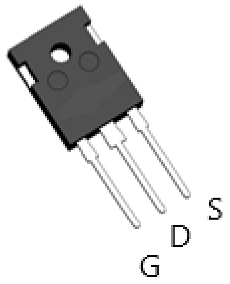
# Silicon N-Channel Power MOSFET ®

## CS6N120 AKR-G

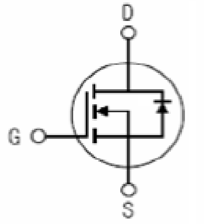
| | | |
|---|---|---|
| $V_{DSS}$ | 1200 | V |
| $I_D$ | 6 | A |
| $P_D$ ($T_C$=25℃) | 205 | W |
| $R_{DS(ON)Typ}$ | 2.3 | Ω |

## General Description：

CS6N120 AKR-G, 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-247 which accords with the RoHS standard.



**Inner Equivalent Principium Chart**



## Features：

- **Fast Switching**
- **Low ON Resistance(Rdson≤2.9Ω)**
- **Low Gate Charge (Typical Data:13.1 nC)**
- **Low Reverse transfer capacitances(Typical:.2.3 pF)**
- **100% Single Pulse avalanche energy Test**
- **Halogen Free**

## Applications：

Electric welder、Inverter.

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

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DSS}$ | Drain-to-Source Voltage | 1200 | V |
| $I_D$ | Continuous Drain Current $T_C$ = 25 ℃ | 6 | A |
| | Continuous Drain Current $T_C$ = 100 ℃ | 3.7 | A |
| $I_{DM}$ [a1] | Pulsed Drain Current $T_C$ = 25 ℃ | 24 | A |
| $V_{GS}$ | Gate-to-Source Voltage | ±30 | V |
| $E_{AS}$ [a2] | Single Pulse Avalanche Energy | 102 | mJ |
| dv/dt [a3] | Peak Diode Recovery dv/dt | 5.0 | V/ns |
| $P_D$ | Power Dissipation | 205 | W |
| | Derating Factor above 25 ℃ | 1.6 | W/℃ |
| $T_J$，$T_{stg}$ | Operating Junction and Storage Temperature Range | 150，–55 to 150 | ℃ |

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

**OFF Characteristics**

| Symbol | Parameter | Test Conditions | Rating | | | Units |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $V_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS}$=0V, $I_D$=250μA | 1200 | -- | -- | V |
| $I_{DSS}$ | Drain to Source Leakage Current | $V_{DS}$ =1200V, $V_{GS}$= 0V, $T_J$ = 25℃ | -- | -- | 25 | μA |
| | | $V_{DS}$ =960V, $V_{GS}$= 0V, $T_J$ = 125℃ | -- | -- | 250 | 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,$I_D$=3.0A | -- | 2.3 | 2.9 | Ω |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 3.0 | -- | 5.0 | V |
| Pulse width tp≤300μs, δ ≤2% | | | | | | |

**Dynamic Characteristics**

| Symbol | Parameter | Test Conditions | Rating | | | Units |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $g_{fs}$ | Forward Trans conductance | $V_{DS}$=30V, $I_D$ =3.0A | -- | 7.6 | -- | S |
| Rg | Gate resistance | f = 1.0MHz | -- | 3.5 | -- | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V $V_{DS}$ = 25V<br>f = 1.0MHz | -- | 2333 | -- | pF |
| $C_{oss}$ | Output Capacitance | | -- | 115 | -- | |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 1.8 | -- | |

**Resistive Switching Characteristics**

| Symbol | Parameter | Test Conditions | Rating | | | Units |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $t_{d(ON)}$ | Turn-on Delay Time | $I_D$ =6A $V_{DD}$ = 600V<br>$R_G$ =10Ω | | 34 | | **ns** |
| tr | Rise Time | | | 27 | | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | | 49 | | |
| $t_f$ | Fall Time | | | 24 | | |
| $Q_g$ | Total Gate Charge | $I_D$ =6A $V_{DD}$ =800V<br>$V_{GS}$ = 10V | -- | 45 | -- | nC |
| $Q_{gs}$ | Gate to Source Charge | | -- | 13 | -- | |
| $Q_{gd}$ | Gate to Drain (“Miller”)Charge | | -- | 18 | -- | |

