

6367254 MOTOROLA SC (XSTRS/R F)

96D 82041 D

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	40	Vdc
Collector-Base Voltage	V_{CBO}	40	Vdc
Emitter-Base Voltage	V_{EBO}	5.0	Vdc
Collector Current — Continuous	I_C	200	mA dc

THERMAL CHARACTERISTICS

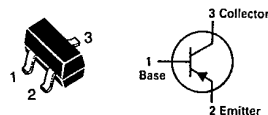
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
		1.8	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{mW}$
Total Device Dissipation Alumina Substrate,** $T_A = 25^\circ\text{C}$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

*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

MMBT3906 = 2A

T-29-15
MMBT3906CASE 318-02/03, STYLE 6
SOT-23 (TO-236AA/AB)

GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N3905 for graphs.

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) ($I_C = 1.0 \text{ mA dc}, I_B = 0$)	$V_{(BR)CEO}$	40	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu\text{A dc}, I_E = 0$)	$V_{(BR)CBO}$	40	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu\text{A dc}, I_C = 0$)	$V_{(BR)EBO}$	5.0	—	Vdc
Base Cutoff Current ($V_{CE} = 30 \text{ Vdc}, V_{BE} = 3.0 \text{ Vdc}$)	I_{BL}	—	50	nA dc
Collector Cutoff Current ($V_{CE} = 30 \text{ Vdc}, V_{BE} = 3.0 \text{ Vdc}$)	I_{CEX}	—	50	nA dc
ON CHARACTERISTICS(1)				
DC Current Gain ($I_C = 0.1 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 1.0 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 10 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 50 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$)	h_{FE}	60 80 100 60 30	— — 300 — —	—
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mA dc}, I_B = 1.0 \text{ mA dc}$) ($I_C = 50 \text{ mA dc}, I_B = 5.0 \text{ mA dc}$)	$V_{CE(sat)}$	— —	0.25 0.4	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mA dc}, I_B = 1.0 \text{ mA dc}$) ($I_C = 50 \text{ mA dc}, I_B = 5.0 \text{ mA dc}$)	$V_{BE(sat)}$	0.65 —	0.85 0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product ($I_C = 10 \text{ mA dc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz}$)	f_T	250	—	MHz
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz}$)	C_{obo}	—	4.5	pF
Input Capacitance ($V_{BE} = 0.5 \text{ Vdc}, I_C = 0, f = 100 \text{ kHz}$)	C_{ibo}	—	10.0	pF
Input Impedance ($I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$)	h_{ie}	2.0	12	k ohms
Voltage Feedback Ratio ($I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$)	h_{re}	0.1	10	$\times 10^{-4}$
Small-Signal Current Gain ($I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$)	h_{fe}	100	400	—

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

6367254 MOTOROLA SC (XSTRS/R F)

96D 82042 D

MMBT3906

T-29-15

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

Characteristic	Symbol	Min	Max	Unit
Output Admittance ($I_C = 1.0\text{ mAdc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	h_{oe}	3.0	60	μmhos
Noise Figure ($I_C = 100\text{ }\mu\text{Adc}$, $V_{CE} = 5.0\text{ Vdc}$, $R_S = 1.0\text{ k ohm}$, $f = 10\text{ Hz to }15.7\text{ kHz}$)	NF	—	4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	(VCC = 3.0 Vdc, VBE = 0.5 Vdc $I_C = 10\text{ mAdc}$, $I_{B1} = 1.0\text{ mAdc}$)	t_d	—	35	ns
Rise Time		t_r	—	35	ns
Storage Time	(VCC = 3.0 Vdc, $I_C = 10\text{ mAdc}$, $I_{B1} = I_{B2} = 1.0\text{ mAdc}$)	t_s	—	225	ns
Fall Time		t_f	—	75	ns

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

6367254 MOTOROLA SC (XSTRS/R F)
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	V
Collector-Base Voltage	V_{CBO}	40	V
Emitter-Base Voltage	V_{EBO}	5.0	V
Collector Current — Continuous	I_C	200	mA

THERMAL CHARACTERISTICS

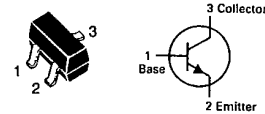
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{mW}$
Total Device Dissipation Alumina Substrate,** $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{mW}$
Junction and Storage Temperature	T_J, T_{stg}	150	$^\circ\text{C}$

*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

MMBT4123 = 5B

T-29-15
MMBT4123CASE 318-02/03, STYLE 6
SOT-23 (TO-236AA/AB)

GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N4123 for graphs.

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) ($I_C = 1.0 \text{ mA}$, $I_E = 0$)	$V_{(BR)CEO}$	25	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu\text{A}$, $I_E = 0$)	$V_{(BR)CBO}$	30	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu\text{A}$, $I_C = 0$)	$V_{(BR)EBO}$	5.0	—	Vdc
Collector Cutoff Current ($V_{CB} = 20 \text{ Vdc}$, $I_E = 0$)	I_{CBO}	—	50	nA
Emitter Cutoff Current ($V_{BE} = 3.0 \text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	50	nA
ON CHARACTERISTICS				
DC Current Gain(1) ($I_C = 2.0 \text{ mA}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 50 \text{ mA}$, $V_{CE} = 1.0 \text{ Vdc}$)	h_{FE}	50 25	150 —	—
Collector-Emitter Saturation Voltage(1) ($I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$)	$V_{CE(sat)}$	—	0.3	Vdc
Base-Emitter Saturation Voltage(1) ($I_C = 50 \text{ mA}$, $I_B = 5.0 \text{ mA}$)	$V_{BE(sat)}$	—	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product ($I_C = 10 \text{ mA}$, $V_{CE} = 20 \text{ Vdc}$, $f = 100 \text{ MHz}$)	f_T	250	—	MHz
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_E = 0$, $f = 100 \text{ kHz}$)	C_{obo}	—	4.0	pF
Input Capacitance ($V_{BE} = 0.5 \text{ Vdc}$, $I_C = 0$, $f = 100 \text{ kHz}$)	C_{ibo}	—	8.0	pF
Collector-Base Capacitance ($I_E = 0$, $V_{CB} = 5.0 \text{ V}$, $f = 100 \text{ kHz}$)	C_{cb}	—	4.0	pF
Small-Signal Current Gain ($I_C = 2.0 \text{ mA}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h_{fe}	50	200	—
Current Gain — High Frequency ($I_C = 10 \text{ mA}$, $V_{CE} = 20 \text{ Vdc}$, $f = 100 \text{ MHz}$)	$ h_{fe} $	2.5	—	—
Noise Figure ($I_C = 100 \mu\text{A}$, $V_{CE} = 5.0 \text{ Vdc}$, $R_S = 1.0 \text{ kohm}$, Noise Bandwidth = 10 Hz to 15.7 kHz)	NF	—	6.0	dB

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

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

6367254 MOTOROLA SC (XSTRS/R F)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CE0}	30	Vdc
Collector-Base Voltage	V_{CB0}	30	Vdc
Emitter-Base Voltage	V_{EB0}	4.0	Vdc
Collector Current — Continuous	I_C	200	mA dc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	350 2.8	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.0 8.0	Watt mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

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

*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

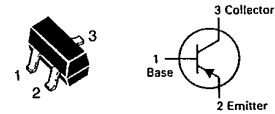
MMBT4125 = 2D

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) ($I_C = 1.0 \text{ mA dc}, I_E = 0$)	$V_{(BR)CEO}$	30	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu\text{A dc}, I_E = 0$)	$V_{(BR)CBO}$	30	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu\text{A dc}, I_C = 0$)	$V_{(BR)EBO}$	4.0	—	Vdc
Collector Cutoff Current ($V_{CB} = 20 \text{ Vdc}, I_E = 0$)	I_{CBO}	—	50	nA dc
Emitter Cutoff Current ($V_{BE} = 3.0 \text{ Vdc}, I_C = 0$)	I_{EBO}	—	50	nA dc
ON CHARACTERISTICS				
DC Current Gain(1) ($I_C = 2.0 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 50 \text{ mA dc}, V_{CE} = 1.0 \text{ Vdc}$)	h_{FE}	50 25	150 —	—
Collector-Emitter Saturation Voltage(1) ($I_C = 50 \text{ mA dc}, I_B = 5.0 \text{ mA dc}$)	$V_{CE(sat)}$	—	0.4	Vdc
Base-Emitter Saturation Voltage(1) ($I_C = 50 \text{ mA dc}, I_B = 5.0 \text{ mA dc}$)	$V_{BE(sat)}$	—	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product ($I_C = 10 \text{ mA dc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz}$)	f_T	200	—	MHz
Input Capacitance ($V_{BE} = 0.5 \text{ Vdc}, I_C = 0, f = 100 \text{ kHz}$)	C_{ibo}	—	10	pF
Collector-Base Capacitance ($V_{CB} = 5.0 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz}$)	C_{cb}	—	4.5	pF
Small-Signal Current Gain ($I_C = 2.0 \text{ mA dc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$)	h_{fe}	50	200	—
Current Gain — High Frequency ($I_C = 10 \text{ mA dc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz}$)	$ h_{fe} $	2.0	—	—
Noise Figure ($I_C = 100 \mu\text{A dc}, V_{CE} = 5.0 \text{ Vdc}, R_S = 1.0 \text{ kohm}$, Noise Bandwidth = 10 Hz to 15.7 kHz)	NF	—	5.0	dB

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

96D 82044 D

T-29-15
MMBT4125CASE 318-02/03, STYLE 6
SOT-23 (TO-236AA/AB)

GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N4125 for graphs.

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

6367254 MOTOROLA SC (XSTRS/R F)

96D 82045 D

T-35-17

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	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C/mW}$
Total Device Dissipation Alumina Substrate,** $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C/mW}$
Junction and Storage Temperature	T_J, T_{stg}	150	$^\circ\text{C}$

*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

MMBT4401 = 2X

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

Refer to 2N4401 for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	$V_{(BR)CEO}$	40	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}, I_E = 0$)	$V_{(BR)CBO}$	60	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 0.1 \text{ mAdc}, I_C = 0$)	$V_{(BR)EBO}$	6.0	—	Vdc
Base Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$)	I_{BEV}	—	0.1	μA
Collector Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$)	I_{CEX}	—	0.1	μA

ON CHARACTERISTICS(1)

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

SMALL-SIGNAL CHARACTERISTICS

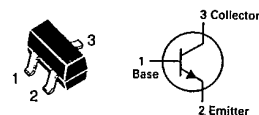
Current-Gain — Bandwidth Product ($I_C = 20 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz}$)	f_T	250	—	MHz
Collector-Base Capacitance ($V_{CB} = 5.0 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz}$)	C_{cb}	—	6.5	pF
Emitter-Base Capacitance ($V_{BE} = 0.5 \text{ Vdc}, I_C = 0, f = 100 \text{ kHz}$)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

SWITCHING CHARACTERISTICS

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

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

MMBT4401

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

SWITCHING TRANSISTOR

NPN SILICON

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS