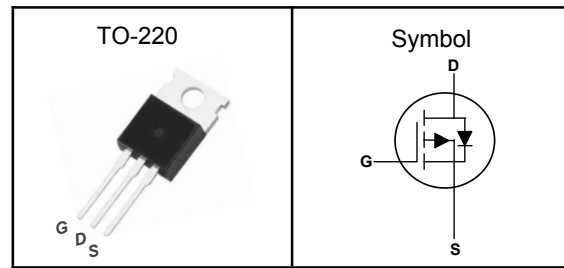


**P-Channel Enhancement Mode MOSFET**
**Features**

- Low  $R_{ds(on)}$  for low conduction loss
- Reliable and Rugged
- ROHS Compliant & Halogen-Free

**Applications**

- Power Management in Desktop Computer
- DC/DC Converters

**Pin Description**


|                  |     |            |
|------------------|-----|------------|
| $V_{DSS}$        | -60 | V          |
| $R_{DS(ON)-Typ}$ | 20  | m $\Omega$ |
| $I_D$            | -45 | A          |

**Absolute Maximum Ratings** ( $T_C=25^\circ\text{C}$ , Unless Otherwise Noted)

| Symbol       | Parameter                     | P-Channel  | Unit             |
|--------------|-------------------------------|------------|------------------|
| $V_{DSS}$    | Drain-Source Voltage          | -60        | V                |
| $V_{GSS}$    | Gate-Source Voltage           | $\pm 20$   | V                |
| $T_J$        | Maximum Junction Temperature  | -55 to 150 | $^\circ\text{C}$ |
| $T_{STG}$    | Storage Temperature Range     | -55 to 150 | $^\circ\text{C}$ |
| $I_{DM}^{①}$ | Pulse Drain Current Tested    | -90        | A                |
| $I_D$        | Continuous Drain Current      | -45        | A                |
| $P_D$        | Maximum Power Dissipation     | 86.8       | W                |
| $E_{AS}$     | Single Pulse Avalanche Energy | 101        | mJ               |

**Thermal Characteristics**

| Symbol              | Parameter                              | Rating | Unit               |
|---------------------|--|--------|--------------------|
| $R_{\theta JA}^{③}$ | Thermal Resistance-Junction to Ambient | 62     | $^\circ\text{C/W}$ |
| $R_{\theta JC}$     | Thermal Resistance Junction-Case       | 1.44   | $^\circ\text{C/W}$ |

Note ① : Max. current is limited by bonding wire.

Note ② : UIS tested and pulse width are limited by maximum junction temperature  $150^\circ\text{C}$ .

