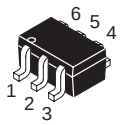
MBT3904DW1T1
MBT3906DW1T1
MBT3946DW1T1

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.

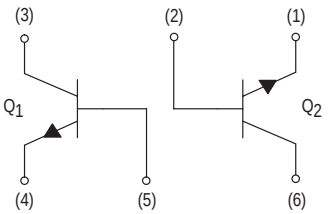
- h_{FE}, 100–300
- Low $V_{CE(sat)}$, ≤ 0.4 V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7–inch/3,000 Unit Tape and Reel

MBT3904DW1T1
MBT3906DW1T1
MBT3946DW1T1

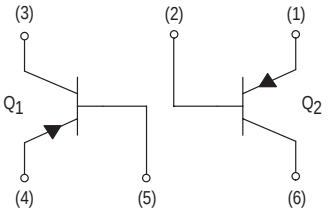


CASE 419B–01, STYLE 1

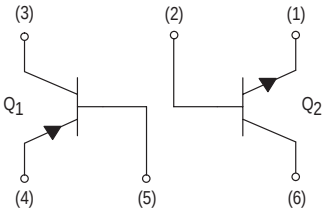
MBT3904DW1T1



MBT3906DW1T1



MBT3946DW1T1*



*Q1 same as MBT3906DW1T1
Q2 same as MBT3904DW1T1

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Collector–Emitter Voltage	MBT3904DW1T1 (NPN) MBT3906DW1T1 (PNP)	V_{CEO}	40 –40	Vdc
Collector–Base Voltage	MBT3904DW1T1 (NPN) MBT3906DW1T1 (PNP)	V_{CBO}	60 –40	Vdc
Emitter–Base Voltage	MBT3904DW1T1 (NPN) MBT3906DW1T1 (PNP)	V_{EBO}	6.0 –5.0	Vdc
Collector Current — Continuous	MBT3904DW1T1 (NPN) MBT3906DW1T1 (PNP)	I_C	 200 –200	mAdc

THERMAL CHARACTERISTICS

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

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

DEVICE MARKING

MBT3904DW1T1 = MA MBT3946DW1T1 = 46
MBT3906DW1T1 = A2

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

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

2. Pulse Test: Pulse Width ≤ 300 μs; Duty Cycle ≤ 2.0%.

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

Characteristic		Symbol	Min	Max	Unit
Input Impedance		h_{ie}			k Ω
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MBT3904DW1T1 (NPN)		1.0	10	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	MBT3906DW1T1 (PNP)		2.0	12	
Voltage Feedback Ratio		h_{re}			X 10^{-4}
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MBT3904DW1T1 (NPN)		0.5	8.0	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	MBT3906DW1T1 (PNP)		0.1	10	
Small–Signal Current Gain		h_{fe}			—
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MBT3904DW1T1 (NPN)		100	400	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	MBT3906DW1T1 (PNP)		100	400	
Output Admittance		h_{oe}			μmhos
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MBT3904DW1T1 (NPN)		1.0	40	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	MBT3906DW1T1 (PNP)		3.0	60	
Noise Figure		NF			dB
(V_{CE} = 5.0 Vdc, I_C = 100 μAdc, R_S = 1.0 k Ω, f = 1.0 kHz)	MBT3904DW1T1 (NPN)		—	5.0	
(V_{CE} = –5.0 Vdc, I_C = –100 μAdc, R_S = 1.0 k Ω, f = 1.0 kHz)	MBT3906DW1T1 (PNP)		—	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	
	(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	
	(I_{B1} = I_{B2} = –1.0 mAdc)	MBT3906DW1T1 (PNP)		—	75	

MBT3904DW1T1 (NPN)

