

6 Lake Street, Lawrence, MA 01841 1-800-446-1158 / (978) 620-2600 / Fax: (978) 689-0803

Website: http://www.microsemi.com

## NPN SILICON SWITCHING TRANSISTOR

Qualified per MIL-PRF-19500/255

### **DEVICES**

2N2221A 2N2222A 2N2221AL 2N2222AL 2N2221AUA 2N2222AUA 2N2221AUB 2N2222AUB 2N2221AUBC \* 2N2222AUBC \*

# LEVELS

JAN JANTX JANTXV JANS

## ABSOLUTE MAXIMUM RATINGS ( $T_C = +25$ °C unless otherwise noted)

Parameters / Test Conditions	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	50	Vdc
Collector-Base Voltage	$V_{CBO}$	75	Vdc
Emitter-Base Voltage	$V_{EBO}$	6.0	Vdc
Collector Current	$I_{C}$	800	mAdc
Total Power Dissipation @ $T_A = +25^{\circ}C$	$P_{T}$	0.5	W
Operating & Storage Junction Temperature Range	$T_{op}, T_{stg}$	-65 to +200	°C

### THERMAL CHARACTERISTICS

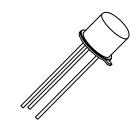
Parameters / Test Cond	Symbol	Max.	Unit	
Thermal Resistance, June				
2N2221A, L	2N2222A, L	$R_{ heta IA}$	325	°C/W
2N2221AUA	2N2222AUA	TOJA	210	
2N2221AUB, UBC	2N2222AUB, UBC		325	

**Note:** Consult 19500/255 for thermal performance curves.

- 1. Derate linearly  $3.08 \text{mW}/^{\circ}\text{C}$  above  $T_A > +37.5 ^{\circ}\text{C}$
- 2. Derate linearly  $4.76 \text{mW}/^{\circ}\text{C}$  above  $T_A > +63.5^{\circ}\text{C}$

## ELECTRICAL CHARACTERISTICS ( $T_A = +25$ °C, unless otherwise noted)

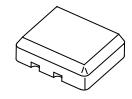
Parameters / Test Conditions	Symbol	Min.	Max.	Unit
OFF CHARACTERTICS				
Collector-Emitter Breakdown Voltage $I_C = 10$ mAdc	V <sub>(BR)CEO</sub>	50		Vdc
Collector-Base Cutoff Current $V_{CB} = 75 Vdc$ $V_{CB} = 60 Vdc$	$I_{CBO}$		10 10	μAdc ηAdc
Emitter-Base Cutoff Current $V_{EB} = 6.0 Vdc$ $V_{EB} = 4.0 Vdc$	$I_{EBO}$		10 10	μAdc ηAdc
Collector-Emitter Cutoff Current $V_{CE} = 50Vdc$	I <sub>CES</sub>		50	ηAdc



TO-18 (TO-206AA) 2N2221A, 2N2222A



4 PIN 2N2221AUA, 2N2222AUA



3 PIN 2N2221AUB, 2N2222AUB 2N2221AUBC, 2N2222AUBC (UBC = Ceramic Lid Version)

<sup>\*</sup> Available to JANS quality level only.



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## ELECTRICAL CHARACTERISTICS ( $T_A = +25$ °C, unless otherwise noted)

Parameters / Test Conditions	Symbol	Min.	Max.	Unit	
ON CHARACTERISTICS (2)					
Forward-Current Transfer Ratio					
$I_C = 0.1 \text{mAdc}, V_{CE} = 10 \text{Vdc}$	2N2221A, L, UA, UB, UBC 2N2222A, L, UA, UB, UBC		30 50		
$I_C = 1.0 \text{mAdc}, V_{CE} = 10 \text{Vdc}$	2N2221A, L, UA, UB, UBC 2N2222A, L, UA, UB, UBC		35 75	150 325	
$I_C = 10$ mAdc, $V_{CE} = 10$ Vdc	2N2221A, L, UA, UB, UBC 2N2222A, L, UA, UB, UBC	$h_{\mathrm{FE}}$	40 100		
$I_C = 150 \text{mAdc}, V_{CE} = 10 \text{Vdc}$	2N2221A, L, UA, UB, UBC 2N2222A, L, UA, UB, UBC		40 100	120 300	
$I_C = 500 \text{mAdc}, V_{CE} = 10 \text{Vdc}$	2N2221A, L, UA, UB, UBC 2N2222A, L, UA, UB, UBC		20 30		
Collector-Emitter Saturation Voltage					
$\begin{split} &I_{C}=150\text{mAdc},I_{B}=15\text{mAdc}\\ &I_{C}=500\text{mAdc},I_{B}=50\text{mAdc} \end{split}$		V <sub>CE(sat)</sub>		0.3 1.0	Vdc
Base-Emitter Voltage $I_{C} = 150 \text{mAdc}, I_{B} = 15 \text{mAdc}$ $I_{C} = 500 \text{mAdc}, I_{B} = 50 \text{mAdc}$		V <sub>BE(sat)</sub>	0.6	1.2 2.0	Vdc

