

## -40V P-Channel Enhancement Mode MOSFET

### Description

The AP5P04MI 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

$V_{DS} = -40V$   $I_D = -5.0A$

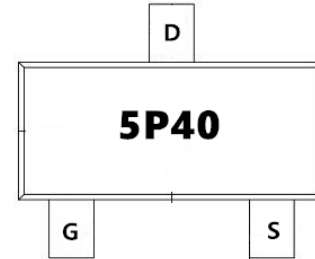
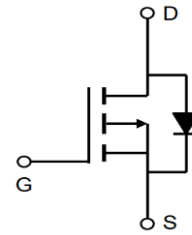
$R_{DS(ON)} < 72m\Omega @ V_{GS} = -10V$  (Type: 65m $\Omega$ )

### Application

Battery protection

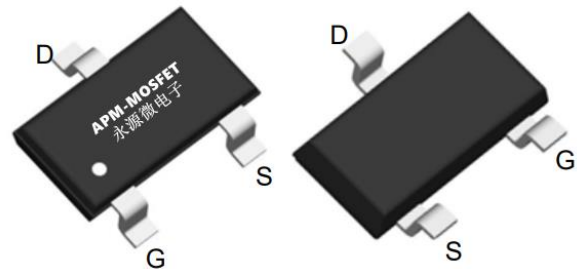
Load switch

Uninterruptible power supply



Top View

Bottom View



### Package Marking and Ordering Information

| Product ID | Pack     | Marking | Qty(PCS) |
|------------|----------|---------|----------|
| AP5P04MI   | SOT23-3L | 5P40    | 3000     |

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

| Symbol                 | Parameter  | Steady State | Units        |
|------------------------|--|--------------|--------------|
| $V_{DS}$               | Drain-Source Voltage                             | -40          | V            |
| $V_{GS}$               | Gate-Source Voltage                              | $\pm 20$     | V            |
| $I_{D@T_A=25^\circ C}$ | Continuous Drain Current, $V_{GS} @ -4.5V^1$     | -5.0         | A            |
| $I_{D@T_A=70^\circ C}$ | Continuous Drain Current, $V_{GS} @ -4.5V^1$     | -3.0         | A            |
| IDM                    | Pulsed Drain Current <sup>2</sup>                | -16.1        | A            |
| $P_{D@T_A=25^\circ C}$ | Total Power Dissipation <sup>3</sup>             | 1.32         | W            |
| $P_{D@T_A=70^\circ C}$ | Total Power Dissipation <sup>3</sup>             | 0.84         | W            |
| TSTG                   | 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> | 125          | $^\circ C/W$ |
| $R_{\theta JC}$        | Thermal Resistance Junction-Case <sup>1</sup>    | 80           | $^\circ C/W$ |

