



## General Description

FSMOS<sup>®</sup> MOSFET is based on Oriental Semiconductor's unique device design to achieve low  $R_{DS(ON)}$ , low gate charge, fast switching and excellent avalanche characteristics. The low  $V_{th}$  series is specially optimized for synchronous rectification systems with low driving voltage.

## Features

- Low  $R_{DS(ON)}$  & FOM
- Extremely low switching loss
- Excellent reliability and uniformity
- Fast switching and soft recovery



## Applications

- PD charger
- Motor driver
- Switching voltage regulator
- DC-DC convertor
- Switching mode power supply

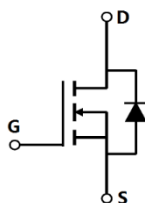
## Key Performance Parameters

| Parameter                         | Value | Unit       |
|-----------------------------------|-------|------------|
| $V_{DS}$                          | 45    | V          |
| $I_D$ , pulse                     | 840   | A          |
| $R_{DS(ON)}$ , max @ $V_{GS}=10V$ | 1.1   | m $\Omega$ |
| $Q_g$                             | 105   | nC         |
| PD                                | 170   | W          |

## Marking Information

| Product Name | Package | Marking     |
|--------------|---------|-------------|
| SFS04R011UGF | PDFN5×6 | SFS04R011UG |

## Package & Pin information



**Absolute Maximum Ratings** at  $T_j=25^{\circ}\text{C}$  unless otherwise noted

| Parameter                                                                 | Symbol                | Value      | Unit               |
|---------------------------------------------------------------------------|-----------------------|------------|--------------------|
| Drain-source voltage                                                      | $V_{DS}$              | 45         | V                  |
| Gate-source voltage                                                       | $V_{GS}$              | $\pm 20$   | V                  |
| Continuous drain current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$         | $I_D$                 | 210        | A                  |
| Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{D, \text{pulse}}$ | 840        | A                  |
| Continuous diode forward current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$ | $I_S$                 | 210        | A                  |
| Diode pulsed current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{S, \text{pulse}}$ | 840        | A                  |
| Power dissipation <sup>3)</sup> , $T_C=25^{\circ}\text{C}$                | $P_D$                 | 170        | W                  |
| Single pulsed avalanche energy <sup>5)</sup>                              | $E_{AS}$              | 240        | mJ                 |
| Operation and storage temperature                                         | $T_{stg}, T_j$        | -55 to 150 | $^{\circ}\text{C}$ |

**Thermal Characteristics**

| Parameter                                          | Symbol          | Value | Unit                 |
|----------------------------------------------------|-----------------|-------|----------------------|
| Thermal resistance, junction-case                  | $R_{\theta JC}$ | 0.73  | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction-ambient <sup>4)</sup> | $R_{\theta JA}$ | 62    | $^{\circ}\text{C/W}$ |

**Electrical Characteristics** at  $T_j=25^{\circ}\text{C}$  unless otherwise specified

| Parameter                        | Symbol       | Min. | Typ. | Max. | Unit             | Test condition                                  |
|----------------------------------|--------------|------|------|------|------------------|-------------------------------------------------|
| Drain-source breakdown voltage   | $BV_{DSS}$   | 45   |      |      | V                | $V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$ |
| Gate threshold voltage           | $V_{GS(th)}$ | 1.5  |      | 2.5  | V                | $V_{DS}=V_{GS}, I_D=250\text{ }\mu\text{A}$     |
| Drain-source on-state resistance | $R_{DS(ON)}$ |      | 0.9  | 1.1  | $\text{m}\Omega$ | $V_{GS}=10\text{ V}, I_D=20\text{ A}$           |
| Drain-source on-state resistance | $R_{DS(ON)}$ |      | 1.5  | 2.2  | $\text{m}\Omega$ | $V_{GS}=4.5\text{ V}, I_D=20\text{ A}$          |
| Gate-source leakage current      | $I_{GSS}$    |      |      | 100  | nA               | $V_{GS}=20\text{ V}$                            |
|                                  |              |      |      | -100 |                  | $V_{GS}=-20\text{ V}$                           |
| Drain-source leakage current     | $I_{DSS}$    |      |      | 1    | $\mu\text{A}$    | $V_{DS}=45\text{ V}, V_{GS}=0\text{ V}$         |
| Gate resistance                  | $R_G$        |      | 2.7  |      | $\Omega$         | $f=1\text{ MHz}$ , Open drain                   |

