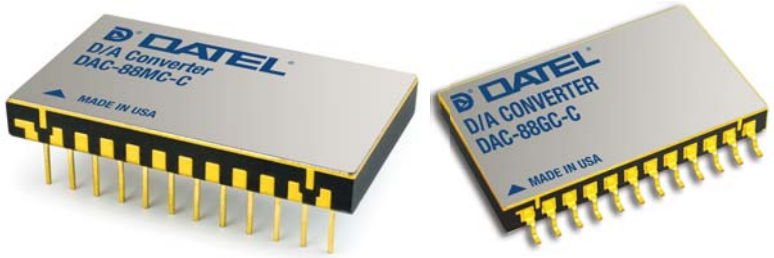
DAC-88 Series

High-Performance, 12-Bit DACs with Input Registers

FEATURES

- 12-Bit resolution
- Integral nonlinearity error ±1/2LSB, max.
- Differential nonlinearity error ±3/4LSB, max.
- MIL-STD-883 high-reliability versions available
- Input register
- 3µs fast output settling time
- Guaranteed monotonicity over full temperature range



INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	BIT 1 (MSB)	24	REFERENCE OUT
2	BIT 2	23	GAIN ADJUST
3	BIT 3	22	+15V SUPPLY
4	BIT 4	21	GROUND
5	BIT 5	20	SUMMING JUNCTION
6	BIT 6	19	LOAD/Register Enable
7	BIT 7	18	10V RANGE
8	BIT 8	17	BIPOLAR OFFSET
9	BIT 9	16	REFERENCE IN
10	BIT 10	15	VOLTAGE OUTPUT
11	BIT 11	14	–15V SUPPLY
12	BIT 12 (LSB)	13	+5V SUPPLY

PRODUCT OVERVIEW

The DAC-88 Series D/A converters are high performance 12-bit devices with a fast settling voltage output. They are compatible and pin-pin replacement for the standard DAC88 and 3860 series. They incorporate a level-controlled input storage register and are specifically designed for systems applications such as data bus interfacing with computers. When the "load/Register Enable" input is high, data in the storage register is held, and when the load input is low, data is transferred through to the DAC. There are two basic models available by coding option: binary and two's complement. The output voltage ranges are externally pin programmable and include 0 to +10V, ±5V, and ±10V. The DAC-88 Series contains a precision zener reference circuit. This eliminates code-dependent ground currents by routing current from the positive supply to the internal ground node as determined by the R-2R ladder network. The internal feedback resistors for the on-board amplifier track the ladder network resistors, enhancing temperature performance. The excellent tracking of the resistors results in a differential nonlinearity tempco of ±2ppm/°C maximum. The temperature coefficient of gain is ±20ppm/°C maximum, and the tempco of zero is ±5ppm/°C maximum.