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

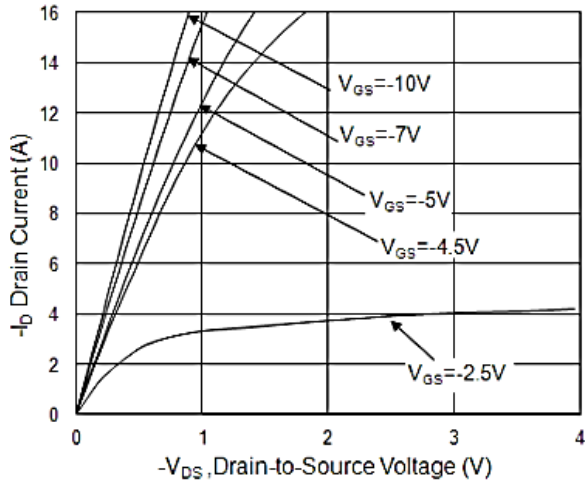
| Symbol                 | Parameter                                      | Conditions   | Min. | Typ    | Max.  | Unit  |
|------------------------|--|--|------|--------|-------|-------|
| BVDSS                  | Drain-Source Breakdown Voltage                 | V <sub>GS</sub> =0V, I <sub>D</sub> =-250uA  | -40  | -46    | ---   | V     |
| ΔBVDSS/ΔT <sub>J</sub> | BV <sub>DSS</sub> Temperature Coefficient      | Reference to 25°C, I <sub>D</sub> =-1mA  | ---  | -0.018 | ---   | V/°C  |
| RDS(ON)                | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-3A  | ---  | 65     | 72    | mΩ    |
|                        |  | V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-2A  | ---  | 89     | 100   |       |
| VGS(th)                | Gate Threshold Voltage                         | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =-250uA                                | -1.0 | -1.5   | -2.5  | V     |
| ΔVGS(th)               | VGS(th) Temperature Coefficient                |  | ---  | 2.5    | ---   | mV/°C |
| IDSS                   | Drain-Source Leakage Current                   | V <sub>DS</sub> =-24V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C                         | ---  | ---    | -1    | uA    |
|                        |  | V <sub>DS</sub> =-24V, 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  | ---  | 5.8    | ---   | S     |
| Q <sub>g</sub>         | Total Gate Charge (-4.5V)                      | V <sub>DS</sub> =-32V, V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-3A                       | ---  | 6.4    | ---   | nC    |
| Q <sub>gs</sub>        | Gate-Source Charge                             |  | ---  | 2.1    | ---   |       |
| Q <sub>gd</sub>        | Gate-Drain Charge                              |  | ---  | 2.5    | ---   |       |
| Td(on)                 | Turn-On Delay Time                             | V <sub>DD</sub> =-20V, V <sub>GS</sub> =-4.5V, R <sub>G</sub> =3.3Ω, I <sub>D</sub> =-3A | ---  | 4.2    | ---   | ns    |
| T <sub>r</sub>         | Rise Time                                      |  | ---  | 23     | ---   |       |
| Td(off)                | Turn-Off Delay Time                            |  | ---  | 26.8   | ---   |       |
| T <sub>f</sub>         | Fall Time                                      |  | ---  | 20.6   | ---   |       |
| Ciss                   | Input Capacitance                              | V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                                       | ---  | 620    | ---   | pF    |
| Coss                   | Output Capacitance                             |  | ---  | 65     | ---   |       |
| Crss                   | Reverse Transfer Capacitance                   |  | ---  | 53     | ---   |       |
| IS                     | Continuous Source Current <sup>1,4</sup>       | V <sub>G</sub> =V <sub>D</sub> =0V, Force Current  | ---  | ---    | -5.2  | A     |
| ISM                    | Pulsed Source Current <sup>2,4</sup>           |  | ---  | ---    | -16.1 | 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    | V     |

**Note :**

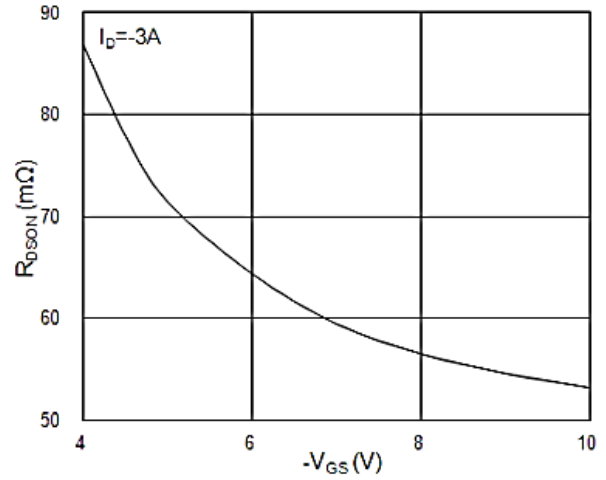
- 1、The data tested by surface mounted on a 1 inch FR-4 board with 2OZ copper.
- 2、The data tested by pulsed , pulse width ≤ 300us , duty cycle ≤ 2%
- 3、The power dissipation is limited by 150°C junction temperature
- 4、The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub> , in real applications , should be limited by total power dissipation.

