PLESSEY
Semiconductors

T-51-09-07

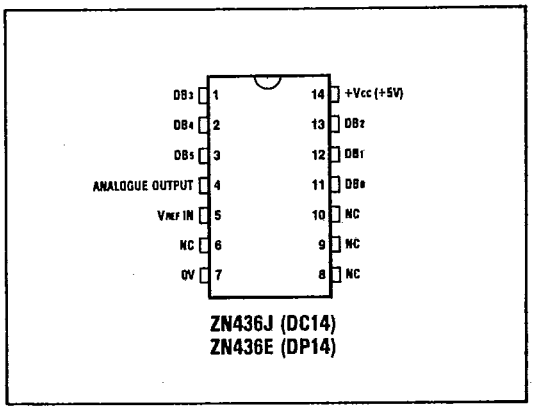
ZN436

LOW COST 6-BIT D-A CONVERTER

The ZN436 is a monolithic 6-bit D-A converter containing an R-2R ladder network of diffused resistors with precision bipolar switches.

FEATURES

- 6-Bit Accuracy
- TTL and 5V CMOS Compatible
- Single +5V Supply
- Settling Time 1 microsecond Typical
- Designed for Low-Cost Applications
- Commercial and Military Temperature Ranges



ZN436J (DC14)
ZN436E (DP14)

Pin connections - top view

ORDERING INFORMATION

Device type	Operating temperature	Package
ZN436E	0°C to +70°C	DP14
ZN436J	-55°C to +125°C	DC14

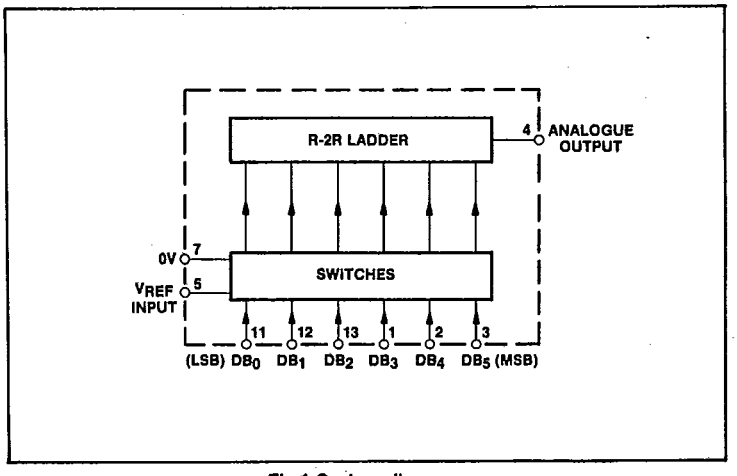


Fig.1 System diagram

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INTRODUCTION

The ZN436 is an 6-bit D-A converter. It contains an advanced design of R-2R ladder network and an array of precision bipolar switches on a single monolithic chip.

The special design of ladder network results in full 6-bit accuracy using normal diffused resistors.

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

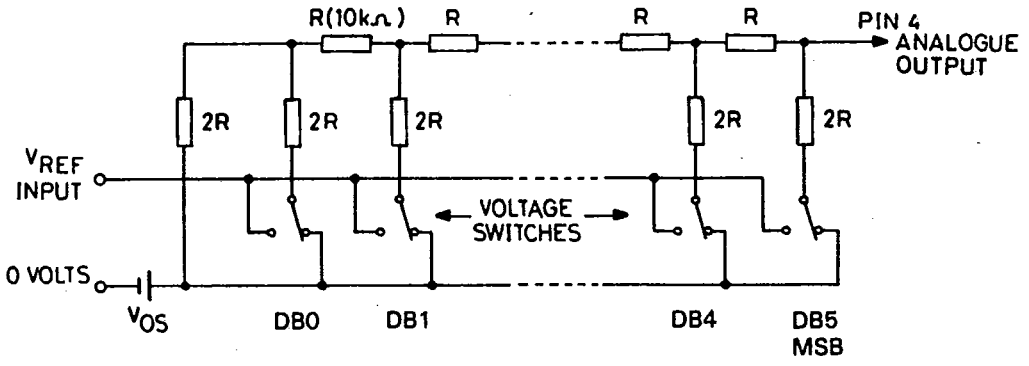

Fig. 2 The R-2R ladder network

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.