BLOCK DIAGRAM

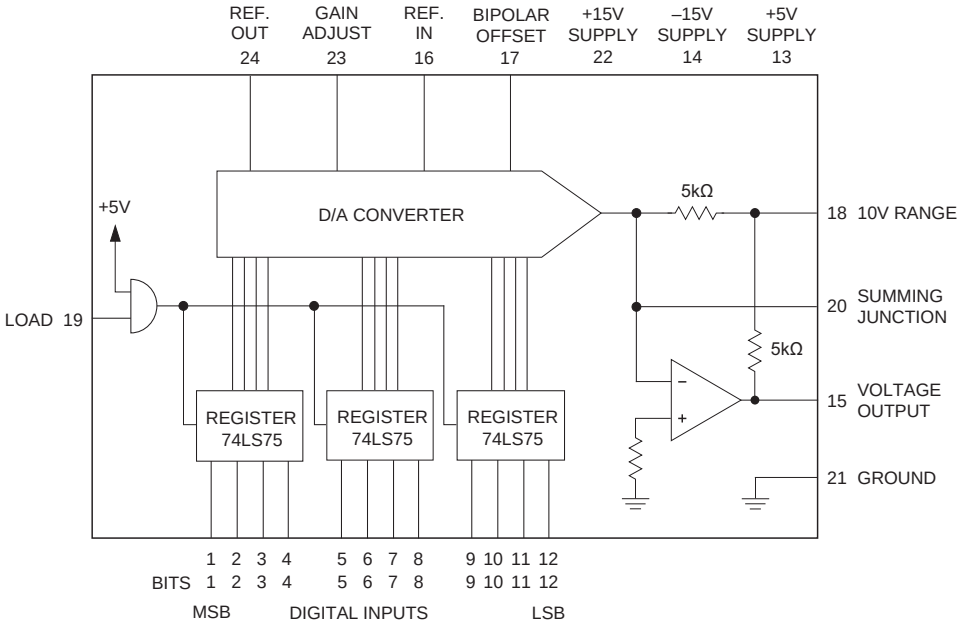


Figure 1. DAC-88 Functional Block Diagram

FUNCTIONAL SPECIFICATIONS

(Typical at +25°C and ±15V and +5V supplies unless otherwise noted.)

DESCRIPTION	
INPUTS	
Resolution	12 bits
Coding, Unipolar Output	Straight binary
Coding, Bipolar Output	Offset binary, two's complement ①
Input Logic Level, Bit ON ("1")	+2.0V to +5.5V
Input Logic Level, Bit OFF ("0")	0V to +0.8V
Logic Loading	1 LSTTL load
Load Input ②	High ("1") = hold data
	Low ("0") = transfer data
Load Input Loading	3 LSTTL loads
PERFORMANCE ④	
Nonlinearity Error, max.	±1/2LSB
Differential Nonlinearity Error, max.	±3/4LSB
Gain Error, Before Trimming	±0.1% ③
Zero Error, Before Trimming	±0.1% of FSR ③
Gain Tempco, max.	±20ppm/°C
Zero Tempco, Unipolar, max.	±5ppm/°C of FSR
Offset Tempco, Bipolar, max.	±10ppm/°C of FSR
Diff. Nonlinearity Tempco, max.	±2ppm/°C of FSR
Monotonicity	Guaranteed over temperature
Settling Time, 10V Change	3µs
Settling Time, 20V Change	4µs
Settling Time, 1LSB Change	800ns
Slew Rate	±20V/µs
Power Supply Rejection	±0.002%FSR/%
OUTPUTS	
Output Voltage Ranges, Unipolar ⑤	0 to +10V
Output Voltage Ranges, Bipolar ⑤	±5V
	±10V
Output Current	±5mA min.
Output Impedance	0.05Ω
POWER REQUIREMENTS	
Power Supply Voltages ⑥	+15V, ±0.5V at 10mA
	–15V, ±0.5V at 20mA
	+5V, ±0.25V at 50mA
PHYSICAL/ENVIRONMENTAL	
Operating Temperature Range, Case	0°C to +70°C (MC,MC-C)
	-40°C to +100°C (ME,ME-C)
	–55°C to +125°C (MM, MM-C, 883,-C/883)
Storage Temperature Range	–65°C to +125°C
Package Type	24-pin DDIP
Weight	0.22 ounces (6.3 grams)

Footnotes:

① For two's complement coding, order the "-2" model as described in Ordering Information.

② Logic levels are the same as for data inputs.

③ Initial errors are trimmable to zero. See Connection Diagram.

④ FSR is full scale range and is 10V for 0 to +10V output range, 20V for ±10V output range, etc.

⑤ By external pin connection.

⑥ For ±12V, +5V operation, contact factory.

ABSOLUTE MAXIMUM RATINGS		
PARAMETERS	**LIMITS**	**UNITS**
Positive Supply,	Pin 22	+18 Volts
Negative Supply,	Pin 14	–18 Volts
Logic Supply,	Pin 13	+5.25 Volts
Digital Input Voltage,	Pins 1–12 & 19	+5.5 Volts
Output Current,	Pin 15	±20 mA
Lead Temperature	(soldering, 10s)	300 °C

TECHNICAL NOTES

1. It is recommended that these converters be operated with local supply bypass capacitors of 1µF (tantalum type) at the +15V, –15V and +5V supply pins. The capacitors should be connected as close to the pins as possible. In high RFI noise environments, these capacitors should be shunted with 0.01µF ceramic capacitors.

