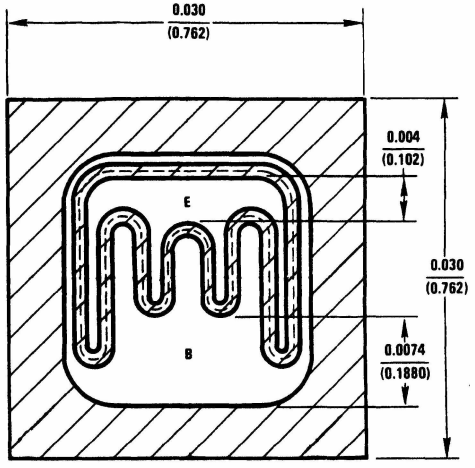
National Semiconductor

Process 12
NPN Medium Power



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DESCRIPTION

Process 12 was a non-overlay, double-diffused, silicon epitaxial device. Complement to Process 67.

APPLICATION

This device was designed for general purpose medium power amplifiers and switches requiring collector currents to 0.5A and collector voltages up to 80V.

PRINCIPAL DEVICE TYPES

TO-39 EBC: 2N3019
TO-92 EBC: MPSA06
TO-116: MPQA06
TO-202 EBC: NSDU06
TO-226 EBC: MPSW06
TO-236: MMBTA06
TO-237 EBC: TN3019

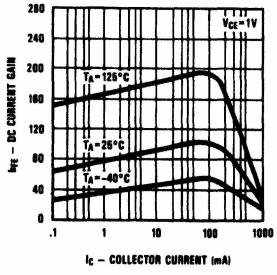
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Symbol	Conditions	Min	Typ	Max	Units
t_{ON}	I_C = 150 mA, I_{B1} = 15 mA (*Figure 1*)		50		ns
t_{OFF}	I_C = 150 mA, I_{B2} = 15 mA (*Figure 1*)		400		ns
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	4.0	6.5		
C_{ob}	V_{CB} = 10V, f = 1 MHz		6.5	10	pF
C_{eb}	V_{EB} = 0.5V, f = 1 MHz			60	pF
h_{FE}	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 50 75 30	175	350	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA I_C = 500 mA, I_B = 50 mA			0.2 0.8	V V
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA I_C = 500 mA, I_B = 50 mA			0.90 1.20	V V
BV_{CEO}	I_C = 10 mA	65			V
BV_{CBO}	I_C = 100 μA	100			V
BV_{EBO}	I_C = 10 μA	7			V
I_{CBO}	V_{CB} = 80V			100	nA
I_{EBO}	V_{EB} = 6V			100	nA

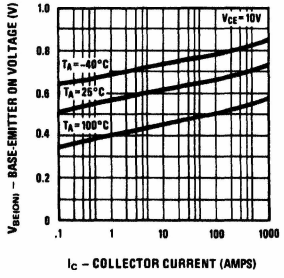
Process 12

Symbol	Conditions	Min	Typ	Max	Units
$P_{D(max)}$					
TO-202	T_C = 25°C	10			W
	T_A = 25°C	2			W
TO-39	T_C = 25°C	7			W
	T_A = 25°C	1			W
TO-226	T_A = 25°C	1			W
TO-237	T_C = 25°C	2			W
	T_A = 25°C	850			mW
TO-92	T_A = 25°C	600			mW
TO-236	T_C = 25°C	350			mW
TO-116	T_A = 25°C				
	(Total)	900			mW
	(Each Transistor)	500			mW

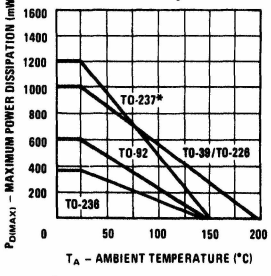
DC Current Gain vs Collector Current



Base-Emitter ON Voltage vs Collector Current



Maximum Power Dissipation vs Ambient Temperature



* One square inch of copper run

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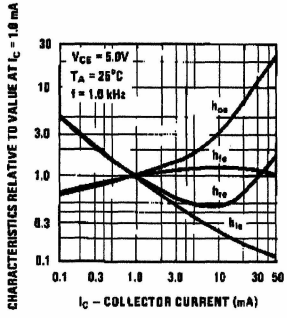
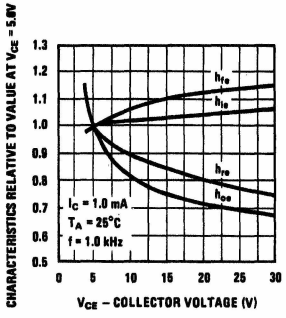
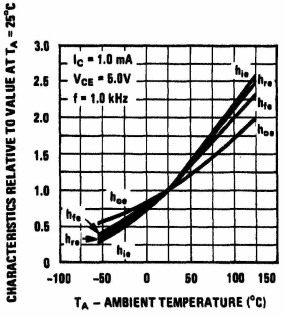
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

Symbol	Parameter	Conditions	Typ	Units
h_{ie}	Input Resistance	I_C = 1.0 mA, V_{CE} = 5.0V	3000	Ω
h_{oe}	Output Conductance	I_C = 1.0 mA, V_{CE} = 5.0V	8.0	μmhos
h_{re}	Voltage Feedback Ratio	I_C = 1.0 mA, V_{CE} = 5.0V	2.1	$\times 10^{-4}$
h_{fe}	Small Signal Current Gain	I_C = 1.0 mA, V_{CE} = 5.0V	100	

