

## N-Channel Power MOSFET

600V, 28A, 196mΩ

### FEATURES

- Super-Junction technology
- High performance, small  $R_{DS(on)} * Q_g$  figure of merit (FOM)
- High ruggedness performance
- 100% UIS &  $R_g$  tested
- High commutation performance
- ROHS Compliant
- Halogen-free according to IEC 61249-2-21

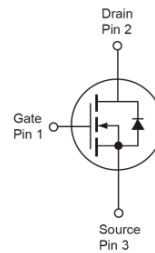
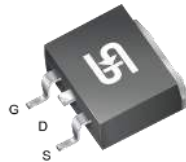
KEY PERFORMANCE PARAMETERS		
PARAMETER	VALUE	UNIT
$V_{DS}$	600	V
$R_{DS(on)}$ (max)	196	mΩ
$Q_g$	39	nC

### APPLICATIONS

- Power Supply
- AC/DC LED Lighting



TO-263-2L (D<sup>2</sup>PAK-2L)



**Note:** MSL 3 (Moisture Sensitivity Level) per J-STD-020

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	600	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current <sup>(Note 1)</sup>	$I_D$	$T_C = 25^\circ\text{C}$	28
		$T_C = 100^\circ\text{C}$	18
Pulsed Drain Current <sup>(Note 2)</sup>	$I_{DM}$	84	A
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	152	W
Single Pulse Avalanche Energy <sup>(Note 3)</sup>	$E_{AS}$	440	mJ
Single Pulse Avalanche Current <sup>(Note 3)</sup>	$I_{AS}$	4.2	A
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$

THERMAL PERFORMANCE			
PARAMETER	SYMBOL	MAXIMUM	UNIT
Junction to Case Thermal Resistance	$R_{\theta JC}$	0.82	$^\circ\text{C/W}$
Junction to Ambient Thermal Resistance	$R_{\theta JA}$	40	$^\circ\text{C/W}$

**Thermal Performance Note:**  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistances. The case-thermal reference is defined at the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.

<b>ELECTRICAL SPECIFICATIONS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted)						
PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{GS} = 0\text{V}, I_D = 1\text{mA}$	$BV_{DSS}$	600	--	--	V
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{mA}$	$V_{GS(TH)}$	3	4.2	5	V
Gate Body Leakage	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$	$I_{GSS}$	--	--	$\pm 100$	nA
Zero Gate Voltage Drain Current	$V_{DS} = 600\text{V}, V_{GS} = 0\text{V}$	$I_{DSS}$	--	--	1	$\mu\text{A}$
Drain-Source On-State Resistance (Note 4)	$V_{GS} = 10\text{V}, I_D = 9.5\text{A}$	$R_{DS(on)}$	--	182	196	m $\Omega$
<b>Dynamic</b> (Note 5)						
Total Gate Charge	$V_{DS} = 300\text{V}, I_D = 20\text{A},$ $V_{GS} = 10\text{V}$	$Q_g$	--	39	--	nC
Gate-Source Charge		$Q_{gs}$	--	12	--	
Gate-Drain Charge		$Q_{gd}$	--	17	--	
Input Capacitance	$V_{DS} = 300\text{V}, V_{GS} = 0\text{V},$ $f = 1.0\text{MHz}$	$C_{iss}$	--	1566	--	pF
Output Capacitance		$C_{oss}$	--	46	--	
Reverse Transfer Capacitance		$C_{rss}$	--	11	--	
Gate Resistance	$f = 1.0\text{MHz}$	$R_g$	--	2.3	4.6	$\Omega$
<b>Switching</b> (Note 6)						
Turn-On Delay Time	$V_{DD} = 300\text{V}, R_G = 10\Omega,$ $I_D = 10\text{A}, V_{GS} = 10\text{V},$	$t_{d(on)}$	--	32	--	ns
Turn-On Rise Time		$t_r$	--	31	--	
Turn-Off Delay Time		$t_{d(off)}$	--	55	--	
Turn-Off Fall Time		$t_f$	--	11	--	
<b>Source-Drain Diode</b>						
Body-Diode Continuous Forward Current		$I_S$	--	--	20	A
Body-Diode Pulsed Current		$I_{SM}$	--	--	60	A
Forward Voltage (Note 4)	$I_S = 20\text{A}, V_{GS} = 0\text{V}$	$V_{SD}$	--	--	1.5	V
Reverse Recovery Time	$I_S = 20\text{A}$ $di_F/dt = 100\text{A}/\mu\text{s}$	$t_{rr}$	--	420	--	ns
Reverse Recovery Charge		$Q_{rr}$	--	8.4	--	$\mu\text{C}$

