

## Description:

This N+P Channel MOSFET uses advanced trench technology and design to provide excellent  $R_{DS(on)}$  with low gate charge.

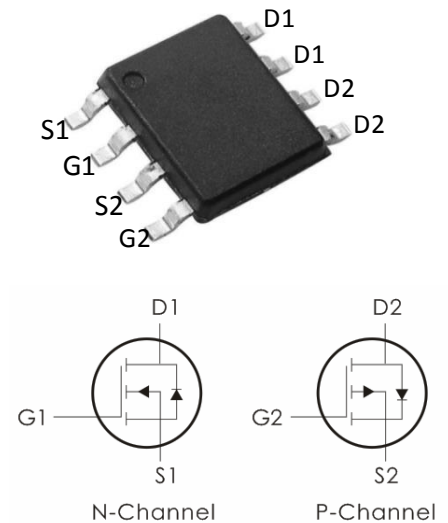
It can be used in a wide variety of applications.

## Features:

N-Channel:  $V_{DS}=60V, I_D=8A, R_{DS(on)} < 18m\Omega @ V_{GS}=10V$

P-Channel:  $V_{DS}=-60V, I_D=-9A, R_{DS(on)} < 25m\Omega @ V_{GS}=-10V$

- 1) Low gate charge.
- 2) Green device available.
- 3) Advanced high cell density trench technology for ultra low  $R_{DS(on)}$ .
- 4) Excellent package for good heat dissipation.



## Package Marking and Ordering Information:

| Part NO. | Marking | Package | Packing       |
|----------|---------|---------|---------------|
| DOS4610  | S4610   | SOP-8D  | 3000 pcs/Reel |

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

| Symbol         | Parameter                                        | N-Channel   | P-Channel | Units      |
|----------------|--------------------------------------------------|-------------|-----------|------------|
| $V_{DS}$       | Drain-Source Voltage                             | 60          | -60       | V          |
| $V_{GS}$       | Gate-Source Voltage                              | $\pm 20$    | $\pm 20$  | V          |
| $I_D$          | Continuous Drain Current- $T_A=25^\circ C$       | 8           | -9        | A          |
|                | Continuous Drain Current- $T_A=100^\circ C$      | 6           | -6        |            |
| $I_{DM}$       | Pulsed Drain Current                             | 36.8        | -48       | A          |
| $P_D$          | Power Dissipation - $T_A=25^\circ C$             | 3.6         | 3.6       | W          |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150 |           | $^\circ C$ |

## Thermal Characteristics:

| Symbol          | Parameter                               | N-CH | P-CH | Units                       |
|-----------------|-----------------------------------------|------|------|-----------------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 34.7 | 34.7 | $^{\circ}\text{C}/\text{W}$ |

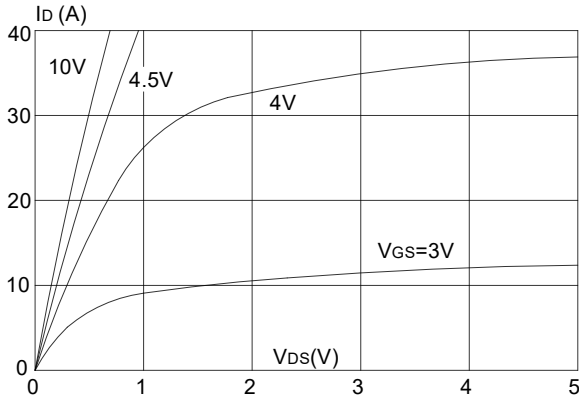
## N-Channel Electrical Characteristics: ( $T_A=25^{\circ}\text{C}$ unless otherwise noted)

| Symbol                                 | Parameter                                       | Conditions                                                                                     | Min | Typ  | Max   | Units |
|----------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------|-----|------|-------|-------|
| Off Characteristics                    |                                                 |                                                                                                |     |      |       |       |
| BV <sub>DSS</sub>                      | Drain-Source Breakdown Voltage                  | V <sub>GS</sub> =0V, I <sub>D</sub> =250 μ A                                                   | 60  | ---  | ---   | V     |
| I <sub>DSS</sub>                       | Zero Gate Voltage Drain Current                 | V <sub>GS</sub> =0V, V <sub>DS</sub> =20V                                                      | --- | ---  | 1     | μ A   |
| I <sub>GSS</sub>                       | Gate-Source Leakage Current                     | V <sub>GS</sub> = ± 20V, V <sub>DS</sub> =0A                                                   | --- | ---  | ± 100 | nA    |
| On Characteristics                     |                                                 |                                                                                                |     |      |       |       |
| V <sub>GS(th)</sub>                    | GATE-Source Threshold Voltage                   | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250 μ A                                     | 1   | 1.6  | 2.5   | V     |
| R <sub>DS(ON)</sub>                    | Drain-Source On Resistance <sup>2</sup>         | V <sub>GS</sub> =10V, I <sub>D</sub> =9A                                                       | --- | 16   | 18    | m Ω   |
|                                        |                                                 | V <sub>GS</sub> =4.5V, I <sub>D</sub> =5A                                                      | --- | 20   | 25    |       |
| Dynamic Characteristics                |                                                 |                                                                                                |     |      |       |       |
| C <sub>iss</sub>                       | Input Capacitance                               | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1MHz                                              | --- | 2030 | ---   | pF    |
| C <sub>OSS</sub>                       | Output Capacitance                              |                                                                                                | --- | 139  | ---   |       |
| C <sub>rss</sub>                       | Reverse Transfer Capacitance                    |                                                                                                | --- | 123  | ---   |       |
| Q <sub>g</sub>                         | Gate Charge                                     | V <sub>GS</sub> =10V , V <sub>DS</sub> =10V<br><br>I <sub>D</sub> =5A                          | --- | 45   | ---   | nC    |
| Q <sub>gs</sub>                        | Gate-Source Charge                              |                                                                                                | --- | 5    | ---   |       |
| Q <sub>gd</sub>                        | Gate-Drain Charge                               |                                                                                                | --- | 14   | ---   |       |
| Switching Characteristics <sup>4</sup> |                                                 |                                                                                                |     |      |       |       |
| t <sub>d(on)</sub>                     | Turn-On Delay Time                              | V <sub>DS</sub> =30V, I <sub>D</sub> =5A,<br><br>R <sub>REN</sub> =1.8 Ω ,V <sub>GS</sub> =10V | --- | 7.3  | ---   | ns    |
| t <sub>r</sub>                         | Rise Time                                       |                                                                                                | --- | 5    | ---   | ns    |
| t <sub>d(off)</sub>                    | Turn-Off Delay Time                             |                                                                                                | --- | 28.1 | ---   | ns    |
| t <sub>f</sub>                         | Fall Time                                       |                                                                                                | --- | 5.4  | ---   | ns    |
| Drain-Source Diode Characteristics     |                                                 |                                                                                                |     |      |       |       |
| I <sub>S</sub>                         | Continuous Drain to Source Diode                | VD=VG=0V                                                                                       | --- | ---- | 8     | A     |
| I <sub>SM</sub>                        | Pulsed Drain to Source Diode                    | VD=VG=0V                                                                                       | --- | ---  | 36.8  | A     |
| V <sub>SD</sub>                        | Source-Drain Diode Forward Voltage <sup>2</sup> | V <sub>GS</sub> =0V, I <sub>S</sub> =9.2A                                                      | --- | ---  | 1.2   | V     |

