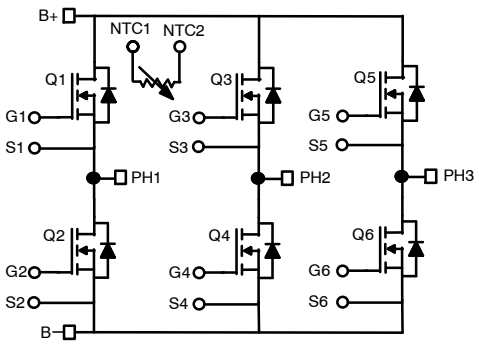
# SiC Power MOSFET Module

## 1200 V, 80 mΩ, 31 A
## 3-Phase Bridge Power Module

# NVXK2VR80WXT2

| $V_{(BR)DSS}$ | $R_{DS(on)}$ Max | $I_D$ Max |
|---|---|---|
| 1200 V | 116 mΩ @ 20 V | 31 A |



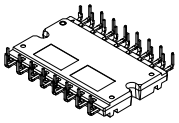

**SiC MOSFET 3–Phase Bridge Module**

### Features

- DIP Silicon Carbide 3–Phase 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

- PFC for On–Board Charger in xEV Applications



**APM32**
**44.00x28.80x5.70**
**CASE MODHM**

### MARKING DIAGRAM

NVXK2VR80WXT2
ZZZ ATYWW
NNNNNNN

NVXK2VR80WXT2 = Specific Device Code
ZZZ = Lot Number
AT = Assembly Site & Test Location
Y = Year
W = Work Week
NNN = Serial Number

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

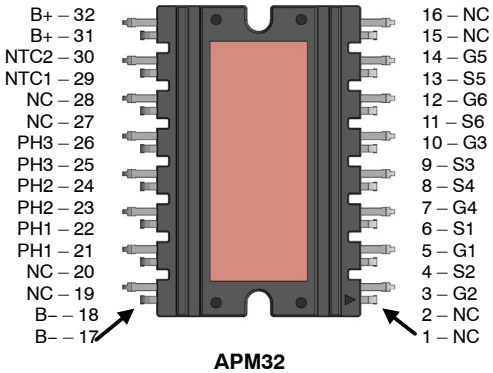
| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain–to–Source Voltage | | $V_{DSS}$ | 1200 | V |
| Gate–to–Source Voltage | | $V_{GS}$ | +25/–15 | V |
| Recommended Operation Values of Gate–to–Source Voltage, $T_J \le 175°C$ | | $V_{GSop}$ | +20/–5 | V |
| Continuous Drain Current (Note 1) | $T_C$ = 25°C | $I_D$ | 31 | A |
| Power Dissipation (Note 1) | | $P_D$ | 208 | W |
| Pulsed Drain Current (Note 2) | $T_C$ = 25°C | $I_{DM}$ | 153 | A |
| Single Pulse Surge Drain Current Capability | $T_C$ = 25°C, $t_p$ = 10 μs, $R_G$ = 4.7 Ω | $I_{DSC}$ | 425 | A |
| Operating Junction Temperature | | $T_J$ | –55 to 175 | °C |
| Storage Temperature | | $T_{stg}$ | –40 to 125 | °C |
| Source Current (Body Diode) | | $I_S$ | 18 | A |
| Single Pulse Drain–to–Source Avalanche Energy (Note 3) | | $E_{AS}$ | 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.

### THERMAL CHARACTERISTICS (Note 1)

| Parameter | Symbol | Typ | Max | Unit |
|---|---|---|---|---|
| Thermal Resistance Junction–to–Case (Note 1) | $R_{\theta JC}$ | 0.56 | 0.72 | °C/W |
| Thermal Resistance Junction–to–Sink (Note 1) | $R_{\Psi JS}$ | 0.98 | 1.14 | °C/W |

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. Repetitive rating limited by maximum junction temperature and transconductance.
3. $E_{AS}$ based on initial $T_J$ = 25°C, L = 1 mH, $I_{AS}$ = 10 A, $V_{DD}$ = 120 V, $V_{GS}$ = 18 V.