**Notes:**

1. Current limited by package.
2. Pulse width limited by the maximum junction temperature.
3.  $L = 50\text{mH}, I_{AS} = 4.2\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega,$  Starting  $T_J = 25^\circ\text{C}$
4. Pulse test:  $PW \leq 300\mu\text{s},$  duty cycle  $\leq 2\%$ .
5. For DESIGN AID ONLY, not subject to production testing.
6. Switching time is essentially independent of operating temperature.

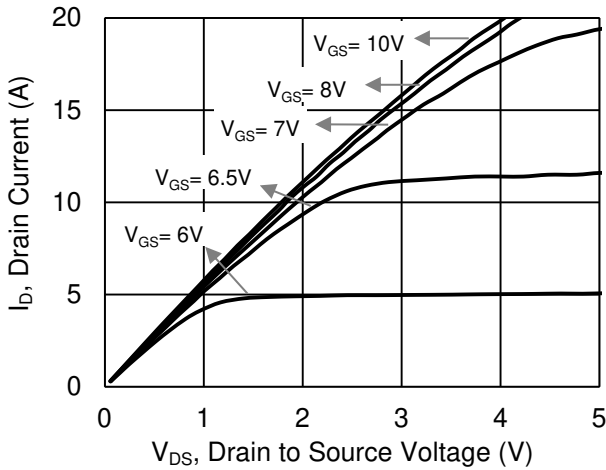
**ORDERING INFORMATION**

ORDERING CODE	PACKAGE	PACKING
TSM60NC196CM2 RNG	TO-263-2L (D <sup>2</sup> PAK-2L )	800pcs / 13" Reel

