

**TO-252**


1 2 3

**TO-251**


1 2 3

**Pin Definition:**

1. Gate
2. Drain
3. Source

**PRODUCT SUMMARY**

$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A)
600	12 @ $V_{GS}=10V$	1

### General Description

The TSM1N60L 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.

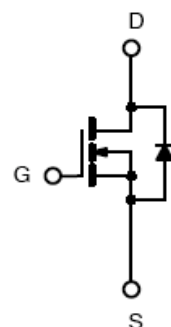
### Features

- 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.
- $I_{DSS}$  and  $V_{DS(on)}$  specified at elevated temperature

### Ordering Information

Part No.	Package	Packing
TSM1N60LCP RO	TO-252	2.5Kpcs / 13" Reel
TSM1N60LCH C5	TO-251	50pcs / Tube

### Block Diagram



N-Channel MOSFET

### Absolute Maximum Rating ( $T_a = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	600	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	V
Continuous Drain Current	$I_D$	1	A
Pulsed Drain Current	$I_{DM}$	4	A
Continuous Source Current (Diode Conduction) <sup>a,b</sup>	$I_S$	1	A
Single Pulse Drain to Source Avalanche Energy ( $V_{DD} = 100V, V_{GS}=10V, I_{AS}=2A, L=10mH, R_G=25\Omega$ )	EAS	20	mJ
Maximum Power Dissipation @ $T_a = 25^\circ C$	$P_D$	2.5	W
Operating Junction Temperature	$T_J$	+150	$^\circ C$
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to +150	$^\circ C$

### Thermal Performance

Parameter	Symbol	Limit	Unit
Lead Temperature (1/8" from case)	$T_L$	10	S
Thermal Resistance - Junction to Ambient	$R\theta_{JA}$	62.5	$^{\circ}\text{C/W}$

Notes: Surface mounted on FR4 board  $t \leq 10\text{sec}$

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

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$	$BV_{DSS}$	600	--	--	V
Drain-Source On-State Resistance	$V_{GS} = 10\text{V}, I_D = 0.6\text{A}$	$R_{DS(ON)}$	--	10.5	12	$\Omega$
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	$V_{GS(TH)}$	2.0	--	4.0	V
Zero Gate Voltage Drain Current	$V_{DS} = 600\text{V}, V_{GS} = 0\text{V}$	$I_{DSS}$	--	--	10	$\mu\text{A}$
Gate Body Leakage	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$	$I_{GSS}$	--	--	$\pm 100$	nA
Forward Transconductance	$V_{DS} \geq 50\text{V}, I_D = 0.5\text{A}$	$g_{fs}$	--	10	--	S
Diode Forward Voltage	$I_S = 1\text{A}, V_{GS} = 0\text{V}$	$V_{SD}$	--	--	1.5	V

### Dynamic<sup>b</sup>

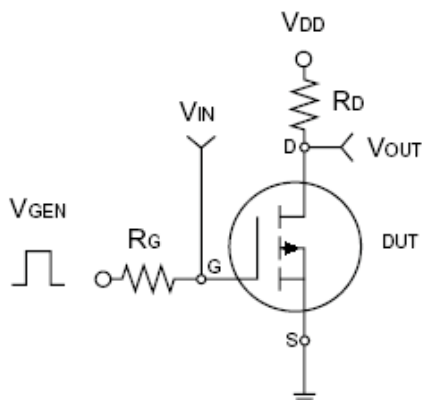
Total Gate Charge	$V_{DS} = 400\text{V}, I_D = 1\text{A},$ $V_{GS} = 10\text{V}$	$Q_g$	--	8.5	14	nC
Gate-Source Charge		$Q_{gs}$	--	1.8	--	
Gate-Drain Charge		$Q_{gd}$	--	4	--	
Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V},$ $f = 1.0\text{MHz}$	$C_{iss}$	--	210	--	pF
Output Capacitance		$C_{oss}$	--	28	--	
Reverse Transfer Capacitance		$C_{rss}$	--	4.2	--	

