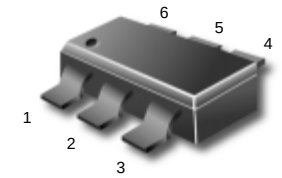
Dual General Purpose Transistors

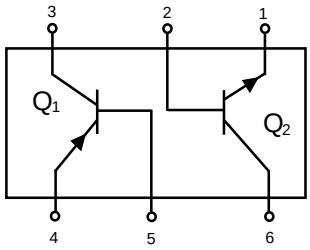
LMBT3946DW1T1

The LMBT3946DW1T1 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 $V_{CE(sat)}$, ≤ 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: LMBT3946DW1T1 = 46



SOT–363/SC-88



LMBT3946DW1T1*
*Q1 PNP
Q2 NPN

MAXIMUM RATINGS

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

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 Range	T_J,T_{stg}	–55 to +150	°C

ORDERING INFORMATION

Device	Package	Shipping
LMBT3946DW1T1	SOT-363	3000Units/Reel

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

LMBT3946DW1T1

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)	(NPN)		40	–	
(I_C = –1.0 mAdc, I_B = 0)	(PNP)		–40	–	
Collector–Base Breakdown Voltage		$V_{(BR)CBO}$			Vdc
(I_C = 10 μAdc, I_E = 0)	(NPN)		60	–	
(I_C = –10 μAdc, I_E = 0)	(PNP)		–40	–	
Emitter–Base Breakdown Voltage		$V_{(BR)EBO}$			Vdc
(I_E = 10 μAdc, I_C = 0)	(NPN)		6.0	–	
(I_E = –10 μAdc, I_C = 0)	(PNP)		–5.0	–	
Base Cutoff Current		I_{BL}			nAdc
(V_{CE} = 30 Vdc, V_{EB} = 3.0 Vdc)	(NPN)		–	50	
(V_{CE} = –30 Vdc, V_{EB} = –3.0 Vdc)	(PNP)		–	–50	
Collector Cutoff Current		I_{CEX}			nAdc
(V_{CE} = 30 Vdc, V_{EB} = 3.0 Vdc)	(NPN)		–	50	
(V_{CE} = –30 Vdc, V_{EB} = –3.0 Vdc)	(PNP)		–	–50	
ON CHARACTERISTICS (2)					
DC Current Gain		h_{FE}			–
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)	(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)	(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)	(NPN)		–	0.2	
(I_C = 50 mAdc, I_B = 5.0 mAdc)			–	0.3	
(I_C = –10 mAdc, I_B = –1.0 mAdc)	(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)	(NPN)		0.65	0.85	
(I_C = 50 mAdc, I_B = 5.0 mAdc)			–	0.95	
(II_C = –10 mAdc, I_B = –1.0 mAdc)	(PNP)		–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%.

LMBT3946DW1T1

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

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)	(NPN)		300	–	
(I_C = –10 mAdc, V_{CE} = –20 Vdc, f = 100 MHz)	(PNP)		250	–	
Output Capacitance		C_{obo}			pF
(V_{CB} = 5.0 Vdc, I_E = 0, f = 1.0 MHz)	(NPN)		–	4.0	
(V_{CB} = –5.0 Vdc, I_E = 0, f = 1.0 MHz)	(PNP)		–	4.5	
Input Capacitance		C_{ibo}			pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	(NPN)		–	8.0	
(V_{EB} = –0.5 Vdc, I_C = 0, f = 1.0 MHz)	(PNP)		–	10.0	
Input Impedance		h_{ie}			kΩ
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	(NPN)		1.0	10	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	(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)	(NPN)		0.5	8.0	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	(PNP)		0.1	10	
Small–Signal Current Gain		h_{FE}			–
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	(NPN)		100	400	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	(PNP)		100	400	
Output Admittance		h_{oe}			μmhos
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	(NPN)		1.0	40	
(V_{CE} = –10 Vdc, I_C = –1.0 mAdc, f = 1.0 kHz)	(PNP)		3.0	60	
Noise Figure		NF			dB
(V_{CE}=5.0 Vdc,I_C=100 μAdc, R_S=1.0 kΩ, f=1.0kHz)	(NPN)	–	5.0		
(V_{CE}=–5.0 Vdc,I_C=–100 μAdc, R_S=1.0 kΩ, f=1.0kHz)	(PNP)	–	4.0		

SWITCHING CHARACTERISTICS

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

TYPICAL ELECTRICAL CHARACTERISTICS
LMBT3946DW1T1
(NPN)

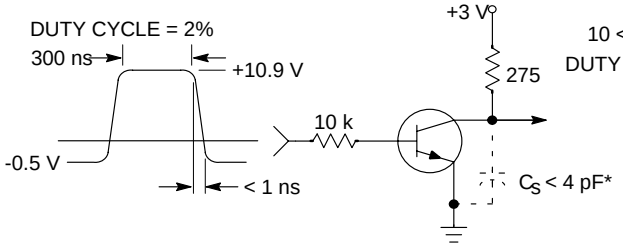


Figure 1. Delay and Rise T ime
Equivalent T est Circuit

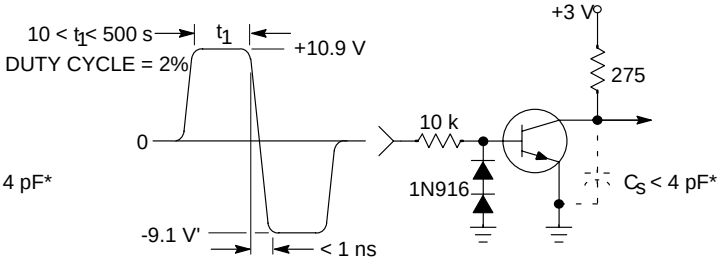


Figure 2. Storage and Fall T ime
Equivalent T est Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

