

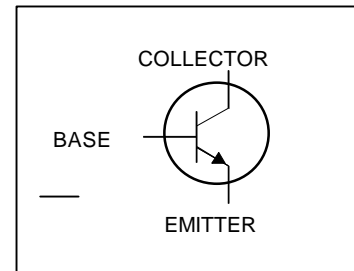
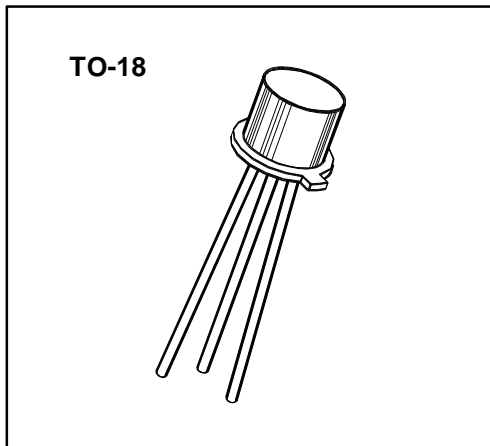
2N2221A

## 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



## Maximum Ratings

RATING	SYMBOL	VALUE	UNIT
Collector - Emitter Voltage	$V_{CE0}$	50	Vdc
Collector - Base Voltage	$V_{CB0}$	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	$^\circ\text{C}/\text{W}$

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	mAdc
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  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

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

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

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

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

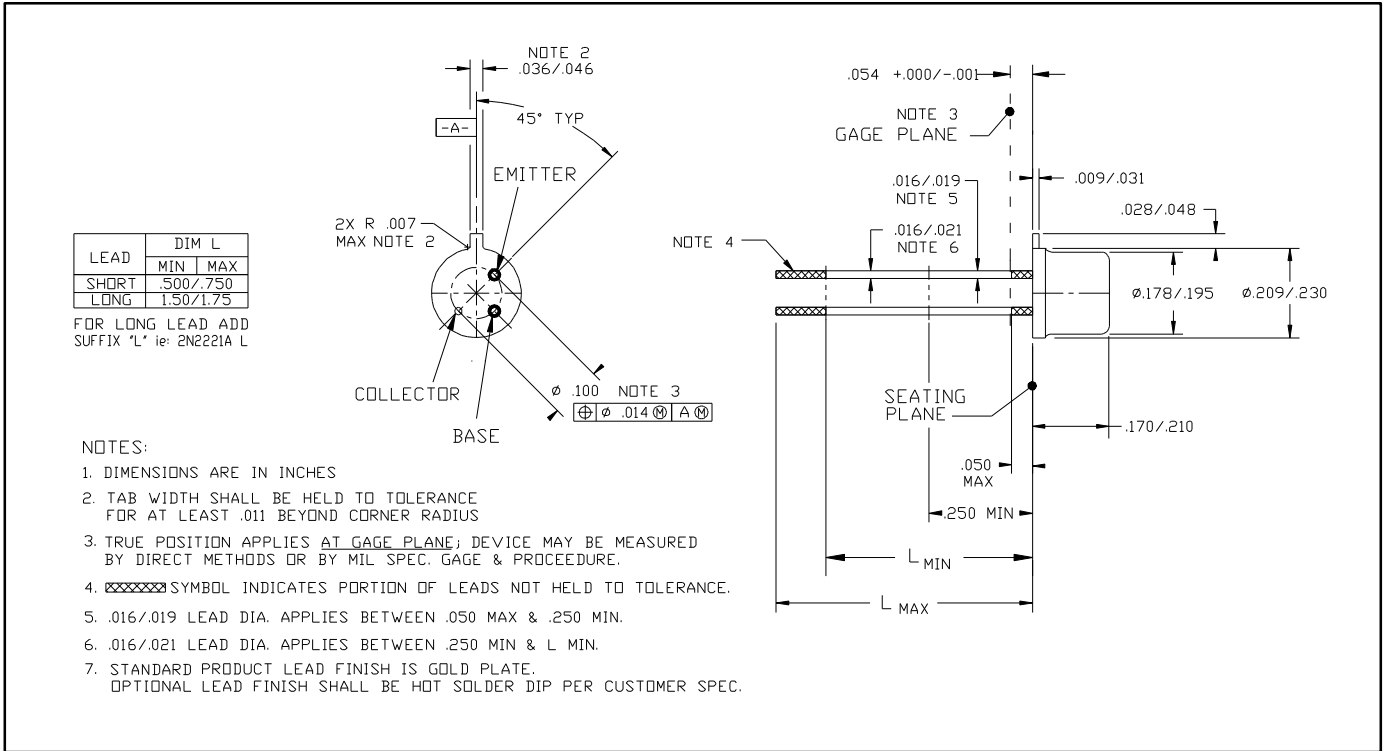
LOW FREQUENCY	SYMBOL	MIN	MAX	UNIT
<b>Common - Emitter Forward Current Transfer Ratio</b> ( $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$ )	$h_{fe}$	30		
<b>HIGH FREQUENCY</b>				
<b>Common - Emitter Forward Current Transfer Ratio</b> ( $I_C = 20\text{ mA}$ , $V_{CE} = 20\text{ V}$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

