

# HMS3N65R2

## 650V 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

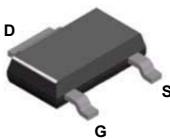
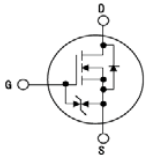
### Application

- 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
$BV_{DSS} @T_{J,max}$	650	V
$I_D$	3.0	A
$R_{DS(on), max}$	1.5	$\Omega$
$Q_g, Typ$	9.3	nC

### Package & Internal Circuit

SOT-223-2L	SYMBOL
	

### Absolute Maximum Ratings

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

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	650	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$I_D$	Drain Current - Continuous ( $T_C = 25^{\circ}\text{C}$ )	3.0	A
	Drain Current - Continuous ( $T_C = 100^{\circ}\text{C}$ )	2.1	A
$I_{DM}^{1)}$	Drain Current - Pulsed	9.0	A
$E_{AS}^{2)}$	Single Pulsed Avalanche Energy	35	mJ
$I_{AR}$	Avalanche Current	0.9	A
dv/dt	MOSFET dv/dt ruggedness, $V_{DS}=0\ldots 400\text{V}$	50	V/ns
dv/dt	Reverse diode dv/dt, $V_{DS}=0\ldots 400\text{V}$ , $I_{DS}\leq I_D$	15	V/ns
$P_D$	Power Dissipation ( $T_C = 25^{\circ}\text{C}$ )	50	W
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^{\circ}\text{C}$

### Thermal Resistance Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	2.5	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	$^{\circ}\text{C}/\text{W}$

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
On Characteristics						
V <sub>GS</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 140 μA	2.5	-	4.0	V
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.2 A	-	-	1.5	Ω
Off Characteristics						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1mA	650	-	-	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0	-	-	1	μA
		V <sub>DS</sub> = 650 V, T <sub>C</sub> = 150°C	-	-	100	μA
I <sub>GSS</sub>	Gate-Body Leakage Current	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V	-	-	±1	μA
Dynamic Characteristics						
C <sub>iSS</sub>	Input Capacitance	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	-	410	-	pF
C <sub>oSS</sub>	Output Capacitance		-	13	-	pF
C <sub>rSS</sub>	Reverse Transfer Capacitance		-	2.7	-	pF
Switching Characteristics						
t <sub>d(on)</sub>	Turn-On Time	V <sub>DS</sub> = 350 V, I <sub>D</sub> = 1.8 A, R <sub>G</sub> = 25 Ω  (Note 3,4)	-	20	-	ns
t <sub>r</sub>	Turn-On Rise Time		-	18	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	54	-	ns
t <sub>f</sub>	Turn-Off Fall Time		-	19	-	ns
Q <sub>g(</sub>	Total Gate Charge	V <sub>DS</sub> = 560 V, I <sub>D</sub> = 1.8 A, V <sub>GS</sub> = 10 V  (Note 3,4)	-	9.3	-	nC
Q <sub>gs</sub>	Gate-Source Charge		-	1.8	-	nC
Q <sub>gd</sub>	Gate-Drain Charge		-	3.0	-	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		-	-	3.0	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		-	-	9.0	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 1.8 A	-	-	1.3	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>R</sub> = 400 V, I <sub>F</sub> = 1.8 A di <sub>F</sub> /dt = 100 A/μs	-	210	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	1.2	-	μC

