# **Switching Transistor**

## **PNP Silicon**

#### **Features**

• Moisture Sensitivity Level: 1

• ESD Rating: Human Body Model; 4 kV,

Machine Model; 400 V

• These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### **MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	-40	Vdc
Collector-Base Voltage	V <sub>CBO</sub>	-40	Vdc
Emitter-Base Voltage	V <sub>EBO</sub>	-5.0	Vdc
Collector Current – Continuous	Ic	-600	mAdc

#### THERMAL CHARACTERISTICS

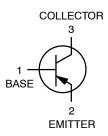
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board T <sub>A</sub> = 25°C	P <sub>D</sub>	150	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	833	°C/W
Junction and Storage Temperature	T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C

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.



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SC-70 CASE 419 STYLE 3

#### **MARKING DIAGRAM**



2T = Specific Device Code

M = Date Code ■ Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation may vary depending upon manufacturing location.

## **ORDERING INFORMATION**

Device	Package	Shipping <sup>†</sup>
MMBT4403WT1G	SC-70 (Pb-Free)	3000 / 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.

## **ELECTRICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C unless otherwise noted)

Characteristic			Min	Max	Unit	
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (Note	V <sub>(BR)CEO</sub>	-40	_	Vdc		
Collector-Base Breakdown Voltage (I <sub>C</sub> = -0.	1 mAdc, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	-40	-	Vdc	
Emitter-Base Breakdown Voltage (I <sub>E</sub> = -0.1	mAdc, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	-5.0	-	Vdc	
Base Cutoff Current (V <sub>CE</sub> = -35 Vdc, V <sub>EB</sub> = -	-0.4 Vdc)	I <sub>BEV</sub>	-	-0.1	μAdc	
Collector Cutoff Current (V <sub>CE</sub> = -35 Vdc, V <sub>EE</sub>	<sub>3</sub> = -0.4 Vdc)	I <sub>CEX</sub>	-	-0.1	μAdc	
ON CHARACTERISTICS		•				
$\begin{array}{c} \text{DC Current Gain} \\ (I_C = -0.1 \text{ mAdc, V}_{CE} = -1.0 \text{ Vdc}) \\ (I_C = -1.0 \text{ mAdc, V}_{CE} = -1.0 \text{ Vdc}) \\ (I_C = -10 \text{ mAdc, V}_{CE} = -1.0 \text{ Vdc}) \\ (I_C = -150 \text{ mAdc, V}_{CE} = -2.0 \text{ Vdc}) \\ (I_C = -500 \text{ mAdc, V}_{CE} = -2.0 \text{ Vdc}) \end{array}$		h <sub>FE</sub>	30 60 100 100 20	- - 300 -	-	
Collector–Emitter Saturation Voltage (Note 1) ( $I_C = -150$ mAdc, $I_B = -15$ mAdc) ( $I_C = -500$ mAdc, $I_B = -50$ mAdc)				-0.4 -0.75	Vdc	
Base – Emitter Saturation Voltage (Note 1) $ (I_C = -150 \text{ mAdc}, I_B = -15 \text{ mAdc}) $ $ (I_C = -500 \text{ mAdc}, I_B = -50 \text{ mAdc}) $			-0.75 -	-0.95 -1.3	Vdc	
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain – Bandwidth Product ( $I_C = -20$	mAdc, V <sub>CE</sub> = -10 Vdc, f = 100 MHz)	f <sub>T</sub>	200	-	MHz	
Collector-Base Capacitance (V <sub>CB</sub> = -10 Vdc	, I <sub>E</sub> = 0, f = 1.0 MHz)	C <sub>cb</sub>	-	8.5	pF	
Emitter-Base Capacitance (V <sub>BE</sub> = -0.5 Vdc,	I <sub>C</sub> = 0, f = 1.0 MHz)	C <sub>eb</sub>	-	30	pF	
Input Impedance (I <sub>C</sub> = -1.0 mAdc, V <sub>CE</sub> = -10 Vdc, f = 1.0 kHz)			1.5	15	kΩ	
Voltage Feedback Ratio (I <sub>C</sub> = -1.0 mAdc, V <sub>CE</sub> = -10 Vdc, f = 1.0 kHz)			0.1	8.0	X 10 <sup>-4</sup>	
Small-Signal Current Gain (I <sub>C</sub> = -1.0 mAdc, V <sub>CE</sub> = -10 Vdc, f = 1.0 kHz)			60	500	-	
Output Admittance (I <sub>C</sub> = -1.0 mAdc, V <sub>CE</sub> = -10 Vdc, f = 1.0 kHz)			1.0	100	μmhos	
SWITCHING CHARACTERISTICS						
Delay Time	(V <sub>CC</sub> = -30 Vdc, V <sub>EB</sub> = -2.0 Vdc,	t <sub>d</sub>	1	15	no	
Rise Time	$I_{C} = -150 \text{ mAdc}, I_{B1} = -15 \text{ mAdc})$	t <sub>r</sub>	1	20	ns	
Storage Time	(V <sub>CC</sub> = -30 Vdc, I <sub>C</sub> = -150 mAdc,	t <sub>s</sub>	1	225		
Fall Time	$I_{B1} = I_{B2} = -15 \text{ mAdc}$	t <sub>f</sub>	-	30	ns	

<sup>1.</sup> Pulse Test: Pulse Width  $\leq$  300  $\mu$ s, Duty Cycle  $\leq$  2.0%.

## SWITCHING TIME EQUIVALENT TEST CIRCUIT

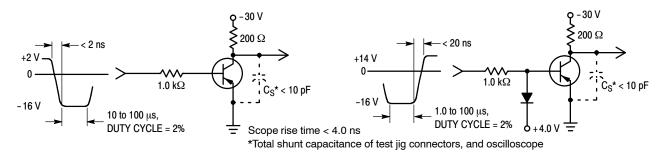


Figure 1. Turn-On Time

Figure 2. Turn-Off Time

## TRANSIENT CHARACTERISTICS

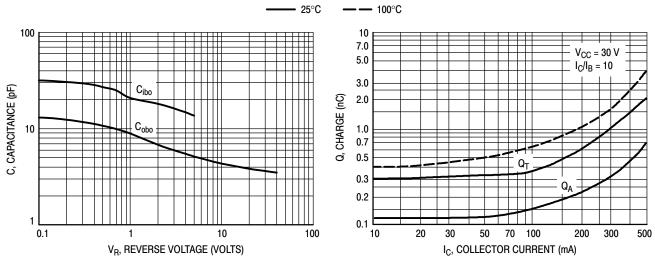


Figure 3. Capacitances

Figure 4. Charge Data

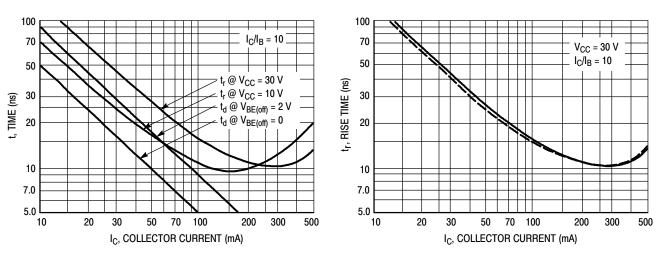


Figure 5. Turn-On Time

Figure 6. Rise Time

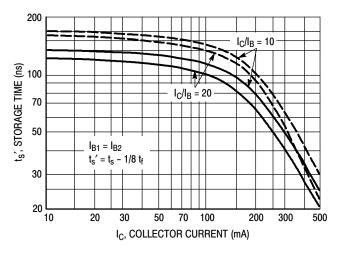


Figure 7. Storage Time

## SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

 $V_{CE} = -10 \text{ Vdc}$ ,  $T_A = 25^{\circ}\text{C}$ ; Bandwidth = 1.0 Hz

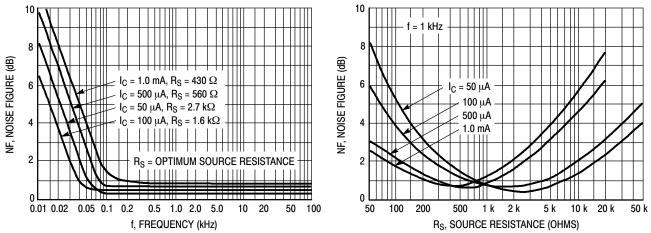


Figure 8. Frequency Effects

Figure 9. Source Resistance Effects

#### h PARAMETERS

 $V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}, T_A = 25^{\circ}\text{C}$ 

This group of graphs illustrates the relationship between  $h_{fe}$  and other "h" parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were selected from the MMBT4403WT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

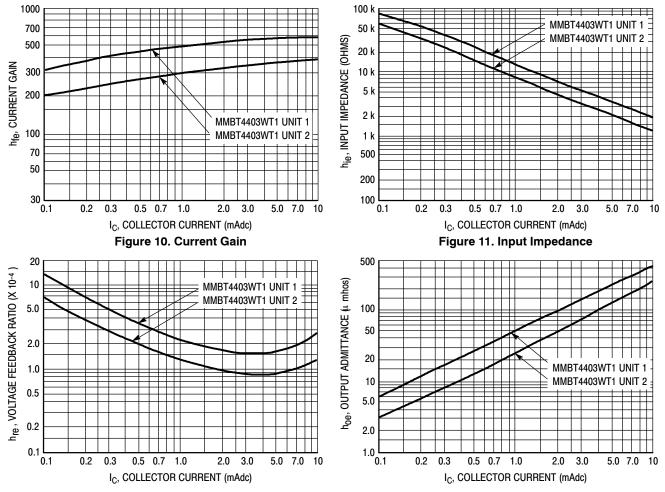


Figure 12. Voltage Feedback Ratio

Figure 13. Output Admittance

#### STATIC CHARACTERISTICS

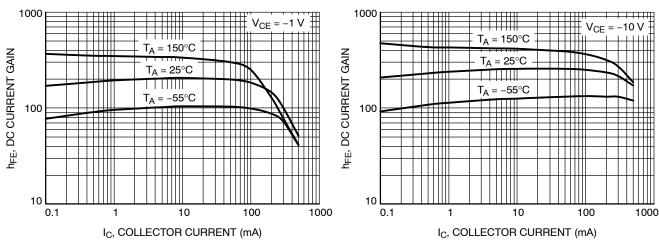


Figure 14. DC Current Gain vs. Collector Current

Figure 15. DC Current Gain vs. Collector Current

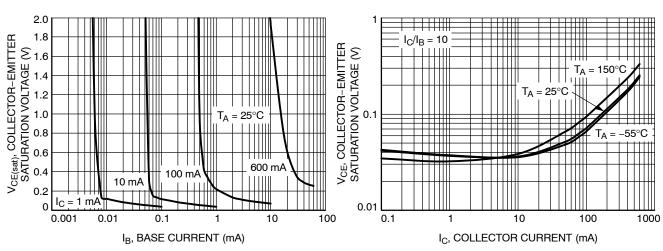


Figure 16. Saturation Region

Figure 17. Collector Emitter Saturation Voltage vs. Collector Current

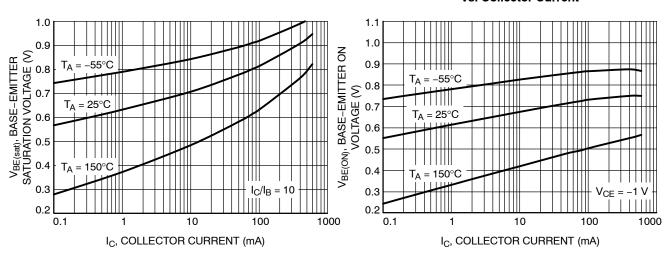


Figure 18. Base Emitter Saturation Voltage vs. Collector Current

Figure 19. Base-Emitter Turn-On Voltage vs.
Collector Current

## STATIC CHARACTERISTICS

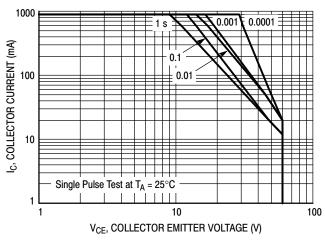


Figure 20. Safe Operating Area

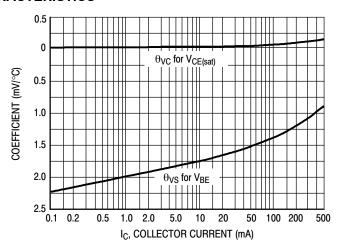


Figure 21. Temperature Coefficients





SC-70 (SOT-323) **CASE 419** ISSUE R

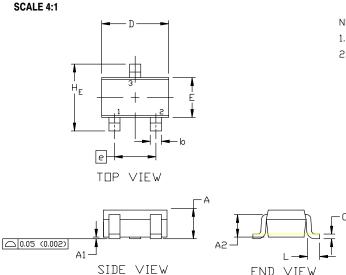
END VIEW

**DATE 11 OCT 2022** 

#### NOTES:

- 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1982.
- 2. CONTROLLING DIMENSION: INCH

	MILLIMETERS			INCHES			
DIM	MIN.	N□M.	MAX.	MIN.	N□M.	MAX.	
Α	0.80	0.90	1.00	0.032	0.035	0.040	
A1	0.00	0.05	0.10	0.000	0.002	0.004	
A2		0.70 REF	-		0.028 BSC		
b	0.30	0.35	0.40	0.012	0.014	0.016	
C	0.10	0.18	0.25	0.004	0.007	0.010	
D	1.80	2.00	2.20	0.071	0.080	0.087	
E	1.15	1.24	1.35	0.045	0.049	0.053	
е	1.20	1.30	1.40	0.047	0.051	0.055	
e1	0.65 BSC				0.026 BS	C	
L	0.20	0.38	0.56	0.008	0.015	0.022	
HE	2.00	2.10	2.40	0.079	0.083	0.095	



## **GENERIC MARKING DIAGRAM**

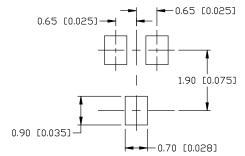


= Specific Device Code XX

Μ = Date Code

= Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.



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

SOLDERING FOOTPRINT

STYLE 1: CANCELLED	STYLE 2: PIN 1. ANODE 2. N.C. 3. CATHODE	STYLE 3: PIN 1. BASE 2. EMITTER 3. COLLECTOR	STYLE 4: PIN 1. CATHODE 2. CATHODE 3. ANODE	STYLE 5: PIN 1. ANODE 2. ANODE 3. CATHODE	
STYLE 6: PIN 1. EMITTER	STYLE 7: PIN 1. BASE	STYLE 8: PIN 1. GATE	STYLE 9: PIN 1. ANODE	STYLE 10: PIN 1. CATHODE	STYLE 11: PIN 1. CATHODE
2. BASE	2. EMITTER	2. SOURCE	2. CATHODE	2. ANODE	2. CATHODE
<ol><li>COLLECTOR</li></ol>	<ol><li>COLLECTOR</li></ol>	3. DRAIN	<ol><li>CATHODE-ANODE</li></ol>	3. ANODE-CATHODE	<ol><li>CATHODE</li></ol>

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