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July 2014

# 2N4403 / MMBT4403 PNP General-Purpose Amplifier

# **Description**

This device is designed for use as a general-purpose amplifier and switch for collector currents to 500 mA.



Figure 1. 2N4403 Device Package

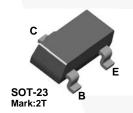


Figure 2. MMBT4403 Device Package

# **Ordering Information**

Part Number	Marking	Package	Packing Method
2N4403BU 2N4403		TO-92 3L	Bulk
2N4403TF 2N4403		TO-92 3L	Tape and Reel
2N4403TFR	2N4403	TO-92 3L	Tape and Reel
2N4403TA	2N4403	TO-92 3L	Ammo
2N4403TAR	2N4403TAR 2N4403		Ammo
MMBT4403	2T	SOT-23 3L	Tape and Reel

## **Absolute Maximum Ratings**(1),(2)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_A = 25$ °C unless otherwise noted.

Symbol	Parameter	Value	Unit
V <sub>CEO</sub>	Collector-Emitter Voltage	-40	V
V <sub>CBO</sub>	Collector-Base Voltage	-40	V
V <sub>EBO</sub>	Emitter-Base Voltage	-5.0	V
I <sub>C</sub>	Collector Current - Continuous	-600	mA
T <sub>J,</sub> T <sub>STG</sub>	Operating and Storage Junction Temperature Range	-55 to +150	°C

#### Notes:

- 1. These ratings are based on a maximum junction temperature of 150°C.
- 2. These are steady-state limits. Fairchild Semiconductor should be consulted on applications involving pulsed or low-duty cycle operations.

#### **Thermal Characteristics**

Values are at  $T_A = 25$ °C unless otherwise noted.

Symbol	Parameter	Ma	Unit	
	raiailietei	2N4403 <sup>(3)</sup>	MMBT4403 <sup>(4)</sup>	Oilit
D	Total Device Dissipation	625	350	mW
P <sub>D</sub>	Derate Above 25°C	5.0	2.8	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

#### Notes:

- 3. PCB size: FR-4, 76 mm x 114 mm x 1.57 mm (3.0 inch x 4.5 inch x 0.062 inch) with minimum land pattern size.
- 4. Device mounted on FR-4 PCB 1.6 inch x 1.6 inch x 0.06 inch.

#### **Electrical Characteristics**

Values are at  $T_A = 25$ °C unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Max.	Unit
Off Charact	eristics				
V <sub>(BR)CEO</sub>	Collector-Emitter Breakdown Voltage <sup>(5)</sup>	I <sub>C</sub> = -1.0 mA, I <sub>B</sub> = 0	-40		V
V <sub>(BR)CBO</sub>	Collector-Base Breakdown Voltage	I <sub>C</sub> = -0.1 mA, I <sub>E</sub> = 0	-40		V
V <sub>(BR)EBO</sub>	Emitter-Base Breakdown Voltage	$I_E = -0.1 \text{ mA}, I_C = 0$	-5.0		V
I <sub>BL</sub>	Base Cut-Off Current	$V_{CE} = -35 \text{ V}, V_{EB} = -0.4 \text{ V}$		-0.1	μΑ
I <sub>CEX</sub>	Collector Cut-Off Current	$V_{CE} = -35 \text{ V}, V_{EB} = -0.4 \text{ V}$		-0.1	μΑ
On Charact	eristics				
		I <sub>C</sub> = -0.1 mA, V <sub>CE</sub> = -1.0 V	30		
		$I_C = -1.0 \text{ mA}, V_{CE} = -1.0 \text{ V}$	60		
h <sub>FE</sub> I	DC Current Gain	$I_C = -10 \text{ mA}, V_{CE} = -1.0 \text{ V}$	100		
		$I_C = -150 \text{ mA}, V_{CE} = -2.0 \text{ V}^{(5)}$	100	300	
		$I_C = -500 \text{ mA}, V_{CE} = -2.0 \text{ V}^{(5)}$	20		
	Collector-Emitter Saturation	I <sub>C</sub> = -150 mA, I <sub>B</sub> = -15 mA		-0.40	V
V <sub>CE</sub> (sat)	Voltage <sup>(5)</sup>	$I_C = -500 \text{ mA}, I_B = -50 \text{ mA}$		-0.75	- V
	5 5 11 6 1 11 11 11	$I_C = -150 \text{ mA}, I_B = -15 \text{ mA}^{(5)}$	-0.75	-0.95	.,
V <sub>BE</sub> (sat)	Base-Emitter Saturation Voltage	$I_C = -500 \text{ mA}, I_B = -50 \text{ mA}$		-1.30	- V
Small Signa	al Characteristics			<u>'</u>	
f <sub>T</sub>	Current Gain - Bandwidth Product	$I_C = -20 \text{ mA}, V_{CE} = -10 \text{ V},$ f = 100  MHz	200		MHz
C <sub>cb</sub>	Collector-Base Capacitance	$V_{CB} = -10 \text{ V}, I_{E} = 0,$ f = 140 kHz		8.5	pF
C <sub>eb</sub>	Emitter-Base Capacitance	$V_{BE} = -0.5 \text{ V}, I_{C} = 0,$ f = 140 kHz		30	pF
h <sub>ie</sub>	Input Impedance	$I_C = -1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ f = 1.0  kHz	1.5	15.0	kΩ
h <sub>re</sub>	Voltage Feedback Ratio	$I_C = -1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ f = 1.0  kHz	0.1	8.0	x10 <sup>-4</sup>
h <sub>fe</sub>	Small-Signal Current Gain	$I_C = -1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ f = 1.0  kHz	60	500	
h <sub>oe</sub>	Output Admittance	$I_C = -1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ f = 1.0  kHz	1	100	μmhos
Switching (	Characteristics				
t <sub>d</sub>	Delay Time	$V_{CC} = -30 \text{ V}, I_{C} = -150 \text{ mA},$		15	ns
t <sub>r</sub>	Rise Time	I <sub>B1</sub> = -15 mA		20	ns
t <sub>s</sub>	Storage Time	$V_{CC} = -30 \text{ V}, I_{C} = -150 \text{ mA},$		225	ns
t <sub>f</sub>	Fall Time	I <sub>B1</sub> = I <sub>B2</sub> = -15 mA		30	ns

#### Note:

5. Pulse test: pulse width  $\leq 300~\mu s,$  duty cycle  $\leq 2.0\%.$ 

# **Typical Performance Characteristics**

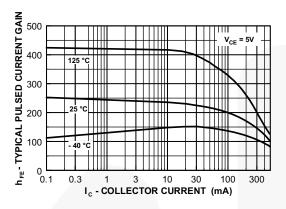


Figure 3. Typical Pulsed Current Gain vs. Collector Current

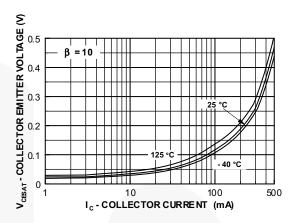


Figure 4. Collector-Emitter Saturation Voltage vs. Collector Current

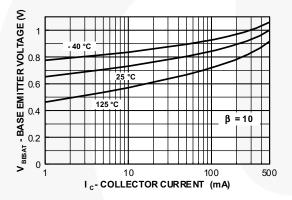


Figure 5. Base-Emitter Saturation Voltage vs. Collector Current

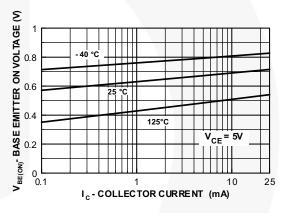


Figure 6. Base-Emitter On Voltage vs. Collector Current

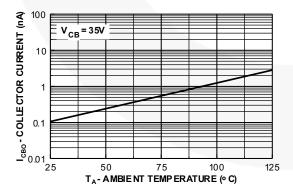


Figure 7. Collector Cut-Off Current vs. Ambient Temperature

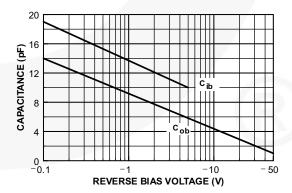


Figure 8. Input and Output Capacitance vs. Reverse Bias Voltage

## **Typical Performance Characteristics (Continued)**

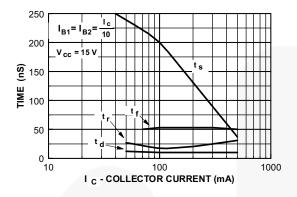


Figure 9. Switching Times vs. Collector Current

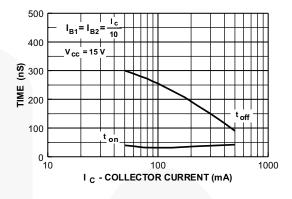


Figure 10. Turn-On and Turn-Off Times vs. Collector Current

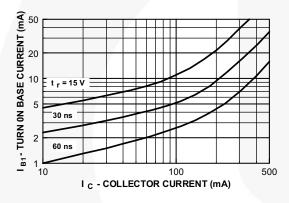


Figure 11. Rise Time vs. Collector and Turn-On Base Currents

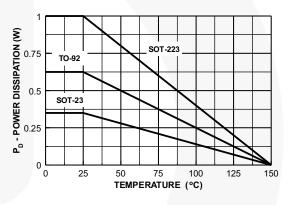


Figure 12. Power Dissipation vs. Ambient Temperature

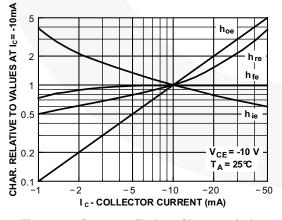


