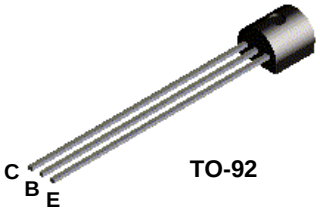
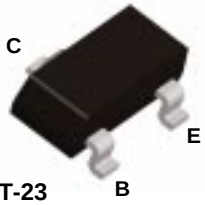
FAIRCHILD
SEMICONDUCTOR TM

2N4400



TO-92

MMBT4400



SOT-23
Mark: 83

NPN General Purpose Amplifier

This device is designed for use as general purpose amplifiers and switches requiring collector currents to 500 mA.

Absolute Maximum Ratings*

TA = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
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	600	mA
T_J, T_{stg}	Operating and Storage Junction Temperature Range	-55 to +150	°C

*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

NOTES:
1) These ratings are based on a maximum junction temperature of 150 degrees C.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Thermal Characteristics

TA = 25°C unless otherwise noted

Symbol	Characteristic	Max		Units
		2N4400	*MMBT4400	
P_D	Total Device Dissipation Derate above 25°C	625 5.0	350 2.8	mW mW/°C
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3		°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	357	°C/W

NPN General Purpose Amplifier
(continued)

Electrical Characteristics
TA = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Max	Units
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 = 100 µA, I_E = 0	60		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	I_E = 100 µA, I_C = 0	6.0		V
I_{CEX}	Collector Cutoff Current	V_{CE} = 35 V, V_{EB} = 0.4 V		0.1	µA
I_{BL}	Emitter Cutoff Current	V_{CE} = 35 V, V_{EB} = 0.4 V		0.1	µA
ON CHARACTERISTICS*					
h_{FE}	DC Current Gain	V_{CE} = 1.0 V, I_C = 1.0 mA V_{CE} = 1.0 V, I_C = 10 mA V_{CE} = 1.0 V, I_C = 150 mA V_{CE} = 2.0 V, I_C = 500 mA	20 40 50 20	 150 	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C = 150 mA, I_B =15 mA I_C = 500 mA, I_B = 50 mA		0.40 0.75	V V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	I_C = 150 mA, I_B =15 mA I_C = 500 mA, I_B = 50 mA	0.75	0.95 1.2	V V
SMALL SIGNAL CHARACTERISTICS					
C_{ob}	Output Capacitance	V_{CB} = 5.0 V, f = 140 kHz		6.5	pF
C_{ib}	Input Capacitance	V_{EB} = 0.5 V, f = 140 kHz		30	pF
h_{fe}	Small-Signal Current Gain	I_C = 20 mA, V_{CE} = 10 V, f = 100 MHz	2.0		
h_{fe}	Small-Signal Current Gain	V_{CE} = 10 V, I_C = 1.0 mA, f = 1.0 kHz	20	250	
h_{ie}	Input Impedance		0.5	7.5	KΩ
h_{re}	Voltage Feedback Ratio		0.1	8.0	x 10^{-4}
h_{oe}	Output Admittance		1.0	30	µmhos
SWITCHING CHARACTERISTICS					
t_d	Delay Time	V_{CC} = 30 V, I_C = 150 mA, I_{B1} = 15 mA ,V_{EB} = 2 V		15	ns
t_r	Rise Time			20	ns
t_s	Storage Time	V_{CC} = 30 V, I_C = 150 mA, I_{B1} = I_{B2} = 15 mA		225	ns
t_f	Fall Time			30	ns

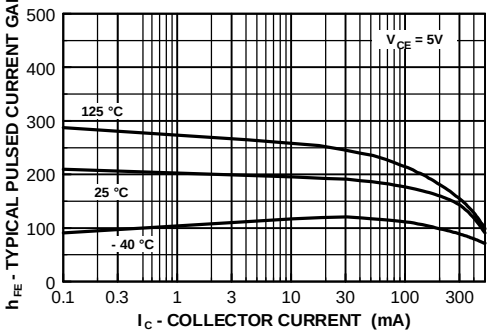
*Pulse Test: Pulse Width £ 300 ms, Duty Cycle £ 2.0%

NPN General Purpose Amplifier

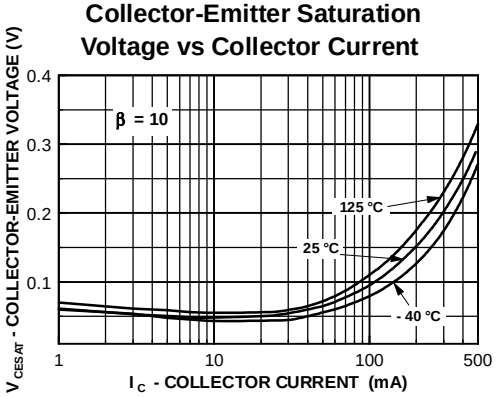
(continued)

Typical Characteristics

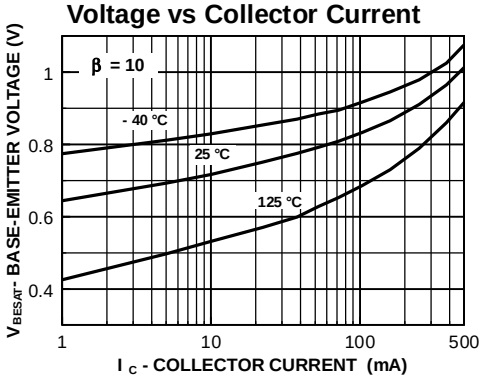
Typical Pulsed Current Gain vs Collector Current



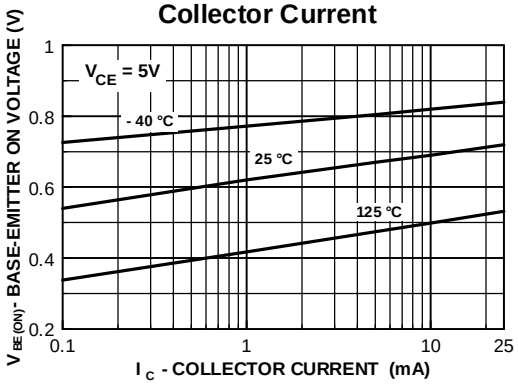
Collector-Emitter Saturation Voltage vs Collector Current



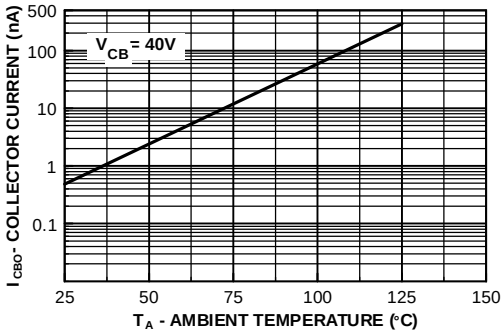
Base-Emitter Saturation Voltage vs Collector Current



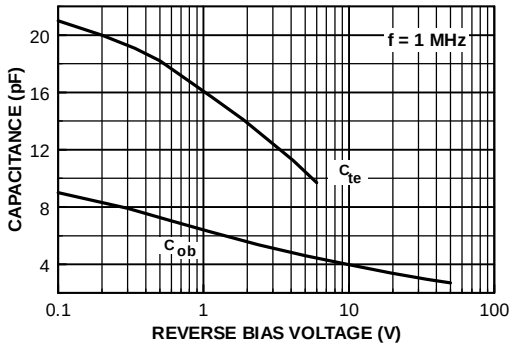
Base-Emitter ON Voltage vs Collector Current



Collector-Cutoff Current vs Ambient Temperature

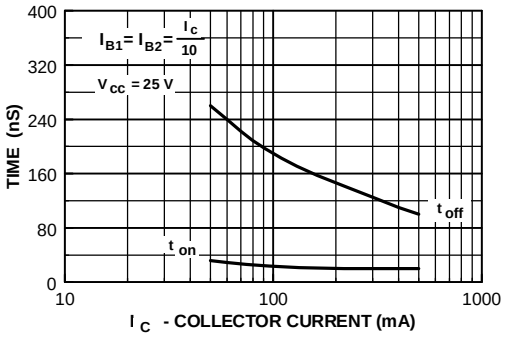


Emitter Transition and Output Capacitance vs Reverse Bias Voltage

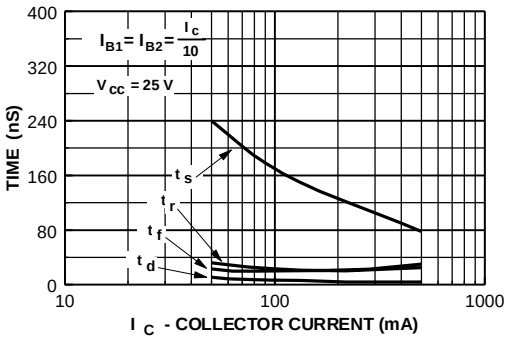


Typical Characteristics (continued)

