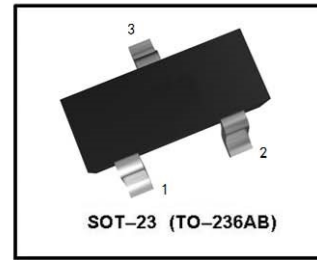
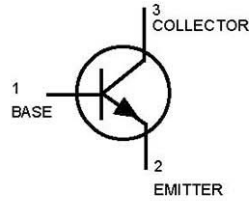


NPN Silicon



● MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	40	Vdc
Collector–Base Voltage	V_{CBO}	60	Vdc
Emitter–Base Voltage	V_{EBO}	6.0	Vdc
Collector Current — Continuous	I_C	600	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°C		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C/W}$
Total Device Dissipation Alumina Substrate, (2) $T_A = 25^\circ\text{C}$	P_D	300	mW
Derate above 25°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	$^\circ\text{C}$

● DEVICE MARKING

MMBT4401 = 2X

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage (3) ($I_C = 1.0\text{ mAdc}, I_B = 0$)	$V_{(BR)CEO}$	40	—	Vdc
Collector–Base Breakdown Voltage ($I_C = 0.1\text{ mAdc}, I_E = 0$)	$V_{(BR)CBO}$	60	—	Vdc
Emitter–Base Breakdown Voltage ($I_E = 0.1\text{ mAdc}, I_C = 0$)	$V_{(BR)EBO}$	6.0	—	Vdc
Base Cutoff Current ($V_{CE} = 35\text{ Vdc}, V_{EB} = 0.4\text{ Vdc}$)	I_{BEV}	—	0.1	μAdc
Collector Cutoff Current ($V_{CE} = 35\text{ Vdc}, V_{EB} = 0.4\text{ Vdc}$)	I_{CEX}	—	0.1	μAdc

1. FR–5 = $1.0 \times 0.75 \times 0.062\text{ in.}$

2. Alumina = $0.4 \times 0.3 \times 0.024\text{ in.}$ 99.5% alumina.

3. 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
ON CHARACTERISTICS (3)				
DC Current Gain ($I_C = 0.1\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)	h_{FE}	20	—	—
($I_C = 1.0\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)		40	—	
($I_C = 10\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)		80	—	
($I_C = 150\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)		100	300	
($I_C = 500\text{ mAdc}$, $V_{CE} = 2.0\text{ Vdc}$)		40	—	
Collector–Emitter Saturation Voltage ($I_C = 150\text{ mAdc}$, $I_B = 15\text{ mAdc}$)	$V_{CE(sat)}$	—	0.4	Vdc
($I_C = 500\text{ mAdc}$, $I_B = 50\text{ mAdc}$)		—	0.75	
Base–Emitter Saturation Voltage ($I_C = 150\text{ mAdc}$, $I_B = 15\text{ mAdc}$)	$V_{BE(sat)}$	0.75	0.95	Vdc
($I_C = 500\text{ mAdc}$, $I_B = 50\text{ mAdc}$)		—	1.2	

● **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
Collector–Base Capacitance ($V_{CB} = 5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	C_{cb}	—	6.5	pF
Emitter–Base 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	k Ω
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	μmhos

