

# Automotive Power MOSFET Module

## NXV08H400XT1

### Features

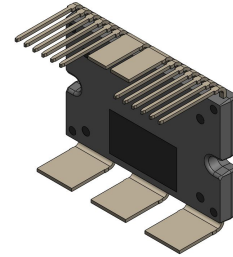
- 2 Phase MOSFET Module
- At Customer Side this Module Can Be Used as 1/2 Bridge MOSFET Module by Combining 2 Phase Out Power Terminals
- Electrically Isolated DBC Substrate for Low Rthjc
- Compact Design for Low Total Module Resistance
- Module Serialization for Full Traceability
- Module Level AQC324 Qualified. Components Inside are AEC Q101 (MOSFET) & AEC Q200 (Passives) Qualified
- UL 94 V-0 Compliant
- This Device is Pb-Free and is RoHS Compliant

### Applications

- 48 V Inverter, 48 V Traction

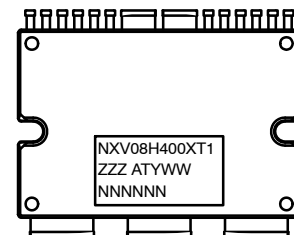
### Benefits

- Enable Design of Small, Efficient and Reliable System for Reduced Vehicle Fuel Consumption and CO<sub>2</sub> Emission
- Simplified Vehicle Assembly
- Low Thermal Resistance to Junction to Heat Sink by Direct Mounting via Thermal Interface Material between Module Case and Heat Sink
- Low Inductance



APM17-MDC  
CASE MODHH

### MARKING DIAGRAM



|              |                            |
|--------------|----------------------------|
| NXV08H400XT1 | = Specific Device Code     |
| ZZZ          | = Lot ID                   |
| AT           | = Assembly & Test Location |
| Y            | = Year                     |
| WW           | = Work Week                |
| NNN          | = Serial Number            |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# NXV08H400XT1

## ORDERING INFORMATION

| Part Number  | Package   | Pb-Free and RoHS Compliant | Operating Ambient Temperature Range | Packing Method |
|--------------|-----------|----------------------------|-------------------------------------|----------------|
| NXV08H400XT1 | APM17-MDC | yes                        | -40~125°C                           | Tube           |

## Pin Configuration

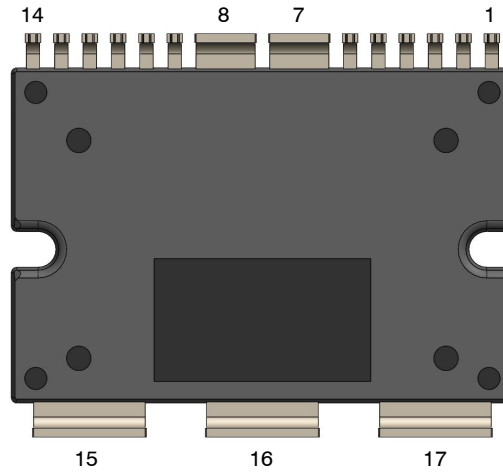


Figure 1. Pin Configuration

## PIN DESCRIPTION

| Pin No. | Description     | Remark                                                                |
|---------|-----------------|-----------------------------------------------------------------------|
| 1       | Q2 Gate         |                                                                       |
| 2       | Q2 Source Sense |                                                                       |
| 3       | B+ #2 Sense     |                                                                       |
| 4       | Q4 Gate         |                                                                       |
| 5       | Q4 Source Sense |                                                                       |
| 6       | NTC1            |                                                                       |
| 7       | Phase Out2      | For 3 phase motor inverter, those 2 pins can be used as one phase out |
| 8       | Phase Out1      |                                                                       |
| 9       | NTC2            |                                                                       |
| 10      | Q3 Source Sense |                                                                       |
| 11      | Q3 Gate         |                                                                       |
| 12      | B+ #1 Sense     |                                                                       |
| 13      | Q1 Source Sense |                                                                       |
| 14      | Q1 Gate         |                                                                       |
| 15      | B+ #1           |                                                                       |
| 16      | GND             |                                                                       |
| 17      | B+ #2           |                                                                       |

