

### General Description

It combines advanced trench MOSFET technology with a low resistance package to provide extremely low  $R_{DS(ON)}$ . It is suitable for automotive application.

### Features

- AEC-Q101 Qualified
- Low  $R_{DS(ON)}$  to minimize conductive loss
- Low Gate Charge for fast switching
- Low Thermal resistance

### Application

- BLDC Motor driver
- DC-DC
- Load Switch

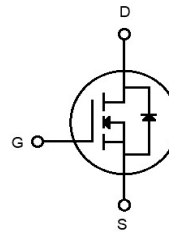
### Ordering Information:

|                           |              |
|---------------------------|--------------|
| Part NO.                  | ZMSA011N04HP |
| Marking                   | ZMS011N04H   |
| Packing Information       | REEL TAPE    |
| Basic ordering unit (pcs) | 1000         |

### Absolute Maximum Ratings ( $T_C=25^{\circ}\text{C}$ )

| Parameter                        | Symbol    | Conditions                                                          | Value       | Unit               |
|----------------------------------|-----------|---------------------------------------------------------------------|-------------|--------------------|
| Drain-Source Voltage             | $V_{DS}$  |                                                                     | 40          | V                  |
| Gate-Source Voltage <sup>①</sup> | $V_{GS}$  |                                                                     | $\pm 20$    | V                  |
| Continuous Drain Current         | $I_D$     | $T_C=25^{\circ}\text{C}$                                            | 140         | A                  |
|                                  | $I_D$     | $T_C=75^{\circ}\text{C}$                                            | 140         | A                  |
|                                  | $I_D$     | $T_C=100^{\circ}\text{C}$                                           | 140         | A                  |
| Pulsed Drain Current             | $I_{DM}$  | Pulsed; $t_p \leq 10 \mu\text{s}$ ; $T_{mb} = 25^{\circ}\text{C}$ ; | 560         | A                  |
| Total Power Dissipation          | $P_D$     | $T_C=25^{\circ}\text{C}$                                            | 167         | W                  |
| Total Power Dissipation          | $P_D$     | $T_A=25^{\circ}\text{C}$                                            | 3.1         | W                  |
| Operating Junction Temperature   | $T_J$     |                                                                     | -55 to +175 | $^{\circ}\text{C}$ |
| Storage Temperature              | $T_{STG}$ |                                                                     | -55 to +175 | $^{\circ}\text{C}$ |
| Single Pulse Avalanche Energy    | $E_{AS}$  | $L=0.1\text{mH}$ , $V_{GS}=10\text{V}$ , $R_g=25\Omega$ ,           | 320         | mJ                 |
|                                  |           | $L=0.5\text{mH}$ , $V_{GS}=10\text{V}$ , $R_g=25\Omega$ ,           | 736         | mJ                 |
| ESD Level (HBM)                  | CLASS 2   |                                                                     |             |                    |

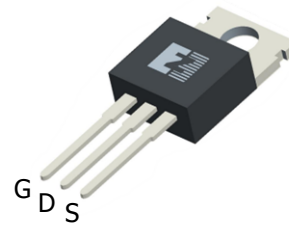
### Product Summary



$$V_{DS} = 40\text{V}$$

$$R_{DS(ON)} = 1.4\text{m}\Omega$$

$$I_D = 140\text{A}$$



TO-220



**•Thermal resistance**

| Parameter                              | Symbol         | Min. | Typ. | Max. | Unit |
|----------------------------------------|----------------|------|------|------|------|
| Thermal resistance, junction - case    | $R_{thJC}$     |      | -    | 0.9  | °C/W |
| Thermal resistance, junction-ambient   | $R_{thJA}^{②}$ |      | -    | 40   | °C/W |
| Soldering temperature (total time<10s) | $T_{sold}$     |      | -    | 260  | °C   |

