

N and P-Channel Enhancement Mode Power MOSFET

Description

The NCE4503S uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. The SOP-8 package is universally preferred for all commercial industrial surface mount applications and suited for low voltage applications such as DC/DC converters.

General Features

● N-Channel

$V_{DS} = 30V, I_D = 10A$
 $R_{DS(ON)} < 20m\Omega @ V_{GS}=4.5V$
 $R_{DS(ON)} < 13.5m\Omega @ V_{GS}=10V$

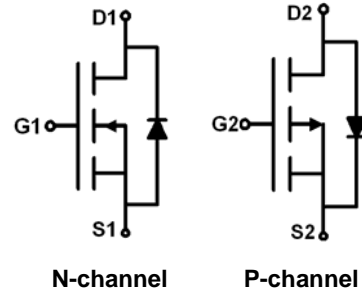
● P-Channel

$V_{DS} = -30V, I_D = -9.1A$
 $R_{DS(ON)} < 35m\Omega @ V_{GS}=-4.5V$
 $R_{DS(ON)} < 20m\Omega @ V_{GS}=-10V$

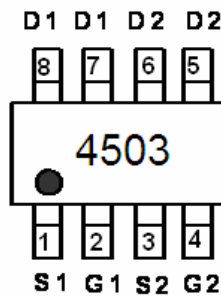
- High power and current handling capability
- Lead free product is acquired
- Surface mount package

Application

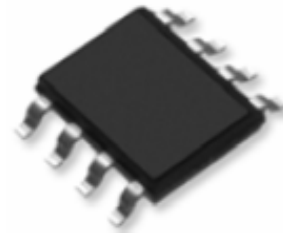
- Battery protection
- Load switch
- Power management



Schematic diagram



Marking and pin assignment



SOP-8 top view

Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|----------------|----------|----------------|-----------|------------|------------|
| 4503 | NCE4503S | SOP-8 | Ø330mm | 12mm | 2500 units |

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

| Parameter | Symbol | N-Channel | P-Channel | Unit | |
|--|----------------|------------------|------------|------------|---|
| Drain-Source Voltage | V_{DS} | 30 | -30 | V | |
| Gate-Source Voltage | V_{GS} | ± 20 | ± 20 | V | |
| Continuous Drain Current | I_D | $T_A=25^\circ C$ | 10 | -9.1 | A |
| | | $T_A=70^\circ C$ | 7.9 | -7.2 | |
| Pulsed Drain Current ^(Note 1) | I_{DM} | 30 | -30 | A | |
| Maximum Power Dissipation | P_D | 2.5 | 2.5 | W | |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55 To 150 | -55 To 150 | $^\circ C$ | |

Thermal Characteristic

| | | | | |
|--|-----------------|------|----|------|
| Thermal Resistance, Junction-to-Ambient ^(Note2) | $R_{\theta JA}$ | N-Ch | 50 | °C/W |
| | | P-Ch | 50 | |

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

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|--|--------------|---|-----|------|-----------|------------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu A$ | 30 | 33 | - | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=30V, V_{GS}=0V$ | - | - | 1 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | - | - | ± 100 | nA |
| On Characteristics ^(Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$ | 1 | 1.6 | 3 | V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=10A$ | - | 7.5 | 13.5 | m Ω |
| | | $V_{GS}=4.5V, I_D=5A$ | - | 11 | 20 | m Ω |
| Forward Transconductance | g_{FS} | $V_{DS}=5V, I_D=10A$ | 15 | - | - | S |
| Dynamic Characteristics ^(Note4) | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS}=15V, V_{GS}=0V,$ $F=1.0MHz$ | - | 1550 | - | PF |
| Output Capacitance | C_{oss} | | - | 300 | - | PF |
| Reverse Transfer Capacitance | C_{rss} | | - | 180 | - | PF |
| Switching Characteristics ^(Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=25V, I_D=1A$ $V_{GS}=10V, R_{GEN}=6\Omega$ | - | 30 | - | nS |
| Turn-on Rise Time | t_r | | - | 20 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 100 | - | nS |
| Turn-Off Fall Time | t_f | | - | 80 | - | nS |
| Total Gate Charge | Q_g | $V_{DS}=15V, I_D=10A,$ $V_{GS}=4.5V$ | - | 13 | - | nC |
| Gate-Source Charge | Q_{gs} | | - | 5.5 | - | nC |
| Gate-Drain Charge | Q_{gd} | | - | 3.5 | - | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage ^(Note 3) | V_{SD} | $V_{GS}=0V, I_S=6A$ | - | 0.8 | 1.2 | V |

