

## Low-power, low-gate-count, highly-configurable DSP core for audio and control processing

### Overview

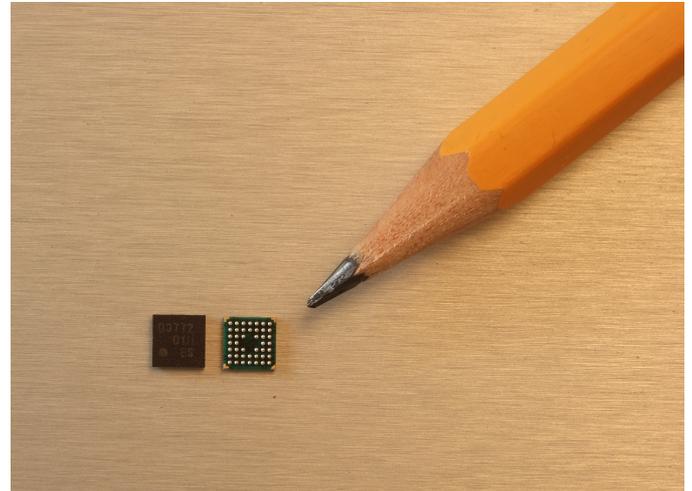
**TinyCore** is a DSP core that supports stream-based processing of time domain audio or control data samples including single cycle multiply-adds and multiply-subtracts. With built-in support for sample delay memory of varying size and automatically saturating arithmetic instructions, **TinyCore** makes it possible to implement a bi-quad filter in five instructions.

**TinyCore** is a reconfigurable RTL model that permits synthesis of FPGA and ASIC gate-level netlists with a wide range of configurable parameters that can be selected for the needs of the application. From low-cost ICs demanding the smallest gate count, through to top-end pro-audio systems, **TinyCore** can be configured to give the performance you require.

**TinyCore** makes no assumptions on master clock frequency and so is independent of audio sample rate. It is optimised for low power and low gate count through a configurable memory access method and a split multiplier design.

### Configurable Parameters

- 1 - 32 audio I/O channels
- data path bit width from 16 to 48 bits
- 128 - 8192 instructions per audio sample period
- 1 - 3 data storage RAMs, each containing between 32 and 4096 data words
- optional external memory interface for effects requiring large delays (e.g. sparse FIR filters, reverbs)
- support for encrypted code so that effects can be used securely



Sony's CXD3772 (pictured above) was the first ASIC to employ **TinyCore**.

### Programming Options

Custom DSP effects options:

- **GPE** - Graphical Programming Environment for algorithm development
- Simulink Netlister for direct transfer of algorithms developed in Matlab Simulink® to optimised **TinyCore** code
- Bespoke programming service from the experts at Oxford Digital

Off-the-shelf DSP effects:

- **FixFx** - a pre-configured back-end tuning toolset incorporating effects and control GUI for enhancement of the sonic performance of a variety of devices from digital stills cameras, through cell phones and portable media players to flat panel TVs
- SRS Labs Inc. StudioSound HD effects

## Highlights

**TinyCore** and tools are a world class end-to-end solution for audio DSP that provides:

- a comprehensive design environment and toolset
- very fast work-flow through the use of high-level front-end hierarchical Graphical Programming Environment, Core Synthesis and back-end “Tuning” tools
- very low gate count solutions for FPGA and ASIC
- very efficient execution (e.g. only five instructions for a bi-quad filter with saturating arithmetic)
- compact code: the high level compiler produces code that on average is 10% smaller than that produced by an expert Assembly Level programmer
- a scalable solution in bit-width, sampling frequency, instructions per sample and number of channels
- automatic software re-use for different configurations of the **TinyCore**; no changes are required at the top design level as the compiler produces the required executable code automatically
- support for encrypted code to allow effects manufacturers (e.g. SRS Labs Inc.) to provide library items that remain private (i.e. it is not possible to push down through the hierarchy to see the internal workings)
- HDL that is easily portable across different FPGAs and ASIC processes and geometries
- audio DSP effects library
- real-time adjustment of parameters (whilst listening and/or taking measurements) on either evaluation boards or target hardware

- real-time injection of test signals and ‘scope probe’ type debugging/audio monitoring
- provision of Test Bench and Test Vectors for **TinyCore** including the ability to simulate the DSP output from the Graphical Programming front-end. Semiconductor manufacturers can validate their results by simulating the **TinyCore** including the desired effect pre- and post-synthesis as part of the sign-off process
- extremely fast time-to-market for both FPGA and ASIC implementations through the use of the Tiny Toolset (e.g. delivery of DSP code for an application together with HDL for a custom core in six days)
- provision of programmability (as opposed to fixed architecture) by use of the **TinyCore** de-serialises development of algorithms and silicon and allows substantial overlap in the process, thus reducing time-to-market even further

## Applications

- Improving sound quality by removing “honky” resonances
- Aiding listening in noisy environments
- Providing exciting, dramatic audio effects
- Loudspeaker and earphone correction and protection
- Improving bass response
- Enhancing dialogue intelligibility
- Noise reduction
- Acoustic Echo Cancellation
- Closed loop control systems