

## General Description

It combines 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
- High GOX reliability
- Low Thermal resistance

## Application

- BLDC Motor driver
- DC-DC
- Load Switch

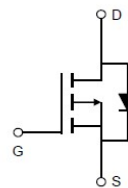
## Ordering Information:

|                           |            |
|---------------------------|------------|
| Part NO.                  | ZMA930P06D |
| Marking                   | ZM930P06   |
| 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             | $V_{DS}$  |                                                                   | -60         | V                |
| Gate-Source Voltage <sup>①</sup> | $V_{GS}$  |                                                                   | $\pm 20$    | V                |
| Continuous Drain Current         | $I_D$     | $T_C=25^\circ\text{C}$                                            | -10         | A                |
|                                  | $I_D$     | $T_C=75^\circ\text{C}$                                            | -10         | A                |
|                                  | $I_D$     | $T_C=100^\circ\text{C}$                                           | -8          | A                |
| Pulsed Drain Current             | $I_{DM}$  | Pulsed; $t_p \leq 10 \mu\text{s}$ ; $T_{mb} = 25^\circ\text{C}$ ; | -40         | A                |
| Total Power Dissipation          | $P_D$     | $T_C=25^\circ\text{C}$                                            | 38          | W                |
| Total Power Dissipation          | $P_D$     | $T_A=25^\circ\text{C}$                                            | 2.4         | 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    | $E_{AS}$  | $L=0.1\text{mH}$ , $V_{GS}=-10\text{V}$ , $R_g=25\Omega$ ,        | 5           | mJ               |
|                                  |           | $L=0.5\text{mH}$ , $V_{GS}=-10\text{V}$ , $R_g=25\Omega$ ,        | 10.5        | mJ               |
| ESD Level (HBM)                  | CLASS 1C  |                                                                   |             |                  |

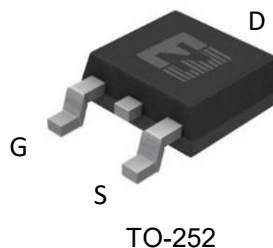
## Product Summary



$$V_{DS} = -60\text{V}$$

$$R_{DS(ON)} = 100\text{m}\Omega$$

$$I_D = -10\text{A}$$



**•Thermal resistance**

| Parameter                                         | Symbol     | Min. | Typ. | Max. | Unit |
|---------------------------------------------------|------------|------|------|------|------|
| Thermal resistance, junction - case               | $R_{thJC}$ |      | -    | 4    | °C/W |
| Thermal resistance, junction-ambient <sup>②</sup> | $R_{thJA}$ |      | -    | 62   | °C/W |
| Soldering temperature                             | $T_{sold}$ |      | -    | 260  | °C   |

**•Electronic Characteristics**

| Parameter                         | Symbol       | Condition                      | Min. | Typ. | Max. | Unit       |
|-----------------------------------|--------------|--------------------------------|------|------|------|------------|
| Drain-Source Breakdown Voltage    | $BV_{DSS}$   | $V_{GS}=0V, I_D=-250\mu A$     | -60  |      |      | V          |
| Gate Threshold Voltage            | $V_{GS(TH)}$ | $V_{GS}=V_{DS}, I_D=-250\mu A$ | -1.3 | -1.8 | -2.5 | V          |
| Drain-Source Leakage Current      | $I_{DSS}$    | $V_{GS}=0V, V_{DS}=-60V$       |      |      | 1.0  | $\mu A$    |
| Gate- Source Leakage Current      | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$    |      |      | 100  | nA         |
| Static Drain-source On Resistance | $R_{DS(ON)}$ | $V_{GS}=-10V, I_D=-5A$         |      | 100  | 130  | m $\Omega$ |
|                                   |              | $V_{GS}=-4.5V, I_D=-4A$        |      | 128  | 166  | m $\Omega$ |
| Forward Transconductance          | $g_{FS}$     | $V_{DS}=-5V, I_{SD}=-1A$       |      | 20   |      | S          |
| Diode Forward Voltage             | $V_{FSD}$    | $V_{GS}=0V, I_{SD}=-5A$        |      |      | 1.3  | V          |

