

MBT3946DW1T1

Dual General Purpose Transistor

The MBT3946DW1T1 device is a spin-off of our popular SOT-23/SOT-323 three-leaded device. It is designed for general purpose amplifier applications and is housed in the SOT-363-6 surface mount package. By putting two discrete devices in one package, this device is 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
- Device Marking: MBT3946DW1T1 = 46
- Pb-Free Package May be Available. The G-Suffix Denotes a Pb-Free Lead Finish

MAXIMUM RATINGS

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

THERMAL CHARACTERISTICS

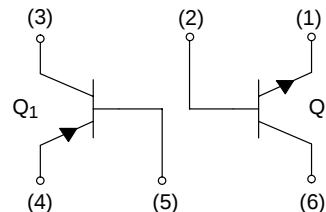
Characteristic	Symbol	Max	Unit
Total Package Dissipation (Note 1) $T_A = 25^\circ\text{C}$	P_D	150	mW
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	833	$^\circ\text{C/W}$
Junction and Storage Temperature Range	T_J, T_{stg}	–55 to +150	$^\circ\text{C}$

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



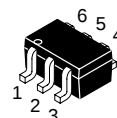
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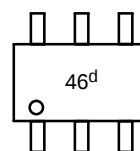
MBT3946DW1T1*

*Q1 PNP
Q2 NPN



SOT-363-6/SC-88
CASE 419B
Style 1

MARKING DIAGRAM



46 = Specific Device Code
d = Date Code

ORDERING INFORMATION

Device	Package	Shipping†
MBT3946DW1T1	SOT-363	3000/Tape & Reel
MBT3946DW1T1G	SOT-363	3000/Tape & Reel
MBT3946DW1T2	SOT-363	3000/Tape & Reel
MBT3946DW1T2G	SOT-363	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.

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (Note 2) (I _C = 1.0 mA _{dc} , I _B = 0) (NPN) (I _C = –1.0 mA _{dc} , I _B = 0) (PNP)	V _{(BR)CEO}	40 –40	– –	V _{dc}
Collector–Base Breakdown Voltage (I _C = 10 μA _{dc} , I _E = 0) (NPN) (I _C = –10 μA _{dc} , I _E = 0) (PNP)	V _{(BR)CBO}	60 –40	– –	V _{dc}
Emitter–Base Breakdown Voltage (I _E = 10 μA _{dc} , I _C = 0) (NPN) (I _E = –10 μA _{dc} , I _C = 0) (PNP)	V _{(BR)EBO}	6.0 –5.0	– –	V _{dc}
Base Cutoff Current (V _{CE} = 30 V _{dc} , V _{EB} = 3.0 V _{dc}) (NPN) (V _{CE} = –30 V _{dc} , V _{EB} = –3.0 V _{dc}) (PNP)	I _{BL}	– –	50 –50	nA _{dc}
Collector Cutoff Current (V _{CE} = 30 V _{dc} , V _{EB} = 3.0 V _{dc}) (NPN) (V _{CE} = –30 V _{dc} , V _{EB} = –3.0 V _{dc}) (PNP)	I _{CEX}	– –	50 –50	nA _{dc}
ON CHARACTERISTICS (Note 2)				
DC Current Gain (I _C = 0.1 mA _{dc} , V _{CE} = 1.0 V _{dc}) (NPN) (I _C = 1.0 mA _{dc} , V _{CE} = 1.0 V _{dc}) (NPN) (I _C = 10 mA _{dc} , V _{CE} = 1.0 V _{dc}) (NPN) (I _C = 50 mA _{dc} , V _{CE} = 1.0 V _{dc}) (NPN) (I _C = 100 mA _{dc} , V _{CE} = 1.0 V _{dc}) (NPN) (I _C = –0.1 mA _{dc} , V _{CE} = –1.0 V _{dc}) (PNP) (I _C = –1.0 mA _{dc} , V _{CE} = –1.0 V _{dc}) (PNP) (I _C = –10 mA _{dc} , V _{CE} = –1.0 V _{dc}) (PNP) (I _C = –50 mA _{dc} , V _{CE} = –1.0 V _{dc}) (PNP) (I _C = –100 mA _{dc} , V _{CE} = –1.0 V _{dc}) (PNP)	h _{FE}	40 70 100 60 30 60 80 100 60 30	– – 300 – – – – 300 – –	–
Collector–Emitter Saturation Voltage (I _C = 10 mA _{dc} , I _B = 1.0 mA _{dc}) (NPN) (I _C = 50 mA _{dc} , I _B = 5.0 mA _{dc}) (NPN) (I _C = –10 mA _{dc} , I _B = –1.0 mA _{dc}) (PNP) (I _C = –50 mA _{dc} , I _B = –5.0 mA _{dc}) (PNP)	V _{CE(sat)}	– – – –	0.2 0.3 –0.25 –0.4	V _{dc}
Base–Emitter Saturation Voltage (I _C = 10 mA _{dc} , I _B = 1.0 mA _{dc}) (NPN) (I _C = 50 mA _{dc} , I _B = 5.0 mA _{dc}) (NPN) (I _C = –10 mA _{dc} , I _B = –1.0 mA _{dc}) (PNP) (I _C = –50 mA _{dc} , I _B = –5.0 mA _{dc}) (PNP)	V _{BE(sat)}	0.65 – –0.65 –	0.85 0.95 –0.85 –0.95	V _{dc}
SMALL–SIGNAL CHARACTERISTICS				
Current–Gain – Bandwidth Product (I _C = 10 mA _{dc} , V _{CE} = 20 V _{dc} , f = 100 MHz) (NPN) (I _C = –10 mA _{dc} , V _{CE} = –20 V _{dc} , f = 100 MHz) (PNP)	f _T	300 250	– –	MHz
Output Capacitance (V _{CB} = 5.0 V _{dc} , I _E = 0, f = 1.0 MHz) (NPN) (V _{CB} = –5.0 V _{dc} , I _E = 0, f = 1.0 MHz) (PNP)	C _{obo}	– –	4.0 4.5	pF
Input Capacitance (V _{EB} = 0.5 V _{dc} , I _C = 0, f = 1.0 MHz) (NPN) (V _{EB} = –0.5 V _{dc} , I _C = 0, f = 1.0 MHz) (PNP)	C _{ibo}	– –	8.0 10.0	pF

