VS1011 to VS1053

VS1011 to VS1053 Migration Guide

Description

This document describes how to migrate from VS1011 to VS1053. It lists hardware and software differencies and other considerations.

This document applies to all versions of VS1011 and VS1053.

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

Revision History			
Rev	**Date**	**Author**	**Description**
1.13	2025-03-14	POj	(old) sine test requires 12 zeroes.
1.12	2023-12-22	POj	Clarifications to CLOCKF and CVDD.
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 VS1011. The most significant differences are:

- VS1011 and VS1053 have different operating voltage ranges.
  VS1053 has an additional supply voltage pin CVDD.

- VS1053 is only available in LQFP-48 packaging.

- VS1053 has a HiFi stereo line input / differential microphone input.

- VS1053 can decode many new formats that the VS1011 cannot: Ogg Vorbis, WMA, AAC and HE-AAC, MIDI (Only Ogg Vorbis and MIDI available in VS8053).

- VS1053 can decode FLAC with a software plugin.

- VS1053 can encode IMA ADPCM in mono or stereo.

- VS1053 can encode Ogg Vorbis with a software plugin.

- VS1053 has an internal PLL and a control register for it.

- VS1053 has a UART so it can be connected to VSIDE.

- VS1053 has an I2S interface for external DACs.

- VS1053 has 8 GPIO pins.

- VS1053 features EarSpeaker spatial processing.

Due to these new features the pin-out and register interface has been changed accordingly.

2   Hardware

VS1011 and VS1053 have a few hardware differences.

2.1   New: Core Voltage

The biggest difference is the Core Voltage in VS1053. In addition to Analog and Digital (IO) Voltage the VS1053 features a separate voltage input for the VSDSP core. The range for this voltage is 1.7 V. . . 1.85 V.

2.2   Changed: Analog and I/O Voltage

At 2.5. . . 3.6 V, the VS1011's analog voltage AVDD has stayed the same in VS1053 (unless you use the higher 1.65 V reference voltage REF, which makes the limits 3.3. . . 3.6 V, but most designs are easier with the default REF = 1.23 V).

VS1011's DVDD which was 2.3. . . 3.6 V has been replaced with IOVDD, which is 1.8. . . 3.6 V in VS1053.

With VS1011 it is easy to use only one operating voltage between 2.5 V and 3.6 V for both DVDD and AVDD. With VS1053 you need at least two supply voltages: one for CVDD and another for AVDD and IOVDD.

2.3   New: Internal PLL

VS1053 has an internal PLL that can be used to generate an internal clock sufficiently high for decoding the new audio formats and for effects. See more info on the PLL and the associated SCI_CLOCKF register in the *VS1053 Datasheet*.

VS1053 has a VCO output pin. This pin is used for tests only and should be left unconnected.

2.4   Changed: Clocking

VS1011 is clocked with either a 24. . . 26 MHz or 12. . . 13 MHz crystal. In the latter case an internal clock doubler could be used to achieve internal clock speed of up to 26 MHz.

VS1053 uses similar external clock ranges. However, it can use its PLL to increase the internal clock to up to 55.3 MHz. The recommended crystal for vs1053 is 12.288 MHz.

2.5   New: HiFi Stereo Line Input

VS1053 features a differential microphone and one-sided HiFi stereo line-level input.

2.6   Changed: LQFP-48 and BGA-49 Pin Descriptions

The following table describes the new pins and functions for VS1053.

See dimensions for the LQFP-48 package from *http://www.vlsi.fi/* .

Both LPQFP-48 and BGA-49 are lead (Pb) free and also RoHS compliant packages. 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*.

Pin descriptions:

Pin Name	LQFP Pin	Pin Type	Change for VS1053
MICP / LINE1	1	AI	Microphone input or left line input, new for VS1053.
MICN	2	AI	Microphone input, new for VS1053.
XRESET	3	DI	
DGND0	4	DGND	
CVDD0	5	CPWR	Core power, new for VS1053.
IOVDD0	6	IOPWR	Only I/O Power in VS1053.
CVDD1	7	CPWR	Core power, new for VS1053.
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	Only I/O Power in VS1053.
VCO	15	DO	For testing purposes (don't connect), new for VS1053
DGND1	16	DGND	
XTALO	17	AO	
XTALI	18	AI	
IOVDD2	19	IOPWR	Only I/O Power in VS1053.
DGND2	20	DGND	
DGND3	21	DGND	
DGND4	22	DGND	
XCS	23	DI	
CVDD2	24	CPWR	Core power, new for VS1053.
GPIO5 / I2S_MCLK	25	DIO	Both functions new for VS1053
RX	26	DI	UART receive, new for VS1053.
TX	27	DO	UART transmit, new for VS1053.
SCLK	28	DI	
SI	29	DI	
SO	30	DO3	
CVDD3	31	CPWR	Core power, new for VS1053.
TEST	32	DI	Connect to IOVDD instead of VDD on VS1053.
GPIO0 / SPIBOOT	33	DIO	Use 100 kΩ pull-down resistor if you don't want SPI Boot
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	
LINEIN	48	AI	Right channel line input, new for 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.

