

Precision Monolithics Inc.

**FEATURES**

- Complete ..... Includes Reference and Op Amp
- Compact ..... Single 18-Pin DIP Package
- Bipolar Output ..... ( $\pm 10V$ ) Sign-Magnitude Coding
- DAC-03 – Unipolar Only ..... +5V or +10V
- Monotonicity Guaranteed
- Nonlinearity .....  $\pm 1$  LSB
- Fast ..... 2.0 $\mu$ s Settling Time
- Stable ..... Full-Scale Tempco 60ppm/ $^{\circ}C$
- Low Power Consumption ..... 300mW Max
- TTL, CMOS Compatible Inputs
- Available in Die Form

**ORDERING INFORMATION †**

MONO-TONOCITY BITS		PACKAGE: 18-PIN CERDIP	
		COMMERCIAL TEMP	
10		DAC02ACX	DAC03ADX
8		DAC02CCX	DAC03CDX
7		DAC02DDX	—

† Burn-in is available on commercial and industrial temperature range parts in CerDIP, plastic DIP, and TO-can packages. For ordering information, see 1990/91 Data Book, Section 2.

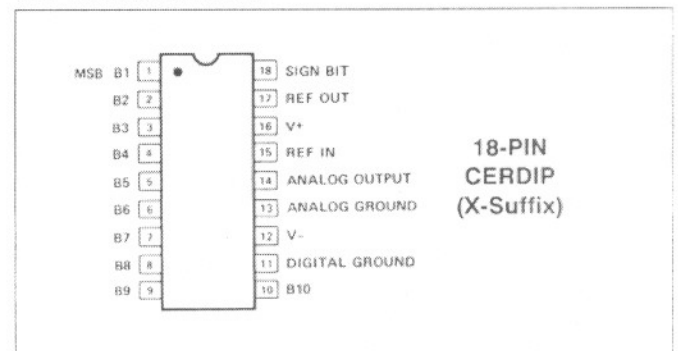
**GENERAL DESCRIPTION**

The DAC-02 is a complete 10-bit plus sign D/A converter on a single monolithic chip. All elements of a complete sign-magnitude DAC are included; precision voltage reference, current

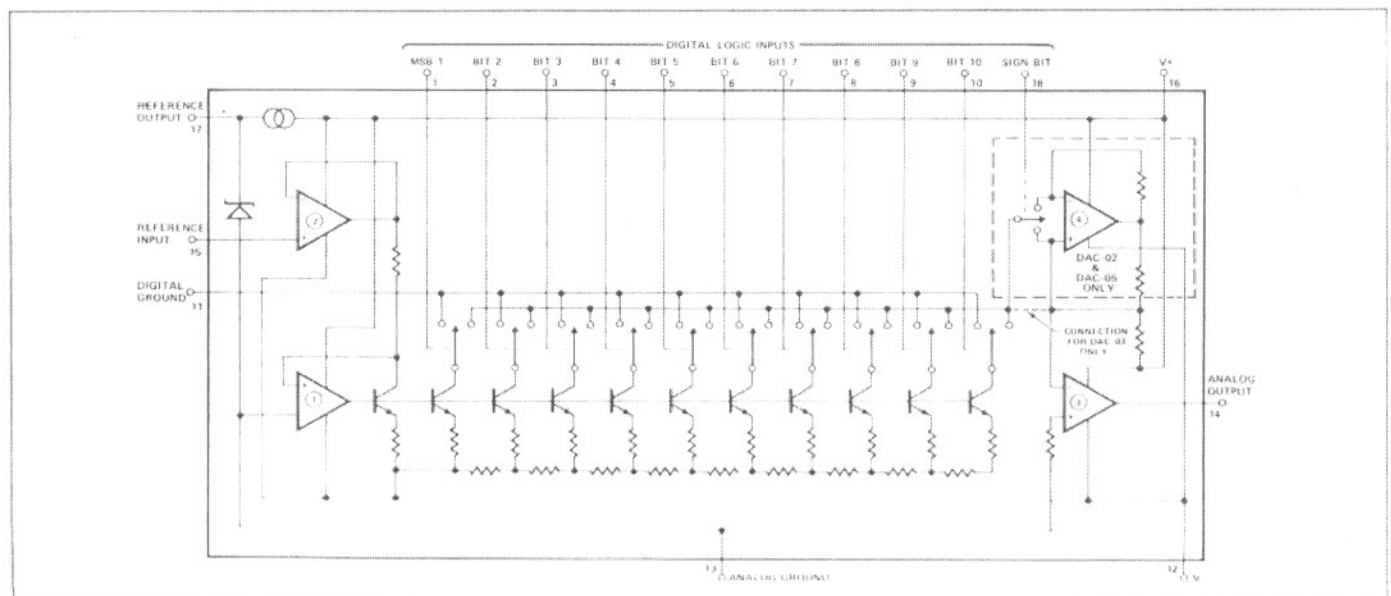
steering logic, current sources, R-2R resistor network, logic-controlled polarity switch, and high speed internally-compensated output op amp. Monotonicity guaranteed over the entire temperature range is achieved using an untrimmed diffused R-2R resistor network. The buffered reference input is capable of tracking over a wide range of voltages, increasing application flexibility. The wide power supply range, low power consumption, wide logic input compatibility and sign-magnitude coding assures utility in a wide range of applications including CRT displays, data acquisition systems, A/D converters, servo positioning controls, and audio digitizing/reconstruction systems.

