

RoHS Compliant Product
A suffix of "-C" indicates halogen-free

FEATURE

- Complementary Pair
- One 3904-Type NPN
One 3906-Type PNP
- Epitaxial Planer Die Construction
- Ideal for Low Power Amplification and Switching

MARKING

46

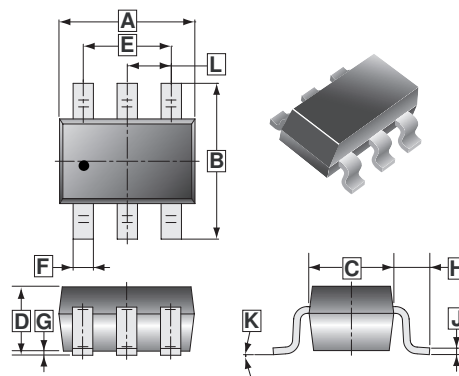
PACKAGE INFORMATION

Package	MPQ	Leader Size
SOT-363	3K	7 inch

ORDER INFORMATION

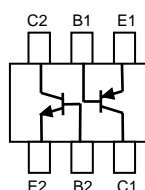
Part Number	Type
MMDT3946-C	Lead (Pb)-free and Halogen-free

SOT-363

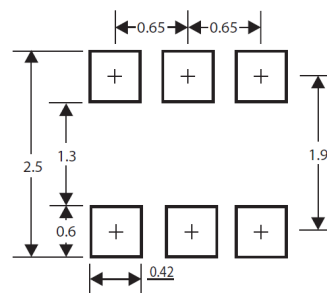


REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	1.80	2.20	G	0.10 REF.	
B	1.80	2.45	H	0.525 REF.	
C	1.15	1.35	J	0.05	0.25
D	0.70	1.10	K	8°	
E	1.30 REF.		L	0.65 TYP.	
F	0.10	0.35			

Mounting Pad Layout



E1, B1, C1 = PNP 3906
E2, B2, C2 = NPN 3904



*Dimensions in millimeters

ABSOLUTE MAXIMUM RATINGS (T_A=25°C unless otherwise noted)

Parameter	Symbol	Value	Units
Collector-Base Voltage	V _{CBO}	60	V
		-40	
Collector-Emitter Voltage	V _{CEO}	40	V
		-40	
Emitter-Base Voltage	V _{EBO}	6	V
		-5	
Continuous Collector Current	I _C	0.2	A
		-0.2	
Collector Power Dissipation ¹	P _D	150	mW
Thermal Resistance, Junction-Ambient	R _{θJA}	833	°C/W
Junction & Storage Temperature	T _J , T _{STG}	150, -55~150	°C

Notes:

1. Device Mounted on FR-4 glass epoxy printed circuit board using the minimum recommend footprint.
2. Pulse Test: Pulse Width 300μs, Duty Cycle 2%.

ELECTRICAL CHARACTERISTICS OF NPN 3904 ($T_A=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min.	Max.	Unit	Test Condition
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	60	-	V	$I_C=10\mu\text{A}, I_E=0$
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	40	-	V	$I_C=1\text{mA}, I_B=0$
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	6	-	V	$I_E=10\mu\text{A}, I_C=0$
Base Cut-off Current	I_{BL}	-	50	nA	$V_{CE}=30\text{V}, V_{EB}=3\text{V}$
Collector Cut-off Current	I_{CEX}	-	50	nA	$V_{CE}=30\text{V}, V_{EB}=3\text{V}$
DC Current Gain	h_{FE}	40	-		$V_{CE}=1\text{V}, I_C=0.1\text{mA}$
		70	-		$V_{CE}=1\text{V}, I_C=1\text{mA}$
		100	300		$V_{CE}=1\text{V}, I_C=10\text{mA}$
		60	-		$V_{CE}=1\text{V}, I_C=50\text{mA}$
		30	-		$V_{CE}=1\text{V}, I_C=100\text{mA}$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	-	0.2	V	$I_C=10\text{mA}, I_B=1\text{mA}$
		-	0.3		$I_C=50\text{mA}, I_B=5\text{mA}$
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	0.65	0.85	V	$I_C=10\text{mA}, I_B=1\text{mA}$
		-	0.95		$I_C=50\text{mA}, I_B=5\text{mA}$
Output Capacitance	C_{obo}	-	4	pF	$V_{CB}=5\text{V}, I_E=0, f=1\text{MHz}$
Input Capacitance	C_{ibo}		8		$V_{EB}=0.5\text{V}, I_C=0, f=1\text{MHz}$
Transition Frequency	f_T	300	-	MHz	$V_{CE}=20\text{V}, I_C=10\text{mA}, f=100\text{MHz}$
Input Impedance	h_{ie}	1	10	k ohms	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Voltage Feedback Ratio	h_{re}	0.5	8	$\times 10^{-4}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Small-Signal Current Gain	h_{fe}	100	400		$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Output Admittance	h_{oe}	1	40	μmhos	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Noise Figure	NF	-	5	dB	$V_{CE}=5\text{V}, I_C=0.1\text{mA}, f=1\text{kHz}$ $R_S=1\text{k}\Omega$
Delay Time	T_d	-	35	nS	$V_{CC}=3\text{V}, V_{BE}=0.5\text{V},$ $I_C=10\text{mA}, I_{B1}=1\text{mA}$
Rise Time	T_r	-	35		
Storage Time	T_s	-	200	nS	$V_{CC}=3\text{V}, I_C=10\text{mA},$ $I_{B1}=I_{B2}=1\text{mA}$
Fall Time	T_f	-	50		

ELECTRICAL CHARACTERISTICS OF PNP 3906 ($T_A=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min.	Max.	Unit	Test Condition
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	-40	-	V	$I_C = -10\mu\text{A}, I_E = 0$
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	-40	-	V	$I_C = -1\text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	-5	-	V	$I_E = -10\mu\text{A}, I_C = 0$
Base Cut-off Current	I_{BL}	-	-50	nA	$V_{CE} = -30\text{V}, V_{EB} = -3\text{V}$
Collector Cut-off Current	I_{CEX}	-	-50	nA	$V_{CE} = -30\text{V}, V_{EB} = -3\text{V}$
DC Current Gain	h_{FE}	60	-		$V_{CE} = -1\text{V}, I_C = -0.1\text{mA}$
		80	-		$V_{CE} = -1\text{V}, I_C = -1\text{mA}$
		100	300		$V_{CE} = -1\text{V}, I_C = -10\text{mA}$
		60	-		$V_{CE} = -1\text{V}, I_C = -50\text{mA}$
		30	-		$V_{CE} = -1\text{V}, I_C = -100\text{mA}$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	-	-0.25	V	$I_C = -10\text{mA}, I_B = -1\text{mA}$
		-	-0.4		$I_C = -50\text{mA}, I_B = -5\text{mA}$
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	-0.65	-0.85	V	$I_C = -10\text{mA}, I_B = -1\text{mA}$
		-	-0.95		$I_C = -50\text{mA}, I_B = -5\text{mA}$
Collector Output Capacitance	C_{ob}	-	4.5	pF	$V_{CB} = -5\text{V}, I_E = 0, f = 1\text{MHz}$
Input Capacitance	C_{ibo}	-	10		$V_{EB} = -0.5\text{V}, I_C = 0, f = 1\text{MHz}$
Transition Frequency	f_T	250	-	MHz	$V_{CE} = -20\text{V}, I_C = -10\text{mA}, f = 100\text{MHz}$
Input Impedance	h_{ie}	2	12	k ohms	$V_{CE} = -10\text{V}, I_C = -1\text{mA}, f = 1\text{kHz}$
Voltage Feedback Ratio	h_{re}	0.1	10	$\times 10^{-4}$	$V_{CE} = -10\text{V}, I_C = -1\text{mA}, f = 1\text{kHz}$
Small-Signal Current Gain	h_{fe}	100	400		$V_{CE} = -10\text{V}, I_C = -1\text{mA}, f = 1\text{kHz}$
Output Admittance	h_{oe}	3	60	μmhos	$V_{CE} = -10\text{V}, I_C = -1\text{mA}, f = 1\text{kHz}$
Noise Figure	NF	-	4	dB	$V_{CE} = -5\text{V}, I_C = -0.1\text{mA}, f = 1\text{kHz}$ $R_S = 1\text{k}\Omega$
Delay Time	T_d	-	35	nS	$V_{CC} = -3\text{V}, V_{BE} = -0.5\text{V},$ $I_C = -10\text{mA}, I_{B1} = -1\text{mA}$
Rise Time	T_r	-	35		
Storage Time	T_s		225	nS	$V_{CC} = -3\text{V}, I_C = -10\text{mA},$ $I_{B1} = -I_{B2} = -1\text{mA}$
Fall Time	T_f	-	75		

CHARACTERISTIC CURVES (NPN)

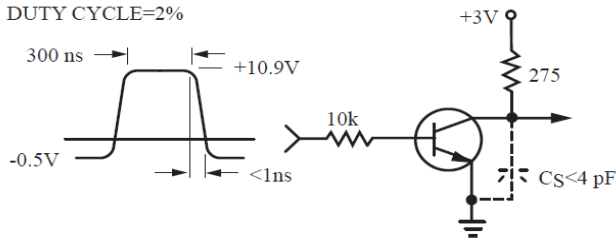


Figure 1. Delay and Rise Time Equivalent Test Circuit

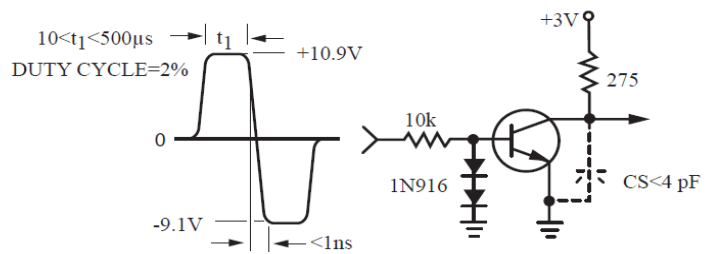


Figure 2. Storage and Fall Time Equivalent Test Circuit

*Total shunt capacitance of test jig and connectors

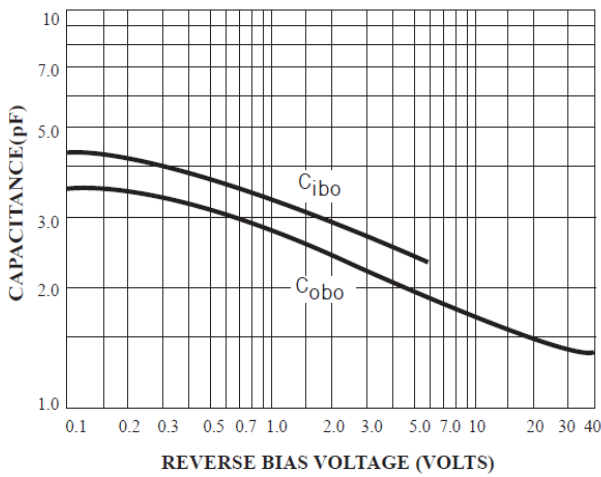


Figure 3. Capacitance

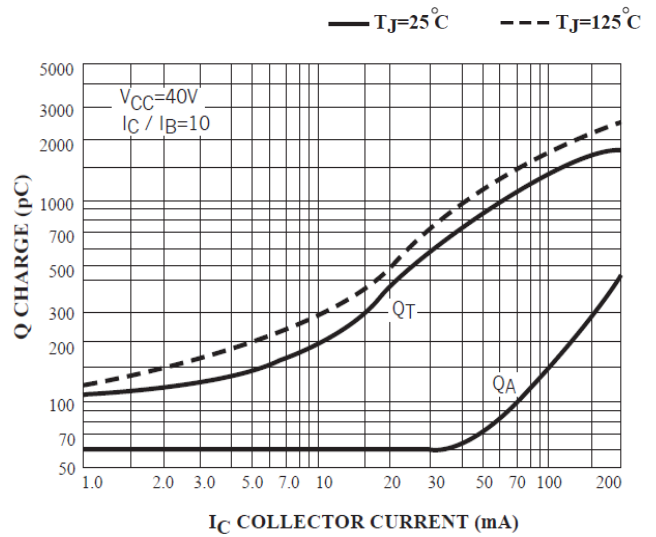


Figure 4. Charge Data

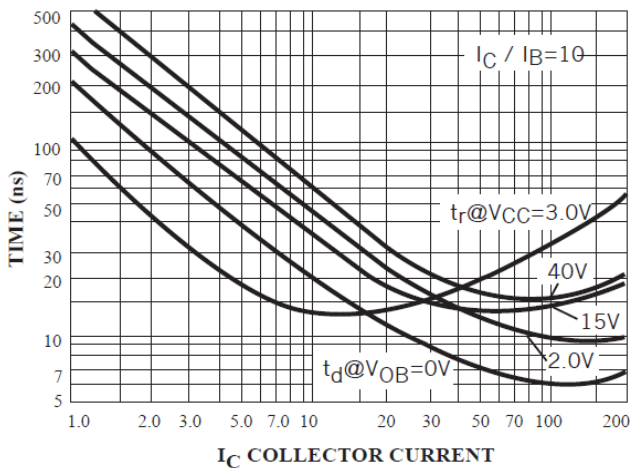


Figure 5. Turn-On Time

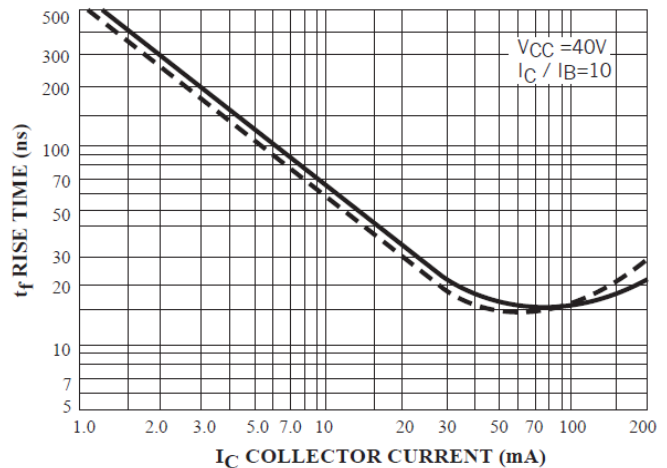


Figure 6. Rise Time

CHARACTERISTIC CURVES (NPN)

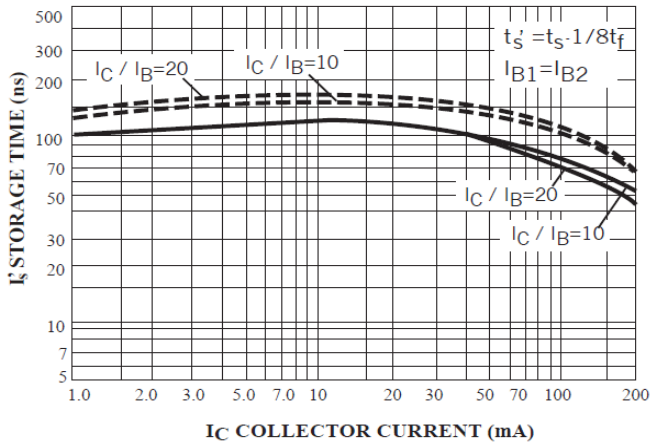


Figure 7. Storage Time

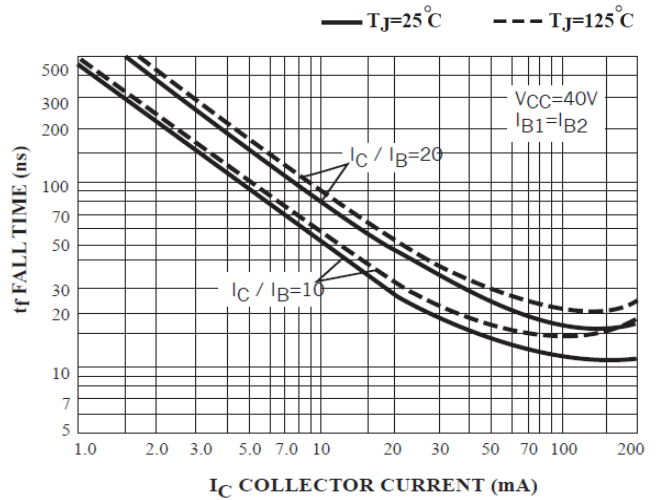


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

($V_{CE}=5.0$ Vdc, $T_A=25^\circ\text{C}$, Bandwidth=1.0Hz)

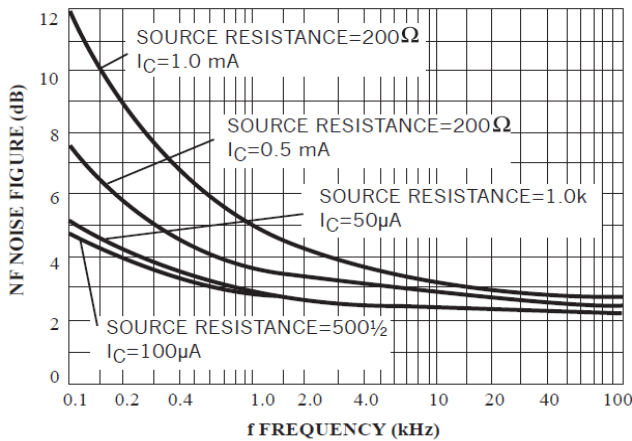


Figure 9.

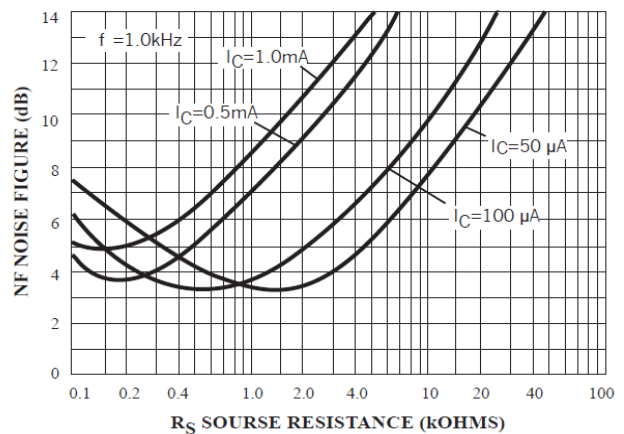


Figure 10.

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

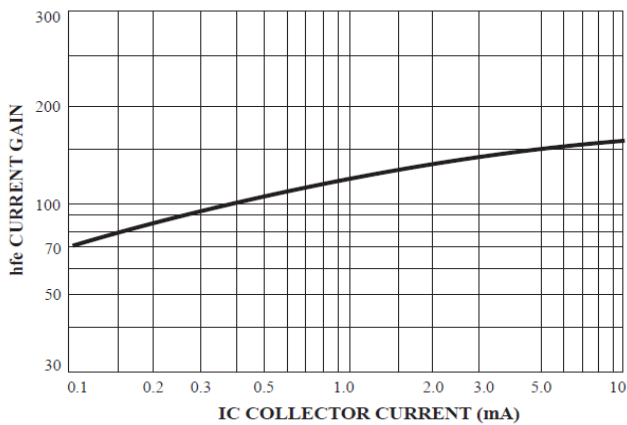


Figure 11. Current Gain

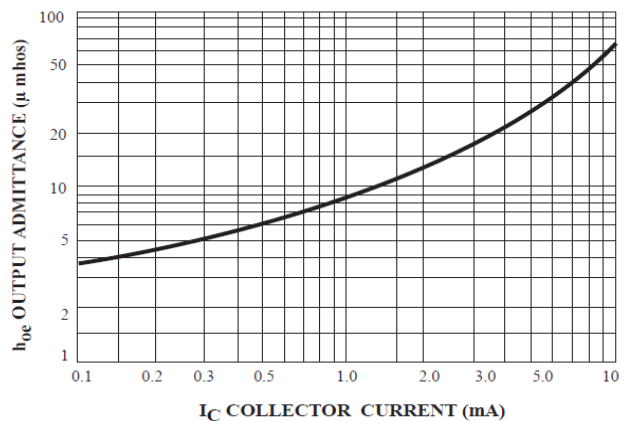


Figure 12. Output Admittance

CHARACTERISTIC CURVES (NPN)

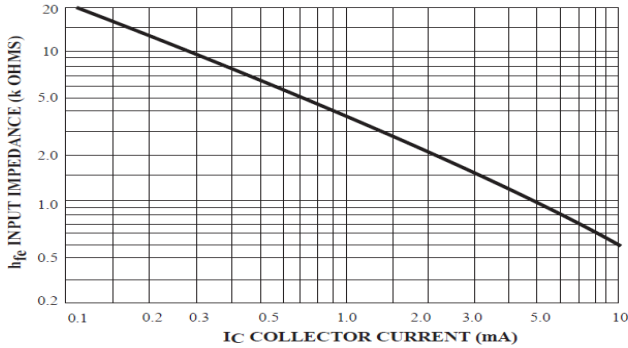


Figure 13. Input Impedance

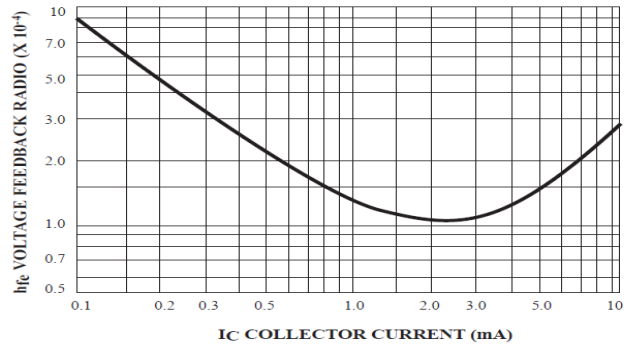


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

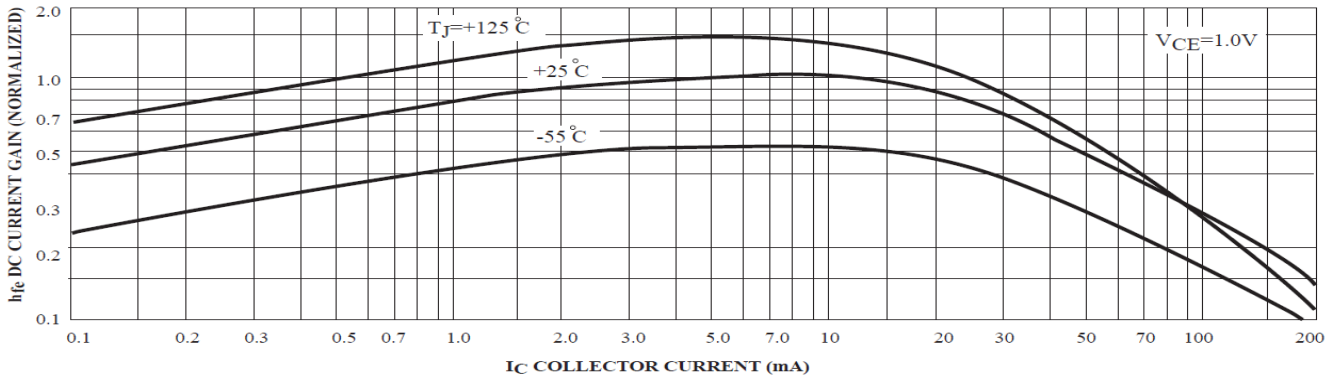


Figure 15. DC Current Gain

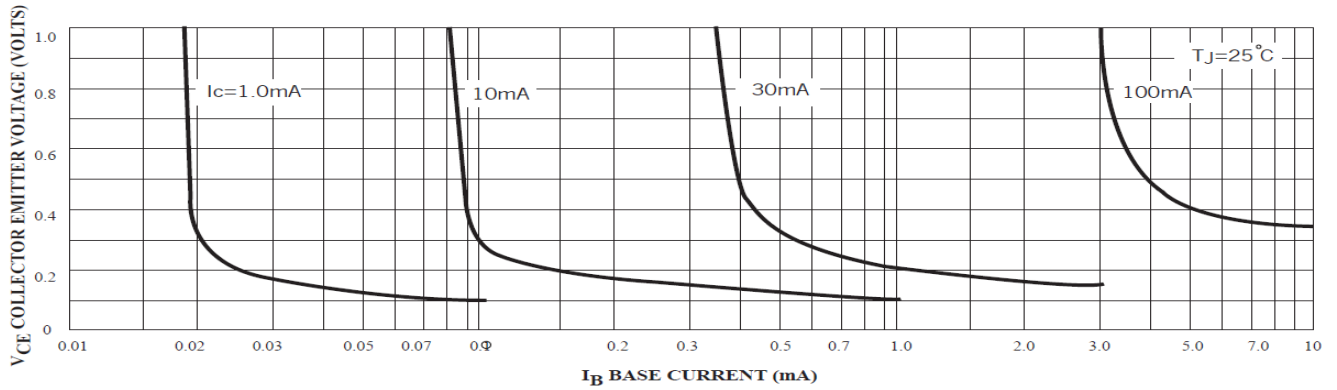


Figure 16. Collector Saturation Region

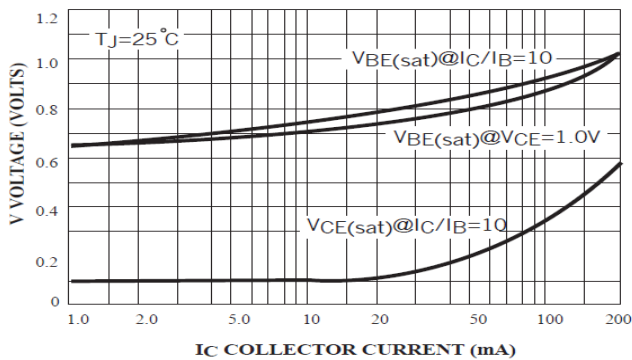


Figure 17. "ON" Voltage

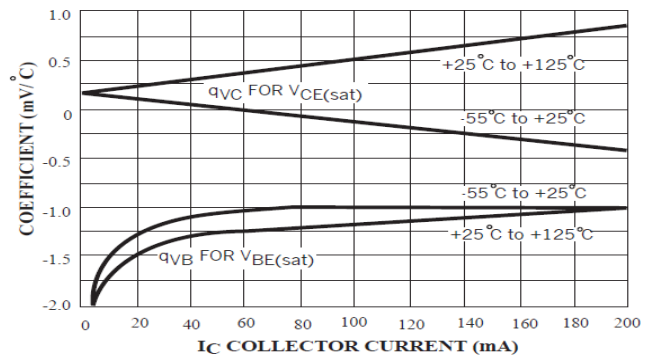


Figure 18. Temperature Coefficients

CHARACTERISTIC CURVES (PNP)

