

NCE N&P-Channel complementary Power MOSFET

Description

The NCE60NP2016G 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.

General Features

N channel

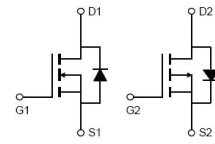
- $V_{DS} = 60V, I_D = 20A$
 $R_{DS(ON)} < 28m\Omega @ V_{GS} = 10V$
 $R_{DS(ON)} < 32m\Omega @ V_{GS} = 4.5V$

p channel

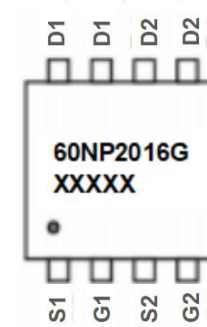
- $V_{DS} = -60V, I_D = -16A$
 $R_{DS(ON)} < 60m\Omega @ V_{GS} = -10V$
 $R_{DS(ON)} < 72m\Omega @ V_{GS} = -4.5V$
- High density cell design for ultra low R_{dson}
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high E_{AS}
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

Application

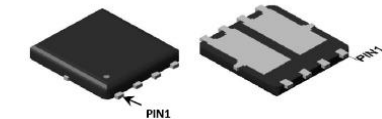
- H-bridge
- Inverters



Schematic diagram



Marking and pin assignment



Top View

Bottom View

Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|----------------|--------------|----------------|-----------|------------|----------|
| 60NP2016G | NCE60NP2016G | DFN5X6-8L | - | - | - |

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

| Parameter | Symbol | N-Channel | P-Channel | Unit |
|--------------------------------------------------|----------------|---------------------|-----------|------------|
| Drain-Source Voltage | V_{DS} | 60 | -60 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | ± 20 | V |
| Continuous Drain Current | I_D | $T_C = 25^\circ C$ | -16 | A |
| | | $T_C = 100^\circ C$ | -11.2 | |
| Pulsed Drain Current (Note 1) | I_{DM} | 60 | -48 | A |
| Maximum Power Dissipation | P_D | 42 | | W |
| Single pulse avalanche energy (Note 5) | E_{AS} | 72 | | mJ |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55 To 150 | | $^\circ C$ |

Thermal Characteristic

| | | | |
|-----------------------------------------------|-----------------|---|--------------|
| Thermal Resistance, Junction-to-Case (Note 2) | $R_{\theta JC}$ | 3 | $^\circ C/W$ |
|-----------------------------------------------|-----------------|---|--------------|

| | | | |
|--------------------------------------------------|-----------------|----|---------------|
| Thermal Resistance, Junction-to-Ambient (Note 2) | $R_{\theta JA}$ | 60 | $^{\circ}C/W$ |
|--------------------------------------------------|-----------------|----|---------------|

N-Channel Electrical Characteristics ($T_C=25^{\circ}C$ unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|-------------------------------------------|--------------|----------------------------------------------------------------------|-----|-------|-----------|------------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu A$ | 60 | - | - | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=60V, V_{GS}=0V$ | - | - | 1 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | - | - | ± 100 | nA |
| On Characteristics (Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$ | 1.2 | 1.6 | 2.5 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=10A$ | - | 23 | 28 | m Ω |
| | | $V_{GS}=4.5V, I_D=10A$ | - | 27 | 32 | m Ω |
| Forward Transconductance | g_{FS} | $V_{DS}=5V, I_D=10A$ | 11 | - | - | S |
| Gate resistance | R_g | $V_{DS}=0V, V_{GS}=0V, F=1.0MHz$ | | 2.2 | | Ω |
| Dynamic Characteristics (Note 4) | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS}=30V, V_{GS}=0V,$ $F=1.0MHz$ | - | 973.2 | - | PF |
| Output Capacitance | C_{oss} | | - | 61.2 | - | PF |
| Reverse Transfer Capacitance | C_{rss} | | - | 58.8 | - | PF |
| Switching Characteristics (Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=30V, R_L=3\Omega$ $V_{GS}=10V, R_G=3\Omega$ | - | 7 | - | nS |
| Turn-on Rise Time | t_r | | - | 20 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 16 | - | nS |
| Turn-Off Fall Time | t_f | | - | 23 | - | nS |
| Total Gate Charge | Q_g | $V_{DS}=30V, I_D=10A,$ $V_{GS}=10V$ | - | 25 | | nC |
| Gate-Source Charge | Q_{gs} | | - | 4.5 | | nC |
| Gate-Drain Charge | Q_{gd} | | - | 6.5 | | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage (Note 3) | V_{SD} | $V_{GS}=0V, I_S=10A$ | - | | 1.2 | V |
| Diode Forward Current (Note 2) | I_S | | - | - | 20 | A |
| Reverse Recovery Time | t_{rr} | $T_J = 25^{\circ}C, I_F = 10A$ $di/dt = 100A/\mu s$ (Note 3) | - | 29 | - | nS |
| Reverse Recovery Charge | Q_{rr} | | - | 49 | - | nC |
| Forward Turn-On Time | t_{on} | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) | | | | |

