

6367254 MOTOROLA SC (XSTRS/R F)

96D 82376 D  
T-29-27

**MAXIMUM RATINGS**

Rating	Symbol	2N2060	2N2480	2N2480A	Unit
		2N2223,A			
Collector-Emitter Voltage	V <sub>CEO</sub>	60	40	40	V <sub>dc</sub>
Collector-Emitter Voltage	V <sub>CER</sub>	80	—	—	V <sub>dc</sub>
Collector-Base Voltage	V <sub>CBO</sub>	100	75	80	V <sub>dc</sub>
Emitter-Base Voltage	V <sub>EBO</sub>	7.0	5.0	5.0	V <sub>dc</sub>
Collector Current — Continuous	I <sub>C</sub>	500			mAdc
		One Die		All Die Equal Power	
Total Device Dissipation @ T <sub>A</sub> = 25°C	P <sub>D</sub>	2N2060,A	0.5	0.6	mW
		2N2223,A	0.5	0.6	
		2N2480,A	0.3	0.6	
		Derate above 25°C			
Total Device Dissipation @ T <sub>C</sub> = 25°C	P <sub>D</sub>	2N2060,A	2.86	3.43	mW/°C
		2N2223,A	2.86	3.43	
		2N2480,A	1.72	3.43	
		Derate above 25°C			
Total Device Dissipation @ T <sub>C</sub> = 25°C	P <sub>D</sub>	2N2060,A	1.5	3.0	Watts
		2N2223,A	1.6	3.0	
		2N2480,A	1.0	2.0	
		Derate above 25°C			
Total Device Dissipation @ T <sub>C</sub> = 25°C	P <sub>D</sub>	2N2060,A	8.6	17.2	mW/°C
		2N2223,A	9.1	11.4	
		2N2480,A	5.7	11.4	
		Derate above 25°C			
Operating and Storage Junction Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-65 to +200			°C

**2N2060  
2N2223,A  
2N2480A**

**2N2060 JAN, JTX, JTXV  
AVAILABLE  
CASE 654-07, STYLE 1**

**DUAL  
AMPLIFIER TRANSISTOR**

**NPN SILICON**

Refer to MD2218 for graphs.

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**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> = 100 mAdc, R <sub>BE</sub> ≤ 10 ohms)	V <sub>CER(sus)</sub>	80	—	V <sub>dc</sub>
Collector-Emitter Sustaining Voltage(1) (I <sub>C</sub> = 20 mAdc, I <sub>B</sub> = 0) (I <sub>C</sub> = 30 mAdc, I <sub>B</sub> = 0)	V <sub>CEO(sus)</sub>	40 60	— —	V <sub>dc</sub>
Collector-Base Breakdown Voltage (I <sub>C</sub> = 100 μAdc, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	100 80	— —	V <sub>dc</sub>
Emitter-Base Breakdown Voltage (I <sub>E</sub> = 100 μAdc, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	7.0 5.0	— —	V <sub>dc</sub>
Collector Cutoff Current (V <sub>CB</sub> = 30 Vdc, I <sub>E</sub> = 0, T <sub>A</sub> = 150°C)	I <sub>CBO</sub>	—	15	μAdc
(V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0)		—	0.02	
(V <sub>CB</sub> = 80 Vdc, I <sub>E</sub> = 0)		—	0.002 0.01	
(V <sub>CB</sub> = 80 Vdc, I <sub>E</sub> = 0, T <sub>A</sub> = 150°C)		—	10 15	
Emitter Cutoff Current (V <sub>BE</sub> = 5.0 Vdc, I <sub>C</sub> = 0)	I <sub>EBO</sub>	—	2.0 10 20	nAdc

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

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS</b>				
DC Current Gain ( $I_C = 10 \mu\text{Adc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )  ( $I_C = 100 \mu\text{Adc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )  ( $I_C = 1.0 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )  ( $I_C = 10 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	2N2060 2N2223, 2N2223A	25 15	75 —	—
	2N2060 2N2223, 2N2223A 2N2480A	30 25 35	90 150 —	
	2N2060 2N2480A	40 50	120 200	
	2N2060 2N2223, 2N2223A	50 50	150 200	
Collector-Emitter Saturation Voltage ( $I_C = 50 \text{ mAdc}$ , $I_B = 5.0 \text{ mAdc}$ )	2N2060A 2N2060, 2N2223, 2N2223A, 2N2480A	— —	0.6 1.2	Vdc
Base-Emitter Saturation Voltage ( $I_C = 50 \text{ mAdc}$ , $I_B = 5.0 \text{ mAdc}$ )	2N2060, 2N2223, 2N2223A, 2N2480A	—	0.9	Vdc
<b>SMALL-SIGNAL CHARACTERISTICS</b>				
Current-Gain — Bandwidth Product ( $I_C = 50 \text{ mAdc}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 20 \text{ MHz}$ )	2N2223, 2N2223A, 2N2480A 2N2060	50 60	— —	MHz
Output Capacitance ( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	2N2060, 2N2060A, 2N2223, 2N2223A 2N2480A	— —	15 18	pF
Input Capacitance ( $V_{BE} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$ )	2N2060, 2N2223A, 2N2480A	—	85	pF
Input Impedance ( $I_C = 1.0 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	2N2060 2N2480A	1000 1000	4000 5000	ohms
Input Impedance ( $I_C = 1.0 \text{ mAdc}$ , $V_{CB} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	2N2060, 2N2223, 2N2223A 2N2480A	20 20	30 35	ohms
Voltage Feedback Ratio ( $I_C = 1.0 \text{ mAdc}$ , $V_{CB} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	2N2223, 2N2223A	—	3.0	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C = 1.0 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	2N2060 2N2223, 2N2223A 2N2480A	50 40 50	150 200 300	—
Output Admittance ( $I_C = 1.0 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	2N2060, 2N2480A	—	16	$\mu\text{mhos}$
Output Admittance ( $I_C = 1.0 \text{ mAdc}$ , $V_{CB} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	2N2223, 2N2223A	—	0.5	$\mu\text{mhos}$



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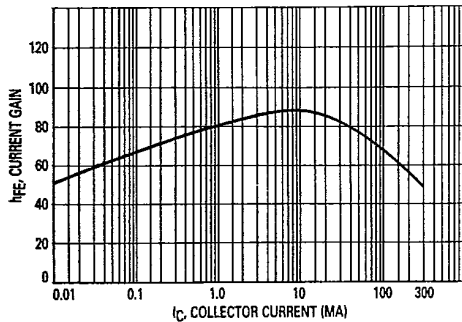
**ELECTRICAL CHARACTERISTICS** (continued) ( $T_A = 25^\circ\text{C}$  unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
<b>Noise Figure</b> $(I_C = 0.3 \text{ mA dc}, V_{CE} = 10 \text{ V dc},$ $R_S = 510 \Omega,$ $f = 1.0 \text{ kHz}, BW = 1.0 \text{ Hz})$ 2N2480A	NF	—	8.0	dB
$(I_C = 0.3 \text{ mA dc}, V_{CE} = 10 \text{ V dc},$ $R_S = 510 \Omega,$ $f = 1.0 \text{ kHz}, BW = 200 \text{ Hz})$ 2N2060		—	8.0	
$(I_C = 0.3 \text{ mA dc}, V_{CE} = 10 \text{ V dc},$ $R_S = 1.0 \text{ k}\Omega,$ $f = 1.0 \text{ kHz}, BW = 15.7 \text{ kHz})(2)$		—	8.0	
<b>MATCHING CHARACTERISTICS</b>				
<b>DC Current Gain Ratio(3)</b> $(I_C = 100 \mu\text{A dc}, V_{CE} = 5.0 \text{ V dc})$ 2N2060, 2N2223A 2N2223, 2N2480A	$h_{FE1}/h_{FE2}$	0.9 0.8	1.0 1.0	—
$(I_C = 1.0 \text{ mA dc}, V_{CE} = 5.0 \text{ V dc})$ 2N2060 2N2480		0.9 0.8	1.0 1.0	
<b>Base-Emitter Voltage Differential</b> $(I_C = 100 \mu\text{A dc}, V_{CE} = 5.0 \text{ V dc})$ 2N2060, 2N2223A, 2N2480A 2N2223	$ V_{BE1} - V_{BE2} $	— — —	5.0 15 5.0	mVdc
$(I_C = 1.0 \text{ mA dc}, V_{CE} = 5.0 \text{ V dc})$ 2N2060, 2N2060A, 2N2480A 2N2480		— — —	5.0 10	
<b>Base-Emitter Voltage Differential Change Due to Temperature</b> $(I_C = 100 \mu\text{A dc}, V_{CE} = 5.0 \text{ V dc},$ $T_A = -55^\circ\text{C to } +125^\circ\text{C})$ 2N2060 2N2223, 2N2223A 2N2480A	$\frac{\Delta(V_{BE1} - V_{BE2})}{\Delta T}$	— — —	10 25 15	$\mu\text{V}^\circ\text{C}$

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- (1) Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .
- (2) Amplifier: 3.0 dB points at 25 Hz and 10 kHz with a roll-off of 6.9 dB per octave.
- (3) The lowest  $h_{FE}$  reading is taken as  $h_{FE1}$  for this ratio.

**FIGURE 1 — DC CURRENT GAIN versus COLLECTOR CURRENT**



**FIGURE 2 — "ON" VOLTAGES**

