

TYPES 2N2217 THRU 2N2222, 2N2218A, 2N2219A, 2N2221A, 2N2222A N-P-N SILICON TRANSISTORS

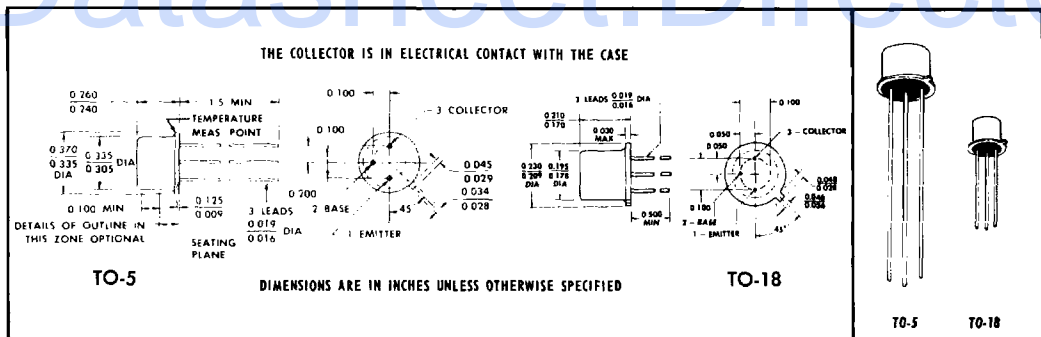
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DESIGNED FOR HIGH-SPEED, MEDIUM-POWER SWITCHING
AND GENERAL PURPOSE AMPLIFIER APPLICATIONS

- h_{FE} . . . Guaranteed from 100 μA to 500 mA
- High f_T at 20 V, 20 mA . . . 300 MHz (2N2219A, 2N2222A)
250 MHz (all others)
- 2N2218, 2N2221 for Complementary Use with 2N2904, 2N2906
- 2N2219, 2N2222 for Complementary Use with 2N2905, 2N2906

*mechanical data

Device types 2N2217, 2N2218, 2N2218A, 2N2219, and 2N2219A are in JEDEC TO-5 packages.
Device types 2N2220, 2N2221, 2N2221A, 2N2222, and 2N2222A are in JEDEC TO-18 packages.



*absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

	2N2217 2N2218 2N2219	2N2218A 2N2219A	2N2220 2N2221 2N2222	2N2221A 2N2222A	UNIT
Collector-Base Voltage	60	75	60	75	V
Collector-Emitter Voltage (See Note 1)	30	40	30	40	V
Emitter-Base Voltage	5	6	5	6	V
Continuous Collector Current	0.8	0.8	0.8	0.8	A
Continuous Device Dissipation at (or below) 25°C Free-Air Temperature (See Notes 2 and 3)	0.8	0.8	0.5	0.5	W
Continuous Device Dissipation at (or below) 25°C Case Temperature (See Notes 4 and 5)	3	3	1.8	1.8	W
Operating Collector Junction Temperature Range	-65 to 175				°C
Storage Temperature Range	-65 to 200				°C
Lead Temperature 1/16 Inch from Case for 10 Seconds	230				°C

- NOTES: 1. These values apply between 0 and 500 mA collector current when the base-emitter diode is open-circuited.
2. Derate 2N2217, 2N2218, 2N2218A, 2N2219, and 2N2219A linearly to 175°C free-air temperature at the rate of 5.33 mW/°C.
3. Derate 2N2220, 2N2221, 2N2221A, 2N2222, and 2N2222A linearly to 175°C free-air temperature at the rate of 3.33 mW/°C.
4. Derate 2N2217, 2N2218, 2N2218A, 2N2219, and 2N2219A linearly to 175°C case temperature at the rate of 20.0 mW/°C.
5. Derate 2N2220, 2N2221, 2N2221A, 2N2222, and 2N2222A linearly to 175°C case temperature at the rate of 12.0 mW/°C.

*JEDEC registered data. This data sheet contains all applicable registered data in effect at the time of publication.

