

MAXIMUM RATINGS

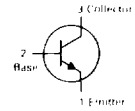
Rating	Symbol	2N2219 2N2222	2N2218A 2N2219A 2N2222A	Unit
Collector-Emitter Voltage	V _{CEO}	30	40	Vdc
Collector-Base Voltage	V _{CBO}	60	75	Vdc
Emitter-Base Voltage	V _{EBO}	5.0	6.0	Vdc
Collector Current — Continuous	I _C	800	800	mAdc
		2N2218A 2N2219,A	2N2222,A	
Total Device Dissipation (a T _A = 25°C Derate above 25°C)	P _D	0.8 4.57	0.4 2.28	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C)	P _D	3.0 17.1	1.2 6.85	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	2N2218A 2N2219,A	2N2222,A	Unit
Thermal Resistance, Junction to Ambient	R _{θJA}	219	437.5	°C/W
Thermal Resistance, Junction to Case	R _{θJC}	58	145.8	°C/W

**2N2218A, 2N2219,A★
2N2222,A★**

**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.

Datasheet Directory

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	Non-A Suffix A-Suffix V _{(BR)CEO}	30 40	— —	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	Non-A Suffix A-Suffix V _{(BR)CBO}	60 75	— —	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	Non-A Suffix A-Suffix V _{(BR)EBO}	5.0 6.0	— —	Vdc
Collector Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	A-Suffix I _{CEX}	—	10	nAdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 150°C) (V _{CB} = 60 Vdc, I _E = 0, T _A = 150°C)	Non-A Suffix A-Suffix Non-A Suffix A-Suffix I _{CBO}	— — — —	0.01 0.01 10 10	μAdc
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)	A-Suffix I _{EBO}	—	10	nAdc
Base Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	A-Suffix I _{BL}	—	20	nAdc
ON CHARACTERISTICS				
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 10 Vdc)	2N2218A 2N2219,A, 2N2222,A h _{FE}	20 35	—	—
(I _C = 1.0 mAdc, V _{CE} = 10 Vdc)	2N2218A 2N2219,A, 2N2222,A	25 50	—	—
(I _C = 10 mAdc, V _{CE} = 10 Vdc)(1)	2N2218A 2N2219,A, 2N2222,A	35 75	—	—
(I _C = 10 mAdc, V _{CE} = 10 Vdc, T _A = -55°C)(1)	2N2218A 2N2219,A, 2N2222,A	15 35	—	—
(I _C = 150 mAdc, V _{CE} = 10 Vdc)(1)	2N2218A 2N2219,A, 2N2222,A	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	— —	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	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	h_{ie}	1.0 2.0	3.5 8.0	kohms
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A 2N2219A, 2N2222A		0.2 0.25	1.0 1.25	
Voltage Feedback Ratio $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A 2N2219A, 2N2222A	h_{re}	— —	5.0 8.0	$\times 10^{-4}$
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A 2N2219A, 2N2222A		— —	2.5 4.0	
Small-Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A 2N2219A, 2N2222A	h_{fe}	30 50	150 300	—
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A 2N2219A, 2N2222A		50 75	300 375	
Output Admittance $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A 2N2219A, 2N2222A	h_{oe}	3.0 5.0	15 35	μmhos
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A 2N2219A, 2N2222A		10 15	100 200	
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_{cb} 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	$(V_{CC} = 30\text{ Vdc}, V_{BE(off)} = -0.5\text{ Vdc}, I_C = 150\text{ mA}, I_{B1} = 15\text{ mA})$ (Figure 12)	t_d	—	10	ns
Rise Time		t_r	—	25	ns
Storage Time	$(V_{CC} = 30\text{ Vdc}, I_C = 150\text{ mA}, I_{B1} = I_{B2} = 15\text{ mA})$ (Figure 13)	t_s	—	225	ns
Fall Time		t_f	—	60	ns
Active Region Time Constant ($I_C = 150\text{ mA}, V_{CE} = 30\text{ Vdc}$) (See Figure 11 for 2N2218A, 2N2219A, 2N2221A, 2N2222A)		T_A	—	2.5	ns

