

ABSOLUTE MAXIMUM RATINGS, ALL MODELS

Positive Supply, Pin 24	+18V
Negative Supply, Pin 22	–18V
Digital Input Voltage, Pins 1-12	+15V
Lead Temperature (soldering, 10s)	300°C

FUNCTIONAL SPECIFICATIONS

(Typical at +25°C and ±15V supplies unless otherwise noted.)

Resolution, Bits Coding, Unipolar Output Coding, Bipolar Output Input Logic Level, Bit ON ("1") Input Logic Level, Bit OFF ("0") PERFORMANCE Nonlinearity Error, max. T _{MIN} to T _{MAX} Differential Nonlinearity Error, max. T _{MIN} to T _{MAX} Monotonicity Gain Tempco, max. Offset Tempco, Bipolar, max. Zero Tempco, max. Settling Time, ns max. Settling Time, ns max. Settling Time, ns max. Output Current Range, Unipolar Output Current Range, Bipolar Output Capacitance Output Capacitance Output Leakage Current, All Bits OFF POWER REQUIREMENTS Supply Voltages Positive Quiescent Current, max. Negative Quiescent Current, max. PHYSICAL ENVIRONMENTAL Operating Temperature Range, Case O°C to +70°C (BMC)	DESCRIPTION	8B	10B	12B
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		000 to 7	00C (DMC)	
-55°C to +125°C (BMM, 883)	Operating Temperature Range, Case			M, 883)
Storage Temperature Range -65°C to +150°C	Storage Temperature Range	-65°C to +150°C		
Package Type 24-pin ceramic DDIP	Package Type			
Weight 0.22 ounces (6.3 grams)		0.22 ounc	es (6.3 gran	ns)

Footnotes

- ① With external operational amplifier.
- ② FSR is Full Scale Range, or the difference between minimum and maximum output values.

TECHNICAL NOTES

- Proper operation of the DAC-HF Series converters is dependent on good board layout and connection practices. Bypass supplies as shown in the connection diagrams. Mount bypass capacitors close to the converter, directly to the supply pins where possible.
- 2. Use of a ground plane is particularly important in high-speed D/A converters as it reduces high-frequency noise and aids in decoupling the digital inputs from the analog output. Avoid ground loop problems by connecting all grounds on the board to the ground plane. The remainder of the ground plane should include as much of the circuit board as possible.
- When the converter is configured for voltage output with an external operational amplifier, keep the leads from the converter to the output amplifier as short as possible.
- 4. The high-speed current switching technique used in the DAC-HF Series inherently reduces the amplitude and duration of large transient spikes at the output ("glitches"). The most severe glitches occur at half-scale, the major carry transition from 011 ... 1 to 100 ... 0 or vice versa. At this time, a skewing of the input codes can create a transition state code of 111 ... 1. The duration of the "transition state code" is dependent on the degree of skewing, but its effect is dependent on the speed of the DAC (an ultra-fast DAC will respond to these brief spurious inputs to a greater degree than a slow DAC).

Minimize the effects of input skewing by using a highspeed input register to match input switching times. The input register recommended for use with the DAC-HF is easily implemented with two Texas Instruments SN74S174 hex D-type flip-flops. This register will reduce glitches to a very low level and ensure fast output settling times.

- 5. Test the DAC-HF using a low-capacitance test probe (such as a 10X probe). Take care to assure the shortest possible connection between probe ground and circuit ground. Long probe ground leads may pick up environmental E.M.I. causing artifacts on the scope display, i.e., signals that do not originate at the unit under test.
- 6. Passive components used with the DAC-HF may be as indicated here: $0.1\mu\text{F}$ and $1\mu\text{F}$ bypass capacitors should be ceramic type and tantalum type respectively; the 400Ω output load is a $\pm 0.1\%$, 10ppm/°C, metal-film type; adjustment potentiometers are ceremet types; other resistors may be $\pm 10\%$ carbon composition types.
- 7. Output voltage compliance is $\pm 1.2V$ to preserve the linearity of the converter. In the bipolar mode, the DAC-HF can be operated with no load to give an output voltage of $\pm 1.0V$. In the unipolar mode, the load resistance must be less than 600Ω to give less than +1.2V output. The specified output currents of 0 to +5mA and $\pm 2.5\text{mA}$ are measured into a short circuit or an operational amplifier summing junction.



