

**2N2221A**

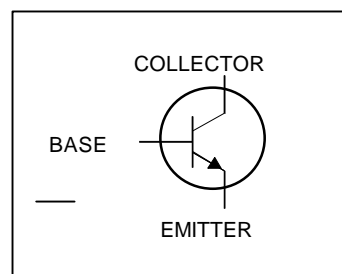
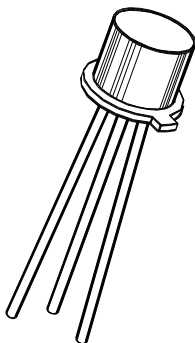
## Features

- Meets MIL 19500 /255
- Collector - Base Voltage 75 V
- Collector - Current 800 mA
- High Speed, Medium Current Bipolar Transistor

**SWITCHING  
TRANSISTOR  
JAN, JANTX, JANTXV**

**SMALL SIGNAL  
BIPOLAR  
NPN SILICON**

TO-18



## Maximum Ratings

RATING	SYMBOL	VALUE	UNIT
Collector - Emitter Voltage	$V_{CEO}$	50	Vdc
Collector - Base Voltage	$V_{CBO}$	75	Vdc
Emitter - Base Voltage	$V_{EBO}$	6	Vdc
Collector Current -- Continuous	$I_C$	800	mA <sub>dc</sub>
Total Device Dissipation @ $T_A = 25\text{ }^{\circ}\text{C}$	$P_D$	500	mW
Derate above 25 $^{\circ}\text{C}$		2.85	mW/ $^{\circ}\text{C}$
Total Device Dissipation @ $T_C = 25\text{ }^{\circ}\text{C}$	$P_D$	1.8	WATTS
Derate above 25 $^{\circ}\text{C}$		10.3	mW/ $^{\circ}\text{C}$
Operating Junction&Storage Temperature Range	$T_J, T_{stg}$	- 65 to + 200	$^{\circ}\text{C}$

## Thermal Characteristics

CHARACTERISTIC	SYMBOL	MAX	UNIT
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	350	$^{\circ}\text{C}/\text{W}$

Electrical Characteristics ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

OFF CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Collector - Emitter Breakdown Voltage (1) ( $I_C = 10\text{ mA dc}, I_B = 0$ )	$V(BR)_{CEO}$	50		Vdc
Collector - Base Breakdown Voltage (1) ( $I_C = 10\text{ mA dc}, I_E = 0$ )	$V(BR)_{CBO}$	75		Vdc
Emitter - Base Breakdown Voltage (1) ( $I_E = 10\text{ mA dc}, I_C = 0$ )	$V(BR)_{EBO}$	6		Vdc
Collector - Emitter Cutoff Current ( $V_{CE} = 50\text{ Vdc}, V_{BE(off)} = 0\text{ V}$ )	$I_{CES}$		50	nAdc
Collector - Base Cutoff Current ( $V_{CB} = 60\text{ Vdc}, I_E = 0$ )	$I_{CBO}$		10	nAdc
( $V_{CB} = 60\text{ Vdc}, I_E = 0, T_A = 150^\circ\text{C}$ )			10	μAdc
Emitter - Base Cutoff Current ( $V_{EB} = 4\text{ Vdc}$ )	$I_{EBO}$		10	nAdc

ON CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
DC Current Gain ( $I_C = 100\text{ mA dc}, V_{CE} = 10\text{ Vdc}$ )	$h_{FE}$	30		
( $I_C = 1\text{ mA dc}, V_{CE} = 10\text{ Vdc}$ )		35	150	
( $I_C = 10\text{ mA dc}, V_{CE} = 10\text{ Vdc}$ )		40		
( $I_C = 150\text{ mA dc}, V_{CE} = 10\text{ Vdc}$ ) (1)		40	120	
( $I_C = 500\text{ mA dc}, V_{CE} = 10\text{ Vdc}$ ) (1)		20		
( $I_C = 10\text{ mA dc}, V_{CE} = 10\text{ Vdc}, T_J = -55^\circ\text{C}$ )		15		
Collector - Emitter Saturation Voltage ( $I_C = 150\text{ mA dc}, I_B = 15\text{ mA dc}$ ) (1)	$V_{CE(sat)}$		0.3	Vdc
( $I_C = 500\text{ mA dc}, I_B = 50\text{ mA dc}$ ) (1)			1.0	Vdc
Base - Emitter Saturation Voltage ( $I_C = 150\text{ mA dc}, I_B = 15\text{ mA dc}$ ) (1)	$V_{BE(sat)}$	0.6	1.2	Vdc
( $I_C = 500\text{ mA dc}, I_B = 50\text{ mA dc}$ ) (1)			2.0	Vdc

1. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

Electrical Characteristics ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

SMALL - SIGNAL CHARACTERISTICS	SYMBOL	MIN	MAX	UNIT
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , 100kHz &f &1 MHz )	$C_{obo}$		8	pF
Input Capacitance ( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , 100kHz &f &1 MHz )	$C_{ibo}$		25	pF

SWITCHING CHARACTERISTICS	SYMBOL	MIN	MAX	UNIT
Turn - On Time ( $V_{CC} = 30\text{ Vdc}$ , $I_C = 150\text{ mAdc}$ , $I_{B1} = 15\text{ mAdc}$ ) ( See FIGURE 1 )	$t_{on}$		35	ns
Turn - Off Time ( $V_{CC} = 30\text{ Vdc}$ , $I_C = 150\text{ mAdc}$ , $I_{B1} = -I_{B2} = 15\text{ mAdc}$ ) ( See FIGURE 2 )	$t_{off}$		300	ns

Small - Signal AC Characteristics ( $T_A = 25^\circ\text{C}$ )

LOW FREQUENCY	SYMBOL	MIN	MAX	UNIT
Common - Emitter Forward Current Transfer Ratio ( $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$ )	$h_{fe}$	30		
HIGH FREQUENCY				
Common - Emitter Forward Current Transfer Ratio ( $I_C = 20\text{ mA}$ , $V_{CE} = 20\text{ V}$ , $f = 100\text{ MHz}$ )	$ h_{fe} $	2.5		

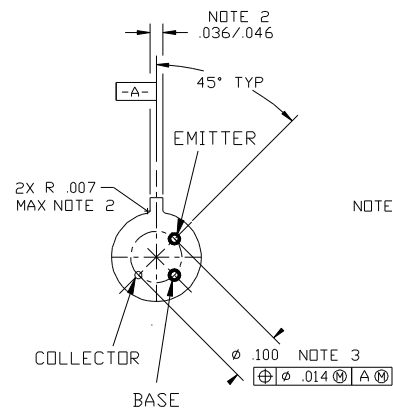
Spice Model (based upon typical device characteristics) \*1

Q2N2221A NPN ( IS = 426.3f XTI = 3.0 EG = 1.11 VAF =250.3 BF = 72.14 ISE = 48.14p  
+ NE = 2.935 IKF = 2.935 NK = 1.401 XTB = 1.5 BR = 11.49 ISC = 19.9f  
+ NC = 1.88 IKR = 10.75 RC = 0.3567 CJC = 11.02p VJC = 0.3869 MJC = 0.3292  
+ FC = 0.5 CJE = 29.31p VJE = 0.9036 MJE = 0.4101 TR = 16.89n TF = 537.5p  
+ ITF = 0.1383 XTF = 84.83m VTF=10 )


\*1. Microsemi Corp. claims no responsibility for misapplication of Spice Model information. Spice modeling should be used as a precursor guide to in-circuit performance. Actual performance is the responsibility of the user/designer.

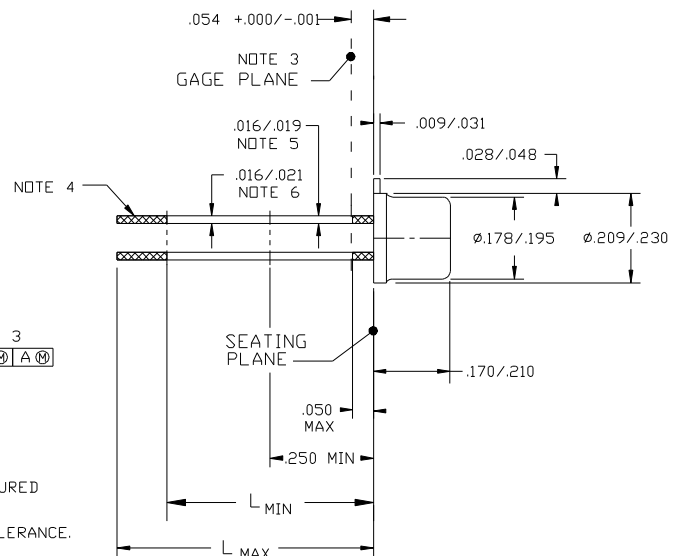
LEAD	DIM L	
	MIN	MAX
SHORT	.500	.750
LONG	1.50	1.75

