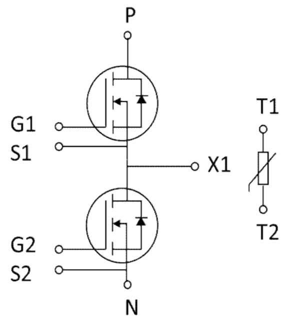
# 1200V N-Channel SiC MOSFET Module

## • General Description

This silicon carbide Power MOSFET module has been developed using ZMJ's advanced 1st generation SiC MOSFET technology. The device features a very low $R_{DS(on)}$ over the entire temperature range combined with low capacitances and very high switching operations. It improves application performance in frequency, energy efficiency, system size and weight reduction.

## • Product Summary




$V_{DS}$= 1200V

$R_{DS(ON)}$ = 10mΩ

$I_D$= 100A

## • Features

■High Blocking Voltage

■High Speed Switching With Low Capacitances

■Low $R_{DS(ON)}$ to Minimize Conductive Loss

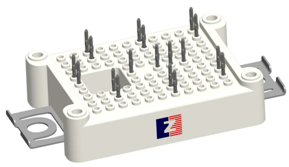
■Low Gate Charge For Fast Switching

■Low Inductive Design

■AMB Substrate for lower thermal resistance

■Pressfit Pin

■Integrated NTC Sensor



A5D

## •Application

■High-frequency switching application

■DC-DC

■UPS

## •Ordering Information:

| | |
|---|---|
| Part NO. | ZMC010R120Z1AAFF |
| Marking | ZMC010R120Z1AAFF |
| Packing Information | TRAY |
| Basic Ordering Unit (pcs) | 20 |

## •Absolute Maximum Ratings ($T_A$=25°C,unless otherwise specified)

| Parameter | Symbol | Conditions | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | | - | 1200 | V |
| Gate-Source Voltage① | $V_{GS}$ | Transient Voltage | -10 | 25 | V |
| | $V_{GS}$ | Static Voltage | -10 | 24 | V |
| Recommended Turn On Gate Voltage | $V_{GS(on)}$ | | 15 | 18 | V |
| Recommended Turn Off Gate Voltage | $V_{GS(off)}$ | | -4 | 0 | V |
| Continuous Drain Current② | $I_D$ | $V_{GS}$=18V,$T_H$=25°C | - | 100 | A |
| | $I_D$ | $V_{GS}$=18V,$T_H$=75°C | - | 82 | A |
| | $I_D$ | $V_{GS}$=18V,$T_H$=100°C | - | 71 | A |
| Pulsed Drain Current | $I_{DM}$ | Pulsed; $t_p \leqslant$ 10 μs; $T_H$ = 25 °C; | - | 200 | A |
| Total Power Dissipation | $P_D$ | $T_C$=25℃ | - | 268 | W |
| Operating Junction Temperature | $T_J$ | | -55 | 175 | ℃ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Storage Temperature | $T_{STG}$ | | -55 | 175 | ℃ |
| Single Pulse Avalanche Energy | $E_{AS}$ | L=0.5mH, $V_{GS}$=10V, Rg=25Ω, | - | 2450 | mJ |
| ESD Level (HBM) | CLASS 2 | | | | |

## ●Thermal resistance

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Thermal Resistance, Junction - Heatsink | $R_{thJH}$ | - | - | 0.56 | °C/W |

## ●Electronic Characteristics (Tj=25°C,unless otherwise specified)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$ =0V, $I_D$ =500uA | 1200 | - | - | V |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$=$V_{DS}$, $I_D$=10mA, Tj=25°C | 2 | 2.9 | 4 | V |
| Drain-Source Leakage Current | $I_{DSS}$ | $V_{GS}$=0V, $V_{DS}$=1200V, Tj=25°C | - | - | 20 | uA |
| Gate- Source Leakage Current | $I_{GSS}$ | $V_{GS}$=-10V, $V_{DS}$ =0V | - | - | -100 | nA |
| | | $V_{GS}$=25V, $V_{DS}$ =0V | - | - | 100 | nA |
| Static Drain-Source On Resistance | $R_{DS(ON)}$ | $V_{GS}$=18V, $I_D$=100A, Tj=25°C | - | 10 | 13 | mΩ |
| | | $V_{GS}$=18V, $I_D$=100A, Tj=175°C | - | 20 | 26 | mΩ |
| | | $V_{GS}$=15V, $I_D$=100A, Tj=25°C | - | 13.5 | 17.6 | mΩ |
| Diode Forward Voltage | $V_{FSD}$ | $V_{GS}$ =0V, $I_{SD}$ = 100A | - | 4.2 | 5.2 | V |

