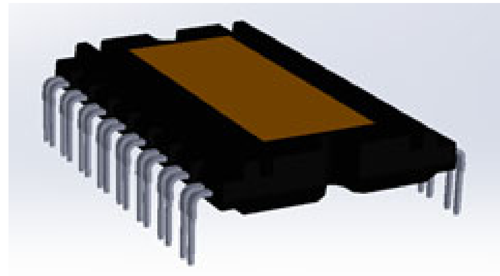
Silicon Carbide (SiC) Module – EliteSiC Power Module for OBC, 80 mohm, 1200 V, 20 A, Dual Half-Bridge, in APM32 Series

NVXK2TR80WDT

$V_{(BR)DSS}$	$R_{DS(on)}$ Max	I_D Max
1200 V	116 mΩ @ 20 V	20 A



APM32

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

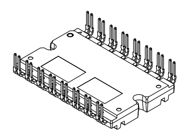
MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameter		Symbol	Value	Unit
Drain−to−Source Voltage		V_{DSS}	1200	V
Gate−to−Source Voltage		V_{GS}	+25/−15	V
Recommended Operation Values of Gate−to−Source Voltage, $T_J \le 175°C$		V_{GSop}	+20/−5	V
Continuous Drain Current (Notes 1, 2)	T_C = 25°C	I_D	20	A
Power Dissipation (Note 1)		P_D	82	W
Pulsed Drain Current (Note 3)	T_C = 25°C	I_{DM}	110	A
Single Pulse Surge Drain Current Capability	T_C = 25°C, t_p = 10 μs, R_G = 4.7 Ω	I_{DSC}	266	A
Operating Junction Temperature		T_J	−40 to 175	°C
Storage Temperature		T_{stg}	−40 to 125	°C
Source Current (Body Diode) (Note 2)		I_S	18	A
Single Pulse Drain−to−Source Avalanche Energy (Note 4)		E_{AS}	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_C = 100°C for $R_{\theta JC}$. For $R_{\Psi JS}$ 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_{AS} based on initial T_J = 25°C, L = 1 mH, I_{AS} = 19 A, V_{DD} = 120 V, V_{GS} = 18 V.

MARKING DIAGRAM



APM32
AUTOMOTIVE MODULE
CASE MODHL

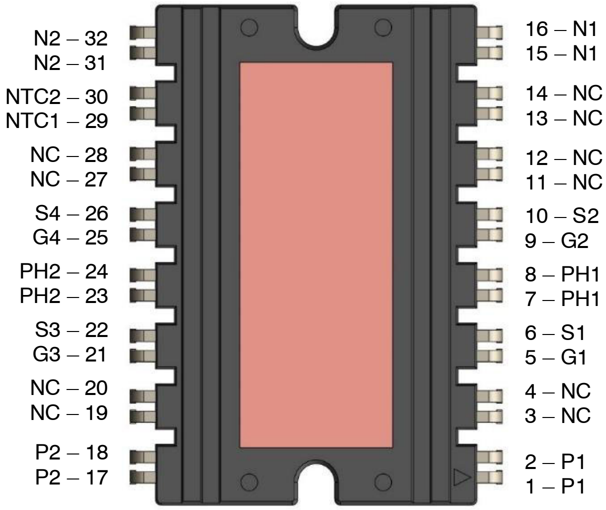
NVXK2TR80WDT
ZZZ ATYWW
NNNNNNN

NVXK2TR80WDT	= Specific Device Code
ZZZ	= Lot ID
AT	= Assembly Site & Test Location
Y	= Year
W	= Work Week
NNN	= Serial Number

ORDERING INFORMATION

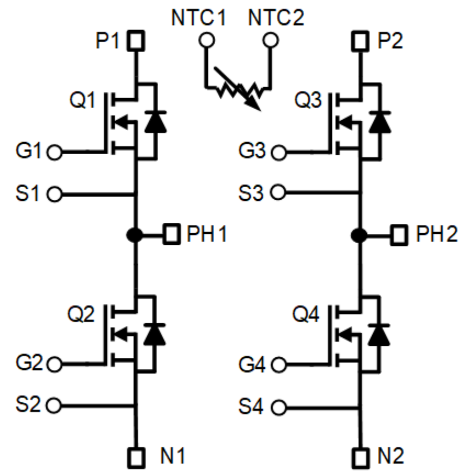
Device	Package	Shipping
NVXK2TR80WDT	APM32 (Pb−Free)	10 ea / Tube

