

## General Description

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

## 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
- Battery protection

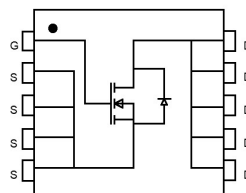
## Ordering Information:

|                           |                |
|---------------------------|----------------|
| Part NO.                  | ZMSA006N04HTNC |
| Marking                   | 06N04H         |
| Packing Information       | REEL TAPE      |
| Basic ordering unit (pcs) | 2500           |

## 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         | $I_D$     | $T_C=25^\circ\text{C}$                                            | 340         | A                |
|                                  | $I_D$     | $T_C=75^\circ\text{C}$                                            | 280         | A                |
|                                  | $I_D$     | $T_C=100^\circ\text{C}$                                           | 242         | A                |
| Pulsed Drain Current             | $I_{DM}$  | Pulsed; $t_p \leq 10 \mu\text{s}$ ; $T_{mb} = 25^\circ\text{C}$ ; | 1020        | A                |
| Total Power Dissipation          | $P_D$     | $T_C=25^\circ\text{C}$                                            | 200         | W                |
| Total Power Dissipation          | $P_D$     | $T_A=25^\circ\text{C}$                                            | 5.0         | 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    | $E_{AS}$  | $L=0.1\text{mH}$ , $V_{GS}=10\text{V}$ , $R_g=25\Omega$ ,         | 360         | mJ               |
|                                  |           | $L=0.5\text{mH}$ , $V_{GS}=10\text{V}$ , $R_g=25\Omega$ ,         | 680         | mJ               |
| ESD Level (HBM)                  | CLASS 2   |                                                                   |             |                  |

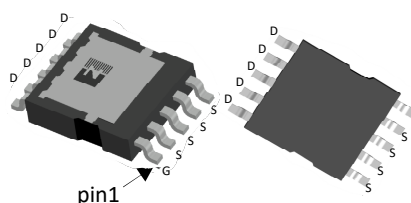
## Product Summary



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

$$R_{DS(ON)} = 0.6\text{m}\Omega$$

$$I_D = 340\text{A}$$



TCPAK5x7



**•Thermal resistance**

| Parameter                            | Symbol         | Min. | Typ. | Max. | Unit |
|--------------------------------------|----------------|------|------|------|------|
| Thermal resistance, junction - case  | $R_{thJC}$     |      | -    | 0.75 | °C/W |
| Thermal resistance, junction-ambient | $R_{thJA}^{②}$ |      | -    | 30   | °C/W |
| Soldering temperature                | $T_{sld}$      |      | -    | 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    | 2.7  | 4    | 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 | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=40A$         |      | 0.6  | 0.74 | m $\Omega$ |
| Forward Transconductance          | $g_{FS}$     | $V_{DS}=5V, I_{SD}=10A$       |      | 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            | $C_{iss}$    | $f=1MHz, V_{DS}=25V$                             | -    | 6900 | -    | pF       |
| Output capacitance           | $C_{oss}$    |                                                  | -    | 2100 | -    |          |
| Reverse transfer capacitance | $C_{rss}$    |                                                  | -    | 86   | -    |          |
| Gate Resistance              | $R_g$        | $f=1MHz$                                         | -    | 1.4  |      | $\Omega$ |
| Total gate charge            | $Q_g$        | $V_{DD}=15V, I_D=20A, V_{GS}=10V$                | -    | 94   | -    | nC       |
| Gate - Source charge         | $Q_{gs}$     |                                                  | -    | 21   | -    |          |
| Gate - Drain charge          | $Q_{gd}$     |                                                  | -    | 26   | -    |          |
| Turn-ON Delay time           | $t_{D(on)}$  | $V_{GS}=10V, V_{DS}=15V, R_G=3.3\Omega, I_D=20A$ | -    | 16   | -    | ns       |
| Turn-ON Rise time            | $t_r$        |                                                  | -    | 11   | -    | ns       |
| Turn-Off Delay time          | $t_{D(off)}$ |                                                  | -    | 40   | -    | ns       |
| Turn-Off Fall time           | $t_f$        |                                                  | -    | 19   | -    | ns       |
| Reverse Recovery Time        | $t_{RR}$     | $V_{DD}=20V, dI_S/dt=100A/\mu s, I_S=50A$        | -    | 72   | -    | ns       |
| Reverse Recovery Charge      | $Q_{RR}$     |                                                  | -    | 133  | -    | nC       |