## ●Dynamic characteristics (Tj=25°C,unless otherwise specified)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Input Capacitance | Ciss | f = 100KHz, $V_{DS}$=800V, $V_{GS}$=0V | - | 9234 | - | pF |
| Output Capacitance | Coss | | - | 415 | - | |
| Reverse Transfer Capacitance | Crss | | - | 26 | - | |
| Output Charge | $Q_{oss}$ | f = 100KHz,$V_{GS}$=0V, $V_{DS}$=0V to 800V | - | 561 | - | nC |
| Coss Stored Energy | $E_{oss}$ | | - | 155 | - | uJ |
| Gate Resistance | Rg | f = 1MHz | - | 0.8 | - | Ω |
| Total Gate Charge | Qg | $V_{DD}$ = 800V, $I_D$ = 100A, $V_{GS}$ = -4V/18V | - | 373 | - | nC |
| Gate - Source Charge | Qgs | | - | 121 | - | |
| Gate - Drain Charge | Qgd | | - | 122 | - | |
| Turn-On Delay Time | $t_{D(on)}$ | $V_{GS}$=-5V/20V,$V_{DS}$=600V, $R_{G\_ON}$ =10Ω, $R_{G\_OFF}$ =10Ω, $I_D$ =100A,L=100uH | - | 52 | - | ns |
| Turn-On Rise Time | $t_r$ | | - | 34 | - | ns |
| Turn-Off Delay Time | $t_{D(off)}$ | | - | 158 | - | ns |
| Turn-Off Fall Time | $t_f$ | | - | 38 | - | ns |
| Turn-On Energy | $E_{on}$ | | - | 1.4 | - | mJ |
| Turn-Off Energy | $E_{off}$ | | - | 1.11 | - | mJ |

## •NTC Charateristic

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Rated Resistance | $R_{25}$ | $T_{NTC}$=25°C | - | 5 | - | kΩ |
| Deviation of $R_{100}$ | △R/R | $T_{NTC}$=100°C,$R_{100}$=512Ω | -5 | - | 5 | % |
| Power Dissipation | $P_{25}$ | $T_{NTC}$=25°C | - | - | 20 | mW |
| B-value | $B_{25/50}$ | $R2 = R_{25} \exp[B_{25}/_{50}(1/T2-1/(298.15\ K))]$ | - | 3380 | - | K |

## •Module Charateristic

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Isolation Test Voltage | $V_{ISO}$ | RMS, f =50Hz, t =1 min | - | 3 | - | kV |
| Internal Isolation Material | | | SiN | | | - |
| Stray Inductance | $L_s$ | | - | 9 | - | nH |
| Module Pin Resistance, Terminal - Chip | $R_{DD-SS}$ | $T_H$=25°C,Per Switch | - | 2 | - | mΩ |
| Mounting Force Per Clamp | F | | 20 | - | 50 | N |
| Module Weight | G | | - | 23 | - | g |

Fig.1 Gate-source voltage as a function of gate charge;Typical values;Tj=25°C

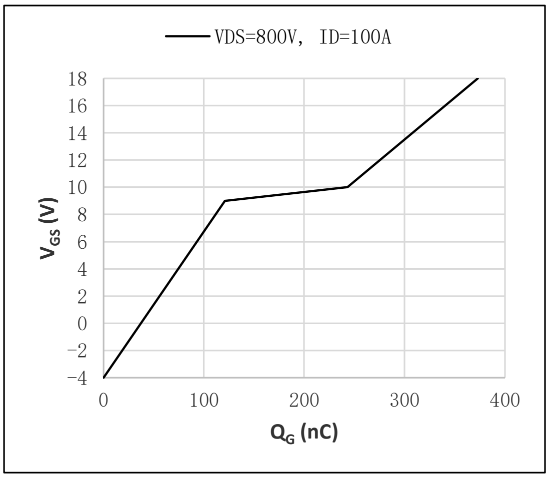



Fig.2 Input, output and reverse transfer capacitances as a function of drain-source voltage;Typical values;Tj=25°C

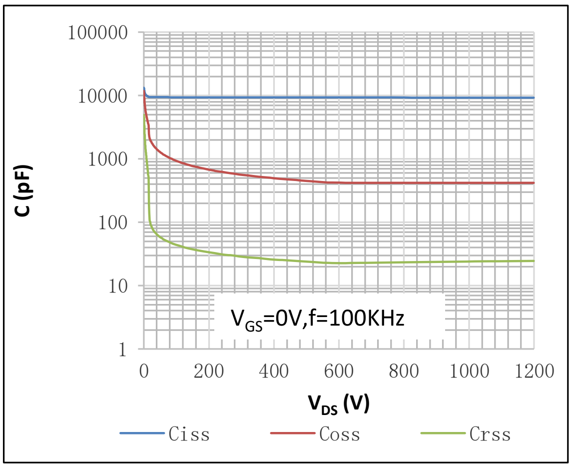



Fig.3 Output characteristics: drain current as a function of drain-source voltage;Typical values; Tj=25°C

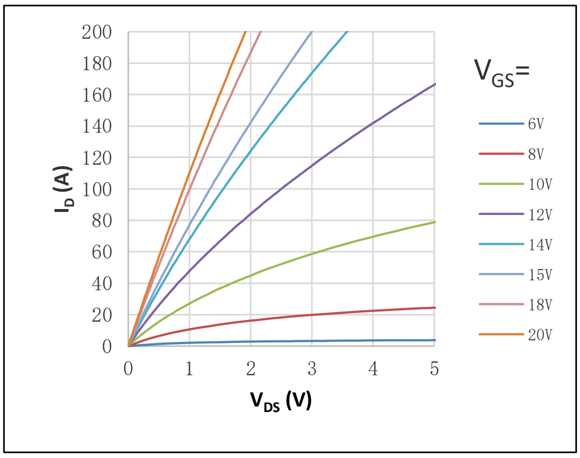



Fig.4 Output characteristics: drain current as a function of drain-source voltage;Typical values:Expanded curve;Tj=25°C

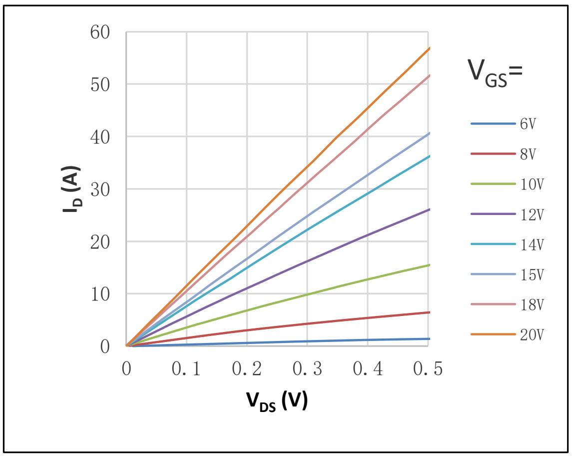



Fig.5 Gate-source threshold voltage as a function of junction temperature;Typical values

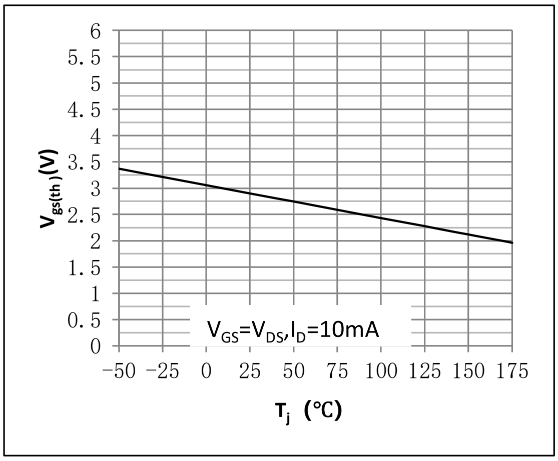



Fig.6 Drain-source on-state resistance as a function of drain current;Typical values;Tj=25°C

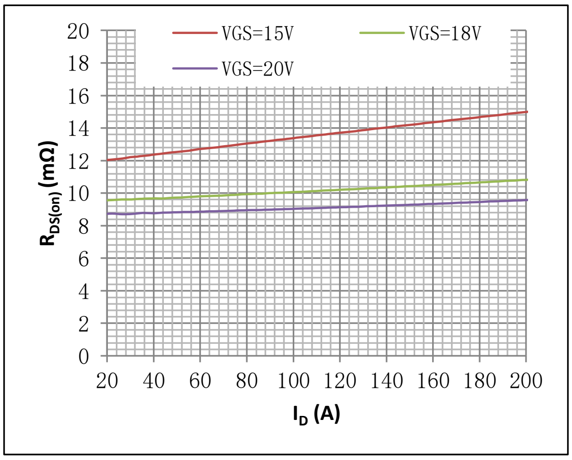


Fig.7 Drain-source on-state resistance as a function of gate-source voltage;Typical values