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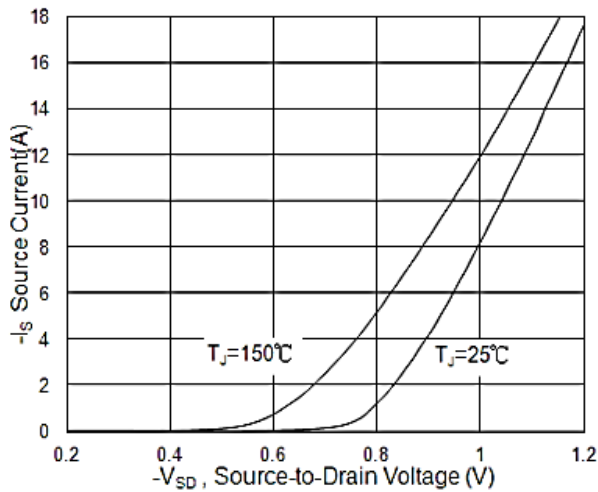
**Typical Characteristics**



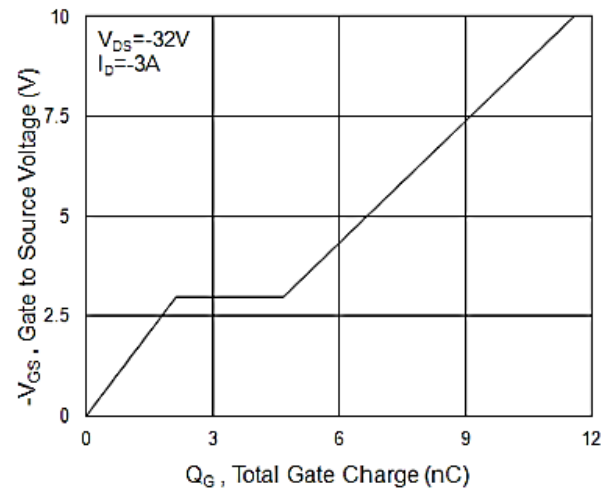
**Fig.1 Typical Output Characteristics**



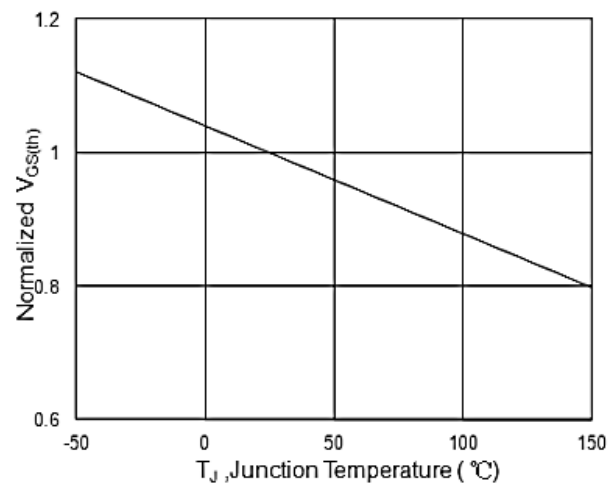
**Fig.2 On-Resistance vs. G-S Voltage**



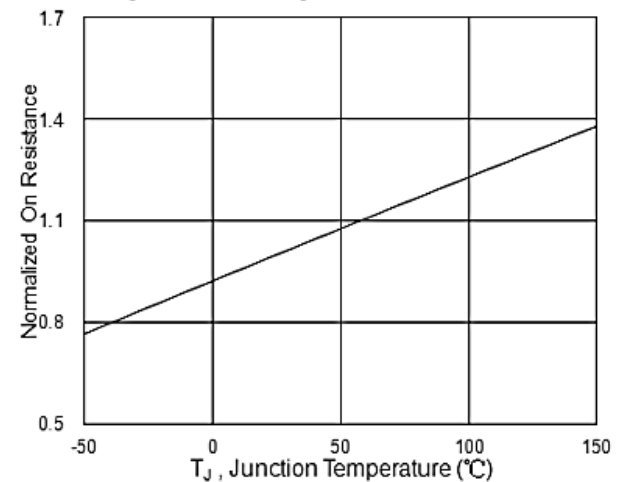
**Fig.3 Forward Characteristics Of Reverse**



