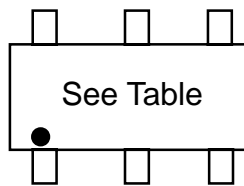


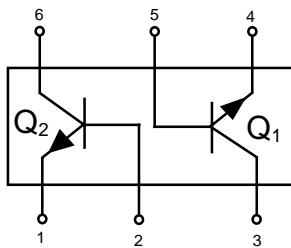
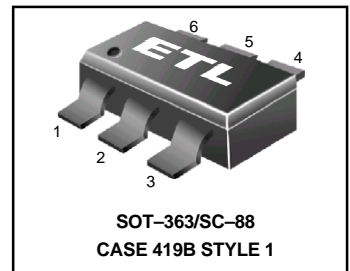
Dual General Purpose Transistors

The MBT3904DW1T1, MBT3906DW1T1, and MBT3946DW1T1 devices are spin-offs of our popular SOT-23/SOT-323 three-leaded devices. They are designed for general purpose amplifier applications and are housed in the SOT-363 six-leaded surface mount package. By putting two discrete devices in one package, these devices are ideal for low-power surface mount applications where board space is at a premium.

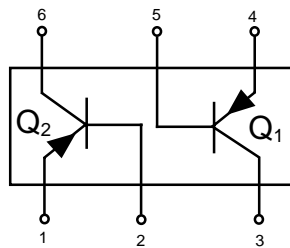
- h_{FE} , 100–300
- Low $V_{CE(sat)}$, 3.0–4.0 V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7-inch/3,000 Unit Tape and Reel



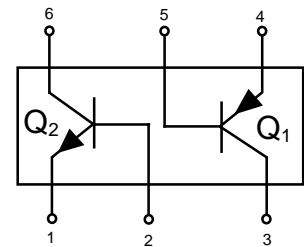
MBT3904DW1T1
MBT3906DW1T1
MBT3946DW1T1



MBT3904DW1T1



MBT3906DW1T1



MBT3946DW1T1

*Q₁ same as MBT3906DW1T1
 Q₂ same as MBT3904DW1T1

MAXIMUM RATINGS

Rating	Symbol	Voltage	Unit
Collector–Emitter Voltage	V_{CEO}		V
MBT3904DW1T1 (NPN)		40	
MBT3906DW1T1 (PNP)		–40	
Collector–Base Voltage	V_{CBO}		V
MBT3904DW1T1 (NPN)		60	
MBT3906DW1T1 (PNP)		–40	
Emitter–Base Voltage	V_{EBO}		V
MBT3904DW1T1 (NPN)		6.0	
MBT3906DW1T1 (PNP)		–5.0	
Collector Current –Continuous	I_C		mAdc
MBT3904DW1T1 (NPN)		200	
MBT3906DW1T1 (PNP)		–200	
Electrostatic Discharge	ESD	HBM>16000, MM>2000	V

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation(1) $T_A = 25^\circ\text{C}$	P_D	150	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	833	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	T_J, T_{stg}	–55 to +150	$^\circ\text{C}$

ORDERING INFORMATION

Device	Package	Shipping
MBT3904DW1T1	SOT-363	3000 Units/Reel
MBT3906DW1T1	SOT-363	3000 Units/Reel
MBT3946DW1T1	SOT-363	3000 Units/Reel

1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.

MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (2) ($I_C = 1.0\text{ mAdc}$, $I_B = 0$) MBT3904DW1T1 (NPN) ($I_C = -1.0\text{ mAdc}$, $I_B = 0$) MBT3906DW1T1 (PNP)	$V_{(BR)CEO}$	40 -40	— —	Vdc
Collector–Base Breakdown Voltage ($I_C = 10\ \mu\text{Adc}$, $I_E = 0$) MBT3904DW1T1 (NPN) ($I_C = -10\ \mu\text{Adc}$, $I_E = 0$) MBT3906DW1T1 (PNP)	$V_{(BR)CBO}$	60 -40	— —	Vdc
Emitter–Base Breakdown Voltage ($I_E = 10\ \mu\text{Adc}$, $I_C = 0$) MBT3904DW1T1 (NPN) ($I_E = -10\ \mu\text{Adc}$, $I_C = 0$) MBT3906DW1T1 (PNP)	$V_{(BR)EBO}$	6.0 -5.0	— —	Vdc
Base Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$) MBT3904DW1T1 (NPN) ($V_{CE} = -30\text{ Vdc}$, $V_{EB} = -3.0\text{ Vdc}$) MBT3906DW1T1 (PNP)	I_{BL}	— —	50 -50	nAdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$) MBT3904DW1T1 (NPN) ($V_{CE} = -30\text{ Vdc}$, $V_{EB} = -3.0\text{ Vdc}$) MBT3906DW1T1 (PNP)	I_{CEX}	— —	50 -50	nAdc
ON CHARACTERISTICS (2)				
DC Current Gain ($I_C = 0.1\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) MBT3904DW1T1 (NPN) ($I_C = 1.0\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 10\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 50\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 100\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = -0.1\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) MBT3906DW1T1 (PNP) ($I_C = -1.0\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) ($I_C = -10\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) ($I_C = -50\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) ($I_C = -100\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$)	h_{FE}	40 70 100 60 30 60 80 100 60 30	— — — — — — — — — —	Vdc
Collector–Emitter Saturation Voltage ($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$) MBT3904DW1T1 (NPN) ($I_C = 50\text{ mAdc}$, $I_B = 5.0\text{ mAdc}$) ($I_C = -10\text{ mAdc}$, $I_B = -1.0\text{ mAdc}$) MBT3906DW1T1 (PNP) ($I_C = -50\text{ mAdc}$, $I_B = -5.0\text{ mAdc}$)	$V_{CE(sat)}$	— — — —	0.2 0.3 -0.25 -0.4	Vdc
Base–Emitter Saturation Voltage ($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$) MBT3904DW1T1 (NPN) ($I_C = 50\text{ mAdc}$, $I_B = 5.0\text{ mAdc}$) ($I_C = -10\text{ mAdc}$, $I_B = -1.0\text{ mAdc}$) MBT3906DW1T1 (PNP) ($I_C = -50\text{ mAdc}$, $I_B = -5.0\text{ mAdc}$)	$V_{BE(sat)}$	0.65 — -0.65 —	0.85 0.95 -0.85 -0.95	Vdc
SMALL–SIGNAL CHARACTERISTICS				
Current–Gain — Bandwidth Product ($I_C = 10\text{ mAdc}$, $V_{CE} = 20\text{ Vdc}$, $f = 100\text{ MHz}$) MBT3904DW1T1 (NPN) ($I_C = -10\text{ mAdc}$, $V_{CE} = -20\text{ Vdc}$, $f = 100\text{ MHz}$) MBT3906DW1T1 (PNP)	f_T	300 250	— —	MHz
Output Capacitance ($V_{CB} = 5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) MBT3904DW1T1 (NPN) ($V_{CB} = -5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) MBT3906DW1T1 (PNP)	C_{obo}	— —	4.0 4.5	pF
Input Capacitance ($V_{EB} = 0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$) MBT3904DW1T1 (NPN) ($V_{EB} = -0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$) MBT3906DW1T1 (PNP)	C_{ibo}	— —	8.0 10.0	pF

