

MAXIMUM RATINGS

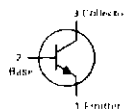
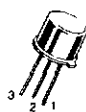
Rating	Symbol	2N2219 2N2222	2N2218A 2N2219A 2N2222A	Unit
Collector-Emitter Voltage	V_{CE0}	30	40	Vdc
Collector-Base Voltage	V_{CBO}	60	75	Vdc
Emitter-Base Voltage	V_{EBO}	5.0	6.0	Vdc
Collector Current — Continuous	I_C	800	800	mA
Total Device Dissipation (a) $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	0.8 4.57	0.4 2.28	Watt mW/ $^\circ\text{C}$
Total Device Dissipation (a) $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	3.0 17.1	1.2 6.85	Watts mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	2N2218A 2N2219A	2N2222A	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	219	437.5	$^\circ\text{C/W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	58	145.8	$^\circ\text{C/W}$

2N2218A, 2N2219A★ 2N2222A★

2N2218, A/2N2219, A
CASE 79-04
TO-39 (TO-205AD)
STYLE 1



A/2N2222, A
CASE 22-03
TO-18 (TO-206AA)
STYLE 1

GENERAL PURPOSE
TRANSISTORS
NPN SILICON

★2N2219A and 2N2222A
are Motorola designated
preferred devices.

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage ($I_C = 10\text{ mA}$, $I_E = 0$)	$V_{(BR)CEO}$	30 40	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 10\text{ }\mu\text{A}$, $I_E = 0$)	$V_{(BR)CBO}$	60 75	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10\text{ }\mu\text{A}$, $I_C = 0$)	$V_{(BR)EBO}$	5.0 6.0	—	Vdc
Collector Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 3.0\text{ Vdc}$)	I_{CEX}	—	10	nA
Collector Cutoff Current ($V_{CB} = 50\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 60\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 50\text{ Vdc}$, $I_E = 0$, $T_A = 150^\circ\text{C}$) ($V_{CB} = 60\text{ Vdc}$, $I_E = 0$, $T_A = 150^\circ\text{C}$)	I_{CBO}	— — — —	0.01 0.01 10 10	μA
Emitter Cutoff Current ($V_{EB} = 3.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	10	nA
Base Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 3.0\text{ Vdc}$)	I_{BL}	—	20	nA
ON CHARACTERISTICS				
DC Current Gain ($I_C = 0.1\text{ mA}$, $V_{CE} = 10\text{ Vdc}$)	h_{FE}	20 35	—	—
($I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$)		25 50	—	—
($I_C = 10\text{ mA}$, $V_{CE} = 10\text{ Vdc}$)		35 75	—	—
($I_C = 10\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $T_A = -55^\circ\text{C}$)		15 35	—	—
($I_C = 150\text{ mA}$, $V_{CE} = 10\text{ Vdc}$)		40 100	120 300	—

2N2218A 2N2219,A 2N2222,A

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
$(I_C = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})(1)$ 2N2218A 2N2219,A, 2N2222,A		20 50	— —	
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$ 2N2219, 2N2222 2N2218A 2N2219A, 2N2222A		30 25 40	— — —	
Collector-Emitter Saturation Voltage(1) $(I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$ Non-A Suffix A-Suffix	$V_{CE(sat)}$	— —	0.4 0.3	Vdc
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$ Non-A Suffix A-Suffix		— —	1.6 1.0	
Base-Emitter Saturation Voltage(1) $(I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$ Non-A Suffix A-Suffix	$V_{BE(sat)}$	0.6 0.6	1.3 1.2	Vdc
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$ Non-A Suffix A-Suffix		— —	2.6 2.0	

SMALL-SIGNAL CHARACTERISTICS

Current Gain — Bandwidth Product(2) $(I_C = 20 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz})$ All Types, Except 2N2219A, 2N2222A	f_T	250 300	— —	MHz
Output Capacitance(3) $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$	C_{obo}	—	8.0	pF
Input Capacitance(3) $(V_{EB} = 0.5 \text{ Vdc}, I_C = 0, f = 1.0 \text{ MHz})$ Non-A Suffix A-Suffix	C_{ibo}	— —	30 25	pF
Input Impedance $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A	h_{ie}	1.0 2.0 0.2 0.25	3.5 8.0 1.0 1.25	kohms
Voltage Feedback Ratio $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A	h_{re}	— — — —	5.0 8.0 2.5 4.0	$\times 10^{-4}$
Small-Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A	h_{fe}	30 50 50 75	150 300 300 375	—
Output Admittance $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2218A 2N2219A, 2N2222A	h_{oe}	3.0 5.0 10 15	15 35 100 200	μmhos
Collector Base Time Constant $(I_E = 20 \text{ mAdc}, V_{CB} = 20 \text{ Vdc}, f = 31.8 \text{ MHz})$ A-Suffix	$r_b' C_c$	—	150	ps
Noise Figure $(I_C = 100 \mu\text{Adc}, V_{CE} = 10 \text{ Vdc}, R_S = 1.0 \text{ kohm}, f = 1.0 \text{ kHz})$ 2N2222A	NF	—	4.0	dB
Real Part of Common-Emitter High Frequency Input Impedance $(I_C = 20 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 300 \text{ MHz})$ 2N2218A, 2N2219A 2N2222A	$\text{Re}(h_{ie})$	—	60	Ohms

