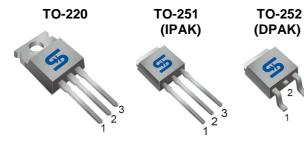


# **TSM2N60**

### 600V N-Channel Power MOSFET





**Pin Definition:** 1. Gate

Gate
 Drain
 Source

#### **PRODUCT SUMMARY**

V <sub>DS</sub> (V)	$R_{DS(on)}(\Omega)$	I <sub>D</sub> (A)
600	5 @ V <sub>GS</sub> =10V	1

#### **General Description**

The TSM2N60 is used an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain- to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power supplies, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.

#### **Features**

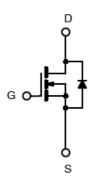
- Robust high voltage termination
- Avalanche energy specified
- Diode is characterized for use in bridge circuits
- Source to Drain diode recovery time comparable to a discrete fast recovery diode.

### **Ordering Information**

Part No.	Package	Packing
TSM2N60CP RO	TO-252	2.5Kpcs/ 13" Reel
TSM2N60CP ROG	TO-252	2.5Kpcs/ 13" Reel
TSM2N60CH C5	TO-251	75pcs / Tube
TSM2N60CH C5G	TO-251	75pcs / Tube
TSM2N60CZ C0	TO-220	50pcs / Tube

Note: "G" denotes for Halogen Free

#### **Block Diagram**



N-Channel MOSFET

#### **Absolute Maximum Rating** (Ta = 25°C unless otherwise noted)

Parameter		Symbol	Limit	Unit	
Drain-Source Voltage		$V_{DS}$	600	V	
Gate-Source Voltage		$V_{GS}$	±30	V	
Continuous Drain Current		I <sub>D</sub>	2	А	
Pulsed Drain Current		I <sub>DM</sub>	9	А	
Continuous Source Current (Diode Conduction) <sup>a,b</sup>		I <sub>S</sub>	1	Α	
Single Pulse Drain to Source Avalanche Energy $(V_{DD} = 50V, I_{AS} = 1.8A, L = 68mH, R_G = 25\Omega)$		EAS	120	mJ	
Maximum Power Dissipation @ Tc = 25°C	TO-251 / TO-252	D	70	W	
	TO-220	P <sub>DTOT</sub>	70		
Operating Junction Temperature	T <sub>J</sub>	+150	°C		
Operating Junction and Storage Temperature Range		$T_J,T_STG$	-55 to +150	°C	

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# **TSM2N60**

## 600V N-Channel Power MOSFET



#### **Thermal Performance**

Parameter		Symbol	Limit	Unit	
The word Decistance I bundies to Occa-	TO-251 / TO-252	R⊖ <sub>JC</sub>	2.87	°C/W	
Thermal Resistance - Junction to Case	TO-220		2.32	C/VV	
Thornal Desistance Investiga to Ambient	TO-251 / TO-252	DO.	110	°C 44/	
Thermal Resistance - Junction to Ambient	TO-220	$R\Theta_{JA}$	62.5	°C/W	

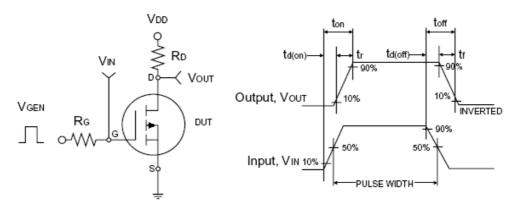
Notes: Surface mounted on FR4 board t ≤ 10sec

## **Electrical Specifications** (Ta = 25°C unless otherwise noted)

Parameter	Conditions	Symbol	Min	Тур	Max	Unit
Static						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250uA$	BV <sub>DSS</sub>	600			V
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 1A$	R <sub>DS(ON)</sub>			5	Ω
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = 250uA$	$V_{GS(TH)}$	2.0		4.0	V
Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	I <sub>DSS</sub>			10	uA
Gate Body Leakage	$V_{GS} = \pm 20V, V_{DS} = 0V$	I <sub>GSS</sub>			± 100	nA
Forward Transconductance	$V_{DS} = 40V, I_{D} = 1A$	g <sub>fs</sub>		5		S
Diode Forward Voltage	$I_S = 2A$ , $V_{GS} = 0V$	$V_{SD}$			1.6	V
Dynamic <sup>b</sup>						
Total Gate Charge	)/ 400\/ L 0A	$Q_g$		13	22	
Gate-Source Charge	$V_{DS} = 400V, I_{D} = 2A,$ $V_{GS} = 10V$	$Q_{gs}$		2		nC
Gate-Drain Charge		$Q_{gd}$		6		
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ f = 1.0MHz	C <sub>iss</sub>		435		
Output Capacitance		C <sub>oss</sub>		56		pF
Reverse Transfer Capacitance		$C_{rss}$		9.2		
Switching <sup>c</sup>						
Turn-On Delay Time	$V_{GS} = 10V, I_D = 2A,$	t <sub>d(on)</sub>		12		
Turn-On Rise Time		t <sub>r</sub>		21		~C
Turn-Off Delay Time	$V_{DD} = 300V, R_G = 18\Omega$	t <sub>d(off)</sub>		30		nS
Turn-Off Fall Time		t <sub>f</sub>		24		