**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

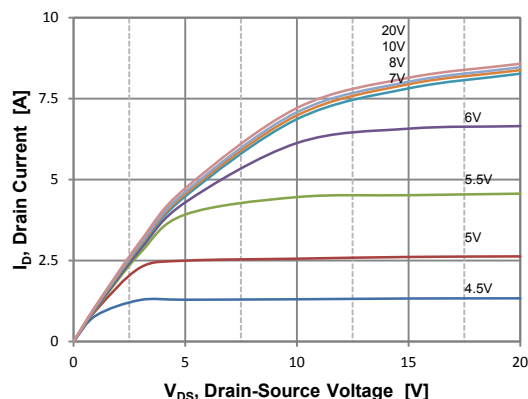


Figure 1. On Region Characteristics

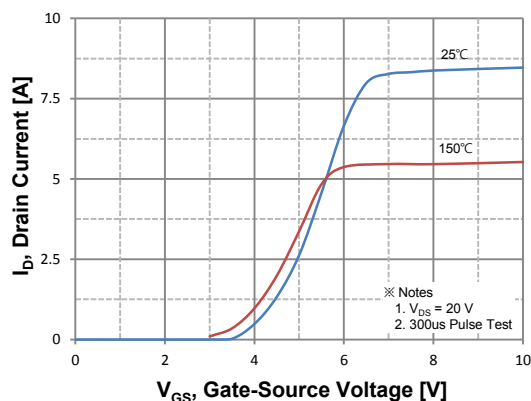


Figure 2. Transfer Characteristics

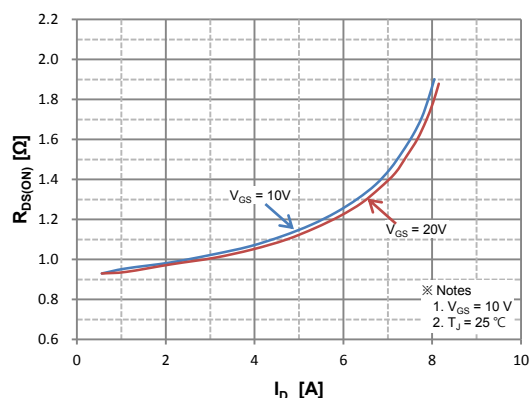


Figure 3. On Resistance Variation vs Drain Current and Gate Voltage

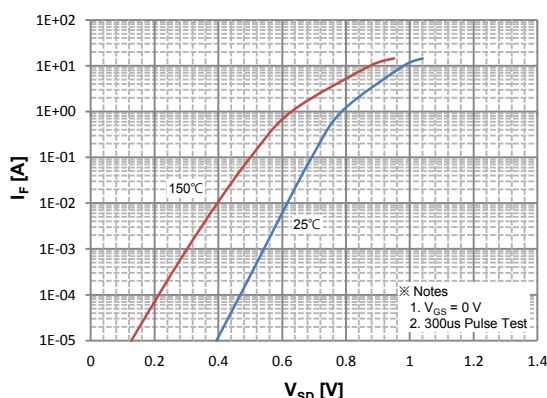


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

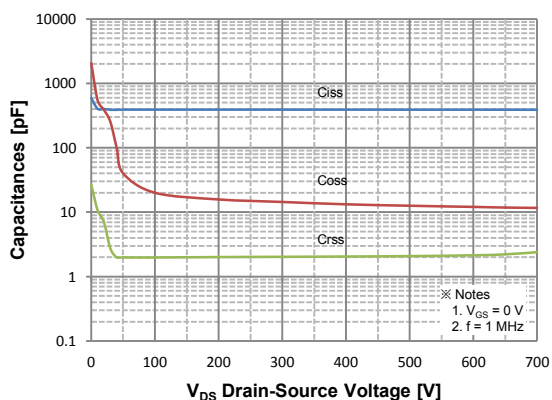


Figure 5. Capacitance Characteristics

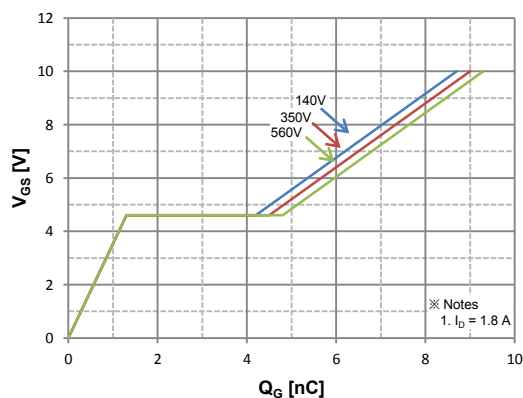


