

**TO - 92 BIPOLAR TRANSISTORS  
TRANSISTOR(NPN)**

**FEATURES**

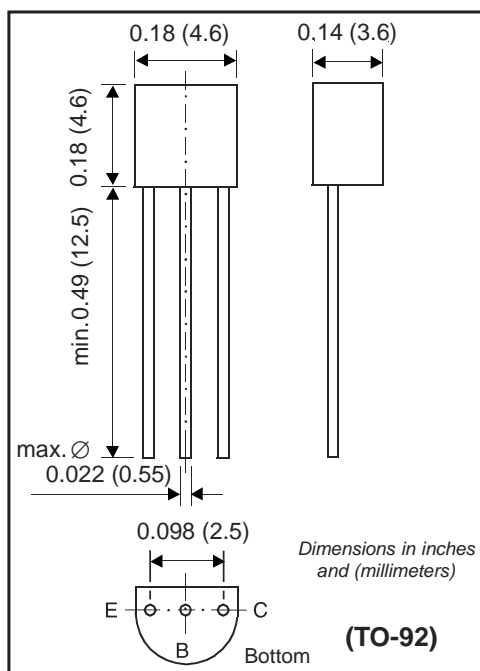
- \* Power dissipation  
P<sub>CM</sub>: 0.6 W(T<sub>amb</sub>=25°C)
- \* Collector current  
I<sub>CM</sub>: 0.6 A
- \* Collector-base voltage  
V<sub>(BR)CBO</sub>: 60 V
- \* Operating and storage junction temperature range  
T<sub>J</sub>, T<sub>stg</sub>: -55°C to +150°C

**MECHANICAL DATA**

- \* Case: Molded plastic
- \* Epoxy: UL 94V-O rate flame retardant
- \* Lead: MIL-STD-202E method 208C guaranteed
- \* Mounting position: Any
- \* Weight: 0.008 gram

**MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS**

Ratings at 25°C ambient temperature unless otherwise specified.  
Single phase, half wave, 60 Hz, resistive or inductive load.  
For capacitive load, derate current by 20%.



**MAXIMUM RATINGS** ( @ T<sub>A</sub> = 25°C unless otherwise noted)

RATINGS	SYMBOL	VALUE	UNITS
Max. Steady State Power Dissipation <sup>(1)</sup> @T <sub>A</sub> =25°C Derate above 25°C	P <sub>D</sub>	600	mW
Max. Operating Temperature Range	T <sub>J</sub>	150	°C
Storage Temperature Range	T <sub>STG</sub>	-55 to +150	°C

**ELECTRICAL CHARACTERISTICS** ( @ T<sub>A</sub> = 25°C unless otherwise noted)

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	-	-	417	°C/W

Notes : 1. Alumina=0.4\*0.3\*0.024in.99.5% alumina  
2. "Fully ROHS Compliant", "100% Sn plating (Pb-free)".

**ELECTRICAL CHARACTERISTICS** (@TA=25°C unless otherwise noted)

Chatacteristic	Symbol	Min	Max	Unit
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**OFF CHARACTERISTICS**

Collector-Emitter Breakdown Voltage(1) ( $I_C = 1.0 \text{ mAdc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	40	-	Vdc
Collector-Base Breakdown Voltage ( $I_C = 0.1 \text{ uAdc}$ , $I_E = 0$ )	$V_{(BR)CBO}$	60	-	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 0.1 \text{ uAdc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	6.0	-	Vdc
Base Cutoff Current ( $V_{CE} = 35 \text{ Vdc}$ , $V_{BE(off)} = 0.4 \text{ Vdc}$ )	$I_{BEV}$	-	0.1	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = 35 \text{ Vdc}$ , $V_{EB} = 0.4 \text{ Vdc}$ )	$I_{CEX}$	-	0.1	$\mu\text{Adc}$