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

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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 mA, f = 1.0 kHz) (NPN) (V _{CE} = -10 Vdc, I _C = -1.0 mA, f = 1.0 kHz) (PNP)	h _{ie}	1.0 2.0	10 12	kΩ
Voltage Feedback Ratio (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz) (NPN) (V _{CE} = -10 Vdc, I _C = -1.0 mA, f = 1.0 kHz) (PNP)	h _{re}	0.5 0.1	8.0 10	X 10 ⁻⁴
Small-Signal Current Gain (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz) (NPN) (V _{CE} = -10 Vdc, I _C = -1.0 mA, f = 1.0 kHz) (PNP)	h _{fe}	100 100	400 400	—
Output Admittance (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz) (NPN) (V _{CE} = -10 Vdc, I _C = -1.0 mA, f = 1.0 kHz) (PNP)	h _{oe}	1.0 3.0	40 60	μmhos
Noise Figure (V _{CE} = 5.0 Vdc, I _C = 100 μA, R _S = 1.0 kΩ, f = 1.0 kHz) (NPN) (V _{CE} = -5.0 Vdc, I _C = -100 μA, R _S = 1.0 kΩ, f = 1.0 kHz) (PNP)	NF	— —	5.0 4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} = 3.0 Vdc, V _{BE} = -0.5 Vdc) (NPN) (V _{CC} = -3.0 Vdc, V _{BE} = 0.5 Vdc) (PNP)	t _d	— —	35 35	ns
Rise Time	(I _C = 10 mA, I _{B1} = 1.0 mA) (NPN) (I _C = -10 mA, I _{B1} = -1.0 mA) (PNP)	t _r	— —	35 35	
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mA) (NPN) (V _{CC} = -3.0 Vdc, I _C = -10 mA) (PNP)	t _s	— —	200 225	ns
Fall Time	(I _{B1} = I _{B2} = 1.0 mA) (NPN) (I _{B1} = I _{B2} = -1.0 mA) (PNP)	t _f	— —	50 75	

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(NPN)

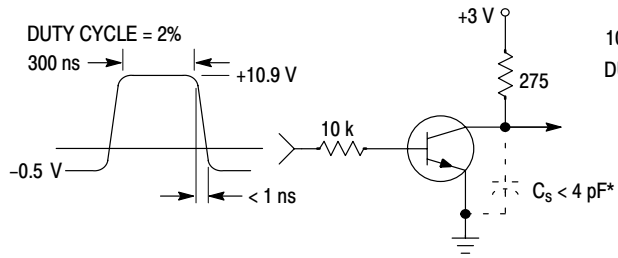


Figure 1. Delay and Rise Time
Equivalent Test Circuit

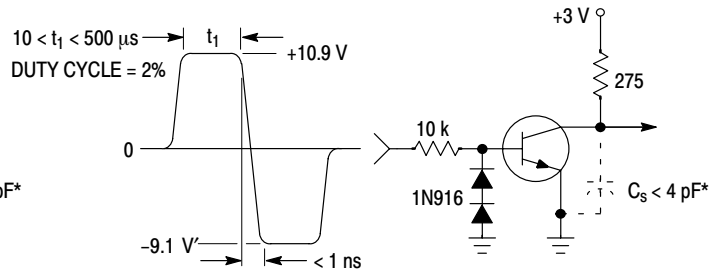


Figure 2. Storage and Fall Time
Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

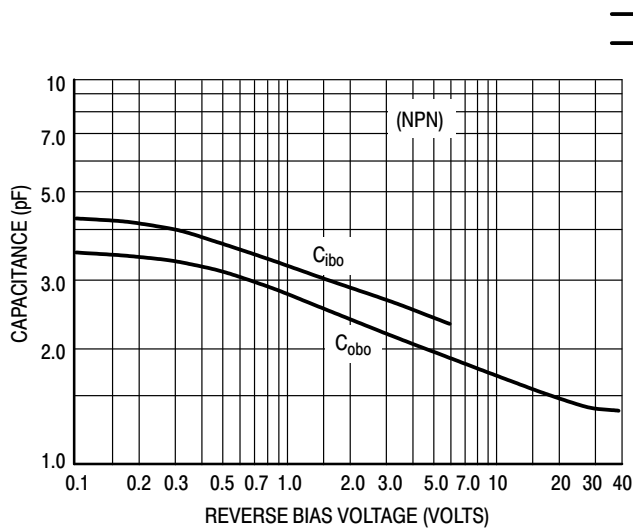


Figure 3. Capacitance

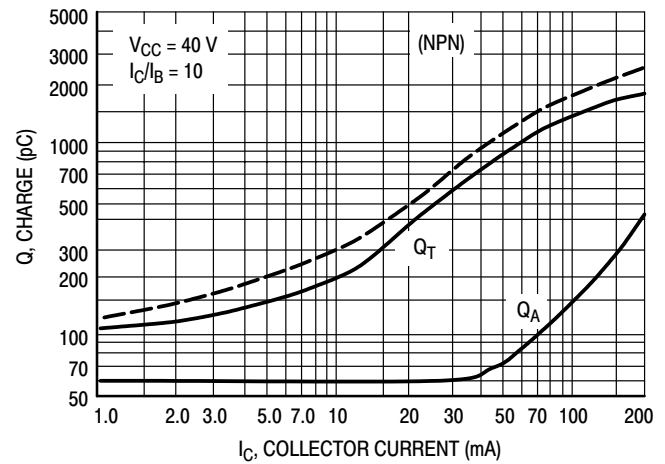


Figure 4. Charge Data

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(NPN)