## DYNAMIC CHARACTERISTICS

Parameters / Test Conditions	Symbol	Min.	Max.	Unit	
Small-Signal Short-Circuit Forward Current Tr	ansfer Ratio				
$I_C = 1.0 \text{mAdc}, V_{CE} = 10 \text{Vdc}, f = 1.0 \text{kHz}$	2N2221A, L, UA, UB, UBC 2N2222A, L, UA, UB, UBC	$h_{\mathrm{fe}}$	30 50		
$\begin{aligned} & \text{Magnitude of Small-Signal Short-Circuit} \\ & \text{Forward Current Transfer Ratio} \\ & I_C = 20 \text{mAdc}, \ V_{CE} = 20 \text{Vdc}, \ f = 100 \text{MHz} \end{aligned}$		h <sub>fe</sub>	2.5		
Output Capacitance $V_{CB} = 10 V dc,  I_E = 0,  100 kHz \leq f \leq 1.0 MHz$		$C_{ m obo}$		8.0	pF
$\label{eq:capacitance} Input Capacitance $$V_{EB} = 0.5 V dc, \ I_C = 0, \ 100 kHz \le f \le 1.0 MHz$$$		$C_{ibo}$		25	pF

## **SWITCHING CHARACTERISTICS**

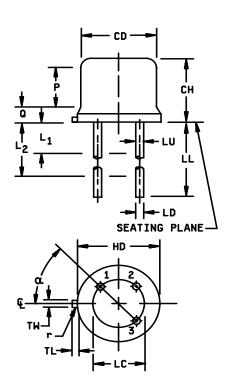
Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-On Time See figure 8 of MIL-PRF-19500/255	t <sub>on</sub>		35	ηs
Turn-Off Time See Figure 9 of MIL-PRF-19500/255	$t_{ m off}$		300	ηs

<sup>(2)</sup> Pulse Test: Pulse Width =  $300\mu s$ , Duty Cycle  $\leq 2.0\%$ .



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## PACKAGE DIMENSIONS



### **NOTES:**

- 1. Dimensions are in inches.
- 2. Millimeters are given for general information only.
- 3. Beyond r (radius) maximum, TL shall be held for a minimum length of .011 inch (0.28 mm).
- 4. Dimension TL measured from maximum HD.
- 5. Body contour optional within zone defined by HD, CD, and Q.
- 6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
- 7. Dimension LU applies between  $L_1$  and  $L_2$ . Dimension LD applies between  $L_2$  and LL minimum. Diameter is uncontrolled in  $L_1$  and beyond LL minimum.
- 8. All three leads.
- 9. The collector shall be internally connected to the case.
- 10. Dimension r (radius) applies to both inside corners of tab.
- 11. In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.
- 12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.
- 13. For L suffix devices, dimension LL = 1.5 inches (38.10 mm) min. and 1.75 inches (44.45 mm) max.

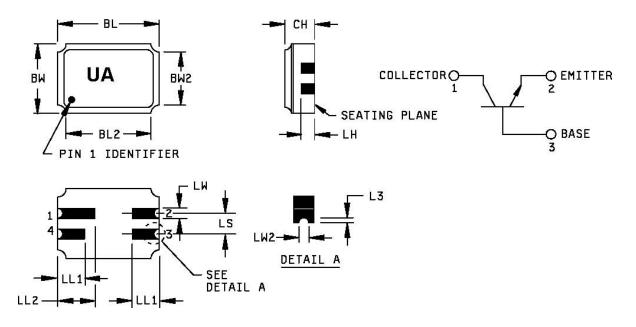
	Dimensions						
Symbol	Inc	hes	Millir	neters	Note		
	Min	Max	Min	Max			
CD	.178	.195	4.52	4.95			
CH	.170	.210	4.32	5.33			
HD	.209	.230	5.31	5.84			
LC	.100	) TP	2.54	I TP	6		
LD	.016	.021	0.41	0.53	7,8		
LL	.500	.750	12.70	19.05	7,8,13		
LU	.016	.019	0.41	0.48	7,8		
$L_1$		.050		1.27	7,8		
$L_2$	.250		6.35		7,8		
P	.100		2.54				
Q		.030		0.76	5		
TL	.028	.048	0.71	1.22	3,4		
TW	.036	.046	0.91	1.17	3		
r		.010		0.25	10		
α	45° TP		45° TP		6		
	1, 2, 9, 11, 12, 13						

FIGURE 1. Physical dimensions (similar to TO-18).