USES CHIP N24

TYPES 2N2217 THRU 2N2222, 2N2218A, 2N2219A, 2N2221A, 2N2222A N-P-N SILICON TRANSISTORS

2N2217 THRU 2N2222

*electrical characteristics at 25°C free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TO-5 →	2N2217	2N2218	2N2219	UNIT		
		TO-18 →	2N2220	2N2221	2N2222			
			MIN	MAX	MIN		MAX	MIN
$V_{(BR)CBO}$ Collector-Base Breakdown Voltage	$I_C = 10 \mu A, I_E = 0$		60	60	60	V		
$V_{(BR)CEO}$ Collector-Emitter Breakdown Voltage	$I_C = 10 \text{ mA}, I_B = 0$, See Note 6		30	30	30	V		
$V_{(BR)EBO}$ Emitter-Base Breakdown Voltage	$I_E = 10 \mu A, I_C = 0$		5	5	5	V		
I_{CBO} Collector Cutoff Current	$V_{CB} = 50 \text{ V}, I_E = 0$		10	10	10	nA		
	$V_{CB} = 50 \text{ V}, I_E = 0, T_A = 150^\circ \text{C}$		10	10	10	μA		
I_{EBO} Emitter Cutoff Current	$V_{EB} = 3 \text{ V}, I_C = 0$		10	10	10	nA		
h_{FE} Static Forward Current Transfer Ratio	$V_{CE} = 10 \text{ V}, I_C = 100 \mu A$			20	35			
	$V_{CE} = 10 \text{ V}, I_C = 1 \text{ mA}$		12	25	50			
	$V_{CE} = 10 \text{ V}, I_C = 10 \text{ mA}$	See Note 6	17	35	75			
	$V_{CE} = 10 \text{ V}, I_C = 150 \text{ mA}$		20	60	40	120	100	300
	$V_{CE} = 10 \text{ V}, I_C = 500 \text{ mA}$			20	30			
$V_{CE} = 1 \text{ V}, I_C = 150 \text{ mA}$		10	20	50				
V_{BE} Base-Emitter Voltage	$I_B = 15 \text{ mA}, I_C = 150 \text{ mA}$	See Note 6	1.3	1.3	1.3	V		
	$I_B = 50 \text{ mA}, I_C = 500 \text{ mA}$			2.6	2.6			
$V_{CE(sat)}$ Collector-Emitter Saturation Voltage	$I_B = 15 \text{ mA}, I_C = 150 \text{ mA}$	See Note 6	0.4	0.4	0.4	V		
	$I_B = 50 \text{ mA}, I_C = 500 \text{ mA}$			1.6	1.6			
$ h_{fe} $ Small-Signal Common-Emitter Forward Current Transfer Ratio	$V_{CE} = 20 \text{ V}, I_C = 20 \text{ mA}, f = 100 \text{ MHz}$		2.5	2.5	2.5			
f_T Transition Frequency	$V_{CE} = 20 \text{ V}, I_C = 20 \text{ mA}$, See Note 7		250	250	250	MHz		
C_{obo} Common-Base Open-Circuit Output Capacitance	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1 \text{ MHz}$		8	8	8	pF		
$h_{ie(real)}$ Real Part of Small-Signal Common-Emitter Input Impedance	$V_{CE} = 20 \text{ V}, I_C = 20 \text{ mA}, f = 300 \text{ MHz}$		60	60	60	Ω		

NOTES: 6. These parameters must be measured using pulse techniques. $t_w = 300 \mu s$, duty cycle $\leq 2\%$.

7. To obtain f_T , the h_{fe} response with frequency is extrapolated at the rate of -6 dB per octave from $f = 100 \text{ MHz}$ to the frequency at which $|h_{fe}| = 1$.

switching characteristics at 25°C free-air temperature

PARAMETER	TEST CONDITIONS†	TYP	UNIT
t_d Delay Time	$V_{CC} = 30 \text{ V}, I_C = 150 \text{ mA}, I_{B(1)} = 15 \text{ mA}, V_{BE(off)} = -0.5 \text{ V}$, See Figure 1	5	ns
t_r Rise Time		15	ns
t_s Storage Time	$V_{CC} = 30 \text{ V}, I_C = 150 \text{ mA}, I_{B(1)} = 15 \text{ mA}, I_{B(2)} = -15 \text{ mA}$, See Figure 2	190	ns
t_f Fall Time		23	ns

† Voltage and current values shown are nominal; exact values vary slightly with transistor parameters.

