

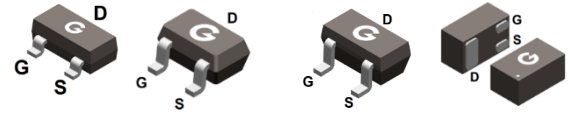
Features

- Advanced trench technology
- Low On-Resistance
- Low gate threshold voltage
- 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

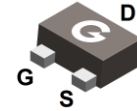
HF

Mechanical Data

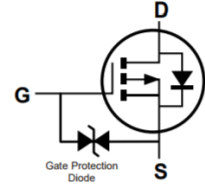
- Case: SOT-23, SOT-323, SOT-523, DFN1006-3, SOT-723
- Molding Compound: UL Flammability Classification Rating 94V-0
- Terminals: Matte tin-plated leads; solderability-per MIL-STD-202, Method 208



TBL1013 SOT-23 TBL1013W SOT-323 TBL1013T SOT-523 TBL1013L DFN1006-3



TBL1013M
SOT-723



Ordering Information

Part Number	Package	Shipping Quantity	Marking Code
TBL1013	SOT-23	3000 pcs / Tape & Reel	PA1
TBL1013W	SOT-323	3000 pcs / Tape & Reel	PA1
TBL1013T	SOT-523	3000 pcs / Tape & Reel	PA1
TBL1013L	DFN1006-3	10000 pcs / Tape & Reel	PA1
TBL1013M	SOT-723	10000 pcs / Tape & Reel	PA1

Maximum Ratings (@ T_A = 25°C unless otherwise specified)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	V _{DSS}	-20	V
Gate-to-Source Voltage	V _{GSS}	±12	V
Continuous Drain Current (T _A = 25°C) *1	I _D	-0.78	A
Continuous Drain Current (T _A = 70°C) *1		-0.62	A
Pulsed Drain Current (t _p = 10μs, T _A = 25°C)	I _{DM}	-4.9	A
Single Pulse Avalanche Energy *3	E _{AS}	0.5	mJ

Thermal Characteristics

Parameter		Symbol	Value	Unit
Power Dissipation ($T_A = 25^\circ\text{C}$) *1	SOT-23	P_D	0.35	W
	SOT-323		0.29	
	SOT-523		0.28	
	DFN1006-3		0.15	
	SOT-723		0.15	
Thermal Resistance Junction-to-Air *1	SOT-23	$R_{\theta JA}$	357	$^\circ\text{C/W}$
	SOT-323		431	
	SOT-523		447	
	DFN1006-3		834	
	SOT-723		834	
Thermal Resistance Junction-to-Lead *1	SOT-23	$R_{\theta JL}$	214	$^\circ\text{C/W}$
	SOT-323		258	
	SOT-523		268	
	DFN1006-3		500	
	SOT-723		500	
Thermal Resistance Junction-to-Case *1	SOT-23	$R_{\theta JC}$	180	$^\circ\text{C/W}$
	SOT-323		217	
	SOT-523		225	
	DFN1006-3		421	
	SOT-723		421	
Operating Junction Temperature Range		T_J	-55 ~ +150	$^\circ\text{C}$
Storage Temperature Range		T_{STG}	-55 ~ +150	$^\circ\text{C}$

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	-20	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = -20V, V _{GS} = 0V	-	-	-1	μA
I _{GSS}	Gate-Body Leakage Current	V _{GS} = ±4.5V, V _{DS} = 0V	-	-	±10	μA
On Characteristics						
R _{DS(ON)}	Drain-Source On-resistance *2	V _{GS} = -4.5V, I _D = -780mA	-	0.4	0.48	Ω
		V _{GS} = -2.5V, I _D = -660mA	-	0.6	0.67	
		V _{GS} = -1.8V, I _D = -100mA	-	0.75	2.2	
V _{GS(TH)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = -250uA	-0.45	-0.6	-1.2	V
R _G	Gate Resistance	V _{GS} = 0V, f = 1MHz	-	94	-	Ω
Dynamic Characteristics						
C _{ISS}	Input Capacitance	V _{GS} = 0V V _{DS} = -16V f = 1.0MHz	-	76	-	pF
C _{OSS}	Output Capacitance		-	13	-	
C _{RSS}	Reverse Transfer Capacitance		-	10	-	
Switching Characteristics						
t _{d(ON)}	Turn-on Delay Time *4	V _{DD} = -10V	-	8	-	ns
t _r	Turn-on Rise Time *4	V _{GS} = -4.5V	-	5.5	-	
t _{d(OFF)}	Turn-Off Delay Time *4	R _G = 3Ω	-	30	-	
t _f	Turn-Off Fall Time *4	R _G = 50Ω	-	17	-	
Q _G	Total Gate-Charge	V _{DS} = -16V V _{GS} = -4.5V I _D = -0.2A	-	2.6	-	nC
Q _{GS}	Gate to Source Charge		-	0.57	-	
Q _{GD}	Gate to Drain (Miller) Charge		-	0.34	-	
Source-Drain Diode Characteristics						
V _{SD}	Diode Forward Voltage *2	I _S = -0.35A, V _{GS} = 0 V	-	-0.8	-1.2	V

