



WILLAS

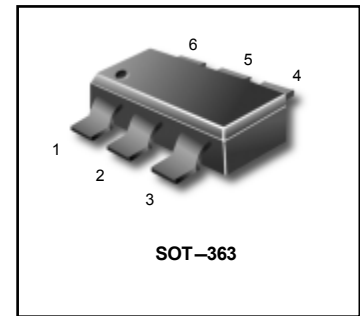


MMBT3946DW1T1

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 $V_{CE(sat)}$, ≤ 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: MMBT3946DW1T1 = 46



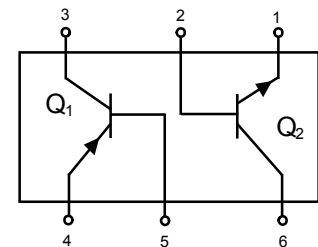
We declare that the material of product compliance with RoHS requirements.

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"



AMBT3946DW1T1*

*Q1 PNP

Q2 NPN

ORDERING INFORMATION

Device	Marking	Shipping
MMBT3946DW1T1	46	3000Units/Reel

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Package Dissipation ⁽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.



Dual General Purpose Transistors

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	
(I _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%.



Dual General Purpose Transistors

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

Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain – Bandwidth Product (I _C = 10 mA, V _{CE} = 20 V, f = 100 MHz) (NPN)	f _T	300	–	MHz
(I _C = –10 mA, V _{CE} = –20 V, f = 100 MHz) (PNP)		250	–	
Output Capacitance (V _{CB} = 5.0 V, I _E = 0, f = 1.0 MHz) (NPN)	C _{obo}	–	4.0	pF
(V _{CB} = –5.0 V, I _E = 0, f = 1.0 MHz) (PNP)		–	4.5	
Input Capacitance (V _{EB} = 0.5 V, I _C = 0, f = 1.0 MHz) (NPN)	C _{ibo}	–	8.0	pF
(V _{EB} = –0.5 V, I _C = 0, f = 1.0 MHz) (PNP)		–	10.0	
Input Impedance (V _{CE} = 10 V, I _C = 1.0 mA, f = 1.0 kHz) (NPN)	h _{ie}	1.0	10	kΩ
(V _{CE} = –10 V, I _C = –1.0 mA, f = 1.0 kHz) (PNP)		2.0	12	
Voltage Feedback Ratio (V _{CE} = 10 V, I _C = 1.0 mA, f = 1.0 kHz) (NPN)	h _{re}	0.5	8.0	X 10 ⁻⁴
(V _{CE} = –10 V, I _C = –1.0 mA, f = 1.0 kHz) (PNP)		0.1	10	
Small-Signal Current Gain (V _{CE} = 10 V, I _C = 1.0 mA, f = 1.0 kHz) (NPN)	h _{FE}	100	400	–
(V _{CE} = –10 V, I _C = –1.0 mA, f = 1.0 kHz) (PNP)		100	400	
Output Admittance (V _{CE} = 10 V, I _C = 1.0 mA, f = 1.0 kHz) (NPN)	h _{oe}	1.0	40	μmhos
(V _{CE} = –10 V, I _C = –1.0 mA, f = 1.0 kHz) (PNP)		3.0	60	
Noise Figure (V _{CE} = 5.0 V, I _C = 100 μA, R _S = 1.0 kΩ, f = 1.0 kHz) (NPN)	NF	–	5.0	dB
(V _{CE} = –5.0 V, I _C = –100 μA, R _S = 1.0 kΩ, f = 1.0 kHz) (PNP)		–	4.0	

SWITCHING CHARACTERISTICS

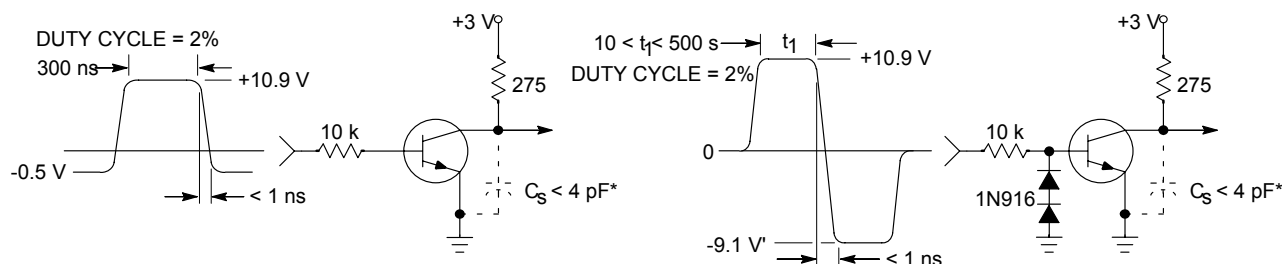
Delay Time	(V _{CC} = 3.0 V, V _{BE} = –0.5 V) (NPN)	t _d	–	35	ns
	(V _{CC} = –3.0 V, V _{BE} = 0.5 V) (PNP)		–	35	
Rise Time	(I _C = 10 mA, I _{B1} = 1.0 mA) (NPN)	t _r	–	35	ns
	(I _C = –10 mA, I _{B1} = –1.0 mA) (PNP)		–	35	
Storage Time	(V _{CC} = 3.0 V, I _C = 10 mA) (NPN)	t _s	–	200	ns
	(V _{CC}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

Dual General Purpose Transistors

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1

(NPN)



* 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

TYPICAL TRANSIENT CHARACTERISTICS

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

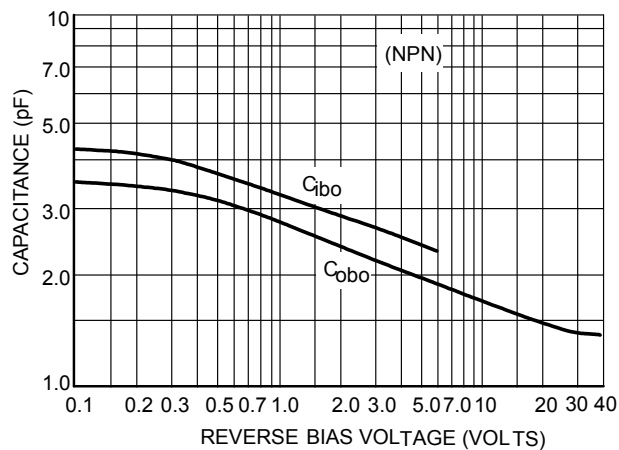


Figure 3. Capacitance

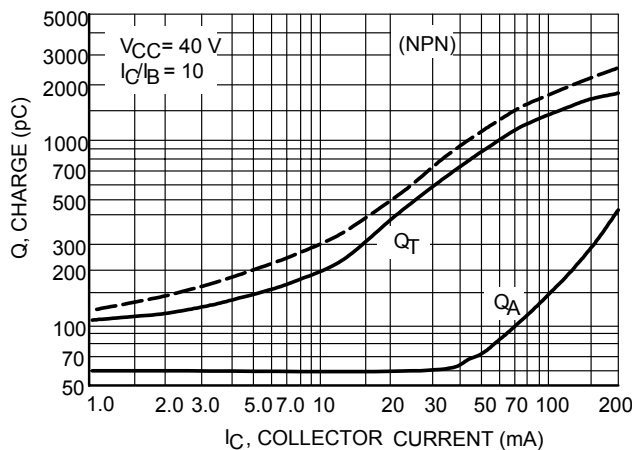


Figure 4. Charge Data



Dual General Purpose Transistors

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1

(NPN)

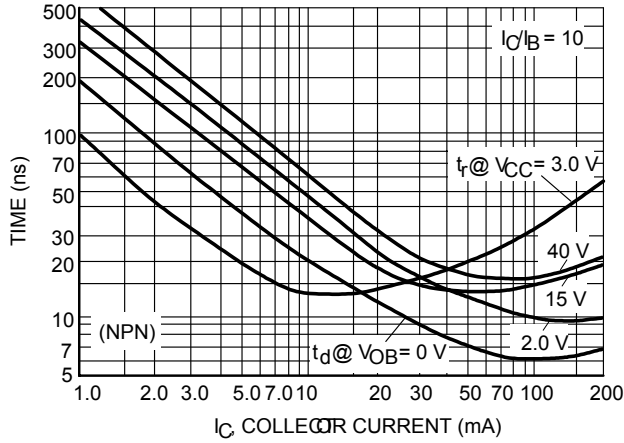


Figure 5. Turn-On Time

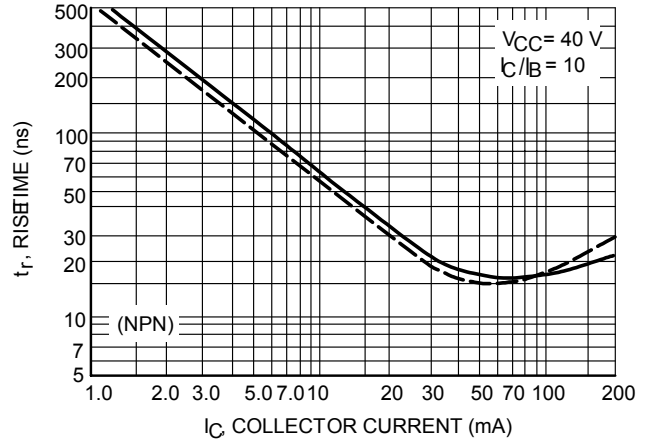


Figure 6. Rise Time

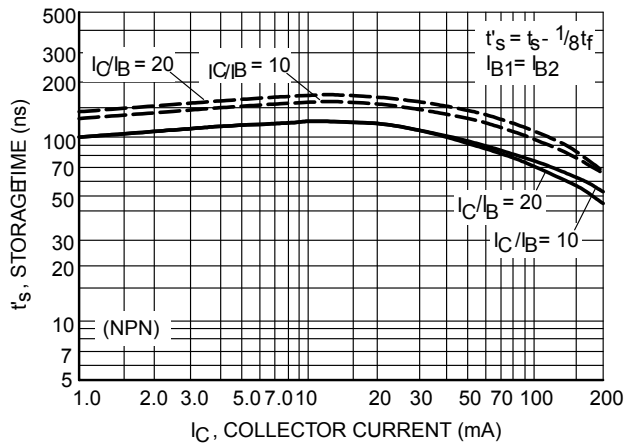


Figure 7. Storage Time

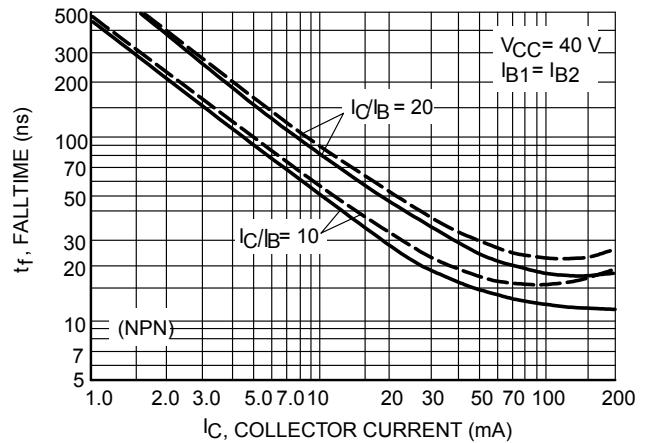


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

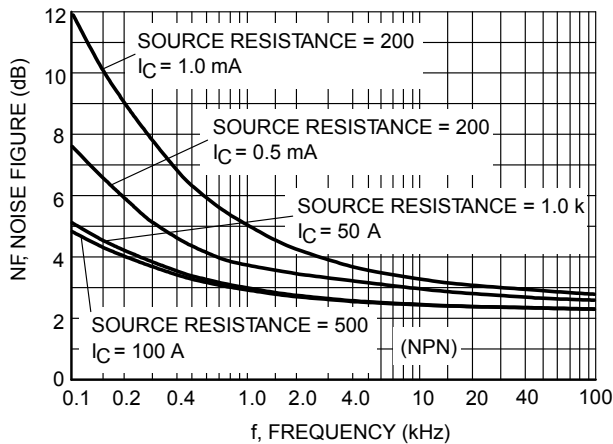


Figure 9. Noise Figure

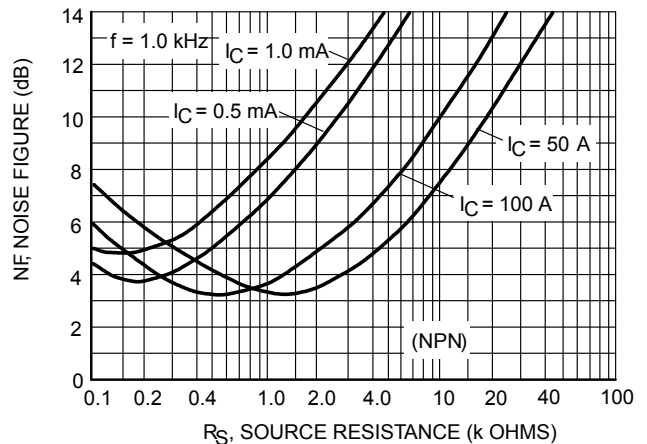


Figure 10. Noise Figure

Dual General Purpose Transistors

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1

(NPN)

h PARAMETERS

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

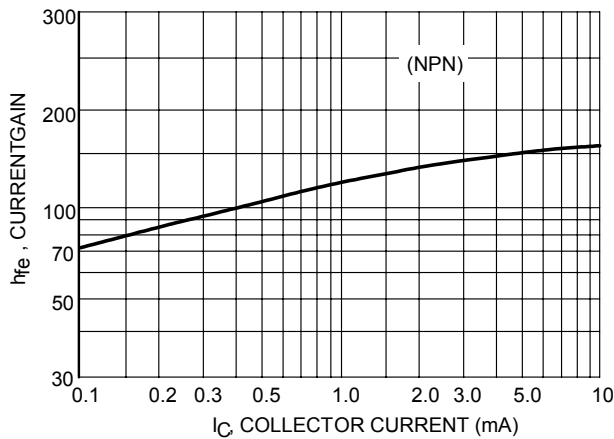


Figure 11. Current Gain

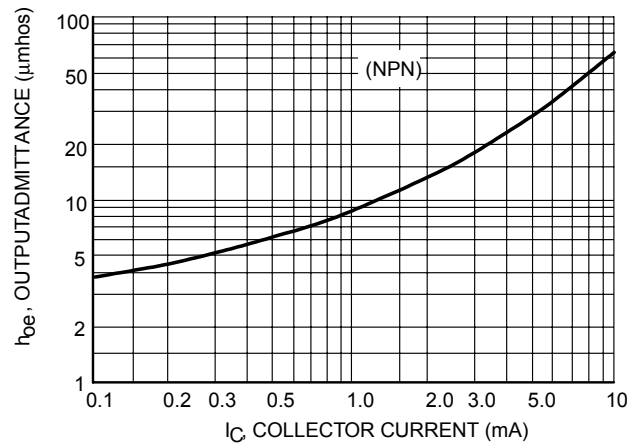


Figure 12. Output Admittance

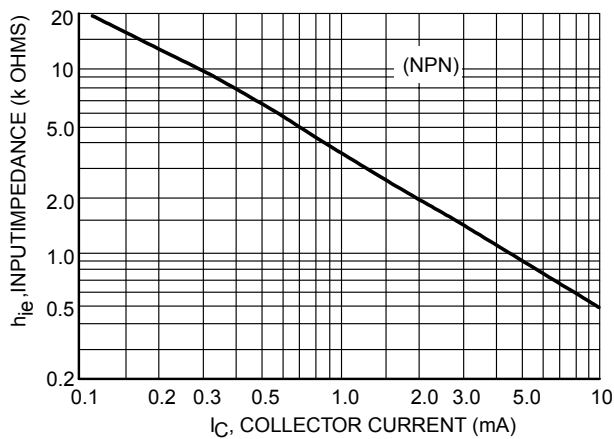


Figure 13. Input Impedance

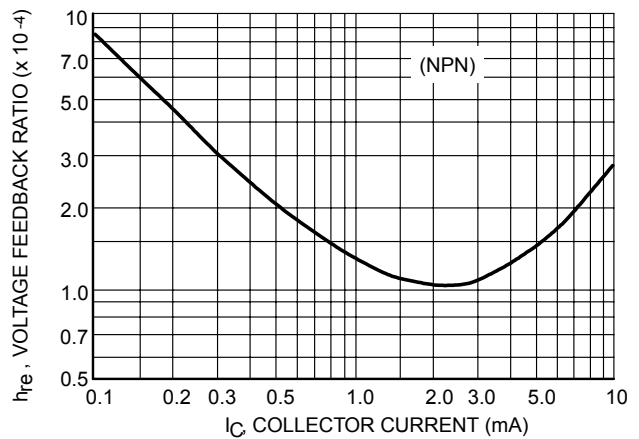


Figure 14. Voltage Feedback Ratio

Dual General Purpose Transistors

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1

(NPN)

