# -20V P-Channel Enhancement Mode MOSFET

## 1.Product Information

### 1.1 Features

- ◇ Advanced TRENCH cell design
- ◇ Low Gate Charge
- ◇ Low On-Resistance
- ◇ RoHS and Halogen-Free Compliant
- ◇ 100% ΔVDS & UIS & Rg Tested

### 1.2 Applications

- ◇ DC-DC Converter
- ◇ Drones
- ◇ Motor drivers
- ◇ Light electric vehicles

### 1.3 Quick reference

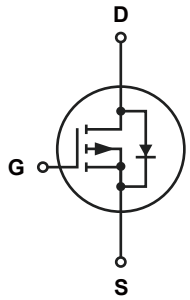
- ◇ BV ≧ -20 V
- ◇ $P_{tot}$ ≦ 1.1 W
- ◇ $I_D$ ≦ -3.6 A
- ◇ $R_{DS(ON)}$ ≦ 75.0 mΩ @ $V_{GS}$ = -4.5V
- ◇ $R_{DS(ON)}$ ≦ 90.0 mΩ @ $V_{GS}$ = -2.5V

Green Product

RoHS

## 2.Pin Description

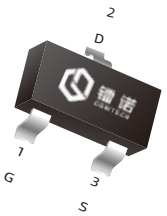
Symbol




Simplified Outline

Top View

SOT-23



## 3.Limiting Values

| Symbol | Parameter | Conditions | Min | Max | Unit | Note |
|---|---|---|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | $T_C$ = 25 ℃ | - | -20 | V | - |
| $V_{GS}$ | Gate-Source Voltage | $T_C$ = 25 ℃ | - | ±20 | V | - |
| $I_D$* | Drain Current ( DC ) | $T_C$ = 25 ℃, $V_{GS}$ = -10 V | - | -3.6 | A | Fig.2 |
| | | $T_C$ = 100 ℃, $V_{GS}$ = -10 V | - | -2.3 | A | |
| $I_{DM}$**,*** | Drain Current ( Pulsed ) | $T_C$ = 25 ℃, $V_{GS}$ = -10 V | - | -5.7 | A | - |
| $P_{tot}$ | Drain power dissipation | $T_C$ = 25 ℃ | - | 1.1 | W | Fig.1 |
| | | $T_C$ = 100 ℃ | - | 0.4 | W | |
| | Linear reduction | $T_A$ > 25 ℃ | - | 0.008 | W/℃ | |
| $T_{stg}$ | Storage Temperature | | -55 | 150 | ℃ | - |
| $T_J$ | Junction Temperature | | - | 150 | ℃ | - |
| $I_S$ | Continuous-Source Current | $T_C$ = 25 ℃ | - | -3.6 | A | - |
| $E_{AS}$* | Single Pulsed Avalanche Energy | $V_{DD}$= -20V ,L= 0.1mH | - | 11 | mJ | Fig.19 |

## 4.Thermal Characteristics

| | | | | | |
|---|---|---|---|---|---|
| $R_{\theta JA}$* | Thermal Resistance- Junction to Ambient | - | 116 | ℃/W | Fig.16 |

Notes：

* Surface Mounted on 1 in² pad area, t ≤ 10 sec

** Pulse width ≤ 300 μs, duty cycle ≤ 2 %

*** limited by bonding wire

## 5.Marking Information

| Product Name | Package | Reel size | Tape width | Quantity | Note |
|---|---|---|---|---|---|
| LN2301SA | SOT-23 | 177.8mm | 8mm | 3000 | |

Note: COMTECH defines “ Green ” as lead-free ( RoHS compliant ) and halogen free ( Br or Cl does not exceed900 ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500 ppm by weight;Follow IEC 61249-2-21 and IPC / JEDEC J-STD-020C )

