

2N2221A

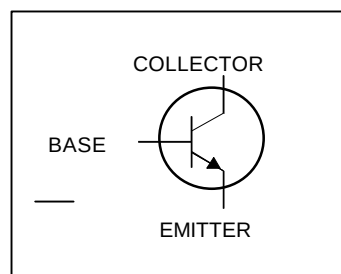
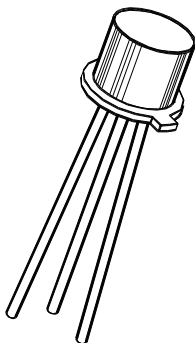
Features

- 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	mAdc
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	$^{\circ}\text{C/W}$

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

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

ON CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
DC Current Gain	h_{FE}			
($I_C = 100 \text{ mA dc}$, $V_{CE} = 10 \text{ Vdc}$)		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	$V_{CE(sat)}$			
($I_C = 150 \text{ mA dc}$, $I_B = 15 \text{ mA dc}$) (1)			0.3	Vdc
($I_C = 500 \text{ mA dc}$, $I_B = 50 \text{ mA dc}$) (1)			1.0	Vdc
Base - Emitter Saturation Voltage	$V_{BE(sat)}$			
($I_C = 150 \text{ mA dc}$, $I_B = 15 \text{ mA dc}$) (1)		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 $\leq 300 \mu\text{s}$, 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 ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $100\text{kHz} \leq f \leq 1\text{ MHz}$)	C_{obo}		8	pF
Input Capacitance ($V_{EB} = 0.5\text{ Vdc}$, $I_C = 0$, $100\text{kHz} \leq f \leq 1\text{ MHz}$)	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		

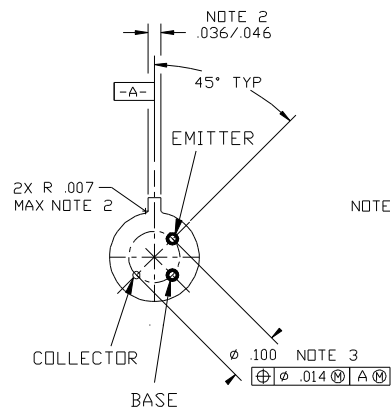
Spice Model (based upon typical device characteristics) ^{*1}

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.

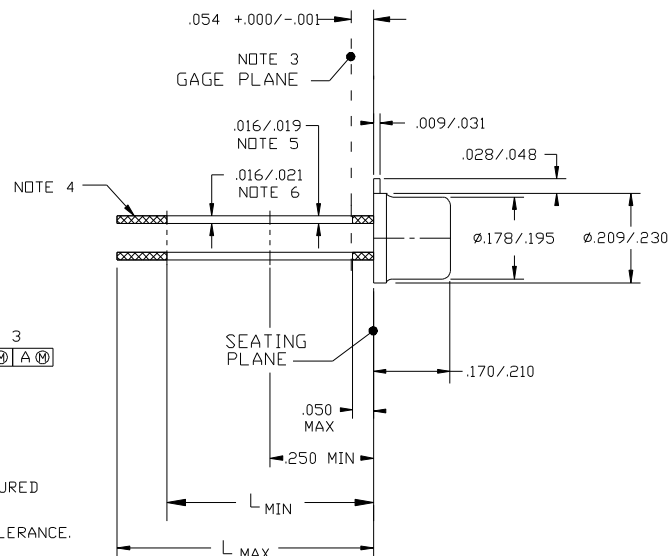
LEAD	DIM L	
	MIN	MAX
SHORT	.500	.750
LONG	1.50	1.75

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

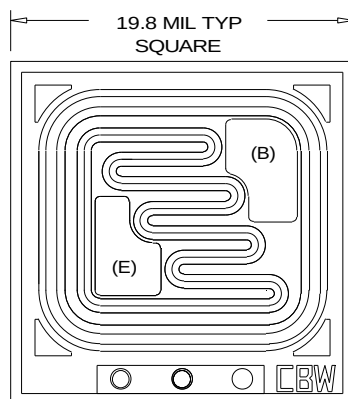


NOTES:

