



### Features

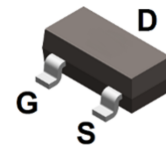
- Low on-resistance
- N-Channel MOSFET
- Low input capacitance
- Fast switching speed
- HBM: JESD22-A114-B: 2
- RoHS compliant with Halogen-free

### Typical Applications

- DC-DC converters
- Power management functions
- Battery operated systems and solid-state relays
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.

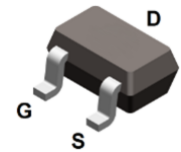
### Mechanical Data

- Case: SOT-23, SOT-323, SOT-523,DFN1006-3, SOT-723
- Molding Compound: UL Flammability Classification Rating 94V-0
- Terminals: Matte Tin-Plated Leads, Solderability-per MIL-STD-202, Method 208



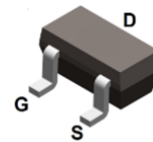
**BSS138ES**

**SOT-23**



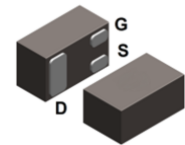
**BSS138ESW**

**SOT-323**



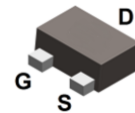
**BSS138EST**

**SOT-523**



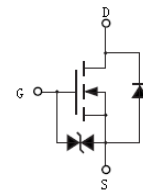
**BSS138ESL**

**DFN1006-3**



**BSS138ESM**

**SOT-723**



### Ordering Information

Part Number	Package	Shipping Quantity	Marking Code
BSS138ES	SOT-23	3000 pcs / Tape & Reel	MM5
BSS138ESW	SOT-323	3000 pcs / Tape & Reel	MM5
BSS138EST	SOT-523	3000 pcs / Tape & Reel	MM5
BSS138ESL	DFN1006-3	10000 pcs / Tape & Reel	MM5
BSS138ESM	SOT-723	10000 pcs / Tape & Reel	MM5



### Maximum Ratings (@ $T_A = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	50	V
Gate-to-Source Voltage	$V_{GSS}$	$\pm 20$	V
Continuous Drain Current ( $T_A = 25^\circ\text{C}$ ) <sup>*1</sup>	$I_D$	360	mA
Pulsed Drain Current ( $t_p = 10\mu\text{s}$ , $T_A = 25^\circ\text{C}$ )	$I_{DM}$	1500	mA
Single Pulse Avalanche Energy <sup>*3</sup>	$E_{AS}$	0.2	mJ
Power Dissipation ( $T_A = 25^\circ\text{C}$ ) <sup>*1</sup>	SOT-23	0.35	W
	SOT-323	0.26	
	SOT-523	0.15	
	DFN1006-3	0.15	
	SOT-723	0.15	
Operating Junction Temperature Range	$T_J$	-55 ~ +150	$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-55 ~ +150	$^\circ\text{C}$

### Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance Junction-to-Air <sup>*1</sup>		370	$^\circ\text{C/W}$
	SOT-323	480	$^\circ\text{C/W}$
	SOT-523	834	$^\circ\text{C/W}$
	DFN1006-3	834	$^\circ\text{C/W}$
	SOT-723	834	$^\circ\text{C/W}$
Thermal Resistance Junction-to-Lead <sup>*1</sup>		222	$^\circ\text{C/W}$
	SOT-323	288	$^\circ\text{C/W}$
	SOT-523	500	$^\circ\text{C/W}$
	DFN1006-3	500	$^\circ\text{C/W}$
	SOT-723	500	$^\circ\text{C/W}$
Thermal Resistance Junction-to-Case <sup>*1</sup>		187	$^\circ\text{C/W}$
	SOT-323	242	$^\circ\text{C/W}$
	SOT-523	421	$^\circ\text{C/W}$
	DFN1006-3	421	$^\circ\text{C/W}$
	SOT-723	421	$^\circ\text{C/W}$