*JEDEC registered data

TYPES 2N2217 THRU 2N2222, 2N2218A, 2N2219A, 2N2221A, 2N2222A

N-P-N SILICON TRANSISTORS

2N2218A, 2N2219A, 2N2221A, 2N2222A

*electrical characteristics at 25°C free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TO-5 →	2N2218A		2N2219A		UNIT
		TO-18 →	MIN	MAX	MIN	MAX	
V(BR)CBO	Collector-Base Breakdown Voltage	I _C = 10 μA, I _E = 0	75		75		V
V(BR)CEO	Collector-Emitter Breakdown Voltage	I _C = 10 mA, I _B = 0, See Note 6	40		40		V
V(BR)EBO	Emitter-Base Breakdown Voltage	I _E = 10 μA, I _C = 0	6		6		V
I _{CBO}	Collector Cutoff Current	V _{CB} = 60 V, I _E = 0		10		10	nA
I _{CEV}	Collector Cutoff Current	V _{CE} = 60 V, V _{BE} = -3 V		10		10	nA
I _{BEV}	Base Cutoff Current	V _{CE} = 60 V, V _{BE} = -3 V		-20		-20	nA
I _{EBO}	Emitter Cutoff Current	V _{EB} = 3 V, I _C = 0		10		10	nA
h _{FE}	Static Forward Current Transfer Ratio	V _{CE} = 10 V, I _C = 100 μA	20		35		
		V _{CE} = 10 V, I _C = 1 mA	25		50		
		V _{CE} = 10 V, I _C = 10 mA	35		75		
		V _{CE} = 10 V, I _C = 150 mA	40	120	100	300	
		V _{CE} = 10 V, I _C = 500 mA	25		40		
		V _{CE} = 1 V, I _C = 150 mA	20		50		
		V _{CE} = 10 V, I _C = 10 mA, T _A = -55°C	15		35		
V _{BE}	Base-Emitter Voltage	I _B = 15 mA, I _C = 150 mA	0.6	1.2	0.6	1.2	V
		I _B = 50 mA, I _C = 500 mA		2		2	
V _{CE(sat)}	Collector-Emitter Saturation Voltage	I _B = 15 mA, I _C = 150 mA		0.3		0.3	V
		I _B = 50 mA, I _C = 500 mA		1		1	
h _{ie}	Small-Signal Common-Emitter Input Impedance	V _{CE} = 10 V, I _C = 1 mA	1	3.5	2	8	kΩ
		V _{CE} = 10 V, I _C = 10 mA	0.2	1	0.25	1.25	
h _{fe}	Small-Signal Forward Current Transfer Ratio	V _{CE} = 10 V, I _C = 1 mA	30	150	50	300	
		V _{CE} = 10 V, I _C = 10 mA	50	300	75	375	
h _{re}	Small-Signal Common-Emitter Reverse Voltage Transfer Ratio	V _{CE} = 10 V, I _C = 1 mA	5 × 10 ⁻⁴		8 × 10 ⁻⁴		
		V _{CE} = 10 V, I _C = 10 mA	2.5 × 10 ⁻⁴		4 × 10 ⁻⁴		
h _{oe}	Small-Signal Common-Emitter Output Admittance	V _{CE} = 10 V, I _C = 1 mA	3	15	5	35	μmho
		V _{CE} = 10 V, I _C = 10 mA	10	100	25	200	
h _{fe}	Small-Signal Common-Emitter Forward Current Transfer Ratio	V _{CE} = 20 V, I _C = 20 mA, f = 100 MHz	2.5		3		
f _T	Transition Frequency	V _{CE} = 20 V, I _C = 20 mA, See Note 7	250		300		MHz
C _{obo}	Common-Base Open-Circuit Output Capacitance	V _{CB} = 10 V, I _E = 0, f = 100 kHz		8		8	pF
C _{ibo}	Common-Base Open-Circuit Input Capacitance	V _{EB} = 0.5 V, I _C = 0, f = 100 kHz		25		25	pF
h _{ie(real)}	Real Part of Small-Signal Common-Emitter Input Impedance	V _{CE} = 20 V, I _C = 20 mA, f = 300 MHz		60		60	Ω
r _b 'C _c	Collector-Base Time Constant	V _{CE} = 20 V, I _C = 20 mA, f = 31.8 MHz		150		150	ps

NOTES: 6. These parameters must be measured using pulse techniques. t_w = 300 μs, duty cycle ≤ 2%.