● **SWITCHING CHARACTERISTICS**

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

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

SWITCHING TIME EQUIVALENT TEST CIRCUITS

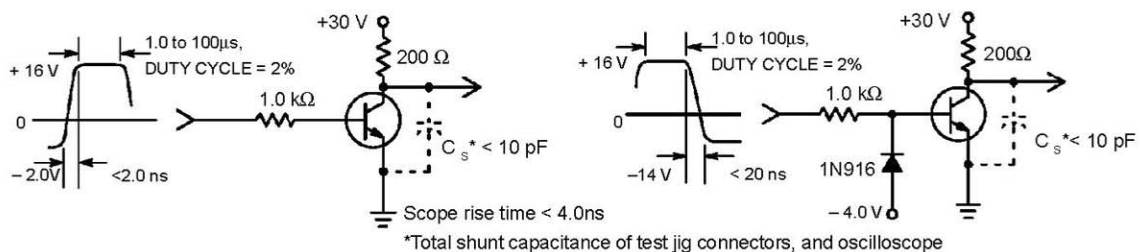


Figure 1. Turn–On Time

Figure 2. Turn–Off Time

TRANSIENT CHARACTERISTICS

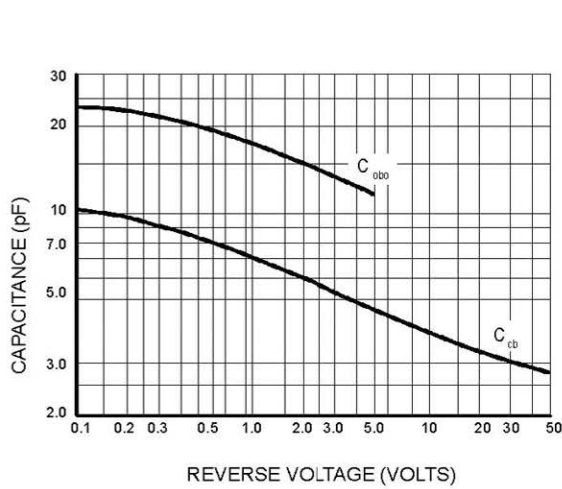


Figure 3. Capacitance

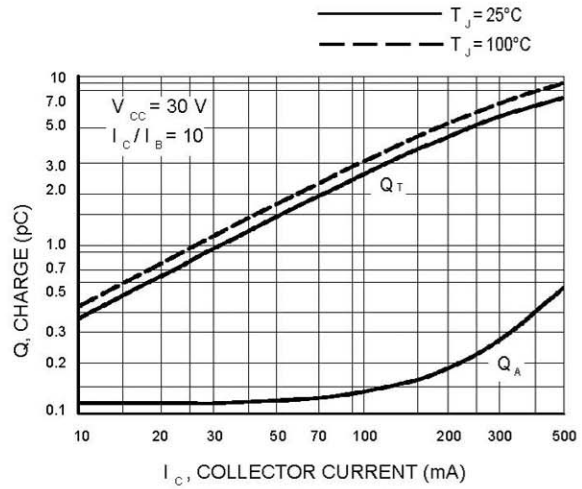


Figure 4. Charge Data

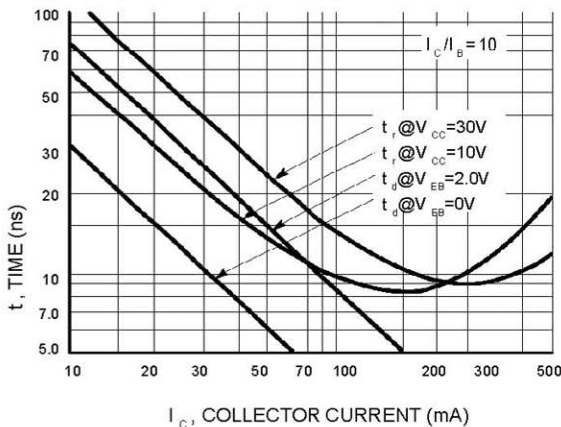


Figure 5. Turn-On Time

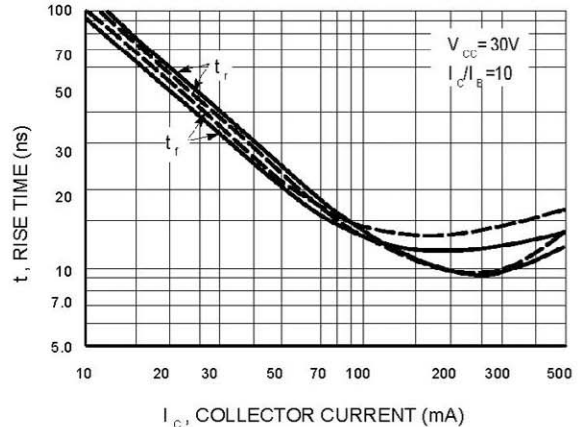


