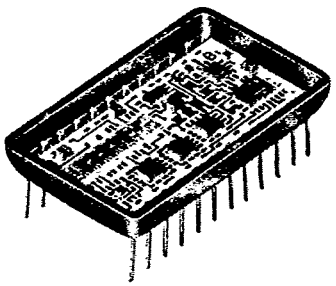
DDC
ILC DATA DEVICE CORPORATION

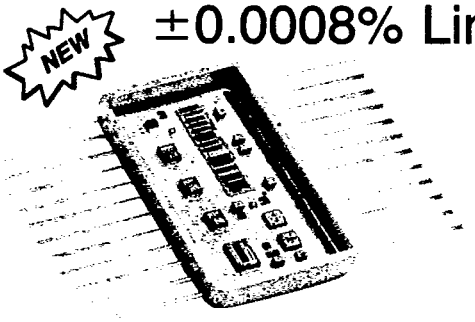
DAC-02900 AND DAC-02901

T-51-09-16

16 BIT D/A CONVERTER
±0.0008% Linearity; Voltage Output



DAC-02900



DAC-02901

DESCRIPTION

The DAC-02900 is a 16 bit 15 microsecond hybrid D/A converter with a 10 volt full scale output range. Packaged in either a small hermetic 24 pin DDIP or 24 pin flatpack, it operates over the −55°C to +125°C temperature range and is available screened to MIL-STD-883. DAC-02900 has a precision internal reference and is available in linearity grades of 16 bit (±0.0008%), 15 bit (±0.0015%) and 14 bit (±0.003%). It is a pin-for-pin replacement for DAC-HP16 and DAC72 types with increased linearity performance.

With its 16 bit linearity, broad operating temperature range, and small hermetic package, the DAC-02900 is ideal for the most demanding military and industrial requirements. It is particularly well suited for audio reconstruction, waveform generation, and precision test equipment applications.

FEATURES

- *±0.0008% FSR LINEARITY AVAILABLE*
- *10 V FULL SCALE VOLTAGE OUTPUT*
- *+6.2 V PRECISION INTERNAL REFERENCE*
- *−55°C TO +125° TEMPERATURE RANGE*
- *SMALL HERMETIC 24 PIN DDIP OR FLATPACK PACKAGE*
- *PIN FOR PIN REPLACES DAC-HP16 AND DAC72 TYPES WITH INCREASED LINEARITY*

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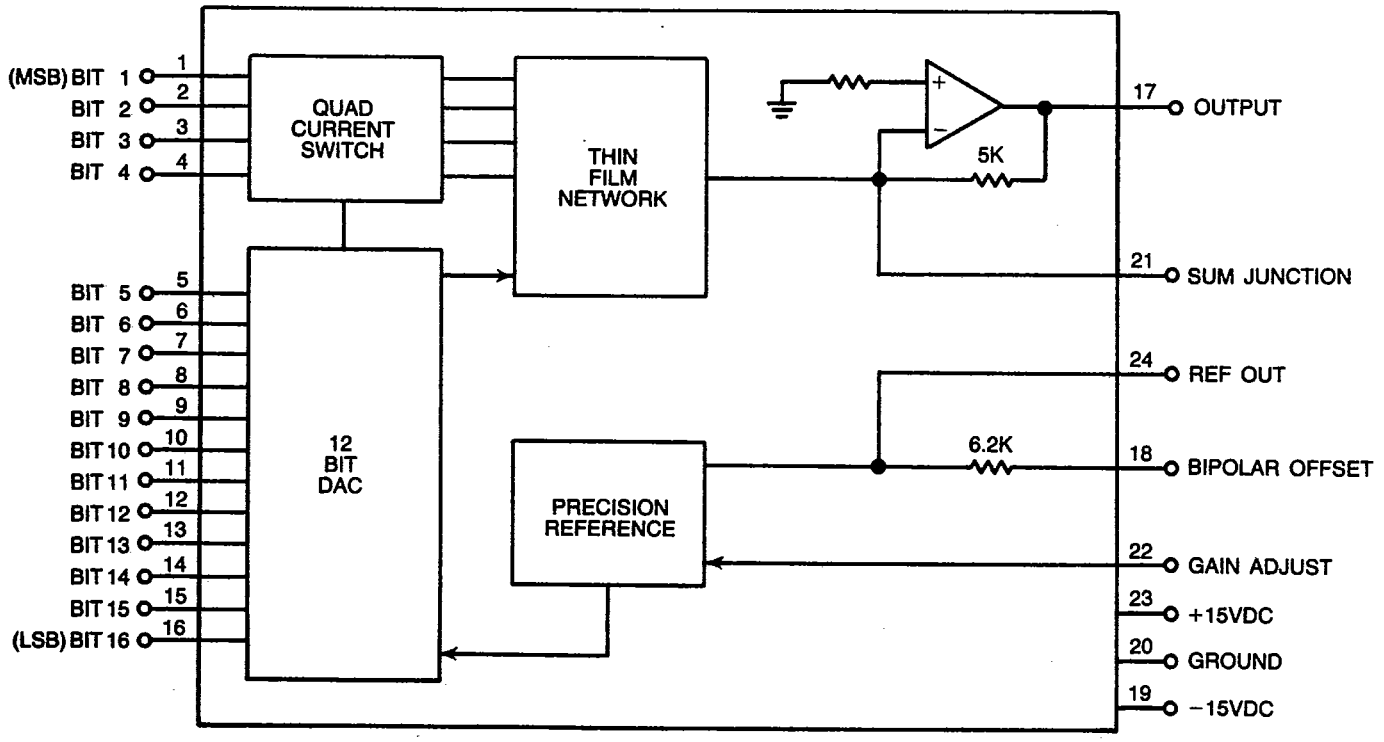

