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MAY 1994

DS3021-2.2

ZN426E8

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

- ±1/2 LSB Linearity Error
- Guaranteed Monolithic over the Full Operating Temperature Range
- 0°C to +70°C
- TTL and 5V CMOS Compatible
- Single 5V Supply
- Settling Time 1 microsecond Typical
- Only Reference Capacitor and Resistor Required

ABSOLUTE MAXIMUM RATINGS

Supply voltage +7.0V
Max.voltage, logic and V_{REF} inputs+5.5V
Operating temperature range0°C to +70°C
Storage temperature range-55°C to +125°C

ORDERING INFORMATION

Ambient operating temperature 0°C to +70°C
Package, ZN426E8DP14

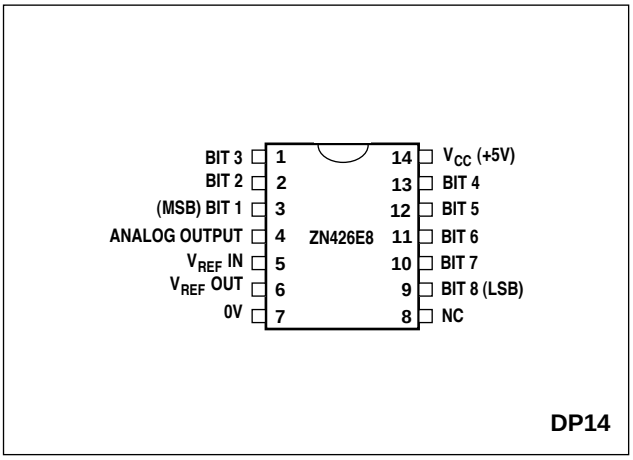

Fig.1 Pin connections (not to scale) - top view

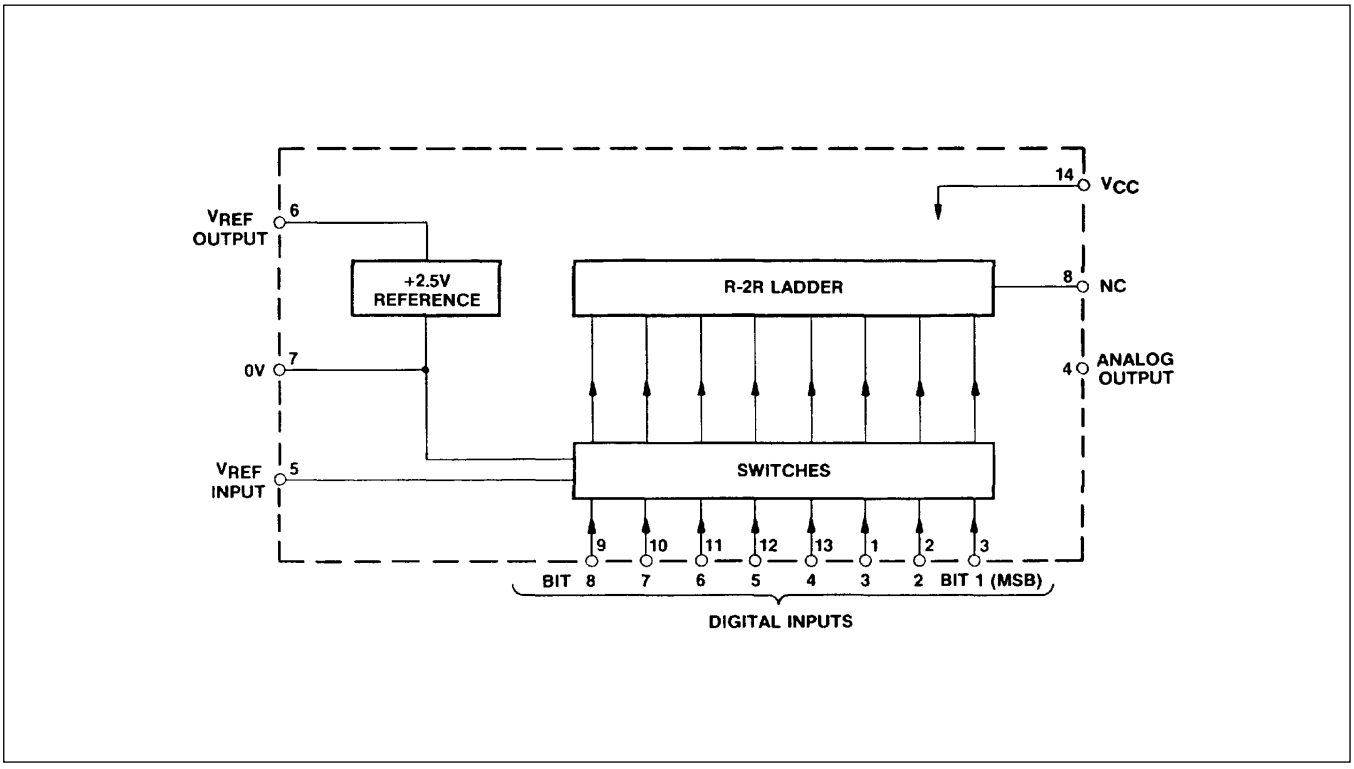

Fig.2 System diagram

ELECTRICAL CHARACTERISTICS

(at T_{amb} = 25°C and V_{CC} = +5V unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Converter Resolution		8	-	-	bits	
Non-linearity		-	-	±0.5	LSB	
Differential non-linearity		-	±0.5	-	LSB	Note 1
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 ZN426E8 and D	V_{OS}	-	3.0	5.0	mV	All bits OFF
