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 AQG324 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 CO₂ 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

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.
ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>Pb−Free and RoHS Compliant</th>
<th>Operating Ambient Temperature Range</th>
<th>Packing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXV08H400XT1</td>
<td>APM17−MDC</td>
<td>yes</td>
<td>−40−125°C</td>
<td>Tube</td>
</tr>
</tbody>
</table>

Pin Configuration

![Pin Configuration Diagram]

Figure 1. Pin Configuration

PIN DESCRIPTION

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

ABSOLUTE MAXIMUM RATINGS \((T_J = 25°C \text{ unless otherwise specified})\)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDS(Q1–Q4)</td>
<td>Drain to Source Voltage</td>
<td>80</td>
<td>V</td>
</tr>
<tr>
<td>VGS(Q1–Q4)</td>
<td>Gate to Source Voltage</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>EAS(Q1–Q4)</td>
<td>Single Pulse Avalanche Energy (Note 1)</td>
<td>2445</td>
<td>mJ</td>
</tr>
<tr>
<td>(T_J)</td>
<td>Maximum Junction Temperature</td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>(T_{STG})</td>
<td>Storage Temperature</td>
<td>125</td>
<td>°C</td>
</tr>
</tbody>
</table>

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 \(T_J = 25°C\), \(L = 0.47 \, \text{mH}, I_{AS} = 102 \, \text{A}, V_{DD} = 72 \, \text{V}\) during inductor charging and \(V_{DD} = 0 \, \text{V}\) during time in avalanche.

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.
ELECTRICAL CHARACTERISTICS (T_J = 25°C, unless otherwise noted)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVDSS</td>
<td>Drain–to–Source Breakdown Voltage</td>
<td>80</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>VGS(th)</td>
<td>Gate to Source Threshold Voltage</td>
<td>2</td>
<td>–</td>
<td>4.6</td>
<td>V</td>
</tr>
<tr>
<td>VSD</td>
<td>Source–to–Drain Diode Voltage</td>
<td>–</td>
<td>0.79</td>
<td>1.1</td>
<td>V</td>
</tr>
<tr>
<td>RDS(ON)Q1, Q2</td>
<td>Q1, Q2 (High Side) MOSFET (Note 2)</td>
<td>–</td>
<td>0.65</td>
<td>0.765</td>
<td>mΩ</td>
</tr>
<tr>
<td>RDS(ON) Q3, Q4</td>
<td>Q3, Q4 (Low Side) MOSFET (Note 2)</td>
<td>–</td>
<td>0.46</td>
<td>0.58</td>
<td>mΩ</td>
</tr>
<tr>
<td>IGSS</td>
<td>Gate–to–Source Leakage Current</td>
<td>−100</td>
<td>−</td>
<td>+100</td>
<td>nA</td>
</tr>
<tr>
<td>IDSS</td>
<td>Drain–to–Source Leakage Current</td>
<td>−</td>
<td>−</td>
<td>2</td>
<td>μA</td>
</tr>
</tbody>
</table>

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 Rdson value. However the different Rdson values listed in the datasheet are due to the different access points available inside the module for Rdson measurement. Q3 and Q4 (Low side FETs) has the shortest Rdson measurement path in the layout, in this reason, so Q3 or Q4 Rdson value can be used for the Rdson value per switch for simple power loss calculation.

Each Rdson measurement paths are as below table, “Resistance Measurement Methods” 3. Module Rdson means total resistance of the measurement path btw Power terminals, referring to the resistance measurement methods table.