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

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|--------------|---|-----|------|-----------|------------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=-250\mu A$ | -30 | -33 | - | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=-30V, V_{GS}=0V$ | - | - | -1 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | - | - | ± 100 | nA |
| On Characteristics (Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-250\mu A$ | -1 | -1.5 | -3 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}=-10V, I_D=-9.1A$ | - | 15 | 20 | m Ω |
| | | $V_{GS}=-4.5V, I_D=-5A$ | - | 21 | 35 | m Ω |
| Forward Transconductance | g_{FS} | $V_{DS}=-15V, I_D=-9.1A$ | 10 | - | - | S |
| Dynamic Characteristics (Note 4) | | | | | | |
| Input Capacitance | C_{ISS} | $V_{DS}=-15V, V_{GS}=0V,$ $F=1.0MHz$ | - | 1600 | - | PF |
| Output Capacitance | C_{OSS} | | - | 350 | - | PF |
| Reverse Transfer Capacitance | C_{RSS} | | - | 300 | - | PF |
| Switching Characteristics (Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=-15V, I_D=-1A,$ $V_{GS}=-10V, R_{GEN}=6\Omega$ | - | 10 | - | nS |
| Turn-on Rise Time | t_r | | - | 15 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 110 | - | nS |
| Turn-Off Fall Time | t_f | | - | 70 | - | nS |
| Total Gate Charge | Q_g | $V_{DS}=-15V, I_D=-9.1A$ $V_{GS}=-10V$ | - | 30 | - | nC |
| Gate-Source Charge | Q_{gs} | | - | 5.5 | - | nC |
| Gate-Drain Charge | Q_{gd} | | - | 8 | - | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage (Note 3) | V_{SD} | $V_{GS}=0V, I_S=-6A$ | - | - | -1.2 | V |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production

N- Channel Typical Electrical and Thermal Characteristics (Curves)

