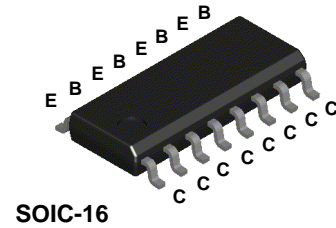
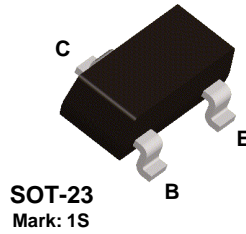
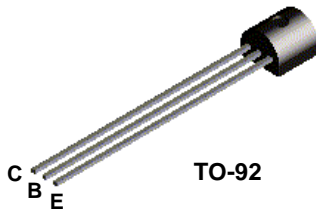


**PN2369A**

**MMBT2369A**

**MMPQ2369**



**NPN Switching Transistor**

This device is designed for high speed saturation switching at collector currents of 10 mA to 100 mA. Sourced from Process 21.

**Absolute Maximum Ratings\***

TA = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
V <sub>CEO</sub>	Collector-Emitter Voltage	15	V
V <sub>CBO</sub>	Collector-Base Voltage	40	V
V <sub>EBO</sub>	Emitter-Base Voltage	4.5	V
I <sub>C</sub>	Collector Current - Continuous	200	mA
T <sub>J</sub> , T <sub>stg</sub>	Operating and Storage Junction Temperature Range	-55 to +150	°C

\*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

**NOTES:**

- 1) These ratings are based on a maximum junction temperature of 150 degrees C.
- 2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

**Thermal Characteristics**

TA = 25°C unless otherwise noted

Symbol	Characteristic	Max			Units
		PN2369A	MMBT2369A*	MMPQ2369	
P <sub>D</sub>	Total Device Dissipation	350	225	1,000	mW
	Derate above 25°C	2.8	1.8	8.0	mW/°C
R <sub>θJC</sub>	Thermal Resistance, Junction to Case	125			°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient Effective 4 Die Each Die	357	556		°C/W
				125	°C/W
				240	°C/W

\* Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06."

# NPN Switching Transistor

(continued)

## Electrical Characteristics

TA = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Max	Units
<b>OFF CHARACTERISTICS</b>					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage*	$I_C = 10 \text{ mA}, I_B = 0$	15		V
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$I_C = 10 \text{ } \mu\text{A}, V_{BE} = 0$	40		V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10 \text{ } \mu\text{A}, I_E = 0$	40		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10 \text{ } \mu\text{A}, I_C = 0$	4.5		V
$I_{CBO}$	Collector Cutoff Current	$V_{CB} = 20 \text{ V}, I_E = 0$ $V_{CB} = 20 \text{ V}, I_E = 0, T_A = 125^\circ\text{C}$		0.4 30	$\mu\text{A}$ $\mu\text{A}$

## ON CHARACTERISTICS

$h_{FE}$	DC Current Gain*	$I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 0.35 \text{ V}, T_A = -55^\circ\text{C}$ $I_C = 100 \text{ mA}, V_{CE} = 2.0 \text{ V}$	40 20 20	120	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage*	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, T_A = 125^\circ\text{C}$ $I_C = 30 \text{ mA}, I_B = 3.0 \text{ mA}$ $I_C = 100 \text{ mA}, I_B = 10 \text{ mA}$		0.2 0.3 0.25 0.5	V V V V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, T_A = -55^\circ\text{C}$ $I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}, T_A = 125^\circ\text{C}$ $I_C = 30 \text{ mA}, I_B = 3.0 \text{ mA}$ $I_C = 100 \text{ mA}, I_B = 10 \text{ mA}$	0.7 0.59	0.85 1.02	V V V V V

## SMALL SIGNAL CHARACTERISTICS

$C_{obo}$	Output Capacitance	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$		4.0	pF
$C_{ibo}$	Input Capacitance	$V_{EB} = 0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$		5.0	pF
$h_{fe}$	Small-Signal Current Gain	$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V},$ $R_G = 2.0 \text{ k}\Omega, f = 100 \text{ MHz}$	5.0		