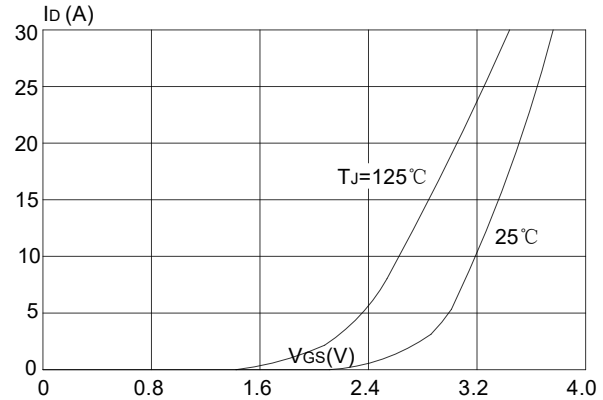
## Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2. EAS condition :  $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=30\text{V}$ ,  $V_G=10\text{V}$ ,  $L=0.5\text{mH}$ ,  $R_g=25\ \Omega$ ,  $I_{AS}=16\text{A}$
3. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 0.5\%$

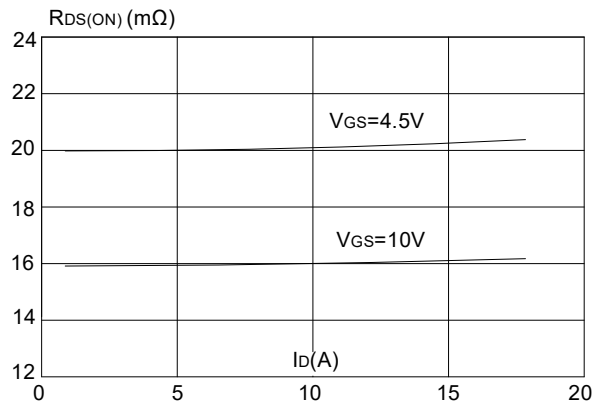
## N-Typical Characteristics: ( $T_A=25^{\circ}\text{C}$ unless otherwise noted)



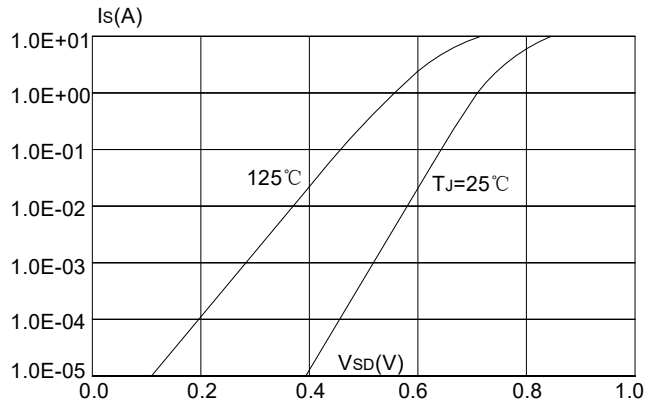
**Figure 1:** Output Characteristics



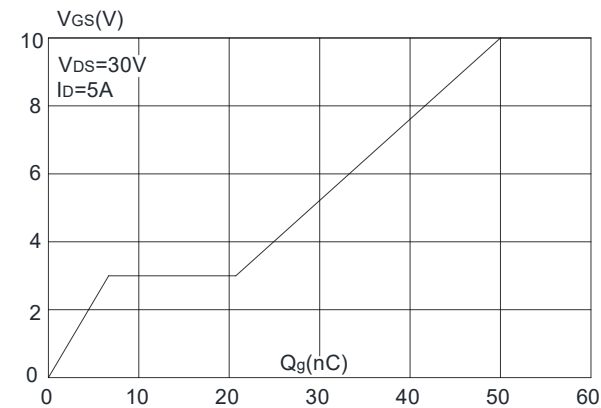
**Figure 2:** Typical Transfer Characteristics



