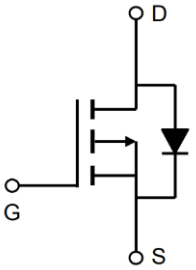
# AP15P06D

## -60V P-Channel Enhancement Mode MOSFET

### Description

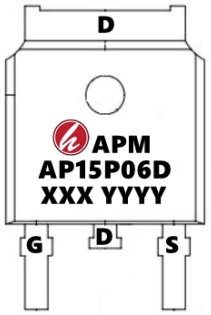
The AP15P06D uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.




### General Features

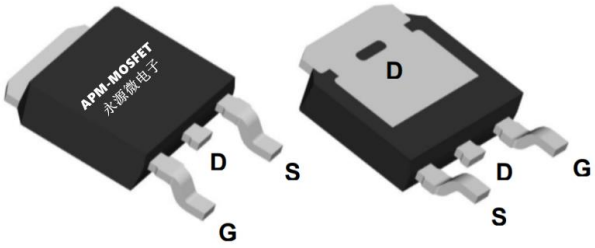
$V_{DS}$ = -60V $I_D$ =-18.8A

$R_{DS(ON)}$ < 70mΩ @ $V_{GS}$=10V (Type：53mΩ)




### Application

Brushless motor
Load switch
Uninterruptible power supply




### Package Marking and Ordering Information

| Product ID | Pack | Marking | Qty(PCS) |
|---|---|---|---|
| AP15P06D | TO-252-3 | AP15P06D XXXX YYYY | 2500 |

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

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | -60 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | V |
| $I_D$@$T_C$=25℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -18.8 | A |
| $I_D$@$T_C$=100℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -11 | A |
| $I_D$@$T_A$=25℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -4.3 | A |
| $I_D$@$T_A$=70℃ | Continuous Drain Current, $V_{GS}$ @ -10V[1] | -3.5 | A |
| $I_{DM}$ | Pulsed Drain Current[2] | -36 | A |
| EAS | Single Pulse Avalanche Energy[3] | 35.4 | mJ |
| $I_{AS}$ | Avalanche Current | -26.6 | A |
| $P_D$@$T_C$=25℃ | Total Power Dissipation[4] | 34.7 | W |
| $P_D$@$T_A$=25℃ | Total Power Dissipation[4] | 2 | W |
| $T_{STG}$ | Storage Temperature Range | -55 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -55 to 150 | ℃ |
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient [1] | 62 | ℃/W |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case[1] | 3.6 | ℃/W |

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

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| BVDSS | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=-250uA | -60 | --- | --- | V |
| △BVDSS /△Tj | $BV_{DSS}$ Temperature Coefficient | Reference to 25℃ , $I_D$=-1mA | --- | -0.03 | --- | V/℃ |
| RDS(ON) | Static Drain-Source On-Resistance | $V_{GS}$=-10V , $I_D$=-12A | --- | 53 | 70 | mΩ |
| | | $V_{GS}$=-4.5V , $I_D$=-8A | --- | 64 | 105 | |
| VGS(th) | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =-250uA | -1.2 | -1.5 | -2.5 | V |
| △$V_{GS(th)}$ | $V_{GS(th)}$ Temperature Coefficient | | --- | 4.56 | --- | mV/℃ |
| IDSS | Drain-Source Leakage Current | $V_{DS}$=-48V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=-48V , $V_{GS}$=0V , $T_J$=55℃ | --- | --- | 5 | |
| IGSS | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |
| gfs | Forward Transconductance | $V_{DS}$=-5V , $I_D$=-12A | --- | 15.4 | --- | S |
| $R_g$ | Gate Resistance | $V_{DS}$=0V , $V_{GS}$=0V , f=1MHz | --- | 13.5 | --- | Ω |
| $Q_g$ | Total Gate Charge (-4.5V) | $V_{DS}$=-48V , $V_{GS}$=-4.5V , $I_D$=-10A | --- | 9.86 | --- | nC |
| $Q_{gs}$ | Gate-Source Charge | | --- | 3.08 | --- | |
| $Q_{gd}$ | Gate-Drain Charge | | --- | 2.95 | --- | |
| Td(on) | Turn-On Delay Time | $V_{DD}$=-15V , $V_{GS}$=-10V , $R_G$=3.3□, $I_D$=-1A | --- | 28.8 | --- | ns |
| $T_r$ | Rise Time | | --- | 19.8 | --- | |
| Td(off) | Turn-Off Delay Time | | --- | 60.8 | --- | |
| $T_f$ | Fall Time | | --- | 7.2 | --- | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=-15V , $V_{GS}$=0V , f=1MHz | --- | 1447 | --- | pF |
| Coss | Output Capacitance | | --- | 97.3 | --- | |
| Crss | Reverse Transfer Capacitance | | --- | 70 | --- | |
| $I_S$ | Continuous Source Current[1,5] | $V_G$=$V_D$=0V , Force Current | --- | --- | -18 | A |
| ISM | Pulsed Source Current[2,5] | | --- | --- | -36 | 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=-26.6A

