

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

**FEATURES**

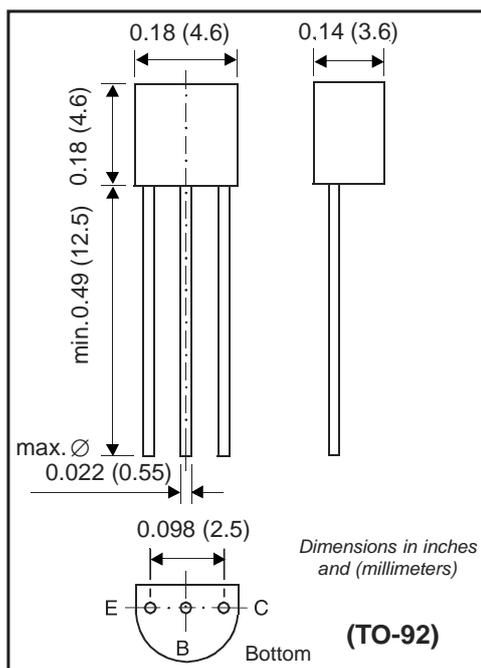
- \* Power dissipation  
P<sub>CM</sub>: 0.6 W(T<sub>amb</sub>=25°C)
- \* Collector current  
I<sub>CM</sub>: 0.6 A
- \* Collector-base voltage  
V<sub>(BR)CBO</sub>: 60 V
- \* Operating and storage junction temperature range  
T<sub>J</sub>, T<sub>stg</sub>: -55°C to +150°C

