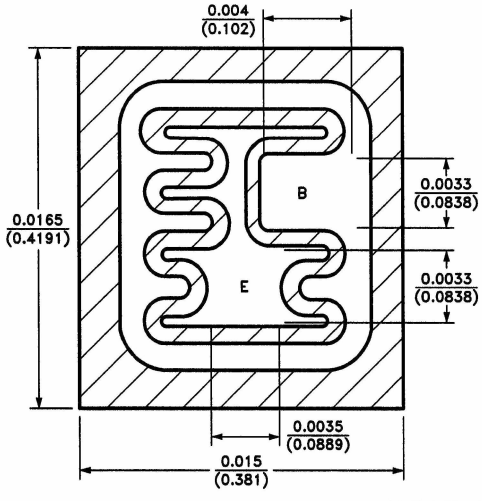
National Semiconductor

Process 19
NPN General Purpose Amplifier



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DESCRIPTION

Process 19 is a non-overlay, double-diffused, gold doped, silicon epitaxial device. Complement to Process 63.

APPLICATION

This device was designed for use as a medium power amplifier and switch requiring collector currents up to 500 mA.

PRINCIPAL DEVICE TYPES

TO-5 EBC: 2N2219, 2219A
TO-18 EBC: 2N2222, 2222A
TO-92 EBC: PN2222A, 2N4401
TO-116: MPQ2222
TO-236: MMBT2222
16-SOIC: MMPQ2222

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

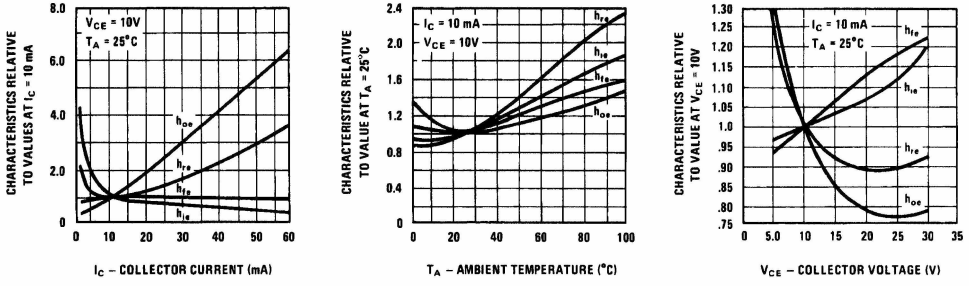
Symbol	Conditions	Min	Typ	Max	Units
t_{ON}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns
t_{OFF}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.0	3.5		
C_{ob}	V_{CB} = 10V, f = 1 MHz		4.0	6.0	pF
C_{ib}	V_{EB} = 0.5V, f = 1 MHz			25	pF
NF (spot)	I_C = 100 μA, V_{CE} = 10V, R_S = 1 kΩ, f = 1 kHz		2.0		dB
h_{FE}	I_C = 100 μA, V_{CE} = 10V I_C = 1 mA, V_{CE} = 10V I_C = 10 mA, V_{CE} = 10V I_C = 150 mA, V_{CE} = 10V I_C = 500 mA, V_{CE} = 10V	30 40 50 60 30	180	420	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA I_C = 500 mA, I_B = 50 mA			0.50 1.0	V V
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA I_C = 500 mA, I_B = 50 mA			1.2 1.5	V V
BV_{CEO}	I_C = 10 mA	35			V
BV_{CBO}	I_C = 100 μA	60			V
BV_{EBO}	I_E = 10 μA	6			V
I_{CBO}	V_{CB} = 40V			100	nA
I_{EBO}	V_{EB} = 4V			100	nA

Process 19

SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

Symbol	Parameter	Conditions	Typ	Units
h_{ie}	Input Resistance	I_C = 10 mA, V_{CE} = 10V	700	Ω
h_{oe}	Output Conductance	I_C = 10 mA, V_{CE} = 10V	120	μmhos
h_{fe}	Small Signal Current Gain	I_C = 10 mA, V_{CE} = 10V	240	
h_{re}	Voltage Feedback Ratio	I_C = 10 mA, V_{CE} = 10V	460	$\times 10^{-6}$

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)



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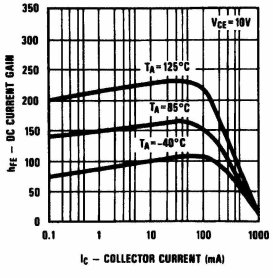
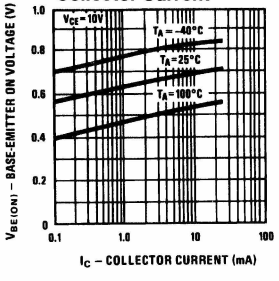
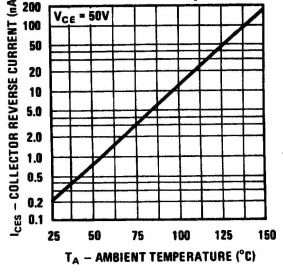
DC Current Gain vs Collector Current



