

### Description

The SX50P04D 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

$V_{DS} = -40V$   $I_D = -50 A$

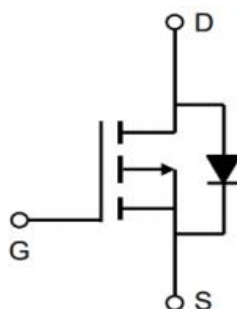
$R_{DS(ON)} < -13m\Omega$  @  $V_{GS} = -10V$

### Application

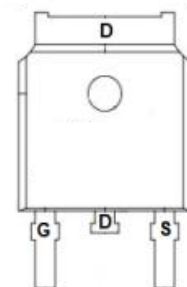
Battery protection

Load switch

Uninterruptible power supply



TO-252-3L



### Absolute Maximum Ratings (TC=25°C unless otherwise noted)

| Symbol                    | Parameter                                        | Rating     | Units        |
|---------------------------|--------------------------------------------------|------------|--------------|
| $V_{DS}$                  | Drain-Source Voltage                             | -40        | V            |
| $V_{GS}$                  | Gate-Source Voltage                              | $\pm 20$   | V            |
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ -10V^1$      | -50        | A            |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$      | -32        | A            |
| $I_{DM}$                  | Pulsed Drain Current <sup>2</sup>                | -105       | A            |
| EAS                       | Single Pulse Avalanche Energy <sup>3</sup>       | 146        | mJ           |
| $I_{AS}$                  | Avalanche Current                                | -54        | A            |
| $P_D @ T_C = 25^\circ C$  | Total Power Dissipation <sup>4</sup>             | 52.1       | W            |
| $P_D @ T_A = 25^\circ C$  | Total Power Dissipation <sup>4</sup>             | 2          | 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> | 62         | $^\circ C/W$ |
| $R_{\theta JC}$           | Thermal Resistance Junction-Case <sup>1</sup>    | 2.4        | $^\circ C/W$ |

**Electrical Characteristics (T<sub>J</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  | -44    | ---  | V     |
| $\Delta BV_{DSS}/\Delta T_J$ | BV <sub>DSS</sub> Temperature Coefficient      | Reference to 25°C, I <sub>D</sub> =-1mA                                                 | ---  | -0.023 | ---  | V/°C  |
| R <sub>DS(ON)</sub>          | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-30A                                             | ---  | 10.5   | 13   | mΩ    |
|                              |                                                | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-20A                                            | ---  | 15     | 20   |       |
| V <sub>GS(th)</sub>          | Gate Threshold Voltage                         | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =-250uA                               | -1.0 | -1.6   | -2.5 | V     |
| $\Delta V_{GS(th)}$          | V <sub>GS(th)</sub> Temperature Coefficient    |                                                                                         | ---  | 4.74   | ---  | 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> =-18A                                              | ---  | 24     | ---  | S     |
| R <sub>g</sub>               | Gate Resistance                                | V <sub>DS</sub> =0V, V <sub>GS</sub> =0V, f=1MHz                                        | ---  | 7      | 14   | Ω     |
| Q <sub>g</sub>               | Total Gate Charge (-4.5V)                      | V <sub>DS</sub> =-20V, V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-12A                     | ---  | 27.9   | ---  | nC    |
| Q <sub>gs</sub>              | Gate-Source Charge                             |                                                                                         | ---  | 7.7    | ---  |       |
| Q <sub>gd</sub>              | Gate-Drain Charge                              |                                                                                         | ---  | 7.5    | ---  |       |
| T <sub>d(on)</sub>           | Turn-On Delay Time                             | V <sub>DD</sub> =-15V, V <sub>GS</sub> =-10V, R <sub>G</sub> =3.3Ω, I <sub>D</sub> =-1A | ---  | 40     | ---  | ns    |
| T <sub>r</sub>               | Rise Time                                      |                                                                                         | ---  | 35.2   | ---  |       |
| T <sub>d(off)</sub>          | Turn-Off Delay Time                            |                                                                                         | ---  | 100    | ---  |       |
| T <sub>f</sub>               | Fall Time                                      |                                                                                         | ---  | 9.6    | ---  |       |
| C <sub>iss</sub>             | Input Capacitance                              | V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                                      | ---  | 3500   | ---  | pF    |
| C <sub>oss</sub>             | Output Capacitance                             |                                                                                         | ---  | 323    | ---  |       |
| C <sub>rss</sub>             | Reverse Transfer Capacitance                   |                                                                                         | ---  | 222    | ---  |       |
| I <sub>S</sub>               | Continuous Source Current <sup>1,5</sup>       | V <sub>G</sub> =V <sub>D</sub> =0V, Force Current                                       | ---  | ---    | -52  | A     |
| I <sub>SM</sub>              | Pulsed Source Current <sup>2,5</sup>           |                                                                                         | ---  | ---    | -105 | A     |
| V <sub>SD</sub>              | Diode Forward Voltage <sup>2</sup>             | V <sub>GS</sub> =0V, I <sub>S</sub> =-1A, T <sub>J</sub> =25°C                          | ---  | ---    | -1   | V     |

**Note :**

- 1、The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ 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>=-54A
- 4、The power dissipation is limited by 150°C junction temperature
- 5、The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub>, in real applications, should be limited by total power dissipation.

## Typical Characteristics

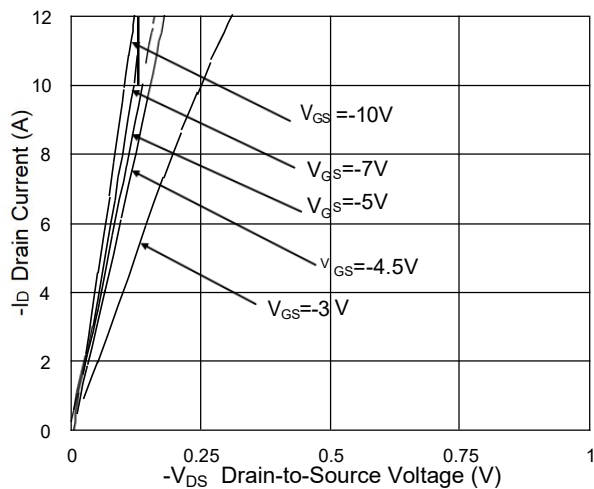


Fig.1 Typical Output Characteristics

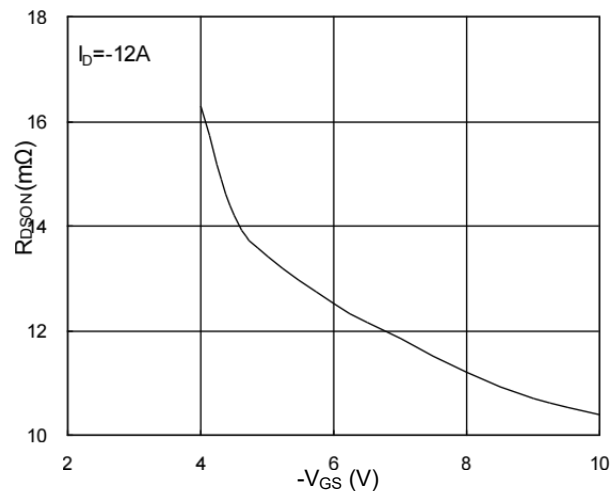


Fig.2 On-Resistance v.s Gate-Source

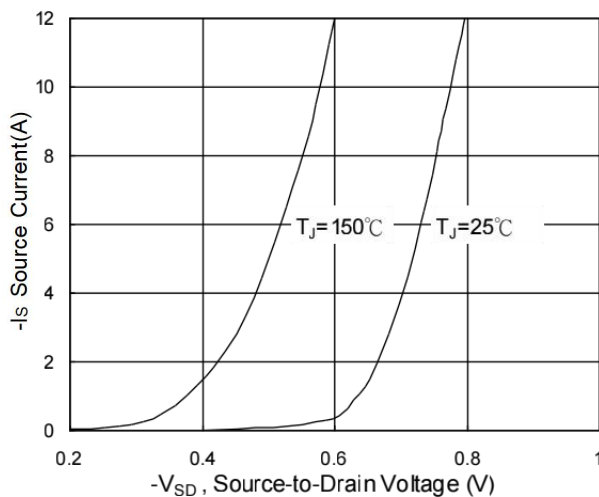


Fig.3 Forward Characteristics Of Reverse

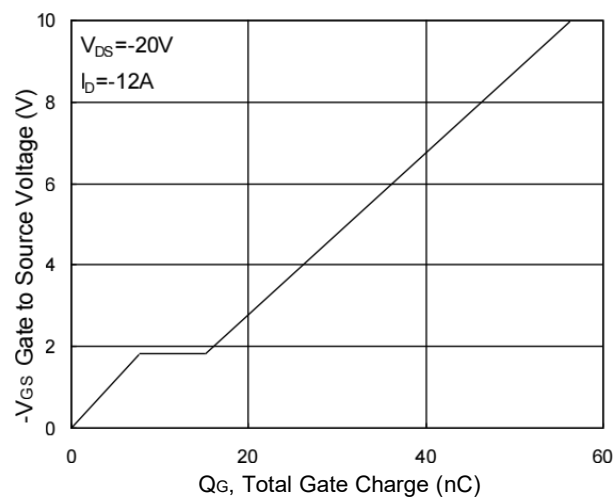


Fig.4 Gate-Charge Characteristics