The DAC-03 is similar in construction to the DAC-02 except for a unipolar only output. This device is intended for low cost, limited temperature range applications, with the same general specifications as its premium counterparts.

**PIN CONNECTIONS**



**SIMPLIFIED SCHEMATIC**





**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $0 \leq T_A \leq +70^\circ C$  for DAC-02,  $T_A = +25^\circ C$  for DAC-03, unless otherwise noted.

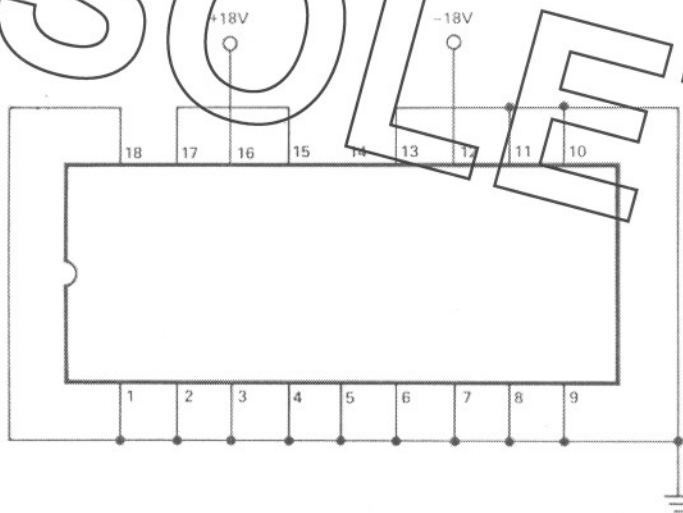
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PARAMETER	SYMBOL	CONDITIONS	DAC-02	DAC-03	MIN	TYP	MAX	UNITS
Positive Supply Current	$I_+$	SB High. All other logic inputs low.	AC/CC DD	ALL	-	+7	+10	mA
Negative Supply Current	$I_-$	SB High. All other logic inputs low.	AC/CC DD	ALL	-	-9	-10	mA
Power Supply Sensitivity	$P_{SS}$	$V_S = \pm 12$ to $\pm 18V$	AC/CC DD	ALL	-	$\pm 0.015$	$\pm 0.05$	% $V_{FS}/V$
Power Dissipation	$P_d$	$I_{OUT} = 0$	AC/CC DD	ALL	-	225	300	mW
Output Drive Current	$I_O$	Guaranteed by $V_{FR}$ test	ALL	ALL	-	-	5	mA

**NOTES:**

- Reference output terminal connected directly to reference input terminal,  $R_L = 2k\Omega$  for 10V devices,  $R_L = 1k\Omega$  for 5V devices, all logic inputs  $\geq 2.0V$ .
- Zero-scale symmetry is the change in the output voltage produced by switching the sign-bit with all logic bits low ( $V_{ZS+} - V_{ZS-}$ ).
- Full-scale bipolar symmetry is the magnitude of the difference between  $V_{FR+}$  and  $|V_{FR-}|$ .
- Guaranteed by design.
- Tested with Best Straight Line method.

BURN-IN CIRCUIT





**ABSOLUTE MAXIMUM RATINGS**

Operating Temperature Range	0°C to +70°C
Storage Temperature Range	-65°C to +150°C
V+ Supply to Analog Ground	0 to +18V
V- Supply to Analog Ground	0 to -18V
Analog Ground to Digital Ground	0 to ±0.5V
Logic Inputs to Digital Ground	-5V to (V+ - 0.7V)
Internal Reference Output Current	300µA
Reference Input Voltage	0 to +10V
Lead Temperature (Soldering, 60 sec)	300°C
Output Short-Circuit Duration	Indefinite

(Short circuit may be to ground or either supply.)

PACKAGE TYPE	$\theta_{JA}$ (Note 1)	$\theta_{JC}$	UNITS
18-Pin Hermetic DIP (X)	79	11	°C/W

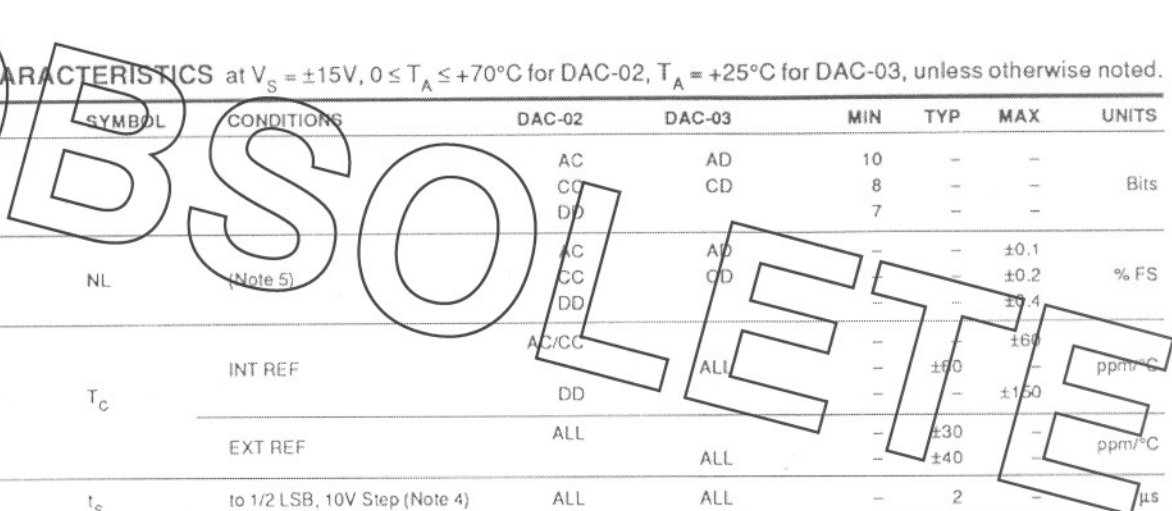
**NOTE:**  
 1.  $\theta_{JA}$  is specified for worst case mounting conditions, i.e.,  $\theta_{JA}$  is specified for device in socket for CerDIP package.

**OUTPUT VOLTAGE RANGE SELECTION TABLE**

PRODUCT	OUTPUT VOLTAGE RANGE	ADD AS SUFFIX TO PART NO.
DAC02	±10V	1
DAC03	0 to +10V	1
DAC03	0 to +5V	2

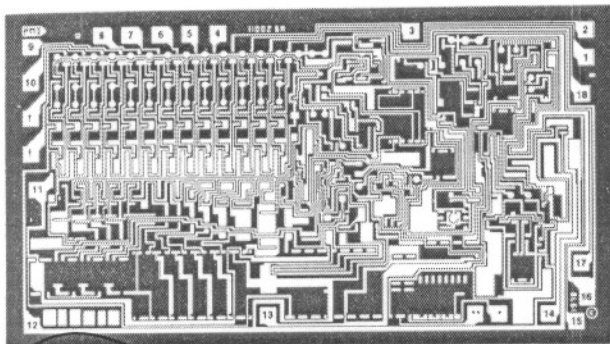
**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $0 \leq T_A \leq +70^\circ C$  for DAC-02,  $T_A = +25^\circ C$  for DAC-03, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	DAC-02	DAC-03	MIN	TYP	MAX	UNITS
Monotonicity			AC	AD	10	-	-	Bits
			CC	CD	8	-	-	
			DD		7	-	-	
Nonlinearity	NL	(Note 5)	AC	AD	-	-	±0.1	% FS
			CC	CD	-	-	±0.2	
			DD		-	-	±0.4	
Full-Scale Tempco	$T_C$	INT REF	AC/CC	ALL	-	±60	-	ppm/°C
			DD		-	-	±150	
		EXT REF	ALL	ALL	-	±30	-	ppm/°C
Settling Time	$t_s$	to 1/2 LSB, 10V Step (Note 4)	ALL	ALL	-	2	-	µs
Full Range Output Voltage (Note 1)	$V_{FR}$	$V_{FR+}$ (SB High)	ALL		+10	-	+11.5	V
		$V_{FR-}$ (SB Low)	ALL		-11.5	-	-10	
		DAC-03 +10V		ALL	+10	-	+11.5	
		+5V		ALL	+5.00	-	+5.75	
Zero-Scale Offset	$V_{ZS}$	SB High. All other logic inputs low. $T_A = +25^\circ C$		ALL	-	±1	±10	mV
		$T_A = \text{Min or Max}$	ALL		-	±5	±10	
Zero-Scale Symmetry	$V_{ZSS}$	(Note 2)	AC/CC		-	±1	±5	mV
			DD	N/A	-	±1	±10	
Full Range Bipolar Symmetry	$V_{FRS}$	$V_{FR+} -  V_{FR-} $ (Note 3)	AC/CC	N/A	-	±30	±60	mV
			DD		-	±30	±80	
Reference Input Bias Current	$I_B$		ALL	ALL	-	100	-	nA
Reference Input Impedance	$Z_{IN}$		ALL	ALL	-	200	-	MΩ
Reference Input Slew Rate	SR		ALL	ALL	-	2	-	V/µs
Reference Output Voltage	$V_{REF}$		ALL	ALL	-	6.7	-	V
Logic Input Current	$I_{IN}$	Each Input -5V to (V+ - 0.7)V	ALL	ALL	-	±1	±10	µA
Logic Input 0	$V_{INL}$		ALL	ALL	-	-	0.8	V
Logic Input 1	$I_{INH}$		ALL	ALL	2	-	-	