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.
Analog 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 2 R_{REF} = 390Ω
Slope resistance	R_S	-	1	2	Ω	R_{REF} = 390Ω
V_{REF} temperature coefficient		-	40	-	ppm/°C	R_{REF} = 390Ω

NOTE 1: Monotonic over full temperature range.

NOTE 2:The internal reference requires a 1µF stabilising capacitor between $V_{REF\ OUT}$ and 0V and a 390Ω resistor, R_{REF}, between V_{CC} and $V_{REF\ OUT}$.

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 on a single monolithic chip.

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

The use of on-chip voltage reference 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.3.

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.

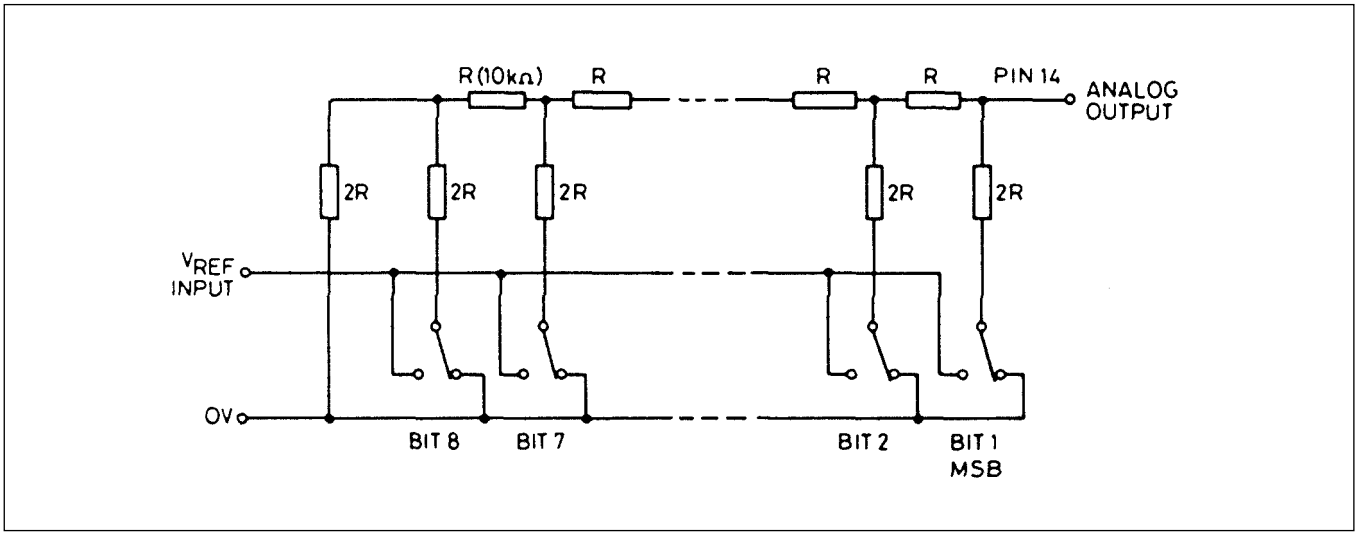

Fig.3 The R-2R ladder network

APPLICATIONS

8-bit D-A Converter

The ZN426 gives an analog 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 analog 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.4 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} = Normal 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)

