

晁元國際半導體股份有限公司  
MaxPower SiC Semiconductor Co., Ltd.

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**Change History:**

| Date      | Version | Change Item    | Author    |
|-----------|---------|----------------|-----------|
| 2023/7/28 | V1.0    | First release. | John Ruan |
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|           |         |                |           |
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|           |         |                |           |

## M1P-1200-400D

### All Silicon Carbide Power Module

#### 1200V/400A 2-in-1 SiC MOSFET EconoDual Power Module

#### Features

- Low  $R_{DS(on)}$
- Low surge, low switching loss
- High-speed switching possible
- Silicon Nitride AMB substrate for high reliability
- Halogen Free, RoHS Compliant

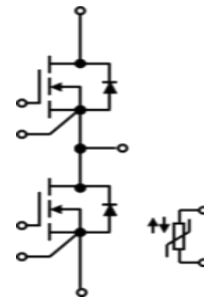
#### Benefits

- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

#### Applications

- Motor drive
- Electrified vehicle traction inverter
- Photovoltaics, wind power generation
- Induction heating equipment

#### Equivalent Circuit Schematic



#### Maximum Ratings ( $T_c = 25^\circ\text{C}$ unless otherwise specified)

| Symbol               | Parameter                                  | Value          | Unit             | Test Conditions   | Note |
|----------------------|--|----------------|------------------|---|------|
| $V_{DSmax}$          | Drain - Source Voltage                     | 1200           | V                |   |      |
| $V_{GSmax}$          | Gate - Source Voltage                      | -8/+25         | V                | Absolute maximum values   |      |
| $V_{GSop}$           | Gate - Source Voltage                      | -5/+20         | V                | Recommended operational values  |      |
| $I_D$                | Continuous Drain Current                   | 400<br>300     | A                | $V_{GS} = 20\text{V}$ , $T_{VJ} = 25^\circ\text{C}$<br>$V_{GS} = 20\text{V}$ , $T_{VJ} = 150^\circ\text{C}$ |      |
| $I_{D,peak}$         | Repetitive peak drain current              | 1450           | A                | Pulsed Drain Current, $t_p$ limited by $T_{jmax}$   |      |
| $T_{VJ}$ , $T_{stg}$ | Operating Junction and Storage Temperature | -55 to<br>+175 | $^\circ\text{C}$ |   |      |
| $V_{ISO}$            | Isolation Test Voltage                     | 3400           |                  | AC, 50Hz, 1 s   |      |

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**Electrical Characteristics**

| Symbol        | Parameter                        | Min. | Typ. | Max. | Unit       | Test Conditions  | Note |
|---------------|----------------------------------|------|------|------|------------|--|------|
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage   | 1200 |      |      | V          | $V_{GS}=0V, I_D=100\mu A$  |      |
| $V_{GS(th)}$  | Gate Threshold Voltage           | 2.0  | 2.50 | 4.0  | V          | $V_{GS}=V_{DS}, I_{DS}=150mA, T_{VJ}=25^\circ C$                                       |      |
|               |                                  |      | 1.80 |      |            | $V_{GS}=V_{DS}, I_{DS}=150mA, T_{VJ}=150^\circ C$                                      |      |
| $I_{DSS}$     | Zero Gate Voltage Drain Current  |      | 48   | 360  | $\mu A$    | $V_{DS}=1200V, V_{GS}=0V$  |      |
| $I_{GSS}$     | Gate-Source Leakage Current      |      | 120  | 540  | nA         | $V_{GS}=20V, V_{DS}=0V$  |      |
| $R_{DS(on)}$  | Drain-Source on-state Resistance |      | 3.35 | 3.9  | m $\Omega$ | $V_{GS}=20V, I_D=300A, T_{VJ}=25^\circ C$  |      |
|               |                                  |      | 4.53 |      | m $\Omega$ | $V_{GS}=20V, I_D=300A, T_{VJ}=150^\circ C$   |      |
| $C_{iss}$     | Input Capacitance                |      | 21.2 |      | nF         | $V_{GS}=0V, V_{DS}=800V, f=1MHz, V_{AC}=25mV$  |      |
| $C_{oss}$     | Output Capacitance               |      | 136  |      |            |  |      |
| $C_{rss}$     | Reverse Transfer Capacitance     |      | 1.2  |      |            |  |      |
| $E_{ON}$      | Turn-On Switching Energy         |      | 17.5 |      | mJ         | $V_{DS}=800V, V_{GS}=-5/20V, I_D=300A, R_{G(ext)}=5\Omega, L=80\mu H, di/dt=4kA/\mu s$ |      |
| $E_{OFF}$     | Turn-Off Switching Energy        |      | 15.4 |      |            |  |      |
| $t_{d(on)}$   | Turn-On Delay Time               |      | 66   |      | ns         | $V_{DS}=800V, V_{GS}=-5/20V, I_D=300A, R_{G(ext)}=5\Omega,$                            |      |
| $t_r$         | Rise Time                        |      | 62   |      |            |  |      |
| $t_{d(off)}$  | Turn-Off Delay Time              |      | 218  |      |            |  |      |
| $t_f$         | Fall Time                        |      | 53   |      |            |  |      |
| $Q_{gs}$      | Gate to Source Charge            |      | 280  |      | nC         | $V_{DS}=800V, V_{GS}=-5/20V, I_D=300A$   |      |
| $Q_{gd}$      | Gate to Drain Charge             |      | 370  |      |            |  |      |
| $Q_g$         | Total Gate Charge                |      | 1120 |      |            |  |      |

