

## HD60N03 / HU60N03

### 30V N-Channel MOSFET

#### FEATURES

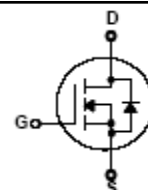
- Originative New Design
- Superior Avalanche Rugged Technology
- Robust Gate Oxide Technology
- Very Low Intrinsic Capacitances
- Excellent Switching Characteristics
- Unrivalled Gate Charge : 18.5 nC (Typ.)
- Extended Safe Operating Area
- Lower  $R_{DS(ON)}$  : 0.014  $\Omega$  (Typ.) @  $V_{GS}=10V$
- 100% Avalanche Tested

$$BV_{DSS} = 30 V$$

$$R_{DS(on)} = 0.014\Omega$$

$$I_D = 60 A$$

**TO-252 TO-251**

**HD60N03 HU60N03**
**1.Gate 2. Drain 3. Source**


#### Absolute Maximum Ratings $T_C=25^\circ C$ unless otherwise specified

Symbol	Parameter	Value	Units
$V_{DSS}$	Drain-Source Voltage	30	V
$I_D$	Drain Current – Continuous ( $T_C = 25^\circ C$ )	60	A
	Drain Current – Continuous ( $T_C = 100^\circ C$ )	36.6	A
$I_{DM}$	Drain Current – Pulsed (Note 1)	220	A
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	230	mJ
$I_{AR}$	Avalanche Current (Note 1)	60	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	11	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	7.0	V/ns
$P_D$	Power Dissipation ( $T_A = 25^\circ C$ )*	2.0	W
	Power Dissipation ( $T_C = 25^\circ C$ )	100	W
	- Derate above $25^\circ C$	0.7	W/ $^\circ C$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ C$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	$^\circ C$

#### Thermal Resistance Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	--	1.0	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient*	--	40	
$R_{\theta JA}$	Junction-to-Ambient	--	62.5	

\* When mounted on the minimum pad size recommended (PCB Mount)

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**On Characteristics**

$V_{GS}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	1.0	--	2.5	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\ \text{V}, I_D = 30\ \text{A}$	--	0.012	0.014	$\Omega$

**Off Characteristics**

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\ \text{V}, I_D = 250\ \mu\text{A}$	30	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25\text{ }^\circ\text{C}$	--	0.03	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 30\ \text{V}, V_{GS} = 0\ \text{V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 24\ \text{V}, T_C = 150\text{ }^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 20\ \text{V}, V_{DS} = 0\ \text{V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -20\ \text{V}, V_{DS} = 0\ \text{V}$	--	--	-100	nA

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 25\ \text{V}, V_{GS} = 0\ \text{V}, f = 1.0\ \text{MHz}$	--	875	1140	pF
$C_{oss}$	Output Capacitance		--	570	740	pF
$C_{rss}$	Reverse Transfer Capacitance		--	155	200	pF

**Switching Characteristics**

$t_{d(on)}$	Turn-On Time	$V_{DS} = 15\ \text{V}, I_D = 30\ \text{A}, R_G = 25\ \Omega$  (Note 4,5)	--	17	45	ns
$t_r$	Turn-On Rise Time		--	155	320	ns
$t_{d(off)}$	Turn-Off Delay Time		--	10	30	ns
$t_f$	Turn-Off Fall Time		--	75	160	ns
$Q_g$	Total Gate Charge	$V_{DS} = 24\ \text{V}, I_D = 60\ \text{A}, V_{GS} = 5.0\ \text{V}$  (Note 4,5)	--	18.5	24	nC
$Q_{gs}$	Gate-Source Charge		--	7	--	nC
$Q_{gd}$	Gate-Drain Charge		--	9.5	--	nC

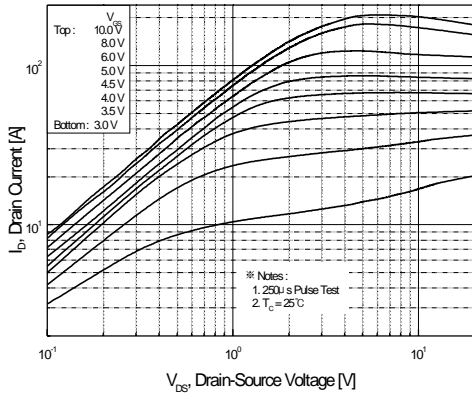
**Source-Drain Diode Maximum Ratings and Characteristics**

