PLESSEY
Semiconductors

T-51-09-08

ZN426E-8/ZN426J-8/ZN426D

8-BIT D-A CONVERTER

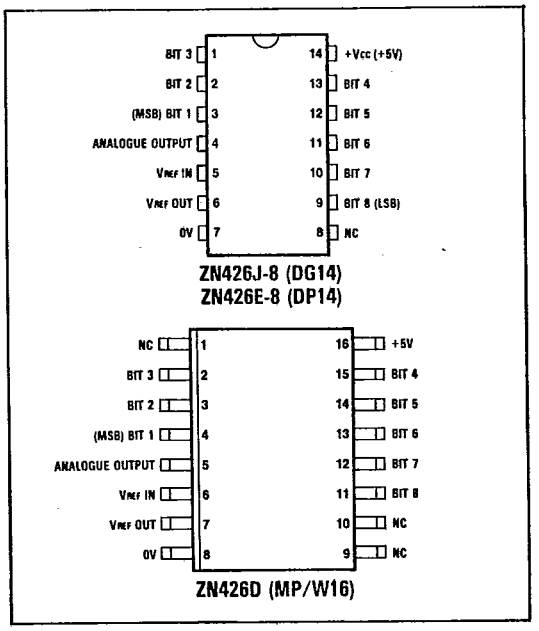
The ZN426 is a monolithic 8-bit D-A converter containing an R-2R ladder network of diffused resistors with precision bipolar switches and a 2.5V precision voltage reference.

FEATURES

- ±½ LSB Linearity Error
- Guaranteed Monotonic over the Full Operating Temperature Range
- 0°C to +70°C (ZN426E-8, ZN426D)
- -55°C to +125°C (ZN426J-8)
- TTL and 5V CMOS Compatible
- Single +5V Supply
- Settling Time 1 microsecond Typical
- Only Reference Capacitor and Resistor Required

ORDERING INFORMATION

Device type	Operating temperature	Package
ZN426D	0°C to +70°C	MP16W
ZN426E-8	0°C to +70°C	DP14
ZN426J-8	-55°C to +125°C	DG14



Pin connections - top view

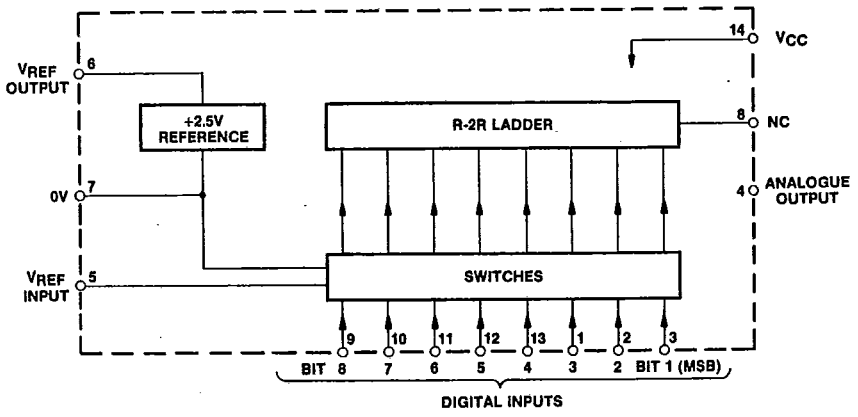


Fig.1 System diagram

INTRODUCTION

The ZN426 is an 8-bit D-A converter. It contains an advanced design of R-2R ladder network and an array of precision bipolar switches plus a 2.5V 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.

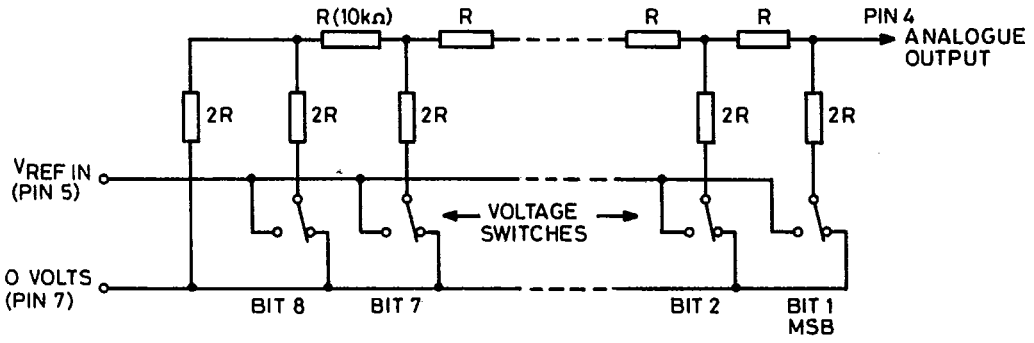


Fig. 2 The R-2R ladder network

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

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.