**Source-Drain Diode Characteristics**

| Symbol | Parameter | Test Conditions | Rating | | | Units |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $I_S$ | Continuous Source Current (Body Diode) | $T_C$ = 25 ℃ | -- | -- | 6 | A |
| $I_{SM}$ | Maximum Pulsed Current (Body Diode) | | -- | -- | 24 | A |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=6.0A,$V_{GS}$=0V | -- | -- | 1.5 | V |
| trr | Reverse Recovery Time | $I_S$=6A,$T_j$ = 25℃<br>$dI_F$/dt=100A/us,<br>$V_{GS}$=0V | | 683 | -- | ns |
| Qrr | Reverse Recovery Charge | | | 7240 | -- | nC |
| $I_{RRM}$ | Reverse Recovery Current | | | 21 | -- | A |
| Pulse width tp≤300μs, δ ≤2% | | | | | | |

| Symbol | Parameter | Max. | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | 0.61 | ℃/W |
| $R_{\theta JA}$ | Junction-to-Ambient | 40 | ℃/W |

[a1]: Repetitive rating; pulse width limited by maximum junction temperature

[a2]: L=10mH, $I_D$=4.5A, Start $T_J$=25℃

[a3]: $I_{SD}$ =6A,di/dt ≤100A/us,$V_{DD}$≤$BV_{DS}$, Start $T_J$=25℃

## Characteristics Curve：

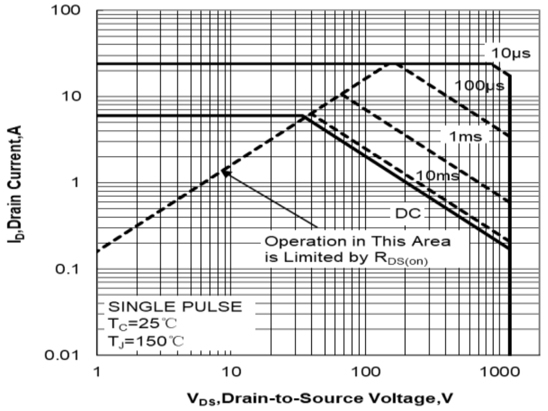


Figure 1 Maximum Forward Bias Safe Operating Area

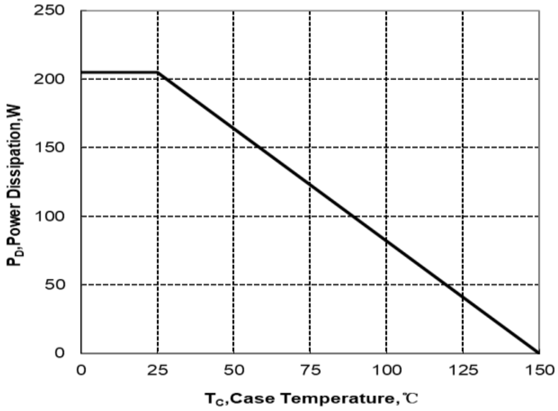


Figure 2 Maximum Power dissipation vs Case Temperature

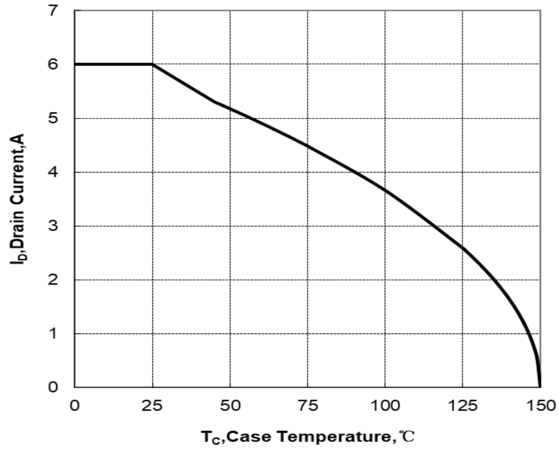


Figure 3 Maximum Continuous Drain Current vs Case Temperature

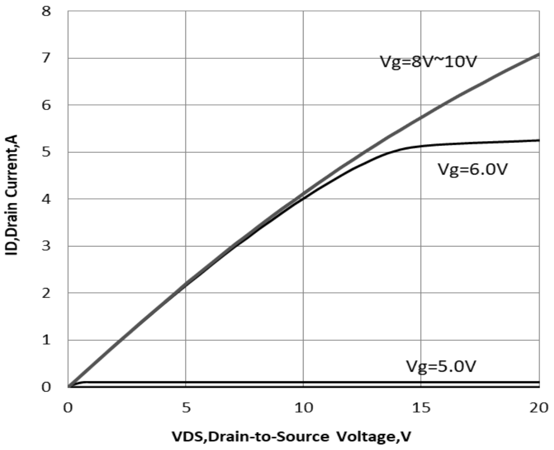


Figure 4 Typical Output Characteristics

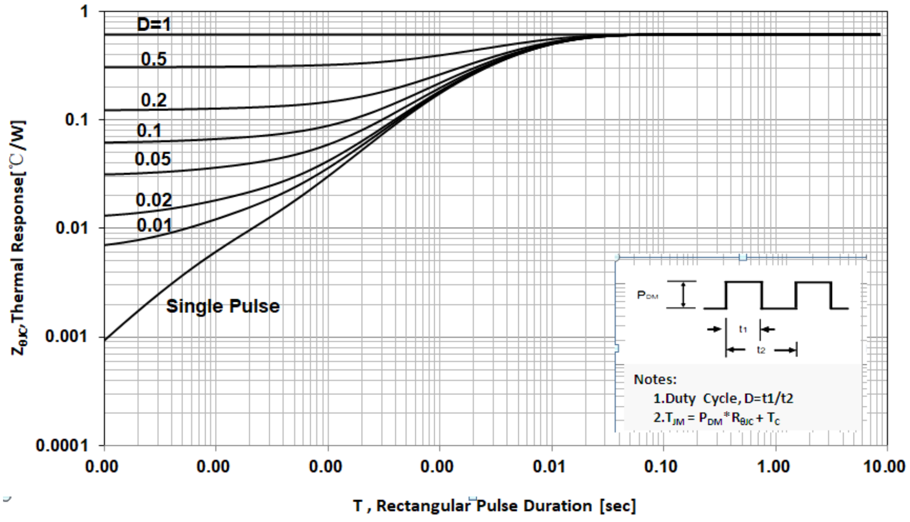


Figure 5 Maximum Effective Thermal Impedance , Junction to Case

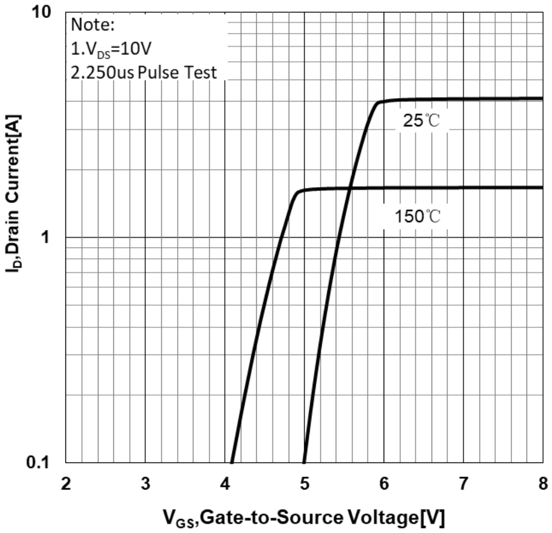


Figure.6 Typical Transfer Characteristics

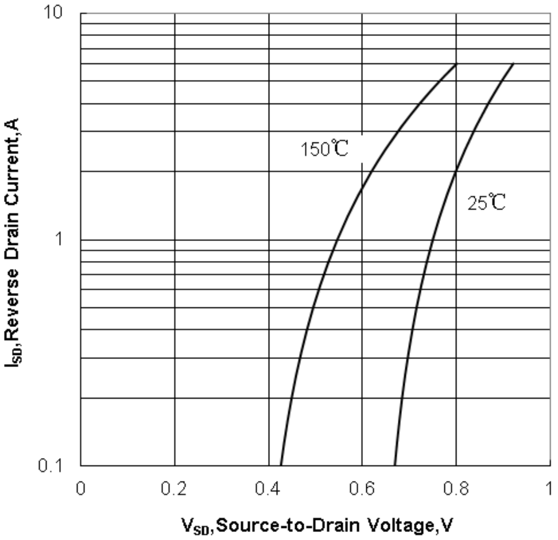


Figure.7 Typical Body Diode Transfer Characteristics

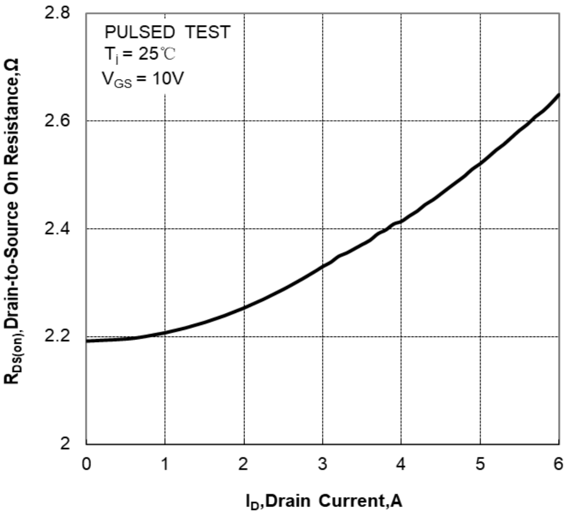


Figure.8 Typical Drain to Source ON Resistance vs Drain Current

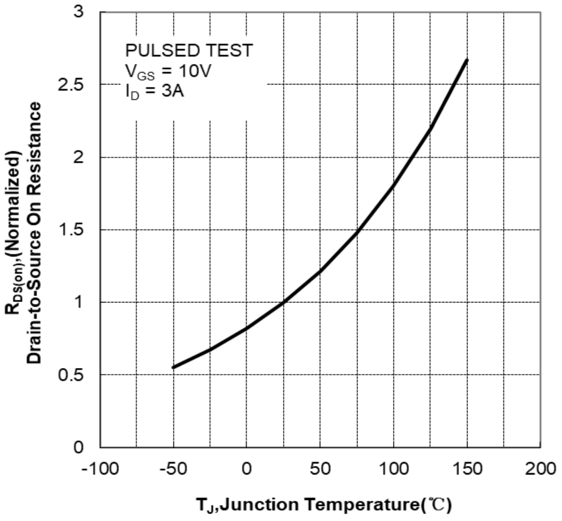


Figure.9 Typical Drian to Source on Resistance vs Junction Temperature

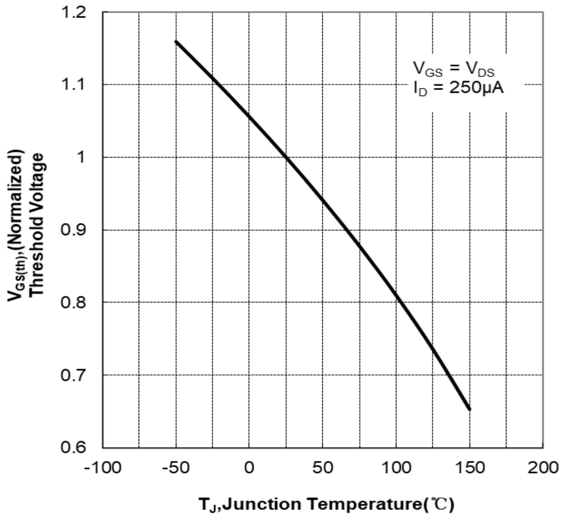


Figure.10 Typical Theshold Voltage vs Junction Temperatu

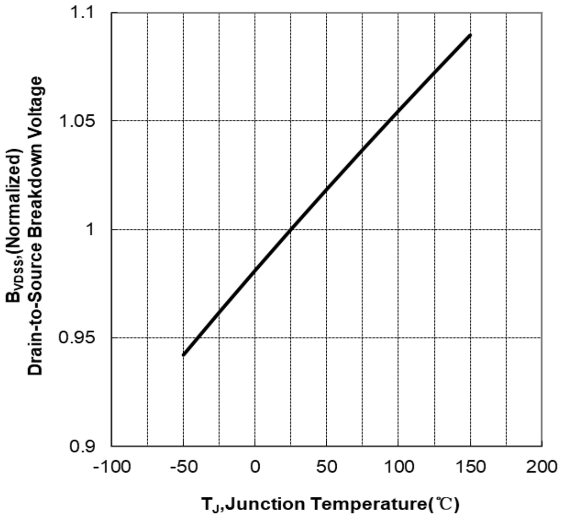


Figure 11 Typical Breakdown Voltage vs Junction Temperature

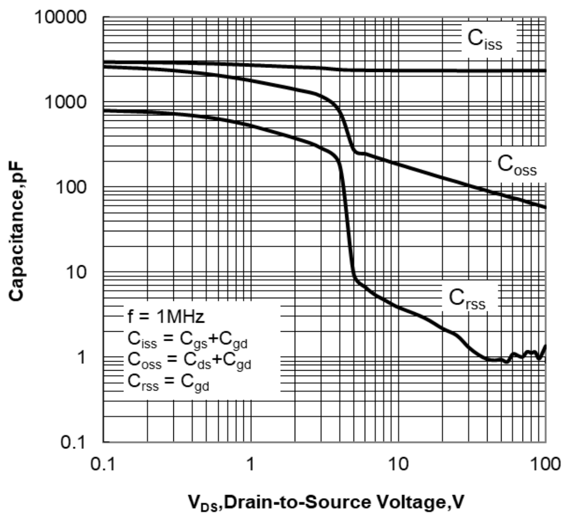


Figure.12 Typical Capacitance vs Drain to Source Voltage

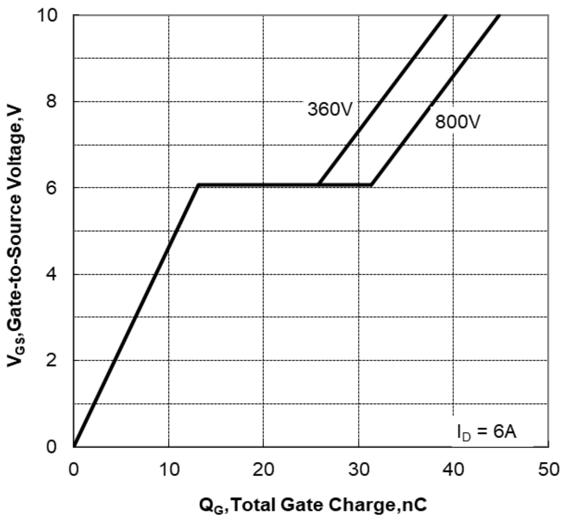


Figure.13 Typical Gate Charge vs Gate to Source Voltage