Fig.1 Gate-Charge Characteristics

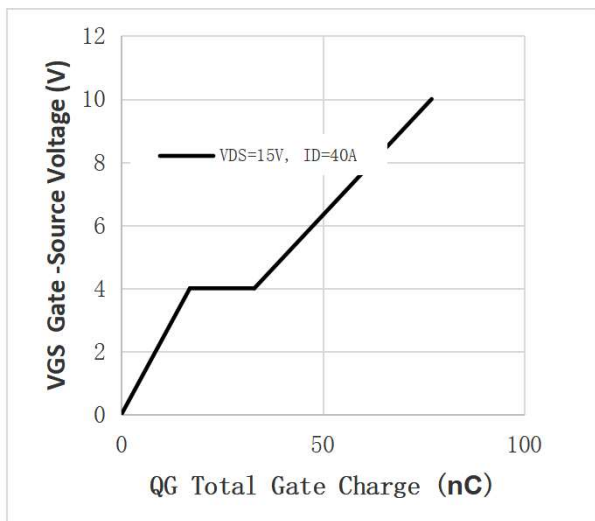


Fig.2 Capacitance Characteristics

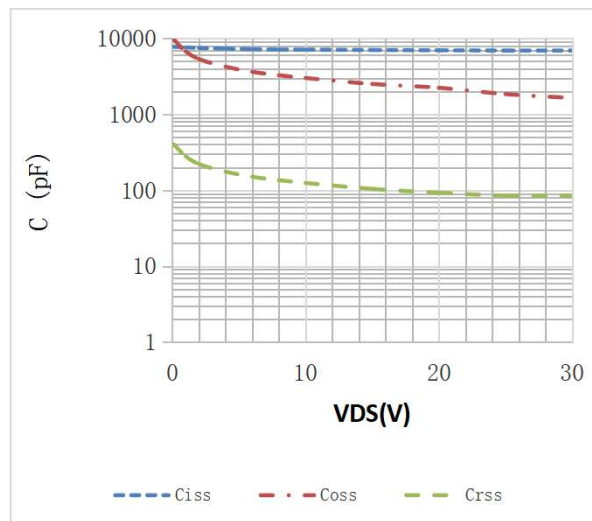


Fig.3 Power Dissipation

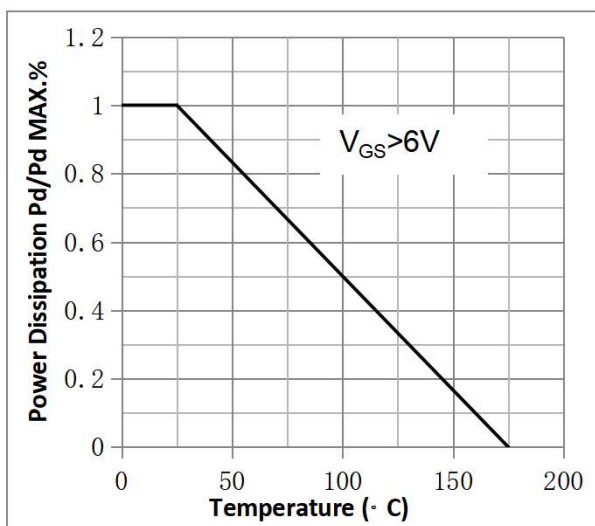


Fig.4 Typical output Characteristics

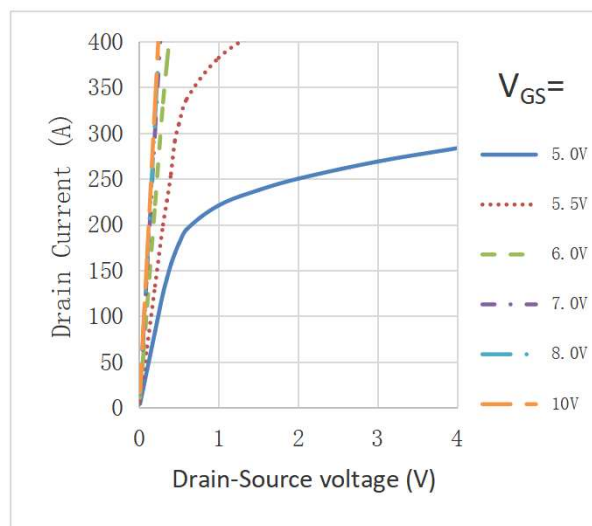


Fig.5 Threshold Voltage V.S Junction Temperature

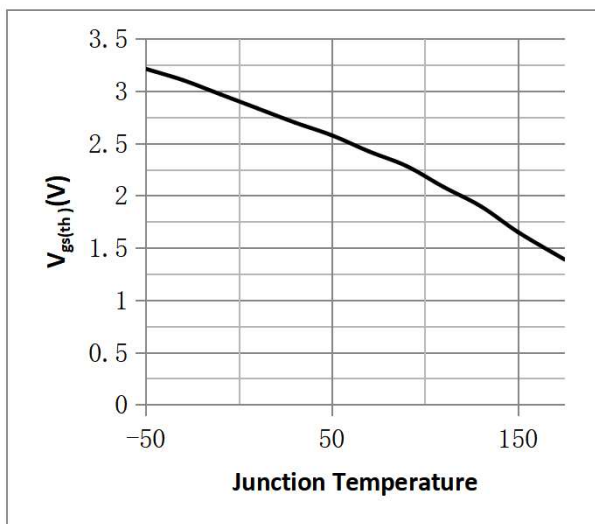


Fig.6 Resistance V.S Drain Current

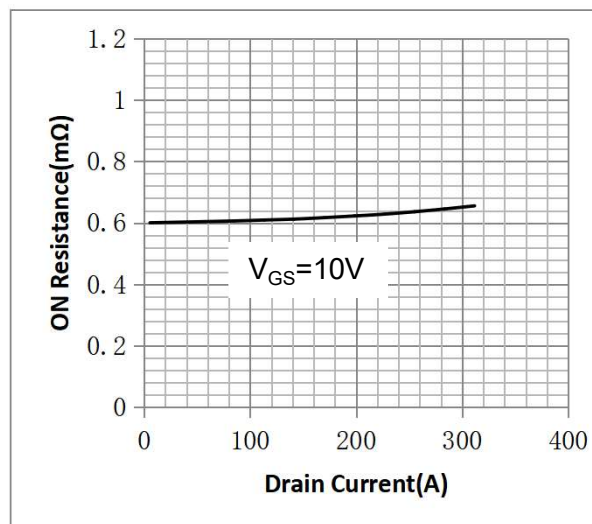


Fig.7 On-Resistance VS Gate Source Voltage

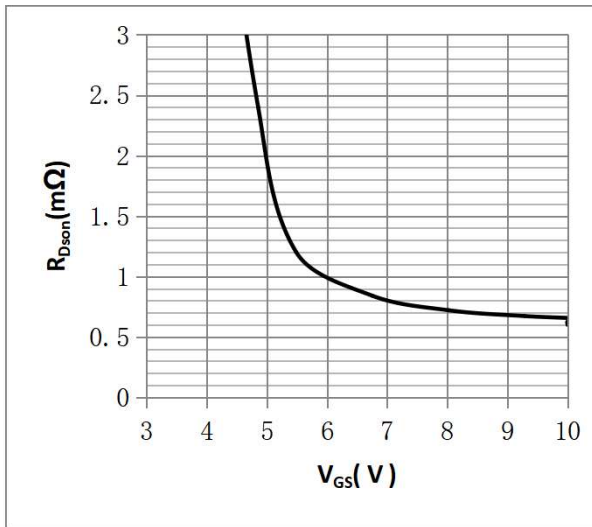


Fig.8 On-Resistance V.S Junction Temperature

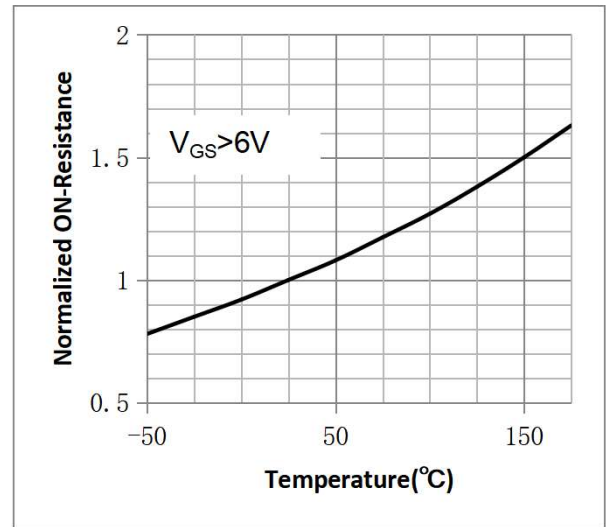


Figure 9. Diode Forward Voltage vs. Current

