

Dual General Purpose Transistors

The MMBT3946DW1T1 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 six-leaded 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 $V_{CE(sat)}$, $\leq 0.4V$
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7-inch/3,000 Unit Tape and Reel
- Device Marking: MMBT3946DW1T1G = 46

MAXIMUM RATINGS

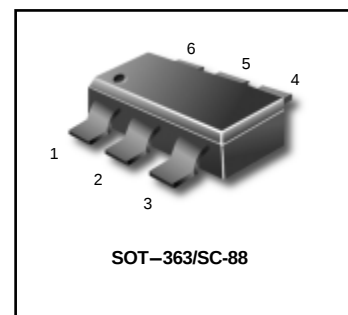
Rating	Symbol	Value	Unit
Collector-Emitter Voltage (NPN) (PNP)	V_{CEO}	40 -40	Vdc
Collector-Base Voltage (NPN) (PNP)	V_{CBO}	60 -40	Vdc
Emitter-Base Voltage (NPN) (PNP)	V_{EBO}	6.0 -5.0	Vdc
Collector Current-Continuous (NPN) (PNP)	I_C	200 -200	mAdc
Electrostatic Discharge	E_{SD}	HBM>16000, MM>2000	V

THERMAL CHARACTERISTICS

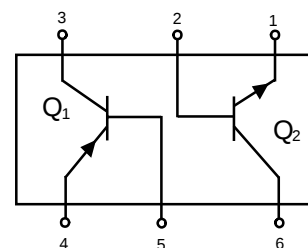
Characteristic	Symbol	Max	Unit
Total Package Dissipation ⁽¹⁾ $T_A = 25^\circ C$	P_D	150	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	833	$^\circ C/W$
Junction and Storage Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ C$

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

MMBT3946DW1T1G



We declare that the material of product compliance with RoHS requirements.



MMBT3946DW1T1*
*Q1 PNP
Q2 NPN

ORDERING INFORMATION

Device	Marking	Shipping
MMBT3946DW1T1G	46	3000Units/Reel
MMBT3946DW1T3G	46	10000Units/Reel

MMBT3946DW1T1G

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 ⁽²⁾	$V_{(BR)CEO}$			Vdc
($I_C = 1.0\text{ mAdc}$, $I_B = 0$) (NPN)		40	–	
($I_C = -1.0\text{ mAdc}$, $I_B = 0$) (PNP)		–40	–	
Collector–Base Breakdown Voltage	$V_{(BR)CBO}$			Vdc
($I_C = 10\text{ }\mu\text{Adc}$, $I_E = 0$) (NPN)		60	–	
($I_C = -10\text{ }\mu\text{Adc}$, $I_E = 0$) (PNP)		–40	–	
Emitter–Base Breakdown Voltage	$V_{(BR)EBO}$			Vdc
($I_E = 10\text{ }\mu\text{Adc}$, $I_C = 0$) (NPN)		6.0	–	
($I_E = -10\text{ }\mu\text{Adc}$, $I_C = 0$) (PNP)		–5.0	–	
Base Cutoff Current	I_{BL}			nAdc
($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$) (NPN)		–	50	
($V_{CE} = -30\text{ Vdc}$, $V_{EB} = -3.0\text{ Vdc}$) (PNP)		–	–50	
Collector Cutoff Current	I_{CEX}			nAdc
($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$) (NPN)		–	50	
($V_{CE} = -30\text{ Vdc}$, $V_{EB} = -3.0\text{ Vdc}$) (PNP)		–	–50	

ON CHARACTERISTICS (2)

DC Current Gain	h_{FE}			–
($I_C = 0.1\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) (NPN)		40	–	
($I_C = 1.0\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)		70	–	
($I_C = 10\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)		100	300	
($I_C = 50\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)		60	–	
($I_C = 100\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$)		30	–	
($I_C = -0.1\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) (PNP)		60	–	
($I_C = -1.0\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$)		80	–	
($I_C = -10\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$)		100	300	
($I_C = -50\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$)		60	–	
($I_C = -100\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$)		30	–	
Collector–Emitter Saturation Voltage	$V_{CE(sat)}$			Vdc
($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$) (NPN)		–	0.2	
($I_C = 50\text{ mAdc}$, $I_B = 5.0\text{ mAdc}$)		–	0.3	
($I_C = -10\text{ mAdc}$, $I_B = -1.0\text{ mAdc}$) (PNP)		–	–0.25	
($I_C = -50\text{ mAdc}$, $I_B = -5.0\text{ mAdc}$)		–	–0.4	
Base–Emitter Saturation Voltage	$V_{BE(sat)}$			Vdc
($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$) (NPN)		0.65	0.85	
($I_C = 50\text{ mAdc}$, $I_B = 5.0\text{ mAdc}$)		–	0.95	
($I_C = -10\text{ mAdc}$, $I_B = -1.0\text{ mAdc}$) (PNP)		–0.65	–0.85	
($I_C = -50\text{ mAdc}$, $I_B = -5.0\text{ mAdc}$)		–	–0.95	

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

MMBT3946DW1T1G
ELECTRICAL CHARACTERISTICS($T_A=25^{\circ}\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain – Bandwidth Product	f_T			MHz
($I_C = 10\text{ mAdc}$, $V_{CE} = 20\text{ Vdc}$, $f = 100\text{ MHz}$) (NPN)		300	–	
($I_C = -10\text{ mAdc}$, $V_{CE} = -20\text{ Vdc}$, $f = 100\text{ MHz}$) (PNP)		250	–	
Output Capacitance	C_{obo}			pF
($V_{CB} = 5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) (NPN)		–	4.0	
($V_{CB} = -5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) (PNP)		–	4.5	
Input Capacitance	C_{ibo}			pF
($V_{EB} = 0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$) (NPN)		–	8.0	
($V_{EB} = -0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$) (PNP)		–	10.0	
Input Impedance	h_{ie}			k Ω
($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (NPN)		1.0	10	
($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (PNP)		2.0	12	
Voltage Feedback Ratio	h_{re}			$\times 10^{-4}$
($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (NPN)		0.5	8.0	
($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (PNP)		0.1	10	
Small-Signal Current Gain	h_{FE}			–
($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (NPN)		100	400	
($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (PNP)		100	400	
Output Admittance	h_{oe}			μmhos
($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (NPN)		1.0	40	
($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) (PNP)		3.0	60	
Noise Figure	NF			dB
($V_{CE}=5.0\text{ Vdc}$, $I_C=100\text{ }\mu\text{Adc}$, $R_S=1.0\text{ k}\Omega$, $f=1.0\text{ kHz}$) (NPN)	–	5.0		
($V_{CE}=-5.0\text{ Vdc}$, $I_C=-100\text{ }\mu\text{Adc}$, $R_S=1.0\text{ k}\Omega$, $f=1.0\text{ kHz}$) (PNP)	–	4.0		

