



VPROC SDK Package

Quick Start Guide

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TABLE OF CONTENTS

CHAPTER 1	INTRODUCTION	1
1.1	Overview	1
1.2	ZLS38100 Software Design Flow	1
1.3	VPROC Software Package Components	2
CHAPTER 2	FIRST STEPS	5
2.1	Step 1: Configure the VPROC SDK PRE-COMPILE OPTIONS	5
2.2	Step 2: Write/Modify the SSL and HAL modules	7
2.3	Step 3: Test the HBI and HAL	8
2.4	Step 4: Load a firmware and config into the VPROC	8
2.5	Step 5: Write the Final Application	9
CHAPTER 3	PORTING	11
3.1	The Ambarella platform SDK	11
3.2	Ambarella SDK device tree modifications	11
3.2.1	Device tree modification for VPROC HBI=I2C device registration	11
3.2.2	Device tree modification for VPROC HBI=SPI device registration	12
3.2.3	Device tree modification for VPROC SOUND device registration	13
3.3	Loading and testing the VPROC SDK on an Ambarella platform	13
CHAPTER 4	QUICK START APPLICATIONS	15
4.1	Overview	15
4.2	User Modifications	16
CHAPTER 5	BUILDING THE CUSTOMER APPLICATION	19
5.1	Generating VPROC configuration record and convert files	21
5.2	Compile/Recompile the Application and Run	27
5.3	Next Steps	27

1.1 OVERVIEW

The ZLS38100 Software Development Kit (SDK) is a collection of software, tools, code examples, and documents that allow rapid application development with the Microsemi Timberwolf device series. With the ZLS38100 Software Package, little or no knowledge of the low-level control of Timberwolf ICs is needed to fully utilize the chipset. The ZLS38100 software is designed to simplify implementation and reduce customers' time to market.

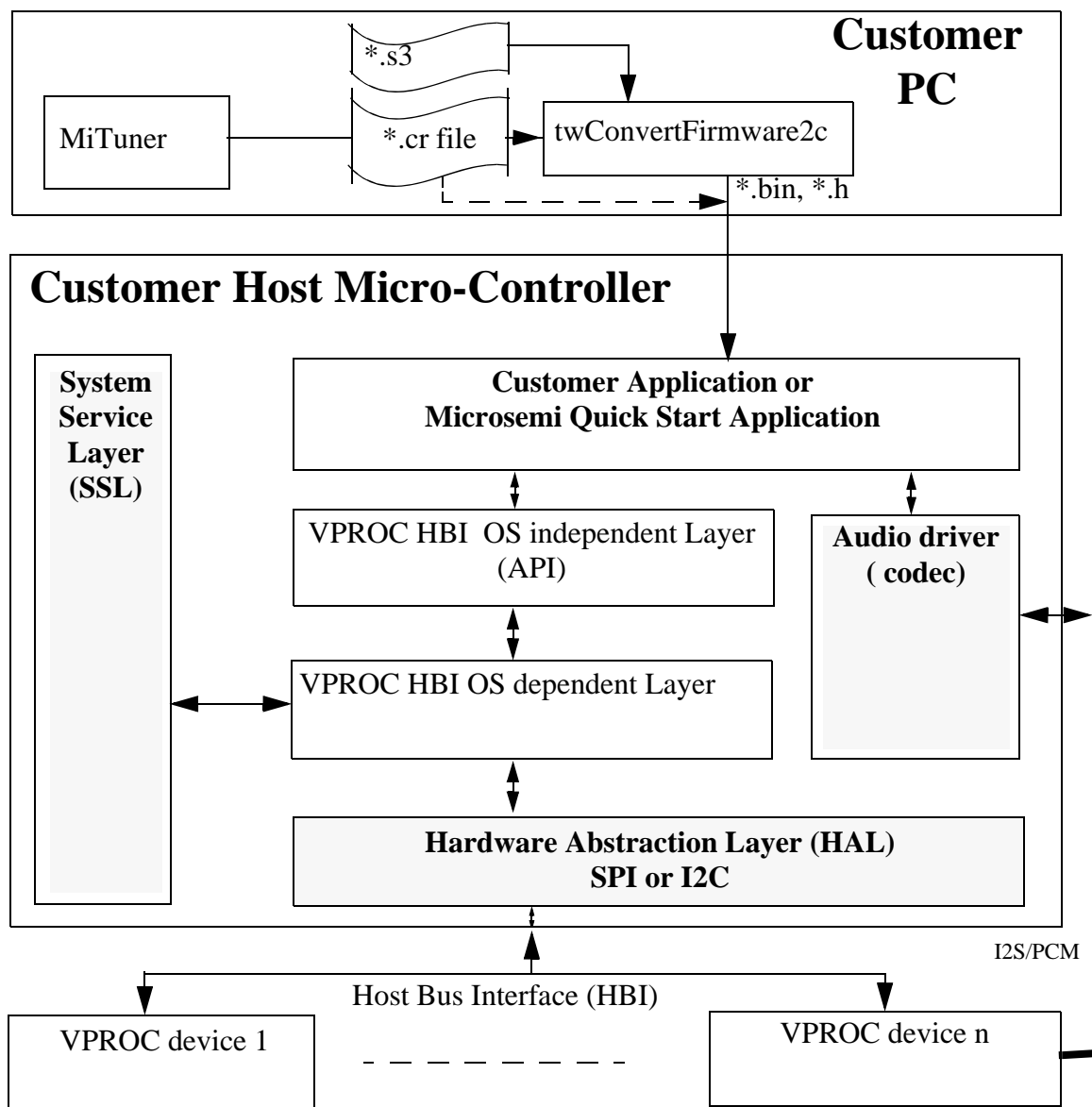
This Quick Start Guide provides an overview of the ZLS38100 SDK and how the Package is used to demonstrate some of the features supported by the Timberwolf devices.

Note: Within this document, the terms VPROC SDK and ZLS38100 SDK or ZLS38100 Software package are used interchangeably

1.2 ZLS38100 SOFTWARE DESIGN FLOW

The following diagram introduces the prominent elements of the VPROC SDK software architecture. It is recommended that the user reads the VPROC SDK Reference Guide introduction for more precise details on these elements.

Figure 1–1 System Diagram



1.3

VPROC SOFTWARE PACKAGE COMPONENTS

The ZLS38100 Software Package contains tools, code, documentation, and examples applications for developing products based on the Timberwolf chipset. The following is a list of components distributed in the SDK.

- ZLS38100 SDK (source and documentation)
- ZLS38100 Software Release and Errata Notice
- Quick Start Demo Applications
- Platform - SPI, I2C, ALSA & SSL Example drivers (See shaded blocks in the above software block diagram)

To find more about these items and where they (and their documentation) can be located, refer to Table 1 below. The pathnames found in the table use "xxx" to represent version numbers and product strings that are subject to change.

