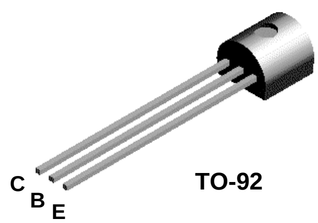
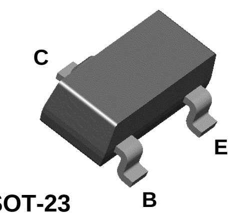
FAIRCHILD
SEMICONDUCTOR™

2N4401 MMBT4401



TO-92



SOT-23
Mark: 2X

NPN General Pupose Amplifier

This device is designed for use as a medium power amplifier and switch requiring collector currents up 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
		2N4401	*MMBT4401	
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

*Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06."

NPN General Purpose Amplifier
(continued)

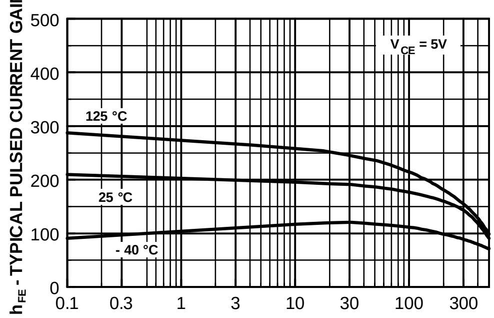
Electrical Characteristics
TA = 25°C unless otherwise noted

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	$I_C = 0.1$ mA, $I_E = 0$	60		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 0.1$ mA, $I_C = 0$	6.0		V
I_{BL}	Base Cutoff Current	$V_{CE} = 35$ V, $V_{EB} = 0.4$ V		0.1	μA
I_{CEX}	Collector Cutoff Current	$V_{CE} = 35$ V, $V_{EB} = 0.4$ V		0.1	μA
ON CHARACTERISTICS*					
h_{FE}	DC Current Gain	$I_C = 0.1$ mA, $V_{CE} = 1.0$ V $I_C = 1.0$ mA, $V_{CE} = 1.0$ V $I_C = 10$ mA, $V_{CE} = 1.0$ V $I_C = 150$ mA, $V_{CE} = 1.0$ V $I_C = 500$ mA, $V_{CE} = 2.0$ V	20 40 80 100 40	 300 	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 150$ mA, $I_B = 15$ mA $I_C = 500$ mA, $I_B = 50$ mA		0.4 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					
f_T	Current Gain - Bandwidth Product	$I_C = 20$ mA, $V_{CE} = 10$ V, f = 100 MHz	250		MHz
C_{cb}	Collector-Base Capacitance	$V_{CB} = 5.0$ V, $I_E = 0$, f = 140 kHz		6.5	pF
C_{eb}	Emitter-Base Capacitance	$V_{BE} = 0.5$ V, $I_C = 0$, f = 140 kHz		30	pF
h_{ie}	Input Impedance	$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	1.0	15	kΩ
h_{re}	Voltage Feedback Ratio	$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	0.1	8.0	$\times 10^{-4}$
h_{fe}	Small-Signal Current Gain	$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	40	500	
h_{oe}	Output Admittance	$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	1.0	30	μmhos
SWITCHING CHARACTERISTICS					
t_d	Delay Time	$V_{CC} = 30$ V, $V_{EB} = 2$ V,		15	ns
t_r	Rise Time	$I_C = 150$ mA, $I_{B1} = 15$ mA		20	ns
t_s	Storage Time	$V_{CC} = 30$ V, $I_C = 150$ mA		225	ns
t_f	Fall Time	$I_{B1} = I_{B2} = 15$ mA		30	ns

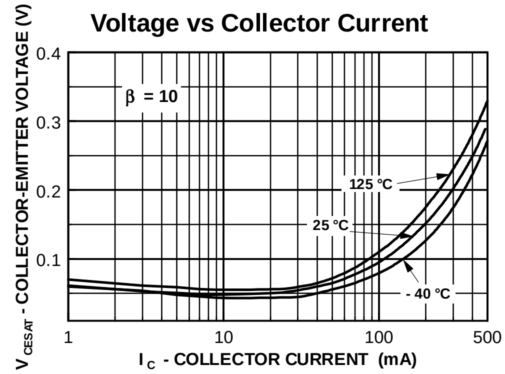
*Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%

Typical Characteristics

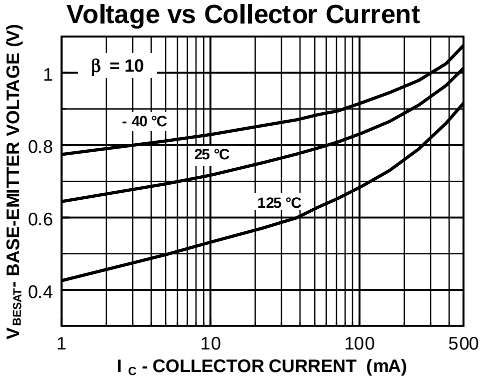
Typical Pulsed Current Gain vs Collector Current



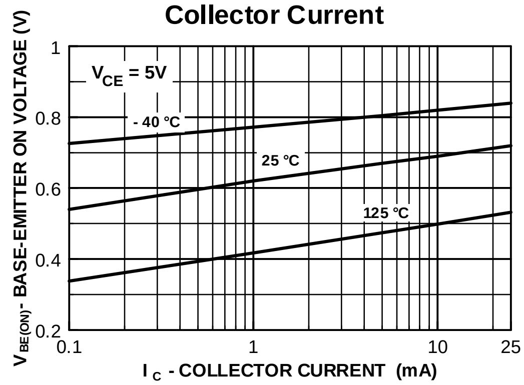
Collector-Emitter Saturation Voltage vs Collector Current



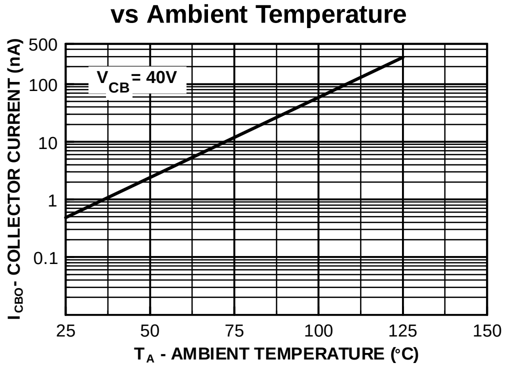
Base-Emitter Saturation Voltage vs Collector Current



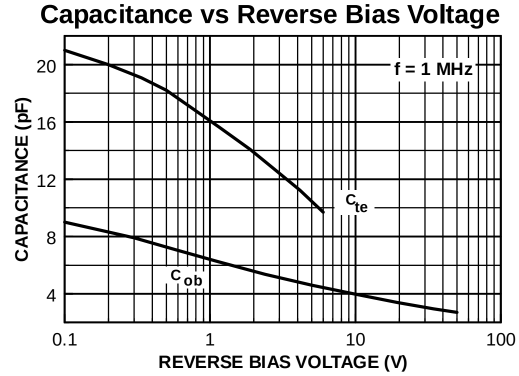
Base-Emitter ON Voltage vs Collector Current



Collector-Cutoff Current vs Ambient Temperature



Emitter Transition and Output Capacitance vs Reverse Bias Voltage

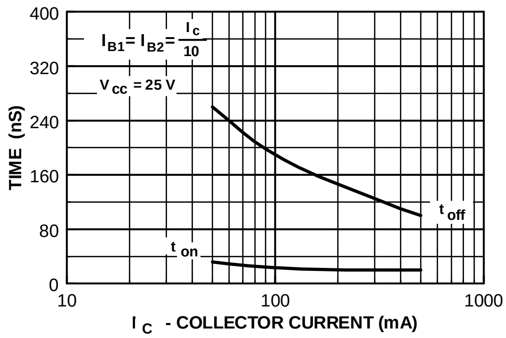


NPN General Purpose Amplifier

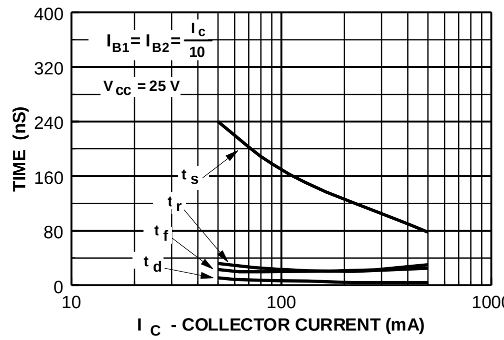
(continued)

Typical Characteristics (continued)

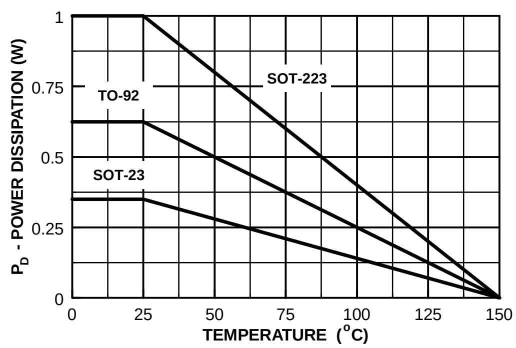
Turn On and Turn Off Times vs Collector Current



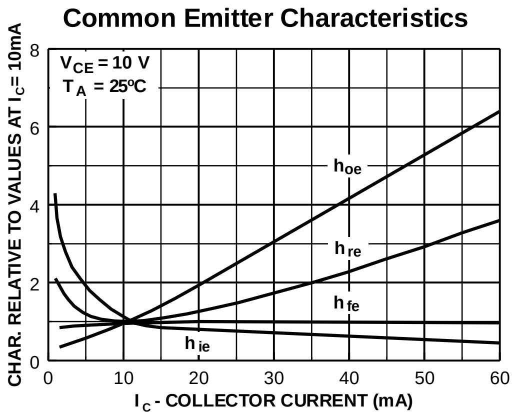
Switching Times vs Collector Current

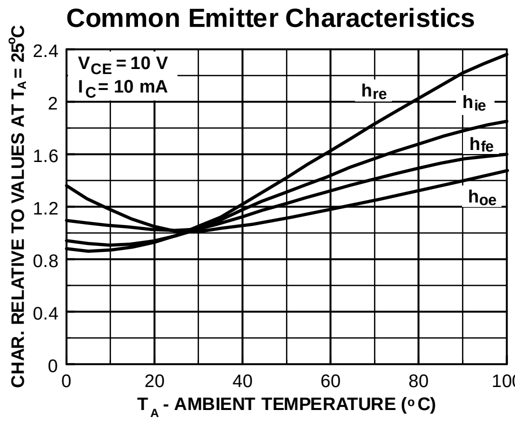


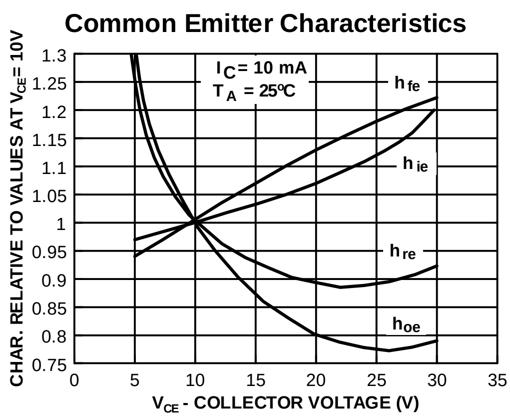
Power Dissipation vs Ambient Temperature



Typical Common Emitter Characteristics (f = 1.0kHz)







Test Circuits

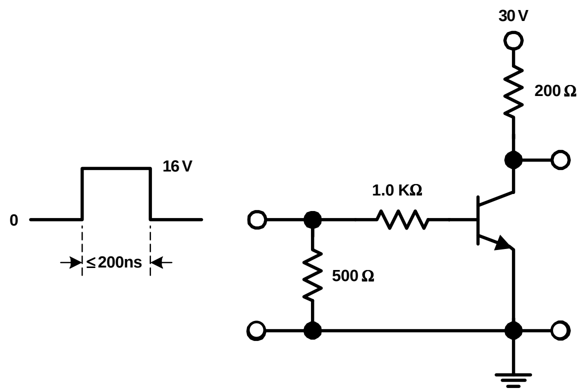


FIGURE 1: Saturated Turn-On Switching Timer

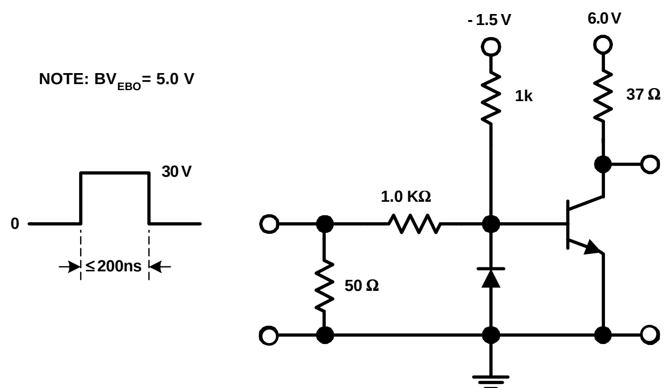


FIGURE 2: Saturated Turn-Off Switching Time

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