Notes:

1. The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper
2. The data tested by pulsed, pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$
3. The E_{AS} data shows Max. rating. The test condition is $V_{DD} = -15V, V_{GS} = -5V, L = 0.1mH$
4. Guaranteed by design, not subject to production

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

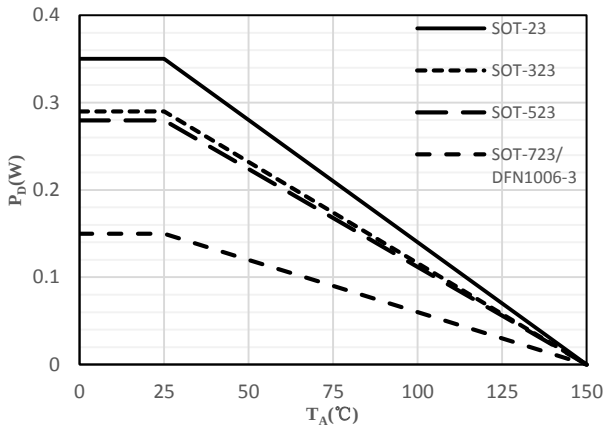


Fig 1 Power Dissipation

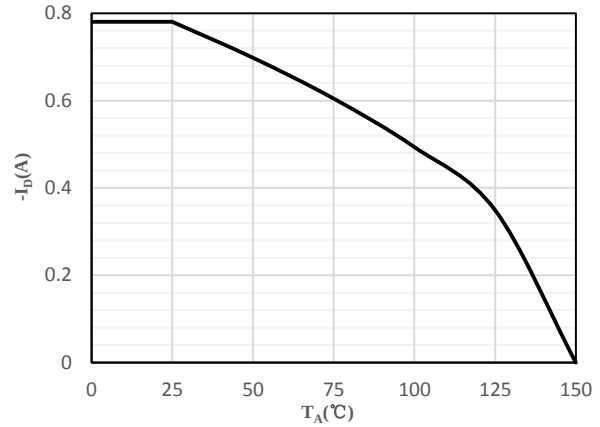


