

## General Description

The Sanrise SRT04N037LS is a low voltage power MOSFET, fabricated using advanced split gate trench technology. The resulting device has extremely low on resistance, low gate charge and fast switching time, making it especially suitable for applications which require superior power density.

The SRT04N037LS break down voltage is 40V and it has a high rugged avalanche characteristics. The SRT04N037LS is available in PDFN5\*6 and PDFN3.3\*3.3 packages.

## Symbol

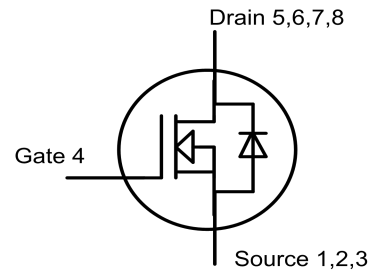


Figure 1 Symbol of SRT04N037LS

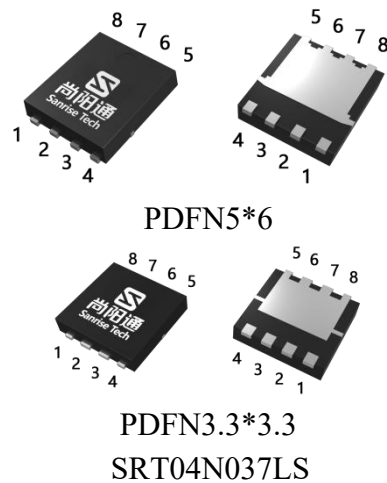
## Features

- Ultra Low  
 $R_{DS(ON\_TYP)} = 3.25m\Omega, PDFN5*6 @ V_{GS} = 10V$ .  
 $R_{DS(ON\_TYP)} = 3.8m\Omega, PDFN3.3*3.3 @ V_{GS} = 10V$ .
- Ultra Low Gate Charge,  $Q_g = 26nC$  typ.
- Fast switching capability
- Robust design with better EAS performance
- Non-automotive Qualified

## Application

- Motor Driver
- E-Tools
- BMS
- Synchronous Rectifier

## Package Type



## Ordering Information

|                  |  |                 |
|------------------|--|-----------------|
| SRT04N037L□□-□   |  |                 |
| Circuit Type     |  | E: Lead Free    |
| Package          |  | GS: Green       |
| D56: PDFN5*6     |  | Blank: Tube     |
| D33: PDFN3.3*3.3 |  | TR: Tape & Reel |

| Package     | Part Number        | Marking ID      | Packing Type |
|-------------|--------------------|-----------------|--------------|
|             | Green              | Green           |              |
| PDFN5*6     | SRT04N037LD56TR-GS | SRT04N037LD56GS | Tape & Reel  |
| PDFN3.3*3.3 | SRT04N037LD33TR-GS | 04N037LD33GS    | Tape & Reel  |

**Absolute Maximum Ratings**

| Parameter                                           |                       | Symbol                | Rating      |     | Unit |
|-----------------------------------------------------|-----------------------|-----------------------|-------------|-----|------|
| Drain-Source Voltage                                |                       | V <sub>DSS</sub>      | 40          |     | V    |
| Gate-Source Voltage                                 |                       | V <sub>GSS</sub>      | ±20         |     | V    |
| Continuous Drain Current                            | T <sub>C</sub> =25°C  | I <sub>D</sub>        | PDFN5*6     | 80  | A    |
|                                                     |                       |                       | PDFN3.3*3.3 | 60  |      |
|                                                     | T <sub>C</sub> =125°C |                       | PDFN5*6     | 40  |      |
|                                                     |                       |                       | PDFN3.3*3.3 | 38  |      |
| Pulsed Drain Current (Note 2)                       | T <sub>C</sub> =25°C  | I <sub>DM</sub>       | PDFN5*6     | 240 | A    |
|                                                     |                       |                       | PDFN3.3*3.3 | 180 |      |
| Power Dissipation (T <sub>C</sub> = 25°C)           |                       | P <sub>D</sub>        | 54          |     | W    |
| Avalanche Destructive Energy, Single Pulse (Note 4) |                       | E <sub>AS_Limit</sub> | 225         |     | mJ   |
| Avalanche Energy, Single Pulse (Note 3)             |                       | E <sub>AS</sub>       | 36          |     | mJ   |
| Avalanche Energy, Repetitive (Note 2)               |                       | E <sub>AR</sub>       | 0.1         |     | mJ   |
| Avalanche Current, Repetitive (Note 2)              |                       | I <sub>AR</sub>       | 20          |     | A    |
| Continuous Diode Forward Current                    |                       | I <sub>S</sub>        | 80          |     | A    |
| Diode Pulse Current                                 |                       | I <sub>S.PULSE</sub>  | 240         |     | A    |
| Operating Junction Temperature                      |                       | T <sub>J</sub>        | 150         |     | °C   |
| Storage Temperature                                 |                       | T <sub>STG</sub>      | -55 to 150  |     | °C   |
| Lead Temperature (Soldering, 10 sec)                |                       | T <sub>LEAD</sub>     | 260         |     | °C   |

Note:

1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3.  $I_{AS} = 12\text{A}$ ,  $V_{DD} = 20\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
4.  $I_{AS\_Limit} = 30\text{A}$ ,  $V_{DD} = 20\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

**Thermal Resistance**

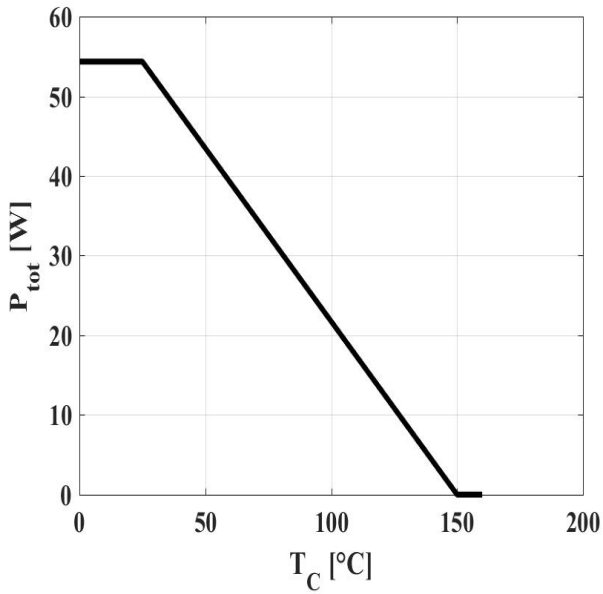
| Parameter                               |             | Symbol     | Min | Typ | Max | Unit               |
|-----------------------------------------|-------------|------------|-----|-----|-----|--------------------|
| Thermal Resistance, Junction-to-Case    | PDFN5*6     | $R_{thJC}$ |     |     | 2.3 | $^\circ\text{C/W}$ |
|                                         | PDFN3.3*3.3 | $R_{thJC}$ |     |     | 2.3 |                    |
| Thermal Resistance, Junction-to-Ambient | PDFN5*6     | $R_{thJA}$ |     |     | 50  |                    |
|                                         | PDFN3.3*3.3 | $R_{thJA}$ |     |     | 60  |                    |

**3.7mΩ, 40V, N-Channel Power MOSFET**
**SRT04N037LS**
**Electrical Characteristics**
 $T_J = 25^\circ\text{C}$ , unless otherwise specified.