### Switching<sup>c</sup>

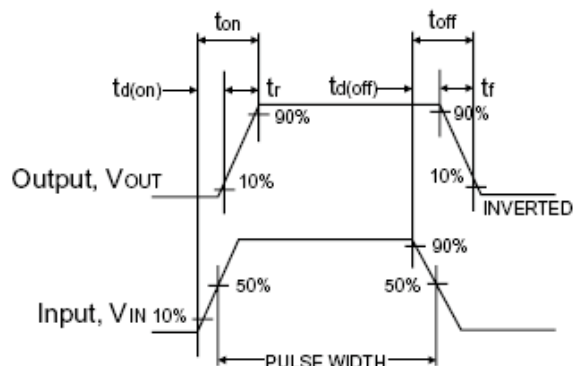
Turn-On Delay Time	$V_{GS} = 10\text{V}, I_D = 1\text{A},$ $V_{DS} = 300\text{V}, R_G = 6\Omega$	$t_{d(on)}$	--	8	--	nS
Turn-On Rise Time		$t_r$	--	21	--	
Turn-Off Delay Time		$t_{d(off)}$	--	18	--	
Turn-Off Fall Time		$t_f$	--	24	--	

Notes:

- Pulse test: pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$
- For design reference only, not subject to production testing.
- Switching time is essentially independent of operating temperature.