CALIBRATION PROCEDURE

Unipolar Output Current

- 1. Connect the converter as shown in Figure 2.
- Set all inputs low and adjust the ZERO ADJUST potentiometer for a reading of 0V at the output.
- 3. Set all inputs high and adjust the GAIN ADJUST potentiometer for a reading of –F.S. + 1LSB (See Table 1).

Bipolar Output Current

- 1. Connect the converter as shown in Figure 3.
- Set all inputs low and adjust the OFFSET ADJUST and LOAD potentiometer for an output reading of +F.S. (See Table 2).
- 3. Set all inputs high and adjust the GAIN ADJUST potentiometer for an output reading of –F.S. + 1LSB (See Table 2).

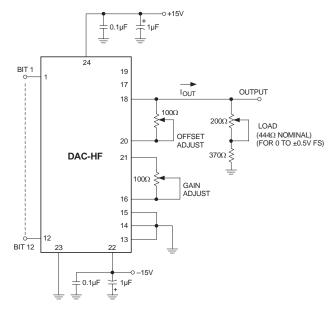


Figure 3. Bipolar Current Output Connections

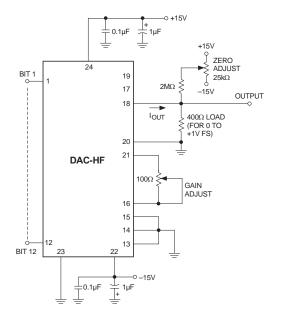


Figure 2. Unipolar Current Output Connections

Table 1. 12-Bit Unipolar Output Coding

UNIPOLAR	INPUT CODING	ANALOG OUTPUT		
SCALE	STRAIGHT BINARY	0 to 1V F.S.	0 to -5V F.S.	0 to -10V F.S.
-F.S. + 1LSB	1111 1111 1111	+0.9998V	-4.9988V	-9.9976V
-3/4F.S.	1100 0000 0000	+0.7500V	-3.7500V	-7.5000V
-1/2F.S.	1000 0000 0000	+0.5000V	-2.5000V	-5.0000V
-1/4F.S.	0100 0000 0000	+2.5000V	-1.2500V	-2.5000V
-1LSB	0000 0000 0001	+0.0002V	-0.0012V	-0.0024V
0	0000 0000 0000	0.0000V	0.0000V	0.0000V

Table 2. 12-Bit Bipolar Output Coding

BIPOLAR	INPUT CODING	ANALOG OUTPUT			
SCALE	OFFSET BINARY	±0.5V F.S.	±2.5V F.S.	±5V F.S.	±10V F.S.
-F.S. + 1LSB	1111 1111 1111	+0.4998V	-2.4988V	-4.9976V	-9.9951V
-1/2F.S.	1100 0000 0000	+0.1250V	-1.2500V	-2.5000V	-5.0000V
-1LSB	1000 0000 0001	+0.0002V	-0.0012V	-0.0024V	-0.0049V
0	1000 0000 0000	0.0000V	0.0000V	V0000V	0.0000V
+1/2F.S.	0100 0000 0000	-0.1250V	+1.2500V	+2.5000V	+5.0000V
+F.S. – 1LSB	0000 0000 0001	-0.4998V	+2.4988V	+4.9976V	+9.9951V
+F.S.	0000 0000 0000	-0.5000V	+2.5000V	+5.0000V	+10.0000V

Table 3. Programmable Output Range Pin Connections

OUTPUT VOLTAGE RANGE	FEEDBACK CONNECTIONS	CONNECT THESE PINS TOGETHER
0 to -5V	PIN 19	PIN 17 to PIN 18 / PIN 20 to PIN 23
0 to -10V	PIN 19	PIN 20 to PIN 23
±2.5V	PIN 19	PIN 17 to PIN 18 / PIN 20 to PIN 18
±5V	PIN 19	PIN 20 to PIN 18
±10V	PIN 17	PIN 20 to PIN 18

In all programmable output ranges, pin 18 connects to external operational amplifier inverting input.

