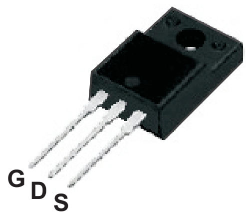
# N-Channel Power MOSFET
# (3A, 900Volts)

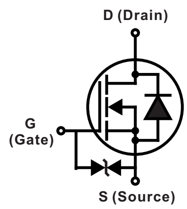
## DESCRIPTION

The Nell **2SK3564** is a three-terminal silicon device with current conduction capability of 3A, fast switching speed, low on-state resistance, breakdown voltage rating of 900V, and max. threshold voltage of 4 volts.

They are designed for use in applications such as switched mode power supplies, DC to DC converters, motor control circuits, UPS, switching regulator relay drive and general purpose switching applications.




TO-220F




## FEATURES

- $R_{DS(ON)}$ = 3.70Ω @ $V_{GS}$ = 10V
- Ultra low gate charge(17nC typical)
- Low reverse transfer capacitance ($C_{RSS}$ = 15pF typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature

| PRODUCT SUMMARY | |
|---|---|
| $I_D$ (A) | 3 |
| $V_{DSS}$ (V) | 900 |
| $R_{DS(ON)}$ (Ω) | 3.70 @ $V_{GS}$ = 10V |
| $Q_G$(nC) max. | 17 |

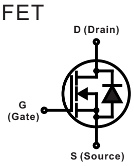
**ABSOLUTE MAXIMUM RATINGS ($T_C$ = 25°C unless otherwise specified)**

| SYMBOL | PARAMETER | TEST CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source voltage | $T_J$=25°C to 150°C | 900 | |
| $V_{DGR}$ | Drain to Gate voltage | $R_{GS}$=20KΩ | 900 | V |
| $V_{GS}$ | Gate to Source voltage | | ±30 | |
| $I_D$ | Continuous Drain Current ($V_{GS}$ = 10V) | $T_C$=25°C | 3 | |
| | | $T_C$=100°C | 1.9 | |
| $I_{DM}$ | Pulsed Drain current(Note 1) | | 9 | A |
| $I_{AR}$ | Avalanche current(Note 1) | | 3 | |
| $E_{AR}$ | Repetitive avalanche energy(Note 1) | $I_{AR}$=3A, $R_{GS}$=50Ω, $V_{GS}$=10V | 4.0 | mJ |
| $E_{AS}$ | Single pulse avalanche energy(Note 2) | $I_{AS}$=3A, L=83mH | 408 | mJ |
| dv/dt | Peak diode recovery dv/dt(Note 3) | | 3.5 | V /ns |
| $P_D$ | Total power dissipation | $T_C$=25°C TO-220F | 40 | W |
| $T_J$ | Operation junction temperature | | -55 to 150 | |
| $T_{STG}$ | Storage temperature | | -55 to 150 | °C |
| $T_L$ | Maximum soldering temperature, for 10 seconds | 1.6mm from case | 300 | |
| | Mounting torque, #6-32 or M3 screw | | 10 (1.1) | lbf·in (N·m) |

Note: 1.Repetitive rating: pulse width limited by junction temperature.
2. $I_{AS}$=3A, L=83mH, $V_{DD}$ = 90V, $R_G$=25Ω, starting $T_J$ =25°C.
3.$I_{SD}$ ≤ 3A, di/dt ≤ 100A/μs, $V_{DD}$ ≤ $V_{(BR)DSS}$, starting $T_J$ =25°C.

| THERMAL RESISTANCE | | | | | |
|---|---|---|---|---|---|
| **SYMBOL** | **PARAMETER** | **Min.** | **Typ.** | **Max.** | **UNIT** |
| $R_{th(j\text{-}c)}$ | Thermal resistance, junction to case | | | 3.1 | °C/W |
| $R_{th(j\text{-}a)}$ | Thermal resistance, junction to ambient | | | 62.5 | |

| ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **SYMBOL** | **PARAMETER** | **TEST CONDITIONS** | **Min.** | **Typ.** | **Max.** | **UNIT** |
| ◎ **STATIC** | | | | | | |
| $V_{(BR)DSS}$ | Drain to source breakdown voltage | $I_D$ = 10mA, $V_{GS}$ = 0V | 900 | | | V |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown voltage temperature coefficient | $I_D$ = 250μA, $V_{DS}$ = $V_{GS}$ | | 0.99 | | V/ºC |
| $I_{DSS}$ | Drain to source leakage current | $V_{DS}$=900V, $V_{GS}$=0V, $T_C$ = 25°C | | | 50.0 | μA |
| | | $V_{DS}$=720V, $V_{GS}$=0V, $T_C$=125°C | | | 500 | |
| $I_{GSS}$ | Gate to source forward leakage current | $V_{GS}$ = 30V, $V_{DS}$ = 0V | | | 10 | μA |
| | Gate to source reverse leakage current | $V_{GS}$ = -30V, $V_{DS}$ = 0V | | | -10 | |
| $R_{DS(ON)}$ | Static drain to source on-state resistance | $I_D$ = 1.5A, $V_{GS}$ = 10V | | 3.70 | 4.30 | Ω |
| $V_{GS(TH)}$ | Gate threshold voltage | $V_{GS}$=$V_{DS}$=10V, $I_D$=1mA | 2.0 | | 4.0 | V |
| $g_{fS}$ | Forward transconductance | $V_{DS}$=20V, $I_D$=1.5A | 0.65 | 2.6 | | S |
| ◎ **DYNAMIC** | | | | | | |
| $C_{ISS}$ | Input capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f =1MHz | | 700 | | pF |
| $C_{OSS}$ | Output capacitance | | | 75 | | |
| $C_{RSS}$ | Reverse transfer capacitance | | | 15 | | |
| $t_{d(ON)}$ | Turn-on delay time | $V_{DD}$ = 200V, $V_{GS}$ = 10V<br>$I_D$ = 1.5A, $R_G$=50Ω, $R_D$ = 133Ω,<br>(Note 1,2) | | 20 | | ns |
| $t_r$ | Rise time | | | 60 | | |
| $t_{d(OFF)}$ | Turn-off delay time | | | 35 | | |
| $t_f$ | Fall time | | | 125 | | |
| $Q_G$ | Total gate charge | $V_{DD}$ = 400V, $V_{GS}$ = 10V,<br>$I_D$ =3A (Note 1,2) | | 17 | | nC |
| $Q_{GS}$ | Gate to source charge | | | 10 | | |
| $Q_{GD}$ | Gate to drain charge (Miller charge) | | | 7 | | |

| SOURCE TO DRAIN DIODE RATINGS AND CHARACTERISTICS ($T_C$ = 25°C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **SYMBOL** | **PARAMETER** | **TEST CONDITIONS** | **Min.** | **Typ.** | **Max.** | **UNIT** |
| $V_{SD}$ | Diode forward voltage | $I_{SD}$ = 3A, $V_{GS}$ = 0V | | | 1.9 | V |
| $I_S(I_{SD})$ | Continuous source to drain current | Integral reverse P-N junction diode in the MOSFET   | | | 3 | A |
| $I_{SM}$ | Pulsed source current | | | | 9 | |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$=3A, $V_{GS}$ = 0V,<br>$dI_F/dt$ = 100A/μs | | 850 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | | 4.7 | | μC |

Note: 1. Pulse test: Pulse width ≤ 10μs, duty cycle ≤ 1%.
2. Essentially independent of operating temperature.

