VS1003 to VS1053

VS1003 to VS1053 Migration Guide

Description

This document describes how to migrate from VS1003 to VS1053. It lists hardware and software differencies and other considerations.

This document applies to all versions of VS1003 and VS1053.

Unless otherwise noted, all VS1053 points in this document also apply to VS8053.

Revision History			
Rev	**Date**	**Author**	**Description**
1.11	2019-02-04	POj	Contact information updated.
1.01	2012-11-28	HH	Minor modifications.
1.00	2012-11-21	HH	Initial revision.

Contents

1 General

VS1053 has many updated features compared to VS1003. The most significant differences are:

- VS1053 has a HiFi stereo line input as opposed to VS1003's mono voice input
- VS1053 can decode many new formats that the VS1003 cannot: Ogg Vorbis, AAC and HE-AAC, MP1/MP2 (Only Ogg Vorbis available in VS8053).
- VS1053 can decode FLAC with a software plugin.
- VS1053 can encode IMA ADPCM also in stereo.
- VS1053 can encode Ogg Vorbis with a software plugin.
- VS1003 could be used with a 12...13 MHz fundamental frequency clock. In addition to this, VS1053 can also use a 24...26 MHz clock.
- The highest allowed internal clock speed for VS1003 was 52.0 MHz. VS1053 can run at 55.3 MHz.
- VS1053 has an I2S interface for external DACs.
- VS1053 has more GPIO pins.
- VS1053 and VS1003 have different operating voltage ranges.
- VS1053 is only available in LQFP-48 packaging.
- VS1053 features EarSpeaker spatial processing.

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

2   Hardware

VS1003 and VS1053 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 VS1053 (3.3...3.6 V if you use the higher 1.65 V reference voltage REF, but most designs are easier with the default REF = 1.23 V).

Digital core voltage CVDD has changed from 2.4...2.85 V in VS1003 to 1.7...1.85 V in VS1053.

I/O voltage IOVDD has changed from CVDD-0.6...3.6 V in VS1003 to 1.8...3.6 V in VS1053.

In practise this means that it is not possible to design a system for VS1053 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 up to 52 MHz.

VS1053 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. Then an internal PLL can be used to increase the clock to a speed up to 55.3 MHz.

2.3   New: HiFi Stereo Line Input

Both VS1003 and VS1053 feature a differential microphone and one-sided line-level input. However, VS1053 adds another channel to the line-level input allowing stereo input. VS1053'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 VS1053.

Pin description changes:

Pad Name	LQFP Pin	Pin Type	New Function For VS1053
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 VS1053
GPIO7 / I2S_SDATA	12	DIO	Both functions new for VS1053
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 VS1053
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 VS1053
GPIO4 / I2S_LROUT	36	DIO	Both functions new for VS1053
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 VS1053

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 VS1053.

3.1   Hardware Design

VS1053 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 *VS1053 Datasheet* for details.

Outputs of the DACs need RC filters when connecting them to an external power amplifier. The DAC type for VS1053 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 *VS1053 Datasheet* for details.

3.2   Software Considerations

VS1053 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 *VS1053 Datasheet* Chapter *Extra Parameters* for more info.

When using VS1053 in playback mode, it is highly recommended that the latest version of VS1053b Patches w/ FLAC Decoder is loaded and running. This package corrects several bugs in the VS1053 ROM firmware and also adds some new features. The package can be downloaded from
`http://www.vlsi.fi/en/support/software/vs10xxpatches.html`

Because VS1053 allows both stereo and mono recording, the ADPCM recording interface has been changed accordingly, making it possible to record in stereo or in mono through either of the inputs.

In addition to the recording options in the ROM firmware, there are also two different VS1053 applications that make it possible to record in Hi-Fi PCM or compressed Ogg Vorbis formats, called VS1053 WAV PCM Recorder Application and VS1053 Ogg Vorbis Encoder Application, respectively. For these applications, see
`http://www.vlsi.fi/en/support/software/vs10xxapplications.html`

4 SCI Registers

VS1003 and VS1053 have a few differences in registers that are not compatible with each other. Care should be taken when porting VS1003 microcontroller software to VS1053. The following chapters list these differences. See for more info on the registers in the *VS1003 Datasheet* and *VS1053 Datasheet*.

4.1 Changed: SCI_MODE

SM_LAYER12 allows decoding of MP1 and MP2 files on VS1053.

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 replaced with SM_EARSPEAKER_LO which controls the EarSpeaker earphone audio auralization algorithm. For the same reason also a bit SM_EARSPEAKER_HI has been added.

SM_ADPCM has been renamed SM_ENCODE because VS1053 can also encode in other formats than IMA ADPCM.

SM_ADPCM_HP has been removed in the VS1053.

SM_CLK_RANGE has been added to VS1053. 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 VS1053. 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 VS1053. 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 4 for VS1053. The field has also been expanded to four bits in VS1053 (bits 6:4 on VS1003, bits 7:4 on VS1053). Note that bit 7 is 0 in all earlier VS10XX IC's, so all four bits can be read regardless of IC version.

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 VS1053.

5   User Applications

Because the memory addresses have changed the user applications, plugins and patches are different between VS1003 and VS1053.

6   Microcontroller Examples

Examples on how to control VS1053 using a microcontroller are available at
http://www.vlsi.fi/en/support/software/microcontrollersoftware.html

7   Latest Document Version Changes

This chapter describes the most important changes to this document.

Version 1.11, 2019-02-04

- Contact information updated.

Version 1.01, 2012-11-28

- Added Chapter 6, *Microcontroller Examples*.
- Other minor modifications.

Version 1.00, 2012-11-21

- Initial revision.

8   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

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support@vlsi.fi