

## -60V P-Channel Enhancement Mode MOSFET

### Description

The AP15P06DF 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

$V_{DS} = -60V$   $I_D = -15A$

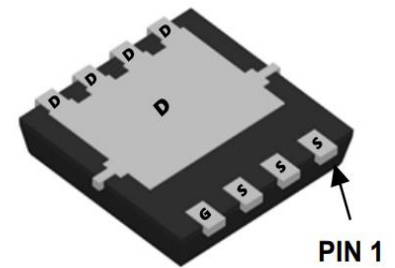
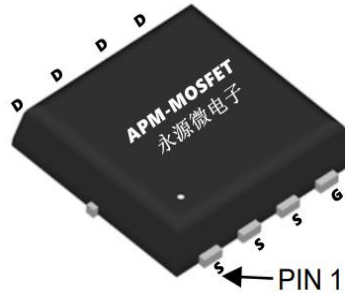
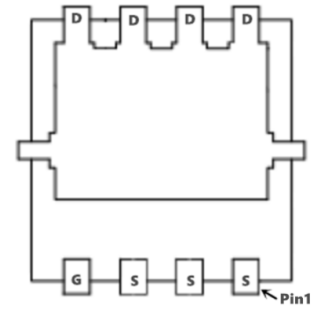
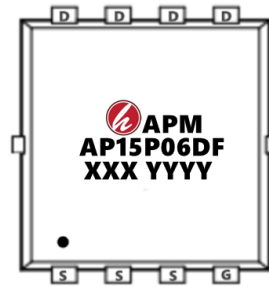
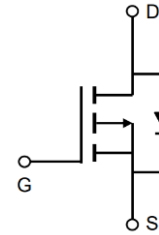
$R_{DS(ON)} < 85m\Omega$  @  $V_{GS}=10V$  (Type: 68m $\Omega$ )

### Application

Brushless motor

Load switch

Uninterruptible power supply



### Package Marking and Ordering Information

| Product ID | Pack       | Marking             | Qty(PCS) |
|------------|------------|---------------------|----------|
| AP15P06DF  | PDFN3*3-8L | AP15P06DF XXXX YYYY | 5000     |

### Absolute Maximum Ratings ( $T_C=25^\circ C$ unless otherwise noted)

| Symbol                | Parameter  | Rating     | Units        |
|-----------------------|--|------------|--------------|
| $V_{DS}$              | Drain-Source Voltage                             | -60        | V            |
| $V_{GS}$              | Gate-Source Voltage                              | $\pm 20$   | V            |
| $I_D@T_C=25^\circ C$  | Continuous Drain Current, $V_{GS} @ -10V^1$      | -15        | A            |
| $I_D@T_C=100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$      | -8.3       | A            |
| $I_{DM}$              | Pulsed Drain Current <sup>2</sup>                | -30        | A            |
| EAS                   | Single Pulse Avalanche Energy <sup>3</sup>       | 29.8       | mJ           |
| $P_D@T_C=25^\circ C$  | Total Power Dissipation <sup>4</sup>             | 31.3       | W            |
| $P_D@T_A=25^\circ C$  | Total Power Dissipation <sup>4</sup>             | 2          | W            |
| $T_{STG}$             | Storage Temperature Range                        | -55 to 150 | $^\circ C$   |
| $T_J$                 | Operating Junction Temperature Range             | -55 to 150 | $^\circ C$   |
| $R_{\theta JA}$       | Thermal Resistance Junction-Ambient <sup>1</sup> | 25         | $^\circ C/W$ |
| $R_{\theta JC}$       | Thermal Resistance Junction-Case <sup>1</sup>    | 4.0        | $^\circ C/W$ |

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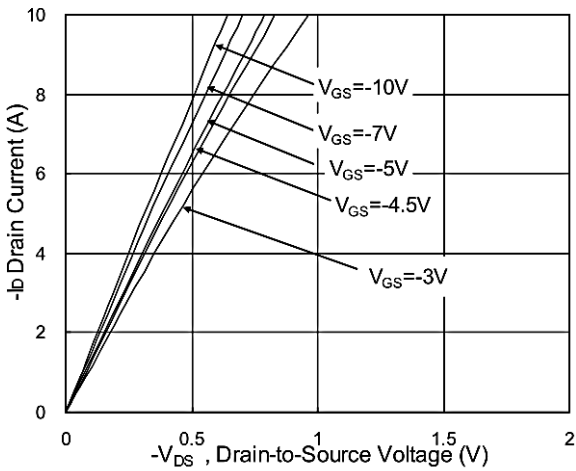
### P-Channel Electrical Characteristics (T<sub>J</sub> =25 °C, unless otherwise noted)