## ORDERING INFORMATION SCHEME

**2SK 3564**

**MOSFET series** (2SK)
N-Channel, Toshiba series

**Current & Voltage rating, $I_D$ & $V_{DS}$** (3564)
3A / 900V

**Fig.1 Typical output characteristics, $T_C$=25°C**

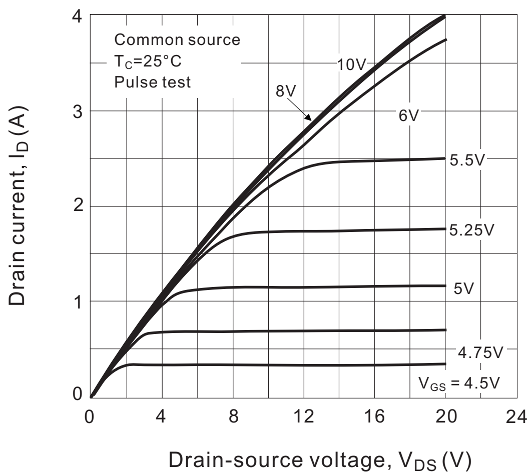



**Fig.2 Typical output characteristics, $T_C$=25°C**

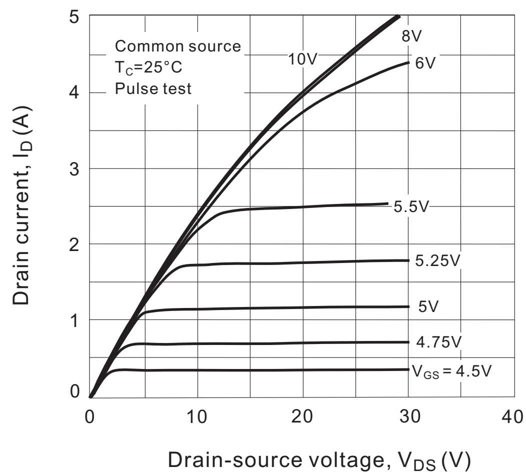



**Fig.3 Typical transfer characteristics**

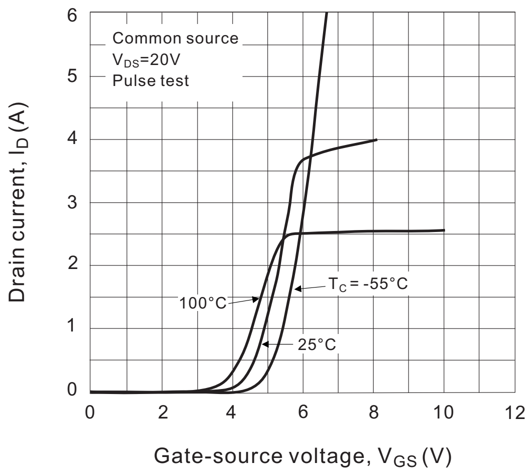



**Fig.4 Drain-source voltage vs. gate-source voltage and drain current**

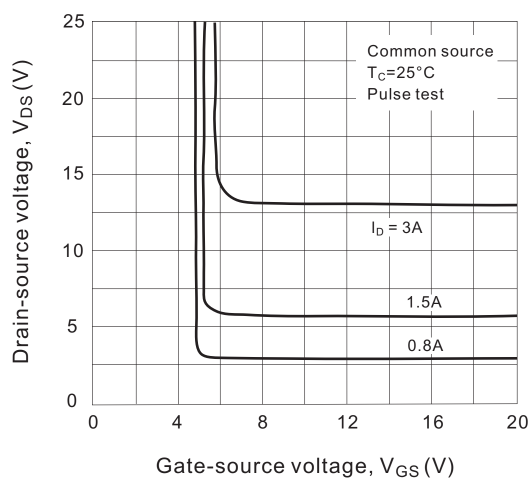


