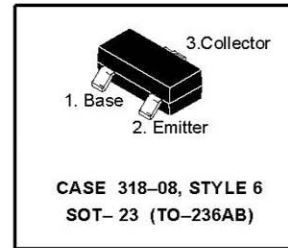
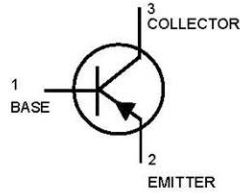


## PNP Silicon



### ● MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CE0}$	-40	Vdc
Collector–Base Voltage	$V_{CBO}$	-40	Vdc
Emitter–Base Voltage	$V_{EBO}$	-5.0	Vdc
Collector Current — Continuous	$I_C$	-500	mAdc

### ● THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board (1) $T_A = 25^\circ\text{C}$	$P_D$	225	mW
Derate above $25^\circ\text{C}$		1.8	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C/W}$
Alumina Substrate (2) $T_A = 25^\circ\text{C}$	$P_D$	300	mW
Derate above $25^\circ\text{C}$		2.4	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C/W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

### ● ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage (3) ( $I_C = -1.0\text{ mAdc}, I_B = 0$ )	$V_{(BR)CE0}$	-40	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = -0.1\text{ mAdc}, I_E = 0$ )	$V_{(BR)CBO}$	-40	—	Vdc
Emitter–Base Breakdown Voltage ( $I_E = -0.1\text{ mAdc}, I_C = 0$ )	$V_{(BR)EBO}$	-5.0	—	Vdc
Base Cutoff Current ( $V_{CE} = -35\text{ Vdc}, V_{EB} = -0.4\text{ Vdc}$ )	$I_{BEV}$	—	-0.1	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = -35\text{ Vdc}, V_{EB} = -0.4\text{ Vdc}$ )	$I_{CEX}$	—	-0.1	$\mu\text{Adc}$

- FR-5 = 1.0 x 0.75 x 0.062 in.
- Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.
- Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

● **ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS</b>				
DC Current Gain ( $I_C = -0.1\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ )	$h_{FE}$	30	—	—
( $I_C = -1.0\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ )		60	—	
( $I_C = -10\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ )		100	—	
( $I_C = -150\text{ mAdc}$ , $V_{CE} = -2.0\text{ Vdc}$ )(3)		180	390	
( $I_C = -500\text{ mAdc}$ , $V_{CE} = -2.0\text{ Vdc}$ )(3)		20	—	
Collector–Emitter Saturation Voltage(3) ( $I_C = -150\text{ mAdc}$ , $I_B = -15\text{ mAdc}$ )	$V_{CE(sat)}$	—	-0.4	Vdc
( $I_C = -500\text{ mAdc}$ , $I_B = -50\text{ mAdc}$ )		—	-0.75	
Base–Emitter Saturation Voltage (3) ( $I_C = -150\text{ mAdc}$ , $I_B = -15\text{ mAdc}$ )	$V_{BE(sat)}$	-0.75	-0.95	Vdc
( $I_C = -500\text{ mAdc}$ , $I_B = -50\text{ mAdc}$ )		—	-1.3	

● **SMALL-SIGNAL CHARACTERISTICS**

Current–Gain — Bandwidth Product ( $I_C = -20\text{ mAdc}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 100\text{ MHz}$ )	$f_T$	200	—	MHz
Collector–Base Capacitance ( $V_{CB} = -10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{cb}$	—	8.5	pF
Emitter–Base Capacitance ( $V_{BE} = -0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{eb}$	—	30	pF
Input Impedance ( $V_{CE} = -10\text{ Vdc}$ , $I_C = -1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	$h_{ie}$	1.5	15	k $\Omega$
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 ( $V_{CE} = -10\text{ Vdc}$ , $I_C = -1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	60	500	—
Output Admittance ( $V_{CE} = -10\text{ Vdc}$ , $I_C = -1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	$h_{oe}$	1.0	100	$\mu\text{mhos}$