## 6. Electrical Characteristics ( $T_A$=25 ° Unless Otherwise Noted )

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_{DS}$ = -250 μA | -20 | - | - | V | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_{DS}$ = -250 μA | -0.5 | - | -1 | V | |
| $I_{DSS}$ | Drain Leakage Current | $V_{DS}$ = -20V, $V_{GS}$ = 0 V | - | - | -1 | μA | |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$ = ± 12 V, $V_{DS}$ = 0 V | - | - | ±100 | nA | |
| $R_{DS(ON)}$ [a] | On-State Resistance | $V_{GS}$ =-4.5V, $I_{DS}$ =-5A | - | 56.0 | 75.0 | mΩ | Fig.8 |
| | | $V_{GS}$ =-2.5V, $I_{DS}$ =-5A | - | 76.0 | 90.0 | | |
| **Diode Characteristics** | | | | | | | |
| $V_{SD}$ [a] | Diode Forward Voltage | $I_{SD}$ = -5A , $V_{GS}$ = 0 V | - | - | 1.3 | V | Fig.7 |
| $t_{rr}$ | Reverse Recovery Time | $I_{DS}$ = -5A , $V_{GS}$ = 0 V | - | 20 | - | nS | Fig.20 |
| $Q_{rr}$ | Reverse Recovery Charge | $dI_{SD/dt}$ = 100 A/μs | - | 7 | - | nC | |
| **Dynamic Characteristics[b]** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0 V, $V_{DS}$ =-10V Frequency = 1 MHz | - | 485 | - | pF | Fig.10 |
| $C_{oss}$ | Output Capacitance | | - | 78 | - | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 70 | - | | |
| $R_G$ | Gate Resistance | F= 1 MHz | - | 44.2 | - | Ω | |
| $t_d$(on) | Turn-on Delay Time | $V_{DS}$ =-10V, $V_{GS}$ = -10 V, $RG_{(ext)}$=2.7Ω , $R_L$=20uH $I_{DS}$ =-5A | - | 5 | - | nS | Fig.18 |
| $t_r$ | Turn-on Rise Time | | - | 10 | - | | |
| $t_d$(off) | Turn-off Delay Time | | - | 16 | - | | |
| $t_f$ | Turn-off Fall Time | | - | 11 | - | | |
| dv/dt(on) | Turn-on Peak Diode Recovery | | - | 2.599 | - | KV/us | |
| dv/dt(off) | Turn-off Peak Diode Recovery | | - | 0.737 | - | | |
| di/dt(on) | Turn-on Peak Diode Recovery | | - | 138 | - | A/us | |
| di/dt(off) | Turn-off Peak Diode Recovery | | - | 150 | - | | |
| **Gate Charge Characteristics[b]** | | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$ =-10V, $V_{GS}$ = -10 V, $I_{DS}$ = -5A | - | 21 | - | nC | Fig.9 |
| $Q_{gs}$ | Gate-Source Charge | | - | 1 | - | | |
| Qgd | Gate-Drain Charge | | - | 2 | - | | |
| Vplateau | Gate plateau voltage | | - | -2 | - | V | |

Notes :
a : Pulse test ; pulse width ≤ 300 μs, duty cycle ≤ 2%
b : Guaranteed by design, not subject to production testing