**Fig.5 Forward transconductance characteristics**

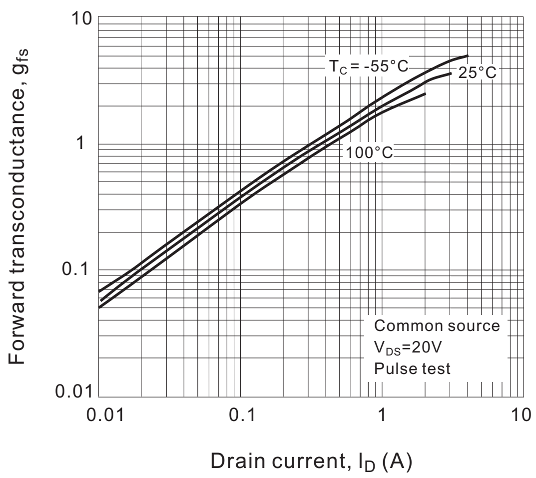



**Fig.6 On-Resistance variation vs. Drain current and gate voltage**

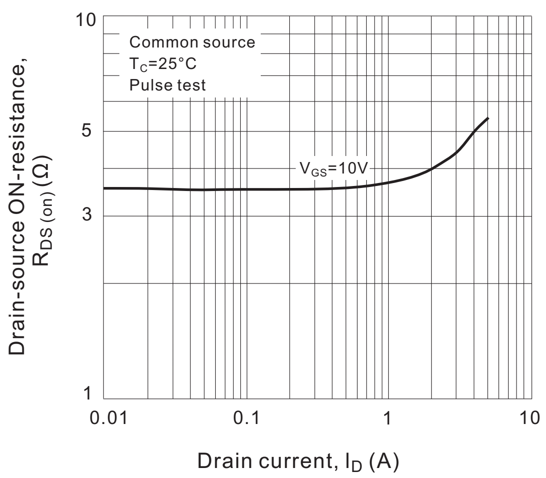



**Fig.7 On-Resistance variation vs. case temperature**

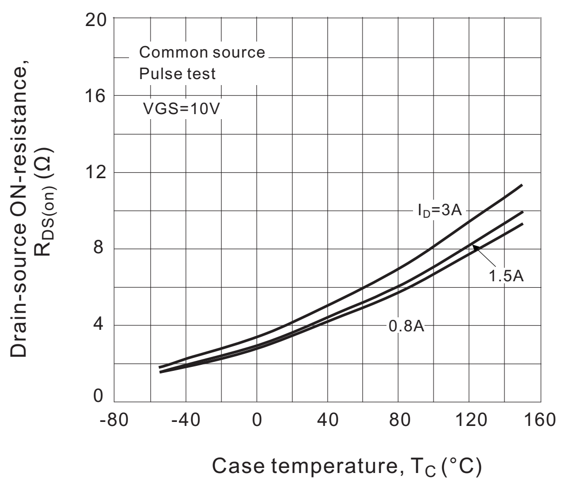



**Fig.8 Drain reverse current vs. Drain-Source voltage**

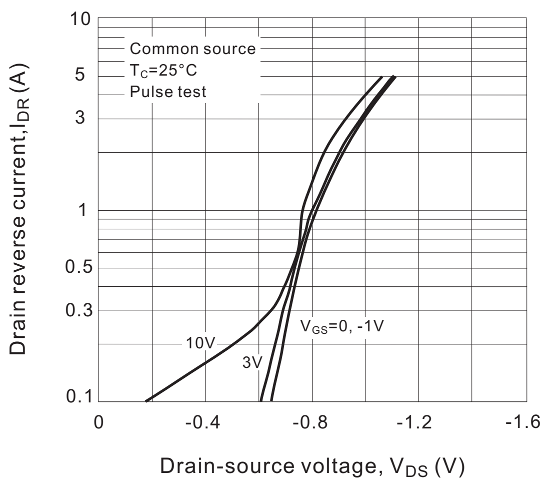



**Fig.9 Capacitance characteristics**

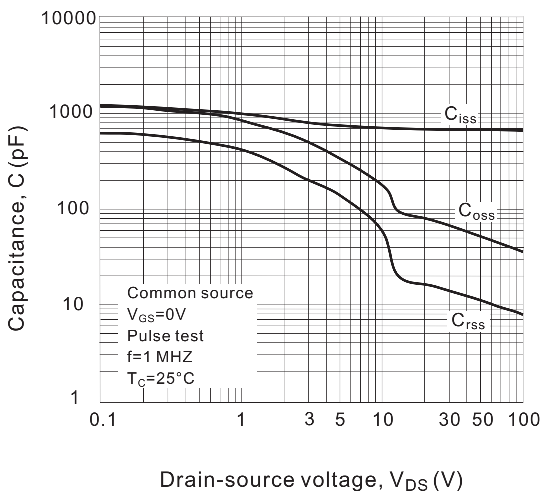