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
5. EAS condition: $T_J=25^{\circ}C, V_{DD}=30V, V_G=10V, L=0.5mH, R_g=25\Omega$

N- Channel Typical Electrical and Thermal Characteristics (Curves)

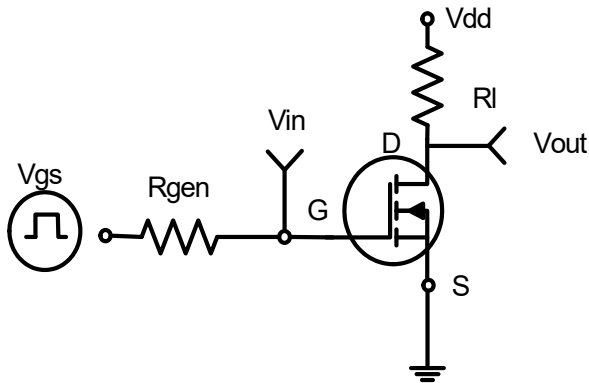


Figure 1: Switching Test Circuit

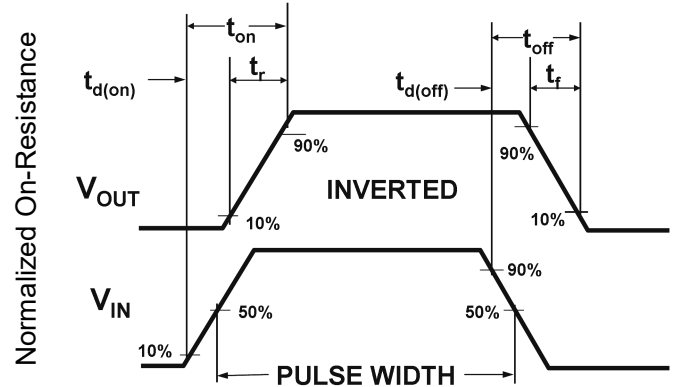


Figure 2: Switching Waveforms