FIGURE 1. DAC-02900 AND DAC-02901 BLOCK DIAGRAM

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DAC-02900 AND DAC-02901

T-51-09-16

TABLE 1. DAC-02900 AND DAC-02901 SPECIFICATIONS
Typical values at 25°C and nominal power supply voltages unless otherwise noted.

PARAMETER	UNITS	VALUE		
		14 BIT LIN	15 BIT LIN	16 BIT LIN
RESOLUTION	Bits	16	16	16
ACCURACY				
Linearity Error	%FSR	±0.003 max	±0.0015 max	±0.0008 max
Linearity Tempco	ppm/°C	0.5 max	0.5 max	0.5 max
Gain Error(1)	%FSR	0.1	0.1	0.1
Gain Tempco	ppm/°C	15 max	10 max	10 max
Zero Error (Unipolar)(1)	%FSR	0.1	0.1	0.1
Zero Tempco (Unipolar)	ppm/°C	4 max	4 max	4 max
Offset Tempco (Bipolar)	ppm/°C	6 max	6 max	6 max
Monotonicity (+10°C to +40°C	bits	14	15	16
DYNAMIC CHARACTERISTICS				
Settling Time to ±0.005% FSR for 10V step	µs	15 max		
to ±0.01% FSR for LSB step	ns	200 typ, 1000 max		
DIGITAL INPUTS				
Logic Compatibility		TTL and 5V CMOS		
Voltage Input Logic "1"	V	+2.4 to +5.5		
Logic "0"	V	0 to +0.8		
Current Load Logic "1"	µA	+40		
Logic "0"	µA	−400		
Coding Unipolar		Complementary Binary		
Bipolar		Complementary Offset Binary		
REFERENCE				
Output Voltage	V	+6.2 typ, ±5%		
Output Impedance	ohms	0.2		
Output Current	µA	±3 max		

TABLE 1. DAC-02900 AND DAC-02901 SPECIFICATIONS (Cont.)
Typical values at 25°C and nominal power supply voltages unless otherwise noted.

PARAMETER	UNITS	VALUE	
ANALOG OUTPUT			
Voltage – Unipolar	V	0 to +10	
Voltage – Bipolar	V	±5	
Current	mA	±5 min	
Impedance	ohms	0.1 max	
Noise(2)	µVrms	20	
POWER SUPPLIES			
Voltage	V	+15	−15
Tolerance	%	±5	±5
Max Voltage w/o Damage	V	+18	−18
Current Drain	mA	35 typ 42 max	20 typ 30 max
PS Rejection Ratio	%FSR	±0.001	±0.001
TEMPERATURE RANGE			
Operating (Case)			
-1 Option	°C	−55 to +125	
-2 Option	°C	−25 to +85	
Storage	°C	−65 to +150	
PHYSICAL CHARACTERISTICS			
Size			
24 Pin DDIP	in. (mm)	1.275 x 0.775 x 0.165 (32.385 x 19.685 x 4.19)	
24 Pin Flatpack	in. (mm)	1.275 x 0.775 x 0.175 (32.385 x 19.685 x 4.45)	
Weight			
DDIP	oz (gm)	0.4 (11.3)	
Flatpack	oz (gm)	0.4 (11.3)	

Notes:
(1) Gain and Offset errors are trimmable to zero.
(2) Noise specified for DC to 100 KHz bandwidth.

