Complementary General Purpose Transistor MBT3946DW1T1G, SMBT3946DW1T1G

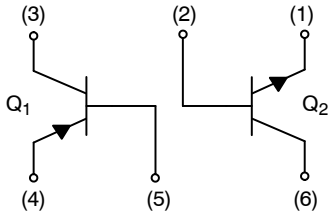
The MBT3946DW1T1G device is a spin-off of our popular SOT-23/SOT-323 three-leaded device. It is designed for general purpose amplifier applications and is housed in the SOT-363-6 surface mount package. By putting two discrete devices in one package, this device is ideal for low-power surface mount applications where board space is at a premium.

Features

- h_{FE}, 100-300
- Low $V_{CE(sat)}$, ≤ 0.4 V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

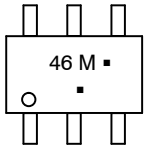


SOT−363/SC−88
CASE 419B
STYLE 1



MBT3946DW1T1*
*Q1 PNP
Q2 NPN

MARKING DIAGRAM



46 = Specific Device Code
M = Date Code
▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
MBT3946DW1T1G	SC-88 (Pb-Free)	3,000 / Tape & Reel
SMBT3946DW1T1G	SC-88 (Pb-Free)	3,000 / Tape & Reel
MBT3946DW1T2G	SC-88 (Pb-Free)	3,000 / 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.

Table 1. 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 Class 2 MM Class B	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 2. THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Package Dissipation (Note 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

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

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Table 3. ELECTRICAL CHARACTERISTICS (T_A = 25 °C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector – Emitter Breakdown Voltage (Note 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 (Note 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	
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	

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Table 4. ELECTRICAL CHARACTERISTICS (T_A = 25 °C unless otherwise noted) (continued)

Characteristic		Symbol	Min	Max	Unit
Output Admittance (V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz) (V_{CE} = −10 Vdc, I_C = −1.0 mAdc, f = 1.0 kHz)	 (NPN) (PNP)	h_{oe}	 1.0 3.0	 40 60	μmhos
Noise Figure (V_{CE} = 5.0 Vdc, I_C = 100 μAdc, R_S = 1.0 kΩ, f = 1.0 kHz) (V_{CE} = −5.0 Vdc, I_C = −100 μAdc, R_S = 1.0 kΩ, f = 1.0 kHz)	 (NPN) (PNP)	NF	 – –	 5.0 4.0	dB
SWITCHING CHARACTERISTICS					
Delay Time	(V_{CC} = 3.0 Vdc, V_{BE} = −0.5 Vdc) (V_{CC} = −3.0 Vdc, V_{BE} = 0.5 Vdc)	t_d	–	35	ns
Rise Time	(I_C = 10 mAdc, I_{B1} = 1.0 mAdc) (I_C = −10 mAdc, I_{B1} = −1.0 mAdc)	t_r	–	35	ns
Storage Time	(V_{CC} = 3.0 Vdc, I_C = 10 mAdc) (V_{CC} = −3.0 Vdc, I_C = −10 mAdc)	t_s	–	200	ns
Fall Time	(I_{B1} = I_{B2} = 1.0 mAdc) (I_{B1} = I_{B2} = −1.0 mAdc)	t_f	–	50	ns

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

(NPN)

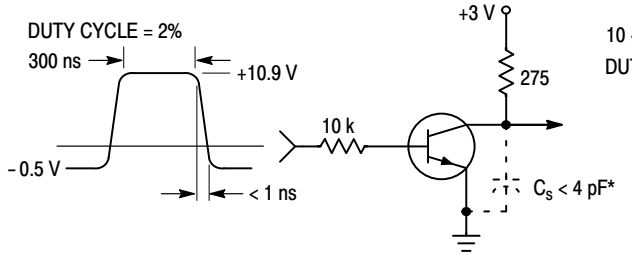


Figure 1. Delay and Rise Time Equivalent Test Circuit

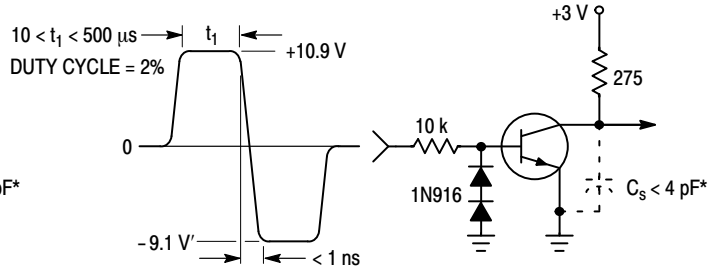


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

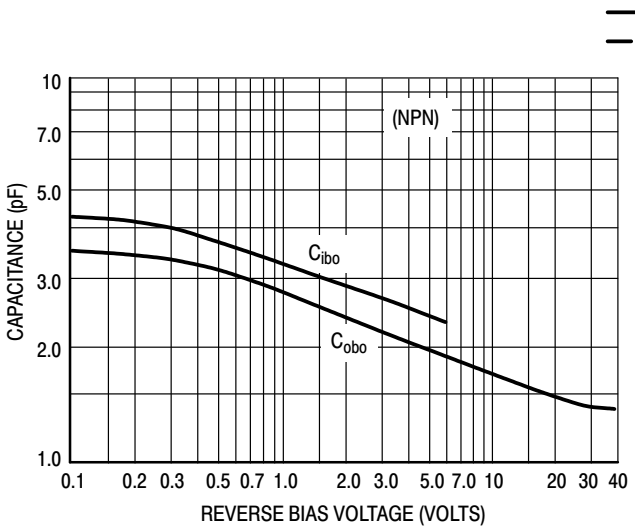


Figure 3. Capacitance

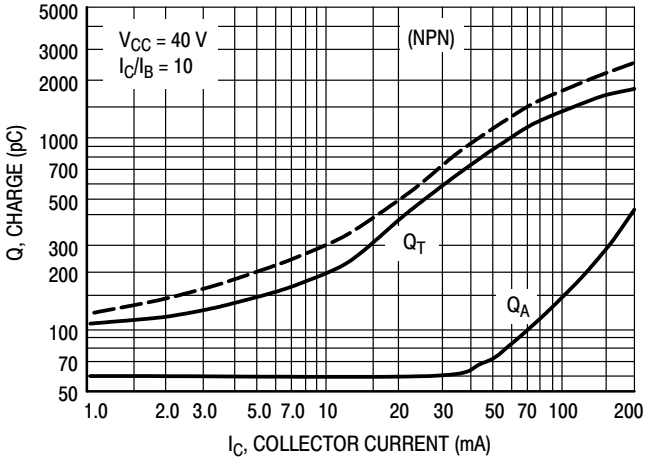


Figure 4. Charge Data

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(NPN)