2. The analog, digital and power grounds should be separated from each other as close as possible to pin 21 where they all must come together.

3. The "load" control pin is a level-triggered input which causes the register to hold data with a high input and transfer data to the DAC with a low input.

4. A setup time of 40ns minimum must be allowed for the input data. The DAC output voltage begins to change when the register output changes.

CALIBRATION PROCEDURE

Select the desired output voltage range and connect the converter as shown in the Output Range Selection Table and the Connection Diagrams. Refer to the Coding Tables.

Unipolar Operation

1. **Offset Adjustment.** Set the input digital code to 1111 1111 1111 and adjust the Offset ADJ. potentiometer to give 0.0000V output.
2. **Gain Adjustment.** Set the input digital code to 0000 0000 0000 (straight binary) and adjust the GAIN ADJ. potentiometer to give the full-scale output voltage shown in Table 1.

Bipolar Operation

1. **Offset Adjustment.** Set the digital input code to 1111 1111 1111 (offset binary) or 0111 1111 1111 (two's complement) and adjust the OFFSET ADJ. potentiometer to give the negative full-scale output voltage shown in Table 2.
2. **Gain Adjustment.** Set the digital input code to 0000 0000 0000 (offset binary) or 1000 0000 0000 two's complement) and adjust the GAIN ADJ. potentiometer to give the positive full-scale output voltage shown in Table 2.

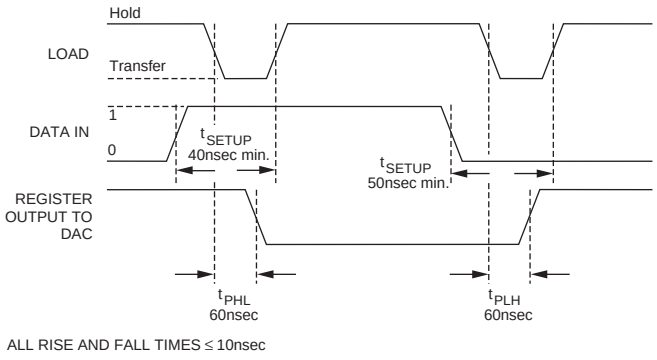


Figure 2. DAC-88 Timing

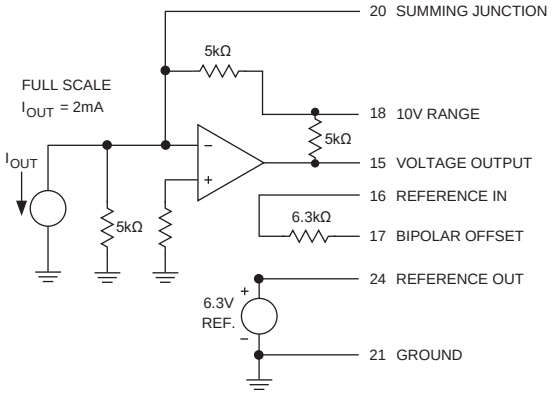


Figure 3. Output Circuit

CONNECTION DIAGRAMS

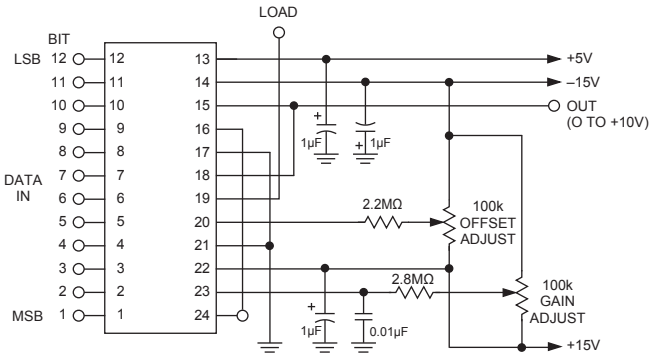


Figure 4. Unipolar Operation (0 to +10V)