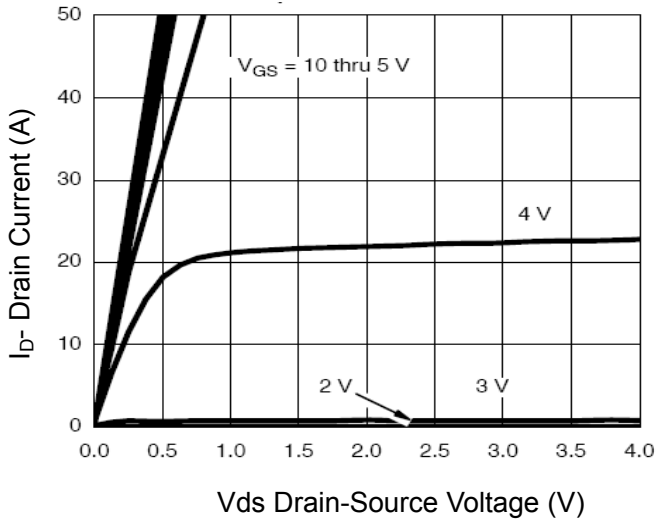


Figure 1 Output Characteristics

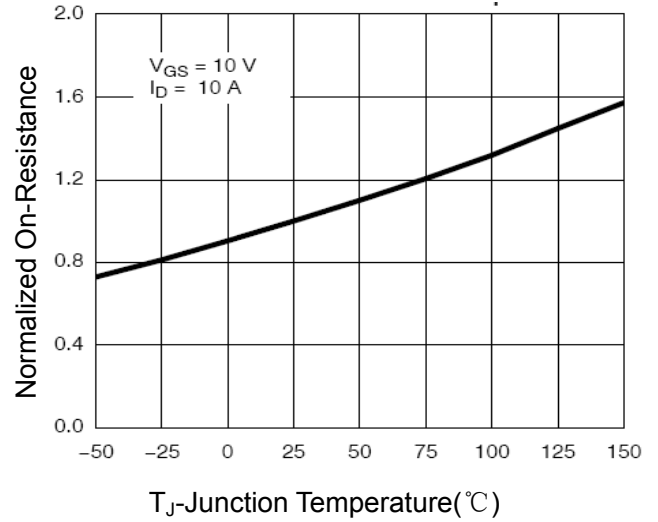


Figure 4 R_{dson} - Junction Temperature

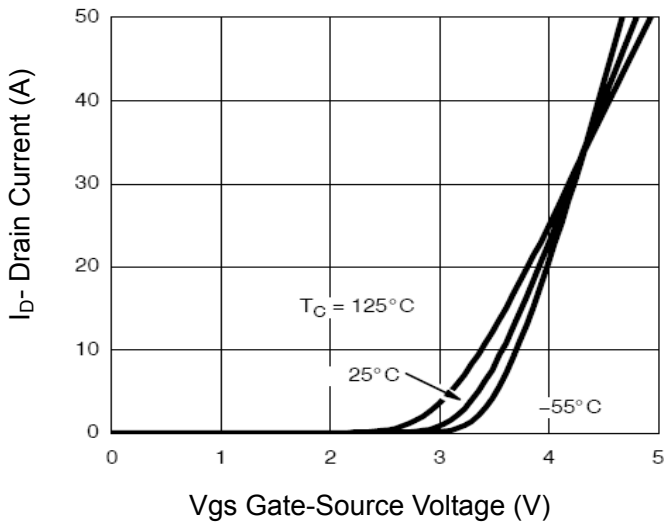


Figure 2 Transfer Characteristics

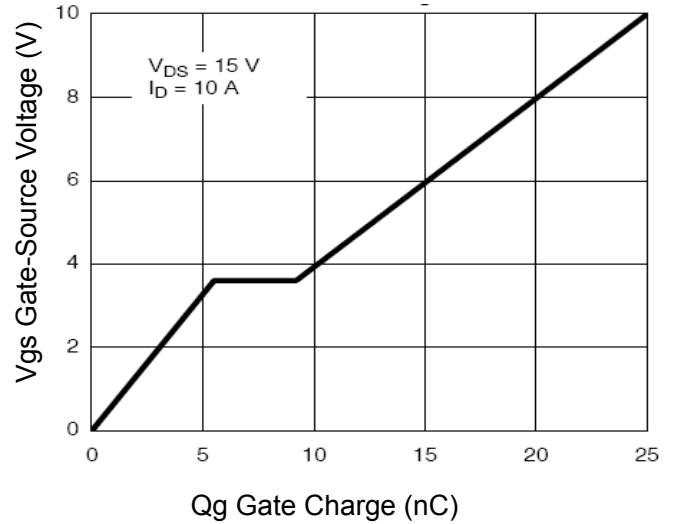


Figure 5 Gate Charge

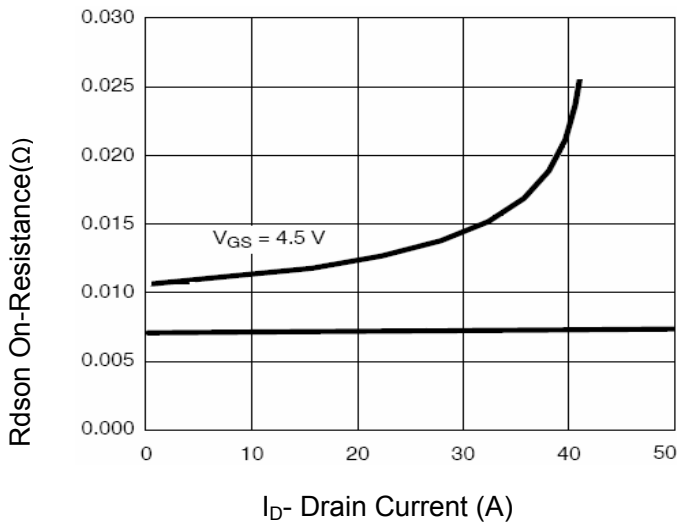


Figure 3 R_{dson} - Drain Current

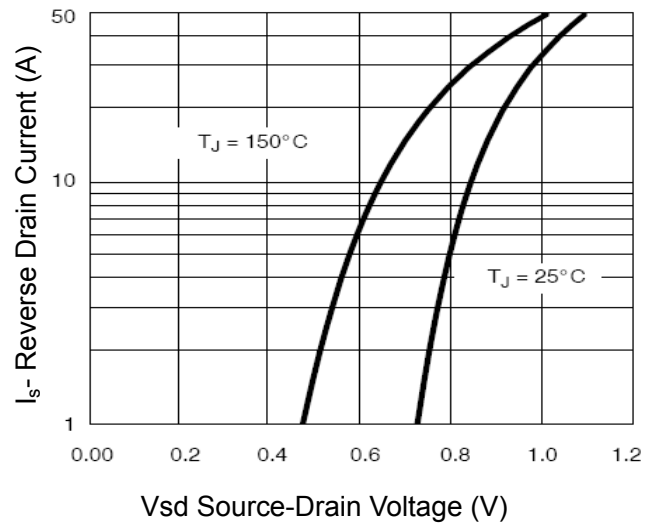
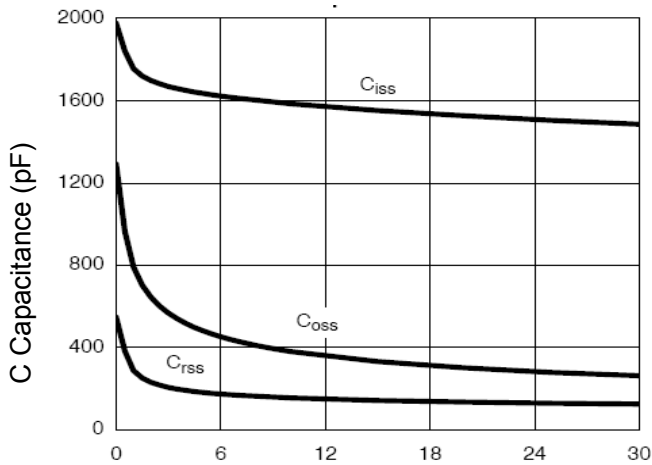
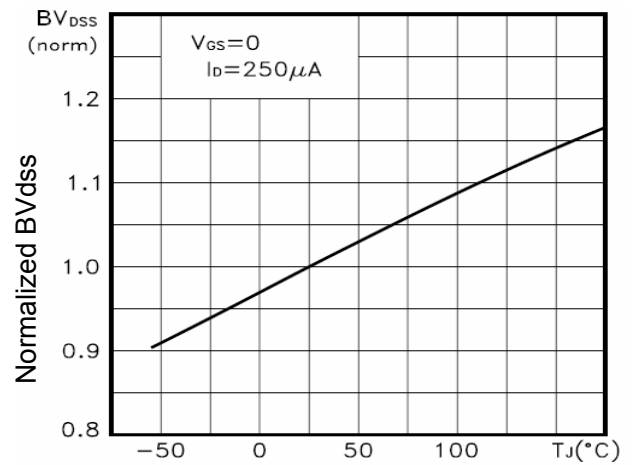