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

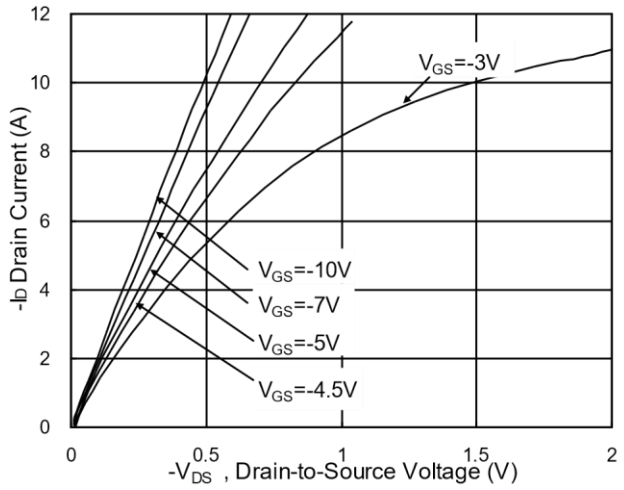


Fig.1 Typical Output Characteristics

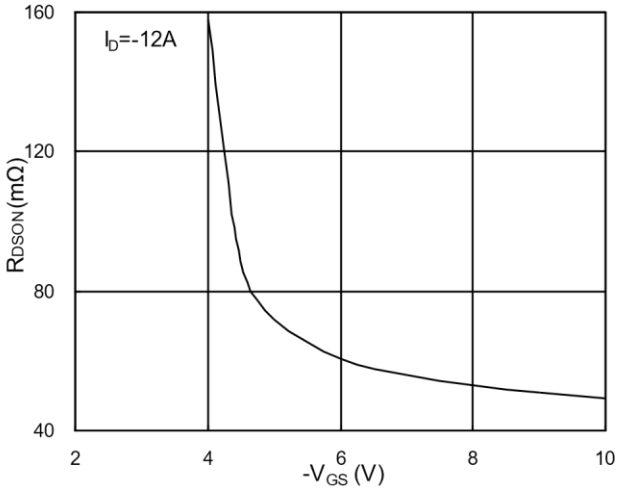


Fig.2 On-Resistance v.s Gate-Source

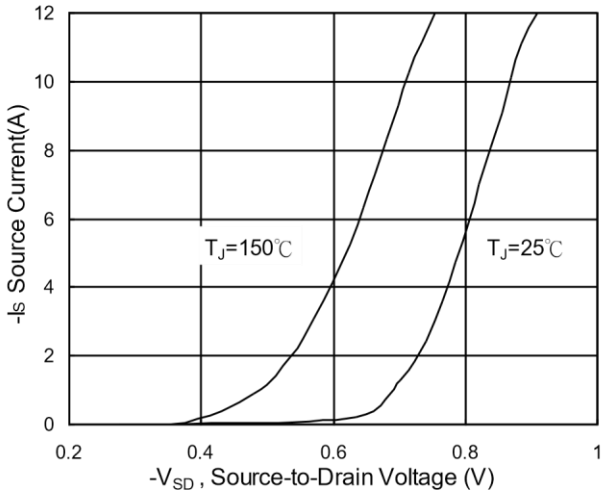


Fig.3 Forward Characteristics of Reverse