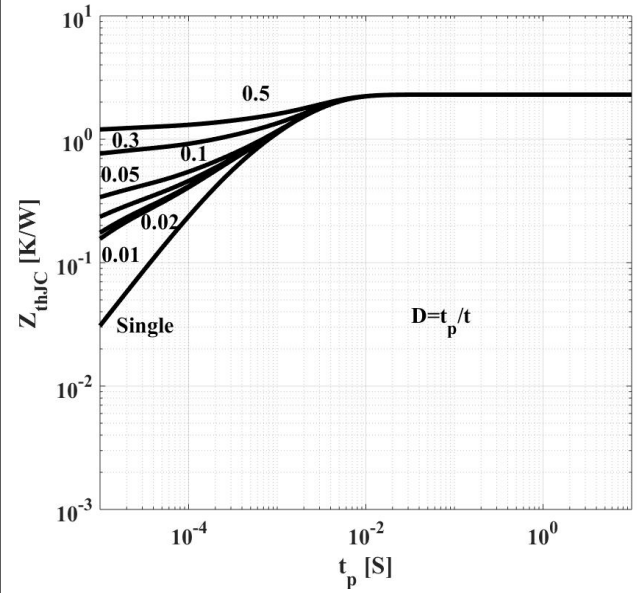
| Parameter                                                     |         | Symbol               | Test Conditions                                                                         | Min | Typ  | Max  | Unit |
|---------------------------------------------------------------|---------|----------------------|-----------------------------------------------------------------------------------------|-----|------|------|------|
| Statistic Characteristics                                     |         |                      |                                                                                         |     |      |      |      |
| Drain-Source Breakdown Voltage                                |         | BV <sub>DSS</sub>    | V <sub>GS</sub> =0V, I <sub>D</sub> =250uA                                              | 40  |      |      | V    |
| Zero Gate Voltage Drain Current                               |         | I <sub>DSS</sub>     | V <sub>DS</sub> =40V, V <sub>GS</sub> =0V                                               |     |      | 1    | uA   |
| Gate-Body Leakage Current                                     | Forward | I <sub>GSSF</sub>    | V <sub>GS</sub> =20V, V <sub>DS</sub> =0V                                               |     |      | 200  | nA   |
|                                                               | Reverse | I <sub>GSSR</sub>    | V <sub>GS</sub> =-20V, V <sub>DS</sub> =0V                                              |     |      | -200 |      |
| Gate Threshold Voltage                                        |         | V <sub>GS(TH)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =0.25mA                               | 1.2 | 1.8  | 2.6  | V    |
| Static Drain-Source On-Resistance                             | PDFN56  | R <sub>DS(ON)</sub>  | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                               |     | 3.25 | 3.7  | mΩ   |
|                                                               | PDFN33  |                      | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                               |     | 3.80 | 4.1  | mΩ   |
| Gate Resistance                                               |         | R <sub>G</sub>       | f=1MHz, Open Drain                                                                      |     | 3.0  |      | Ω    |
| Dynamic Characteristics                                       |         |                      |                                                                                         |     |      |      |      |
| Input Capacitance                                             |         | C <sub>ISS</sub>     | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, f=1MHz                                       |     | 1.8  |      | nF   |
| Output Capacitance                                            |         | C <sub>OSS</sub>     |                                                                                         |     | 487  |      | pF   |
| Reverse Transfer Capacitance                                  |         | C <sub>RSS</sub>     |                                                                                         |     | 31   |      | pF   |
| Effective output capacitance, energy related <sup>NOTE5</sup> |         | C <sub>O(er)</sub>   | V <sub>GS</sub> =0V, V <sub>DS</sub> =0...20V                                           |     | 760  |      | pF   |
| Effective output capacitance, time related <sup>NOTE6</sup>   |         | C <sub>O(tr)</sub>   |                                                                                         |     | 936  |      |      |
| Turn-on Delay Time                                            |         | t <sub>d(on)</sub>   | V <sub>DD</sub> =20V, I <sub>D</sub> =20A<br>R <sub>G</sub> =1.6Ω, V <sub>GS</sub> =10V |     | 13   |      | ns   |
| Rise Time                                                     |         | t <sub>r</sub>       |                                                                                         |     | 35   |      |      |
| Turn-off Delay Time                                           |         | t <sub>d(off)</sub>  |                                                                                         |     | 40   |      |      |
| Fall Time                                                     |         | t <sub>f</sub>       |                                                                                         |     | 8    |      |      |
| Gate Charge Characteristics                                   |         |                      |                                                                                         |     |      |      |      |
| Gate to Source Charge                                         |         | Q <sub>gs</sub>      | V <sub>DD</sub> =20V, I <sub>D</sub> =20A<br>V <sub>GS</sub> =0 to 10V                  |     | 3.9  |      | nC   |
| Gate to Drain Charge                                          |         | Q <sub>gd</sub>      |                                                                                         |     | 3.0  |      |      |
| Gate Charge Total                                             |         | Q <sub>g</sub>       |                                                                                         |     | 26   |      |      |
| Gate Plateau Voltage                                          |         | V <sub>plateau</sub> |                                                                                         |     | 2.4  |      | V    |
| Gate Charge Total, sync FET                                   |         | Q <sub>g</sub>       | V <sub>DD</sub> =0.1V, V <sub>GS</sub> =0 to 10V                                        |     | 24.6 |      | nC   |
| Reverse Diode Characteristics                                 |         |                      |                                                                                         |     |      |      |      |
| Drain-Source Diode Forward Voltage                            |         | V <sub>SD</sub>      | V <sub>GS</sub> =0V, I <sub>SD</sub> =20A                                               |     | 0.82 | 1.0  | V    |
| Reverse Recovery Time                                         |         | t <sub>rr</sub>      | V <sub>R</sub> =20V, I <sub>F</sub> =20A<br>dI <sub>F</sub> /dt=100A/us                 |     | 46   |      | ns   |
| Reverse Recovery Charge                                       |         | Q <sub>rr</sub>      |                                                                                         |     | 70   |      | nC   |
| Peak Reverse Recovery Current                                 |         | I <sub>rrm</sub>     |                                                                                         |     | 3.1  |      | A    |