## 7. Typical Characteristics

**Fig.1 Power Capability**

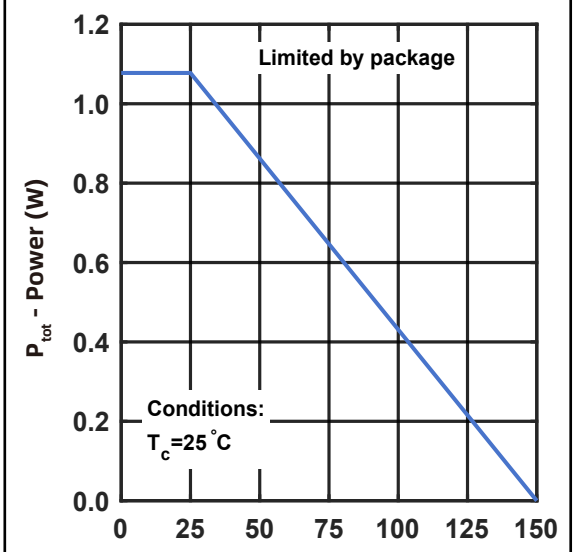



**Fig.2 Current Capability**

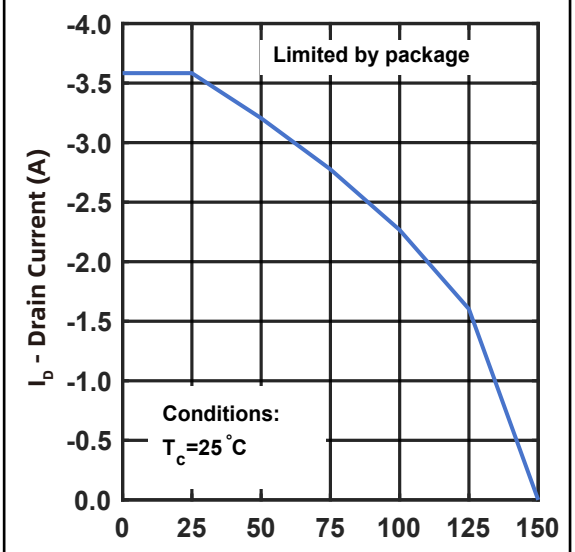



**Fig.3 Output Characteristics@Tj -55°C**

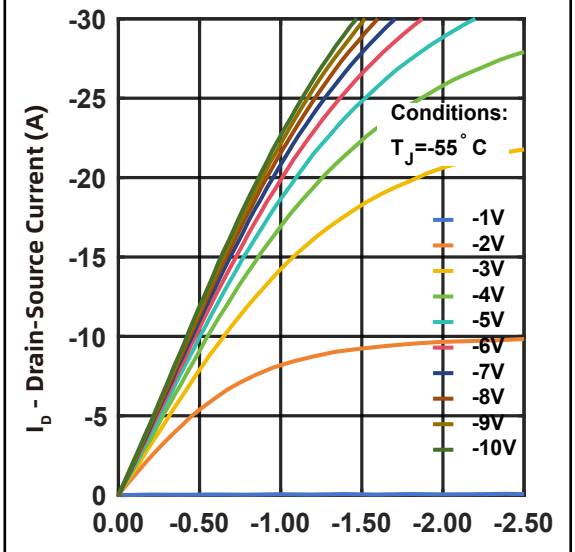
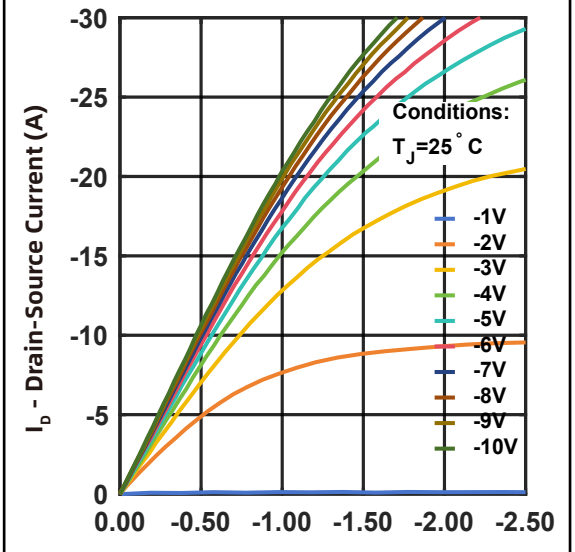



**Fig.4 Output Characteristics@Tj 25°C**






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## 7. Typical Characteristics