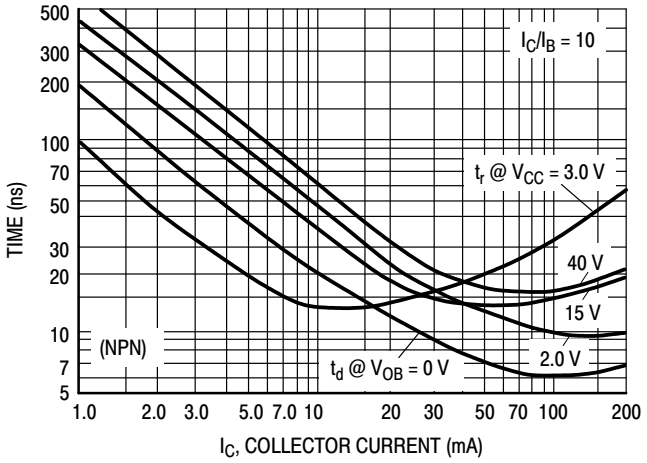


Figure 5. Turn-On Time

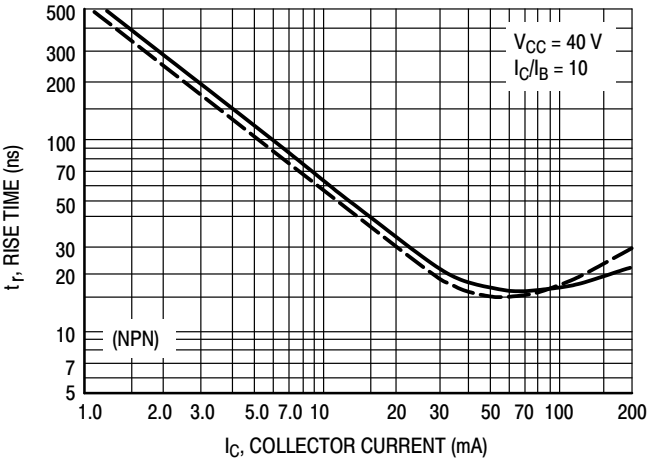


Figure 6. Rise Time

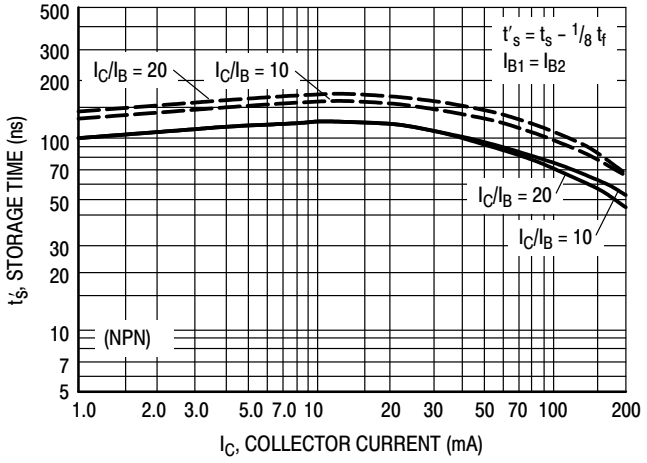


Figure 7. Storage Time

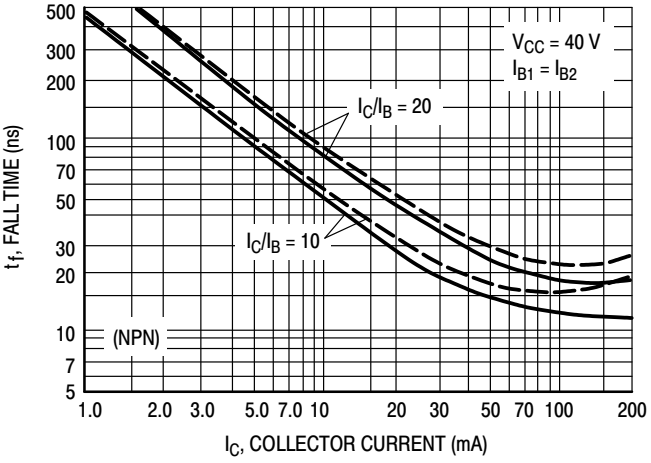


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

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

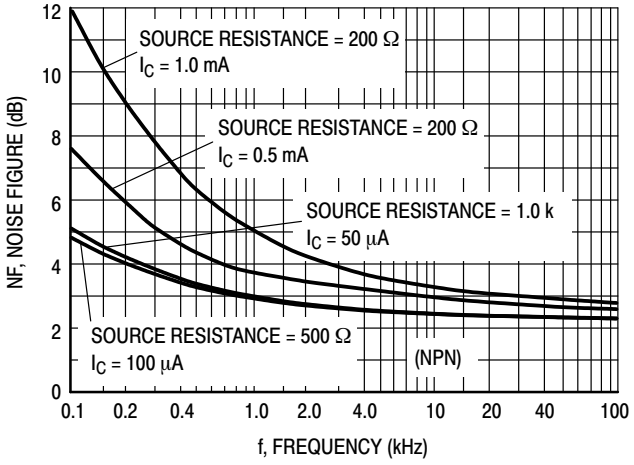


Figure 9. Noise Figure

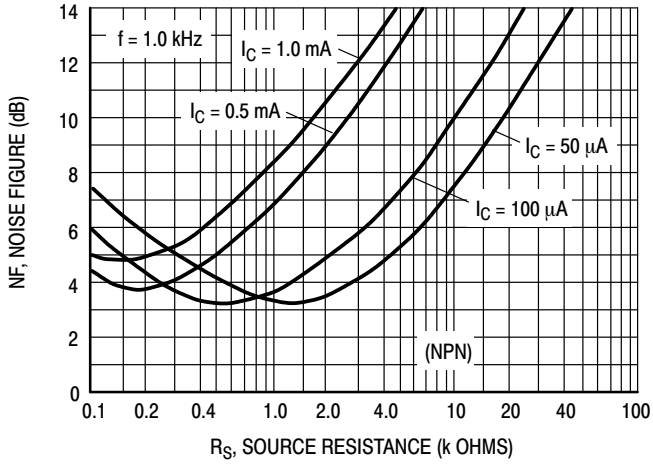


Figure 10. Noise Figure

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

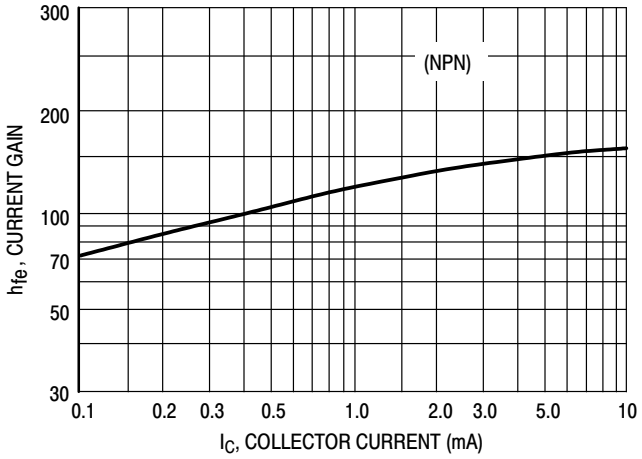


Figure 11. Current Gain

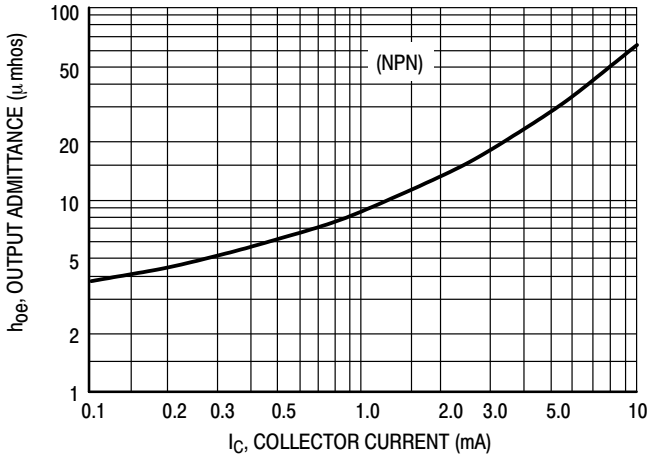


Figure 12. Output Admittance

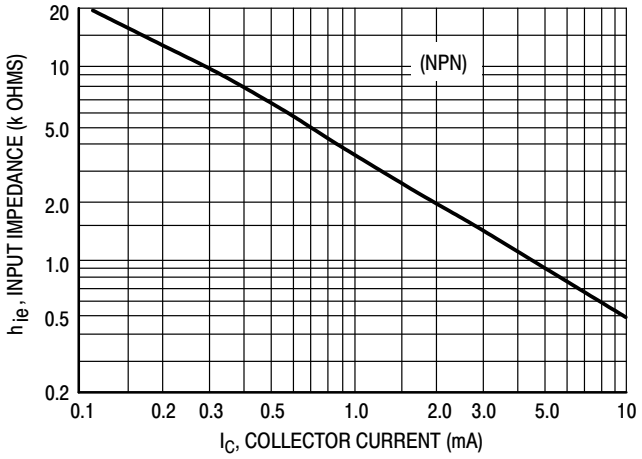


Figure 13. Input Impedance

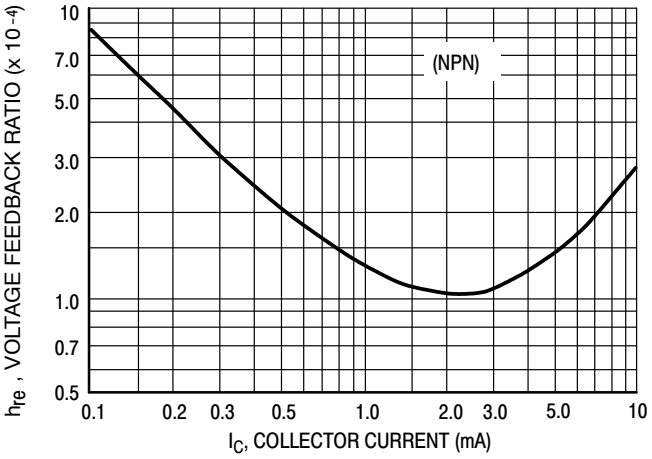


Figure 14. Voltage Feedback Ratio

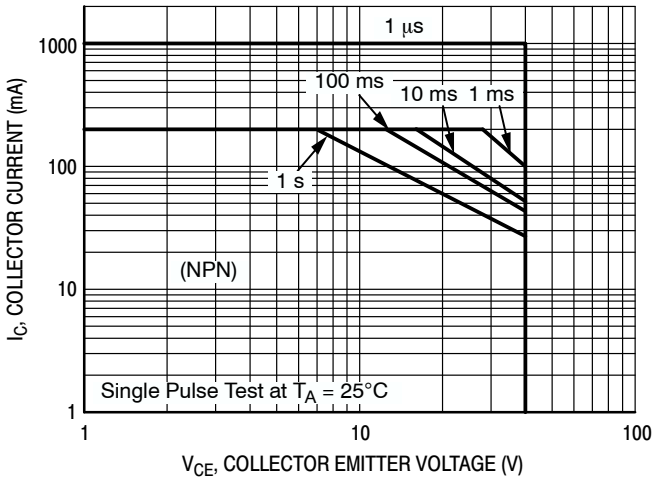


Figure 15. Safe Operating Area

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TYPICAL STATIC CHARACTERISTICS

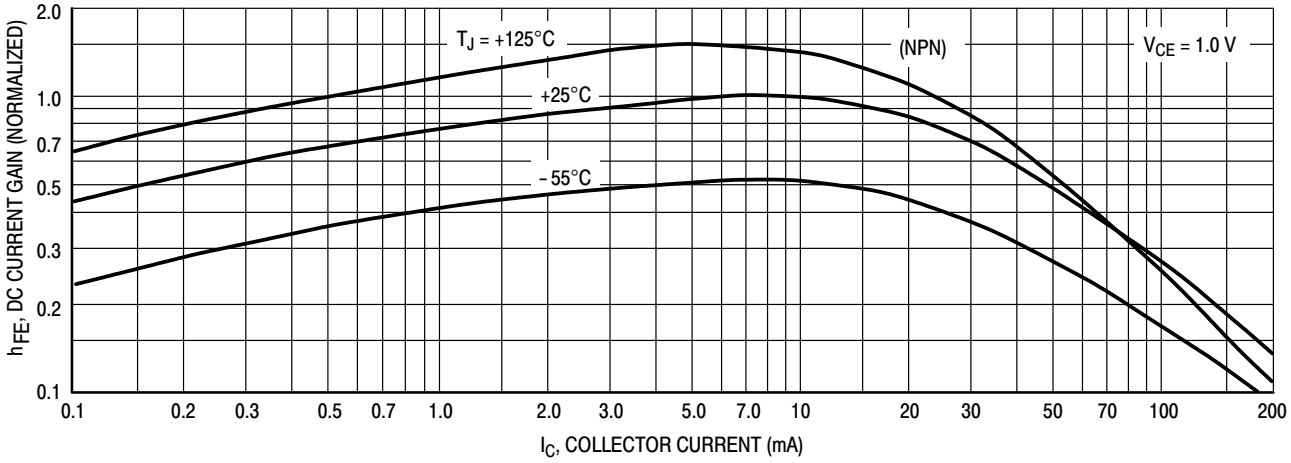


Figure 16. DC Current Gain

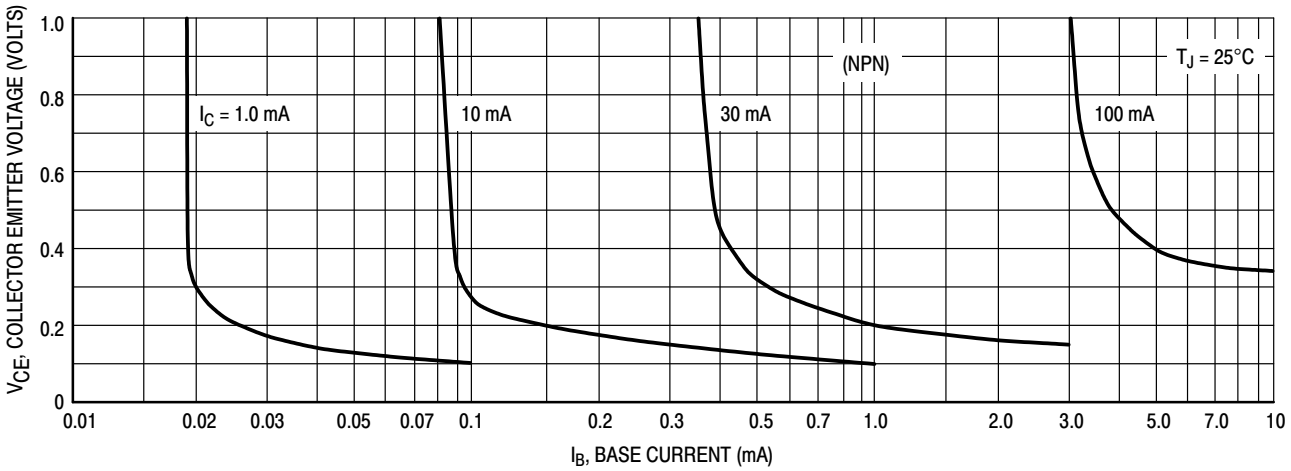


Figure 17. Collector Saturation Region

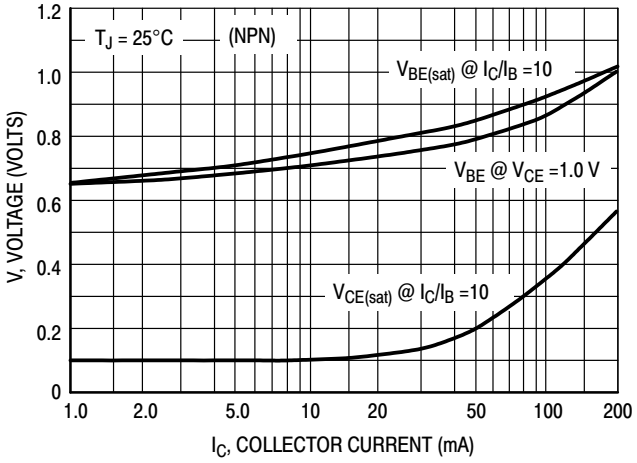


Figure 18. “ON” Voltages

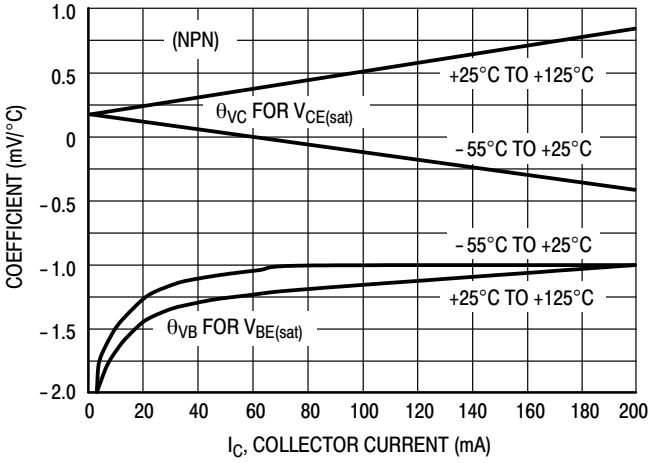


Figure 19. Temperature Coefficients

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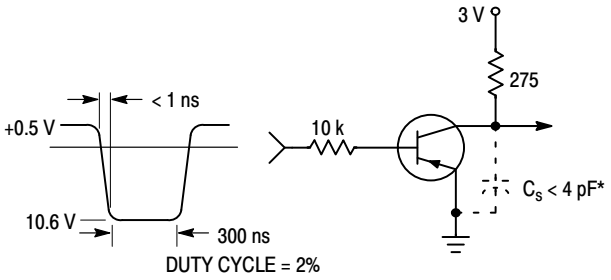


Figure 20. Delay and Rise Time Equivalent Test Circuit

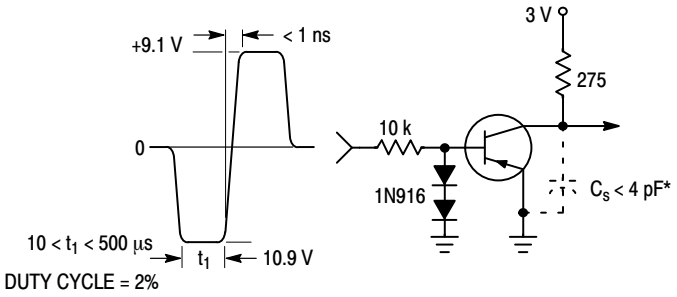


Figure 21. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

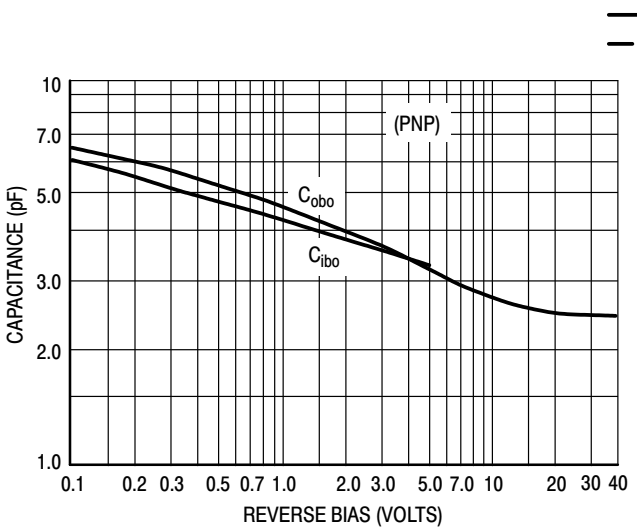


Figure 22. Capacitance

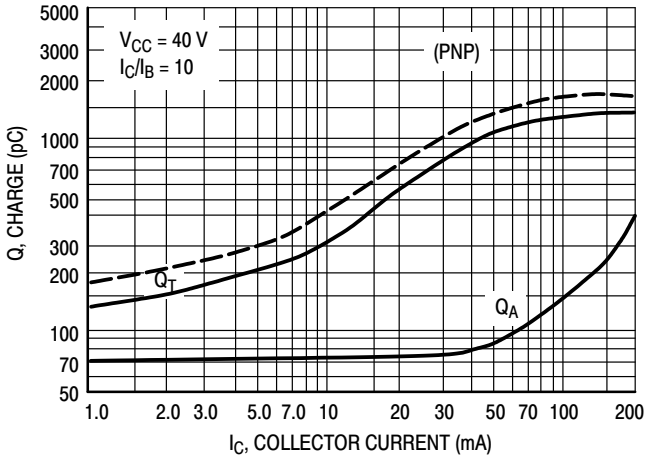


Figure 23. Charge Data

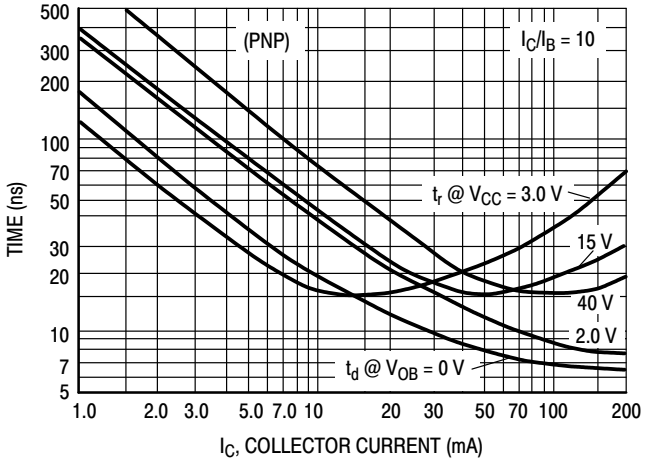


Figure 24. Turn-On Time

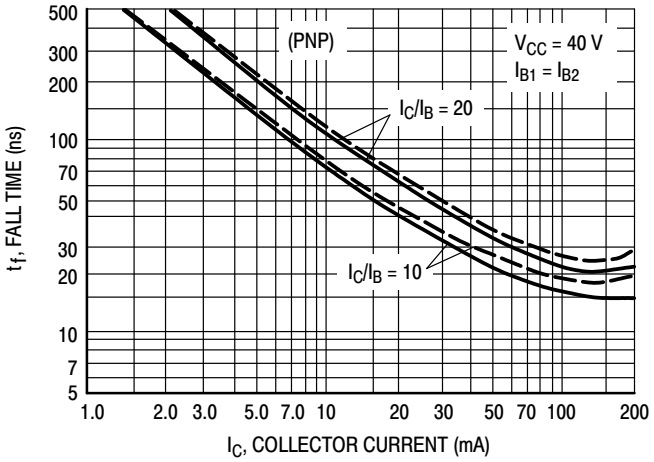


Figure 25. Fall Time

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TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

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

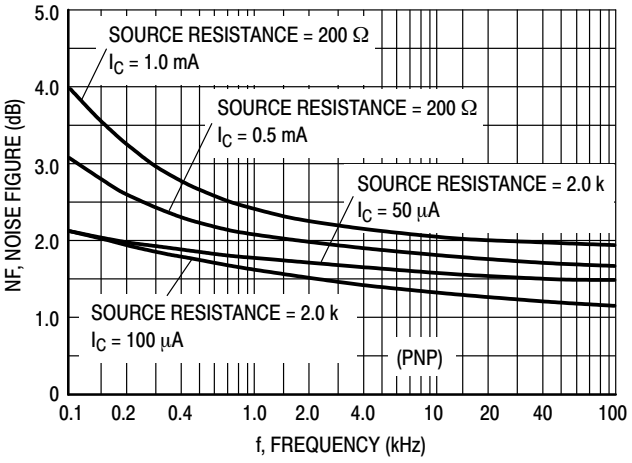


Figure 26.