SWITCHING CHARACTERISTICS

Delay Time	($V_{CC} = 3.0\text{ Vdc}$, $V_{BE} = -0.5\text{ Vdc}$) (NPN)	t_d	–	35	ns
	($V_{CC} = -3.0\text{ Vdc}$, $V_{BE} = 0.5\text{ Vdc}$) (PNP)		–	35	
Rise Time	($I_C = 10\text{ mAdc}$, $I_{B1} = 1.0\text{ mAdc}$) (NPN)	t_r	–	35	ns
	($I_C = -10\text{ mAdc}$, $I_{B1} = -1.0\text{ mAdc}$) (PNP)		–	35	
Storage Time	($V_{CC} = 3.0\text{ Vdc}$, $I_C = 10\text{ mAdc}$) (NPN)	t_s	–	200	ns
	($V_{CC} = -3.0\text{ Vdc}$, $I_C = -10\text{ mAdc}$) (PNP)		–	225	
Fall Time	($I_{B1} = I_{B2} = 1.0\text{ mAdc}$) (NPN)	t_f	–	50	ns
	($I_{B1} = I_{B2} = -1.0\text{ mAdc}$) (PNP)		–	75	

TYPICAL ELECTRICAL CHARACTERISTICS
MMBT3946DW1T1G
(NPN)

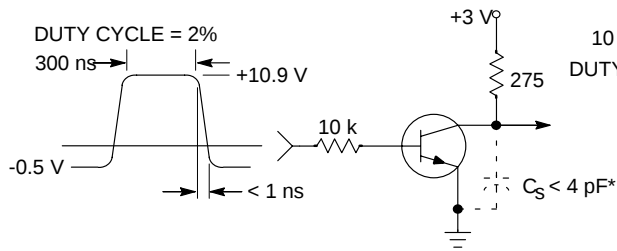


Figure 1. Delay and Rise Time
Equivalent Test Circuit

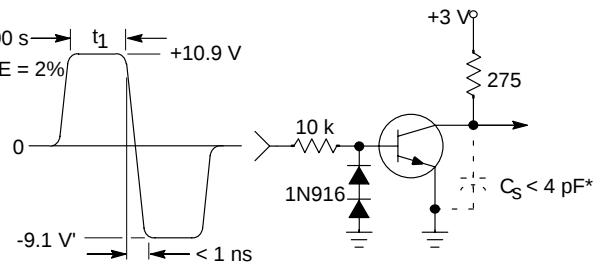


Figure 2. Storage and Fall Time
Equivalent Test Circuit

TYPICAL TRANSIENT CHARACTERISTICS

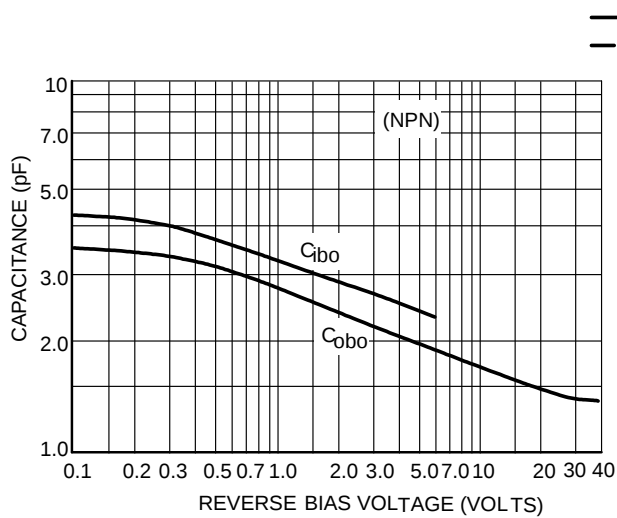


Figure 3. Capacitance

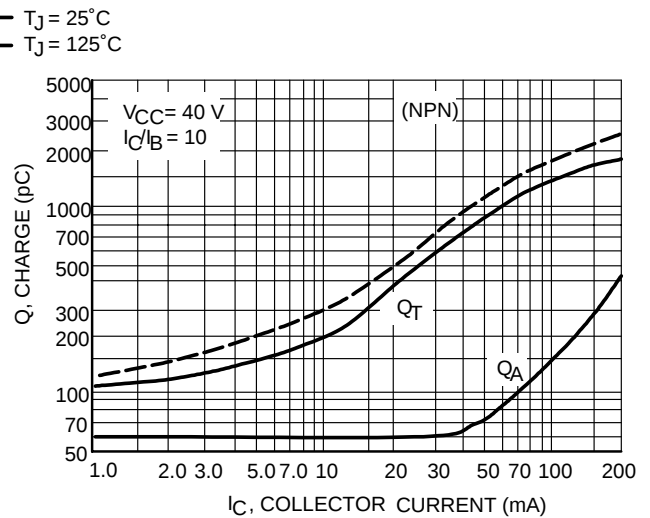


Figure 4. Charge Data

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1G

(NPN)

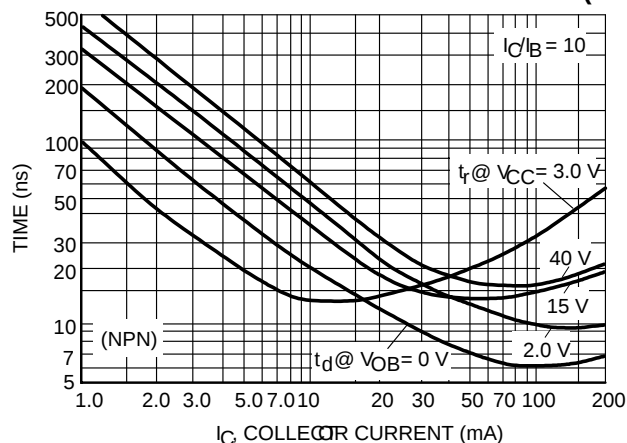


Figure 5. Turn-On Time

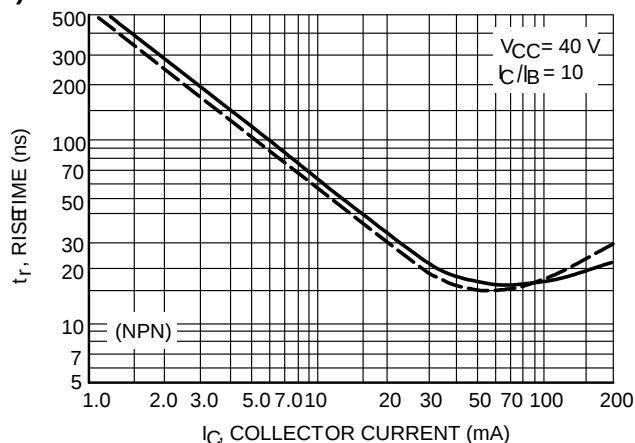


Figure 6. Rise Time

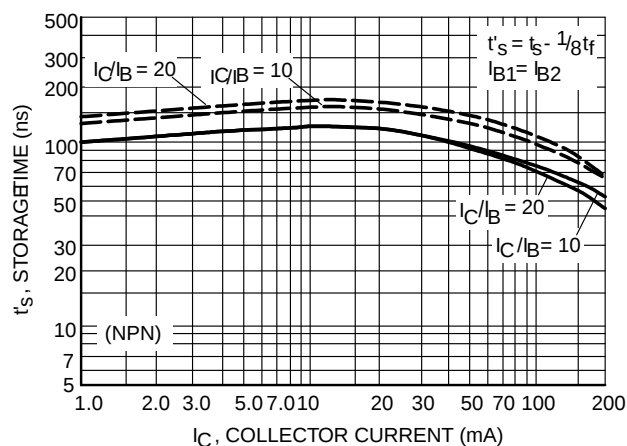


Figure 7. Storage Time

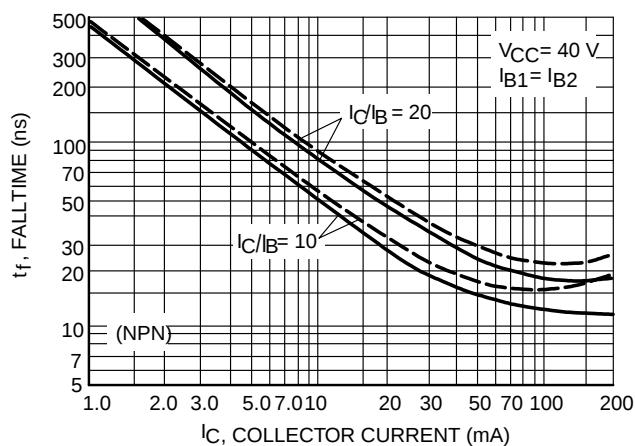


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS

(VCE = 5.0 Vdc, TA = 25°C, Bandwidth = 1.0 Hz)

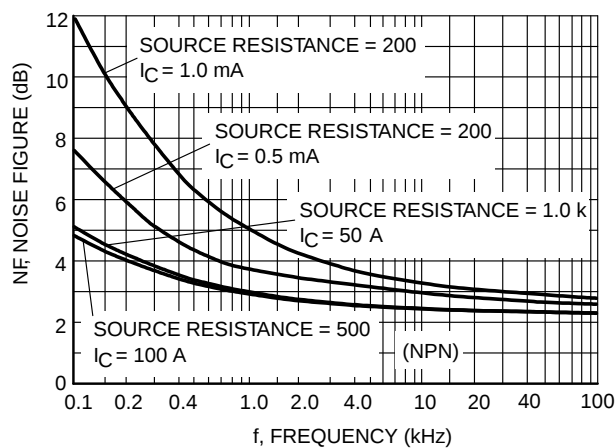


Figure 9. Noise Figure

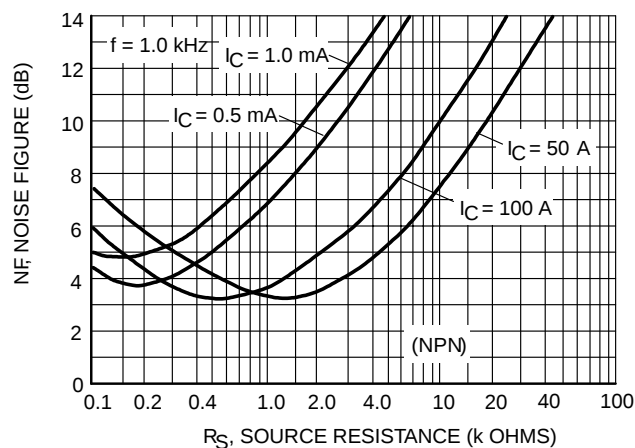


Figure 10. Noise Figure

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1G

(NPN)