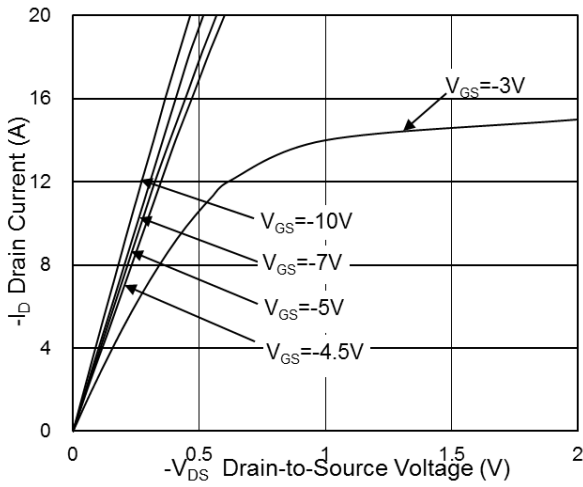
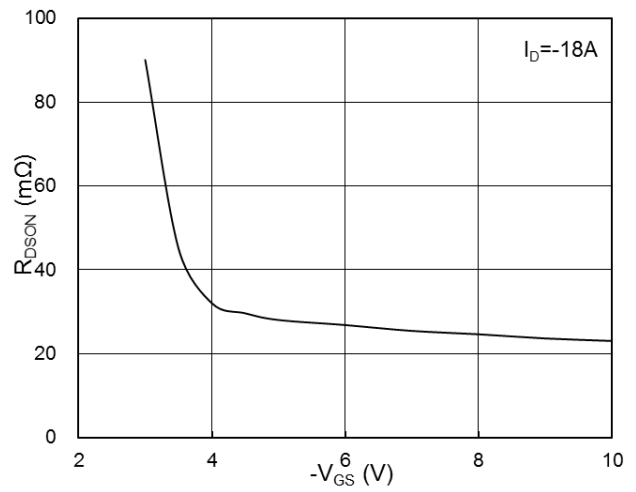
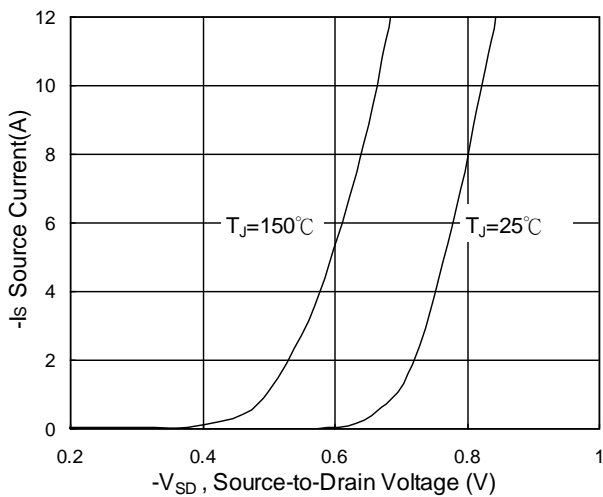
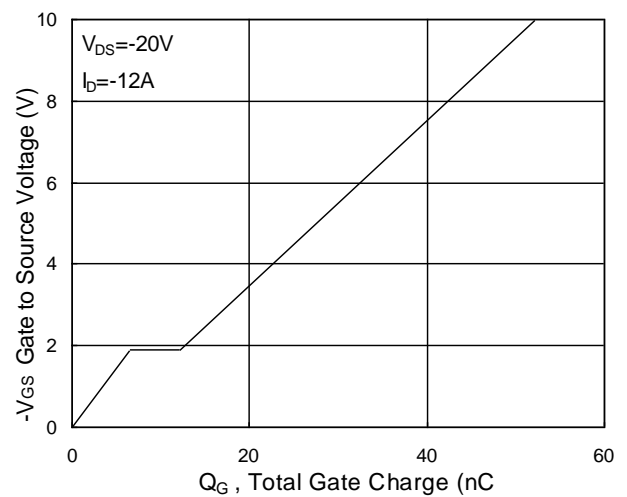
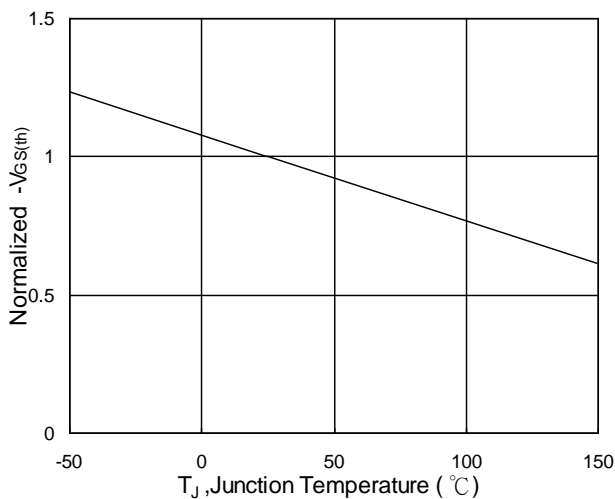
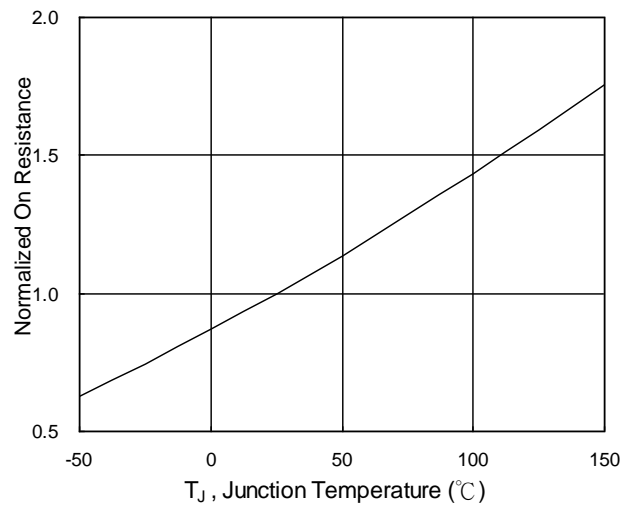
Note ③ : Surface Mounted on  $1\text{in}^2$  FR-4 board with 1oz.