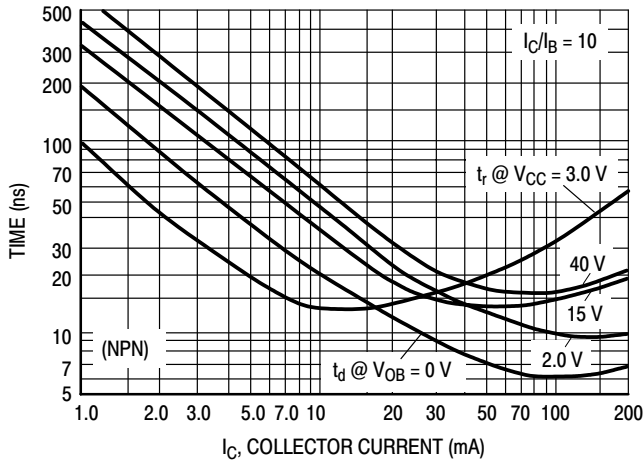


Figure 5. Turn-On Time

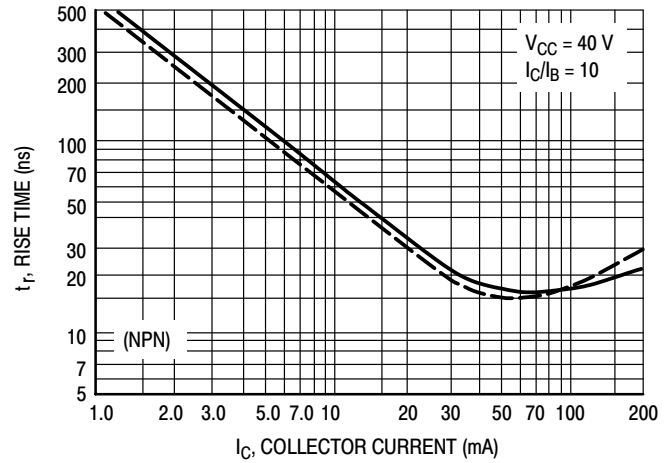


Figure 6. Rise Time

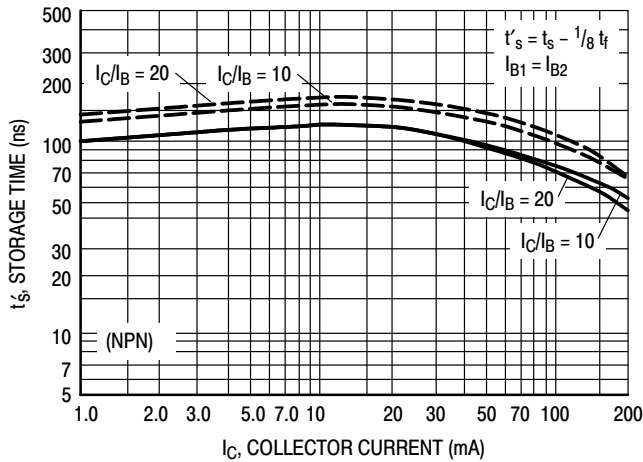


Figure 7. Storage Time

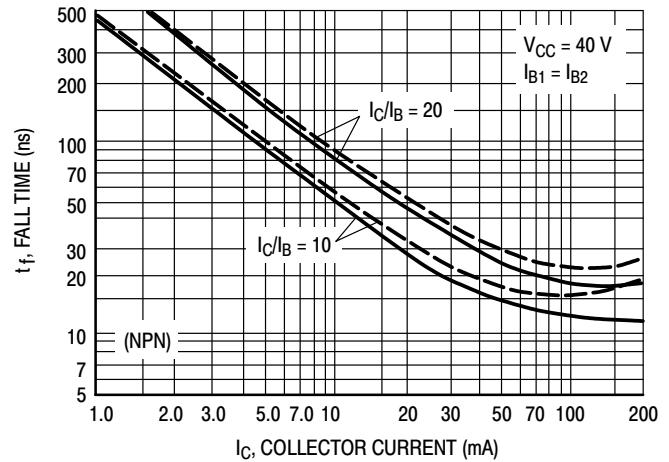


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

($V_{CE} = 5.0$ Vdc, $T_A = 25^\circ\text{C}$, Bandwidth = 1.0 Hz)

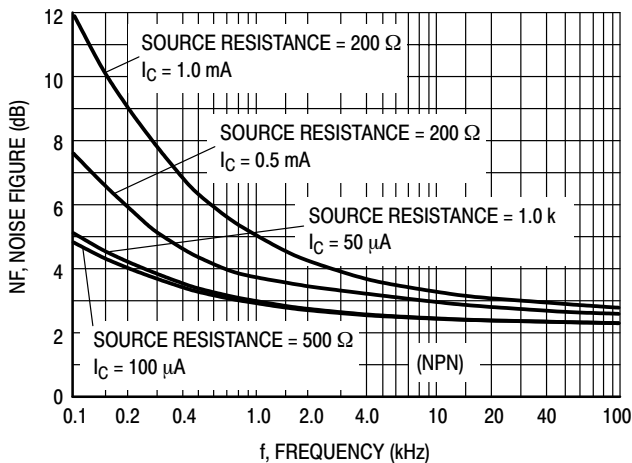


Figure 9. Noise Figure

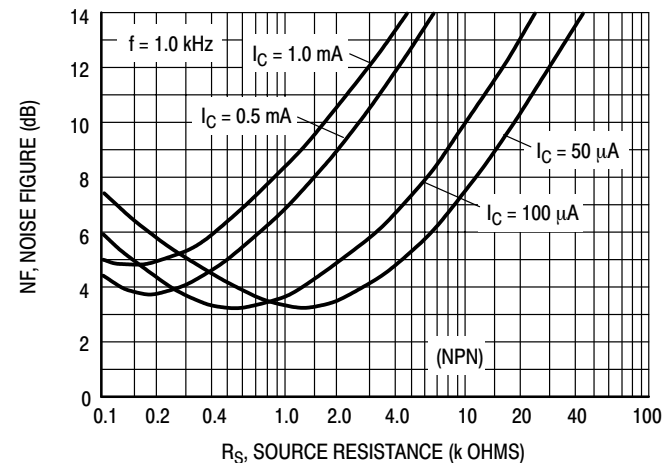


Figure 10. Noise Figure

MBT3946DW1T1

(NPN)

