

MD7002 (SILICON)
MD7002A
MD7002B

NPN SILICON ANNULAR MULTIPLE TRANSISTORS

... designed for use as differential amplifiers, dual general-purpose amplifiers, front end detectors and temperature compensation applications.

- Excellent Matching Characteristics @ $I_C = 100 \mu\text{Adc}$ –
 $h_{FE1}/h_{FE2} = 0.75$ (Min) – MD7002A
 $= 0.85$ (Min) – MD7002B
- Low Collector-Emitter Saturation Voltage –
 $V_{CE(sat)} = 0.35$ Vdc (Max) @ $I_C = 10$ mAdc
- DC Current Gain Specified @ $100 \mu\text{Adc}$ and 10 mAdc
- High Current-Gain-Bandwidth Product –
 $f_T = 260$ MHz (Typ) @ $I_C = 5.0$ mAdc

**NPN SILICON
MULTIPLE TRANSISTORS**



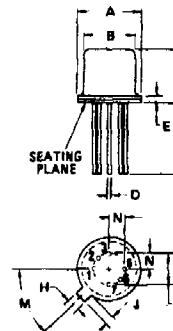
MAXIMUM RATINGS

Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	V_{CEO}	40	Vdc	
Collector-Base Voltage	V_{CB}	50	Vdc	
Emitter-Base Voltage	V_{EB}	5.0	Vdc	
Collector Current	I_C	30	mAdc	
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200	$^{\circ}\text{C}$	
		One Die	Both Die Equal Power	
Total Power Dissipation @ $T_A = 25^{\circ}\text{C}$ Derate above 25°C	P_D	575	625 3.29	mW mW/ $^{\circ}\text{C}$
Total Power Dissipation @ $T_C = 25^{\circ}\text{C}$ Derate above 25°C	P_D	1.8	2.5 10.3	Watts mW/ $^{\circ}\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	Both Die Equal Power	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$ (1)	304	280	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	97	70	$^{\circ}\text{C}/\text{W}$
		Junction to Ambient	Junction to Case	
Coupling Factors		84	44	%

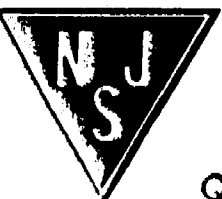
(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.



STYLE 1:
PIN 1. COLLECTOR 5. EMITTER
2. BASE 6. BASE
3. EMITTER 7. COLLECTOR
4. OMITTED 8. OMITTED

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.51	9.40	0.335	0.370
B	7.75	8.61	0.305	0.338
C	3.81	4.70	0.150	0.185
D	0.41	0.53	0.016	0.021
E	5.08 BSC		0.200 BSC	
J	0.71	0.86	0.028	0.034
K	0.74	1.14	0.029	0.045
M	12.70		0.500	
N	4.8 BSC		0.187 BSC	
N	2.54 BSC		0.100 BSC	

CASE 054-07



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MD7002, MD7002A, MD7002B (continued)

THERMAL COUPLING AND EFFECTIVE THERMAL RESISTANCE	
In multiple chip devices, coupling of heat between die occurs. The junction temperature can be calculated as follows:	Assuming equal thermal resistance for each die, equation (1) simplifies to:
(1) $\Delta T_{J1} = R_{\theta 1} P_{D1} + R_{\theta 2} K_{\theta 2} P_{D2}$	(3) $\Delta T_{J1} = R_{\theta 1} (P_{D1} + K_{\theta 2} P_{D2})$
Where ΔT_{J1} is the change in junction temperature of die 1 $R_{\theta 1}$ and $R_{\theta 2}$ is the thermal resistance of die 1 and die 2 P_{D1} and P_{D2} is the power dissipated in die 1 and die 2 $K_{\theta 2}$ is the thermal coupling between die 1 and die 2.	For the conditions where $P_{D1} = P_{D2} = P_{DT} / 2$, equation (3) can be further simplified and by substituting into equation (2) results in:
An effective package thermal resistance can be defined as follows:	(4) $R_{\theta (EFF)} = R_{\theta 1} (1 + K_{\theta 2}) / 2$
(2) $R_{\theta (EFF)} = \Delta T_{J1} / P_{DT}$	Values for the coupling factors when either the case or the ambient is used as a reference are given in the table on page 1
Where P_{DT} is the total package power dissipation.	

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

Characteristic	Symbol	Min	Typ	Max	Unit	
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (1) ($I_C = 10 \text{ mAdc}$, $I_B = 0$)	BV_{CEO}	40	—	—	Vdc	
Collector-Base Breakdown Voltage ($I_C = 10 \mu\text{Adc}$, $I_E = 0$)	BV_{CBO}	50	—	—	Vdc	
Emitter-Base Breakdown Voltage ($I_E = 10 \mu\text{Adc}$, $I_C = 0$)	BV_{EBO}	5.0	—	—	Vdc	
Collector Cutoff Current ($V_{CB} = 30 \text{ Vdc}$, $I_E = 0$)	I_{CBO}	—	—	100	nAdc	
ON CHARACTERISTICS						
DC Current Gain (1) ($I_C = 100 \mu\text{Adc}$, $V_{CE} = 10 \text{ Vdc}$) ($I_C = 10 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$)	h_{FE}	40 50	130 170	— —	—	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$)	$V_{CE(sat)}$	—	0.2	0.35	Vdc	
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$)	$V_{BE(sat)}$	—	0.8	1.0	Vdc	
DYNAMIC CHARACTERISTICS						
Current-Gain-Bandwidth Product (1) ($I_C = 5.0 \text{ mAdc}$, $V_{CE} = 20 \text{ Vdc}$, $f = 100 \text{ MHz}$)	f_T	200	260	—	MHz	
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 100 \text{ kHz}$)	C_{ob}	—	2.8	6.0	pF	
Input Capacitance ($V_{BE} = 2.0 \text{ Vdc}$, $I_C = 0$, $f = 100 \text{ kHz}$)	C_{ib}	—	2.3	8.0	pF	
MATCHING CHARACTERISTICS						
DC Current Gain Ratio (2) ($I_C = 100 \mu\text{Adc}$, $V_{CE} = 10 \text{ Vdc}$)	MD7002A MD7002B	h_{FE1}/h_{FE2}	0.75 0.85	— —	1.0 1.0	—
Base Voltage Differential ($I_C = 100 \mu\text{Adc}$, $V_{CE} = 10 \text{ Vdc}$)	MD7002A MD7002B	$ V_{BE1} - V_{BE2} $	— —	— —	25 15	mVdc

(1) Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.
 (2) The lowest h_{FE} reading is taken as h_{FE1} for this ratio.