**APM32**

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| NVXK2VR80WXT2 | APM32 (Pb–Free) | 10 ea / Tube |

## PIN DESCRIPTION

| Pin No. | Name | Description |
|---|---|---|
| 1, 2, 15, 16, 19, 20, 27, 28 | NC | Not Connected |
| 3 | G2 | Q2 Gate |
| 4 | S2 | Q2 Source |
| 5 | G1 | Q1 Gate |
| 6 | S1 | Q1 Source |
| 7 | G4 | Q4 Gate |
| 8 | S4 | Q4 Source |
| 9 | S3 | Q3 Source |
| 10 | G3 | Q3 Gate |
| 11 | S6 | Q6 Source |
| 12 | G6 | Q6 Gate |
| 13 | S5 | Q5 Source |
| 14 | G5 | Q5 Gate |
| 17, 18 | B– | Negative Power Terminal |
| 21, 22 | PH1 | Phase 1 Output |
| 23, 24 | PH2 | Phase 2 Output |
| 25, 26 | PH3 | Phase 3 Output |
| 29 | NTC1 | NTC pin1 |
| 30 | NTC2 | NTC pin2 |
| 31, 32 | B+ | Positive Power Terminal |

## 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 | $B_{(BR)DSS}/T_J$ | $I_D$ = 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 4) | | | | | | | |
| 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 |
| | | $V_{GS}$ = 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 | – | |

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

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **CHARGES, CAPACITANCES & GATE RESISTANCE** | | | | | | |
| 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 | – | – | 31 | A |
| Pulsed Drain−Source Diode Forward Current (Note 2) | $I_{SDM}$ | $V_{GS}$ = −5 V, $T_J$ = 25°C | – | – | 153 | A |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = −5 V, $I_{SD}$ = 10 A, $T_J$ = 25°C | – | 3.9 | – | V |
| 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.