● **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	

3. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

**SWITCHING TIME EQUIVALENT TEST CIRCUITS**

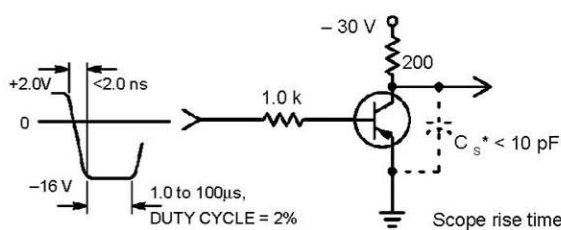


Figure 1. Turn–On Time

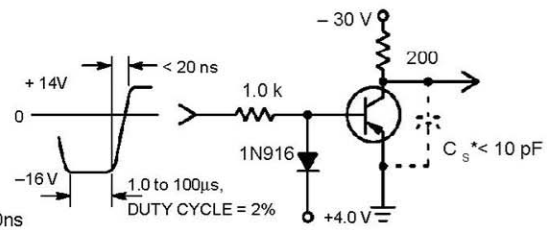


Figure 2. Turn–Off Time

## TYPICAL TRANSIENT CHARACTERISTICS

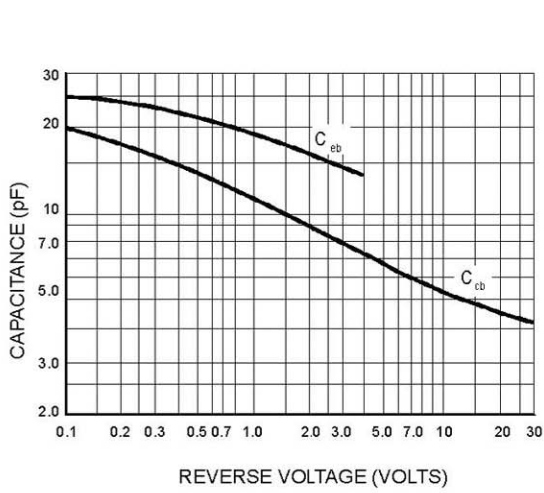


Figure 3. Capacitance

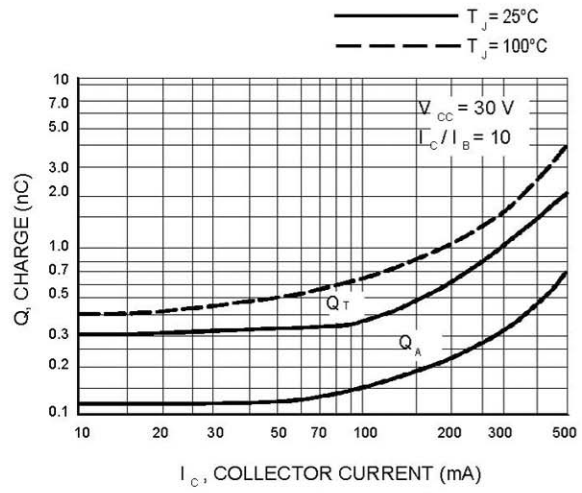


Figure 4. Charge Data

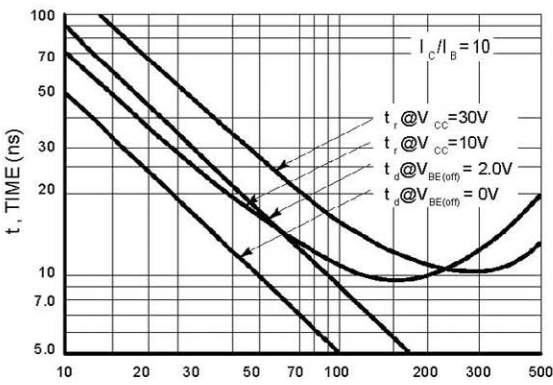


Figure 5. Turn-On Time

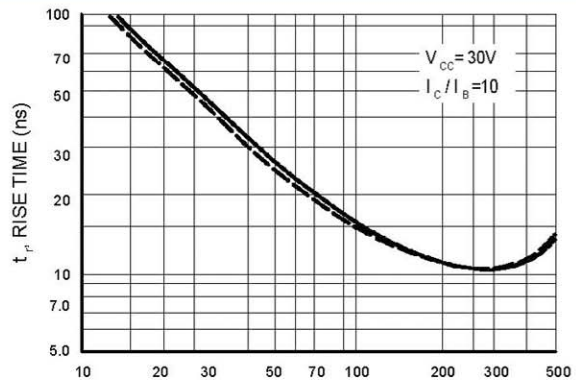


Figure 6. Rise Time

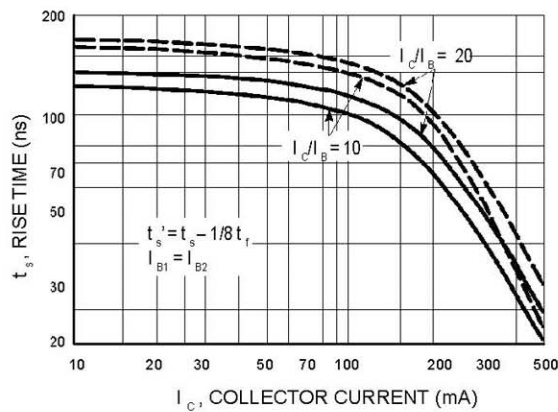