Note:

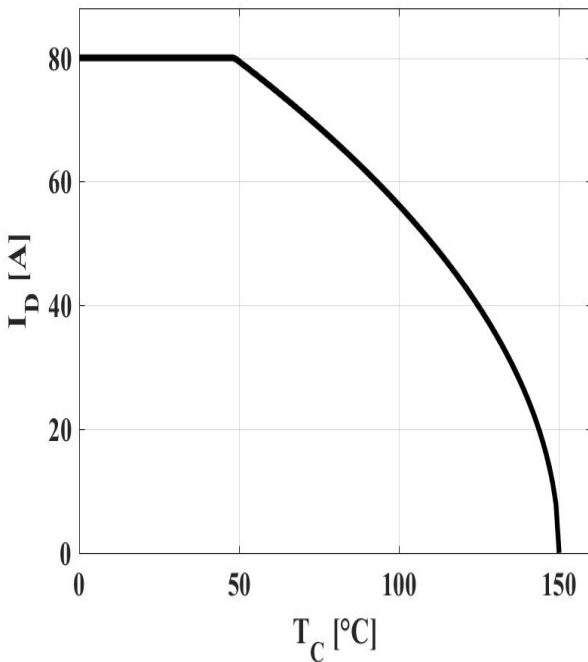
- $C_{O(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 20V
- $C_{O(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 20 V

**Typical Performance Characteristics**
**Figure 3: Power Dissipation**


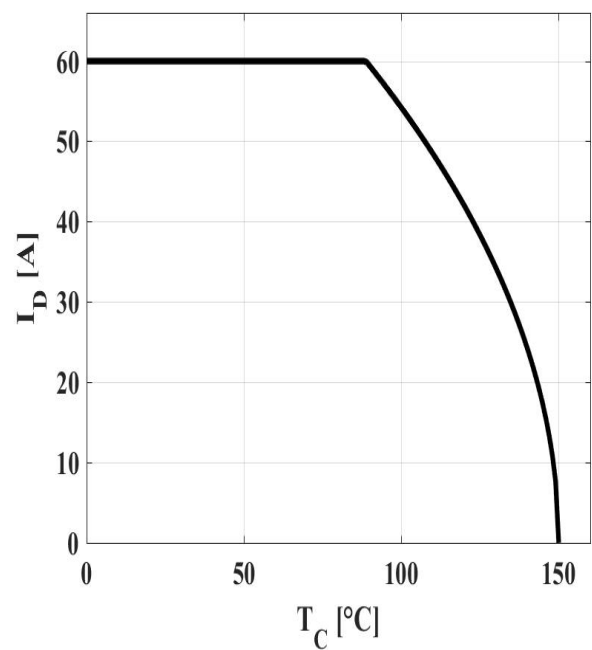
$$P_{tot}=f(T_C)$$

**Figure 4: Max. Transient Thermal Impedance**


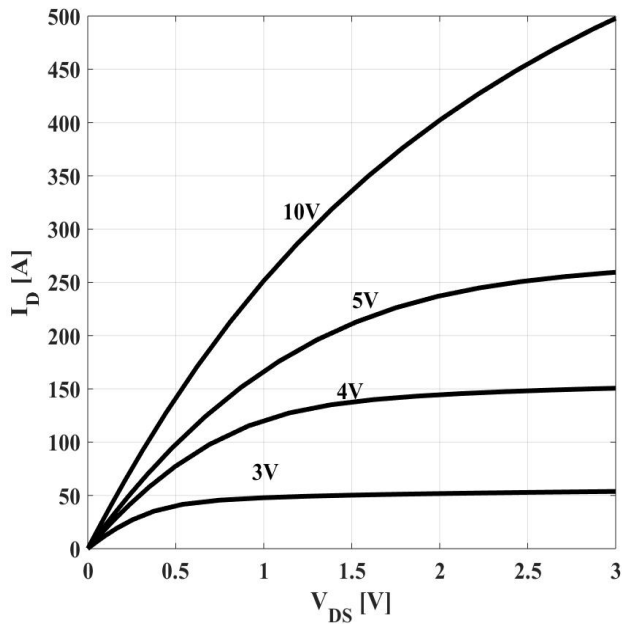
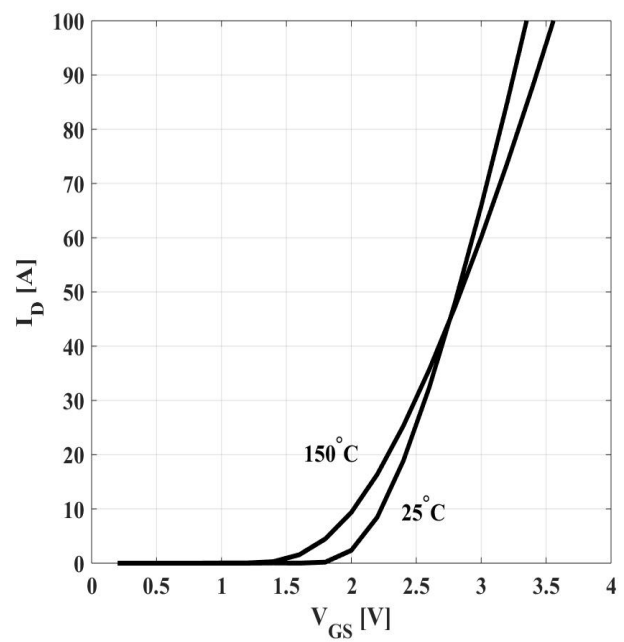
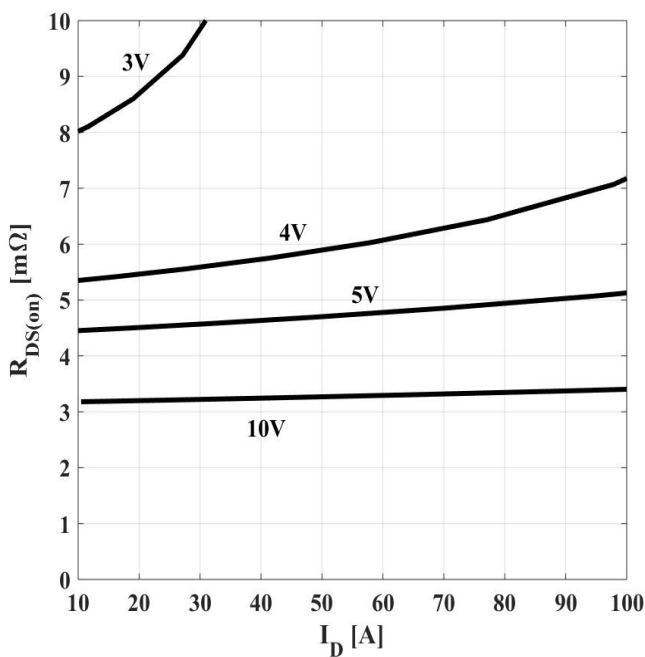
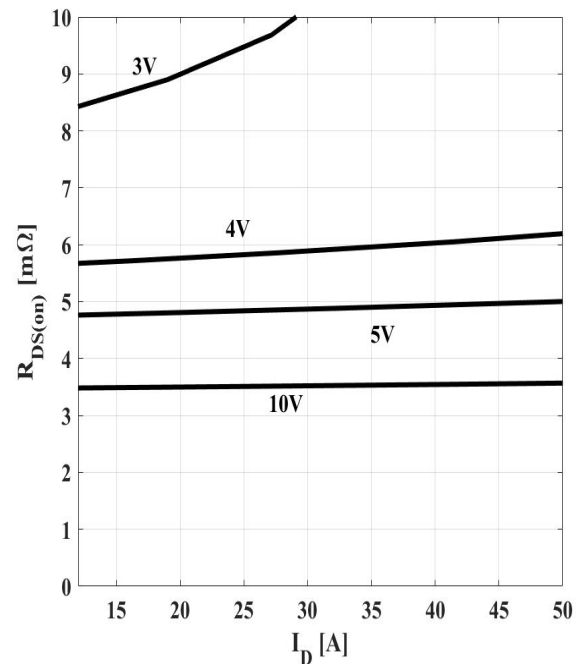
$$Z_{(thJC)}=f(t_p); \text{parameter: } D=t_p/T$$