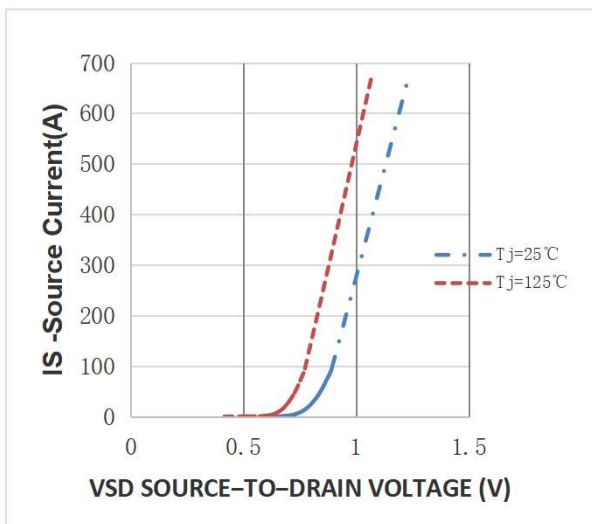


Figure 10. Transfer Characteristics

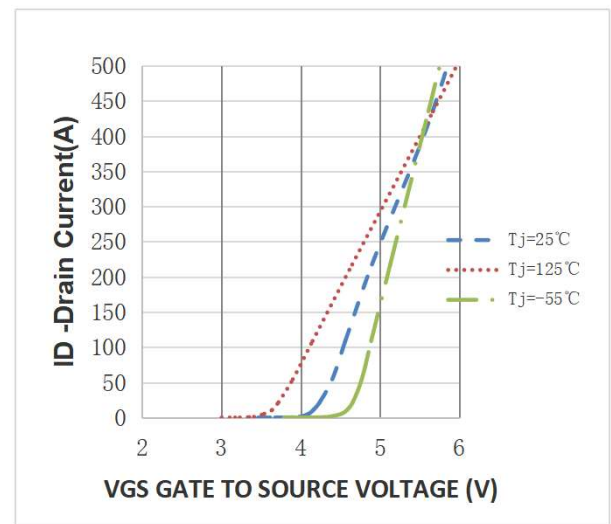


Fig.11 Safe Operating Area

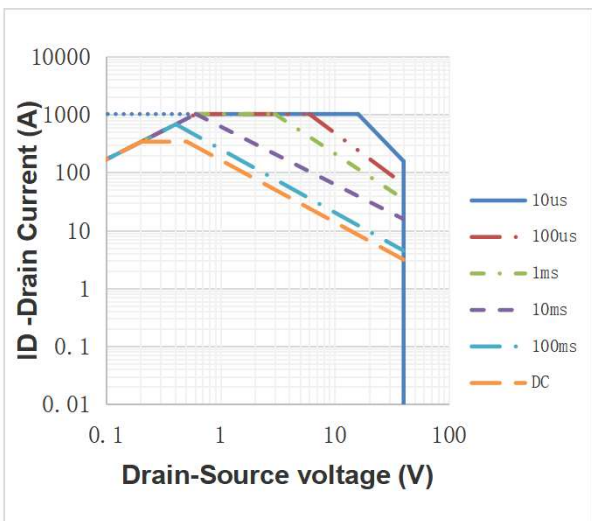
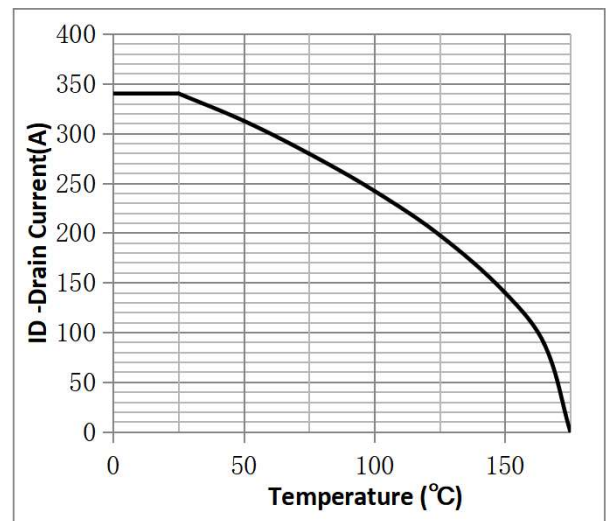
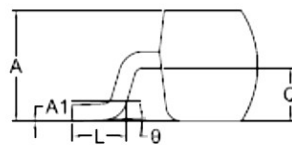
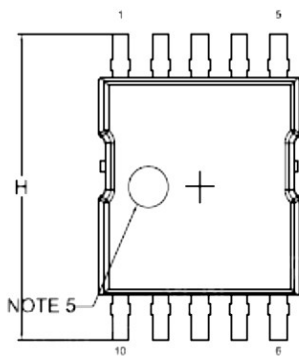
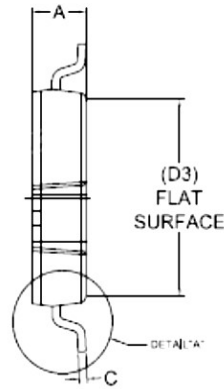
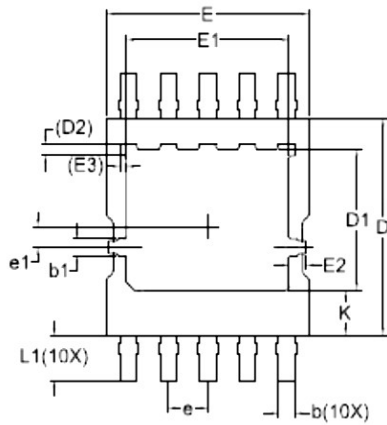


Fig.12 ID vs. Junction Temperature<sup>③</sup>



•TCPAK5x7 Package Outline



| MILLIMETERS |          |      |       |
|-------------|----------|------|-------|
| DIM         | MIN      | NOM  | MAX   |
| A           | 1,25     | 1,35 | 1,45  |
| A1          | -0,05    | 0    | 0,075 |
