VS1053 to VS1073 Migration Guide

Description

This document describes how to migrate from VS1053 to VS1073. It lists hardware and software differences and other considerations.

This document applies to all versions of VS1053 and VS1073.

Revision History			
Rev	**Date**	**Author**	**Description**
1.15	2025-04-03	HH	Initial release.

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1 General

With the one exception mentioned below, VS1073 is pin-compatible with VS1053.

Major updates in VS1073 are:

- Core voltage for CVDD0. . . CVDD3 has changed from 1.85 V to 1.25 V.
- Encoders:
  - Added MP3, Ogg Vorbis, FLAC, μ-law, A-law and G.722 encoding.
  - RIFF-WAV header is generated automatically in WAV encoding (and codec) modes. The user still needs to fix RIFF size and data size fields to get valid WAV files.
- Added SCI Multiple Read mode to be able to read encoded data without 100 % overhead.
- Codecs:
  - Added codec mode (both encoder and decoder work at the same time) that works with μ-law, A-law G.722, IMA ADPCM and PCM WAV.
- Decoders:
  - Added FLAC, ALAC, APE, DSD, AIFF, Opus decoding up to 2 channels, as well as AC-3 downmixed to stereo.
  - Removed MIDI, and MPEG layer I (MP1) decoders.
  - MPEG layers II (MP2) and III (MP3): New, more robust and accurate decoding. MP3 is now full accuracy compliant. Highest-quality MP3 files require 2.5$\times$ clock.
  - CRC checking added for MP3 files that contain CRC. CRC checking can be disabled.
  - Keeps track of the valid data in bit MP3 reservoir, which allows noiseless start of decoding in the middle of an MP3 file.
  - WAV decoding supports 24-bit, 32-bit and floating-point formats.
  - AAC, WMA, MP3 and FLAC decoding can be individually disabled using bits in parametric_x.config1.
- The highest allowed internal clock speed for VS1053 was 55.3 MHz. VS1073 can run at up to 98.304 MHz (number based on engineering samples and subject to change).
- Sample rate finetuning in parametric_x.rateTune.
- SCI Register SCI_WRAMADDR 0xc0c0..0xc0ff is mapped to parametric_x structure.
- SCI Registers SCI_HDAT0, SCI_HDAT1, and SCI_CLOCKF changed.
- Support reading u_int32's (almost) atomically through WRAM.
- Reading of stream and audio buffer fill states possible.
- Sample-exact sample rate and volume change.
- Added mono mode and pause mode for player (parametric_x.playMode).
- Added 5-channel equalizer.
- Added VU meter.
- Added AD mixer.
- Added PCM mixer.
- Added Speed shifter.
- Added I2C memory boot option.
- Sine tests activated from SDI have been removed.
- The I2S output is now capable of 16-bit audio up to 192 kHz, or 32 bits up to 96 kHz.
- Analog drivers are not powered up automatically if no audio is played.

Some of these new features have required for the register interface to be changed accordingly.

2 Hardware

With the exception of the lowered core voltage CVDD, VS1053 and VS1073 are pin compatible, so there are no other needs to update PCBs for VS1073.

3 Application Considerations

This chapter gives general info on applications using VS1073.

3.1 Hardware Design

From a hardware point of view, and with the exception of the core voltage, VS1073 is a drop-in replacement for the VS1053.

Nevertheless, VS1073 has an option to boot from external I2C memory. If this functionality is required, GPIO0, GPIO4 and GPIO6 need to be connected accordingly. Read the *VS1073 Datasheet* Chapter *I2C boot* for details.

3.2 Software Considerations

Basic operation of VS1053 and VS1073 similar: playing back audio files doesn't usually require many changes to the controller software, except for replacing loading of the *VS1053b Patches w/ FLAC Decoder* package with the *VS1073 Patches* package, available at
`http://www.vlsi.fi/en/support/software/vs10xxpatches.html`
Using the *VS1073 Patches* package is highly recommended.

Major changes to microcontroller software is only needed when the features new to the VS1073 are required, or if audio encoding is used.

Note: Applications running on VS1053 will not run on VS1073 without porting them first.

4 SCI Registers

VS1053 and VS1073 have a few differencies in registers. The following chapters list these differencies. See more info from VS1053 and VS1073 datasheets.