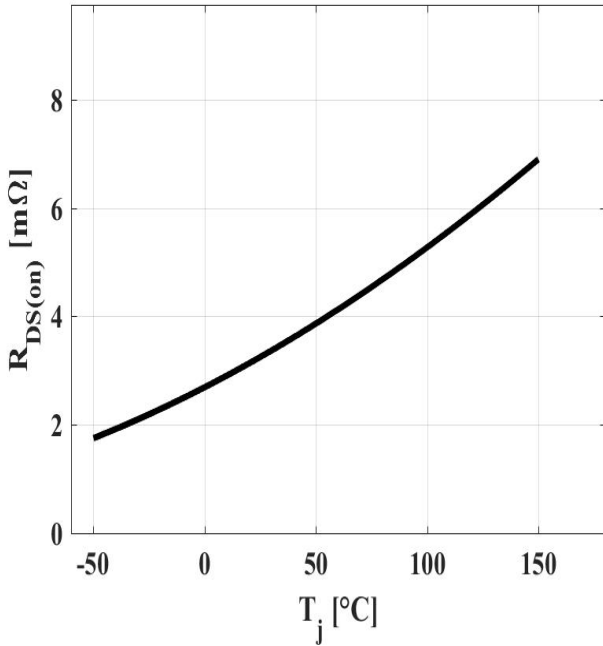
**Figure5A: Drain Current(PDFN5\*6)**


$$I_D=f(T_C); V_{GS} \geq 10V$$

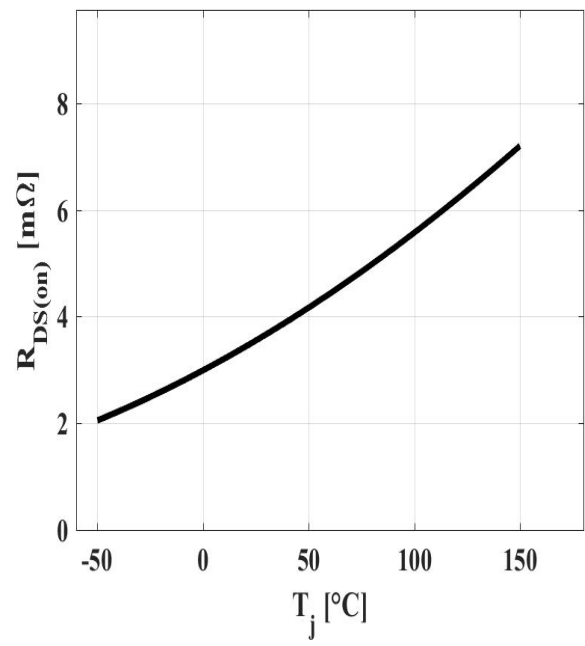
**Figure5B: Drain Current(PDFN3.3\*3.3)**


$$I_D=f(T_C); V_{GS} \geq 10V$$

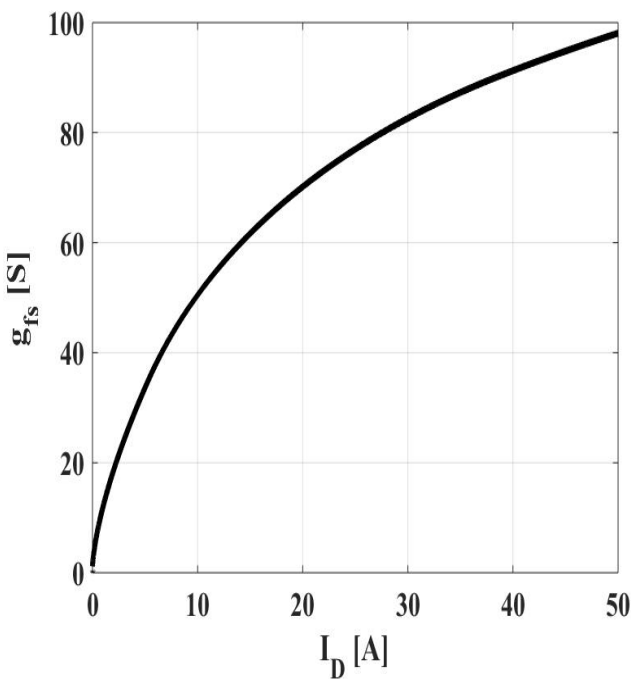
**Figure6: Typ. Output Characteristics**