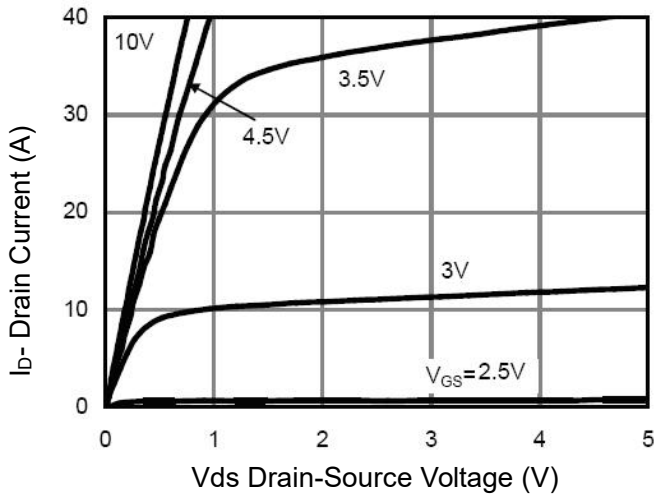


Figure 3 Output Characteristics

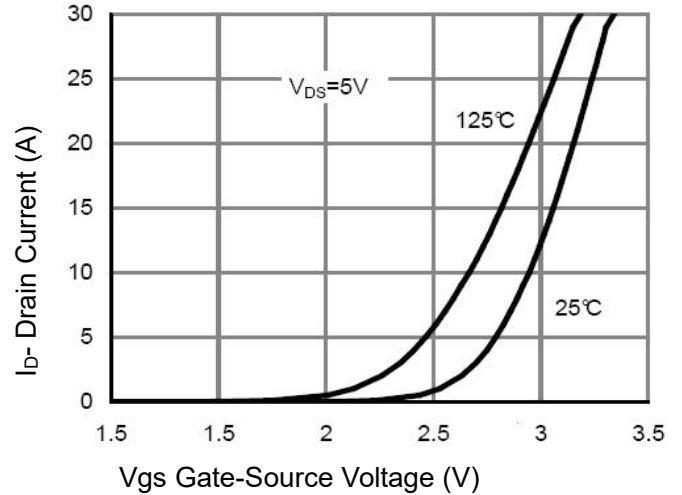


Figure 4 Transfer Characteristics

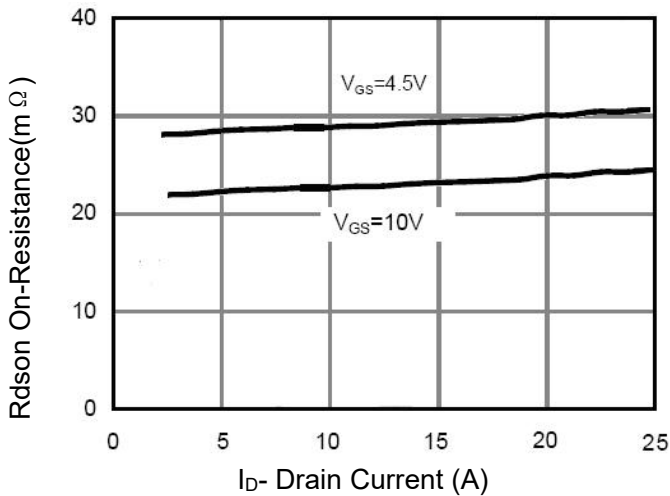


Figure 5 Rdson- Drain Current

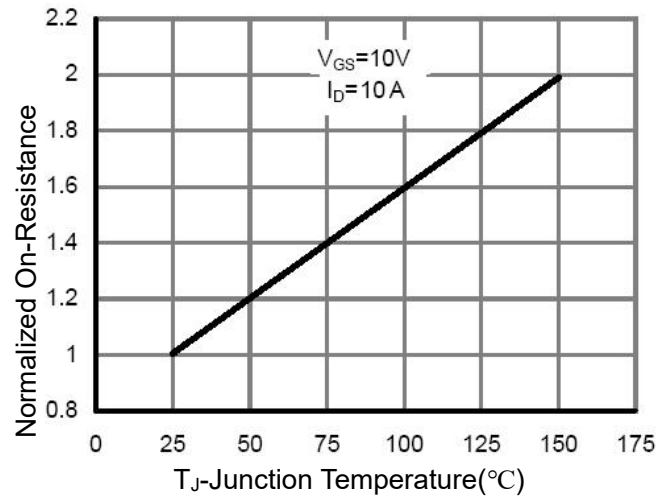
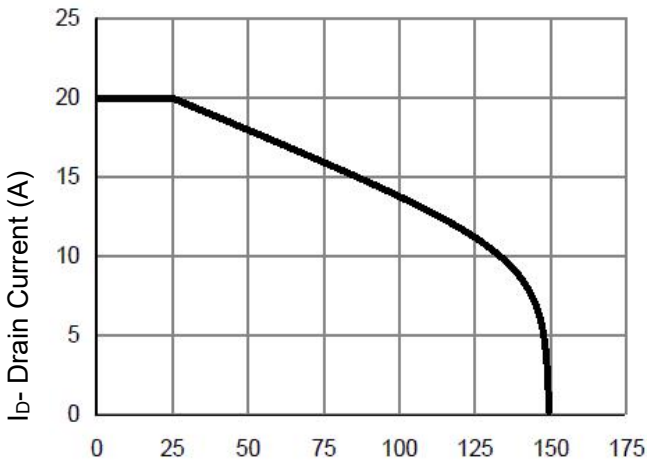
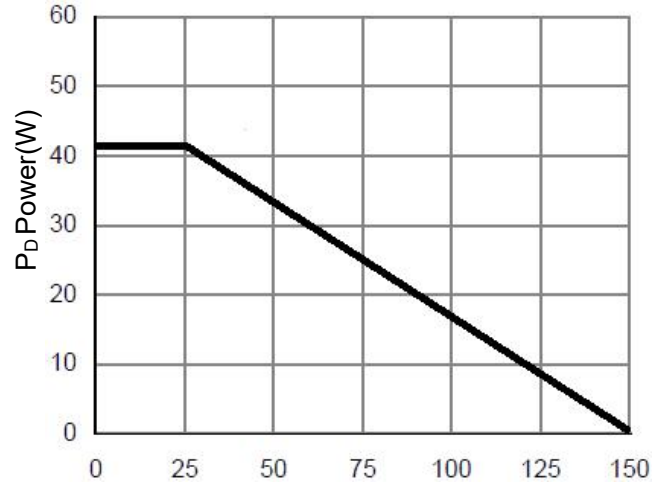