GENERAL

The DAC-02900 is a 16 bit, 15µs digital-to-analog converter. As shown in the block diagram of figure 1, it contains a quad current switch, 12 bit DAC, precision DC reference, output amplifier, and a thin film resistive network. It is a pin-for-pin replacement for the DAC-HP16 and DAC72 with increased linearity performance.

OUTPUT VOLTAGE PROGRAMMING

For bipolar operation, jumper connect pin 18 (BIPOLAR OFFSET) to pin 21 (SUM JUNCTION). This effectively shifts the normal output by −5VDC. Jumpers are not required for unipolar operation.

INTERNAL REFERENCE

The precision 6.2V internal reference is available for external use for bipolar offset capability. The reference is rated at ±3µA, max current load.

APPLICATIONS

The DAC-02900 is ideal for the most demanding military and industrial requirements. It is especially well suited for audio reconstruction, low and medium frequency waveform generation, precision test equipment, data acquisition, and high resolution display applications.

LOGIC CODING

The DAC-02900 uses Complementary Binary Coding in Unipolar output mode and a complementary offset binary coding in the Bipolar output mode. Table 2 lists the output voltages as a function of input data in Bipolar and Unipolar modes.

TABLE 2. INPUT DATA CODING

INPUT DATA	OUTPUT VOLTAGE	
	BIPOLAR	UNIPOLAR
00 0000 0000 000000	+4.99985	9.99985
01 1111 1111 111111	0.00000	5.00000
10 0000 0000 000000	−0.00015	4.99985
11 1111 1111 111111	−5.0000	0

EXTERNAL TRIMS

Factory adjustment of the DAC-02900 offset and gain errors result in performance that is adequate for most applications. For more critical applications, the DAC-02900 provides pins for externally trimming offset and gain errors to zero. Figure 2 illustrates trim pot values and circuit connections for external trims.

LAYOUT PRECAUTIONS

To achieve the minimum noise performance available from the DAC-02900, high accuracy layout considerations must be taken when designing its printed circuit board.

For a 16 bit converter with a +10V full scale range, 1 LSB is 153 μV. With a load current of 5mA, series wiring and connector resistance of only 0.030 ohms will cause the output to be in error of 1 LSB. To understand what this means in terms of a system layout, the resistance of #23 wire is about 0.021 ohms/ft. Neglecting contact resistance, less than 18 inches of wire will produce a 1 LSB of error in the analog output voltage. Consequently, all connector lengths must be kept to a minimum.

In particular, circuits connected to the analog output must be kept as close to the DAC-02900 hybrid package as possible. Furthermore, circuit connections to the external adjustment pins must be kept as short as possible, and must be kept separated from digital lines to minimize noise coupling. Finally, digital inputs and analog outputs must be kept separated from each other to minimize crosstalk.

POWER SUPPLY DECOUPLING

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

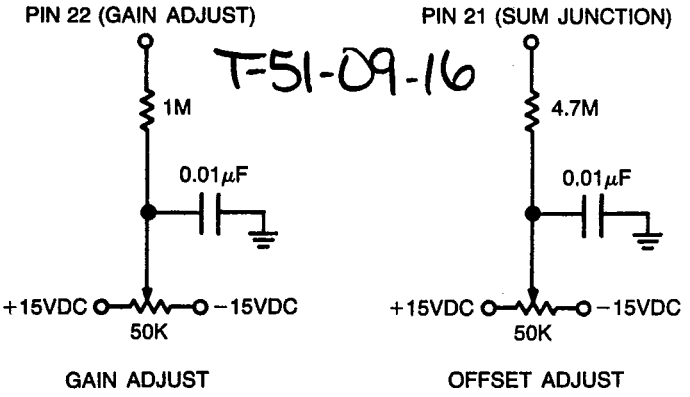

FIGURE 2. DAC-02900 EXTERNAL TRIMS

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GROUNDING

A large area ground plane may be used to keep ground impedances as low as possible. Again, the nature of the high accuracy system requires special considerations to eliminate potential sources of error.

