DAC-02306 AND DAC-02307

14 BIT LATCHED D/A CONVERTER
Fast Settling Times: 50 ns Current Output
350 ns Voltage Output

FEATURES

- **DAC-02306 HAS CURRENT OUTPUT: ±2mA**

- **DAC-02307 HAS VOLTAGE OUTPUT: ±2.5V, ±5V, AND ±10V AT 10mA**

- **TRANSPARENT INPUT LATCH**

- **WIDE OPERATING TEMPERATURE RANGE: −55°C TO +125°C**

- **MIL-STD-883 SCREENING AVAILABLE**
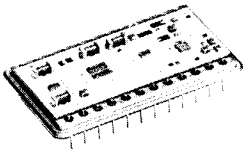
DESCRIPTION

The DAC-02306 and DAC-02307 family is one of the fastest D/A converters available. Both units offer transparent input latches. The voltage output device settles to within 1 LSB of final value for a full scale step change in 350 nsec. Settling time for the current output device is 50 ns.

The DAC-02307 offers pin programmable output voltages of ±2.5V, ±5V, or ±10V at 10mA and the DAC-02306 provides a ±2mA current output. Linearity is ±0.012% of full scale and gain accuracy is ±0.075% of full scale.

Both converters are calibrated with their own internal references, operate over a −55°C to +125°C temperature range, have trimmable gain and offset, and are available screened to MIL-STD-883.

Packaged in hermetically sealed 24 pin DDIPs, the DAC-02306 and DAC-02307 combine custom monolithic technology with thick and thin film fabrication techniques to provide both superior performance and high reliability.

With their small size and a high MTBF, DDC's DAC-02306 and DAC-02307 are exceptionally well-suited for high reliability military and industrial applications. These converters offer outstanding performance in aircraft or shipboard displays, computer interfaces, sonar systems, and automated processing plants.

DAC-02306
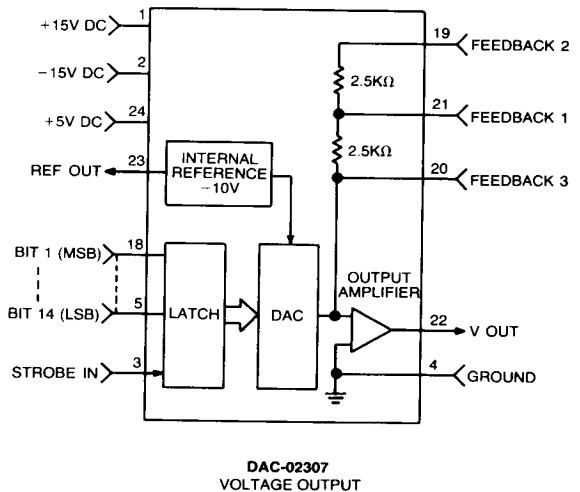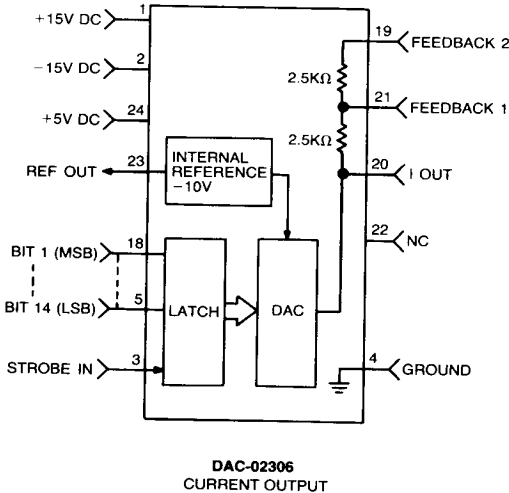CURRENT OUTPUT

DAC-02307
VOLTAGE OUTPUT

FIGURE 1. BLOCK DIAGRAM

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TABLE 1. DAC-02306 AND DAC-02307 SPECIFICATIONS
Typical valves at +25°C and nominal power supply voltages unless otherwise noted.

PARAMETER	UNITS	VALUE	
		13 BIT LIN	**12 BIT LIN**
RESOLUTION	Bits	14	14
ACCURACY			
Linearity Error	% FS range	±0.006 max	±0.012 max
Linearity Tempco	ppm/°C	0.5 max	1 max
Gain Error	% FS range	±0.075 max	±0.150 max
Gain Tempco	ppm/°C	±25 max	±25 max
Current Output (DAC-02306)			
Current Offset	μA	4.0 max	8.0 max
Current Offset Tempco	μA/°C	0.04	0.04
Voltage Output (DAC-02307)			
Voltage Offset	mV	5.0 max	10.0 max
Voltage Offset Tempco	μV/°C	100	100
Monotonicity	bits	13	12
DYNAMIC CHARACTERISTICS			
Settling Time to ±0.01% FSR (for F.S. Input Change)			
Current Output	ns	50 typ for RL ≤100 Ohms	
Voltage Output			
±2.5V Scale	ns	300 max	
±5V Scale	ns	350 max	
±10V Scale	ns	350 max	
Output Capacitance (Current Output)	pF	20	
DIGITAL INPUTS			
Logic Type		TTL Compatible, parallel positive logic.	
Coding		Complementary Offset Binary.	
Loading		1 Standard HCT Load	
V_{IH} (High Level Input Voltage)	V	2.0 min	
V_{IL} (Low Level Input Voltage)	V	0.8 max	

