

6367254 MOTOROLA SC (XSTRS/R F)

96D 82036 D

## MAXIMUM RATINGS

Rating	Symbol	MPS2907	MPS2907A	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	40	60	V <sub>dc</sub>
Collector-Base Voltage	V <sub>CBO</sub>	60		V <sub>dc</sub>
Emitter-Base Voltage	V <sub>EBO</sub>	5.0		V <sub>dc</sub>
Collector Current — Continuous	I <sub>C</sub>	600		mAdc

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	225	mW
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	556	°C/mW
Total Device Dissipation Alumina Substrate,** T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	300	mW
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	417	°C/mW
Junction and Storage Temperature	T <sub>J</sub> , T <sub>stg</sub>	150	°C

\*FR-5 = 1.0 x 0.75 x 0.62 in.

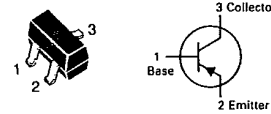
\*\*Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

## DEVICE MARKING

MMBT2907 = 2B; MMBT2907A = 2F

T-29-15  
**MMBT2907**  
**MMBT2907A**

CASE 318-02/03, STYLE 6  
 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to MPS2907 for graphs.

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage(1) (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	40 60	—	V <sub>dc</sub>
Collector-Base Breakdown Voltage (I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	60	—	V <sub>dc</sub>
Emitter-Base Breakdown Voltage (I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	5.0	—	V <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = 30 Vdc, V <sub>BE(off)</sub> = 0.5 Vdc)	I <sub>CEX</sub>	—	50	nAdc
Collector Cutoff Current (V <sub>CB</sub> = 50 Vdc, I <sub>E</sub> = 0)	I <sub>CBO</sub>	— —	0.020 0.010	μAdc
(V <sub>CB</sub> = 50 Vdc, I <sub>E</sub> = 0, T <sub>A</sub> = 125°C)		— —	20 10	
Base Current (V <sub>CE</sub> = 30 Vdc, V <sub>BE(off)</sub> = 0.5 Vdc)	I <sub>B</sub>	—	50	nAdc
<b>ON CHARACTERISTICS</b>				
DC Current Gain (I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 10 Vdc)	h <sub>FE</sub>	35 75	—	—
(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc)		50 100	—	
(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc)		75 100	—	
(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 10 Vdc)(1)		100	300	
(I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc)(1)		30 50	—	
Collector-Emitter Saturation Voltage(1) (I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc) (I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)	V <sub>CE(sat)</sub>	— —	0.4 1.6	V <sub>dc</sub>
Base-Emitter Saturation Voltage(1) (I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc) (I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)	V <sub>BE(sat)</sub>	— —	1.3 2.6	V <sub>dc</sub>

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

6367254 MOTOROLA SC (XSTRS/R F)  
MMBT2907,A

96D 82037 D

T-29-15

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

Characteristic	Symbol	Min	Max	Unit	
<b>SMALL-SIGNAL CHARACTERISTICS</b>					
Current-Gain — Bandwidth Product(1),(2) ( $I_C = 50\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )	$f_T$	200	—	MHz	
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	—	8.0	pF	
Input Capacitance ( $V_{BE} = 2.0\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$	—	30	pF	
<b>SWITCHING CHARACTERISTICS</b>					
Turn-On Time	$(V_{CC} = 30\text{ Vdc}$ , $I_C = 150\text{ mAdc}$ , $I_{B1} = 15\text{ mAdc}$ )	$t_{on}$	—	45	ns
Delay Time		$t_d$	—	10	ns
Rise Time		$t_r$	—	40	ns
Turn-Off Time	$(V_{CC} = 6.0\text{ Vdc}$ , $I_C = 150\text{ mAdc}$ , $I_{B1} = I_{B2} = 15\text{ mAdc}$ )	$t_{off}$	—	100	ns
Storage Time		$t_s$	—	80	ns
Fall Time		$t_f$	—	30	ns

(1) Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .(2)  $f_T$  is defined as the frequency at which  $|h_{fe}|$  extrapolates to unity.

6367254 MOTOROLA SC (XSTRS/R F)

96D 82038 D  
T-37-15

**MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	12	Vdc
Collector-Base Voltage	V <sub>CBO</sub>	12	Vdc
Emitter-Base Voltage	V <sub>EBO</sub>	4.0	Vdc
Collector Current — Continuous	I <sub>C</sub>	80	mAdc

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	225	mW
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	556	°C/mW
Total Device Dissipation Alumina Substrate,** T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	300	mW
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	417	°C/mW
Junction and Storage Temperature	T <sub>J</sub> , T <sub>stg</sub>	150	°C

\*FR-5 = 1.0 x 0.75 x 0.62 in.