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

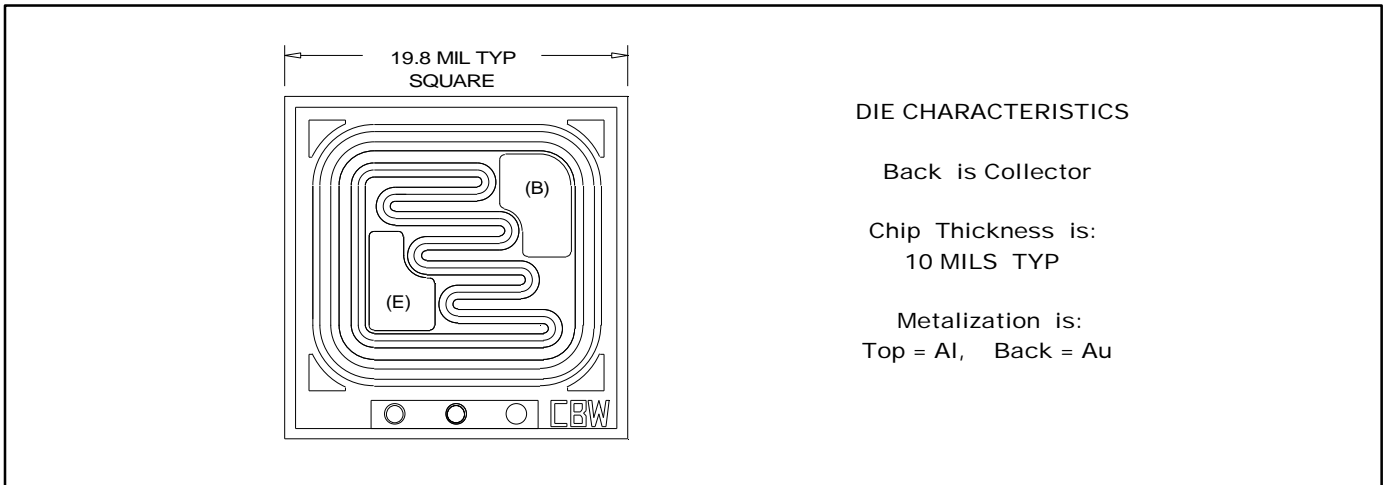
Q2N2221A NPN ( IS = 426.3f XTI = 3.0 EG = 1.11 VAF = 250.3 BF = 72.14 ISE = 48.14p  
 + NE = 2.935 IKF = 2.935 NK = 1.401 XTB = 1.5 BR = 11.49 ISC = 19.9f  
 + NC = 1.88 IKR = 10.75 RC = 0.3567 CJC = 11.02p VJC = 0.3869 MJC = 0.3292  
 + FC = 0.5 CJE = 29.31p VJE = 0.9036 MJE = 0.4101 TR = 16.89n TF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

