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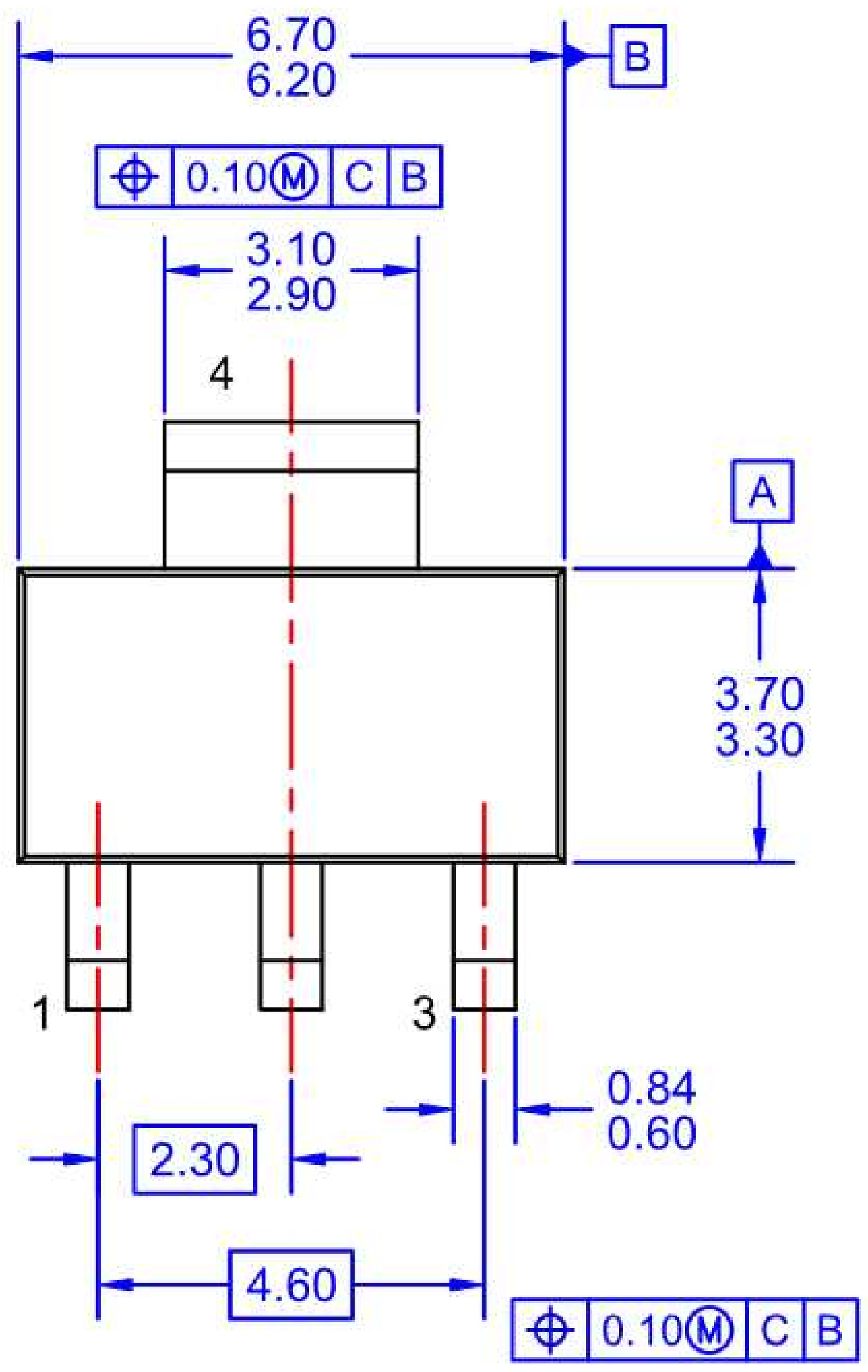
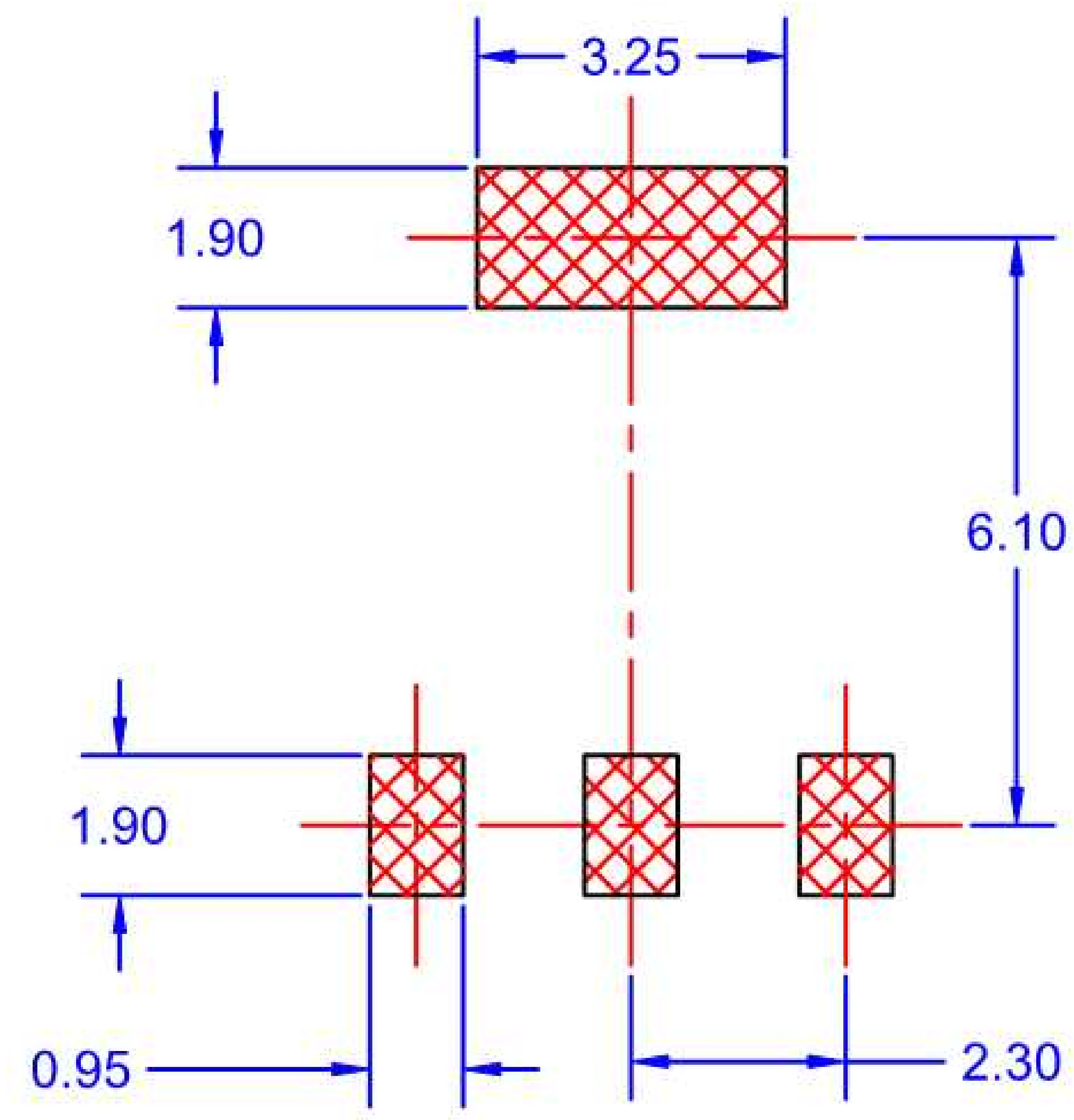
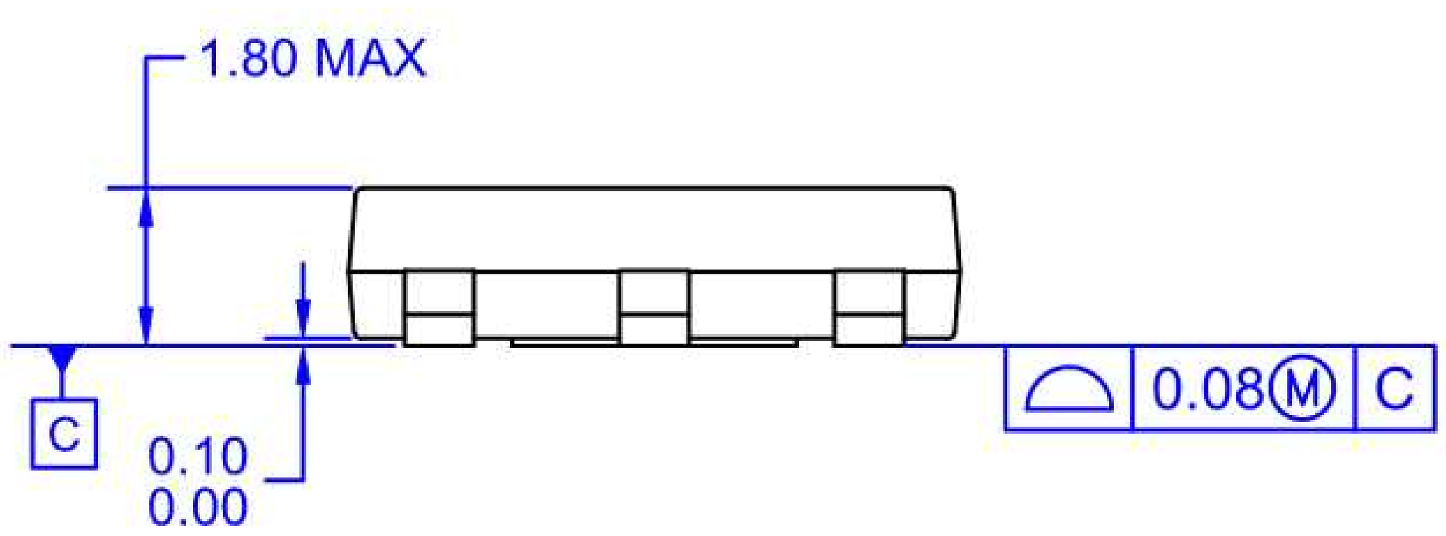
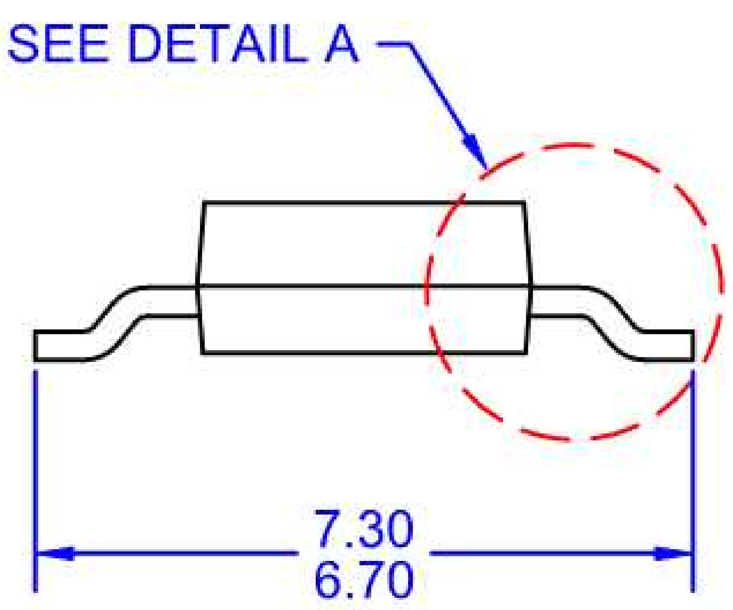




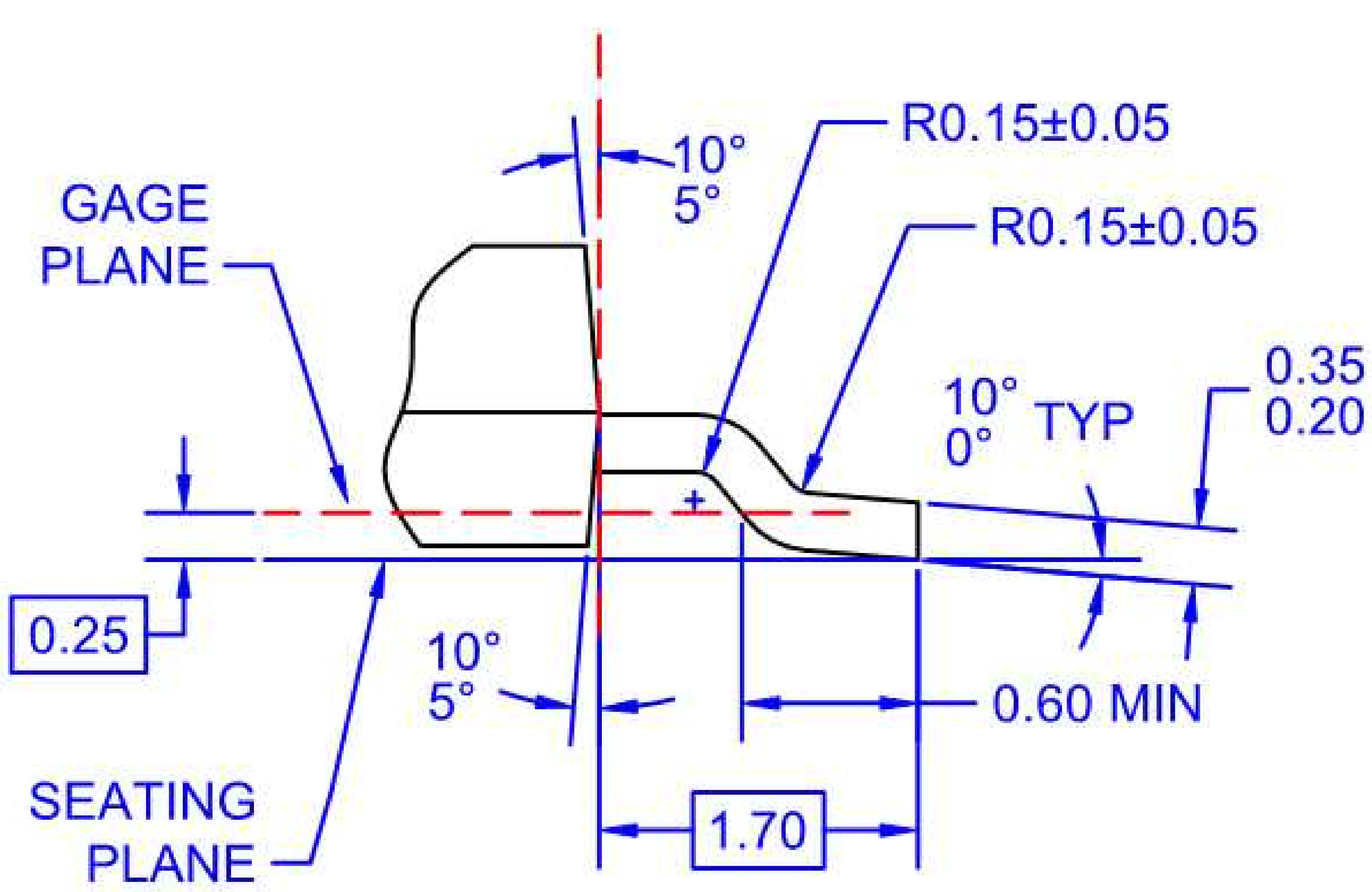
LAND PATTERN RECOMMENDATION





NOTES: UNLESS OTHERWISE SPECIFIED

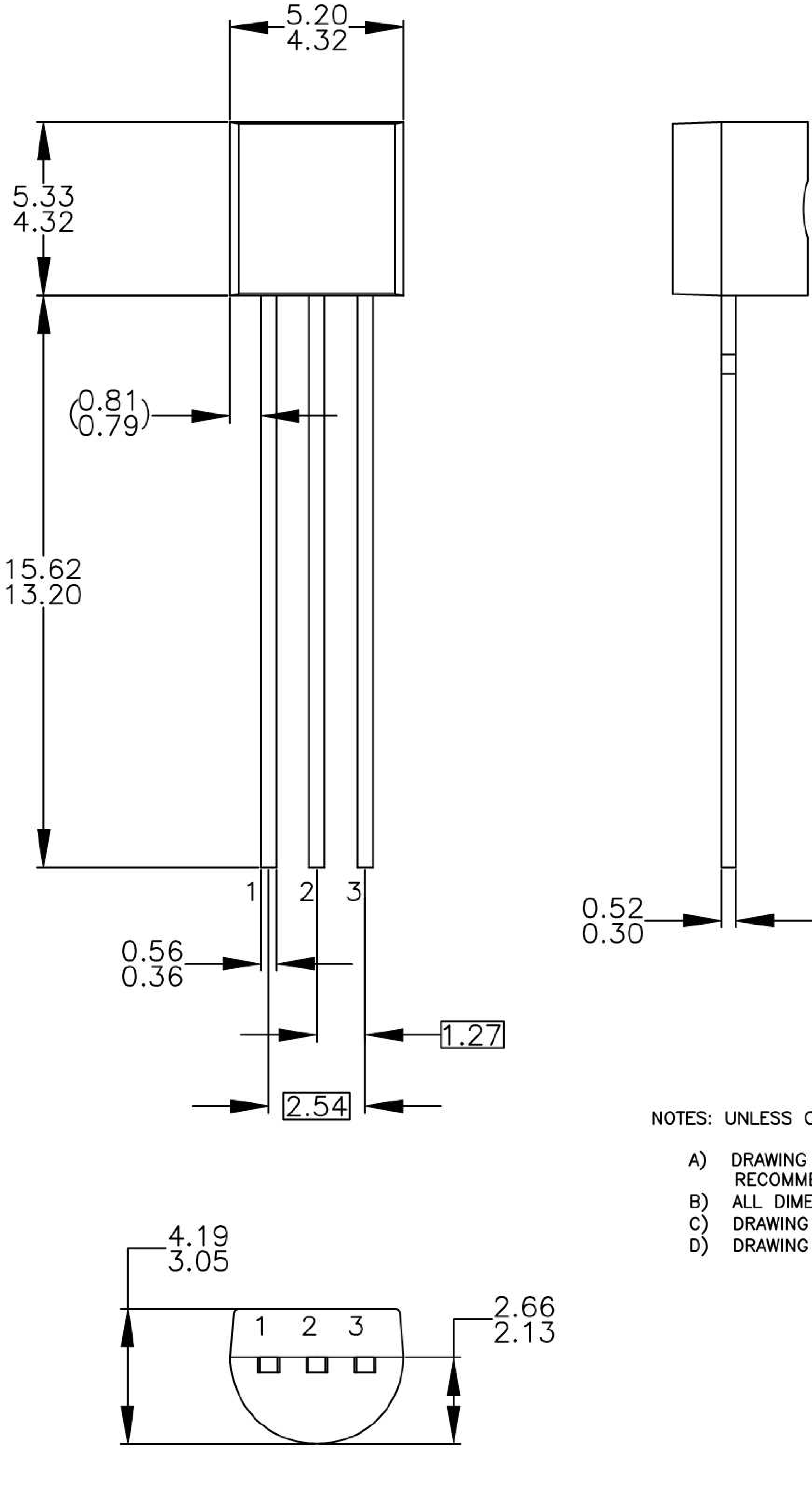
A) DRAWING BASED ON JEDEC REGISTRATION TO-261C, VARIATION AA.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
E) LANDPATTERN NAME: SOT230P700X180-4BN
F) DRAWING FILENAME: MKT-MA04AREV3



DETAIL A
SCALE: 2:1

万联芯城

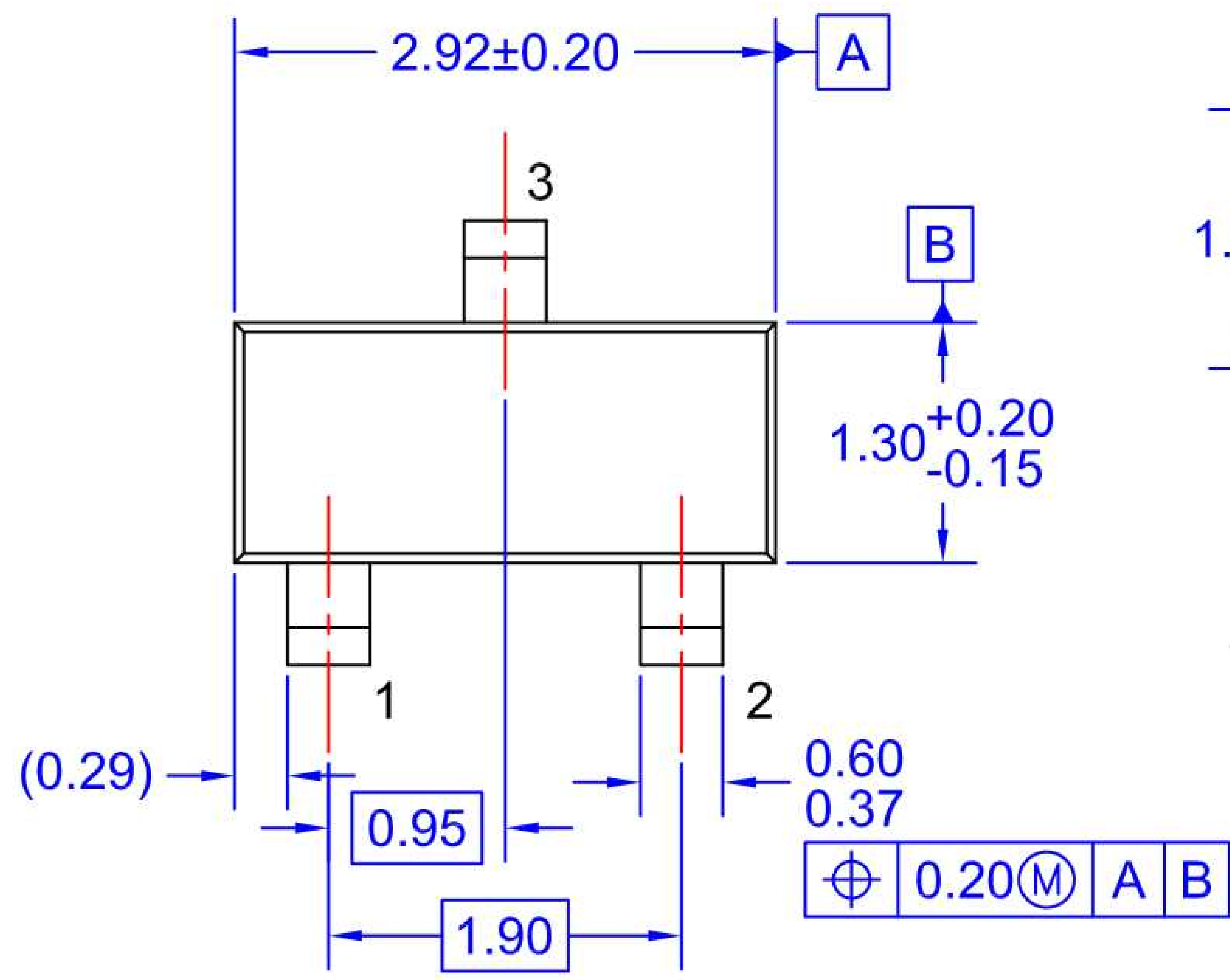
www.wlxmall.com 万联芯城-电子元器件采购网，专为终端工厂客户提供一站式电子元器件配套服务，万联芯城所售电子元器件均为原装现货库存，提交 BOM 表立即报价。万联芯城代理长电，顺络，先科 ST 等知名电子元器件品牌，价格有明显的优势，欢迎广大客户咨询相关采购业务。点击进入万联芯城。

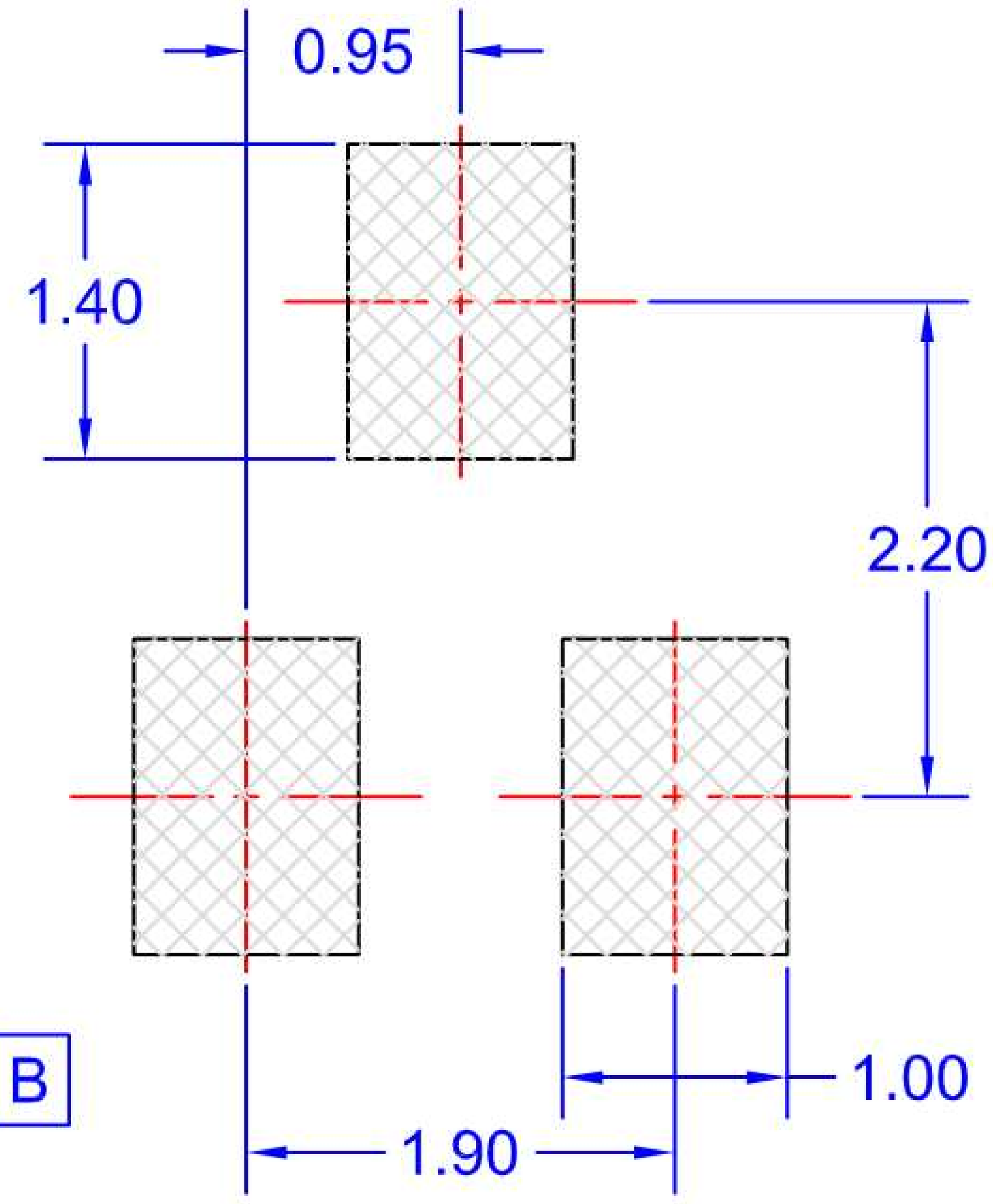


NOTES: UNLESS OTHERWISE SPECIFIED

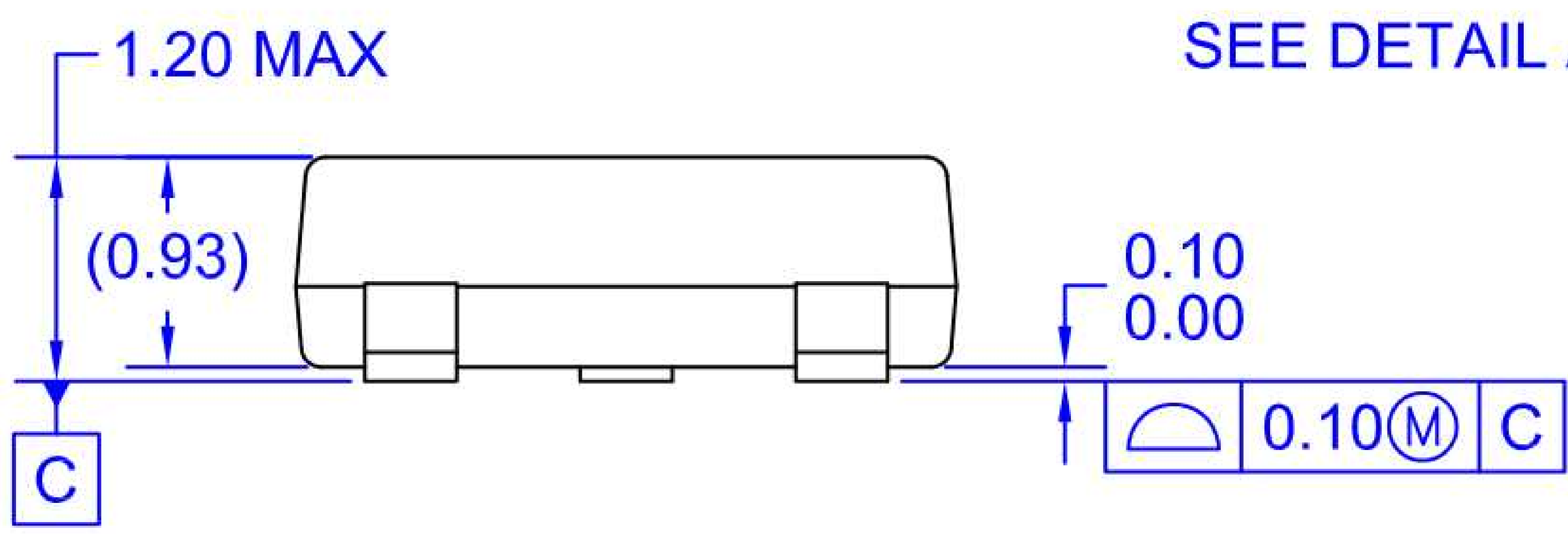
A) DRAWING WITH REFERENCE TO JEDEC TO-92 RECOMMENDATIONS.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DRAWING CONFORMS TO ASME Y14.5M-2009.
D) DRAWING FILENAME: MKT-ZA03DREV4.

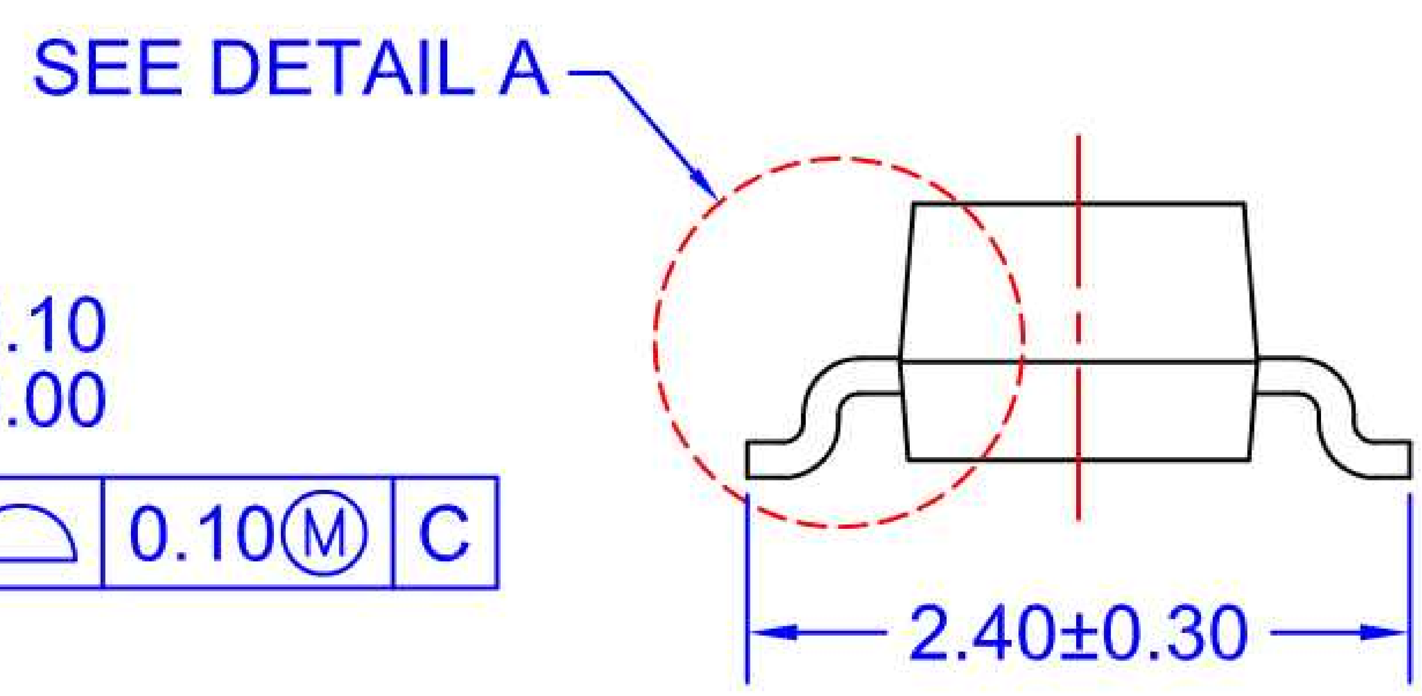
FAIRCHILD™





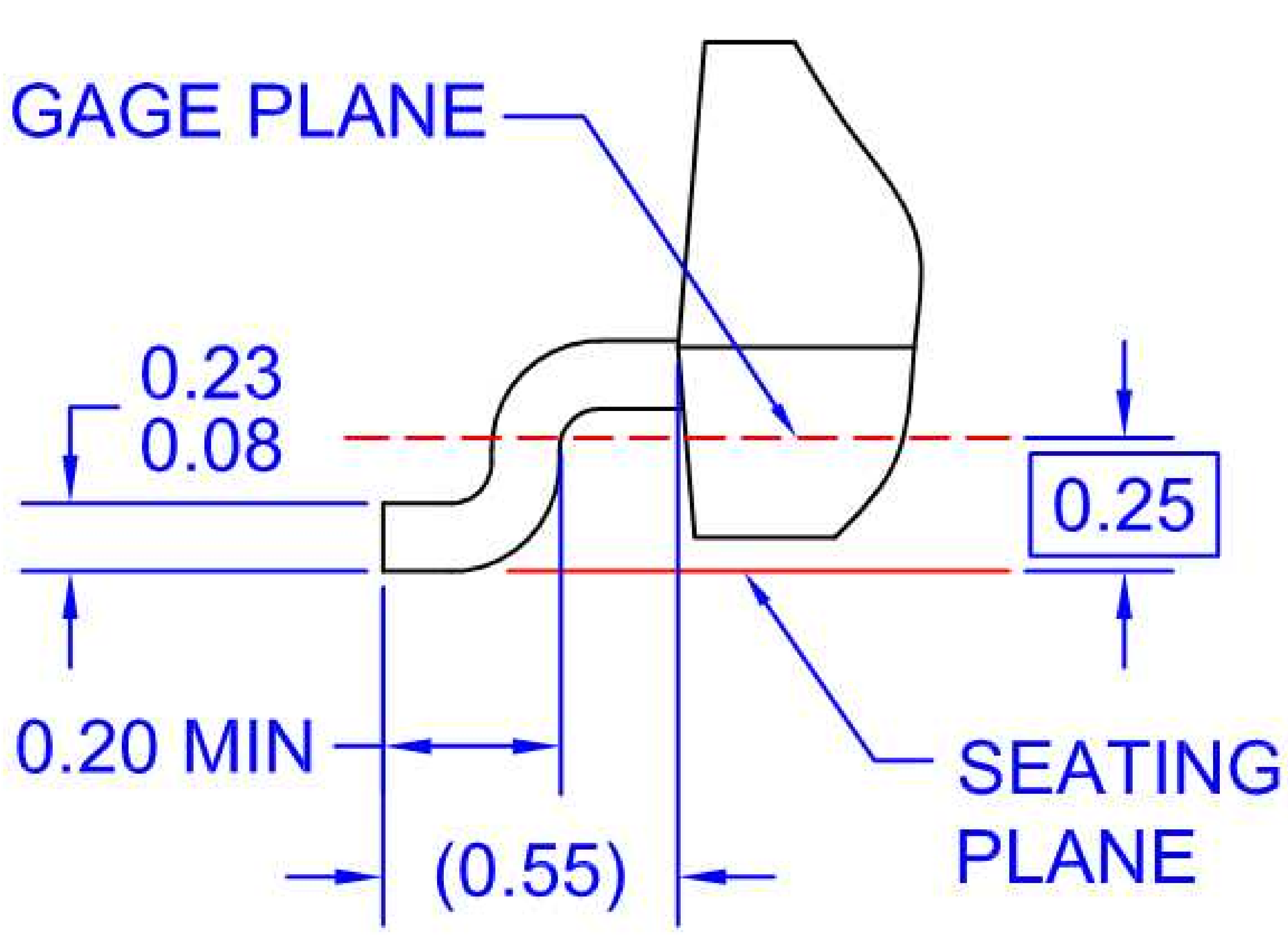
LAND PATTERN RECOMMENDATION





NOTES: UNLESS OTHERWISE SPECIFIED

A) REFERENCE JEDEC REGISTRATION TO-236, VARIATION AB, ISSUE H.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS ARE INCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M - 2009.
E) DRAWING FILE NAME: MA03DREV12



DETAIL A
SCALE: 2X

FAIRCHILD™

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
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Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
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FAIRCHILD

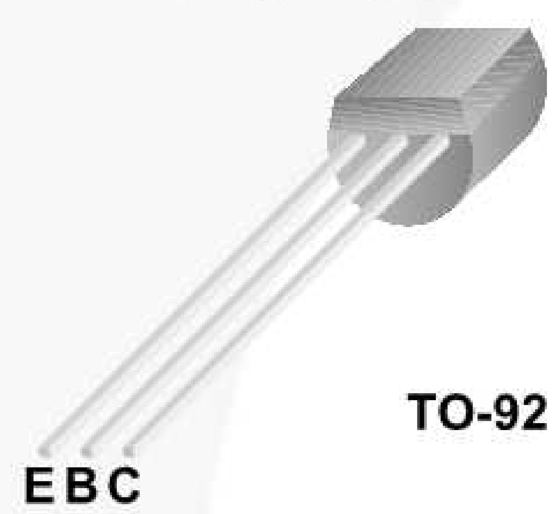
October 2014

2N3904 / MMBT3904 / PZT3904
NPN General-Purpose Amplifier

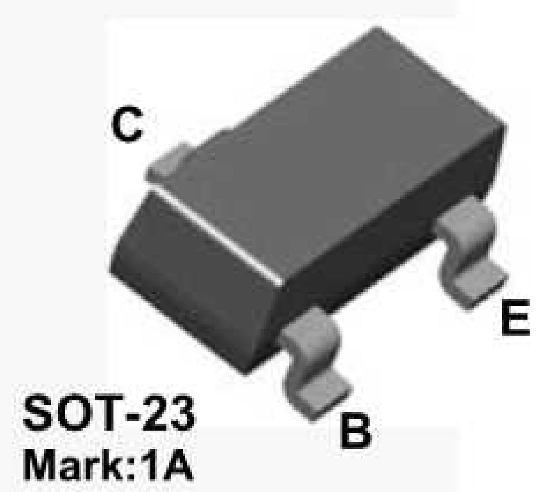
Description

This device is designed as a general-purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier.

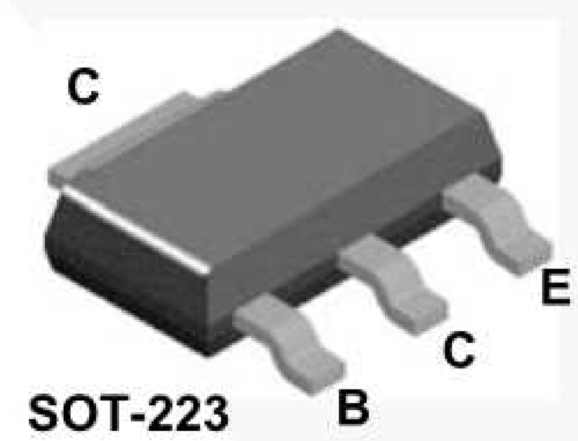
2N3904



MMBT3904



PZT3904



Ordering Information

Part Number	Marking	Package	Packing Method	Pack Quantity
2N3904BU	2N3904	TO-92 3L	Bulk	10000
2N3904TA	2N3904	TO-92 3L	Ammo	2000
2N3904TAR	2N3904	TO-92 3L	Ammo	2000
2N3904TF	2N3904	TO-92 3L	Tape and Reel	2000
2N3904TFR	2N3904	TO-92 3L	Tape and Reel	2000
MMBT3904	1A	SOT-23 3L	Tape and Reel	3000
PZT3904	3904	SOT-223 4L	Tape and Reel	2500

Absolute Maximum Ratings[1], [2]

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Value	Unit
V_{CEO}	Collector-Emitter Voltage	40	V
V_{CBO}	Collector-Base Voltage	60	V
V_{EBO}	Emitter-Base Voltage	6.0	V
I_C	Collector Current - Continuous	200	mA
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°C

Notes:

1. These ratings are based on a maximum junction temperature of 150°C.
2. These are steady-state limits. Fairchild Semiconductor should be consulted on applications involving pulsed or low-duty cycle operations.

Thermal Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Maximum			Unit
		2N3904	MMBT3904[3]	PZT3904[4]	
P_D	Total Device Dissipation	625	350	1,000	mW
	Derate Above 25°C	5.0	2.8	8.0	mW/°C
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3			°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	357	125	°C/W

Notes:

3. Device is mounted on FR-4 PCB 1.6 inch X 1.6 inch X 0.06 inch.
4. Device is mounted on FR-4 PCB 36 mm X 18 mm X 1.5 mm, mounting pad for the collector lead minimum 6 cm^2.

Electrical Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Max.	Unit
OFF CHARACTERISTICS					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	I_C = 1.0 mA, I_B = 0	40		V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	I_C = 10 μA, I_E = 0	60		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	I_E = 10 μA, I_C = 0	6.0		V
I_{BL}	Base Cut-Off Current	V_{CE} = 30 V, V_{EB} = 3 V		50	nA
I_{CEX}	Collector Cut-Off Current	V_{CE} = 30 V, V_{EB} = 3 V		50	nA
ON CHARACTERISTICS[5]					
h_{FE}	DC Current Gain	I_C = 0.1 mA, V_{CE} = 1.0 V	40		
		I_C = 1.0 mA, V_{CE} = 1.0 V	70		
		I_C = 10 mA, V_{CE} = 1.0 V	100	300	
		I_C = 50 mA, V_{CE} = 1.0 V	60		
		I_C =100 mA, V_{CE} = 1.0V	30		
$V_{CE}(sat)$	Collector-Emitter Saturation Voltage	I_C = 10 mA, I_B = 1.0 mA		0.2	V
		I_C = 50 mA, I_B = 5.0 mA		0.3	
$V_{BE}(sat)$	Base-Emitter Saturation Voltage	I_C = 10 mA, I_B = 1.0 mA	0.65	0.85	V
		I_C = 50 mA, I_B = 5.0 mA		0.95	
SMALL SIGNAL CHARACTERISTICS					
f_T	Current Gain - Bandwidth Product	I_C = 10 mA, V_{CE} = 20 V, f = 100 MHz	300		MHz
C_{obo}	Output Capacitance	V_{CB} = 5.0 V, I_E = 0, f = 100 kHz		4.0	pF
C_{ibo}	Input Capacitance	V_{EB} = 0.5 V, I_C = 0, f = 100 kHz		8.0	pF
NF	Noise Figure	I_C = 100 μA, V_{CE} = 5.0 V, R_S = 1.0 kΩ, f = 10 Hz to 15.7 kHz		5.0	dB
SWITCHING CHARACTERISTICS					
t_d	Delay Time	V_{CC} = 3.0 V, V_{BE} = 0.5 V I_C = 10 mA, I_{B1} = 1.0 mA		35	ns
t_r	Rise Time			35	ns
t_s	Storage Time	V_{CC} = 3.0 V, I_C = 10 mA, I_{B1} = I_{B2} = 1.0 mA		200	ns
t_f	Fall Time			50	ns

Note:

5. Pulse test: pulse width ≤ 300 μs, duty cycle ≤ 2.0%.

Typical Performance Characteristics

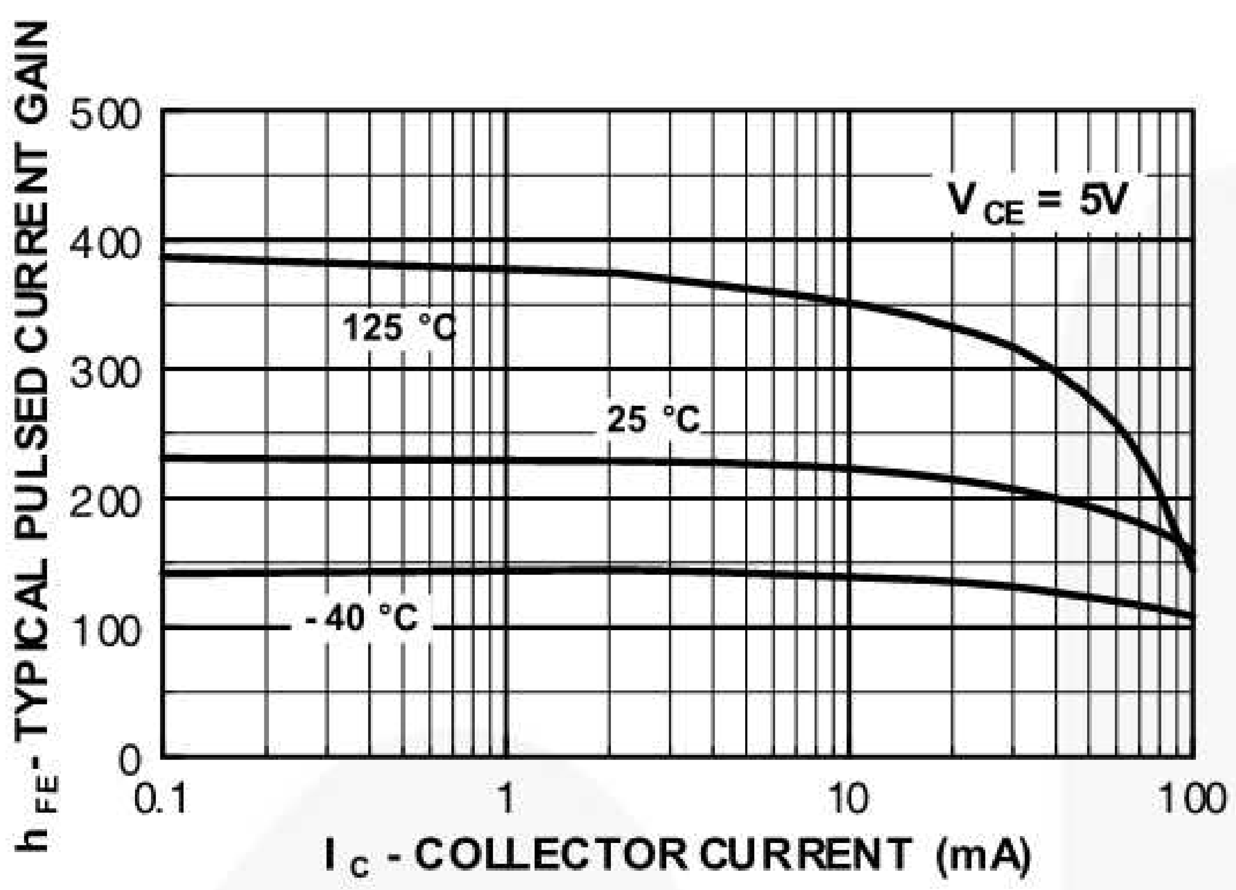


Figure 1. Typical Pulsed Current Gain vs. Collector Current

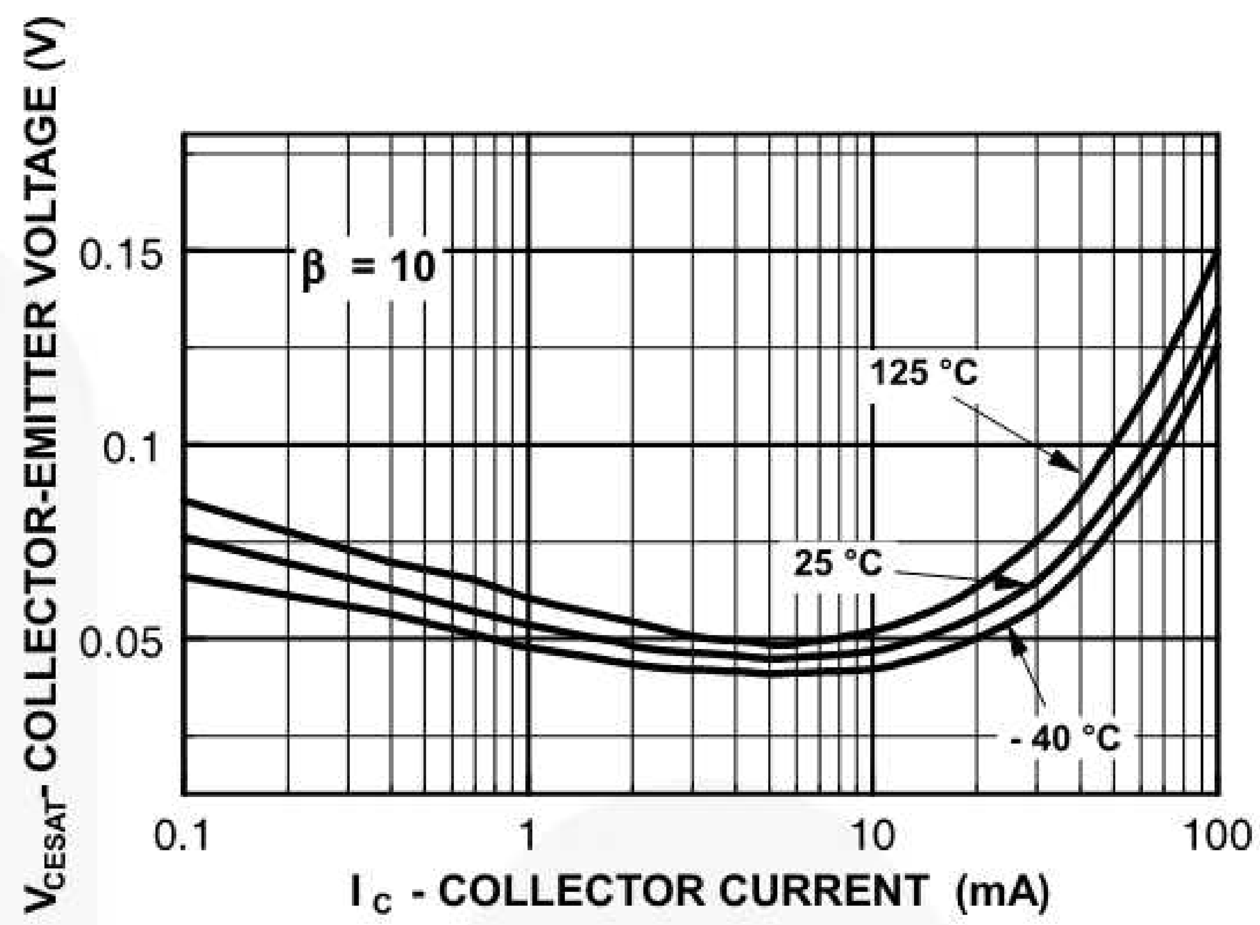


Figure 2. Collector-Emitter Saturation Voltage vs. Collector Current

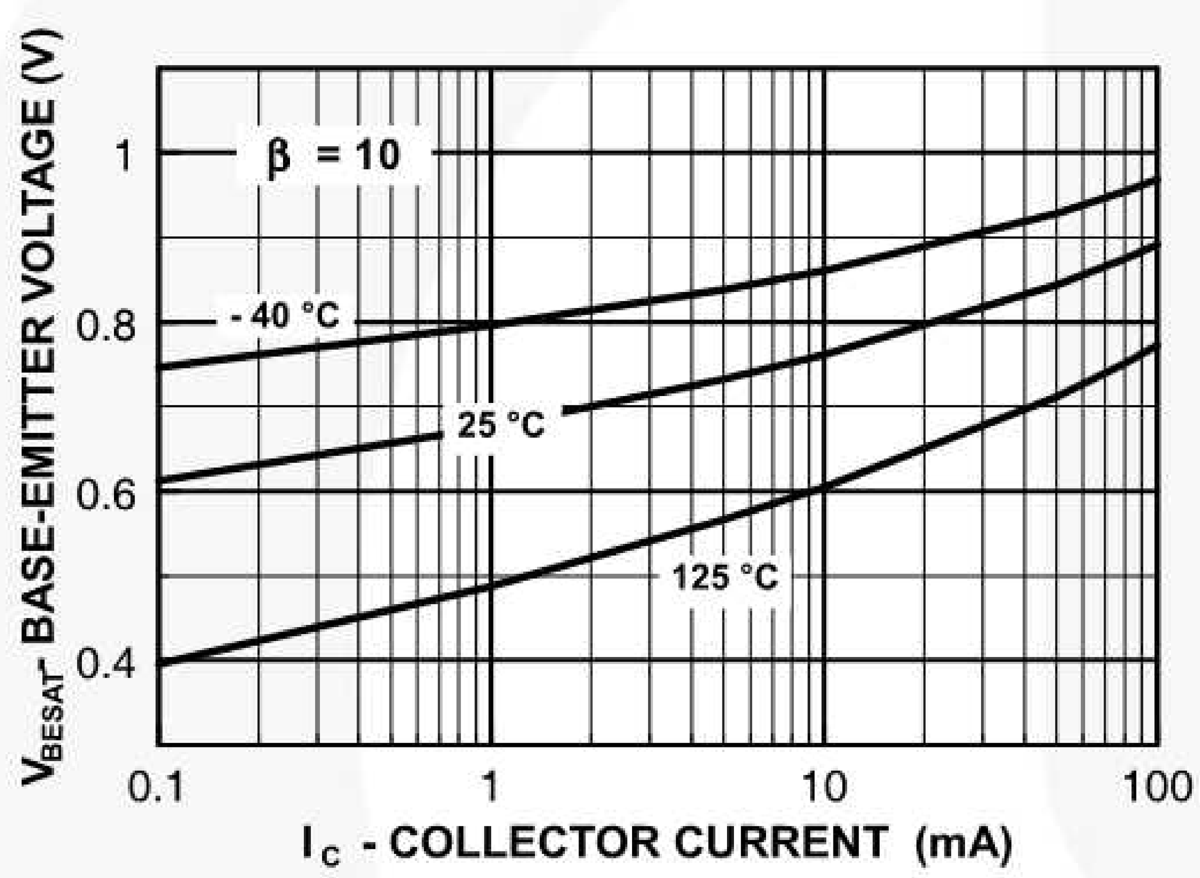


Figure 3. Base-Emitter Saturation Voltage vs. Collector Current

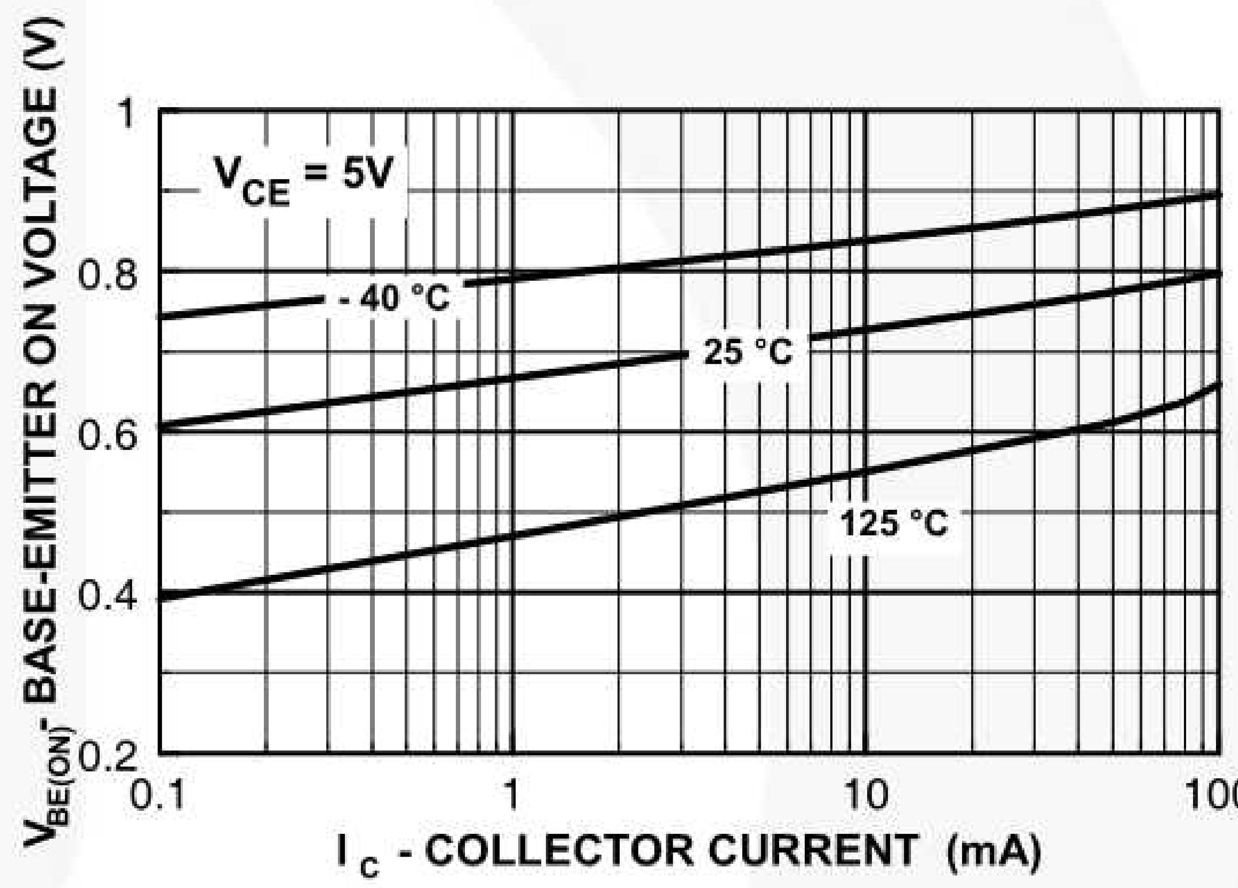


Figure 4. Base-Emitter On Voltage vs. Collector Current

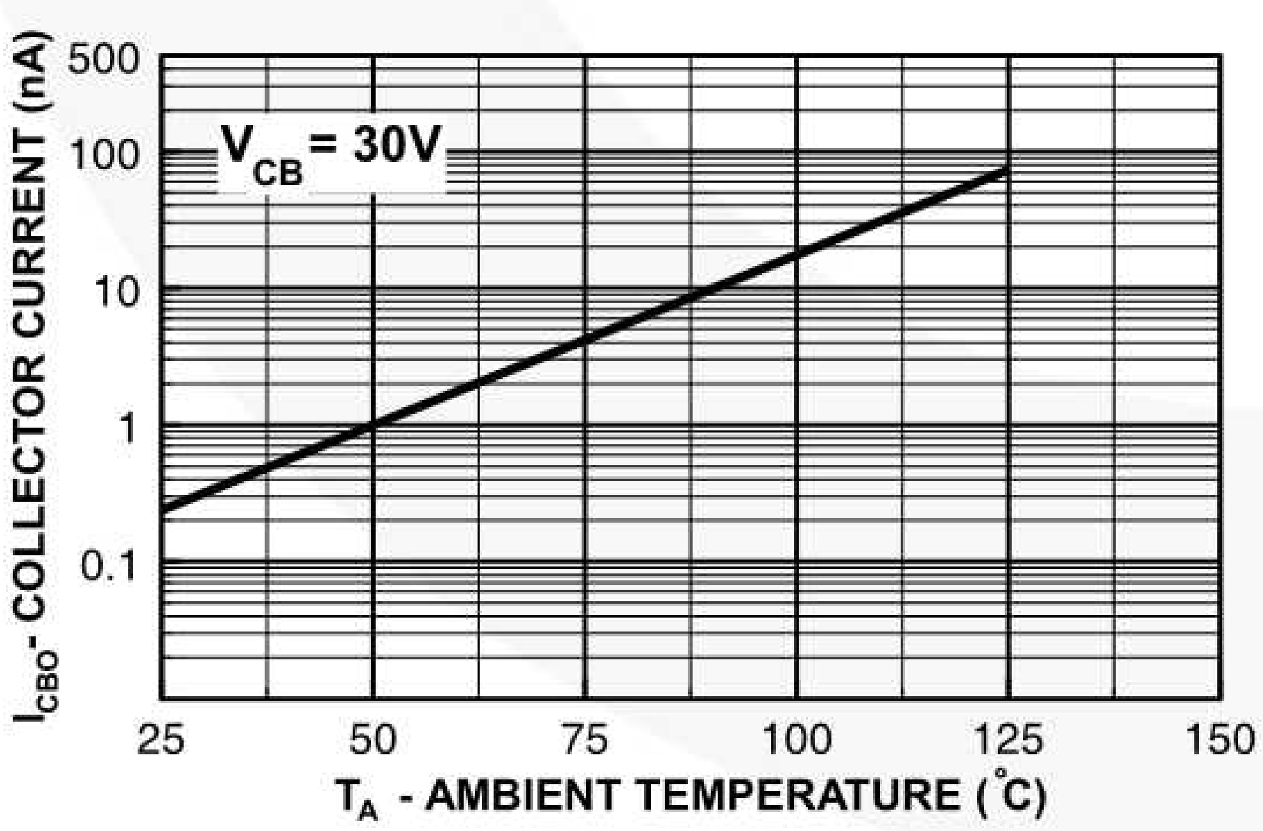


Figure 5. Collector Cut-Off Current vs. Ambient Temperature

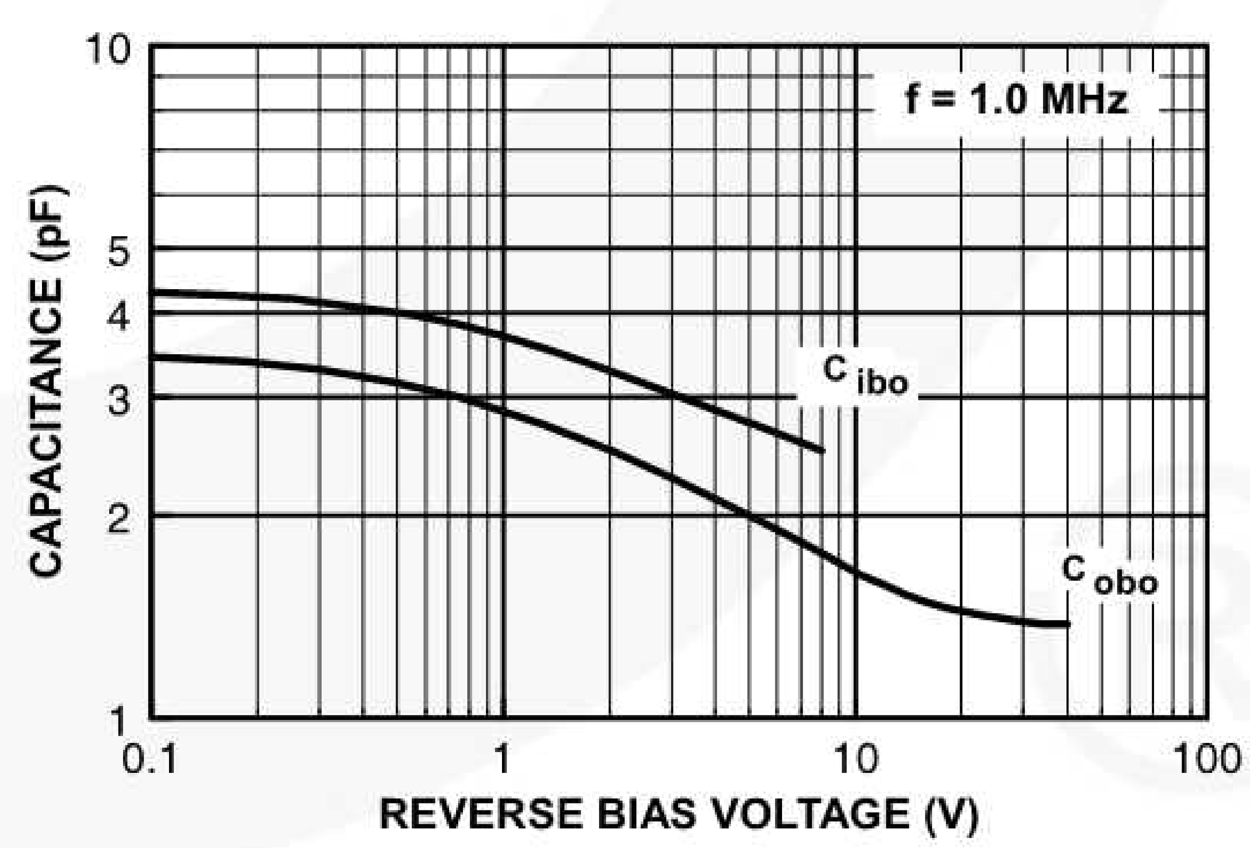


Figure 6. Capacitance vs. Reverse Bias Voltage

Typical Performance Characteristics (Continued)

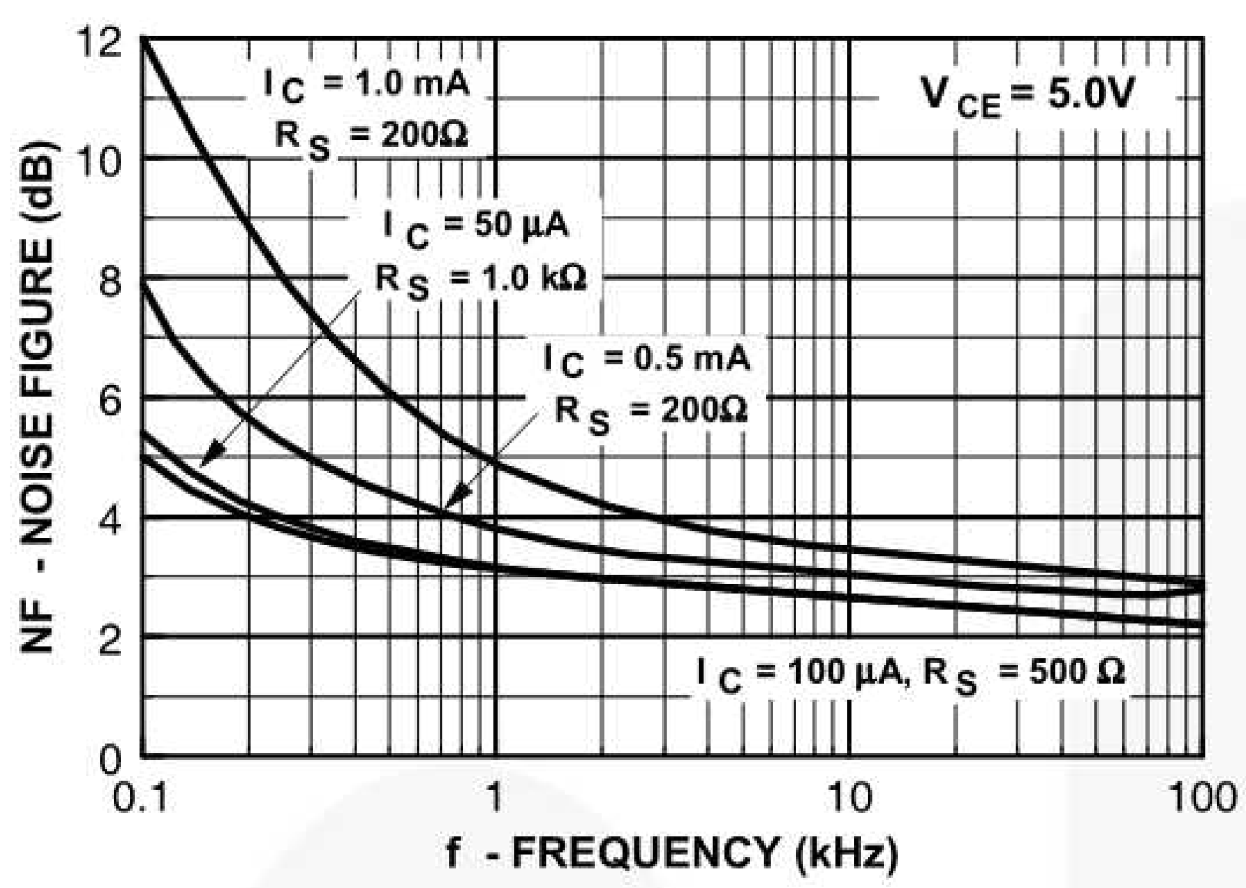


Figure 7. Noise Figure vs. Frequency

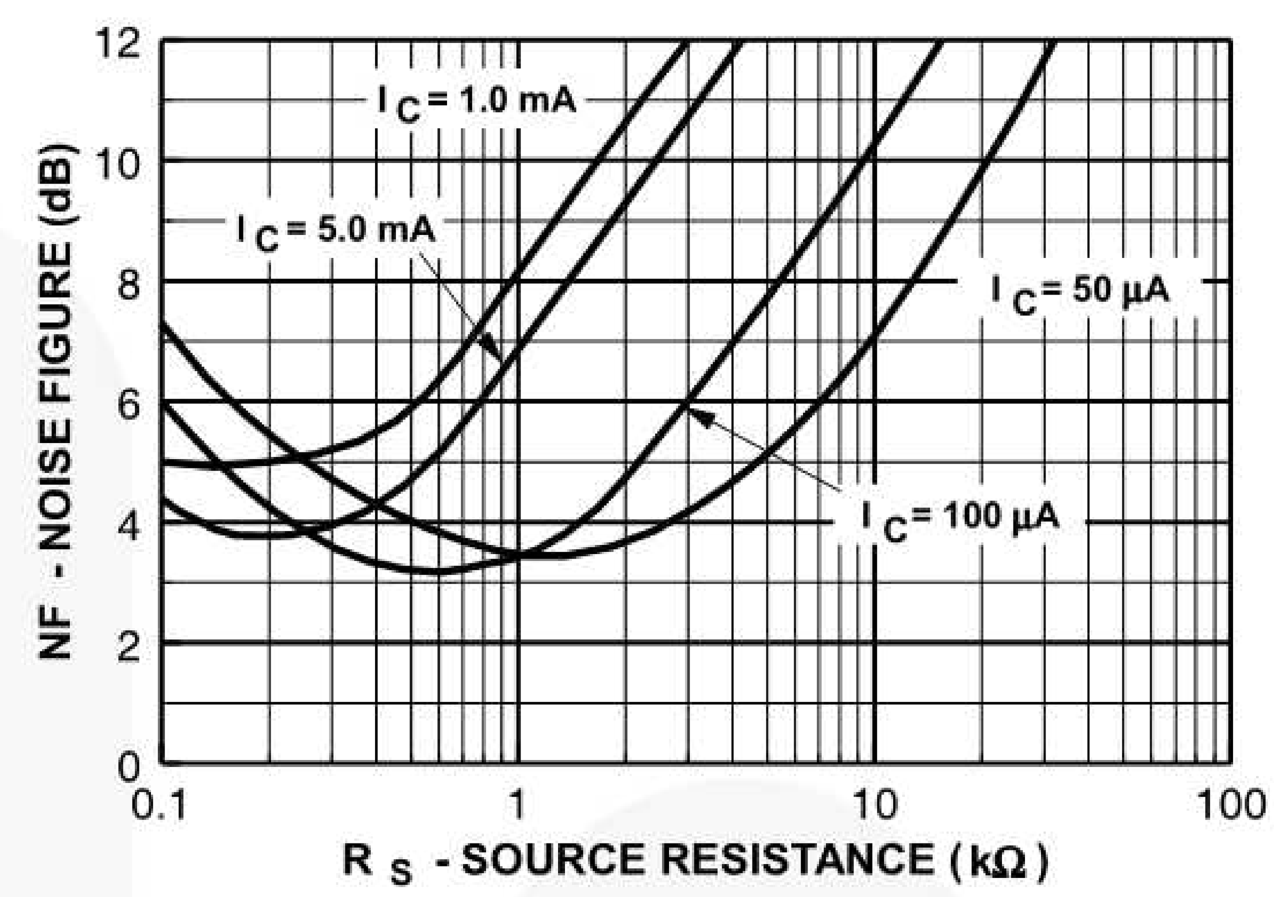


Figure 8. Noise Figure vs. Source Resistance

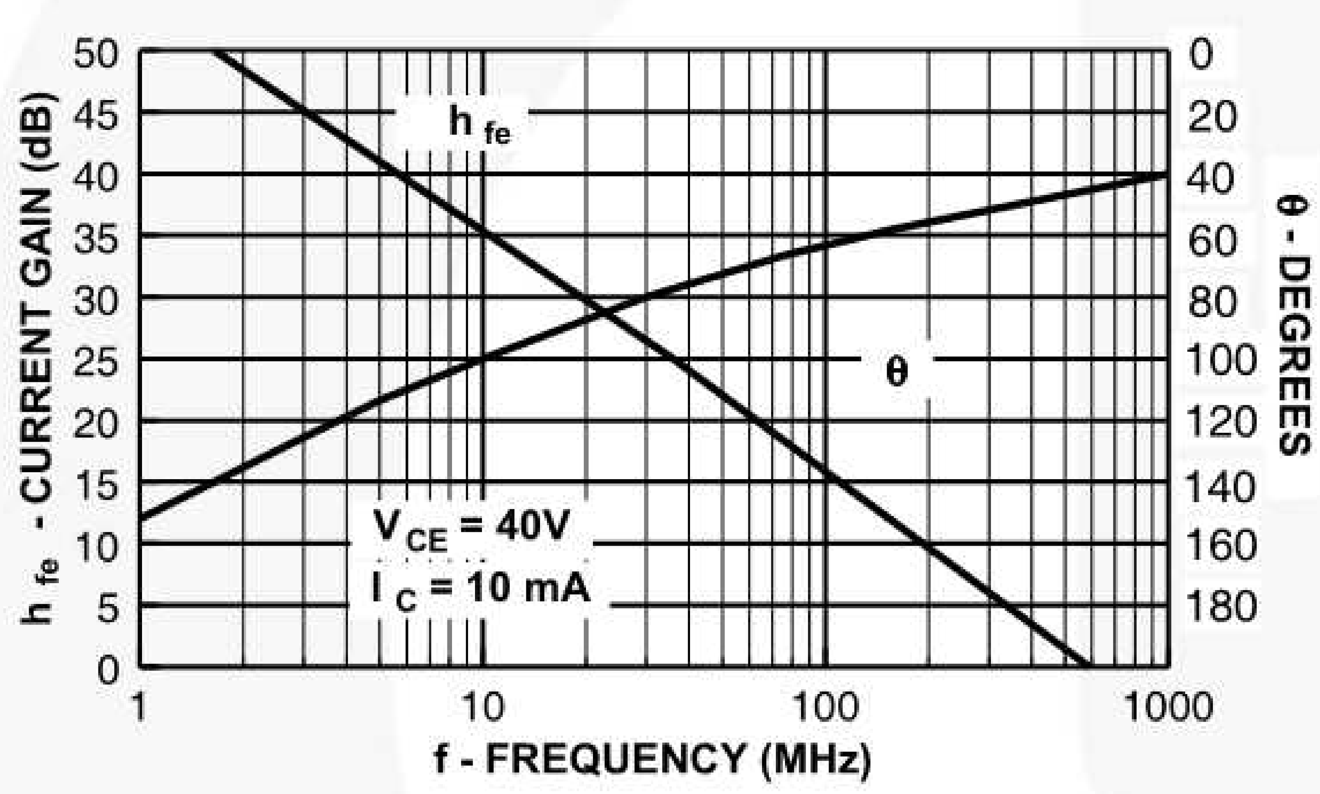


Figure 9. Current Gain and Phase Angle vs. Frequency

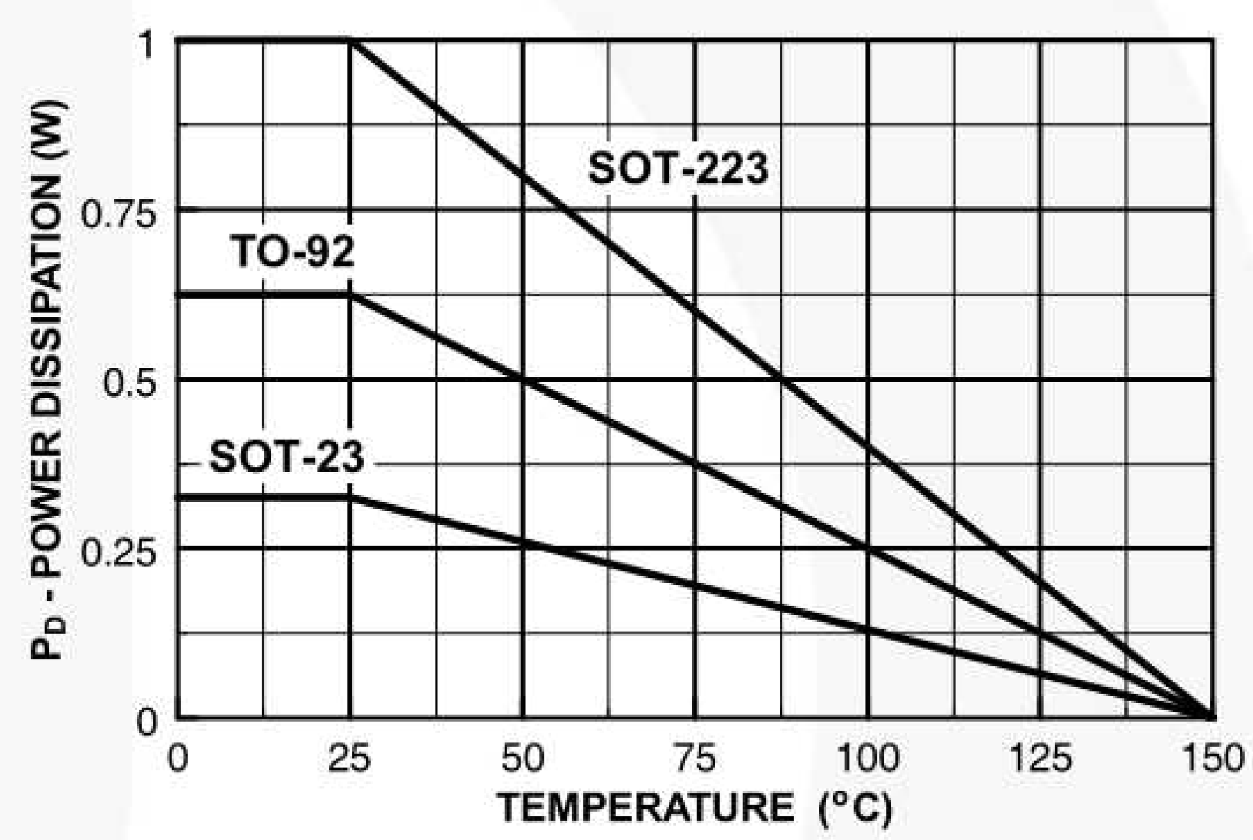