h PARAMETERS

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

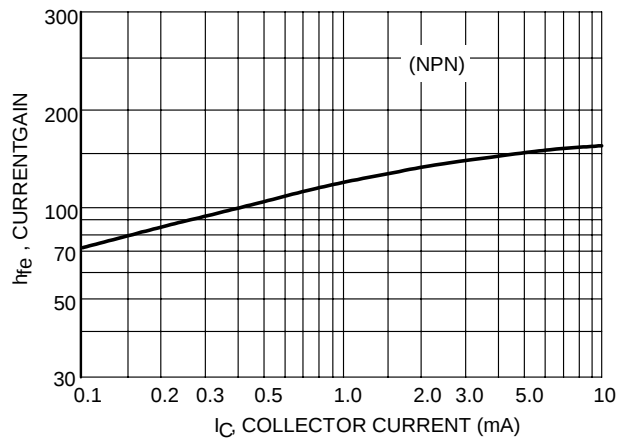


Figure 11. Current Gain

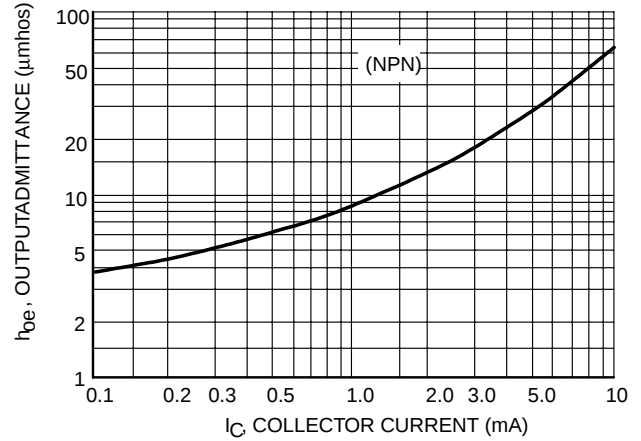


Figure 12. Output Admittance

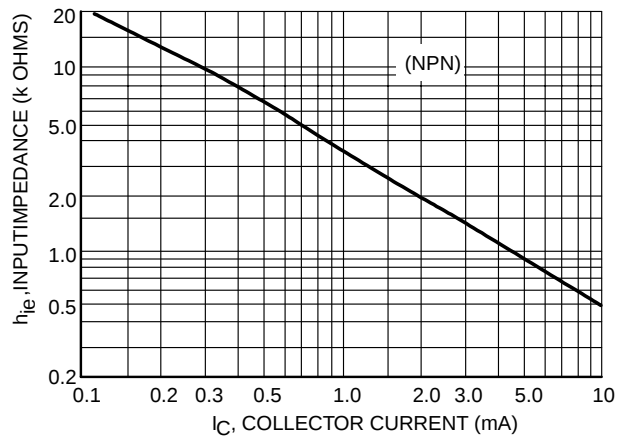


Figure 13. Input Impedance

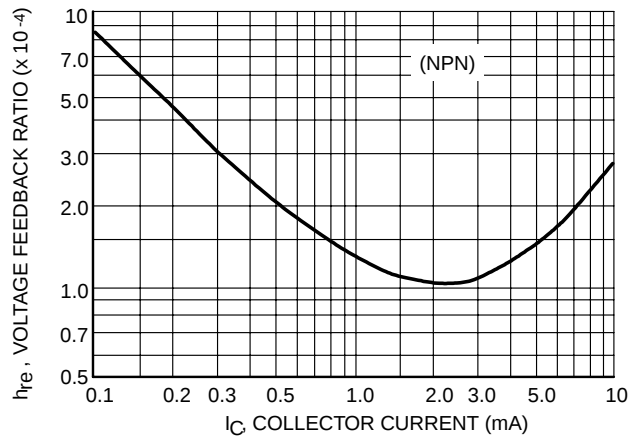
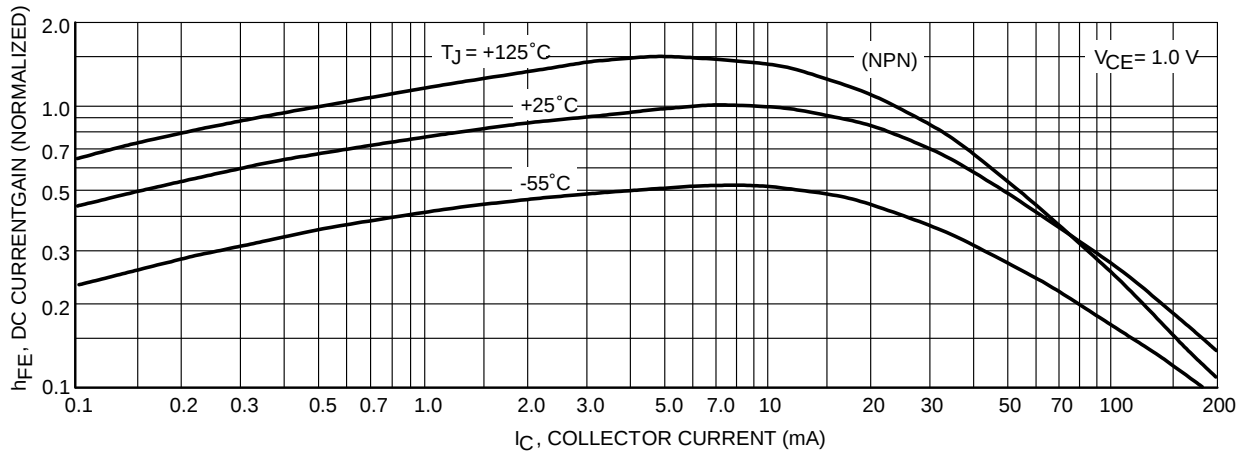
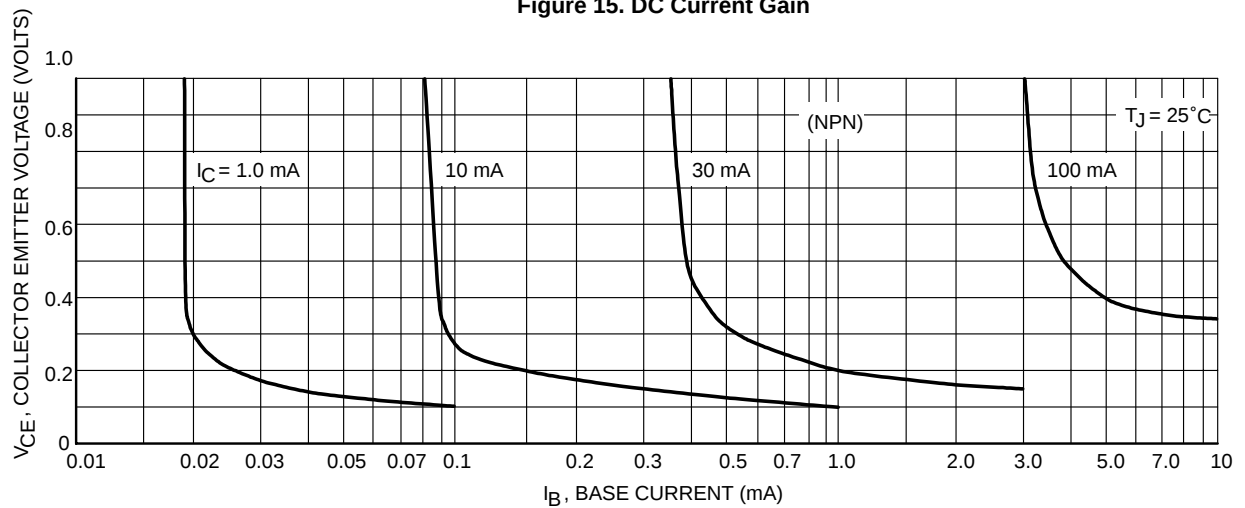
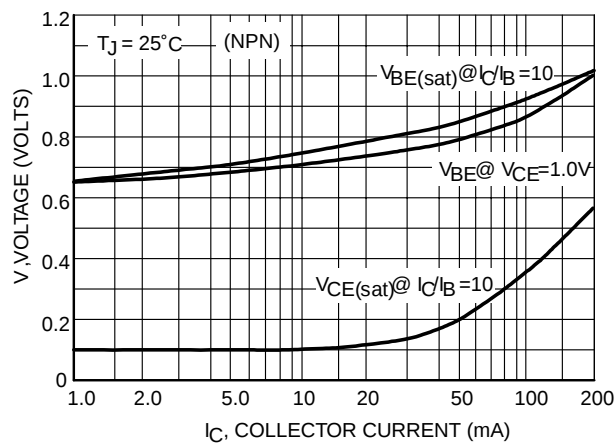
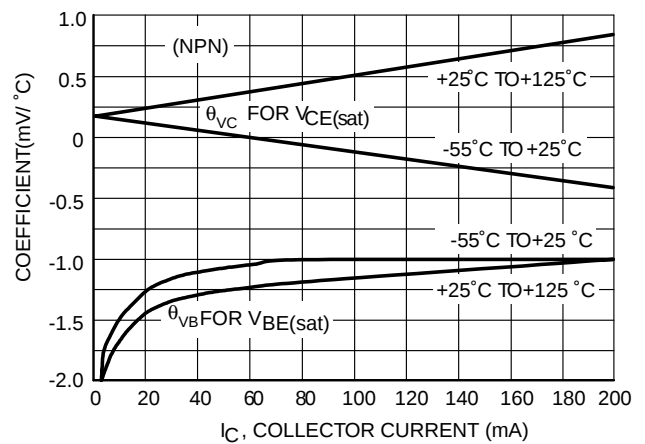
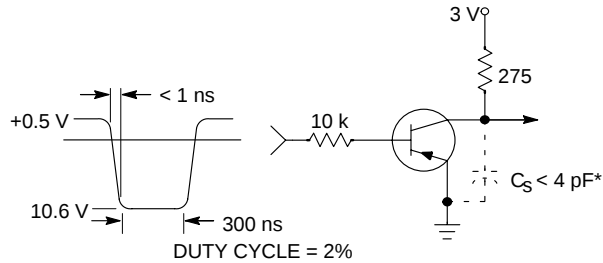
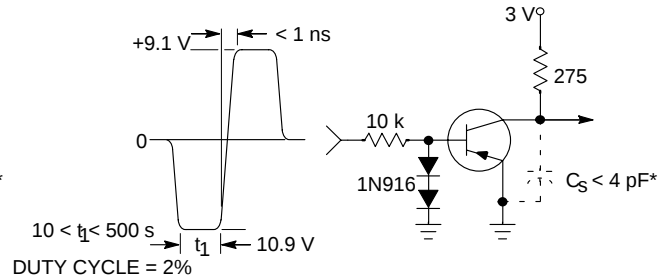