PIN CONFIGURATION



APM32

INTERNAL EQUIVALENT CIRCUIT



SiC MOSFET H–Bridge Module

PIN DESCRIPTION

Pin	Name	Pin Description
1, 2	P1	Intermediate DC Bus Plus1
5	G1	SiC MOSFET Gate1
6	S1	SiC MOSFET Source1
7, 8	PH1	Phase Connection1
9	G2	SiC MOSFET Gate2
10	S2	SiC MOSFET Source2
15, 16	N1	Intermediate DC Bus Minus1
17, 18	P2	Intermediate DC Bus Plus2
21	G3	SiC MOSFET Gate3
22	S3	SiC MOSFET Source3
23, 24	PH2	Phase Connection2
25	G4	SiC MOSFET Gate4
26	S4	SiC MOSFET Source4
29	NTC1	Negative Temperature Coefficient Thermistor1
30	NTC2	Negative Temperature Coefficient Thermistor2
31, 32	N2	Intermediate DC Bus Minus2
3, 4, 11, 12, 13, 14, 19, 20, 27, 28	NC	Not Connected pin

THERMAL CHARACTERISTICS (Note 1)

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

ELECTRICAL CHARACTERISTICS (T_J = 25°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 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			500		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 1200 V	T_J = 25°C			100	µA
			T_J = 175°C			1	mA
Gate−to−Source Leakage Current	I_{GSS}	V_{GS} = +25/−15 V, V_{DS} = 0 V				±1	µA
ON CHARACTERISTICS (Note 5)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 5 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 V, I_D = 20 A, T_J = 25°C			80	116	mΩ
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = 20 V, I_D = 20 A, T_J = 175°C			150		mΩ
Forward Transconductance	g_{FS}	V_{DS} = 20 V, I_D = 20 A			11		S
CHARGES, CAPACITANCES & GATE RESISTANCE							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V			1154		pF
Output Capacitance	C_{OSS}				79		
Reverse Transfer Capacitance	C_{RSS}				7.9		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −5/20 V, V_{DS} = 600 V, I_D = 20 A			56		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 V, f = 1 MHz			1.2		Ω
INDUCTIVE SWITCHING CHARACTERISTICS							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = −5/20 V, V_{DS} = 800 V, I_D = 20 A, R_G = 4.7 Ω, 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		µJ
Turn−Off Switching Loss	E_{OFF}				46		µJ
Total Switching Loss	E_{tot}				181		µJ
DRAIN−SOURCE DIODE CHARACTERISTICS							
Continuous Drain−Source Diode Forward Current (Note 1)	I_{SD}	V_{GS} = −5 V, T_J = 25°C				18	A
Pulsed Drain−Source Diode Forward Current (Note 3)	I_{SDM}	V_{GS} = −5 V, T_J = 25°C				110	A
Forward Diode Voltage	V_{SD}	V_{GS} = −5 V, I_{SD} = 10 A, T_J = 25°C			3.9		V

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise stated) (continued)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
DRAIN–SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	V_{GS} = −5 V, dI_S/dt = 1000 A/µs, I_{SD} = 20 A		16.2		ns
Peak Reverse Recovery Current	I_{RRM}			7.6		A
Reverse Recovery Energy	E_{REC}			4.1		µJ
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 ≤300 µs, duty ratio ≤2%.