### Dynamic Characteristics

| Parameter                    | Symbol       | Min. | Typ. | Max. | Unit | Test condition                                                                             |
|------------------------------|--------------|------|------|------|------|--------------------------------------------------------------------------------------------|
| Input capacitance            | $C_{iss}$    |      | 7490 |      | pF   | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=25\text{ V}$ ,<br>$f=100\text{ kHz}$                      |
| Output capacitance           | $C_{oss}$    |      | 1400 |      | pF   |                                                                                            |
| Reverse transfer capacitance | $C_{rss}$    |      | 95   |      | pF   |                                                                                            |
| Turn-on delay time           | $t_{d(on)}$  |      | 16.4 |      | ns   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=20\text{ V}$ ,<br>$R_G=2\ \Omega$ ,<br>$I_D=20\text{ A}$ |
| Rise time                    | $t_r$        |      | 9.4  |      | ns   |                                                                                            |
| Turn-off delay time          | $t_{d(off)}$ |      | 77.6 |      | ns   |                                                                                            |
| Fall time                    | $t_f$        |      | 23.2 |      | ns   |                                                                                            |

### Gate Charge Characteristics

| Parameter            | Symbol        | Min. | Typ. | Max. | Unit | Test condition                                                        |
|----------------------|---------------|------|------|------|------|-----------------------------------------------------------------------|
| Total gate charge    | $Q_g$         |      | 105  |      | nC   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=20\text{ V}$ ,<br>$I_D=20\text{ A}$ |
| Gate-source charge   | $Q_{gs}$      |      | 19.4 |      | nC   |                                                                       |
| Gate-drain charge    | $Q_{gd}$      |      | 13.1 |      | nC   |                                                                       |
| Gate plateau voltage | $V_{plateau}$ |      | 2.9  |      | V    |                                                                       |

### Body Diode Characteristics

| Parameter                     | Symbol    | Min. | Typ. | Max. | Unit | Test condition                                                                 |
|-------------------------------|-----------|------|------|------|------|--------------------------------------------------------------------------------|
| Diode forward voltage         | $V_{SD}$  |      |      | 1.1  | V    | $I_S=20\text{ A}$ ,<br>$V_{GS}=0\text{ V}$                                     |
| Reverse recovery time         | $t_{rr}$  |      | 66.4 |      | ns   | $V_R=32\text{ V}$ ,<br>$I_S=20\text{ A}$ ,<br>$di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge       | $Q_{rr}$  |      | 81   |      | nC   |                                                                                |
| Peak reverse recovery current | $I_{rrm}$ |      | 2.2  |      | A    |                                                                                |

### Note

- 1) Calculated continuous current based on maximum allowable junction temperature.
- 2) Repetitive rating; pulse width limited by max. junction temperature.
- 3)  $P_d$  is based on max. junction temperature, using junction-case thermal resistance.
- 4) The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in square FR-4 board with 2oz. Copper, in a still air environment with  $T_a=25\text{ }^{\circ}\text{C}$ .
- 5)  $V_{DD}=32\text{ V}$ ,  $V_{GS}=10\text{ V}$ ,  $L=0.3\text{ mH}$ , starting  $T_j=25\text{ }^{\circ}\text{C}$ .

