

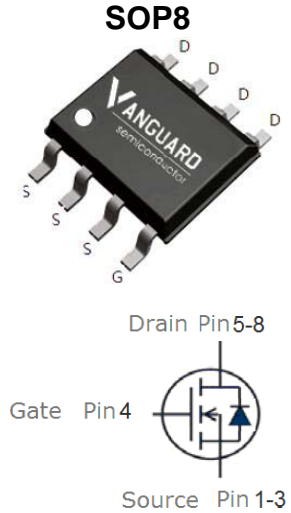
## Features

- N-Channel, 5V Logic Level Control
- Enhancement mode
- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5\text{ V}$
- 100% Avalanche test
- Pb-free lead plating; RoHS compliant



| Part ID     | Package Type | Marking | Tape and reel information |
|-------------|--------------|---------|---------------------------|
| VSO013N04MS | SOP8         | 013N04M | 3000PCS/Reel              |

|  |    |            |
|--|----|------------|
| $V_{DS}$                               | 40 | V          |
| $R_{DS(on),TYP} @ V_{GS}=10\text{ V}$  | 11 | m $\Omega$ |
| $R_{DS(on),TYP} @ V_{GS}=4.5\text{ V}$ | 13 | m $\Omega$ |
| $I_D$                                  | 13 | A          |



## Maximum ratings, at $T_C = 25^\circ\text{C}$ , unless otherwise specified

| Symbol        | Parameter                                      | Rating                           | Unit             |
|---------------|--|----------------------------------|------------------|
| $V_{(BR)DSS}$ | Drain-Source breakdown voltage                 | 40                               | V                |
| $I_S$         | Diode continuous forward current               | $T_A = 25^\circ\text{C}$<br>3.8  | A                |
| $I_D$         | Continuous drain current @ $V_{GS}=10\text{V}$ | $T_A = 25^\circ\text{C}$<br>13   | A                |
|               |  | $T_A = 100^\circ\text{C}$<br>8.4 | A                |
| $I_{DM}$      | Pulse drain current tested ①                   | $T_A = 25^\circ\text{C}$<br>52   | A                |
| EAS           | Avalanche energy, single pulsed ②              | TBD                              | mJ               |
| $P_D$         | Maximum power dissipation                      | $T_A = 25^\circ\text{C}$<br>3.1  | W                |
| $V_{GS}$      | Gate-Source voltage                            | $\pm 20$                         | V                |
| MSL           |  | Level 3                          |                  |
| $T_{STG} T_J$ | Storage and operating temperature range        | -55 to 150                       | $^\circ\text{C}$ |

## Thermal Characteristics

| Symbol          | Parameter                           | Typical | Unit               |
|-----------------|-------------------------------------|---------|--------------------|
| $R_{\theta JL}$ | Thermal Resistance-Junction to Lead | 24      | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient | 40      | $^\circ\text{C/W}$ |

