# TF60N02

## ● General Description

The TF60N02 combines advanced trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$ .This device is ideal for load switch and battery protection applications.

## ● Features

Advance high cell density Trench technology

Low $R_{DS(ON)}$ to minimize conductive loss

Low Gate Charge for fast switching

Low Thermal resistance

## ●Application

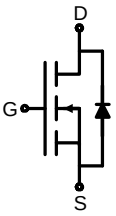
MB/VGA Vcore

SMPS 2nd Synchronous Rectifier

POL application

BLDC Motor driver

## ● Product Summary




$V_{DS}$ =20V $I_D$=60A

$R_{DSON(4.5V\ typ)}$ =4.3mΩ

$R_{DSON(2.5V\ typ)}$ =5.6mΩ

RoHS compliant




TO-251




TO-252

## ●Ordering Information:

| | |
|---|---|
| Part NO. | TF60N02 |
| Marking 1 | 60N02 |
| Marking 2 | TF:tuofeng; Y:year code; X:Week; AA:device code; |
| MOQ | TO-251:50/PCS TO-252:2500/PCS |

## ●Absolute Maximum Ratings ($T_C$ =25℃)

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 20 | V |
| Gate-Source Voltage | $V_{GS}$ | ±12 | V |
| Continuous Drain Current | $I_{D@}T_C$=25℃ | 60 | A |
| | $I_{D@}T_C$=75℃ | 45 | A |
| | $I_{D\ @}T_C$=100℃ | 36 | A |
| Pulsed Drain Current ① | $I_{DM}$ | 120 | A |
| Total Power Dissipation | $P_D@T_C$=25℃ | 50 | W |
| Total Power Dissipation | $P_D@T_A$=25℃ | 2.0 | W |
| Operating Junction Temperature | $T_J$ | -55 to 150 | ℃ |
| Storage Temperature | $T_{STG}$ | -55 to 150 | ℃ |

Note: ① Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2% ;

| | | | |
|---|---|---|---|
| Single Pulse Avalanche Energy | $E_{AS}$ | 130 | mJ |
| Avalanche Current | $I_{AS}$ $I_{AR}$ | 20 | A |

**●Thermal resistance**

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 2.0 | ° C/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | - | - | 47 | ° C/W |
| Soldering temperature, wave soldering for 8s | $T_{sold}$ | - | - | 265 | ° C |

**●Electronic Characteristics**

| Parameter | Symbol | Condition | Min. | Typ | Max. | Unit |
|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$ =0V,$I_D$ =250uA | 20 | | | V |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ =$V_{DS}$, $I_D$ =250uA | 0.45 | 0.58 | 0.90 | V |
| Drain-Source Leakage Current | $I_{DSS}$ | $V_{DS}$=20V, $V_{GS}$ =0V | | | 1.0 | uA |
| Gate- Source Leakage Current | $I_{GSS}$ | $V_{GS}$=±12V ,$V_{DS}$ =0V | | | ±100 | nA |
| Static Drain-source On Resistance | $R_{DS(ON)}$ | $V_{GS}$=4.5V, $I_D$=20A | | 4.3 | 5.5 | mΩ |
| | | $V_{GS}$=2.5V, $I_D$=15A | | 5.6 | 8.5 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ =15V, $I_D$=10A | | 15 | | S |
| Source-drain voltage | $V_{SD}$ | Is=20A | | | 1.20 | V |

**●Electronic Characteristics**

| Parameter | Symbol | Condition | Min. | Typ | Max. | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | Ciss | Vds=10V,Vgs=0V f = 1MHz | - | 1784 | - | pF |
| Output capacitance | Coss | | - | 266 | - | |
| Reverse transfer capacitance | Crss | | - | 212 | - | |

**●Gate Charge characteristics**($T_a$ = 25℃)

| Parameter | Symbol | Condition | Min. | Typ | Max. | Unit |
|---|---|---|---|---|---|---|
| Gate Risistance | $R_g$ | f = 1MHz | | 1.5 | | Ω |
| Total gate charge | Qg | $V_{DD}$ = 10V | - | 38 | - | nC |
| Gate - Source charge | Qgs | $I_D$ = 20A | - | 5.8 | - | |
| Gate - Drain charge | Qgd | $V_{GS}$ = 4.5V | - | 7.9 | - | |
| Turn-ON Delay time | $t_{D(on)}$ | $V_{GS}$=4.5V ,$V_{DS}$=10V $R_G$ =6.0Ω, I=20A | | 7 | | ns |
| Turn-ON Rise time | $t_r$ | | | 6 | | ns |
| Turn-Off Delay time | $t_{D(off)}$ | | | 30 | | ns |
| Turn-Off Fall time | $t_f$ | | | 8 | | ns |

Fig.1 Power Dissipation

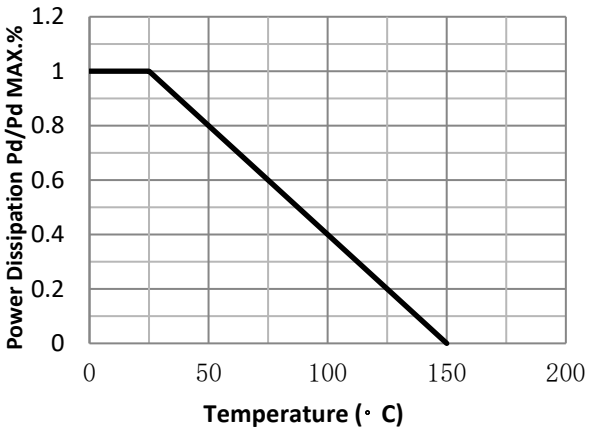



Fig.2 Typical output Characteristics

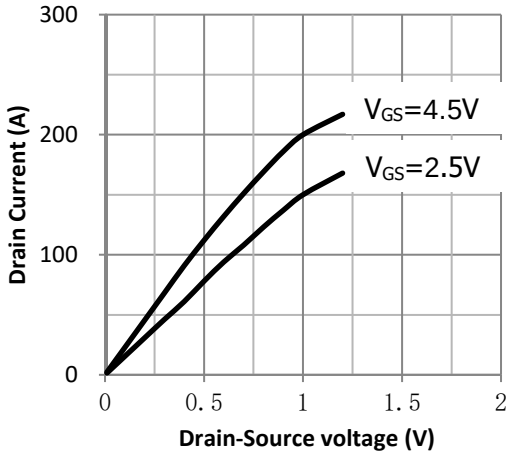



Fig.3 Threshold Voltage V.S Junction Temperature

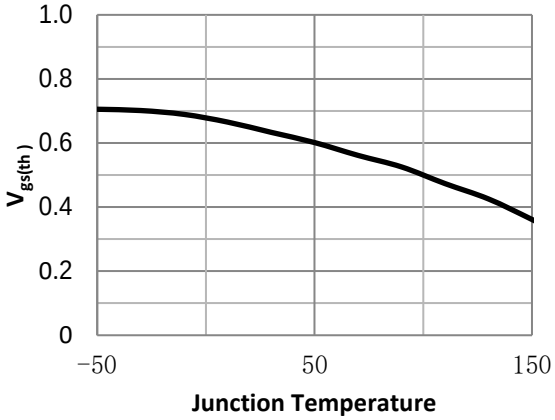



Fig.4 Resistance V.S Drain Current

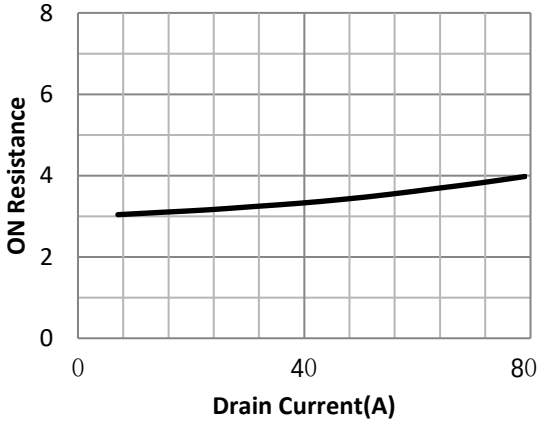



Fig.5 On-Resistance VS Drain Current

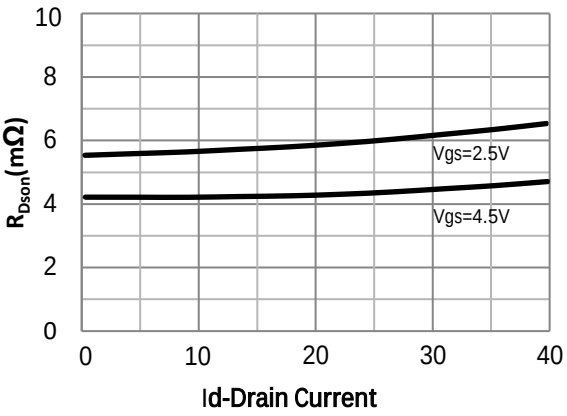



Fig.6 On-Resistance V.S Junction Temperature