FOR LONG LEAD ADD  
SUFFIX "L" i.e. 2N2221A L

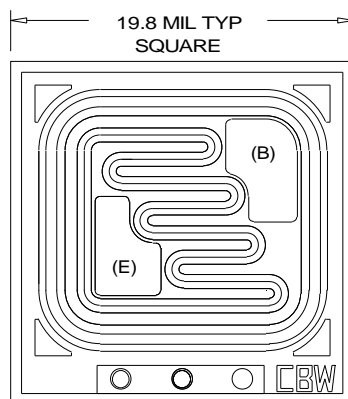


**NOTES:**

1. DIMENSIONS ARE IN INCHES
2. TAB WIDTH SHALL BE HELD TO TOLERANCE FOR AT LEAST .011 BEYOND CORNER RADIUS
3. TRUE POSITION APPLIES AT GAGE PLANE; DEVICE MAY BE MEASURED BY DIRECT METHODS OR BY MIL SPEC. GAGE & PROCEEDURE.
4.  SYMBOL INDICATES PORTION OF LEADS NOT HELD TO TOLERANCE.
5. .016/.019 LEAD DIA. APPLIES BETWEEN .050 MAX & .250 MIN.
6. .016/.021 LEAD DIA. APPLIES BETWEEN .250 MIN & L MIN.
7. STANDARD PRODUCT LEAD FINISH IS GOLD PLATE. OPTIONAL LEAD FINISH SHALL BE HOT SOLDER DIP PER CUSTOMER SPEC.