**•Dynamic characteristics**

| Parameter                    | Symbol       | Condition                                           | Min. | Typ. | Max. | Unit     |
|------------------------------|--------------|-----------------------------------------------------|------|------|------|----------|
| Input capacitance            | $C_{iss}$    | $f=1MHz, V_{DS}=-25V$                               | -    | 920  | -    | pF       |
| Output capacitance           | $C_{oss}$    |                                                     | -    | 67   | -    |          |
| Reverse transfer capacitance | $C_{rss}$    |                                                     | -    | 44   | -    |          |
| Gate Resistance              | $R_g$        | $f=1MHz$                                            | -    | 8    |      | $\Omega$ |
| Total gate charge            | $Q_g$        | $V_{DD}=-15V, I_D=-10A, V_{GS}=-10V$                | -    | 13   | -    | nC       |
|                              | $Q_g(-4.5V)$ |                                                     | -    | 6    | -    |          |
| Gate - Source charge         | $Q_{gs}$     |                                                     | -    | 2.3  | -    |          |
| Gate - Drain charge          | $Q_{gd}$     |                                                     | -    | 2.4  | -    |          |
| Turn-ON Delay time           | $t_{D(on)}$  | $V_{GS}=-10V, V_{DS}=-15V, R_G=3.3\Omega, I_D=-10A$ | -    | 14   | -    | ns       |
| Turn-ON Rise time            | $t_r$        |                                                     | -    | 17   | -    | ns       |
| Turn-Off Delay time          | $t_{D(off)}$ |                                                     | -    | 41   | -    | ns       |
| Turn-Off Fall time           | $t_f$        |                                                     | -    | 18   | -    | ns       |

