ANALOG DEVICES

High Performance Digital-to-Analog Converter

DAC1132

PRELIMINARY TECHNICAL DATA

FEATURES
- 12 Bit Resolution
- Input Register Included
- Small Module Package
- Programmable Output Ranges
- 0 to +70°C Monotonicity
- Low 8ppm/°C Gain TC
- 2μs Settling Time

GENERAL DESCRIPTION

The DAC1132 is a 12 bit, high performance digital-to-analog converter packaged in a very compact 2" x 2" x 0.4" module. It comes complete with an input storage register and a fast settling output amplifier which can be jumper programmed to produce either of five output voltage ranges. Performance specifications include 2μs settling time to 0.01%, 8ppm/°C gain temperature coefficient, ±½LSB linearity error, and monotonicity from 0 to +70°C.

The DAC1132 combines the AD562 integrated circuit D/A with a TTL input register, an output amplifier, and a precision reference source to form a complete converter package. The laser trimmed AD562 which consists of precision current switches, and a very stable thin film resistor network provides the DAC1132 with excellent performance over temperature and makes possible its small module size.

DIGITAL INPUT CHARACTERISTICS

The TTL/DTL compatible storage register contained within the DAC1132 accepts either Binary or Offset Binary coded inputs. Digital data appearing at the converter's 12 input terminals will be strobed into the register whenever a positive going transition is applied to the STROBE input (pin 6). With the STROBE input held at either logic "0" or logic "1", the input data may be changed without affecting either the contents of the register or the output of the converter. The transfer characteristics of the DAC1132 are such that a full scale digital input (111111111111) results in a positive full scale voltage output.

OUTPUT CHARACTERISTICS

The 12 binary-weighted current sources which form the basis of the digital-to-analog conversion process are directly controlled by the digital data stored in the input register. The combined output of these sources is applied to the internal op amp summing junction to produce a voltage output signal. By connecting jumpers between the proper module pins, various values of op amp feedback resistance and thus, output voltage ranges can be selected.

In order to produce bipolar outputs, the current input to the internal op amp is offset by ½ Full Scale. This offset current is generated by the precision internal reference source and is applied to the op amp summing junction by means of a jumper connected between appropriate module terminals.

Note: this data sheet includes "Preliminary Technical Data" describing a new product. Though highly unlikely, it may be necessary to alter the specifications to reflect life data collected during the initial months of the product's use.

Route 1 Industrial Park; P.O. Box 280; Norwood, Mass. 02062
Tel: 617/329-4700 TWX: 710/394-6577
West Coast Tel: 213/595-1783
Mid-West Tel: 312/297-8710

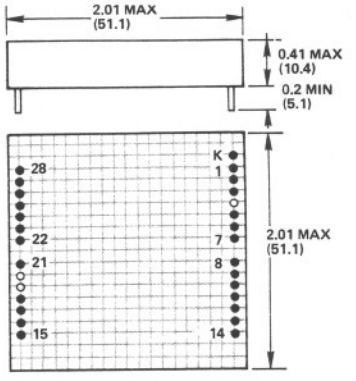
SPECIFICATIONS (typical @ +25°C and rated supply voltages, unless otherwise specified)

RESOLUTION	12 Bits
DIGITAL INPUTS	
Logic Levels	0V ≤ Logic "0" ≤ 0.8V +2V ≤ Logic "1" ≤ +5V
Data Input Load	1 Standard TTL Load/bit
Strobe Input Load	2 Standard TTL Loads
Strobe Pulse Width	20ns (Min)
Data Setup Time	20ns (Min)
Data Hold Time	5ns (Min)
INPUT CODES	
Unipolar	Binary
Bipolar	Offset Binary
OUTPUT RANGES	0 to +5V @ 10mA 0 to +10V @ 10mA ±2.5V @ 10mA ±5V @ 10mA ±10V @ 10mA
OUTPUT IMPEDANCE	0.02Ω
SETTLING TIME	2.0μs (3.0μs Max) to 0.01%[1]
LINEARITY ERROR	±½LSB
TEMPERATURE COEFFICIENT	
Gain[2]	±8.0ppm/°C (±10ppm/°C Max) of Reading
Unipolar Offset	±1.3μV/°C (±16μV/°C Max)
Bipolar Offset[2]	±2.6ppm/°C (±3.2ppm/°C Max)
Differential Nonlinearity	±2.8ppm/°C (±3.0ppm/°C Max) of Full Scale
Reference Voltage	±5ppm/°C (±12ppm/°C Max)
TEMPERATURE RANGE	
Operating	0 to +70°C
Storage	−55°C to +100°C
POWER REQUIREMENTS	+15V ±3% @ 32mA (37mA Max) −15V ±3% @ 27mA (30mA Max) +5V ±3% @ 140mA (150mA Max)
POWER SUPPLY SENSITIVITY[3]	
Gain	4mV/V (7mV/V Max)
Offset (unipolar)	4mV/V (7mV/V Max)
Offset (bipolar)	4mV/V (7mV/V Max)
Reference	2μV/V (5μV/V Max)
ADJUSTMENTS (User Provided)	
Gain	±8LSB (Min)
Offset	±10LSB (Min)
PRICE (1-9)	$159