Table 1–1 Common Components List

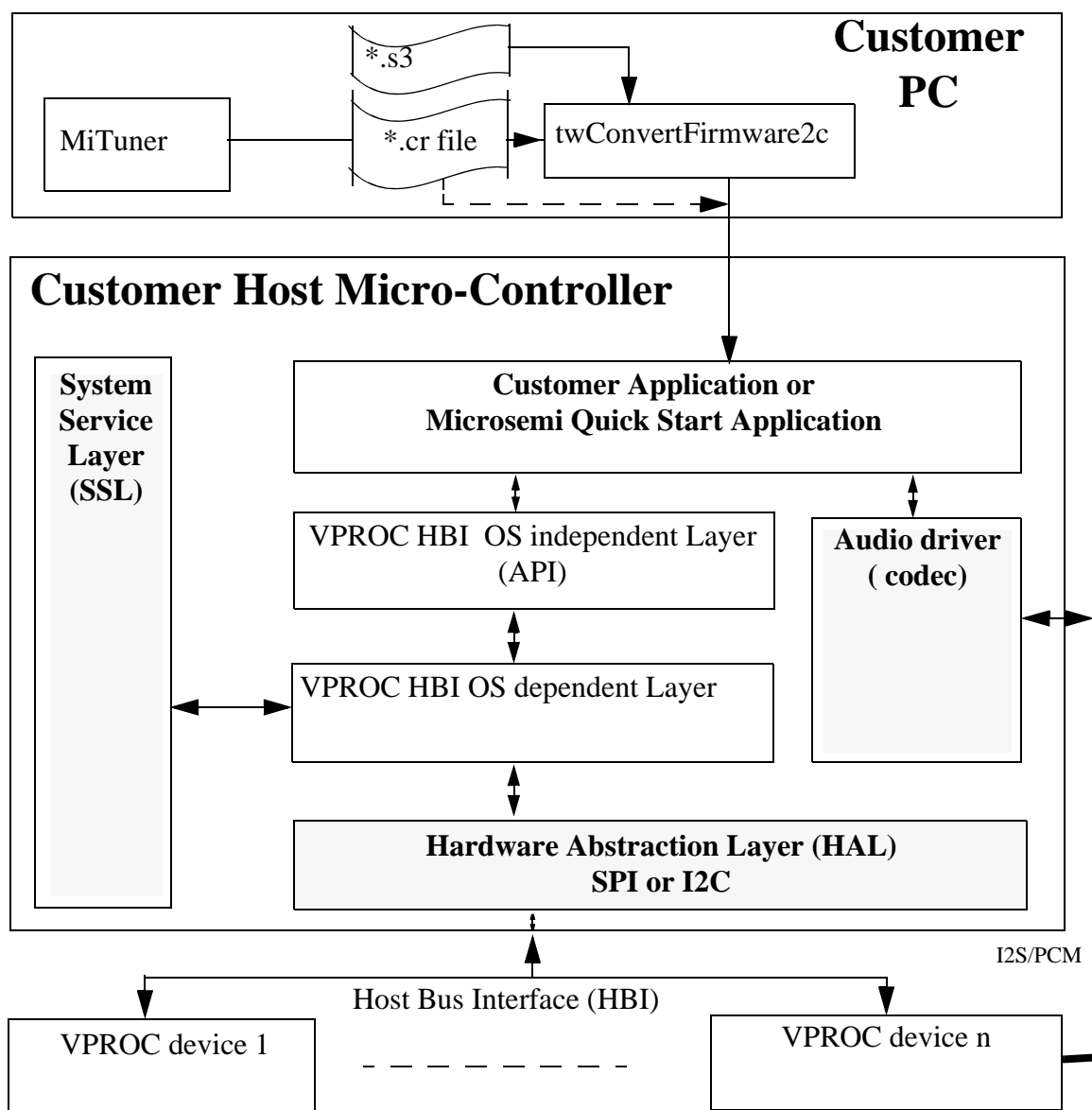
Component	Description	Documentation
Makefile, Makefile.globals	Main makefiles for the SDK. The makefile.globals contains system hardware and software configurations that must be set accordingly by the VPROC SDK user, prior to compiling the SDK.	See first Steps chapter within this document
config.mk	It converts the Makefile.globals variables to "C" compiler options and add relevant include paths.	
VPROC HBI	This C-language library provides a common, consistent interface to Microsemi's Timberwolf Voice Processing devices. This is referred in this document as the VPROC API layer of the SDK, which is executed on a host processor, simplifies the task of communicating with the VPROC chipset. Location: <i>install_dir/drivers/hbi</i>	VPROC SDK Reference Guide - the primary reference to consult when developing VPROC application software. (<i>"/install_dir/documents"</i>) Location: <i>install_dir/documents</i>
VPROC Linux	This component exists only in release that depends on Linux. It is the C-language library that binds the VPROC HBI layer to the platform layer to the application layer of the SDK. This layer of code is divided into a kernel specific library that provides the interfacing between the VPROC HBI layer and the platform (HAL drivers) layer, and a user-space library that provides the interfacing between the VPROC HBI layer to the user-applications layer.	
Sound drivers	<i>The sound codec and machine driver are integrated to the VPROC SDK in order to interface the Timberwolf to an audio controller. These modules must be tailored to meet the specific underlying platform. The example working implementation of the machine driver is provided for a Linux platform based on the Ambarella S2L Micro-controllers. The codec driver is not controller specific.</i> Location: <i>install_dir/platform/ambarella/driver/sound</i>	VPROC SDK getting started guide Location: <i>install_dir/documents</i>
Firmware and Configuration Conversion tool	The Conversion tool must be used to format the Timberwolf firmware into either a binary file that can be loaded into the device dynamically or in c source code that can be compiled with the VPROC SDK application statically. Location: <i>install_dir/tools</i>	

Table 1–1 Common Components List

Component	Description	Documentation
HAL & SSL Examples	<p>These C language samples of Hardware Abstraction Layer and System Services Layer implementations provide examples of the functions the user must implement for their architecture. Extensively commented.</p> <p>Location: <i>install_dir/platform/ambarella/driver/ssl</i></p> <p>Note: <i>There are two samples of the HAL (for I2C and SPI) and one sample of the System Services Layer. User should choose the one that is most appropriate for their application when starting development of a VPROC application.</i></p>	<p>VPROC SDK Reference Guide</p> <p>Location: <i>install_dir/documents</i></p>
Quick Start Applications	<p>This source code may be compiled to create an application that demonstrates functional aspects of the VPROC SDK.</p> <p>Location: <i>install_dir/apps/</i></p> <p>This directory contains examples VPROC application initializing and controlling the Timberwolf chipset.</p>	<p>Chapter 4, on page 15</p>

There is a natural sequence to VPROC system development to ensure quick and proper system operation. The first steps in bringing up a new VPROC design are shown in [Figure 2–1, Steps To Take, on page 5](#). Steps to follow.

Figure 2–1 Steps To Take



2.1

STEP 1: CONFIGURE THE VPROC SDK PRE-COMPILE OPTIONS

The API contains several pre-processor options used throughout the code that must be configured in accordance to the platform and design. These options are defined in the "Makefile.globals" located in the "root" directory of the VPROC SDK source tree. The options that must be set for a basic configuration are:

PLATFORM= *this option must be named as per the directory created under the platform folder of the SDK. For the ZLS38100 the platform is by default set to ambarella, since the platform related codes for the Ambarella Micro-controllers are located within a folder named "ambarella".*

VPROC_MAX_NUM_DEVS= *this option must be set to the exact number of Timberwolf VPROC chipsets that need to be controlled by the SDK. Default setting is set to 1. Example to support 4 Timberwolf devices in the design, simply set this variables to 4.*

HBI_MAX_INST_PER_DEV= *this option must set to the number of instances that can be opened per device driver. This is only required for multi-threaded or multi-process applications that want's to access the device from multiple threads or processes.*

KSRC= *this variable must be set to the exact path to where to find the Linux kernel for which to compile the kernel related codes of the SDK.*

Example:

```
export KSRC=$(PLATFORM_DIR)/s2l_purelinux_sdk2_0/Ambarella/out/s2lm_kiwi/kernel
```

TOOLSPATH= *this must be set to the exact path to where the tool chain needed to compile the SDK is located on the development machine.*

ARCH= *Micro-controller architecture. For the ZLS38100 release this is set to arm for an arm cortex architecture.*

CROSS_COMPILE= *this must be set to the exact compiler that should be used to compile the SDK.*

Example

```
export TOOLSPATH=$(PLATFORM_DIR)/tools/linaro-multilib-2014.09-gcc4.9
```

All other options can be left as per default definition. See table below for a full list of the variables defined within the "Makefile.globals".

Option	Value	Comments
BOOT_FROM_HOST	yes, no	Yes if the VPROC firmware is to be loaded into the device via the SPI/I2C. No, otherwise
HBI_MAX_INST_PER_DEV	a value from 1 to 2^31	Specifies the maximum number of simultaneous user per VPROC device. Keep it to 1
FLASH_PRESENT	yes, no	Yes, if the VPROC device is controlling a slave FLASH. No, otherwise
VPROC_DEV_ENDIAN	big	Endianness of the VPROC device. Keep this setting to big
HBI_BUFFER_SIZE	a value greater than 16	This must set to a value large enough to support large HBI transaction to the VPROC device. This option must not be set to a value lower than 16.
HBI_ENABLE_PROCFS	0, 1	This is optional procfs interface to the SDK. It provided an alternative way to perform all the device access features supported by the SDK
VPROC_MAX_NUM_DEVS	a value from 1 to 2^31	Specifies the total number of VPROC devices in the design to be supported by the SDK.