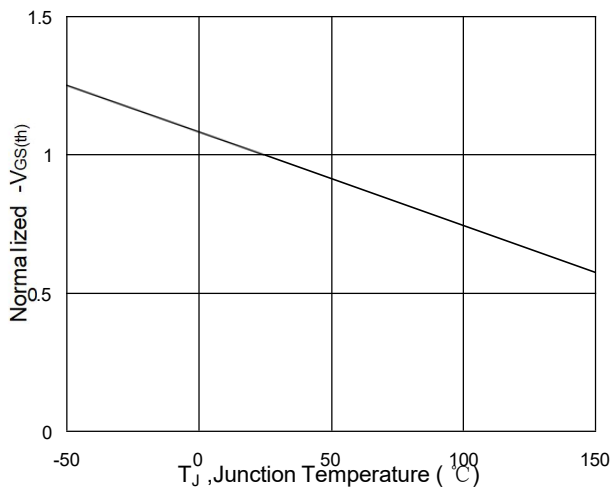


Fig.5 Normalized  $V_{GS(th)}$  v.s  $T_J$

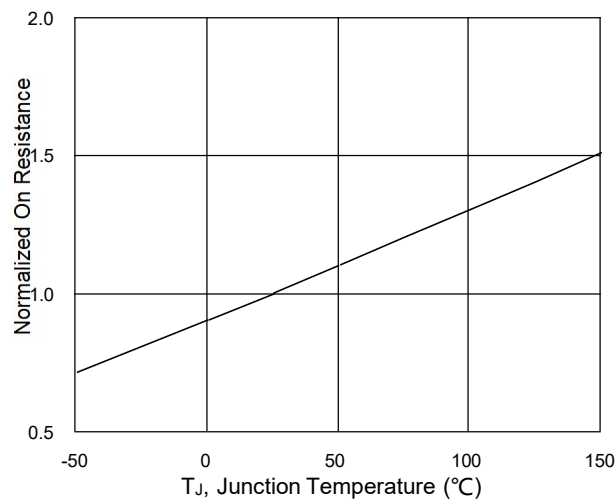


Fig.6 Normalized  $R_{DS(on)}$  v.s  $T_J$

## Typical Characteristics

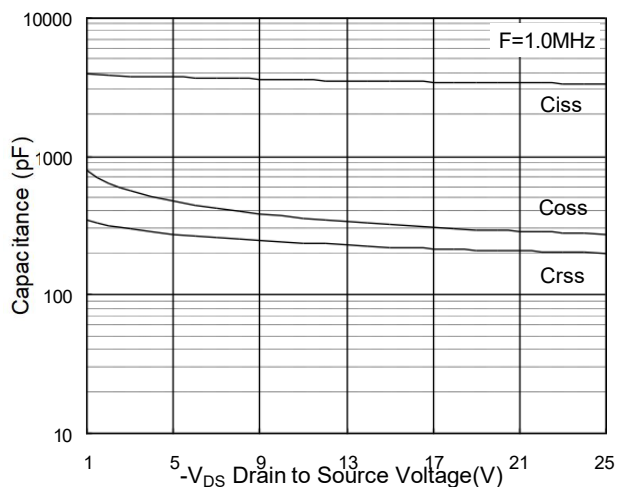


Fig.7 Capacitance

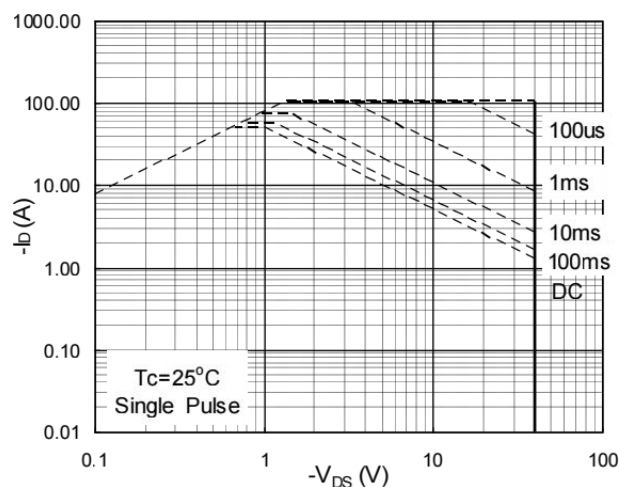


Fig.8 Safe Operating Area

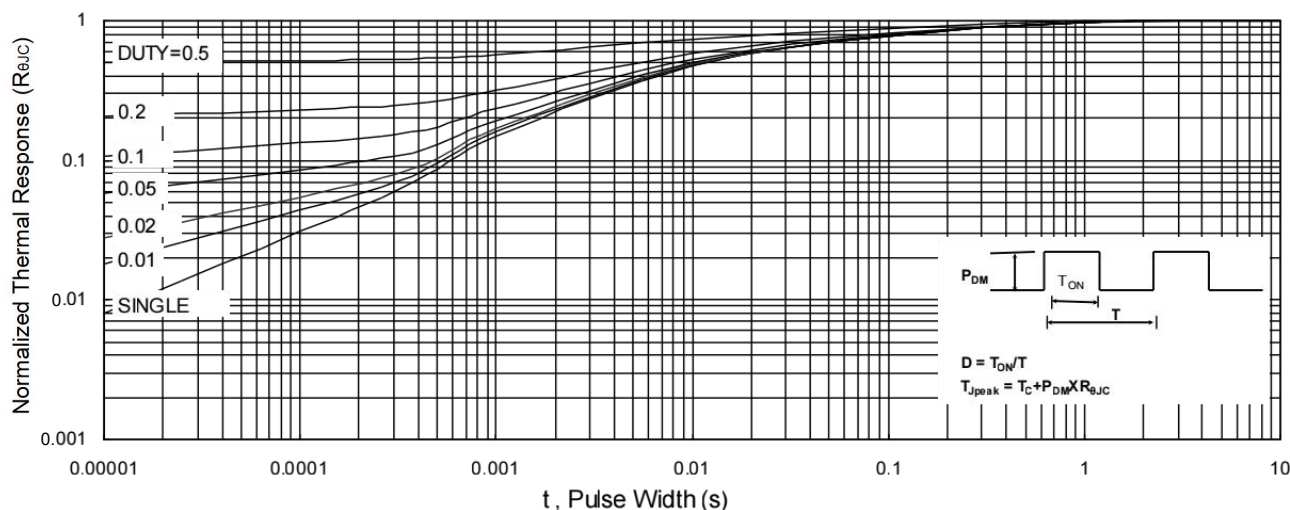


Fig.9 Normalized Maximum Transient Thermal Impedance

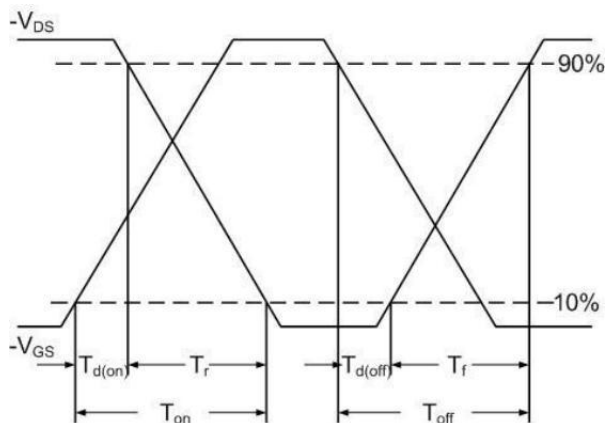


Fig.10 Switching Time Waveform

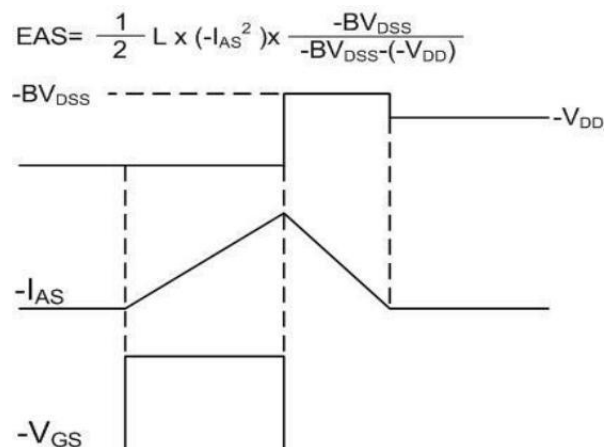
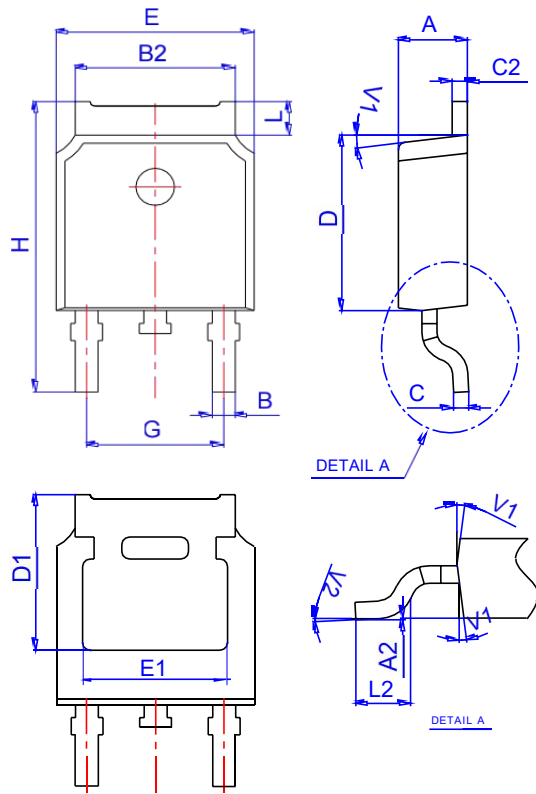


Fig.11 Unclamped Inductive Waveform

## Package Mechanical Data: TO-252-3L



| Ref. | Dimensions  |      |       |          |      |       |