**Fig.4 Gate-Charge Characteristics**

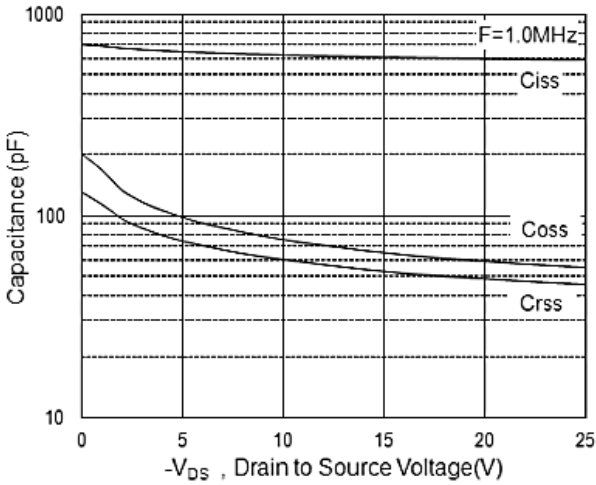


**Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$**

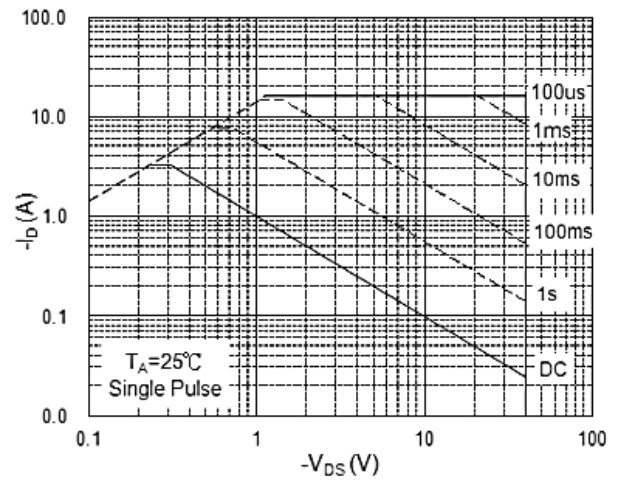


**Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$**

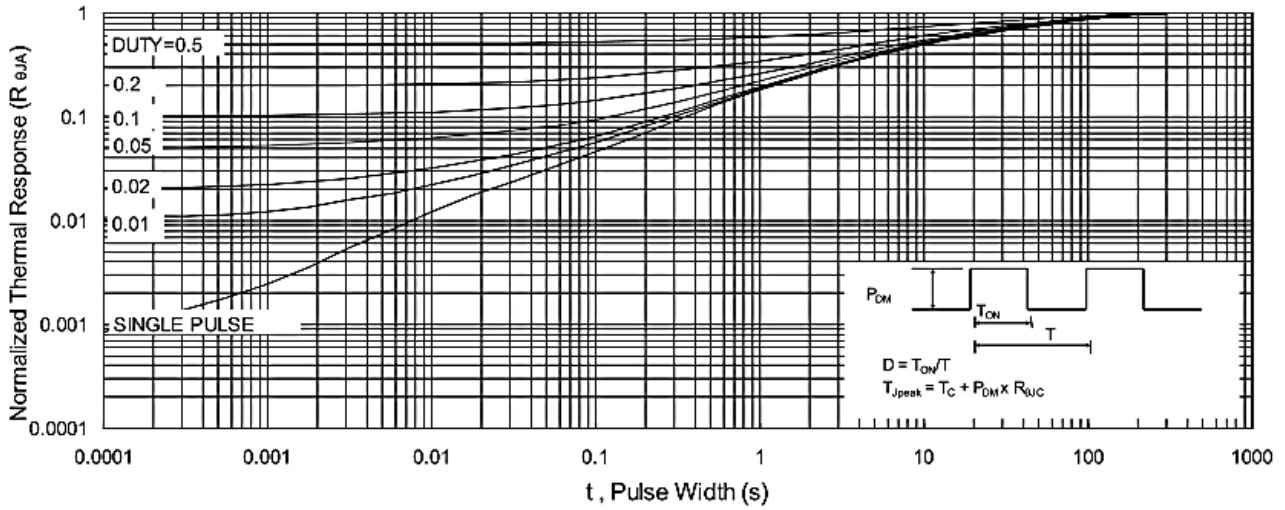
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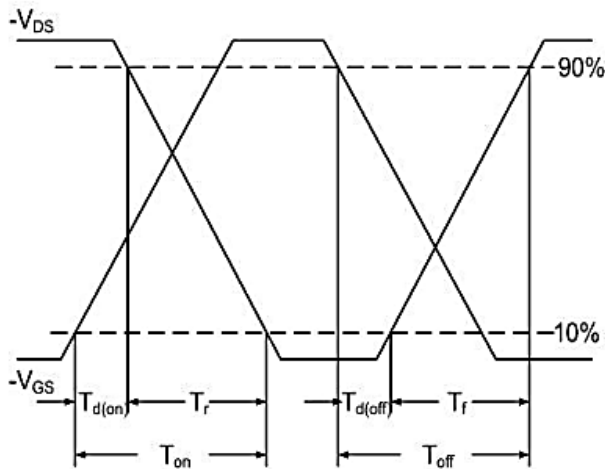
**Fig.7 Capacitance**