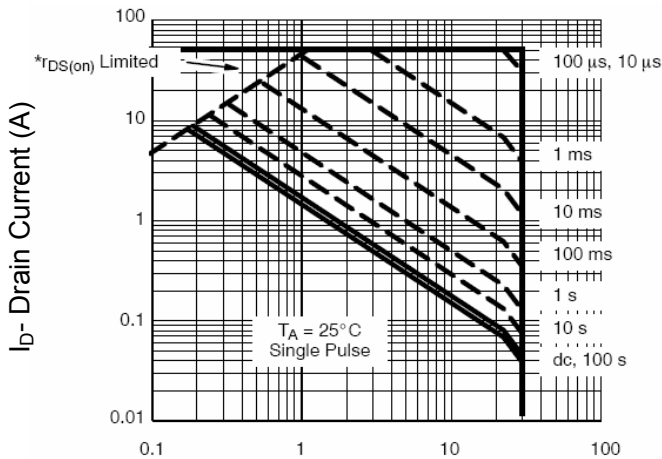
Figure 6 Source- Drain Diode Forward



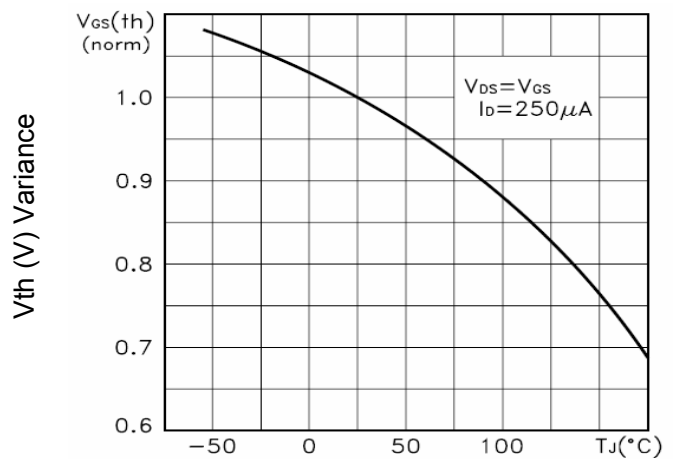
Vds Drain-Source Voltage (V)
Figure 7 Capacitance vs Vds



