# CR10N60F A9K

## General Description：

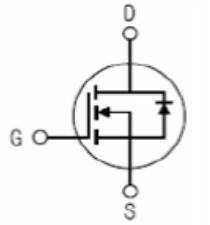
CR10N60F A9K, the silicon N-channel Enhanced VDMOSFETs, is obtained by the self-aligned planar Technology which reduce the conduction loss, improve switching performance and enhance the avalanche energy. The transistor can be used in various power switching circuit for system miniaturization and higher efficiency. The package form is TO-220F, which accords with the RoHS standard.

| | | |
|---|---|---|
| $V_{DSS}$ | 600 | V |
| $I_D$ | 10 | A |
| $P_D(T_C=25℃)$ | 40 | W |
| $R_{DS(ON)Typ}$ | 0.68 | Ω |

TO-220F


1. Gate 2. Drain 3. Source

Inner Equivalent Principium Chart




## Features：

- **Fast Switching**
- **Low ON Resistance**
- **Low Gate Charge**
- **Low Reverse transfer capacitances**
- **100% Single Pulse avalanche energy Test**

## Applications：

Power switch circuit of adaptor and charger.

**Absolute**（Tc= 25℃ unless otherwise specified）：

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DSS}$ | Drain-to-Source Voltage | 600 | V |
| $I_D$ | Continuous Drain Current | 10 | A |
| | Continuous Drain Current $T_C$ = 100 ℃ | 6.3 | A |
| $I_{DM}$ [a1] | Pulsed Drain Current | 40 | A |
| $V_{GS}$ | Gate-to-Source Voltage | ±30 | V |
| $E_{AS}$ [a2] | Single Pulse Avalanche Energy | 580 | mJ |
| dv/dt [a3] | Peak Diode Recovery dv/dt | 5.0 | V/ns |
| $P_D$ | Power Dissipation | 40 | W |
| | Derating Factor above 25 ℃ | 0.32 | W/℃ |
| $T_J$， $T_{stg}$ | Operating Junction and Storage Temperature Range | 150，–55 to 150 | ℃ |
| $T_L$ | Maximum Temperature for Soldering | 300 | ℃ |

**Electrical Characteristics**（$T_J$= 25℃ unless otherwise specified）:

| **OFF Characteristics** | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | Parameter | Test Conditions | Rating | | | Unit |
| | | | Min. | Typ. | Max. | s |
| $V_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS}$=0V, $I_D$=250μA | 600 | -- | -- | V |
| $\Delta BV_{DSS}/\Delta T_J$ | Bvdss Temperature Coefficient | ID=250uA,Reference25℃ | -- | 0.67 | -- | V/℃ |
| $I_{DSS}$ | Drain to Source Leakage Current | $V_{DS}$ =600V, $V_{GS}$= 0V, $T_J$ = 25℃ | -- | -- | 1 | μA |
| | | $V_{DS}$ =480V, $V_{GS}$= 0V, $T_J$ = 125℃ | -- | -- | 100 | μA |
| $I_{GSS(F)}$ | Gate to Source Forward Leakage | $V_{GS}$ =+30V | -- | -- | 100 | nA |
| $I_{GSS(R)}$ | Gate to Source Reverse Leakage | $V_{GS}$ =-30V | -- | -- | -100 | nA |

| **ON Characteristics** | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | Parameter | Test Conditions | Rating | | | Units |
| | | | Min. | Typ. | Max. | |
| $R_{DS(ON)}$ | Drain-to-Source On-Resistance | $V_{GS}$=10V,$I_D$=5A | -- | 0.68 | 0.9 | Ω |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 2.0 | -- | 4.0 | V |
| Pulse width tp≤300μs, δ ≤2% | | | | | | |