|------|-------------|------|-------|----------|------|-------|
|      | Millimeters |      |       | Inches   |      |       |
|      | Min.        | Typ. | Max.  | Min.     | Typ. | Max.  |
| A    | 2.10        |      | 2.50  | 0.083    |      | 0.098 |
| A2   | 0           |      | 0.10  | 0        |      | 0.004 |
| B    | 0.66        |      | 0.86  | 0.026    |      | 0.034 |
| B2   | 5.18        |      | 5.48  | 0.202    |      | 0.216 |
| C    | 0.40        |      | 0.60  | 0.016    |      | 0.024 |
| C2   | 0.44        |      | 0.58  | 0.017    |      | 0.023 |
| D    | 5.90        |      | 6.30  | 0.232    |      | 0.248 |
| D1   | 5.30REF     |      |       | 0.209REF |      |       |
| E    | 6.40        |      | 6.80  | 0.252    |      | 0.268 |
| E1   | 4.63        |      |       | 0.182    |      |       |
| G    | 4.47        |      | 4.67  | 0.176    |      | 0.184 |
| H    | 9.50        |      | 10.70 | 0.374    |      | 0.421 |
| L    | 1.09        |      | 1.21  | 0.043    |      | 0.048 |
| L2   | 1.35        |      | 1.65  | 0.053    |      | 0.065 |
| V1   |             | 7°   |       |          | 7°   |       |
| V2   | 0°          |      | 6°    | 0°       |      | 6°    |

## Package Marking and Ordering Information

| Product ID | Pack      | Marking | Qty(PCS) |
|------------|-----------|---------|----------|
| TAPING     | TO-252-3L |         | 2500     |