MMBT3904WT1, NPN
MMBT3906WT1, PNP

General Purpose Transistors

NPN and PNP Silicon

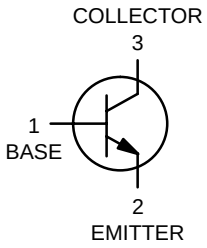
These transistors are designed for general purpose amplifier applications. They are housed in the SOT−323/SC−70 package which is designed for low power surface mount applications.

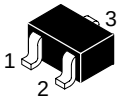
Features

- Pb−Free Packages are Available

ON Semiconductor®

http://onsemi.com





SC−70 (SOT−323)
CASE 419
STYLE 3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−Emitter Voltage MMBT3904WT1 MMBT3906WT1	V_{CEO}	 40 −40	Vdc
Collector−Base Voltage MMBT3904WT1 MMBT3906WT1	V_{CBO}	 60 −40	Vdc
Emitter−Base Voltage MMBT3904WT1 MMBT3906WT1	V_{EBO}	 6.0 −5.0	Vdc
Collector Current − Continuous MMBT3904WT1 MMBT3906WT1	I_C	 200 −200	mAdc

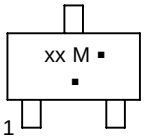
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation (Note 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

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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

MARKING DIAGRAM



xx = AM for MMBT3904WT1
= 2A for MMBT3906WT1
M = Date Code*
▪ = Pb−Free Package

(Note: Microdot may be in either location)
*Date Code orientation may vary depending upon manufacturing location.

ORDERING INFORMATION

Device	Package	Shipping†
MMBT3904WT1	SC−70/ SOT−323	3000/Tape & Reel
MMBT3904WT1G	SC−70/ SOT−323 (Pb−Free)	3000/Tape & Reel
MMBT3906WT1	SC−70/ SOT−323	3000/Tape & Reel
MMBT3906WT1G	SC−70/ SOT−323 (Pb−Free)	3000/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector−Emitter Breakdown Voltage (Note 2)		$V_{(BR)CEO}$			Vdc
(I_C = 1.0 mAdc, I_B = 0)	MMBT3904WT1		40	−	
(I_C = −1.0 mAdc, I_B = 0)	MMBT3906WT1		−40	−	
Collector−Base Breakdown Voltage		$V_{(BR)CBO}$			Vdc
(I_C = 10 μAdc, I_E = 0)	MMBT3904WT1		60	−	
(I_C = −10 μAdc, I_E = 0)	MMBT3906WT1		−40	−	
Emitter−Base Breakdown Voltage		$V_{(BR)EBO}$			Vdc
(I_E = 10 μAdc, I_C = 0)	MMBT3904WT1		6.0	−	
(I_E = −10 μAdc, I_C = 0)	MMBT3906WT1		−5.0	−	
Base Cutoff Current		I_{BL}			nAdc
(V_{CE} = 30 Vdc, V_{EB} = 3.0 Vdc)	MMBT3904WT1		−	50	
(V_{CE} = −30 Vdc, V_{EB} = −3.0 Vdc)	MMBT3906WT1		−	−50	
Collector Cutoff Current		I_{CEX}			nAdc
(V_{CE} = 30 Vdc, V_{EB} = 3.0 Vdc)	MMBT3904WT1		−	50	
(V_{CE} = −30 Vdc, V_{EB} = −3.0 Vdc)	MMBT3906WT1		−	−50	
ON CHARACTERISTICS (Note 2)					
DC Current Gain		h_{FE}			−
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)	MMBT3904WT1		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)	MMBT3906WT1		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)	MMBT3904WT1		−	0.2	
(I_C = 50 mAdc, I_B = 5.0 mAdc)			−	0.3	
(I_C = −10 mAdc, I_B = −1.0 mAdc)	MMBT3906WT1		−	−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)	MMBT3904WT1		0.65	0.85	
(I_C = 50 mAdc, I_B = 5.0 mAdc)			−	0.95	
(I_C = −10 mAdc, I_B = −1.0 mAdc)	MMBT3906WT1		−0.65	−0.85	
(I_C = −50 mAdc, I_B = −5.0 mAdc)			−	−0.95	

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

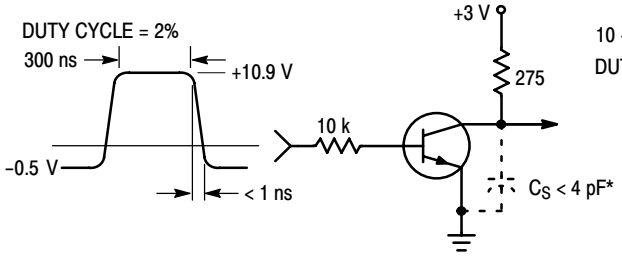
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