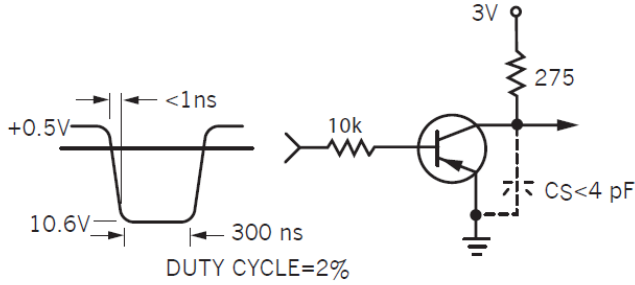


Figure 19. Delay and Rise Time Equivalent Test Circuit

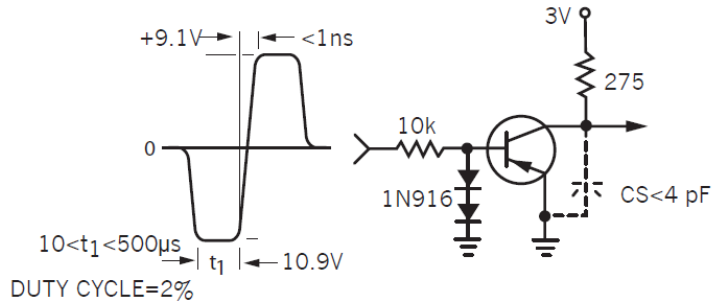


Figure 20 . Storage and Fall Time Equivalent Test Circuit

*Total shunt capacitance of test jig and connectors

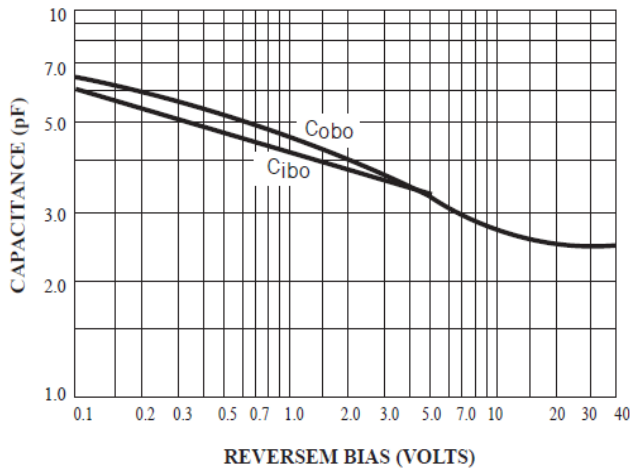


Figure 21. Capacitance

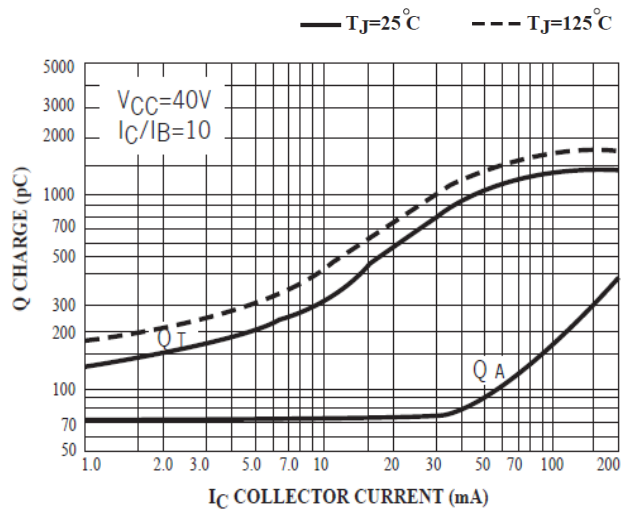


Figure 22. Charge Data

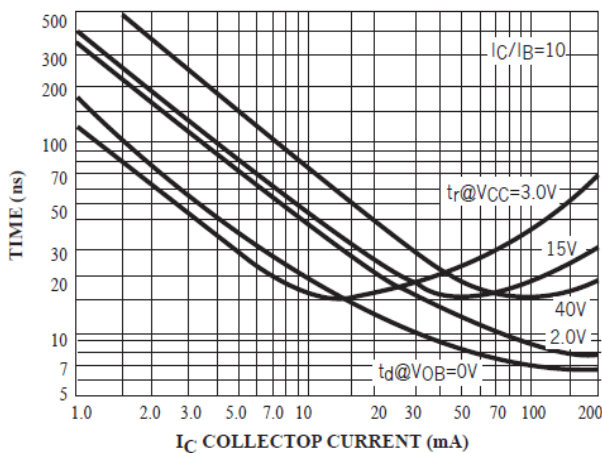


Figure 23. Turn-On Time

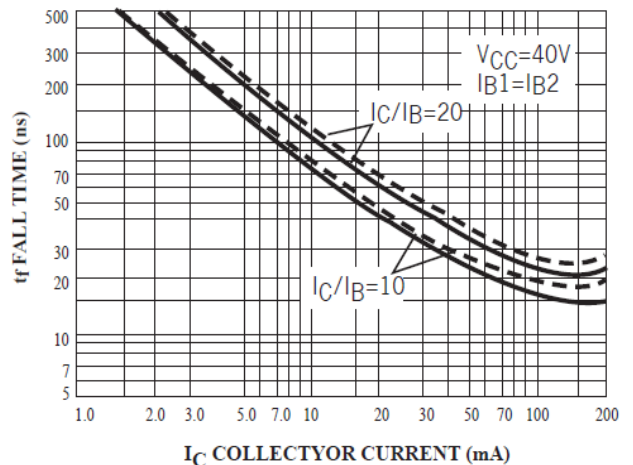


Figure 24. Fall Time

CHARACTERISTIC CURVES (PNP)

($V_{CE} = -5.0 \text{ Vdc}$, $T_A = 25^\circ\text{C}$, Bandwidth = 1.0Hz)

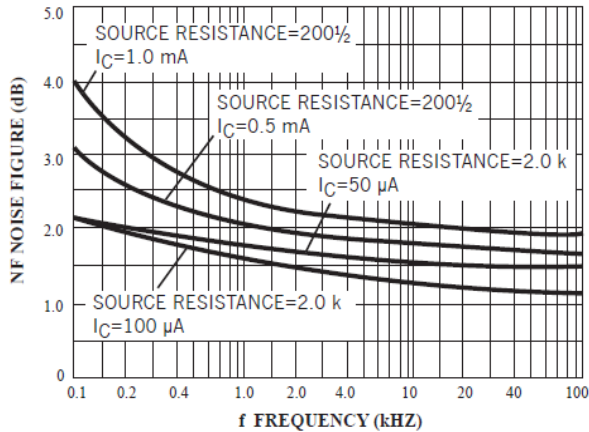


Figure 25.

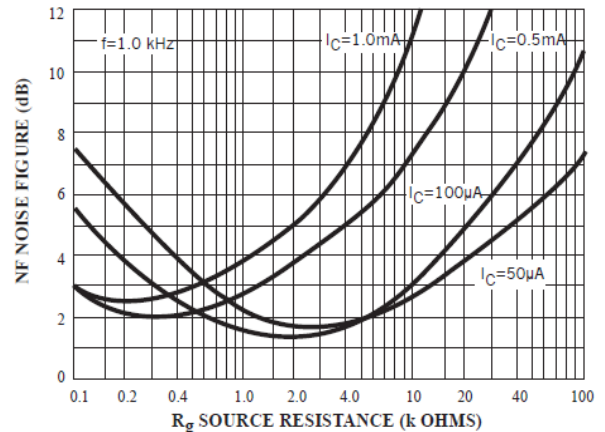


Figure 26.

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

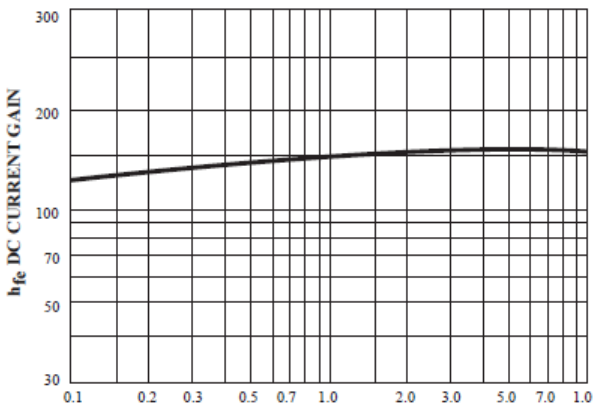


Figure 27. Current Gain

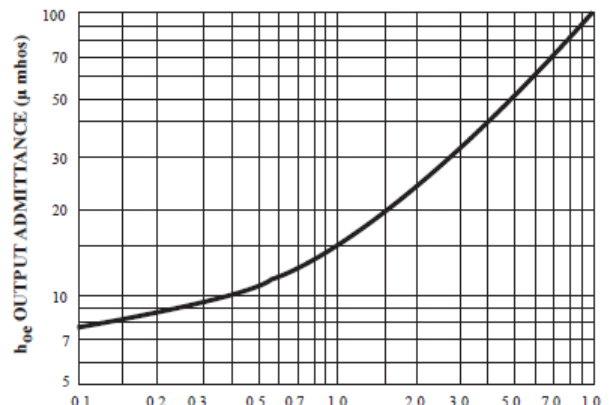


Figure 28. Input Impedance

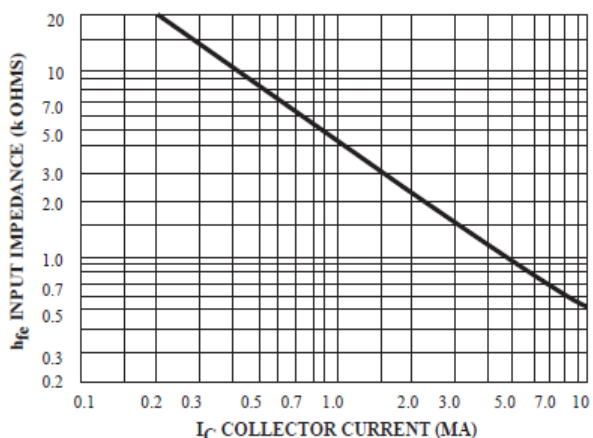


Figure 29. Input Impedance

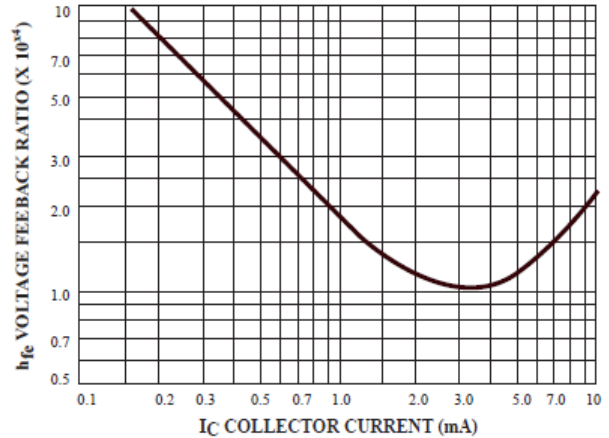
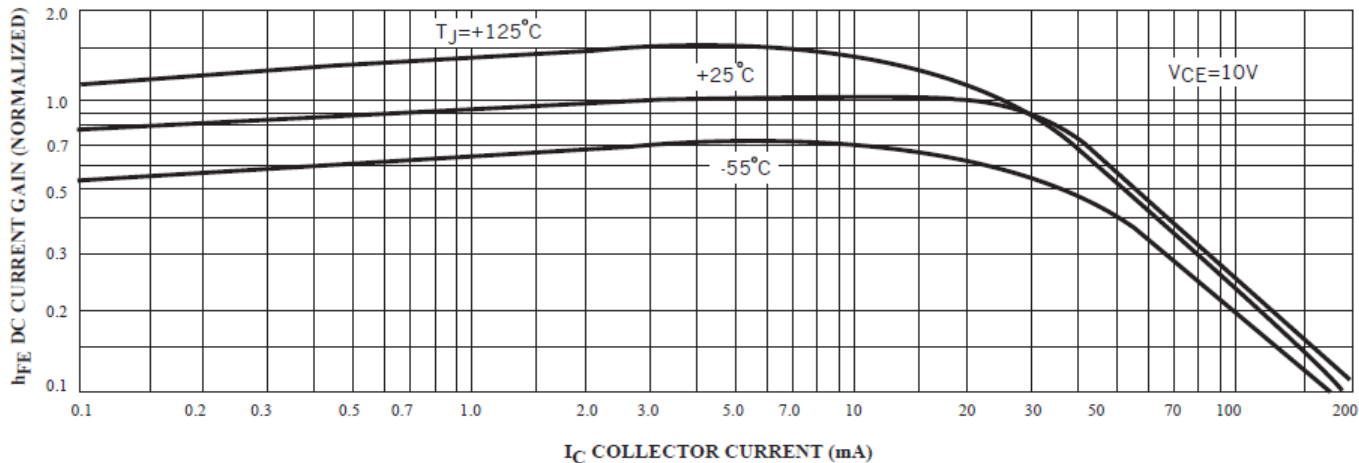