| **Dynamic Characteristics** | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | Parameter | Test Conditions | Rating | | | Units |
| | | | Min. | Typ. | Max. | |
| $g_{fs}$ | Forward Transconductance | $V_{DS}$=15V, $I_D$ =5A | -- | 9.5 | -- | S |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V $V_{DS}$ = 25V f = 1.0MHz | -- | 1530 | -- | pF |
| $C_{oss}$ | Output Capacitance | | -- | 116 | -- | |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 4.9 | -- | |

| **Resistive Switching Characteristics** | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | Parameter | Test Conditions | Rating | | | Units |
| | | | Min. | Typ. | Max. | |
| $t_{d(ON)}$ | Turn-on Delay Time | $I_D$ =10A $V_{DD}$ = 300V $R_G$ =10Ω | -- | 26 | -- | ns |
| tr | Rise Time | | -- | 23 | -- | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | -- | 49 | -- | |
| $t_f$ | Fall Time | | -- | 27 | -- | |
| $Q_g$ | Total Gate Charge | $I_D$ =10A $V_{DD}$ =480V $V_{GS}$ = 10V | -- | 31 | -- | nC |
| $Q_{gs}$ | Gate to Source Charge | | -- | 7 | -- | |
| $Q_{gd}$ | Gate to Drain (“Miller”)Charge | | -- | 12 | -- | |

| Source-Drain Diode Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | Parameter | Test Conditions | Rating | | | Units |
| | | | Min. | Typ. | Max. | |
| $I_S$ | Continuous Source Current (Body Diode) | | -- | -- | 10 | A |
| $I_{SM}$ | Maximum Pulsed Current (Body Diode) | | -- | -- | 40 | A |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=10A,$V_{GS}$=0V | -- | -- | 1.5 | V |
| trr | Reverse Recovery Time | $I_S$=10A,$T_j$ = 25℃ dI$_F$/dt=100A/us, $V_{GS}$=0V | -- | 1010 | -- | ns |
| Qrr | Reverse Recovery Charge | | -- | 5150 | -- | nC |
| $I_{RRM}$ | Reverse Recovery Current | | -- | 13.5 | -- | A |
| Pulse width tp≤300μs, δ ≤2% | | | | | | |

| Symbol | Parameter | Max. | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | 3.13 | ℃/W |
| $R_{\theta JA}$ | Junction-to-Ambient | 62.5 | ℃/W |

[a1]: Repetitive rating; pulse width limited by maximum junction temperature
[a2]: L=10mH, $I_D$=10A, Start $T_J$=25℃
[a3]: $I_{SD}$ =10A,di/dt ≤100A/us,$V_{DD}$≤$BV_{DS,}$ Start $T_J$=25℃