[1] For a 10V step.
[2] These figures include the effects of Reference Voltage Temperature Drift.
[3] For ±15V supplies only with +15V and -15V supplies tracking.
Specifications subject to change without notice.

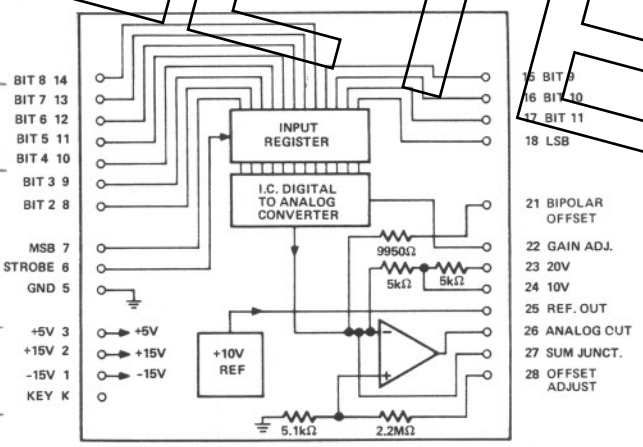
OUTLINE DIMENSIONS AND PIN DESIGNATIONS

Dimensions shown in inches and (mm).



NOTE:
Terminal pins installed only in shaded hole locations.
Module weight: 1.6 ounces (45 grams)
All pins are gold plated half-hard brass, (MIL-G-45204), 0.019" ±0.001" (0.483 ±0.025mm) dia.
For plug-in mounting card order Board No. AC1506 @ $30.

BLOCK DIAGRAM



DIGITAL INPUT DATA

All digital inputs to the DAC1132 are fully DTL/TTL compatible. The 12 data inputs (pins 7–18) each represent one standard TTL load and the STROBE (pin 6) represents two TTL loads. The converter uses Binary input code to produce unipolar outputs and Offset Binary code to produce bipolar outputs.

Provided that certain timing requirements are met, data appearing at the converter's input terminals is loaded into the register by the positive-going edge of the strobe pulse. Figure 1 illustrates the required strobe timing.

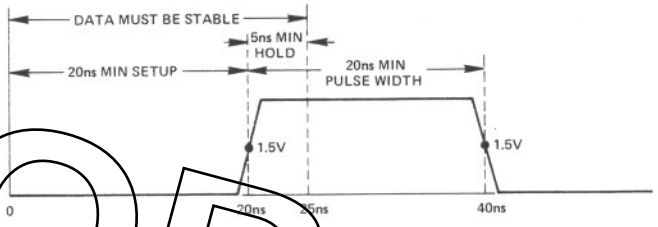


Figure 1. Strobe Timing Diagram

Note that the input data must be stable for at least 20ns before and 5ns after the pulse's leading edge. Note also that the strobe pulse must be a minimum of 20ns wide. In order to allow adequate time for the converter's analog output to settle between conversions, the strobe frequency should be limited to 500kHz.

OUTPUT CONNECTIONS

Figure 2, below, shows the output configuration of the DAC1132 in simplified form.

