

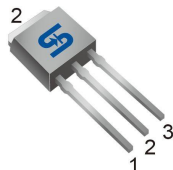
# TSM60N1R4

600V, 3.3A, 1.4  
N-Channel Power MOSFET

TO-252  
(DPAK)



TO-251  
(IPAK)



**Pin Definition:**

1. Gate
2. Drain
3. Source

**Key Parameter Performance**

Parameter	Value	Unit
$V_{DS}$	600	V
$R_{DS(on)}$ (max)	1.4	
$Q_g$	7.7	nC

**Features**

- Super-Junction technology
- High performance due to small figure-of-merit
- High ruggedness performance
- High commutation performance

**Application**

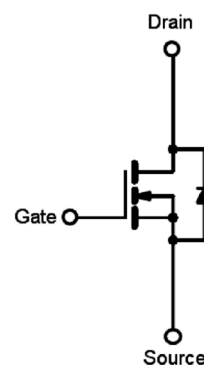
- Power Supply
- Lighting

**Ordering Information**

Part No.	Package	Packing
TSM60N1R4CH C5G	TO-251	75pcs / Tube
TSM60N1R4CP ROG	TO-252	2.5kpcs / 13+Reel

**Note:** %G+denotes for Halogen- and Antimony-free as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds

**Block Diagram**



N-Channel MOSFET

**Absolute Maximum Ratings** ( $T_C = 25^\circ\text{C}$  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 <sup>(Note 1)</sup>	$I_D$	3.3	A
Pulsed Drain Current <sup>(Note 2)</sup>			
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_{DTOT}$	38	W
Single Pulsed Avalanche Energy <sup>(Note 3)</sup>	$E_{AS}$	64	mJ
Single Pulsed Avalanche Current <sup>(Note 3)</sup>	$I_{AS}$	1.6	A
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	- 55 to +150	$^\circ\text{C}$

**Thermal Performance**

Parameter	Symbol	Limit	Unit
Junction to Case Thermal Resistance	$R_{JC}$	3.3	$^\circ\text{C/W}$
Junction to Ambient Thermal Resistance	$R_{JA}$	62	$^\circ\text{C/W}$

**Electrical Specifications** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

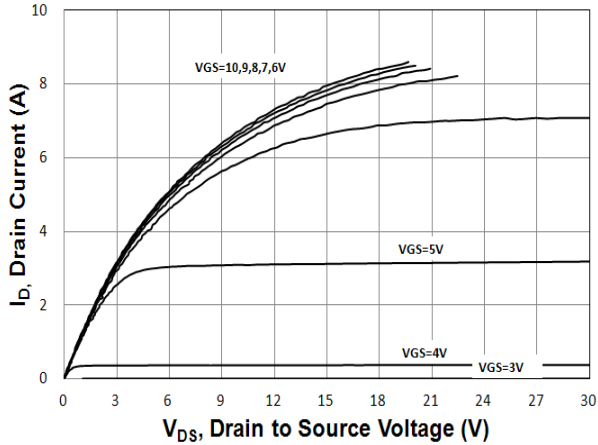
Parameter	Conditions	Symbol	Min	Typ	Max	Unit
<b>Static</b> (Note 4)						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	600	--	--	V
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	$V_{GS(TH)}$	2	3	4	V
Gate Body Leakage	$V_{GS} = \pm 30V, V_{DS} = 0V$	$I_{GSS}$	--	--	$\pm 100$	nA
Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	$I_{DSS}$	--	--	1	$\mu A$
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 2A$	$R_{DS(ON)}$	--	0.88	1.4	
<b>Dynamic</b> (Note 5)						
Total Gate Charge	$V_{DS} = 380V, I_D = 3.3A,$ $V_{GS} = 10V$	$Q_g$	--	7.7	--	nC
Gate-Source Charge		$Q_{gs}$	--	1.9	--	
Gate-Drain Charge		$Q_{gd}$	--	2.8	--	
Input Capacitance	$V_{DS} = 100V, V_{GS} = 0V,$ $f = 1.0MHz$	$C_{iss}$	--	370	--	pF
Output Capacitance		$C_{oss}$	--	34	--	
Gate Resistance	$f = 1MHz, \text{open drain}$	$R_g$	--	3.4	--	
<b>Switching</b> (Note 6)						
Turn-On Delay Time	$V_{DD} = 380V,$ $R_{GEN} = 25 \Omega,$ $I_D = 3.3A, V_{GS} = 10V,$	$t_{d(on)}$	--	14	--	ns
Turn-On Rise Time		$t_r$	--	22	--	
Turn-Off Delay Time		$t_{d(off)}$	--	24	--	
Turn-Off Fall Time		$t_f$	--	20	--	
<b>Source-Drain Diode</b> (Note 4)						
Forward On Voltage	$I_S = 3.3A, V_{GS} = 0V$	$V_{SD}$	--	--	1.4	V
Reverse Recovery Time	$V_R = 200V, I_S = 2A$ $di_f/dt = 100A/\mu s$	$t_{rr}$	--	163	--	ns
Reverse Recovery Charge		$Q_{rr}$	--	1	--	C