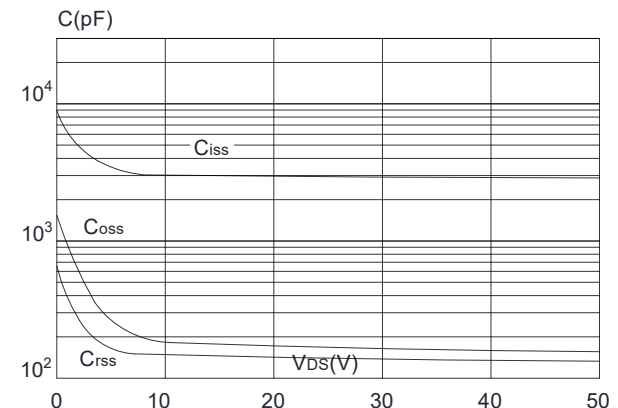
**Figure 3:** On-resistance vs. Drain Current



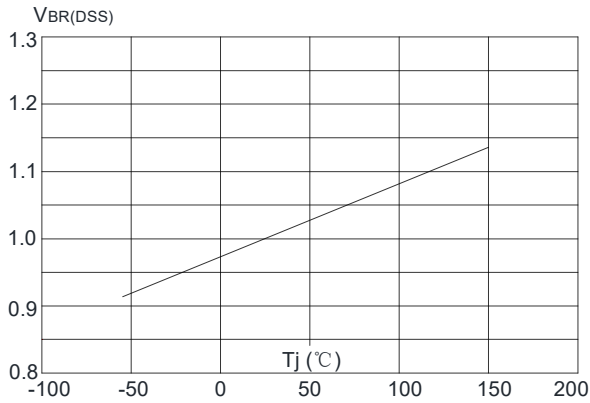
**Figure 4:** Body Diode Characteristics



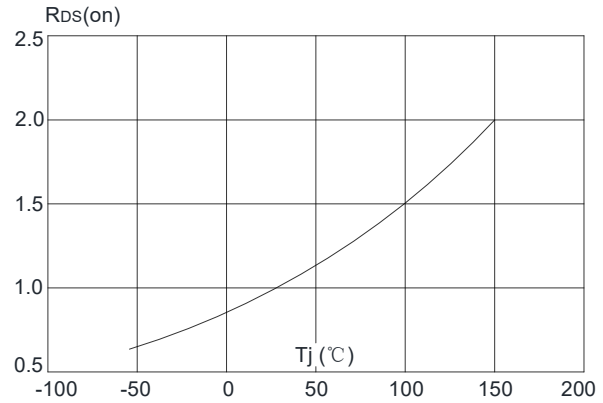
**Figure 5:** Gate Charge Characteristics



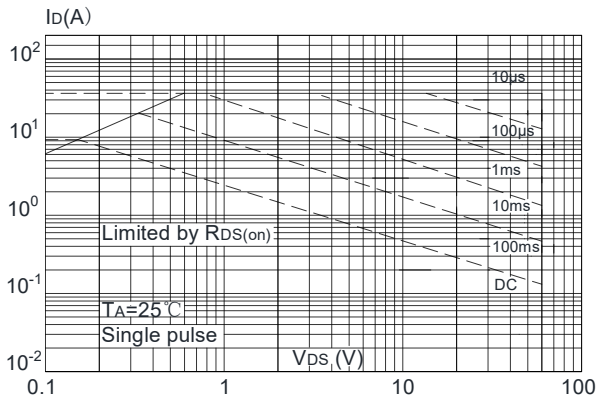
**Figure 6:** Capacitance Characteristics



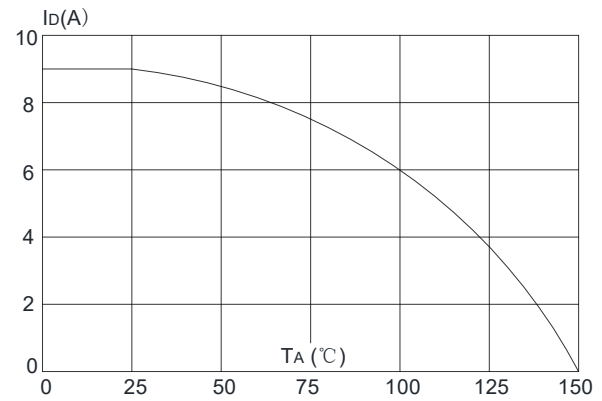
**Figure 7:** Normalized Breakdown Voltage vs. Junction Temperature



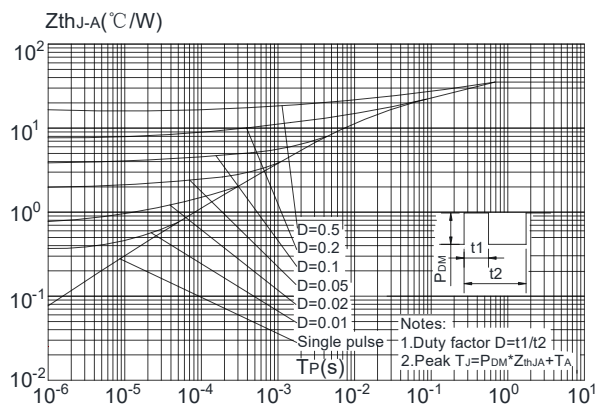
**Figure 8:** Normalized on Resistance vs. Junction Temperature



