

• General Description

The TF60N04 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.

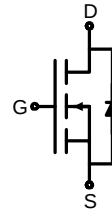
• Features

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



$V_{DS} = 40V$ $I_D = 60A$
 $R_{DS(ON)}(10V_{typ}) = 6.5m\Omega$
 $R_{DS(ON)}(4.5V_{typ}) = 9.0m\Omega$



TO-251



TO-252

• Ordering Information:

Part NO.	TF60N04
Marking 1	60N04:TF60N04
Marking 2	TF:tuofeng; YY:year code; XX:Week; AA:device code;
MOQ	TO-251:50/PCS TO-252:2500/PCS

• Absolute Maximum Ratings ($T_C = 25^\circ C$)

Parameter	Symbol	Rating	Unit
Drain-Source Voltage	V_{DS}	40	V
Gate-Source Voltage	V_{GS}	± 20	V
Continuous Drain Current	$I_D @ T_C = 25^\circ C$	60	A
	$I_D @ T_C = 75^\circ C$	42	A
	$I_D @ T_C = 100^\circ C$	36	A
Pulsed Drain Current ①	I_{DM}	150	A
Total Power Dissipation	$P_D @ T_C = 25^\circ C$	55	W
Total Power Dissipation	$P_D @ T_A = 25^\circ C$	2.0	W
Operating Junction Temperature	T_J	-55 to 150	$^\circ C$
Storage Temperature	T_{STG}	-55 to 150	$^\circ C$

Note: ① Pulse Test : Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$;

Single Pulse Avalanche Energy	E_{AS}	120			mJ	
Avalanche Current	$I_{AS} \ I_{AR}$	30			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}	-	-	55	° 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}	$V_{GS} = 0V, I_D = 250\mu A$	40			V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu A$	1.0	1.5	2.3	V
Drain-Source Leakage Current	I_{DSS}	$V_{DS} = 40V, V_{GS} = 0V$			1.0	uA
Gate- Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$			±100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 20A$		6.5	8.5	mΩ
		$V_{GS} = 4.5V, I_D = 20A$		9.0	12	mΩ
Forward Transconductance	g_{FS}	$V_{DS} = 15V, I_D = 20A$		15		S
Source-drain voltage	V_{SD}	$I_S = 20A$			1.20	V
●Electronic Characteristics						
Parameter	Symbol	Condition	Min.	Typ	Max.	Unit
Input capacitance	C_{iss}	$V_{ds} = 20V, V_{gs} = 0V$ $f = 1MHz$	-	1235	-	pF
Output capacitance	C_{oss}		-	152.5	-	
Reverse transfer capacitance	C_{rss}		-	138.5	-	
●Gate Charge characteristics($T_a = 25^{\circ}C$)						
Parameter	Symbol	Condition	Min.	Typ	Max.	Unit
Gate Resistance	R_g	$f = 1MHz$		1.5		Ω
Total gate charge	Q_g	$V_{DD} = 20V$ $I_D = 20A$ $V_{GS} = 10V$	-	25.5	-	nC
Gate - Source charge	Q_{gs}		-	3.2	-	
Gate - Drain charge	Q_{gd}		-	6.5	-	
Turn-ON Delay time	$t_{D(on)}$	$V_{GS} = 10V, V_{DS} = 20V$ $R_G = 2.7\Omega, I = 20A$		8.0		ns
Turn-ON Rise time	t_r			17.8		ns
Turn-Off Delay time	$t_{D(off)}$			120		ns
Turn-Off Fall time	t_f			70		ns

