



# TM60N02D

# N-Channel Enhancement Mosfet

### General Description

- Low  $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

### Applications

- Load switch
- PWM

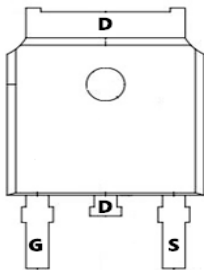
### General Features

$V_{DS} = 20V$   $I_D = 60A$

$R_{DS(ON)} = 4.9m\Omega$  (typ.) @  $V_{GS} = 4.5V$

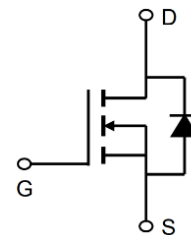
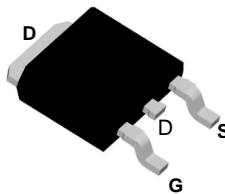
100% UIS Tested

100%  $R_g$  Tested



Marking: 60N02

D:TO-252-3L



### Absolute Maximum Ratings ( $T_A = 25^\circ C$ Unless Otherwise Noted)

Symbol	Parameter	Rating	Units
$V_{DS}$	Drain-Source Voltage	20	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V^1$	60	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V^1$	35	A
$I_{DM}$	Pulsed Drain Current <sup>2</sup>	240	A
EAS	Single Pulse Avalanche Energy <sup>3</sup>	48	mJ
$I_{AS}$	Avalanche Current	31	A
$P_D @ T_C = 25^\circ C$	Total Power Dissipation <sup>4</sup>	38	W
$T_{STG}$	Storage Temperature Range	-55 to 150	$^\circ C$
$T_J$	Operating Junction Temperature Range	-55 to 150	$^\circ C$

### Thermal Data

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$	Thermal Resistance Junction Case <sup>1</sup>		4.2	$^\circ C/W$



**TM60N02D**

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**Electrical Characteristics** ( $T_J=25^{\circ}\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
<b>Off Characteristic</b>						
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	20	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=20V, V_{GS}=0V,$	-	-	1.0	$\mu A$
$I_{GSS}$	Gate to Body Leakage Current	$V_{DS}=0V, V_{GS}=\pm 12V$	-	-	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	0.4	0.7	1.0	V
$R_{DS(on)}$	Static Drain-Source on-Resistance <small>note3</small>	$V_{GS}=4.5V, I_D=25A$	-	4.9	6.0	m $\Omega$
		$V_{GS}=2.5V, I_D=15A$	-	6.0	7.2	
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS}=10V, V_{GS}=0V,$ $f=1.0MHz$	-	1832	-	pF
$C_{oss}$	Output Capacitance		-	289	-	pF
$C_{rss}$	Reverse Transfer Capacitance		-	271	-	pF
$Q_g$	Total Gate Charge	$V_{DS}=10V, I_D=25A,$ $V_{GS}=4.5V$	-	23	-	nC
$Q_{gs}$	Gate-Source Charge		-	4.5	-	nC
$Q_{gd}$	Gate-Drain("Miller") Charge		-	7.3	-	nC
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-on Delay Time	$V_{DS}=10V,$ $I_D=25A, R_{GEN}=3\Omega,$ $V_{GS}=4.5V$	-	15	-	ns
$t_r$	Turn-on Rise Time		-	37	-	ns
$t_{d(off)}$	Turn-off Delay Time		-	52	-	ns
$t_f$	Turn-off Fall Time		-	21	-	ns
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain to Source Diode Forward Current		-	-	60	A
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current		-	-	240	A
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS}=0V, I_S=30A$	-	-	1.2	V
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=25A, dI/dt=100A/\mu s$	-	25	-	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge		-	21	-	nC

- Notes: 1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature  
 2. EAS condition:  $T_J=25^{\circ}\text{C}, V_{DD}=10V, V_G=4.5V, L=0.5mH, R_G=25\Omega, I_{AS}=13.8A$   
 3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 0.5\%$

## Typical Performance Characteristics

Figure 1: Output Characteristics

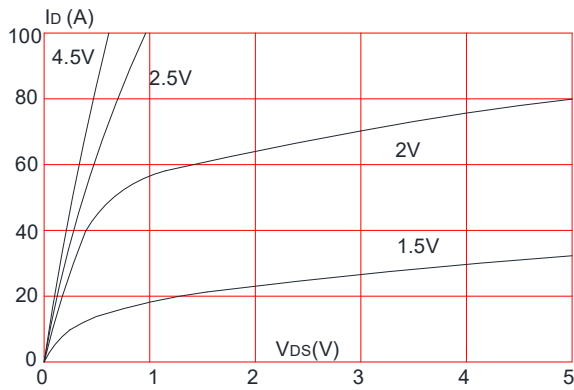


Figure 2: Typical Transfer Characteristics

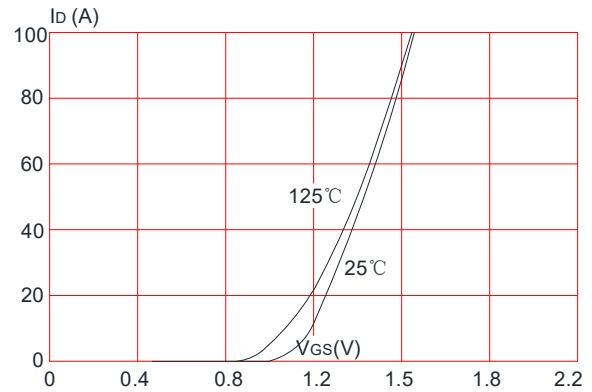


Figure 3: On-resistance vs. Drain Current

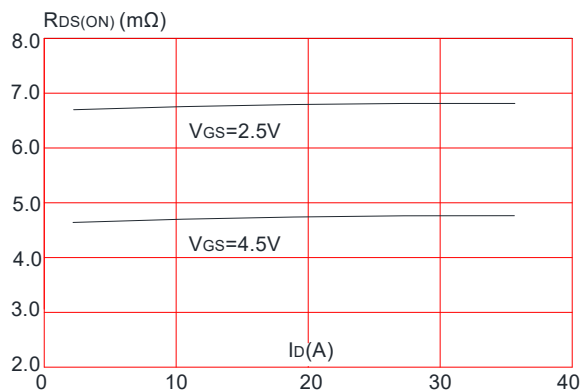


Figure 4: Body Diode Characteristics

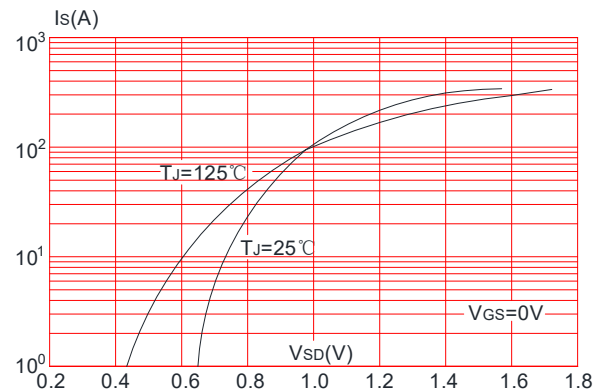


Figure 5: Gate Charge Characteristics

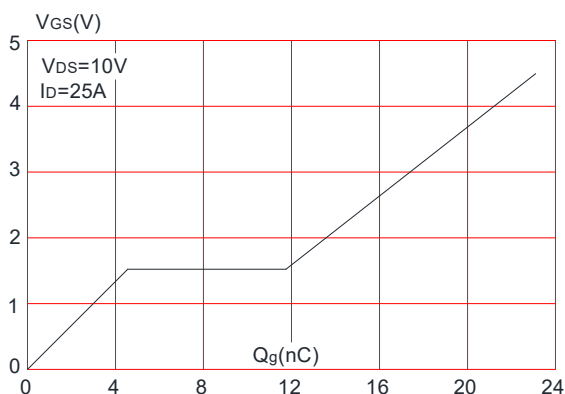
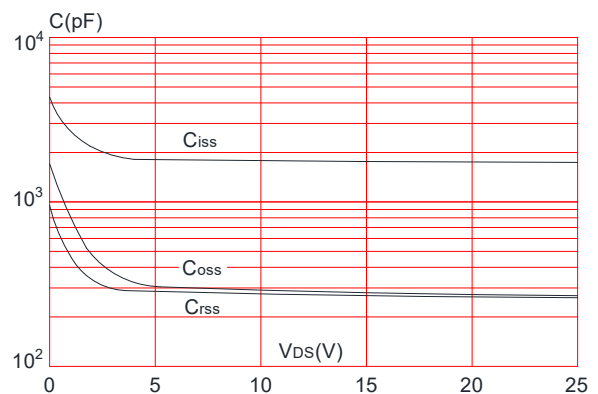