| Symbol  | Parameter  | Condition   | Min. | Typ. | Max. | Unit |
|---|--|---|------|------|------|------|
| <b>Static Electrical Characteristics @ T<sub>j</sub>=25°C (unless otherwise stated)</b>     |  |   |      |      |      |      |
| V <sub>(BR)DSS</sub>  | Drain-Source Breakdown Voltage                         | V <sub>GS</sub> =0V I <sub>D</sub> =250μA   | 40   | --   | --   | V    |
| I <sub>DSS</sub>  | Zero Gate Voltage Drain Current                        | V <sub>DS</sub> =40V, V <sub>GS</sub> =0V   | --   | --   | 0.1  | μA   |
|   | Zero Gate Voltage Drain Current(T <sub>j</sub> =125°C) | V <sub>DS</sub> =40V, V <sub>GS</sub> =0V   | --   | --   | 100  | μA   |
| I <sub>GSS</sub>  | Gate-Body Leakage Current                              | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V  | --   | --   | ±100 | nA   |
| V <sub>GS(TH)</sub>   | Gate Threshold Voltage                                 | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                      | 1.0  | 1.6  | 2.5  | V    |
| R <sub>DS(ON)</sub>   | Drain-Source On-State Resistance <sup>③</sup>          | V <sub>GS</sub> =10V, I <sub>D</sub> =8A  | --   | 11   | 13   | mΩ   |
| R <sub>DS(ON)</sub>   | Drain-Source On-State Resistance <sup>③</sup>          | V <sub>GS</sub> =4.5V, I <sub>D</sub> =5A   | --   | 13   | 15   | mΩ   |
| <b>Dynamic Electrical Characteristics @ T<sub>j</sub> = 25°C (unless otherwise stated)</b>  |  |   |      |      |      |      |
| C <sub>iss</sub>  | Input Capacitance                                      | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V,<br>f=1MHz  | --   | 1180 | --   | pF   |
| C <sub>oss</sub>  | Output Capacitance                                     |   | --   | 160  | --   | pF   |
| C <sub>rss</sub>  | Reverse Transfer Capacitance                           |   | --   | 120  | --   | pF   |
| R <sub>g</sub>  | Gate Resistance  | f=1MHz  | --   | 3.7  | --   | Ω    |
| Q <sub>g</sub>  | Total Gate Charge                                      | V <sub>DS</sub> =20V, I <sub>D</sub> =8A,<br>V <sub>GS</sub> =10V                             | --   | 29   | --   | nC   |
| Q <sub>gs</sub>   | Gate-Source Charge                                     |   | --   | 5    | --   | nC   |
| Q <sub>gd</sub>   | Gate-Drain Charge                                      |   | --   | 7    | --   | nC   |
| <b>Switching Characteristics</b>  |  |   |      |      |      |      |
| t <sub>d(on)</sub>  | Turn-on Delay Time                                     | V <sub>DD</sub> =20V,<br>I <sub>D</sub> =8A,<br>R <sub>G</sub> =6.8Ω,<br>V <sub>GS</sub> =10V | --   | 8    | --   | nS   |
| t <sub>r</sub>  | Turn-on Rise Time                                      |   | --   | 19   | --   | nS   |
| t <sub>d(off)</sub>   | Turn-Off Delay Time                                    |   | --   | 31   | --   | nS   |
| t <sub>f</sub>  | Turn-Off Fall Time                                     |   | --   | 17   | --   | nS   |
| <b>Source- Drain Diode Characteristics @ T<sub>j</sub> = 25°C (unless otherwise stated)</b> |  |   |      |      |      |      |
| V <sub>SD</sub>   | Forward on voltage                                     | I <sub>SD</sub> =8A, V <sub>GS</sub> =0V  | --   | 0.79 | 1.20 | V    |
| t <sub>rr</sub>   | Reverse Recovery Time                                  | T <sub>j</sub> =25°C, I <sub>sd</sub> =8A,<br>V <sub>GS</sub> =0V<br>di/dt=500A/μs            | --   | 33   | --   | nS   |
| Q <sub>rr</sub>   | Reverse Recovery Charge                                |   | 21   | --   | --   | nC   |

**NOTE:**

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by T<sub>jmax</sub>, starting T<sub>j</sub> = 25°C, L = 0.5mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = TBD, V<sub>GS</sub> = 10V. Part not recommended for use above this value
- ③ Pulse width ≤ 300μs; duty cycle ≤ 2%.