**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
----------------	--------	-----	-----	------

**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

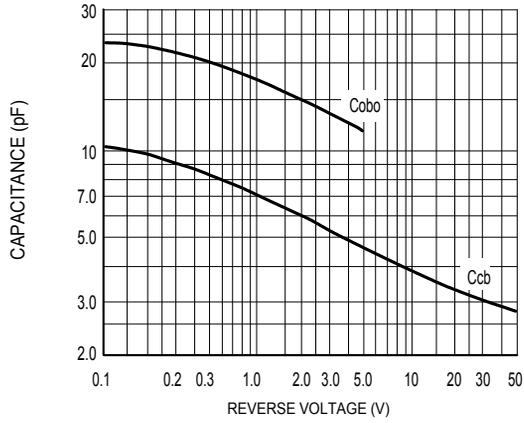


Figure 1. Capacitances

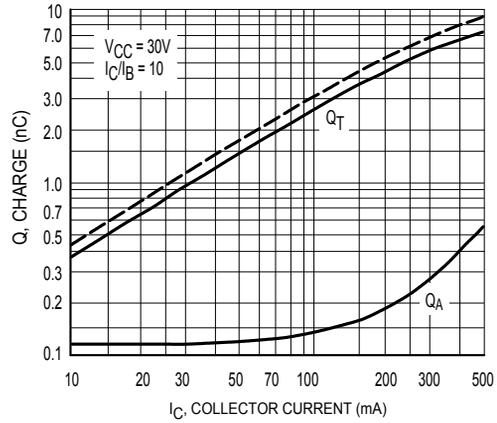


Figure 2. Charge Data

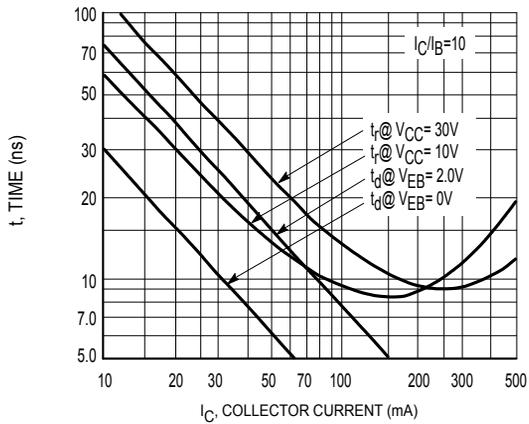


Figure 3. Turn-On Time

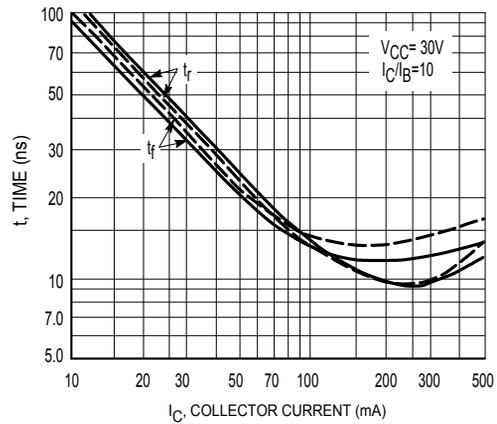


Figure 4. Rise and Fall Times

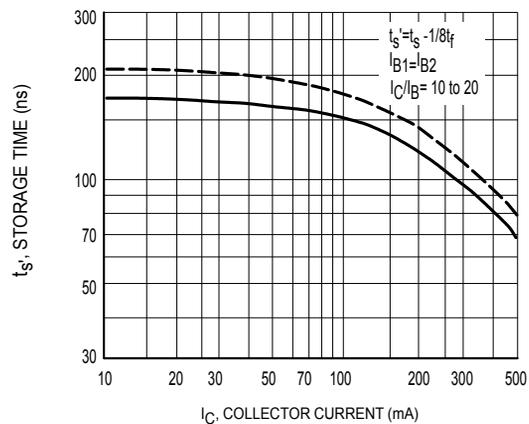


Figure 5. Storage Time

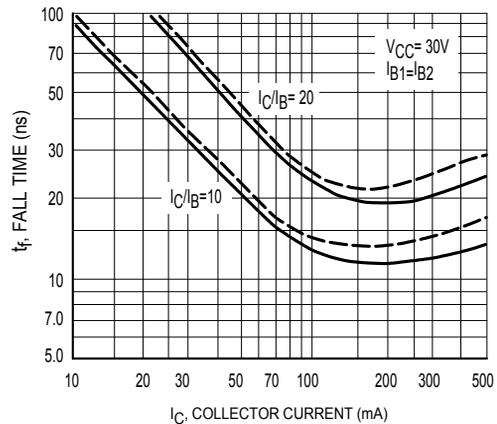


Figure 6. Fall Time

## RATING AND CHARACTERISTICS CURVES ( 2N4401 )

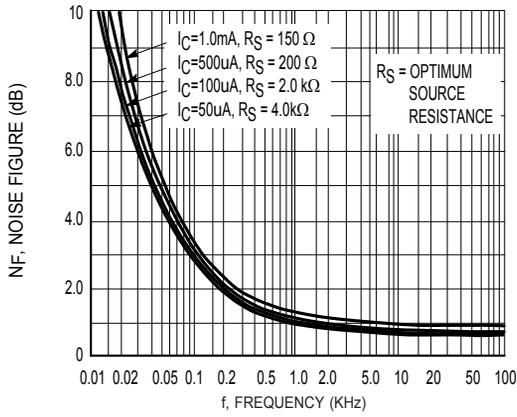


Figure 7. Frequency Effects

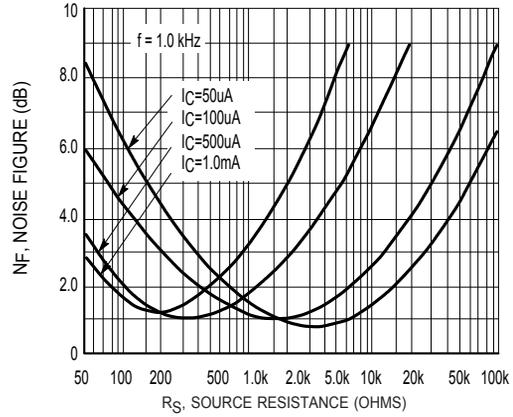


Figure 8. Source Resistance Effects

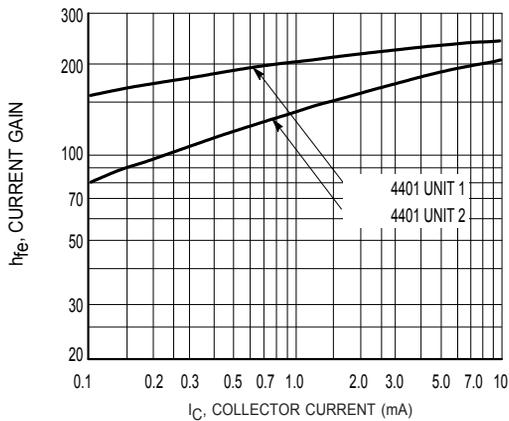


Figure 9. Current Gain

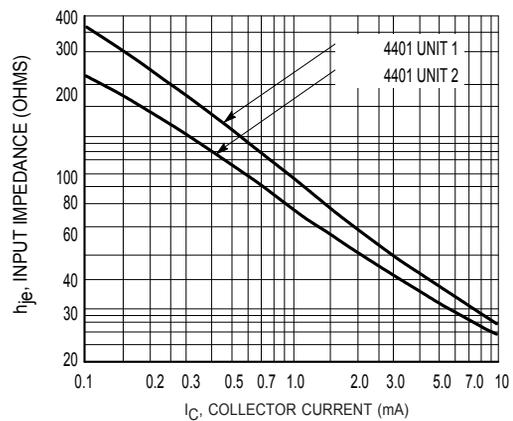


