FERRANTI semiconductors®

ZN426 Series

8 Bit Monolithic D to A Converter

FEATURES

- 8, 7 and 6-bit Accuracy
- ZN426E Series Commercial Temp. Range 0°C to +70°C
- ZN426J-8 Military Temp. Range −55°C to +125°C
- TTL and 5V CMOS Compatible
- Single +5V Supply
- Settling Time 1 μsec. Typical
- Only Reference Capacitor and Resistor required

DESCRIPTION

The ZN426 is a monolithic 8-bit digital to analogue converter containing an R-2R ladder network of diffused resistors with precision bipolar switches and a 2.5V precision voltage reference.

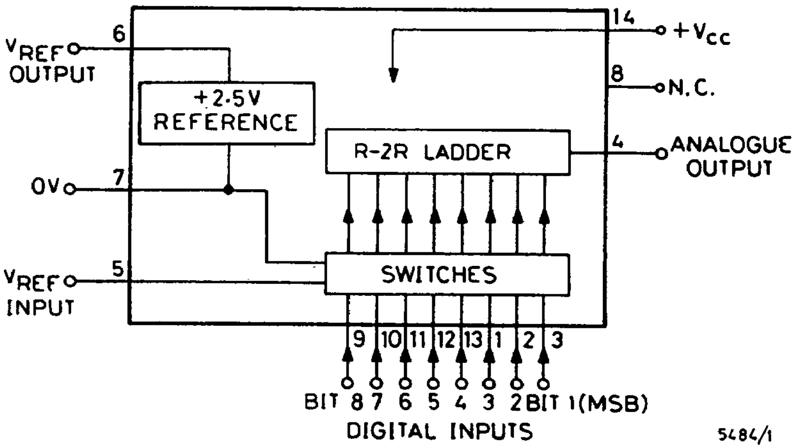

Fig. 1. System Diagram

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INTRODUCTION

The ZN426 is an 8-bit digital to analogue converter. It contains an advanced design of R-2R ladder network and an array of precision bipolar switches plus a 2.5 volt precision voltage reference all on a single monolithic chip.

The special design of ladder network results in full 8-bit accuracy using normal diffused resistors.

The use of the on-chip reference voltage is pin optional to retain flexibility. An external fixed or varying reference may therefore be substituted. In this case there is no need to supply power to the internal reference so R_{REF} and C_{REF} can be omitted.

The converter is of the voltage switching type and uses an R-2R resistor ladder network as shown in Fig. 2.

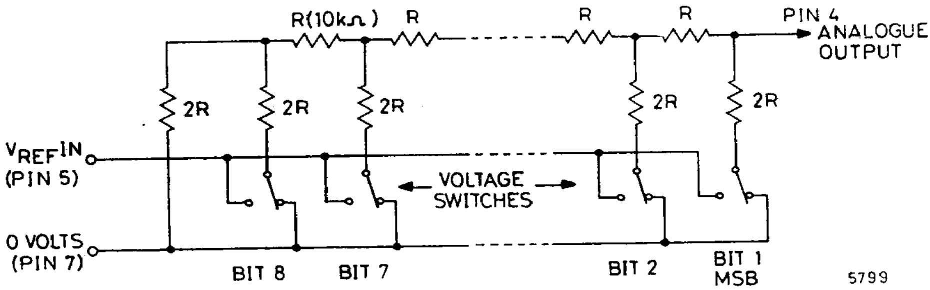

Fig. 2. The R-2R Ladder Network

Each 2R element is connected either to 0V or V_{REF} by transistor switches specially designed for low offset voltage (typically 1 millivolt).

Binary weighted voltages are produced at the output of the R-2R ladder. the value depending on the digital number applied to the bit inputs.