Fig.5 Output Characteristics@Tj 150℃

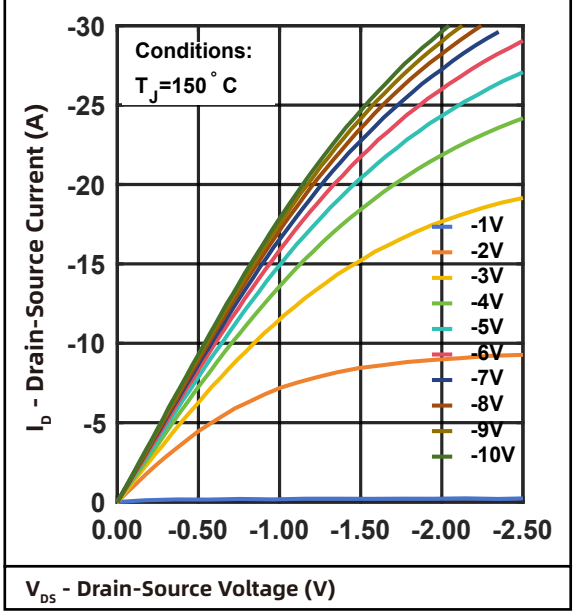



Fig.6 Transfer Characteristics vs Temp

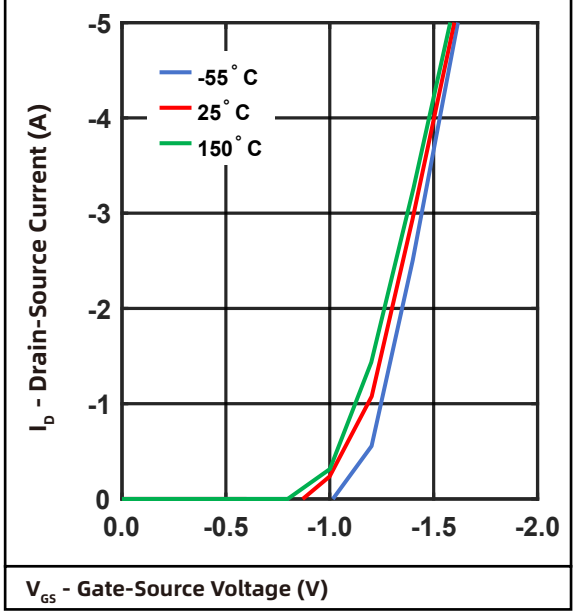



Fig.7 Body Diode Characteristics

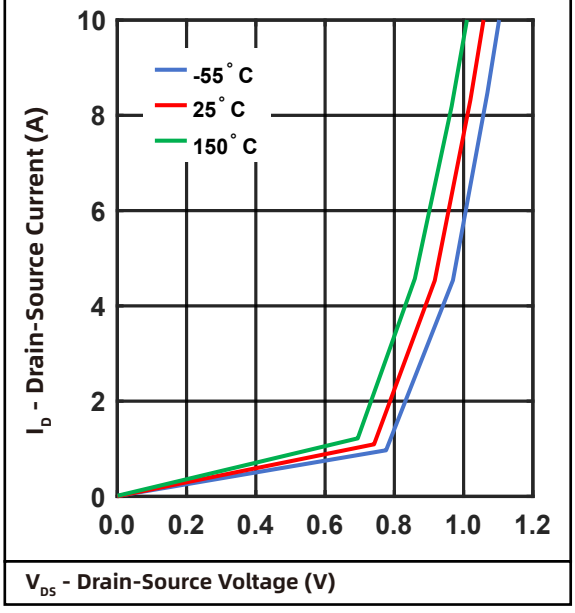
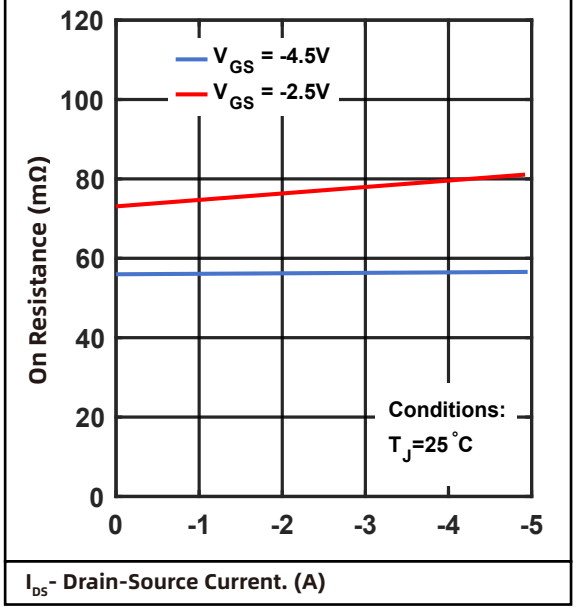