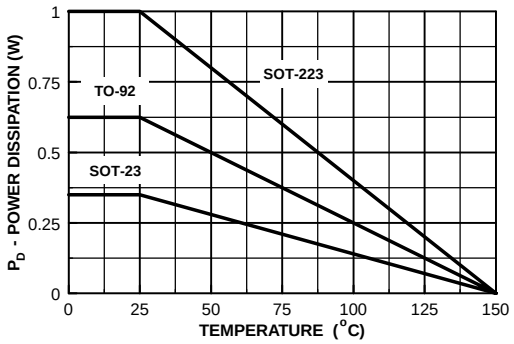
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current



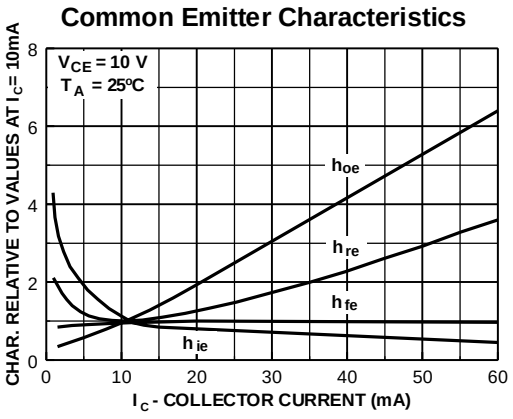
Power Dissipation vs Ambient Temperature

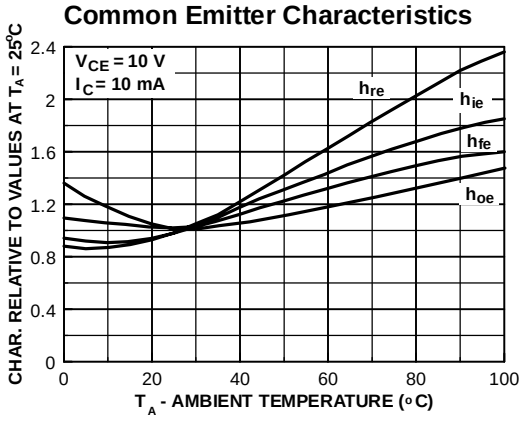


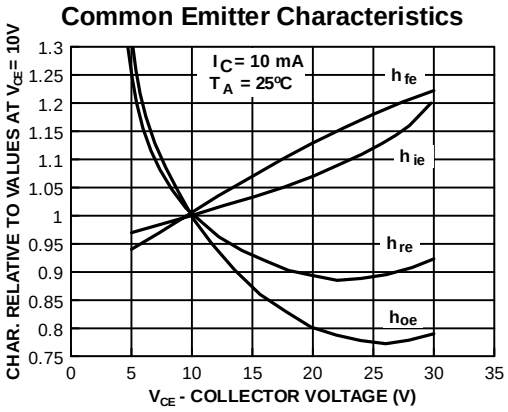
NPN General Purpose Amplifier

(continued)

Typical Common Emitter Characteristics (f = 1.0kHz)







Test Circuits

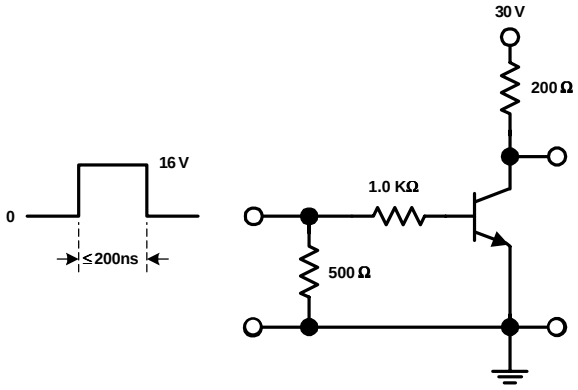


FIGURE 1: Saturated Turn-On Switching Timer

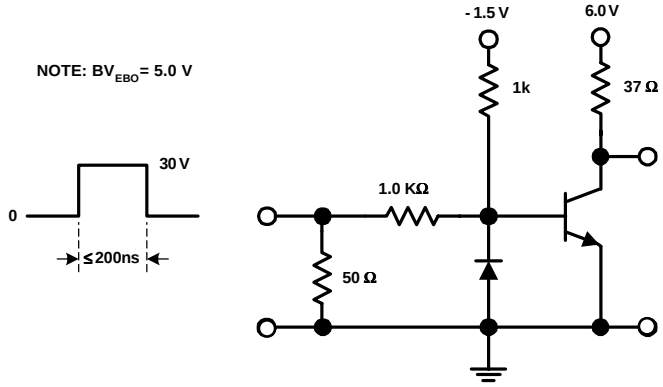


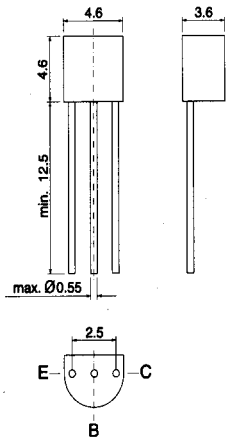
FIGURE 2: Saturated Turn-Off Switching Time

HN / 2N 4400/4401
NPN EPITAXIAL SILICON TRANSISTOR

General purpose transistor

Collector Emitter Voltage: V_{CEO} = 40V
Collector Dissipation: P_C (max) = 625mW

On special request, these transistors can be manufactured in different pin configurations. Please refer to the "TO-92 TRANSISTOR PACKAGE OUTLINE" on page 80 for the available pin options.



TO-92 Plastic Package
Weight approx. 0.18 g
Dimensions in mm

Absolute Maximum Ratings (T_a = 25°C)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6	V
Collector Current	I_C	600	mA
Collector Dissipation	P_C	625	mW
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_S	-55 to + 150	°C

G S P FORM A AVAILABLE

HN / 2N 4400/4401
NPN EPITAXIAL SILICON TRANSISTOR

Characteristics at T_{amb} =25 °C

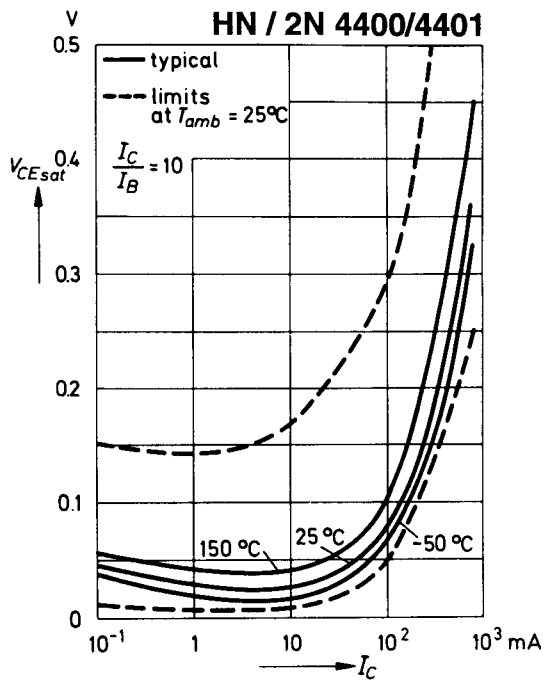
	Symbol	Min.	Typ.	Max.	Unit
DC Current Gain.					
at V_{CE} = 1V, I_C = 0.1 mA					
HN / 2N 4401	h_{FE}	20	-		-
at V_{CE} = 1V, I_C = 1 mA					
HN / 2N 4400	h_{FE}	20	-		-
HN / 2N 4401	h_{FE}	40	-		-
at V_{CE} = 1V, I_C = 10 mA					
HN / 2N 4400	h_{FE}	40	-		-
HN / 2N 4401	h_{FE}	80	-		-
at V_{CE} = 1V, I_C = 150 mA					
HN / 2N 4400	h_{FE}	50	-	150	-
HN / 2N 4401	h_{FE}	100	-	300	-
at V_{CE} = 2V, I_C = 500 mA					
HN / 2N 4400	h_{FE}	20	-		-
HN / 2N 4401	h_{FE}	40	-		-
Collector Cutoff Current at V_{CE} = 35 V, at V_{EB} = 0.4V	I_{CEX}	-	-	100	nA
Collector Emitter Breakdown Voltage at I_C = 1 mA, I_B = 0	$V_{(BR)CEO}$	40	-	-	V
Collector Base Breakdown Voltage at I_C = 100 µA, I_E = 0	$V_{(BR)CBO}$	60	-	-	V
Collector Emitter Saturation Voltage					
at I_C = 150 mA, I_B = 15 mA	V_{CEsat}	-	-	0.4	V
at I_C = 50 mA, I_B = 50 mA			-	0.75	V
Collector Saturation Voltage					
at I_C = 150 mA, I_B = 15 mA	V_{BEsat}	0.75	-	0.95	V
at I_C = 500 mA, I_B = 50 mA		-		1.2	
Emitter Base Breakdown Voltage at I_E = 100 µA, I_C = 0	$V_{BR(EBO)}$	6	-	-	V
Gain Bandwidth Product at V_{CE} = 10V, I_C = 20 mA, f = 100MHz					
HN / 2N 4400		200	-	-	MHz
HN / 2N 4401	f_T	250	-	-	MHz
Collector Base Capacitance at V_{CB} = 5 V, f = 100MHz, I_E = 0	$C_{(CBO)}$	-	-	6.5	pF
Turn On Time at V_{CC} = 30 V, V_{BE} = 2V, I_C = 150 mA, I_B1 = 15 mA	t_{on}	-	-	35	ns
Turn Off Time at V_{CC} = 30 V, I_C = 150 mA, I_B1 = I_B2 = 15mA	t_{off}	-	-	255	ns

