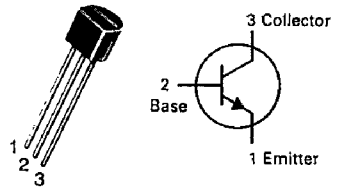
MPS2222,A★

CASE 29-04, STYLE 1
TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTORS

NPN SILICON

★MPS2222A is a Motorola designated preferred device.

MAXIMUM RATINGS

Rating	Symbol	MPS2222	MPS2222A	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	600		mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0		mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W

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)	 MPS2222 MPS2222A	$V_{(BR)CEO}$	 30 40	 — —	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	 MPS2222 MPS2222A	$V_{(BR)CBO}$	 60 75	 — —	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	 MPS2222 MPS2222A	$V_{(BR)EBO}$	 5.0 6.0	 — —	Vdc
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	 MPS2222A	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 = 125°C) (V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C)	 MPS2222 MPS2222A MPS2222 MPS2222A	I_{CBO}	 — — — —	 0.01 0.01 10 10	μAdc
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0)	 MPS2222A	I_{EBO}	 —	 100	nAdc
Base Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	 MPS2222A	I_{BL}	 —	 20	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 0.1 mAdc, V_{CE} = 10 Vdc) (I_C = 1.0 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = −55°C) (I_C = 150 mAdc, V_{CE} = 10 Vdc)(1) (I_C = 150 mAdc, V_{CE} = 1.0 Vdc)(1) (I_C = 500 mAdc, V_{CE} = 10 Vdc)(1)	 MPS2222A only MPS2222 MPS2222A	h_{FE}	 35 50 75 35 100 50 30 40	 — — — — 300 — — —	—
Collector-Emitter Saturation Voltage(1) (I_C = 150 mAdc, I_B = 15 mAdc) (I_C = 500 mAdc, I_B = 50 mAdc)	 MPS2222 MPS2222A MPS2222 MPS2222A	$V_{CE(sat)}$	 — — — —	 0.4 0.3 1.6 1.0	Vdc

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

Characteristic		Symbol	Min	Max	Unit
Base-Emitter Saturation Voltage(1)		$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	MPS2222		—	1.3	
	MPS2222A		0.6	1.2	
(I_C = 500 mAdc, I_B = 50 mAdc)	MPS2222		—	2.6	
	MPS2222A		—	2.0	
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2)		f_T			MHz
(I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	MPS2222		250	—	
	MPS2222A		300	—	
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	—	8.0	pF
Input Capacitance		C_{ibo}			pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	MPS2222		—	30	
	MPS2222A		—	25	
Input Impedance		h_{ie}			kΩ
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		2.0	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		0.25	1.25	
Voltage Feedback Ratio		h_{re}			X 10^{-4}
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		—	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		—	4.0	
Small-Signal Current Gain		h_{fe}			—
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		50	300	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		75	375	
Output Admittance		h_{oe}			μmhos
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		5.0	35	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MPS2222A		25	200	
Collector Base Time Constant (I_E = 20 mAdc, V_{CB} = 20 Vdc, f = 31.8 MHz)	MPS2222A	$rb'C_c$	—	150	ps
Noise Figure (I_C = 100 μAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz)	MPS2222A	NF	—	4.0	dB
SWITCHING CHARACTERISTICS MPS2222A only					
Delay Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = −0.5 Vdc,	t_d	—	10	ns
Rise Time	I_C = 150 mAdc, I_{B1} = 15 mAdc) (Figure 1)	t_r	—	25	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc,	t_s	—	225	ns
Fall Time	I_{B1} = I_{B2} = 15 mAdc) (Figure 2)	t_f	—	60	ns

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
(2) f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