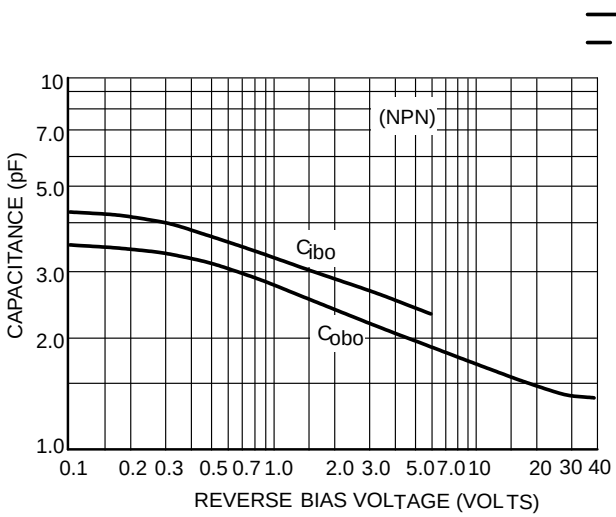


Figure 3. Capacitance

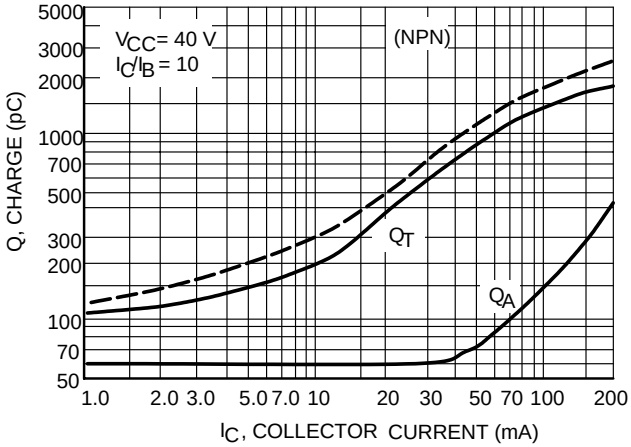


Figure 4. Charge Data

TYPICAL ELECTRICAL CHARACTERISTICS

LMBT3946DW1T1

(NPN)