# NXV08H400XT1

## Block Diagram

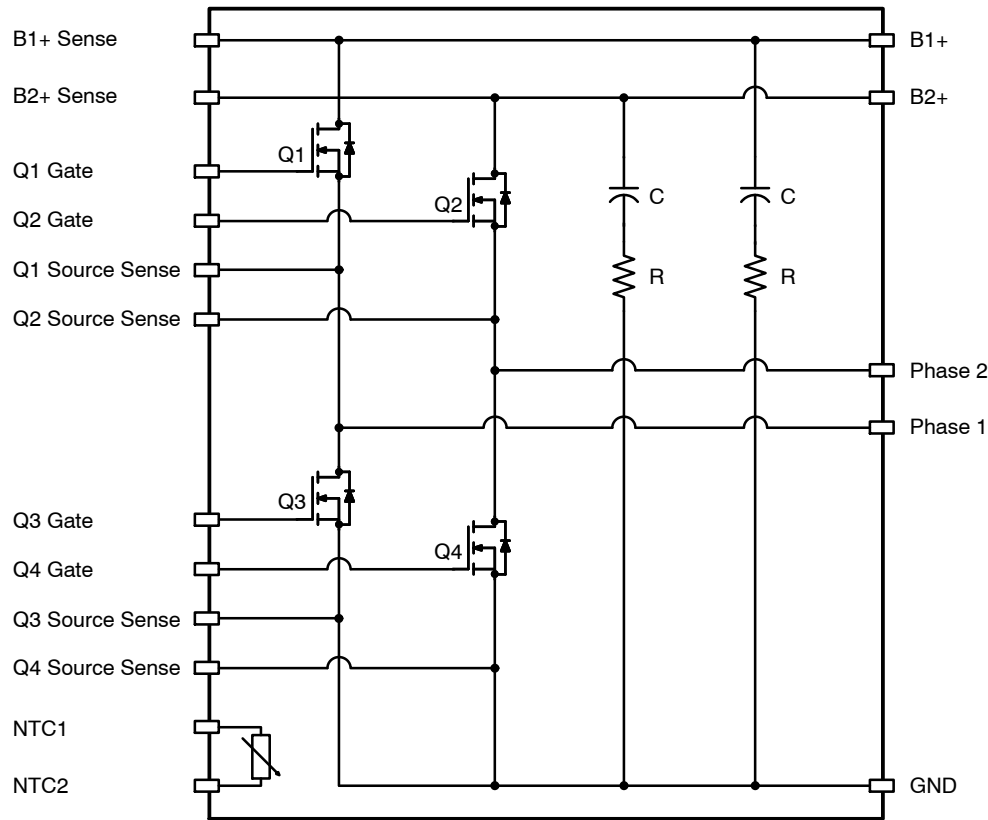


Figure 2. Schematic

### Flammability Information

All materials present in the power module meet UL flammability rating class 94V-0.

### Compliance to RoHS Directives

The power module is 100% lead free and RoHS compliant 2000/53/C directive.

### Solder

Solder used is a lead free SnAgCu alloy.

Base of the leads, at the interface with the package body should not be exposed to more than 200°C during mounting on the PCB, this to prevent the remelt of the solder joints.

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

| Symbol                  | Parameter                              | Max. | Unit |
|-------------------------|----------------------------------------|------|------|
| V <sub>DS</sub> (Q1~Q4) | Drain to Source Voltage                | 80   | V    |
| V <sub>GS</sub> (Q1~Q4) | Gate to Source Voltage                 | ±20  | V    |
| E <sub>AS</sub> (Q1~Q4) | Single Pulse Avalanche Energy (Note 1) | 2445 | mJ   |
| T <sub>J</sub>          | Maximum Junction Temperature           | 175  | °C   |
| T <sub>STG</sub>        | Storage Temperature                    | 125  | °C   |

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. Starting T<sub>J</sub> = 25°C, L = 0.47 mH, I<sub>AS</sub> = 102 A, V<sub>DD</sub> = 72 V during inductor charging and V<sub>DD</sub> = 0 V during time in avalanche.

# NXV08H400XT1

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C, unless otherwise noted)