# Test Circuit and Waveform:

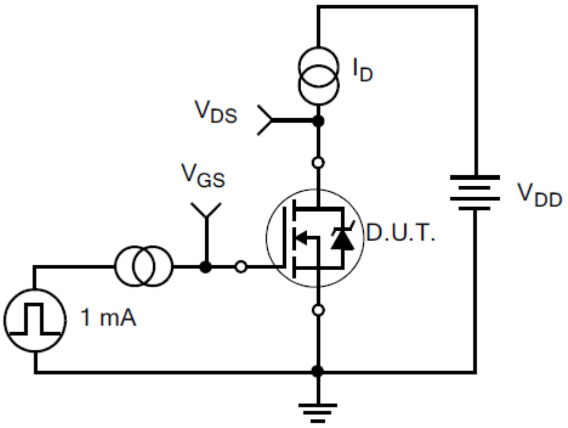


Figure 14. Gate Charge Test Circuit

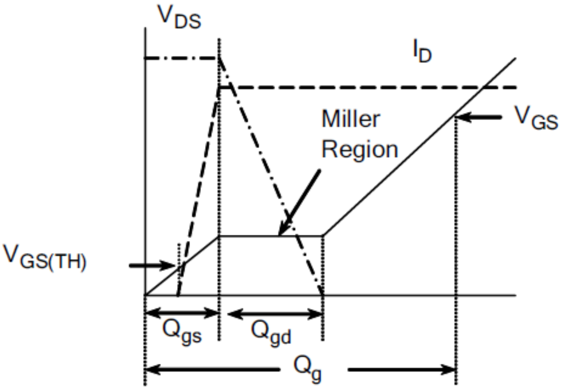


Figure 15. Gate Charge Waveforms

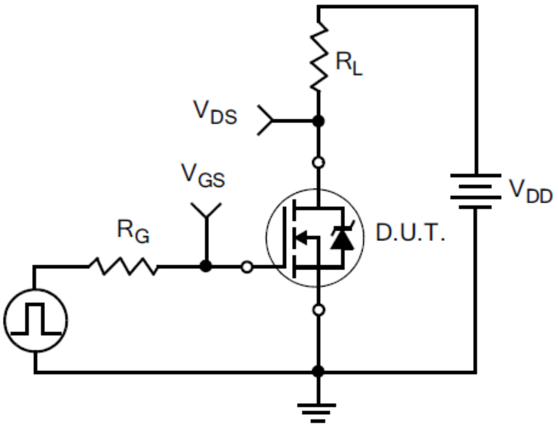


Figure 16. Resistive Switching Test Circuit

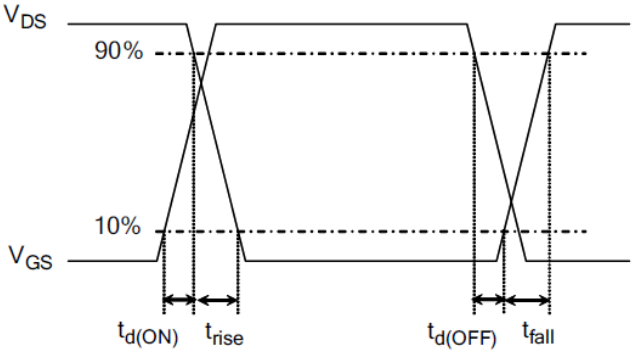


Figure 17. Resistive Switching Waveforms

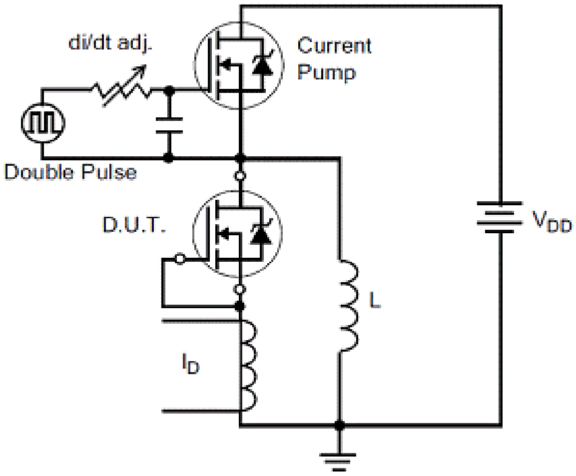


Figure 18. Diode Reverse Recovery Test Circuit

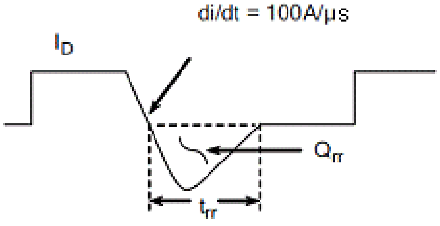


Figure 19. Diode Reverse Recovery Waveform

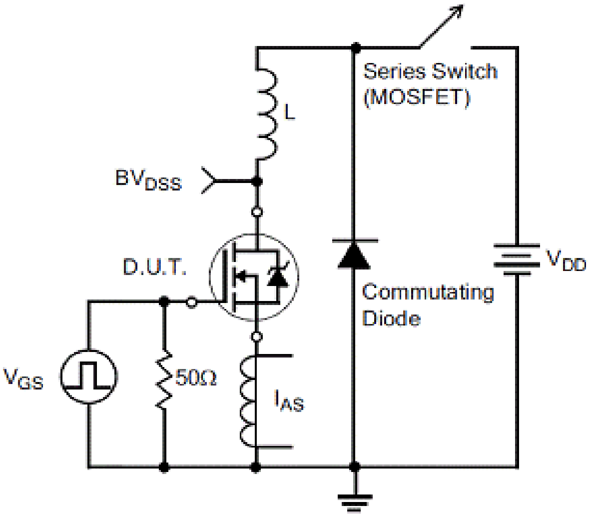
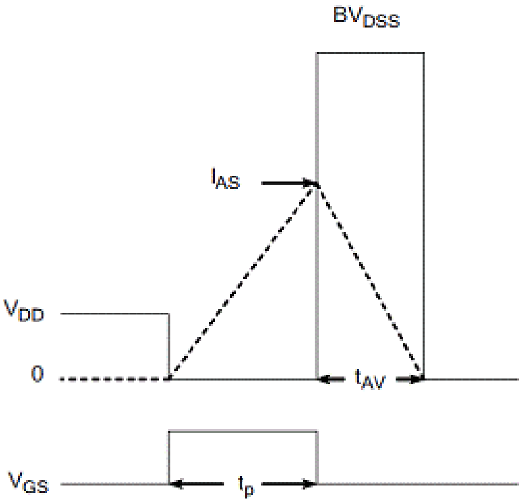