Figure 6. Rise and Fall Time

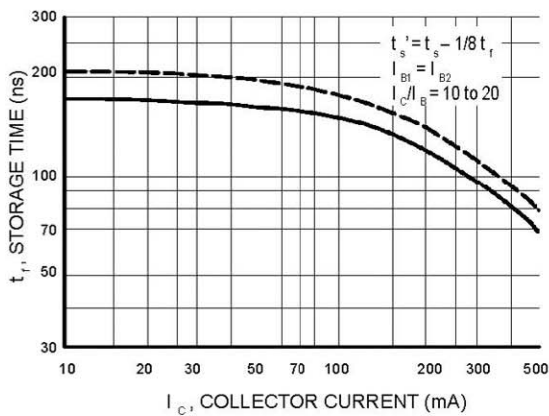


Figure 7. Storage Time

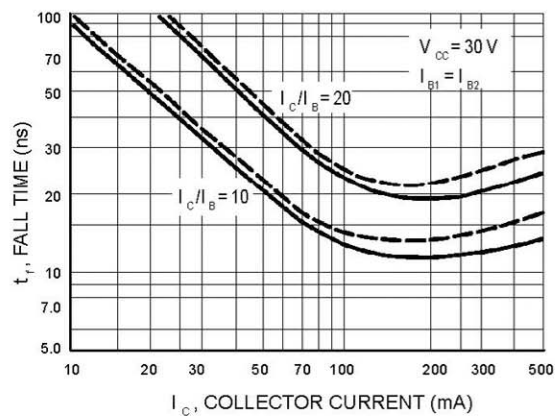


Figure 8. Fall Time

SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE

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

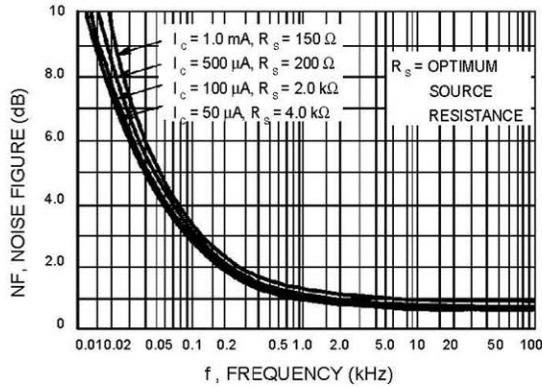


Figure 9. Frequency Effects

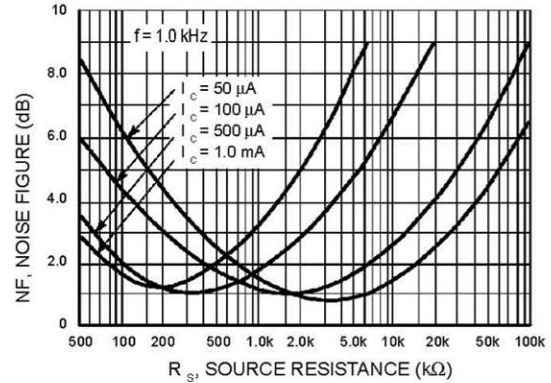


Figure 10. Source Resistance Effects

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 MMBT4401LT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