**ON CHARACTERISTICS(1)**

DC Current Gain ( $I_C = 0.1 \text{ mAdc}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 1.0 \text{ mAdc}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 10 \text{ mAdc}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 150 \text{ mAdc}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 500 \text{ mAdc}$ , $V_{CE} = 2.0 \text{ Vdc}$ )	$h_{FE}$	20 40 80 100 40	- - - 300 -	-
Collector-Emitter Saturation Voltage (1) ( $I_C = 150 \text{ mAdc}$ , $I_B = 15 \text{ mAdc}$ ) ( $I_C = 500 \text{ mAdc}$ , $I_B = 50 \text{ mAdc}$ )	$V_{CE(sat)}$	- -	0.4 0.75	Vdc
Base-Emitter Saturation Voltage (1) ( $I_C = 150 \text{ mAdc}$ , $I_B = 15 \text{ mAdc}$ ) ( $I_C = 500 \text{ mAdc}$ , $I_B = 50 \text{ mAdc}$ )	$V_{BE(sat)}$	0.75 -	0.95 1.2	Vdc

**SMALL-SIGNAL CHARACTERISTICS**

Current-Gain-Bandwidth Product ( $I_C = 20 \text{ mAdc}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 100 \text{ MHz}$ )	$f_T$	250	-	MHz
Output Capacitance ( $V_{CB} = 5.0 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{cb}$	-	6.5	pF
Input Capacitance ( $V_{EB} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{eb}$	-	30	pF
Input Impedance ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{ie}$	1.0	15	kohms
Voltage Feedback Ratio ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{re}$	0.1	8.0	$\times 10^{-4}$
Small-Signal Current Gain ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{fe}$	40	500	-
Output Admittance ( $V_{CE} = 10 \text{ Vdc}$ , $I_C = 1.0 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{oe}$	1.0	30	$\mu\text{mos}$

**SWITCHING CHARACTERISTICS**

Delay Time	$(V_{CC} = 30 \text{ Vdc}$ , $V_{EB} = 2.0 \text{ Vdc}$ , $I_C = 150 \text{ mAdc}$ , $I_{B1} = 15 \text{ mAdc}$ )	$t_d$	-	15	ns
Rise Time		$t_r$	-	20	
Storage Time	$(V_{CC} = 30 \text{ Vdc}$ , $I_C = 150 \text{ mAdc}$ , $I_{B1} = I_{B2} = 15 \text{ mAdc}$ )	$t_s$	-	225	ns
Fall Time		$t_f$	-	30	