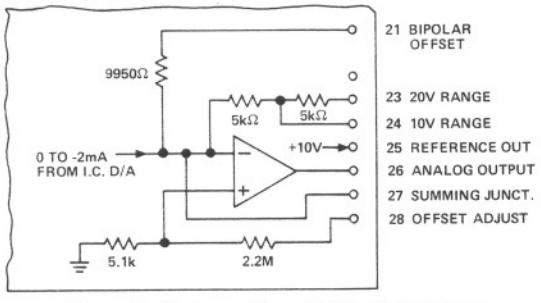


Figure 2. Output Circuit Block Diagram

External jumper connections determine whether the DAC1132 will be a unipolar or a bipolar device. Figures 3a and 3b below show the proper connections for both configurations.

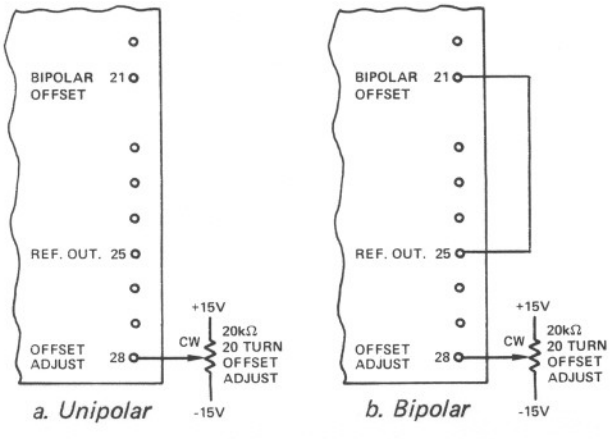


Figure 3. Unipolar/Bipolar Output Connection

The two 5kΩ feedback resistors associated with the op amp of Figure 2 are used to determine the output voltage range. Serial and parallel combinations of these resistors yield three different resistance values. Table 1 shows the feedback connections used to obtain the various output voltage ranges.

Output Range		Pins Jumpered Together	
Unipolar Units	Bipolar Units	Pin 26 To:	Pin 23 To:
±2.5V	0 to +5V	24	27
±5.0V	0 to +10V	24	--
±10V		23	--

Table 1. Range Programming Table

INPUT-OUTPUT RELATIONSHIPS

Table 2 and Table 3 list the analog outputs associated with various digital inputs for unipolar and bipolar units respectively.

DIGITAL INPUT	NOMINAL VOLTAGE OUTPUT	
	0 to +5V Range	0 to +10V Range
Binary Code		
111111111111	+4.9988V	+9.9976V
000000000001	+0.0012V	+0.0024V
000000000000	0.0000V	0.0000V

Table 2. Unipolar Input-Output Relationships

DIGITAL INPUT	NOMINAL VOLTAGE OUTPUT		
	±2.5V Range	±5V Range	±10V Range
Offset Binary Code			
111111111111	+2.4988V	+4.9976V	+9.9951V
100000000001	0.0012V	0.0024V	0.0048V
100000000000	0.0000V	0.0000V	0.0000V
000000000000	-2.5000V	-5.0000V	-10.0000V

Table 3. Bipolar Input-Output Relationships

GAIN, AND OFFSET ADJUSTMENTS

The gain and offset adjustments are made with two external potentiometers which the user supplies. With certain digital inputs applied, these potentiometers are adjusted until the desired output voltage is obtained. The voltmeter used to measure the output must be capable of clear and stable resolution of 1/10LSB in the region of zero and full scale. The adjustment procedure, described below, should be carefully followed to assure optimum converter performance.

The proper connection for the offset potentiometer was shown in Figures 3a and 3b. The gain potentiometer should be connected as shown below in Figure 4.

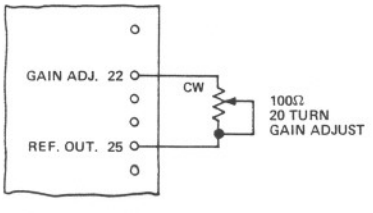


Figure 4. Gain Adjustment Connection

For unipolar units apply a digital input of 000000000000 and adjust the offset potentiometer until an output of 0V ±1/10LSB is obtained.

For bipolar units apply a digital input of 000000000000 and adjust the offset potentiometer until the negative full scale output shown in Table 3 is obtained within ±1/10LSB.

Once the appropriate offset adjustment has been made, apply a digital input of 111111111111. Adjust the gain potentiometer until the positive full scale output shown in Table 2 or Table 3 is obtained within ±1/10LSB.

