# 20V N-Channel Enhancement-Mode MOSFET

**RDS(ON), Vgs@1.8V, Ids@2.0A = 75mΩ**

**RDS(ON), Vgs@2.5V, Ids@3.5A = 38mΩ**

**RDS(ON), Vgs@4.0V, Ids@4.5A = 30mΩ**

**RDS(ON), Vgs@4.5V, Ids@4.5A = 28mΩ**

**RDS(ON), Vgs@10V, Ids@5.0A = 25mΩ**

## Features

Ø Advanced trench process technology

Ø High Density Cell Design For Ultra Low On-Resistance

Ø High Power and Current handing capability

Ø Ideal for Li ion battery pack applications



TSSOP-08    SOT-23-6    Internal Schematic Diagram

Top View

N-Channel MOSFET

## Maximum Ratings and Thermal Characteristics ($T_A$ = 25oC unless otherwise noted)

| Parameter | | Symbol | Limit | Umit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 20 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 12 | |
| Continuous Drain Current[1] | | $I_D$ | 6 | A |
| Pulsed Drain Current[2] | | $I_{DM}$ | 20 | |
| Maximum Power Dissipation | TA = 25℃ | $P_D$ | 2 | W |
| | TA = 75℃ | | 1.28 | |
| Operating Junction and Storage Temperature Range | | $T_{j1}$　$T_{stg}$ | -55 to 150 | ℃ |
| Junction-to-Ambient Thermal Resistance (PCB mounted)[3] | | $R_{OUA}$ | 62.5 | ℃/W |

Note:　1. Fused current that based on wire numbers and diameter

2. Repetitive Rating: Pulse width limited by the maximum junction temperature

3. 1-in$^2$　2oz Cu PCB board

# ELECTRICAL CHARACTERISTICS

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS} = 0V, I_D = 250uA$ | 20 | | | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS} = 1.8V, I_D = 2.0A$ | | 53.0 | 75.0 | |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS} = 2.5V, I_D = 3.5A$ | | 30.0 | 38.0 | |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS} = 4.0V, I_D = 4.5A$ | | 23.0 | 30.0 | $m\Omega$ |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS} = 4.5V, I_D = 4.5A$ | | 22.0 | 28.0 | |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS} = 10V, I_D = 5.0A$ | | 20.0 | 25.0 | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{GS} = VGS, I_D = 250uA$ | 0.6 | 0.75 | 1 | V |
| Zero Gate Voltage drain Current | $I_{DSS}$ | $V_{GS} = 20V, V_{GS} = 0V$ | | | 1 | uA |
| Gate Body Leakage | $I_{GSS}$ | $V_{GS} = \pm12V, V_{DS} = 0V$ | | | $\pm100$ | nA |
| **Dynamic[3]** | | | | | | |
| Total Gate Charge | $Q_G$ | $V_{DS} = 10V, I_D = 6A$ $V_{GS} = 4.5V$ | | 6.24 | 8.11 | nC |
| Gate-Source Charge | $Q_{GS}$ | | | 1.64 | 2.13 | |
| Gate-Drain Charge | $Q_{GB}$ | | | 1.34 | 1.74 | |
| Tum-On Delay Time | $T_{d(on)}$ | $V_{DD} = 10V, I_D = 6A$ $I_D = 1A, V_{GS} = 4.5V$ | | 10.4 | 20.8 | ns |
| Tum-On Rise Time | $T_r$ | | | 4.4 | 8.8 | |
| Tum-Off Delay Time | $T_{d(off)}$ | | | 27.36 | 54.72 | |
| Tum-Off Fall Time | $T_f$ | | | 4.16 | 8.32 | |
| Input Capacitance | $C_{iss}$ | $V_{DS} = 8V, V_{GS} = 0V$ $f = 1.0MHz$ | | 522.3 | | pF |
| Output Capacitance | $C_{oss}$ | | | 98.48 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 74.69 | | |
| **Source-Drain Diode** | | | | | | |
| Max.Diode Forward Current | $I_s$ | | | | 1.7 | A |
| Diode Forward Voltage | $V_{SD}$ | $I_S = 1.7A, V_{GS} = 0V$ | | 0.74 | | V |

