

# HCT70R1K1

## 700V N-Channel Super Junction MOSFET

### Features

- Very Low FOM ( $R_{DS(on)} \times Q_g$ )
- Extremely low switching loss
- Excellent stability and uniformity
- 100% Avalanche Tested
- Built-in ESD Diode

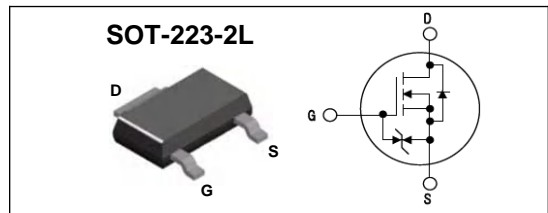
### Application

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)
- TV power & LED Lighting Power
- AC to DC Converters
- Telecom

### Key Parameters

Parameter	Value	Unit
$BV_{DSS} @ T_{j,max}$	750	V
$I_D$	4.5	A
$R_{DS(on), max}$	1.1	$\Omega$
$Q_g, Typ$	9.3	nC

### Package & Internal Circuit



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

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	700	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )	4.5 *	A
	Drain Current - Continuous ( $T_C = 100^\circ\text{C}$ )	2.9 *	A
$I_{DM}^{(1)}$	Drain Current - Pulsed	13.6 *	A
$E_{AS}^{(2)}$	Single Pulsed Avalanche Energy	35	mJ
$I_{AR}$	Avalanche Current	0.9	A
dv/dt	MOSFET dv/dt ruggedness, $V_{DS}=0\dots 400\text{V}$	50	V/ns
dv/dt	Reverse diode dv/dt, $V_{DS}=0\dots 400\text{V}$ , $I_{DS} \leq I_D$	15	V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	6.3	W
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$

\* Drain current limited by maximum junction temperature

### Thermal Resistance Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JS}$	Thermal Resistance, Junction-to-Solder point, Max.	19.8	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	60	$^\circ\text{C}/\text{W}$

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>On Characteristics</b>						
$V_{GS}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 140 \mu\text{A}$	2.0	-	4.0	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS} = 10 \text{ V}, I_D = 1.2 \text{ A}$	-	0.955	1.1	$\Omega$
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}$	700	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 700 \text{ V}, V_{GS} = 0$	-	-	1	$\mu\text{A}$
		$V_{DS} = 700 \text{ V}, T_C = 150^\circ\text{C}$	-	-	100	$\mu\text{A}$
$I_{GSS}$	Gate-Body Leakage Current	$V_{GS} = \pm 20 \text{ V}, V_{DS} = 0 \text{ V}$	-	-	$\pm 1$	$\mu\text{A}$
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 400 \text{ V}, V_{GS} = 0 \text{ V},$ $f = 1.0 \text{ MHz}$	-	410	-	pF
$C_{oss}$	Output Capacitance		-	13	-	pF
$C_{rss}$	Reverse Transfer Capacitance		-	2.7	-	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Time	$V_{DS} = 350 \text{ V}, I_D = 1.8 \text{ A},$ $R_G = 25 \Omega$  (Note 3,4)	-	20	-	ns
$t_r$	Turn-On Rise Time		-	18	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	54	-	ns
$t_f$	Turn-Off Fall Time		-	19	-	ns
$Q_{g()}$	Total Gate Charge	$V_{DS} = 560 \text{ V}, I_D = 1.8 \text{ A},$ $V_{GS} = 10 \text{ V}$  (Note 3,4)	-	9.3	-	nC
$Q_{gs}$	Gate-Source Charge		-	1.8	-	nC
$Q_{gd}$	Gate-Drain Charge		-	3.0	-	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		-	-	4.5	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		-	-	13.6	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_S = 1.8 \text{ A}$	-	-	1.3	V
$t_{rr}$	Reverse Recovery Time	$V_R = 400 \text{ V}, I_F = 1.8 \text{ A}$ $di_F/dt = 100 \text{ A}/\mu\text{s}$	-	210	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	1.2	-	$\mu\text{C}$

**Notes :**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $I_{AS}=0.9\text{A}$   $V_{DD}=50\text{V}$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$
3. Pulse Test : Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
4. Essentially Independent of Operating Temperature