Fig.1 Power Dissipation

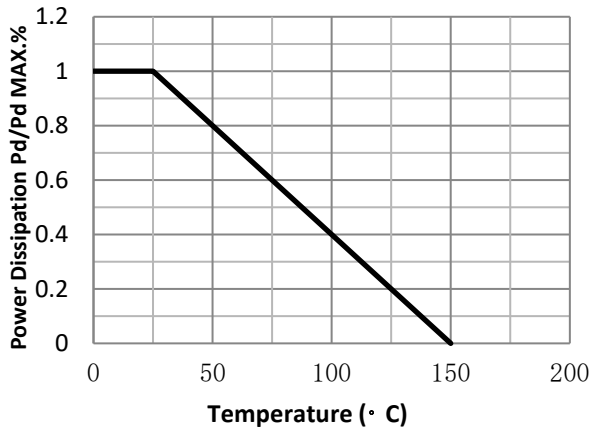


Fig.2 Typical output Characteristics

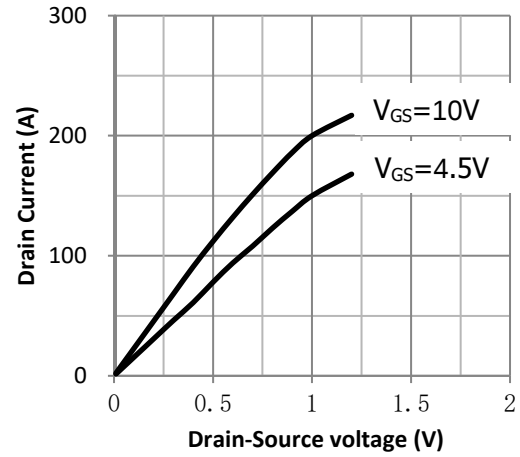


Fig.3 Threshold Voltage V.S Junction Temperature

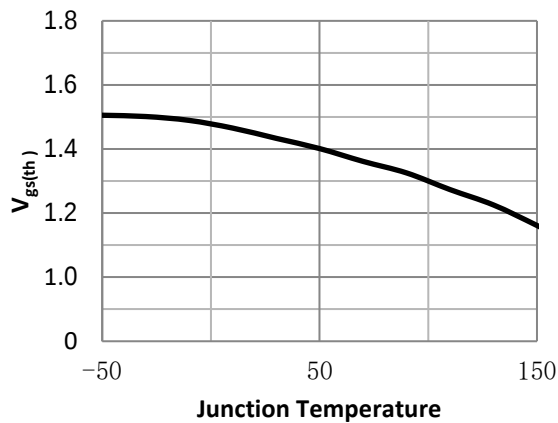


Fig.4 Resistance V.S Drain Current

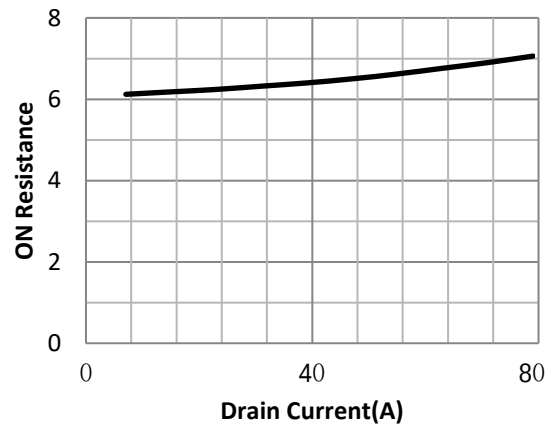


Fig.5 On-Resistance VS Drain Current

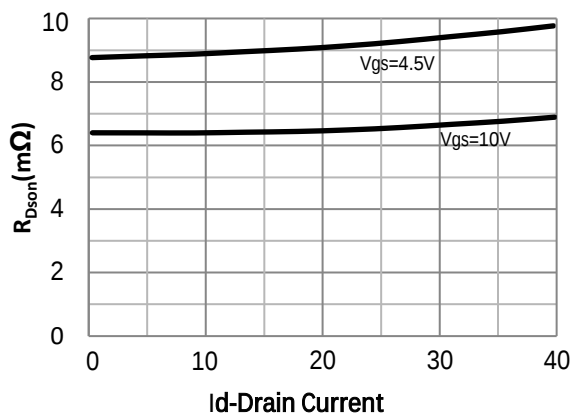


Fig.6 On-Resistance V.S Junction Temperature

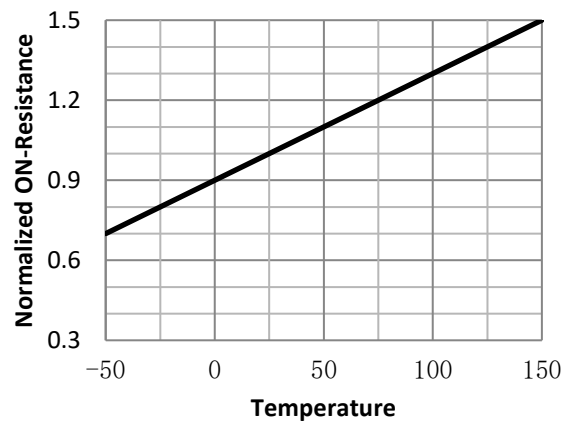


