

## VS1003 to VS1063 Migration Guide

### Description

This document describes how to migrate from VS1003 to VS1063. It lists hardware and software differences and other considerations.

This document applies to all versions of VS1003 and VS1063.

| <b>Revision History</b> |             |               |                    |
|-------------------------|-------------|---------------|--------------------|
| <b>Rev</b>              | <b>Date</b> | <b>Author</b> | <b>Description</b> |
| 1.00                    | 2012-11-28  | HH            | Initial revision.  |

## Contents

|   |           |
|---|-----------|
| <b>Description</b>                              | <b>1</b>  |
| <b>Table of Contents</b>                        | <b>2</b>  |
| <b>1 General</b>                                | <b>3</b>  |
| <b>2 Hardware</b>                               | <b>4</b>  |
| 2.1 Changed: Voltages . . . . .                 | 4         |
| 2.2 Changed: Clocking . . . . .                 | 4         |
| 2.3 New: HiFi Stereo Line Input . . . . .       | 4         |
| 2.4 Changed: LQFP-48 Pin Descriptions . . . . . | 4         |
| <b>3 Application Considerations</b>             | <b>6</b>  |
| 3.1 Hardware Design . . . . .                   | 6         |
| 3.2 Software Considerations . . . . .           | 6         |
| <b>4 SCI Registers</b>                          | <b>7</b>  |
| 4.1 Changed: SCI_MODE . . . . .                 | 7         |
| 4.2 Changed: SCI_STATUS . . . . .               | 8         |
| 4.3 Changed: SCI_CLOCKF . . . . .               | 8         |
| 4.4 Changed: SCI_HDAT0 and SCI_HDAT1 . . . . .  | 8         |
| <b>5 User Applications</b>                      | <b>9</b>  |
| <b>6 Licenses</b>                               | <b>9</b>  |
| <b>7 Microcontroller Examples</b>               | <b>9</b>  |
| <b>8 Latest Document Version Changes</b>        | <b>10</b> |
| <b>9 Contact Information</b>                    | <b>11</b> |

## 1 General

VS1063 has many updated features compared to VS1003. The most significant differences are:

- VS1063 has a HiFi stereo line input as opposed to VS1003's mono voice input
- Added MP3, Ogg Vorbis,  $\mu$ -law, A-law, G.722, and PCM WAV encoding.
- New decoder formats: Ogg Vorbis, AAC and HE-AAC, MP2, FLAC, G.722.
- MPEG layers II (MP2) and III (MP3): new, more robust and accurate decoding. MP3 is now full accuracy compliant.
- Removed MIDI decoder.
- Added codec mode (both encoder and decoder work at the same time) that works with  $\mu$ -law, A-law G.722, IMA ADPCM, PCM WAV, 24-bit and 32-bit floating point WAV.
- VS1003 could be used with a 12...13 MHz fundamental frequency clock. In addition to this, VS1063 can also use a 24...26 MHz clock.
- The highest allowed internal clock speed has increased from 52.0 MHz to 67.6 MHz.
- VS1063 has an I2S interface for external DACs.
- VS1063 has more GPIO pins.
- VS1063 and VS1003 have different operating voltage ranges.
- VS1063 is only available in LQFP-48 packaging.
- CRC checking added for MP3 files that contain CRC. CRC checking can be disabled.
- Keeps track of the valid data in MP3 bit reservoir, which allows noiseless start of decoding in the middle of an MP3 file.
- Reading of stream and audio buffer fill states possible.
- Proportional and fixed-width font in data ROM for standalone applications.
- RIFF-WAV header is generated automatically in WAV encoding (and codec) modes. The user still needs to fix the RIFF size and data size fields to make them valid WAV files.
- Sample-exact samplerate and volume change.
- Added parametric data structure that contains lots of new functionality
  - Mono mode and pause mode for player
  - 5-channel equalizer
  - VU meter
  - AD mixer
  - PCM mixer
  - Samplerate finetuning.
  - Speed shifter
  - EarSpeaker spatial processing.
  - Potential to individually disable AAC, WMA, MP3 and FLAC decoders.
- Added I2C memory boot option.

Due to these new features the pinout and register interface has been changed accordingly.

## 2 Hardware

VS1003 and VS1063 have a few hardware differences which are listed in this chapter.

### 2.1 Changed: Voltages

Analog voltage AVDD has changed from 2.6...2.85 V in VS1003 to 2.5...3.6 V in VS1063 (3.3...3.6 V if you use the higher 1.65 V reference voltage REF).

Digital core voltage CVDD has changed from 2.4...2.85 V in VS1003 to 1.7...1.85 V in VS1063.

I/O voltage IOVDD has changed from CVDD-0.6...3.6 V in VS1003 to 1.8...3.6 V in VS1063.