**Figure 9:** Maximum Safe Operating Area



**Figure 10:** Maximum Continuous Drain Current vs. Ambient Temperature



**Figure.11:** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

## P-Channel Electrical Characteristics: ( $T_A=25^{\circ}\text{C}$ unless otherwise noted)

| Symbol                             | Parameter                          | Conditions                                                                                        | Min  | Typ   | Max   | Units |
|------------------------------------|------------------------------------|---------------------------------------------------------------------------------------------------|------|-------|-------|-------|
| Off Characteristics                |                                    |                                                                                                   |      |       |       |       |
| BV <sub>DSS</sub>                  | Drain-Sourctce Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>D</sub> =250 μ A                                                      | -60  | ---   | ---   | V     |
| I <sub>DSS</sub>                   | Zero Gate Voltage Drain Current    | V <sub>GS</sub> =0V, V <sub>DS</sub> =-60V                                                        | ---  | ---   | -1    | μ A   |
| I <sub>GSS</sub>                   | Gate-Source Leakage Current        | V <sub>GS</sub> =± 20V, V <sub>DS</sub> =0A                                                       | ---  | ---   | ± 100 | nA    |
| On Characteristics                 |                                    |                                                                                                   |      |       |       |       |
| V <sub>GS(th)</sub>                | GATE-Source Threshold Voltage      | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250 μ A                                        | -1.3 | -1.8  | -2.3  | V     |
| R <sub>DS(ON)</sub>                | Drain-Source On Resistance         | V <sub>GS</sub> =-10V, I <sub>D</sub> =-10A                                                       | ---  | 20    | 25    | m Ω   |
|                                    |                                    | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-8A                                                       | ---  | 25    | 32    |       |
| Dynamic Characteristics            |                                    |                                                                                                   |      |       |       |       |
| C <sub>iss</sub>                   | Input Capacitance                  | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V, f=1MHz                                                | ---  | 1575  | ---   | pF    |
| C <sub>oss</sub>                   | Output Capacitance                 |                                                                                                   | ---  | 235   | ---   |       |
| C <sub>rss</sub>                   | Reverse Transfer Capacitance       |                                                                                                   | ---  | 11.4  | ---   |       |
| Switching Characteristics          |                                    |                                                                                                   |      |       |       |       |
| t <sub>d(on)</sub>                 | Turn-On Delay Time                 | V <sub>DD</sub> = -30V, I <sub>D</sub> =-10A<br><br>V <sub>GS</sub> = -10V, R <sub>GEN</sub> =3 Ω | ---  | 14.25 | ---   | ns    |
| t <sub>r</sub>                     | Rise Time                          |                                                                                                   | ---  | 16.15 | ---   | ns    |
| t <sub>d(off)</sub>                | Turn-Off Delay Time                |                                                                                                   | ---  | 38    | ---   | ns    |
| t <sub>f</sub>                     | Fall Time                          |                                                                                                   | ---  | 47.25 | ---   | ns    |
| Q <sub>g</sub>                     | Total Gate Charge                  | V <sub>GS</sub> =-10V, V <sub>DS</sub> =-30V,<br><br>I <sub>D</sub> =-10A                         | ---  | 20.9  | ---   | nC    |
| Q <sub>gs</sub>                    | Gate-Source Charge                 |                                                                                                   | ---  | 3.88  | ---   | nC    |
| Q <sub>gd</sub>                    | Gate-Drain “Miller” Charge         |                                                                                                   | ---  | 2.85  | ---   | nC    |
| Drain-Source Diode Characteristics |                                    |                                                                                                   |      |       |       |       |
| V <sub>SD</sub>                    | Source-Drain Diode Forward Voltage | V <sub>GS</sub> =0V, I <sub>S</sub> =-5A                                                          | ---  | ---   | -1.2  | V     |
| I <sub>S</sub>                     | Continuous Drain to Source Diode   | VD=VG=0V                                                                                          | ---  | ---   | -9    | A     |
| I <sub>SM</sub>                    | Pulsed Drain to Source Diode       |                                                                                                   | ---  | ---   | -48   | A     |

P-Typical Characteristics: ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)