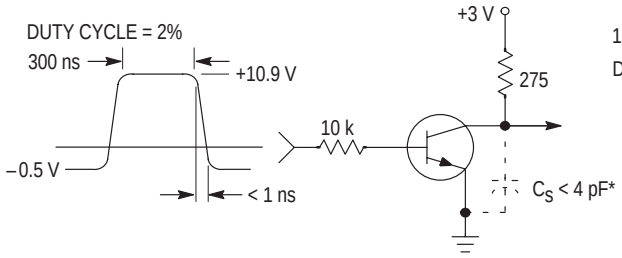


Figure 1. Delay and Rise Time Equivalent Test Circuit

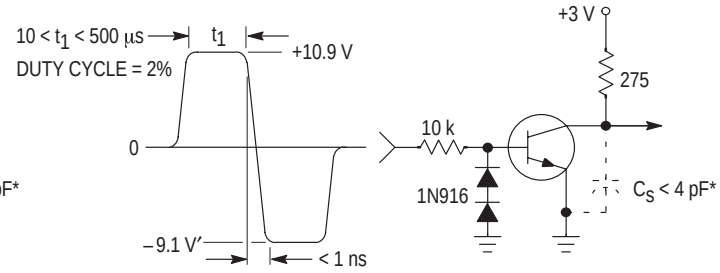


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

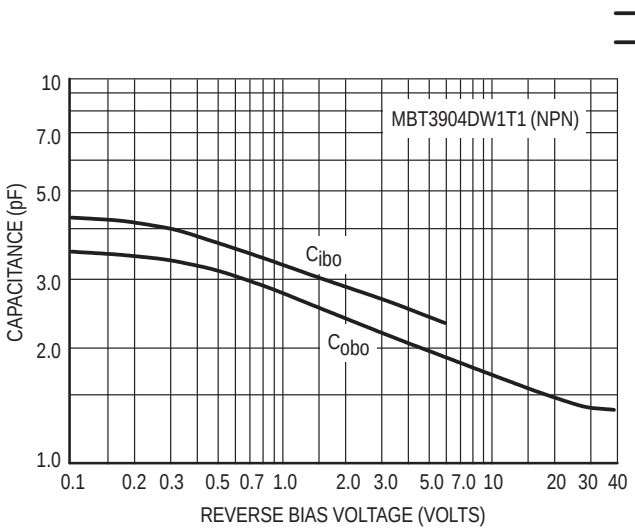


Figure 3. Capacitance

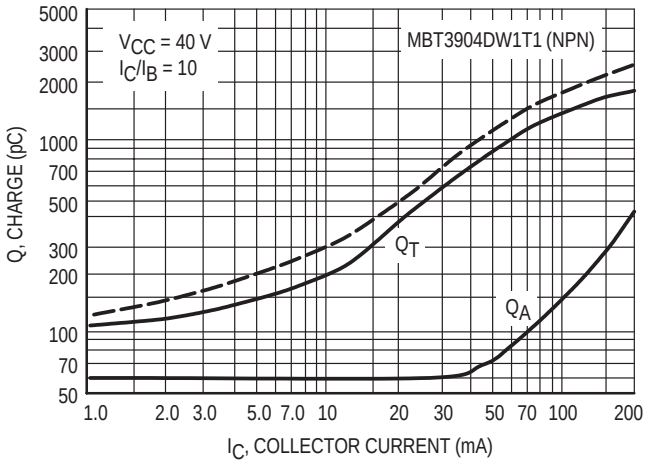


Figure 4. Charge Data

MBT3904DW1T1 (NPN)

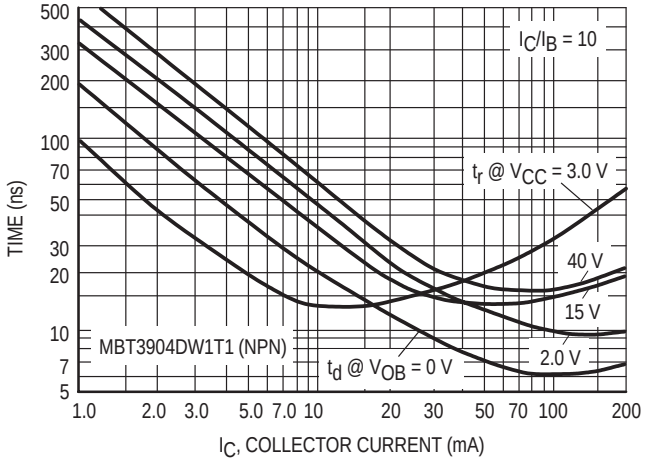


Figure 5. Turn–On Time

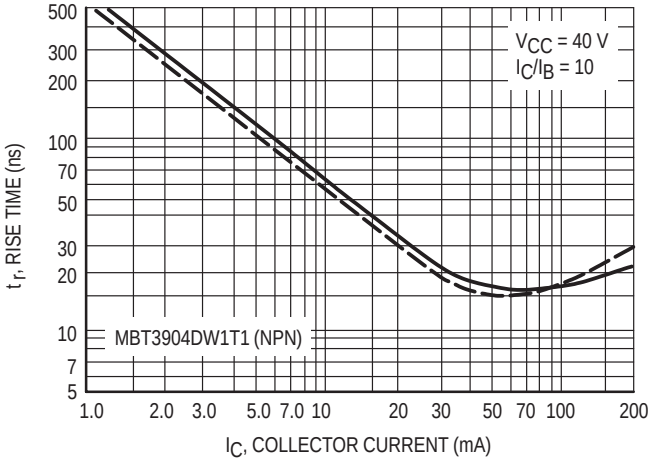


Figure 6. Rise Time

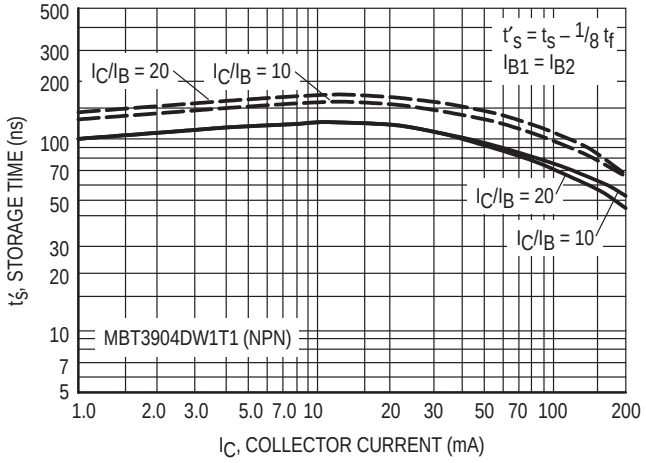


Figure 7. Storage Time

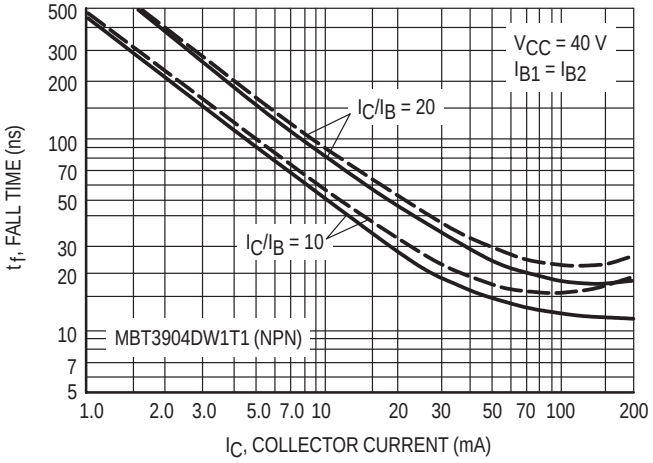


Figure 8. Fall Time

TYPICAL AUDIO SMALL–SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

(V_{CE} = 5.0 Vdc, T_A = 25°C, Bandwidth = 1.0 Hz)

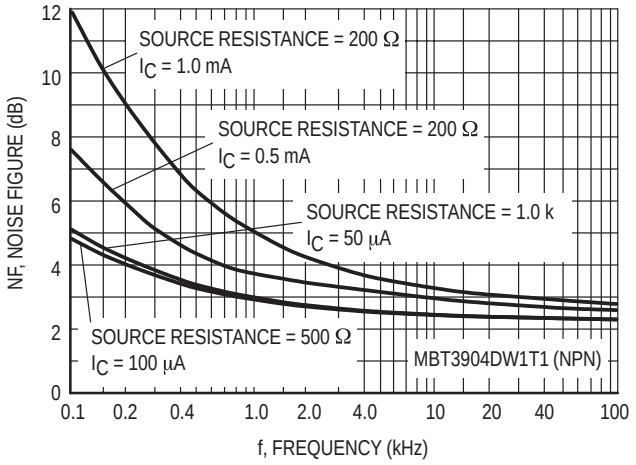


Figure 9. Noise Figure

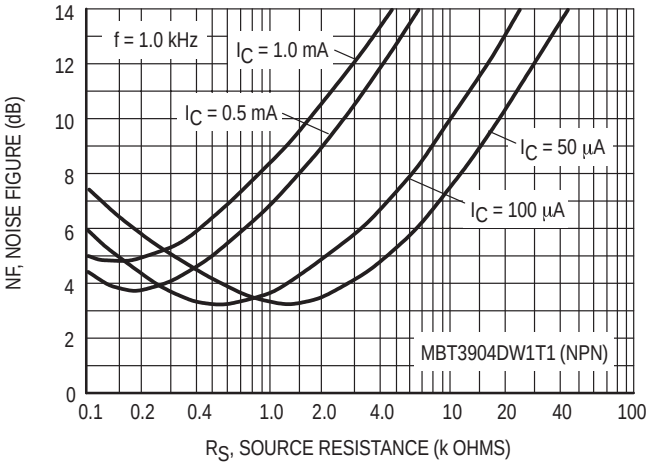


Figure 10. Noise Figure

MBT3904DW1T1 (NPN)

h PARAMETERS

(V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°C)