DIGITAL CONSIDERATIONS

External latches may be used to minimize digital feedthrough and data skew effects. An example is shown in figure 3 where a rank of 54LS273's serve as separate latched buffers. Low power Schottky logic is recommended when external latches are used because of the uniform nature of the propagation delays between the rising and falling signal. This is not usually the case with other logic (or standard Schottky) devices. The latches should be as close to the DAC as possible and DAC input lines should be of equal length.

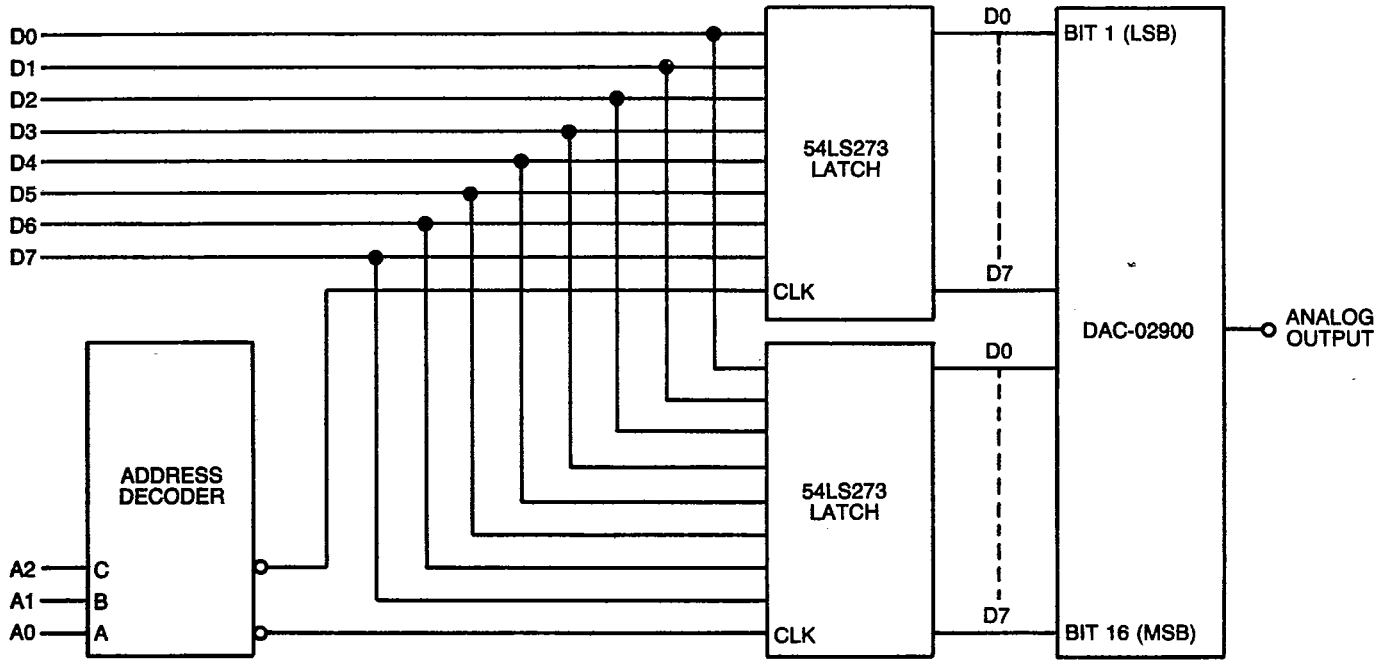

FIGURE 3. EXTERNAL LATCHES

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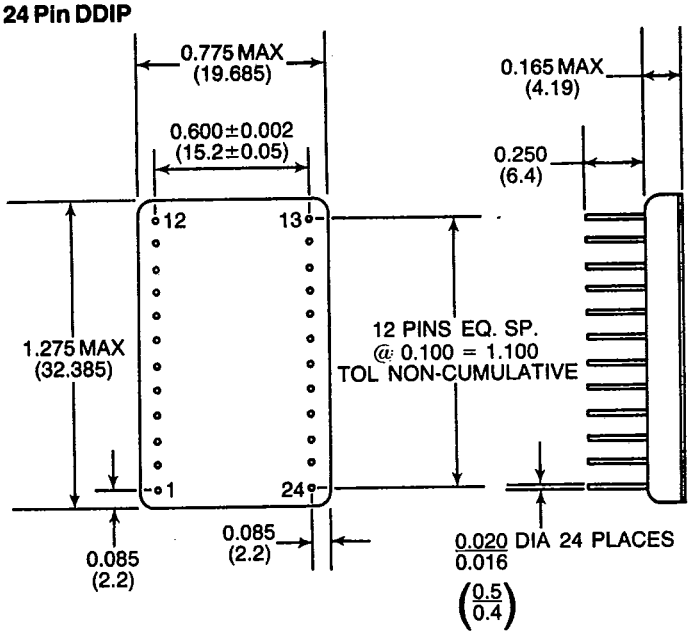
TABLE 3. DAC-02900 AND DAC-02901 PIN FUNCTIONS			
PIN	FUNCTION	PIN	FUNCTION
1	BIT 1 (MSB)	13	BIT 13
2	BIT 2	14	BIT 14
3	BIT 3	15	BIT 15
4	BIT 4	16	BIT 16 (LSB)
5	BIT 5	17	OUTPUT
6	BIT 6	18	BIPOLAR OFFSET
7	BIT 7	19	−15VDC
8	BIT 8	20	GROUND
9	BIT 9	21	SUM JUNCTION
10	BIT 10	22	GAIN ADJUST
11	BIT 11	23	+15VDC
12	BIT 12	24	REF OUT

ORDERING INFORMATION

DAC-02900-1 0 6

- Linearity Grade:
  - 6 = 16 bit
  - 5 = 15 bit
  - 4 = 14 bit
- Reliability Grade:
  - 0 = Standard DDC procedures.
  - 1 = Fully compliant with MIL-STD 883.
  - 2 = Screened to MIL-STD-883 but without QCI testing.
- Operating Temperature Range (Case):
  - 1 = −55°C to +125°C
  - 2 = −25°C to +85°C
- Packaging:
  - 0 = 24 Pin DDIP
  - 1 = 24 Pin Flatpack

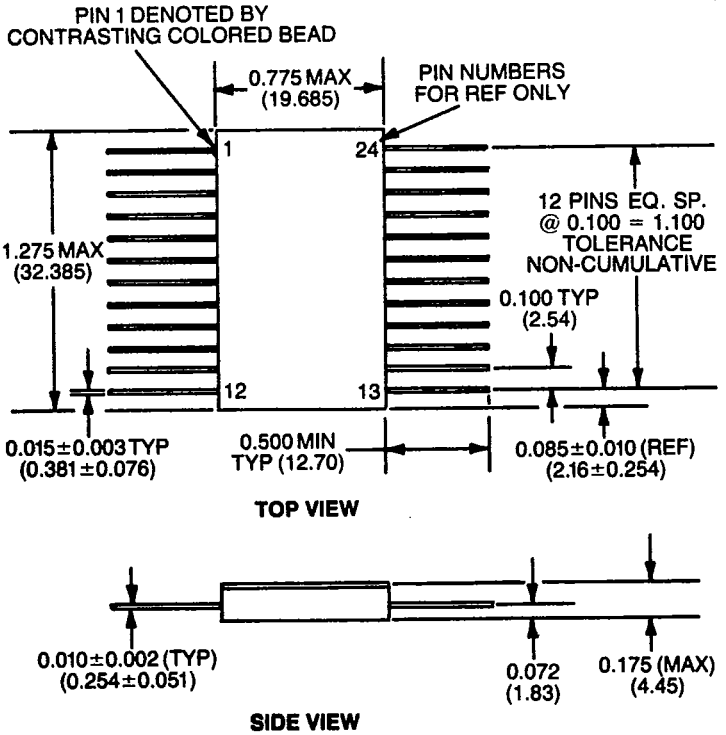
DAC-02900
24 Pin DDIP



BOTTOM VIEW SIDE VIEW

Notes:
1. Dimensions shown are in inches (millimeters).
2. Lead identification numbers are for reference only.
3. Lead spacing dimensions apply at seating plane.
4. Pin material meets solderability requirements of MIL-STD-202E, Method 208C.

DAC-02901
24 Pin Flatpack



TOP VIEW

SIDE VIEW

FIGURE 4. MECHANICAL OUTLINES

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