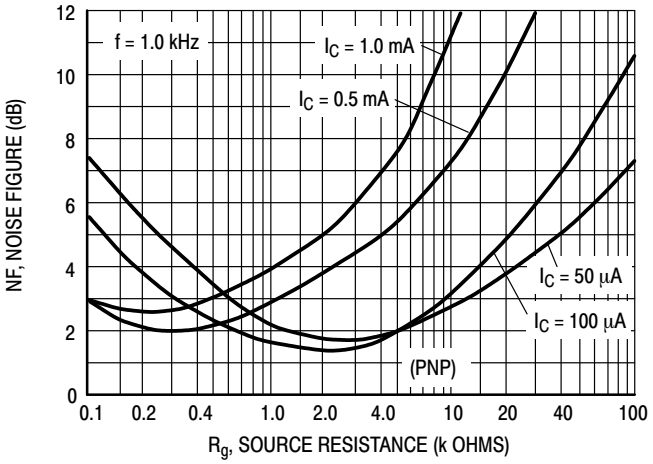


Figure 27.

h PARAMETERS

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

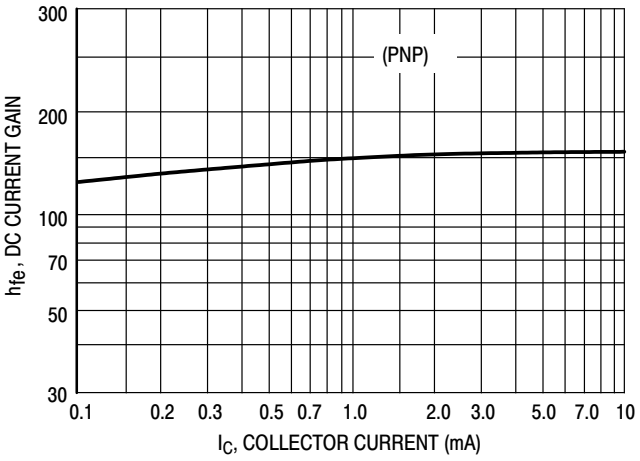


Figure 28. Current Gain

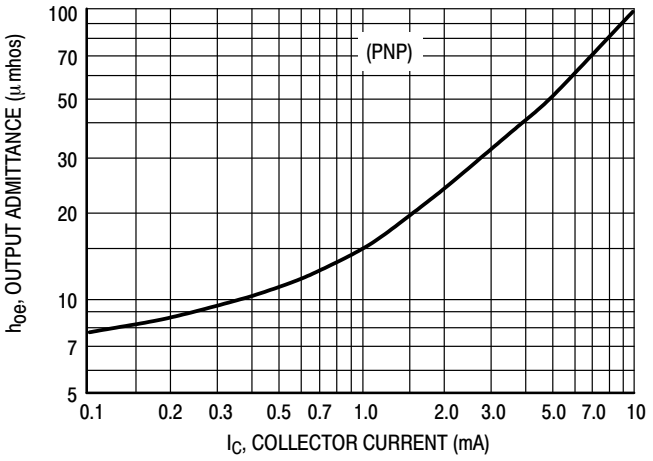


Figure 29. Output Admittance

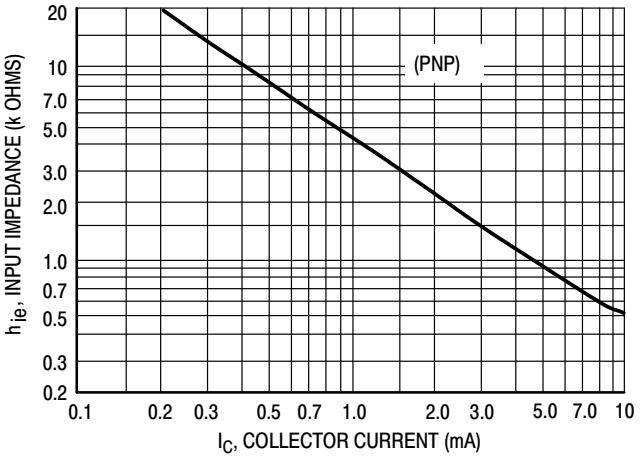


Figure 30. Input Impedance

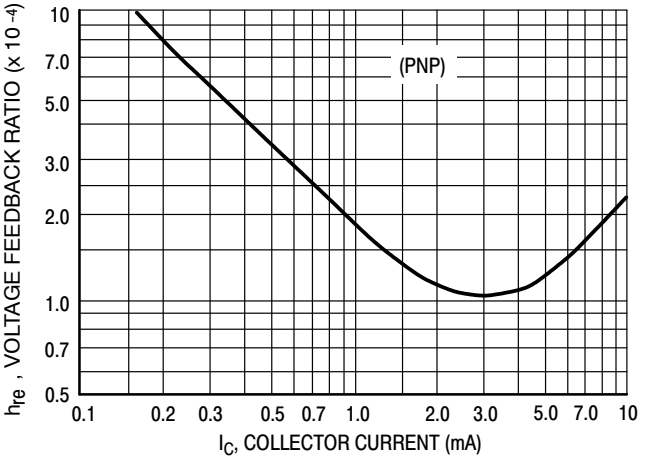


Figure 31. Voltage Feedback Ratio

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(PNP)

TYPICAL STATIC CHARACTERISTICS

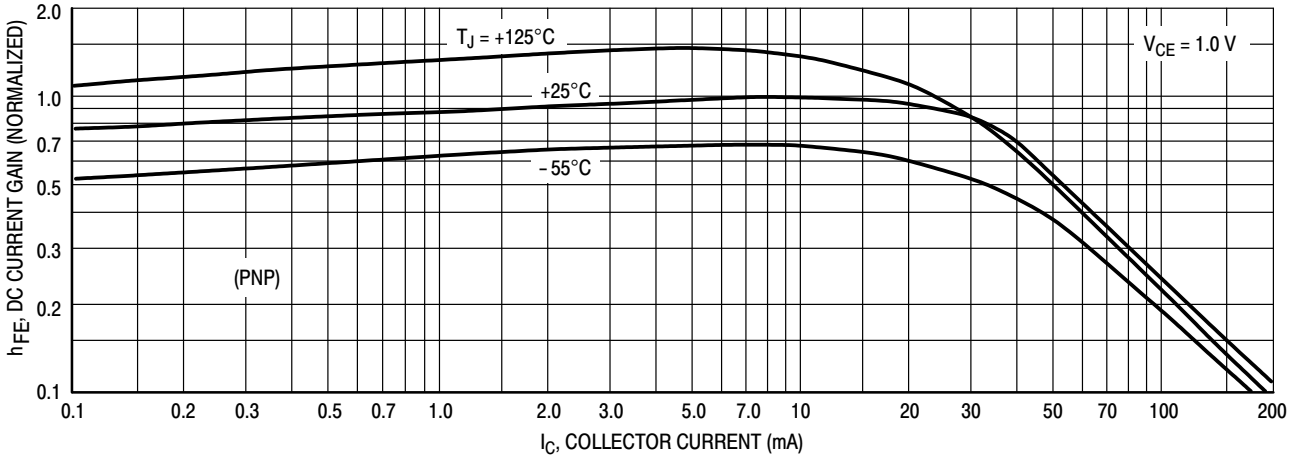


Figure 32. DC Current Gain

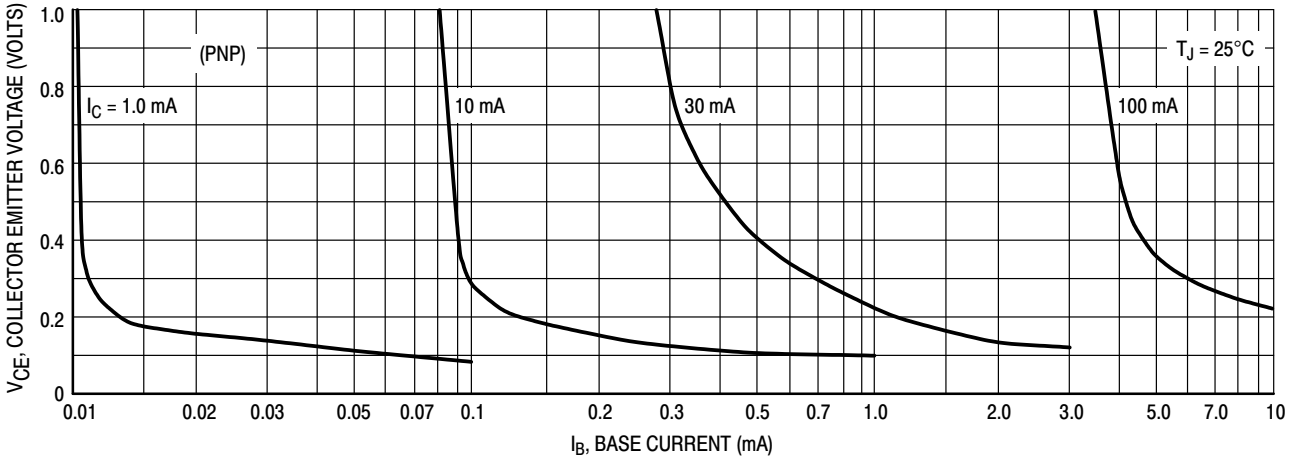


Figure 33. Collector Saturation Region

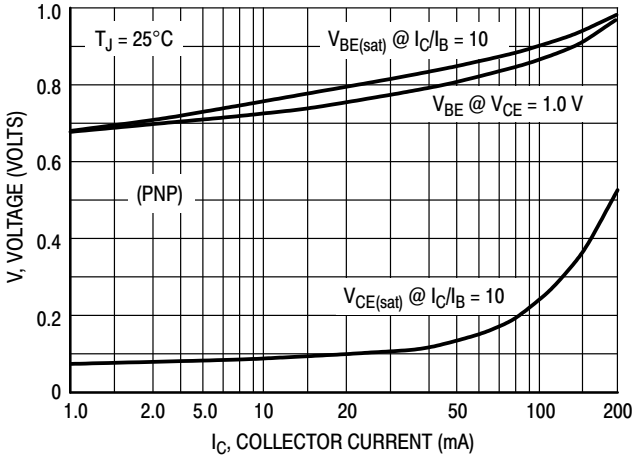


Figure 34. “ON” Voltages

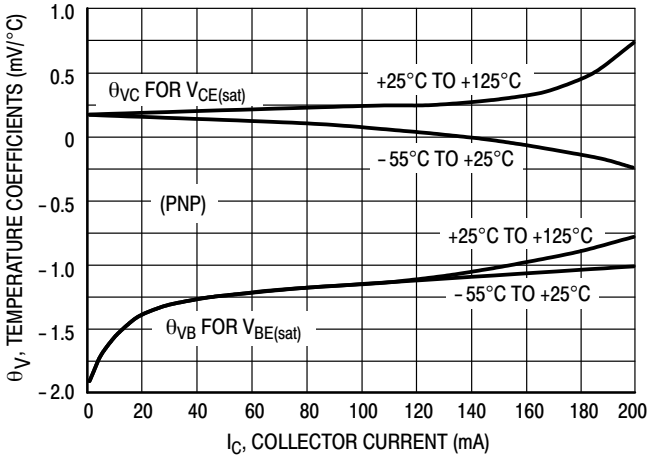


Figure 35. Temperature Coefficients

Share Feedback
Your Opinion Matters

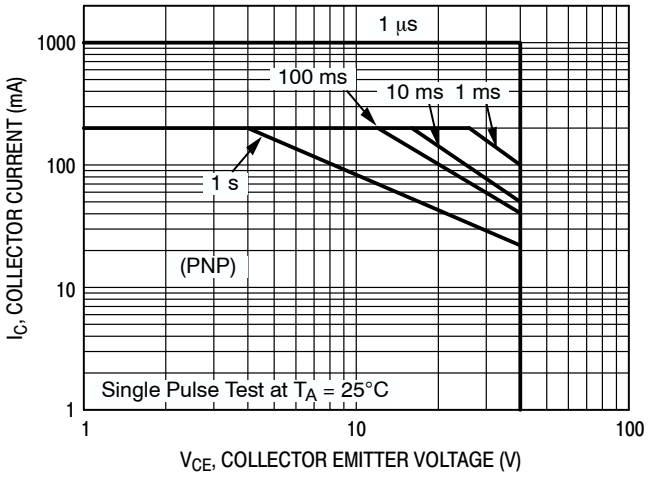


Figure 36. Safe Operating Area

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Your Opinion Matters

REVISION HISTORY

Revision	Description of Changes	Date
8	Rebranded the Data Sheet to **onsemi** format	7/7/2025

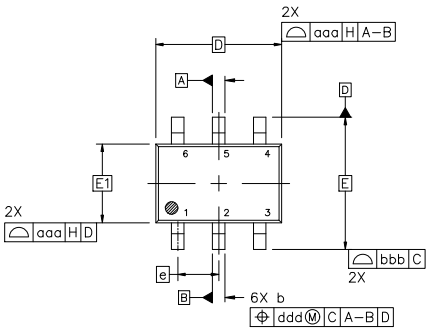
This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.