## Test Circuit and Waveform

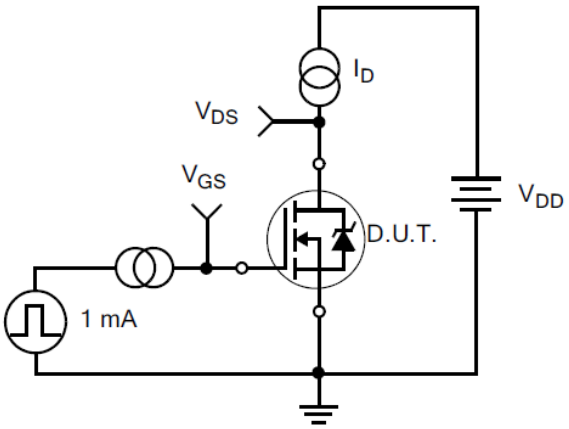



Figure 14. Gate Charge Test Circuit

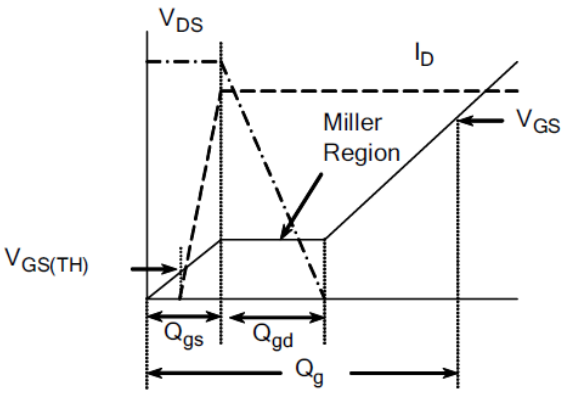



Figure 15. Gate Charge Waveforms

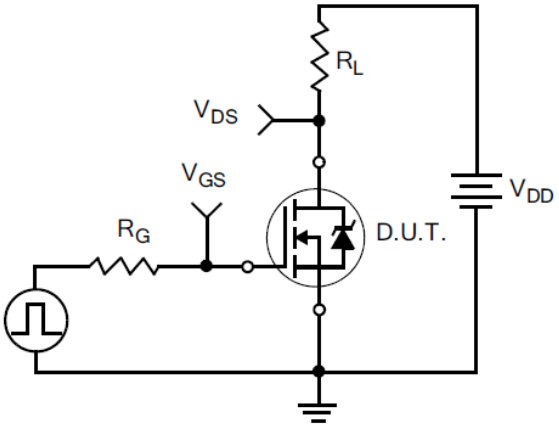



Figure 16. Resistive Switching Test Circuit

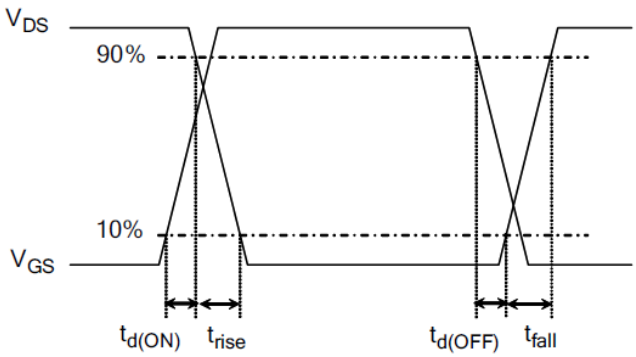



Figure 17. Resistive Switching Waveforms

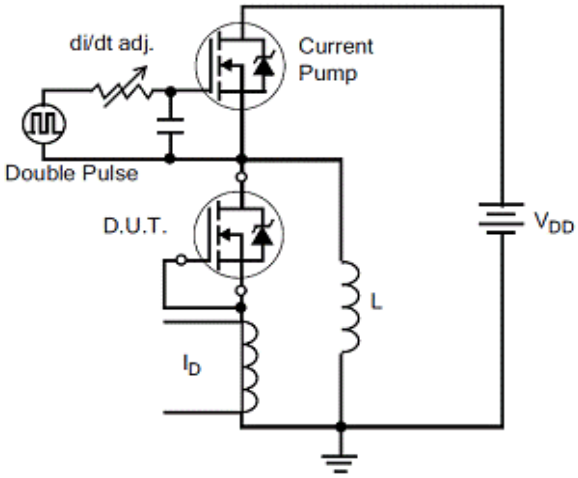



Figure 18. Diode Reverse Recovery Test Circuit

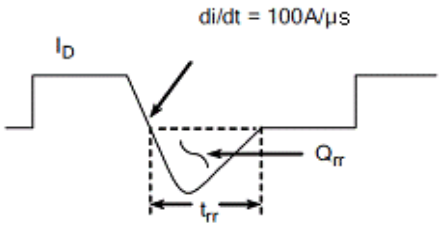



Figure 19. Diode Reverse Recovery Waveform

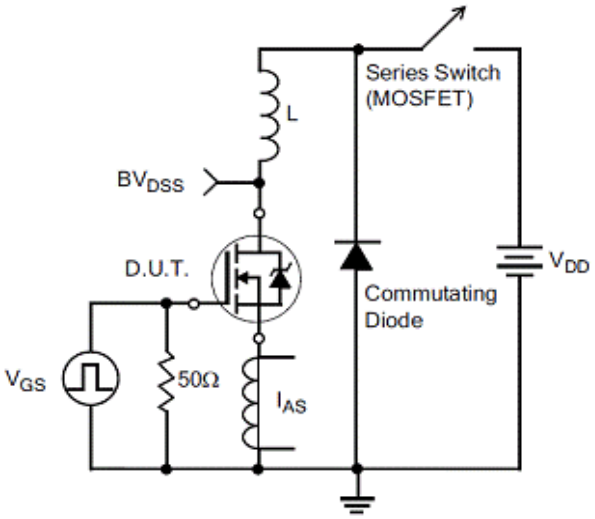