NTC THERMISTOR

Description	Type	Quantity	Specification
10 kΩ, ±3% Case Size 0603	Discrete	1	B Constants $B_{25/50}$: 3590 $B_{25/85}$ = 3635 $B_{25/100}$ = 3650 ±3%

TYPICAL CHARACTERISTICS

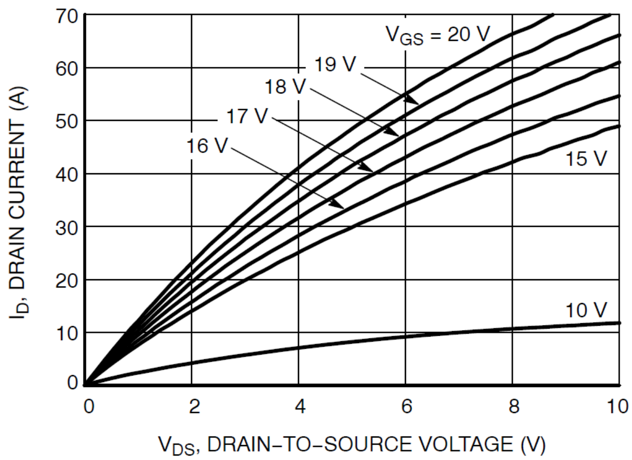


Figure 1. On−Region Characteristics

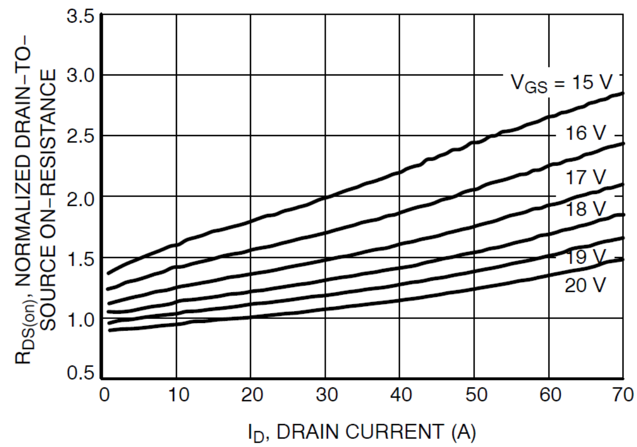


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