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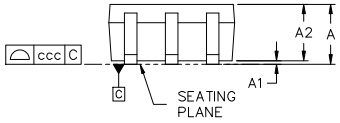


SC−88 2.00x1.25x0.90, 0.65P
CASE 419B−02
ISSUE Z

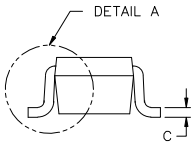
DATE 18 APR 2024



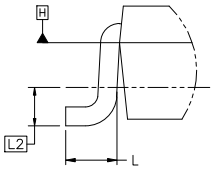
TOP VIEW



SIDE VIEW



END VIEW

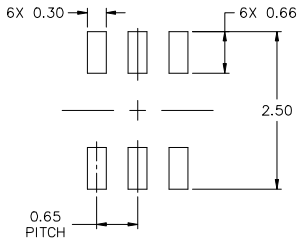


DETAIL A
SCALE 2:1

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5−2018.
2. ALL DIMENSION ARE IN MILLIMETERS.
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
5. DATUMS A AND B ARE DETERMINED AT DATUM H.
6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

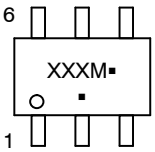
	MILLIMETERS		
DIM	MIN.	NOM.	MAX.
A	−−−	−−−	1.10
A1	0.00	−−−	0.10
A2	0.70	0.90	1.00
b	0.15	0.20	0.25
c	0.08	0.15	0.22
D	2.00 BSC		
E	2.10 BSC		
E1	1.25 BSC		
e	0.65 BSC		
L	0.26	0.36	0.46
L2	0.15 BSC		
aaa	0.15		
bbb	0.30		
ccc	0.10		
ddd	0.10		



RECOMMENDED MOUNTING FOOTPRINT*

* FOR ADDITIONAL INFORMATION ON OUR Pb−FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code
M = Date Code*
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing location.

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

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SC−88 2.00x1.25x0.90, 0.65P
CASE 419B−02
ISSUE Z

DATE 18 APR 2024

STYLE 1:
PIN 1. EMITTER 2
2. BASE 2
3. COLLECTOR 1
4. EMITTER 1
5. BASE 1
6. COLLECTOR 2

STYLE 2:
CANCELLED

STYLE 3:
CANCELLED

STYLE 4:
PIN 1. CATHODE
2. CATHODE
3. COLLECTOR
4. EMITTER
5. BASE
6. ANODE

STYLE 5:
PIN 1. ANODE
2. ANODE
3. COLLECTOR
4. EMITTER
5. BASE
6. CATHODE

STYLE 6:
PIN 1. ANODE 2
2. N/C
3. CATHODE 1
4. ANODE 1
5. N/C
6. CATHODE 2

STYLE 7:
PIN 1. SOURCE 2
2. DRAIN 2
3. GATE 1
4. SOURCE 1
5. DRAIN 1
6. GATE 2

STYLE 8:
CANCELLED

STYLE 9:
PIN 1. EMITTER 2
2. EMITTER 1
3. COLLECTOR 1
4. BASE 1
5. BASE 2
6. COLLECTOR 2

STYLE 10:
PIN 1. SOURCE 2
2. SOURCE 1
3. GATE 1
4. DRAIN 1
5. DRAIN 2
6. GATE 2

STYLE 11:
PIN 1. CATHODE 2
2. CATHODE 2
3. ANODE 1
4. CATHODE 1
5. CATHODE 1
6. ANODE 2

STYLE 12:
PIN 1. ANODE 2
2. ANODE 2
3. CATHODE 1
4. ANODE 1
5. ANODE 1
6. CATHODE 2

STYLE 13:
PIN 1. ANODE
2. N/C
3. COLLECTOR
4. EMITTER
5. BASE
6. CATHODE

STYLE 14:
PIN 1. VREF
2. GND
3. GND
4. IOUT
5. VEN
6. VCC

STYLE 15:
PIN 1. ANODE 1
2. ANODE 2
3. ANODE 3
4. CATHODE 3
5. CATHODE 2
6. CATHODE 1

STYLE 16:
PIN 1. BASE 1
2. EMITTER 2
3. COLLECTOR 2
4. BASE 2
5. EMITTER 1
6. COLLECTOR 1

STYLE 17:
PIN 1. BASE 1
2. EMITTER 1
3. COLLECTOR 2
4. BASE 2
5. EMITTER 2
6. COLLECTOR 1

STYLE 18:
PIN 1. VIN1
2. VCC
3. VOUT2
4. VIN2
5. GND
6. VOUT1

STYLE 19:
PIN 1. I OUT
2. GND
3. GND
4. V CC
5. V EN
6. V REF

STYLE 20:
PIN 1. COLLECTOR
2. COLLECTOR
3. BASE
4. EMITTER
5. COLLECTOR
6. COLLECTOR

STYLE 21:
PIN 1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. N/C
6. CATHODE 1

STYLE 22:
PIN 1. D1 (i)
2. GND
3. D2 (i)
4. D2 (c)
5. VBUS
6. D1 (c)

STYLE 23:
PIN 1. Vn
2. CH1
3. Vp
4. N/C
5. CH2
6. N/C

STYLE 24:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE

STYLE 25:
PIN 1. BASE 1
2. CATHODE
3. COLLECTOR 2
4. BASE 2
5. EMITTER
6. COLLECTOR 1

STYLE 26:
PIN 1. SOURCE 1
2. GATE 1
3. DRAIN 2
4. SOURCE 2
5. GATE 2
6. DRAIN 1

STYLE 27:
PIN 1. BASE 2
2. BASE 1
3. COLLECTOR 1
4. EMITTER 1
5. EMITTER 2
6. COLLECTOR 2

STYLE 28:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. SOURCE
5. DRAIN
6. DRAIN

STYLE 29:
PIN 1. ANODE
2. ANODE
3. COLLECTOR
4. EMITTER
5. BASE/ANODE
6. CATHODE

STYLE 30:
PIN 1. SOURCE 1
2. DRAIN 2
3. DRAIN 2
4. SOURCE 2
5. GATE 1
6. DRAIN 1

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

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