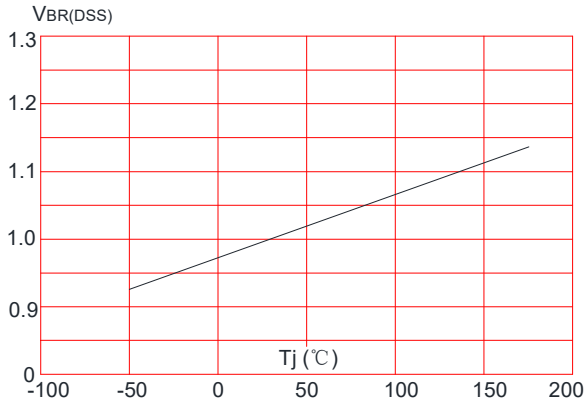
Figure 6: Capacitance Characteristics



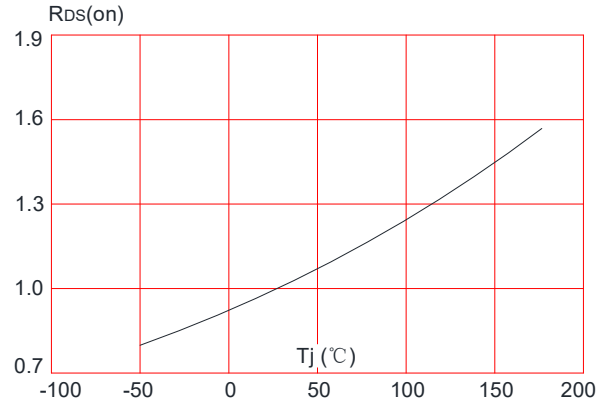
**TM60N02D**

**N-Channel Enhancement Mosfet**

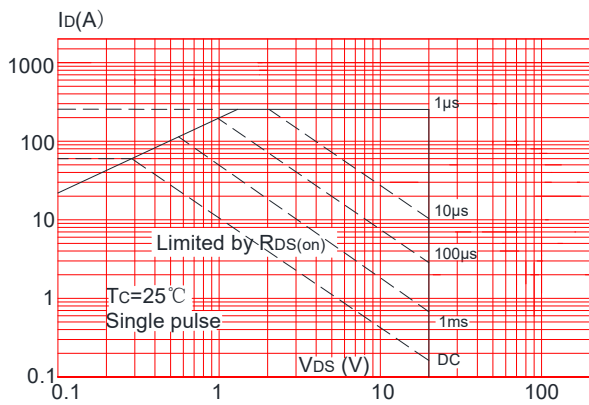
**Figure 7: Normalized Breakdown Voltage vs. Junction Temperature**



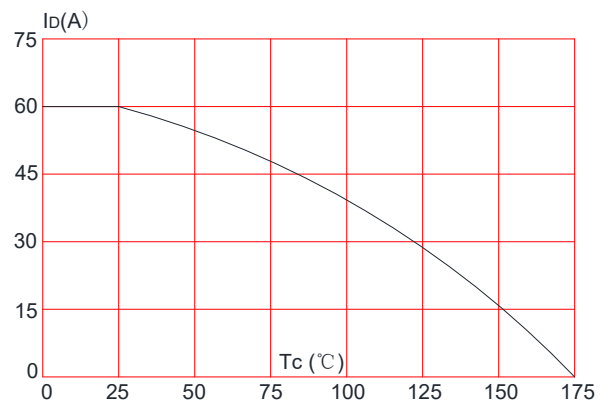
**Figure 8: Normalized on Resistance vs. Junction Temperature**