<table>
<thead>
<tr>
<th>RESISTANCE MEASUREMENTS METHODS</th>
<th>+ Force Pin#</th>
<th>– Force Pin#</th>
<th>+ Sense Pin#</th>
<th>– Sense Pin#</th>
</tr>
</thead>
<tbody>
<tr>
<td>FET Rdson Q1</td>
<td>B1+</td>
<td>Phase1</td>
<td>B1+ Sense</td>
<td>Q1 Source Sense</td>
</tr>
<tr>
<td>FET Rdson Q2</td>
<td>B2+</td>
<td>Phase2</td>
<td>B2+ Sense</td>
<td>Q2 Source Sense</td>
</tr>
<tr>
<td>FET Rdson Q3</td>
<td>Phase1</td>
<td>GND</td>
<td>Q1 Source Sense</td>
<td>Q3 Source Sense</td>
</tr>
<tr>
<td>FET Rdson Q4</td>
<td>Phase2</td>
<td>GND</td>
<td>Q2 Source Sense</td>
<td>Q4 Source Sense</td>
</tr>
<tr>
<td>Module Rdson Q1</td>
<td>B1+</td>
<td>Phase1</td>
<td>B1+</td>
<td>Phase1</td>
</tr>
<tr>
<td>Module Rdson Q2</td>
<td>B2+</td>
<td>Phase2</td>
<td>B2+</td>
<td>Phase2</td>
</tr>
<tr>
<td>Module Rdson Q3</td>
<td>Phase1</td>
<td>GND</td>
<td>Phase1</td>
<td>GND</td>
</tr>
<tr>
<td>Module Rdson Q4</td>
<td>Phase2</td>
<td>GND</td>
<td>Phase2</td>
<td>GND</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEMPERATURE SENSE (NTC THERMISTOR)</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Current = 1 mA, Temperature 25°C</td>
<td>7.5</td>
<td>–</td>
<td>12</td>
<td>V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL RESISTOR</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
</table>
| Rthjc: Thermal Resistance Junction to case, Single Inverter FET     | Q1, Q2, Q3, Q4 Thermal Resistance J–C               | –   | –   | 0.19 | °C/W
### ISOLATION VOLTAGE
(Isolation voltage between the Base plate and to control pins or power terminals.)

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Condition</th>
<th>Test Time</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage @ Isolation Voltage (Hi-Pot)</td>
<td>VAC = 3 kV</td>
<td>Time = 1 s</td>
<td>–</td>
<td>250</td>
<td>μA</td>
</tr>
</tbody>
</table>

### DYNAMIC AND SWITCHING CHARACTERISTICS
(T\(_J\) = 25°C unless otherwise noted)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DYNAMIC CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(C_{iss})</td>
<td>Input Capacitance</td>
<td>(V_{DS} = 40 \text{ V}, V_{GS} = 0 \text{ V}, f = 750 \text{ kHz})</td>
<td>–</td>
<td>30,150</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>(C_{oss})</td>
<td>Output Capacitance</td>
<td></td>
<td>–</td>
<td>4,505</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>(C_{rss})</td>
<td>Reverse Transfer Capacitance</td>
<td></td>
<td>–</td>
<td>77</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>(R_{g})</td>
<td>Gate Resistance</td>
<td>(f = 750 \text{ kHz})</td>
<td>–</td>
<td>4.3</td>
<td>–</td>
<td>Ω</td>
</tr>
<tr>
<td>(Q_{g(tot)})</td>
<td>Total Gate Charge</td>
<td>(V_{GS} = 0) to 12 \text{ V}, (I_{D} = 160 \text{ A})</td>
<td>–</td>
<td>502</td>
<td>–</td>
<td>nC</td>
</tr>
<tr>
<td>(Q_{gs})</td>
<td>Gate to Source Gate Charge</td>
<td></td>
<td>–</td>
<td>193</td>
<td>–</td>
<td>nC</td>
</tr>
<tr>
<td>(Q_{gd})</td>
<td>Gate to Drain “Miller” Charge</td>
<td></td>
<td>–</td>
<td>89</td>
<td>–</td>
<td>nC</td>
</tr>
</tbody>
</table>

### SWITCHING CHARACTERISTICS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(t_{on})</td>
<td>Turn–On Time</td>
<td>(V_{DD} = 48 \text{ V}, I_{D} = 400 \text{ A}) (V_{GS} = 12 \text{ V}, R_{G(on/off)} = 15/15 \text{ Ω},)</td>
<td>–</td>
<td>710</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>(t_{d(on)})</td>
<td>Turn–On Delay Time</td>
<td></td>
<td>–</td>
<td>235</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>(t_{r})</td>
<td>Turn–On Rise Time</td>
<td></td>
<td>–</td>
<td>475</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>(t_{d(off)})</td>
<td>Turn–Off Delay Time</td>
<td></td>
<td>–</td>
<td>608</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>(t_{f})</td>
<td>Turn–Off Fall Time</td>
<td></td>
<td>–</td>
<td>290</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>(t_{off})</td>
<td>Turn–Off Time</td>
<td></td>
<td>–</td>
<td>898</td>
<td>–</td>
<td>ns</td>
</tr>
</tbody>
</table>

### DRAIN–SOURCE DIODE CHARACTERISTICS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(t_{RR})</td>
<td>Reverse Recovery Time</td>
<td>(V_{DD} = 48 \text{ V}, I_{D} = 400 \text{ A}) (V_{GS} = 12 \text{ V}, R_{G(on/off)} = 15/15 \text{ Ω},)</td>
<td>–</td>
<td>59</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>(Q_{RR})</td>
<td>Reverse Recovery Charge</td>
<td></td>
<td>–</td>
<td>1433</td>
<td>–</td>
<td>nC</td>
</tr>
</tbody>
</table>