FIGURE 1 – NORMALIZED DC CURRENT GAIN

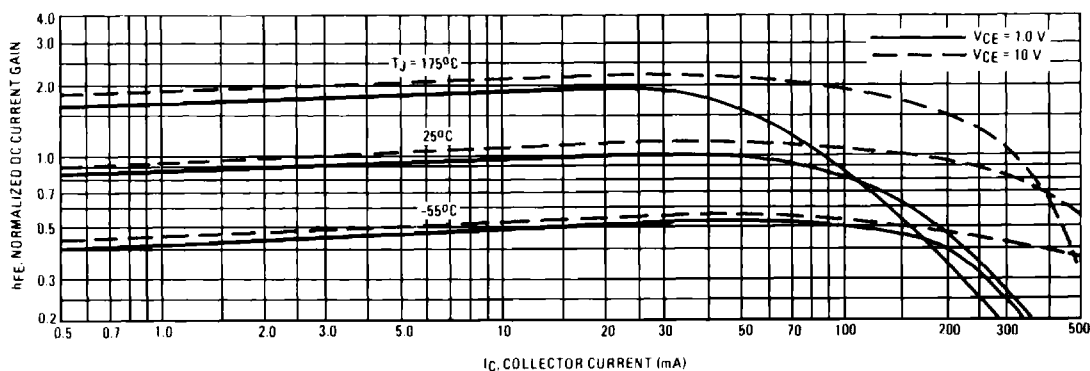
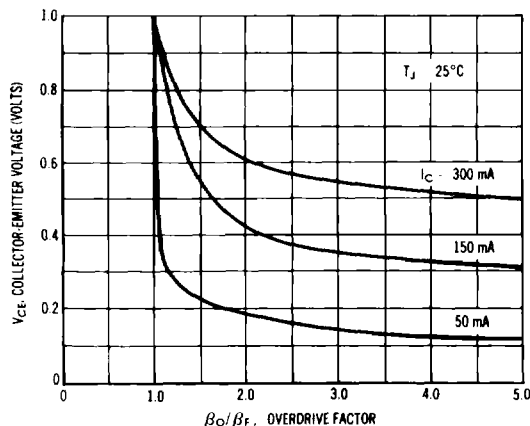


FIGURE 2 – COLLECTOR CHARACTERISTICS IN SATURATION REGION



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, $\beta_o = 62$ and substituting values in the overdrive equation, we find:

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

2N2218A 2N2219,A 2N2222,A

FIGURE 3 — "ON" VOLTAGES

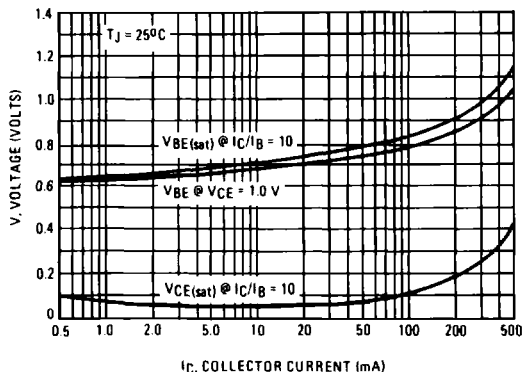
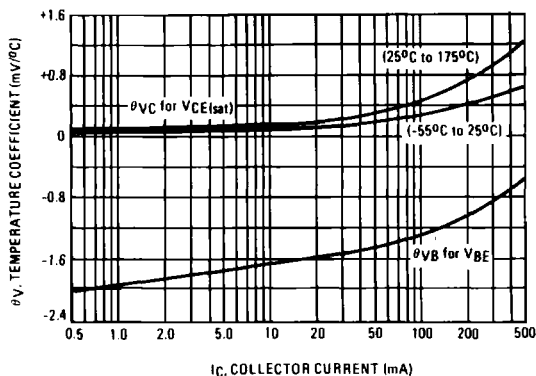


FIGURE 4 — TEMPERATURE COEFFICIENTS



h PARAMETERS

$V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$, $T_A = 25^\circ\text{C}$