$I_S$	Continuous Source-Drain Diode Forward Current	--	--	60	A	
$I_{SM}$	Pulsed Source-Drain Diode Forward Current	--	--	240		
$V_{SD}$	Source-Drain Diode Forward Voltage	$I_S = 60\ \text{A}, V_{GS} = 0\ \text{V}$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_S = 60\ \text{A}, V_{GS} = 0\ \text{V}, di_f/dt = 100\ \text{A}/\mu\text{s}$ (Note 4)	--	40	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	35	--	$\mu\text{C}$

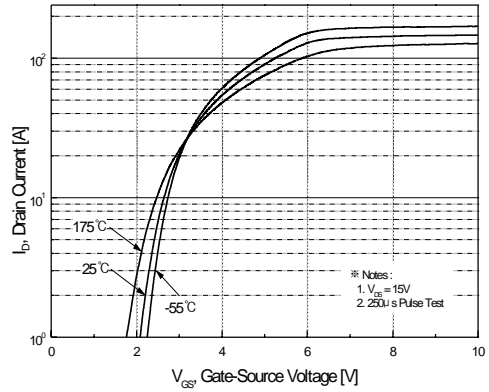
**Notes ;**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L=230\ \mu\text{H}, I_{AS}=60\ \text{A}, V_{DD}=15\ \text{V}, R_G=25\ \Omega$ , Starting  $T_J=25\text{ }^\circ\text{C}$
3.  $I_{SD} \leq 50\ \text{A}, di/dt \leq 300\ \text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J=25\text{ }^\circ\text{C}$
4. Pulse Test : Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$
5. Essentially Independent of Operating Temperature

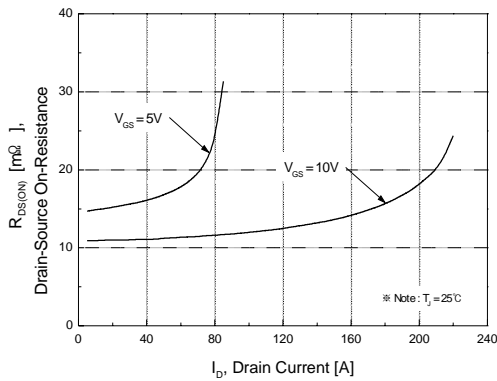
## Typical Characteristics



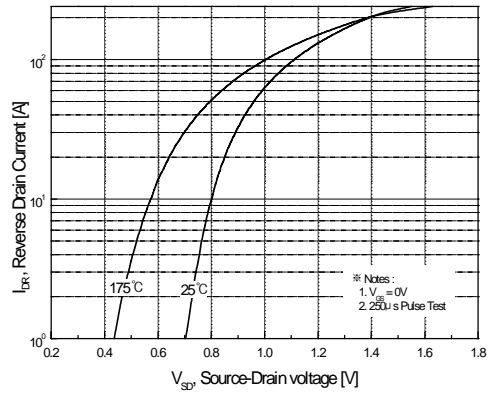
**Figure 1. On-Region Characteristics**



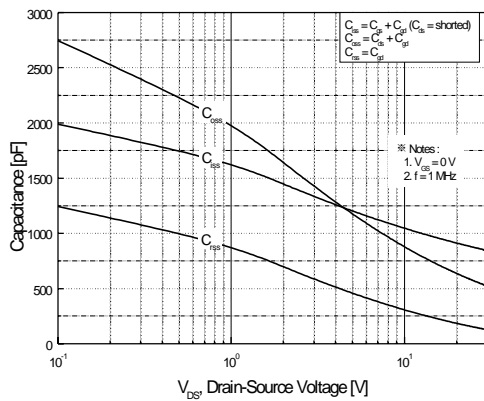
**Figure 2. Transfer Characteristics**



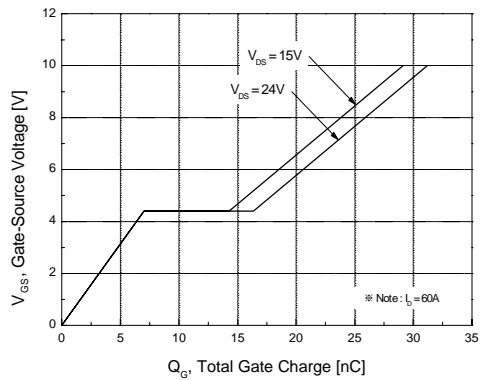
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