PCB traces from analog connections (perticularly mic and line inputs) should be kept as short as possible.

Each voltage input pin should be bypassed with 100 nF capacitor for best performance.

3.2   Software Considerations

Fast Forward and Rewind operations differ between different audio formats. MP3 and WAV are well suited for random access and can be fast forwarded and rewinded as with VS1011. Other formats need special attention.

If you don't want the product to play certain formats, you can use SCI_HDAT1 register to determine the currently playing file type. You can then skip the file if the format is something you don't want played. See the *VS1053 Datasheet* for detailed info.

When using VS1053, it is highly recommended that the latest version of VS1053b Patches 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`

If you use the (old) sine test, send 12 zero bytes (instead of 4) after the sine test start and exit sequences (i.e. 16 bytes each). The same applies to other tests started through SDI.

4   SCI Registers

VS1011 and VS1053 have a few differencies in registers that are not compatible with each other. Extreme care should be taken when porting VS1011 microcontroller software to VS1053. The following chapters list these differencies. See more info from the *VS1011 Datasheet* and *VS1053 Datasheet*.

4.1   Changed: SCI_MODE

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_SETTOZERO1 and SM_SETTOZERO2 have been replaced with SM_EARSPEAKER_LO and SM_EARSPEAKER_HI which controls the EarSpeaker earphone audio auralization algorithm.

SM_ADPCM, SM_LINE1 have been added to control audio recording in ADPCM or PCMformat.

SM_CLK_RANGE has been added to tell whether the crystal is 12...13 MHz, or 24...26 MHz. The recommended crystal for vs1053 is 12.288 MHz. If you use 24.576 MHz instead, set the SM_CLK_RANGE bit in SCI_MODE as soo as possible after reset (and make sure you keep it set in subsequent writes to SCI_MODE).

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 1 for VS1011B, 2 for VS1011E, and 4 for VS1053. The field has also been expanded to four bits in VS1053 (bits 6:4 on VS1011, 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

In VS1011 SCI_CLOCKF was used to tell if the input crystal was something else than 24.576 MHz, and to activate its optional clock doubler.

VS1053 has an internal PLL which can be run at $0.5{\times}$XTALI steps between $1.0{\times}$XTALI and $7.0{\times}$XTALI (but without exceeding the maximum internal clock CLKI = 55.3 MHz). This PLL is controlled with the same register SCI_CLOCKF.

The suggested crystal for VS1053 is 12.288 MHz. With vs1053 a good default for SCI_CLOCKF is 0x8000 (for $3.5{\times}$ clock), which is the same value that vs1011 uses with a 12.288 MHz crystal and clock doubler.

Read the *VS1053 Datasheet* for more details.

4.4   Changed: SCI_HDAT0 and SCI_HDAT1

These registers give info on the supported audio formats. With the new codecs supported in VS1053 these registers contain new info. They are also used for reading data when recording audio.

You can use SCI_HDAT1 register to determine the currently playing file type. You can then skip the file if the format is something you don't want played. See the *VS1053 Datasheet* for detailed info.

5   User Applications

Because the memory addresses have changed the user applications, plugins and patches are different between VS1011 and VS1053.

6   Licenses

If the end product plays formats that require licenses, refer to the *Licenses* chapter of the VS1053 Datasheet. As of year 2017 patents related to MP3 have expired and MP3 does not require licenses.

See section 4.4 on how to detect file formats.

7   Microcontroller Examples

Examples on how to control VS1053 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 1.13, 2025-03-14

- Tests started through SDI require 12 zero bytes to start.

Version 1.12, 2023-12-22

- Clarifications for CLOCKF and CVDD.

Version 1.11, 2019-02-04

- Contact information updated.

9   Contact Information

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