# AP50N04DF

## 40V N-Channel Enhancement Mode MOSFET

### Description

The AP50N04DF uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.

### General Features

$V_{DS}$ = 40V $I_D$ =50A

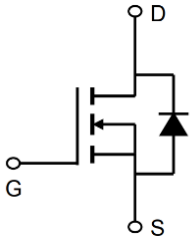
$R_{DS(ON)}$ < 18mΩ @ $V_{GS}$=10V （**Type：13mΩ**）

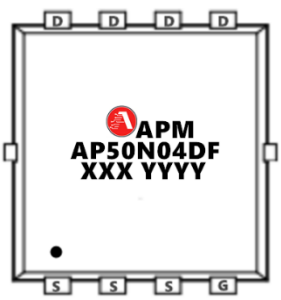
### Application

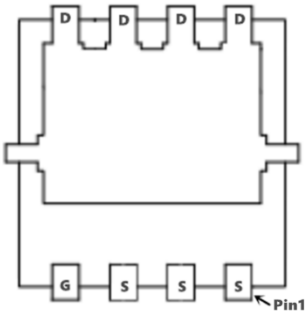
VBUS

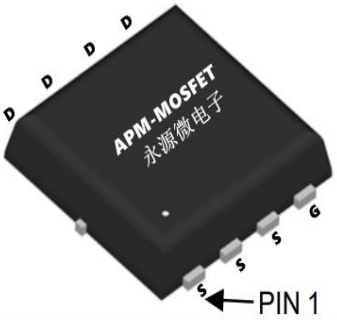
Wireless impact

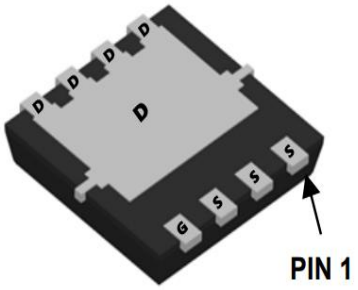
Mobile phone fast charging




### Package Marking and Ordering Information

| Product ID | Pack | Marking | Qty(PCS) |
|---|---|---|---|
| AP50N04DF | PDFN3X3-8L | AP50N04DF XXX YYYY | 5000 |

### Absolute Maximum Ratings ($T_C$=25℃unless otherwise noted)

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| VDS | Drain-Source Voltage | 40 | V |
| VGS | Gate-Source Voltage | ±20 | V |
| $I_D$@$T_C$=25℃ | Continuous Drain Current, $V_{GS}$ @ 10V[1] | 50 | A |
| $I_D$@$T_C$=100℃ | Continuous Drain Current, $V_{GS}$ @ 10V[1] | 25 | A |
| IDM | Pulsed Drain Current[2] | 180 | A |
| EAS | Single Pulse Avalanche Energy[3] | 313 | mJ |
| IAS | Avalanche Current | 25 | A |
| $P_D$@$T_C$=25℃ | Total Power Dissipation[4] | 31.3 | W |
| TSTG | Storage Temperature Range | -55 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -55 to 150 | ℃ |
| $R_{\theta}$JA | Thermal Resistance Junction-ambient | 62.5 | ℃/W |
| $R_{\theta}$JC | Thermal Resistance Junction-Case[1] | 3 | ℃/W |

