



# WILLAS

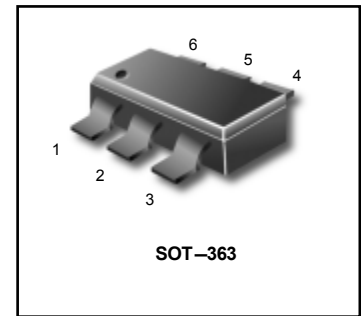


## MMBT3946DW1T1

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



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

#### MAXIMUM RATINGS

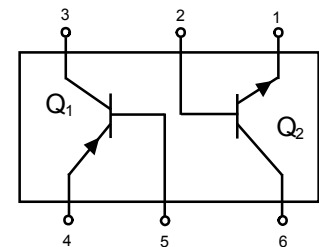
Rating	Symbol	Value	Unit
Collector-Emitter Voltage (NPN) (PNP)	$V_{CEO}$	40 -40	Vdc
Collector-Base Voltage (NPN) (PNP)	$V_{CBO}$	60 -40	Vdc
Emitter-Base Voltage (NPN) (PNP)	$V_{EBO}$	6.0 -5.0	Vdc
Collector Current-Continuous (NPN) (PNP)	$I_C$	200 -200	mAdc
Electrostatic Discharge	$E_{SD}$	HBM>16000,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

#### Pb-Free package is available

RoHS product for packing code suffix "G"  
Halogen free product for packing code suffix "H"  
Moisture Sensitivity Level 1

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Package Dissipation <sup>(1)</sup> $T_A = 25^\circ\text{C}$	$P_D$	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	$^\circ\text{C}$



AMBT3946DW1T1\*

\*Q1 PNP

Q2 NPN

#### ORDERING INFORMATION

Device	Marking	Shipping
MMBT3946DW1T1	46	3000Units/Reel

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



### Dual General Purpose Transistors

#### ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage <sup>(2)</sup>	V <sub>(BR)CEO</sub>			Vdc
(I <sub>C</sub> = 1.0 mAdc, I <sub>B</sub> = 0) (NPN)		40	–	
(I <sub>C</sub> = –1.0 mAdc, I <sub>B</sub> = 0) (PNP)		–40	–	
Collector–Base Breakdown Voltage	V <sub>(BR)CBO</sub>			Vdc
(I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0) (NPN)		60	–	
(I <sub>C</sub> = –10 μAdc, I <sub>E</sub> = 0) (PNP)		–40	–	
Emitter–Base Breakdown Voltage	V <sub>(BR)EBO</sub>			Vdc
(I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0) (NPN)		6.0	–	
(I <sub>E</sub> = –10 μAdc, I <sub>C</sub> = 0) (PNP)		–5.0	–	
Base Cutoff Current	I <sub>BL</sub>			nAdc
(V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc) (NPN)		–	50	
(V <sub>CE</sub> = –30 Vdc, V <sub>EB</sub> = –3.0 Vdc) (PNP)		–	–50	
Collector Cutoff Current	I <sub>CEx</sub>			nAdc
(V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc) (NPN)		–	50	
(V <sub>CE</sub> = –30 Vdc, V <sub>EB</sub> = –3.0 Vdc) (PNP)		–	–50	

#### ON CHARACTERISTICS (2)

DC Current Gain	h <sub>FE</sub>			–
(I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 1.0 Vdc) (NPN)		40	–	
(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 1.0 Vdc)		70	–	
(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 1.0 Vdc)		100	300	
(I <sub>C</sub> = 50 mAdc, V <sub>CE</sub> = 1.0 Vdc)		60	–	
(I <sub>C</sub> = 100 mAdc, V <sub>CE</sub> = 1.0 Vdc)		30	–	
(I <sub>C</sub> = –0.1 mAdc, V <sub>CE</sub> = –1.0 Vdc) (PNP)		60	–	
(I <sub>C</sub> = –1.0 mAdc, V <sub>CE</sub> = –1.0 Vdc)		80	–	
(I <sub>C</sub> = –10 mAdc, V <sub>CE</sub> = –1.0 Vdc)		100	300	
(I <sub>C</sub> = –50 mAdc, V <sub>CE</sub> = –1.0 Vdc)		60	–	
(I <sub>C</sub> = –100 mAdc, V <sub>CE</sub> = –1.0 Vdc)		30	–	
Collector–Emitter Saturation Voltage	V <sub>CE(sat)</sub>			Vdc
(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc) (NPN)		–	0.2	
(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc)		–	0.3	
(I <sub>C</sub> = –10 mAdc, I <sub>B</sub> = –1.0 mAdc) (PNP)		–	–0.25	
(I <sub>C</sub> = –50 mAdc, I <sub>B</sub> = –5.0 mAdc)		–	–0.4	
Base–Emitter Saturation Voltage	V <sub>BE(sat)</sub>			Vdc
(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc) (NPN)		0.65	0.85	
(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc)		–	0.95	
(I <sub>C</sub> = –10 mAdc, I <sub>B</sub> = –1.0 mAdc) (PNP)		–0.65	–0.85	
(I <sub>C</sub> = –50 mAdc, I <sub>B</sub> = –5.0 mAdc)		–	–0.95	

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



### Dual General Purpose Transistors

#### ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>SMALL-SIGNAL CHARACTERISTICS</b>				
Current-Gain – Bandwidth Product (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz) (NPN)	f <sub>T</sub>	300	–	MHz
(I <sub>C</sub> = –10 mAdc, V <sub>CE</sub> = –20 Vdc, f = 100 MHz) (PNP)		250	–	
Output Capacitance (V <sub>CB</sub> = 5.0 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz) (NPN)	C <sub>obo</sub>	–	4.0	pF
(V <sub>CB</sub> = –5.0 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz) (PNP)		–	4.5	
Input Capacitance (V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz) (NPN)	C <sub>ibo</sub>	–	8.0	pF
(V <sub>EB</sub> = –0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz) (PNP)		–	10.0	
Input Impedance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz) (NPN)	h <sub>ie</sub>	1.0	10	kΩ
(V <sub>CE</sub> = –10 Vdc, I <sub>C</sub> = –1.0 mAdc, f = 1.0 kHz) (PNP)		2.0	12	
Voltage Feedback Ratio (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz) (NPN)	h <sub>re</sub>	0.5	8.0	X 10 <sup>-4</sup>
(V <sub>CE</sub> = –10 Vdc, I <sub>C</sub> = –1.0 mAdc, f = 1.0 kHz) (PNP)		0.1	10	
Small-Signal Current Gain (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz) (NPN)	h <sub>FE</sub>	100	400	–
(V <sub>CE</sub> = –10 Vdc, I <sub>C</sub> = –1.0 mAdc, f = 1.0 kHz) (PNP)		100	400	
Output Admittance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz) (NPN)	h <sub>oe</sub>	1.0	40	μmhos
(V <sub>CE</sub> = –10 Vdc, I <sub>C</sub> = –1.0 mAdc, f = 1.0 kHz) (PNP)		3.0	60	
Noise Figure (V <sub>CE</sub> = 5.0 Vdc, I <sub>C</sub> = 100 μAdc, R <sub>S</sub> = 1.0 kΩ, f = 1.0 kHz) (NPN)	NF	–	5.0	dB
(V <sub>CE</sub> = –5.0 Vdc, I <sub>C</sub> = –100 μAdc, R <sub>S</sub> = 1.0 kΩ, f = 1.0 kHz) (PNP)		–	4.0	

#### SWITCHING CHARACTERISTICS

Delay Time	(V <sub>CC</sub> = 3.0 Vdc, V <sub>BE</sub> = –0.5 Vdc) (NPN)	t <sub>d</sub>	–	35	ns
	(V <sub>CC</sub> = –3.0 Vdc, V <sub>BE</sub> = 0.5 Vdc) (PNP)		–	35	
Rise Time	(I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = 1.0 mAdc) (NPN)	t <sub>r</sub>	–	35	ns
	(I <sub>C</sub> = –10 mAdc, I <sub>B1</sub> = –1.0 mAdc) (PNP)		–	35	
Storage Time	(V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mAdc) (NPN)	t <sub>s</sub>	–	200	ns
	(V <sub>CC</sub> = –3.0 Vdc, I <sub>C</sub> = –10 mAdc) (PNP)		–	225	
Fall Time	(I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mAdc) (NPN)	t <sub>f</sub>	–	50	ns
	(I <sub>B1</sub> = I <sub>B2</sub> = –1.0 mAdc) (PNP)		–	75	

# Dual General Purpose Transistors

## TYPICAL ELECTRICAL CHARACTERISTICS

### MMBT3946DW1T1

#### (NPN)

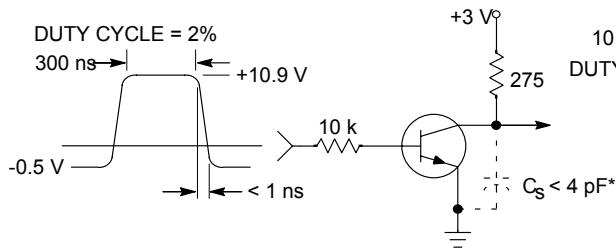


Figure 1. Delay and Rise Time Equivalent Test Circuit

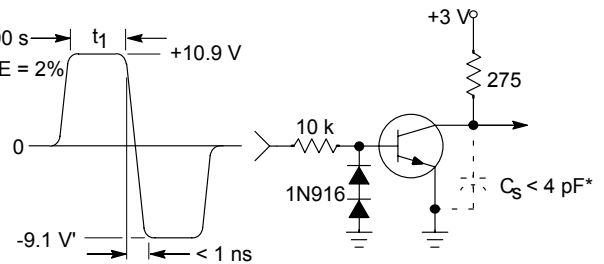


Figure 2. Storage and Fall Time Equivalent Test Circuit

\* Total shunt capacitance of test jig and connectors

## TYPICAL TRANSIENT CHARACTERISTICS

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

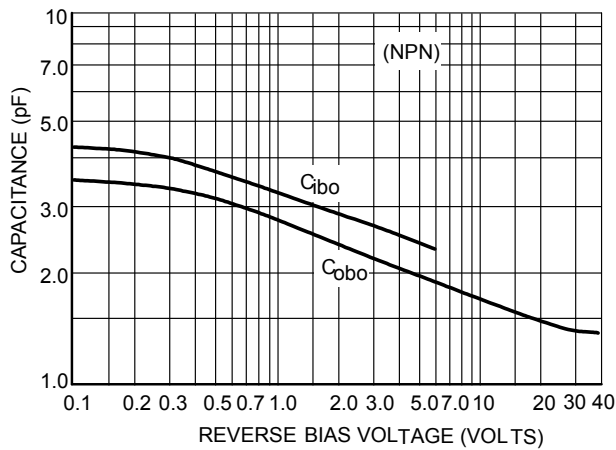


Figure 3. Capacitance

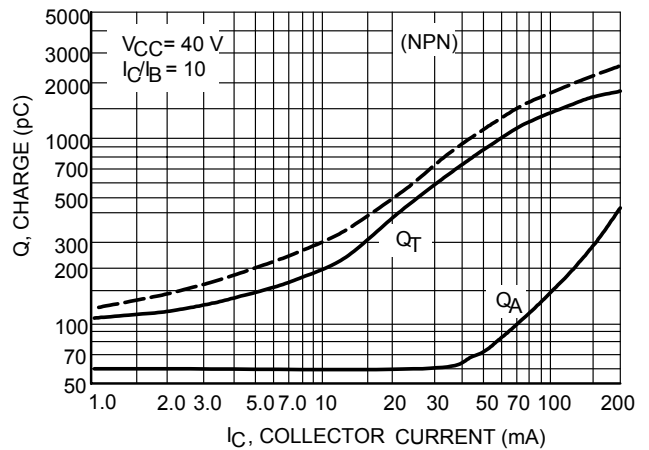


Figure 4. Charge Data



### Dual General Purpose Transistors

#### TYPICAL ELECTRICAL CHARACTERISTICS

##### MMBT3946DW1T1

(NPN)

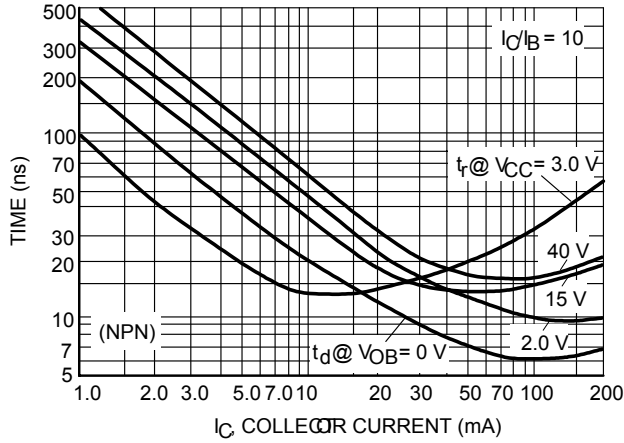


Figure 5. Turn-On Time

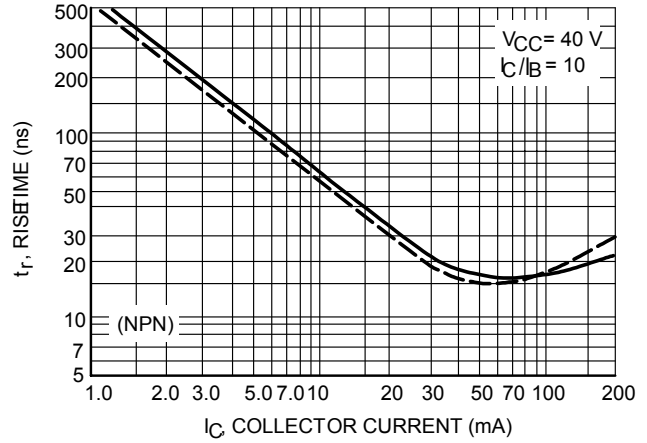


Figure 6. Rise Time

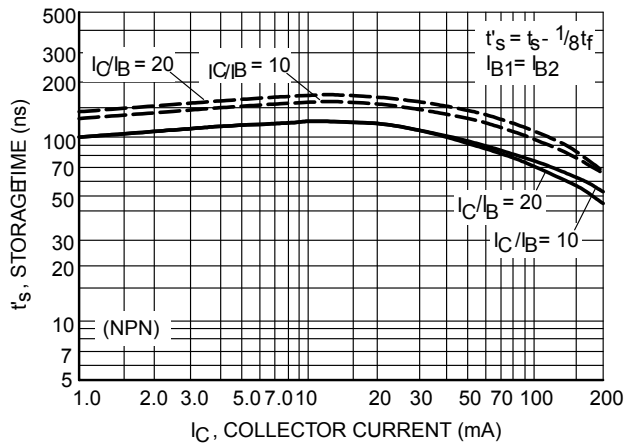


Figure 7. Storage Time

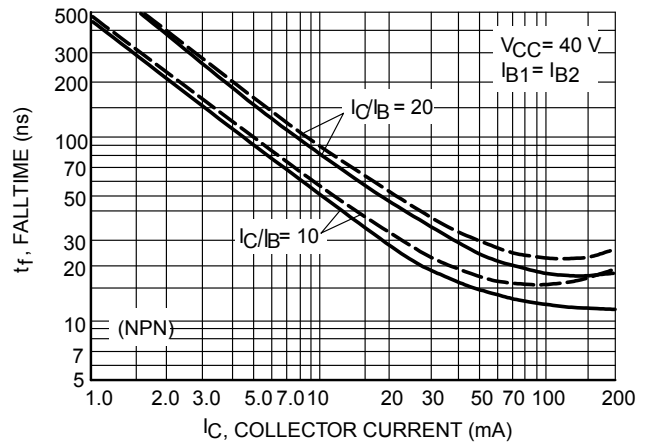


Figure 8. Fall Time

#### TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

(VCE = 5.0 Vdc, TA = 255C, Bandwidth = 1.0 Hz)