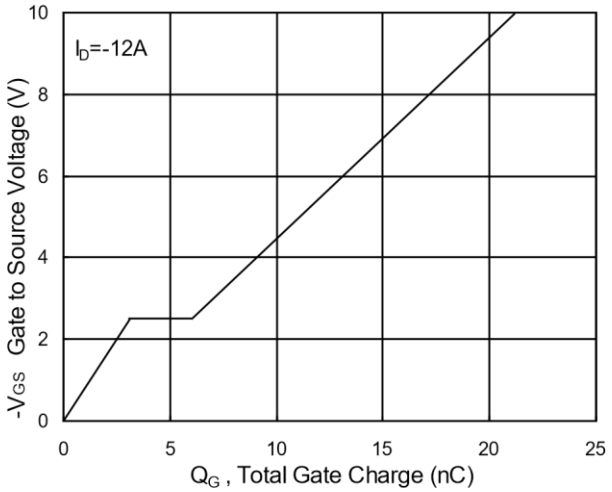


Fig.4 Gate-Charge Characteristics

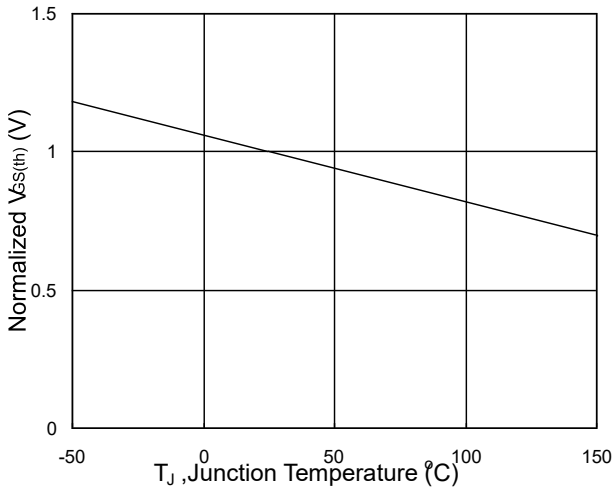


Fig.5 Normalized $V_{GS(th)}$ v.s $T_J$

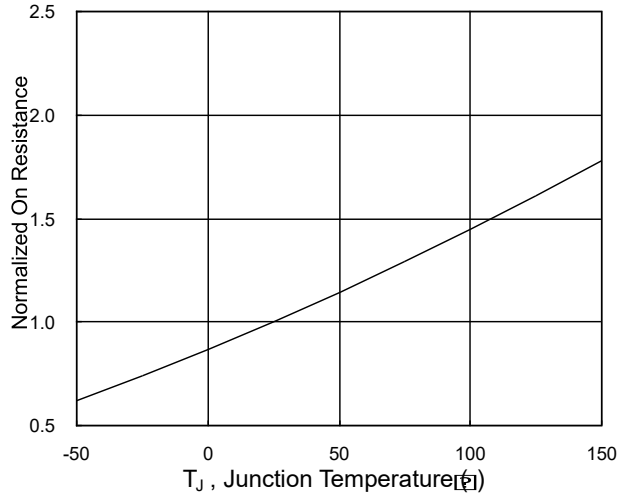


Fig.6 Normalized $R_{DSON}$ v.s $T_J$

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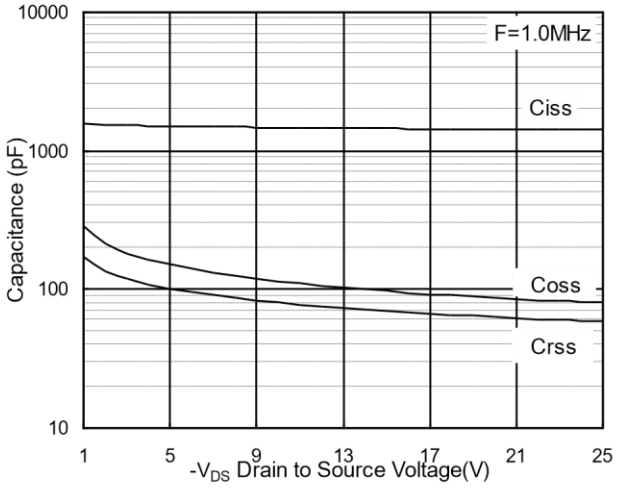