Note : Pulse Test: Pulse Width $\leq$ 300ms,Duty Cycle $\leq$ 2.0%

# RATING AND CHARACTERISTICS CURVES ( 2N4401 )

— 25°C    - - - 100°C

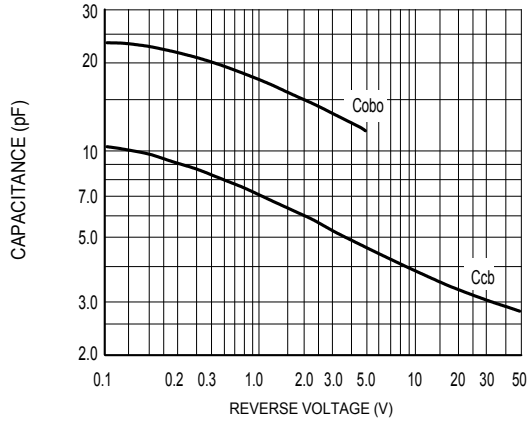


Figure 1. Capacitances

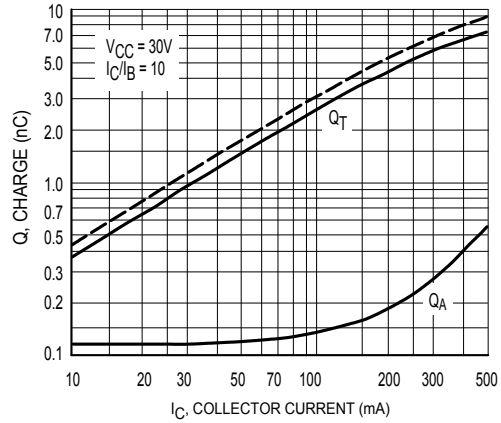


Figure 2. Charge Data

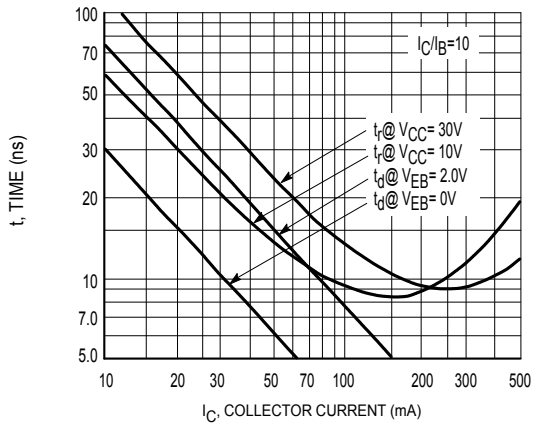


Figure 3. Turn-On Time

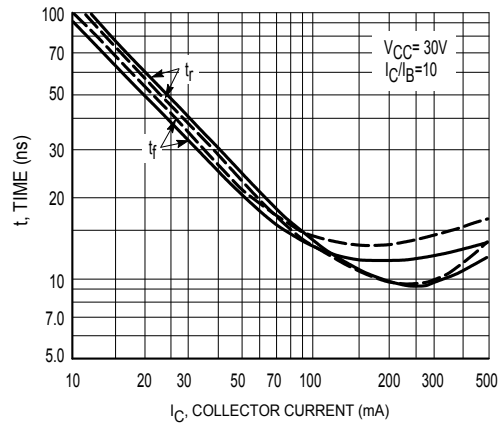


Figure 4. Rise and Fall Times

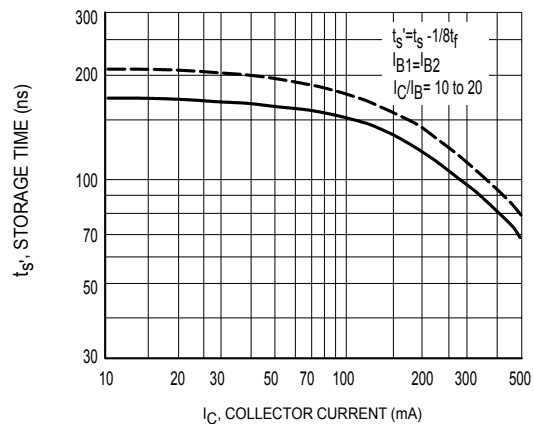


Figure 5. Storage Time