 $I_D = f(V_{DS}); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$ 
**Figure7: Typ. Transfer Characteristics**

 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}; \text{parameter: } T_j$ 
**Figure8A: Typ. Drain-Source On-State Resistance (PDFN5\*6)**

 $R_{DS(ON)} = f(I_D); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$ 
**Figure8B: Typ. Drain-Source On-State Resistance (PDFN3.3\*3.3)**

 $R_{DS(ON)} = f(I_D); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$

**Figure9A: Typ. Drain-Source On-State Resistance (PDFN5\*6)**


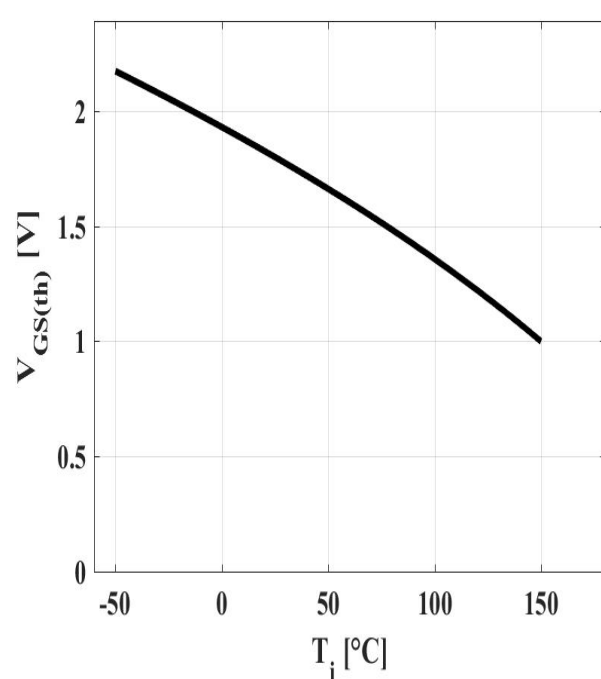
$$R_{DS(ON)}=f(T_j); I_D=20A; V_{GS}=10V$$

**Figure9B: Typ. Drain-Source On-State Resistance (PDFN3.3\*3.3)**


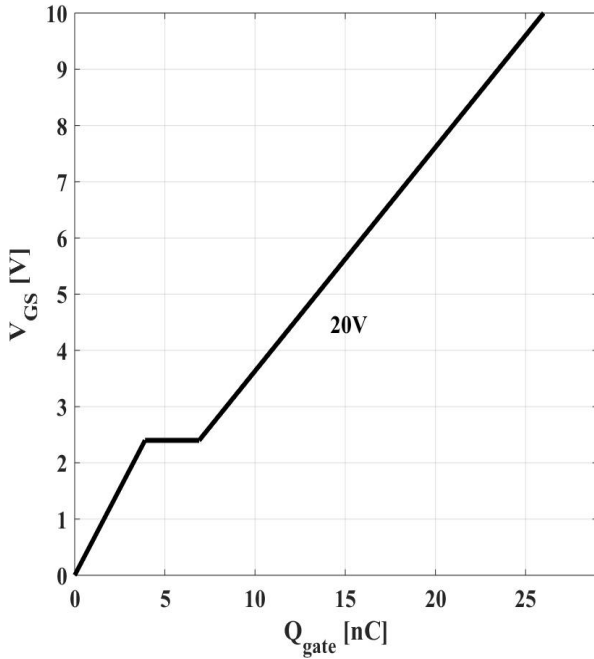
$$R_{DS(ON)}=f(T_j); I_D=20A; V_{GS}=10V$$

**Figure10: Typ. Forward Transconductance**


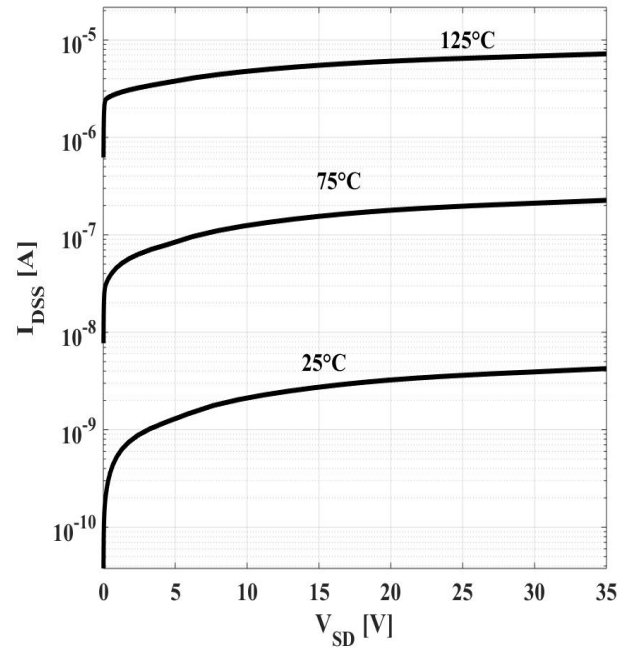
$$g_{fs}=f(I_D); T_j=25^{\circ}C$$

**Figure11: Typ. Gate Threshold Voltage**


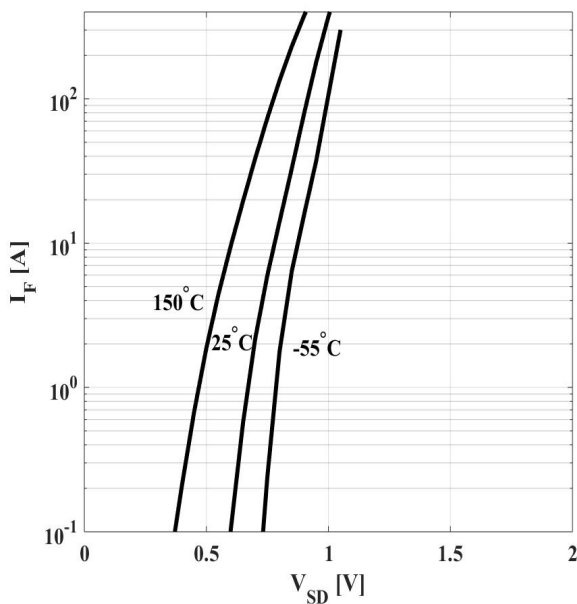
$$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}; I_{DS}=250\mu A$$

