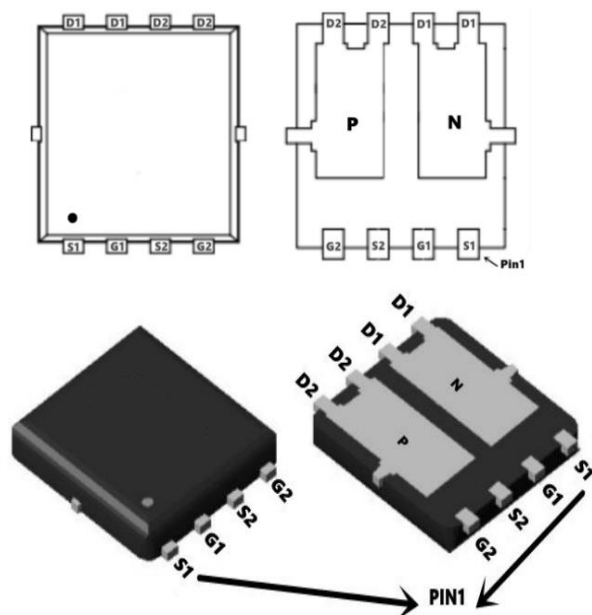


## Description

The SX40G04NF 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

$V_{DS} = 40V$   $I_D = 42A$

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

$V_{DS} = -40V$   $I_D = -38A$

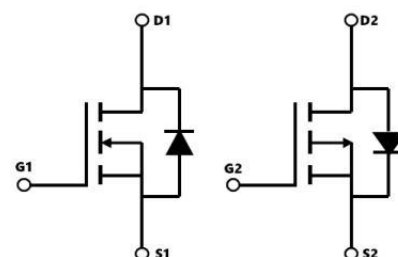
$R_{DS(ON)} < 13m\Omega$  @  $V_{GS}=-10V$

## Application

Wireless charging

Boost driver

Brushless motor



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

| Symbol                  | Parameter                                             | N-Ch       | P-Ch       | Units        |
|-------------------------|-------------------------------------------------------|------------|------------|--------------|
| $V_{DS}$                | Drain-Source Voltage                                  | 40         | -40        | V            |
| $V_{GS}$                | Gate-Source Voltage                                   | $\pm 20$   | $\pm 20$   | V            |
| $I_{D@T_c=25^\circ C}$  | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup> | 42         | -38        | A            |
| $I_{D@T_c=100^\circ C}$ | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup> | 32.5       | -27.5      | A            |
| $I_{DM}$                | Pulsed Drain Current <sup>2</sup>                     | 123        | -115       | A            |
| EAS                     | Single Pulse Avalanche Energy <sup>3</sup>            | 289        | 378        | mJ           |
| $I_{AS}$                | Avalanche Current                                     | 42         | 50         | A            |
| $P_{D@T_c=25^\circ C}$  | Total Power Dissipation <sup>4</sup>                  | 46         | 41.3       | W            |
| $T_{STG}$               | Storage Temperature Range                             | -55 to 150 | -55 to 150 | $^\circ C$   |
| $T_J$                   | Operating Junction Temperature Range                  | -55 to 150 | -55 to 150 | $^\circ C$   |
| $R_{\theta JA}$         | Thermal Resistance Junction-Ambient <sup>1</sup>      | 25         |            | $^\circ C/W$ |
| $R_{\theta JC}$         | Thermal Resistance Junction-Case <sup>1</sup>         | 2.3        |            | $^\circ C/W$ |