h PARAMETERS

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

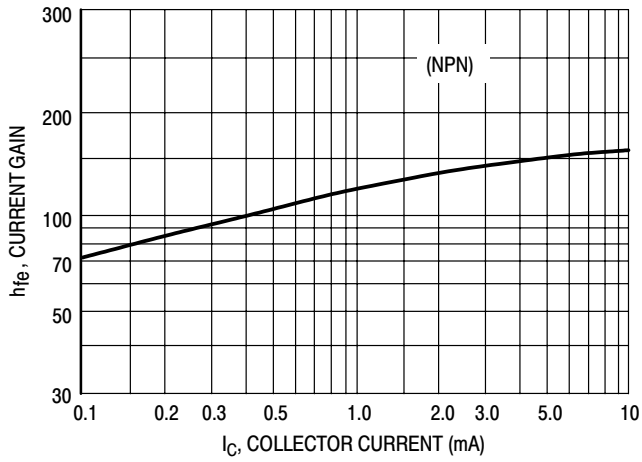


Figure 11. Current Gain

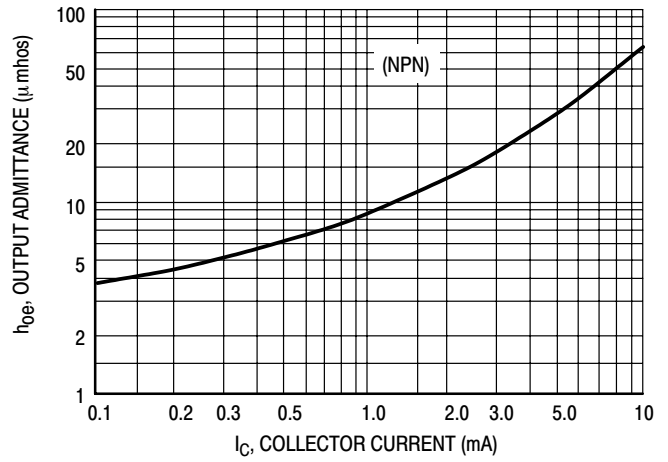


Figure 12. Output Admittance

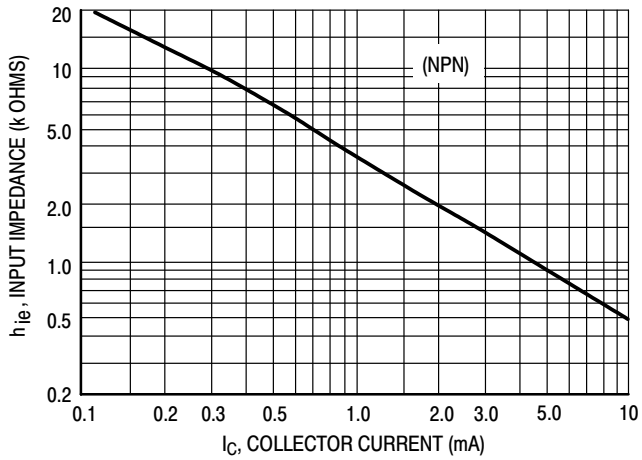


Figure 13. Input Impedance

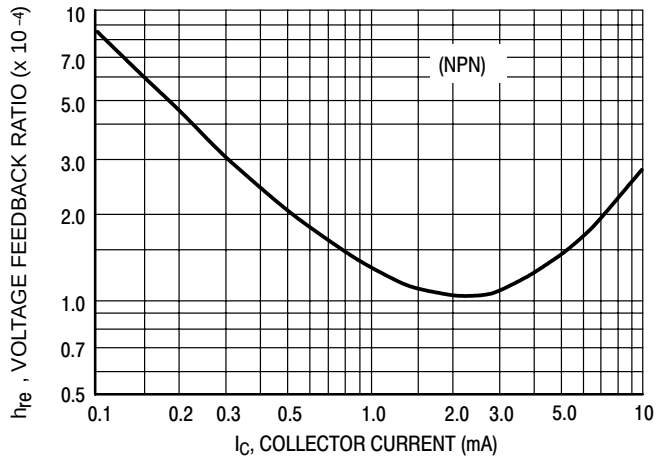


Figure 14. Voltage Feedback Ratio

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(NPN) TYPICAL STATIC CHARACTERISTICS