## Electrical Characteristics Diagrams

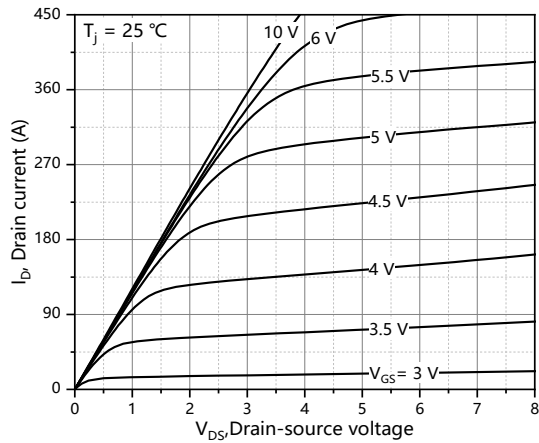


Figure 1. Typ. output characteristics

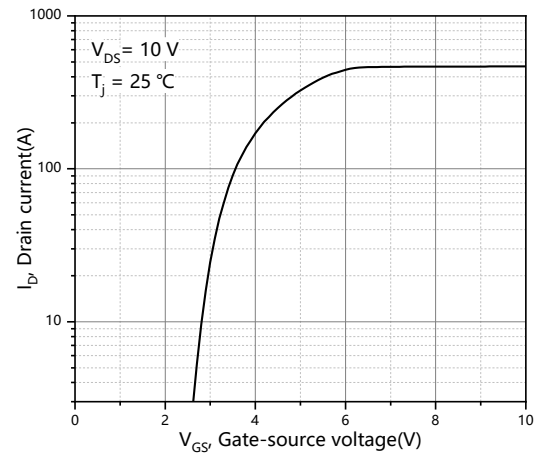


Figure 2. Typ. transfer characteristics

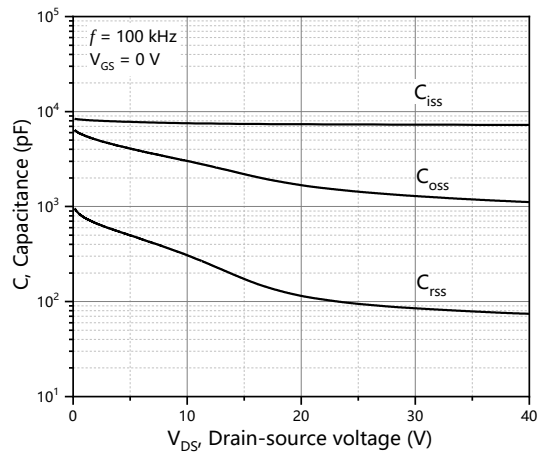


Figure 3. Typ. capacitances

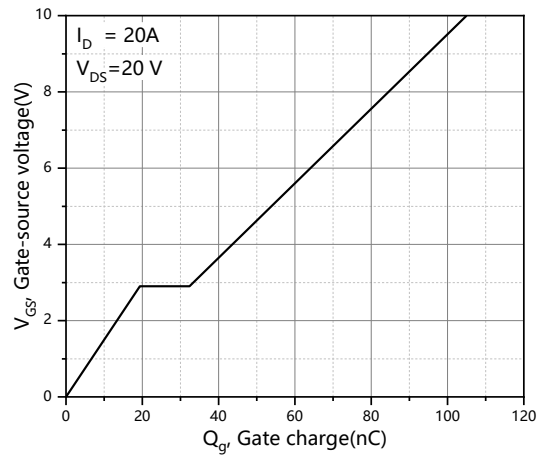