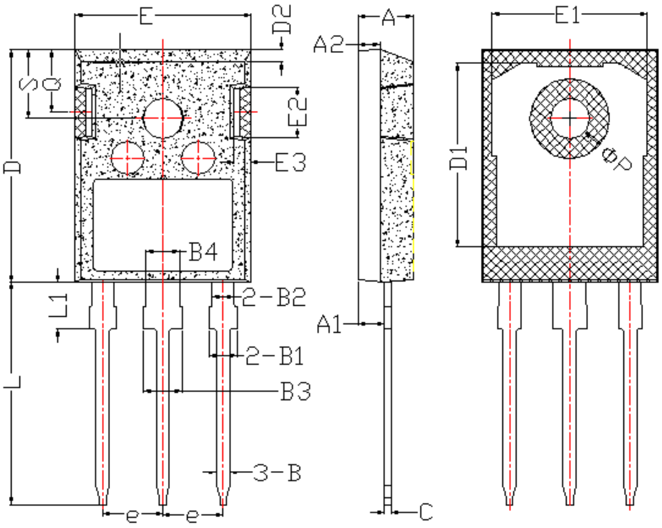
Figure20.Unclamped Inductive Switching Test Circuit



$$E_{AS}=\frac{I_{AS}{}^2L}{2}$$

Figure21.Unclamped Inductive Switching Waveform

## Package Information：



| 项　目 | 规范(mm) | |
|---|---|---|
| | MIN | MAX |
| A | 4.6 | 5.2 |
| A1 | 2,2 | 2.6 |
| B | 0.9 | 1.4 |
| B1 | 1.75 | 2.35 |
| B2 | 1.75 | 2.15 |
| B3 | 2.8 | 3.35 |
| B4 | 2.8 | 3.15 |
| C | 0.5 | 0.7 |
| D | 20.60 | 21.30 |
| D1 | 16 | 18 |
| E | 15.5 | 16.10 |
| E1 | 13 | 14.7 |
| E2 | 3.80 | 5.3 |
| E3 | 0.8 | 2.60 |
| e | 5.2 | 5.7 |
| L | 19 | 20.5 |
| L1 | 3.9 | 4.6 |
| ΦP | 3.3 | 3.70 |
| Q | 5.2 | 6.00 |
| S | 5.8 | 6.6 |

TO-247 Package

## The name and content of poisonous and harmful material in products

| | **Hazardous Substance** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pb | Hg | Cd | Cr(VI) | PBB | PBDE | DIBP | DEHP | DBP | BBP |
| Limit | ⩽0.1% | ⩽0.1% | ⩽ 0.01% | ⩽0.1% | ⩽0.1% | ⩽0.1% | ⩽0.1% | ⩽0.1% | ⩽0.1% | ⩽0.1% |
| Lead Frame | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Molding | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Chip | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Wire Bonding | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Solder | × | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Note | ○：Means the hazardous material is under the criterion of 2011/65/EU.<br>×：Means the hazardous material exceeds the criterion of 2011/65/EU.<br>The plumbum element of solder exist in products presently, but within the allowed range of Eurogroup's RoHS. | | | | | | | | | |

## Warnings

**1.** Exceeding the maximum ratings of the device in performance may cause damage to the device, even the permanent failure, which may affect the dependability of the machine. It is suggested to be used under 80 percent of the maximum ratings of the device.

**2.** When installing the heat sink, please pay attention to the torsional moment and the smoothness of the heat sink.

**3.** VDMOSFETs is the device which is sensitive to the static electricity, it is necessary to protect the device from being damaged by the static electricity when using it.

**4.** This publication is made by Huajing Microelectronics and subject to regular change without notice.

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