T_J-Junction Temperature(°C)
Figure 9 BV_{DSS} vs Junction Temperature



Vds Drain-Source Voltage (V)
Figure 8 Safe Operation Area



T_J-Junction Temperature(°C)
Figure 10 V_{GS(th)} vs Junction Temperature

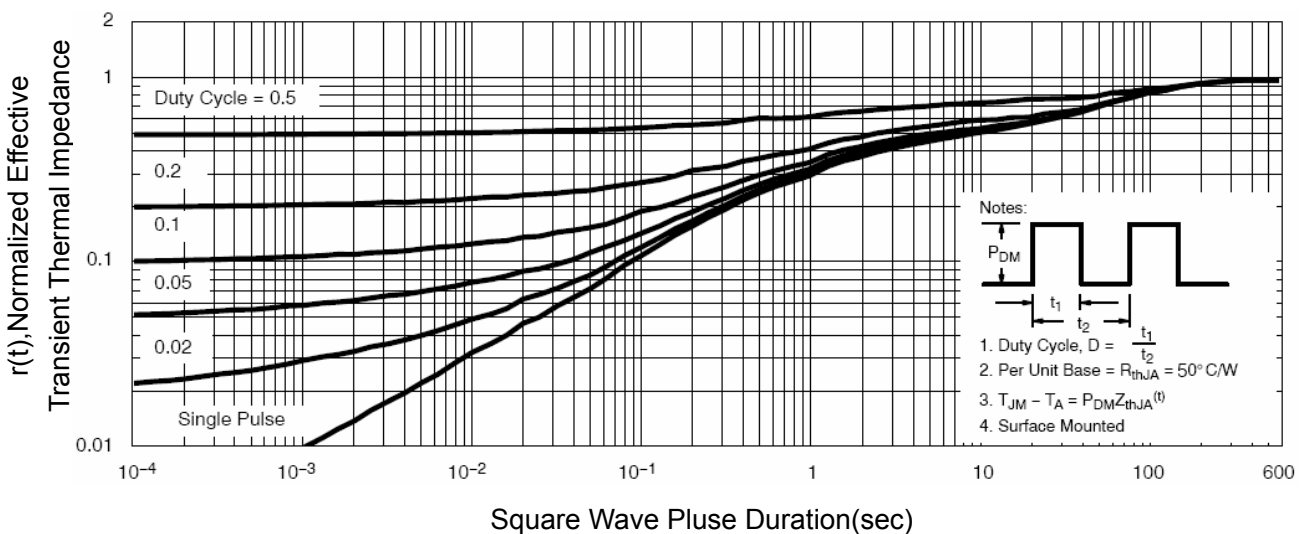


Figure 11 Normalized Maximum Transient Thermal Impedance

P-Channel Typical Electrical and Thermal Characteristics

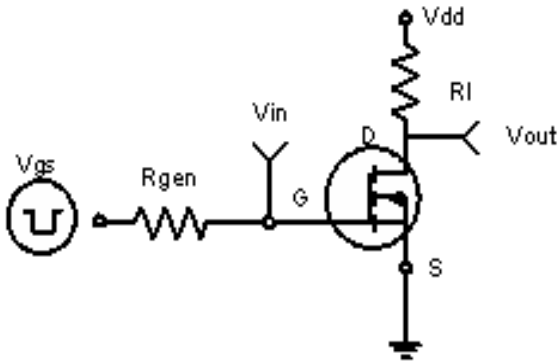


Figure 1: Switching Test Circuit