Fig.8 Drain-Source On Resistance

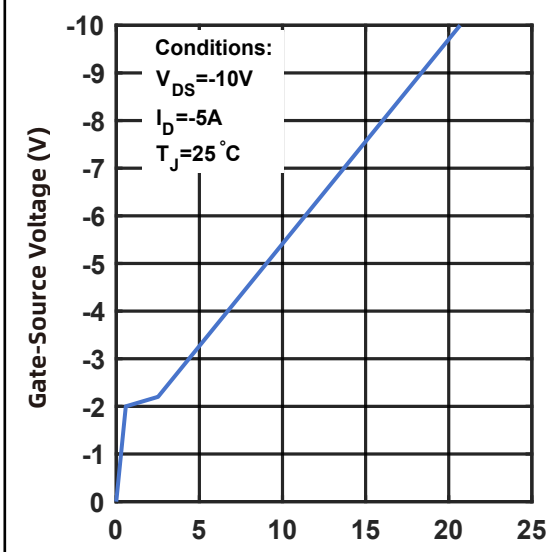





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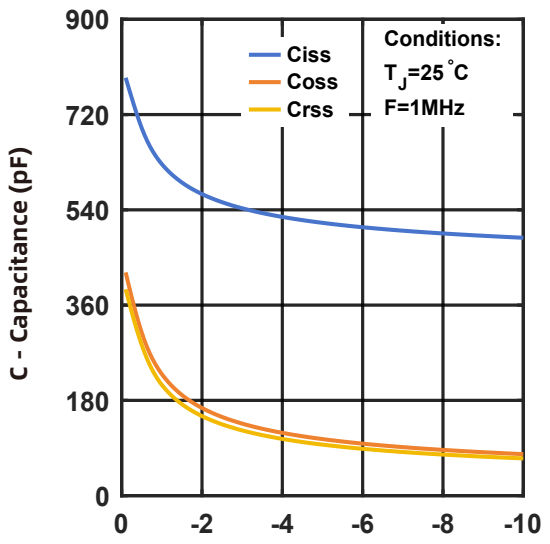
## 7. Typical Characteristics

**Fig.9 Gate Charge**



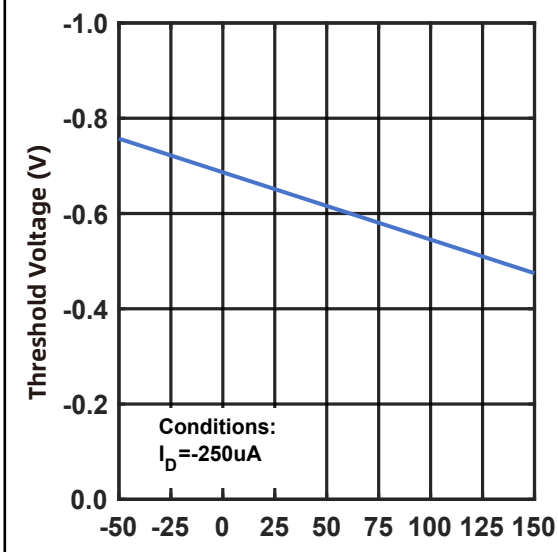

$Q_G$ - Gate Charge (nC)

**Fig.10 Capacitance**



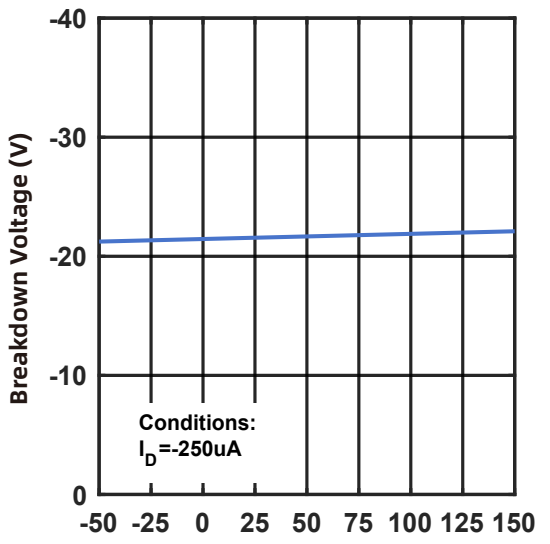

$V_{DS}$ - Drain-Source Voltage (V)

**Fig.11 Normalized Threshold Voltage**




$T_j$ - Junction Temperature (°C)

**Fig.12 Normalized Breakdown Voltage**



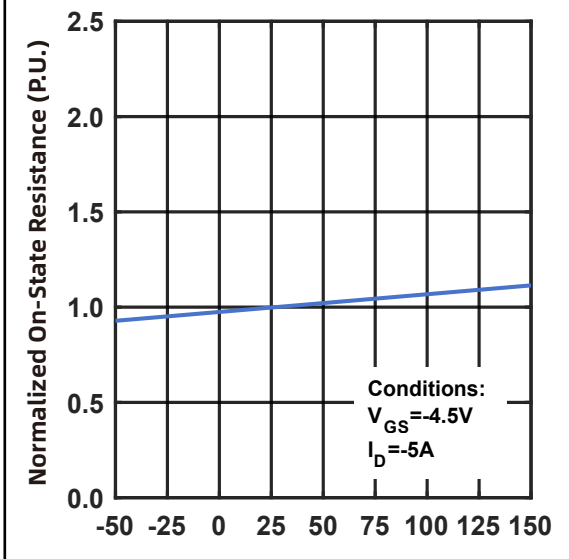

$T_j$ - Junction Temperature (°C)