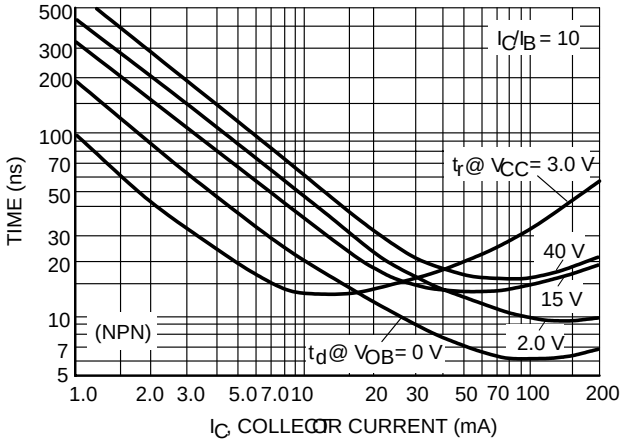


Figure 5. Turn±On Time

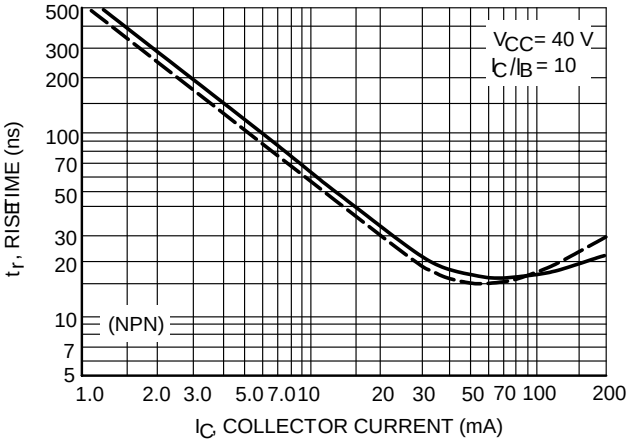


Figure 6. Rise Time

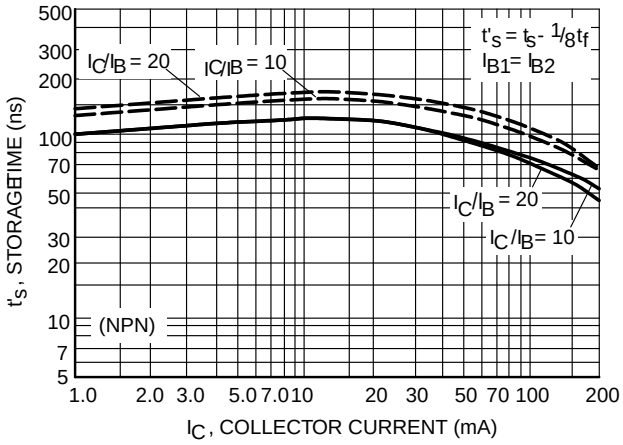


Figure 7. Storage Time

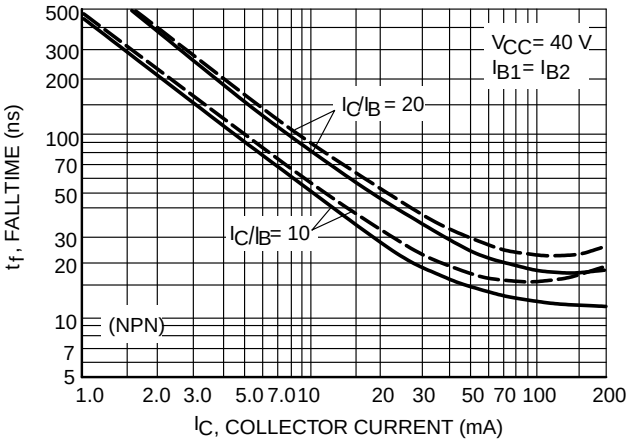


Figure 8. Fall Time

TYPICAL AUDIO SMALL±SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

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

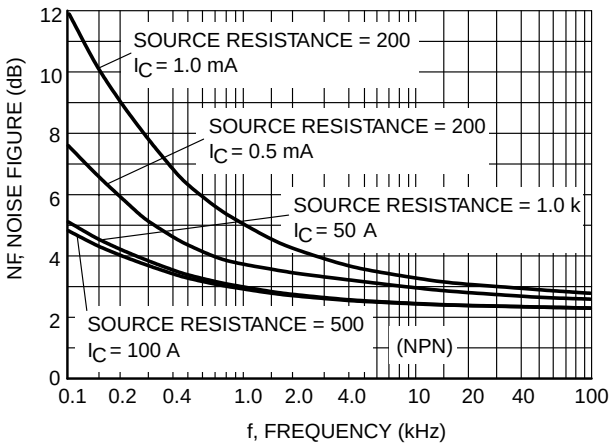


Figure 9. Noise Figure

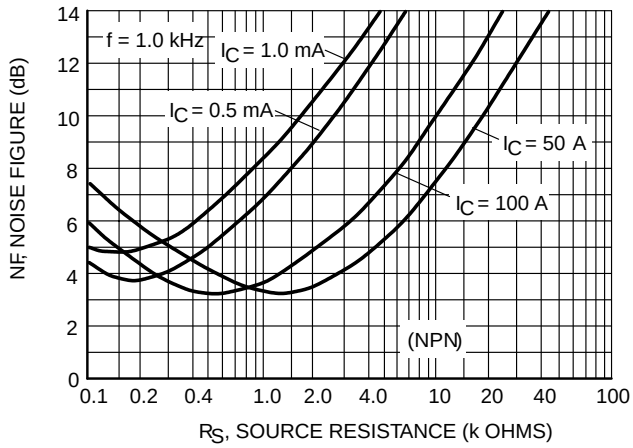


Figure 10. Noise Figure

TYPICAL ELECTRICAL CHARACTERISTICS
LMBT3946DW1T1
(NPN)