[1] Valid provided that leads are kept at ambient temperature at a distance of 2 mm from case.

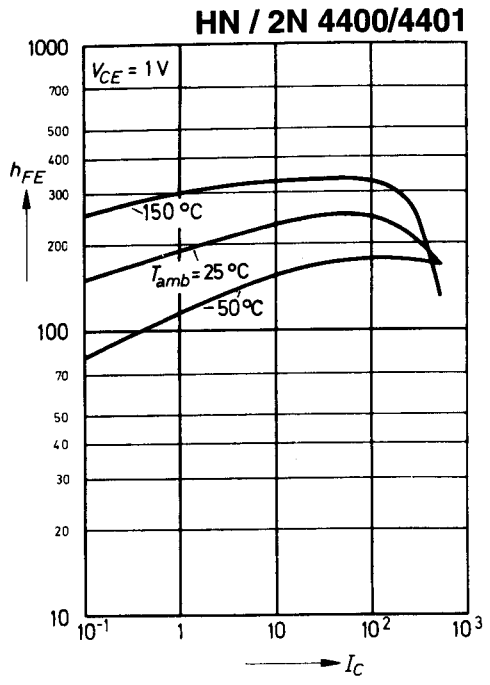
G S P FORM A AVAILABLE

HN / 2N 4400/4401
NPN EPITAXIAL SILICON TRANSISTOR

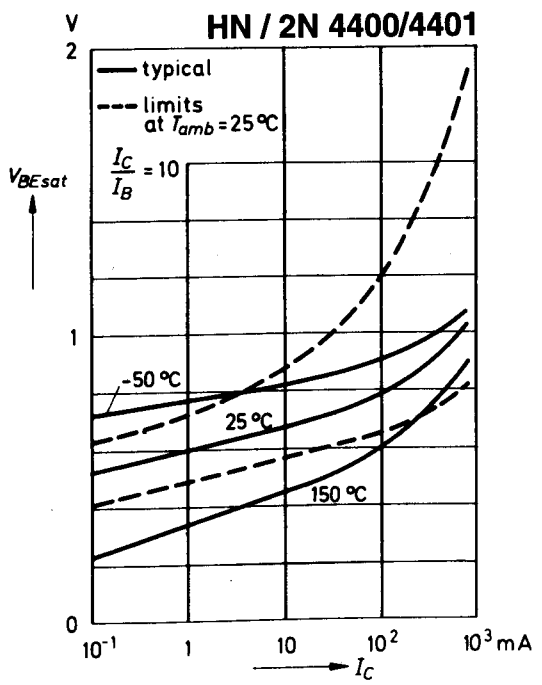
Collector saturation voltage versus collector current



DC current gain versus collector current



Base saturation voltage versus collector current



Common emitter collector characteristics