Figure 30. Voltage Feedback Ratio

CHARACTERISTIC CURVES (PNP)



Figurer 31. DC Current Gain

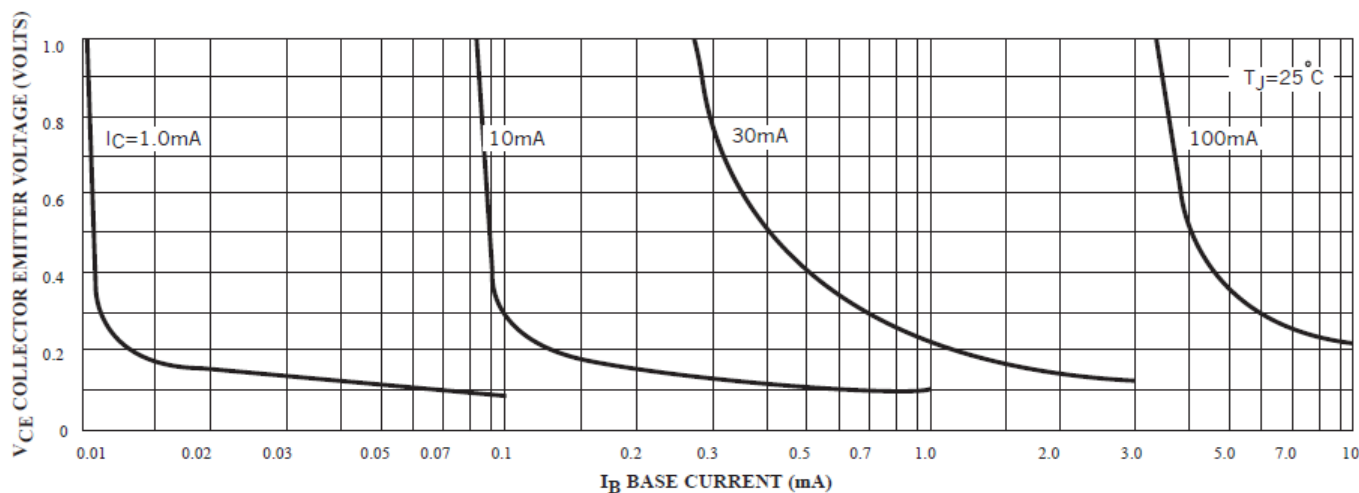


Figure 32. Collector Saturation Region

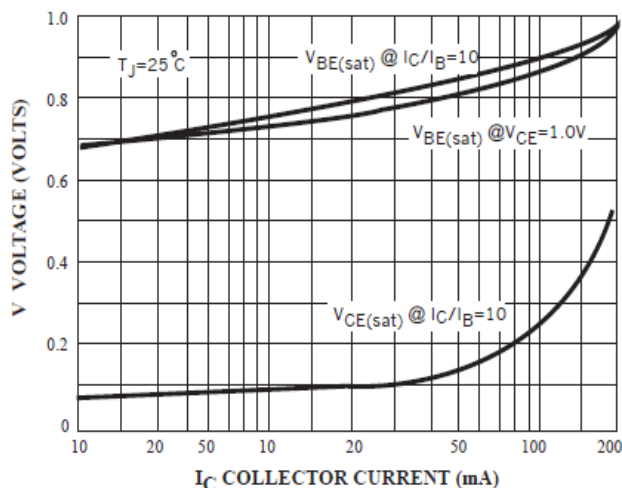


Figure 33. "ON" Voltages

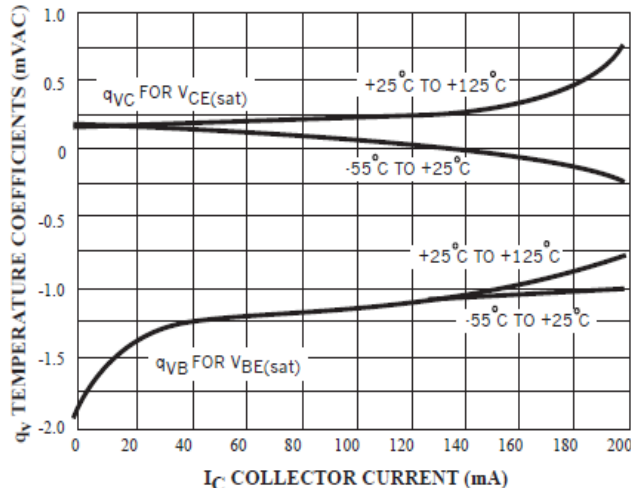


Figure 34. Temperature Coefficients