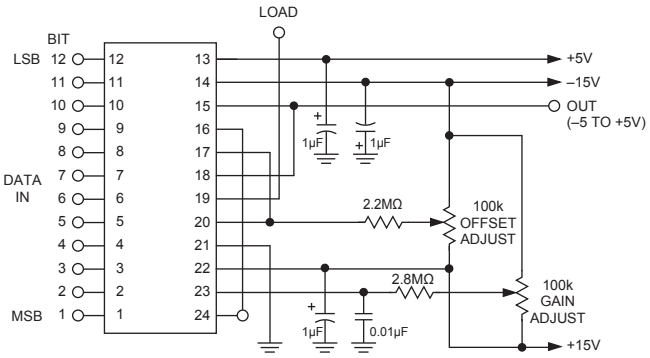


Figure 5. Bipolar Operation (±5V)

APPLICATIONS

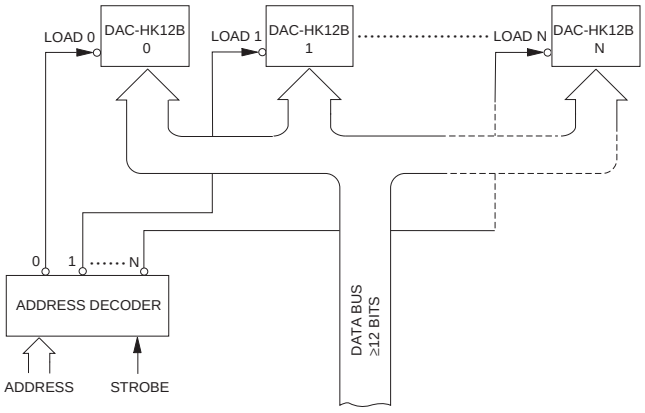


Figure 6. Interfacing to ≥12-Bit Data Bus

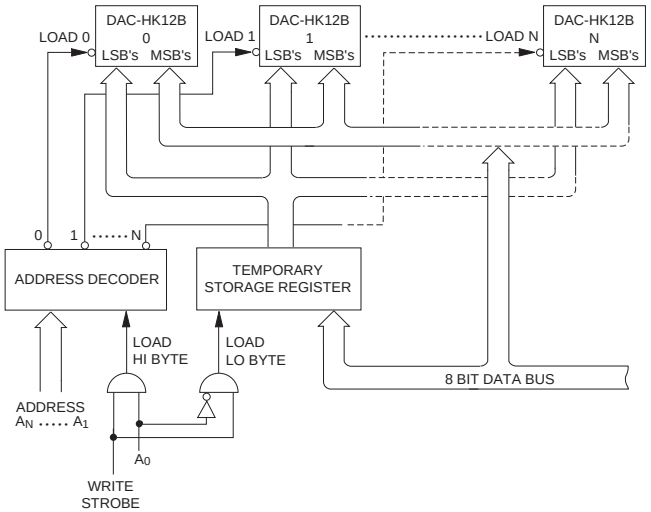


Figure 7. Interfacing to 8-Bit Data Bus

CODING TABLES

COMPLEMENTARY STRAIGHT BINARY			OUTPUT RANGES
MSB		LSB	0 to +10V
0000	0000	0000	+9.9976
0000	0000	0001	+9.9951
0111	1111	1111	+5.0000
1011	1111	1111	+2.5000
1111	1111	1110	+0.0024
1111	1111	1111	0.0000