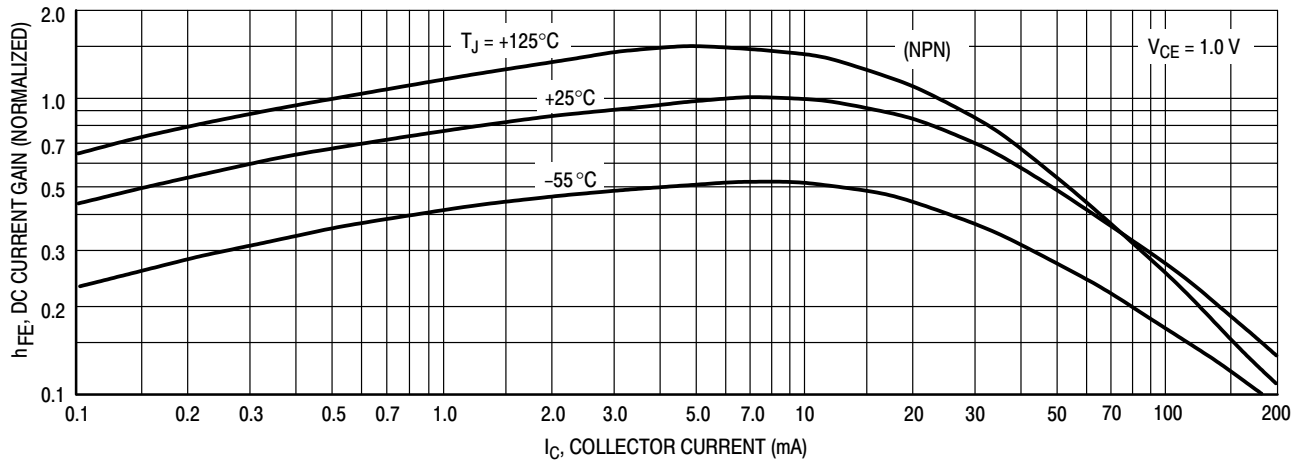


Figure 15. DC Current Gain

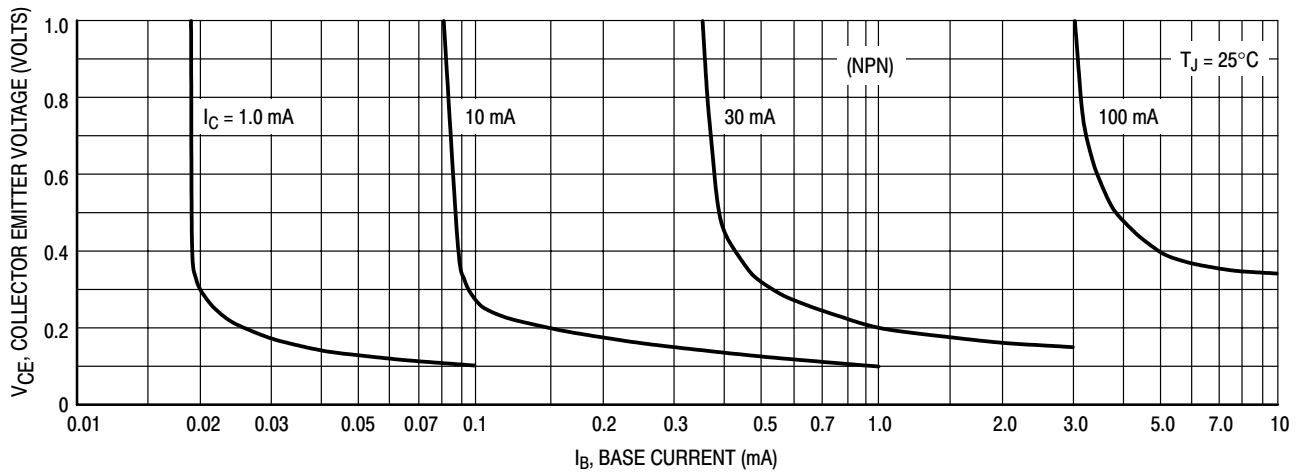


Figure 16. Collector Saturation Region

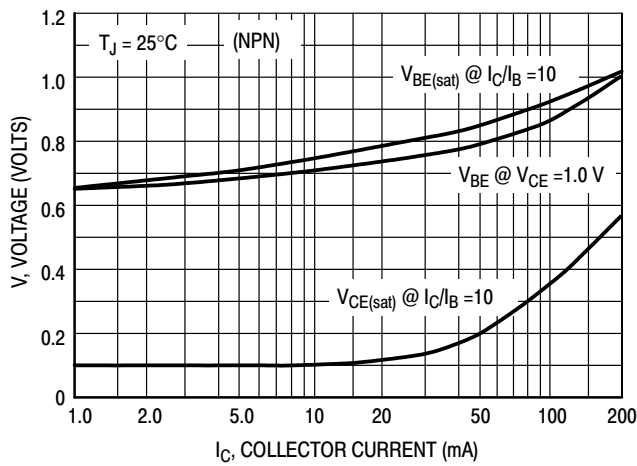


Figure 17. "ON" Voltages

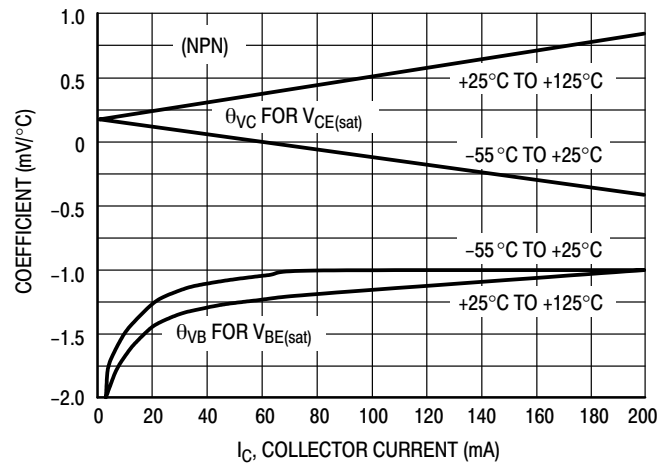


Figure 18. Temperature Coefficients

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(PNP)