Figure 10. Input Impedance

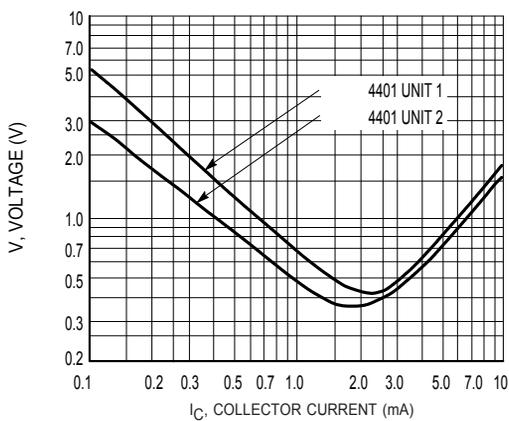


Figure 11. Voltage Feedback Ratio

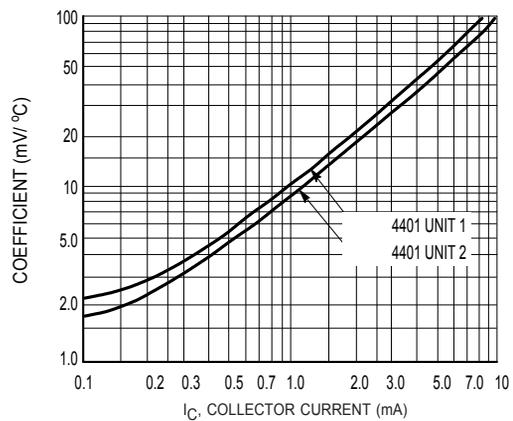


Figure 12. Temperature Coefficients

## RATING AND CHARACTERISTICS CURVES ( 2N4401 )

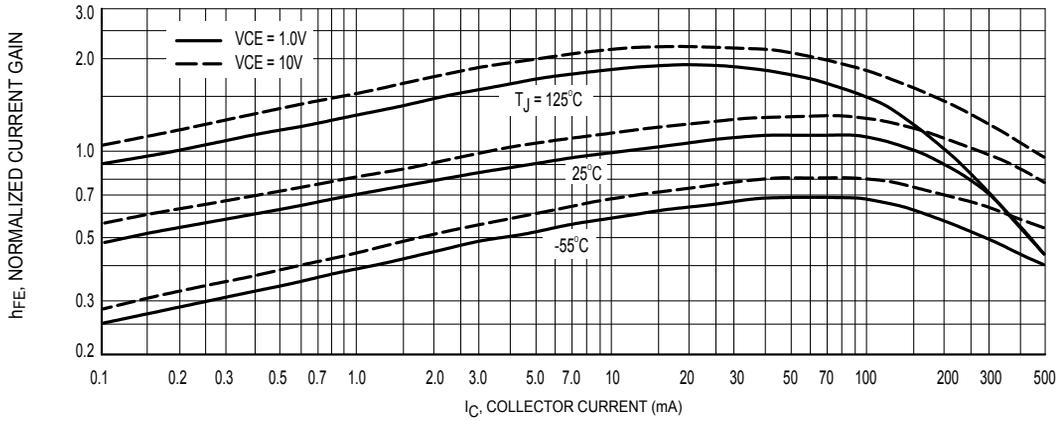


Figure 13. DC Current Gain

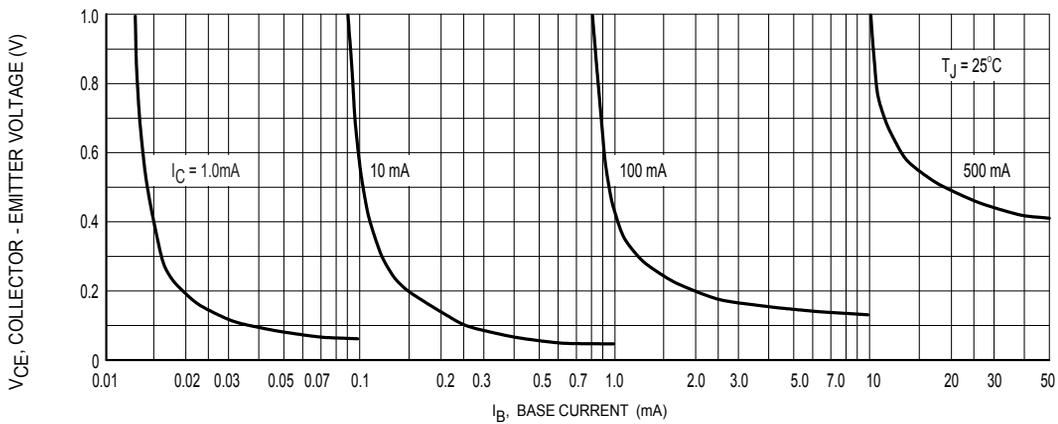


Figure 14. Collector Saturation Region

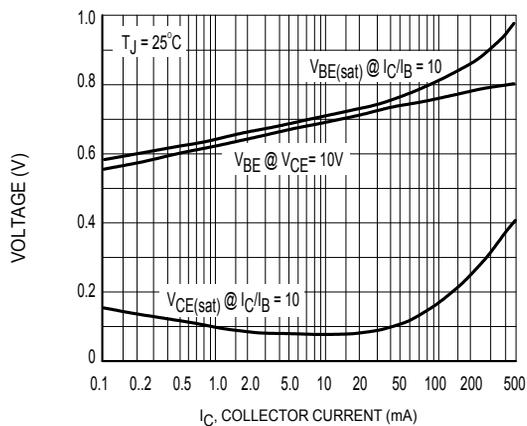


Figure 15. "ON" Voltages

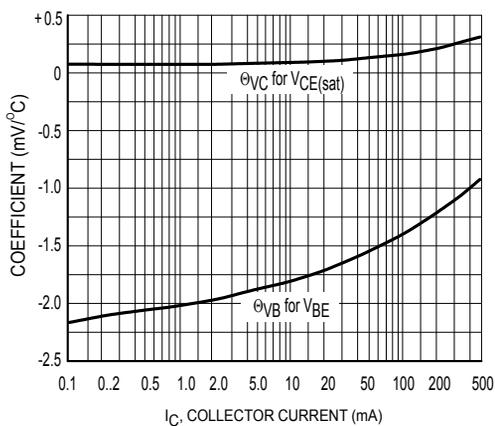


Figure 16. Temperature Coefficients

## DISCLAIMER NOTICE

Rectron Inc reserves the right to make changes without notice to any product specification herein, to make corrections, modifications, enhancements or other changes. Rectron Inc or anyone on its behalf assumes no responsibility or liability for any errors or inaccuracies. Data sheet specifications and its information contained are intended to provide a product description only. "Typical" parameters which may be included on RECTRON data sheets and/ or specifications can and do vary in different applications and actual performance may vary over time. Rectron Inc does not assume any liability arising out of the application or use of any product or circuit.

Rectron products are not designed, intended or authorized for use in medical, life-saving implant or other applications intended for life-sustaining or other related applications where a failure or malfunction of component or circuitry may directly or indirectly cause injury or threaten a life without expressed written approval of Rectron Inc. Customers using or selling Rectron components for use in such applications do so at their own risk and shall agree to fully indemnify Rectron Inc and its subsidiaries harmless against all claims, damages and expenditures.