

### Description

The SX10N04S uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.

### General Features

$V_{DS} = 40V$   $I_D = 10 A$

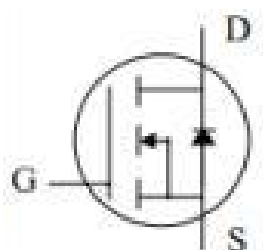
$R_{DS(ON)} < 17m\Omega$  @  $V_{GS}=10V$

### Application

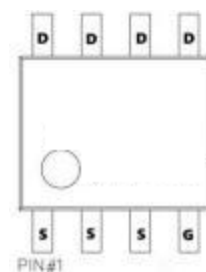
Battery protection

Load switch

Uninterruptible power supply



SOP-8



### Absolute Maximum Ratings ( $T_c=25^\circ C$ unless otherwise specified)

| Symbol               | Parameter                                                         | Rating     | Units        |
|----------------------|-------------------------------------------------------------------|------------|--------------|
| $V_{DS}$             | Drain-Source Voltage                                              | 40         | V            |
| $V_{GS}$             | Gate-Source Voltage                                               | $\pm 20$   | V            |
| $I_D@T_A=25^\circ C$ | Continuous Drain Current <sup>1</sup>                             | 10         | A            |
| $I_D@T_A=70^\circ C$ | Continuous Drain Current <sup>1</sup>                             | 6.7        | A            |
| $I_{DM}$             | Pulsed Drain Current <sup>2</sup>                                 | 50         | A            |
| EAS                  | Single Pulse Avalanche Energy <sup>3</sup>                        | 31         | mJ           |
| $I_{AS}$             | Avalanche Current                                                 | 25         | A            |
| $P_D@T_A=25^\circ C$ | Total Power Dissipation <sup>4</sup>                              | 1.9        | W            |
| $T_{STG}$            | Storage Temperature Range                                         | -55 to 150 | $^\circ C$   |
| $T_J$                | Operating Junction Temperature Range                              | -55 to 150 | $^\circ C$   |
| $R_{\theta JA}$      | Thermal Resistance Junction-ambient <sup>1</sup> ( $t \leq 10s$ ) | 40         | $^\circ C/W$ |
|                      | Thermal Resistance Junction-ambient <sup>1</sup>                  | 65         | $^\circ C/W$ |