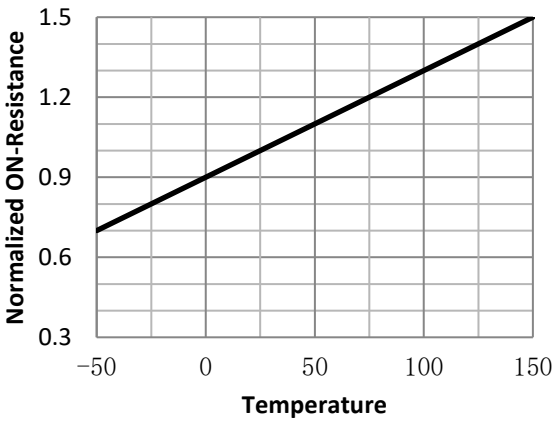


Fig.7 Switching Time Measurement Circuit

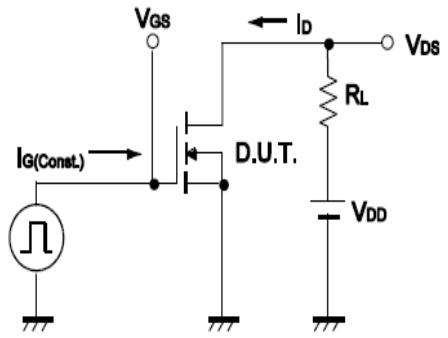



Fig.8 Gate Charge Waveform

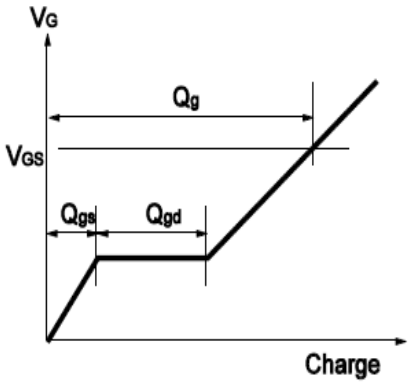



Fig.9 Switching Time Measurement Circuit

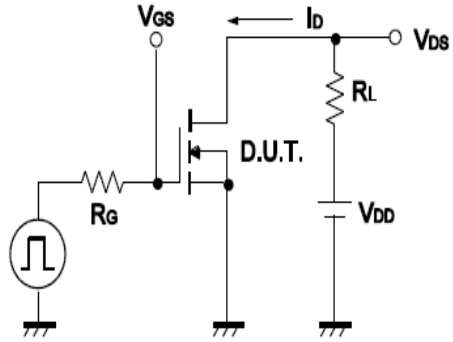



Fig.10 Gate Charge Waveform

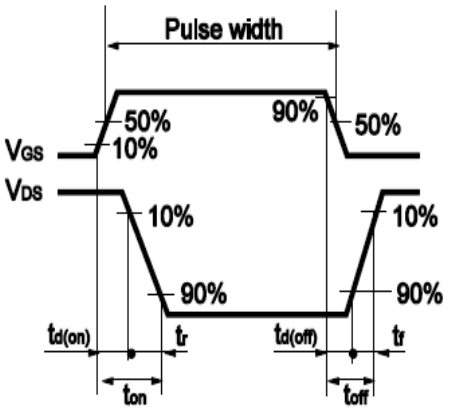



Fig.11 Avalanche Measurement Circuit

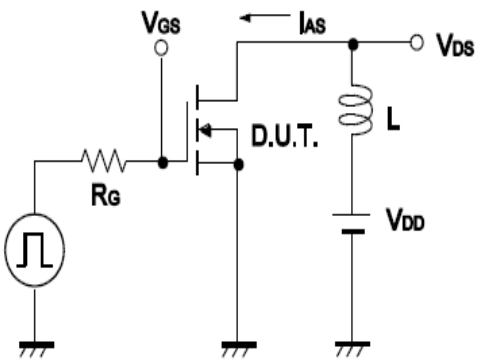
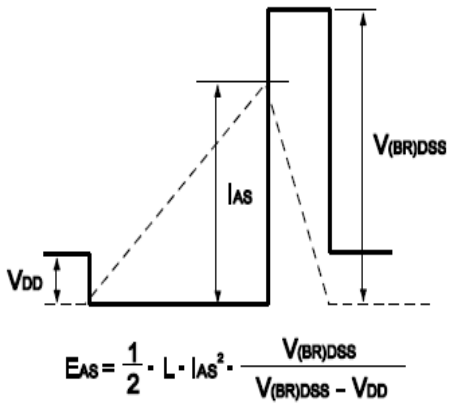
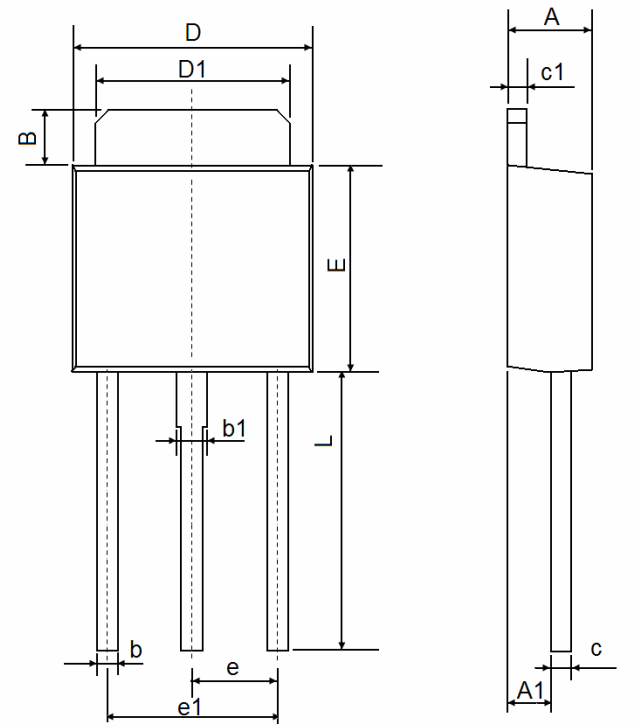