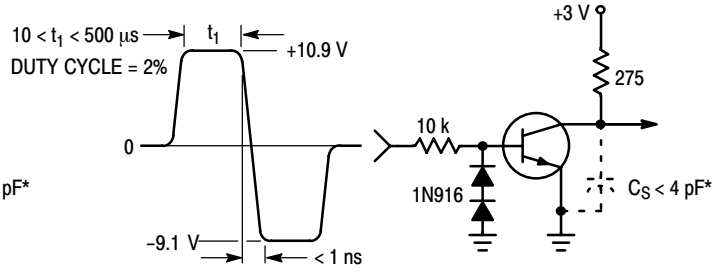
Characteristic		Symbol	Min	Max	Unit
SMALL−SIGNAL CHARACTERISTICS					
Current−Gain − Bandwidth Product		f_T			MHz
(I_C = 10 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	MMBT3904WT1		300	−	
(I_C = −10 mAdc, V_{CE} = −20 Vdc, f = 100 MHz)	MMBT3906WT1		250	−	
Output Capacitance		C_{obo}			pF
(V_{CB} = 5.0 Vdc, I_E = 0, f = 1.0 MHz)	MMBT3904WT1		−	4.0	
(V_{CB} = −5.0 Vdc, I_E = 0, f = 1.0 MHz)	MMBT3906WT1		−	4.5	
Input Capacitance		C_{ibo}			pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	MMBT3904WT1		−	8.0	
(V_{EB} = −0.5 Vdc, I_C = 0, f = 1.0 MHz)	MMBT3906WT1		−	10.0	
Input Impedance		h_{ie}			k Ω
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MMBT3904WT1		1.0	10	
(V_{CE} = −10 Vdc, I_C = −1.0 mAdc, f = 1.0 kHz)	MMBT3906WT1		2.0	12	
Voltage Feedback Ratio		h_{re}			X 10^{-4}
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MMBT3904WT1		0.5	8.0	
(V_{CE} = −10 Vdc, I_C = −1.0 mAdc, f = 1.0 kHz)	MMBT3906WT1		0.1	10	
Small−Signal Current Gain		h_{fe}			−
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MMBT3904WT1		100	400	
(V_{CE} = −10 Vdc, I_C = −1.0 mAdc, f = 1.0 kHz)	MMBT3906WT1		100	400	
Output Admittance		h_{oe}			μmhos
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MMBT3904WT1		1.0	40	
(V_{CE} = −10 Vdc, I_C = −1.0 mAdc, f = 1.0 kHz)	MMBT3906WT1		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)	MMBT3904WT1		−	5.0	
(V_{CE} = −5.0 Vdc, I_C = −100 μAdc, R_S = 1.0 k Ω, f = 1.0 kHz)	MMBT3906WT1		−	4.0	

SWITCHING CHARACTERISTICS

Characteristic	Condition		Symbol	Min	Max	Unit
Delay Time	(V_{CC} = 3.0 Vdc, V_{BE} = −0.5 Vdc)	MMBT3904WT1	t_d	−	35	ns
	(V_{CC} = −3.0 Vdc, V_{BE} = 0.5 Vdc)	MMBT3906WT1		−	35	
Rise Time	(I_C = 10 mAdc, I_{B1} = 1.0 mAdc)	MMBT3904WT1	t_r	−	35	
	(I_C = −10 mAdc, I_{B1} = −1.0 mAdc)	MMBT3906WT1		−	35	
Storage Time	(V_{CC} = 3.0 Vdc, I_C = 10 mAdc)	MMBT3904WT1	t_s	−	200	ns
	(V_{CC} = −3.0 Vdc, I_C = −10 mAdc)	MMBT3906WT1		−	225	
Fall Time	(I_{B1} = I_{B2} = 1.0 mAdc)	MMBT3904WT1	t_f	−	50	
	(I_{B1} = I_{B2} = −1.0 mAdc)	MMBT3906WT1		−	75	