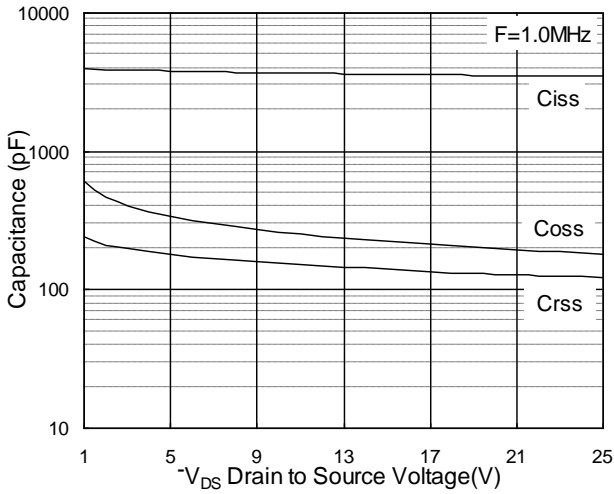
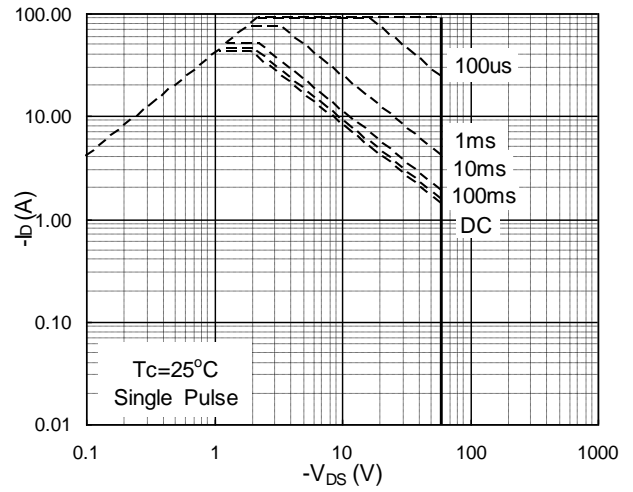
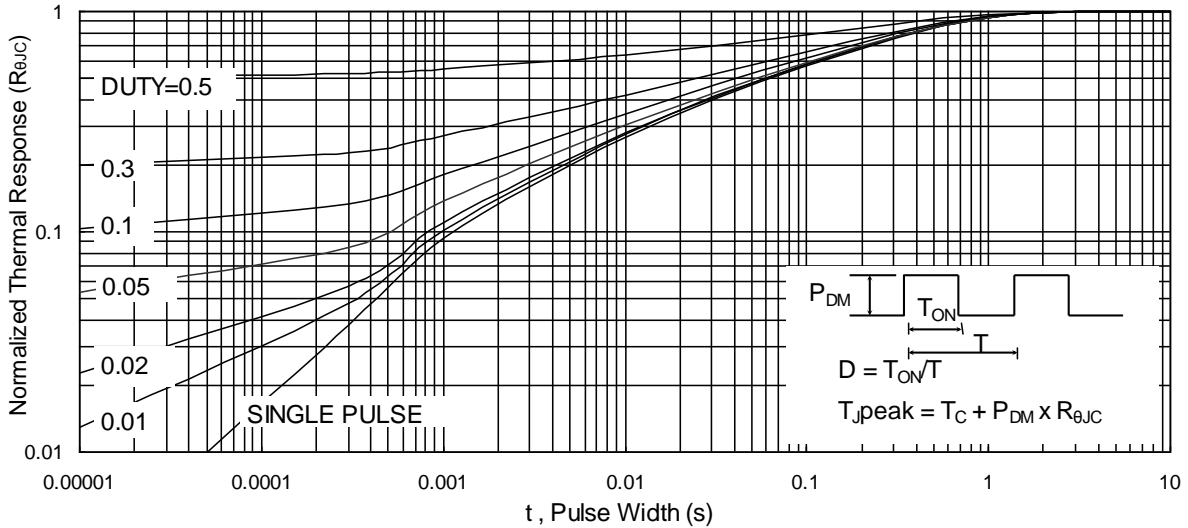
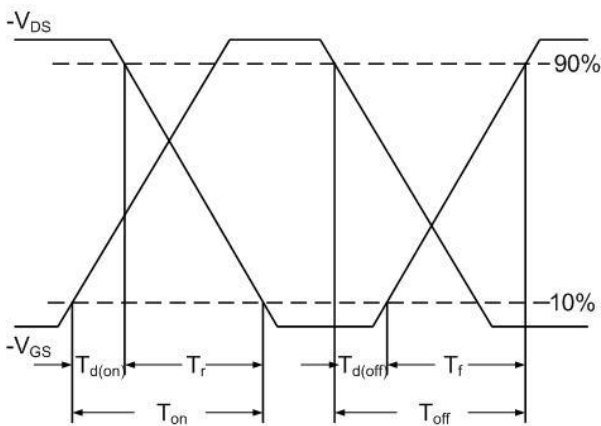
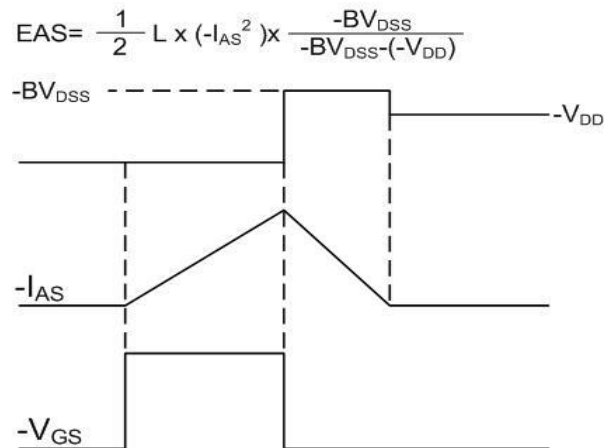
**P-Channel Enhancement Mode MOSFET****Electrical Characteristics** ( $T_J=25^{\circ}\text{C}$ , Unless Otherwise Noted)