#### Notes:

- a. Pulse test: pulse width <=300uS, duty cycle <=2%
- b. For design reference only, not subject to production testing.
- c. Switching time is essentially independent of operating temperature.



**Switching Test Circuit** 

Switchin Waveforms

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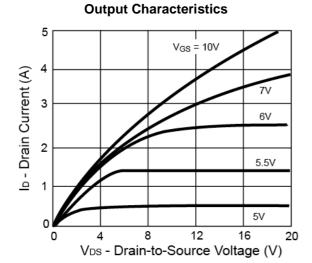


# **TSM2N60**

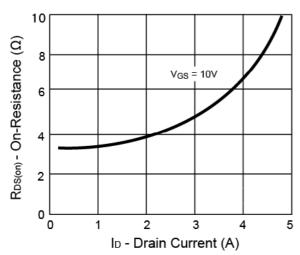
## 600V N-Channel Power MOSFET



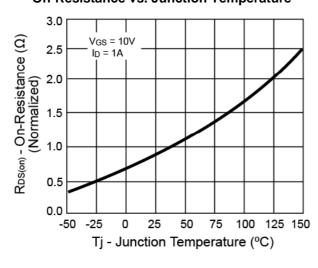
### Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)



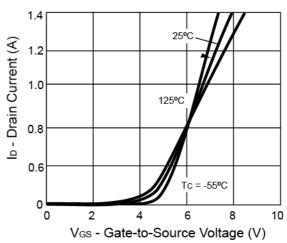
#### **On-Resistance vs. Drain Current**



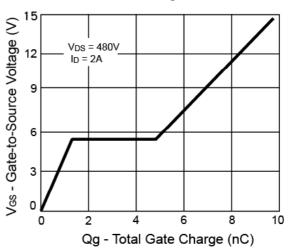
**On-Resistance vs. Junction Temperature** 



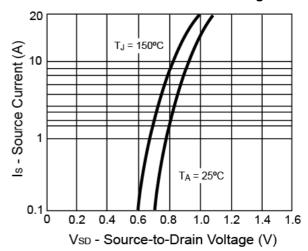
**Transfer Characteristics** 



**Gate Charge** 



#### **Source-Drain Diode Forward Voltage**



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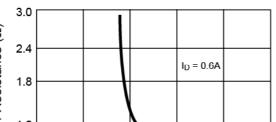
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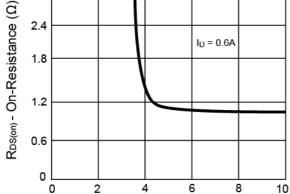




#### Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)



On-Resistance vs. Gate-Source Voltage



## 1.3 V<sub>GS(th)</sub> - Gate Threshold Voltage (Normalized) 1.2 1.1 $I_D = 250 \mu A$ 1.0 0.9 0.8 0.7 0.6

75

50

Tj - Junction Temperature (°C)

100 125 150

0.5

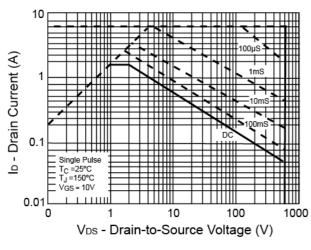
0.4

-50 -25 0

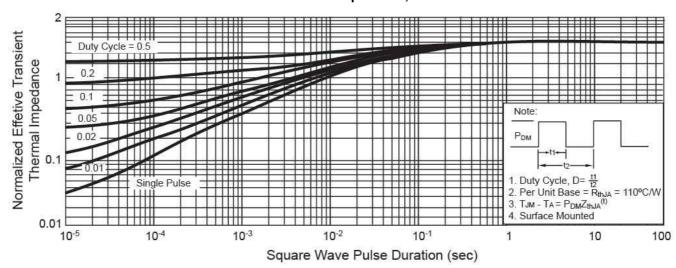
**Threshold Voltage** 

### **Maximum Safe Operating Area**

V<sub>GS</sub> - Gate-to-Source Voltage (V)



