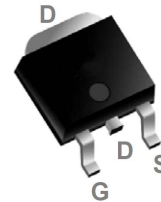


## Features

- 60V/28A,  
 $R_{DS(ON)} = 28m\Omega$  (TYP.) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 38m\Omega$  (TYP.) @  $V_{GS} = 5V$
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)
- 100% UIS +  $R_g$  Tested

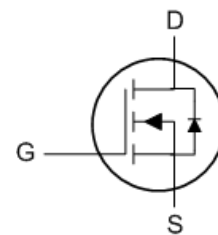
## Pin Configuration



Top View of TO-252-2

## Applications

- Switching Application for Actuator.
- Converter Application in LED TV.
- Switching Application in Industry.



N-Channel MOSFET

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

Symbol	Parameter	Rating	Unit
<b>Common Ratings</b>			
$V_{DSS}$	Drain-Source Voltage	60	V
$V_{GSS}$	Gate-Source Voltage	$\pm 20$	
$T_J$	Maximum Junction Temperature	175	$^\circ C$
$T_{STG}$	Storage Temperature Range	-55 to 175	$^\circ C$
$I_S$	Diode Continuous Forward Current	$T_C=25^\circ C$ 12	A
$I_{DP}$	Pulse Drain Current Tested	$T_C=25^\circ C$ 96	A
		$T_C=100^\circ C$ 68	
$I_D$	Continuous Drain Current	$T_C=25^\circ C$ 28	A
		$T_C=100^\circ C$ 17	
$P_D$	Maximum Power Dissipation	$T_C=25^\circ C$ 60	W
		$T_C=100^\circ C$ 30	
$R_{\theta JC}$	Thermal Resistance-Junction to Case	2.5	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	50	$^\circ C/W$
$E_{AS}$	Drain-Source Avalanche Energy	$L=0.5mH$ 22	mJ

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

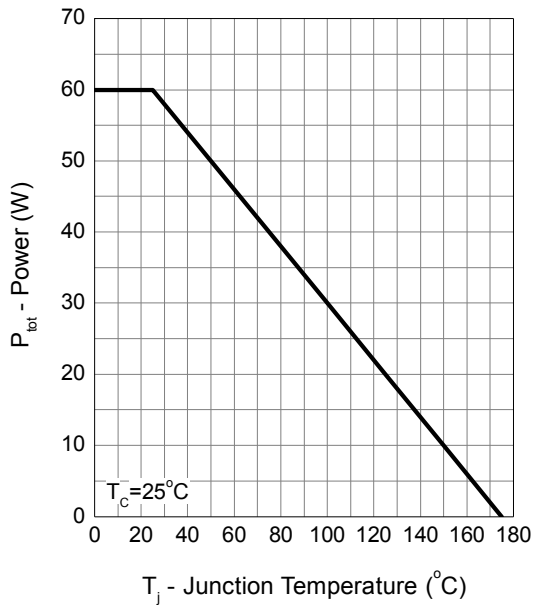
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_{DS}=250\mu A$	60	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=48V, V_{GS}=0V$	-	-	1	$\mu A$
		$T_J=125^\circ\text{C}$	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu A$	1	2	3	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 16V, V_{DS}=0V$	-	-	$\pm 10$	$\mu A$
$R_{DS(ON)}^a$	Drain-Source On-state Resistance	$V_{GS}=10V, I_{DS}=12A$	-	28	40	m $\Omega$
		$V_{GS}=5V, I_{DS}=11A$	-	38	50	
<b>Diode Characteristics</b>						
$V_{SD}^a$	Diode Forward Voltage	$I_{SD}=12A, V_{GS}=0V$	-	0.8	1.3	V
$t_{rr}$	Reverse Recovery Time	$I_{DS}=12A, di_{SD}/dt=100A/\mu s$	-	30	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	35	-	nC
<b>Dynamic Characteristics<sup>b</sup></b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=30V,$ Frequency=1.0MHz	-	530	-	pF
$C_{oss}$	Output Capacitance		-	85	-	
$C_{rss}$	Reverse Transfer Capacitance		-	40	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=30V, R_L=30\Omega,$ $I_{DS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$	-	8	15	ns
$T_r$	Turn-on Rise Time		-	8	15	
$t_{d(OFF)}$	Turn-off Delay Time		-	28	51	
$T_f$	Turn-off Fall Time		-	22	41	
<b>Gate Charge Characteristics<sup>b</sup></b>						
$Q_g$	Total Gate Charge	$V_{DS}=30V, V_{GS}=10V,$ $I_{DS}=12A$	-	12	17	nC
$Q_{gs}$	Gate-Source Charge		-	3	-	
$Q_{gd}$	Gate-Drain Charge		-	3	-	

Note a : Pulse test ; pulse width $\leq 300\mu s$ , duty cycle $\leq 2\%$ .