| Characteristic                                                                                            |                                    | Condition                                                             | Min  | Typ  | Max   | Unit |
|-----------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------------------------------------------------------|------|------|-------|------|
| BVDSS                                                                                                     | Drain-to-Source Breakdown Voltage  | I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V                          | 80   | –    | –     |      |
| VGS(th)                                                                                                   | Gate to Source Threshold Voltage   | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1 mA             | 2    | –    | 4.6   | V    |
| VSD                                                                                                       | Source-to-Drain Diode Voltage      | I <sub>SD</sub> = 160 A, V <sub>GS</sub> = 0 V                        | –    | 0.79 | 1.1   | V    |
| RDS(ON) Q1, Q2                                                                                            | Q1, Q2 (High Side) MOSFET (Note 2) | V <sub>GS</sub> = 12 V, I <sub>D</sub> = 160 A, T <sub>J</sub> = 25°C | –    | 0.65 | 0.765 | mΩ   |
| RDS(ON) Q3, Q4                                                                                            | Q3, Q4 (Low Side) MOSFET (Note 2)  | V <sub>GS</sub> = 12 V, I <sub>D</sub> = 160 A, T <sub>J</sub> = 25°C | –    | 0.46 | 0.58  | mΩ   |
| IGSS                                                                                                      | Gate-to-Source Leakage Current     | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V, T <sub>J</sub> = 25°C | –100 | –    | +100  | nA   |
| IDSS                                                                                                      | Drain-to-Source Leakage Current    | V <sub>DS</sub> = 80 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 25°C  | –    | –    | 2     | μA   |
| Module RDS(ON) for Q1 and Q2:<br>From B+1 (or B+2), via Q1 (or Q2), to Phase Out 1 (Phase Out 2) (Note 3) |                                    | V <sub>GS</sub> = 12 V, I <sub>D</sub> = 160 A, T <sub>J</sub> = 25°C | –    | 0.96 | 1.32  | mΩ   |
| Module RDS(ON) for Q3 and Q4:<br>From Phase Out 1 (Phase Out 2), via Q3 (Q4), to GND PINs (Note 3)        |                                    | V <sub>GS</sub> = 12 V, I <sub>D</sub> = 160 A, T <sub>J</sub> = 25°C | –    | 0.9  | 1.25  | mΩ   |

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.

2. All bare die MOSFETs have same die size and same level of R<sub>ds(on)</sub> value. However the different R<sub>ds(on)</sub> values listed in the datasheet are due to the different access points available inside the module for R<sub>ds(on)</sub> measurement. Q3 and Q4 (Low side FETs) has the shortest R<sub>ds(on)</sub> measurement path in the layout, in this reason, so Q3 or Q4 R<sub>ds(on)</sub> value can be used for the R<sub>ds(on)</sub> value per switch for simple power loss calculation.

Each R<sub>ds(on)</sub> measurement paths are as below table, "Resistance Measurement Methods"

3. Module R<sub>ds(on)</sub> means total resistance of the measurement path btw Power terminals, referring to the resistance measurement methods table.

## RESISTANCE MEASUREMENTS METHODS

|                               | + Force Pin# | – Force Pin# | + Sense Pin#    | – Sense Pin#    |
|-------------------------------|--------------|--------------|-----------------|-----------------|
| FET R <sub>ds(on)</sub> Q1    | B1+          | Phase1       | B1+ Sense       | Q1 Source Sense |
| FET R <sub>ds(on)</sub> Q2    | B2+          | Phase2       | B2+ Sense       | Q2 Source Sense |
| FET R <sub>ds(on)</sub> Q3    | Phase1       | GND          | Q1 Source Sense | Q3 Source Sense |
| FET R <sub>ds(on)</sub> Q4    | Phase2       | GND          | Q2 Source Sense | Q4 Source Sense |
| Module R <sub>ds(on)</sub> Q1 | B1+          | Phase1       | B1+             | Phase1          |
| Module R <sub>ds(on)</sub> Q2 | B2+          | Phase2       | B2+             | Phase2          |
| Module R <sub>ds(on)</sub> Q3 | Phase1       | GND          | Phase1          | GND             |
| Module R <sub>ds(on)</sub> Q4 | Phase2       | GND          | Phase2          | GND             |

## TEMPERATURE SENSE (NTC THERMISTOR)

| Parameter |                                  | Min | Typ | Max | Unit |
|-----------|----------------------------------|-----|-----|-----|------|
| Voltage   | Current = 1 mA, Temperature 25°C | 7.5 | –   | 12  | V    |

## THERMAL RESISTOR

| Parameter                                                                      |                                       | Min | Typ | Max  | Unit |
|--------------------------------------------------------------------------------|---------------------------------------|-----|-----|------|------|
| R <sub>th(jc)</sub> : Thermal Resistance Junction to case, Single Inverter FET | Q1, Q2, Q3, Q4 Thermal Resistance J–C | –   | –   | 0.19 | °C/W |