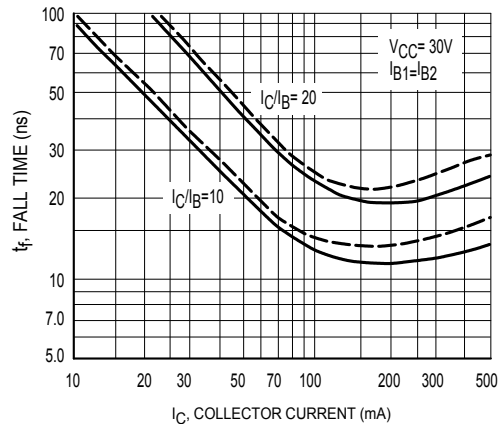


Figure 6. Fall Time

## RATING AND CHARACTERISTICS CURVES ( 2N4401 )

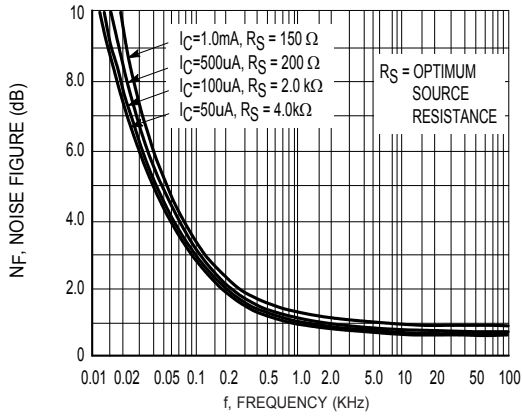


Figure 7. Frequency Effects

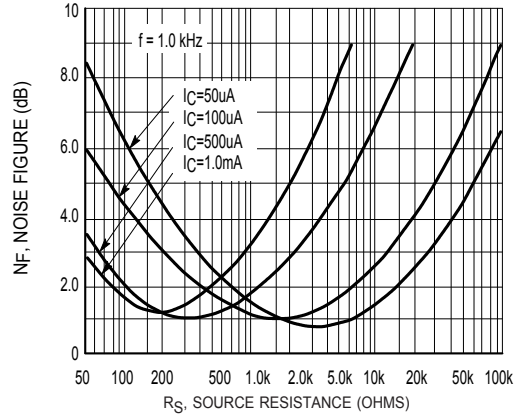


Figure 8. Source Resistance Effects

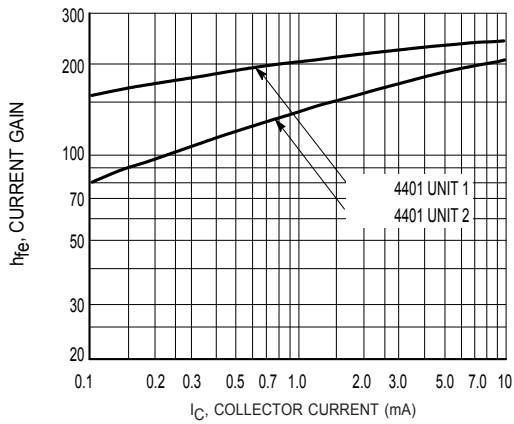


Figure 9. Current Gain

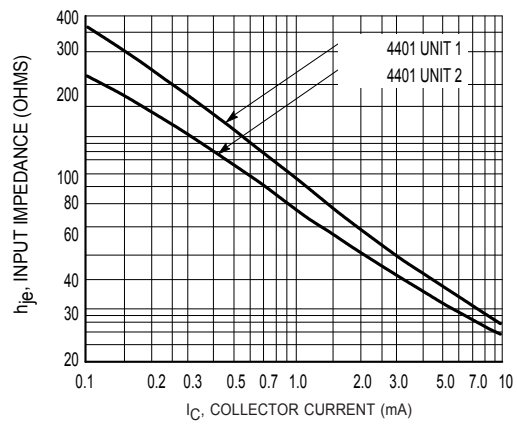


Figure 10. Input Impedance

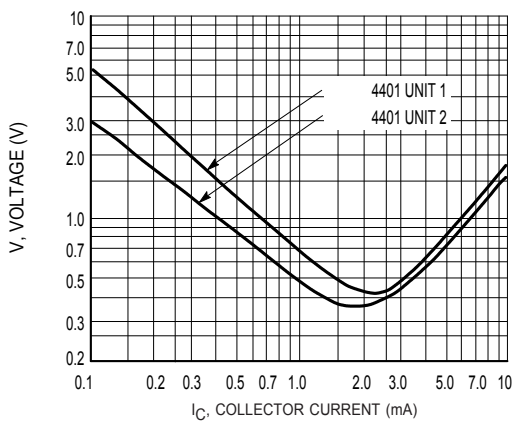


Figure 11. Voltage Feedback Ratio