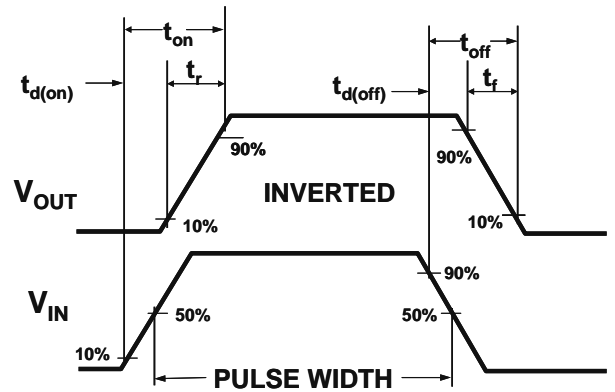


Figure 2: Switching Waveforms

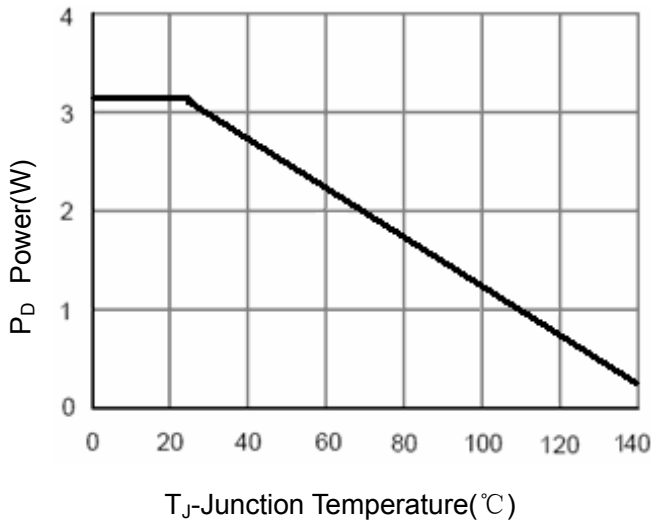


Figure 3 Power Dissipation

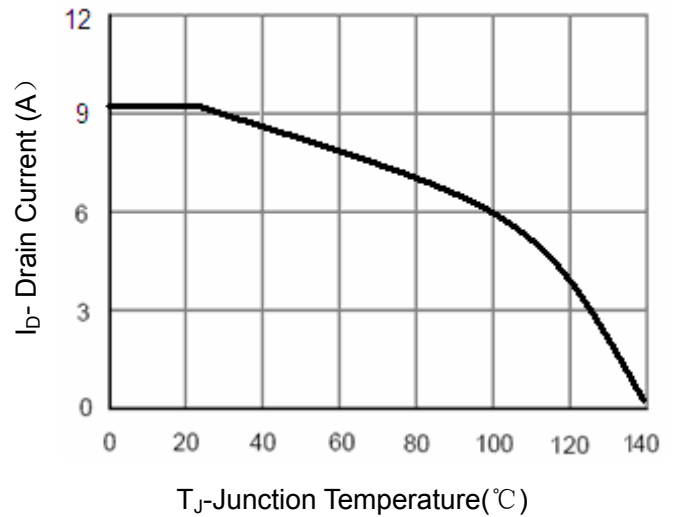


Figure 4 Drain Current

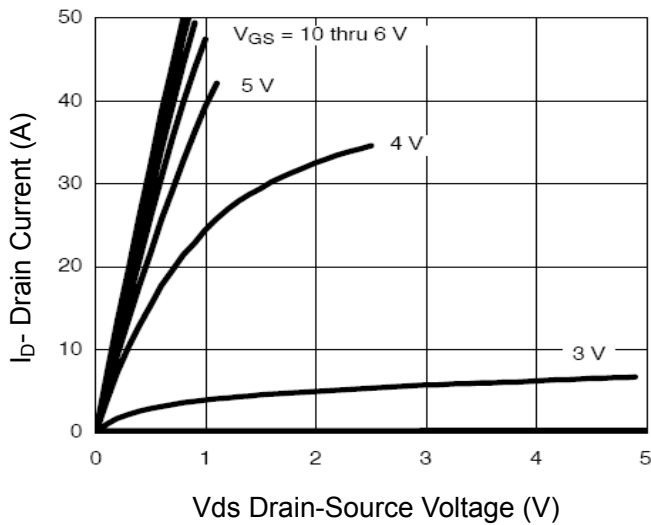


Figure 5 Output Characteristics

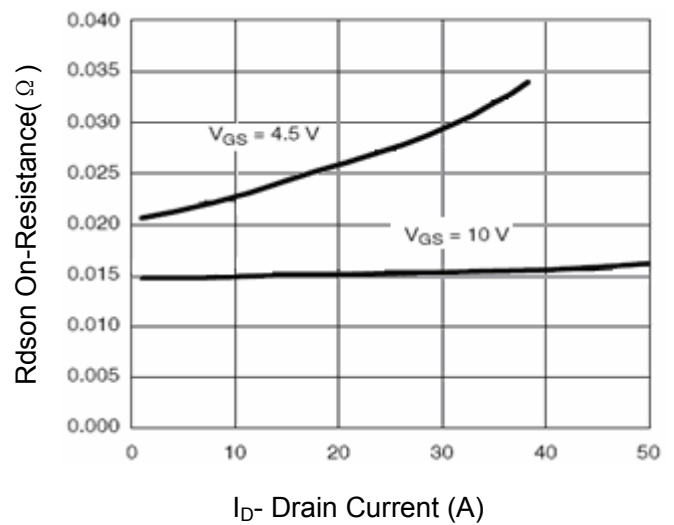
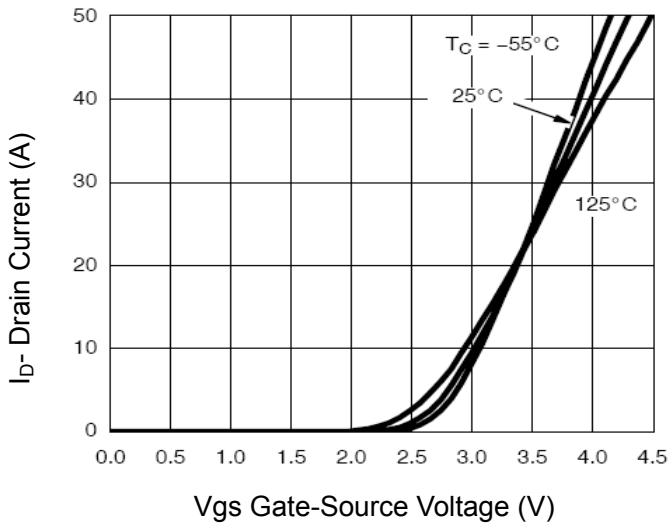
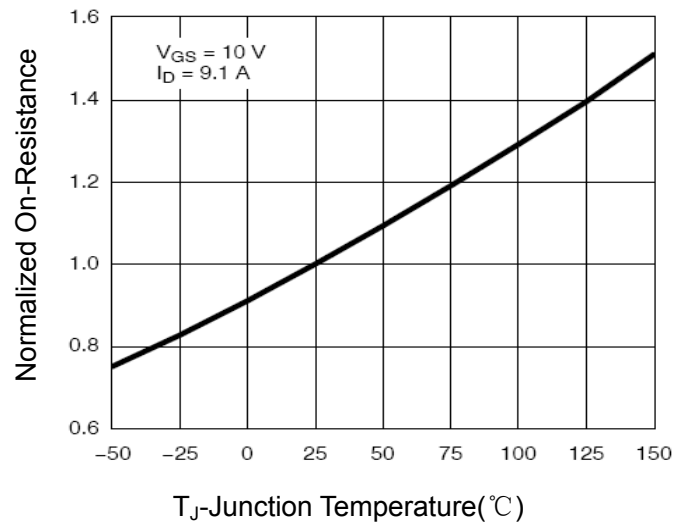