4.1 Changed: SCI_MODE

SM_EARSPEAKER_LO (bit 4) and SM_EARSPEAKER_HI (bit 7) register bits are removed from VS1073. A much more fine-grained 16-bit EarSpeaker tuning register is offered in the earSpeakerLevel field of the Extra Parameters structure. To port from old register values, see the following table:

VS1053		VS1073
SM_EARSPEAKER_HI	**RF_EARSPEAKER_LO**	**earSpeakerLevel**
0	0	0
0	1	12000
1	0	38000
1	1	50000

SM_STREAM (bit 6) has been removed from VS1073. The option was limited in VS1053 so it was decided it could be dropped from VS1073. To stream using VS1073, use sample rate finetuning.

SM_ADPCM (bit 12) has been renamed SM_ENCODE because VS1073 can encode also in many other formats than only IMA ADPCM.

A new register bit SM_SCIMULTIREAD (12) activates the option for SCI Multiple Read operations. With this operation, the same SCI register can be read multiple times, making it twice as fast to read high-bitrate encoded audio data (e.g. PCM or FLAC).

4.2 Changed: SCI_STATUS

SS_VER is 4 for VS1053, and 8 for VS1073.

SS_REFERENCE_SEL was inconvenient to use on VS1053 due to a firmware bug. With VS1073 the higher reference voltage 1.65 V can be used as described in the VS1073 datasheet (AVDD$\geq$3.3 V).

4.3 Changed: SCI_WRAMADDR

More memory areas can now be accessed with this register. See the *VS1073 Datasheet* Chapter *SCI_WRAMADDR* for details.

4.4 Changed: SCI_HDAT0 and SCI_HDAT1

When decoding MP3 files, SCI registers SCI_HDAT0 and SCI_HDAT1 used to show the 32 bits of the MP3 header, and for other files they would show other, relevant information to the files. In VS1073, the contents of these registers is unified between all audio formats.

4.5 Changed: SCI_CLOCKF

The values for setting up SCI_CLOCKF have changed. Changing the format was necessary because the old format was insufficient for setting the new, higher clock frequencies that VS1073 can handle.

5 Sine and Memory Tests

VS1073 tests that are started through SDI require additional 7-8 zero bytes to be sent to SDI for them to start. These bytes are shown in the datasheet examples. Read Chapter *SDI Tests* of the *VS1073 Datasheet* for details.

SDI-bus activated Sine Test has been removed. New, more versatile sine and sweep tests may be activated through the SCI bus. Read Chapter *Sine and Sweep Tests* of the *VS1073 Datasheet* for details.

6 User Applications

Because memory addresses have changed, the user applications, plugins and patches are different between VS1053 and VS1073. Many of them are not needed anyway because VS1073 directly supports the functionality of many of VS1053's plugins and applications.

Also, the new SCI Multiple Read functionality removes the 100 % overhead that was an earlier inconvenience with reading high-bitrate data.

7 Audio Encoding

Audio encoding has changed considerably between VS1053 and VS1073. While the basic interface, namely reading data through registers SCI_HDAT0 and SCI_HDAT1 remains, both initializing and finalizing recording has changed significantly. Read Chapter *Audio Encoding* of the *VS1073 Datasheet* for details.

8 Analog Wake-Up

Unlike VS10XX audio ICs up to VS1063, VS1073 does not wake up its analog drivers automatically after power-up. It will wake them up only after audio has been decoded for a while. If the user wants to turn up the analog drivers manually, then turn SCI_STATUS register bit SS_APDOWN2 (bit 3) off after waiting for a short while after reset. If you turn SS_APDOWN2 on too quick after a reset, you may hear a small, single click.

9 Extra Parameters parametric_x

The Extra Parameters parametric_x data structure has many new fields and effects, ranging from a fine-tuned playback speed shifter to a 5-channel equalizer. Read Chapter *Extra Parameters* of the *VS1073 Datasheet* for details.

10 Licenses

If the end product plays formats that require licenses, refer to the *Licenses* chapter of the VS1073 Datasheet. To the best knowledge of VLSI Solution, patents related to MP3 have expired years ago and do not require licenses anymore.

11 Microcontroller Examples

Examples on how to control VS1073 using a microcontroller are available at
http://www.vlsi.fi/en/support/software/microcontrollersoftware.html

12 Latest Document Version Changes

This chapter describes the most important changes to this document.

Version 1.15, 2025-04-03

- Initial release, using VS1053 to VS1063 Migration Guide as a basis.

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