Figure 6. Gate Charge Characteristics

## Typical Characteristics

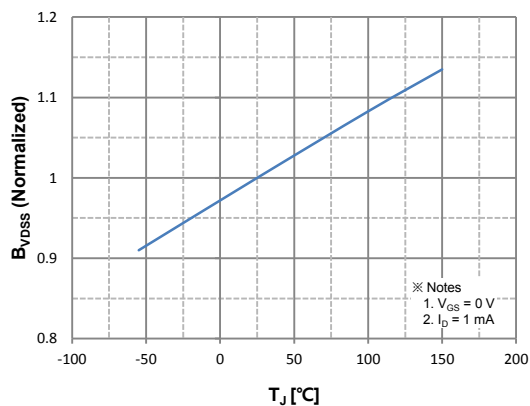


Figure 7. Breakdown Voltage Variation vs. Temperature

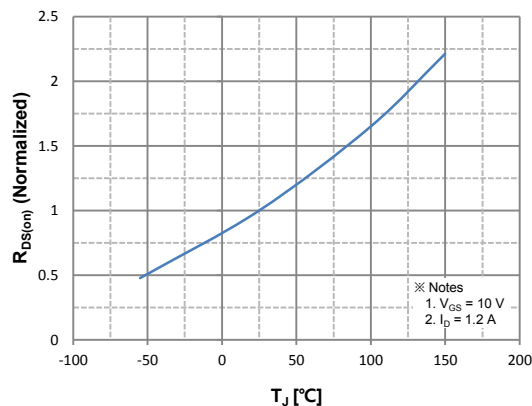


Figure 8. On-Resistance Variation vs. Temperature

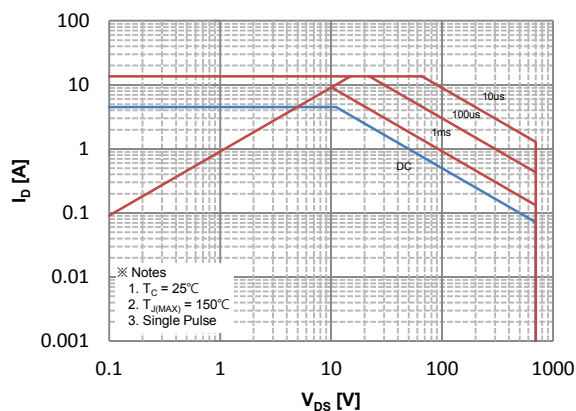


Figure 9. Maximum Safe Operating Area

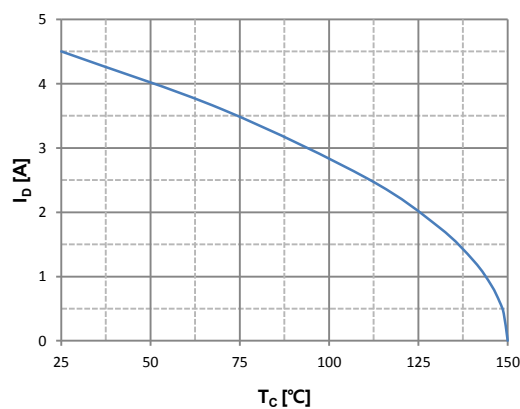


Figure 10. Maximum Drain Current vs. Case Temperature

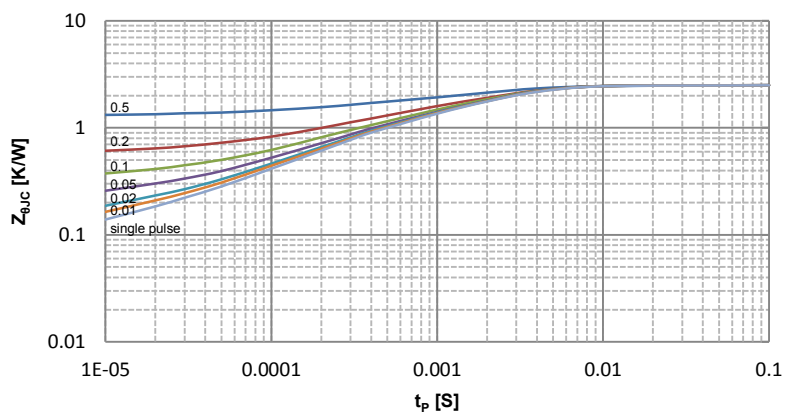
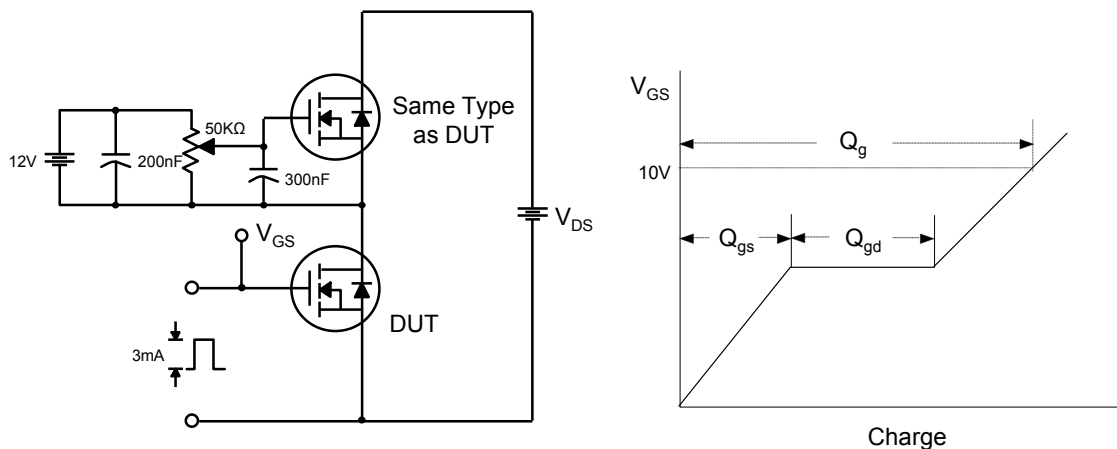
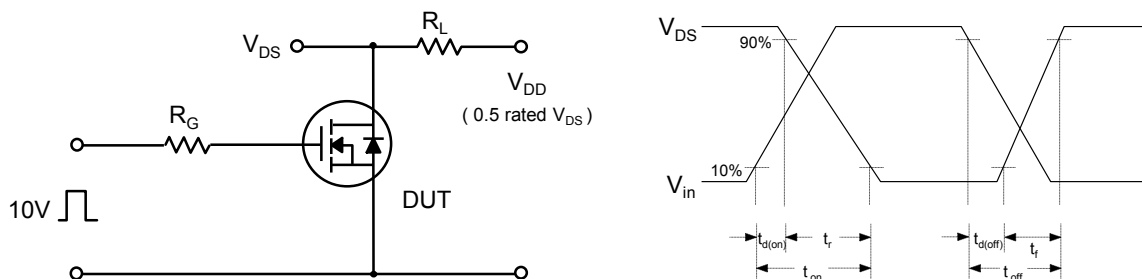