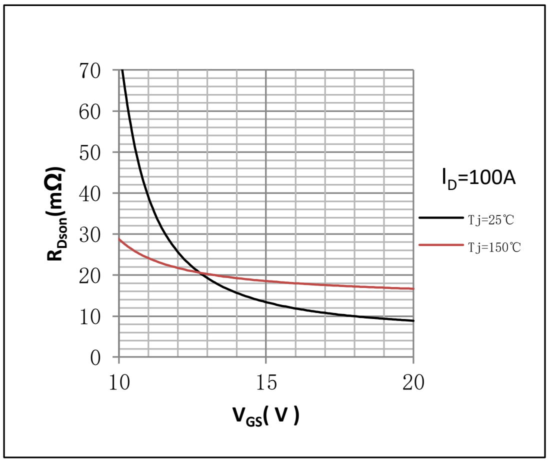



Fig.8 Normalized drain-source on-state resistance factor as a function of junction temperature;Typical values
Normalized On-Resistance=RDSon/RDSon(25°C)

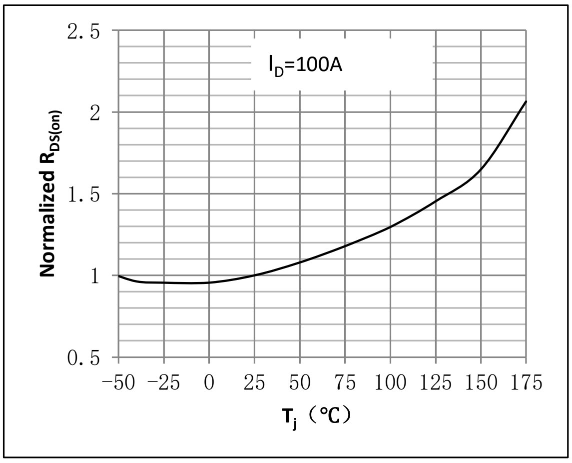



Figure 9. Source (diode forward) current as a function of source-drain (diode forward) voltage ;Typical values

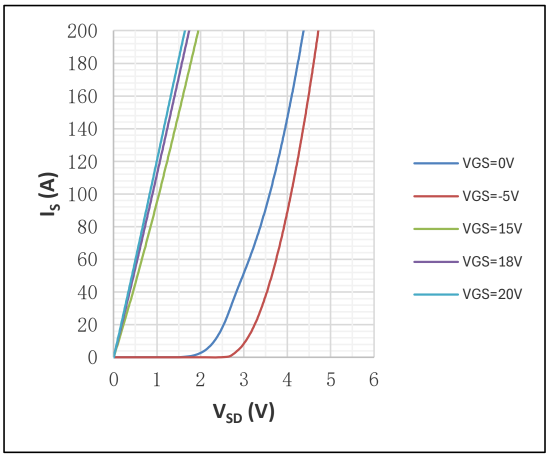



Figure 10. Transfer characteristics: drain current as a function of gate-source voltage;Typical values

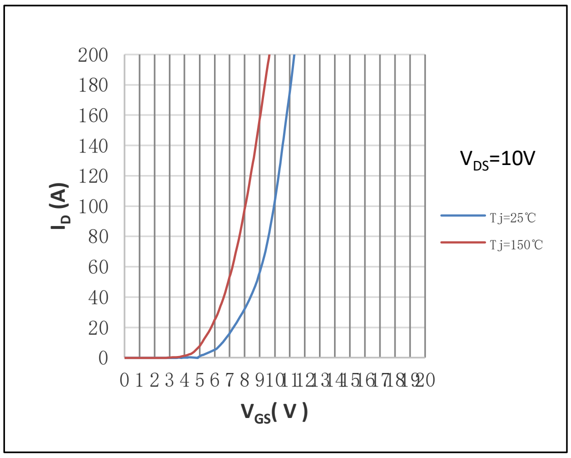



Fig.11 Safe operating area: continuous and peak drain currents as a function of drain-source voltage;Calculative values