### Electrical Characteristics (@ T<sub>A</sub> = 25°C unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>Static Characteristics</b>						
V <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	50	-	-	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 50V, V <sub>GS</sub> = 0V	-	-	1	μA
I <sub>GSS</sub>	Gate-Body Leakage Current	V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V	-	-	±10	μA
<b>On Characteristics</b>						
R <sub>DS(ON)</sub>	Drain-Source On-resistance *2	V <sub>GS</sub> = 10V, I <sub>D</sub> = 0.5A	-	1	1.6	Ω
		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 0.2A	-	1.2	2.5	
		V <sub>GS</sub> = 2.5V, I <sub>D</sub> = 0.1A	-	1.7	4.5	
V <sub>GS(TH)</sub>	Static Drain-Source On-resistance	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	0.8	1	1.5	V
R <sub>G</sub>	Gate Resistance	V <sub>GS</sub> = 0V, f = 1MHz	-	48	-	Ω
<b>Dynamic Characteristics</b>						
C <sub>ISS</sub>	Input Capacitance	V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V f = 1.0MHz	-	32	-	pF
C <sub>OSS</sub>	Output Capacitance		-	6	-	
C <sub>RSS</sub>	Reverse Transfer Capacitance		-	3	-	
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-on Delay Time *4	V <sub>DD</sub> = 25V, I <sub>D</sub> = 0.36A V <sub>GS</sub> = 10V, R <sub>G</sub> = 6Ω	-	2.2	-	ns
t <sub>r</sub>	Turn-on Rise Time *4		-	19.2	-	
t <sub>d(off)</sub>	Turn-Off Delay Time *4		-	6.2	-	
t <sub>f</sub>	Turn-Off Fall Time *4		-	23	-	
Q <sub>G</sub>	Total Gate-Charge	V <sub>DS</sub> = 25V V <sub>GS</sub> = 10V I <sub>D</sub> = 0.2A	-	4	-	nC
Q <sub>GS</sub>	Gate to Source Charge		-	0.5	-	
Q <sub>GD</sub>	Gate to Drain (Miller) Charge		-	0.4	-	
<b>Source-Drain Diode Characteristics</b>						
V <sub>SD</sub>	Diode Forward Voltage *2	I <sub>S</sub> = 0.5A, V <sub>GS</sub> = 0V	-	0.89	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 1A, V <sub>GS</sub> = 0V	-	15	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge	dI <sub>F</sub> /dt = 100A/μs	-	8	-	nC

Notes:

- The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper
- The data tested by pulsed, pulse width ≤ 300μs, duty cycle ≤ 2%
- The E<sub>AS</sub> data shows Max. rating. The test condition is V<sub>DD</sub> = 30V, V<sub>GS</sub> = 10V, L = 0.5mH
- Guaranteed by design, not subject to production