2. Pulse Test: Pulse Width $\leq 300\text{ ms}$; Duty Cycle $\leq 2.0\%$.

MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

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

Characteristic	Symbol	Min	Max	Unit
Input Impedance (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{ie}	1.0	10	k Ω
(V _{CE} = -10 Vdc, I _C = -1.0 mAdc, f = 1.0 kHz)		2.0	12	
Voltage Feedback Ratio (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{re}	0.5	8.0	X 10 ⁻⁴
(V _{CE} = -10 Vdc, I _C = -1.0 mAdc, f = 1.0 kHz)		0.1	10	
Small-Signal Current Gain (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{fe}	100	400	—
(V _{CE} = -10 Vdc, I _C = -1.0 mAdc, f = 1.0 kHz)		100	400	
Output Admittance (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{oe}	1.0	40	μmhos
(V _{CE} = -10 Vdc, I _C = -1.0 mAdc, f = 1.0 kHz)		3.0	60	
Noise Figure (V _{CE} = 5.0 Vdc, I _C = 100 μAdc, R _S = 1.0 k Ω, f = 1.0 kHz)	NF	—	5.0	dB
(V _{CE} = -5.0 Vdc, I _C = -100 μAdc, R _S = 1.0 k Ω, f = 1.0 kHz)		—	4.0	

SWITCHING CHARACTERISTICS

Delay Time (V _{CC} = 3.0 Vdc, V _{BE} = -0.5 Vdc)	MBT3904DW1T1 (NPN)	t _d	—	35	ns
(V _{CC} = -3.0 Vdc, V _{BE} = 0.5 Vdc)	MBT3906DW1T1 (PNP)		—	35	
Rise Time (I _C = 10 mAdc, I _{B1} = 1.0 mAdc)	MBT3904DW1T1 (NPN)	t _r	—	35	ns
(I _C = -10 mAdc, I _{B1} = -1.0 mAdc)	MBT3906DW1T1 (PNP)		—	35	
Storage Time (V _{CC} = 3.0 Vdc, I _C = 10 mAdc)	MBT3904DW1T1 (NPN)	t _s	—	200	ns
(V _{CC} = -3.0 Vdc, I _C = -10 mAdc)	MBT3906DW1T1 (PNP)		—	225	
Fall Time (I _{B1} = I _{B2} = 1.0 mAdc)	MBT3904DW1T1 (NPN)	t _f	—	50	ns
(I _{B1} = I _{B2} = -1.0 mAdc)	MBT3906DW1T1 (PNP)		—	70	

MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

MBT3904DW1T1 (NPN)