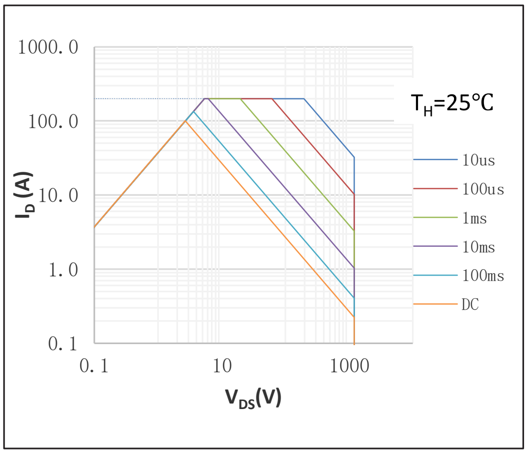



Fig.12 Continuous drain current as a function of heatsink temperaturease[3];Calculative values

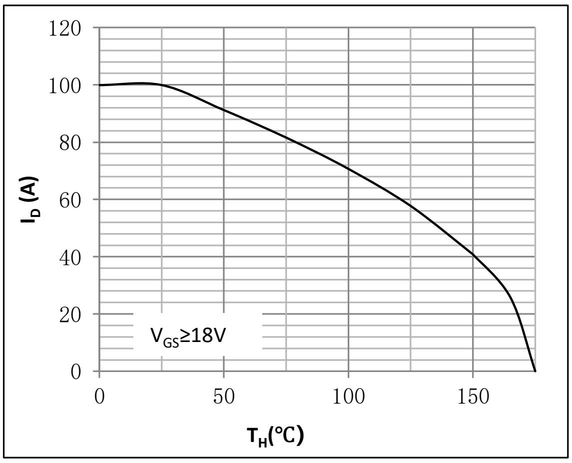


Fig.13 Drain-source breakdown voltage as a function of junction temperature;Typical values

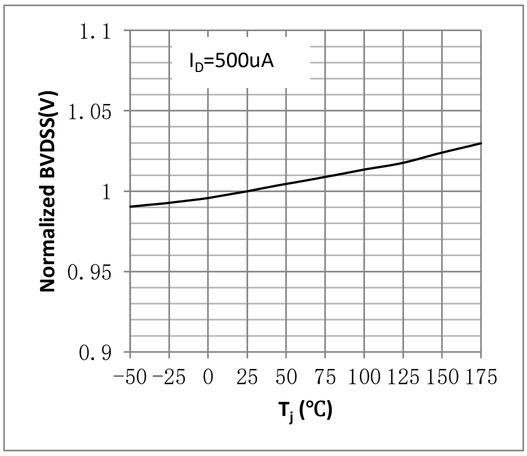



Fig.14 Normalized total power dissipation as a function of heatsink temperature;Calculative values