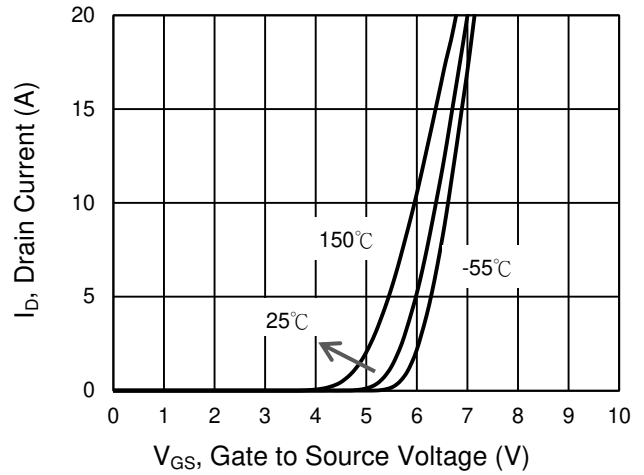
**CHARACTERISTICS CURVES**

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

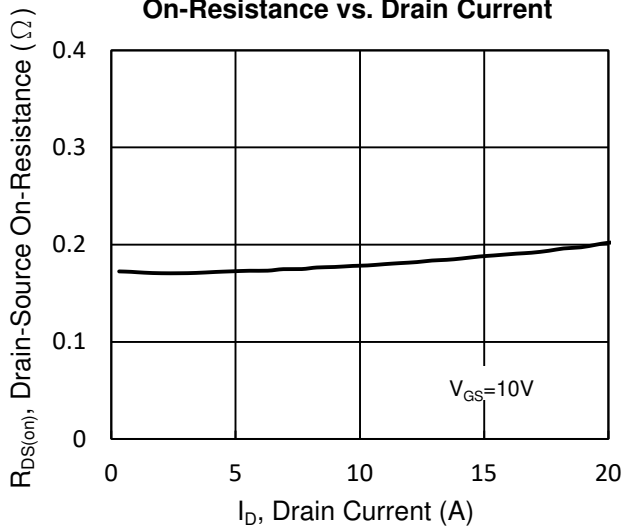
**Output Characteristics**



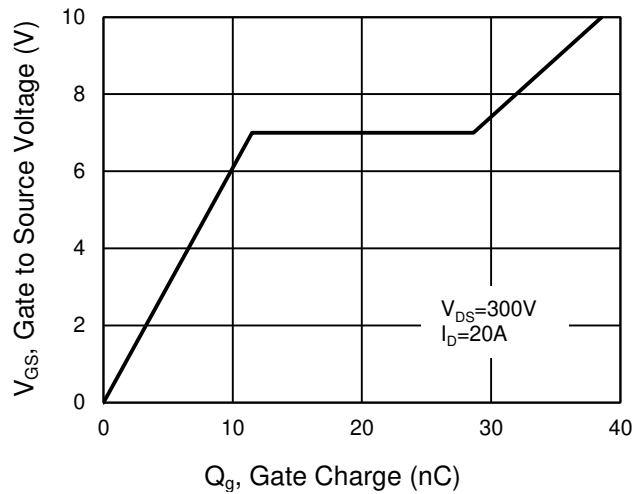
**Transfer Characteristics**



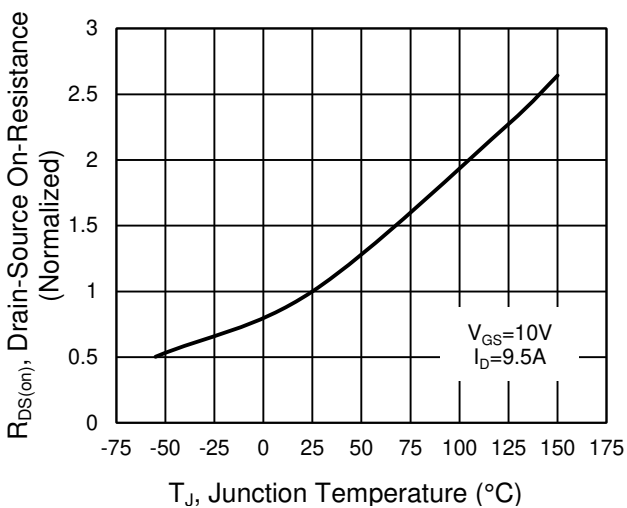
**On-Resistance vs. Drain Current**



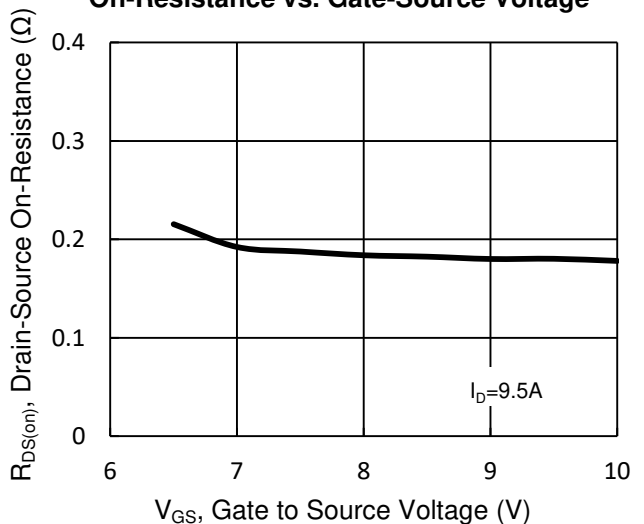
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**



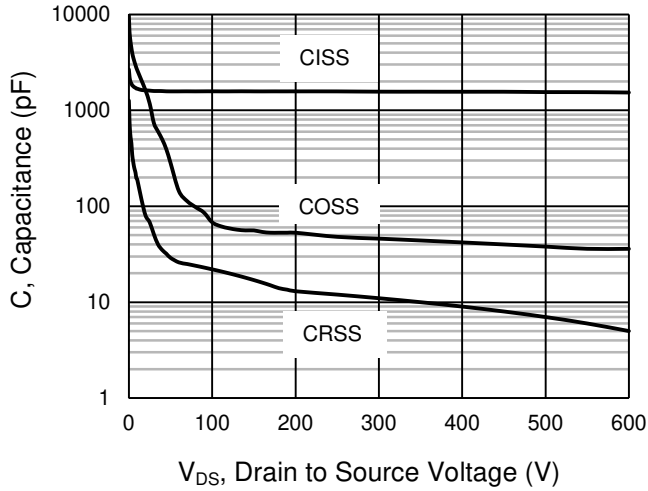
**On-Resistance vs. Gate-Source Voltage**