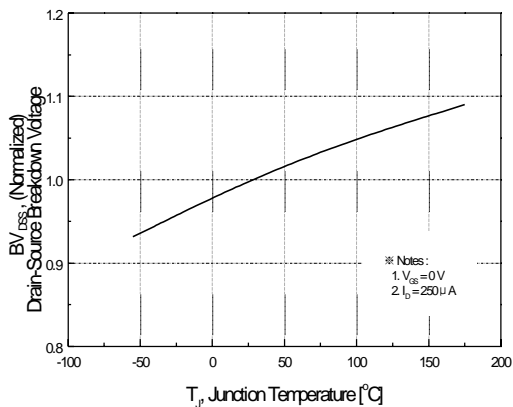


**Figure 5. Capacitance Characteristics**

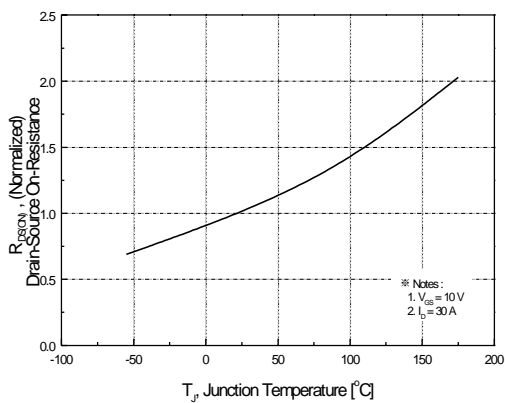


**Figure 6. Gate Charge Characteristics**

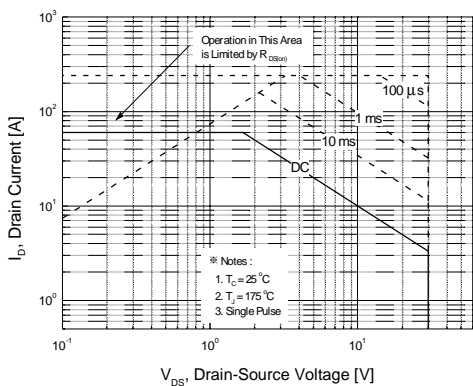
**Typical Characteristics** (Continued)



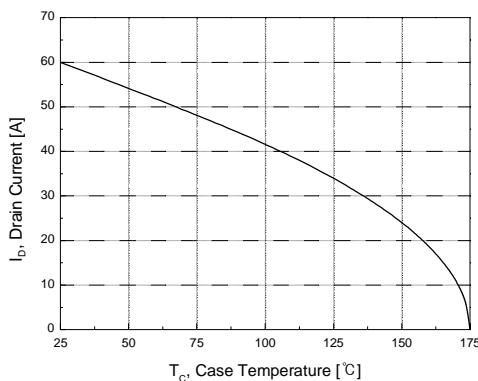
**Figure 7. Breakdown Voltage Variation vs. Temperature**



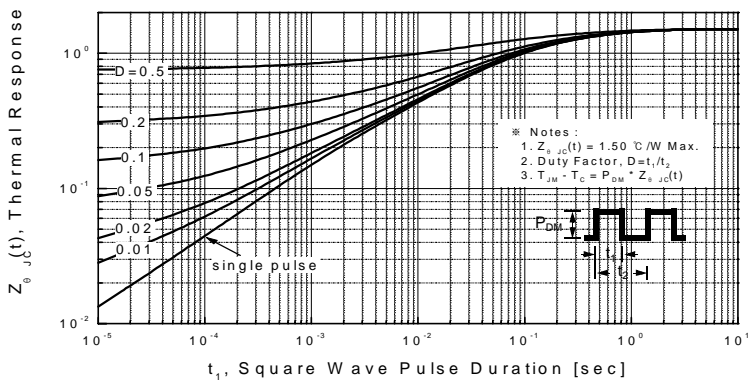
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