Figure 11. Transient Thermal Response Curve

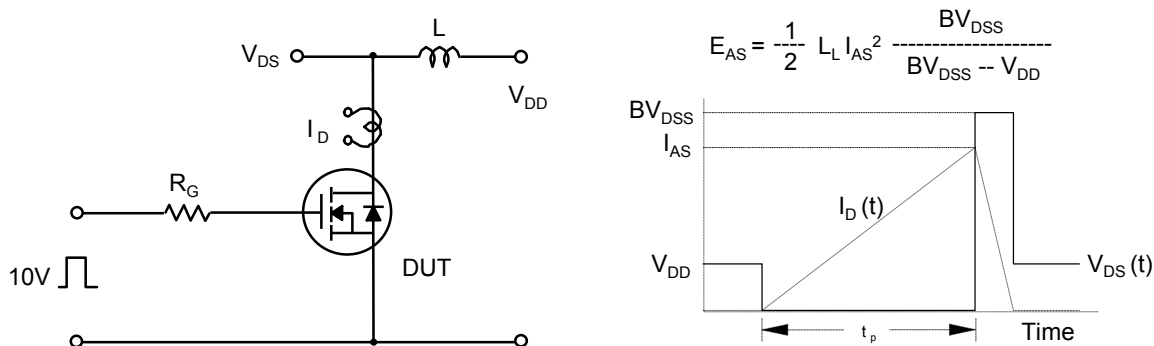
**Fig 12. Gate Charge Test Circuit & Waveform**