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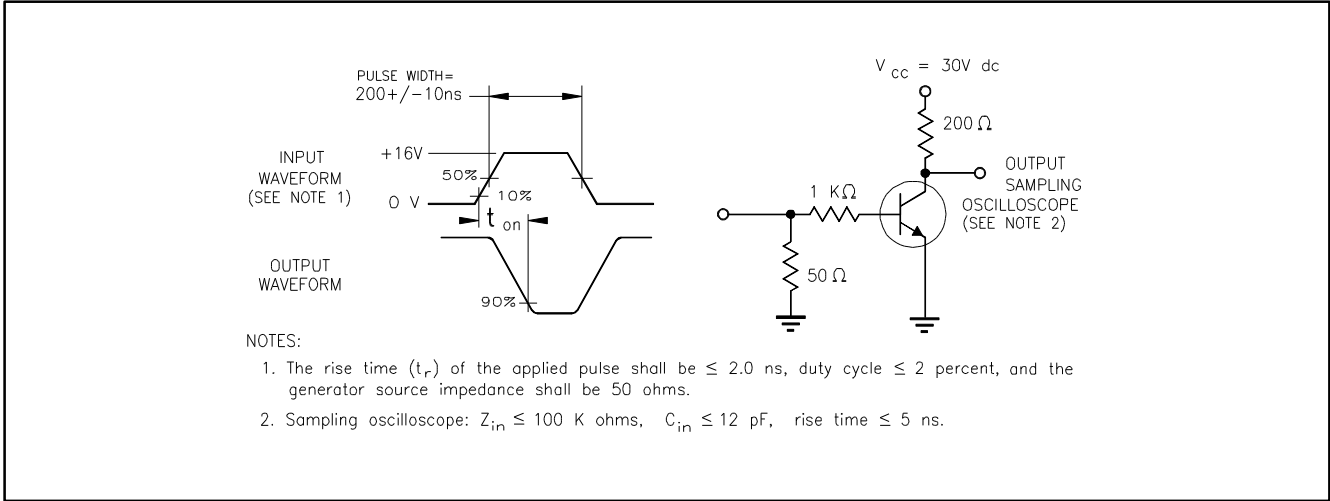


