

Features

- Low on-resistance
- N-Channel MOSFET
- Low input capacitance
- Fast switching speed
- HBM: AEC-Q101-001: H2 (JESD22-A114-B: 2)
- RoHS compliant with Halogen-free
- Qualified to AEC-Q101 Standards

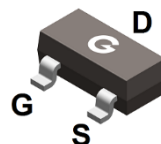
HF

Typical Applications

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

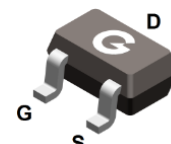
Mechanical Data

- 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



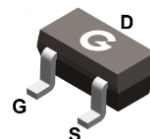
TBSS138ES

SOT-23



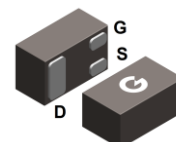
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SOT-323



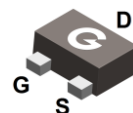
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SOT-523



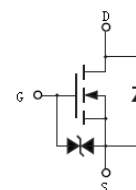
TBSS138ESL

DFN1006-3



TBSS138ESM

SOT-723



Ordering Information

Part Number	Package	Shipping Quantity	Marking Code
TBSS138ES	SOT-23	3000 pcs / Tape & Reel	MM5
TBSS138ESW	SOT-323	3000 pcs / Tape & Reel	MM5
TBSS138EST	SOT-523	3000 pcs / Tape & Reel	MM5
TBSS138ESL	DFN1006-3	10000 pcs / Tape & Reel	MM5
TBSS138ESM	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_{DS}	50	V
Gate-to-Source Voltage		V_{GS}	± 20	V
Continuous Drain Current ($T_A = 25^\circ\text{C}$) ^{*1}		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 ^{*3}		E_{AS}	0.2	mJ
Power Dissipation ($T_A = 25^\circ\text{C}$) ^{*1}	SOT-23	P_D	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	$-55 \sim +150$	$^\circ\text{C}$
Storage Temperature Range		T_{STG}	$-55 \sim +150$	$^\circ\text{C}$

Thermal Characteristics

Parameter		Symbol	Value	Unit
Thermal Resistance Junction-to-Air ^{*1}	SOT-23	$R_{\theta JA}$	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 ^{*1}	SOT-23	$R_{\theta JL}$	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 ^{*1}	SOT-23	$R_{\theta JC}$	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 (@ $T_A = 25^\circ\text{C}$ unless otherwise specified)

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

Notes:

- The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper
- The data tested by pulsed, pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$
- The E_{AS} data shows Max. rating. The test condition is $V_{DD} = 30V, V_{GS} = 10V, L = 0.5mH$
- Guaranteed by design, not subject to production