Figure 14. Voltage Feedback Ratio

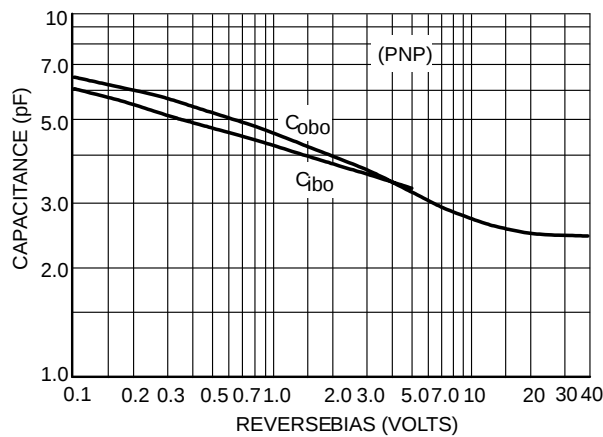
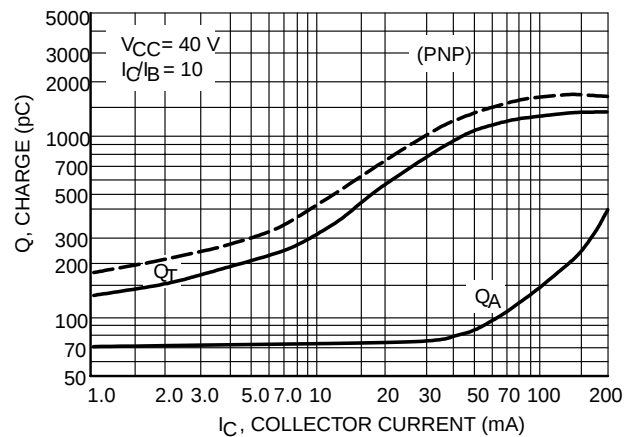
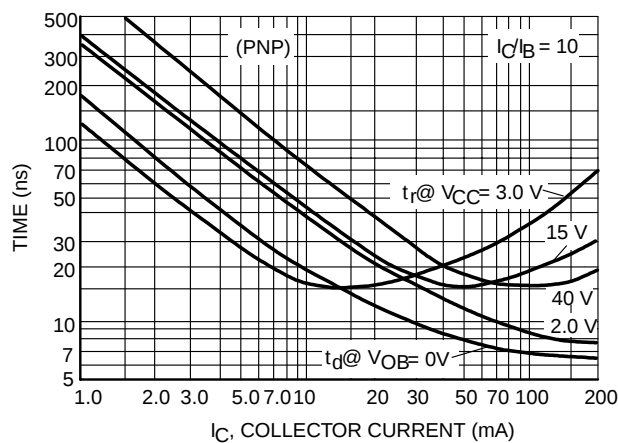
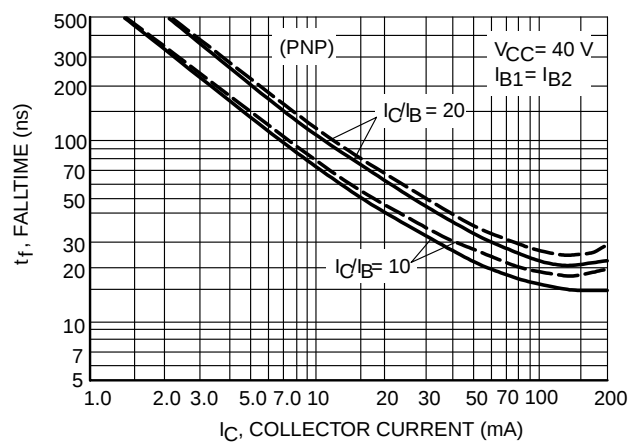
TYPICAL ELECTRICAL CHARACTERISTICS
MMBT3946DW1T1G
(NPN)