## 40V N-Channel Enhancement Mode MOSFET

### Electrical Characteristics ($T_C$=25℃unless otherwise noted)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| BVDSS | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=250uA | 40 | 44 | --- | V |
| △BVDSS/△TJ | BVDSS Temperature Coefficient | Reference to 25℃ , $I_D$=1mA | --- | 0.034 | --- | V/℃ |
| RDS(ON) | Static Drain-Source On-Resistance[2] | $V_{GS}$=10V , $I_D$=5A | --- | 13 | 18 | mΩ |
| | | $V_{GS}$=4.5V , $I_D$=4A | --- | 18 | 36 | |
| VGS(th) | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =250uA | 1.2 | 1.6 | 2.5 | V |
| △$V_{GS(th)}$ | $V_{GS(th)}$ Temperature Coefficient | | --- | -4.56 | --- | mV/℃ |
| IDSS | Drain-Source Leakage Current | $V_{DS}$=32V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=32V , $V_{GS}$=0V , $T_J$=55℃ | --- | --- | 5 | |
| IGSS | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |
| gfs | Forward Transconductance | $V_{DS}$=5V , $I_D$=5A | --- | 14 | --- | S |
| $R_g$ | Gate Resistance | $V_{DS}$=0V , $V_{GS}$=0V , f=1MHz | --- | 2.6 | --- | Ω |
| $Q_g$ | Total Gate Charge (4.5V) | $V_{DS}$=20V , $V_{GS}$=4.5V , $I_D$=5A | --- | 5.5 | --- | nC |
| $Q_{gs}$ | Gate-Source Charge | | --- | 1.25 | --- | |
| $Q_{gd}$ | Gate-Drain Charge | | --- | 2.5 | --- | |
| Td(on) | Turn-On Delay Time | $V_{DD}$=20V , $V_{GS}$=10V , $R_G$=3.3Ω $I_D$=1A | --- | 8.9 | --- | ns |
| $T_r$ | Rise Time | | --- | 2.2 | --- | |
| Td(off) | Turn-Off Delay Time | | --- | 41 | --- | |
| $T_f$ | Fall Time | | --- | 2.7 | --- | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=15V , $V_{GS}$=0V , f=1MHz | --- | 593 | --- | pF |
| Coss | Output Capacitance | | --- | 76 | --- | |
| Crss | Reverse Transfer Capacitance | | --- | 56 | --- | |
| $I_S$ | Continuous Source Current[1,5] | $V_G$=$V_D$=0V , Force Current | --- | --- | 6.1 | A |
| ISM | Pulsed Source Current[2,5] | | --- | --- | 23 | A |
| VSD | Diode Forward Voltage[2] | $V_{GS}$=0V , $I_S$=1A , $T_J$=25℃ | --- | --- | 1.2 | V |

Note :

1、The data tested by surface mounted on a 1 inch2 FR-4 board with 2OZ copper.

2、The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%

3、The EAS data shows Max. rating . The test condition is VDD=25V,VGS=10V,L=0.1mH,IAS=25A

4、The power dissipation is limited by 150℃ junction temperature

5、The data is theoretically the same as ID and IDM , in real applications , should be limited by total power dissipation.