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

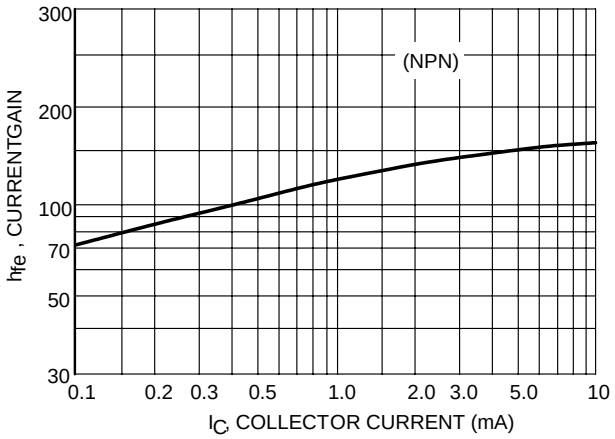


Figure 11. Current Gain

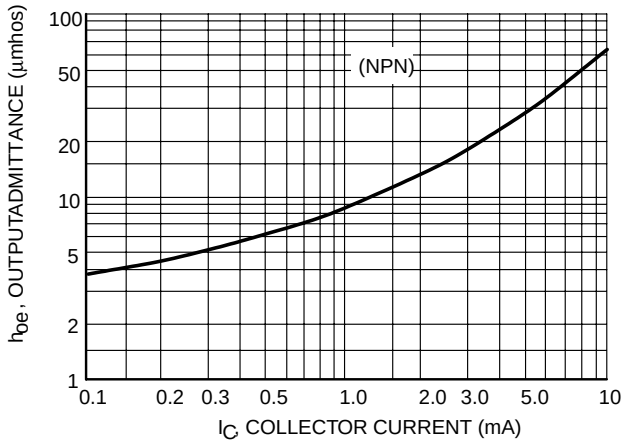


Figure 12. Output Admittance

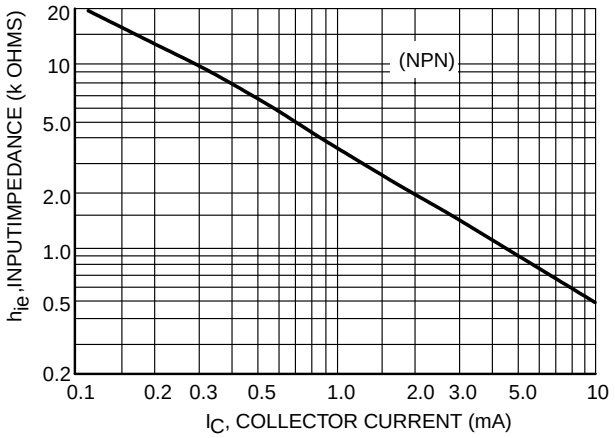


Figure 13. Input Impedance

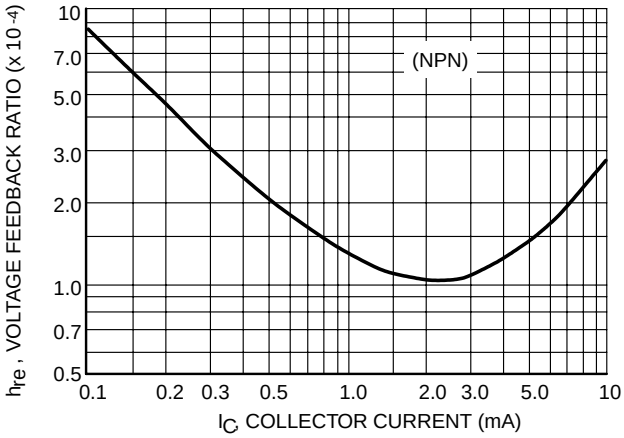


Figure 14. Voltage Feedback Ratio

TYPICAL ELECTRICAL CHARACTERISTICS
LMBT3946DW1T1
(NPN)