**Notes:**

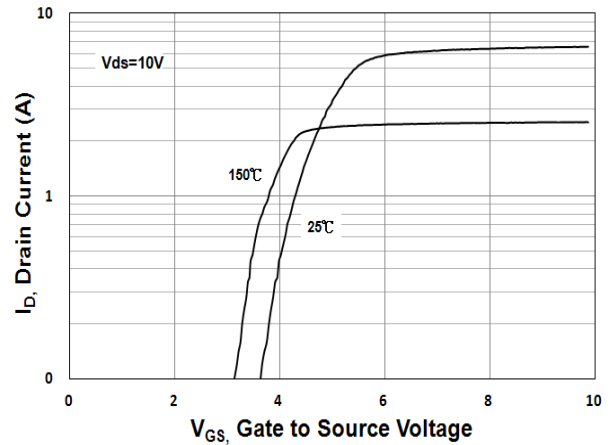
- Current limited by package
- Pulse width limited by the maximum junction temperature
- $L = 50mH, I_{AS} = 1.6A, V_{DD} = 50V, R_G = 25 \Omega$ , Starting  $T_J = 25^\circ\text{C}$
- Pulse test: PW  $300\mu s$ , duty cycle  $2\%$
- For DESIGN AID ONLY, not subject to production testing.
- Switching time is essentially independent of operating temperature.