Fig.7 Capacitance

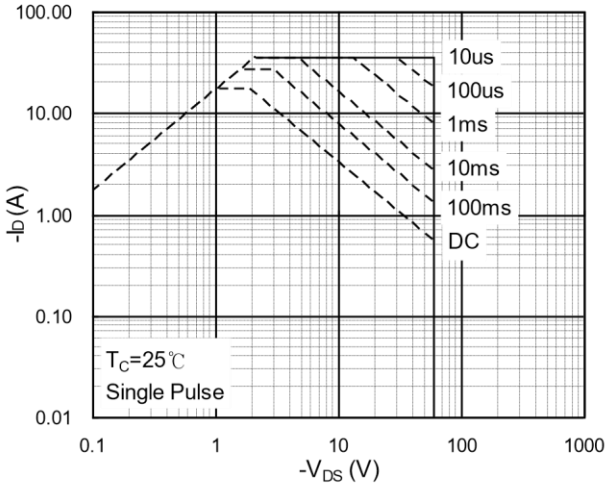


Fig.8 Safe Operating Area

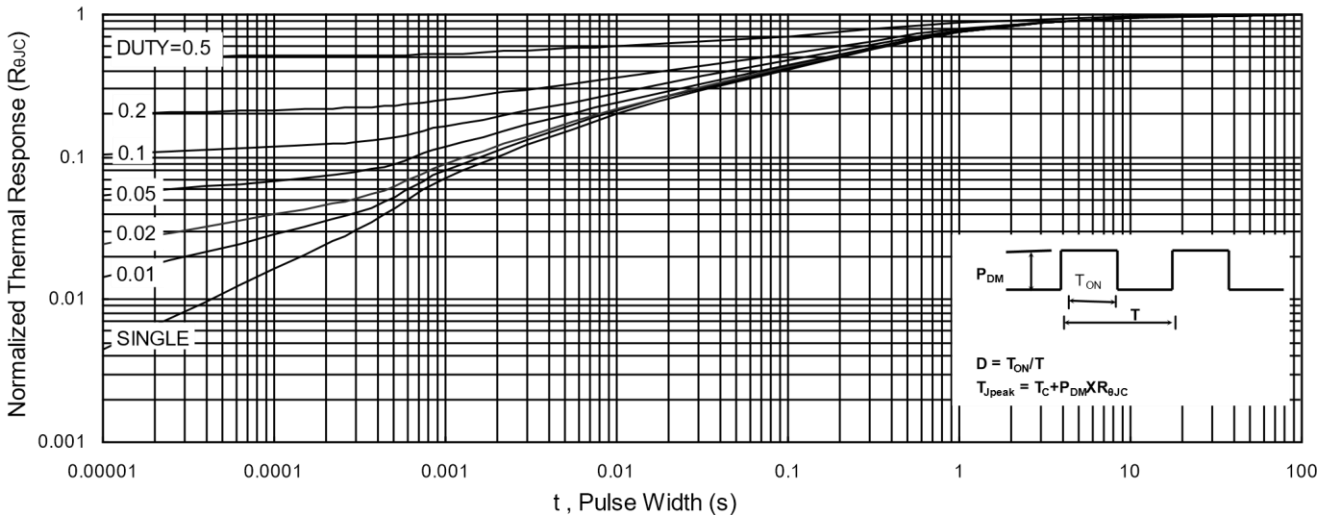


Fig.9 Normalized Maximum Transient Thermal Impedance

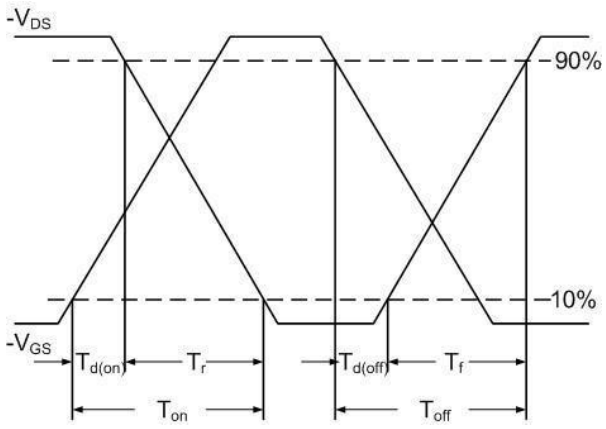


Fig.10 Switching Time Waveform