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

(2) f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

(3) 2N5581 and 2N5582 are Listed C_{cb} and C_{eb} for these conditions and values.

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS					
Delay Time	(V _{CC} = 30 Vdc, V _{BE(off)} = -0.5 Vdc, I _C = 150 mAdc, I _{B1} = 15 mAdc) (Figure 12)	t _d	—	10	ns
Rise Time		t _r	—	25	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc, I _{B1} = I _{B2} = 15 mAdc) (Figure 13)	t _s	—	225	ns
Fall Time		t _f	—	60	ns
Active Region Time Constant (I _C = 150 mAdc, V _{CE} = 30 Vdc) (See Figure 11 for 2N2218A, 2N2219A, 2N2221A, 2N2222A)		T _A	—	2.5	ns

FIGURE 1 – NORMALIZED DC CURRENT GAIN

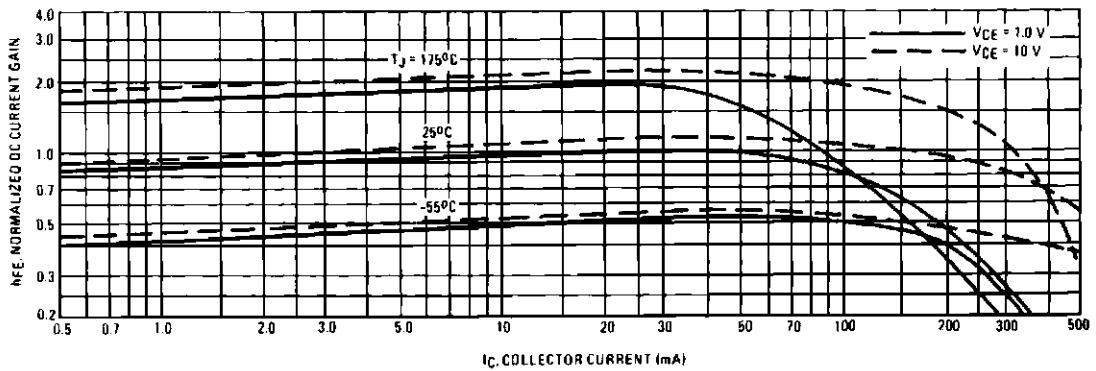
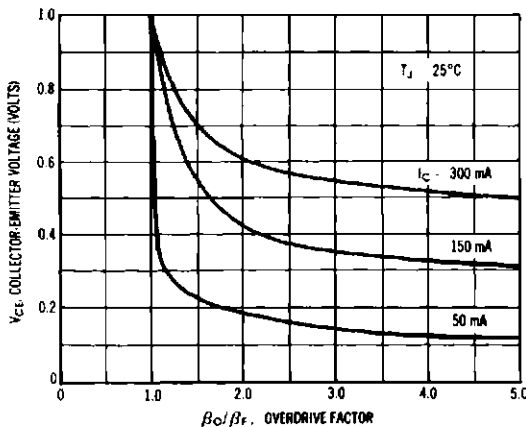


FIGURE 2 – COLLECTOR CHARACTERISTICS IN SATURATION REGION



This graph shows the effect of base current on collector current. β_o (current gain at the edge of saturation) is the current gain of the transistor at 1 volt, and β_F (forced gain) is the ratio of I_C/I_B in a circuit.

EXAMPLE: For type 2N2219, estimate a base current (I_B) to insure saturation at a temperature of 25°C and a collector current of 150 mA.