**TO 18 CASE OUTLINE**



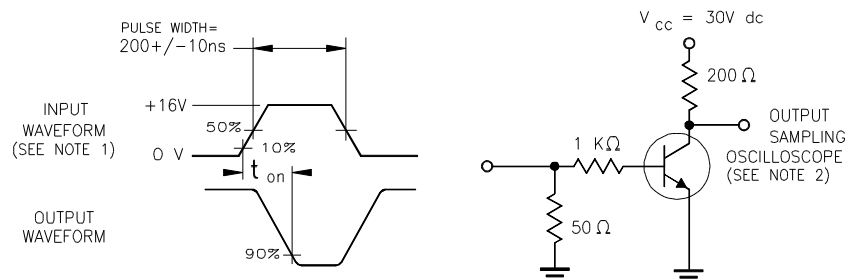
**DIE CHARACTERISTICS**

Back is Collector

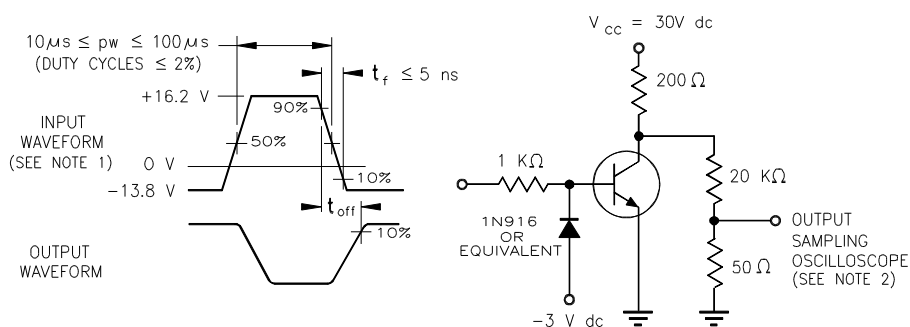
Chip Thickness is:  
10 MILS TYP

Metalization is:  
Top = Al, Back = Au

**DIE OUTLINE**



**FIGURE 1 Saturated Turn-on Time Test Circuit**



**FIGURE 2 Saturated Turn-off Time Test Circuit**

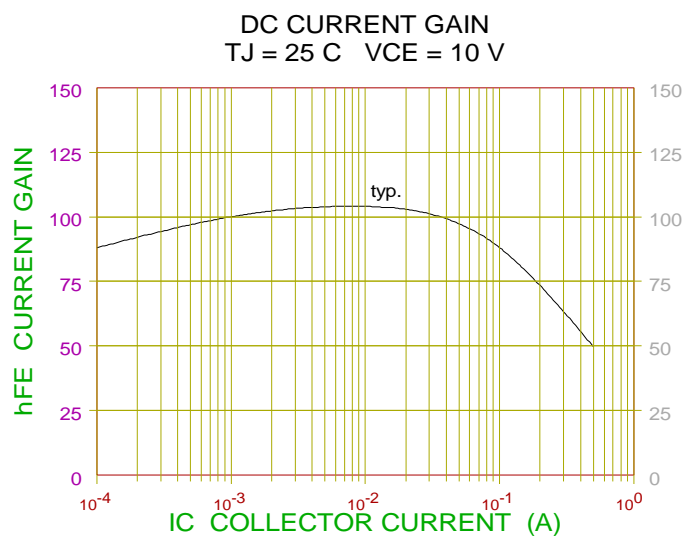


FIGURE 3

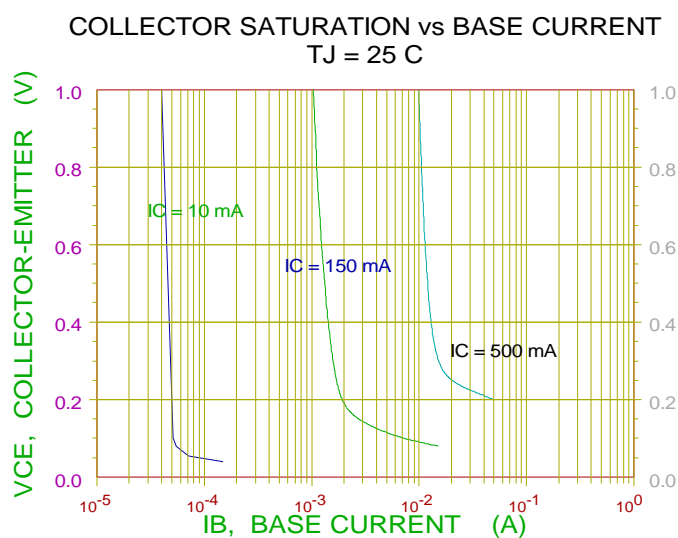


FIGURE 4

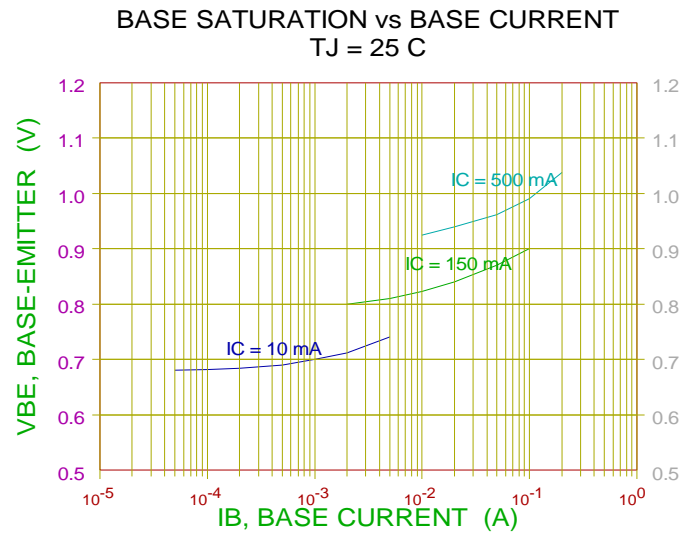