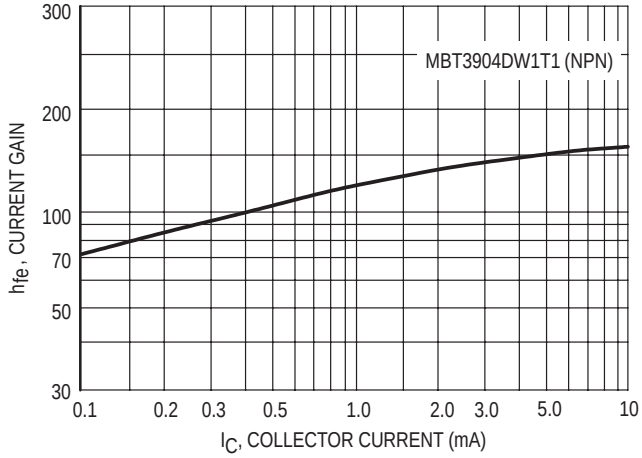


Figure 11. Current Gain

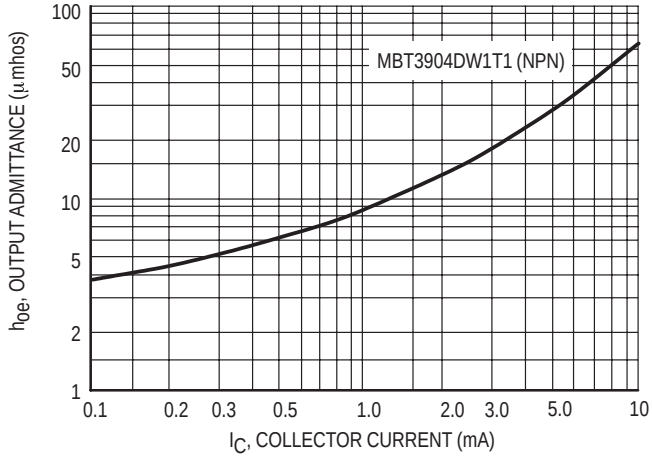


Figure 12. Output Admittance

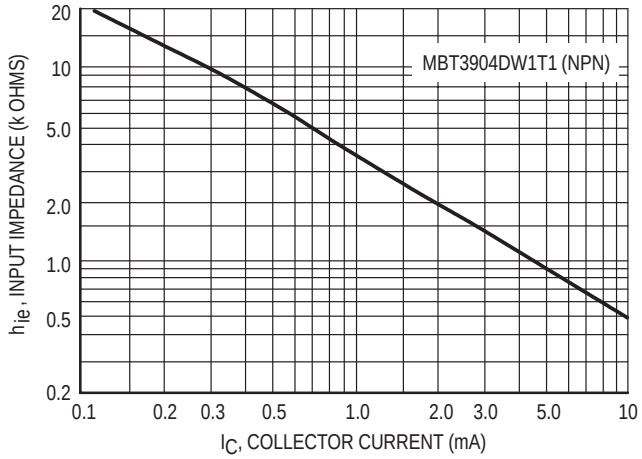


Figure 13. Input Impedance

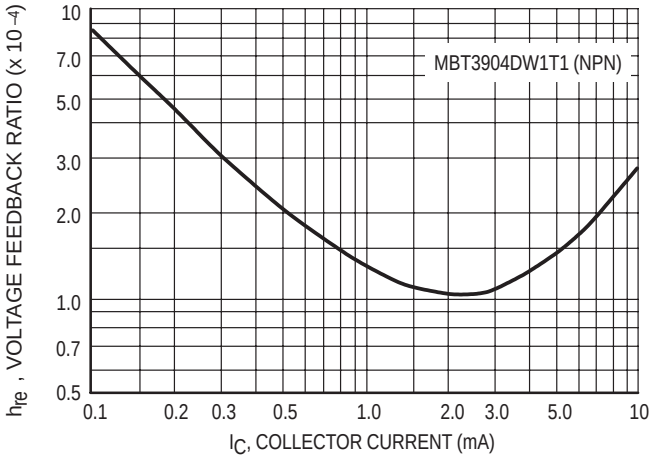


Figure 14. Voltage Feedback Ratio

MBT3904DW1T1 (NPN)