# NXV08H400XT1

**ISOLATION VOLTAGE** (Isolation voltage between the Base plate and to control pins or power terminals.)

| Test                                 | Test Condition | Test Time  | Min | Max | Unit |
|--------------------------------------|----------------|------------|-----|-----|------|
| Leakage @ Isolation Voltage (Hi-Pot) | VAC = 3 kV     | Time = 1 s | –   | 250 | μA   |

**DYNAMIC AND SWITCHING CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|--------|-----------|-----------|-----|-----|-----|------|
|--------|-----------|-----------|-----|-----|-----|------|

## DYNAMIC CHARACTERISTICS

|              |                               |                                                                 |   |        |   |    |
|--------------|-------------------------------|-----------------------------------------------------------------|---|--------|---|----|
| $C_{iss}$    | Input Capacitance             | $V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, f = 750\text{ kHz}$ | – | 30,150 | – | pF |
| $C_{oss}$    | Output Capacitance            |                                                                 | – | 4,505  | – | pF |
| $C_{rss}$    | Reverse Transfer Capacitance  |                                                                 | – | 77     | – | pF |
| $R_g$        | Gate Resistance               | $f = 750\text{ kHz}$                                            | – | 4.3    | – | Ω  |
| $Q_{g(tot)}$ | Total Gate Charge             | $V_{GS} = 0\text{ to }12\text{ V}, I_D = 160\text{ A}$          | – | 502    | – | nC |
| $Q_{gs}$     | Gate to Source Gate Charge    |                                                                 | – | 193    | – | nC |
| $Q_{gd}$     | Gate to Drain “Miller” Charge |                                                                 | – | 89     | – | nC |

## SWITCHING CHARACTERISTICS

|              |                     |                                                                                                      |   |     |   |    |
|--------------|---------------------|------------------------------------------------------------------------------------------------------|---|-----|---|----|
| $t_{on}$     | Turn-On Time        | $V_{DD} = 48\text{ V}, I_D = 400\text{ A}$<br>$V_{GS} = 12\text{ V}, R_{G(on/off)} = 15/15\text{ Ω}$ | – | 710 | – | ns |
| $t_{d(on)}$  | Turn-On Delay Time  |                                                                                                      | – | 235 | – | ns |
| $t_r$        | Turn-On Rise Time   |                                                                                                      | – | 475 | – | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                                      | – | 608 | – | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                                      | – | 290 | – | ns |
| $t_{off}$    | Turn-Off Time       |                                                                                                      | – | 898 | – | ns |

## DRAIN-SOURCE DIODE CHARACTERISTICS

| Symbol   | Parameter               | Condition                                                                                            | Min | Typ  | Max | Unit |
|----------|-------------------------|------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| $t_{RR}$ | Reverse Recovery Time   | $V_{DD} = 48\text{ V}, I_D = 400\text{ A}$<br>$V_{GS} = 12\text{ V}, R_{G(on/off)} = 15/15\text{ Ω}$ | –   | 59   | –   | ns   |
| $Q_{RR}$ | Reverse Recovery Charge |                                                                                                      | –   | 1433 | –   | nC   |

4. Dynamic & Switching characteristics data is by characterization test result and guaranteed by design factors.

## COMPONENTS

| Component           | Description                 | Type     | Qty. | Specification                                                                                         |
|---------------------|-----------------------------|----------|------|-------------------------------------------------------------------------------------------------------|
| MOSFET              | Bare Die                    | Bare Die | 4    | 80 V 0.58 mΩ                                                                                          |
| NTC                 | 10 kΩ ±1%<br>1,600 x 800 μm | Discrete | 1    | B-Constant<br>B <sub>25/50</sub> = 3380K<br>B <sub>25/85</sub> = 3435K<br>B <sub>25/100</sub> = 3455K |
| Capacitor (Snubber) | 1,800 x 800 μm              | Discrete | 2    | 15 nF                                                                                                 |
| Resistor (Snubber)  | 2,000 x 1,250 μm            | Discrete | 2    | 1 Ω                                                                                                   |

TYPICAL CHARACTERISTICS

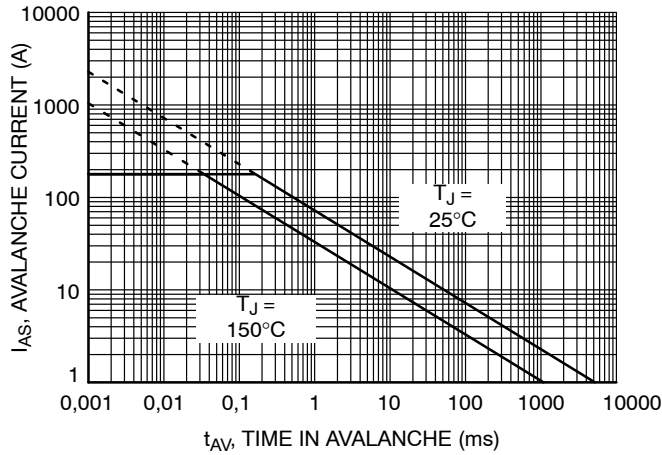


Figure 3. Unclamped Inductive Switching Capability

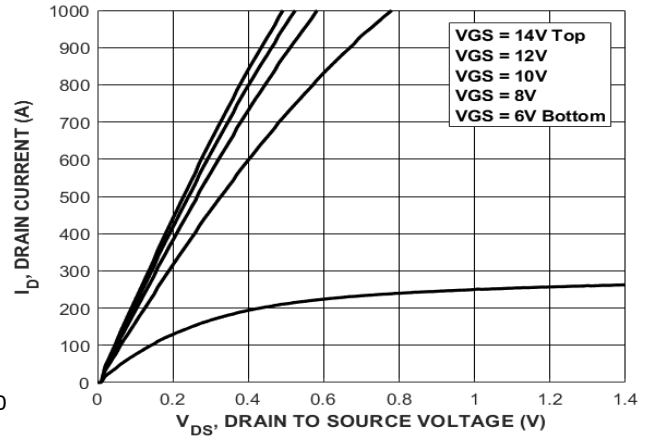


Figure 4. Saturation Characteristics

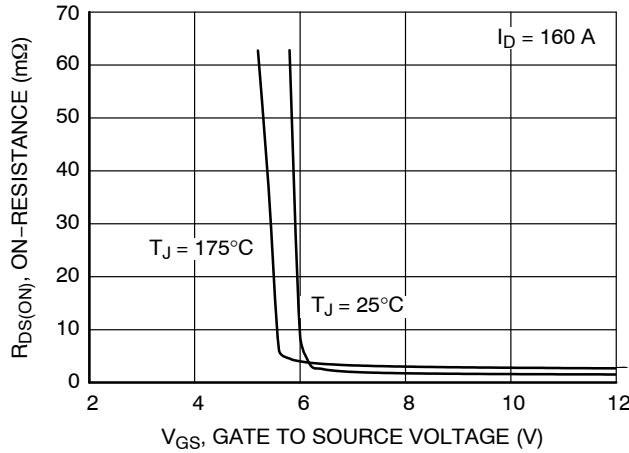


Figure 5.  $R_{DS(on)}$  vs. Gate Voltage

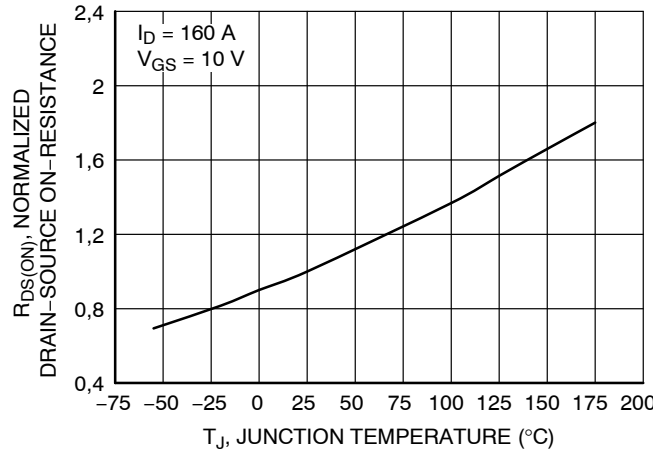


Figure 6.  $R_{DS(on)}$  vs. Temperature

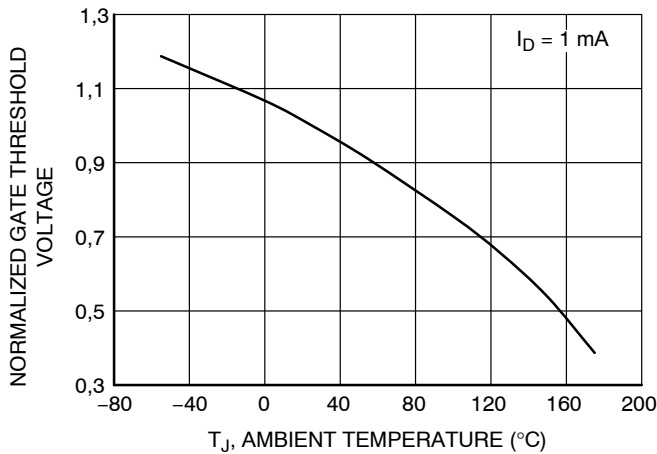


Figure 7. Normalized Gate Threshold Voltage vs. Temperature

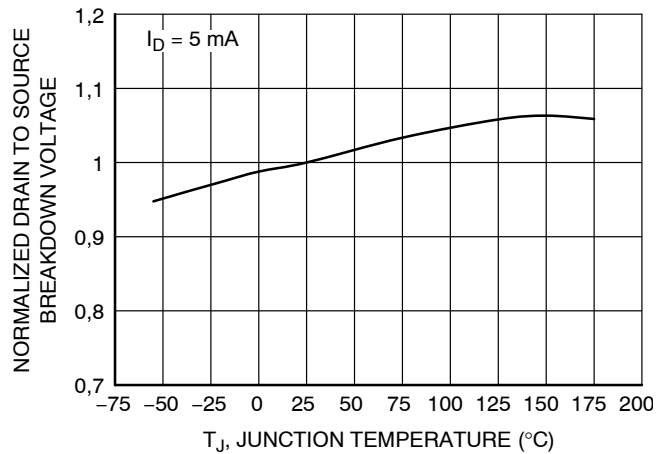


Figure 8. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature

TYPICAL CHARACTERISTICS (CONTINUED)