Fig 2 Drain Current

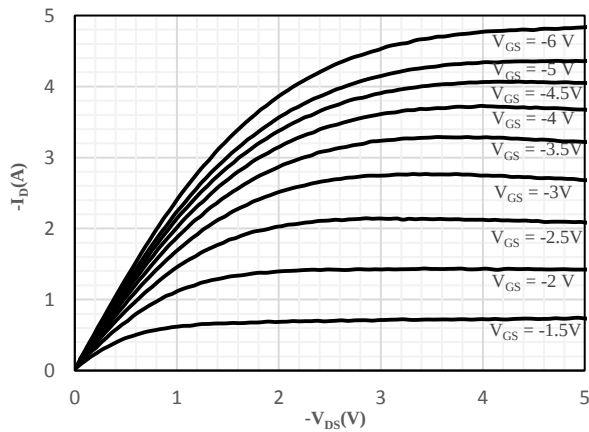


Fig 3 Typical Output Characteristics

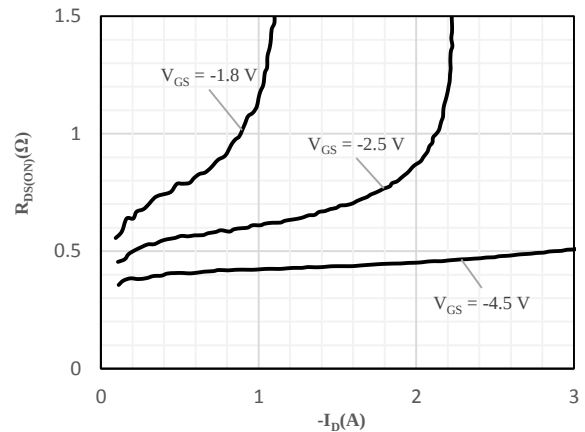


Fig 4 On-Resistance vs. Drain Current
and Gate Voltage

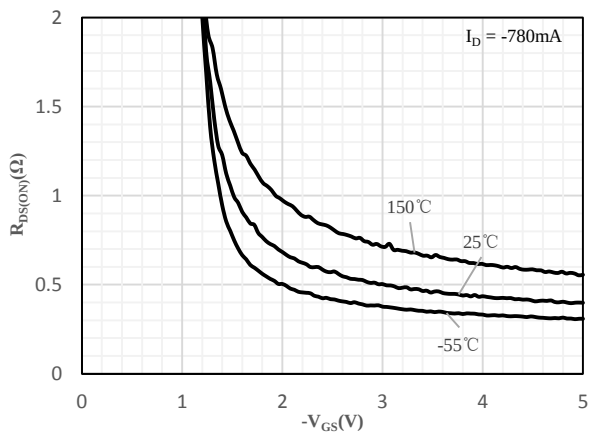


Fig 5 On-Resistance vs. Gate-Source Voltage

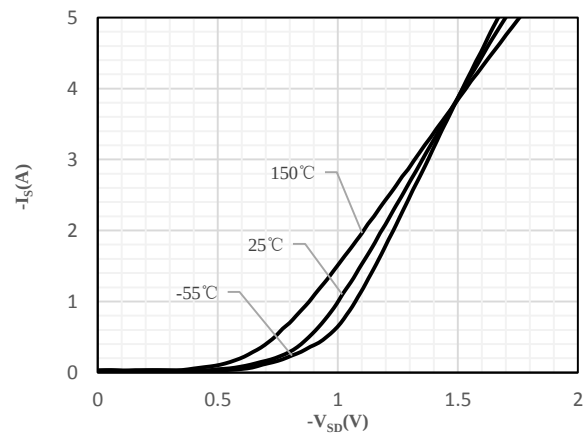


Fig 6 Body-Diode Characteristics

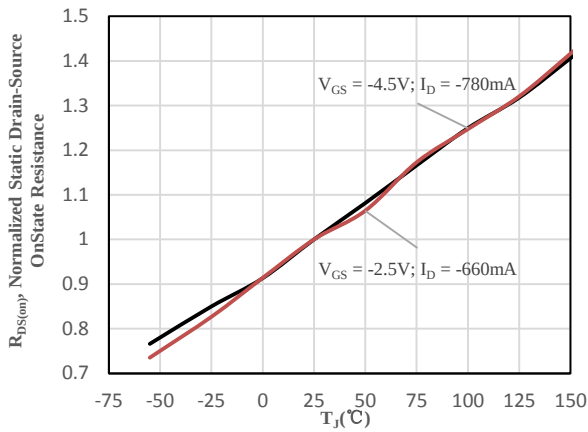


Fig 7 Normalized On-Resistance vs. Junction Temperature