**•Electronic Characteristics**

| Parameter                         | Symbol       | Condition                     | Min. | Typ. | Max. | Unit       |
|-----------------------------------|--------------|-------------------------------|------|------|------|------------|
| Drain-Source Breakdown Voltage    | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$     | 40   |      |      | V          |
| Gate Threshold Voltage            | $V_{GS(TH)}$ | $V_{GS}=V_{DS}, I_D=250\mu A$ | 2.0  | 2.7  | 4.0  | V          |
| Drain-Source Leakage Current      | $I_{DSS}$    | $V_{GS}=0V, V_{DS}=40V$       |      |      | 1.0  | $\mu A$    |
| Gate- Source Leakage Current      | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$   |      |      | 100  | nA         |
| Static Drain-source On Resistance | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=40A$         |      | 1.4  | 1.6  | m $\Omega$ |
| Forward Transconductance          | $g_{FS}$     | $V_{DS}=5V, I_{SD}=20A$       |      | 30   |      | s          |
| Diode Forward Voltage             | $V_{FSD}$    | $V_{GS}=0V, I_{SD}=40A$       |      |      | 1.3  | V          |

**•Dynamic characteristics**

| Parameter                    | Symbol       | Condition                                        | Min. | Typ. | Max. | Unit     |
|------------------------------|--------------|--------------------------------------------------|------|------|------|----------|
| Input capacitance            | $C_{iss}$    | $f=1MHz, V_{DS}=25V$                             | -    | 5430 | 7059 | pF       |
| Output capacitance           | $C_{oss}$    |                                                  | -    | 1520 | 1976 |          |
| Reverse transfer capacitance | $C_{rss}$    |                                                  | -    | 84   | 109  |          |
| Gate Resistance              | $R_g$        | $f=1MHz$                                         | -    | 1.6  | 2.9  | $\Omega$ |
| Total gate charge            | $Q_g$        | $V_{DD}=15V, I_D=20A, V_{GS}=10V$                | -    | 87   | 122  | nC       |
| Gate - Source charge         | $Q_{gs}$     |                                                  | -    | 21   | 29   |          |
| Gate - Drain charge          | $Q_{gd}$     |                                                  | -    | 19   | 27   |          |
| Turn-ON Delay time           | $t_{D(on)}$  | $V_{GS}=10V, V_{DS}=15V, R_G=3.3\Omega, I_D=20A$ | -    | 15   | 23   | ns       |
| Turn-ON Rise time            | $t_r$        |                                                  | -    | 10   | 15   | ns       |
| Turn-Off Delay time          | $t_{D(off)}$ |                                                  | -    | 26   | 39   | ns       |
| Turn-Off Fall time           | $t_f$        |                                                  | -    | 14   | 26   | ns       |
| Reverse Recovery Time        | $t_{RR}$     | $V_{DD}=20V, di_S/dt=100A/\mu s, I_S=50A$        | -    | 72   | 85   | ns       |
| Reverse Recovery Charge      | $Q_{RR}$     |                                                  | -    | 98   | 124  | nC       |