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

| Symbol                 | Parameter                                      | Conditions                                                                                  | Min. | Typ.  | Max. | Unit  |
|------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------|------|-------|------|-------|
| BVDSS                  | Drain-Source Breakdown Voltage                 | V <sub>GS</sub> =0V , I <sub>D</sub> =250uA                                                 | 40   | 44    | ---  | V     |
| ΔBVDSS/ΔT <sub>J</sub> | BVDSS Temperature Coefficient                  | Reference to 25°C , I <sub>D</sub> =1mA                                                     | ---  | 0.034 | ---  | V/°C  |
| RDS(ON)                | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =10V , I <sub>D</sub> =10A                                                  | ---  | 7.0   | 10   | mΩ    |
|                        |                                                | V <sub>GS</sub> =4.5V , I <sub>D</sub> =8A                                                  | ---  | 9.0   | 12   |       |
| VGS(th)                | Gate Threshold Voltage                         | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250uA                                    | 1.0  | 1.6   | 2.5  | V     |
| ΔVGS(th)               | VGS(th) Temperature Coefficient                |                                                                                             | ---  | -4.96 | ---  | mV/°C |
| IDSS                   | 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    |       |
| IGSS                   | Gate-Source Leakage Current                    | V <sub>GS</sub> =±20V , V <sub>DS</sub> =0V                                                 | ---  | ---   | ±100 | nA    |
| gfs                    | Forward Transconductance                       | V <sub>DS</sub> =5V , I <sub>D</sub> =10A                                                   | ---  | 40    | ---  | S     |
| R <sub>g</sub>         | Gate Resistance                                | V <sub>DS</sub> =0V , V <sub>GS</sub> =0V , f=1MHz                                          | ---  | 1.6   | ---  | 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> =10A                          | ---  | 18.8  |      | nC    |
| Q <sub>gs</sub>        | Gate-Source Charge                             |                                                                                             | ---  | 4.7   |      |       |
| Q <sub>gd</sub>        | Gate-Drain Charge                              |                                                                                             | ---  | 8.2   |      |       |
| Td(on)                 | Turn-On Delay Time                             | V <sub>DD</sub> =15V , V <sub>GS</sub> =10V<br>, R <sub>G</sub> =3.3Ω<br>I <sub>D</sub> =1A | ---  | 14.3  |      | ns    |
| T <sub>r</sub>         | Rise Time                                      |                                                                                             | ---  | 2.6   |      |       |
| Td(off)                | Turn-Off Delay Time                            |                                                                                             | ---  | 77    |      |       |
| T <sub>f</sub>         | Fall Time                                      |                                                                                             | ---  | 4.8   |      |       |
| Ciss                   | Input Capacitance                              | V <sub>DS</sub> =15V , V <sub>GS</sub> =0V , f=1MHz                                         | ---  | 2332  |      | pF    |
| Coss                   | Output Capacitance                             |                                                                                             | ---  | 193   |      |       |
| Crss                   | Reverse Transfer Capacitance                   |                                                                                             | ---  | 138   |      |       |
| IS                     | Continuous Source Current <sup>1,5</sup>       | V <sub>G</sub> =V <sub>D</sub> =0V , Force Current                                          | ---  | ---   | 10.5 | A     |
| ISM                    | Pulsed Source Current <sup>2,5</sup>           |                                                                                             | ---  | ---   | 42   | A     |
| VSD                    | 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 2 FR-4 board with 2OZ copper.
- 2、The data tested by pulsed , pulse width .The EAS data shows Max. rating .
- 3、The power dissipation is limited by 175°C junction temperature
- 4、EAS condition: T<sub>J</sub>=25°C , V<sub>DD</sub>=32V, V<sub>G</sub>= 10V, R<sub>G</sub>=25Ω, L=0.1mH, I<sub>AS</sub>= 25A
- 5、The data is theoretically the same as ID and IDM , in real applications , should be limited by total power dissipation.

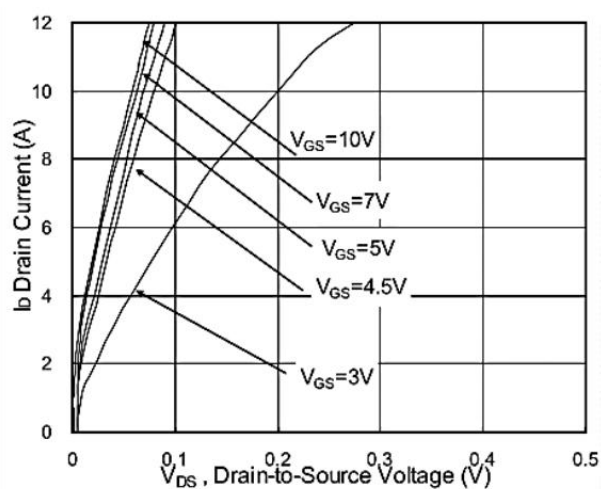
**P-Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**

