

# MMBT4401LT1

Preferred Device

## Switching Transistor

### NPN Silicon

#### Features

- Pb-Free Packages are Available

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector - Emitter Voltage	$V_{CEO}$	40	Vdc
Collector - Base Voltage	$V_{CBO}$	60	Vdc
Emitter - Base Voltage	$V_{EBO}$	6.0	Vdc
Collector Current - Continuous	$I_C$	600	mA dc

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board (Note 1) @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	225 1.8	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate (Note 2) @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	300 2.4	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

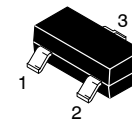
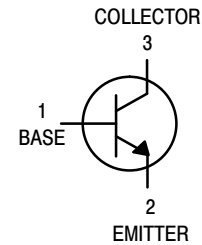
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

\*Transient pulses must not cause the junction temperature to be exceeded.

- FR-5 =  $1.0 \times 0.75 \times 0.062$  in.
- Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.

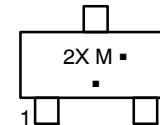


ON Semiconductor®



SOT-23 (TO-236)  
CASE 318  
STYLE 6

#### MARKING DIAGRAM



2X = Specific Device Code  
M = Date Code\*  
■ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.

#### ORDERING INFORMATION

Device	Package	Shipping†
MMBT4401LT1	SOT-23	3000 Tape & Reel
MMBT4401LT1G	SOT-23 (Pb-Free)	3000 Tape & Reel
MMBT4401LT3	SOT-23	10,000 Tape & Reel
MMBT4401LT3G	SOT-23 (Pb-Free)	10,000 Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

Preferred devices are recommended choices for future use and best overall value.

# MMBT4401LT1

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector - Emitter Breakdown Voltage (Note 3) ( $I_C = 1.0 \text{ mA dc}, I_B = 0$ )	$V_{(BR)CEO}$	40	-	Vdc
Collector - Base Breakdown Voltage ( $I_C = 0.1 \text{ mA dc}, I_E = 0$ )	$V_{(BR)CBO}$	60	-	Vdc
Emitter - Base Breakdown Voltage ( $I_E = 0.1 \text{ mA dc}, I_C = 0$ )	$V_{(BR)EBO}$	6.0	-	Vdc
Base Cutoff Current ( $V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$ )	$I_{BEV}$	-	0.1	$\mu\text{A dc}$
Collector Cutoff Current ( $V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$ )	$I_{CEX}$	-	0.1	$\mu\text{A dc}$

## ON CHARACTERISTICS (Note 3)

DC Current Gain ( $I_C = 0.1 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 1.0 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 10 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 150 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 500 \text{ mA dc}, V_{CE} = 2.0 \text{ Vdc}$ )	$h_{FE}$	20 40 80 100 40	- - - 300 -	- - - - -
Collector - Emitter Saturation Voltage ( $I_C = 150 \text{ mA dc}, I_B = 15 \text{ mA dc}$ ) ( $I_C = 500 \text{ mA dc}, I_B = 50 \text{ mA dc}$ )	$V_{CE(sat)}$	- -	0.4 0.75	Vdc
Base - Emitter Saturation Voltage ( $I_C = 150 \text{ mA dc}, I_B = 15 \text{ mA dc}$ ) ( $I_C = 500 \text{ mA dc}, I_B = 50 \text{ mA dc}$ )	$V_{BE(sat)}$	0.75 -	0.95 1.2	Vdc

## SMALL-SIGNAL CHARACTERISTICS

Current - Gain - Bandwidth Product ( $I_C = 20 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz}$ )	$f_T$	250	-	MHz
Collector - Base Capacitance ( $V_{CB} = 5.0 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$ )	$C_{cb}$	-	6.5	pF
Emitter - Base Capacitance ( $V_{EB} = 0.5 \text{ Vdc}, I_C = 0, f = 1.0 \text{ MHz}$ )	$C_{eb}$	-	30	pF
Input Impedance ( $I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{ie}$	1.0	15	$k\Omega$
Voltage Feedback Ratio ( $I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{re}$	0.1	8.0	$\times 10^{-4}$
Small - Signal Current Gain ( $I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{fe}$	40	500	-
Output Admittance ( $I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{oe}$	1.0	30	$\mu\text{mhos}$

## SWITCHING CHARACTERISTICS

Delay Time	( $V_{CC} = 30 \text{ Vdc}, V_{EB} = 2.0 \text{ Vdc}, I_C = 150 \text{ mA dc}, I_{B1} = 15 \text{ mA dc}$ )	$t_d$	-	15	ns
Rise Time		$t_r$	-	20	
Storage Time	( $V_{CC} = 30 \text{ Vdc}, I_C = 150 \text{ mA dc}, I_{B1} = I_{B2} = 15 \text{ mA dc}$ )	$t_s$	-	225	ns
Fall Time		$t_f$	-	30	

3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

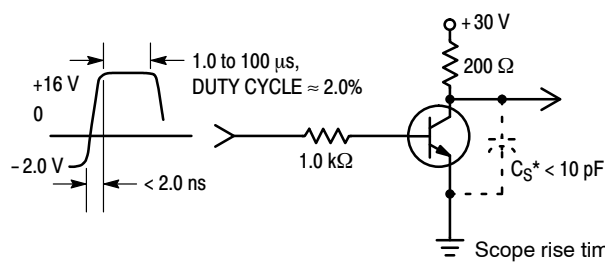


Figure 1. Turn-On Time

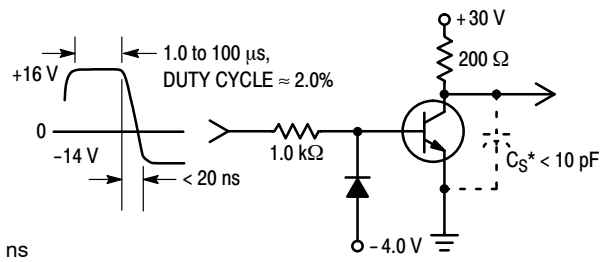
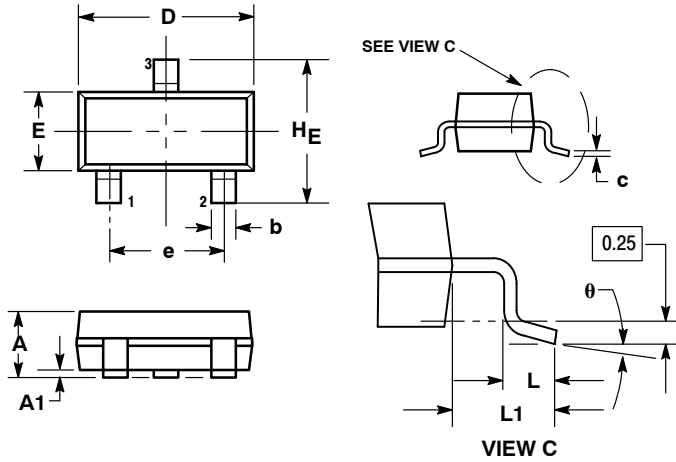


Figure 2. Turn-Off Time

# MMBT4401LT1

## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AN

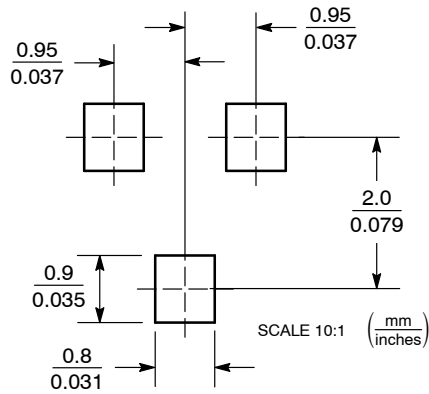


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
  4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.040	0.044
A1	0.01	0.06	0.10	0.001	0.002	0.004
b	0.37	0.44	0.50	0.015	0.018	0.020
c	0.09	0.13	0.18	0.003	0.005	0.007
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.081
L	0.10	0.20	0.30	0.004	0.008	0.012
L1	0.35	0.54	0.69	0.014	0.021	0.029
HE	2.10	2.40	2.64	0.083	0.094	0.104

- STYLE 6:  
PIN 1. BASE  
2. EMITTER  
3. COLLECTOR

### SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.