7. To obtain f_T, the |h_{fe}| response with frequency is extrapolated at the rate of -6 dB per octave from f = 100 MHz to the frequency at which |h_{fe}| = 1.

*JEDEC registered data

TYPES 2N2217 THRU 2N2222, 2N2218A, 2N2219A, 2N2221A, 2N2222A N-P-N SILICON TRANSISTORS

*operating characteristics at 25°C free-air temperature

PARAMETER	TEST CONDITIONS	TO-5 →	2N2218A	2N2219A	UNIT
		TO-18 →	2N2221A	2N2222A	
F Spot Noise Figure	$V_{CE} = 10 \text{ V}$, $I_C = 100 \mu\text{A}$, $R_G = 1 \text{ k}\Omega$, $f = 1 \text{ kHz}$		MAX	MAX	4 dB

*switching characteristics at 25°C free-air temperature

PARAMETER	TEST CONDITIONS†	TO-5 →	2N2218A	2N2219A	UNIT
		TO-18 →	2N2221A	2N2222A	
t_d Delay Time	$V_{CC} = 30 \text{ V}$, $I_C = 150 \text{ mA}$, $I_{B(1)} = 15 \text{ mA}$, $V_{BE(\text{off})} = -0.5 \text{ V}$, See Figure 1		10	10	ns
t_r Rise Time			25	25	ns
τ_A Active Region Time Constant‡			2.5	2.5	ns
t_s Storage Time	$V_{CC} = 30 \text{ V}$, $I_C = 150 \text{ mA}$, $I_{B(1)} = 15 \text{ mA}$, $I_{B(2)} = -15 \text{ mA}$, See Figure 2		225	225	ns
t_f Fall Time			60	60	ns

† Voltage and current values shown are nominal; exact values vary slightly with transistor parameters.

‡ Under the given conditions τ_A is equal to $\frac{t_r}{10}$.

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*PARAMETER MEASUREMENT INFORMATION

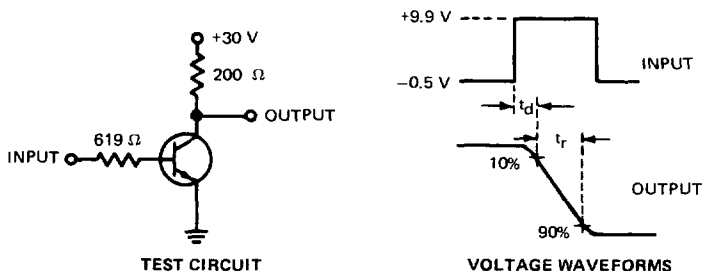


FIGURE 1—DELAY AND RISE TIMES

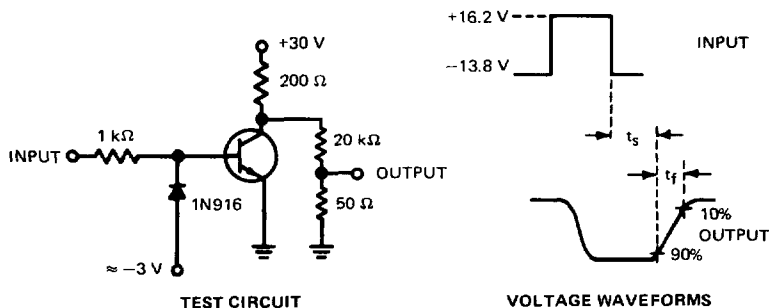


FIGURE 2—STORAGE AND FALL TIMES

NOTES: a. The input waveforms have the following characteristics: For Figure 1, $t_r \leq 2 \text{ ns}$, $t_w \leq 200 \text{ ns}$, duty cycle $\leq 2\%$; for Figure 2, $t_f \leq 5 \text{ ns}$, $t_w \approx 100 \mu\text{s}$, duty cycle $\leq 17\%$.
b. All waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 5 \text{ ns}$, $R_{in} \geq 100 \text{ k}\Omega$, $C_{in} \leq 12 \text{ pF}$.

*JEDEC registered data