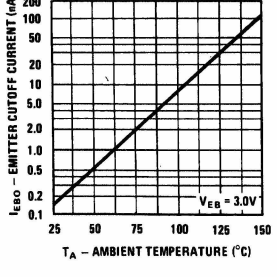
Base-Emitter ON Voltage vs Collector Current



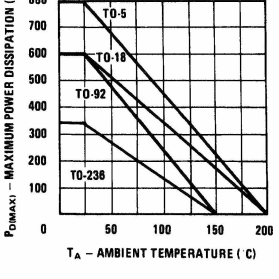
Collector Reverse Current vs Ambient Temperature



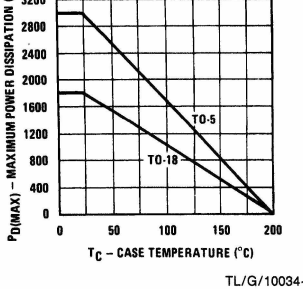
Emitter Cutoff Current vs Ambient Temperature



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



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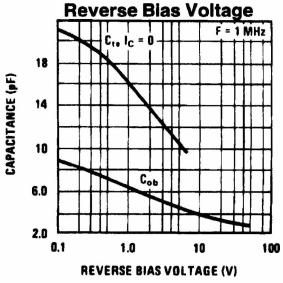
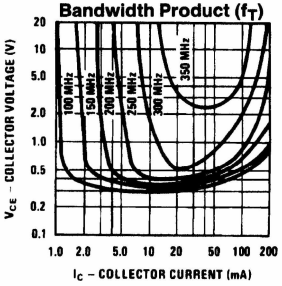
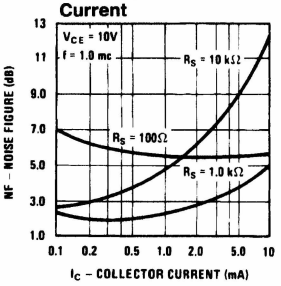
Emitter Transition and Output Capacitance vs Reverse Bias Voltage



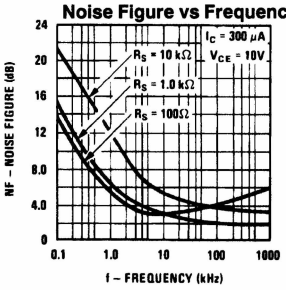
Contours of Constant Gain Bandwidth Product (f_T)



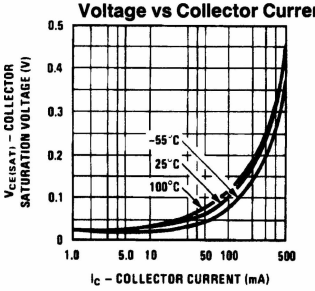
Noise Figure vs Collector Current



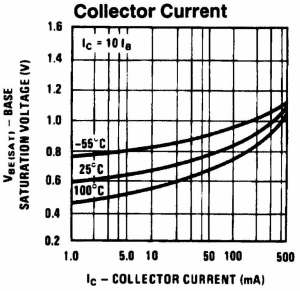
Noise Figure vs Frequency



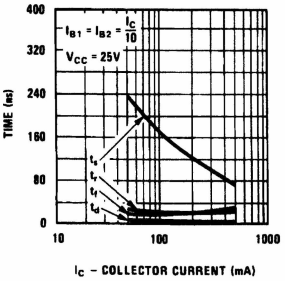
Collector Saturation Voltage vs Collector Current



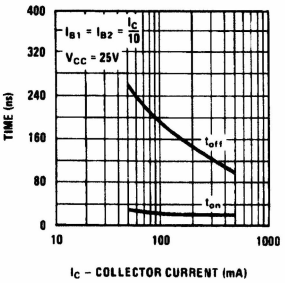
Base Saturation Voltage vs Collector Current



Switching Time vs Collector Current



Turn On and Turn Off Times vs Collector Current



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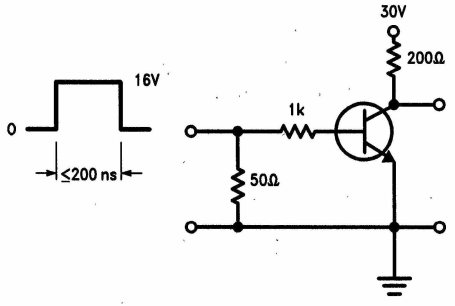

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FIGURE 1. Saturated Turn On Switching Time Test Circuit

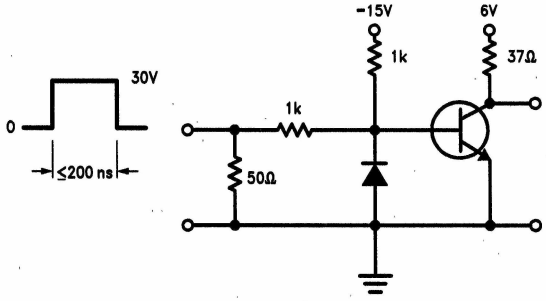

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FIGURE 2. Saturated Turn Off Switching Time Test Circuit