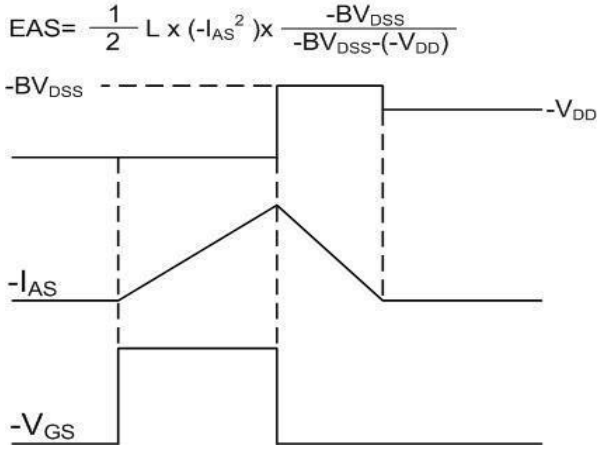


Fig.11 Unclamped Inductive Waveform

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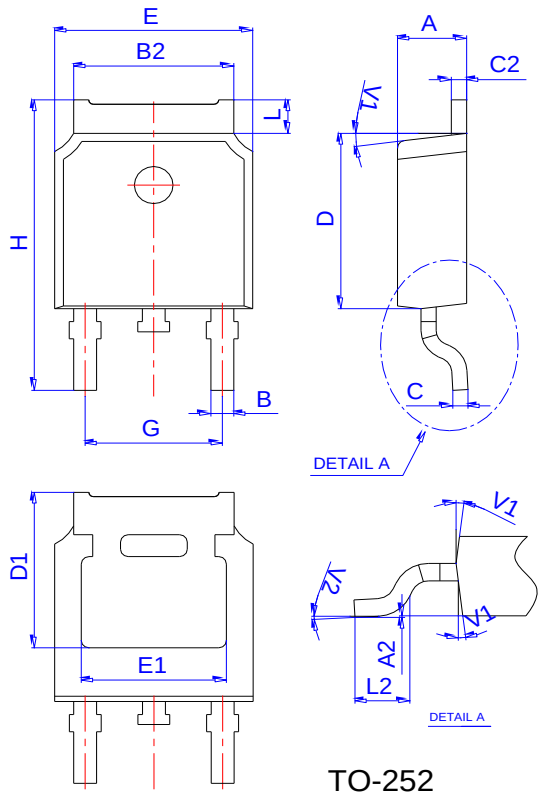
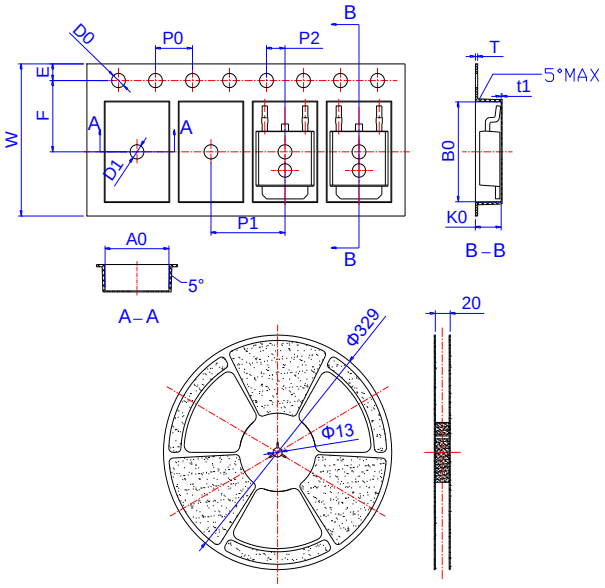
## Package Mechanical Data