TABLE 1. DAC-02306 AND DAC-02307 SPECIFICATIONS (Cont.)
Typical valves at +25°C and nominal power supply voltages unless otherwise noted.

PARAMETER	UNITS	VALUE		
		13 BIT LIN	**12 BIT LIN**	
RESOLUTION	Bits	14	14	
REFERENCE				
Internal Reference				
Voltage	V	−10±1%		
Current	mA	±3 max		
OUTPUT				
Voltage Output				
Voltage Ranges (Pin Programmable)	V	DAC-02307 ±2.5, ±5, or ±10		
Current Output	mA	10 max		
DC Impedance	Ohms	0.1		
Current Output		DAC-02306		
Current Range	mA	±2		
Output Impedance	Ohms	830		
Compliance	V	−1 to +1		
POWER SUPPLIES				
Voltage	V	+15	−15	+5
Voltage Tolerances	%	±2	±2	±5
Max Voltage w/o Damage	V	+18 max	−18 max	+7 max
Current Drain				
DAC-02306	mA typ/max	30/40	20/25	1.5/2.5
DAC-02307	mA typ/max	65/85	55/65	1.5/2.5
TEMPERATURE RANGES				
Operating (Case)				
-3 Option	°C	0 to +70		
-1 Option	°C	−55 to +125		
Storage	°C	−65 to +150		
PHYSICAL CHARACTERISTICS				
Size (24 Pin DDIP)	in. (cm)	0.8 x 1.4 x 0.2		
		(2.0 x 3.6 x 0.5)		
Weight	oz (gm)	0.38 (10.8)		

TECHNICAL INFORMATION

INTRODUCTION

Figure 1 illustrates the block diagrams for the DAC-02306 and DAC-02307. On the DAC-02306, there is no connection to pin 22 and the current output connection is pin 20. These converters generate current or voltage outputs which are binary weighted fractions of the reference voltage. The gain and offset are factory trimmed to very tight tolerances so that external trimming is not required. The outputs are bipolar with complementary offset binary coding as listed in table 2.

DAC-02307 VOLTAGE OUTPUT CONNECTIONS

Output connections for all three output voltage ranges are listed in table 3. The feedback connection should be made as close to the load as possible to minimize the effects of line and contact impedance. Output drive capacity is ±10mA for all voltage ranges.

DAC-02306 CURRENT OUTPUT CONNECTIONS

The current output of the DAC-02306 is taken directly from pin 20. The feedback pins 19 and 21 may be left floating or may be used as feedback from an external amplifier. Pin 22 is left unconnected for current output.

TABLE 2. COMPLEMENTARY OFFSET BINARY

OUTPUT	DIGITAL BIT INPUTS													
	MSB													LSB
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
+F.S. −1 LSB	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+½ F.S.	0	0	1	1	1	1	1	1	1	1	1	1	1	1
+1 LSB	0	1	1	1	1	1	1	1	1	1	1	1	1	0
0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
−1 LSB	1	0	0	0	0	0	0	0	0	0	0	0	0	0
−½ F.S.	1	0	1	1	1	1	1	1	1	1	1	1	1	1
−F.S. +1 LSB	1	1	1	1	1	1	1	1	1	1	1	1	1	0
−F.S.	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 3. DAC-02307 FEEDBACK CONNECTIONS

VOLTAGE. RANGE	CONNECT V OUT (PIN 22) TO PIN	OTHER CONNECTIONS
±2.5V	21 (FB1)	19-20
±5V	21 (FB1)	—
±10V	19 (FB2)	—

INTERNAL REFERENCE

The DAC-02306 and DAC-02307 have an internal reference output and are factory calibrated with this internal reference. REF OUT is rated for ±3mA, max at −10V±1%.

LAYOUT PRECAUTIONS

To achieve the minimum noise performance available from the DAC-02306 and DAC-02307, high frequency layout considerations must be taken when laying out their printed circuit boards.

All analog conductor lengths must be kept to a minimum, and a large area ground plane must be used to keep ground impedance as low as possible. Digital inputs and analog output must be kept separated from each other to minimize crosstalk. Circuits connected to the analog output and any FEEDBACK pins must be kept as close as possible to the hybrid.