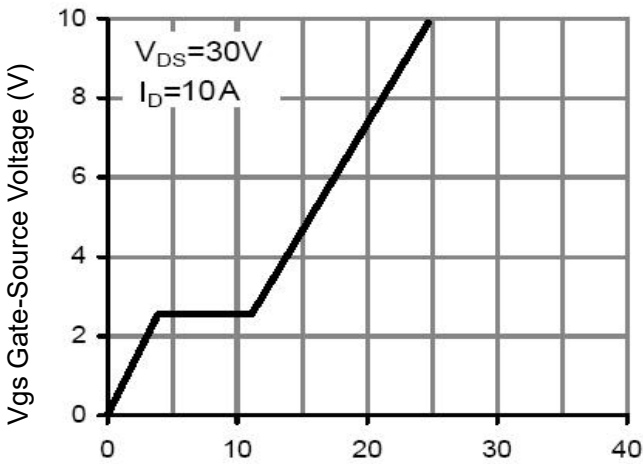
Figure 6 Drain-Source On-Resistance



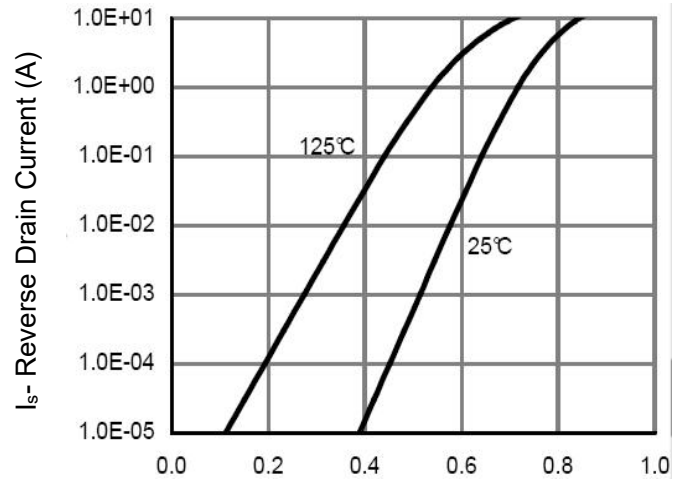
T_J-Junction Temperature(°C)
Figure 7 Rdson vs Vgs



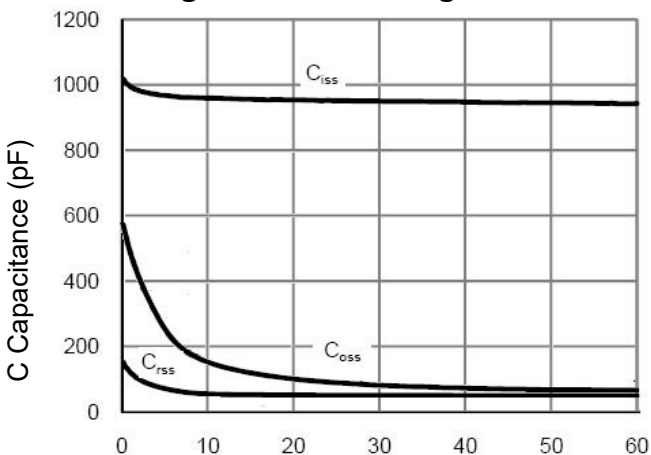
T_J-Junction Temperature(°C)
Figure 8 Power Dissipation



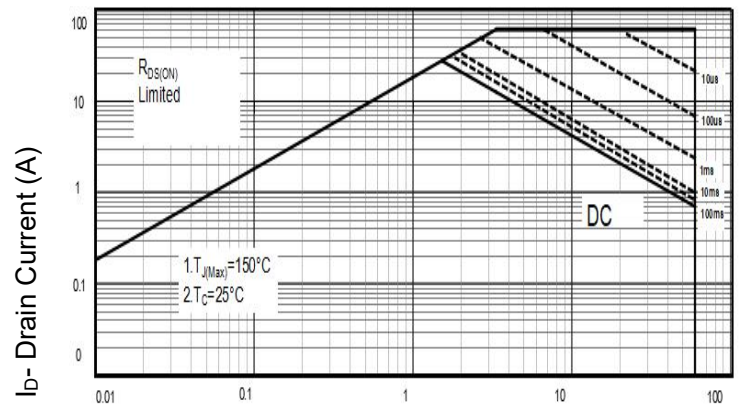
Q_g Gate Charge (nC)
Figure 9 Gate Charge



