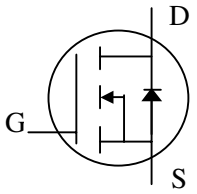
# N-channel Enhancement-mode Power MOSFET

**Low Gate Charge**

**Simple Drive Requirement**

**Fast Switching Performance**

**RoHS-compliant, halogen-free**

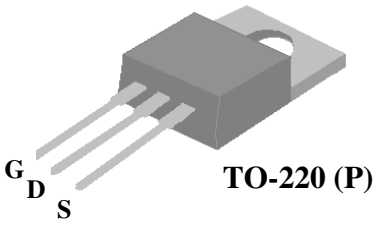



| | |
|---|---|
| $BV_{DSS}$ | 60V |
| $R_{DS(ON)}$ | 16mΩ |
| $I_D$ | 60A |

## Description

Advanced Power MOSFETs from APEC provide the designer with the best combination of fast switching, low on-resistance and cost-effectiveness.

The AP9972AGP-HF-3 is in the TO-220 package, which is widely used for commercial and industrial applications, and is well-suited for low-voltage applications such as DC-DC converters, motor drives and high-current high-speed switching circuits.




TO-220 (P)

## Absolute Maximum Ratings

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 60 | V |
| $V_{GS}$ | Gate-Source Voltage | ±25 | V |
| $I_D$ at $T_C$=25℃ | Continuous Drain Current | 60 | A |
| $I_D$ at $T_C$=100℃ | Continuous Drain Current | 38 | A |
| $I_{DM}$ | Pulsed Drain Current[1] | 240 | A |
| $P_D$ at $T_C$=25℃ | Total Power Dissipation | 89 | W |
| | Linear Derating Factor | 0.7 | W/℃ |
| $T_{STG}$ | Storage Temperature Range | -55 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -55 to 150 | ℃ |

## Thermal Data

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| Rthj-c | Maximum Thermal Resistance, Junction-case | 1.4 | ℃/W |
| Rthj-a | Maximum Thermal Resistance, Junction-ambient | 62 | ℃/W |

## Ordering Information

**AP9972AGP-HF-3TB** **RoHS-compliant halogen-free TO-220, shipped in tubes**

## Electrical Specifications at $T_j$=25℃ (unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V, $I_D$=250uA | 60 | - | - | V |
| $\Delta BV_{DSS}/\Delta Tj$ | Breakdown Voltage Temperature Coefficient | Reference to 25℃, $I_D$=1mA | - | 0.06 | - | V/℃ |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance[2] | $V_{GS}$=10V, $I_D$=30A | - | - | 16 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$=250uA | 2 | - | 4 | V |
| $g_{fs}$ | Forward Transconductance | $V_{DS}$=10V, $I_D$=40A | - | 44 | - | S |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$=60V, $V_{GS}$=0V | - | - | 10 | uA |
| | Drain-Source Leakage Current ($T_j$=125°C) | $V_{DS}$=48V ,$V_{GS}$=0V | - | - | 250 | uA |
| $I_{GSS}$ | Gate-Source Leakage | $V_{GS}$=±25V, $V_{DS}$=0V | - | - | ±100 | nA |
| $Q_g$ | Total Gate Charge[2] | $I_D$=40A | - | 49 | 80 | nC |
| $Q_{gs}$ | Gate-Source Charge | $V_{DS}$=48V | - | 13 | - | nC |
| $Q_{gd}$ | Gate-Drain ("Miller") Charge | $V_{GS}$=10V | - | 20 | - | nC |
| $t_{d(on)}$ | Turn-on Delay Time[2] | $V_{DS}$=30V | - | 14 | - | ns |
| $t_r$ | Rise Time | $I_D$=40A | - | 80 | - | ns |
| $t_{d(off)}$ | Turn-off Delay Time | $R_G$=3.3Ω , $V_{GS}$=10V | - | 27 | - | ns |
| $t_f$ | Fall Time | $R_D$=0.75Ω | - | 57 | - | ns |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V | - | 2410 | 3860 | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$=25V | - | 290 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | f=1.0MHz | - | 240 | - | pF |
| $R_g$ | Gate Resistance | f=1.0MHz | - | 2 | 3 | Ω |

## Source-Drain Diode

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Forward On Voltage[2] | $I_S$=40A, $V_{GS}$=0V | - | - | 1.3 | V |
| $t_{rr}$ | Reverse Recovery Time[2] | $I_S$=30A, $V_{GS}$=0V, | - | 48 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | dI/dt=100A/μs | - | 75 | - | nC |

### Notes:

1.Pulse width limited by maximum junction temperature.

2.Pulse test

## Typical Electrical Characteristics

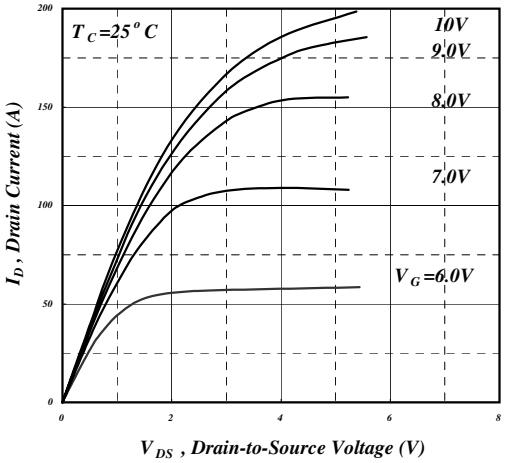



Fig 1. Typical Output Characteristics

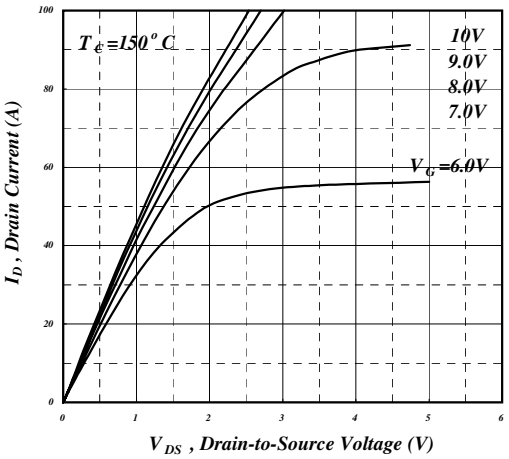



Fig 2. Typical Output Characteristics