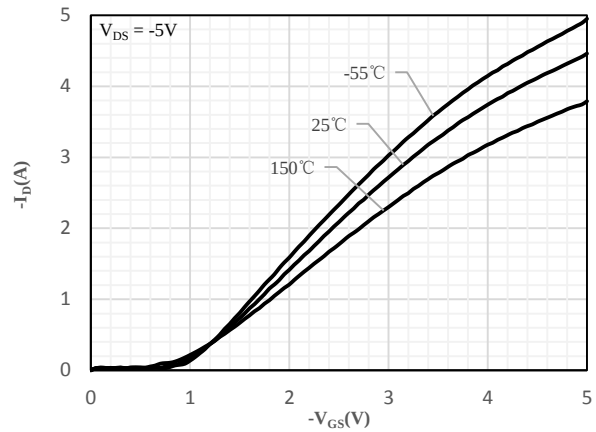


Fig 8 Transfer Characteristics

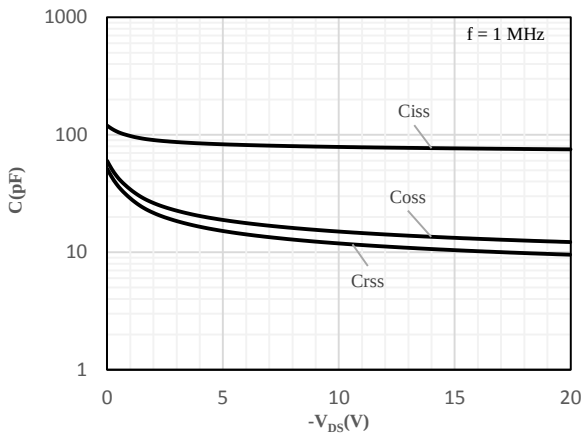


Fig 9 Capacitance Characteristics

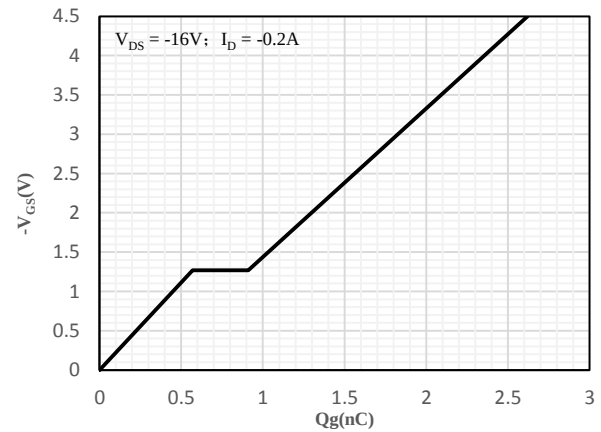


Fig 10 Gate-Charge Characteristics

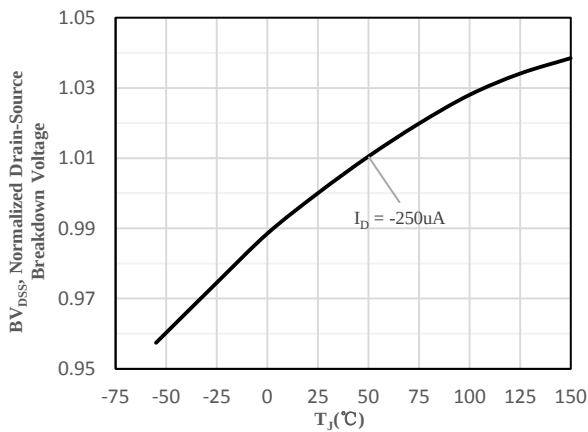


Fig 11 Normalized Breakdown Voltage vs. Junction Temperature

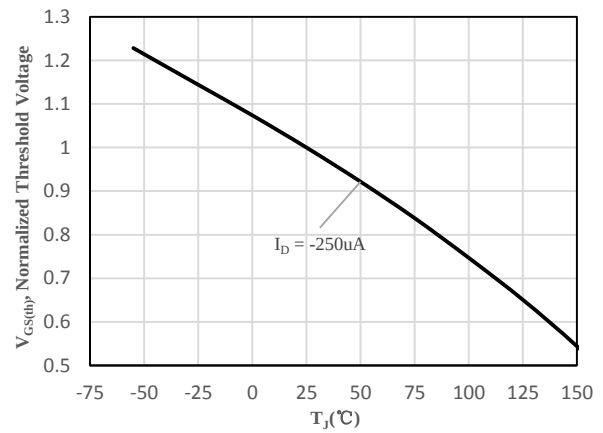
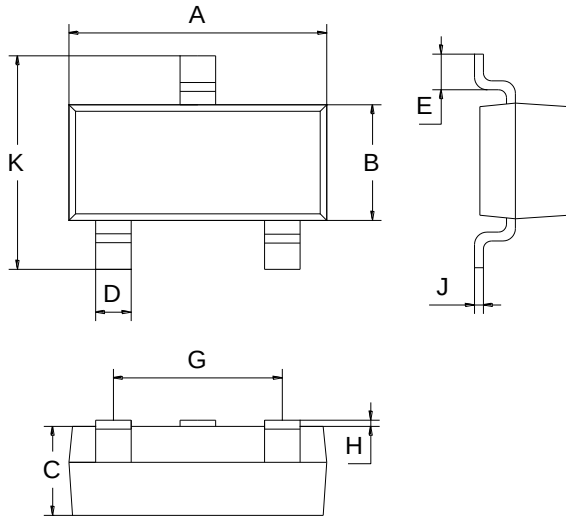
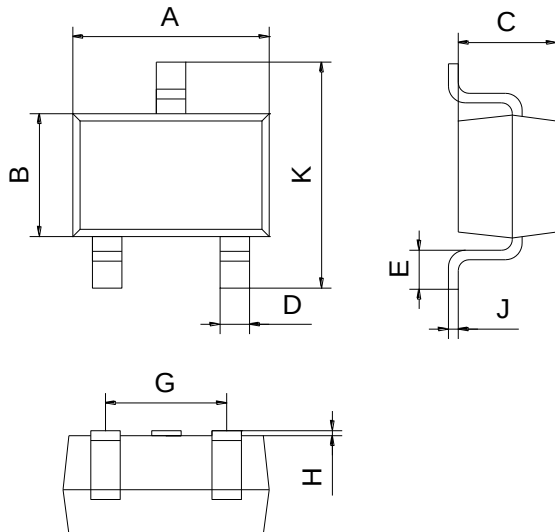