Figure 15. DC Current Gain

Figure 16. Collector Saturation Region

Figure 17. "ON" Voltages

Figure 18. Temperature Coefficients

TYPICAL ELECTRICAL CHARACTERISTICS
MMBT3946DW1T1G
(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

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1G

MMBT3946DW1T1G

(PNP)

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

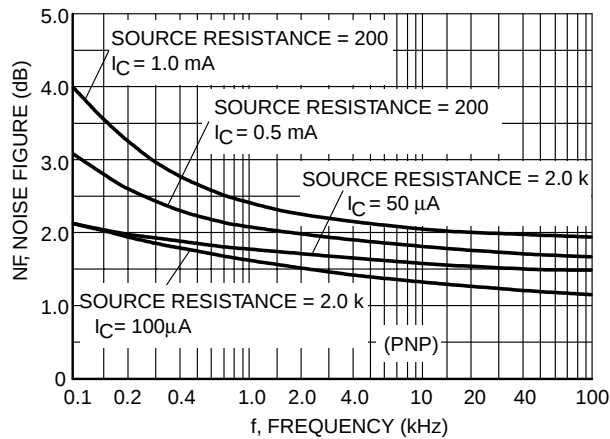


Figure 25.

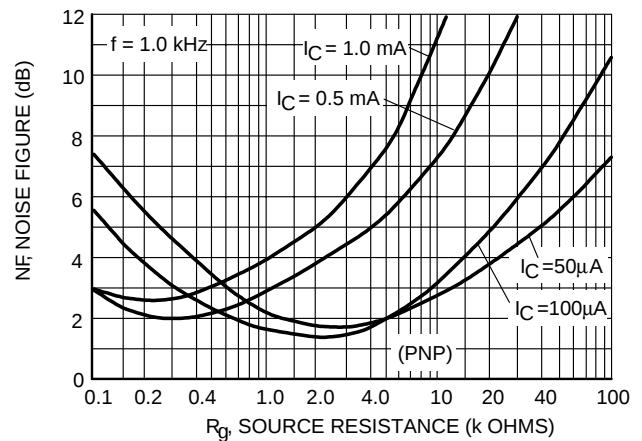


Figure 26.