**Figure 12: Typ. Gate Charge**


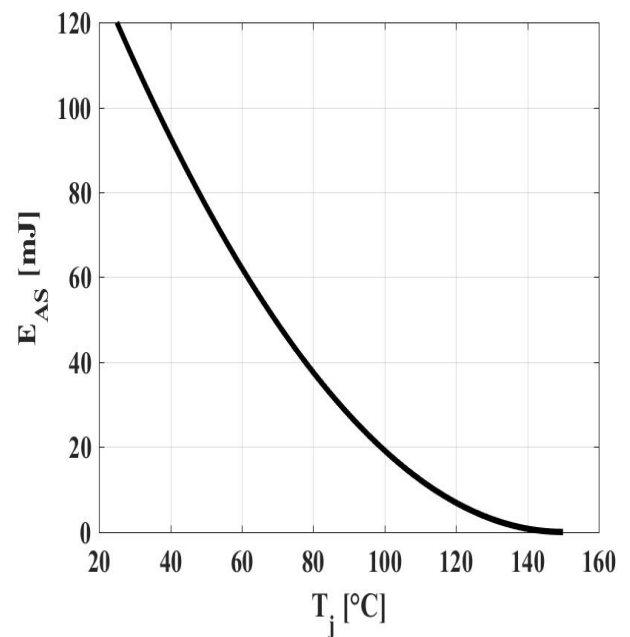
$$V_{GS} = f(Q_{gate}), I_D = 20A \text{ pulsed}$$

**Figure 13: Drain-Source Leakage Current**


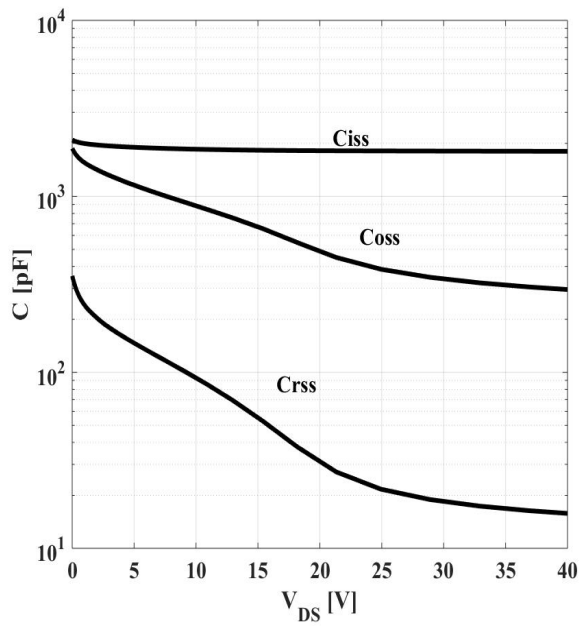
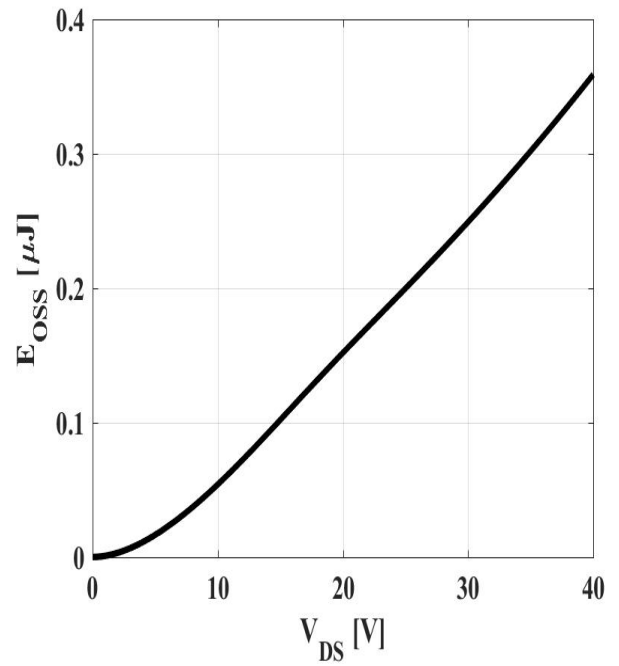
$$I_{DSS} = f(V_{DS}); V_{GS} = 0V; \text{parameter: } T_j$$

**Figure 14: Forward Characteristics of Reverse Diode**


$$I_F = f(V_{SD}); \text{parameter: } T_j$$

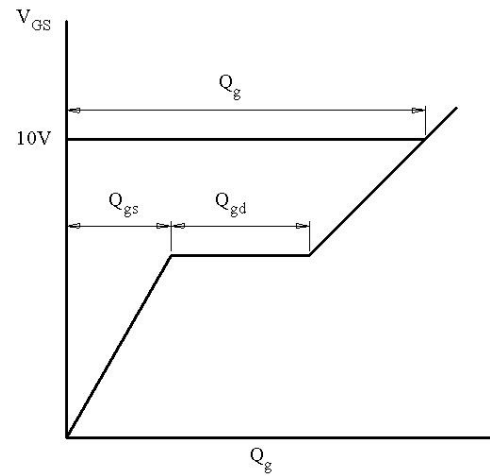
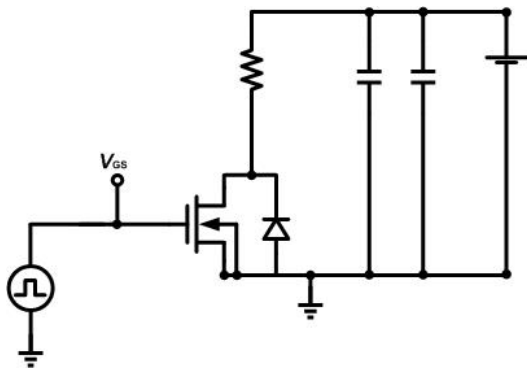
**Figure 15: Avalanche Energy**


$$E_{AS} = f(T_j); I_D = 20.0A; V_{DD} = 20V$$

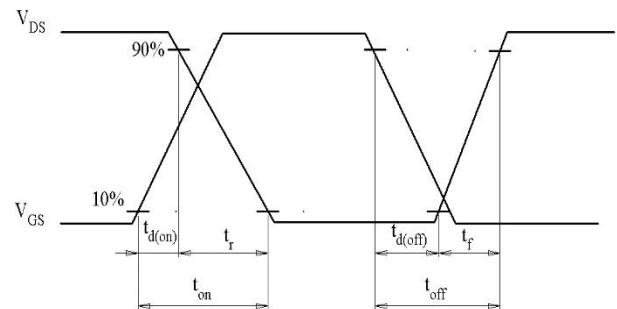
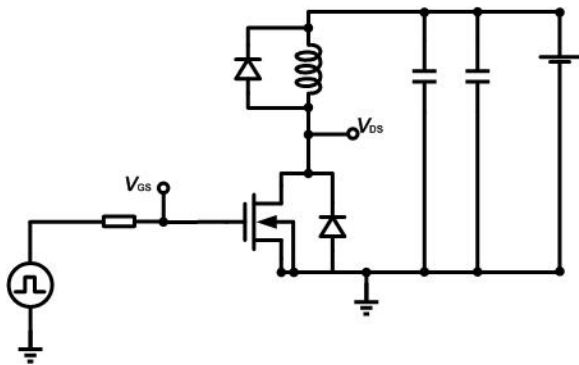
**Figure 16: Typ. Capacitances**