POWER SUPPLY AND GROUNDING CONNECTIONS

The proper power supply and grounding connections are shown below in Figure 5.

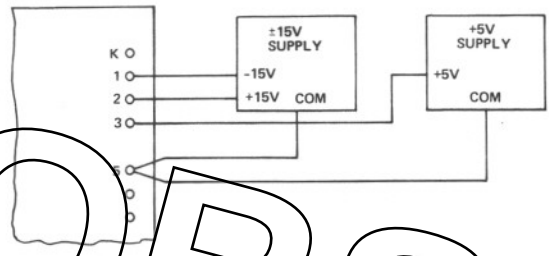


Figure 5. Power Supply and Grounding Connections

Capacitors have been added within the DAC1132 to bypass the ±15V and +5V power inputs. Under normal circumstances, no external bypass capacitors are needed.

REFERENCE OUTPUT

The +10V reference output (pin 25) is used to set the converter's gain as shown in Figure 4 and to provide the offset for bipolar devices as shown in Figure 3. It may also be used to provide a reference voltage for other circuits in the user's system provided that the output current is limited. No more than 1.5mA should be drawn from bipolar devices and no more than 2.5mA should be drawn from unipolar devices. Excessive current drain will degrade the converter's analog output and could damage the internal reference source.

THE AC1506 MOUNTING CARD

The AC1506 mounting card is available to assist in the application of the DAC1132. This 4.5″ x 3.0″ printed circuit card, shown below in Figure 6, has sockets which allow a DAC1132 to be plugged directly onto it. It includes the necessary gain, and offset adjustment potentiometers and it mates with a Cinch 250-22-30-170 (or equivalent) edge connector which is supplied with every card.

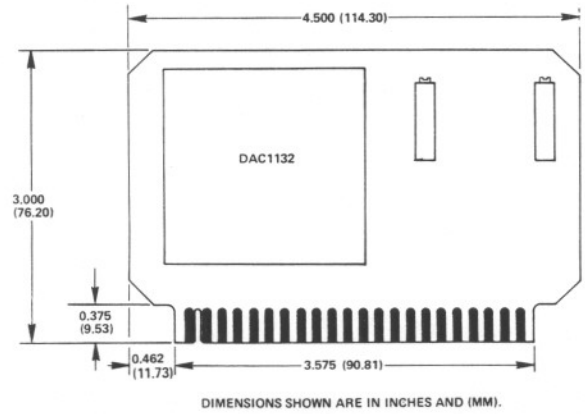
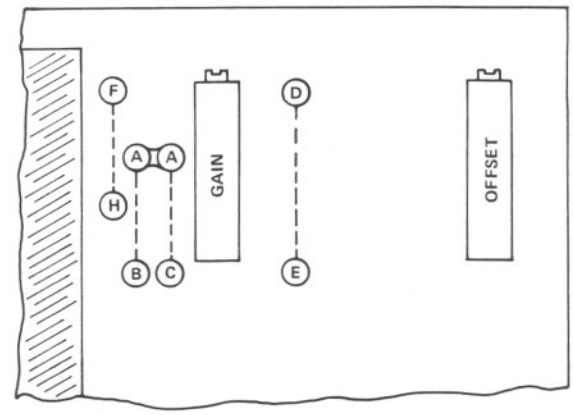


Figure 6. AC1506 Outline Drawing

The output voltage range is programmed by means of jumpers which the user installs as shown in Figure 7.



OUTPUT VOLTAGE RANGE	JUMPER CONNECTION
0 to +10V	A – C
0 to +5V	A – C, F – H
±2.5V	D – E, A – C, F – H
±5V	D – E, A – C
±10V	A – B, D – E

Figure 7. AC1506 Range Programming

The pin connections are as shown below in Table 4.

Pin	Designation	Pin	Designation
A	MSB	N	Bit 12
B	Bit 2	P	N.C.
C	Bit 3	R	N.C.
D	Bit 4	S	Ground
E	Bit 5	T	Ref. Out.
F	Bit 6	U	Analog Out.
H	Bit 7	V	Strobe
J	Bit 8	W	+5V
K	Bit 9	X	+15V
L	Bit 10	Y	-15V
M	Bit 11	Z	Ground

Table 4. AC1506 Pin Designations

C217–10–10/74

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