Table 1. Unipolar Operation

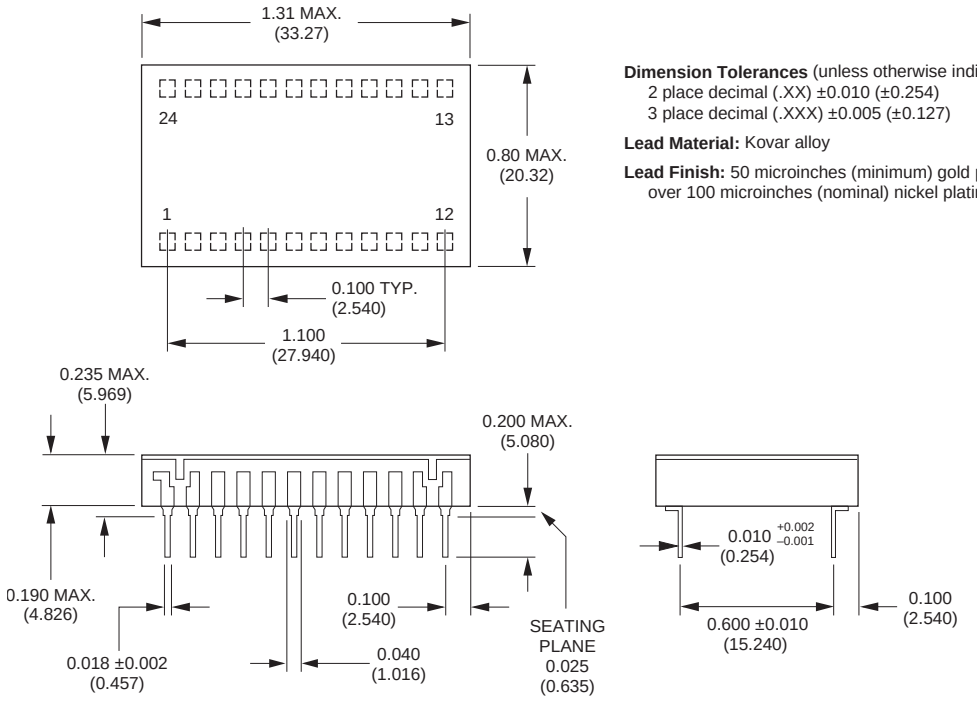
COMPLEMENTARY OFFSET BINARY			TWO'S COMPLEMENT			OUTPUT RANGES	
MSB		LSB	MSB		LSB	±10V	±5V
0000	0000	0000	1000	0000	0000	+9.9951	+4.9976
0000	0000	0001	1000	0000	0001	+9.9902	4.9951
0111	1111	1111	1111	1111	1111	0.0000	0.0000
1111	1111	1110	0111	1111	1110	–9.9951	–4.9976
1111	1111	1111	1111	1111	1111	–10.0000	–5.0000