**TO 18 CASE OUTLINE**

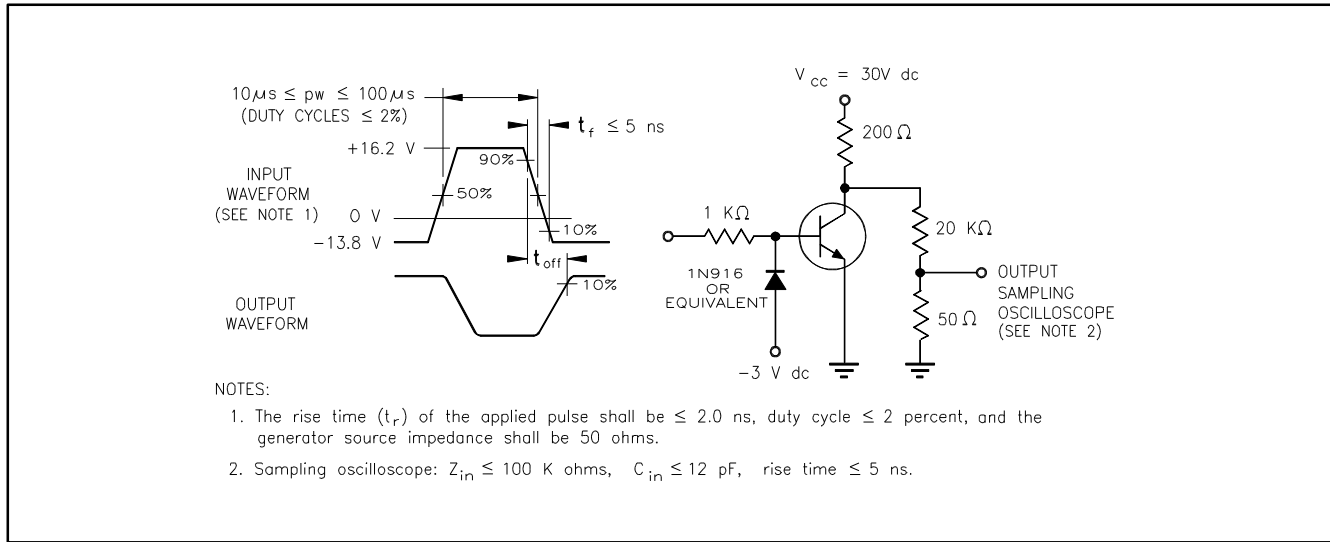


**DIE OUTLINE**

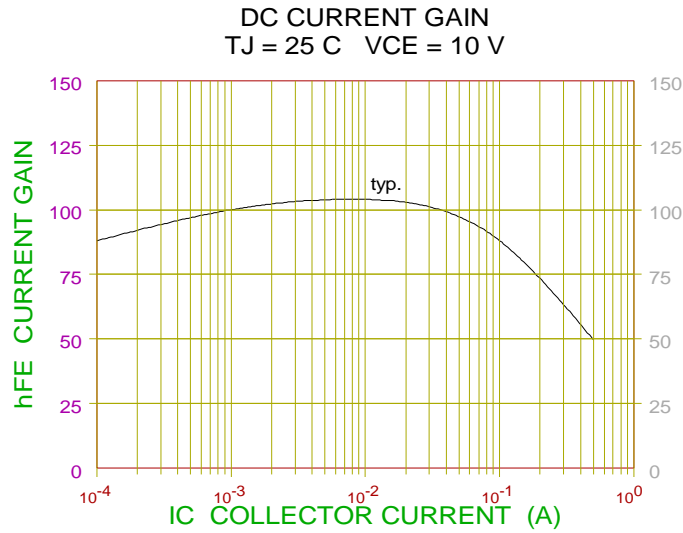
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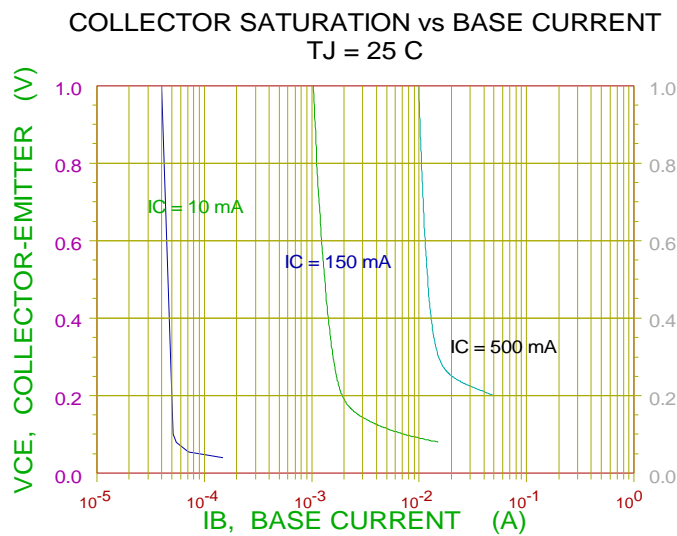
**FIGURE 1 Saturated Turn-on Time Test Circuit**