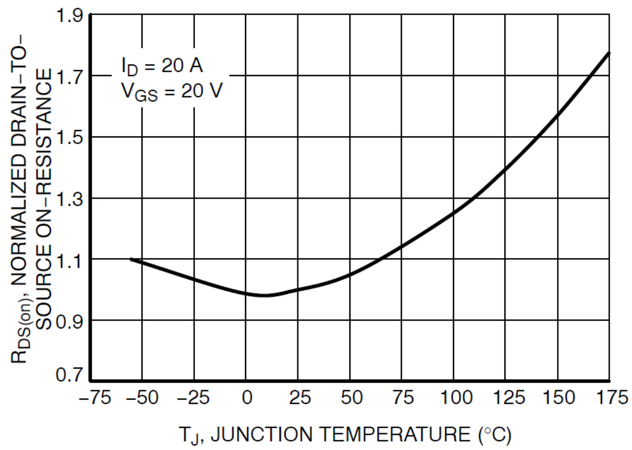


Figure 3. On−Resistance Variation with Temperature

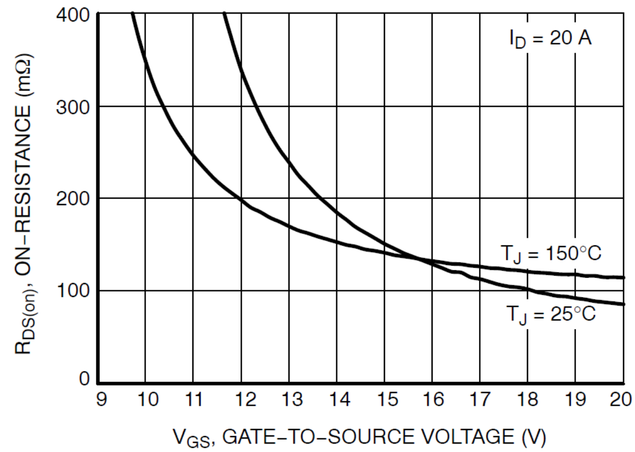


Figure 4. On−Resistance vs. Gate−to−Source Voltage

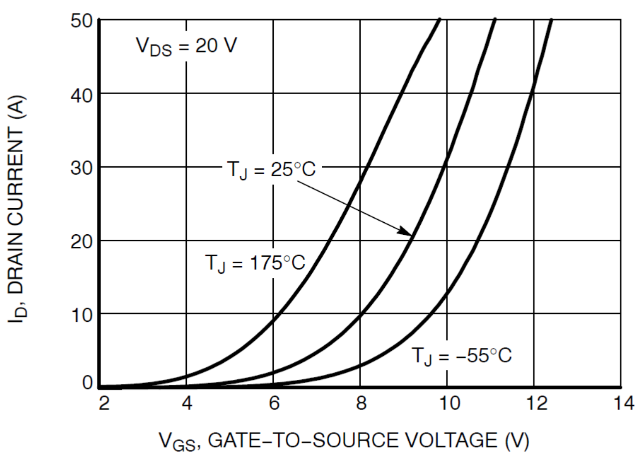


Figure 5. Transfer Characteristics

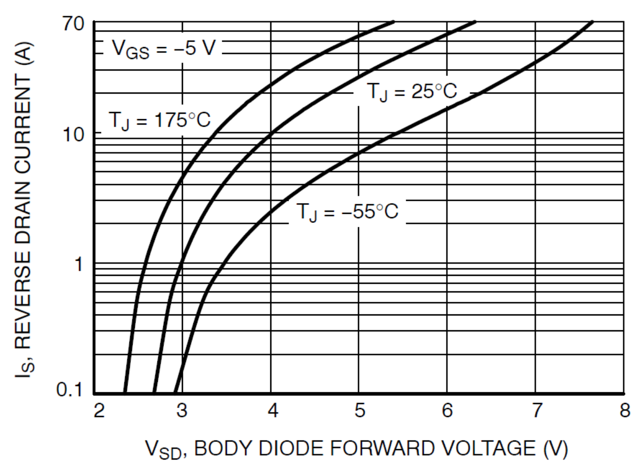


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (CONTINUED)