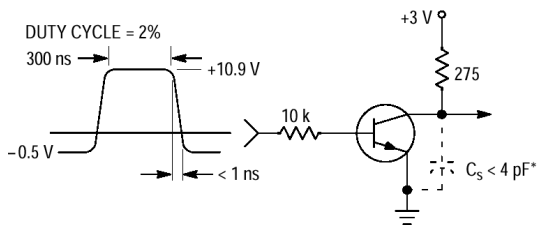


Figure 1. Delay and Rise Time Equivalent Test Circuit

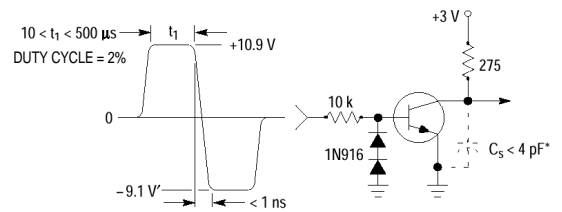


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

— $T_J = 25^\circ\text{C}$
 - - - $T_J = 125^\circ\text{C}$

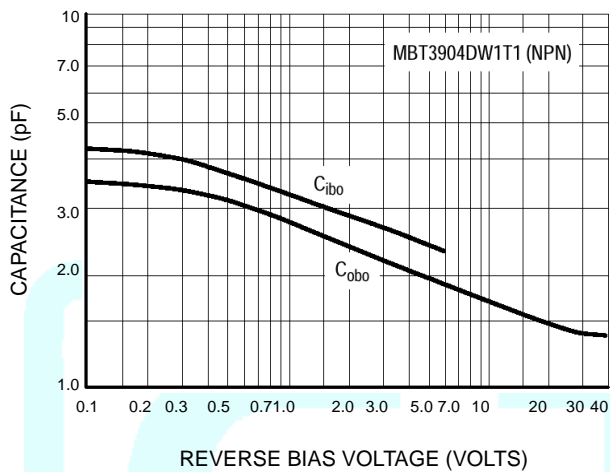


Figure 3. Capacitance

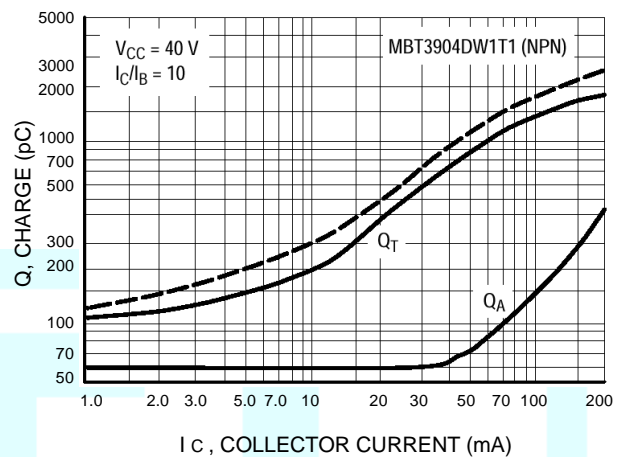
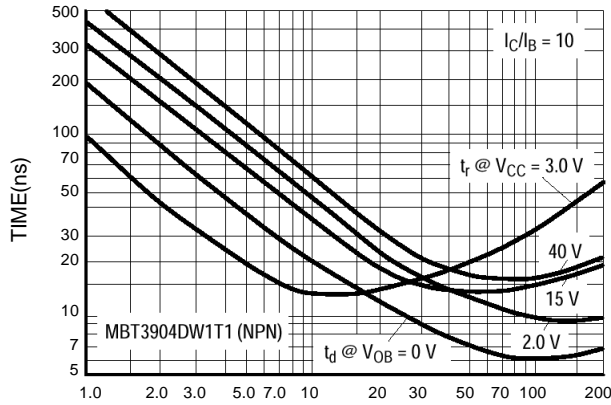


Figure 4. Charge Data

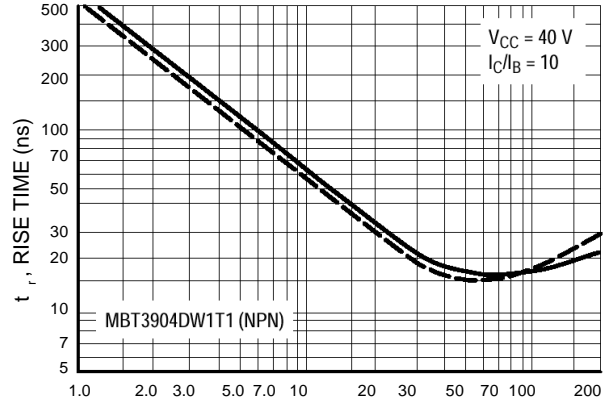
MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

MBT3904DW1T1 (NPN)



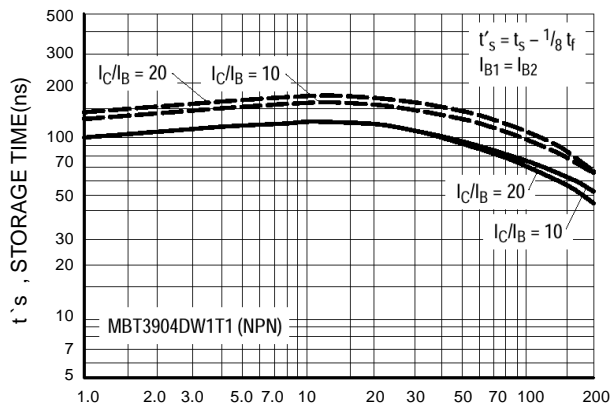
I_C, COLLECTOR CURRENT (mA)

Figure 5. Turn-On Time



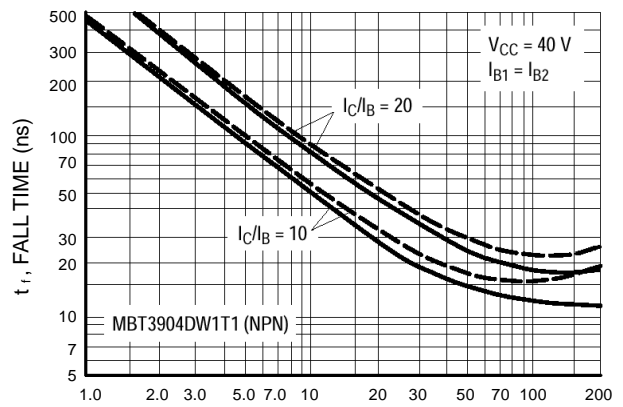
I_C, COLLECTOR CURRENT (mA)

Figure 6. Rise Time



I_C, COLLECTOR CURRENT (mA)

Figure 7. Storage Time



I_C, COLLECTOR CURRENT (mA)

Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS

(V = 5.0 Vdc, T = 25°C, Bandwidth = 1.0 Hz)

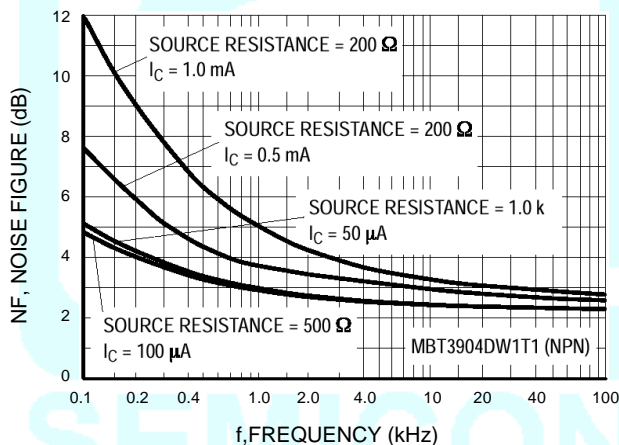


Figure 9. Noise Figure

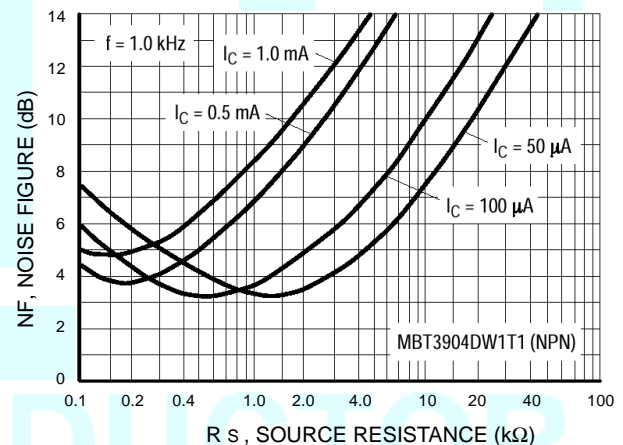


Figure 10. Noise Figure

MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

MBT3904DW1T1 (NPN)