## Typical Characteristics

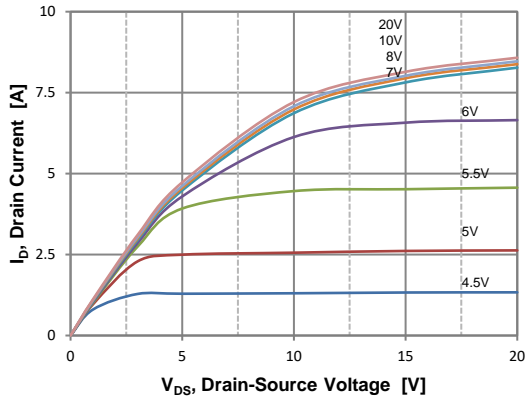


Figure 1. On Region Characteristics

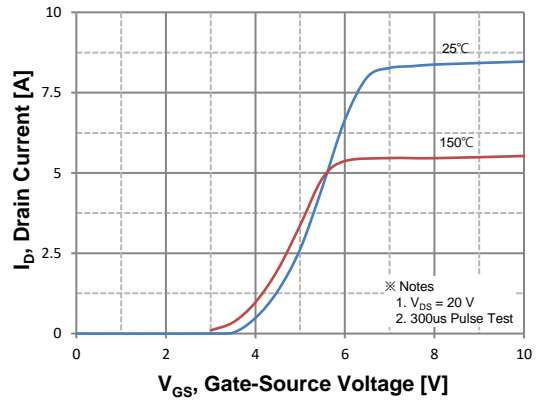


Figure 2. Transfer Characteristics

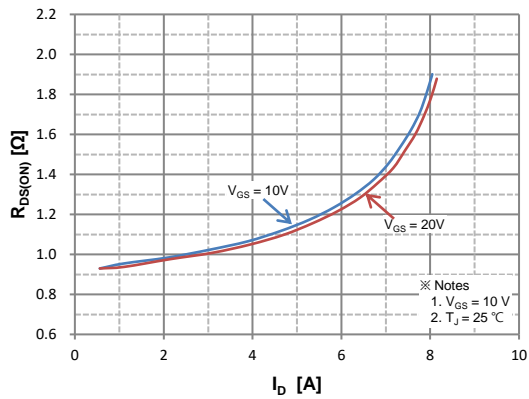


Figure 3. On Resistance Variation vs Drain Current and Gate Voltage

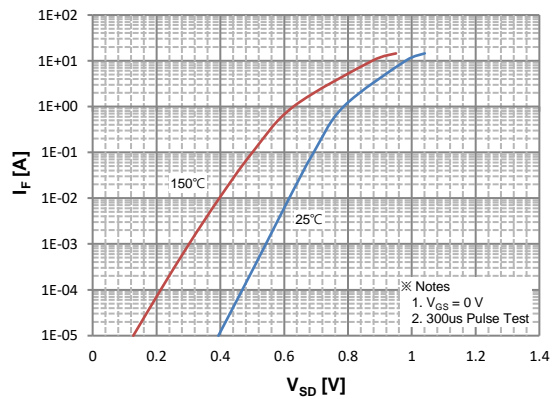


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

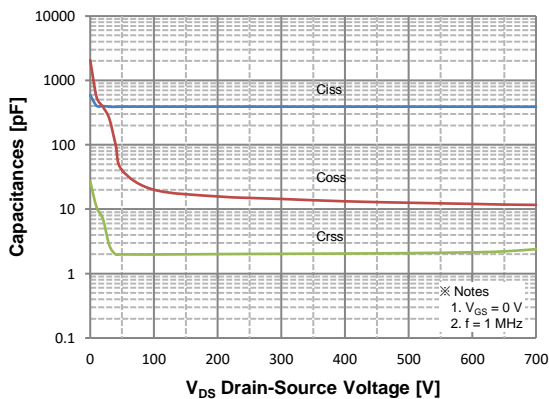


Figure 5. Capacitance Characteristics

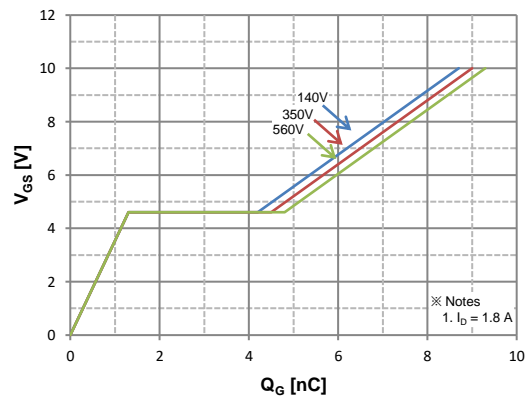


Figure 6. Gate Charge Characteristics

Typical Characteristics



Figure 7. Breakdown Voltage Variation vs. Temperature

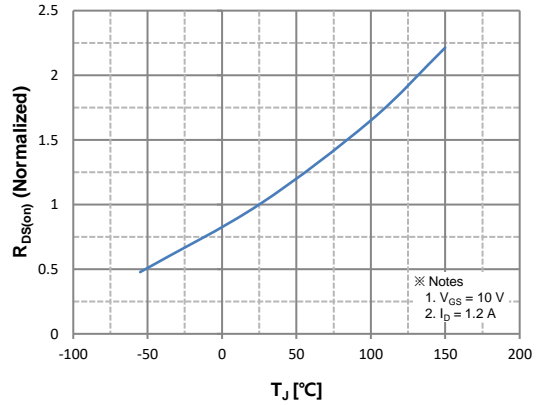


Figure 8. On-Resistance Variation vs. Temperature

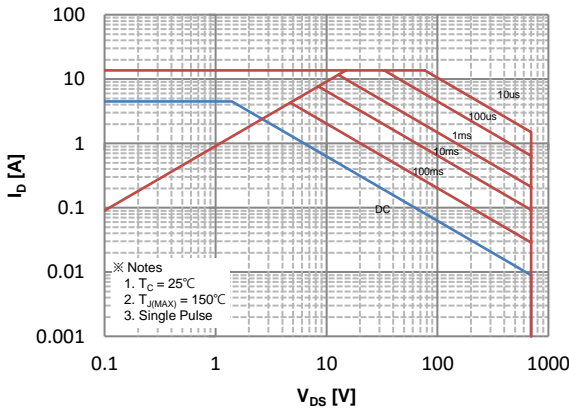


Figure 9. Maximum Safe Operating Area

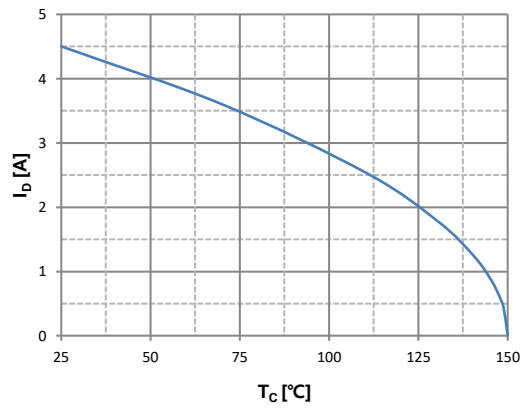


Figure 10. Maximum Drain Current vs. Case Temperature

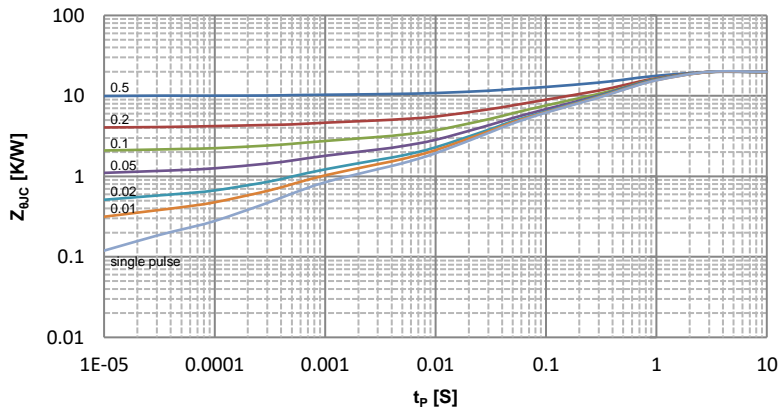
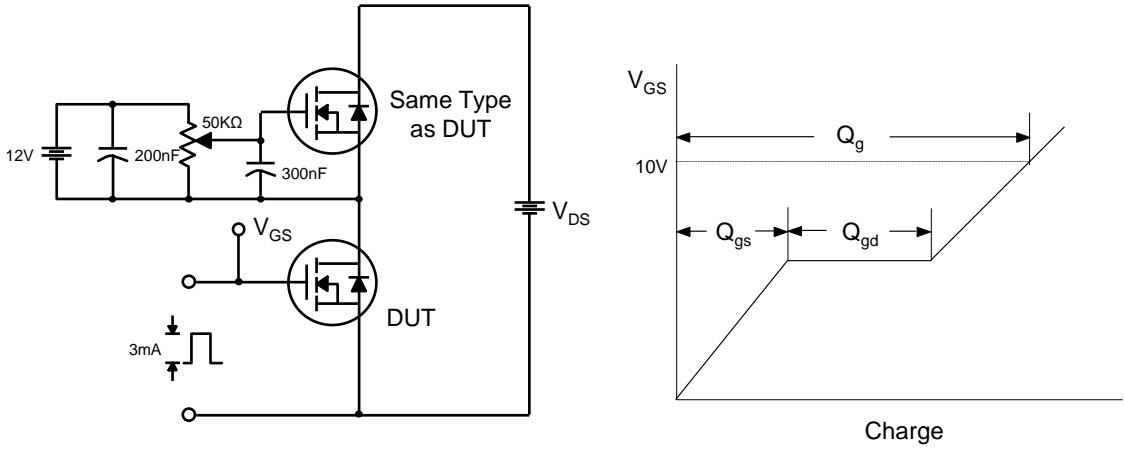
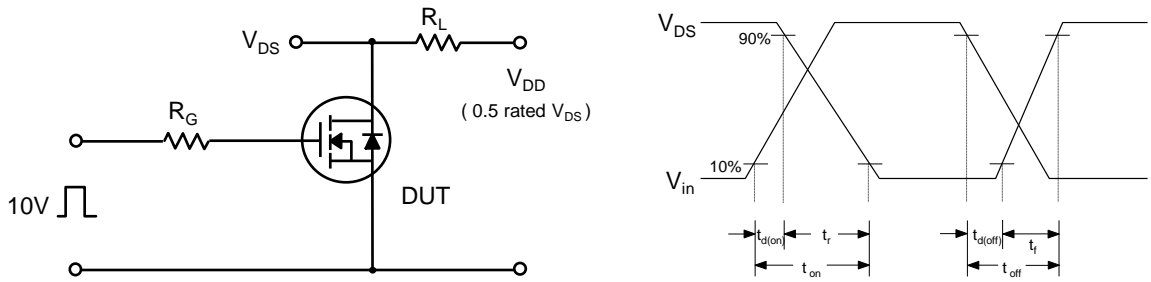