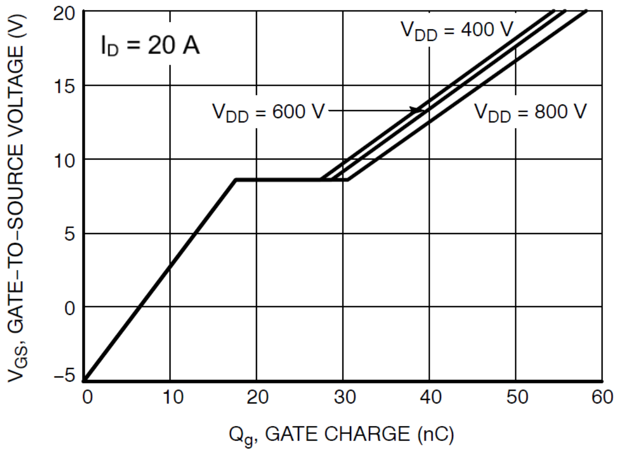


Figure 7. Gate−to−Source Voltage vs. Total Charge

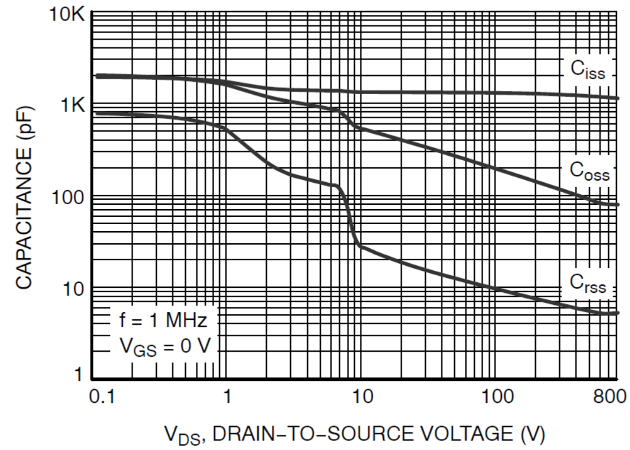


Figure 8. Capacitance vs. Drain−to−Source Voltage

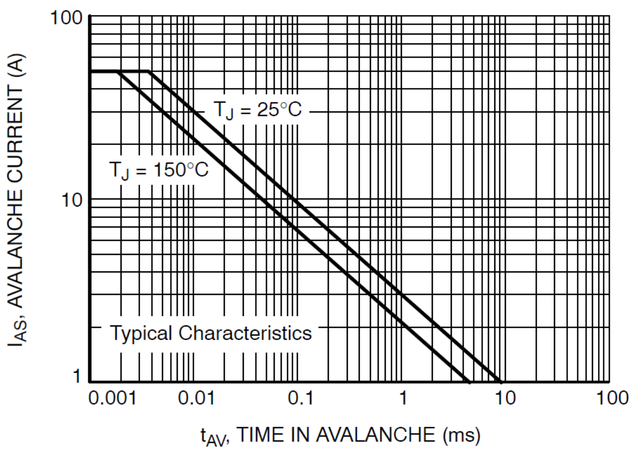


Figure 9. Unclamped Inductive Switching Capability

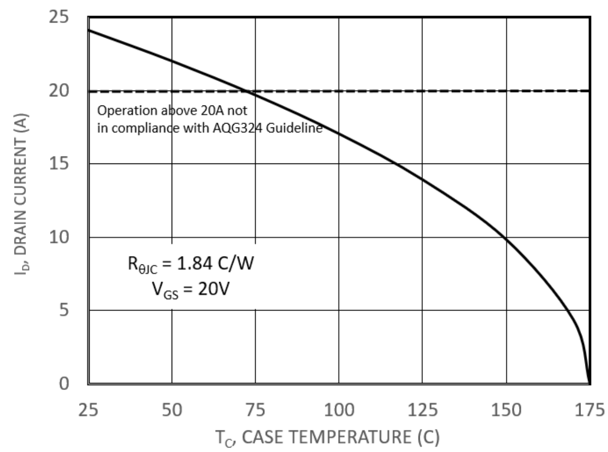


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

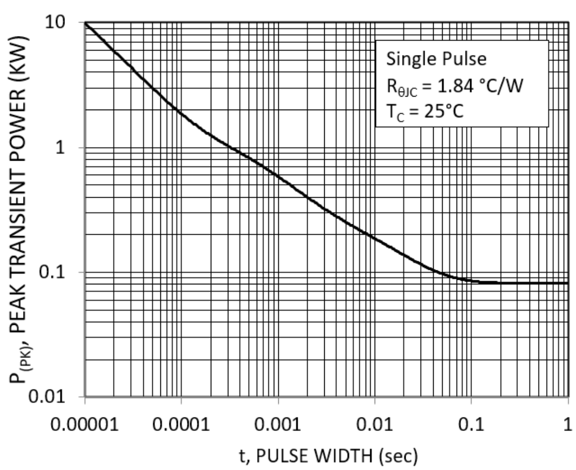


Figure 11. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS (CONTINUED)