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

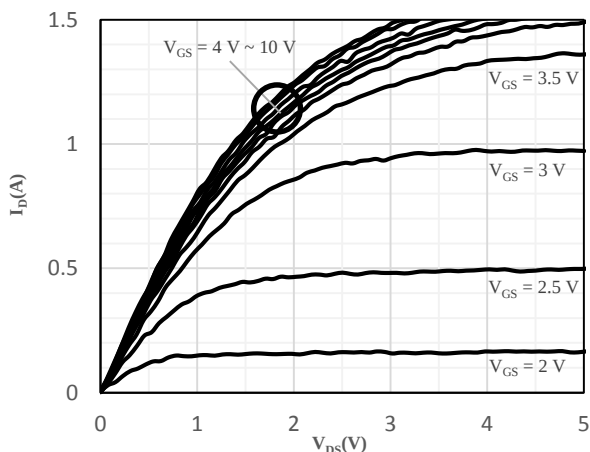


Fig 1 Typical Output Characteristics

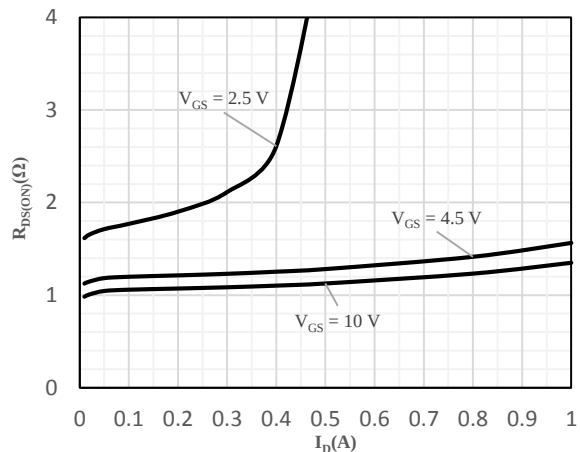


Fig 2 On-Resistance vs. Drain Current
and Gate Voltage

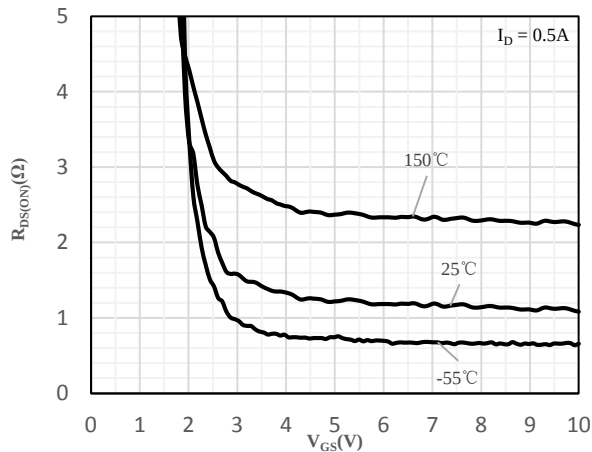


Fig 3 On-Resistance vs. Gate-Source Voltage

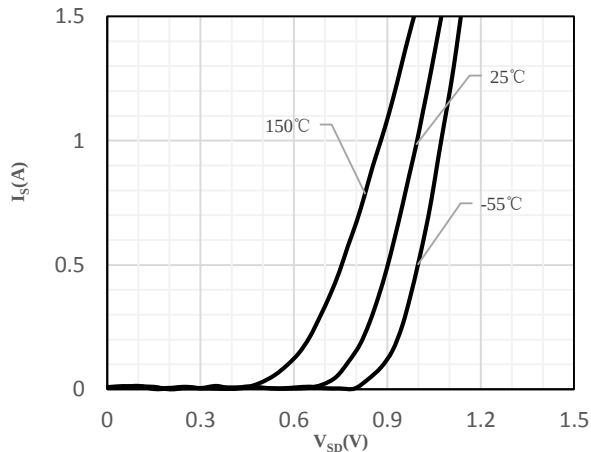


Fig 4 Body-Diode Characteristics

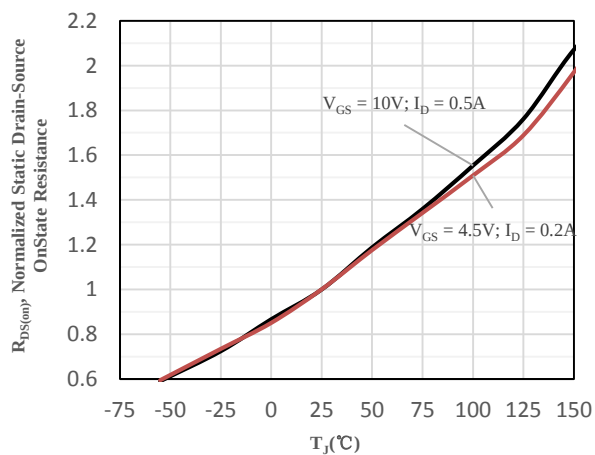


Fig 5 Normalized On-Resistance vs. Junction