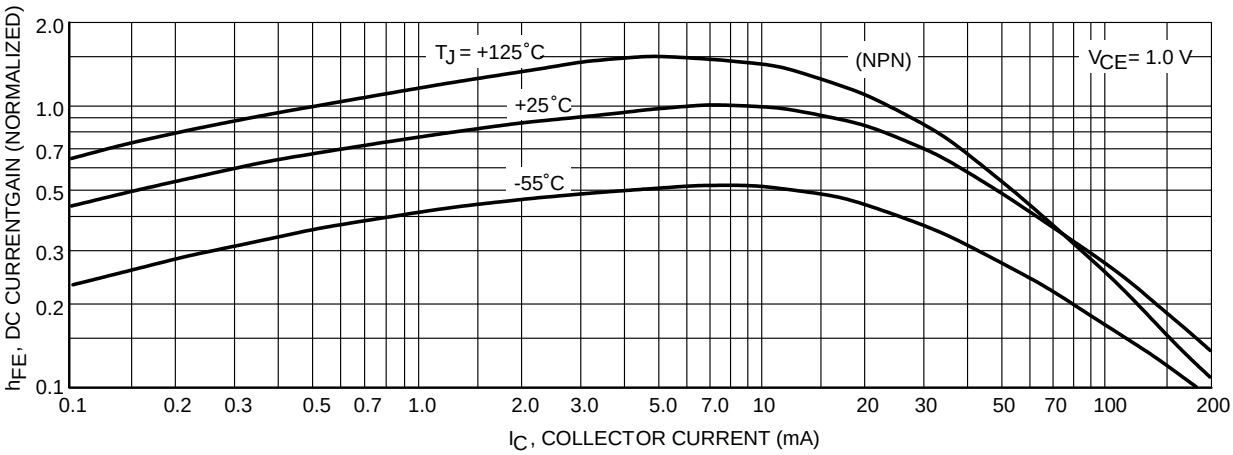


Figure 15. DC Current Gain

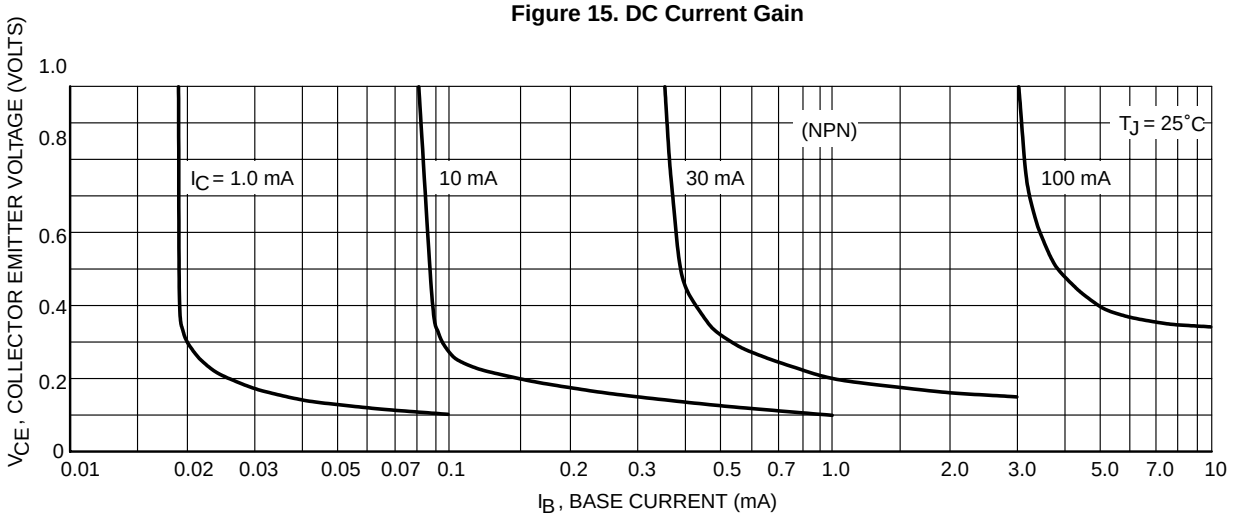


Figure 16. Collector Saturation Region

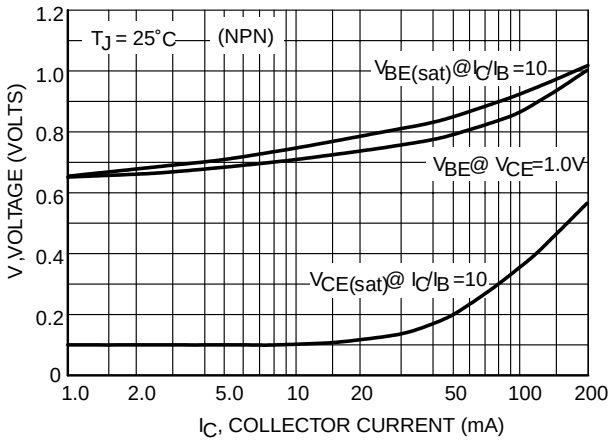


Figure 17. "ON" Voltages

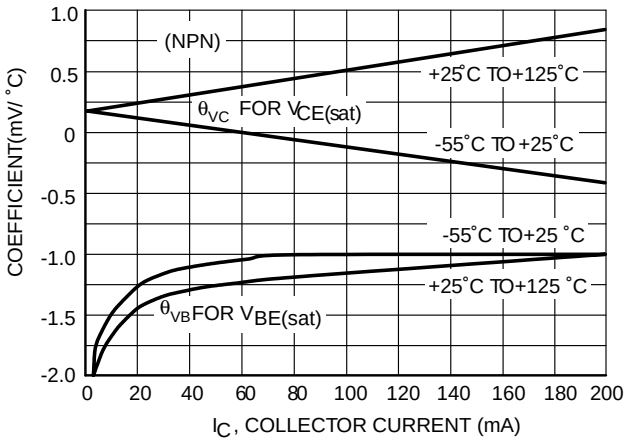


Figure 18. Temperature Coefficients

TYPICAL ELECTRICAL CHARACTERISTICS
LMBT3946DW1T1
(PNP)