V_{ds} Drain-Source Voltage (V)
Figure 10 Source-Drain Diode Forward



V_{ds} Drain-Source Voltage (V)
Figure 11 Capacitance vs Vds



V_{ds} Drain-Source Voltage (V)
Figure 12 Safe Operation Area

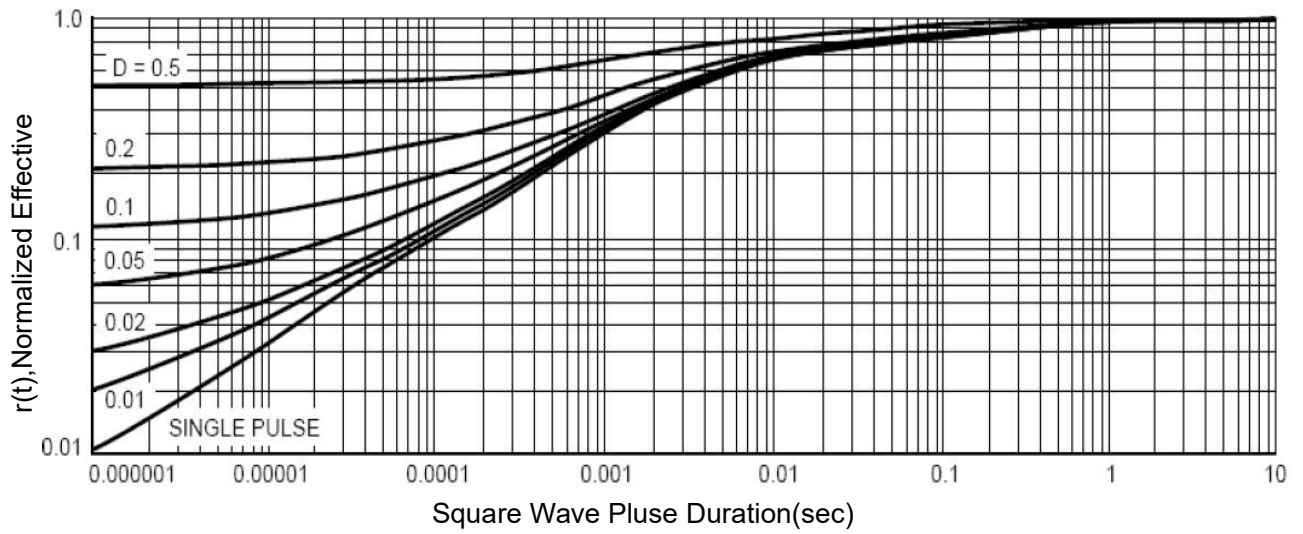


Figure 13 Normalized Maximum Transient Thermal Impedance

P-Channel Electrical Characteristics (T_C=25°C unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|-------------------------------------------|---------------------|---------------------------------------------------------------------------------------------|------|------|------|------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV _{DSS} | V _{GS} =0V I _D =-250μA | -60 | - | - | V |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} =-60V, V _{GS} =0V | - | - | -1 | μA |
| Gate-Body Leakage Current | I _{GSS} | V _{GS} =±20V, V _{DS} =0V | - | - | ±100 | nA |
| On Characteristics (Note 3) | | | | | | |
| Gate Threshold Voltage | V _{GS(th)} | V _{DS} =V _{GS} , I _D =-250μA | -1.0 | -1.5 | -2.0 | V |
| Drain-Source On-State Resistance | R _{DS(ON)} | V _{GS} =-10V, I _D =-8A | - | 52 | 60 | mΩ |
| | | V _{GS} =-4.5V, I _D =-8A | - | 60 | 72 | mΩ |
| Forward Transconductance | g _{FS} | V _{DS} =-5V, I _D =-8A | - | 15 | - | S |
| Gate resistance | R _g | V _{DS} =0V, V _{GS} =0V, F=1.0MHz | | 8.5 | | Ω |
| Dynamic Characteristics (Note4) | | | | | | |
| Input Capacitance | C _{iss} | V _{DS} =-30V, V _{GS} =0V, F=1.0MHz | - | 1108 | - | PF |
| Output Capacitance | C _{oss} | | - | 73.7 | - | PF |
| Reverse Transfer Capacitance | C _{rss} | | - | 58.2 | - | PF |
| Switching Characteristics (Note 4) | | | | | | |
| Turn-on Delay Time | t _{d(on)} | V _{DD} =-30V, R _L =3.75Ω V _{GS} =-10V, R _{GEN} =3Ω | - | 8 | - | nS |
| Turn-on Rise Time | t _r | | - | 4 | - | nS |
| Turn-Off Delay Time | t _{d(off)} | | - | 32 | - | nS |
| Turn-Off Fall Time | t _f | | - | 7 | - | nS |
| Total Gate Charge | Q _g | V _{DS} =-30V, I _D =-8A V _{GS} =-10V | - | 23.4 | - | nC |
| Gate-Source Charge | Q _{gs} | | - | 4.1 | - | nC |
| Gate-Drain Charge | Q _{gd} | | - | 4.8 | - | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage (Note 3) | V _{SD} | V _{GS} =0V, I _S =-16A | - | - | -1.2 | V |
| Diode Forward Current (Note 2) | I _S | | - | - | -16 | A |
| Reverse Recovery Time | t _{rr} | T _J = 25°C, I _F = -8A di/dt = -100A/μs (Note3) | - | 25 | | nS |
| Reverse Recovery Charge | Q _{rr} | | - | 31 | | nC |

P- Channel Typical Electrical and Thermal Characteristics (Curves)