Fig.1 Gate-Charge Characteristics

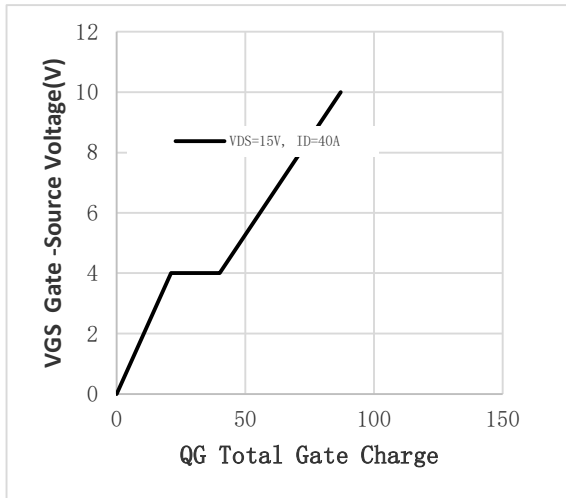


Fig.2 Capacitance Characteristics

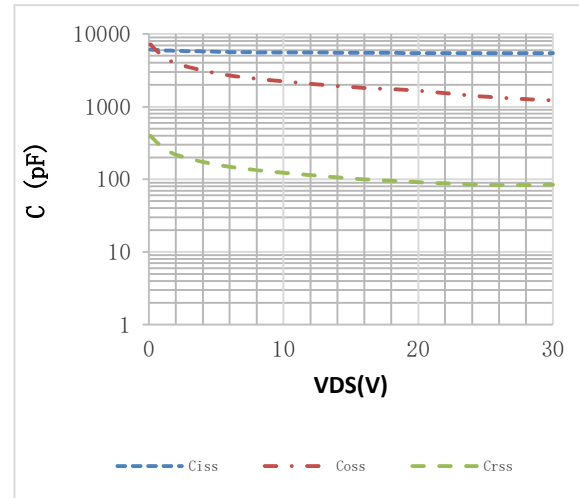


Fig.3 Power Dissipation

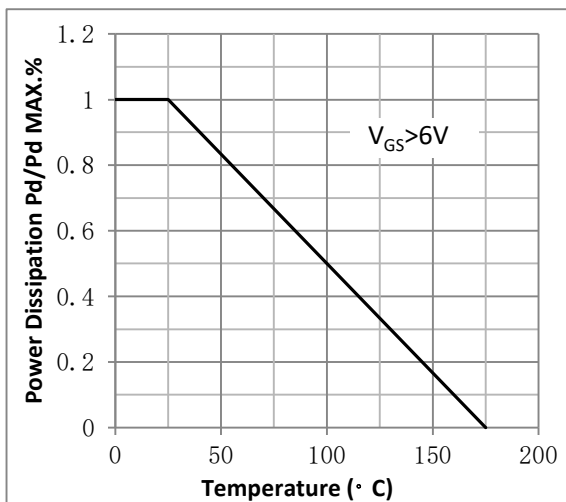


Fig.4 Typical output Characteristics

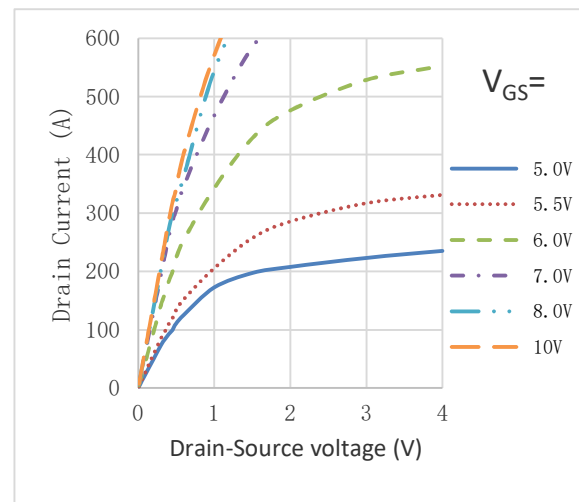