Figure 7. Storage Time

## SMALL-SIGNAL CHARACTERISTICS

### NOISE FIGURE

$V_{CE} = -10 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$   
Bandwidth = 1.0 Hz

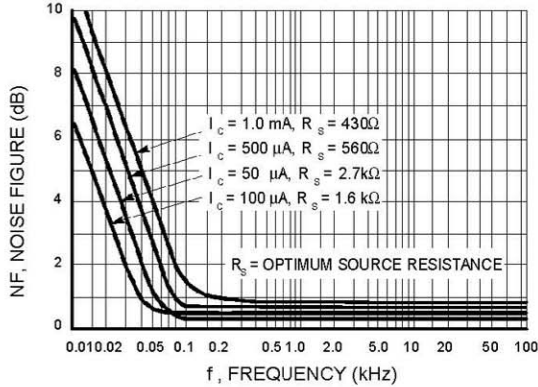


Figure 8. Frequency Effects

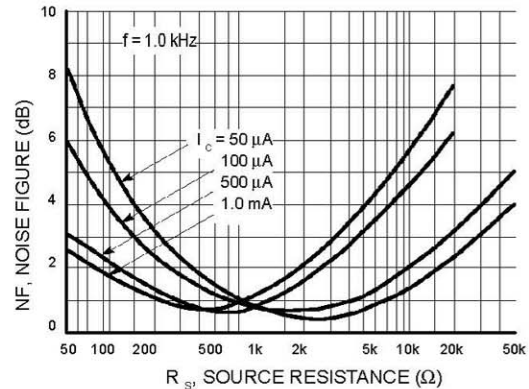


Figure 9. Source Resistance Effects

### h PARAMETERS

$(V_{CE} = -10 \text{ Vdc}$ ,  $f = 1.0 \text{ kHz}$ ,  $T_A = 25^\circ\text{C}$ )

This group of graphs illustrates the relationship between  $h_{fe}$  and other "h" parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were selected from the MMBT4403LT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