Fig 12 Normalized $V_{GS(th)}$ vs. Junction Temperature

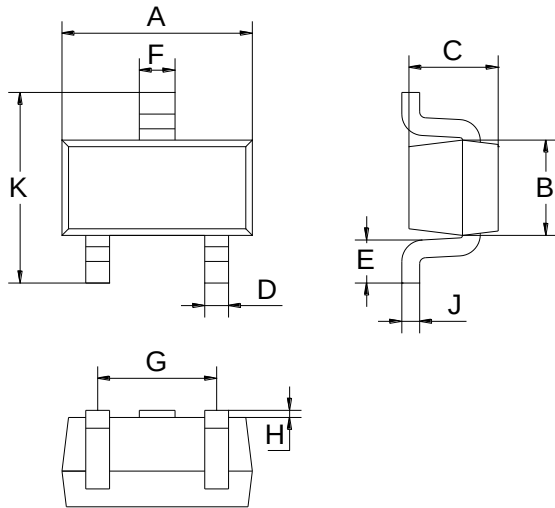
Package Outline Dimensions (Unit: mm)



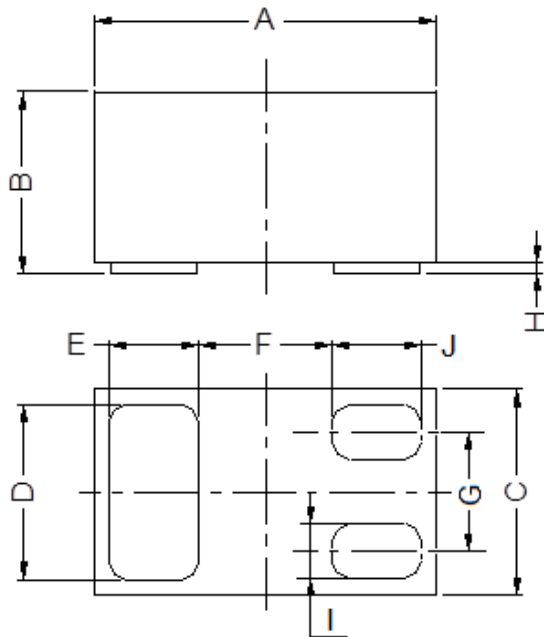
SOT-23		
Dimension	Min.	Max.
A	2.70	3.10
B	1.10	1.50
C	0.90	1.10
D	0.30	0.50
E	0.35	0.48
G	1.80	2.00
H	0.02	0.10
J	0.05	0.15
K	2.20	2.60



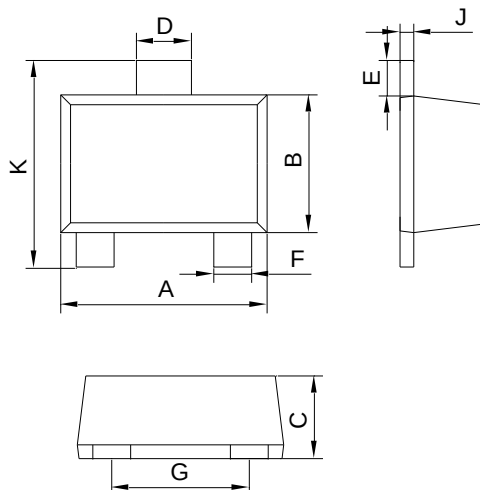
SOT-323		
Dimension	Min.	Max.
A	2.00	2.20
B	1.15	1.35
C	0.90	1.10
D	0.15	0.35
E	0.25	0.40
G	1.20	1.40
H	0.02	0.10
J	0.05	0.15
K	2.20	2.40