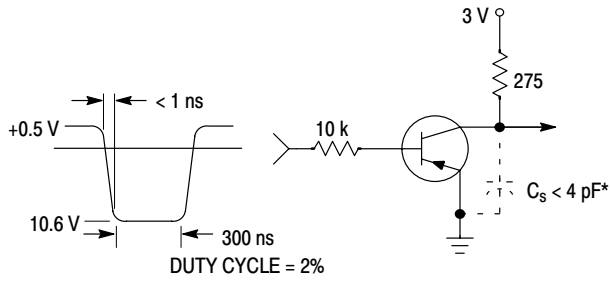


Figure 19. Delay and Rise Time Equivalent Test Circuit

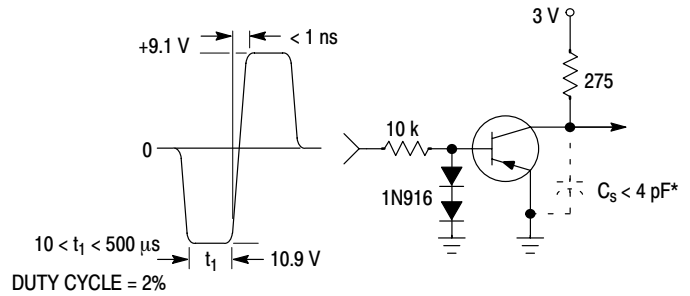


Figure 20. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

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

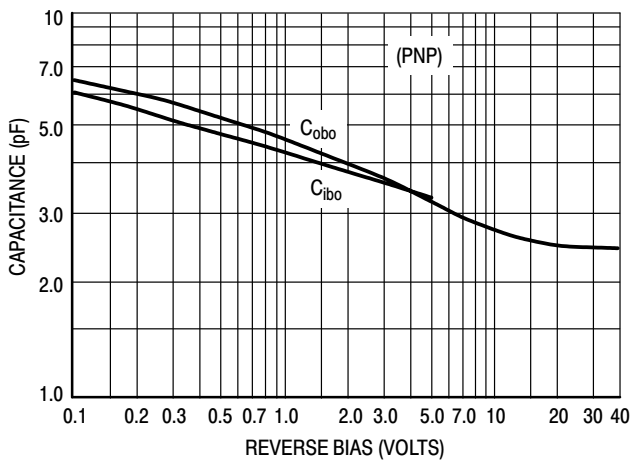


Figure 21. Capacitance

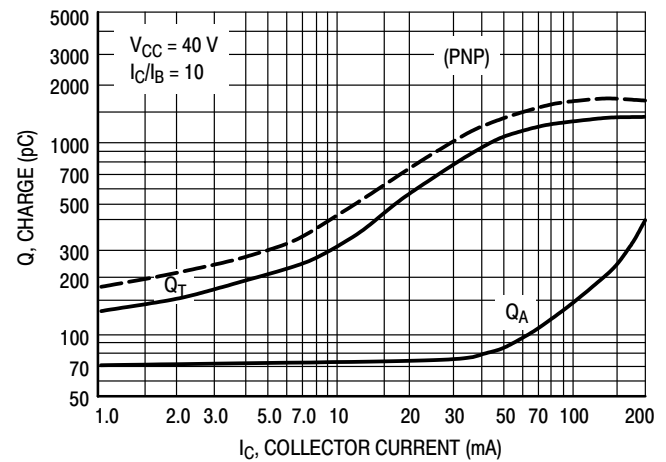


Figure 22. Charge Data

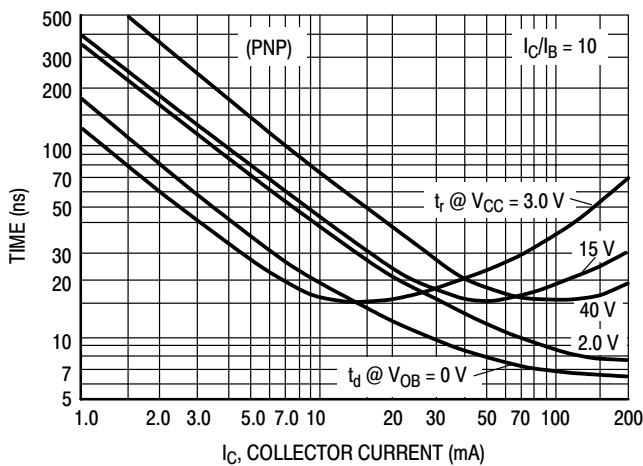


Figure 23. Turn-On Time

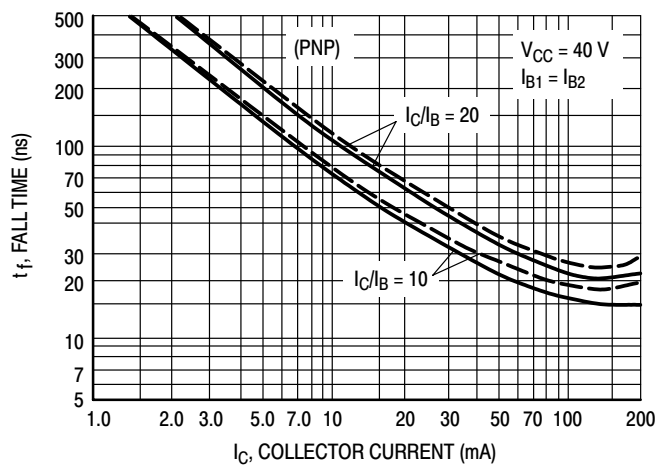


Figure 24. Fall Time

(PNP)

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

($V_{CE} = -5.0$ Vdc, $T_A = 25^\circ\text{C}$, Bandwidth = 1.0 Hz)

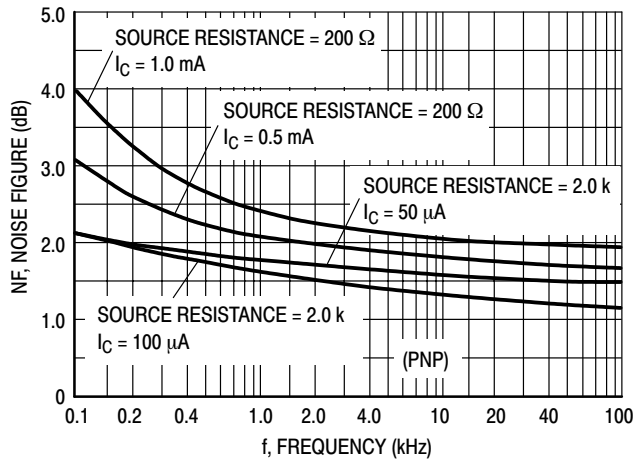


Figure 25.

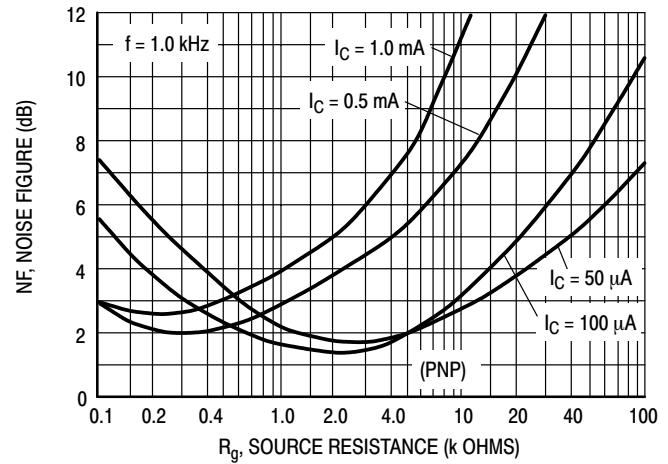


Figure 26.