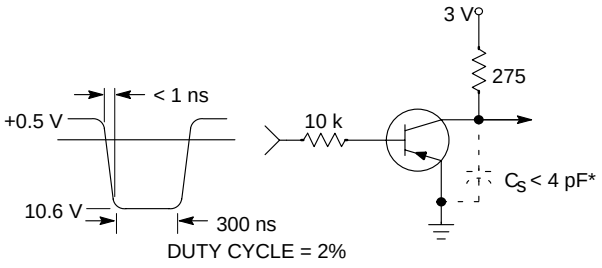


Figure 19. Delay and Rise Time Equivalent Test Circuit

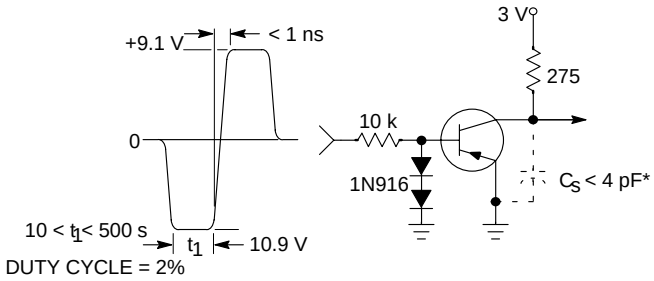


Figure 20. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

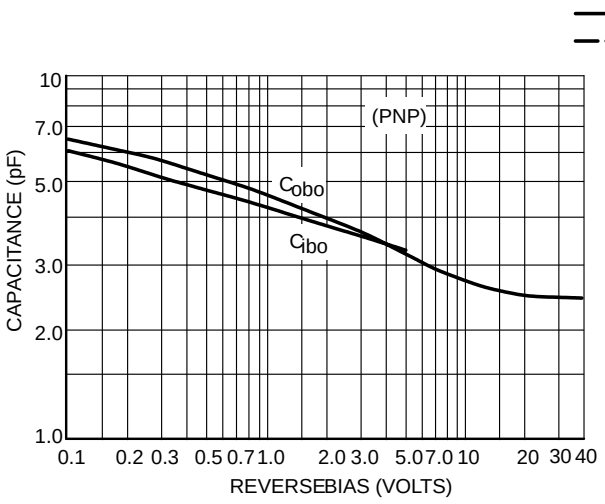


Figure 21. Capacitance

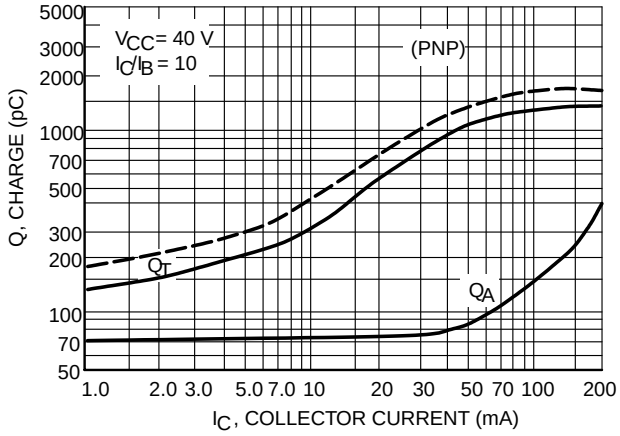


Figure 22. Charge Data

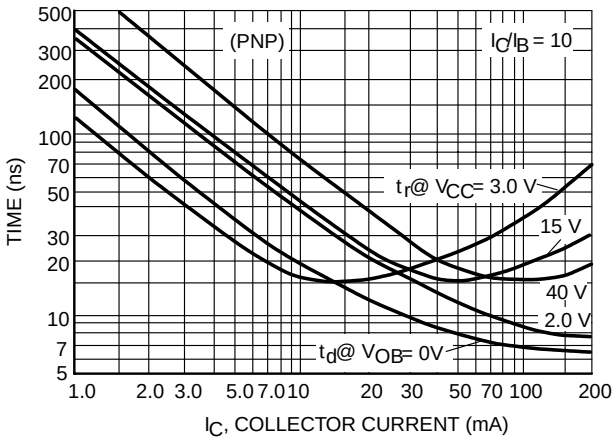


Figure 23. Turn-On Time

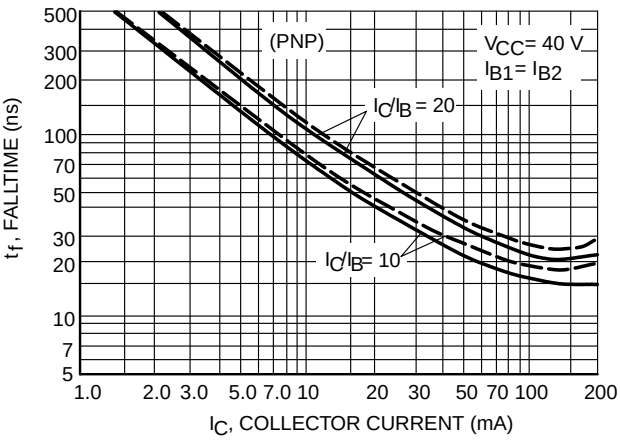


Figure 24. Fall Time

TYPICAL ELECTRICAL CHARACTERISTICS
LMBT3946DW1T1
(PNP)

TYPICAL AUDIO SMALL±SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

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

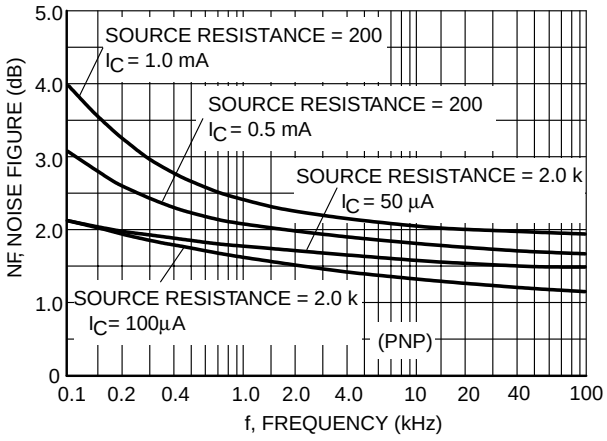


Figure 25.

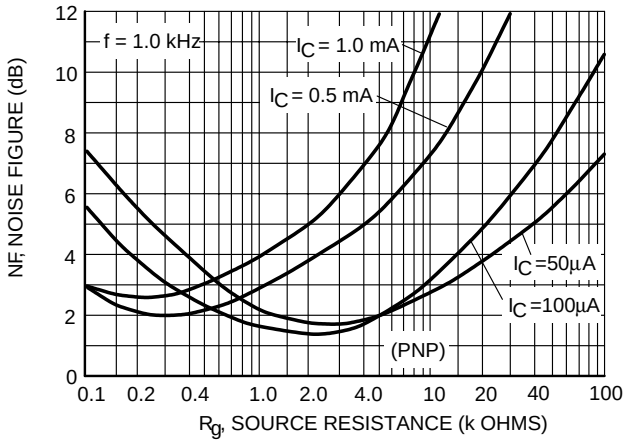


Figure 26.