| Symbol                 | Parameter                                      | Conditions  | Min. | Typ.  | Max. | Unit |
|------------------------|--|---|------|-------|------|------|
| BVDSS                  | Drain-Source Breakdown Voltage                 | V <sub>GS</sub> =0V, I <sub>D</sub> =-250uA   | -60  | ---   | ---  | V    |
| ΔBVDSS/ΔT <sub>J</sub> | BV <sub>DSS</sub> Temperature Coefficient      | Reference to 25°C, I <sub>D</sub> =-1mA   | ---  | -0.03 | ---  | V/°C |
| RDS(ON)                | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-3A  | ---  | 68    | 85   | mΩ   |
|                        |  | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-2A   | ---  | 90    | 110  |      |
| VGS(th)                | Gate Threshold Voltage                         | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =-250uA                               | -1.2 | 1.75  | -2.5 | V    |
| IDSS                   | Drain-Source Leakage Current                   | V <sub>DS</sub> =-48V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C                        | ---  | ---   | 1    | uA   |
|                        |  | V <sub>DS</sub> =-48V, V <sub>GS</sub> =0V, T <sub>J</sub> =55°C                        | ---  | ---   | 5    |      |
| IGSS                   | Gate-Source Leakage Current                    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V  | ---  | ---   | ±100 | nA   |
| gfs                    | Forward Transconductance                       | V <sub>DS</sub> =-5V, I <sub>D</sub> =-3A   | ---  | 8.5   | ---  | S    |
| Q <sub>g</sub>         | Total Gate Charge (-4.5V)                      | V <sub>DS</sub> =-48V, V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-3A                      | ---  | 12.1  | ---  | nC   |
| Q <sub>gs</sub>        | Gate-Source Charge                             |   | ---  | 2.2   | ---  |      |
| Q <sub>gd</sub>        | Gate-Drain Charge                              |   | ---  | 6.3   | ---  |      |
| Td(on)                 | Turn-On Delay Time                             | V <sub>DD</sub> =-15V, V <sub>GS</sub> =-10V, R <sub>G</sub> =3.3Ω, I <sub>D</sub> =-1A | ---  | 9.2   | ---  | ns   |
| T <sub>r</sub>         | Rise Time                                      |   | ---  | 20.1  | ---  |      |
| Td(off)                | Turn-Off Delay Time                            |   | ---  | 46.7  | ---  |      |
| T <sub>f</sub>         | Fall Time                                      |   | ---  | 9.4   | ---  |      |
| Ciss                   | Input Capacitance                              | V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                                      | ---  | 1137  | ---  | pF   |
| Coss                   | Output Capacitance                             |   | ---  | 76    | ---  |      |
| Crss                   | Reverse Transfer Capacitance                   |   | ---  | 50    | ---  |      |
| IS                     | Continuous Source Current <sup>1,5</sup>       | V <sub>G</sub> =V <sub>D</sub> =0V, Force Current                                       | ---  | ---   | -13  | A    |
| VSD                    | Diode Forward Voltage <sup>2</sup>             | V <sub>GS</sub> =0V, I <sub>S</sub> =-1A, T <sub>J</sub> =25°C                          | ---  | ---   | -1.2 | V    |

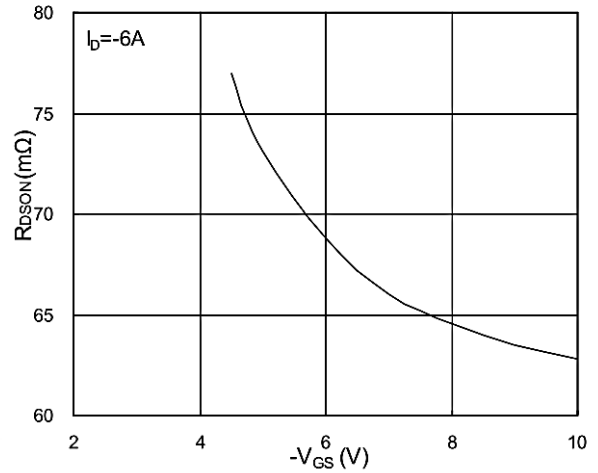
Note :

- 1、 The data tested by surface mounted on a 1 inch 2 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 =-24A
- 4、 The power dissipation is limited by 150°C junction temperature
- 5、 The data is theoretically the same as I D and I DM , in real applications , should be limited by total power dissipation.

