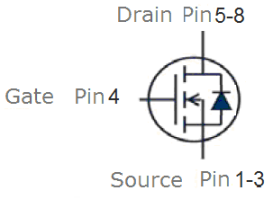
## Features

- N-Channel，5V Logic Level Control
- Enhancement mode
- Very low on-resistance $R_{DS(on)}$ @ $V_{GS}$=4.5 V
- VitoMOS® Technology
- 100% Avalanche test
- Pb-free lead plating; RoHS compliant

Pb-Free RoHS HF Halogen-Free

| | | |
|---|---|---|
| $V_{DS}$ | 60 | V |
| $R_{DS(on),TYP}$@ $V_{GS}$=10 V | 14.5 | mΩ |
| $R_{DS(on),TYP}$@ $V_{GS}$=4.5 V | 16.0 | mΩ |
| $I_D$ | 31 | A |

**PDFN5x6**


| Part ID | Package Type | Marking | Tape and reel information |
|---|---|---|---|
| VS6412APL | PDFN5x6 | 6412AP | 3000PCS/Reel |

## Maximum ratings, at $T_A$ =25°C, unless otherwise specified

| Symbol | Parameter | | Rating | Unit |
|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-Source breakdown voltage | | 60 | V |
| $I_S$ | Diode continuous forward current | $T_C$ =25°C | 31 | A |
| $I_D$ | Continuous drain current@VGS=10V | $T_C$ =25°C | 31 | A |
| | | $T_C$ =100°C | 19 | A |
| $I_{DM}$ | Pulse drain current tested ① | $T_C$ =25°C | 110 | A |
| EAS | Avalanche energy, single pulsed ② | | 121 | mJ |
| $P_D$ | Maximum power dissipation | $T_C$ =25°C | 35 | W |
| VGS | Gate-Source voltage | | ±20 | V |
| $T_{STG}$ $T_J$ | Storage and operating temperature range | | -55 to 150 | °C |

## Thermal Characteristics

| Symbol | Parameter | Typical | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance-Junction to Case | 3.5 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient | 40 | °C/W |

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Electrical Characteristics @ $T_j$=25°C (unless otherwise stated)** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V $I_D$=250μA | 60 | -- | -- | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=60V,$V_{GS}$=0V | -- | -- | 0.1 | μA |
| | Zero Gate Voltage Drain Current($T_j$=125℃) | $V_{DS}$=60V,$V_{GS}$=0V | -- | -- | 100 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$=±20V,$V_{DS}$=0V | -- | -- | ±100 | nA |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$,$I_D$=250μA | 1.2 | 1.6 | 2.5 | V |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance③ | $V_{GS}$=10V, $I_D$=15A | -- | 14.5 | 17.0 | mΩ |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance③ | $V_{GS}$=4.5V, $I_D$=10A | -- | 16.0 | 20.0 | mΩ |
| **Dynamic Electrical Characteristics @ $T_j$ = 25°C (unless otherwise stated)** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=30V,$V_{GS}$=0V, f=1MHz | -- | 1240 | -- | pF |
| $C_{oss}$ | Output Capacitance | | -- | 95 | -- | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 85 | -- | pF |
| $R_g$ | Gate Resistance | f=1MHz | -- | 2.4 | -- | Ω |
| $Q_g$ | Total Gate Charge | $V_{DS}$=30V,$I_D$=5A, $V_{GS}$=10V | -- | 21 | -- | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 6 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 8.5 | -- | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD}$=30V, $I_D$=5A, $R_G$=6.8Ω, $V_{GS}$=10V | -- | 12 | -- | nS |
| $t_r$ | Turn-on Rise Time | | -- | 8.5 | -- | nS |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 42 | -- | nS |
| $t_f$ | Turn-Off Fall Time | | -- | 6 | -- | nS |
| **Source- Drain Diode Characteristics@ $T_j$ = 25°C (unless otherwise stated)** | | | | | | |
| $V_{SD}$ | Forward on voltage | $I_{SD}$=15A,$V_{GS}$=0V | -- | 0.82 | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $T_j$=25℃,$I_{sd}$=5A, $V_{GS}$=0V di/dt=100A/μs | -- | 22 | -- | nS |
| $Q_{rr}$ | Reverse Recovery Charge | | | 86 | | nC |

NOTE:

① Repetitive rating; pulse width limited by max. junction temperature.

② Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 0.5mH,$R_G$ = 25Ω, $I_{AS}$ = 22A, $V_{GS}$ =10V. Part not recommended for use above this value

③ Pulse width ≤ 300μs; duty cycle≤ 2%.

## Typical Characteristics

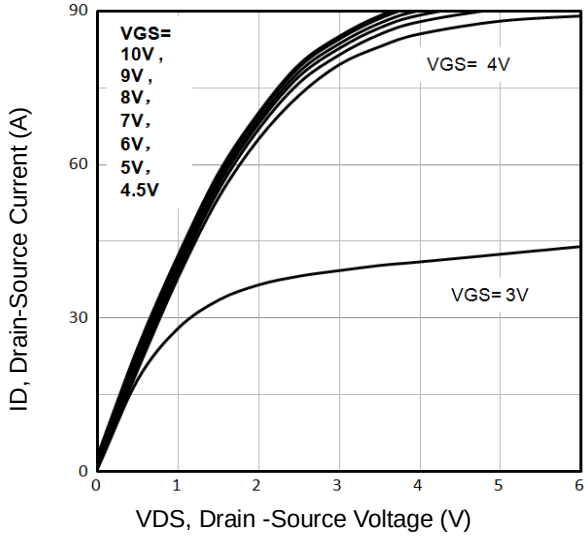



**Fig1.** Typical Output Characteristics

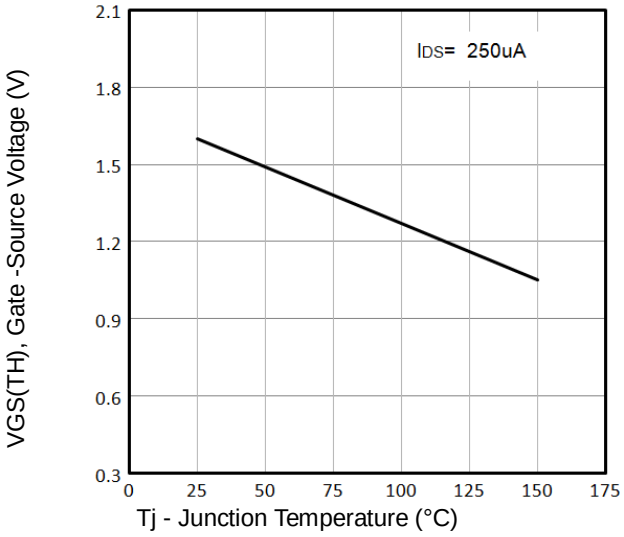



**Fig2.** $V_{GS(TH)}$ Gate -Source Voltage Vs.Tj

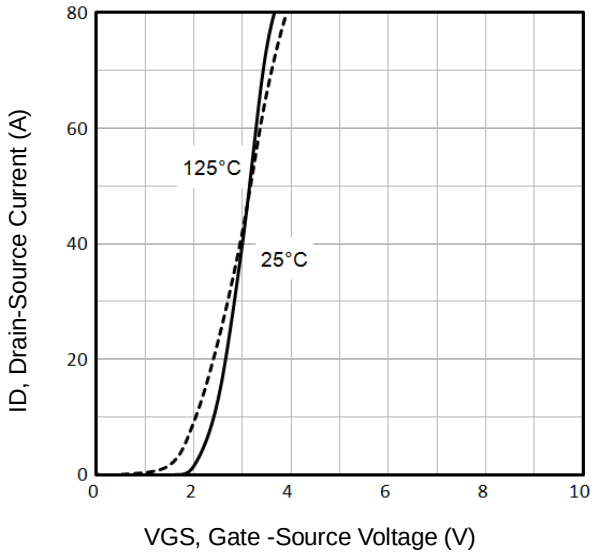



**Fig3.** Typical Transfer Characteristics

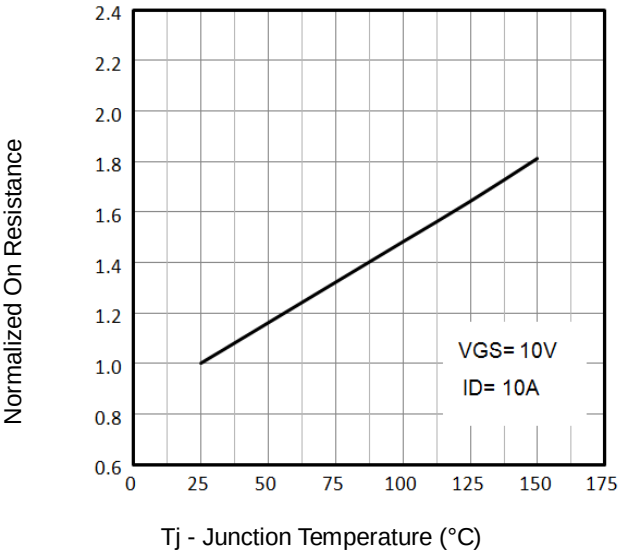