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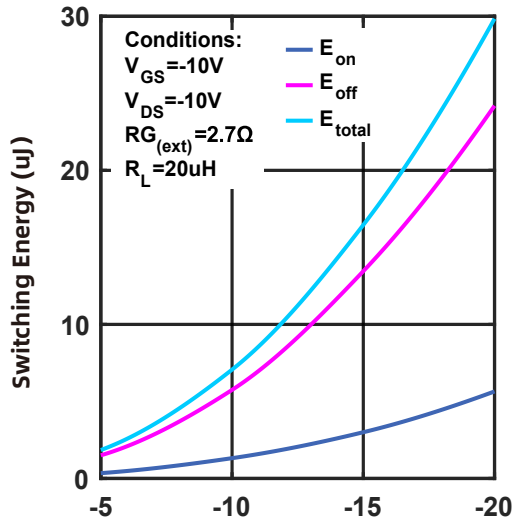
## 7. Typical Characteristics

**Fig.13 Normalized On Resistance**



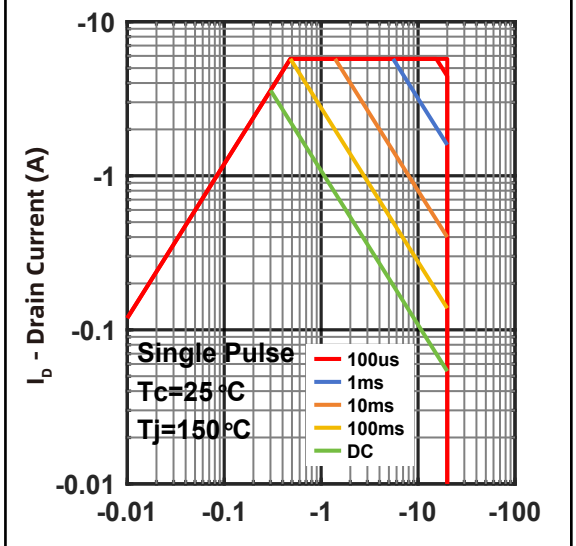

$T_j$ - Junction Temperature (°C)

**Fig.14 Switching Energy vs ID**



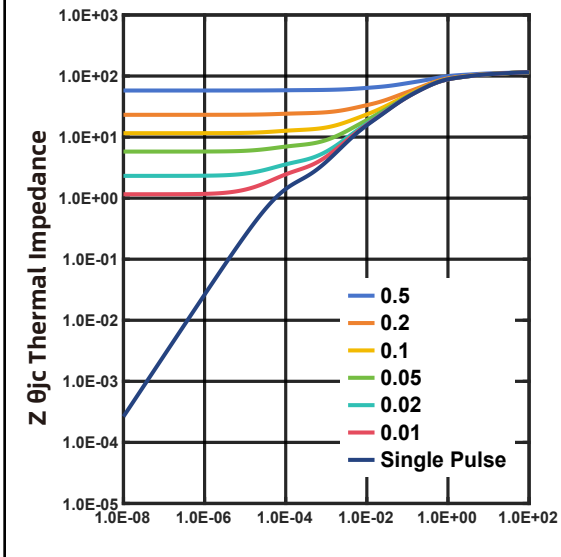

$I_{DS}$- Drain-Source Current. (A)

**Fig.15 Safe Operating Area**




$V_{DS}$ - Drain-Source Voltage (V)

