

VS1033 to VS1063 Migration Guide

Description

This document describes how to migrate from VS1033 to VS1063. It lists hardware and software differences and other considerations.

This document applies to all versions of VS1033 and VS1063, including VS1163 and VS8063.

| Revision History | | | |
|-------------------------|-------------|---------------|---------------------------------|
| Rev | Date | Author | Description |
| 1.11 | 2019-02-04 | POj | MP3 patents expired in 2017. |
| 1.1 | 2016-04-01 | POj | Analog output levels, SDI tests |
| 1.0 | 2016-02-02 | POj | Initial revision. |

Contents

| | |
|---|-----------|
| Description | 1 |
| Table of Contents | 2 |
| 1 General | 3 |
| 2 Hardware | 4 |
| 2.1 Changed: Voltages | 4 |
| 2.2 Changed: Analog Output Level | 4 |
| 2.3 Changed: PLL | 4 |
| 2.4 New: HiFi Stereo Line Input | 4 |
| 2.5 Changed: LQFP-48 Pin Descriptions | 4 |
| 3 Application Considerations | 6 |
| 3.1 Hardware Design | 6 |
| 3.2 Software Considerations | 6 |
| 4 SCI Registers | 7 |
| 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 |
| 4.5 SCI_VOL | 8 |
| 4.6 Sine and Memory Tests | 8 |
| 5 User Applications, Patches, Plugins | 9 |
| 6 Licenses | 9 |
| 7 Microcontroller Examples | 9 |
| 8 Latest Document Version Changes | 10 |
| 9 Contact Information | 10 |

1 General

VS1063 has many updated features compared to VS1033. The most significant differences are:

- New decoder formats: Ogg Vorbis, AAC and HE-AAC,FLAC, G.722.
- MPEG layer I (MP1) and MIDI decoders removed.
- VS1063 has a HiFi stereo line input instead of VS1033's single-channel input
- Encoding
 - Added MP3¹, Ogg Vorbis, μ -law, A-law, G.722, and PCM WAV encoding.
 - Added codec mode (encoder and decoder at the same time) that works with μ -law, A-law G.722, IMA ADPCM, PCM WAV, 24-bit and 32-bit floating point WAV.
 - RIFF-WAV header is generated automatically in WAV encoding (and codec) mode. The user needs to fix the RIFF size and data size fields to make them valid WAV files.
- The highest allowed internal clock speed has increased from 50.0 MHz to 67.6 MHz.
- Two I2S interface pins moved from GPIO0 and GPIO1 to GPIO6 and GPIO7.
- VS1063 and VS1033 have different operating voltage ranges.
- VS1063 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.
- Sample-exact samplerate and volume change.
- Parametric data structure contains 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

¹ MP3 encoder is not available in VS1163, MP3 encoder and decoder are not available in VS8063.

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

See the VS1063 Datasheet and VS1063 Hardware Guide for details about the new features.

2 Hardware

VS1033 and VS1063 have a few external hardware differences which are listed in this chapter.

2.1 Changed: Voltages

Analog voltage AVDD has changed from 2.7...3.6 V in VS1033 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...2.7 V in VS1033 to 1.7...1.85 V in VS1063.

I/O voltage IOVDD has changed from CVDD-0.6...3.6 V in VS1033 to 1.8...3.6 V in VS1063.

In most cases you only need to change the CVDD regulator from 2.5 V to 1.8 V.

2.2 Changed: Analog Output Level

The Typical, Min and Max levels of the analog outputs are on average from 1 dB to 2 dB higher in VS1063 than in vs1033d. Typical: 1.85 Vpp vs. 1.5 Vpp, respectively.

2.3 Changed: PLL

The PLL control through the SCI_CLOCKF register allows higher clocks by leaving out 1.5× multiplier and 0.5× addition.

This means that the value written to SCI_CLOCKF needs to be verified. With the same value the vs1063 will be clocked with up to 1.0× higher clock, which is just within limits, if you use the quite normal vs1033 CLOCKF value of 0x9800.

A good default SCI_CLOCKF value for vs1063 is 0xc000.

The internal PLL can be used to increase the clock to a speed up to 67.6 MHz.