**Electrical Characteristics (T<sub>c</sub>=25°C unless otherwise noted)**

| Symbol                              | Parameter                                      | Conditions                                                                                 | Min. | Typ.  | Max. | Unit  |
|-------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------|------|-------|------|-------|
| BV <sub>DSS</sub>                   | Drain-Source Breakdown Voltage                 | V <sub>GS</sub> =0V , I <sub>D</sub> =250uA                                                | 40   | ---   | ---  | V     |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | BVDSS Temperature Coefficient                  | Reference to 25°C , I <sub>D</sub> =1mA                                                    | ---  | 0.032 | ---  | V/°C  |
| R <sub>DS(ON)</sub>                 | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =10V , I <sub>D</sub> =7A                                                  | ---  | 14.5  | 17   | mΩ    |
|                                     |                                                | V <sub>GS</sub> =4.5V , I <sub>D</sub> =6A                                                 | ---  | 18    | 22   |       |
| V <sub>GS(th)</sub>                 | Gate Threshold Voltage                         | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250uA                                   | 1.0  | ---   | 2.5  | V     |
| ΔV <sub>GS(th)</sub>                | V <sub>GS(th)</sub> Temperature Coefficient    |                                                                                            | ---  | -4.8  | ---  | mV/°C |
| I <sub>DSS</sub>                    | Drain-Source Leakage Current                   | V <sub>DS</sub> =32V , V <sub>GS</sub> =0V , T <sub>J</sub> =25°C                          | ---  | ---   | 1    | uA    |
|                                     |                                                | V <sub>DS</sub> =32V , V <sub>GS</sub> =0V , T <sub>J</sub> =55°C                          | ---  | ---   | 5    |       |
| I <sub>GSS</sub>                    | Gate-Source Leakage Current                    | V <sub>GS</sub> =±20V , V <sub>DS</sub> =0V                                                | ---  | ---   | ±100 | nA    |
| g <sub>fs</sub>                     | Forward Transconductance                       | V <sub>DS</sub> =5V , I <sub>D</sub> =7A                                                   | ---  | 32    | ---  | S     |
| R <sub>g</sub>                      | Gate Resistance                                | V <sub>DS</sub> =0V , V <sub>GS</sub> =0V , f=1MHz                                         | ---  | 2.1   | ---  | Ω     |
| Q <sub>g</sub>                      | Total Gate Charge (4.5V)                       | V <sub>DS</sub> =32V , V <sub>GS</sub> =4.5V , I <sub>D</sub> =7A                          | ---  | 9.8   | ---  | nC    |
| Q <sub>gs</sub>                     | Gate-Source Charge                             |                                                                                            | ---  | 2.8   | ---  |       |
| Q <sub>gd</sub>                     | Gate-Drain Charge                              |                                                                                            | ---  | 3.9   | ---  |       |
| T <sub>d(on)</sub>                  | Turn-On Delay Time                             | V <sub>DD</sub> =20V , V <sub>GS</sub> =10V ,<br>R <sub>G</sub> =3.3<br>I <sub>D</sub> =7A | ---  | 2.8   | ---  | ns    |
| T <sub>r</sub>                      | Rise Time                                      |                                                                                            | ---  | 40.4  | ---  |       |
| T <sub>d(off)</sub>                 | Turn-Off Delay Time                            |                                                                                            | ---  | 22.8  | ---  |       |
| T <sub>f</sub>                      | Fall Time                                      |                                                                                            | ---  | 6.4   | ---  |       |
| C <sub>iss</sub>                    | Input Capacitance                              | V <sub>DS</sub> =15V , V <sub>GS</sub> =0V , f=1MHz                                        | ---  | 1013  | ---  | pF    |
| C <sub>oss</sub>                    | Output Capacitance                             |                                                                                            | ---  | 107   | ---  |       |
| C <sub>rss</sub>                    | Reverse Transfer Capacitance                   |                                                                                            | ---  | 76    | ---  |       |
| I <sub>S</sub>                      | Continuous Source Current <sup>1,5</sup>       | V <sub>G</sub> =V <sub>D</sub> =0V , Force Current                                         | ---  | ---   | 8.4  | A     |
| I <sub>SM</sub>                     | Pulsed Source Current <sup>2,5</sup>           | V <sub>GS</sub> =0V , I <sub>S</sub> =1A , T <sub>J</sub> =25°C                            | ---  | ---   | 50   | A     |
| V <sub>SD</sub>                     | Diode Forward Voltage <sup>2</sup>             |                                                                                            | ---  | ---   | 1    | V     |
| t <sub>rr</sub>                     | Reverse Recovery Time                          | I <sub>F</sub> =7A , dI/dt=100A/μs ,<br>T <sub>J</sub> =25°C                               | ---  | 10    | ---  | nS    |
| Q <sub>rr</sub>                     | Reverse Recovery Charge                        |                                                                                            | ---  | 3.3   | ---  | nC    |

**Note :**

1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper. 2.The data tested by pulsed , pulse width ≤ 300us , duty cycle ≤ 2%

3.The EAS data shows Max. rating . The test condition is V<sub>DD</sub>=25V,V<sub>GS</sub>=10V,L=0.1mH,I<sub>AS</sub>=25A

45.The po.The data is theoretically the same as I<sub>wer</sub> dissipation is limited by 150<sub>b</sub>°C and I junction temperature<sub>DM</sub> , in real applications , should be limited by total power dissipation.