**Fig4.** Normalized On-Resistance Vs. Tj

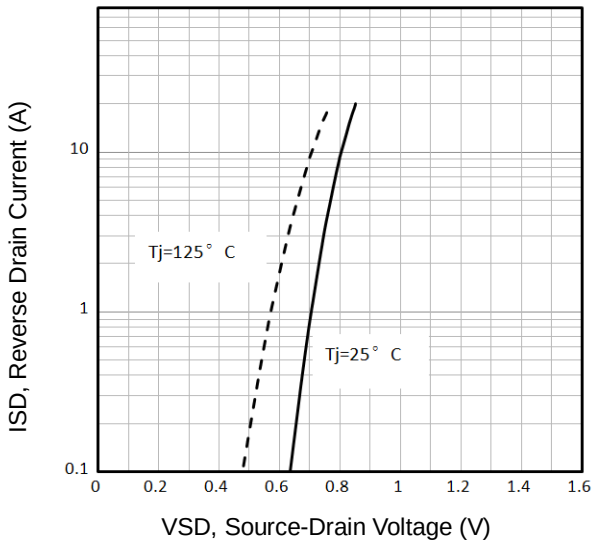



**Fig5.** Typical Source-Drain Diode Forward Voltage

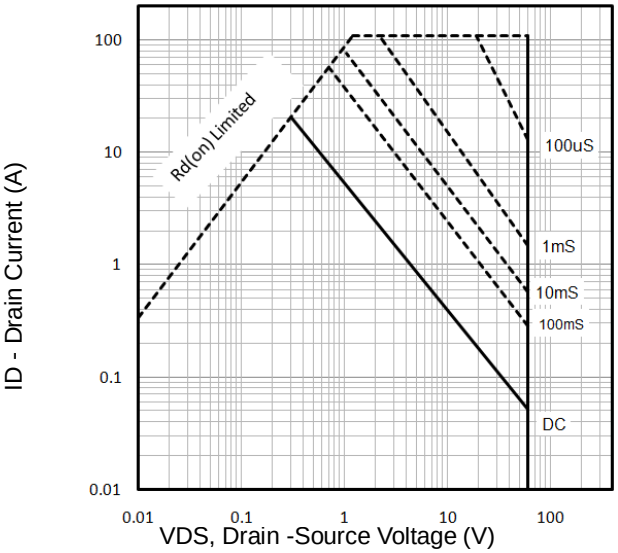



**Fig6.** Maximum Safe Operating Area

## Typical Characteristics

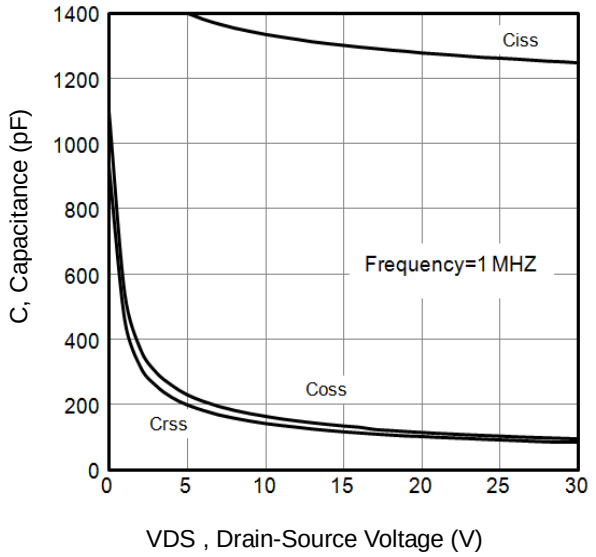



**Fig7.** Typical Capacitance Vs.Drain-Source Voltage

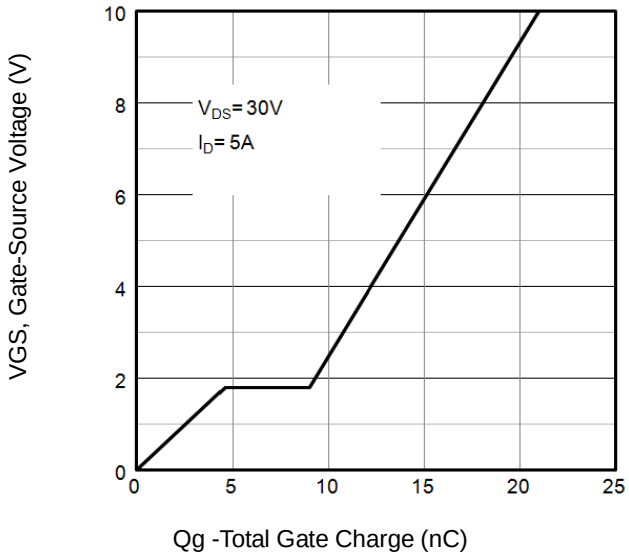



**Fig8.** Typical Gate Charge Vs.Gate-Source Voltage

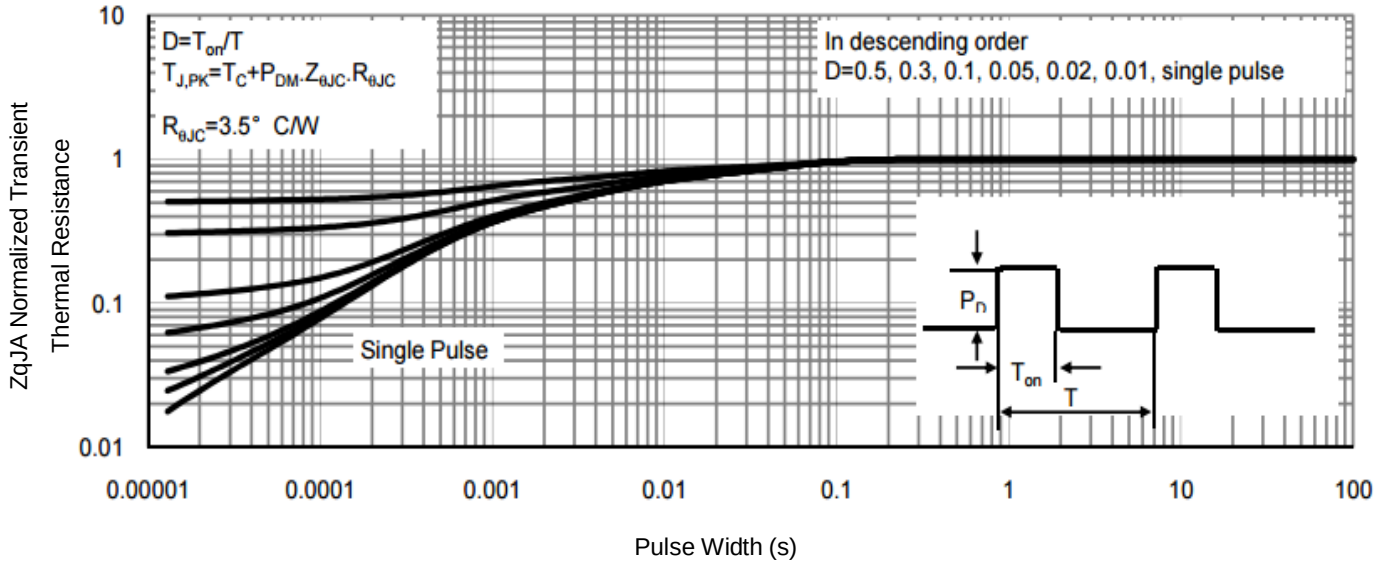