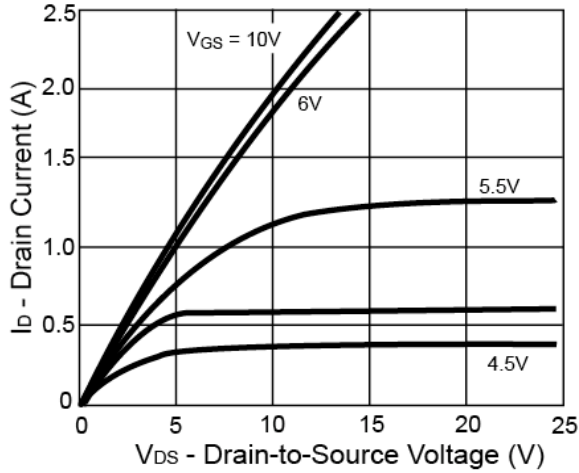
Switching Test Circuit



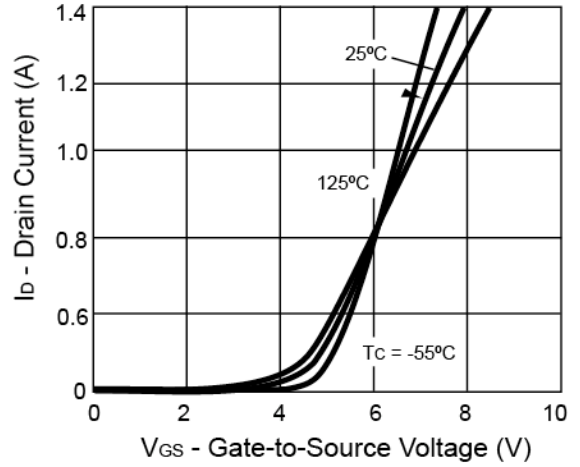
Switchin Waveforms

**Electrical Characteristics Curve** ( $T_a = 25^\circ\text{C}$ , unless otherwise noted)

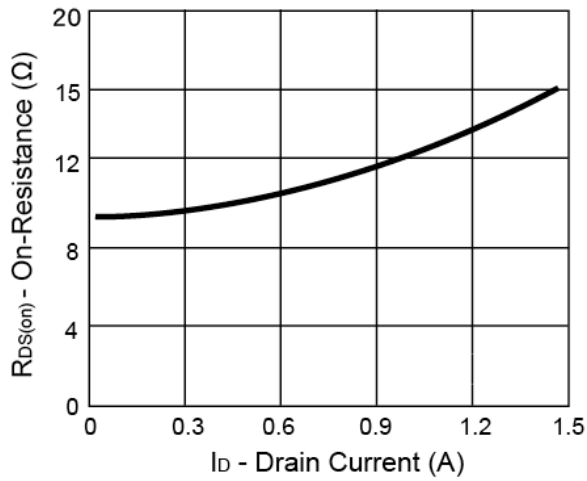
**Output Characteristics**



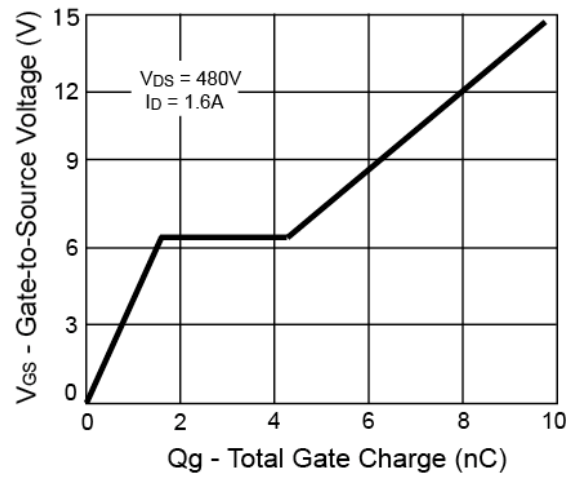
**Transfer Characteristics**



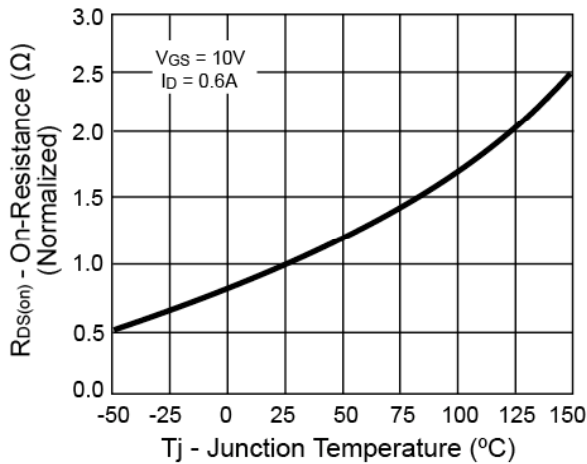
