



# TYPES 2N2904 THRU 2N2907, 2N2904A THRU 2N2907A P-N-P SILICON TRANSISTORS

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

PARAMETER	TEST CONDITIONS	TO-5 →	2N2904	2N2904A	2N2905	2N2905A	UNIT
		TO-18 →	2N2906	2N2906A	2N2907	2N2907A	
			MIN	MAX	MIN	MAX	
$V_{(BR)CBO}$ Collector-Base Breakdown Voltage	$I_C = -10 \mu A, I_E = 0$		-60	-60	-60	-60	V
$V_{(BR)CEO}$ Collector-Emitter Breakdown Voltage	$I_C = -10 mA, I_B = 0,$ See Note 6		-40	-60	-40	-60	V
$V_{(BR)EBO}$ Emitter-Base Breakdown Voltage	$I_E = -10 \mu A, I_C = 0$		-5	-5	-5	-5	V
$I_{CBO}$ Collector Cutoff Current	$V_{CB} = -50 V, I_E = 0$		-20	-10	-20	-10	nA
	$V_{CB} = -50 V, I_E = 0,$ $T_A = 150^\circ C$		-20	-10	-20	-10	$\mu A$
$I_{CEV}$ Collector Cutoff Current	$V_{CE} = -30 V, V_{BE} = 0.5 V$		-50	-50	-50	-50	nA
$I_{BEV}$ Base Cutoff Current	$V_{CE} = -30 V, V_{BE} = 0.5 V$		50	50	50	50	nA
$h_{FE}$ Static Forward Current Transfer Ratio	$V_{CE} = -10 V, I_C = -100 \mu A$		20	40	35	75	V
	$V_{CE} = -10 V, I_C = -1 mA$		25	40	50	100	
	$V_{CE} = -10 V, I_C = -10 mA$		35	40	75	100	
	$V_{CE} = -10 V, I_C = -150 mA,$ See Note 6		40 120	40 120	100 300	100 300	
	$V_{CE} = -10 V, I_C = -500 mA,$ See Note 6		20	40	30	50	
$V_{BE}$ Base-Emitter Voltage	$I_B = -15 mA, I_C = -150 mA,$ See Note 6		-1.3	-1.3	-1.3	-1.3	V
	$I_B = -50 mA, I_C = -500 mA,$ See Note 6		-2.6	-2.6	-2.6	-2.6	
$V_{CE(sat)}$ Collector-Emitter Saturation Voltage	$I_B = -15 mA, I_C = -150 mA,$ See Note 6		-0.4	-0.4	-0.4	-0.4	V
	$I_B = -50 mA, I_C = -500 mA,$ See Note 6		-1.6	-1.6	-1.6	-1.6	
$ h_{fe} $ Small-Signal Common-Emitter Forward Current Transfer Ratio	$V_{CE} = -20 V, I_C = -50 mA,$ $f = 100 MHz$		2	2	2	2	
$C_{obo}$ Common-Base Open-Circuit Output Capacitance	$V_{CB} = -10 V, I_E = 0,$ $f = 100 kHz$		8	8	8	8	pF
$C_{ibo}$ Common-Base Open-Circuit Input Capacitance	$V_{EB} = -2 V, I_C = 0,$ $f = 100 kHz$		30	30	30	30	pF

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

\*JEDEC registered data

# TYPES 2N2904 THRU 2N2907, 2N2904A THRU 2N2907A P-N-P SILICON TRANSISTORS

\*switching characteristics at 25°C free-air temperature

PARAMETER	TEST CONDITIONS†	MAX	UNIT
$t_d$ Delay Time	$V_{CC} = -30\text{ V}$ , $I_C = -150\text{ mA}$ , $I_{B(1)} = -15\text{ mA}$ , $V_{BE(off)} = 0$ , See Figure 1	10	ns
$t_r$ Rise Time		40	ns
$t_{on}$ Turn-On Time		45	ns
$t_s$ Storage Time	$V_{CC} = -6\text{ V}$ , $I_C = -150\text{ mA}$ , $I_{B(1)} = -13\text{ mA}$ , $I_{B(2)} = 17\text{ mA}$ , See Figure 2	80	ns
$t_f$ Fall Time		30	ns
$t_{off}$ Turn-Off Time		100	ns

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

## \*PARAMETER MEASUREMENT INFORMATION

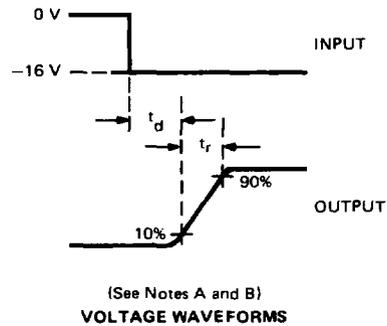
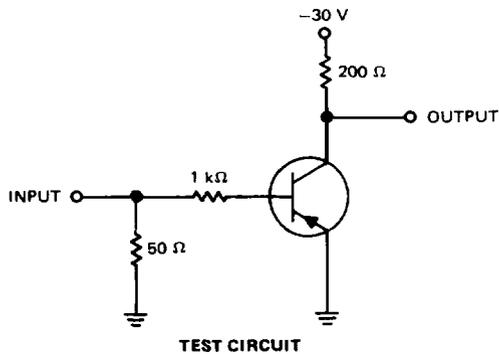


FIGURE 1

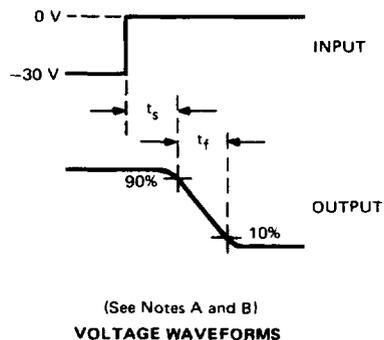
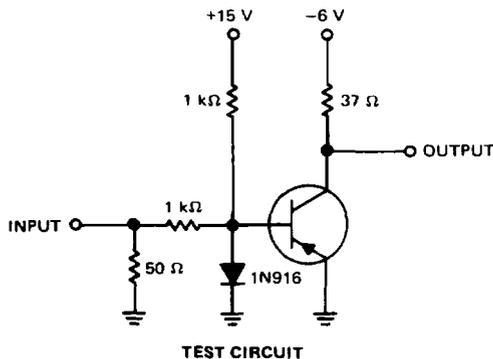


FIGURE 2

NOTES: A. The input waveforms are supplied by a generator with the following characteristics:  $Z_{out} = 50\ \Omega$ ,  $t_r \leq 2\text{ ns}$ ,  $t_f \leq 2\text{ ns}$ ,  $t_w = 200\text{ ns}$ ,  $PRR = 150\text{ Hz}$ .

B. Waveforms are monitored on an oscilloscope with the following characteristics:  $t_r \leq 5\text{ ns}$ ,  $R_{in} = 10\text{ M}\Omega$ .

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