\*\*Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

**DEVICE MARKING**

MMBT3640 = 2J

## MMBT3640

CASE 318-02/03, STYLE 6  
SOT-23 (TO-236AA/AB)

**SWITCHING TRANSISTOR**

PNP SILICON

Refer to MPS3640 for graphs.

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage (I <sub>C</sub> = 100 μAdc, V <sub>BE</sub> = 0)	V <sub>(BR)CES</sub>	12	—	Vdc
Collector-Emitter Sustaining Voltage(1) (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 0)	V <sub>CEO(sus)</sub>	12	—	Vdc
Collector-Base Breakdown Voltage (I <sub>C</sub> = 100 μAdc, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	12	—	Vdc
Emitter-Base Breakdown Voltage (I <sub>E</sub> = 100 μAdc, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	4.0	—	Vdc
Collector Cutoff Current (V <sub>CE</sub> = 6.0 Vdc, V <sub>BE</sub> = 0)	I <sub>CES</sub>	—	0.01	μAdc
(V <sub>CE</sub> = 6.0 Vdc, V <sub>BE</sub> = 0, T <sub>A</sub> = 65°C)		—	1.0	
Base Current (V <sub>CE</sub> = 6.0 Vdc, V <sub>BE</sub> = 0)	I <sub>B</sub>	—	10	nAdc
<b>ON CHARACTERISTICS(1)</b>				
DC Current Gain (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 0.3 Vdc)	h <sub>FE</sub>	30	120	—
(I <sub>C</sub> = 50 mAdc, V <sub>CE</sub> = 1.0 Vdc)		20	—	
Collector-Emitter Saturation Voltage (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc)	V <sub>CE(sat)</sub>	—	0.2	Vdc
(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc)		—	0.6	
(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc, T <sub>A</sub> = 65°C)		—	0.25	
Base-Emitter Saturation Voltage (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 0.5 mAdc)	V <sub>BE(sat)</sub>	0.75	0.95	Vdc
(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc)		0.8	1.0	
(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc)		—	1.5	
<b>SMALL SIGNAL CHARACTERISTICS</b>				
Current-Gain — Bandwidth Product (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 5.0 Vdc, f = 100 MHz)	f <sub>T</sub>	500	—	MHz
Output Capacitance (V <sub>CB</sub> = 5.0 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)	C <sub>obo</sub>	—	3.5	pF
Input Capacitance (V <sub>BE</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)	C <sub>ibo</sub>	—	3.5	pF
<b>SWITCHING CHARACTERISTICS</b>				
Delay Time (V <sub>CC</sub> = 6.0 Vdc, I <sub>C</sub> = 50 mAdc, V <sub>BE(off)</sub> = 1.9 Vdc, I <sub>B1</sub> = 5.0 mAdc)	t <sub>d</sub>	—	10	ns
Rise Time	t <sub>r</sub>	—	30	ns
Storage Time (V <sub>CC</sub> = 6.0 Vdc, I <sub>C</sub> = 50 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 5.0 mAdc)	t <sub>s</sub>	—	20	ns
Fall Time	t <sub>f</sub>	—	12	ns
Turn-On Time (V <sub>CC</sub> = 6.0 Vdc, I <sub>C</sub> = 50 mAdc, V <sub>BE(off)</sub> = 1.9 Vdc, I <sub>B1</sub> = 5.0 mAdc)	t <sub>on</sub>	—	25	ns
(V <sub>CC</sub> = 1.5 Vdc, I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = 0.5 mAdc)		—	60	
Turn-Off Time (V <sub>CC</sub> = 6.0 Vdc, I <sub>C</sub> = 50 mAdc, V <sub>BE(off)</sub> = 1.9 V, I <sub>B1</sub> = I <sub>B2</sub> = 5.0 mAdc)	t <sub>off</sub>	—	35	ns
(V <sub>CC</sub> = 1.5 Vdc, I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 0.5 mAdc)		—	75	

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

6367254 MOTOROLA SC (XSTRS/R F)

96D 82039 D

T-29-15

**MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	40	Vdc
Collector-Base Voltage	V <sub>CBO</sub>	60	Vdc
Emitter-Base Voltage	V <sub>EBO</sub>	6.0	Vdc
Collector Current — Continuous	I <sub>C</sub>	200	mA <sub>dc</sub>

**THERMAL CHARACTERISTICS**

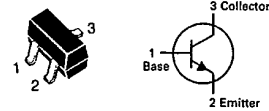
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	225	mW
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	556	°C/mW
Total Device Dissipation Alumina Substrate,** T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	300	mW
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	417	°C/mW
Junction and Storage Temperature	T <sub>J</sub> , T <sub>stg</sub>	150	°C

\*FR-5 = 1.0 x 0.75 x 0.62 in.

\*\*Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

**DEVICE MARKING**

MMBT3903 = 1Y; MMBT3904 = 1A

**MMBT3903  
MMBT3904****CASE 318-03, STYLE 6  
SOT-23 (TO-236AA/AB)****GENERAL PURPOSE TRANSISTOR****NPN SILICON**

Refer to 2N3903 for graphs.

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage(1) (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	40	—	Vdc
Collector-Base Breakdown Voltage (I <sub>C</sub> = 10 μA <sub>dc</sub> , I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	60	—	Vdc
Emitter-Base Breakdown Voltage (I <sub>E</sub> = 10 μA <sub>dc</sub> , I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	6.0	—	Vdc
Base Cutoff Current (V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc)	I <sub>BL</sub>	—	50	nA <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc)	I <sub>CEX</sub>	—	50	nA <sub>dc</sub>
<b>ON CHARACTERISTICS</b>				
DC Current Gain(1) (I <sub>C</sub> = 0.1 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 Vdc)	h <sub>FE</sub>	20	—	—
	MMBT3903	40	—	—
	MMBT3904	—	—	—
(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 Vdc)	MMBT3903	35	—	—
	MMBT3904	70	—	—
(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 Vdc)	MMBT3903	50	150	—
	MMBT3904	100	300	—
(I <sub>C</sub> = 50 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 Vdc)	MMBT3903	30	—	—
	MMBT3904	60	—	—
(I <sub>C</sub> = 100 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 Vdc)	MMBT3903	15	—	—
	MMBT3904	30	—	—
Collector-Emitter Saturation Voltage(1) (I <sub>C</sub> = 10 mA <sub>dc</sub> , I <sub>B</sub> = 1.0 mA <sub>dc</sub> ) (I <sub>C</sub> = 50 mA <sub>dc</sub> , I <sub>B</sub> = 5.0 mA <sub>dc</sub> )	V <sub>CE(sat)</sub>	—	0.2 0.3	Vdc
Base-Emitter Saturation Voltage(1) (I <sub>C</sub> = 10 mA <sub>dc</sub> , I <sub>B</sub> = 1.0 mA <sub>dc</sub> ) (I <sub>C</sub> = 50 mA <sub>dc</sub> , I <sub>B</sub> = 5.0 mA <sub>dc</sub> )	V <sub>BE(sat)</sub>	0.65 —	0.85 0.95	Vdc
<b>SMALL-SIGNAL CHARACTERISTICS</b>				
Current-Gain — Bandwidth Product (I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 20 Vdc, f = 100 MHz)	f <sub>T</sub>	250 300	—	MHz
	MMBT3903	—	—	—
	MMBT3904	—	—	—

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

6367254 MOTOROLA SC (XSTRS/R F)

96D 82040 D

MMBT3903, MMBT3904

T-29-15

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

Characteristic		Symbol	Min	Max	Unit
Output Capacitance ( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )		$C_{obo}$	—	4.0	pF
Input Capacitance ( $V_{BE} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )		$C_{ibo}$	—	8.0	pF
Input Impedance ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT3903 MMBT3904	$h_{ie}$	1.0 1.0	8.0 10	k ohms
Voltage Feedback Ratio ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT3903 MMBT3904	$h_{re}$	0.1 0.5	5.0 8.0	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT3903 MMBT3904	$h_{fe}$	50 100	200 400	—
Output Admittance ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )		$h_{oe}$	1.0	40	$\mu\text{mhos}$
Noise Figure ( $I_C = 100\ \mu\text{A}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 1.0\text{ k ohms}$ , $f = 10\text{ Hz to }15.7\text{ kHz}$ )	MMBT3903 MMBT3904	NF	—	6.0 5.0	dB

## SWITCHING CHARACTERISTICS

Characteristic	Conditions	Symbol	Min	Max	Unit
Delay Time	$(V_{CC} = 3.0\text{ Vdc}$ , $V_{BE} = 0.5\text{ Vdc}$ , $I_C = 10\text{ mAdc}$ , $I_{B1} = 1.0\text{ mAdc}$ )	$t_d$	—	35	ns
Rise Time		$t_r$	—	35	ns
Storage Time	$(V_{CC} = 3.0\text{ Vdc}$ , $I_C = 10\text{ mAdc}$ , $I_{B1} = I_{B2} = 1.0\text{ mAdc}$ )	$t_s$	—	175	ns
Fall Time		$t_f$	—	50	ns

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