MMBT3904WT1





* Total shunt capacitance of test jig and connectors

Figure 1. Delay and Rise Time Equivalent Test Circuit

Figure 2. Storage and Fall Time Equivalent Test Circuit

MMBT3904WT1

TYPICAL TRANSIENT CHARACTERISTICS

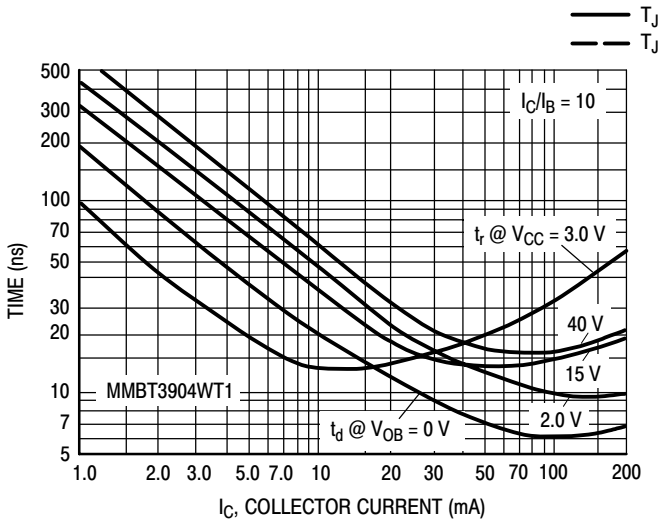


Figure 3. Turn−On Time

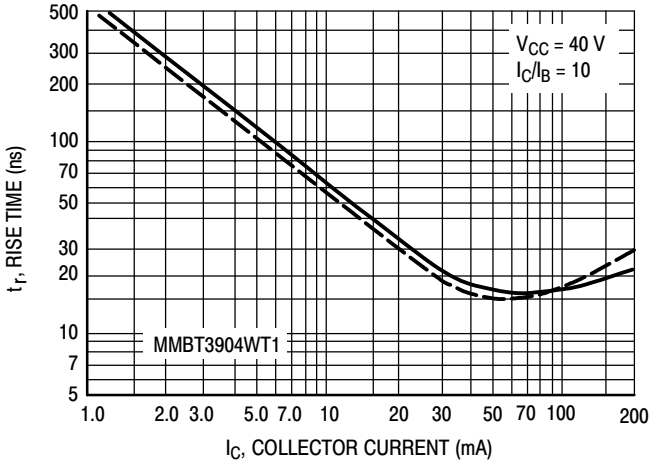


Figure 4. Rise Time

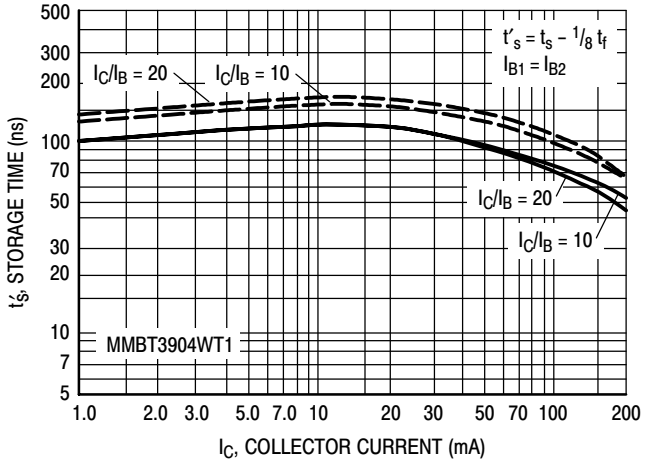


Figure 5. Storage Time

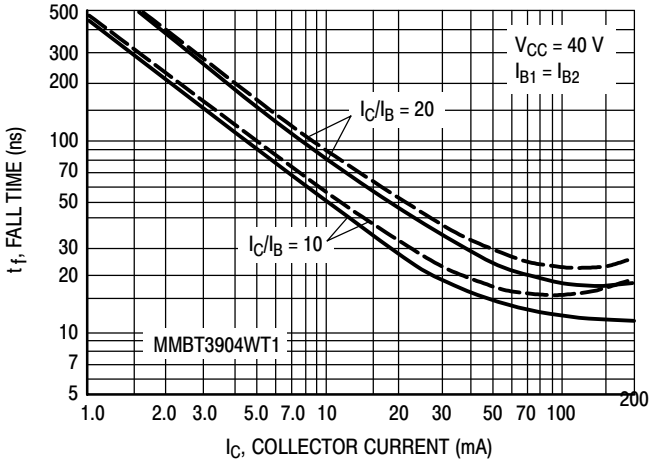


Figure 6. Fall Time

TYPICAL AUDIO SMALL−SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

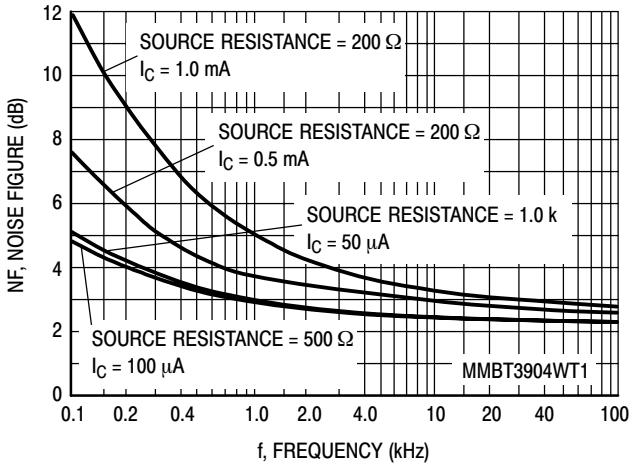


Figure 7. Noise Figure

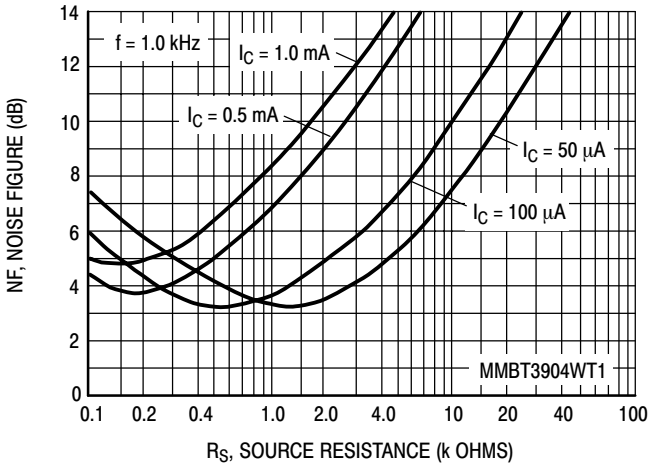


Figure 8. Noise Figure

MMBT3904WT1

h PARAMETERS

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

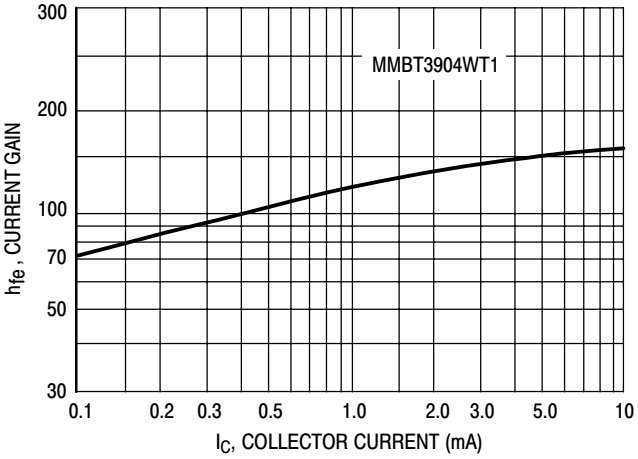


Figure 9. Current Gain

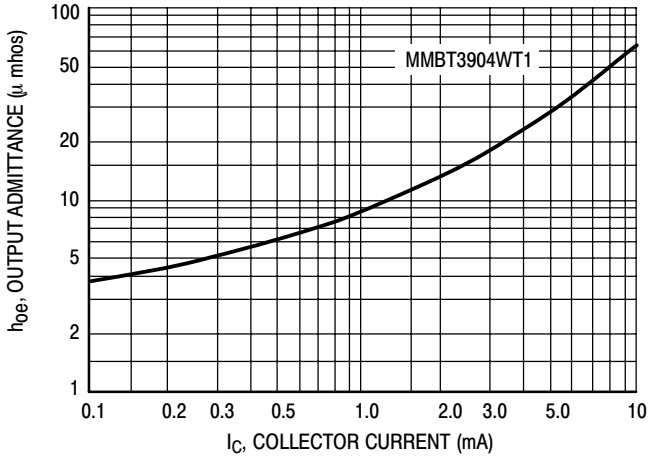


Figure 10. Output Admittance

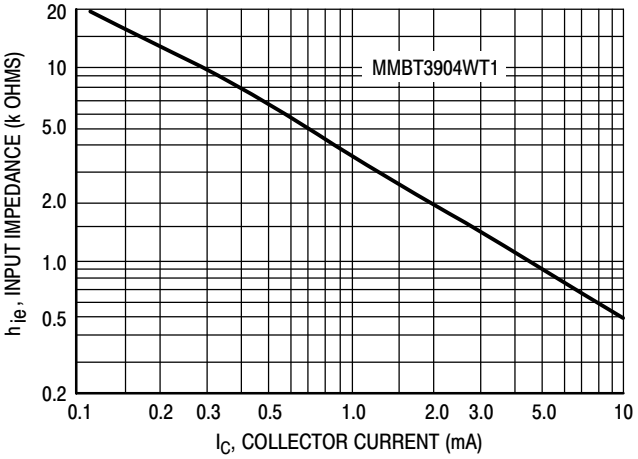


Figure 11. Input Impedance

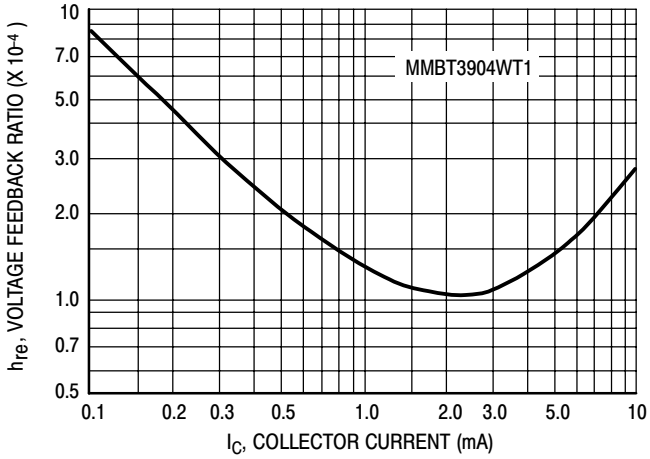


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

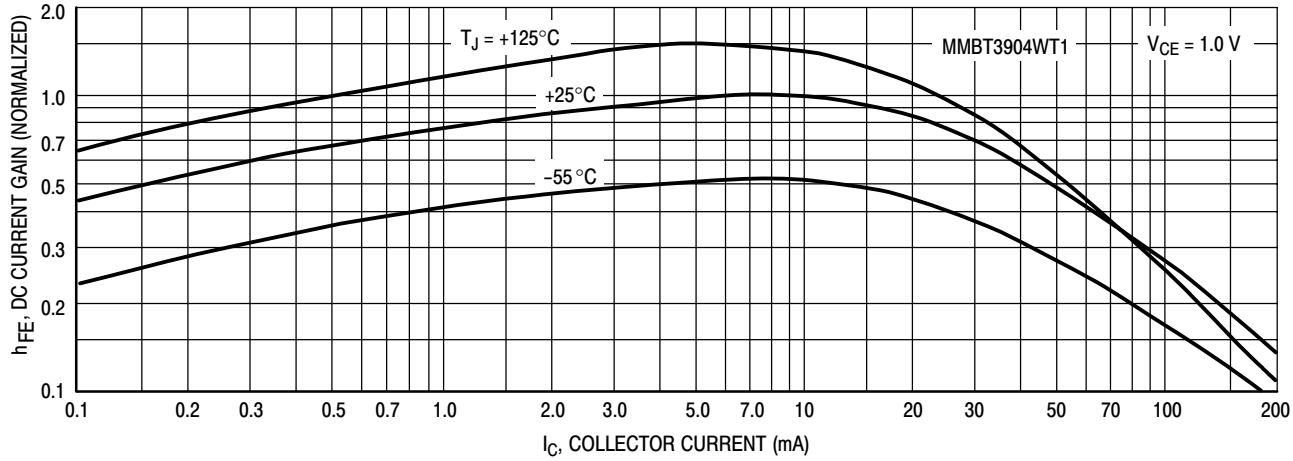


Figure 13. DC Current Gain

MMBT3904WT1

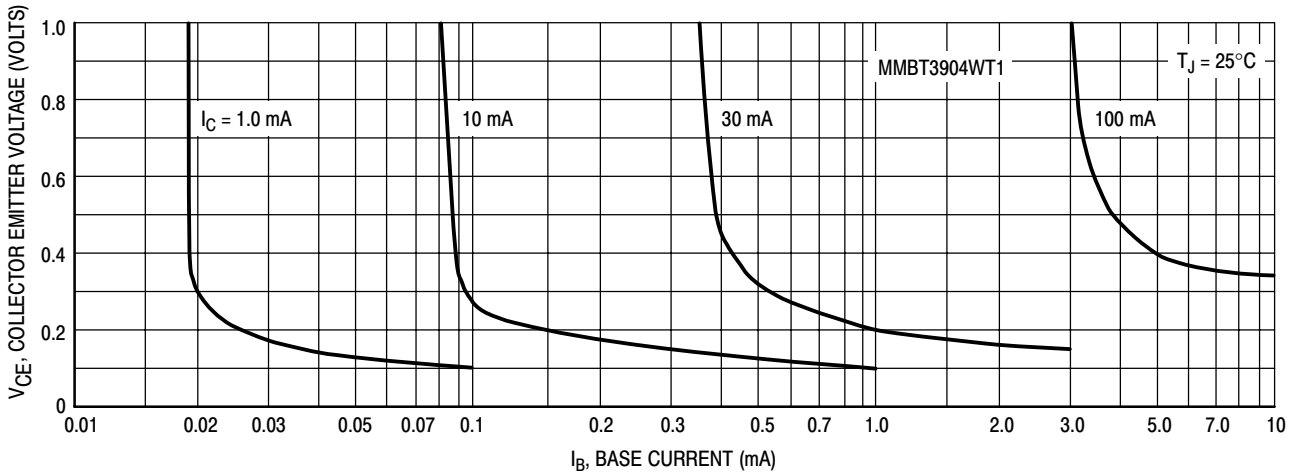


Figure 14. Collector Saturation Region

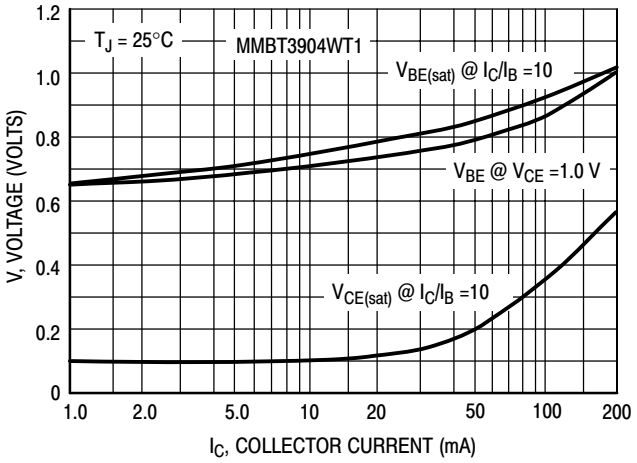


Figure 15. “ON” Voltages

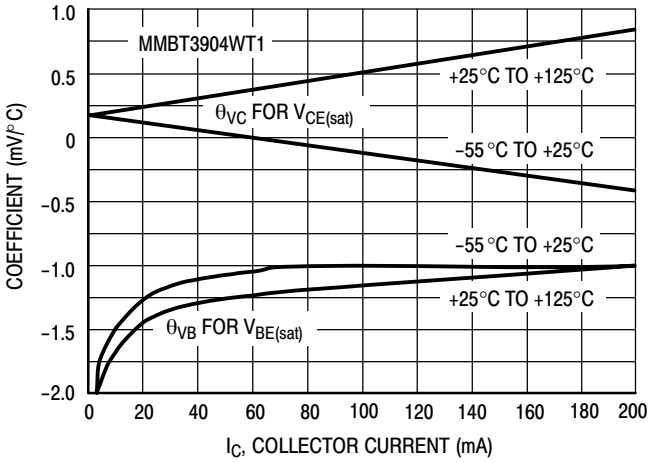


Figure 16. Temperature Coefficients

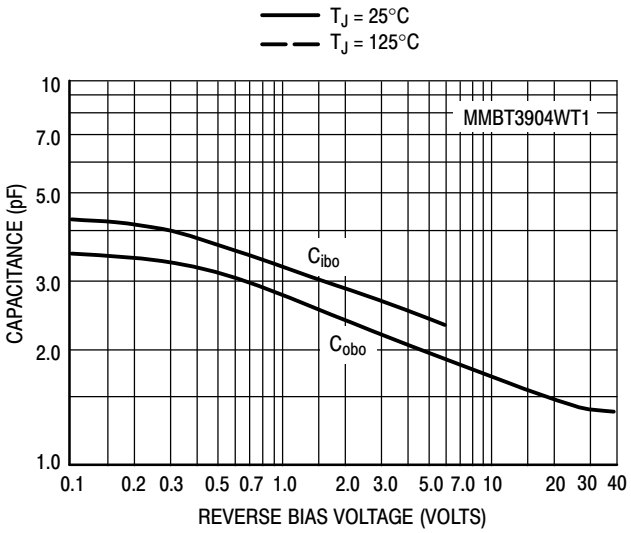
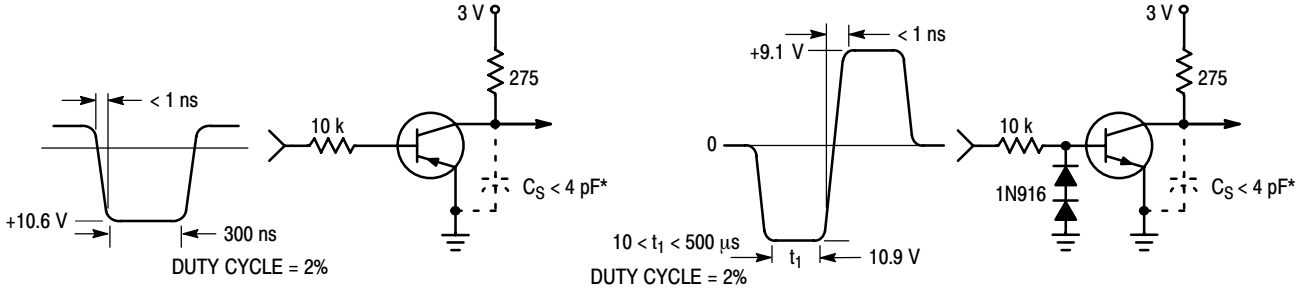