Fig.12 Avalanche Waveform



## Package Information

TO-251



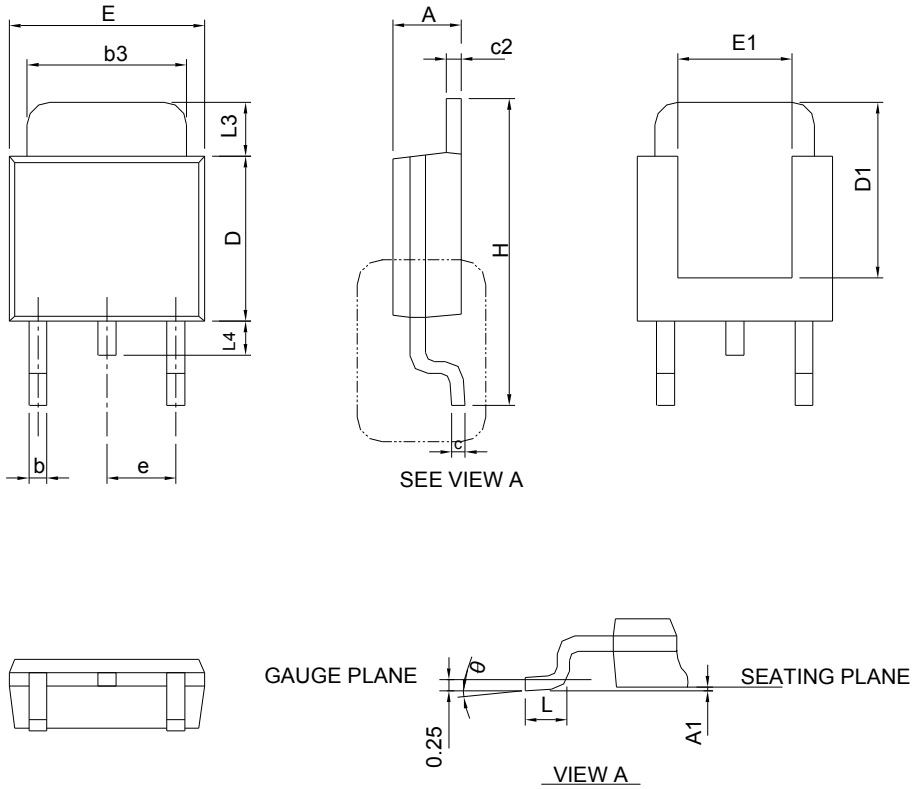

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 2.200 | 2.400 | 0.087 | 0.094 |
| A1 | 1.050 | 1.350 | 0.042 | 0.054 |
| B | 0.700 | 1.000 | 0.028 | 0.040 |
| b | 0.500 | 0.700 | 0.020 | 0.028 |
| b1 | 0.700 | 0.900 | 0.028 | 0.035 |
| c | 0.430 | 0.580 | 0.017 | 0.023 |
| c1 | 0.430 | 0.580 | 0.017 | 0.023 |
| D | 6.350 | 6.650 | 0.250 | 0.262 |
| D1 | 5.200 | 5.400 | 0.205 | 0.213 |
| E | 5.400 | 6.000 | 0.213 | 0.237 |
| e | 2.300 TYP. | | 0.091 TYP. | |
| e1 | 4.500 | 4.700 | 0.177 | 0.185 |
| L | 4.900 | 9.400 | 0.194 | 0.372 |

Notes

1. All dimensions are in millimeters.
2. Tolerance ±0.10mm (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exac

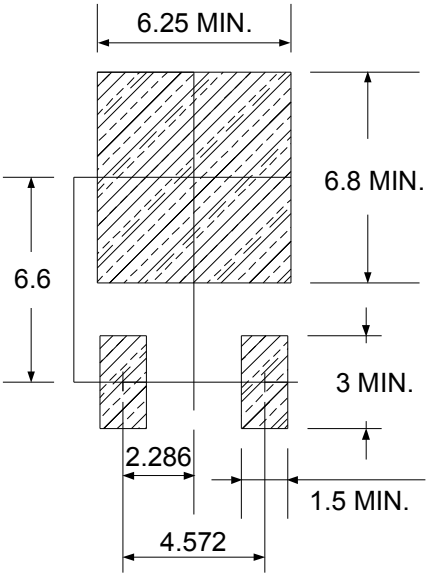
## Package Information

TO-252




| SYMBOL | TO-252 | | | |
|---|---|---|---|---|
| | MILLIMETERS | | INCHES | |
| | MIN. | MAX. | MIN. | MAX. |
| A | 2.18 | 2.39 | 0.086 | 0.094 |
| A1 | | 0.13 | | 0.005 |
| b | 0.50 | 0.89 | 0.020 | 0.035 |
| b3 | 4.95 | 5.46 | 0.195 | 0.215 |
| c | 0.46 | 0.61 | 0.018 | 0.024 |
| c2 | 0.46 | 0.89 | 0.018 | 0.035 |
| D | 5.33 | 6.22 | 0.210 | 0.245 |
| D1 | 4.57 | 6.00 | 0.180 | 0.236 |
| E | 6.35 | 6.73 | 0.250 | 0.265 |
| E1 | 3.81 | 6.00 | 0.150 | 0.236 |
| e | 2.29 BSC | | 0.090 BSC | |
| H | 9.40 | 10.41 | 0.370 | 0.410 |
| L | 0.90 | 1.78 | 0.035 | 0.070 |
| L3 | 0.89 | 2.03 | 0.035 | 0.080 |
| L4 | | 1.02 | | 0.040 |
| θ | 0° | 8° | 0° | 8° |

**RECOMMENDED LAND PATTERN**




UNIT: mm