Fig.5 Threshold Voltage V.S Junction Temperature

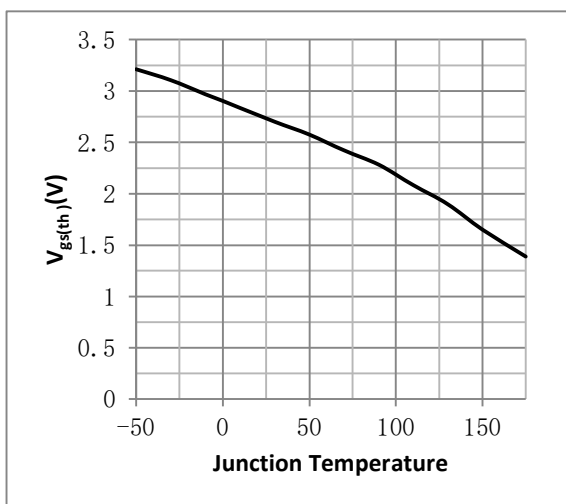


Fig.6 Resistance V.S Drain Current

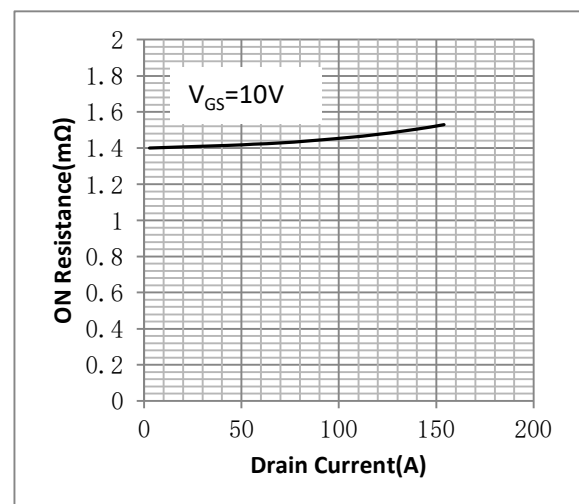


Fig.7 On-Resistance VS Gate Source Voltage

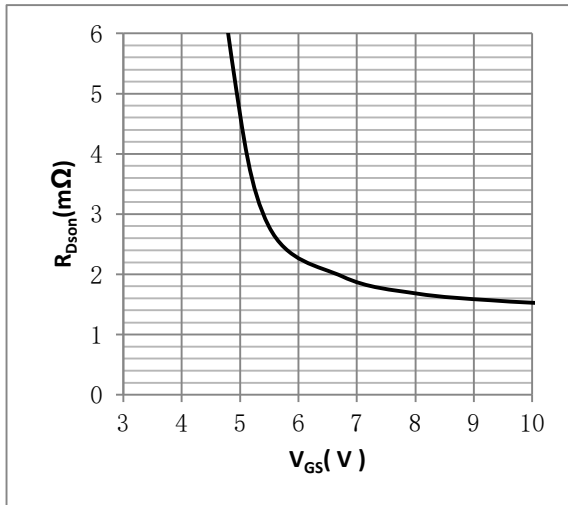


Fig.8 On-Resistance V.S Junction Temperature

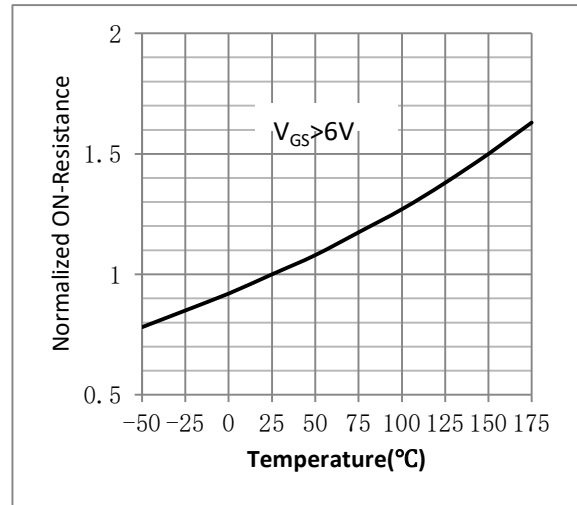


Figure 9. Diode Forward Voltage vs. Current

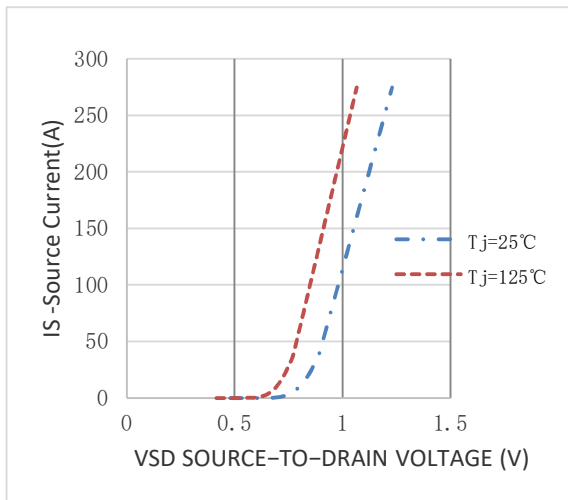


Figure 10. Transfer Characteristics

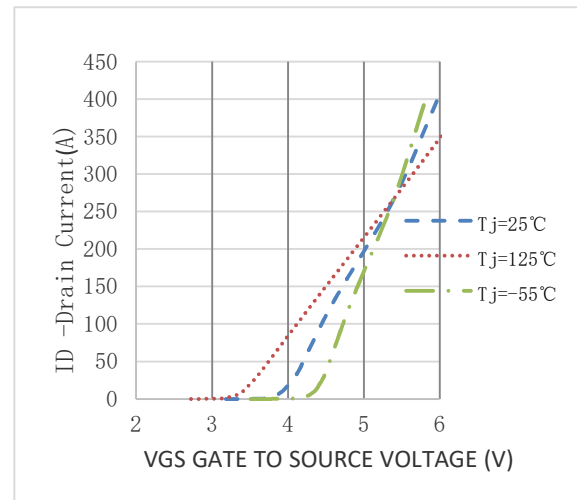


Fig.11 Safe Operating Area

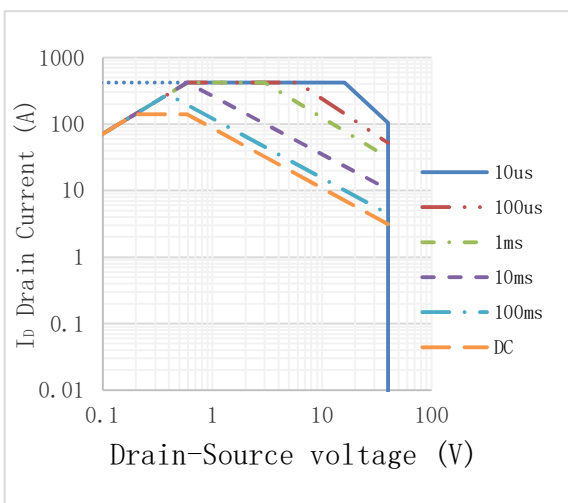
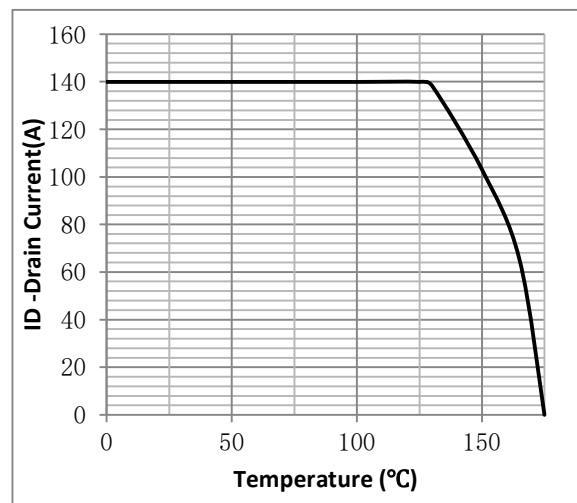
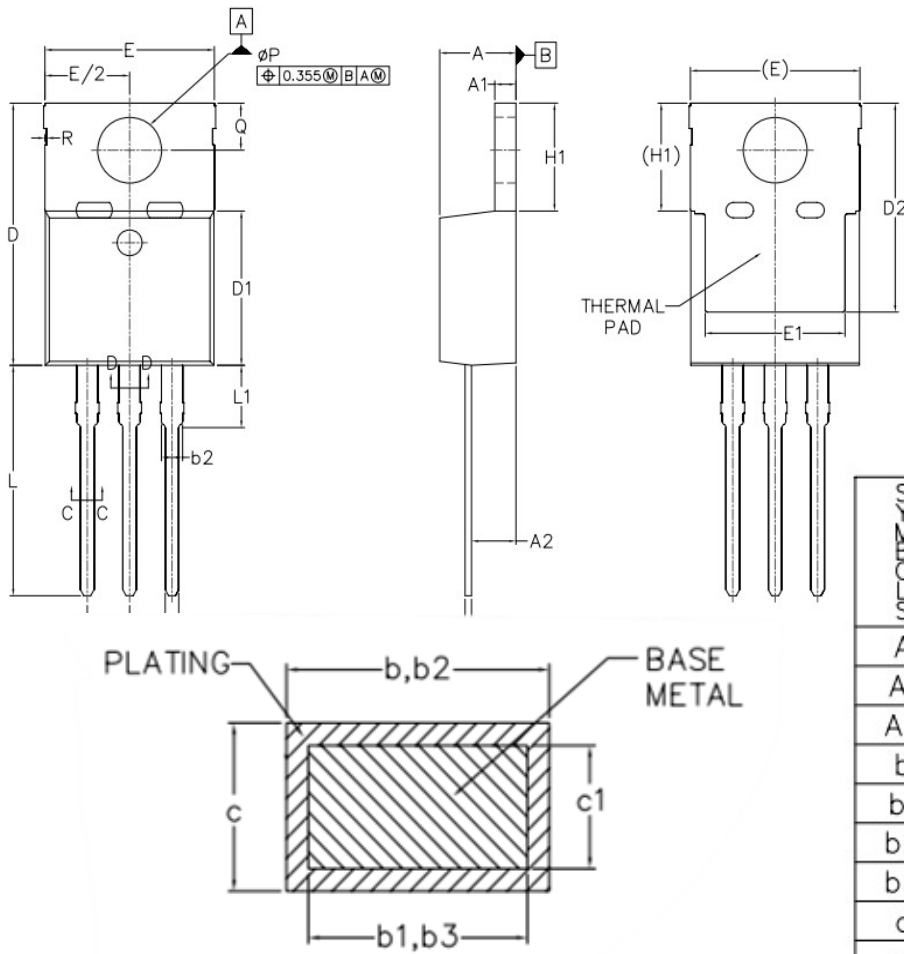