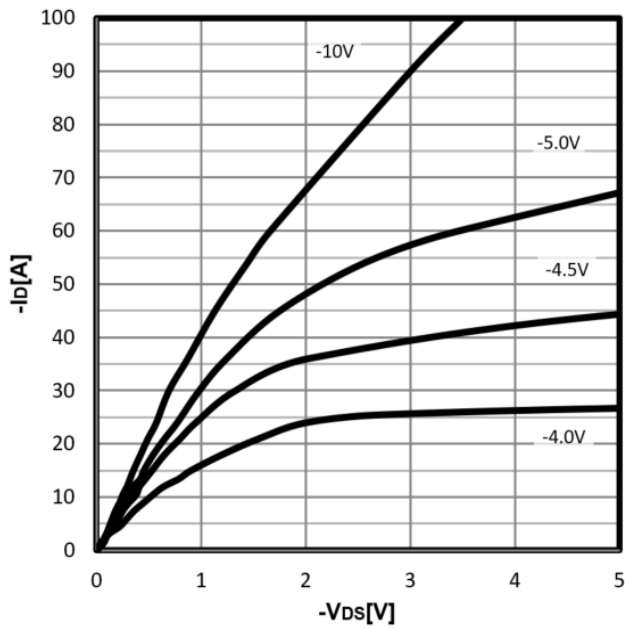


Fig1. Typ. output characteristics  
 $-I_D = f(-V_{DS})$

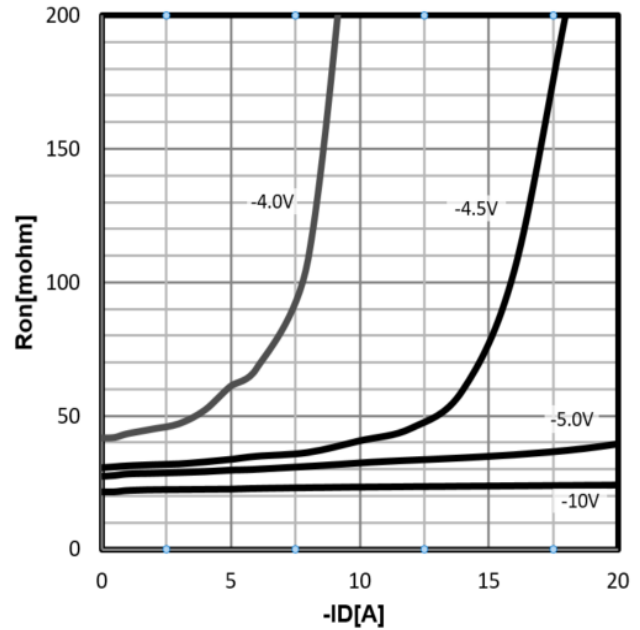


Fig2. Typ. drain-source on resistance  
 $R_{DS(on)} = f(-I_D)$

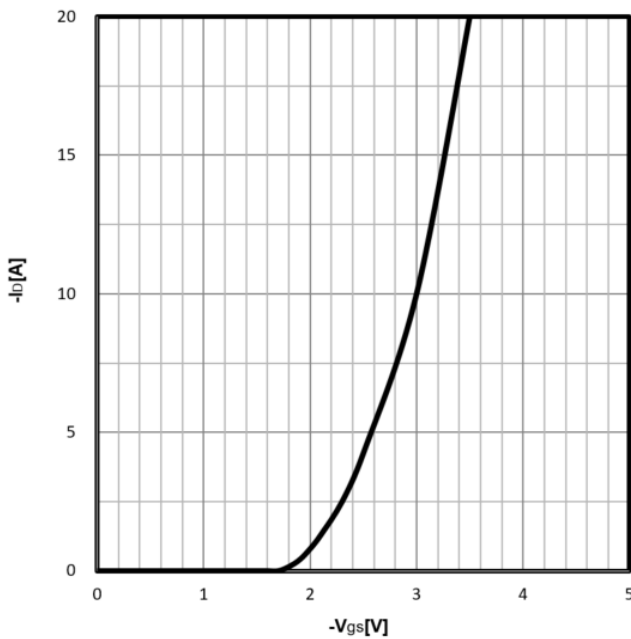


Fig3. Typ. transfer characteristics  
 $-I_D = f(-V_{GS})$

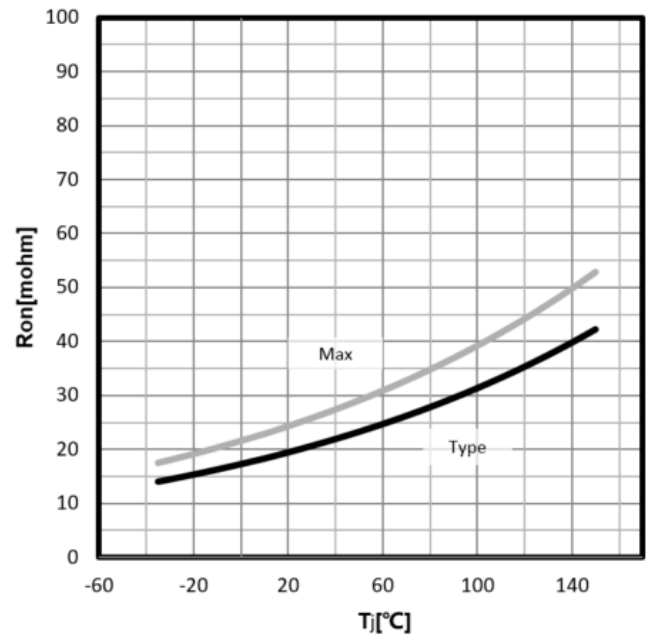


Fig4. Drain-source on-state resistance  
 $R_{DS(on)} = f(T_j); I_D = -10\text{A}; V_{GS} = -10\text{V}$

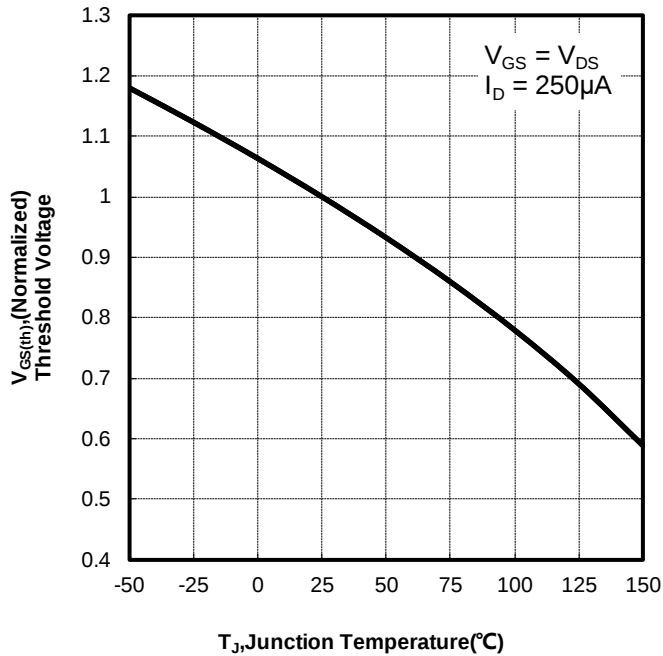


Fig5. Gate Threshold Voltage  
 $-V_{TH}=f(T_j)$ ;  $I_D=-250 \mu A$

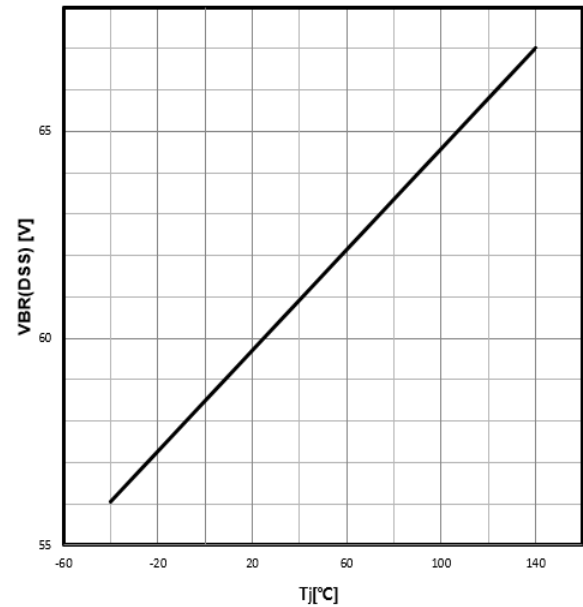


Fig6. Drain-source breakdown voltage  
 $-V_{BR(DSS)}=f(T_j)$ ;  $I_D=-250 \mu A$