h PARAMETERS

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

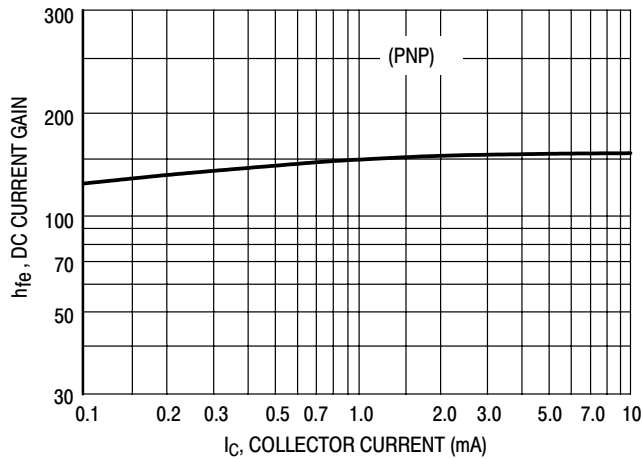


Figure 27. Current Gain

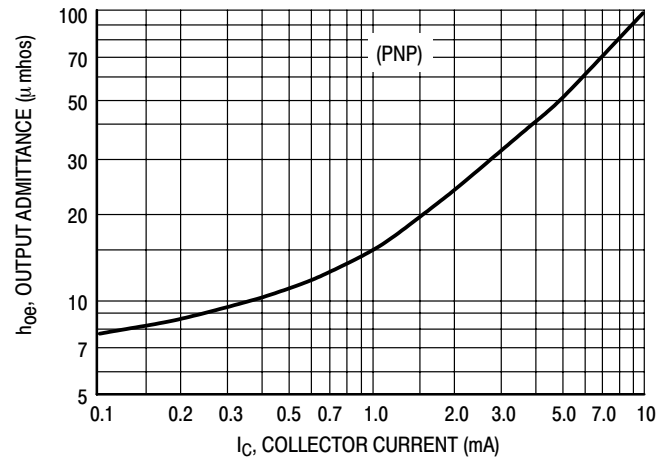


Figure 28. Output Admittance

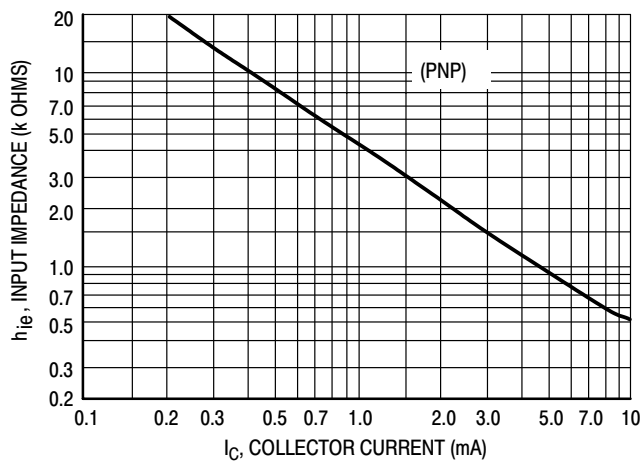


Figure 29. Input Impedance

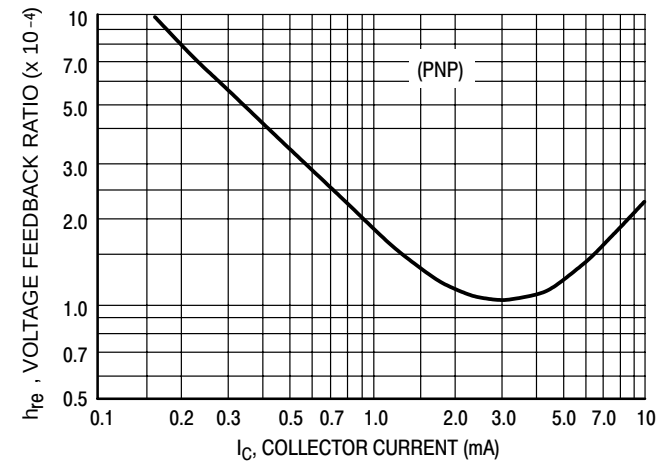


Figure 30. Voltage Feedback Ratio

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(PNP)