Note: Pulse test: pulse width <= 300us, duty cycle<= 2%

3. Guaranteed by design; not subject to production testing

**Switching Test Circuit**

**Switching Waveforms**
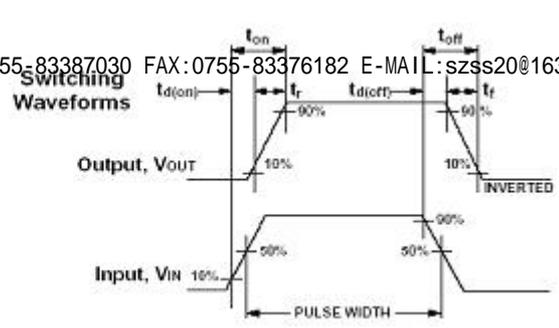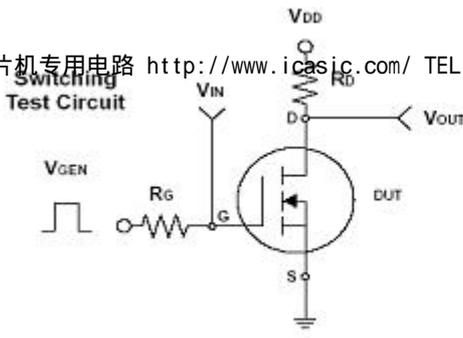
## Typical Characteristics Curves ( Ta=25°C, unless otherwise note )