Option	Value	Comments
TARGET	TW	This defines the VPROC device type. Currently only TW VPROC device type is supported by the SDK
HBI	I2C, SPI	Specifies the physical host control bus interfaced to the VPROC device.
BUILD_TYPE	DEBUG, RELEASE	Set to release if the SDK is to be built for a formal release. For release, Debug print are disabled. Debug level are only accessible in DEBUG build type
HOST_ENDIAN	big, little	Endianness of the host platform
VPROC_DEV_NAME_SIZE	any decimal number up to 2 ³¹	This is optional. It specifies the maximum number of characters for the device name.
NUM_MAX_LOCKS	a value from 1 to 2 ³¹	This is optional. It indicates the maximum number of SSL locks that can be used by the driver.
DEBUG_LEVEL	Bitmask for VPROC_DBG_LVL 0 - none 1 - function entry/exit 2 - information 3 - warning 4 - error 5 - All (levels: 2-4)	This debug level to the exception of error are only available if the BUILD_TYPE = DEBUG

2.2

STEP 2: WRITE/MODIFY THE SSL AND HAL MODULES

These thin layers provide functions allowing the VPROC SDK to enforce mutual exclusion and to communicate with the VPROC device through the HBI bus. The SDK supports both I2C or SPI interfacing to the Host controller.

Example implementations of both of these layers in accordance to a Linux platform are available in the `/install_dir/platform/driver/ssl` directory of the VPROC SDK. (See the *Porting the SDK to the Raspberry Pi platform* chapter for more info)

Note:

These modules are platform dependant, therefore, the user must ensure that the types defined in `/install_dir/platform/include/typedefs.h` are applicable to the customer's target environment.

At this point, the VPROC SDK should be able to compile.

Compile the SDK by issuing the command or as per your compile environment.

```
make hbi_clean
make hbilnx_clean
make hbilnx <options>
```

This will build `/platform`, `/hbi` and `/hbilnx` components and save output `hbi.ko`, `s2l_z1380xx_audio.ko`, and `snd-soc-z1380xx.ko` in `/libs` directory.

<options>: HBI=I2C to build the HBI for I2C host access or HBI=SPI to build the HBI for SPI host access. If option is omitted then the SDK will be compiled by default with HBI=SPI as defined within the Makefile.globals.

If error during compile, verify the following are included in the build process:

1. Compiler or tool chain needed to compile the SDK is defined within the Makefile.globals.
2. If using a Linux OS then make sure the Linux kernel path is defined within the Makefile.globals as indicated in step 1 above.

2.3 **STEP 3: TEST THE HBI AND HAL**

Various examples of demo host applications are provided within the *install_dir/APPS* directory of the SDK. Compile the *hbi_test.c* host application, use it to verify that the host can communicate with the VPROC device. This Quick Start application demonstrates successful top-to-bottom integration of the system from the user application, to the VPROC HBI, to the HAL/SSL drivers, to the hardware.

To compile the apps issue the command

```
make apps
```

If compiled successfully, the executable *hbi_test* will be located in the same apps directory.

Use the *hbi_test* apps to write the following bytes into register 0x000C of the Microsemi VPROC device ID 0

Write: 0x1234, 0x5678 into register 0x00C of the VPROC device ID 0

```
hbi_test -d 0 -w 0x00C 0x1234 0x5678
```

Then read back the 4 bytes of data from register 0x00C

```
hbi_test -d 0 -r 0x00C 4
```

If successful, the expected read data from the VPROC device should be 0x1234, 0x5600. The last byte of the read is zeroed out by the VPROC device in order to signal to the host that it is alive and working properly.

2.4 **STEP 4: LOAD A FIRMWARE AND CONFIG INTO THE VPROC**

Optionally, if a firmware is to be loaded into the VPROC device via the host, then use the *twConvertFirmware2c* tool within the *install_dir/tools* directory to convert the Timberwolf firmware into a file format supported by the SDK.

The tool can be compiled and used on a Microsoft Windows system or a Linux system. Compile the *twConvertFirmware2c.c* code using any gcc compiler or optionally the same compiler used to compile the SDK.

Example:

```
gcc twConvertFirmware2c.c -o twConvertFirmware2c
```

The tool can convert the Timberwolf firmware *.s3 image and *.cr2 config record files into either a binary format that can be loaded into the device at runtime or into a c code header format that can be compiled with the SDK.

Example:

To see usage menu, run

```
twConvertFirmware2c.exe -h
```

To convert the a firmware image named *z138040_firmware.s3* in c-code format with block size of 16 words

```
twConvertFirmware2c.exe -i z138040_firmware.s3 -o z138040_firmware.h
```

```
-b 16 -f 38040
```

To convert a Timberwolf firmware image named `zl38040_firmware.s3` in binary format

```
twConvertFirmware2c.exe -i zl38040_firmware.s3 -o zl38040_firmware.bin
```

```
-b 16 -f 38040
```

To convert a Timberwolf VPROC configuration record into c-code format

```
twConvertFirmware2c.exe i zl38040_config.cr2 -o zl38040_config.h
```

Note: the block size is optional. If specified it must be a multiple of 16 (Ex: $16 \cdot 2^n$, where n : 0, 1, 2, 3) for the firmware and 1 (Ex: $16 \cdot 1^n$, where n : 0, 1, 2, 3, 4, 5, 6, 7) for the configuration record, and the maximum supported block size is 128. If not specified the block size default to 16 for the firmware and 1 for the configuration record.

Compile the `hbi_load_firmware.c` demo application and execute to load the converted firmware and the config record into the device

Example: to load the converted `zl38040_firmware.bin` and related `zl38040_config.bin` configuration record into the VPROC device

```
hbi_load_firmware -i zl38040_firmware.bin -c zl38040_config.bin
```

Run the Quick Start Application by following the instructions in [Chapter 4, on page 15](#).

2.5

STEP 5: WRITE THE FINAL APPLICATION

All physical connections are now verified to be working correctly, greatly simplifying the control application troubleshooting process. Refer to the VPROC Reference Guide for information on the API interface used by the host program to control the VPROC chipset. Please see also [Chapter 5, on page 19](#) for further advice.

3.1 THE AMBARELLA PLATFORM SDK

The Ambarella S2L SDK is based on Linux kernel 3.10.xx, the Ambarella S2L device driver registration is based on the Linux device tree driver registration method. Therefore the Microsemi HBI drivers for the Ambarella platform are implemented accordingly. The code within the platform folder is specific to the Ambarella SDK. The code implements both Hardware Abstraction Layer (HAL) and System Service Layer (SSL) codes, but also ALSA sound codec driver for the Microsemi VPROC device.

The HAL and SSL codes are located in directory "*install_dir/platform/ambarella/driver/ssl/*".

3.2 AMBARELLA SDK DEVICE TREE MODIFICATIONS

Ambarella provides a device configuration overlay with their SDK. The device tree configuration overlay (*.dts) file for the S2L SDK is located within the particular S2L board bsp folder ("*/s2l_purelinux_sdk2_x/ambarella/boards/s2lm_xx/bsp/s2lm_xx.dts*"). This file must be modified as per below to support the VPROC SDK.

The HAL drivers of the VPROC SDK supports either SPI or I2C HBI mode. the SDK can only be compiled for one or the other.

3.2.1 Device tree modification for VPROC HBI=I2C device registration

If the VPROC SDK is compiled with the HBI option set to I2C, then the following device tree node must be added into the S2L device tree (*.dts) for your board under the related I2C bus node within the *.dts file.