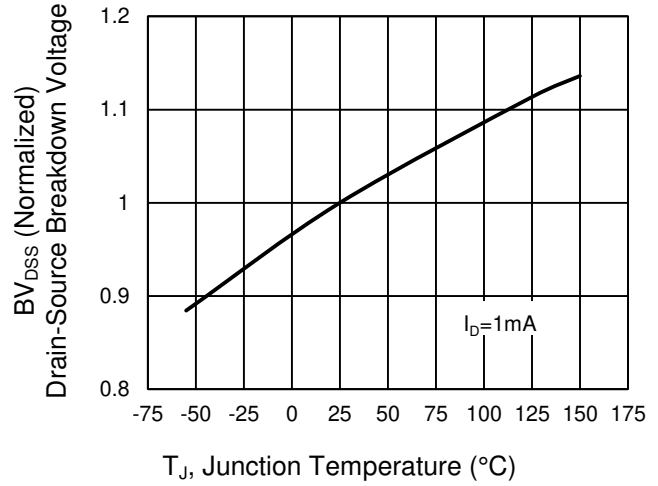
**CHARACTERISTICS CURVES**

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

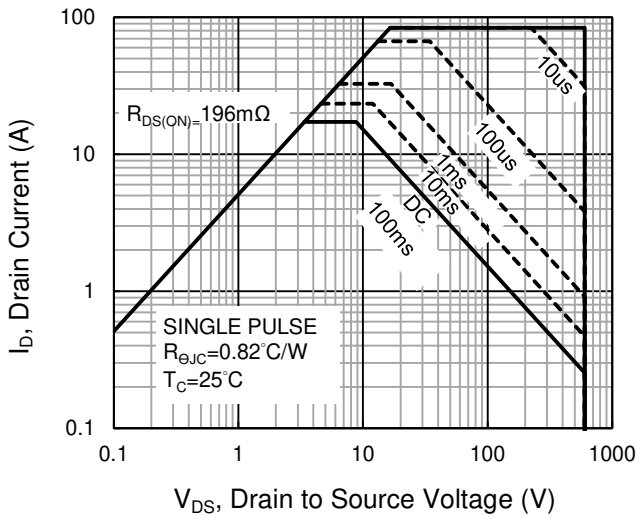
**Capacitance vs. Drain-Source Voltage**



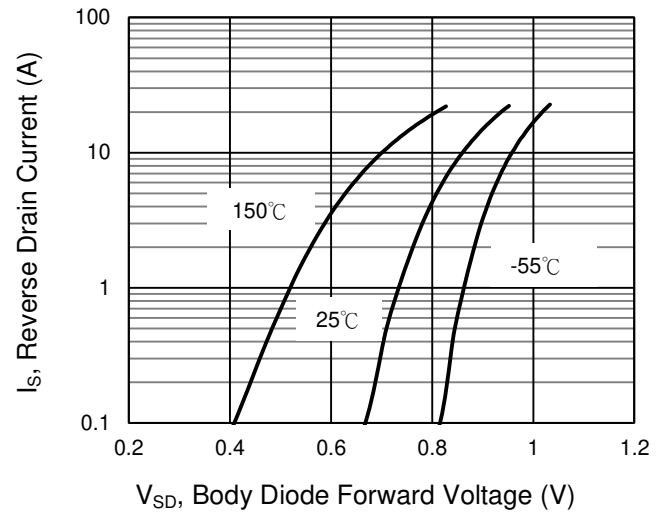
**$BV_{DSS}$  vs. Junction Temperature**