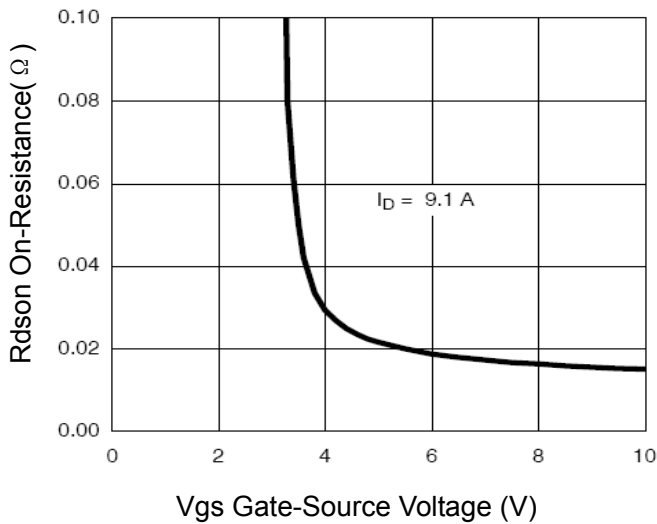
Figure 6 Drain-Source On-Resistance



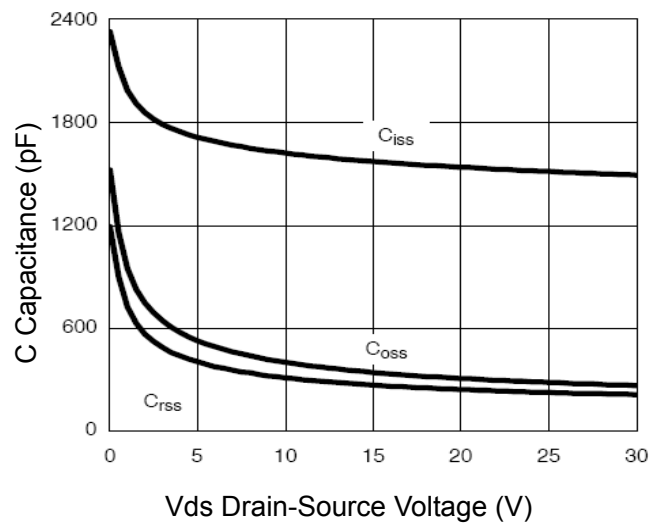
Vgs Gate-Source Voltage (V)
Figure 7 Transfer Characteristics



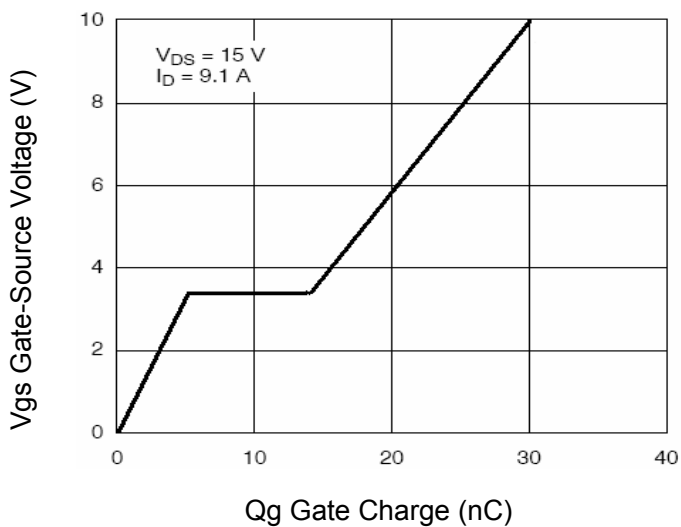
T_J -Junction Temperature($^\circ\text{C}$)
Figure 8 Drain-Source On-Resistance



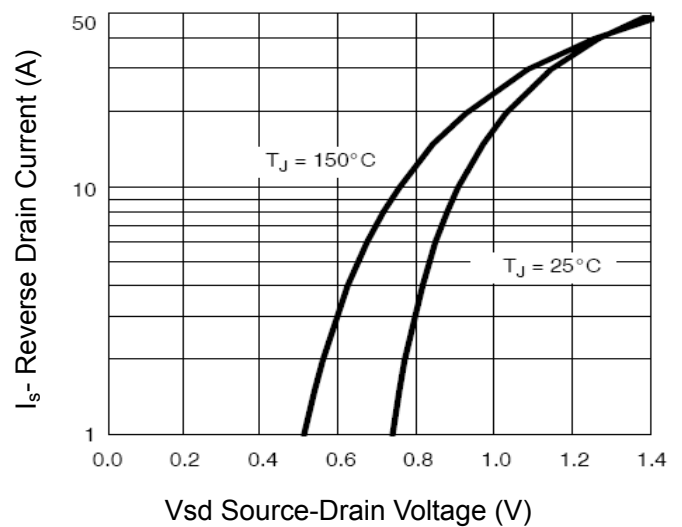
Vgs Gate-Source Voltage (V)
Figure 9 Rdson vs Vgs