Table 2. Bipolar Operation

RANGE	CONNECT THESE PINS TOGETHER		
±10V	16 & 24	17 & 20	
±5V	16 & 24	17 & 20	15 & 18
+10V	16 & 24	17 & 21	15 & 18

Table 3. Output Range Selection

MECHANICAL DIMENSIONS – DDIP PACKAGE

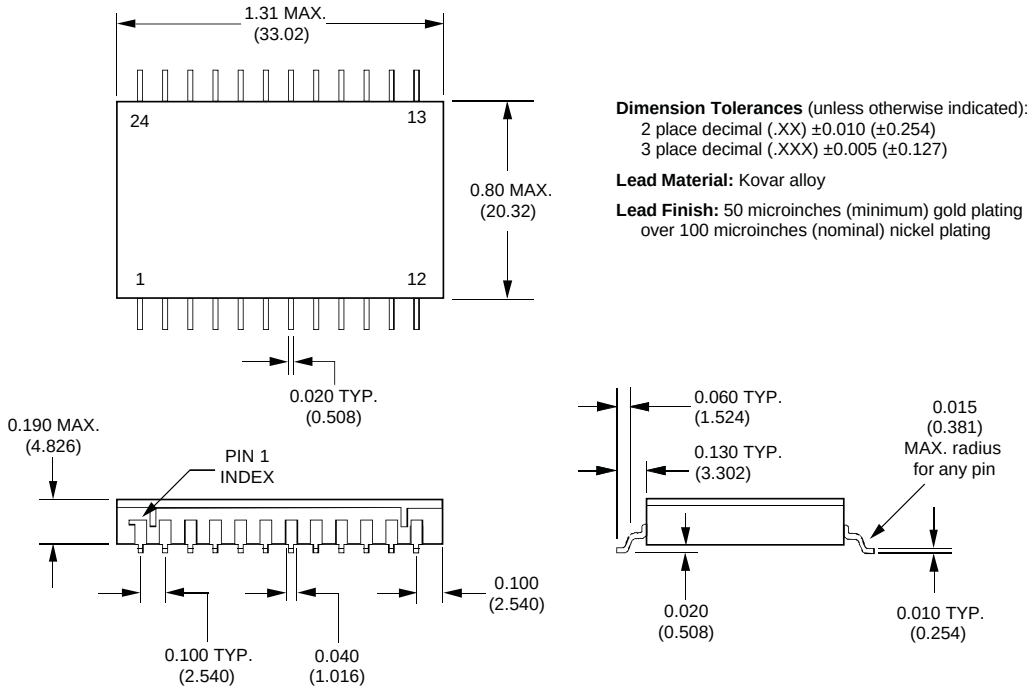


Dimension Tolerances (unless otherwise indicated):
2 place decimal (.XX) ±0.010 (±0.254)
3 place decimal (.XXX) ±0.005 (±0.127)

Lead Material: Kovar alloy

Lead Finish: 50 microinches (minimum) gold plating over 100 microinches (nominal) nickel plating

MECHANICAL DIMENSIONS – SMT GULL-WING PACKAGE



Dimension Tolerances (unless otherwise indicated):
2 place decimal (.XX) ±0.010 (±0.254)
3 place decimal (.XXX) ±0.005 (±0.127)

Lead Material: Kovar alloy

Lead Finish: 50 microinches (minimum) gold plating over 100 microinches (nominal) nickel plating

Dimensions are in inches (mm)

ORDERING INFORMATION

MODEL	OPERATING TEMPERATURE RANGE	RoHS RATING	PACKAGE
Binary Coding			
DAC-88MC	0 to +70°C	Non-RoHS	DDIP
DAC-88ME	–40 to +100°C	Non-RoHS	DDIP
DAC-88MM	–55 to +125°C	Non-RoHS	DDIP
DAC-88/883	–55 to +125°C	Non-RoHS	DDIP
DAC-88MC-C	0 to +70°C	RoHS	DDIP
DAC-88ME-C	–40 to +100°C	RoHS	DDIP
DAC-88MM-C	–55 to +125°C	RoHS	DDIP
DAC-88-C/883	–55 to +125°C	RoHS	DDIP
DAC-88GC	0 to +70°C	Non-RoHS	SMT
DAC-88GE	–40 to +100°C	Non-RoHS	SMT
DAC-88GM	–55 to +125°C	Non-RoHS	SMT
DAC-88G/883	–55 to +125°C	Non-RoHS	SMT
DAC-88GC-C	0 to +70°C	RoHS	SMT
DAC-88GE-C	–40 to +100°C	RoHS	SMT
DAC-88GM-C	–55 to +125°C	RoHS	SMT
DAC-88G-C/883	–55 to +125°C	RoHS	SMT
Two's Complement Coding			
DAC-88MC-2	0 to +70°C	Non-RoHS	DDIP
DAC-88ME-2	–40 to +100°C	Non-RoHS	DDIP
DAC-88MM-2	–55 to +125°C	Non-RoHS	DDIP
DAC-88-2/883	–55 to +125°C	Non-RoHS	DDIP
DAC-88MC-2-C	0 to +70°C	RoHS	DDIP
DAC-88ME-2-C	–40 to +100°C	RoHS	DDIP
DAC-88MM-2-C	–55 to +125°C	RoHS	DDIP
DAC-88-2-C/883	–55 to +125°C	RoHS	DDIP
DAC-88GC-2	0 to +70°C	Non-RoHS	SMT
DAC-88GE-2	–40 to +100°C	Non-RoHS	SMT
DAC-88GM-2	–55 to +125°C	Non-RoHS	SMT
DAC-88G-2/883	–55 to +125°C	Non-RoHS	SMT
DAC-88GC-2-C	0 to +70°C	RoHS	SMT
DAC-88GE-2-C	–40 to +100°C	RoHS	SMT
DAC-88GM-2-C	–55 to +125°C	RoHS	SMT
DAC-88G-2-C/883	–55 to +125°C	RoHS	SMT

The MIL-STD-883 units are available under DSCC/DLA Drawing Number 5962-9057001HXA (Solder Dipped) or 5962-9057001HXC. Contact DATEL for 883 product specifications

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