**Fig.1 Output Characteristic**

**Fig.2 Transfer Characteristics**

**Fig.3 On-Resistance Variation with Temperature**

**Fig.4 Body Diode Forward Voltage Variation with Source Current**

### Fig.5 Gate Threshold Variation with Temperature



### Fig.6 Capacitance



### Fig. 7 Gate Charge Waveform



### Fig. 8 Gate Charge
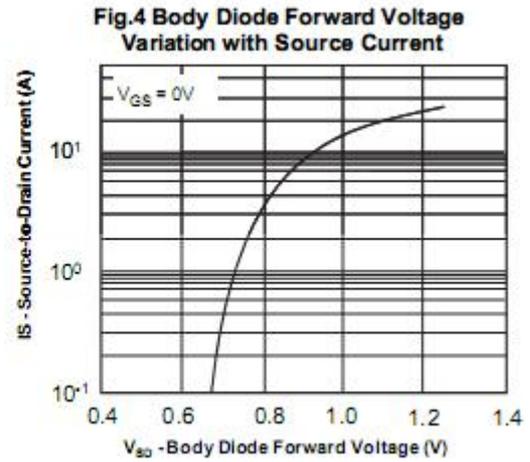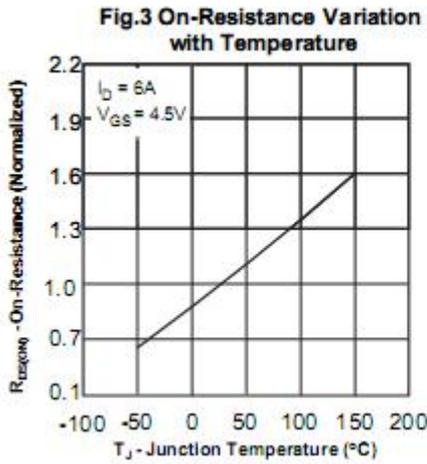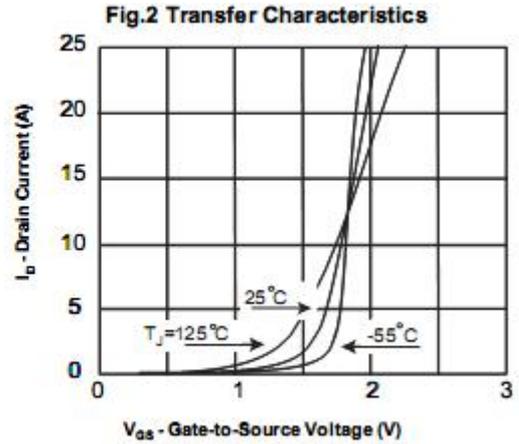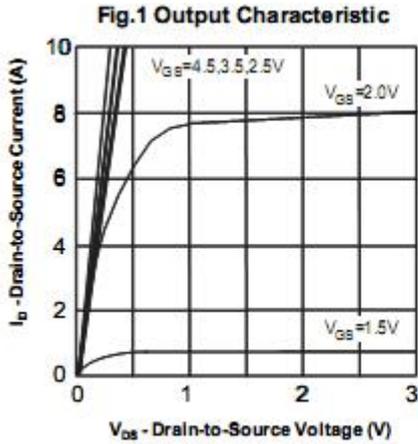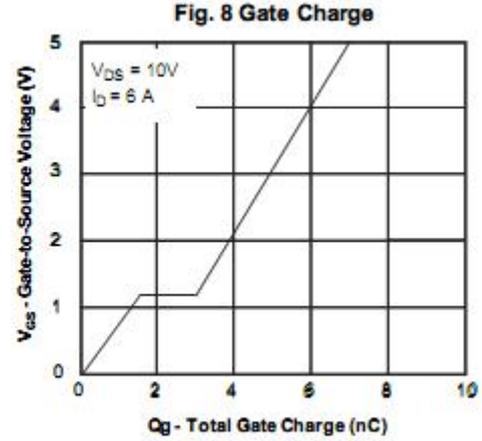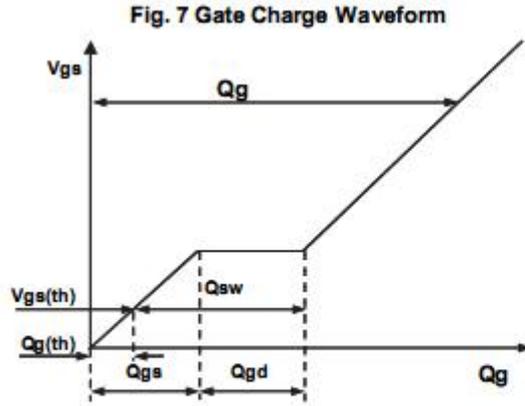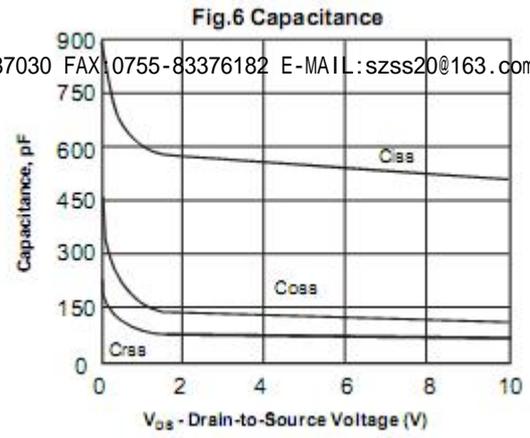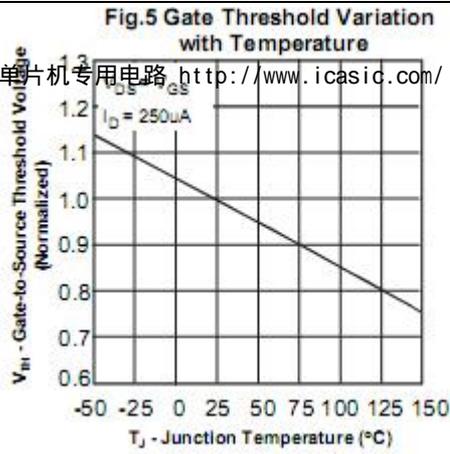


### Fig. 9 Maximum Safe Operating Area



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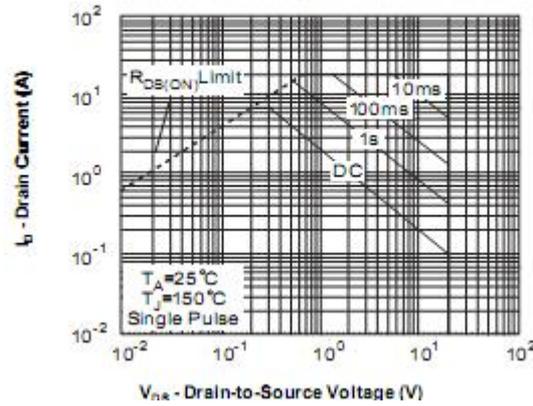
**Fig. 10 Normalized Thermal Transient Impedance Curve**
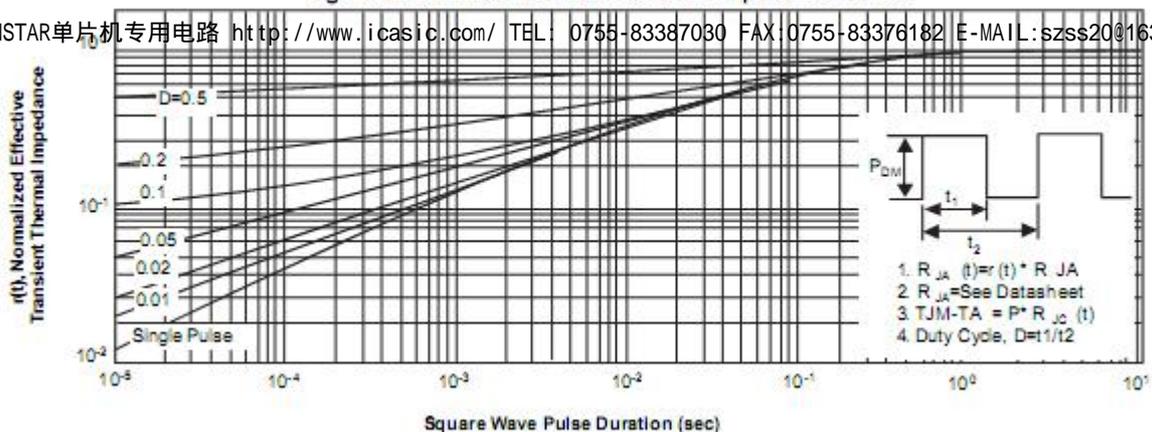


1. $R_{JA}(t) = r(t) * R_{JA}$
2. $R_{JA}$ = See Datasheet
3. TJM-TA = $P * R_{JC}(t)$
4. Duty Cycle, D=t1/t2

# Features

Ø　Advanced trench process technology;

Ø　High density cell design for ultra low On-Resistance;

Ø　High power and current handing capability;

Ø　Ideal for Li ion battery pack applications;

Ø　$V_{DS} = 20V$

　$R_{DS(ON)}$, $V_{gs}$@2.5V, $I_{ds}$@3.3A = 30mΩ;

　$R_{DS(ON)}$, $V_{gs}$@4.5V, $I_{ds}$@8.2A = 20mΩ;

Ø　Recommended Package: TSSOP-8/SO-8/SOT-23-6.

# Package

**TSSOP-08**
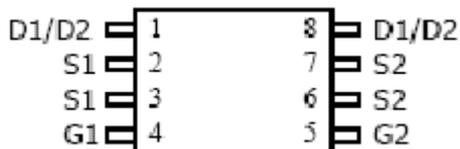
**SOP-8**
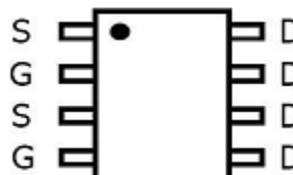


**Top View**

**SOT-23-6**
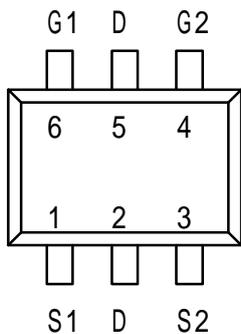
**Internal Schematic Diagram**
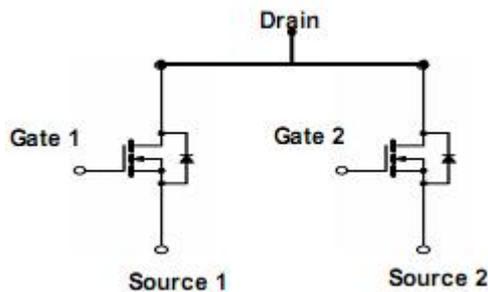