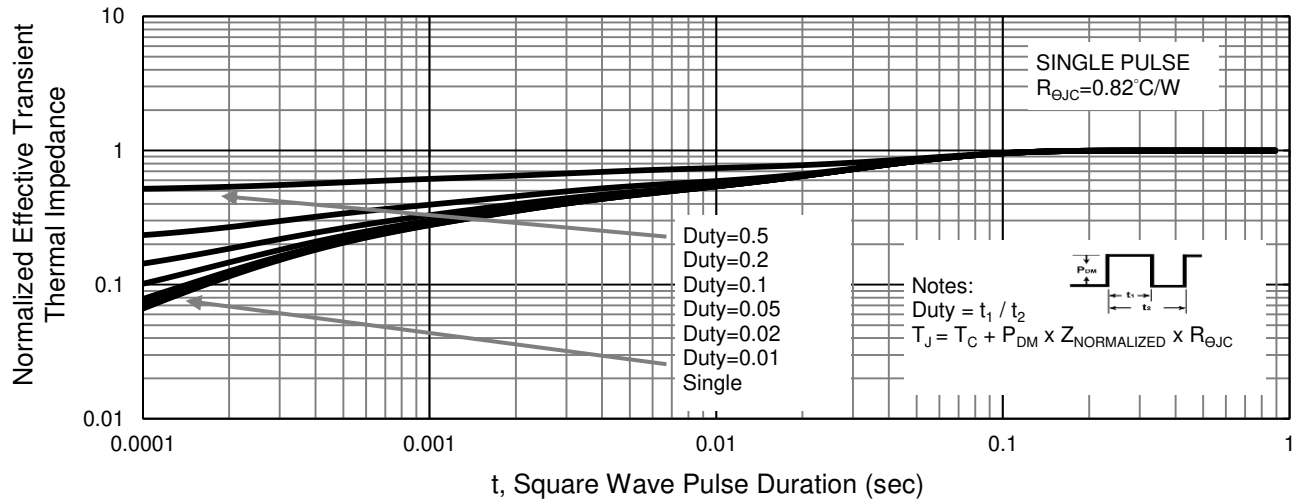
**Maximum Safe Operating Area, Junction-to-Case**



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

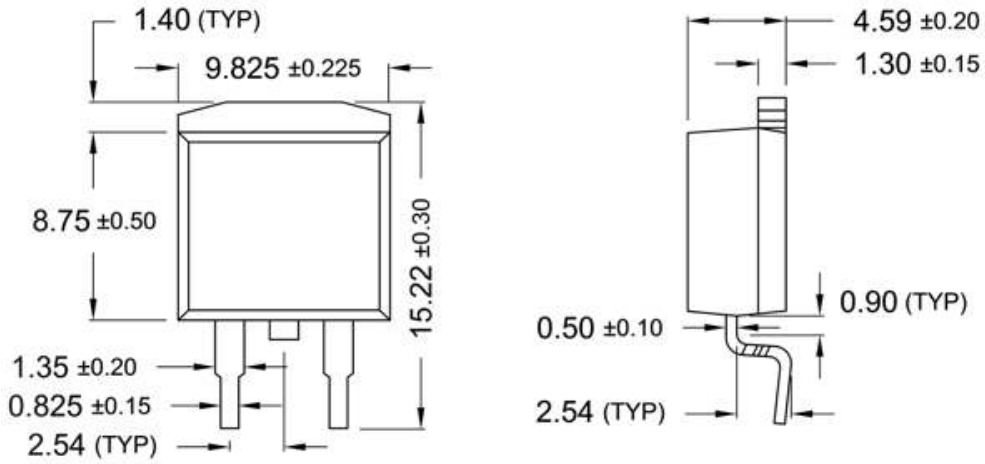


**Normalized Thermal Transient Impedance, Junction-to-Case**

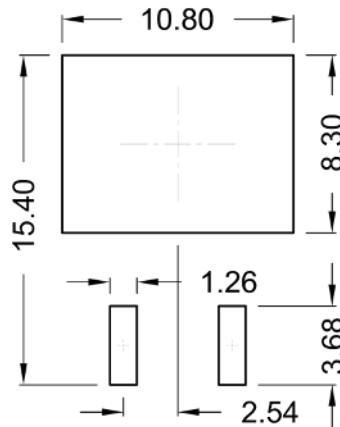


**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

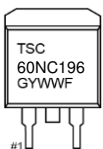
**TO-263**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



- G** = Halogen Free
- Y** = Year Code
- WW** = Week Code (01~52)
- F** = Factory Code

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