FIGURE 1 – TURN-ON TIME

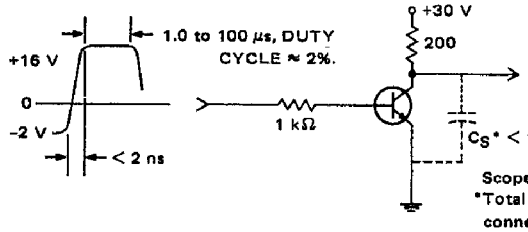


FIGURE 2 – TURN-OFF TIME

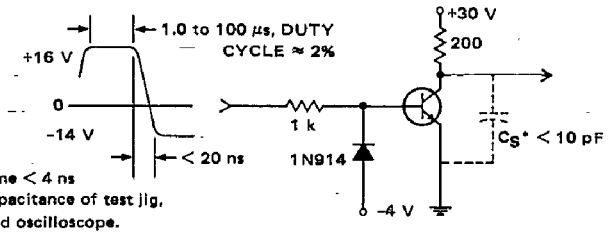


FIGURE 3 – DC CURRENT GAIN

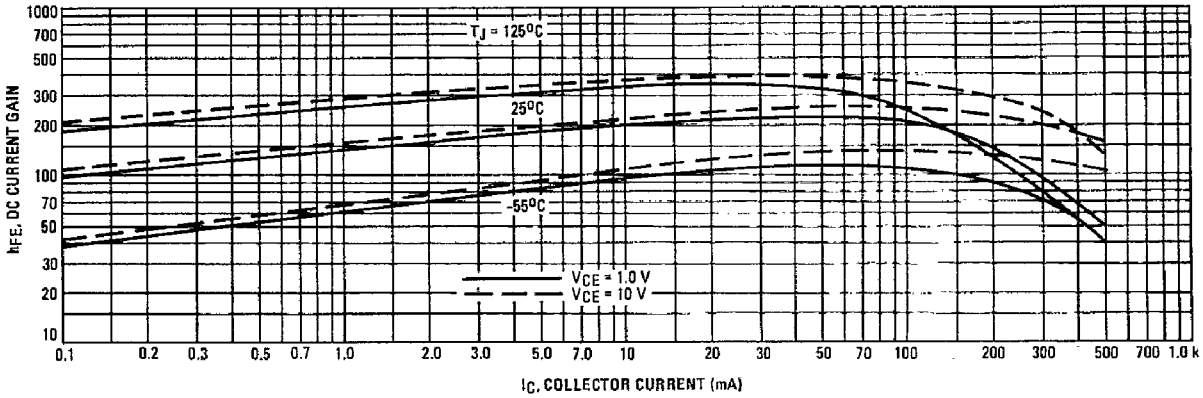


FIGURE 4 – COLLECTOR SATURATION REGION

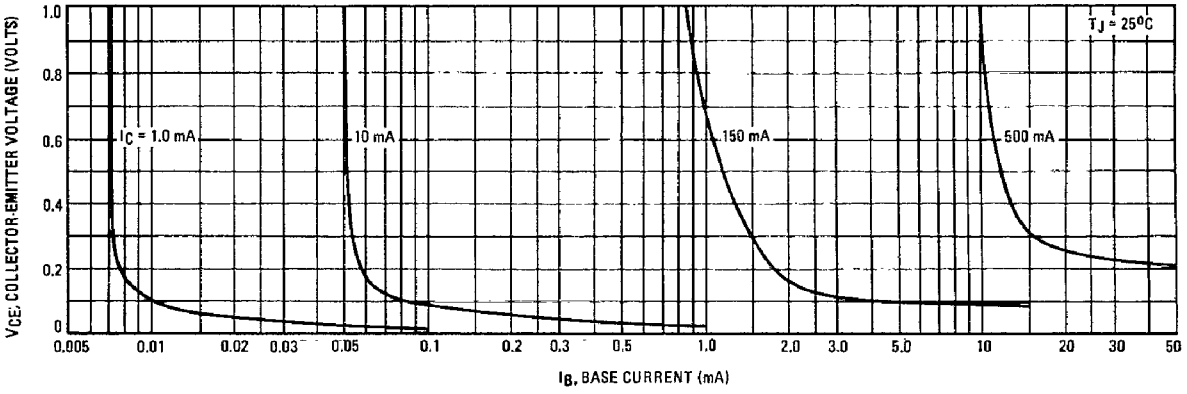


FIGURE 5 – TURN-ON TIME

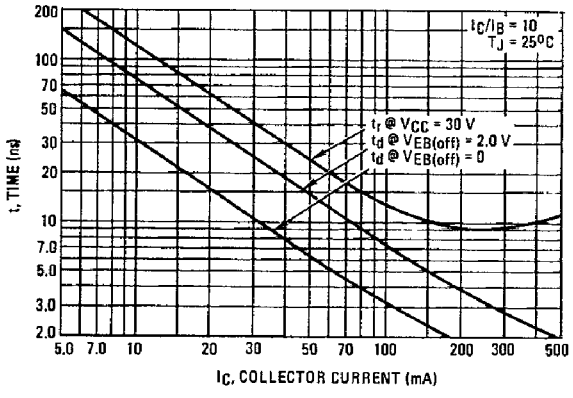


FIGURE 6 – TURN-OFF TIME

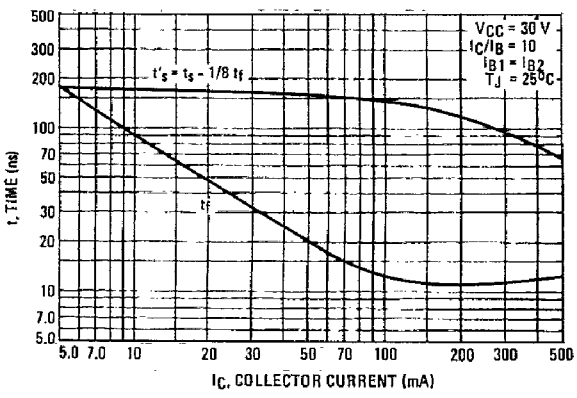


FIGURE 7 – FREQUENCY EFFECTS

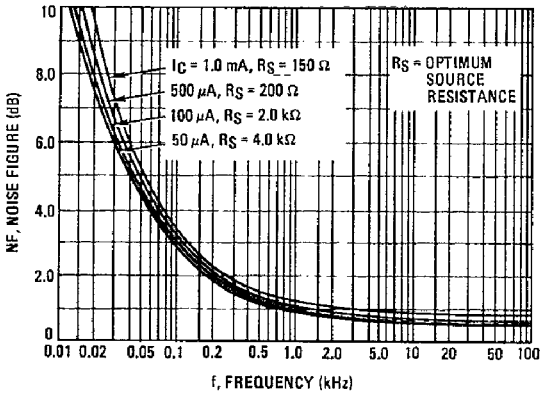


FIGURE 8 – SOURCE RESISTANCE EFFECTS

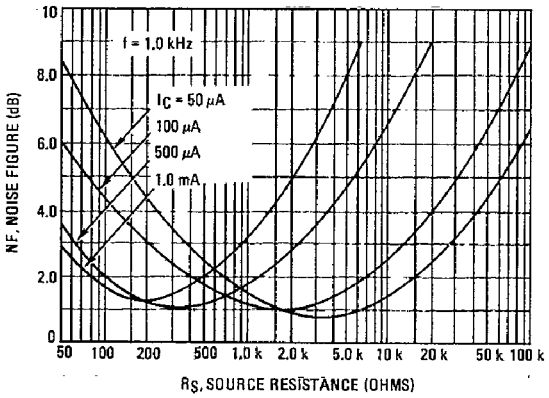


FIGURE 9 – CAPACITANCES

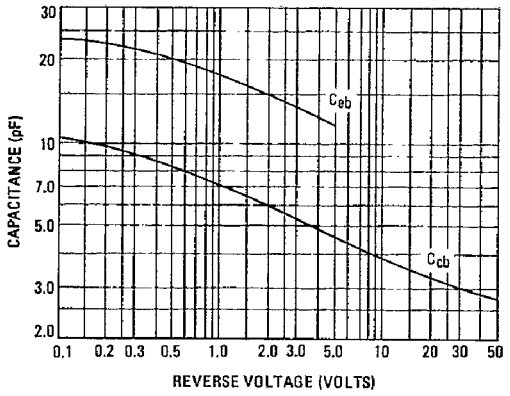


FIGURE 10 – CURRENT-GAIN BANDWIDTH PRODUCT

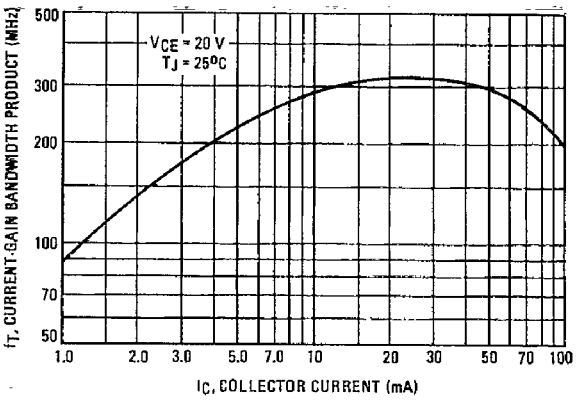


FIGURE 11 – "ON" VOLTAGES

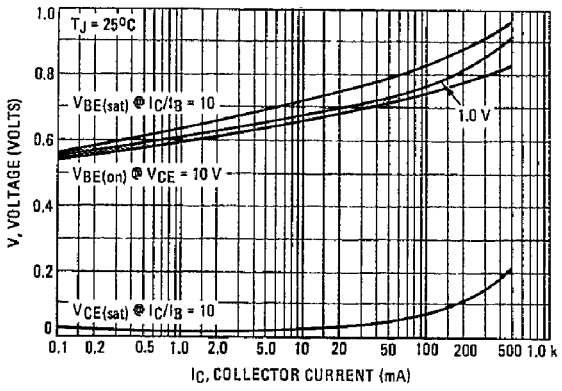
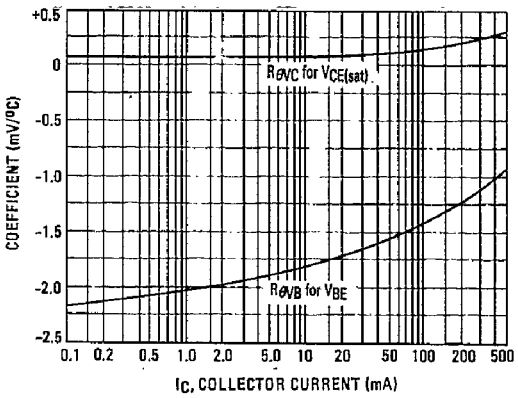
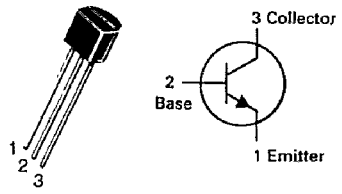


FIGURE 12 – TEMPERATURE COEFFICIENTS



MPS2369,A★

CASE 29-04, STYLE 1
TO-92 (TO-226AA)



SWITCHING TRANSISTORS

NPN SILICON

★MPS2369A is a Motorola designated preferred device.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Collector-Emitter Voltage	V_{CES}	40	Vdc
Collector-Base Voltage	V_{CBO}	40	Vdc
Emitter-Base Voltage	V_{EBO}	4.5	Vdc
Collector Current — Continuous	I_C	200	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0	mW mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(1) (I_C = 10 mAdc, I_B = 0)	MPS2369A	$V_{(BR)CEO}$	15	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 10 μAdc, V_{BE} = 0)	MPS2369,A	$V_{(BR)CES}$	40	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	MPS2369,A	$V_{(BR)CBO}$	40	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	MPS2369,A	$V_{(BR)EBO}$	4.5	—	—	Vdc
Collector Cutoff Current (V_{CB} = 20 Vdc, I_E = 0) (V_{CB} = 20 Vdc, I_E = 0, T_A = 125°C)	 MPS2369,A	I_{CBO}	 — —	 — —	 0.4 30	μAdc
Collector Cutoff Current (V_{CE} = 20 Vdc, V_{BE} = 0)	MPS2369,A	I_{CES}	—	—	0.4	μAdc
ON CHARACTERISTICS						
DC Current Gain(1) (I_C = 10 mAdc, V_{CE} = 1.0 V) (I_C = 10 mAdc, V_{CE} = 1.0 Vdc, T_A = −55°C) (I_C = 10 mAdc, V_{CE} = 1.0 Vdc) (I_C = 10 mAdc, V_{CE} = 0.35 Vdc) (I_C = 10 mAdc, V_{CE} = 0.35 Vdc, T_A = −55°C) (I_C = 30 mAdc, V_{CE} = 0.4 Vdc) (I_C = 100 mAdc, V_{CE} = 2.0 Vdc) (I_C = 100 mAdc, V_{CE} = 1.0 Vdc)	 MPS2369A MPS2369 MPS2369 MPS2369A MPS2369A MPS2369A MPS2369A MPS2369 MPS2369A	h_{FE}	 — 20 40 40 20 30 20 20	 — — — — — — — —	 120 — 120 — — — — —	—
Collector-Emitter Saturation Voltage(1) (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 10 mAdc, I_B = 1.0 mAdc, T_A = +125°C) (I_C = 30 mAdc, I_B = 3.0 mAdc) (I_C = 100 mAdc, I_B = 10 mAdc)	 MPS2369 MPS2369A MPS2369A MPS2369A MPS2369A	$V_{CE(sat)}$	 — — — — —	 — — — — —	 0.25 0.20 0.30 0.25 0.50	Vdc
Base-Emitter Saturation Voltage(1) (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 10 mAdc, I_B = 1.0 mAdc, T_A = +125°C) (I_C = 10 mAdc, I_B = 1.0 mAdc, T_A = −55°C) (I_C = 30 mAdc, I_B = 3.0 mAdc) (I_C = 100 mAdc, I_B = 10 mAdc)	 MPS2369 MPS2369A MPS2369A MPS2369A MPS2369A	$V_{BE(sat)}$	 0.7 0.5 — — —	 — — — — —	 0.85 — 1.02 1.15 1.60	Vdc