#### Normalized Thermal Transient Impedance, Junction-to-Ambient

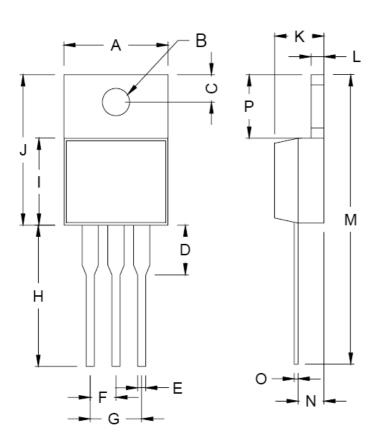


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# **TO-220 Mechanical Drawing**



TO-220 DIMENSION					
DIM	MILLIMETERS		INCHES		
	MIN	MAX	MIN	MAX	
Α	10.000	10.500	0.394	0.413	
В	3.740	3.910	0.147	0.154	
С	2.440	2.940	0.096	0.116	
D	-	6.350	-	0.250	
Е	0.381	1.106	0.015	0.040	
F	2.345	2.715	0.092	0.058	
G	4.690	5.430	0.092	0.107	
Н	12.700	14.732	0.500	0.581	
J	14.224	16.510	0.560	0.650	
K	3.556	4.826	0.140	0.190	
L	0.508	1.397	0.020	0.055	
М	27.700	29.620	1.060	1.230	
N	2.032	2.921	0.080	0.115	
0	0.255	0.610	0.010	0.024	
Р	5.842	6.858	0.230	0.270	

# **Marking Diagram**



= Year Code

M = Month Code

(A=Jan, B=Feb, C=Mar, D=Apl, E=May, F=Jun, G=Jul, H=Aug,

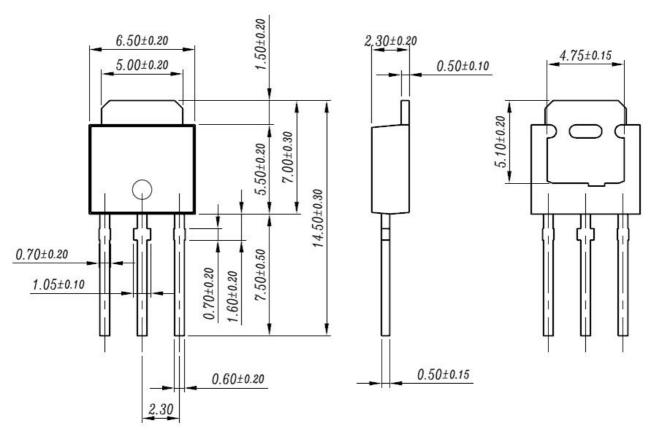
I=Sep, J=Oct, K=Nov, L=Dec)

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L = Lot Code

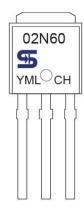


# **TO-251 Mechanical Drawing**



**Unit: Millimeters** 

## **Marking Diagram**



Y = Year Code

**M** = Month Code

(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apl, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)

Month Code for Halogen Free Product
 (O=Jan, P=Feb, Q=Mar, R=Apl, S=May, T=Jun, U=Jul, V=Aug, W=Sep, X=Oct, Y=Nov, Z=Dec)

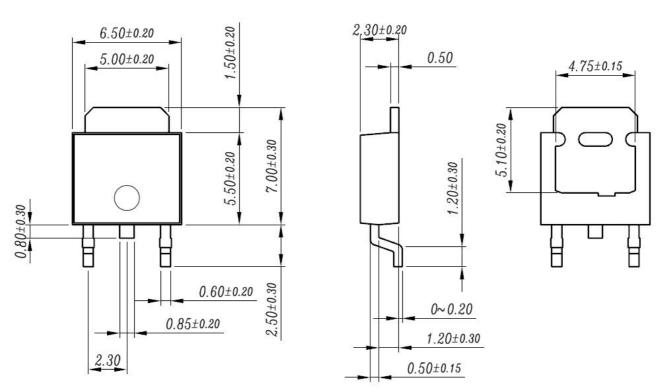
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L = Lot Code





# **TO-252 Mechanical Drawing**



Unit: Millimeters

# **Marking Diagram**



Y = Year Code

M = Month Code

(A=Jan, B=Feb, C=Mar, D=Apl, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)

= Month Code for Halogen Free Product
(O=Jan, P=Feb, Q=Mar, R=Apl, S=May, T=Jun, U=Jul, V=Aug, W=Sep, X=Oct, Y=Nov, Z=Dec)

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L = Lot Code



# TSM2N60 600V N-Channel Power MOSFET

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