## Typical Characteristics

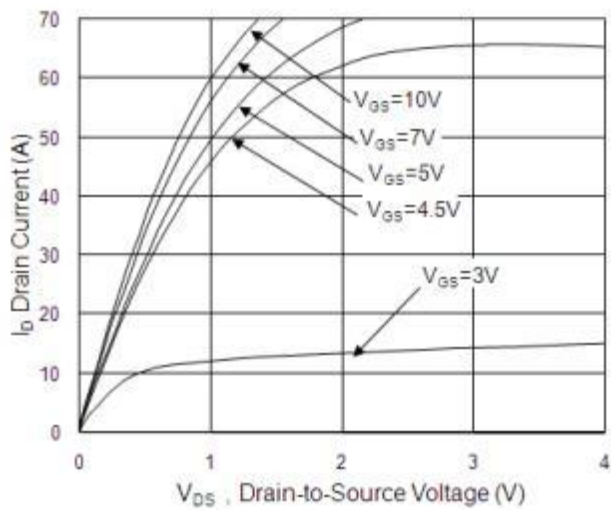


Fig.1 Typical Output Characteristics

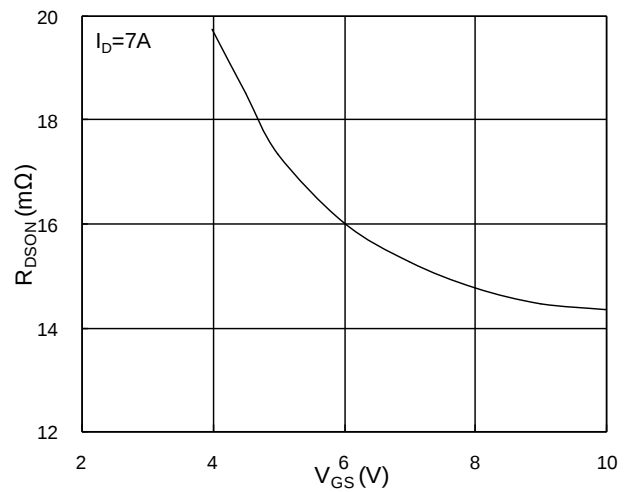


Fig.2 On-Resistance vs. G-S Voltage

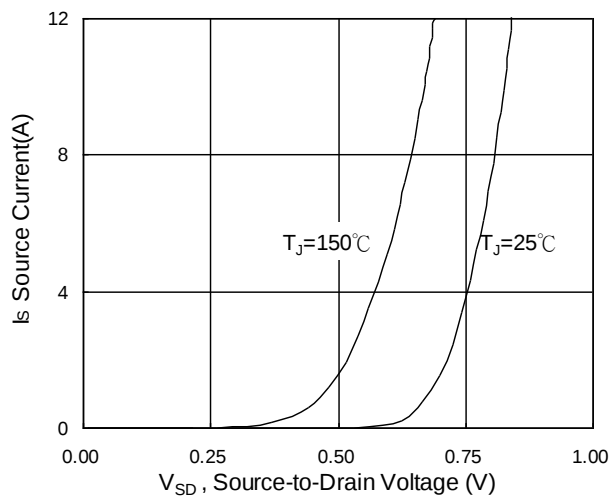


Fig.3 Forward Characteristics of Reverse

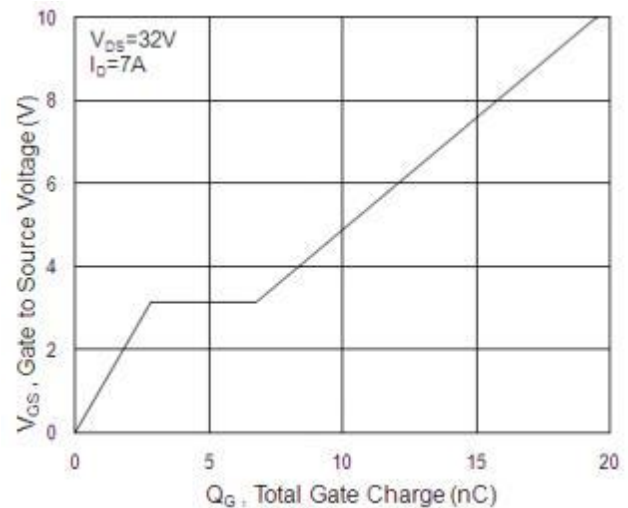


Fig.4 Gate-Charge Characteristics

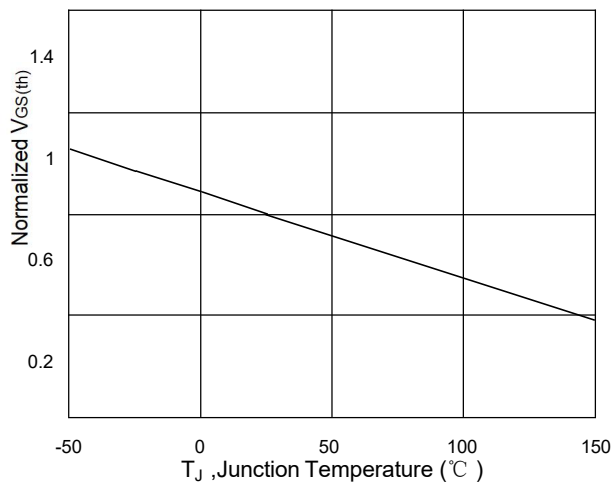


Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$

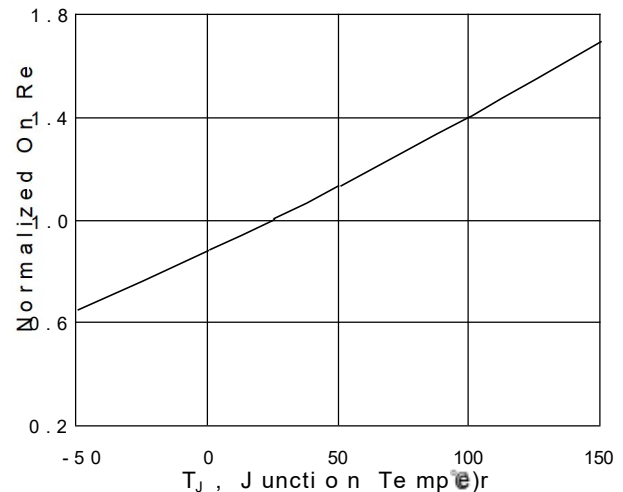


Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$