h PARAMETERS

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

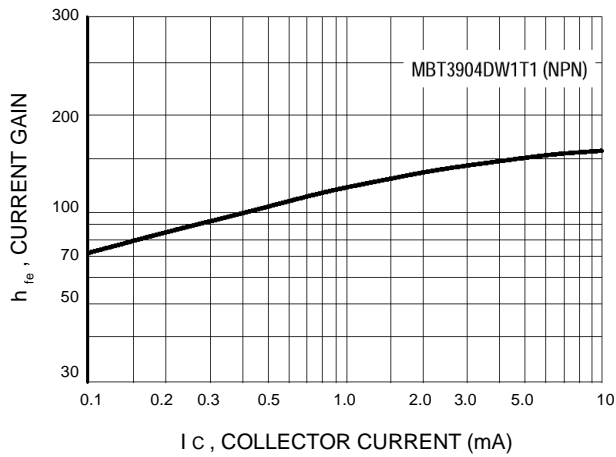


Figure 11. Current Gain

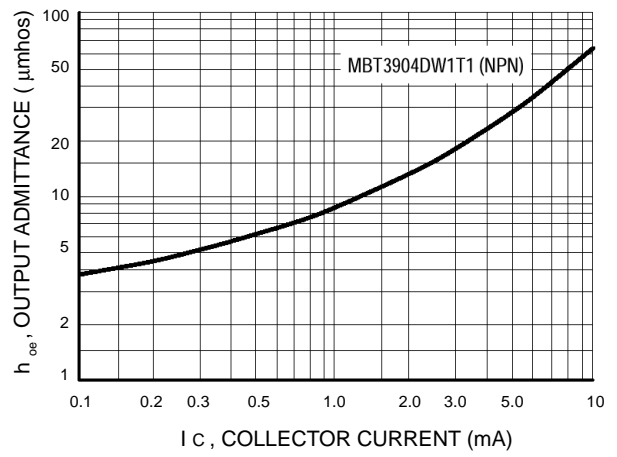


Figure 12. Output Admittance

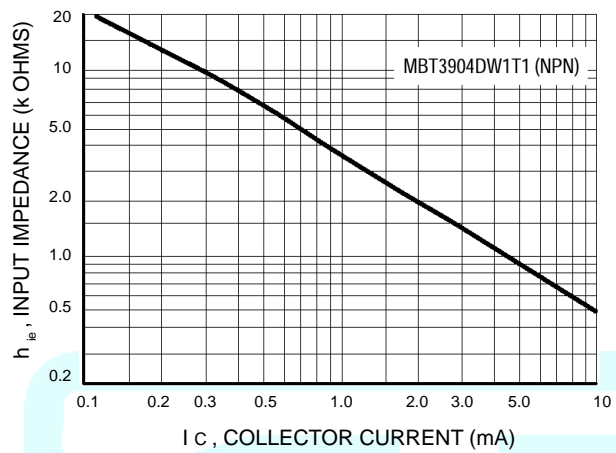


Figure 13. Input Impedance

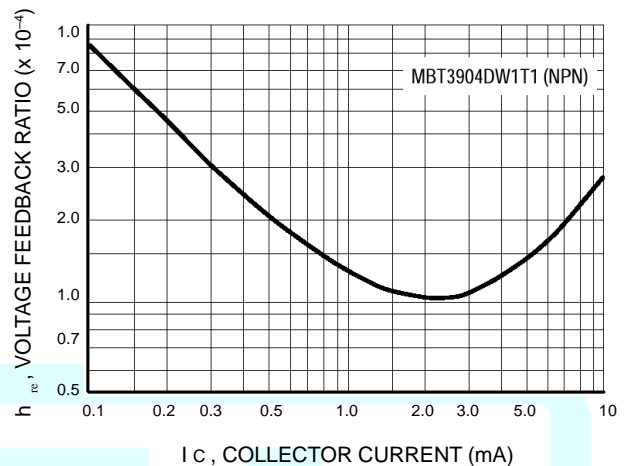
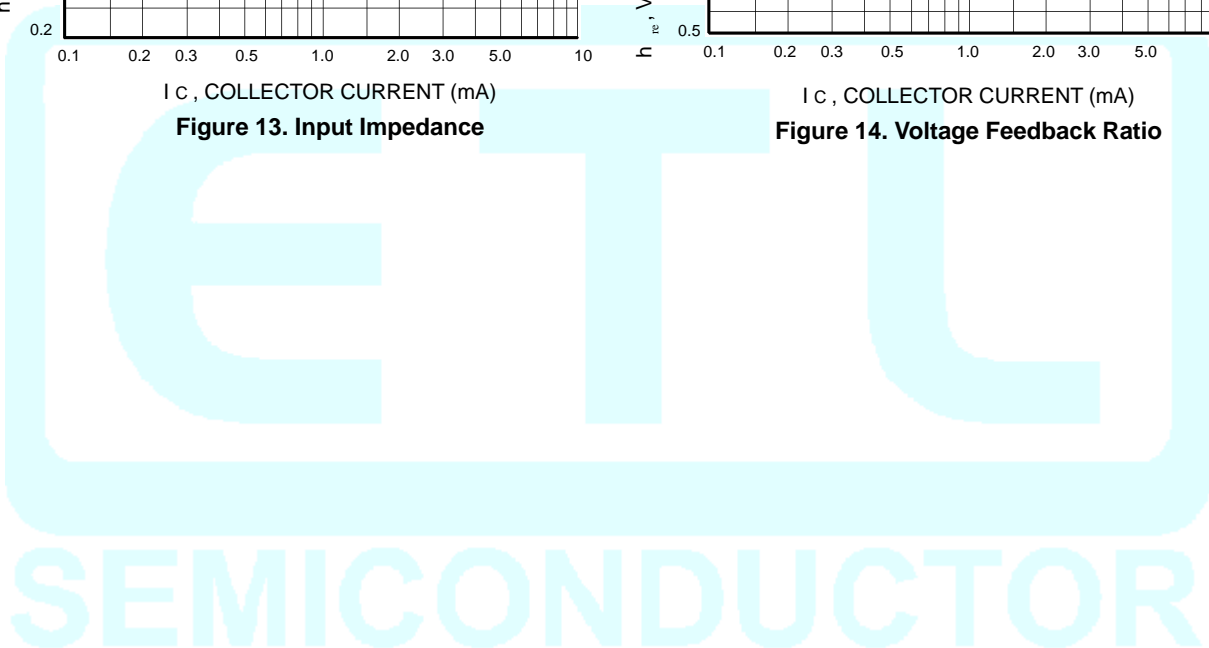