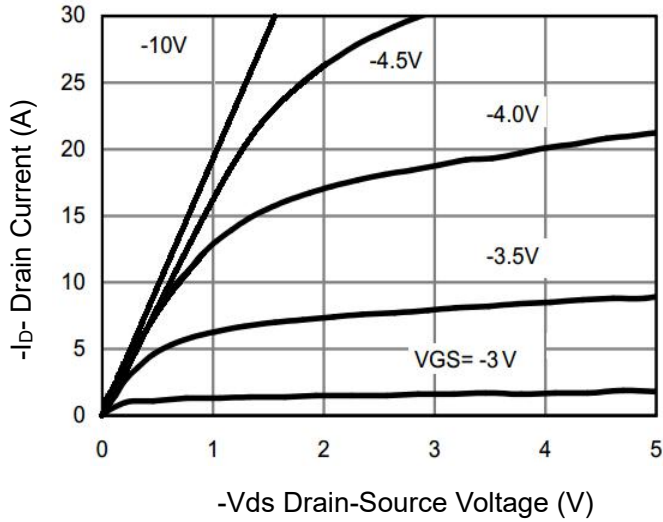


Figure 1 Output Characteristics

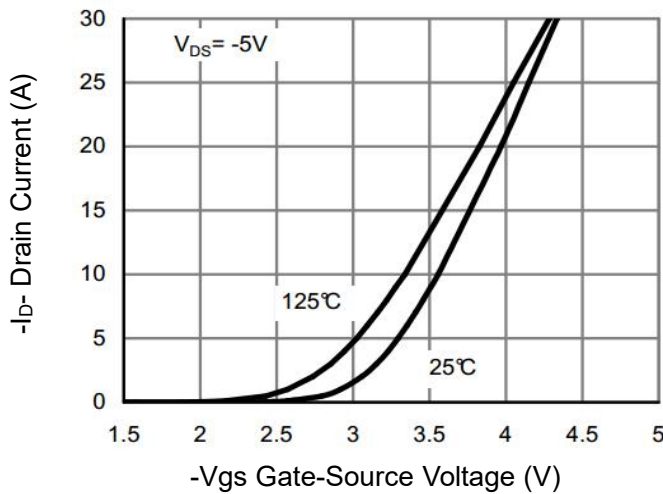


Figure 2 Transfer Characteristics

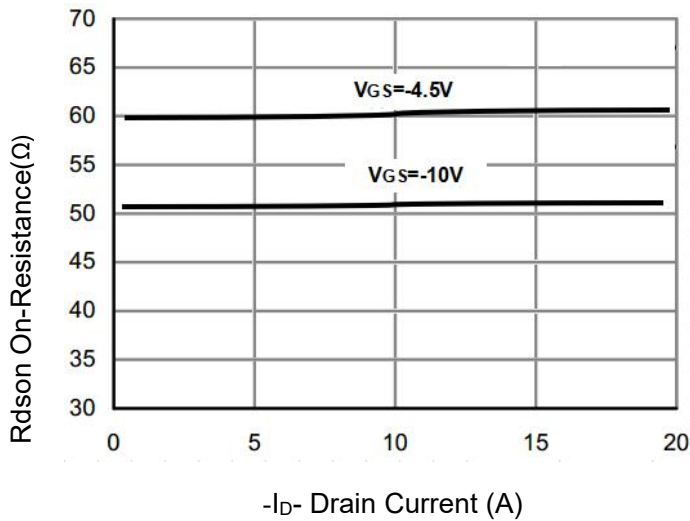


Figure 3 R_{dson} - Drain Current

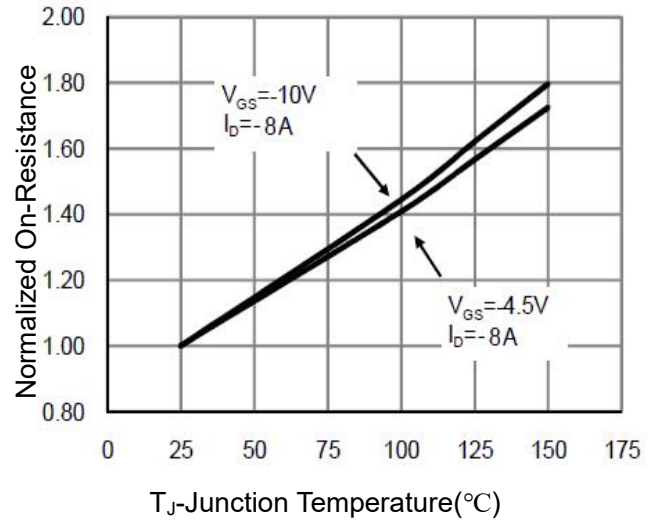


Figure 4 R_{dson} -Junction Temperature

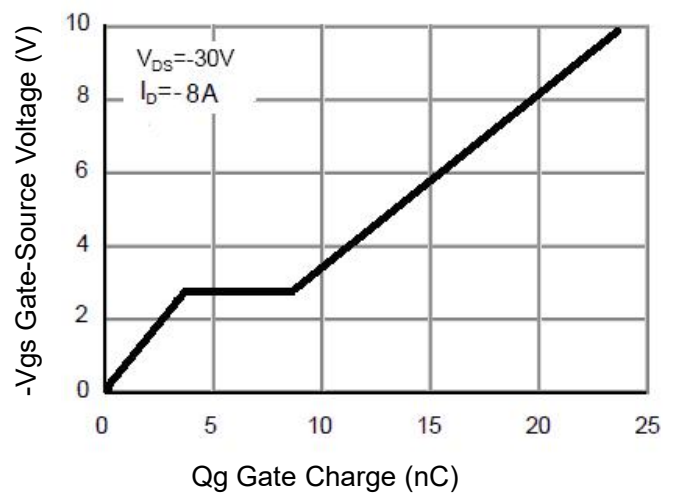