## SWITCHING CHARACTERISTICS (except MMPQ2369)

$t_s$	Storage Time	$I_{B1} = I_{B2} = I_C = 10 \text{ mA}$		13	ns
$t_{on}$	Turn-On Time	$V_{CC} = 3.0 \text{ V}, I_C = 10 \text{ mA},$ $I_{B1} = 3.0 \text{ mA}$		12	ns
$t_{off}$	Turn-Off Time	$V_{CC} = 3.0 \text{ V}, I_C = 10 \text{ mA},$ $I_{B1} = 3.0 \text{ mA}, I_{B2} = 1.5 \text{ mA}$		18	ns

\*Pulse Test: Pulse Width  $\leq 300 \text{ } \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

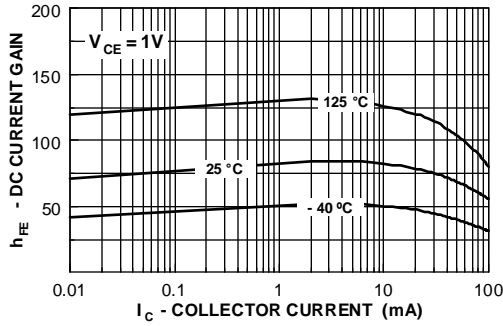
## Spice Model

NPN (Is=44.14f Xti=3 Eg=1.11 Vaf=100 Bf=78.32 Ne=1.389 Ise=91.95f Ikf=.3498 Xtb=1.5 Br=12.69m Nc=2 Isc=0 Ikr=0 Rc=.6 Cjc=2.83p Mjc=86.19m Vjc=.75 Fc=.5 Cje=4.5p Mje=.2418 Vje=.75 Tr=1.073u Tf=227.6p Itf=.3 Vtf=4 Xtf=4 Rb=10)

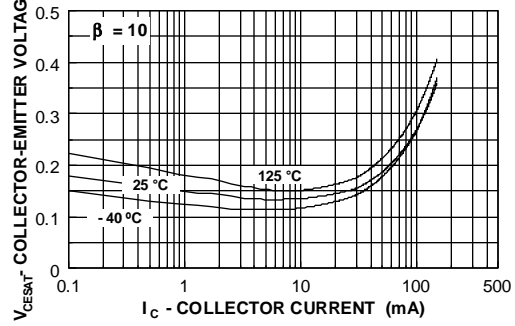
PN2369A / MMBT2369A / MMPQ2369

DC Typical Characteristics

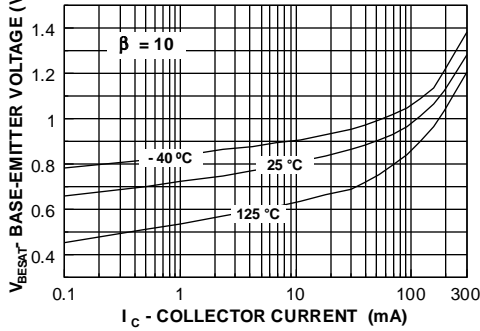
DC Current Gain vs Collector Current



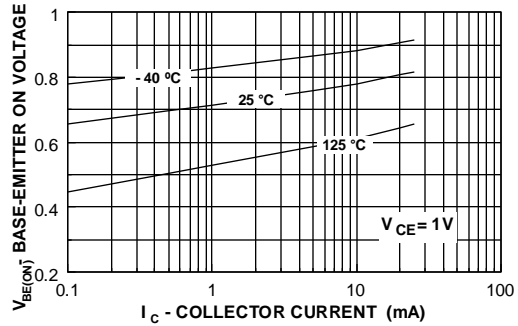
Collector-Emitter Saturation Voltage vs Collector Current