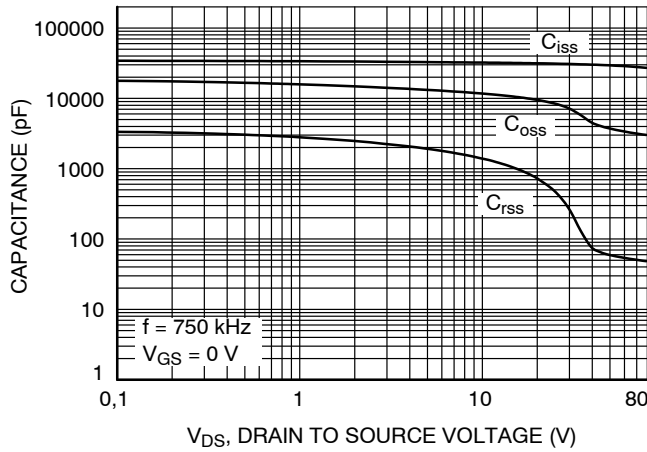


Figure 9. Capacitance vs. Drain to Source Voltage

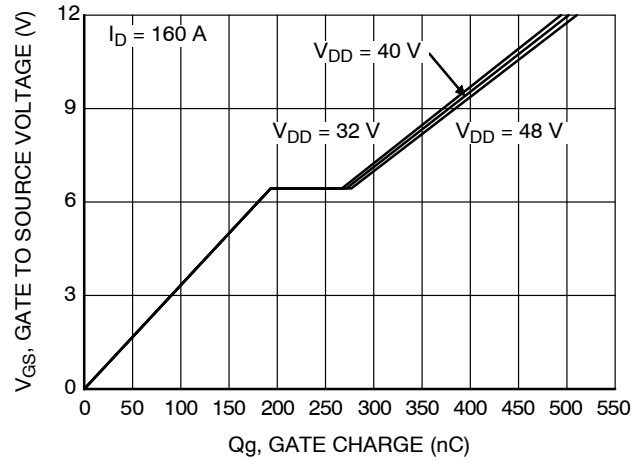


Figure 10. Gate Charge vs. Drain to Source Voltage

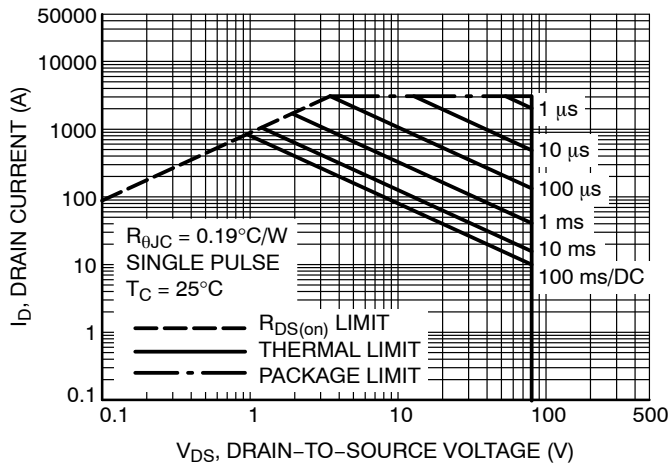


Figure 11. Safe Operating Area

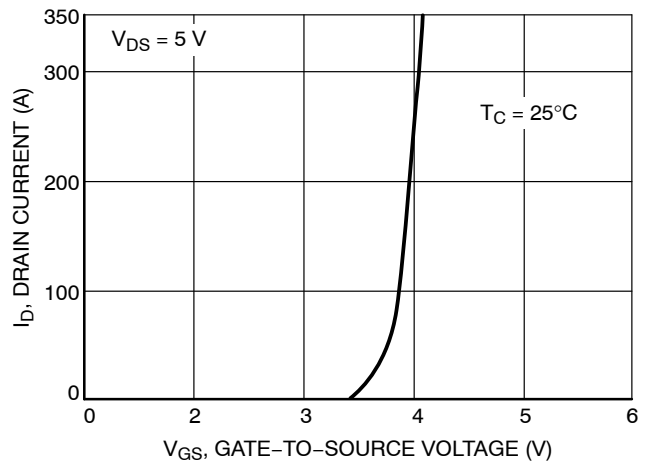


Figure 12. Transfer Characteristics

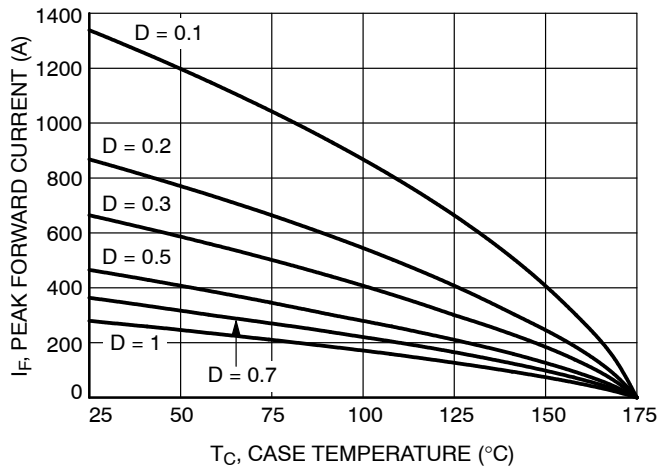
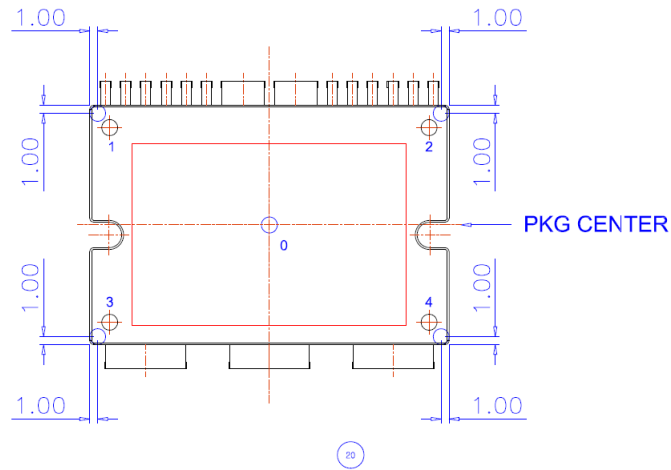


Figure 13. Body Diode Current

# NXV08H400XT1



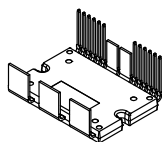
FLATNESS : MAX. 150um  
 -, MEASURING AT INDICATING POINTS  
 1, 2, 3, AND 4 (BASED ON "0")

**Figure 14. Flatness Measurement Position**

## MECHANICAL CHARACTERISTICS AND RATINGS

| Parameter       | Test Conditions                         | Min | Typ  | Max          | Units |
|-----------------|-----------------------------------------|-----|------|--------------|-------|
| Device Flatness | Refer to the package dimensions         | 0   | –    | 150          | um    |
| Mounting Torque | Mounting screw: M3, recommended 0.7 N•m | 0.4 | –    | 1.4 (Note 5) | N•m   |
| Weight          |                                         | –   | 23.6 | –            | g     |

5. Max Torque rating can be different by the type of screw, such as the screw head diameter, use or without use of Washer. In case of special screw mounting method is applied, contact to **onsemi** for the proper information of mounding condition.