 $C=f(V_{DS}); V_{GS}=0; f=1\text{MHz}$ 
**Figure 17: CossStored Energy**

 $E_{OSS}=f(V_{DS})$

## Test Circuits

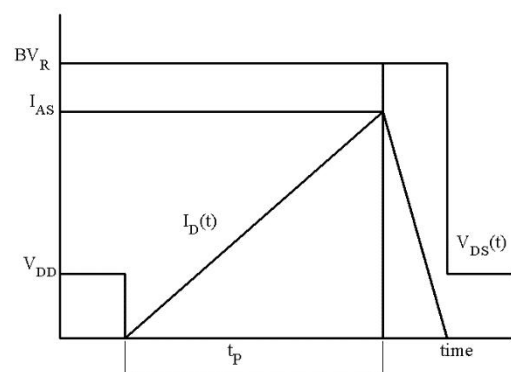
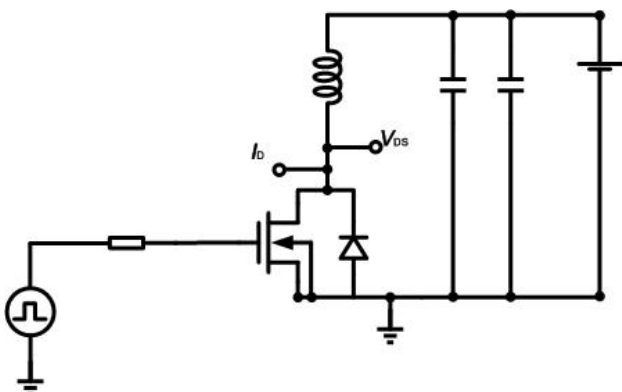
### 1. Gate Charge Test Circuit & Waveform



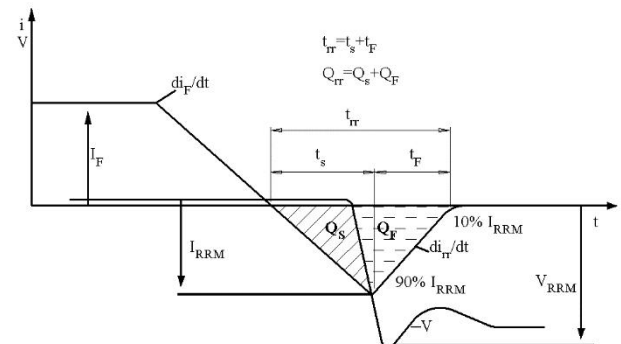
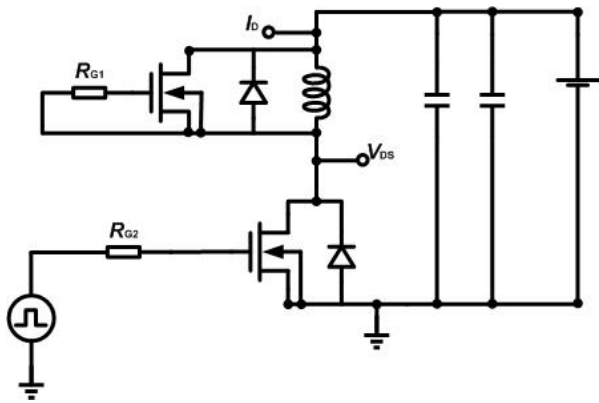
### 2. Switch Time Test Circuit