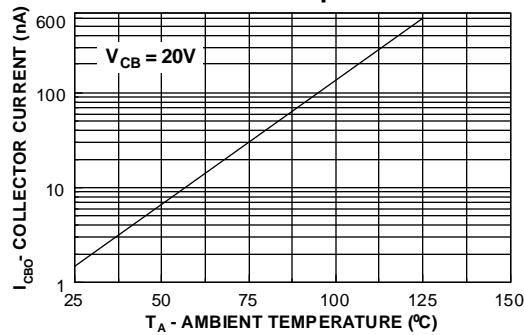
Base-Emitter Saturation Voltage vs Collector Current



Base-Emitter ON Voltage vs Collector Current



Collector-Cutoff Current vs Ambient Temperature



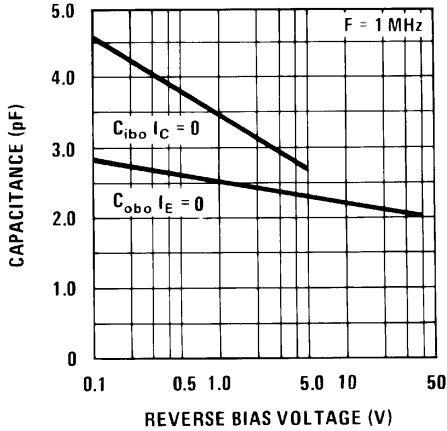
# NPN Switching Transistor

(continued)

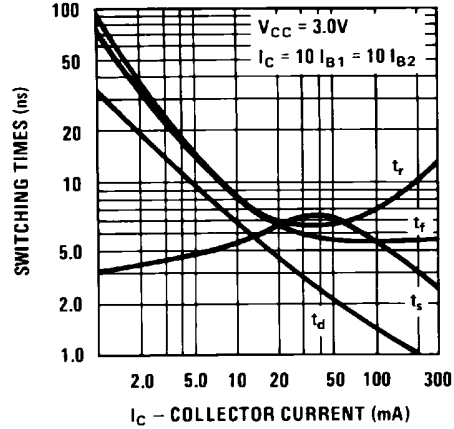
PN2369A / MMBT2369A / MMPO2369

## AC Typical Characteristics

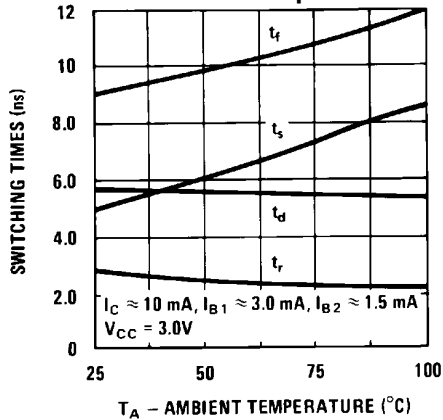
### Output Capacitances vs. Reverse Bias Voltage



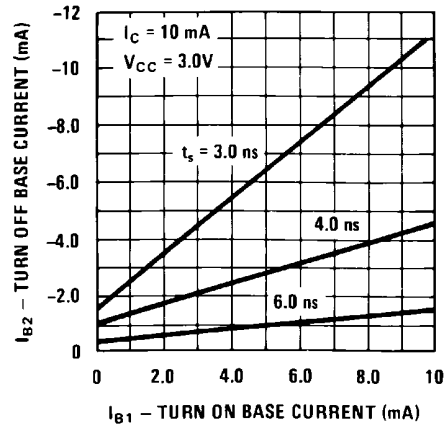
### Switching Times vs. Collector Current



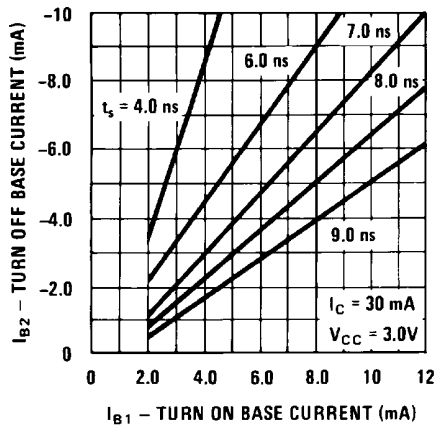
### Switching Times vs. Ambient Temperature