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

### COMPONENTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Type</th>
<th>Qty.</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOSFET</td>
<td>Bare Die</td>
<td>Bare Die</td>
<td>4</td>
<td>80 V 0.58 mΩ</td>
</tr>
<tr>
<td>NTC</td>
<td>10 kΩ ±1% 1,600 x 800 μm</td>
<td>Discrete</td>
<td>1</td>
<td>B–Constant (B_{25/60} = 3380)K (B_{25/85} = 3435)K (B_{25/100} = 3455)K</td>
</tr>
<tr>
<td>Capacitor (Snubber)</td>
<td>1,800 x 800 μm</td>
<td>Discrete</td>
<td>2</td>
<td>15 nF</td>
</tr>
<tr>
<td>Resistor (Snubber)</td>
<td>2,000 x 1,250 μm</td>
<td>Discrete</td>
<td>2</td>
<td>1 Ω</td>
</tr>
</tbody>
</table>
Figure 3. Unclamped Inductive Switching Capability

Figure 4. Saturation Characteristics

Figure 5. $R_{DSON}$ vs. Gate Voltage

Figure 6. $R_{DSON}$ 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
MECHANICAL CHARACTERISTICS AND RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Flatness</td>
<td>Refer to the package dimensions</td>
<td>0</td>
<td>−</td>
<td>150</td>
<td>um</td>
</tr>
<tr>
<td>Mounting Torque</td>
<td>Mounting screw: M3, recommended 0.7 N•m</td>
<td>0.4</td>
<td>−</td>
<td>1.4 (Note 5)</td>
<td>N•m</td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td>−</td>
<td>23.6</td>
<td>−</td>
<td>g</td>
</tr>
</tbody>
</table>

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 mounting condition.
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

**APM17-MDC**
CASE MODHH
ISSUE C

**DATE 08 DEC 2021**

**NOTES:**
1. DIMENSIONING AND TOLERANCING PER.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS ARE EXCLUSIVE OF BURRS,
   MOLD FLASH AND TIE BAR EXTRUSIONS.

<table>
<thead>
<tr>
<th>MILLIMETERS</th>
<th>MIN.</th>
<th>NOM.</th>
<th>MAX.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>4.90</td>
<td>5.00</td>
<td>5.10</td>
</tr>
<tr>
<td>b</td>
<td>5.20</td>
<td>5.30</td>
<td>5.40</td>
</tr>
<tr>
<td>b1</td>
<td>0.70</td>
<td>0.80</td>
<td>0.90</td>
</tr>
<tr>
<td>b2</td>
<td>9.90</td>
<td>10.00</td>
<td>10.10</td>
</tr>
<tr>
<td>c</td>
<td>0.75</td>
<td>0.80</td>
<td>0.90</td>
</tr>
<tr>
<td>D</td>
<td>44.90</td>
<td>45.00</td>
<td>45.10</td>
</tr>
<tr>
<td>E1</td>
<td>29.90</td>
<td>30.00</td>
<td>30.10</td>
</tr>
<tr>
<td>E2</td>
<td>13.65</td>
<td>13.75</td>
<td>13.85</td>
</tr>
<tr>
<td>E3</td>
<td>19.00</td>
<td>19.30</td>
<td>19.60</td>
</tr>
<tr>
<td>E4</td>
<td>16.50</td>
<td>16.80</td>
<td>17.10</td>
</tr>
<tr>
<td>L1</td>
<td>14.70</td>
<td>15.00</td>
<td>15.30</td>
</tr>
<tr>
<td>L2</td>
<td>20.70</td>
<td>21.00</td>
<td>21.30</td>
</tr>
<tr>
<td>L3</td>
<td>14.70</td>
<td>15.00</td>
<td>15.30</td>
</tr>
<tr>
<td>q</td>
<td>40.10</td>
<td>40.20</td>
<td>40.30</td>
</tr>
<tr>
<td>φA</td>
<td>3.10</td>
<td>3.20</td>
<td>3.30</td>
</tr>
</tbody>
</table>

**SPECIFIC DEVICE CODE**

**ZXX = Specific Device Code**
**ZZZ = Lot ID**
**ATT = 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 "C", may or may not be present. Some products may not follow the Generic Marking.

**DOCUMENT NUMBER:** 98AON28701H
**DESCRIPTION:** APM17-MDC

Electronic versions are uncontrolled except when accessed directly from the Document Repository.
Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.

© Semiconductor Components Industries, LLC, 2018 www.onsemi.com

**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.