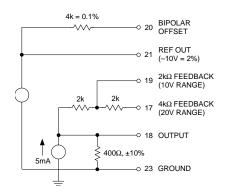


Figure 4. Equivalent Output Circuit

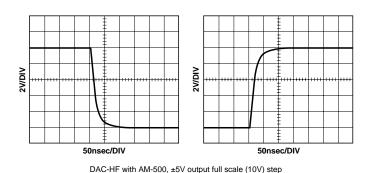


Figure 5. Voltage Output Waveforms



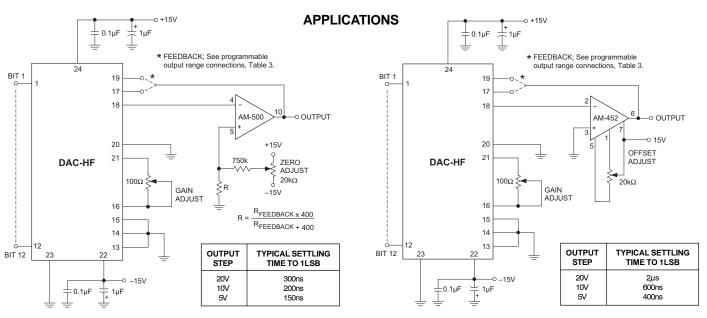
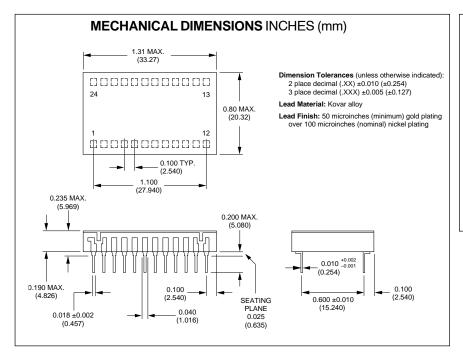


Figure 6. Unipolar Ultra-Fast Voltage Output Circuit

Figure 7. Unipolar Fast Voltage Output Circuit



ORDERING INFORMATION				
MODEL	OPERATING TEMP. RANGE	BITS		
DAC-HF8BMC	0 to +70°C	8		
DAC-HF8BMM	-55 to +125°C	8		
DAC-HF8/883 ①	–55 to +125°C	8		
DAC-HF10BMC	0 to +70°C	10		
DAC-HF10BMM	-55 to +125°C	10		
DAC-HF10/883 ①	-55 to +125°C	10		
DAC-HF12BMC	0 to +70°C	12		
DAC-HF12BMM	-55 to +125°C	12		
DAC-HF12/883 ①	–55 to +125°C	12		



C&D Technologies, Inc.

11 Cabot Boulevard, Mansfield, MA 02048-1151 U.S.A. Tel: (508) 339-3000 (800) 233-2765 Fax: (508) 339-6356

www.cd4power.com email: sales@cdtechno.com

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USA: Tucson (Az), Tel: (800) 547 2537, email: sales@cdtechno.com Portland (OR), Tel: 971 206 2800, email: portland@cdtechno.com

Canada: Toronto, Tel: (905) 944 2850, email: toronto@cdtechno.com

United Kingdom: Milton Keynes, Tel: +44 (0)1908 615232, email: mk@cdtechno.com

France: Montigny Le Bretonneux, Tel: +33 (0)1 34 60 01 01, email: france@cdtechno.com

Germany: München, Tel: +49 (0)89-544334-0, email: ped.munich@cdtechno.com

Japan: Tokyo, Tel: 3-3779-1031, email: sales_tokyo@cdtechno.com Osaka, Tel: 6-6354-2025, email: sales_osaka@cdtechno.com Website: www.cd4power.jp

China: Shanghai, Tel: +86 215 027 3678, email: shanghai@cdtechno.com Guangzhou, Tel: +86 208 221 8066, email: guangzhou@cdtechno.com