## Typical Characteristics

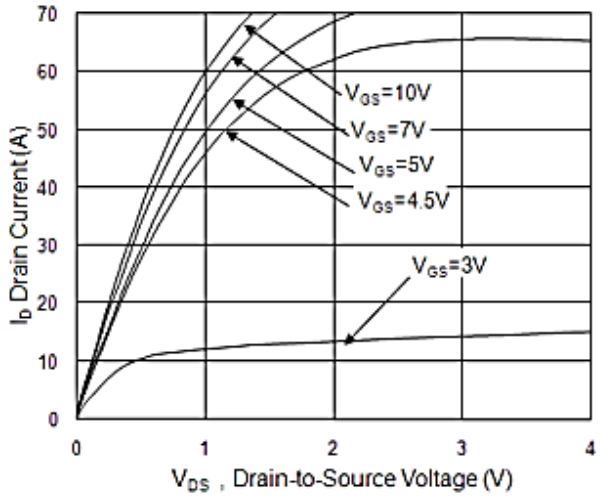



Fig.1 Typical Output Characteristics

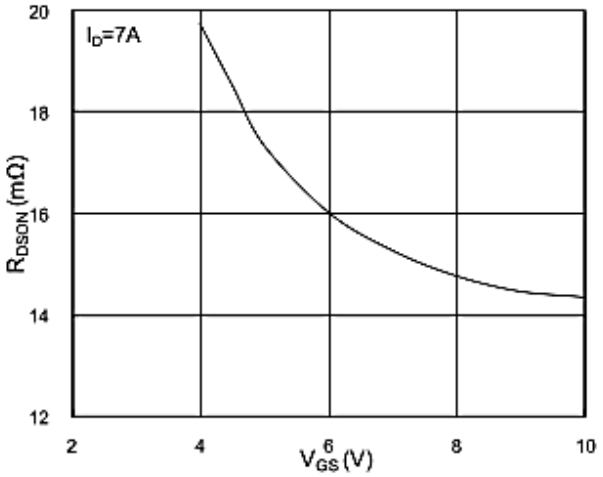



Fig.2 On-Resistance vs. G-S Voltage

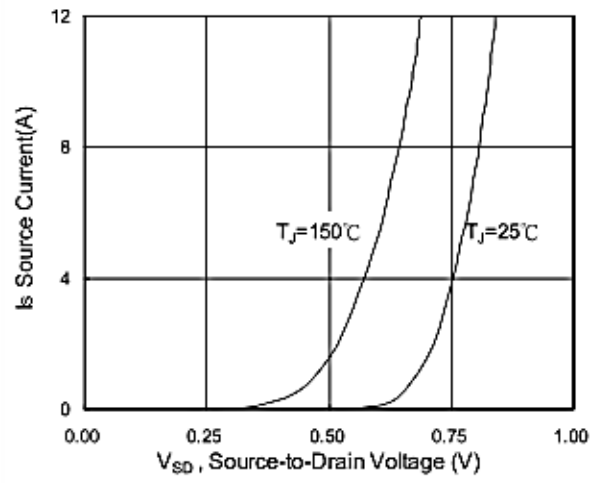



Fig.3 Forward Characteristics of Reverse

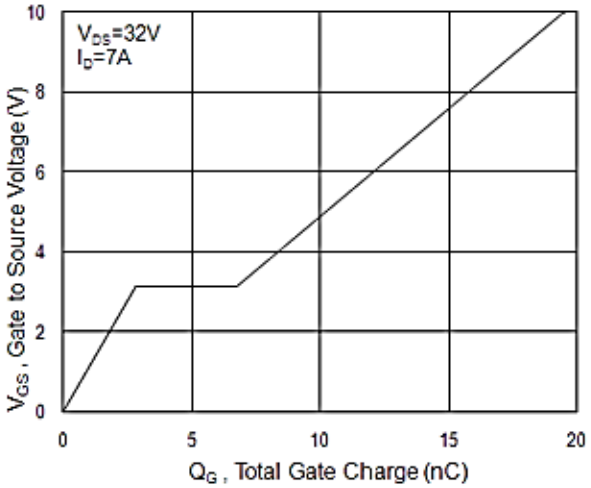



Fig.4 Gate-Charge Characteristics

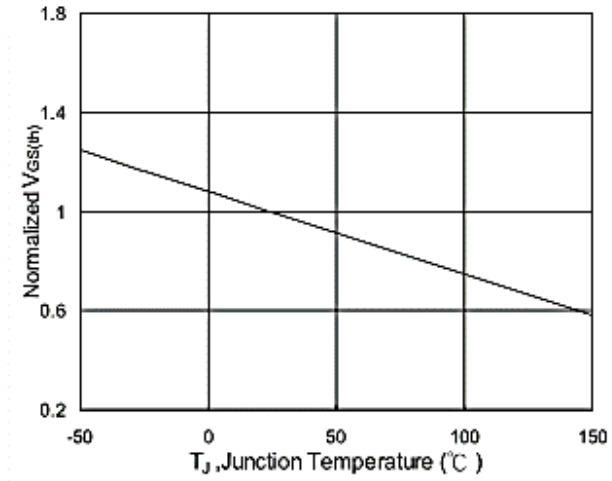



Fig.5 Normalized $V_{GS(th)}$ vs. $T_J$

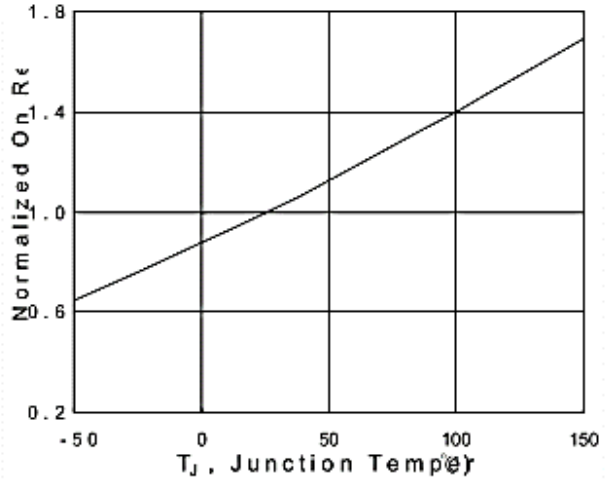



Fig.6 Normalized $R_{DSON}$ vs. $T_J$