Example: If the VPROC device is interfaced to the S2L via I2C bus 0

```
i2c0: i2c@e8003000 {
    status = "ok";
    z1380i2c0: codec@45 {
        compatible = "ambarella, z1380i2c0";
        reg = <0x45>;
    };
};
```

Note: change the I2C address defined by the variable reg accordingly. The VPROC device can be configured for I2C address 0x45 if the HDIN pin of the device is tied to ground. Or, address 0x52 if the HDIN pin is tied to 3.3V. If registering multiple VPROC devices, then add extra nodes in the main i2cx node accordingly

Example: to support two VPROC devices one at address 0x45 and the other at address 0x52

```
i2c0: i2c@e8003000 {
    status = "ok";
    z1380i2c0: codec@45 {
        compatible = "ambarella, z1380i2c0";
        reg = <0x45>;
    };
    z1380i2c1: codec@52 {
        compatible = "ambarella, z1380i2c1";
```

```
        reg = <0x52>;
    };
};
```

3.2.2 Device tree modification for VPROC HBI=SPI device registration

If the VPROC SDK is compiled with the HBI option set to SPI, then comment out the uart1 node within the S2L *.dts file related node, and make sure the SPIx (x=0 in example below) node entry is as per below.

```
/*
uart1: uart@e0032000 {
    compatible = "ambarella,uart";
    reg = <0xe0032000 0x1000>;
    interrupts = <25 0x4>;
    pinctrl-names = "default";
    pinctrl-0 = <&uart1_pins_d &uart1_flow_pins_e>;
    status = "ok";
};
*/
spi0: spi@e0020000 {
    cs-gpios = <&gpio 37 0>, <&gpio 38 0>;
};
```

The VPROC SPI driver can also be instantiated using the device tree method by defining the following macro within the install_dir/platform/ambarella/driver/ssl/hal_spi.c driver code

```
#define SUPPORT_LINUX_DEVICE_TREE_OF_MATCHING
```

If this macro is defined, then a zl380xx node must be added within the SPI node of the dts file. Example below is given for a zl380spi01 connected to the S2L via SPI bus 0, and Chip Select 1. The SPI clock frequency is configured to 25MHz. The VPROC device can support SPI clock up to 25MHz (25000000). Keep the clock setting definition in the device tree file to the maximum 25MHz, if a lower SPI clock is desired set the desired value in the "install_dir/platform/Ambarella/driver/ssl/hal_spi.c" driver probe function code.

```
/*
uart1: uart@e0032000 {
    compatible = "ambarella,uart";
    reg = <0xe0032000 0x1000>;
    interrupts = <25 0x4>;
    pinctrl-names = "default";
    pinctrl-0 = <&uart1_pins_d &uart1_flow_pins_e>;
    status = "ok";
};
*/
spi0: spi@e0020000 {
    cs-gpios = <&gpio 37 0>, <&gpio 38 0>;
    zl380spi01: codec@1 {
        compatible = "ambarella, zl380spi01";
        spi-max-frequency = <25000000>;
        reg = <1>;
        spi-cpha;
        spi-cpol;
    };
};
```


An example modified *.dts file for the Ambarella S2L Kiwi platform in compatibility with the ZLS38120 SDK is included with the "install_dir/platform/ambarella/driver/ssl/" directory for guidance in modifying the Ambarella provided *.dts file.

3.2.3 Device tree modification for VPROC SOUND device registration

To add support for ALSA SoC audio driver, the sdk includes a codec driver that must be registered as a platform driver in order to keep it independent from the I2C or SPI communication driver. To port that codec driver into the Ambarella S2L SDK, first modify the device tree sound node within the *.dts file by adding the following two nodes as per below to add an entry for the zl380xx codec driver:

Add a dummy node as per below within the dts existing bogus_bus sub-node

```
bogus_bus {
zl380snd0: zl380snd0@1 {
    compatible = "ambarella,zl380snd0";
    status = "okay";
};
};
```

Then add a sound node as per below

```
sound {
    compatible = "ambarella,s2lmkiwi-zl380snd0";
    amb,model = " zl380snd0 @ S2LMKIWI";
    amb,i2s-controllers = <&i2s0>;
    amb,audio-codec = <& zl380snd0>;
};
```

Optionally, the VPROC SDK includes a modified version of the Ambarella ALSA machine driver for the Ambarella S2LM SoC in compliance with the Microsemi ZL380xx devices codec driver. The ALSA audio driver is located within "install_dir/platform/ambarella/driver/sound/lnxalsa/"

This file implements the ALSA machine driver aspect of the Ambarella S2L SoC in accordance to the Ambarella S2L SDK. Ambarella provides an equivalent ALSA machine driver with their SDK which can be modified as a replacement by simply modifying the following structures as per the ALSA machine driver provided with the ZLS38120.

```
static struct snd_soc_dai_link
static const struct of_device_id
```

Save the modified *.dts file and recompile the Ambarella S2L SDK.

If the specified bus resources assigned to zl380xx driver are unused, the driver will register itself with the Ambarella controller within the Linux kernel

3.3 LOADING AND TESTING THE VPROC SDK ON AN AMBARELLA PLATFORM

If the VPROC SDK is successfully compiled as described in the "First Steps" chapter of this document, then these resulting *.ko modules will be created.

```
install_dir/libs/lib/modules/`uname -r`/extra/hbi.ko
install_dir/libs/lib/modules/`uname -r`/extra/s2l_zl380xx_audio.ko
install_dir/libs/lib/modules/`uname -r`/extra/snd-soc-zl380xx.ko
```

Load these modules into the Ambarella platform using the insmod command or simply modify the Ambarella's SDK config and makefiles accordingly to load these drivers at platform power up. A successfully loading of these modules will result in the creation of the sound card entry under

/proc/asound

```
COM53 - PuTTY
# ls /proc/asound
S2LMKIWI card0      cards      devices    modules    pcm         timers      version
# aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: S2LMKIWI [z1380xx @ S2LMKIWI], device 0: z1380xx-STREAM z1380xx-dai-0 []
  Subdevices: 1/1
  Subdevice #0: subdevice #0
#
```

```
COM53 - PuTTY
# cd /proc/asound
# ls
S2LMKIWI card0      cards      devices    modules    pcm         timers      version
# cat devices
0: [ 0]      : control
16: [ 0- 0]: digital audio playback
24: [ 0- 0]: digital audio capture
33:          : timer
# cat cards
0 [S2LMKIWI   ]: z1380xx__S2LMK - z1380xx @ S2LMKIWI
                  z1380xx @ S2LMKIWI
#
```

The Quick Start Applications located in directory "*install_dir/apps*" demonstrate some of the basic functionalities of the VPROC API. The purpose of these applications is to ensure that the major system components (HBI, HAL, SSL) are configured properly without the user having to write custom application code. The Quick Start applications provide basic device functionality sanity check and these example codes can be used as starting point for the customer application development.

4.1

OVERVIEW

The VPROC SDK is provided with 3 examples quickstart applications.

hbi_test.c: is a simple application to test the HBI driver functions. This application demonstrates the usage of the API functions implemented by the VPROC HBI (API) layer of the SDK such as:

- Reset the VPROC device (This macro `TEST_RST` must be defined in order to enable this feature)
- Read one or more registers of the VPROC device via SPI or I2C
- Write one or more registers of the device via SPI or I2C
- Load pre-stored VPROC firmware and related configuration from an external slave flash device controlled by the VPROC device into the VPROC device internal RAM. (this macro `TEST_LOAD_FWRCFG_FROM_FLASH` must be defined in order to enable this feature)
- Erase specific or all VPROC firmware image(s) and related configuration record(s) from an external slave flash device controlled by the VPROC device into the VPROC device internal RAM. (this macro `TEST_ERASE_IMAGE` must be defined in order to enable this feature)

Note: the amount of bytes for the above transactions is defined by the following macro within the application

```
#define MAX_RW_SIZE 64    /*in bytes*/
```

The registers and data words of the VPROC devices are 16-bit in size, therefore a `MAX_RW_SIZE` of 64 bytes allows to perform access read or write of up to 32 registers of the device at a time.

For execution usage run '`hbi_test -h`'.

hbi_load_firmware.c: is a simple application to load the VPROC device firmware and related configuration record into the VPROC device internal memory and optionally save the combined image to a slave flash device controlled by the VPROC device.

Prior to compiling this application the user must first perform the followings:

The VPROC firmware image for the VPROC device is formatted as a Motorola S-record format, this format can not be used directly by the VPROC SDK. The VPROC SDK provides a tool to convert the S-record file into either a binary or c- code header file format.

The binary file format can be loaded into the VPROC device dynamically (at runtime), the c-code file format must be statically compiled into the `hbi_load_firmware` application.