## Typical Characteristics

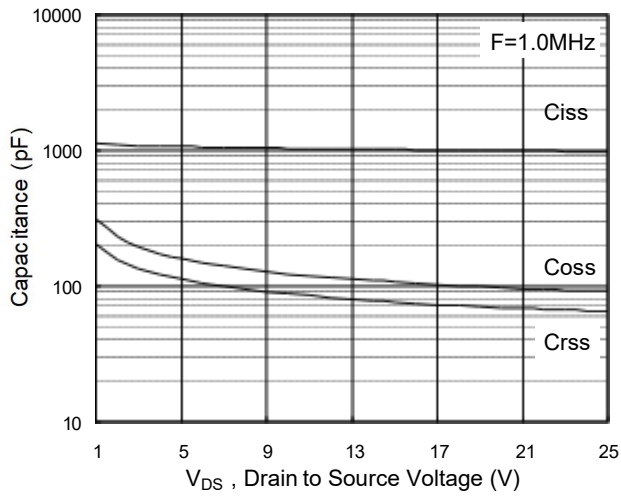


Fig.7 Capacitance

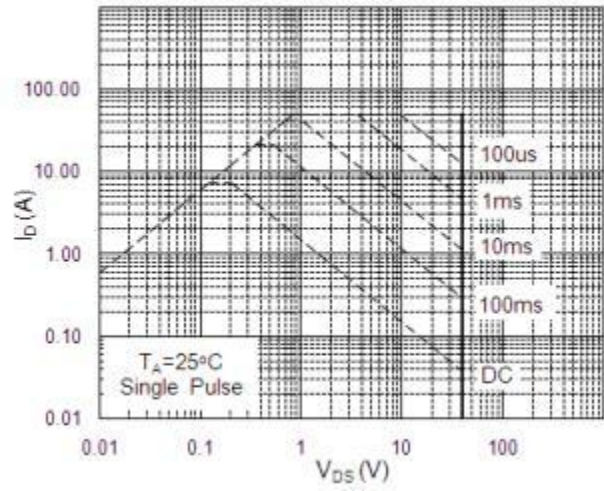


Fig.8 Safe Operating Area

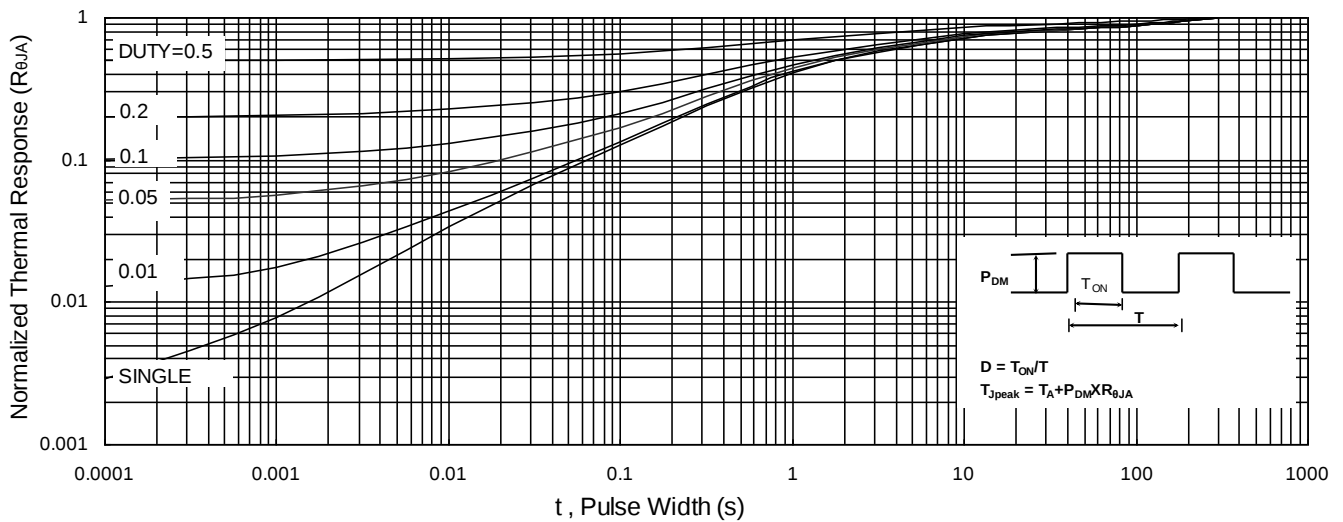


Fig.9 Normalized Maximum Transient Thermal Impedance

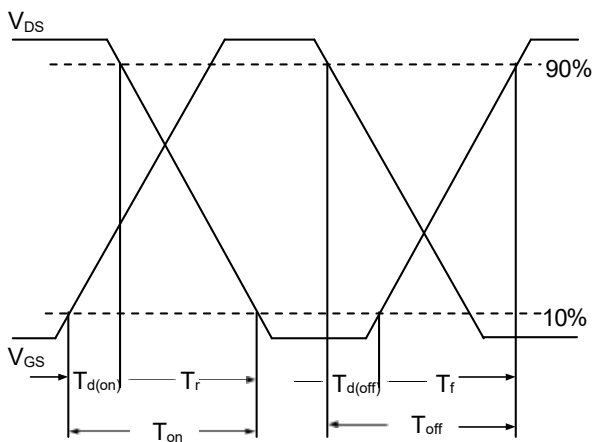


Fig.10 Switching Time Waveform

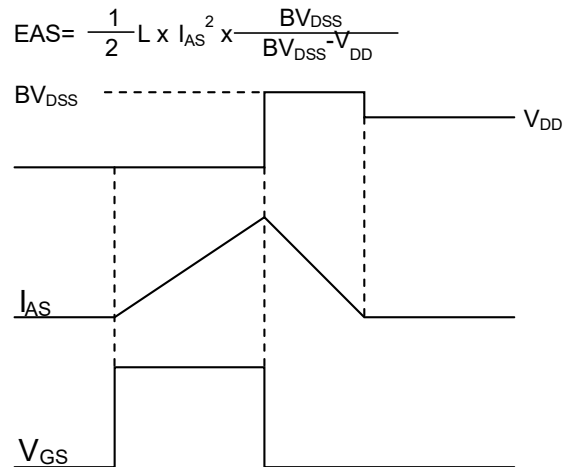
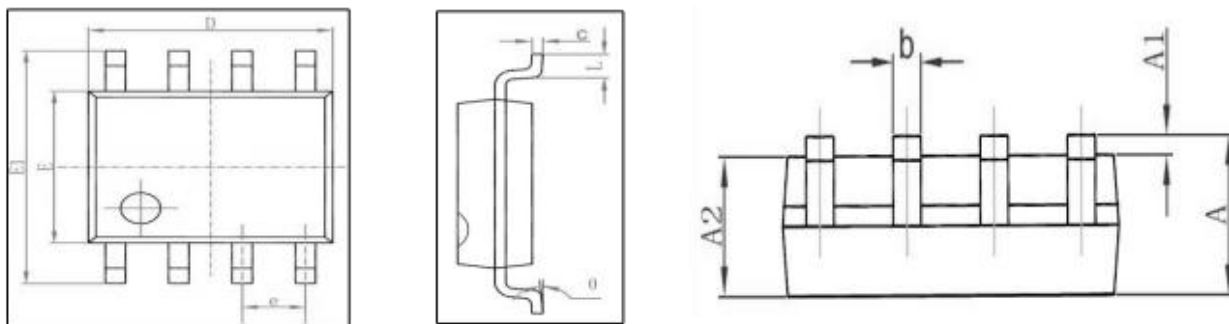
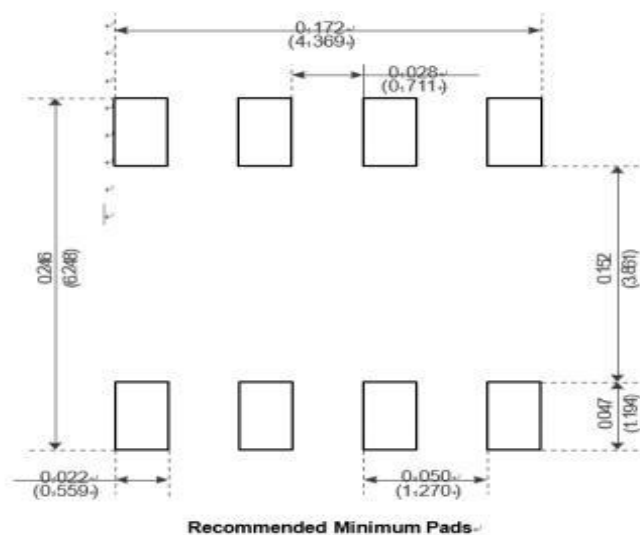


Fig.11 Unclamped Inductive Switching Waveform

## Package Mechanical Data-SOP-8



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.350                     | 1.750 | 0.053                | 0.069 |
| A1     | 0.100                     | 0.250 | 0.004                | 0.010 |
| A2     | 1.350                     | 1.550 | 0.053                | 0.061 |
| b      | 0.330                     | 0.510 | 0.013                | 0.020 |
| c      | 0.170                     | 0.250 | 0.006                | 0.010 |
| D      | 4.700                     | 5.100 | 0.185                | 0.200 |
| E      | 3.800                     | 4.000 | 0.150                | 0.157 |
| E1     | 5.800                     | 6.200 | 0.228                | 0.244 |
| e      | 1.270 (BSC)               |       | 0.050 (BSC)          |       |
| L      | 0.400                     | 1.270 | 0.016                | 0.050 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |



## Package Marking and Ordering Information

| Product ID | Pack  | Marking | Qty(PCS) |
|------------|-------|---------|----------|
| TAPING     | SOP-8 |         | 3000     |