**Fig.16 Transient Thermal Impedance**



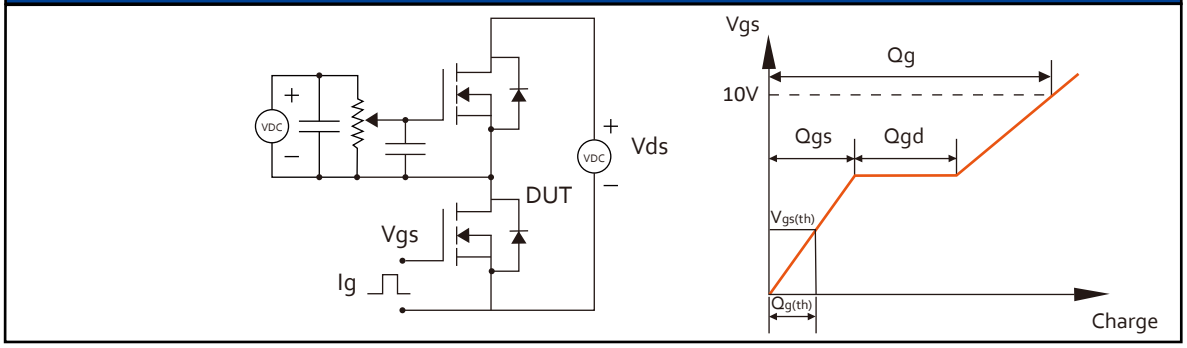

Square Wave Pulse Duration (sec)



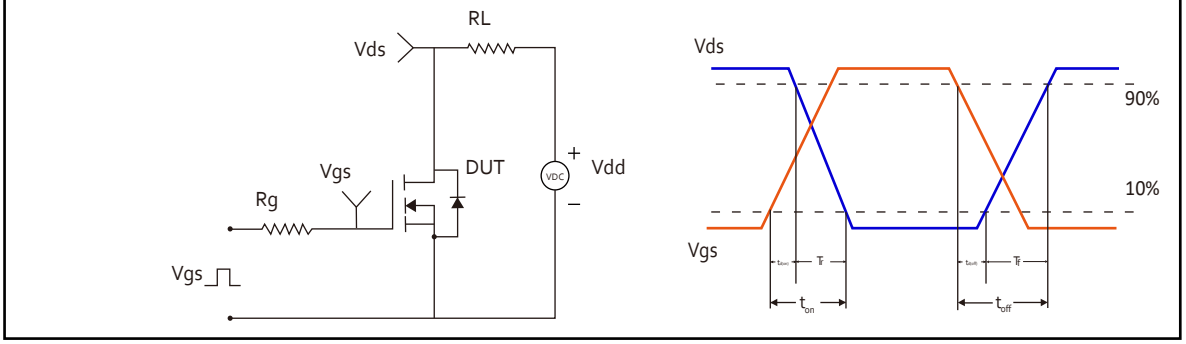
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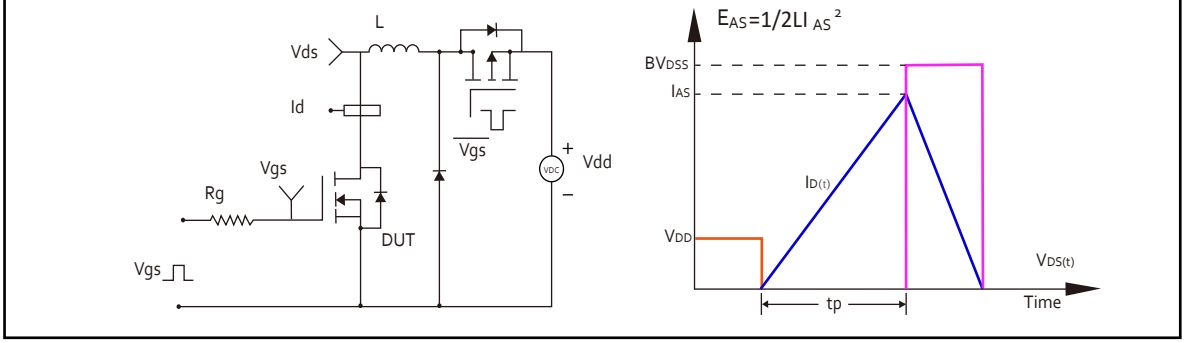
### Fig.17 Gate Charge Test Circuit & Waveform