For static compilation, user needs to define the following four macros at compile time along with `TEST_FWR_LOAD`

`LOAD_FWR_STATIC` - Defined at Makefile. if defined, expects user to provide a C header (*.h) file containing firmware boot image for static compilation

FWR - C header file containing firmware boot image for static compilation. if not provided, then **hbi_load_firmware** would throw a compile-time error

LOAD_CFGREC_STATIC - Defined at Makefile.if defined, expects user to provide C files containing configuration record

CFGREC - C files to be included during compilation

The conversion tool is located in the "*install_dir/tools*" directory of the VPROC SDK. This code can be compiled on a Microsoft Windows machine or a Linux machine. Compile the *twConvertFirmware2c.c* code and use it to convert the firmware and related config in accordance to the VPROC SDK VPROC image file format requirements.

With the above **hbi_load_firmware** application the user can:

- Load the VPROC firmware image and related config into the VPROC device
- Save firmware and related config currently running into the VPROC device into a slave flash device controlled by the VPROC device

For execution usage run '**hbi_load_firmware -h**'.

test_doa.c: Is a simple application to demonstrate the usage of the Beam Forming and Direction of Arrival (DoA) features of the VPROC devices within the VPROC device family that support such feature. Example of such device is the ZL38051.

The application simply polls the Direction of Arrival Register of the VPROC device and whenever a DoA is detected within the programmed Beam it is reported to the host as an angle in range of 0 to 180 degree.

The application includes an example configuration record converted to c-code header file format that will be compiled with the application. The related registers of these features are configured accordingly within this file.

To test the application with a specific configuration record, run it with the **-m** option to load compiled-in config record before starting the test.

For execution usage run '**test_doa -h**'.

4.2 USER MODIFICATIONS

There are several platform specific parameters that need to be set accordingly prior to compiling the QuickStart applications. The parameters that need to be modified are described below. This section assumes the user has completed configuring the VPROC and written or modified the example SSL and HAL modules. If not, consult the "First Steps" section of this guide.

The HBI parameters:

Default settings for this parameters are configured as per below within each of the example applications. These parameters need to be configured accordingly.

```
#undef I2C /*define to use HBI=I2C*/
#ifdef I2C
static int bus_num = 0; /*Host I2C bus number*/
static int dev_id = 0x45; /*I2C slave device address*/
#else /*if I2C is not defined, then HBI=SPI will be used*/
```

```
static int bus_num = 0;    /*Host SPI bus number*/
static int dev_id = 0;     /*Host SPI Chip Select*/
#endif
```

Example Quickstart execution logs:

```
root@:/home/Public/RELEASE_ZLS38100_P2.0.1/apps# ./hbi_test -d 0 -w 0x000C 0x1234
0x5678
```

HBI_init Entry..

Returned HBI handle 0xa9500000

wr: addr 0x000C = 0x1234

wr: addr 0x000E = 0x5678

```
root@:/home/Public/RELEASE_ZLS38100_P2.0.1/apps# ./hbi_test -d 0 -r 0x000C 4
```

HBI_init Entry..

Returned HBI handle 0xa9500000

Read 4 bytes

RD: addr 0x000c = 0x1234

RD: addr 0x000e = 0x5600

```
root@:/home/pi/Public/RELEASE_ZLS38100_P2.0.1/apps#
```

```
root@:/home/Public/RELEASE_ZLS38100_P2.0.1/apps# ./hbi_load_firmware -d 0 -i
zls38051_firmware.bin -c zls38051_config.bin
```

inpath zls38051_firmware.bin

HBI_init Entry..

Returned HBI handle 0xa9600000

Calling HBI_get_header()

image_type 0, major 0 minor 0, block size 128,total len 154112, code 0, endian 0

Start firmware load ...

Firmware loaded into Device

Loading file Configuration Record...

opened config file zls38051_config.cr2

using getline..

Image Loading Done.

Start Firmware

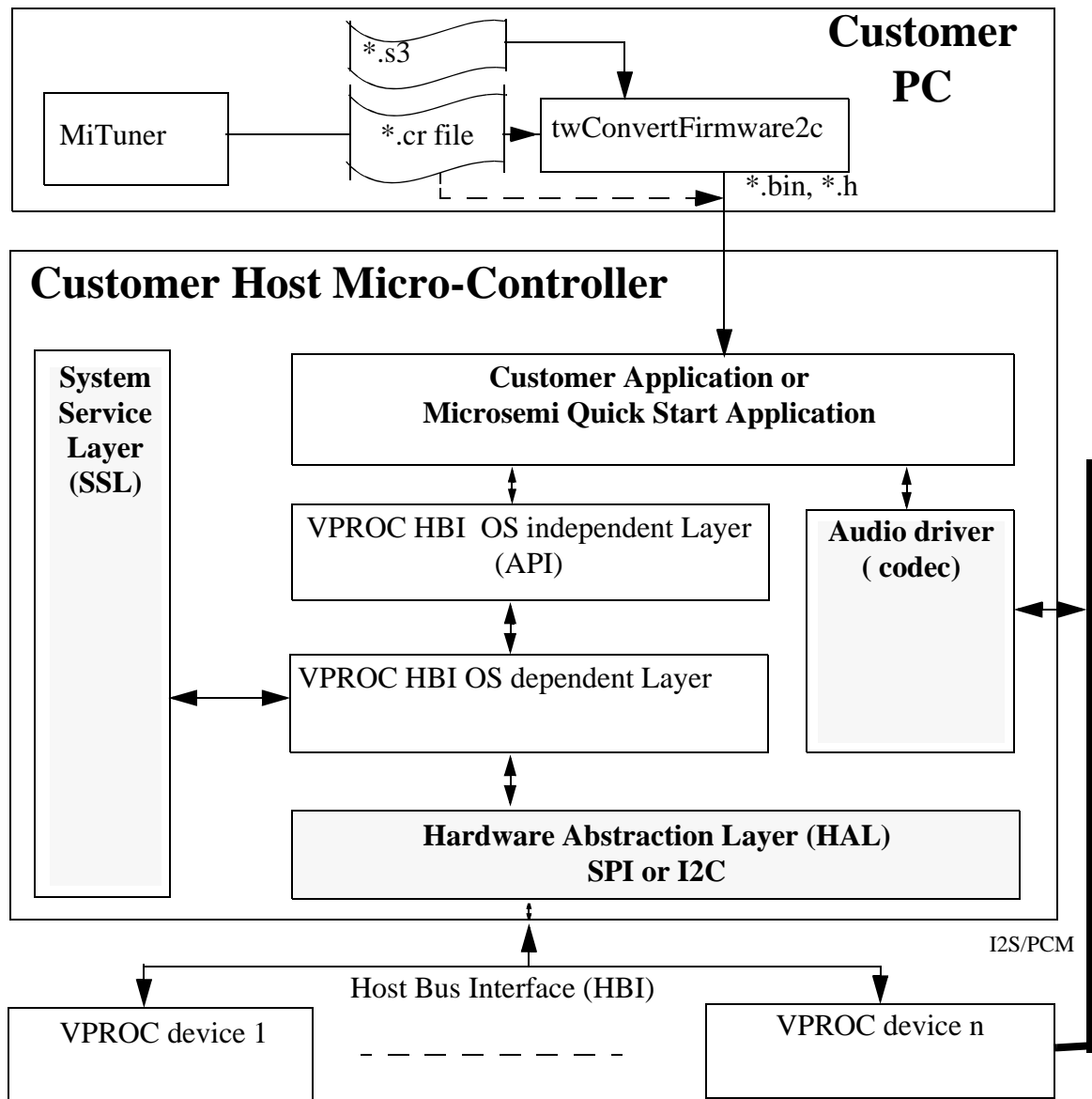
```
root@:/home/Public/RELEASE_ZLS38100_P2.0.0/apps# ./hbi_load_grammar -d -l
grammar_light.bin
```

Info - Grammar successfully loaded to RAM

This section continues from the previous chapter with steps to build the customer application. Customer's should have completed all steps from [Chapter 2, on page 5](#) before proceeding with the following.