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



**FIGURE 3**



**FIGURE 4**

BASE SATURATION vs BASE CURRENT  
 T<sub>J</sub> = 25 C

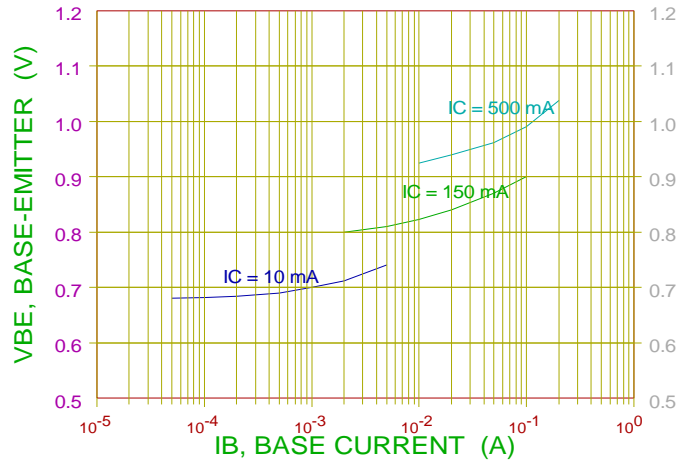


FIGURE 5

JUNCTION CAPACITANCE  
 T<sub>J</sub> = 25 C    100 kHz < f < 1 MHz

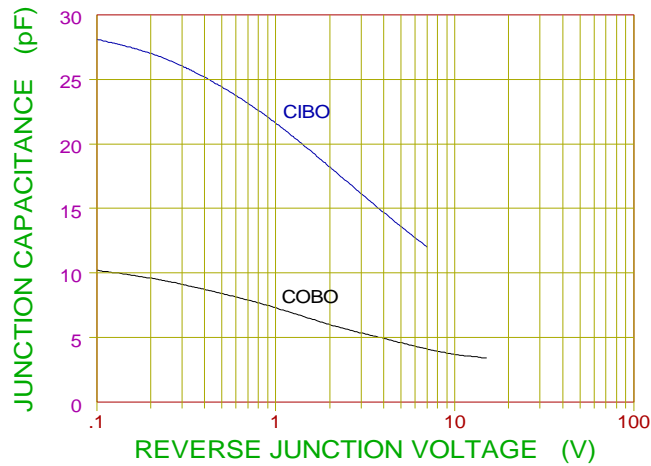


FIGURE 6

SMALL SIGNAL CURENT GAIN vs COLLECTOR CURRENT  
TJ = 25 C VCE = 10 V f = 1kHz

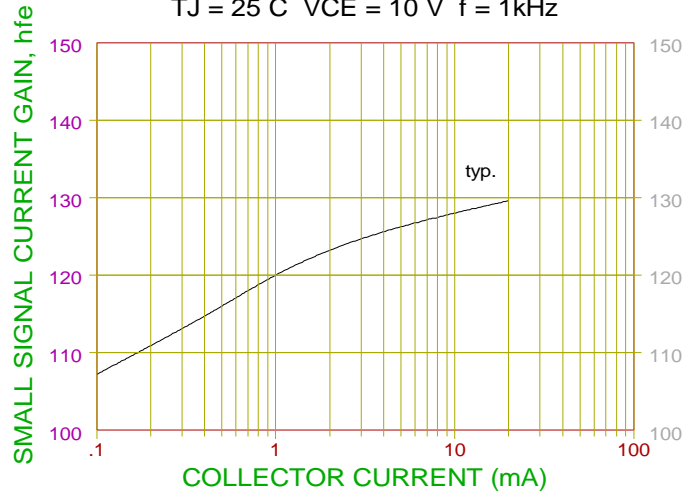


FIGURE 7

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

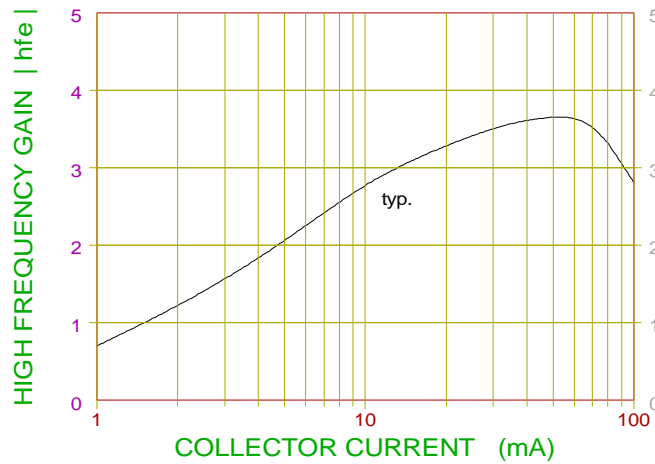


FIGURE 8



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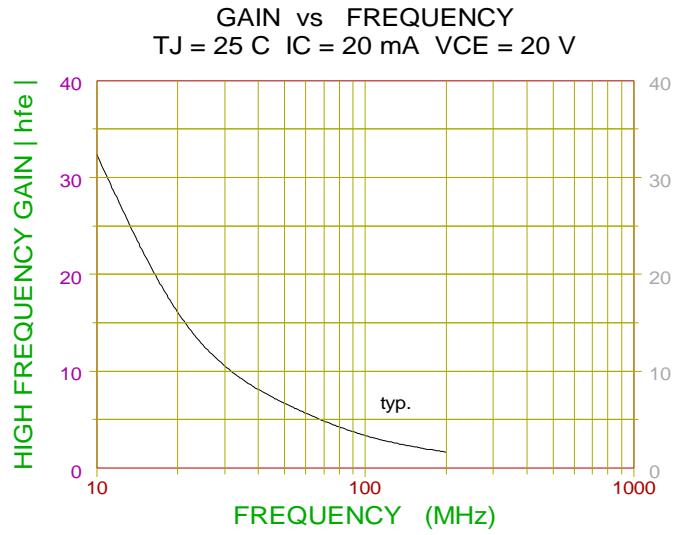


FIGURE 9