Figure 14. Voltage Feedback Ratio



MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

**MBT3904DW1T1 (NPN)
TYPICAL STATIC CHARACTERISTICS**

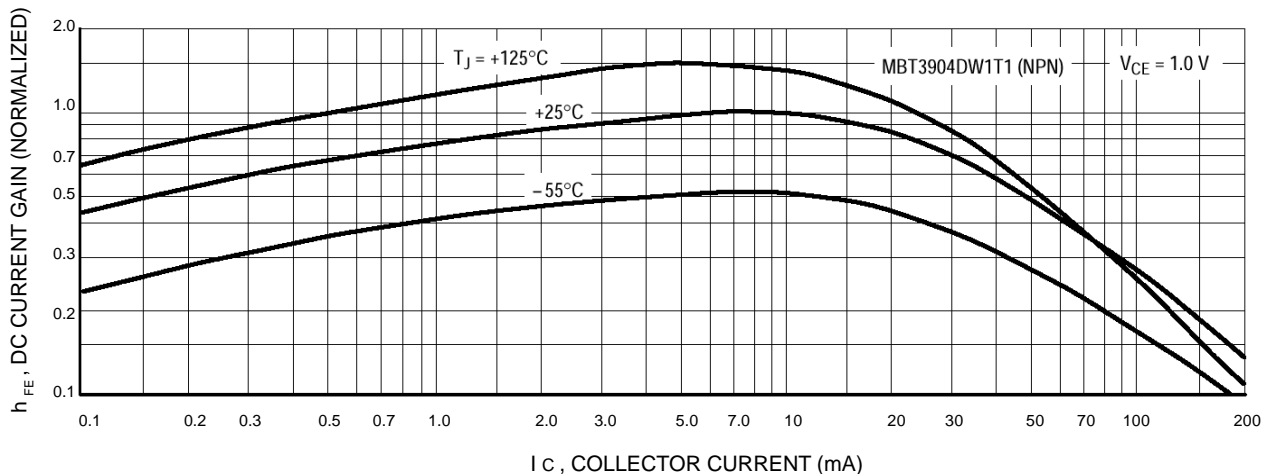


Figure 15. DC Current Gain

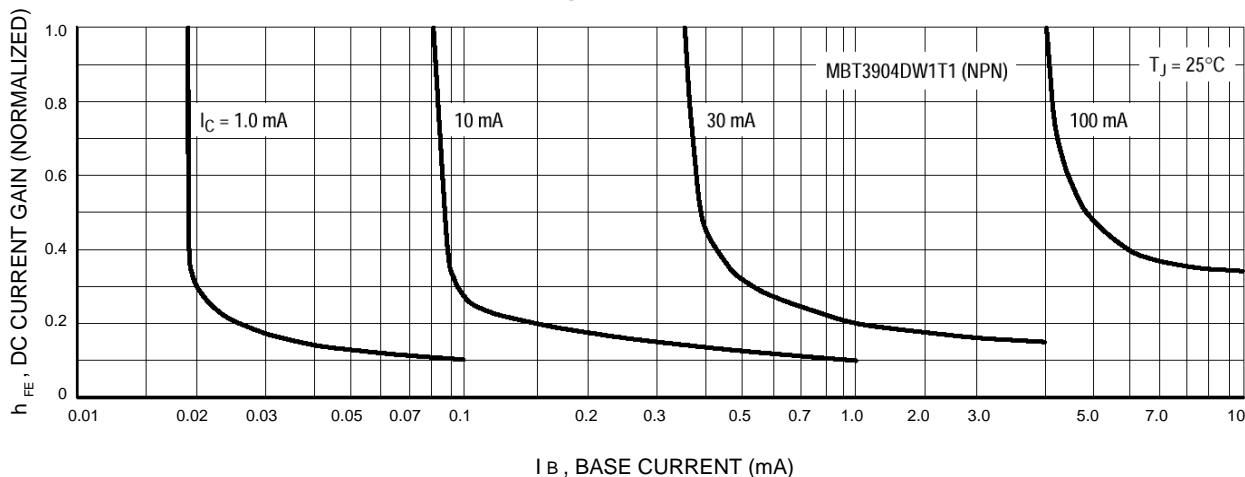


Figure 16. Collector Saturation Region

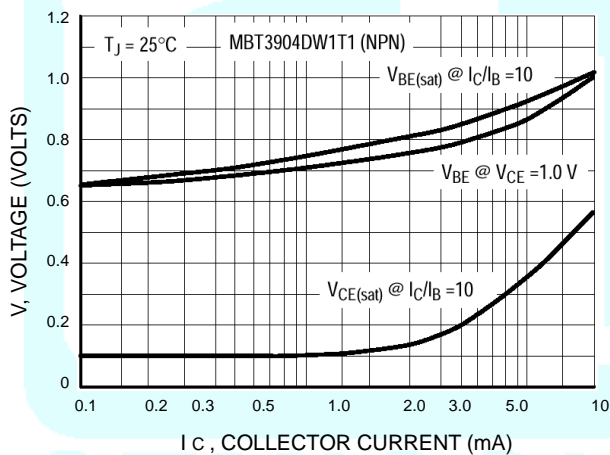


Figure 17. "ON" Voltages

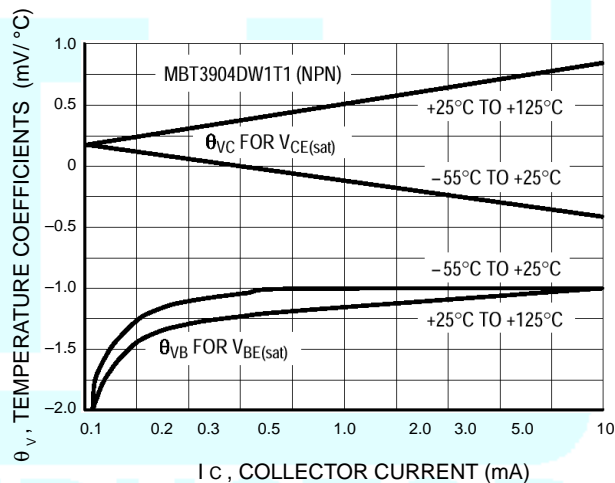


Figure 18. Temperature Coefficients

MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

MBT3906DW1T1 (PNP)

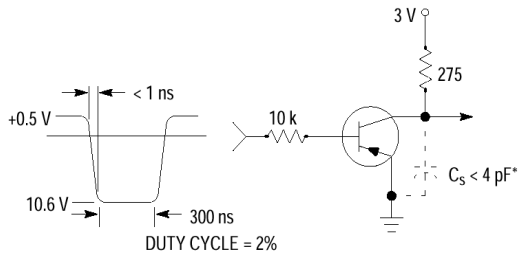