**Fig.10 Gate threshold voltage vs. case temperature**

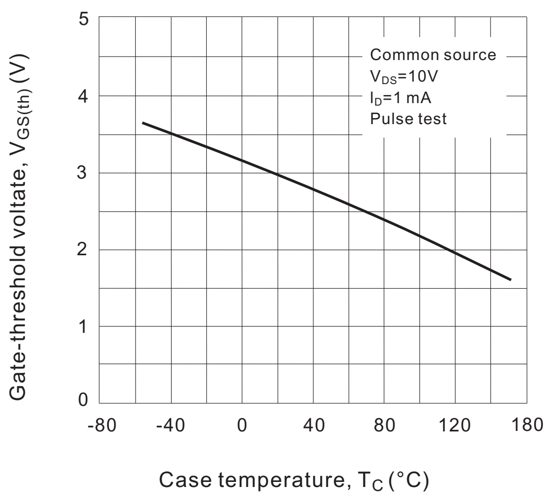


**Fig.11 Drain power dissipation vs. case temperature**

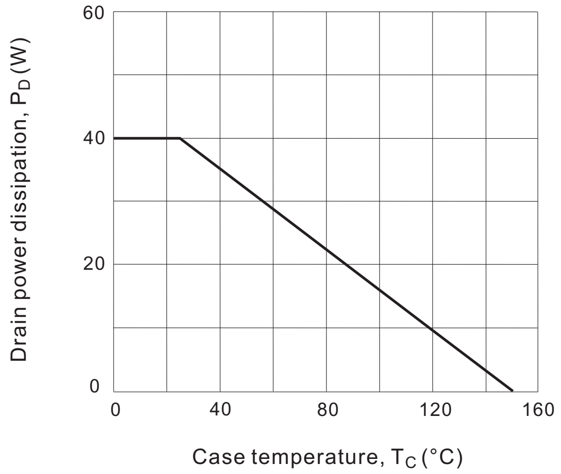



**Fig.12 Dynamic input/output characteristics**

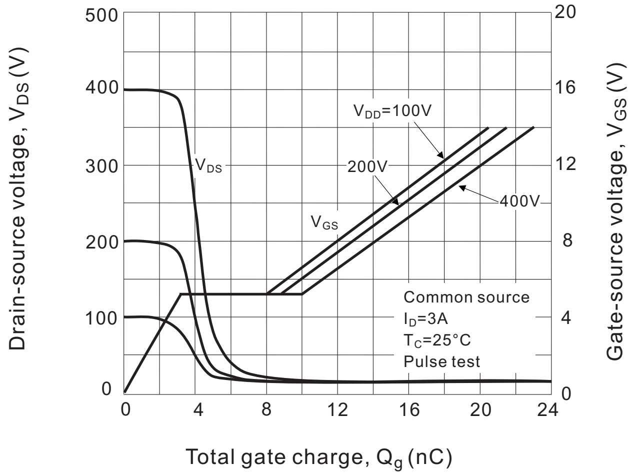



**Fig.13 Transient thermal response curve**

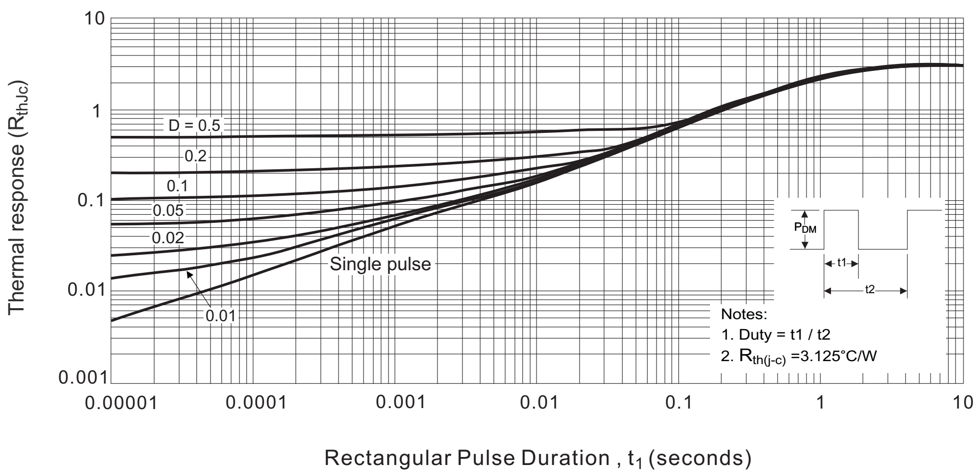



**Fig.14 Maximum safe operating area**

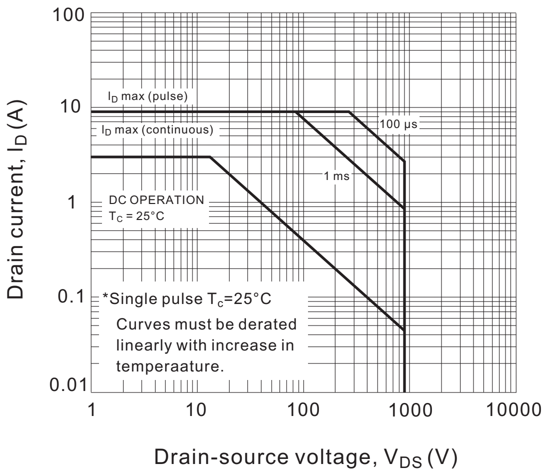