Figure 11. Transient Thermal Response Curve

**Fig 12. Gate Charge Test Circuit & Waveform**



**Fig 13. Resistive Switching Test Circuit & Waveforms**



**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

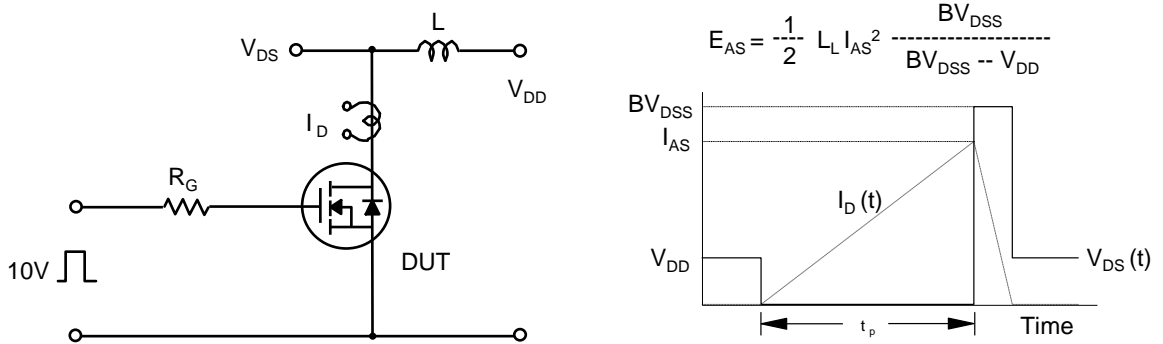
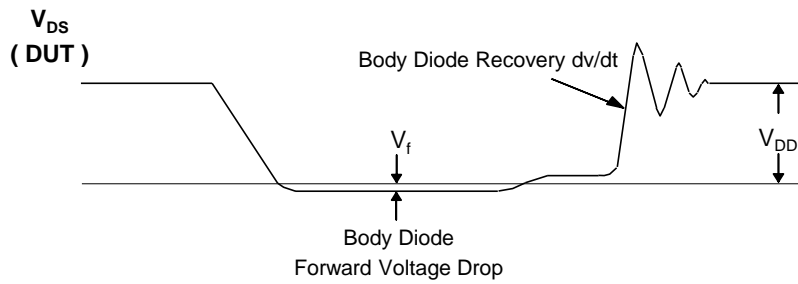
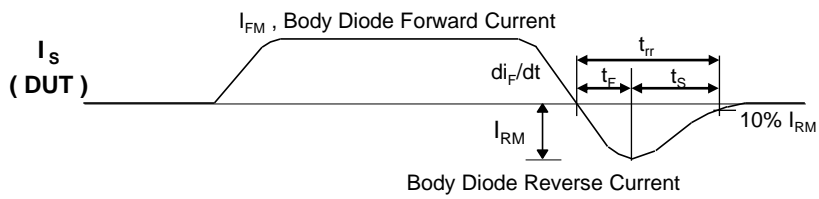
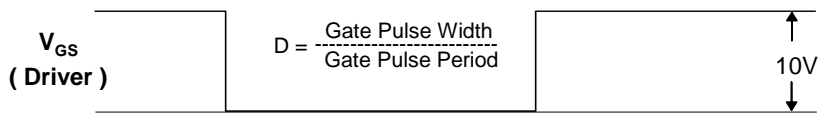
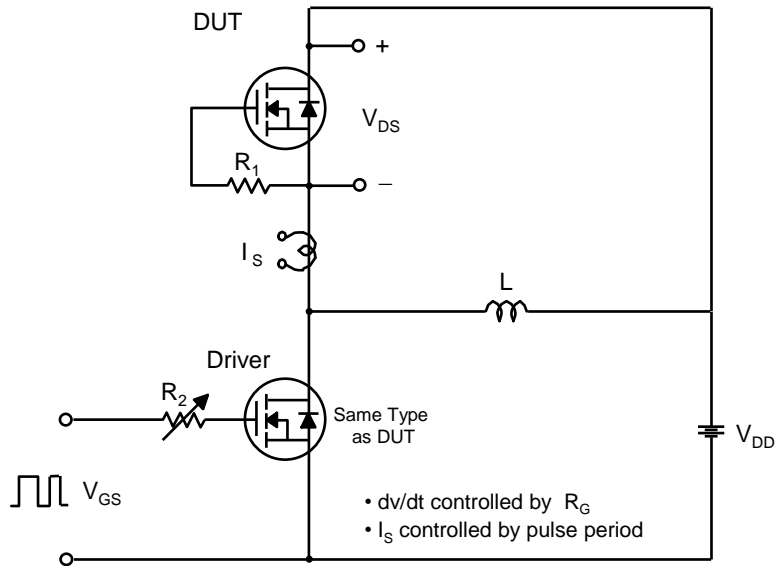
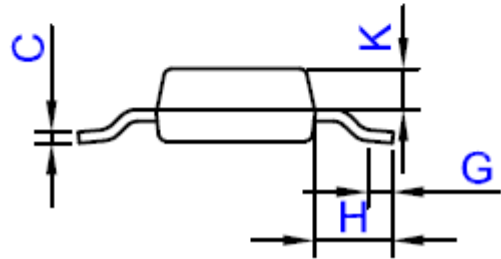
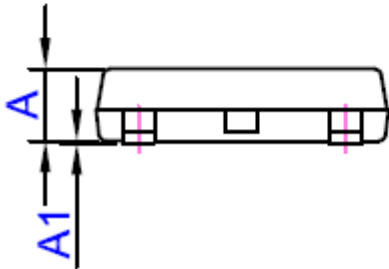
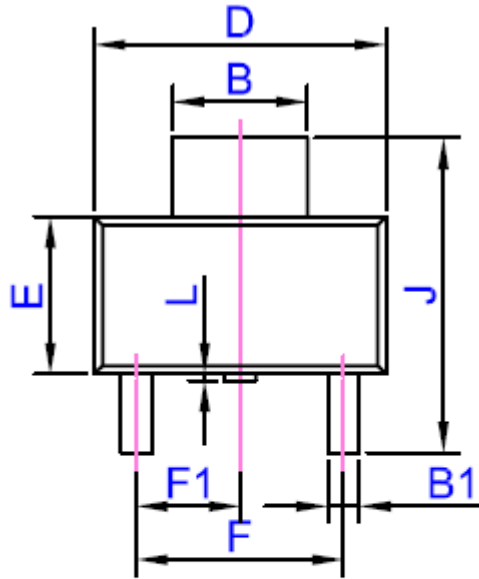


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



Package Dimension

SOT-223-2L



Ref	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.5	1.6	1.8	0.059	0.063	0.071
A1	0.01	0.06	0.10	0.001	0.002	0.004
B	2.9	3.0	3.1	0.114	0.118	0.122
B1	0.6	0.7	0.8	0.024	0.028	0.031
C	0.22	0.254	0.32	0.009	0.010	0.013
D	6.3	6.5	6.7	0.248	0.256	0.264
E	3.3	3.5	3.7	0.130	0.138	0.146
F		4.6			0.181	
F1		2.3			0.091	
G	0.7	0.9	1.1	0.028	0.035	0.043
H	1.5	1.75	2.0	0.059	0.069	0.079
J	6.7	7.0	7.3	0.264	0.276	0.287
K		0.9			0.035	
L	0	0.1	0.2	0	0.004	0.008