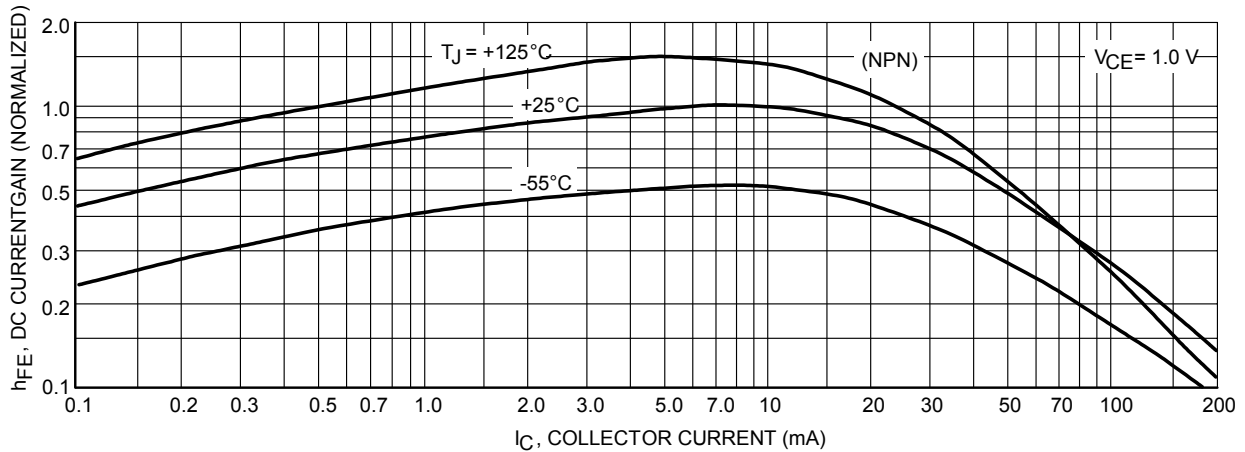


Figure 15. DC Current Gain

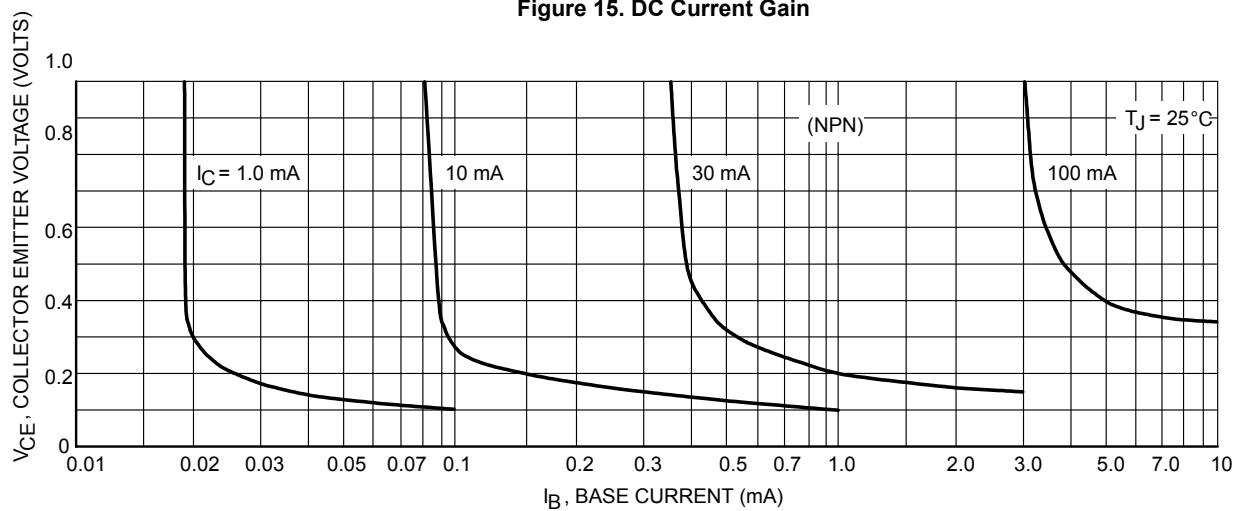


Figure 16. Collector Saturation Region

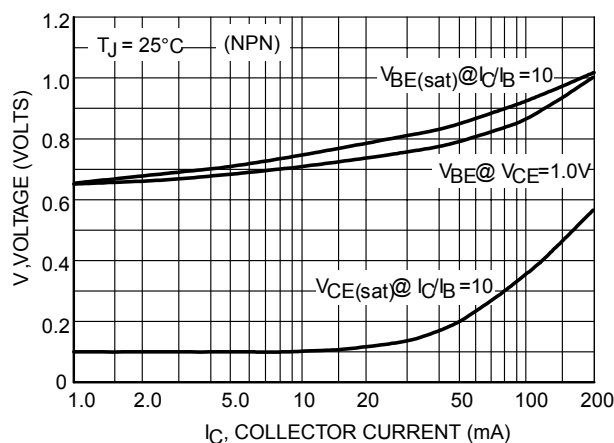


Figure 17. "ON" Voltages

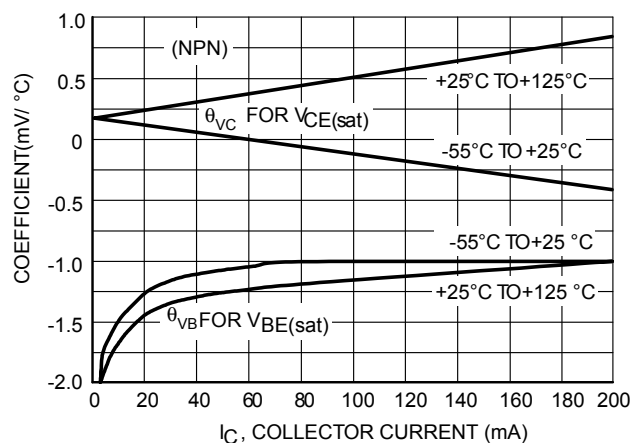


Figure 18. Temperature Coefficients

Dual General Purpose Transistors

TYPICAL ELECTRICAL CHARACTERISTICS

MMBT3946DW1T1

(PNP)

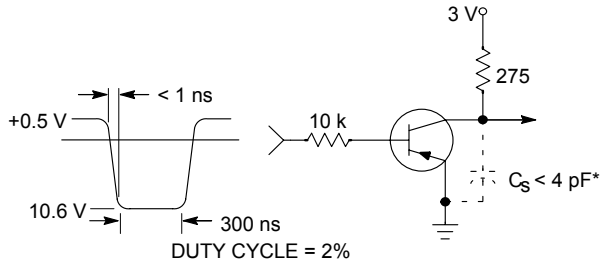


Figure 19. Delay and Rise Time Equivalent Test Circuit

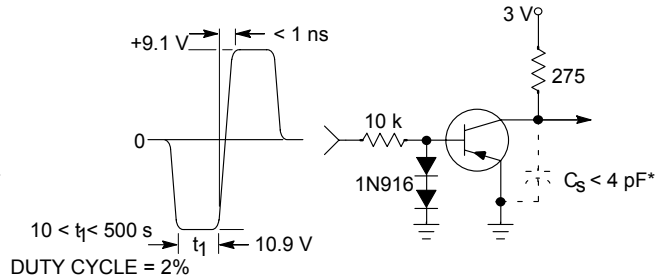


Figure 20. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

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

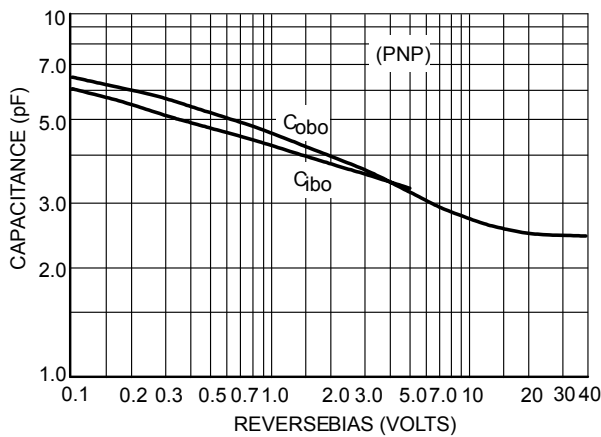


Figure 21. Capacitance

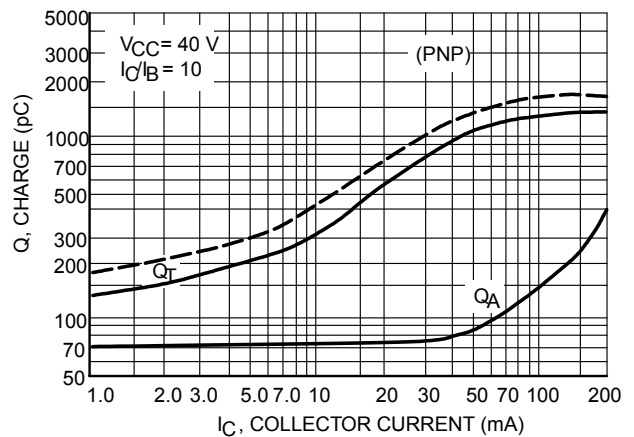


Figure 22. Charge Data

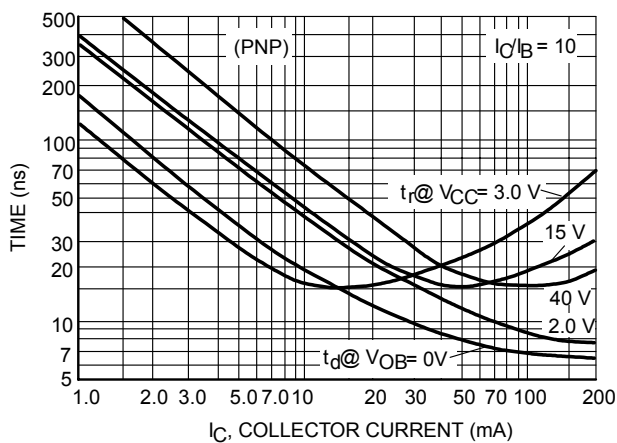


Figure 23. Turn-On Time

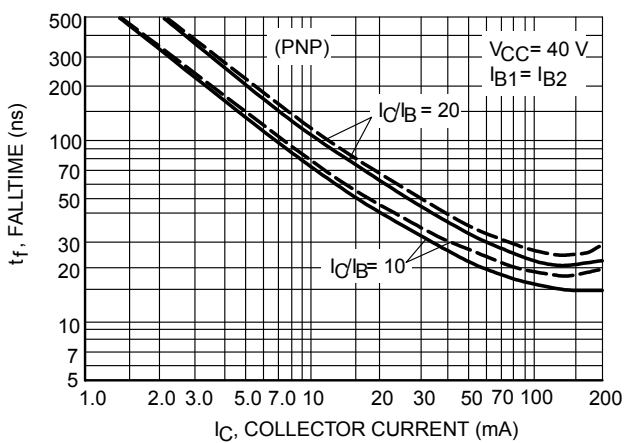


Figure 24. Fall Time



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)

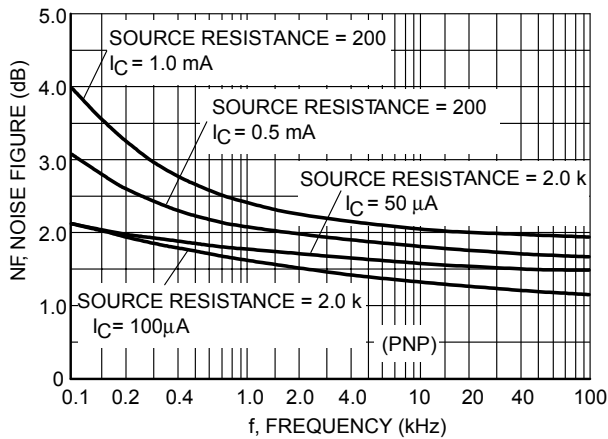


Figure 25.

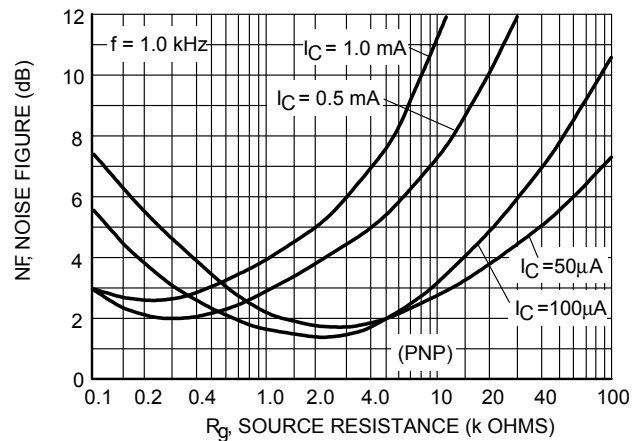


Figure 26.