Figure 4. Typ. gate charge

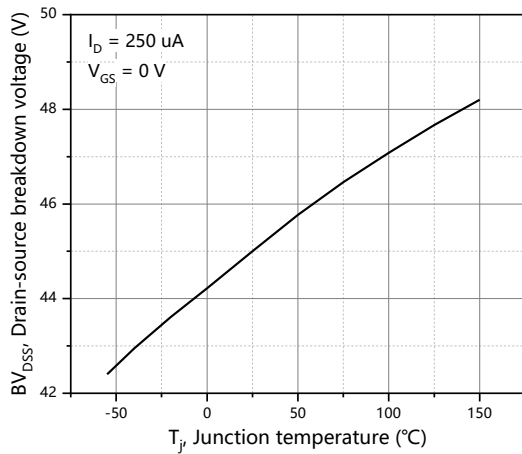


Figure 5. Drain-source breakdown voltage

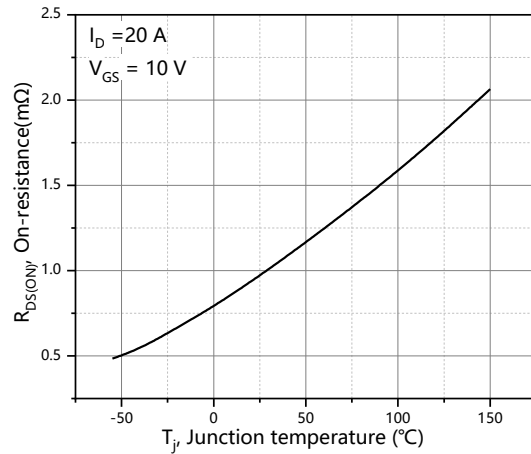
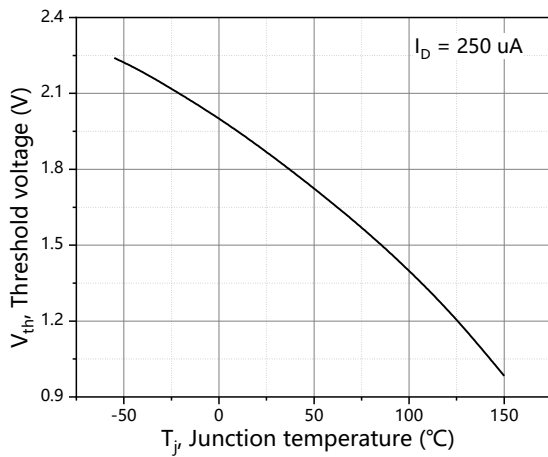
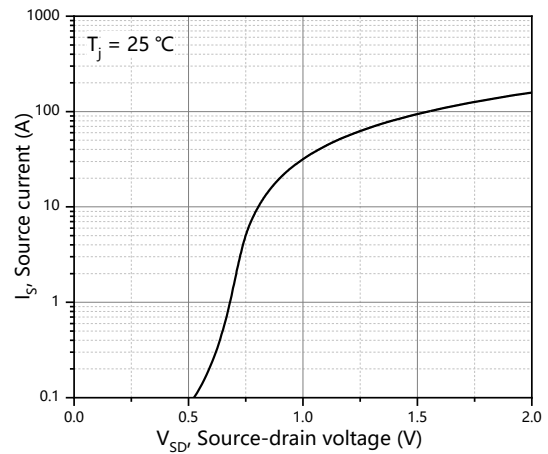


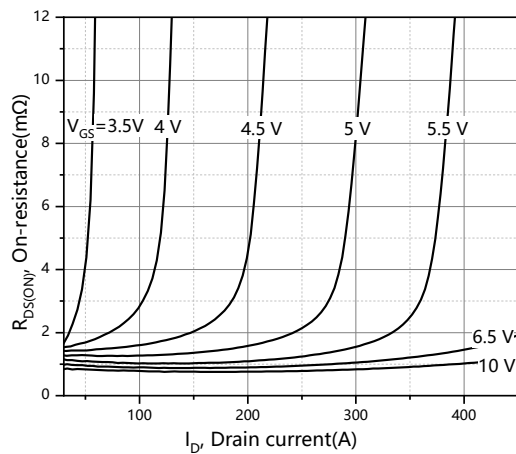
Figure 6. Drain-source on-state resistance