**Reverse Diode Characteristics**

| Symbol   | Parameter                        | Typ. | Max. | Unit | Test Conditions                               | Note |
|----------|----------------------------------|------|------|------|---|------|
| $V_{SD}$ | Diode Forward Voltage            | 3.7  |      | V    | $V_{GS}=-5V, I_{SD}=300A, T_{VJ}=25^\circ C$  |      |
|          |                                  | 3.4  |      | V    | $V_{GS}=-5V, I_{SD}=300A, T_{VJ}=150^\circ C$ |      |
| $I_S$    | Continuous Diode Forward Current |      | 400  | A    | $V_{GS}=-5V, T_{VJ}=25^\circ C$               |      |
|          |                                  |      | 165  | A    | $V_{GS}=-5V, T_{VJ}=150^\circ C$              |      |

| Symbol    | Parameter                     | Typ. | Max. | Unit | Test Conditions  | Note |
|-----------|-------------------------------|------|------|------|--|------|
| $I_{rrm}$ | Peak reverse recovery current |      | 210  | A    | $V_{GS}=-5V, I_{SD}=300A, V_{R,DS}=800V, T_{VJ}=25^\circ C$  |      |
|           |                               |      | 445  | A    | $V_{GS}=-5V, I_{SD}=300A, V_{R,DS}=800V, T_{VJ}=150^\circ C$ |      |
| $Q_{rr}$  | Reverse recovery charge       |      | 13.8 | nC   | $V_{GS}=-5V, I_{SD}=300A, V_{R,DS}=800V, T_{VJ}=25^\circ C$  |      |
|           |                               |      | 26.1 | nC   | $V_{GS}=-5V, I_{SD}=300A, V_{R,DS}=800V, T_{VJ}=150^\circ C$ |      |

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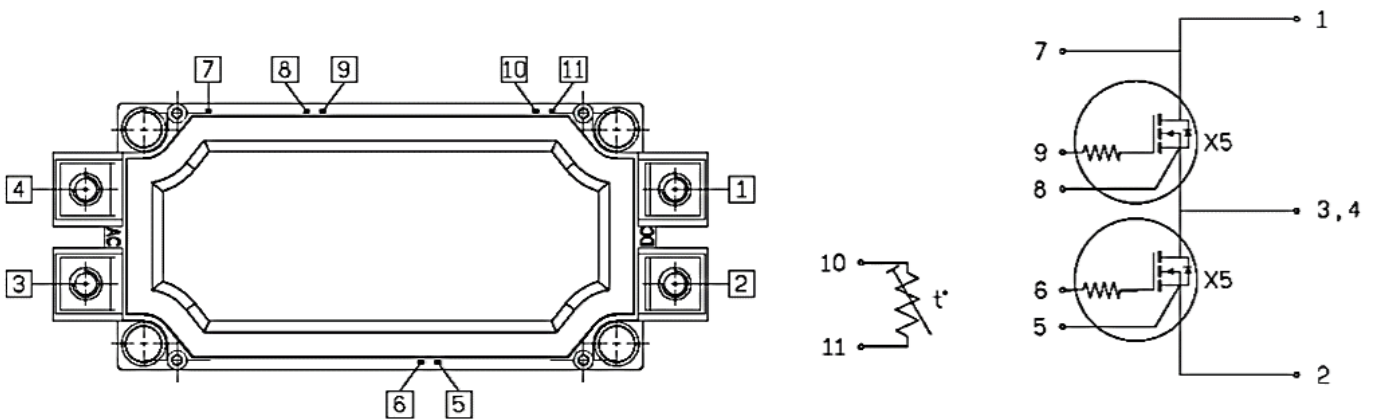
**NTC Characteristics**

| Symbol          | Parameter  | Min. | Typ. | Max. | Unit | Test Conditions                                  | Note |
|-----------------|--|------|------|------|------|--|------|
| R <sub>25</sub> | Rated Resistance                                       |      | 5.0  |      | kΩ   | T <sub>C</sub> = 25 °C                           |      |
| ΔR/R            | Deviation of R <sub>100</sub>                          | -5   |      | 5    | %    | T <sub>C</sub> = 100 °C R <sub>100</sub> = 493 Ω |      |
| P <sub>25</sub> | Power Dissipation                                      |      |      | 20   | mW   | T <sub>C</sub> = 25 °C                           |      |
| B-25/50         | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15 K))]$  |      | 3375 |      | K    |  |      |
| B-25/80         | $R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298.15 K))]$  |      | 3411 |      | K    |  |      |
| B-25/100        | $R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15 K))]$ |      | 3433 |      | K    |  |      |

**Package Characteristics**

| Symbol            | Parameter                           | Min. | Typ. | Max. | Unit | Test Conditions                | Note |
|-------------------|-------------------------------------|------|------|------|------|--------------------------------|------|
| L <sub>s,DS</sub> | Stray inductance of module          |      | 7.2  |      | nH   | T <sub>C</sub> = 25 °C         |      |
| M <sub>T</sub>    | Mounting torque for module mounting | 1.8  | 2.0  | 2.2  | Nm   | Screw M4 baseplate to heatsink |      |
| W <sub>P</sub>    | Weight                              |      | 320  |      | g    |                                |      |

**Circuit Schematic**



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**Package Dimension**