### Typical Characteristics

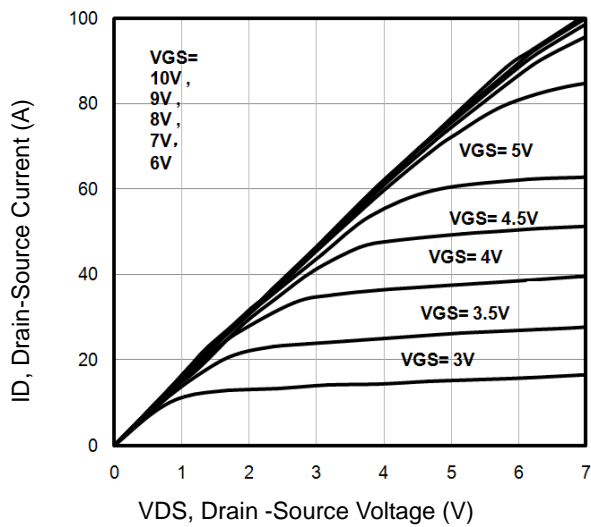


Fig1. Typical Output Characteristics

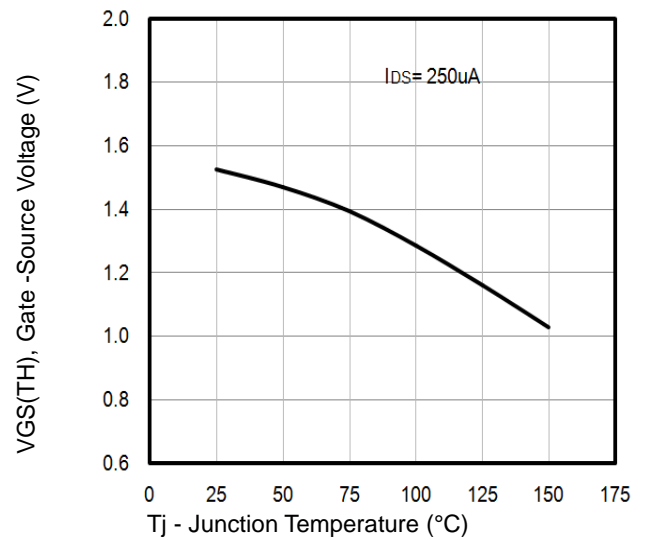


Fig2.  $V_{GS(TH)}$  Gate -Source Voltage Vs.  $T_j$

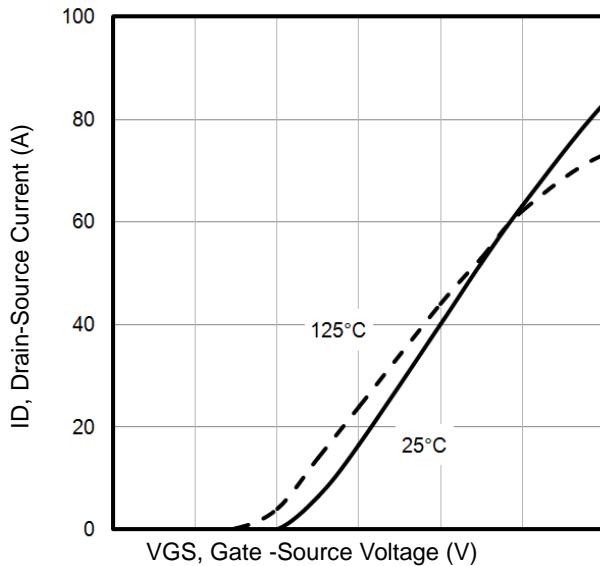


Fig3. Typical Transfer Characteristics

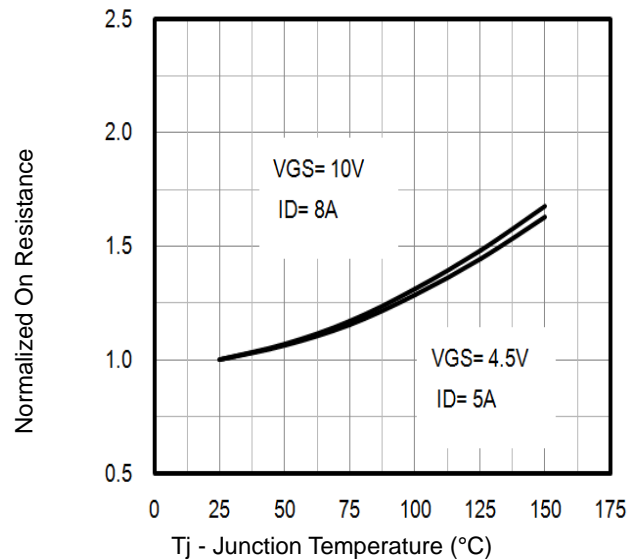