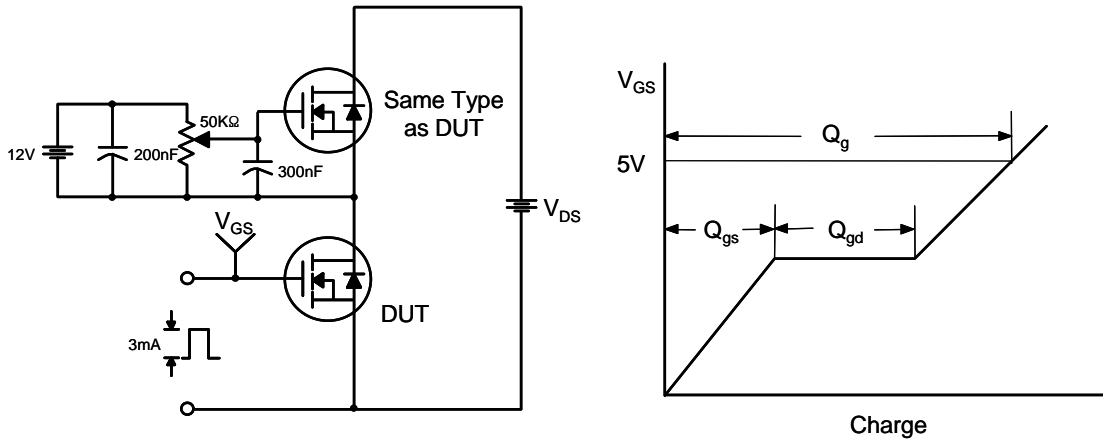


**Figure 10. Maximum Drain Current vs. Case Temperature**

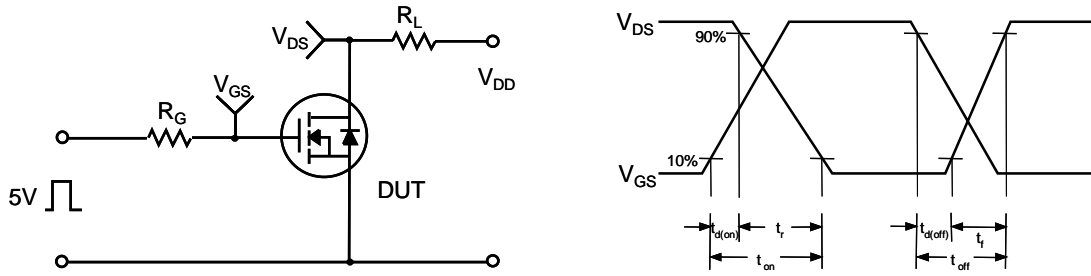


**Figure 11. Transient Thermal Response Curve**

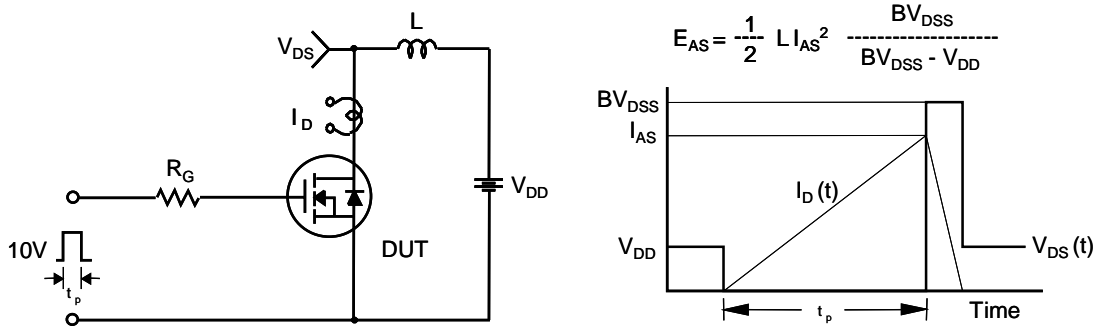
**Gate Charge Test Circuit & Waveform**



**Resistive