2.4 New: HiFi Stereo Line Input

Both VS1033 and VS1063 feature a differential microphone and single-ended line-level input. However, VS1063 adds another channel to the analog-to-digital converter allowing stereo input. The input can be two line inputs or mic + line input depending on the configuration bit SM_LINE1 in the SCI_MODE register. VS1063's analog-to-digital converters are also more advanced, so they offer true HiFi sound.

2.5 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 compared to VS1033.

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 | Moved from GPIO0 for VS1063 |
| GPIO7 / I2S_SDATA | 12 | DIO | Moved from GPIO1 for VS1063 |
| XDCS / BSYNC | 13 | DI | Can be read as a GPI pin |
| 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 | Can be read as a GPI pin |
| CVDD2 | 24 | CPWR | |
| GPIO5 / I2S_MCLK | 25 | DIO | |
| RX | 26 | DI | |
| TX | 27 | DO | |
| SCLK | 28 | DI | Can be read as a GPI pin |
| SI | 29 | DI | Can be read as a GPI pin |
| SO | 30 | DO3 | The state of SO while xCS is low can be set in VS1063 |
| CVDD3 | 31 | CPWR | |
| XTEST | 32 | DI | |
| GPIO0 | 33 | DIO | |
| GPIO1 | 34 | DIO | |
| GND | 35 | DGND | |
| GPIO4 / I2S_LROUT | 36 | DIO | |
| 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 | This 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

VS1033 and VS1063 have a few differences in registers that are not compatible with each other. Care should be taken when porting VS1033 microcontroller software to VS1063. The following chapters list some of these differences. For more info on the registers, see *VS1033 Datasheet* and *VS1063 Datasheet*.

4.1 Changed: SCI_MODE

SM_LAYER12 allows decoding of MP2 files on VS1063.

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_LINE1 (was SM_LINE_IN) switches between differential microphone (MICP/MICN) and line input (LINE1) operation. This bit is set after reset by default and selects the line input mode. Clear this bit to select the differential mode and to enable the microphone amplifier.

4.2 Changed: SCI_STATUS

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 5 for VS1033 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.

Due to a hardware volume control, there are no longer digital filter scaling (AVOL) bits in SCI_STATUS. These bits have been replaced by SS_AD_CLOCK and SS_REFERENCE_SEL.

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. The setting increases analog output and input swing accordingly.

4.3 Changed: SCI_CLOCKF

SCI_CLOCKF allows higher clocks to be configured by leaving out the $1.5\times$ multiplier and $+0.5\times$ addition. The regular SCI_CLOCKF value 0x9800 is barely within the speed limits (with 12.288 MHz XTALI), but you may consider changing the value. 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 values for new codecs supported by VS1063.

4.5 SCI_VOL

Operation and format of the volume control register SCI_VOL has not changed.

VS1063 contains hardware volume control that changes volume when zero-crossing is detected in the data (or after a timeout). This minimizes the audible disturbance when volume is changed.

4.6 Sine and Memory Tests

In vs1063a sine test and other tests started through SDI require additional 7-8 zero bytes to be sent to SDI for them to start.

5 User Applications, Patches, Plugins

Because the memory addresses change between the chip revisions, user applications, plugins and patches are almost always chip-specific and revision-specific.

With vs1063a you would be using the vs1063a Patches Package. Refer to its documentation for details.

6 Licenses

If the end product plays formats that require licenses, refer to the *Licenses* chapter of the VS1063 Datasheet. As of year 2017 patents related to MP3 have expired and MP3 does not require licenses.

7 Microcontroller Examples

Examples on how to control VS1063 using a microcontroller are available in VSDSP Forum thread **Microcontroller examples for VS1063, VS1053, VS1003, VS1011**
<http://www.vsdsp-forum.com/phpbb/viewforum.php?f=11>

8 Latest Document Version Changes

This chapter describes the most important changes to this document.

Version 1.11, 2019-02-04

- MP3 patents have expired in 2017.

Version 1.10, 2016-03-29

- Added the difference in output level.

Version 1.00, 2016-02-03

- Initial revision.

9 Contact Information

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

URL: <http://www.vlsi.fi/>
Phone: +358-50-462-3200
Commercial e-mail: sales@vlsi.fi

For technical support or suggestions regarding this document, please participate at
<http://www.vsdsp-forum.com/>
For confidential technical discussions, contact
support@vlsi.fi