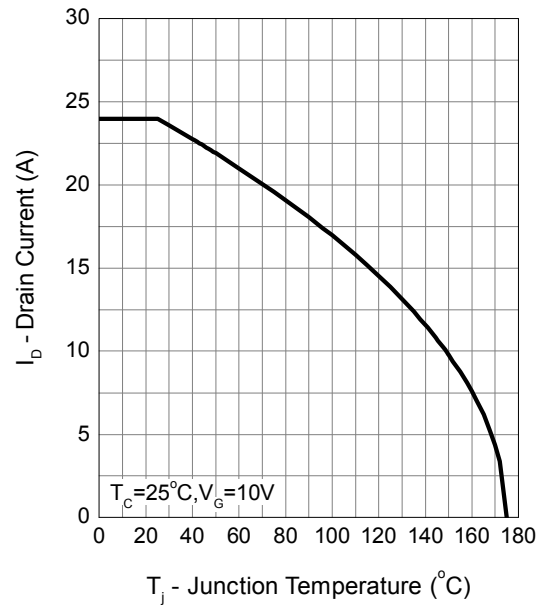
Note b : Guaranteed by design, not subject to production testing.

## Typical Operating Characteristics

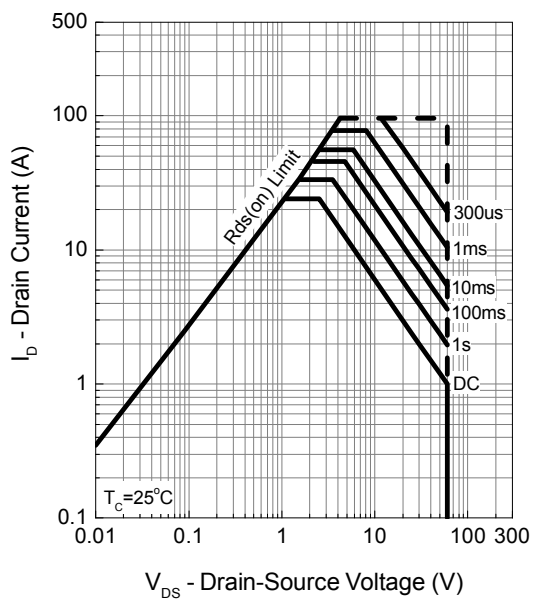
**Power Dissipation**



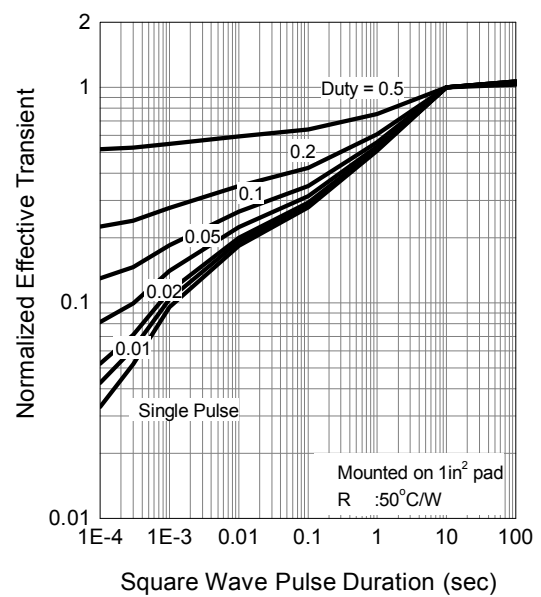
**Drain Current**



**Safe Operation Area**

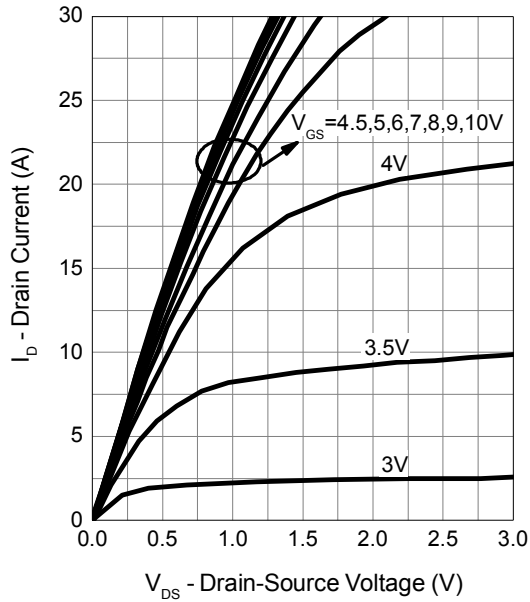


**Thermal Transient Impedance**

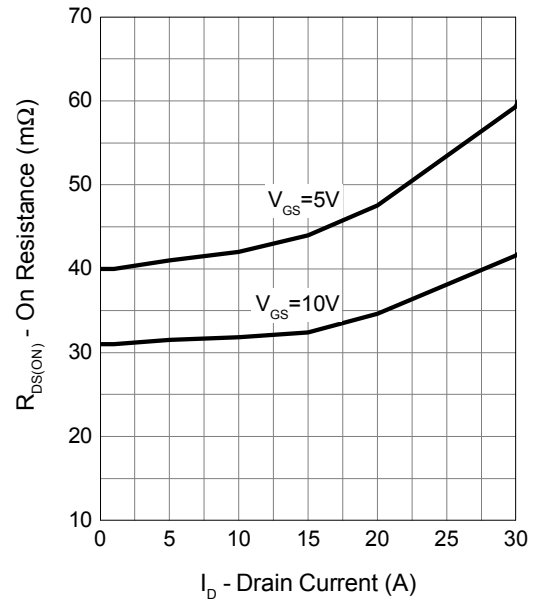


### Typical Operating Characteristics (Cont.)

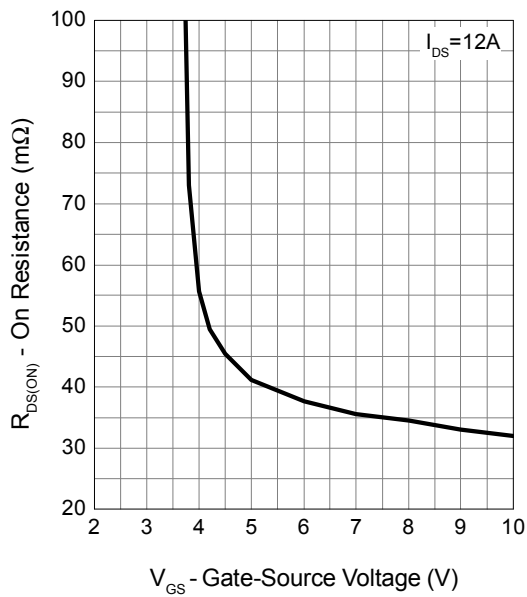
**Output Characteristics**



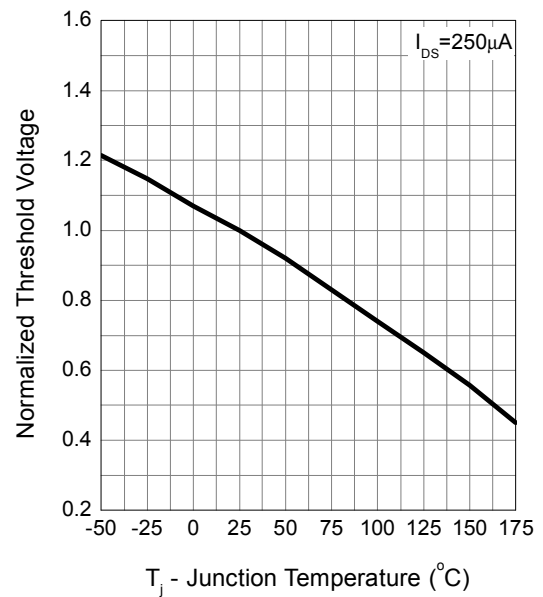