4. Pulse test: pulse width ≤300 μs, duty ratio ≤2%.

## COMPONENTS

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

## TYPICAL CHARACTERISTICS

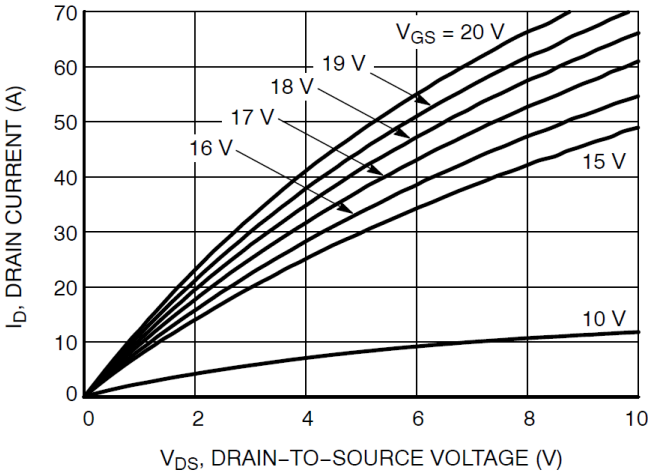



**Figure 1. On−Region Characteristics**

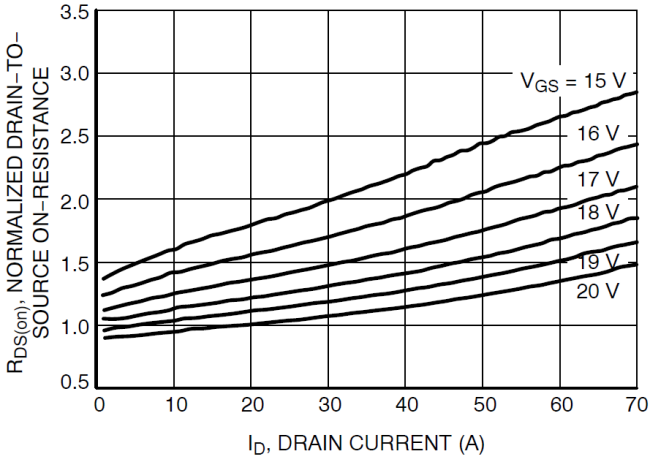



**Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage**

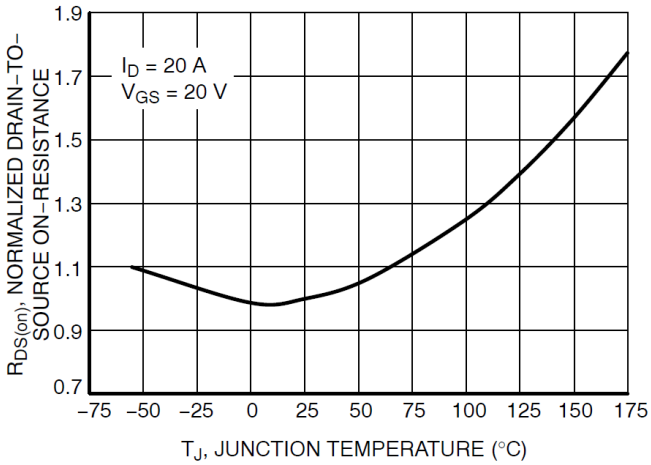



**Figure 3. On−Resistance Variation with Temperature**

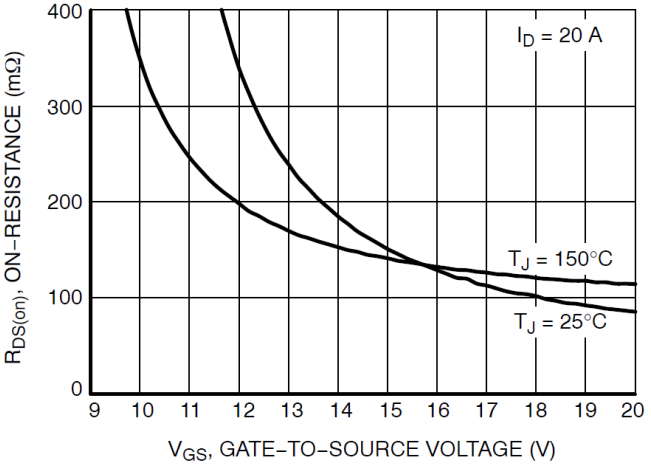