Figure 19. Delay and Rise Time Equivalent Test Circuit

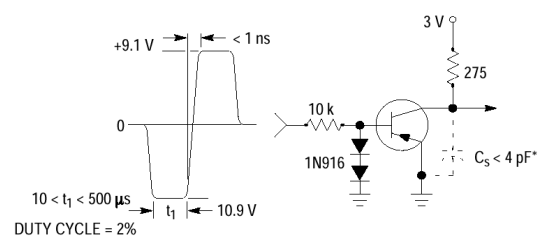
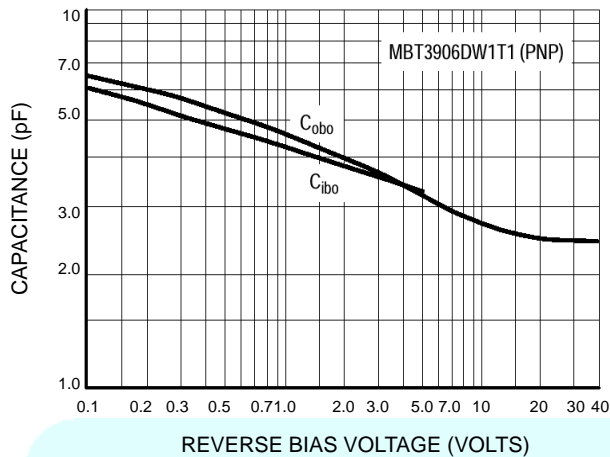


Figure 20. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

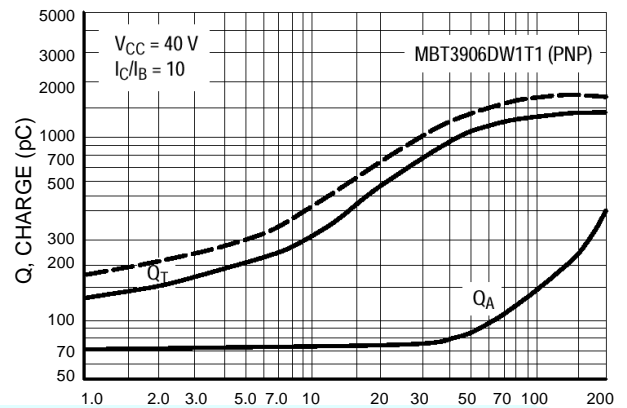
TYPICAL TRANSIENT CHARACTERISTICS

— $T_J = 25^\circ\text{C}$
 - - - $T_J = 125^\circ\text{C}$



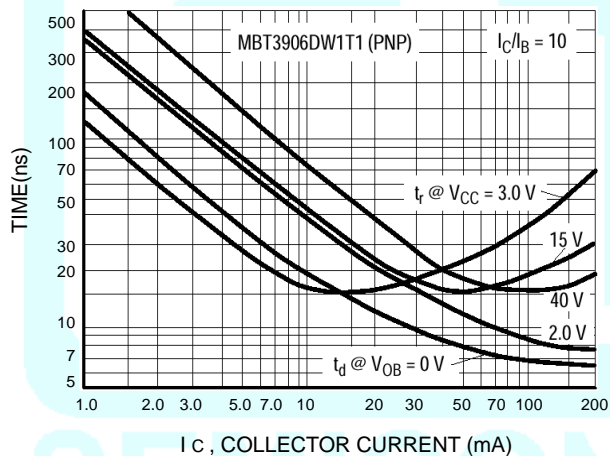
REVERSE BIAS VOLTAGE (VOLTS)

Figure 21. Capacitance



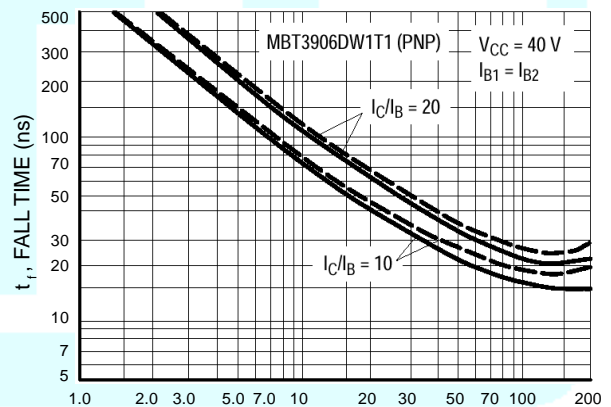
I_C , COLLECTOR CURRENT (mA)

Figure 22. Charge Data



I_C , COLLECTOR CURRENT (mA)

Figure 23. Turn-On Time



I_C , COLLECTOR CURRENT (mA)

Figure 24. Fall Time

MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

MBT3906DW1T1 (PNP)

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS

($V = -5.0$ Vdc, $T = 25^\circ\text{C}$, Bandwidth = 1.0 Hz)

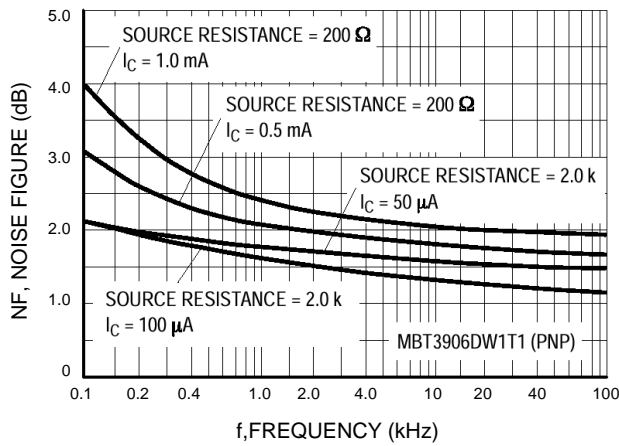


Figure 25. Noise Figure

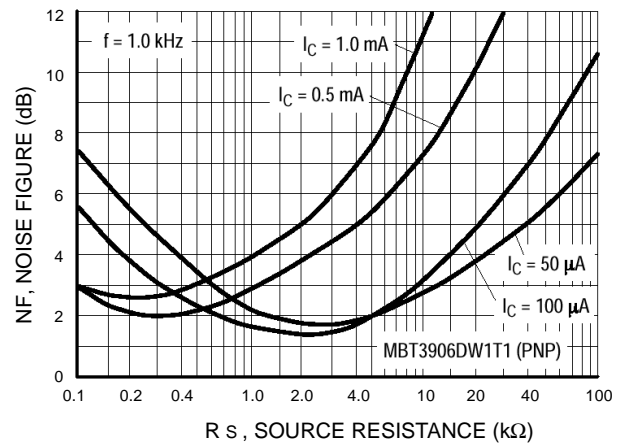


Figure 26. Noise Figure

h PARAMETERS

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

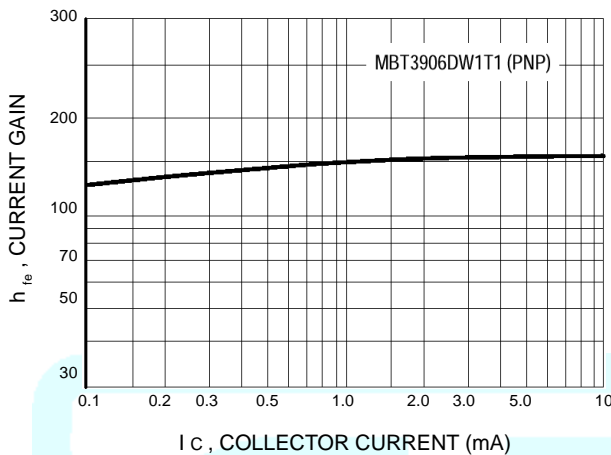


Figure 27. Current Gain

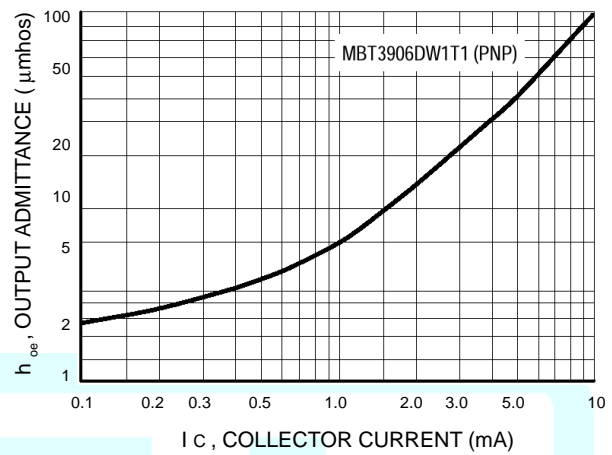


Figure 28. Output Admittance