Observe that at $I_C = 150\text{ mA}$ an overdrive factor of at least 2.5 is required to drive the transistor well into the saturation region. From Figure 1, it is seen that h_{FE} @ 1 volt is approximately 0.62 of h_{FE} @ 10 volts. Using the guaranteed minimum gain of 100 @ 150 mA and 10 V, $\beta_F = 62$ and substituting values in the overdrive equation, we find:

$$\frac{\beta_o}{\beta_F} = \frac{h_{FE} @ 1.0\text{ V}}{I_C/I_B} \quad 2.5 = \frac{62}{150/I_B} \quad I_B \approx 6.0\text{ mA}$$

FIGURE 3 — "ON" VOLTAGES

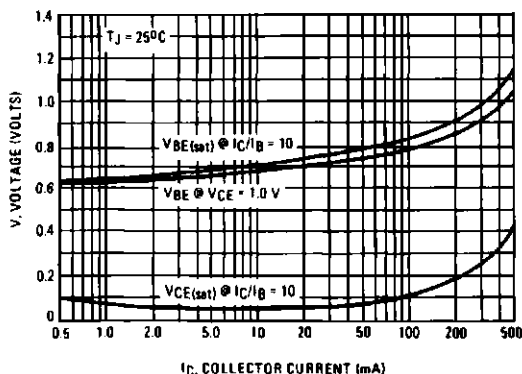
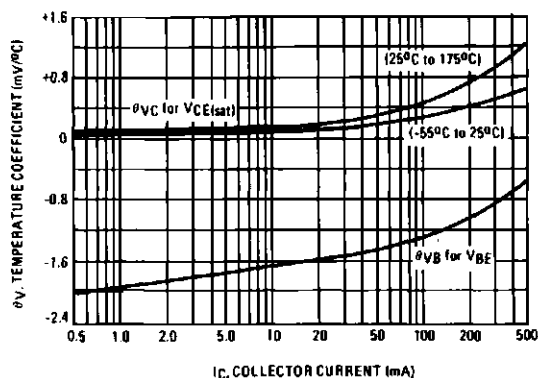


FIGURE 4 — TEMPERATURE COEFFICIENTS



h PARAMETERS

V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°C

This group of graphs illustrates the relationship between h_{fe} and other "h" parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were selected and the same units were used to develop the correspondingly numbered curves on each graph.

FIGURE 5 — INPUT IMPEDANCE

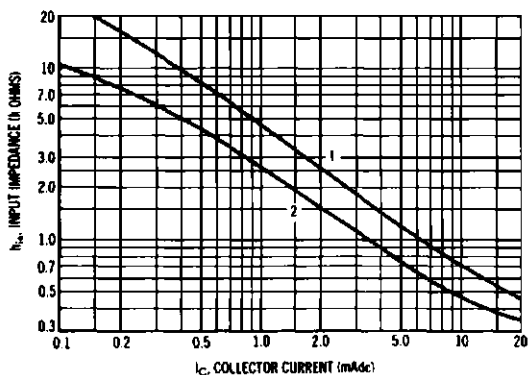


FIGURE 6 — VOLTAGE FEEDBACK RATIO

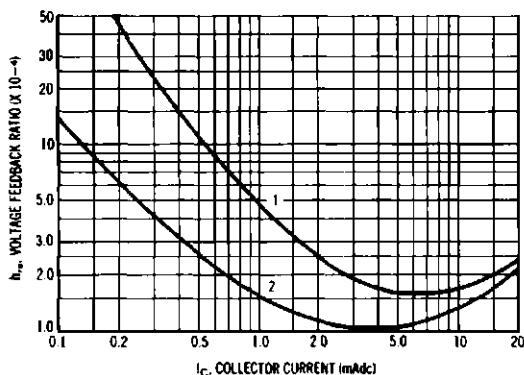


FIGURE 7 — CURRENT GAIN

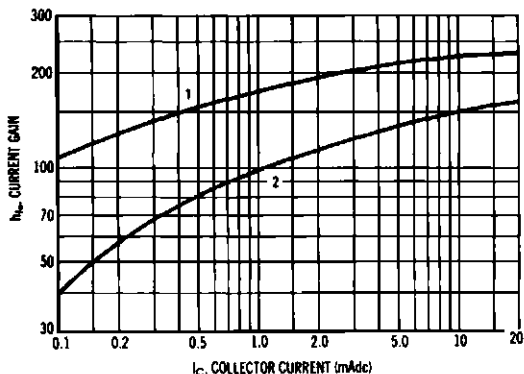
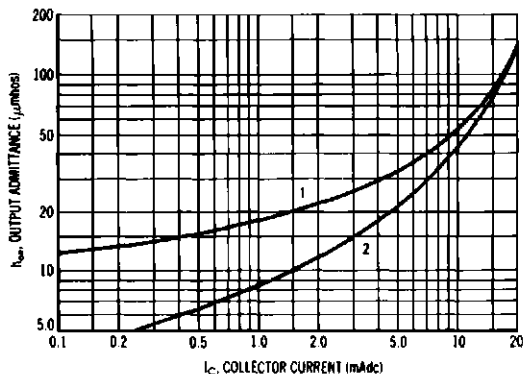