TYPICAL STATIC CHARACTERISTICS

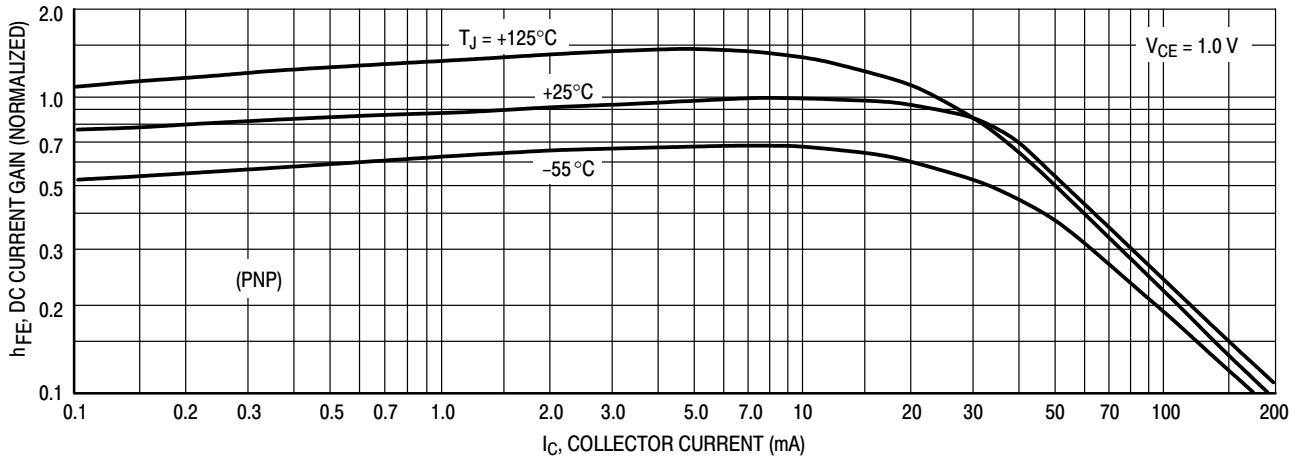


Figure 31. DC Current Gain

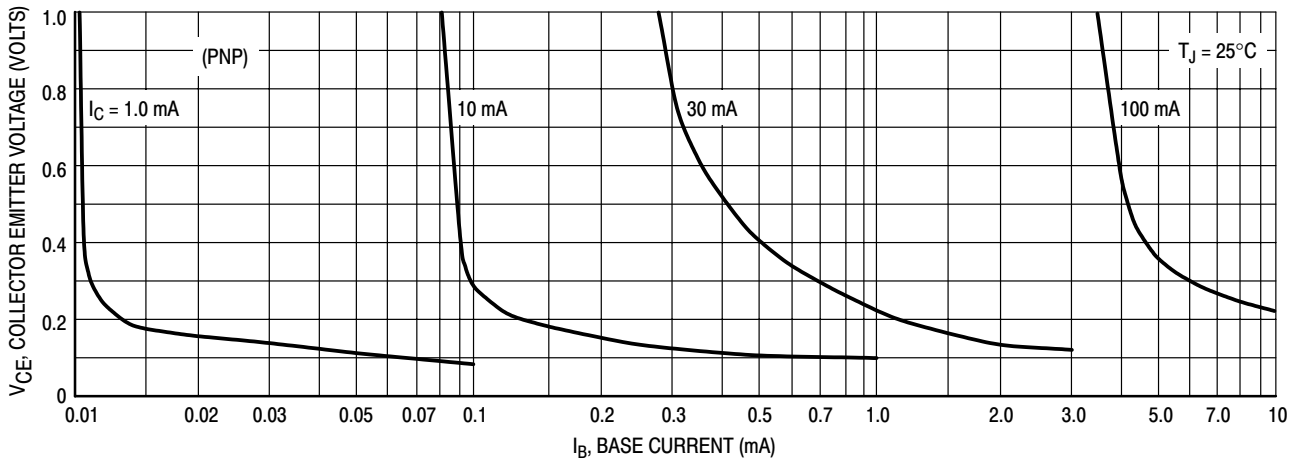


Figure 32. Collector Saturation Region

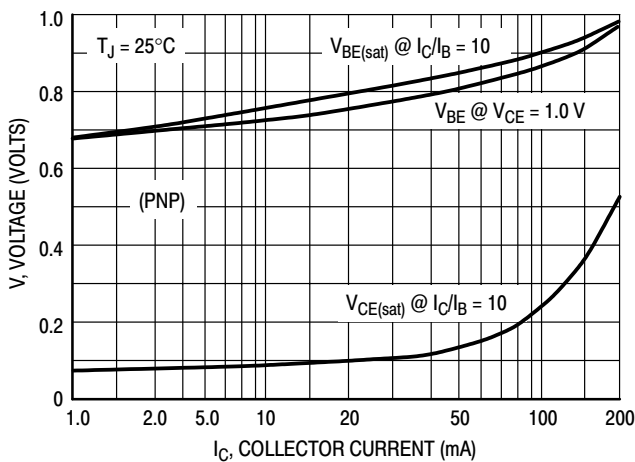


Figure 33. "ON" Voltages

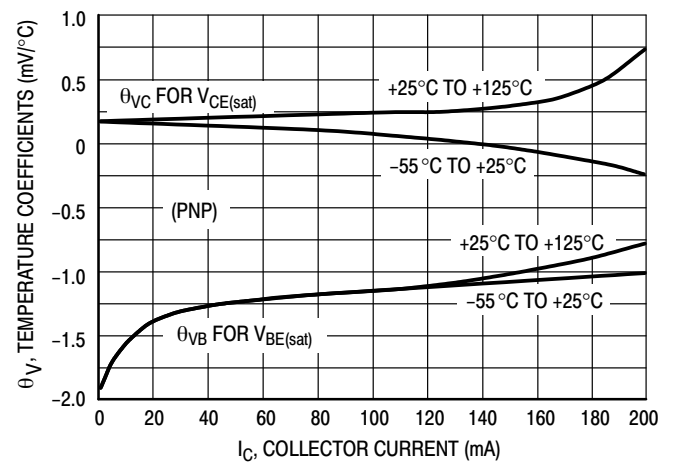
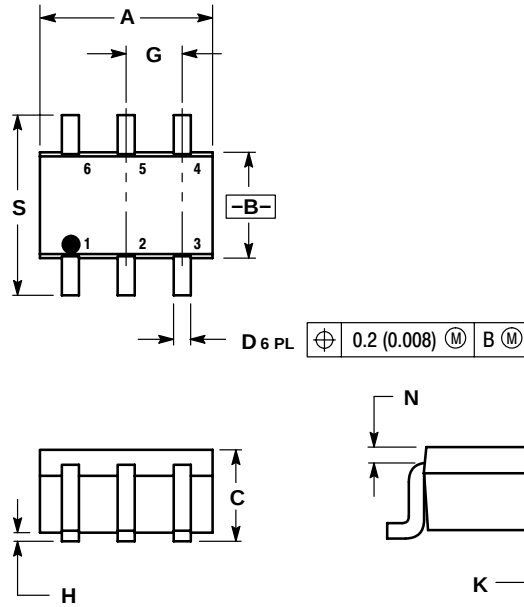


Figure 34. Temperature Coefficients

MBT3946DW1T1

PACKAGE DIMENSIONS

SOT-363-6/SC-88
CASE 419B-02
ISSUE L



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419B-01 OBSOLETE, NEW STANDARD 419B-02.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20

STYLE 1:

- PIN 1. EMITTER 2
- BASE 2
- COLLECTOR 1
- EMITTER 1
- BASE 1
- COLLECTOR 2

SOLDERING FOOTPRINT*

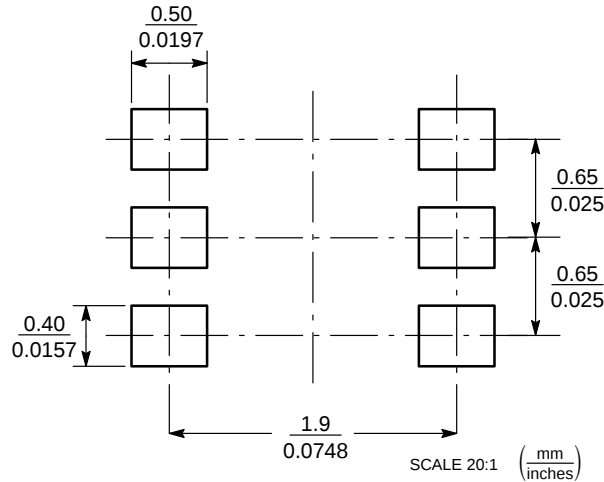


Figure 35. SC-88/SC70-6

*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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