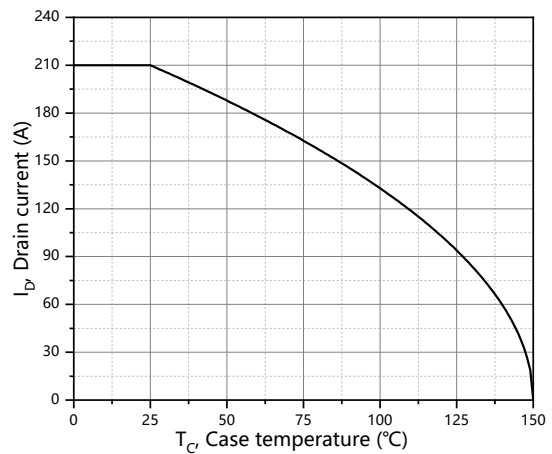
**Figure 7. Threshold voltage**



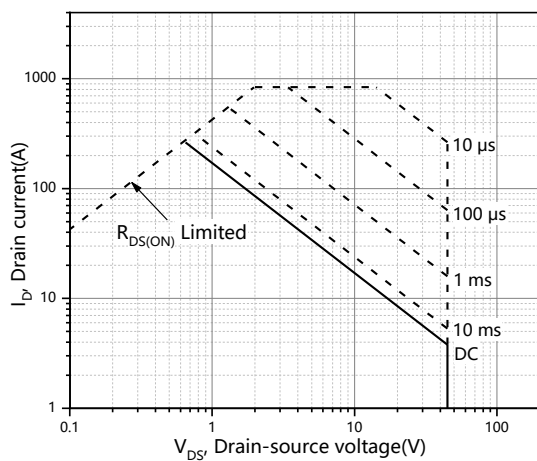
**Figure 8. Forward characteristic of body diode**



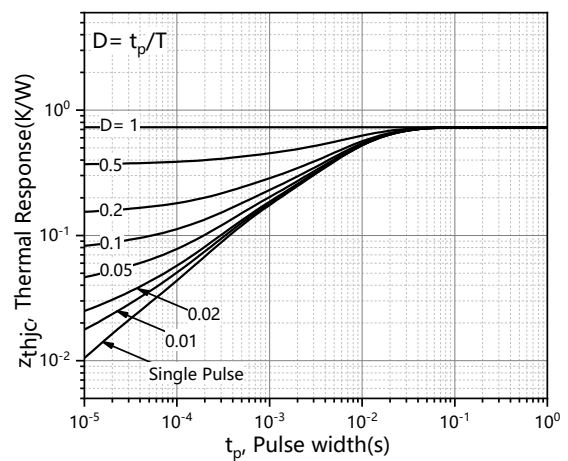
**Figure 9. Drain-source on-state resistance**



**Figure 10. Drain current**



**Figure 11. Safe operation area  $T_C=25^{\circ}\text{C}$**



**Figure 12. Max. transient thermal impedance**

## Test circuits and waveforms



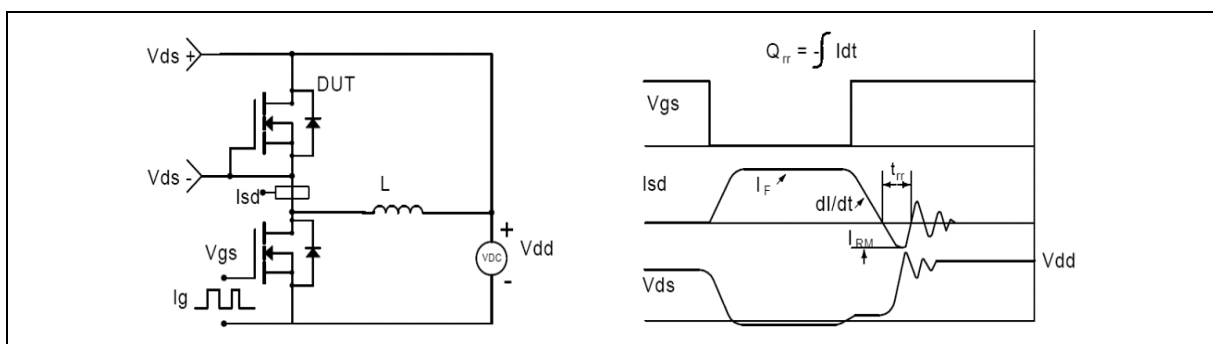
**Figure 1. Gate charge test circuit & waveform**



**Figure 2. Switching time test circuit & waveforms**

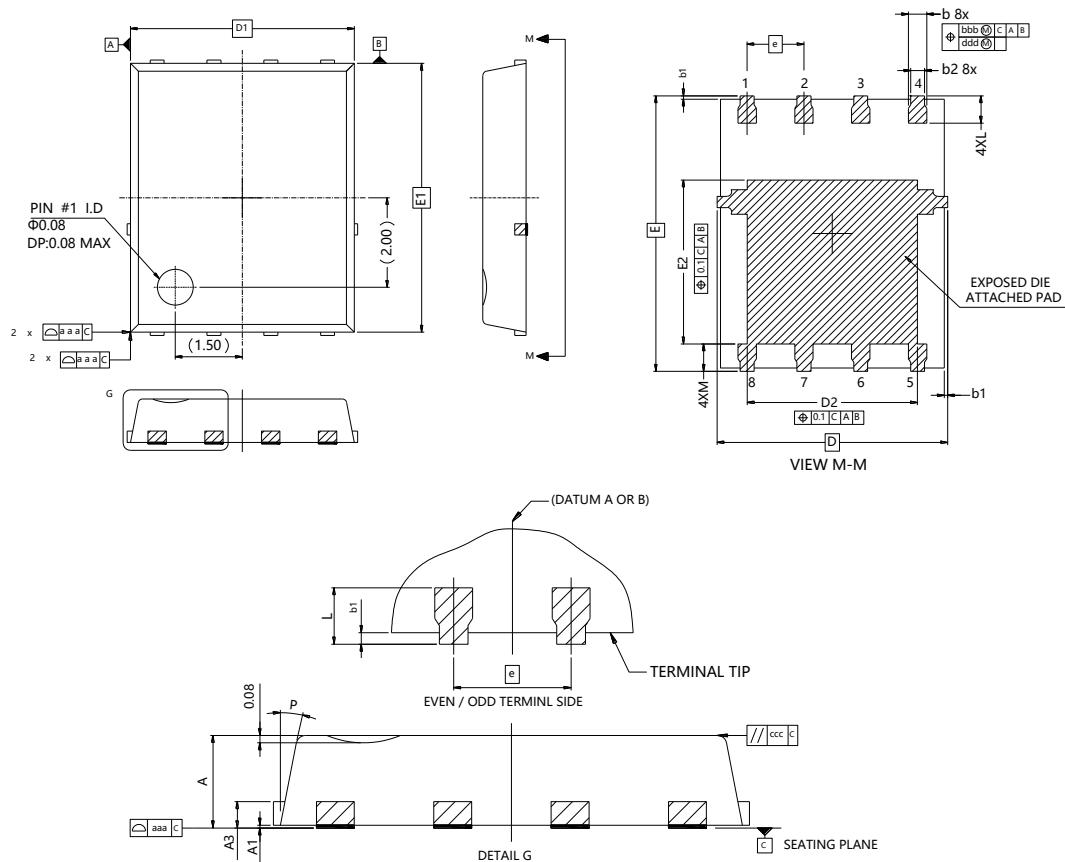


**Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms**



**Figure 4. Diode reverse recovery test circuit & waveforms**

## Package Information



| Symbol | mm       |      |
|--------|----------|------|
|        | Min      | Max  |
| A      | 0.95     | 1.05 |
| A1     | 0.00     | 0.05 |
| A3     | 0.25 REF |      |
| b      | 0.31     | 0.51 |
| b1     | 0.03     | 0.13 |
| b2     | 0.21     | 0.41 |
| D      | 5.15 BSC |      |
| D1     | 5.00 BSC |      |
| D2     | 3.70     | 3.90 |
| E      | 6.15 BSC |      |
| E1     | 6.00 BSC |      |
| E2     | 3.56     | 3.76 |
| e      | 1.27 BSC |      |
| L      | 0.51     | 0.71 |
| M      | 0.51     | 0.71 |
| P      | 10°      | 12°  |

Version 1: PDFN5×6-S package outline dimension

**Ordering Information**

| Package Type | Units/ Reel | Reels/ Inner Box | Units/ Inner Box | Inner Boxes/ Carton Box | Units/ Carton Box |
|--------------|-------------|------------------|------------------|-------------------------|-------------------|
| PDFN5×6-S    | 5000        | 1                | 5000             | 10                      | 50000             |

**Product Information**

| Product      | Package | Pb Free | RoHS | Halogen Free |
|--------------|---------|---------|------|--------------|
| SFS04R011UGF | PDFN5×6 | yes     | yes  | yes          |

**Legal Disclaimer**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Oriental Semiconductor hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

For further information on technology, delivery terms and conditions and prices, please contact the Oriental Semiconductor sales representatives ([www.orientalsemi.com](http://www.orientalsemi.com)).

© Oriental Semiconductor Co.,Ltd. All Rights Reserved 