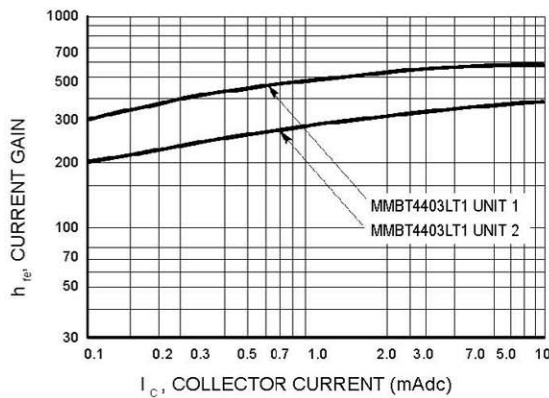


Figure 10. Current Gain

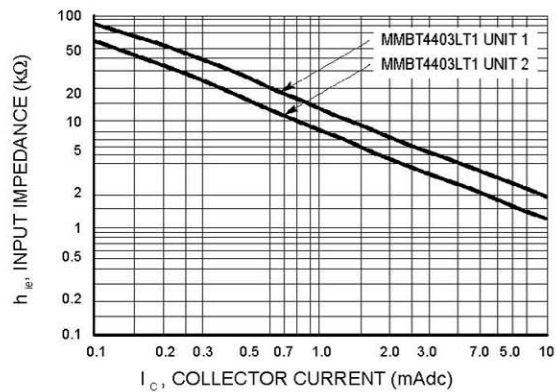


Figure 11. Input Impedance

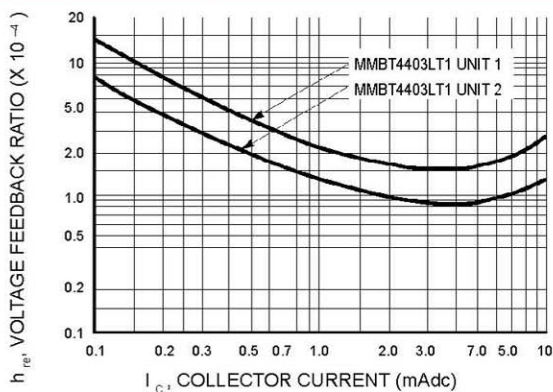


Figure 12. Voltage Feedback Ratio

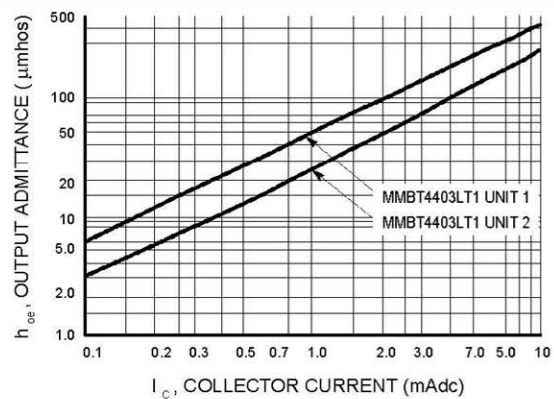


Figure 13. Output Admittance