SOT-523		
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



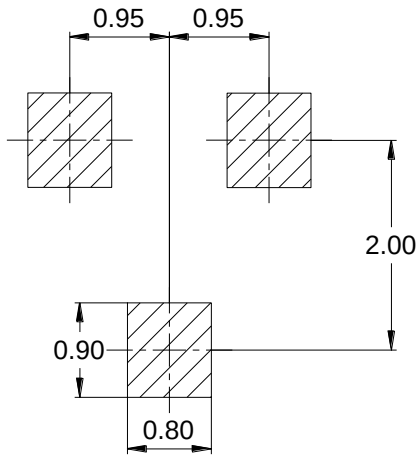
DFN1006-3			
Dimension	Min.	Typ.	Max.
A	0.95	1.00	1.075
B	0.47	0.50	0.53
C	0.55	0.60	0.675
D	0.45	0.50	0.55
E/J	0.20	0.25	0.30
F	-	0.40	-
G	-	0.35	-
H	0	0.03	0.05
I	0.10	0.15	0.20



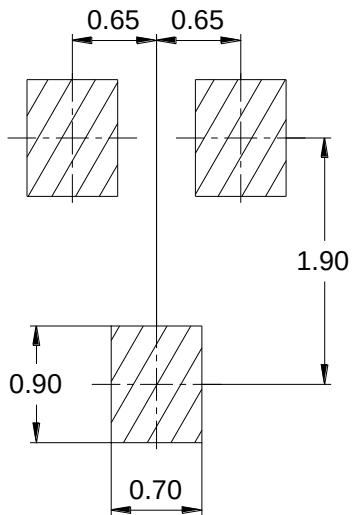
SOT-723		
Dimension	Min.	Max.
A	1.10	1.30
B	0.70	0.90
C	0.40	0.54
D	0.22	0.42
E	0.10	0.30
F	0.12	0.32
G	0.70	0.90
J	0.08	0.15
K	1.10	1.30

Mounting Pad Layout (Unit: mm)

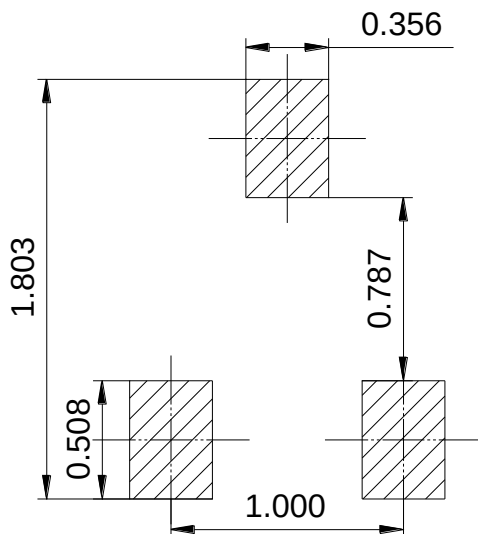
SOT-23



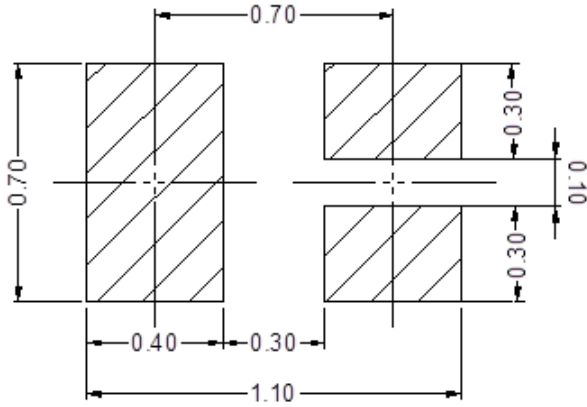
SOT-323



SOT-523



DFN1006-3



SOT-723