| 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     |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | 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     | 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     |
| ΔV <sub>GS(th)</sub>                | V <sub>GS(th)</sub> Temperature Coefficient    |                                                                                                                  | ---  | 4.74   | ---  | mV/°C |
| I <sub>DSS</sub>                    | Drain-Source Leakage Current                   | V <sub>DS</sub> =-40V , V <sub>GS</sub> =0V , T <sub>J</sub> =25 °C                                              | ---  | ---    | 1    | uA    |
|                                     |                                                | V <sub>DS</sub> =-40V , 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    |
| Q <sub>g</sub>                      | Total Gate Charge (-4.5V)                      | V <sub>DS</sub> =-20V , V <sub>GS</sub> =-4.5V ,<br>I <sub>D</sub> =-12A                                         | ---  | 25     | ---  | nC    |
| Q <sub>gs</sub>                     | Gate-Source Charge                             |                                                                                                                  | ---  | 11     | ---  |       |
| Q <sub>gd</sub>                     | Gate-Drain Charge                              |                                                                                                                  | ---  | 9.5    | ---  |       |
| T <sub>d(on)</sub>                  | Turn-On Delay Time                             | V <sub>DD</sub> =-15V, R <sub>L</sub> =15Ω<br>I <sub>D</sub> =-1A, V <sub>GEN</sub> =-10V,<br>R <sub>G</sub> =6Ω | ---  | 48     | ---  | ns    |
| T <sub>r</sub>                      | Rise Time                                      |                                                                                                                  | ---  | 24     | ---  |       |
| T <sub>d(off)</sub>                 | Turn-Off Delay Time                            |                                                                                                                  | ---  | 88     | ---  |       |
| T <sub>f</sub>                      | Fall Time                                      |                                                                                                                  | ---  | 9.6    | ---  |       |
| C <sub>iss</sub>                    | Input Capacitance                              | V <sub>DS</sub> =-20V , V <sub>GS</sub> =0V , f=1MHz                                                             | ---  | 2760   | ---  | pF    |
| C <sub>oss</sub>                    | Output Capacitance                             |                                                                                                                  | ---  | 260    | ---  |       |
| C <sub>rss</sub>                    | Reverse Transfer Capacitance                   |                                                                                                                  | ---  | 85     | ---  |       |
| I <sub>S</sub>                      | Continuous Source Current <sup>1,5</sup>       | V <sub>G</sub> =V <sub>D</sub> =0V , Force Current                                                               | ---  | ---    | -40  | A     |
| I <sub>SM</sub>                     | Pulsed Source Current <sup>2,5</sup>           |                                                                                                                  | ---  | ---    | -90  | 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                                                | ---  | ---    | -1.3 | V     |

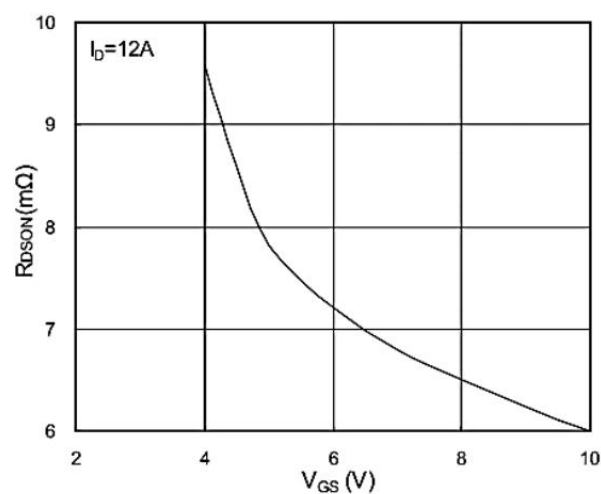
**Note :**

- 1、The data tested by surface mounted on a 1 inch 2 FR-4 board with 2OZ copper.
- 2、The data tested by pulsed , pulse width .The EAS data shows Max. rating .
- 3、The power dissipation is limited by 175 °C junction temperature
- 4、EAS condition: T<sub>J</sub>=25 °C , V<sub>DD</sub>= -24V, V<sub>G</sub>= -10V, R<sub>G</sub>=7Ω, L=0.1mH, I<sub>AS</sub>= -29A
- 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.

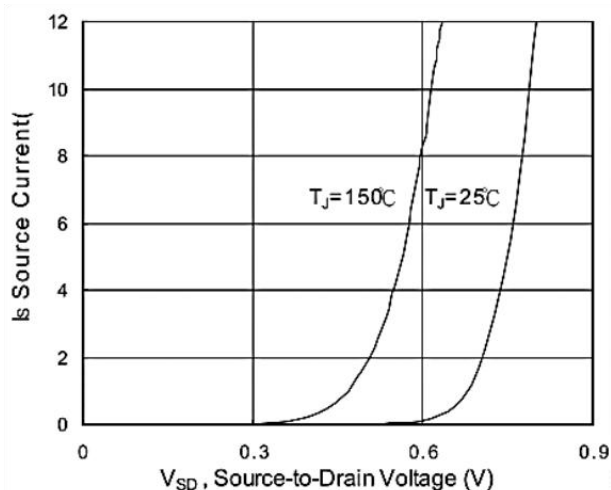
## N-Typical Characteristics



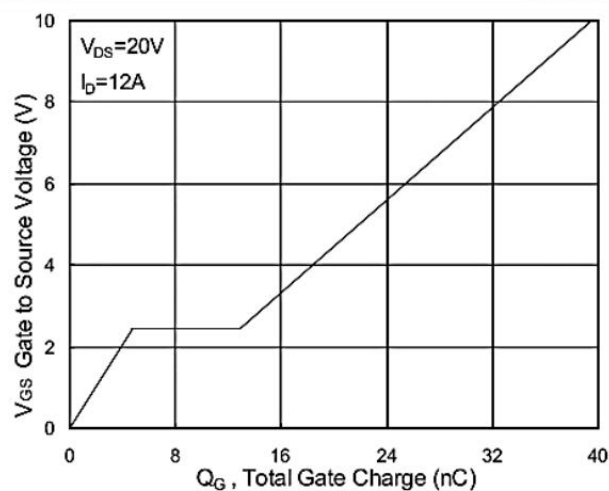
**Fig.1 Typical Output Characteristics**