Fig.1 Gate-Charge Characteristics

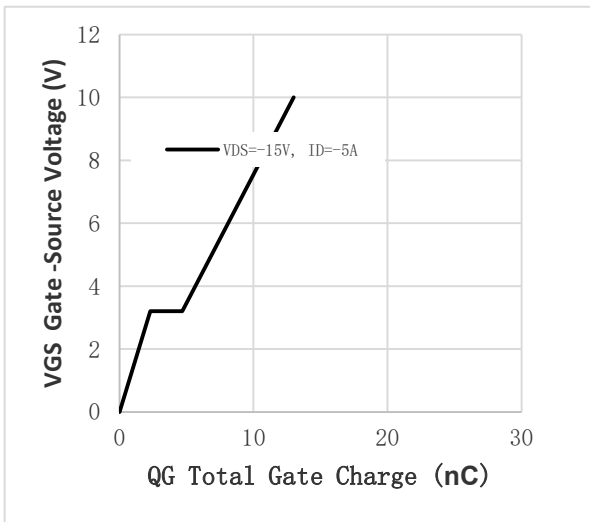


Fig.2 Capacitance Characteristics

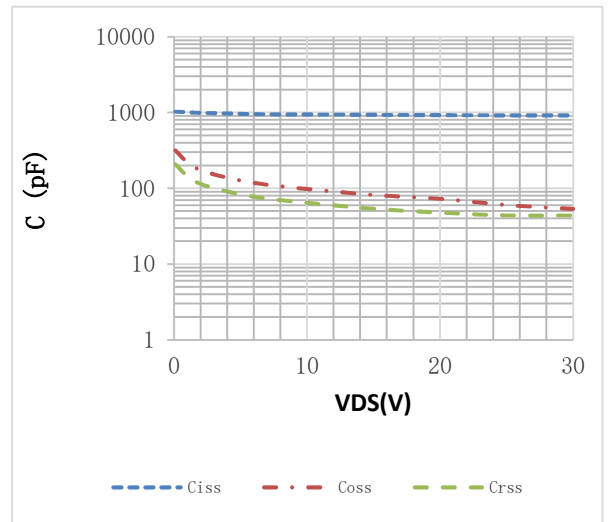


Fig.3 Power Dissipation

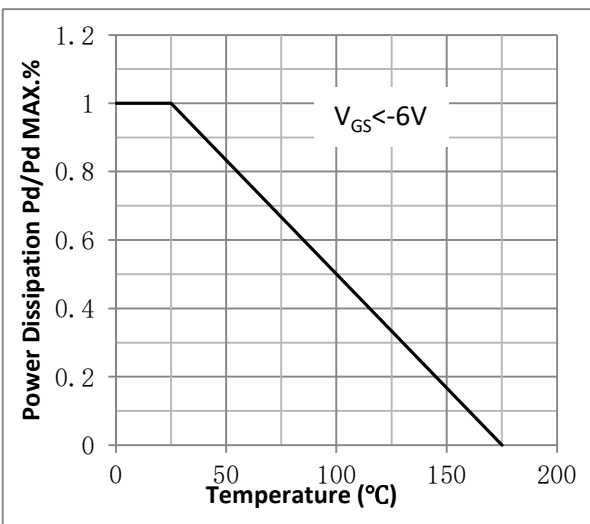


Fig.4 Typical output Characteristics

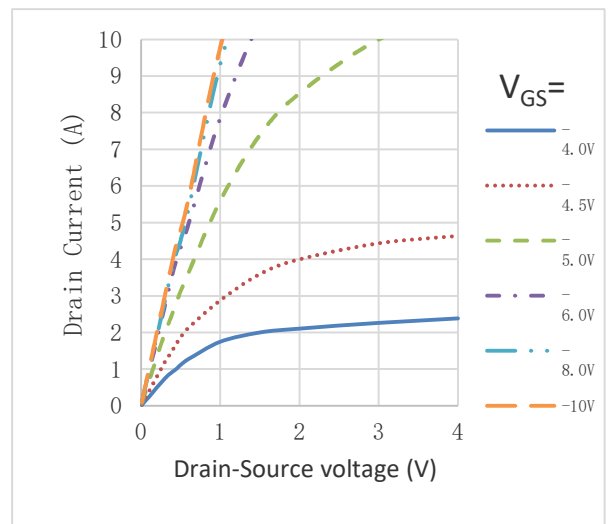


Fig.5 Threshold Voltage V.S Junction Temperature