Referring to the "Steps to Take" figure, repeated here for convenience (this chapter will cover "Step 5" from the figure):

Figure 5–1 Steps To Take



The customer application can either be built from an existing quickstart application or created from scratch (with guidance from what has been learned from the previous steps). While this document is not intended to be a tutorial on MiTuner (See MiTuner guide document for more info on usage of

MiTuner), it is intended to walk the customer through the basic procedure of SW development using these tools

5.1**GENERATING VPROC CONFIGURATION RECORD AND CONVERT FILES:**

If Microsemi Customer Support has provided the necessary *.cr2 file, the customer may skip this step and move on to implementation of their application.

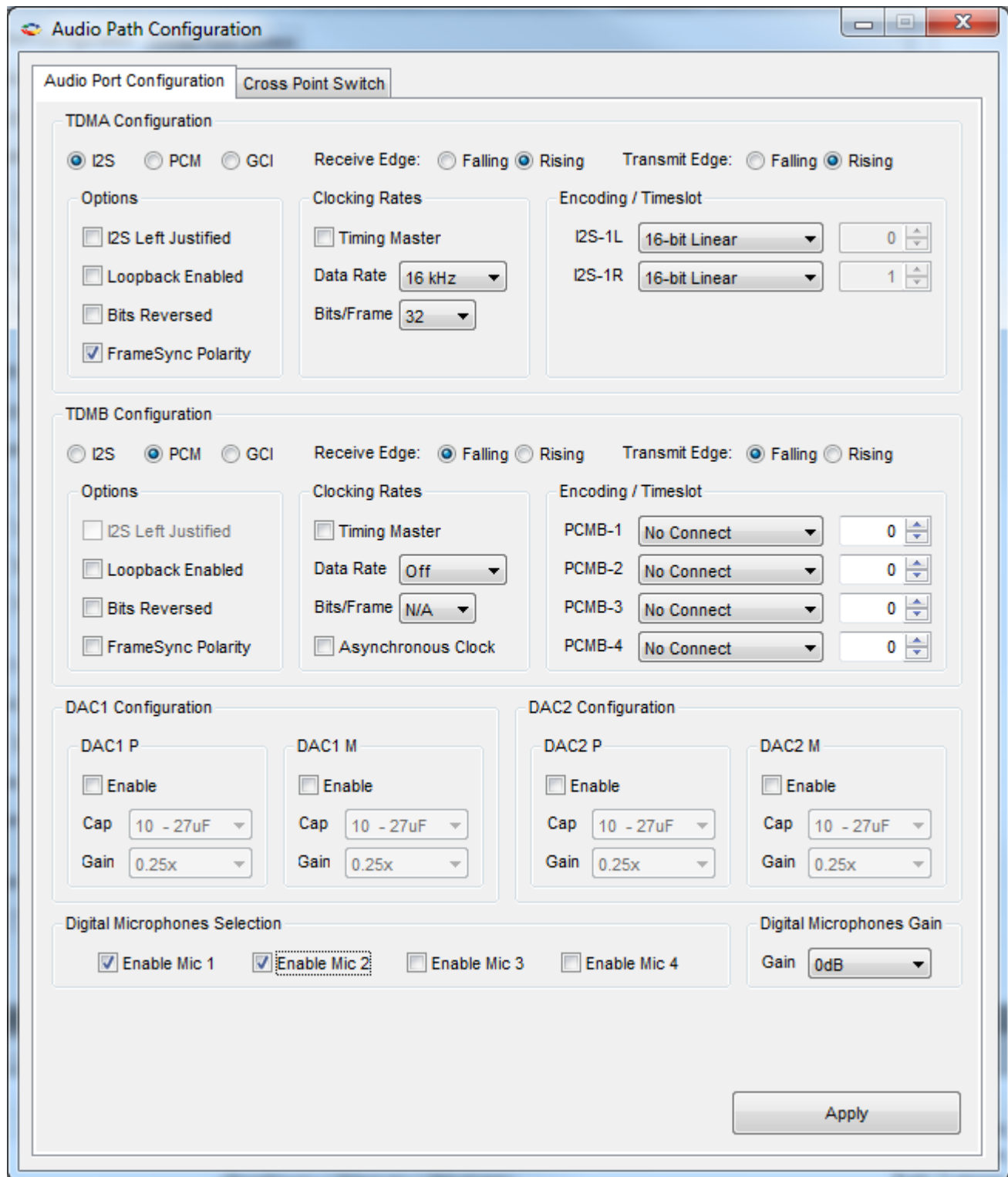
Prerequisites:

- Installation of Microsemi ZLS38508LITE: MiTuner version 6.2.0 or later.
- Compile the `install_dir/tools/twConvertFirmware2c.c` source
-

Steps:

1. Launch MiTuner, then from MiTuner "Audio Path Configuration" configure the TDM and audio cross-point switch settings accordingly to the design

Figure 5–2 TDM Configuration



Audio Path Configuration

Audio Port Configuration **Cross Point Switch**

TDMA Configuration

☒ I2S ☐ PCM ☐ GCI Receive Edge: ☐ Falling ☒ Rising Transmit Edge: ☐ Falling ☒ Rising

Options

☐ I2S Left Justified
☐ Loopback Enabled
☐ Bits Reversed
☒ FrameSync Polarity

Clocking Rates

☐ Timing Master
Data Rate: 16 kHz
Bits/Frame: 32

Encoding / Timeslot

I2S-1L: 16-bit Linear 0
I2S-1R: 16-bit Linear 1

TDMB Configuration

☐ I2S ☒ PCM ☐ GCI Receive Edge: ☒ Falling ☐ Rising Transmit Edge: ☒ Falling ☐ Rising

Options

☐ I2S Left Justified
☐ Loopback Enabled
☐ Bits Reversed
☐ FrameSync Polarity

Clocking Rates

☐ Timing Master
Data Rate: Off
Bits/Frame: N/A
☐ Asynchronous Clock

Encoding / Timeslot

PCMB-1: No Connect 0
PCMB-2: No Connect 0
PCMB-3: No Connect 0
PCMB-4: No Connect 0