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

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

Characteristic		Symbol	Min	Typ	Max	Unit
SMALL-SIGNAL CHARACTERISTICS						
Output Capacitance (V_{CB} = 5.0 Vdc, I_E = 0, f = 1.0 MHz)	MPS2369,A	C_{obo}	—	—	4.0	pF
Small Signal Current Gain (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	MPS2369,A	h_{fe}	5.0	—	—	—
SWITCHING CHARACTERISTICS						
Storage Time (I_{B1} = I_{B2} = I_C = 10 mAdc) (Figure 3)	MPS2369,A	t_s	—	5.0	13	ns
Turn-On Time (V_{CC} = 3.0 Vdc, I_C = 10 mAdc, I_{B1} = 3.0 mAdc) (Figure 1)	MPS2369,A	t_{on}	—	8.0	12	ns
Turn-Off Time (V_{CC} = 3.0 Vdc, I_C = 10 mAdc, I_{B1} = 3.0 mAdc, I_{B2} = 1.5 mAdc) (Figure 2)	MPS2369,A	t_{off}	—	10	18	ns

FIGURE 1 — t_{on} CIRCUIT

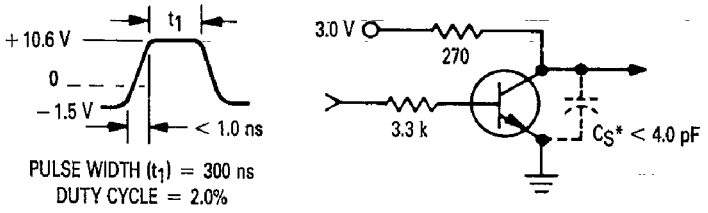


FIGURE 2 — t_{off} CIRCUIT

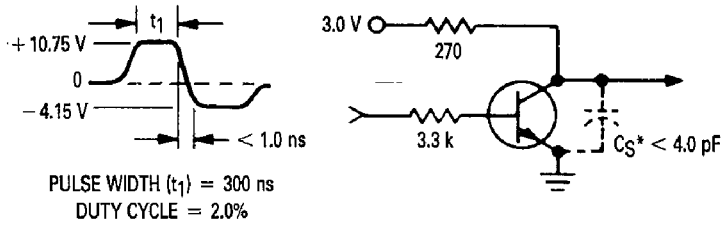
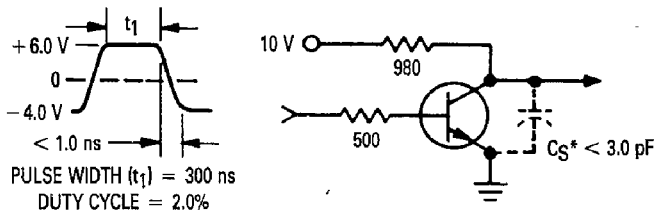


FIGURE 3 — STORAGE TEST CIRCUIT



*TOTAL SHUNT CAPACITANCE OF TEST JIG AND CONNECTORS.