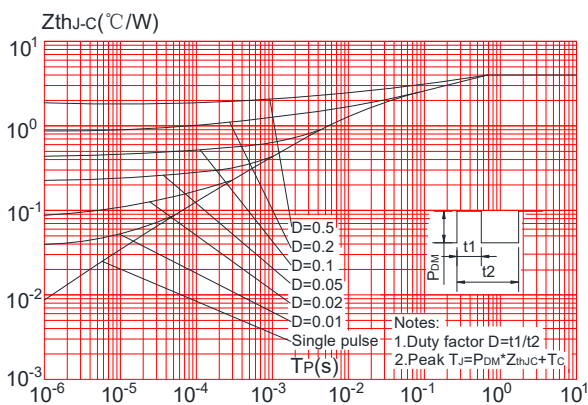
**Figure 9: Maximum Safe Operating Area**



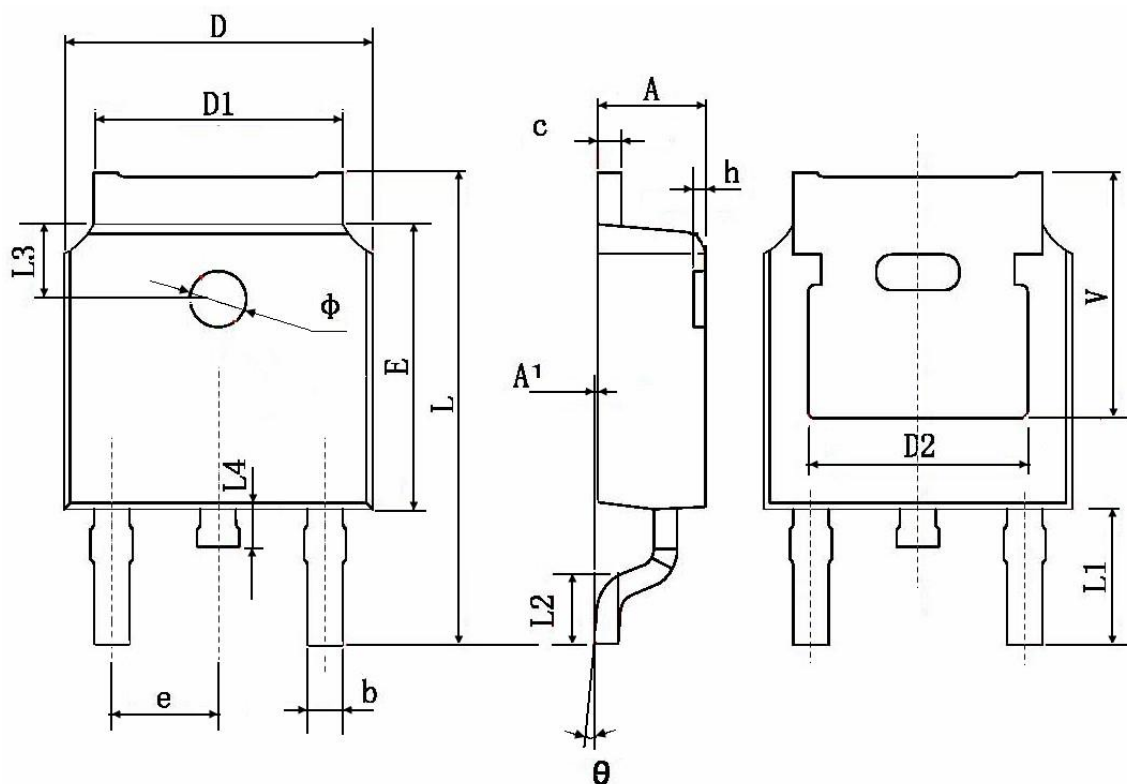
**Figure 10: Maximum Continuous Drain Current vs. Case Temperature**



**Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Case**



### Package Information:TO-252-3L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	4.830 TYP.		0.190 TYP.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 TYP.		0.114 TYP.	
L2	1.400	1.700	0.055	0.067
L3	1.600 TYP.		0.063 TYP.	
L4	0.600	1.000	0.024	0.039
phi	1.100	1.300	0.043	0.051
theta	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
v	5.350 TYP.		0.211 TYP.	

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