ABSOLUTE MAXIMUM RATINGS

Supply voltage, V_{CC}	+7.0V
Max. voltage, logic and V_{REF} inputs	+5.5V
Operating temperature range	0°C to 70°C (ZN426E-8, ZN426D) -55°C to +125°C (ZN426J-8)
Storage temperature range	-55°C to +125°C

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

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Converter Resolution		8	–	–	bits	
Non-linearity		–	–	±0.5	LSB	Note 1
Differential non-linearity		–	±0.5	–	LSB	Note 2
Settling time to 0.5LSB		–	1.0	–	μs	1LSB step
Settling time to 0.5LSB		–	2.0	–	μs	All bits ON to OFF or OFF to ON
Offset voltage ZN426J-8	V_{OS}	–	5.0	8.0	mV	All bits OFF Note 1
ZN426E-8 and ZN426D		–	3.0	5.0	mV	
V_{OS} temperature coefficient		–	5	–	μV/°C	
Full-scale output		2.545	2.550	2.555	V	All bits ON Ext. V_{REF} = 2.560V
Full-scale temp. coefficient		–	3	–	ppm/°C	Ext. V_{REF} = 2.560V
Non-linearity temp. coefficient		–	7.5	–	ppm/°C	Relative to F.S.R.

Notes
1. The ZN426J-8 differs from the ZN426E-8 and ZN426D 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.

ELECTRICAL CHARACTERISTICS (cont.)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Analogue output resistance	R_o	–	10	–	kΩ	
External reference voltage		0	–	3.0	V	
Supply voltage	V_{CC}	4.5	–	5.5	V	
Supply current	I_s	–	5	9	mA	
High level input voltage	V_{IH}	2.0	–	–	V	
Low level input voltage	V_{IL}	–	–	0.7	V	
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	2.626	V	Note* R_{REF} = 390Ω
Slope resistance	R_s	–	1	2	Ω	R_{REF} = 390Ω
V_{REF} temperature coefficient		–	40	–	ppm/°C	R_{REF} = 390Ω

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

APPLICATIONS

8-bit D-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 1LSB/100°C) if R_L is chosen to be ⩾650kΩ.

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 6kΩ. 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 - 1LSB.

iii. Repeat i. and ii.

e.g.

Set F.S.R. to +3.840V − 1LSB = 3.825V

$$(1LSB = \frac{3.84}{256} = 15.0mV)$$

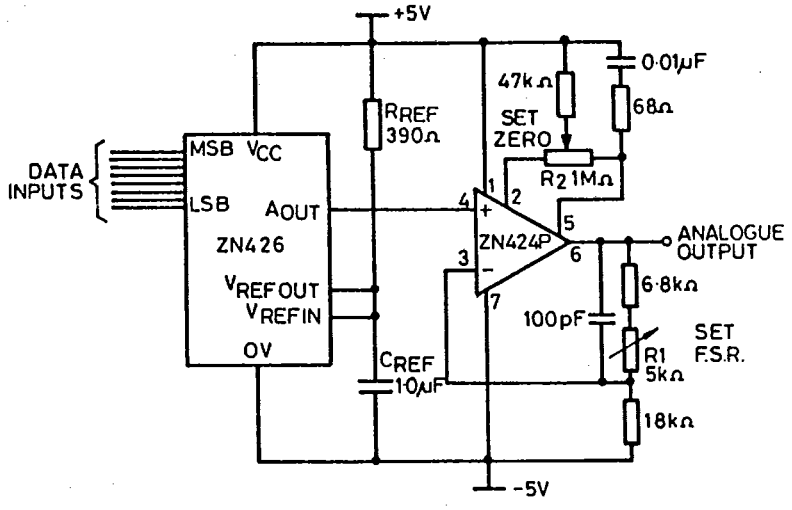


Fig. 3 8-bit D-A converter

Alternative output buffer using the 741

The circuit of Fig.4, employing the 741 operational amplifier, may be used as the output buffer.

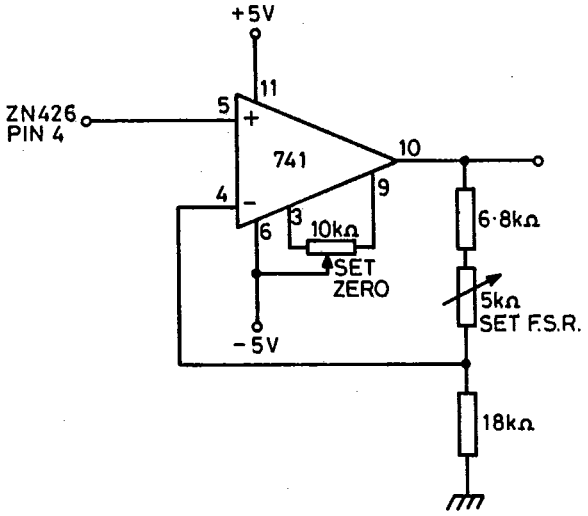


Fig.4 The 741 as output buffer