Figure 5 Gate Charge

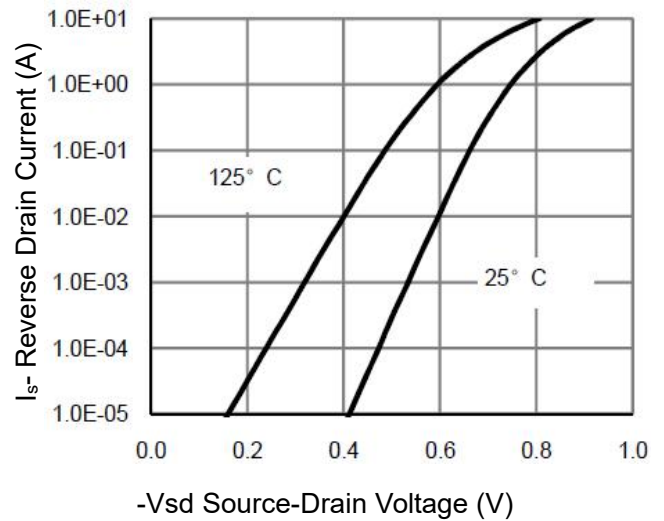
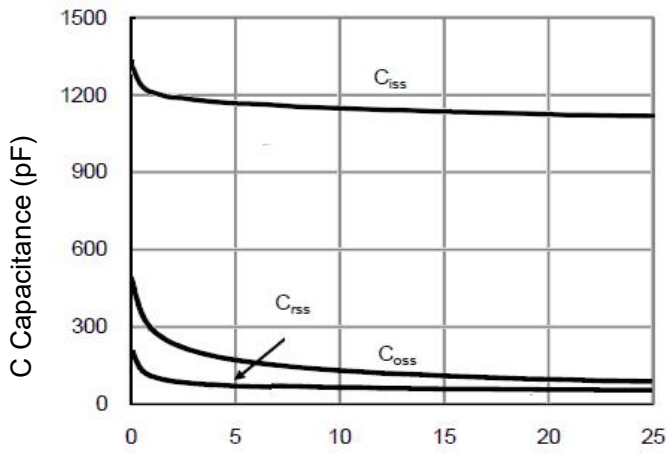
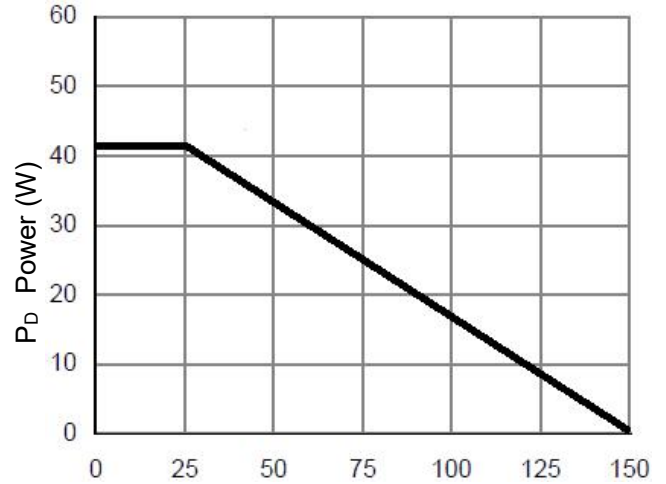


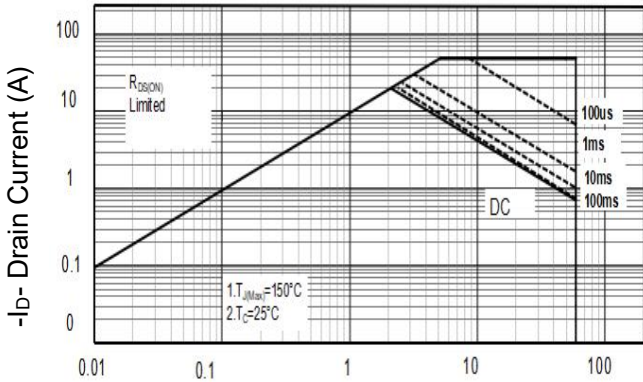
Figure 6 Source- Drain Diode Forward



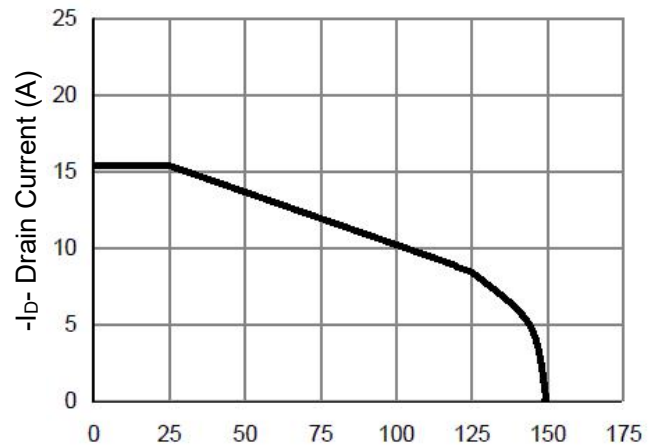
-Vds Drain-Source Voltage (V)
Figure 7 Capacitance vs Vds



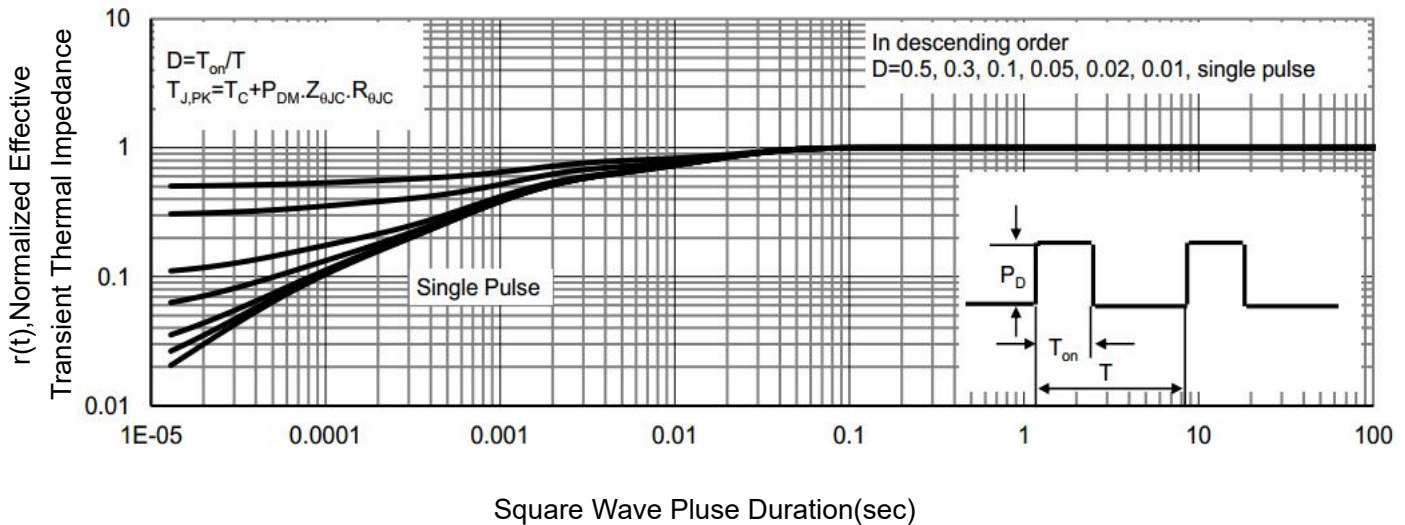
T_J-Junction Temperature(°C)
Figure 9 Power Dissipation



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

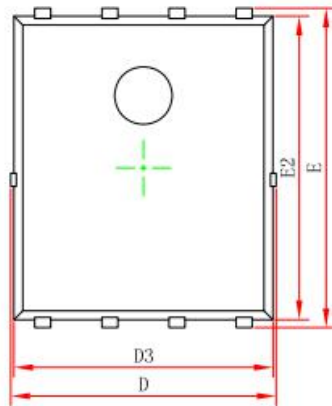


T_J-Junction Temperature(°C)
Figure 10 ID Current De-rating

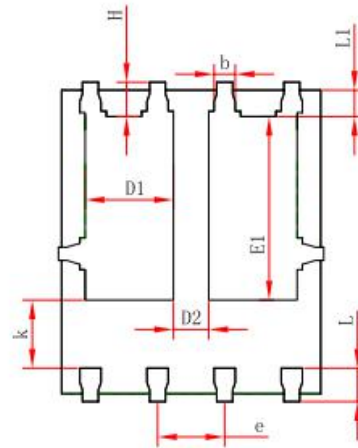


Square Wave Pluse Duration(sec)
Figure 11 Normalized Maximum Transient Thermal Impedance

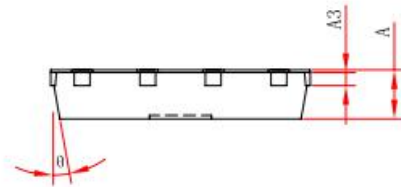
DFN5X6-8L Package Information



Top View
[顶视图]



Bottom View
[背视图]



Side View
[侧视图]

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 0.900 | 1.000 | 0.035 | 0.039 |
| A3 | 0.254 REF. | | 0.010REF. | |
| D | 4.944 | 5.096 | 0.195 | 0.201 |
| E | 5.974 | 6.126 | 0.235 | 0.241 |
| D1 | 1.470 | 1.870 | 0.058 | 0.074 |
| D2 | 0.470 | 0.870 | 0.019 | 0.034 |
| E1 | 3.375 | 3.575 | 0.133 | 0.141 |
| D3 | 4.824 | 4.976 | 0.190 | 0.196 |
| E2 | 5.674 | 5.826 | 0.223 | 0.229 |
| k | 1.190 | 1.390 | 0.047 | 0.055 |
| b | 0.350 | 0.450 | 0.014 | 0.018 |
| e | 1.270TYP. | | 0.050TYP. | |
| L | 0.559 | 0.711 | 0.022 | 0.028 |
| L1 | 0.424 | 0.576 | 0.017 | 0.023 |
| H | 0.574 | 0.726 | 0.023 | 0.029 |
| θ | 10° | 12° | 10° | 12° |

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