h PARAMETERS

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

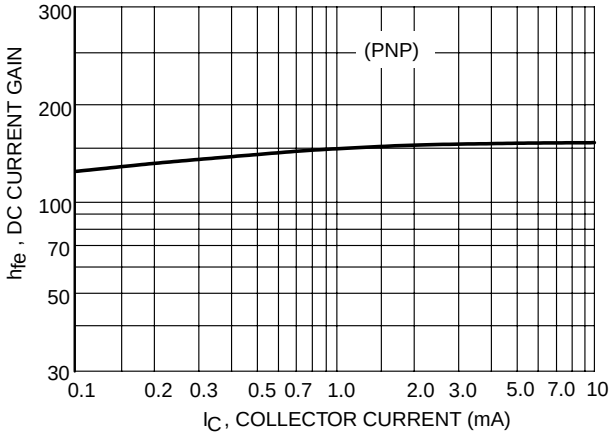


Figure 27. Current Gain

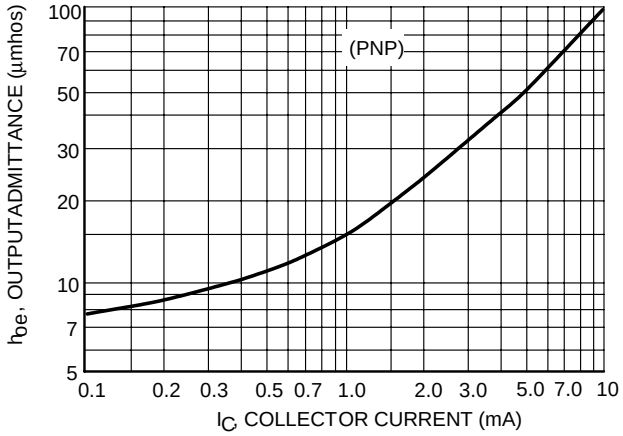


Figure 28. Output Admittance

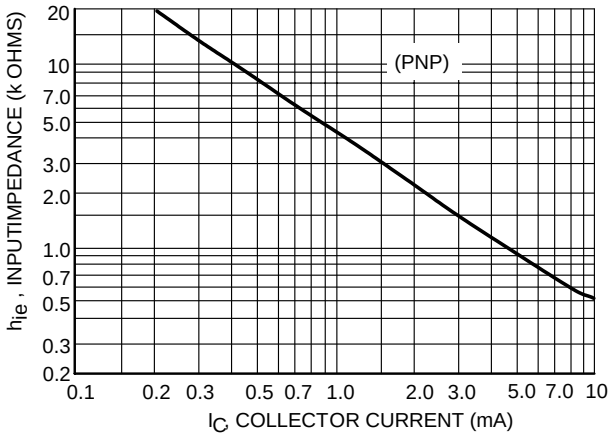


Figure 29. Input Impedance

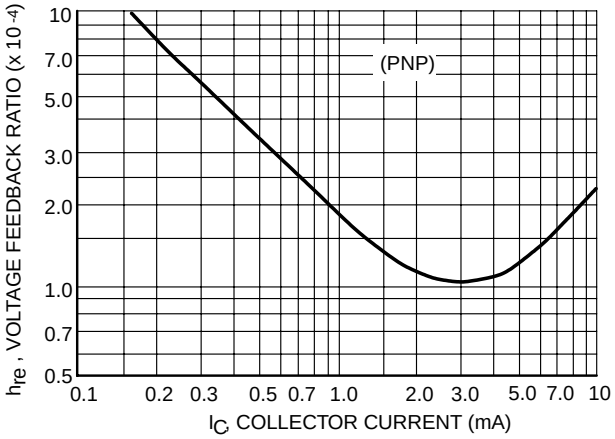


Figure 30. Voltage Feedback Ratio

TYPICAL ELECTRICAL CHARACTERISTICS
LMBT3946DW1T1
(PNP)

