



- When using 100nF integrating capacitors, headroom is limited by clipping below 1kHz. Above 1kHz it is mainly slew-rate limited.
- The data sheet quotes THD at <0.5%. This is highly unlikely; THD barely drops below 1% at the shortest delay times using a 1kHz 100mV input signal and 100nF integrating capacitors.
- The heaviest load that the on-board opamps can drive is  $\sim 1k\Omega$ .

### Delay:

A delay-control resistance of less than  $1k\Omega$  is not recommended, due to excessive current demand. With a  $100\Omega$  delay resistor a delay time of 25ms is achieved with most samples. A zero-ohm delay resistor (dead short) gives almost no further decrease in delay time, and is not recommended.

### Latch up:

If the delay resistance is less than  $1k\Omega$  then the PT2399 may latch up at power on, which can lead to catastrophic failure. If very short delay times are required, ensure that the delay resistance is greater than  $1k\Omega$  for the first 400ms after power on.

Some devices appear to latch up or fail to function properly if digital ground (pin 4) is left unconnected. This pin should usually be connected to analog ground (pin 3).

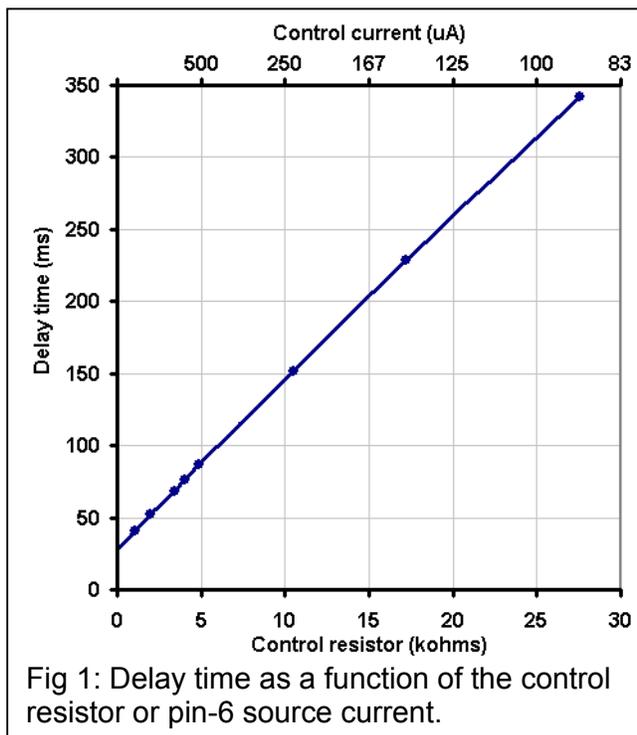


Fig 1: Delay time as a function of the control resistor or pin-6 source current.

### Minimising noise:

The data sheet quotes noise at  $<-90dBV$  ( $32\mu V$ ). This appears to be pure fantasy; it is difficult to reduce noise below  $-60dBV$  ( $500\mu V$ ) before filtering.

Noise is minimised by heavily filtering the audio, particularly at the output of the chip. For the longest delay times it may be necessary to severely limit the bandwidth to 1kHz or less.

Quantisation noise becomes worse as delay time is increased. Longer delay times may require larger integrating capacitors at the expense of bandwidth.

A significant source of noise is due to the internal clock modulating the power supply rail. The following advice may be used to minimise this noise:

- Use a dedicated power rail for the PT2399; do not use it to supply any other analog circuitry.
- $V_{cc}$  (pin 1) *must* be decoupled *directly* to the analog ground. Even a few centimetres of PCB track will spoil this decoupling.
- A tantalum capacitor greater than  $1\mu F$  is most effective for decoupling  $V_{cc}$  (and  $V_{ref}$ ). Ceramic or plastic capacitors can also be used and are nearly as good as tantalum. A combination of tantalum, ceramic, and aluminium electrolytic capacitors can be used in parallel for improved results.
- A 7805 regulator IC gives reasonable rejection of power supply noise. However, an alternative is to use a zener follower which gives superior load regulation at high frequencies, see fig. 2. This results in less power supply noise at the expense of poorer line regulation.

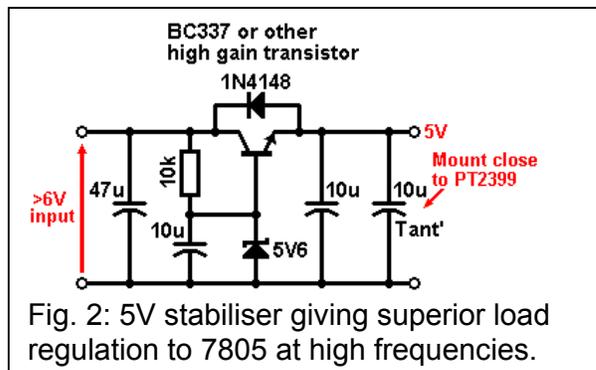


Fig. 2: 5V stabiliser giving superior load regulation to 7805 at high frequencies.