| b           | 0,36     | 0,41 | 0,46  |
| b1          | 0,30     | 0,40 | 0,50  |
| c           | 0,16     | 0,20 | 0,26  |
| D           | 5,20     | 5,30 | 5,40  |
| D1          | 3,35     | 3,45 | 3,55  |
| D2          | 0,29 REF |      |       |
| D3          | 4,82 REF |      |       |
| E           | 5,00     | 5,10 | 5,20  |
| E1          | 4,02     | 4,12 | 4,22  |
| E2          | 0,30     | 0,44 | 0,50  |
| E3          | 0,14 REF |      |       |
| e           | 1,00 BSC |      |       |
| e1          | 0,50 BSC |      |       |
| K           | 1,00     | 1,10 | 1,20  |
| H           | 7,30     | 7,50 | 7,70  |
| L           | 0,49     | 0,69 | 0,89  |
| L1          | 0,90     | 1,10 | 1,30  |
| Q           | 0,60     | 0,65 | 0,70  |
| θ           | 0°       | 2,5° | 5°    |

**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       | 2023.10.24 | new                                  |
| B       | 2024.4.16  | Modified ciss,Qg,switch time         |
| C       | 2024.6.19  | Modified Package NAME AS<br>TCPAK5×7 |
| D       | 2024.9.24  | Modified Rdson limit 0.8 to 0.74     |
| E       | 2024.11.27 | Modified basic ordering unit.        |
|         |            |                                      |
|         |            |                                      |
|         |            |                                      |