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







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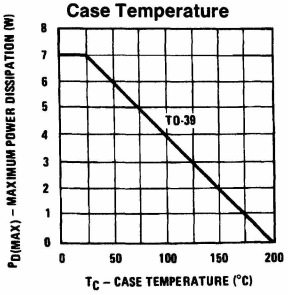
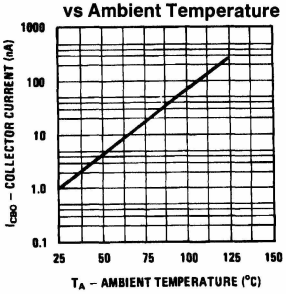
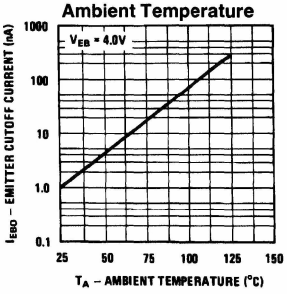
Maximum Power Dissipation vs Case Temperature



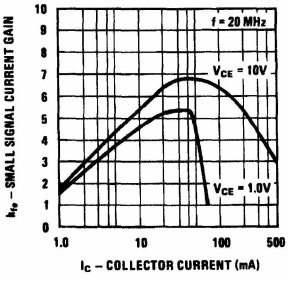
Collector Reverse Current vs Ambient Temperature



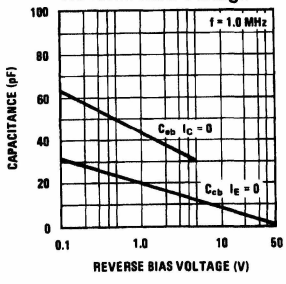
Emitter Cutoff Current vs Ambient Temperature



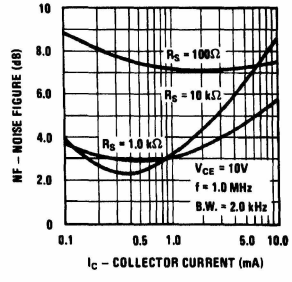
Small Signal Current Gain at 20 MHz



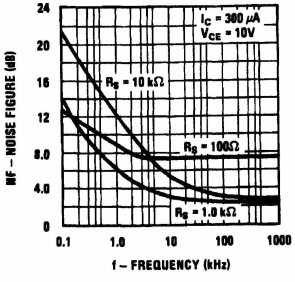
Collector-Base and Emitter-Base Capacitance vs Reverse Bias Voltage



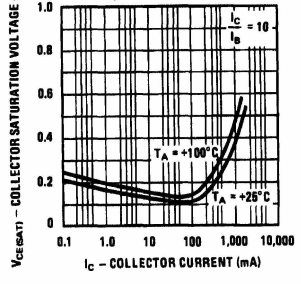
Noise Figure vs Collector Current



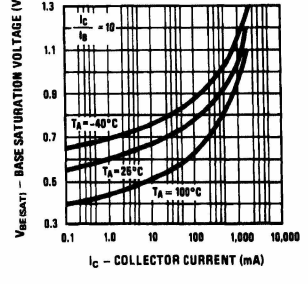
Noise Figure vs Frequency



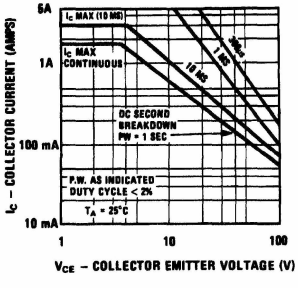
Collector Saturation Voltage vs Collector Current



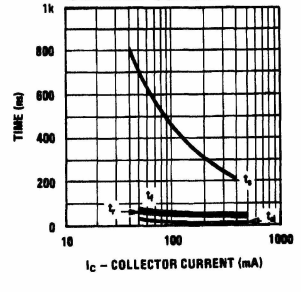
Base Saturation Voltage vs Collector Current



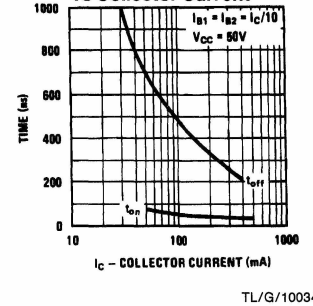
Safe Operating Area TO-39 with "Wake Field" Type 296-4 Heat Sink



Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current



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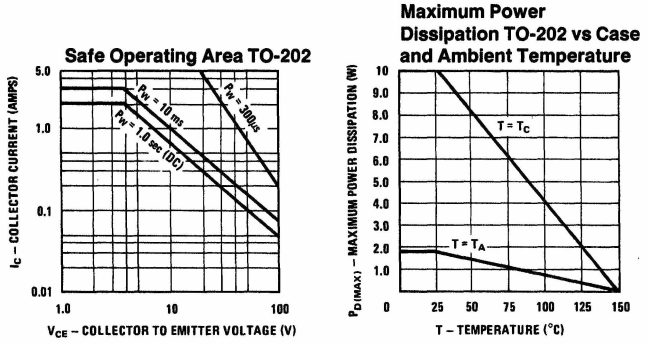

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I_C	R_b	R_L
150 mA	314Ω	330Ω
300 mA	157Ω	167Ω
500 mA	94Ω	100Ω

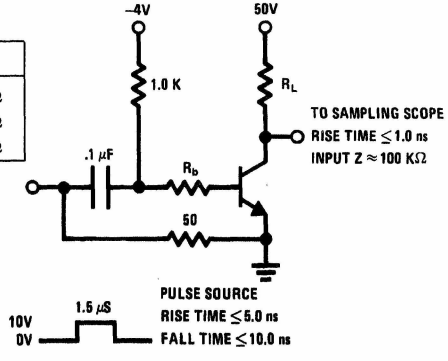

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FIGURE 1. t_{ON}, t_{OFF} Test Circuit