ORDERING INFORMATION

Operating Temperature	8-bit accuracy	7-bit accuracy	6-bit accuracy	Package
0 to +70°C	ZN426E-8	ZN426E-7	ZN426E-6	Plastic
–55 to +125°C	ZN426J-8	—	—	Ceramic

ABSOLUTE MAXIMUM RATINGS

Supply voltage V_{CC} .. .. +7.0 volts
Max. voltage, logic and V_{REF} inputs .. .. +5.5 volts
Storage temperature range .. .. –55 to +125°C

ELECTRICAL CHARACTERISTICS (V_{CC} = +5 volts, T_{amb} = 25°C unless otherwise specified).

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Converter Resolution		8	—	—	bits	
Accuracy (useful resolution) ZN426J-8 ZN426E-8 ZN426E-7 ZN426E-6		8 7 6	— — —	— — —	bits bits bits	V_{REF} input = 2.0 to 3.0 volts
Non-linearity		—	—	±0.5	L.S.B.	*Note 1*
Differential non-linearity		—	±0.5	—	L.S.B.	*Note 2*
Settling time to 0.5 L.S.B.		—	1.0	—	µs	1 L.S.B. step
Settling time to 0.5 L.S.B.		—	2.0	—	µs	All bits ON to OFF or OFF to ON
Offset voltage ZN426J-8 ZN426E-8 ZN426E-7 ZN426E-6	V_{OS}	— —	5.0 3.0	8.0 5.0	mV mV	All bits OFF *Note 1*
V_{OS} temperature coefficient		—	5	—	µV/°C	
Full scale output		2.545	2.550	2.555	volts	All bits ON Ext. V_{REF} = 2.560V
Full scale temp. coefficient		—	3	—	ppm/°C	Ext. V_{REF} = 2.560V
Non-linearity temp. coeff.		—	7.5	—	ppm/°C	Relative to F.S.R.

Notes:

1. The ZN426J-8 differs from the ZN426E-8 in the following respects:
   (a) For the ZN426J-8, the maximum linearity error may increase to ±0.4% FSR i.e. ±1 LSB over the temperature ranges −55°C to 0°C and +70°C to +125°C.
   (b) Offset voltage. The difference is due to package lead resistance. This offset will normally be removed by the setting up procedure, and because the offset temperature coefficient is low, the specified accuracy will be maintained.
2. Monotonic over full temperature range at resolution appropriate to accuracy.

ELECTRICAL CHARACTERISTICS *(continued)*

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Analogue output resistance	R_o	—	10	—	kΩ	
External reference voltage		0	—	3.0	volts	
Supply voltage	V_{CC}	4.5	—	5.5	Volts	
Supply current	I_s	—	5	9	mA	
High level input voltage	V_{IH}	2.0	—	—	volts	
Low level input voltage	V_{IL}	—	—	0.7	volts	
High level input current	I_{IH}	—	—	10	μA	V_{CC} = max., V_I = 2.4V
		—	—	100	μA	V_{CC} = max., V_I = 5.5V
Low level input current	I_{IL}	—	—	–0.18	mA	V_{CC} = max., V_I = 0.3V
Internal Voltage Reference Output voltage	V_{REF}	2.475	2.55	2.625	volts	*Note** R_{REF} = 390Ω
Slope resistance	R_s	—	1	2	ohms	R_{REF} = 390Ω
V_{REF} temperature coefficient		—	40	—	ppm/°C	R_{REF} = 390Ω

*Note** The internal reference requires a 1 μF stabilising capacitor between pins 7 and 6 (C_{REF}) and a 390Ω resistor between pins 14 and 6 (R_{REF}).