FIGURE 5

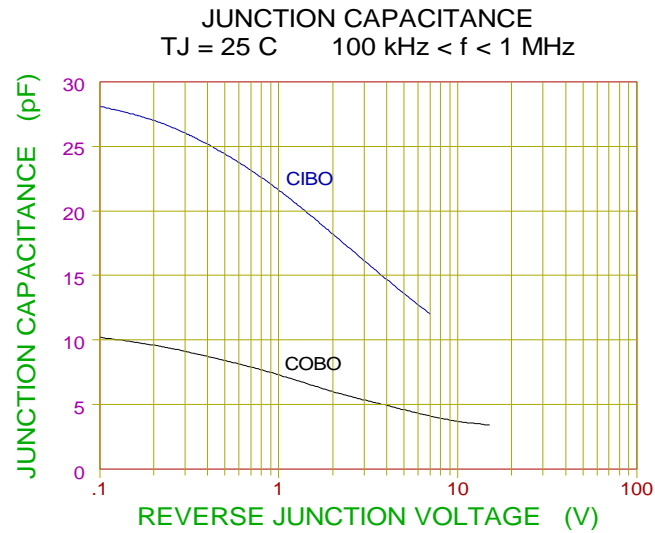


FIGURE 6

SMALL SIGNAL CURRENT GAIN vs COLLECTOR CURRENT

$T_J = 25\text{ }^{\circ}\text{C}$   $V_{CE} = 10\text{ V}$   $f = 1\text{ kHz}$

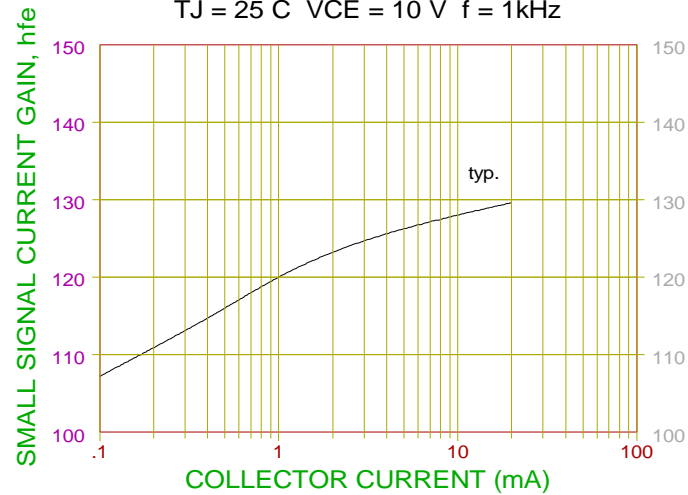


FIGURE 7

HIGH FREQUENCY GAIN  
 $T_J = 25\text{ }^{\circ}\text{C}$   $V_{CE} = 20\text{ V}$   $f = 100\text{ MHz}$

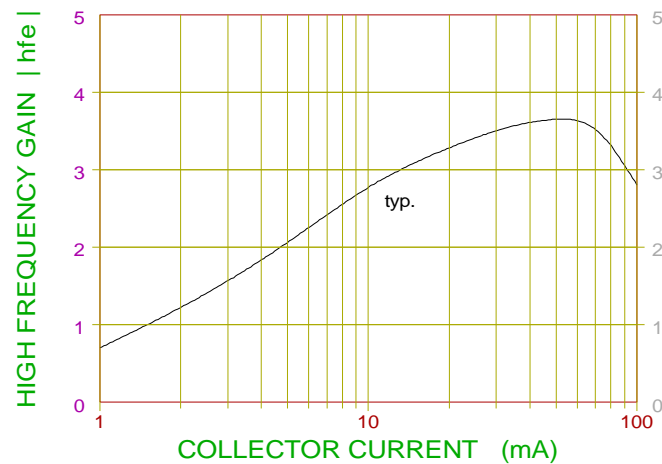
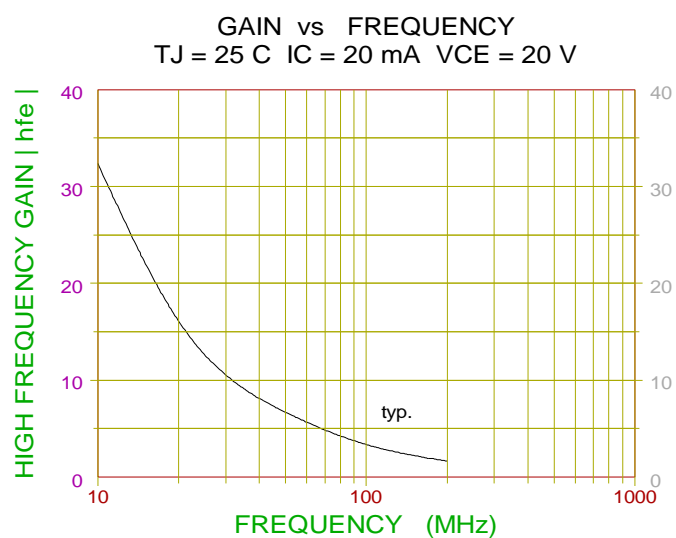


FIGURE 8





**FIGURE 9**