Fig4. Normalized On-Resistance Vs.  $T_j$

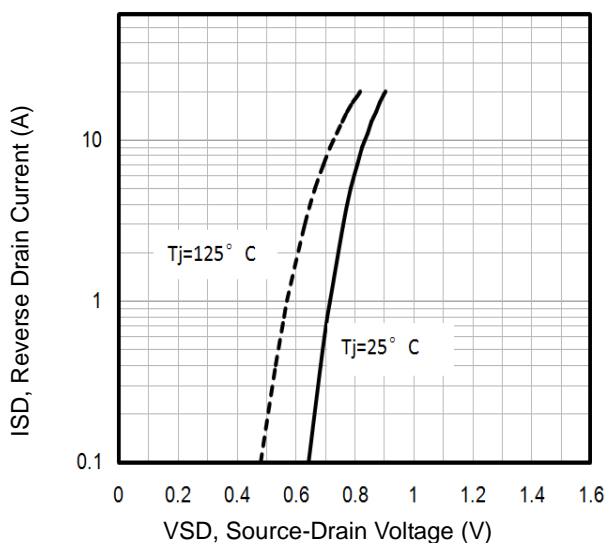


Fig5. Typical Source-Drain Diode Forward Voltage

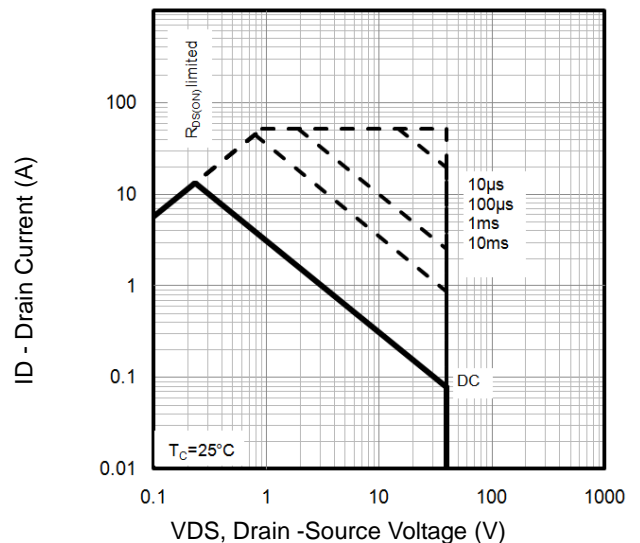


Fig6. Maximum Safe Operating Area

Typical Characteristics

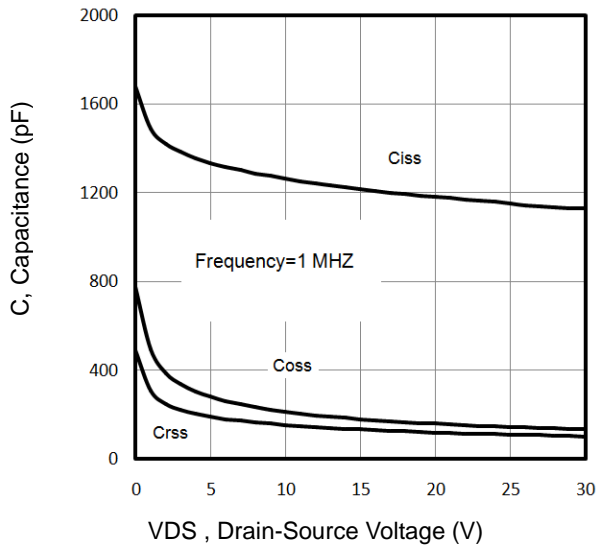


Fig7. Typical Capacitance Vs.Drain-Source Voltage

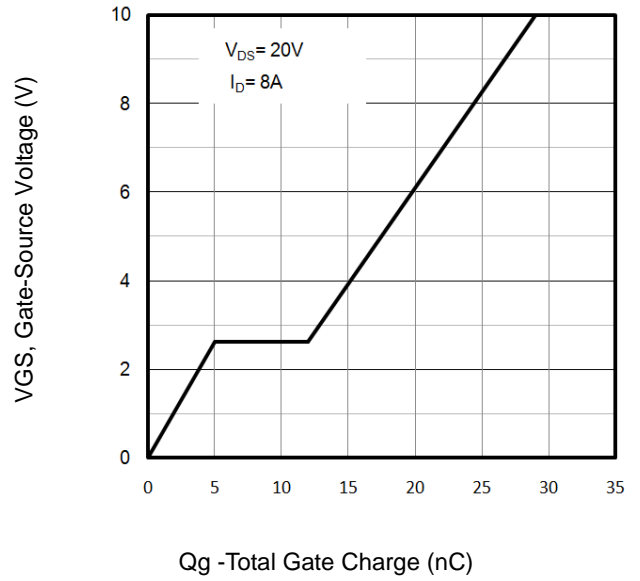