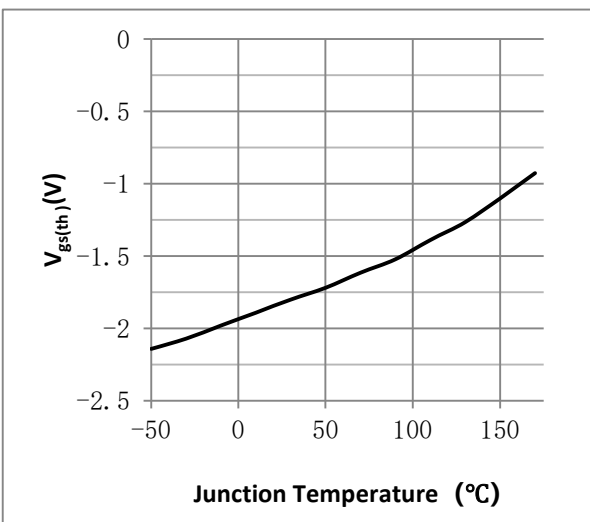


Fig.6 Resistance V.S Drain Current

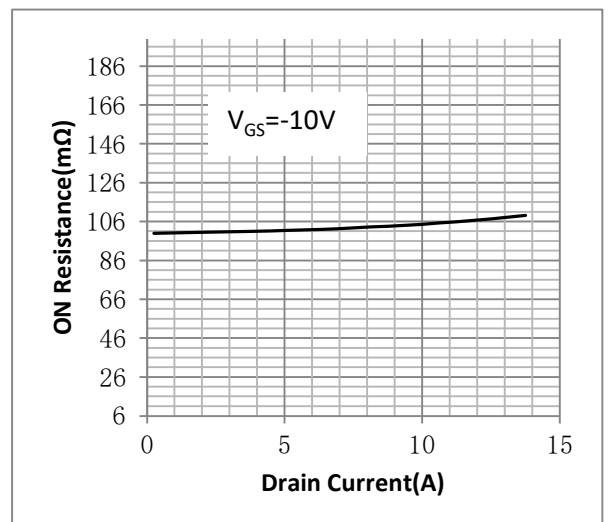


Fig.7 On-Resistance VS Gate Source Voltage

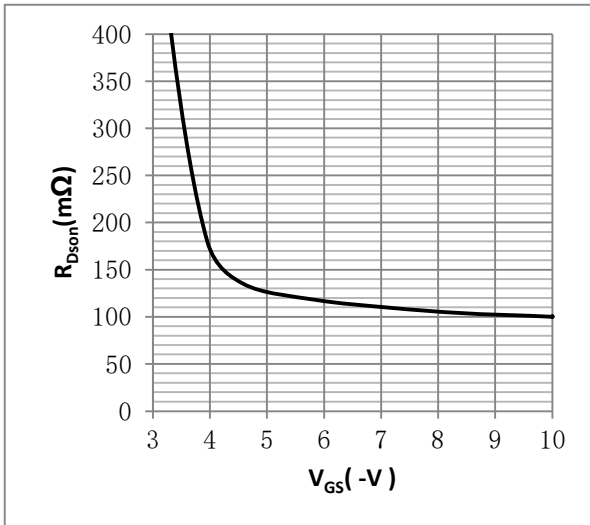


Fig.8 On-Resistance V.S Junction Temperature

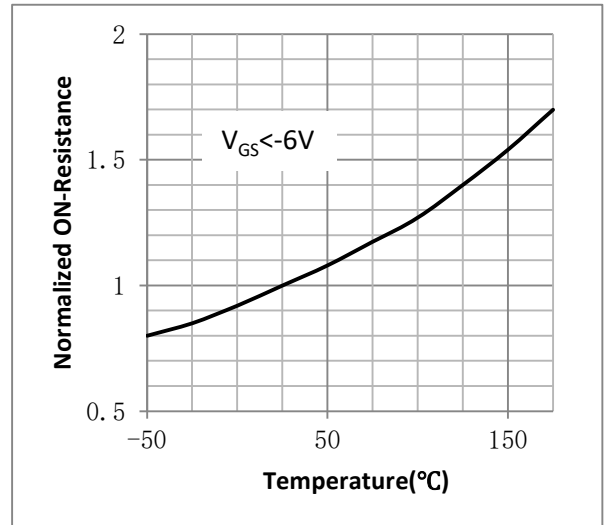


Figure 9. Diode Forward Voltage vs. Current

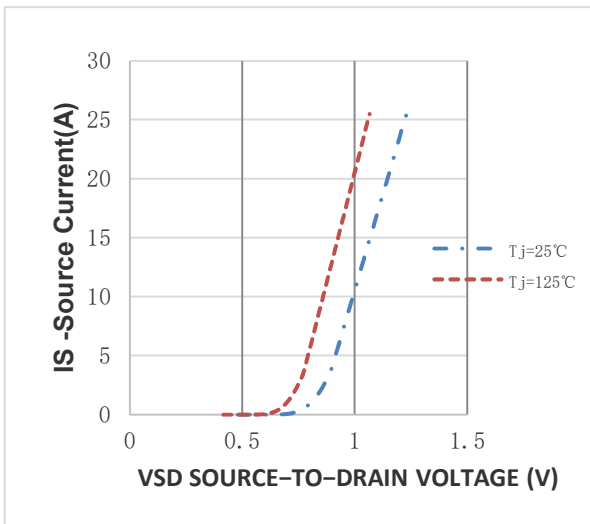