**Drain-Source On Resistance**



**Gate-Source On Resistance**

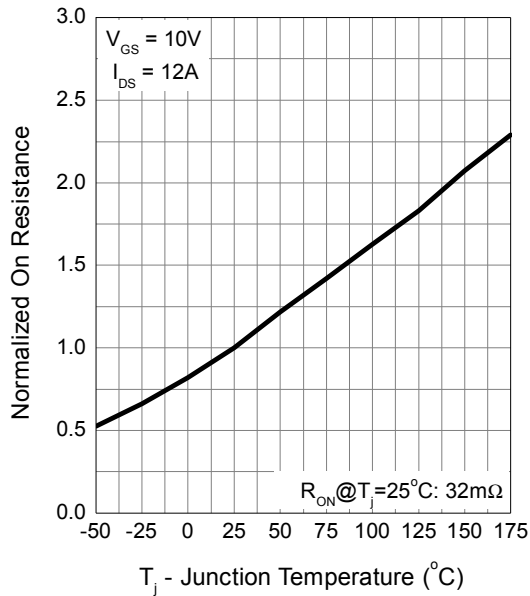


**Gate Threshold Voltage**

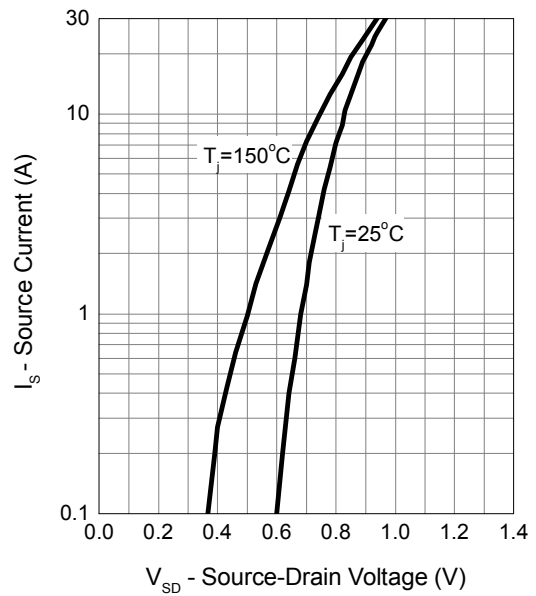


**Typical Operating Characteristics (Cont.)**

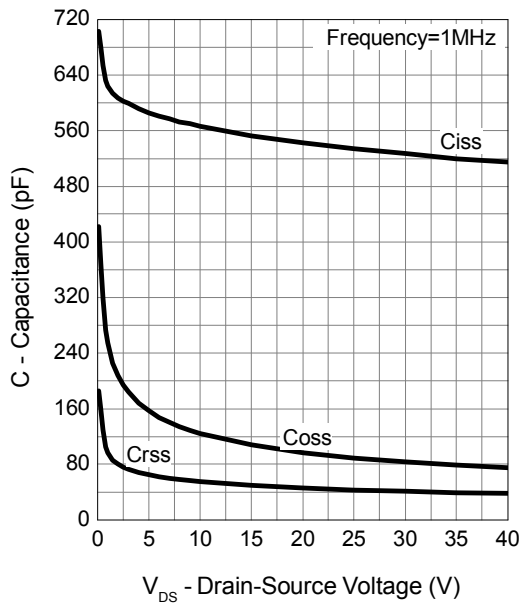
**Drain-Source On Resistance**



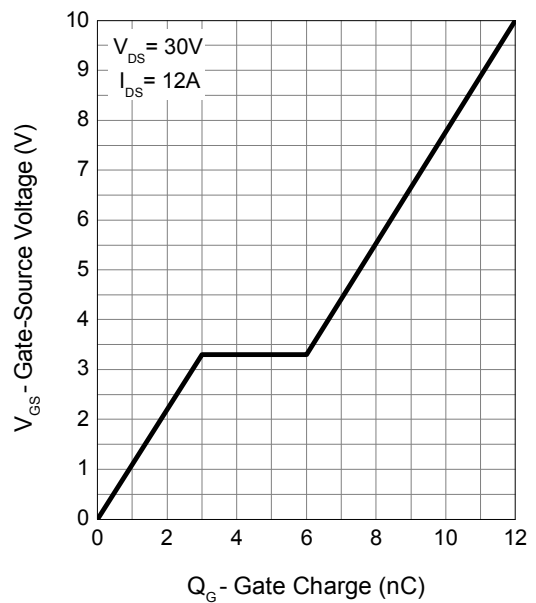
**Source-Drain Diode Forward**



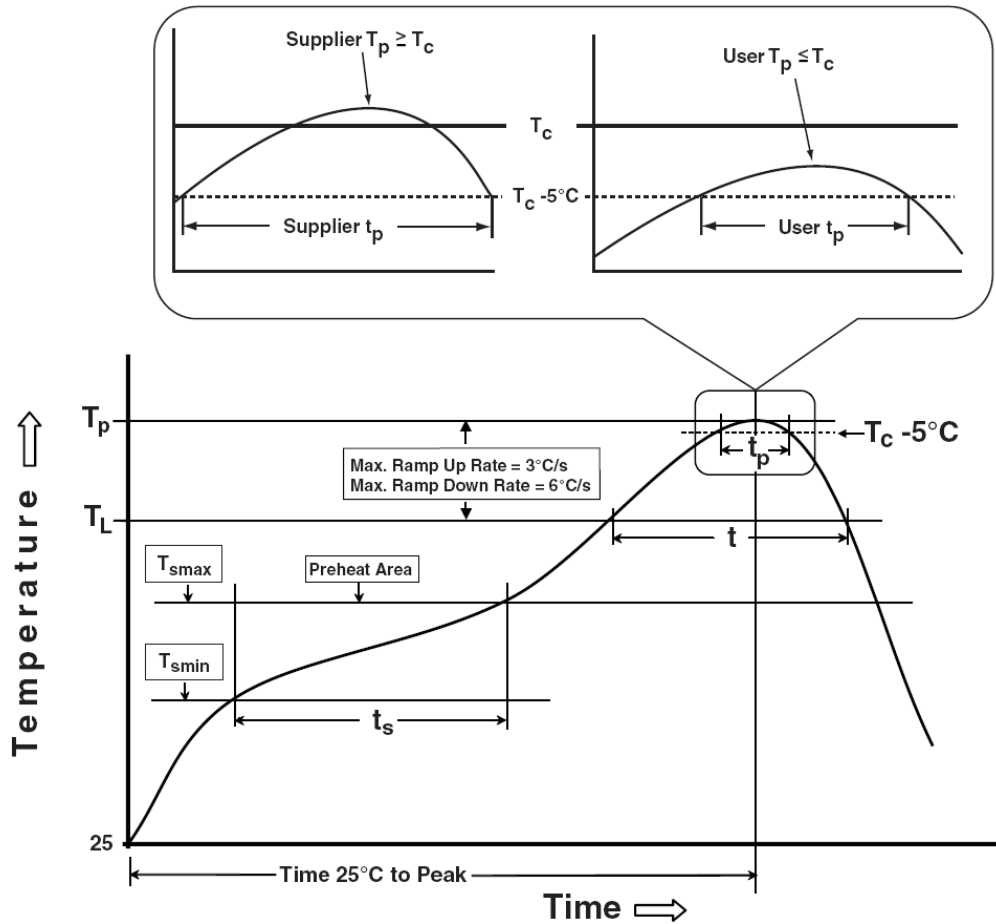
**Capacitance**



**Gate Charge**



### Classification Profile



## Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat &amp; Soak</b>		
Temperature min ( $T_{smin}$ )	100 °C	150 °C
Temperature max ( $T_{smax}$ )	150 °C	200 °C
Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )	60-120 seconds	60-120 seconds
Average ramp-up rate ( $T_{smax}$ to $T_P$ )	3 °C/second max.	3°C/second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time at liquidous ( $t_L$ )	60-150 seconds	60-150 seconds
Peak package body Temperature ( $T_P$ )*	See Classification Temp in table 1	See Classification Temp in table 2
Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_c$ )	20** seconds	30** seconds
Average ramp-down rate ( $T_P$ to $T_{smax}$ )	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum.		

Table 1. SnPb Eutectic Process – Classification Temperatures ( $T_c$ )

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures ( $T_c$ )

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

## Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HTRB	JESD-22, A108	1000 Hrs, 80% of VDS max @ Tjmax
HTGB	JESD-22, A108	1000 Hrs, 100% of VGS max @ Tjmax
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C

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