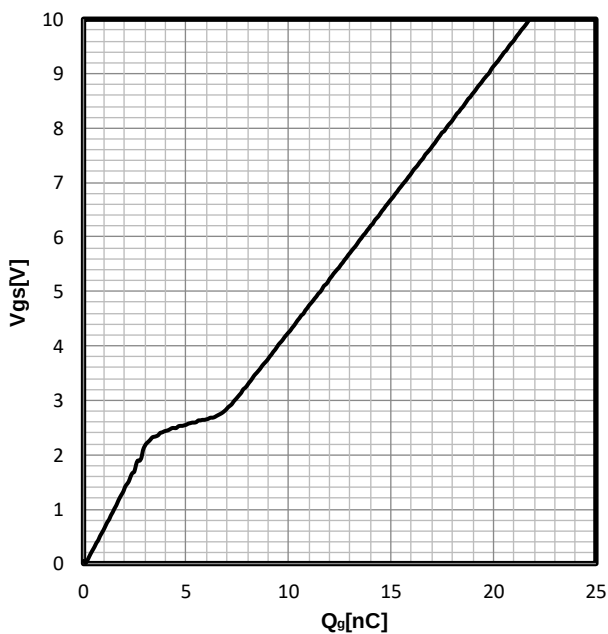


Fig7. Typ. gate charge  
 $V_{GS}=f(Q_{gate})$ ;  $I_D=-5 A$

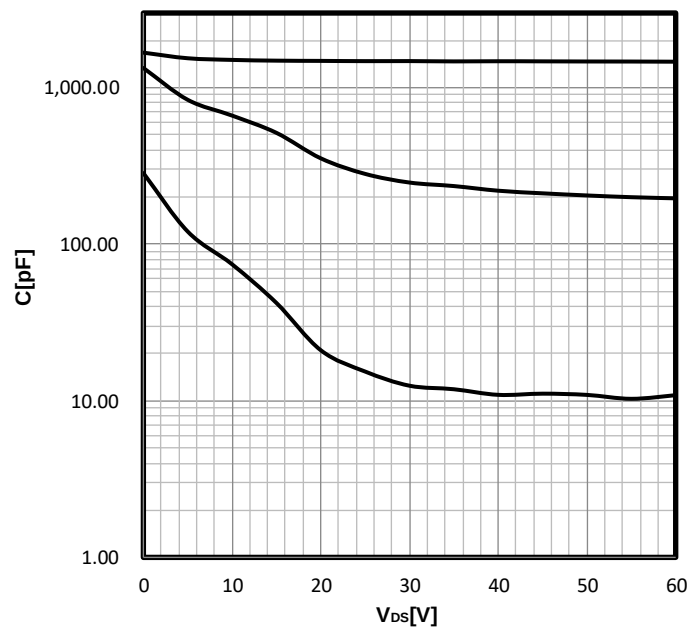
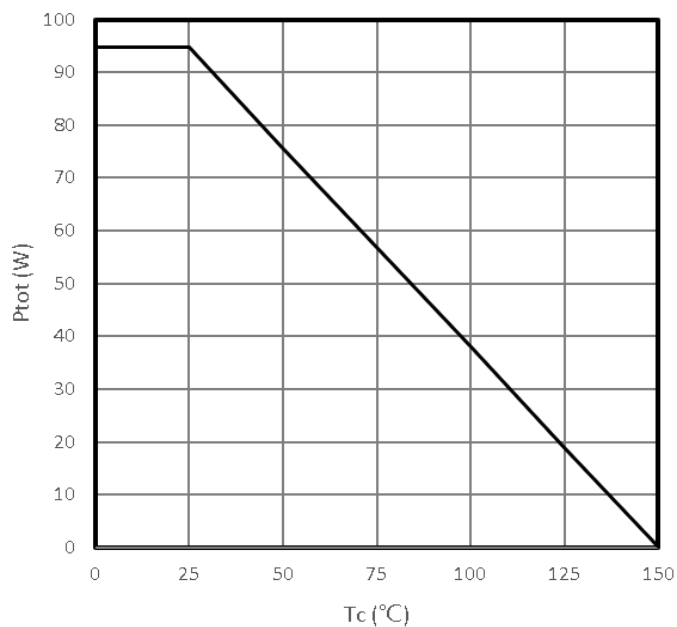
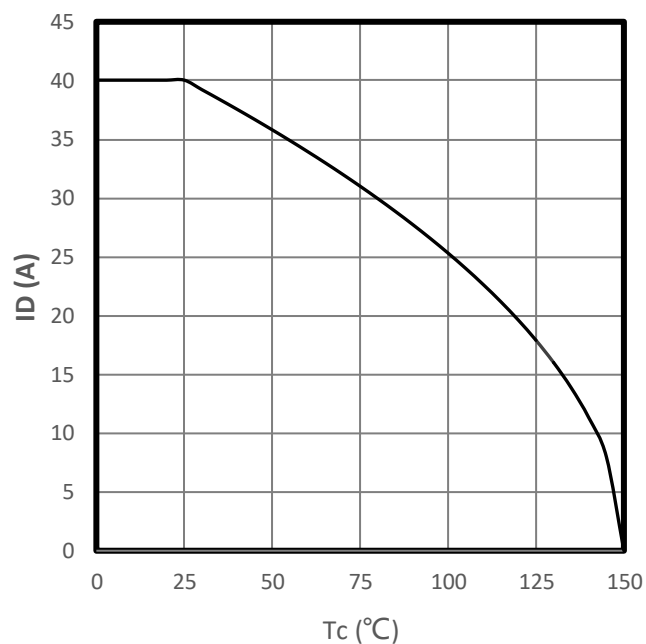