h PARAMETERS

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

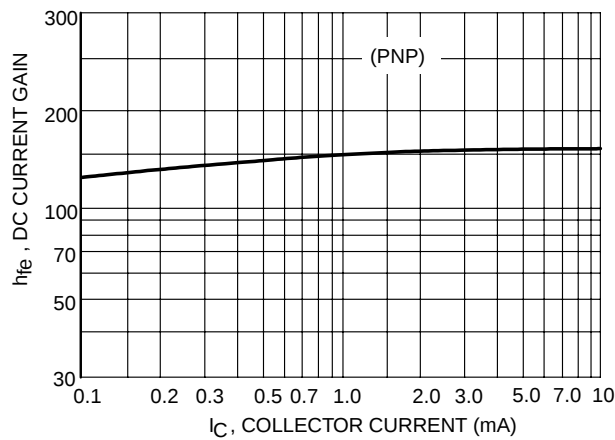


Figure 27. Current Gain

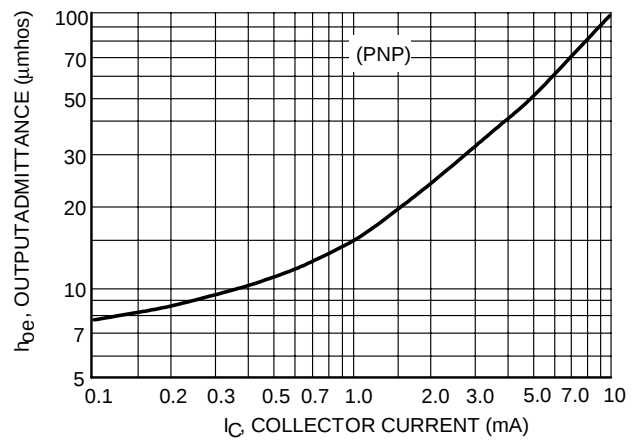


Figure 28. Output Admittance

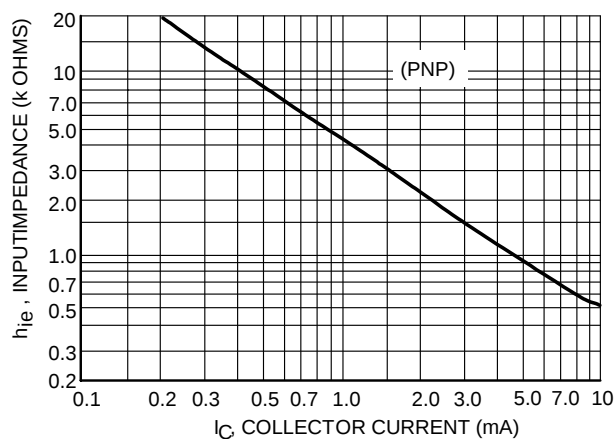


Figure 29. Input Impedance

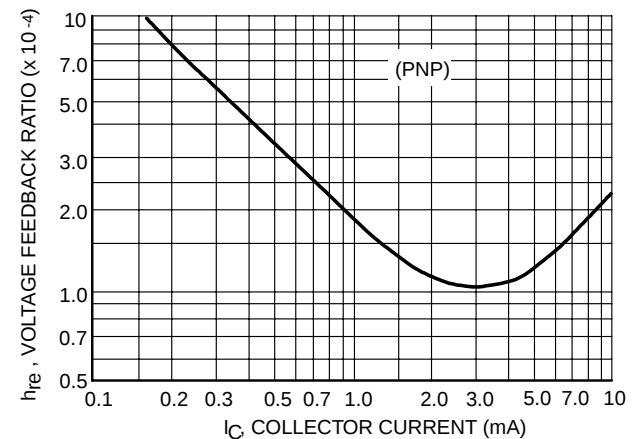


Figure 30. Voltage Feedback Ratio

TYPICAL ELECTRICAL CHARACTERISTICS
MMBT3946DW1T1G
(PNP)

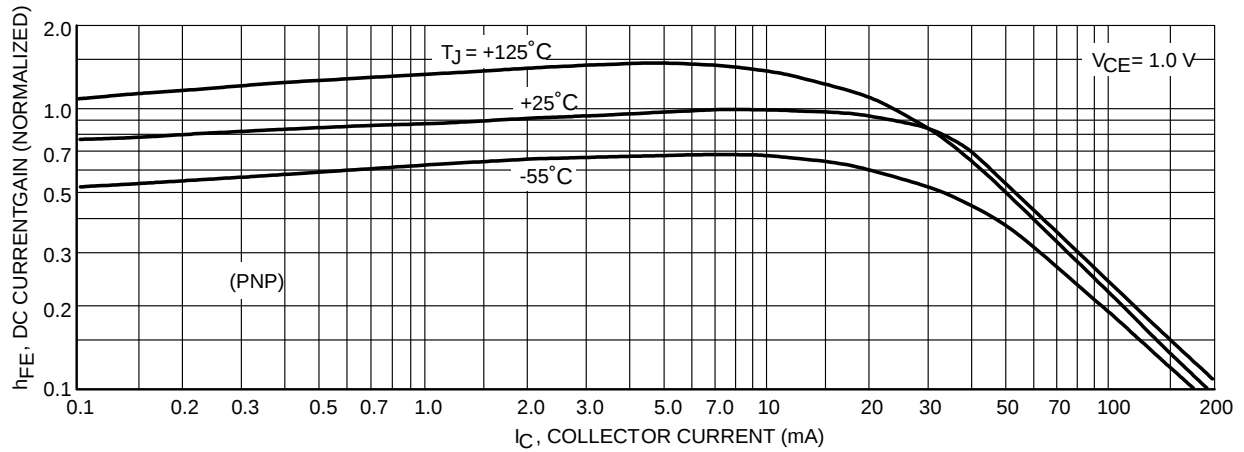


Figure 31. DC Current Gain

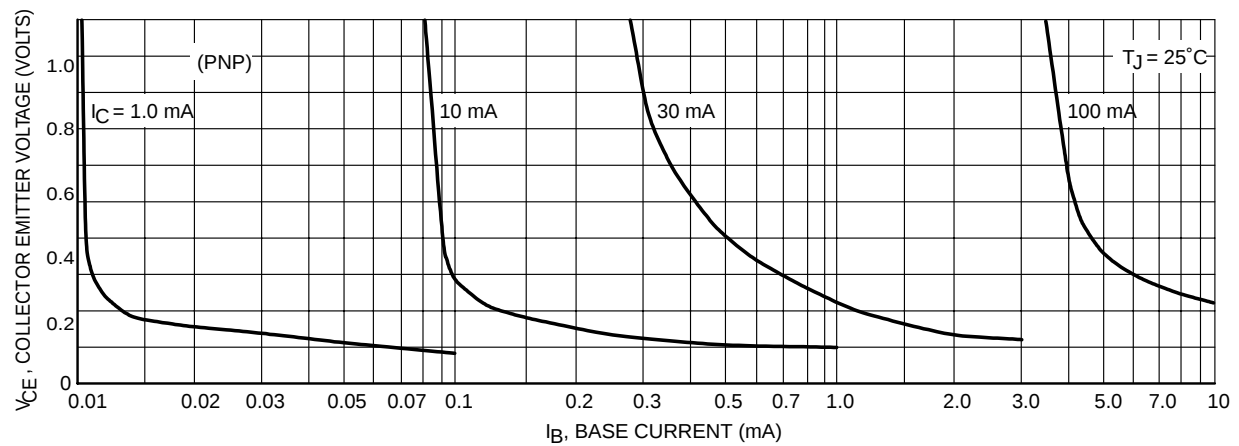


Figure 32. Collector Saturation Region

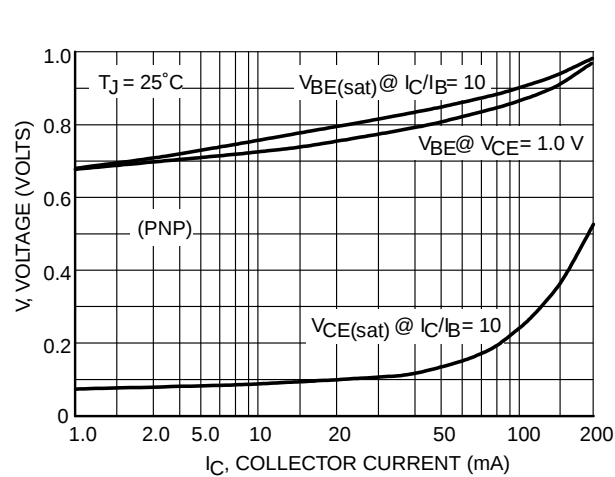


Figure 33. "ON" Voltages

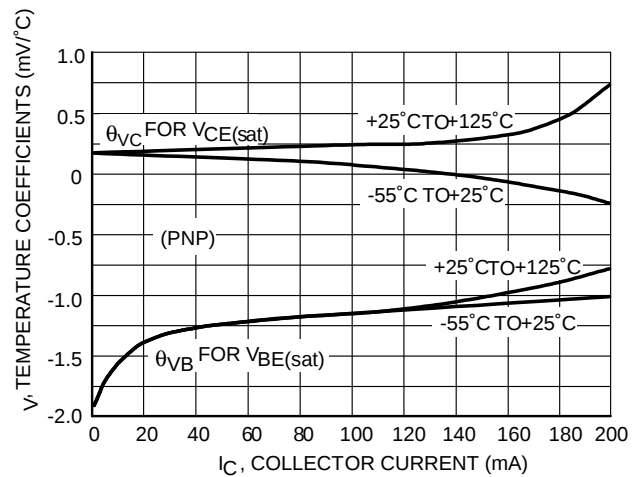
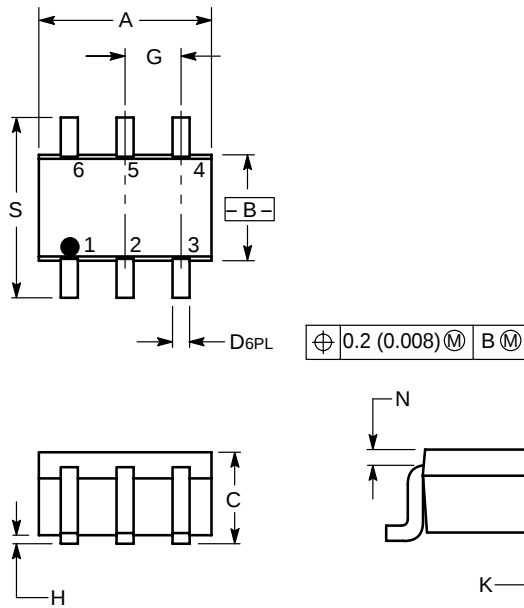


Figure 34. Temperature Coefficients

SC-88/SOT-363

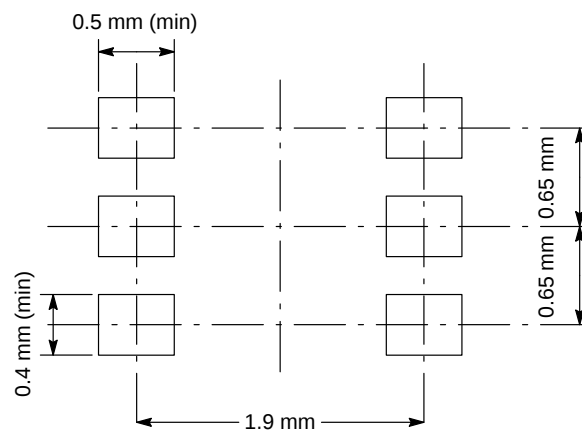
NOTES:

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

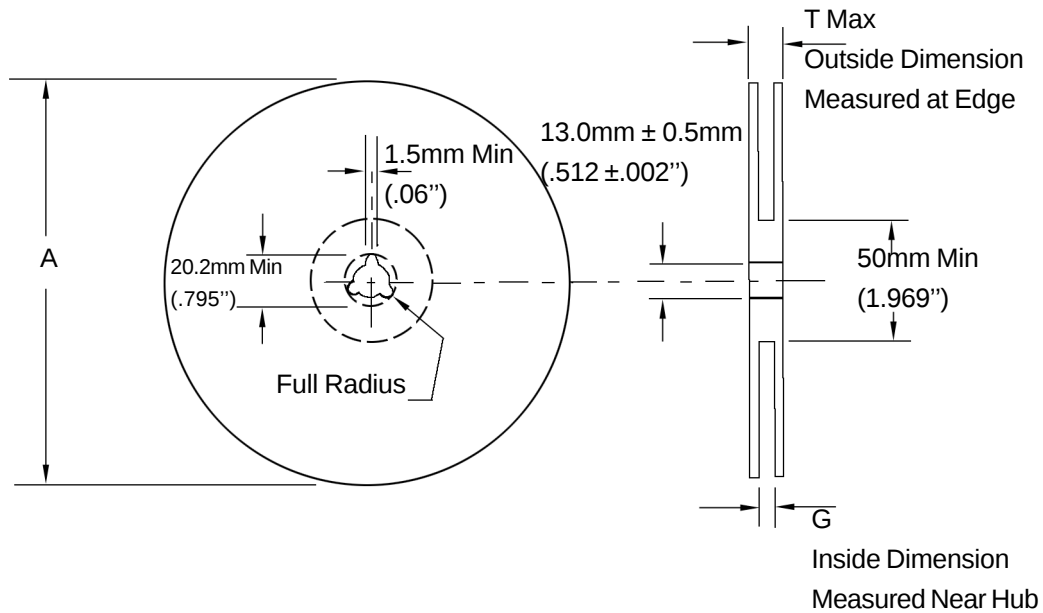


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20

- PIN 1. EMITTER 2
 2. BASE 2
 3. COLLECTOR 1
 4. EMITTER 1
 5. BASE 1
 6. COLLECTOR 2



EMBOSED TAPE AND REEL DATA FOR DISCRETES



Size	A Max	G	T Max
8 mm	330mm (12.992")	8.4mm+1.5mm, -0.0 (.33"+.059", -0.00)	14.4mm (.56")

Reel Dimensions

Metric Dimensions Govern — English are in parentheses for reference only

Storage Conditions

Temperature: 5 to 40 Deg.C (20 to 30 Deg. C is preferred)

Humidity: 30 to 80 RH (40 to 60 is preferred)

Recommended Period: One year after manufacturing

(This recommended period is for the soldering condition only. The characteristics and reliabilities of the products are not restricted to this limitation)

Shipment Specification