FIGURE 8 — OUTPUT ADMITTANCE



SWITCHING TIME CHARACTERISTICS

FIGURE 9 — TURN-ON TIME

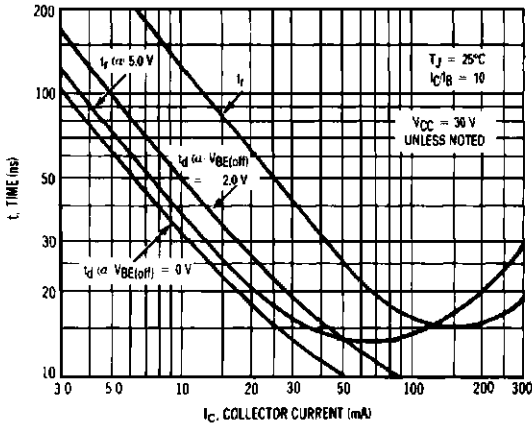


FIGURE 10 — CHARGE DATA

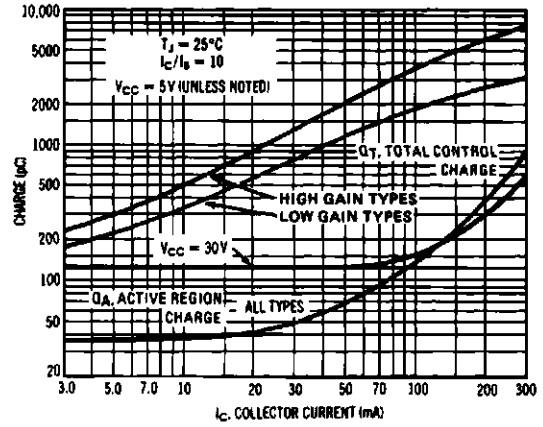


FIGURE 11 — TURN-OFF BEHAVIOR

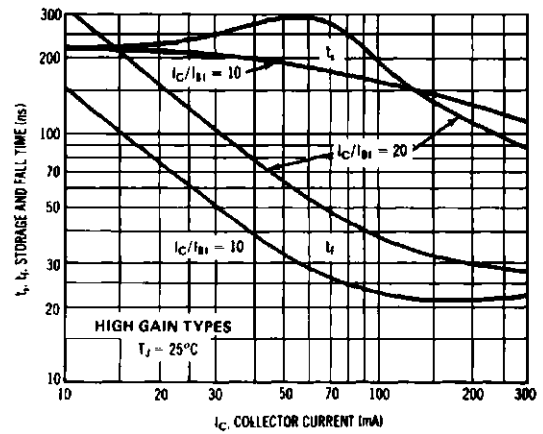
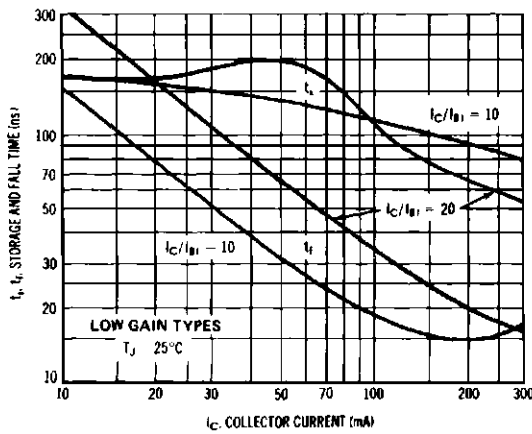


FIGURE 12 — DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

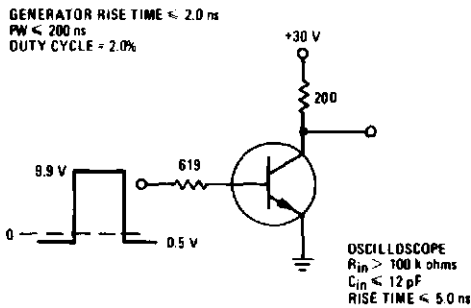


FIGURE 13 — STORAGE TIME AND FALL TIME EQUIVALENT TEST CIRCUIT