## Electrical Characteristics Curves

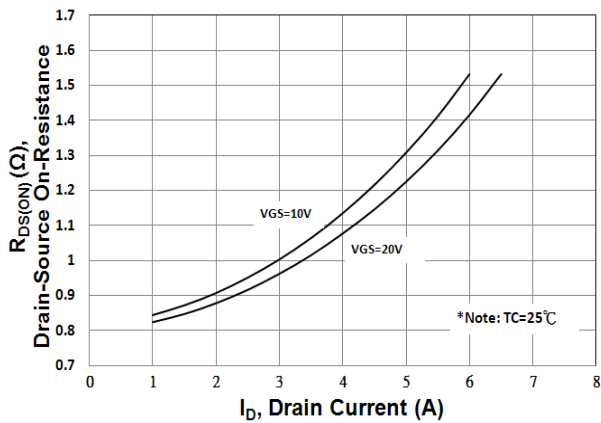
**Output Characteristics**



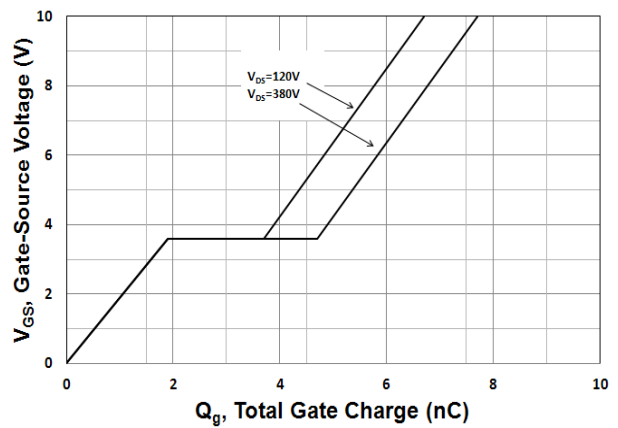
**Transfer Characteristics**



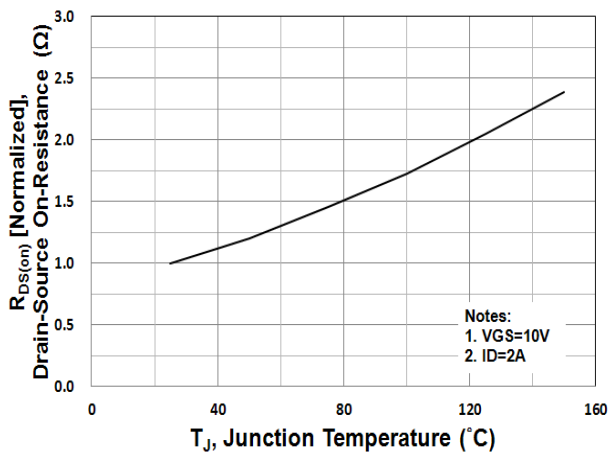
**On-Resistance vs. Drain Current**



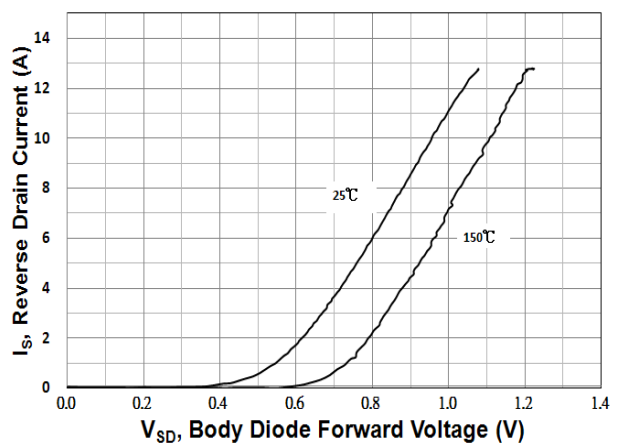
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**