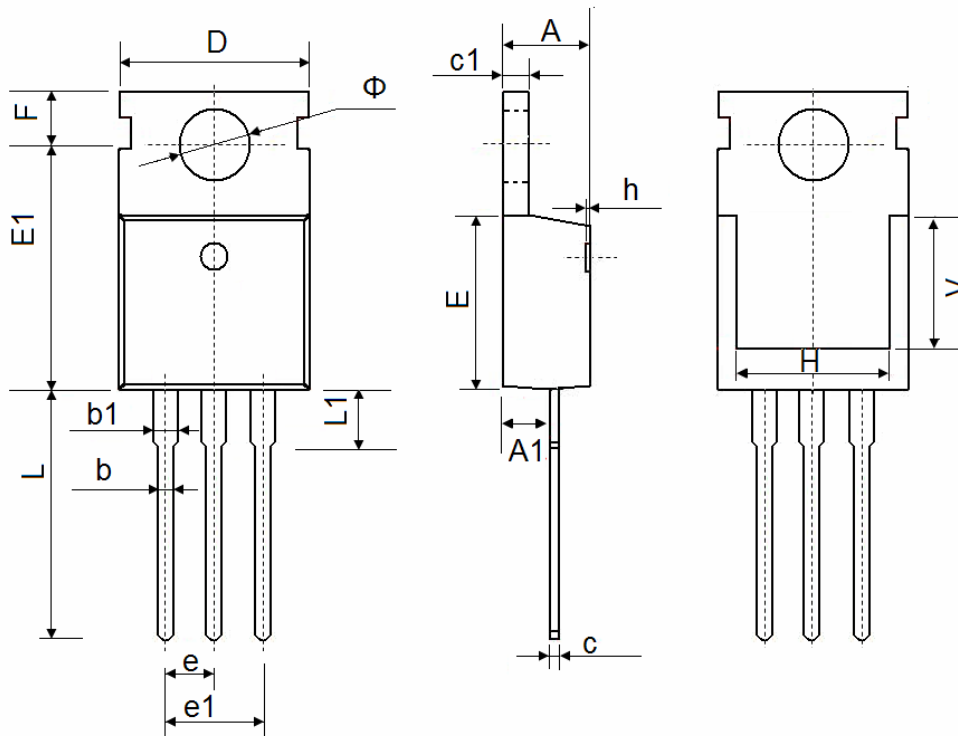
| Symbol                                      | Parameter                        | Test Conditions                                    | Min  | Typ  | Max       | Unit       |
|---|----------------------------------|--|------|------|-----------|------------|
| <b>Static Electrical Characteristics</b>    |                                  |  |      |      |           |            |
| $BV_{DSS}$                                  | Drain-Source Breakdown Voltage   | $V_{GS}=0V, I_D=-250\mu A$                         | -60  | ---  | ---       | V          |
| $I_{DSS}$                                   | Zero Gate Voltage Drain Current  | $V_{DS}=-48V, V_{GS}=0V$                           | ---  | ---  | -1        | $\mu A$    |
| $V_{GS(th)}$                                | Gate Threshold Voltage           | $V_{DS}=V_{GS}, I_D=-250\mu A$                     | -1.0 | ---  | -2.5      | V          |
| $I_{GSS}$                                   | Gate Leakage Current             | $V_{GS}=\pm 20V, V_{DS}=0V$                        | ---  | ---  | $\pm 100$ | nA         |
| $R_{DS(ON)}$                                | Drain-Source On-state Resistance | $V_{GS}=-10V, I_D=-18A$                            | ---  | 20   | 24        | m $\Omega$ |
|   |                                  | $V_{GS}=-4.5V, I_D=-12A$                           | ---  | 29   | 35        |            |
| gfs   | Forward Transconductance         | $V_{DS}=-10V, I_D=-18A$                            | ---  | 23   | ---       | S          |
| <b>Dynamic Characteristics</b> <sup>⑤</sup> |                                  |  |      |      |           |            |
| $C_{iss}$                                   | Input Capacitance                | $V_{GS}=0V, V_{DS}=-15V, \text{Freq.}=1\text{MHz}$ | ---  | 3235 | ---       | pF         |
| $C_{oss}$                                   | Output Capacitance               |  | ---  | 210  | ---       |            |
| $C_{rss}$                                   | Reverse Transfer Capacitance     |  | ---  | 120  | ---       |            |
| $T_{d(on)}$                                 | Turn-on Delay Time               | $V_{DD}=-15V, V_{GS}=-10V, R_G=3.3\Omega, I_D=-1A$ | ---  | 38   | ---       | nS         |
| $T_r$                                       | Turn-on Rise Time                |  | ---  | 23.6 | ---       |            |
| $T_{d(off)}$                                | Turn-off Delay Time              |  | ---  | 100  | ---       |            |
| $T_f$                                       | Turn-off Fall Time               |  | ---  | 6.8  | ---       |            |
| $Q_g$                                       | Total Gate Charge                | $V_{DS}=-20V, V_{GS}=-4.5V, I_D=-12A$              | ---  | 25   | ---       | nC         |
| $Q_{gs}$                                    | Gate-Source Charge               |  | ---  | 6.7  | ---       |            |
| $Q_{gd}$                                    | Gate-Drain Charge                |  | ---  | 5.5  | ---       |            |
| <b>Source-Drain Characteristics</b>         |                                  |  |      |      |           |            |
| $V_{SD}$ <sup>④</sup>                       | Diode Forward Voltage            | $I_S=-1A, V_{GS}=0V$                               | ---  | ---  | -1.0      | V          |