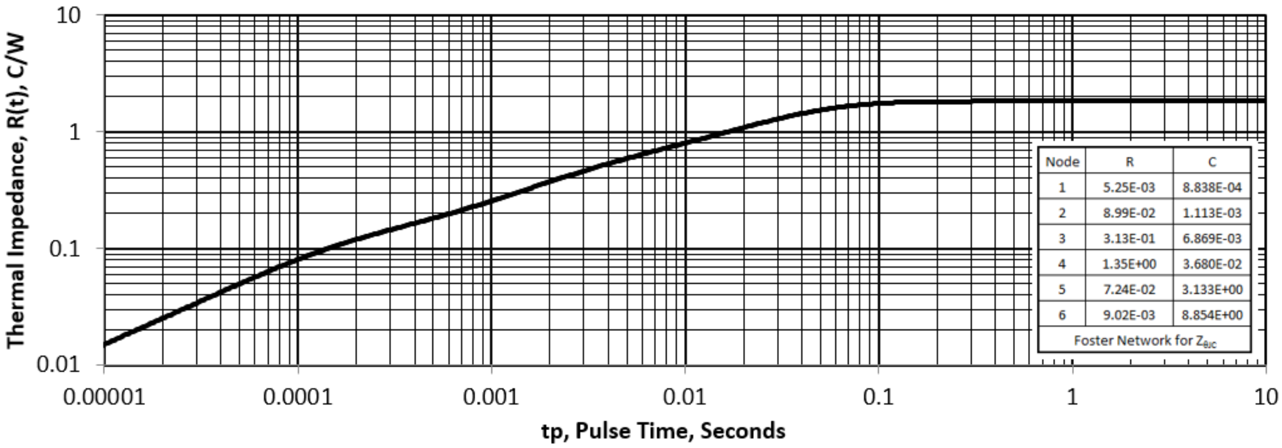
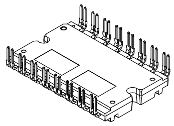
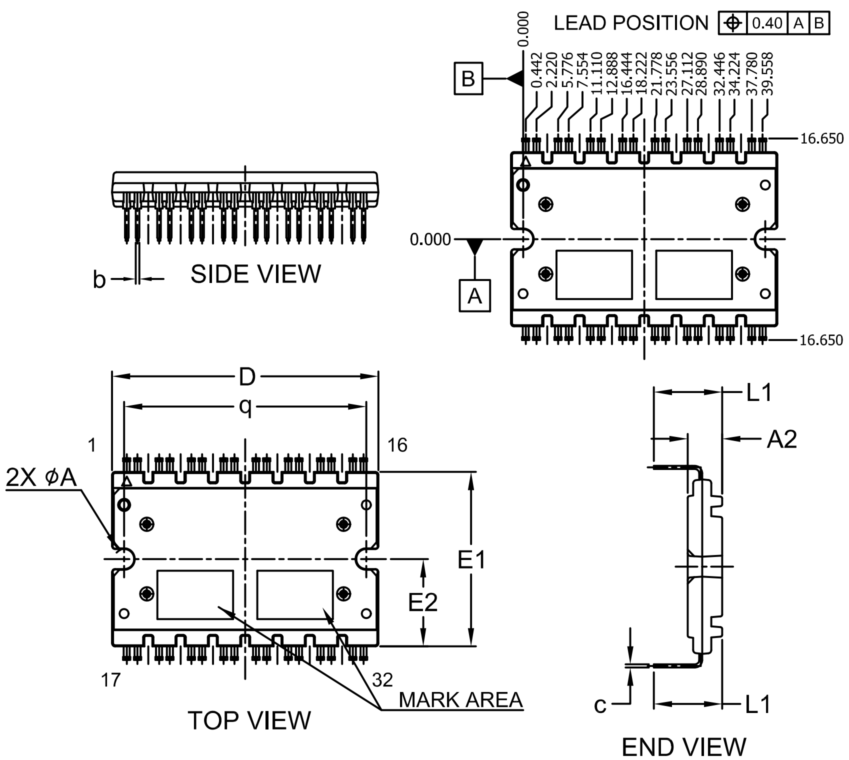


Figure 12. Thermal Response



APM32 AUTOMOTIVE MODULE
CASE MODHL
ISSUE B

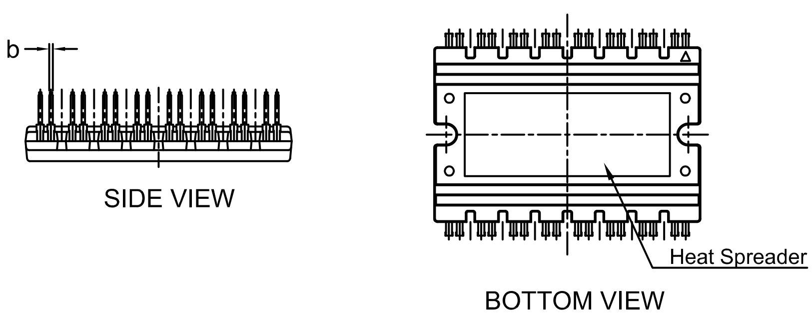
DATE 05 APR 2022



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
ϕA	3.20	3.30	3.40



GENERIC MARKING DIAGRAM*

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XXXXXXXXXXXXXXXXX
ZZZ ATYWW
NNNNNNN
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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 “▪”, may or may not be present. Some products may not follow the Generic Marking.

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