Figure 17. Capacitance

MMBT3906WT1



* Total shunt capacitance of test jig and connectors

Figure 18. Delay and Rise Time Equivalent Test Circuit

Figure 19. Storage and Fall Time Equivalent Test Circuit

TYPICAL TRANSIENT CHARACTERISTICS

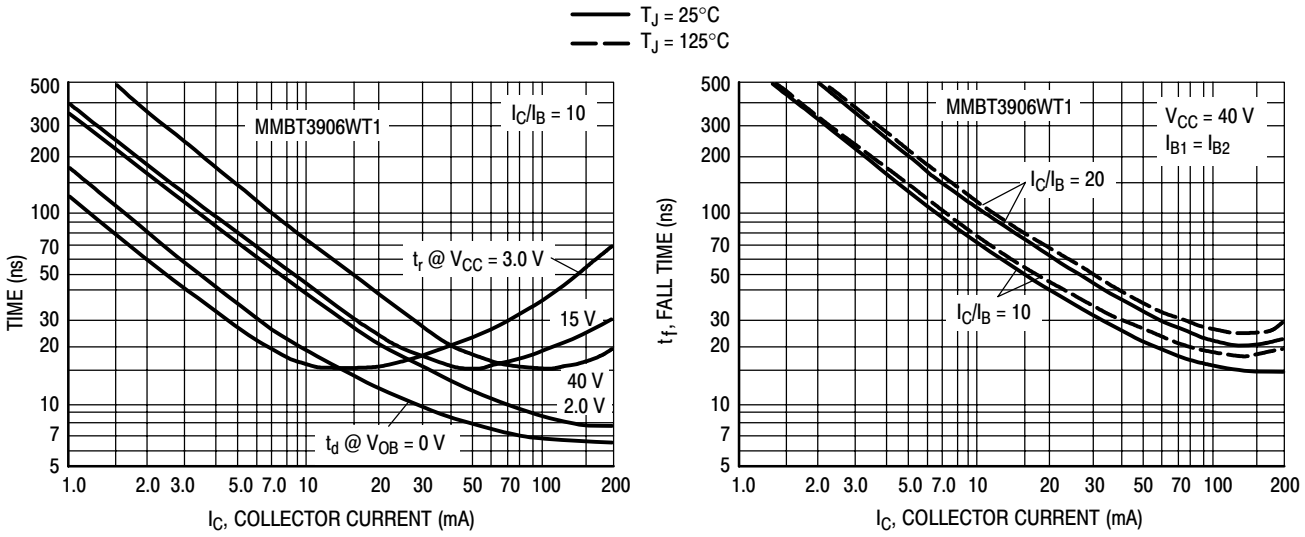


Figure 20. Turn−On Time

Figure 21. Fall Time

TYPICAL AUDIO SMALL−SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

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

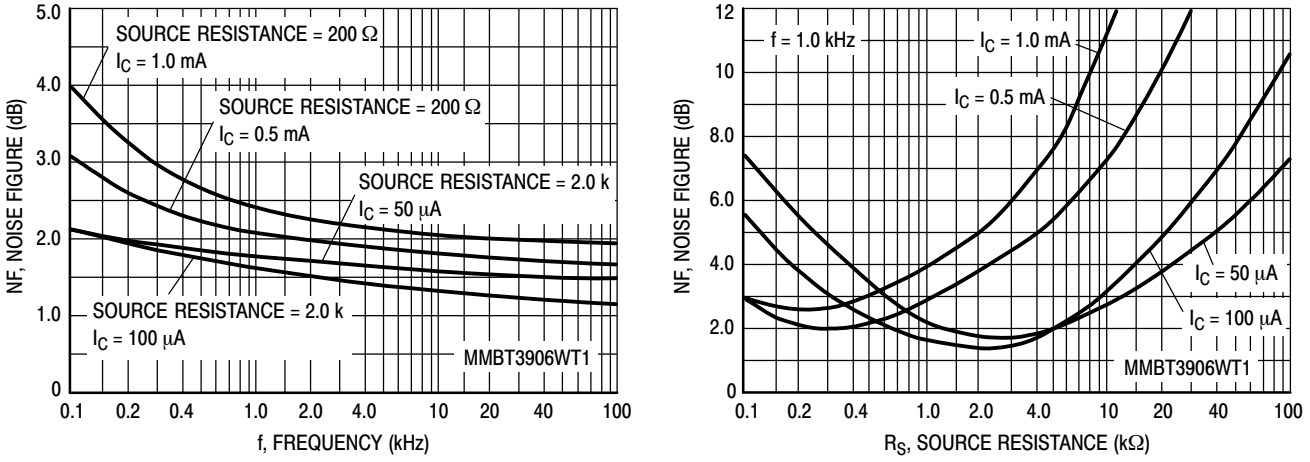


Figure 22.

Figure 23.