**Figure 4. On−Resistance vs. Gate−to−Source Voltage**

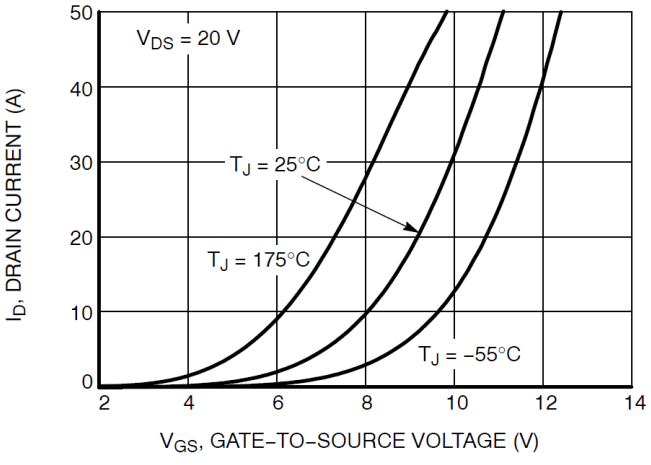



**Figure 5. Transfer Characteristics**

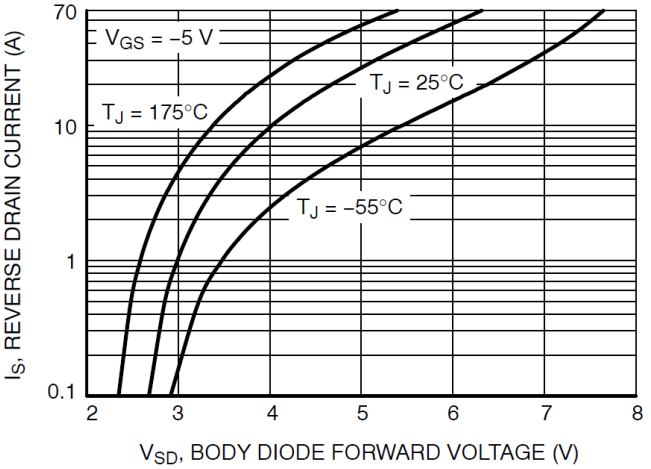



**Figure 6. Diode Forward Voltage vs. Current**

## TYPICAL CHARACTERISTICS (continued)

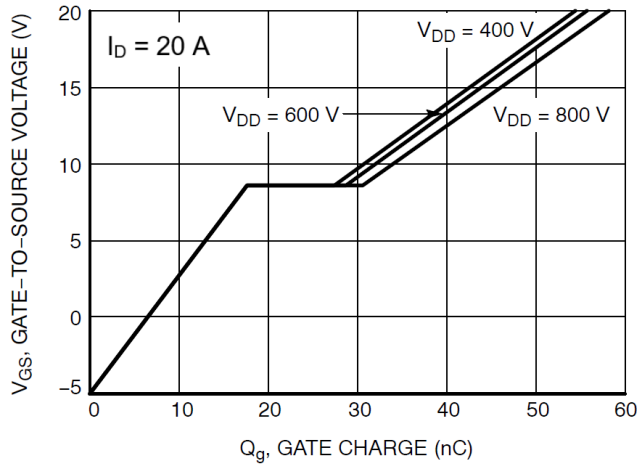



**Figure 7. Gate−to−Source Voltage vs. Total Charge**

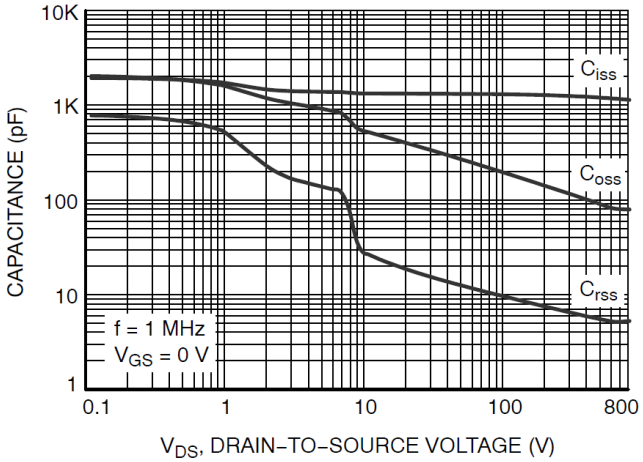



**Figure 8. Capacitance vs. Drain−to−Source Voltage**

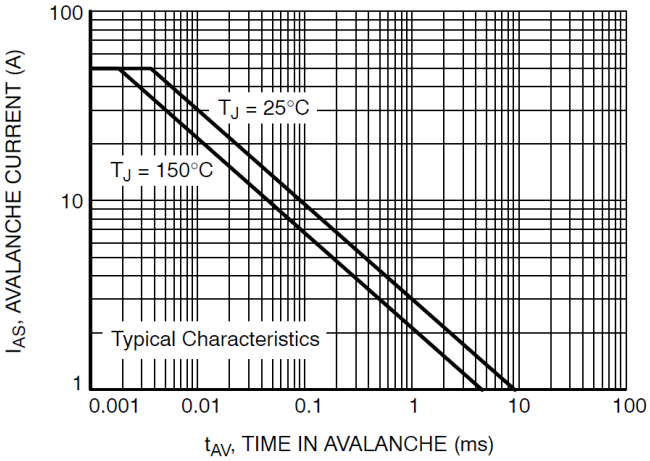



