2N3959
2N3960

JAN, JTX, JTXV AVAILABLE
CASE 22-03, STYLE 1
TO-18 (TO-206AA)

HIGH FREQUENCY TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	12	Vdc
Collector-Base Voltage	V_{CBO}	20	Vdc
Emitter-Base Voltage	V_{EBO}	4.5	Vdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	400 2.3	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	750 4.3	mW mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.233	°C/mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.436	°C/mW

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)		$V_{(BR)CEO}$	12	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)		$V_{(BR)CBO}$	20	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)		$V_{(BR)EBO}$	4.5	—	—	Vdc
Collector Cutoff Current (V_{CE} = 10 Vdc, V_{EB} = 2.0 Vdc) (V_{CE} = 10 Vdc, V_{EB} = 2.0 Vdc, T_A = 150°C)		I_{CEX}	 — —	 — —	 0.005 5.0	μAdc
Collector Forward Current (V_{CE} = 5.0 Vdc, V_{BE} = 0.4 Vdc)		I_{CEX}	—	—	1.0	μAdc
Base Cutoff Current (V_{CE} = 10 Vdc, V_{EB} = 2.0 Vdc)		I_{BL}	—	—	0.005	μAdc
ON CHARACTERISTICS						
DC Current Gain (I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc) (I_C = 10 mAdc, V_{CE} = 1.0 Vdc) (I_C = 30 mAdc, V_{CE} = 1.0 Vdc)		h_{FE}	 25 40 25	 — — —	 — 400 —	—
Collector-Emitter Saturation Voltage (I_C = 1.0 mAdc, I_B = 0.1 mAdc) (I_C = 30 mAdc, I_B = 3.0 mAdc)		$V_{CE(sat)}$	 — —	 — —	 0.2 0.3	Vdc
Base-Emitter On Voltage (I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc) (I_C = 30 mAdc, V_{CE} = 1.0 Vdc)		$V_{BE(on)}$	 — —	 — —	 0.8 1.0	Vdc
SMALL SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (I_C = 5.0 mAdc, V_{CE} = 4.0 Vdc, f = 100 MHz)	2N3959 2N3960	f_T	 1000 1300	 — —	 — —	MHz
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	2N3959 2N3960		1300 1600	— —	— —	
(I_C = 30 mAdc, V_{CE} = 4.0 Vdc, f = 100 MHz)	2N3959 2N3960		1000 1200	— —	— —	
Output Capacitance (V_{CB} = 4.0 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	—	2.0	2.5	pF

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

Characteristic		Symbol	Min	Typ	Max	Unit
Input Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 100 MHz)		C_{ibo}	—	1.5	2.5	pF
Collector Base Time Constant		$rb'C_c$				ps
(I_C = 5.0 mAdc, V_{CE} = 4.0 Vdc)	2N3959		—	—	30	
	2N3960		—	—	50	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)	2N3959		—	—	25	
	2N3960		—	—	40	
(I_C = 30 mAdc, V_{CE} = 4.0 Vdc)	2N3959		—	—	30	
	2N3960		—	—	50	
SWITCHING CHARACTERISTICS (FIGURE 7)						
Turn-On Delay Time		$t_{d(on)}$				ns
(I_C = 10 mAdc, V_{out} = 1.0 Vdc)			—	2.4	—	
(I_C = 30 mAdc, V_{out} = 1.0 Vdc)			—	2.0	—	
Rise Time		t_r				ns
(I_C = 10 mAdc, V_{out} = 1.0 Vdc)	Both Devices		—	3.0	—	
(I_C = 30 mAdc, V_{out} = 1.0 Vdc)	2N3959		—	2.2	—	
	2N3960		—	1.7	—	
Turn-Off Delay Time		$t_{d(off)}$				ns
(I_C = 10 mAdc, V_{out} = 1.0 Vdc)			—	1.6	—	
(I_C = 30 mAdc, V_{out} = 1.0 Vdc)			—	1.6	—	
Fall Time		t_f				ns
(I_C = 10 mAdc, V_{out} = 1.0 Vdc)	Both Devices		—	3.3	—	
(I_C = 30 mAdc, V_{out} = 1.0 Vdc)	2N3959		—	2.3	—	
	2N3960		—	1.9	—	

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FIGURE 1 – TYPICAL DC CURRENT GAIN