Fig8. Typical Gate Charge Vs.Gate-Source Voltage

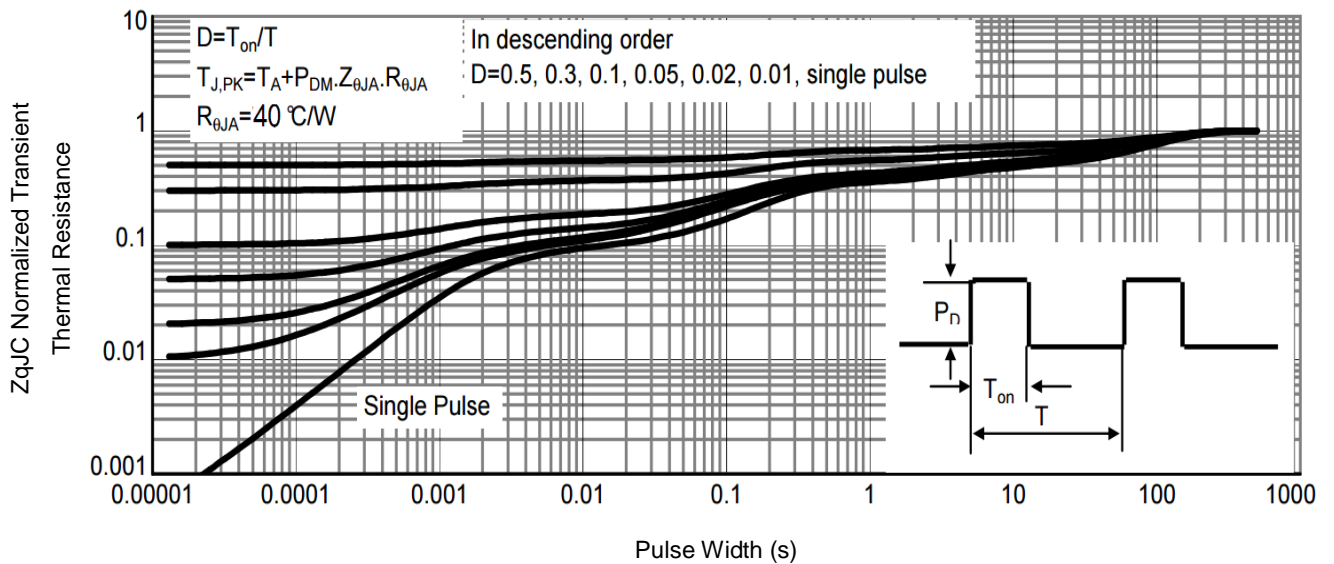


Fig9. Normalized Maximum Transient Thermal Impedance

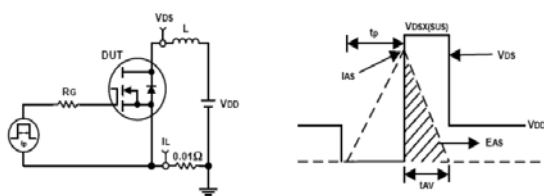


Fig10. Unclamped Inductive Test Circuit and waveforms

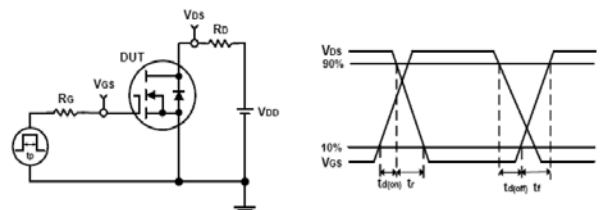
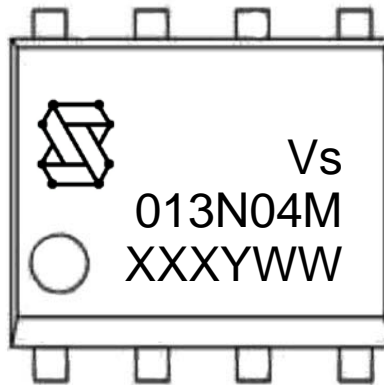