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

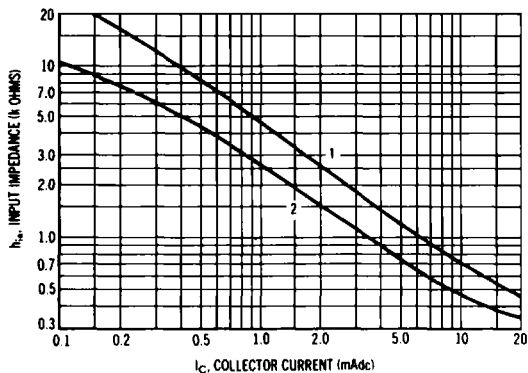


FIGURE 6 — VOLTAGE FEEDBACK RATIO

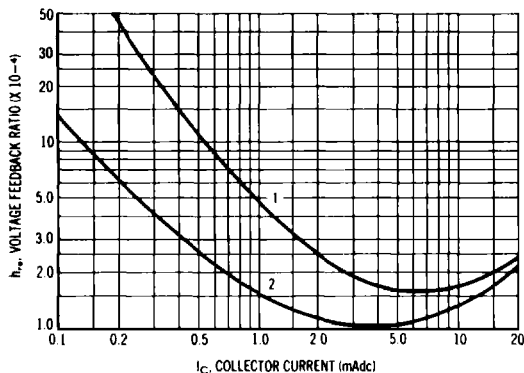


FIGURE 7 — CURRENT GAIN

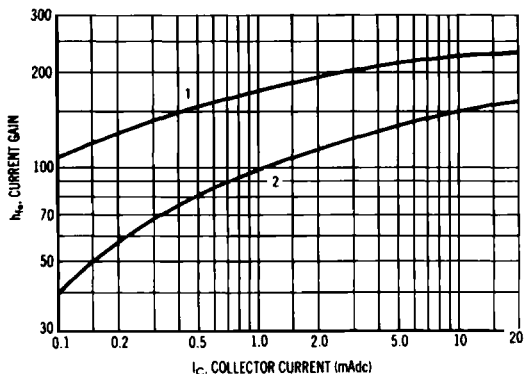
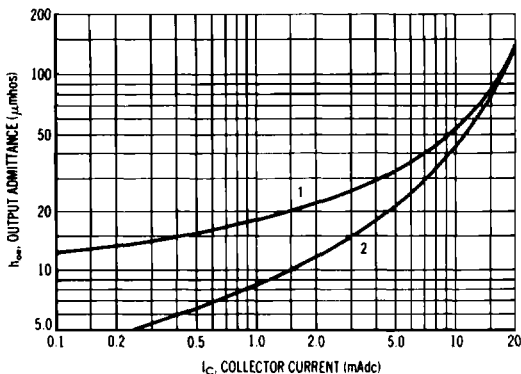


FIGURE 8 — OUTPUT ADMITTANCE



SWITCHING TIME CHARACTERISTICS

FIGURE 9 — TURN-ON TIME

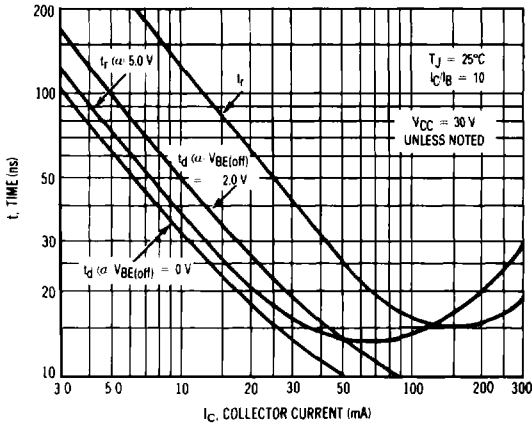


FIGURE 10 — CHARGE DATA

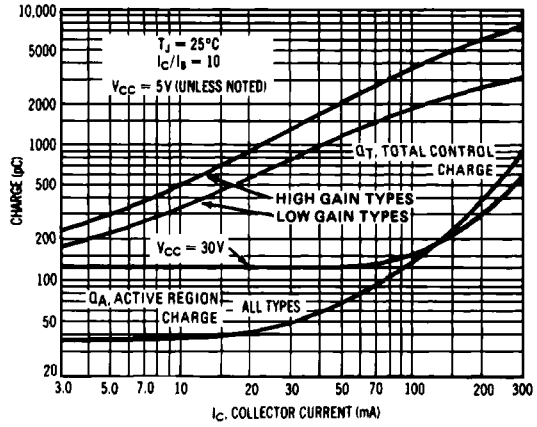


FIGURE 11 — TURN-OFF BEHAVIOR

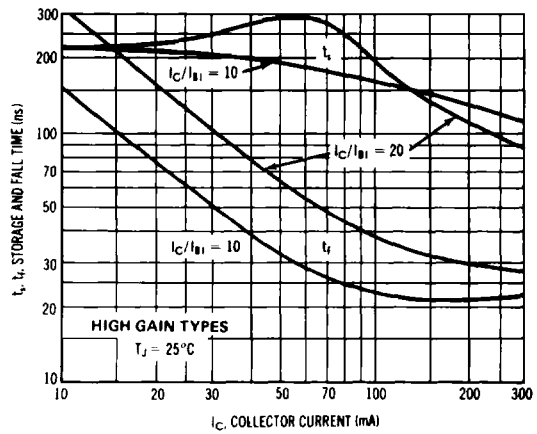
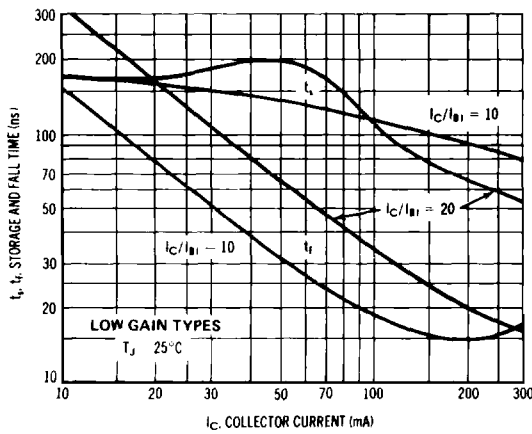


FIGURE 12 — DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

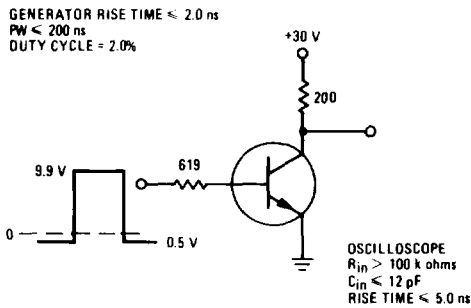


FIGURE 13 — STORAGE TIME AND FALL TIME EQUIVALENT TEST CIRCUIT