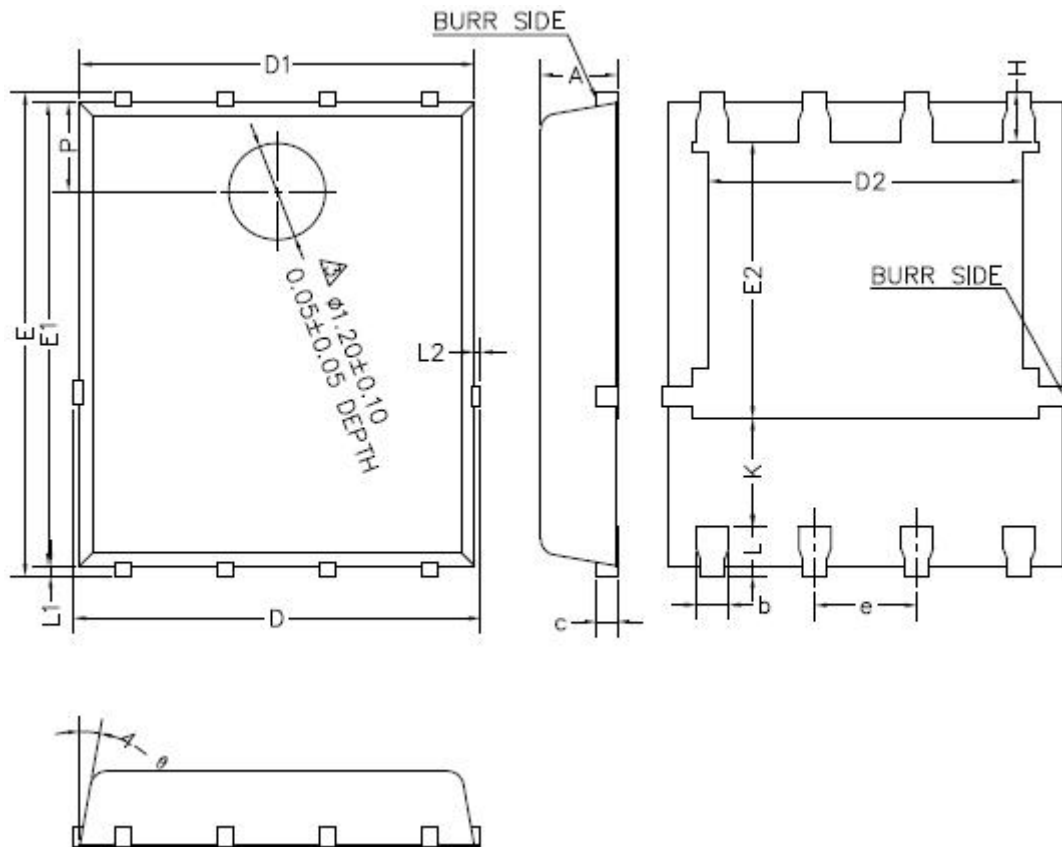


### 3. Unclamped Inductive Switching Test Circuit & Waveforms

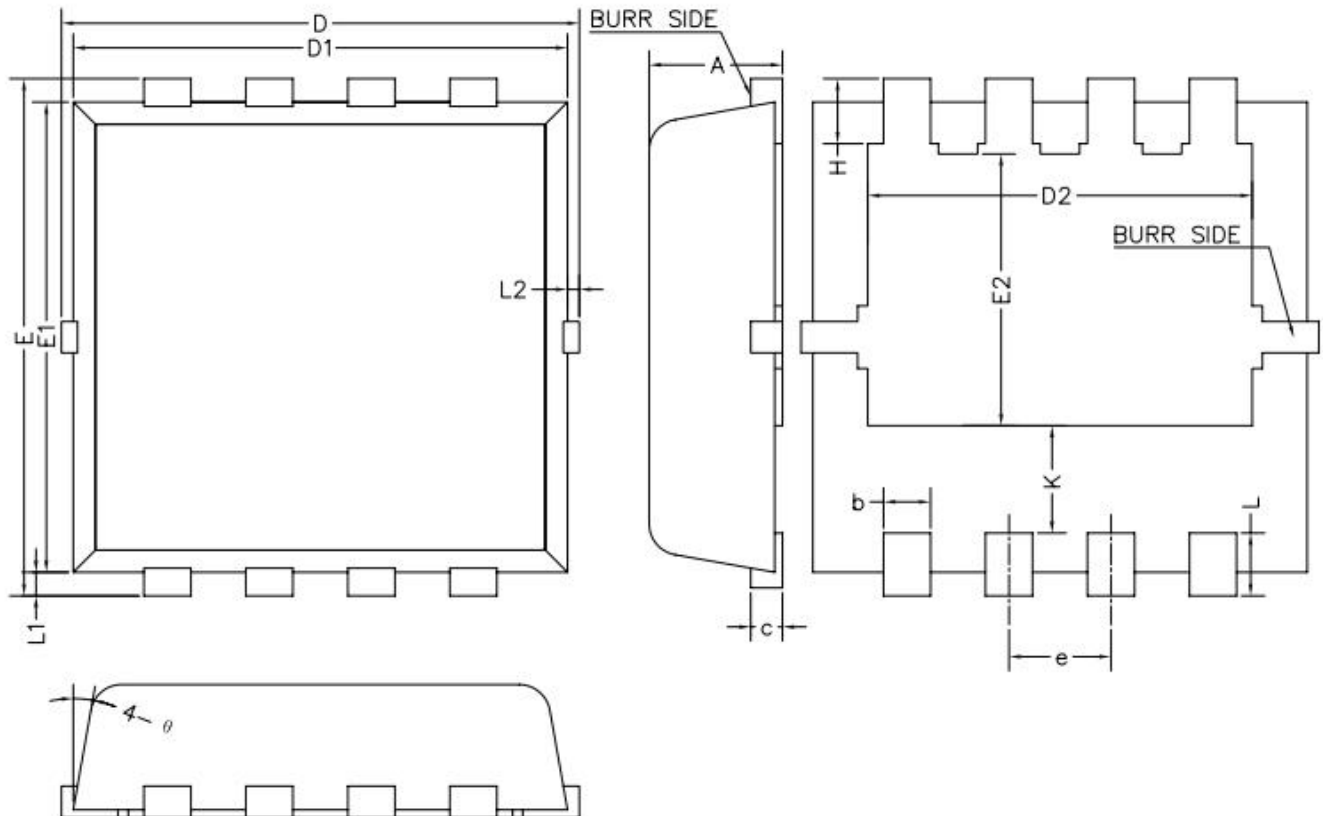


#### 4. Test Circuit and Waveform for Diode Characteristics



**Mechanical Dimensions**
**PDFN5\*6-8**
**Unit: mm**


| Symbol | Dimensions(mm) |      |      |
|--------|----------------|------|------|
|        | Min.           | Typ. | Max. |
| A      | 0.90           | 1.10 | 1.20 |
| b      | 0.35           | 0.40 | 0.45 |
| c      | 0.21           | 0.25 | 0.34 |
| D      |                |      | 5.10 |
| D1     | 4.80           | 4.90 | 5.00 |
| D2     | 3.91           | 4.01 | 4.11 |
| e      | 1.17           | 1.27 | 1.37 |
| E      | 5.90           | 6.00 | 6.10 |
| E1     | 5.70           | 5.75 | 5.80 |
| E2     | 3.34           | 3.44 | 3.54 |
| H      | 0.51           | 0.61 | 0.71 |
| K      | 1.10           |      |      |
| L      | 0.51           | 0.61 | 0.71 |
| L1     | 0.06           | 0.13 | 0.20 |
| L2     |                |      | 0.10 |
| P      | 1.00           | 1.10 | 1.20 |
| θ      | 8°             | 10°  | 12°  |

**Mechanical Dimensions (Continued)**
**PDFN3.3\*3.3-8**
**Unit: mm**


| Symbol | Dimensions (mm) |      |      | Symbol | Dimensions (mm) |      |      |
|--------|-----------------|------|------|--------|-----------------|------|------|
|        | Min.            | Typ. | Max. |        | Min.            | Typ. | Max. |
| A      | 0.70            | 0.80 | 0.90 | E1     | 2.90            | 3.00 | 3.10 |
| b      | 0.25            | 0.30 | 0.35 | E2     | 1.64            | 1.74 | 1.84 |
| c      | 0.14            | 0.15 | 0.20 | H      | 0.32            | 0.42 | 0.52 |
| D      | 3.10            | 3.30 | 3.50 | K      | 0.59            | 0.69 | 0.79 |
| D1     | 3.05            | 3.15 | 3.25 | L      | 0.25            | 0.40 | 0.55 |
| D2     | 2.35            | 2.45 | 2.55 | L1     | 0.10            | 0.15 | 0.20 |
| e      | 0.55            | 0.65 | 0.75 | L2     | —               | —    | 0.15 |
| E      | 3.10            | 3.30 | 3.50 | θ      | 8°              | 10°  | 12°  |



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