## STATIC CHARACTERISTICS

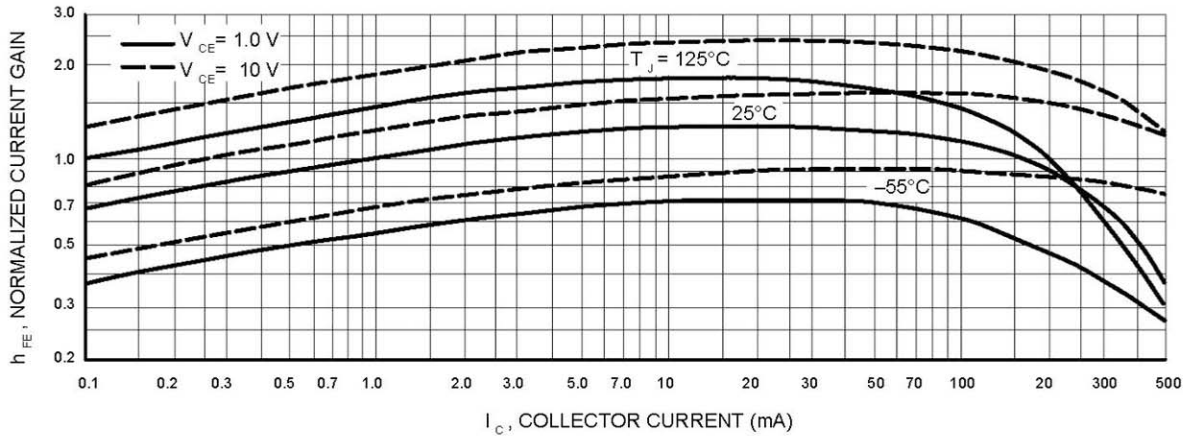


Figure 14. DC Current Gain

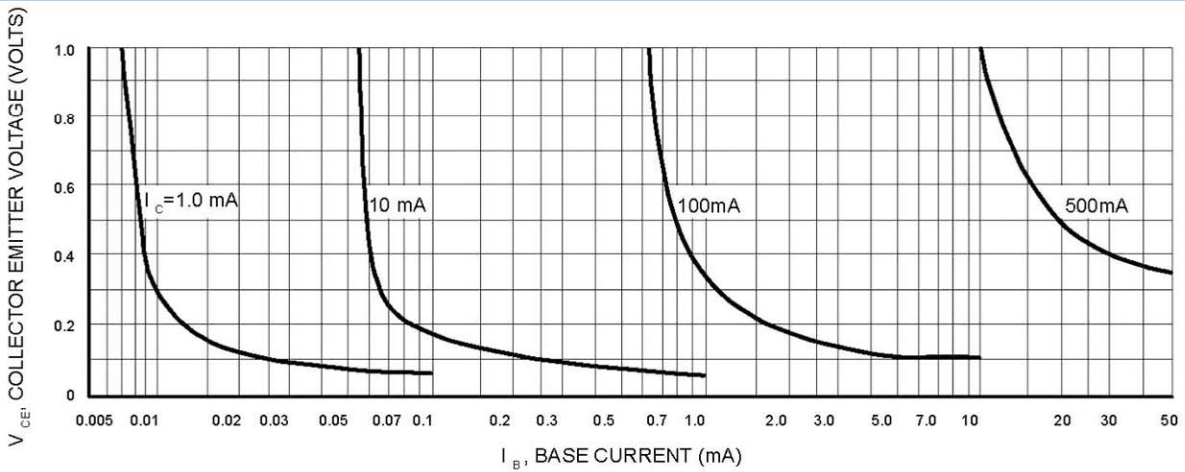


Figure 15. Collector Saturation Region

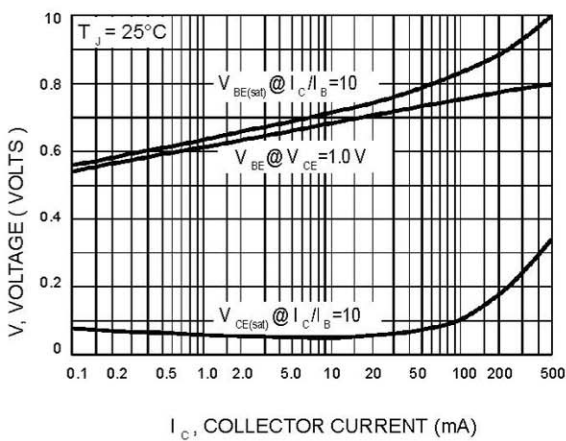


Figure 16. "On" Voltages

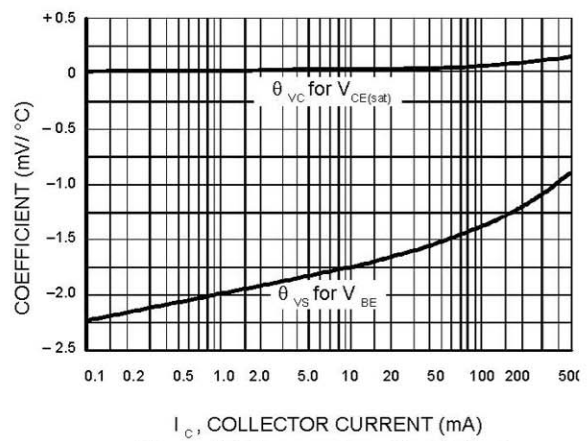


Figure 17. Temperature Coefficients