**Figure 9. Unclamped Inductive Switching Capability**

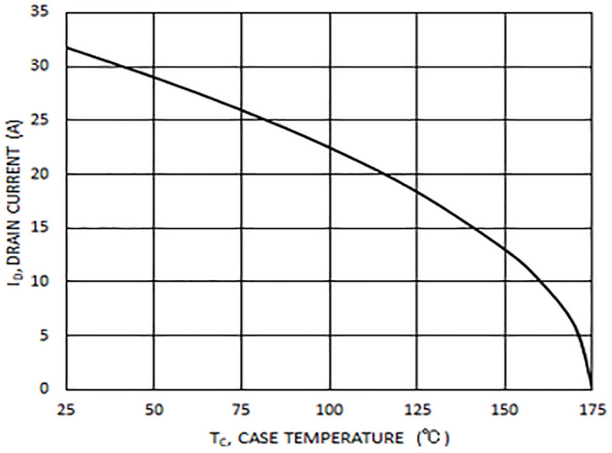



**Figure 10. Maximum Continuous Drain Current vs. Case Temperature**

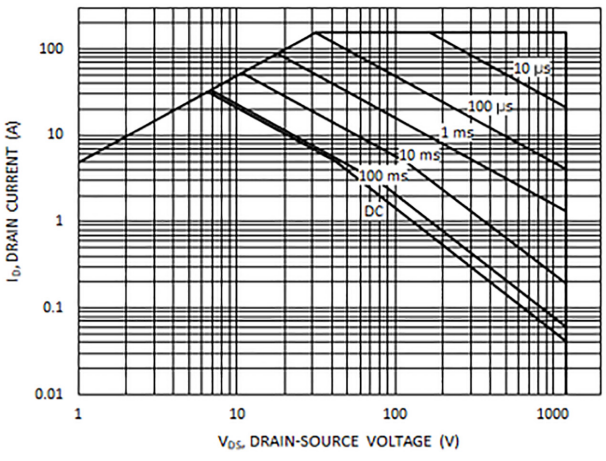



**Figure 11. Safe Operating Area**

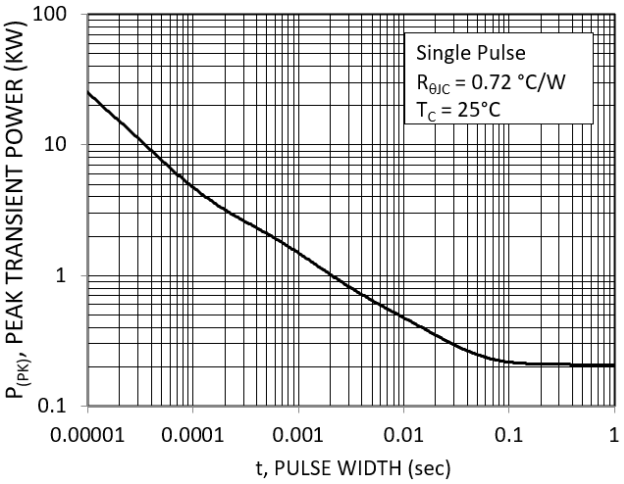



**Figure 12. Single Pulse Maximum Power Dissipation**

## TYPICAL CHARACTERISTICS (continued)

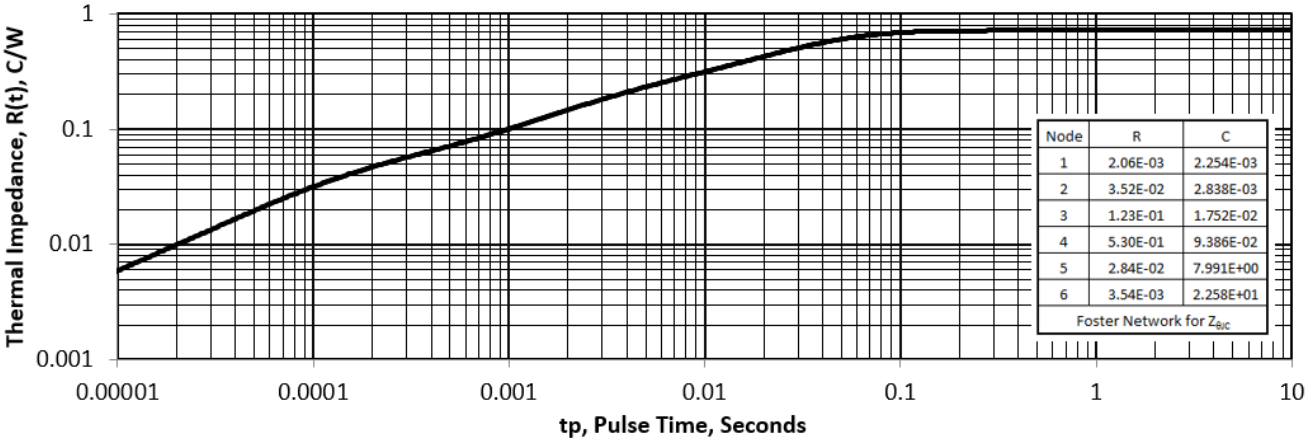
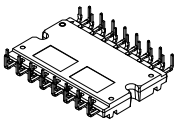