**Fig.15 Single pulse avalanche energy vs. Junction temperature**

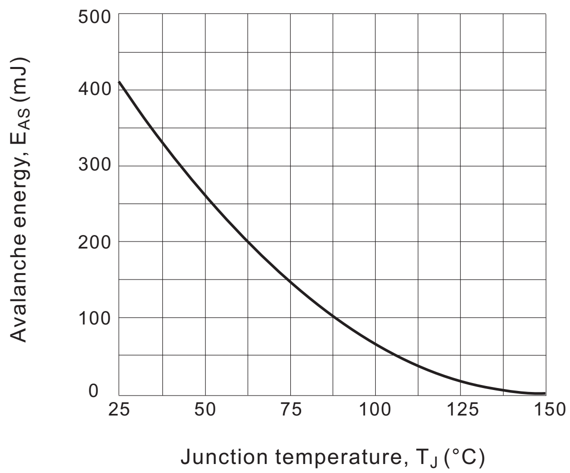
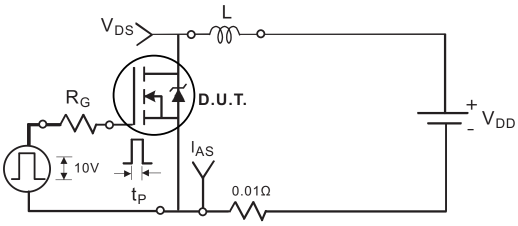
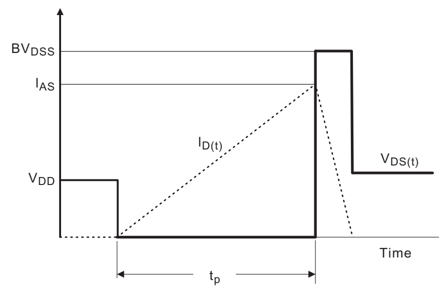


**Fig.16 Unclamped inductive test circuit and waveforms**



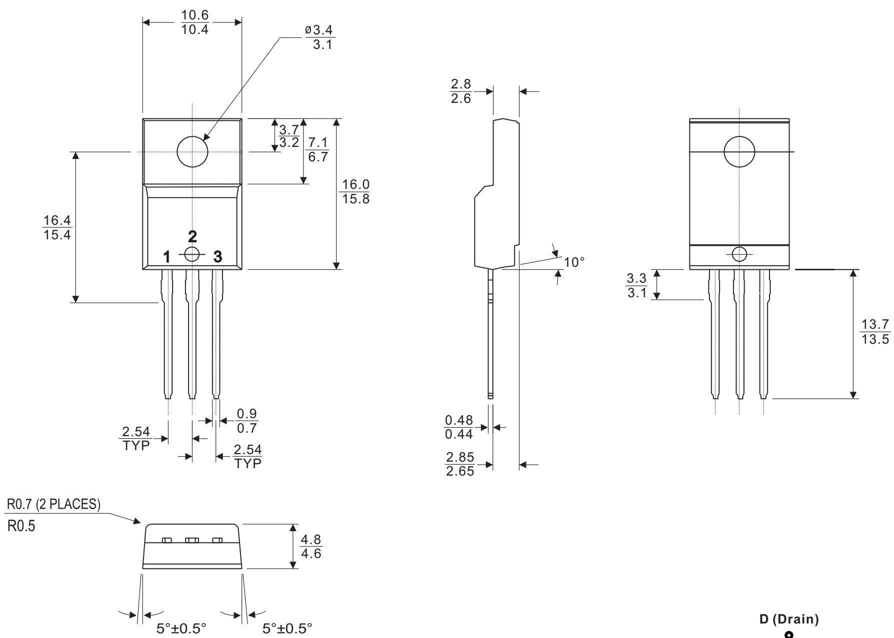



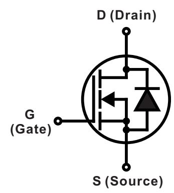

$R_G = 25\Omega$
$V_{DD} = 90V$, L =83mH

$$E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \frac{B_{VDSS}}{B_{VDSS} - V_{DD}}$$

## Case Style

**TO-220F**




All dimensions in millimeters