In practise this means that it is not possible to design a system for VS1063 with one operating voltage. At least one regulator or step-down transformer is required for CVDD.

### 2.2 Changed: Clocking

VS1003 is clocked with a 12...13 MHz fundamental frequency clock. The PLL of VS1003 is used to increase the internal clock to speeds upto 52.0 MHz.

VS1063 is clocked with either a 12...13 MHz or 24...26 MHz crystal. In the latter case an internal clock divider needs to be activated in register SCI\_MODE for playback and recording, and another in SCI\_STATUS for recording. An internal PLL can be used to increase the clock to a speed upto 67.6 MHz.

### 2.3 New: HiFi Stereo Line Input

Both VS1003 and VS1063 feature a differential microphone and one-sided line-level input. However, VS1063 adds another channel to the line-level input allowing stereo input. VS1063's analog-to-digital converters are also more advanced, so they offer true HiFi sound.

### 2.4 Changed: LQFP-48 Pin Descriptions

LQFP-48 is a lead (Pb) free and RoHS compliant package. RoHS is a short name of *Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment*. See dimensions for the LQFP package from <http://www.vlsi.fi/>

The table on the following page describes the new pins and functions for VS1063.

Pin description changes:

| Pad Name          | LQFP Pin | Pin Type | New Function For VS1063                                     |
|-------------------|----------|----------|---|
| MICP / LINE1      | 1        | AI       | LINE1 = left channel line input option added.               |
| MICN              | 2        | AI       |   |
| XRESET            | 3        | DI       |   |
| DGND0             | 4        | DGND     |   |
| CVDD0             | 5        | CPWR     |   |
| IOVDD0            | 6        | IOPWR    |   |
| CVDD1             | 7        | CPWR     |   |
| DREQ              | 8        | DO       |   |
| GPIO2 / DCLK      | 9        | DIO      |   |
| GPIO3 / SDATA     | 10       | DIO      |   |
| GPIO6 / I2S_SCLK  | 11       | DIO      | Both functions new for VS1063                               |
| GPIO7 / I2S_SDATA | 12       | DIO      | Both functions new for VS1063                               |
| XDCS / BSYNC      | 13       | DI       |   |
| IOVDD1            | 14       | IOPWR    |   |
| VCO               | 15       | DO       |   |
| DGND1             | 16       | DGND     |   |
| XTALO             | 17       | AO       |   |
| XTALI             | 18       | AI       |   |
| IOVDD2            | 19       | IOPWR    |   |
| DGND2             | 20       | DGND     |   |
| DGND3             | 21       | DGND     |   |
| DGND4             | 22       | DGND     |   |
| XCS               | 23       | DI       |   |
| CVDD2             | 24       | CPWR     |   |
| GPIO5 / I2S_MCLK  | 25       | DIO      | Both functions new for VS1063                               |
| RX                | 26       | DI       |   |
| TX                | 27       | DO       |   |
| SCLK              | 28       | DI       |   |
| SI                | 29       | DI       |   |
| SO                | 30       | DO3      |   |
| CVDD3             | 31       | CPWR     |   |
| XTEST             | 32       | DI       |   |
| GPIO0             | 33       | DIO      |   |
| GPIO1             | 34       | DIO      |   |
| GND               | 35       | DGND     | I/O ground, new for VS1063                                  |
| GPIO4 / I2S_LROUT | 36       | DIO      | Both functions new for VS1063                               |
| AGND0             | 37       | APWR     |   |
| AVDD0             | 38       | APWR     |   |
| RIGHT             | 39       | AO       |   |
| AGND1             | 40       | APWR     |   |
| AGND2             | 41       | APWR     |   |
| GBUF              | 42       | AO       |   |
| AVDD1             | 43       | APWR     |   |
| RCAP              | 44       | AIO      |   |
| AVDD2             | 45       | APWR     |   |
| LEFT              | 46       | AO       |   |
| AGND3             | 47       | APWR     |   |
| LINE2             | 48       | AI       | VS1003 line input is now right-channel line input in VS1063 |

Pin types:

| Type | Description                                |
|------|--|
| DI   | Digital input, CMOS Input Pad              |
| DO   | Digital output, CMOS Input Pad             |
| DIO  | Digital input/output                       |
| DO3  | Digital output, CMOS Tri-stated Output Pad |
| AI   | Analog input                               |

| Type  | Description             |
|-------|-------------------------|
| AO    | Analog output           |
| AIO   | Analog input/output     |
| APWR  | Analog power supply pin |
| DGND  | Core or I/O ground pin  |
| CPWR  | Core power supply pin   |
| IOPWR | I/O power supply pin    |

### 3 Application Considerations

This chapter gives general info on applications using VS1063.

#### 3.1 Hardware Design

VS1063 requires 10 nF capacitors near the ADC pins as well as series resistors to cut the capacitive load for the other device that drives the inputs. See figure *Typical Connection Diagram Using LQFP-48* in the *VS1063 Datasheet* for details.