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

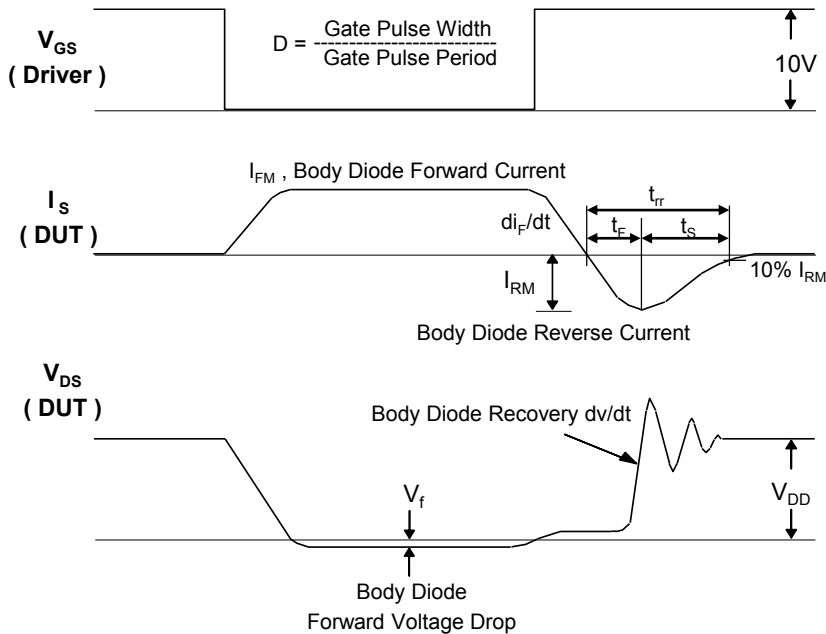


**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**



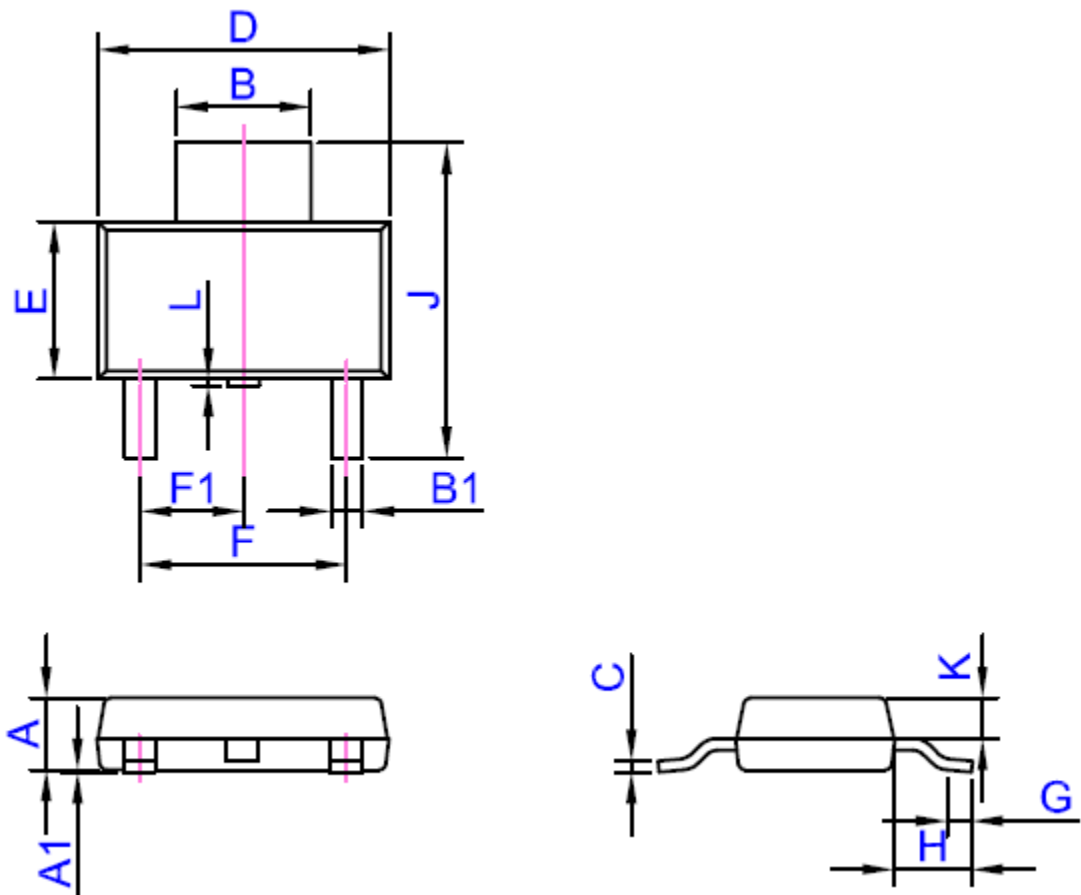
The diagram shows a switching circuit. A DUT (Device Under Test) is represented by a circle containing a MOSFET symbol. Its drain is connected to a positive terminal (+) and its source is connected to a negative terminal (-) through a resistor  $R_1$ . The drain-source voltage is labeled  $V_{DS}$ . A current source  $I_s$  is connected in parallel with the DUT. The output of the DUT is connected to an inductor  $L$ . The inductor is connected to a positive terminal (+) and a negative terminal (-) through a resistor  $R_2$ . The driver is represented by a circle containing a MOSFET symbol, labeled "Same Type as DUT". Its gate is connected to a pulse input  $V_{GS}$  through a resistor  $R_2$ . Its drain is connected to the inductor  $L$  and its source is connected to the negative terminal (-). The supply voltage is  $V_{DD}$ . A list of parameters is provided: 

- $\bullet$   $dv/dt$  controlled by  $R_G$
- $\bullet$   $I_s$  controlled by pulse period



Package Dimension

SOT-223-2L



Ref	Dimensions					
	Milimeters			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