### Ratings and Characteristic Curves (@ $T_A = 25^\circ\text{C}$ unless otherwise specified)

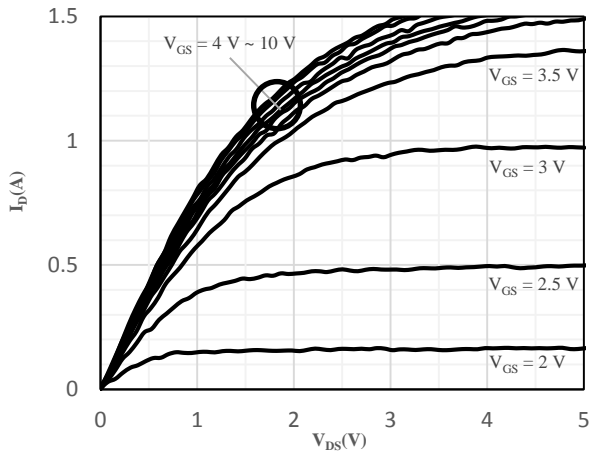


Fig 1 Typical Output Characteristics

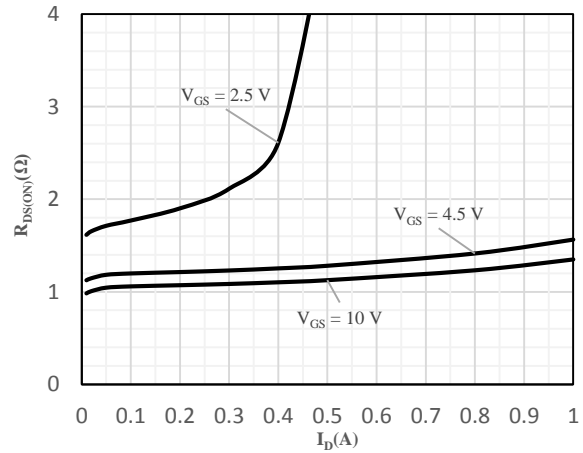


Fig 2 On-Resistance vs. Drain Current and Gate Voltage

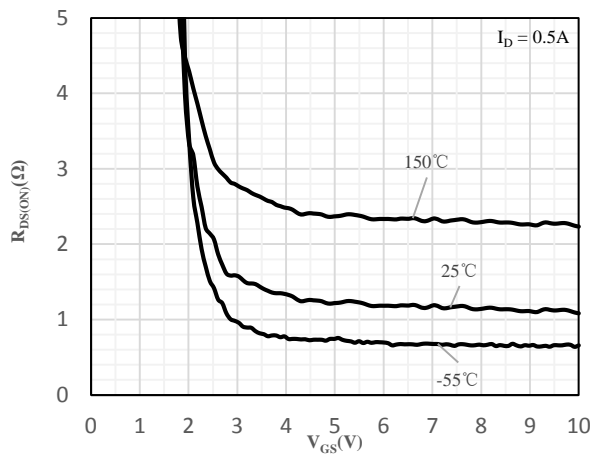


Fig 3 On-Resistance vs. Gate-Source Voltage

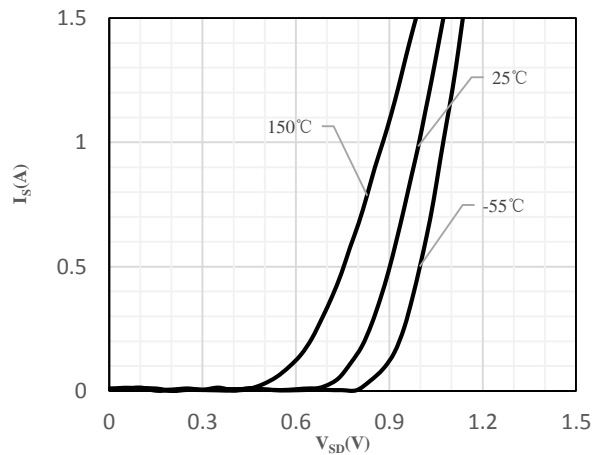


Fig 4 Body-Diode Characteristics

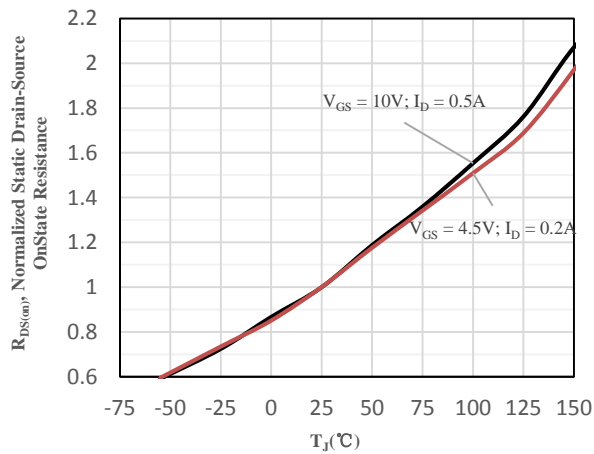


Fig 5 Normalized On-Resistance vs. Junction Temperature