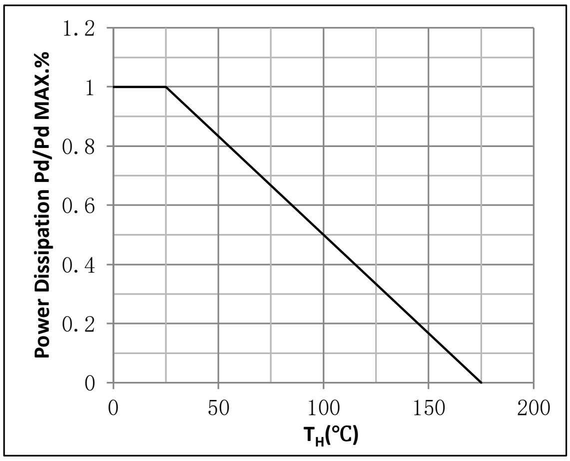
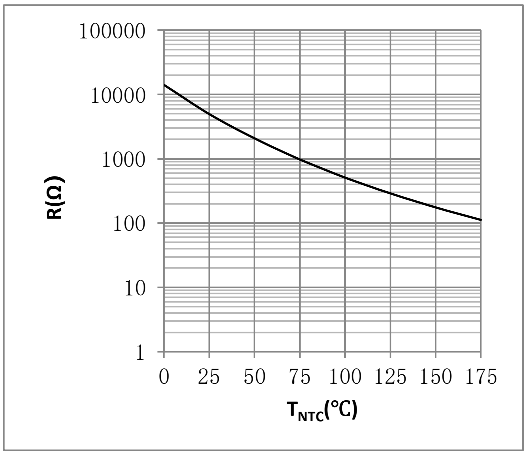
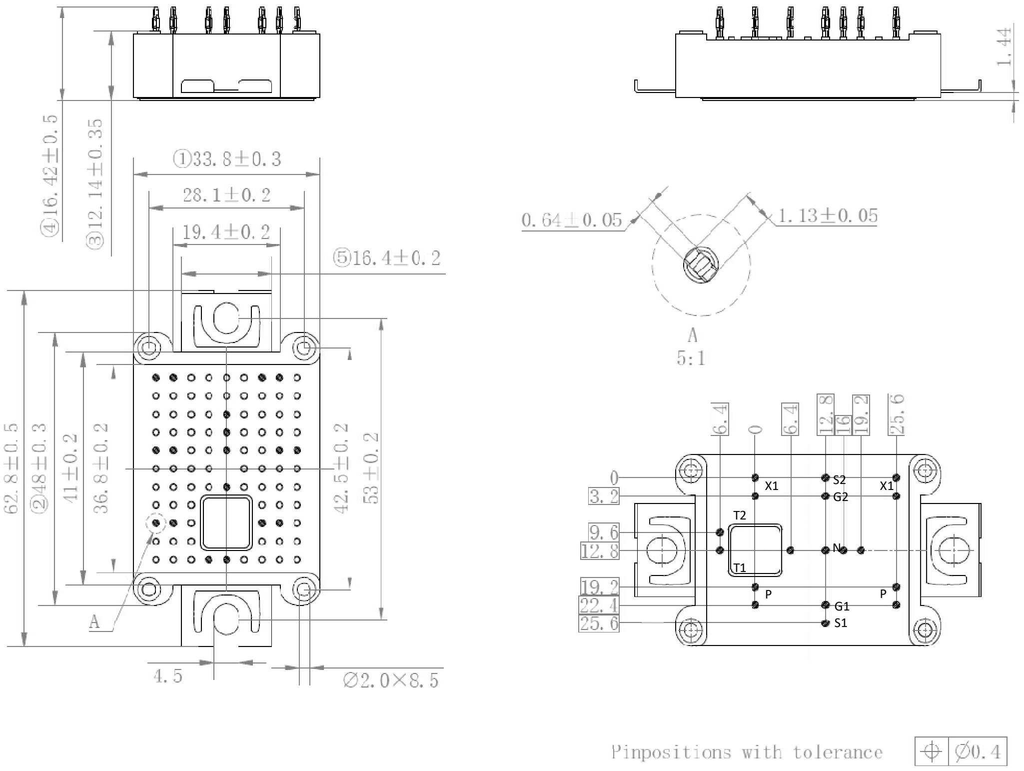



Fig.15 NTC thermistor resistance as a function of NTC temperature;Typical values



**●A5D Package Outline**



**Note:**

① Pulse : VGS=+25V/-10V, Duty cycle=50%,Tj=175℃, t=1000 hours; For DC， the following test conditions can be passed: VGS=+24V/-10V, Tj=175℃, t=1000 hours；

②Practically the current will be limited by PCB, thermal design and operating temperature. VGS=18V.

**Disclaimer**

● Reproducing and modifying information of the document is prohibited without permission from ZMJ SEMICONDDUCTORS CO.,LTD.

● ZMJ SEMICONDDUCTORS CO.,LTD. reserves the rights to make changes of the content herein the document anytime without notification. Please refer to our website for the latest document.

● ZMJ SEMICONDDUCTORS CO.,LTD. disclaims any and all liability arising out of the application or use of any product including damages incidentally and consequentially occurred.

● ZMJ SEMICONDDUCTORS CO.,LTD. does not assume any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

● Applications shown on the herein document are examples of standard use and operation. Customers are responsible in comprehending the suitable use in particular applications. ZMJ SEMICONDDUCTORS CO.,LTD. makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

● The products shown herein are not designed and authorized for equipments relating to human life and for any applications concerning life-saving or life-sustaining, such as medical instruments, aerospace machinery et cetera. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify ZMJ SEMICONDDUCTORS CO.,LTD. for any damages resulting from such improper use or sale.

● Since ZMJ uses lot number as the tracking base, please provide the lot number for tracking when complaining.

| Version | Date | Change |
|---|---|---|
| A | 2025/1/21 | New |
| | | |
| | | |
| | | |
| | | |