Figure 10. Power Dissipation vs. Ambient Temperature

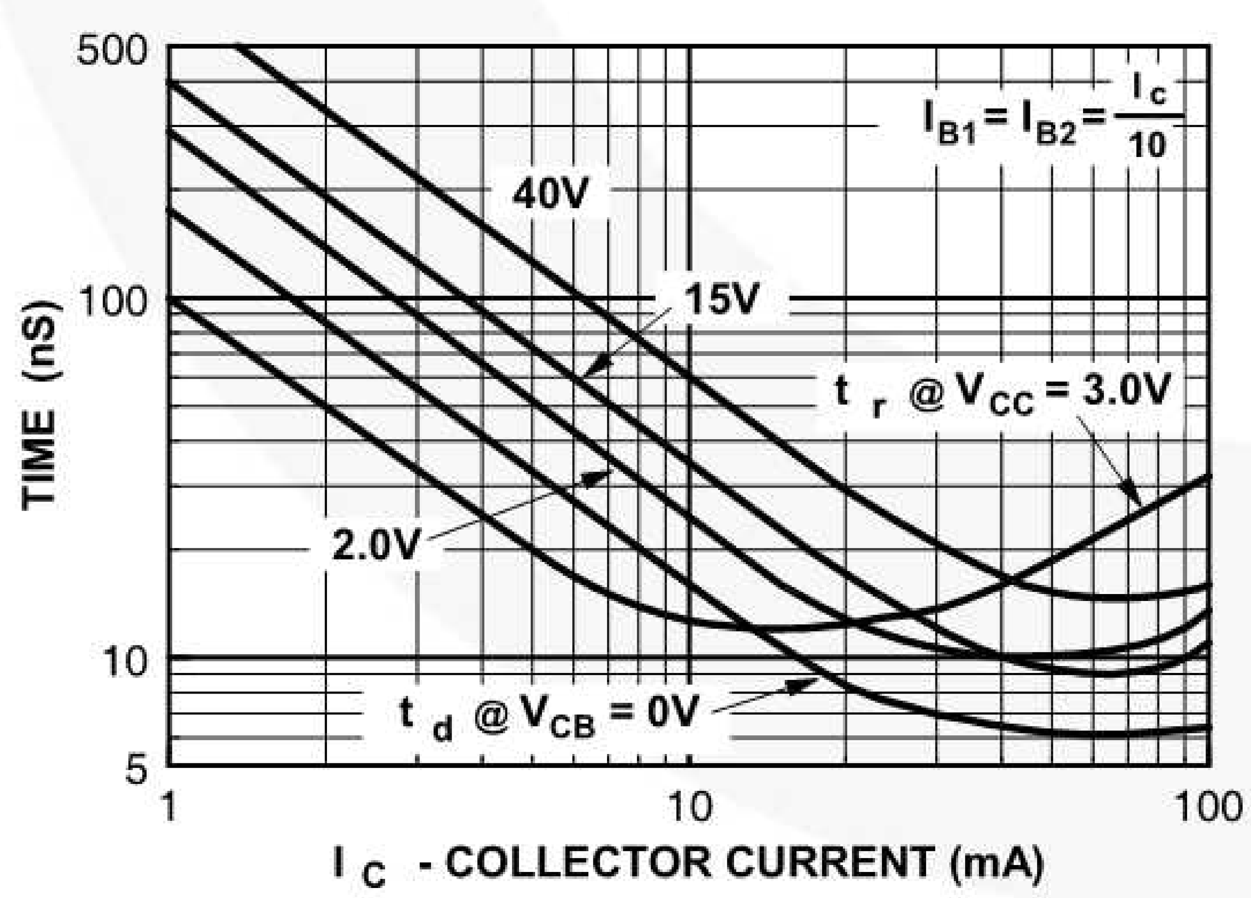


Figure 11. Turn-On Time vs. Collector Current

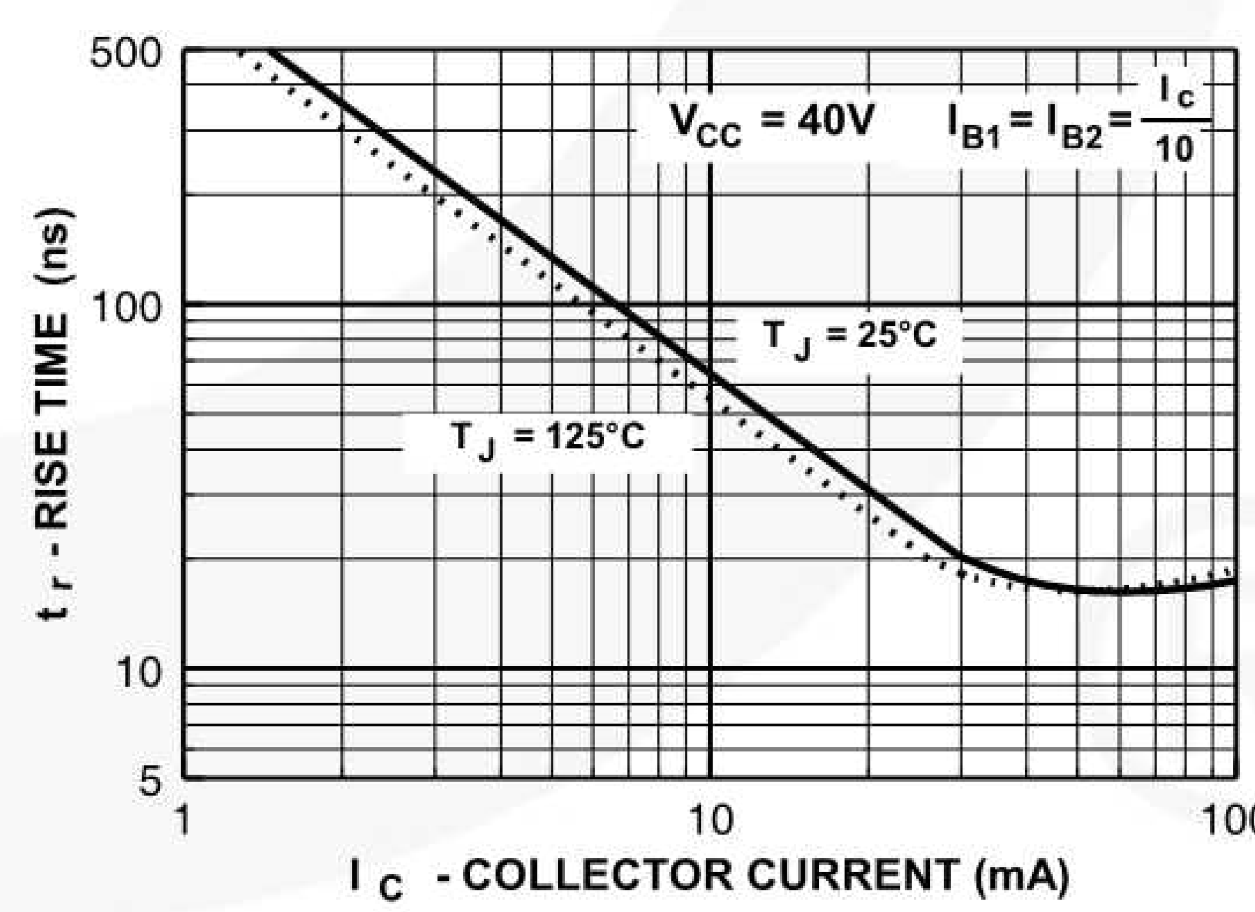


Figure 12. Rise Time vs. Collector Current

Typical Performance Characteristics (Continued)

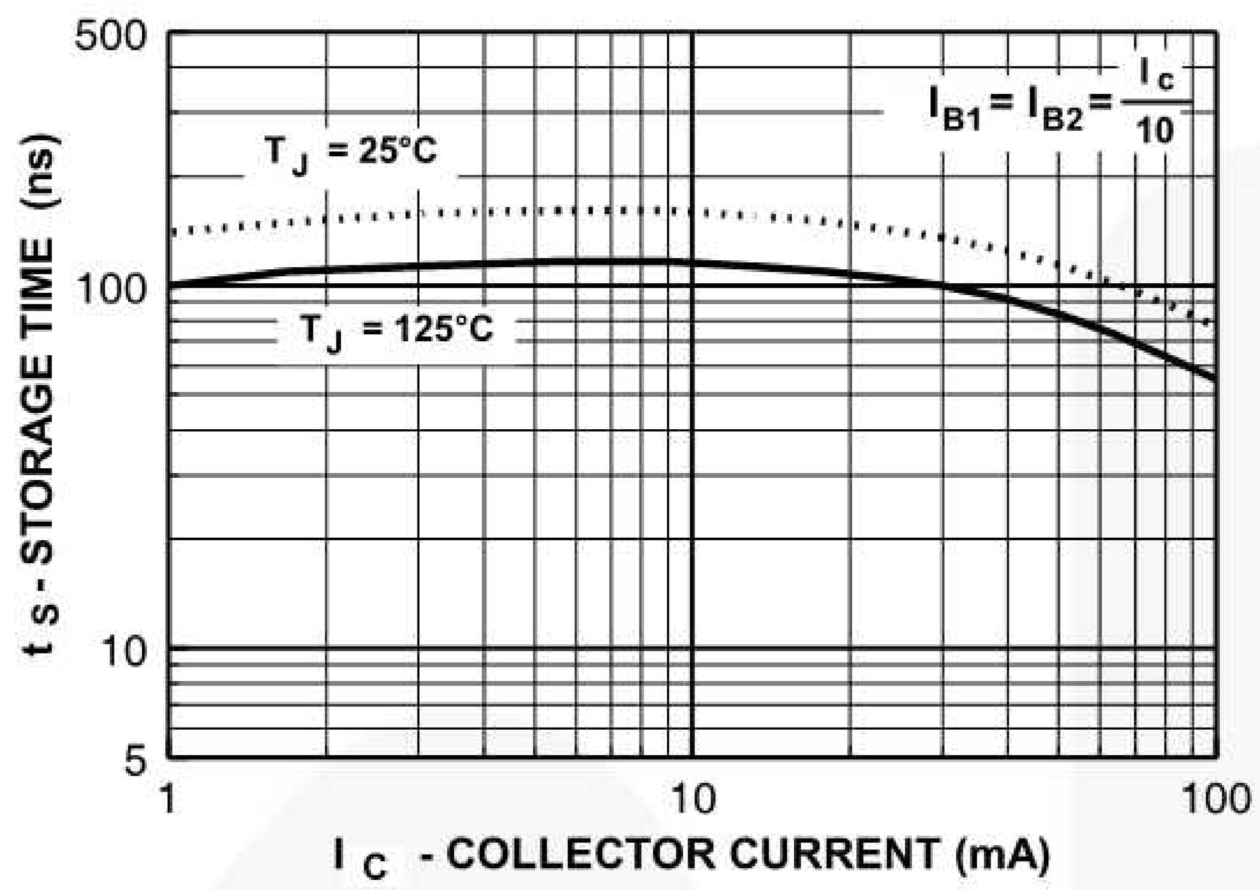


Figure 13. Storage Time vs. Collector Current

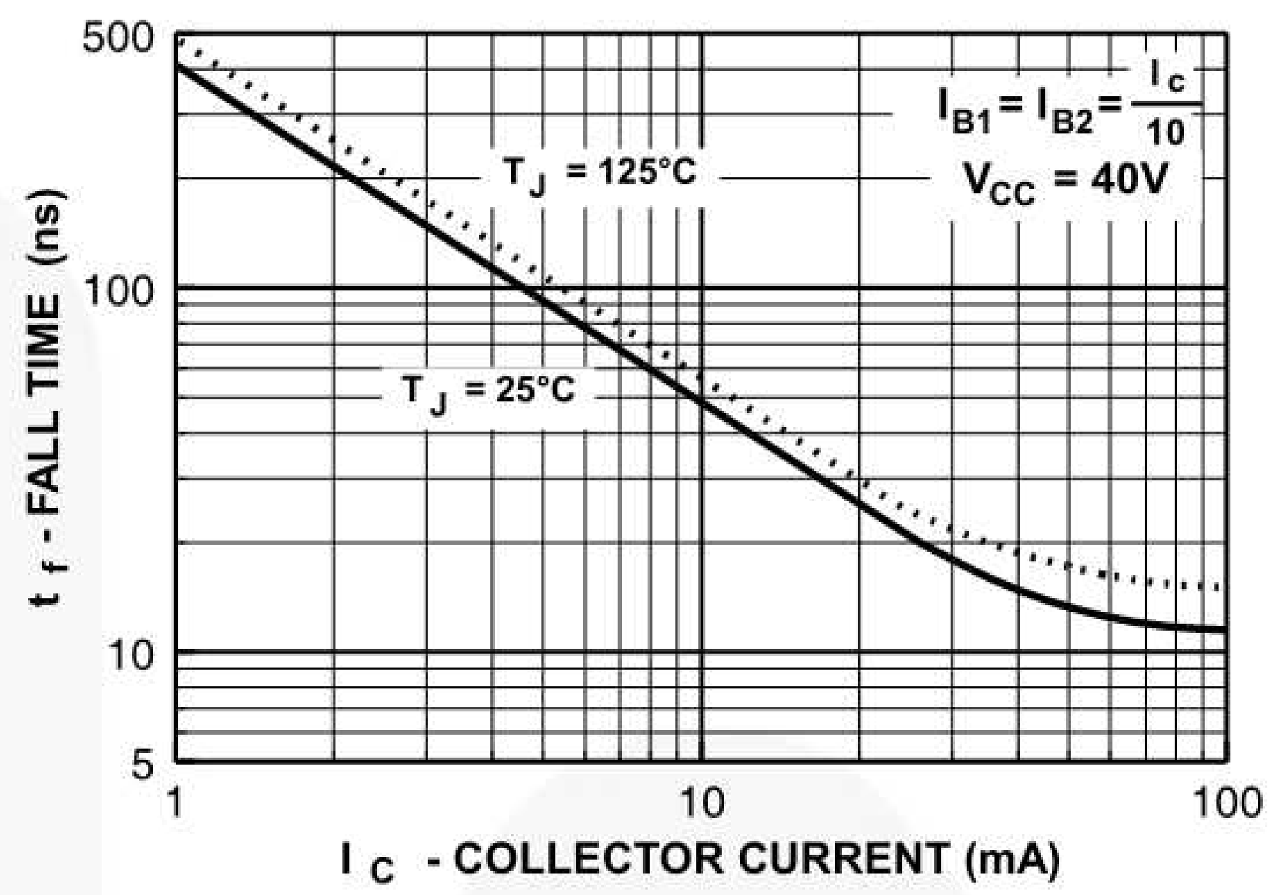


Figure 14. Fall Time vs. Collector Current

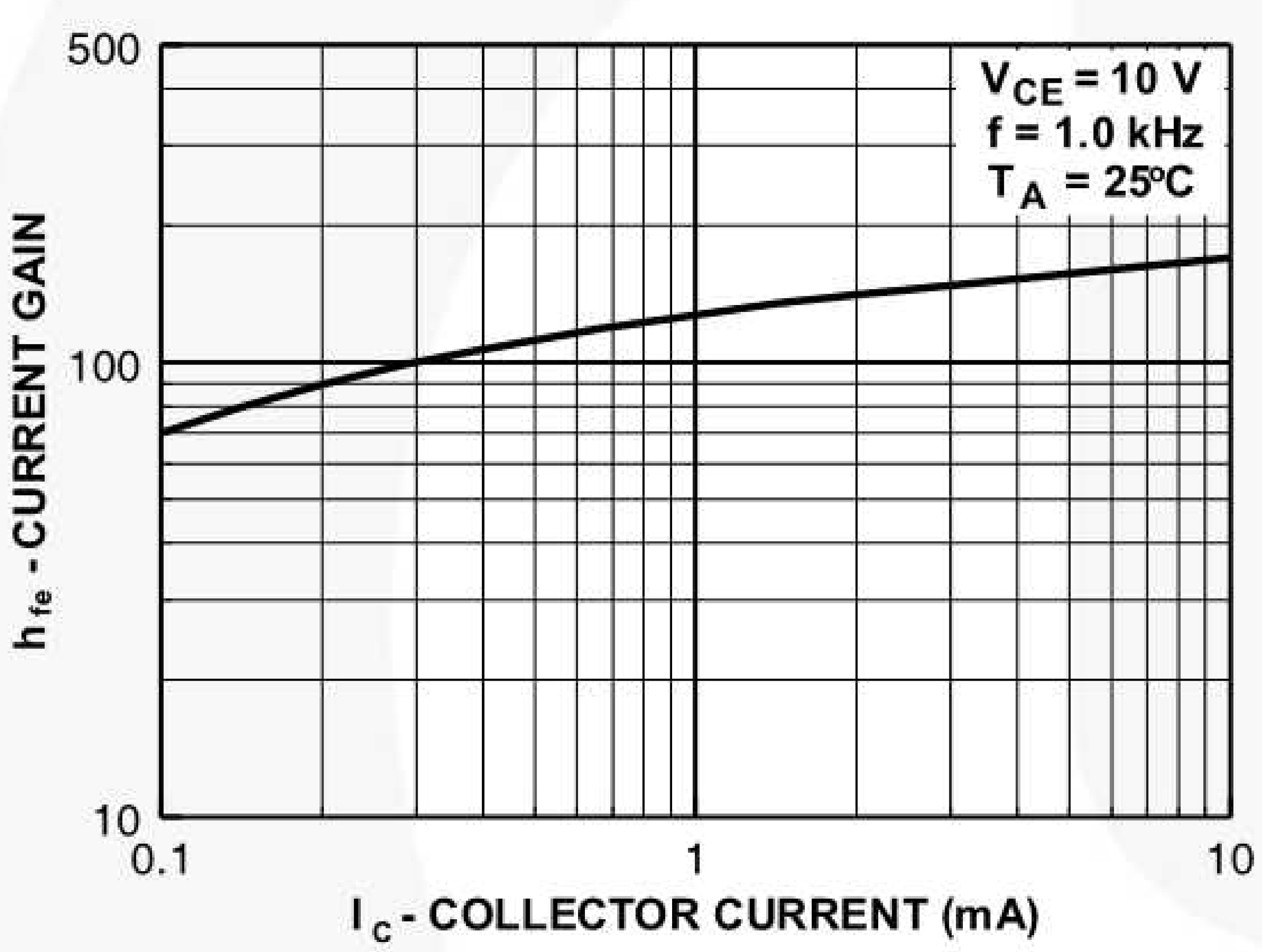


Figure 15. Current Gain

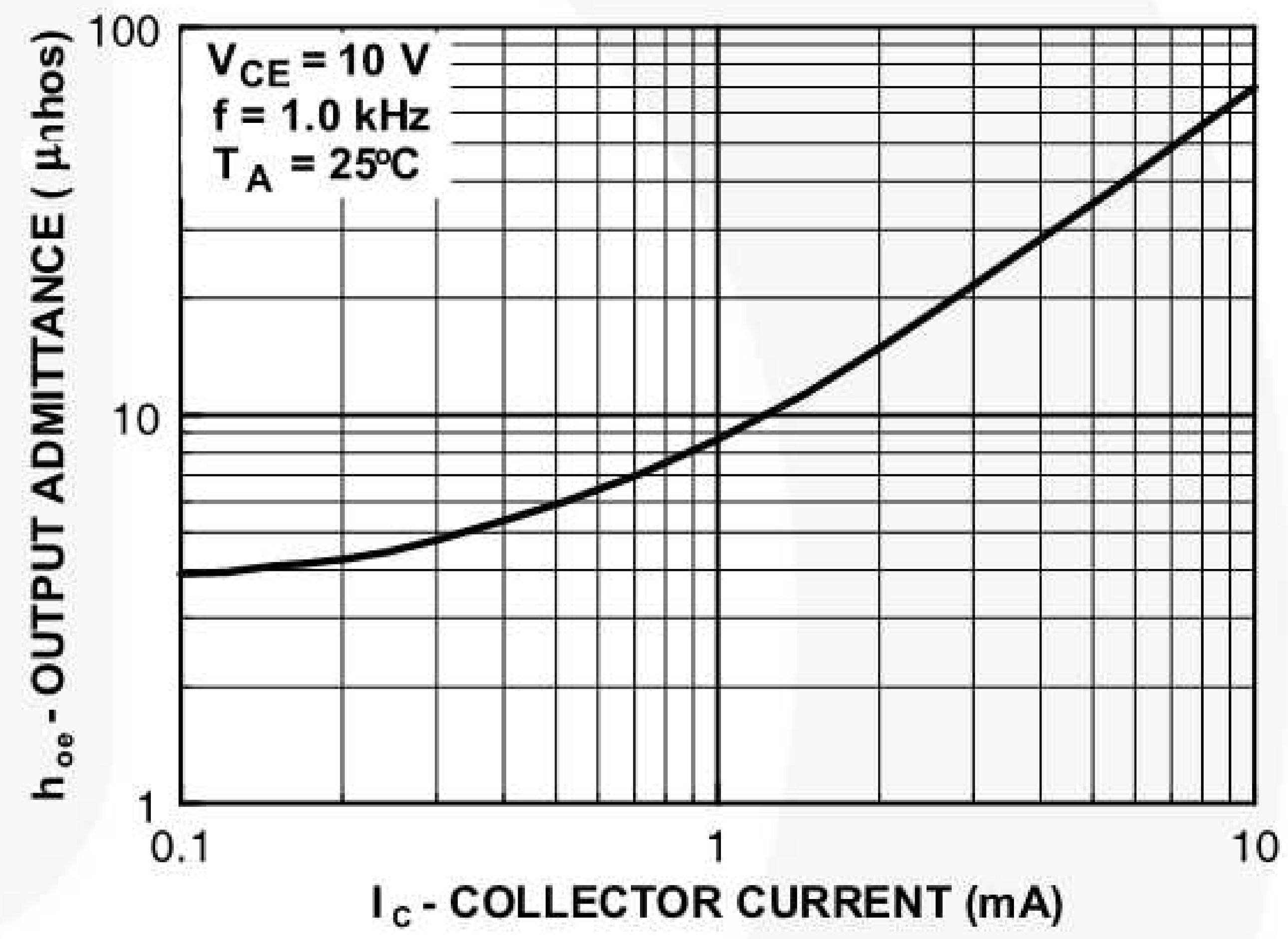


Figure 16. Output Admittance

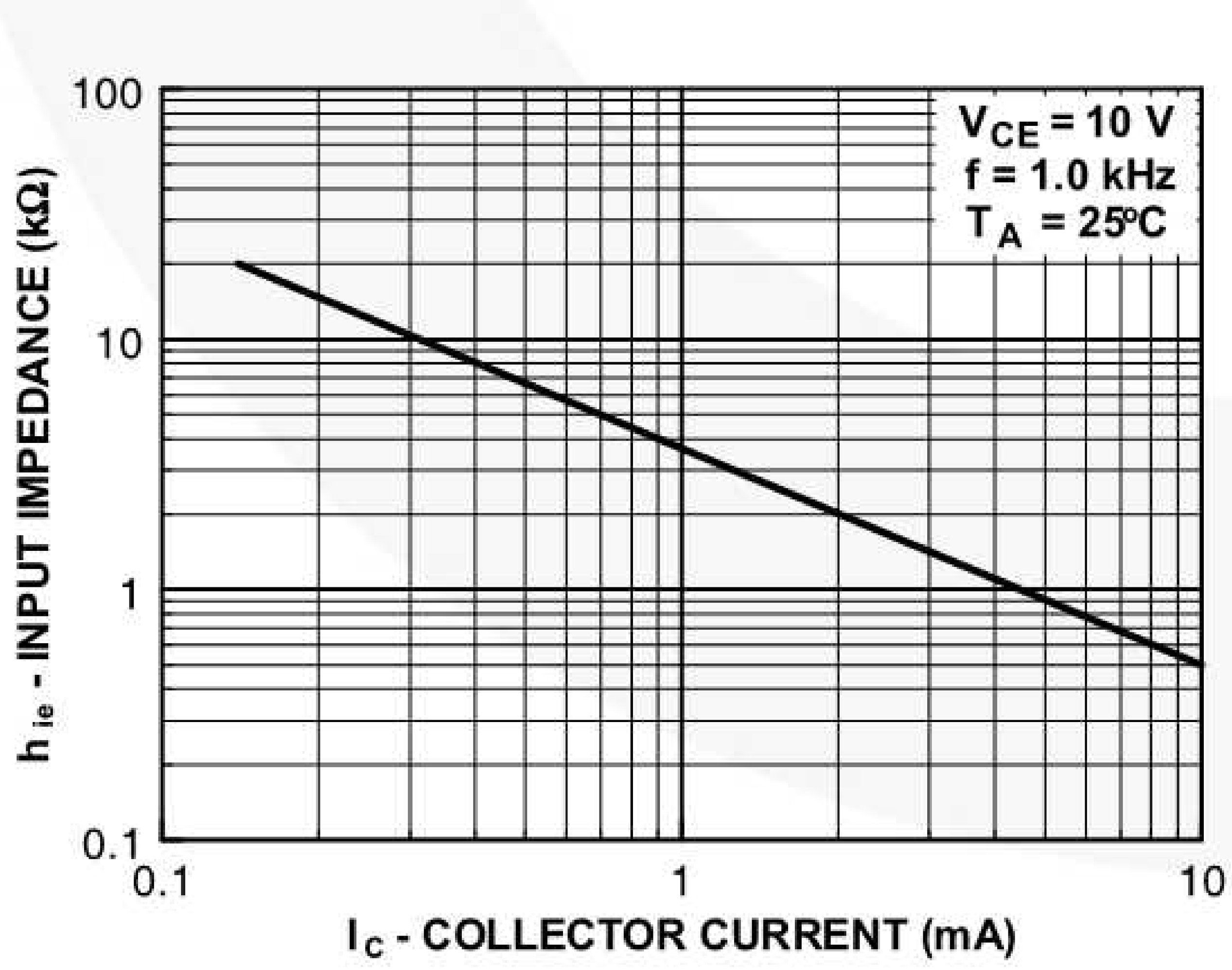


Figure 17. Input Impedance

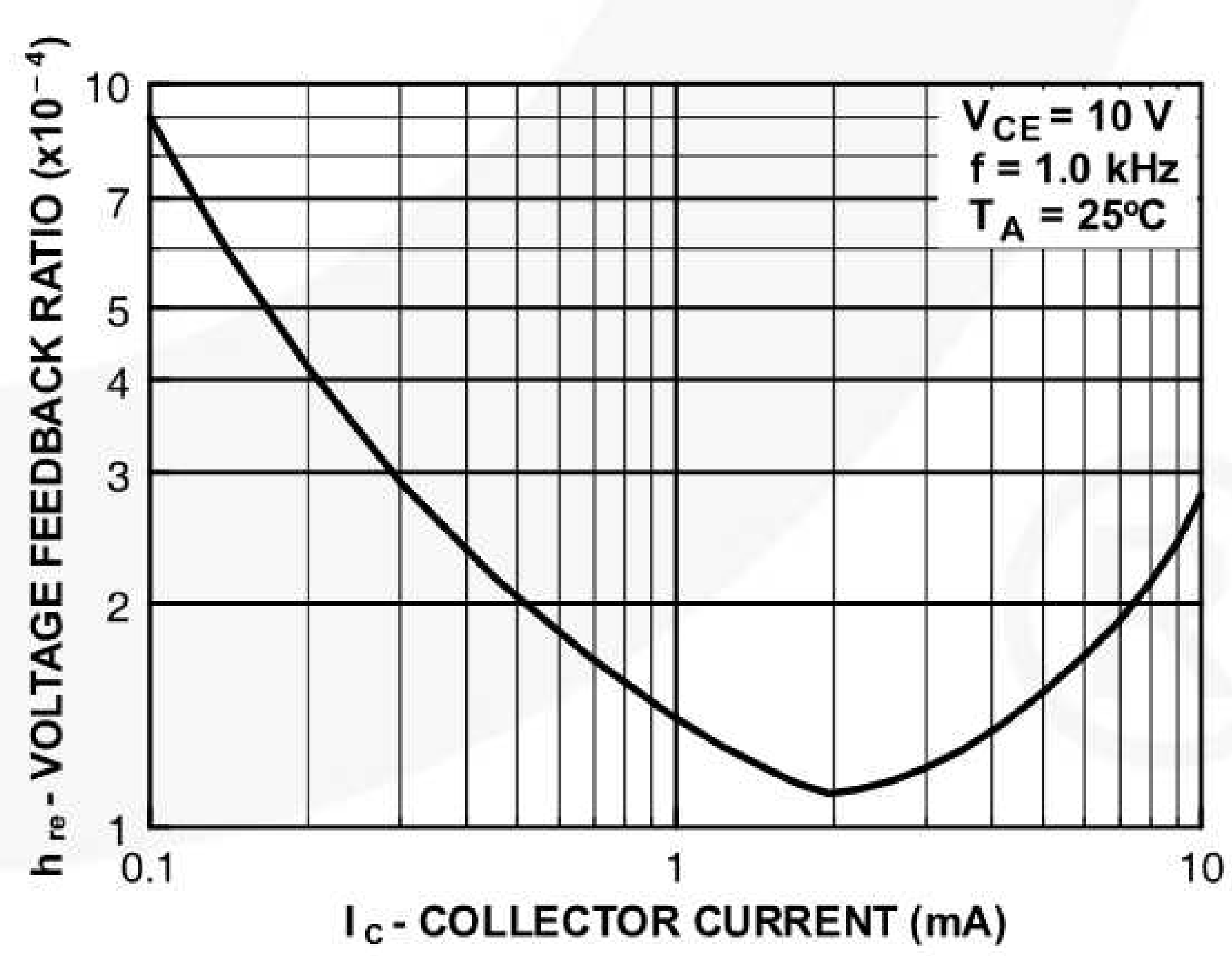


Figure 18. Voltage Feedback Ratio

Test Circuits

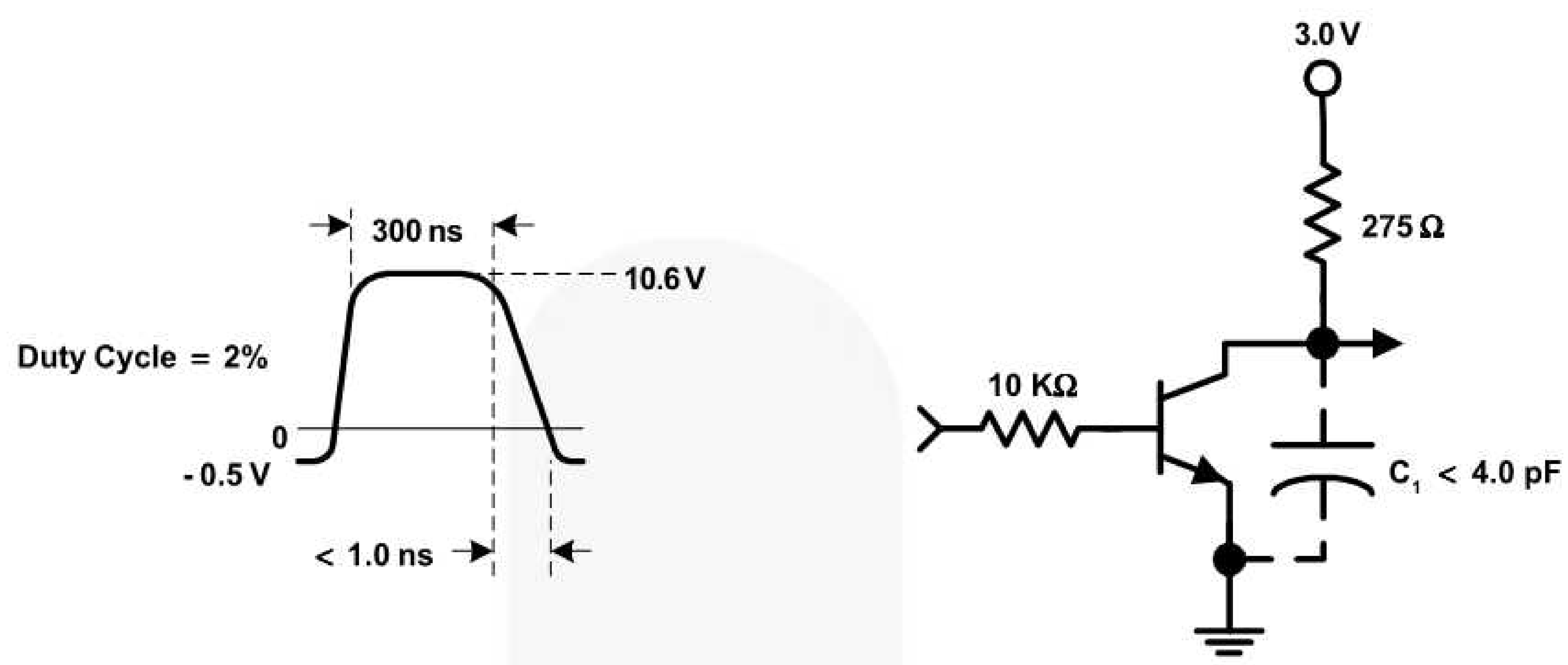


Figure 19. Delay and Rise Time Equivalent Test Circuit

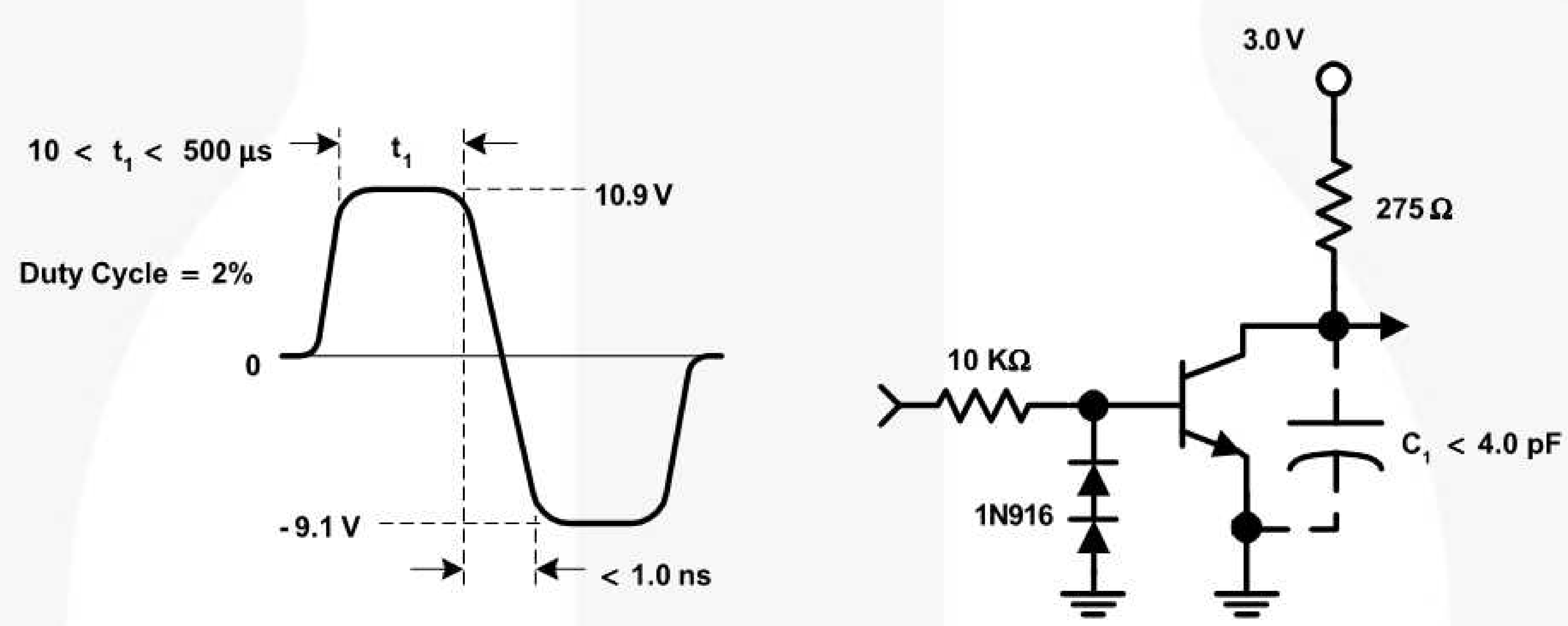
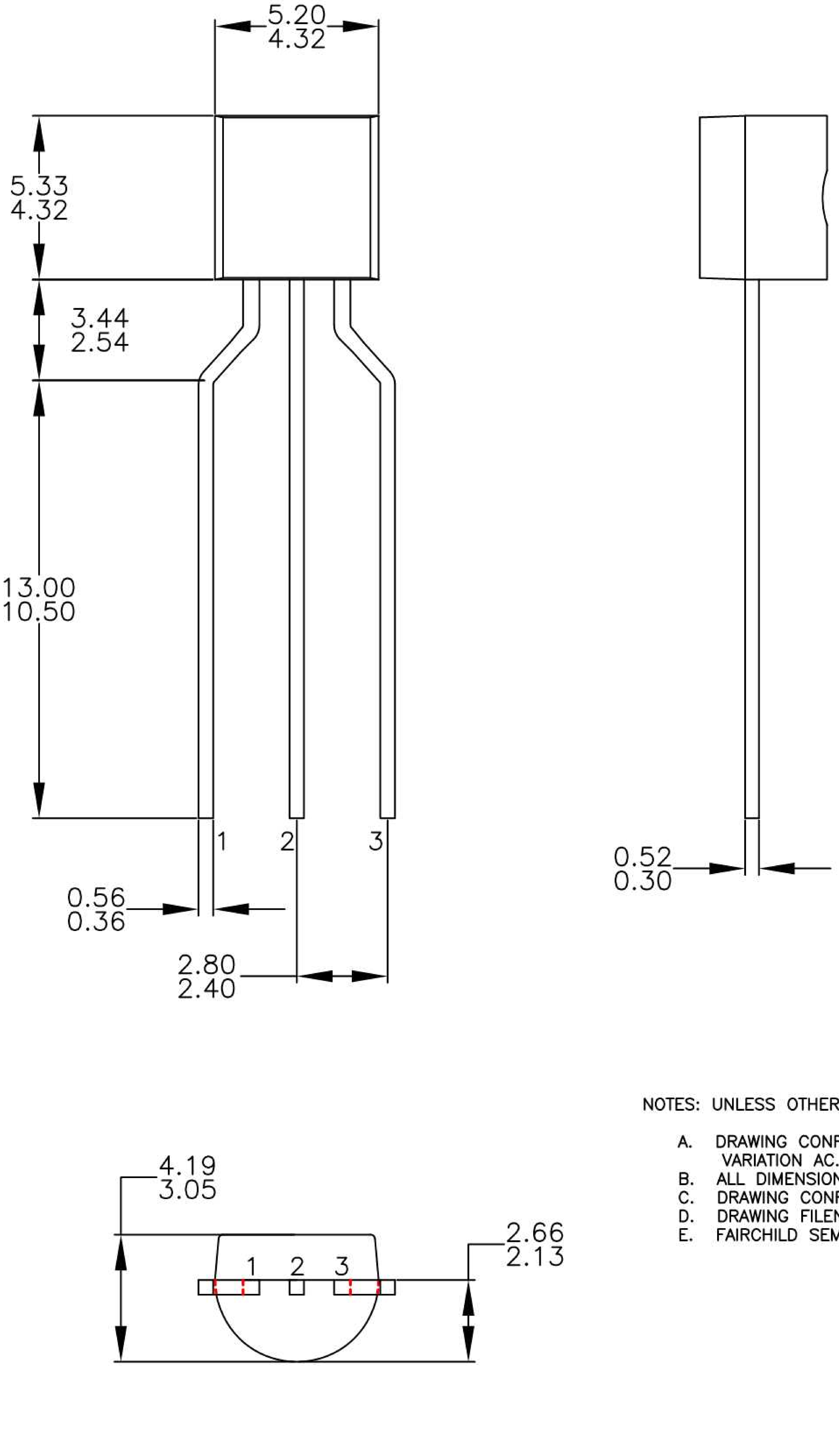


Figure 20. Storage and Fall Time Equivalent Test Circuit



NOTES: UNLESS OTHERWISE SPECIFIED

A. DRAWING CONFORMS TO JEDEC MS-013, VARIATION AC.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5M-2009.
D. DRAWING FILENAME: MKT-ZA03FREV3.
E. FAIRCHILD SEMICONDUCTOR.

MMBT3904 / PZT3904 REV. B0 3典型的性能特征基极发射极导通电压对集电极电流 0.1 1 10 100 0.2 0.4 0.6 0.8 1一世 - 集电极电流（MA） C V = 5V CE 25 ° C 125 ° C - 40 ° C基极发射极饱和电压与集电极电流 0.1 1 10 100 0.4 0.6 0.8 1一世 - 集电极电流（MA） C β = 10 25 ° C 125 ° C - 40 ° C集电极 - 发射极饱和电压与集电极电流 0.1 1 10 100 0.05 0.1 0.15一世 - 集电极电流（MA） 25 ° C C β = 10 125 ° C - 40 ° C集电极截止电流对环境温度 25 50 75 100 125 150 0.1 1 10 100 500 T - 环境温度（C）一个 V = 30V CB ° 电容与反向偏置电压 0.1 1 10 100 1 2 3 4五 10反向偏置电压（V） C OBO C IBO F = 1.0MHZ典型的脉冲电流增益 VS COLLECTOR CURRENT 0.1 1 10 100 0 100 200 300 400 500一世 - 集电极电流（MA） - 40 ° C 25 ° C C V = 5V CE 125 ° C β β REV. B0 4 典型性能特征 （续）功率耗散VS环境温度 0 25 50 75 100 125 150 0 0.25 0.5 0.75 1温度（°C） ? SOT-223 SOT-23 TO-92噪声系数与频率 0.1 1 10 100 0 2 4 6 8 10 12 F - 频率（KHZ） V = 5.0V CE一世 = 100 μA， R = 500 Ω C小号一世 = 1.0MA [R = 200 Ω C小号一世 = 50 μA [R = 1.0 K Ω C小号一世 = 0.5MA [R = 200 Ω C小号 ? Ω噪声系数与源阻力 0.1 1 10 100 0 2 4 6 8 10 12 [R - 源阻力（ ）一世 = 100 μA C一世 = 1.0MA C小号一世 = 50 μA C一世 = 5.0MA C 0 40 60 80 100 120 140 160 20 180电流增益和相角与频率 1 10 100 1000 0五 10 15 20 25三十 35 40 45 50 F - 频率（MHZ） θ V = 40V CE一世 = 10毫安 C H FE开启时间VS集电极电流 110 100五 10 100 500一世 - 集电极电流（MA）一世 = I = B1 C B2 我 C 10 40V 15V 2.0V ? @ V = 0V CB D ? @ V = 3.0V CC [R上升时间VS集电极电流 1 10 100五 10 100 500一世 - 集电极电流（MA）一世 = I = B1 C B2 我 C 10 ? = 125°C ? = 25°C ? V = 40V CC ? Ω θ μA ? Ω μA μA Ω Ω μA （K Ω）