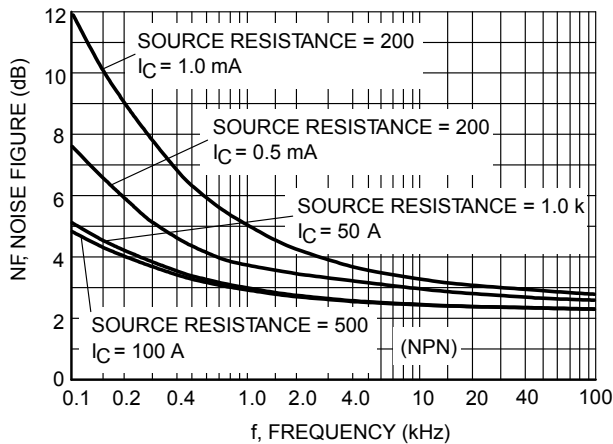


Figure 9. Noise Figure

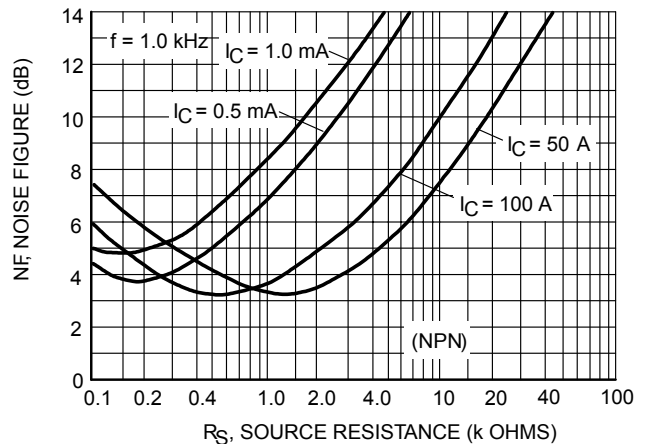


Figure 10. Noise Figure

# Dual General Purpose Transistors

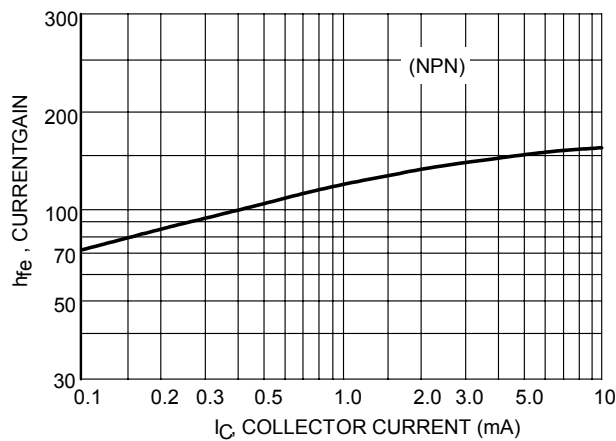
## TYPICAL ELECTRICAL CHARACTERISTICS

**MMBT3946DW1T1**

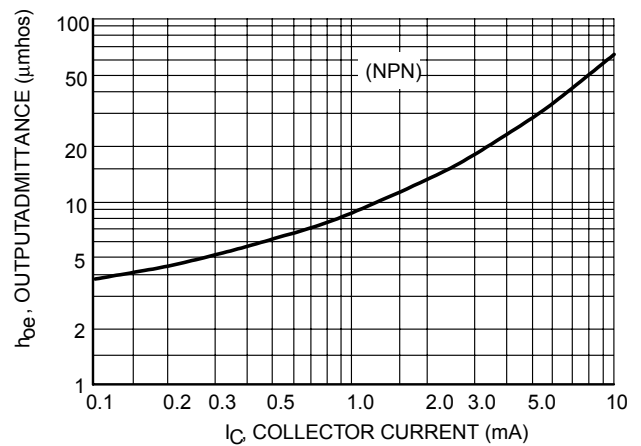
**(NPN)**

### h PARAMETERS

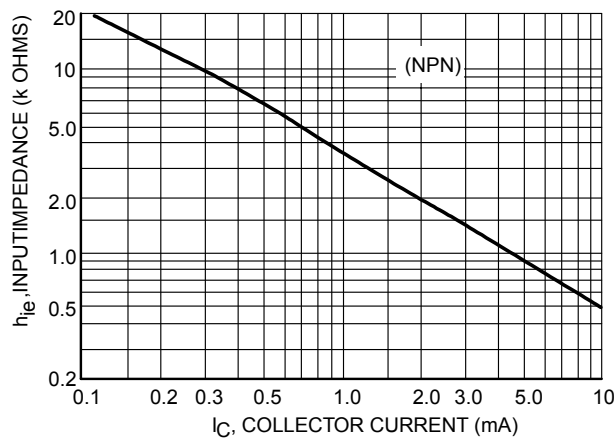
( $V_{CE} = 10 \text{ Vdc}$ ,  $f = 1.0 \text{ kHz}$ ,  $T_A = 25^\circ\text{C}$ )



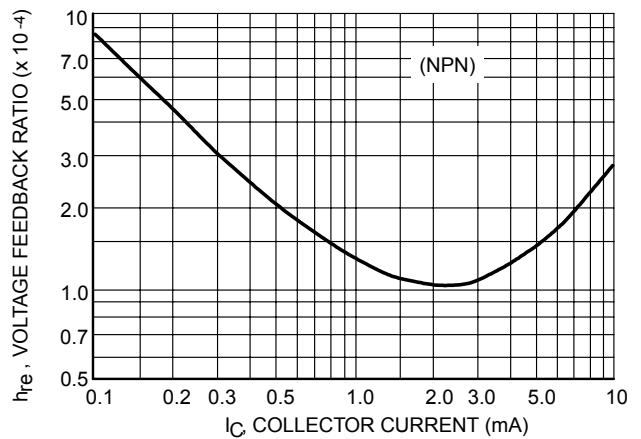
**Figure 11. Current Gain**



**Figure 12. Output Admittance**



**Figure 13. Input Impedance**



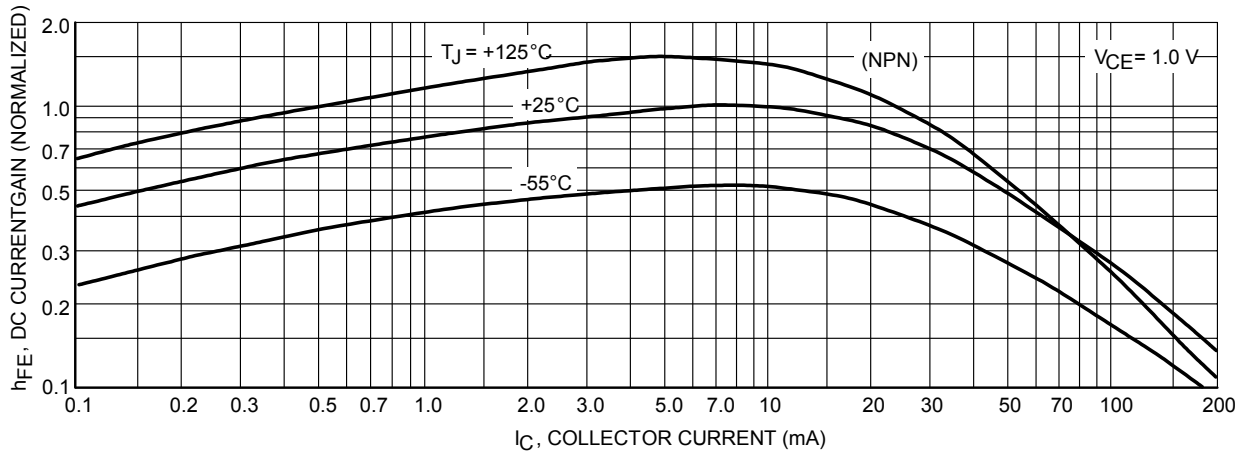
**Figure 14. Voltage Feedback Ratio**

**Dual General Purpose Transistors**

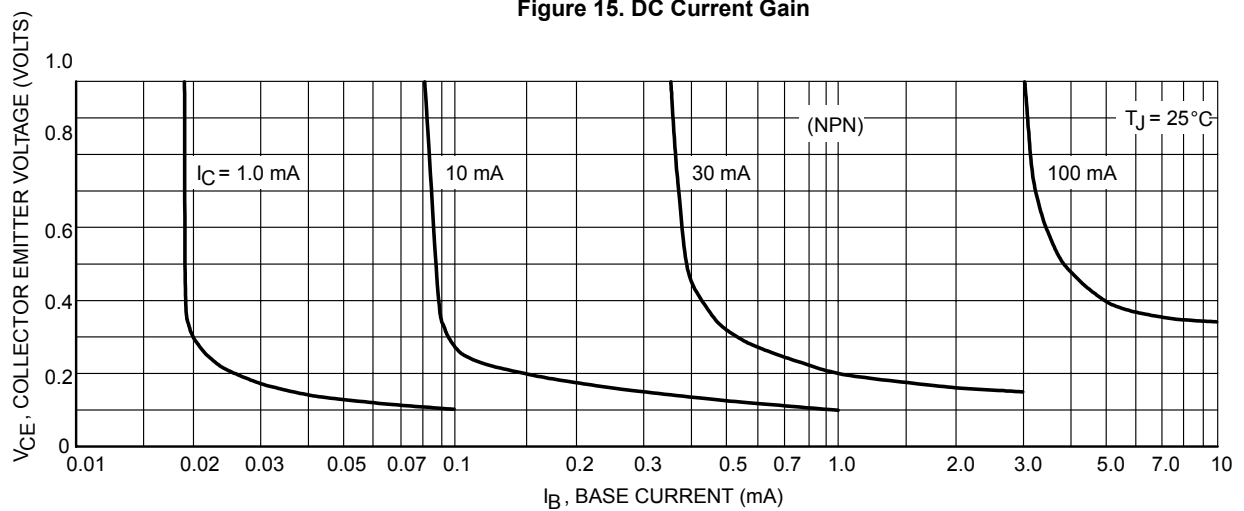
**TYPICAL ELECTRICAL CHARACTERISTICS**

**MMBT3946DW1T1**

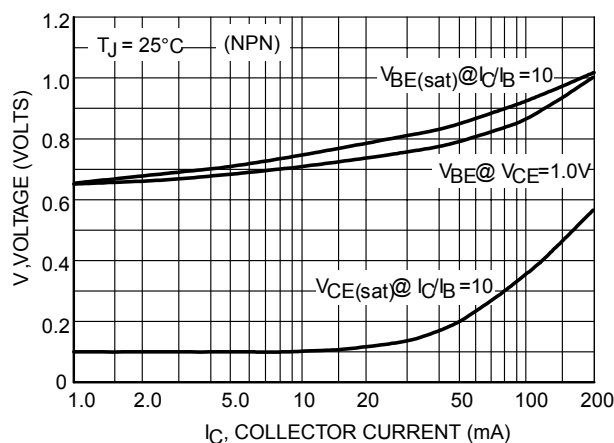
(NPN)



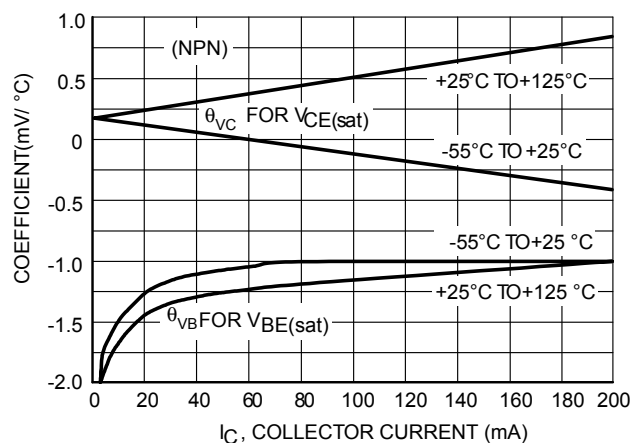
**Figure 15. DC Current Gain**



**Figure 16. Collector Saturation Region**



**Figure 17. "ON" Voltages**



**Figure 18. Temperature Coefficients**



### Dual General Purpose Transistors

#### TYPICAL ELECTRICAL CHARACTERISTICS

##### MMBT3946DW1T1

(PNP)