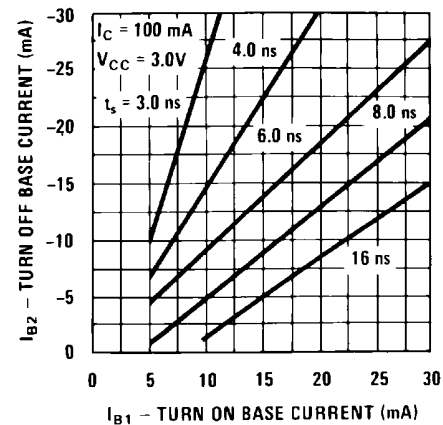
### Storage Time vs. Turn On and Turn Off Base Currents



### Storage Time vs. Turn On and Turn Off Base Currents

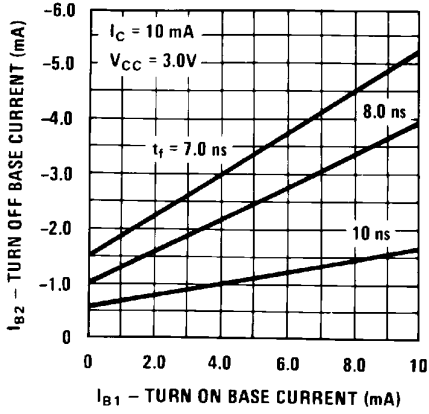


### Storage Time vs. Turn On and Turn Off Base Currents

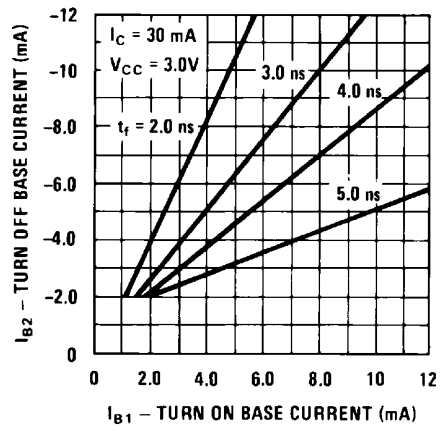


AC Typical Characteristics (continued)

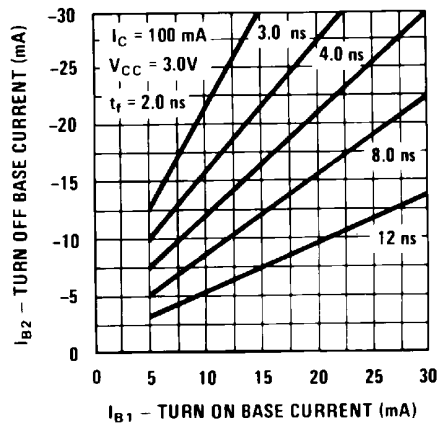
Fall Time vs. Turn On and Turn Off Base Currents



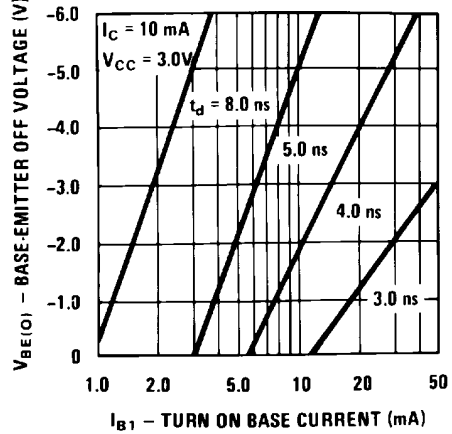
Fall Time vs. Turn On and Turn Off Base Currents



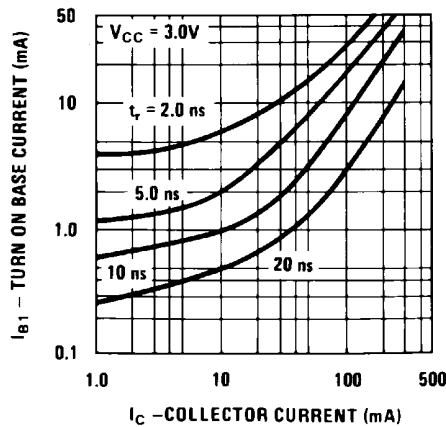
Fall Time vs. Turn On and Turn Off Base Currents