MMBT3906WT1

h PARAMETERS

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

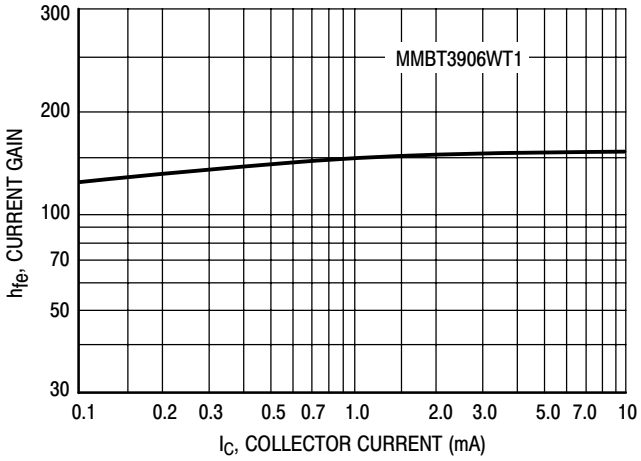


Figure 24. Current Gain

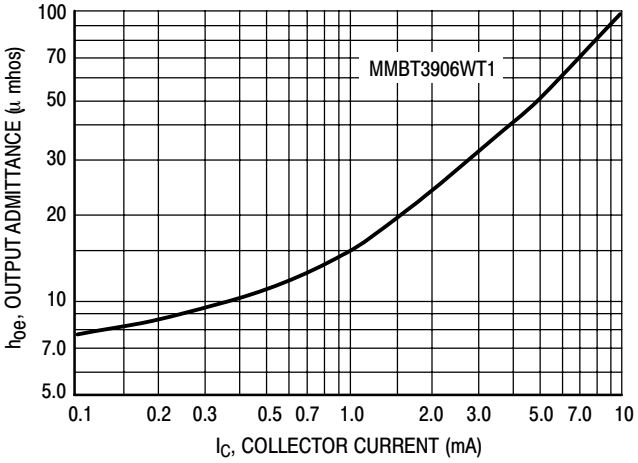


Figure 25. Output Admittance

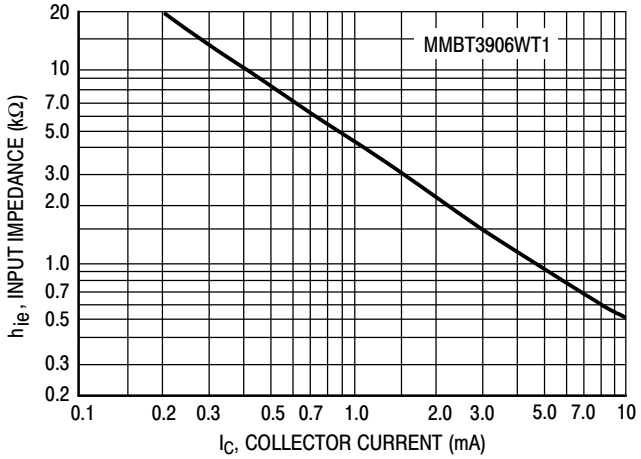


Figure 26. Input Impedance

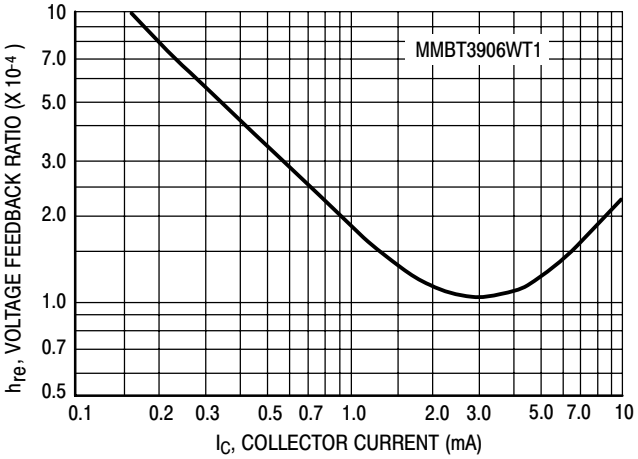


Figure 27. Voltage Feedback Ratio

STATIC CHARACTERISTICS

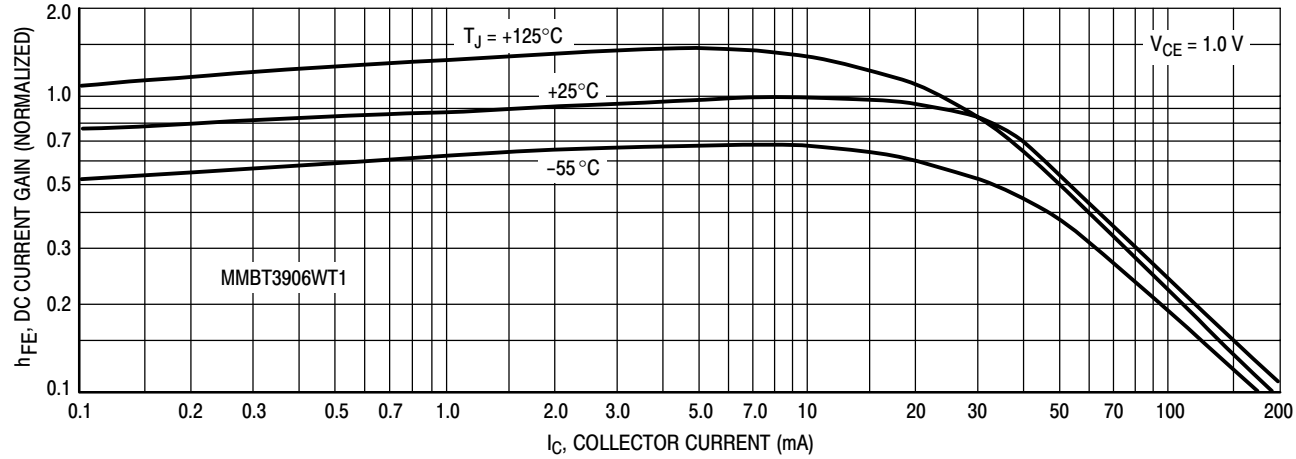


Figure 28. DC Current Gain

MMBT3906WT1

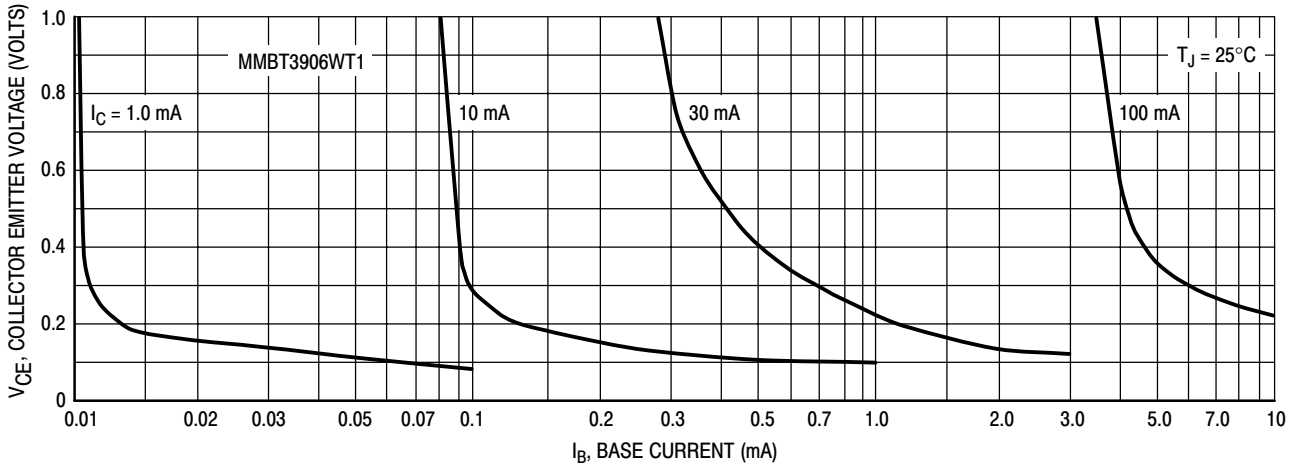


Figure 29. Collector Saturation Region

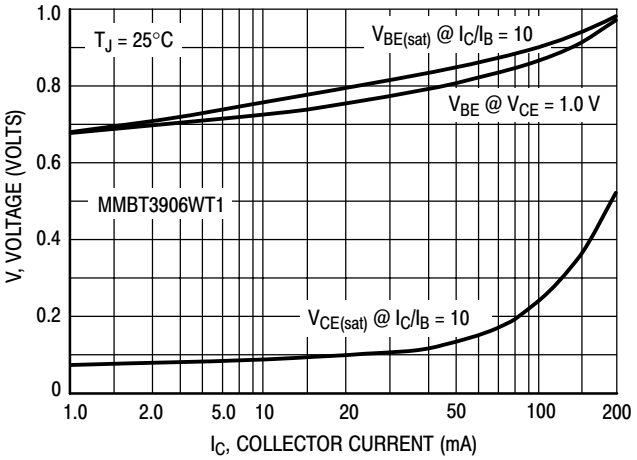


Figure 30. "ON" Voltages

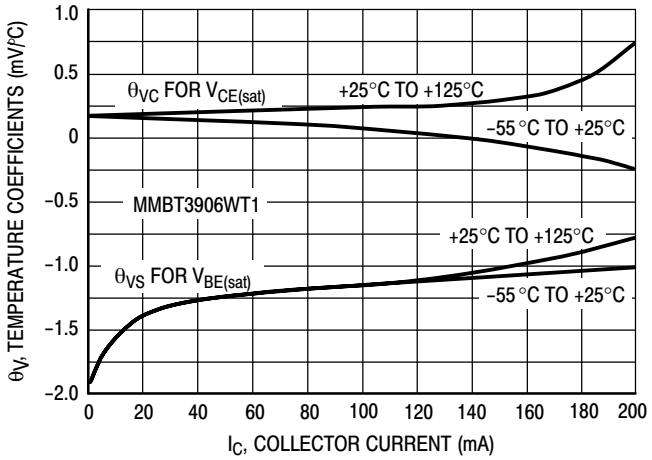


Figure 31. Temperature Coefficients