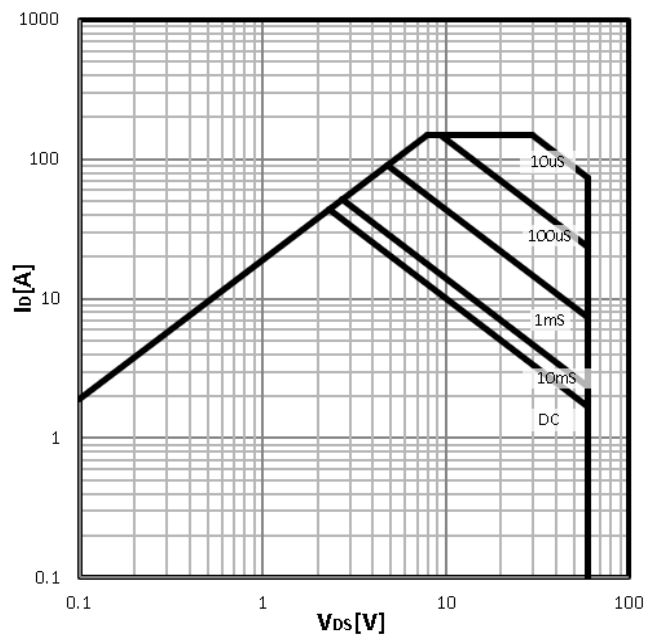
Fig8. Typ. Capacitances  
 $C=f(-V_{DS})$ ;  $V_{GS}=0 V$ ;  $f=1 MHz$



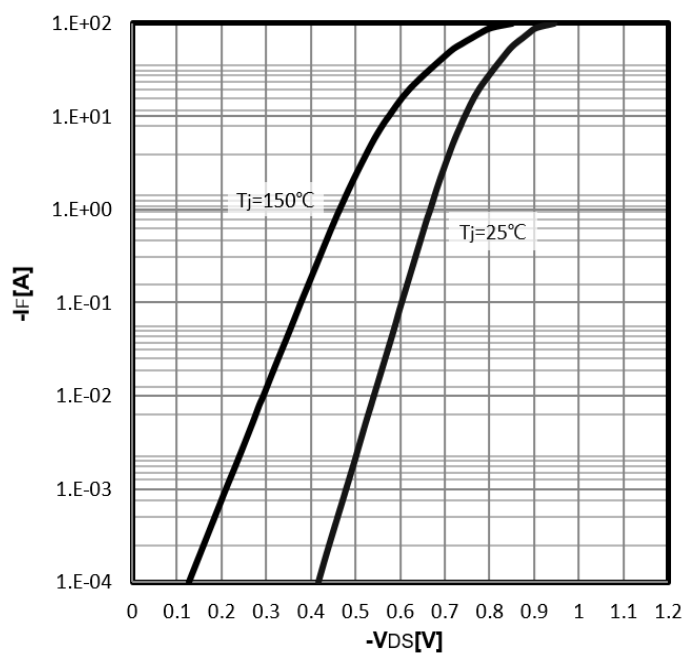
**Fig9. Power Dissipation**  
 $P_{tot}=f(T_c)$



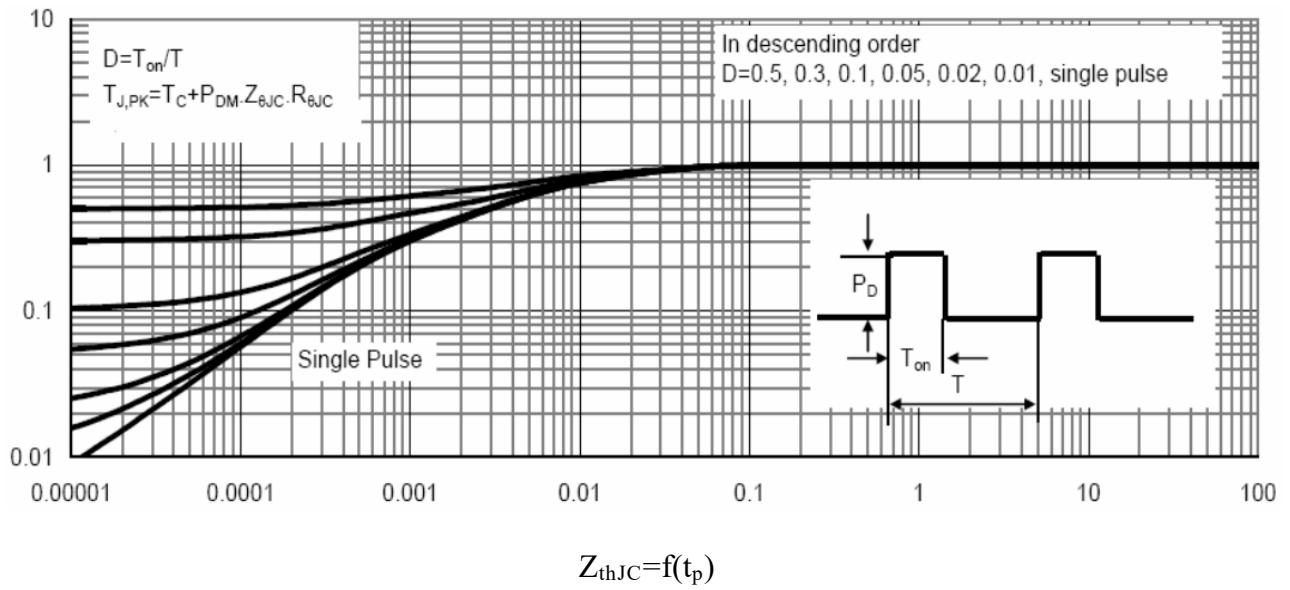
**Fig10 Maximum Drain Current**  
 $-I_D=f(T_c)$