**Fig9.** Normalized Maximum Transient Thermal Impedance

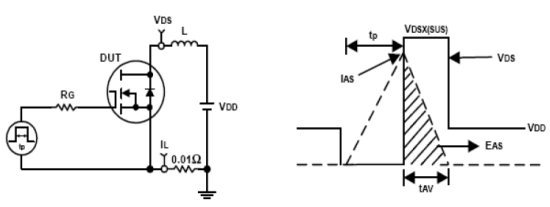



**Fig10.** Unclamped Inductive Test Circuit and waveforms

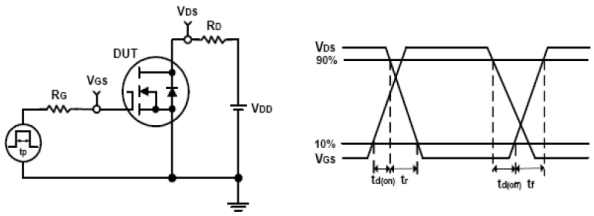
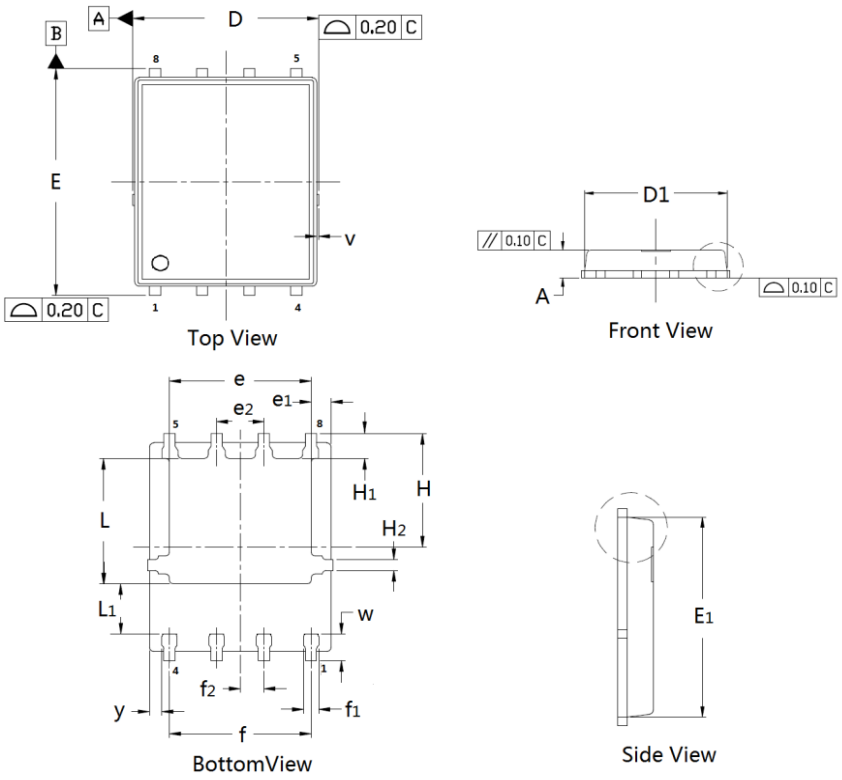



**Fig11.** Switching Time Test Circuit and waveforms

## PDFN5×6 Package Outline Data




**DIMENSIONS** ( unit : mm )

| Symbol | Min | Typ | Max | Symbol | Min | Typ | Max |
|---|---|---|---|---|---|---|---|
| **A** | 0.90 | 1.02 | 1.10 | **D** | 4.90 | 4.98 | 5.10 |
| **$D_1$** | 4.80 | 4.89 | 5.00 | **E** | 6.00 | 6.11 | 6.20 |
| **$E_1$** | 5.65 | 5.74 | 5.85 | **e** | 3.72 | 3.80 | 3.92 |
| **$e_1$** | -- | 0.54 | -- | **$e_2$** | -- | 1.27 | -- |
| **f** | -- | 3.82 | -- | **$f_1$** | 0.31 | 0.37 | 0.51 |
| **$f_2$** | -- | 0.64 | -- | **H** | -- | 3.15 | -- |
| **$H_1$** | 0.59 | 0.63 | 0.79 | **$H_2$** | 0.26 | 0.28 | 0.32 |
| **L** | 3.38 | 3.45 | 3.58 | **$L_1$** | -- | 1.39 | -- |
| **v** | -- | 0.13 | -- | **w** | 0.64 | 0.68 | 0.84 |
| **y** | -- | 0.34 | -- | | -- | | -- |

## Customer Service

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