An external fixed or varying reference is required which should have a slope resistance less than 2Ω

Suggested external reference sources are the ZN404 or one of the ZN458 range. Each ZN404 is capable of supplying up to five ZN436 circuits and this is increased to ten for the ZN458 range.

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ABSOLUTE MAXIMUM RATINGS

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

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

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Accuracy (useful resolution)						
ZN436J		6	–	–	bits	V_{REF} input = 2.0 to 3.0V
ZN436E		6	–	–	bits	
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 ZN436J	V_{OS}	–	5.0	8.0	mV	All bits OFF note 1
ZN436E		–	3.0	5.0	mV	
V_{OS} temperature coefficient		–	5.0	–	μV/°C	
Full-scale output		2.510	2.520	2.530	V	All bits ON Ext. V_{REF} = 2.560V
Full-scale temp. coefficient		–	3.0	–	ppm/°C	Ext. V_{REF} = 2.560V
Non-linearity temp. coefficient		–	7.5	–	ppm/°C	Relative to F.S.R.

Notes:

1. The ZN436J differs from the ZN436E in the following respects:
   (a) For the ZN436J, the maximum linearity error may increase to ± 1LSB over the temperature ranges −55 to 0°C and +70 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 the full operating temperature range.

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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	V_{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

APPLICATIONS

1. 6-bit D-A converter

The ZN436 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. 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.

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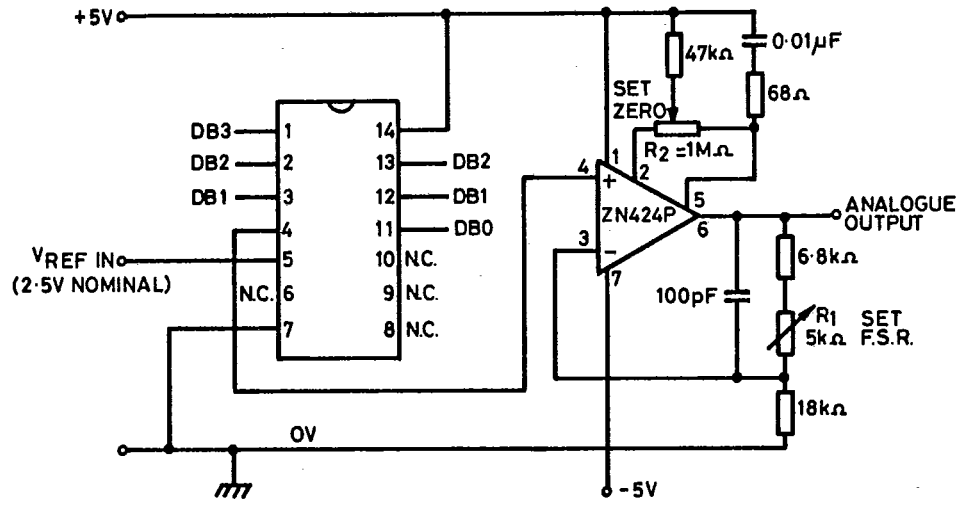

Fig. 3 6-bit D-A converter

Alternative output buffer using the 741

The following circuit, employing the 741 operational amplifier, may be used as the output buffer (Fig. 3).

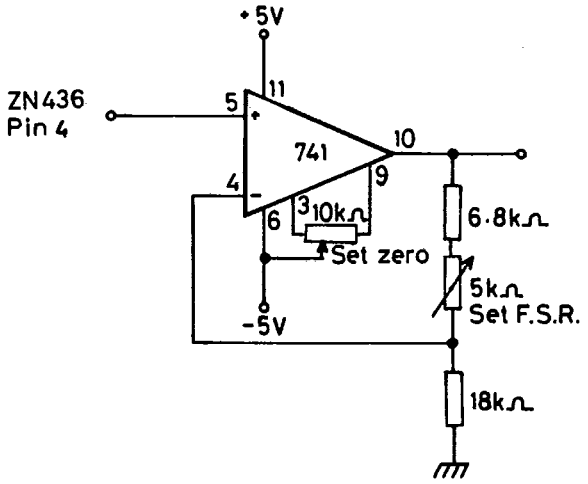

Fig.4 The 741 as output buffer