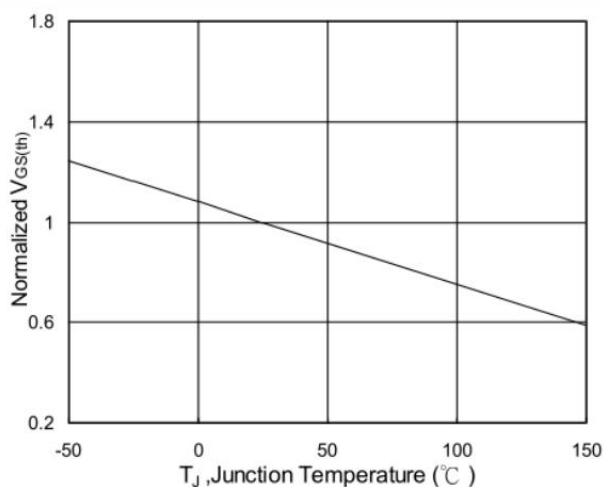
**Fig.2 On-Resistance vs. G-S Voltage**



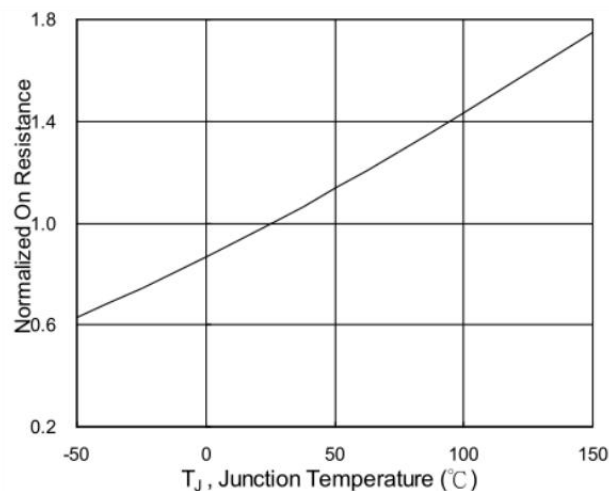
**Fig.3 Forward Characteristics of Reverse**



