# KSN60N04Q

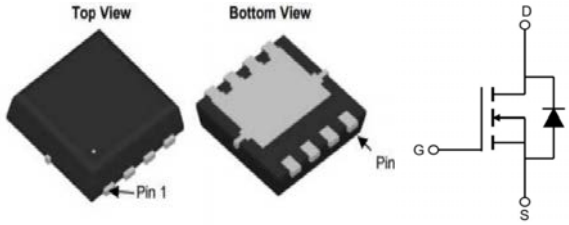
## General Description

The KSN60N04Q is the high performance complementary N-ch and P-ch MOSFET with high cell density, whichprovide excellent RDSON and gate charge for most of the synchronous buck converter applications .

**40V N-Channel MOSFETs**

| BVDSS | RDSON | ID |
|---|---|---|
| 40V | 6.9mΩ | 60A |

## PDFN3X3 Pin Configuration




## Features

- 40V, 60A, $R_{DS}$(ON)=6.0mΩ@VGS = 10V
- Improved dv/dt capability
- Fast switching
- Green Device Available

## Applications

- Notebook
- Load Switch
- LED applications
- Hand-Held Device

## Absolute Maximum Ratings Tc=25℃ unless otherwise noted

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 40 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | V |
| $I_D$ | Drain Current – Continuous ($T_C$=25℃) | 60 | A |
| | Drain Current – Continuous ($T_C$=100℃) | 44 | A |
| $I_{DM}$ | Drain Current – Pulsed[1] | 180 | A |
| EAS | Single Pulse Avalanche Energy[2] | 64 | mJ |
| IAS | Single Pulse Avalanche Current[2] | 39 | A |
| $P_D$ | Power Dissipation ($T_C$=25℃) | 65 | W |
| | Power Dissipation – Derate above 25℃ | 0.58 | W/℃ |
| $T_{STG}$ | Storage Temperature Range | -50 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -50 to 150 | ℃ |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance Junction to ambient | --- | 62 | ℃/W |
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | --- | 1.73 | ℃/W |

## Electrical Characteristics ($T_J$=25 ℃, unless otherwise noted) Off

### Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=250uA | 40 | --- | --- | V |
| $\triangle BV_{DSS}/\triangle T_J$ | $BV_{DSS}$ Temperature Coefficient | Reference to 25℃ , $I_D$=1mA | --- | 0.03 | --- | V/℃ |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$=40V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=32V , $V_{GS}$=0V , $T_J$=85℃ | --- | --- | 10 | uA |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |

### On Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V , $I_D$=15A | --- | 6.9 | 8.5 | mΩ |
| | | $V_{GS}$=4.5V , $I_D$=8A | --- | 9 | 12 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =250uA | 1.2 | 1.6 | 2.5 | V |
| $\triangle V_{GS(th)}$ | $V_{GS(th)}$ Temperature Coefficient | | --- | -5 | --- | mV/℃ |
| gfs | Forward Transconductance | $V_{DS}$=10V , $I_D$=10A | --- | 13 | --- | S |

### Dynamic and switching Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge[3,4] | $V_{DS}$=20V , $V_{GS}$=10V , $I_D$=10A | --- | 19.7 | 30 | nC |
| $Q_{gs}$ | Gate-Source Charge[3,4] | | --- | 2.8 | 4.2 | |
| $Q_{gd}$ | Gate-Drain Charge[3,4] | | --- | 5.1 | 7.6 | |
| $T_{d(on)}$ | Turn-On Delay Time[3,4] | $V_{DD}$=15V, $V_{GS}$=10V , $R_G$=3.3Ω $I_D$=1A | --- | 13.2 | 25 | ns |
| $T_r$ | Rise Time[3,4] | | --- | 2.2 | 5 | |
| $T_{d(off)}$ | Turn-Off Delay Time[3,4] | | --- | 72 | 130 | |
| $T_f$ | Fall Time[3,4] | | --- | 4.5 | 10 | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=25V , $V_{GS}$=0V , F=1MHz | --- | 1578 | 2200 | pF |
| $C_{oss}$ | Output Capacitance | | --- | 135 | 250 | |
| $C_{rss}$ | Reverse Transfer Capacitance | | --- | 87 | 170 | |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, F=1MHz | --- | 2.2 | --- | Ω |