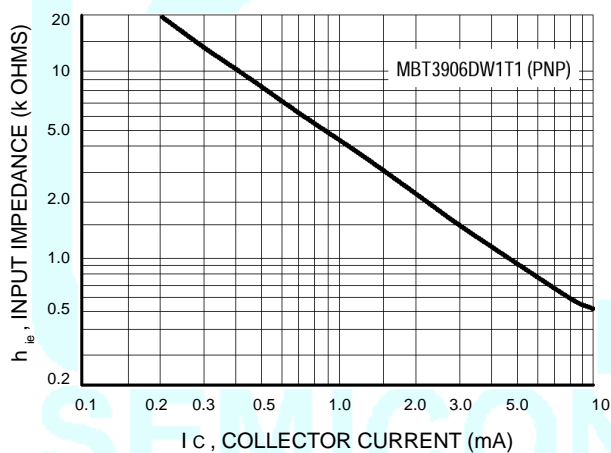


Figure 29. Input Impedance

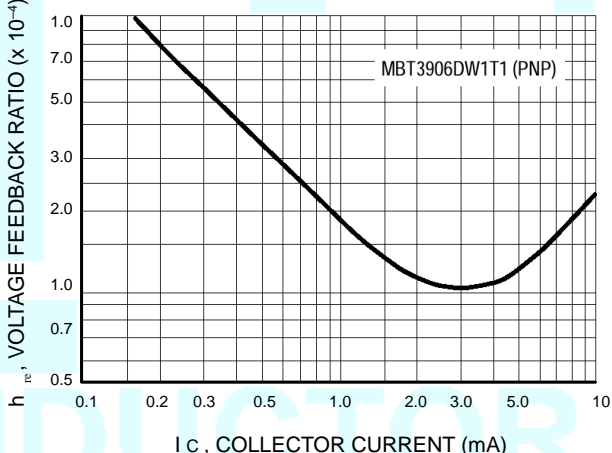


Figure 30. Voltage Feedback Ratio

MBT3904DW1T1, MBT3906DW1T1, MBT3946DW1T1

**MBT3906DW1T1 (PNP)
TYPICAL STATIC CHARACTERISTICS**

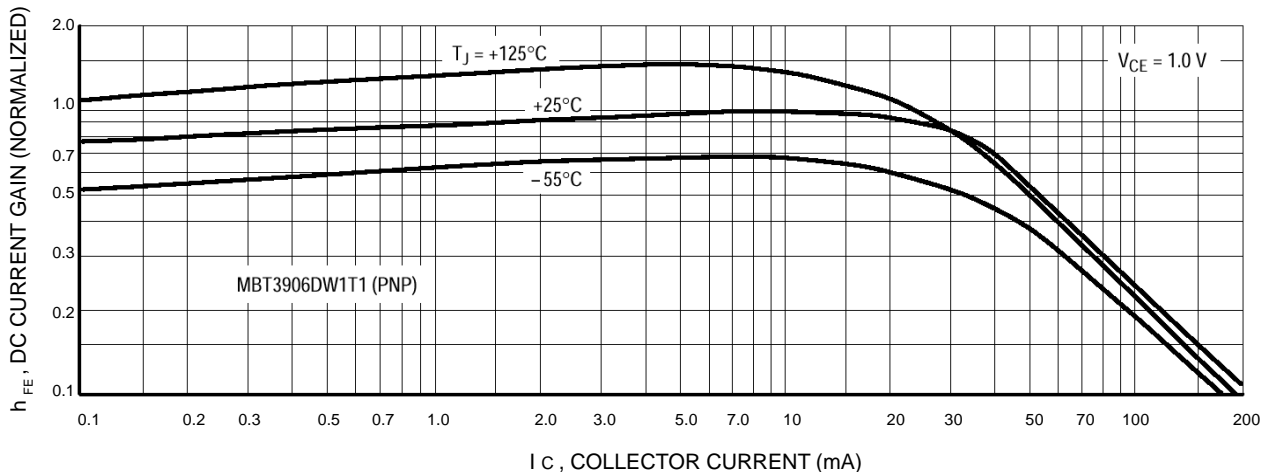


Figure 31. DC Current Gain

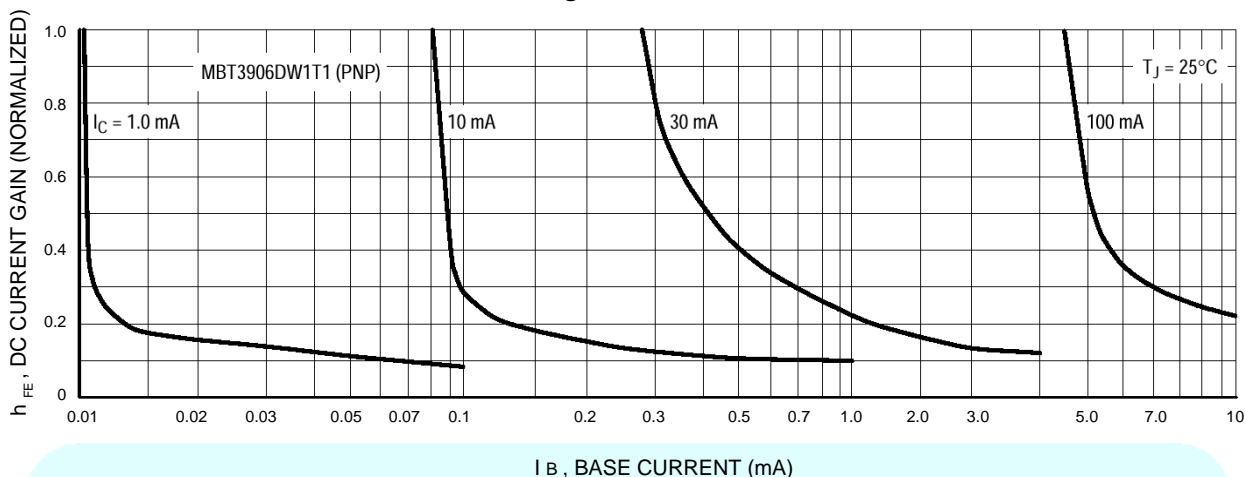


Figure 32. Collector Saturation Region

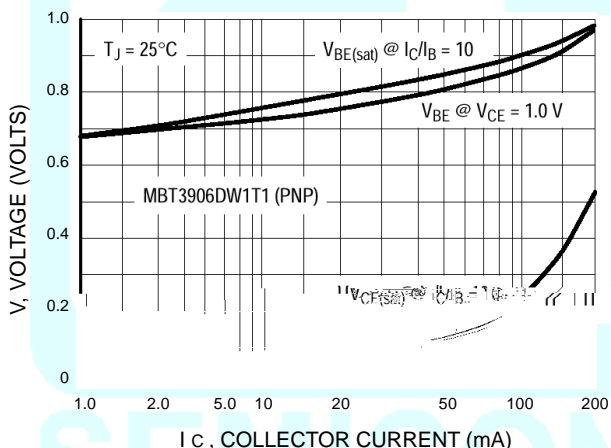


Figure 33. "ON" Voltages

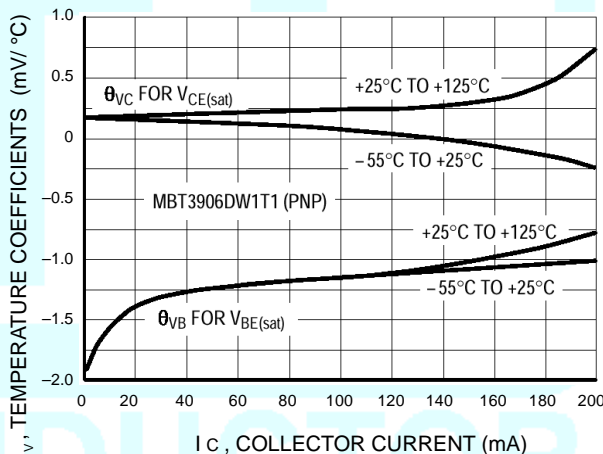


Figure 34. Temperature Coefficients