h PARAMETERS

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

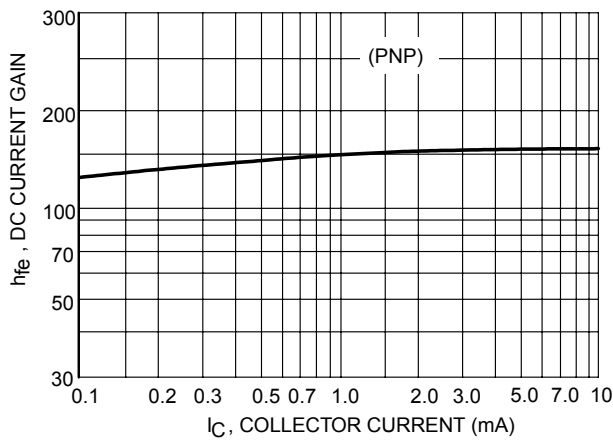


Figure 27. Current Gain

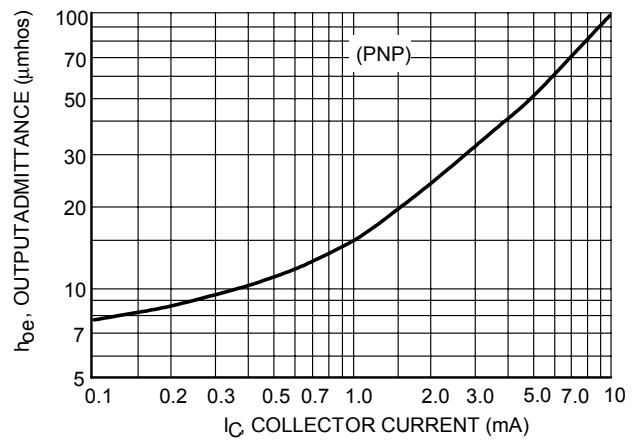


Figure 28. Output Admittance

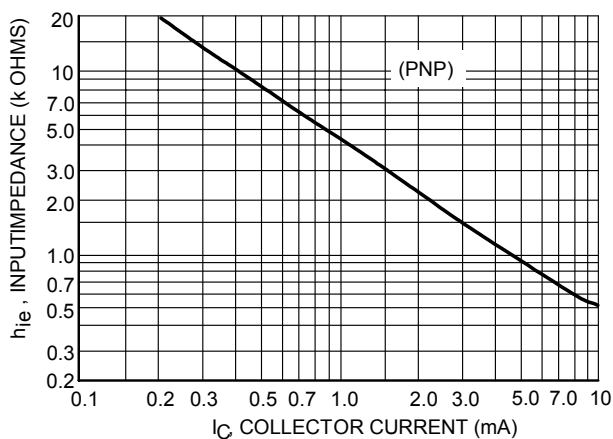


Figure 29. Input Impedance

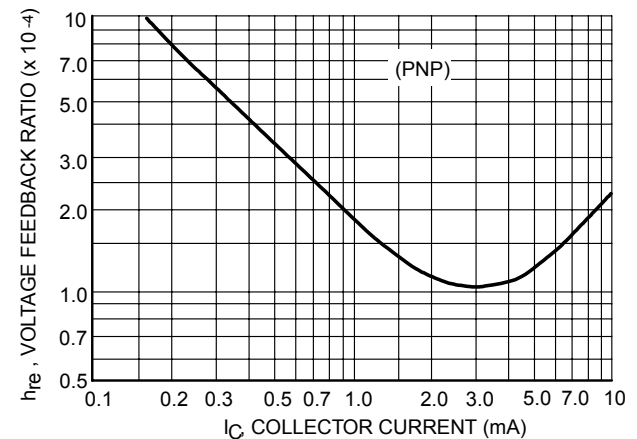


Figure 30. Voltage Feedback Ratio



Dual General Purpose Transistors

TYPICAL ELECTRICAL CHARACTERISTICS MMBT3946DW1T1 (PNP)

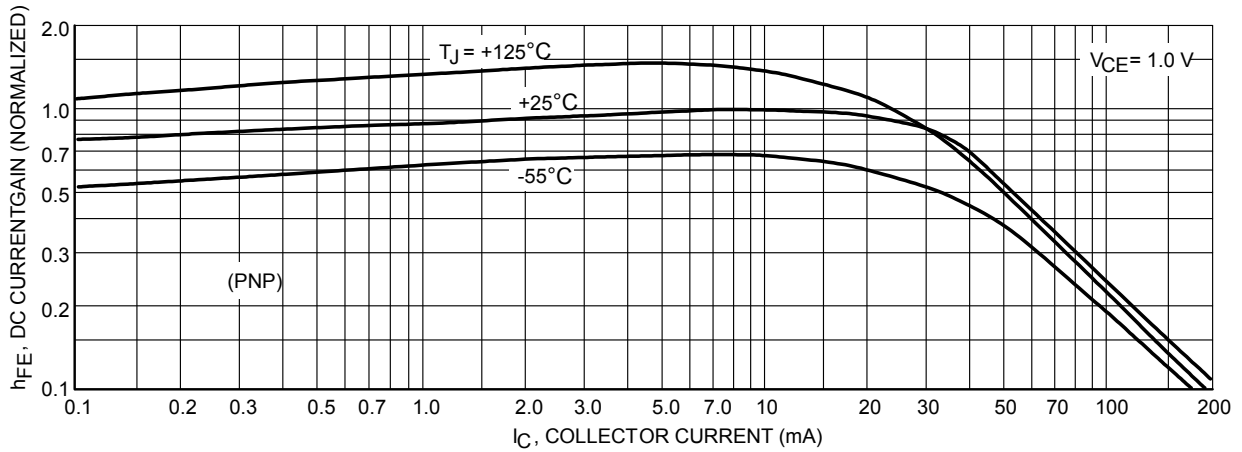


Figure 31. DC Current Gain

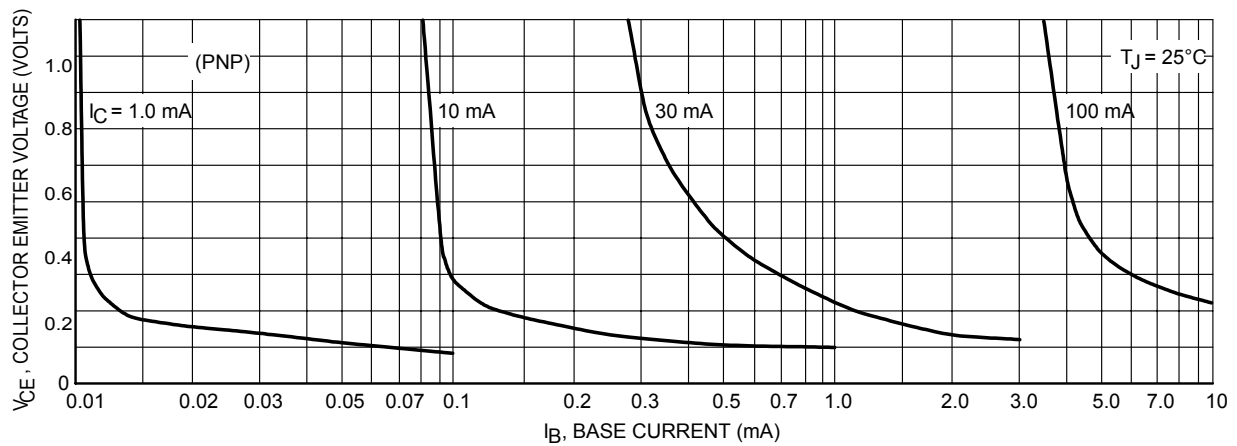


Figure 32. Collector Saturation Region

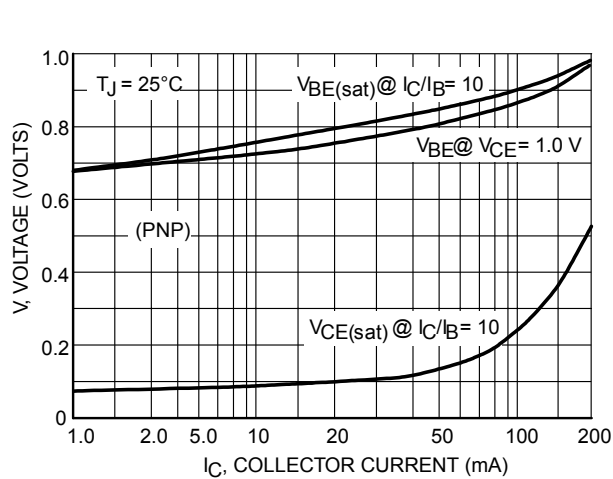


Figure 33. "ON" Voltages

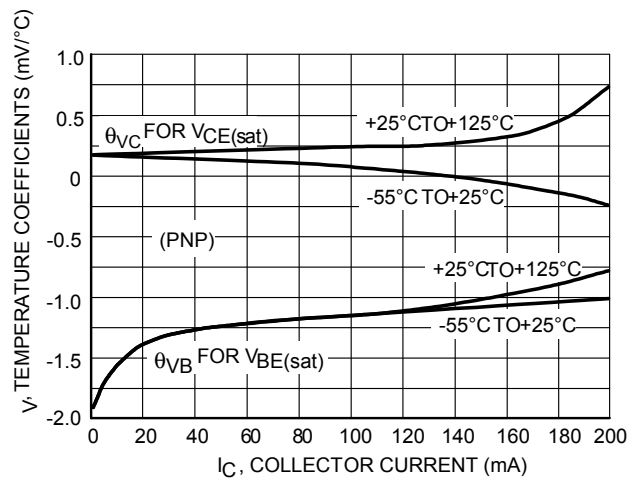


Figure 34. Temperature Coefficients



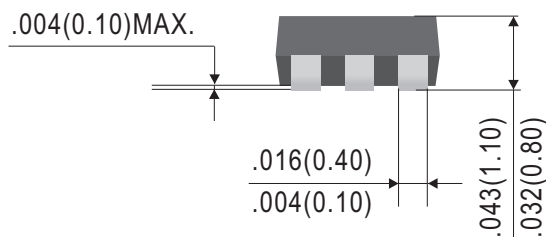
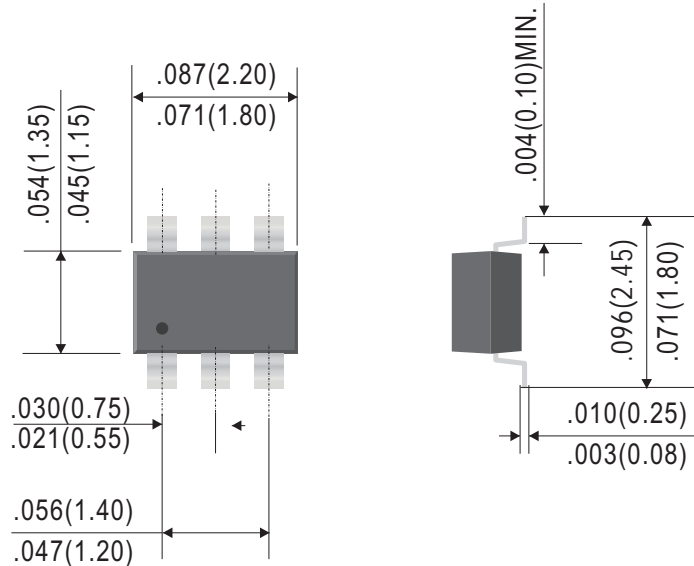
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MMBT3946DW1T1

Dual General Purpose Transistors

SOT-363



Dimensions in inches and (millimeters)