Fig.7 Switching Time Measurement Circuit

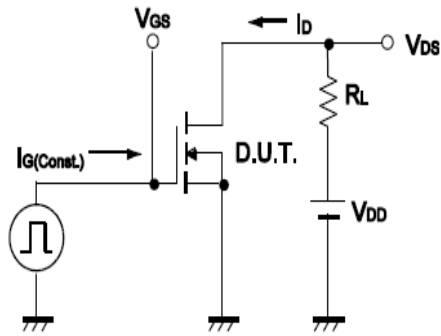


Fig.8 Gate Charge Waveform

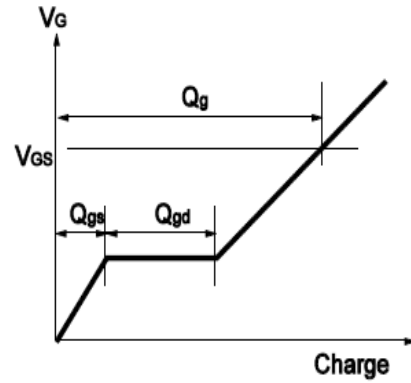


Fig.9 Switching Time Measurement Circuit

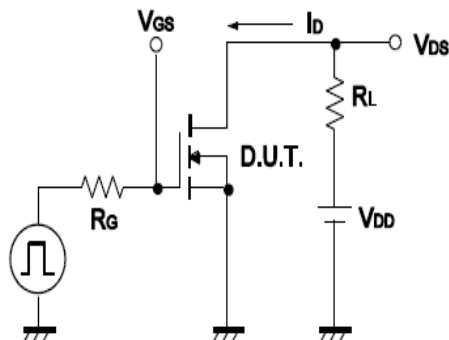


Fig.10 Gate Charge Waveform

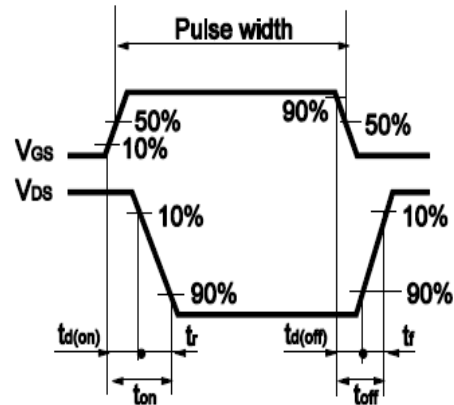


Fig.11 Avalanche Measurement Circuit

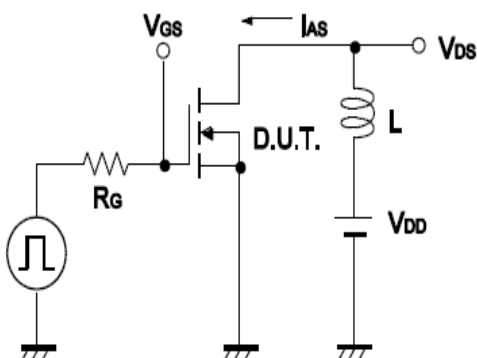
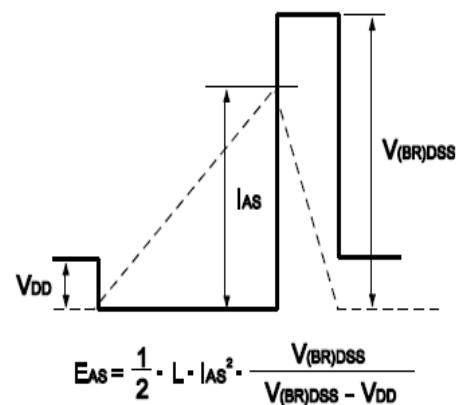
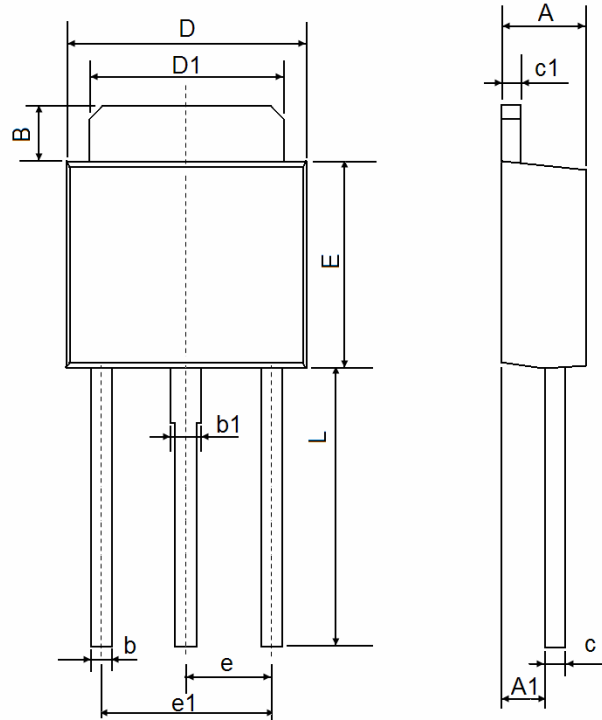