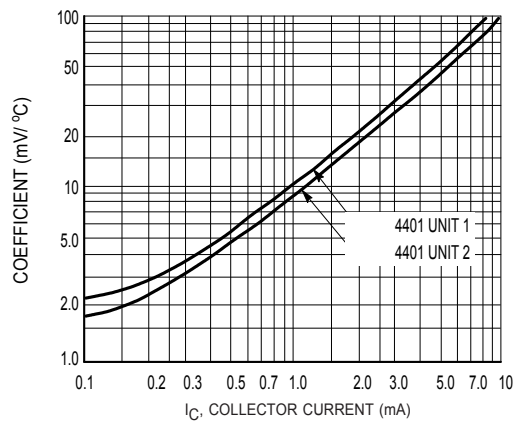


Figure 12. Temperature Coefficients

## RATING AND CHARACTERISTICS CURVES ( 2N4401 )

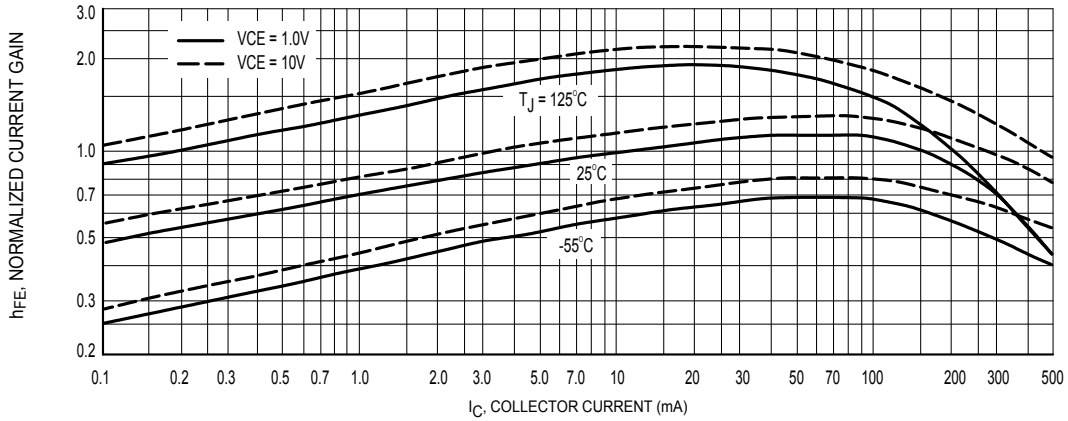


Figure 13. DC Current Gain

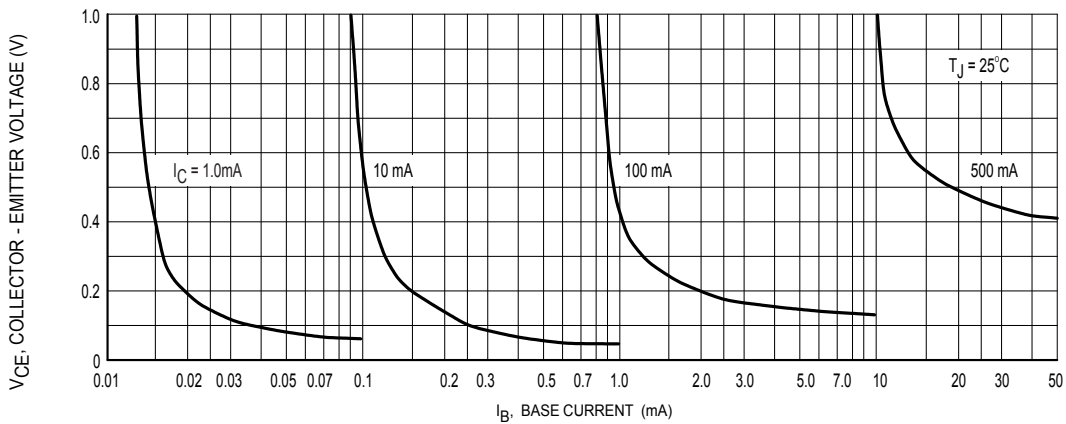


Figure 14. Collector Saturation Region

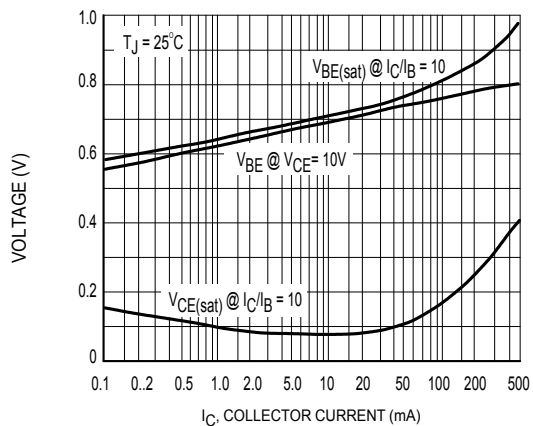


Figure 15. "ON" Voltages

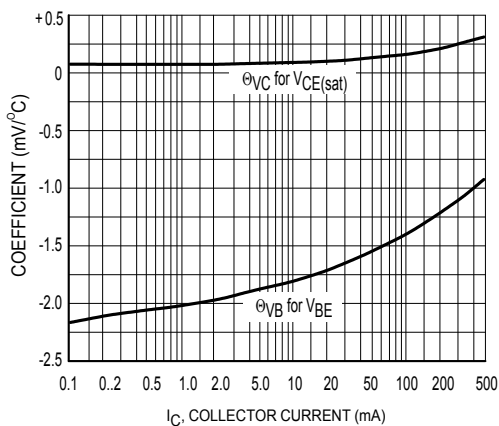


Figure 16. Temperature Coefficients

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