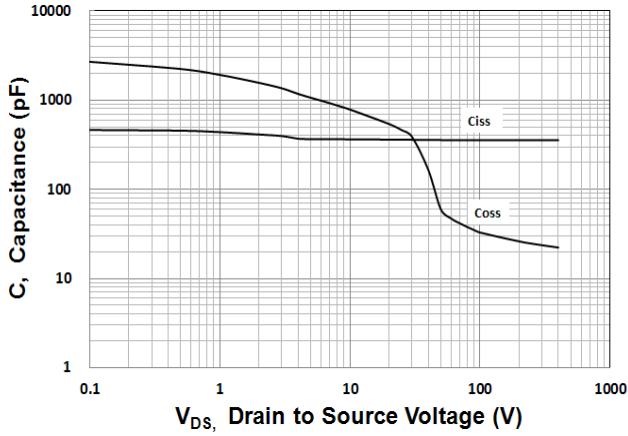


**Source-Drain Diode Forward Current vs. Voltage**

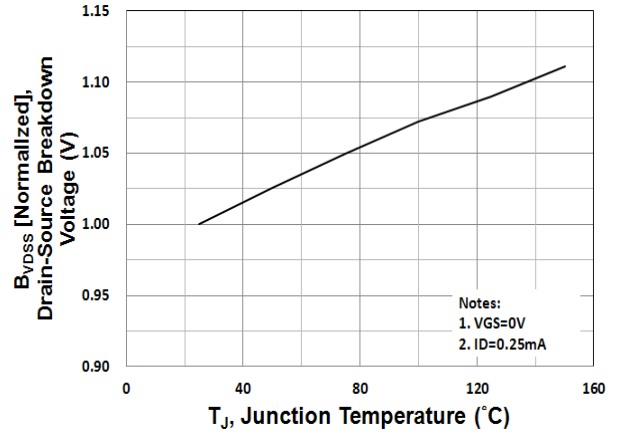


## Electrical Characteristics Curves

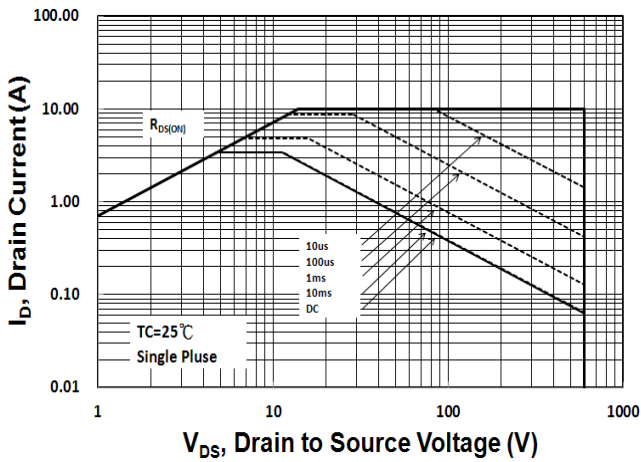
Capacitance vs. Drain-Source Voltage



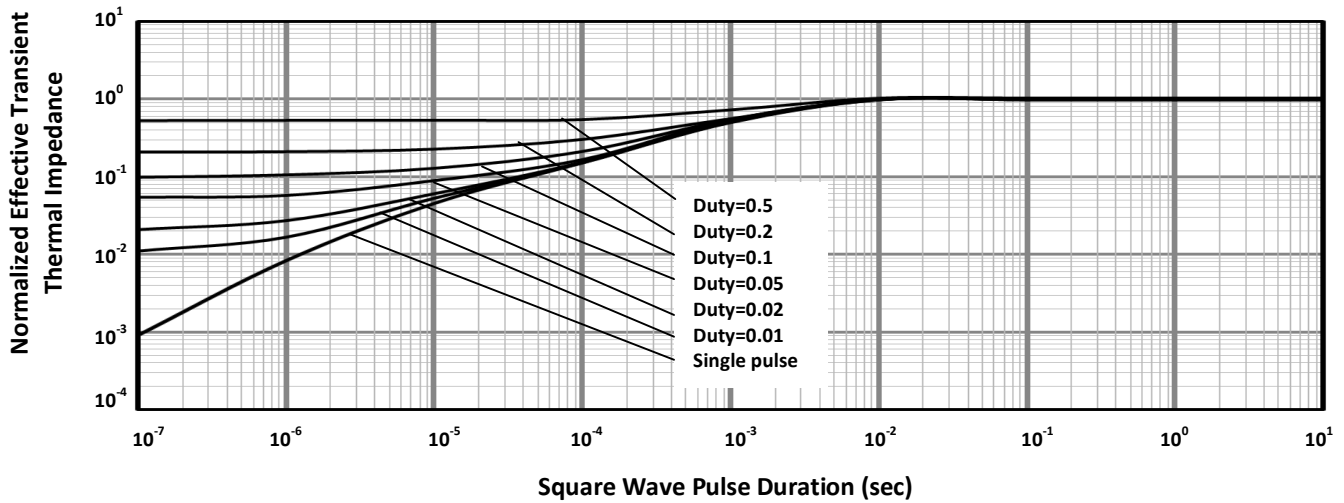
$BV_{DSS}$  vs. Junction Temperature



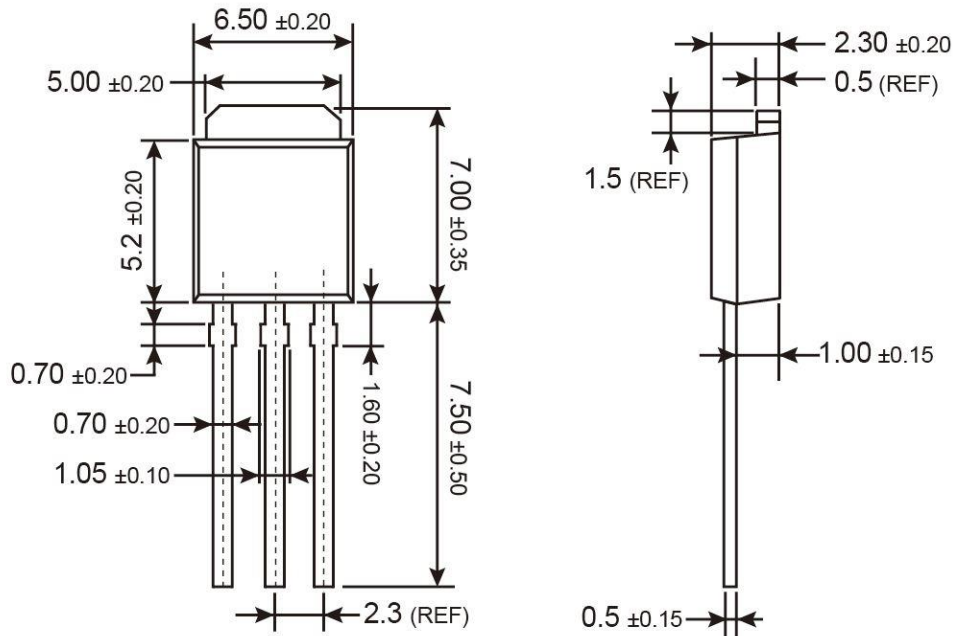
Maximum Safe Operating Area (DPAK/IPAK)



Normalized Thermal Transient Impedance, Junction-to-Case (DPAK/IPAK)

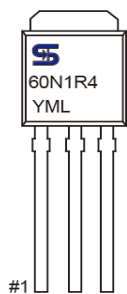