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### **NOTES:**

- 1. Dimensions are in inches.
- 2. Millimeters are given for general information only.
- 3. Dimension CH controls the overall package thickness. When a window lid is used, dimension CH must increase by a minimum of .010 inch (0.254 mm) and a maximum of .040 inch (1.020 mm).
- 4. The corner shape (square, notch, radius) may vary at the manufacturer's option, from that shown on the drawing.
- 5. Dimensions LW2 minimum and L3 minimum and the appropriate castellation length define an unobstructed three-dimensional space traversing all of the ceramic layers in which a castellation was designed. (Castellations are required on the bottom two layers, optional on the top ceramic layer.) Dimension LW2 maximum and L3 maximum define the maximum width and depth of the castellation at any point on its surface. Measurement of these dimensions may be made prior to solder dipping.
- 6. The co-planarity deviation of all terminal contact points, as defined by the device seating plane, shall not exceed .006 inch (0.15mm) for solder dipped leadless chip carriers.
- 7. In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.

Symbol	Inc	hes	Millir	neters	Note
	Min	Max	Min	Max	
BL	.215	.225	5.46	5.71	
BL2		.225		5.71	
BW	.145	.155	3.68	3.93	
BW2		.155		3.93	
CH	.061	.075	1.55	1.90	3
L3	.003	.007	0.08	0.18	5
LH	.029	.042	0.74	1.07	
LL1	.032	.048	0.81	1.22	
LL2	.072	.088	1.83	2.23	
LS	.045	.055	1.14	1.39	
LW	.022	.028	0.56	0.71	
LW2	.006	.022	0.15	0.56	5

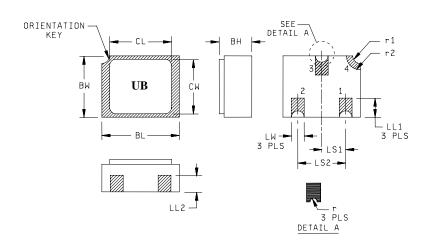
Pin no.	1	2	3	4
Transistor	Collector	Emitter	Base	N/C

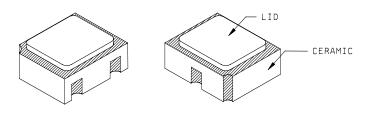
FIGURE 2. Physical dimensions, surface mount (UA version).



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	Dimensions				
Symbol	Inc	Inches		neters	Note
	Min	Max	Min	Max	
BH	.046	.056	1.17	1.42	
BL	.115	.128	2.92	3.25	
BW	.085	.108	2.16	2.74	
CL		.128		3.25	
CW		.108		2.74	
LL1	.022	.038	0.56	0.96	
LL2	.017	.035	0.43	0.89	

	Dimensions				
Symbol	Symbol Inch		Millin	neters	Note
	Min	Max	Min	Max	
$LS_1$	.036	.040	0.91	1.02	
$LS_2$	.071	.079	1.81	2.01	
LW	.016	.024	0.41	0.61	
r		.008		.203	
$\mathbf{r}_1$		.012		.305	
$\mathbf{r}_2$		.022		.559	

### **NOTES:**

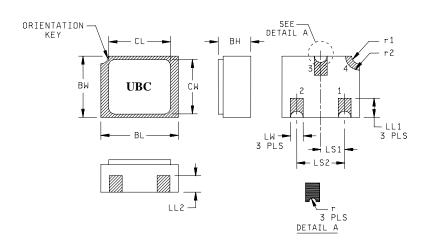
- 1. Dimensions are in inches.
- 2. Millimeters are given for general information only.
- 3. Hatched areas on package denote metalized areas.
- 4. Pad 1 = Base, Pad 2 = Emitter, Pad 3 = Collector, Pad 4 = Shielding connected to the lid.
- 5. In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.

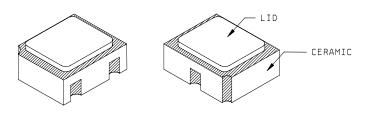
FIGURE 3. Physical dimensions, surface mount (UB version)



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	Dimensions				
Symbol	Inc	Inches		Millimeters	
	Min	Max	Min	Max	
BH	.046	.071	1.17	1.80	
BL	.115	.128	2.92	3.25	
BW	.085	.108	2.16	2.74	
CL		.128		3.25	
CW		.108		2.74	
LL1	.022	.038	0.56	0.96	
LL2	.017	.035	0.43	0.89	

	Dimensions				
Symbol	Inches		Millimeters		Note
	Min	Max	Min	Max	
$LS_1$	.036	.040	0.91	1.02	
$LS_2$	.071	.079	1.81	2.01	
LW	.016	.024	0.41	0.61	
r		.008		.203	
$\mathbf{r}_1$		.012		.305	
$\mathbf{r}_2$		.022		.559	

### **NOTES:**

- 1. Dimensions are in inches.
- 2. Millimeters are given for general information only.
- 3. Hatched areas on package denote metalized areas.
- 4. Pad 1 = Base, Pad 2 = Emitter, Pad 3 = Collector, Pad 4 = Connected to the lid braze ring.
- 5. In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.

FIGURE 4. Physical dimensions, surface mount (UBC version, ceramic lid)

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