



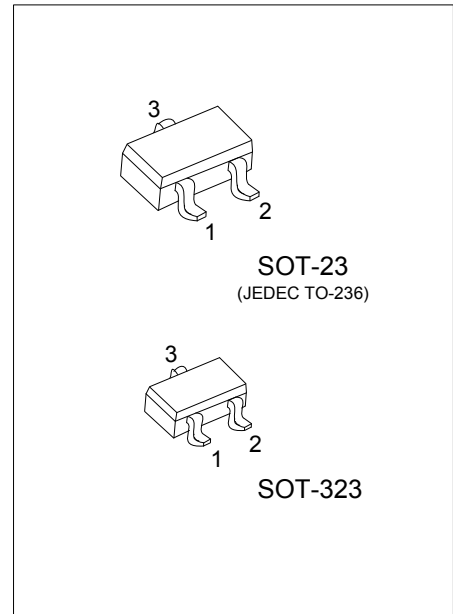
# MMBT4401

## NPN SILICON TRANSISTOR

### NPN GENERAL PURPOSE AMPLIFIER

■ DESCRIPTION

The UTC **MMBT4401** is designed for use as a medium power amplifier and switch requiring collector currents up to 500mA.



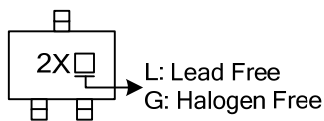
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
MMBT4401L-AE3-R	MMBT4401G-AE3-R	SOT-23	B	E	C	Tape Reel
MMBT4401L-AL3-R	MMBT4401G-AL3-R	SOT-323	B	E	C	Tape Reel

Note: Pin Assignment: B: Base E: Emitter C: Collector

<p>MMBT4401G-AE3-R</p> <ul style="list-style-type: none"> <li>(1) Packing Type</li> <li>(2) Package Type</li> <li>(3) Green Package</li> </ul>	<ul style="list-style-type: none"> <li>(1) R: Tape Reel</li> <li>(2) AE3: SOT-23, AL3: SOT-323</li> <li>(3) G: Halogen Free and Lead Free, L: Lead Free</li> </ul>
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■ MARKING



# MMBT4401

## NPN SILICON TRANSISTOR

### ■ ABSOLUTE MAXIMUM RATING ( $T_A=25^\circ\text{C}$ , unless otherwise specified) (Note)

PARAMETER	SYMBOL	RATINGS	UNIT
Collector-Base Voltage	$V_{CBO}$	60	V
Collector-Emitter Voltage	$V_{CEO}$	40	V
Emitter-Base Voltage	$V_{EBO}$	6	V
Collector Current-Continuous	$I_C$	600	mA
Total Device Dissipation	$P_D$	350	mW
Derate above $25^\circ\text{C}$		2.8	mW/ $^\circ\text{C}$
Junction Temperature	$T_J$	+150	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	-40 ~ +150	$^\circ\text{C}$

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

### ■ THERMAL CHARACTERISTICS ( $T_A=25^\circ\text{C}$ , unless otherwise specified)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Junction to Ambient	$\theta_{JA}$	357	$^\circ\text{C/W}$

### ■ ELECTRICAL CHARACTERISTICS ( $T_A=25^\circ\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Collector-Base Breakdown Voltage	$BV_{CBO}$	$I_C=0.1\text{mA}, I_E=0$	60			V
Collector-Emitter Breakdown Voltage (note)	$BV_{CEO}$	$I_C=1\text{mA}, I_B=0$	40			V
Emitter-Base Breakdown Voltage	$BV_{EBO}$	$I_E=0.1\text{mA}, I_C=0$	6			V
Collector Cut-off Current	$I_{CEX}$	$V_{CE}=35\text{V}, V_{EB}=0.4\text{V}$				$\mu\text{A}$
Base Cut-off Current	$I_{BL}$	$V_{CE}=35\text{V}, V_{EB}=0.4\text{V}$				$\mu\text{A}$
<b>ON CHARACTERISTICS (note)</b>						
DC Current Gain	$h_{FE1}$	$V_{CE}=1\text{V}, I_C=0.1\text{mA}$	20			
	$h_{FE2}$	$V_{CE}=1\text{V}, I_C=1\text{mA}$	40			
	$h_{FE3}$	$V_{CE}=1\text{V}, I_C=10\text{mA}$	80			
	$h_{FE4}$	$V_{CE}=1\text{V}, I_C=150\text{mA}$	100		300	
	$h_{FE5}$	$V_{CE}=2\text{V}, I_C=500\text{mA}$	40			
Collector-Emitter Saturation Voltage	$V_{CE(SAT1)}$	$I_C=150\text{mA}, I_B=15\text{mA}$			0.4	V
	$V_{CE(SAT2)}$	$I_C=500\text{mA}, I_B=50\text{mA}$			0.75	V
Base-Emitter Saturation Voltage	$V_{BE(SAT1)}$	$I_C=150\text{mA}, I_B=15\text{mA}$	0.75		0.95	V
	$V_{BE(SAT2)}$	$I_C=500\text{mA}, I_B=50\text{mA}$			1.2	V
<b>SMALL SIGNAL CHARACTERISTICS1</b>						
Current Gain Bandwidth Product	$f_T$	$V_{CE}=10\text{V}, I_C=20\text{mA}, f=100\text{MHz}$	250			MHz
Collector-Base Capacitance	$C_{CB}$	$V_{CB}=5\text{V}, I_E=0, f=140\text{kHz}$			6.5	pF
Emitter-Base Capacitance	$C_{EB}$	$V_{BE}=0.5\text{V}, I_C=0, f=140\text{kHz}$			30	pF
Input Impedance	$h_{iE}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$	1		15	k $\Omega$
Voltage Feedback Ratio	$h_{RE}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$	0.1		8	$\times 10^{-4}$
Small-Signal Current Gain	$h_{FE}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$	40		500	
Output Admittance	$h_{oE}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$	1		30	$\mu\text{mhos}$
<b>SWITCHING CHARACTERISTICS</b>						
Delay Time	$t_D$	$V_{CC}=30\text{V}, V_{EB}=2\text{V}, I_C=150\text{mA}$ $I_{B1}=15\text{mA}$			15	ns
Rise Time	$t_R$	$V_{CC}=30\text{V}, V_{EB}=2\text{V}, I_C=150\text{mA}$ $I_{B1}=15\text{mA}$			20	ns
Storage Time	$t_S$				225	ns
Fall Time	$t_F$	$V_{CC}=30\text{V}, I_C=150\text{mA}$ $I_{B1}=I_{B2}=15\text{mA}$			30	ns

Note: Pulse test: PulseWidth  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .



■ TEST CIRCUIT

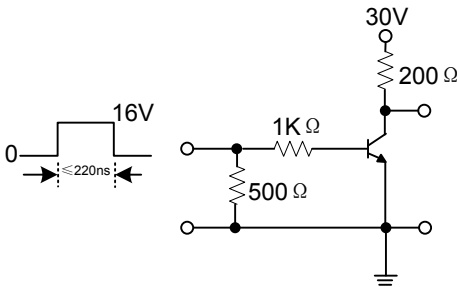


Figure1. Saturated Turn-On Switching Timer

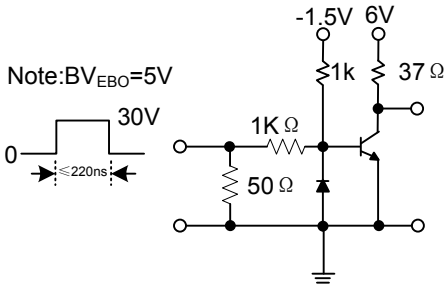
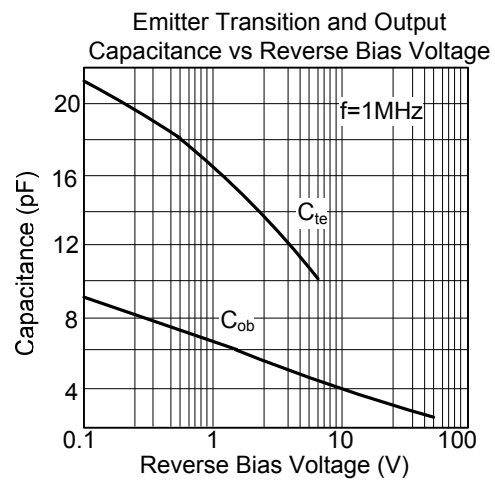
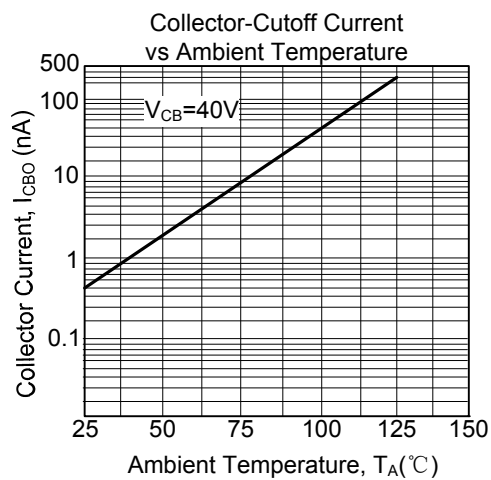
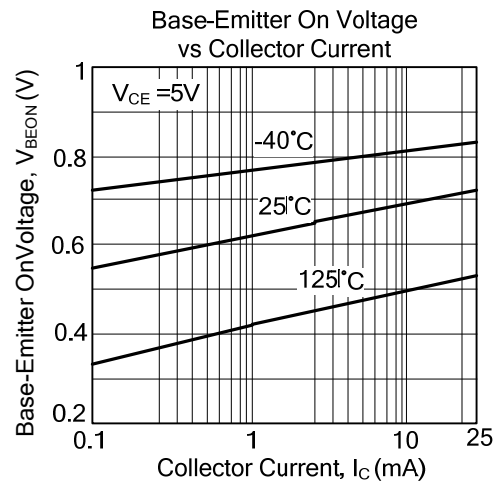
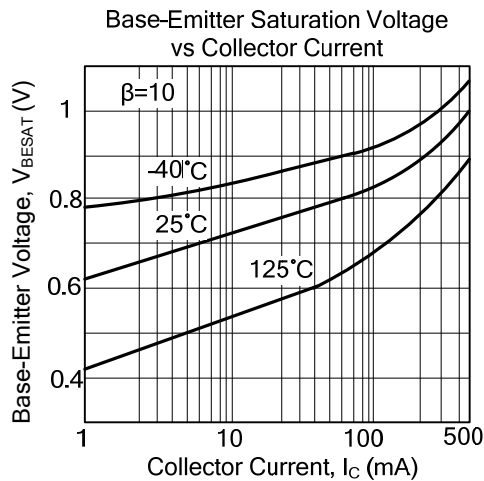
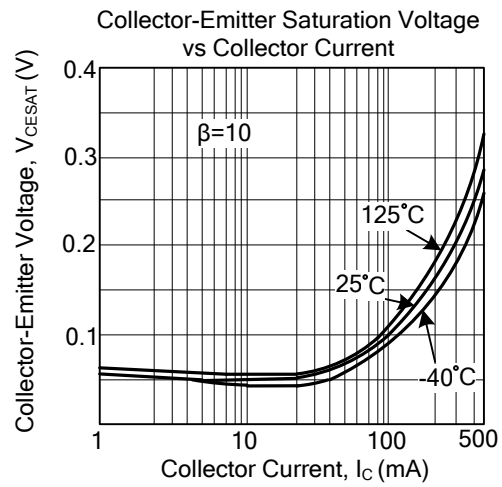
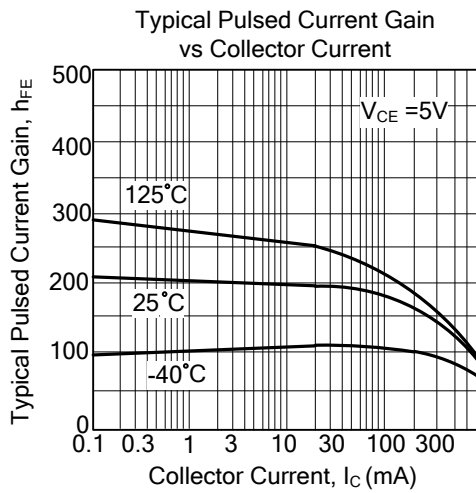
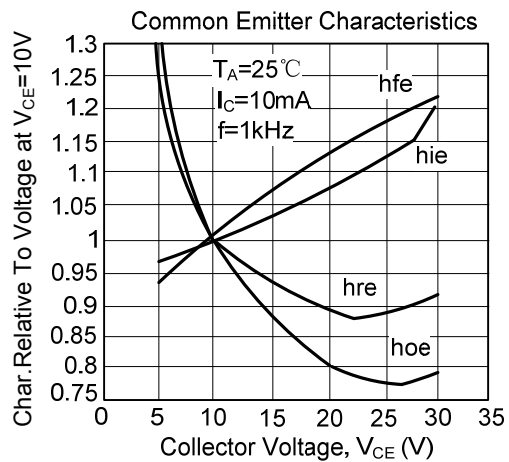
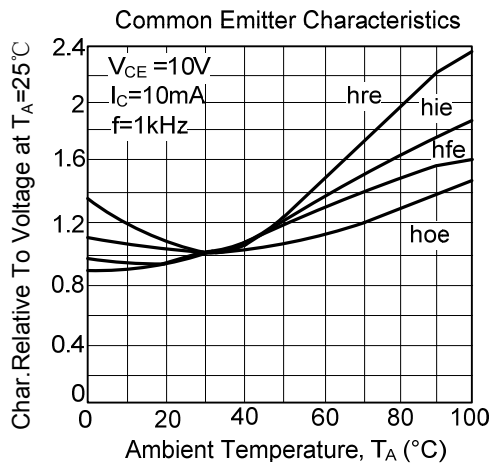
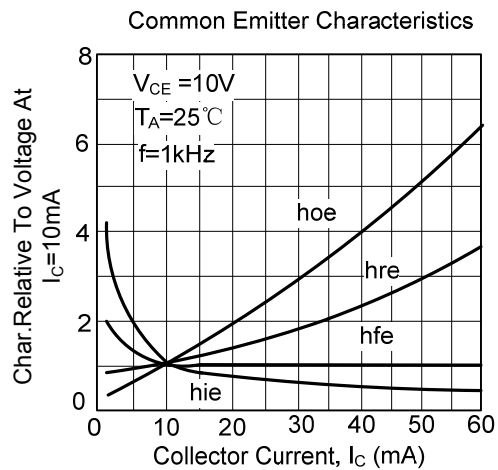
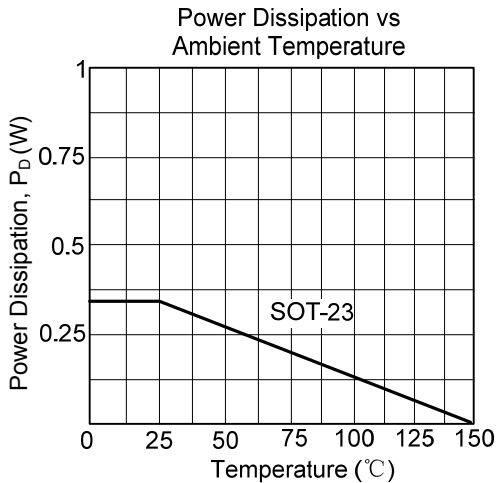
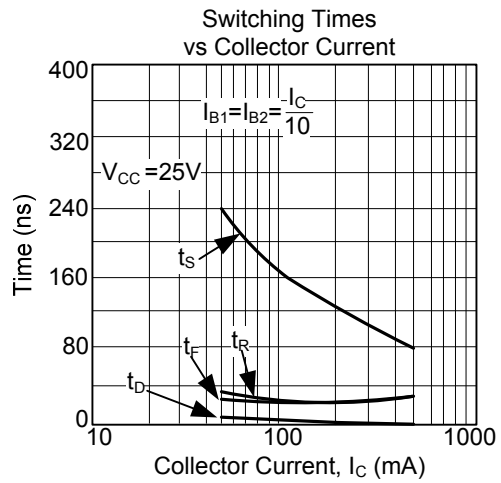
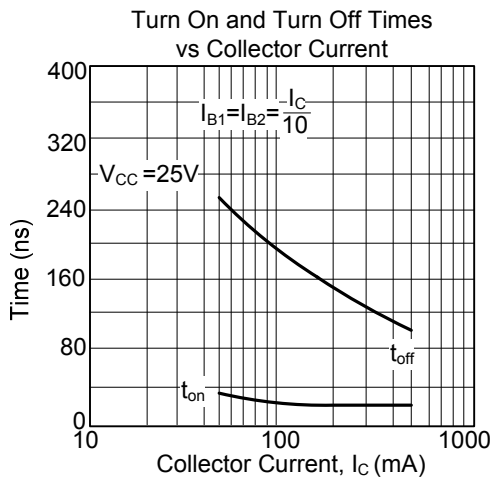


Figure2. Saturated Turn-Off Switching Timer

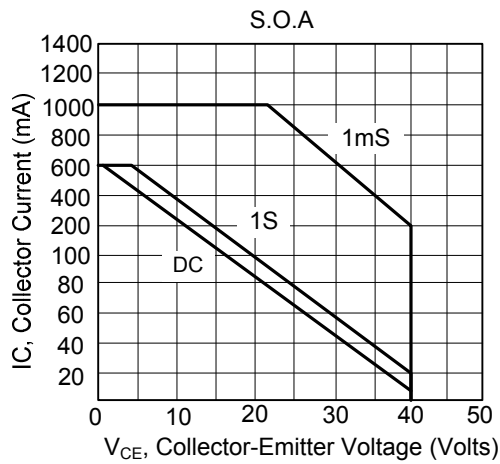
### TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS (Cont.)



### ■ TYPICAL CHARACTERISTICS (Cont.)



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