Figure 13. Common Emitter Characteristics

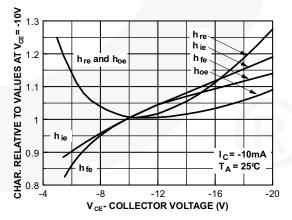


Figure 14. Common Emitter Characteristics

# **Typical Performance Characteristics** (Continued)

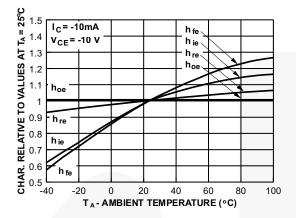
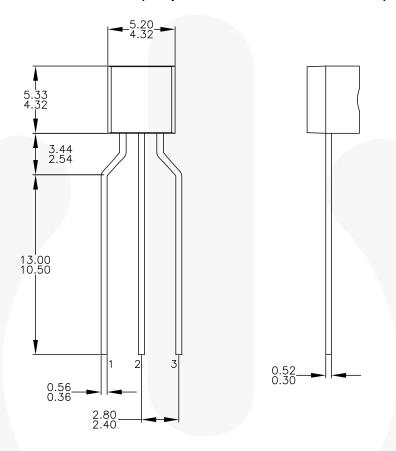
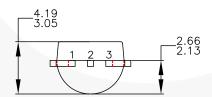


Figure 15. Common Emitter Characteristics

## **Physical Dimensions**

# TO-92 3L (Tape and Reel, Ammo)





NOTES: UNLESS OTHERWISE SPECIFIED

- DRAWING CONFORMS TO JEDEC MS-013, VARIATION AC.
  ALL DIMENSIONS ARE IN MILLIMETERS. DRAWING CONFORMS TO ASME Y14.5M-2009. DRAWING FILENAME: MKT-ZAO3FREV3. FAIRCHILD SEMICONDUCTOR.

Figure 16. 3-LEAD, TO-92, MOLDED 0.200 IN LINE SPACING LD FORM (J61Z OPTION) (ACTIVE)

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### Physical Dimensions (Continued)

# TO-92 3L (Bulk)

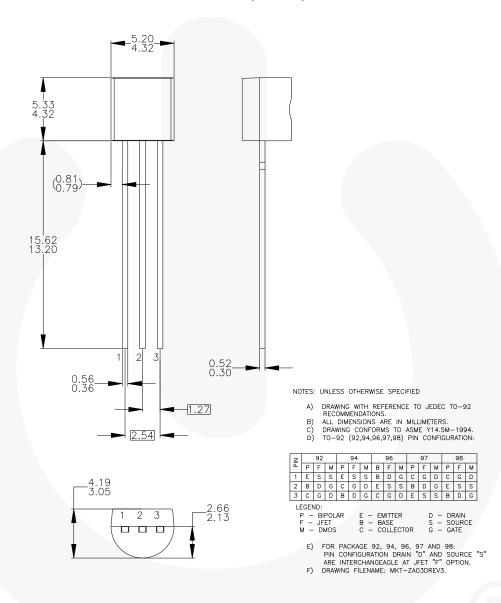


Figure 17. 3-LEAD, JEDEC TO-92 COMPLIANT STRAGHIT LEAD CONFIGURATION (OLD TO92AM3)

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### Physical Dimensions (Continued)

# **SOT-23 3L**

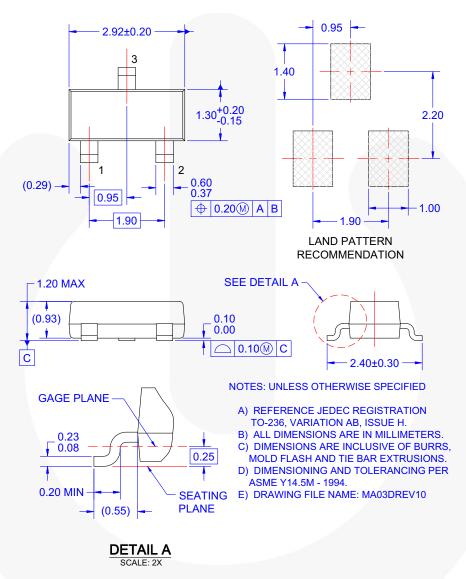


Figure 18. 3-LEAD, SOT23, JEDEC TO-236, LOW PROFILE (ACTIVE)

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Definition of Terms			
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