Note ④: Pulse test (pulse width 300us, duty cycle 2%).

Note ⑤: Guaranteed by design, not subject to production testing.

**P-Channel Enhancement Mode MOSFET**
**Typical Characteristics**

**Fig.1 Typical Output Characteristics**

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

**Fig.3 Source Drain Forward Characteristics**

**Fig.4 Gate-Charge Characteristics**

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

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

**P-Channel Enhancement Mode MOSFET**

**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**

**P-Channel Enhancement Mode MOSFET**
**TO-220 Package Outline Data**


| Symbol | Dimensions In Millimeters |        |
|--------|---------------------------|--------|
|        | Min.                      | Max.   |
| A      | 4.350                     | 4.650  |
| A1     | 2.250                     | 2.550  |
| b      | 0.710                     | 0.910  |
| b1     | 1.170                     | 1.400  |
| c      | 0.330                     | 0.650  |
| c1     | 1.200                     | 1.400  |
| D      | 9.910                     | 10.250 |
| E      | 8.9500                    | 9.750  |
| E1     | 12.650                    | 12.950 |
| e      | 2.540 TYP.                |        |
| e1     | 4.980                     | 5.180  |
| F      | 2.650                     | 2.950  |
| H      | 7.900                     | 8.100  |
| h      | 0.000                     | 0.300  |
| L      | 12.700                    | 13.500 |
| L1     | 2.850                     | 3.250  |
| V      | 7.500 REF.                |        |
| Φ      | 3.400                     | 3.800  |