DAC1 Configuration

DAC1 P

☐ Enable
Cap: 10 - 27uF
Gain: 0.25x

DAC1 M

☐ Enable
Cap: 10 - 27uF
Gain: 0.25x

DAC2 Configuration

DAC2 P

☐ Enable
Cap: 10 - 27uF
Gain: 0.25x

DAC2 M

☐ Enable
Cap: 10 - 27uF
Gain: 0.25x

Digital Microphones Selection

☒ Enable Mic 1 ☒ Enable Mic 2 ☐ Enable Mic 3 ☐ Enable Mic 4

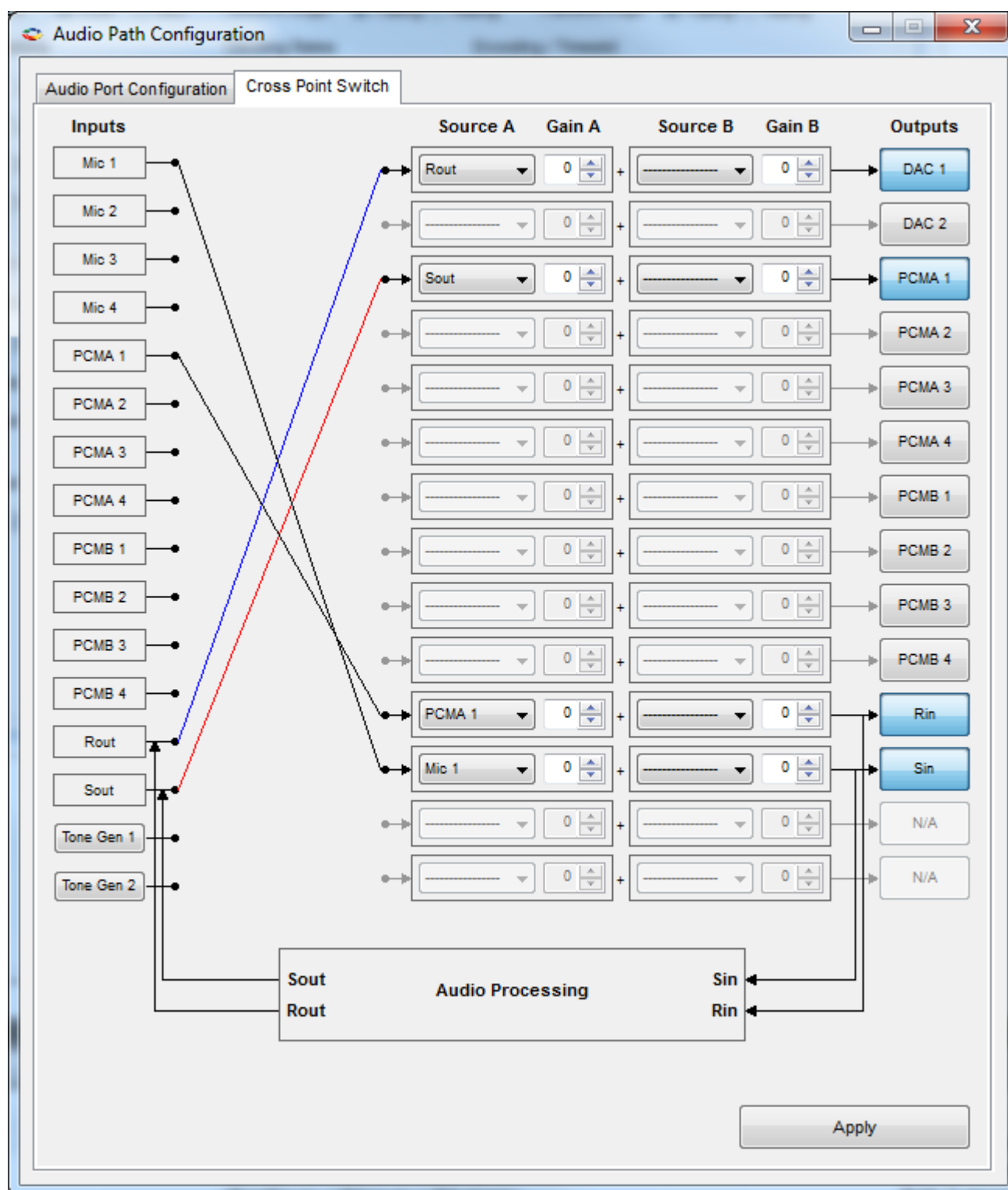
Digital Microphones Gain

Gain: 0dB

Apply

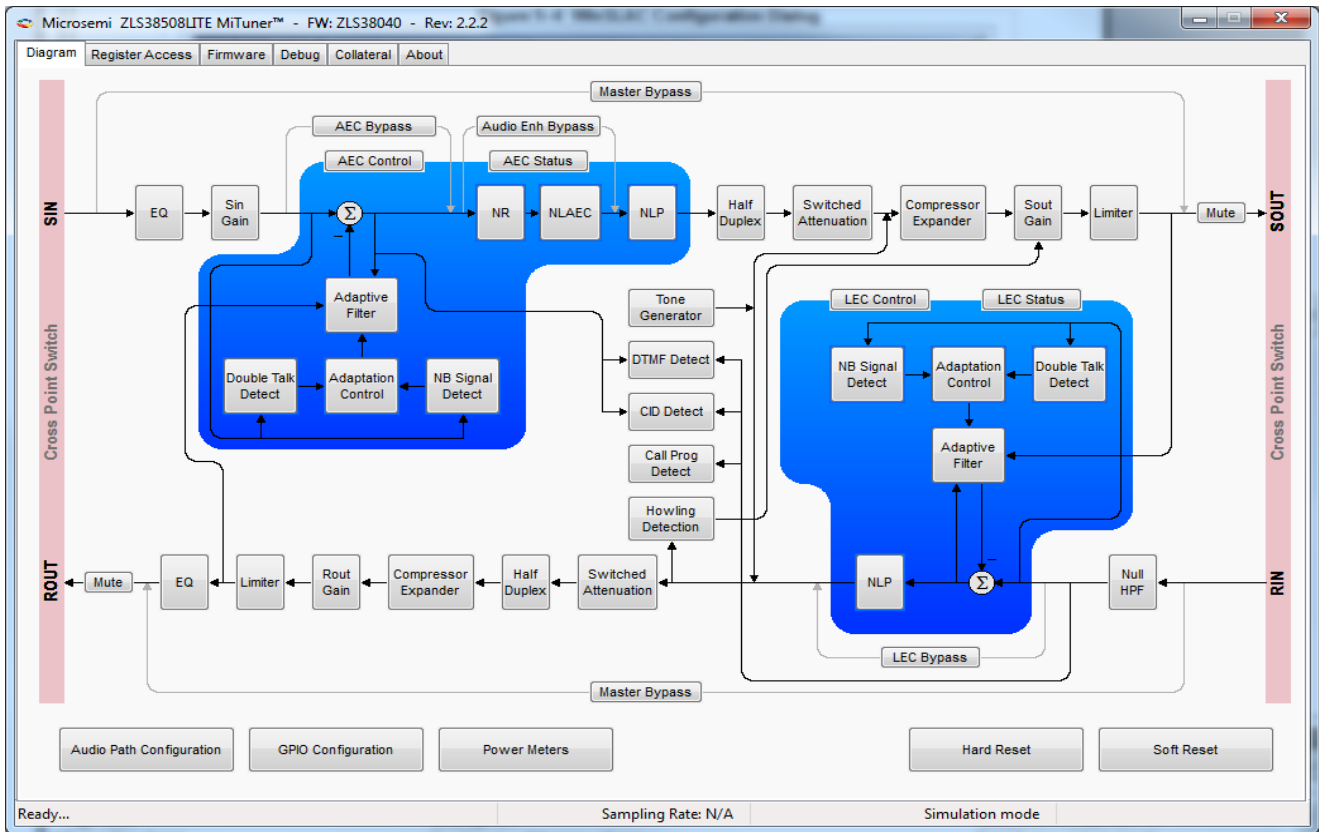
2. Configure the Audio Cross-Point switch in accordance to how audio should be routed in and out of the VPROC device. See example configuration below

Figure 5–3 Audio Cross-point Switch Selection



3. Configure the VPROC audio processing block. This step requires considerable knowledge of the VPROC device in order to properly configure these parameters. Therefore, either the help of a Microsemi Field Application Engineer is required or the customer can use our Auto Tuner Kit to tune these parameters.

Figure 5–4 VPROC Audio Processing Configuration



The dialog shown in [Figure 5–4](#) configures the Acoustic Echo Canceller, input and output gains and other processing parameters of the VPROC device in accordance to the design. Once these parameters are configured, then save the resulting configuration record by clicking on the "Firmware" tab, then "Save Config to PC".

4. If the VPROC firmware and the generated configuration record in step 3 are to be compiled with the SDK, then use the `twConvertFirmware2c` tool to convert each file into c code.

