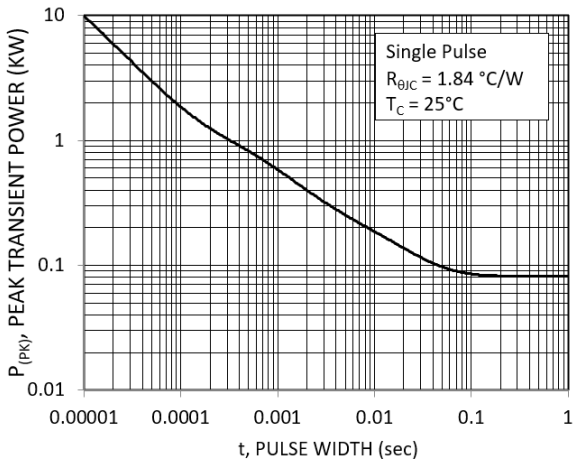
**Figure 8. Capacitance vs. Drain-to-Source Voltage**



**Figure 9. Unclamped Inductive Switching Capability**



**Figure 10. Maximum Continuous Drain Current vs. Case Temperature**



**Figure 11. Single Pulse Maximum Power Dissipation**

# NVXK2TR80WDT

## TYPICAL CHARACTERISTICS (CONTINUED)

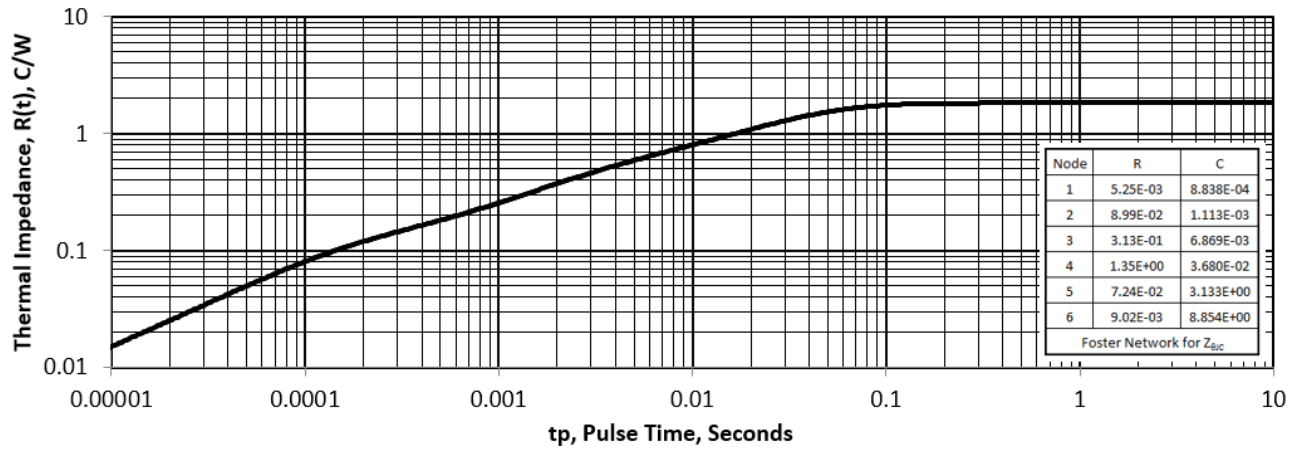
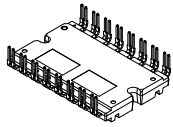


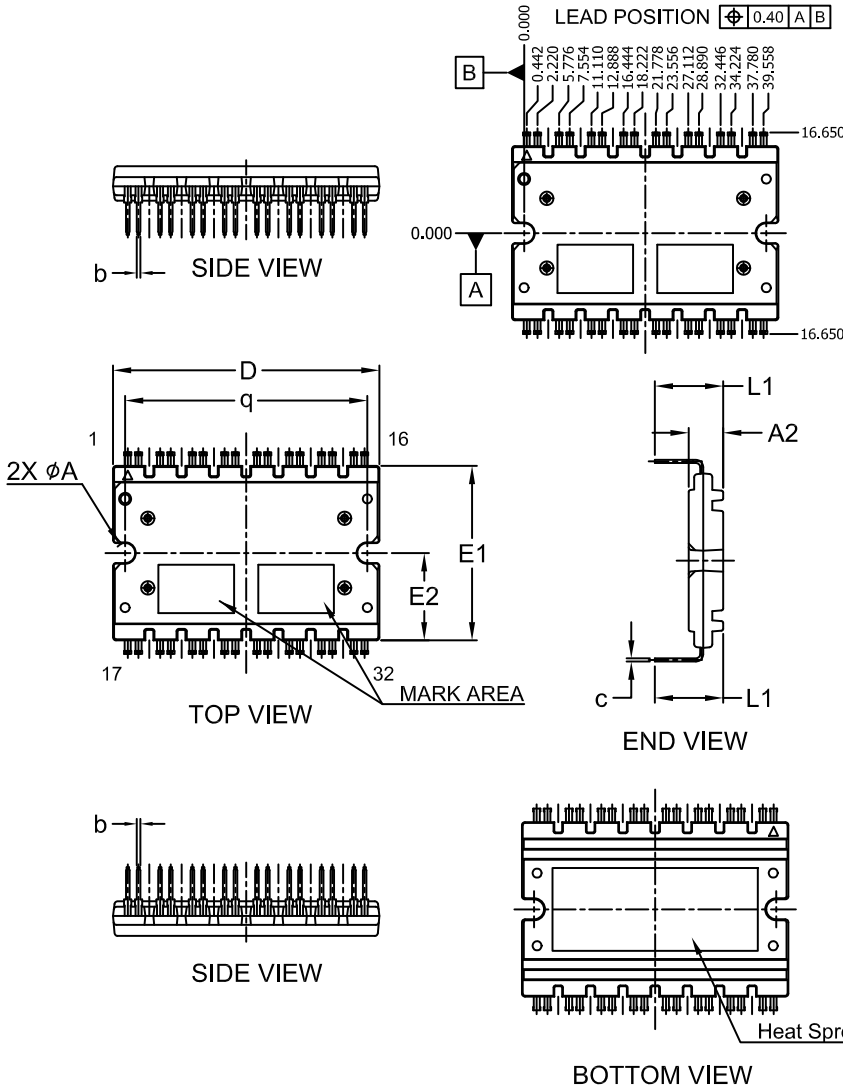
Figure 12. Thermal Response

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



## APM32 AUTOMOTIVE MODULE CASE MODHL ISSUE B

DATE 05 APR 2022

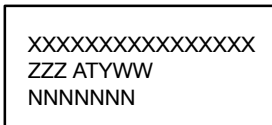


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A2	5.60	5.70	5.80
b	0.50	0.60	0.70
c	0.45	0.50	0.60
D	43.80	44.00	44.20
E1	28.60	28.80	29.00
E2	14.25	14.40	14.55
L1	11.00	11.30	11.60
q	39.85	40.00	40.15
$\phi A$	3.20	3.30	3.40

### GENERIC MARKING DIAGRAM\*



- XXXX = Specific Device Code
- ZZZ = Lot ID
- AT = Assembly & Test Location
- Y = Year
- W = Work Week
- NNN = Serial Number

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "u", may or may not be present. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	98AON29478H	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	APM32 AUTOMOTIVE MODULE	PAGE 1 OF 1

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the 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. onsemi does not convey any license under its patent rights nor the rights of others.

**onsemi**, **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**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://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.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**onsemi Website:** [www.onsemi.com](http://www.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