TO-252

| Ref. | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 2.10 | | 2.50 | 0.083 | | 0.098 |
| A2 | 0 | | 0.10 | 0 | | 0.004 |
| B | 0.66 | | 0.86 | 0.026 | | 0.034 |
| B2 | 5.18 | | 5.48 | 0.202 | | 0.216 |
| C | 0.40 | | 0.60 | 0.016 | | 0.024 |
| C2 | 0.44 | | 0.58 | 0.017 | | 0.023 |
| D | 5.90 | | 6.30 | 0.232 | | 0.248 |
| D1 | 5.30REF | | | 0.209REF | | |
| E | 6.40 | | 6.80 | 0.252 | | 0.268 |
| E1 | 4.63 | | | 0.182 | | |
| G | 4.47 | | 4.67 | 0.176 | | 0.184 |
| H | 9.50 | | 10.70 | 0.374 | | 0.421 |
| L | 1.09 | | 1.21 | 0.043 | | 0.048 |
| L2 | 1.35 | | 1.65 | 0.053 | | 0.065 |
| V1 | | 7° | | | 7° | |
| V2 | 0° | | 6° | 0° | | 6° |

## Reel Specification-TO-252




| Ref. | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| W | 15.90 | 16.00 | 16.10 | 0.626 | 0.630 | 0.634 |
| E | 1.65 | 1.75 | 1.85 | 0.065 | 0.069 | 0.073 |
| F | 7.40 | 7.50 | 7.60 | 0.291 | 0.295 | 0.299 |
| D0 | 1.40 | 1.50 | 1.60 | 0.055 | 0.059 | 0.063 |
| D1 | 1.40 | 1.50 | 1.60 | 0.055 | 0.059 | 0.063 |
| P0 | 3.90 | 4.00 | 4.10 | 0.154 | 0.157 | 0.161 |
| P1 | 7.90 | 8.00 | 8.10 | 0.311 | 0.315 | 0.319 |
| P2 | 1.90 | 2.00 | 2.10 | 0.075 | 0.079 | 0.083 |
| A0 | 6.85 | 6.90 | 7.00 | 0.270 | 0.271 | 0.276 |
| B0 | 10.45 | 10.50 | 10.60 | 0.411 | 0.413 | 0.417 |
| K0 | 2.68 | 2.78 | 2.88 | 0.105 | 0.109 | 0.113 |
| T | 0.24 | | 0.27 | 0.009 | | 0.011 |
| t1 | 0.10 | | | 0.004 | | |
| 10P0 | 39.80 | 40.00 | 40.20 | 1.567 | 1.575 | 1.583 |

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## -60V P-Channel Enhancement Mode MOSFET

| Edition | Date | Change |
|---|---|---|
| Rve3.8 | 2018/1/31 | Initial release |
| Rve3.9 | 2018/5/25 | Reduce CiSS and QG |
| Rve4.0 | 2021/4/13 | Change layout format |