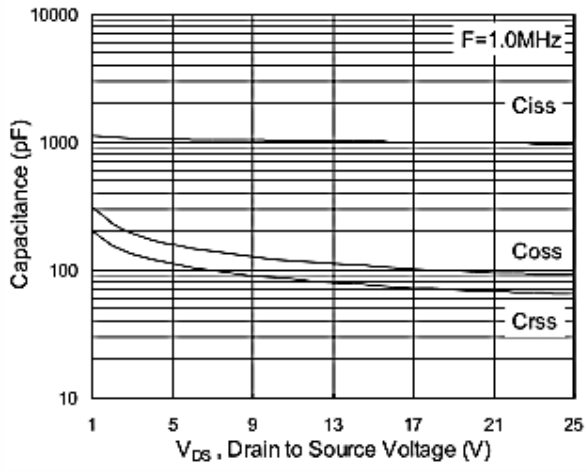



Fig.7 Capacitance

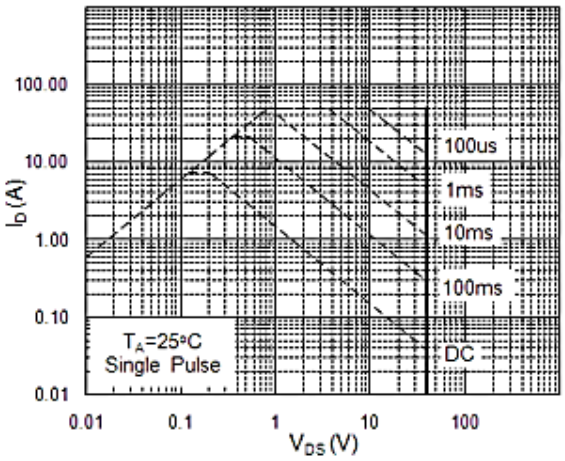



Fig.8 Safe Operating Area

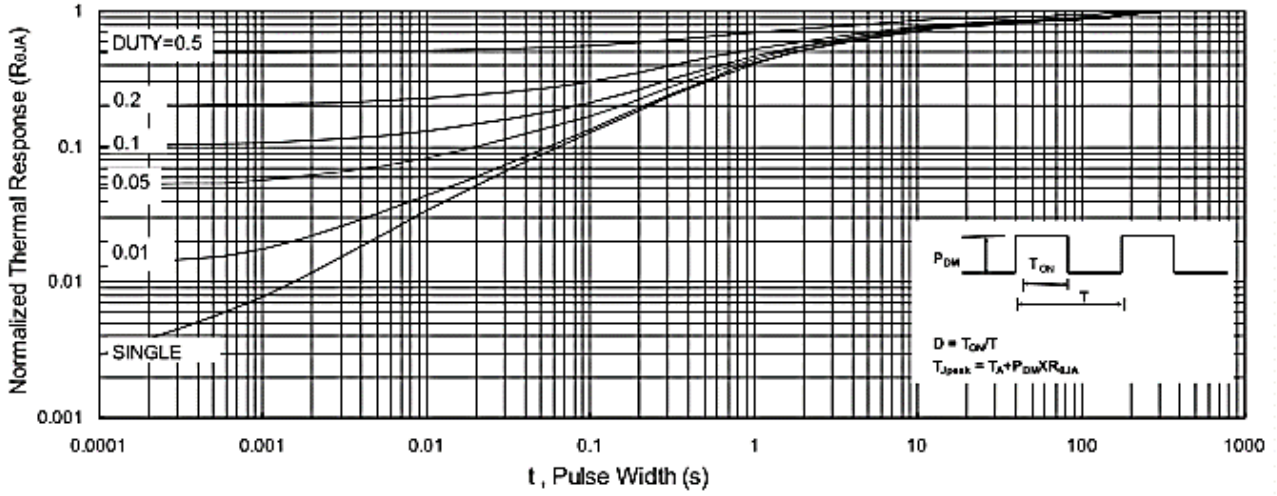



Fig.9 Normalized Maximum Transient Thermal Impedance

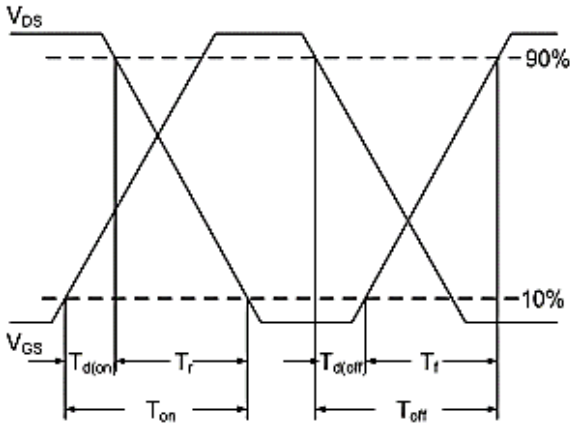



Fig.10 Switching Time Waveform

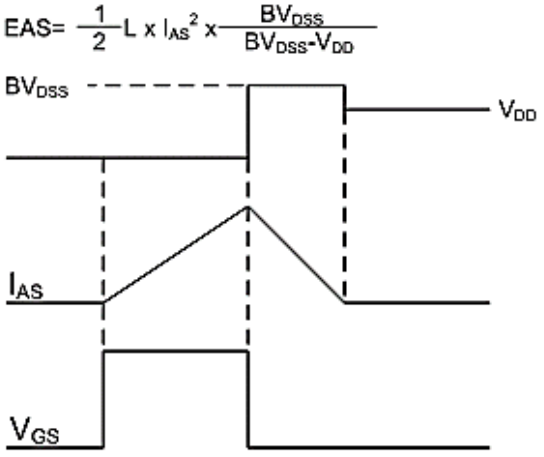
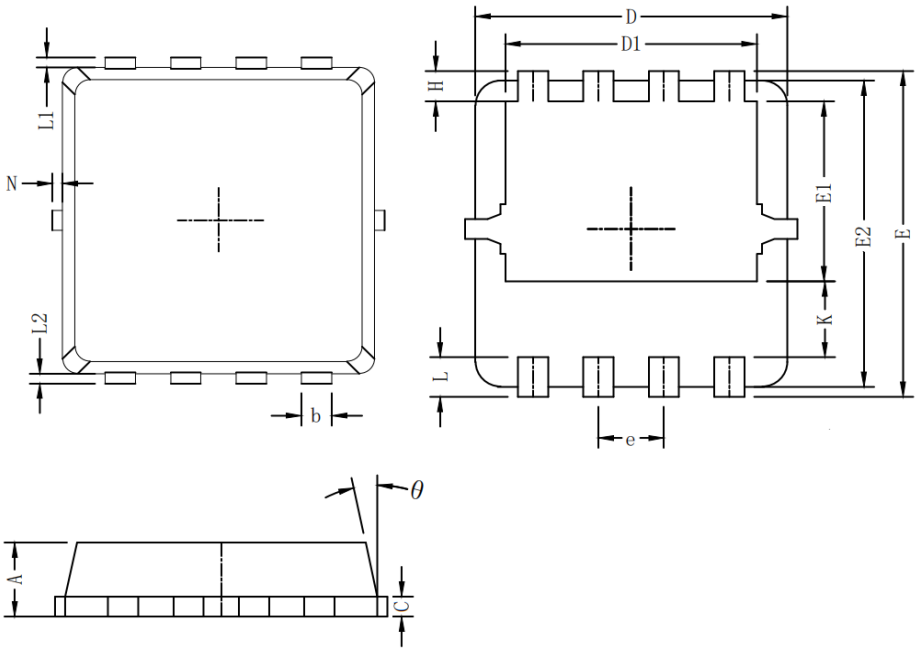



Fig.11 Unclamped Inductive Switching Waveform

## Package Mechanical Data-PDFN3X3-8L




| Symbol | Dim in mm | | |
|---|---|---|---|
| | Min | Typ | Max |
| A | 0.6 | 0.75 | 0.9 |
| b | 0.2 | 0.3 | 0.4 |
| C | 0.15 | 0.2 | 0.25 |
| D | 3 | 3.1 | 3.2 |
| D1 | 2.3 | 2.45 | 2.6 |
| E | 3.15 | 3.3 | 3.45 |
| E1 | 1.43 | 1.73 | 1.93 |
| E2 | 2.9 | 3.05 | 3.2 |
| e | 0.65BSC | | |
| H | 0.2 | 0.35 | 0.5 |
| K | 0.57 | 0.77 | 0.87 |
| L | 0.3 | 0.4 | 0.5 |
| L1/L2 | 0.1REF | | |
| θ | 8° | 10° | 13° |
| N | 0 | | 0.15 |

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## 40V N-Channel Enhancement Mode MOSFET

| Edition | Date | Change |
|---|---|---|
| REV1.0 | 2024/4/10 | Initial release |