TYPICAL STATIC CHARACTERISTICS

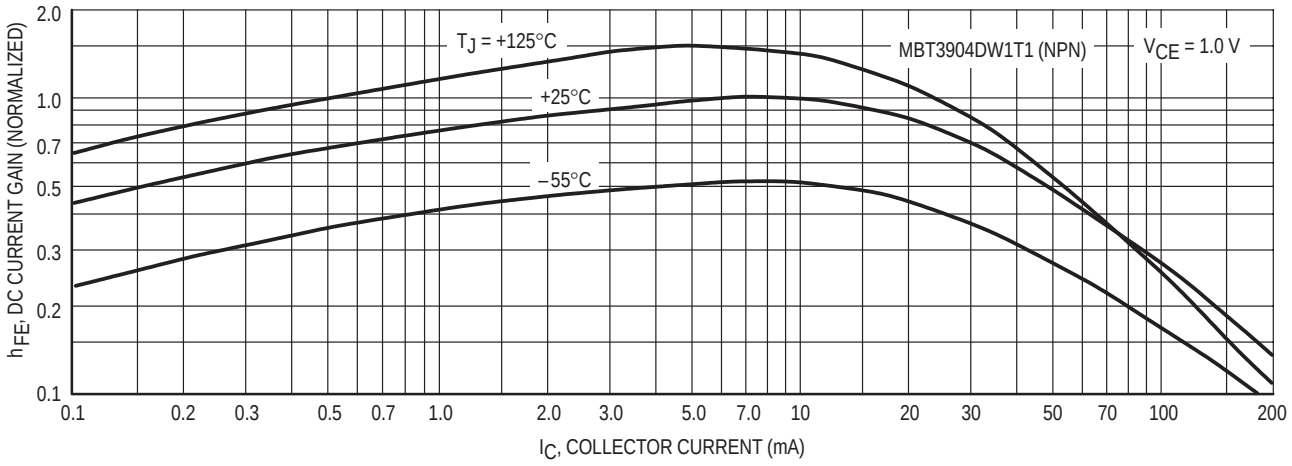


Figure 15. DC Current Gain

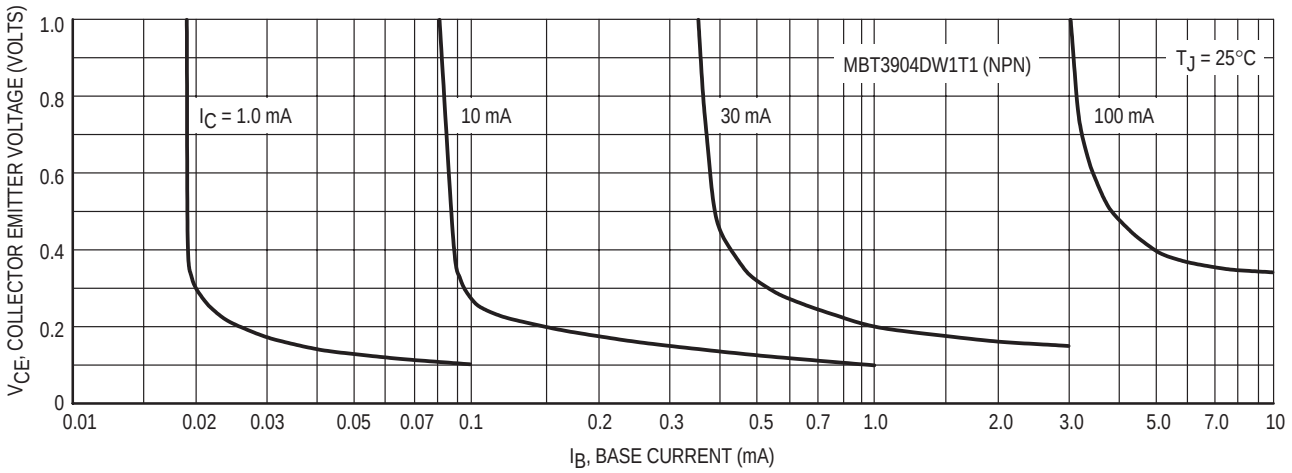


Figure 16. Collector Saturation Region

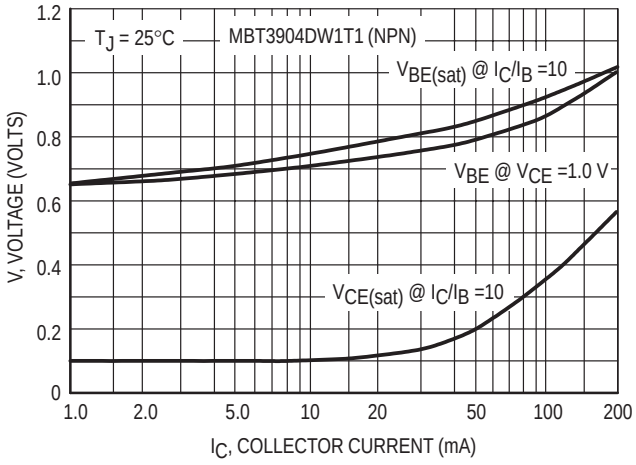


Figure 17. “ON” Voltages

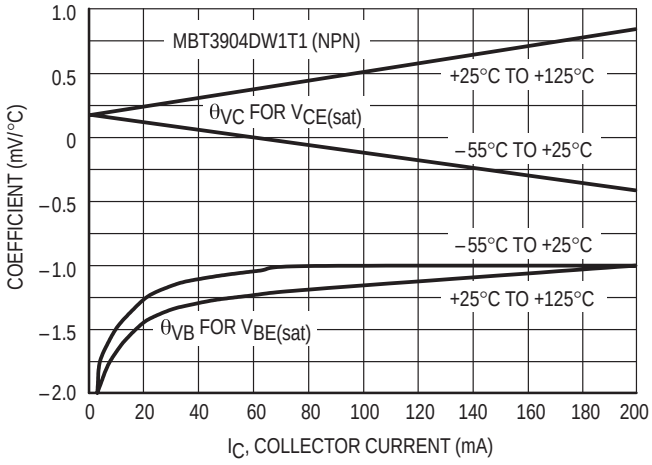


Figure 18. Temperature Coefficients

MBT3906DW1T1 (PNP)