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

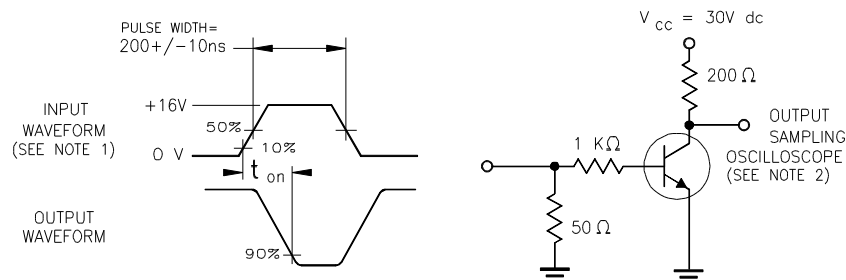


FIGURE 1 Saturated Turn-on Time Test Circuit

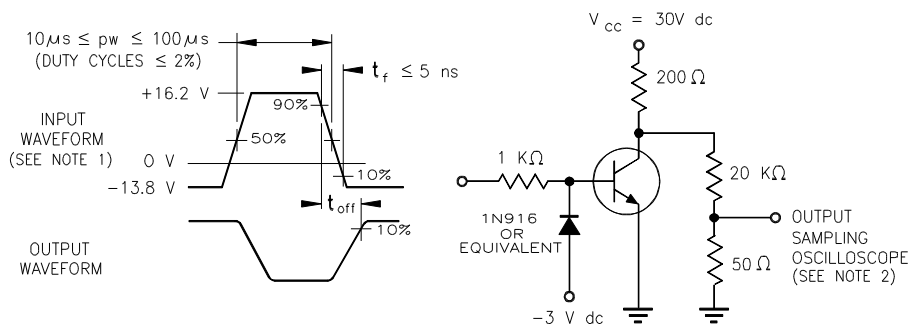


FIGURE 2 Saturated Turn-off Time Test Circuit

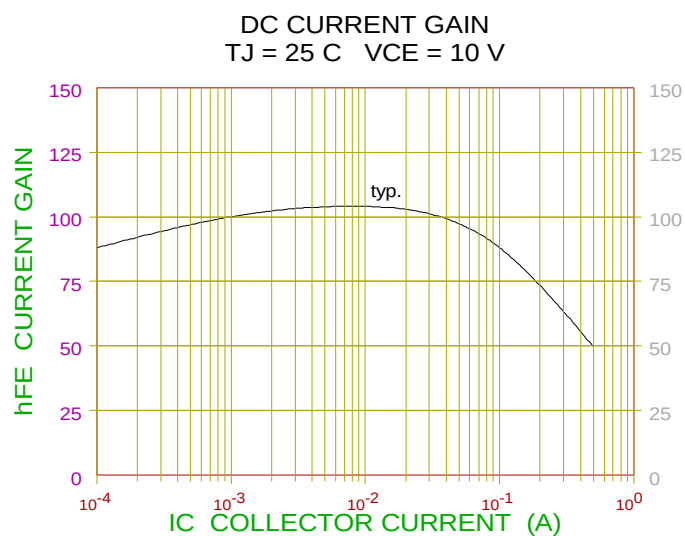


FIGURE 3

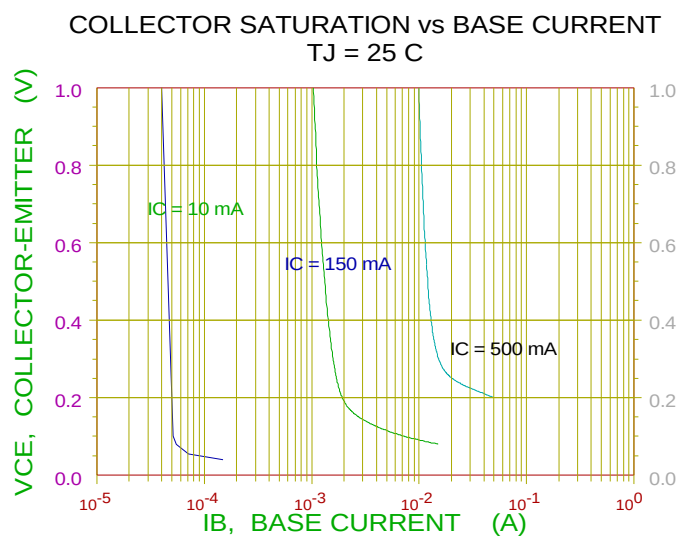


FIGURE 4

BASE SATURATION vs BASE CURRENT
 $T_J = 25^\circ\text{C}$

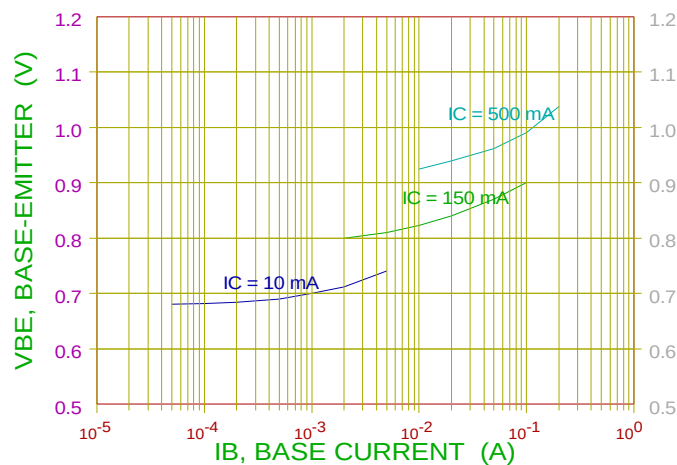


FIGURE 5

JUNCTION CAPACITANCE
 $T_J = 25^\circ\text{C}$ $100\text{ kHz} < f < 1\text{ MHz}$