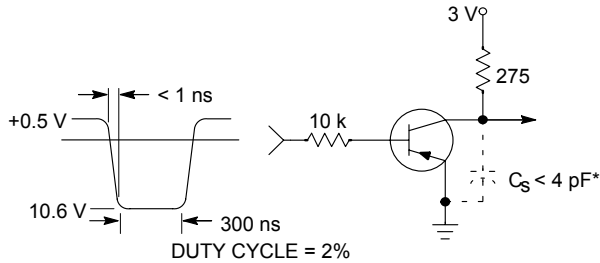


Figure 19. Delay and Rise Time Equivalent Test Circuit

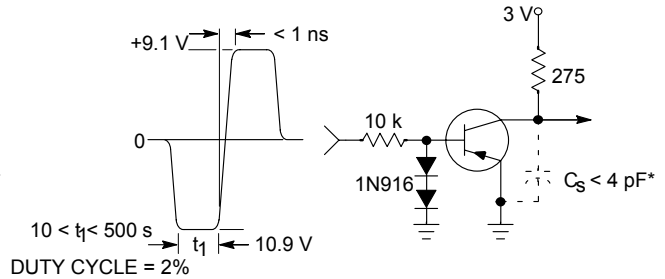


Figure 20. Storage and Fall Time Equivalent Test Circuit

\* Total shunt capacitance of test jig and connectors

#### TYPICAL TRANSIENT CHARACTERISTICS

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

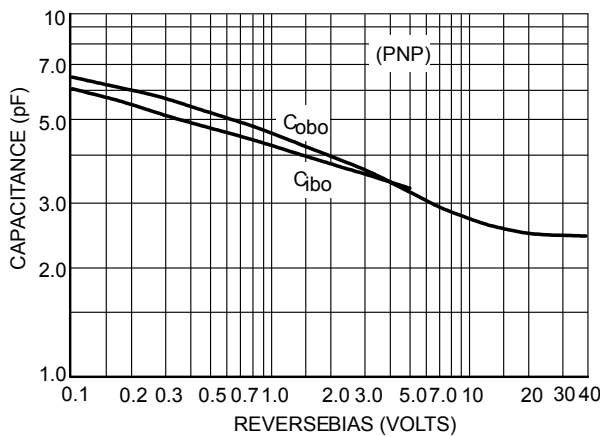


Figure 21. Capacitance

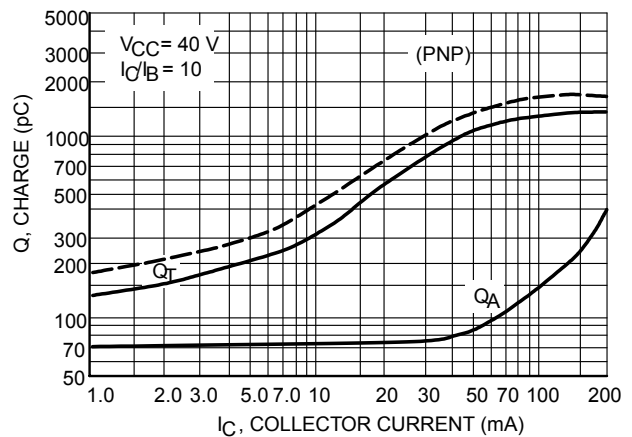


Figure 22. Charge Data

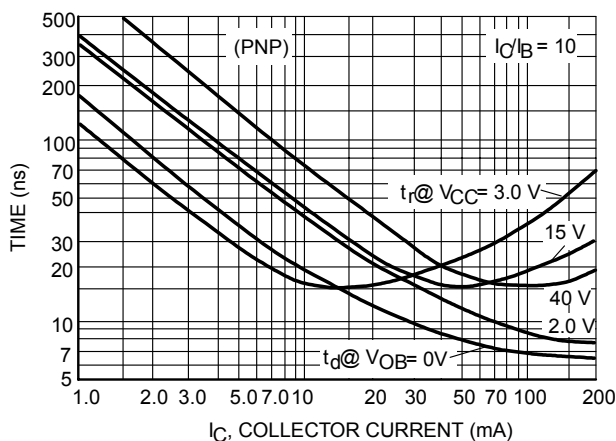


Figure 23. Turn-On Time

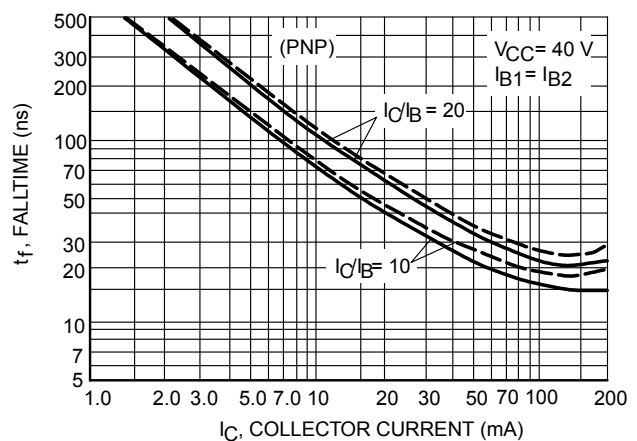


Figure 24. Fall Time





## Dual General Purpose Transistors

### TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1

(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)

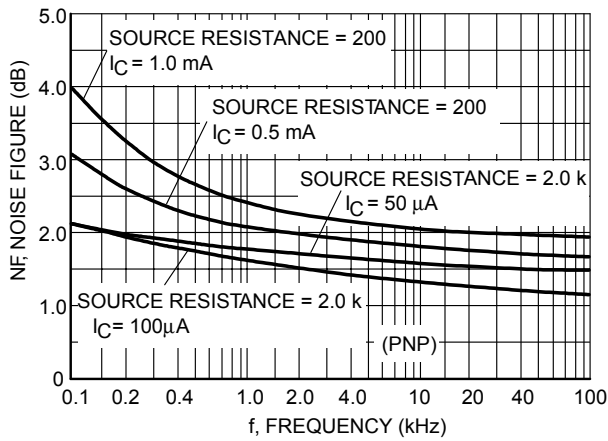


Figure 25.

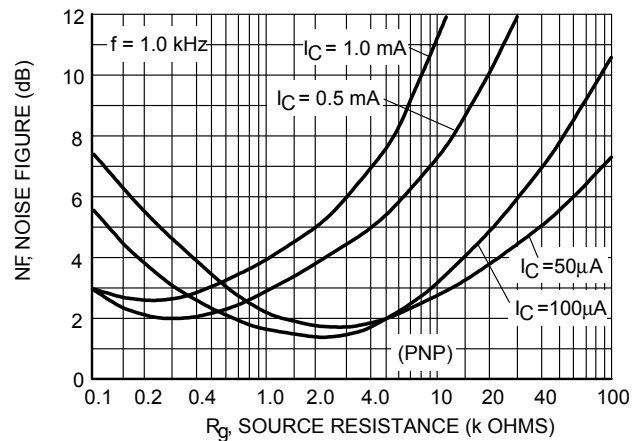


Figure 26.