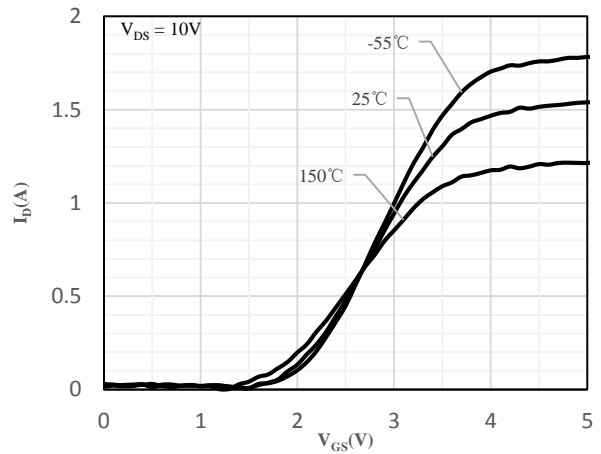


Fig 6 Transfer Characteristics

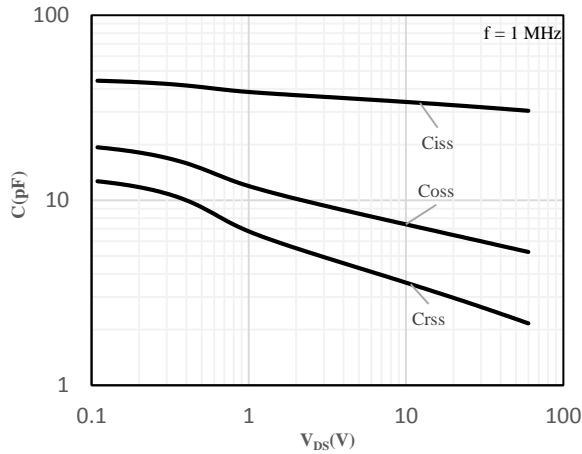


Fig 7 Capacitance Characteristics

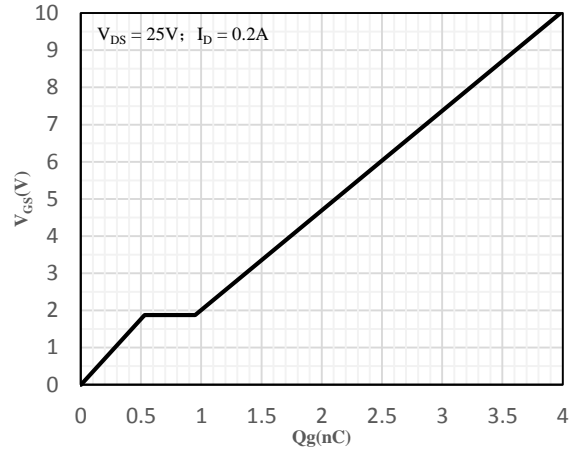


Fig 8 Gate-Charge Characteristics

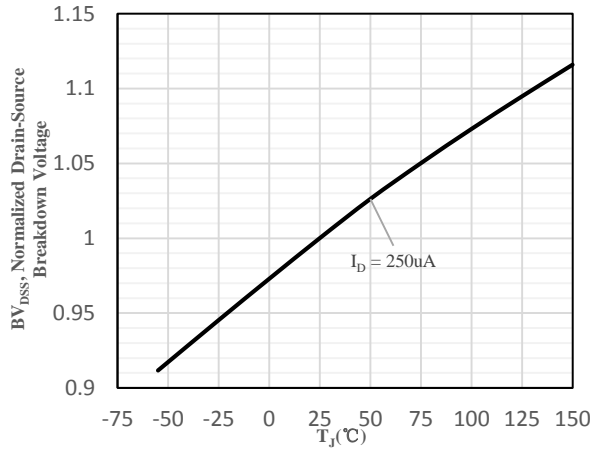


Fig 9 Normalized Breakdown Voltage vs. Junction Temperature

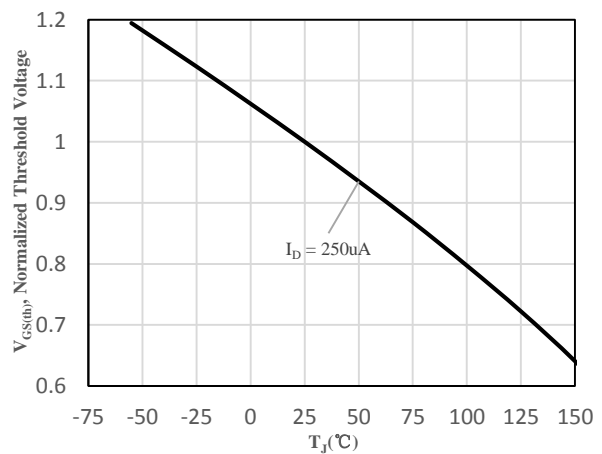


Fig 10 Normalized  $V_{GS(th)}$  vs. Junction Temperature

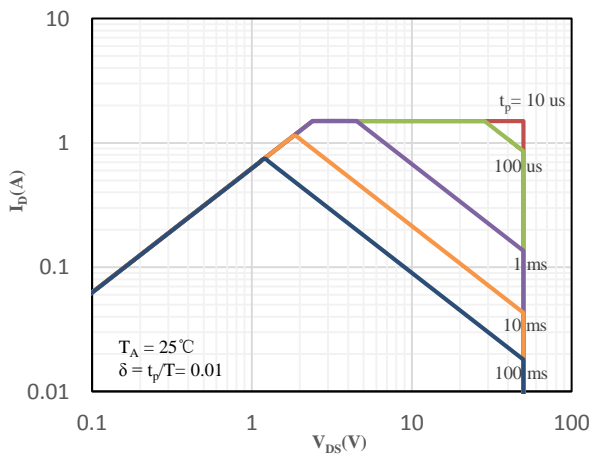


Fig 11 Safe Operation Area

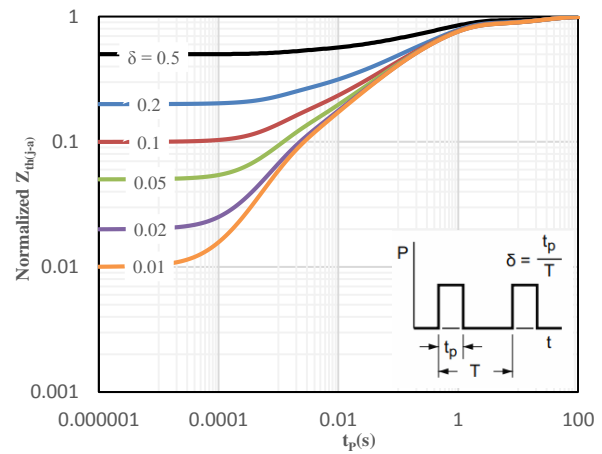