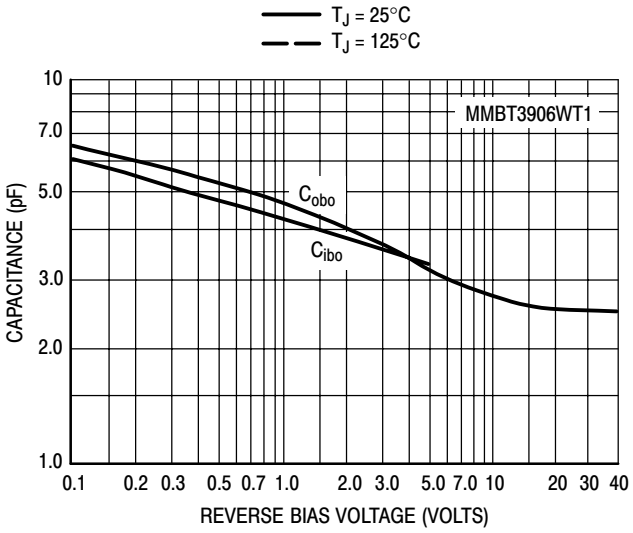
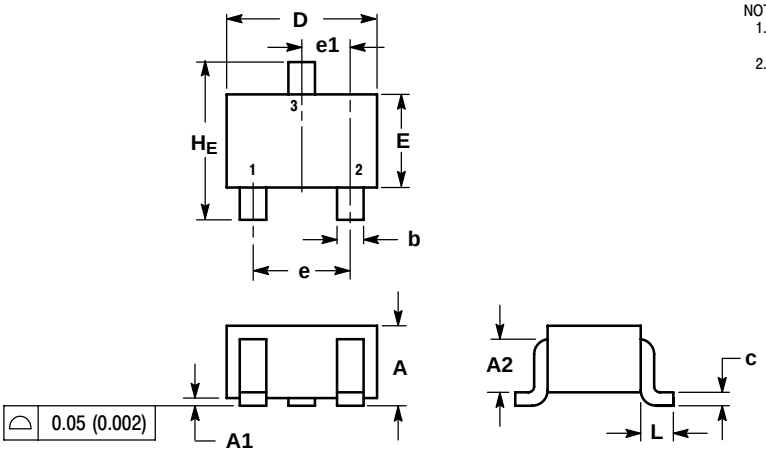


Figure 32. Capacitance

PACKAGE DIMENSIONS

SC−70 (SOT−323)
CASE 419−04
ISSUE M

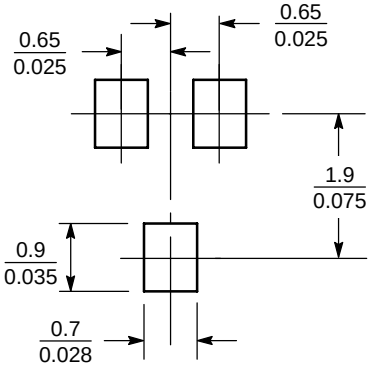


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.90	1.00	0.032	0.035	0.040
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2		0.7 REF			0.028 REF	
b	0.30	0.35	0.40	0.012	0.014	0.016
c	0.10	0.18	0.25	0.004	0.007	0.010
D	1.80	2.10	2.20	0.071	0.083	0.087
E	1.15	1.24	1.35	0.045	0.049	0.053
e	1.20	1.30	1.40	0.047	0.051	0.055
e1		0.65 BSC			0.026 BSC	
L		0.425 REF			0.017 REF	
H_E	2.00	2.10	2.40	0.079	0.083	0.095

STYLE 3:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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