Fig.12 Avalanche Waveform



Package Information

TO-251



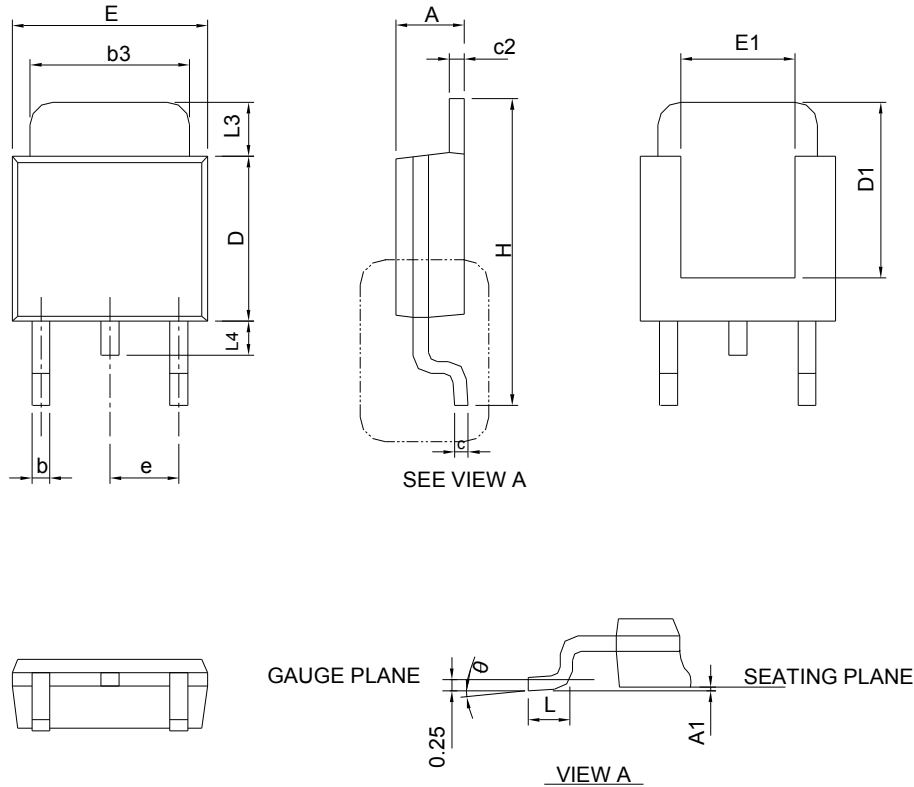
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	1.050	1.350	0.042	0.054
B	0.700	1.000	0.028	0.040
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	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 $\pm 0.10\text{mm}$ (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 exact

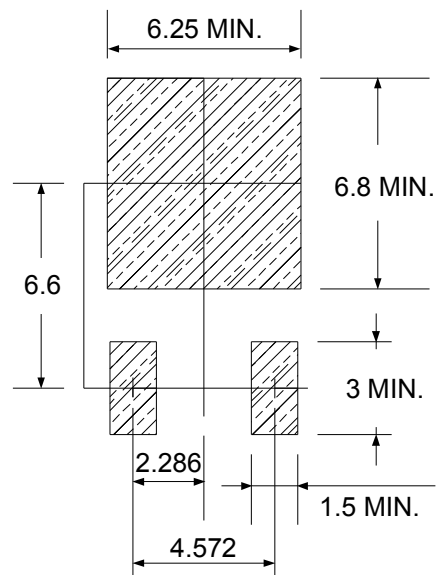
Package Information

TO-252



DIMENSIONS	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