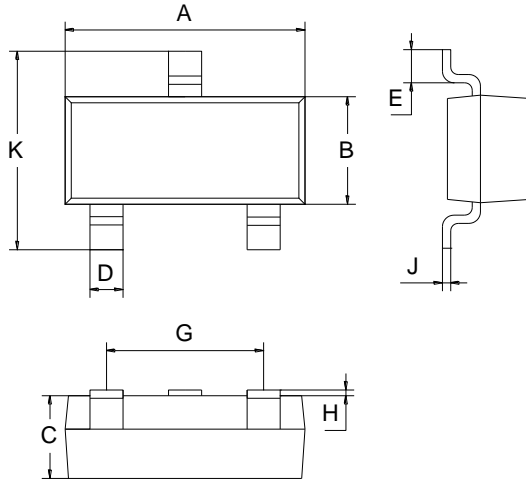


Fig 12 Normalized Maximum transient thermal impedance



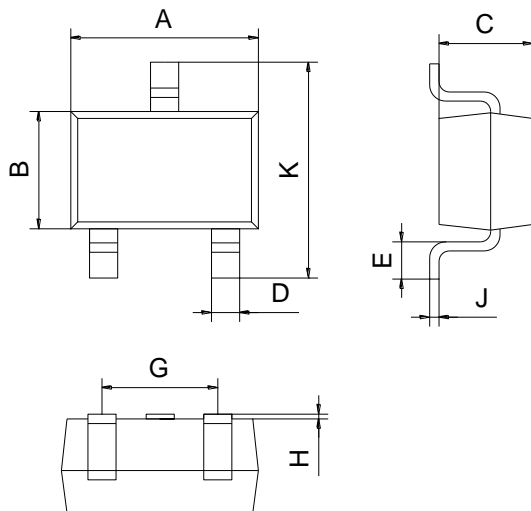
### Package Outline Dimensions (Unit: mm)

#### SOT-23



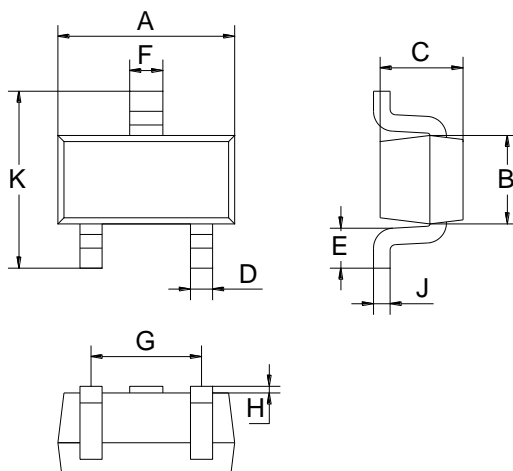
SOT-23		
Dimension	Min.	Max.
A	2.70	3.10
B	1.10	1.50
C	0.90	1.10
D	0.30	0.50
E	0.35	0.48
G	1.80	2.00
H	0.02	0.10
J	0.05	0.15
K	2.20	2.60

#### SOT-323



SOT-323		
Dimension	Min.	Max.
A	2.00	2.20
B	1.15	1.35
C	0.90	1.10
D	0.15	0.35
E	0.25	0.40
G	1.20	1.40
H	0.02	0.10
J	0.05	0.15
K	2.20	2.40