**On-Resistance vs. Drain Current**



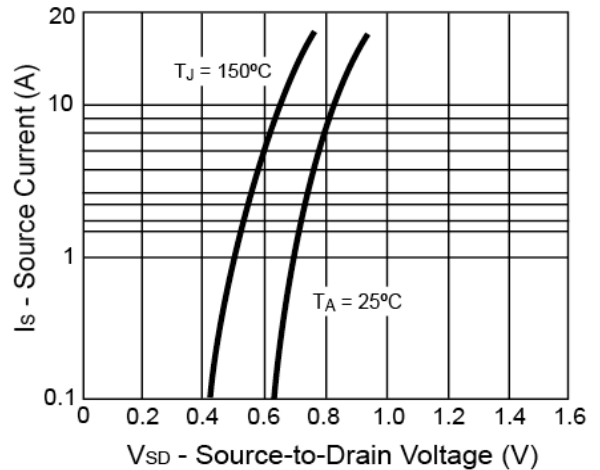
**Gate Charge**



**On-Resistance vs. Junction Temperature**

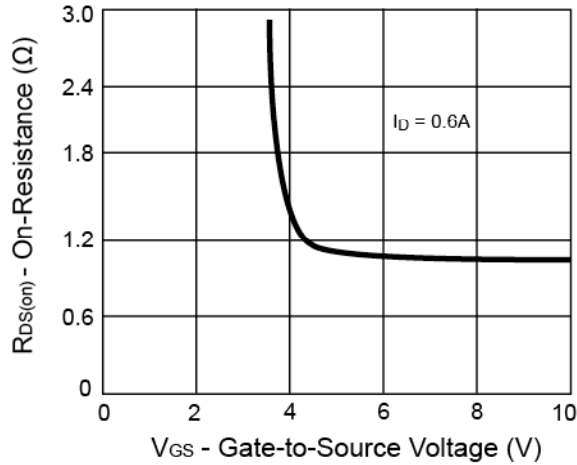


**Source-Drain Diode Forward Voltage**

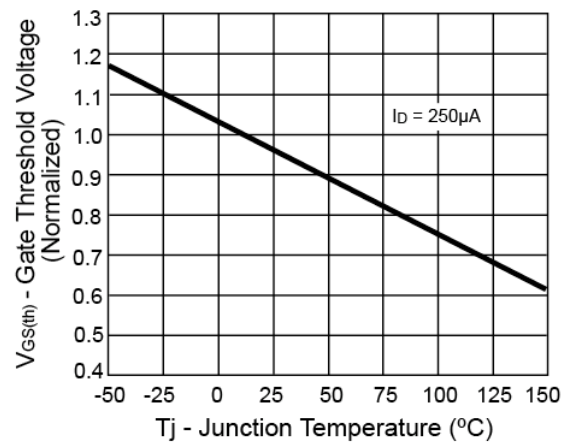


**Electrical Characteristics Curve** (Ta = 25°C, unless otherwise noted)

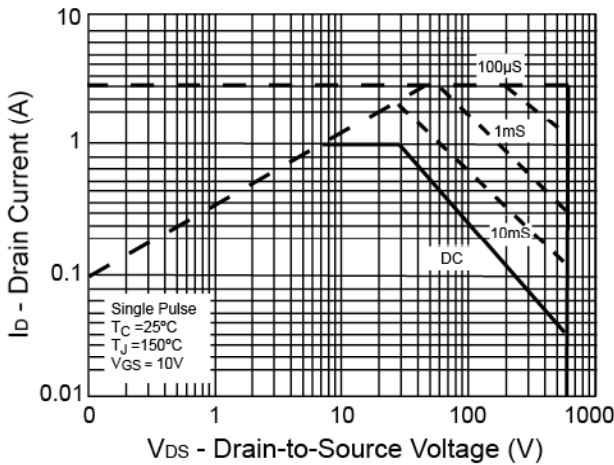
**On-Resistance vs. Gate-Source Voltage**



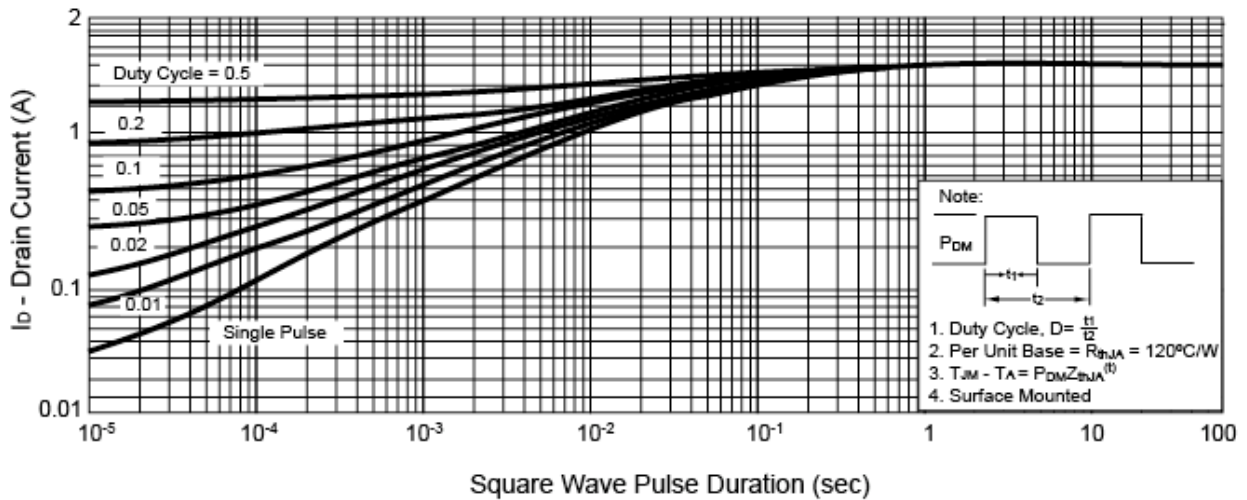
**Threshold Voltage**



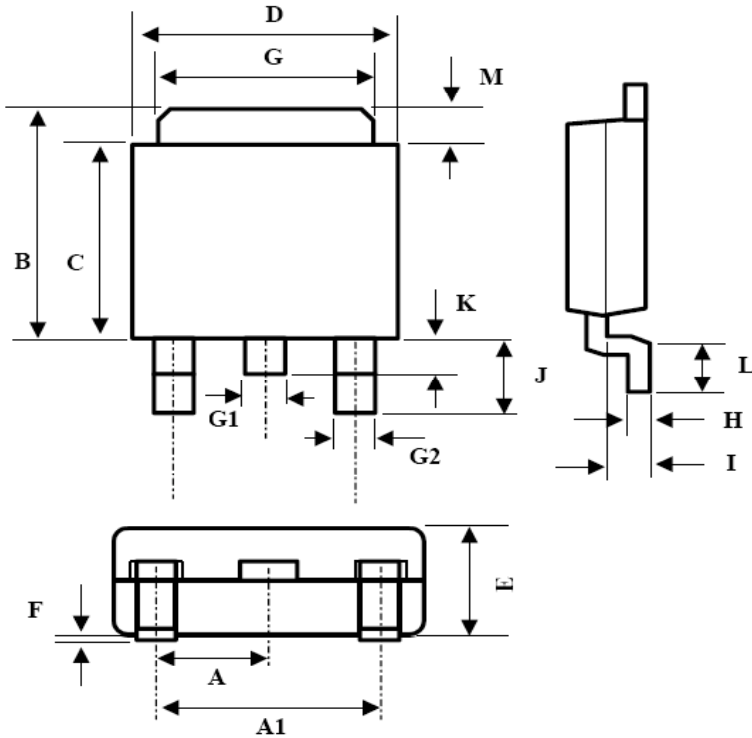
**Maximum Safe Operating Area**



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

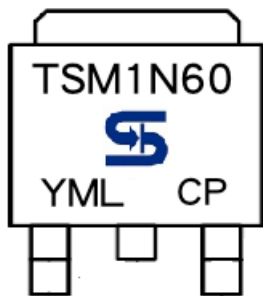


## SOT-252 Mechanical Drawing



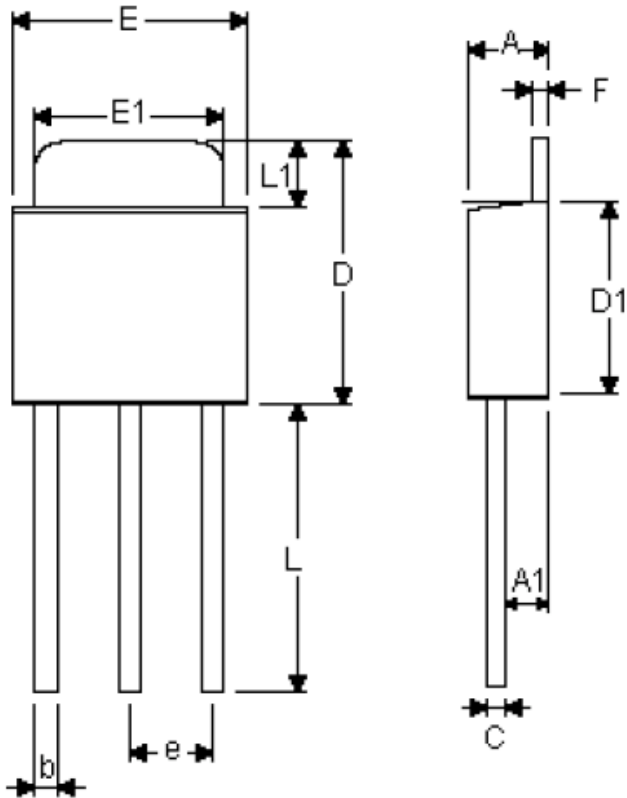
DIM	TO-252 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.3BSC		0.09BSC	
A1	4.6BSC		0.18BSC	
B	6.80	7.20	0.268	0.283
C	5.40	5.60	0.213	0.220
D	6.40	6.65	0.252	0.262
E	2.20	2.40	0.087	0.094
F	0.00	0.20	0.000	0.008
G	5.20	5.40	0.205	0.213
G1	0.75	0.85	0.030	0.033
G2	0.55	0.65	0.022	0.026
H	0.35	0.65	0.014	0.026
I	0.90	1.50	0.035	0.059
J	2.20	2.80	0.087	0.110
K	0.50	1.10	0.020	0.043
L	0.90	1.50	0.035	0.059
M	1.30	1.70	0.051	0.67

## Marking Diagram



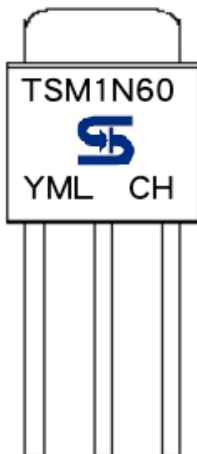
- Y = Year Code
- M = Month Code  
(A=Jan, B=Feb, C=Mar, D=Apr, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L = Lot Code

**SOT-251 Mechanical Drawing**



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.4	0.087	0.095
A1	1.10	1.30	0.043	0.051
b	0.40	0.80	0.016	0.032
C	0.40	0.60	0.016	0.024
D	6.70	7.30	0.264	0.287
D1	5.40	5.65	0.213	0.222
E	6.40	6.65	0.252	0.262
e	2.10	2.50	0.083	0.098
F	0.40	0.60	0.016	0.024
L	7.00	8.00	0.276	0.315
L1	1.60	1.86	0.063	0.073

**Marking Diagram**



- Y** = Year Code
- M** = Month Code  
(A=Jan, B=Feb, C=Mar, D=Apr, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code

### Notice

Specifications of the products displayed herein are subject to change without notice. TSC or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, to any intellectual property rights is granted by this document. Except as provided in TSC's terms and conditions of sale for such products, TSC assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of TSC products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify TSC for any damages resulting from such improper use or sale.