Fig.12 ID vs. Junction Temperature<sup>③</sup>



•TO-220 Package Outline



| SYMBOLS | COMMON     |        |
|---------|------------|--------|
|         | MM         |        |
|         | MIN.       | MAX.   |
| A       | 3.556      | 4.826  |
| A1      | 0.508      | 1.397  |
| A2      | 2.032      | 2.921  |
| b       | 0.381      | 1.016  |
| b1      | 0.381      | 0.965  |
| b2      | 1.143      | 1.778  |
| b3      | 1.143      | 1.727  |
| c       | 0.356      | 0.610  |
| c1      | 0.356      | 0.559  |
| D       | 14.224     | 16.510 |
| D1      | 8.382      | 9.017  |
| D2      | 12.042     | 12.878 |
| E       | 9.652      | 10.668 |
| E1      | 6.858      | 8.890  |
| e       | 2.540 BSC. |        |
| H1      | 5.842      | 6.858  |
| L       | 12.700     | 14.732 |
| L1      | 3.560      | 4.060  |
| ØP      | 3.810      | 3.860  |
| Q       | 2.540      | 3.048  |
| R       | 0.127 BSC  |        |

**Note:**

- ① Pulse :  $V_{GS}=+20V/-20V$ , Duty cycle=50%,  $T_j=175^{\circ}C$ ,  $t=1000$  hours; For DC , the following test conditions can be passed:  $V_{GS}=+20V/-10V$ ,  $T_j=175^{\circ}C$ ,  $t=1000$  hours;
- ② Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate;
- ③ Practically the current will be limited by PCB, thermal design and operating temperature.  $V_{GS}=10V$ .

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## Revision History

| Version | Date       | Change                                                             |
|---------|------------|--------------------------------------------------------------------|
| A       | 2022.6.6   | New                                                                |
| B       | 2022.9.5   | 1.Add Reach,HF figure,2.ID modify                                  |
| C       | 2022.11.14 | 1.Add Dynamic characteristics max limit 2.Add details of dimension |
| D       | 2022.12.20 | 1.Modified id curve , junction temperature change to case          |
| E       | 2023.12.21 | Correct Package Outline Dimensiom                                  |
| F       | 2024.11.25 | Update RDSON typical value                                         |
|         |            |                                                                    |
|         |            |                                                                    |