**Fig.4 Gate-Charge Characteristics**



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



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

## N-Typical Characteristics

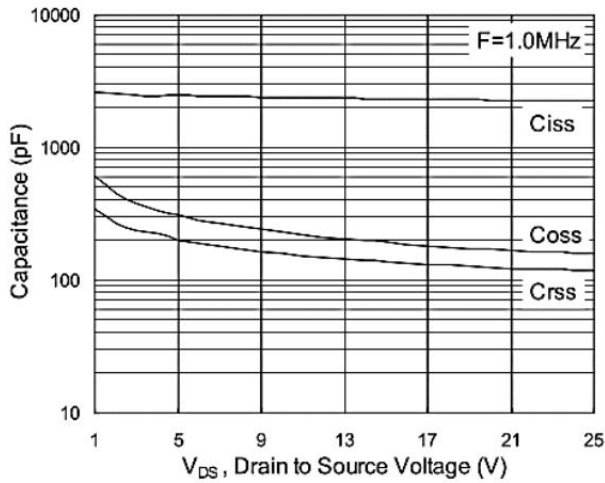


Fig.7 Capacitance

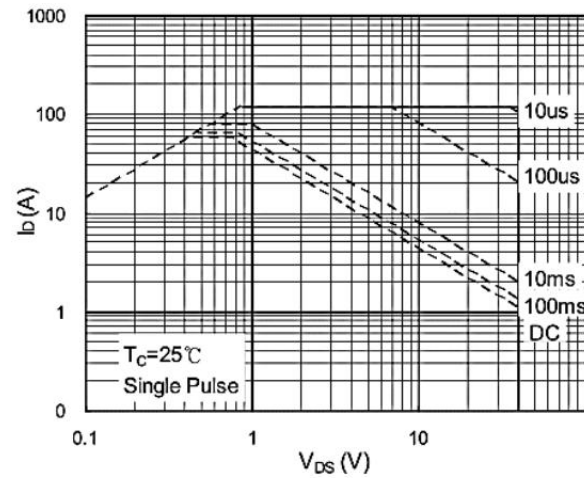


Fig.8 Safe Operating Area

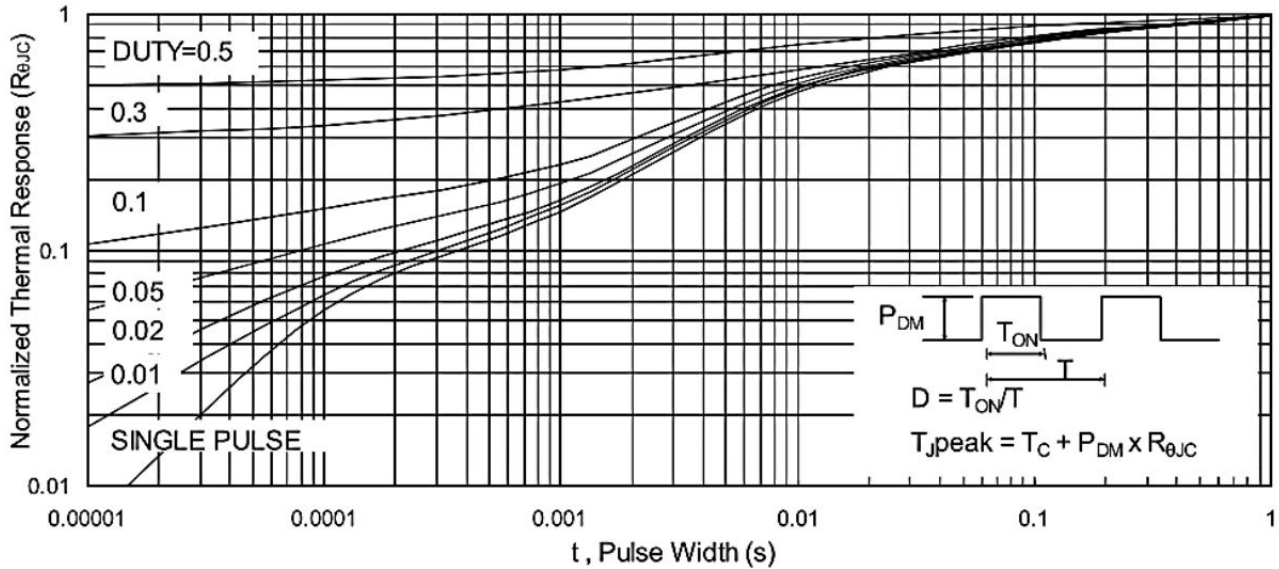


Fig.9 Normalized Maximum Transient Thermal Impedance