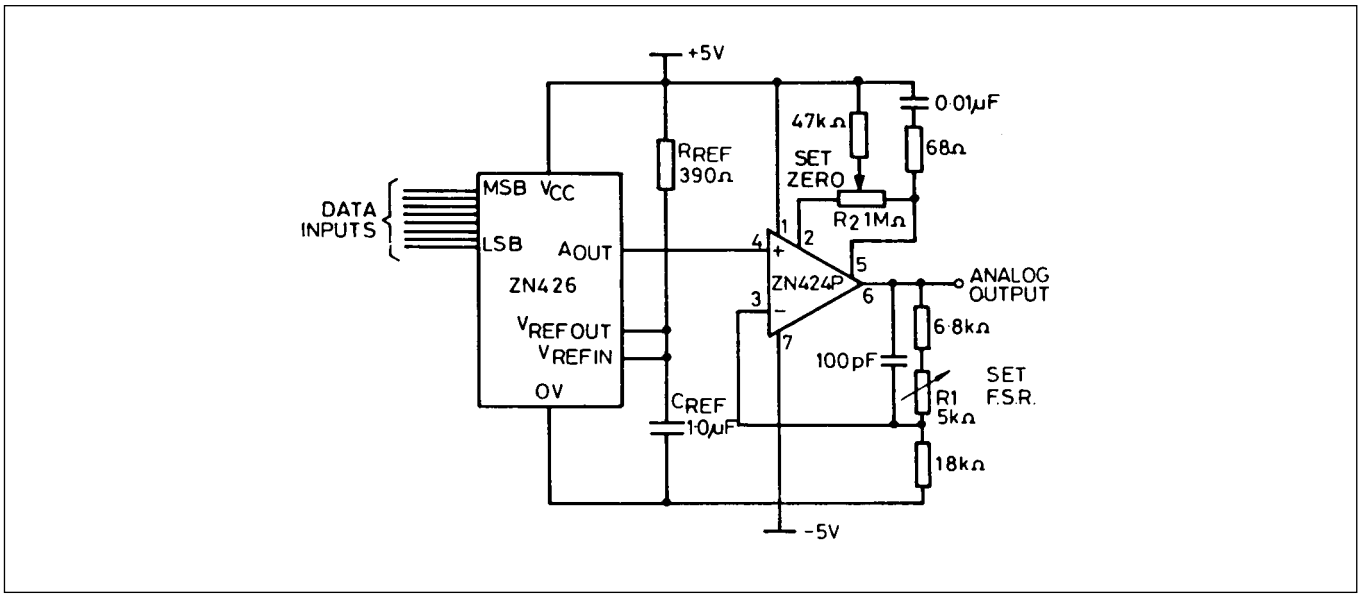

Fig.4 8-bit D-A converter

Alternative Output Buffer Using the 741

The circuit of Fig.5, employing the 741 operational amplifier, may be used as the output buffer.

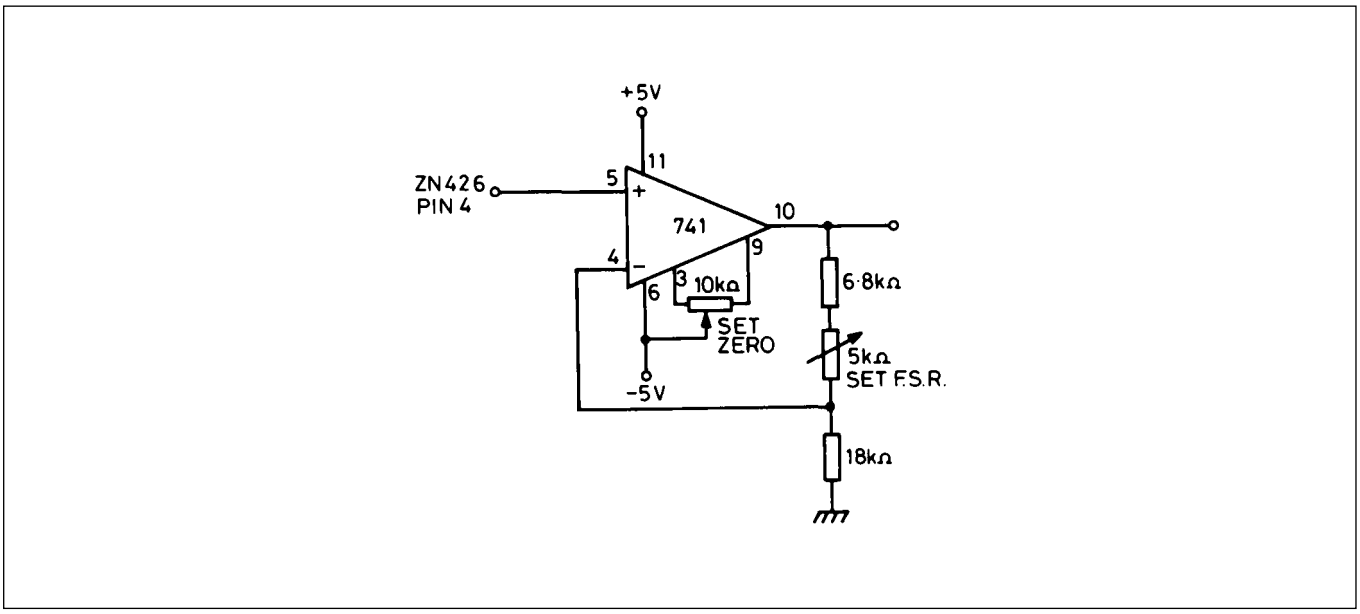

Fig.5 The ZLD741 as output buffer

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