POWER SUPPLY DECOUPLING

Decoupling capacitors are recommended on each power supply for minimum noise operation. Each power supply should have a 1 uF or larger tantalum capacitor in parallel with a 0.01 uF ceramic capacitor. All capacitors must be mounted as close as possible to the hybrid package.

CODING

Offset binary coding for the DAC-02306 and DAC-02307 is illustrated by the bit weight in table 4. Values for full scale voltage (F.S.) and 1 LSB are given.

TABLE 4. OFFSET BINARY CODING		
RANGE	FULL SCALE	1 LSB
±2.5V	2.50000V	0.00031V
±5V	5.00000V	0.00061V
±10V	10.00000V	0.00122V
±2mA	2.00000mA	0.00024mA

TIMING

Upon application of a STROBE IN signal, the input registers are updated and DAC-02306 and DAC-02307 outputs settle to their new values. As shown in figure 2, the rising edge of STROBE IN latches the input date. Setup and hold times are also illustrated.

The input latches may be made transparent by keeping STROBE IN at a logic "1". Since STROBE IN has an internal pull-up resistor, it may be left unconnected for transparent latch operation.

EXTERNAL TRIMS

The gain and offset errors are trimmed at the factory to within the limits listed in the specifications table. With the optional trim adjustment circuits shown in Figures 3, 4 and 5, both errors can be trimmed to zero, making the overall accuracy equal to the linearity. The fixed resistors shown in Figures 3, 4 and 5 should be located close to the converter pins to reduce noise, and the potentiometers should have a tempco of 100 ppm/°C or less to minimize drift.

To trim the offset, apply the all zero's digital code. As shown in the bit table, Table 2, this corresponds to +F.S. −1 LSB for current and voltage output. Adjust the offset trim potentiometer for the proper current or voltage output value in each case.

After trimming the offset, apply the all one's code to trim the gain. This corresponds to −F.S. for current and voltage output. Adjust the output to this value with the gain potentiometer.

RELIABILITY

The use of custom monolithic technology, thick and thin film networks, as well as careful thermal design results in very high MTBF values. All DAC-02306 and DAC-02307 hybrids are built in accordance with MIL-STD-883.
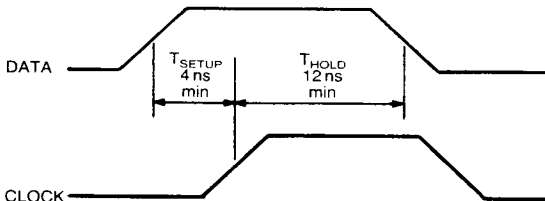

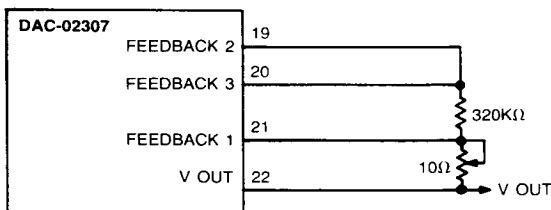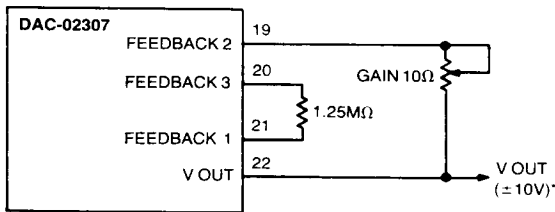FIGURE 2. SETUP AND HOLD TIMING

FIGURE 3. DAC-02307 GAIN ADJUST
CIRCUIT FOR ±2.5V OUTPUT

*For ±5V output, refer to table 3.

FIGURE 4. DAC-02307 GAIN ADJUST CIRCUIT
FOR ±5V AND ±10V OUTPUTS
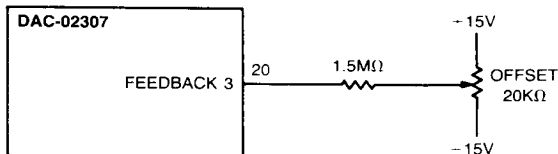
FIGURE 5. DAC-02307 OFFSET ADJUST CIRCUIT

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TABLE 5. DAC-02306 PIN FUNCTIONS	
PIN	FUNCTION
1	+15VDC Input
2	−15VDC Input
3	STROBE IN
4	Ground
5	Bit 14 (LSB)
6	Bit 13
7	Bit 12
8	Bit 11
9	Bit 10
10	Bit 9
11	Bit 8
12	Bit 7
13	Bit 6
14	Bit 5
15	Bit 4
16	Bit 3
17	Bit 2
18	Bit 1 (MSB)
19	FEEDBACK 2
20	I OUT
21	FEEDBACK 1
22	NC
23	REF OUT
24	+5VDC Input

TABLE 6. DAC-02307 PIN FUNCTIONS	
PIN	FUNCTION
1	+15VDC Input
2	−15VDC Input
3	STROBE IN
4	Ground
5	Bit 14 (LSB)
6	Bit 13
7	Bit 12
8	Bit 11
9	Bit 10
10	Bit 9
11	Bit 8
12	Bit 7
13	Bit 6
14	Bit 5
15	Bit 4
16	Bit 3
17	Bit 2
18	Bit 1 (MSB)
19	FEEDBACK 2
20	FEEDBACK 3
21	FEEDBACK 1
22	V OUT
23	REF OUT
24	+5VDC Input
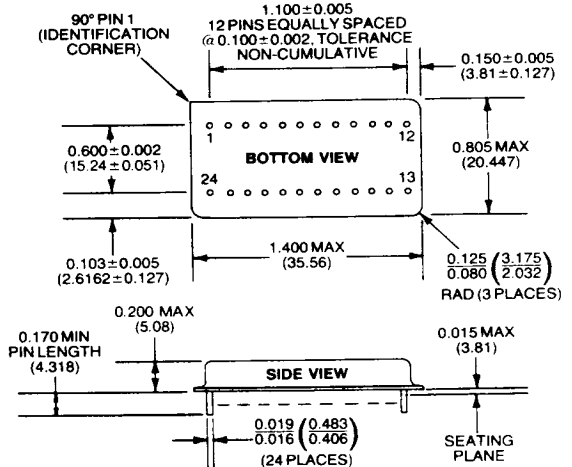
Notes:
(1.) Dimensions are shown in inches (millimeters).
(2.) Lead identification numbers are for reference only.
(3.) Lead spacing dimensions apply only at seating plane.
(4.) Pin material meets solderability requirements of MIL-STD-202E, Method 208C.
(5.) Case tied to analog ground.

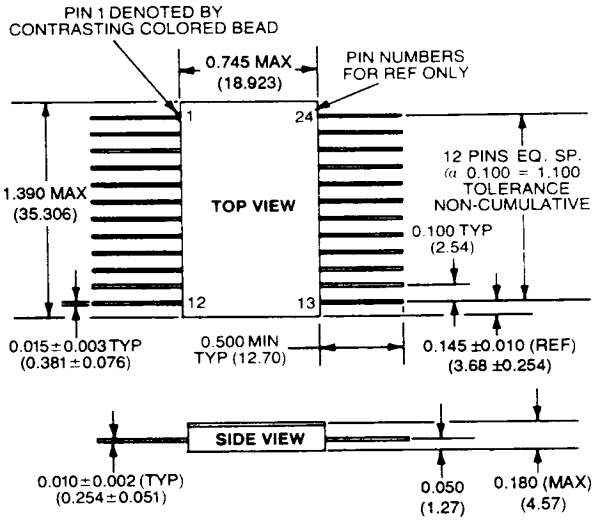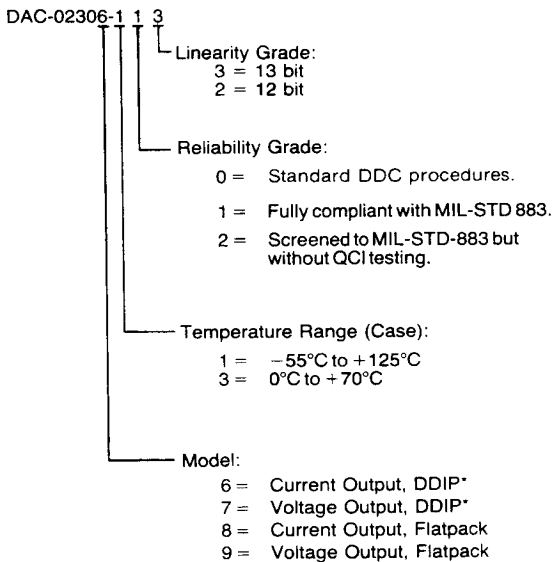**FIGURE 6. DAC-02306/DAC-02307 MECHANICAL OUTLINE**

ORDERING INFORMATION

DAC-02306-1 1 3

Linearity Grade:
3 = 13 bit
2 = 12 bit

Reliability Grade:
0 = Standard DDC procedures.
1 = Fully compliant with MIL-STD 883.
2 = Screened to MIL-STD-883 but without QCI testing.

Temperature Range (Case):
1 = −55°C to +125°C
3 = 0°C to +70°C

Model:
6 = Current Output, DDIP*
7 = Voltage Output, DDIP*
8 = Current Output, Flatpack
9 = Voltage Output, Flatpack

**Socket: Augat 324-AG2D or equivalent

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FIGURE 7. DAC-02308/DAC-02309 MECHANICAL OUTLINE