APPLICATIONS

1. 8-bit D to A Converter

The ZN426 gives an analogue voltage output directly from pin 4 therefore the usual current to voltage converting amplifier is not required. The output voltage drift, due to the temperature coefficient of the Analogue Output Resistance R_o, will be less than 0.004% per °C (or 1 L.S.B./100°C) if R_L is chosen to be ⩾650 kΩ

In order to remove the offset voltage and to calibrate the converter a buffer amplifier is necessary. Fig. 3 shows a typical scheme using the internal reference voltage. To minimise temperature drift in this and similar applications the source resistance to the inverting input of the operational amplifier should be approximately 6 kΩ. The calibration procedure is as follows:

i. Set all bits to OFF (low) and adjust R_2 until V_{out} = 0.000V.

ii. Set all bits to ON (high) and adjust R_1 until V_{out} = Nominal full scale reading –1 L.S.B.

iii. Repeat *i.* and *ii.*

e.g. Set F.S.R. to +3·840 volts – 1 L.S.B. = 3·825 volts

$$(1\ \text{L.S.B.} = \frac{3\cdot84}{256} = 15.0\ \text{millivolts.})$$

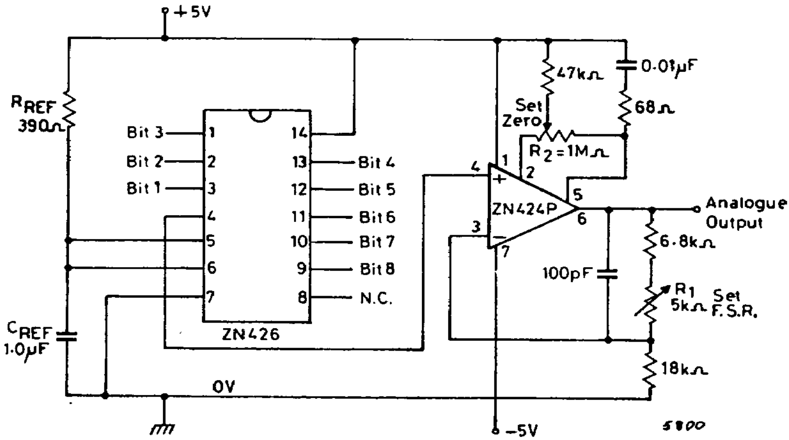

Fig. 3. 8-bit Digital to Analogue Converter

Alternative Output Buffer using the ZLD741

The following circuit, employing the ZLD741 operational amplifier, may be used as the output buffer (Fig. 3).

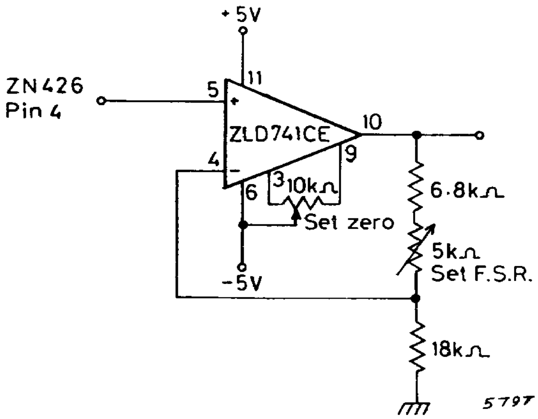

Fig. 4. The ZLD741 as Output Buffer

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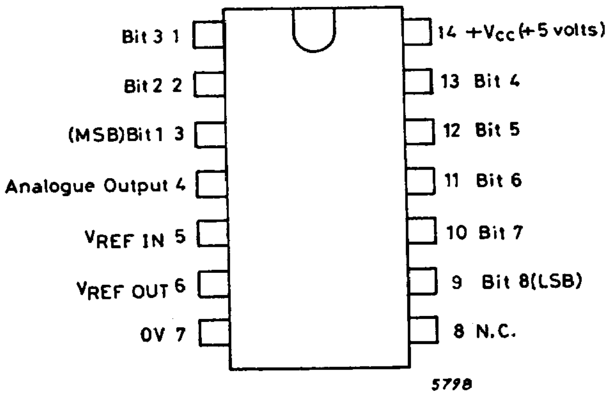
PIN CONNECTIONS



CHIP DIMENSIONS AND LAYOUT