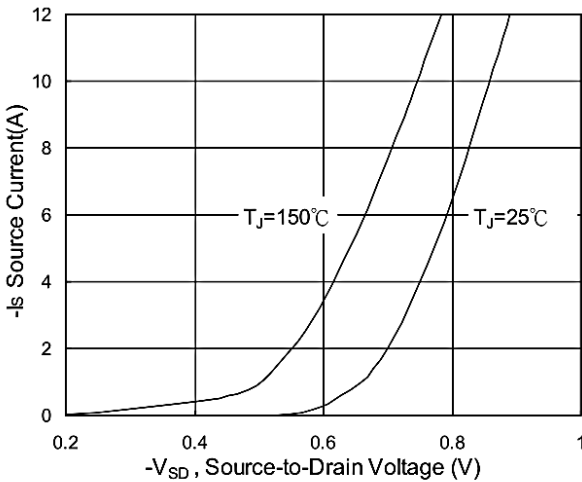
**P-Channel Typical Characteristics**



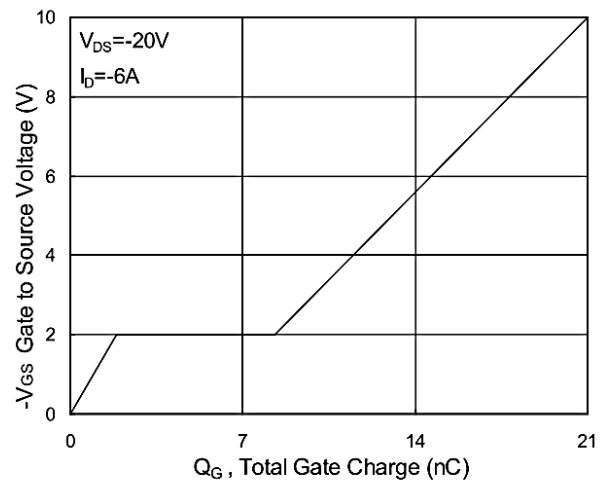
**Fig.1 Typical Output Characteristics**



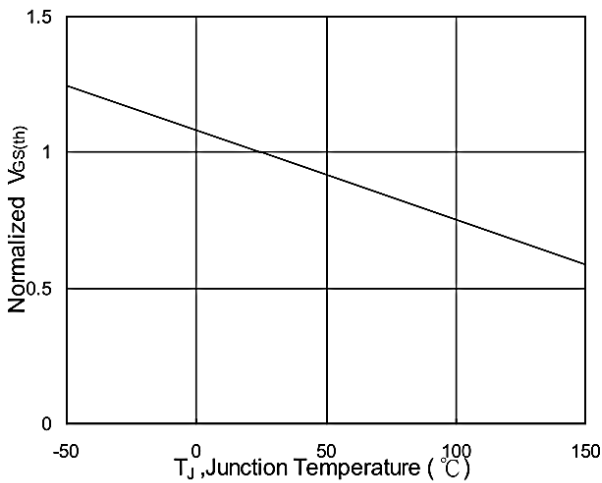
**Fig.2 On-Resistance v.s Gate-Source**



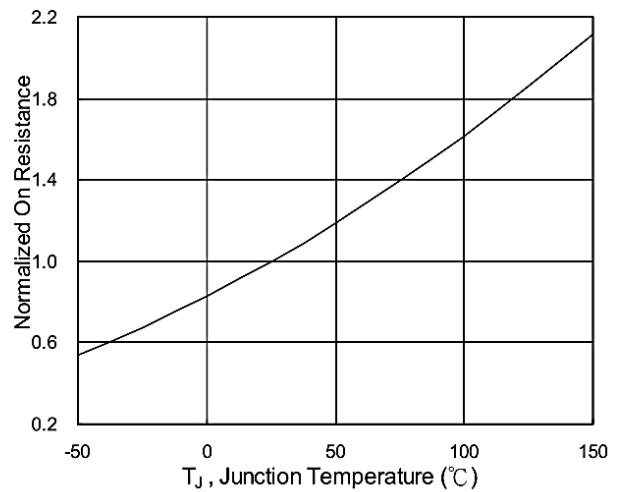
**Fig.3 Forward Characteristics of Reverse**