Outputs of the DACs need RC filters when connecting them to an external power amplifier. The DAC type for VS1063 has been changed for improved distortion but with a cost of some additional high frequency noise outside of the hearing band. Without the filters there may be excessive noise with some audio amplifiers, particularly digital ones. See figure *Typical Connection Diagram Using LQFP-48* in the *VS1063 Datasheet* for details.

#### 3.2 Software Considerations

VS1063 has a set of extra parameters to give the user additional control over the chips functions. For example fast forward and rewind for WMA and AAC is supported through the extra parameters interface. See *VS1063 Datasheet Chapter Extra Parameters* for more info.

When using VS1063, it is highly recommended that the latest version of VS1063a Patches is loaded and running. This package corrects several bugs in the VS1063 ROM firmware and also adds some new features. The package can be downloaded from <http://www.vlsi.fi/en/support/software/vs10xxpatches.html>

Because VS1063 allows both stereo and mono recording, recording interface has been changed extensively. If you want to create a valid file from your MP3, Ogg Vorbis, or IMA ADPCM recording, you have to ask VS1063 to stop recording, and read all data that comes from it before recording actually ends. This ensures that your file ends correctly.

## 4 SCI Registers

VS1003 and VS1063 have a few differences in registers that are not compatible with each other. Care should be taken when porting VS1003 microcontroller software to VS1063. The following chapters list some of these differences. For more info on the registers, see *VS1003 Datasheet* and *VS1063 Datasheet*.

### 4.1 Changed: SCI\_MODE

SM\_LAYER12 allows decoding of MP2 files on VS1063. Notice that using this option may require a separate decoder licence not included in the chip price.

SM\_OUTOFWAV has been renamed SM\_CANCEL because it is used as a general playback or recording cancellation bit regardless of the format being played / recorded.

SM\_PDOWN has been removed.

SM\_STREAM has been removed from VS1063. To sync streams using VS1063, use samplerate finetuning.

SM\_ADPCM has been renamed SM\_ENCODE because VS1063 can also encode in other formats than IMA ADPCM.

SM\_ADPCM\_HP has been removed in the VS1063.

SM\_CLK\_RANGE has been added to VS1063. This should be activated if the input clock XTALI is 24...26 MHz.

## 4.2 Changed: SCI\_STATUS

SS\_DO\_NOT\_JUMP has been added to VS1063. This instructs the user that it is not allowed to fast forward or rewind in a file. Typically this bit is set when decoding important headers, e.g. the first 4 KiB headers of an Ogg Vorbis file, or if the file type doesn't allow random access, like MIDI files.

SS\_SWING bits have been added to VS1063. Typical users will not need to touch these bits. The same is true for new bits SS\_VCM\_OVERLOAD and SS\_VCM\_DISABLE.

SS\_VER is 3 for VS1003 and 6 for VS1063. The field has also been expanded to four bits in VS1063 (bits 6:4 on VS1003, bits 7:4 on VS1063). Note that bit 7 is 0 in all earlier VS10XX IC's, so all four bits can be read regardless of IC version.

SS\_AD\_CLOCK can be set to divide the Analog-to-Digital modulator frequency by 2 if XTALI is in the 24...26 MHz range.

SS\_REFERENCE\_SEL has been added to VS1063. If AVDD  $\geq$  3.3 V, setting this bit will set reference voltage to 1.65 V instead of the default 1.25 V and increases analog output and input swing accordingly.

## 4.3 Changed: SCI\_CLOCKF

Bits in register SCI\_CLOCKF has changed. See the datasheets for details.

## 4.4 Changed: SCI\_HDAT0 and SCI\_HDAT1

These registers give info on the supported audio formats. These registers contain new info for new codecs supported by VS1063.



## 5 User Applications

Because the memory addresses have changed the user applications, plugins and patches are different between VS1003 and VS1063.

## 6 Licenses

Earlier MP3 decoder ICs from VLSI Solution, including the VS1003, have included the MP3 decoder license. The price for VS1063 also includes the MP3 encoding license from Fraunhofer IIS and Thomson.

## 7 Microcontroller Examples

Examples on how to control VS1063 using a microcontroller are available at <http://www.vlsi.fi/en/support/software/microcontrollersoftware.html>

## 8 Latest Document Version Changes

This chapter describes the most important changes to this document.

### Version 1.00, 2012-11-28

- Initial revision.

## 9 Contact Information

VLSI Solution Oy  
Entrance G, 2nd floor  
Hermiankatu 8  
FI-33720 Tampere  
FINLAND

Fax: +358-3-3140-8288  
Phone: +358-3-3140-8200  
Email: [sales@vlsi.fi](mailto:sales@vlsi.fi)  
URL: <http://www.vlsi.fi/>