V_{DS} Drain-Source Voltage (V)
Figure 10 Capacitance vs Vds



Q_g Gate Charge (nC)
Figure 11 Gate Charge



V_{SD} Source-Drain Voltage (V)
Figure 12 Source- Drain Diode Forward

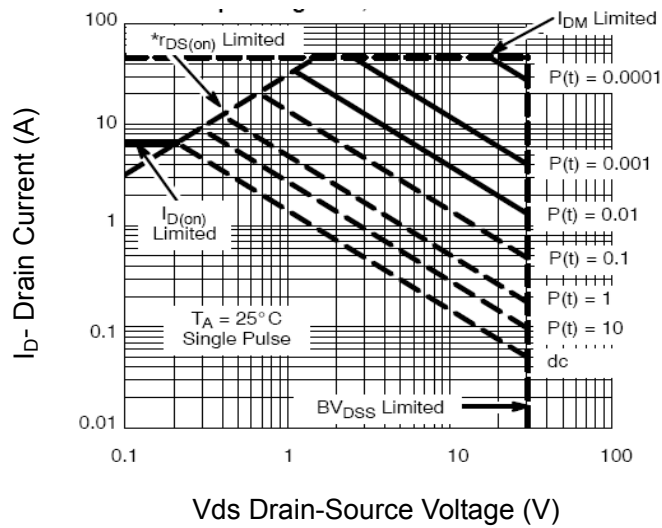


Figure 13 Safe Operation Area

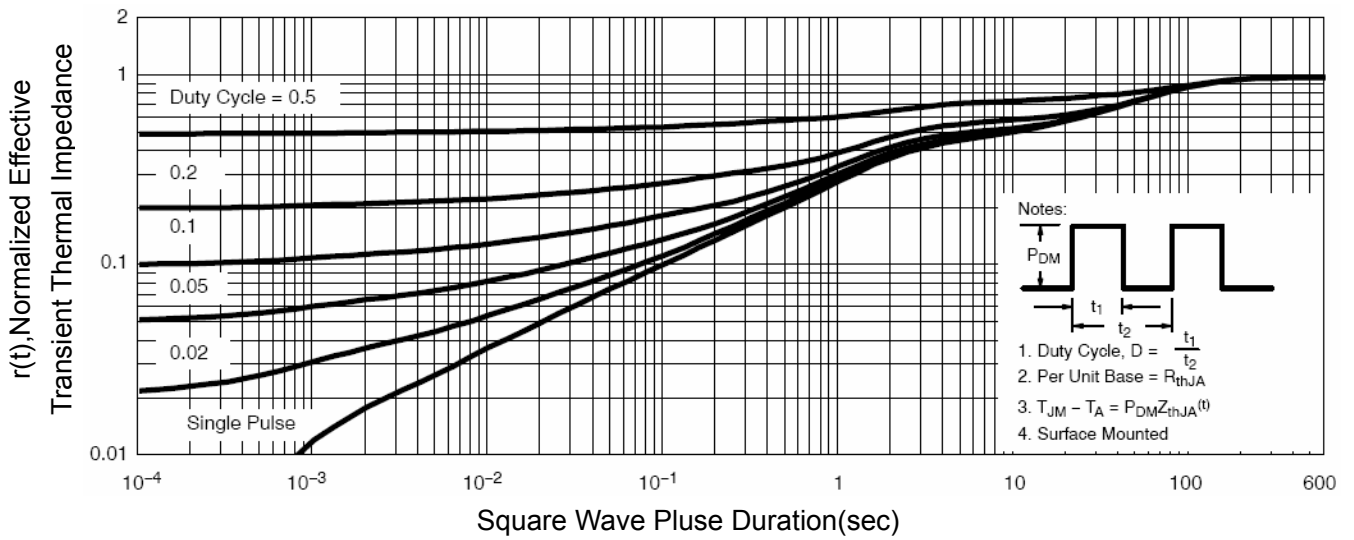
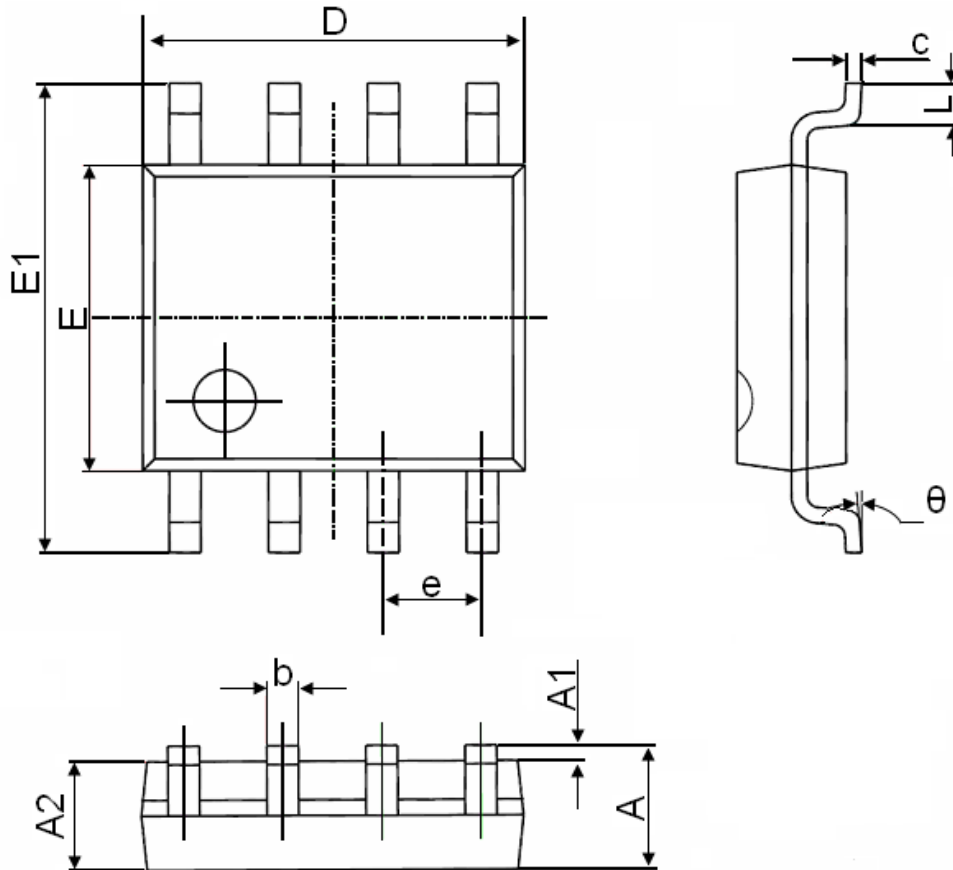


Figure 14 Normalized Maximum Transient Thermal Impedance

SOP-8 Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.006 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.200 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| e | 1.270(BSC) | | 0.050(BSC) | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| theta | 0° | 8° | 0° | 8° |

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