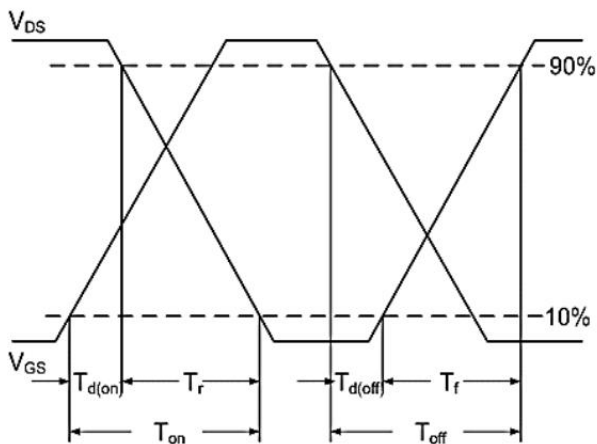


Fig.10 Switching Time Waveform

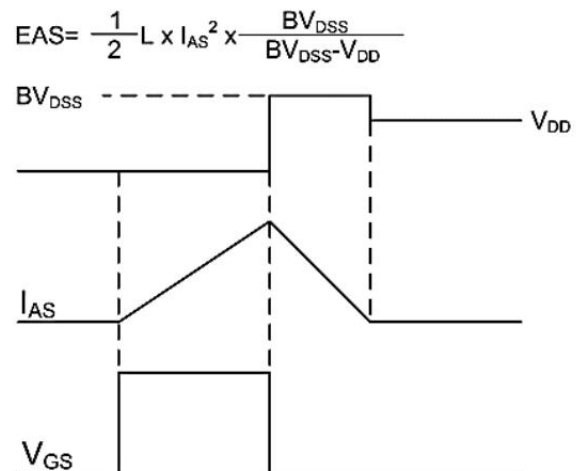


Fig.11 Unclamped Inductive Waveform

## P-Typical Characteristics

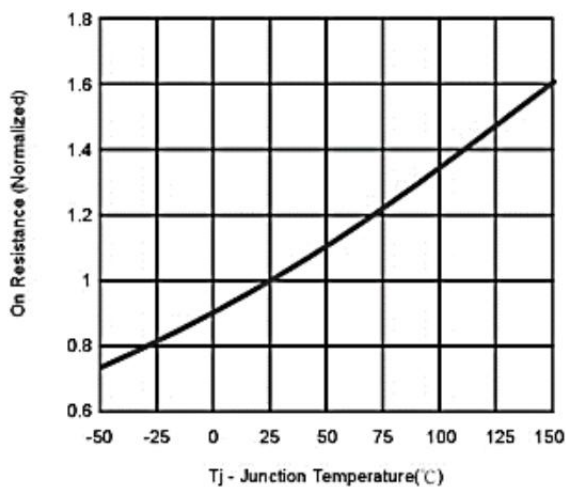


Fig.1 On Resistance Vs Junction Temperature

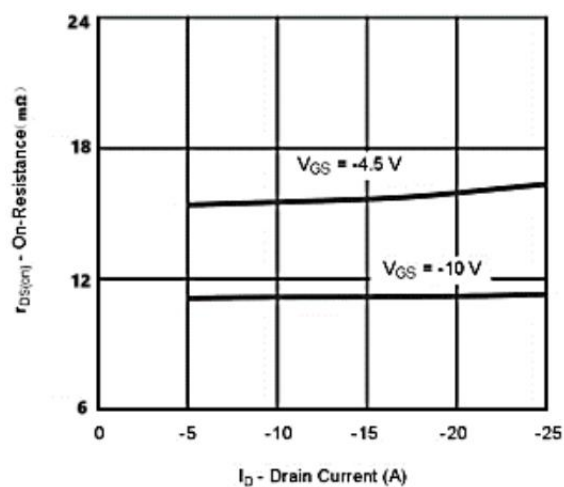


Fig.2 On-Resistance Vs. Drain Current

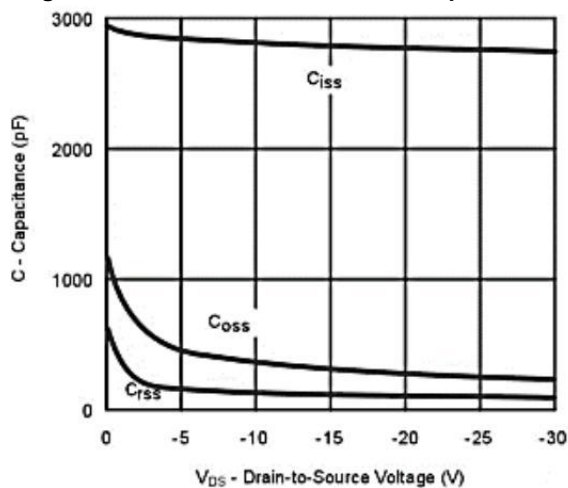


Fig.3 Capacitance