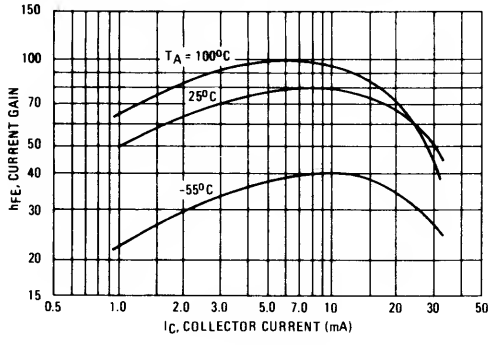


FIGURE 2 – TYPICAL CURRENT-GAIN – BANDWIDTH PRODUCT

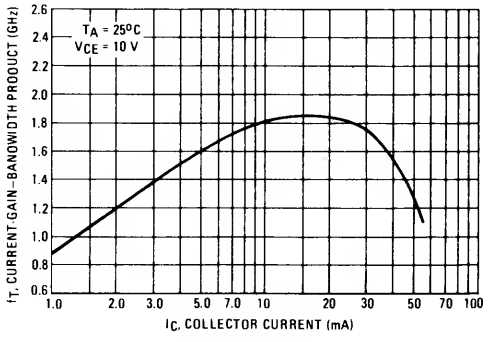


FIGURE 3 – TYPICAL COLLECTOR-BASE TIME CONSTANT

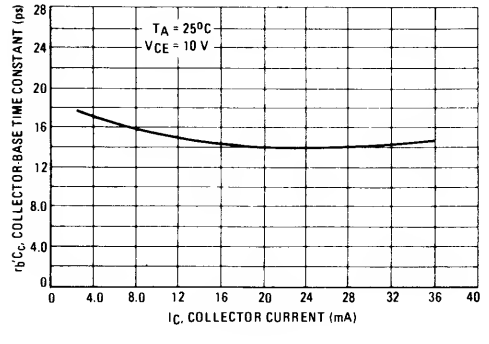
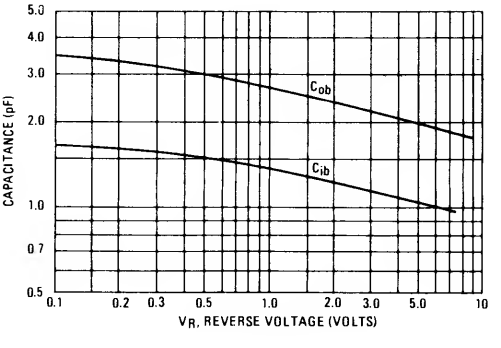


FIGURE 4 – TYPICAL JUNCTION CAPACITANCE



TURN-ON AND TURN-OFF TIMES

FIGURE 5 – V_{out} = 1.0 Vdc

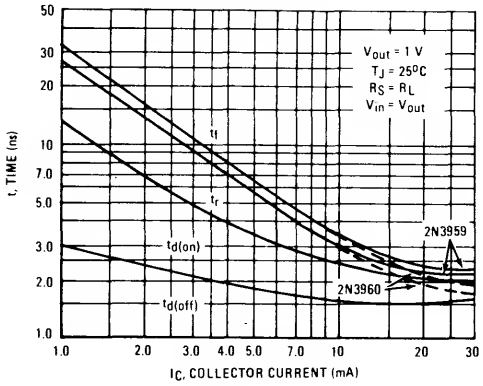


FIGURE 6 – V_{out} = 2.0 Vdc

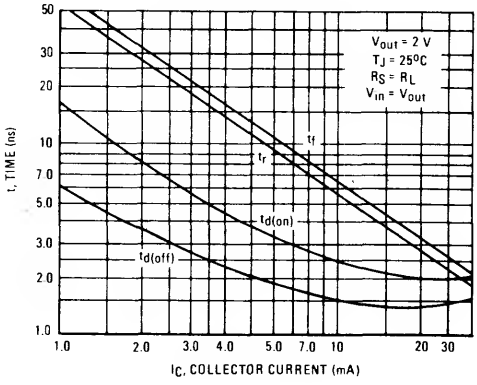
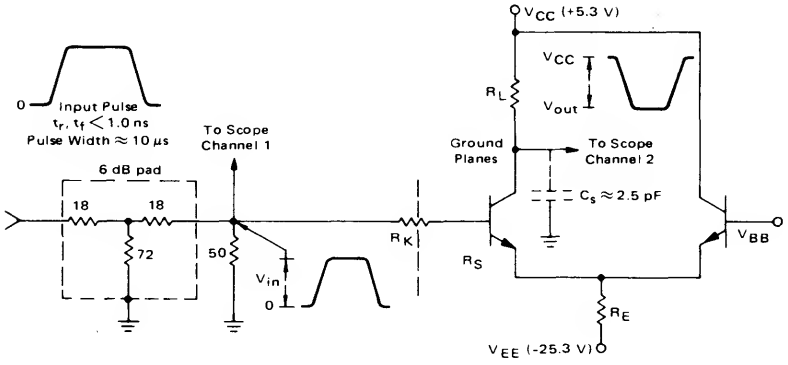


FIGURE 7 – SWITCHING TIMES TEST CIRCUIT



This test set up is designed to simulate a cascade of identical stages. The source resistance (R_S) equals the load resistance (R_L). Values used in the test are shown in the table.

For V_{in} = V_{out} = 1 V, V_{BB} = +0.5 V, R_L & R_K values appropriately reduced.

V_{in} = V_{out} = 2 volts, V_{BB} = +1.0V			
I_C (mA)	R_E (kΩ)	R_L (Ω)	R_K (Ω)
10	24.0	2.0 k	2.0 k
30	8.2	680	680
10	2.4	200	180
30	0.8	68	36