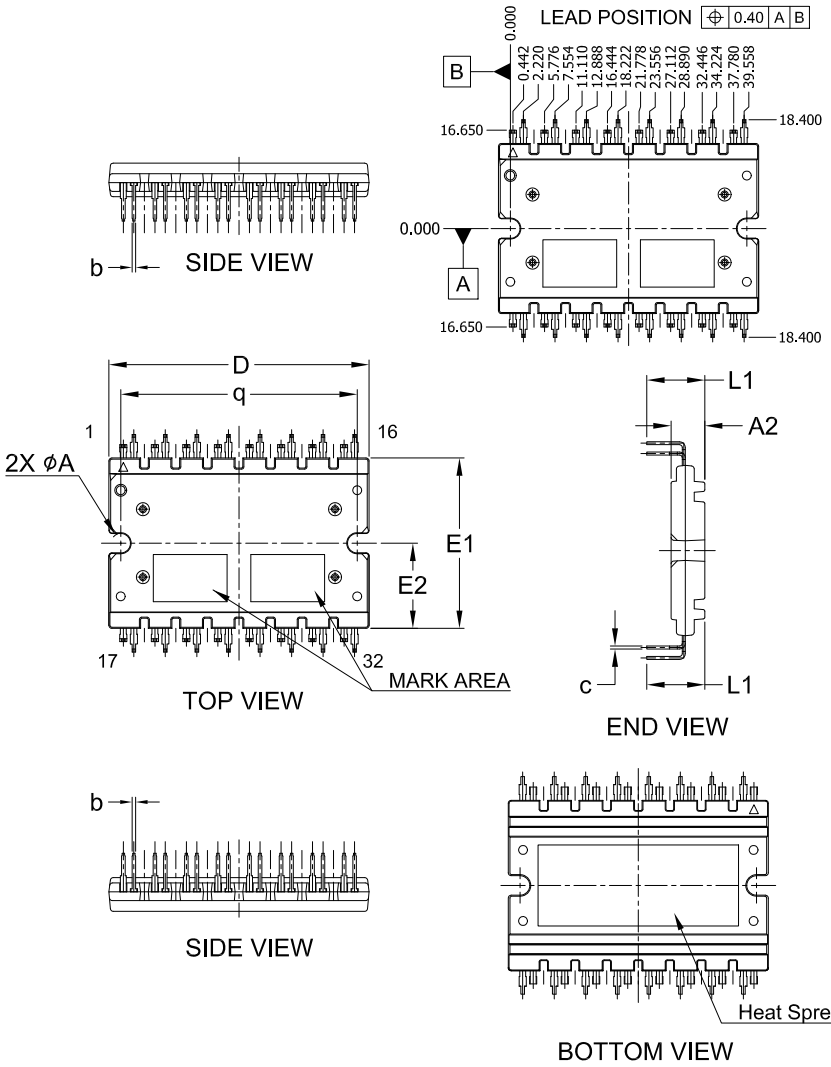

**Figure 13. Thermal Response**

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS



**APM32 44.00x28.80x5.70**
CASE MODHM
ISSUE A

DATE 01 AUG 2023




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.

| | MILLIMETERS | | |
|---|---|---|---|
| DIM | 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 | 9.50 | 9.80 | 10.10 |
| q | 39.85 | 40.00 | 40.15 |
| ϕA | 3.20 | 3.30 | 3.40 |

**GENERIC MARKING DIAGRAM***

XXXXXXXXXXXXXXXXX
ZZZ ATYWW
NNNNNNN

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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|---|---|---|
| DESCRIPTION: | APM32 44.00x28.80x5.70 | PAGE 1 OF 1 |

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical−documentation
**onsemi Website:** www.onsemi.com

**ONLINE SUPPORT**: www.onsemi.com/support
**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales