

T-51-09-16 **DAC-HP16B**

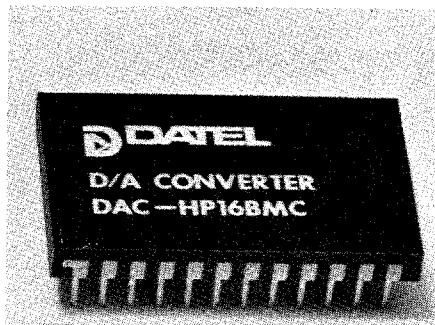
16-Bit, Micro-electronic Digital-to-Analog Converter

FEATURES

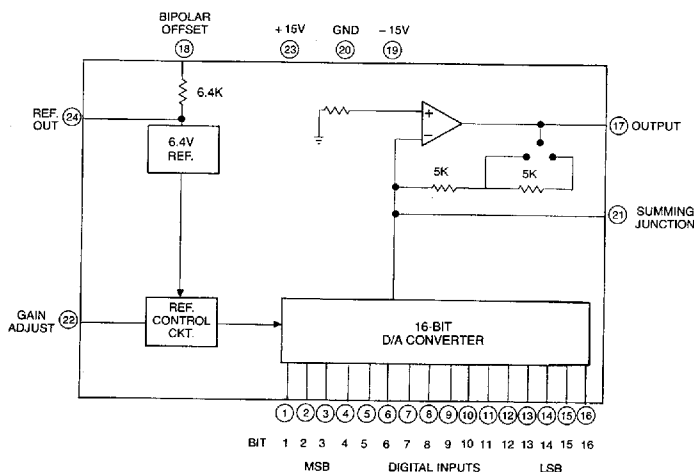
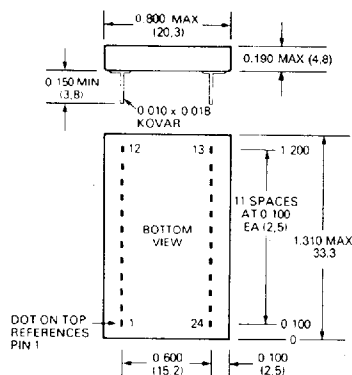
- 16-Bit binary model
- Voltage outputs
- 15 ppm/°C Maximum gain tempco
- Linearity to $\pm 0.003\%$

GENERAL DESCRIPTION

The DAC-HP series are high resolution hybrid D/A converters with voltage output. They are self-contained, including a low tempco zener reference circuit and output operational amplifier, all in a miniature 24-pin double spaced ceramic DIP package. The DAC-HP16B has 16-bit binary resolution with $\pm 0.003\%$ linearity. Input coding is complementary binary and complementary offset binary for the DAC-HP16B. This device operates in both unipolar and bipolar modes with output voltages of 0 to +10V dc and $\pm 5V$ dc respectively. Binary versions with a bipolar output voltage range of $\pm 10V$ dc are available, denoted by the suffix "-1" after the model designation.



MECHANICAL DIMENSIONS
INCHES (MM)



INPUT/OUTPUT
CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	BIT 1 IN (MSB)	13	BIT 13 IN
2	BIT 2 IN	14	BIT 14 IN
3	BIT 3 IN	15	BIT 15 IN
4	BIT 4 IN	16	BIT 16 IN (LSB)
5	BIT 5 IN	17	OUTPUT
6	BIT 6 IN	18	BIPOLAR OFF
7	BIT 7 IN	19	-15VDC
8	BIT 8 IN	20	GROUND
9	BIT 9 IN	21	SUM JUNCTION
10	BIT 10 IN	22	GAIN ADJ
11	BIT 11 IN	23	+15VDC
12	BIT 12 IN	24	REF OUT

DAC-HP16B**ABSOLUTE MAXIMUM RATINGS**

Positive Supply, pin 23	+ 18V
Negative Supply, pin 19	- 18V
Digital Input Voltage, pins 1-16	+ 5.5V
Output Current, pin 17	± 20 mA

FUNCTIONAL SPECIFICATIONS

Typical at 25°C, and ± 15V supplies unless otherwise noted.