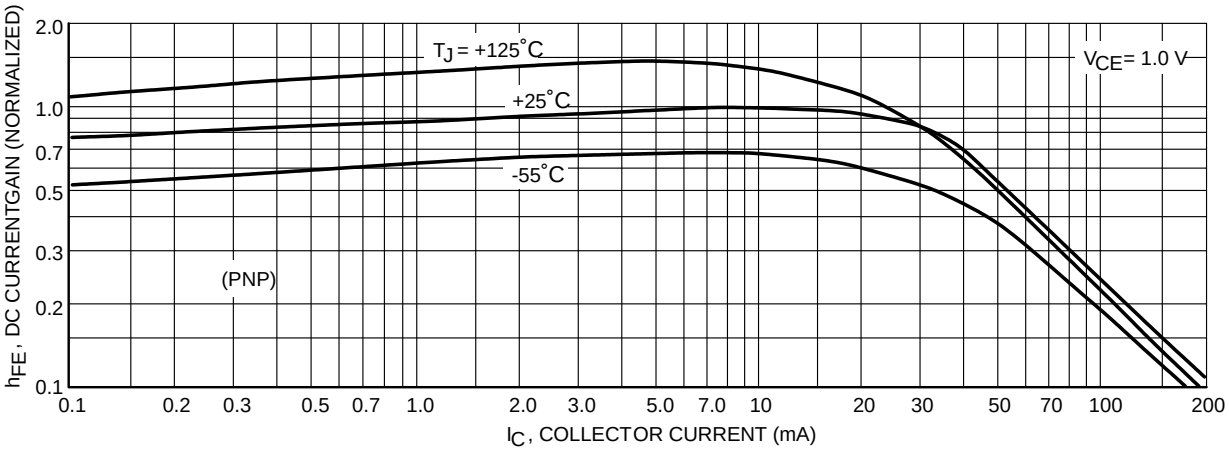


Figure 31. DC Current Gain

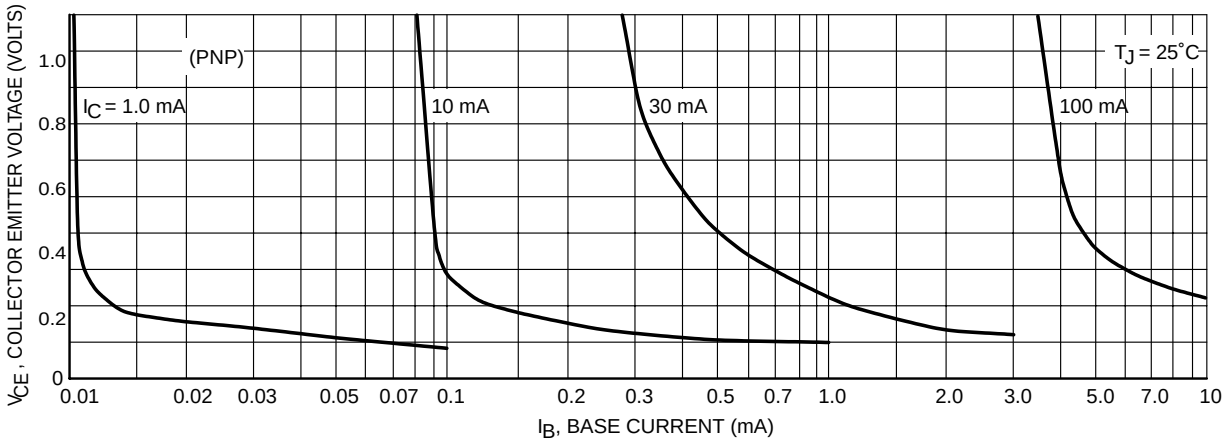


Figure 32. Collector Saturation Region

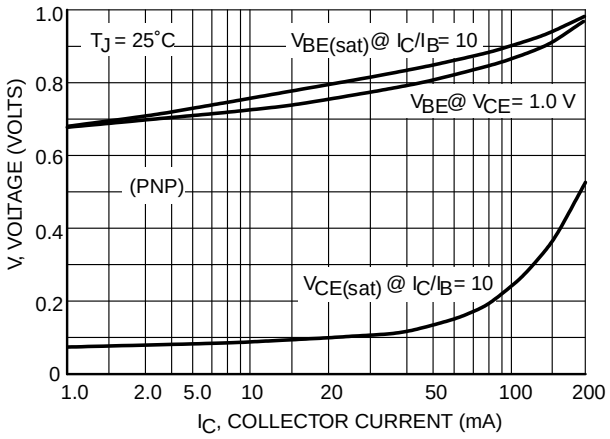


Figure 33. "ON" Voltages

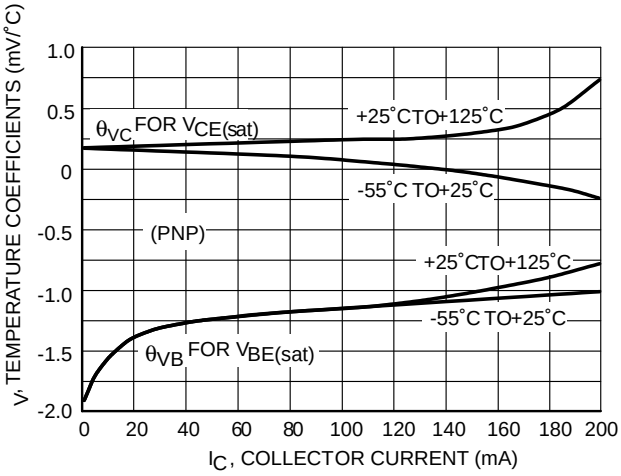
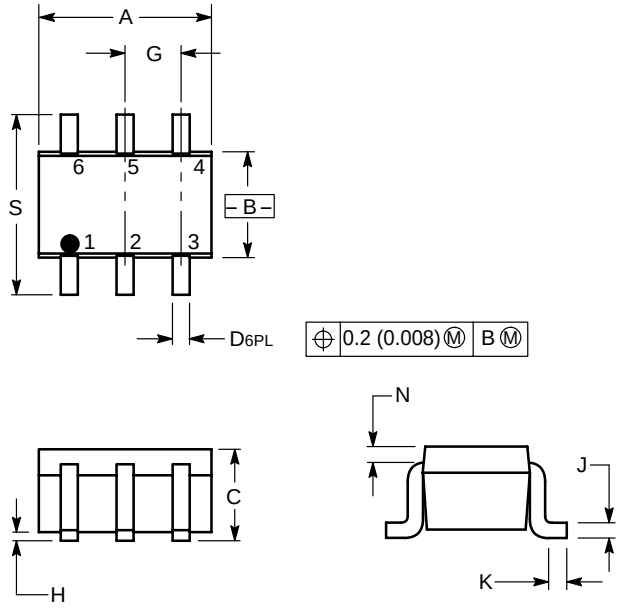


Figure 34. Temperature Coefficients

LMBT3946DW1T1

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