**TO-251 (IPAK) Mechanical Drawing**



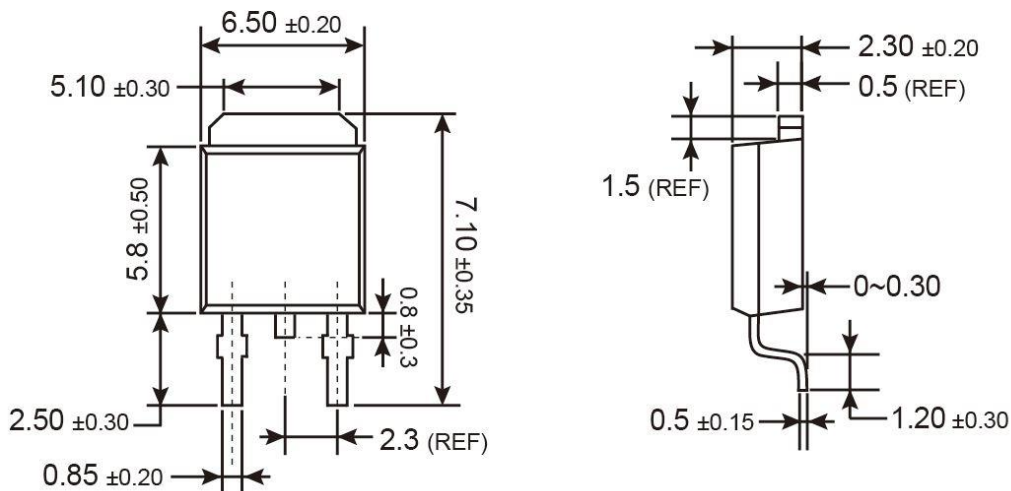
Unit: Millimeter

**Marking Diagram**



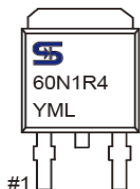
- Y** = Year Code
- M** = Month Code for Halogen Free Product  
(**O**=Jan, **P**=Feb, **Q**=Mar, **R**=Apr, **S**=May, **T**=Jun, **U**=Jul, **V**=Aug, **W**=Sep, **X**=Oct, **Y**=Nov, **Z**=Dec)
- L** = Lot Code

**TO-252 (DPAK) Mechanical Drawing**



Unit: Millimeters

**Marking Diagram**



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