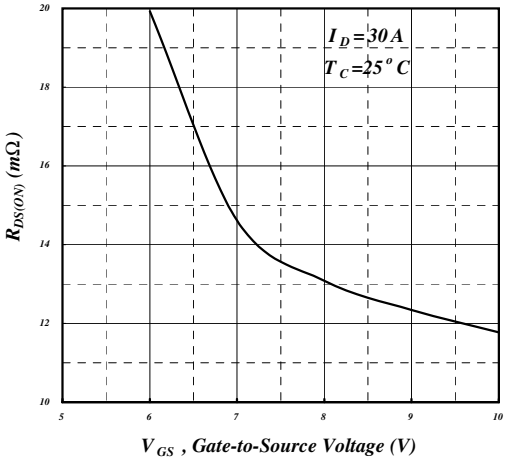



Fig 3. On-Resistance vs. Gate Voltage

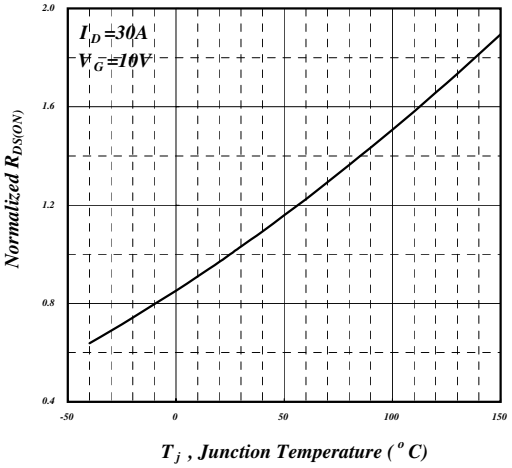



Fig 4. Normalized On-Resistance vs. Junction Temperature

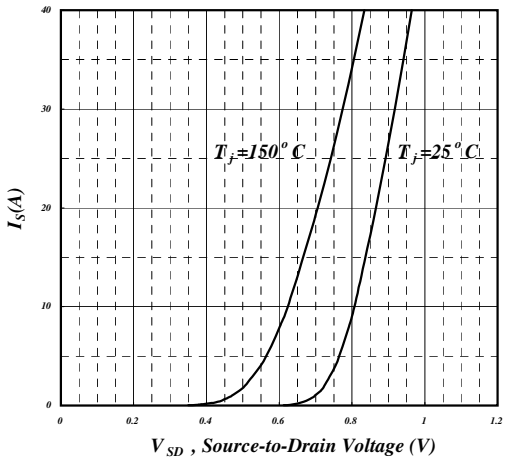



Fig 5. Forward Characteristic of the Reverse Diode

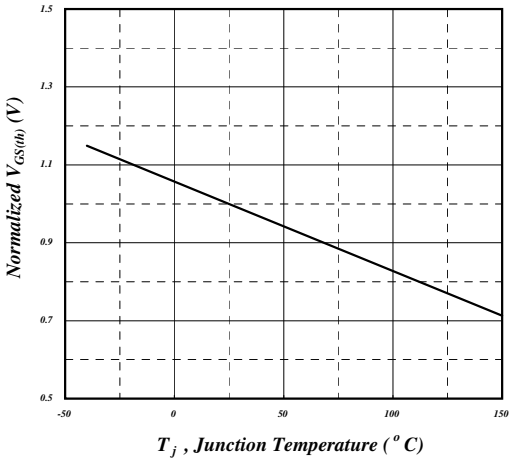



Fig 6. Gate Threshold Voltage vs. Junction Temperature

## Typical Electrical Characteristics (cont.)

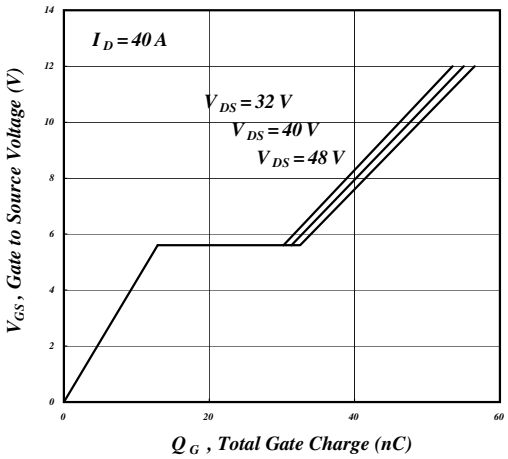



Fig 7. Gate Charge Characteristics

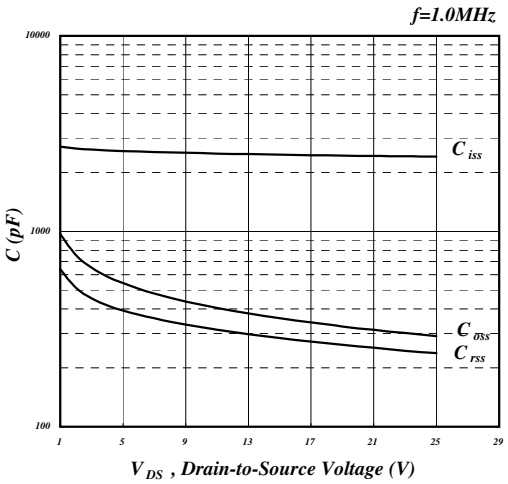



Fig 8. Typical Capacitance Characteristics

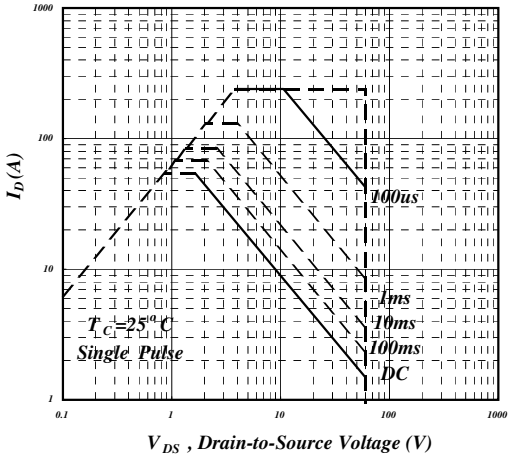



Fig 9. Maximum Safe Operating Area

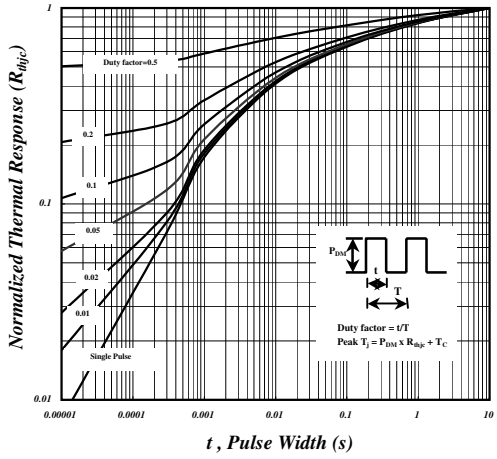



Fig 10. Effective Transient Thermal Impedance

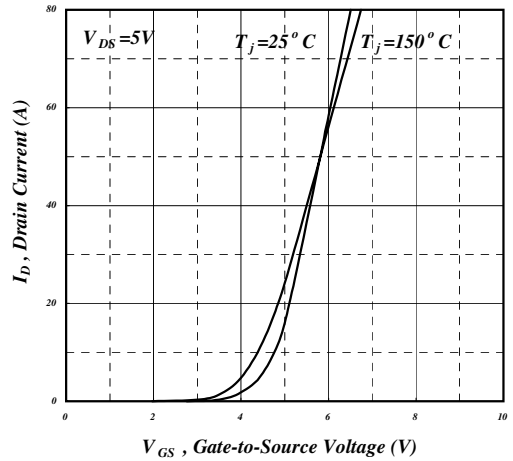



Fig 11. Transfer Characteristics

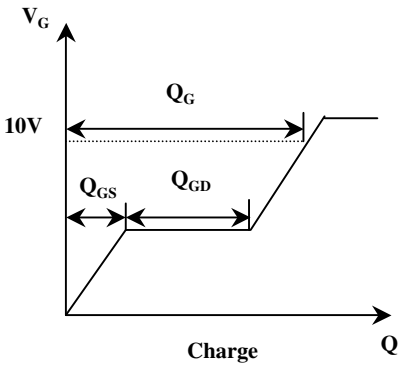
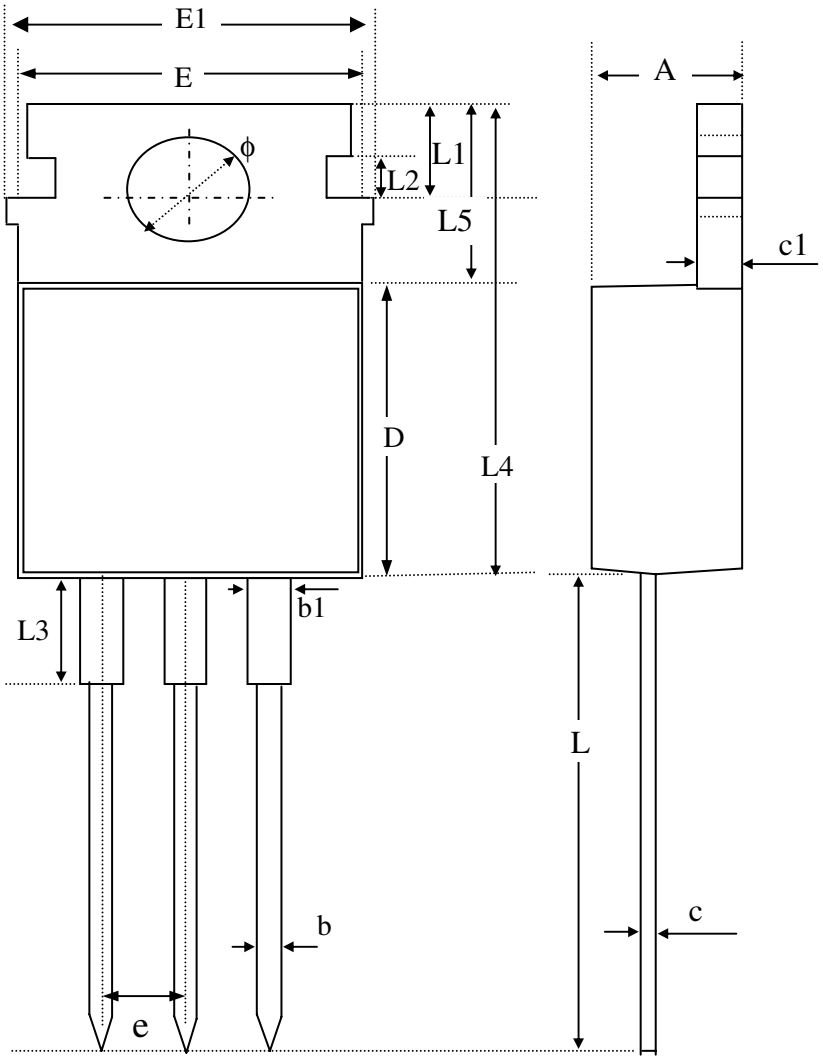



Fig 12. Gate Charge Waveform

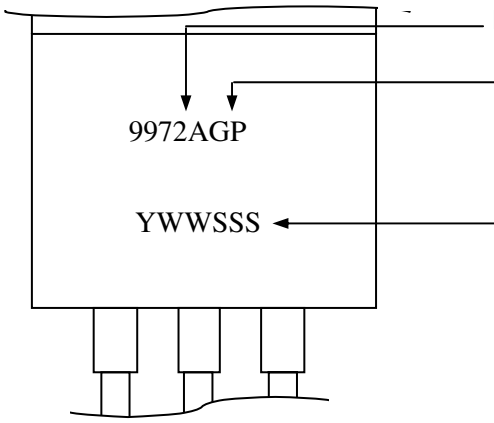
## Package Dimensions: TO-220




| SYMBOLS | Millimeters | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.25 | 4.48 | 4.70 |
| b | 0.65 | 0.80 | 0.90 |
| b1 | 1.15 | 1.38 | 1.60 |
| c | 0.40 | 0.50 | 0.60 |
| c1 | 1.00 | 1.20 | 1.40 |
| E | 9.70 | 10.00 | 10.40 |
| E1 | --- | --- | 11.50 |
| e | ---- | 2.54 | ---- |
| L | 12.70 | 13.60 | 14.50 |
| L1 | 2.60 | 2.80 | 3.00 |
| L2 | 1.00 | 1.40 | 1.80 |
| L3 | 2.6 | 3.10 | 3.6 |
| L4 | 14.70 | 15.50 | 16 |
| L5 | 6.30 | 6.50 | 6.70 |
| ϕ | 3.50 | 3.60 | 3.70 |
| D | 8.40 | 8.90 | 9.40 |

1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

## Marking Information: TO-220




Product: AP9972A

Package code
GP = RoHS-compliant halogen-free TO-220

Date/lot code (YWWSSS)
Y: Last digit of the year
WW: Work week
SSS: Lot code sequence