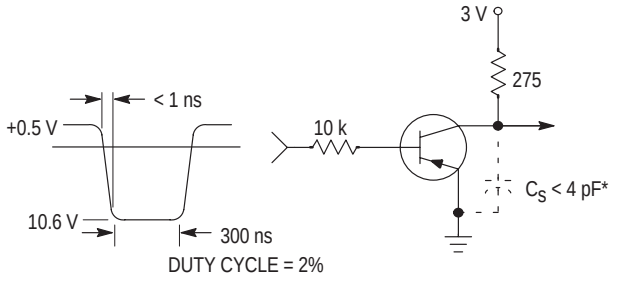


Figure 19. Delay and Rise Time Equivalent Test Circuit

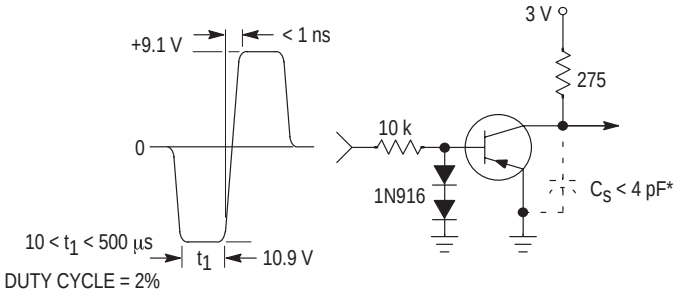


Figure 20. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

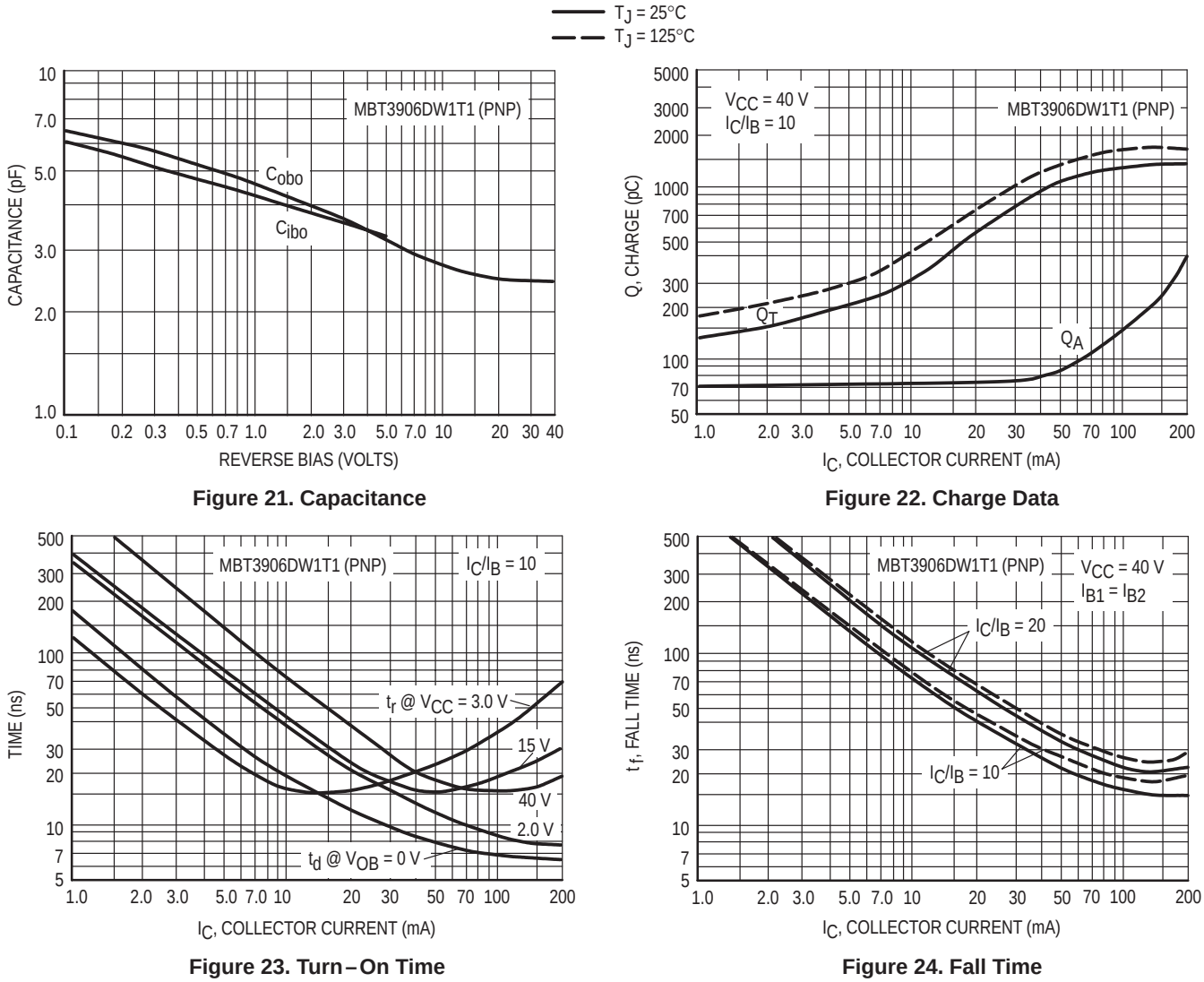


Figure 21. Capacitance

Figure 22. Charge Data

Figure 23. Turn – On Time

Figure 24. Fall Time

MBT3906DW1T1 (PNP)

TYPICAL AUDIO SMALL–SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

(V_{CE} = –5.0 Vdc, T_A = 25°C, Bandwidth = 1.0 Hz)

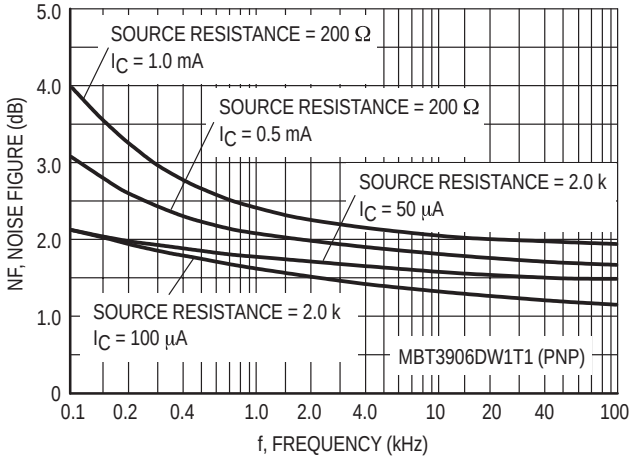


Figure 25.

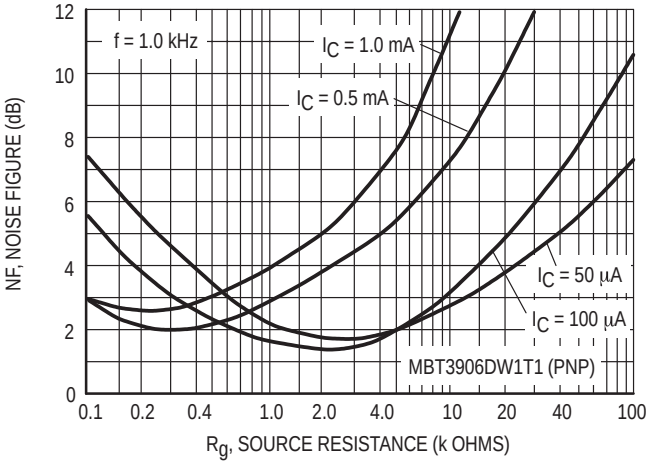


Figure 26.