Figure20.Unclamped Inductive Switching Test Circuit

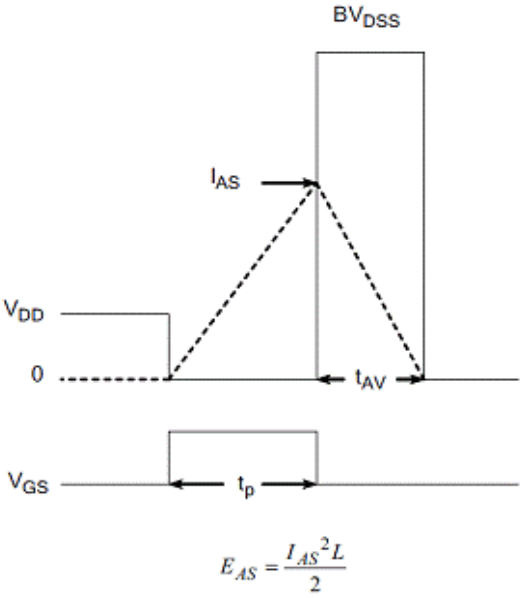
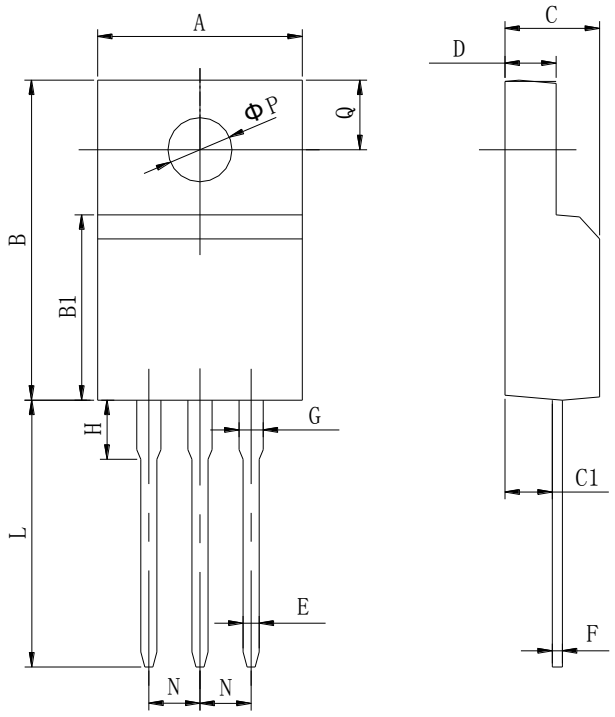



Figure21.Unclamped Inductive Switching Waveform

## Package Information




| Items | Values(mm) | |
|---|---|---|
| | MIN | MAX |
| A | 9.60 | 10.4 |
| B | 15.4 | 16.2 |
| B1 | 8.90 | 9.50 |
| C | 4.30 | 4.90 |
| C1 | 2.10 | 3.00 |
| D | 2.40 | 3.00 |
| E | 0.60 | 1.00 |
| F | 0.30 | 0.60 |
| G | 1.12 | 1.42 |
| H | 3.40 | 3.80 |
| L* | 12.0 | 14.0 |
| N | 2.34 | 2.74 |
| Q | 3.15 | 3.55 |
| ΦP | 2.90 | 3.30 |

*adjustable

TO-220F Package