PLESSEY
Semiconductors

T-51-09-07

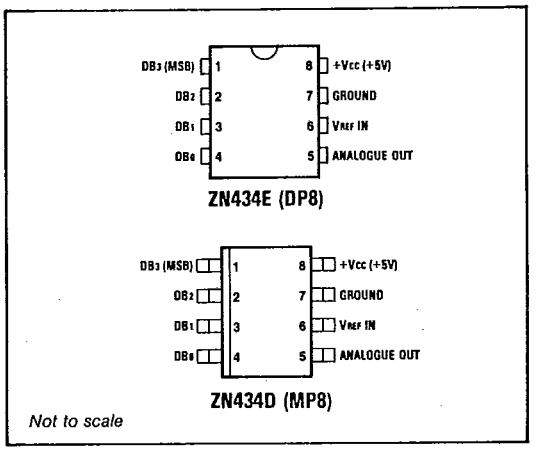
# ZN434

## LOW COST 4-BIT D-A CONVERTER

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.

### FEATURES

- 4-Bit Resolution
- ¼ LSB Linearity
- Voltage Output
- 300ns Settling Time
- TTL and CMOS Compatible
- Single +5V Supply
- On-Chip $\frac{V_{CC}}{2}$ Reference



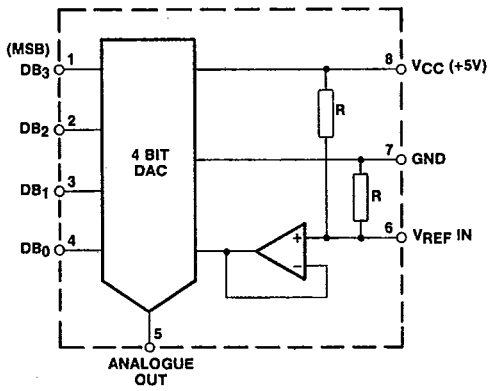

Pin connections - top view

### ORDERING INFORMATION

| Device type | Operating temperature | Package |
|---|---|---|
| ZN434E | -40°C to +85°C | DP8 |
| ZN434D | -40°C to +85°C | MP8 |

### ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Supply voltage | +7V |
| Logic and $V_{REF}$ inputs | 0V to Vcc |
| Operating temperature range | -40°C to +85°C |
| Storage temperature range | -55°C to +125°C |




ZN434 system diagram

**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.) T-51-09-07

| 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.