Figure 5–5 Convert firmware to c header

```

pi@JBrasberryPi3: ~/RELEASE_ZLS38100_P2.0.1/tools
File Edit Tabs Help

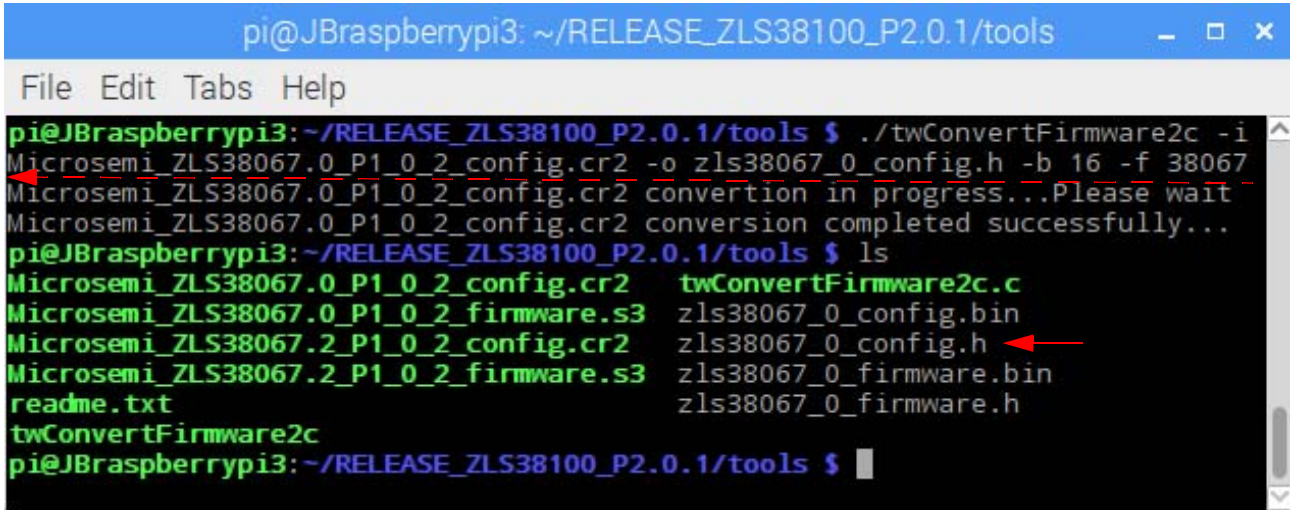
pi@JBrasberryPi3: ~/RELEASE_ZLS38100_P2.0.1/tools $ ./twConvertFirmware2c -i
Microsemi_ZLS38067.0_P1_0_2_firmware.s3 -o zls38067_0_firmware.h -b 16 -f 380
67
Microsemi_ZLS38067.0_P1_0_2_firmware.s3 conversion in progress...Please wait
Firmware Read Complete
Microsemi_ZLS38067.0_P1_0_2_firmware.s3 conversion completed successfully...
pi@JBrasberryPi3: ~/RELEASE_ZLS38100_P2.0.1/tools $ ls
Microsemi_ZLS38067.0_P1_0_2_config.cr2      twConvertFirmware2c
Microsemi_ZLS38067.0_P1_0_2_firmware.s3    twConvertFirmware2c.c
Microsemi_ZLS38067.2_P1_0_2_config.cr2     zls38067_0_firmware.bin
Microsemi_ZLS38067.2_P1_0_2_firmware.s3    zls38067_0_firmware.h
readme.txt
pi@JBrasberryPi3: ~/RELEASE_ZLS38100_P2.0.1/tools $

```

5. Copy the converted firmware *.h file into the SDK apps folder or set the path within the Makefile accordingly to where to find the file.

6. Convert the *.cr2 to c code.

Figure 5–6 Convert Configuration to c code



```

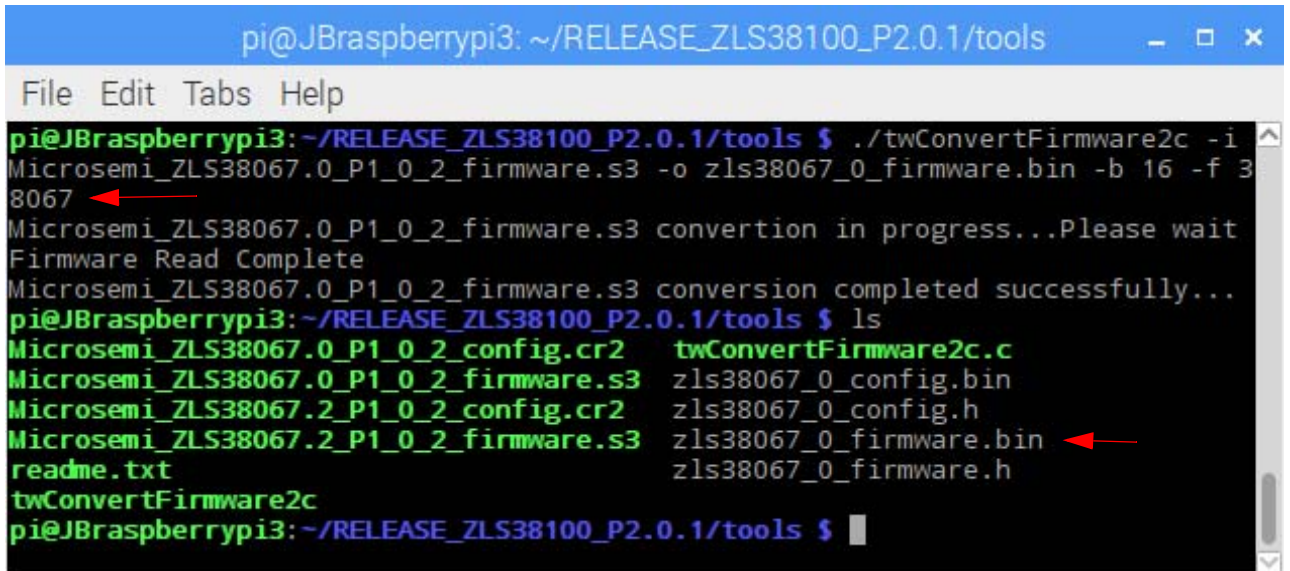
pi@JBrasberryPi3: ~/RELEASE_ZLS38100_P2.0.1/tools
File Edit Tabs Help

pi@JBrasberryPi3:~/RELEASE_ZLS38100_P2.0.1/tools $ ./twConvertFirmware2c -i
Microsemi_ZLS38067.0_P1_0_2_config.cr2 -o zls38067_0_config.h -b 16 -f 38067
Microsemi_ZLS38067.0_P1_0_2_config.cr2 conversion in progress...Please wait
Microsemi_ZLS38067.0_P1_0_2_config.cr2 conversion completed successfully...
pi@JBrasberryPi3:~/RELEASE_ZLS38100_P2.0.1/tools $ ls
Microsemi_ZLS38067.0_P1_0_2_config.cr2    twConvertFirmware2c.c
Microsemi_ZLS38067.0_P1_0_2_firmware.s3    zls38067_0_config.bin
Microsemi_ZLS38067.2_P1_0_2_config.cr2    zls38067_0_config.h
Microsemi_ZLS38067.2_P1_0_2_firmware.s3    zls38067_0_firmware.bin
readme.txt                                zls38067_0_firmware.h
twConvertFirmware2c
pi@JBrasberryPi3:~/RELEASE_ZLS38100_P2.0.1/tools $

```

7. Copy the converted *.h file into the apps directory of the VPROC SDK or modify the makefile accordingly to where to find these files. To convert the *.cr2 to *.bin simply change the output file name extension to .bin
8. If the firmware and configuration record are to be loaded dynamically (at runtime), then convert the firmware *.s3 file into a binary format.

Figure 5–7 Convert firmware to binary



```

pi@JBrasberryPi3: ~/RELEASE_ZLS38100_P2.0.1/tools
File Edit Tabs Help

pi@JBrasberryPi3:~/RELEASE_ZLS38100_P2.0.1/tools $ ./twConvertFirmware2c -i
Microsemi_ZLS38067.0_P1_0_2_firmware.s3 -o zls38067_0_firmware.bin -b 16 -f 3
8067
Microsemi_ZLS38067.0_P1_0_2_firmware.s3 conversion in progress...Please wait
Firmware Read Complete
Microsemi_ZLS38067.0_P1_0_2_firmware.s3 conversion completed successfully...
pi@JBrasberryPi3:~/RELEASE_ZLS38100_P2.0.1/tools $ ls
Microsemi_ZLS38067.0_P1_0_2_config.cr2    twConvertFirmware2c.c
Microsemi_ZLS38067.0_P1_0_2_firmware.s3    zls38067_0_config.bin
Microsemi_ZLS38067.2_P1_0_2_config.cr2    zls38067_0_config.h
Microsemi_ZLS38067.2_P1_0_2_firmware.s3    zls38067_0_firmware.bin
readme.txt                                zls38067_0_firmware.h
twConvertFirmware2c
pi@JBrasberryPi3:~/RELEASE_ZLS38100_P2.0.1/tools $

```

9. The *.cr2 configuration record and the converted firmware *.bin firmware files can be loaded into the VPROC device dynamically (at runtime).

5.2

COMPILE/RECOMPILE THE APPLICATION AND RUN

1. If the previous steps were done on an existing quickstart application (and none of the file names changed), simply recompile the application as-is and run.
2. If the previous steps contained modification to the converted files or names, update the Makefile and application to refer to the new names.
3. Recompile the application and run it.

5.3**NEXT STEPS**

The customer is strongly encouraged to experiment with both MiTuner software and the configuration of the VPROC processing parameters until comfortable with the use of the tool and the configuration of the parameters of the device for rapid product development.

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