T-51-09-05

Low cost 4-bit D-A converter

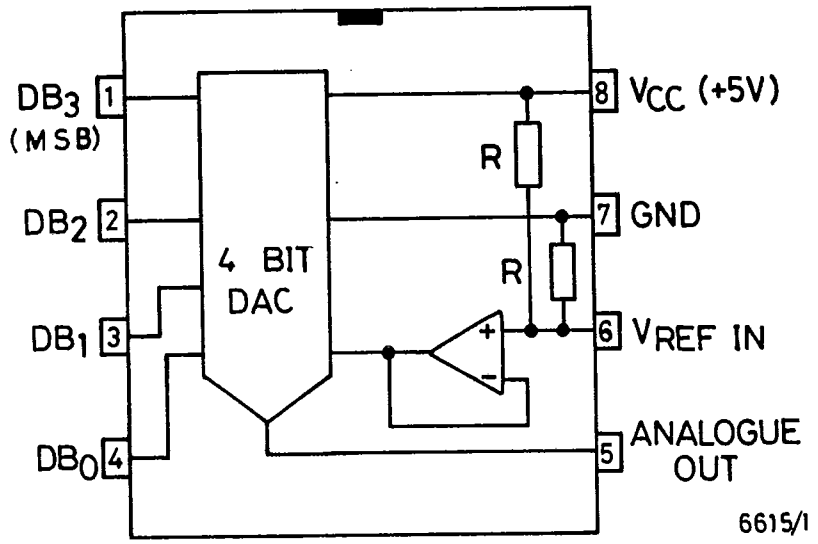
ZN434

FEATURES

- 4-bit resolution
- ¼LSB linearity
- Voltage output
- 300ns settling time
- TTL and CMOS compatible
- Single +5V supply
- On-chip $\frac{V_{CC}}{2}$ reference
- 0 to +70°C or −40 to +85°C temperature range

DESCRIPTION

The ZN434 is a 4-bit D-A converter containing an R-2R ladder network of diffused resistors and precision bipolar switches. An on-chip reference amplifier and attenuator provide a reference voltage of $\frac{V_{CC}}{2}$, allowing the IC to function with no external components.



ZN434 System diagram

ZN434

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ABSOLUTE MAXIMUM RATINGS

Supply voltage .. .. +7V

Logic and V_{REF} inputs .. .. 0V to V_{CC}

	Min.	Max.
Operating temperature range ZN434E	0°C	+70°C
ZN434BE	−40°C	+85°C
Storage temperature range	−55°C	+125°C

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

Parameter	Min.	Typ.	Max.	Units	Conditions
D-A converter resolution	4	–	–	Bits	
Linearity error	–	–	±0.25	LSB	1.5V < V_{REFin} < 3V
Differential linearity error	–	–	±0.25	LSB	
Linearity error T.C.	–	±30	–	ppm/°C	Relative to FSR
Differential linearity error T.C.	–	±11	–	ppm/°C	Relative to FSR
Zero error	–	3.0	5.0	mV	
Zero error T.C.	–	+6	–	μV/°C	
Full-scale output	2.235	2.345	2.456	V	
Full-scale output (external reference)	0.922	0.938	0.954	V_{ref}in	1.5V < V_{REFin} < 3V
Full-scale T.C.	–	±30	–	ppm/°C	External V_{REF} = 2.56V
Analogue output resistance	1.75	2.5	3.25	kΩ	
Analogue output capacitance	–	15	–	pF	
Settling time to 0.5 LSB	–	200	300	ns	Code transition 0000 1111 or 1111 0000
	–	100	150	ns	1 LSB step
Supply voltage	+4.5	+5	+5.5	V	
Supply current	–	10	15	mA	

ELECTRICAL CHARACTERISTICS (Cont.)

Parameter	Min.	Typ.	Max.	Units	Conditions
On-chip reference amplifier					
Output voltage	$\frac{V_{CC}}{2} \times 0.97$	$\frac{V_{CC}}{2}$	$\frac{V_{CC}}{2} \times 1.03$		
Input current	–	1	–	μA	
Offset voltage		±10		mV	
Input resistance at pin 6	9	18	27	kΩ	Note 1
Logic inputs					
High level input voltage V_{IH}	2.0	–	–	V	
Low level input voltage V_{IL}	–	–	0.8	V	
High level input current I_{IH}	–	–	10	μA	$V_{CC}=5.5V$, $V_I=2.4V$
	–	–	100	μA	$V_{CC}=V_I=5.5V$
Low level input current I_{IL}	–	–	180	μA	$V_{CC}=5.5V$, $V_I=0.3V$

Note 1: Includes on-chip attenuator. Nominal value of R is 36kΩ.

CIRCUIT DESCRIPTION

D-A converter

The ZN434 is a 4-bit D-A converter consisting of an R-2R ladder of diffused resistors and precision bipolar switches designed for low offset voltage.

The ladder operates in the voltage switching mode and produces an output voltage $V_{out}=\frac{n}{16}(V_{REF\ IN}-V_{OS})+V_{OS}$, where n is the digital code set at the bit inputs and V_{OS} is a small offset voltage caused by the supply current flowing through the lead resistance of the ground pin.

On-chip reference amplifier

The ZN434 contains a reference amplifier and attenuator that provides a reference voltage of nominally $\frac{V_{CC}}{2}$ without any external components. Taking into account the attenuator error, input current and offset voltage of the amplifier and gain error of the D-A converter the full-scale output will be within ± ½LSB of the nominal value of 0.469 × V_{CC}.

By maintaining an accurate and stable supply voltage the ZN434 may thus be used without an external reference. Where several ZN434's are used in a system the V_{REF} inputs may be joined together to improve V_{REF} matching.

If a reference voltage other than $\frac{V_{CC}}{2}$ is required then the on-chip attenuator may be overridden, either by connecting a lower resistance attenuator in parallel or by using an active reference such as a bandgap reference source.