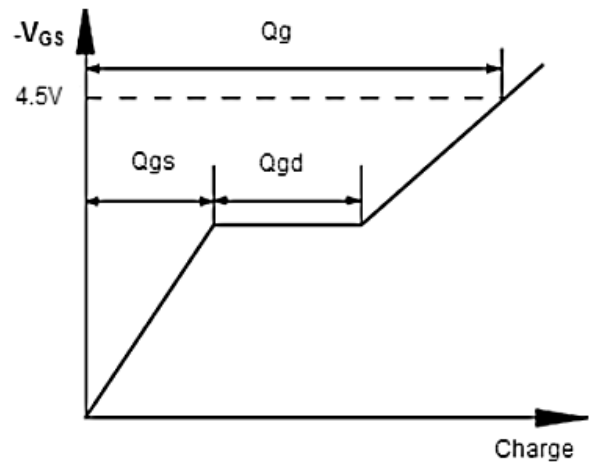
**Fig.8 Safe Operating Area**



**Fig.9 Normalized Maximum Transient Thermal Impedance**



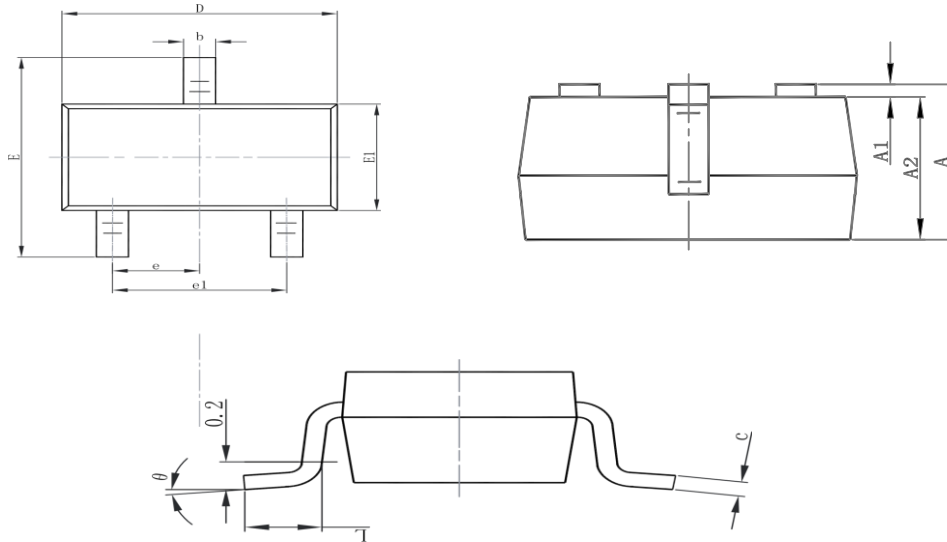
**Fig.10 Switching Time Waveform**



**Fig.11 Gate Charge Waveform**

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### Package Mechanical Data:SOT23-3L



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 1.050                     | 1.250 | 0.041                | 0.049 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 1.050                     | 1.150 | 0.041                | 0.045 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.100                     | 0.200 | 0.004                | 0.008 |
| D      | 2.820                     | 3.020 | 0.111                | 0.119 |
| E1     | 1.500                     | 1.700 | 0.059                | 0.067 |
| E      | 2.650                     | 2.950 | 0.104                | 0.116 |
| e      | 0.950(BSC)                |       | 0.037(BSC)           |       |
| e1     | 1.800                     | 2.000 | 0.071                | 0.079 |
| L      | 0.300                     | 0.600 | 0.012                | 0.024 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |

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