h PARAMETERS

(V_{CE} = –10 Vdc, f = 1.0 kHz, T_A = 25°C)

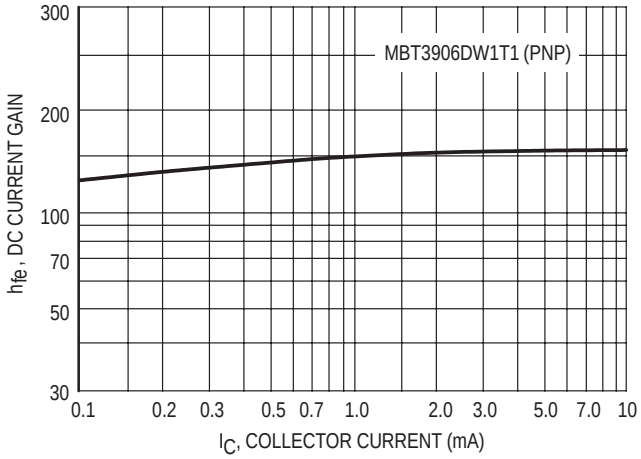


Figure 27. Current Gain

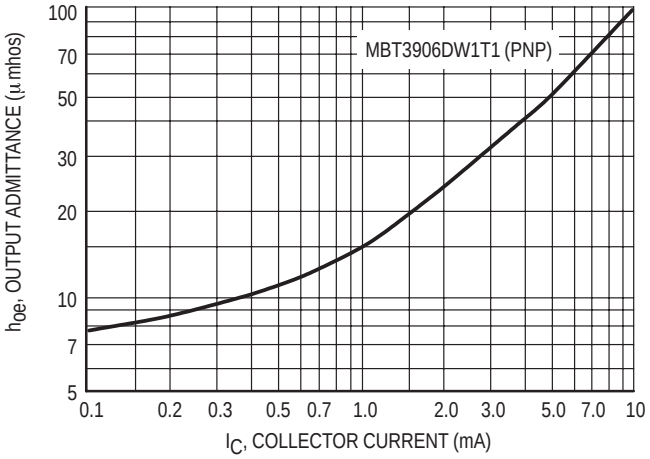


Figure 28. Output Admittance

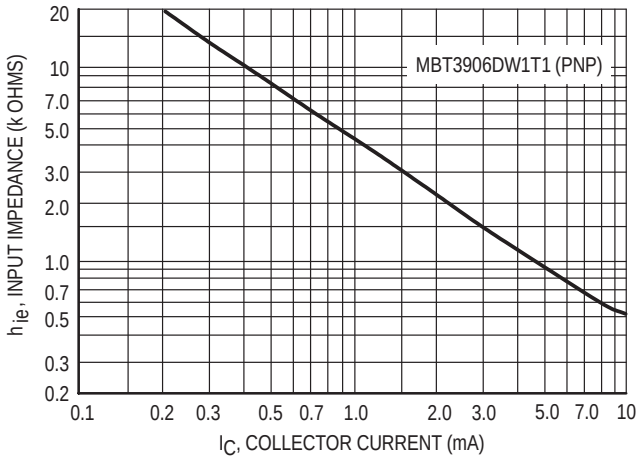


Figure 29. Input Impedance

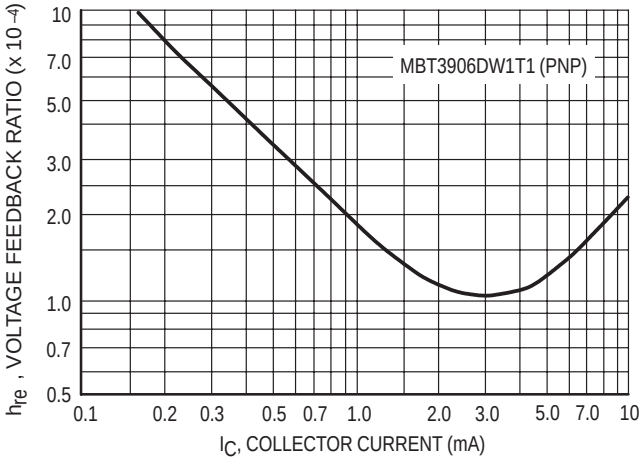


Figure 30. Voltage Feedback Ratio

MBT3906DW1T1 (PNP)