**Fig.4 Gate-Charge Characteristics**



**Fig.5 Normalized V<sub>GS(th)</sub> v.s T<sub>J</sub>**



**Fig.6 Normalized R<sub>DS(on)</sub> v.s T<sub>J</sub>**

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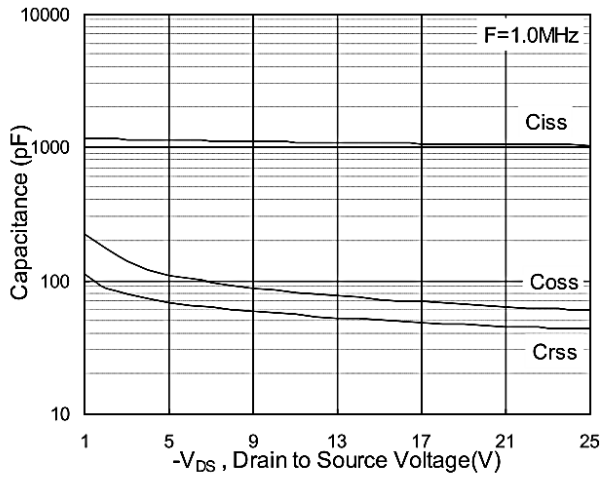


Fig.7 Capacitance

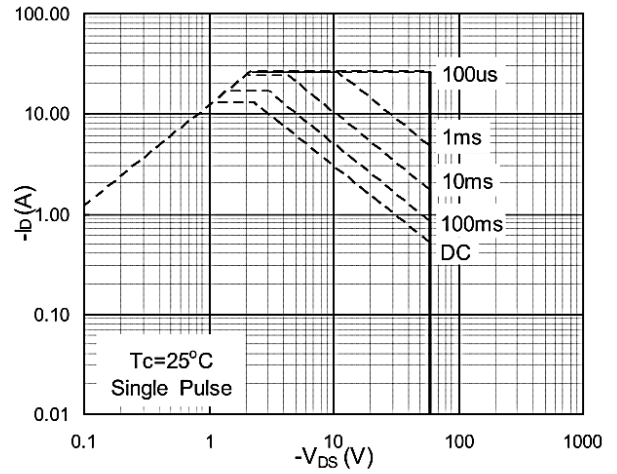


Fig.8 Safe Operating Area

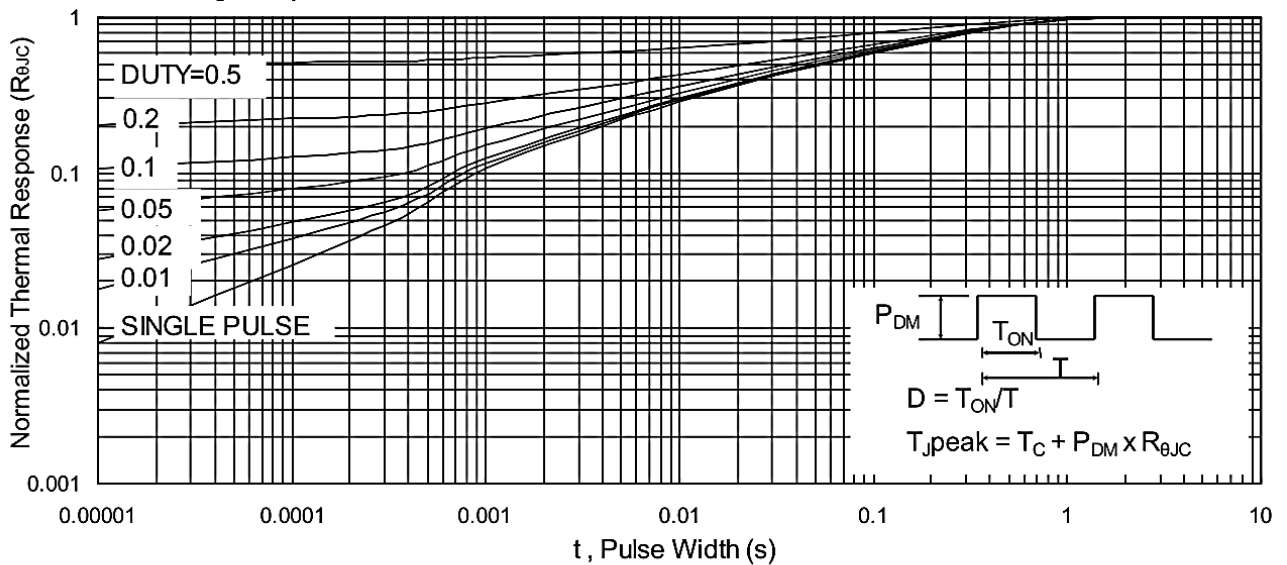


Fig.9 Normalized Maximum Transient Thermal Impedance

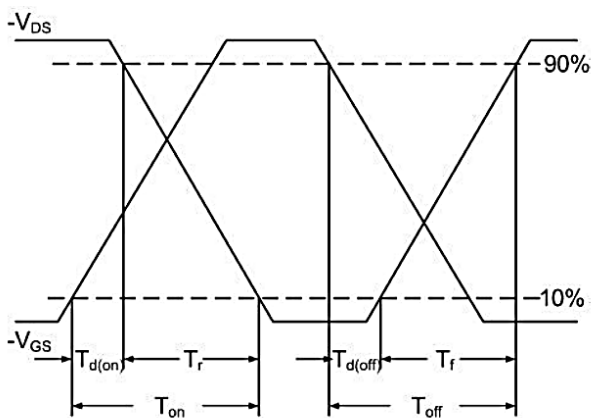


Fig.10 Switching Time Waveform

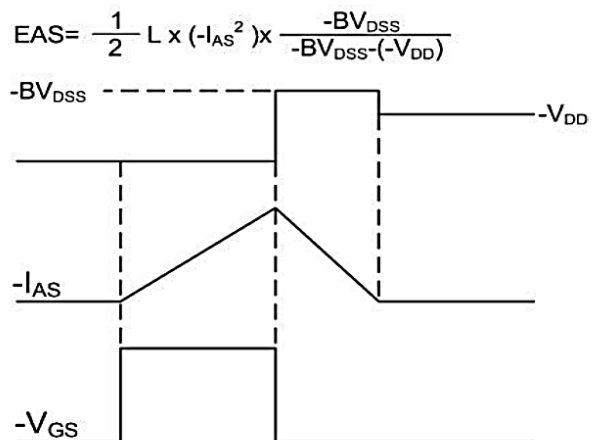
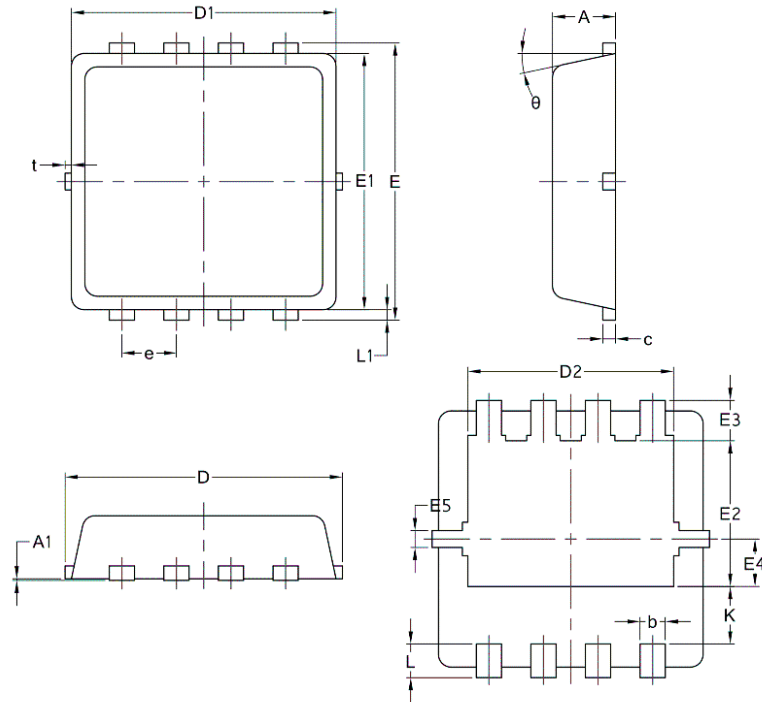


Fig.11 Unclamped Inductive Switching Waveform

### Package Mechanical Data-DFN3\*3-8L-JQ Single



| Symbol | Common |       |      |
|--------|--------|-------|------|
|        | mm     |       |      |
|        | Mim    | Nom   | Max  |
| A      | 0.70   | 0.75  | 0.85 |
| A1     | /      | /     | 0.05 |
| b      | 0.20   | 0.30  | 0.40 |
| c      | 0.10   | 0.152 | 0.25 |
| D      | 3.15   | 3.30  | 3.45 |
| D1     | 3.00   | 3.15  | 3.25 |
| D2     | 2.29   | 2.45  | 2.65 |
| E      | 3.15   | 3.30  | 3.45 |
| E1     | 2.90   | 3.05  | 3.20 |
| E2     | 1.54   | 1.74  | 1.94 |
| E3     | 0.28   | 0.48  | 0.65 |
| E4     | 0.37   | 0.57  | 0.77 |
| E5     | 0.10   | 0.20  | 0.30 |
| e      | 0.60   | 0.65  | 0.70 |
| K      | 0.59   | 0.69  | 0.89 |
| L      | 0.30   | 0.40  | 0.50 |
| L1     | 0.06   | 0.125 | 0.20 |
| t      | 0      | 0.075 | 0.13 |
| Φ      | 10     | 12    | 14   |

**-60V P-Channel Enhancement Mode MOSFET****Attention**

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