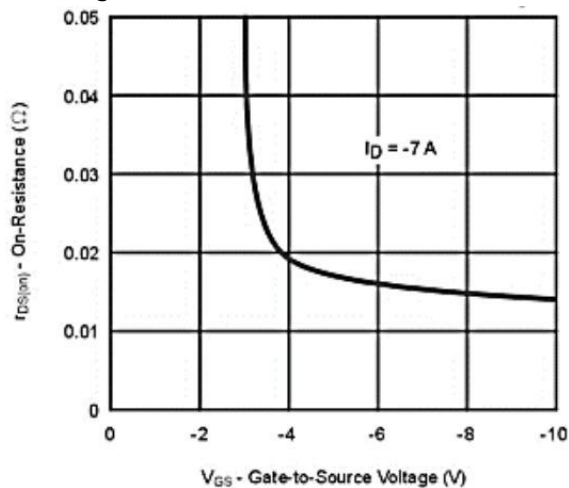


Fig.4 On-Resistance Vs. Gate-to-Source Voltage

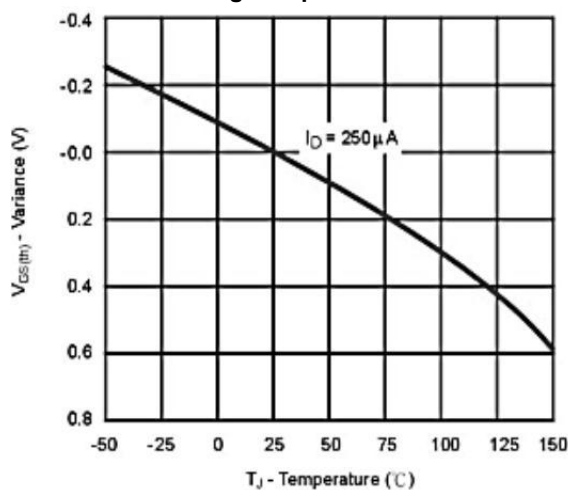


Fig.5 Threshold Voltage

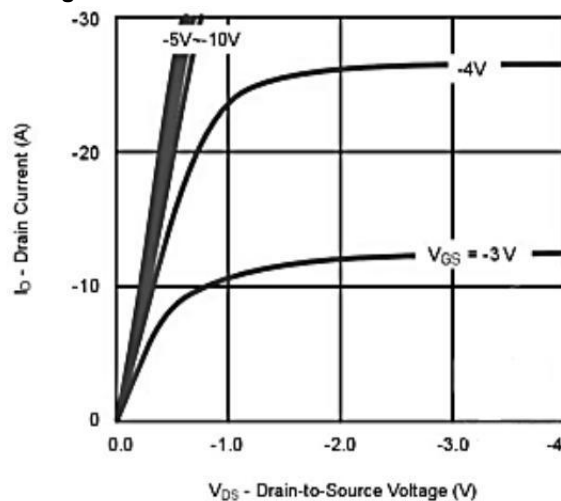
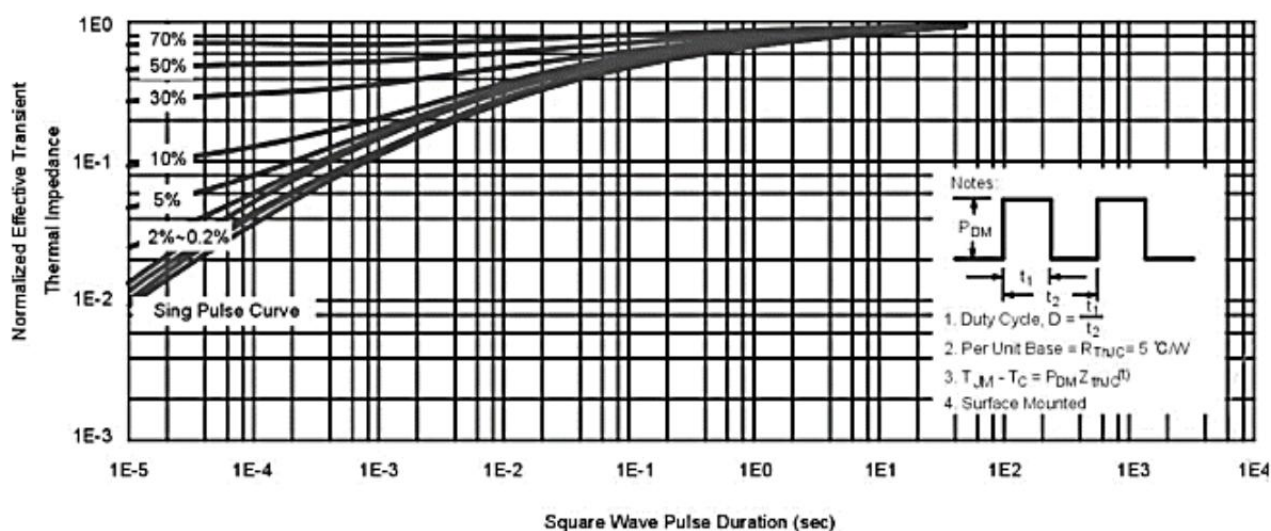
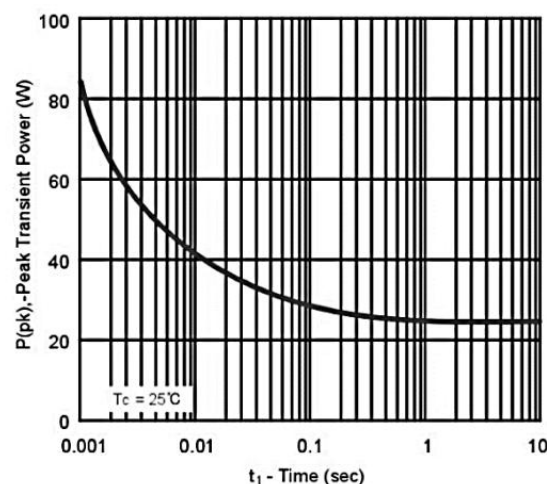
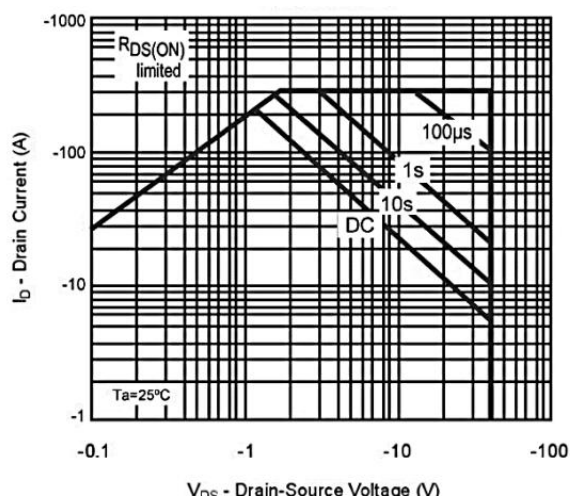
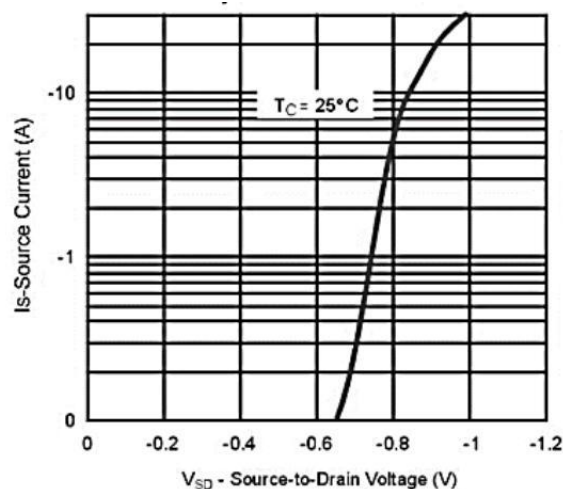
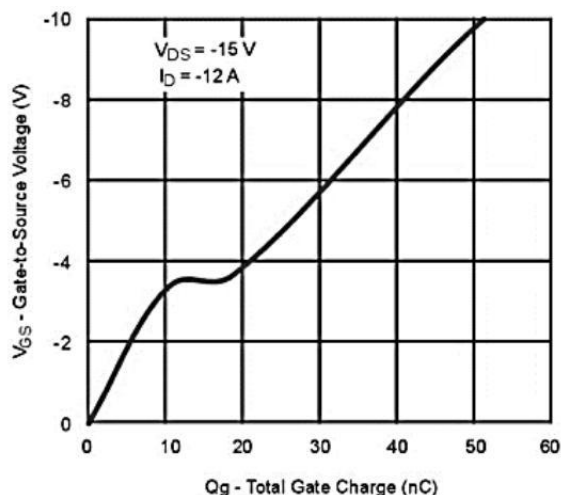