TYPICAL STATIC CHARACTERISTICS

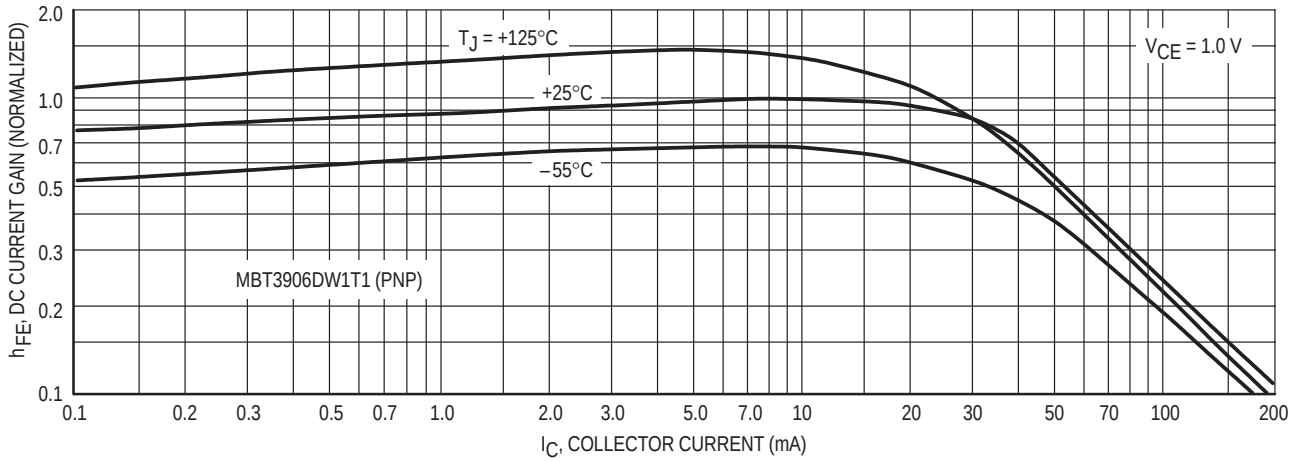


Figure 31. DC Current Gain

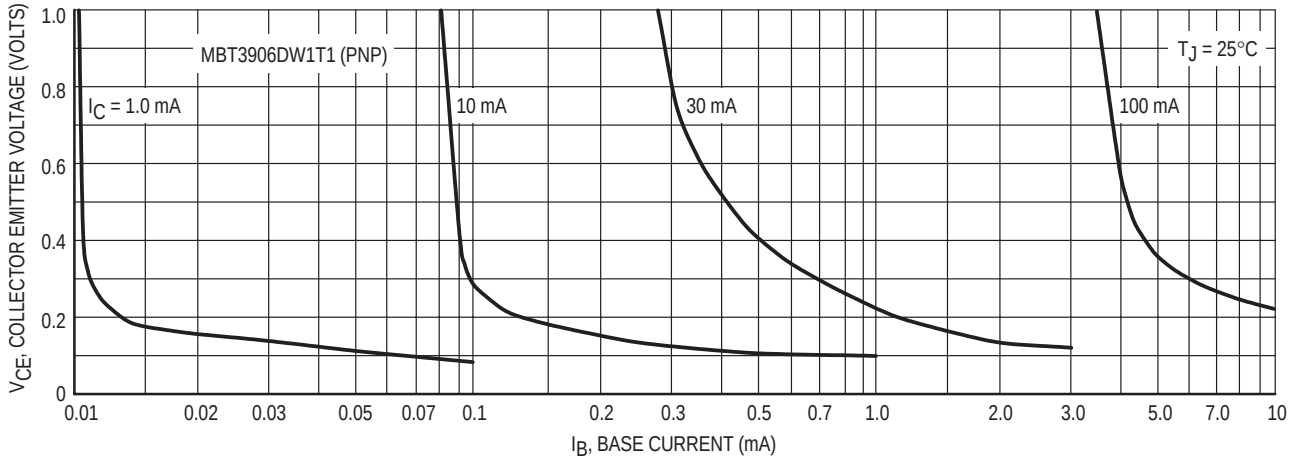


Figure 32. Collector Saturation Region

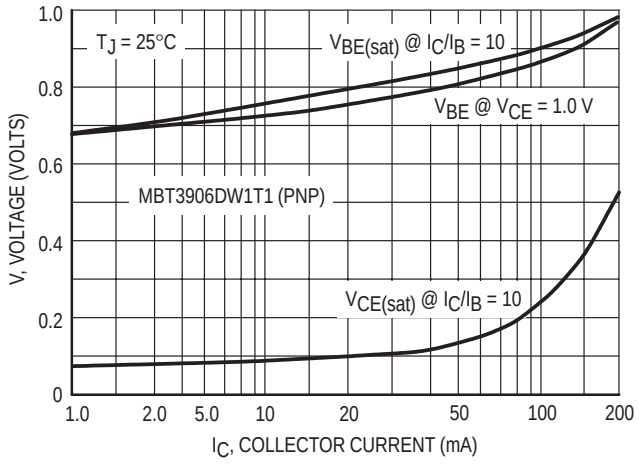


Figure 33. “ON” Voltages

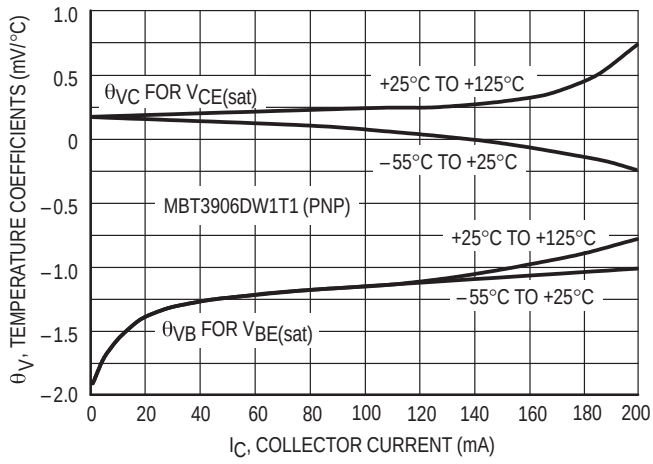


Figure 34. Temperature Coefficients