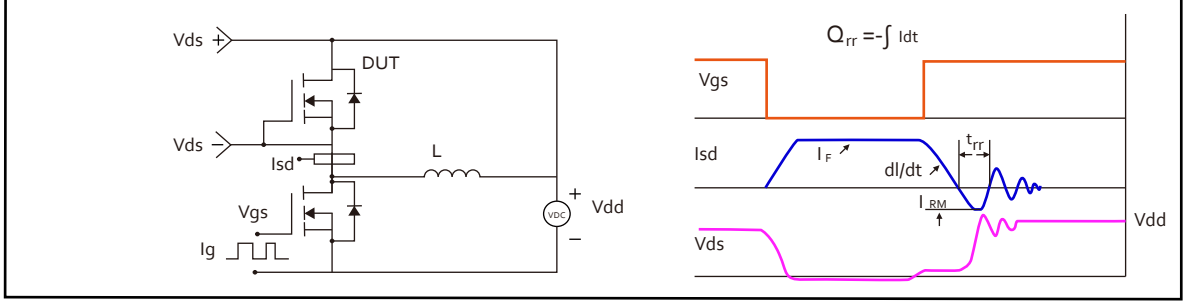

### Fig.18 Resistive Switching Test Circuit & Waveforms




### Fig.19 Unclamped Inductive Switching (UIS) Test Circuit & Waveforms




### Fig.20 Diode Recovery Test Circuit & Waveforms

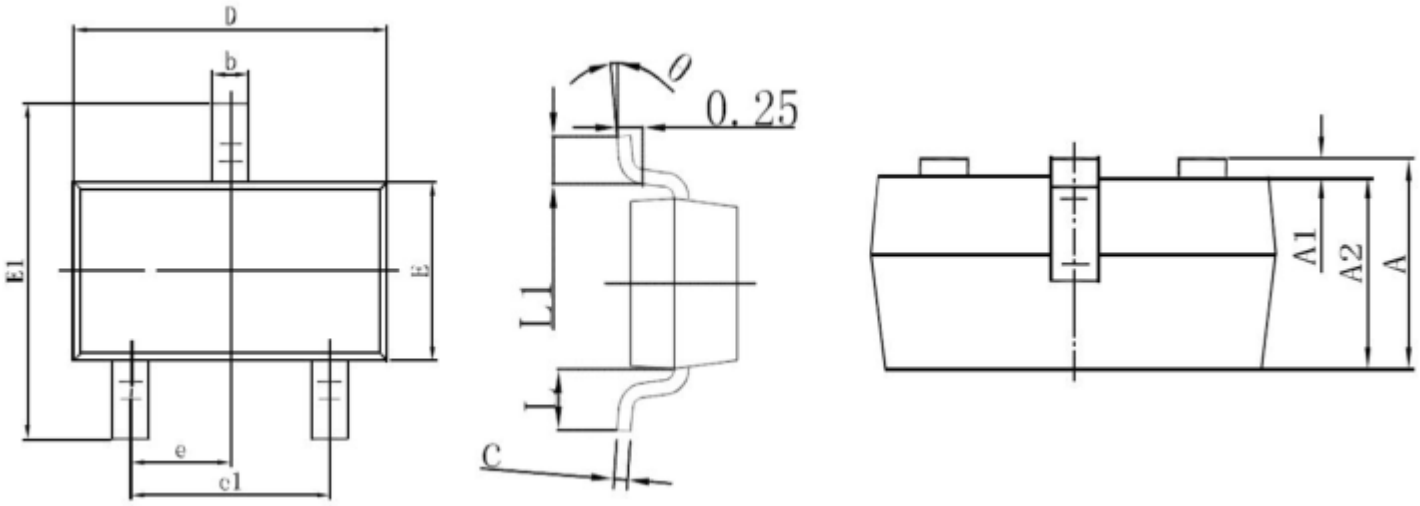





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## 8. Package Dimensions

**SOT-23 Package**




| Symbol | Dimensions In Millimeters | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.900 | 1.025 | 1.150 |
| A1 | 0.000 | 0.050 | 0.100 |
| A2 | 0.900 | 0.975 | 1.050 |
| b | 0.300 | 0.400 | 0.500 |
| c | 0.102 | 0.110 | 0.118 |
| D | 2.900 | 3.000 | 3.100 |
| E | 1.200 | 1.300 | 1.400 |
| E1 | 2.250 | 2.400 | 2.550 |
| e | 0.95REF | | |
| e1 | 1.800 | 1.900 | 2.000 |
| L | 0.55REF | | |
| L1 | 0.300 | 0.400 | 0.500 |

## 9. Record of Document amendment

产品名称：LN2301SA
版权说明：镭诺电子（宁波）有限公司
联系电话：4008887385

文档类型：产品手册
公司主页：www.leinuosemi.com

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1.初版发行