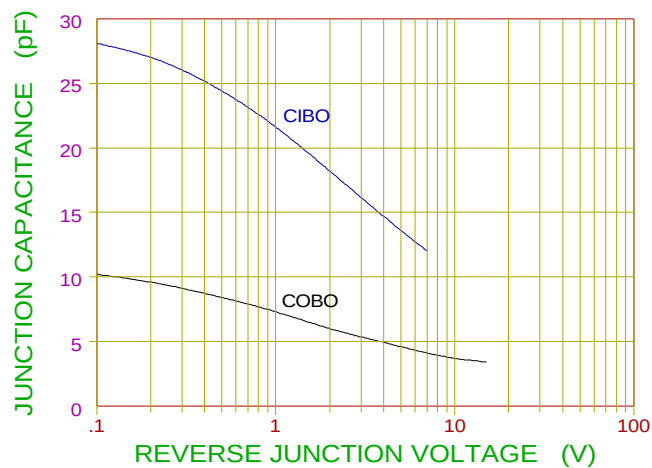


FIGURE 6

SMALL SIGNAL CURENT GAIN vs COLLECTOR CURRENT

TJ = 25 C VCE = 10 V f = 1kHz

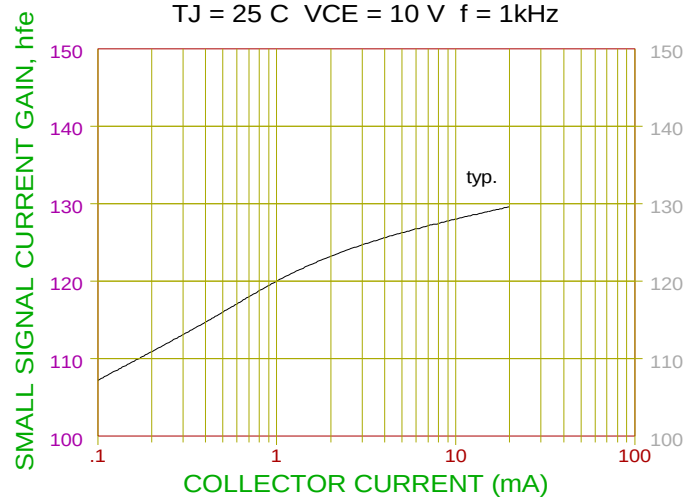


FIGURE 7

HIGH FREQUENCY GAIN
TJ = 25 C VCE = 20 V f = 100 MHz

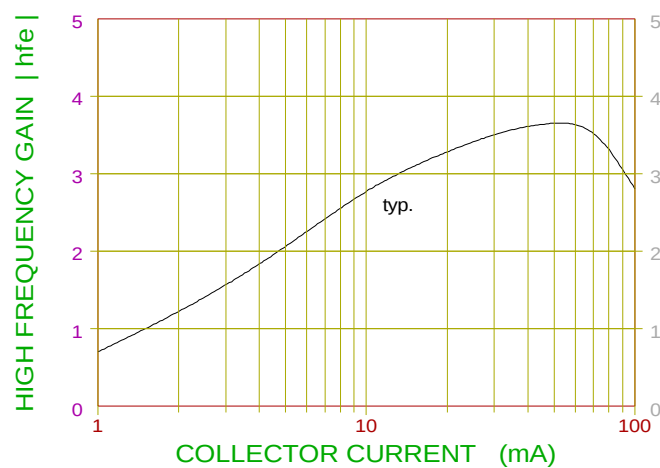


FIGURE 8

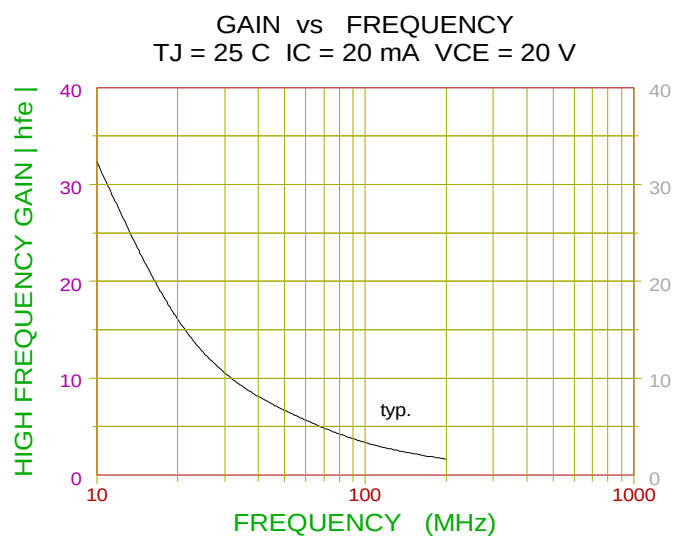


FIGURE 9