INPUTS

Resolution	16 bits
Coding, unipolar output	Comp. Binary
Coding, bipolar output	Comp. Off. Binary
Input Logic Level, bit ON ("0") ¹	0V to +0.8V at -1 mA
Input Logic Level, bit OFF ("1") ¹	+2.4V to +5.5V at +40 μ A
Logic Loading	1 TTL load

OUTPUTS

Output Voltage Range, Unipolar ²	0 to +10V
Output Voltage Range, Bipolar	± 5V
Output Voltage Range, "-1" Suffix	± 10V
Output Current, min. ⁶	± 5 mA
Output Impedance	0.05 ohm

PERFORMANCE

Linearity Error, max.	± 0.003%
Monotonicity, 10°C to 40°C	14 bits
Gain Error, before trimming	± 0.1%
Zero Error, before trimming	± 0.1%
Gain Tempco, max. ³	± 15 ppm/°C
Gain Tempco, max. BGC	± 20 ppm/°C
Zero Tempco, unipolar, max.	± 5 ppm/°C of FSR ⁴
Offset Tempco, bipolar, max.	± 8 ppm/°C of FSR ⁴
Differential Linearity Tempco, max.	± 2 ppm/°C of FSR ⁴
Settling Time, 10V change ⁵	15 μ sec.
Slew Rate	20V/ μ sec.
Power Supply Rejection	± 0.002% FSR/%

POWER REQUIREMENTS

(Quiescent, all bits high)	+ 15V dc, ± 0.5V dc at 20 mA
	- 15V dc, ± 0.5V dc at 25 mA
	± 12V dc operation ⁷

PHYSICAL/ENVIRONMENTAL

Operating Temperature Range	0°C to +70°C (BMC, BGC) -55°C to +125°C (BMM, 883B)
Storage Temperature Range	-65°C to +150°C
Package Type	24 pin ceramic
Pins	0.010 x 0.018 inch diameter Kovar
Weight	0.2 ounces (6 grams)

FOOTNOTES:

1. Drive from TTL output with only the DAC-HP as load.
2. Unipolar output range for suffix "-1" models, 0 to +10V, is reached at 1/2 scale input.
3. For all models except DAC-HP16BGC.
4. FSR is 0 to +FS or -FS to +FS voltage.
5. To 0.005% FSR.
6. Pin 17.
7. For ± 12V dc operation, consult factory.

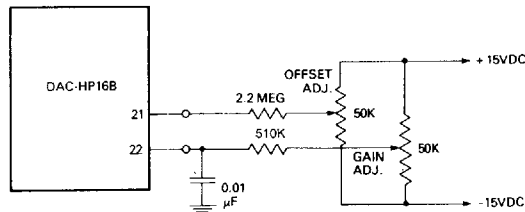
TECHNICAL NOTES

1. It is recommended that these converters be operated with local supply bypass capacitors of 1 μ F (tantalum type) at the +15V and -15V supply pins. The capacitors should be connected as close to the pins as possible. In high frequency noise environments an additional 0.01 μ F ceramic capacitor should be used in parallel with each tantalum bypass.
2. When laying out the circuit board for this device, isolate the analog, digital, and power grounds as much as possible from each other before joining them at pin 20.
3. The external gain adjustment shown in the diagrams gives an adjustment of ± 0.2% of full-scale range. The converters are internally trimmed to ± 0.1% at full scale. A wider range of adjustment may be achieved by decreasing the value of the 510 Kohm resistor.
4. The zero adjustment, or offset adjustment, has an adjustment range of ± 0.35% of full-scale range. The unipolar zero is internally set to zero within ± 0.1% of full-scale range.
5. If the reference output (pin 24) is used, it must be buffered by an operational amplifier in the noninverting mode. Current drawn from pin 24 should be limited to ± 10 μ A in order that the temperature coefficient of the reference circuit not be affected. This is sufficient current for the bias current of most of the popular operational amplifier types.

CALIBRATION PROCEDURE

For bipolar operation connect Bipolar Offset (pin 18) to Summing Junction (pin 21). For unipolar operation connect Bipolar Offset (pin 18) to Ground (pin 20). In making the following adjustments, refer to the coding tables.

1. **Zero Adjustment.** Set the input digital code to 1111 1111 1111 1111 and adjust the ZERO ADJ. potentiometer to give 0.00000V output unipolar or -FS bipolar operation.
2. **Gain Adjustment.** Set the input digital code to 0000 0000 0000 0000 (complementary binary) and adjust the GAIN ADJ. potentiometer to give +9.99985V output unipolar or +FS -1 LSB output bipolar operation.

OFFSET AND GAIN ADJUST

CONNECTION AND CALIBRATION

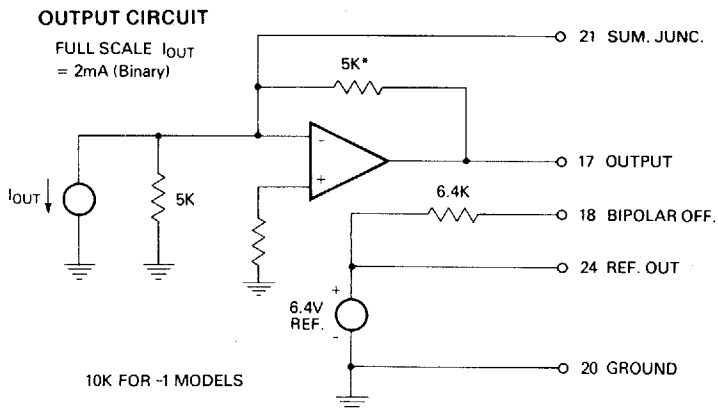
CODING TABLES
BIPOLAR OUTPUT — Complementary Offset Binary

INPUT CODE				SCALE	OUTPUT VOLTAGE	OUTPUT VOLTAGE SUFFIX " -1 " MODELS
MSB	LSB					
0000	0000	0000	0000	+ FS - 1 LSB	+ 4.99985V	+ 9.99969V
0011	1111	1111	1111	+ ½FS	+ 2.50000	+ 5.00000
0111	1111	1111	1111	0	0.00000	0.00000
1011	1111	1111	1111	- ½FS	- 2.50000	- 5.00000
1111	1111	1111	1110	- FS + 1 LSB	- 4.99985	- 9.99969
1111	1111	1111	1111	- FS	- 5.00000V	- 10.00000V

UNIPOLAR OUTPUT — Complementary Binary

INPUT CODE				SCALE	OUTPUT VOLTAGE
MSB	LSB				
0000	0000	0000	0000	+ FS - 1 LSB	+ 9.99985V
0011	1111	1111	1111	+ ¾ FS	+ 7.50000
0111	1111	1111	1111	+ ½ FS	+ 5.00000
1011	1111	1111	1111	+ ¼ FS	+ 2.50000
1111	1111	1111	1110	+ 1 LSB	+ 153 μV
1111	1111	1111	1111	0	0

APPLICATION



ORDERING INFORMATION

MODEL NO.	OPERATING TEMP. RANGE	SEAL
DAC-HP16BMC	0 to +70 °C	Herm.
DAC-HP16BMM	-55 to +125 °C	Herm.
DAC-HPB/883B	-55 to +125 °C	Herm.
DAC-HP16BMC-1	0 to +70 °C	Herm.
DAC-HP16BMM-1	-55 to +125 °C	Herm.
DAC-HPB-1/883B	-55 to +125 °C	Herm.
DAC-HP16BGC-1	0 to +70 °C	Epoxy
DAC-HP16BGC	0 to +70 °C	Epoxy

The MIL-STD-883B units are available under DESC
Drawing Number 5962-89531.