### Drain-Source Diode Characteristics and Maximum Ratings

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current | $V_G$=$V_D$=0V , Force Current | --- | --- | 50 | A |
| $I_{SM}$ | Pulsed Source Current | | --- | --- | 110 | A |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$=0V , $I_S$=1A , $T_J$=25℃ | --- | --- | 1 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$=0V,$I_S$=1A , dI/dt=100A/μs $T_J$=25℃ | --- | 17 | --- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | --- | 2.8 | --- | nC |

Note :
1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. $V_{DD}$=25V,$V_{GS}$=10V,L=0.1mH,$I_{AS}$=39A.,$R_G$=25Ω,Starting $T_J$=25℃.
3. The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%.
4. Essentially independent of operating temperature.

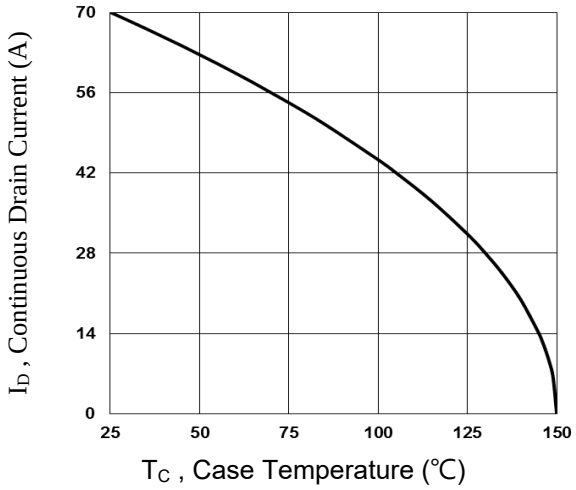



**Fig.1 Continuous Drain Current vs. $T_C$**

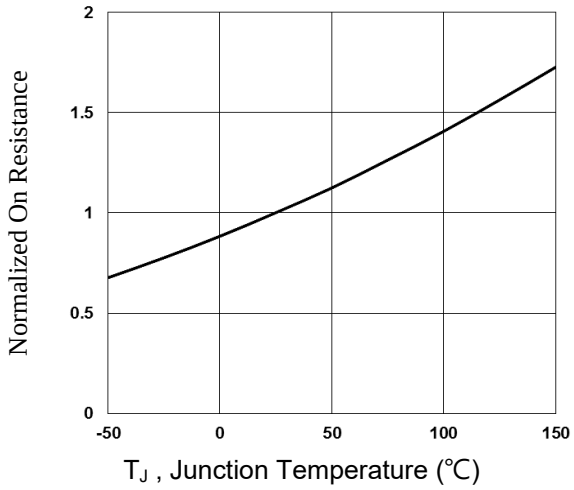



**Fig.2 Normalized RDSON vs. $T_J$**

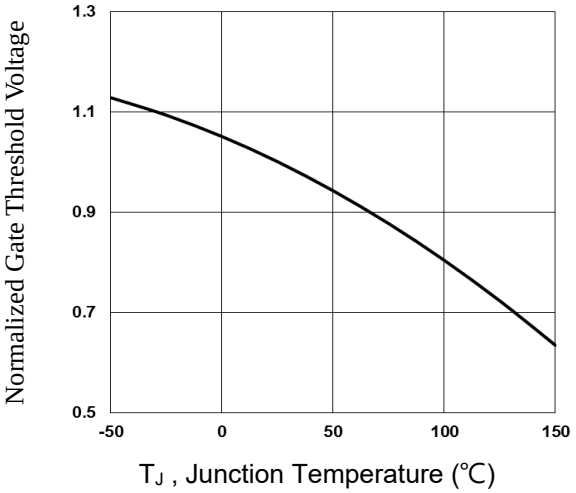



**Fig.3 Normalized $V_{th}$ vs. $T_J$**

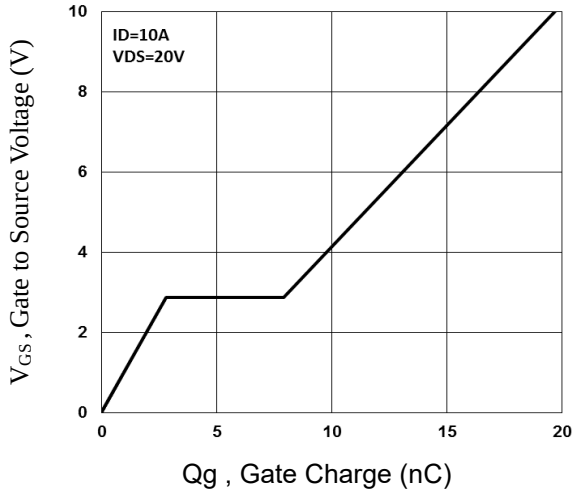



**Fig.4 Gate Charge Waveform**

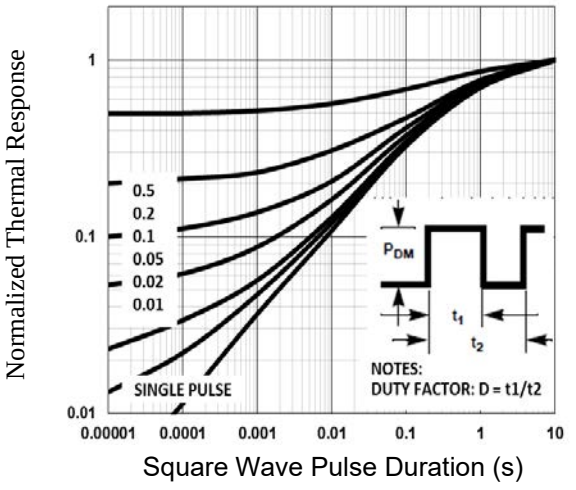



**Fig.5 Normalized Transient Impedance**

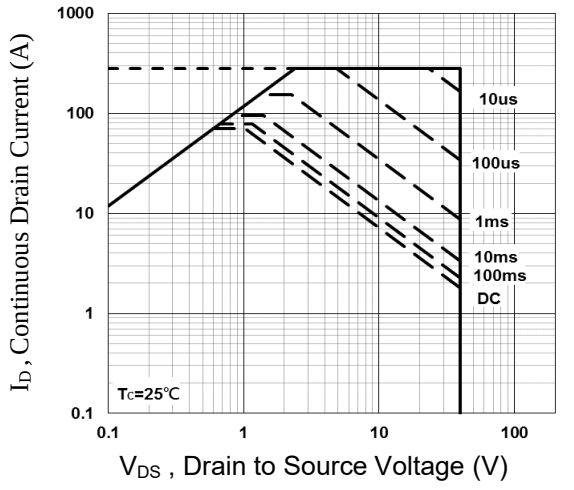



**Fig.6 Maximum Safe Operation Area**

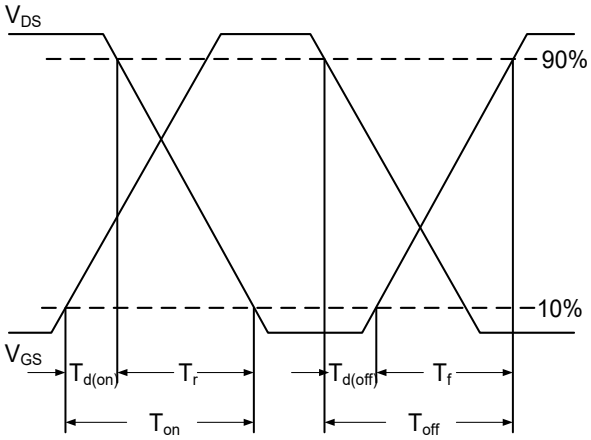



**Fig.7 Switching Time Waveform**

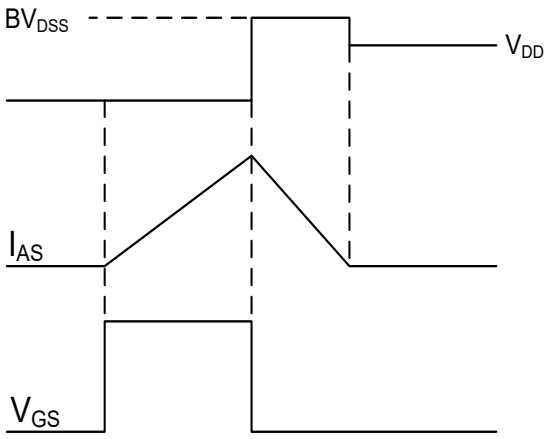



**Fig.8 EAS Waveform**