### h PARAMETERS

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

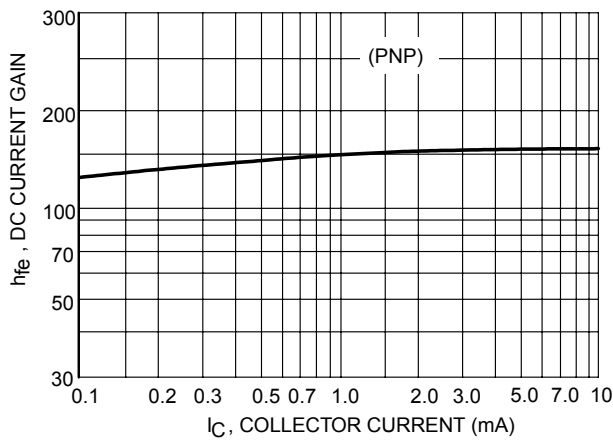


Figure 27. Current Gain

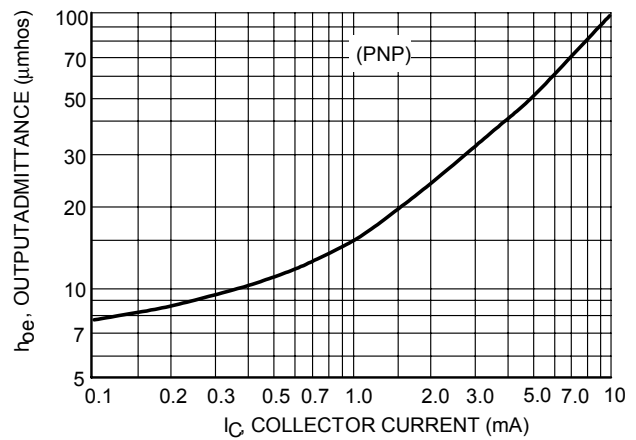


Figure 28. Output Admittance

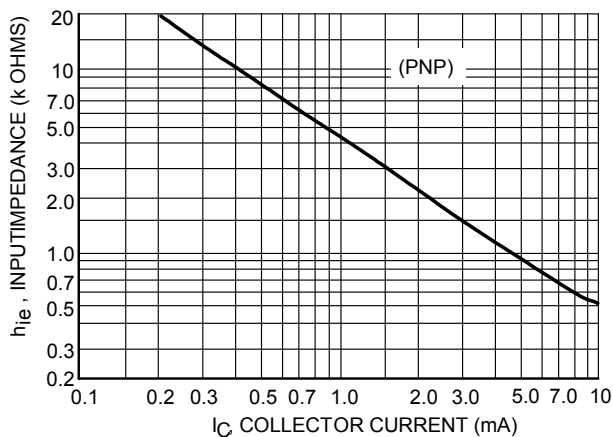


Figure 29. Input Impedance

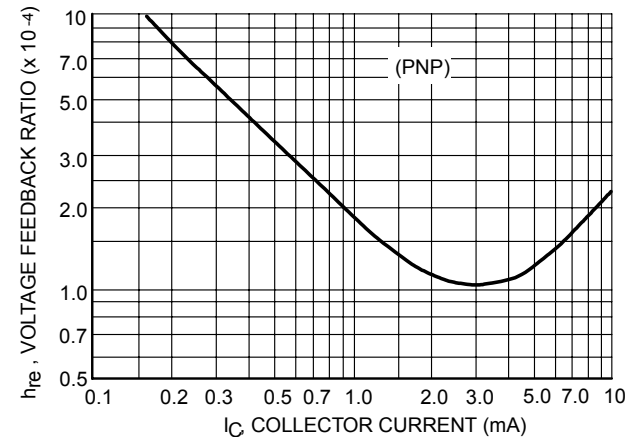


Figure 30. Voltage Feedback Ratio



### Dual General Purpose Transistors

#### TYPICAL ELECTRICAL CHARACTERISTICS MMBT3946DW1T1 (PNP)

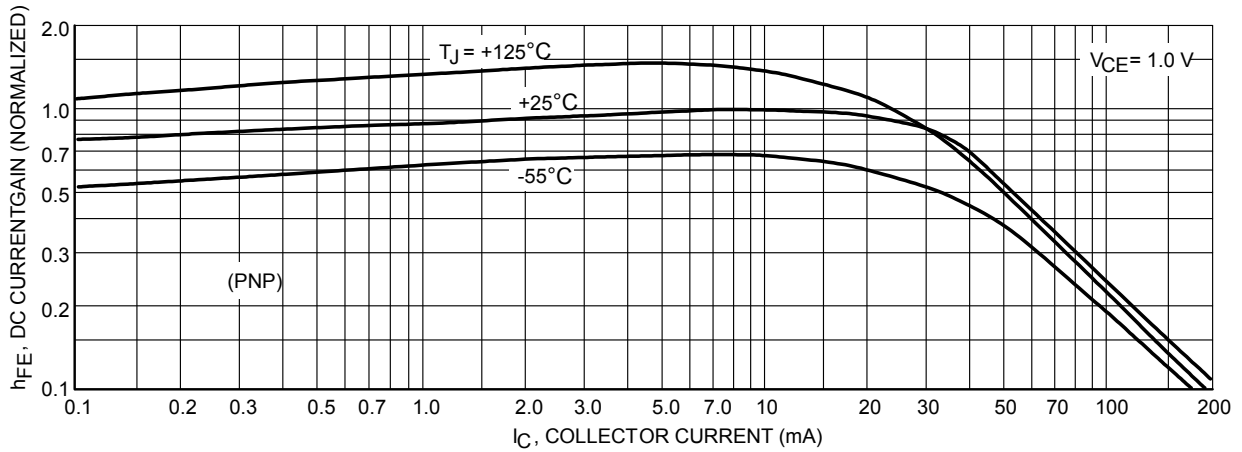


Figure 31. DC Current Gain

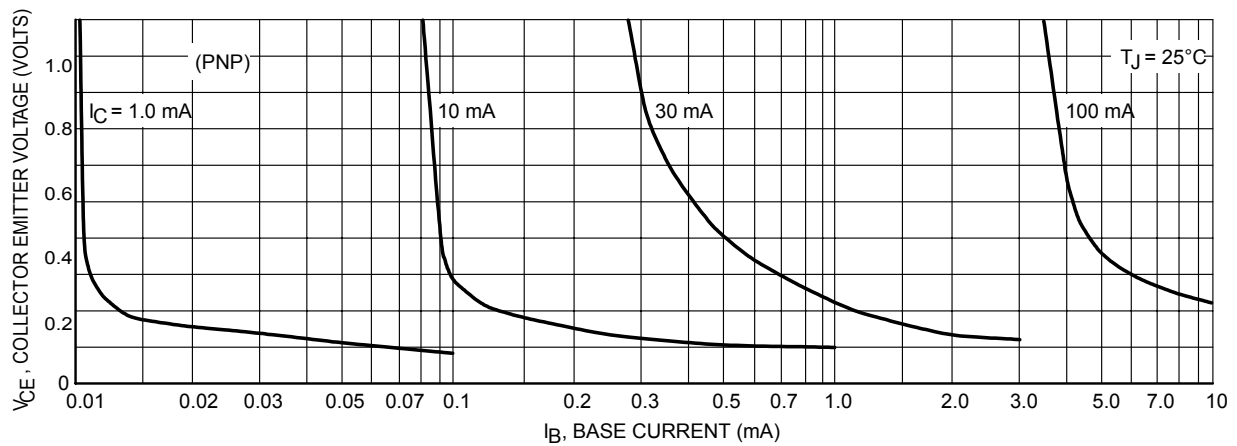


Figure 32. Collector Saturation Region

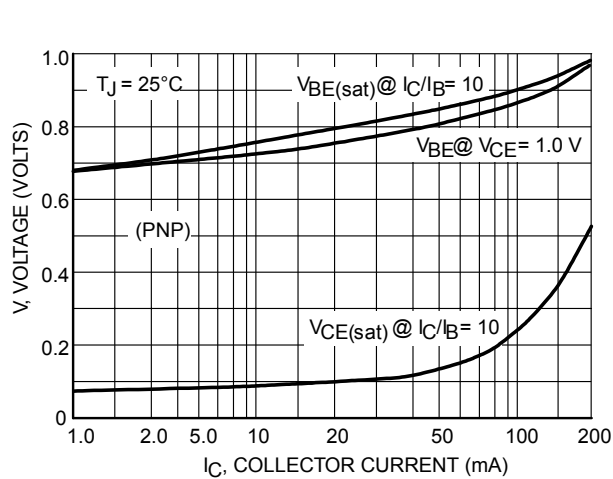


Figure 33. "ON" Voltages

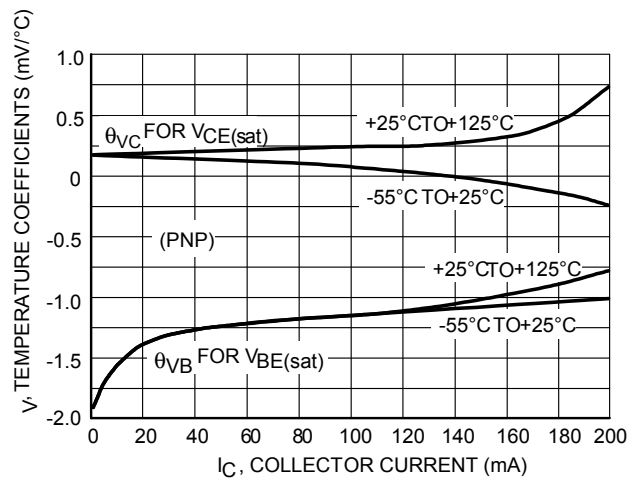


Figure 34. Temperature Coefficients



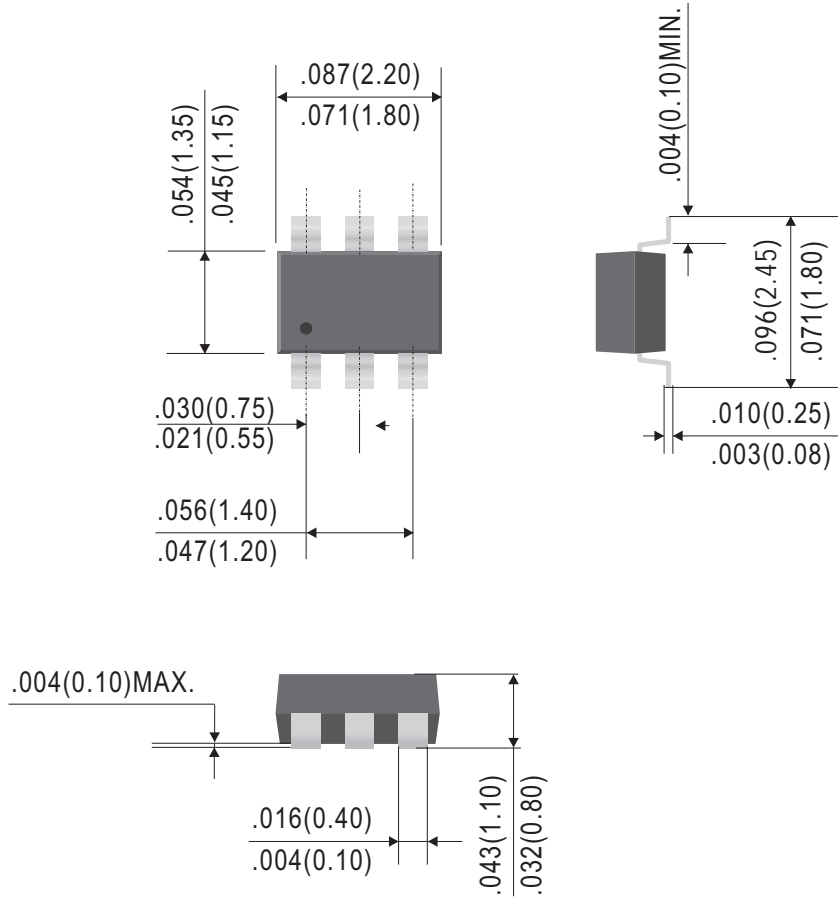
# WILLAS



## MMBT3946DW1T1

### Dual General Purpose Transistors

SOT-363



Dimensions in inches and (millimeters)



# WILLAS



## MMBT3946DW1T1

### Dual General Purpose Transistors

#### Ordering Information:

Device PN	Packing
MMBT3946DW1T1 G <sup>(1)</sup> -WS	Tape&Reel: 3 Kpcs/Reel

Note: (1) RoHS product for packing code suffix "G" ; Halogen free product for packing code suffix "H"

#### \*\*\*Disclaimer\*\*\*

WILLAS reserves the right to make changes without notice to any product specification herein, to make corrections, modifications, enhancements or other changes. WILLAS or anyone on its behalf assumes no responsibility or liability for any errors or inaccuracies. Data sheet specifications and its information contained are intended to provide a product description only. "Typical" parameters which may be included on WILLAS data sheets and/ or specifications can and do vary in different applications and actual performance may vary over time. WILLAS does not assume any liability arising out of the application or use of any product or circuit.

WILLAS products are not designed, intended or authorized for use in medical, life-saving implant or other applications intended for life-sustaining or other related applications where a failure or malfunction of component or circuitry may directly or indirectly cause injury or threaten a life without expressed written approval of WILLAS. Customers using or selling WILLAS components for use in such applications do so at their own risk and shall agree to fully indemnify WILLAS Inc and its subsidiaries harmless against all claims, damages and expenditures.