Figure 10. Transfer Characteristics

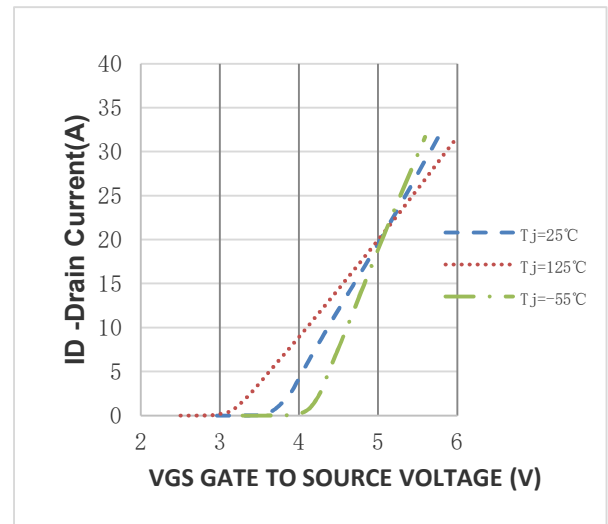


Fig.11 Safe Operating Area

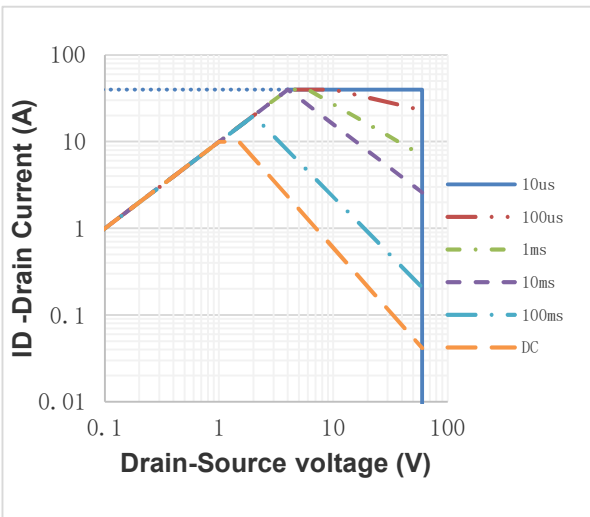
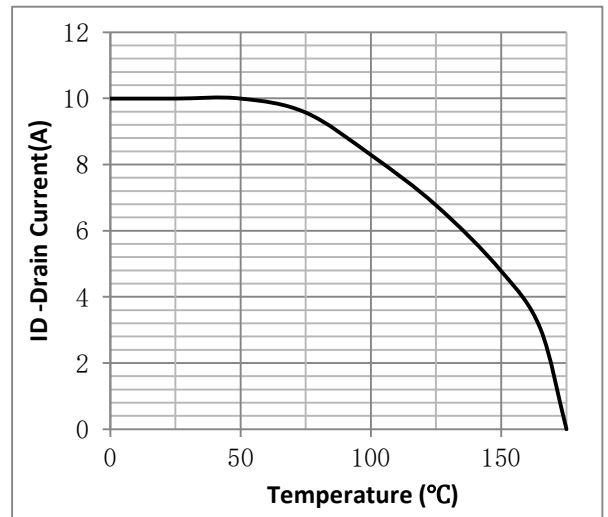
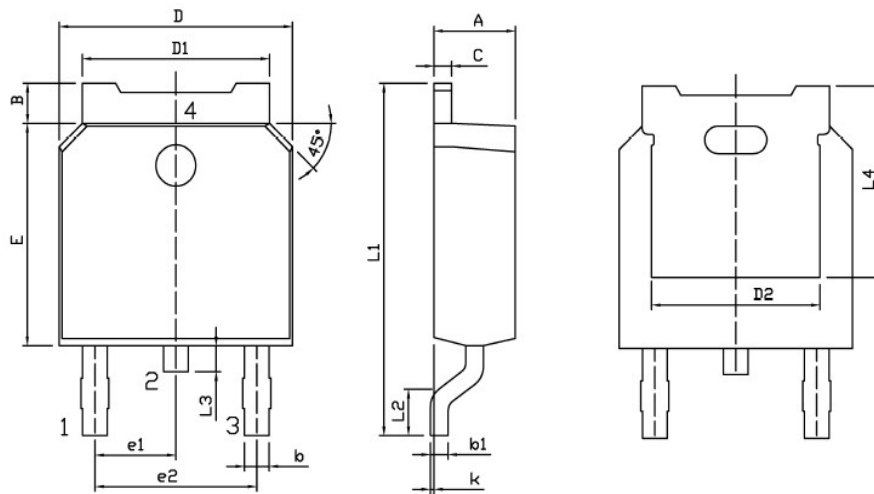


Fig.12  $I_D$  vs. Case Temperature<sup>③</sup>



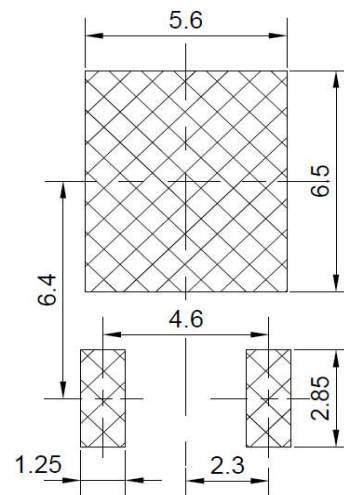
•TO-252 Package Outline

Option L:



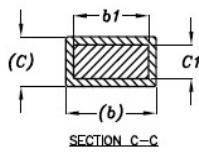
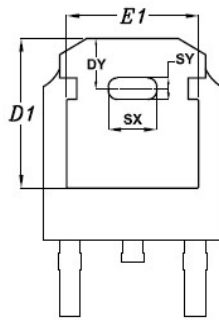
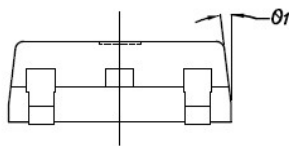
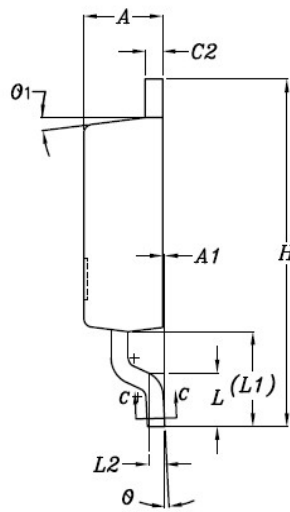
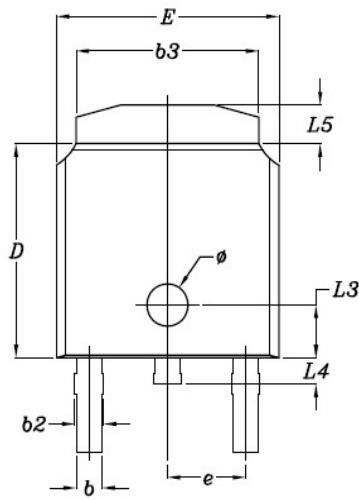
| Dimensions In Millimeters |      |      |        |      |       |
|---------------------------|------|------|--------|------|-------|
| Symbol                    | MIN  | MAX  | Symbol | MIN  | MAX   |
| A                         | 2.20 | 2.40 | E      | 5.95 | 6.25  |
| B                         | 0.95 | 1.25 | e1     | 2.24 | 2.34  |
| b                         | 0.70 | 0.90 | e2     | 4.43 | 4.73  |
| b1                        | 0.45 | 0.55 | L1     | 9.85 | 10.35 |
| C                         | 0.45 | 0.55 | L2     | 1.70 | 2.00  |
| D                         | 6.45 | 6.75 | L3     | 0.60 | 0.90  |
| D1                        | 5.10 | 5.50 | L4     | 5.05 |       |
| D2                        | 4.85 |      | k      | 0.00 | 0.10  |

Land Pattern  
(Only for Reference)



•TO-252 Package Outline

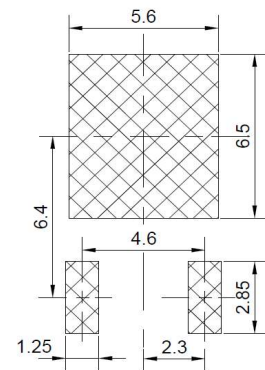
Option Q:



| I<br>T<br>E<br>M | DIMENSIONS  |       |           |       |
|------------------|-------------|-------|-----------|-------|
|                  | MILLIMETERS |       | INCHES    |       |
|                  | MIN         | MAX   | MIN       | MAX   |
| A                | 2.18        | 2.39  | 0.086     | 0.094 |
| A1               | —           | 0.13  | —         | 0.005 |
| b                | 0.70        | 0.89  | 0.028     | 0.035 |
| b1               | 0.70        | 0.86  | 0.028     | 0.034 |
| b2               | 0.76        | 1.14  | 0.030     | 0.045 |
| b3               | 4.95        | 5.46  | 0.195     | 0.215 |
| c                | 0.46        | 0.61  | 0.018     | 0.024 |
| c1               | 0.41        | 0.56  | 0.016     | 0.022 |
| c2               | 0.46        | 0.89  | 0.018     | 0.035 |
| D                | 5.97        | 6.22  | 0.235     | 0.245 |
| D1               | 5.21        | 5.54  | 0.205     | 0.218 |
| E                | 6.35        | 6.73  | 0.250     | 0.265 |
| E1               | 4.32        | 5.27  | 0.170     | 0.207 |
| e                | 2.29 BSC    |       | 0.090 BSC |       |
| H                | 9.40        | 10.41 | 0.370     | 0.410 |
| L                | 1.40        | 1.78  | 0.055     | 0.070 |
| L1               | 2.60        | 2.90  | 0.102     | 0.114 |
| L2               | 0.51 BSC    |       | 0.020 BSC |       |
| L3               | 1.65        | 1.95  | 0.065     | 0.077 |
| L4               | 0.60        | 0.90  | 0.024     | 0.035 |
| L5               | 0.89        | 1.27  | 0.035     | 0.050 |
| theta            | 1°          | 5°    | 1°        | 5°    |
| theta1           | 7° REF      |       | 7° REF    |       |
| phi              | 1.20 REF    |       | 0.047 REF |       |
| SX               | 1.52 REF    |       | 0.060 REF |       |
| SY               | 0.50 REF    |       | 0.020 REF |       |
| DY               | 1.70 REF    |       | 0.067 REF |       |



Land Pattern  
(Only for Reference)



**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       | 2021.11.12 | NEW                                                  |
| B       | 2021.12.7  | Add ESD LEVEL                                        |
| C       | 2022.9.8   | 1.Add Reach, HF figure 2.ID Modify<br>3.Rth modified |
| D       | 2025.11.14 | Update POD                                           |
|         |            |                                                      |
|         |            |                                                      |
|         |            |                                                      |
|         |            |                                                      |