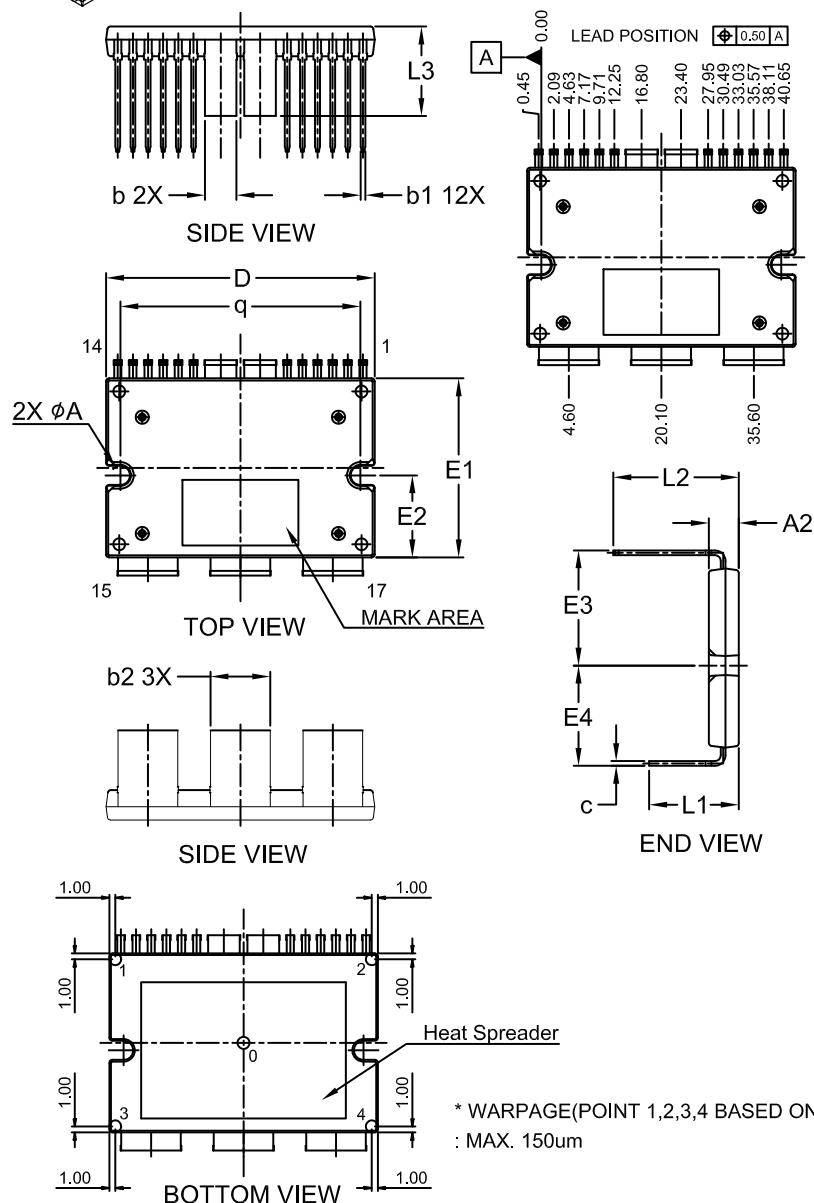
**APM17-MDC**  
**CASE MODHH**  
**ISSUE C**

DATE 08 DEC 2021

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  | 4.90        | 5.00  | 5.10  |
| b   | 5.20        | 5.30  | 5.40  |
| b1  | 0.70        | 0.80  | 0.90  |
| b2  | 9.90        | 10.00 | 10.10 |
| c   | 0.75        | 0.80  | 0.90  |
| D   | 44.90       | 45.00 | 45.10 |
| E1  | 29.90       | 30.00 | 30.10 |
| E2  | 13.65       | 13.75 | 13.85 |
| E3  | 19.00       | 19.30 | 19.60 |
| E4  | 16.50       | 16.80 | 17.10 |
| L1  | 14.70       | 15.00 | 15.30 |
| L2  | 20.70       | 21.00 | 21.30 |
| L3  | 14.70       | 15.00 | 15.30 |
| q   | 40.10       | 40.20 | 40.30 |
| øA  | 3.10        | 3.20  | 3.30  |



### GENERIC MARKING DIAGRAM\*

XXXXXXXXXXXXXXXXXX  
ZZZ ATYWW  
NNNNNNNN

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 "a", may or may not be present. Some products may not follow the Generic Marking.

|                         |                    |                                                                                                                                                                                     |
|-------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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