11  
DIGITAL-TO-ANALOG CONVERTERS

DICE CHARACTERISTICS



DIE SIZE 0.162 x 0.090 inch, 14,580 sq. mils  
(4.144 x 2.286 mm, 9,405 sq. mm)

- |              |                    |
|--------------|--------------------|
| 1. BIT 1-MSB | 10. BIT 10         |
| 2. BIT 2     | 11. DIGITAL GROUND |
| 3. BIT 3     | 12. V-             |
| 4. BIT 4     | 13. ANALOG GROUND  |
| 5. BIT 5     | 14. ANALOG OUTPUT  |
| 6. BIT 6     | 15. REF IN         |
| 7. BIT 7     | 16. V+             |
| 8. BIT 8     | 17. REF OUT        |
| 9. BIT 9     | 18. SIGN BIT       |

For additional DICE ordering information, refer to 1990/91 Data Book, Section 2.

NOTE:

Voltage output range programmable by connecting \*(10V) to analog output for 10 volt range. Jumps from \*\* (5V) to analog output for 5 volt range. †Bits 11 & 12 (not normally used)

WAFER TEST LIMITS at  $V_S = \pm 15V$ ,  $T_A = +25^\circ C$  and +10V full-scale output, unless otherwise noted.

PARAMETER	CONDITIONS	DAC-02-N LIMIT	DAC-02-G LIMIT	UNITS
Resolution (Bits 11 and 12 Not Normally Used)	Bipolar Output Unipolar Output	13 12	13 12	Bits MAX
Monotonicity		9	8	Bits MIN
Nonlinearity		$\pm 0.1$	$\pm 0.2$	% FS MAX
Zero-Scale Offset	Sign Bit High, All Other Inputs Low	$\pm 10$	$\pm 10$	mV MAX
Zero-Scale Symmetry	$\pm 10V$ Full-Scale	$\pm 5$	$\pm 5$	mV MAX
Full-Scale Bipolar Symmetry	$\pm 10V$ Full-Scale	$\pm 60$	$\pm 60$	mV MAX
Power Supply Rejection	$V_S = \pm 12V$ to $\pm 18V$	0.05	0.05	% $V_{FS}$ /V MAX
Power Dissipation	$I_{OUT} = 0$	300	300	mW MAX
Logic Input "0"		0.8	0.8	V MAX
Logic Input "1"		2	2	V MIN
Full Range Output Voltage	Sign-Bit High or Low	$\pm 11.5$ $\pm 10$	$\pm 11.5$ $\pm 10$	V MAX V MIN

NOTE:

Electrical tests are performed at wafer probe to the limits shown. Due to variations in assembly methods and normal yield loss, yield after packaging is not guaranteed for standard product dice. Consult factory to negotiate specifications based on dice lot qualifications through sample lot assembly and testing.

TYPICAL ELECTRICAL CHARACTERISTICS at  $V_S = \pm 15V$  and +10V full-scale output, unless otherwise noted.

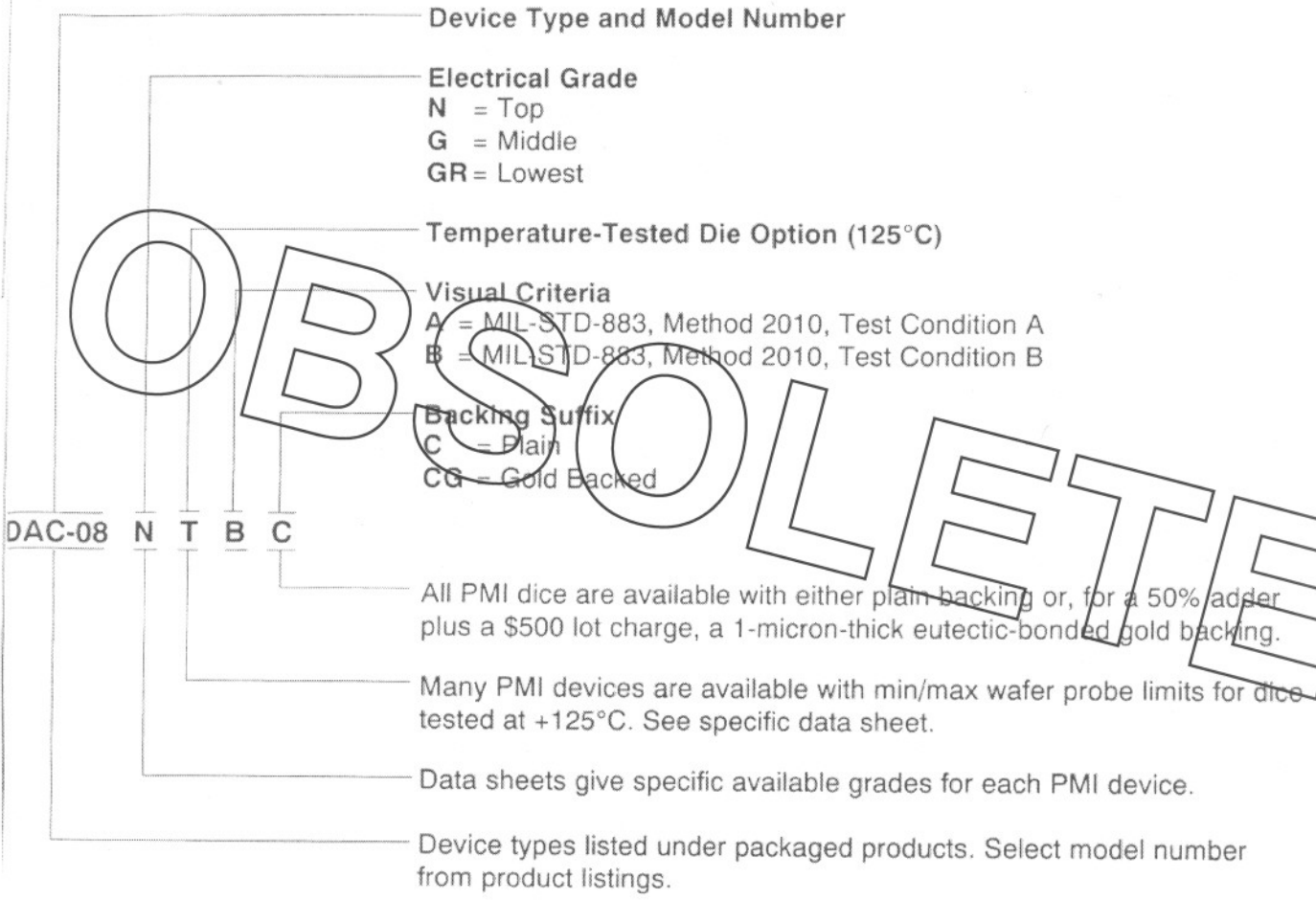
PARAMETER	SYMBOL	CONDITIONS	DAC-02-N TYPICAL	DAC-02-G TYPICAL	UNITS
Full-Scale Tempco	$TVC_{FS}$	Internal Reference	60	60	ppm/ $^\circ C$
Settling Time ( $T_A = +25^\circ C$ )	$t_s$	To $\pm 1/2$ LSB 10 Volt Step	2	2	$\mu s$
Logic Input Current	$I_{IN}$	$T_A = +25^\circ C$	1	1	$\mu A$

NOTE:

When ordering DICE in this series, use DAC-02 numbers and grades above.

OBSOLETE

## DICE PART NUMBERING SYSTEM



**OBSOLETE**