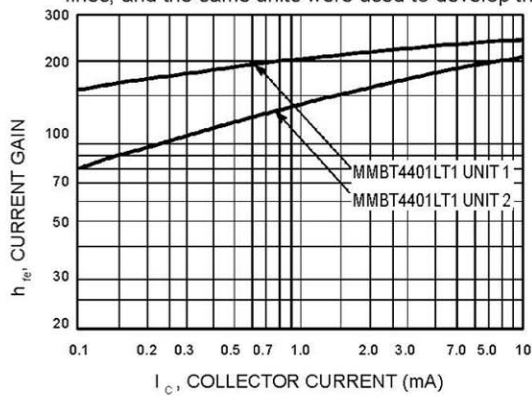


Figure 11. Current Gain

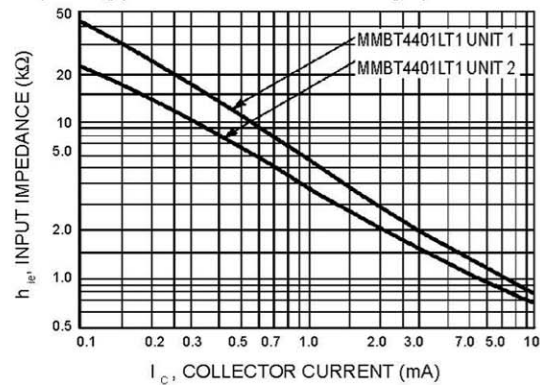


Figure 12. Input Impedance

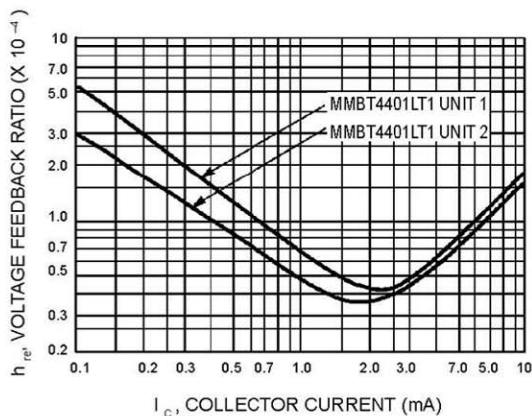


Figure 13. Voltage Feedback Ratio

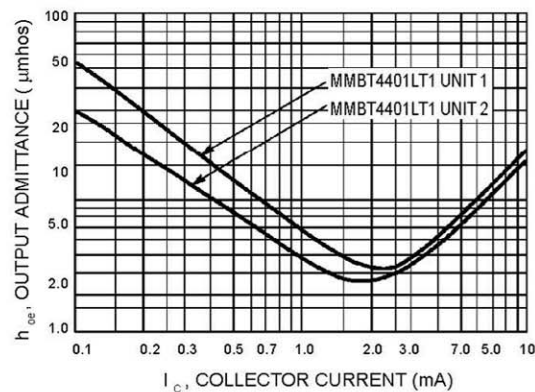


Figure 14. Output Admittance

STATIC CHARACTERISTICS

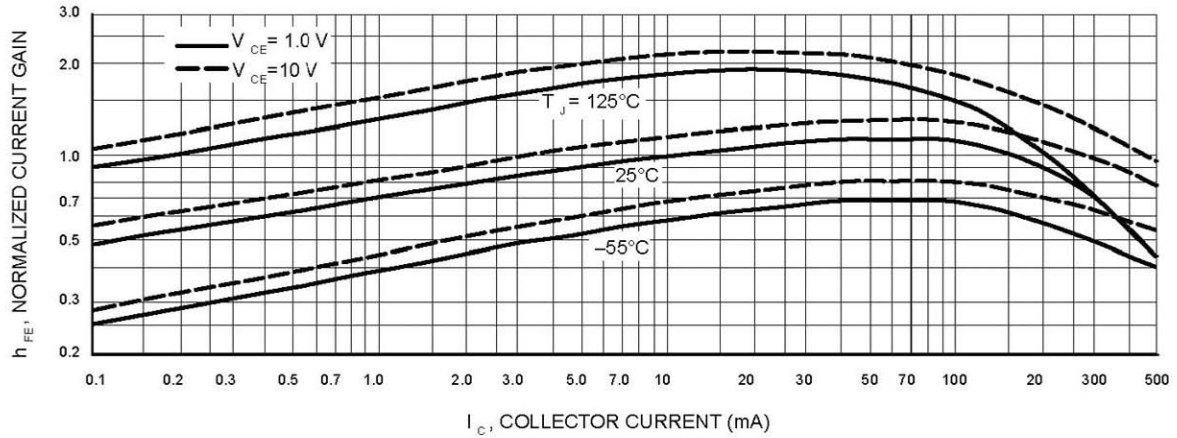


Figure 15. DC Current Gain

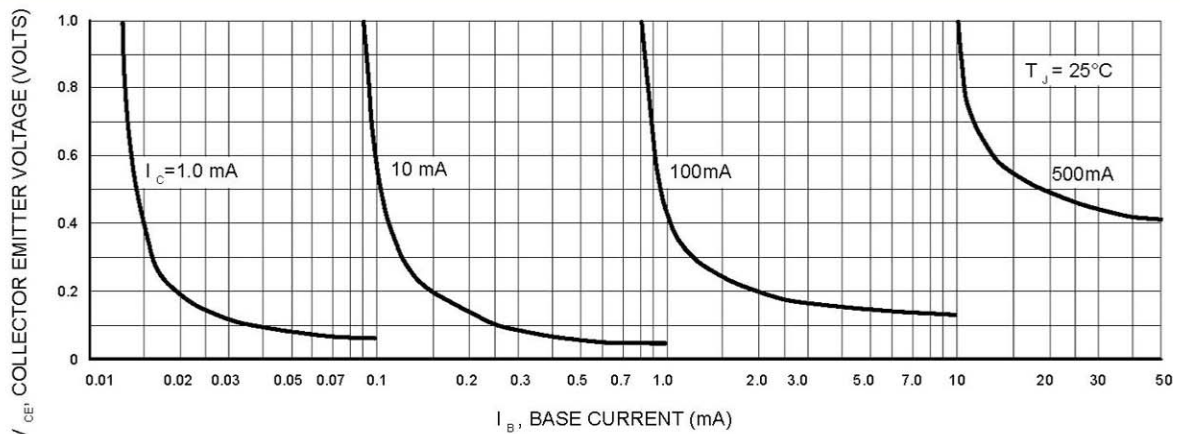


Figure 16. Collector Saturation Region

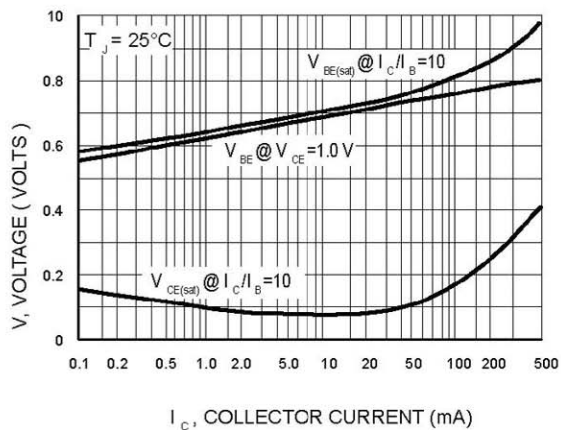


Figure 17. "On" Voltages

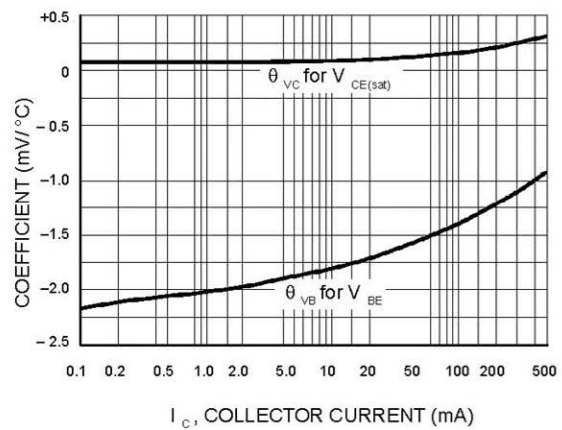


Figure 18. Temperature Coefficients