**N-Channel MOSFET**

# Maximum Ratings and Thermal Characteristics (Ta = 25℃　unless otherwise noted)

| Parameter | | Symbol | Limit | Unit |
|---|---|---|---|---|
| Drain-Source voltage | | $V_{DS}$ | 20 | V |
| Gate-Source voltage | | $V_{GS}$ | ±12 | |
| Continuous drain current | | $I_D$ | 8.2 | A |
| Pulsed drain current [1] | | $I_{DM}$ | 30 | |
| Maximum power dissipation | TA = 25℃ | $P_D$ | 2 | W |
| | TA = 75℃ | | 1.3 | |
| Operating junction and storage temperature range | | $T_J$, $T_{stg}$ | -55 to 150 | ℃ |
| Junction-to-Ambient thermal resistance (PCB mounted) [2] | | $R_{\theta JA}$ | 62.5 | ℃/W |

Note: 1. Repetitive Rating: Pulse width limited by the maximum junction temperature

　　　2. 1-in$^2$ 2oz Cu PCB board

# Electrical Characteristics

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS} = 0V, I_D = 250uA$ | 20 | -- | -- | V |
| Drain-Source On-Stage Resistance | $R_{DS}(on)$ | $V_{GS} = 2.5V, I_D = 3.3A$ | -- | 22.0 | 30.0 | m$\Omega$ |
| Drain-Source On-Stage Resistance | $R_{DS}(on)$ | $V_{GS} = 4.5V, I_D = 8.2A$ | -- | 16.0 | 20.0 | |
| Gate Threshold Voltage | $V_{GS}(th)$ | $V_{DS} = V_{GS}, I_D = 250uA$ | 0.6 | -- | 1.5 | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS} = 20V, V_{GS} = 0V$ | -- | -- | 1 | uA |
| Gate Body Leakage | $I_{GSS}$ | $V_{GS} = \pm12V, I_D=0uA$ | -- | -- | $\pm100$ | nA |
| Forward Tran conductance | $g_{fs}$ | $V_{DS} = 15V, I_D = 8.2A$ | -- | 29 | -- | S |
| **Dynamic**[3)] | | | | | | |
| Total Gate Charge | $Q_g$ | $V_{DS} = 10V, I_D = 8.2A$ $V_{GS} = 4.5V$ | -- | 11 | 14.3 | nC |
| Gate-Source Charge | $Qg_s$ | | -- | 2.5 | 3.25 | |
| Gate-Drain Charge | $Q_{gd}$ | | -- | 3.2 | 4.16 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 10V, R_G = 6\Omega$ $I_D = 1A, V_{GEN} = 4.5V$ | -- | 45 | 90 | ns |
| Turn-On Rise Time | $t_r$ | | -- | 50 | 100 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 35 | 70 | |
| Turn-Off Fall Time | $t_f$ | | -- | 20 | 40 | |
| Input Capacitance | $C_{iss}$ | $V_{DS} = 8V, V_{GS} = 0V$ f=1.0MHz | -- | 560 | -- | pF |
| Output Capacitance | $C_{oss}$ | | -- | 95 | -- | |
| Reverse Transfer Capacitance | $C_{rss}$ | | -- | 75 | -- | |
| **Source-Drain Diode** | | | | | | |
| Max. Diode Forward Current | $I_S$ | -- | -- | -- | 1.7 | A |
| Diode Forward Voltage | $V_{SD}$ | $I_S = 1.7A, V_{GS} = 0V$ | -- | -- | 1.2 | V |

Note: 1. Pulse test: Pulse width <=300us, duty cycle<=2%

2. Guaranteed by design; not subject to production testing