Temperature

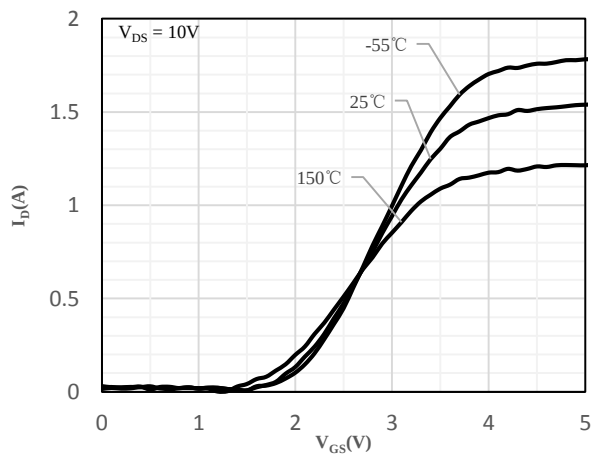


Fig 6 Transfer Characteristics

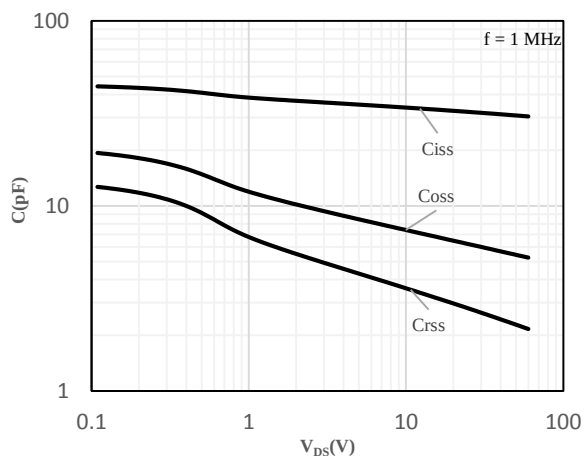


Fig 7 Capacitance Characteristics

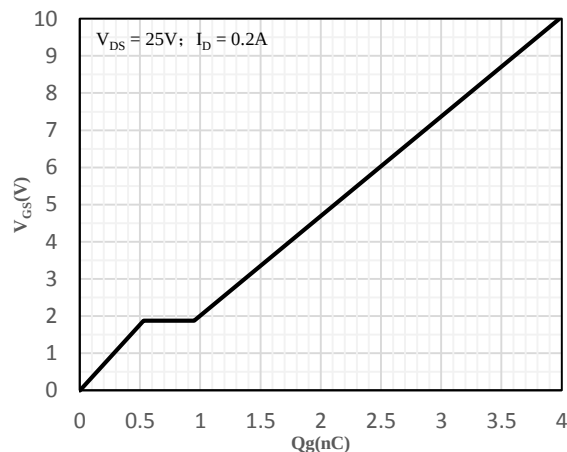


Fig 8 Gate-Charge Characteristics

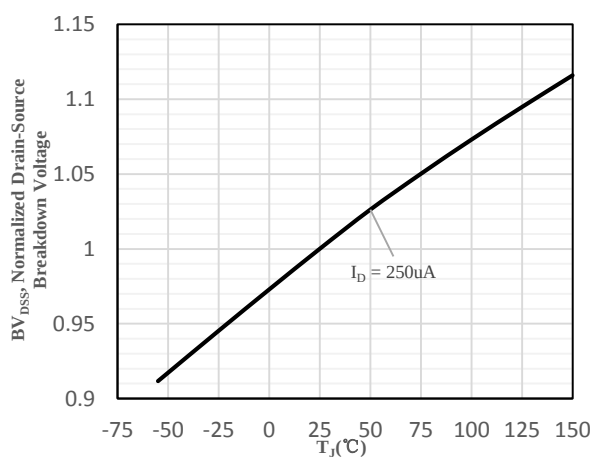


Fig 9 Normalized Breakdown Voltage
vs. Junction Temperature

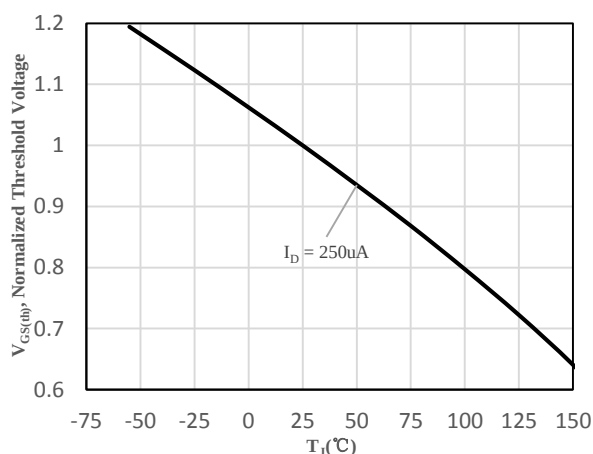


Fig 10 Normalized $V_{GS(th)}$ vs. Junction Temperature

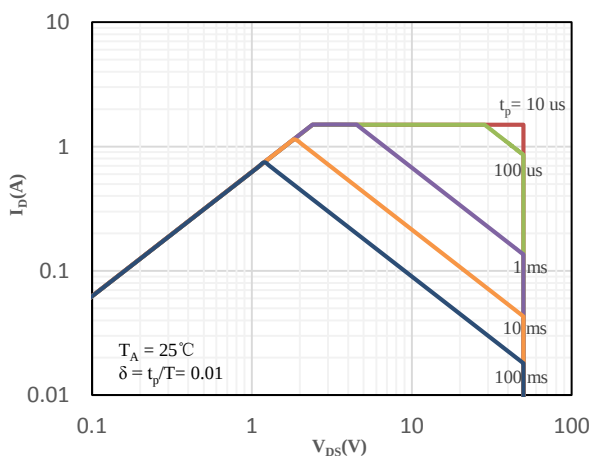


Fig 11 Safe Operation Area

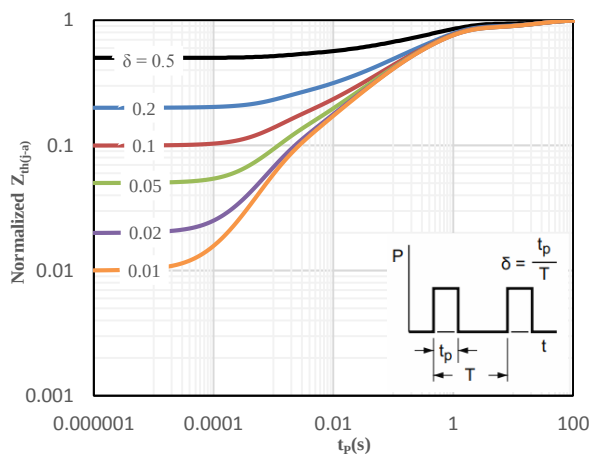
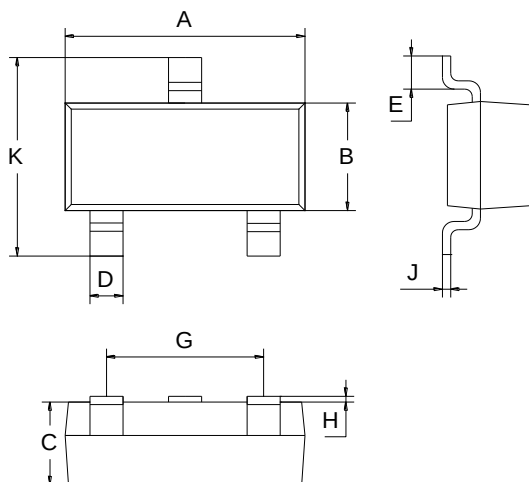


Fig 12 Normalized Maximum transient thermal
impedance

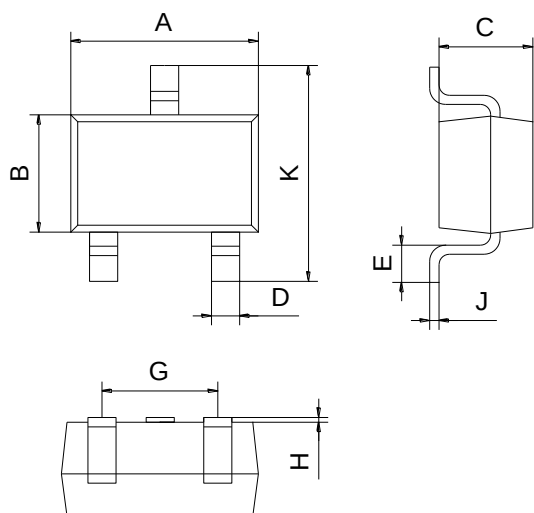
Package Outline Dimensions (Unit: mm)

SOT-23



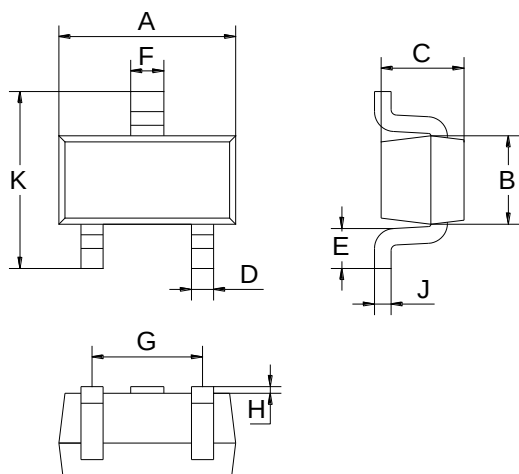
SOT-23		
Dimension	Min.	Max.
A	2.70	3.10
B	1.10	1.50
C	0.90	1.10
D	0.30	0.50
E	0.35	0.48
G	1.80	2.00
H	0.02	0.10
J	0.05	0.15
K	2.20	2.60

SOT-323



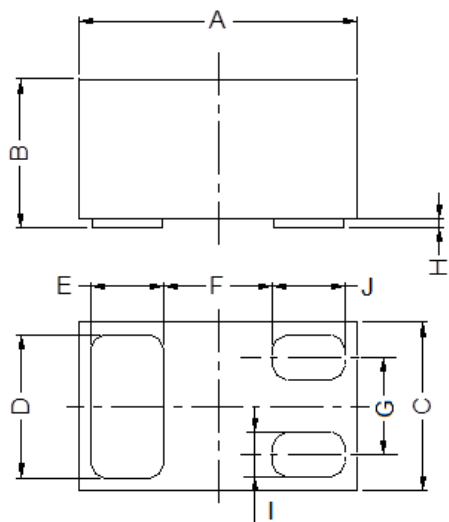
SOT-323		
Dimension	Min.	Max.
A	2.00	2.20
B	1.15	1.35
C	0.90	1.10
D	0.15	0.35
E	0.25	0.40
G	1.20	1.40
H	0.02	0.10
J	0.05	0.15
K	2.20	2.40

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

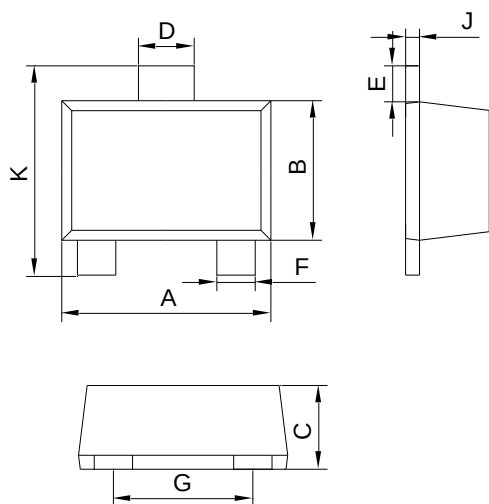
DFN1006-3



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

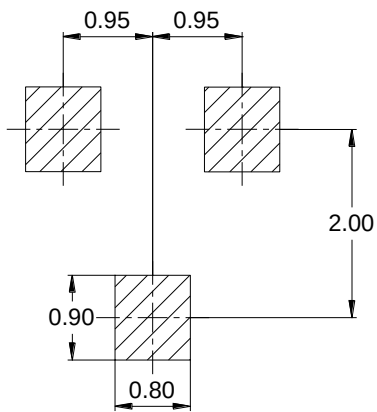


SOT-723

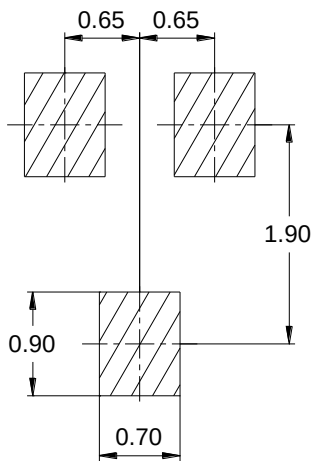
Dimension	Min.	Max.
A	1.10	1.30
B	0.70	0.90
C	0.40	0.54
D	0.22	0.42
E	0.10	0.30
F	0.12	0.32
G	0.70	0.90
J	0.08	0.15
K	1.10	1.30

Mounting Pad Layout (Unit: mm)

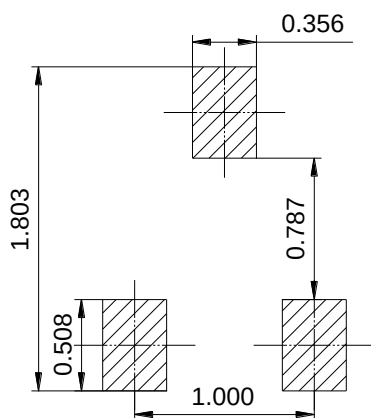
SOT-23



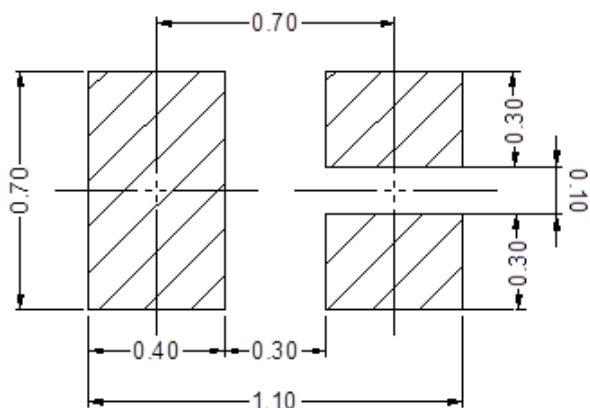
SOT-323



SOT-523



DFN1006-3



SOT-723