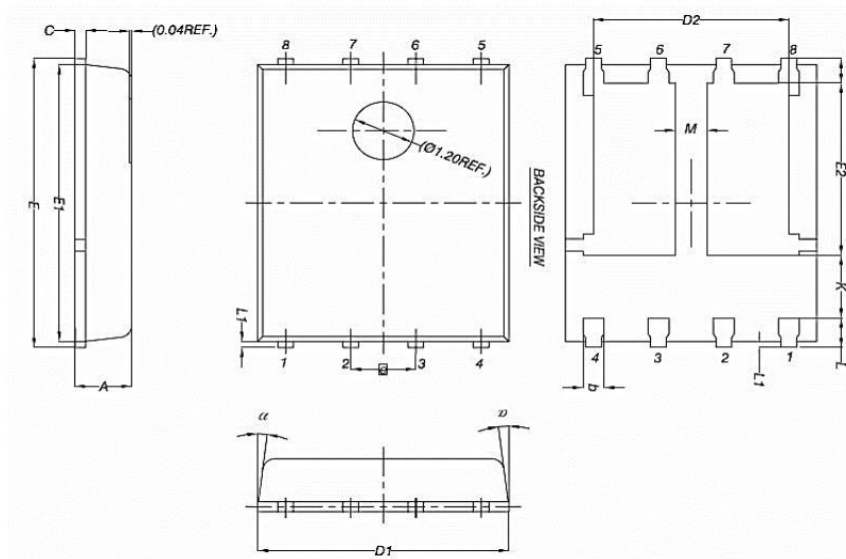
Fig.6 On-Region Characteristics



## P-Typical Characteristics



## Package Mechanical Data-PDFN5\*6-8L-JQ Double



| Symbol | Common  |      |      |
|--------|---------|------|------|
|        | mm      |      |      |
|        | Mim     | Nom  | Max  |
| A      | 0.90    | 1.00 | 1.10 |
| b      | 0.33    | 0.41 | 0.51 |
| C      | 0.20    | 0.25 | 0.30 |
| D1     | 4.80    | 4.90 | 5.00 |
| D2     | 3.61    | 3.81 | 3.96 |
| E      | 5.90    | 6.00 | 6.10 |
| E1     | 5.70    | 3.30 | 3.45 |
| E2     | 3.38    | 3.05 | 3.20 |
| e      | 1.27BSC |      |      |
| H      | 0.41    | 0.51 | 0.61 |
| K      | 1.10    | --   | --   |
| L      | 0.51    | 0.61 | 0.71 |
| L1     | 0.06    | 0.13 | 0.20 |
| M      | 0.50    | --   | --   |
| a      | 0°      | --   | 12°  |

### Package Marking and Ordering Information

| Product ID | Pack       | Marking | Qty(PCS) |
|------------|------------|---------|----------|
| TAPING     | PDFN5*6-8L |         | 5000     |