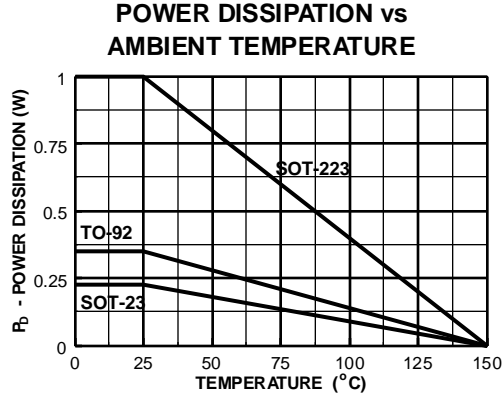
Delay Time vs. Base-Emitter OFF Voltage and Turn On Base Current



Rise Time vs. Turn On Base Current and Collector Current



AC Typical Characteristics (continued)



Test Circuits

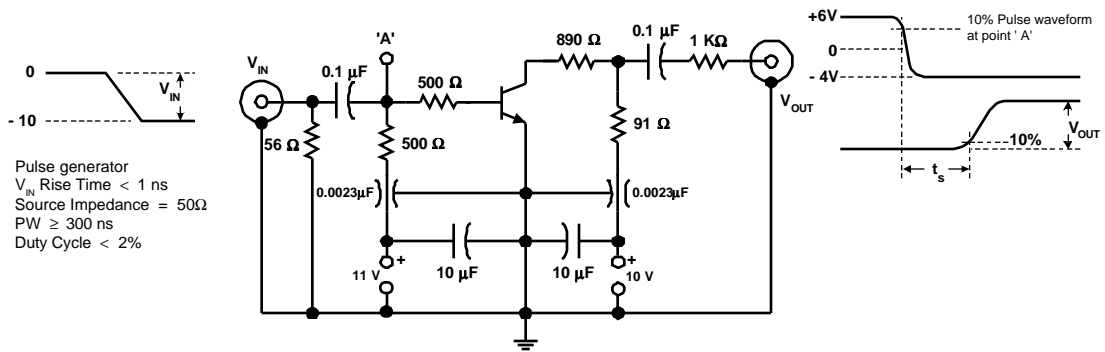


FIGURE 1: Charge Storage Time Measurement Circuit

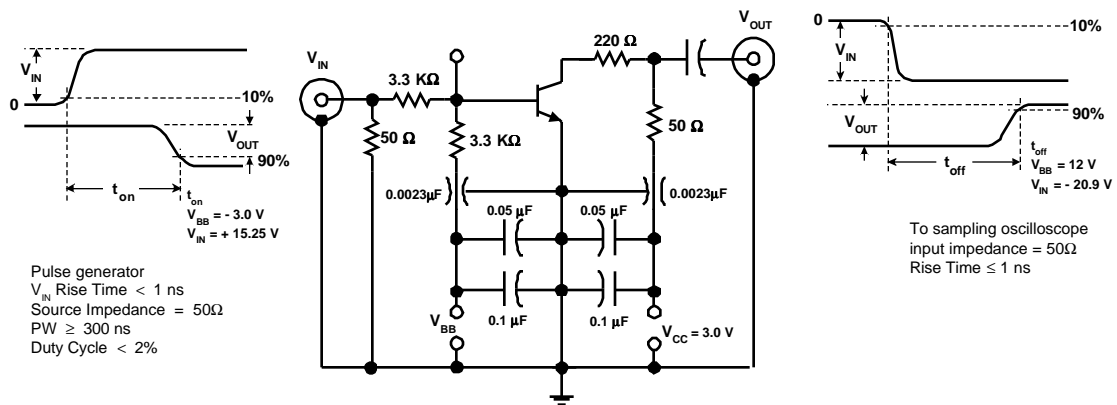


FIGURE 2:  $t_{ON}$ ,  $t_{OFF}$  Measurement Circuit