**Fig11. Safe operating area**  
 $-I_D$   $-V_{DS}$

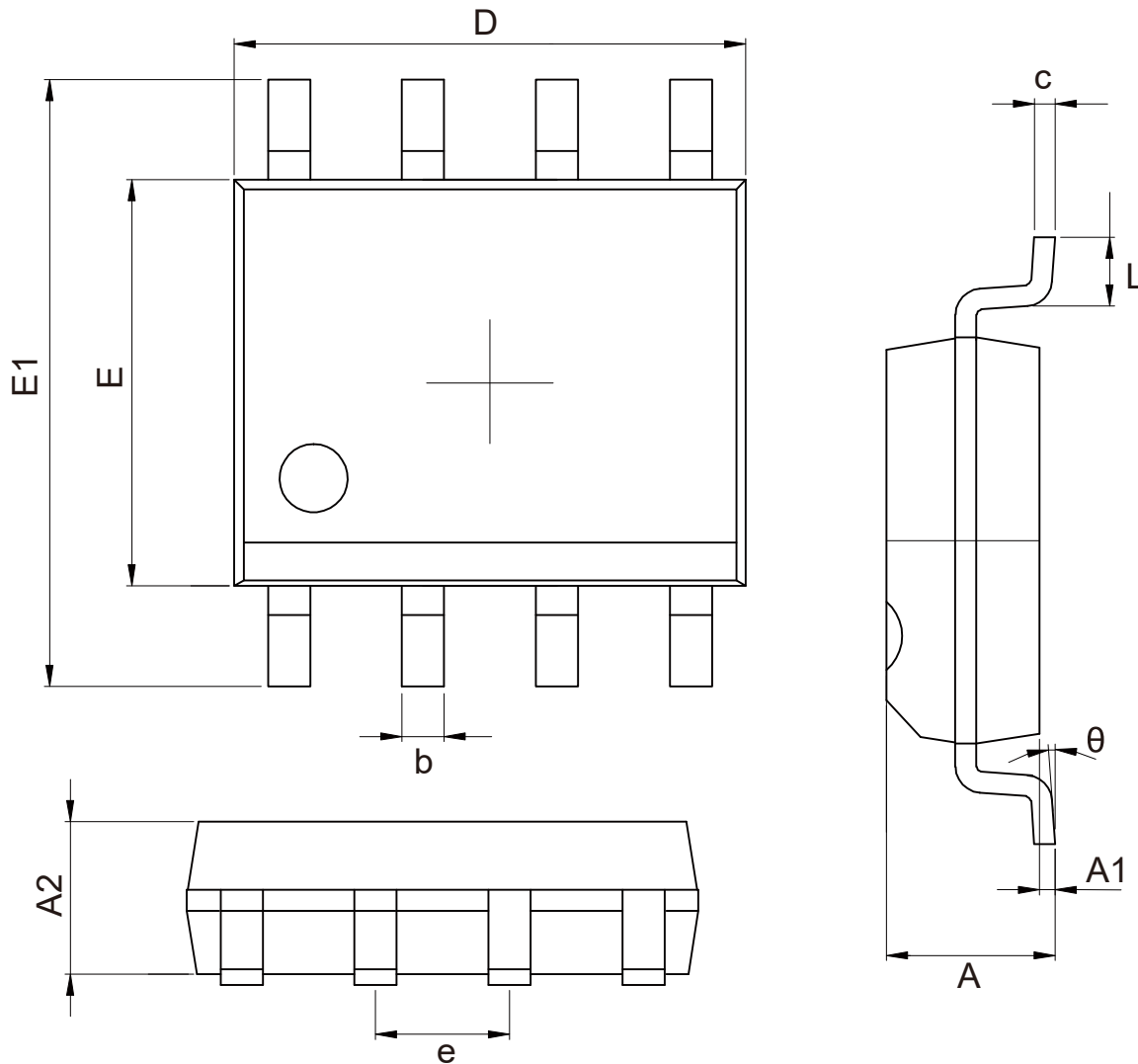


**Fig12. Body Diode Forward Voltage Variation**  
 $-I_F$   $-V_{DS}$



**Fig13. Max. transient thermal impedance**

## SOP-8D Package Information:



| COMMON DIMENSIONS         |          |       |       |
|---------------------------|----------|-------|-------|
| CUNITS MEASURE=MILLIMETER |          |       |       |
| SYMBOL                    | MIN      | NOM   | MAX   |
| A                         | 1.350    | —     | 1.750 |
| A1                        | 0.100    | —     | 0.250 |
| A2                        | 1.350    | —     | 1.550 |
| b                         | 0.330    | —     | 0.510 |
| c                         | 0.170    | —     | 0.250 |
| D                         | 4.700    | —     | 5.100 |
| E                         | 3.800    | 3.900 | 4.000 |
| E1                        | 5.800    | —     | 6.200 |
| e                         | 1.270BSC |       |       |
| L                         | 0.400    | —     | 1.270 |
| $\theta$                  | 0°       | —     | 8°    |

Unit:mm

## Marking Information:

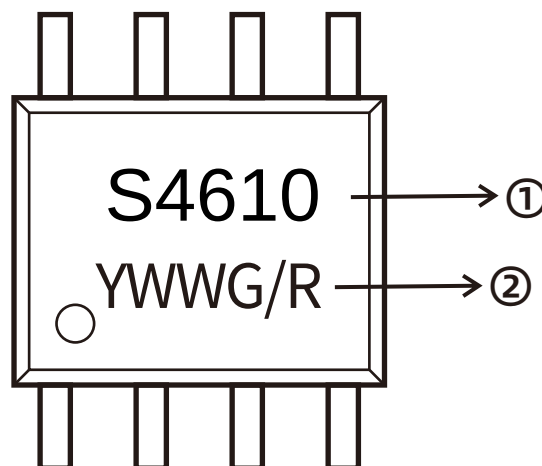
①. Part NO.

②. Date Code(YWWG / R)

Y : Year Code , last digit of the year

WW : Week Code(01-53)

G/R : G(Green) /R(Lead Free)



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