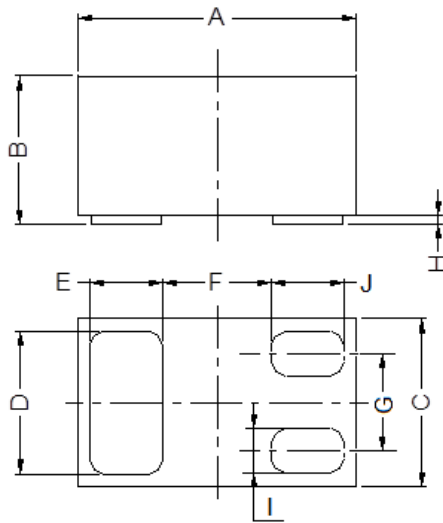
#### SOT-523



SOT-523		
Dimension	Min.	Max.
A	1.50	1.70
B	0.75	0.85
C	0.60	0.80
D	0.15	0.30
E	0.30	0.40
F	0.25	0.40
G	0.90	1.10
H	0.02	0.10
J	0.08	0.18
K	1.45	1.75

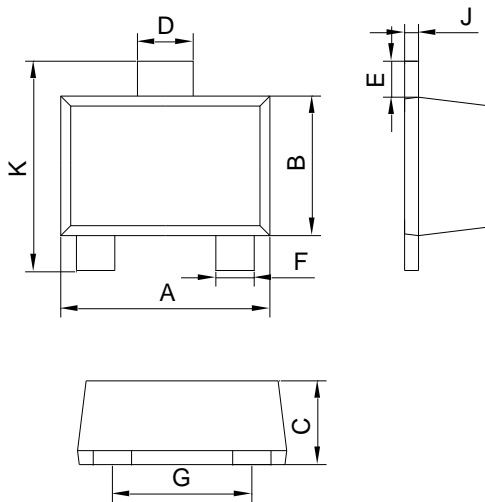


### DFN1006-3



DFN1006-3			
Dimension	Min.	Typ.	Max.
A	0.95	1.00	1.075
B	0.47	0.50	0.53
C	0.55	0.60	0.675
D	0.45	0.50	0.55
E/J	0.20	0.25	0.30
F	-	0.40	-
G	-	0.35	-
H	0	0.03	0.05
I	0.10	0.15	0.20

### SOT-723

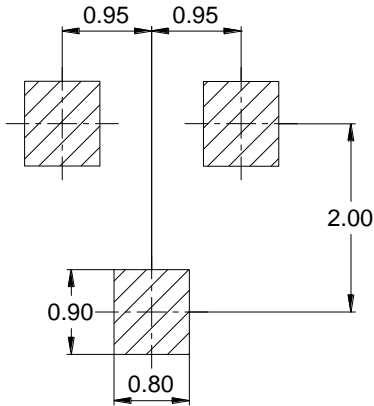


SOT-723		
Dimension	Min.	Max.
A	1.10	1.30
B	0.70	0.90
C	0.40	0.54
D	0.22	0.42
E	0.10	0.30
F	0.12	0.32
G	0.70	0.90
J	0.08	0.15
K	1.10	1.30

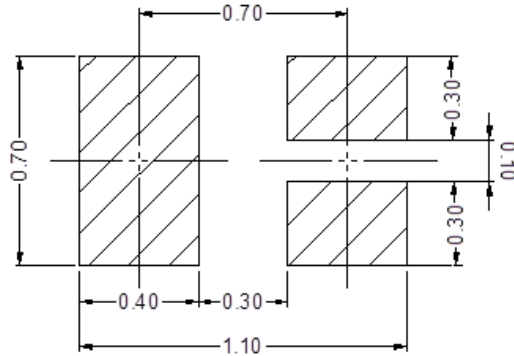


### Mounting Pad Layout (Unit: mm)

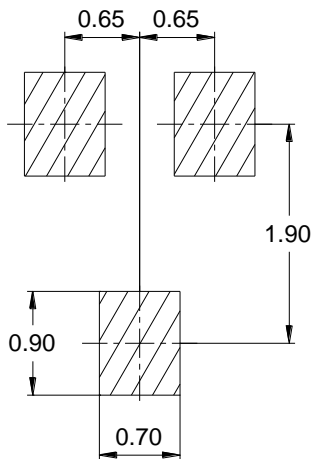
**SOT-23**



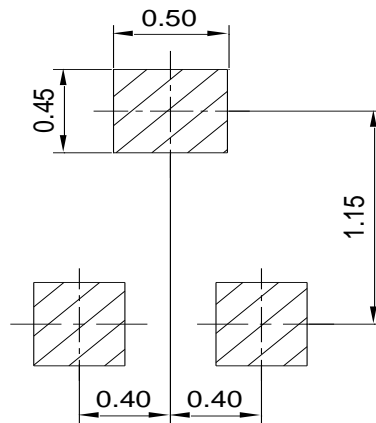
**DFN1006-3**



**SOT-323**



**SOT-723**



**SOT-523**