Fig11. Switching Time Test Circuit and waveforms

## Marking Information



1<sup>st</sup> line: Company Code (Vs), Company Logo

2<sup>nd</sup> line: Part Number (013N04M)

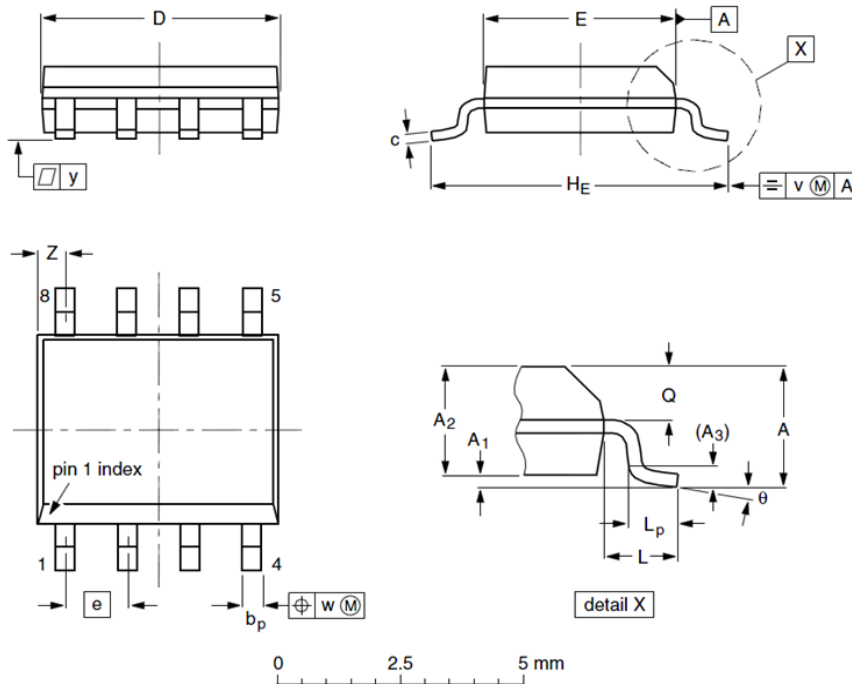
3<sup>rd</sup> line: Date code (XXXYWW)

XXX: Wafer Lot Number

Y: Year Code, e.g. E means 2017

WW: Week Code

### SOP8 Package Outline Data



| Label          | Dimensions (unit: mm) |      |       |
|----------------|-----------------------|------|-------|
|                | Min                   | Typ  | Max   |
| A              | --                    | --   | 1.75  |
| A <sub>1</sub> | 0.10                  | 0.18 | 0.25  |
| A <sub>2</sub> | 1.25                  | 1.35 | 1.50  |
| A <sub>3</sub> | --                    | 0.25 | --    |
| b <sub>p</sub> | 0.36                  | 0.42 | 0.51  |
| c              | 0.19                  | 0.22 | 0.25  |
| D              | 4.80                  | 4.92 | 5.00  |
| E              | 3.80                  | 3.90 | 4.00  |
| e              | --                    | 1.27 | --    |
| H <sub>E</sub> | 5.80                  | 6.00 | 6.20  |
| L              | --                    | 1.05 | --    |
| L <sub>p</sub> | 0.40                  | 0.68 | 1.00  |
| Q              | 0.60                  | 0.65 | 0.725 |
| v              | --                    | 0.25 | --    |
| w              | --                    | 0.25 | --    |
| y              | --                    | 0.10 | --    |
| Z              | 0.30                  | 0.50 | 0.70  |
| θ              | 0°                    |      | 8°    |

#### Notes:

1. Follow JEDEC MS-012.
2. Dimension "D" does NOT include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15mm per side.
3. Dimension "E" does NOT include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25mm per side.
4. Dimension "bp" does NOT include dambar protrusion. Allowable dambar protrusion shall be 0.1mm total in excess of "bp" dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot.

## Customer Service

#### Sales and Service:

[sales@vgsemi.com](mailto:sales@vgsemi.com)

Vanguard Semiconductor CO., LTD

TEL: (86-755) -26902410

FAX: (86-755) -26907027

WEB: [www.vgsemi.com](http://www.vgsemi.com)