Switching Test Circuit & Waveforms**



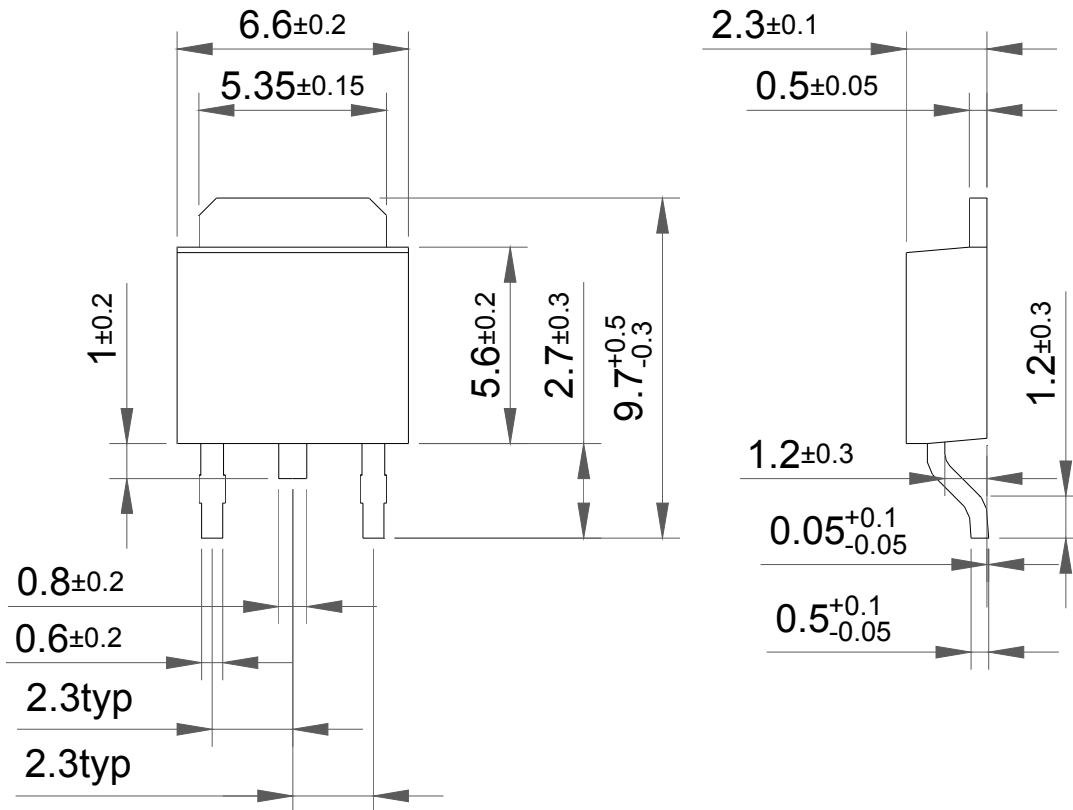
**Unclamped Inductive Switching Test Circuit & Waveforms**





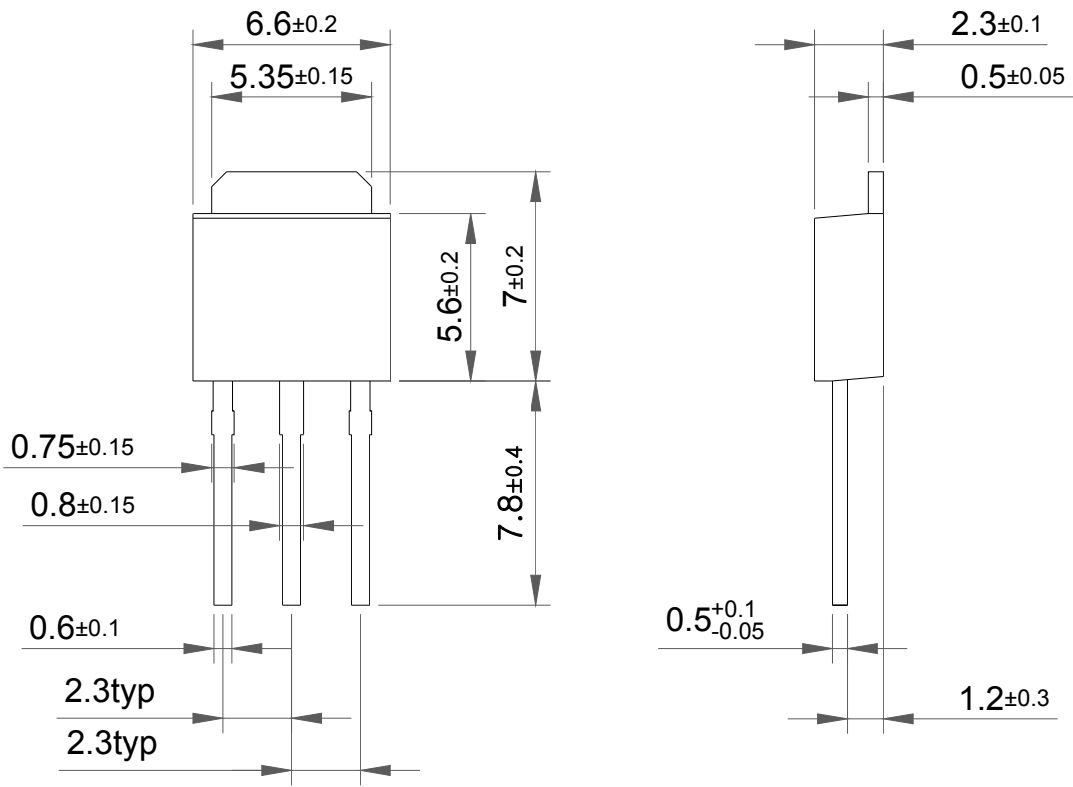
Package Dimension

TO-252



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TO-251



HD60N03\_HU60N03